SHEFFIELD HEALTH AND WELLBEING BOARD PAPER

Report of:	Dr Jeremy Wight, Director of Public Health
Date:	26th March 2015
Subject:	Air Quality and health in Sheffield
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Summary:

This report is to inform the Health & Wellbeing Board (HWB) about Air quality as a public health priority in Sheffield, to draw attention to the level of air pollution in the city, particularly with respect to nitrogen dioxide (NO_2) gas and PM_{10} fine dust particles, and to provide an update on progress towards achieving target outcomes of:

- A reduction in pollutants;
- A measurable improvement in air quality; and,
- A reduction in mortality attributable to air quality;

Poor air quality adversely affects human health, and has recently been estimated to account for up to 500 premature deaths per year in Sheffield, with health costs of around £160 million per year (PHE, April 2014, SCC, 2012, Environment Select Committee, 2010).

Sheffield declared an Air Quality Management Area (AQMA) in 2010, across the entire urban area of the city, for breaching the health based EU limit values for NO_2 and PM_{10}.

As a result, the Council produced an Air Quality Action Plan (AQAP) 2015 to cover, the period up to 2015, with the aim of reducing NO_2 and PM_{10} levels in order to improve the health of local people. Simon Green, Executive Director of Place Portfolio is the Delivery Champion. The Director of Public Health is the Vision Champion and is reporting in this capacity to HWB. The AQAP will be refreshed in 2015.

£54k from the PH Grant is currently invested in this work annually to support public health priorities. The service will be reviewed, re-scoped, re-specified and tendered in 2015 to ensure this investment supports public health outcomes.

This report will briefly summarise:
What we know about air quality in Sheffield e.g. trends from baseline
What we are doing to improve air quality in Sheffield, by implementing the AQAP 2015 and what is the likely impact on health, in terms of both morbidity and mortality

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Questions for the Health and Wellbeing Board:

This report is intended to facilitate discussion by the HWB on:

- What is the likely impact on air quality, in quantitative terms, of the implementation of the AQAP 2015 and will that have sufficient impact on reducing ill health and mortality?

- If what we are doing is not likely to have sufficient impact on reducing morbidity and mortality, how can we secure these outcomes, including through investing more or differently?

Recommendations:

- The Health & Wellbeing Board notes the current data on air quality in Sheffield;
- The Health & Wellbeing Board supports the ongoing investment from the public health grant in this work;
- That further work is undertaken to assess what the likely impact of implementation of the AQAP on air pollution is likely to be, and further, what the impact will be of any consequent reduction in air pollution on health.
- The Health & Wellbeing Board is involved in the review and refresh of the Air Quality Action Plan 2015, in particular to consider whether it is sufficiently ambitious given the scale of the public health problem.

Reasons for Recommendations:

- Improving air quality in Sheffield will contribute to reducing morbidity and mortality attributable to air pollution;
- £54,000 of the public health grant is annually invested in this work;
- We cannot currently be confident about the likely impact of the AQAP on health in Sheffield.
- The Air Quality Action Plan 2015 refresh is an opportunity for the Health & Wellbeing Board to engage in this agenda which impacts on many key aspects of population health;

Background Papers:
Sheffield Air Quality Action Plan 2015
Air Aware Campaign Materials

AIR QUALITY AND HEALTH IN SHEFFIELD

1.0 SUMMARY

This report is to inform the Health & Wellbeing Board (HWB) about air quality as a public health priority in Sheffield, also to draw attention to the level of air pollution in the city, particularly with respect to nitrogen dioxide (NO_2) gas and PM_{10} fine dust particles, and to provide an update on progress towards achieving target outcomes of:

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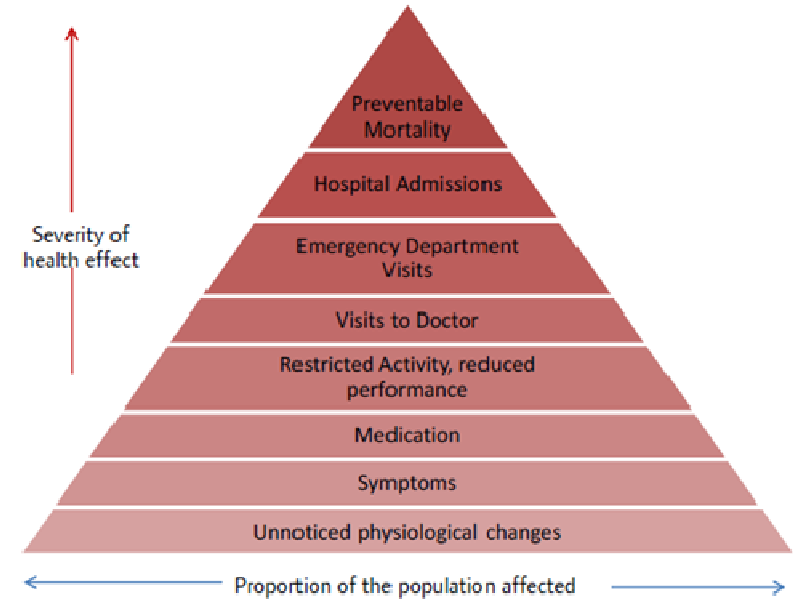
What we are doing to improve air quality in Sheffield – implementing the AQAP 2015, and what is the likely impact on health, in terms of both morbidity and mortality

2.0 WHAT DOES THIS MEAN FOR SHEFFIELD PEOPLE?

2.1 Air quality is a major public health issue for the city. An estimated 300-500 premature deaths per year in Sheffield are attributable to poor air quality (PHE, April 2014, SCC, 2012).

Image 1: Impact of Air Pollution on Health



WHO, 2005

2.2 The impacts on life expectancy and ill health are unequal, with more effects on the young, the old and those with pre-existing heart and lung conditions. For individuals who are particularly sensitive and exposed to the most elevated levels of air pollution, the reduction in life expectancy is estimated to be as high as nine years (SCC, 2012).

2.3 Air quality is worse along busy road corridors and in the more disadvantaged areas. Poor air quality is therefore a significant contributor to health inequalities in the City.

2.4 Reducing exposure of individuals to air pollution, as well as reducing the production of pollutants may reduce health effects, although further research is needed on the relationship between long and short term exposure and health impacts (DH, 2006). Therefore, public information and awareness on reducing exposure, such as the recent "Air Aware" campaign in Sheffield, may be beneficial. The campaign information can be accessed from the website https://www.sheffield.gov.uk/environment/air-quality/air-aware-sheffield.html

3.0 MAIN BODY OF THE REPORT

3.1 This report will briefly summarise:

- What we know about air quality in Sheffield e.g. trends from baseline
- What we are doing to improve air quality in Sheffield, by implementing the AQAP 2015 and what is the likely impact on health, in terms of both morbidity and mortality

3.2 What we know about air quality in Sheffield?

3.3 Reflecting national trends and many other major cities in the UK, Sheffield currently breaches UK and European Union (EU) health-based thresholds for air quality, particularly NO_2 and PM_{10}, and declared an Air Quality Management Area (AQMA) in 2010, across the entire urban area of Sheffield. The deadline for compliance with EU and National Law on Air Quality Limit Values was 01 January 2015 and the Council is not likely to be compliant of these regulations until 2020 at the earliest (House of Commons, 8 December 2014, SCC 2013).

3.4 Road transport is the most significant overall single contributor to Sheffield's NO_2 emissions. Addressing traffic related emissions, with a particular focus on the most polluting vehicles (buses, taxis and OGVs) would therefore have a significant beneficial impact on Sheffield's air quality (data from Sheffield LEZ study).

3.5 In line with Government regulation, Sheffield City Council has continuously monitored air quality over the past decade through its' monitoring programme including, Local Transport Plan (LTP), Local Sustainable Transport Fund (LSTF) and specific schemes funded programmes.

3.6 Sheffield City Council owns six automatic air quality monitors sited at Tinsley Infant School (PM_{10}, $PM_{2.5}$, NO_2) , Lowfield School (PM_{10}, SO_2, NO_2), King Ecgbert old School site (PM_{10}, 0_3, NO_2), Firvale School (PM_{10}, SO_2, NO_2), Waingate (PM_{10}, NO_2) and The Wicker (PM_{10}, NO_2, O_3). In addition DEFRA own a further two sites in the city centre and at Tinsley. Further detail of what is monitored at each site and maps of air quality are available through the Sheffield City Council website: https://www.sheffield.gov.uk/environment/air-quality/monitoring.html

3.7 Sheffield City Council also funds 'East End Quality of Life (EEQOL)' to conduct community monitoring of NO_2 using diffusion tubes and to communicate the results to community groups and interested individuals in Sheffield. The sites are selected and managed by volunteers based on their perceptions of where air quality is likely to be poor or require monitoring; laboratory analysis of the diffusion tubes and data analysis of the results is provided by the project. The data provides a useful addition to the automatic monitoring sites results.

3.8 Data is therefore collected at hundreds of sites across the Sheffield area. Analysis of the data from these sites identified 51 locations within the AQMA, where the 40µg/m^3 health-based annual average limit for NO_2 was breached in

one or more of the 3 years for which the AQ data was studied (2010-2012) (Sheffield LEZ Study, 2013).

3.9 The Table below shows an estimate of how much these sites are likely to exceed the 40µg/m^3 EU limit in 2013 (Sheffield LEZ Study, 2013). It shows that 41 out of 51 (80.39%) sites would require NO_2 reduction to comply with EU limit and protect health (SCC LEZ Study, 2013).

PERCENT REDUCTION REQUIRED	NUMBER OF SITES
0%	10
0-5%	8
5-10%	12
10-20%	13
20-30%	8
Total	**51**

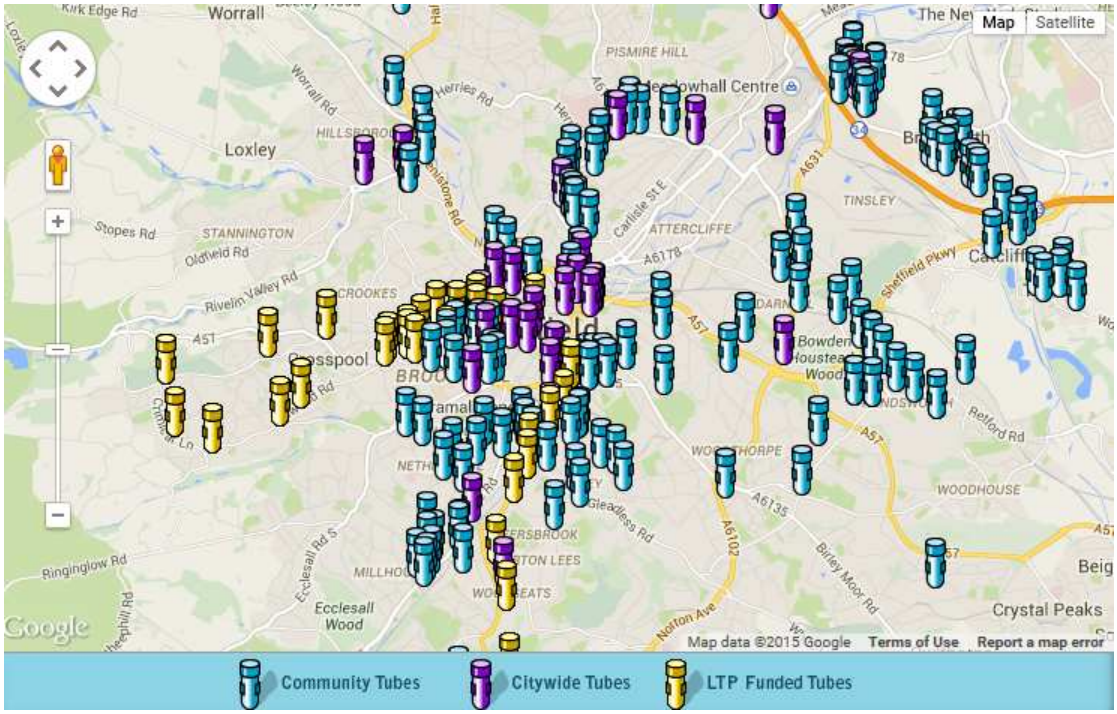
3.10 Analysis of Sheffield's hospital admissions for 'Circulatory diseases' and for coronary heart disease also both show a strong correlation with the annual average concentration of small particulate matter in the relevant neighbourhoods – see Appendix A for details. This observation is important, given there is no safe level for particulate matter, particularly, $PM_{2.5}$ (SCC LEZ Study, 2013).

3.11 Results from Sheffield air quality monitoring can be accessed through the Sheffield City Council website https://www.sheffield.gov.uk/environment/air-quality.html, which links to a Sheffield Air Quality monitoring website with an interactive map https://www.sheffield.gov.uk/environment/air-quality/monitoring.html

3.12 EEQOL monitoring information demonstrates a number of neighbourhoods are breaching NO_2 European annual limit values, particularly areas around busy roads such as Abbeydale Road Corridor http://www.sheffieldeastend.org.uk/AQmonitoring.htm

3.13 Although the majority of the local data is for NO_2, linked to the EU health limit value, the best evidence for health harms from poor air quality concerns fine particulate matter ($PM_{2.5}$) (DH, 2006). The Public Health Outcomes Framework indicator for air pollution 3.01 Fraction of mortality attributable to particulate air pollution concerns $PM_{2.5}$ for this reason. COMEAP cites emerging evidence of the health effects of NO_2 alone, rather than as part of ambient air pollution, but further research is required to quantify the specific health effects (COMEAP, March 2015).

3.14 Sheffield Air Map showing site and type of air quality monitoring (source: http://www.sheffieldairmap.org/view_map.html, accessed 16/03/15)



3.15 What we are doing to improve air quality in Sheffield, including the AQAP actions?

3.16 Sheffield produced an Air Quality Action Plan (AQAP) for Sheffield in July 2012, approved by Cabinet, which sets out how problems with air quality in the city will be tackled.

3.17 The AQAP sets out 7 key actions with designated lead officers who are represented on the AQAP Steering Group - chaired by the Director of Regeneration and Development – and on the AQAP Working Group. Progress against each of these 7 key actions is set out in

Action 1: Assess feasibility for a Low Emission Zone

Action 2: Develop infrastructure for refuelling low emission vehicles

Action 3: Promote smarter travel choices

Action 4: Improve engine performance of commercial diesel vehicles

Action 5: Mitigate the impact of the M1 motorway (particularly in the Tinsley Area)

Action 6: Develop policies to support better air quality

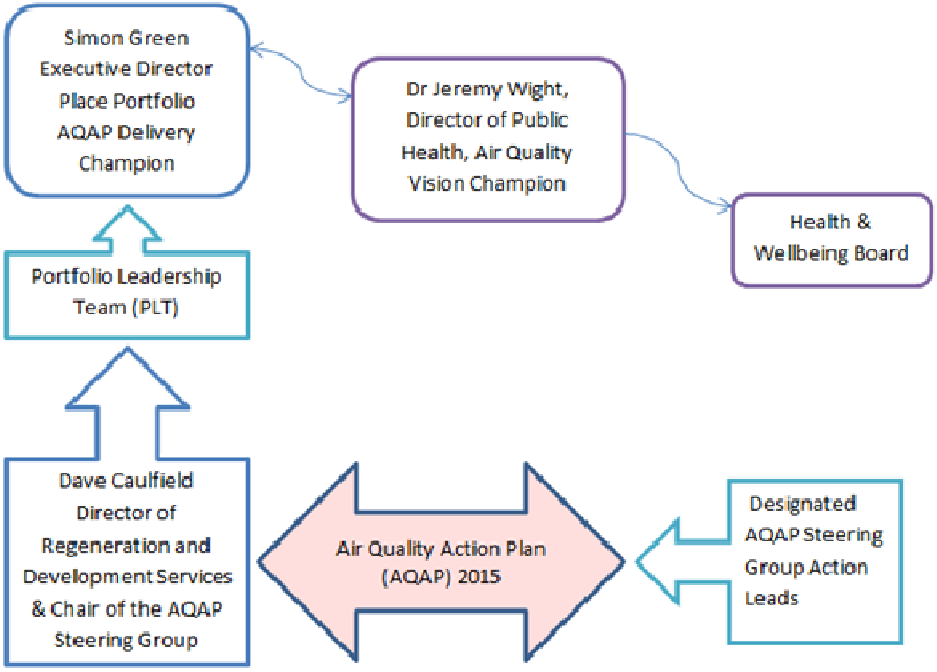
Action 7: Control industrial emissions

(appendix1)

3.18 The governance of the Air Quality Action Plan is described in the diagram below. The senior leads are the Director of Public Health, who is the Vision

Champion (as part of his role on the City's Health and Wellbeing Board) and the Executive Director of the Place Portfolio, who is the Delivery Champion of the Air Quality Action Plan.

Air Quality Action Plan (AQAP) 2015: Governance



3.19 The success of the AQAP is dependent on a major shift away from the use of diesel fuel in the urban area of Sheffield. Without significant investment it is likely that NO_2 limit values will continue to be breached. The success or otherwise of Sheffield in attracting OLEV funding for ultra-low emission vehicles is therefore a critical success factor for the AQAP in Sheffield.

3.20 If the recommended LEZ Strategy, a key action of AQAP 2015, was implemented, the Table below shows an estimate of how by much these sites are likely to exceed the 40µg/m3 EU limit (SCC LEZ Study, 2013).

PERCENT REDUCTION REQUIRED	NUMBER OF SITES (PRE-LEZ STRATEGY)	NUMBER OF SITES (POST-LEZ STRATEGY)
0%	10	33
0-5%	8	2
5-10%	12	6
10-20%	13	8
20-30%	8	1
30-35%	0	1
Total	**51**	**51**

3.21 From the findings presented in the above Table, it can be concluded that the full implementation of the AQAP 2015 would make air quality better at approximately 33 out of 51 (45%) of the sites that exceed the 40µg/m^3 limit, though not before 2020. The forecast improvement in air quality should also have a likely beneficial impact on health, in terms of both morbidity and mortality, though this cannot currently be quantified.

3.22 The likely impact of implementation of the AQAP on particulate air pollution has not been estimated. As a consequence, it is not possible to state by how much the implementation of the Plan will improve health in the City.

3.23 Further modelling is required to estimate the health benefits that could be derived from the different air pollution reduction forecasts in 3.19 (above). In general terms, the best evidence of health impacts of air pollution is from long term exposure to ambient air pollution, therefore any action by Sheffield City Council to reduce exposure over time is likely to be beneficial

4.0 QUESTIONS FOR THE BOARD

4.1 This report is intended to facilitate discussion by the HWB on:

4.2 Whether the implementation of the AQAP will that have sufficient impact on reducing ill health and mortality?

4.3 If what we are doing is not likely to have sufficient impact on reducing morbidity and mortality, how can we secure these outcomes, including through investing more or differently?

5.0 RECOMMENDATIONS

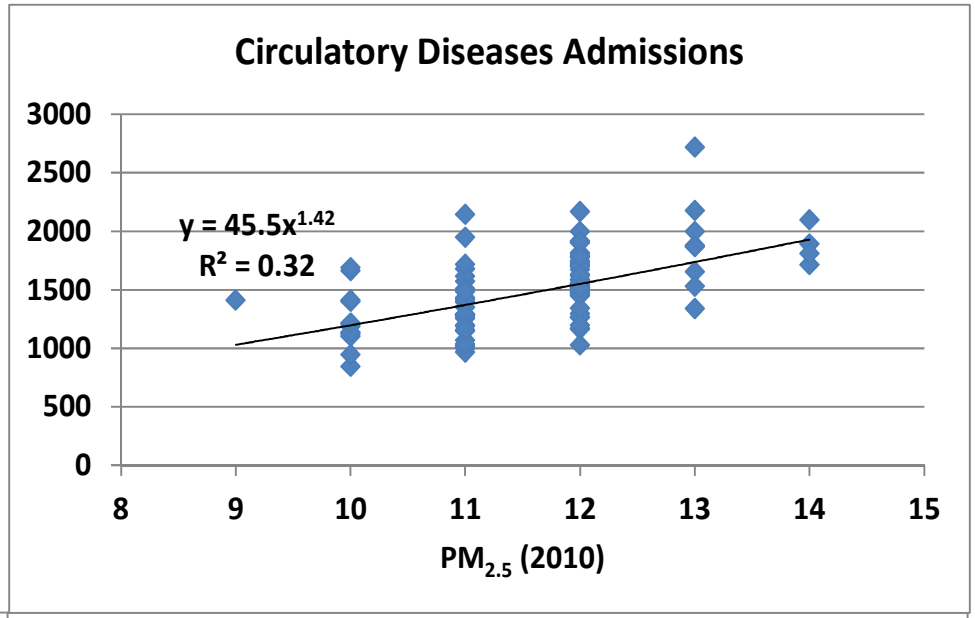
5.1 The Health & Wellbeing Board notes the current data on air quality in Sheffield;
5.2 The Health & Wellbeing Board supports the ongoing investment from the public health grant in this work;
5.3 That further work is undertaken to assess what the likely impact of implementation of the AQAP on air pollution is likely to be, and further, what the impact will be of any consequent reduction in air pollution on health.
5.4 The Health & Wellbeing Board is involved in the review and refresh of the Air Quality Action Plan 2015, in particular to consider whether it is sufficiently ambitious given the scale of the public health problem.

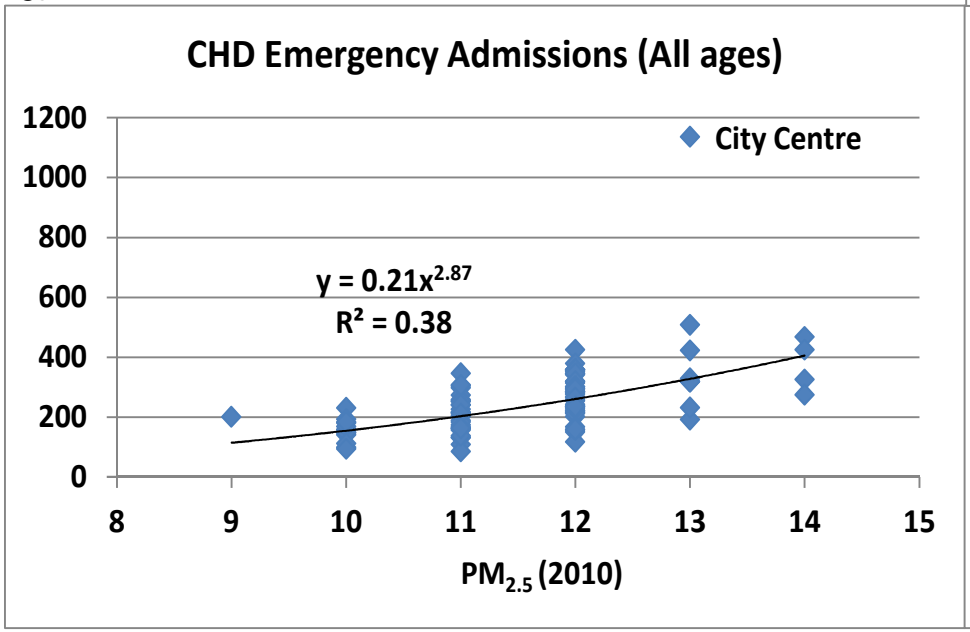
6.0 REASONS FOR THE RECOMMENDATIONS

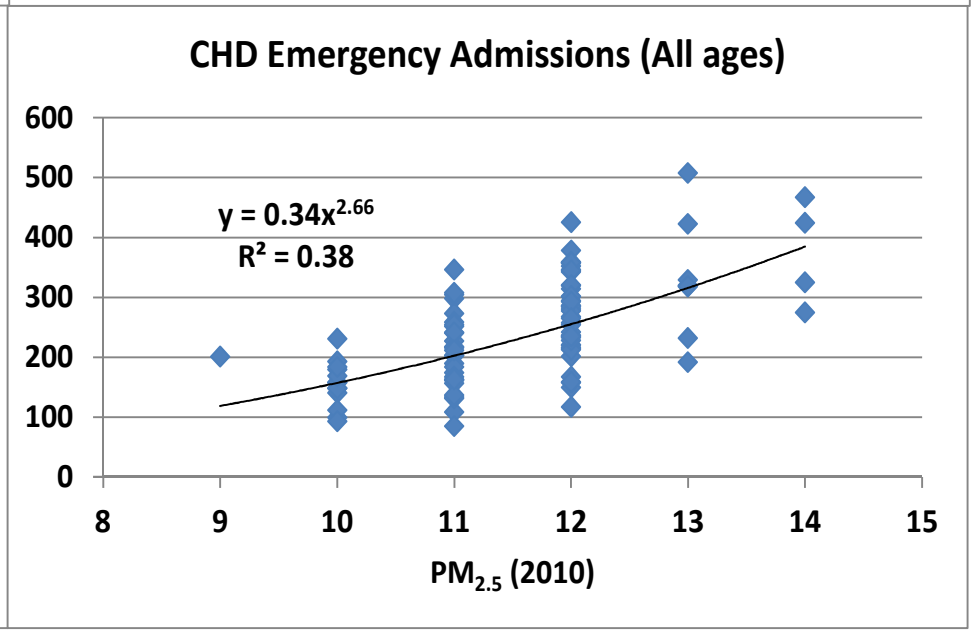
6.1 Improving air quality in Sheffield will contribute to reducing morbidity and mortality attributable to air pollution;
6.2 £54,000 of the public health grant is annually invested in this work;
6.3 We cannot currently be confident about the likely impact of the AQAP on health in Sheffield.
6.4 The Air Quality Action Plan 2015 refresh is an opportunity for the Health & Wellbeing Board to engage in this agenda which impacts on many key aspects of population health;

Report Appendix A – Health Data Analysis

The estimate of annual average concentrations of particulate matter ($PM_{2.5}$) in each Sheffield neighbourhood in 2010 was plotted against the number of hospital admissions per 100,000 population from these neighbourhoods for: a) circulatory diseases and b) coronary heart disease emergencies. The results and the corresponding best-fitting trends are illustrated in the figures below.







References:

COMEAP (March 2015) Statement on the evidence for the effects of nitrogen dioxide on health.

Department for Environment, Food and Rural Affairs, September 2014, Air Pollution in the UK 2013, Crown Copyright 2014

Department of Health, February 2006, Cardiovascular Disease and Air Pollution: A report by the Committee on the Medical Effects of Air Pollutants, Crown Copyright 2005

House of Commons Environmental Audit Committee, 8 December 2014, Action on Air Quality Sixth Report of Session 2014-15, The Stationery Office Limited

Sheffield City Council, 2012, Air Quality Action Plan 2015

Sheffield City Council's interpretation of the Evidence of Robert Vaughn from DEFRA to Environment Select Committee 2010 accessed at http://www.parliament.uk/business/committees/committees-a-z/commons-select/environmental-audit-committee/inquiries/parliament-2010/air-quality-a-follow-up-report/

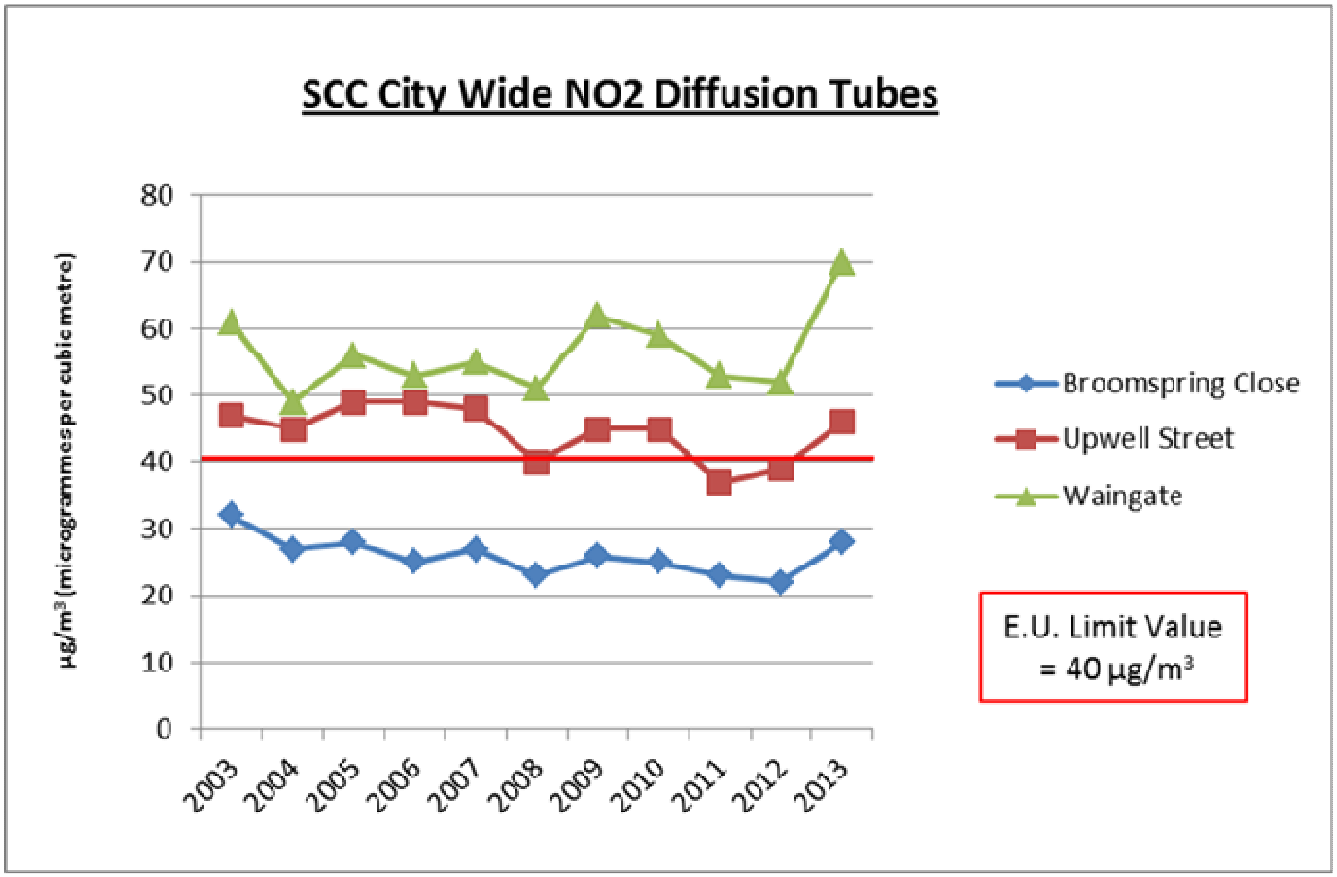
Public Health England, April 2014, estimating local mortality burdens associated with particulate air pollution

APPENDIX B - DASHBOARD OF PERFORMANCE MEASURES COLLECTED FOR SHEFFIELD AIR QUALITY

Overarching theme: Communication Plan	Sheffield City Council Air Quality Actions	Update as of March 2015
	Action 1: Assess feasibility for a Low Emission Zone	Task and finish Work Packages have been developed for the Sheffield Low Emission Zone (LEZ) Strategy and designated leads identified to take forward the recommendations of the LEZ Feasibility Study. A range of pollutant emissions reduction measures are being implemented, including: the introduction of 40[1] new hybrid and 45 new Euro V buses through Sheffield Bus Partnership investment; Clean Vehicle Technology Funded retrofitting of 41[2] buses with Thermo Management Technology; and 175 Yorkshire Ambulance Rapid Response Vehicles to be fitted with Solar Roof Panels.
	Action 2: Develop infrastructure for refuelling low emission vehicles	The Office of Low Emission Vehicles (OLEV) announced a £500m Ultra Low Emissions Vehicle (ULEV) scheme funding package. Sheffield City Council hopes to take advantage of this funding to develop initiatives around Taxi and Bus themes. As part of the scheme OLEV recently announced the launch of a £35m fund (go ultra-low city scheme) to promote the uptake of ultra-low emission vehicles and invites bids from Local Authorities by 20th February 2015. Local Sustainable Transport Fund (LSTF) and OLEV funding has been used to support small and medium enterprises to switch to electric vehicles and for the installation of rapid charging points across South Yorkshire.
	Action 3: Promote smarter travel choices	The council uses a range of information to monitor the methods people use to travel. We aim to reduce the car-related proportion share by providing an attractive range of alternatives, whilst securing the most effective performance of our existing roads through effective Network Management and Control. This has the benefit of reducing congestion and hence reducing air pollution. Capital investment in Network Management includes improved telecommunications between computerised traffic signals operation and major junctions to optimise signal settings and manage the network; a series of parking management schemes to make sure roads aren't unnecessarily obstructed at peak times; and a programme of lorry route management schemes to minimise the impact of lorries in residential or other sensitive areas. Bus Boost schemes are promoted as part of LSTF programmes. Sheffield Bus Partnership has to date

[1] This is estimated to represent 22% of the Stagecoach fleet.
[2] This is estimated to represent 8% of the First fleet to low emission vehicles.

		delivered 9% increase in the number of fare-paying passengers. SCC will bid for Low Emission Vehicles funding from Government to improve the quality of the bus travel experience. A review of the Sheffield bus is underway, to improve co-ordination between operators and frequency of services, the changes likely to be introduced in September. Cycle and Walk boost schemes aimed at commuters are promoted as part of LSTF programmes, alongside School Travel Change Programmes. Progress on improving cycling and walking includes: investment in pedestrian crossings and cycle routes, Streets Ahead-related pedestrian enhancements and opportunities, refresh of SCC cycling strategy/strategic network and the Cycles boost initiative. We await new National Guidance regarding Cycling Delivery Plan. An air quality public awareness campaign, "Air Aware" www.sheffield.gov.uk/AirAware has provided information to local residents on main air quality pollutants, *active travel* as a means of reducing air pollutants and advice on avoiding personal exposure. Other schemes include: Green Driving, Eco Stars and Plugged in S Yorkshire, Car Club and Car Share.
	Action 4: Improve engine performance of commercial diesel vehicles	Focusses on improving emissions produced by taxis, buses and other goods vehicles (>3.5tons). Progress to date includes achieving agreement from partner organisations – 40 x new Stagecoach hybrid buses; 41 x First Group double decker Euro 4 engines to be retrofitted with Thermo Management Technology. Other schemes include: Green driving, ECO stars and Plugged in S Yorkshire.
	Action 5: Mitigate the impact of the M1 motorway (particularly in the Tinsley Area)	Smart motorway construction and discussions to build a barrier along M1 J34 south slip have started – ongoing partnership working with Highways England (previously Highways Agency).
	Action 6: Develop policies to support better air quality	The focus of action is to restrict new sensitive uses (homes, schools) from being developed in areas where national air quality objectives are being exceeded, unless significant mitigation measures are included within those developments. Sheffield Local Plan will have policies aimed at improving air quality and will ensure air quality impacts from new developments across the City are minimised.
	Action 7: Control industrial emissions	The focus of action is to regulate installations which are permitted under the Environmental Permitting Regulations. Formalised site specific Permit conditions are used, which lay down emission limits and measures for industry to comply with. Inspection regimes are undertaken to determine whether the emissions limits and pollution control measures are complied with.



This figure shows that over time, at two of the sites, NO_2 levels are gradually coming down but has remained stubbornly high at the third site.

Public Health Outcomes Framework Indicator 3.1

There has been no update since 2012, the baseline year for Sheffield Air Quality Action Plan. Sheffield performs better than the England average and in the top 3 of core cities. The percentage of mortality attributable to particulate air pollution has reduced since 2010. However, as this is a % of all mortality this could be due to an increase in mortality from other causes rather than a reduction in mortality attributable to air pollution. Particulate air pollution in this context means $PM_{2.5}$

Public Health Outcomes Framework (PHOF) Indicator 3.1

3.1 Percentage of mortality attributable to particulate air pollution		
Baseline period 2010		
Sheffield 4.7	England 5.1	(2012)
Sheffield 5.1	England 5.4	(2011)
Sheffield 5.5	England 5.6	(2010)

Indicator 3.1	Percentage of mortality attributable to particulate air pollution	Better compared to England (not statistically)	Sheffield General Trend	Sheffield Change Last period	Baseline year: 2010	Latest period: 2012	Core Cities rank (1= best) 3/8

APPENDIX C - Estimating morbidity or illness and mortality or death from air pollution

Ground-level ozone (O_3) and fine particulate matter ($PM_{2.5}$) are associated with increased risk of mortality.
There is strong evidence of an association between acute exposure to particulate air pollution (PM10) and daily mortality, one day later.

This association is strongest for respiratory and cardiovascular causes of death.
The association cannot be attributed to other pollutants including NO_2, CO, SO_2 or O_3 not due to weather.

There is also evidence that the health effect of poor air quality is not limited to mortality or deaths only. Admissions to hospital for respiratory conditions, cardio-vascular conditions, and accident and emergency visits for exacerbation of Asthma (with variation of up to 30-fold for $PM_{2.5}$, and 11-fold for O_3, by neighbourhood), have been shown to increase.

[Ref: The Health Effects Institute (HEI) has recently released an announcement that Johns Hopkins University investigators of the National Morbidity, Mortality and Air Pollution Study (NMMAPS) have updated their previous estimates of the mortality effects of acute exposure to particulate air pollution.]

Cohort studies across major cities have estimated an increase in total mortality of roughly 4% and 5% per 10 microgram per m3 of increase in the long-term level of particulates, after chronic and acute exposures respectively. [Ref: The major U.S. cohort studies are the American Cancer Society Study (Pope et al. 2002) and the Six Cities Studies (Dockery et al, 1993)]

Animal (mice) experiments have also suggested that long-term exposure to air pollution can lead to physical changes in the brain, as well as learning and memory problems, and even depression (L K Fonken, X Xu, Z M Weil, G Chen, Q Sun, S Rajagopalan, R J Nelson. Air pollution impairs cognition, provokes depressive-like behaviours and alters hippocampal cytokine expression and morphology. Molecular Psychiatry, 2011; DOI: 10.1038/mp.2011.76).

The above indicate that despite significant improvements in air quality in recent decades, air pollution and ozone still pose a non-trivial risks to the public health.

Challenges remain around communicating results and implications to the public. Also, the attributable fraction of each pollutant is difficult to disentangle because their analysis varies with patterns of exposure e.g. single, repeat, short-term or long-term; requires many impact assessment strategies, e.g. time series, cohort; assumptions and complex, multi-stage analyses for developing robust and valid risk estimates.

The UK COMEAP (Committee on the Medical Effects of Air Pollutants) acknowledges this complexity in its 2010 report, by summing up that as everyone dies eventually, no lives are ever saved by reducing environmental exposures, but – deaths are delayed resulting in increased life expectancy. Also, measures to reduce air pollution result in effects that are averages or aggregates across the population, and it is not known how the effects are distributed among individuals

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