A major sourceAir Quality Grant 2021/22 - Final Report

Grant Determination Number 31/5979 and 31/5980

Unique Project reference: ecm_64111

Contents

1. Introduction

This report is the final report of Air Quality Grant funded project number ecm_64111 undertaken by North West Leicestershire District Council and Harborough Borough Council from April 2022 to the end of December 2023.

The Final report is required within 6 months of the project reaching completion. There is no set template for this report, but guidance from Defra suggests that as a minimum it should set out:

- The project summary and aims.
- Work undertaken and an assessment of how work may have differed from the initial proposal.
- Whether this was a Sole or Joint Proposal and a review of the benefits and challenges of the chosen delivery model.
- An assessment on whether the project was effective and achieved its objectives and milestones.
- An assessment of how the outcomes of the project will be delivered or maintained longer term.
- Details of stakeholder engagement.
- Sharing of best practice or lessons learned.
- A financial breakdown of how the funding was used and a financial reconciliation of the funding awarded

This report is therefore structured around the bullet points above and covers elements of feedback from both authorities, including details of implementation in relation to the original application, and whether the project delivered the original objectives.

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Project Partners	Harborough District Council
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2. Project Summary and Aims

The project was led by North West Leicestershire District Council, in collaboration with Harborough Borough Council. The main objective of the project was to increase the level of knowledge of the effects of solid fuel burning on $PM_{2.5}$ (particularly related to health), and ultimately reduce $PM_{2.5}$ emissions by changing attitudes to solid fuel burning, resulting in behaviour change. There is increasing local public concern around $PM_{2.5}$ across North West Leicestershire and Harborough, and in air quality in general. It was recognised that for $PM_{2.5}$ in particular, currently there is little information in relation to current concentrations, how concentrations vary across the districts and how the magnitude of contributions from different sources relate to the overall emissions. The project used a combination of monitoring, and a public awareness programme to try to increase awareness around solid fuel burning, and increase the evidence base as to the contribution of solid fuel burning in three locations, where it was thought that the incidence of solid fuel burning was likely to be high.

The project commenced with some communication around solid fuel burning (general social media posts etc), and further communication was undertaken when the air quality monitoring was commissioned. A questionnaire survey was undertaken prior to the main winter solid fuel burning season, to gauge attitudes to, and levels of, solid fuel burning. The survey focused on the villages where monitoring was being undertaken, but the survey links were more widely advertised (for example on social media and in local press articles) inviting responses more generally across the districts. Further communications aimed at behaviour change (burning less and cleaner) were undertaken throughout the winter season. Monitoring continued for a year, in 3 locations identified as having the potential to have high levels of burning, following which a further questionnaire survey was undertaken to assess changes in attitudes or behaviour.

Analysis of monitoring data was undertaken at the end of the 12-month period, and the outcomes of the analysis are appended to this report. Detailed statistical analysis of the monitoring results, using 'openair' software did not identify any clear influences from solid fuel burning in the vicinity of the any of the monitors. The plots produced seem to show periods of higher concentrations, at times, during colder temperatures, during the evening and over the weekend, which could be interpreted as times when residents are more likely to be burning solid fuel; however, variations in $PM_{2.5}$ can occur for multiple reasons, due to source, meteorology, chemistry or measurement method, In the absence of a clear signal from the monitoring data and its subsequent analysis, it was concluded that the data are not clear enough to draw a conclusion as to what is driving these elevated concentrations. Evidence from the questionnaires showed that there was already a very high awareness that solid fuel burning can have a detrimental effect on health. Of the respondents who burnt inside, most respondents burnt wood, or manufactured fuels/ smokeless coal, which reflects the national picture. The appliances used by respondents inside were mostly wood burners or enclosed fireplaces, followed by open fires. The main purpose of burning was for heat, but some respondents also used their appliance for cooking, aesthetics and hot water. Most use of appliances was during the evenings, with weekends slightly more popular than during the week. There appeared to be a high awareness of the need to season wood, with the majority of respondents saying they bought seasoned wood, or seasoned it at home, with no respondents saying that they bought unseasoned wood.

It is anticipated that the public awareness work will be built on in the future (if funding and resources allow) and expanded to a more ambitious, and potentially regional awareness campaign in line with public health priorities. One way this could be done is through supporting Clean Air Night (which focusses on solid fuel burning).

3. Work undertaken and how this differed from the application

The project was implemented much as the application suggested with no major changes. This section describes what work has been undertaken and provides more detail as to how the project was implemented and managed. The work was undertaken across four work packages; monitoring, public awareness raising, survey of behaviour and evaluation and knowledge transfer. Each of work packages are summarised below. Although the work did not differ from the application to any degree, it was refined as the project was implemented, based on experience and outcomes. Each of the above work packages (WPs) are described in more detail below. in addition, a short section on stakeholder engagement is included.

WP1 Monitoring

This work package began with identifying locations for the monitors. The three sites were selected in 'off gas' areas where there is old housing stock, and using local knowledge, to best represent areas of high levels of solid fuel burning. The monitoring equipment was procured from Earthsense; lamppost surveys, which are required for permissions from Leicestershire County Council for the monitors to be sited, were undertaken. It was originally envisaged that the monitors would be commissioned in the Summer of 2022, however, this was delayed until 15th September 2022. This was due to delays in obtaining the necessary permissions and procuring the monitors. In addition, consultants were procured to provide assistance with project management and technical advice on the project as a whole, including the data analysis element of the project.

The monitors were sited in Donisthorpe and Oakthorpe (North West Leicestershire) and North Kilworth (Harborough). Particulate matter (PM_{10} and $PM_{2.5}$) monitoring was undertaken using Zephyr analysers, which use sensors to measure various parameters, which include $PM_{2.5,}$ PM_{10} and temperature. The locations of the monitors are included in the Monitoring Report in Appendix A. Zephyrs are not considered to be 'reference equivalent'[1], but have been approved as compliant with the Monitoring Certification Scheme - MCERTS performance standards - as an indicative ambient particulate monitor[2]. Measurements were carried out at the three sites for a 12-month period, between 15th September 2022 and 30th September 2023, within which time, data were collected without any issues. A brief review of the monitoring data was undertaken in December 2022. The review checked that the locations of the monitors weren't causing any bias within the data. A second review of the data was undertaken at the halfway point of monitoring (data downloaded and a brief initial look at the data) and no issues identified.

Statistical analysis was undertaken on the measured pollutant concentrations for the three sites, for comparison with the air quality objectives (monitoring report included in full in Appendix A). The analysis of the monitoring data also included detailed statistical analysis using 'openair' software, to determine if the monitoring showed any influence of nearby solid fuel burning.   The analysis undertaken has not identified any clear influences from solid fuel burning in the vicinity of any of the monitors. The plots produced indicate periods of higher concentrations, at times, during colder temperatures, during the evening and over the weekend, which could be interpreted from the questionnaire outcomes as times when residents are more likely to be burning solid fuel; however, variations in $PM_{2.5}$ can occur for multiple reasons, due to source, meteorology, chemistry or measurement method. In the absence of a clear signal from the monitoring data and its subsequent analysis, it is not possible to draw a firm conclusion as to what is driving these elevated concentrations. WP1 was delivered as described in the original application.

WP2 Public Awareness Raising

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[1] The definition of 'reference equivalent' refers to a monitoring method that meets a certain standard to ensure accuracy and precision of results – in the UK, monitors that operate within Defra's AURN (Defra, 2023a), are considered to be reference equivalent.

[2] https://www.earthsense.co.uk/post/zephyr-meets-indicative-mcerts

Initially, several internal meetings were held to gather ideas on the form that a 'public awareness campaign' would take. Discussions were formalised through a 'Communications Plan' which outlined target audiences, key messages, objectives and communication tools, followed by specific timings of communications and surveys. The Communications Plan is included in Appendix B. Information was focussed on the areas where monitoring was carried out and where there was thought to be a high incidence of solid fuel burners. Alongside this, the initial survey sought to obtain a better understanding of the current awareness of the general public in these areas of solid fuel burners and their influence on air quality.

A wider campaign was launched by the councils to the general public on Clean Air Day (June 2022), through social media, to raise awareness of solid fuel burning and the potential detrimental effects to local air quality. At around the same time, there was an article in the Leicester Mercury about the project (Wood burners ban calls over pollution more turn to solid fuel as energy prices rise - Leicestershire Live (leicestermercury.co.uk) and in the Harborough Mail (https://www.harboroughmail.co.uk/news/environment/council-focusses-on-air-pollution-in-harborough-3648884). Other media also ran articles, such as the Leicester Mercury (x3), Burton Mail, Nub News and Harborough FM.

Throughout most of the project, monthly meetings were held by the project team (which included Communications Officers from both authorities), within which public awareness raising was discussed, including any updates to the communications plan. Further public awareness raising work included the preparation of a leaflet and poster promoting the campaign, for use at a Parish Fair and other suitable forums, social media (Twitter and Facebook) presence about the campaign and updates to NWLDC[3] and HDC[4] websites regarding the project and ward councillors/parishes agreeing to support the project and committing to raising its awareness. In order to encourage participation in the questionnaire, a prize draw was organised.

Further press releases resulted in the following local media stories being published.
https://www.leicestermercury.co.uk/news/local-news/monitoring-homes-wood-burners-solid-7742854
https://ashby.nub.news/news/local-news/two-villages-near-ashby-chosen-as-part-of-council-campaign-to-reduce-air-particles-154427
https://harboroughfm.co.uk/new-air-quality-monitoring-begins-in-north-kilworth/
Public Awareness Raising increased as the second phase of the questionnaire was implemented. Clean Air Day in June 2023 was used to raise awareness of air quality in general, using social media posts and material published for Clean Air Day. Both authorities also contacted schools with a poster competition, using materials published for Clean Air Day, but there was no uptake on this element of awareness raising. Community events were identified in both authorities and posters and leaflets used at these events.

WP3 Survey of Behaviour.
The initial survey was undertaken prior to the main winter solid fuel burning season, with the survey issued to the public on 3rd October 2022 (during Big Green Week); alongside the survey, residents received a letter about the air quality project. Completion of the questionnaire was incentivised by entry to a prize draw to win vouchers for entry to local attractions/leisure passes etc. As outlined in the Communications Plan, targets for engagement were to recruit 200 residents to a targeted survey group with 100% response rate, and to achieve 30% response rate within the target communities/600 responses to a wider community survey. This response target appears to have been ambitious; from the first survey there were 73 responses (24 from NW Leicestershire, 39 from Harborough and 3 unknown). This was as a result of 620 letters sent out across the two authorities. An evaluation of the geographical spread of respondents showed that in the first round of questionnaires, only 13% of the responses were a direct result of the letters sent, with the majority instigated from wider communications.

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[3] https://www.nwleics.gov.uk/pages/air_quality
[4] https://www.harborough.gov.uk/info/20025/environmental_health/101/air_quality

There was already a very high awareness that solid fuel burning can have a detrimental effect on health. Approximately 75% of respondents had burnt solid fuel (inside or outside) in the last 12 months, with most respondents who burnt inside, burning wood, or manufactured fuels/ smokeless coal. Most respondents who burnt outside, burnt charcoal or wood. The appliances used by respondents inside were mostly wood burners or enclosed fireplaces, followed by open fires, outside (mainly barbeques or chimeneas). The main purpose of burning was for heat, but some respondents also used their appliance for cooking, aesthetics and hot water. Most of the use of appliances was during the evenings, with weekends slightly more popular than during the week. Respondents mainly got their wood from specialist suppliers, but also from their own garden, salvaged wood, landowners, fallen trees, family members etc. A large proportion of the respondents (90%) were willing to have a follow up questionnaire and these were directly targeted in the subsequent survey.

The second survey went live on 31 March 2023 as planned, with the questionnaire amended to obtain both consistency of reporting with the first round of the questionnaire, but also to make sure any changes to behaviour are reported. For those completing a follow up survey, a reduced number of questions were asked (mainly about changes to previous behaviour), and a more general survey (for those coming new to the topic), was kept consistent with the first survey round, in order that responses can be directly comparable.

For the second survey, 30 respondents filled out the repeat questionnaire and 27 filled out the online questionnaire for new respondents. In the repeat questionnaire, most respondents hadn't changed burning behaviour. There was a 50/50 split between those who thought their awareness had increased, and those who didn't. In the main, any increase in awareness had come from national or local press articles. For the new respondents, the distribution of responses to questions was very similar to the baseline questionnaire results, suggesting a degree of robustness of the outcomes. There was still a predominance of wood burning, including the burning of waste wood. Wood burning stoves, enclosed fireplaces or barbeques were the most likely appliance to be used, with the main purpose for indoor burning being heat. Most of the use of appliances was during the evenings, with weekends and weekdays equally popular. With regards to maintenance, nearly 70% of respondents sweep their chimney/ maintain wood burner at least once a year. Approximately 40% of respondents thought the cost-of-living crisis would result in an increase in their burning habits.

WP4 Evaluation and Knowledge Transfer
The specific knowledge transfer activities outlined in the application for dissemination of lessons learnt and best practice, with neighbouring local authorities and public health colleagues, were undertaken following the data analysis. The following knowledge transfer activities were undertaken:
- Environmental Protection Best Practice Group (Leicestershire wide Environmental Health Managers group)
- Public Health and Air Quality Forum (County wide group including Public Health colleagues). this element of knowledge transfer was ongoing throughout the course of the project.
- Updates to elected members (through member briefings, and also as part of a cabinet update).

In addition, it is likely that there will also be some dissemination of outcomes to the public through ongoing communications methods, as resources allow. Any other opportunities for knowledge transfer will also be taken. An overview of the project was also included in Local Air Quality Management (LAQM) annual reporting (ASR).

Stakeholder Engagement
Throughout the project, the public were engaged with, mainly through social media and local media as set out in the Communications Plan. Other stakeholders were also engaged with, in particular other local authorities (for example through the Environmental Protection Best Practice Group

(Leicestershire wide Environmental Health Managers group), and Leicestershire County Council (public health), as well as elected members in each of the local authorities.

4. Project outputs and benefits

The main project outputs have been the results of both phases of the questionnaire, and the monitoring analysis report (outlining the outputs of 12 months of monitoring funded by this project). Both are included as appendices to this report. Less tangible outputs relate to increased communications work on air quality, particularly solid fuel burning, which have been illustrated through the communications plan (also included in the appendices).

Project benefits include:
- increased knowledge about $PM_{2.5}$ concentrations (through monitoring)
- increased awareness around domestic solid fuel burning (both within the local authorities involved, more widely across the County and with the public)
- more knowledge within the local authorities about PM monitoring methods and analysis

Effectiveness of the Project

The project was led by North West Leicestershire District Council, in collaboration with Harborough Borough Council. The collaborative nature of the project was enhanced by the two authorities sharing an air quality officer, who works 50% FTE in each authority. This also provided consistency in implementation across the two authorities. Another benefit of the joint approach was a reduction in administration time (which effectively covered both authorities), for example with regards to getting the monitoring in place, and undertaking surveys (which were implemented across both authorities), and with regards to undertaking progress reports etc. Also in terms of staff shortages, for example when the communications officer from Harborough left the authority and was not immediately replaced, this was mitigated largely by the project being implemented across 2 authorities, with the communications plan still being delivered by North West Leicestershire, in partnership with other members of the project team in Harborough.

North West Leicestershire and Harborough District Councils' options for action on $PM_{2.5}$ are limited and need to be supported by relevant local information. Available evidence is extremely uncertain for domestic solid fuel use, particularly in terms of activity levels (i.e., what proportion of households are burning sold fuel, what fuel and how often it is being burnt, and in what appliances). Nationally, surveys have shown that for the great majority of users, wood is a secondary heating fuel. This suggests that the majority of users could therefore be amenable to a behavioural change intervention.

The main aim of the project was to reduce emissions from solid fuel burning through behaviour change, but also raise awareness of solid fuel burning more generally. Reduced emissions should ultimately reduce pollutant ($PM_{2.5}$) concentrations within solid fuel burning areas, and therefore improve health. It is not possible from the small sample size of the follow up questionnaire to identify any positive behaviour change, although 50% of respondents thought that their awareness of the impacts of solid fuel burning had increased (not necessarily as a direct result of this project). Of those responding to the follow up survey, a third had changed behaviour in the last 6 months, with marginally more increasing burning than decreasing. The main reasons for these changes were cited as cost, or 'other' with one respondent saying the change had been down to more knowledge on impacts.

Although the project did not result in a clear signal for solid fuel burning at the locations monitored, the questionnaires showed that there was potentially a high level of solid fuel burning, with most respondents who burn inside, burning wood. It is judged that the effectiveness of the project has been less tangible, in terms of providing a base to build on for doing further work on solid fuel burning, rather than in providing robust data on which to base an emission inventory or provide input data for modelling studies.

It is noted that there are a number of factors external to the project which may simultaneously be affecting levels of solid fuel burning, in particular the effect of an increased cost of living on increasing burning behaviour, and the implementation of the Domestic Solid Fuel Regulations (which reduces the availability of 'wet' wood through a ban on sales in smaller quantities, and bans the sale of house coal in England). The questionnaires asked to respondents as to whether they thought that the cost of living would change their behaviour. in the first phase approximately half of respondents thought the cost-of-living crisis would result in an increase in their burning habits and in the second phase of the questionnaire, approximately 40% of respondents said that they would increase burning and the other 60% saying it wouldn't change behaviour.

The project team were asked to feedback on what went well, and what didn't go as well. The benefits of the project have been identified across the team as:
- the collaborative working with both authorities, through structured meetings on teams and the use of an action log;
- the use of consultants to support the project through the application and implementation phases;
- the good use of comms teams across both authorities to support public awareness work, and the questionnaire; and
- a good response from businesses to support prizes for the questionnaires.

Elements that were less successful were identified as:
- issues with siting the monitors;
- limited engagement from the public;
- lack of resources to really push the behaviour change element of the project work; and
- the poster competition planned for Clean Air Day needed more clarity on purpose, and more time for planning and incorporating into the project.

What would be done differently/ advice for other local authorities
Prior to the project being bid for, there could have been a more realistic consideration of the actual resource (in terms of staff time) needed to take forward and progress the project. The time required by a team of people (including comms teams, air quality officers etc.) was underestimated at the outset, which was reflected in the overspend on staff time (see section 5 for details). This is an element which needs to be carefully considered prior to taking on a project such as this, particularly at a time with staff resource issues within local authorities.

It is also considered that with more resources, other methods of engagement with the public could have been undertaken as well as further collaboration either at County level, or with other similar grant funded projects, or more widely through other organisations such as Global Action Plan collaborative working for Clean Air Night.

With this type of project, the messaging needs to be carefully thought about at the outset. For example, using messaging around 'burning better' (i.e., using seasoned wood, maintaining appliances etc), can come across as endorsing wood burning, when for many users (particularly those who use it for aesthetic purposes), the message around burning less needs to be clearer. for future projects, messaging needs to be agreed at the outset of the project.

One of the key difficulties of the project, was low response rates for questionnaires. This was addressed mainly through the communications strategy, with media stories through both social media and in the local press continue to promote the project (providing a link to the questionnaire) and council officer presence at local events to further promote the project. However, it may be that different approaches could be tried in future similar projects to increase the level of data on which the behavioural change outcomes were based.

5. Financial Performance

The following table provides an overview of both the revenue and capital spend on the grant project. The overspend was mainly on the match funding element, which was provided through staff time on the project, particularly in implementing the questionnaire, and undertaking public awareness communications (through social media and at other events). The capital spend was used for the monitoring. The revenue spend related to the data analysis which was contracted out. Financial performance was judged to be good, with spend on the grant funded elements of the project, as predicted at application stage.

High Level Financial Summary at completion of Project				
	£ RDEL Defra grant	£ CDEL Defra grant	£ Match Funding	£ Total
Original application values	£6,000	£21,240	£2,745	£29,985
Total project cost at project completion	£6,000	£21,555 (£12,175 (3X zephyrs), + £1,505 (for lamppost surveys) + £2,025 (for Zephyr renewal HDC) + £5,850 (Zephyr renewal NWLDC)	£4,700.39	£32,092.39
Over/ underspend at project completion	n/a	£315 overspend	£1,955.39 overspend	Overspend mainly on match funding

6. Signatory

Name of Officer at the local authority:

Clare Proudfoot

Name of Local Authority:

North West Leicestershire District Council

Date:

15th April 2024

7. Appendix A: Monitoring Analysis Report

Air Quality Monitoring Report:
Domestic Solid-Fuel Burning Grant Funded Project

December 2023

Document Control

Client	North West Leicestershire District Council and Harborough Council	**Principal Contact**	Minna Scott (NWLDC)

Job Number	J10/12348A/10

Report Prepared By:	Suzanne Hodgson, Dr Kate Wilkins and Dr Clare Beattie

Document Status and Review Schedule

Report No.	**Date**	**Status**	**Reviewed by**
J10/12348A/10/1/F1	21 December 2023	Final Report	Dr Ben Marner (Director)

Contents

1   Introduction

1.1   Poor air quality is one of the greatest environmental risks to public health in the UK. Long term exposure to air pollution can cause chronic conditions such as cardiovascular and respiratory diseases as well as lung cancer, leading to reduced life expectancy. Short term exposure (over hours or days) to elevated levels of air pollution can also cause a range of health effects related to lung function, exacerbation of asthma, increases in respiratory and cardiovascular hospital admissions, and mortality. There are a number of other emerging links for air pollution and health, including dementia, a variety of mental health conditions, and adverse pregnancy outcomes.

1.2   This report provides the results and analysis of a 12-month $PM_{2.5}$ monitoring programme carried out at three sites in the administrative areas covered by North West Leicestershire (NWL) and Harborough District Council's, as part of a Defra grant funded project investigating domestic solid fuel burning. The key objective of the project was to reduce $PM_{2.5}$ emissions by increasing awareness of, and changing attitudes to, solid fuel burning, resulting in behaviour change. Changes could include a reduction in burning or use of fuels which have lower emissions (for example, dry wood has lower emissions than unseasoned wood). To support the project, 12-months of air quality monitoring was undertaken at three sites which were thought to represent areas with high levels of domestic solid fuel burning, in order to provide a better understanding of current concentrations, how they vary and how they relate to overall $PM_{2.5}$ emissions within the NWL and Harborough areas. AQC has been commissioned by NWL and Harborough District Council's to collate the data and provide an interpretation of the outcomes of the monitoring study.

1.3   The three sites were selected in off gas areas where there is old housing stock, using local knowledge, to best represent areas of high levels of solid fuel burning. Monitoring at the three sites was undertaken using Zephyr monitors (provided by Earthsense[1]). This report provides the results and analysis of the 12-month monitoring programme (15th September 2022 to 30th September 2023), at the three sites, to determine both the concentrations at the sites, and if measured $PM_{2.5}$ concentrations in the vicinity of each site show any influence of solid-fuel wood burning. Analysis has been undertaken based on standard statistics for comparison with air quality objectives and targets and 'openair' (Carslaw D. R., 2012) software[2] to derive a range of graphical plots. Comparison has also been made between the Zephyr data and results from nearby urban background sites within Defra's Automatic Urban and Rural Network (AURN) (Defra, 2023a).

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[1] https://www.earthsense.co.uk/zephyr

2 'openair' is an R package (which is a programming language for statistical computing and graphics) developed for the purpose of analysing air quality data.

2   Context

2.1   Emissions from solid fuel burning will mainly impact on concentrations of Particulate Matter (PM), which is the term for particles found in the air, including dust, dirt, soot, smoke, and liquid droplets. PM has many different sources, both natural and anthropogenic, including solid fuel burning. In terms of the health effects, exposure to $PM_{2.5}$ (PM less than 2.5 micrometres in diameter) is the most important, although other pollutants all add to the burden of disease, to a greater or lesser extent. Current evidence suggests that there is no safe threshold for exposure to $PM_{2.5}$. For this reason, the analysis will focus on $PM_{2.5}$.

2.2   Wood burning stoves and coal fires are a major contributor nationally to emissions of particulate matter, and the Government is taking steps to tackle these emissions, largely through the Domestic Solid Fuel Regulations which have phased out sales of bagged coal and wet wood, two of the most polluting fuels. Accompanying information campaigns such as 'Burn Better' encourages solid fuel users to make positive changes to their burning habits.

Air Quality Objectives and Targets

2.3   The Government has established a set of air quality standards and objectives to protect human health. The 'standards' are set as concentrations below which effects are unlikely even in sensitive population groups, or below which risks to public health would be exceedingly small. They are based purely upon the scientific and medical evidence of the effects of an individual pollutant. The 'objectives' set out the extent to which the Government expects the standards to be achieved by a certain date. They take account of economic efficiency, practicability, technical feasibility and timescale. There is no current air quality objective in regulations for $PM_{2.5}$ for local authorities to meet, and in the absence of a numerical objective, it is convention to assess local air quality against the limit value, originally set at 25 $\mu g/m^3$ and currently set at 20 $\mu g/m^3$.

2.4   Resulting from the Environment Act (2021), which gives the Government the power to set long-term, legally binding environmental targets, Defra has set two targets, and two interim targets, for $PM_{2.5}$ concentrations in England. One set of targets focuses on absolute concentrations. The long-term target is to achieve an annual mean $PM_{2.5}$ concentration of 10 $\mu g/m^3$ by the end of 2040, with the interim target being a value of 12 $\mu g/m^3$ by the start of 2028. The second set of targets relate to reducing overall population exposure to $PM_{2.5}$. By the end of 2040, overall population exposure to $PM_{2.5}$ should be reduced by 35% compared with 2018 levels, with the interim target being a reduction of 22% by the start of 2028. Local authorities have an important role delivering the required improvements, which are expected to focus on controlling emissions.

2.5   The air quality criteria relevant for this monitoring report are provided in Table 1.

Table 1:   Air Quality Objectives for PM$_{10}$ and Target for PM$_{2.5}$

Pollutant	Time Period	Value
PM$_{10}$	24-hour Mean	50 µg/m^3 not to be exceeded more than 35 times a year
	Annual Mean	40 µg/m^3
PM$_{2.5}$	Annual Mean	20 µg/m$^{3\ a}$
		12 µg/m^3 (to be achieved by 2028)
		10 µg/m^3 (to be achieved by 2040)

[a]   There is no numerical PM$_{2.5}$ objective for local authorities (see Paragraph 2.3). Convention is to assess against the UK limit value which is currently 20 µg/m^3.

Sources and Variation in PM$_{2.5}$

2.6   PM$_{2.5}$ concentrations vary across the year. For example, a peak in early spring is typical for PM$_{2.5}$, as elevated concentrations of nitrates (a pre-curser to PM$_{2.5}$) are transported from agricultural operations across continental Europe (Air Quality Expert Group, 2012). Domestic combustion of wood and coal in stoves and open fires is a large contributor to emissions of PM$_{2.5}$ and is a contributing factor towards elevated concentrations in winter months. There are, however, also meteorological reasons why PM$_{2.5}$ may be higher in colder months. PM$_{2.5}$ includes volatile components which exist as gases when warm, only forming PM$_{2.5}$ when it turns cold. Colder air is also denser than warmer air and when the temperature drops, cold air can form a barrier to the dispersion of pollutants (Defra, 2023b). Hence comparisons with temperature may not be solely attributable to peaks in solid fuel burning.

2.7   It should be noted that there are a large number of emission sources for particulate matter, and there may be other sources which contribute to changing concentrations. There can be considerable contribution from sources originating outside of the UK. The level of transboundary derived particulates is determined by wider-scale emissions and weather conditions.

3   Monitoring Locations and Technology
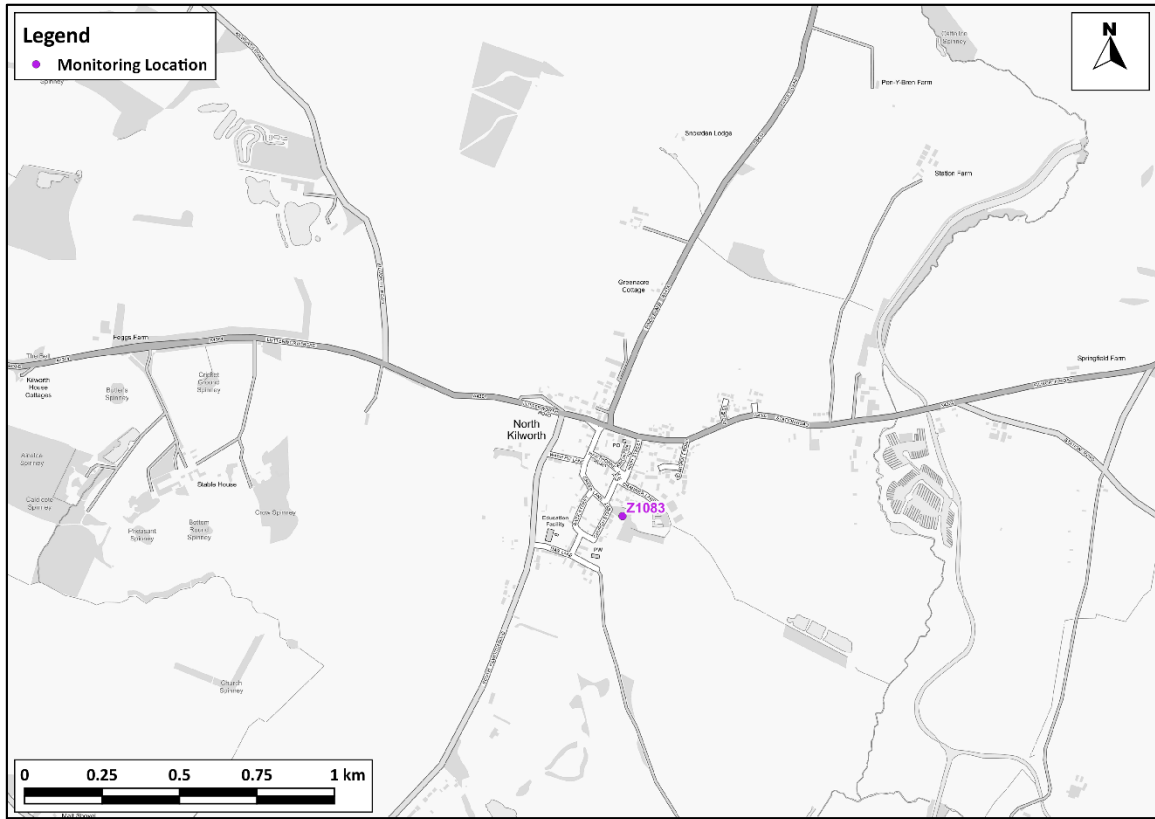
Monitoring Locations

3.1   Monitoring was undertaken at three locations within the study area, the locations are listed below and shown in Figures 1a and 1b:

- Z1141 – Donisthorpe

- Z1142 – Oakthorpe

- Z1083 – North Kilworth
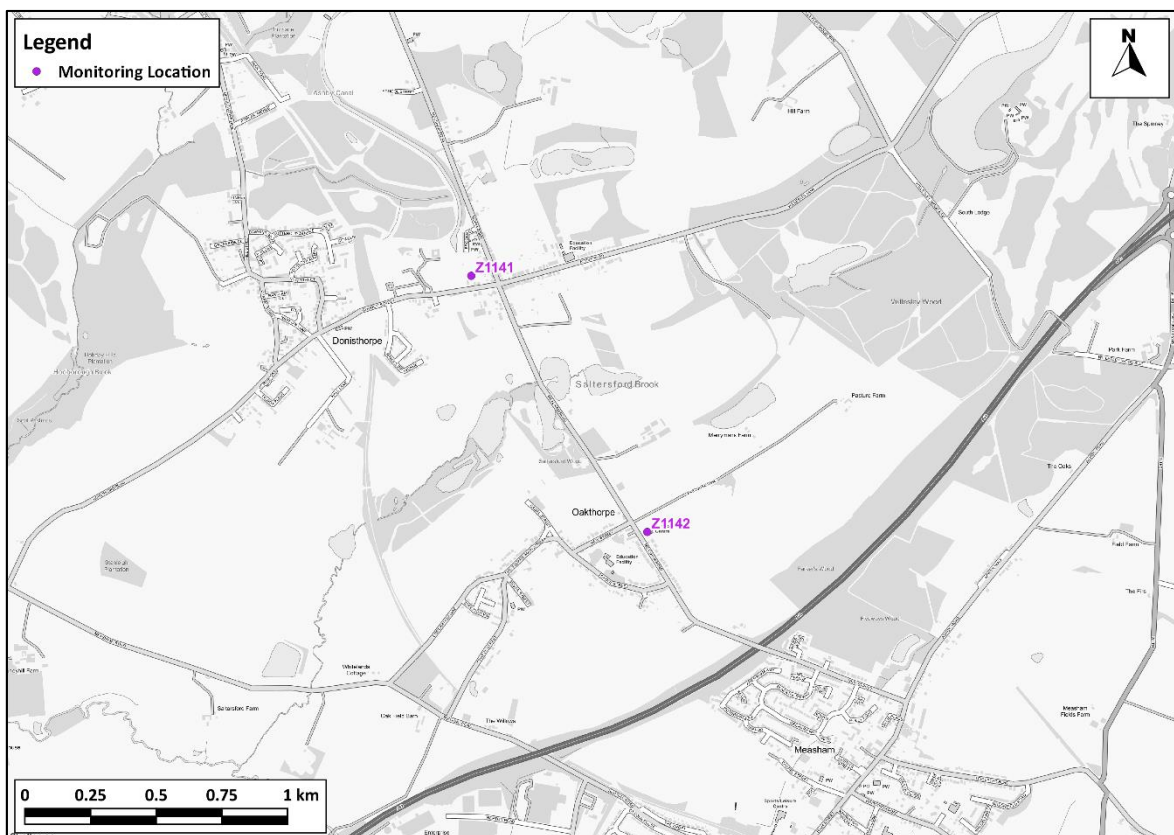
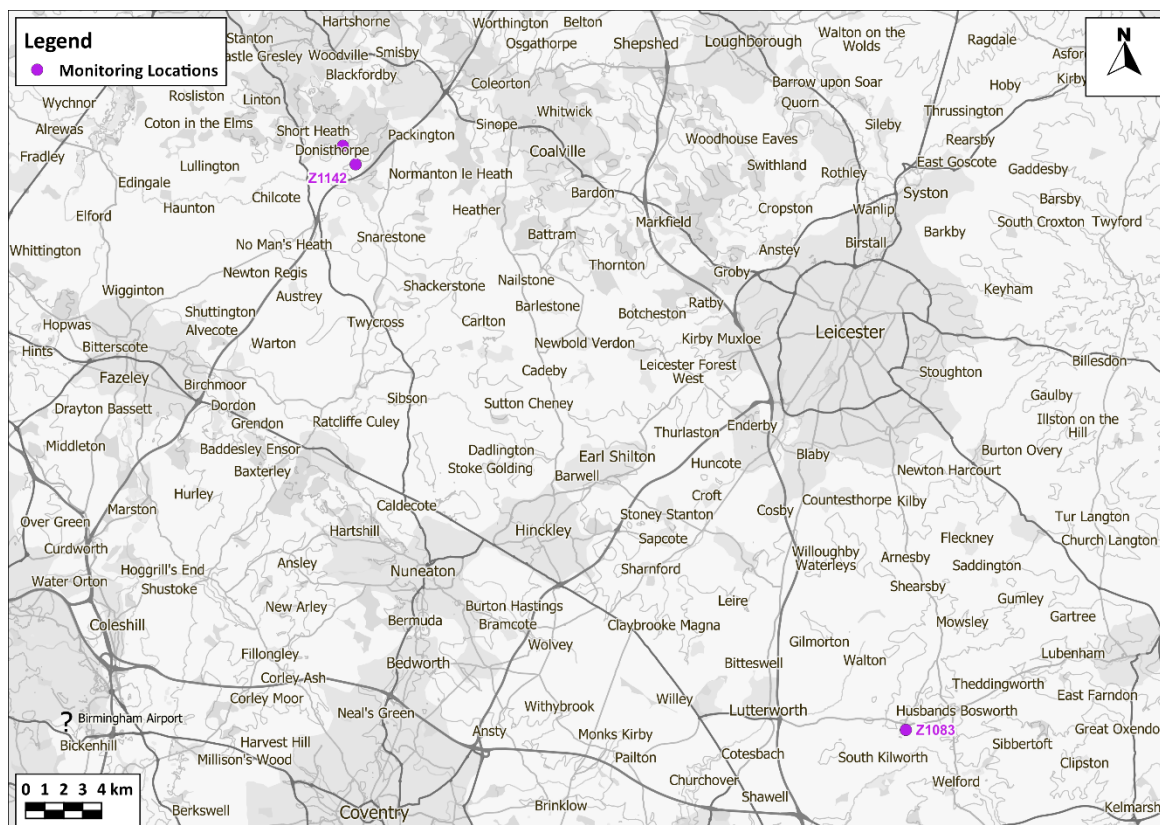**Figure 1a: Location of Z1141 (Donisthorpe) and Z1142 (Oakthorpe)**

Imagery ©2023 Getmapping plc, Infoterra Ltd & Bluesky, Maxar Technologies, The GeoInformation Group.

Figure 2b: Location of Z1083 (North Kilworth)

Imagery ©2023 Getmapping plc, Infoterra Ltd & Bluesky, Maxar Technologies, The GeoInformation Group.

3.2   The locations of all three monitors are also shown in Figure 2; to contextualise the overall geographic location of the monitors within the districts.

Figure 2:   Location of Z1141 (Donisthorpe), Z1142 (Oakthorpe) and Z1083 (North Kilworth)

Imagery ©2023 Getmapping plc, Infoterra Ltd & Bluesky, Maxar Technologies, The GeoInformation Group.

Monitoring Equipment

3.3   Particulate matter (PM_{10} and $PM_{2.5}$) monitoring was undertaken using Zephyr analysers, which use sensors to measure various parameters, which include $PM_{2.5}$ (µg/m^3), PM_{10} (µg/m^3) and temperature (°C).   Measurements were carried out at the three sites for a 12-month period, between 15th September 2022 to 30th September 2023. Although PM_{10} is included in the statistics for comparison with relevant objectives and targets, this report discusses $PM_{2.5}$, which is the focus of the project, has the greatest health effects and is of increasing concern to government, local authorities and the public (see Section 2).

3.4   Zephyrs are not considered to be 'reference equivalent'[3], but have been approved as compliant with the Monitoring Certification Scheme - MCERTS performance standards - as an indicative ambient particulate monitor[4]. The uncertainties and limitations to the use of sensors for monitoring pollutant concentrations are outlined in Section 4.

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[3] The definition of 'reference equivalent' refers to a monitoring method that meets a certain standard to ensure accuracy and precision of results – in the UK, monitors that operate within Defra's AURN (Defra, 2023a), are considered to be reference equivalent.

[4] https://www.earthsense.co.uk/post/zephyr-meets-indicative-mcerts

Quality Assurance

3.5   The analysers are calibrated for performance and operation annually, outside of this no quality checks on data check are carried out. By way of validation of the data being recorded, data were downloaded from each monitor periodically ensure the values being recorded were within the expected range and broadly fitted expected patterns.

4 Monitoring Analysis Methodology

4.1 Statistical analysis has been undertaken on the measured pollutant concentrations for the three Zephyrs, for comparison with the air quality criteria outlined in Table 1.

4.2 Further analysis has subsequently been undertaken on the measured concentrations, using 'openair' software, to determine if the monitoring shows any influence of nearby solid fuel burning. As part of this analysis, the results of monitoring (for the same period of time as the Zephyrs) undertaken at three nearby urban background (UB) sites (Leicester University, Northampton Spring Park and Burton-on-Trent Horninglow[5]), operating within the AURN have also been considered – the expectation being that as they are 'background' sites, they would not be influenced by specific pollutant sources, such as nearby domestic solid fuel burning.

4.3 The following plots have been produced:

- Time plots – designed to plot a chronological time series of data, such as pollutant concentration or temperature;

- Time variation plots – this function produces four plots: day-of-the week variation, mean hour-of-day variation and a combined hour-of-day to day-of-week plot and a monthly plot; and

- Polar plots[6] – a bivariate plot of concentrations, varying by wind speed and wind direction.

Uncertainty

4.4 All methods of air quality monitoring have inherent uncertainties. The use of sensors may have additional uncertainties because the analytical chemistry method is more uncertain than reference methods. For example, many sensors are sensitive to changes in atmospheric humidity and temperature, or can give false signals if other air pollutants are present in high concentrations. Additionally, Zephyrs have no form of on-going quality control or calibration applied to them once in the field, unlike reference measurements (Defra, 2023c).

4.5 The Zephyr monitors measured concentrations for one year between 15th September 2022 and 30th September 2023, thus any conclusions drawn based on seasonality should be treated with caution.

4.6 Where data have been extracted for specific dates, times and temperatures to determine whether there is a correlation between measured concentrations and weather conditions, these have been based on judgement about when solid fuel burning is likely to be most prevalent.

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5 The Leicester and Burton monitors are FIDAS; the Burton monitor is a BAM (heated) – where applicable, all used measured concentrations used has been corrected to be 'reference equivalent'

6 Modelled meteorological data (wind speed and direction) derived from the WRF (Weather Research and Forecasting Model) have been downloaded for the Leicester University AURN monitor (LECU), as it is deemed the most representative nearby AURN monitoring site.

4.7   The meteorological data used to create the polar plots shown in Appendix A2 are derived using openair**Error! Bookmark not defined.** and are not site-specific to the monitoring locations. As such, definite conclusions cannot be drawn by comparing the measured $PM_{2.5}$ concentrations and wind direction/wind speed, and the meteorological data can only be used to indicate a potential source of $PM_{2.5}$ emissions.

4.8   Significant care is needed when comparing $PM_{2.5}$ measurements made using different monitoring equipment, particularly when comparing analysers such as the Zephyrs with those within the AURN. The analysis is also limited, to some extent, by the interpretation of data from a single monitoring site within each of the villages.

5   Results and Analysis

Simple Statistics

5.1   The particulate matter (PM_{10} and $PM_{2.5}$) concentrations for the three Zephyrs are summarised in Table 2. Data capture was good across the three sites (89.6 – 96.4%) over the monitoring period. The recorded annual mean PM_{10} and $PM_{2.5}$ concentrations were well below the objective and limit value of 40 µg/m^3 and 20 µg/m^3, respectively. The recorded annual mean $PM_{2.5}$ concentration is marginally above the interim target for 2028 (12 µg/m^3) at Z1141. There was only one measured exceedance of the 24-hour mean objective level of 50 µg/m^3 across the three sites, in Donisthorpe (Z1141), compared with the 35 exceedances allowed in a year; at the other sites there were no 24-hour periods measuring more than 50 µg/m^3. The 90th percentile of daily mean concentrations were also well below 50 µg/m^3, at all sites.

Table 2: Particulate Matter Data Summary for Z1141, Z1142 and Z1083, September 2022 to September 2023

Pollutant	Metric	Z1141 (Donisthorpe)	Z1142 (Oakthorpe)	Z1083 (North Kilworth)	Objectives
PM_{10}	Maximum 24-hour Mean	212.6 µg/m^3	41.2 µg/m^3	36.7 µg/m^3	-
	No. 24-Hour Means >50 µg/m^3	1	0	0	50 µg/m^3; no more than 35 exceedances
	90th Percentile	25.4 µg/m^3	25.3 µg/m^3	21.7 µg/m^3	50 µg/m^3
	Period Mean (12months)	13.7 µg/m^3	12.0 µg/m^3	13.7 µg/m^3	40 µg/m^3
$PM_{2.5}$	Period Mean (12months)	12.4 µg/m^3	11.0 µg/m^3	9.9 µg/m^3	20 µg/m^3
	Data Capture	89.6%	96.4%	95.9%	-

'openair' Analysis

5.2   Figures showing the local Zephyr measurements, as well as measurements from the AURN sites, and an analysis of results are set out in Appendix A2.   The data have been examined specifically to find any signal that solid fuel burning is taking place in the vicinity, and comments are included to that effect within Appendix A2. Evidence of the effects of Solid Fuel Burning are not clear cut, for a number of reasons, which are set out in paragraphs 2.6 and 2.7 and in Appendix A2.

6   Conclusions

6.1   A 12-month PM_{10} and $PM_{2.5}$ monitoring programme was carried out in three villages (Donisthorpe, Oakthorpe and North Kilworth) in NWL and Harborough. The monitoring was funded through a grant funded project awarded to NWL and Harborough District Councils, to support work to increase public awareness of the air quality impacts of solid-fuel burning. This report provides an overview of the monitoring results, to try to identify any quantified evidence of domestic solid fuel burning in the three villages.

6.2   Measured concentrations are below national air quality objectives/targets at the three monitoring sites during the 12-month monitoring period, other than at Donisthorpe which is marginally over the target value for 2028.

6.3   Detailed statistical analysis of the monitoring results, using 'openair' software included in Appendix A2, has not identified any clear influences from solid fuel burning in the vicinity of the any of the monitors. The plots produced seem to show periods of higher concentrations, at times, during colder temperatures, during the evening and over the weekend, which could be interpreted as times when residents are more likely to be burning solid fuel, however, as noted in Section 2, variations in $PM_{2.5}$ can occur for multiple reasons, due to source, meteorology, chemistry or measurement method; in the absence of a clear signal from the monitoring data and its subsequent analysis, it is concluded that data are not clear enough to draw a conclusion as to what is driving these elevated concentrations.

7   References

Air Quality Expert Group. (2012). *Fine Particulate Matter (PM2.5) in the United Kingdom.*

Carslaw, D. R. (2012). openair — An R package for air quality data analysis. *Science Direct*, 52-61.

Defra. (2023a). *Defra AURN Archive.* Retrieved from https://uk-air.defra.gov.uk/interactive-map?network=aurn

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Defra. (2023c). *Low cost pollution sensor - understanding uncertainties.* Retrieved from https://uk-air.defra.gov.uk/research/aqeg/pollution-sensors/understanding-uncertainties.php#:~:text=For%20example%2C%20many%20sensors%20are,are%20present%20in%20high%20concentrations

Environment Act 2021. (2021).

8   Appendices

A1   Summary of AURN Results

A1.1   Particulate matter (PM_{10} and $PM_{2.5}$) concentrations, for three urban background sites within the AURN network, within 50 miles of the Zephyr sites, for the same period of monitoring (September 2022 to September 2023) are summarised in Table A1.1. Measured concentrations (across parameters) at all of the Zephyrs were higher than the AURN background concentrations.

Table A1.1: PM_{10} Data Summary of Background Monitoring Sites, 2022

Pollutant	Statistic	Leicester University	Northampton Spring Park[a]	Burton on Trent Horninglow
PM_{10}	**Maximum 24-hr mean (µg/m³)**	47.5	n/a	45.6
	No. 24-hr mean >50 µg/m³	0	n/a	0
	90th Percentile	19.7	n/a	19.5
	Period Mean (µg/m³)	11.7	n/a	12.1
$PM_{2.5}$	**Period Mean (µg/m³)**	7.3	7.6	7.5
	Data Capture (%)	98.0	89.0	56.4

[a] This site does not measure PM_{10}.

A2 'openair' Plots

Donisthorpe (Z1141)

Time Plots

A2.1   Figure A2.1 shows a time series plot of daily mean $PM_{2.5}$ concentrations at site Z1141. It also shows the daily mean $PM_{2.5}$ averaged across each of the AURN sites and the daily average recorded temperature. A visual examination of the data shows that the Zephyr and AURN average follow broadly similar patterns and that, where there are differences between the two; these differences appear on visual inspection to be smaller than the shared range in the two sets of concentrations. The highest concentrations at both types of sites appear to broadly coincide with the lowest air temperatures, with the data also showing some elevated concentrations in spring and late summer. It is difficult to say whether the higher concentrations which coincide with lower temperatures are caused by solid fuel burning, for the reasons set out in paragraphs 2.6 and 2.7.

Time Variation Plots

A2.2   Figure A2.2 shows measured data according to day-of-the-week, month-of-the-year and time-of-the-day, across the monitoring period; the plot indicates elevated concentrations in the evening time, in particular during September to December 2022 and on a Sunday in general.

A2.3   Figure A2.3, which shows measured data according to temperature[12], indicates elevated concentrations during times when temperatures are below 10°C and in the evening time in general. This is a common observation which often correlates with the condensing of ammonium nitrate. The increase in Sunday concentrations appears to be caused at times where the temperature is over 10 degrees and hence is unlikely to be as a result of solid fuel burning.

Polar plots

A2.4   Figure A2.4 shows the measured concentrations as a function of wind direction and wind speed. The colour shows the measured concentration, the direction from the centre of the plot (where the horizontal and vertical black lines cross) shows the wind direction, and the distance from the centre shows the wind speed when that concentration was measured. It is often the case that sources which are some distance away, or released from tall chimneys, are associated with higher wind speeds, which bring plumes back to ground. Nearby sources which emit close to ground are often associated with slower wind speeds, which could indicate an influence from domestic solid fuel burning, but there can also be many other reasons for higher concentrations when wind speeds are low and hence it is difficult to attribute it to a specific source with any certainty.

A2.5   Figure A2.4a, which shows measured data during cold winter nights[7], shows the highest concentrations occurred during the lowest wind speeds (centre of the plot), and from all wind directions. The all-other time plot (Figure A2.4b) shows the highest concentrations occurred at slow wind speeds, with higher concentrations also when winds were from the east and southeast. Higher concentrations tend to be associated with stronger winds from the south and northeast when the temperature was cold, and from the east and southeast when it was warmer.

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[7] 'Cold winter nights' are defined in this study as any temperature <10°C, 6 pm to midnight, between 1st November 2022 to 1st March 2023.

Figure A2.1: Time series plot of daily mean PM$_{2.5}$ concentrations (µg/m^3) at Z1141 (blue), average AURN PM$_{2.5}$ concentrations (µg/m^3) (red) and temperature (at Zephyr) (°C) (green), September 2022 to September 2023
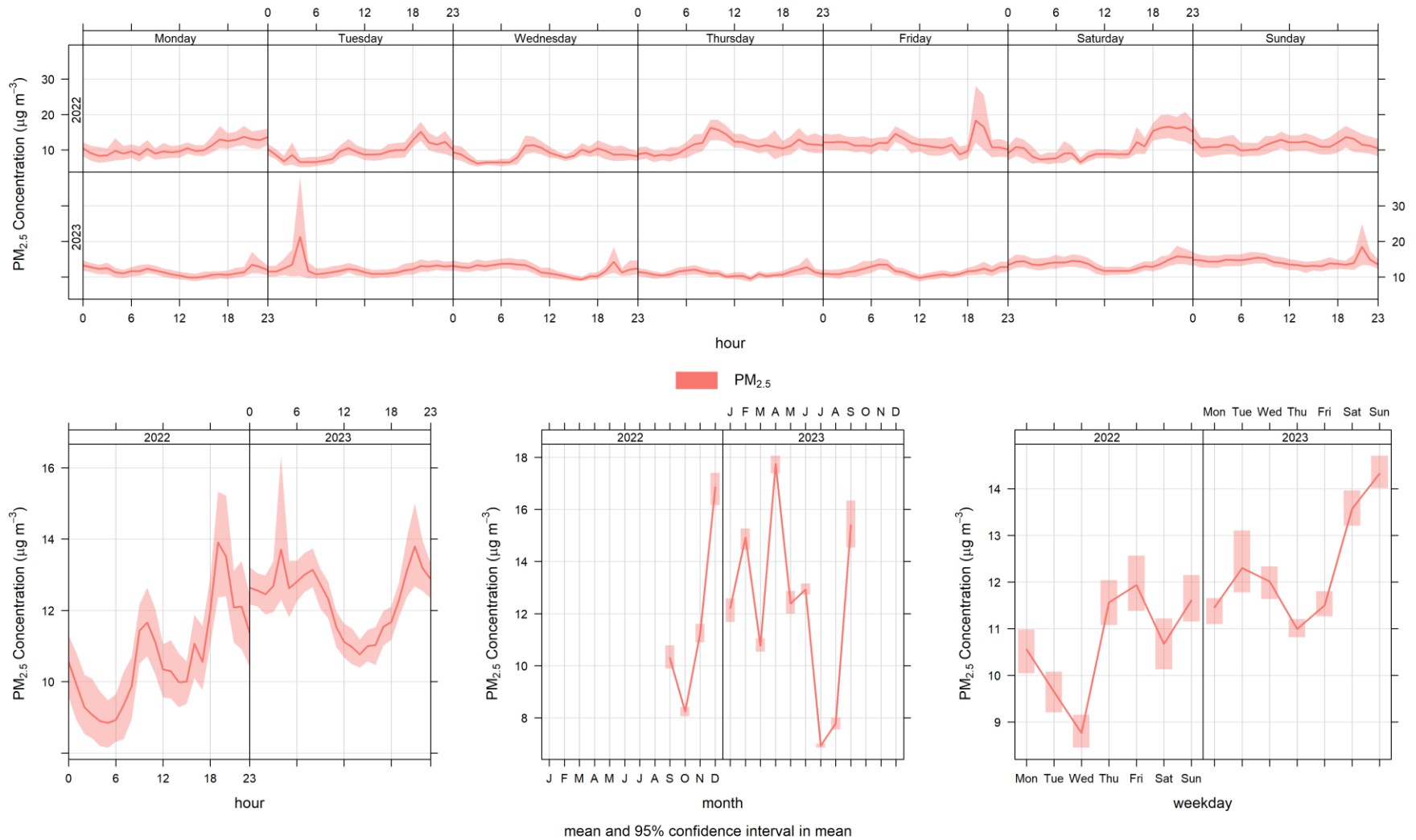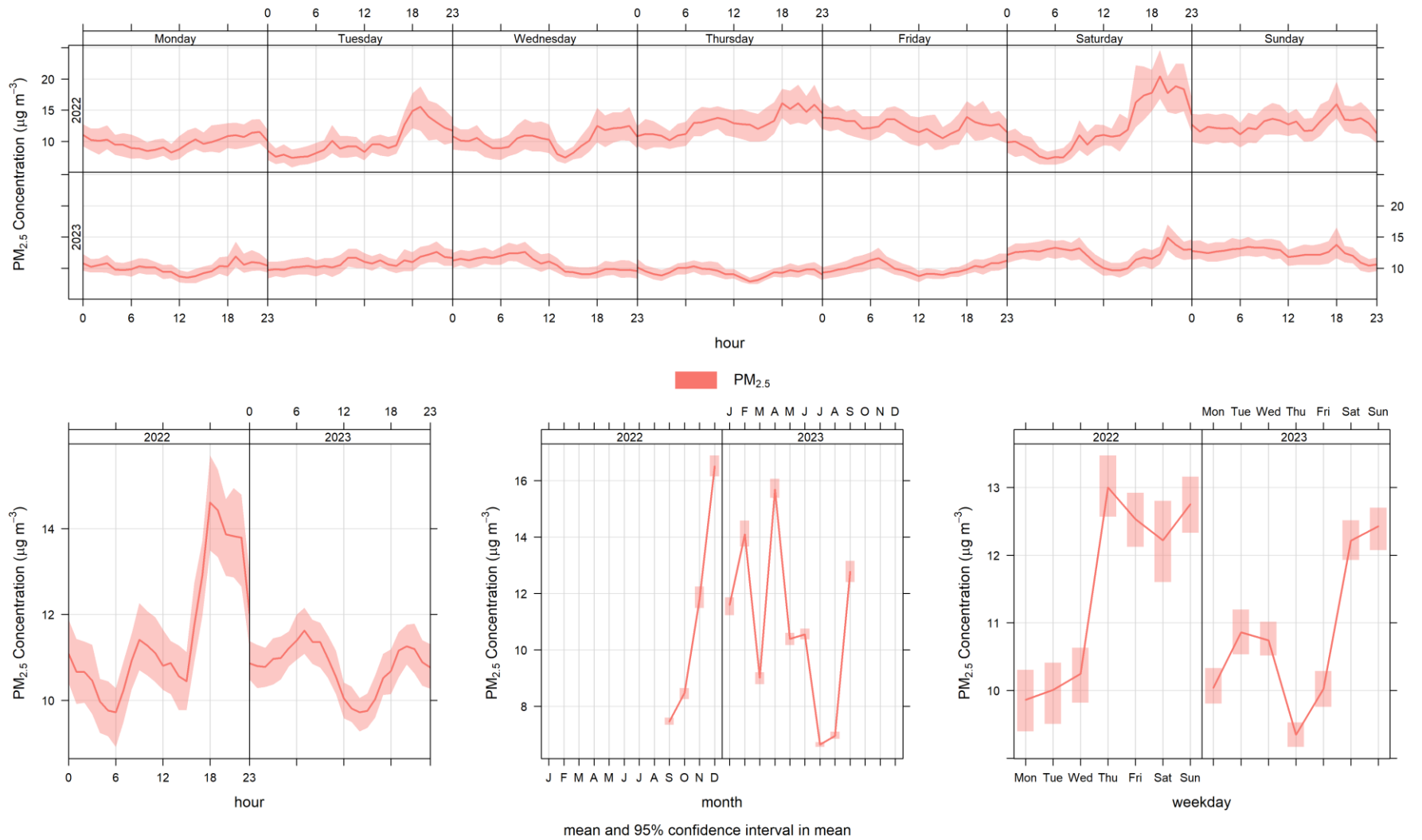
Figure A2.2: Time variation plot of measured PM$_{2.5}$ concentrations (µg/m^3) at Z1141, September 2022 to September 2023
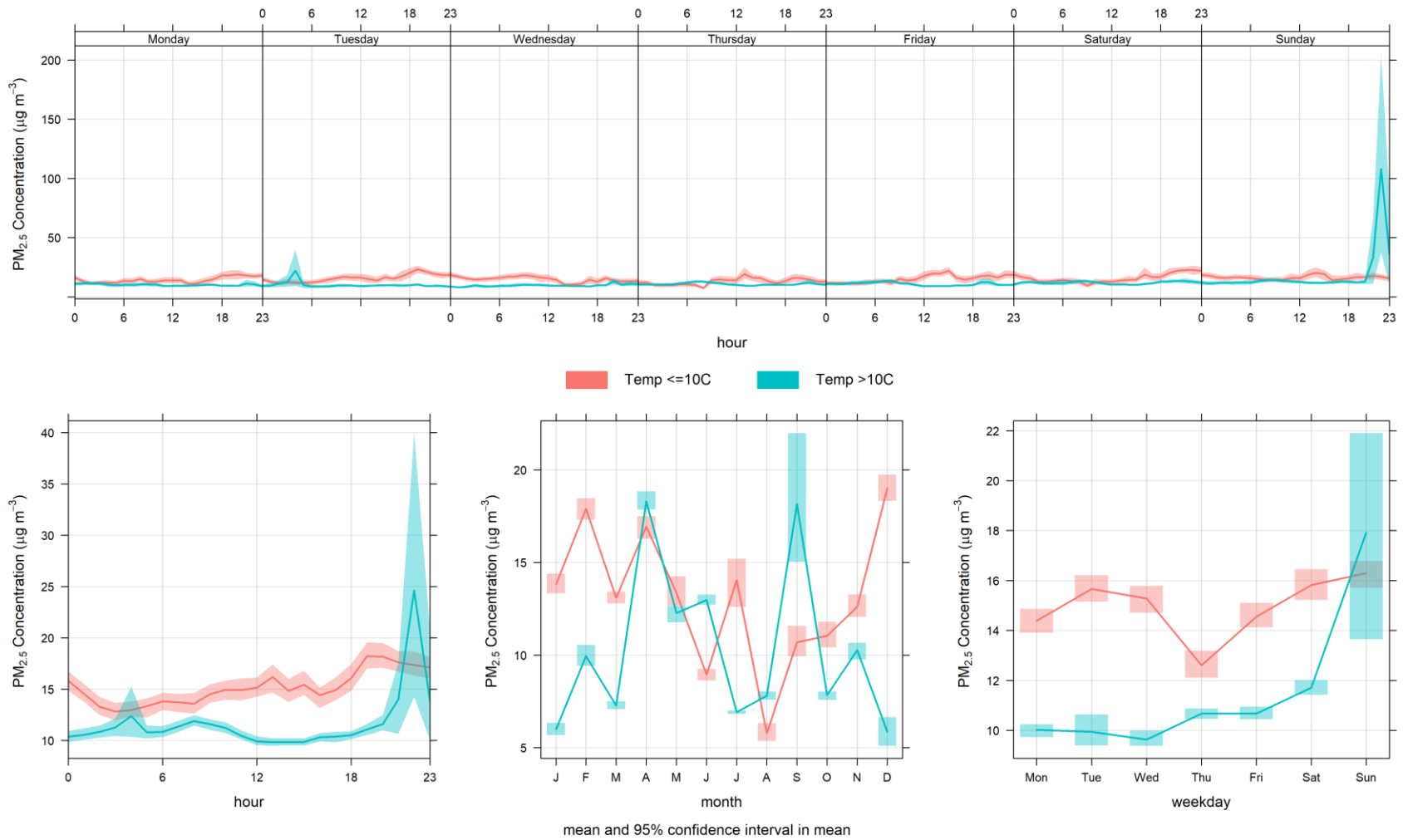
Figure A2.3: Time variation plot of measured PM$_{2.5}$ concentrations (µg/m^3) at Z1141, September 2022 to September 2023, with concentrations separated according to whether the ambient temperature was greater, or less than, 10°C
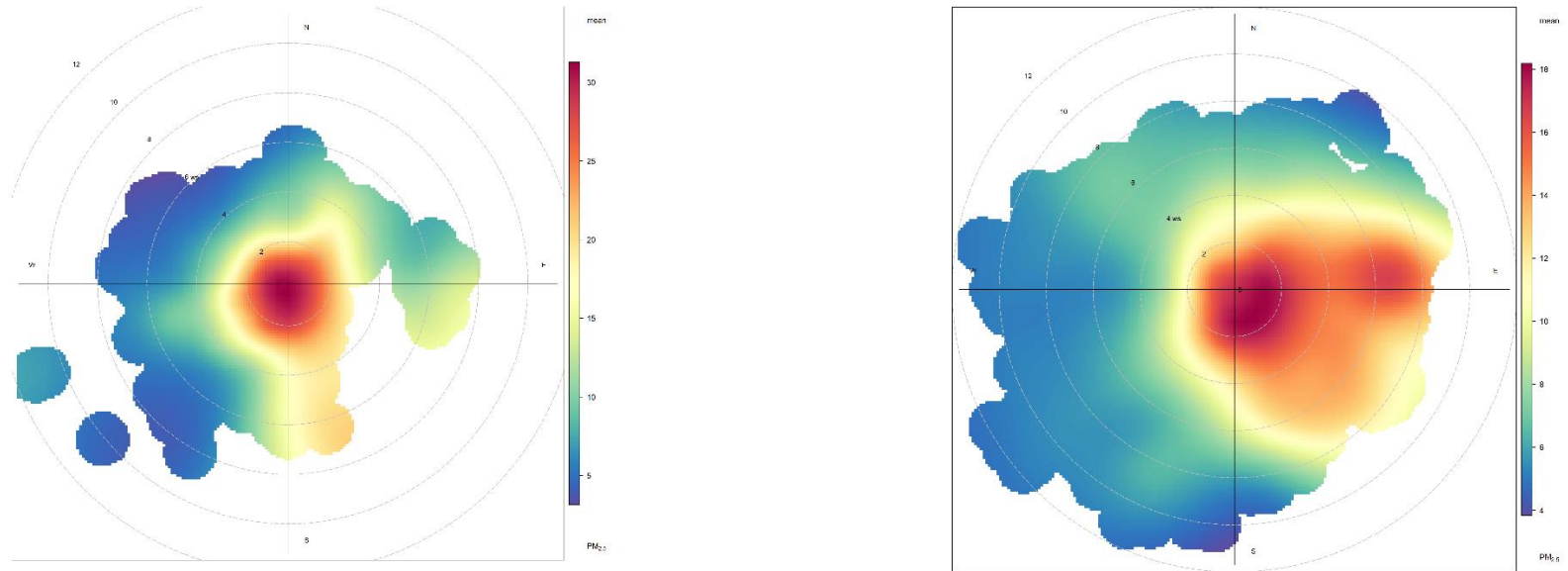
Figure A2.4: Bivariate Pollution Roses at Z1141, September 2022 to September 2023, accounting for 'cold winter nights'[8] (a - left) and rest of the period (b - right), PM$_{2.5}$ (µg/m^3)

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[8] 'Cold winter nights' are defined in this study as any temperature <10°C, 6 pm to midnight, between 1st November 2022 to 1st March 2023.

Oakthorpe (Z1142)

Time Plots

A2.6   Figure A2.5 shows a similar pattern over time at Z1142 and the AURN sites. A visual examination of the data shows that the Zephyr and AURN average follow broadly similar patterns and that, where there are differences between the two; these differences appear on visual inspection to be smaller than the shared range in the two sets of concentrations. The highest concentrations at both types of sites appear to broadly coincide with the lowest air temperatures, with the data also showing some elevated concentrations in spring and late summer. It is difficult to say whether the higher concentrations which coincide with lower temperatures are caused by solid fuel burning, for the reasons set out in paragraphs 2.6 and 2.7.

Time Variation Plots

A2.7   Figure A2.6 shows measured data, according to day-of-the-week, month-of-the-year or time-of-the-day, across the monitoring period; the plot indicates elevated concentrations in the evening time, and on Thursday through to Sunday during September to December 2022, which may coincide with times of higher solid fuel burning.

A2.8   Figure A2.7, which shows measured data according to temperature, indicates elevated concentrations during times when temperatures are below 10°C, in the evening time in general and on Saturday and Sunday, which again, could indicate an influence from domestic solid fuel burning, although as discussed, it is difficult to attribute the elevated concentrations to this source with certainty.

Polar plots

A2.9   Figure A2.8a, which shows measured data during cold winter nights[9], shows the highest concentrations occurred during the lowest wind speeds (centre of the plot) from all wind directions and also at higher windspeeds when winds blew from the south. The all-other time plot (Figure A2.8b) has a stronger signal from the east and southeasterly directions. These are most likely to reflect long-range transport, although local sources, such as domestic solid fuel burning, may also affect the observed patterns.

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[9] 'Cold winter nights' are defined in this study as any temperature <10°C, 6 pm to midnight, between 1st November 2022 to 1st March 2023.

Figure A2.5: Time series plot of daily mean PM$_{2.5}$ concentrations (µg/m^3) at Z1142 (blue), average AURN PM$_{2.5}$ concentrations (µg/m^3) (red) and temperature (at Zephyr) (°C) (green), September 2022 to September 2023
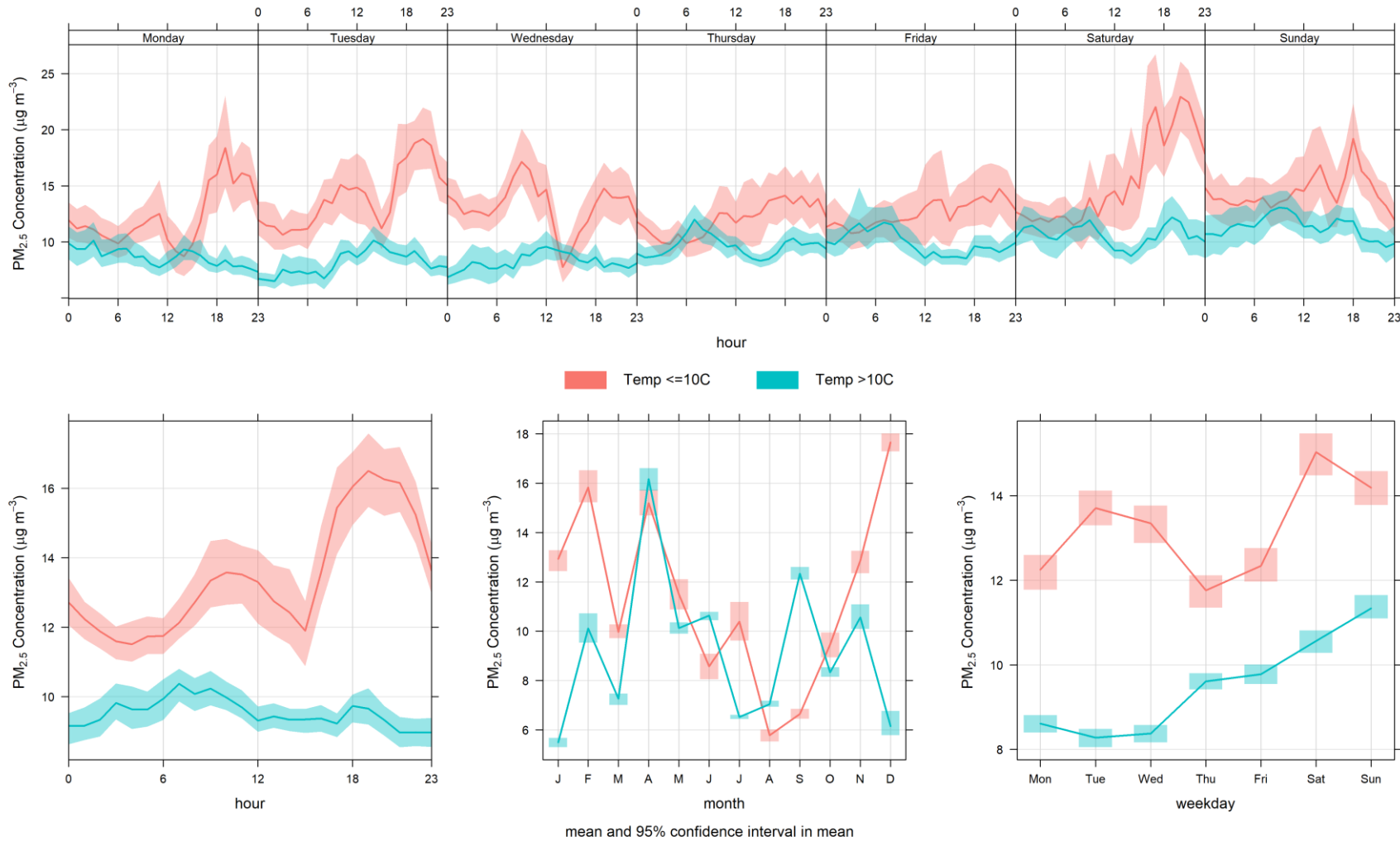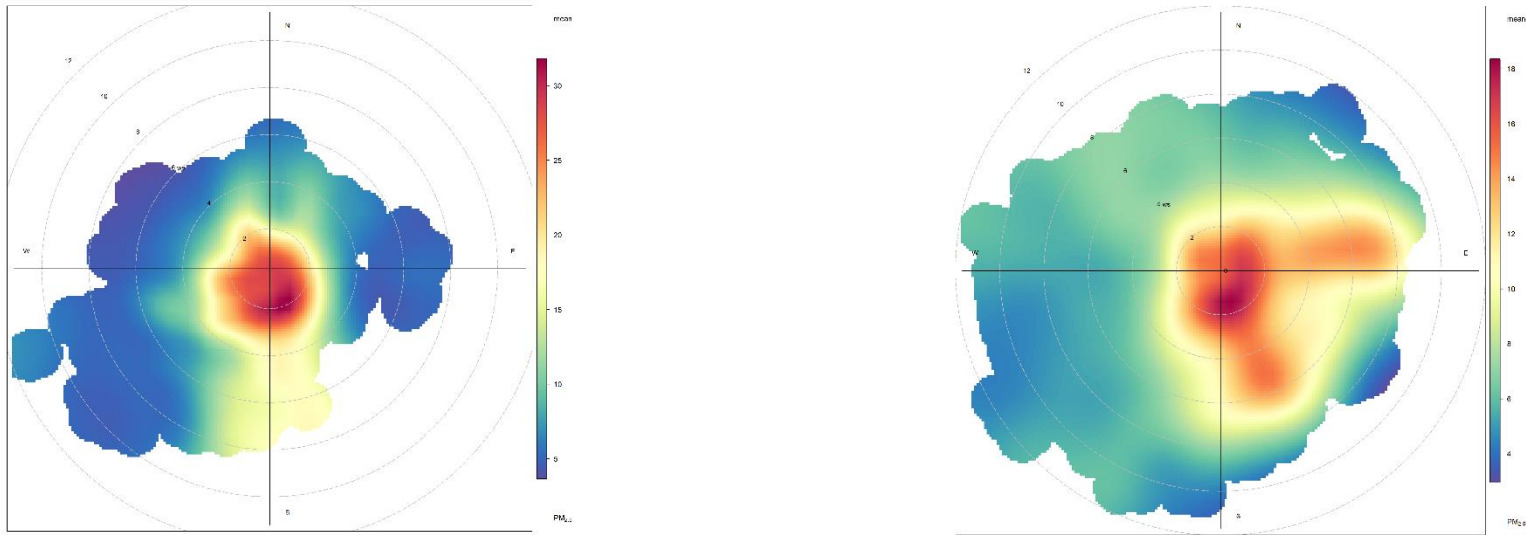
Figure A2.6: Time variation plot of measured PM$_{2.5}$ concentrations (µg/m^3) at Z1142, September 2022 to September 2023

Figure A2.7: Time variation plot of measured PM₂.₅ concentrations (µg/m³) at Z1142, September 2022 to September 2023, with concentrations separated according to whether the ambient temperature was greater, or less than, 10°C

Figure A2.8: Bivariate Pollution Roses at Z1142, September 2022 to September 2023, accounting for 'cold winter nights'[10] (a - left) and rest of the period (b - right), PM$_{2.5}$ (µg/m³)

North Kilworth (Z1083)

Time Plots

A2.10   Figure A2.9 shows a similar pattern over time at Z1083 and the AURN sites. A visual examination of the data shows that the Zephyr and AURN average follow broadly similar patterns and that, where there are differences between the two; these differences appear on visual inspection to be smaller than the shared range in the two sets of concentrations. The highest concentrations at both types of sites appear to broadly coincide with the lowest air temperatures, with the data also showing some elevated concentrations in spring and late summer. It is difficult to say whether the higher concentrations which coincide with lower temperatures are caused by solid fuel burning, for the reasons set out in paragraphs 2.6 and 2.7.

Time Variation Plots

A2.11   Figure A2.10 shows measured data, according to day-of-the-week, month-of-the-year and time-of-the-day, across the monitoring period; the plot indicates elevated concentrations on Thursday, Friday and Sunday during September to December 2022 and on Saturday and Sunday during January to September 2023. There also appear to be elevated concentrations in the morning. It is difficult to attribute these patterns to domestic solid fuel burning.

A2.12   Figure A2.11, which shows measured data according to temperature, clearly indicates elevated concentrations during times when temperatures are below 10°C, which could be attributable to domestic solid burning, but for reasons already set out, it is difficult to be definitive regarding source.

Polar plots

A2.13   Figure A2.12a, which shows measured data during cold winter nights, shows the highest concentrations occurred during the lowest wind speeds (centre of the plot), from all wind directions. The all-other time plot (Figure A2.12b) shows the highest concentrations also occur during a range of wind speeds, during winds with a southern and easterly component. The higher concentrations at lower windspeeds indicate the potential predominance of a local source, such as domestic solid fuel burning, but it is difficult to be definitive on sources of $PM_{2.5}$.

Figure A2.9: Time series plot of daily mean PM$_{2.5}$ concentrations (μg/m^3) at Z1083 (blue), average AURN PM$_{2.5}$ concentrations (μg/m^3) (red) and temperature (at Zephyr) (°C) (green), September 2022 to September 2023
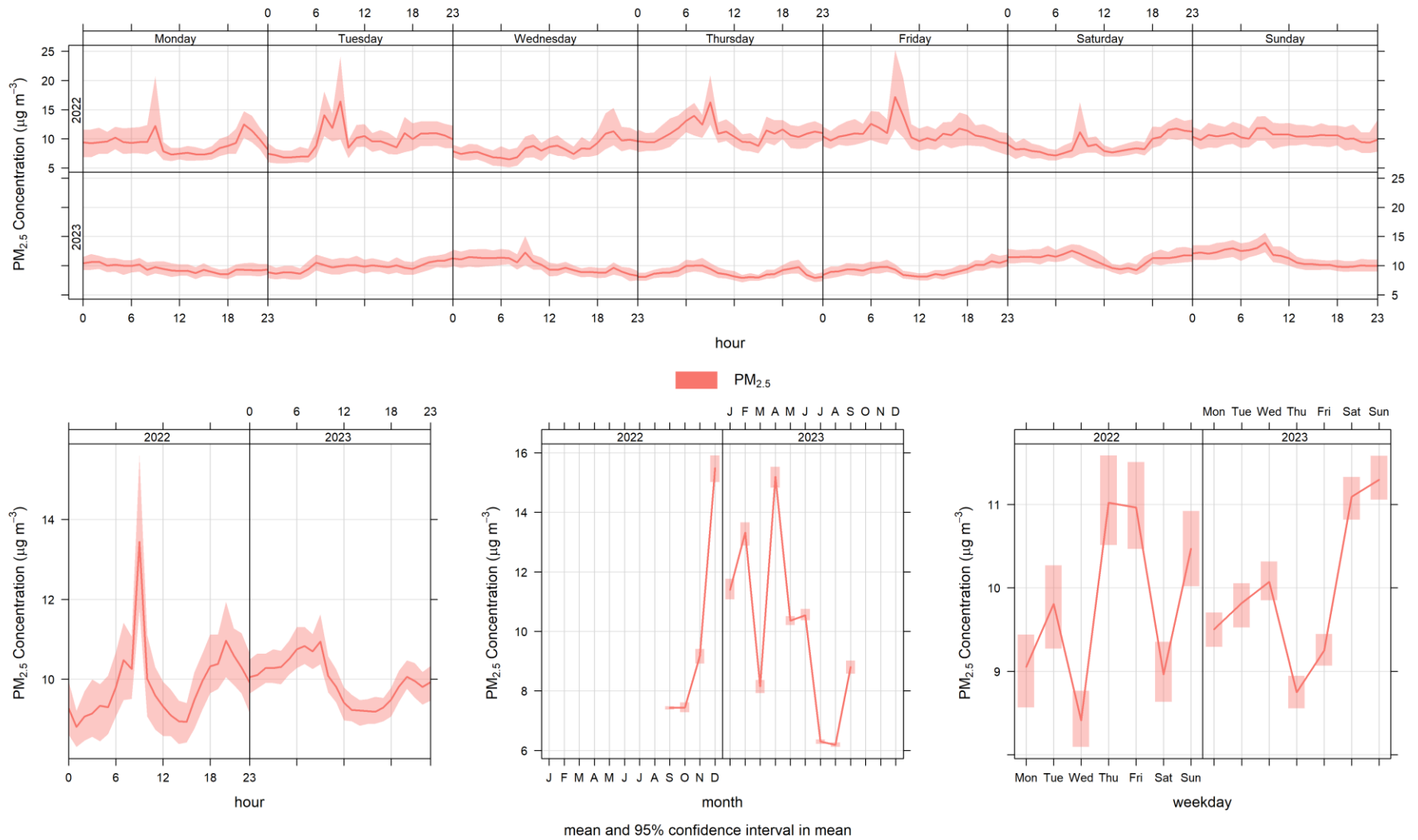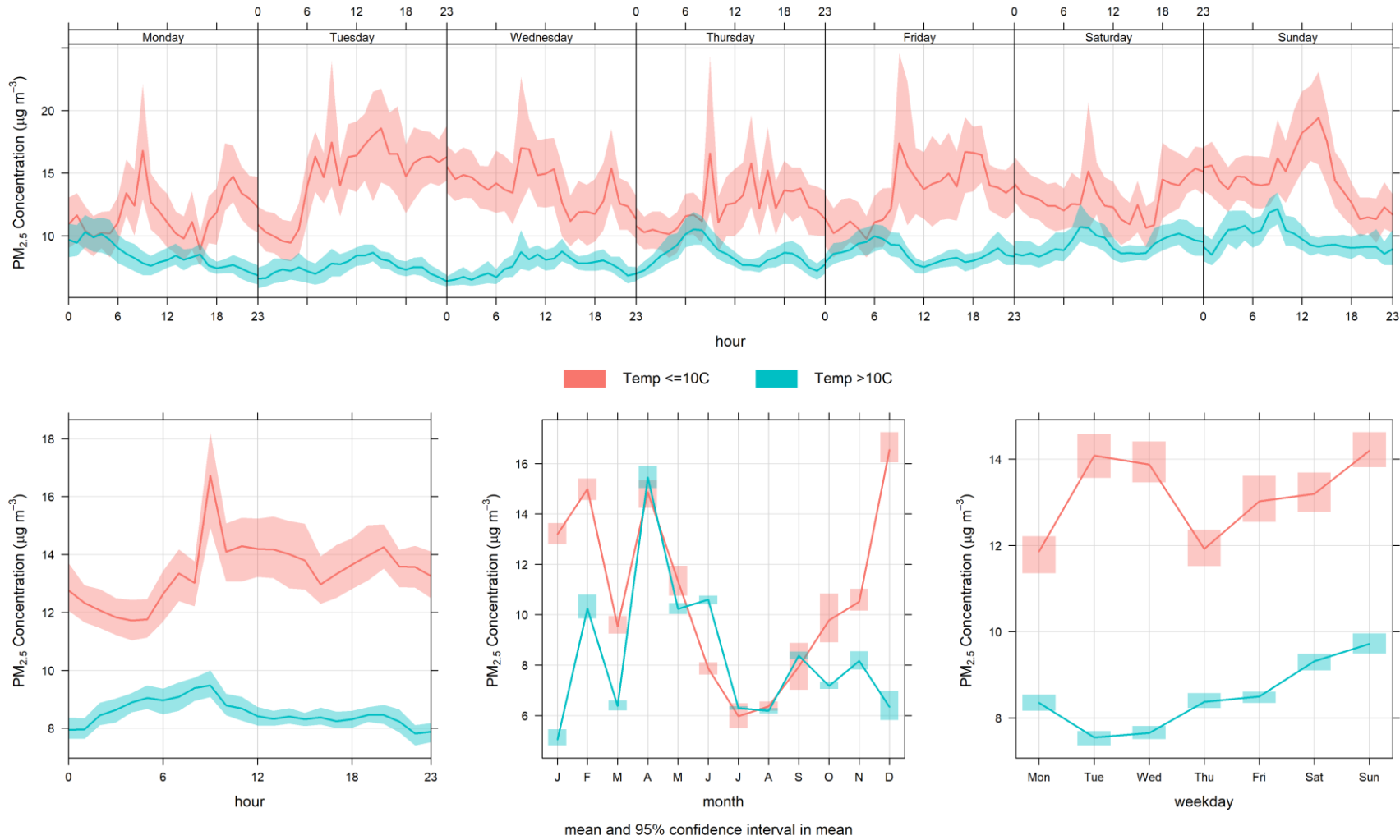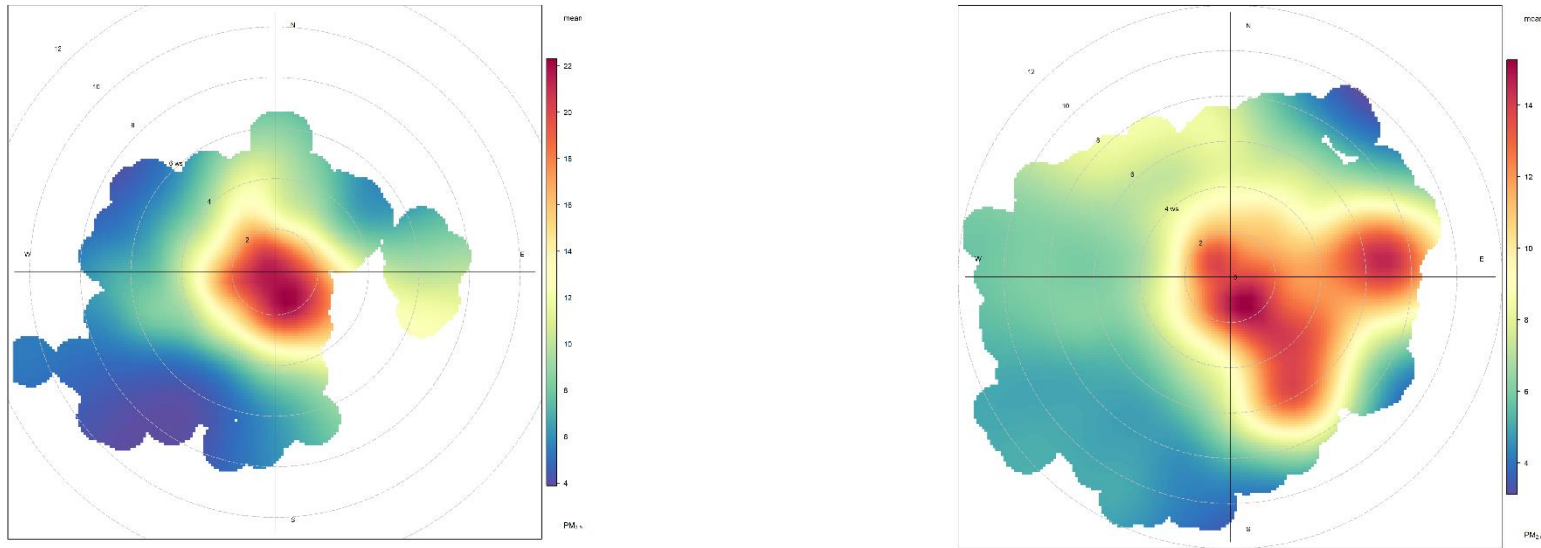
Figure A2.10: Time variation plot of measured PM$_{2.5}$ concentrations (µg/m^3) at Z1083, September 2022 to September 2023

Figure A2.11: Time variation plot of measured PM$_{2.5}$ concentrations (µg/m^3) at Z1083, September 2022 to September 2023, with concentrations separated according to whether the ambient temperature was greater, or less than, 10°C

Figure A2.12: Bivariate Pollution Roses at Z1083, September 2022 to September 2023, accounting for 'cold winter nights'[10] (a - left) and rest of the period (b - right), PM$_{2.5}$ (µg/m³)

8. Appendix B: Communications Plan

DEFRA Air quality project Communications plan

Project manager	Clare Proudfoot
Author	Caroline Ormond
Date	June 2022
Last updated	June 2022

Background

- North West Leicestershire District Council (NWLDC) and Harborough District Council (HDC) have successfully bid for DEFRA funding to look into air quality issues

- There are two grants - a capital grant for monitoring equipment and surveys (£21,240), and a revenue grant for data analysis (£6,000) totalling £27,240. Match funding from both councils provides a further £2,745 (based on officer time)

- The project (air quality monitoring, surveying and targeted behaviour change campaigning) will be located in two settlements – Donisthorpe and Oakthorpe in North West Leicestershire and Kilworth in Harborough

- The chosen communities do not have mains gas supply in the main and households may use solid fuel as their main heating system. Some households may still receive free coal.

- The project will monitor for particulates (tiny, harmful particles that are released into the air when burning solid fuels, and from other sources) in each community

- Monitors will be installed within the settlements to give readings of particulate levels every 15 minutes – this monitoring will take place over 12 months, giving the councils a good idea of particulate concentration in the air, and any variations over time

- The monitoring equipment is the same used elsewhere in each district

- The campaign aims to educate people – within the target settlements and across each district - about the negative impact of burning solid fuels – and hopes to lead to behaviour change with people choosing cleaner fuels or alternative heating systems, and maintaining their existing systems

Target audiences

- Residents in project communities – Oakthorpe and Donisthorpe, and Kilworth – This will be a 50% random selection of properties out of the total number.
- Selected households in project communities – a targeted survey group to complete a follow up survey
- Parish councils
- Community groups – online and in person
- All district residents
- Ward councillors
- All councillors

Key messages

- Particulates can be damaging to people who breathe them in, particularly those with respiratory illnesses, like Asthma, younger people and older people

- In communities like Oakthorpe and Donisthorpe / Kilworth, there could be increased amounts of particulates in the air because more people may burn solid fuel as their main heat source (because there is no mains gas)

- Everyone can help to reduce particulates in the air. Simple changes can make a big difference:
  - Change the appliance (moving to a modern wood burner from an open fire cuts down particulates by about 90%)
  - Change the fuel you use to a 'cleaner' solid fuel (e.g. burning seasoned, rather than unseasoned wood reduces particulates)
  - Maintain your system (e.g. sweep the chimney once a year)

- Your local district council is monitoring air quality in your community to get a clearer picture of particulates present in the air you breathe

- This project aligns with NWLDC and HDC's ongoing air quality monitoring strategy, which, along with other local authorities across the UK has focussed on traffic related pollutants such as nitrogen dioxide. Consideration of particulates is part of a shift in focus at national level through updated legislation, which is likely to require further action by local authorities.

- North West Leicestershire and Harborough have generally good air quality. Councils have a duty to monitor to help make improvements in areas that are found to have poorer air quality

Objectives	- To recruit residents to a targeted survey group, to improve response rates - To raise awareness about the negative impact of solid fuel burning, fuel choice, heating system choice and maintenance within the targeted group and wider community surveyed - To communicate effectively about the monitoring, minimising any anxiety amongst the communities - To effectively communicate the results of the monitoring and next steps - To build on DEFRAs existing 'Burn better' campaign and the existing Global Action Plan resources (using graphics and branding where possible)
Communication tools (think about your audiences – what are the best ways of communicating with them?)	- Leaflets / letters – hand delivered and posted out - Community events – face to face - Direct contact with key stakeholders and influencers – phone and email - Social media (organic and paid), using known influencers, community groups, with graphics and video content to increase reach - Traditional media - E-newsletters - Internal communications – intranet / Member Hub / newsletters

Date	What is being communicated?	To who?	Using which communication tool(s)?	Key message	How will you monitor communication success?
4.4.22	Announcement of funding	All audiences	News release Social media Member communication Internal communication	NWLDC and HDC have been granted funding to raise awareness and tackle air pollution in the two districts	Story carried in five local media outlets (7 instances) Leicester Mercury x 3 Burton Mail x 1 Nub News x 1 Harborough FM x 1 Harborough Mail x 1 Social media engagement rate / reach
16.6.22	Clean Air Day Initial gentle messaging giving key messages about solid fuel	All audiences	Social media	Appliance | Fuel | Maintenance	Social media engagement rate / reach
June 2022	Overview of project Installation of monitoring equipment	All audiences	News release and photo opp Social media Member communication	Project overview Photo showing equipment Appliance | Fuel | Maintenance	*This didn't happen due to delays in installing the equipment.*

Sep 2022	Overview of project – request for support	Parish councils Ward councillors – Cllr Ashman	Direct contact (phone / email)	Overview of project How parish councils can support	Parish councils agree to support the project Ward councillors aware of the project and committed to raising awareness
Sep 2022	Recruitment of targeted survey group	Target households	Leaflet drop Social media (targeted – community groups)	'Get involved' messaging	Recruit target number of households
Sep / Oct 2022	Messaging giving key messages about solid fuel – awareness raising Installation of the monitoring equipment. Using national awareness days (e.g. Big Green Week) and festivals (e.g. Bonfire night) to promote messaging Sensitivity required around Cost of Living crisis	All audiences	Social media	Appliance | Fuel | Maintenance Cheapest clean fuel options in the winter months Maintenance increases efficiency	Social media engagement rate / reach HDC Twitter 432 Impressions 10 Engagements HDC Facebook 336 reach 7 engagements HDC press release x 1 Harborough FM x 1 NWLDC news release x 1 Story carried in three local media outlets – Nub News, Coalville Times, Leicester Mercury

					Four NWLDC Facebook posts during October 2022 – total reach 9,903 accounts
Oct / Nov 2022	Survey	Target communities Parish councils	Printed publicity (banners, posters, flyers) Social media (paid and organic) Direct contact (parish councils)	Take part in survey (incentive?)	No. of surveys completed
April 2023	Survey results	All audiences	News release (stats) Social media Member communication	Results of survey Link to project Appliance | Fuel | Maintenance	Story carried in two local media outlets – Nub News and Coalville Times One NWLDC Facebook post – total reach 1,191 accounts
March 2023	Follow up survey	Target households Target communities Parish councils	Target audience (previously respondents)	Take part in survey (incentive?)	No. of surveys completed
16 June	Clean Air Day	All audiences	News release Social media	Appliance | Fuel | Maintenance	No. of engagements HDC twitter 359 impressions

			Website		24 engagements
			Member comms		HDC Facebook 164 reach 5 engagements
			Internal comms		
			Letters to 5 Schools in NWL - School Competition		HDC Instagram 229 reach 3 engagements
54					NWLDC – one Facebook post (shared Clean Air Day assets) – 584 accounts reached

Possible opportunities:

- Halfway point – monitoring results
- Links with clean solid fuel suppliers (discount, sponsorship?)
- Competitions / incentives
- 'Show home' – linked to supplier, improves heating system and monitored for the community to see

9. Appendix C: Questionnaire Responses

Solid Fuel Burning Project:
Summary of Baseline Questionnaire Reponses

January 2023

Experts in air quality
management & assessment

Document Control

Client	North West Leicestershire District Council	Principal Contact	Leigh Oliver

Job Number	J10-12348C-10

Report Prepared By:	Dr Clare Beattie

Document Status and Review Schedule

Report No.	Date	Status	Reviewed by
J10-12348C-10A/1/F1	12 January 2023	Draft	Choose an item.

1   Introduction

1.1   The objective of the project is to increase the level of knowledge of $PM_{2.5}$ and ultimately reduce $PM_{2.5}$ emissions by changing attitudes to solid fuel burning, resulting in behaviour change. There is increasing local public concern around $PM_{2.5}$ across North West Leicestershire and Harborough, who are jointly undertaking this project. It is recognised that currently there is little information in relation to current concentrations, how concentrations vary across the districts and how the magnitude of contributions from different sources relate to the overall emissions. The project will use a combination of additional monitoring, and a public awareness programme to achieve these objectives.

1.2   The project started with communication around solid fuel burning (general social media posts etc), and when the air quality monitoring was installed. A baseline questionnaire survey was undertaken prior to the main winter solid fuel burning season, to gauge attitudes, and levels of solid fuel burning. The survey focussed on the villages where monitoring is being undertaken, but was available more generally across the districts between 3rd October and 30th November 2022[1]. This short note summarises the responses to the questionnaire up to the end of November 2022.

1.3   Further communications aimed at behaviour change (burning less and cleaner) are being undertaken throughout the winter season. Monitoring will continue for a year, in 3 locations identified as having the potential to have high levels of burning, following which a further questionnaire survey will be undertaken to assess any changes in attitudes or behaviour.

1.4   There were 73 responses (39 from Harborough District Council, 24 from North West Leicestershire District Council and 3 of unknown address).

1.5   The graphs in Section 3 are automatically produced by Power-Bi software.

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[1] Available at https://consultation.nwleics.gov.uk/communities/air-quality/

2   Summary of Outcomes

2.1   The following summarises the key outcomes of the questionnaire responses for the baseline survey which ran from 3 October to the 30th November 2022. There was already a very high awareness of that solid fuel burning can have a detrimental effect on health (Figure 1).

2.2   Approximately 75% of respondents had burnt solid fuel (inside or outside) in the last 12 months (Figure 2), with most respondents who burnt inside, burning wood, or manufactured fuels/ smokeless coal (Figure 3). Most respondents who burnt outside, burnt charcoal or wood (Figure 4). There was a relatively low level of burning waste wood, garden wate or household rubbish (inside or outside) (Figure 5 and Figure 6).

2.3   The appliances used by respondents inside were mostly wood burners or enclosed fireplaces, followed by open fires, outside, appliances were mainly barbeques or chimeneas (Figure 7). Most respondents didn't know whether their burner is an appliance approved by Defra or ecodesign appliance, but in cases where respondents knew what type of burner they had, there was a good take up of Defra approved or ecodesign wood burners (Figure 8). It is likely that the respondents that knew what type of stove they had, were those who had purchased one recently.

2.4   The main purpose of burning was for heat, but some respondents also used their appliance for cooking, aesthetics and hot water (Figure 9). Most of the use of appliances was during the evenings, with weekends slightly more popular than during the week (Figure 10). Respondents mainly got their wood from specialist suppliers (also from their own garden, salvaged wood, landowners, fallen trees, family members etc) (Figure 11). Most respondents were not aware of Woodsure's Ready to Burn (Figure 12). However, despite this, the majority of respondents buy seasoned wood, or season it at home, with no respondents saying that they bought unseasoned wood (Figure 13).

2.5   With regards to maintenance, over half of respondents sweep their chimney/ maintain wood burner at least once a year (Figure 14). Roughly half of respondents thought the cost-of-living crisis would result in an increase in their burning habits (Figure 15).

2.6   90% of respondents would be willing to do a follow up survey, which should include comparable questions in order that changes in behaviours or attitudes can be picked up.

3 Data from Questionnaire Results

3.1 The following data have been provided by North West Leicestershire District Council, using Power-Bi software and are reproduced below.

**1. Are you aware of the impacts of solid fuel burning and health impacts**

Figure 1:   Awareness of Solid Fuel Burning and Health Impacts

2. Have you, or anyone in your household, burned anything at your property in the last 12 months
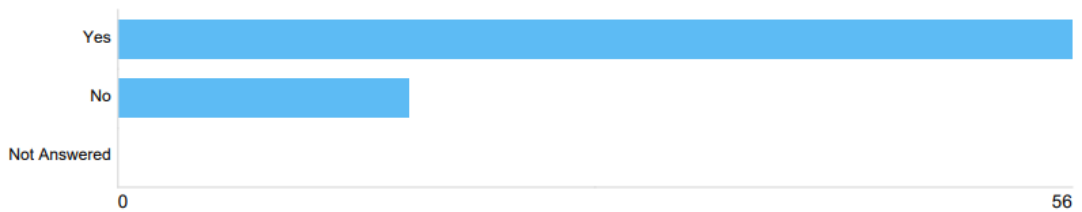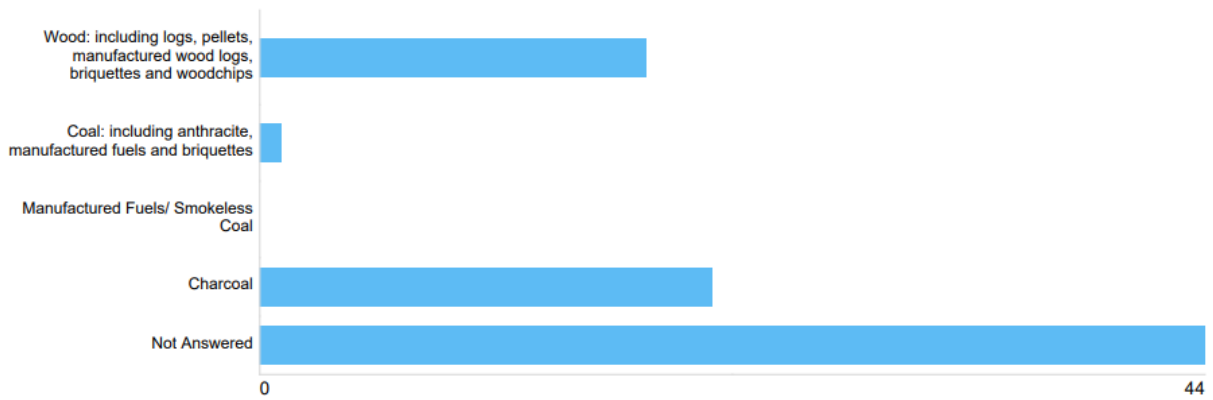

Figure 2:   Burning Behaviour in last 12 months

3. Which of the following fuels have you burnt at your property in the last 12 months? - Yes - Burned inside
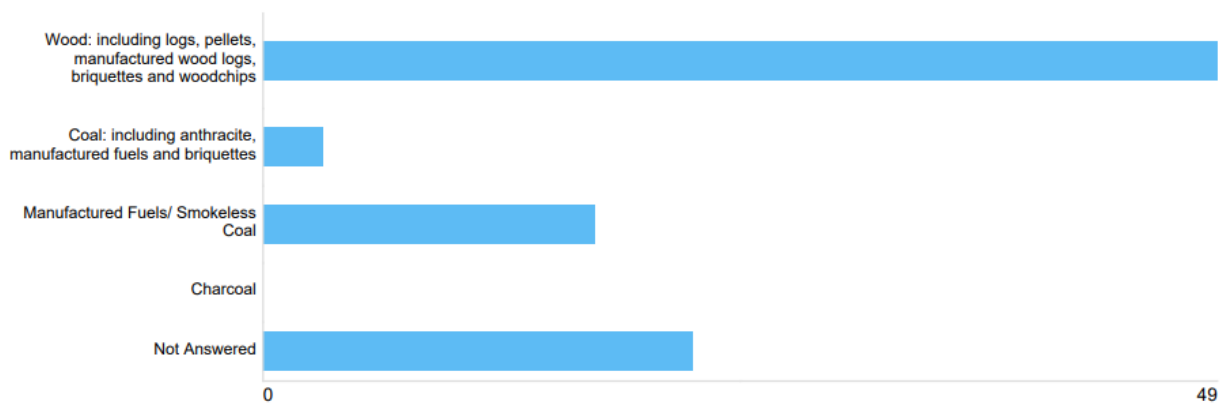
Figure 3:   Fuels burned Inside in last 12 months

3. Which of the following fuels have you burnt at your property in the last 12 months? - Yes – Burned outside

Figure 4:   Fuels burned Outside in last 12 months

3. Which of the following fuels have you burnt at your property in the last 12 months? - Yes – Burned inside

Figure 5:   Waste burned Inside in last 12 months

3. Which of the following fuels have you burnt at your property in the last 12 months? - Yes – Burned outside
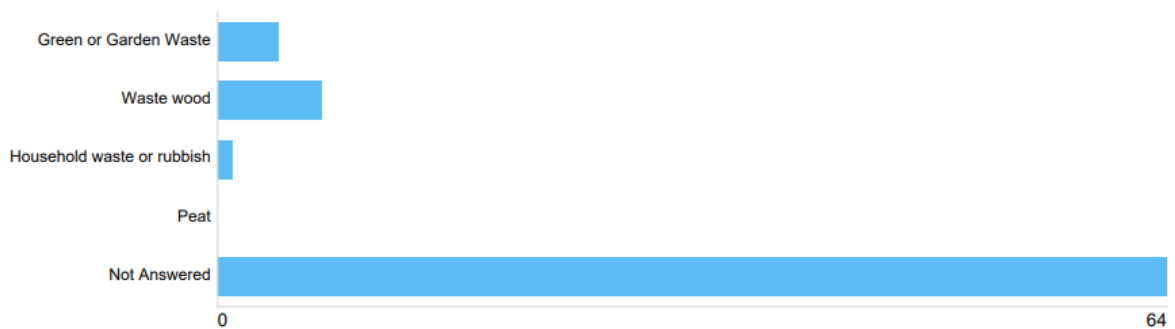
Figure 6:   Waste burned Outside in last 12 months

4. Which appliance(s) have you used to burn solid fuel in the last 12 months
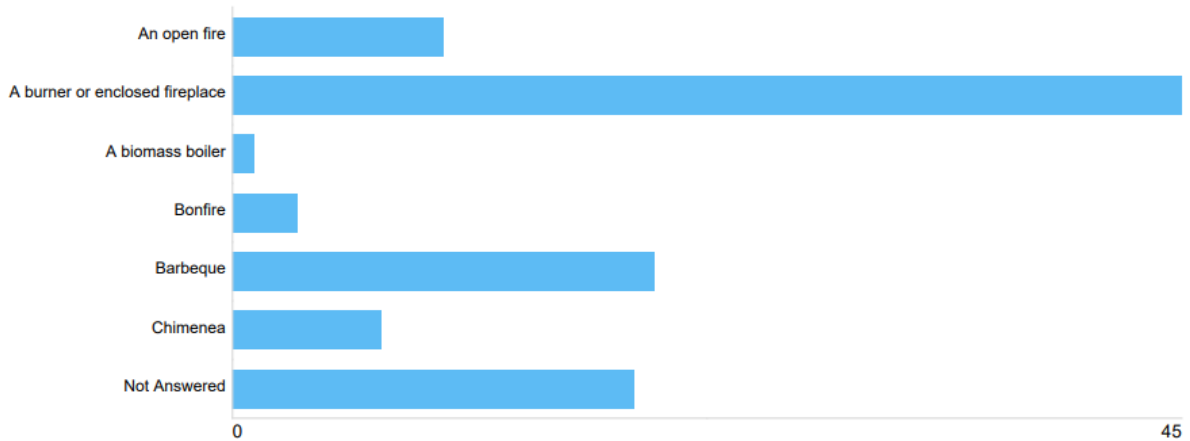
Figure 7:   **Appliances used in last 12 months**

5. Thinking about your burner or enclosed fireplace, do you know if it is any of the following…
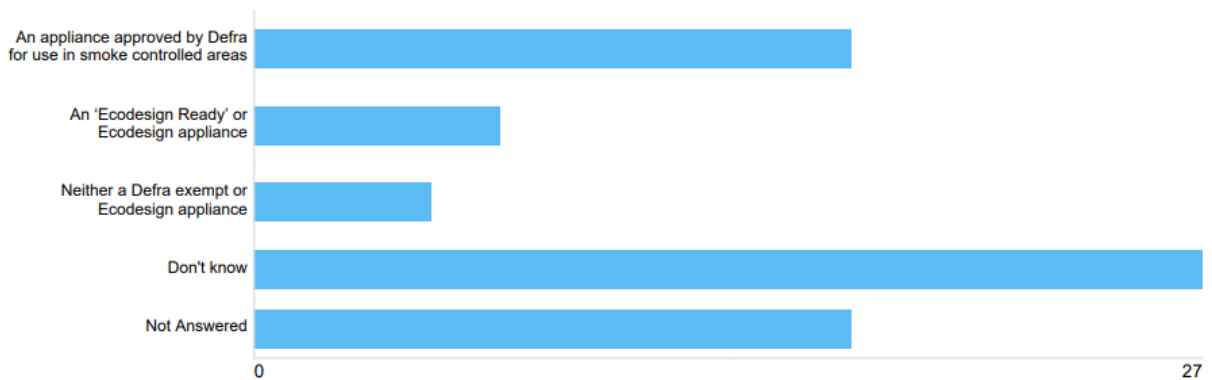
Figure 8:   **Types of wood burners/ enclosed fireplaces used**

6. What is the main purpose of the appliance(s) you use?
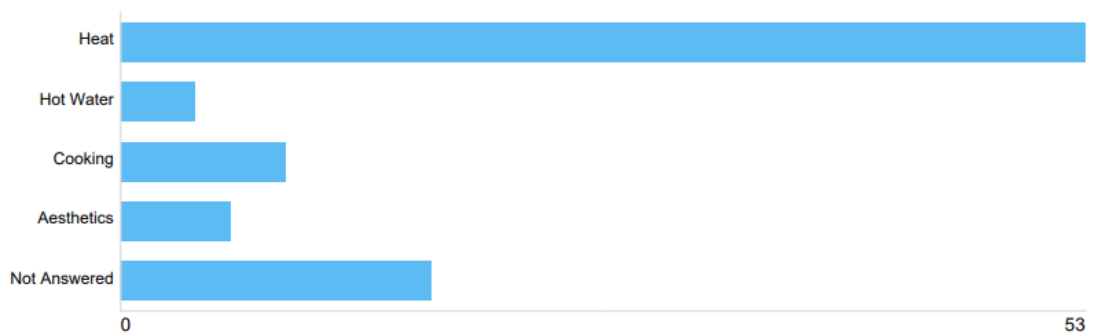
Figure 9:   **Purpose of Appliance**

7. In a typical week in winter, at what times of day are you likely to burn inside? Tick as many as required
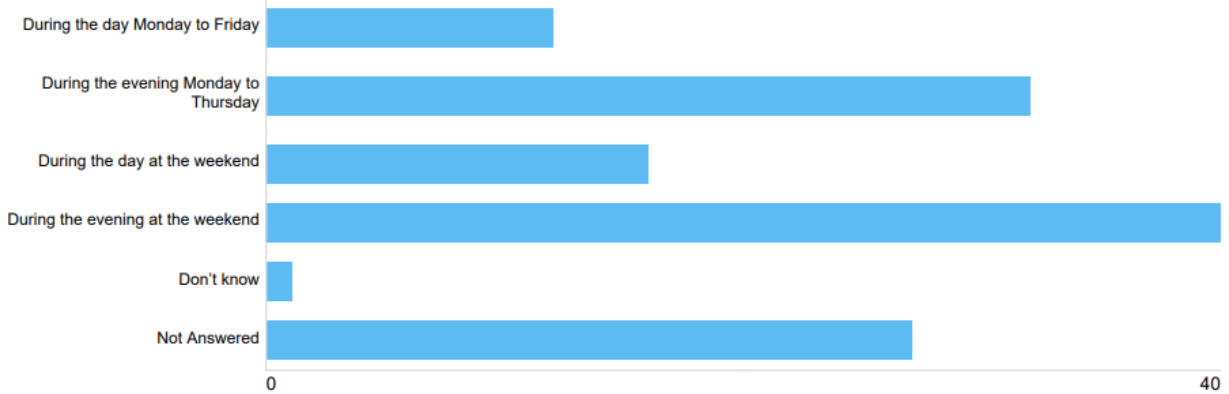
Figure 10:   Times of day Inside Burning Takes Place

8. Where does the solid fuel that you burn mostly come from?
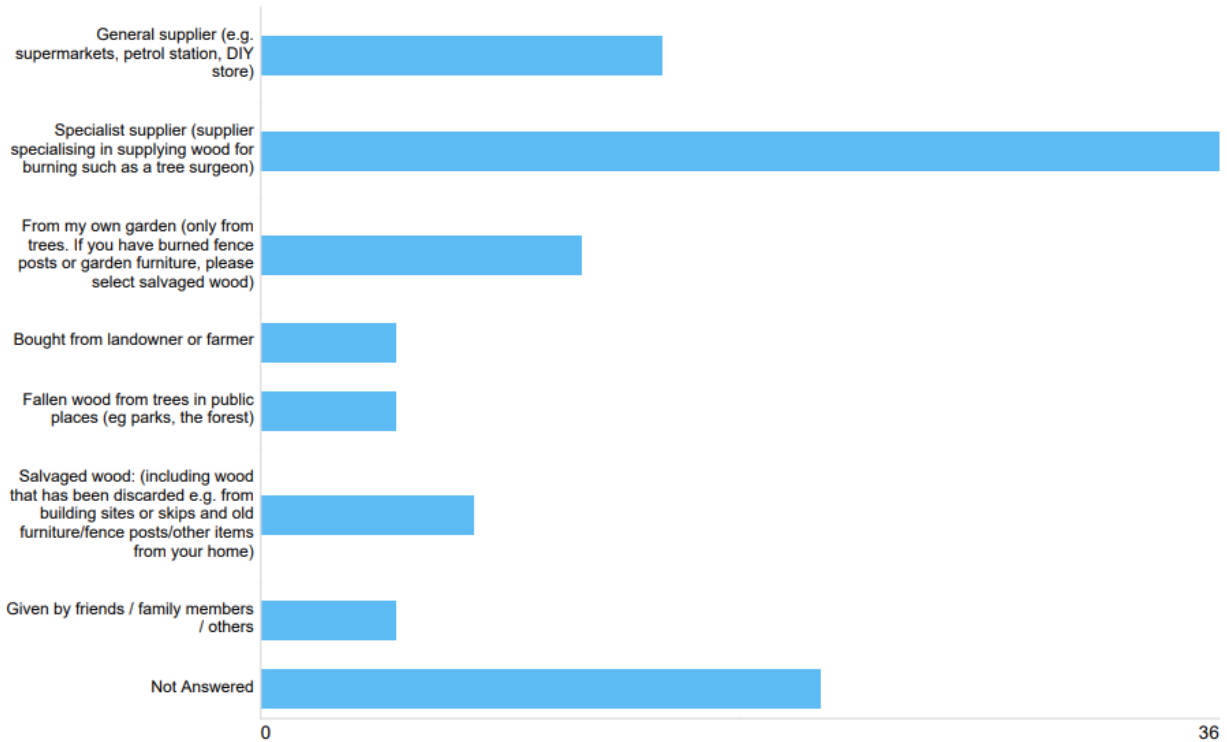
Figure 11:   Supply of Solid Fuels

9. Are you aware of the Woodsure "Ready to Burn" certification?
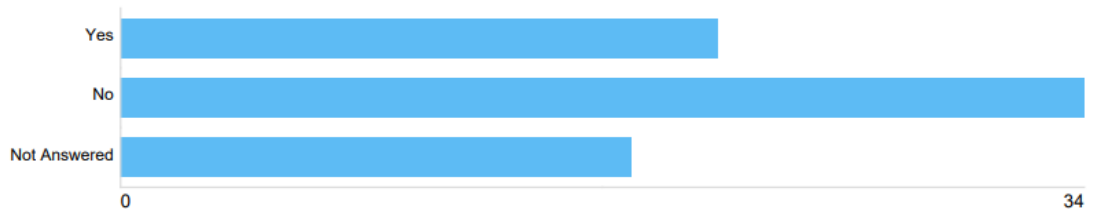
Figure 12:   Awareness of Woodsure 'Ready to Burn' Certification

10. How would you describe the seasoning of most of the wood you burn?
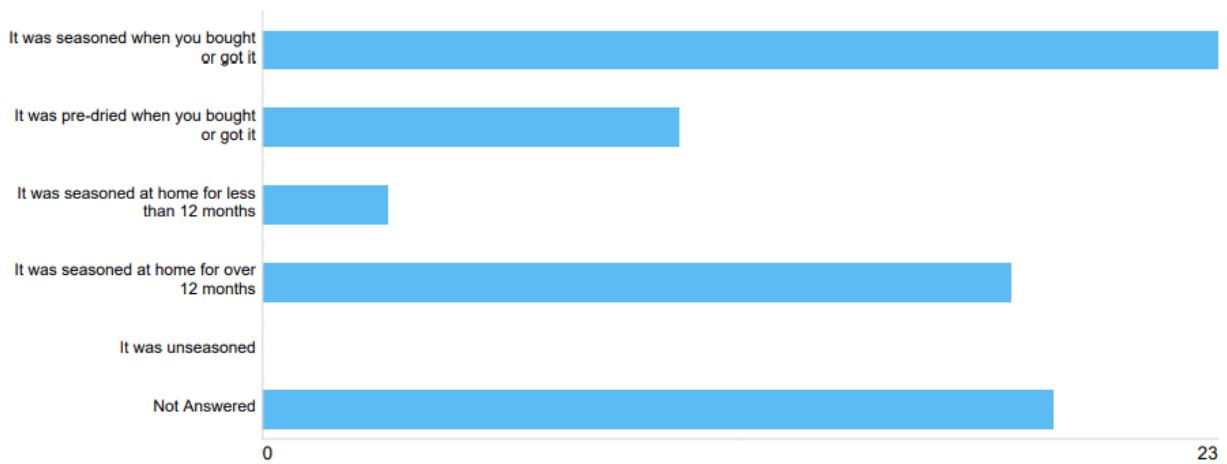
Figure 13:   Seasoning of Wood

11. How often do you maintain your wood burner/ sweep your chimney?
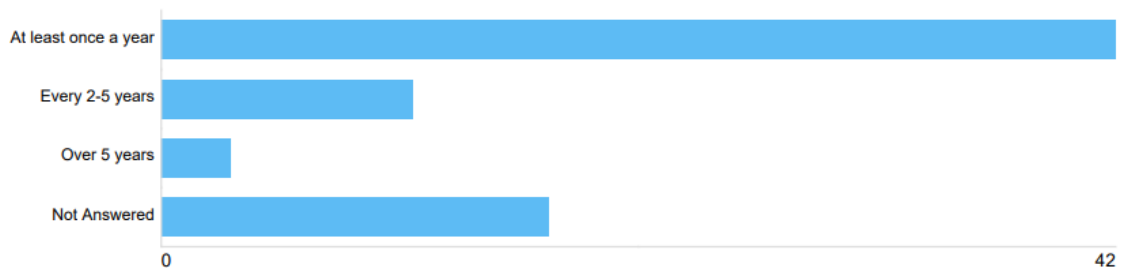
Figure 14:   Maintenance of Wood Burner and Chimney

12. Do you anticipate the Cost of Living Crisis changing your behaviour in relation to solid fuel burning?
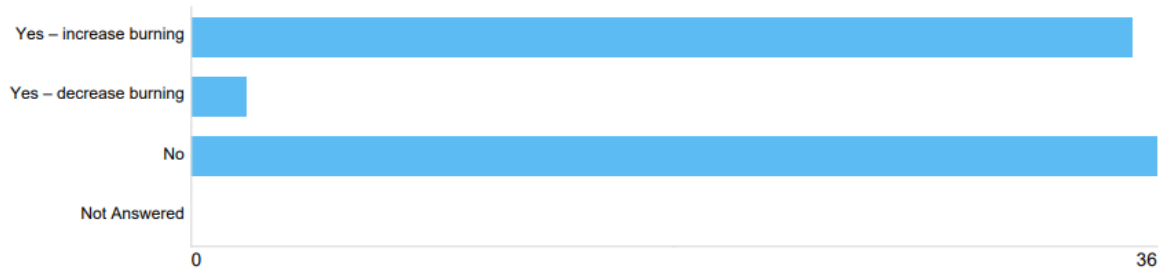
Figure 15:   Effect of Cost-of-Living Crisis on Behaviour

Solid Fuel Burning Project:
Summary of Follow Up Questionnaire Reponses

April 2024

Experts in air quality
management & assessment

Document Control

Client	North West Leicestershire District Council	Principal Contact	Minna Scott

Job Number	J10-12348C-10

Report Prepared By:	Dr Clare Beattie

Document Status and Review Schedule

Report No.	Date	Status	Reviewed by
J10-12348C-10A/3/F1	4 April 2024	Draft	Choose an item.

1   Introduction

1.1   The objective of the project is to increase the level of knowledge of $PM_{2.5}$ and ultimately reduce $PM_{2.5}$ emissions by changing attitudes to solid fuel burning, resulting in behaviour change. There is increasing local public concern around $PM_{2.5}$ across North West Leicestershire and Harborough, who are jointly undertaking this project. It is recognised that currently there is little information in relation to current concentrations, how concentrations vary across the districts and how the magnitude of contributions from different sources relate to the overall emissions. The project will use a combination of additional monitoring, and a public awareness programme to achieve these objectives.

1.2   A baseline questionnaire survey was undertaken prior to the main winter solid fuel burning season, to gauge attitudes, and levels of solid fuel burning. The survey focussed on the villages where monitoring is being undertaken, but was available more generally across the districts between 3rd October and 30th November 2022. A second survey using the same questions was undertaken between March 2023 and end of May 2023. Both questionnaires are summarised in similar notes.

1.3   This note summarises the follow up questionnaire to those which had filled out the first wave questionnaire, for which there were 30 responses.

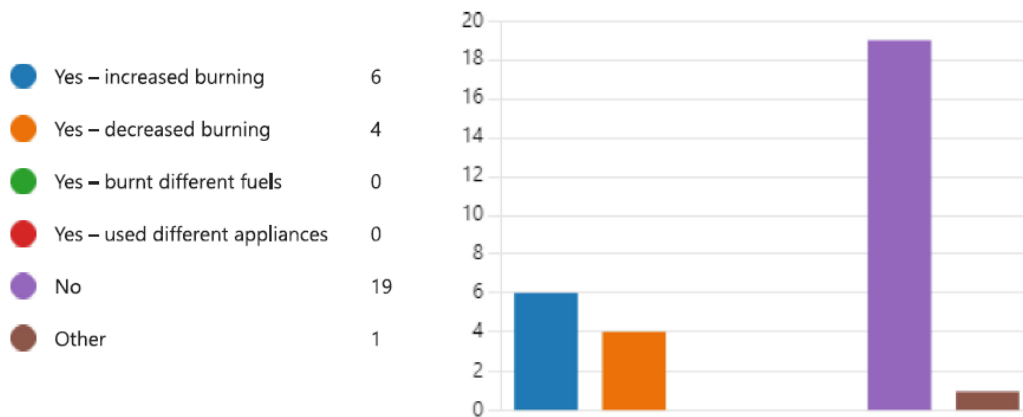1.4   The graphs in Section 3 are automatically produced by Power-Bi software.

2 Summary of Outcomes

2.1 The following summarises the key outcomes of the questionnaire responses for the follow up survey (ie those which had responded to the baseline survey and were willing to have a second survey to assess any changes in behaviour etc). The survey ran from 31st March to the end of May 2023. The majority of respondents (63%) had not changed burning behaviour, with 20% having increased burning and 13% having reduced burning (Figure 1). Reasons for the change in behaviour were mainly described as 'other' with some changing due to cost reasons (Figure 2). Most respondents who burnt inside, burnt wood, or the same fuels as burnt 6 months ago (Figure 3). Most respondents who burnt outside, burnt charcoal or wood (Figure 4).

2.2 The appliances used by respondents inside were mostly wood burners or enclosed fireplaces, outside, appliances were mainly barbeques, bonfires or chimeneas (Figure 5).

2.3 Most of the use of appliances was during the evenings, with weekends slightly more popular than during the week (Figure 6). 47% of respondents thought that their awareness of the impacts of solid fuel burning had increased (Figure 7), with most respondents obtaining information from national press articles, with fewer from social media posts or local press articles (Figure 8).

3   Data from Questionnaire Results

3.1   The following data have been provided by North West Leicestershire District Council, using Power-Bi software and are reproduced below.

3. Have you changed your burning behaviour in the last 6 months (ie since the previous questionnaire)? If you select Other then please describe in the box provided.

|	
● Yes – increased burning	6
● Yes – decreased burning	4
● Yes – burnt different fuels	0
● Yes – used different appliances	0
● No	19
● Other	1

Figure 1:   Changes to Burning Behaviour in the last 6 months

4. What was the main reason for any changes described above? If you select Other then please describe in the box provided.

● Environmental	0
● Cost	4
● More knowledge on impacts	1
● Other	6
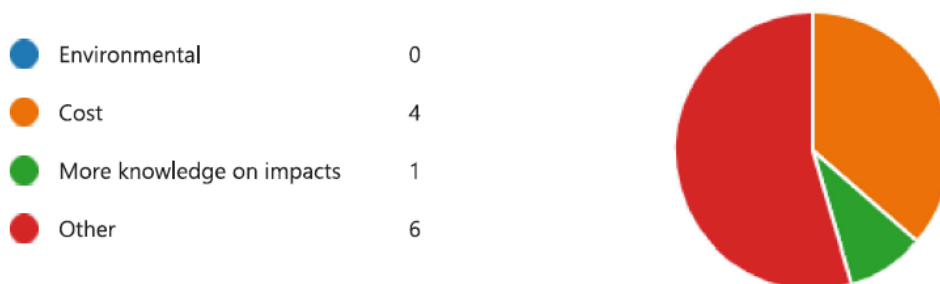
**Figure 2:   Main Reason for any Changes**

5. Which of the following fuels have you burnt Inside your property in the last 12 months? For example on an open fire or wood burning stove. Tick as many as required
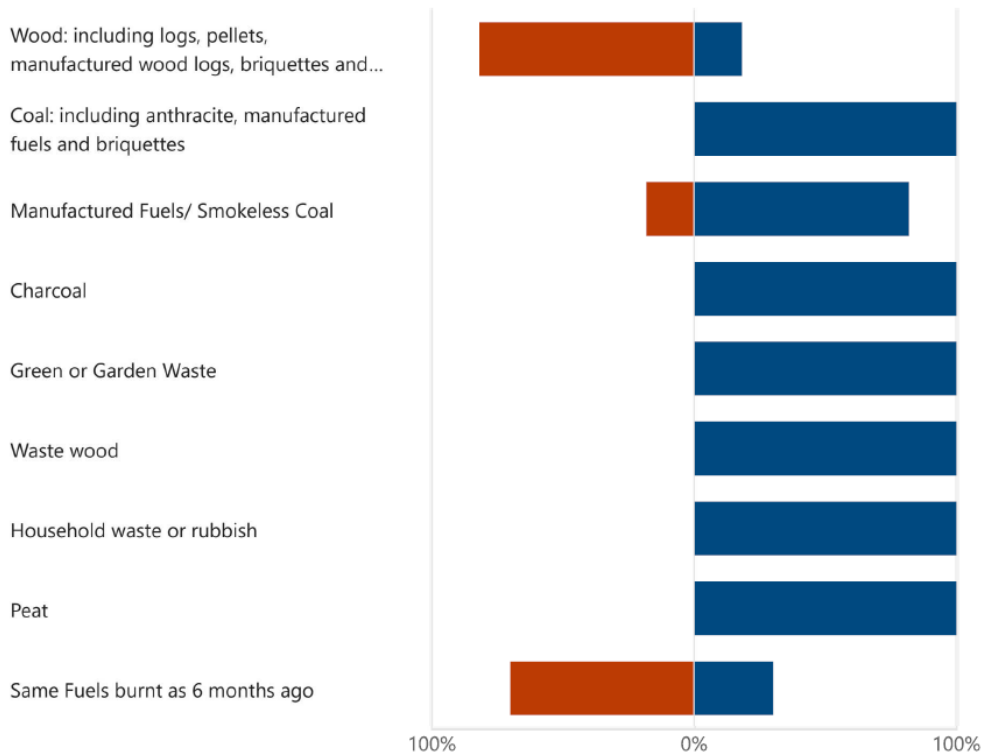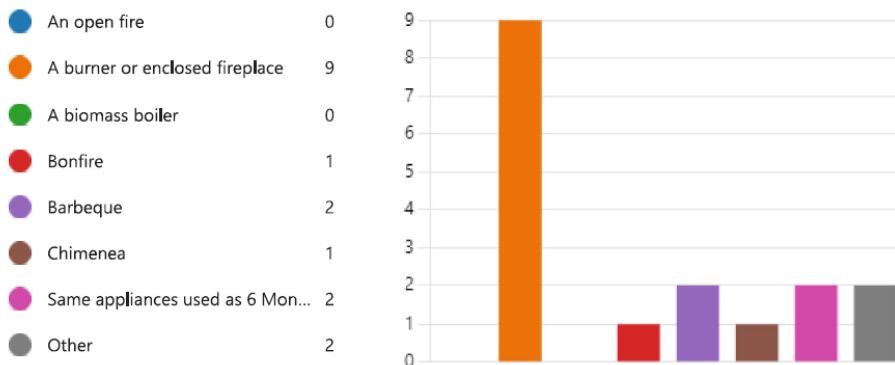

Figure 3:   Fuels burned Inside in last 12 months

6. Which of the following fuels have you burnt Outside your property in the last 12 months? For example on a bonfire, barbecue or chimenea. Tick as many as required
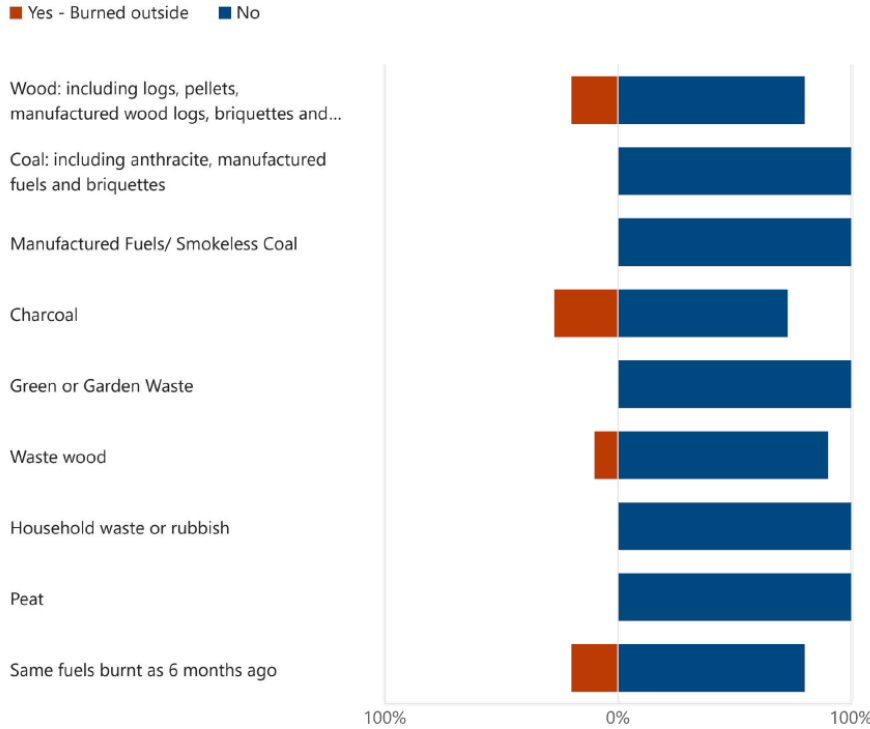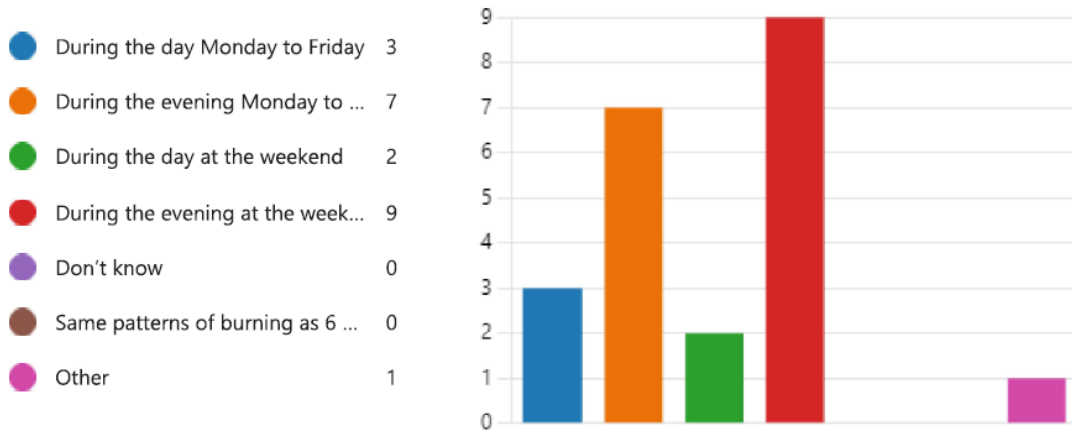

Figure 4:   Fuels burned Outside in last 12 months

7. Which appliance(s) have you used to burn solid fuel in the last 6 months? Tick as many as required

Figure 5:   Appliances used in last 12 months

8. In a typical week in winter, at what times of day are you likely to burn inside? Tick as many as required
   If you tick Other then please describe in the box provided

● During the day Monday to Friday	3
● During the evening Monday to ...	7
● During the day at the weekend	2
● During the evening at the week...	9
● Don't know	0
● Same patterns of burning as 6 ...	0
● Other	1

Figure 6:   Times of day Inside Burning Takes Place

9. Has your awareness of the impacts of solid fuel burning increased?

● Yes	14
● No	14
● Not sure	2

Figure 7:   Awareness of the Impacts of Solid Fuel Burning

10. If your awareness has increased, where have you obtained the information from? If you select Other then please describe in the box provided.

● Social media posts	1
● Local press articles	2
● National press articles	8
● Other	5
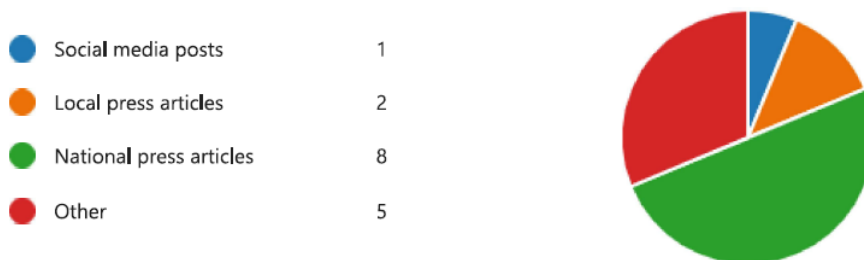
Figure 8:   Where has the Information come from for any Awareness?

Air Quality
CONSULTANTS

Solid Fuel Burning Project:
Summary of Second Wave Questionnaire Reponses

April 2024

Experts in air quality
management & assessment

Document Control

Client	North West Leicestershire District Council	Principal Contact	Minna Scott

Job Number	J10-12348C-10

Report Prepared By:	Dr Clare Beattie

Document Status and Review Schedule

Report No.	Date	Status	Reviewed by
J10-12348C-10A/2/F1	4 April 2024	Draft	Choose an item.

1   Introduction

1.1   The objective of the project is to increase the level of knowledge of $PM_{2.5}$ and ultimately reduce $PM_{2.5}$ emissions by changing attitudes to solid fuel burning, resulting in behaviour change. There is increasing local public concern around $PM_{2.5}$ across North West Leicestershire and Harborough, who are jointly undertaking this project. It is recognised that currently there is little information in relation to current concentrations, how concentrations vary across the districts and how the magnitude of contributions from different sources relate to the overall emissions. The project will use a combination of additional monitoring, and a public awareness programme to achieve these objectives.

1.2   A baseline questionnaire survey was undertaken prior to the main winter solid fuel burning season, to gauge attitudes, and levels of solid fuel burning. The survey focussed on the villages where monitoring is being undertaken, but was available more generally across the districts between 3rd October and 30th November 2022. This questionnaire is summarised in a similar note.

1.3   a second survey was undertaken between 31 March 2023 and end of May 2023. This note summarises the responses to this second wave of questionnaire results for which there were 27 responses.

1.4   The graphs in Section 3 are automatically produced by Power-Bi software.

2   Summary of Outcomes

2.1   The distribution of responses to different questions was very similar to the baseline questionnaire results, suggesting a degree of robustness of the outcomes.

2.2   The following summarises the key outcomes of the questionnaire responses for the survey which ran from 31 March 2023 to the end of May 2023. There was already a very high awareness (100%) of that solid fuel burning can have a detrimental effect on health (Figure 1).

2.3   Approximately 85% of respondents had burnt solid fuel (inside or outside) in the last 12 months (Figure 2), with most respondents who burnt inside, burning wood, or manufactured fuels/ smokeless coal (Figure 3). Most respondents who burnt outside, burnt charcoal or wood (Figure 4). There was some burning of burning garden waste (mainly outside) (Figure 4).

2.4   The appliances used by respondents inside were mostly wood burners or enclosed fireplaces, followed by open fires, outside, appliances were mainly barbeques, chimeneas or bonfires (Figure 5). Most respondents didn't know whether their burner is an appliance approved by Defra or ecodesign appliance, but in cases where respondents knew what type of burner they had, there was a good take up of Defra approved wood burners (Figure 6). It is likely that the respondents that knew what type of stove they had, were those who had purchased one recently.

2.5   The main purpose of burning was for heat, but some respondents also used their appliance for cooking, aesthetics and hot water (Figure 7). Most of the use of appliances was during the evenings, with weekends and weekdays equally popular (Figure 8). Respondents mainly got their wood from specialist suppliers (also from their general suppliers, their own garden, salvaged wood, landowners, fallen trees, family members etc) (Figure 9). Most respondents were not aware of Woodsure's Ready to Burn (Figure 10). However, despite this, the majority of respondents buy seasoned wood, or season it at home, with only 1 respondent saying that they bought unseasoned wood (Figure 11).

2.6   With regards to maintenance, nearly 70% of respondents sweep their chimney/ maintain wood burner at least once a year (Figure 12). Approximately 40% of respondents thought the cost-of-living crisis would result in an increase in their burning habits (Figure 13).

3   Data from Questionnaire Results

3.1   The following data have been provided by North West Leicestershire District Council, using Power-Bi software and are reproduced below.

3. Are you aware that solid fuel burning can increase air pollution which can have a detrimental effect on health?

● Yes	27
● No	0
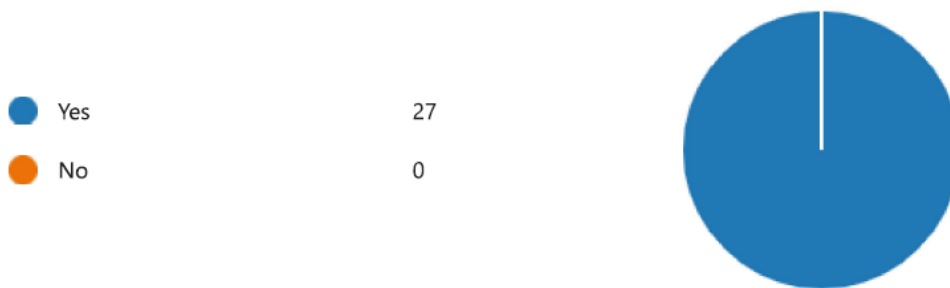
**Figure 1:   Awareness of Solid Fuel Burning and Health Impacts**

4. Have you, or anyone in your household, burned anything at your property in the last 12 months? This can be anything you have burnt inside, for example on an open fire or a wood burner, or outside, for example on a bonfire, a barbecue or a chimenea

● Yes	23
● No	4

Figure 2:   Burning Behaviour in last 12 months

5. Which of the following fuels have you burnt Inside your property in the last 12 months? For example on an open fire or wood burning stove. Tick as many as required
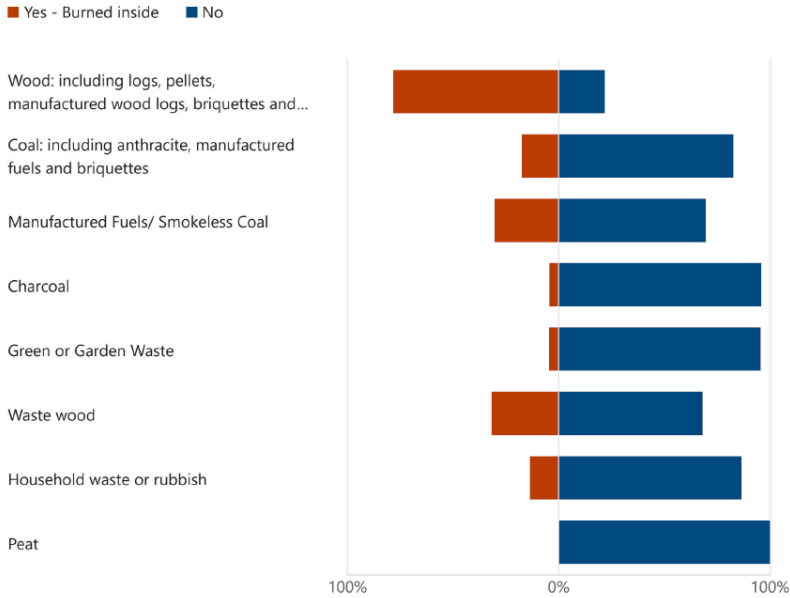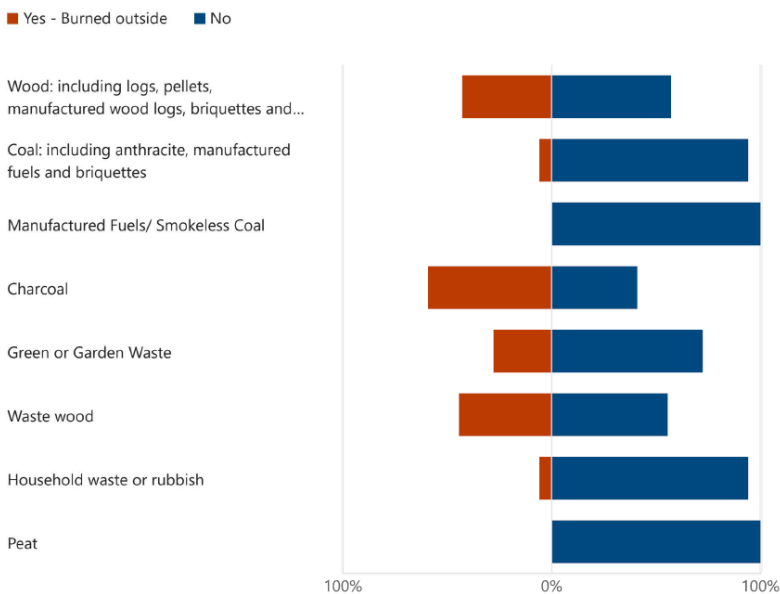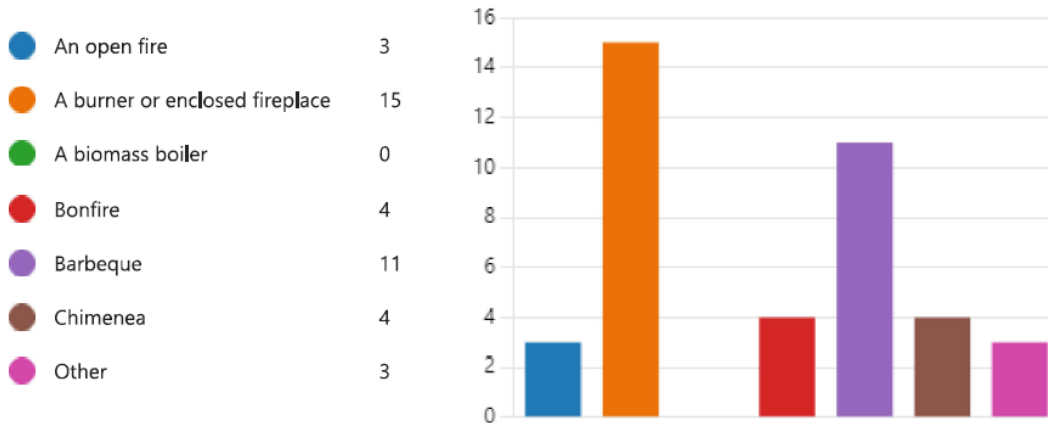

Figure 3:   Fuels burned Inside in last 12 months

6. Which of the following fuels have you burnt Outside your property in the last 12 months? For example on a bonfire, barbecue or chimenea. Tick as many as required

Figure 4:   Fuels burned Outside in last 12 months

8. Which appliance(s) have you used to burn solid fuel in the last 12 months? Tick as many as required

An open fire	3
A burner or enclosed fireplace	15
A biomass boiler	0
Bonfire	4
Barbeque	11
Chimenea	4
Other	3

Figure 5:   **Appliances used in last 12 months**

9. Thinking about your burner or enclosed fireplace, do you know if it is any of the following... Choose one option

An appliance approved by Defra...	7
An 'Ecodesign Ready' or Ecodesi...	0
Neither a Defra exempt or Ecod...	2
Don't know	14

Figure 6:   **Types of wood burners/ enclosed fireplaces used**
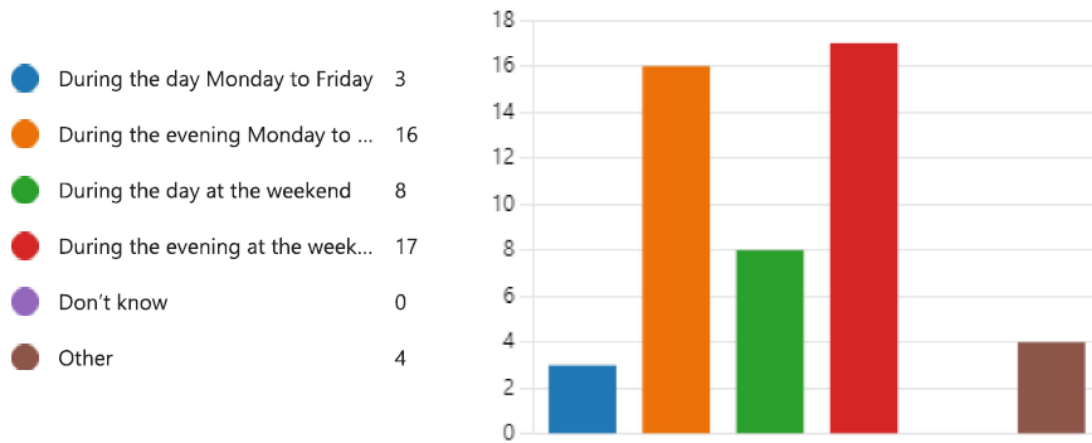
10. What is the main purpose of the appliance(s) you use? Tick as many as required

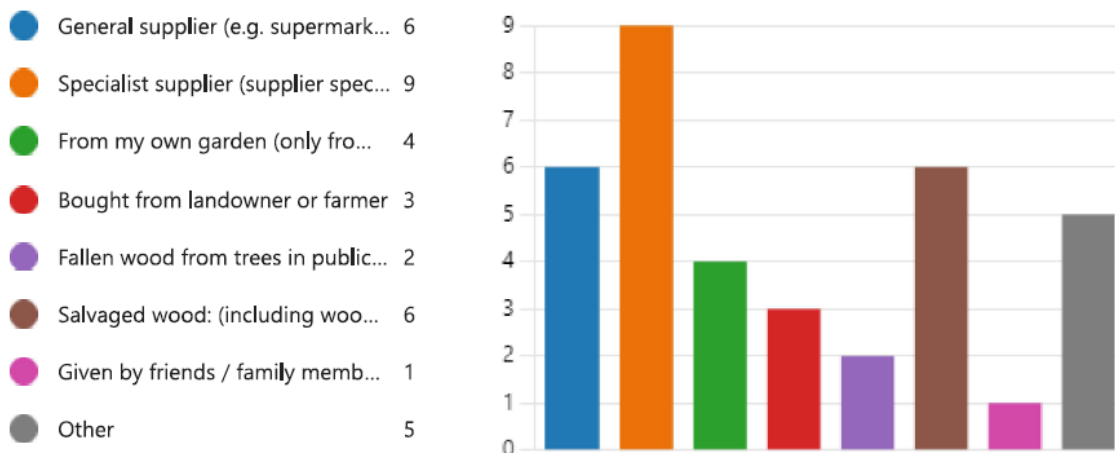If you tick Other then please describe in the box provided

Heat	20
Hot Water	2
Cooking	5
Aesthetics	2
Other	2

Figure 7:   **Purpose of Appliance**

11. In a typical week in winter, at what times of day are you likely to burn inside? Tick as many as required
    If you tick Other then please describe in the box provided

During the day Monday to Friday	3
During the evening Monday to ...	16
During the day at the weekend	8
During the evening at the week...	17
Don't know	0
Other	4

Figure 8:   Times of day Inside Burning Takes Place

12. Where does the solid fuel that you burn mostly come from? Tick as many as required
    If you tick Other then please describe in the box provided

General supplier (e.g. supermark...	6
Specialist supplier (supplier spec...	9
From my own garden (only fro...	4
Bought from landowner or farmer	3
Fallen wood from trees in public...	2
Salvaged wood: (including woo...	6
Given by friends / family memb...	1
Other	5

Figure 9:   Supply of Solid Fuels

13. Are you aware of the Woodsure "Ready to Burn" certification?

Yes	10
No	12

Figure 10:   Awareness of Woodsure 'Ready to Burn' Certification

14. How would you describe the seasoning of most of the wood you burn? (ie leaving the wood to dry for a period after the tree has been felled or cut) Choose one option
   If you choose Other then please describe in the box provided

It was seasoned when you boug...	5
It was pre-dried when you boug...	3
It was seasoned at home for les...	1
It was seasoned at home for ove...	13
It was unseasoned	1
Other	0
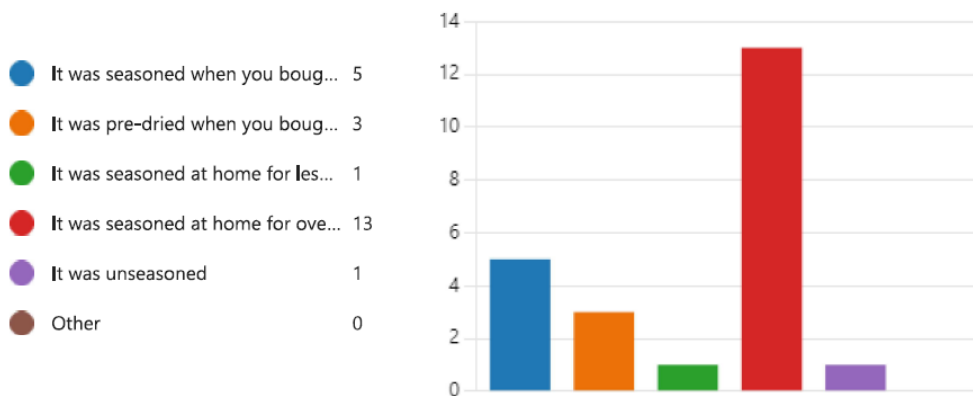
Figure 11:   Seasoning of Wood

15. How often do you maintain your wood burner/ sweep your chimney? Choose one option

At least once a year	16
Every 2-5 years	5
Over 5 years	2

Figure 12:   Maintenance of Wood Burner and Chimney

16. Do you anticipate the Cost of Living Crisis changing your behaviour in relation to solid fuel burning?

🔵	Yes – increase burning	11
🟠	Yes – decrease burning	0
🟢	No	16
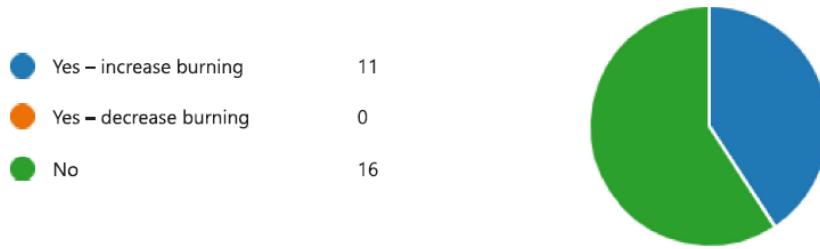
Figure 13:   Effect of Cost-of-Living Crisis on Behaviour