Air Quality

A Beginners Guide

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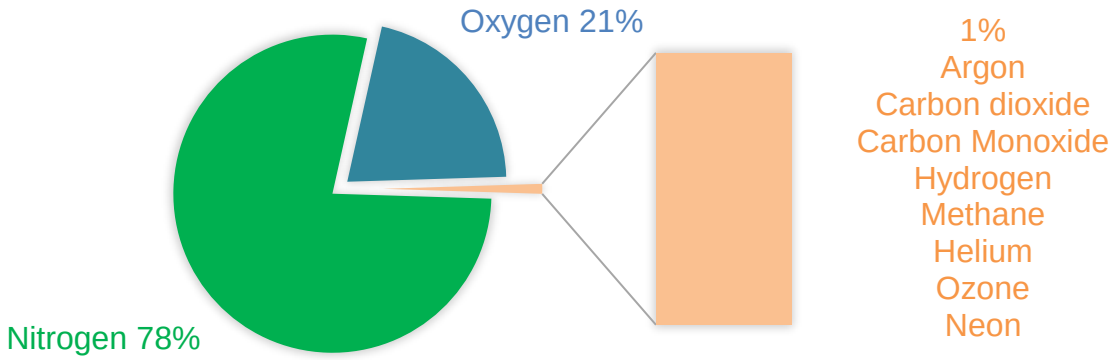
South Ribble Borough Council

CLIMATE EMERGENCY

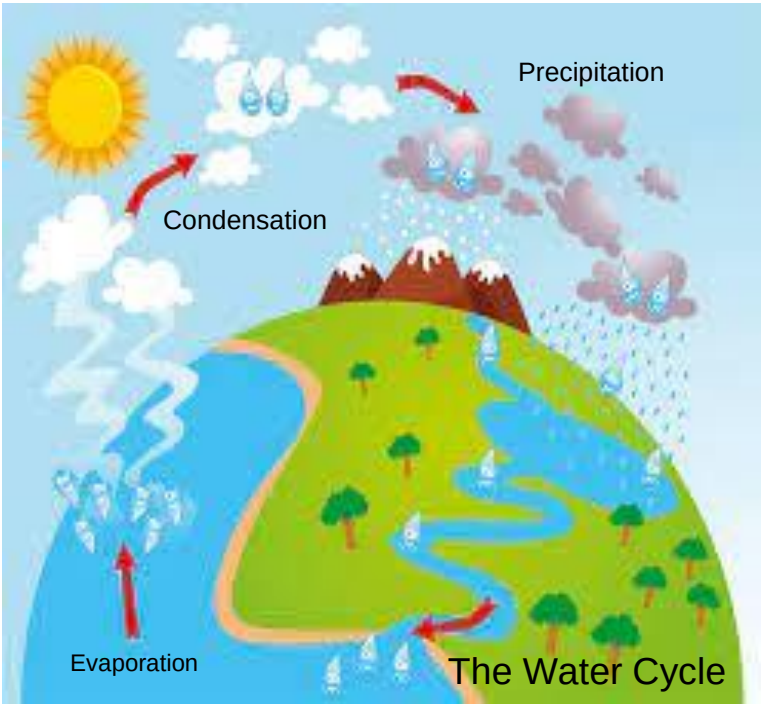
What is air?

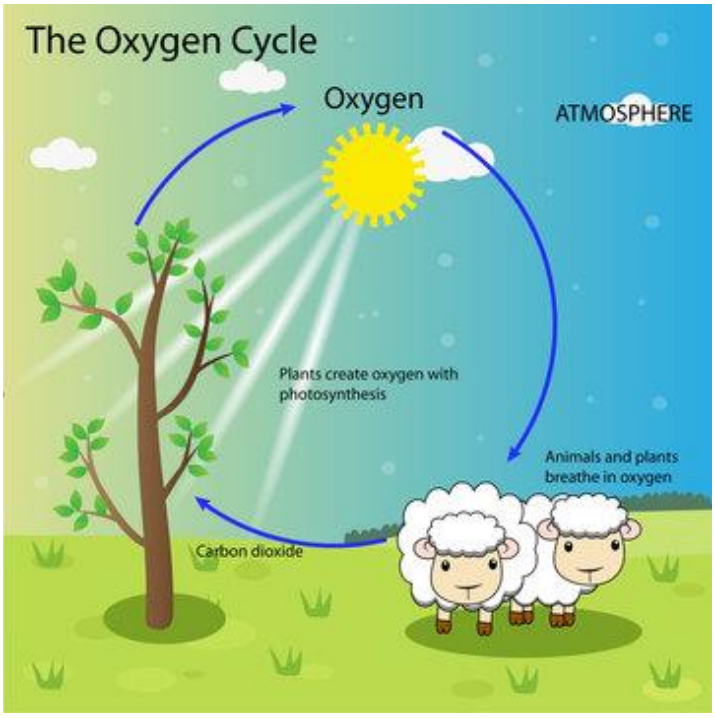
Our air is made up of gases - 78% nitrogen, 21% oxygen and 1% of other gases like argon, carbon dioxide, carbon monoxide, hydrogen, methane, helium, ozone, nitrous oxide and neon.



Air also holds water vapour (as part of the water cycle) and lots of tiny particles like dust, sea salt and pollen.

It is important because all humans, animals and plants need to breathe. Humans and animals breathe in air and use the oxygen within it and breathe out carbon dioxide. Plants use carbon dioxide and sunlight to make food and grow, as part of this process they give off oxygen (this is called photosynthesis).





Air Quality – what is it?

Air quality is the term that is used to describe how clean the air is.

How did our air get dirty?

Our air gets dirty (polluted) when it starts to hold on to more tiny particles and the balance of the natural gases, that make air, change.

This started happening when man discovered fire but got worse at the beginning of the industrial revolution in the 18th century when humans started to develop industries and continues to this day. The invention of the car, burning fossil fuels and farming all contribute to increased levels of particles and gases.

The increase in particles can also be from natural sources like pollen, dust as a result of droughts or windy days in the desert, ash from volcanic eruptions and wildfires.

Air pollution is also caused by changing amounts of gases in the atmosphere. Many of these occur because of chemical reactions with other gases, sunlight or water vapour. One of these gases is called ozone, which is formed when sunlight reacts with chemicals that come from burning fossil fuels or vehicle exhaust fumes. When particles in the air combine with ozone they create smog. Smog looks a bit like fog and makes it difficult to see.

London Smog Scare 2012 - https://www.standard.co.uk/news/london/london-smog-scare-7575337.html

Air pollution closes schools in Delhi, Indian 2021 https://edition.cnn.com/2021/11/14/asia/new-delhi-air-pollution-intl/index.html

How dirty is our air experiment - https://www.education.com/science-fair/article/dirty-air/

What pollutes our air today?

There are a number of substances that can affect air quality.

- **Particulate Matter –** tiny particles in the air that you can't see
  - smoke from wood and coal fires at home (38%),
  - non-domestic burning (16%).
  - dust from brakes and tyres (12%),
  - manufacturing industries (13%),

- **Nitrogen Oxides (NOx) -** These are a group of gases mainly created by burning fossil fuels. They can react with other gases in our air and create new gases such as nitrogen dioxide (NO_2) and Ozone (O_3). Nitrogen oxides come from
  - Road transport (35%)
  - Other transport – such as rail and shipping (17%)
  - Energy generation (22%)
  - Industrial combustion (19%)

- **Ammonia (NH_3) -** This is a gas that is released from
  - rotting waste (4%)
  - agricultural slurry, manure and fertiliser (88%)

- **Sulphur Dioxide (SO_2) -** This is an acidic gas that when it combines with water vapour in the air will cause acid rain. It is released from
  - Energy generation (37%)
  - Industrial burning (22%)
  - Domestic burning (22%)

Why does it matter?

Clean air is a requirement for a healthy life for us and all plants and animals on the planet. When we breathe in the pollutants over a long time period, they can lead to a number of health conditions associated with the lungs and heart.

The effects are seen more in children, as their bodies are still developing and growing and because they are generally shorter in height, they are closer to the source of pollutants from vehicles.

High levels of pollutants landing on the earth can change soil nutrient levels, make lakes and stream more acidic, damage crops and cause acid rain.

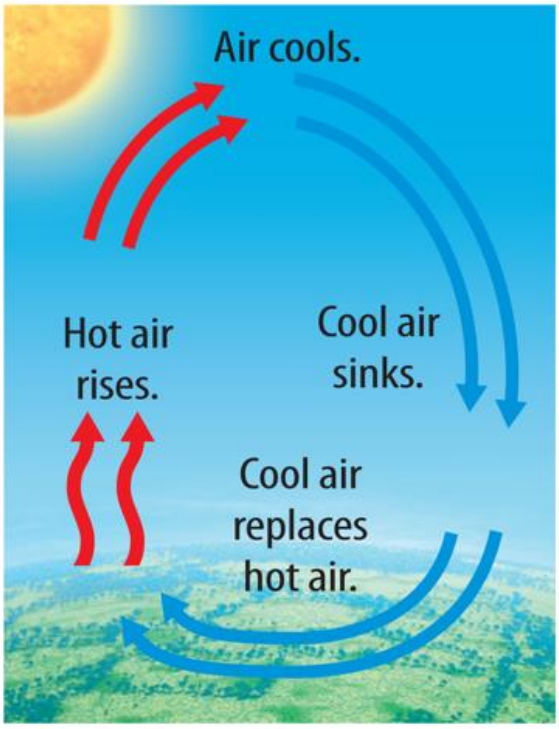
I don't live in a city, does air quality still affect me?

Yes, air quality is a global issue, it doesn't matter where you live you will still be affected.

The air that we breathe travels around the globe as a result of wind patterns, caused by the sun heating and cooling the land and sea, and the rotation of the earth. As the air carries gases, water vapour and particulate matter, this too is spread around the world.

How does air pollution spread around the globe?

As air is heated up it rises, forming areas of low pressure, and as it cools it falls back down, forming areas of high pressure. The sun heats up the earth quicker than the oceans. This means that during the day the air over the land rises and to fill the gap, colder air is drawn in from the sea. This cooler air heats up, rises and more cool air is pulled in to fill the gap. As the air rises it cools and flows out to sea. Creating an air current. At night the opposite happens. The earth cools faster than the sea, so the warm air above the sea rises pulling cool air off the land and creating an air current that flows in the opposite direction to the one during the day.

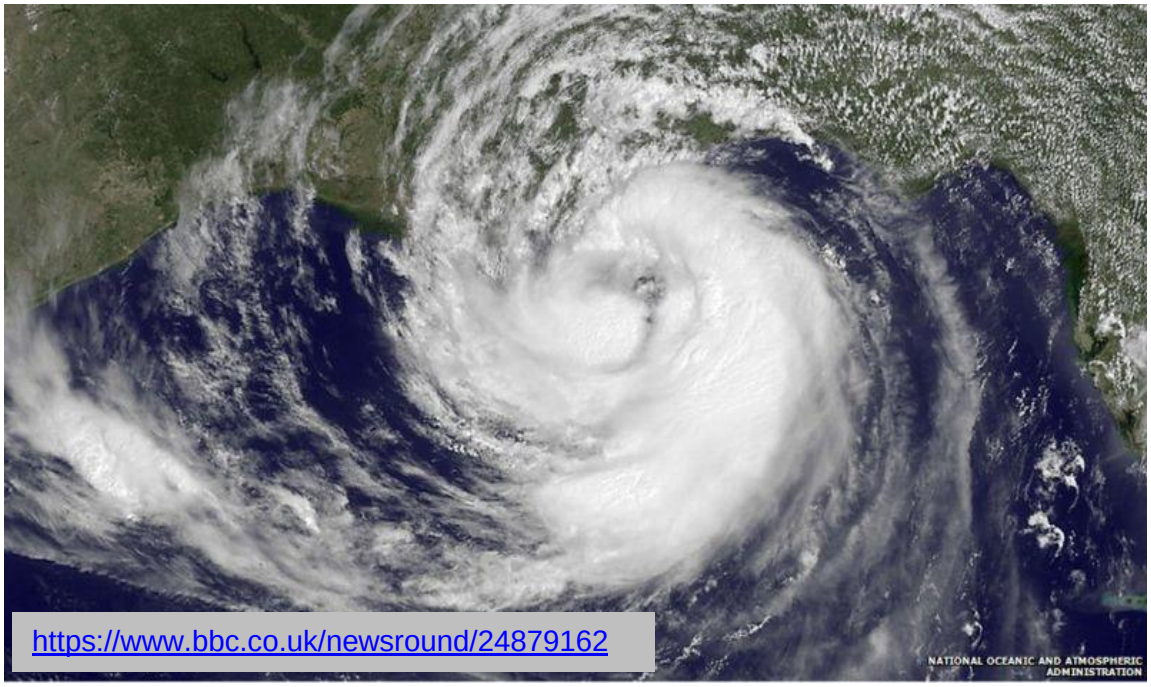


Warm air rises experiments –

https://www.metoffice.gov.uk/weather/learn-about/met-office-for-schools/other-content/other-resources/experiments/fronts

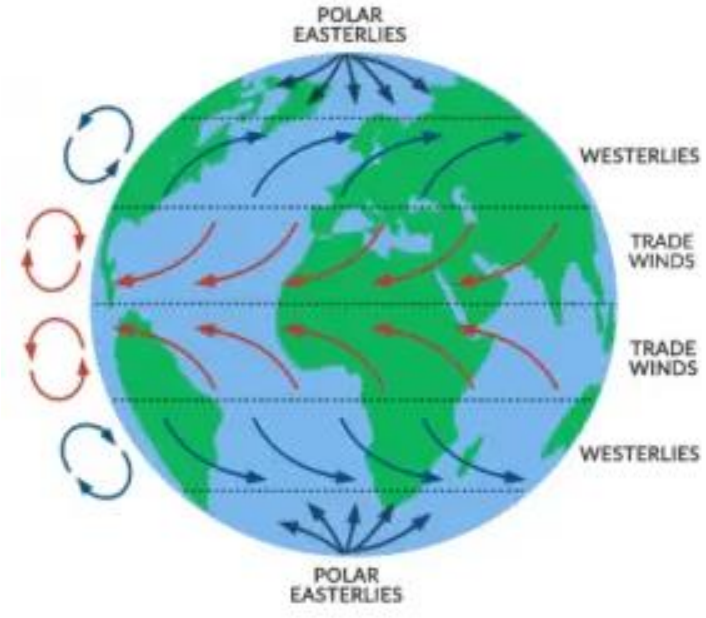
https://www.sublimescience.com/free-science-experiments/homemade-hot-air-balloon/

The differences in air pressure create wind events like hurricanes and cyclones.



https://www.bbc.co.uk/newsround/24879162

If the earth didn't rotate, then air currents would travel from the equator to the poles in a relatively straight line. Because it does, the air north of the equator is deflected to the right and the air to the south of the equator is deflected to the left. This is called the Coriolis Effect.



The Coriolis Effect Diagram

https://earthhow.com/coriolis-effect-air-circulation/

All this happens in the ~10km (about 6 miles) above the earth's surface, a part of our atmosphere called the Troposphere. This is where all our weather happens. The Troposphere contains 75% of all the air and 99% of all the water vapour on earth.

Without wind there would be no weather.

How can I find out how polluted the air is near me?

The government has a website that provides a daily air quality forecast provided by the Met Office https://uk-air.defra.gov.uk/ . You can see air quality levels across the UK or put in your postcode and get data local to you. This site also offers health advice for those who need it, if the air quality is forecast as poor.

Local authorities also measure Air Quality and often publish this information on their websites.

Why do we measure air quality?

Many organisations around the world measure air quality in many different ways. For example, NASA uses satellites orbiting the earth to take pictures of particles and gases or specific polluting events like wildfires or volcanic eruptions.

These records allow us to track the changes in air quality and predict trends and problems that may occur. For example, tracking the direction of plumes of volcanic ash after an eruption allows planes to change course and can save lives on the ground by evacuating people from areas that may be at risk. https://www.bbc.co.uk/news/uk-13513981

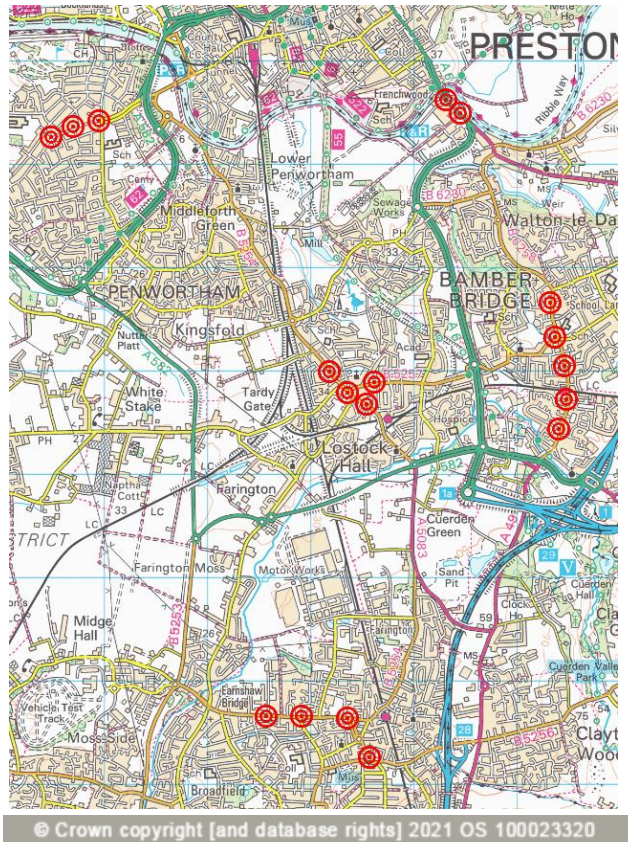
What does the Council do about air quality?

Local authorities must consider air quality in their area and report the results to central government. Government then reports the results for the whole country to the UN.

If a local authority finds an area where air quality results are above levels set by Government, it has to declare the area as an Air Quality Management Area or AQMA and then produce an Air Quality Action Plan which shows how they will improve the situation.

In South Ribble we measure particulate matter in Leyland and Lostock Hall and nitrogen oxides in Leyland, Lostock Hall, Penwortham, Walton le Dale and Bamber Bridge.

All our AQMA coincide with areas of high traffic flow restricted by traffic lights and / or roundabouts.



We currently have AQMAs at these locations

- Penwortham – Liverpool Road shopping area
- Walton le Dale – A6 at the Capitol Centre
- Lostock Hall – Leyland Road / Brownedge Road
- Bamber Bridge – Station Road
- Leyland – Turpin Green / Golden Hill Lane area

Map to show Air Quality Management Areas in South Ribble

How do we measure it? (The science bit!)

In South Ribble we measure particulate matter using Zephyr Air Quality Monitors and nitrogen oxides using Diffusion Tubes.

Zephyr monitors give us real time data, while diffusion tubes are changed monthly and sent away to a laboratory to be analysed

Particulate Matter

Particulate matter is measured by size in micrometres (µm) which is one-millionth of a metre, or one-thousandth of a millimetre. The sizes that are measured and reported on are 10µm, 2.5µm and 1µm in diameter known as PM10, PM2.5 and PM1. For a sense of scale, a grain of sand measures about 90µm and a grain of salt is about 40µm, so measurements are taken on particles 4 to 40 times smaller than a grain of salt.

Concentrations of particulate matter are measured in cubic meter of air volume (m^3), the total is written as a measurement of micrograms (one-millionth of a gram) per cubic meter ($\mu g/m^3$). A set amount of air is drawn through a filter, the particulate matter that is left on the filter is weighed and gives a mass of PM that was in that volume of air. A value of 1 $\mu g/m^3$ means one cubic metre of air contains one microgram of pollutant.

Global advisory levels for PM levels are set by the World Health Organisation. The UK Government says that concentrations must not exceed

- PM10 an annual average value of 40 µg/m^3
- PM10 a running 24-hour average of 50 µg/m^3 more than 35 times in a single year
- PM2.5 an annual average of 25 µg/m^3

The running 24-hour average is there to ensure that we are not exposed to high concentrations of pollutants for short periods of time and the annual average protects us from exposure over a long time period.

The number of pollution incidents varies year on year. Spikes in pollution can be seen around bonfire night, especially if the weather is cloudy, and as a result of construction work, dust blown over from the Sahara or periods of hot, sunny weather with little wind.

Nitrogen Oxides

Nitrogen dioxide levels are measured using diffusion tubes that are supplied and analysed by a laboratory. These small plastic tubes are attached in a vertical position and fixed to a lamp column or drainpipe. They have a cap at the top end that contains a filter that absorbs nitrogen dioxide. When analysed in the lab, it can tell us how much nitrogen dioxide was in the air during the monitoring period (usually about a month).

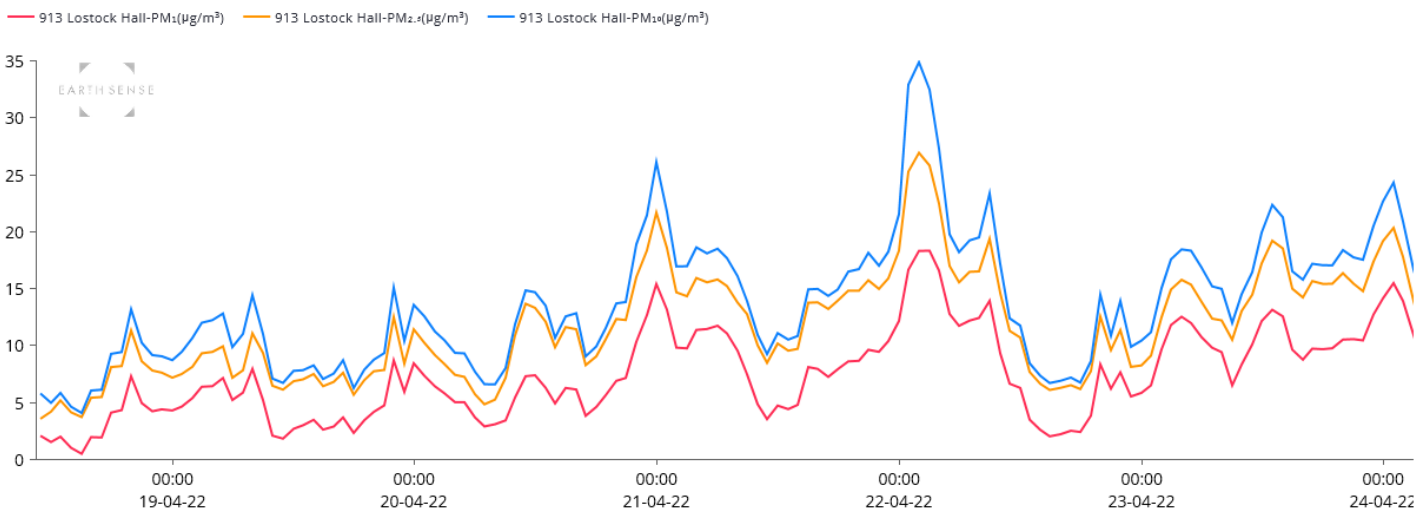
The UK government says that levels of nitrogen dioxide must not exceed 40 µg/m^3.

PM and NOx are measured in 3 locations

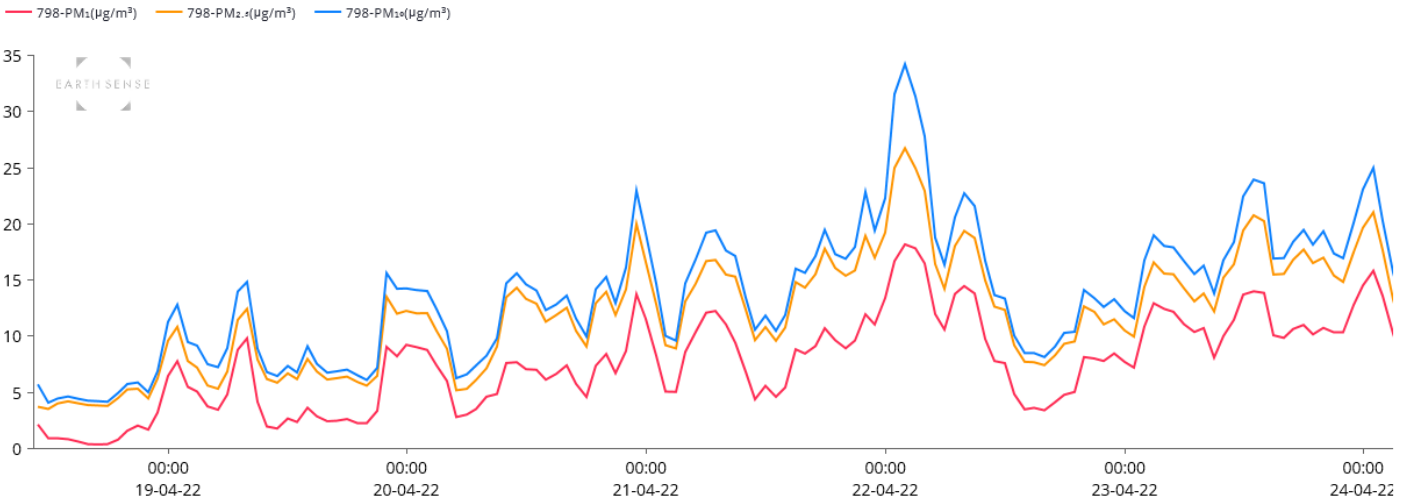
- Kerbside – within one metre of the edge of a busy road
- Roadside – between 1m from the edge of the busy road and the back of the pavement, usually 5m from the road
- Urban background – sites in an urban area, away from emission sources and used to measure the roadside levels against.

What are the results locally?

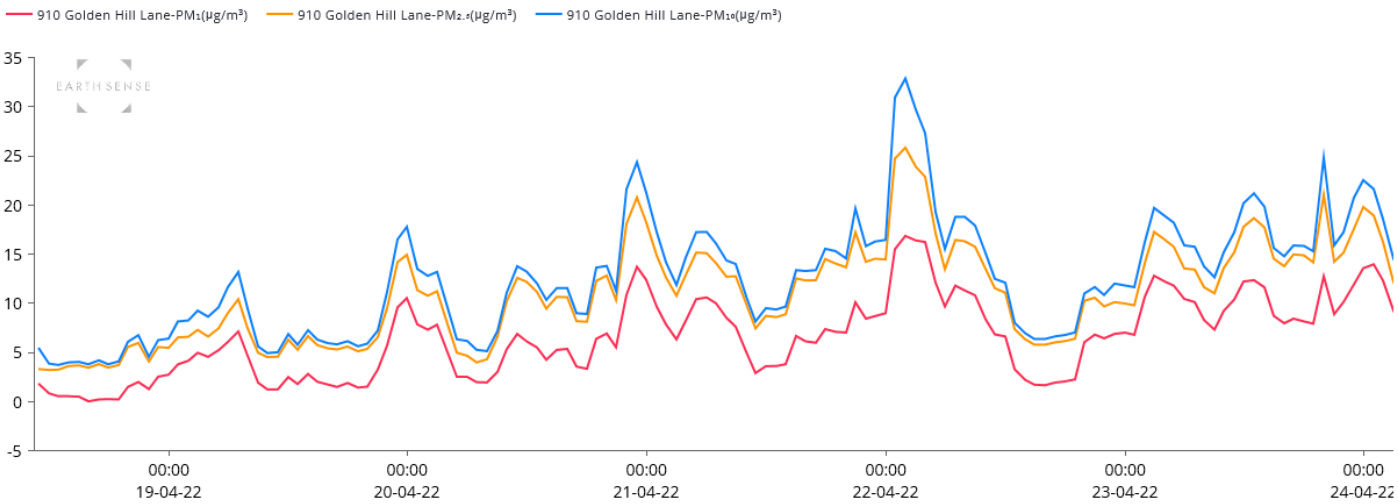
The Zephyr monitors produce real time data that is used to produce graphs for different time periods. The following graphs show results for the three monitored areas for a five-day period from the 19th – 24th April 2022. The pink line is the measure of PM1, the yellow line PM2 and the blue line PM10. You can see that levels of PM10 never reach the maximum allowed level of 40 µg/m^3 and the levels of PM2.5 never reach the maximum levels of 25 µg/m^3.



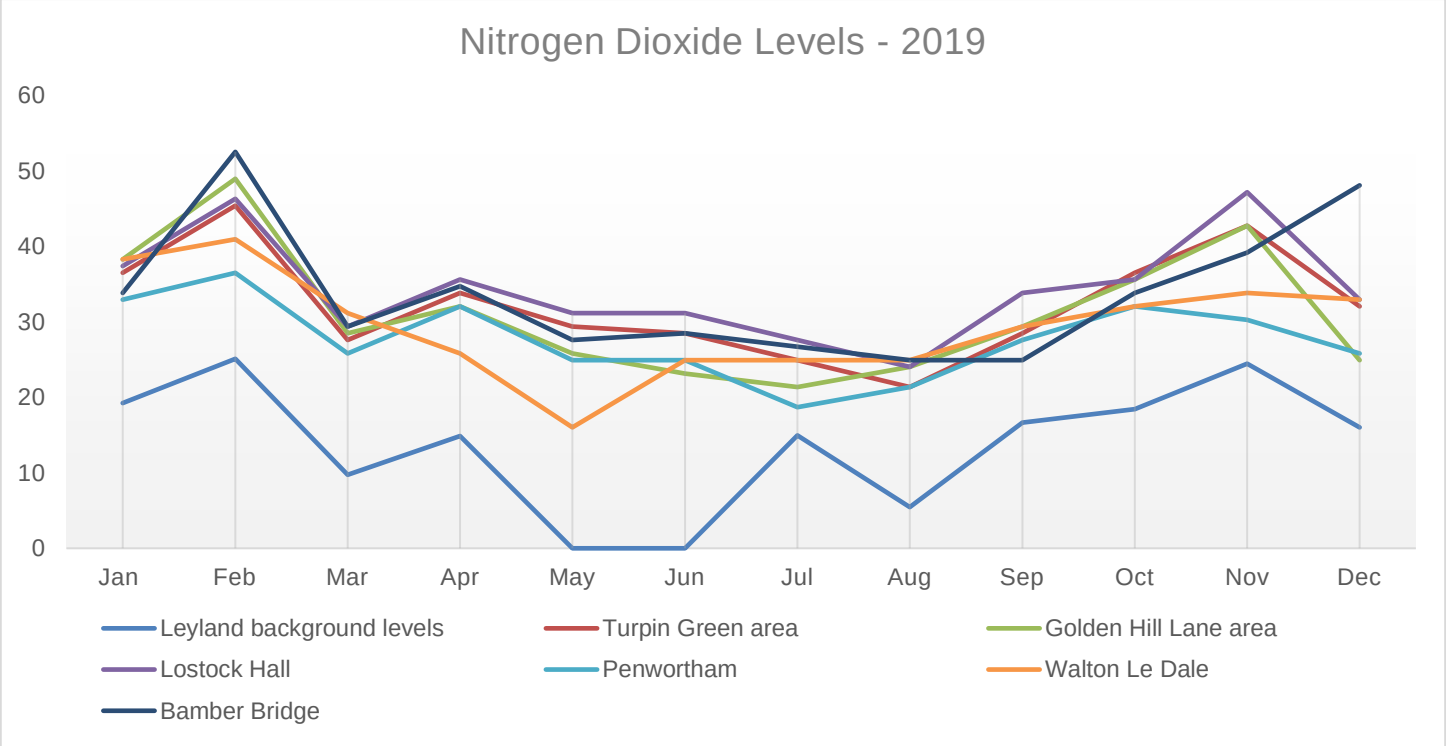
Particulate Matter – Lostock Hall - 19th April – 24th April 2022



Particulate Matter – Leyland – Turpin Green area - 19th April – 24th April 2022



Particulate Matter – Leyland – Golden Hill Lane area – 19th April – 24th April 2022



Nitrogen dioxide tubes are collected monthly and sent away to a laboratory to be processed. The graph shows average figures for 2019, the last full set of data that is available, pre Covid-19. These are the most realistic figures, as traffic levels dropped dramatically during lockdown and the laboratories shut for a period of time. You can see that there is a peak above the maximum 40 µg/m^3 level in February and again in November. Background pollution levels were also higher during these months.

Is it just an outdoor issue?

No, air quality inside your home and workplace is also important to your health and the health of the planet.

There are many sources of pollution in your home including from –

- **Wood burners, coal fires, gas fires and gas cookers**

  While most of the smoke from your fire goes up your chimney, all fires will also release particulate matter into your room. It can cause irritation of the nose and throat, coughs and breathing problems. It could make existing lung conditions worse.

  When wood, coal, oil or gas don't burn properly, because of a faulty appliance or blocked chimney, they release carbon monoxide and nitrogen oxide. Carbon monoxide is a poisonous gas with no smell or taste and can kill in a couple of hours

- **Damp and Mould**

Condensation is caused by damp air as a result of cooking, showers and baths and drying clothes. Long term condensation can cause damp and mould to occur. An allergy to mould can cause irritation to the nose and throat.

- **Smoke and Vapour**

Cigarettes, e-cigs, candles and incense sticks release particles as they burn that can remain in the air for up to 5 hours. Incense sticks emit 100 times more fine particles than candles. Scented candles contain Volatile Organic Compounds (VOCs) (see below). They may cause irritations to the nose and throat, coughs or breathing difficulties, especially in children.

- **Volatile Organic Compounds**

VOC's are a group of chemicals that are commonly found in many cleaning products and other everyday household products such as –

- Washing detergents
- Furniture polish
- Air fresheners
- Deodorants and perfumes
- Scented candles
- Paints, varnish and glues
- Petrol
- Cement
- Pesticides and fungicides

Some products carry a Globe Symbol that is designed to tell you what level of VOC is in the product.

Exposure to these chemicals may irritate the lungs and cause allergies.

What can I do to improve air quality?

At home

- Burn clean dry wood that displays the Ready to Burn logo
- Service appliances regularly – get an annual RoSPA gas safety check of boilers, cookers and fires.
- Open windows or use an extractor fan when cooking with gas
- Clean chimneys and vents
- Install carbon monoxide alarms in every room where fuel is burnt
- Don't burn candles or incense in small enclosed spaces (like bathrooms) and open windows or use an extractor fan while you are burning them.
- Open windows for 5 – 10 minutes every day. If you live on a main road, pick a time when traffic levels are low, outside of rush hour.
- Use environmentally friendly, chemical free cleaning products
- Use solid deodorants rather than sprays
- To prevent condensation,
    - Dry your washing outside whenever possible. If drying indoors then open a window or use an extractor fan
    - Fix leaks and water damage which will decrease humidity and therefore mold
    - Keep homes between 19 – 21 degrees centigrade.
- Use the extractor fans installed in kitchens and bathrooms

Outside

- Reduce the amount you use the car – can you walk or cycle instead?
- Cut the numbers of cars making the same journey by car sharing
- Use public transport for some of your journeys
- Fly less
- Turn off the car engine when you are not driving / waiting for someone
- Don't override the auto stop function
- Consider buying an electric vehicle
- Don't burn waste, take it to the tip instead
- If you are walking or cycling avoid the main roads and use quieter side roads with less traffic
- Change the times you make your journey, to avoid queuing in traffic
- Greening up our cities. All plants take in carbon dioxide and toxins and give off oxygen

References

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