East Sussex JSNA Joint Strategic Needs Assessment

Air Quality in East Sussex

JSNA Local Briefing 2024

Contents

Introduction to JSNA Air Quality Report

The purpose of this JSNA report is to describe the effects of air pollution on human health and paint the local picture about how air pollution is being managed in East Sussex. The intended audience is environment, health, and transport colleagues, interested members of the public and elected members.

Members of the public can review estimated levels of the main air pollutants and the associated health risks at their own home address at the air pollution website [produced by Imperial College London.]

This report mainly focuses on outdoor air pollution and its health effects in the short and long term. There is a short section on indoor air quality which is increasingly recognised as an important area for future research.

We give an overview of the roles and responsibilities of local organisations, what action is happening now at County, district, and borough level, and what we would hope and want to see going forward.

The Chief Medical Officer's (CMO) Annual Report 2022 on air pollution gives a very clear view of the national picture from experts in their respective fields. We recommend interested readers to consult the CMO report for more detailed explanations. We gratefully acknowledge where the CMO Report has informed and influenced this local JSNA report.

Air Pollution Applying All Our Health is a resource explaining the importance of understanding the effects of Air Pollution on health for health and care professionals.

A detailed annual summary of Air Quality across Sussex, produced by Bureau Veritas and commissioned by the Sussex Air Partnership, is available on the Sussex Air website.

The evidence base for public health interventions is described in: Review of interventions to improve outdoor air quality and public health (publishing.service.gov.uk)

The Clean Air Hub is a helpful source of information about air pollution in one place for the general public.

We hope this summary will contribute to the increasing attention that is being focussed locally on this important and evolving area of population health.

Acknowledgements

We are very grateful for the professional advice of Dr. Gary Fuller and colleagues of the Environment Research Group, Imperial College London (ICL), and for permission to use sections from the recent Impacts of Air Pollution Across the Life Course-evidence highlight note.

We are most grateful to members of the Sussex Air Partnership and Environmental Health colleagues in Districts and Boroughs for their annual Air Quality Status Reports and for the future air pollution modelling maps produced by Bureau Veritas.

This report has been written with the essential help of colleagues in public health and Andy Arnold and colleagues in the Communities, Economy and Transport (CET) directorate within East Sussex County Council (ESCC).

Summary

The World Health Organisation [WHO] has described air pollution as a global health emergency and, in the context of climate change, will continue to affect all our lives.[1] WHO targets are defined as 'the lowest exposure level of an air pollutant above which … there is an increase in adverse health effects'.

General principles in the management of air pollution include the hierarchy of:

- prevention [prevent or reduce emissions of pollutants into the air]
- mitigate [take steps to reduce air pollution] by reducing environmental concentrations
- avoid [avoid exposure to air pollution] by reducing individual exposure

Local action is being taken now at all levels in Sussex at County, District and Borough level to address air quality and will be recognised in future policy decision-making processes.

Each local authority in the Sussex Air Partnership plays a key role as an employer, through the services they commission and deliver, their public health role, regulatory powers and enforcement, and through their community leadership roles.

Whilst all East Sussex districts and boroughs currently meet the most recent UK air quality standards and future Government targets, apart from one or two exceptions, none of the air quality indicator levels at Air Quality monitoring points meet the revised WHO guideline standards. [Please see a summary of air quality guideline levels in Appendix 3].

The Committee on the Medical Effects of Air Pollutants (COMEAP) which advises the Government on all matters concerning the health effects of air pollutants concluded that:

- a focus on reducing long-term average concentrations of fine particulate matter ($PM_{2.5}$) is appropriate.
- newer evidence indicates that PM2.5 pollution can have harmful effects on people's health at lower concentrations than had been studied previously.
- continuing to reduce concentrations to, or below, the World Health Organization's new Air Quality Guideline (5 µg/m3) would benefit public health.

- there is less evidence for benefits of reductions below this level, although the available studies have not indicated a threshold of effect below which there is no harm.
- reducing exposure of the whole population would achieve the greatest overall public health benefit.
- some individuals or groups are more at risk, but it might be difficult to reflect this in a national targets framework.
- reducing air pollution to low levels is likely to be challenging and cost-benefit assessments may play a role in defining targets.
- the health benefits of reducing other pollutants, such as nitrogen dioxide and ozone, should not be overlooked.2
- Our local analyses have mapped those areas at greatest vulnerability to outdoor air pollution according to the experimental UKHSA Index for annual PM2.5 and NO2 exposure levels. [Please see Appendix 5]

We have included modelled projections to 2024, 2028 and 2030 showing that WHO guideline annual levels for $PM_{2.5}$ are unlikely to be met in future. For larger particles [PM_{10}] the picture is slightly different. Most of East Sussex LSOAs meet the WHO guideline annual mean concentration levels in 2024 with the exception of three LSOAs. The elevated levels in these three LSOAs relate to activities of tile and brickworks.

The Chief Medical Officer's 2022 report on Air Quality [CMO Report] cautions against becoming too preoccupied with meeting guideline pollutant level targets, however. Ultrafine particles, which come from diesel exhaust and aviation, are thought to be the most damaging to health, although the evidence is evolving. Ultrafine particles make a very small contribution to the measured particulate matter [$PM_{2.5}$] concentration level. Ultrafine particles are not routinely measured except in research studies. Particulate matter concentrations are also difficult to measure accurately at low concentrations.

The CMO report also notes that it may not be feasible to reduce air pollution levels down to the WHO guideline levels [at least in London and the South-East] because of Regional and international sources.

There is an association between annual mean $PM_{2.5}$ levels and emergency respiratory admissions of East Sussex residents [for the period 2018/19 to 2022/23]. At higher levels of $PM_{2.5}$ exposure [annual mean levels] the rates of emergency respiratory admissions increase. This is the case for all three broad age groups [under 16s, 16 to 64 and 65 and over]. An association does not necessarily imply causation but is consistent with the strength of evidence from the published literature. The effect of smoking in the household as a confounding factor affecting internal air quality is not accounted for in these descriptive analyses. Air pollution would reasonably be expected to have made the effect of smoking on respiratory admissions even worse.

There is also a relationship between increasing levels of annual mean $PM_{2.5}$ and A&E attendances for respiratory reasons in both the 16-64 and 65+ age bands for the period 2014/15 to 2018/19. Increasing levels of exposure to $PM_{2.5}$ (and NO_2) have been shown to be associated with the presence of respiratory and other long-term conditions.[3] It would be desirable to review effects of air pollution on GP practice respiratory and cardiovascular disease consultations as and when the data become available.

From our analyses, there is no consistent relationship shown locally with emergency respiratory admissions and annual mean NO_2 levels. However, published evidence from Dundee, over a much longer time scale, has clearly shown that increasing NO_2 levels are indeed associated with increasing emergency respiratory admissions for children and young people under 16.[4]

A Coroner's Prevention of Future Deaths (PFD) report after the second Inquest in 2020 into the very sad death from asthma of a 9-year-old girl in Lewisham in 2013, has highlighted matters of concern nationally:

- national limits for Particulate Matter were set at a level far higher than the World Health Organization Guidelines.
- there is low public awareness of the sources of information about national and local pollution levels.
- the adverse effects of air pollution on health were not being sufficiently communicated to patients and their carers by medical and nursing professionals.

Having identified evidence of adverse health outcomes at LSOA level there is now scope for further, targeted local action to reduce the main sources of exposures to outdoor [and indoor] air pollutants.

Action on air pollution will contribute to achieving the objectives of the Improving-Lives-Together-Shared-Delivery-Plan: most notably the

immediate improvement area [primary and emergency care-providing more support to stay well] and continuous improvement area [by reducing health inequalities].

Ongoing scrutiny in the Council will ensure that the impacts of new business activities on local air quality are duly considered prior to and during their implementation.

Work to improve electric vehicle (EV) take-up is ongoing. ESCC is working with the District and Borough councils to coordinate Sussex-wide efforts to improve EV uptake. The intention is to install more EV charging points across the county once the EV strategy has been finalised.

ESCC is working with District & Borough Planning Authorities to develop and implement consistent, robust Local Plan policies on air quality, including securing developer contributions to air quality mitigation measures. The aim is to strengthen policies in the plans to prioritise active and sustainable travel, enabling walkable environments and mix use communities, whilst reducing the need to travel by car. This will maximise benefits to local air quality and reduce exposure to pollution during design stages.

There is scope to improve implementation of the Sussex Air Quality Partnership guidance on mitigation measures and to evaluate the effectiveness of these measures.

Public Health in ESCC is working with Local Planning Authorities to establish a requirement for Health Impact Assessments [HIAs] on developments which are likely to have significant impacts on health and wellbeing.[5] An HIA would include consideration of air quality impacts from the development on the local population and would provide recommendations for mitigation and improvement measures.[6]

Clean Air Zones (areas where access is restricted to vehicles that meet a set emission standard) or schemes which redesign road space to prioritise people walking, wheeling, and cycling in pollution hotspots remain an area for local, political discussions. It is important with the development of these types of measures that they are co-designed with local communities. Current evidence suggests Low Emission Zones (LEZs) can reduce air pollution-related health outcomes, with the most consistent effect on cardiovascular disease.[7]

The Council aims to adopt the East Sussex Local Transport Plan 4 (LTP4) in autumn 2024. The current draft includes policies and infrastructure improvements to enable more people to walk, wheel and cycle. It also includes policies to redesign road space, especially in town centres. The delivery of this plan is subject to ESCC and their partners securing funding for the measures. Further work will be undertaken to evaluate transport infrastructure schemes/initiatives to assess their impact on air quality where feasible.[8]

The Healthy Streets Approach, developed by Lucy Saunders, is a good example of a tool which poses key questions about peoples' experience of a given road/environment and suggests ways to improve this. The Healthy Streets Approach uses 10 indicators which focus on the human experience needed on all streets, everywhere, for everyone. It includes the indicator 'Clean Air' which highlights that reducing air pollution benefits us all and helps to reduce unfair health inequalities. The use of this tool is being considered in East Sussex by Public Health and Transport Planners.[9]

Restricting vehicle access to streets around schools during the times children arrive and leave school is a desirable goal, whilst retaining access for residents, blue badge holders and emergency services. ESCC is currently in the process of delivering three permanent school street schemes, following a successful trial of these during the Covid 19 Pandemic. These aim to restrict vehicle access outside of the school, making it easier for the school community to walk, wheel and cycle. The evaluation of these schemes will inform the development of a framework to help assess future county-wide schemes. The real-world practicalities of this scheme are recognised as school travel choices are complex, with safety a key concern.

The ongoing inclusion of air quality in school curricula will help develop understanding and encourage behavioural change in the longer term. Re-energising local initiatives in collaboration with Living Streets charity could encourage more children and young people to walk to school.

Any proposed new schools in the county should consider reducing air pollution risks in the planning process.[10] Comprehensive recommendations have been made by the Royal College of Paediatrics and Child Health (RCPCH) regarding protection from poor air quality at home and school.[11]

District and Borough Councils are developing Local Plan policies that improve the public realm [streets, green space, sea front and beaches].

Public health will continue to highlight key published research findings about the effects of air quality on human health. There is a case for local research looking at the effect of air pollution and fatal and near-fatal asthma attacks.[12] Future local research may choose to focus on personalized monitoring and plans for mitigating exposure to air pollution.[13]

Interested residents are advised to refer to the annual Air Quality Status Reports [ASRs] produced by the respective District and Borough councils. These annual reports include specific actions that residents can take to reduce their own contribution to air pollution, for example by reducing anti-idling of vehicles. These can be found here:

- Lewes and Eastbourne 2023
- Hastings 2023
- Rother 2023
- Wealden 2023

Public health communications will continue to provide residents with information on poor air quality locally by means of the Sussex Air alert and Daily Air Quality Indicator [DAQI] reports. The reasons for the very low uptake of the Sussex air alert service are under review. How people can best be assisted to reduce their exposure to air pollution after receiving these alerts remains an ongoing issue.[14] Members of the public can review levels of the main pollutants at their own home address which may stimulate local action.[15]

The UKHSA air quality vulnerability mapping index shown in Appendix 5 may be useful in future:

- To consider as part of Sussex Directors of Public Health [DsPH] priorities for life chances for children and young people, climate change and sustainability.
- To develop targeted intervention guidance for each vulnerability decile in the index (1 Low -10 High)
- Could be considered for inclusion into District and Borough Air Quality Strategies and Action Plans

ESCC is working with partner agencies (via links with District and Borough housing departments) to improve indoor air quality in council-owned properties. This includes reducing damp and mould, and ensuring appropriate environmental temperatures.

There is scope for further action to improve air quality particularly as it affects vulnerable groups. It is important to pay specific attention to the interfaces between indoor and outdoor air. Poor air quality, for example from a busy adjacent road, or from local industrial processes, can enter through windows and doors. This can potentially adversely affect children in schools, people living in residential and nursing homes, and persons living at home with long-term conditions such as asthma, COPD and coronary heart disease [CHD] .

Wood burning is known to be one of the largest sources of particulate pollution in urban areas.[16] It is also likely to be a significant source in small villages, although these areas may not be covered in detail by official air quality monitoring networks. Recent research from Germany may be equally applicable to rural villages in East Sussex. This highlights that there is clearly an urgent need for better information, and for actions to reduce exposure to wood and coal pollution in rural communities across Europe.[17]

Conclusion

Attention to reducing the harm caused by air pollution from health and inequalities points of view continues to be very important at all levels in East Sussex. There is a lot of activity already going on across the county to address this. Good examples include:

- the increased focus on particulate matter [$PM_{2.5}$] in Hastings Borough, adjacent to the former Air Quality Management Area
- the work to improve indoor air quality in council-owned premises at District and Borough level

Nonetheless, more effort could and should be focused on reducing risk in those areas where the population has been identified as at even greater risk of harm, as illustrated in Appendix 5.

Partnership working across organisations in health, environment, transport, and planning is essential to improving air quality. Multiple interventions, each producing a small benefit, are likely to act cumulatively to produce significant change in air pollution levels.

Ongoing evaluation of the effectiveness of changes that are being implemented is essential. This JSNA will be updated in three years' time to assess the effectiveness of existing actions.

Evaluation by ESCC should include consideration of the wider public health benefits of those interventions designed to address air pollution.

What is air pollution?

'Air pollution refers to gases or particles in the air that can harm the health of humans, animals and plants. This JSNA report focuses on human health. The main pollutants of public health concern are:

Particulate Matter (PM)

Particulate matter consists of microscopic particles of solids or liquids suspended in the air. Their small size allows these particles to be inhaled deep into our lungs and the smallest can enter our blood stream.

Particles are defined by their sizes, which are measured in microns (a micron is 1,000th of a millimetre):

- PM_{10}, particles less than 10 microns,
- $PM_{2.5}$, particles less than 2.5 microns, and
- $PM_{0.1}$, particles less than 0.1 microns.

Although all categories of particulate matter are associated with negative health outcomes, the majority of epidemiological evidence for adverse health outcomes is associated with $PM_{2.5}$. $PM_{2.5}$ particles contain a complex mix of chemical species.

Particles larger than 10 microns are mainly deposited in the nose or throat, whereas particles smaller than 10 microns pose the greatest risk because they can be drawn deeper into the lungs. $PM_{2.5}$ can reach the terminal bronchioles and ultrafine particles $PM_{0.1}$ can enter the alveoli, with a small proportion able to cross into the blood stream and reach other organs. Much of the research, particularly the epidemiological studies, has investigated the effects of $PM_{2.5}$.The Environment Act, for air quality, is focused on developing targets specifically for $PM_{2.5}$.

Raised PM_{10} is also associated with an increased risk of death. Risks from PM_{10} are quoted in many epidemiological studies of harm to human health.

Some exposure to PM comes from naturally occurring sources such as pollen and sea spray (approximately 15 per cent). About a third of PM in the UK is transboundary, travelling from other European countries. Importantly, half of UK concentrations of PM are human- made [anthropogenic], secondary to activities such as domestic wood burning, and tyre and brake wear from vehicles (please see Appendix 1 for further details of the sources).

Particulate matter (PM10/PM2.5) - GOV.UK (www.gov.uk)

Nitrogen Dioxide (NO_2)

Nitrogen dioxide is a gas that is mainly produced during the combustion of fossil fuels, along with nitric oxide (NO). NO_2 can also be formed when NO reacts with certain gases in the atmosphere. These reactions take place very quickly and are reversible, so the two gases are referred to together as nitrogen oxides (NO_x). In the UK, the most significant source of NOx emissions is road transport, primarily from diesel vehicles. This is because vehicles are both the largest single source of emissions (30% of UK NO_x emissions) and emit directly into the streets where people live and work. Additionally, NO_x is a precursor to another component of air pollution, ozone [O_3]. NO_2 emissions are potentially more amenable to local action.

Nitrogen dioxide (NO2) - GOV.UK (www.gov.uk)

Sulphur Dioxide (SO_2)

SO_2 is another gas, primarily produced from the combustion of coal or crude oil. In 2022 the three largest sources of SO_2 emissions were domestic combustion (31 per cent of the national total), industrial combustion (26 per cent) and fuel combustion in energy production and transformation (23 per cent).

Exposure to SO_2 can cause respiratory irritation, leading to the constriction of the airways, which can be especially life-threatening among high-risk individuals such as asthmatics.

Upon reaction with water vapour in the atmosphere, acid rain is produced which can damage ecosystems and habitats leading to biodiversity loss.

Emissions of air pollutants in the UK – Sulphur dioxide (SO2) - GOV.UK (www.gov.uk)

Ammonia (NH_3)

Ammonia is a gas which is particularly relevant in air pollution due to its potential to react with other gases in the atmosphere to produce secondary particulate matter [PM]. Like SO_2, it can also contribute to acidification of terrestrial and aquatic ecosystems and damage the environment through excess deposition in water [eutrophication]. The emission of ammonia mainly stems from agricultural practices such as the use of use and storage of manure and fertilisers.

Emissions of air pollutants in the UK – Ammonia (NH3) - GOV.UK (www.gov.uk)

Ozone (O_3)

Ozone is a gas which does not have a direct source of emission and is generated though chemical reactions with other pollutants in the atmosphere. Non-methane volatile organic compounds (NMVOCs) or NO_x, in the presence of sunlight, can be photochemically changed to produce ground-level ozone.

O_3 can have direct health effects, causing irritation to our respiratory tracts. It can also damage the environment through oxidative damage to vegetation including crops.

Ozone (O_3) - GOV.UK (www.gov.uk)

Non-Methane Volatile Organic Compounds (NMVOCs)

As described above, NMVOCs are gases that react with other air pollutants to form ozone. Industry is the main producer of NMVOC's accounting for 72% of emissions (2017). They can be emitted by a wide range of processes, primarily through the products of combustion, and through vapour arising from solvents, air fresheners, cleaning products, or perfumes. In addition, they contribute to the concentration of PM in the atmosphere.

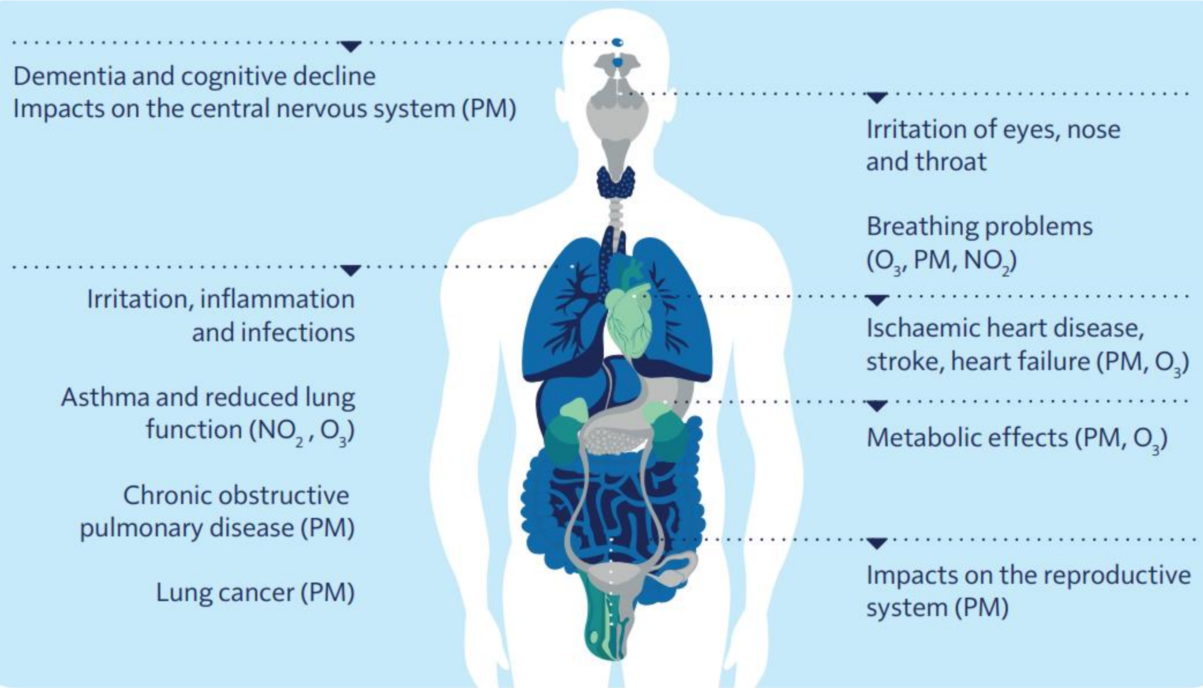
Emissions of air pollutants in the UK – Non-methane volatile organic compounds (NMVOCs) - GOV.UK (www.gov.uk)

Appendix 1 provides a summary of the sources of the main air pollutants and their associated health risks. Health effects are discussed further in the next section.

What are the health effects of poor air quality?

The health effects of poor air quality are summarised in Figure 1.

Figure 1 Health effects of air pollutants



Source: CMO Annual Report 2022, Air Pollution

Epidemiological Evidence

A summary of the epidemiological evidence, adapted from a recent review by Imperial College London, is presented below.[18]

Air pollution influences many different aspects of health, including respiratory disease, cardiovascular disease, lung cancer, perinatal health as well as emerging evidence of mental health and cognition.

Background

Air pollution is the greatest environmental risk to public health in the UK.[19] Estimates of annual mortality related to air pollution in the UK is equivalent to between 28,000 and 36,000 deaths.

The WHO described air pollution as a global health emergency,[20] hence the increase of scientific studies addressing the impact of air pollution on our health. Over the last ten years there have been over 35,000 new studies on air pollution and health.[21]

In 2016, the evidence of the impact of air pollution throughout our lives was compiled by the Royal College of Physicians (RCP) report, Every breath we take: the lifelong impact of air pollution.[22]

Much of the evidence is focussed on components of air pollution such as particulate matter and nitrogen dioxide and are based on observational studies. Therefore, the causal relationship between air pollution and it's health effects can only be inferred from the associations and from different sources of evidence.

Poor air quality presents as a major risk to the quality and duration of our lives. There is strong evidence of a significant association between both short-term and long-term exposure of fine particulate matter with all-cause, cardiovascular, stroke [cerebrovascular], and lung cancer-related mortality.[23] Air pollution increases the risk of lung cancer in smokers and non-smokers.[24]

Respiratory effects

The respiratory effects of air pollution are well documented. Strong evidence supports that both short-term and long-term exposure to air pollutants are associated with mortality and morbidity from respiratory illnesses.

Children are more susceptible to the harmful effects of air pollutants. As they are shorter in height, children walk at the level of traffic fumes and are therefore exposed to higher concentrations of pollutants.

Exposure to air pollution during childhood can affect lung development, leading to reduced lung function.[25,26] [27,28] Air pollution is linked to the development of asthma and asthma onset,[29] as well as exacerbations of asthma, leading to increased frequency of hospitalisations or emergency department visits.[30,31] Both nitric oxide [NO] and nitrogen dioxide [NO_2] are associated with increased respiratory hospital admissions in children under 16 years of age.[32]

The elderly population appears to be more susceptible to the respiratory effects of air pollution, with studies showing reduced lung function, development of respiratory illness such as chronic obstructive pulmonary disease (COPD), and increased hospital admissions. These are mainly secondary to worsening of COPD or asthma, and respiratory tract infections.[33,34,35]

Cardiovascular effects

The health effects of air pollution on the cardiovascular system have been studied extensively, and adverse outcomes include mortality and admissions to hospital following exposure to air pollution.[36] There is strong evidence to support the association between exposure to air pollution and ischaemic heart disease, and stroke-related mortality.[37,38]

Strong evidence supports the association of long-term exposure to particulate matter [PM] and increased incidence of acute coronary events. The increased risk was found to persist even at levels below current annual European targets.[39] A comparison of UK, EU and WHO guideline levels can be found at Appendix 2. Air pollution is associated with an increased risk of heart failure.[40]

In older persons, there is a raised relative risk of hospital admission for cardiovascular diseases [CVD] from long-term exposure to $PM_{2.5}$ when compared with persons at lower levels of exposure. There is an increase in the absolute risk of first hospital admissions for CVD with the effects persisting at least three years after exposure to $PM_{2.5}$.[41] There is an increased risk of cardiac arrhythmias, notably atrial fibrillation.[42]

Air pollution is associated with the development of maturity onset diabetes.[43] Specifically there is moderate evidence for an association of long-term Traffic Related Air Pollution exposure with diabetes.[44]

There have been limited studies on the long-term impact of air pollution on the developing cardiovascular system among young people.[45]

Some evidence based in the US, Netherlands and UK has shown positive associations of exposure to air pollutants with development of atherosclerosis and increased systolic blood pressure among adolescents.[46,47,48]

Pregnancy and birth effects

Air pollution is known to be associated with adverse pregnancy and birth outcomes.[49,50,51, 52] Adverse effects on placental function contribute to compromised foetal growth as well increasing the risk of stillbirth. Increased exposure to air pollution during pregnancy is associated with low birthweight and premature birth.[53,54] Low birthweight and premature birth are established risk factors for early life mortality and lifetime morbidity.[55]

A global study showed that 18 percent of all pre-term births worldwide were associated with an annual average concentration of $PM_{2.5}$ exposure higher than 10 $\mu g\ m^{-3}$.[56]

In terms of male fertility, exposure to higher air pollution was associated with significant decreases in semen volume, concentration of sperm, motility, and normal morphology.[57]

Neurological

In children, studies have revealed an association between exposure to air pollution and cognitive, behavioural, and psychomotor function.[58,59] The BREATHE project revealed among those exposed to higher levels of air pollution to have slower brain development and a negative impact on brain maturation.[60] Some studies showed long-term exposure is associated with reduced attention, working memory, conduct problems and emotional symptoms .[61,62] This is not a consistent observation, however.[63]

Emerging evidence has revealed the association of air pollution with cognitive decline and risk of dementia.[64,65]

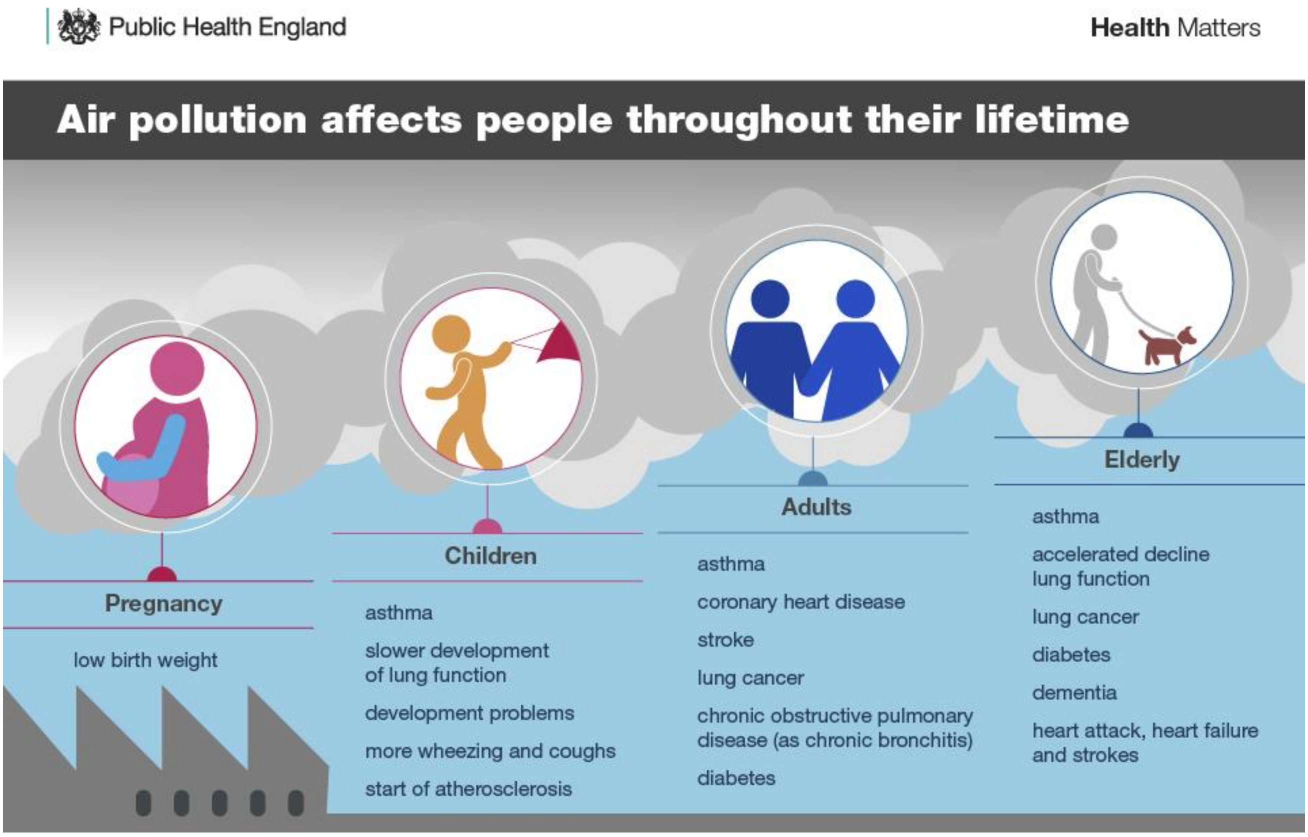
Mental health

Several studies show an association of air pollution exposure during youth and major depressive disorder diagnoses or other psychiatric outcomes.[66,67,68]

A study of adults in London concluded that poor air quality is associated with an increased risk of mental health disorders.[69]

A study of English participants from the UK Biobank showed a significant association between $PM_{2.5}$, and NO_2 concentrations with common mental health problems. An association was also seen for increased risk of a number of other long-term conditions.[70]

Figure 2 How air pollution affects people throughout their lifetime.



Source: Public Health England (PHE) Health Matters

What problems are caused by acute exposure to air pollution?

Short-term, ambient air pollution episodes routinely occur, particularly during spring and summer. Short-term pollution episodes are associated with several adverse health effects including making asthma worse, effects on lung function, increased daily mortality and admissions to hospital.

When levels of air pollutants are high, adults suffering from cardio-vascular disease, and adults and children with lung conditions, are at increased risk of becoming symptomatic and needing treatment. Only a minority of those who suffer from these conditions are likely to be affected but it is not possible to predict in advance who these people will be. Some people are aware that air pollution affects their health: adults and children with asthma may notice that they need to increase their use of inhaled reliever medication on days when levels of ambient air pollution are high.

At very high levels of air pollution, some people amongst the general population may experience a sore or dry throat, sore eyes or, in some cases, a tickly cough even in healthy individuals. Short-term increases in levels of air pollutants have been shown to increase daily mortality rates. On average, mortality is a little higher on days of higher air pollution, or days immediately afterwards.

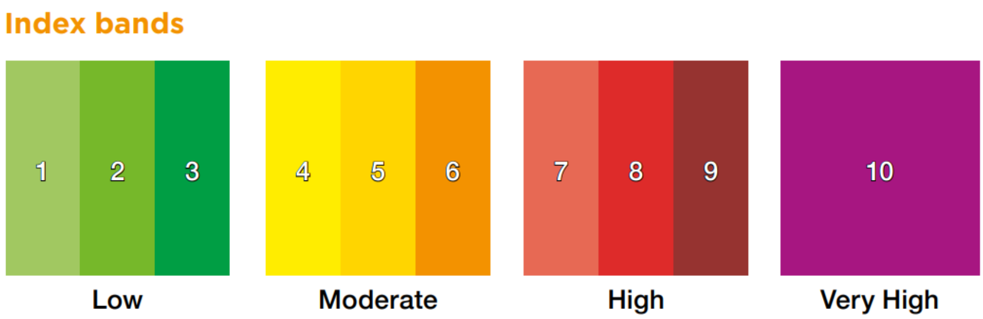
Heatwaves have been associated with increased levels of air pollution.[71]

Air quality services such as Sussex-air Air Quality Alert provide free information about the quality of outdoor air they breathe. These alerts enable residents to make informed decisions on when to reduce their exposure and if required, to manage their health conditions better.[72]

Air pollution is forecast by the UK Met Office and presented using the Daily Air Quality Index (DAQI), Figure 3. An up to 5-day air pollution forecast can be found on Department for Environment, Food & Rural Affairs (Defra) UK Air website along with the latest measured and summary air quality data.[73]

Within the DAQI, air pollution is given a value from 1-10 with 1 being the lowest pollutants concentrations and 10 being the highest. These values are banded into Low (1 – 3), Moderate (4 – 6), High (7 – 9) and Very High (10).

Figure 3 Daily Air Quality Index [DAQI]



Public health advice for action, based on a given air pollution banding, is the same whatever the pollutant. Advice is available on the UK-Air website.[74] Also shown on this website are the number of days, in a given year, in each air quality index band, by local authority.

What proportion of mortality each year in East Sussex is contributed to by long-term exposure to air pollution?

An estimated 4.7% of deaths in East Sussex are attributable to $PM_{2.5}$ air pollution (2021) which would amount to 344 deaths. [This figure is the proportion of all deaths in the county in 2021 and represents the contribution to overall mortality, not individual deaths.]

In 2022, the proportion is estimated to be 3.9% which amounts to 276 deaths.

Table 1 shows the causes of mortality in East Sussex in 2021 and 2022 by main disease categories. The category 'all-respiratory causes' does not include those deaths caused by influenza which are included in communicable diseases.

Table 1: Causes of mortality in East Sussex in 2021 and 2022 by main disease categories

Year	All causes	All cancers	Cardio vascular	Respiratory	Liver disease	Suicide	Communicable diseases
2021	7,311	1,770	1,889	611	168	51	60
2022	7,077	1,835	1,927	695	134	45	99

Source: PH Dept. ESCC

Nitrogen oxides [NO_x] and other pollutants will also have contributed to mortality in the population.[75]

NB - Table 1 refers to the number of deaths in persons aged 30 and over. Air pollution is well-recognised to contribute to and cause deaths in persons under 30.[76]

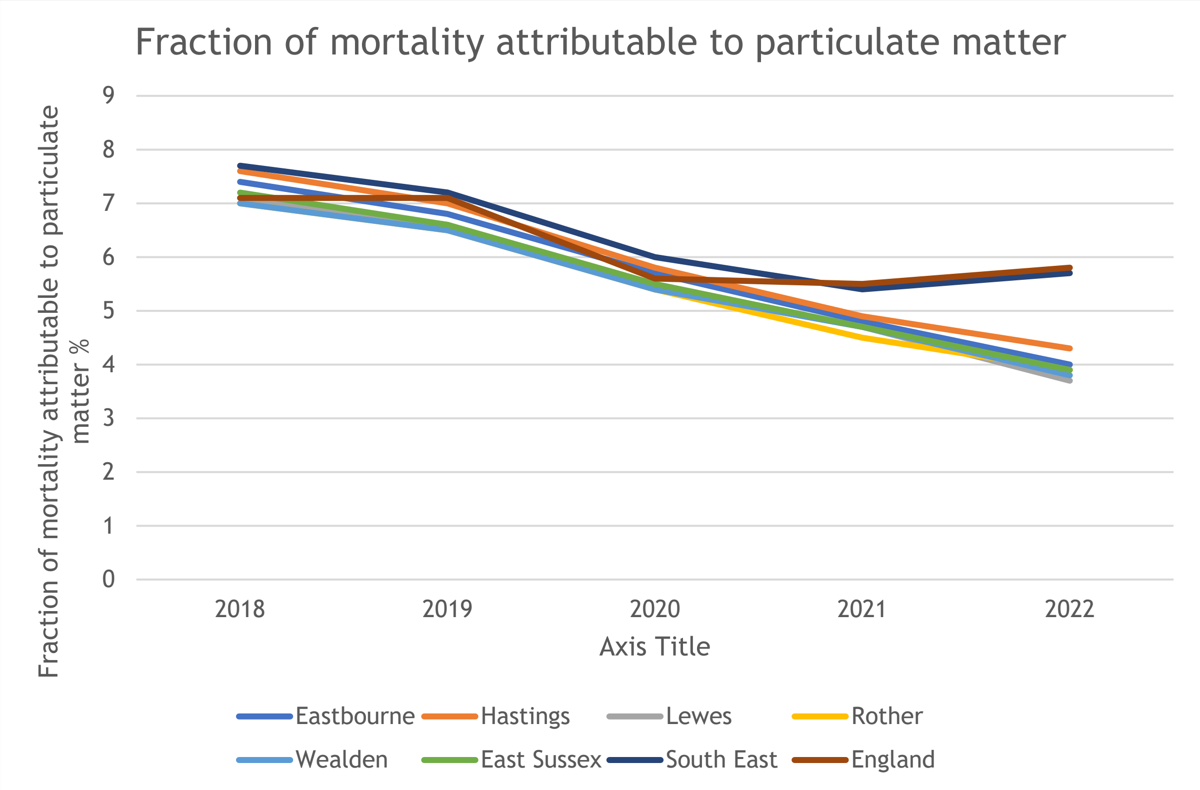
An increase of 10 μg m^{-3} in population-weighted annual average background concentration of $PM_{2.5}$ is assumed to increase all-cause mortality rates by 8% - a relative risk (RR) of 1.08 per 10 μg m^{-3} (COMEAP, 2022).

Although nationally there has been a gradual downward trend in the proportion of mortality that is attributable to air pollution, air pollution from $PM_{2.5}$ is estimated to have contributed to between 4.5% [in Rother District] and 4.9% [in Hastings Borough] of all deaths [in persons aged 30 and older] in 2021. The difference between Hastings Borough and Rother District shows the range of attributable mortality and highlights the health inequality.

Table 1 above shows the absolute total number of deaths is lower in 2022 than 2021. The calculation of the proportion contributed to by $PM_{2.5}$ is based on total number and not individual causes of death. Overall mortality is not getting worse [whilst recognising that air pollution may well be contributing to increasing some causes of death in vulnerable persons.]

Figure 3 shows the trends in attributable mortality from $PM_{2.5}$ air pollution. In terms of scale, Districts and Boroughs in East Sussex fare better than the SE Region and England.

Figure 4 Trends in the proportion of deaths each year contributed to by $PM_{2.5}$ air pollution.



Source: Fingertips

More importantly, while headline figures on the health impact of air pollution focus on the equivalent number of attributable deaths, the wider impact of the contribution of air pollution to the burden of ill health and long-term conditions locally is hiding in plain sight. Air pollution is exacerbating conditions such as coronary heart disease [CHD], COPD, strokes, and asthma.

The WHO guidelines draw attention to the uncomfortable reality that current levels of air pollution will be having an adverse effect on all citizens, including those living in the least polluted suburbs, and especially those with pre-existing vulnerabilities.

Notably, there will be health effects of exposure to past and current $PM_{2.5}$ air pollution in years to come [owing to well established time lag effects in the causation of some cancers, for example lung cancer, and in the causation of cardiovascular disease].[77]

A note on association and causation

[This section comes from the ICL evidence review paper and is acknowledged with thanks.]

Epidemiological analysis of air pollution and health data are generally based on observations and not experiments. Statistical association, or apparent linkage, from these studies is not the same as causation. Confidence that an association is causal requires the triangulation of information from many studies. Factors to be considered include the strength of the association, consistency across different types of study and populations, that exposure comes before effect, a dose response relationship (more air pollutant, more effect), biological plausibility, an absence of alternative plausible explanations and evidence that reducing the exposure decreases the risk.

To inform policy it is therefore important to draw together results from many studies through reviews and meta-analysis along with the work of expert panels who pull together evidence from many sources. The ICL report (Impacts of Air Pollution Across the Life Course-evidence highlight note) refers to expert panels including those convened by the World Health Organization, the UK Committee on the Medical Effects of Air Pollution (COMEAP), the Royal College of Physicians (RCP), the Health Effects Institute (HEI) and the International Agency for Research on Cancer (IARC).

What are the effects of air quality on health inequalities?

Summary

- Local analyses have mapped those areas at greatest vulnerability to outdoor air pollution according to the UKHSA Index for annual $PM_{2.5}$ and NO_2 exposure levels.
- There is an association between annual mean $PM_{2.5}$ levels and emergency respiratory admissions of East Sussex residents [for the period 2018/19 to 2022/23].
- At higher levels of $PM_{2.5}$ exposure [annual mean levels] the rates of emergency respiratory admissions increase. This is the case for all three broad age groups [under 16s, 16 to 64 and 65 and over].
- There is also a relationship between increasing levels of annual mean $PM_{2.5}$ and A&E attendances for respiratory reasons in both the 16-64 and 65+ age bands for the period 2014/15 to 2018/19.

The greatest burden of air pollution often falls on the most deprived communities and the most vulnerable individuals. It is often (though not always) the most deprived communities that live closest to the busiest roads, and with least access to green space, therefore increasing their exposure to air pollution.

The Marmot Review notes that individuals in deprived areas experience more adverse health effects at the same level of exposure to air pollutants compared to those from less deprived areas. The Marmot Review also highlights the role that action to tackle air pollution can play in addressing health inequalities.[78]

We have analysed the association of long-term exposure to air pollutants for East Sussex residents on A&E attendances [for the period 2014/15 to 2018/19] for respiratory conditions and on hospital admissions for respiratory conditions [for the period 2018/19 to 2022/23]. The effect of smoking in the household as a confounding factor affecting internal air quality is not accounted for in these descriptive analyses.

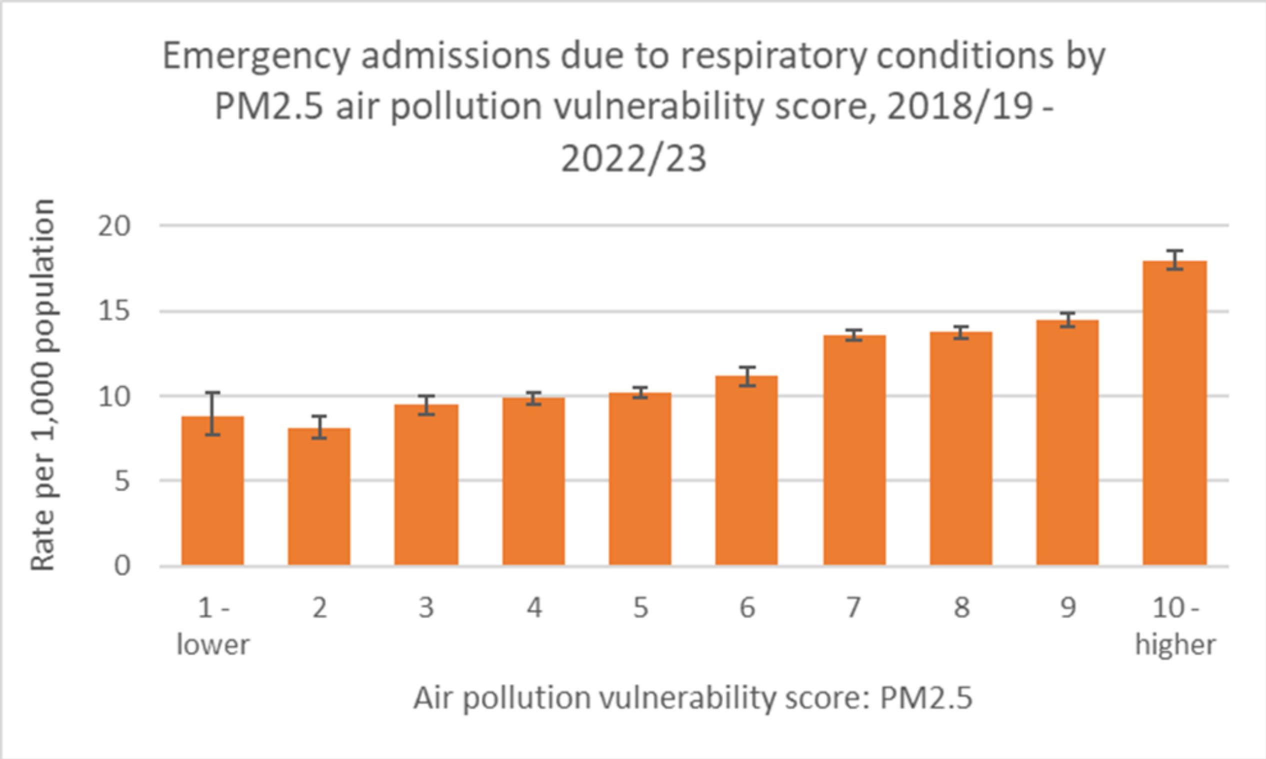
Air Quality Tool (AQT) Vulnerability Index Analyses

The Air Quality Tool vulnerability index score for a given Lower Super Output Area [LSOA] is based on: the population characteristics: (% of the total LSOA population made up of young people (<16 years) and of older adults (65+ years); levels of Deprivation (Index of Multiple Deprivation 2019 score); are there vulnerable populations there (hospitals, schools, care homes and child care facilities) and the annual average concentration of air pollution (NO_2 or $PM_{2.5}$). Please see Appendix 5 for more detail.

Figure 5 shows that the rate of emergency respiratory admissions [for all ages] increases significantly according to the AQT $PM_{2.5}$ vulnerability index score. [If we compare the highest and lowest deciles for example]. A score of one is the lowest and ten the highest on the AQT vulnerability index. However, the AQT vulnerability index includes Index of Multiple Deprivation (IMD) scores as one of its component variables, so could simply be reflecting a deprivation effect.

The AQT vulnerability index score also takes account of vulnerable receptors in the population. Not all schools or nursing homes will be located in areas of deprivation in East Sussex. The index also shows a difference in vulnerability to NO_2 and $PM_{2.5}$.Please see Appendix 5.

Figure 5 Emergency admissions of East Sussex residents due to respiratory conditions by $PM_{2.5}$ air pollution vulnerability score, 2018/19 – 2022/23



Source: PH Dept. ESCC

The black bars are 95% confidence intervals for the admission rate per 1,000. For each value of the air pollution vulnerability score there is a 95% probability that the true value will lie between the range shown.

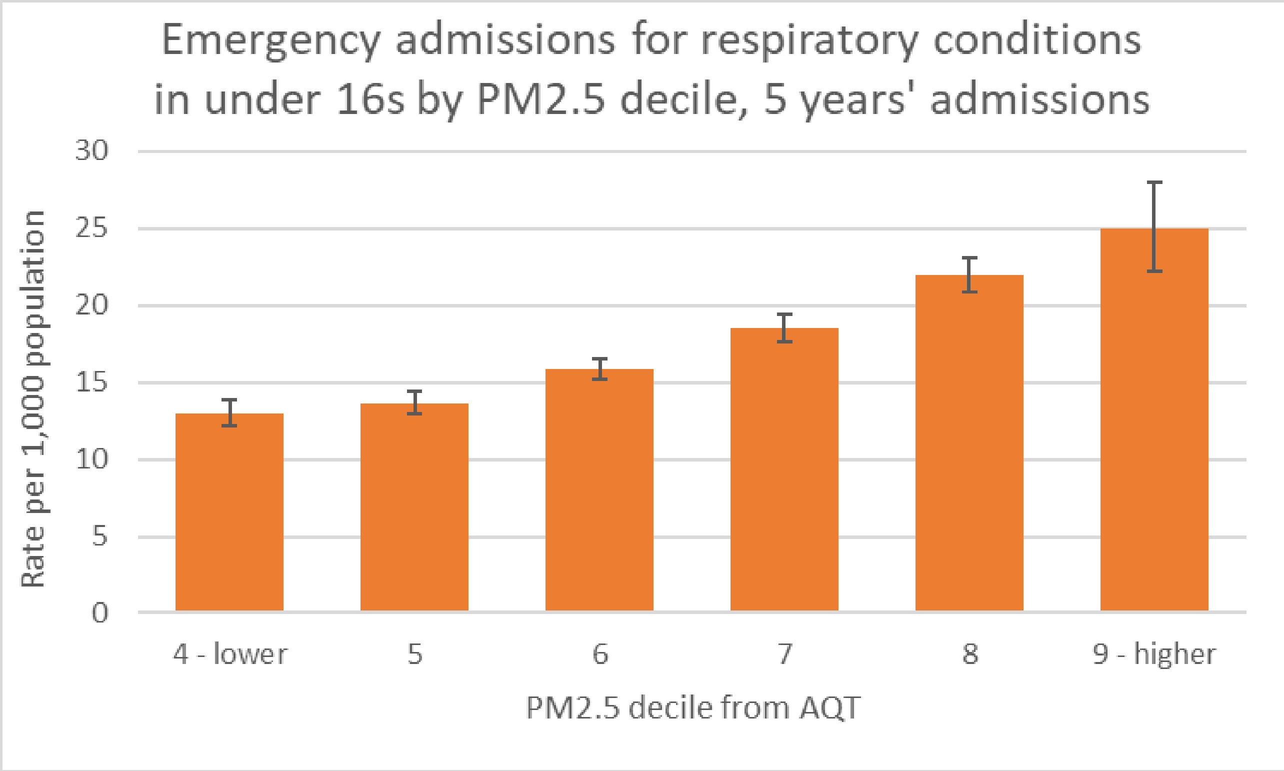
Our subsequent analyses have been confined to looking at annual $PM_{2.5}$ and NO_2 levels in deciles- the same data as were used in the Air Quality Tool [AQT]. The relationship between the annual mean levels of $PM_{2.5}$ and NO_2 and emergency respiratory admissions for the period 2018/19 to 2022/23 is explored below. The admission rates are calculated in broad age groups: under 16; 16 to 64; and 65 and over. A similar analysis has looked at rates of A&E attendances for the period 2014/15 to 2018/19.

Please note, the following analyses do not include the other variables which are included in the overall AQT index, Appendix 5.

Emergency Respiratory Admissions

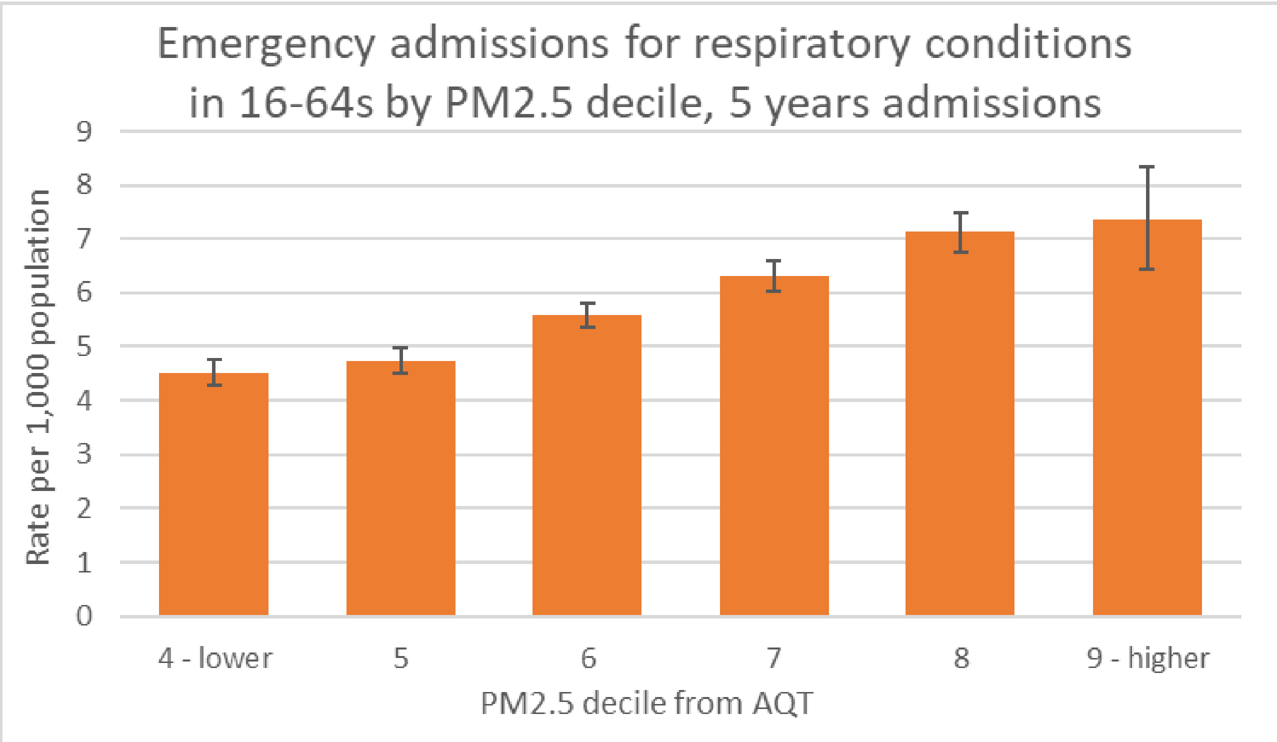
Figures 6,7 and 8 show an association that, as $PM_{2.5}$ levels [annual mean] increase, so does the rate of emergency respiratory admissions of local residents.

Figure 6 Emergency admissions for respiratory conditions in under 16s by $PM_{2.5}$ decile for the period 2018/19 to 2022/23



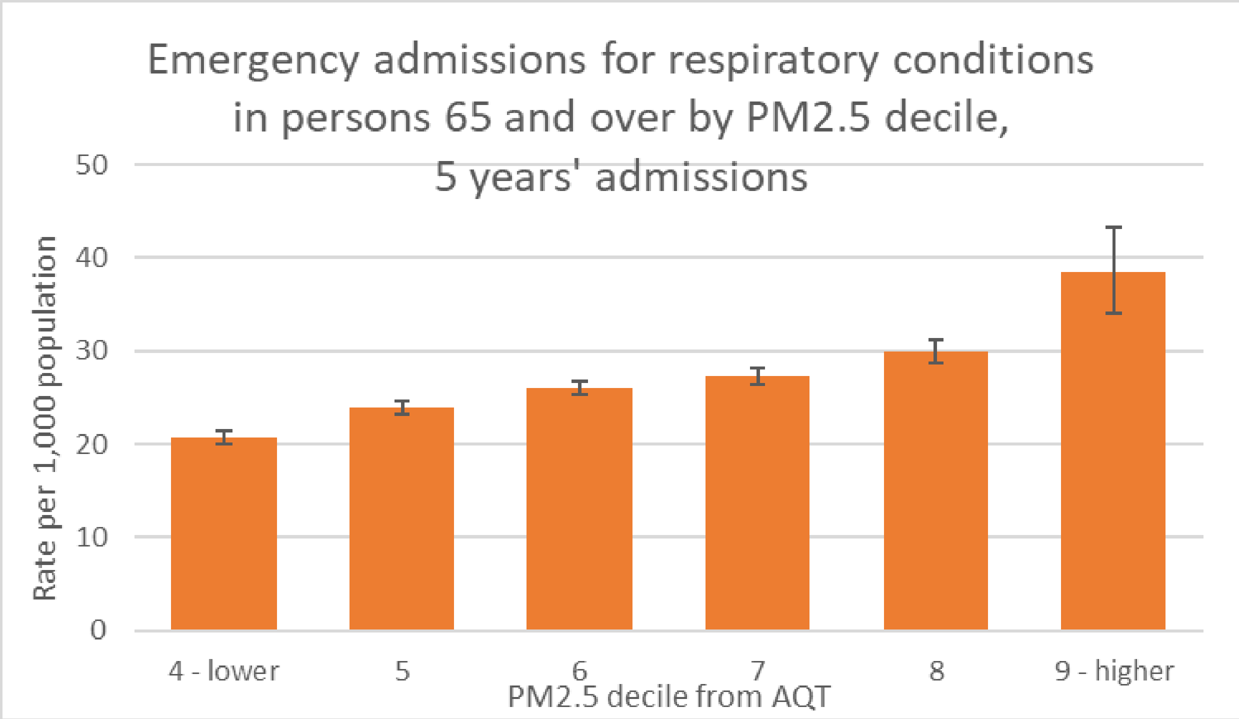
Source: PH Dept. ESCC

Figure 7 Emergency admissions for respiratory conditions in 16- to 64-year-olds by $PM_{2.5}$ decile for the period 2018/19 to 2022/23.



Source: PH Dept. ESCC

Figure 8 Emergency admissions for respiratory conditions in persons aged 65 and over by $PM_{2.5}$ decile for the period 2018/19 to 2022/23.

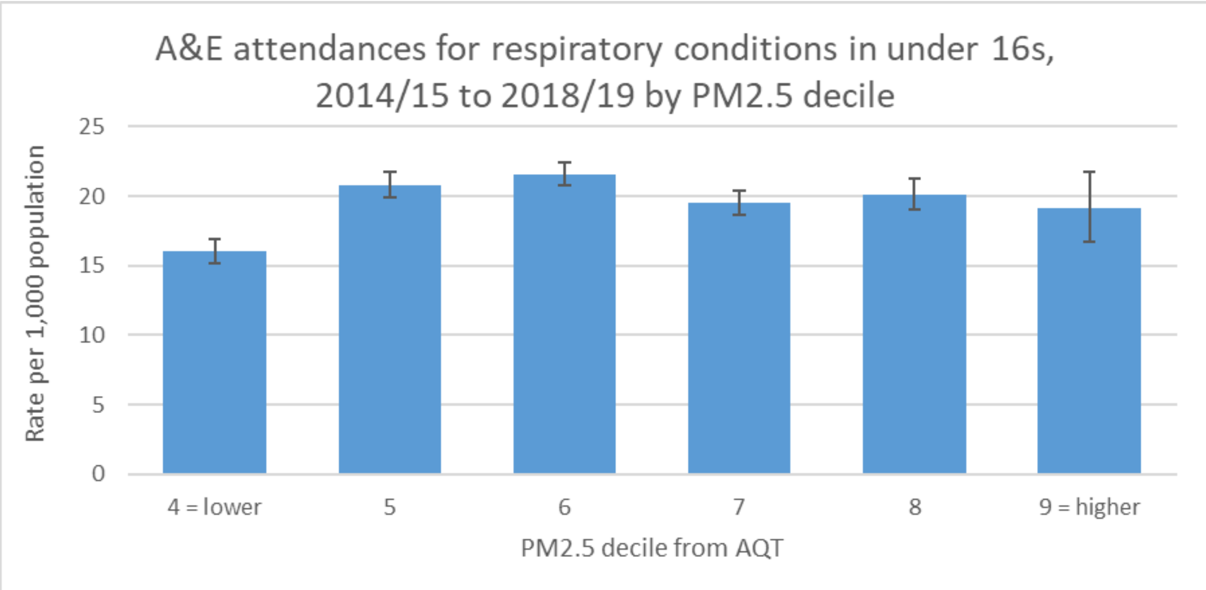


Source: PH Dept. ESCC

A&E attendances

There is no relationship with $PM_{2.5}$ decile and rate of A&E attendances in the under 16s, Figure 9.

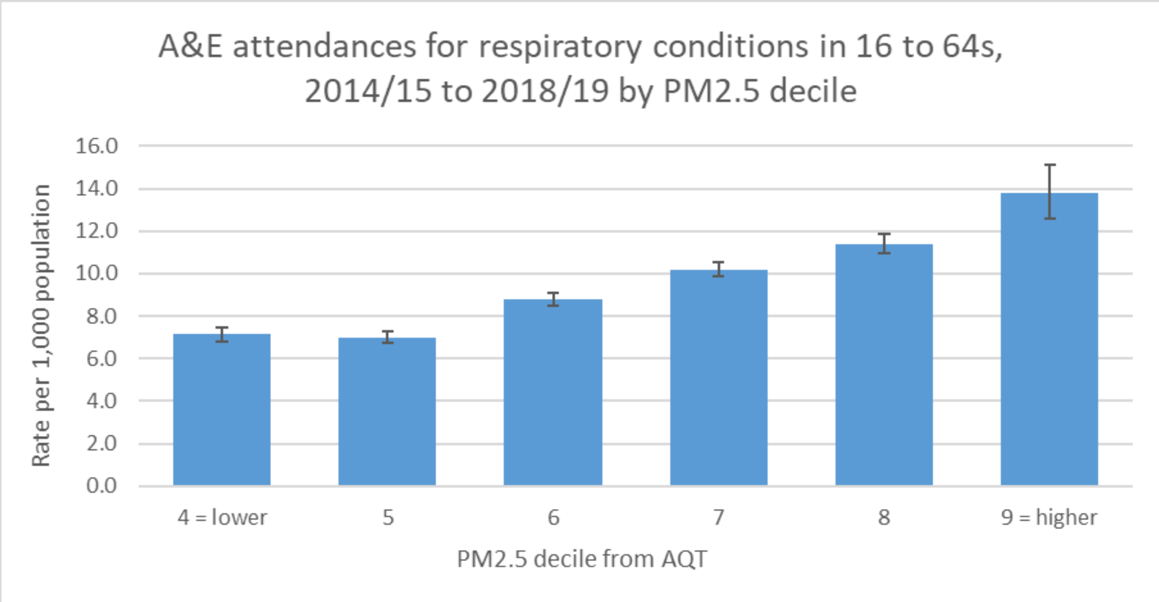
Figure 9 A&E attendances for respiratory conditions in the under 16s, 2014/15 to 2018/19 by $PM_{2.5}$ decile.



Source: PH Dept. ESCC

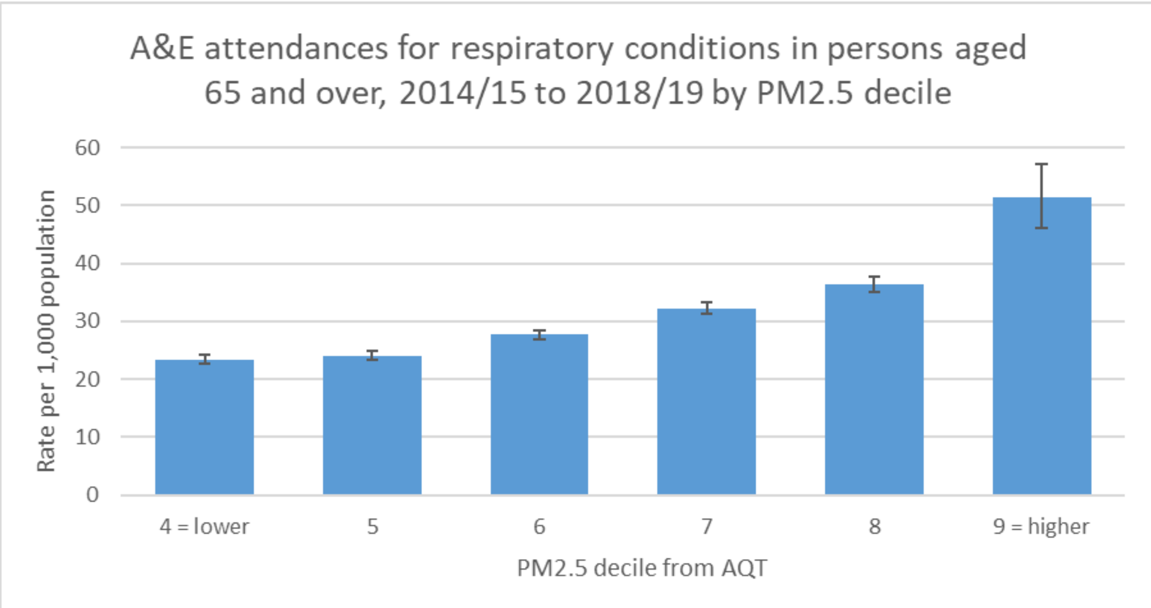
There is a relationship between increases in annual $PM_{2.5}$ levels and rate of A&E attendances in the 16 to 64 and 65+age groups, Figures 10 and 11.

Figure 10 A&E attendances for respiratory conditions in 16 to 64s, 2014/15 to 2018/19 by $PM_{2.5}$ decile.



Source: PH Dept. ESCC

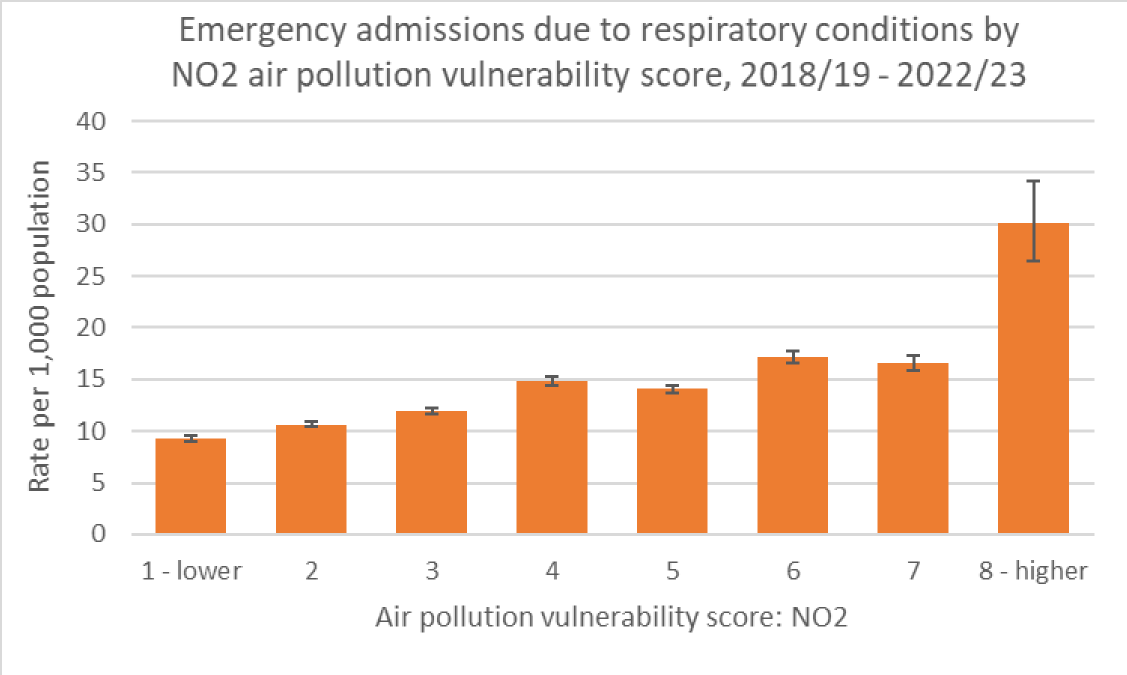
Figure 11 A&E attendances for respiratory conditions in persons aged 65 and over, 2014/15 to 2018/19 by $PM_{2.5}$ decile.



Source: PH Dept. ESCC

There appears to be a relationship between the AQT index score for NO_2 vulnerability and emergency respiratory admission rates, Figure 12.

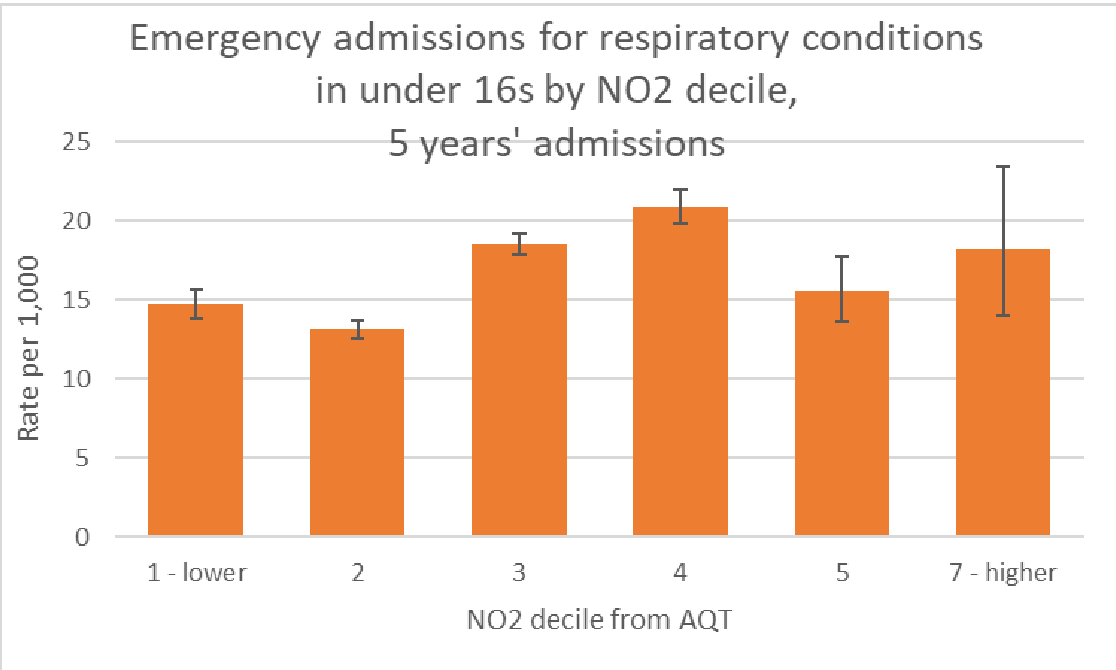
Figure 12 Emergency admissions due to respiratory conditions by NO_2 air pollution index [AQT] vulnerability score, 2018/19 – 2022/23



Source: PH Dept. ESCC

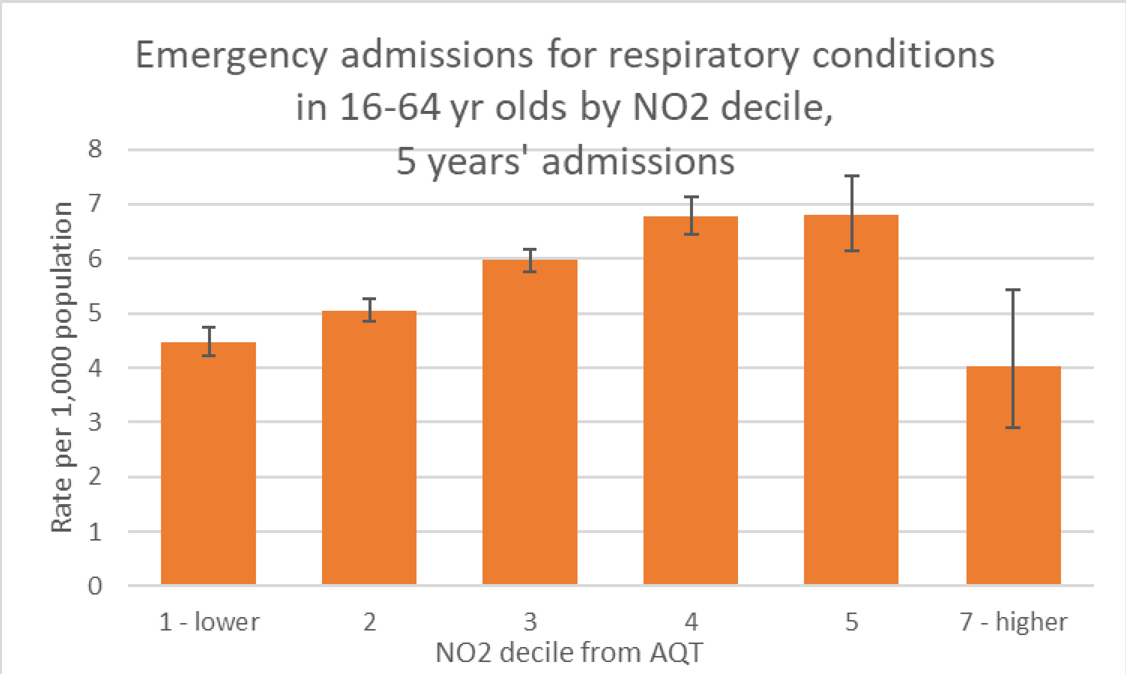
However, there is no apparent relationship if the annual mean NO_2 level decile levels are plotted against emergency respiratory admission rates in the under 16s presented in Figure 13. There is no consistent relationship with increasing annual NO_2 exposure levels in the 16-64 and 65 and over age groups shown in Figures 14 and 15. There is a suggestion that there may be an effect of NO_2 exposure in the 65+ age group. The absence of effect at very high levels [deciles 7 and above] of exposure requires further explanation.

Figure 13 Emergency admissions for respiratory conditions in under 16s by NO_2 decile, 5 years' admissions [2018/19 – 2022/23].



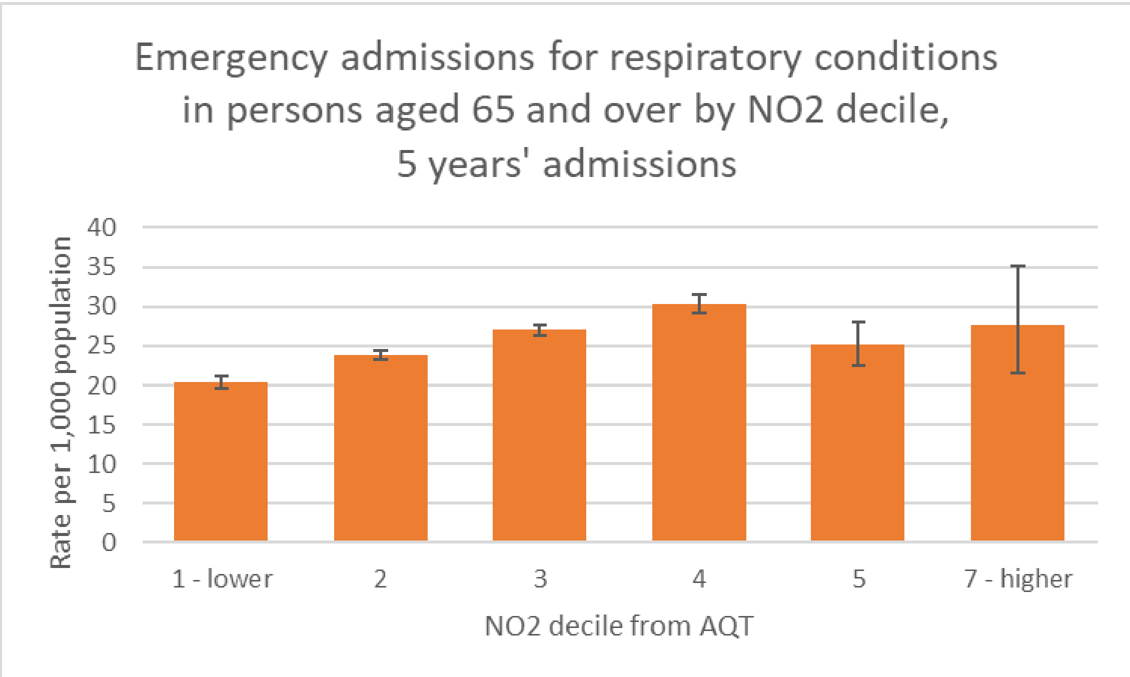
Source: PH Dept. ESCC

Figure 14 Emergency admissions for respiratory conditions in 16-64-year-olds by NO_2 decile, 5 years' admissions [2018/19 – 2022/23].



Source: PH Dept. ESCC

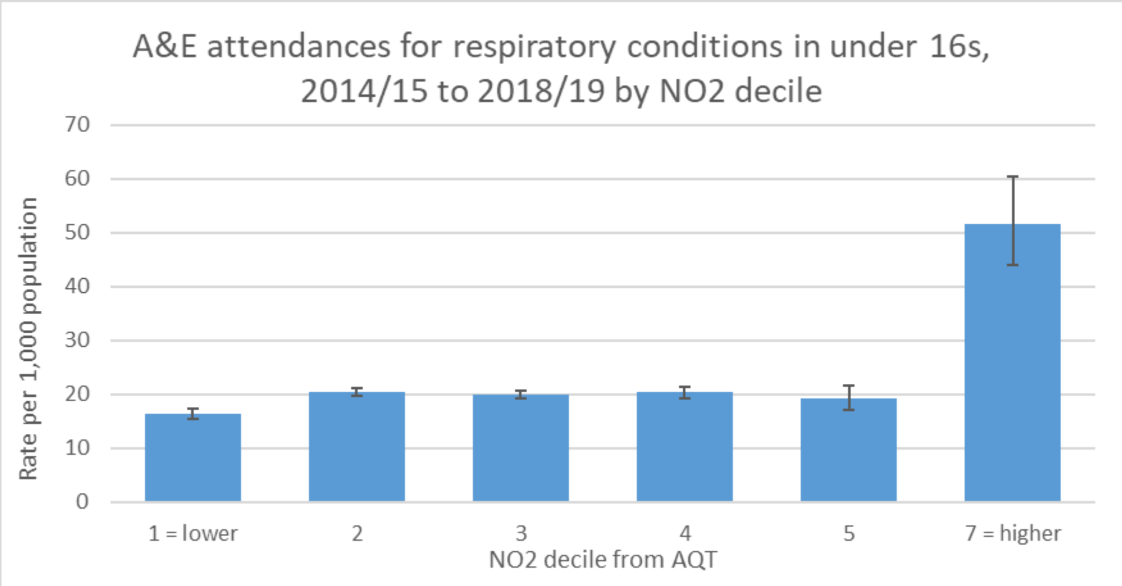
Figure 15 Emergency admissions for respiratory conditions in people aged 65 and over by NO_2 decile, 5 years' admissions [2018/19 – 2022/23].



Source: PH Dept. ESCC

Figure 16 shows a relationship in very high levels of NO_2 concentration and rates of A&E attendances for respiratory conditions in the under 16s.

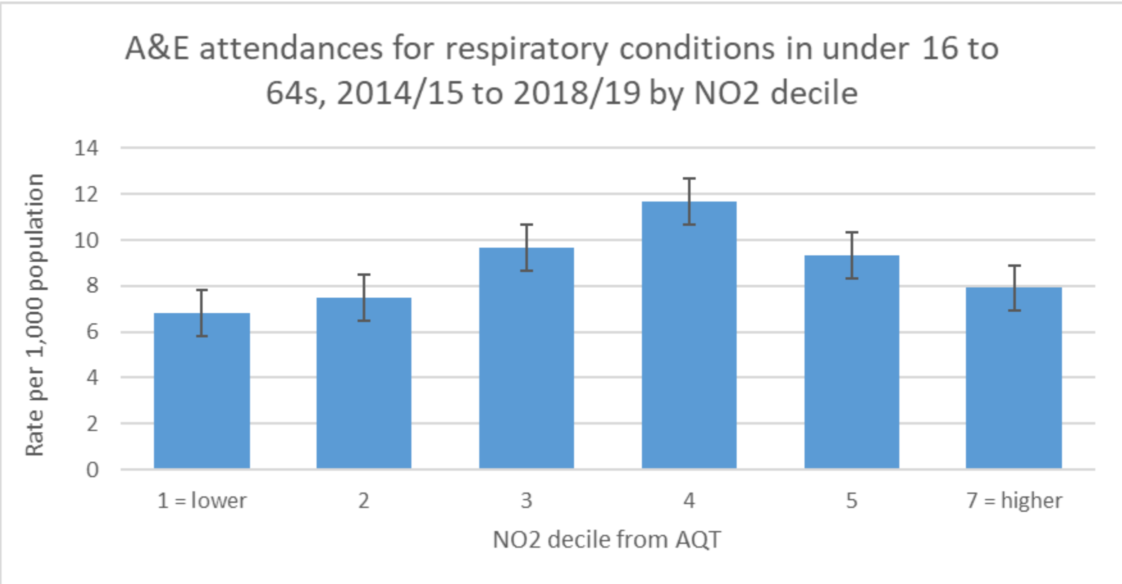
Figure 16 A&E attendances for respiratory conditions in under 16s, 2014/15 to 2018/19 by NO_2 decile.



Source: PH Dept. ESCC

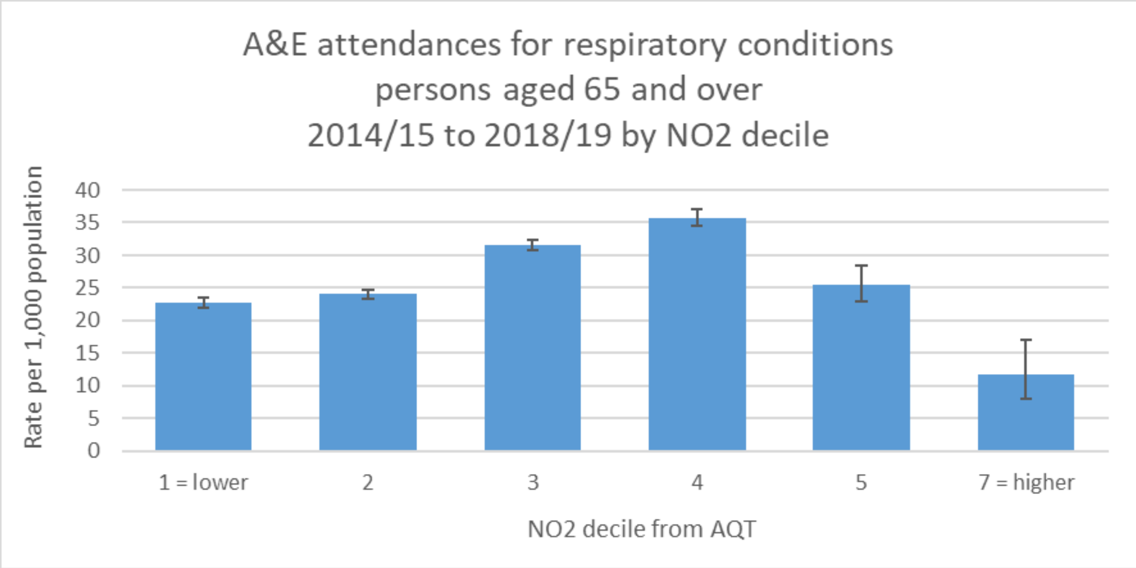
However, in Figures 17 and 18 there appears to be no relationship between NO_2 annual mean level and rate of respiratory attendance at A&E in the 16-64 and 65+ age groups.

Figure 17 A&E attendances for respiratory conditions in under 16 to 64s, 2014/15 to 2018/19 by NO_2 decile.



Source: PH Dept. ESCC

Figure 18 A&E attendances for respiratory conditions in 65+ years, 2014/15 to 2018/19 by NO_2 decile.



Source: PH Dept. ESCC

Figure 19 shows where the local population at Lower Layer Super Output Area (LSOA) level in East Sussex is more vulnerable to the effects of $PM_{2.5}$ according to the AQT index [experimental UKHSA statistics].

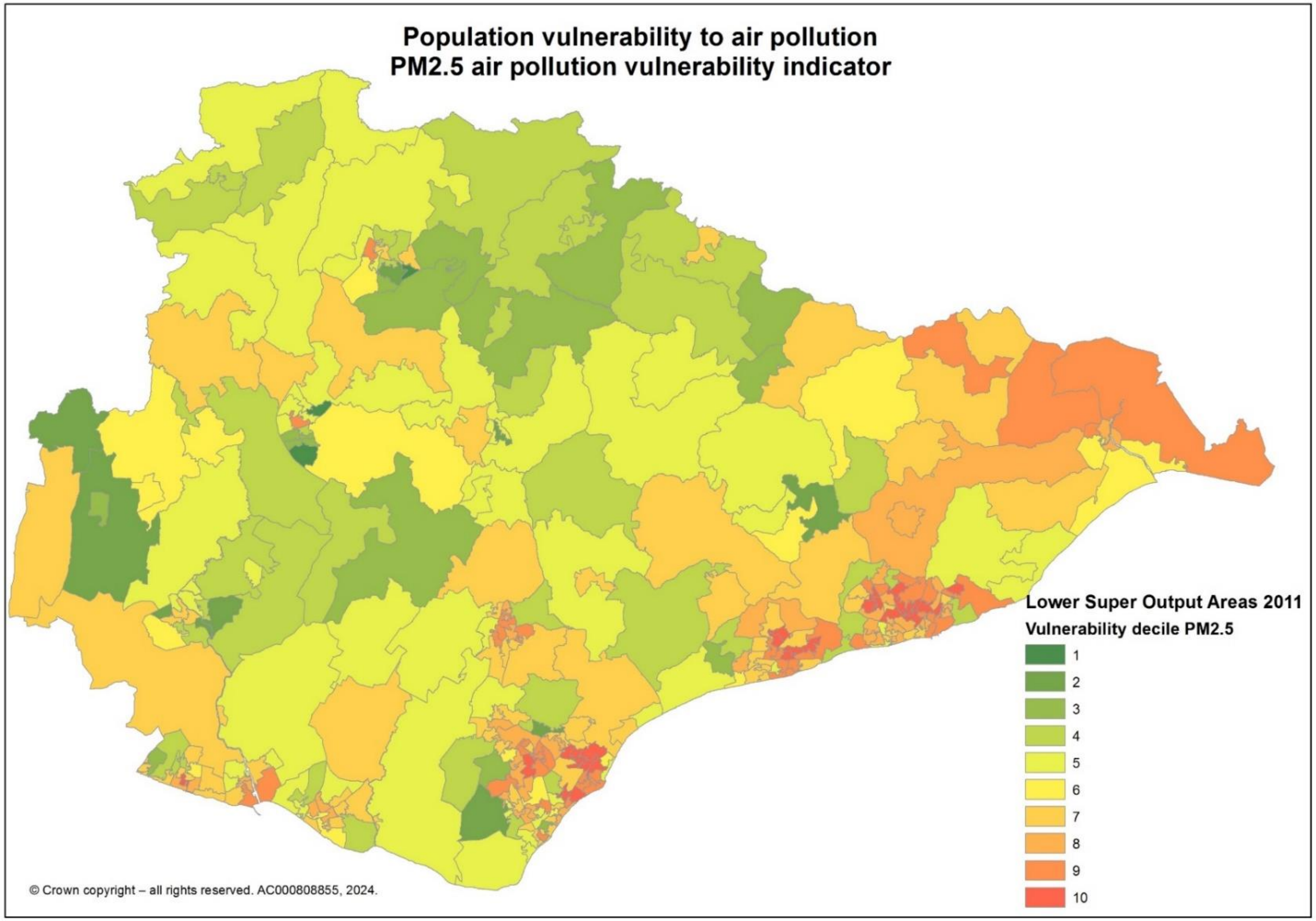
Figure 20 shows where the population is more vulnerable to NO_2 air pollution, according to the Air Quality Tool index [experimental UKHSA statistics].

Areas of increased vulnerability are shown at LSOA level in Appendix 5 in more detail.

Lewes county town has an Air Quality Management Area but does not have very high scores in terms of the vulnerability index.

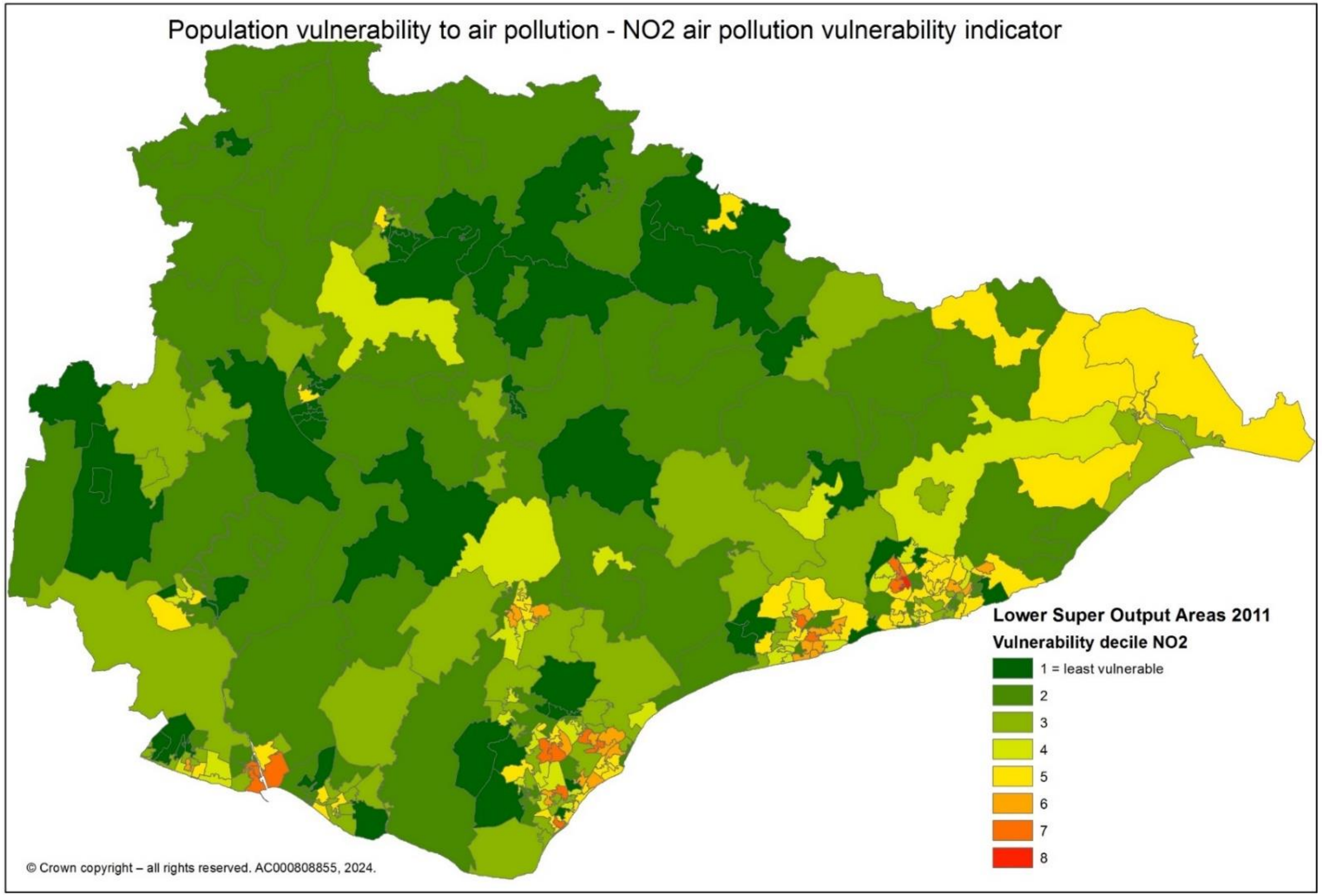
Components of the air quality index are explained in Appendix 5. Newhaven, in Lewes District, has a high score [9] near the harbour. The large area to the East of the county is a visual artefact showing a few LSOAs with low populations and small pockets of deprivation.

Figure 19 Population vulnerability to air pollution $PM_{2.5}$ vulnerability indicator. [2018 data] Most vulnerable areas in East Sussex



Source: PH Dept. ESCC

Figure 20 Population vulnerability to air pollution NO_2 vulnerability indicator. [2018 data] Most vulnerable areas in East Sussex



Source: PH Dept. ESCC

What are the key regulatory, policy and evidence drivers for action?

Air quality is managed through a complex array of policies, guidance, and regulation. These apply at multiple scales: they address the problem bottom-up through limiting emissions sector by sector, and top-down through setting national targets for ambient air quality and a maximum ceiling on national emissions. No single sector can deliver clean air in isolation; instead, controls must work across the spectrum of sources.

International level

UK air quality legislation comprises of international commitments, retained EU law and domestic legislation. The control of air pollution is a cross-continental responsibility, necessitating the need for the coordination of intergovernmental organisations.

In 1979, the UK became a signatory to the first international treaty to create a regional coordinated response to tackle air pollution. The Convention on Long-range Transboundary Air Pollution created by The United Nations Economic Commission for Europe (UNECE) has outlined a framework for controlling and reducing transboundary air pollution as well as contributing to the development of international environmental law.

Within the Convention, the 1999 Gothenburg Protocol and its amendments set national human-made [anthropogenic] emissions ceiling levels of pollutants and commitments for reducing various air pollutants.

The UK's response was implemented by the National Emission Ceilings Regulations 2018, setting national emission ceiling levels and emission reduction requirements for sulphur dioxide [SO_2], oxides of nitrogen [NO_x], ammonia [NH_3], non-methane volatile organic compounds in 2010, 2020 and 2030 and for $PM_{2.5}$ in 2020 and 2030. The UK did not meet its 2020-2029 emission reduction commitment for emissions of fine particulate matter ($PM_{2.5}$) in 2021.

The World Health Organization (WHO) published its updated Global Air Quality Guidelines in 2021. The guidance acts to provide evidence-based recommendations to reduce the adverse health effects of key air pollutants and provides evidence-based maximum target concentration levels.

UK National Government[79,80,81]

The Secretary of State for Environment, Food and Rural Affairs has responsibility for meeting the limit values in England and the Department for Environment, Food and Rural Affairs (Defra) co-ordinates assessment and air quality plans for the UK as a whole.

National legislation relating to the control of ambient air quality is outlined by the Air Quality Standards Regulations 2010, which has set limit values for concentrations of different air pollutants. These regulations stem from the EU directive 2008/50/EC, and cover the following pollutants: sulphur dioxide, nitrogen oxides, particulate matter (as PM_{10} and $PM_{2.5}$), lead, benzene, carbon monoxide and ozone and directive 2004/107/EC, which covers cadmium, arsenic, nickel and mercury, and polycyclic aromatic hydrocarbons (PAHs).

The Environment Act 1995 requires the UK Government to produce a national Air Quality Strategy (AQS) setting out air quality standards, targets, objectives, and measures for improving ambient air quality. In 2007 the Air Quality Strategy for England, Scotland, Wales, and Northern Ireland was published. In April 2023 the UK Government published, Air Quality Strategy: framework for local authority delivery, which supersedes the 2007 Strategy in respect of England only.

The Clean Air Strategy, outlined a comprehensive suite of actions required across all parts of Government to improve air quality and maximise public health benefits. As part of this, the Environment Act 2021 was established, and this required long-term targets to be set for fine particulate matter ($PM_{2.5}$). These have been set through the Environmental Targets (Fine Particulate Matter) (England) Regulations 2023 and are as follows:

- Annual Mean Concentration Target (‘concentration target’) – a target of 10 micrograms per cubic metre ($\mu g\ m^{-3}$) to be met across England by 2040.
- Population Exposure Reduction Target (‘exposure reduction target’) – a 35% reduction in population exposure by 2040 (compared to a base year of 2018).

The clean air chapter of the Environmental Improvement Plan 2023 (EIP 2023) builds on and updates the 2019 Clean Air Strategy. The EIP 2023 set out 25-year goals to include:

- cut overall air pollution by tackling the key sources of emissions, including reducing the maximum limits for domestic burning appliances in Smoke Control Areas.
- tackle specific hotspots by challenging councils to improve air quality more quickly, while supporting them with clear guidance, funding, and tools.

(Please see Appendix 2 for a comparison between UK, EU and WHO maximum target concentrations of pollutants.)

Local authorities

Under the Environment Act 1995, local authorities in the UK are required by law to assess air quality standards in their respective area according to the national air quality strategy.

Air quality strategy framework for local delivery 2023 recognises that local government has an essential role to play in delivering cleaner air for communities and nature right across England. They have many of the powers and local insight to tackle issues that cause pollution locally. For areas where specified standards and objectives are not being met, authorities are expected to declare Air Quality Management Areas (AQMAs) and then prepare Air Quality Action Plans (AQAPs) setting out the measures they will take to come back into compliance with those standards. Preventative action is also expected in all local authorities by means of a local Air Quality Strategy, rather than waiting for a legal limit to be breached in a given area.

Under the Environment Act 2021, implications for local authorities,[82] the Act updates, simplifies and strengthens the local air quality management framework (LAQM). It ensures that responsibility for solutions to poor air pollution is shared across local government structures and with relevant public bodies.

The Local Government Association are seeking as wide as possible interpretation of 'relevant public authorities' and as strong as possible duty for them to co-operate with local authorities in their clean air target. The LGA would also seek for local authority air quality plans to override the national policy of public agencies where it is in direct conflict with air quality goals.

The Act includes Amendments to the Clean Air Act (1993), with a simpler regime for smoke control enforcement, allowing a possible decriminalised regime with a simplified structure for issuing penalty notices. There are additional enforcement powers for domestic burning. It extends these powers to allow enforcement on moored vessels.

Principles to guide action on air quality

The following sections are adapted from the PHE report Review of interventions to improve outdoor air quality and public health (publishing.service.gov.uk)[83]

The different air pollutants should be considered and tackled together.

They are rarely independent of each other, either in their production or resulting exposures. Interventions to reduce individual pollutants should not be considered in isolation from other pollutants, otherwise reducing harm from one may be countered by an increase in another.

Tackling air quality and greenhouse gas emissions

Many interventions to reduce greenhouse gas emissions also improve air quality, but not all. We need to ensure that air pollution implications are considered in the important net zero transition – for example, changes to energy systems so that (as a minimum) air quality is not worsened and ideally improved by net zero initiatives.

Local authorities need to work together.

Air pollutants don't respect borders, and there is little benefit in reducing air pollution in one population centre but increasing it elsewhere. Neighbouring authorities therefore need to work together, especially on interventions that apply to defined spatial areas, such as clean air zones. These can be effective in reducing harm from air pollution in cities and must be carefully designed to reduce all pollution and to avoid displacing it from one populated area to another.

Effective strategies require a coherent approach.

This should be between local authority functions (such as environmental and public health, transport, and spatial planning) and between local government and local communities, as well as other public and private sector organisations.

Everyone has a role to play.

Individuals need to reduce their own contribution to pollution and should be encouraged to reduce their exposure. Local authorities are at the centre of local leadership and should coordinate and lead action. Employers, private and public-sector organisations should engage with local initiatives and play their part. The public sector should lead by example and national government needs to ensure a policy environment which supports local action and creates the right incentives.

It is better to reduce air pollution at source than to mitigate the consequences.

There is a hierarchy of interventions with preventing, reducing or replacing polluting activities to reduce emissions as the first priority. Actions to reduce the concentration of air pollution once it has occurred is the second priority, and individual avoidance of exposure is the third. The hierarchy for the most effective approaches is to reduce emissions, then reduce concentrations, then reduce exposure.

Improving air quality can go hand in hand with economic growth.

A common misconception is that air pollution is a necessary consequence of economic prosperity, whereas a clean environment is increasingly understood to support, rather than hinder, economic growth. People prefer to live, and employers are likely to prefer to establish businesses, in places which are clean and support a healthy workforce.

As action is taken some groups may need particular support.

Some evidence-based actions may disproportionally affect some groups of people. For example, those whose livelihoods depend on driving but who do not have access to, or the resources for, cleaner vehicles may need support because some of the most effective interventions target road vehicle emissions. Without such support, action on air quality may have the perverse impact of increasing inequalities.

What can local action achieve?

What air pollution is being generated locally over which local organisations have some degree of either control or influence?

Our atmosphere does not exist in isolation from the rest of the world, so changes in emissions, regulation, agriculture, and industry in near neighbours in Europe, and further afield, will play a role in determining the concentrations of outdoor air pollution.

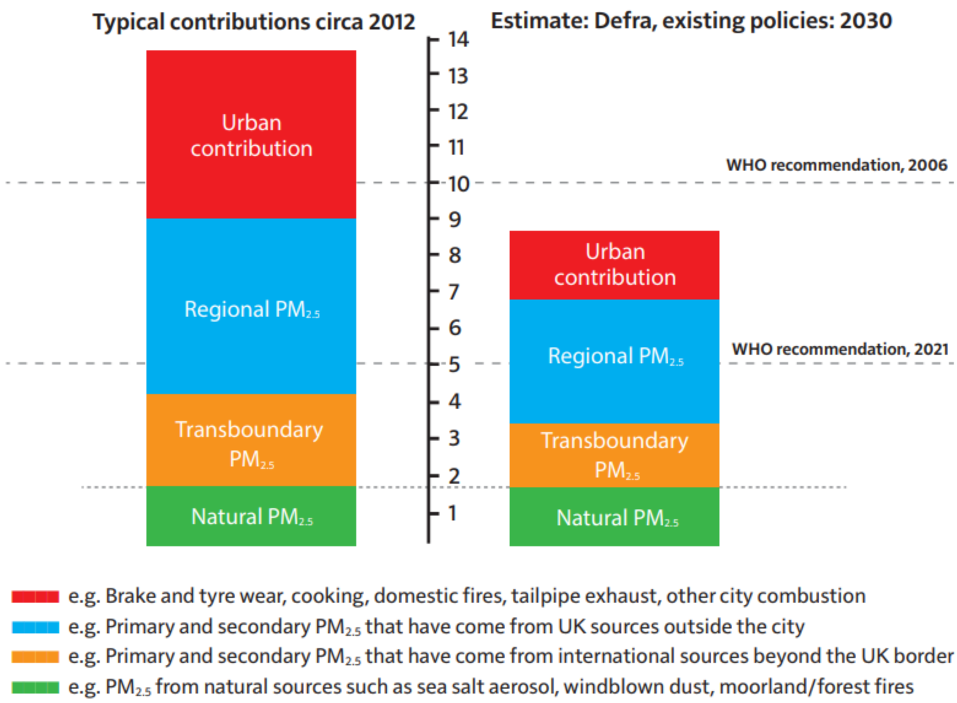
Pollutant concentrations are also controlled by dilution and atmospheric removal. Air pollutants are removed from the atmosphere in several ways: by rain, snow, and fog; the direct uptake of gases and particles to land and water surfaces; as well as chemical reactions caused by the absorption of sunlight.

Wetter, windier weather tends to reduce air pollution concentrations, while stable conditions with low wind speeds can make them worse. These meteorological factors are not fixed, and climate change over the next 50 years will alter how pollution is dispersed and removed.[84]

Air pollutants vary in how long they persist in the atmosphere. This has implications on how far away from their source they can influence health. NO_2 is a local pollutant with a short duration, whereas $PM_{2.5}$ and ozone persist for much longer in the atmosphere.

The relative importance of the differing sources of pollutants will be expected to change over the next decade. By way of example, Figure 21 shows estimates of the contributions to $PM_{2.5}$ for an urban background location in 2012 and as estimated for 2030.

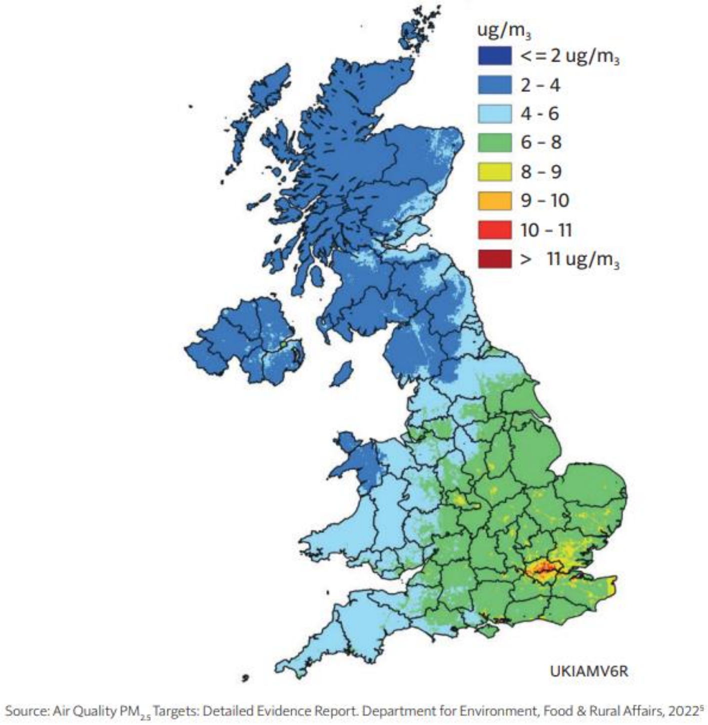
Figure 21 Estimates of the contributions to $PM_{2.5}$ for an urban background location in 2012 and estimated for 2030.



Source: CMO Annual Report 2022, Air Pollution

With existing policies, outdoor air quality will be expected to have improved right across the UK by 2030. However, some areas will still experience annual average concentrations of $PM_{2.5}$, higher than the Government's annual target of 10 micrograms/m^3, particularly in South-East England, as shown in Figure 6, and above the revised WHO guideline levels, Figure 22.

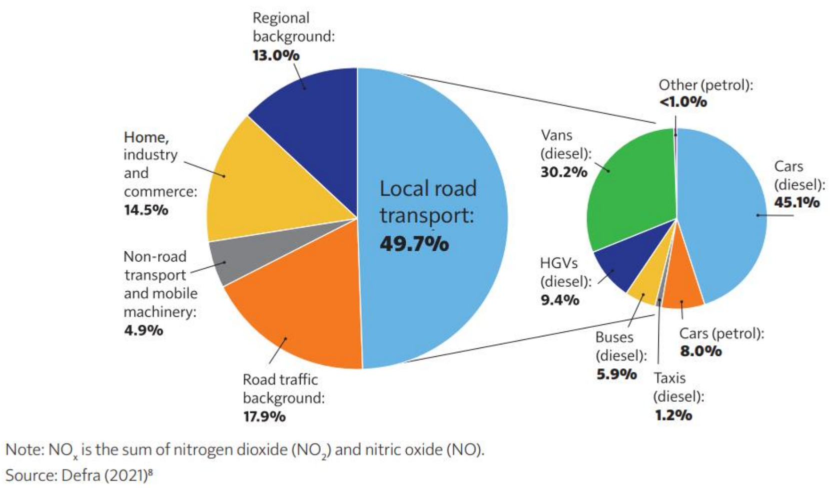
Figure 22 Modelled Annual Average Concentrations of $PM_{2.5}$ in 2030 based on a baseline [existing agreed Government policies] emission reduction scenario.



Source: CMO Annual Report 2022, Air Pollution

Central and local government can both change local air pollution, including through regulation and the purchasing of cleaner vehicles for public transport, and the effect on nitrogen oxides [NO_x] can be substantial, Figure 23.

Figure 23 UK average NO_x roadside concentration apportioned by source of NO_x emissions 2020.



Source: CMO Annual Report 2022, Air Pollution

Who / which organisations are taking action locally to improve health outcomes relating to Air Quality?

Action is being taken at all levels within the county to improve air quality. This section begins with a discussion of the role of organisations and moves on to discuss key interventions that are aiming to improve air quality in Sussex.

East Sussex Health & Wellbeing Board [HWB]

Action on air pollution will contribute to achieving the objectives of the Improving-Lives-Together-Shared-Delivery-Plan: most notably the immediate improvement area [primary and emergency care, by providing more support to stay well] and continuous improvement area [by reducing health inequalities].

East Sussex County Council's travel plan, adopted in 2023, focuses on supporting:

- Electric vehicle (EV) adoption
- Car sharing
- Active travel

Agile working (working from home) has greatly increased over recent years, reducing the need for staff to travel.

Departments within ESCC

The Community, Environment and Transport [CET] Directorate

The CET Directorate has hosted the Sussex Air Quality Partnership and will continue to support this in the future. The ESCC Climate Emergency Plan contains several measures with air quality co-benefits. There is a Climate Change Roadmap. New work on Scope 3 carbon emissions (procurement) will help to reduce air pollutant emissions from the supply chain.

The current JSNA [which this document updates] includes air quality, recognising the co-benefits of measures to improve air quality and active lifestyles.

There is a statutory requirement for local authorities to develop a Local Transport Plan (LTP). This sets out the transport strategy, for all modes of travel, for a local authority's geographic area. The CET department is responsible for the development of this plan, but with this being a partnership plan, the responsibility lies with the county council alongside key strategic transport partners (National Highways, Network Rail, Train Operating Companies etc.), district and borough local councils and other key local partners. The latest draft, LTP4, is currently being reviewed and is proposed to be published in autumn 2024.The LTP objective of ‘supporting healthier lifestyles and communities’, includes a key outcome about ‘supporting the reduction of emissions to improve air quality’.

Elected Members

Members represent their residents if they raise concerns, find out about local pollution hotspots, raise the issue with the HWB, encourage overview and scrutiny across the range of council strategies, consider the issues as part of local planning decisions, and ensure the council is encouraging others to act and informing the public.

The Planning Committee considers air quality issues with larger planning applications (for example, those with an Environmental Impact Assessment [EIA]). The East Sussex Environment Strategy includes actions to improve air quality. The strategy was developed by the East Sussex Environment Board, which sits under (and reports to) Team East Sussex. Elected members have been offered carbon literacy training, which includes information on air quality.

Planning policy & development management

The National Planning Policy Framework (NPPF, 2023) sets out the Government’s planning policies for England and how these should be applied. ESCC aims to ensure planning applications consider the health impacts of air pollution. Please see the next two sections on development management and local authority infrastructure planning and place.

ESCC aims to ensure local facilities and services are easily accessible by low pollution means and that they promote ways of accessing them without polluting.

Development Management

Development management policies within Local Plans and Section 106 agreements for individual developments help to mitigate against the particulate matter generated from construction and demolition works.

Guidance developed by the Sussex Air Quality Partnership encourages a ['mitigation first'](#) approach to air quality in the planning system. Air quality is also routinely reviewed and assessed in planning applications that are accompanied by an Environment Impact Assessment [EIA].

Applications for larger developments are required to assess air quality impacts as part of their Environmental Impact Assessment. Very few developments on their own have a significant impact on air quality, and it is the cumulative impact of multiple developments that significantly (adversely) affect air quality.

The approach where all major development is required to implement, or fund, air quality mitigation measures is one of the basic principles of the Air Quality and Planning guidance developed by the Sussex Air Quality Partnership.

[Air quality and emissions mitigation guidance for Sussex (2021)](#)

Policies are included in District, Borough and the South Downs National Park Local Plans which require developments to avoid, minimise and mitigate pollution and environmental hazards including air pollution. Local Plan policies also have an impact on air quality through supporting access to new residential and commercial development by walking, wheeling and cycling, public transport and Electric Vehicle [EV] infrastructure, thereby reducing journeys by petrol or diesel driven cars. The delivery of these schemes is supported by Infrastructure Delivery Plans – which outline the infrastructure requirements to support development, the timescale, the funding required and the likely sources of funding.

Local Highway Authority, Infrastructure Planning and Place

East Sussex Local Transport Plan 4 (LTP Plan 4 draft)

The [ESCC Local Transport Plan 4](#), currently being updated following a public consultation, is a vision-led transport strategy for the county for all modes of travel. The vision focusses on delivering on **'an inclusive transport system that connects people and places;** that is decarbonised, safer, resilient, and supports our natural environment, communities, and businesses to be healthy, thrive and prosper'.

The **approach of the LTP plans for 'people and places'** focuses on encouraging integrated journeys and reducing the need to travel by means of land-use and planning policies that support sustainable travel. Encouraging and enabling inclusive and sustainable travel modes (walking, wheeling, cycling and public transport), adopting vehicles with cleaner fuels alongside the utilisation of emerging transport technologies will all help to achieve the Council's net-zero ambitions and improve air quality.

The provision of ''safer, healthier and more active travel' is a key chapter within LTP4 and includes a specific policy (B5) regarding Air Quality, with component policy measures related to the need to improve air quality by the following:

- Investigating the potential for traffic management schemes in the centres of our largest urban areas
- Reducing the need to travel by higher polluting transport modes through better, integrated spatial and transport planning
- Promoting less polluting forms of travel (for example, active travel, public transport, and electric vehicles) for people and goods movement
- Assisting Local Planning Authorities in the development and implementation of Air Quality Strategies and Action Plans to ensure agreed targets are met
- Harnessing improvements to vehicle technology, including the use of ultra-low and zero emission vehicles and fuels

A Health Impact Assessment was undertaken on the draft LTP4. This included information, evidence, and issues on air quality. It provided greater understanding of the links between transport and health impacts and made recommendations including mitigation measures against poor air quality which influenced the Plan's development.

LTP4 Supporting Modal Strategies

There are several existing and emerging supporting modal strategies to LTP4, which will have a positive impact on improving air quality. These include the East Sussex Local Cycling & Walking Infrastructure Plan 2020, the East Sussex-- Bus Service Improvement Plan 2021 and the East Sussex Rail Strategy & Action Plan 2013 (these are all currently being reviewed). In addition, we are developing a Freight Strategy, which will be published in the autumn 2024.

Teams within ESCC will continue working in partnership with the District and Borough councils, South Downs National Park Authority, transport operators and infrastructure providers and local communities to deliver schemes and behaviour changes. These partnerships will contribute to success in achieving the objectives and health outcomes of LTP4 plan.

East Sussex Electric Vehicle Charging Infrastructure Strategy (Draft)

Electric Vehicles

The number and proportion of all cars that are electric has been steadily increasing nationally and locally.

The proportions of Electric Vehicles registered in Q4 2023 were:

- Plug-in (including hybrid) cars and LGVs

in East Sussex 2.3% [SE Region 5.4%; England 4.3%]

- Battery electric cars and LGVs

in East Sussex 1.4% [SE Region 3.6%; England 2.8%]

In January 2022 there were 136 (off-road) public charge electric vehicle points in East Sussex, an increase of 76.6% over a two-year period. This increase is supporting a take-up of and use of electric vehicles. Increasing the availability of electric vehicle charging infrastructure, particularly on roads in residential areas which have limited off-street parking and in more rural areas where there is relatively low availability, can better support residents to transition to electric vehicles.

This will be supported through the delivery of a strategic approach in providing on street charging points for electric vehicles. This approach will focus on how we might procure the installation of public charging points in the most effective manner. It must be done in a way that addresses the complex range of technical, legal, procurement and practical issues. ESCC has received a grant of more than £4 million from the Government's Local Electric Vehicle Infrastructure (LEVI) Capital Fund to install EV charging points.

Funding

A key challenge in delivering the LTP4 will be the availability of funding, how the schemes are ultimately paid for over time, with consideration to the costs of construction, maintenance, renewals, and operational costs. An additional barrier, in the short term, will be routes for financing-how and from whom the funding is raised to meet the costs of construction as they arise.

However, the LTP4 is made up of several diverse schemes and there is not going to be a 'one size fits all' funding and financing solution that applies across the programme. So over the timescale of the plan, up to 2050, the LTP4, more than previous plans, will provide ESCC, their partners and communities, an opportunity to explore opportunities to innovate how funding can be secured and combined to deliver transport infrastructure interventions and initiatives.

ESCC Transport Development Control often secures travel plans for new development and has secured EV charging points in some developments (mostly put forward by developers).

Non-electric vehicles

The Air Quality (Taxis and Private Hire Vehicles Database, England and Wales) Regulations 2019 require licensing authorities to send information on licensed taxis and private hire vehicles to a central portal on a regular basis. Taxis are licensed by Districts and Boroughs.

Environmental Health/Environmental Protection Teams

ESCC works to support environmental health [EHO] teams in Districts and Boroughs.

District and Borough Councils' Environmental Protection/Environmental Health teams work to reduce air pollution through local Air Quality Action Plans, including communication about Smoke Control Areas (SCAs) and their enforcement. In these areas it is illegal to emit smoke from a chimney, fixed boiler or furnace. Only authorised fuels are permitted to be used in Smoke Control Areas, or residents could face fines of up to £1000.

Anti-idling legislation is enforced at District and Borough level. A case example is quoted in Colchester, Essex: https://www.gov.uk/government/publications/the-air-quality-strategy-for-england/air-quality-strategy-framework-for-local-authority-delivery#summary-of-powers-available-to-local-authorities

Regulation and permitting of polluting local industrial activities is undertaken by the Environment Agency and/or the relevant local authority. Examples of local permits with an explanation of the different parts of the permitting process can be found here:

- Rother District
- Wealden District
- Lewes District and Eastbourne Borough
- Hastings Borough

Not all industrial processes are regulated formally by permits from the Environment Agency or local authority if they are on a small scale.

Localism and community engagement

Local authorities are looking at ways of involving local communities, neighbourhood groups and parish councils in decision-making processes as part of the localism agenda.

Localised air pollution hotspots are a potential focal point for measures to encourage community engagement and ownership of the problem. Local community groups or schools can be equipped to measure NO_2 levels [using diffusion tubes] if concentrations are particularly high as part of raising awareness and encouraging changes in people's behaviour.

Management of Streetscape and Public Realm

Areas of public realm and parks should be designed and managed in such a way to ensure that those who use them are not exposed to high levels of pollution. The East Sussex LTP4 highlights the need to 'create places that are well designed, attractive, safe, inclusive, and which improve connectivity and walkability. They should reduce social isolation, improve community cohesion and enable more sustainable use of the built and natural environment. A good recent example of a scheme being developed is Hastings Town Centre Public Realm and Green Connections [which has been the subject of a Public Consultation between 22nd January to 1st March 2024 in East Sussex Citizen Space].

Bids to the Urban Tree Challenge Fund and the Local Authority Treescapes Fund have facilitated street tree planting in Seaford and Eastbourne.

Sussex Integrated Care Board [ICB]

The Integrated Care Board can ensure that advice on managing exposure to air pollution is incorporated into clinical care pathways when commissioning NHS primary care services to prevent or treat long term conditions such as cardiovascular and respiratory disease.

Primary care practitioners – including exercise professionals, GPs, health trainers, health visitors, midwives, pharmacists, and practice nurses can develop their own understanding of the health impacts of air pollution. They can proactively identify individuals who might be more affected and use their professional judgement to advise them accordingly.

Primary Care Networks (PCNs)/GP Collaboratives

PCNs can seek to understand how, by reducing air pollution, this could help address health inequalities in vulnerable groups in their locality. PCNs can build their understanding of the impact of local air pollution on emergency admissions.

Giving air pollution advice to the public is included in the training of health visitors and school nurses in Sussex.

Raising awareness of air quality with primary care practitioners and reducing exposure to air pollution can be built into long-term disease management pathways.

Local NHS Acute and Community Services

The NHS contributes to local air pollution through its energy consumption, transport, and travel. It also emits 5% of total UK carbon emissions and 40% of all public sector carbon emissions.

The NHS is taking action to reduce its own contribution to air pollution. The NHS also has a role as an anchor institution to support local communities to do the same, while reducing health inequalities.

The NHS has two performance targets: to halve the NHS contribution to poor air quality within a decade while reducing health inequalities, and to reach net zero for all carbon emissions related to delivering its health service by 2045.

Every NHS Trust in the country has developed its own Green Plan and net zero strategy, including a localised approach to decarbonising heating, as well as transitioning the fleet to less polluting vehicles and encouraging active travel. Trusts can reduce the use of diesel generators or biomass fuels and put in place appropriate emission abatement measures.

By redesigning patient care pathways, it is safe and feasible for the NHS to manage more patients in primary care settings. A good example is redesign of primary care pathways to access urgent eye [ophthalmic] services.[85]

Local Industry

Local industry can work together with statutory agencies to reduce the impact of air pollution created by economic development.

Reviewing how environmental permits are awarded to specific industrial installations when evaluating applications to control pollution has been recommended. This would be to ensure they maximise potential benefits to public health outcomes, accounting for local health profiles and health inequalities (including the possibility of local approaches which impose tighter controls in certain areas or circumstances).[86]

As a rural county there will be opportunities in East Sussex to improve the management of ammonia [NH_3] and Nitrogen use in farming, learning from best practice in Europe. The impact of interventions will depend on the extent of uptake of best practice on local farms as current mitigation strategies rely on voluntary uptake. Please see CMO Annual Report S4.6 about agriculture. A map of ammonia emissions can be found at: UK Emissions Interactive Map (beis.gov.uk).

Voluntary Sector

Voluntary sector organisations can get involved in community action to reduce air pollution and help raise awareness among local people and in particular vulnerable groups.

Local Media [print and broadcast]

Local media can report on positive action being taken to improve air quality and encourage awareness amongst the public of reliable information sources about air quality.

Local People

Local people can find out about local air pollution levels and measures to reduce their own exposure.

Members of the public can review estimated levels of the main pollutants and the associated health risks at their own home address at the air pollution website [produced by Imperial College London.]

They can let their councillor know about concerns and get involved in community activities to make improvements. Each District and Borough annual air quality status report includes suggested actions for local people.

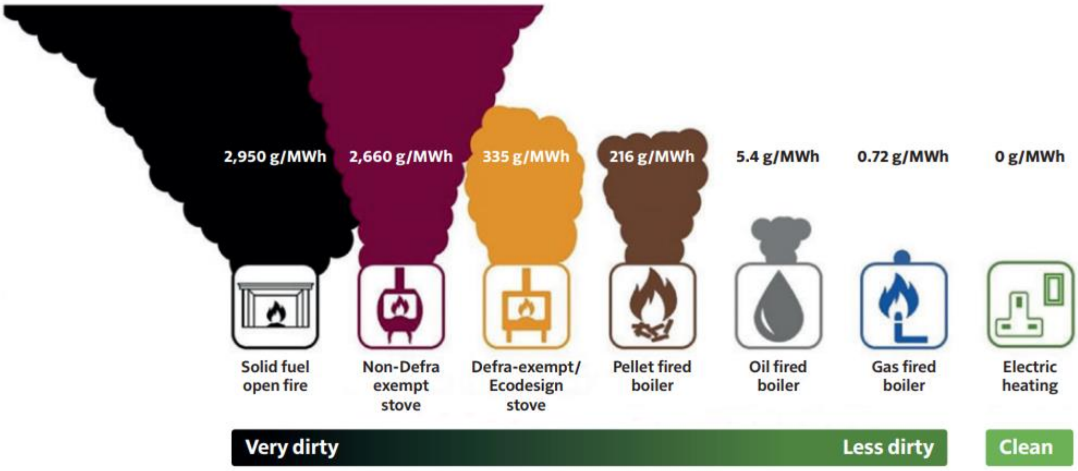
Clean Burn Sussex Project

Solid fuels are by far the most polluting method of domestic heating, and wood burning has increased in popularity over recent years. Reasons for burning wood and other solid fuels vary, and include aesthetic as well as practical, or economic reasons. There are substantial differences between open fire and stove designs, the age of the appliance and how well maintained they are. In urban areas, burning wood [particularly wet wood] has the potential to degrade local air quality significantly.

Domestic solid fuels are burned both indoors and outdoors. These solid fuels include wood, wood-based briquettes, smokeless fuels, and coal-based briquettes, manufactured solid fuels and coal. They are burned using indoor open fireplaces, closed stoves and boilers, and in outdoor chimneys, firepits, barbecues, pizza ovens, bonfires, and incinerators. There are also public indoor (and outdoor) spaces, such as pubs and restaurants, which burn solid fuel.

There is a substantial difference between the least and most polluting methods of domestic heating, as shown in Figure 24.

Figure 24 Differences between most and least polluting methods of domestic heating.



Source: CMO Annual Report 2022, Air Pollution

The Department for Environment, Food & Rural Affairs (DEFRA) estimated that nationally, in 2020, domestic combustion from indoor appliances contributed 15% of all primary PM_{10} emissions and 25% of all primary $PM_{2.5}$ emissions. Wood as a fuel contributed 17% of all primary $PM_{2.5}$ emissions. These estimates were calculated using the revised estimates of fuel use in domestic combustion in 2022.

Most of the wood burning takes place as secondary [additional] heating in homes with gas or oil-fired primary [main] heating systems.

The Clean Burn Sussex project aimed to raise awareness about domestic burning and promote better burning methods and choices. A residents' survey aimed to identify households that use solid fuels for domestic heating, the types of stoves and fuels used, and the primary reasons for burning solid fuels.[87]

Wood users in Sussex do not tend to live in the most fuel poor areas [LSOAs]. Similarly, coal users do not live in the most fuel poor areas [LSOAs]. There is a small proportion of 'essential' solid fuel users. These are people who said they used wood or coal as the main fuel to heat their homes and/or said that they used solid fuel for all their heating. Most 'essential' solid fuel users live in rural LSOAs but not in the most fuel poor LSOAs.

DEFRA has produced a practical guide to provide simple steps for people who use wood burning stoves or open fires to reduce the impacts.[88]

People in Vulnerable Groups

People in vulnerable groups are encouraged to talk to their doctor or health professional about any concerns they may have, can raise the issue of air pollution at their annual review, and understand how they can best reduce their exposure on high pollution days. They can make use of national and localised air pollution forecast services.

Active travel

Active travel means people making everyday journeys by walking, wheeling, and cycling, and can include trips made by wheelchair, mobility scooters, adapted cycles, e-cycles, and scooters, rather than by motorised transport. Increasing the number of journeys through active travel reduces air pollution emissions from motorised transport and has significant health co-benefits through promoting physical activity and improving mental health and wellbeing.

Walking, including with mobility aids, is the most common form of active travel, and is a particularly important contributor to physical activity for women, disabled people, older people, people on lower incomes, and people from ethnic minority backgrounds.

Healthy People, Healthy Places co-ordinates action across government to ensure that the design of the built and natural environment contributes to improving public health and reducing health inequalities. People may be discouraged from cycling and walking in areas of high air pollution. (This the case even though the long-term benefits of the physical activity outweigh the risks of exposure except in the most extreme air pollution concentrations.)

The East Sussex Health and Wellbeing Strategy encourages active transport. The East Sussex LTP4 includes a key chapter focussed on ‘safer, healthier and more active travel’, including a specific policy on active travel. The council’s Local Cycling and Walking Infrastructure Plan (LCWIP) sets out infrastructure investment to facilitate cycling and walking.

Self-management

Individuals with cardiovascular disease or respiratory conditions, such as COPD, or asthma, can be helped to reduce their exposure to air pollution. Air pollution information services, such as Sussex-air Air Quality Alert, and Defra’s daily air quality forecasts enable individuals to take mitigating action, such as increasing the use of their reliever inhaler medication (if appropriate) or reducing exercise on days when pollution is particularly high. Some people may access this information directly from the Met Office.

The Sussex-air Air Quality Alert service warns people of air pollution episodes by text message, voicemail or a smartphone app. Currently the take up of this service across Sussex is very low. [The number signed up as a proportion of all persons with long-term respiratory disease is less than 1% of the total.]

The ESCC corporate communications team supports the marketing of the Sussex-air Air Quality Alert service. People are encouraged to sign up for this service. A targeted air quality alert for health care professionals is being trialled in London.[89]

Indoor Air Quality [IAQ]

Overview

Individuals tend to sleep, work and take their leisure in indoor spaces, and therefore spend a substantial part of their lives indoors. Hence the environment of our indoor spaces, especially the quality of the air surrounding us, holds great importance. The Office for National Statistics (ONS) Time Use Survey indicates that around 40% of people's time is 'sleeping and resting' which is largely at home, while the USA National Human Activity Pattern Survey indicates that up to 87% of a typical adult day is spent in enclosed buildings and 6% in vehicles.

The same components of outdoor air pollution are largely present within indoor spaces. These spaces are not completely distinct from each other as outdoor air can often flow into indoor spaces. However, some specific indoor practices and factors contribute to poor IAQ. Examples of these include the production of NO_x or PM through cooking and the use of solid fuel burning stoves or cooking on gas hobs. Poorly maintained gas boilers and solid fuel appliances may also lead up to carbon monoxide (CO) build-up. The build-up of high concentrations of CO_2 can be used as a proxy for other pollutants. Other indoor air pollutants may be more evident such as asbestos, cigarette smoke, or formaldehyde which all have detrimental health effects following exposure.

Specific Volatile Organic Compounds [VOCs] may be more common in indoor spaces due to the use of different household products i.e. personal care products, cleaning products, paints, glues, and aerosols and in the fabric of the building.

Poorly maintained or designed buildings may develop mould, which produce spores that can be inhaled leading to health risks. The new Social Housing (Regulation) Act includes new powers to set strict time limits for social landlords to address hazards such as damp and mould. UKHSA guidance sets out actions that can be taken by social and private rented landlords to address these risks.[90]

Differences across buildings

The variations of indoor air quality between households can be very marked and are often associated with the stark differences in the levels of deprivation. In areas of increased deprivation, homes are more likely to be overcrowded, have more shared spaces, with poor design or ventilation. In addition, across rental homes, landlords have greater control as well as responsibilities to ensure a healthy space.

In public buildings such as schools, libraries and governmental offices, individuals have less influence over the factors affecting their indoor environment compared to home-owner dwellings

Addressing poor IAQ

The overall principles of tackling poor IAQ can be summarised into three main points, as outlined in the 2022 CMO Annual Report on air pollution:

Remove the source

- One of the most effective approaches is to remove the source of the air pollution within the indoor space. Having identified the main air pollutants and the source within the indoor space, the aim is to remove, reduce, enclose, or consider changing the use of the polluting source. Although, the idea may be simple in theory, in practice can be complicated by the type of air pollutant, its source(s), availability of alternatives and the structure of the house.

Manage airway pollution pathways

- Air pollutants are airborne and can be transferred across indoor spaces via airflow. By improving airflow via ventilation, this could help remove or dilute the concentration of the air pollutant, limiting an individual's exposure. This approach is highly dependent on the methods of ventilation used and its feasibility [how costly the technology is to install and maintain].

Protect people

- Other approaches to improving indoor air quality include a focus on individual behavioural change, for example making people more aware of the problem and choosing certain cleaning products that are less polluting. During the construction process of the indoor space, the use of building materials that may contain pollutants could be avoided.

How are the effects of local action measured and reported?

In areas with two tiers of local government (districts and counties), the air quality duties mostly sit at the lower tier [Districts and Boroughs]. In unitary areas, the single authority holds responsibility. In two-tier areas, county councils [ESCC] have a duty to contribute improvements to air quality where relevant.

Bureau Veritas UK Ltd has been commissioned by East Sussex County Council on behalf of the Sussex local authorities (who collectively form the Sussex Air Quality Partnership) to manage, provide support and report on air quality monitoring data collected from the Sussex Air Quality Network. Their annual report provides an overview of the monitoring data collected from the Sussex Air Quality Network air quality monitoring stations (AQMS) during 2022. (The 2023 data report is available on the Sussex Air website).

AIR13115731-Sussex-Annual-Air-Quality-Monitoring-Report-2022_Aug-23.pdf (sussex-air.net)

Each local authority air quality Annual Status Report [ASR] has a map showing the individual air quality monitoring sites.

Lewes District Council (LDC)

ASR_Lewes_Eastbourne_2023_Final.pdf (sussex-air.net)

Within the county of East Sussex, there are two designated Air Quality Management Areas (AQMAs) both of which are located within Lewes District. These were both initially declared following exceedances of the UK Air Quality Standard (AQS) for annual mean nitrogen dioxide (NO_2). As per statutory requirements, respective Air Quality Action Plans (AQAPs) for Lewes and Newhaven were put in place to reduce pollutant emissions.

The Energy Recovery Facility in Newhaven treats household waste that cannot be reused, composted or recycled and generates electricity from it. The operator is regulated by the Environment Agency.

Eastbourne Borough Council (EBC)

ASR_Lewes_Eastbourne_2023_Final.pdf (sussex-air.net)

There are no declared Air Quality Management Areas [AQMAs] within Eastbourne Borough at present, and there are no current or historical concerns regarding exceedances of UK Air Quality Standards within the area.

Hastings Borough Council (HBC)

https://sussex-air.net/reports/AnnualStatusReports/Hastings%20ASR%20Final.pdf

There is no declared Air Quality Management Area [AQMA] within Hastings Borough at present.

Rother District Council (RDC)

Rother ASR_2023_v2.pdf (sussex-air.net)

Wealden District Council (EDC)

Wealden ASR 2023 Final.pdf (sussex-air.net)

Monitoring in future

A direct comparison between each local authority compliance with UK and WHO air quality guidelines can be found in Appendix 3.

In terms of improving the quality and precision of air quality monitoring going forward, the Real Time Sensors project is launching in 2024. Although most sensors will be going to Brighton & Hove, others will be installed around East and West Sussex, including Newhaven and Shoreham.

Climate change

Climate change can directly impact air quality and health through increases in air pollution concentrations. Individual events, like wildfires or dust storms, will directly result in greater pollutant emissions. Extreme weather conditions such as heatwaves or drought increase the likelihood of simultaneous poor air quality events.

Health Effects of Climate Change in the UK: state of the evidence 2023 (publishing.service.gov.uk) summarises the current evidence.

Climate change will affect exposure to air borne allergens, such as pollens, dust mites, and moulds in future.[91]

Section 8.7 of the CMO Report on air pollution discusses models describing effects of climate change policies and effects on human health.

Predicted levels of outdoor air pollution

Summary

Background concentrations [non-roadside] which are based on a 1x1km resolution, represent ambient air quality concentrations at background locations.[92]

Modelled projections to 2024, 2028 and 2030 show that WHO guideline annual levels for $PM_{2.5}$ are unlikely to be met in the foreseeable future.

For larger particles [PM_{10}] most of East Sussex LSOAs meet the WHO guideline annual mean concentration levels in 2024 with the exception of three LSOAs. The elevated levels in these three LSOAs relate to activities of tile and brickworks.

Elevated annual mean concentrations for NO_2 which exceed WHO guideline levels, can be explained by traffic emissions within and around highly populated areas including Brighton, Newhaven, Eastbourne and St. Anthony's Hill [in Eastbourne.]

Please see the maps in Appendix 4.

Appendix 1:

Air Pollutants Sources and Health Risks[93]

Pollutant	Sources	Risks
Particulate Matter ($PM_{2.5}$)	Industrial combustion* (26%), industrial processes (13%), road transport (13%), domestic combustion (27%)	**Long-term exposure associated with** • All-cause, cardiovascular, cerebrovascular, respiratory (COPD and ALRI) and lung cancer mortality. • Lung development and asthma in children. • Lung cancer incidence. • Diabetes-related mortality. • Premature birth and low birth weight. • Cognitive decline and dementia. • Depression and suicide. **Short-term exposure associated with** • All-cause, cardiovascular, cerebrovascular, respiratory (COPD and ALRI) and lung cancer mortality. • Respiratory-related hospital admissions including asthma and COPD exacerbations. IHD, stroke, heart failure emergency department and hospital admissions.
Particulate Matter (PM_{10}	Industrial combustion (16%), industrial processes (34%), road transport (12%), domestic combustion (16%)	
Ozone (O_3)	No major direct source. Formed via chemical reactions between other compounds such as nitrogen oxides and volatile organic compounds.	Short-term exposure associated with: • All-cause mortality risk. • Respiratory hospital admissions and emergency department attendances. Limited evidence of association with long-term exposure with all-cause mortality and respiratory mortality.

Nitrogen Dioxide (NO_2)	Road transport (25%), other forms of transport** (14%), industrial combustion, industrial processes	Long-term exposure associated with: • All-cause, respiratory, COPD and ALRI mortality risk. • Development of asthma. • Dementia and cognitive decline. Short-term exposure associated with: • All-cause mortality risk • Acute respiratory effects such as acute exacerbation of asthma IHD
Nitrogen Dioxide (NO_2) Sulphur dioxide (SO_2)	Road transport (25%), other forms of transport** (14%), industrial combustion, industrial processes Industry combustion (26%), domestic combustion (31%)	Long-term exposure associated with: • All-cause, respiratory, COPD and ALRI mortality risk. • Development of asthma. • Dementia and cognitive decline. Short-term exposure associated with: • All-cause mortality risk • Acute respiratory effects such as acute exacerbation of asthma • IHD Short-term exposure associated with all-cause and respiratory mortality risk
Carbon Monoxide (CO)	Primarily road transport	Short-term and long-term effects of severe exposure well understood. Limited known effects of low-level exposure.

Notes:

*Industrial processes refer to emissions from specific industrial processes, including some where fuel combustion is a necessary part of the process, such as the production of steel.

Industrial combustion refers to emissions from industrial burning of fuels, either to generate energy, or to drive mobile machinery. This does not include emissions from combustion in the agricultural, forestry and fishing sectors, or emissions from institutional/commercial combustion.

** aviation, rail, shipping

ALRI: acute lower respiratory illness

COPD: chronic obstructive pulmonary disease

Sources: [94,95,96,97,98,99,100,101,102,103,104,105,106,107,108,109,110,111]

Appendix 2

Comparison between UK, EU & WHO air quality standards

Pollutant	Current UK Target	Current European Target	WHO Guidelines 2021 to be achieved by 2030
Particulate matter ($PM_{2.5}$)	• Annual mean concentration: 12 µg m^{-3} by 2028 • Annual mean concentration: 10 µg m^{-3} by 2040	• Annual mean concentration: 20 µg m^{-3} by 2020	Annual exposure: 5 µg m^{-3}
	• Population exposure reduction by 22% compared to 2018 by 2028 Population exposure reduction by 35% compared to 2018 by 2040		24-hour exposure: 5 µg m^{-3}
Particulate matter (PM_{10})	• 50 µg m^{-3} not to be exceeded by 35 times a year (24-hour mean) • Annual mean concentration: 40 µg m^{-3}	• Annual mean concentration: 40 µg m^{-3} by 2005 • Daily mean concentration: 50 µg m^{-3} by 2005	Annual Exposure: 15 µg m^{-3}
			24-hour exposure: 45 µg m^{-3}

Pollutant	Current UK Target	Current European Target	WHO Guidelines 2021 to be achieved by 2030
NO_2	• Annual mean concentration: 40 µg m^{-3} • 200 µg m^{-3} not to be exceeded by 18 times in a year (1-hour mean)	• Annual mean concentration: 40 µg m^{-3} by 2010 • Hourly mean concentration: 200 µg m^{-3} by 2010	Annual: 10 µg m^{-3}
			24-hour: 25 µg m^{-3}
SO_2	• 350 µg m^{-3} not to be exceeded more than 24 times a year (1-hour mean) • 125 µg m^{-3} not to be exceeded more than 3 times a year (24 hour mean)	• Daily mean concentration: 125 µg m^{-3} by 2005 • Hourly mean concentration: 350 µg m^{-3} by 2005	24-hour: 40 µg m^{-3}
O_3	• 120 µg m^{-3} daily 8-hour mean	• 8-hourly mean concentration: 120 µg m^{-3} by 2010	Peak season: 60 µg m^{-3}
			8-hour: 100 µg m^{-3}
CO	• 10 mg m^{-3} maximum daily running 8-hour mean	• Maximum daily 8 hour mean:	24-hour: 4 mg m^{-3}

Pollutant	Current UK Target	Current European Target	WHO Guidelines 2021 to be achieved by 2030
		10 mg m^{-3} by 2005	
Benzene	• 5 µg m^{-3} annual mean	• Annual mean concentration: 5 µg m^{-3} by 2010	
Benzo(a)pyrene	• 1 ng m^{-3} annual mean	• Annual mean concentration: 1 ng m^{-3}	
Lead	• 0.5 µg m^{-3} annual mean	• Annual mean concentration: 0.5 µg m^{-3} by 2005	
Arsenic	• 6 ng m^{-3} annual mean	• Annual mean concentration: 6 ng m^{-3} by 2012	
Cadmium	• 5 ng m^{-3} annual mean	• Annual mean concentration: 5 ng m^{-3} by 2012	
Nickel	• 20 ng m^{-3} annual mean	• Annual mean concentration: 20 µg m^{-3} by 2012	

UK Sources:

1) Air quality strategy: framework for local authority delivery - GOV.UK (www.gov.uk)
2) UK Environment Act 2021: Particulate Matter (PM_{2.5} targets) in the Environment Act: Monitoring Assessment Methods - Defra, UK
3) Air Quality Standards Regulations 2010: The Air Quality Standards Regulations 2010 (legislation.gov.uk)

EU Sources: EU air quality standards - European Commission (europa.eu)

resource.html (europa.eu)

Appendix 3:

Air pollutant concentration levels in Districts and Boroughs in 2022. Achievement of current UK Environment Act targets and WHO guidelines, Appendix 2.

Local Authority	Site	Measurements (2022)	UK	WHO
Lewes	Diffusion tubes (50)	Annual NO_2 concentration	Yes (all sites)	No (except for 2 sites)
	LS8	Annual $PM_{2.5}$ concentration: 9.8 µg m^{-3}	Yes*	No
		Annual PM_{10} concentration: 15.6 µg m^{-3}	Yes	No
Eastbourne	Diffusion tubes (21)	Annual NO_2 concentration	Yes (all sites)	No (all sites)
	EB1	Annual NO_2 concentration: 12.8 µg m^{-3}	Yes	No
		Annual PM_{10} concentration: 19.3 µg m^{-3}	Yes	No
	EB3	Annual NO_2 concentration: 9.3 µg m^{-3}	Yes	Yes
		Annual PM_{10} concentration: 14.6 µg m^{-3}	Yes	No

Local Authority	Site	Measurements (2022)	UK	WHO
		Annual $PM_{2.5}$ concentration: 8.9 µg m^{-3}	Yes	No
Hastings	Diffusion tubes (14)	Annual NO_2 concentration	Yes (all sites)	No (all sites)
	HT1	Annual NO_2 concentration: 12.8 µg m^{-3}	Yes	No
		Annual PM_{10} concentration: 23.5 µg m^{-3}	Yes	No
Rother	Diffusion tubes (20)	Annual NO_2 concentration	Yes (all sites)	No (except for 3 sites)
	RY2	Annual NO_2 concentration: 14.7 µg m^{-3}	Yes	No
		Annual PM_{10} concentration: 22.3 µg m^{-3}	Yes	No
Wealden	Diffusion tubes (16)	Annual NO_2 concentration: 14.7 µg m^{-3}	Yes (all sites)	No (except 3 sites)
	LL1	Annual PM_{10} concentration: 12.3 µg m^{-3}	Yes	No
		Annual $PM_{2.5}$ concentration: 7.6 µg m^{-3}	Yes*	No

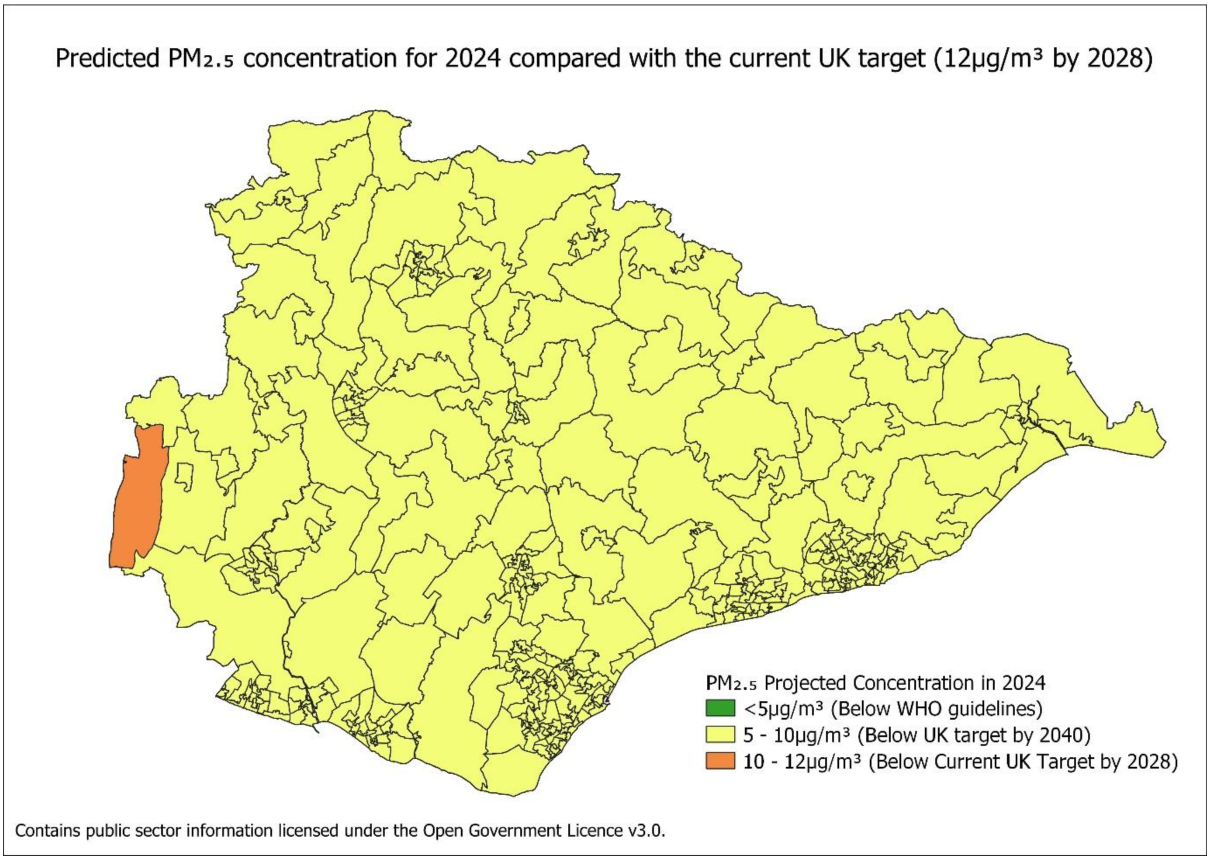
*Updated $PM_{2.5}$ target of 12 and 10 µg m^{-3} to be achieved by 2028 and 2040 respectively

Appendix 4:

Predicted levels of outdoor air pollution

Figures 25 to 31 from Bureau Veritas illustrate the predicted concentration of $PM_{2.5}$, in 2024. Figure 25 shows the maximum concentration projected for each East Sussex LSOA according to DEFRA air pollution background concentration maps which are based on 1*1 km² background units.

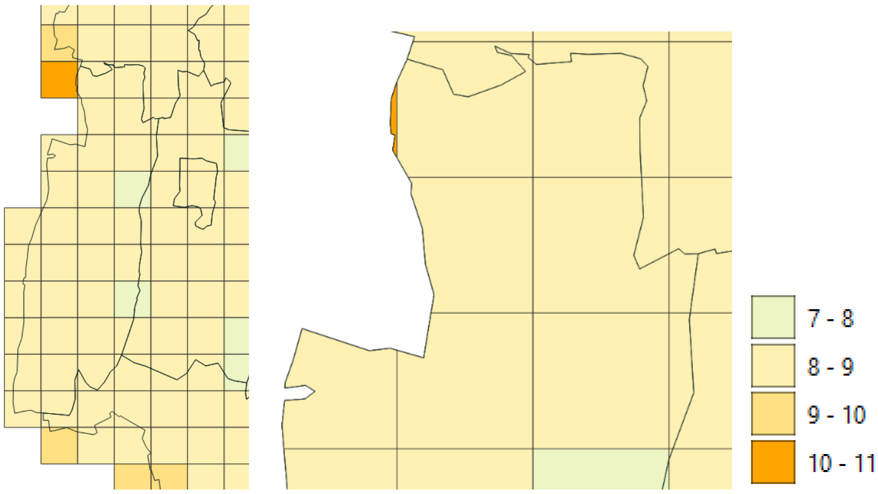
Figure 25 Predicted annual mean concentration of $PM_{2.5}$ in 2024



Source: Bureau Veritas

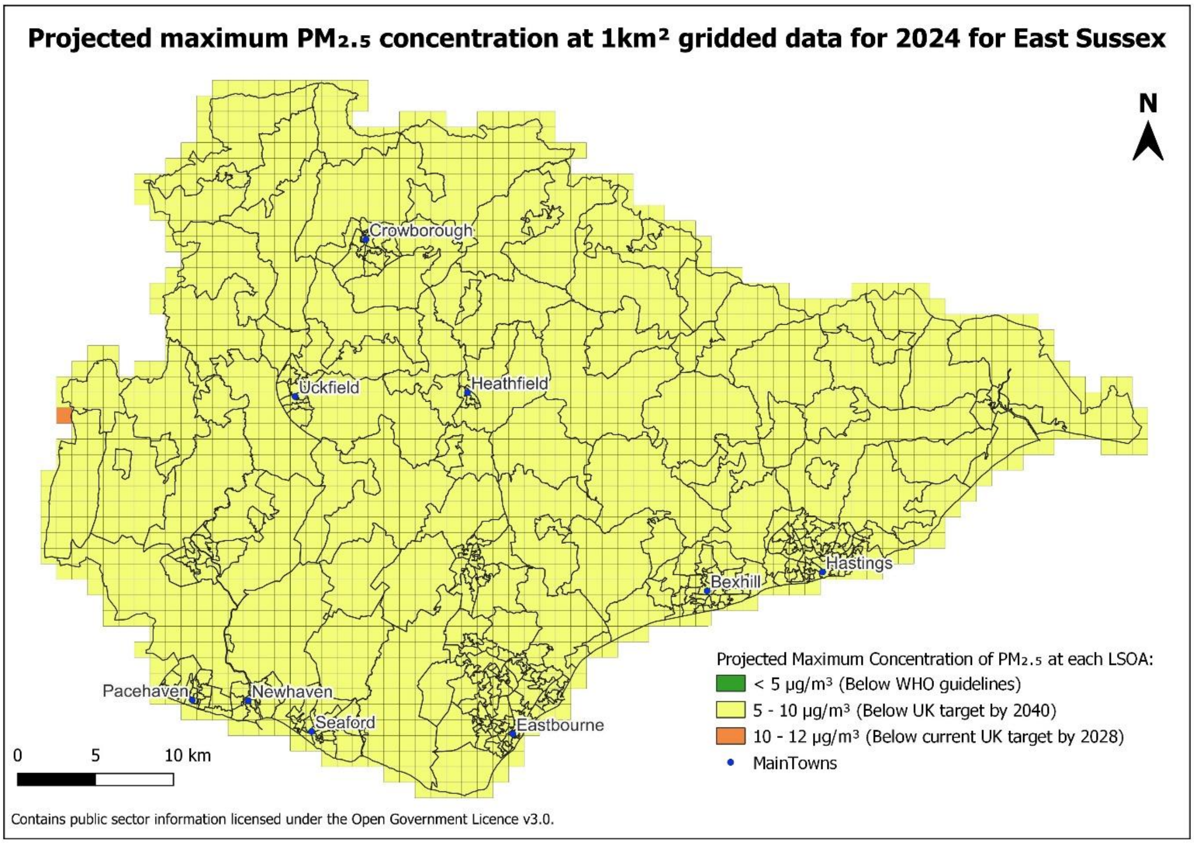
Figure 26 shows the background concentrations for each 1km^2 area within and near Ditchling. There is a predicted background concentration higher than 10 µg m^{-3} (10.88 µg m^{-3}) at the northwest area of Lewes 002B. However, this only covers a small percentage of the total area of Lewes 002B (0.074%) and the predicted concentration for the immediate surrounding area is 2ug/m^3 lower (8.82 µg m^{-3}).

Figure 26 Explanation of $PM_{2.5}$ mapping in Ditchling LSOA



Source: Bureau Veritas

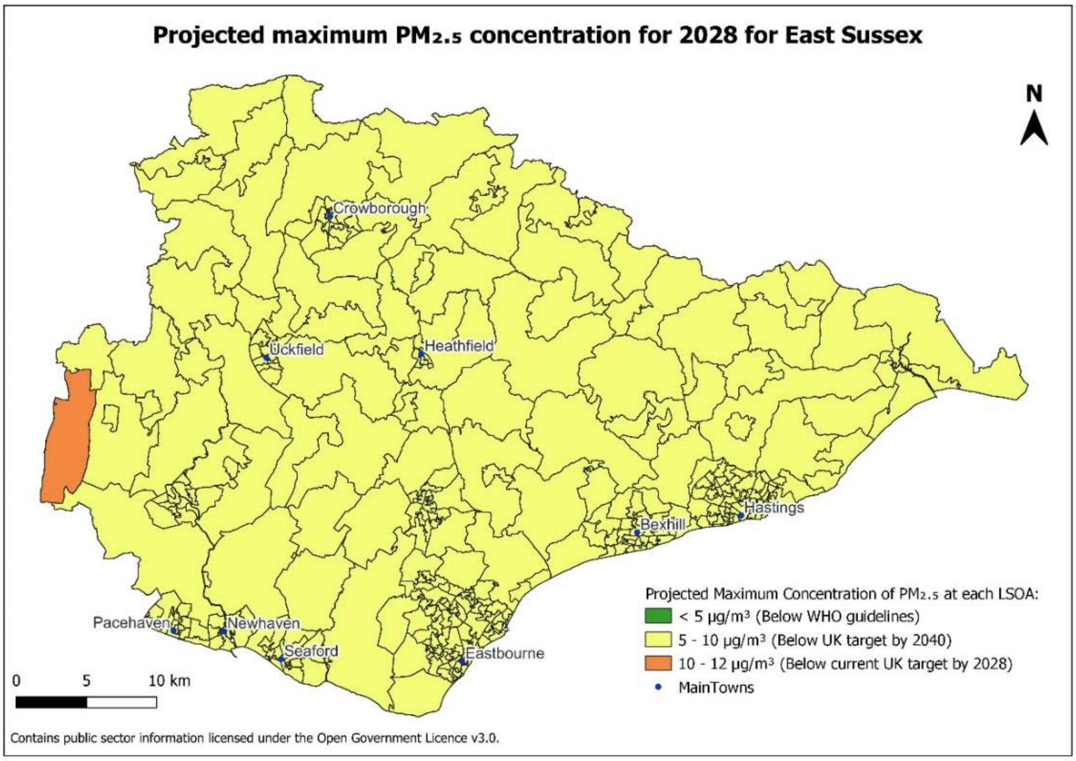
Figure 27 the maximum predicted annual $PM_{2.5}$ concentration in 2024 shown in 1*1km^2 grids for the whole of East Sussex.



Source: Bureau Veritas

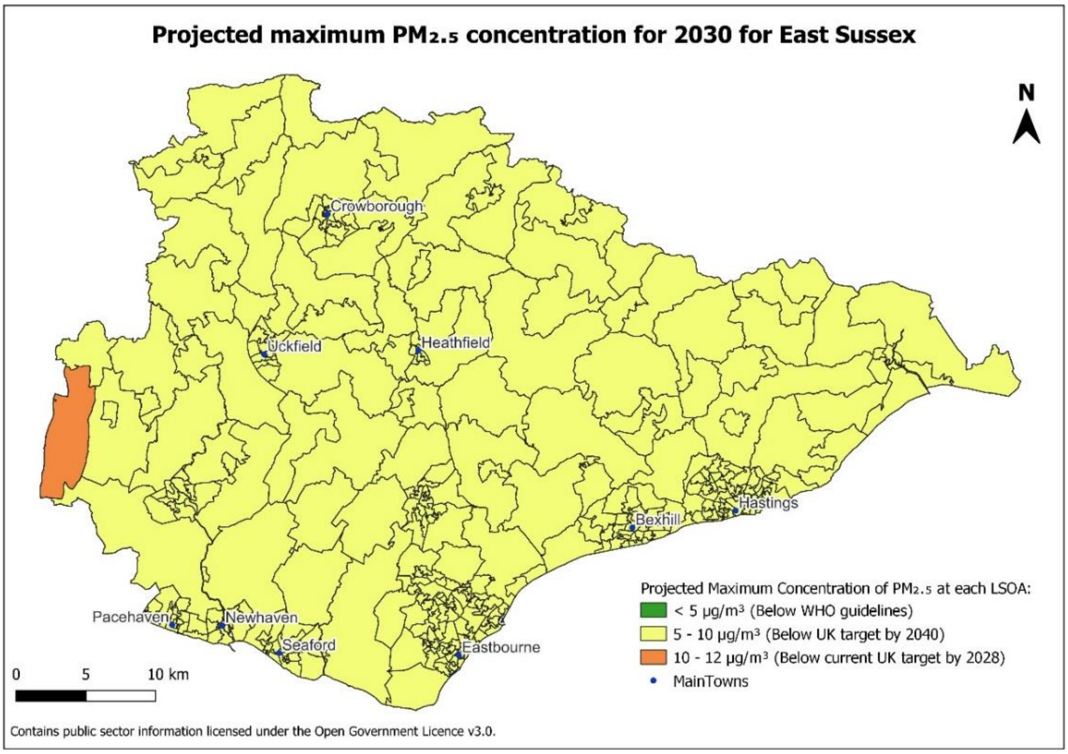
All the projected annual $PM_{2.5}$ mean levels in 2024 in East Sussex exceed the current annual mean WHO guideline level of 5 µg m^{-3}. This is also the case in modelled levels of annual mean $PM_{2.5}$ levels in 2028 and 2030, Figure 28 and Figure 29.

Figure 28 Projected maximum annual mean $PM_{2.5}$ concentration for 2028 for East Sussex



Source: Bureau Veritas

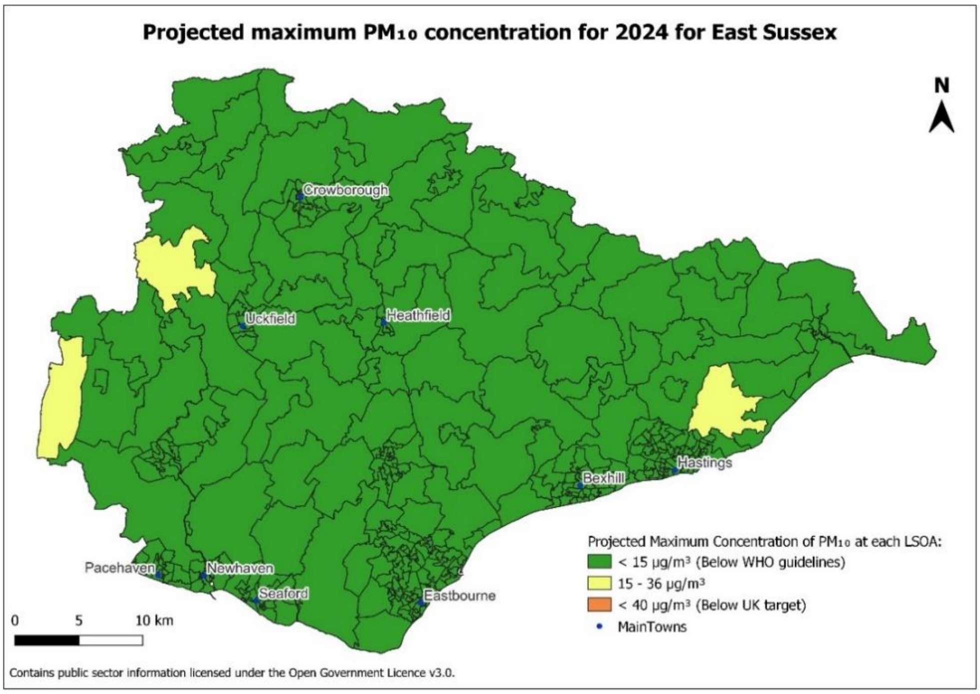
Figure 29 Projected maximum annual mean $PM_{2.5}$ concentration for 2030 for East Sussex



Source: Bureau Veritas

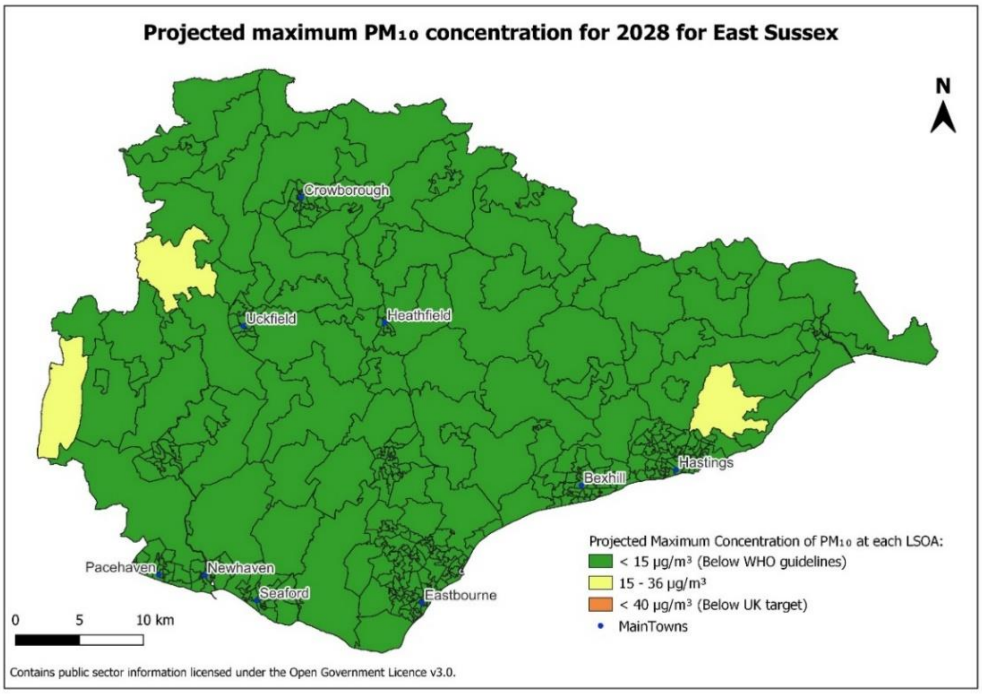
For larger particles [PM_{10}] the picture is slightly different. Most of East Sussex LSOAs meet the WHO guideline annual mean concentration levels in 2024 with the exception of three LSOAs, Figure 30.The elevated levels in these LSOAs relate to activities of tile and brickworks. The modelled picture is the same in 2028 [Figure 31] and 2030 [not shown here].

Figure 30 Projected maximum annual PM_{10} concentration for 2024 for East Sussex



Source: Bureau Veritas

Figure 31 Projected maximum annual PM_{10} concentration for 2028 for East Sussex

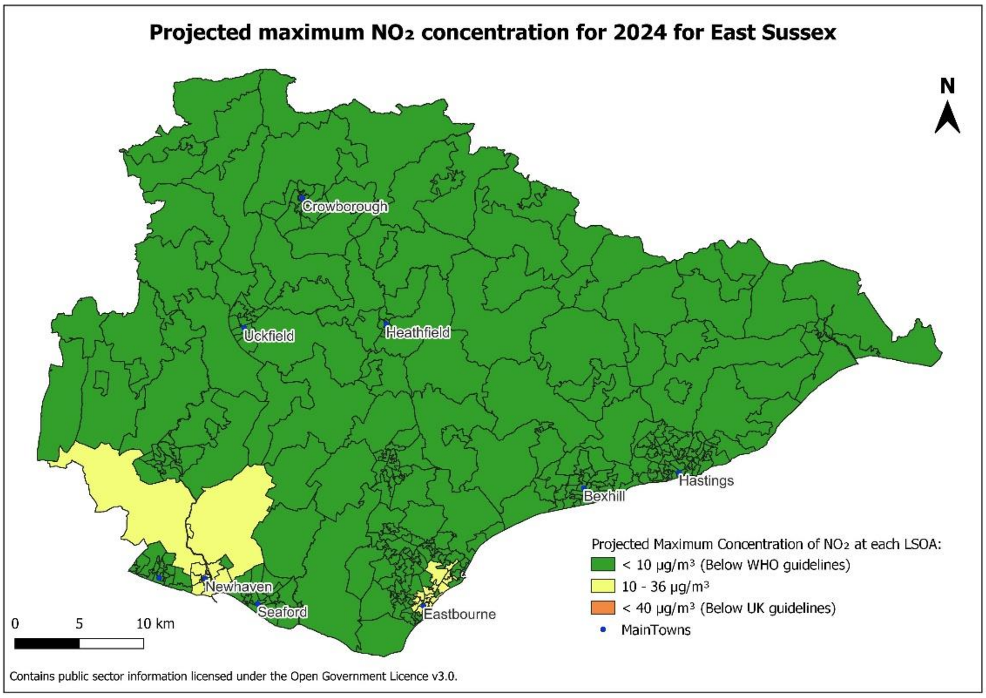


Source: Bureau Veritas

Nitrogen Dioxide:

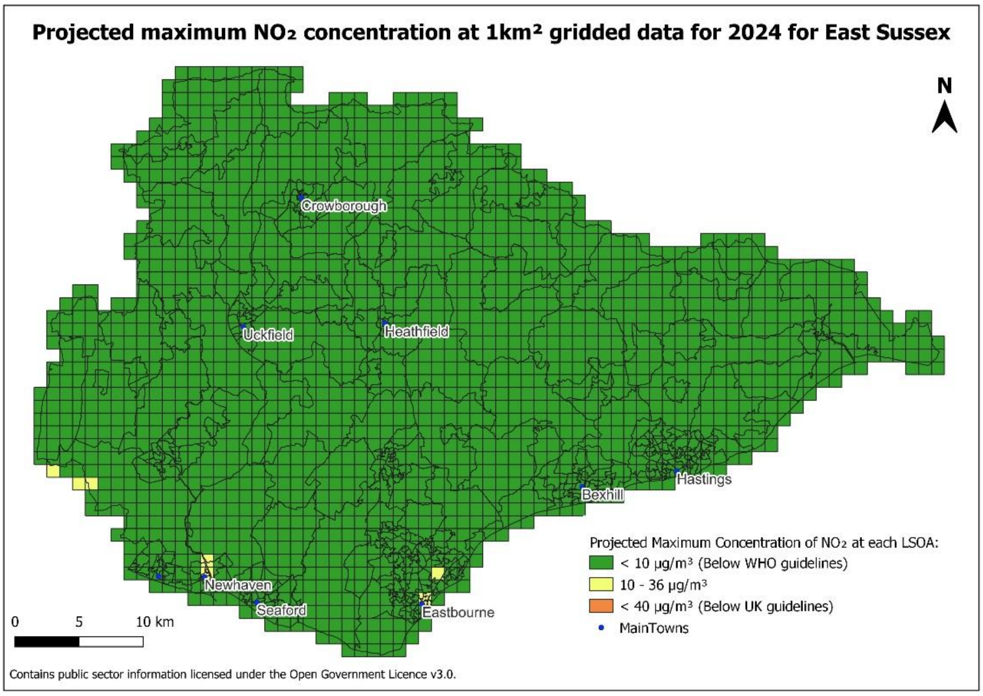
Elevated concentrations for NO_2 can be explained by traffic emissions within and around highly populated areas as Brighton, Newhaven, Eastbourne and St. Anthony's Hill, Figures Figure 32-Figure 35.

Figure 32 Projected maximum NO_2 concentration for 2024 for East Sussex



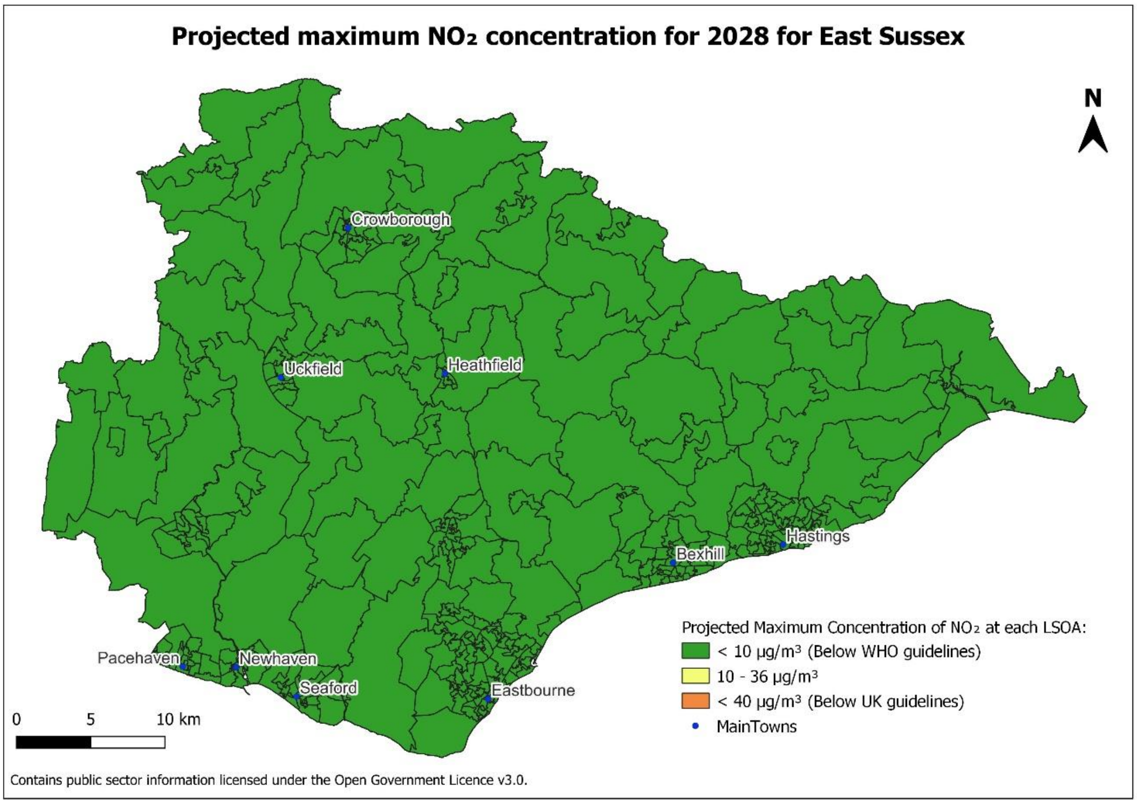
Source: Bureau Veritas

Figure 33 Projected maximum NO_2 concentration shown in 1*1km^2 grids for 2024 for East Sussex



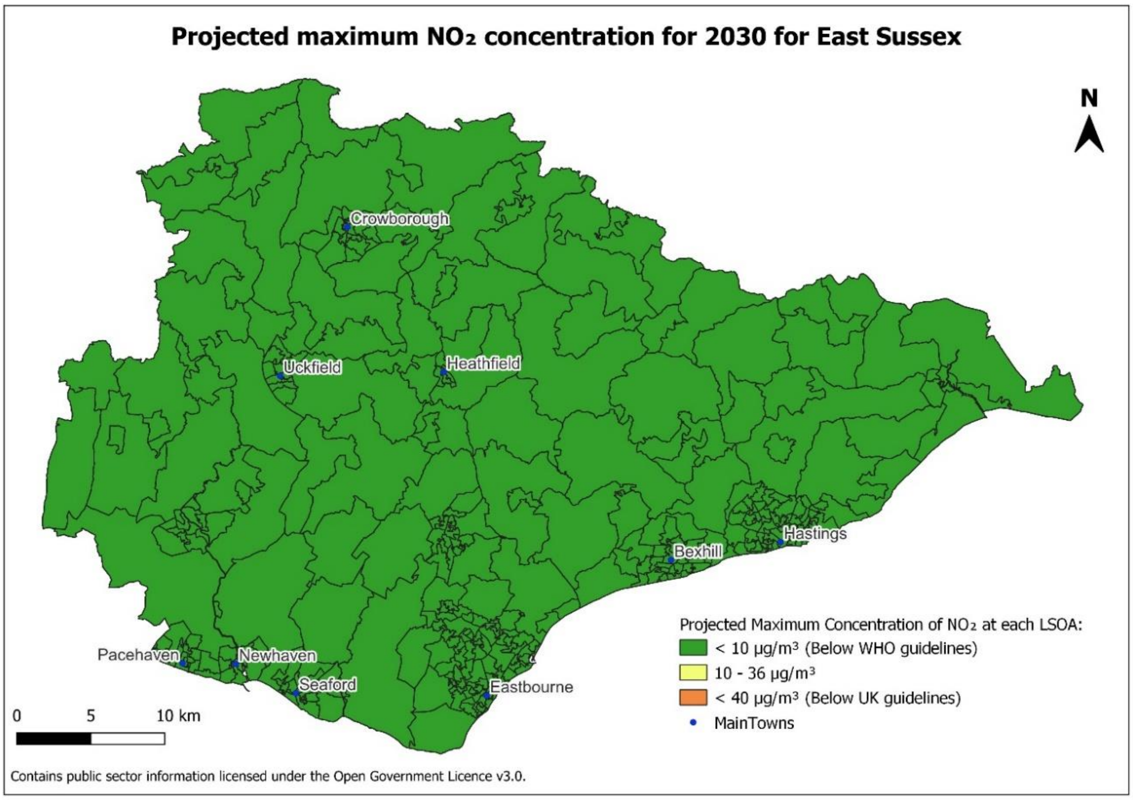
Source: Bureau Veritas

Figure 34 Projected maximum NO_2 concentration for 2028 for East Sussex



Source: Bureau Veritas

Figure 35 Projected maximum NO_2 concentration for 2030 for East Sussex



Source: Bureau Veritas

Appendix 5:

Examples of local populations at increased vulnerability to long-term PM2.5 and NO2 exposures

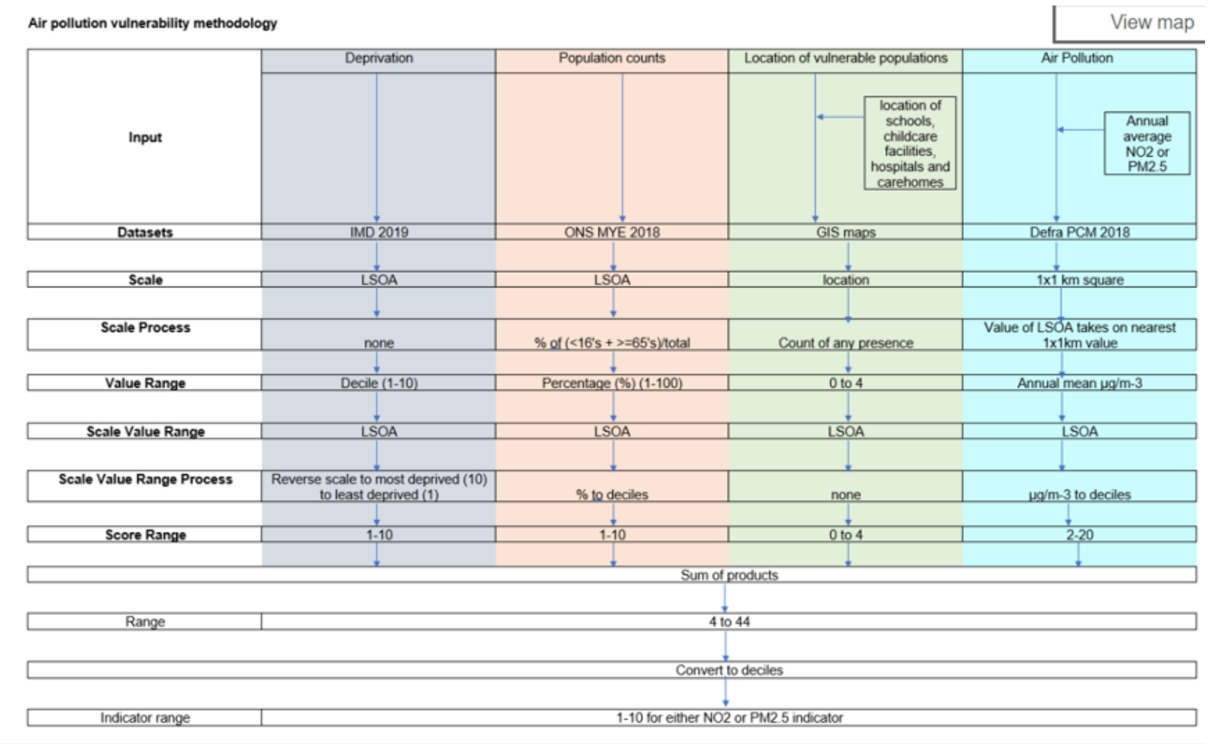
Key:
1 and 2: low vulnerability
9 and 10: high vulnerability

UKHSA has developed a pilot indicator [experimental statistics] to represent population level vulnerability to air pollution at Lower Super Output Area [LSOA] level. This is a ranking of the level of vulnerability from low (1-2) to high (9-10) decile scores.

This score is based on: the population characteristics (% of the total LSOA population made up of young people (<16 years) and of older adults (65+ years), Levels of Deprivation (Index of Multiple Deprivation 2019 score); are there vulnerable populations there (hospitals, schools, care homes and child care facilities) and the annual average concentration of air pollution (NO_2 or $PM_{2.5}$) as modelled by DEFRA for 2018.

How the Air Pollution Index has been constructed is shown in Figure 36.

Figure 36 Air Pollution Index Methodology



A spreadsheet of Air Quality Tool vulnerabilty scores at LSOA level for $PM_{2.5}$ and NO_2 can be made available on request.

More detailed maps showing the vulnerability index in East Sussex are shown in Figures 37 to 54. Source: SHAPE

Eastbourne

Figure 37 Eastbourne $PM_{2.5}$

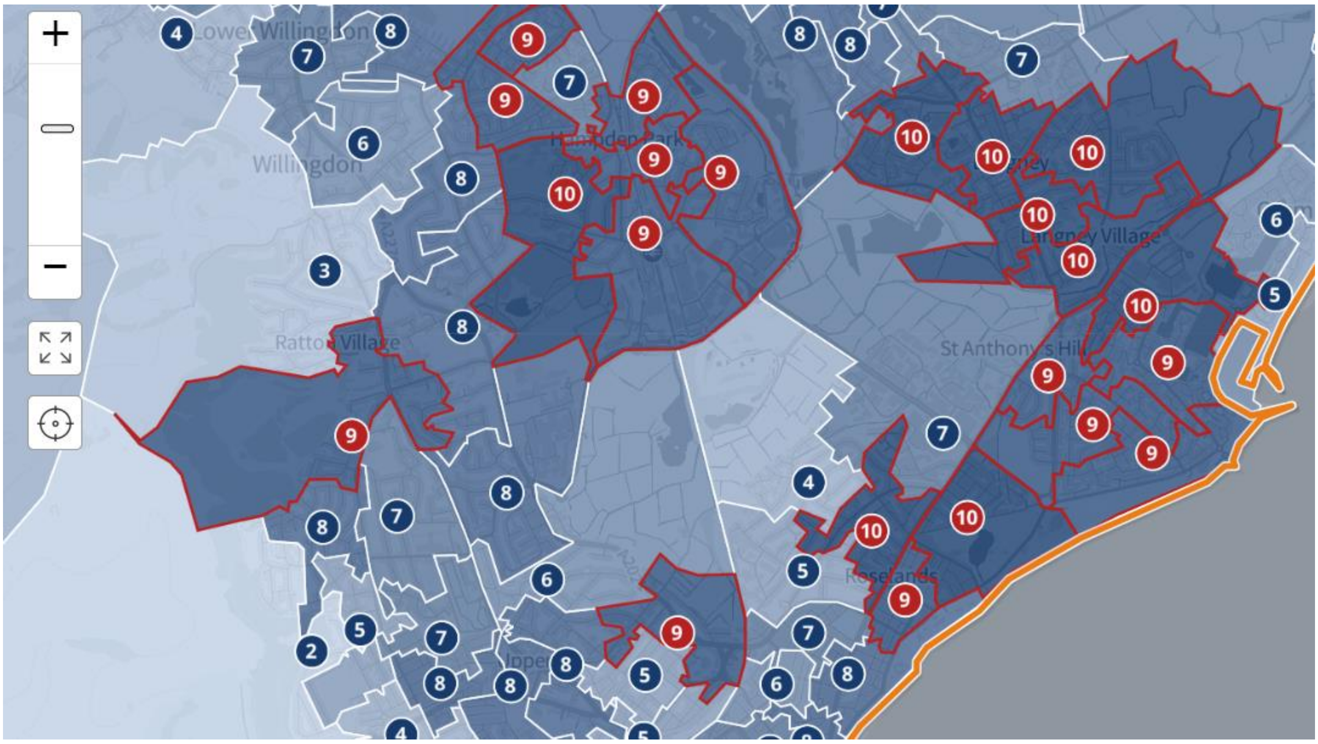
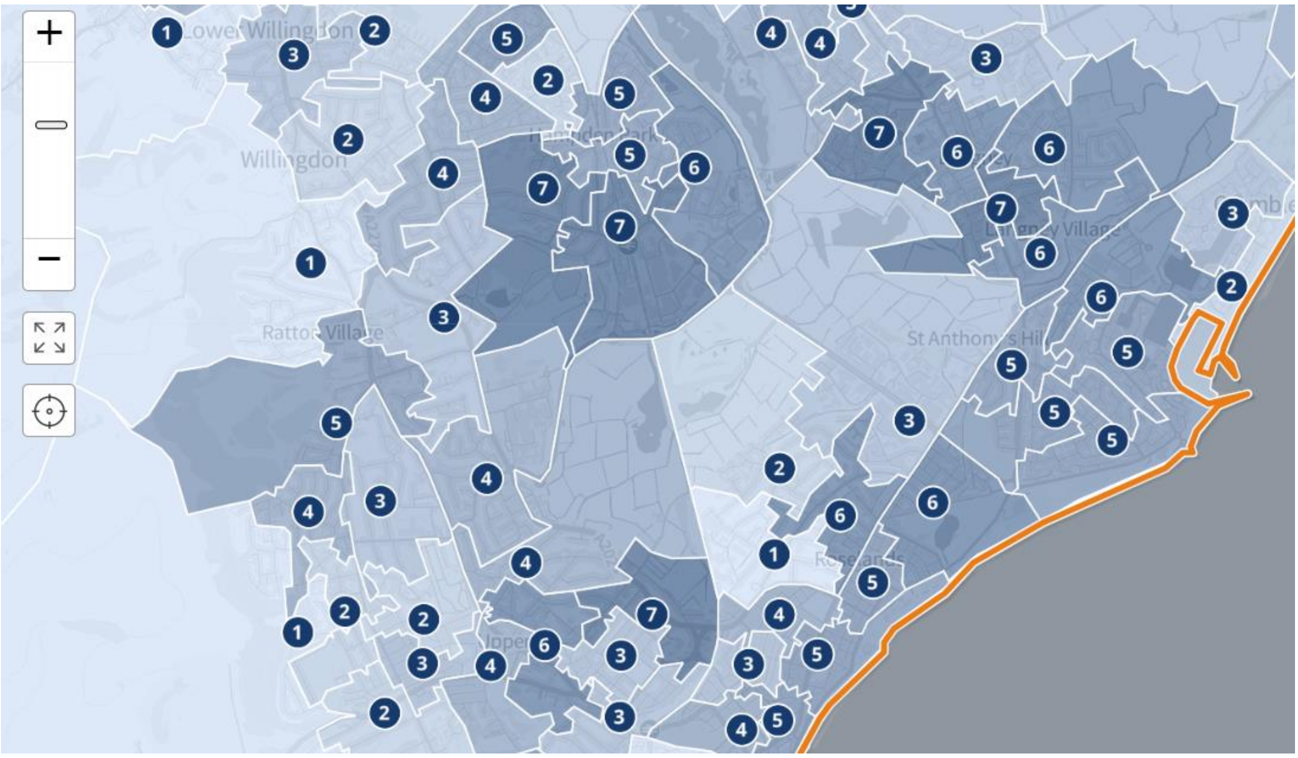


Figure 38 Eastbourne NO_2


Lower Willingdon
Willingdon
Ratton Village
Langney Village
St Anthony's Hill
Roselands
1
2
3
4
5
6
7

Bexhill

Figure 39 Bexhill $PM_{2.5}$

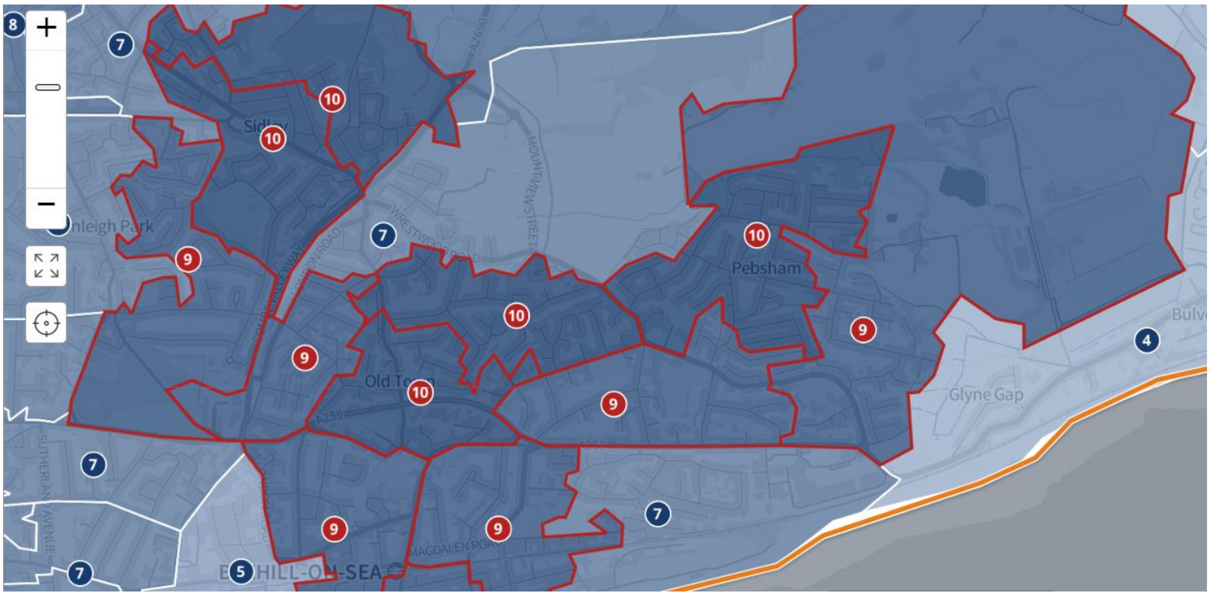


Figure 40 Bexhill NO_2

Hastings

Figure 41 Hastings $PM_{2.5}$

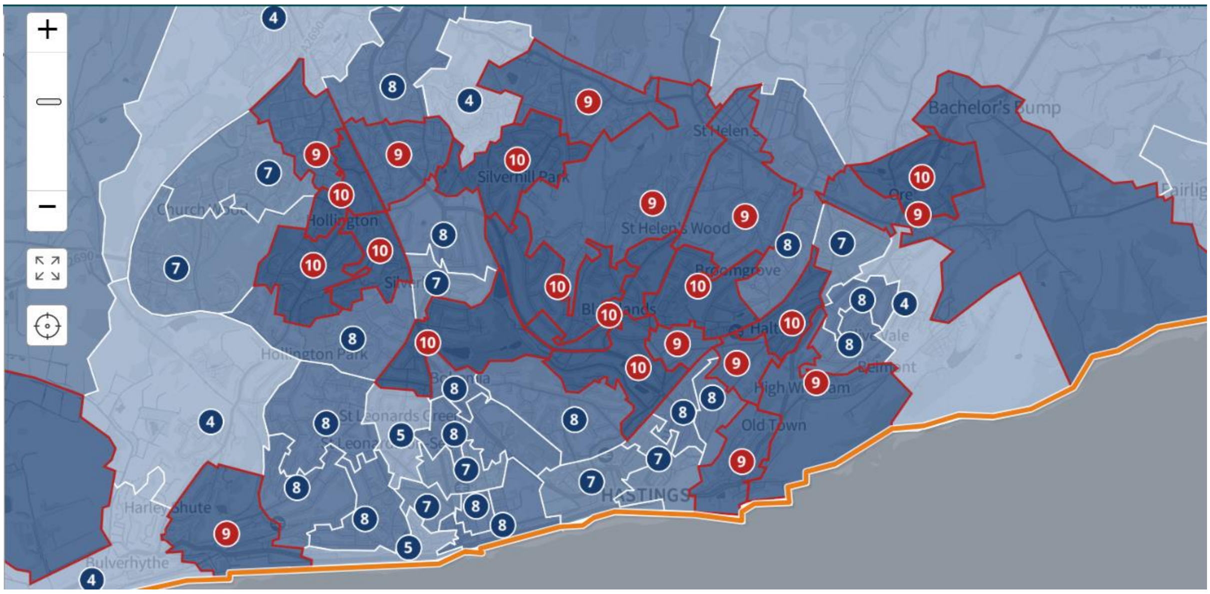
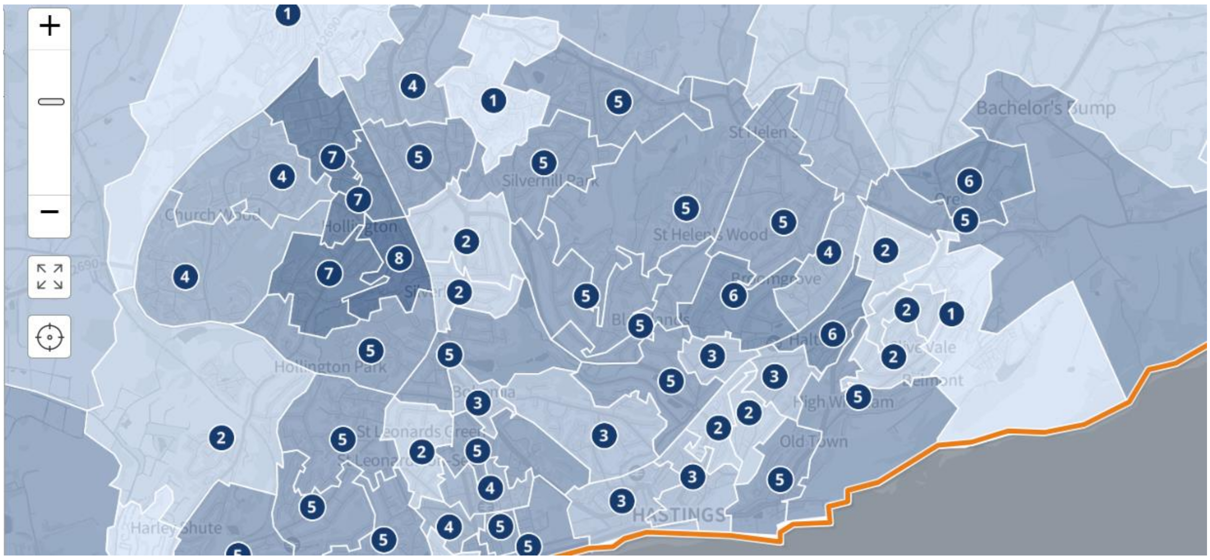


Figure 42 Hastings NO_2



Lewes

Figure 43 Lewes Air Quality Management Area [AQMA]

Figure 44 Lewes NO_2

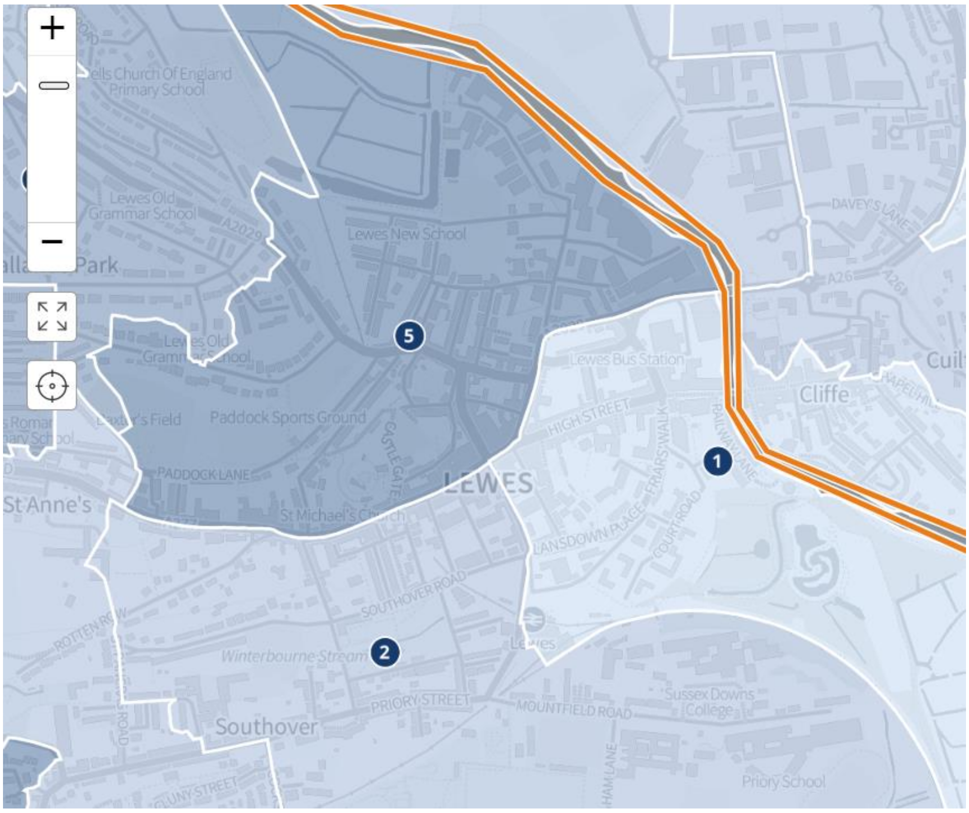
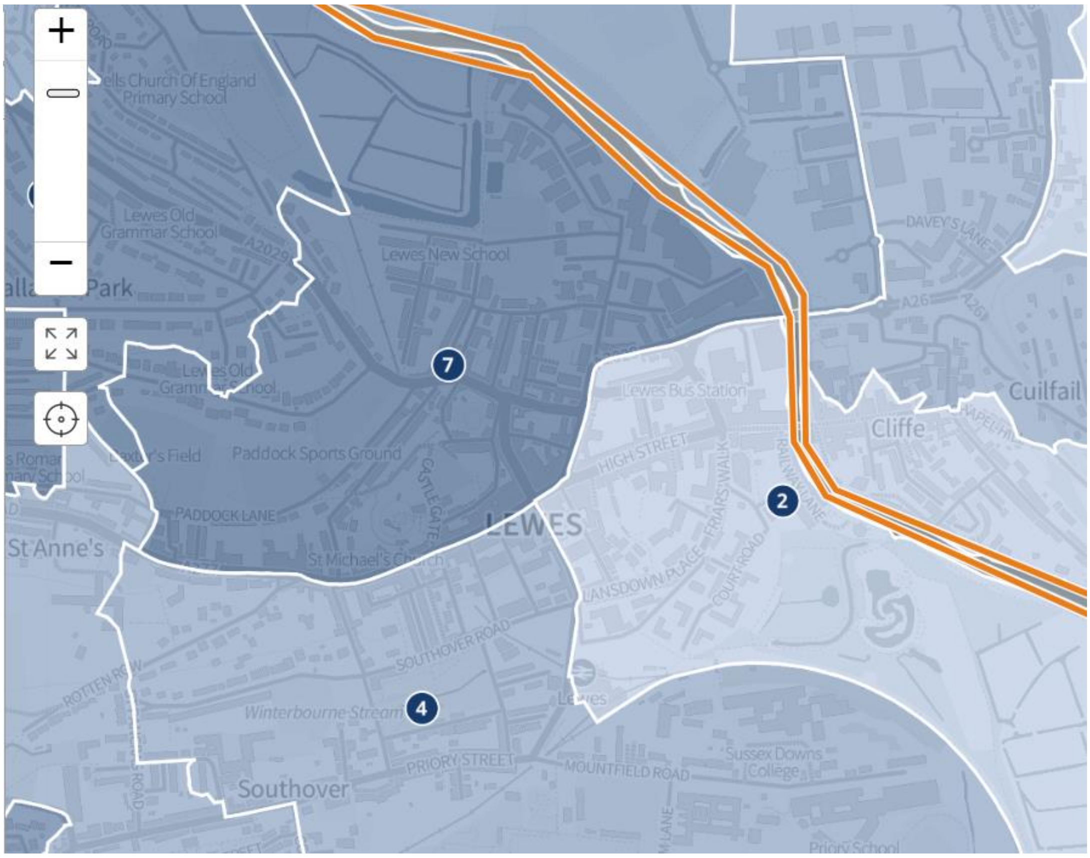


Figure 45 Lewes $PM_{2.5}$



Newhaven

Figure 46 Newhaven Air Quality Management Area [AQMA]

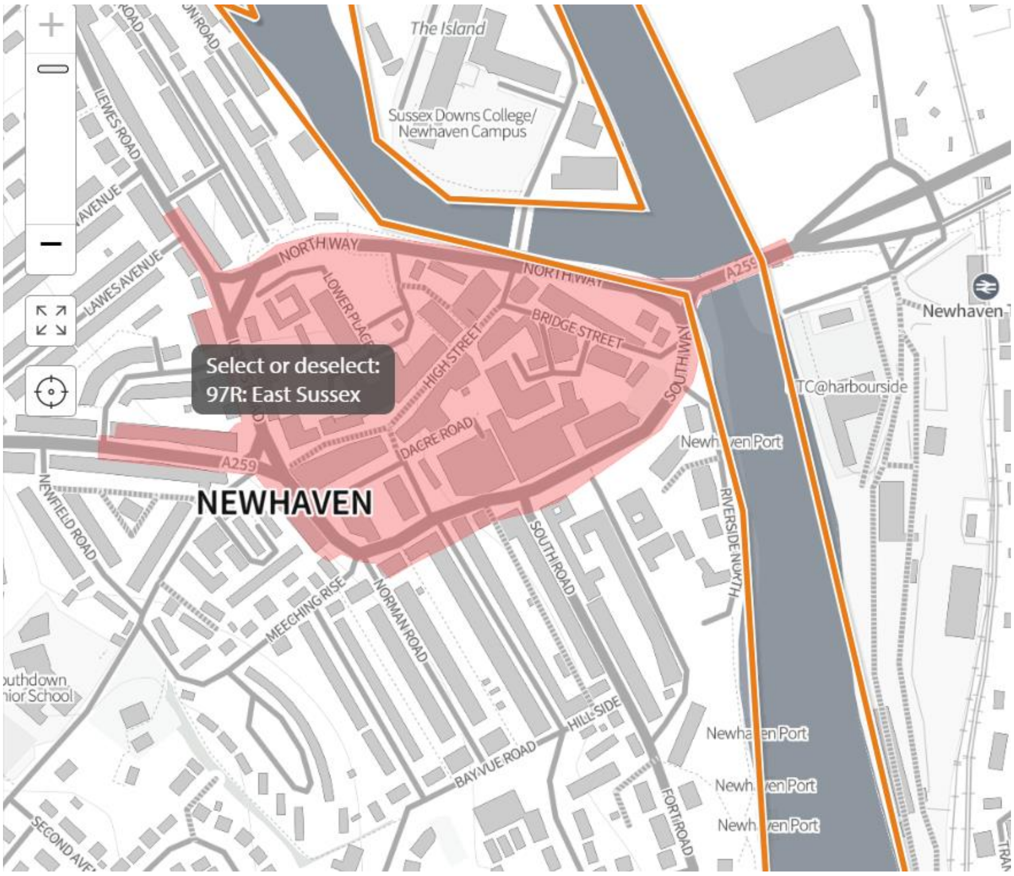


Figure 47 Newhaven NO_2

Figure 48 Newhaven $PM_{2.5}$

Peacehaven

Figure 49 Peacehaven $PM_{2.5}$

Figure 50 Peacehaven NO_2

Hailsham

Figure 51 Hailsham $PM_{2.5}$

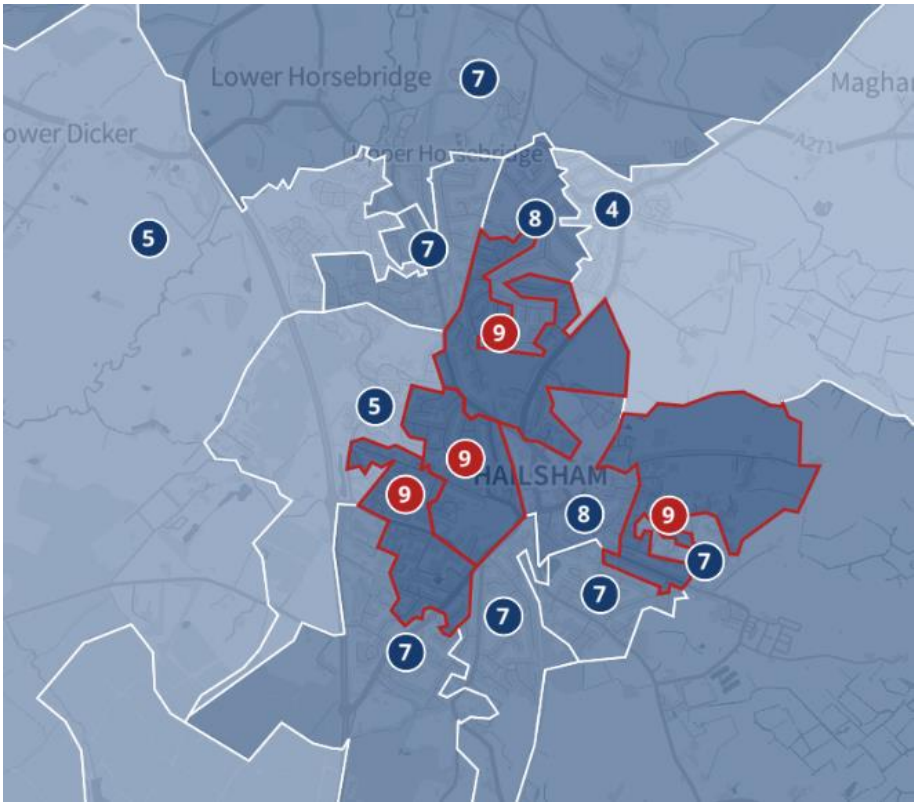
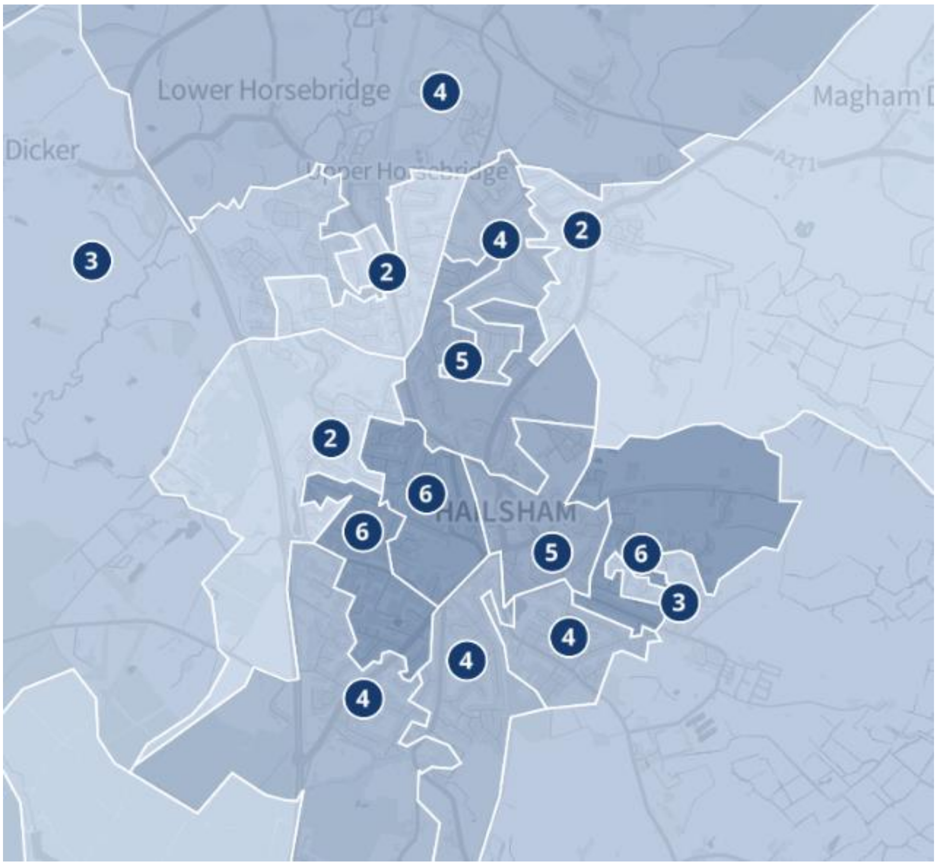


Figure 52 Hailsham NO_2



Uckfield

Figure 53 Uckfield $PM_{2.5}$

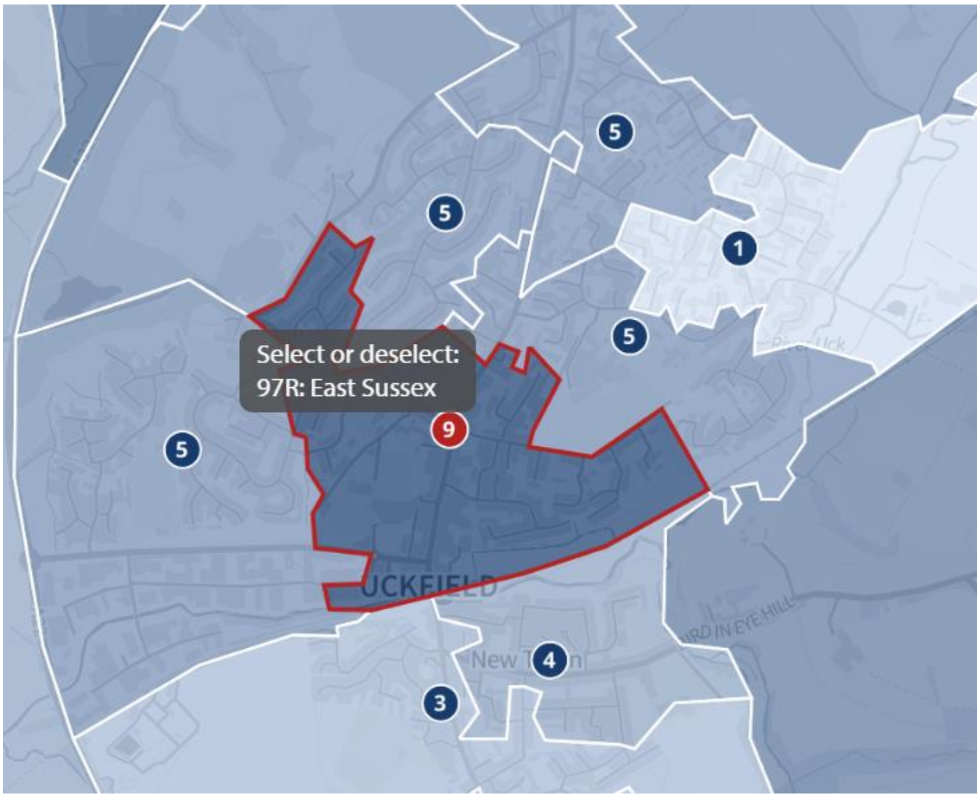


Figure 54 Uckfield NO_2

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