Hertfordshire Local Authorities Report
on
Particulate Matter ($PM_{2.5}$) in Ambient Air in 2022
for
Hertfordshire County Council Public Health

February 2024

DOCUMENT INFORMATION

Contributing Local Authorities (Hertfordshire):

North Hertfordshire District Council (NHDC)

Hertsmere Borough Council (HBC)

East Hertfordshire District Council (EHDC)

Watford Borough Council (WBC)

Stevenage Borough Council (SBC)

Welwyn and Hatfield District Council (WHDC)

Dacorum Borough Council (DBC)

Hertfordshire County Council – Public Health (HCC-PH)

Additional data obtained from

Central Bedfordshire Council

Luton Borough Council

London Luton Airport

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Executive Summary

Hertfordshire has an estimated 1,198,800 residents (Census 2021) and as well as large rural areas has over a dozen medium sized towns all close to London. It also has a heavy reliance on personal motor vehicles and at many locations across the County is faced with risk of road congestion.

Hertfordshire County Council (HCC) does not have responsibility for monitoring or managing local air quality; that duty rests with the ten District and Borough Authorities within Hertfordshire. However, it does have responsibility through the Local Transport Plan to work with local authorities in producing Air Quality Management Area Action Plans. Furthermore, HCC through its Public Health remit is responsible for working with local authorities to reduce public exposure to elevated concentrations of air pollutants, particularly $PM_{2.5}$. HCC published its Air Quality Strategy and Implementation Plan in April 2019 [9].

HCC has integrated air quality into its sustainability workstream noting the overlap with many sources of carbon and green house gasses also emitting air pollutants of concern. Cleaner air for all has become one of three cross council sustainability threads. A cleaner air action plan has been produced and is published on HCC webpages alongside the Sustainable Hertfordshire Strategy.

Joint working on air quality issues between HCC and the local authorities had been a priority from before the above publication and one of the partnership projects identified in 2014/2015 was a $PM_{2.5}$ monitoring project. This project had the aim of enabling the collection of real-time direct measurements of $PM_{2.5}$ concentrations from multiple locations within Hertfordshire to address the historical paucity of $PM_{2.5}$ data available within the County.

In 2015 Public Health funding was provided for the purchase of ten real-time automatic $PM_{2.5}$ analysers across eight of the ten local authorities. Nine of the ten analysers collected data during 2016, in 2017 eight were operational and from 2018 to 2022 six analysers were still operational. In addition to the Public Health funded analysers, two analysers owned and operated by Hertsmere Borough Council have been operational since 2016.

Prior to the funding the only real-time automatic $PM_{2.5}$ analysers operating in Hertfordshire, were the two owned by Hertsmere Borough Council. The Borehamwood Meadow Park site in Hertsmere is the only site in Hertfordshire on the AURN.

As a result of there being seven years of data available and because of some of the $PM_{2.5}$ analysers not being fully commissioned until part way through 2016 the value of the data collected to date has its limitations. However, it provides a useful baseline against which subsequently collected data can be considered, particularly in those locations where data capture has been consistently good. It also captures the periods (March 2020-July 2020, November 2020-March 2021) of the Covid Lockdowns in the UK.

Broad observations that can be made from the seven years of data are as follows:

- Breaches of the moderate daily air pollution index most commonly occur in the early spring months. A contributing factor to this is that this period is when farmers apply slurry and manure to their fields. This results in a release of ammonia to the atmosphere and subsequent creation of particulate matter.
- Outside of the early spring, breaches of the moderate daily air pollution index typically occur in the winter months when weather conditions are more likely to be still and cold and use of wood burning stoves and heaters would be expected to be higher.
- Peak concentrations often coincide with local contributions from celebrations associated with the use of fireworks, but unlike in 2020, these local contributions will not necessarily be sufficient to breach the moderate air pollution index level.
- Elevated concentrations can also be linked to air pollution that has built up from the continent or further afield and been transported to Britain. For example, agricultural or industrial processes or natural phenomena such as dust storms.
- Elevated concentrations can also be associated with ‘normal’ background concentrations of $PM_{2.5}$ that are exacerbated by locally derived road vehicle pollution, or one off events.
- At this stage the impact of the Covid-19 lockdowns in 2020 and 2021, if any are hard to discern from the available data.

- Defra modelled $PM_{2.5}$ concentrations for each local authority area are broadly consistent with the concentrations being measured by the analysers within each local authority.
- With one exception, where data capture rates have been reliable, the mean annual average concentrations of PM2.5 have been reducing gradually.

It is anticipated that there will be a decline in the availability of $PM_{2.5}$ data from DEFRA approved MCERTS certified real-time monitors with some local authorities choosing to stop funding the maintenance and servicing of their real-time $PM_{2.5}$ monitors. This reflects the ongoing financial pressures faced by local authorities. The absence of any statutory requirement to monitor for particulate matter is considered an anomaly given that there is an air quality standard for $PM_{2.5}$ set at $10\mu g/m^3$ as an annual mean average by 2040 as well as the Public Health Outcome Framework indicator D01 specifically relates to attributable deaths from PM2.5 exposure.

It is hoped that with the development of cheaper air quality sensors, albeit providing only indicative measurements, the loss of data from the closure of some real-time analysers can be offset by data collected by newly deployed air quality sensors.

The provision of a larger dataset, which will be of progressively more value to Hertfordshire County Council in relation to their public health duties will be dependant on the above, or a change in the emphasis and prioritisation given to the local authorities in relation to their local air quality management duties.

The recent $PM_{2.5}$ legislation, following enactment of The Environment Act 2021, does not appear to have had the anticipated impact of incentivising local authorities to collect and act upon local monitoring data for $PM_{2.5}$.

1. Introduction – Local Government Air Quality Responsibilities

Hertfordshire has an estimated 1,198,800 residents (Census 2021) and as well as large rural areas has over a dozen medium sized towns. The location of Hertfordshire close to London creates large commuting flows and, with the exception of the M25, the County has a north-south orientated transport system. Combined with the settlement pattern of widespread towns this means that there is heavy reliance on personal motor vehicles and an associated risk of congestion at many locations across the County.

Figure 1.1: Hertfordshire County

1.1. Roles and Responsibilities

Section 82 of the Environment Act 1995 [13] provides that every local authority shall review the air quality within its area, both at the present time and the likely future air quality. In two-tier local government areas such as Hertfordshire, this duty sits with the District and Borough Councils.

Section 83 requires these local authorities to designate an Air Quality Management Area (AQMA) where air quality objectives are not being achieved (or are not likely to be achieved) as set out in the Air Quality Standard (England) Regulations 2015 [7]. Once designated, Section 84 requires the local authority to develop an Action Plan detailing remedial measures to tackle the problem within the AQMA.

There are also obligations placed on the County Council – detailed in the 2022 Defra Local Air Quality Management Technical Guidance[4]. In summary, the district/borough councils are accountable for monitoring air quality, designating AQMAs, preparing the annual reports and Action Plans. However, the upper tier authorities (county councils) are designated as 'Relevant Public Authorities' and must commit to actions they will take to assist in securing required air quality improvements and to commit to dates by when measures will be implemented.

Hertfordshire County Council (HCC) is an upper tier local authority with statutory responsibilities for both Public Health, Highways and Transport Planning. As the Highway Authority, the County Council has responsibility for A, B, C and most unclassified roads. National Highways is responsible for the Motorway network.

There are ten second tier local authorities within Hertfordshire and it is these local authorities that have responsibility for monitoring local air pollution. The ten local authorities are:

North Hertfordshire District Council	East Hertfordshire District Council	Three Rivers District Council	Dacorum Borough Council	Broxbourne Borough Council
Hertsmere Borough Council	Watford Borough Council	Stevenage Borough Council	Welwyn & Hatfield District Council	St Albans City & District Council

The environmental officers with LAQM responsibility within the ten Hertfordshire local authorities work collaboratively where possible and appropriate via the Hertfordshire, Bedfordshire and Neighbouring Authorities' Air Quality Forum. This forum also comprises officers from Milton Keynes, Buckinghamshire and the three unitary local authorities in Bedfordshire. In addition, the Forum is attended by officers from HCC who bring different areas of expertise to the issue of local air quality, for example public health, transport, air quality and planning. Additionally, a Hertfordshire focussed forum exists that has been set up to enable closer collaboration of the 11 local authority bodies that act within the geographical area.

1.2 National Legislation, Policy, Guidance and Relevant Publications

The Environment Act 2021[14], published during the data collection period on which this report is based, has various implications for local air quality management (LAQM) and complements and builds on the relevant sections of ***Part VI of the Environment Act 1995*** referred to in Section 1.1.

It established a new 'watchdog', the Office for Environmental Protection (OEP), which is intended to hold public authorities to account if they fail to comply with environmental law.

In terms of other changes specific to local air quality, the Act has:

- amended the Environment Act 1995 to "strengthen" the LAQM Framework to enable increased cooperation at the local level and broaden the responsibility for tackling local air pollution from just local authorities.
- amended the Clean Air Act 1993 [8] with the intention of giving local authorities more power to reduce pollution from domestic burning which is estimated to have contributed 38% of $PM_{2.5}$ emissions in 2019. It does so primarily by replacing the criminal offence with a civil penalty regime and strengthens the offences in relation to the sale of certain fuels for use in smoke control areas.
- introduced a new power to "compel vehicle manufacturers to recall vehicles and non-road machinery if they are found not to comply with the environmental standards that they are legally required to meet".

The Government had failed to implement any changes to pre-existing air quality objectives but has placed a duty on the government to bring forward at least two new air quality targets by October 2022. Although, by the end of December 2022 an objective was set which is to achieve $10\mu g/m^3$ of $PM_{2.5}$ as an annual mean average by 2040. (See Section 1.3. and Table 1.1.1 to be introduced by secondary legislation).

Supporting the above-mentioned legislation are two ***LAQM Guidance Documents***, a ***Technical Guidance Document*** [4] and a ***Policy Guidance Document*** [1] that detail how local authorities and other relevant public bodies should implement that legislation.

The Government's 2019 Clean Air Strategy [6] sets out how the government will work to implement its 25-year environment plan, alongside its clean growth proposals. The cross-government plan is published by the Departments for Business, Energy and Industrial Strategy, Environment, Food and Rural Affairs, Transport, the Health and Social Care, the Treasury, and the Ministry of Housing, Communities and Local Government. This reflects its focus on the importance of facilitating the sharing of best practice and knowledge between local authorities.

February 2019 saw the publication of the ***National Institute for Clinical Excellence (NICE) Quality Standard for outdoor air pollution and health*** [12], describing high-quality actions in priority areas for improvement. The standard is endorsed by The

Department of Health and Social Care as required by the Health and Social Care Act (2012) builds on the 2017 publication of NICE air pollution guidance NG70.

Public Health England also published a ***review of interventions*** [18] to improve outdoor air quality and public health in March 2019, and was unequivocal in stating that the evidence for effective air quality interventions is developing all the time and can face challenges and limitations. The PHE review sets out a number of clear principles, including:

- Local authorities need to work together
- Everyone has a role to play
- Effective strategies require a coherent approach
- It is better to reduce air pollution at source than to mitigate the consequences
- Improving air quality can go hand in hand with economic growth

Another recent relevant publication of considerable relevance is the ***Coroner's Inquest*** [15] ***(April 2021) into the death of 9-year-old Ella Kissi-Debrah***. This inquiry found that air pollution, including nitrogen dioxide and particulate matter, principally from traffic emission, was a significant contributory factor to both the induction and exacerbations of her asthma which caused respiratory and cardiac arrest and ultimately her death. It is considered important to reference the Prevention of Future Deaths report that followed which stated a lack of awareness within the general population of the health impacts of exposure to air pollution and a lack of consideration to those presenting to health practitioners of potential air pollution impacts.

It is also worth noting that in the ***Record of Inquest*** [15] the Coroner considered that the best available medical evidence was the World Health Organisation Guideline value and not the UK's Air Quality Objective.

Most recently **The Defra Air Quality Strategy – A Framework for local authority delivery – 2023** [23] states that while PM2.5 is not currently part of the Local Air Quality Management framework, the government still expects all local authorities to effectively use their powers to reduce PM2.5 emissions from the sources which are within their control.

1.3 Air Quality Objectives

As previously specified each of the ten local authorities has an obligation to regularly review and assess air quality in their areas, and to determine whether or not the air quality objectives are likely to be achieved. Where, based on evidence, an exceedance is identified the local authority must declare an Air Quality Management Area (AQMA) and prepare an Air Quality Action Plan (AQAP) setting out the measures it intends to put in place in pursuit of the objectives. Those obligations arise as a result of the Local Air Quality Management (LAQM) regime as defined in Part IV of the Environment Act (1995) and updated by the Environment Act 2021. Integral to this regime are the LAQM Policy and Technical Guidance documents.

The statutory air quality objectives applicable to LAQM in England are set into law via the Air Quality Standards (England) Regulations 2015 [7] and they are shown in Table 1. This table shows the objectives in units of micro-grammes per cubic metre $\mu g/m^3$. Table 1.1 also includes the number of permitted exceedances in any year (where applicable).

Table 1.1 – Air Quality Objectives included in Regulations for the purpose of Local Air Quality Management in England.

Pollutant	**Air Quality Objective**	
	Concentration	**Measured as**
Nitrogen Dioxide (NO_2)	200µg/m³ not to be exceeded more than 18 times a year	1-hour mean
	40µg/m³	Annual mean
Particulate Matter (PM_{10})	50µg/m³ not to be exceeded more than 35 times a year	24-hour mean
	40µg/m³	Annual mean
Sulphur Dioxide (SO_2)	350µg/m³ not to be exceeded more than 24 times a year	1-hour mean
	125µg/m³ not to be exceeded more than 3 times a year	24-hour mean
	266µg/m³ not to be exceeded more than 35 times a year	15-minute mean

There is no $PM_{2.5}$ Objective set in those regulations but the Air Quality Standards Regulations 2010 [11] states that the average exposure indicator for $PM_{2.5}$ (annual mead) should not exceed **20µg/m³**.

The absence of an Air Quality Objective for $PM_{2.5}$ is addressed in Chapter 8 of the LAQM Policy Guidance 2022 [1]. This states that ‘The Environment Act 2021 establishes a legally binding duty to set a target on $PM_{2.5}$; something that was achieved in December 2022, with the limit of 10ug/m³ of $PM_{2.5}$ as an annual average by 2040.

This $PM_{2.5}$ target and a population exposure reduction target has now become a statutory obligation for local authorities pursuant to the Environment Act 2021:

- Annual Mean Concentration Target ('concentration target') - a maximum $PM_{2.5}$ concentration of **10µg/m³** to be met across England **by 2040**
- Population Exposure Reduction Target ('exposure target') - a **35% reduction in population exposure to $PM_{2.5}$ by 2040** (compared to a base year of 2018).

Central Government's 10µg/m³ target concentration is based on the World Health Organisation's (WHO) air quality guideline value of 10µg/m³, however, in 2021 WHO published an even lower guideline value of **5µg/m³**. The WHO guideline is acknowledged to be ambitious and is not legally binding, but it reflects the large impact that particulate pollution has on health and it is hoped that it will influence the ambition of current and future air policy.

In addition to the new $PM_{2.5}$ standards set in legislation the only other UK indicator for $PM_{2.5}$ is included within the Public Health Outcomes Framework (Public Health Outcome Indicator (PHOI) 3.01) which is stated as:
'The fraction of annual all-cause mortality attributable to long-term exposure to current levels of anthropogenic particulate pollution.'

This indicator is based on an estimated amount of $PM_{2.5}$ derived by Defra modelling from local measurement around the UK, including one site in Borehamwood, Hertfordshire and another in Sandy, Bedfordshire. That data has been adjusted by way of population to give a population weighted figure before its use in deriving the PHOI.

However, it is important to recognise that the figures published for PHOI 3.01 are estimates and therefore cannot be used for performance monitoring; they can only provide an indication of the scale of the issue. It is for this reason that this report no longer makes direct reference to the PHOI figures, but uses the population weighted Defra modelled $PM_{2.5}$ concentrations in their place.

The $PM_{2.5}$ focused PHOI reflects the adverse impact that this type of air pollution can have on public health due to the fine particles being carried deep into the lungs where they can cause a wide range of illnesses as discussed in more detail in Section 1.4.

1.4 Impact on Public Health of Particulate Matter ($PM_{2.5}$)

Poor air quality is considered the largest environmental risk to the public's health and contributes to all non-communicable disease although the most commonly referenced are:

- Cardiovascular disease
- Lung cancer
- Respiratory diseases
- Dementia
- Increased chance of hospital admissions and visits to Emergency Departments.

Evidence also states that air pollution is a significant contributor to preventable ill health and early death.

Whilst legal limits are in place evidence suggests that health effects occur significantly below these limits, as recognised by the 2021 WHO guideline value of 5µg/m^3.

The reason why $PM_{2.5}$ is such a significant air pollutant is that it can penetrate deep into the lungs and can irritate and corrode the alveolar wall impairing lung function. $PM_{2.5}$ can also enter the bloodstream and cause both short term and long term health impacts with the causation thought to be oxidative stress [16].

Short term exposure to elevated concentrations is known to worsen the impact of pre-existing respiratory and cardiovascular health conditions, with the elderly and children the most vulnerable. Long term exposure is linked to a range of health impacts including respiratory and cardiovascular diseases, but also cancer and dementia [17].

Further information on the use of health related air quality data is available at https://hertshealthevidence.org/documents/thematic/airqualitydatafaq-briefing-2019-07.pdf.

1.5 Sources of Airborne Particulate Matter ($PM_{2.5}$)

Particulate matter can be classified, by how they are formed, as either primary or secondary particles. Primary particles are released directly into the air and originate from sources including road transport, stationary combustion e.g. domestic burning of logs and coal and bonfires and from industrial processes e.g. metal and cement production, construction, mining and quarrying.

Secondary particulates are formed in the air by chemical reactions and so their origins are harder to pinpoint. They are formed mainly from ammonium, sulphate and nitrate precursors and a major source of these compounds is from agriculture activities. As a result of their slow formation and their persistence in the atmosphere they can form and travel over long distances. A research article [24] published in the City and Environmental Interactions Journal in 2023 concluded that an estimated 38% of the annual mean $PM_{2.5}$ concentration in Leicester originated from agricultural emissions of ammonia and that the same source contributed 32% of the annual mean in Birmingham and 28% in London.

The Air Quality Expert Group (2015) estimated that UK emissions contribute to approximately 50-55% of the total annual average $PM_{2.5}$ in the UK [3].

A large proportion of airborne $PM_{2.5}$ originate from natural sources, including sea-salt, inorganic aerosols and organic aerosols; 15% according to the Emissions of air pollutants in the UK – Particulate matter (PM10 and PM2.5) [19].

However, non-traffic generated rural and urban particulates arising directly from human activity, including agricultural activity and biomass burning both domestic and commercial also represent a significant source of $PM_{2.5}$. Domestic burning has become the second biggest source of $PM_{2.5}$ in the UK creating 25% of all $PM_{2.5s}$ [19]. This represents a growing challenge for local authorities in the face of the 2022/23 energy crisis and the emerging fashion for the installation of log burners into the homes of people that can comfortably afford mains supplied heating.

A lower, but still important, proportion of particulate matter is emitted from exhausts as a result of the combustion process within engines and from tyre and brake wear and other vehicle component wear such as the chassis and clutch (Air Quality Expert Group 2005) [2]. 23% of the UK's $PM_{2.5}$ emissions were calculated to have originated from road transport in 2020, with a split of 13% from exhausts and 10% from brake, tyre and road wear [19].

2. Hertfordshire Particulate Matter ($PM_{2.5}$) Monitoring Project

A 2014 public health conference on local air quality, that was held to bring together professionals from environmental health and public health as well as local councillors, identified that among other gaps in knowledge there was minimal locally available monitoring data for $PM_{2.5}$ concentrations in Hertfordshire.

The $PM_{2.5}$ monitoring project was a direct outcome of that conference and was funded and overseen by Hertfordshire County Council Public Health, with the ten Hertfordshire local authorities being eligible for funding and responsible for providing the technical expertise in sourcing, locating and establishing the appropriate $PM_{2.5}$ monitoring equipment.

A total of £20,000 per district/borough was made available in 2015 as ring fenced money which had to be spent on monitoring equipment for $PM_{2.5}$ as a capital cost only. No equivalent ring-fenced funding was available in future years for ongoing servicing and maintenance.

The funding was available for purchasing mobile or fixed site $PM_{2.5}$ analysers, or for the costs of upgrading existing PM_{10} monitoring equipment to also monitor $PM_{2.5}$, or a combination of those.

All local authorities took up the offer of funding apart from Hertsmere Borough Council and St Albans Council. St Albans chose not to participate and Hertsmere had no need to take up the offer because they already had $PM_{2.5}$ analysers within their monitoring network.

Additional expectations of the funding were that the local authorities would maintain the equipment for at least one year and that on an annual basis the collected data would be reported and made available within an interpretative report to Public Health for consideration and discussion.

2.1 Aims and Objectives

The aim of the $PM_{2.5}$ Monitoring Project is to:

- enable the collection of real-time direct measurements of $PM_{2.5}$ concentrations from multiple locations within Hertfordshire to address the paucity of $PM_{2.5}$ data available within the County.

The objectives are to provide data for:

- consideration and use by HCC Public Health in relation to PHOI 3.01, although this has now been recognised as a limited approach - see section 1.3.
- consideration and use by Hertfordshire's local authority Environmental Health Teams in relation to their Local Air Quality Management duties.
- comparison of data from different locations throughout Hertfordshire
- consideration of trends over time
- consideration of relationships between the measured $PM_{2.5}$ concentrations and the concentrations, both background and roadside, predicted by Defra modelling.

3. Hertfordshire's Air Quality $PM_{2.5}$ Monitoring Network

3.1 Prior to Public Health Funding

Prior to 2016 there were only two $PM_{2.5}$ analysers located within Hertfordshire and both analysers were operated by Hertsmere Borough Council.

Both of the analysers were Tapered Element Oscillating Microbalances with a Filter Dynamics Measurement System in place (TEOM-FDMS). This is one of three types of real-time automatic analysers, along with BAM and FIDAS analysers, that meet the MCERTS performance standards for continuous ambient air quality monitoring systems for UK particulate matter, including $PM_{2.5}$. As such it is approved for that use by Defra.

One of Hertsmere's TEOM-FDMS analysers (AM1) has been operational since the 9th September 2014 and is positioned at a roadside location at Elstree Way, Borehamwood.

The other of Hertsmere's TEOM-FDMS analysers (AM2) was operational between 5th November 2005 and 23rd May 2017 and was positioned at an urban-background location near Thrift Farm Lane, Borehamwood. This analyser was disconnected on the 23rd May 2017 in order to be relocated to the Borehamwood Bowls Club, Meadow Park, because of the development of the land where the analyser was located. Following relocation, to its new urban-background location, the analyser was collecting data again from the 24th May 2017.

The two analysers were located about 300m from each other until the relocation of AM2, so the availability of directly measured $PM_{2.5}$ was limited to a very specific geographical area of the County. Even with the relocation of the AM2 analyser it is still relatively close to the AM1 analyser, being approximately 600m apart.

A site plan showing the location of both $PM_{2.5}$ analysers is included as Figure 3.1.

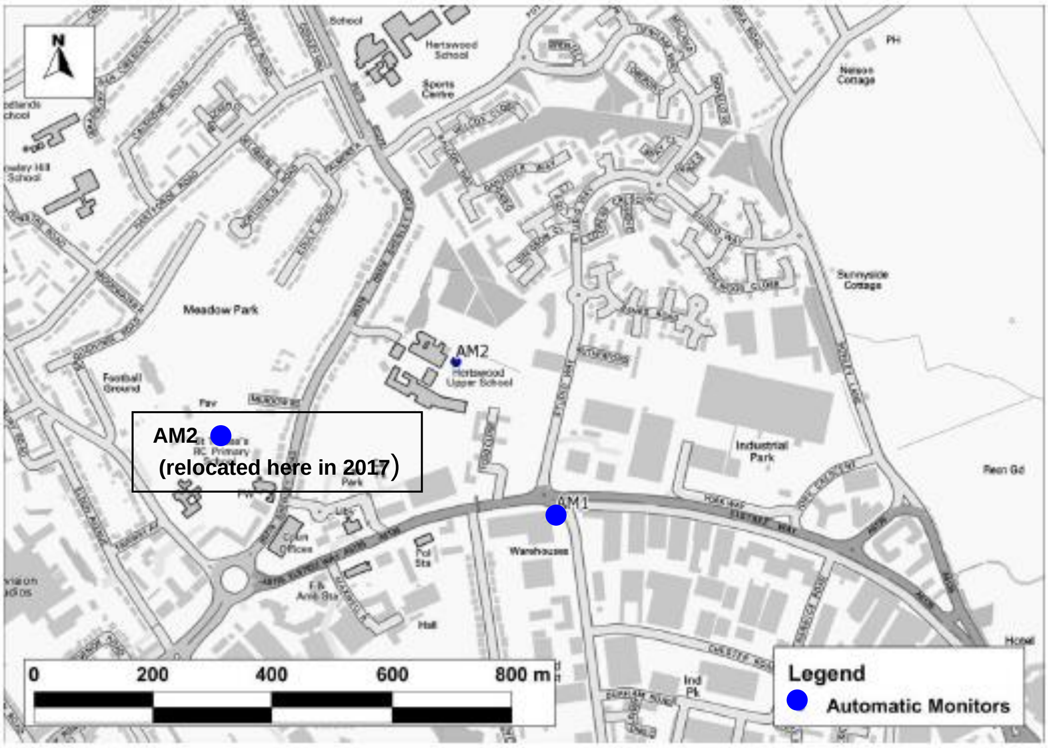


Figure 3.1 Location of $PM_{2.5}$ analysers in Borehamwood, Hertsmere

3.2 Post Public Health Funding

By 2016 the $PM_{2.5}$ monitoring network within Hertfordshire had expanded to eleven analysers with nine of the ten local authority areas having at least one real-time analyser measuring $PM_{2.5}$ concentrations in the ambient air. A summary of the locations and types of $PM_{2.5}$ analysers operating within Hertfordshire in 2021 is included as Table 3.2 and shows that the network now comprises of eight analysers. The analysers lost from the network in 2017 and 2018 are in *red*. No changes occurred between 2018 and 2021.

Table 3.2 Extent & nature of the $PM_{2.5}$ monitoring network in Hertfordshire 2021

Local Authority	Address	Grid Reference	Location Type	Analyser Type
Hertsmere*	Elstree Way, Borehamwood	520319, 197099	Roadside	TEOM-FDMS **
Hertsmere* Opened in 2017	Meadow Park, Borehamwood	519759, 197107	Urban-background	FIDAS **
Dacorum	High Street, Northchurch	497295, 208901	Roadside	FIDAS **
North Hertfordshire	Stevenage Road, Hitchin	518713, 228349	Roadside	BAM **
Welwyn, Hatfield	St Albans Road East, Hatfield	523283, 209161	Roadside	BAM **
East Hertfordshire	Gascoyne Way, Hertford	532764, 212519	Roadside	BAM **
Watford	Rickmansworth Road, Watford	510572, 196809	Roadside	FIDAS **
Stevenage	St George's Way, Stevenage	523589, 223965	Roadside	BAM **
Hertsmere* Closed in May 2017	Thrift Farm Lane, Borehamwood	520147, 197361	Urban-background	TEOM-FDMS **
Broxbourne Closed in 2017	*College Road, Cheshunt*	*535314, 202244*	*Roadside*	*AQ Mesh ****
Broxbourne Closed in 2017	*Eleanor Cross Rd Waltham Cross*	*536266, 200376*	*Roadside*	*AQ Mesh ****
Three Rivers - NOT OPERATIONAL from 2018	Rickmansworth Rd, Chorleywood	504162, 196286	Roadside	AQ Mesh ***
Three Rivers Opened in 2017 - NOT OPERATIONAL 2018	Uxbridge Road, Rickmansworth	505263, 194250	Kerbside	AQ Mesh ***

***** not funded by Public Health
****** Defra approved analysers that are UK MCERTS accredited for continuous ambient air quality monitoring systems and that have MCERTS for $PM_{2.5}$.
******* analyser that is not Defra approved & is not UK MCERTS accredited for continuous ambient air quality monitoring systems for $PM_{2.5}$.

Where an analyser does not have MCERTS accreditation it means that data from the analyser in question should only be utilised as a screening assessment tool, for example to inform the need for more detailed monitoring. As of 2021 the operational analysers were MCERTS accredited.

A roadside monitoring location is one that is typically within 1 - 5 metres of the kerb of a busy road (although can be up to 15m from the kerb) [4].

An urban-background location is one that is in an urban setting but is not located close to a source (i.e. busy road) [4].

An indication of the geographical coverage of $PM_{2.5}$ monitoring is included as Figure 3.2. However, the mapping shown in Figure 3.2 should only be considered as indicative.

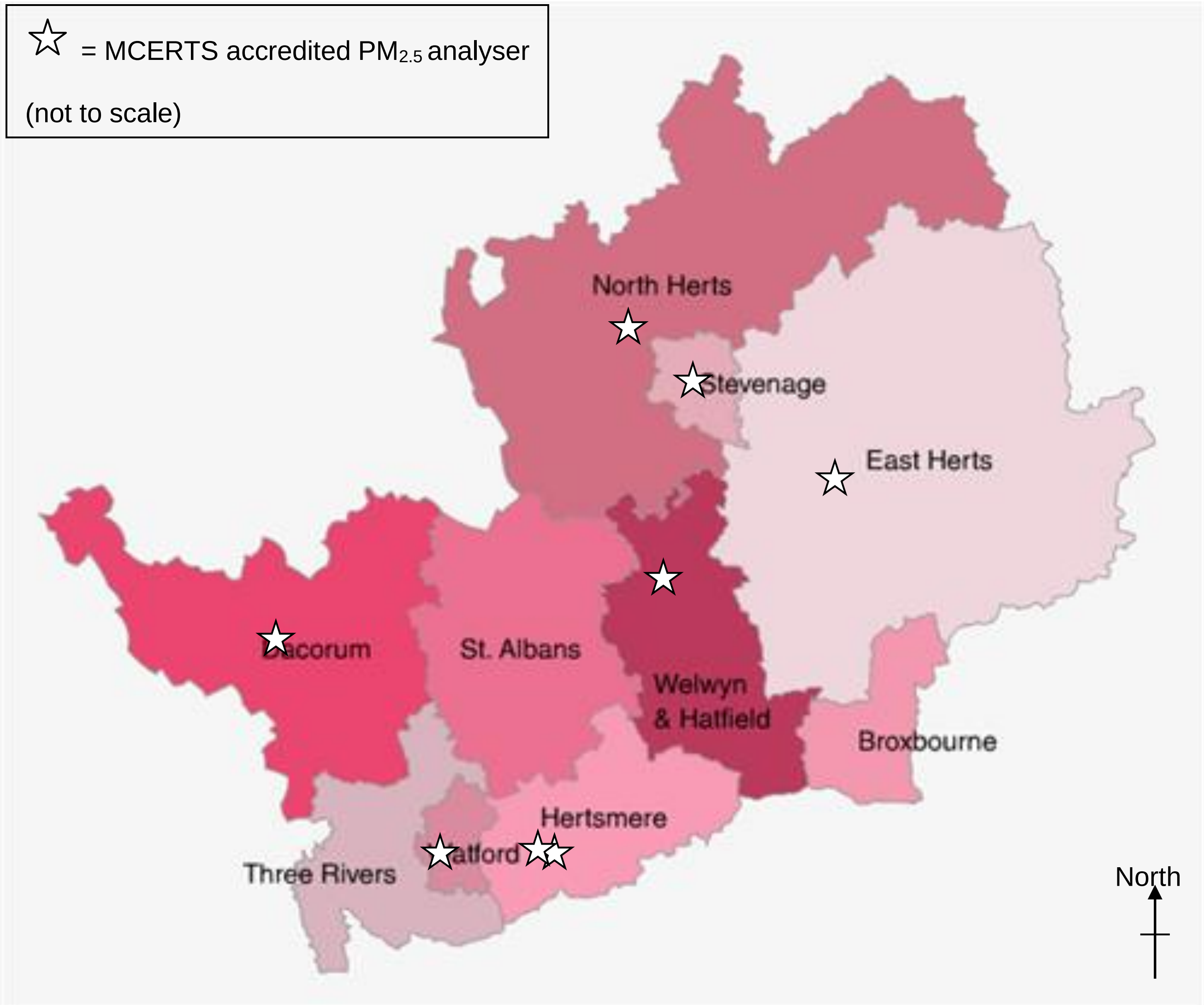


Figure 3.2 Plan of Hertfordshire showing indicative location of $PM_{2.5}$ analysers in 2022

4. Results of $PM_{2.5}$ Monitoring

4.1 Data Capture

In addition to understanding the accreditation status of the monitoring equipment it is necessary to understand the data capture rate for the monitoring period in order to assess the significance that can be attributed to data obtained via air quality monitoring. Table 4.1 summarises the periods of monitoring during 2022 and data capture rates for each $PM_{2.5}$ analyser.

Table 4.1 Performance of the $PM_{2.5}$ monitoring network in 2022

Local Authority	**Location** (roadside unless stated)	**Monitoring Commencement Date**	**Data Capture as % of 2022**	**Analyser**
*Hertsmere**	*Borehamwood*	*01/01/2016*	*66.60*	*TEOM-FDMS*
*Hertsmere**	*Borehamwood (urban background)*	*24/05/2017*	*77.61*	*FIDAS ***
Dacorum	**Northchurch**	**01/01/2016**	**95.67**	**FIDAS**
North Hertfordshire	*Hitchin*	*01/01/2016*	*69.43*	*BAM*
Welwyn, Hatfield	**Hatfield**	**28/04/2016**	**92.32**	**BAM**
East Hertfordshire	**Hertford**	**22/08/2016**	**98.72**	**BAM**
Watford	**Watford**	**24/10/2016**	**99.81**	**FIDAS**
Stevenage	**Stevenage**	**24/10/2016**	**97.81**	**BAM**

* = analysers not funded by PH grant
** = the analyser at Hertsmere's background site was not operating until 22nd March 2023 when a FIDAS was installed, to replace the TEOM-FIDAS.

Sites reporting a data capture of above 85% are considered to have sufficient data capture to provide a reliable annual mean value (4).

In 2022, only five of the analysers returned data capture rates of >85%, which is a return to the poor data capture rates in 2020 and reduction in the performance of the network that was robust during 2021 and prior to 2020.

A mitigating factor for the low capture rate at the Hertsmere background site was the switch from an older technology TEOM-FDMS analyser to the newer technology FIDAS analyser.

The low data collection at the Hertsmere roadside site is related to the increasing unreliability of the older technology TEOM-FDMS analyser. The poor data capture performance at the North Hertfordshire analyser is related to a local issue that proved difficult to overcome.

The other data reliability consideration relates to quality control and quality assurance in terms of the ongoing calibration, maintenance, and servicing of the monitoring equipment. To manage this process the Hertfordshire and Bedfordshire Air Quality Forum employs a consultant recognised to have the relevant expertise and experience to check and ratify the data generated by the monitoring network. All the data presented in this report have been ratified in line with best practice and to meet Defra requirements.

The above highlights that considerable ongoing costs and knowledgeable staff are required to maintain the $PM_{2.5}$ monitoring network with some of the equipment making up the network not aging well.

4.2 Results

Table 4.2 provides an overview of the results of the $PM_{2.5}$ monitoring as a mean annual average. It also shows the number of days on which the levels of $PM_{2.5}$ were measured above a concentration defined by the Defra Index Band for air pollution to be representative of 'moderate', 'high' and 'very high' air pollution.

- '**Moderate**' is defined as being greater than **36μg/m³ but less than 54μg/m³**
- **'High'** is defined as being between **54μg/m³ and 70μg/m³** and
- **'Very High'** is defined as being **71μg/m³ or higher**

all calculated as a **24hour running mean** (5).

The relevant annual mean limits set for $PM_{2.5}$ include the:

- EU's limit value of **25μg/m³**,
- UK's average exposure indicator of **20μg/m³**
- UK Air Quality Objective of **10μg/m³**
- WHO air quality guideline value **5μg/m³**

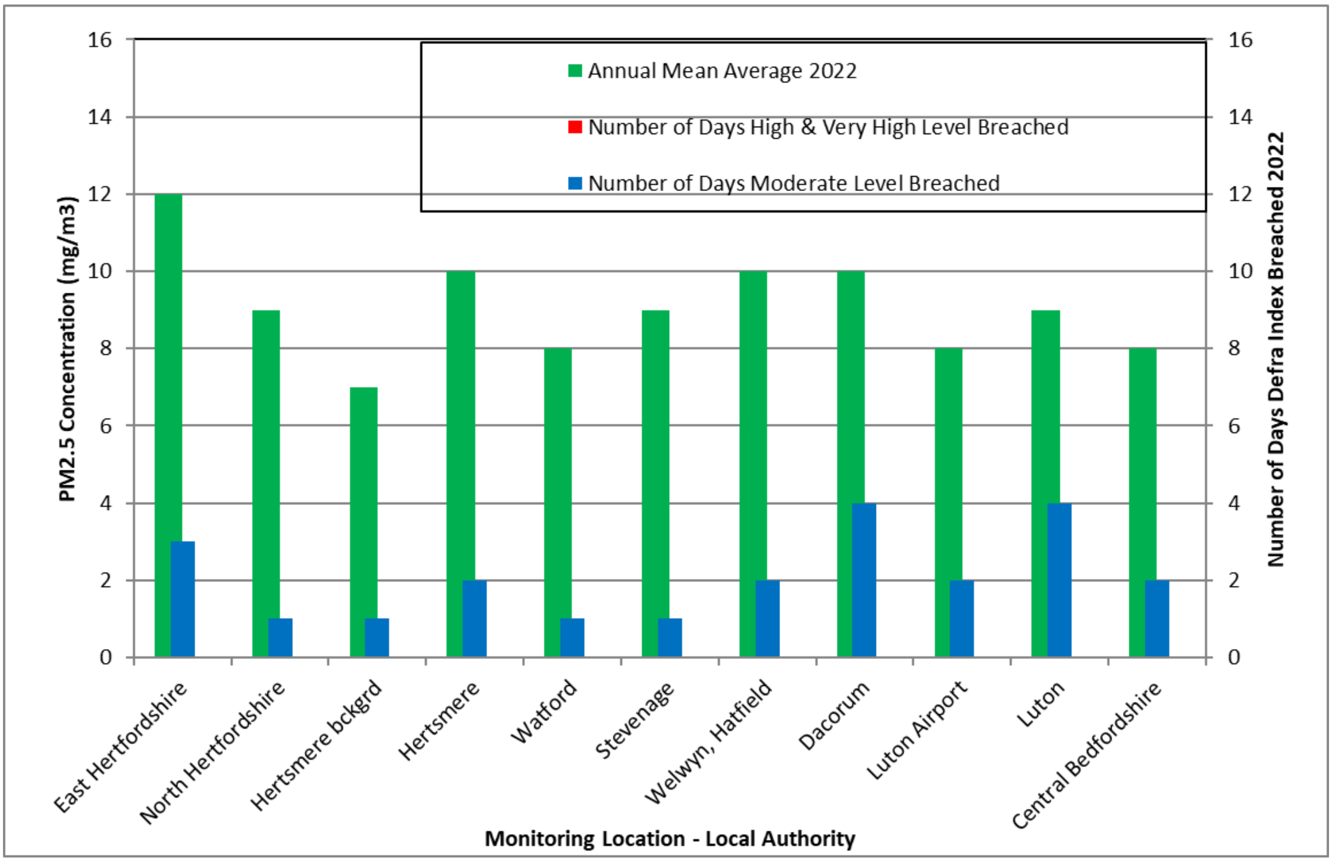
To provide additional local context the 2022 data from the $PM_{2.5}$ analysers operating in Bedfordshire have been included in Table 4.2.

It is important to note that in 2022 the $PM_{2.5}$ monitoring network in Bedfordshire was significantly enhanced by the addition of multiple sensors within Luton.

Table 4.2 Results from the Hertfordshire $PM_{2.5}$ Monitoring Network in 2022

Local Authority	Location	Annual Mean Ave. (μg/m^3)	Number of Days with		
			Moderate Pollution	High Pollution	Very High Pollution
Hertsmere	Borehamwood	10	2	0	0
Hertsmere *	Borehamwood	7	1	0	0
Dacorum	**Northchurch**	**10**	**4**	**0**	**0**
North Hertfordshire	Hitchin	9	1	0	0
Welwyn, Hatfield	**Hatfield**	**10**	**2**	**0**	**0**
East Hertfordshire	**Hertford**	**12**	**3**	**0**	**0**
Watford	**Watford**	**8**	**1**	**0**	**0**
Stevenage	**Stevenage**	**9**	**1**	**0**	**0**
Bedfordshire Local Authorities					
Luton	**Dunstable Rd, Luton (FIDAS)**	**9**	**4**	**0**	**0**
Luton Airport – Future LuToN **	***Eaton Green Rd (GRIMM)***	***8***	***2***	***0***	***0***
Central Bedfordshire	**A1(M) at Sandy (TEOM-FDMS)**	**8**	**2**	**0**	**0**

* = urban background monitoring site. ** = Industrial background. All other sites are roadside.
Bold = **MCERTS accredited with >85% data capture**
Bold = ***Non-MCERTS accredited with >85% data capture***
Normal font = MCERTS accredited with <85% data capture



* = Locations are roadside monitoring sites, except Hertsmere bkgrd (Urban background) and London Luton Airport (industrial background). All equipment is MCERTS accredited except Luton Airport.

Figure 4.1 $PM_{2.5}$ concentrations & number of days Defra Index was breached in 2022

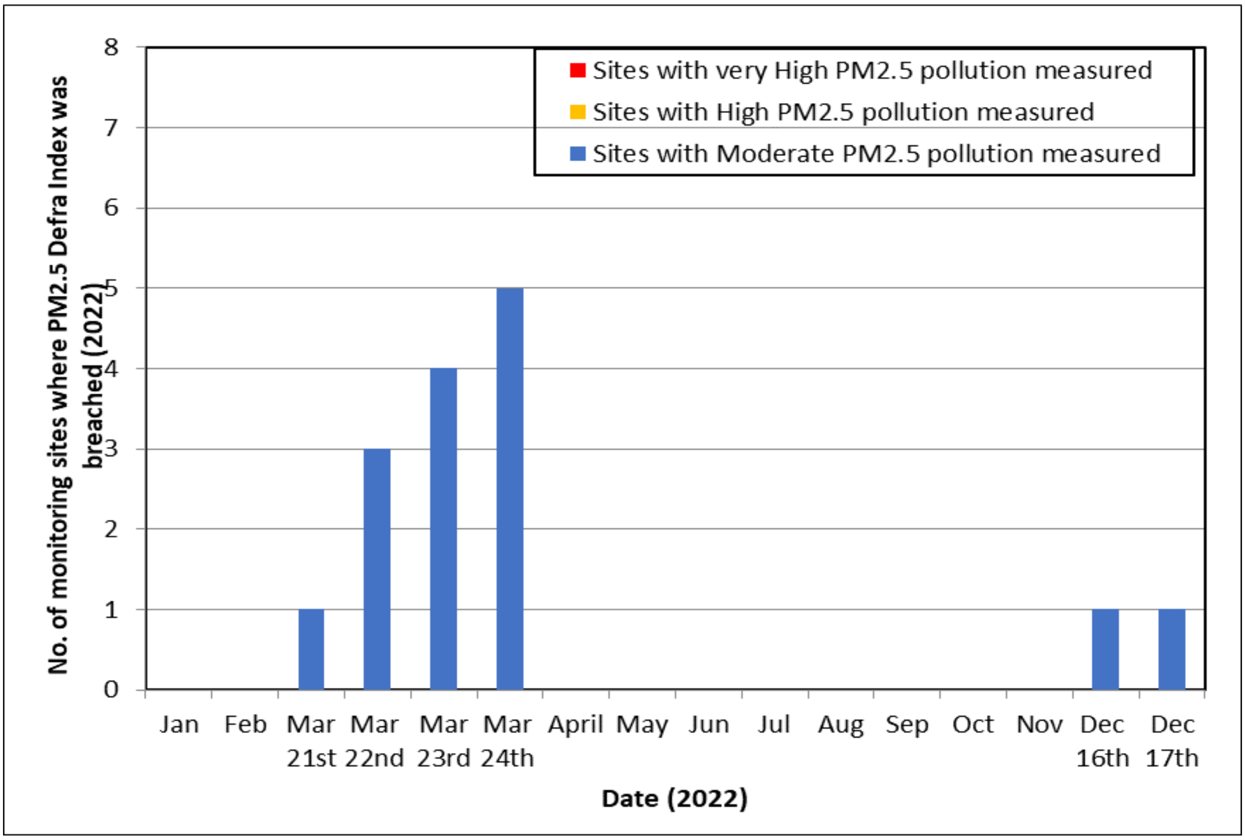


Figure 4.2 Dates of occurrence of breaches by $PM_{2.5}$ of the Defra Index in 2022

Figure 4.2 displays the days in 2022 on which breaches of the Defra Index Bands for air pollution by $PM_{2.5}$ were measured by the Hertfordshire monitoring network.

Table 4.3 shows the annual mean average $PM_{2.5}$ concentrations at each of the Hertfordshire monitoring sites in 2022 with the concentrations that have been modelled by Defra. The Defra data was taken from https://uk-air.defra.gov.uk/data/gis-mapping/ and https://uk-air.defra.gov.uk/data/laqm-background-home on the 9th December 2023 with the year specified to be 2022. Where modelled data is available specific to the road on which the monitoring equipment is located this is also reported. However, where roadside modelled data is not available the background data is used.

Table 4.3 Hertfordshire $PM_{2.5}$ monitoring network results in 2022 compared with modelled data from Defra (https://uk-air.defra.gov.uk/data/gis-mapping/)

Local Authority	**Location** (roadside unless stated)	**Annual Mean Average ($\mu g/m^3$)**	**Defra Modelled Data ($\mu g/m^3$) (Roadside)**	**Defra Modelled Data ($\mu g/m^3$) (background)**
Hertsmere	Borehamwood *(urban-background)*	7	no data	9 - 10
Hertsmere	Borehamwood	10	11-13	9 - 10
Dacorum	**Northchurch**	**10**	9 - 10	6 - 8
North Hertfordshire	Hitchin	9	9 - 10	6 - 8
Welwyn, Hatfield	**Hatfield**	**10**	9 - 10	9 - 10
East Hertfordshire	**Hertford**	**12**	9 - 10	9 - 10
Watford	**Watford**	**8**	11 - 13	9 - 10
Stevenage	**Stevenage**	**9**	9 - 10	6 - 8

Bold = MCERTS accredited with >85% data capture
Normal font = MCERTS accredited with <85% data capture

Table 4.4 shows the mean average annual $PM_{2.5}$ concentration measured at each of the Local Authorities during 2022 alongside the Defra modelled population weighted mean average annual concentration for $PM_{2.5}$. This is the figure from which the PHOI for the fraction of annual all-cause mortality attributable to current levels of anthropogenic particulate pollution is derived. For context, data are included for Central Bedfordshire, Bedford, Luton, Hertfordshire and England as a whole.

Direct comparisons of the two sets of data in this Table should not be made, but it is useful contextual data. It should also be noted that the methodology for calculating the population weighted mean concentration was changed after completion of the 2020 data report, resulting in lower values being calculated than in preceding years.

Table 4.4 Defra modelled, population weighted mean average annual $PM_{2.5}$ data and mean annual average $PM_{2.5}$ concentrations measured in 2022

Regional	**Defra modelled, population weighted, mean average annual $PM_{2.5}$ (µg/m^3) 2021 ****	**Mean Annual Average $PM_{2.5}$ (µg/m^3) 2022**
England	7.4	no data
County/Unitary		
LuTon Rising	8.2	8
Luton (Dunstable Rd)	8.2	9
Central Bedfordshire	7.6	8
Hertfordshire	8	9***
Bedford	7.3	No data
District/Borough		
Hertsmere	8.3	7 (urban-background site)
		10 (roadside site)
St Albans	8.1	no data
East Hertfordshire	7.7	12
Welwyn Hatfield	8.2	10
Three Rivers	8.2	no data
Watford	8.4	8
Broxbourne	8.0	no data
North Hertfordshire	7.6	9
Dacorum	7.8	10
Stevenage	7.7	9

** = values obtained for 2021 (most current available) from Inhale - INteractive Health Atlas of Lung conditions in England - OHID (phe.org.uk) . Air Pollution: fine particulate matter (new method – concentrations of total $PM_{2.5}$) Mean – µg/m3

*** = mean average of annual values from all Hertfordshire based $PM_{2.5}$ analysers

Figure 4.3 shows the $PM_{2.5}$ concentrations measured at each monitoring location in 2022 alongside the concentrations in 2016 - 2021.

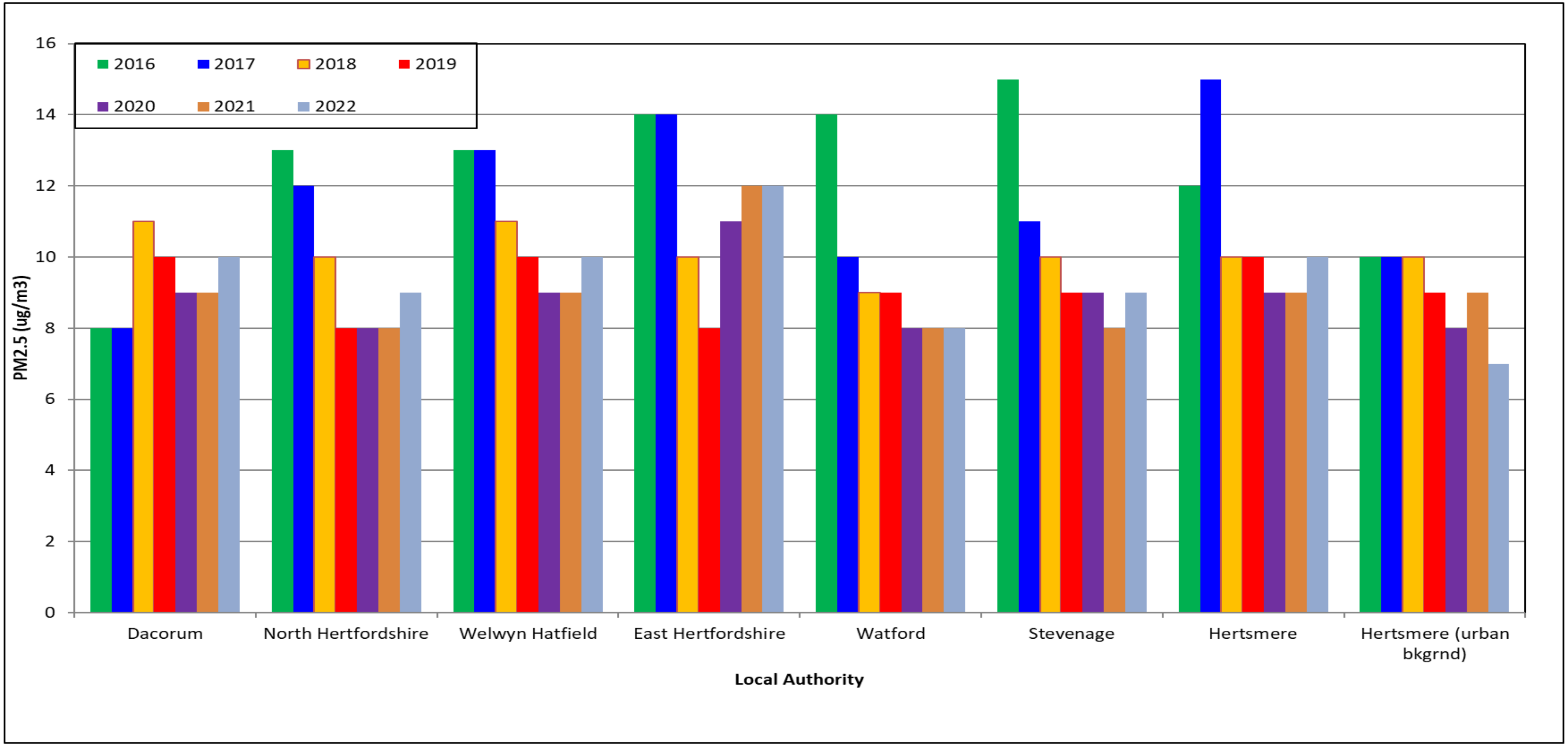


Figure 4.3 $PM_{2.5}$ concentrations measured from 2016-2021

UK Air Quality Objective = 10μg/m^3 by 2040 WHO Limit Value = 5μg/m^3

5. Discussion and Interpretation of PM$_{2.5}$ Results

The data that have been collected and that are presented in Section 4 of this report represent the seventh full year of PM$_{2.5}$ air quality monitoring within Hertfordshire. Data capture rates (**Table 4.1**) were above the required 85% in only five (5) of the eight (8) Hertfordshire monitoring locations that were operational during 2022 and means that the number of locations at which data collection across the County has been reliable and suitably representative is lower than has been in the case in all previous years except for 2020.

The reasons for the low data capture rates at North Hertfordshire were:

- routine, repetitive maintenance issues in 2020
- a significant fault that required repair early in the year combined with ongoing routine and repetitive maintenance issues during 2021
- local issues that were not able to be easily overcome 2022

The low data capture rate at Hertsmere Roadside in 2022 were related to ongoing unreliability of the older technology TEOM-FDMS analyser.

The low data capture rate at Hertsmere Urban-Background in 2022 were due to the removal of the older TEOM-FDMS analyser and installation of a FIDAS, which took place from 1st January to 22nd March 2022.

The discussion of the data and interpretation of trends or patterns will need to bear in mind the data capture rates and the fact that meteorological trends across the years have not been considered. However, overall the data capture levels for most the analyser has been good over the seven years with that period of data collection a range of meteorological conditions would have been encountered. As such the reported concentrations and trends in concentrations of PM$_{2.5}$ can be considered increasingly representative and reliable.

5.1 Urban-background and roadside concentrations

A comparison of the annual mean average at Hertsmere's urban-background monitoring site with that from Hertsmere's roadside monitoring site over the seven years is suggestive of a specific localised contribution to PM$_{2.5}$ air pollution from road traffic.

In 2016, 2017, 2019, 2020 and 2022 the urban-background site recorded concentrations of 2μg/m^3, 5μg/m^3, 1μg/m^3, 1μg/m^3 and 3μg/m^3 respectively below those measured at the roadside site (**Figure 4.3**). The difference was not observed in 2018 when the urban background analyser was relocated to its new site. In 2018 both sites recorded the same level of 10μg/m^3. In 2021 both the urban background site and the roadside site measured the same mean annual average concentrations.

Working on the assumption that there is a localised source of $PM_{2.5}$ that is specific to the roadside site is emissions from exhausts, tyre and chassis wear and road resuspension of particulates it should be noted that in 2020 lower vehicle movements were found on the road network because of Covid Lockdowns. To a lesser extent this was also the case for 2021, with further recovery of traffic numbers seen in 2022. **(Section 5.3 and Appendix 3).** The caveat with the 2022 data is that the data capture from both analysers was below the recommended 85%.

5.2 Defra modelled and local authority measured $PM_{2.5}$ concentrations

The data presented in **Table 4.3** show that the Defra roadside modelled $PM_{2.5}$ data is broadly in line with that measured by the automatic analysers within Hertfordshire. Only the East Hertfordshire analyser measured an annual average concentration above the range modelled by Defra for 2022. The East Hertfordshire analyser has measured concentrations above the Defra modelled concentrations in five (5) of the seven (7) years of monitoring. In comparison the other seven (7) monitoring locations have only measured concentrations above the Defra modelled range in a single year across the seven (7) year period.

5.3 Seasonal trends in $PM_{2.5}$ air pollution episodes

Figure 4.2 shows six (6) days in 2022 where $PM_{2.5}$ concentrations were measured across the network at levels above Defra's moderate daily air quality index (https://uk-air.defra.gov.uk/air-pollution/daqi?view=more-info&pollutant=pm25#pollutant). This was higher than in 2021 when breaches were only recorded on two (2) days, however, it was not exceptional when compared to all previous years:

- 4 days in 2020
- 14 days in 2019

- 9 days in 2018
- 24 days in 2017
- 19 days in 2016.

In all a total of fifteen (15) exceedances were recorded in 2022 across the monitoring network over those six (6) days. This compared to six (6) exceedances in 2021 and 2020, forty-six (46) in 2019 and twenty-three (23) in 2018 and fifty-nine (59) in 2017.

As has been the case since 2020, none of the exceedances recorded breached the high daily air quality index threshold. In all previous years exceedances of the high or, less commonly, the very high index were measured. It should be noted that in 2022 none of the analyser were off-line on the days where exceedances of the moderate daily air quality index were recorded in Hertfordshire.

The notable decline in number of recorded breaches of the Defra moderate daily air quality index might be attributable to the impact of the Covid 19 pandemic. In the UK in 2020 this resulted in nationwide lock-downs comprising 75 days in full lock-down and 211 days of partial lock-down. The main periods of lock-down were from March 2020 to June 2020 and from the November 2020 to early December 2020. In 2021 there were 81 days of full lock-down (the winter months) and 113 days of partial lock-down. The impact of these travel restrictions on road traffic in Hertfordshire are shown in **Appendix 3**.

The above, combined with similar restrictions being in place elsewhere in the world, may have resulted in a reduction in anthropogenic contributions of particulate matter.

Leaving aside the potential impact of the Covid-19 pandemic, the seasonality of the breaches of the Moderate Index Band for $PM_{2.5}$ air pollution throughout the 2016 to 2022 period were consistent. There were no breaches during the summer months in any of the seven years, with any breaches restricted to winter, late autumn or very early spring **(Appendix 1)**.

A more detailed look at the dates of the exceedances identifies some possible contributing causes.

In 2020 the Moderate Index Band was breached on the 1st January and the Bonfire Night weekend, 5th November to 7th November. Although breaches were not identified on these periods during other years a review of data shows that peaks in concentrations of $PM_{2.5}$ are measured compared with the immediately preceding and following weeks.

In 2022 a Saharan dust storm was known to have adversely affected Western Europe between the 13th and 18th March 2022, albeit having its biggest impact on continental Europe [(20)]. This is noted because, although the highest measurements were not recorded on any other days, the peak concentrations of $PM_{2.5}$ across the Hertfordshire monitoring network were measured shortly after that period, between the 21st – 24th March 2022.

In all the monitoring years from 2017 to 2022 the period between late February and early April has been associated with regular exceedances of the Moderate and in some instances the High and Very High Index Band. No other period over a year has such a consistent pattern been observed.

A possible reason for this that the late winter and early spring months is the time that farmers typically apply slurry and manure to their fields, and it is accepted that the application of these substances give rise to the release of ammonia when in contact with the air [(21)]. Once in the air the ammonia mixes with other gases and can form particulate matter [(22)].

More generally a seasonal trend of higher particulate matter concentrations over the colder months would be expected because it is recognised that cold and still weather conditions typically prevent the dispersal of local air pollution including particulate matter. It may also be indicative of higher levels of domestic burning of solid fuels in fireplaces during the colder months.

5.4 Yearly trends in $PM_{2.5}$ air pollution

Seven years of data are now available for the majority of the local authorities in Hertfordshire, so a year to year comparison of $PM_{2.5}$ concentrations measured from each location is of increasing interest. However, 2020 and to a lesser extent 2021 were years dominated by the Covid-19 pandemic and the lockdowns that occurred not just in the UK but across Europe and other continents. Therefore, the 2020 and 2021 data will have to be viewed with that in mind, even though the lockdowns are more likely to have impacted concentrations of other pollutants, such as nitrogen dioxide. This is because of the relatively lower contribution of $PM_{2.5}$ from road traffic emissions.

Figure 4.3 shows that at seven of the eight Hertfordshire and Bedfordshire monitoring locations where seven years of data are available the annual average concentrations measured have declined since 2016 or 2017. The exception is at Dacorum where the decline has occurred since 2018.

Only at the East Hertfordshire monitoring location have $PM_{2.5}$ concentrations been recorded at consistently higher concentrations in 2020, 2021 and 2022 compared to the preceding two years. This may reflect a peculiarity with the location of the monitoring equipment associated with, for example, specific geographical (built or natural) features or proximity to a specific source.

Another feature of note is that in 2022 the annual average $PM_{2.5}$ concentrations recorded were above the previous year's concentration at five monitoring locations. At two monitoring locations the concentrations were the same as in the 2021 and only at the Hertsmere urban background site was the concentration lower than that recorded in 2021.

It will be valuable to continue monitoring to assess whether the gradual reduction in $PM_{2.5}$ identified to date will be a longer-term trend or whether it will eventually plateau as is being suggested by the 2022 data.

6. Summary and Further Work

The investment in $PM_{2.5}$ air pollution analysers in Hertfordshire has provided local authority environmental health officers and their colleagues in public health in HCC with access to county-wide real-time data on concentrations of this non-threshold air pollutant.

As a result of there being seven years of data available the value of the data-set is increasing. It should be recognised, though, that the data is being collected in isolation from meteorological data and without detailed knowledge of the specific characteristics of the locations at which the analysers are positioned.

Nonetheless, it should continue to be a useful dataset against which subsequently collected data can be considered and national scale assumptions and modelling can be checked.

Broad observations that can be made from the seven years of data are as follows:

- Breaches of the moderate daily air pollution index most commonly occur in the early spring months. A contributing factor to this is that this period is when farmers apply slurry and manure to their fields. This results in a release of ammonia to the atmosphere and subsequent creation of particulate matter.
- Outside of the early spring, breaches of the moderate daily air pollution index typically occur in the winter months when weather conditions are more likely to be still and cold and use of wood burning stoves and heaters would be expected to be higher.
- Peak concentrations often coincide with local contributions from celebrations associated with the use of fireworks, but unlike in 2020, these local contributions will not necessarily be sufficient to breach the moderate air pollution index level.
- Elevated concentrations can also be linked to air pollution that has built up from the continent or further afield and been transported to Britain. For example, agricultural or industrial processes or natural phenomena such as dust storms.
- Elevated concentrations can also be associated with ‘normal’ background concentrations of $PM_{2.5}$ that are exacerbated by locally derived road vehicle pollution, or one-off events.

- At this stage the impact of the Covid-19 lockdowns in 2020 and 2021, if any are hard to discern from the available data.
- Defra modelled $PM_{2.5}$ concentrations for each local authority area are broadly consistent with the concentrations being measured by the analysers within each local authority.
- With one exception, where data capture rates have been reliable the mean annual average concentrations of $PM_{2.5}$ have been reducing gradually.

In the short-term the further work should focus on:

- Retention of the existing $PM_{2.5}$ monitoring network to build up a more detailed and reliable picture of the levels of $PM_{2.5}$ air pollution at the selected sites across the County.
- Maintenance of the network and promotion of newer more reliable equipment where appropriate.
- Investigation and if appropriate the use of air quality sensors to provide greater coverage of the geographical area to complement the data being collected from the established analysers.
- Compilation and sharing of an annual report on the $PM_{2.5}$ data collected.

The reports are continuing to be made available on an appropriate HCC webpage and on www.airqualityhertsbeds.co.uk.

This work should, in the medium-term, enable the aim and the objectives of this $PM_{2.5}$ monitoring project (Section 2.1) to be better met. It is hoped that the anticipated inclusion of an Air Quality Objective for $PM_{2.5}$ in the Environment Act 2021 in 2023 will encourage the retention of existing analysers and provide opportunities to enhance the existing $PM_{2.5}$ monitoring network.

The biggest threat to this work is that, despite the above legislation, or perhaps because of its lack of ambition, the Local Authorities will withdraw their funding of the ongoing operation of their $PM_{2.5}$ real-time analysers.

It is already known that both Watford and North Hertfordshire will be turning off their analysers at the end of 2023.

7. References

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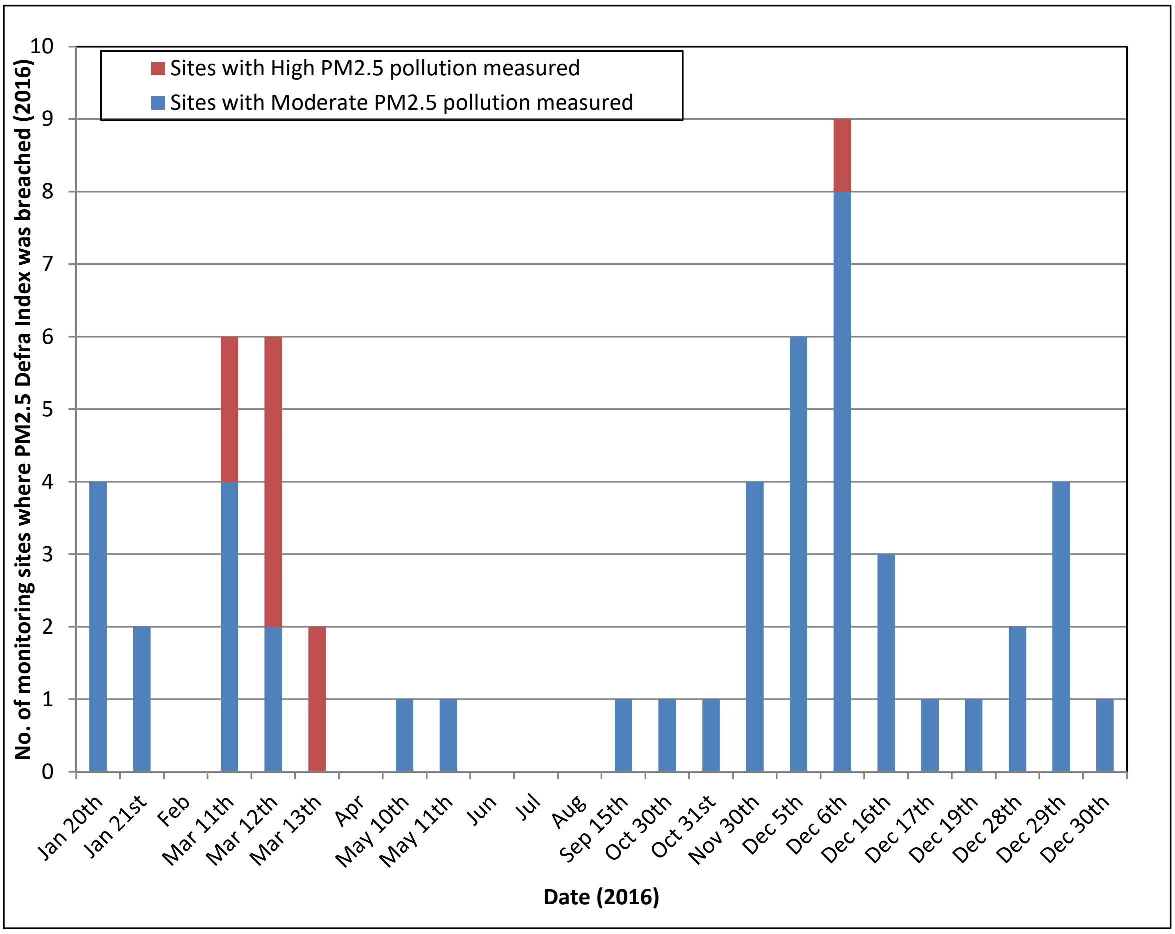
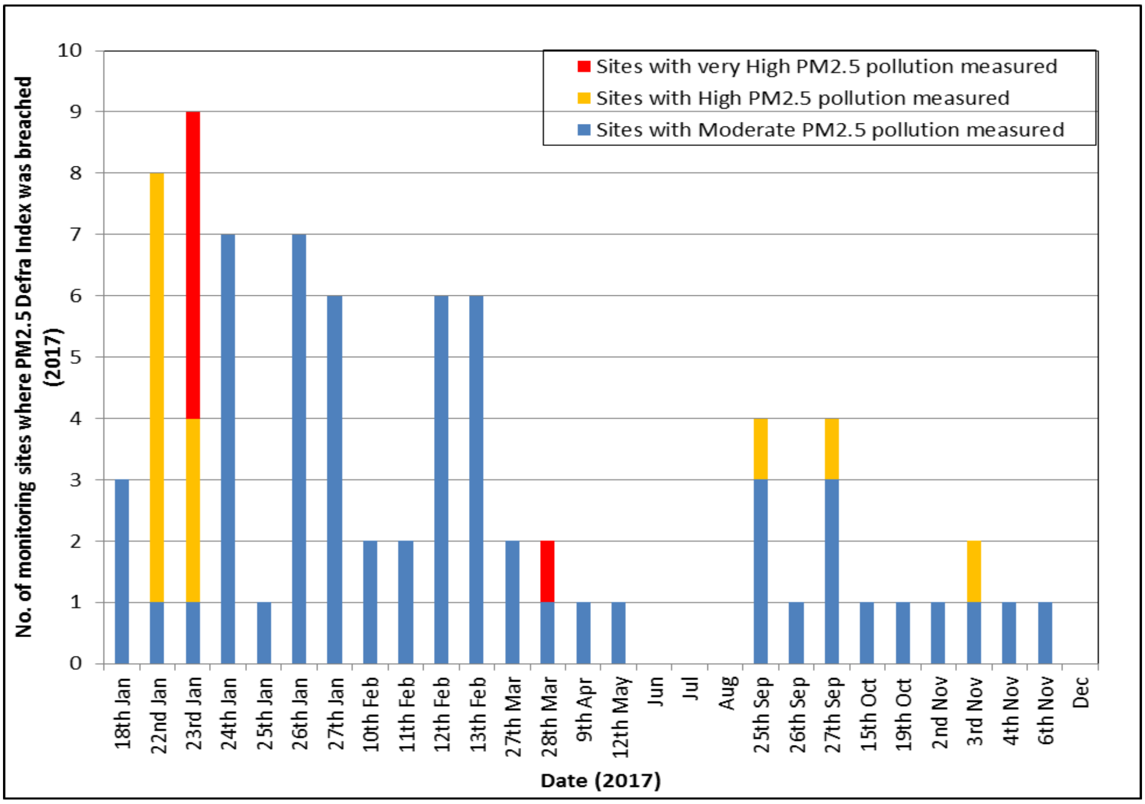
APPENDIX 1

Dates of Occurrence of Breaches by $PM_{2.5}$ of the Defra Index in 2016 - 2021





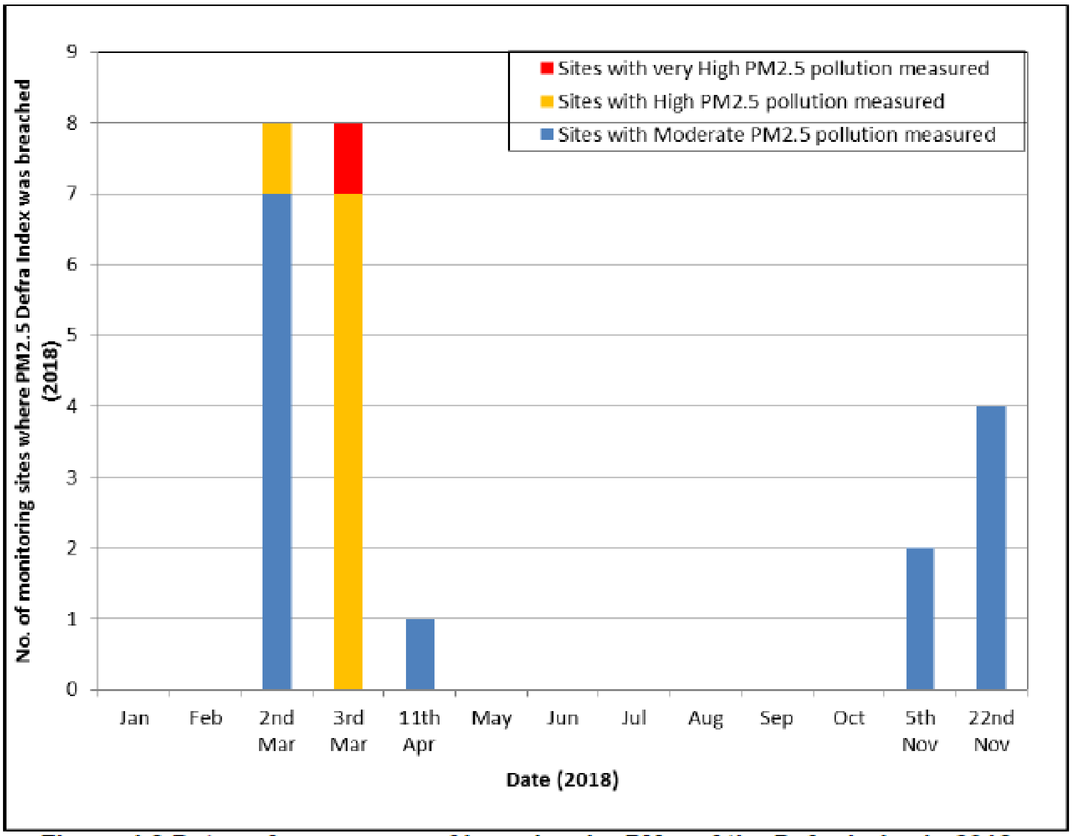
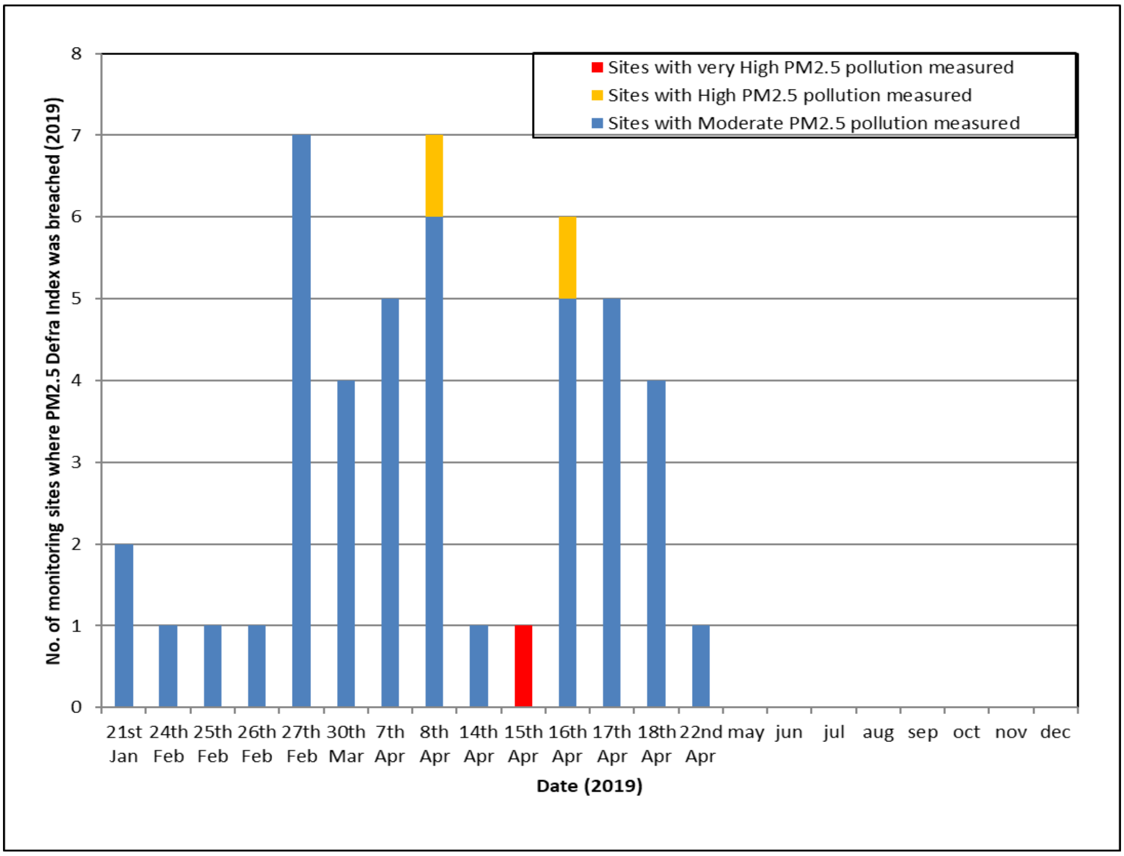
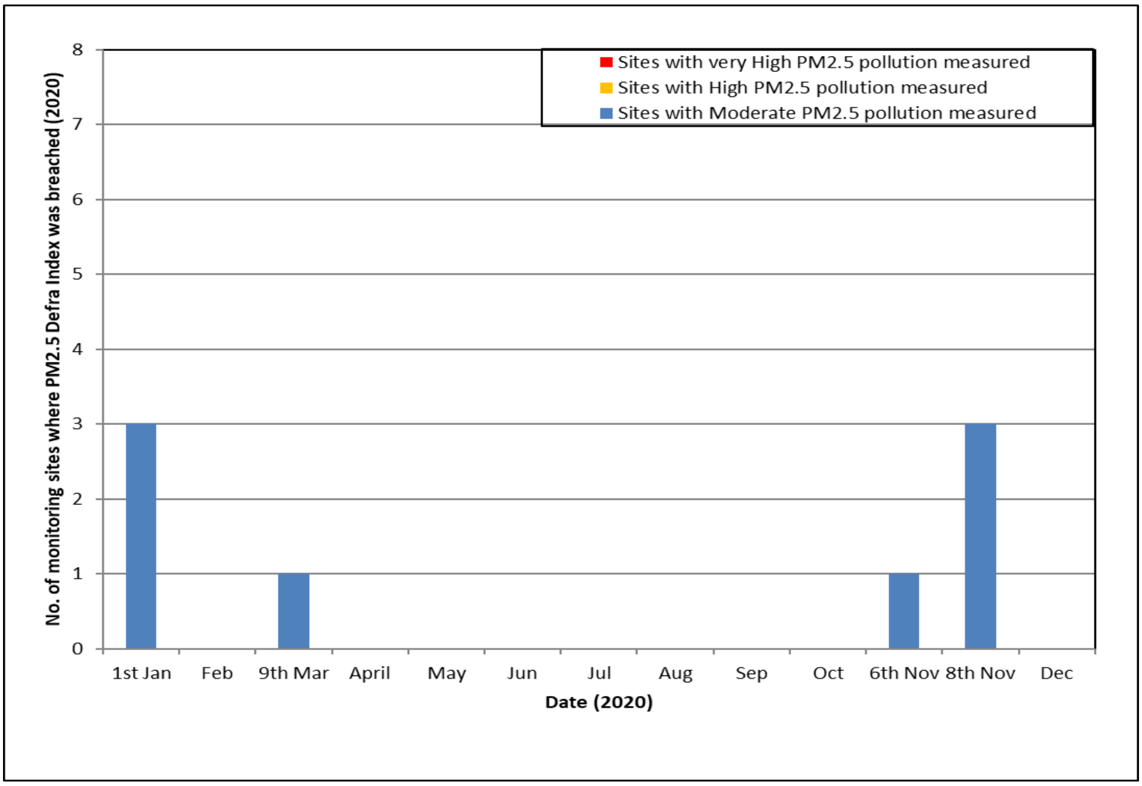
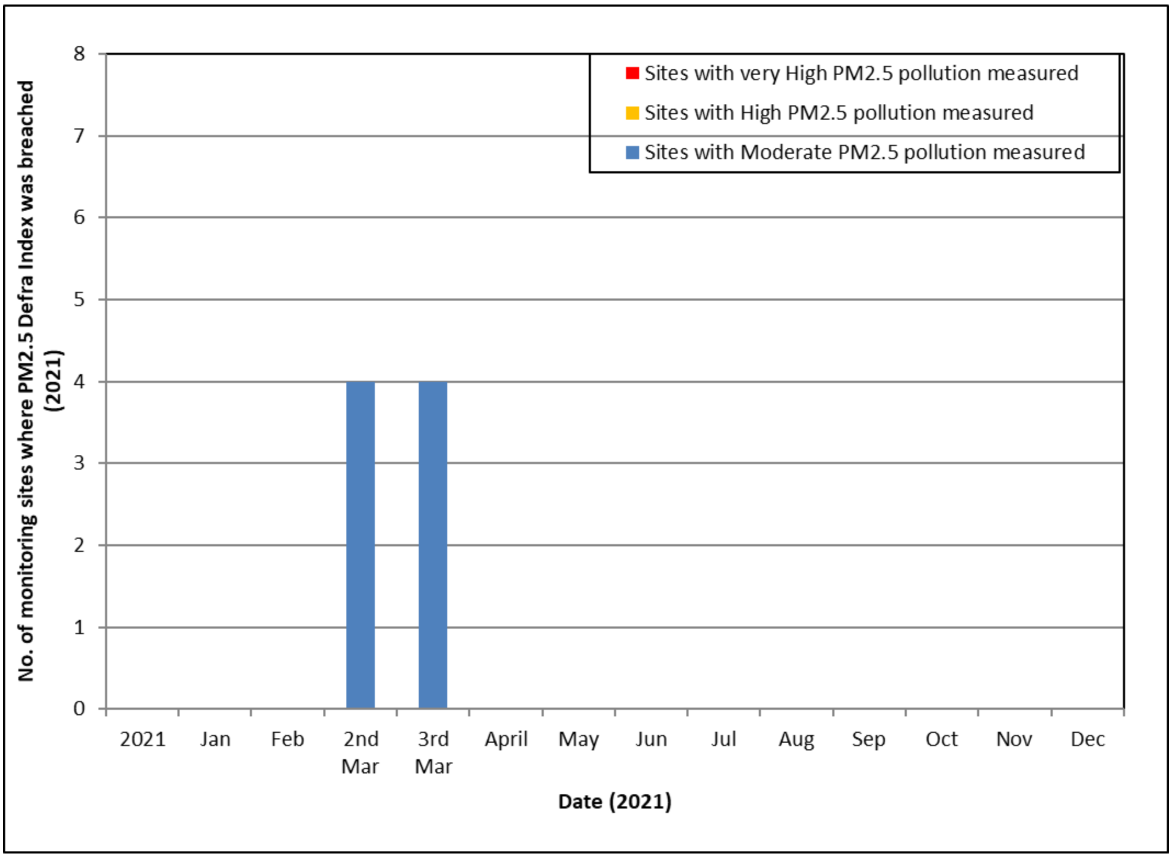


Figure 4.2 Dates of occurrence of breaches by $PM_{2.5}$ of the Defra Index in 2018


Sites with very High PM2.5 pollution measured
Sites with High PM2.5 pollution measured
Sites with Moderate PM2.5 pollution measured
No. of monitoring sites where PM2.5 Defra Index was breached (2019)
0
1
2
3
4
5
6
7
8
21st Jan
24th Feb
25th Feb
26th Feb
27th Feb
30th Mar
7th Apr
8th Apr
14th Apr
15th Apr
16th Apr
17th Apr
18th Apr
22nd Apr
may
jun
jul
aug
sep
oct
nov
dec
Date (2019)


Sites with very High PM2.5 pollution measured
Sites with High PM2.5 pollution measured
Sites with Moderate PM2.5 pollution measured
No. of monitoring sites where PM2.5 Defra Index was breached (2020)
0
1
2
3
4
5
6
7
8
1st Jan
Feb
9th Mar
April
May
Jun
Jul
Aug
Sep
Oct
6th Nov
8th Nov
Dec
Date (2020)


No. of monitoring sites where PM2.5 Defra Index was breached (2021)
8
7
6
5
4
3
2
1
0
Sites with very High PM2.5 pollution measured
Sites with High PM2.5 pollution measured
Sites with Moderate PM2.5 pollution measured
2021
Jan
Feb
2nd Mar
3rd Mar
April
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Date (2021)

APPENDIX 2

Derivation of the Population-weighted annual mean average $PM_{2.5}$ data

These data are population-weighted annual mean concentrations (μg m^{-3}) for each Local Authority. These data are suitable for use in estimating the burden of mortality attributable to long-term exposure to particulate air pollution using methods such as those recommended by COMEAP in its statement "Estimating the mortality burden of particulate air pollution at the local level" and used in calculating the Public Health Outcomes Framework indicator "Fraction of Mortality Attributable to Particulate Air Pollution".

Concentrations of anthropogenic, rather than total, $PM_{2.5}$ are used as the basis for this indicator, as burden estimates based on total $PM_{2.5}$ might give a misleading impression of the scale of the potential influence of policy interventions (COMEAP, 2012). However, modelled concentrations of anthropogenic $PM_{2.5}$ are more uncertain than those of total $PM_{2.5}$ because of the uncertainty associated with the assignment to anthropogenic and non-anthropogenic sources.

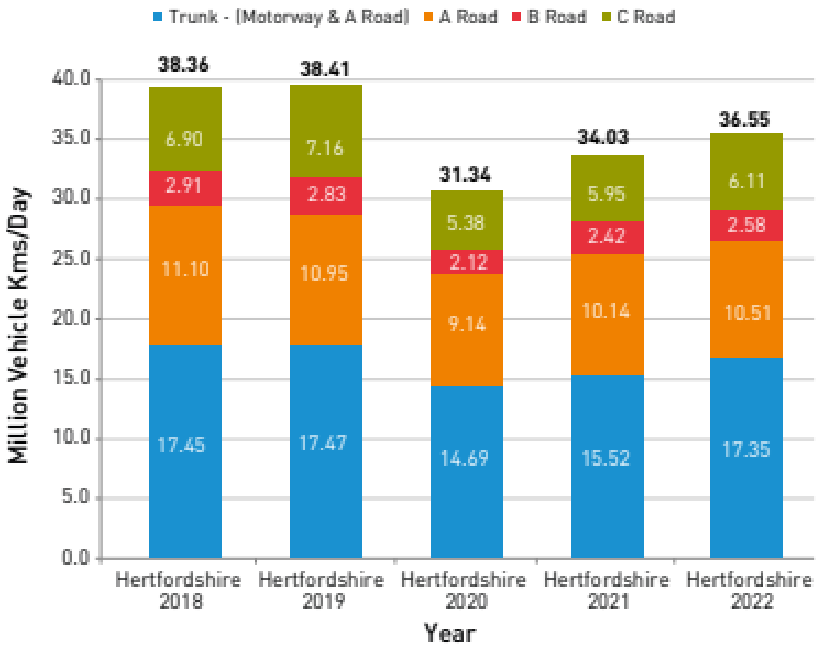
Background annual average $PM_{2.5}$ concentrations for the year of interest are modelled on a 1km x 1km grid using an air dispersion model (Pollution Climate Mapping), and calibrated using measured concentrations taken from background sites in Defra's Automatic Urban and Rural Network. Data on primary emissions from different sources from the National Atmospheric Emissions Inventory and a combination of measurement data for secondary inorganic aerosol and models for sources not included in the emission inventory (including re-suspension of dusts) are used to estimate the anthropogenic (human-made) component of these concentrations. By approximating LA boundaries to the 1km by 1km grid, and using census population data, population weighted background $PM_{2.5}$ concentrations for each lower tier LA are calculated. This work is completed under contract to Defra, as a small extension of its obligations under the Ambient Air Quality Directive (2008/50/EC).

The data are available from the download links in the table below on an annual basis. Estimated concentrations are population-weighted annual mean $PM_{2.5}$ in μg m^{-3}. For 2010 the data are provided for UK by Local Authority only. For 2011 onwards, the data are provided for UK by Local Authority and by country. Data are also provided for England by region and upper tier Local Authority.

APPENDIX 3

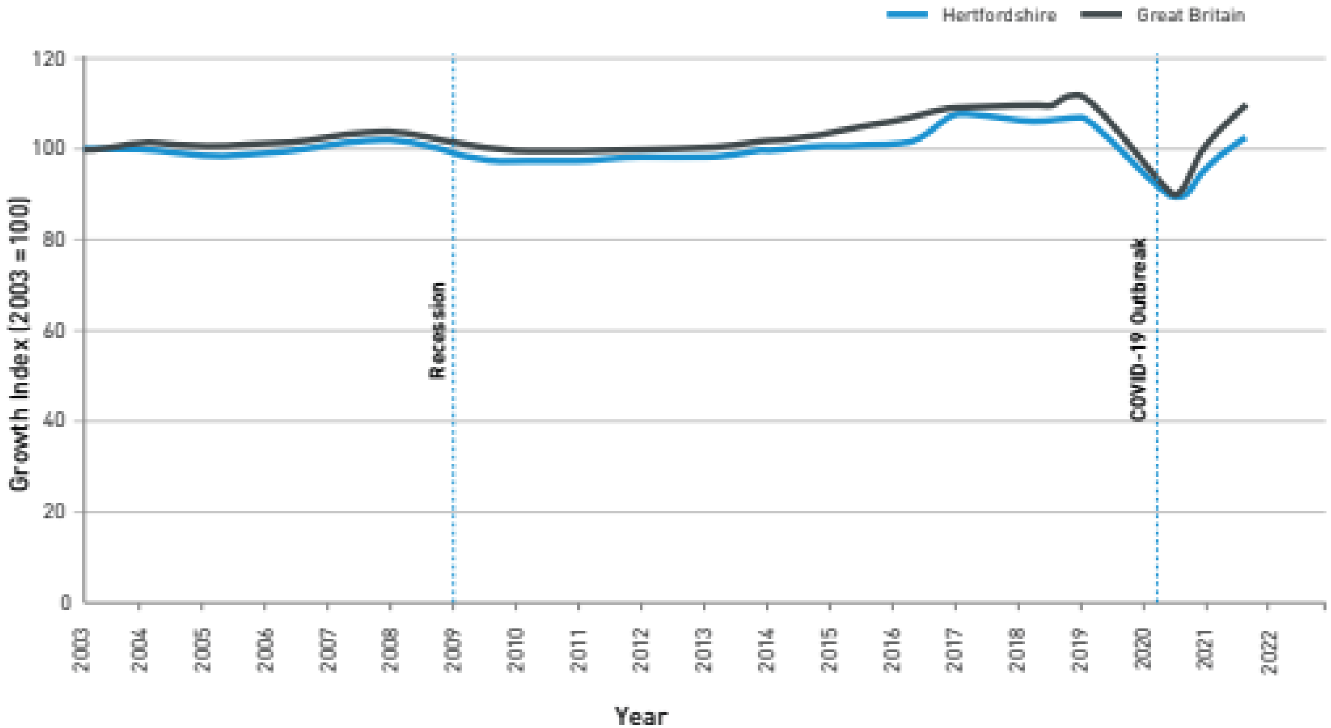
Trends in Levels of Road Traffic in Hertfordshire

Figure 2.2.4 - Change in Vehicle Kilometres.



Source: HCC's TRACAS database (annual traffic count programme).

Figure 2.2.5 - Historical Trends of County and National Traffic.



Footnote: Two new motorway sites were added in 2017 which accounts for some of the rise between 2016 and 2017.

Source: DfT (Transport Statistics Great Britain) Table TRA0204. HCC's TRACAS database. Footnote: Two new motorway sites were added in 2017 which accounts for some of the rise between 2016 and 2017.

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