THIRD WAVE LOCAL AUTHORITIES – TARGETED FEASIBILITY STUDY TO DELIVER NITROGEN DIOXIDE CONCENTRATION COMPLIANCE IN THE SHORTEST POSSIBLE TIME

Local authorities covered	Wakefield Metropolitan District Council

Part 1: Understanding the problem

Wakefield Council has been highlighted by DEFRA as one of a number of Local Authorities where the UK's national air quality assessment has identified road links that are currently exceeding the annual mean nitrogen dioxide (NO_2) limit value, with exceedances predicted to continue into 2020.

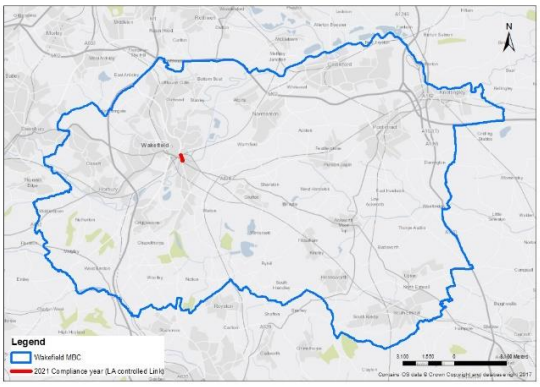
The Council, along with 32 other Local Authorities, received a Ministerial Direction on the 23rd March 2018 to undertake a feasibility study into nitrogen dioxide compliance. This is the 'third wave' of Local Authorities charged with undertaking such a study. Previously five Local Authorities (the so-called 'first wave') were directed to undertake a feasibility study, these were followed by a second wave of 23 Local Authorities directed to undertake a local study in 2017. Wakefield Council have engaged Ricardo AEA to assist in the preparation of the Feasibility Study.

The UK's national Air Quality Plan has identified a length of road, the A61 (Doncaster Road) between the A638/A61 junction and the A61/A638 junction at Ings Road, as in exceedance of the annual mean NO_2 Ambient Air Quality Directive (AAQD) limit value. This road link is a key route for vehicles travelling in and out of Wakefield city centre. A map of the road link identified as being in exceedance of the limit value, together with the projected timeline for achieving compliance is shown in Figure 1. The timeline is based on DEFRA's Pollution Climate Mapping (PCM) model using traffic census data from a baseline year of 2015. This model suggests that the roadside concentrations of Nitrogen Dioxide would not be compliant with AAQD legal limit until 2021.

In order to bring forward compliance compared to the modelled timeline, NO_2 concentrations would need to reduce by at least 2 µg/m^3 to achieve compliance in 2020, 4 µg/m^3 to achieve compliance in 2019, and by at least 6 µg/m^3 to achieve compliance this year (2018).

Figure 1: A61 Link identified as exceeding NO2 Limit Value and projected timeline for compliance based on PCM model.

A61 link



Projected date of compliance

Road	Census ID	2017	2018	2019	2020	2021
A61	56617	**49**	**46**	**44**	**42**	**40**

DEFRA's national PCM model uses traffic flows from the Department for Transport's national traffic counts. The traffic flows that are used were last counted in 2015 and estimated in 2016 and the modelling uses a base year of 2015. Consequently, it does not take into account any road scheme improvements in Wakefield which could influence traffic counts, composition or flow that have been introduced since 2015. In April 2017 a major road scheme, known as the Wakefield Eastern Relief Road (WERR), opened with the aim of reducing congestion in Wakefield city centre, including on the A61 road link identified as exceeding the NO_2 limit value based on the 2015 traffic data.

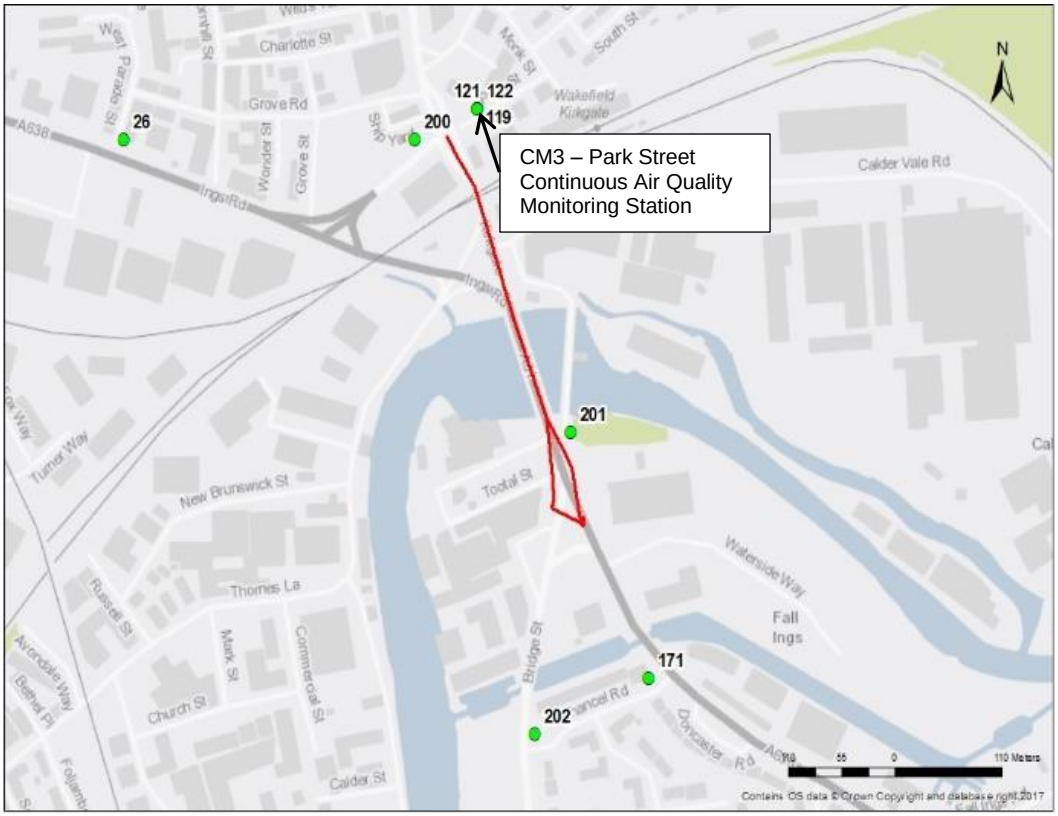
This Feasibility Study considers the impact associated with the WERR road scheme on traffic and hence air quality on the relevant A61 road link and how this has affected the projected compliance with NO_2 legal limit – i.e. what impact has the WERR had in bringing forward compliance with the Ambient Air Quality Directive. Notwithstanding the impact of the WERR, other measures which Wakefield Council have implemented or are planning to implement are also referenced within this Feasibility Study.

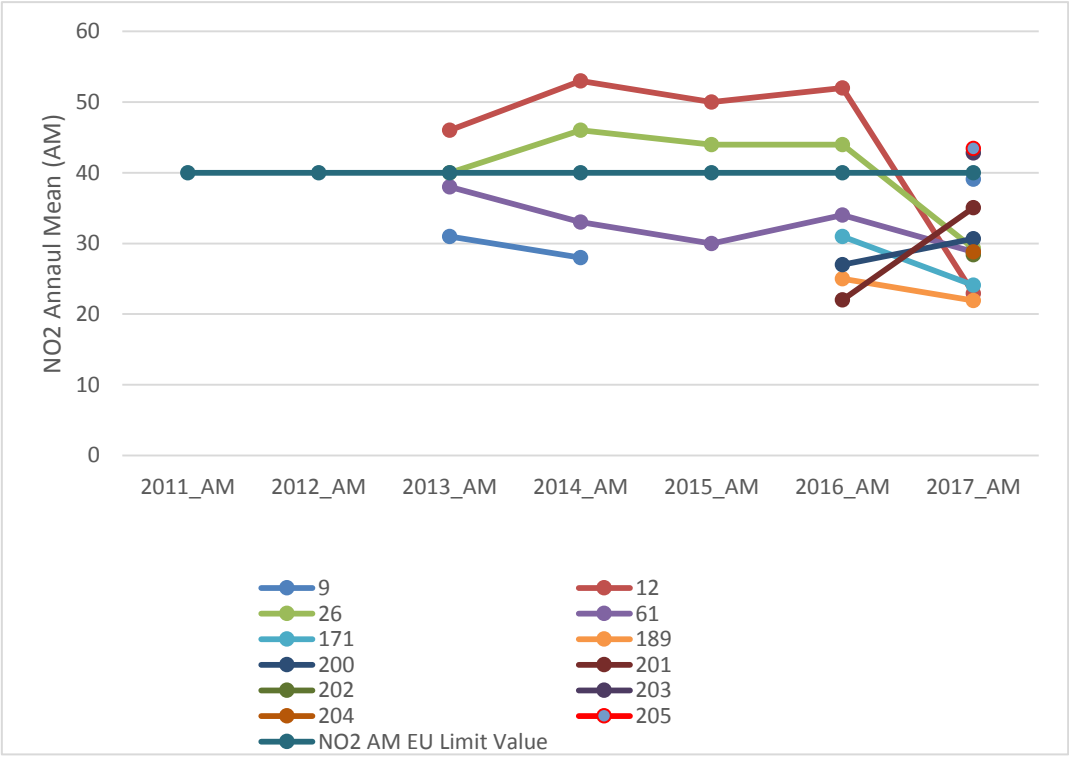
Detailed Air Quality Assessment of Wakefield Eastern Relief Road after implementation with observed data

Baseline Air Quality

Wakefield Council undertakes air quality monitoring in carrying out the Local Air Quality Management duties under the Environment Act 1995. This includes monitoring of Nitrogen Dioxide concentrations across the Wakefield district using a network of diffusion tubes and continuous air quality monitoring stations. Figure 2 presents the monitoring data at locations within close proximity of the A61 non-compliance road link.

Figure 2: Monitoring data surrounding the A61 link, indicating locations of diffusion tubes and annual average NO_2 concentrations at the sites from 2011 – 2017 (µg m^{-3}).





All the above diffusion tubes are representative of roadside concentrations. Locations 203 and 205 were in exceedance of the annual mean in 2017, the causation is proximity to a bus depot and live construction site, respectively. Between 2013 and 2016 diffusion tubes 12 and 26 are exceeding the NO_2 annual average, with large decrease observed in 2017 associated with the introduction of Wakefield Eastern Relief Road, see WERR traffic data section.

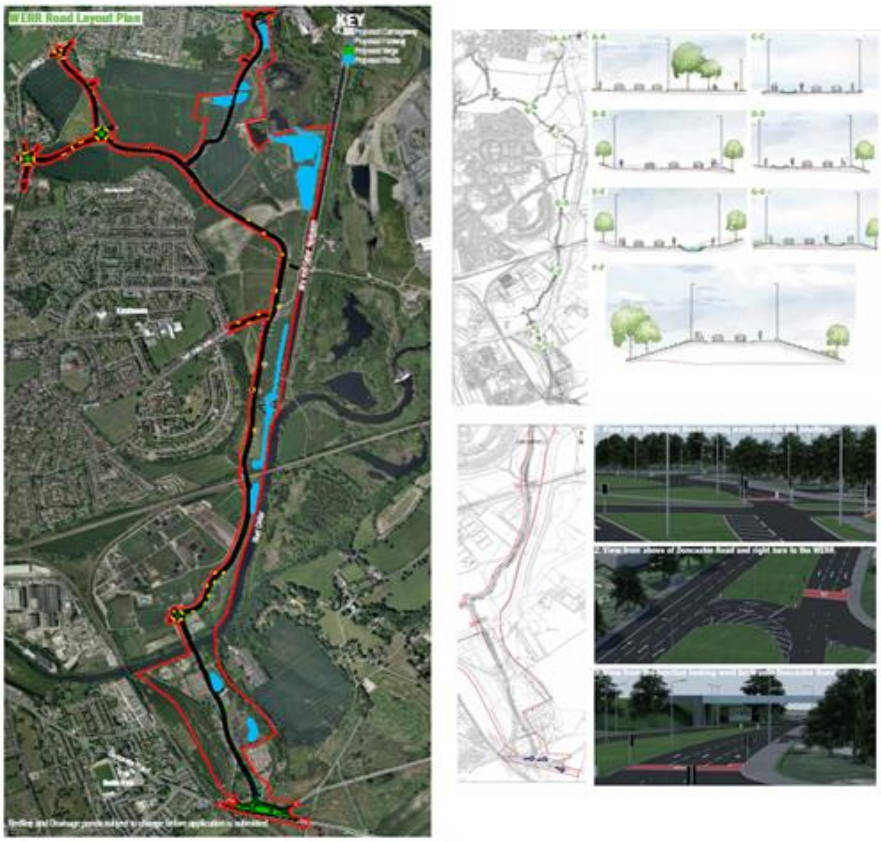
As such, measured concentrations between January through to April reflect air quality before it was re-routed from the centre (A638/A61) of Wakefield to the WERR. It is anticipated that there will continue to be a decrease in the measured annual mean once there is a greater uptake of the bypass and with the bypass operational for every month of the year.

Wakefield Council operate continuous air quality analysers, including two in Wakefield city centre: one (CM4) at Newton Bar to the north of Wakefield City and the second (CM3) at Park Street to the south of the City and located approximately 27 metres from the A61. Whilst the Park Street analyser (CM3) is within the model domain (i.e. the results from the analyser would be valid) its location away from the roadside means that it is classified as Urban Background rather than Roadside, which does not meet the verification roadside classification requirements of the JAQU 3rd wave modelling. In addition, the adjustment factor would not be representative of the highest exposure where the general public have access, such as footpaths. It is worth noting that the Nitrogen Dioxide concentrations measured at the Park Street continuous air quality monitoring station were 29 µg/m^3 (annual mean) for 2017 and well within the AAQD legal limit.

Wakefield Eastern Relief Road (WERR) – Traffic Data

The WERR introduced a new single carriage highway connecting the east and north of the city with the aim of reducing congestion and consequently improving air quality in Wakefield city centre (Figure 3).

Figure 3 – Route of Wakefield Eastern Relief Road (WERR)



Since the scheme became operational in April 2017 traffic counts and nitrogen dioxide (NO_2) measurements were taken to assist with the evaluation of the scheme.

In May and September 2017 Wakefield Council undertook a traffic survey to evaluate the performance of WERR in re-routing traffic away from the city centre. The impact of the road scheme on NO_2 concentrations was assessed using the dispersion model ADMS-Roads for the 2017 annual base year.

On the 30th of April 2018 the baseline modelling assessment submitted for Wakefield was based on annual average weekday traffic (AAWT), which does not account for reductions associated with weekend traffic flows. As such, the recommendation was to update the modelling based upon emission rates calculated from annual average daily traffic (AADT). A coefficient was supplied which converts AAWT to AADT and has been used with Traffic counts taken on traffic survey neutral days (weekdays during term-time). The majority of the traffic count locations measured both peak hours AM (7:30-09:30) and PM (16:00-18:00). A locally derived expansion factor was used to derive annual average daily traffic flows (AADT24).

Traffic counts were taken on traffic survey neutral days (weekdays during term-time). The majority of the traffic count locations measured both peak hours AM (7:30-09:30) and PM (16:00-18:00). A locally derived expansion factor was used to derive annual average weekday traffic flows (AAWT24). Emission rates for road traffic are usually calculated with the annual average daily traffic flow as many of the averaging periods for pollutants are an annual average. As the traffic data is representative of the weekday it is likely to over-estimate the actual annual average traffic flows with WERR operational.

Local Air Quality Management Technical Guidance TG16 (LAQM.TG (16)) was followed to apply reduced speeds for queues/congestion approaching junctions and roundabouts. In the absence

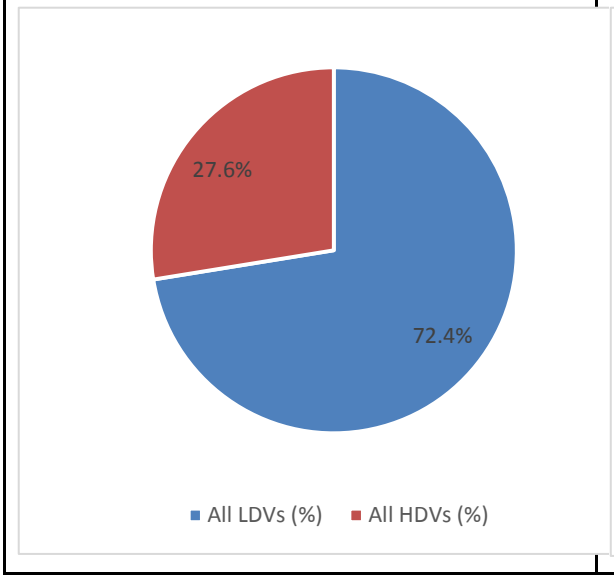
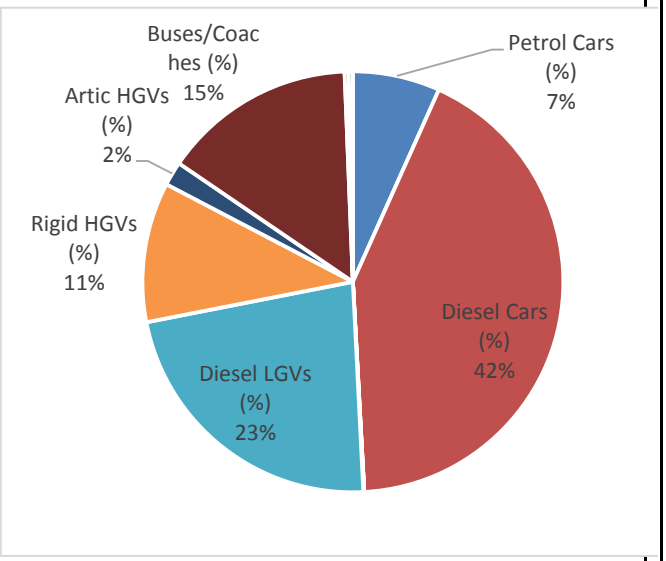
of measured speed data vehicles were assumed to be travelling at the speed limit.

The fleet mix was derived from the traffic survey undertaken in May and September and vehicles were assigned to the following categories:

1. Pedal cycles (PCL);
2. Motor cycles (MCL);
3. Cars;
4. Light goods vehicles (LGV);
5. Rigid heavy good vehicles (OGV1);
6. Articulated heavy good vehicles (OGV2); and
7. Buses and coaches (Bus).

NOx emissions were estimated using the Defra's emission factor toolkit (EFT version 8.0.1) which is based on COPERT V emission factors. The road NOx emission source apportionment is provided in Figure 4.

Figure 4: Average source apportionment across all the modelled road links

Split of emission between light duty vehicles (LDV) and heavy duty vehicles (HDVs)	Split of emission across all vehicle types
	

Model Verification

LAQM.TG (16) guidance on verification was followed with a total of 12 monitoring locations being used in the process. The model was verified against oxides of nitrogen (NO_x) and Nitrogen Dioxide (NO_2) and the root mean square error, fractional bias and correlation coefficient were calculated to assess the model performance, a summary has been provided within Table 1.

Table 1 Dispersion Model Calibration Performance

Process in Verification	No Adjustment	With Primary Road NO_x adjustment
No. sites	**8**	**8**
Modelled NOx Roads v Monitored NOx Rd Factor	na	1.247
Root Mean Square Error	**5.6**	**4.3**
Fractional Bias	0.11	0.14
Correlation Co-efficient	0.82	0.81

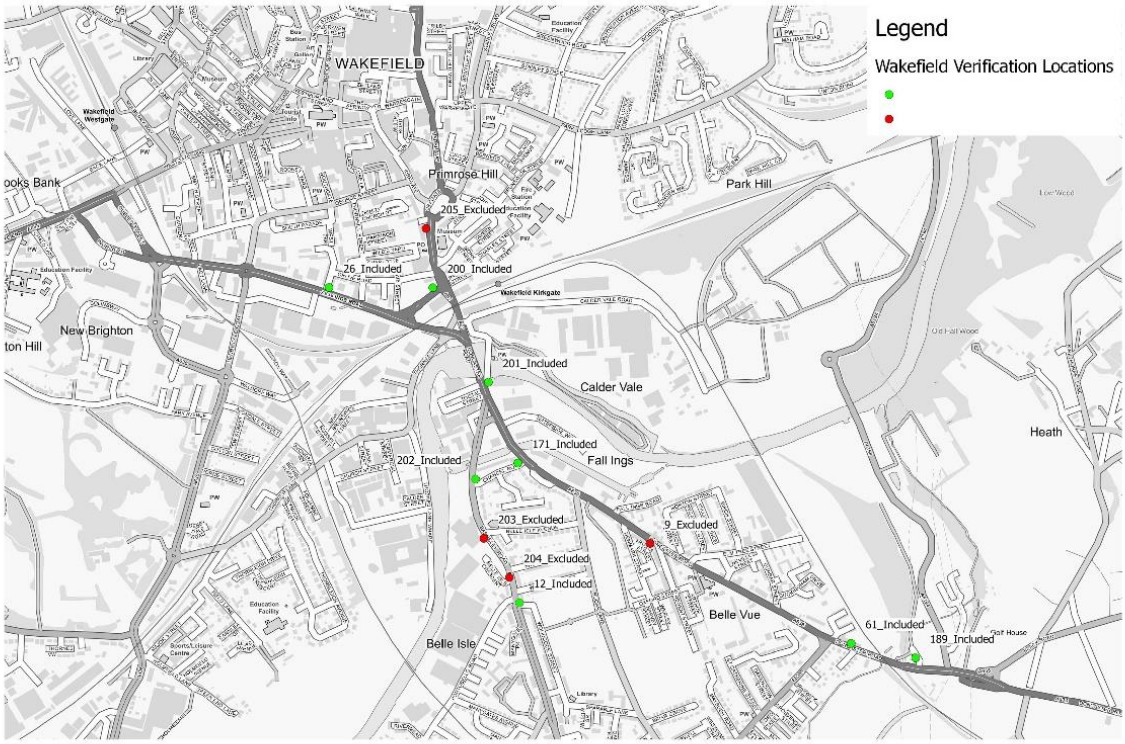
No with +-10%	1	0
No with +-25%	8	8

There was a tendency for the model to under-predict with a range of +4% through to -23% from the comparison of total modelled NO_2 to measured NO_2. Four locations were excluded from the model verification exercise:

1. Location 9 was within a street canyon dispersion environment which was excluded as this was not representative of the roads near the non-compliant PCM link, which has no street canyons;
2. Location 203 was next to the entrance of a bus depot;
3. Location 204 had data capture <75%; and
4. Location 205, was next to the Wakefield Archives whilst under construction.

The monitoring locations which have been excluded from the verification process have been included within Figure5.

Figure 5: Monitoring locations included in model verification.



All verification locations were within ≤+/- 25% of the measured concentrations before adjustment and adjustment of the model outputs did not yield better agreement amongst the verification locations. This was based upon 1 location falling within the +/-0-10% band prior to adjustment and with adjustment moving into +/-10-25% band, which shows a slight worsening in agreement between modelled and measured concentrations at 1 location. As such no adjustment was applied to predicted concentrations at receptors. There is a tendency to under-predict with and without adjustment, whilst adjustment lessen this, it is considered acceptable given that out of the 12 months of monitoring, four months were prior to the WERR opening.

Further details of the modelling parameters can be found on the DEFRA (JAQU) Modelling Checklist in submitted to JAQU.

The Analytical Assurance Statement, required by DEFRA/JAQU to support the modelling carried out as part of the Feasibility Study was submitted to JAQU.

Defining Sensitive receptors

Receptors have been put into two categories, localised and PCM equivalent. Following a desk-based review of the area surrounding the non-compliant link, localised receptors have been selected which meet the requirements of Annex III B 1(a) from the 2008/50/EC Air Quality directive.

The Air Quality Directive 2008/50/EC Annex III B 1(a) states that:

> B. Macroscale siting of sampling points
>
> 1. Protection of human health
>
> (a) Sampling points directed at the protection of human health shall be sited in such a way as to provide data on the areas within zones and agglomerations where the highest concentrations occur to which the population is likely to be directly or indirectly exposed for a period which is significant in relation to the averaging period of the limit value(s).

The EU limit values should be considered for all locations that the general public have access to. As such, the following areas which are not typically classified as a 'sensitive receptor' within LAQM.TG(16) were included in this model:

1. Footpaths;
2. Commercial premises, the general public have access to;
3. Residential fixed habitation dwellings

The above locations were modelled at a height of 1.5m. In addition to this, a receptor file was created which follows the same methodology as the PCM model. Which is a receptor placed 4 metres back from every road link, this was placed at 5 metre resolution. The PCM equivalent receptors were all modelled at a height of 1.5 metres.

DEFRA's modelled 2017 background concentrations with a 2015 base year were used. The primary road contribution was removed to prevent double counting main roads included in the dispersion model such as the Doncaster Road (A61).

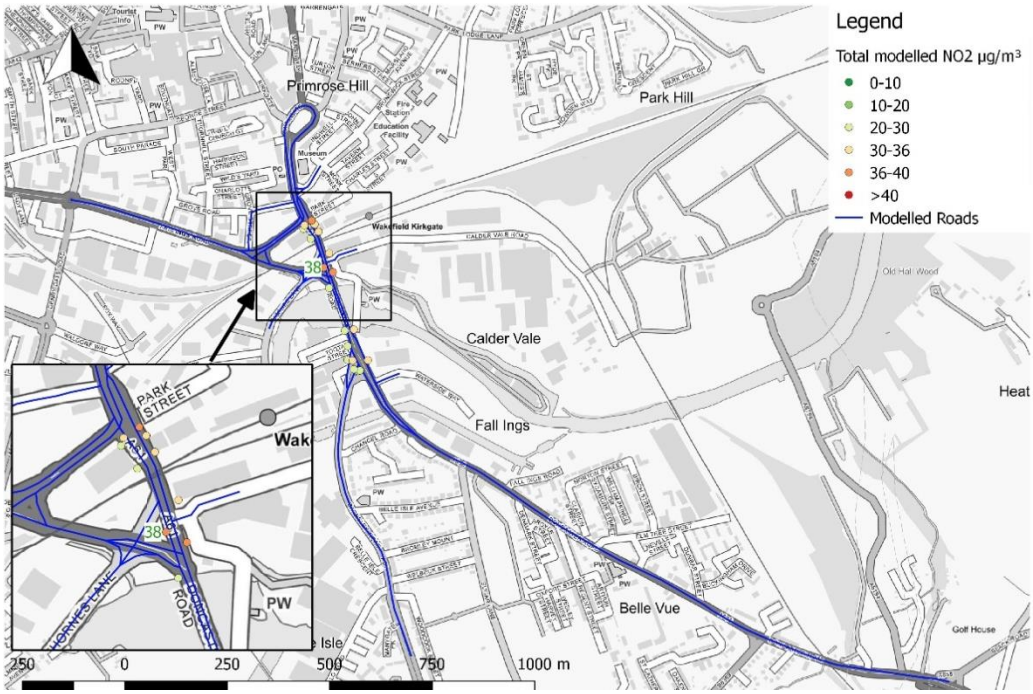
Dispersion model details

ADMS-Roads version 4.0.1 was used, with 2017 Doncaster Airport meteorological data, which contains hourly sequential data with 97% cloud cover for the year, in line with LAQM.TG(16) requirements.

Model Results

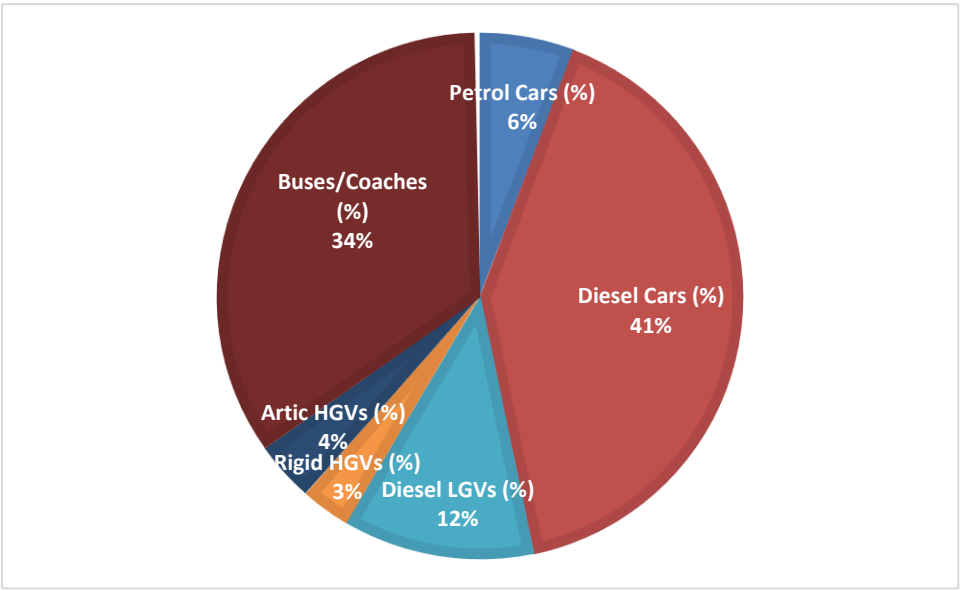
No locations are predicted to experience Nitrogen Dioxide concentrations greater than 40 µg/m^3, the highest modelled concentration is 38 µg/m^3 and can be seen within Figure 6. This is located along the footpath connecting Kirkgate to Thornes Lane.

Figure 6 Predicted concentrations at local receptors



The source apportionment of road NO_x from the closest road (Section of Kirkgate road after junction to Ings Road and before Thornes Lane) is presented within Figure 7. This shows that the two dominant emission sources in this area are diesel cars and buses/coaches.

Figure 7: Source apportionment of link closest to receptor predicted to be in exceedance of the NO_2 annual average EU limit value



Summary

Following the assessment of baseline air quality, the position of Wakefield Metropolitan District Council is as follows

1. A major infrastructure scheme, the Wakefield Eastern Relief Road (WERR), has been completed since DEFRA's national modelling based on DfTs 2015 traffic flows. This scheme has substantially reduced traffic on the road link identified as being non-compliant with the Ambient Air Quality Directive.

2. An assessment of current air quality has been undertaken as part of this targeted feasibility study using ADMS Roads and the new traffic information following the opening of the WERR. This shows that the maximum annual average concentration of NO_2 in 2017 was 38 µg/m^3 along the previously identified non-compliant link.

3. The WERR has been successful in bringing forward compliance from Defra's predicted year of 2021 and the aim of the feasibility study has already been successfully achieved, therefore no further measures will be considered as part of this study.

As predicted concentrations are in compliance with the limit value, no further measures are needed to bring the road link into compliance as concentrations in 2018 will be lower, with a higher proportion of newer vehicles compared to 2017.

Part 2: Developing a long list of measures for addressing the exceedances

Wakefield Metropolitan District Council have built the Wakefield Eastern Relief Road which opened in April 2017. This provides a route between the east and north of the city, creating an opportunity for traffic to travel around the city centre, rather than through it. However, to prepare for JAQU's request for Wakefield to continue through to Part 3 of the feasibility studies we have prepared a "long list" of measures to address exceedances. We have therefore used the information collected in Part 1 of this study to identify a range of measures which might bring forward compliance on this road link in the shortest possible time.

The source apportionment data shows that diesel cars, and buses on the road closest to the predicted exceedance, are the largest contributor to concentrations of NOx on the road link under consideration. In this context, diesel cars also includes taxis (of which over 96% are currently diesel) and which are not distinguished from passenger cars in the traffic data. We have therefore paid particular attention to measures which could reduce emissions from these vehicles. To maximise the chance of bringing forward compliance on the relevant road link and further improving air local air quality we have included measures which would reduce emissions from all other vehicle types which are estimated to contribute to NOx concentrations.

The long list of measures we have identified to reduce NO_2 concentrations on this road link, some have either already been introduced or are committed since the 2015 baseline traffic on which the predicted exceedance was based and others are possible measures that could lead to further air quality improvements. The long list of measures is as follows:

Committed measures

These are measures which have been implemented since the 2015 baseline or are going to be implemented:

- Wakefield Easter Relief Road – opened April 2017 (impact quantified above).
- Minimum Euro Emission standards and age restriction for hackney carriage and private hire vehicles licenses by Wakefield MDC – implemented in March 2018 with two-year implementation period.
- New Contract incorporating minimum Euro VI emission standard for free Wakefield City Bus scheme (operating a circular route in Wakefield city, including the road link) – commenced April 2018.
- Traffic management and improved road layout as part of the Kirkgate redevelopment, which will improve traffic flow and management.
- Retrofit of emission abatement technology on buses through the Clean Bus Technology fund.
- Dedicated EV chargepoints for taxis under the OLEV Ultra-low Emission Taxi Scheme – to be implemented from autumn 2018.
- Installation of more public electric vehicle charging points within the city to promote use of these low emission vehicles – implemented through planning conditions, with public EV chargepoint network also developed as part of the ULEV taxi scheme above (from Autumn 2018.
- Continued use of Local Planning decisions to promote air quality improvements.

New measures

- Low emission vehicle lease/salary sacrifice scheme to target the worst polluting vehicles (such as privately-owned diesel cars).
- Electric vehicle taxi trial to allow taxi operators to try out electric vehicles.
- Designated low emission parking areas to discourage more polluting vehicles to enter the city-centre car parks, or alternatively parking incentives such as reduced fares for low emission vehicles.
- Creation and promotion of electric vehicle car clubs to improve the accessibility of electric vehicle to the public.
- Build on Eco Starts Fleet Recognition scheme introduced in 2016 to target business operations using the road link (Thornes and Caldervale Industrial areas).
- Education campaign in Wakefield schools to raise awareness of air quality and alternative, low emission transport modes, including anti-idling messages and active travel.

Part 3: Assessing deliverability/feasibility and delivering a short list

Part 1 of this Feasibility Study has confirmed that the Wakefield Eastern Relief Road has resulted in reduced traffic and improvements in air quality on the identified A61 road link bringing forward compliance compared to that identified in the PCM model. As the road link is already compliant no further measures are required, although the local authority remains committed to improving the environment for the citizens of Wakefield and will continue to work on delivering those measures identified on Part 2 above.

Part 4: Evidencing the short listed measures to identify options that could bring forward compliance

This section is not relevant as the measure which has brought forward compliance with the Ambient Air Quality Directive, i.e. the Wakefield Eastern Relief Road, has been shown to be effective.

Part 5: Setting out a preferred option

Conclusion

The A61 road link to the south of Wakefield city centre (Census ID 56617) was identified by DEFRA as exceeding the legal limit for Nitrogen Dioxide as set out in the Ambient Air Quality Directive 2008/50/EC. This exceedance was based on the Pollution Climate Mapping model used by DEFRA and based on 2015 traffic data. The PCM projected that compliance with the legal limit would not be achieved until 2021. Consequently Wakefield Council have been required under Ministerial Direction to complete a feasibility study to consider measures that would bring forward compliance in the shortest possible time.

This Feasibility Study has been undertaken in conjunction with the environmental consultants Ricardo AEA, with particular reference to the impact which the opening of a new road scheme, the Wakefield Eastern Relief Road (WERR), has had on bringing forward compliance with the AAQD for the relevant A61 road link. The WERR opened in April 2017 with the aim of diverting traffic away from Wakefield City centre, including on the relevant A61 road link, which is main route into Wakefield City centre. Traffic data has been captured after the opening of the WERR to evaluate its impact.

Ricardo AEA have used the updated traffic data to further model the roadside nitrogen dioxide concentrations on the A61 road link, including verification of the model using local air quality monitoring data. The modelling has been carried out in accordance with the DEFRA/JAQU reporting requirements as detailed in the checklists submitted to JAQU.

The revised model has shown that the introduction of the Wakefield Eastern Relief Road (WERR) has resulted in reduced traffic on the relevant A61 road link and has brought forward compliance with legal limit for roadside Nitrogen Dioxide concentrations. Based on 2017 traffic data, the revised modelling undertaken by Ricardo showed that the maximum concentration of roadside Nitrogen Dioxide for the A61 road link was 38µg/m^3 in 2017 and therefore 2µg/m^3 less than the legal limit of 40µg/m^3. The trend is one of improving air quality as vehicle emissions reduce with newer, less polluting vehicles replacing older ones and, coupled with further measures that Wakefield Council have introduced or committed to implement since the 2015 baseline, the improving trend is set to continue.

This Feasibility Study has concluded that the A61 road link is now compliant with legal limit for roadside Nitrogen Dioxide concentrations as set out in Ambient Air Quality Directive 2008/50/EC.