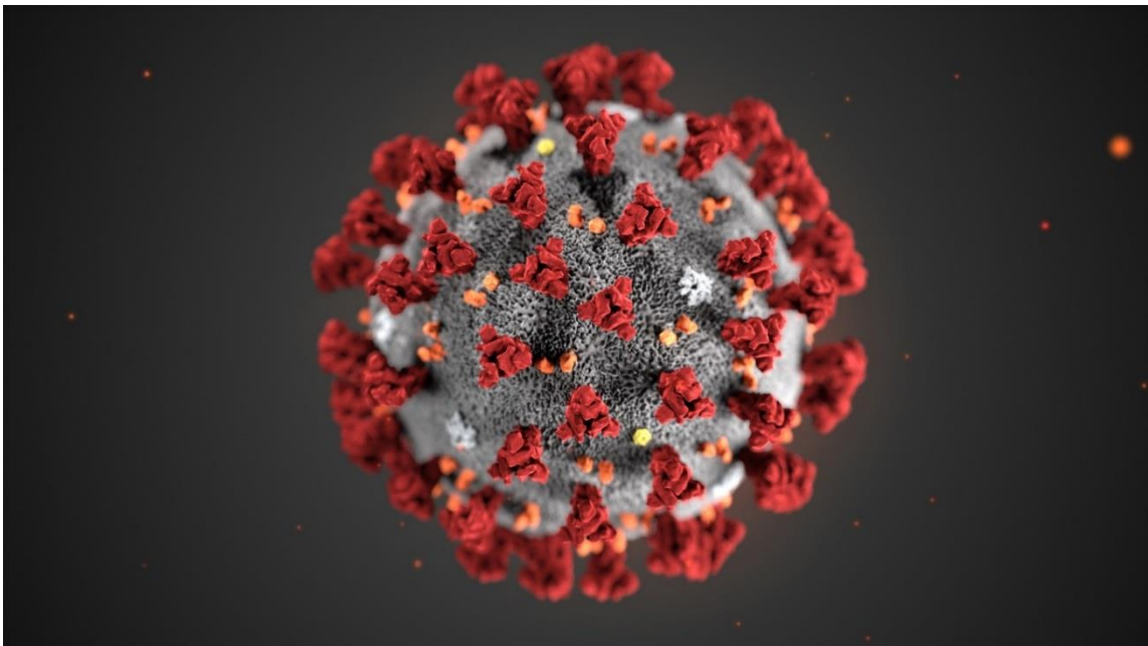


A Preliminary Investigation into the Effects of the Covid-19 Pandemic on Air Quality in Dublin

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1.0 Introduction

Air is the most basic essential need for life, and as people can only breathe the air around them, exposure to air pollution such as emissions from motor vehicles, industry, commercial sources, as well as tobacco smoke, in contrast to some other forms of pollution, is of particular concern.

While air pollution is often considered solely as an environmental issue, rather than a health matter, in fact over 400,000 Europeans die prematurely from the effects of air pollution each year.

1.1 Types of Pollutants

Overall the air quality in Ireland is of high standard, relative to other European Member States. We are fortunate that as a small island with clean prevailing air from the Atlantic and we lack large cities and heavy industry, however there can be incidences of higher pollution.

The main pollutants of concern in Ireland are Particulate Matter (PM) and Nitrogen Dioxide (NO₂) whose main source is traffic.

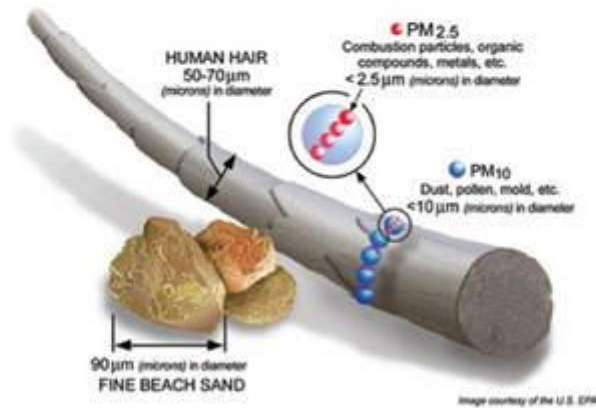
Particulate Matter (PM) is the term for a mixture of solid particles (such as dust, dirt, soot) and liquid droplets found in the air. Particulate pollution includes: PM₁₀ inhalable particles, with diameters of 10 micrometres and smaller, and PM_{2.5} fine inhalable particles, with diameters that are generally 2.5 micrometres and smaller.

The size of PM directly relates to its toxicity. The smaller it is in size, the further it penetrates into the lungs, causing oxidative stress and inflammation.

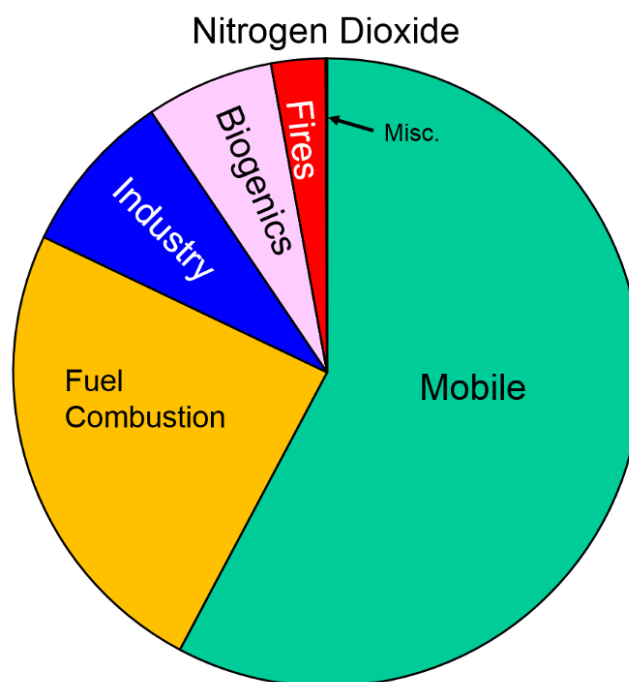
The WHO have classified air pollution in general and particulate matter in particular as carcinogenic to humans. As regards Ireland, the EEA reported that **1,480 deaths** here in 2014 were attributable to particulate matter exposure. In urban settings, domestic use of solid fuel and diesel fuelled vehicular traffic are the principal sources. PM can also be formed from reactions between different pollutant gases.

Particulate Matter (PM)

PM pollution consists of materials (including dust, smoke, and soot), that are directly emitted into the air or result from the transformation of gaseous pollutants



Nitrogen Dioxide (NO₂) is a gas produced from the burning of fossil fuels in vehicles, industrial plant, power plants and other commercial and residential sources that burn fuel. NO₂ irritates the lungs and lowers resistance to respiratory infection, especially for those already suffering with breathing difficulties e.g. asthma, bronchitis. NO₂ along with SO₂ is also a precursor of acid rain. It is therefore responsible for acidification of lakes and streams and accelerated corrosion of buildings.



1.2 Café Directive Limits vs WHO guidelines for PM and NO2

In order to manage/control levels of emissions, The CAFÉ Directive 2008 sets limits for pollutants which are monitored by the local authorities and the EPA. The World Health Organisation sets its own guidelines. The revised limits are much stricter than those of EU limits. The limits for PM and NO2 are compared in the table below.

CAFÉ Directive EU Limits			WHO Revised Guidelines		
Pollutant	Averaging Period	Concentration $\mu\text{g}/\text{m}^3$	Pollutant	Averaging Period	Concentration $\mu\text{g}/\text{m}^3$
PM 10	Annual	40	PM10	Annual	20
PM 2.5	Annual	25	PM2.5	Annual	10
NO2	Annual	40	NO2	Annual	40

1.3 Study Background

The aim of this report is to compare the air quality in Dublin from February-June 2019 Vs February-June 2020 and to investigate if there has been any improvements in the levels of pollutant emissions since the government restrictions were put in place in response to COVID-19. A few key dates to consider are the **12th of March 2020**, where the government announced the closure of schools, colleges and childcare facilities, the **27th March 2020** where a full lockdown was introduced and the **18th May** when phase 1 on the easing of restrictions was introduced.

In this study, we focused on the following multi-pollutant sites which measure both Particulate Matter and Nitrogen Dioxide:

- ***St John's Road***
- ***Civic Offices***
- ***Davitt Road***
- ***Ballyfermot***

St. John's Road, the Civic Offices station on Winetavern Street, and Davitt Road are situated adjacent to heavily trafficked roads, whereas Ballyfermot is situated in a predominantly residential area.

2.0 Results

Pollutant levels from the 2020 lockdown period were compared with the levels recorded for the same time period in 2019. This was done with the aim of identifying if there was any reduction to the levels of PM 2.5, PM 10 and NO₂ in 2020 due to the Covid 19 Lockdown.

All pollutants are measured in micrograms per metre cubed based on weekly averages. This format of presenting the data has been used by the European Environment Agency in examining air quality data across Europe during Covid 19 lock down period. Data presented in all of the graphs below are compared by an approximate start date in both 2020 and 2019

2.1 – St John's Road

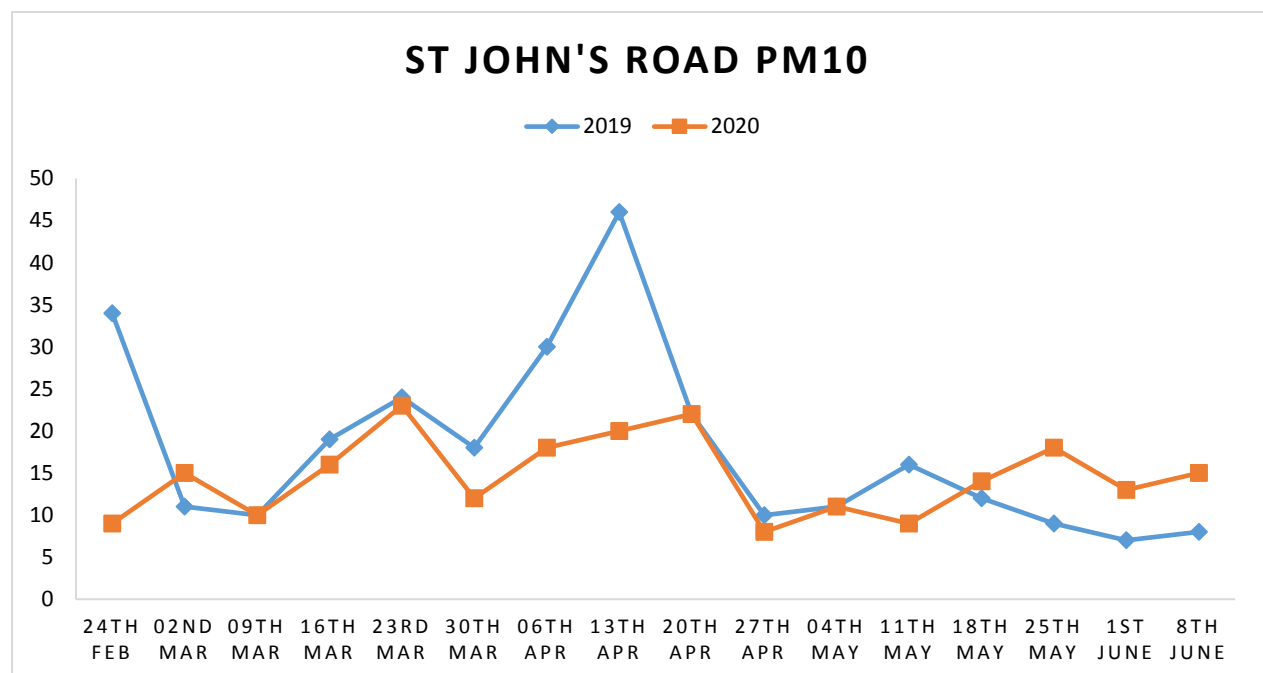


Fig 2.1.1

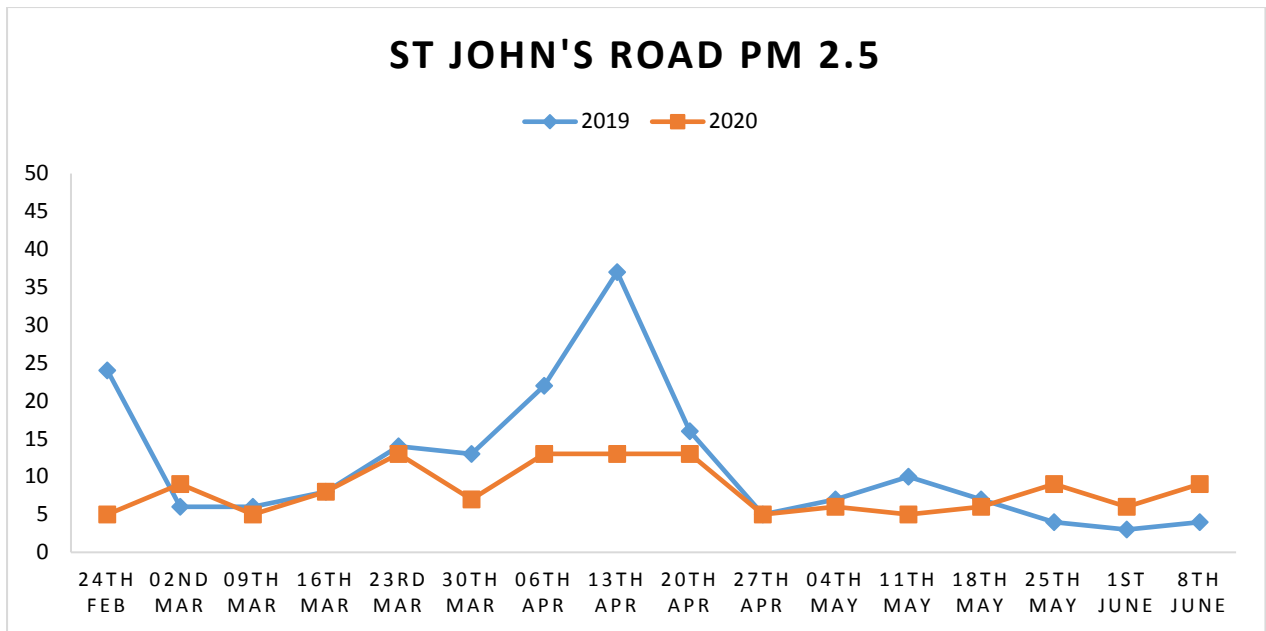


Fig 2.1.2

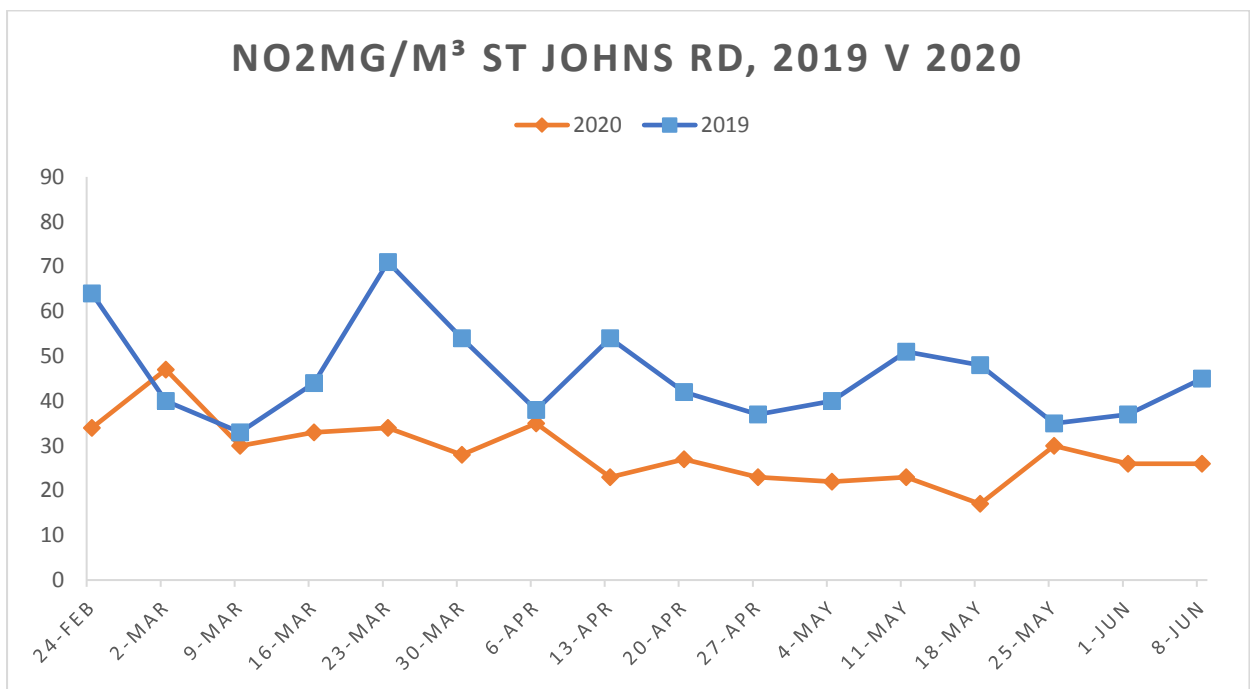


Fig 2.1.3

2.2 Civic Offices

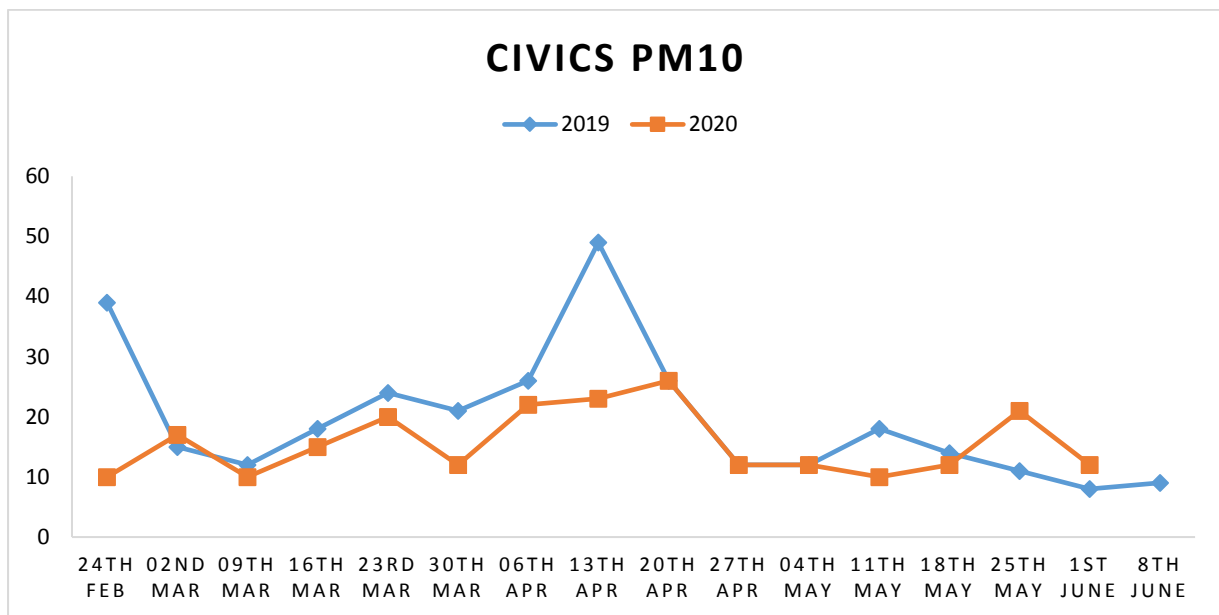


Fig 2.2.1

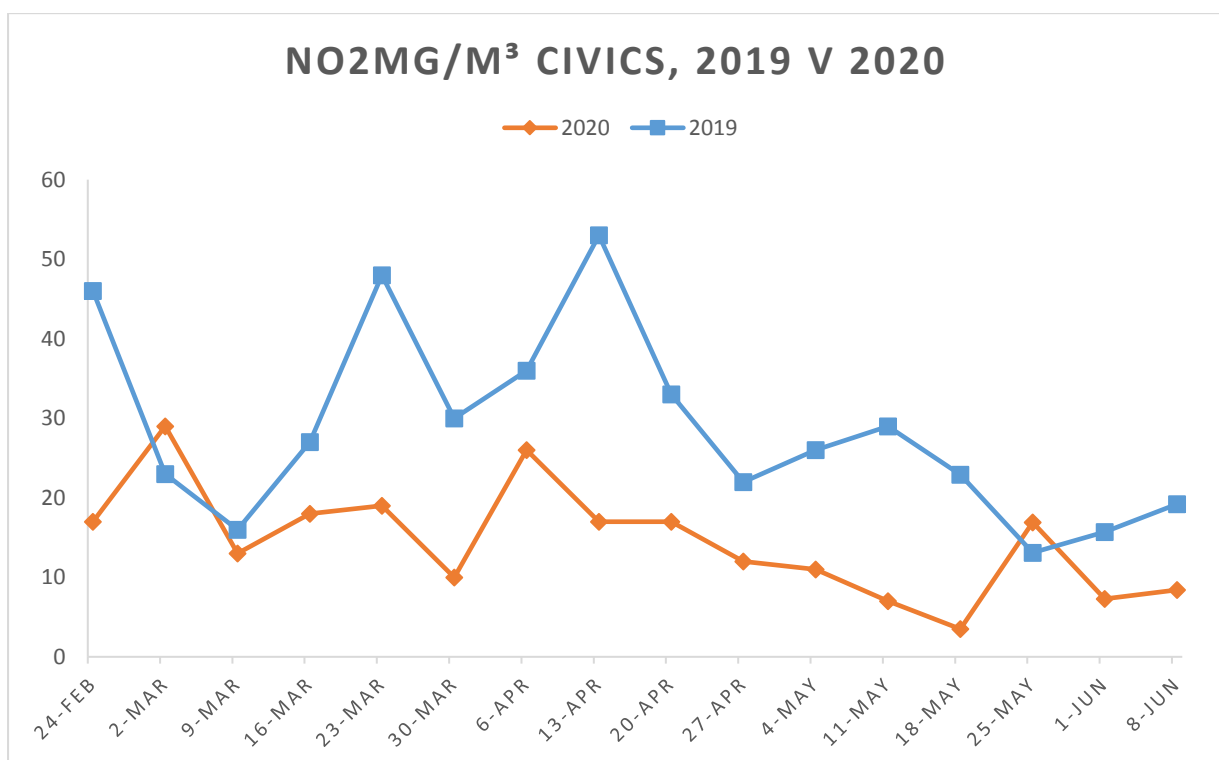


Fig 2.2.2

2.3 Davitt Road

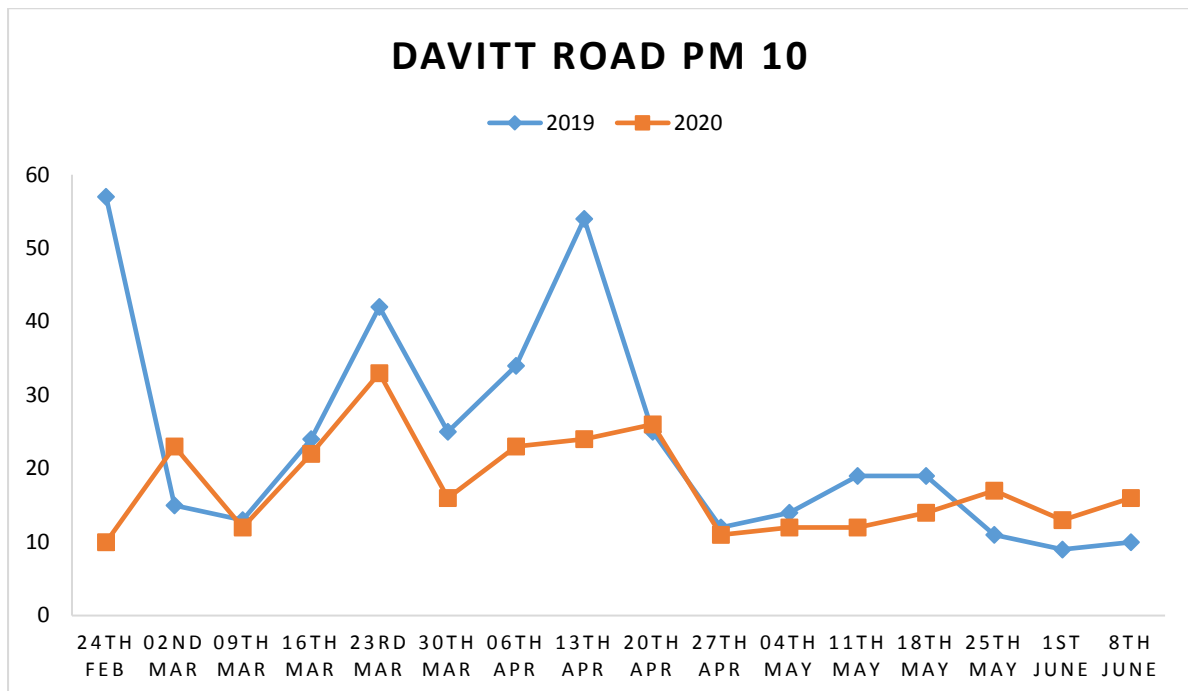


Fig 2.3.1

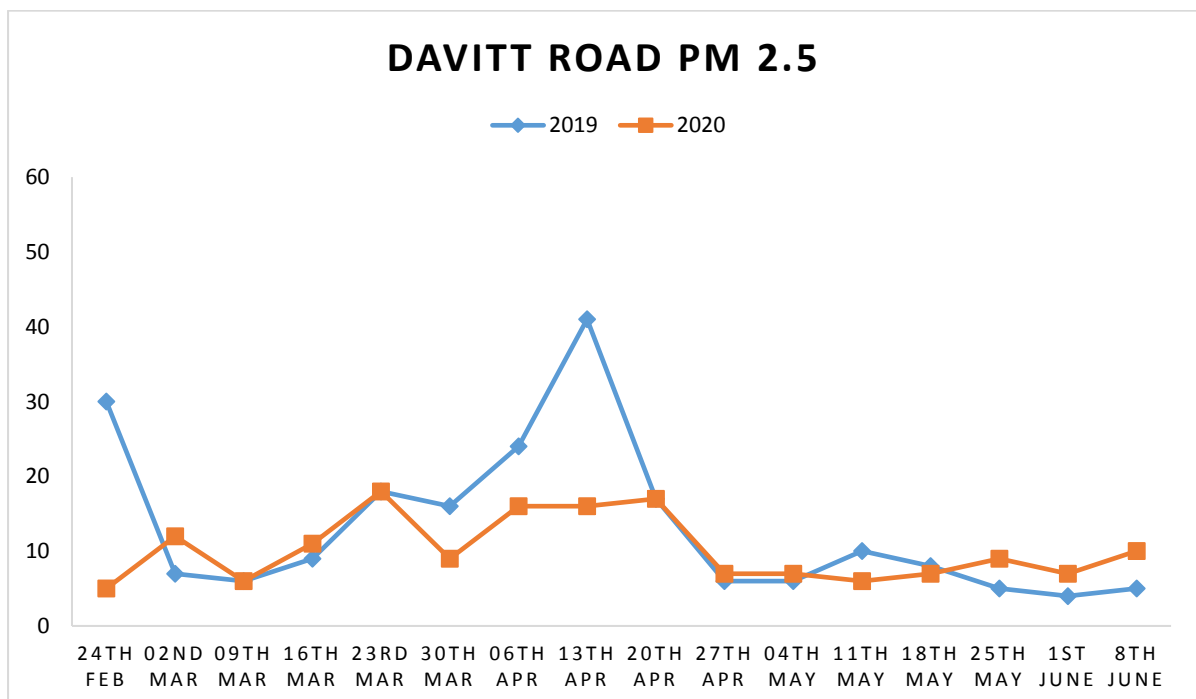


Fig 2.3.2

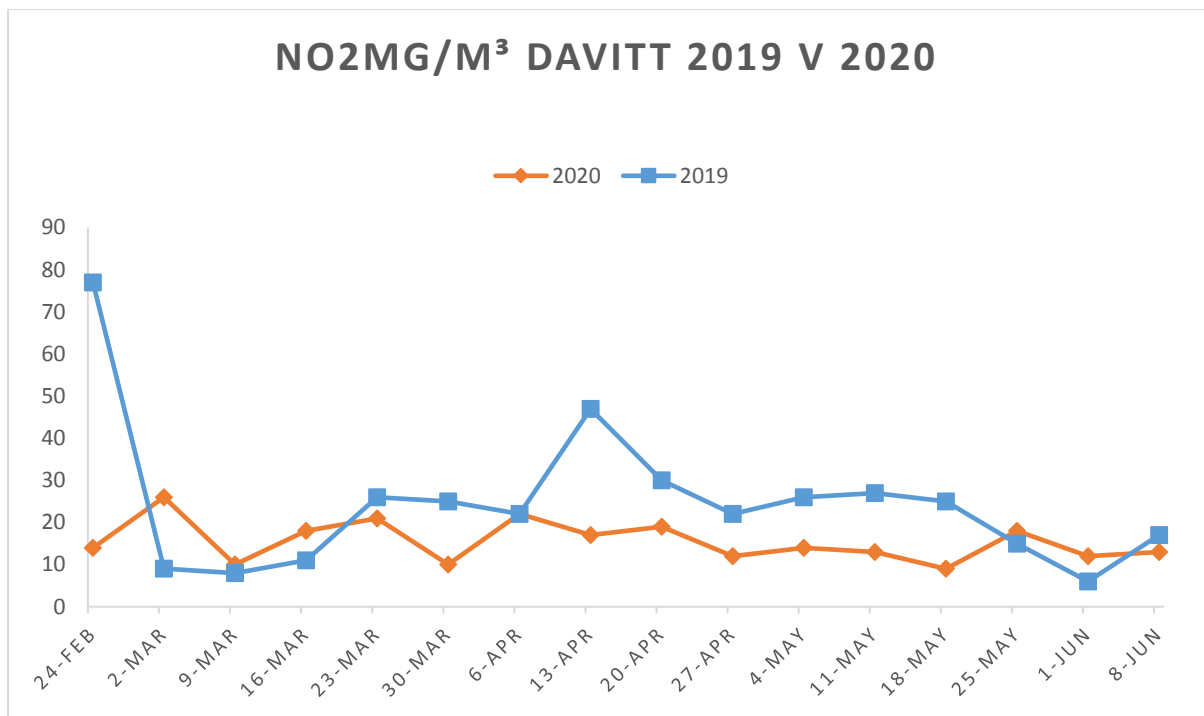


Fig 2.3.3

2.4 Ballyfermot

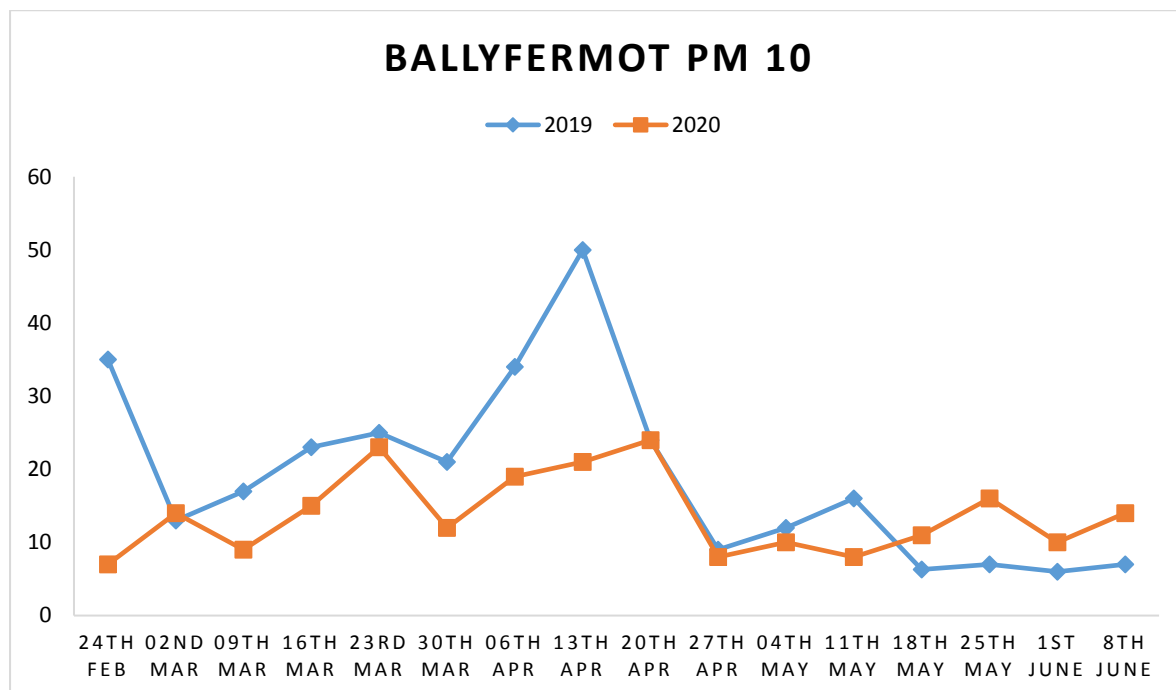


Fig 2.4.1

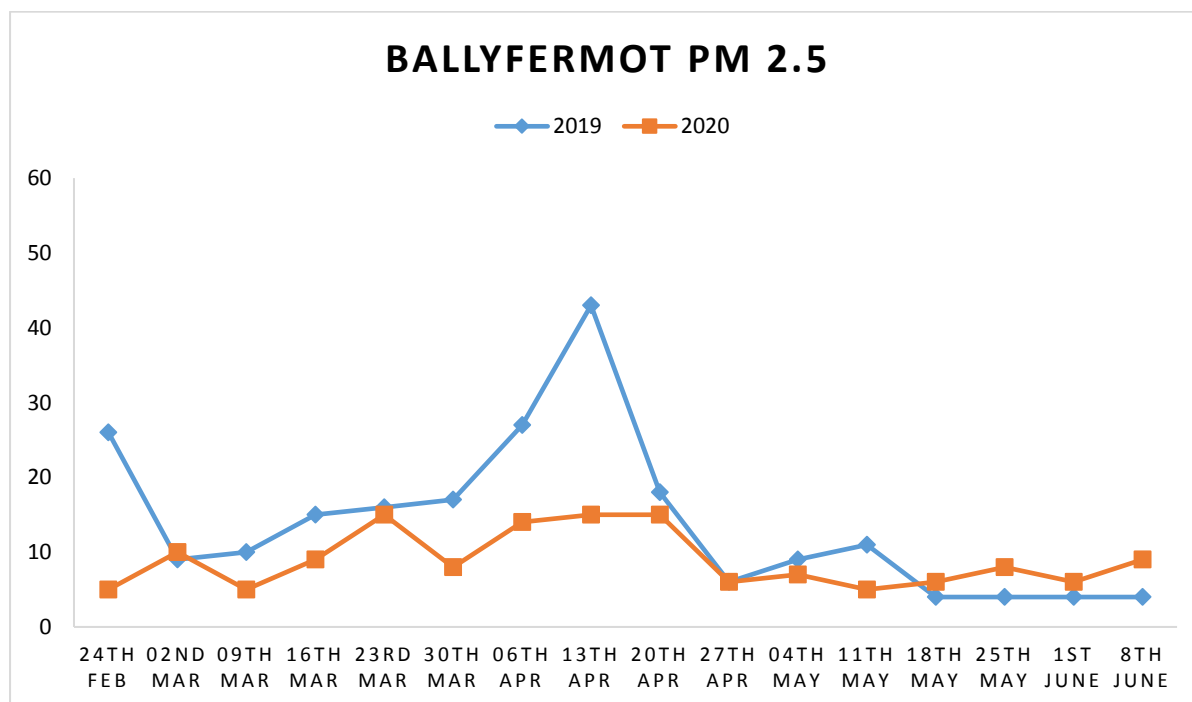


Fig 2.4.2

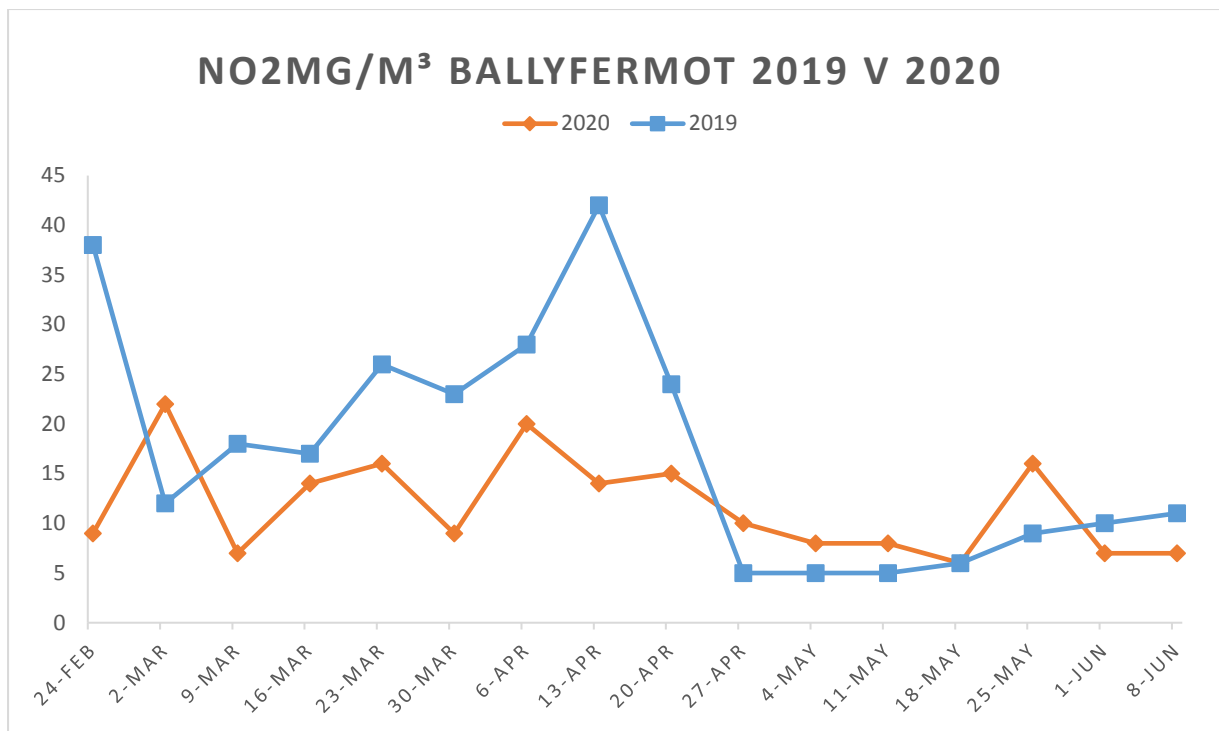


Fig 2.4.3

3.0 Discussion

As can be seen from the graphs above, there have been some clear reductions in the levels of pollutants emitted at each site in Dublin following the government restrictions put in place on the 27th of March, in response to Covid-19. Both PM₁₀ & PM_{2.5} levels are much lower in 2020 at all sites compared to 2019.

After May 18th, when phase 1 of the easing of restrictions was introduced, increases in both PM and NO₂ can be seen, and levels of PM exceed 2019 figures.

There is no substantial change in the levels of NO₂ recorded at the Davitt Road site and the Ballyfermot site. The Civic Offices site and the St Johns Road site have the clearest difference between 2020 and 2019.

The St Johns Road site had the most consistent decrease in all pollutants measured. Some other examples of decreased levels in 2020 when compared to 2019 at this site are as follows -

- 56.52% decrease on the week of the 13th of April in PM 10,
- 64.86% decrease on the week of the 13th of April in PM 2.5
- 64.58% decrease on the week of the 18th of May in NO₂.

The influence of metrological conditions on air quality cannot be overstated particularly when attempting to provide a comparison over different years. Weather conditions, rainfall in particular, play a significant part in the variations in levels of pollutants, so this must also be considered when making a comparison. It is clear that the levels of rainfall were much higher during 2019. According to figures from Met Eireann, the total rainfall for each month is as follows;

Month	2019 Rainfall (mm)	2020 Rainfall (mm)
March	87.7	30.7
April	71.6	13.6
May	34.8	8.6

This reduction in rainfall in 2020 could have played a part in explaining why levels have not decreased as much as expected due to the reduced dispersion effect. Air pollution levels tend to drop after it rains as it has a 'scavenging' effect when it washes particulate matter out of the atmosphere and dissolves gaseous pollutants. Rain also prevents particulate pollution from becoming suspended by making dust particles stick to the ground. If the levels of rainfall

in 2020 were the comparable to 2019, it is not unreasonable to suggest that there would be a more pronounced difference in terms of pollution reduction.

4.0 Conclusion

To conclude, there have been some obvious reductions in the levels of pollutants emitted at each site in Dublin since the lockdown was implemented on the 27th March 2020 in response to Covid-19. Following this, the levels of both PM and NO₂ dropped significantly, until the 18th of May 2020 (phase 1 of easing restrictions) where an increase can be observed.

This is likely attributed to the decrease in traffic due to the lockdown and an increase in traffic following the easing of restrictions.

The Environmental Protection Agency and the European Environment Agency have issued periodic updates on air quality during the Covid19 period, and details of these can be found at the links below

<http://epa.ie/newsandevents/news/name,68808,en.html>

<https://www.eea.europa.eu/themes/air/air-quality-and-covid19>

It will be an ongoing task to review air quality patterns in Dublin in respect of Covid19 influences and similar studies are taking place in many cities in Europe. These preliminary findings for Dublin are very much in line with those being observed in similar cities across the region.