SANDWELL METROPOLITAN BOROUGH COUNCIL – TARGETED FEASIBILITY STUDY TO DELIVER NITROGEN DIOXIDE CONCENTRATION COMPLIANCE IN THE SHORTEST POSSIBLE TIME

Local authorities covered	Sandwell Metropolitan Borough Council

Part 1: Understanding the problem

This section should set out background on the information about the road links projected to have exceedances in the PCM national model, in combination with source apportionment data, to provide a description of the severity of the NO_2 exceedance and its possible sources and causes. It should set out the scale of the problem and the case for change. Maps and local data should be included. ***Each road link should be addressed in turn.***

The following road links within the Sandwell MBC administrative area have been identified in the Department for Environment, Food and Rural Affairs (Defra) PCM National Model 2017 as having projected exceedances of the annual mean nitrogen dioxide (NO_2) National Air Quality Objective (NAQO) of 40 micrograms per cubic metre (μgm^{-3}), subsequently referred to as 'the threshold':

- Census ID 57186; Junction of A41 and All Saints Way A4031 to Junction of A41 and A4031 Trinity Way
- Census ID 26453; Junction of A41 / Bilhay Lane to Junction of A41 and All Saints Way A4031

Table 1 summarises the PCM modelled exceedances of the European Union (EU) Limit / NAQO threshold for these road links, and Figure 1 shows the location. By 2021 concentrations are predicted to be below the threshold.

Figure 1 Exceedance Links 57186 and 26453

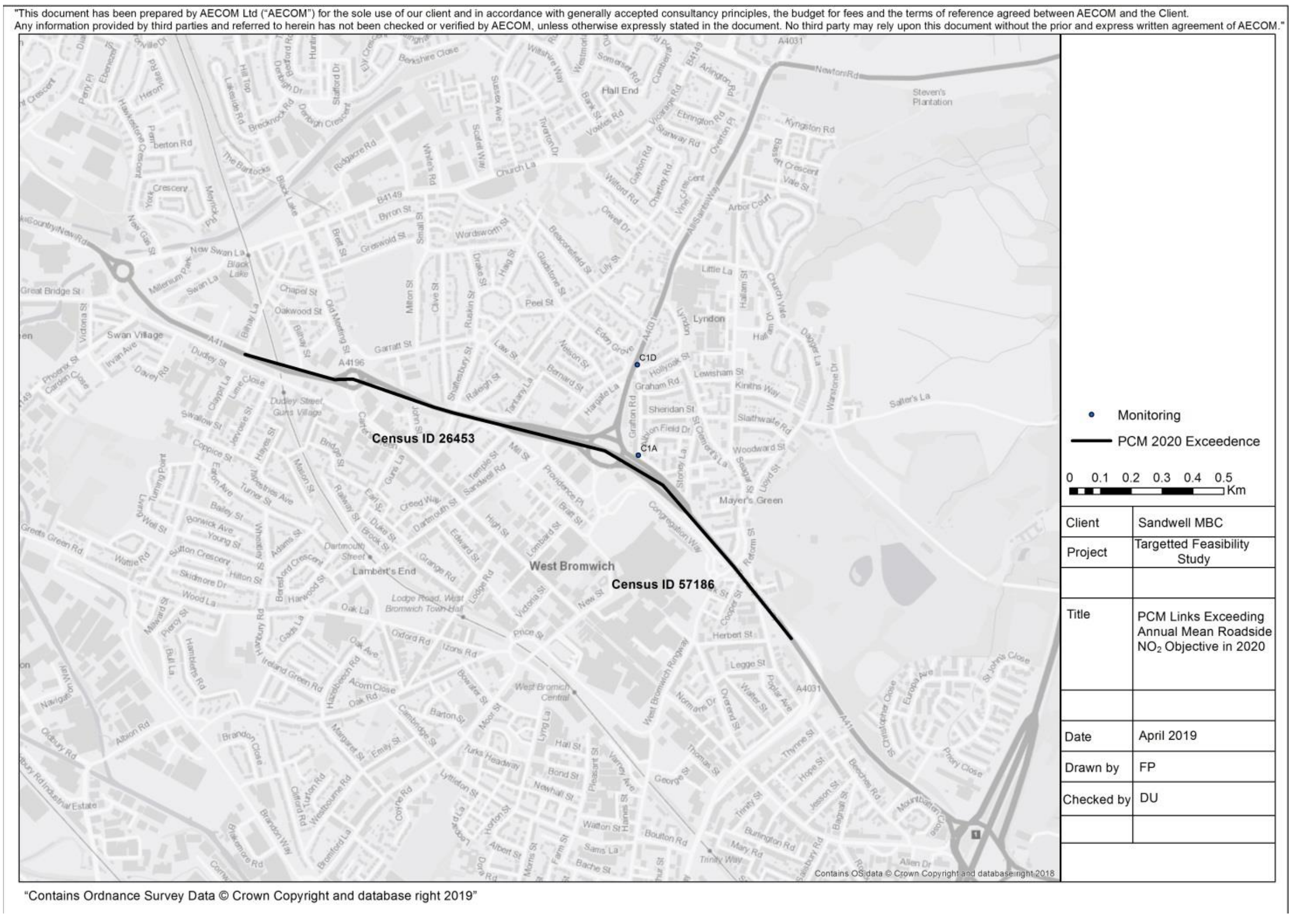

Table 1 Summary of PCM Road Link Exceedances

Census ID	Defra PCM Annual Mean NO_2 Concentration (µg/m^3)		
	2019	2020	2021
57186	44	42	39
26453	43	41	39

This study is concerned only with the PCM compliance links identified above.

Baseline Air Quality Monitoring

Air quality monitoring is undertaken at sites in proximity to the census locations using a network of passive NO_2 diffusion tubes. The sites closest to the study area are identified in

Table 2 and shown in Figure 1. Site C1A is adjacent to census ID 57186, set back from the main carriageway and next to the westbound slip road connecting the A4031 to the A41. Site C1D is approximately 250 m north of the A41 adjacent to the A4031 southbound carriageway.

The data does not indicate any long-term trends, with annual mean concentrations generally staying close to the limit value year-on-year.

Table 2 Local Air Quality Monitoring Results

Census ID	Monitoring			Annual Mean NO_2 Concentration (μgm^{-3})							
	Site ID	Type	Distance to kerb	2011	2012	2013	2014	2015	2016	2017	2018
57186	C1A	Roadside	0.3m to kerb of EB slip from A4031 to A41	34.0	35.1	30.9	31.3	40.5	31.4	31.8	34.6
N/A	C1D	Roadside	2.0m	40.1	48.5[A]	45.5	42.9	39.3	43.0	39.4	44.5

Note: [A] Low data capture at C1D in 2012.

Background Pollutant Sources

For any modelling exercise the ideal situation is to estimate emissions from all known sources (road, rail, industry etc.). In practice, information will only be available for those sources under the spot light. In this case it is the road traffic component. Under these circumstances all other sources are collectively considered to be a background element. The concentrations calculated by the PCM model due to vehicle emissions are therefore added to these background concentrations to give the total concentration.

The annual mean background pollutant concentration used in this assessment were modelled estimations provided by Defra (Defra, 2018)[1], who provide values for the centre point of each 1 km by 1 km grid square in the UK, for each year between 2015 and 2030. Estimated average background concentrations for the Ordnance Survey grid squares containing the exceedance links were downloaded in April 2019.

Pollutants of Concern

NO_2 and nitric oxide (NO) are both oxides of nitrogen and are collectively referred to as NO_X. All combustion processes produce NO_X emissions, largely in the form of NO, which is then converted to NO_2, mainly as a result of its reaction with ozone in the atmosphere. Therefore, the ratio of NO_2 to NO is primarily dependent on the concentration of ozone and the distance from the emission source.

The Government and the Devolved Administrations has adopted two Air Quality Objectives for NO_2 which were to be achieved by the end of 2005. In 2010, mandatory EU air quality limit values on pollutant concentrations were to apply, although it continues to be breached in locations throughout the UK. The EU limit values for NO_2 in relation to human health are the same as the national objectives (Defra, 2007):

- An annual mean concentration of 40 $\mu g/m^3$ (micrograms per metre cubed); and
- An hourly mean concentration of 200 $\mu g/m^3$, to be exceeded no more than 18 times per year (99.79th percentile).

For the purposes of this study it is necessary to convert the NO_2 concentrations to NO_X, as the relationship between NO_2/NO_X is not linear, and also varies depending on region and year.

The emissions from road traffic are presented as R-NO_X, which excludes non-road sources, such as background emissions (see above). This is an essential calculation step to determine the required emissions reduction required for each component of the traffic.

Traffic Model

The traffic data were obtained from the West Midlands PRISM transport model, which was supplied by Transport for West Midlands. These data are categorised as light (LDV) and heavy vehicles (HDV) for peak hours (AM and PM) and daytime interpeak.

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[1] https://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html

As there was no detailed traffic breakdown, the DfT data published online[2] was used to calculate the proportions of each vehicle categories.

The data were scaled to 24-hour AADT (annual average daily traffic) using a 3-hour peak period and 6-hour interpeak period, and nominally scaled to 24-hours using a factor of 1.3. Speeds were adjusted similarly, and then normalised to determine the average hourly value.

Travel West Midlands confirmed the following information with regard to public service buses operating on the A41 West Bromwich (J1 M5 to junction to Great Bridge):

- No public service buses on the A41 (Between J1 M5 and Navigation Roundabout).
- Public service buses cross the A41, across the roundabout from All Saints Way and Old Meeting St as well as under on Shaftesbury St and Reform St (above) but do not travel on the A41.

Furthermore, the regional bus fleet is undergoing a series of upgrades to increase the number of Euro VI compliant vehicles. The data in Table 3 were provided by Transport for West Midlands and indicate that in 2016 the nominal fleet composition used by the EFT was very similar to the actual fleet.

Table 3. West Midlands Bus Fleet Composition

Emission Standard	EFT 2016 Nominal Fleet	Existing Fleet	Planned Upgraded Fleet
Euro II	4%	-	-
Euro III	17%	20%	8%
Euro IV	13%	15%	6%
Euro V	35%	36%	15%
Euro VI	31%	29%	71%

Source: Transport for West Midlands

Emission Factor Toolkit

The emission rates were calculated using the Emission Factor Toolkit (EFT) v8.0.1, with the 2016 basic fleet split for roads outside London. EFT v9.0 was available for use in May 2019, after the calculations and modelling for this study modelling were undertaken; therefore, it was not used in this study.

The fleet age and composition was based on the data defined for England (not London) in the EFT v8.0.1, although this is considered to be a model uncertainty as it is not known if it represents the local fleet.

The NOx to NO_2 calculator v7.1 was published in May 2019 but was not used in this study as it does not include the 2016 baseline verification year, and so v6.1 was used.

The background pollutant data were also published in May 2019 using a 2017 baseline instead of the 2015 baseline. However, as this new data does not include data for the 2016 verification year, the 2015-based background pollutant data were used in the study.

ADMS

The ADMS detailed dispersion model version 4.1.1.0 was used to determine the annual mean NO_2 concentration at locations 4 m from the kerb, at 2 m height and >25 m from a major junction.

The results from the model are presented in Figure 2.

[2] (https://www.dft.gov.uk/traffic-counts/cp

Model Verification

The ADMS model data was compared to data from the two local air quality monitoring sites.

The model compared favourably with the monitoring site C1D, located adjacent to the A4031 on Grafton Road. This is a relatively free-flowing road section, and so the conditions are conducive to the model outputting results that align with monitored conditions.

The site at C1A is near the southbound slip road from the A4031 onto the A41, but is screened by vegetation and buildings, and so the verification in this location leads to the model over-predicting the monitored conditions, because the model cannot account for the effects of vegetation and buildings.

Therefore, the comparison at site C1D was used as evidence to apply no adjustment to the model, as shown in Table 4.

Table 4. ADMS Modelling vs Local Air Quality Monitoring

Site ID	Monitor type	Site type	Background NO_2	Monitored total NO_2	Modelled total NO_2	% Difference [(mod-mon)/mon]
C1A	Passive	Roadside	25.4	31.4	40.6	29%
C1D	Passive	Roadside	24.8	43.0	42.4	-2%

Figure 2 Modelled Receptor Locations and Projected Compliance Years

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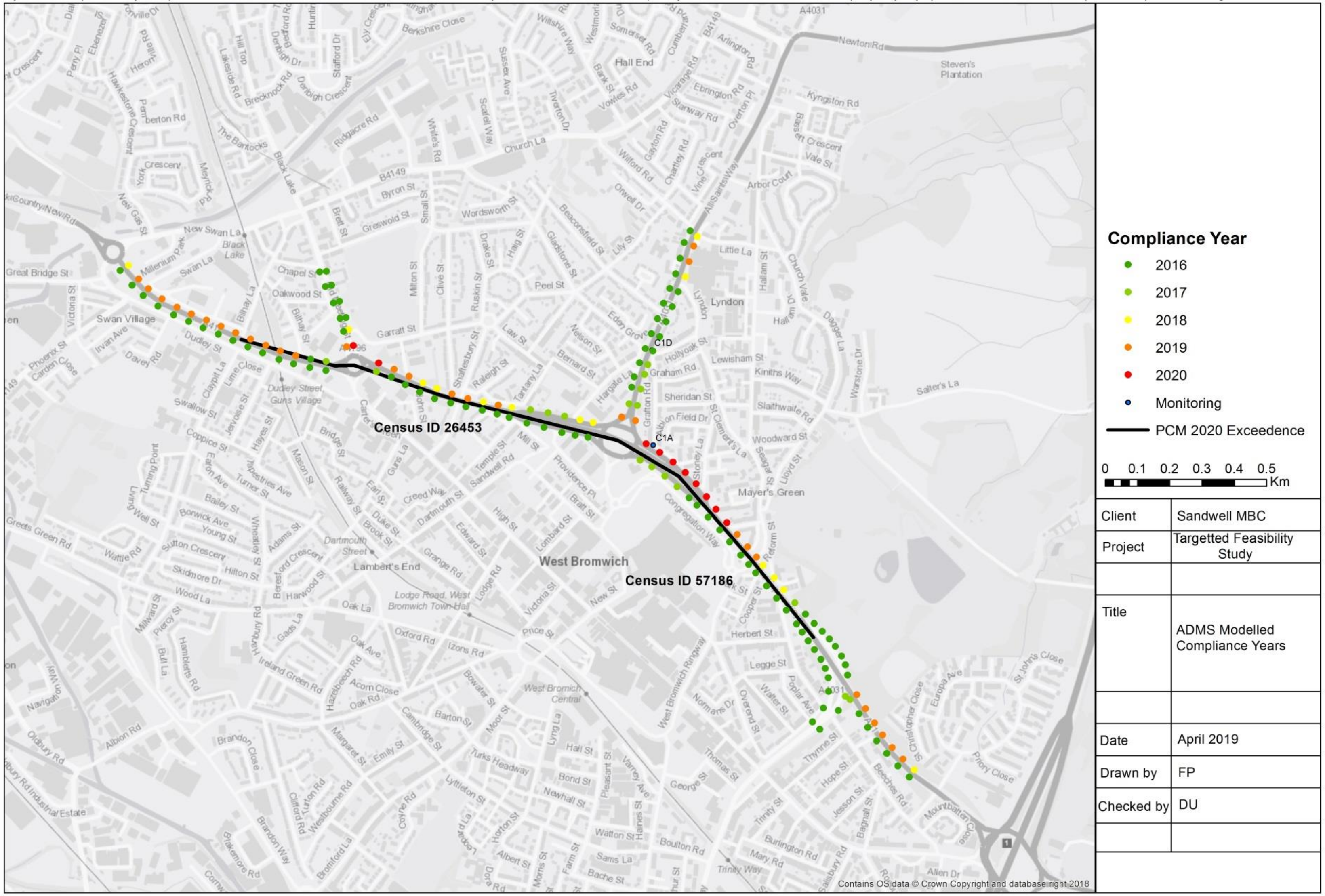


Road Link 57186

The road link for census ID 57186 is a dual carriageway between the junction of the A41 and All Saints Way A4031, to the junction of the A41 and A4031 Trinity Way. The link to the A4031 comprises a series of slip lanes, with the southbound link leading underneath the A41.

The road links directly to Junction 2 of the M5 motorway approximately 750m to the east.

Parts of the A41 are sunk into a cutting lower than the surrounding land to allow a footbridge access to the parkland to the north, and a road bridge at Reform Street.

NO_2 Reductions Required to meet AQ Thresholds

The reduction in road emissions required to meet the annual mean limit value based on the projected PCM roadside concentrations are presented in Table 5. This data uses the Defra background concentrations to calculate the road-source NO_X (R-NO_X), and compare it to the R-NO_X equivalent to 40 μg/m^3 of NO_2.

This data indicates that a reduction of 20% in NO_X emissions is required in 2019, and 15% reduction in 2020, to achieve compliance in these years.

Table 5 Defra PCM Modelled NO_2 Concentrations and Percent Reductions in Road NOx to Achieve Compliance for Census ID 57186

Year	NO_2		NO_X			
	Defra PCM Annual Mean NO_2 Concentration (μg/m^3)	Background NO_2 Concentration (μg/m^3)	Defra PCM Annual Mean R-NO_X Concentration (μg/m^3)	R-NOx Concentration at NO_2 = 40 μg/m^3 (μg/m^3)	R-NOx Required Reduction (μg/m^3)	Percent reduction in R-NOx to achieve compliance
2019	44	22.7	45.9	36.5	9.4	20%
2020	42	21.7	45.6	38.6	7.1	15%
2021	39	20.8	38.1	40.4	N/A	N/A

Note: Background NO_2 concentrations obtained from Defra's background maps of pollutant concentrations (https://uk-air.defra.gov.uk/data/laqm-background-maps?year=2015). Road NOx concentrations calculated using Defra's NOx-to-NO_2 Calculator tool (Local Authority = Sandwell, Traffic mix = All other UK urban traffic)

The results from the ADMS model were also used to determine the projected compliance year for PCM census ID 57186. The highest concentration at a receptor location that satisfies the siting criteria are presented in Table 6. This indicates the link will be compliant in 2019 (i.e. <40.49 μg/m^3).

Table 6 ADMS Modelled NO_2 Concentrations and Percent Reductions in Road NOx to Achieve Compliance for Census ID 57186

Year	NO_2		NO_X			
	ADMS Annual Mean NO_2 Concentration (µg/m³)	**Background NO_2 Concentration (µg/m³)**	**ADMS Annual Mean R-NO_X Concentration (µg/m³)**	**R-NOx Concentration at NO_2 = 40 µg/m³ (µg/m³)**	**R-NOx Required Reduction (µg/m³)**	**Percent reduction in R-NOx to achieve compliance**
2019	40.2	22.7	40.5	36.5	N/A	N/A
2020	38.6	21.7	37.6	38.6	N/A	N/A
2021	37.0	20.8	34.7	40.4	N/A	N/A

Note: Background NO_2 concentrations obtained from Defra's background maps of pollutant concentrations (https://uk-air.defra.gov.uk/data/laqm-background-maps?year=2015). Road NOx concentrations calculated using Defra's NOx-to-NO_2 Calculator tool (Local Authority = Sandwell, Traffic mix = All other UK urban traffic)

As discussed above, there is no long-term trend identified by the monitoring to support NO_2 reductions in the short term. However, the detailed dispersion modelling meets the requirements set out by JAQU and so this study estimates compliance with legal limits in 2019, which is sooner than the PCM estimate of 2021 for link ID 57186.

Relevant Exposure

There are residential properties on either side of the link at the eastern end, and at the north end between Reform Street / Seagar Street.

There is a large area of parkland to the north of the link, and a large commercial shopping park to the south of the A41 accessed from the roundabout junction with the A4031.

Traffic Volume and Source Apportionment

Table 8 shows the source apportionment for emissions from road traffic on the census ID link 57186. This data discount the contribution from non-road sources, which are accounted for in the background. The emission sources relevant to roadside locations are predominantly from road traffic, which is accepted to be the focus of this study.

The peak and inter-peak flows are broadly similar, although there is approximately 25% less traffic on the eastbound carriageway during the daytime inter-peak period, compared with peak periods. This indicates the traffic is not highly tidal, and the roadside pollutant concentrations are not strongly linked to peak hour congestion.

Table 7 Traffic Flow Data for Census ID 57186 in 2016

Direction	AADT	HDV	Speed Km/hr	AM Peak Hour	Inter-peak Hour	PM Peak Hour
WB	24387	5.7%	53.4	1388	1452	1915
EB	25455	5.6%	52.5	2096	1380	1769

Diesel cars and LGVs are predicted to be the most significant road traffic emission sources, contributing approximately 60% of the total NO_X emissions.

HDVs (HGVs and buses) are disproportionally significant in terms of emissions compared to the traffic flow data, comprising approximately 5-6% of the traffic flow, but contributing approximately 15% of the emissions.

The emissions from buses / coaches were specifically notable, as they comprised approximately 1.5% of the traffic flow, based on the DfT count data, but were predicted to contribute approximately 8% of the emissions in 2016. However, as discussed above, there are no local bus routes on these links; this is a major link to the M5 motorway and so these vehicles may be long distance bus or coach services, although additional data is required to verify the situation and determine the breakdown of these vehicles.

Table 8 Emissions Source Apportionment for Census ID 57186 in 2016, NO_X %

Direction	Petrol Car	Diesel Car	Petrol LGV	Diesel LGV	Rigid HGV	Artic HGV	Bus & Coach	M/C	Other
WB	6.8%	38.0%	0.1%	28.2%	11.3%	6.9%	8.3%	0.1%	0.2%
EB	6.7%	37.7%	0.1%	28.1%	11.5%	7.0%	8.4%	0.1%	0.2%

Road Link 26453

The road link for census ID 26453 is a dual carriageway between the junction of A41 / Bilhay Lane to the junction of A41 and All Saints Way A4031. The western end of the link passes through the Albion roundabout junction with the A4196.

NO_2 Reductions Required to meet AQ Thresholds (Defra/JAQU)

The reduction in road emissions required to meet the annual mean limit value based on the projected PCM roadside concentrations are presented in Table 9. This data use the Defra background concentrations to calculate the road-source NO_X (R-NO_X), and compare it to the R-NO_X equivalent to 40 $\mu g/m^3$ of NO_2.

This data indicates that a reduction of 16% in NO_X emissions is required in 2019, and 6% reduction in 2020, to achieve compliance in these years.

Table 9 Defra PCM Modelled NO_2 Concentrations and Percent Reductions in Road NOx to Achieve Compliance for Census ID 26453

Year	NO_2		NO_X			
	Defra PCM Annual Mean NO_2 Concentration (µg/m³)	Background NO_2 Concentration (µg/m³)	Defra PCM Annual Mean R-NO_X Concentration (µg/m³)	R-NOx Concentration at NO_2 = 40 µg/m³ (µg/m³)	R-NOx Required Reduction (µg/m³)	Percent reduction in R-NOx to achieve compliance
2019	43	22.7	43.5	36.5	7.0	16%
2020	41	21.7	40.9	38.6	2.3	6%
2021	39	20.8	38.1	40.4	N/A	N/A
Note: Background NO_2 concentrations obtained from Defra's background maps of pollutant concentrations (https://uk-air.defra.gov.uk/data/laqm-background-maps?year=2015). Road NOx concentrations calculated using Defra's NOx-to-NO_2 Calculator tool (Local Authority = Sandwell, Traffic mix = All other UK urban traffic)						

The results from the ADMS model were also used to determine the projected compliance year for PCM census ID 26453. The highest concentration at a receptor location that satisfies the siting criteria are presented in Table 10. This determines the link will be compliant in 2020.

Table 10 ADMS Modelled NO_2 Concentrations and Percent Reductions in Road NOx to Achieve Compliance for Census ID 26453

Year	NO_2		NO_X			
	ADMS Annual Mean NO_2 Concentration (µg/m³)	Background NO_2 Concentration (µg/m³)	ADMS Annual Mean R-NO_X Concentration (µg/m³)	R-NOx Concentration at NO_2 = 40 µg/m³ (µg/m³)	R-NOx Required Reduction (µg/m³)	Percent reduction in R-NOx to achieve compliance
2019	41.2	22.7	40.0	36.5	3.5	8.8%
2020	39.4	21.7	37.4	38.6	N/A	N/A
2021	37.5	20.8	34.8	40.4	N/A	N/A
Note: Background NO_2 concentrations obtained from Defra's background maps of pollutant concentrations (https://uk-air.defra.gov.uk/data/laqm-background-maps?year=2015). Road NOx concentrations calculated using Defra's NOx-to-NO_2 Calculator tool (Local Authority = Sandwell, Traffic mix = All other UK urban traffic)						

As discussed above, there is no long-term trend identified by the monitoring to support NO_2 reductions in the short-term. However, the detailed dispersion modelling meets the requirements set out by JAQU and so study estimates compliance with the legal limits in 2020, which is sooner than the PCM estimates of 2021 or link ID 26453.

Table 11 shows traffic flow data for Census ID 26453

Relevant Exposure

There are residential properties to the north and south of the link, whilst there is also a school to the north leading off Hargate Lane near the junction with the A4031.

Traffic Volume and Source Apportionment

Table 12 shows the source apportionment for emissions from road traffic on the census ID link 26453.

As for census ID 57186, the peak and inter-peak flows are similar, although there is a notable increase during the AM peak westbound and PM peak eastbound that may indicate some tidal effect due to commuting. However, overall it is not considered that the roadside pollutant concentrations are strongly linked to congestion during peak hours.

Table 11 Traffic Flow Data for Census ID 26453 in 2016

Direction	AADT	HDV	Speed Km/hr	AM Peak Hour	Inter-peak Hour	PM Peak Hour
WB	24776	4.0%	53.3	1969	1459	1574
EB	24196	4.2%	50.1	1321	1471	1888

As for census ID 57186, diesel cars and LGVs are the most significant emission sources.

HDVs are disproportionally significant, where buses and HGVs comprise approximately 4% of the traffic flow but contribute approximately 14% of the emissions. As for census ID 57186, the emissions from buses / coaches were specifically notable compared as the proportion of the traffic flow for this vehicle type was <1%. However, there are no local bus routes on these links; this is a major link to the M5 motorway and so these vehicles may be long distance bus or coach services, although there is no data currently available to further inform this.

Table 12 Emissions Source Apportionment for Census ID 26453 in 2016, NO_X %

Direction	Petrol Car	Diesel Car	Petrol LGV	Diesel LGV	Rigid HGV	Artic HGV	Bus & Coach	M/C	Other
WB	7.4%	41.3%	0.1%	30.8%	8.6%	5.2%	6.3%	0.2%	0.2%
EB	7.2%	40.7%	0.1%	29.8%	9.3%	5.7%	6.8%	0.1%	0.2%

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

This section should provide a long list of possible measures to be considered for each road link. Local authorities should consider the source apportionment set out in part 1.

The projected compliance year for link ID 57186 was 2020 and 26453 was 2019, based on linear interpolation of detailed dispersion model data from 2016 to 2026.

The source apportionment indicates that diesel cars and vans are the most significant source of NO_X emissions from road traffic.

As discussed previously, the source contribution from buses is uncertain, as there are few public service buses on the A41 despite a large number of buses / coaches in the traffic model.

Overall, the high emissions are considered to be mainly associated with large traffic flows; ~50,000 vehicles per day on the A41, rather than specific vehicle operating conditions. The appraisal of the period traffic flows does not indicate that congestion during peak hours is specifically a contributor to emissions, as there are high traffic flows throughout the day.

Review of signalling, UTMC, VMS signage & SCOOT

A UTMC system may be used to actively prioritise air quality concerns by redistributing congestion and slow-moving traffic away from areas of concern, even where it may lead to longer journey times. Where road capacity is made available through successful implementation of the UTMC, it could be utilised for alternative transport. It may also help to smooth the flow of traffic and inform road users about delays, or optimum speeds.

Key considerations are:

- There is a need to identify potential alternative routes with acceptable headroom to accommodate increased traffic flow and emissions.
- It may be possible to implement redirections for only a component of the total traffic flow, or during specific times.
- A mechanism to achieve the desired driver response may not be feasible.

The traffic on the affected links are likely to be travelling between M5, and areas to the south-east, to Wednesbury. Journeys to Oldbury and Dudley are likely to use the closer routes from the M5, whilst journeys further to the north around Wolverhampton would be better served using the M6. However, many drivers may prefer to avoid the busy M5 / M6 junction, which is often subject to congestion at peak hours. Therefore, although there may be opportunity to encourage use of alternative journeys, there may be limited realistic means to achieve this without significant support from Highways England.

There is also limited evidence currently available to determine the splits between local and regional journeys through the study area. This information is required to determine the incentives and outcomes from diverting journeys.

Furthermore, the mechanism to incentivise this behavioural response is unproven, and there may be objections from the businesses with the shopping centre if drivers are diverted or disincentivised from using this route.

Speed Management & Enforcement

Vehicle speeds directly affect the drive-cycle efficiency and emissions, where low speeds, idling and accelerating can significantly affect emissions. Using traffic controls to ensure that movement is relatively ‘smooth’, with a constant speed to limit acceleration, would minimise emissions. Depending on the existing average speed it can also create greater capacity.

We would aim to enforce this accordingly with average speed cameras, and although in the near-term infrastructure can be installed which may create a behavioural change, they are unlikely to be enforced in the short term due to lack of police personnel. The Authorities will continue to look at funding options alongside Transport for West Midlands.

In order to test the effects of changing speeds, the Emission Factor Toolkit (EFT) v. 8.01 was used to calculate emissions resultant with a range of speeds assigned to each road link; speeds from 5 to 100 km/hr in 5 km/hr increments were assigned to all of the links to calculate a speed profile for each vehicle type, as shown in Figure 3.1 for 2016, and Figure 3.2 for 2026. This data is included here to demonstrate the effect of speed management, and how increasing / reducing speeds may affect emissions on the non-compliant links.

These figures show that the speeds with the least emissions are between 65 and 85 kmph. These figures also show that there is a large reduction in emissions between 5 and 15 kmph, showing that if traffic can be kept moving at 15 kmph rather than 5 kmph, a large reduction in emissions can be achieved. Figure 3.1 and Figure 3.2 also show that some traffic components have larger reductions in emissions over the speed profile than other traffic components, such as LDVs compared to Articulated HDVs for example.

The available traffic-flow data indicates that congestion is not specifically a contributor to emissions on the affected road links, and so it may not be feasible to achieve a speed increase, whilst there are also potential risk implications for safety and traffic management. Furthermore, it should be recognised that higher speeds cannot be achieved near junctions and increasing the speed along the link may increase emissions in braking and acceleration zones. Therefore, it is not considered that any further refinement or regulation of speeds may feasibly achieve significant reductions in emissions.

Figure 3.1 2016 Speed vs Emissions Profile

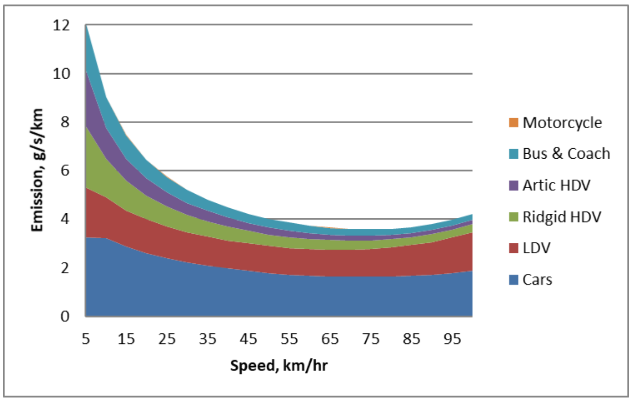
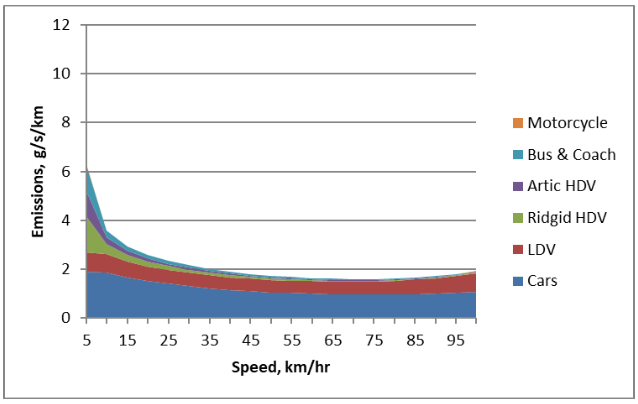


Figure 3.2 2026 Speed vs Emissions Profile



Traffic Calming

Vehicle speeds directly affect the drive-cycle efficiency and emissions, where low speeds, idling and accelerating can significantly affect emissions. Using traffic controls to ensure that movement is relatively ‘smooth’, with a constant speed to limit acceleration, would minimise emissions.

- Alter the red / green times on the traffic lights
- introduce traffic calming measures on roads leading into the areas of concern
- achieve very low speed limits to reduce stop-start movement
- Move stop lines and junction approach sections

There is insufficient evidence to indicate whether congestion is contributing to emissions on the affected links, and as a dual carriageway there are no traffic lights or other locations where this type of control could feasibly be implemented.

Bus Retrofit to Euro VI & Route Management

Individual buses and coaches produce large amounts of emissions in comparison to cars and light-engined vehicle types, and the source apportionment modelling in Part 1 indicates these vehicles are a disproportionate emission source compared to the number of vehicles. Therefore, if emissions from buses and coaches were improved, this could decrease the amount of total emissions on the road.

It is unknown what these vehicles are; there are no public service bus routes on the non-compliant links, and so it is suggested they may be long-distance bus and coach services. This means there may be a large number of individual operators, and so a mechanism to implement the measures discussed here would require additional information.

Improving bus fleet emissions can have a measurable impact on air quality. The Clean Vehicle Retrofit Accreditation Scheme (CVRAS) is a robust certification scheme for manufacturers of retrofit emissions reduction technology that addresses the air pollution emissions from buses to achieve Euro VI performance. This will enable Clean Air Zone (CAZ) compliance of legacy fleet vehicles. This certification scheme supports the operation of Clean Air Zones and is accredited by the Energy Saving Trust.

As such, manufacturers must seek this accreditation before it can be added to the list of approved devices available to vehicles. This ensures that approved filters meet minimum technical standards and that vehicles fitting these approved emission reduction systems meet the national emissions standards. All approved systems have met emission reduction systems and technologies and demonstrated robust technical performance in order to be eligible for approval and manufacturers are required to operate quality management systems to certified standards.

It is also recognised that retrofitting buses to achieve lower emissions may not achieve the same real-world effect as a vehicle designed to achieve Euro VI standards, although a retro-fitted vehicle may be classified as compliant. However, the industry research is not consistent, and the effect is likely to be depending on the real-world use of the vehicle (i.e. the type of routes it is used on) and how the engine control system is programmed.

Though unlikely, should the timescale required for retrofitting the vehicles exceed the deadline for compliance, the most feasible approach may be to determine whether the bus routes that travel through the areas with the worst air quality, and prioritise these routes for vehicles that have already been upgraded. Consultation with the bus operators will be required to determine what routes could be modified based on the available fleet.

- The regional bus fleet is being retrofitted, with an aspiration to achieve 100% Euro VI compliance by 2020. This only affects the public service bus fleet (where few of these vehicles travel on the non-compliant links) and there is no information available about other buses / coaches operating in these roads.
- There may be opportunities to limit access for <Euro VI buses / coaches, although this will lead to detrimental effects on the alternative routes.
- There may be opportunities to implement smart geofencing controls to ensure hybrid buses operate in zero-exhaust emission mode in predefined geographical areas.

It may not be viable to increase the rate of vehicle exhaust abatement retrofitting, although additional information about the buses and coaches operating on the non-compliant links may be recorded to determine the actual emissions profile, and how/if operators are planning to improve this in the future.

Overall, there may be opportunities to implement controls to reduce the contribution of emissions from buses, although it is not realistically expected to achieve significant reductions very soon.

Re-evaluation of Alternative Walking & Cycling Routes

The implementation of this measure would need to focus on a shift towards changing the perception of how the roads are used, and actively discouraging the use of private vehicles in favour of cycling and walking. TfWM is taking a corridor approach to walking and cycling, understanding the key routes used by active transport users and ensuring provision is in place.

As discussed above, there is limited evidence to inform journey-destination decisions, and so it is unclear how this initiative could be most effectively implemented. Therefore, this option is considered unlikely to achieve a significant reduction in emissions within a short time as there are limited modal-shift options for journeys on the two non-compliant links.

Barrier Screening of the Footway

The implementation of this measure would focus around putting up barriers between roads and footpaths and this can be achieved through planting trees or green walls along the identified routes to reduce the impact of vehicle emissions to pedestrians and cyclists. This is not a considered to be an independently sustainable measure but may achieve some reduction in exposure to support the implementation of long-term measures.

There is significant published evidence to support the use of green infrastructure to disrupt the exposure pathway, and this is also recognised by the WMCA as a potential area of interest to support healthy streets and place-making initiatives. Barrier screening can improve the dispersion of pollution, reducing near-source concentrations, with vegetation barriers potentially reducing pollutant concentrations by 50% in the immediate vicinity (AQEG, 2018). Vegetation barriers can reduce pollutant concentrations by 40-60% (AQEG, 2018, Pugh et.al. 2012, Kessler, 2013), and so the modelled vehicle emissions in this study were halved to represent the effect of vegetation barriers. This scaling indicated the resultant annual mean roadside NO_2 concentrations could be reduced by approximately 20% based on the 2016 results at the maximum NO_2 receptor location.

There are numerous potential constraints to the use of roadside barriers, such as highways regulations about visibility and drainage. However, due to the limited options available to reduce emissions from the road links of concern, this could represent a viable opportunity to develop and exemplify a design and implementation policy to inform other areas within Sandwell MDC.

There are existing vegetation barriers on a variety of links including along the A41 and All Saints Way. Parts of the A41 have large existing barriers on both sides of the road, whereas other areas could benefit from the addition of barriers, even if the barriers are not the same size as these ones. There is also some low vegetation cover around Albion roundabout (at the western end of PCM census ID 26453) along the A41 which may provide some pollution reduction due to their height at exhaust level. Where it is feasible to create barriers using Green Infrastructure (GI) there are potential co-benefits for surface drainage and biodiversity, which increases the sustainable credentials.

Therefore, it is recommended that to understand which areas could benefit from barrier construction, air quality monitoring may be carried out in a number of locations to test how effective existing barriers could be in different areas, and to indicate how and where new barriers could be introduced to achieve the greatest benefits.

Therefore, it is suggested this may be considered as a short-term measure to reduce exposure and support long-term strategic measures to reduce emissions, although it would most require a period in the range 6-12 months to design and construct suitable screens.

Driver Training

The periodic training of drivers, potentially alongside the use of telematics has been demonstrated to reduce incidents of harsh braking, acceleration and idling as well as improving road safety. All of these help to improve congestion and have a further benefit to the drivers/operators by reducing fuel usage and therefore costs.

- Training schemes can quickly be delivered but needs the cooperation of vehicle operators freeing up both drivers and vehicles for the training to take place.
- This option must also target drivers who regularly operate on the affected links.

- Driver training has been shown in a number of studies to reduce fuel consumption by approximately 5%[3], and one study[4] estimates a reduction in emissions of 8% due to less time spent at high speed or high engine speed (i.e. high revs). A reduction in the number of events such as extreme accelerations and decelerations was also observed, and the results indicated an average 4.8% decrease of fuel consumption. The study compared a control group and an experimental group, where the control group were aware they were being monitored. The authors acknowledged this may mean that the control group may have altered their driving behaviour during the survey period, which would bias the data, whilst the positive effects of training may deteriorate over time without monitoring and updates.

To achieve the predicted magnitude of emissions reduction would require all commercial vehicle drivers to undergo training, and so a further review would be needed to identify the operators most frequently using the non-compliant road links and to directly promote the adoption of driving training.

Furthermore, the actual effect of the training would be subject to the real-world conditions, which may be limited due to the relatively uncongested and high-speed traffic on the non-compliant links, and training focussed on gentle acceleration/braking and using the correct gear may not achieve significant benefits compared to the exiting conditions.

The effects of driver training may not achieve significant benefits, as the affected road sections do not demonstrate significant congestion or other particular characteristics associated with high emissions that may be mitigated by driver behaviour.

This option will not achieve a significant reduction in emissions within a short time, but may be implemented as part of the long-term strategy for the region to support targeted measures.

Travel Planning

Travel Planning can be used to reduce emissions by changing how, where and when users travel, and includes both private and commercial traffic.

Travel planning has been proven to be successful provided the plans are maintained. A well-designed travel plan highlights options and facilitates a change of behaviour for people travelling to and from destinations such as businesses and schools. Selective assistance in the development, review and update travel plans for workplace/schools along the routes in question could provide rapid benefits.

A Defra review of measures to reduce NO_X emissions highlighting the SUSTRANS (2013)[5] and DfT (2008)[6] Studies indicated that travel planning, and particularly personalised travel planning (PTP), can reduce car use by up to 11% and can also result in walking, cycling and public transport use increasing by 15-33%. Previous research[7] estimates a lower take up of around 5%, though this can be increased depending on the strategy used and cooperation from organisations involved.

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[3] Beusen, B., et al. (2009). Using on-board logging devices to study the longer-term impact of an eco-driving course. Transportation Research
Zarkadoula, M., Zoidis, G., & Tritopoulou, E. (2007). Training urban bus driver
pilot program. Transportation Research Part D, Volume 12 (pp. 449-541).
Part D: Transport and Environment, Volume 14, Issue 7, October 200 (pp. 514-520)

[4] Rolim et al (2014) Impacts of on-board devices and training on Light Duty Vehicle Driving Behaviour, Procedia - Social and Behavioural Sciences 111 (2014) 711 – 720

[5] SUSTRANS 2013. Personalised Travel Planning. Available: http://www.sustrans.org.uk/our-services/what-wedo/personalised-travel-planning

[6] DEPARTMENT FOR TRANSPORT 2008. Making Personal Travel Planning Work: Practitioners' Guide. Available:
http://webarchive.nationalarchives.gov.uk/20101124142120/http:/www.dft.gov.uk/pgr/sustainable/travel plans/ptp/practictionersguide.pdf

[7] Personalised travel planning: evaluation of 14 pilots part funded by DfT, http://www.fietsberaad.nl/library/repository/bestanden/document000097.pdf [accessed 28/06/2018]

As discussed in terms of journey diversions, there is limited information available to support a detailed understanding of how and why individuals travel through the study area, or the wider region. Therefore, it may be difficult to target this measure at the specific road links, and to achieve the predicted magnitude of emissions reduction would require further review to identify whether there are specific groups of road users or journeys, such as people traveling to a discrete employment site, and target these users as part of the personal and commercial travel planning.

Therefore, whilst this scenario does represent a potential positive opportunity, it may be more suitable to be implemented as a strategic measure to complement targeted actions, rather than to specifically reduce emissions on the non-compliant links.

Highway Upgrades

Highway upgrades on routes outside the study area may encourage a redistribution of traffic onto alternative roads that avoid the non-compliant links.

A number of major upgrades are due to take place across the Black Country, often in cooperation with the Highways Agency. These are often related to pinch points such as M6 Junction 10. These improvements will in the long-term help to relieve congestion and help generate additional capacity, though the required traffic management may worsen the situation in the short term.

Highway upgrades to incentivise alternative routes may be feasible, as with UTMC controls to incentivise drivers to use more efficient routes. As discussed above, the opportunities to do this, and the resultant effects are difficult to anticipate without detailed journey-destination data. Furthermore, the timescales for these upgrades are unlikely to be suitable to significantly affect the projected compliance dates.

This scenario would require a significant proportion of the traffic flow on the non-compliant links to divert, and so may not be feasible without significant coordination with other highways operators or may be limited where alternative roads and junctions are already at operating capacity.

These changes in traffic flow may be achieved in to benefit this project and to be implemented within the next 6-18 months by coordinating with Highways England on strategic route network improvements (particularly the M5 and M6 motorways), although it is unlikely to be possible to implement new (i.e. not yet planned) network improvements within this timescale.

Therefore, this opportunity should be investigated through consultation with Highways England to understand how it may affect roads in Sandwell, and to ensure the effects (both beneficial or detrimental) are recognised in a local context.

Summary

The long-list of potential measures were based on experience and previous Targeted Feasibility Studies that were undertaken in the region to determine actions that may be suitable to specifically reduce emissions on the non-compliant road links.

The following options have been including in the long-list of measures in Part 3:

- Review of signalling
- Speed management
- Traffic calming
- Bus retrofit to Euro VI & route management
- Alternative walking & cycling routes
- Barrier screening
- Driver training
- Travel planning
- Highway upgrades

The feasibility of implementing these actions are appraised in Part 3.

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

For each of the measures identified in part 2, local authorities should set out an assessment of deliverability including how long it would take to deliver each measure and whether it is practicably feasible to deliver. Based on this assessment of deliverability and feasibility, the local authority should develop a short list of measures to take forward to part 4 of the report.

The long-list of potential measures to improve air quality on non-compliant links were outlined in Part 2. The following section identified the potential risks and opportunities regarding the feasible implementation, and timescales with the projected compliance date.

The projected compliance year for link ID 57186 was 2020 and 26453 was 2019, based on linear interpolation of detailed dispersion model data from 2016 to 2026.

The long-list appraisal summary is presented in Table 3.1 which applies to both road links

Table 3.1 Long-list Appraisal

Measure	Effect	Time of Effect	Other Effects	Feasibility / Constraints	Shortlisted?
Review of signalling	Traffic light timing would be used to hold vehicles outside the study area, or to alter the acceleration/braking profile. The effect on emissions would be dependent on the proportion of traffic flow for which the speed profile may be altered.	Short / medium	Possible detriments to journey time and/or redistribution effects leading to impacts in other areas	Opportunities to adjust signal timing may require a significant review of junction and road capacity, and a discussion about priorities in terms of journey management. There are no suitable traffic-light junctions identified near the non-compliant links.	**Not shortlisted** as there are no suitable traffic-light junctions identified on or near the non-compliant links.
Speed management	Directly altering the speed on targeted links, using changed limits or enforcement directly affect the emissions profile, depending on whether the speed was increased or decreased.	Short / medium	There may be road safety risks where speeds are increased, journey time effects, and congestion effects at adjacent junctions and road links.	Reducing speeds may be achieved through existing enforcement methods. Increasing speeds may be difficult to achieve without a practical enforcement method.	**Not shortlisted** as a speed increase would be required and this is not considered to be practically feasible.

Traffic Calming	Introducing measures and infrastructure to change driver behaviour, such as additional traffic light controls would alter emissions by changing average speeds, and acceleration/braking zones.	Medium, subject to type and magnitude of the proposed infrastructure	Possible detriments to journey time and/or redistribution effects leading to impacts in other areas due to congestion or pinch-points.	The potential types of traffic-calming measures may be limited, as the non-compliant links are dual-carriageways, and slowing traffic at discrete locations may require significant appraisal.	**Not shortlisted** as there are limited options available for this type of road.
Bus Retrofit to Euro VI & Route Management	Retrofitting buses to achieve better emission standards would be beneficial. Route management would focus on re-routing buses with higher emissions onto alternative routes to reduce emissions from buses on on-compliant links without changing service provision.	Short – Long, subject to the existing commitments, and the capacity of retrofit equipment suppliers to undertake the work and the operator to remove vehicles from service. Route management measures may be implemented sooner where routes can be feasibly managed.	Vehicle routing management may affect fleet availability and service quality	Bus retrofit is being coordinated by TfWM using existing approved funds and is expected to achieve a high level of emissions standard for the local bus fleets, although there are no significant local bus routes through the non-compliant links and so retrofitting may not achieve significant emissions reductions. Therefore, it is not clear how ether upgrades or re-routing may be best implemented to reduce emissions without further data for the buses or coaches on the non-compliant links.	**Not shortlisted** as there are no significant local bus routes through the non-compliant links
Alternative Walking & Cycling Routes	Negligible – it is expected the majority of road users will not change mode without very substantial intervention	Medium / long, where infrastructure changes are required	Incentives need to be used to ensure users are engaged with modal shift options	Routes need to be designated based on journey demand	**Not shortlisted** as it is not considered possible to achieve a significant modal shift on the non-compliant links

Barrier Screening	Research evidence indicates that barriers can significantly reduce exposure from road emissions.	Medium, subject to appropriate design and highways planning	This approach is reactive and will only benefit discrete, targeted locations. However, it may be implemented as part of a wider programme of green infrastructure to demonstrate co-benefits to ecology, drainage, noise, etc.	The effectiveness of barriers is subject to ongoing research and may not be suitable in all locations due to available space, highways regulations for visibility, and introducing structures may increase the road as a 'barrier' through the affected area.	**Not shortlisted** as the link already has large amounts of vegetation and so there are no obvious points where this would have an impact
Driver Training	Research evidence indicates driver training can reduce emissions where there is opportunity to alter driving behaviour	Short / Medium, subject to the time requirement to identify operators and to undertake both the initial and refresher training	Costs and savings to operators in terms of fuel consumption and labour time need to be highlighted	Effects are difficult to measure and may need to use reportable indicators such as fuel consumption. The non-compliant links are relatively free-flowing dual carriageways, and so the opportunities to reduce emissions through changed behaviour may limit the benefits in this area.	**Not shortlisted** as ability to impact emissions on this specific link are minimal.

Travel Planning	Targeted tools to coordinate journeys to alter how and where they travel may reduce the number and timing of journeys to reduce emissions.	Medium / Long, requires engagement with major road user groups (e.g. employers)	Potential efficiency and cost benefits to reduce number and cost of journeys for both individuals and businesses	There is uncertainty about the potential effects that may be achieved on the non-compliant links without further evidence about road users in this area. This also requires ongoing funding to maintain effectiveness and report on success.	**Not shortlisted** as it is considered unlikely that a large number for journeys could be altered through travel planning on this link within the available time period.
Highway Upgrades	Improvements to regional transport networks outside the non-compliant links may encourage drivers to use alternative routes to reduce traffic.	Short, where infrastructure changes are in-place or being undertaken. Long, where significant infrastructure changes are required	Potential significant coordination with Highways England is required	It is not viable to install significant new infrastructure on alternative routes that would encourage drivers to avoid the non-compliant links. Redistribution of journeys may contribute to increasing emissions on other links that may lead to compliance risks.	**Not shortlisted** as no significant strategic diversionary routes have been identified, and there are likely detrimental impacts that would results on these alternative routes.

This study is being completed in July 2019, and so it is unlikely that any measure could be completed that would achieve compliance this year. The model predicted that one link is already compliant in 2019 and the other link would be compliant in 2020 without any measures in place. Therefore, the benefit of implementing these measures would be subject to the confidence assigned to the model projections.

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

In this section, local authorities should set out the likely effectiveness of the shortlisted measures in bringing forward compliance. Local authorities should assess each option against the Primary Critical Success Factor.

No preferred options in Part 3 (i.e. short-listed measures) have been identified that may be viable to achieve compliance sooner than the year projected by the detailed modelling.

The ADMS modelling predicts that compliance will be achieve in 2020 for link ID 57186 and 2019 for link ID 2645.

Part 5: Setting out a preferred option

In this section, local authorities should set out a summary of their preferred option to bringing forward compliance (where such measures exist). Where new measures have been identified that could bring forward compliance, local authorities should also assess a range of Secondary Critical Success Factors in order to identify the preferred option.

Summary

The appraisal considers two sections of the A41:

- Census ID 57186; Junction of A41 and All Saints Way A4031 to Junction of A41 and A4031 Trinity Way
- Census ID 26453; Junction of A41 / Bilhay Lane to Junction of A41 and All Saints Way A4031

These road links make up a contiguous section of dual carriageway providing a connection from the M5 motorway to the west, including West Bromwich, Dudley, Wednesbury and Wolverhampton. The traffic data indicate the links are used predominantly by cars, with few buses (there are no local bus routes on the non-compliant links, although the DfT traffic flow data does identify buses and coaches on these links) and approximately 5% HGVs.

Long-term trends of air quality monitoring near the dual carriageway indicates roadside concentrations have remained consistently close to the annual mean objective.

Detailed dispersion modelling study estimates compliance with the legal limits in 2019 for link ID 57186 and 2020 for link ID 26453, which is sooner than the PCM estimates of 2021,

Appraisal Results

This study is being submitted in July 2019, and concludes that none of the measures considered in the long list could achieve compliance sooner than predicted by the detailed dispersion model. This is due to measures being unable to be delivered in time or not feasible for the particular stretch of road. The model predicted that the links would be compliant in 2019 and 2020 without any measures in place.

Annex A: Model Checklist

Ref	Requirement[8]	LA Model Description (please provide details for each Requirement – see guidance annexed to this document)	Please highlight where the approach differs from the Requirements
A	**Air quality model specification**		
A.1	**Model selection**		
A.1.1	Details of emissions model based on COPERT 5 emission factors.	The emission rates were calculated using the Emission Factor Toolkit (EFT) v8.0.1, using the basic fleet split for roads outside London. The fleet age and composition was based on the nominal values in the EFT.	The EFT version was the most recent available at time of undertaking the modelling
A.1.2	Gradient effects included?	No gradient links identified >2.5%	
A.1.3	Details of air quality dispersion model.	The ADMS-roads detailed dispersion model version 4.1.1.0 was used to determine the annual mean NO_2 concentration	
A.1.4	Canyon effects included?	No canyons identified in the model domain	
A.1.5	Tunnels and flyovers included?	No tunnels identified in the model domain	
A.2	**Air quality model domain**		
A.2.1	Please provide a map showing model domain in relation to exceedance locations identified in PCM model.	See Figure 4, below.	
A.2.2	Locally identified exceedance locations included?	Yes	
A.2.3	Domain includes displacement routes?	Links connecting immediately on the non-compliant PCM links are included in the model; A41 west and east of the non-compliant links, A4031 north, and A4031 south.	

[8] For further details of each requirement please refer to the guidance in Annex A

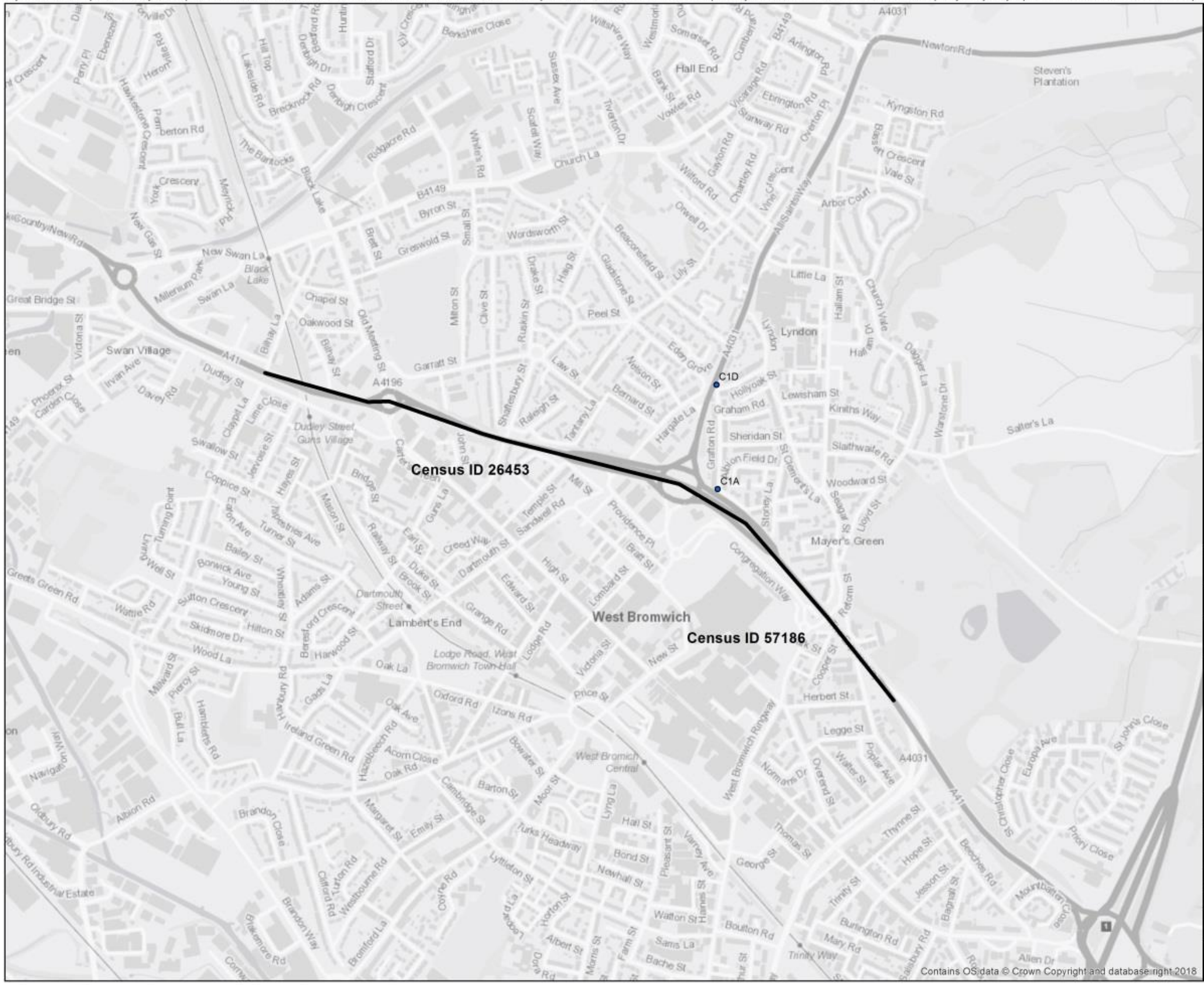
A.3	**Air quality model receptor locations**		
A.3.1	Details of receptor locations.	See Figure 2, below.	
A.3.2	Methods to be used to assign subset of receptors for AQD assessment requirements.	Receptors were assigned every 10m, 4m from the kerb and 2m height, excluding locations within 25m of a junction stop-line. Receptors were not included on the south links from the two roundabouts. The eastern roundabout is primarily access to commercial park and is not a 'through' route. The western roundabout is local access.	
B	**Air quality base year modelling**		
B.1	**General**		
B.1.1	Base year modelled.	2016	
B.1.2	Details of Meteorological data.	2016 recorded at Birmingham Airport	
B.2	**Traffic input data**		
B.2.1	Source of traffic activity data and vehicle types.	The traffic data were obtained from the PRISM strategic transport model, which was supplied by Transport for West Midlands on behalf of Sandwell MBC.	
B.2.2	Details of representation of road locations (achieved through use of a georeferenced transport model or another approach?).	Directional PRISM road links were georeferenced and aligned with the road centrelines within a GIS.	
B.2.3	Source of vehicle fleet composition information (local/EFT).	PRISM data are categorised as light (LDV) and heavy vehicles (HDV) for peak hours (AM and PM) and daytime inter-peak. As there was no detailed traffic breakdown, the DfT data published online ((https://www.dft.gov.uk/traffic-counts/cp) was used	

		to calculate the proportions of each vehicle categories. The data were scaled AADT using two 3-hour peak periods and 6-hour inter-peak period, and scaled from 12 to 24-hours using a factor of 1.3 under guidance from TfWM. AADT were: - Link south of eastern rbt 8043 SB / 9058 NB - Link south of western rbt 8139 NB / 10279 SB These values compare to AADT of 15552 NB / 15039 SB on A4031 so risk of exceedance in these locations was considered to be very low.	
B.2.4	Source of vehicle speed information.	PRISM speeds were adjusted as B.2.3, and then normalised to determine the average hourly value.	
B.3	**NOx/NO_2 emissions assumptions**		
B.3.1	Source of primary NO_2 emission fractions (f-NO_2).	Average f-NO_2 output from EFT v8.0.1a	
B.3.2	Details of method used to calculate projections for f-NO_2 and to calculate NO_2 concentrations from NO_x concentrations.	Linear interpolation of road-source NO_X for 2016 and 2026, with corresponding background contribution. The NOx to NO2 calculator v7.1 was published in May 2019 but was not used in this study as it does not include the 2016 baseline verification year, and so v6.1 was used. The background pollutant data were also published in May 2019 using a 2017 baseline instead of the 2015 baseline. However, as this new data does not include data for the 2016 verification year, the 2015-based background pollutant data were used in the study.	
B.4	**Non-road transport modelling**		
B.4.1	Details of modelling for non-road transport sources.	Non-road sources were not modelled but incorporated using Defra background data. The background pollutant data were also published in May 2019 using a 2017 baseline instead of the 2015 baseline. However, as this new data does not include data for the 2016 verification year, the 2015-based background pollutant data were used in the study.	

B.5	**Measurement data for model calibration**		
B.5.1	Details used for the model calibration e.g. dates, locations of measurements (including x-y coordinates), annual average NO2 concentration values for each location for = relevant years	See Table 1, below	
B.5.2	Type of monitoring data (automatic and/or diffusion tubes) used for the model calibration.	Passive NO_2 diffusion tubes	
B.5.3	All available automatic (and/or diffusion tube) monitoring data included in the model calibration?	No. The model compared favourably with the monitoring site C1D, located adjacent to the A4031 on Grafton Road. This is a relatively free-flowing road section, and so the conditions are conducive to the model outputting results that align with monitored conditions. The site at C1A is near the southbound slip road from the A4031 onto the A41, but is screened by vegetation and buildings, and so the verification in this location leads to the model over-predicting the monitored conditions, because the model cannot account for the effects of vegetation and buildings. Therefore, the comparison at site C1D was used as evidence to apply no adjustment to the model	
B.5.4	Quality assurance of measurement data.	Monitored data was obtained from the ASR	
C	<u>**Projections modelling**</u>		
C.1	**Baseline projections modelling**		
C.1.1	Years modelled.	2016 and 2026	
C.1.2	Details of method for projected vehicle fleet composition.	Vehicle types were based on DfT counts and assumed to be the same in both model years. Fuel types and Euro classifications used unadjusted EFT projections	
C.1.3	Details of method for projected vehicle activity.	Traffic flow data for both years were obtained from PRISM	

C.1.4	Impact of Real Driving Emissions legislation (RDE) included?	No	
C.2	**Future Projections modelling**		
C.2.1	Details of projections modelling	Traffic flow data for both years were obtained from PRISM	

Figure 1 Exceedance Links 57186 and 26453



- Monitoring
- PCM 2020 Exceedence

0 0.1 0.2 0.3 0.4 0.5 Km

Client	Sandwell MBC
Project	Targetted Feasibility Study
Title	PCM Links Exceeding Annual Mean Roadside NO_2 Objective in 2020
Date	April 2019
Drawn by	FP
Checked by	DU

Table 13 Local Air Quality Monitoring Results

Census ID	Monitoring			Annual Mean NO_2 Concentration (μgm^{-3})							
	Site ID	Type	Distance to kerb	2011	2012	2013	2014	2015	2016	2017	2018
57186	C1A	Roadside	0.3m to kerb of EB slip from A4031 to A41	34.0	35.1	30.9	31.3	40.5	31.4	31.8	34.6
N/A	C1D	Roadside	2.0m	40.1	48.5[A]	45.5	42.9	39.3	43.0	39.4	44.5

Note: [A] Low data capture at C1D in 2012.

Table 14. ADMS Modelling vs Local Air Quality Monitoring

Site ID	Monitor type	Site type	Background NO_2	OS Grid Coordinate		Monitored total NO_2	Modelled total NO_2	% Difference [(mod-mon)/mon]
				X	Y			
C1A	Passive	Roadside	25.4	400668	291726	31.4	40.6	29%
C1D	Passive	Roadside	24.8	400664	292020	43.0	42.4	-2%

Figure 2 Modelled Receptor Locations and Projected Compliance Years

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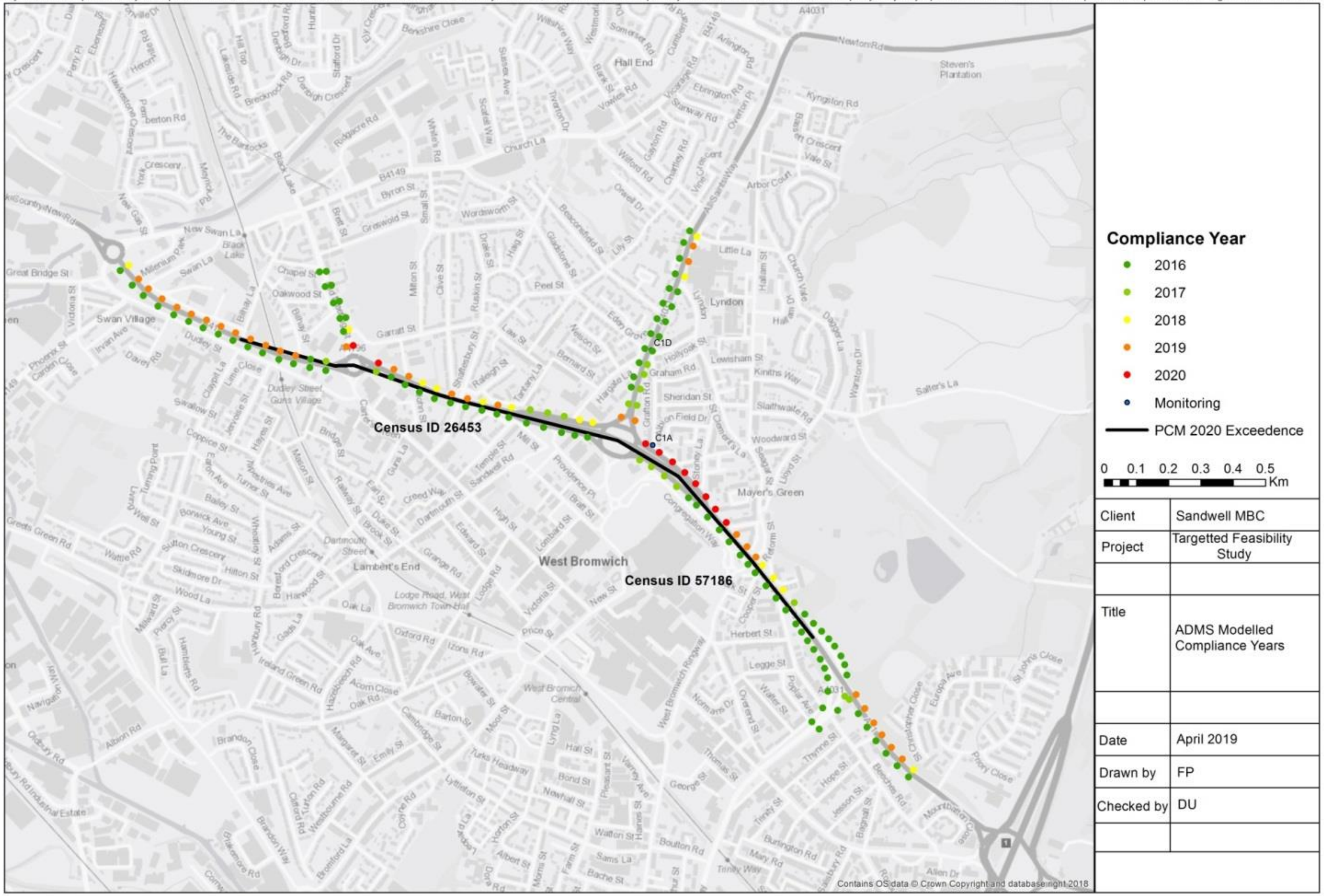

Figure 4 Model Domain

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