Brundall NO_2 Diffusion Tube Project 2022/23

Background:

The aim of the study was to measure Nitrogen dioxide concentrations at a series of locations in Brundall. These locations were chosen by members of the Parish Council due to their proximity to high traffic flows in and around the village.

Nitrogen dioxide was measured because it is the primary air pollutant associated with internal combustion engine vehicles. DEFRA produces air quality objectives for a range of air quality pollutants including nitrogen dioxide. For Nitrogen Dioxide these are divided into 1 hour mean limits and annual mean limits. Below shows the current limits produced by DEFRA.

National air quality objectives and European Directive limit and target values for the protection of human health						
Pollutant	**Applies**	**Objective**	**Concentration measured as**	**Date to be achieved by (and maintained thereafter)**	**European Obligations**	**Date to be achieved by (and maintained thereafter)**
Nitrogen dioxide	UK	200 µg/m³ not to be exceeded more than 18 times a year	1 hour mean	31 December 2005	200 µg/m³ not to be exceeded more than 18 times a year	1 January 2010
	UK	40 µg/m³	annual mean	31 December 2005	40 µg/m³	1 January 2010

Brundall Air Quality Tube Locations (What3Words coordinates)

- **1 ///insolvent.minus.viewers**
  Strumpshaw Road
- **2 ///songbook.surprises.send**
  Opp Train Station
- **3 ///bats.marketing.battling**
  Highfield Avenue
- **4 ///abandons.icon.steer**
  The Street
- **5 ///slowly.oath.punctual**
  The Dales
- **6 ///deposits.breakfast.expired**
  The Street (Co-op)
- **7 ///lows.lipstick.arise**
  Postwick Lane
- **8 ///smokers.haven.stupidly**
  Cucumber Lane


smokers.haven.stupidly
Site 8
bats.marketing.battling
Site 3
lows.lipstick.arise
Site 7
deposits.breakfast.expired
Site 6
slowly.oath.punctual
dons.icon.steer
Site 5
Site 4
songbook.surprises.send
Site 2
insolvent.minus.viewers
Site 1
YARMOUTH ROAD
CHURCH ROAD
STOCKS LANE
BERRYFIELDS
THE STREET
Brundall Broad
Bargate
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Method

NO_2 diffusion tubes were placed in 8 locations and were exposed for a month at a time before being collected and replaced with another set of diffusion tubes. The tubes were exposed for the time specified by DEFRAs diffusion tube monitoring calendar +/- 2 days. This follows the same process for all the diffusion tubes collected by Broadland and South Norfolk Councils.

Tubes were then sent to the Gradko laboratory for UKAS accredited testing and analysis using UV spectrophotometry. The Tube Preparation method was: 20% TEA / Water.

Data management

Bias adjusted mean results for each location have been calculated using national bias adjustment factors see the following link for details: National Bias Adjustment Factors | LAQM (defra.gov.uk). The database of bias adjustment factors is determined from local authority co-location studies throughout the UK and has been collated by the Local Air Quality Management Helpdesk. Using orthogonal regression, combined bias adjustment factors have been calculated for each laboratory, year and preparation method combination for which data are available.

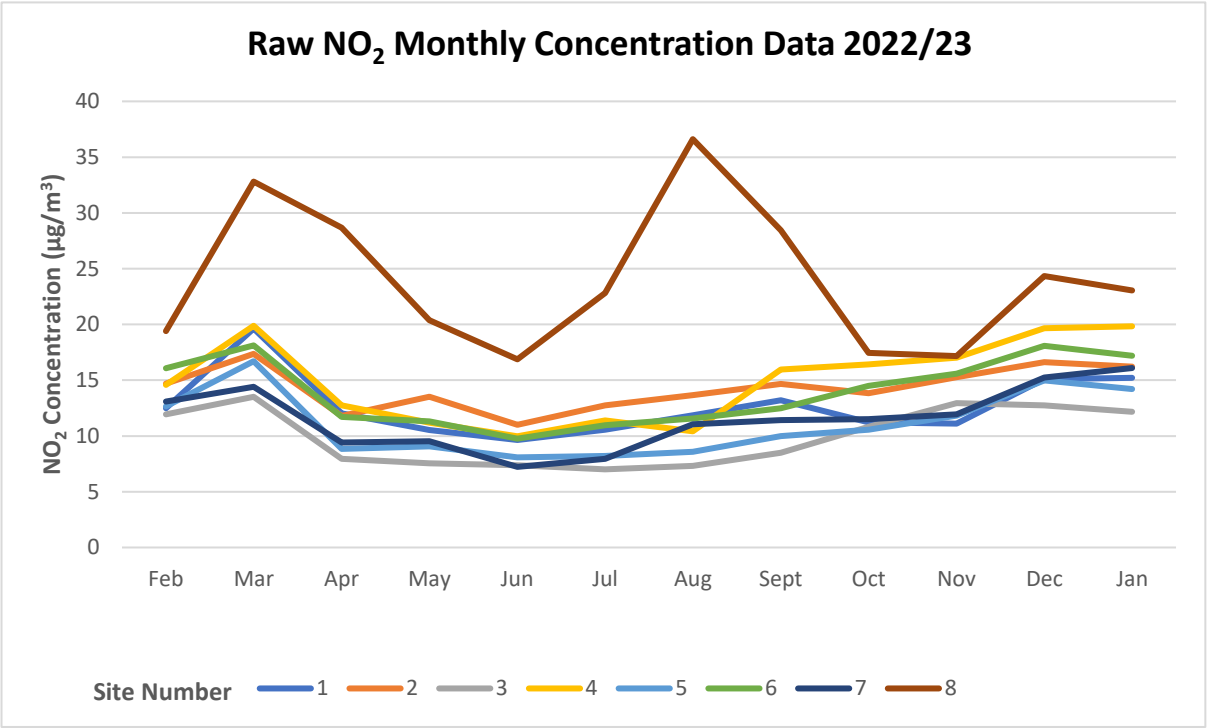
Fall of from distance to the relevant receptor is calculated using the background annual mean figure from the closest automatic monitor to estimate the predicted figure at the nearest relevant receptor. For the purposes of this study the nearest relevant receptor is the nearest residential dwelling to the tube. The nearest automatic monitor is at Lakenfields. The annual mean for NO_2 at Lakenfields for the duration of the study was 9.4µg/m_3. Bias adjusted figures are then inserted into a calculator/model. Tube distance from receptor and tube distance from the kerb are also fed into the calculator to produce a figure. These figures act as a guide only, as there are too many variables which could affect fall off from distance which can't be reproduced accurately using the model. The further the receptor is from the tube the less accurate the results. Two of the sites could not be modelled for fall of from distance as the bias adjusted annual mean was below the background mean. Site 8 has it's closest receptor over the 50 metre limit of the modelling tool. The Figure shown in the results for site 8 therefore uses 50 metres as it's distance to receptor.

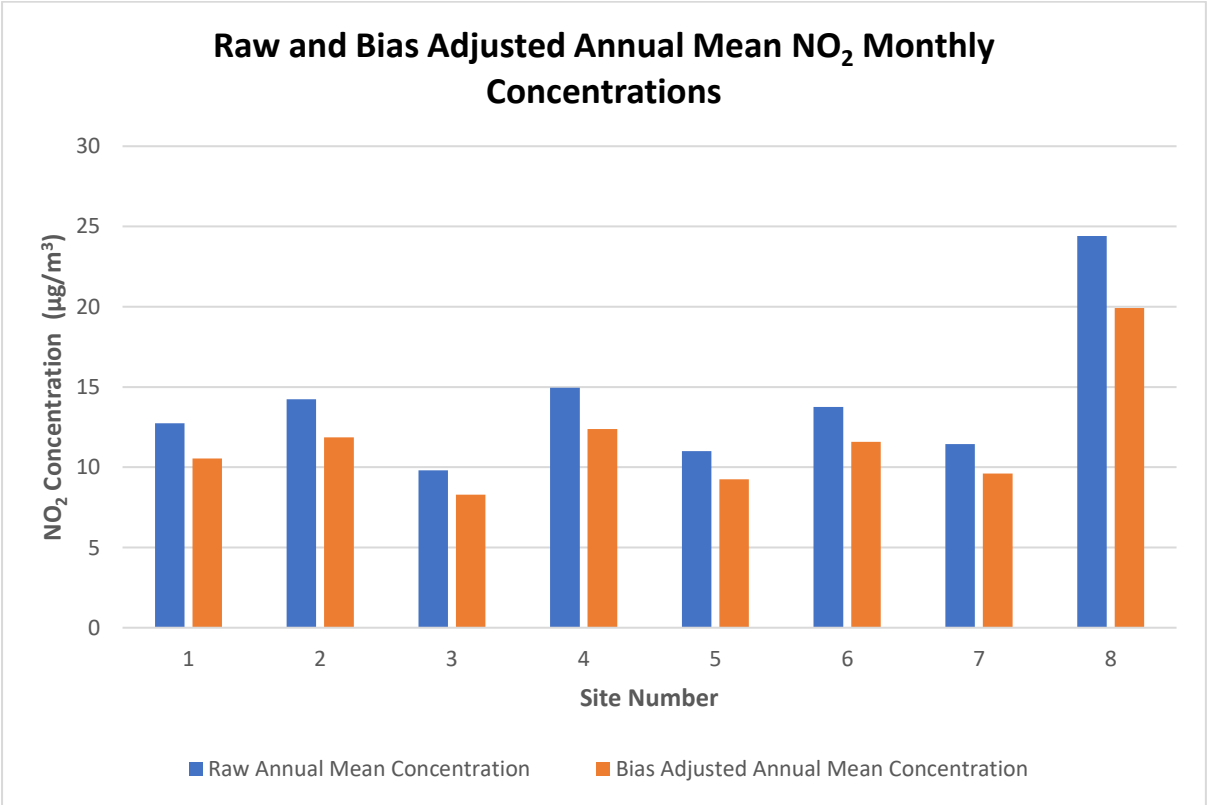
Results

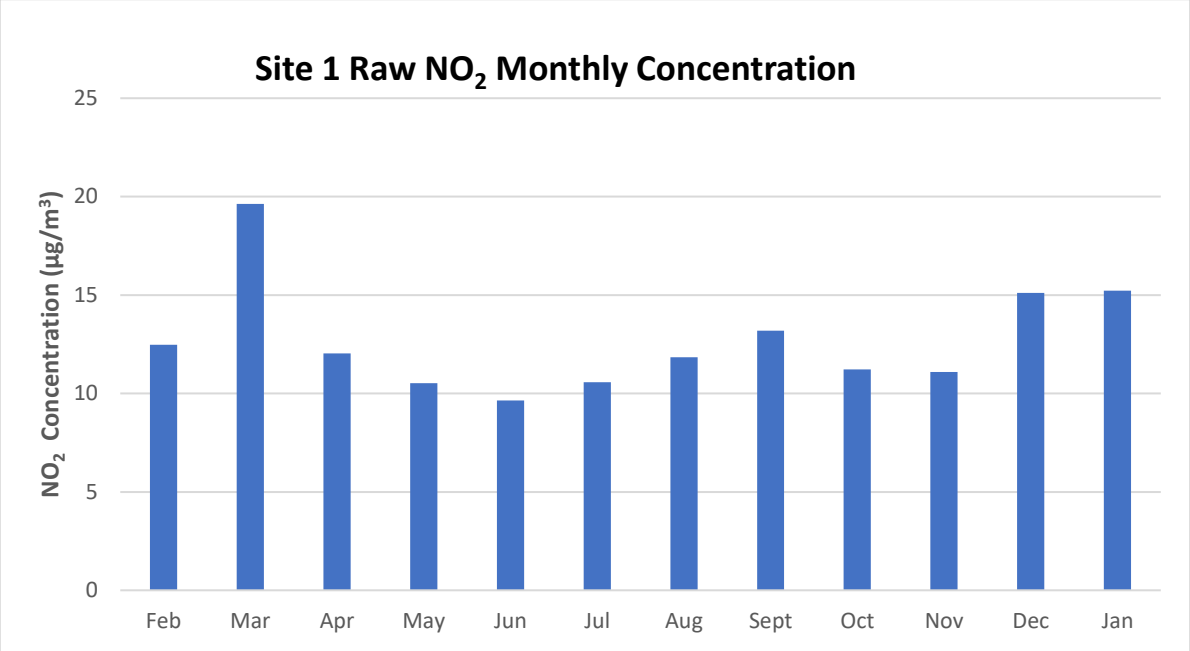
Site Name	X OS Grid Reference	Y OS Grid Reference	Bias Adjustment Factor	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Raw Annual Mean (µg/m3)	Bias Adjusted and Annualised Annual Mean (µg/m3)	Fall off From Distance to relevant receptor
1	633555	307771	0.83	12	20	12	11	10	11	12	13	11	11	15	15	13	10.6	9.8
2	632916	307971	0.83	15	17	12	14	11	13	14	15	14	15	17	16	14	11.9	10.4
3	633191	308768	0.83	12	14	8	8	7	7	7	9	11	13	13	12	10	8.3	n/a
4	632879	308303	0.83	15	20	13	11	10	11	10	16	16	17	20	20	15	12.4	11.2
5	632681	308275	0.83	13	17	9	9	8	8	9	10	11	12	15	14	11	9.2	n/a
6	632479	308485	0.83	16	18	12	11	10	11	12	12	14	16	18	17	14	11.6	10.9
7	631270	308497	0.83	13	14	9	10	7	8	11	11	12	12	15	16	12	9.6	9.5*
8	631908	309215	0.83	19	33	29	20	17	23	37	28	17	17	24	23	24	19.9	11.6*

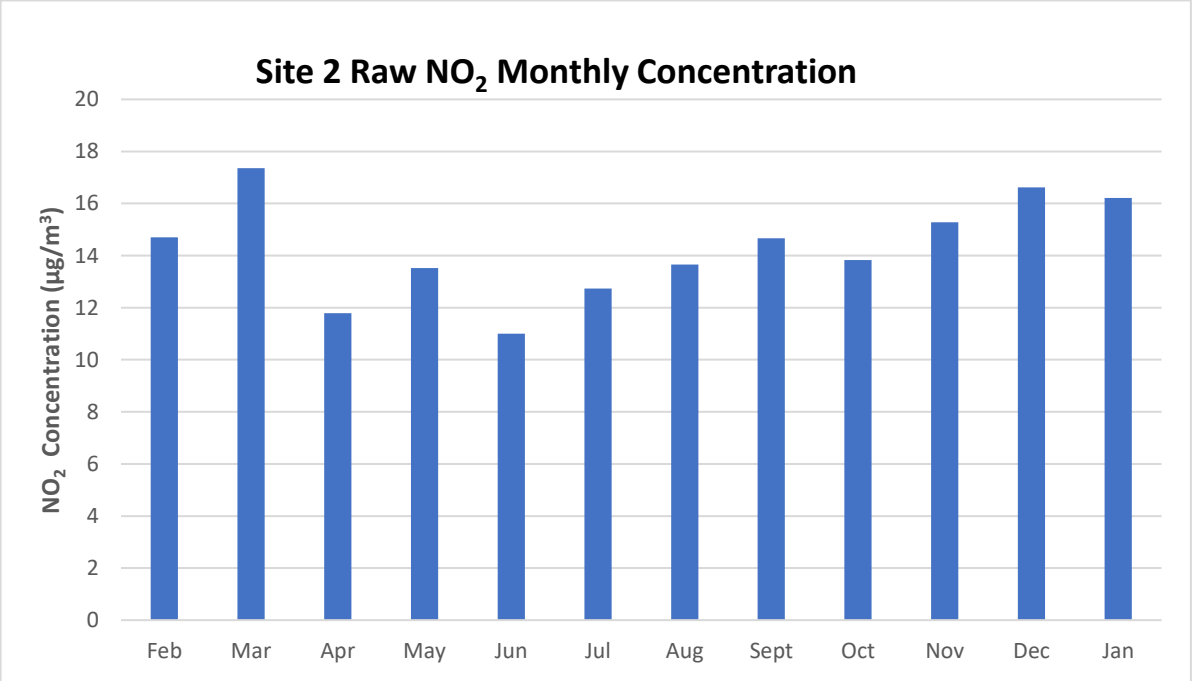
*Closest residential receptor modelled at modelling limit of 50m

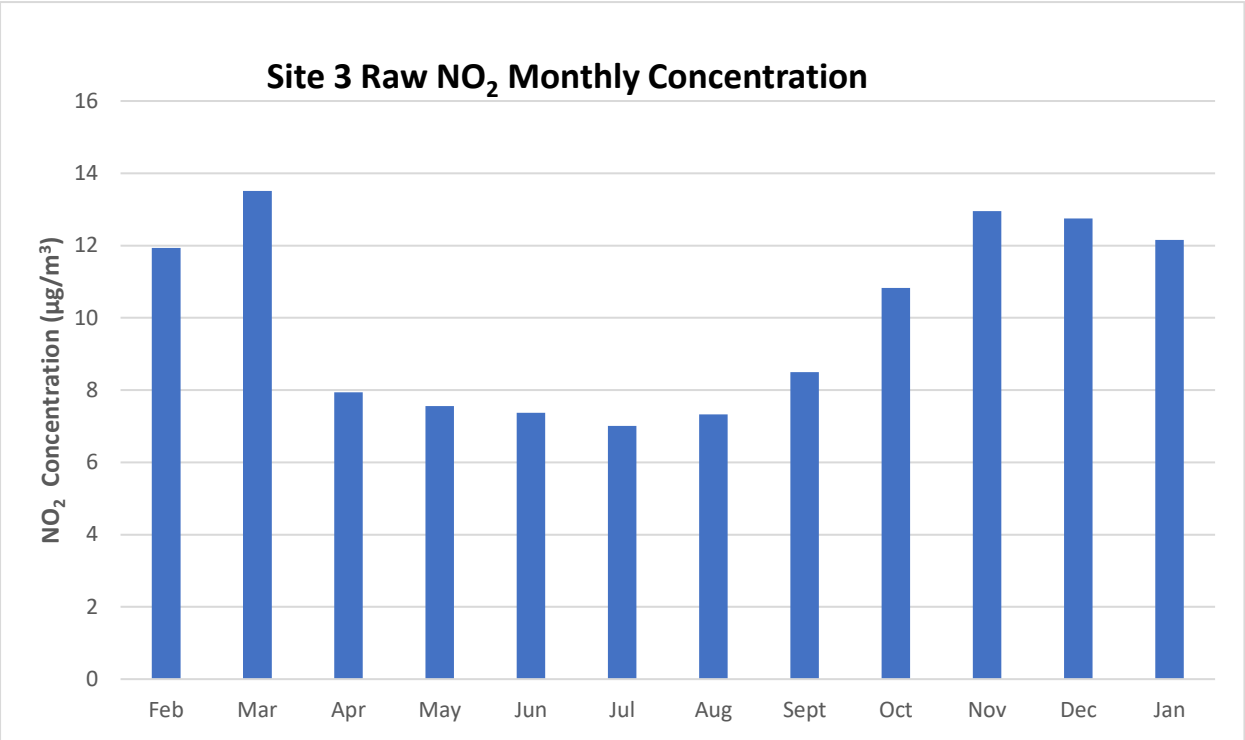
n/a Due to background mean level being higher than recorded mean levels

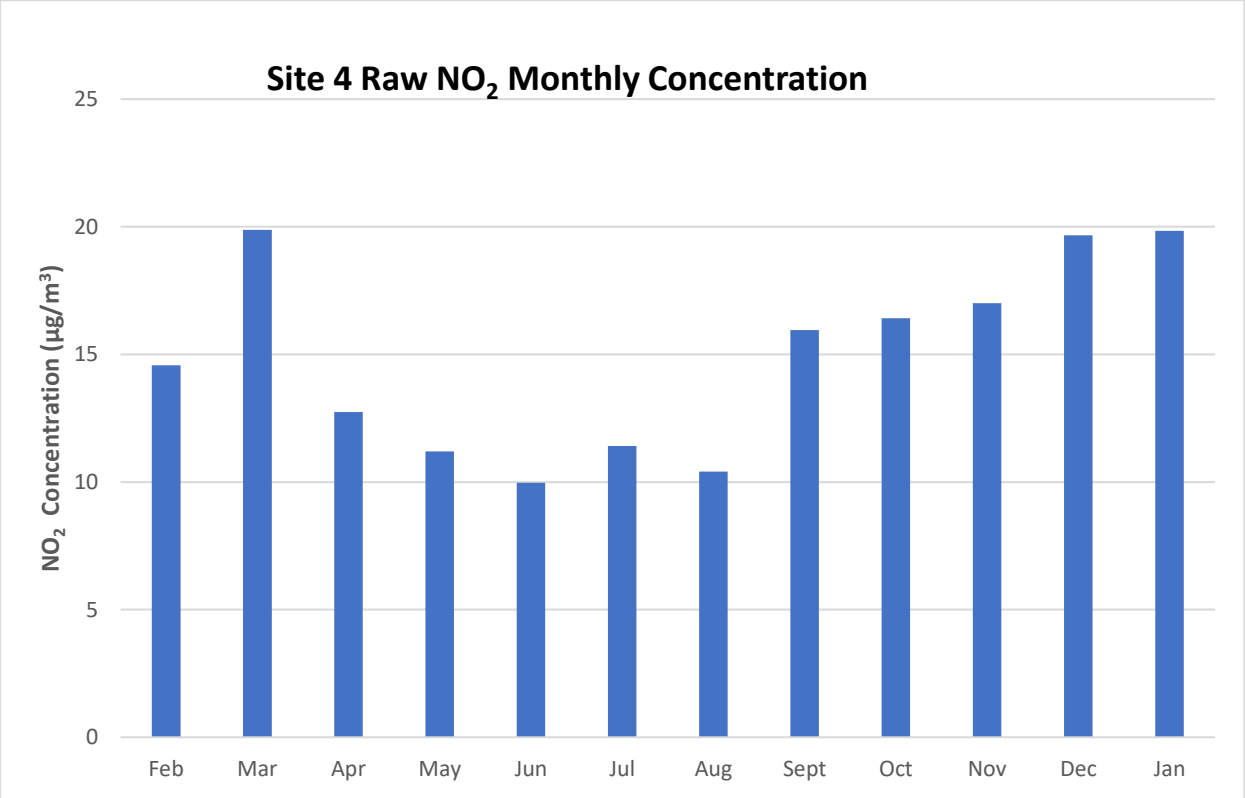

Raw NO2 Monthly Concentration Data 2022/23
NO2 Concentration (µg/m3)
40
35
30
25
20
15
10
5
0
Feb
Mar
Apr
May
Jun
Jul
Aug
Sept
Oct
Nov
Dec
Jan
Site Number
1
2
3
4
5
6
7
8

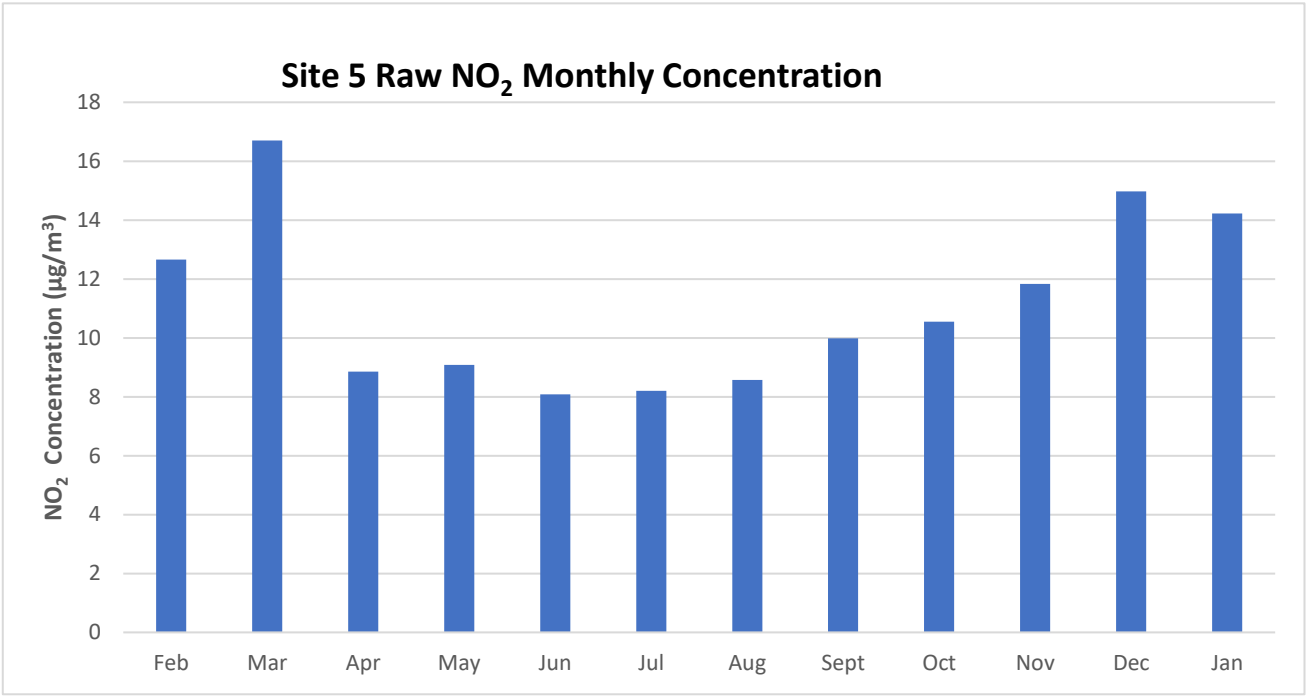

Raw and Bias Adjusted Annual Mean NO2 Monthly Concentrations
NO2 Concentration (µg/m3)
30
25
20
15
10
5
0
1
2
3
4
5
6
7
8
Site Number
Raw Annual Mean Concentration
Bias Adjusted Annual Mean Concentration

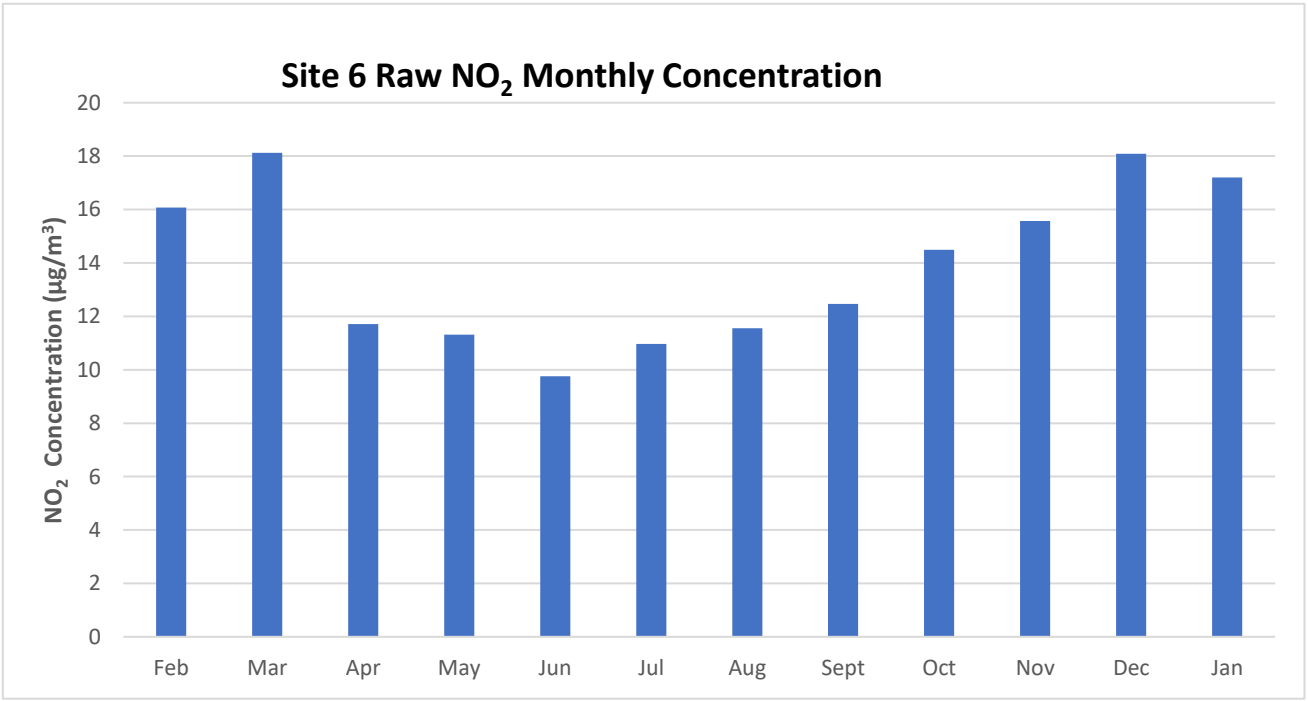

Site 1 Raw NO2 Monthly Concentration
NO2 Concentration (µg/m3)
25
20
15
10
5
0
Feb
Mar
Apr
May
Jun
Jul
Aug
Sept
Oct
Nov
Dec
Jan

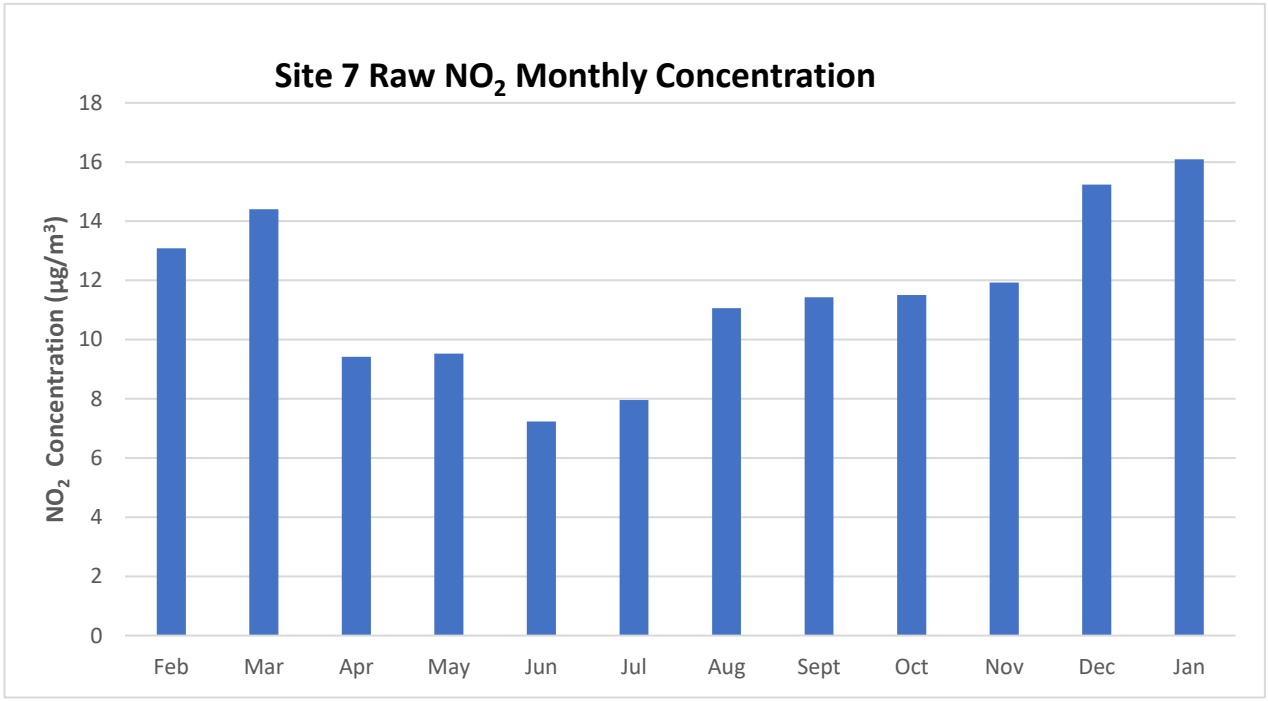

Site 2 Raw NO2 Monthly Concentration
NO2 Concentration (µg/m3)
20
18
16
14
12
10
8
6
4
2
0
Feb
Mar
Apr
May
Jun
Jul
Aug
Sept
Oct
Nov
Dec
Jan

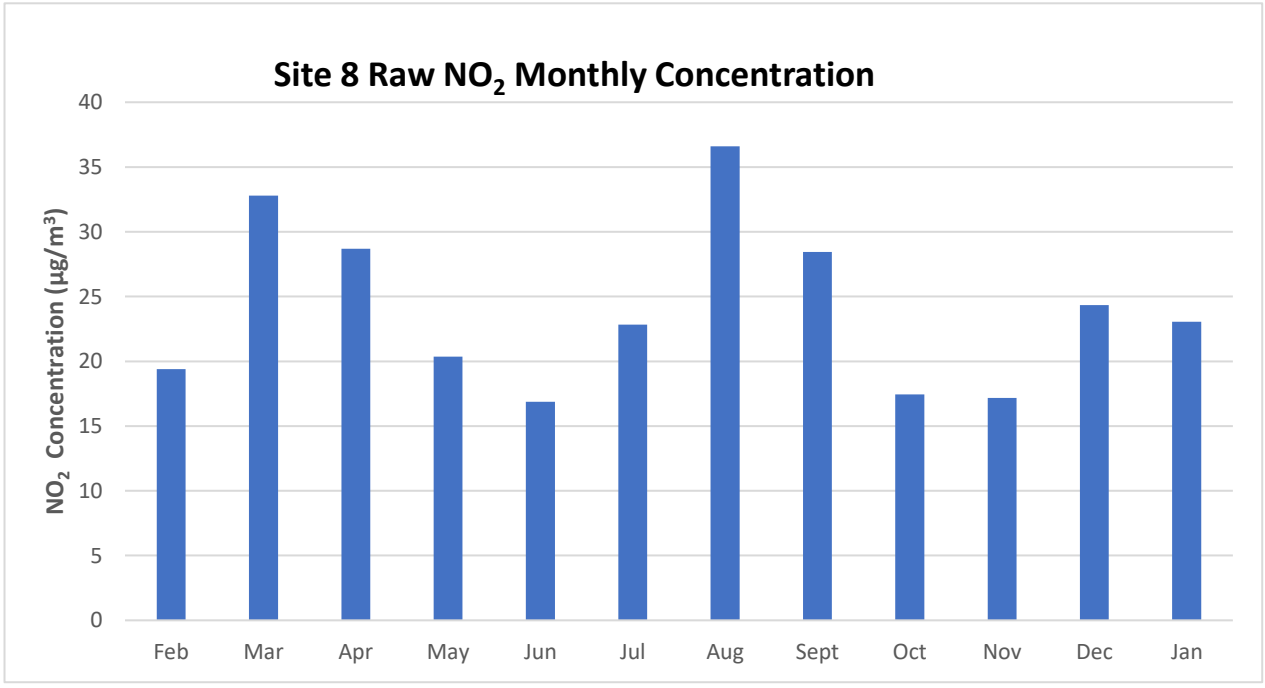

Site 3 Raw NO2 Monthly Concentration
NO2 Concentration (µg/m3)
16
14
12
10
8
6
4
2
0
Feb
Mar
Apr
May
Jun
Jul
Aug
Sept
Oct
Nov
Dec
Jan


Site 4 Raw NO2 Monthly Concentration
NO2 Concentration (µg/m3)
25
20
15
10
5
0
Feb
Mar
Apr
May
Jun
Jul
Aug
Sept
Oct
Nov
Dec
Jan


Site 5 Raw NO2 Monthly Concentration
NO2 Concentration (µg/m3)
18
16
14
12
10
8
6
4
2
0
Feb
Mar
Apr
May
Jun
Jul
Aug
Sept
Oct
Nov
Dec
Jan


Site 6 Raw NO2 Monthly Concentration
NO2 Concentration (µg/m3)
20
18
16
14
12
10
8
6
4
2
0
Feb
Mar
Apr
May
Jun
Jul
Aug
Sept
Oct
Nov
Dec
Jan


Site 7 Raw NO2 Monthly Concentration
NO2 Concentration (µg/m3)
18
16
14
12
10
8
6
4
2
0
Feb
Mar
Apr
May
Jun
Jul
Aug
Sept
Oct
Nov
Dec
Jan


Site 8 Raw NO2 Monthly Concentration
NO2 Concentration (µg/m3)
40
35
30
25
20
15
10
5
0
Feb
Mar
Apr
May
Jun
Jul
Aug
Sept
Oct
Nov
Dec
Jan

Interpretation:

- All the Bias adjusted, and annualised mean results were below the air quality objective target value of 40µg/m_3.
- All the monthly figures were below the air quality objective target of 40µg/m_3
- The highest value was that of site 8, with a bias adjusted mean of 19.9µg/m_3. The lowest value was at site 3 on Highfield Avenue with the figure being 8.39µg/m_3.
- Site 3 and site 5 had bias adjusted means that were below the annual background level for the closest automatic monitor.
- Site 8 was over 50 metres away from the nearest residential receptor. The modelling tool used to calculate distance has a distance limit of 50 metres. Consequently, the fall off from distance figure at the closest receptor is likely to be lower than that displayed in the results, although we cannot accurately produce a figure.
- Apart from site 8, site 5 has the highest figure taken after the fall off from distance calculation (the fall of from distance calculation has a higher degree of accuracy for site 5 than from site 8, due to the shorter distance to the receptor)
- Winter NO_2 levels were generally higher at all sites. This is likely because of the increased likelihood of temperature inversions and colder denser air trapping NO_2 more than in summer where it is more easily dispersed.
- Site 8 had a spike in August to September. This is potentially due to increased traffic on the A47 during the summer.

Conclusion

This study has shown that NO_2 levels across Brundall were found to be relatively low. Bias adjusted annual mean levels are lower than most of the diffusion tube sites across Broadland and South Norfolk.

Next step: Discuss findings at Parish meeting.