

Air Quality in Scotland

Welcome to the second Scottish Air Quality Database (SAQD) stakeholder's newsletter. This newsletter is produced on behalf of the Scottish Government by Ricardo Energy & Environment (Ricardo) and is designed to provide regular updates and news regarding the SAQD and local air quality matters to all stakeholders. This may include; updates to the network; new information on air quality issues; updates on changes in policy and procedures; new initiatives and events; technical reports; and how to access data using the Air Quality in Scotland website.

If you have any information which you think would be beneficial to include in a future newsletter, please email us at info@scottishairquality.co.uk.

NEWS

SCOTTISH AIR QUALITY DATABASE AND WEBSITE ANNUAL SEMINAR – TUESDAY 24TH JANUARY 2017

The Scottish Air Quality Database and Website Annual Seminar took place on Tuesday 24th January 2017. Thank you to all who were able to attend, if not please note that the presentations are now available to view online at <http://www.scottishairquality.co.uk/news/index?id=544>. If you would like to provide feedback, please email info@scottishairquality.co.uk.

PUBLICATION OF THE SCOTTISH AIR QUALITY DATABASE ANNUAL REPORT FOR 2015

The Scottish Air Quality Database Annual Report for 2015 is now available to view online at <http://www.scottishairquality.co.uk/news/index?id=541>

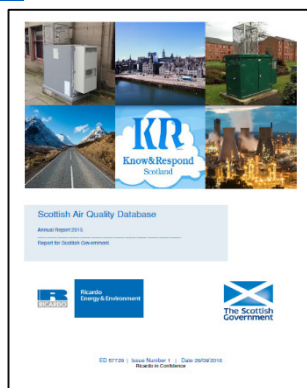


Figure 1. SAQD Annual Report 2015

NEW MONITORING SITES

We are pleased to announce the addition of the following air quality monitoring stations to the SAQD:

Falkirk Bo'ness: this is an urban industrial monitoring station measuring sulphur dioxide.

Falkirk Grahams Road: this is a roadside monitoring station measuring PM₁₀.

Falkirk Bainsford St: this is a roadside monitoring station measuring oxides of nitrogen and PM₁₀.

Inverness Queensgate: this is a roadside monitoring station measuring oxides of nitrogen.



Figure 2. (From left) Bo'Ness, Graham's Road, Bainsford Main Street and Inverness Queensgate

Issued date: 3rd May 2017

LOCAL AIR QUALITY MANAGEMENT (LAQM) HELPDESK UPDATE

The National Diffusion Tube Bias Adjustment Factors Spreadsheet March 2017 has recently undergone a revision and version 2 (v2) is now available. This version (v2) supersedes the first version and should be used for future reference. The new version can be found on the LAQM pages of the Air Quality Scotland website (<http://www.scottishairquality.co.uk/laqm/tools>).

SCOTTISH ENVIRONMENT PROTECTION AGENCY (SEPA)

SEPA SPOTFIRE TOOLS – VISUALISING SCOTLAND'S AIR QUALITY DATA

SEPA launched the new visualisation and data analysis tools at the recent Scottish Air Quality Database and Website Annual Seminar. These tools are currently available as beta test web pages and open for comments – please email SAQD_Spotfire@sepa.org.uk.

The tools pull data from the SAQD and present it in a simple and pre-analysed format. Air quality data is provided to the public in a visual and informative way, providing access to the full range of air quality information collected across Scotland. The tools allow local authorities and members of the public to see what is going on with air quality in their area.

The new data analysis and visualisation tools provided by SEPA are hosted on Air Quality in Scotland, providing:

- Pre-filtered and analysed air quality data that is accessible to everyone to view and interrogate.
- Advanced data analysis that provides a detailed analysis of live and historical air quality data, providing local authorities with reporting data.
- International data to identify movement of transboundary pollution that crosses

Scotland, and the affects this has on local air quality.

- A dedicated area for the National Modelling Framework (NMF), where modelled data is presented for local authorities to develop traffic-specific actions.

The enhancement tools support the delivery of the Cleaner Air for Scotland strategy (CAFS) which was launched in November 2015 and commits Scottish Government and partner organisations to deliver further improvements in air quality to protect human health and fulfil Scotland's legal responsibilities. The strategy aims to promote air quality issues to ensure that the public are well informed, engaged, and empowered to improve our air quality.

Further information on CAFS is available on the Air Quality in Scotland website.

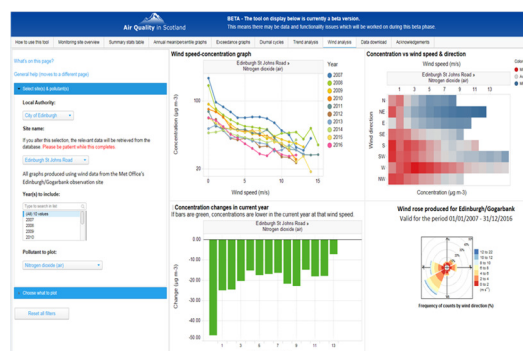


Figure 3. Website display of the new visualisation and data analysis tools

SEPA AIR EXHIBIT AT THE GLASGOW SCIENCE CENTRE

Understanding and reducing air pollution, and its causes, is the theme of a new interactive exhibit launched in January at the Glasgow Science Centre. It encourages school pupils to consider the causes of air pollution such as traffic congestion and industrial production, and how it affects our health and the environment. The exhibit shows that it's the choices we make that are the difference between poor and good air quality.

The exhibit, developed by the Glasgow Science Centre and SEPA, was funded by the Scottish

Government. Designed to help deliver the outcomes of the CAFS, the exhibit is one of a series of activities being rolled out to help educate and inform primary and secondary pupils on the issues around air pollution in Scotland. To launch the exhibit, pupils from St Ninian's primary school in Hamilton were invited along to share their experiences of studying air pollution and to try out the new exhibit.

The exhibit encourages visitors to discover the different sources of air pollutants and how poor air quality affects our health and the environment. The exhibit also features a city model where visitors get the opportunity to control traffic, allowing them to experience how different modes of transport contribute to air pollution in our urban environments. The air quality monitoring data presented in Air Quality in Scotland website is displayed in the exhibit, with visitors encouraged to build their own virtual monitoring station.



Figure 4. Pupils presenting at the exhibit in Glasgow Science Centre

"We know that the air we breathe is something that we all take for granted, as we cannot actually see it. However, air is very important and essential to us, and poor air quality can make us feel unwell, affecting our health in a negative way" – Primary 7 pupil from St Ninian's primary school.

"Our own research showed that in our local area unnecessary short car journeys, is something we could stop! In school we have been encouraging families and friends to walk, cycle or even skateboard to school – stopping the school runs

which are not needed is our priority" – Primary 7 pupil from St Ninian's primary school.

"The exhibition highlights ways in which we can individually help to improve the quality of our life, whilst demonstrating the wider influences that planning and transport policies can have on the quality of the air we breathe. The new exhibit is the start of a larger educational package being developed and will provide inspiration for younger people, amongst others, to tackle air pollution and understand its effects on our own health, communities and the wider environment." – Dr Colin Gillespie, Principle Air Quality Scientist at SEPA.

Glasgow Science Centre Chief Executive Dr Stephen Breslin expressed his enthusiasm for the new exhibit; "Our team of scientists and designers worked closely with SEPA to develop the exhibit and help bring the value of good air quality, and the causes and harms of air pollution, to life in an engaging and interactive way. We are excited for our visitors to get hands on and discover more about the role they can play in improving air quality."

Additionally, SEPA has been working with partners involved in delivering CAFS to further raise awareness of air quality among young people through the development of the 'Learn about air' teaching pack (www.learnaboutair.com) and participating in last year's VentureJam.

You can visit the Cleaner Air for Scotland exhibit on the second floor of the 'Science Mall' at the Glasgow Science Centre, 50 Pacific Quay, Glasgow, G51 1EA. For further information on the Scottish Government strategy for reducing air pollution in Scotland, see the Cleaner Air for Scotland strategy on their website.

Contact: Colin Gillespie, SEPA

LOCAL AUTHORITY

In this section we plan to showcase local authority's contribution to Local Air Quality Management (LAQM). The aim of this section will be to provide information on what air quality initiatives the local authorities are undertaking and the experiences gained. If you would be interested in contributing, please send an email to info@scottishairquality.co.uk. Many thanks to Tanith Allinson (Air Quality Specialist Falkirk Council) for contributing to this issue!

FALKIRK COUNCIL

In order to continue to deliver local air quality management duties, Falkirk Council made a number of improvements to its air quality monitoring network during 2016. Improvements include upgrading three of the sulphur dioxide (SO₂) analysers within the Grangemouth Air Quality Management Area (AQMA) and installing a FIDAS 200 particulate analyser at the West Bridge St station.

The installation of a FIDAS 200 at West Bridge St has added PM_{2.5} monitoring capabilities to the Falkirk Town Centre AQMA. This action supports the development of a national PM_{2.5} network, which is a priority for both local authorities and the Scottish Government following the publication of the Cleaner Air for Scotland (CAFS) document. Falkirk council now monitor PM_{2.5} at three locations across its area.

In addition to the above, all eleven automatic monitoring stations are now affiliated to the Scottish Air Quality network, following the affiliation of Main St Bainsford, Falkirk Grahams Rd and Bo'ness stations to the network in 2016. This action will improve data quality and enable members of the public to access air quality data for each of Falkirk Council's automatic sites.

In other news, the membership of our Falkirk Eco Stars scheme has surpassed 100 members, helping to improve air quality through the promotion of fuel efficient driving. In addition, we are also working closely with fellow

members of the East Central Scotland Vehicle Emissions Partnership, looking to align our vehicle emissions monitoring with the priorities and objectives set out in the Scottish Government's CAFS document.

In 2017, our priorities in terms of the monitoring network will be to continue upgrading obsolete analysers and to replace the damaged air quality enclosure at the Haggs monitoring site. We will also be looking to develop our engagement with schools, through promoting air quality education resources such as the 'Learn about Air' teaching package and the 'Air Pollution Detectives' section of Air Quality in Scotland.

Contact: Tanith Allinson, Falkirk Council

SAQD QA/QC ACTIVITIES

Since 2006, all automatic monitoring data within the SAQD on the website has been subject to harmonised QA/QC procedures. This ensures that all data in the database are quality assured and are traceable to UK national calibration standards for the various pollutants.

Ricardo have completed the winter 6 monthly audits. After each local authority audit, a summary of the auditor's findings should have been emailed to you. If you have not received an audit summary, please contact info@airqualityscotland.co.uk.

HOW TO

This section gives advice to readers on all aspects of the website, including accessing/downloading data, as well as to address general site queries. If you have any requests that you would like included within the newsletter, please feel free to contact us.

ACCESS A SITES ELECTRONIC AIR POLLUTION REPORT

The electronic air pollution report function is now available on the Air Quality in Scotland website for each monitoring site.

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The report function can be located within the individual site summary under the 'Annual Report' tab. Please note that it is stated within the report itself whether the data used to create the statistical report is ratified or provisional.



Figure 5. Example of a site highlighting the location of the new Annual Report function

OPENAIR DATA ANALYSIS TOOL

Openair provides free, open-source and innovative tools to analyse, interpret and understand air pollution data using 'R' (a free programming language). Under the 'Data & Maps' tab on Air Quality in Scotland, select 'Openair data analysis tool' on the side bar menu. There are 12 different tools available under Openair, two of which are described below.

POLAR PLOT

The Polar Plot tool produces plots of pollutant concentrations by wind speed and wind direction. Polar plots are useful to gain a quick graphical representation of the relationship between pollutant concentrations and the meteorological conditions. Please note that polar plots can only be produced for *one site* and *one pollutant* at a time on this website.

Once the desired site and dates are selected in the Polar Plot tool you will be able to change the "Type" of data, this can be 'Hour', 'Month' or 'Season' – the default option will produce a single plot covering the entire range of the data.

Next, the "Statistic" drop down menu will provide the following options:

| | |
|---------------------------|---|
| Mean | The average number |
| Median | The middle number in a data set |
| Maximum | The highest number |
| Frequency | The number of times an event occurs |
| Standard Deviation | The amount of variation in a data set |
| Weighted Mean | The site concentration multiplied by the frequency at which the concentration occurs – this can be useful to highlight which wind speed and direction contribute most strongly to the mean level. |

Finally, the Colours drop-down menu allows the user more control over the colour scheme used to plot which can be useful to highlight the concentration trends.

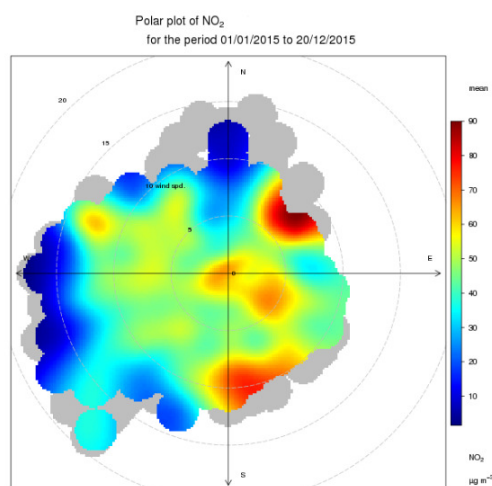


Figure 6. Example of a polar plot for NO₂ between 1st January 2015 – 20th December 2015

SCATTER PLOT

A Scatter Plot is a common and effective technique used to analyse the relationship between one variable and another.

On the Air Quality in Scotland website, select the site of interest. Once the site has been selected, two different variables need to be highlighted for the analysis and can be selected/de-selected by pressing and holding the 'CTRL' key whilst

highlighting the desired pollutants using the left mouse button. The X and Y axis variable menus become available once two variables have been selected.

This data can be plotted over a user defined date range, either a specific date or on an annual basis. The user will be able to change the “Type” of data, this can be 'Weekday', 'Month', 'Season', 'Wind Direction' or 'Wind Speed' (for plots split by modelled wind speed or wind direction from the [UK air quality forecast](#) respectively).

Next, the user has the option to select the “Method”. 'Scatter' will produce a standard scatter plot where each corresponding X and Y combination is presented using a point on the plot.

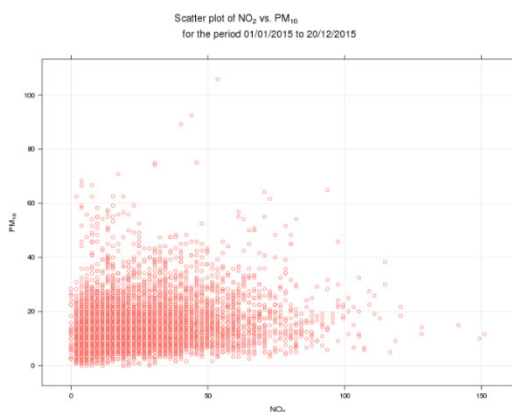


Figure 7. Scatter plot illustrating the NO₂ and PM₁₀ for the period 01/01/2015 to 20/12/2015

'Hexbin' is useful when the dataset is large; in this plot, the data is categorised into hexagonal cells and the colour scale represents the count of data points within each category.

'Density' produces a smooth two dimensional representation of the relationship between the X and Y variables, calculated using a kernel density estimate approach.

Finally, the user will need to select either the 'Fit Linear Trend' or 'Fit Smooth Line'. The 'Fit Linear Trend' option adds a linear model to the 'Scatter Plot' with the equation of the line and the coefficient of determination (R^2) value shown.

The 'Fit Smooth Line' option will add a smooth fit to the underlying data with estimated 95% confidence intervals (grey shading) which can be extremely useful when evaluating if the relationship between variables is non-linear.

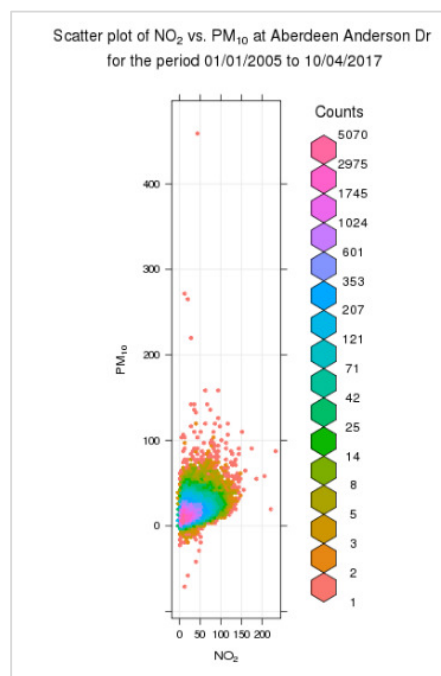


Figure 8. Hexbin plot illustrating the NO₂ and PM₁₀ for the period 01/01/2005 to 30/03/2017

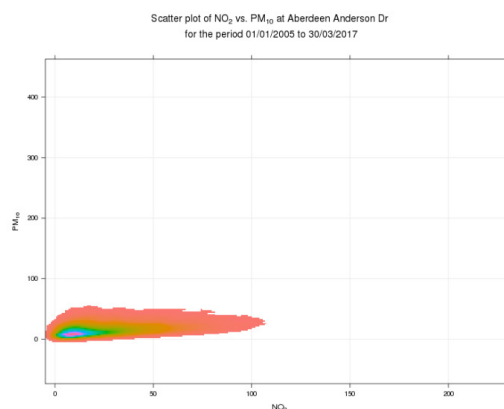


Figure 9. Density plot illustrating the NO₂ and PM₁₀ for the period 01/01/2005 to 30/03/2017

[LAQM POLLUTANT OVERVIEW](#)

Within LAQM there are eight pollutants of concern, these are nitrogen dioxide (NO₂), fine particles (PM₁₀ & PM_{2.5}), benzene (C₆H₆), 1,3-

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Butadiene (C₄H₆), Lead (Pb), sulphur dioxide (SO₂) and carbon monoxide (CO). These major ambient air pollutants are known to have a significant impact on human health and have been set legally binding limits. Two of these pollutants are described below.

FINE PARTICULATE MATTERS (PM₁₀ & PM_{2.5})

Fine Particles are composed of a wide range of materials arising from a variety of sources including:

- combustion sources (mainly road traffic)
- secondary particles, mainly sulphate and nitrate formed by chemical reactions in the atmosphere, and often transported from far across Europe
- coarse particles, suspended soils and dusts (e.g. from the Sahara), sea salt, biological particles and particles from construction work

Particles are measured in a number of different size fractions according to their mean aerodynamic diameter. Most monitoring is currently focussed on PM₁₀, but the finer fractions such as PM_{2.5} and PM₁ are becoming of increasing interest in terms of health effects. Fine particles can be carried deep into the lungs where they can cause inflammation and a worsening of the condition of people with heart and lung diseases. In addition, they may carry surface-absorbed carcinogenic compounds into the lungs.

CARBON MONOXIDE

Carbon Monoxide (CO) is a colourless, odourless poisonous gas produced by incomplete, or inefficient, combustion of fuel. It is predominantly produced by road transport, in particular petrol-engine vehicles.

This gas prevents the normal transport of oxygen by the blood. This can lead to a significant reduction in the supply of oxygen to the heart, particularly in people suffering from heart disease.

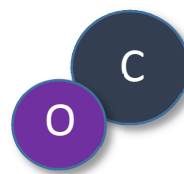


Figure 10. Molecular structure of CO

POLLUTION EPISODE – 15th FEB 2017

This particulate matter (PM₁₀ and PM_{2.5}) episode was the direct result of the weather conditions, air masses and the build-up of locally sourced pollutants on the 15th February 2017.

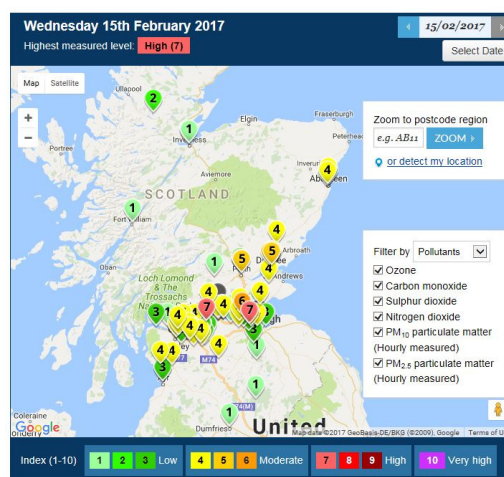


Figure 11. Screenshot of the data on the Air Quality in Scotland website on 15/02/2017

Dry, still and misty weather conditions experienced throughout much of Scotland had initially caused poor pollution dispersion conditions – allowing for locally sourced pollution to build up in areas. The weather conditions coupled with the air masses from the south and east allowed for transboundary pollutants such as particulate matter and nitrogen dioxide to be easily transported north from the rest of the UK and continental Europe.

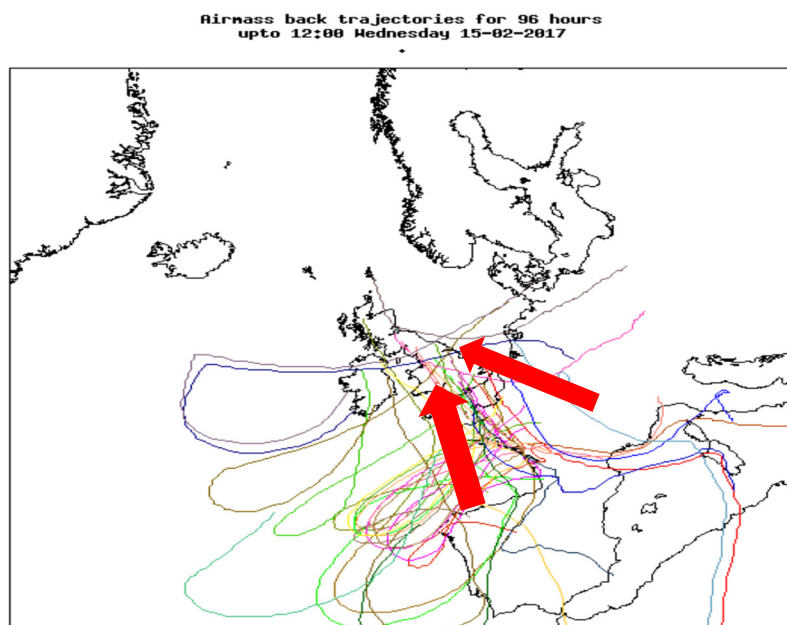
This is evident through investigation of the background sites pollutant levels, for example Perth Muirton. The combination of these factors resulted in particulate concentrations to reach moderate to high levels in mainly urban locations.

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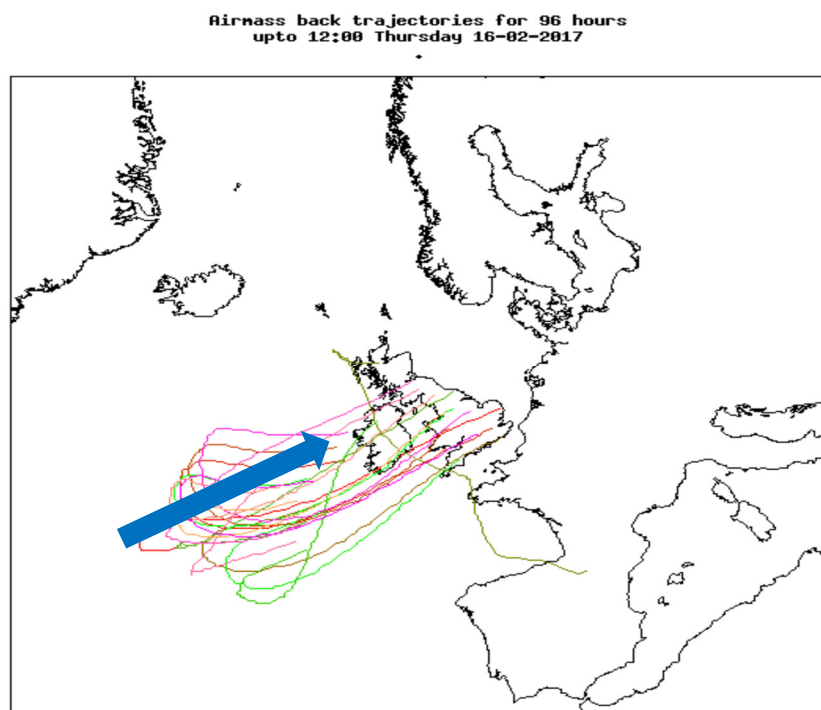
As predicted, the situation improved the following day due to the air mass from the west creating a more turbulent environment for

pollutants to be more easily dispersed, thereby reducing the background concentrations.

WEDNESDAY 15TH FEBRUARY 2017



THURSDAY 16TH FEBRUARY 2017



QUESTION AND ANSWERS SECTION

This section will provide answers to frequently asked questions that relate to different aspects of LAQM ranging from LSO duties to advanced data analysis queries. If you have a question you would like to be answered in this section, please contact info@scottishairquality.co.uk.

Q: Why is it important to update Ricardo of any local activities that may impact the data from your monitoring site?

A: Local activities like road works, construction and general maintenance (i.e. cutting back of trees and shrubs) can directly impact the air quality monitoring data, thus causing the raw data at sites to spike or exhibit periods of unusually high data. LSO insight is invaluable in keeping us informed and ensures that this genuine and valid data is accounted for during the ratification process and is not removed from the dataset. Please email info@scottishairquality.co.uk if you are aware of any issues that may affect the data at any of your sites.


Q: Why is it important to ensure that the analyser sample inlet is in free air?

A: European Union's Air Quality Directive 2008/50/EC states that the flow of air around the analyser inlet must be "unrestricted without any obstructions affecting the airflow" – which is not the case if vegetation is growing around it.

Additionally, vegetation acts as a 'sink' for some pollutants, so if the inlet is heavily overgrown it is likely that the monitoring station's measurements will underestimate actual local concentrations.

We would therefore like to remind all LSOs of the need to keep vegetation trimmed back, so that it does not surround or overhang the inlet.

STAY CONNECTED

| | |
|--|---|
| <p>SAQD PROJECT MANAGEMENT</p> <p>David Hector Tel: 01235 753523 E-mail: david.hector@ricardo.com</p> <p>Stuart Sneddon Tel: 01235 753015 Email: stuart.sneddon@ricardo.com</p> <p>SAQD PROJECT DATA MANAGEMENT</p> <p>Stephen Stratton Tel: 01235 753072 Email: stephen.stratton@ricardo.com</p> | <p>SCOTTISH GOVERNMENT</p> <p>Andrew Taylor Email: andrew.taylor2@gov.scot</p> |
| <p>RICARDO ENERGY & ENVIRONMENT FIELD OPERATIVES</p> <p>Susannah Telfer Tel: 01235 753434 E-mail: susannah.telfer@ricardo.com</p> <p>Sam Copsey Tel: 01235 753153 E-mail: sam.copsey@ricardo.com</p> | <p>Ashleigh Norrie Tel: 01235 753663 E-mail: ashleigh.norrie@ricardo.com</p> <p>Stephen Gray Tel: 01235 753525 E-mail: stephen.gray@ricardo.com</p> |
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