



Air Quality

Joint Strategic Needs Assessment (Refresh) -
February 2018

DRAFT

Contents

Introduction.....	3
What do we know?.....	4
Facts and Figures	4
Trends.....	5
Carbon monoxide.....	7
Nitrogen dioxide (NO ₂).....	7
Particulate Matter (PM ₁₀).....	10
Targets.....	11
Performance	12
Local Views	15
National and local strategies	18
The National Air Quality Strategy	18
Mayor’s Air Quality Strategy	18
Lewisham Air Quality Action Plan.....	18
Current Activity and Services	18
What is this telling us?.....	20
What are the key inequalities?	20
What are the key gaps in knowledge and/or services?.....	20
What is coming on the horizon?	21
What should we be doing next?	21
Indoor Air Pollution.....	23
Appendix 1: Health impacts of air pollution.....	24
Health effect of particulate matter (PM)	24
Impact on morbidity.....	24
Short-term Impacts:.....	24
Long-term impacts	24
Impact on mortality.....	26
References.....	28

Published: February 2018



Joint Strategic Needs Assessment (JSNA): Air Quality

Introduction

The quality of the air in the local environment has an impact on the health of the public and ecosystems. There are several different gases which can occur in ambient air and which have been identified as having health impacts. These include nitrogen dioxide (NO₂), sulphur dioxide (SO₂) and ground-level ozone (O₃). In addition, very small particles of dust can be inhaled and reach the inner airways and lungs.

Breathing in polluted air is linked to respiratory illnesses including Chronic Obstructive Pulmonary Disease (COPD)¹, asthma² cardiovascular disease³ and neurological impairments⁴. In June 2012, the International Agency for Research on Cancer (IARC) confirmed that fumes from diesel engines are carcinogenic⁵.

A study in 2013 has shown association between early exposure to traffic pollution and several childhood cancers⁶. Links have also been reported to diabetes and premature and low birth weight babies⁷. This can lead to restricted activity, hospital admissions and even premature mortality.

What do we know?

Facts and Figures

- The Committee on the Medical Effects of Air Pollutants (COMEAP) speculated that it is reasonable to consider that air pollution may have made some contribution to the earlier deaths of up to 200,000 people in the UK (the number dying of cardiovascular causes) with an average loss of life of about two years per death affected, though that actual amount would vary between individuals.⁸
- Air pollution is estimated to reduce life expectancy of every person in the UK by an average of 7-8 months with estimated equivalent health costs of up to £15 billion each year, within a range of £8-£17 billion.⁹
- It has been estimated that 116 deaths (aged 25+ years) in Lewisham in 2010 were attributable to long-term exposure to small particles. This figure is based upon an amalgamation of the average loss of life of those affected of 12 years.¹⁰
- COMEAP estimate that for every 10µg/m³ increase in PM_{2.5}, there is a 6% increase in annual all-cause death rates. Based on this estimate, there would be an additional 153 early deaths within the London Borough of Lewisham for every such rise.⁸
- Some 40 million people in the 115 largest cities in the European Union (EU) are exposed to air exceeding WHO air quality guideline values for at least one pollutant.¹¹
Children living near roads with heavy-duty vehicle traffic have twice the risk of respiratory problems as those living near less congested streets.¹²
- Persons between the ages of 0-14 years and 65-80+ years and those with pre-existing lung or heart disease are more vulnerable to the effects of air pollution.¹³
- Epidemiological studies on acute exposure to air pollution increases chances of premature mortality, cardiovascular hospital admissions, exacerbated asthma and other respiratory symptoms. This is particularly the case for fine particles (PM₁₀ and PM_{2.5}) and ozone. For these pollutants, the relationships revealed by these studies are widely accepted as causal.¹³
- Chronic exposure to air pollution has been shown to have a more profound effect (measured through changes in life expectancy) than acute exposure. Increasing evidence is showing that association between NO₂ and impact on health is not strong enough to be quantified and is not used widely.¹³

Trends

The UK Air Quality Standards Regulations 2000, updated in 2010, sets standards for a variety of pollutants that are considered to be harmful to human health and the environment. These are based on EU limit values and are for a range of air pollutants, listed below:

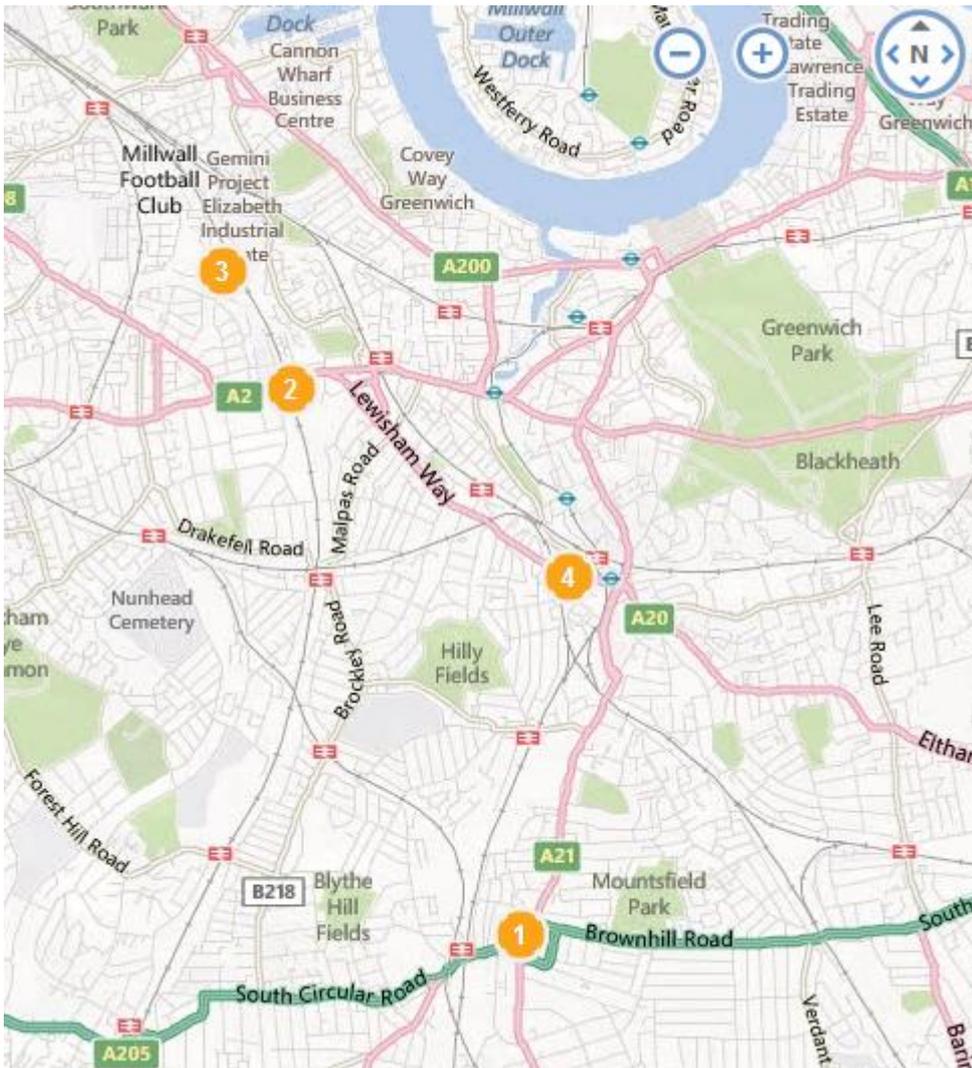
- Benzene
- Benzo(a)pyrene
- Carbon monoxide (CO)
- Lead
- Nitrogen dioxide (NO₂)
- Oxides of nitrogen (NO_x)
- Particulate matter (PM₁₀ & PM_{2.5})
- Sulphur dioxide (SO₂)
- Ozone

Of the pollutants included in the Air Quality Standards Regulations, monitoring of the following has been carried out within London Borough of Lewisham for several years:

- Carbon monoxide (CO) – monitoring site closed in 2010
- Nitrogen dioxide (NO₂)
- Ozone (O₃) – since 2016 no longer monitored
- Particulate matter (PM₁₀) i.e. particles with a diameter <10 microns
- Sulphur dioxide (SO₂) – since 2016 no longer monitored

Monitoring of particulate matter (PM_{2.5}) began at one location in 2012.

The map below shows the locations where automatic monitoring of air pollutants has taken place within the London Borough of Lewisham:



Map 1: Locations of automatic Air Quality Monitoring Stations in London Borough of Lewisham

- 1 = Broadway Theatre, Catford (UB) 2 = New Cross Road (Roadside)
3 = Mercury Way (site closed in 2015) 4= Loampit Vale (Roadside)

Monitoring site 3 in Mercury Way started collecting data between 2010 and 2015 and monitoring site 4 in Loampit Vale opened in 2012. A further site, located in Crystal Palace Parade, is just outside the borough boundary but was a collaborative project with neighbouring boroughs. This site was closed in July 2010 but data from the site up until this date has been included in this report.

Carbon monoxide

Carbon monoxide monitoring was only carried out at the Crystal Palace site which closed in 2010. In 2010, prior to its closure, the maximum 8-hour running mean was 1.2mg/m³ compared to a target of 10mg/m³ set in the National Air Quality Objectives. This period of monitoring confirmed that the air quality objective for Carbon Monoxide was achieved.

Location		2008	2009	2010
Crystal Palace 1, Crystal	Max 8 Hour	1.6	1.5	1.2
	Annual mean	0.4	0.4	0.4
Palace Parade	Max 1 Hour	3	2	1.8
	Data capture %	86	89	56

Table 1: Carbon monoxide monitoring data (Crystal Palace 1)

Nitrogen dioxide (NO₂)

The National Air Quality Objective for the NO₂ annual average is 40µg/m³. The graph below shows the annual averages measured at automatic monitoring sites within the borough for the years where data is available (see Map 1 for locations of monitoring sites).

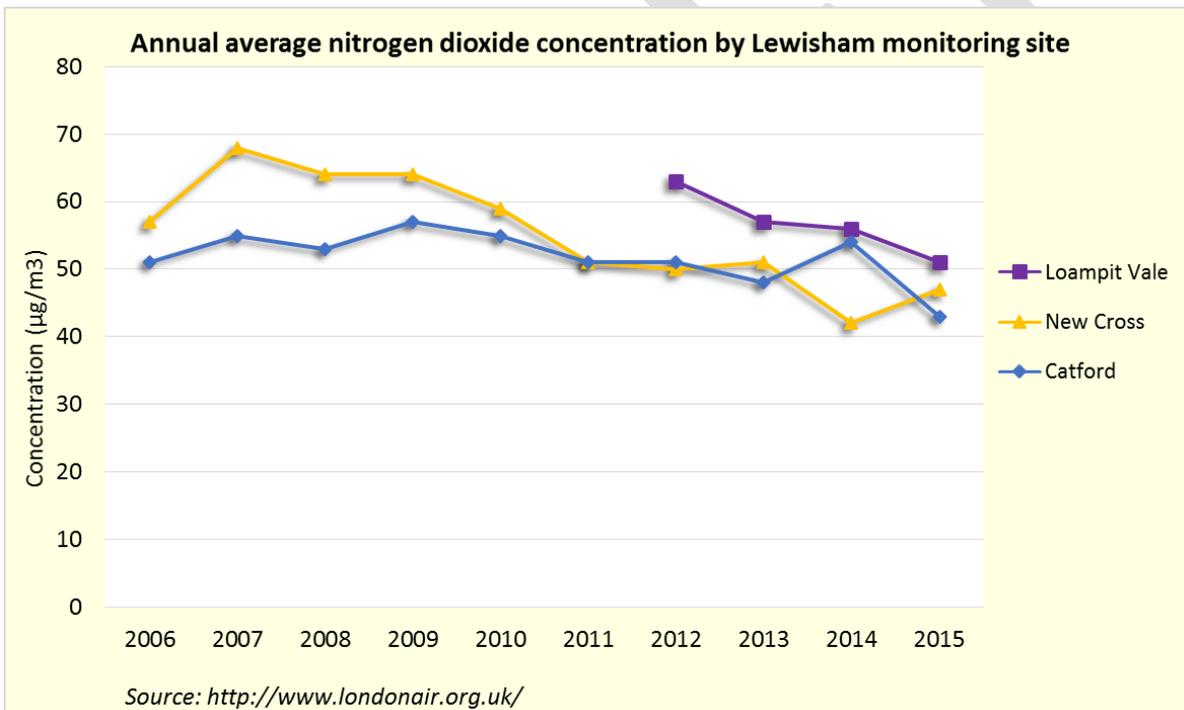


Fig 2: Trends in nitrogen dioxide annual averages

In addition to the automatic monitoring sites, London Borough of Lewisham also gather data on NO₂ concentrations using diffusion tubes which are passive monitors. These have a lower degree of accuracy than the automatic monitors but provide indicative data that is used to calculate annual averages. Data is collected at 34 different locations around the borough, some close to busy roads (roadside) while others are located in residential areas or parks (background). The tables/graphs below show the annual averages for NO₂ at both roadside and background locations.

Ozone is not included in the system of Local Air Quality Management owing to its trans-boundary nature.

Background Site id	2009	2010	2011	2012	2013	2014	2015	2016	Trend
LW1 CM	56.0	55.0	51.0	50.0	48.0	54.0	43.0	45.0	
L2			29.7	31.0	29.6	29.2	28.1	27.0	
L3			34.7	37.9	37.1	35.9	34.3	32.0	
L4			37.2	34.9	37.3	34.9	34.4	30.0	
L6			35.9	37.5	38.3	36.0	35.2	31.0	
L12			30.7	33.7	34.9	30.5	26.9	25.0	
L13		34.9	29.7	32.3	33.3	28.3	27.3	24.0	
L14	35.7	33.3	33.5	34.5	34.7	31.2	29.9	28.0	
L22	37.9	33.1	35.4	34.3	33.5	32.2	30.3	28.0	
L24	30.8	33.4	29.0	35.1	36.3	35.6	32.4	31.0	
L25	27.1	30.8	28.3	28.3	27.5	25.5	23.3	22.0	
L31	28.7	30.7	23.2	25.4	29.6	25.7	23.5	23.0	
L32	33.0	35.3	29.7	29.6	31.6	30.6	28.6	29.0	
L33	60.7	54.7	47.1	51.4	51.0	44.6	41.8	40.0	
L34	34.3	32.7	27.6	30.4	34.0	31.8	27.0	25.0	

Fig 3: Trends in nitrogen dioxide annual averages at background sites (diffusion tubes)

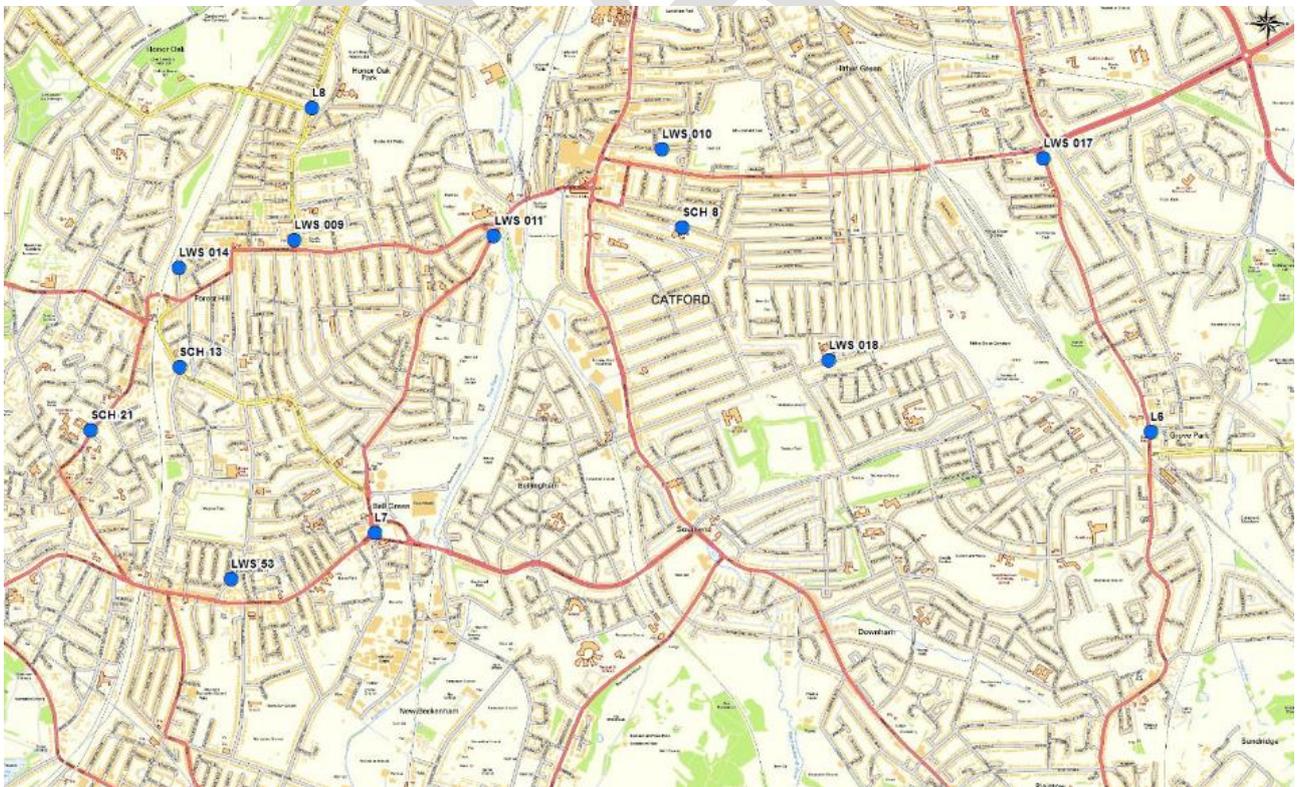
Roadside Site id	2009	2010	2011	2012	2013	2014	2015	2016	Trend
LW2 CM	63.0	59.0	51.0	50.0	51.0	42.0	47.0	47.0	
LW4 CM				64.0	57.0	56.0	51.0	45.0	
L1			36.4	37.8	38.6	38.0	33.1	31.0	
L5			36.6	39.0	43.3	37.7	33.4	32.0	
L7			48.3	53.4	53.8	55.4	48.3	44.0	
L8			44.5	44.8	48.6	42.2	42.2	38.0	
L9			39.9	40.6	40.5	40.8	37.5	35.0	
L10			43.2	44.0	46.2	40.3	39.4	37.0	
L11			44.9	40.0	47.4	38.6	36.1	33.0	
L15	49.2	47.8	43.6	44.3	47.6	46.5	46.6	41.0	
L16	59.4	61.3	48.7	55.0	58.6	52.5	48.7	49.0	
L17	72.8	75.2	75.4	59.2	53.7	49.1	50.6	52.0	
L18	73.1	75.2	75.4	59.2	53.7	51.1	49.1	31.0	
L19	71.2	75.2	75.4	59.2	53.7	49.6	49.7	47.0	
L20		54.1	42.4	45.4	44.7	43.6	43.2	38.0	
L21	56.6	60.9	52.6	54.0	54.0	54.6	50.3	46.0	
L23	57.1	56.1	54.0	56.5	59.9	55.1	51.8	45.0	
L26	60.0	53.8	49.7	48.0	51.9	53.7	47.2	41.0	
L27a* previous site	40.5	38.5	34.6	37.3	37.2	36.2			
L27b* new site							57.1		
L28	49.1	60.7	51.9	59.3	61.9	51.0	58.6	52.0	
L29	31.3	35.1	29.9	32.1	33.3	33.0	28.6	27.0	
L30	31.0	33.0	27.8	31.1	34.3	31.3	32.3	28.0	
L33	60.7	54.7	47.1	51.4	51.0	44.6	41.8	40.0	

Fig 4: Trends in nitrogen dioxide annual averages at roadside sites (diffusion tubes)

NOTE: Data for 2016 in both the above tables uses Bias Adjusted Factor of 0.92

Background Sites		Roadside Sites	
LW1 CM	Catford	LW2 CM	New Cross
L2	Bronze Street, SE8	LW4 CM	Loampit Vale
L3	Grove Street, SE8	L1	Chubworthy Street, SE14
L4	Plough Way, SE8	L5	Lee High Road, SE12
L6	Le May Avenue, SE12	L7	Bell Green, SE6
L12	Hilly Fields, SE13	L8	Stondon Park, SE23
L13	Mayow Road, SE26	L9	Ladywell Road, SE13
L14	Boyne Road, SE13	L10	Whitburn Road, SE13
L22	Ringstead Road, SE6	L11	Sparta Street, SE10
L24	Hazelbank Road, SE6	L15	Lewisham Road, SE13
L25	Stanstead Road, SE23	L16	Loampit Vale, SE13
L31	Howson Road, SE4	L17-L19	New Cross Road, SE14
L32	Clyde Street, SE8	L20	Hatcham Park Road, SE14
L34	Dartmouth Road, SE26	L21	Brockley Rise, SE23
		L23	Catford Hill, SE6
		L26	Shardloes Road, SE14
		L27	Lawn Terrace, SE3
		L28	Baring Road, SE12
		L29	Sangley Road, SE6
		L30	Perry Vale, SE23
		L33	Lewisham High St, SE13

Table 2: Showing names of both Background and Roadside sites



Map 2 showing Diffusion Tube Monitoring Locations in LB of Lewisham: Diffusion Tube Network (South) in 2016



Map 3 showing Diffusion Tube Monitoring Locations in LB of Lewisham: Diffusion Tube Network (North) in 2016

Particulate Matter (PM₁₀)

The National Air Quality Objective for the PM₁₀ annual average is **40µg/m³**. The graph below shows the annual averages recorded at the borough’s monitoring sites for those years where data is available.

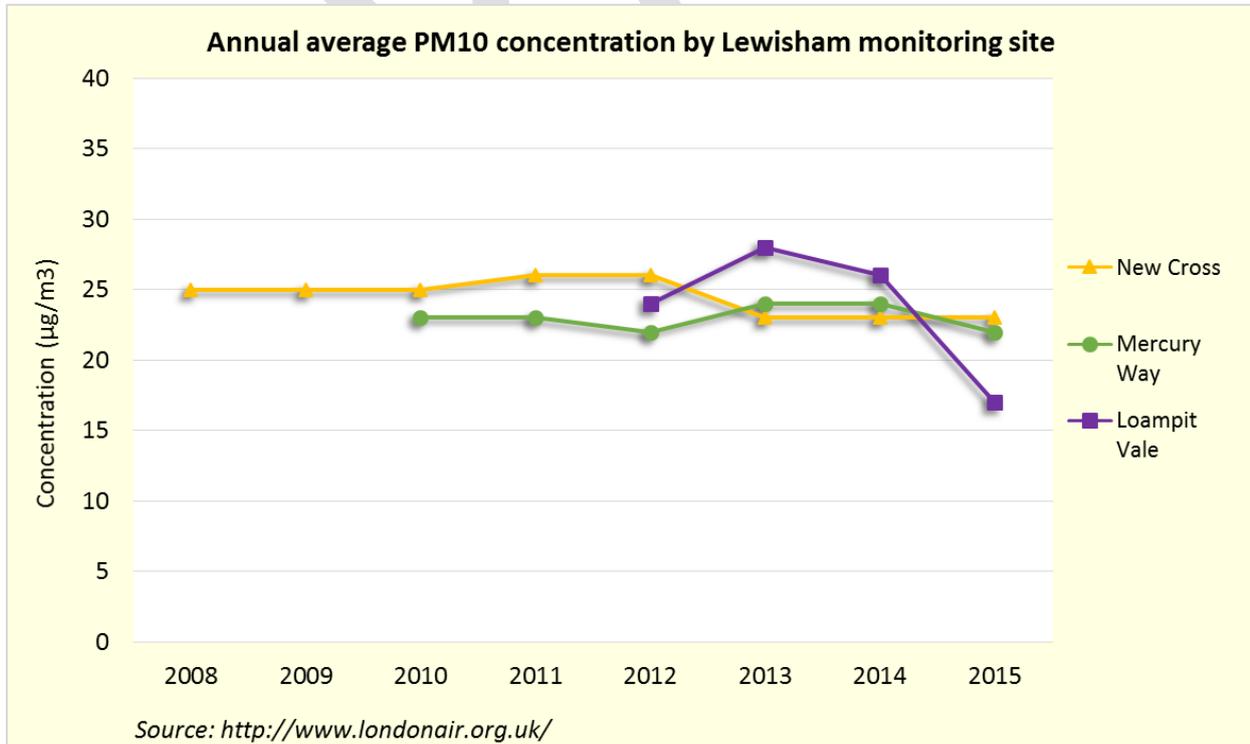


Fig 5: Trends in PM₁₀ annual averages

Targets

The European Union has issued an air quality Directive that sets standards for a variety of pollutants that are considered harmful to human health and the environment. These standards, which are based on WHO guidelines, include limit values, which are legally binding and must not be exceeded. The EU Directive, including the emission concentration limit values, has been transposed into English law by the Air Quality Standards Regulations and a national strategy developed. The table below shows the objectives that are set in the UK National Air Quality Strategy for the different pollutants that occur in ambient air:

Pollutant	Concentration	Averaging period	Legal nature	Permitted exceedances each year
Fine particles (PM _{2.5})	25 µg/m ³ ***	1 year	Target value entered into force 1.1.2010 Limit value enters into force 1.1.2015	n/a
Nitrogen dioxide (NO ₂)	200 µg/m ³	1 hour	Limit value entered into force 1.1.2010	18
	40 µg/m ³	1 year	Limit value entered into force 1.1.2010*	n/a
PM ₁₀	50 µg/m ³	24 hours	Limit value entered into force 1.1.2005**	35
	40 µg/m ³	1 year	Limit value entered into force 1.1.2005**	n/a
Lead (Pb)	0.5 µg/m ³	1 year	Limit value entered into force 1.1.2005 (or 1.1.2010 in the immediate vicinity of specific, notified industrial sources; and a 1.0 µg/m ³ limit value applied from 1.1.2005 to 31.12.2009)	n/a
Carbon monoxide (CO)	10 mg/m ³	Maximum daily 8 hour mean	Limit value entered into force 1.1.2005	n/a
Benzene	5 µg/m ³	1 year	Limit value entered into force 1.1.2010**	n/a
Arsenic (As)	6 ng/m ³	1 year	Target value enters into force 31.12.2012	n/a
Cadmium (Cd)	5 ng/m ³	1 year	Target value enters into force 31.12.2012	n/a
Nickel (Ni)	20 ng/m ³	1 year	Target value enters into force 31.12.2012	n/a
Polycyclic Aromatic Hydrocarbons	1 ng/m ³ (expressed as concentration of Benzo(a)pyrene)	1 year	Target value enters into force 31.12.2012	n/a

Table 3: Air Quality Objectives included in Regulations for the purpose of Local Air Quality Management in England.

Note: Ozone and SO₂ are no longer being monitored so are not included in the above table

* Under the new Directive the member State can apply for an extension of up to five years (i.e. maximum up to 2015) in a specific zone. Request is subject to assessment by the Commission. In such cases within the time extension period the limit value applies at the level of the limit value + maximum margin of tolerance (48 µg/m³ for annual NO₂ limit value).

** Under the new Directive the Member State was able to apply for an extension until three years after the date of entry into force of the new Directive (i.e. May 2011) in a specific zone. Request was subject to assessment by the Commission. In such cases within the time extension period the limit value applies at the level of the limit value + maximum margin of tolerance (35 days at 75µg/m³ for daily PM₁₀ limit value, 48 µg/m³ for annual Pm₁₀ limit value).

*** Standard introduced by the new Directive
(<http://ec.europa.eu/environment/air/quality/legislation/directive.htm>)

These National Air Quality Objectives have been set in regulations which implement European Union Directives on ambient air quality. The EU Directives set limit values for the pollutants which take into account relevant World Health Organisation standards, guidelines and programmes. The limit values are legally binding on the member states and must not be exceeded.

A new European Union directive on ambient air quality and cleaner air entered into force in June 2008. This merges together four earlier directives and one Council decision.

Performance

2015 Data from <http://www.londonair.org.uk/>:

Concentrations of each of the pollutants included in the Air Quality Standards Regulations have been monitored and/or estimated then compared to the relevant standards (objectives).

Pollutant	Lewisham site	Capture rate	Concentration	Target	Measure	Achieved in LBL (Y/N)
Nitrogen dioxide (NO ₂)	Catford	82%	0 µg/m ³	200 µg/m ³ not to be exceeded more than 18 times a year	1 hour mean	n/a*
			43 µg/m ³	40 µg/m ³	Annual mean	n/a*
	Loampit Vale	84%	0 µg/m ³	200 µg/m ³ not to be exceeded more than 18 times a year	1 hour mean	n/a*
			51 µg/m ³	40 µg/m ³	Annual mean	n/a*
	New Cross	92%	7 µg/m ³	200 µg/m ³ not to be exceeded more than 18 times a year	1 hour mean	y
			47 µg/m ³	40 µg/m ³	Annual mean	n
Particulate matter (PM ₁₀)	Loampit Vale	96%	1 µg/m ³	50 µg/m ³ not to be exceeded more than 35 times a year	24 hour mean	y
			17 µg/m ³	40 µg/m ³	Annual mean	y
	Mercury Way	92%	16 µg/m ³	50 µg/m ³ not to be exceeded more than 35 times a year	24 hour mean	y
			22 µg/m ³	40 µg/m ³	Annual mean	y
	New Cross	92%	8 µg/m ³	50 µg/m ³ not to be exceeded more than 35 times a year	24 hour mean	y
			23 µg/m ³	40 µg/m ³	Annual mean	y
Particulate matter (PM _{2.5})	New Cross	88%	16 µg/m ³	25 µg/m ³	Annual mean	n/a*

* n/a applies to sites that do not meet the capture rate requirement of 90%

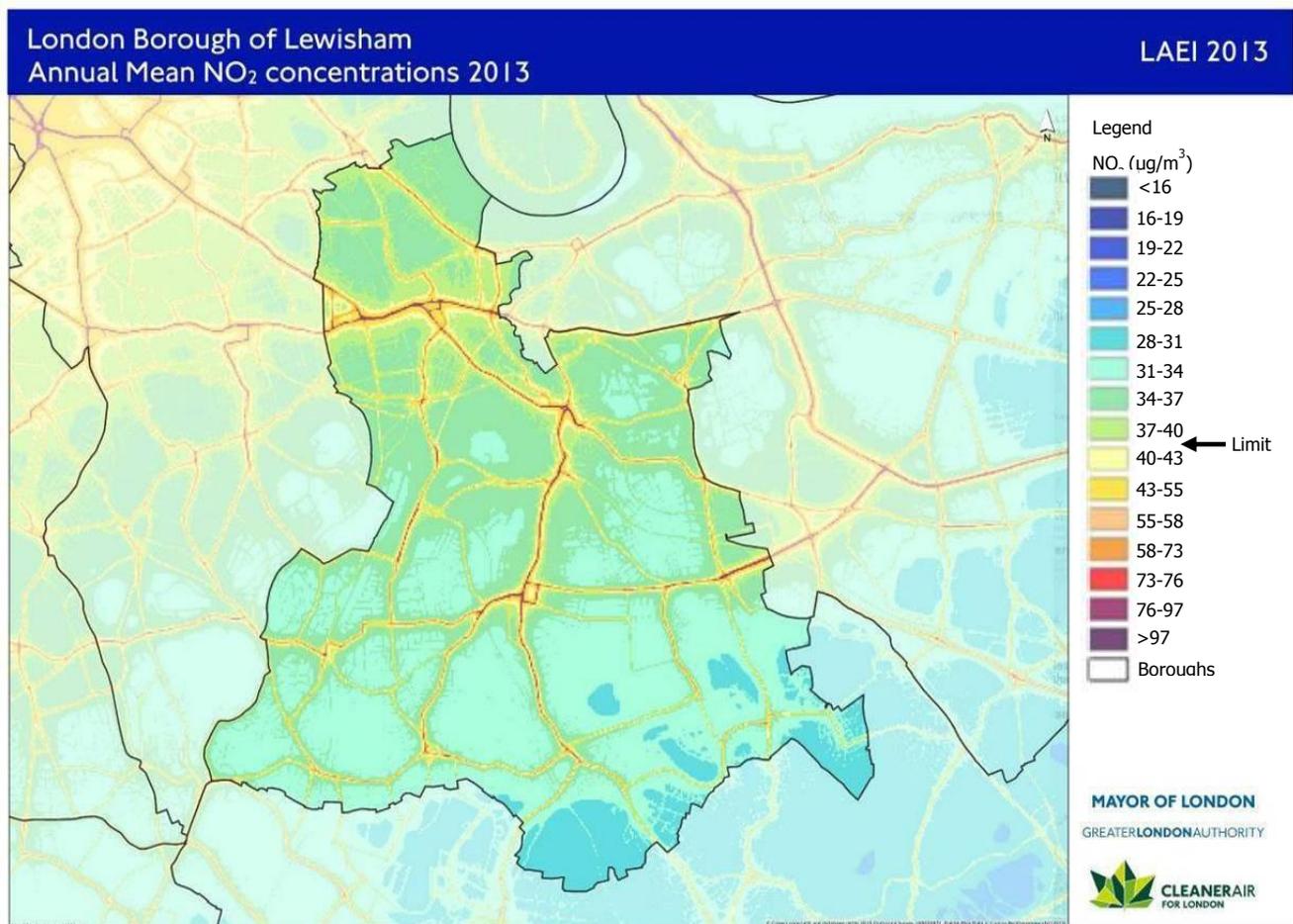
Table 4: List of each of the pollutants with the relevant objective and whether or not the objective was met in the most recent year for which data was available (2015)

From the above table, it can be seen that the objectives were not met for only one of the pollutants; NO₂. These are called 'exceedances'. Exceedances of the annual average objective occur at many roadside locations within the borough while exceedances of the 1-hour mean objective only occur adjacent to those roads that are the most busy and congested. All background sites where monitoring of nitrogen dioxide is undertaken show compliance with both objectives.

To help put the situation in Lewisham in a regional context, the highest annual mean for NO₂ measured at the New Cross monitoring station in 2015 was 47µg/m³. The highest reading recorded at any monitoring station in London was 135µg/m³.

Exceedances of the 24-hour mean objective for PM₁₀ have occurred previously but not since 2003.

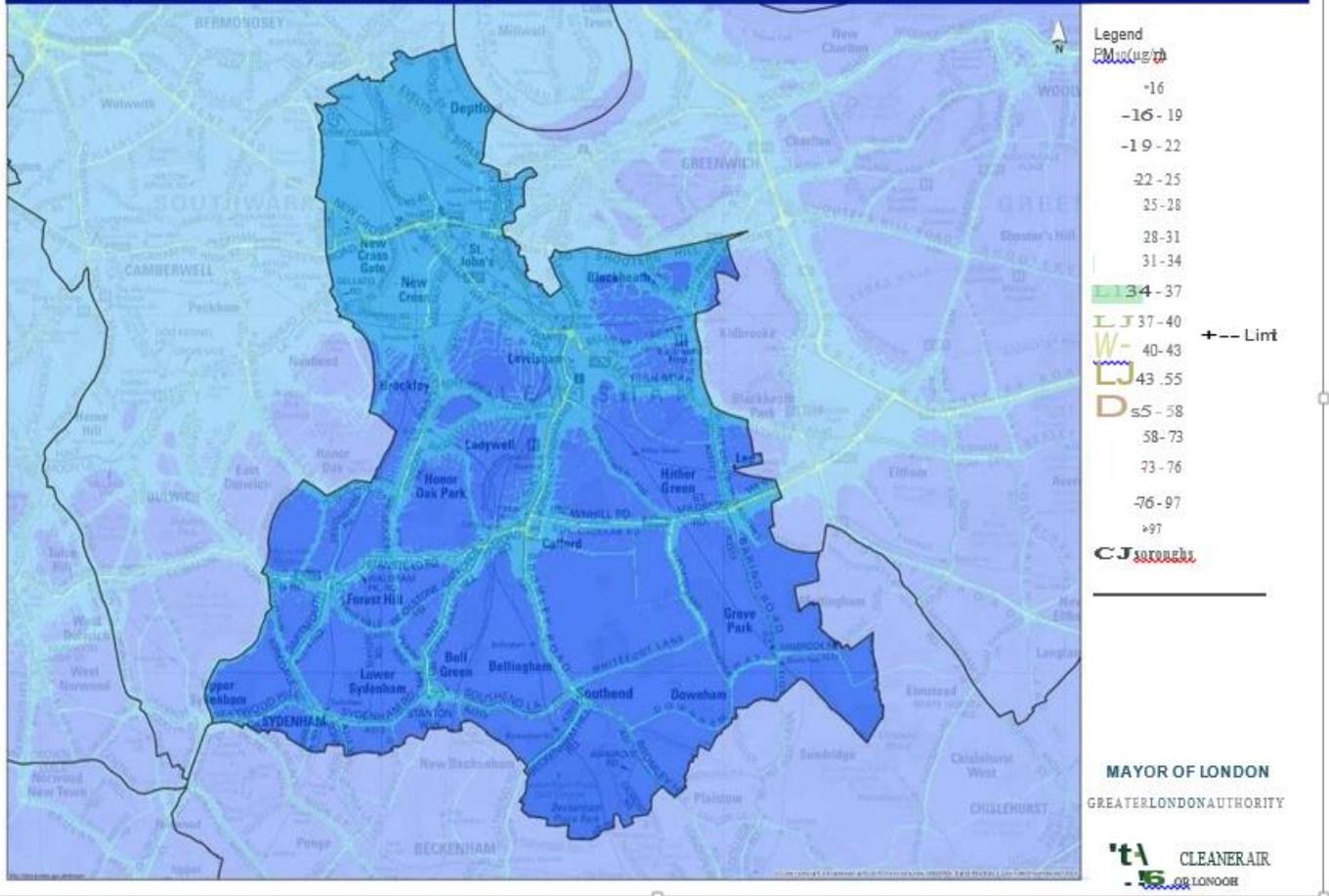
The maps below show the modelled concentrations of nitrogen dioxide and PM₁₀ for 2013 within the borough of Lewisham.



Map 4: NO₂ concentrations in London Borough of Lewisham 2013

London Borough of Lewisham
Annual Mean PM₁₀ concentrations 2013

LAEI 2013



Map 5: PM₁₀ concentrations in London Borough of Lewisham 2013

DR

Local Views

Air quality is of significant concern to many local people and the subject often generates headlines in the national and local media. The 2010 Londoner Survey¹⁴ found that pollution from traffic was the top environmental concern for Londoners.

There is no measure of local attitudes towards air quality within the borough that is carried out on a regular basis. Progress on air quality is reported to DEFRA and the GLA on an annual basis and these reports are available for viewing on the Lewisham Council website (<https://www.lewisham.gov.uk/myservices/environment/air-pollution/Pages/Air-quality-reviews.aspx>). These reports are required to be produced according to a prescribed template and the content is fairly technical. Possibly as a result of this, they rarely generate feedback from members of the public. However, from conversations and calls to the local authority, we know that people are concerned about local air pollution.

Local views are gathered through consultation on specific issues and/or during community engagement events. A consultation on parking regulations within the borough was carried out in 2012 which included questions on public attitudes towards encouraging low emission vehicles using fiscal incentives. In addition, a local consultation was carried out within the Crofton Park / Forest Hill area on the designation of a new Air Quality Management Area. The responses from the latter consultation showed overwhelming support for a larger geographical area to ensure that air quality could be managed on a wider scale.

Another consultation was held 2016 for the Air Quality Action Plan (AQAP) 2016-2021, 303 residents responded to this consultation. The highlights of the consultations are as follows:–

Over 50% of respondents felt that Air Quality had got worse compared to a year ago.

- Nearly all respondents saw traffic as being a main source of the problem and 70% of respondents identifying construction as a source, with industry and domestic/commercial fuel use identified as a source but to a lesser extent.

Traffic was identified as a main priority for the AQAP with emissions specifically from commercial delivery vehicles and freight being particularly important for consideration.

- In relation to emissions from developments and buildings; Localised solutions; Public health and awareness raising 40-50% respondents identified these as being 'Very Important' in relation to emissions from developments and buildings.

Over 69% of respondents were likely or very likely to introduce further energy efficiency measures within their home.

- Respondents were asked whether they wished to receive information on Boiler Cashback information and 60 respondents replied requesting information.

Over 16% of respondents have diesel cars that are older than September 2014, pre-Euro 6 engines, required when the Ultra-Low Emission Zone is introduced.

- Nearly 20% of those that had this aged diesel car answered that they are very likely or quite likely to purchase a more environmentally friendly car if cheaper resident parking and controlled parking zone parking was introduced for cars that complied with modern pollution standards.

If discounted parking meter charges were introduced for zero-emission cars, how likely would you be to purchase a zero-emissions car in the future? Question responses: 286 (94.70%)



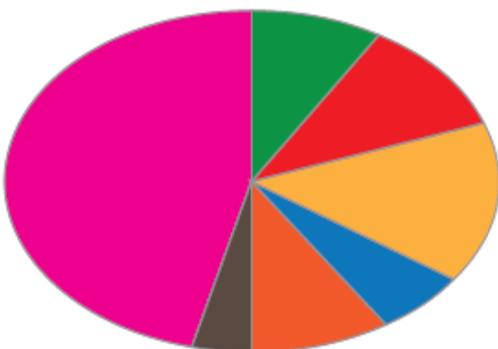
		% Total	% Answer	Count
Very likely		10.93% ■	11.54%	33
Quite likely		13.91% ■	14.69%	42
Neutral		25.50% ■	26.92%	77
Unlikely		15.56% ■	16.43%	47
Very unlikely		17.88% ■	18.88%	54
Don't know		10.93% ■	11.54%	33
[No Response]		5.30% ■	--	16
	Total	100.00%	100.00%	302

When asking whether respondents currently have a motor vehicle, 62.58 % said YES, with 36.09 replying NO and 1.32% with no response.

- Only 1.66% owned a zero emission vehicle. The main reason for not purchasing one was the cost and the availability of the infrastructure i.e. electric charging points.

If discounted parking meter charges were introduced for zero-emission cars, nearly 25% indicated that they were very likely or quite likely to purchase a zero-emissions car in the future.

- If yes to 'Do you have a diesel car that is older than September 2014': If cheaper resident parking and controlled parking zone parking was introduced for cars that complied with modern pollution standards, would you be likely to purchase a more environmentally friendly car? Question responses: 163 (53.97%)



		% Total	% Answer	Count
Very likely		8.61% ■	15.95%	26
Quite likely		10.93% ■	20.25%	33
Neutral		15.23% ■	28.22%	46
Unlikely		6.29% ■	11.66%	19
Very unlikely		8.94% ■	16.56%	27
Don't know		3.97% ■	7.36%	12
[No Response]		46.03% ■	--	139
	Total	100.00%	100.00%	302

Over 85% of respondents thought the introduction of night-time deliveries, where noise disturbance to residents can be minimised, was a very good or good idea. 43% of respondents reported that there was someone in their household that has a health condition affected by poor air quality.

101 respondents requested further information about AirText, a free text and phone application service which provides alerts where high levels of pollution are forecast and relevant health advice for those with breathing conditions. Nearly 80% of respondents were not aware of the free service available.

The Lewisham Cyclist Group felt that the consultation questionnaire focused on questions around the motor car and didn't consider alternative active modes of travel such as walking and cycling, particularly as significant numbers of Lewisham residents and households do not have access to a motor car. The cyclist group would have liked a question that might have identified how many people would choose to cycle if they had somewhere secure to store cycles. The Lewisham Cyclist Group stated that, they are currently working with the council in the preparation of a cycling strategy which considers pollution and public health. We would welcome the opportunity to discuss this issue further with council officers.

The Air Quality Action Plan (AQAP) 2016-21 was developed based on the responses received from this consultation including identifying actions to reduce emissions, particularly Nitrogen Dioxide.

DRAFT

National and local strategies

The National Air Quality Strategy

The Environment Act 1995 put into legislation a requirement for a national strategy to be developed to tackle poor air quality and thereby reduce the associated risks to human health and the environment. Consequently, on March 12th 1997, the National Air Quality Strategy was published, with commitments to achieve new air quality objectives throughout the UK by 2005. A review of the Strategy was published in January 2000 and the most recent version was produced in July 2007.

The National Air Quality Strategy aims to protect health and the environment without imposing unacceptable economic or social costs. It sets out standards and objectives for the 8 main health-threatening air pollutants in the UK. The standards are based on an assessment of the effects of each pollutant on public health. They are based on recommendations by the Expert Panel on Air Quality Standards, The European Union Air Quality Daughter Directive and the World Health Organisation. Local Authorities are responsible for seven of the eight air pollutants under Local Air Quality Management (LAQM).¹⁵ The pollutant that is not covered by LAQM is ozone which is tackled at a national level.

Mayor's Air Quality Strategy

The Mayor of London is also required to keep under review an Air Quality Strategy for the Greater London area. The most recent version of the Mayor's Air Quality Strategy entitled 'Cleaner Air for London' was published in July 2015¹⁶. The Strategy contains policies and proposals that aim to improve air quality across the Greater London area and thereby seek to ensure that the limit values for all pollutants in the area are achieved.

Lewisham Air Quality Action Plan

Although the London Borough of Lewisham does not have an Air Quality Strategy for the borough, much of the area has been declared an Air Quality Management Area. Where an Air Quality Management Area is declared, the local authority is required to develop an Action Plan containing measures that seek to address the particular air quality problems identified. As outlined above, London Borough of Lewisham published a new Air Quality Action Plan (2016-2021) in December 2016 containing 43 measures that will help to reduce the levels of NO₂ and PM₁₀ within the 6 Air Quality Management Areas declared. Although the Action Plan is for these 6 Air Quality Management Areas, the measures implemented will deliver air quality benefits across the whole of the borough.

Current Activity and Services

For the Lewisham areas declared as Air Quality Management Areas, a single Air Quality Action Plan is in place. This details all the measures that London Borough of Lewisham Environmental Protection Team are implementing or intending to do so in order to reduce the levels of NO₂ and PM₁₀.

However, many of the measures will not tackle solely the Air Quality Management Areas since any improvements to air are likely to benefit a much wider area.

A Progress Report is submitted to DEFRA each year (to the GLA from 2016) outlining the progress made with each of the measures in the Action Plan. These reports are available to view on the [Air Pollution](#) pages of the Lewisham Council website. The measures which have been targeted within 2016-21 are as follows:

- Measures to increase awareness on air quality issues including promotion of the air pollution alert service AirTEXT and methods to help people reduce their exposure such as Walkit.com;
- Measures to Encourage the Use of Cleaner Technology and Alternative Fuels through the promotion of the uptake of electric vehicles and installation of infrastructure to support their recharging;
- Promotion of Walking through improvements to the walking environment including signage, lighting and surfacing;
- Promotion of Cycling through cycle training, security marking and repair workshops.
- Measures to Manage Parking through a review of the Parking Strategy including consideration of financial incentives for low emission vehicles.
- Measures to Reduce Emissions from Domestic Buildings through offering energy efficiency measures and advice.

In addition, London Borough of Lewisham is looking at ways to improve community engagement and provide information to residents about air quality and is developing a phone app that will assist residents in finding least polluted travel routes and will provide air quality alerts and information to assist in engagement.

The Lewisham Mayor launched an Air Quality Campaign in July 2016, to help bring about behavioural change by all whilst providing a focused approach with children, schools, transport and infrastructure projects coupled with an evidence-based approach, drawing on available research to maximise effectiveness of actions and to build new knowledge through research partnerships with academic units investigating air quality issues. It is working at encouraging residents to sign a pledge of actions to improve air quality.

What is this telling us?

What are the key inequalities?

Air pollution can often travel some distance away from the source of emissions. Particulate matter, especially, can travel substantially so that concentrations within London are affected by emissions from mainland Europe as well as dust from the Sahara. However, the largest source of emissions within the borough of Lewisham are motor vehicles and, consequently, the areas of poorest air quality are adjacent to the busiest roads.

As the properties alongside busy roads tend to be cheaper and/or rented accommodation, it tends to be those from the lowest socio-economic groups who live in these areas and are, therefore, exposed to higher levels of air pollution. A close link has been shown between areas of high deprivation and pollution.

A recent study by the think tank Policy Exchange sought to quantify the inequalities experienced. The research found the following:

- 5-10 year old children living in the 10% of areas with the lowest air quality in London are nearly 50% more likely than the London average to be on free school meals.
- People living in the 10% of the areas with the lowest air quality are over 25% more likely than the London average to be on income support.

As highlighted in the 2010 Marmot Review¹⁷, individuals in deprived areas experience more adverse health effects at the same level of exposure compared to those from less-deprived areas. This is, in part, because of a higher prevalence of underlying cardio-respiratory and other diseases, as well as greater exposure to air pollution as a result of homes being situated nearer to busy congested roads and with fewer green spaces.

Studies also show that the greatest burden of air pollution usually falls on the most vulnerable in the population, in particular, the young and elderly. The link between health inequalities and pollution is complex.¹⁸

Individuals particularly at risk also include those with existing respiratory problems and chronic illnesses such as asthma and chronic obstructive pulmonary disease (COPD). There are approximately 690,000 asthma sufferers in London and 230,000 individuals suffering from COPD.¹⁹

The Health Effects Institute (HEI) panel concluded that the evidence is sufficient to support a causal relationship between exposure to traffic-related air pollution and exacerbation of asthma. It also found suggestive evidence of a causal relationship with onset of childhood asthma, non-asthma respiratory symptoms, impaired lung function, total and cardiovascular mortality, and cardiovascular morbidity, although the data are not sufficient to fully support causality.²⁰

What are the key gaps in knowledge and/or services?

Although we have information on the current levels of air quality and studies demonstrate a link between air pollution and ill-health, there are still a number of gaps in our knowledge.

The main areas in which further information is needed are:

- the effects of different types of air pollution on hospital admissions and mortality
- the quantitative impacts on pollutant concentrations from individual measures in order to identify those that are the most effective.

What is coming on the horizon?

The move of Public Health into Local Authorities facilitates the integration of considerations of the wider determinant of health into the planning and delivery of local authority services. The Public Health Outcomes Framework is a set of indicators compiled by the Department of Health to measure how effectively the activities of each local authority are addressing the determinants of health. Within four domains, there are a total of 68 indicators. One of these indicators is Air Pollution.

Following on from a recent "Review and Assessment" of air quality within the borough, a Detailed Assessment was carried out which involved modelling the concentrations of NO₂ within an area around Crofton Park and Forest Hill. This area was identified as having concentrations of NO₂ above the limit values in the Air Quality Standards Regulations, being an area where members of the public are exposed and which had not already been declared as an Air Quality Management Area. Consequently, a new Air Quality Management Area was declared to cover the areas of exceedances as a minimum. Officers from the Environmental Protection Team presented a draft order to Mayor and the Cabinet on 10 April 2013 which was approved.

Following the declaration of the new Air Quality Management Area, an Action Plan has been put in place setting out the measures that will be implemented to reduce concentrations of NO₂ in this area.

What should we be doing next?

The aim is to ensure that public health is protected by ensuring that no individuals are exposed to unhealthy levels of air pollution concentrations.

Therefore, we need to reduce exposure to air pollution but, more importantly, reduce emissions at source. While LB Lewisham aims to ensure that we achieve compliance with the prescribed limit values for all pollutants, we will strive to go beyond this and continue to improve air quality in all areas. In this way, we aim to protect even the most vulnerable individuals from the potential health impacts from air pollution.

No one measure is going to deliver the necessary reductions so a package of measures need to be implemented which requires co-operation and input from a variety of stakeholders. Furthermore, as some pollutants are brought into the borough from outside our area of jurisdiction, there are limitations to what can be achieved.

However, we need to ensure that the sources of air pollution that are emitted within the borough area and, therefore, within our remit, are controlled.

Therefore, we need to:

- Reduce emissions from transport by providing a range of sustainable alternatives with readily available information on the options, leading by example to promote

- cleaner technology and alternative fuels and using fiscal options to encourage cleaner vehicles while deterring the most-polluting;
- Reduce emissions from industry through providing advice and information to industrial operators while taking appropriate enforcement action where necessary;
- Reduce emissions from heating by supporting the uptake of energy-efficiency measures;
- Ensure that new developments do not result in increased air pollution nor place people in areas of poor air quality;
- Educate, encourage and advise people to change polluting modes of behaviour and reduce their exposure to harmful levels of air pollution.
- Work with schools to raise awareness and reduce exposure to pollution.

Certain measures to improve air quality have significant co-benefits for health. These are listed below:

Motor traffic is responsible for air pollution and so measures that encourage people to use sustainable transport, such as walking and cycling would have the following benefits:

- Create an environment that is more pleasant to walk and cycle, hence increasing physical activity levels
- Reduce risks of injury and death from road traffic collisions
- Reduce noise pollution which also enables people to open windows to buildings thus reducing the costs of air conditioning
- Reduce community severance, increase community cohesion and social interactions
- Contribute to reducing the urban heat island effect (This effect is explained by the Met Office).²¹

Greater number of trees and vegetation:

- Reduce risks from localised flooding
- Contribute to urban cooling and help to contribute to reducing the urban heat island effect
- Provide shade to enable people to keep cool and out of direct sunlight in sunny weather
- Improve mental health and wellbeing
- Improve resilience to climate change. Information on climate change is available at the Met Office website.²²

Improving the energy efficiency of homes would reduce emissions from heating systems, which would have the additional benefits of:

- Reducing fuel bills, thus reducing fuel poverty (which is the situation where households are required to spend more than 10% of their income to heat their homes to an appropriate temperature)
- Reduces likelihood of damp and mould occurring, which aggravate respiratory disease
- Reduce the number of falls in the home (falls are more likely to occur in cold homes due to poor blood circulation).

Indoor Air Pollution

Research indicates that people may spend up to 90% of their time indoors, so in addition to consideration of the air quality outside, indoor air quality of our homes and workplaces is also important.²³

In the UK, sources of indoor air pollution include domestic gas combustion from cooking and heating, cleaning agents, tobacco smoke, mould, condensation and asbestos. Tobacco smoke is an important source of indoor air pollution, exposure to second hand smoke can cause lung cancer in adults who do not smoke. It can also cause asthma in children who have not shown symptoms of asthma before.²⁴

In urban areas outdoor air pollution may affect indoor air quality. Indoor air quality can be improved through source control, filtration and ventilation.²⁵ It is possible to install filtration to reduce ingress of outdoor air pollution. There are European standards for filtration applicable for non-residential buildings. At home individuals can improve indoor air quality by not smoking at home, and other actions such as keeping types of houseplants known to improve air quality and ensuring there is adequate ventilation and extraction when cooking and using cleaning products.

DRAFT

Appendix 1: Health impacts of air pollution

Health effect of particulate matter (PM)

- PM that have diameters between 0.1 and 1 µm can be suspended in the atmosphere for days or weeks and are hence subject to long-range trans boundary air transport.²⁶
- PM consists of sulphates, nitrates, ammonia, sodium, potassium, magnesium, calcium, chlorine, carbon, transition metals that include cadmium, copper, nickel, vanadium and zinc, and polycyclic aromatic hydrocarbons (PAH). Allergens and microbial compounds have also been detected in PM.²⁶

Impact on morbidity

Exposure to air pollution can exacerbate existing health conditions including cardiovascular and respiratory disease.

Short-term Impacts:

Short-term exposure to air pollution can cause several immediate health problems:

- Air pollution can worsen respiratory symptoms in those with pre-existing lung disease and asthma.²⁷ Gaseous pollutants (NO₂, SO₂, O₃), particulate matter (PM_{2.5} and PM₁₀) and traffic-related air pollution have all been implicated. Exposure to elevated concentrations of these pollutants has been linked with a range of respiratory symptoms, including decreases in immune defence leading to increased susceptibility to respiratory infection.^{28, 29}
- Air pollution can also have immediate impacts on cardiovascular events: Short-term exposure to traffic-related pollution has been associated with increased risk of myocardial infarction for several hours after exposure. One meta-analysis found that admission to hospital or mortality from stroke was strongly associated with increased short-term exposures of SO₂, CO, NO₂, PM_{2.5} and PM₁₀.³⁰
- Use of health services can increase after periods of strong air pollution: PHE's Real Time Surveillance System Team found an increase in GP consultations for respiratory problems immediately following an episode of Saharan air pollution in 2014.³¹

Long-term impacts

Long-term exposure to air pollution can also contribute to increased risk of onset of several diseases and health problems, as summarised below:

Cardiovascular disease

There is abundant evidence air pollution, particularly PM, contributes to the risk of cardiovascular disease, including: coronary artery disease, myocardial infarction, heart failure, and stroke.³²

Cancer

Long-term exposure to outdoor air pollution, particularly PM, is associated with incidence of and deaths from lung cancer.³³ The International Agency for Research on Cancer (IARC) has classified PM and NO₂ from diesel engines as Group 1 carcinogens.³⁴

Reduced lung function

Air pollution has detrimental effects on normal lung function growth in children;³⁵ while for adults there is emerging evidence that air pollution accelerates decline in lung function.^{36,37}

Respiratory disease

Evidence for air quality's contribution to COPD onset is inconclusive,^{38,39} however studies have shown that exposure to air pollution increases risk of progression to "asthma-COPD overlap syndrome" three-fold.⁴⁰

Low-birth weight

Exposure during pregnancy is linked to low birth weight, which itself is a risk factor for several diseases during adulthood. The evidence is strongest for PM, though NO₂, CO and O₃ have also been linked.⁴¹

Development of asthma

A meta-analysis⁴² of 19 studies on the effect of traffic-related air pollution and asthma in children concluded that increased exposure to NO₂ was associated with a higher prevalence (OR 1.05) and incidence (OR 1.12) of childhood asthma.

Pre-term delivery

Some evidence suggests that the gaseous pollutants SO₂ and O₃ as well as particulates, are associated with pre-term delivery.⁴³

Hypertension

A recent cohort study found long-term exposure to PM_{2.5} air pollution and high traffic load to be positively associated with incident self-reported hypertension.⁴⁴

Type II Diabetes

There is moderate evidence that new-onset Type 2 diabetes in adults is associated with exposure PM_{2.5}, PM₁₀ and nitrogen oxides, though causality is not clear.⁴⁵

Table 4 below shows the mortality and hospital admissions data for some of the key diseases which have been associated with, or shown to be exacerbated by, air pollution in Lewisham. It also shows, mortality and hospital admission rates of COPD, cardiovascular disease and lung cancer are all worse in Lewisham compared to London and England. As mentioned earlier, poor air quality is associated with each of these diseases. This local picture highlights the importance of tackling air quality's health effects within the Borough.

Table 5: Prevalence of key air quality-related conditions in Lewisham

Condition	Indicator	Lewisham	London	England
Chronic Obstructive Pulmonary Diseases (COPD)	4.07i. Under 75 mortality per 100,000 from respiratory disease (2014-16) [^]	39.6	30.3	33.8
	Emergency hospital Admissions for COPD per 100,000 population (2015-16) [*]	497	405	411
Cardiovascular Disease (including heart disease and stroke)	4.04i. Under 75 mortality rate per 100,000 (2014-16) [^]	81.8	74.9	73.5
Asthma	Hospital admissions for asthma under 19 years per 100,000 population (2015/16) [*]	305.4	194.9	202.4
Lung cancer	Registration rate per 100,000 for lung cancer (2013-15) [*]	85.7	77.3	78.5
	Mortality from lung cancer per 100,000 population (2014-16) ^{**}	61.3	53.4	57.7

[^] <https://fingertips.phe.org.uk/profile/public-health-outcomes-framework/data#page/1/gid/1000044/pat/6/par/E1200007/ati/102/are/E09000023>

^{*} <http://fingertips.phe.org.uk/tobacco-control#page/1/gid/1938132888/pat/6/par/E1200007/ati/102/are/E09000023>

^{**} <http://fingertips.phe.org.uk/tobacco-control#page/1/gid/1938132887/pat/6/par/E1200007/ati/102/are/E09000023>

Impact on mortality

- There is good evidence of the effects of short-term exposure to PM₁₀ on respiratory health, but for mortality, and especially as a consequence of long-term exposure, PM_{2.5} is a stronger risk factor than the coarse part of PM₁₀ (particles in the 2.5–10 µm range). All-cause daily mortality is estimated to increase by 0.2–0.6% per 10 µg/m³ of PM₁₀. Long-term exposure to PM_{2.5} is associated with an increase in the long-term risk of cardiopulmonary mortality by 6–13% per 10 µg/m³ of PM_{2.5}.²⁶
- Susceptible groups with pre-existing lung or heart disease, as well as elderly people and children, are particularly vulnerable.²⁶
- DEFRA has estimated that in 2008, artificial PM_{2.5} reduced life expectancy of people in the UK by 6 months.⁴⁶ The burden of particulate air pollution in the UK in 2008 was estimated to be equivalent to nearly 29,000 deaths at typical ages and an associated loss of population life of 340,000 life years lost.⁴⁷
- Across the UK, one pollutant alone (PM_{2.5}) has been estimated to have an effect equivalent to 40,000 deaths a year.⁴⁸

It is possible to estimate the proportion of mortality attributable to pollutants in the air and this forms an outcome indicator in the Public Health Outcomes Framework (PHOF) which will enable to prioritise action on air quality in Lewisham to help reduce the health burden from air pollution.⁴⁹

The indicator is named as 'Fraction of mortality attributable to particulate air pollution' which is defined as 'Fraction of annual all-cause adult mortality attributable to anthropogenic (human-made) particulate air pollution (measured as fine particulate matter, PM_{2.5} – which means the mass (in micrograms) per cubic metre of air of individual particles with an aerodynamic diameter generally less than 2.5 micrometers. PM_{2.5} is also known as fine particulate matter)'. This is attributed to mortality burden associated with long-term exposure to anthropogenic particulate air pollution at current levels, expressed as the percentage of annual deaths from all causes in those aged 30+.⁴⁹

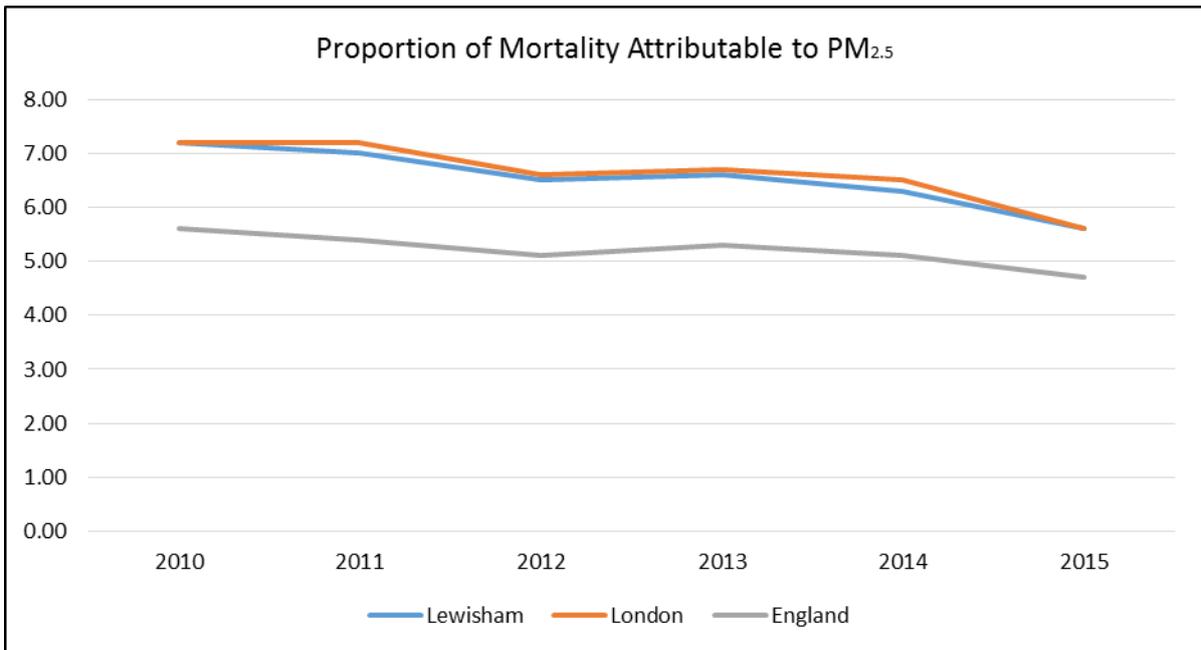


Fig 6: Proportion of mortality attributable to PM_{2.5}

Source: Public Health Outcomes Framework (PHOF)⁴⁹

Lewisham has similar proportion to London, however, England has a much lower proportion indicating air quality in London including Lewisham needs a lot of attention.

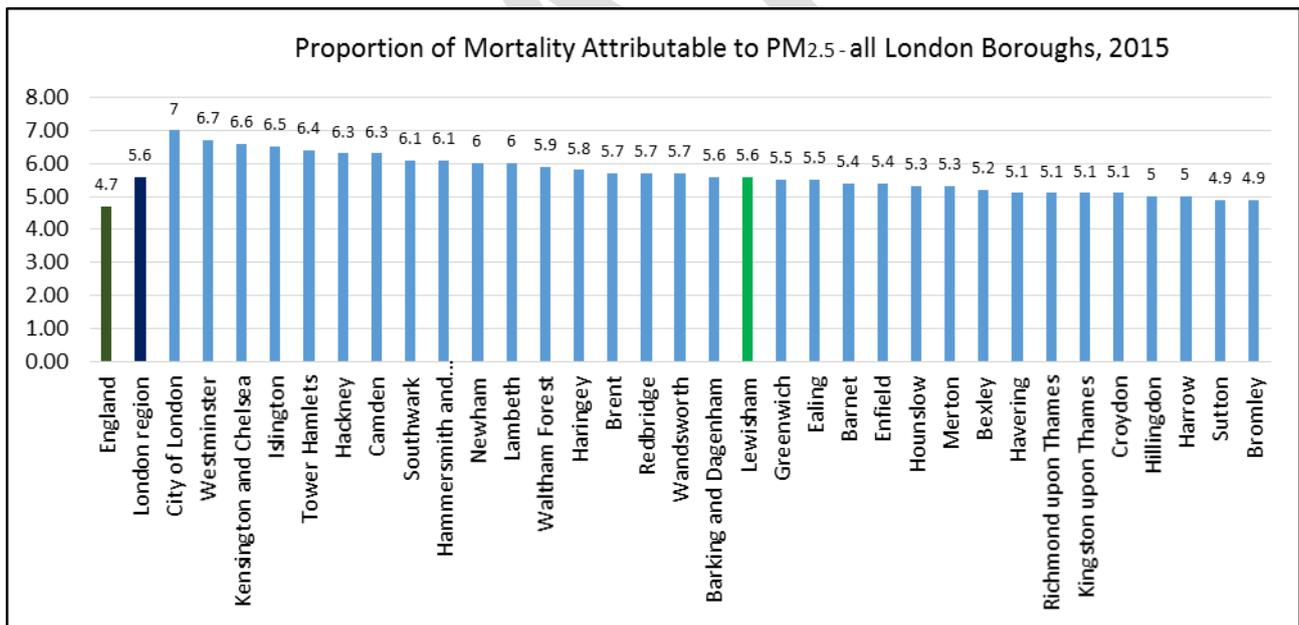


Fig 7: Proportion of mortality attributable to PM_{2.5} – all London Boroughs, 2015

Source: Public Health Outcomes Framework (PHOF)⁴⁹

The above figure shows how Lewisham compares with other London Boroughs in terms of the proportion of mortality that can be attributed to poor air quality. Lewisham’s proportion is similar to that of London as a whole, and little higher than our neighbouring borough, Greenwich. Estimates for the overall burden of mortality attributable to PM_{2.5} in Lewisham show this pollutant contributing a significant amount to the overall mortality in the area. For comparison, this compares with England-wide estimates of 6% of mortality in 1998 due to obesity, and 10% due to smoking.⁵⁰

References

- ¹ Peacock JL, Anderson RH, Bremner SA, Marston L, Seemungal TA, Strachan DP, Wedzicha JA. Outdoor air pollution and respiratory health in patients with COPD. *Thorax*. 2011 Jul;66(7):591-6. doi: 10.1136/thx.2010.155358. Epub 2011 Apr 1. <http://www.environment-health.ac.uk/publications/outdoor-air-pollution-and-respiratory-health-patients-copd>
- ² EPUK, 2010, COMEAP Revises Air Quality and Asthma Position <http://www.environmental-protection.org.uk/news/detail/?id=2701>
http://www.envirotech-online.com/news/air-monitoring/6/breaking_news/main_roads_are_a_main_cause_of_asthma_in_children/22125/
- ³ Tze Wai Wong et al, 1999, Air Pollution and Hospital Admissions for Respiratory and Cardiovascular Diseases in Hong Kong published in *Occup Environ Medicine* 1999;56:679-683
<http://oem.bmj.com/content/56/10/679.full.pdf+html>
- ⁴ <http://www.epa.gov/region7/air/quality/health.htm>
- ⁵ http://press.iarc.fr/pr213_E.pdf
- ⁶ Childhood Cancer and Traffic-Related Air Pollution Exposure in Pregnancy and Early Life. Heck et al. (2013) *Environ Health Perspect* 121:1385-1391. Available at <http://ehp.niehs.nih.gov/1306761/>
- ⁷ ClientEarth, The Health Impacts of Air Pollution <http://www.clientearth.org/health-environment/clean-air/the-health-impacts-of-air-pollution-1427>
- ⁸ The Mortality Effects of Long-Term Exposure to Particulate Air Pollution in the United Kingdom: A report by the Committee on the Medical Effects of Air Pollutants
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/304641/COMEAP_mortality_effects_of_long_term_exposure.pdf
- ⁹ Air Quality Information for Public Health Professionals – City of London.
https://www.london.gov.uk/sites/default/files/air_quality_for_public_health_professionals_-_city_of_london.pdf
- ¹⁰ Estimating local mortality burdens associated with particulate air pollution, 2014
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/332854/PHE_CRCE_010.pdf
- ¹¹ World Health Organisation, <http://www.euro.who.int/en/health-topics/environment-and-health/air-quality/data-and-statistics>
- ¹² World Health Organisation, <http://www.euro.who.int/en/health-topics/environment-and-health/air-quality/data-and-statistics>
- ¹³ http://cleanair.london/wp-content/uploads/CAL-294-ULEZ-HIA_Final_ULEZ-consultation_Reduced-size.pdf
- ¹⁴ The Annual London Survey carried out in early 2010, <https://www.london.gov.uk/get-involved/annual-london-survey/annual-london-survey-2010>
- ¹⁵ Taken from www.air-quality.org.uk
- ¹⁶ Cleaner Air for London: Progress report on the delivery of the mayor's Air Quality Strategy. July 2015
https://www.london.gov.uk/sites/default/files/gla_migrate_files_destination/MAQS%202015%20Progress%20Report%20FINAL%20FOR%20PUBLICATION_0.pdf
- ¹⁷ Sir Michael Marmot. Fair Society Healthy Lives. <http://www.instituteofhealthequity.org/resources-reports/fair-society-healthy-lives-the-marmot-review>
- ¹⁸ Air Quality and Social Deprivation in the UK: an environmental inequalities analysis – Final Report to Defra, June 2006. http://uk-air.defra.gov.uk/reports/cat09/0701110944_AQinequalitiesFNL_AEAT_0506.pdf
- ¹⁹ www.london.gov.uk/publication/mayors-air-quality-strategy
- ²⁰ <http://www.comeap.org.uk/images/stories/Documents/Statements/asthma/does%20outdoor%20air%20pollution%20cause%20asthma%20-%20comeap%20statement.pdf>
- ²¹ Met office, Urban Heat Islands, <http://www.metoffice.gov.uk/services/climate-services/case-studies/urban-heat-islands>
- ²² Met office, What is Climate Change, <http://www.metoffice.gov.uk/climate-guide/climate-change>
- ²³ P511 (2001) *Pollution: Causes, Effects and Control* Eds Roy M Harrison .
<http://opac.vimaru.edu.vn/edata/EBook/TNBook/TL%20tong%20hop/Control/0854046216.pdf>

-
- ²⁴ United States Environmental Protection Agency, [Second hand smoke and the health of your family](#)
- ²⁵ Air Quality in Lewisham: A guide for Public Health Professionals, Mayor of London 2012.
- ²⁶ World Health Organization 2013. Health effects of particulate matter: Policy implications for countries in Eastern Europe, Caucasus and central Asia. http://www.euro.who.int/_data/assets/pdf_file/0006/189051/Health-effects-of-particulate-matter-final-Eng.pdf
- ²⁷ Guarneri M and Balmes JR (2014). Outdoor air pollution and asthma. *The Lancet*. 2014 May 9;383(9928):1581-92.
- ²⁸ Schindler C et al, (2009). Improvements in PM10 Exposure and Reduced Rates of Respiratory Symptoms in a cohort of Swiss Adults (SAPALDIA). *Am J Respir Crit Care Med* Vol 179. pp 579–587
- ²⁹ McConnell R, Berhane K, Gilliland F, Molitor J, Thomas D, Lurmann F, Avol E, Gauderman WJ, Peters JM. Prospective study of air pollution and bronchitic symptoms in children with asthma. *American journal of respiratory and critical care medicine*. 2003 Oct 1;168(7):790-7.
- ³⁰ Shah AS, Lee KK, McAllister DA, Hunter A, Nair H, Whiteley W, Langrish JP, Newby DE, Mills NL. Short term exposure to air pollution and stroke: systematic review and meta-analysis. *bmj*. 2015 Mar 24;350:h1295.
- ³¹ Morbey R et al (2015). The application of a novel 'rising activity, multi-level mixed effects, indicator emphasis' (RAMMIE) method for syndromic surveillance in England. <https://www.evernote.com/Home.action#n=f011df62-45ff-4237-8a67-fb8ed84d79bc&ses=4&sh=2&sds=2&>
- ³² Newby DE, Mannucci PM, Tell GS, Baccarelli AA, Brook RD, Donaldson K, Forastiere F, Franchini M, Franco OH, Graham I, Hoek G. Expert position paper on air pollution and cardiovascular disease. *European heart journal*. 2014 Dec 8;ehu458. *care medicine*. 2014 Oct 15;190(8):914-21
- ³³ Raaschou-Nielsen O, Andersen ZJ, Beelen R, Samoli E, Stafoggia M, Weinmayr G, Hoffmann B, Fischer P, Nieuwenhuijsen MJ, Brunekreef B, Xun WW. Air pollution and lung cancer incidence in 17 European cohorts: prospective analyses from the European Study of Cohorts for Air Pollution Effects (ESCAPE). *The lancet oncology*. 2013 Aug 31;14(9):813-22
- ³⁴ International Agency for Research on Cancer. Outdoor air pollution a leading environmental cause of cancer deaths. Lyon/Geneva. 2013 Oct 17
- ³⁵ Chen Z, Salam MT, Eckel SP, Breton CV, Gilliland FD. Chronic effects of air pollution on respiratory health in Southern California children: findings from the Southern California Children's Health Study. *J Thorac Dis*. 2015 Jan;7(1):46-58. doi: 10.3978/j.issn.2072-1439.2014.12.20
- ³⁶ Lepeule J, Litonjua AA, Coull B, Koutrakis P, Sparrow D, Vokonas PS, Schwartz J. Long-term effects of traffic particles on lung function decline in the elderly. *American journal of respiratory and critical care medicine*. 2014 Sep 1;190(5):542-8
- ³⁷ Schindler C et al, 2009. Improvements in PM10 Exposure and Reduced Rates of Respiratory Symptoms in a cohort of Swiss Adults (SAPALDIA). *Am J Respir Crit Care Med* Vol 179. pp 579–587
- ³⁸ Schikowski T et al, 2014. Ambient air pollution: a cause of COPD? *European Respiratory Journal* 2014 43: 250-263. 54
- ³⁹ Marino E, Carusso M et al, 2015. Impact of air quality on lung health: myth or reality? *Therapeutic Advances in Chronic Disease* September 2015 vol. 6 no. 5 286-298
- ⁴⁰ To T et al, 2015. Progression from Asthma to Chronic Obstructive Pulmonary Disease. Is Air Pollution a Risk Factor? *AJRCCM* Vol. 194, No. 4 | Aug 15, 2016
- ⁴¹ Lamichhane DK, Leem J-H, Lee J-Y, Kim H-C. A meta-analysis of exposure to particulate matter and adverse birth outcomes. *Environmental Health and Toxicology*. 2015;30:e2015011. doi:10.5620/eh.t.e2015011.
- ⁴² Gasana J, Dillikar D, Mendy A, Forno E, Ramos Vieira E. Motor vehicle air pollution and asthma in children: a meta-analysis. *Environ Res*. 2012 Aug;117:36-45. doi: 10.1016/j.envres.2012.05.001. Epub 2012 Jun 6
- ⁴³ Lamichhane DK, Leem J-H, Lee J-Y, Kim H-C. A meta-analysis of exposure to particulate matter and adverse birth outcomes. *Environmental Health and Toxicology*. 2015;30:e2015011. doi:10.5620/eh.t.e2015011.

⁴⁴ Fuks KB et al, 2016. Long-term exposure to ambient air pollution and traffic noise and incident hypertension in seven cohorts of the European study of cohorts for air pollution effects (ESCAPE). *European Heart Journal* 37:42

⁴⁵ Eze IC, Hemkens LG, Bucher HC, Hoffmann B, Schindler C, Künzli N, Schikowski T, Probst-Hensch NM. Association between ambient air pollution and diabetes mellitus in Europe and North America: systematic review and meta-analysis. *Environmental Health Perspectives* (Online). 2015 May 1;123(5):381

⁴⁶ Defra (2010) *Air Pollution: A Changing Climate*. London: Defra. Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69340/pb13378-airpollution.pdf

⁴⁷ Public Health Outcomes Framework. <https://fingertips.phe.org.uk/profile/public-health-outcomes-framework/data#page/3/gid/1000043/pat/6/par/E12000007/ati/102/are/E09000023/iid/30101/age/230/sex/4>

⁴⁸ Royal College of Physicians (2016). *Every breath we take: the lifelong impact of air pollution. Report of a working party*. London: RCP. <https://www.rcplondon.ac.uk/projects/outputs/every-breath-we-take-lifelong-impact-air-pollution>

⁴⁹ Public Health Outcomes Framework (PHOF) <https://fingertips.phe.org.uk/profile/public-health-outcomes-framework/data#page/1/gid/1000049/pat/6/par/E12000007/ati/102/are/E09000023>

⁵⁰ National Audit Office, 2001. *Tackling Obesity in Britain*. London: NAO, 2001 <https://www.nao.org.uk/wp-content/uploads/2001/02/0001220.pdf>