Preston New Road

March 2020

Background Air Quality Monitoring

In August 2017 we deployed a Mobile Monitoring Facility (MMF) in the vicinity of Cuadrilla's shale gas exploratory site at Preston New Road, Little Plumpton.

Initial monitoring has been carried out to understand the background level of the types of pollutants that may be detectable before the hydraulic fracturing and well testing stages commence. This information can be used to assess what the concentrations of each substance in the environment were before the commencement of the flaring stage of operations. We monitored air quality during the first period of hydraulic fracturing (15th October 2018 - 17th December 2018) and we intend to continue monitoring during other stages of the operation to identify if there are any changes. Hydraulic fracturing resumed at Preston New Road on the 15th August 2019 and was suspended on the 26th August 2019. We are also carrying out a comparison of before, during and after operations for both surface water and groundwater monitoring.

The pollutants that have been measured are oxides of nitrogen (NO_X, NO, NO_2), particulates (PM_{10} and $PM_{2.5}$), methane (CH_4), benzene, toluene, ethylbenzene and m&p-xylene (BTEX), wind speed and wind direction.

This is the 27th report to be produced since we started monitoring air quality. We shall publish subsequent reports to our citizen space page.

Figure 1. Photograph of a Mobile Monitoring Facility

The figures below show levels of pollutants from the 23rd August 2017 up until the 3rd March 2020, which includes periods of hydraulic fracturing, from the 15th October 2018 - 17th December 2018 and from the 15th August 2019 to 26th August 2019.

The BTEX data is only reported from the 9th September 2017, due to technical problems with the instrument prior to this date.

The TEOM instruments that measure particulate matter were turned off on the 6th March 2018 due to complaints about noise coming from the monitoring station by a local resident. This has now been resolved and measurement of particulate data at the site resumed on the 6th April 2018 for PM_{10} and the 12th April 2018 for $PM_{2.5}$.

The gap in the CH_4 data, between the 26th April 2018 - 1st May 2018, was due to a technical problem with the analyser.

The gap in the BTEX data between the 29th June 2018 - 6th July 2018 was due to the instrument being removed for servicing.

The mobile monitoring unit (MMF) was changed from MMF2 to MMF1 on the 15th January 2019.

Due to ongoing problems in correcting the TEOM data, it was decided that the instrument used to measure particulate would be swapped to a FIDAS, which does not require correction to be equivalent to the reference method. The exchange took place on the 15th January 2019.

The gap in the NO_X data, between the 24th June 2019 - 11th July 2019, was due to a technical problem with the analyser.

The gap in the BTEX data between the 12th October 2019 - 21st October 2019 was due to technical problems with the instrument.

Results

Provisional data for each pollutant, from the 23rd August 2017 until the 3rd March 2020, is shown in a number of time series plots below. Comparison with the AQS objectives, where applicable, has been made using a years' worth of data ending with the most up to date data. For this report the annual data period is from the 4th March 2019 - 3rd March 2020.

The wind direction data shows that during the first hydraulic fracturing period (15th October 2018 - 17th December 2018) wind only came from the direction of the well pad for ~3% of the time and during the second hydraulic fracturing period (15th August 2019 - 26th August 2019) the wind came from the direction of the well pad <1% of the time.

Toluene is the only pollutant monitored that has an hourly average during the first hydraulic fracturing period (15th October 2018 - 17th December 2018) that is higher than any of the hourly averages measured before the period of hydraulic fracturing. This occurred on the 4/12/18 at 12:00, where the hourly concentration was measured to be 9.53µg/m^3 and the wind direction at the time was not from the direction of the well pad.

Particulates

Figures 2 and 3 show the hourly particulate concentrations (PM_{10} and $PM_{2.5}$) at the monitoring site. Figure 2 particulate data was collected using TEOM instruments. PM_{10} data has been adjusted using the King's College London (KCL) Volatile Correction Model (VCM), which allows you to make a small adjustment to TEOM measurements to correct for the loss of volatile components of PM_{10}. The VCM uses FDMS instrument data from sites within 130km distance of the MMF in order to adjust the PM_{10} measurements to be comparable with the reference method. There is not currently a validated correction factor for $PM_{2.5}$ TEOM data.

However, the patchy availability of FDMS data led to a decision to change the TEOM instruments to a different particulate analyser called a FIDAS, which does not require correction to be equivalent to the reference method. The exchange took place on the 15th January 2019. Figure 3 shows the hourly particulate concentrations (PM_{10} and $PM_{2.5}$) at the monitoring site.

The AQS has two objectives for PM_{10}, the first is to limit the annual mean concentration to 40µg/m^3 and the second objective states that the 24-hour mean (midnight – midnight) must not exceed 50µg/m^3 on more than 35 occasions during one year.

The mean PM_{10} concentration between the 4th March 2019 - 3rd March 2020 at the MMF was 13.6µg/m^3. If the assumption is made that the conditions during the monitoring period were representative of a typical year, then the results would indicate that the AQS annual mean objective would not be exceeded at the monitoring site. However, it is important to note that this does not take into account changes in weather conditions or changes to the site operations that might occur outside of the monitoring period.

Figure 4 shows that for PM_{10} the 24-hour (midnight-midnight) mean concentration at the MMF site was greater than 50µg/m^3 on two occasions during the period 4th March 2019 - 3rd March 2020, the maximum concentration being 64.0µg/m^3 (recorded on 15/04/19). If the assumption is made that the conditions during the monitoring period were representative of a typical year (subject to the limitations mentioned in the paragraph above) then the AQS for 24-Hours (midnight-midnight) mean PM_{10} concentrations would not be exceeded at the monitoring site.

The AQS objective for $PM_{2.5}$ is an annual mean concentration of 25µg/m^3. The mean $PM_{2.5}$ concentration between the 4th March 2019 - 3rd March 2020 at the MMF was 8.50µg/m^3. If the assumption is made that the conditions during the monitoring period were representative of a typical year (again subject to the limitations explained above), then the results would indicate that the AQS annual mean objective for $PM_{2.5}$ would not be exceeded at the monitoring site.

As well as the spike in particulate caused by bonfire night emissions in 2017, Figure 2 also shows spikes in the 1-hour PM_{10} data at the beginning of March and in May - July 2018. The spikes in March may be associated with the start of water main works by United Utilities at the entrance to the PNR site. However, the rise in concentrations at these times did not cause exceedances of the PM_{10} 24-hour AQS and the air quality index for the days in question was still in the low banding.

Figure 2. Time series plot of TEOM PM_{10} and $PM_{2.5}$ 1-Hour Mean Concentrations.

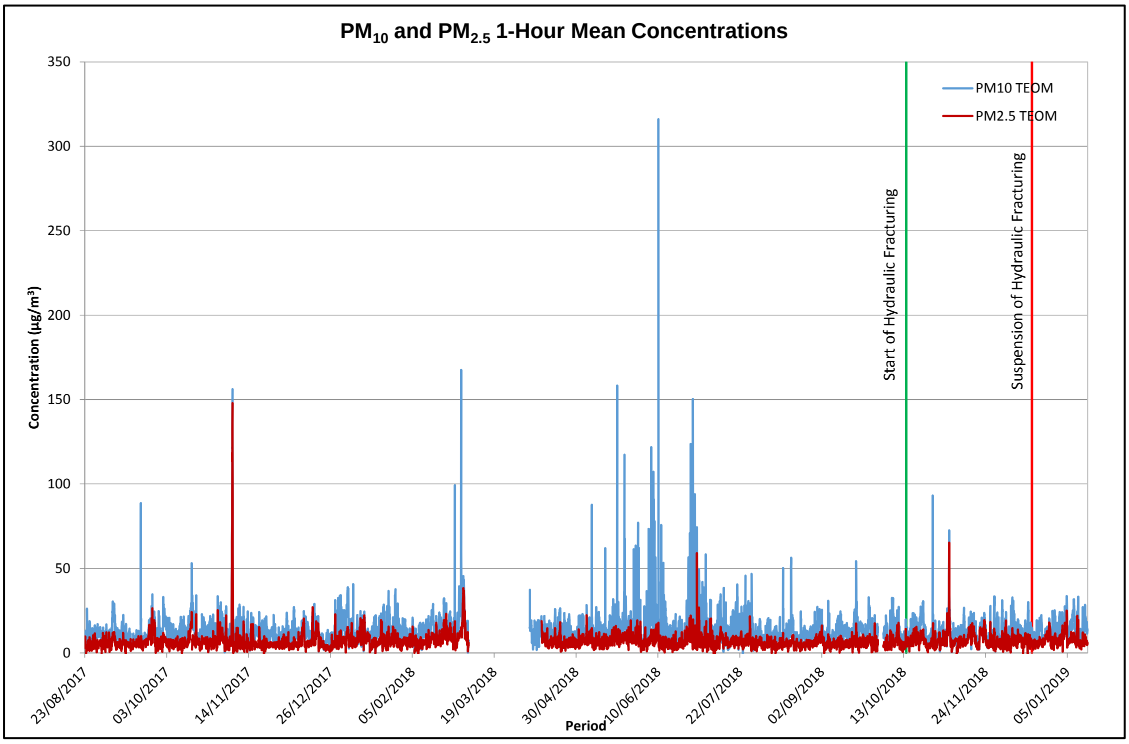


Figure 3 shows that increased levels of particulate were seen during the period 23 February - 1 March 2019. This corresponds with a five day particulate episode that affected most of the UK, apart from the North of Scotland. During this episode, on the 27 February 2019, the 24-Hour AQS for PM_{10} was exceeded, with a concentration of 51.2 µg/m^3 (Figure 4).

The figure also shows increased levels of particulate during the period 15 April 2019 to 24 April 2019. This corresponds with a mainly East South Easterly wind direction bringing in pollution from the continent. During this episode there have been two exceedances of the 24-Hour AQS for PM_{10}, on the 15 April 2019 and the 18 April 2019 (Figure 4).

There were also spikes in the data on the 10th of July and the 20th of October 2019, but the rise in concentrations at these times did not cause exceedances of the PM_{10} 24-hour AQS and the air quality index for the days in question was still in the low banding.

Figure 3. Time series plot of FIDAS PM_{10} and $PM_{2.5}$ 1-Hour Mean Concentrations.

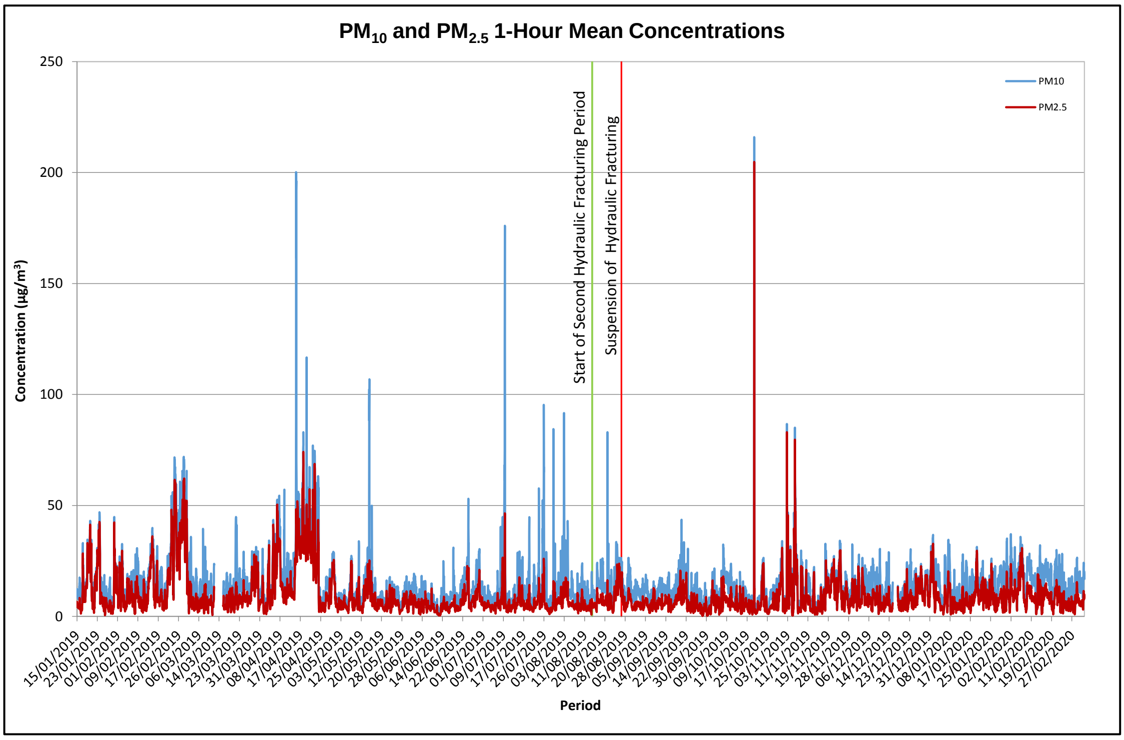
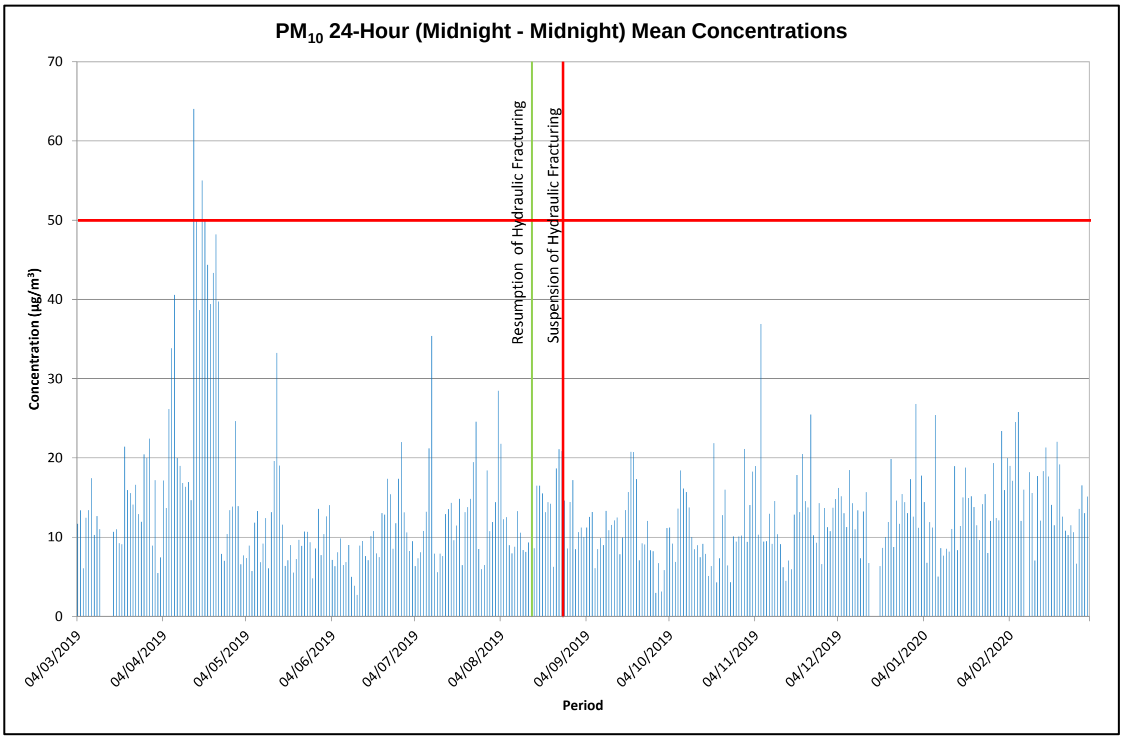


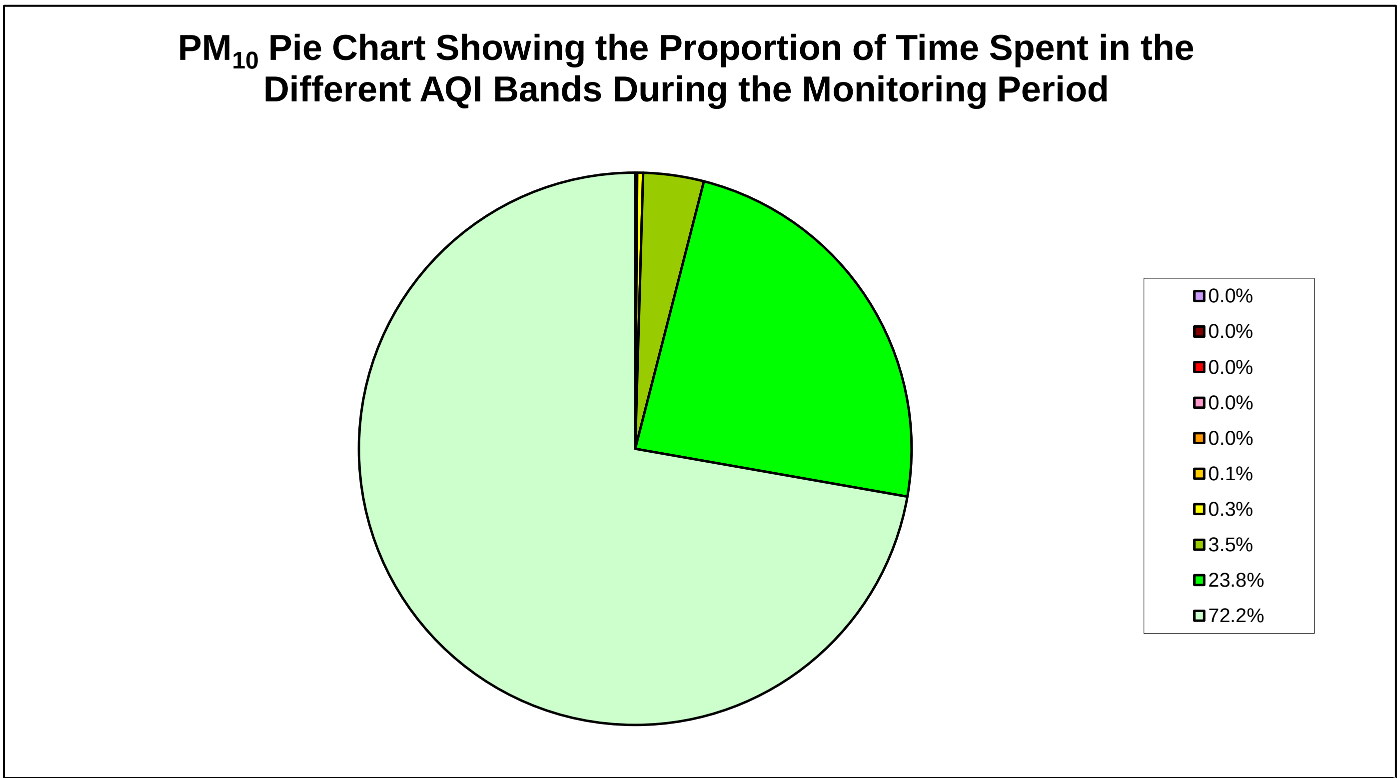
Figure 4. 24-hour (midnight-midnight) mean PM_{10} concentrations at the monitoring site



In the United Kingdom a daily Air Quality Index has been developed. The system uses an index numbered 1-10 (low – high pollution), divided into four bands to provide more detail on a daily basis about air pollution levels to the general population and those at higher risk from air pollution.

Figures 5 looks retrospectively at the daily PM_{10} concentrations at the monitoring site in relation to the Air Quality Index banding. The plot shows that PM_{10} 24-hour concentrations were mainly in the low banding at the monitoring site, with just four days in the moderate banding.

Figure 5. PM$_{10}$ AQI Pie Chart.

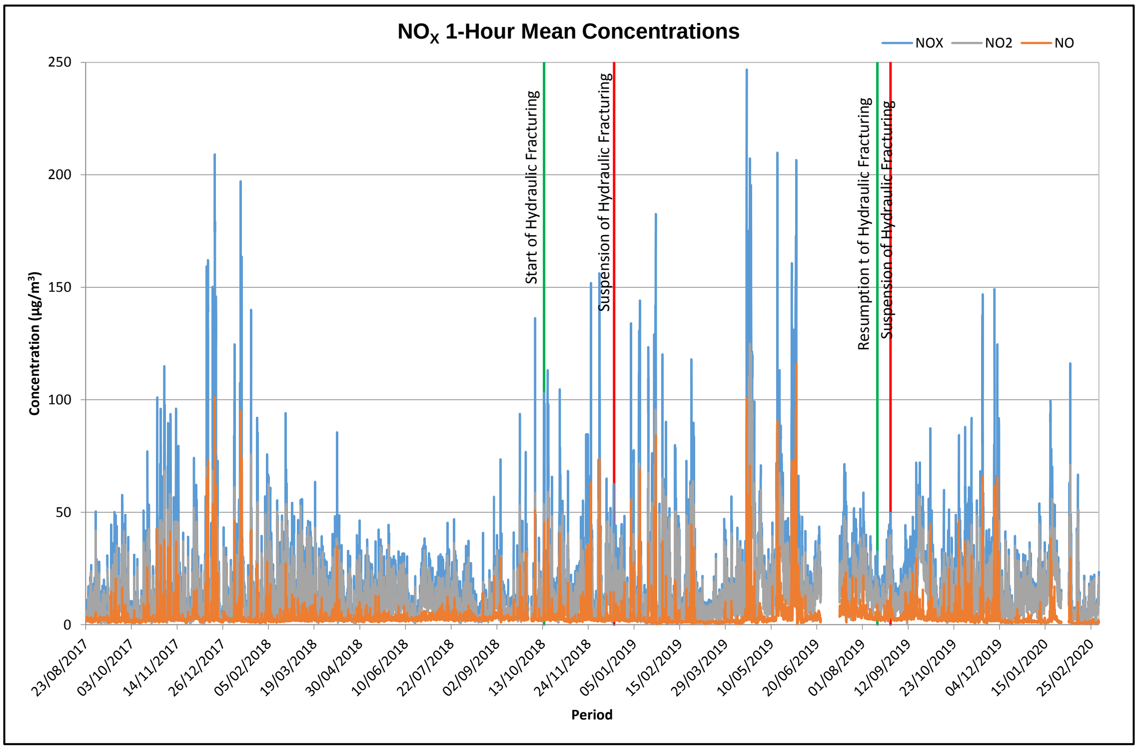


Index Band	10 Very High	9 High	8 High	7 High	6 Moderate	5 Moderate	4 Moderate	3 Low	2 Low	1 Low
µg/m^3	101+	92 - 100	84 - 91	76 - 83	67 - 75	59 - 66	51 - 58	34 - 50	17 - 33	0 - 16
	0.0%	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.1%**	**0.3%**	**3.5%**	**23.8%**	**72.2%**

Oxides of Nitrogen

Figure 6 shows that NO_X levels are relatively low at the monitoring site.

Figure 6. Time series plot of the oxides of nitrogen 1-Hour Mean Concentrations (µg/m^3).



While consideration of NO_X levels can be more informative when determining the source of pollution, the level of NO_2 concentration is more important from a human health stand point. NO_2 is the constituent of NO_X that is harmful to health and consequently a National Air Quality Strategy Objective exists for NO_2 levels. NO_2 has therefore been considered, in addition to NO_X, as it is a pollutant in its own right.

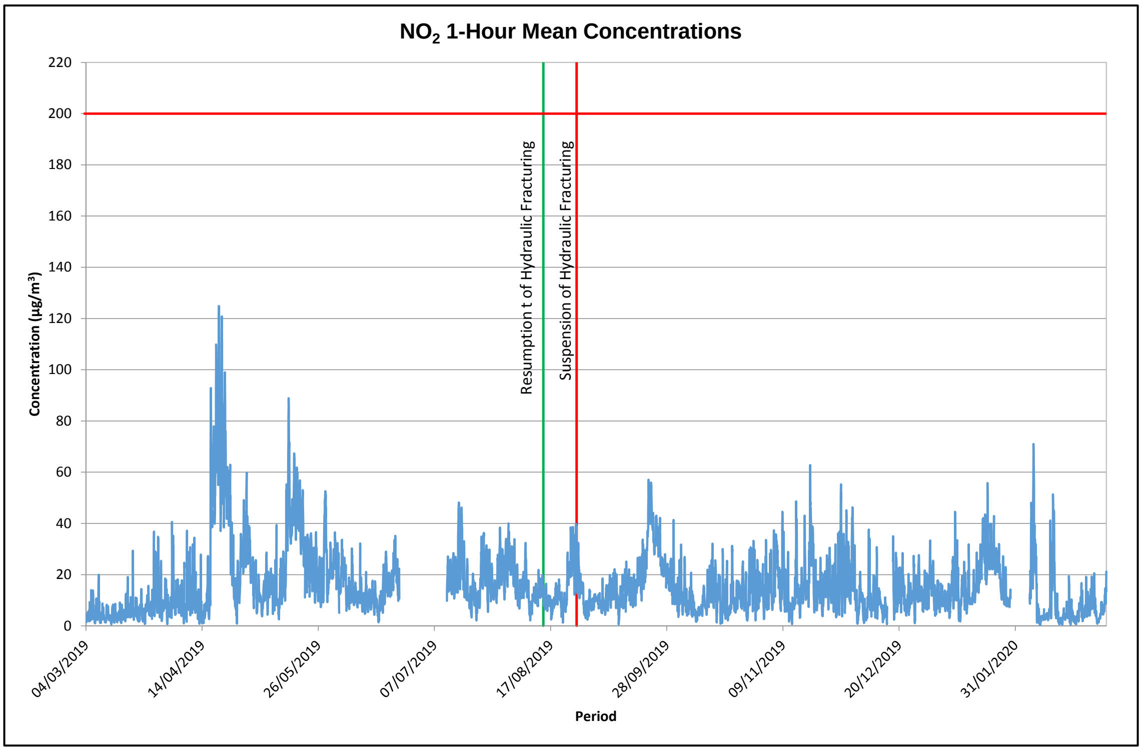
The AQS has objectives for 1-hour mean and annual mean NO_2 concentrations. The AQS objectives for the 1-hour mean concentrations states that a value of 200µg/m^3 must not be exceeded on more than 18 occasions during one year. A time series plot of 1-hour concentrations of NO_2 measured at the monitoring site is shown in Figure 7.

The 1-hour NO_2 concentrations were never greater than 200µg/m^3 between the 4th March 2019 - 3rd March 2020, the maximum concentration being 125µg/m^3. If the assumption is made that the conditions during the monitoring period were representative of a typical year then the AQS for 1-Hour mean NO_2 concentrations would not be exceeded at the monitoring site.

The annual objective states that an average concentration value of 40µg/m^3 must not be exceeded in one year.

The average NO_2 concentration between the 4th March 2019 - 3rd March 2020 was 15.9µg/m^3. If the assumption is made that conditions during the monitoring period were representative of a typical year, then the results would indicate that the annual AQS objective for NO_2 would not be exceeded with the concentrations that existed during the monitoring period.

Figure 7. Time series plot of nitrogen dioxide (NO_2) 1-Hour Mean Concentrations (µg/m^3)



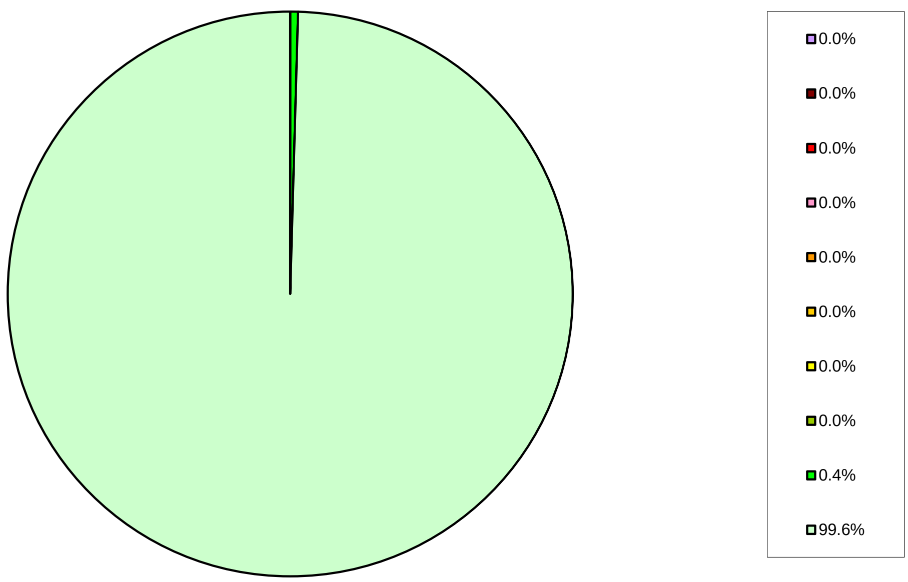
The AQS objective has an annual standard for NO_X of 30µg/m^3, for the protection of vegetation and ecosystems. The mean NO_X concentration between the 4th March 2019 - 3rd March 2020 was 22.3µg/m^3.

In the United Kingdom a daily Air Quality Index has been developed. The system uses an index numbered 1-10 (low – high pollution), divided into four bands to provide more detail on a daily basis about air pollution levels to the general population and those at higher risk from air pollution.

Figure 8 looks retrospectively at the hourly NO_2 concentrations at the monitoring site in relation to the Air Quality Index banding. The figure shows that during the monitoring period the NO_2 1-hour concentrations remained in the low banding of the Air Quality Index.

Figure 8. NO_2 AQI Pie Chart.

NO_2 Pie Chart Showing the Proportion of Time Spent in the Different AQI Bands During the Monitoring Period



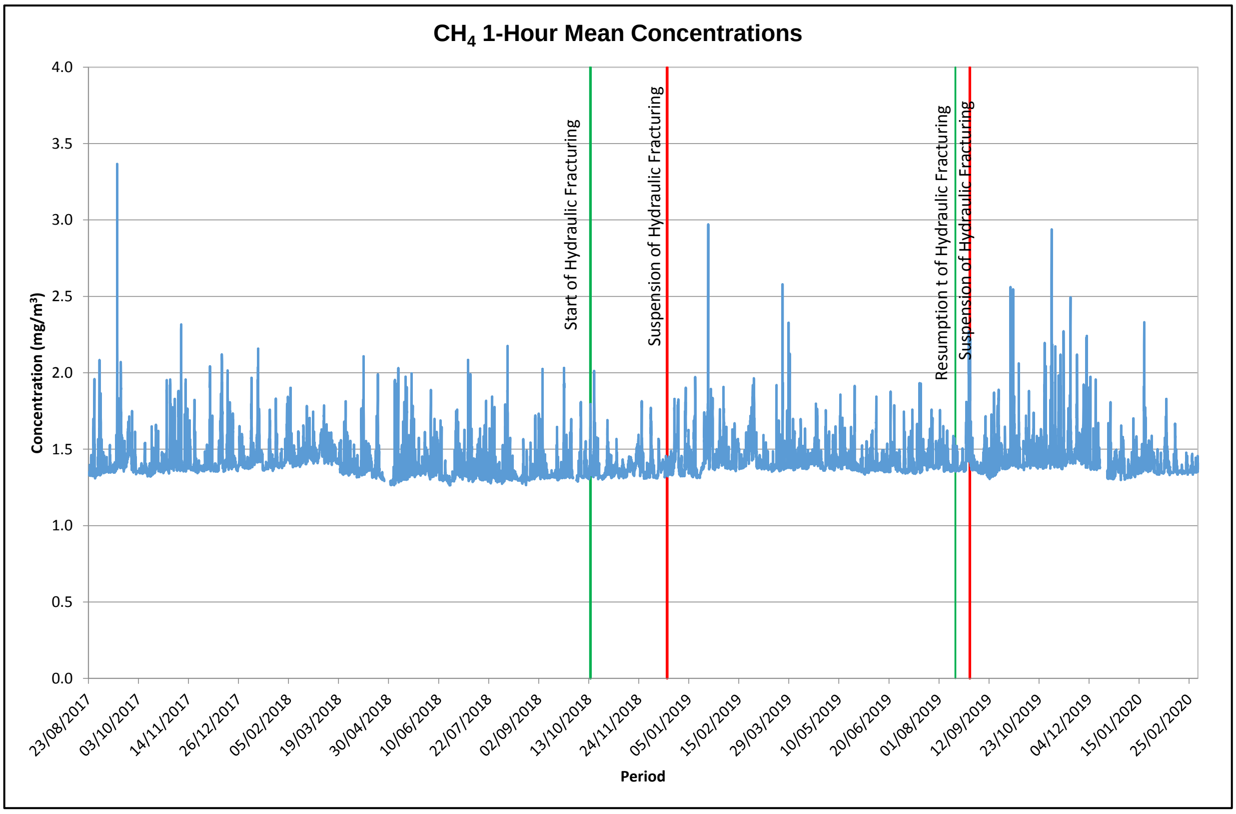
Index Band	10 Very High	9 High	8 High	7 High	6 Moderate	5 Moderate	4 Moderate	3 Low	2 Low	1 Low
µg/m³	601+	535-600	468-534	401-467	335-400	268-334	201-267	135-200	68-134	0-67
	0.0%	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.4%**	**99.6%**

Methane

Methane

Figure 9 shows that the CH_4 levels are relatively low at the monitoring site. The average CH_4 concentration over the entire monitoring period was 1.42mg/m^3.

Figure 9. Time series plot of the methane (CH_4) 1-Hour Mean Concentrations (mg/m^3).



BTEX

Figure 10 shows that the BTEX levels are relatively low at the monitoring site. Table 1 shows the average concentration of each of the BTEX over the entire monitoring period. The build-up of emissions from bonfire night in 2017 is also evident in the BTEX data, especially in the benzene data, where the hourly average benzene concentration was 7.83µg/m^3 at 05:00 on the 6th November 2017. This corresponds with the peak in particulate concentrations.

Benzene is the only BTEX recorded at the monitoring site that has an AQS. The AQS objective for benzene is expressed as an annual mean and is currently set at 5ug/m^3. The mean benzene concentration between the 4th March 2019 - 3rd March 2020 was at 0.25ug/m^3. If the assumption is made that conditions during the monitoring period were representative of a typical year, then the results would indicate that the annual AQS objective for benzene would not be exceeded with the concentrations that existed during the monitoring period.

Toluene is the only pollutant monitored that has an hourly average during the first hydraulic fracturing period (15th October 2018 - 17 December 2018) that is higher than any of the hourly averages measured before the period of hydraulic fracturing. This occurred on the 4/12/18 at 12:00, where the hourly concentration was measured to be 9.53µg/m^3 and the wind direction at the time was not from the direction of the well pad.

Table 1. Average BTEX concentrations (µg/m^3)

VOC	Average (µg/m^3)
Benzene	0.30
Toluene	0.72
Ethylbenzene	0.23
m&p-Xylene	0.80

Figure 10. Time series plot of the BTEX 1-Hour Mean Concentrations (µg/m^3)