

Air Pollution at Schools

WSP

Improving Air Quality for London's Schools: The Mayor's School & Nursery Air Quality Audit Programmes

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*TAPAS
(March 2021)*

A Public Health Emergency

“London’s dirty air is a public health emergency”

The Mayor of London

- Mayor committed to improving air quality
- Over 400 primary schools located in areas which exceed legal pollution limits
- 25% of primary schools in areas with dangerously high levels of air pollution
- Primary school children are amongst the most vulnerable



The Air Quality Challenge

- Illegal levels of air pollution represent a serious challenge
- Increased mortality
 - *Long-term exposure to air pollution causes up to 36,000 premature deaths per year*
- Increased morbidity
 - *Exacerbation of cardio-pulmonary diseases, e.g., asthma, stroke, bronchitis*
- Financial cost to society
 - *Health impacts: £billions*
 - *Damage to ecosystems & crops: £millions*

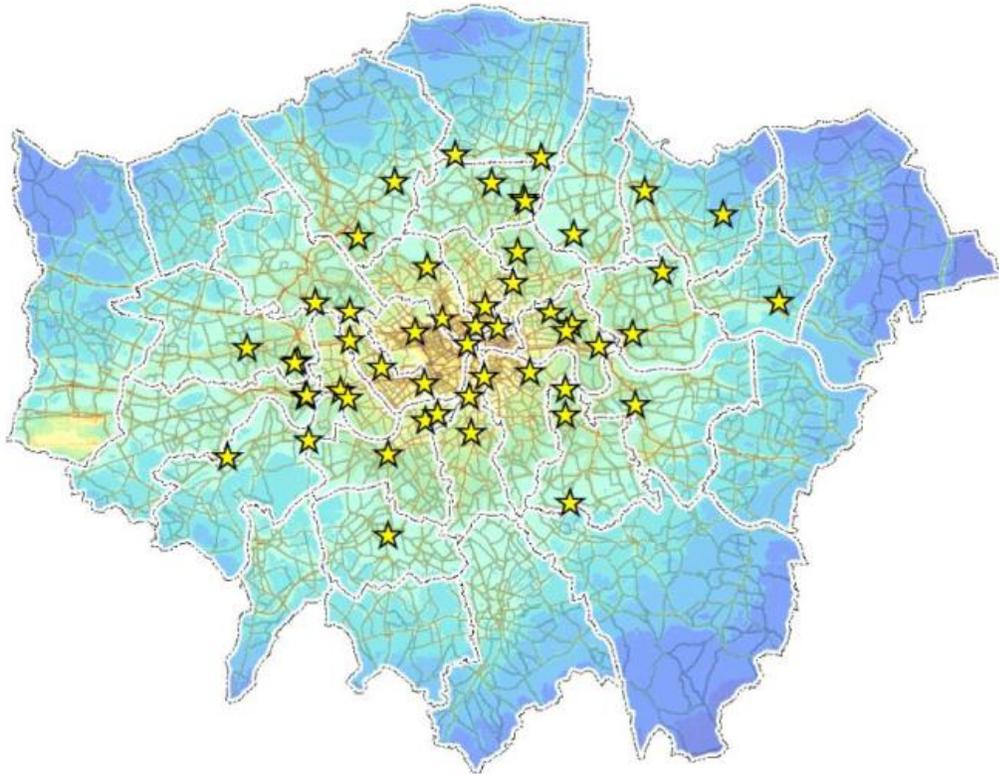
 **Lost productivity**



- Road transport responsible for 80% of NO_x at roadside, large part of that diesels
 - Diesel fumes recently reclassified as a “grade 1 carcinogen”, meaning they are a “definite cause of cancer”
 - World Health Organisation declared diesel exhaust a carcinogenic, in the same category as asbestos and mustard gas.

Project Scope and Objectives of the School Air Quality Audits

— Audited 50 schools across London

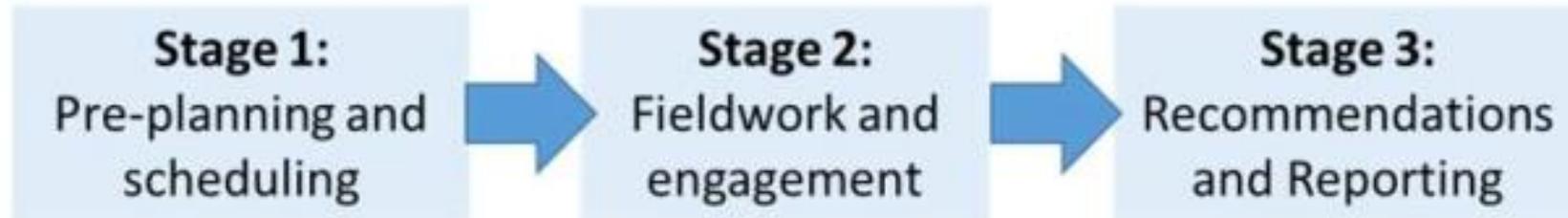


1. Identify the **sources** of outdoor air quality and potential **exposure**
2. Identify, evaluate and recommend a combination of hard hitting measures and pragmatic approaches
3. Engage school children and communities to raise awareness
4. Engage eligible London boroughs and other relevant stakeholders
5. Provide recommendations

...and establish a robust process and toolkit of measures to be rolled out across London by boroughs

Completing an Air Quality Audit

— Three broad stages



Stage 1 - Understanding the Local Context

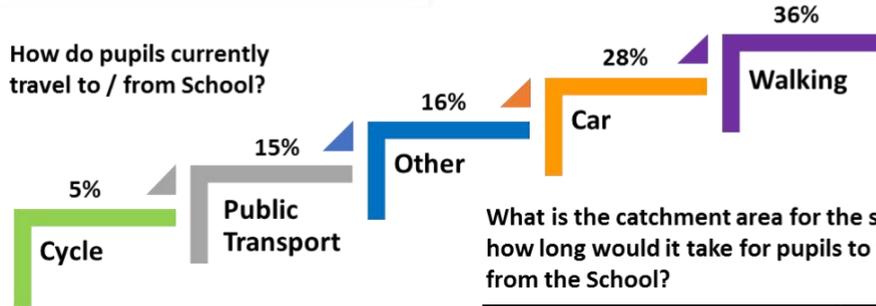
Borough: Lewisham

Address: Haseltine Rd, SE26 EAD

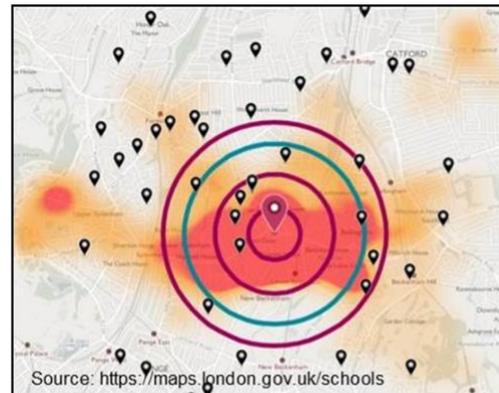
Pupil Numbers: 563



How do pupils currently travel to / from School?



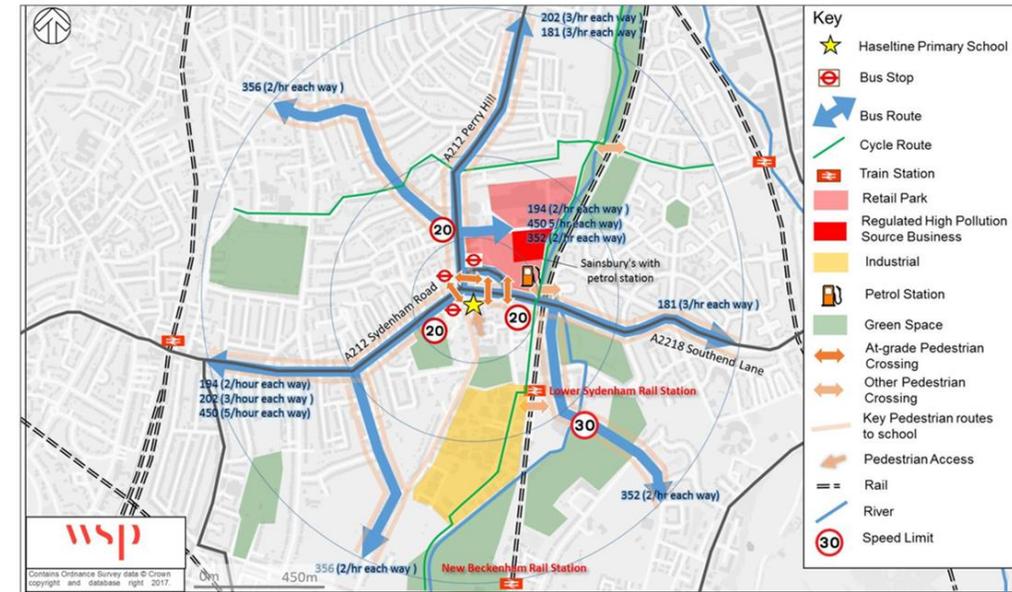
What is the catchment area for the school and how long would it take for pupils to walk to / from the School?



1st Quartile 25% - 0.42km; walking time 5 minutes
 2nd Quartile 50% - 0.97km; walking time 12 minutes
 3rd Quartile 75% - 1.82km; walking time 23 minutes
 Mean - 1.47km; walking time 18 minutes

How do staff currently travel to / from the School?

- 11% of staff said they use public transport
- 27% of staff said they drive to / from school
- 37% of staff said they walk
- 6% of staff stated that they cycle.



Stage 1 – Understanding the Key Air Pollutants & Sources

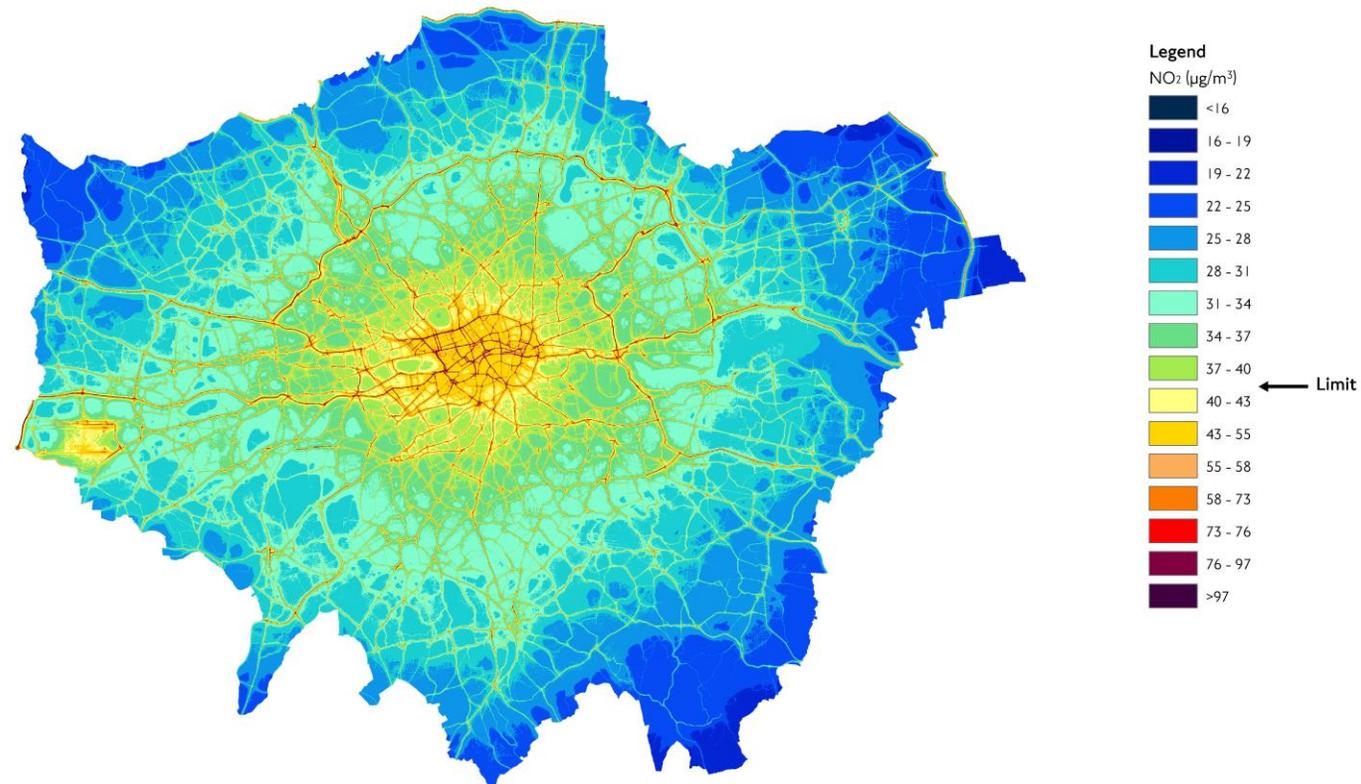
- Nitrogen dioxide (NO₂)
 - *No 'safe' level*
 - *Combustion emissions are the primary source*
 - *~80% of urban NO_x emissions are from road vehicles*

- Particulate matter (PM₁₀ and PM_{2.5})
 - *Wide range of sources: natural & anthropogenic*
 - *Diverse chemical composition*
 - *Particles can penetrate deep into the lung*

Baseline Concentrations

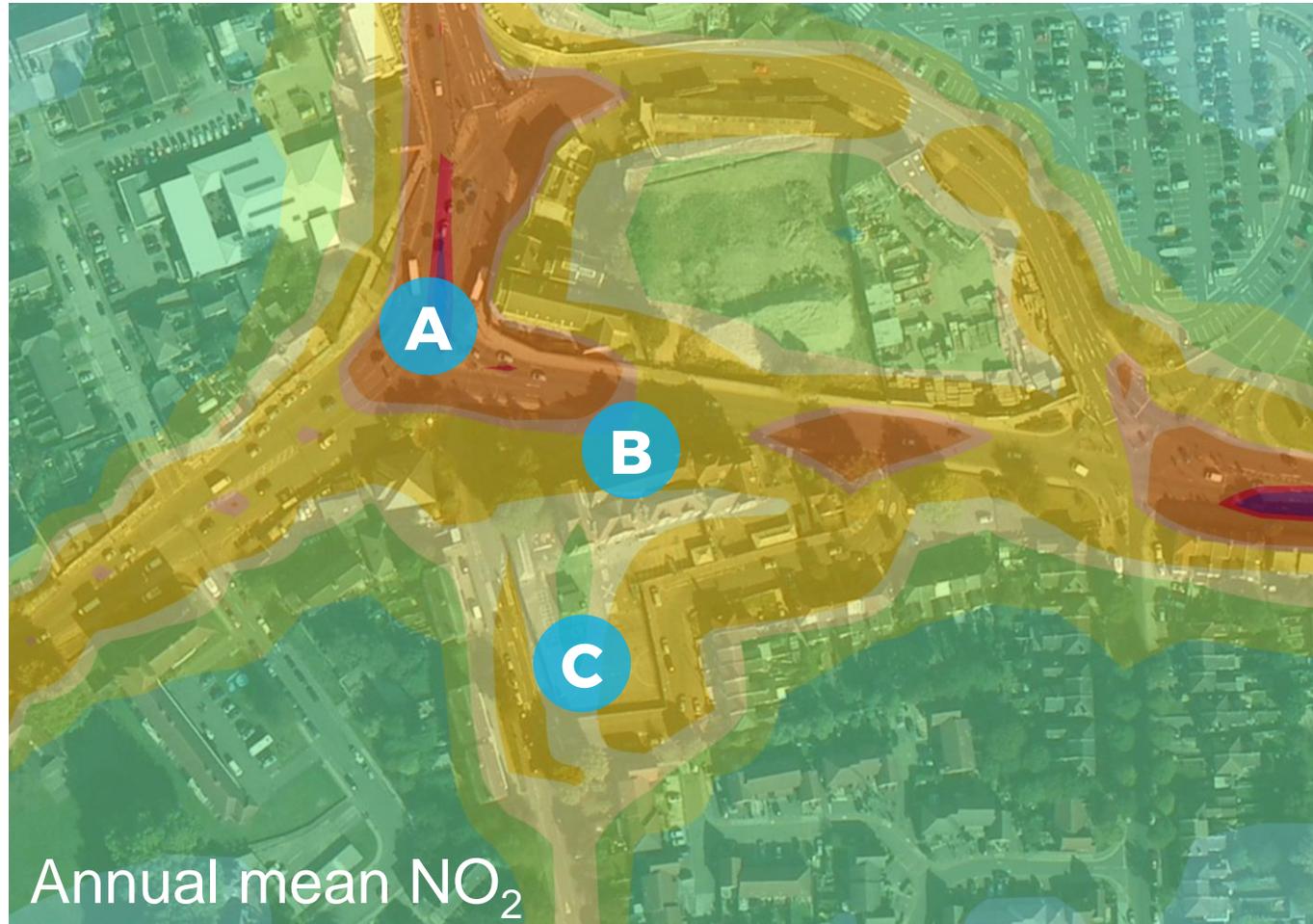
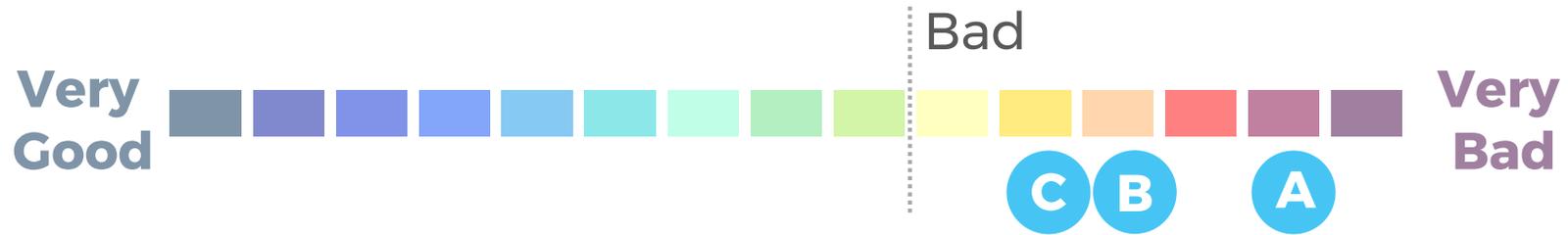
Greater London Authority (GLA) publish maps of modelled air pollutant concentrations

Greater London - Annual Mean NO₂ concentrations 2013



Where is Exposure Greatest?



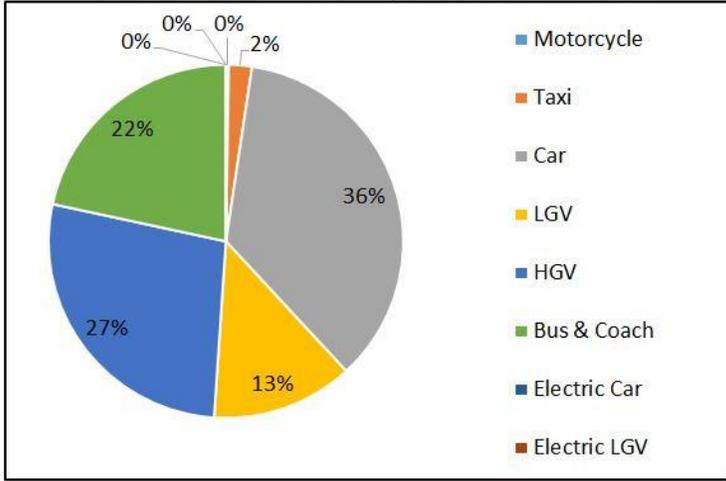


- Exposure dependent on location and duration
- Have all sources been identified?
- Which road sources contribute the most?

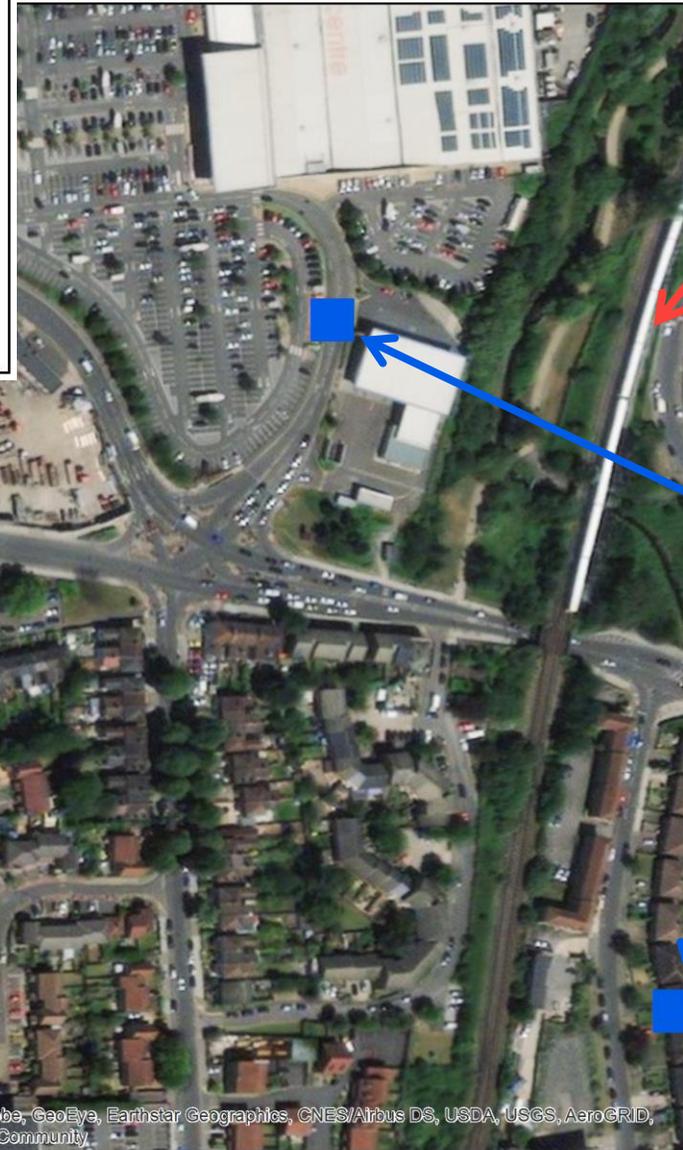
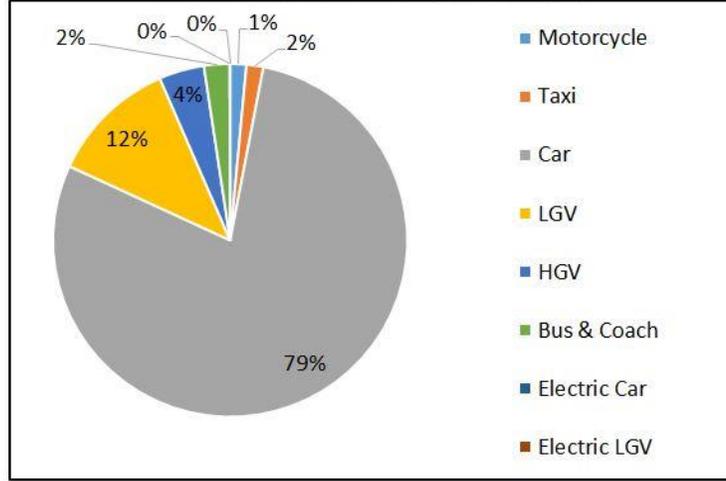
Engagement Activities with the childrenwe asked them the same question



Road Transport Emissions (Split by Source Sector)



Road Transport Volumes (Split by Type)



Railway line

Industrial combustion sources

Stage 2 - Fieldwork - Site Observations and Assessments

- External site walk and observations
 - Peak arrival or departure times
 - with borough school air quality officers/ school transport officer/ school staff
- Internal site walk
 - Layout of the building/ playgrounds
- School building audit



Stage 2 - Fieldwork - Site Observations and Assessments

— Systematic approach: checklists and guidance

14

SCHOOL GROUNDS AUDIT CHECKLIST

- 1) Work through checklist - Label each observation/issue with applicable letter (A, B, C)
- 2) Add number prefix if multiple (A1, A2)
- 3) Score each observation/issue from 1 (Low) to 5 (High) with regards: a) Source (S): influence as to how close the source is to the school b) Exposure (E): influence as to how often the school is exposed to the source
- 4) Verify context plan – i.e. bus stop, tube station locations



SCHOOL BUILDING AUDIT CHECKLIST



Mark on plant room (i.e. Boiler Room).

Internal Layout	
Layout of building – class rooms and other rooms and exposure to emissions sources	Mark onto map – classrooms/assembly hall i.e. you could have store rooms or staff offices on roads rather than classrooms. Class room v. onto main road?
Heating	
Heat source type	e.g. gas boiler, heat pump, biomass boiler (wood fired, bio-diesel). Back up diesel generator?
Number	e.g. 3
Heating only or heating & hot water?	
Central or Distributed	i.e. single plant room or smaller local boilers
If central, common flue	i.e. do all the boilers run into a single large flue
Height of flue?	Take a picture Short - <1m (i.e. similar to domestic boiler) Medium - 1m to 2m (small to medium commercial boiler) Tall - >3m (for larger boilers)



SCHOOL AIR QUALITY AUDIT TEMPLATE

School Name: St James's Hatcham CoE
Address: New Cross, SE14 6AD
Key Telephone Contact: 020 8314 6265
Key Email Contact: Carlene.Campbell@lewisham.gov.uk
Head Teacher:
School Staff (name/role):
School Staff (name/role):
School Staff (name/role):
Borough Name: Lewisham
Sub-region: South East
Borough AQ Officer: Carlene Campbell/ Chris Howard
Borough TP Officer: Simon Moss
Borough School Transport Officer:
WSP Auditor/s:



Background Information

1. Pupil Numbers: 227
2. Building Description
3. School Building Age
 - a. Any extensions (building age)
 - b. Any planned growth?
 - c. BREEM rating (if available)
4. Mode share and trip numbers, recent trends (2016/2017)
 - a. Walk = Pupils – 42%
 - b. Cycle = Pupils – 0%
 - c. Public Transport = Pupils – 28%
 - d. Car = Pupils – 18%
 - e. Other = Pupils – 12%
5. STARS status: Bronze

6. Local Area Type

- a. City Centre
- b. Major Centre
- c. Metropolitan Centre
- d. Suburban
- e. Residential

7. Road Type

- a. TLRN Road
- b. Main Road
- c. **Near Main Road**
- d. Residential Street
- e. Cul-de-sac

8. Street Type (Movement/Place)



9. Proximity to Road

Distance to largest adjacent road (m):

10. Context Notes from School/Borough:





Stage 2 - Brainstorming with council officers and schools

— Discussing observations and possible measures

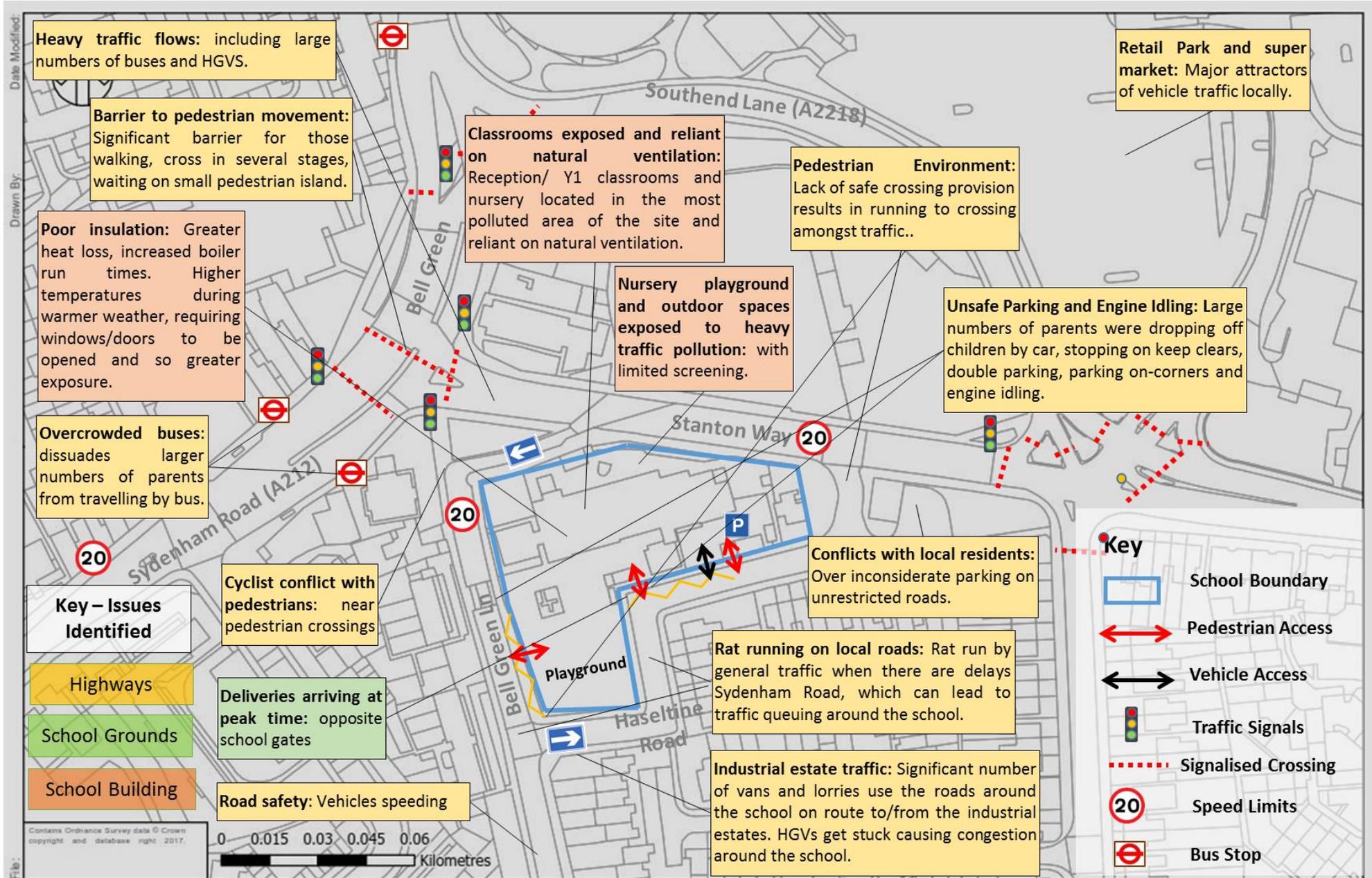


STAKEHOLDER DISCUSSION POINTS:

- 1) Is there anything you would like to add or comment on regarding our recorded observations? Where do children spend time outside, during breaks, PE, sports, off-site? Differ by age groups?
- 2) Any comments on recent trends/ issues regarding travel to school? Travel patterns of children and parents etc.
- 3) What do you feel are likely to be key sources of emissions in and around the school?
- 4) Where do you feel exposure to poor air quality is greatest in and around to school?
- 5) Key initiatives already underway to promote sustainable travel and reduce emissions? Which have worked well? Which haven't?
- 6) What more could the school do to lessen incidents of exposure and reduce sources of emissions?
- 7) Based on the toolkit of measures, and the findings of the observations and analysis, what are the top 3 measures you would prioritise for the school?
- 8) What sources of funding do you feel may be available to contribute towards localized schemes to address poor air quality at the school?
- 9) Is there any planned growth at the school (in terms of number of pupils or the school building)?
- 10) Are there any notable committed developments planned in the local area?
- 11) To what extent do you feel issues relating air quality are well understood by the children, parents, teachers, local community, borough officers and decision makers?
- 12) Are you aware of the air quality related lesson materials available?
- 13) Any other activities or behaviours not observed today you would wish to highlight?
- 14) Can you provide us with a copy of the deliveries log for the week of the audit?

GREATER LONDON AUTHORITY
Transport for London
wsp

Identifying the issues



Summary of key recurring issues

Highways

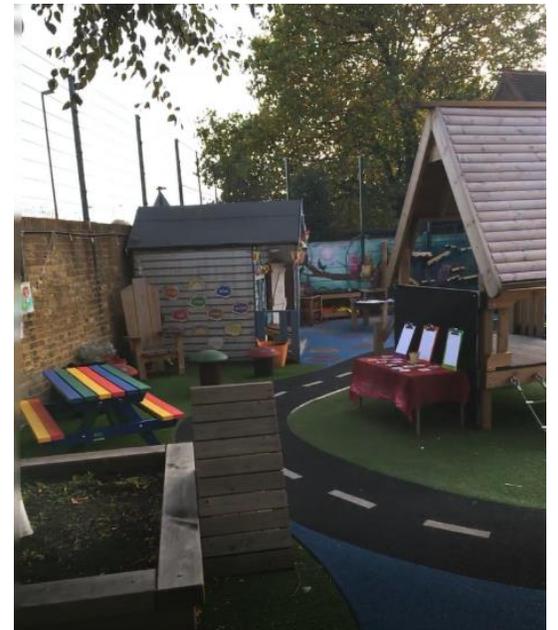
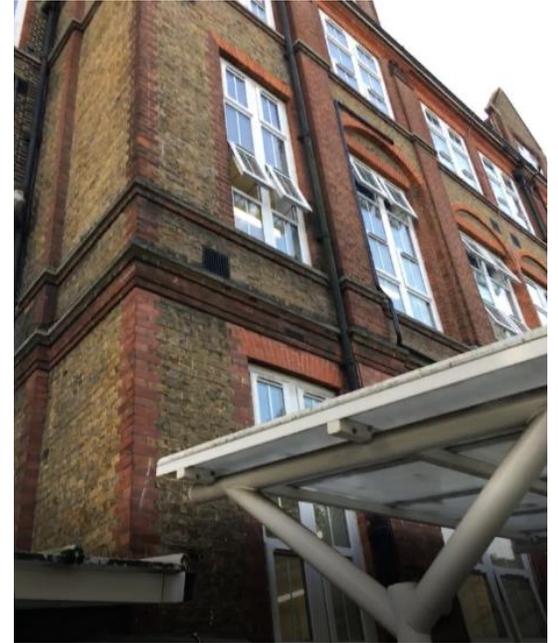
- **Heavily trafficked roads**
 - Road transport ~50% of NO_x emissions in London
- **Large numbers of buses passing the school**
 - 32% of road based emissions for schools audited
- **Lorries and freight activity**
 - 22% of road based emissions
- **Congestion and queuing traffic**
 - Queuing back from junctions and bottlenecks
 - Rat running traffic past schools
- **Hostile environments for pedestrians, cyclists and scooters**
 - Unsafe stopping and parking
 - including on School Keep Clear markings
 - Severance and exposure whilst crossing busy roads
 - Discouraging greater travel by sustainable modes

- **Engine idling**
 - During peak drop off times, close to school gates
- **Construction activity**
 - including non-mobile machinery, such as generators and dust
- **Major trip attractors and sources of emissions nearby**
 - e.g. hospitals, railway stations, colleges, major office complexes or shopping centres
 - Generate vehicle movements, including taxis, cars and delivery vehicles
 - Plus the buildings themselves contribute to local emissions
- **Rail/ tube lines**

Summary of key recurring issues

School grounds and buildings

- **Playgrounds and outdoor spaces exposed to emissions**
- **Children waiting to enter the school grounds on busy roads**
- **School buildings reliant on natural ventilation**
 - worsening exposure to emissions
- **Poor insulation and inefficient heating**
 - Greater heat loss during winter months = potentially increased run times by school boilers, therefore greater emissions
 - Summer - greater heat gain, making it more likely the windows and doors would need to be opened, worsening exposure to local emissions.
- **Aging boilers**
 - Contributes to emissions locally

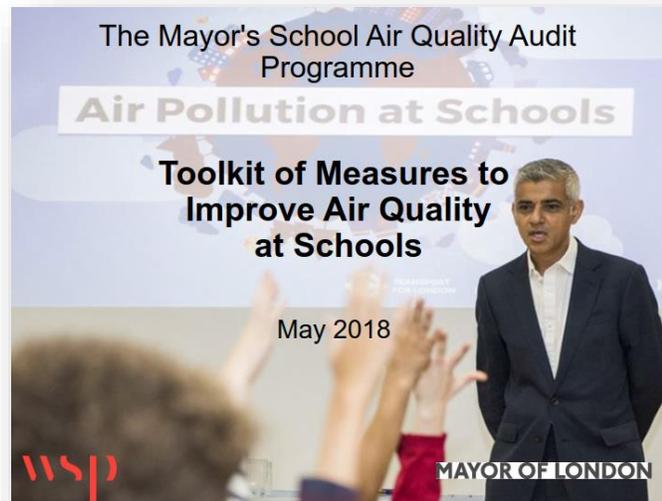


Stage 3 - Developing the Solutions



Toolkit of measures for improving air quality

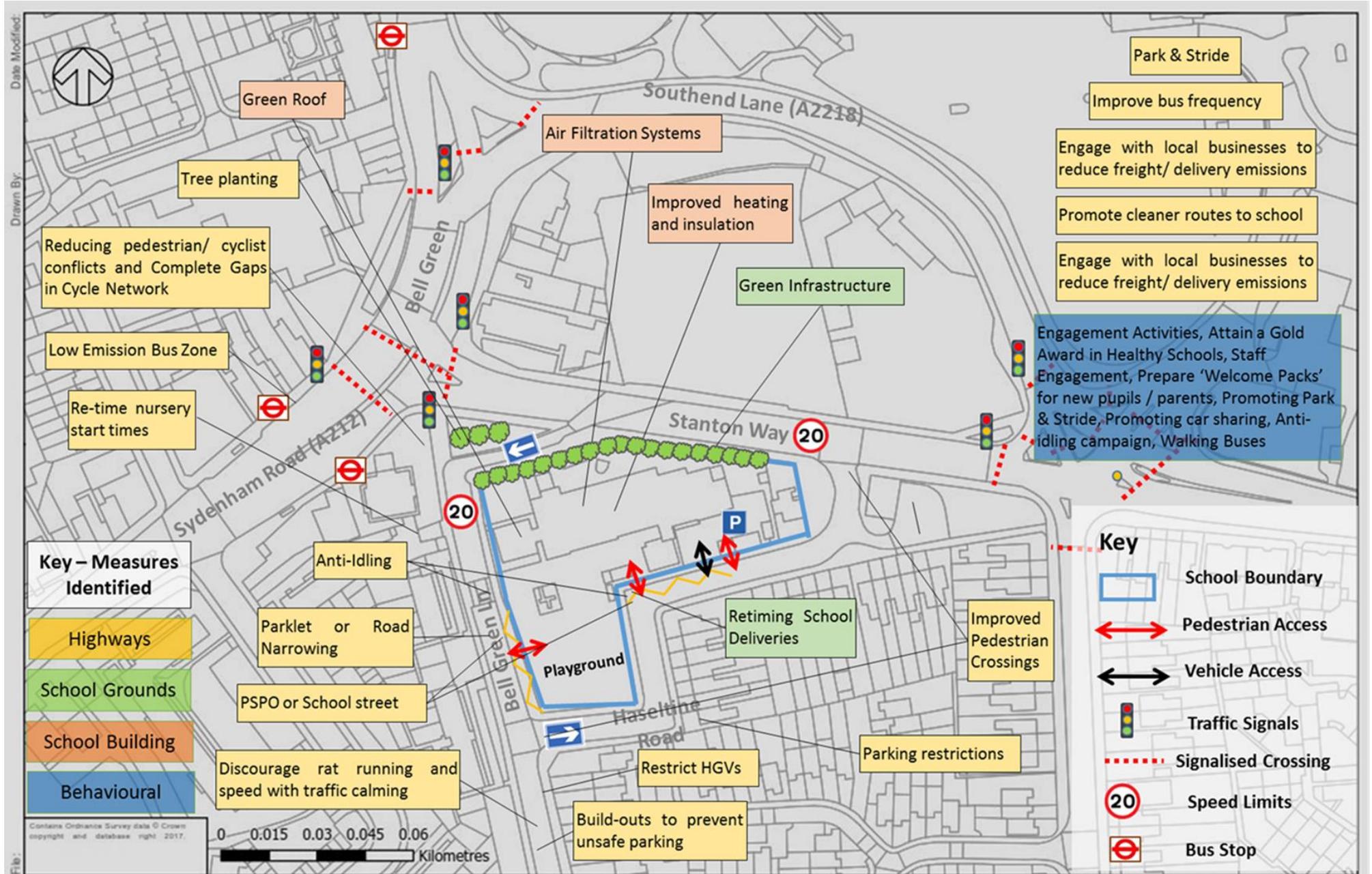
- Comprehensive toolkit of over 100 measures
- Assessed against key criteria including: potential air quality improvement, wider benefits, cost, deliverability, stakeholder support
- Hard hitting measures and low cost approaches
- Includes precedents and examples



https://www.london.gov.uk/sites/default/files/school_aq_audits_-_toolkit_of_measures_dr_v3.3.pdf

1. HIGHWAY MEASURES (Key Stakeholder: Borough/ TfL)	
A	Anti-idling
B	Reducing traffic flow
C	Smoothing traffic flow/speed
D	Reducing drop-off activity
E	Improved pedestrian and cyclist environments
F	Promote a switch to low emission vehicles
G	Parking/loading
H	Buses
I	Freight and Deliveries
J	Construction
K	Planning Policy and Strategy
L	Green Infrastructure
M	Screening and barriers
2. SCHOOL SITE MEASURES (Key Stakeholder: School/ Borough)	
N	School Grounds
School Building	
O	School boilers/ heating
P	Improve product choice (e.g. cleaning products)
Q	Regular service & maintenance of appliances and equipment
R	Improve school building insulation
S	Ventilation / Air Filtration
T	Other
3. BEHAVIOURAL MEASURES (Key Stakeholder: School/ Borough)	
4. WIDER MEASURES (Key Stakeholder: Borough/ TfL/ GLA/ Central Government)	

Developing the Solutions





Highways

— Buses

- Cleaning up the bus fleet, and targeted improvements of bus routes near schools

— Freight

- Weight restrictions and re-routing, re-timing and consolidation schemes
- Engaging with local businesses
- Low emission vehicles and cycle cargo freight
- Delivery and Servicing Plans (DSPs) for new developments

— Sustainable transport

- Footway widening, kerb build-outs, improved crossing facilities on desire line, traffic calming

— Restricting/ reducing traffic

- Scope to fully restrict often limited
- School streets or filtered permeability in places

— Parking and loading restrictions

- Removing or relocating parking/ loading bays
- Amending restrictions, tougher enforcement
- Park and stride sites

- Additional parking charges for more polluting vehicles

- Car clubs

— Promoting a switch to low emission vehicles

- Electric vehicle charging points to facilitate the uptake of ULEVs

— Construction activity

- Planning conditions to reduce impacts
- Engaging with developers to review routings to sites, times of day, opportunities for consolidation
- Promoting lower emission fleet usage

Summary of the key recurring measures

School Grounds

Focus largely on reducing exposure

- **Green infrastructure**
 - Green screening/ climbers, and/or trees and planting
- **Reducing time in exposed areas**
 - Design out use of more polluted parts of the playground/ free-flow spaces
- **Promoting sustainable travel**

School Building

- **Upgrade windows** to be double glazed or add secondary glazing
- **Upgrade aging boilers**
- **Air filtration systems** for classrooms most exposed.
 - Encouraging initial scientific evidence of efficacy, titanium dioxide proven to act as a reducer for NO_x and NO_2
- **Reduce over-heating** and heat gain

22



Summary of the key recurring measures

Behaviour change

- Key role in **raising awareness**
- **Reducing travel by car and engine idling**
- Promote **car sharing**
- Promoting **cleaner walking routes** to school - www.walkit.com
- **Park & Stride**
- **'Welcome packs'** for new pupils / parents

Wider Measures

- London-wide and national level interventions:
- **Targeted scrappage scheme** for polluting vehicles
- **Reforming Vehicle Excise Duty**
- **Promoting a transition to electric heating and heat pumps**
- **Zero emission zones**

23



Some Key Findings and Learnings from the Programme

- Collaboration is fundamental to success
- Borough officers, teachers, pupils, school community all had parts to play
- Stakeholders know their area the best
- Multi-disciplinary approach is fundamental when completing the audits
- Some challenges with borough inter-departmental working



Multiple interventions, each producing a small benefit, cumulatively produce significant overall benefits

Exposure limitation



Improved health & well-being



Environmental co-benefits

Increased physical activity

Noise reduction

Greater road safety

Climate change mitigation



Sir Dave Brailsford: “The 1% factor”

Solutions can be low cost and quick to implement

- Key concern was the availability of funding and challenges with resources



Suitable for trialling, low cost & with wider benefits

St Joseph's Catholic Primary School, Camden

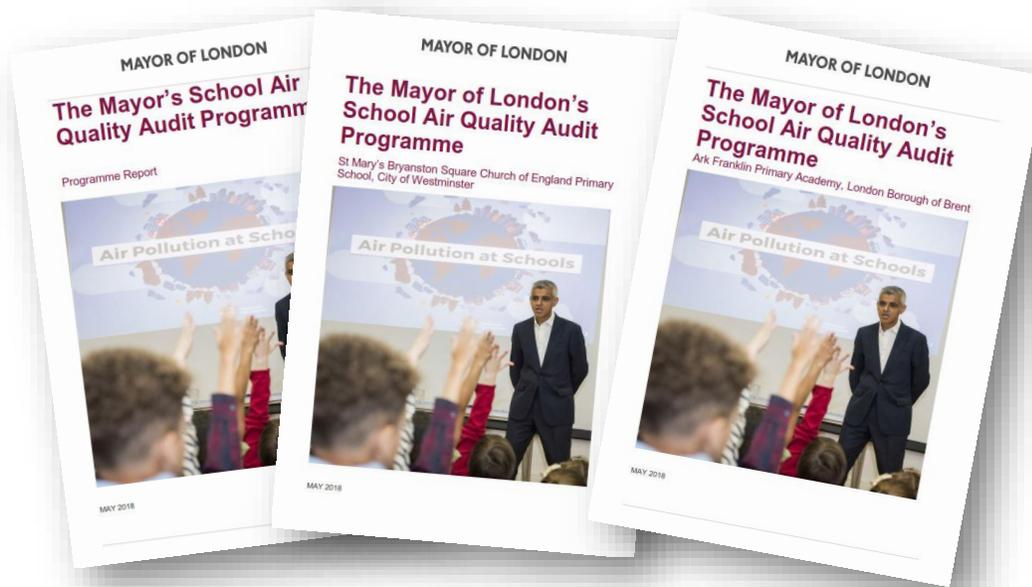
Solutions can be low cost and quick to implement

- Key concern was the availability of funding and challenges with resources



Stage 3 - Reporting and Recommendations

- Summary audit reports prepared for each school
- Featuring a comprehensive set of recommendations
- Presentation to boroughs and schools



<https://www.london.gov.uk/what-we-do/environment/pollution-and-air-quality/mayors-school-air-quality-audit-programme>



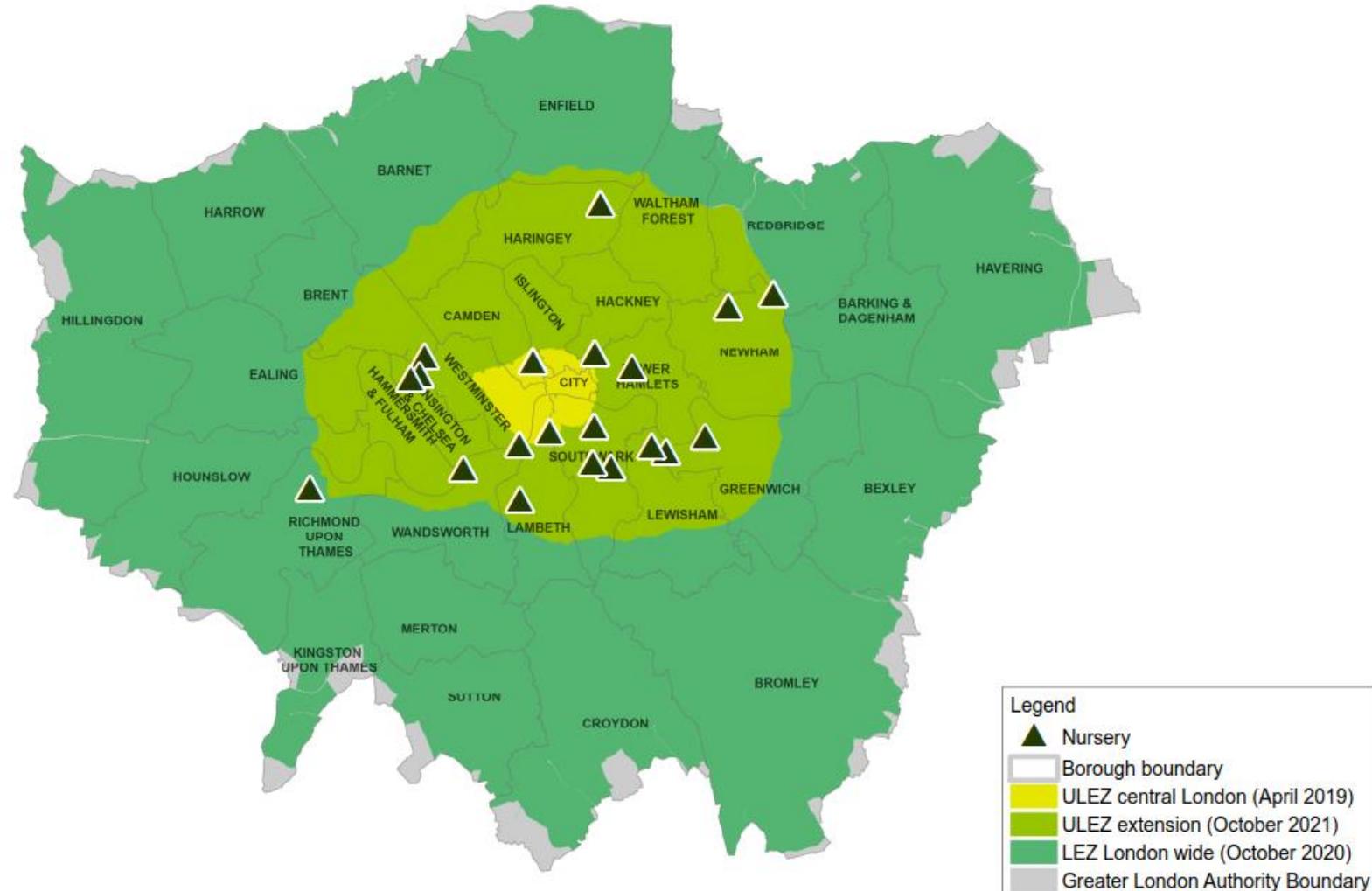
Legacy and ongoing work

- **Additional funding was announced** to implement the measures
 - **Generated real momentum** amongst schools and local authorities
 - **Wide range of schemes already implemented** or underway – best practice summary to be released
 - **Audit approach by the Chief Medical Officer** in annual report on the Health Impacts of Pollution.
-
- **Councils now leading** on auditing the rest of their schools – e.g. Westminster, Brent, Southwark
 - Mayor commissioned further air quality audit programme - **20 of the most polluted nurseries**



Mayor's Nurseries Air Quality Audit Programme Update

– Air Quality Audits completed for 20 nurseries in early 2019



Mayor's Nurseries Air Quality Audit

- Followed the technical methodology developed for the primary school air quality audits, including:
 - *Desktop study highlighting local sources of pollution and exposure*
 - *Air quality modelling*
 - *Visited nurseries and audited the building, grounds and surrounding area*
 - *Stakeholder discussions*
 - *Developing recommendations*



Mayor's Nurseries Air Quality Audit

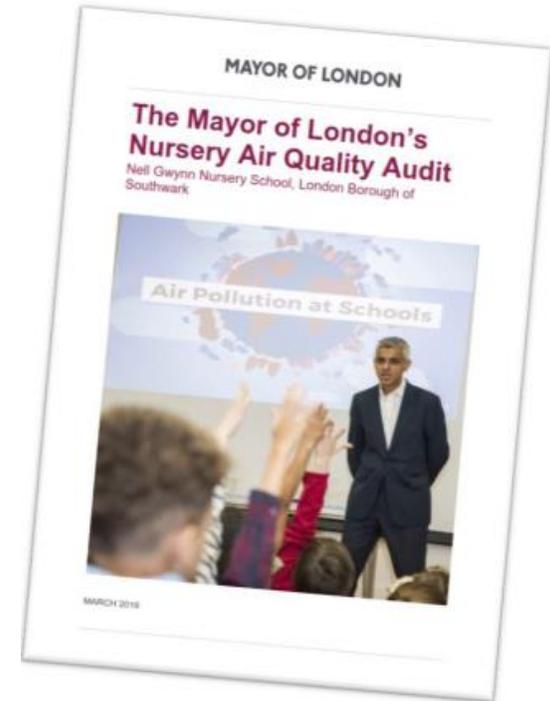
- Additional elements to the Nurseries programme:
 - *Broader scope (PM_{10} , $PM_{2.5}$ and VOC)*
 - *Greater focus on indoor air quality*
 - *Baseline air quality monitoring undertaken*
 - *Air Filtration System Trials*



Mayor's Nurseries Air Quality Audit Programme

- **Audit Reports** published and announced at **Mayoral event**, in March 2020
- **Funding** and match funding awards to Nurseries distributed, boroughs and nurseries are now implementing measures
- Updated **Toolkit of Measures** Report also completed and published alongside the **AFS Trial Report** and an overall **Programme Report**.

<https://www.london.gov.uk/what-we-do/environment/pollution-and-air-quality/mayors-nursery-air-quality-audit-programme#acc-i-60589>



Baseline Air Quality Monitoring in 20 Nurseries

- Nitrogen Dioxide using Passive Diffusion Tubes
- Volatile Organic Compounds using sorption tubes
- Formaldehyde using passive sorption badges



NO2 Diffusion Tube



VOC Sorption Tube



Formaldehyde Badge

Baseline Air Quality Monitoring in 20 Nurseries

- Baseline air pollutant survey:
 - 5 NO₂ diffusion tubes
 - 1 formaldehyde diffusion tube
 - 1 VOC diffusion tube were deployed in
- Nitrogen Dioxide (NO₂)
 - roadside outside the nursery
 - immediately outside the nursery entrance
 - playground
 - immediately inside the nursery entrance
 - inside a nursery classroom.
- Formaldehyde and VOCs
 - Inside a nursery classroom

Baseline Air Quality Monitoring

Borough	Nursery	Air Quality Baseline Monitoring - 3 month averages							LAEI Modelled Air Quality Concentrations		
		NO2					VOC	Formaldehyde	NO2	PM 10	PM 2.5
		Roadside - outside	Playground - outside	Nursery Entrance - outside	Nursery Entrance - inside	Classroom - inside					
Camden	Thomas Coram Centre	40.90	26.39	34.86	24.23	23.44	145.90	13.66	44.70	27.40	17.70
Greenwich	Rachel McMillan Nursery School and Children's Centre						4.60	4.04	44.10	26.70	16.80
Greenwich	Robert Owen Nursery School	34.85	31.46	33.92	25.31	19.19	80.30	3.98	38.30	25.70	16.40
Haringey	Pembury House Nursery School	63.77	37.67	40.66	21.57	22.50	124.10	8.75	44.20	25.90	16.10
Kensington and Chelsea	Maxilla Nursery School and Golborne Children's Centre	42.34	34.9				469.50	10.21	44.00	26.60	16.90
Lambeth	Triangle Nursery School	35.60	32.1				146.00	6.51	40.60	26.00	16.50
Lambeth	Ethelred Nursery School and Children's Centre	39.64	34.2				110.60	8.69	46.00	27.20	17.20
Lewisham	Clyde Nursery School	35.62	30.82	31.02	20.69	18.51	313.30	5.90	40.50	26.10	16.50
Newham	Sheringham Nursery School & Children's Centre	38.15	32.53	37.30	27.37				39.40	25.80	16.20
Newham	Kay Rowe Nursery School	40.69	-	36.71	19.35				38.10	25.30	16.10
Richmond upon Thames	Windham Nursery School	32.09	28.42	26.81	20.73				38.80	25.60	16.00
Southwark	Kintore Way Nursery School and Children's Centre	50.37	32.58	41.01	25.95				43.00	26.70	17.00
Southwark	Nell Gwynn Nursery School	47.20	32.62	35.05	24.40	26.52	190.23	13.64	44.60	26.60	16.70
Southwark	Ann Bernadt Nursery School	32.50	32.95	29.01	27.71	26.33	73.50	5.40	38.80	25.80	16.50
Tower Hamlets	Alice Model Nursery School	46.51	39.38	36.59	29.30	19.12	136.20				
Tower Hamlets	Columbia Market Nursery School	44.14	30.52	41.71	32.59	29.00	433.00				
Wandsworth	Somerset Nursery School and Children's Centre	39.58	30.77	33.75	-	16.58	135.50				
Westminster	Dorothy Gardner Centre	37.52	34.83	33.21	20.99	24.48	89.80	6.04	41.90	26.30	16.60
Westminster	Tachbrook Nursery School	49.78	42.66	38.65	10.70	11.64	73.50	10.16	49.70	28.00	17.60

Distance from roadside

Consistently lower levels of NO2 indoors

Some incidences of high VoC, but both typically well within guidelines

Modelled outdoor data matches well with measurements
PM levels are high in each

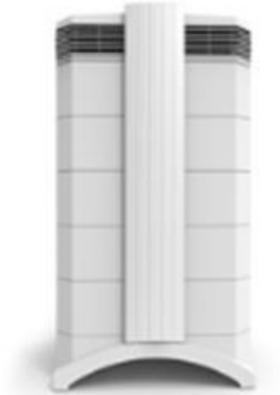
Air Filtration Systems (AFS) Trial

6 month trial of AFS

Aim was to understand their effectiveness at reducing key air pollutants (NO_2), and particulate matter (PM_{10} and $\text{PM}_{2.5}$) in “**Real world**” nursery environments

Reporting on overall effectiveness, plus wider impacts, such as Filtration/removal technology, efficiency, costs, maintenance, operation, nursery feedback

6 Air filtration systems installed at 6 different nurseries



Air Filtration Systems (AFS) Trial



Baseline Air Quality Monitoring

6 Target Nurseries

Nursery	Air Quality Baseline Monitoring - 3-month averages (Dec 2018-Feb 2019 or Jan-Mar 2019)							LAEI (2013) Modelled Air Quality Concentrations		
	NO ₂					VOC	Formaldehyde	NO ₂	PM ₁₀	PM _{2.5}
	Roadside - outside	Playground - outside	Nursery Entrance - outside	Nursery Entrance - inside	Classroom - inside					
Thomas Coram	40.90	26.39	34.86	24.23	23.44	145.90	13.66	44.70	27.40	17.70
Rachel McMillan	36.55	33.11	35.41	21.36	25.55	94.60	4.04	44.10	26.70	16.80
Pembury Housel	63.77	37.67	40.66	21.57	22.50	124.10	8.75	44.20	25.90	16.10
Nell Gwynn	47.20	32.62	35.05	24.40	26.52	190.23	13.64	44.60	26.60	16.70
Columbia Market	44.14	30.52	41.71	32.59	29.00	433.00	3.69	46.80	27.40	17.30
Dorothy Gardner	37.52	34.83	33.21	20.99	24.48	89.80	6.04	41.90	26.30	16.60

Air Filtration Supplier Selection

- AFS suppliers were shortlisted based on the criteria below and invited to participate

Table 2: scoring weights for AFS

Manufacturing Capacity	Technical Strengths	NOx Removal Efficiency	PM Removal Efficiency	Certificates	Maintenance Cost	CAPEX	OPEX	Case Studies
0 - low	0 - none	0 – no removal	0 – extremely low	0 - none	1 – high annual costs	1 – high capex	1 – medium/ high energy consumption	0 – none available
1 – medium	1 – low	1 - some	1 – low	1 – some	2 – medium annual costs	2 – medium capex	2 – low energy consumption	1 – very few
2 - good	2 – medium	2 – claimed removal	2 – medium	2 – more than three	3 – low annual costs	3 – low capex		2 – some
	3 - high	3 – proved removal evidence	3 - good	3 – many and consistent				3 - many

Shortlisted AFS suppliers

A	Camfil
B	Radic8
C	Blueair
D	IQAir
E	Fellowes
F	Airlabs

Detailed Air Quality Monitoring During AFS Trials at 6 Nurseries

- Nitrogen Dioxide using Passive Diffusion Tubes
- PM_{2.5} and NO₂ using Zephyr Continuous monitoring device



NO2 Diffusion Tube

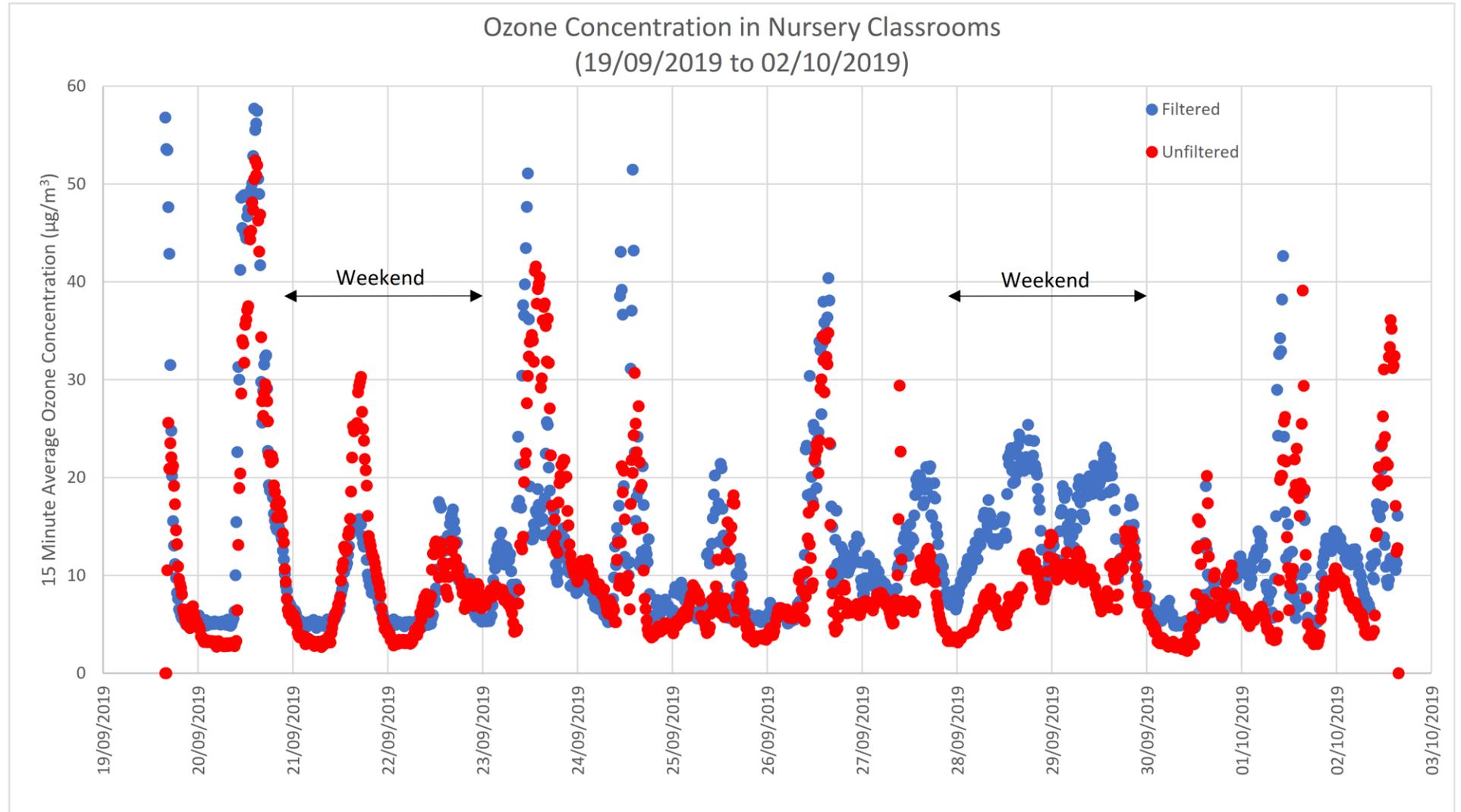


Zephyr Continuous Monitor

Summary AFS Pollutant Reduction - 6 Target Nurseries

Nursery	Effective NO ₂ Reduction		Effective PM _{2.5} Reduction	Effective Ozone Reduction
	Diffusion Tube	Zephyr		
Nell Gwynn	Negligible detected	Reduced peak hour NO ₂ concentration in AFS classroom	Positive PM _{2.5} reduction by approximately 0.8µg/m ³	Slight increase in O ₃ detected
Columbia Market	Negligible detected	Reduced peak hour NO ₂ concentration in AFS classroom	Positive PM _{2.5} reduction by between 5 to 6µg/m ³ .	Negligible difference detected
Rachel McMillan	N/A	Some minor reduction in AFS peak hour NO ₂ in the afternoon, though minor increase in morning	Positive PM _{2.5} reduction by approximately 0.3µg/m ³ .	Negligible difference detected
Pembury House	Significant positive reduction with difference detected of 5.8µg/m ³	Significant NO ₂ reduction in AFS throughout the day	Positive PM _{2.5} reduction by up to 3µg/m ³	Positive O ₃ reduction by between 4 to 6µg/m ³ .
Thomas Coram	Successful positive reduction of 2.2µg/m ³ detected	Reduced peak hour NO ₂ concentration in AFS classroom	Positive PM _{2.5} reduction by between 0.2 to 1µg/m ³ .	N/A
Dorothy Gardner	N/A	Reduction in NO ₂ concentrations in AFS classroom	Positive PM _{2.5} reduction by approximate 1 µg/m ³	N/A

Ozone Testing Columbia Market



AFS Trial – Findings

- **Clear reduction in PM2.5 concentrations** in the ‘AFS’ rooms when compared to the measurements from the ‘control’ classroom. Thereby reducing exposure risk of young pupils to particulate matter.
- Overall, weekend traces are typically lower when compared to the weekday traces, reflecting the lower activity rates when the classrooms are not in use.
- Reductions in NO₂ concentrations measured by diffusion tube have been less distinct, with no substantial increase in NO₂ concentrations detected between the AFS and Control classrooms.
- Nitrogen dioxide concentrations were lower in four of the six AFS classrooms in comparison to the corresponding Control classrooms.

Ozone Results

- Though concentration profiles varied, there appears to be little evidence Ozone is generated by AFS. Ozone in the classrooms is likely to be associated with a combination on intrusion of ambient air and photochemical oxidation within the classrooms.

AFS Trial – Findings

<https://www.london.gov.uk/what-we-do/environment/pollution-and-air-quality/mayors-nursery-air-quality-audit-programme>

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[Home](#) > [What we do](#) > [Environment](#) > [Pollution and air quality](#) > [The Mayor's nursery air quality audit programme](#)



The Mayor's nursery air quality audit programme

Air pollution can cause long-lasting harm to children's health and well-being. [Research shows](#) that children who grow up in areas with high pollution levels are likely to have smaller lung capacity than those living with cleaner air. To address this, the Mayor of London, Sadiq Khan has [audited 50 primary schools](#) in the city's most polluted areas to find ways of reducing children's exposure to toxic air. Following the success of this programme, the Mayor has extended it to **20 nurseries** across the capital.

The nursery audits have made recommendations to reduce emissions and exposure. They include:

- 'no engine idling' schemes to reduce emissions from drop off and collection
- reducing emissions from boilers, kitchens and other sources
- school streets – where the road is closed to traffic at nursery drop off and collection times
- adding green infrastructure like 'barrier bushes' along busy roads and in playgrounds to help filter fumes
- encouraging students to walk, cycle and scoot to nursery along less polluted routes
- six were selected to trial an indoor air filtration system to determine if this could have a

Related articles



Guidance for wood burning

What you can do to reduce pollution from burning wood and other solid fuels in London.



Non-Road Mobile Machinery

Non-Road Mobile Machinery (NRMM)

Health effects from energy from waste

26 August 2020

<https://www.london.gov.uk/what-we-do/environment/pollution-and-air-quality/mayors-nursery-air-quality-audit-programme>

AFS Trial – Findings

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Executive summary

Nursery audit reports ▼

Air filtration study ▼

Taking recommendations forward

The Mayor wants local boroughs to work with the audited nurseries to take forward the recommendations. WSP will also be supporting the nurseries in developing implementation plans. [TfL's Local Implementation Plans](#) will support this by funding delivery of transport recommendations.

Through his school audit programme, the Mayor has encouraged London boroughs to audit every school within an area of high pollution, he is now calling for the same approach to be taken with nurseries. This toolkit can be used by schools, nurseries, workplaces, hospitals and other organisations to get start.

Toolkit

Accessibility Requests

If you need information in a different format, like accessible PDF, large print, easy read, audio recording or braille:

- get in touch via our online form or email mayor@london.gov.uk
- call 020 7983 4100 (Monday to Friday, 9am - 5pm)

We'll consider your request and get back to you within five working days, to advise further.



Working with the boroughs

London's new air quality management system.

AFS Trial – Findings (Non-technical Summary)

MAYOR OF LONDON Air Pollution at Schools and Nurseries “The effectiveness of Air Filtration Systems in a real-world Nursery Environment”



Improving air quality is a priority for the Mayor of London given its significant health impacts, especially on the young and vulnerable.

This summary presents the findings of a 6-month Air Filtration Systems (AFS) trial in six nursery schools, as part of a wider programme of nursery air quality audits, to enable nurseries to make an informed choice about whether to install AFS.

The trial tested the effectiveness of AFS at reducing indoor air pollution in a “real world” nursery environment. It focussed on reducing key air pollutants, Nitrogen Dioxide (NO₂), and particulate matter (PM₁₀ and PM_{2.5}), as these pollutants are more likely to harm young children by causing lung problems and breathing difficulties.

What is an Air Filtration System?

An Air Filtration System is a device that removes or reduces the amount of particles and pollutants within an environment. It operates with the air that passes through it in one or multiple stages. An AFS can simply be a filter, for instance fitted to an air handling unit, or a stand-alone unit which helps reduce particulate matter, oxides of nitrogen and other atmospheric pollutants within a confined area. In either case, the filter traps and

filters out airborne particles before the air is released into the room. They operate using a range of different technologies, and a shortlist of six AFS were selected for the trial that had a range of different air filtration technologies:

Technology Type	AFS					
	CAMFIL	IQAIR	BLUEAIR	RADIC8	AIRLABS	FELLOWES
PM Filter	*	*	*	*	*	*
Carbon Filter	*	*	*	*	*	*
UV	*	*	*	*	*	*
Titanium Dioxide Activated	*	*	*	*	*	*
Electrostatic / Ionisation	*	*	*	*	*	*

Whilst they are established technologies, this trial was seeking to test their suitability in dynamic “real world” nursery environments, where windows and doors are open and children free-flow between classrooms and playgrounds throughout the day.

The intention has been to determine the general effectiveness of the AFS technologies in these unique settings, rather than directly compare the performance of the selected AFS units with one another, as it was recognised each was operating in particular conditions.

before investing

This trial noted that the six nurseries where the trial took place were within ambient air quality limit values, despite the nurseries being in amongst the most polluted areas of London, with their windows and doors open regularly, which serves to underline the importance of establishing the baseline indoor air quality conditions to inform the requirements for an AFS. Though it is important to note that other studies have found indoor air pollutants such as PM_{2.5} were often significantly

higher inside classrooms than outdoors, and that there are no entirely “safe” levels of exposure to harmful pollutants, and children would still benefit from further reductions.

Recommendations

Ultimately, whether a nursery should invest in an AFS is a very much an individual decision for each nursery and its staff. They have a role to play, targeting particular classrooms or high-use areas where indoor air quality is poor, where the need is pressing, and where there are few alternatives to stop the pollution at source. We would not advocate a blanket roll-out of AFS, mindful of the associated financial and environmental costs, and would encourage an evidence-based approach, to ensure AFS are deployed effectively. As such, an appropriately specified AFS could be considered amongst the range of measures for addressing poor air quality

Establishing common performance standard

It is important to recognise that there were limitations to this trial, and to fully quantify the impacts of AFS upon indoor air quality, a series of controlled and more intensive tests are required. Additionally, to allow people to make more informed decisions, a common set of performance standards should be introduced, as well as the development of AFS design standards, certified under common testing criteria by the Government or appropriate regulatory agencies.

Summary of AFS costs and performance

Features	Low	High	Average
Supply price	£750	£1,500	£1,000-1,200
Annual maintenance	£150	£400	£250-300
Annual energy consumption	£80	£185	£105
Noise level (dBa)	25	68	41
PM filter life span (hours)	2,000	8,760	4,000-4,500
Carbon activated filter life span (hours)	4,380	8,760	5,000-5,500

Features	Observations
Fan Setting	Each AFS was set up to run at a rate agreeable with the nursery, balancing the removal rate of polluted air against the noise of the unit. In addition, AFS treatment rates and airflow speeds were varied across operating hours. Typically, the AFS have at least three speed settings. Based on the information gathered the AFS typically run on a manual speed mode, unless additional remote controls are implemented.
Noise Levels	In terms of noise level, the units are no louder than a typical air conditioning unit (< 68 dBa). The noise levels are dependent on the fan speed of the AFS. The fan speed essentially determines how much ambient air is processed per hour. The higher the speed, the greater the noise levels.
Remote and automatic controls	Remote and automatic controls are typically available for each AFS unit (though sometimes at extra cost) and can be used for setting the fan speed of the AFS and are particularly helpful for the wall-mounted units which can otherwise be hard to reach.
AFS Positioning	In some cases, the AFS units were positioned more centrally within rooms to improve air flow to the unit and aide performance, whilst in other cases the AFS had to be positioned in more compromised positions to avoid them obstructing classrooms, or to be out of reach of the children. Wall mounted units were generally felt to be more appropriate for nursery environments than floor mounted / standing units.

Purchasing Arrangements	Observations
	The supply price can be affected by factors such as: <ul style="list-style-type: none"> Long term agreements on replacement filters (which can result in lower initial prices as an annual / monthly fee is charged for maintenance components) Number of units purchased Additional filters fitted to

Participating AFS Suppliers

Camfil wall mounted Air Cleaner CC



IQair CleanZone SL



Radice VK Blue



Blueair “Classic 605”



AeraMax Professional (Fellowes Brands)



Airlabs “Airubbi”



Thank you!

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