PORTSMOUTH CITY COUNCIL – TARGETED FEASIBILITY STUDY TO DELIVER NITROGEN DIOXIDE CONCENTRATION COMPLIANCE IN THE SHORTEST POSSIBLE TIME

Local authorities covered	Portsmouth City Council

Further information on the content of each section is set out in the guidance.

Part 1: Understanding the problem

The following road links in the Portsmouth City Council (PCC) area have been identified in the Defra PCM National Model as having projected exceedances of the annual mean nitrogen dioxide (NO_2) EU Limit Value of 40 µg/m^3:

- Road link 48196 – A3, Mile End Road between the southern end of the M275 and Church Street roundabout. This link is predicted to achieve compliance in 2021.
- Road link 18114 – A3, Alfred Road between Hope Street roundabout and the Queen Street / Anglesea Road / Alfred Road intersection. This link is predicted to achieve compliance in 2020.

Figure 1 shows the locations these road links in relation to the PCC local authority boundary and Air Quality Management Areas (AQMA) and Table 1 summarises the PCM modelled exceedances of the EU Limit Value for both and source apportionment information for link 48196. Further discussion of these data are provided in subsequent sections of Part 1.

The following sections set out for each road link:

- the likely causes of the projected exceedances
- the geographic and temporal extents of the projected exceedances
- the level of emissions reductions required to achieve compliance.

Reference is made to documentation published by Defra relating to the modelled exceedances, PCC's Source Apportionment Study undertaken in 2017[1], and the Council's statutory reports compiled in fulfilment of their Local Air Quality Management (LAQM)

[1] Portsmouth City Council (2017). Source Apportionment Study 2017. Available on request from Portsmouth City Council Regulatory Services.

obligations. It also draws upon traffic count information sourced from the Department for Transport (DfT) and PCC's own traffic count data.

Figure 1 Road Links with Projected Exceedances in Portsmouth City Council Administrative Area

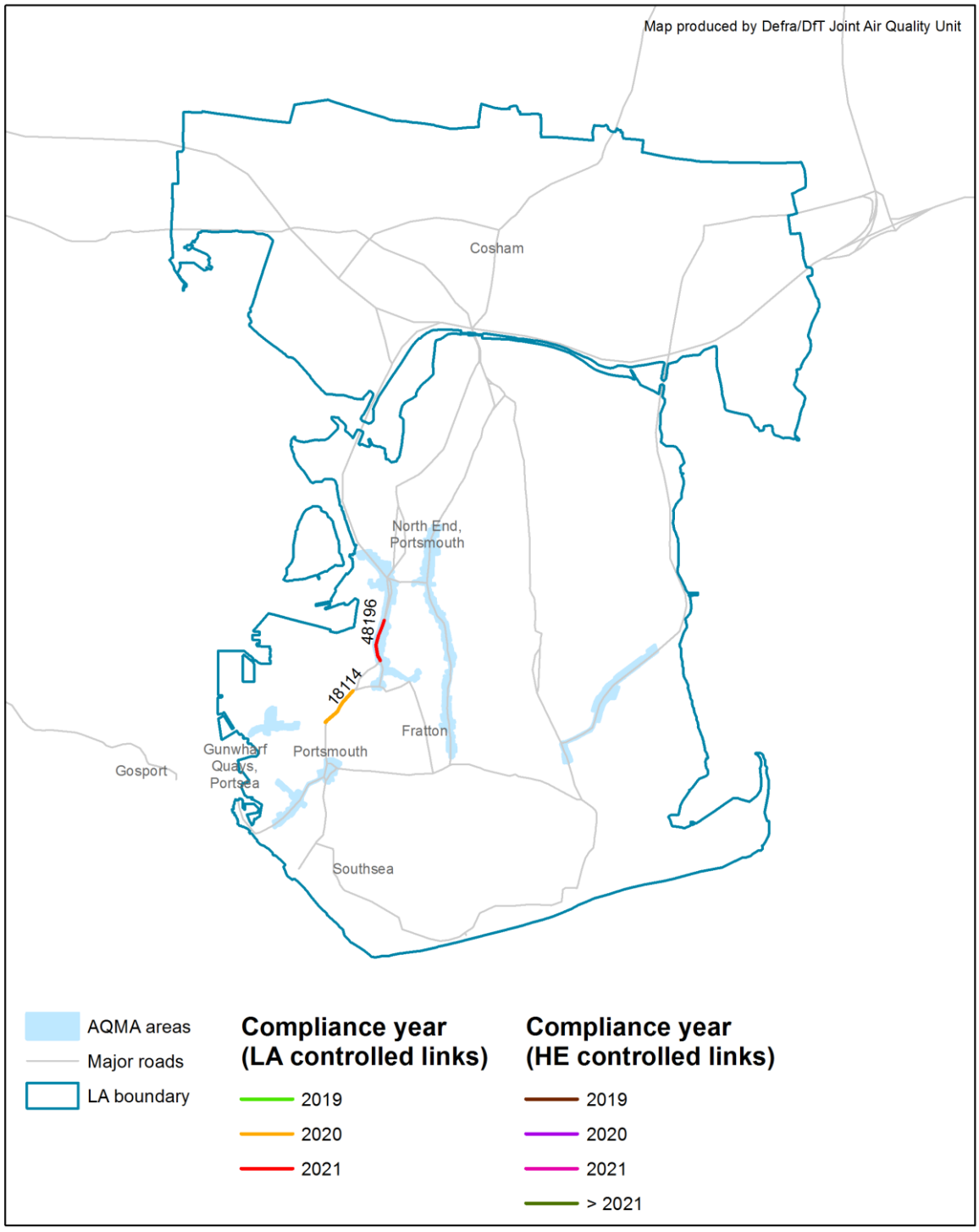


Table 1 Summary of PCM Road Link Exceedances

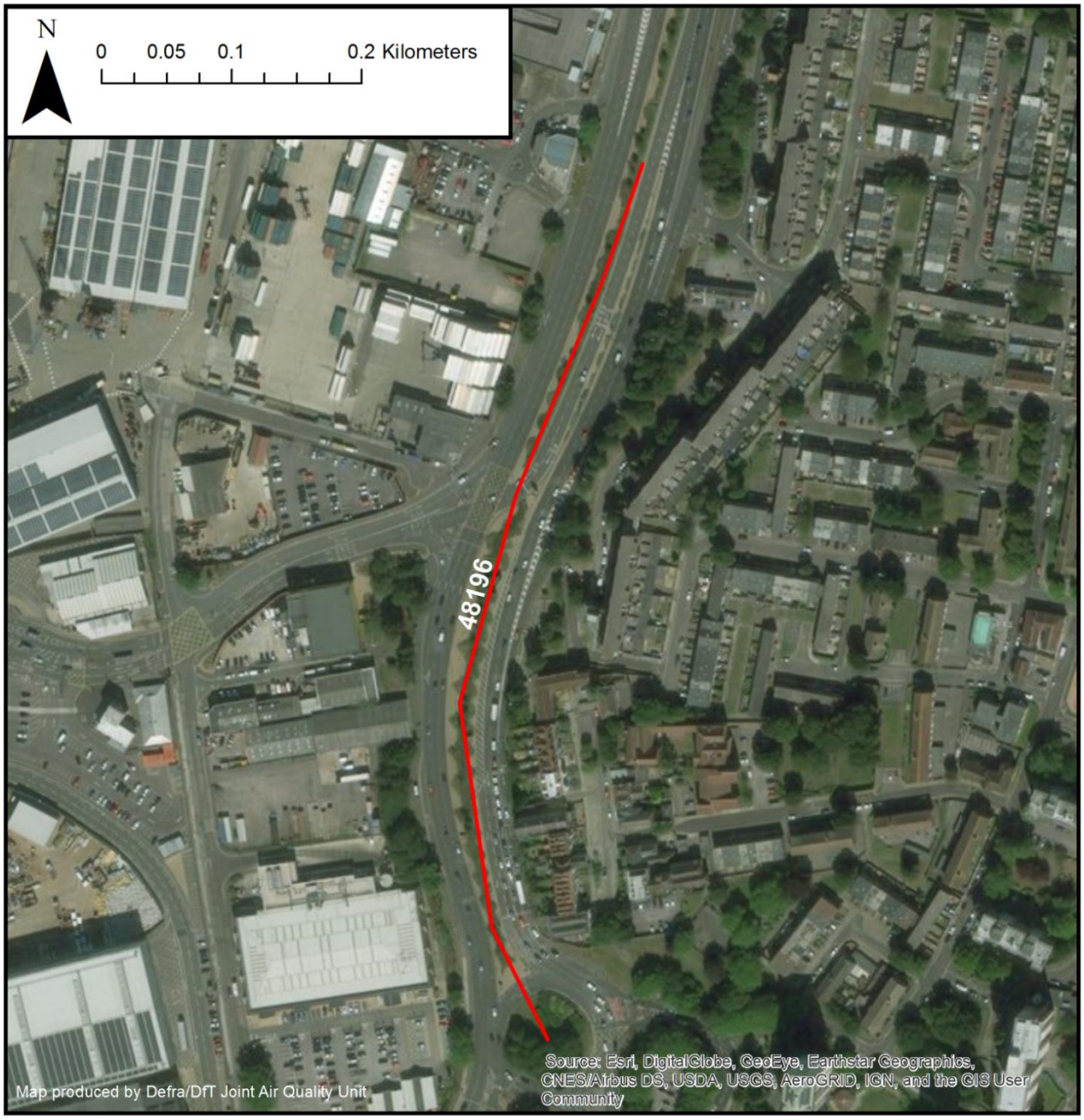
Roads in exceedance	Census ID	Defra PCM Annual Mean NO_2 Concentration ($\mu g/m^3$)					Source apportionment
		2017	2018	2019	2020	2021	
A3 Mile End Road	48196	47	45	44	42	39.6	34% diesel cars; 14% light goods vehicles (diesel); 8% bus; 8% petrol cars; 4% rigid Heavy Goods Vehicles; 1% articulated Heavy Goods Vehicles
A3 Alfred Road	18114	44	42	41	39	37	As above

The PCM Source Apportionment (shown in the above table) fleet composition is different to the fleet composition data reported by the DfT and through the PCC Source Apportionment Study (shown in Table 2).

Road Link 48196

Road link 48196 covers the A3, Mile End Road between the southern end of the M275 to the Church Street Roundabout (Figure 2). The link lies within the boundary of PCC AQMA No. 11. The A3, Mile End Road is one of the three main routes into Portsmouth. The southbound A3 receives traffic directly off the M275 so there is a high volume of traffic, as outlined in the section below.

Figure 2 Road Link 48196



Traffic data

Traffic data collated for PCC's 2017 Source Apportionment Study determined the 24-hour Annual Average Daily Traffic (AADT) on this section of the A3 to be 66,003 vehicles in 2015, comprising 85.8% cars and taxis, 11.6% light goods vehicles (LGVs), 1.7% Heavy Goods Vehicles (HGVs) and 0.9% buses. DfT traffic count data used for the PCM model predictions for the road link (Count Point 48196) for 2015 compare reasonably closely to these figures (Table 2).

Table 2 Traffic data for Road Link 48196 (Year 2015)

Information Source	Annual Average Daily Traffic	Fleet Composition (%)				
		Cars & Taxis	LGVs	Rigid HGVs	Articulated HGVs	Buses & Coaches
PCC Source Apportionment Study	66,003	85.8	11.6	1.0	0.7	0.9
DfT traffic count data	67,852	88.2	9.5	0.9	0.3	1.2
Note: DfT traffic data downloaded 25/04/2018 (https://www.dft.gov.uk/traffic-counts/cp.php?la=Portsmouth#48196)						

Air Quality Monitoring

PCC has been operating a roadside continuous air quality monitoring station (CAQMS) at the most southerly point of road link 48196 for over 15 years. The station is equipped with a Horiba APNA-370 chemiluminescence gas analyser for monitoring NOx, NO_2 and NO concentrations. PM_{10} and (more recently) $PM_{2.5}$ are also measured at the site. The grid reference for this CAQMS is 464397, 101270, which is close to the PCM modelled location at Census ID 48196, as shown in Figure 3.

Figure 3 Location of CAMQS (point 2) relative to Census ID 48196 (point 1)

Table 3 presents the ratified NO_2 annual mean concentrations for 2012 to 2017, inclusive. The results demonstrates continuous compliance with the EU NO_2 Limit Value (40 µg/m^3) throughout this period.

Table 3 NO_2 annual mean concentrations at PCC monitoring site

NO_2 Annual Mean Concentration ($\mu g/m^3$)					
2012	**2013**	**2014**	**2015**	**2016**	**2017**
36.9	35.9	36.5	30.3	35.5	33.5

There has been a gradual downward trend in annual mean NO_2 concentrations over this period; this is consistent with the findings of the 2017 Source Apportionment Study, which demonstrated that the contribution of NO_2 from vehicles is in decline.

The NO_2 data obtained from the CAMQS is considered to be reliable in terms of assessment of compliance with the EU Limit Value. The monitor is located alongside road link 48196, with a distance to the kerbside of 6.5 m. It is 2.0 m from the nearest sensitive receptor (station located closer to kerbside), and has an inlet height of 1.8 m. Data capture for 2017 was 98.4%. The expanded measurement uncertainty for NO_2 is 10.8%, and therefore below 15%.

PCM model predictions and estimated Road NOx Reductions required for compliance

Defra's PCM model predictions (Table 4) indicate an annual mean NO_2 concentration in 2017 of 46.6 $\mu g/m^3$ for road link 48196 and indicate that compliance will be achieved by 2021 (39.6 $\mu g/m^3$). Using Defra's background maps of pollutant concentrations, the percentage reduction in NOx emissions required to achieve compliance has been estimated for each year between 2017 and 2020, inclusive. Based on 2017 data it is estimated that emissions from road NOx would need to be reduced by 30% in order to achieve compliance. In 2020, it is estimated that a 9% reduction in road NOx emissions over the projected reductions, would be required for compliance.

Table 4 Defra PCM Modelled NO_2 Concentrations and Percent Reductions in Road NOx to Achieve Compliance for Road Link 48196

Year	Defra PCM Annual Mean NO_2 Concentration ($\mu g/m^3$)	Background NO_2 Concentration ($\mu g/m^3$)	Road NOx Concentration ($\mu g/m^3$)	Road NOx Concentration at NO_2 = 40 $\mu g/m^3$ ($\mu g/m^3$)	Percent reduction in Road NOx to achieve compliance
2017	46.6	22.5	52.8	37.1	30
2018	45.0	21.9	50.1	38.1	24
2019	43.6	21.4	47.6	39.1	18
2020	41.7	20.8	44.3	40.4	9
2021	39.6	20.3	40.7	41.5	N/A

Note: Background NO_2 concentrations obtained from Defra's background maps of pollutant concentrations, for the 1-km grid square centred on 464500, 101500 (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 = Portsmouth, Traffic mix = All other UK urban traffic)

Source Apportionment and Likely Cause of Projected Exceedance

PCC's 2017 Source Apportionment Study quantified the contributions of different road vehicle types to ambient NO_2 concentrations in areas of likely exceedance. The study provided a breakdown of contributions for the following vehicle types:

- Cars and taxis
- LGVs
- Other Goods Vehicles Class 1 (OGV1) – rigid and articulated HGVs with 3 axles or less
- Other Goods Vehicles Class 2 (OGV2) – rigid and articulated HGVs with more than 3 axles
- Buses and coaches

Table 5 shows the apportionment of 2015 NO_2 concentrations for road link 48196, obtained from the PCC Source Apportionment Study. It was estimated that regional background (13.7%) and local background (37.6%) sources accounted for approximately 51% of annual mean NO_2 concentrations in the vicinity of road link 48196, with local road traffic accounting for approximately 48.6%. Excluding regional and local background sources, cars and taxis (57.0%) were estimated to be the greatest contributor to annual mean NO_2 concentrations, followed by LGVs (18.2%), HGVs (13.7%; 9.4% OGV1 and 4.3% OGV2) and buses (11.1%). The source apportionment data for 2020 (Table 6) shows broadly similar patterns to the 2015 data. Regional and local background sources are estimated to account for around 54% of annual mean NO_2 concentrations in 2020, with

local road traffic accounting for 46%. Cars and taxis remain the greatest road traffic source, followed by LGVs.

Table 5 Source Apportionment of Annual Mean NO_2 Concentrations in 2015 for Road Link 48196

	Contribution to Annual Mean NO_2 Concentration (%)						
	Regional background	**Local background**	**Cars & Taxis**	**LGVs**	**OGV1**	**OGV2**	**Buses & Coaches**
Including regional and local background contributions	13.7	37.6	27.7	8.8	4.6	2.1	5.4
Excluding regional and local background contributions			57.0	18.2	9.4	4.3	11.1
Note: Percentage contributions may not add up to exactly 100% due to rounding to 1 dp. Source: PCC 2017 Source Apportionment Study							

Table 6 Source Apportionment of Annual Mean NO_2 Concentrations in 2020 for Road Link 48196

	Contribution to Annual Mean NO_2 Concentration (%)						
	Regional background	**Local background**	**Cars & Taxis**	**LGVs**	**OGV1**	**OGV2**	**Buses & Coaches**
Including regional and local background contributions	12.6	41.5	28.5	9.2	2.7	1.0	4.6
Excluding regional and local background contributions			61.8	20.1	5.9	2.3	10.0
Note: Percentage contributions may not add up to exactly 100% due to rounding to 1 dp. Source: PCC 2017 Source Apportionment Study							

Table 7 summarises source-apportioned road traffic NOx emissions for road link 48196, calculated using traffic data from PCC's Source Apportionment Study (shown in Table 2) and Defra's Emission Factors Toolkit (Version 8.0.1), in order to provide a more detailed disaggregation of road traffic NOx emissions. The results from this study are provided below and differ to those given in Defra's PCM model for this link (see Table 1),

particularly in terms of the higher contribution from diesel cars. It is likely that the local data provided from this study are more accurate than the PCM data.

In 2015, the study showed that light duty vehicles (cars and LGVs) are estimated to account for 78% of road NOx emissions on road link 48196 and heavy duty vehicles (HGVs and buses) for 22%. Diesel cars (45.9%) are calculated to be the largest contributing road source on road link 48196, followed by diesel LGVs (22.7%). Buses and coaches are estimated to contribute 9.2% of road NOx emissions, with rigid HGVs and articulated HGVs contributing 7.7% and 5.0%, respectively. In 2020, light-duty vehicles are predicted to account for a higher percentage of road NOx emissions (86%) than in 2015. The percentages of emissions attributable to diesel cars and diesel LGVs are predicted to be higher in 2020 compared to 2015. However, in view of the recent decline in diesel car sales the forecasts for 2020 are uncertain.

Table 7 Source Apportionment of Road Traffic NOx Emissions for Road Link 48196

Year	Contribution to Road NOx Emissions (%)							
	Petrol cars	Diesel cars	Petrol LGVs	Diesel LGVs	Rigid HGVs	Artic. HGVs	Buses & coaches	Others
2015	9.0	45.9	0.3	22.7	7.7	5.0	9.2	0.2
2020	7.2	55.5	<0.1	23.5	4.4	2.1	6.4	0.9
Notes: Emission calculations performed using Defra's Emission Factors Toolkit and traffic data from PCC's 2017 Source Apportionment Study.								

Traffic modelling for 2016 conducted as part of the Transport Assessment for the City Centre Critical Infrastructure project (City Centre Road) found that southbound traffic on the A3 Mile End Road was at 89% saturation, whereas the Church Street roundabout was operating above capacity at 116% in the morning peak period, with a maximum queue length of 69 PCUs (passenger car equivalents).

This information, coupled with local knowledge show that the key contributing factor to the modelled exceedance on road link 48196 is therefore highly likely to be the traffic congestion that occurs on the southbound approach to Church Street roundabout, particularly during the morning and evening peak. The congestion is not caused by any one single trip generator: the link is one of the key commuter routes into the city and the traffic movements have many different out-of-city origins and numerous in-city destinations.

Congestion on the southbound carriageway is primarily caused by traffic being brought to a halt by the traffic signals on the approach to Church Street roundabout. Vehicles idling at a red signal and then their subsequent acceleration when the signal turns to green will cause increased exhaust emissions in this location.

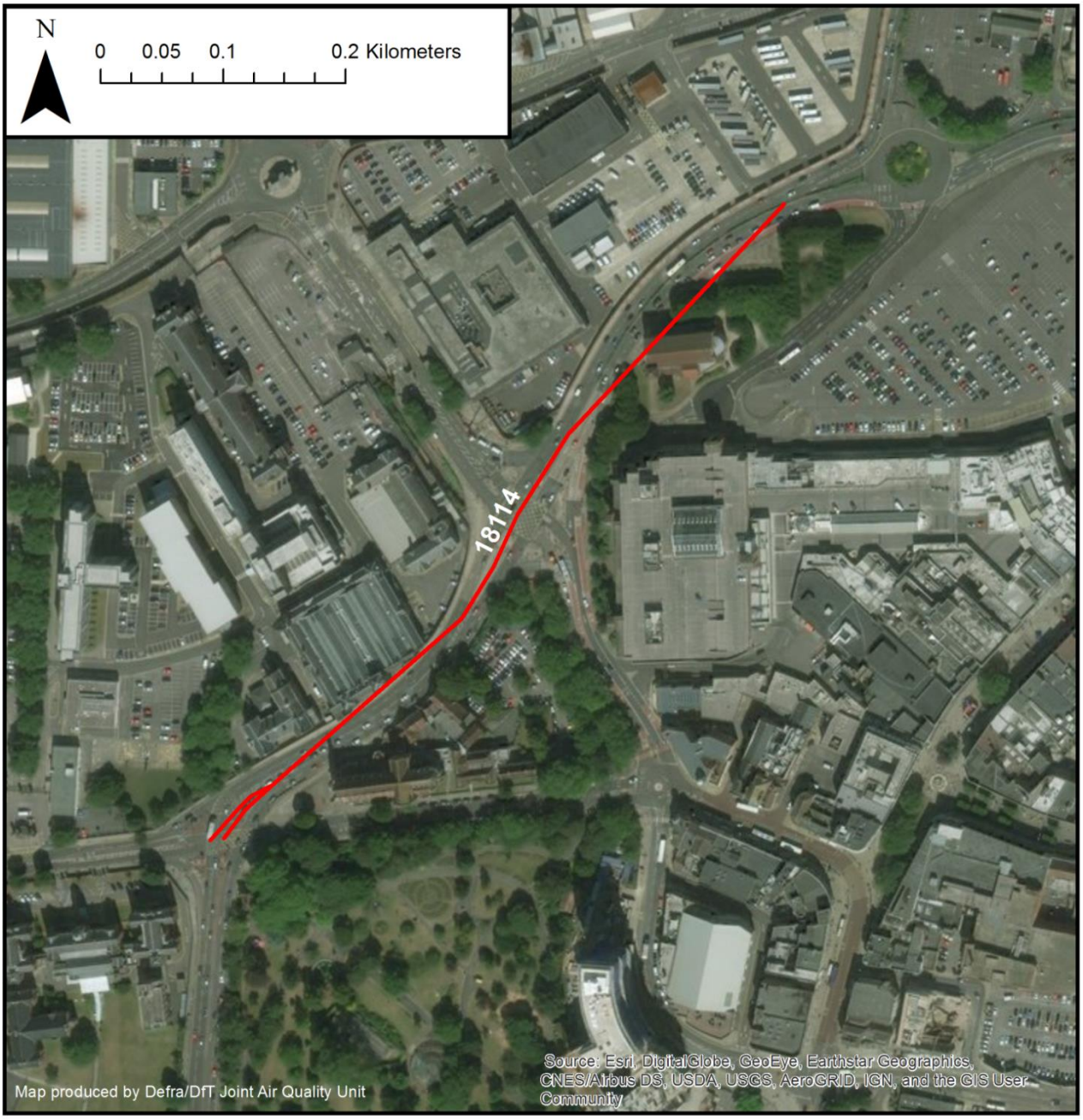
Northbound traffic is also subject to periods of congestion caused by the traffic signals at the junction of Mile End Road and Princess Royal Way. Northbound traffic for the M275 is also slowed when entering Mile End Road from Hope Street as vehicles have to currently change lanes to join the motorway.

A high proportion of the vehicles affected by congestion in these locations will be diesel cars, which are calculated in PCC's Source Apportionment Study to make the largest contribution to overall road traffic NOx emissions.

Road Link 18114

Road link 18114 is south of road link 48196 and extends along the A3, Alfred Road between Hope Street roundabout and the Queen Street / Anglesea Road / Alfred Road intersection (Figure 4). The link is not within any of the PCC AQMAs. This section of the A3 provides the main traffic link between the western corridor (M275) and Portsea, Gunwharf and Old Portsmouth. There is a high volume of traffic and congestion at peak times, as outlined in the section below.

Figure 4 Road Link 18114



Traffic data

Traffic data collated for PCC's 2017 Source Apportionment Study determined the 24-hour Annual Average Daily Traffic (AADT) on this section of the A3 to be 39,512 vehicles in 2015, comprising 87.3% cars and taxis, 10.4% LGVs, 1.6% HGVs and 0.6% buses. DfT traffic count data used for the PCM model predictions for the road link (Count Point 18114) for 2015 show a slightly higher AADT, a lower percentage of cars and taxis, and a higher proportion of buses compared to the Source Apportionment Study data (Table 8).

Table 8 Traffic data for Road Link 18114 (Year 2015)

Information Source	Annual Average Daily Traffic	Fleet Composition (%)				
		Cars & Taxis	LGVs	Rigid HGVs	Articulated HGVs	Buses & Coaches
PCC Source Apportionment Study	39,512	87.3	10.4	1.0	0.6	0.6
DfT traffic count data	43,413	85.3	10.5	1.3	0.3	2.6
Note: DfT traffic data downloaded 25/04/2018 (https://www.dft.gov.uk/traffic-counts/cp.php?la=Portsmouth#18114)						

PCM model predictions and estimated Road NOx Reductions required for compliance

Defra's PCM model predictions (Table 9) indicate an annual mean NO_2 concentration in 2017 of 43.9 µg/m^3 for road link 18114, and indicate that compliance will be achieved by 2020 (38.8 µg/m^3). Using Defra's background maps of pollutant concentrations, the percentage reduction in NOx emissions required to achieve compliance has been estimated for each year between 2017 and 2019, inclusive. Based on 2017 data it is estimated that emissions from road NOx would need to be reduced by 21% in order to achieve compliance. In 2019, it is estimated that a 4% reduction in road NOx emissions over the projected reductions, would be required for compliance.

Table 9 Defra PCM Modelled NO_2 Concentrations and Percent Reductions in Road NOx to Achieve Compliance for Road Link 18114

Year	Defra PCM Annual Mean NO_2 Concentration (µg/m^3)	Background NO_2 Concentration (µg/m^3)	Road NOx Concentration (µg/m^3)	Road NOx Concentration at NO_2 = 40 µg/m^3 (µg/m^3)	Percent reduction in Road NOx to achieve compliance
2017	43.9	23.5	44.1	35.0	21
2018	42.3	23.0	41.2	36.0	13
2019	40.7	22.5	38.6	36.9	4
2020	38.8	21.9	35.4	38.1	N/A
Note: Background NO_2 concentrations obtained from Defra's background maps of pollutant concentrations, average of the two 1-km grid squares centred on 463500, 100500 and 464500, 100500 (https://uk-air.defra.gov.uk/data/laqm-background-maps?year=2015). Road NOx concentrations calculated using Defra's NOx-to-NO2 Calculator tool (Local Authority = Portsmouth, Traffic mix = All other UK urban traffic)					

Source Apportionment and Likely Cause of Projected Exceedance

Table 10 shows the apportionment of 2015 NO_2 concentrations for road link 18114, obtained from the PCC Source Apportionment Study. It was estimated that regional background (13.3%) and local background (41.3%) sources accounted for approximately 55% of annual mean NO_2 concentrations in the vicinity of road link 18114, with local road traffic accounting for approximately 45%. Excluding regional and local background sources, cars and taxis (54.4%) were estimated to be the greatest contributor to annual mean NO_2 concentrations, followed by buses (17.8%), LGVs (14.8%) and HGVs (13.0%; 9.7% OGV1 and 3.3% OGV2). The source apportionment data for 2020 (Table 11) shows broadly similar patterns to the 2015 data. Regional and local background sources are estimated to account for around 57% of annual mean NO_2 concentrations in 2020, with local road traffic accounting for 43%. Cars and taxis remain the greatest road traffic source; however, LGVs are estimated to be the second-largest contributor in 2020, followed by buses.

Table 10 Source Apportionment of Annual Mean NO_2 Concentrations in 2015 for Road Link 18114

	Contribution to Annual Mean NO_2 Concentration (%)						
	Regional background	**Local background**	**Cars & Taxis**	**LGVs**	**OGV1**	**OGV2**	**Buses & Coaches**
Including regional and local background contributions	13.3	41.3	24.7	6.7	4.4	1.5	8.1
Excluding regional and local background contributions			54.4	14.8	9.7	3.3	17.8

Note: Percentage contributions may not add up to exactly 100% due to rounding to 1 dp.

Source: PCC 2017 Source Apportionment Study

Table 11 Source Apportionment of Annual Mean NO_2 Concentrations in 2020 for Road Link 18114

	Contribution to Annual Mean NO_2 Concentration (%)						
	Regional background	**Local background**	**Cars & Taxis**	**LGVs**	**OGV1**	**OGV2**	**Buses & Coaches**
Including regional and local background contributions	12.3	45.1	25.8	6.9	2.5	0.7	6.8
Excluding regional and local background contributions			60.4	16.3	5.9	1.7	15.8

Note: Percentage contributions may not add up to exactly 100% due to rounding to 1 dp.

Source: PCC 2017 Source Apportionment Study

Table 12 summarises source-apportioned road traffic NOx emissions for road link 18114, calculated using traffic data from PCC's Source Apportionment Study (shown in Table 8) and Defra's Emission Factors Toolkit (Version 8.0.1), in order to provide a more detailed disaggregation of road traffic NOx emissions. In 2015, light duty vehicles are estimated to account for 76% of road NOx emissions on road link 18114 and heavy duty vehicles for 21%. Diesel cars (48.5%) are calculated to be the largest contributing road source on road link 18114, followed by diesel LGVs (20.7%). Buses and coaches are estimated to contribute 7.2% of road NOx emissions, with rigid HGVs and articulated HGVs contributing 8.3% and 5.5%, respectively. In 2020, light duty vehicles are estimated to account for a higher percentage of road NOx emissions (87%) than 2015. The percentages of emissions attributable to diesel cars and diesel LGVs are also predicted to be greater in 2020 than in 2015. However, in view of the recent decline in diesel vehicle sales the forecasts for 2020 are uncertain.

Table 12 Source Apportionment of Road Traffic NOx Emissions for Road Link 18114

Year	**Contribution to Road NOx Emissions (%)**							
	Petrol cars	**Diesel cars**	**Petrol LGVs**	**Diesel LGVs**	**Rigid HGVs**	**Artic. HGVs**	**Buses & coaches**	**Others**
2015	9.4	48.5	0.3	20.7	8.3	5.5	7.2	0.2
2020	7.4	58.3	<0.1	21.2	4.8	2.3	5.0	0.9

Notes: Emission calculations performed using Defra's Emission Factors Toolkit and traffic data from PCC's 2017 Source Apportionment Study.

The key contributing factor to the modelled exceedance on road link 18114 is congestion caused by commuter traffic particularly during morning and evening peak times. The signalised junction at Queen Street / Anglesea Road often reaches capacity during the day, and will exceed capacity at peak times, causing queuing traffic.

There are conflicting demands at this location with the main road (A3) being prioritised to optimise bus journey times along this route. Beyond the Queen Street / Anglesea Road junction, the traffic generally flows freely as the traffic dissipates to various destinations in the city.

A high proportion of the vehicles affected by congestion in this location will be diesel cars, which are calculated in PCC's Source Apportionment Study to make the largest contribution to overall road traffic NOx emissions.

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

Road Link 48196

The most likely cause of projected exceedance on road link 48196 has been identified as congestion during peak times due to commuter traffic. The measures suggested below therefore focus on optimising traffic flow and reducing demand for travel by car, although other measures have also been included where appropriate.

The following measures have already been implemented since 2015 and, therefore, are not reflected in Defra's baseline PCM modelling:

- **Church Street Roundabout Linking with crossing on Commercial Road North**. This scheme was implemented in 2016, to alleviate the stop-start traffic conditions on A3 Mile End Road, Commercial Road and Marketway. Previously, southbound traffic from the A3 Mile End Road would pass through a green signal at the Church Street roundabout, but then be held by a red signal at the pedestrian crossing on Commercial Road North, leading to congestion. The signal linking system means that whilst traffic from the southbound A3 Mile End Road has a green signal, the pedestrian crossing is kept on green, thus maintaining free-flowing traffic. Demand for the pedestrian crossing is allowed during the inter-green stages on the Church Street roundabout.

The following measures are currently being implemented or are expected to be implemented soon:

- **Mile End Relining Scheme**. This scheme is expected to be implemented in 2018, to enable better flow of traffic bound for the M275 from the Church Street roundabout into the northbound A3 Mile End Road. The current road layout causes traffic in lane 1 wanting to access the northbound M275 to manoeuvre into lane 2, causing traffic in both lanes to slow down. The one dedicated lane for the M275 has insufficient capacity for the current volume of traffic. The planned work consists of re-lining the lanes on the Hope Street approach to Church Street roundabout, and on the northbound A3 Mile End Road immediately north of the roundabout to guide motorists into the two dedicated lanes for the M275 that will be provided. This will allow for a better flow of traffic, due to significantly less lane-changing.
- **Modification of existing road network around the A3**. A full application has been made for extensive modifications to the road network around the A3, southwards from the junction with Princess Royal Way to the junction with Unicorn Road, including the construction of a new road link between Flathouse Road and the A3 south of Herbert Street. Creation of a new signalised junction on the A3 Mile End Road, north of Church Street roundabout, would route traffic wishing to travel to destinations in the Gunwharf and Dock Yard areas via a new dual carriageway road, effectively bypassing the section of road link 48196 between Princess Royal Way and the Church Street

roundabout. Church Street roundabout, Hope Street roundabout and Marketway roundabout would be upgraded to linked signalised junctions to avoid stop-start traffic. Full details of the application (Reference: 17/02066/CS3) can be viewed at http://publicaccess.portsmouth.gov.uk/online-applications/

- **Air Quality Grant Programme.** PCC were awarded an Air Quality Grant (AQG) of £450,000 in 2017/18 from Defra for targeted improvements in air quality within Portsmouth. Just over half the budget is allocated to infrastructure improvements. This involves improvements to key travel routes to encourage use of active travel modes, making walking and cycling more attractive forms of travel. This will include greening of routes and tree planting. Market research will also be carried out in order to determine the most effective communications and marketing package. This will comprise of an anti-idling campaign, participation in National Clean Air day as well as events to promote good air quality. Residents will also be targeted by the AQG Programme through the promotion of alternative travel such as electric vehicles and training courses focused on cycling. There will also be a discount on the purchase, loan and safety equipment of bikes. Schools and workplaces will have initiatives rolled out such as the Pompey Monsters Walk to School Challenge which is aimed at primary school children. Pedestrian training would also be provided to teach primary school aged children basic road safety and encourage walking to school. A scheme is also being introduced where by children are taught how to safely use scooters. PCC will be working with workplaces that have large fleets to encourage eco-driving; this will be done through training courses and providing advice on the possibilities of improving the environmental impact of their fleets by converting to vehicles with lower emissions. Further information on these schemes and others are outlined in more detail below.
- **Electric Vehicle (EV) Charging Points.** PCC secured funding from the Office for Low Emission Vehicles (OLEV) to install additional charging points for EVs in residential areas. PCC have an off-street trial of fast charging points in three PCC owned car parks, in addition to charge points at the Park and Ride. This trial scheme is jointly funded by PCC and CityEV. With the OLEV funding the council intends to install a further 50 charging points at 30 sites in the city by the end of autumn 2018. Installing EV charging infrastructure is expected to encourage EV ownership.
- **Bike hire**. PCC implemented a park and ride bike hire scheme in 2013 where by the public can hire bikes for the day to cycle around the city. There is a discounted rate for regular users to encourage people to cycle rather than drive. Foldable bikes for hire are kept in a dock by Portsmouth Harbour. PCC are introducing a new bike-sharing scheme, later this year Portsmouth residents and visitors will have access to 150 bikes, in an effort to encourage people to swap their car journeys and travel by bike.
- **Quieter Routes Programme.** As part of the Safer Cycling Work Programme, PCC launched the Quieter Routes programme, aimed at encouraging people to travel by bike around the city. A travel survey conducted in 2014 found that lack of confidence on the roads was a major barrier to people travelling by bike around the city. The Quieter Routes programme established 10 cycle routes connecting key areas of the city, which avoid busy roads and signpost cyclists onto cycle infrastructure or the 20 mph road network.

- **South Western Railway (SWR) Service Improvements.** From December 2018, additional and faster train services will operate to and from Portsmouth to Southampton and London. There will be two additional services per hour in each direction on the core Portsmouth Harbour to Fareham/Havant routes, making rail a more attractive travel option. PCC will work with SWR to promote these enhancements.

The following measures are new measures (or previously implemented measures that could be re-introduced) that could bring forward compliance on road link 48196, as well as benefitting other roads in the city:

- **Reduce private car use**. Measures aimed at reducing private car use could take a number of different forms, such as increasing car parking charges, introducing parking charges at workplaces, or reducing the number of car parking spaces available to discourage people from driving to work. Ensuring that there is effective monitoring and enforcement of travel plans required as part of new developments will also help reduce private car use. Source apportionment figures indicate diesel cars and to a lesser extent, diesel LGVs, to be the main road traffic NOx sources so higher charges for these vehicles could be considered. A surcharge on diesel vehicles could be applied to both workplace and residential parking. This would have benefits not only for road link 48196 (and 18114) but also across a wider area of the city.
- **South East Hampshire Bus Rapid Transit (SEHBRT).** PCC is currently developing a bus rapid transit system in conjunction with Hampshire County Council and district authorities to promote public transport within the Portsmouth travel to work area.
- **Tipner Bridge**. There is commitment in the existing Local Plan for the development of “an all modes” bridge to provide more efficient transport links, however, this scheme is currently not funded.
- **Build a new road**. Provide a new road link into the city that bypasses the area of modelled exceedance.
- **Change traffic priorities**. Make changes to the configuration of the Church Street roundabout to maintain free-flowing traffic from the A3 Mile End Road through the Church Street roundabout and into Commercial Road.
- **Promote and encourage uptake of cleaner vehicles**. Encourage businesses and individuals to switch to ultra-low emissions vehicles through subsidies. Install electric vehicle charging infrastructure at more locations to encourage their uptake and offer free or discounted parking for ultra-low emissions vehicles.
- **Eco-driver training**. Continuation of the eco-driver training initiative for local businesses, previously run between 2013 and 2017.
- **Promote use of public transport**. Further investment in transport links on common journeys such as new bus routes and/or train routes could reduce traffic, in turn reducing congestion on the local road network. Work with bus operators to offer free travel days for commuters.
- **Improve the bus and coach fleet**. Work with bus and coach operators to encourage the use of their cleanest vehicles on routes passing through areas of poor air pollution. Work with the operators to encourage the replacement or retrofit of older vehicles with

low-emission vehicles. Introduce emissions monitoring equipment on vehicles to identify poor driving styles or faulty powertrain equipment.

- **Promotion and expansion of the Park-and-Ride**. A park-and-ride scheme is already operational, linking Tipner to the city centre and the harbour. Additional parking spaces and frequency of connecting bus services could reduce the number of private vehicle journeys into Portsmouth. Explore other potential locations for park-and-ride.
- **Promote cycling**. Expand the cycle route network throughout the city and publicise cycling as an alternative mode of transport. Implement a cycle hire scheme that encourages commuters to park outside of the city centre and complete their journey to work by bike.
- **Workplace travel plans**. Between 2010 and 2015, 49 workplace travel plans were signed. Engaging local businesses to develop or update existing travel plans could help to reduce private car use through car-sharing initiatives, incentivising travel by public transport or active transport (i.e. cycling, walking, running).
- **Promoting easitNETWORK - easitPORTSMOUTH**. EasitPORTSMOUTH is a social enterprise focused on encouraging more people to travel sustainably and to consider their environment. Initiatives include discounts on rail travel, purchase and hire of bicycles, and discounts on electric vehicle charging units. EasitSHARE is a new initiative to encourage people to share their journey to work. Promoting easitPORTSMOUTH could help encourage modal shift from private car to sustainable travel options.
- **Anti-idling campaign**. Variable messaging signs (VMS) could be installed to encourage drivers in queuing traffic to switch off their engines, or to use the automatic stop-start facility that many modern vehicles have. The VMS could also be used to display current information about air quality in the city.
- **Flexible working**. Work with local businesses to encourage flexible working patterns that allow staff to travel to / from work outside of peak times.
- **Inbound flow control**. Regulating the flow of traffic travelling into Portsmouth via the western corridor using traffic signals or variable speed limits with the aim of reducing congestion on Mile End Road, Commercial Road, Marketway, and Alfred Road.
- **Time restrictions on deliveries**. Restrictions on the time of day that goods deliveries can be made to businesses to encourage deliveries to occur outside of peak travel times.
- **Freight consolidation**. Work with distributors to establish local freight micro-consolidation centres. These centres would receive deliveries during less busy times of the day (e.g. during the night). Goods could then be delivered to customers and businesses using ultra-low emissions vehicles (e.g. electric vans and cargo cycles).
- **Increasing public awareness of air pollution**. Using VMS and social media to inform drivers to avoid certain roads on days of high pollution / consider using alternative methods of transport.

Road Link 18114

The most likely cause of projected exceedance on road link 18114 has been identified as congestion during peak times due to commuter traffic. The measures suggested below

therefore focus on optimising traffic flow and reducing demand for travel by car, although other measures have also been included where appropriate.

The following measures are currently being implemented or are expected to be implemented soon:

- **Anglesea Road / Park Road Junction Upgrade**. This scheme is expected to be implemented in 2018, with the aim of managing vehicle and foot traffic more efficiently. The junction is likely to use the Microprocessor Optimisation Vehicle Actuation (MOVA) system, which has been demonstrated to provide maximum efficiency for stand-alone signalised junctions.
- **Air Quality Grant Programme.** PCC were awarded an Air Quality Grant (AQG) of £450,000 in 2017/18 from Defra for targeted improvements in air quality within Portsmouth. Just over half the budget is allocated to infrastructure improvements. This involves improvements to key travel routes to encourage use of active travel modes, making walking and cycling more attractive forms of travel. This will include greening of routes and tree planting. Market research will also be carried out in order to determine the most effective communications and marketing package. This will comprise of an anti-idling campaign, participation in National Clean Air day as well as events to promote good air quality. Residents will also be targeted by the AQG Programme through the promotion of alternative travel such as electric vehicles and training courses focused on cycling. There will also be a discount on the purchase, loan and safety equipment of bikes. Schools and workplaces will have initiatives rolled out such as the Pompey Monsters Walk to School Challenge which is aimed at primary school children. Pedestrian training would also be provided to teach primary school aged children basic road safety and encourage walking to school. A scheme is also being introduced where by children are taught how to safely use scooters. PCC will be working with workplaces that have large fleets to encourage eco-driving; this will be done through training courses and providing advice on the possibilities of improving the environmental impact of their fleets by converting to vehicles with lower emissions. Further information on these schemes and others are outlined in more detail below.
- **Electric Vehicle (EV) Charging Points.** PCC secured funding from the Office for Low Emission Vehicles (OLEV) to install additional charging points for EVs in residential areas PCC have an off-street trial of fast charging points in three PCC owned car parks, in addition to charge points at the Park and Ride. This trial scheme is jointly funded by PCC and CityEV. With the OLEV funding the council intends to install a further 50 charging points at 30 sites in the city by the end of autumn 2018. Installing EV charging infrastructure is expected to encourage EV ownership.
- **Bike hire**. PCC implemented a park and ride bike hire scheme in 2013 where by the public can hire bikes for the day to cycle around the city. There is a discounted rate for regular users to encourage people to cycle rather than drive. Foldable bikes for hire are kept in a dock by Portsmouth Harbour. PCC are introducing a new bike-sharing scheme, later this year Portsmouth residents and visitors will have access to 150 bikes, in an effort to encourage people to swap their car journeys and travel by bike.

- **Quieter Routes Programme.** As part of the Safer Cycling Work Programme, PCC launched the Quieter Routes programme, aimed at encouraging people to travel by bike around the city. A travel survey conducted in 2014 found that lack of confidence on the roads was a major barrier to people travelling by bike around the city. The Quieter Routes programme established 10 cycle routes connecting key areas of the city, which avoid busy roads and signpost cyclists onto cycle infrastructure or the 20 mph road network.
- **South Western Railway (SWR) Service Improvements.** From December 2018, additional and faster train services will operate to and from Portsmouth to Southampton and London. There will be two additional services per hour in each direction on the core Portsmouth Harbour to Fareham/Havant routes, making rail a more attractive travel option. PCC will work with SWR to promote these enhancements.

The following measures are new measures (or previously implemented measures that could be re-introduced) that could bring forward compliance on road link 18114:

- **Reduce private car use**. Measures aimed at reducing private car use could take a number of different forms, such as increasing car parking charges, introducing parking charges at workplaces, or reducing the number of car parking spaces available to discourage people from driving to work. Ensuring that there is effective monitoring and enforcement of travel plans required as part of new developments will also help reduce private car use. Source apportionment figures indicate diesel cars and to a lesser extent, diesel LGVS, to be the main road traffic NOx sources so higher charges for these vehicles could be considered. This would have benefits not only for road link 18114 but also across a wider area.
- **Build a new road**. Provide a new road link into the city that bypasses the area of modelled exceedance.
- **Promote and encourage uptake of cleaner vehicles**. Encourage businesses and individuals to switch to ultra-low emissions vehicles through subsidies. Install electric vehicle charging infrastructure at more locations to encourage their uptake and offer free or discounted parking for ultra-low emissions vehicles.
- **Eco-driver training**. Continuation of the eco-driver training initiative for local businesses, previously run between 2013 and 2017.
- **Promote use of public transport**. Further investment in transport links on common journeys such as new bus routes and/or train routes could reduce traffic, in turn reducing congestion on the local road network. Work with bus operators to offer free travel days for commuters.
- **Improve the bus and coach fleet**. Work with bus and coach operators to encourage the use of their cleanest vehicles on routes passing through areas of poor air pollution. Work with the operators to encourage the replacement or retrofit of older vehicles with low-emission vehicles. Introduce emissions monitoring equipment on vehicles to identify poor driving styles or faulty powertrain equipment.
- **Promote Park-and-Ride**. A park-and-ride scheme is already operational, linking Tipner to the city centre and the harbour. Additional parking spaces and frequency of

connecting bus services could reduce the number of private vehicle journeys into Portsmouth.

- **Promote cycling**. Expand the cycle route network throughout the city and publicise cycling as an alternative mode of transport. Implement a cycle hire scheme that encourages commuters to park outside of the city centre and complete their journey to work by bike.
- **Workplace travel plans**. Between 2010 and 2015, 49 workplace travel plans were signed. Engaging local businesses to develop or update existing travel plans could help to reduce private car use through car-sharing initiatives, incentivising travel by public transport or active transport (i.e. cycling, walking, running).
- **Promoting easitNETWORK - easitPORTSMOUTH**. EasitPORTSMOUTH is a social enterprise focused on encouraging more people to travel sustainably and to consider their environment. Initiatives include discounts on rail travel, purchase and hire of bicycles, and discounts on electric vehicle charging units. EasitSHARE is a new initiative to encourage people to share their journey to work. Promoting easitPORTSMOUTH could help encourage modal shift from private car to sustainable travel options.
- **Anti-idling campaign**. Variable messaging signs (VMS) could be installed to encourage drivers in queuing traffic to switch off their engines, or to use the automatic stop-start facility that many modern vehicles have. The VMS could also be used to display current information about air quality in the city.
- **Flexible working**. Work with local businesses to encourage flexible working patterns that allow staff to travel to / from work outside of peak times.
- **Inbound flow control**. Regulating the flow of traffic travelling into Portsmouth via the western corridor using traffic signals or variable speed limits with the aim of reducing congestion on Mile End Road, Commercial Road, Marketway, and Alfred Road.
- **Time restrictions on deliveries**. Restrictions on the time of day that goods deliveries can be made to businesses to encourage deliveries to occur outside of peak travel times.
- **Freight consolidation**. Work with distributors to establish local freight micro-consolidation centres. These centres would receive deliveries during less busy times of the day (e.g. during the night). Goods could then be delivered to customers and businesses using ultra-low emissions vehicles (e.g. electric vans and cargo cycles).

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.

Existing Measures / Measures Expected to be Implemented Shortly

As discussed in Part 2 of this Feasibility Study, PCC has a number of existing measures that have been implemented since 2015, or are due to be implemented shortly, and so will not have been reflected in the baseline PCM compliance modelling. The potential air quality impacts of these measures will be assessed in Part 4. These measures are summarised in Table 13 and Table 14 for road links 48196 and 18114, respectively.

Table 13 Existing Measures to be taken forward to Part 4 for Road Link 48196

Measure	Completion Date
Church Street Roundabout Linking with crossing on Commercial Road North	2016
Mile End Relining Scheme	Expected End June 2018
VMS Signs on M275	Late 2018 / Early 2019
Bike hire	Ongoing
Quieter routes programme	Ongoing
EV Charging Points	Expected Autumn 2018
Anti-Idling Campaign	Expected September / October 2018
South Western Railway Services Improvements	December 2018
Air Quality Grant Programme	Ongoing

Table 14 Existing Measures to be taken forward to Part 4 for Road Link 18114

Measure	Completion Date
Anglesea Road / Park Road Junction Upgrade	Expected End October 2018
Bike hire	Ongoing
Quieter routes programme	Ongoing
EV Charging Points	Expected Autumn 2018
Anti-Idling Campaign	Expected September / October 2018
South Western Railway Services Improvements	December 2018
Air Quality Grant Programme	Ongoing

New Measures

This section considers which, if any, of the new measures included in Part 2 of this study are practically deliverable in time to be able to bring forward compliance on road links 48196 and 18114.

Road link 48196 is projected to become compliant by 2021, whilst road link 18114 is projected to become compliant by 2020. As a minimum, therefore, measures to bring forward compliance would need to be deliverable before the end of 2020 for road link 48196; in the case of road link 18114 measures would need to be deliverable before the end of 2019.

However, to bring forward compliance in the shortest possible time, realistically any measures would need to be deliverable by the end of 2018. Despite this, we are still planning for measures which have a longer delivery timescale, such as BRT, which would work towards achieving compliance.

Rejected Measures

The measures listed in Table 15 and Table 16 for road links 48196 and 18114, respectively, have been rejected from further study due to deliverability issues within this short timeframe.

Table 15 New Measures Rejected from Shortlist for Road Link 48196

Measure	Reason for Rejection
Tipner Bridge	Presently an aspiration. Not possible to construct within the relevant timeframes
Modification of existing road network around the A3	Currently at early design stage. Unlikely to be deliverable within the relevant timeframes
Build new road bypassing area of exceedance	Not possible to construct within the relevant timeframes
Expansion of park-and-ride	Not likely to be implemented within the relevant timeframes
Change traffic priorities	Likely to increase congestion and deteriorate air quality on adjacent roads
South East Hampshire Bus Rapid Transit (SEHBRT)	Not likely to be implemented fully and/or significantly enough to impact on NOX emissions within the relevant timeframes
Freight consolidation	Not likely to be implemented within the relevant timeframes
Inbound flow control	Existing VMS alone insufficient to effectively control inbound flow. Implementation of required technology not likely within the relevant timeframes

Table 16 New Measures Rejected from Shortlist for Road Link 18114

Measure	Reason for Rejection
Build new road bypassing area of exceedance	Not possible to construct within the relevant timeframes
Expansion of park-and-ride	Not likely to be implemented within the relevant timeframes
Change traffic priorities	Likely to increase congestion and deteriorate air quality on adjacent roads
South East Hampshire Bus Rapid Transit (SEHBRT)	Not likely to be implemented fully and/or significantly enough to impact on NOX emissions within the relevant timeframes
Freight consolidation	Not likely to be implemented within the relevant timeframes

Shortlisted Measures

Table 17 and Table 18 present those new measures for road links 48196 and 18114, respectively that are to be taken forward to Part 4. These are measures that can be implemented sufficiently quickly, are practically feasible, and which have the greatest potential to bring forward compliance in the shortest possible time.

Table 17 New Measures Shortlisted to be taken forward to Part 4 for Road Link 48196

Measure	Supporting information
Reduce private car use	As a package of measures (e.g. Personal Journey Planning, Workplace Travel Planning, Workplace Sustainable Travel Fund, School Travel Planning, promoting cycling), could reduce peak-time congestion by reducing journeys by private car. Includes: - Personal Journey Planning - Workplace Travel Planning - Workplace Sustainable Travel Fund - School Travel Planning - Promoting cycling - Encouragement of flexible working / home-working - Promoting easitPORTSMOUTH **A number of these measures will be delivered through the Air Quality Grant Programme; whilst the focus will be on the city's AQMAs, there are expected to be wider air quality benefits. More details on the Air Quality Grant Programme can be found in** .
Workplace travel plans	PCC will be working with a number of businesses within the city to develop new / update existing Workplace Travel Plans. In conjunction with other measures to reduce journeys by private car, this could improve air quality through reducing peak-time congestion
Improve bus and coach fleet	Approximately 440 public service vehicles use this road link on a weekday. Main bus operators in Portsmouth (First Bus and Stagecoach) are not in a position to introduce new, alternative-fuelled vehicles within the required timescales, and funding through the Clean Bus Fund can only be used for new vehicles. However, the bus operators have shown interest in a retrofitting scheme.
Promotion of park-and-ride	Existing park-and-ride infrastructure in place. Expansion not possible within the relevant timeframes. However, promoting the park-and-ride may increase patronage and reduce private car use. Recent years' patronage figures are presented in Table 20.
Promote / encourage uptake of cleaner vehicles	In conjunction with the rollout of additional EV charging points, this could reduce traffic-related NOx emissions

Table 18 New Measures Shortlisted to be taken forward to Part 4 for Road Link 18114

Measure	Supporting information
Reduce private car use	As a package of measures, could reduce peak-time congestion by reducing journeys by private car. Includes: - Personal Journey Planning - Workplace Travel Planning - Workplace Sustainable Travel Fund - School Travel Planning - Promoting cycling - Encouragement of flexible working / home-working - Promoting easitPORTSMOUTH **A number of these measures will be delivered through the Air Quality Grant Programme; whilst the focus will be on the city's AQMAs, there are expected to be wider air quality benefits. More details on the Air Quality Grant Programme can be found in** .
Workplace travel plans	PCC will be working with a number of businesses within the city to develop new / update existing Workplace Travel Plans. In conjunction with other measures to reduce journeys by private car, this could improve air quality through reducing peak-time congestion
Improve bus and coach fleet	Approximately 650 public service vehicles use this road link on a weekday Main bus operators in Portsmouth (First Bus and Stagecoach) are not in a position to introduce new, alternative-fuelled vehicles within the required timescales, and funding through the Clean Bus Fund can only be used for new vehicles. However, the bus operators have shown interest in a retrofitting scheme.
Promotion of park-and-ride	Existing park-and-ride infrastructure in place. Expansion not possible within the relevant timeframes. However, promoting the park-and-ride may increase patronage and reduce private car use. Recent years' patronage figures are presented in Table 20.
Promote / encourage uptake of cleaner vehicles	In conjunction with the rollout of additional EV charging points, could reduce traffic-related NOx emissions

Table 19 Programme of Works for the Air Quality Grant Programme

Communications and Marketing	Communications and Marketing	Market research would be undertaken in order to determine the most effective communications and marketing package. This could include measures such as an anti-idling campaign, participation in National Clean Air Day, recruitment of Clean Air Champions, formation of a Clean Air Network, events to promote air quality and the introduction of branding to promote good air quality.	Citywide targeting AQMAs
Residents	Personal Journey Planning	Journey planning activity targeted at residents in AQMAs to encourage use of sustainable travel modes and green driving behaviour. This activity will look at demographics to identify how residents will be most receptive and is likely to include face to face, and e-communication, offering a variety of activities from basic advice and information to discounted cycle / driver training courses.	All AQMAs
	Electric vehicle promotion	Promotion of electric vehicle charge points available through OLEVs ORCS scheme and encouraging the further uptake of electric and hybrid in the city.	Citywide, targeting ORCS locations and AQMAs
	Cycle Training	A variety of cycle training courses, targeting new and beginner cyclists in becoming more confident in cycling. Includes adult and family cycle training courses and bike maintenance courses (Bike Doctor) to help maintain uptake by existing cyclists.	Citywide targeting AQMAs
	Family Bike Grant scheme	Offer of discounted purchase or loan of bikes and safety equipment to those residents on low incomes.	Citywide targeting AQMAs
	Bike Doctor	Bike maintenance sessions for free basic cycle repairs.	City centre (AQMA 11), North End (AQMA 6)
Schools	Pompey Monsters Walk to School Challenge	Roll out of the successful Pompey Monster Walk to School Challenge to schools with primary age children in and adjacent to AQMAs.	Schools in and around AQMAs

	School Travel Planning including pedestrian and scooter training	Working with schools in and around AQMAs to encourage sustainable travel for the journey to school. Includes provision of infrastructure such as cycle and scooter parking, and resources such as park-and-stride maps to raise awareness of travel choice. Targeted at parents as decision-makers on travel choice. This could include schools applying for accreditation under the Modeshift STARS scheme. Pedestrian training would teach primary aged children basic road safety to improve safety and encourage walking to school. Scootability training for schools with primary aged children to encourage polite and safe scooting to school.	Schools in and around AQMAs
Workplaces	Workplace Travel Planning	Travel planning activity including personalised journey planning with employees, targeted at large workplaces in AQMAs, or those with staff who travel through AQMAs for commuting or business travel.	Workplaces in AQMAs or with staff who travel through AQMAs.
	Workplace green fleet/driving	Working with businesses in the city with large fleets, to encourage smarter driving behaviour e.g. eco-driver training, and providing advice on the possibilities of improving the environmental impact of their fleets by converting to vehicles with lower emissions.	Businesses in the city with large fleets.
	Workplace Sustainable Travel Fund	A fund available for businesses to apply for measures to promote sustainable travel to their employees for commuting and business use, prioritising those in AQMAs.	Citywide, prioritising those in AQMAs
Infrastructure improvements	Improvements to permeability to encourage walking and cycling.	Physical improvements to key travel routes to improve permeability and encourage use of active travel modes, making walking and cycling more attractive forms of travel. To include greening of routes, tree planting and other public realm where possible.	East-West Active Travel Corridor, in and adjacent to AQMAs 6, 7 and 12.

Table 20 Park-and-Ride Patronage

Period	Passenger Numbers
April 2014 – March 2015	239,249
April 2015 – March 2016	219,079
April 2016 – March 2017	205,802
April 2017 – March 2018	204,269

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.

The potential impacts of each of the shortlisted measures from Part 3 for Road Links 48196 and 18114 are quantified in this section. The Emissions Factors Toolkit (EFT) has been used to generate estimates of total annual NOx emissions in 2017 for model verification and in 2018 for each road link for a baseline scenario and for each shortlisted measure. The EFT has also been used to output NOx emission rates for input to the ADMS-Roads dispersion model in order to predict annual mean NO_2 concentrations at individual receptor locations alongside each road link.

The traffic data used in the calculations of NOx emissions and NO_2 concentrations are based on the 2017 Source Apportionment Study. In the Source Apportionment Study, extensive manual and automatic classified traffic counts were undertaken at key junctions across the city. These data were processed to provide traffic flows for 2015, 2020 and 2025, classified into cars/taxis, LGVs, rigid and articulated HGVs and buses. These data have been interpolated to 2017 and 2018 for the Targeted Feasibility Study.

No local information is available on fuel type or Euro standards at the time of modelling, so the default compositions as defined in the EFT have been used.

NO_2 concentrations have been modelled using ADMS-Roads. Model outputs have been verified against 2017 monitored NO_2 concentrations measured at roadside air quality monitoring stations and diffusion tube sites located in the study area. A meteorological dataset for 2017 from Thorney Island has been used in the dispersion modelling; this is considered representative of meteorological conditions in the modelled area. Background NO_2 concentrations within the study area have been obtained from PCC's urban background continuous monitoring site; site C4 for 2017 and scaled to each future model year based on changes predicted in Defra's background maps. The reduction in background is typically 2-3% each year.

The ADMS-Roads dispersion model input data and model conditions are provided in Table 21.

Table 21 General ADMS-Roads Model Conditions

Variables	ADMS Roads Model Input
Surface roughness at source	0.5m
Minimum Monin-Obukhov length for stable conditions	30m
Terrain types	Flat
Receptor locations	x, y coordinates determined by GIS, z=various
Emissions	NOx
Emission factors	EFT Version 8.0.1. emission factor dataset
Meteorological data	1 year (2017) hourly sequential data from Thorney Island meteorological station
Model output	Long-term annual mean NOx concentrations

For road transport emissions the 'NOx to NO2' conversion spreadsheet (v6.1) provided by Defra (published in July 2016) was used to calculate the road NO_2 contribution from modelled road NO_X contributions. The tool comes in the form of an MS Excel spreadsheet and uses local authority specific data to calculate annual mean concentrations of NO_2 from dispersion model output values of annual mean concentrations of NO_X. Due to the location of the study area, the 'All-UK" traffic setting has been selected.

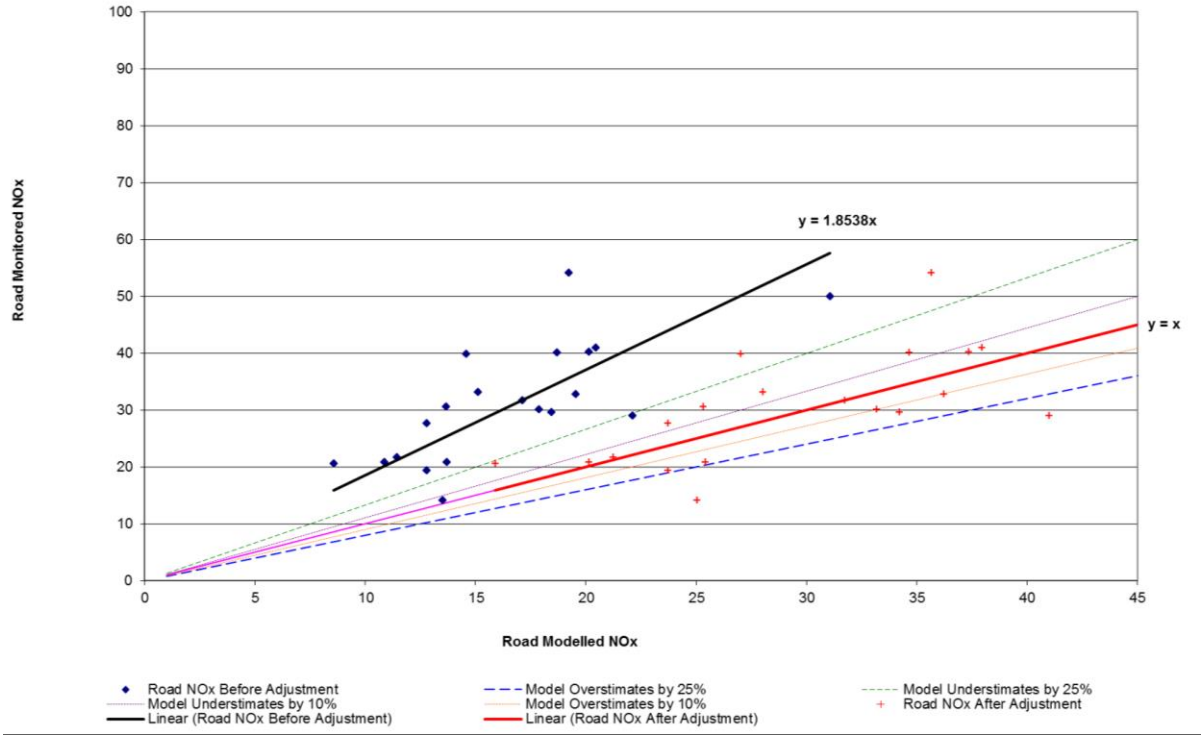
The model verification process was informed by relevant local authority monitoring data located within the study area, as presented in Table 22. A number of monitoring sites were removed from the verification process, for example those further away from modelled roads or background and kerbside sites.

The results of the monitoring were compared to modelled results for those locations, and a bias adjustment factor calculated in line with methods outlined in Defra's LAQM Technical Guidance TG (16) as indicated in Table 25 and Figure 5. The accuracy of the adjusted model was considered using the Root Mean Square Error (RMSE) calculation. An RMSE value of less than 10% of the national air quality objective of 40 µg/m^3 is considered to be ideal i.e. 4 µg/m^3. For this study, the RMSE value for the adjusted model is approximately 3.2µg/m^3, so it is considered to be robust.

Table 22 Summary of NO_2 Verification Exercise

Site ID	Measured Total NO_2 Concentration. ($\mu g/m^3$)	Projected Measured Road NO_X Contribution ($\mu g/m^3$)	Modelled Road NO_X Contribution ($\mu g/m^3$)	Road NO_X Factor
DT1	38.8	40.86	20.47	2.0
DT4	34.2	30.43	13.66	2.2
DT15	29.0	19.22	12.80	1.5
DT16	35.4	33.10	15.12	2.2
DT18	29.6	20.48	8.57	2.4
DT19	34.7	31.54	17.12	1.8
DT20	29.7	20.69	13.72	1.5
DT21	38.4	39.94	18.69	2.1
DT22	26.5	14.03	13.51	1.0
DT23	34.0	29.99	17.90	1.7
DT24	38.3	39.70	14.59	2.7
DT25	44.3	54.01	19.24	2.8
DT30	38.5	40.17	20.15	2.0
DT32	32.9	27.57	12.79	2.2
DT35	30.1	21.54	11.45	1.9
DT36	29.7	20.69	10.87	1.9
C6	35.2	32.65	19.55	1.7
C7	33.5	28.88	22.13	1.3
DT54	33.8	29.54	18.46	1.6
DT116	42.6	49.87	31.07	1.6
Verification factor				**1.854**

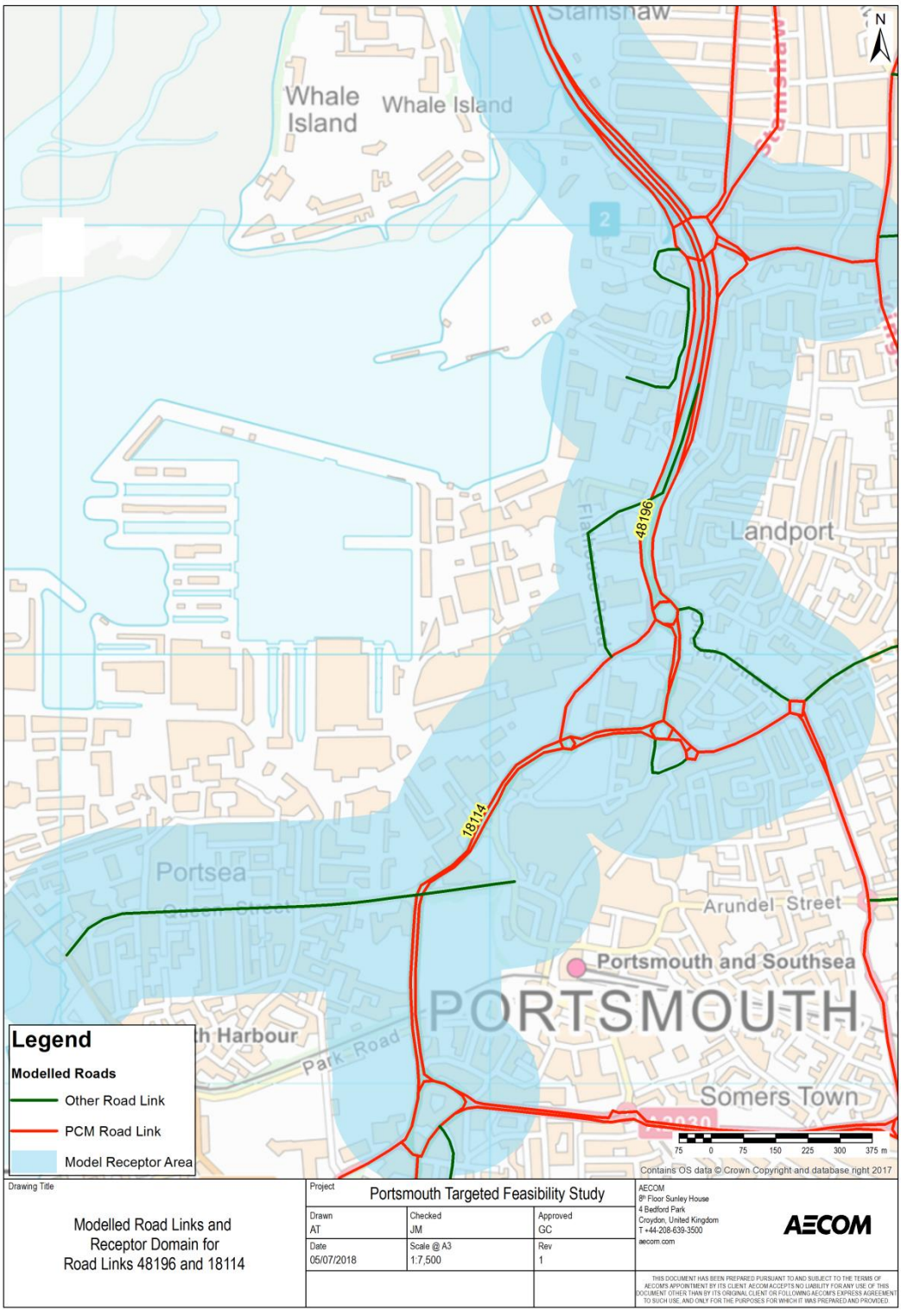
Figure 5 Modelled Annual Mean NO_2 Before and After Adjustment



To consider annual mean NO_2 concentrations close to both road links for the baseline and the shortlisted measures, the ADMS-Roads model was run across a grid of receptors in the model domain indicated in The scenarios were assessed against the base case to determine their potential to bring forward compliance in the shortest possible time, i.e. to achieve Defra's primary critical success factor.

Figure 6. The scenarios were assessed against the base case to determine their potential to bring forward compliance in the shortest possible time, i.e. to achieve Defra's primary critical success factor.

Figure 6 Model Domain for Road links 48196 and 18114



Road Link 48196

Base Situation

The base situation includes an updated traffic fleet compared to that assumed in Defra's PCM model. This base model takes into account the existing measures listed in Table 13

as indicated in the model assumptions (Table 26).

On the basis of NOx emissions calculations using the EFT, it is estimated that total link emissions for road link 48196 will be 5,113 kg/year in 2017 and 4,796 kg/year in 2018. The total link NOx emissions for 2018 are 4.6% higher compared to the PCM estimates, due to the effect of changes implemented since 2015 (see Table 23).

Table 23 Emission Factors Toolkit Inputs and Annual Link Emissions for Road Link 48196 in 2017 and 2018

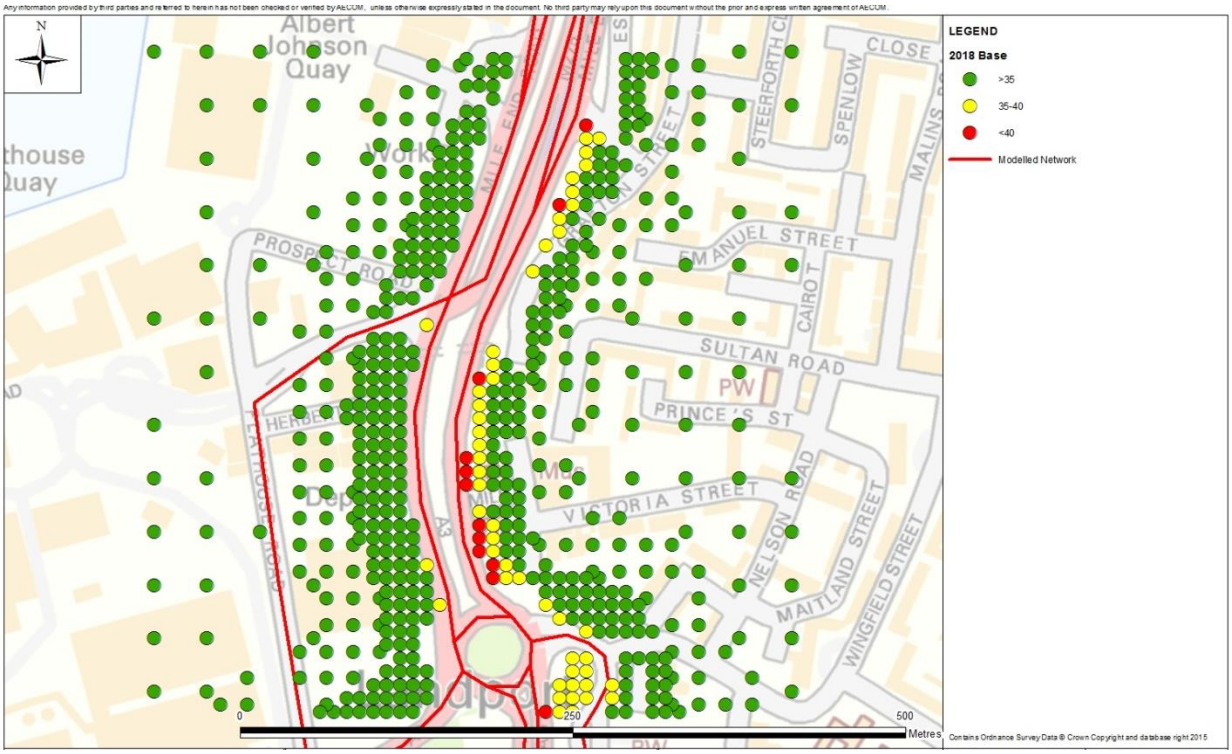
	2017	**2018**
Source ID	48196	48196
Road Type	Urban (not London)	Urban (not London)
Traffic flow	63,855	64,229
% Petrol car	47.5	46.5
% Diesel car	38.7	39.6
% Taxi (black cab)	0	0
% LGV	11.5	11.6
% Rigid HGV	1.0	1.0
% Articulated HGV	0.4	0.4
% Bus / coach	0.9	0.9
% Motorcycles	0	0
Speed (km/h)	26	26
No. of hours	24	24
Link Length	0.45	0.45
Total Link Emissions (kg/year)	5,113	4,796

The maximum verified annual mean NO_2 concentration for this road link in 2018, predicted using ADMS-Roads, is 44.2 µg/m^3 at a receptor within 8m of the roadside. Of the modelled receptors within the wider model domain (The scenarios were assessed against the base case to determine their potential to bring forward compliance in the shortest possible time, i.e. to achieve Defra's primary critical success factor.

Figure 6), there are 587 modelled receptor points that are within 50 metres of this road link. Of these, 12 locations are predicted to be above the EU Limit Value, as shown in

Figure 7.

Figure 7 Modelled NO_2 concentration – Link 48196 – 2018 Base



Therefore, it is expected that road link 48196 will remain in exceedance of the EU Limit Value of 40 µg/m^3 in 2018. Modelling in 2019 show that this link is also predicted to exceed the limit, with the highest modelled concentration of 42.2 µg/m^3. By 2020, the highest modelled concentration at receptors near to road link 48196 is 40.1 µg/m^3, which is compliant.

A number of further new measures from the shortlist developed in Part 3 have therefore been assessed to identify if any of these has the potential to bring forward compliance relative to the base situation, to 2018 or 2019.

New Measure 1: Bus retrofitting

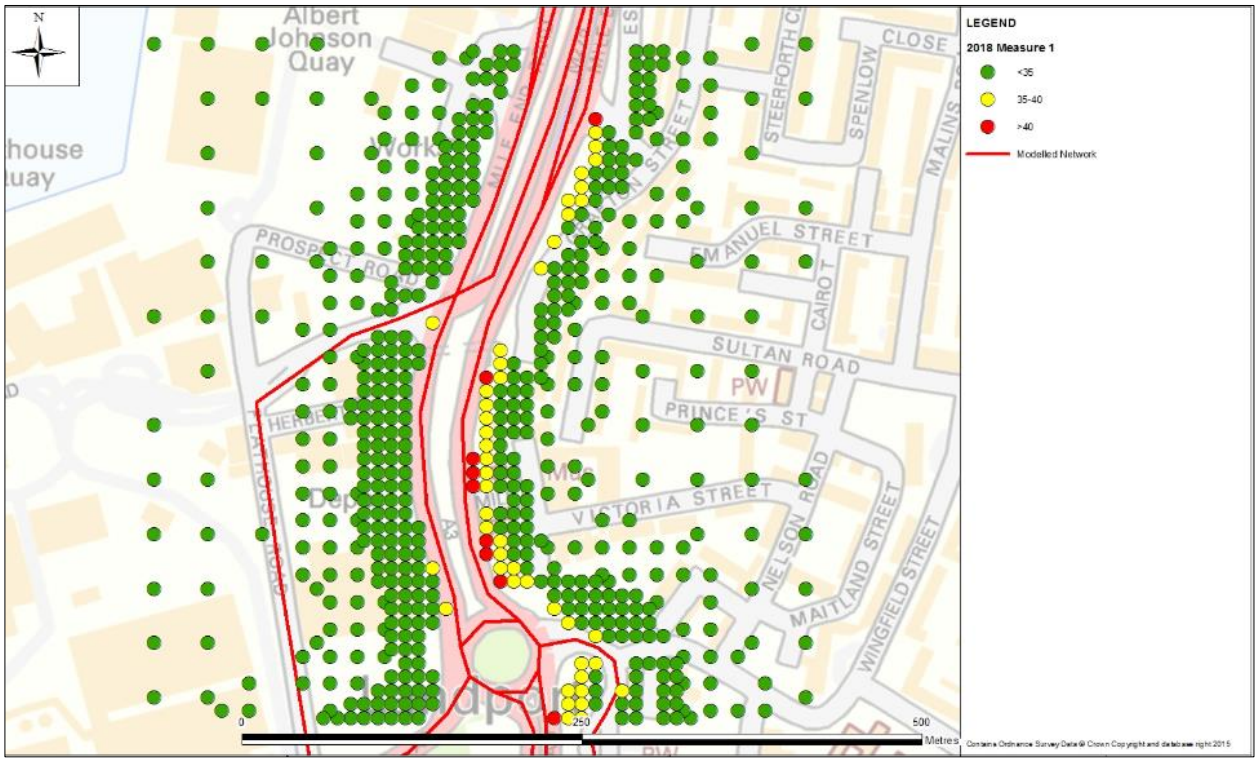
At present there is no information on the Euro composition of the public service vehicles and coaches on this road link and so the default EFT composition has been assumed in the baseline scenario. To assess the effect of bus retrofitting on NOx emissions, it has been assumed that all pre-Euro VI buses and coaches are retrofitted, as shown in Table 24. A summary of assumptions for this measure is given in Table 26.

Table 24 Bus and Coach Euro Compositions in 2018 Base Case and Bus Retrofit Scenario

Buses / Coaches	Euro Proportions Base (2018 – England (not London)	Euro Proportions New Measure 1 (2018 – England (not London)
Pre-Euro I	-	-
Euro I	-	-
Euro II	0.02	-
Euro III	0.10	-
Euro IV	0.09	-
Euro V EGR	0.07	-
Euro V SCR	0.22	-
Euro VI	0.49	0.49
Euro II SCRRF	-	0.02
Euro III SCRRF	-	0.10
Euro IV SCRRF	-	0.09
Euro V EGR + SCRRF	-	0.30

The effect of a bus retrofitting scheme is a 4.3% reduction in annual NOx emissions on road link 48196 from 4,796 kg/year to 4,592 kg/year. The maximum predicted annual mean NO_2 concentration for 2018 with the implementation of this new measure is 43.3 µg/m^3, a 2% reduction compared to the base situation. For this measure, there are 9 locations with concentrations above the EU Limit Value within 50m of the road link as indicated in Figure 8.

Figure 8 Modelled NO_2 concentration – Link 48196 – Measure 1 (2018)



The bus retrofitting measure alone is therefore not sufficient to bring compliance forward to 2018.

The maximum predicted annual mean NO_2 concentrations for this measure for 2019 is 41.3 µg/m^3. In 2019, 3 receptors within 50m of the road link are predicted to remain in exceedance with the implementation of this measure. The highest modelled concentration in 2020 is 39.4 µg/m^3, which is compliant.

New Measure 2: Package of Measures Aimed at Reducing Private Car Use

A significant proportion of vehicle movements on road link 48196 is associated with commuter traffic, which leads to congestion during peak times and low average speeds.

New measure 2 consists of a package of measures, aimed at reducing private car use, as given in Table 17. This includes workplace travel and personal journey planning, school travel planning, promoting active travel options, and encouraging and supporting businesses to offer flexible working/home-working options.

Research published by DfT suggests that an average travel plan can achieve a reduction in car driver trips of 15% to 20%. Assuming a 20% reduction in car travel at peak times and spreading this impact across the day, it is estimated that a 2% reduction in cars on an AADT basis is achievable for road link 48196. Reduced vehicle numbers should also have a benefit in terms of congestion and vehicle speed. It is therefore estimated that a 1% increase in average vehicle speed is possible. A summary of assumptions for this measure is given in Table 26.

Based on a 2% reduction in car traffic and 1% increase in average vehicle speed, annual NOx emissions on road link 48196 are predicted to reduce by 1.7%, from 4,796 kg/year to 4,717 kg/year. The combined influence of the bus retrofitting and reducing private car use measures on annual NOx emissions on road link 48196 is predicted to be a 5.9% reduction, from 4,796 kg/year to 4,515 kg/year.

The maximum predicted annual mean NO_2 concentration for 2018 with the implementation of new measure 2 alone is 43.9 µg/m^3, which is a 1% reduction compared to the base situation. For this measure, there are 10 locations within 50m of the road link with concentrations above the EU Limit Value, as shown in Figure 9.

Figure 9 Modelled NO_2 concentration – Link 48196 – Measure 2 (2018)

Reducing private car use alone is therefore not sufficient to bring compliance forward to 2018.

The maximum predicted annual mean NO_2 concentrations for this measure for 2019 is 41.8 µg/m^3. In 2019, 3 receptors within 50m of the road link are predicted to remain in exceedance with the implementation of this measure. The highest modelled concentration in 2020 is 39.7 µg/m^3, which is compliant.

New Measure 3: Promotion of Park-and-Ride

Evidence from Oxford and Leicestershire Park-and-Ride schemes suggests that a facility of around 800-1000 parking spaces can contribute to a reduction of up to 500 car journeys per day. The Portsmouth Park-and-Ride facility has 665 parking spaces, which at capacity would represent around 400 car journeys per day. A summary of assumptions for this measure is given in Table 26.

Based on the most recent patronage figures, the Park-and-Ride currently operates at around 80% of capacity. It is estimated that 90% could be achieved through promoting and publicising the Park-and-Ride, which would roughly equate to the removal of around 40 cars per day, which would otherwise use the M275 into Portsmouth. This represents a reduction of less than 0.1% of cars on road link 48196 and so would make negligible difference to annual NOx emissions on this link.

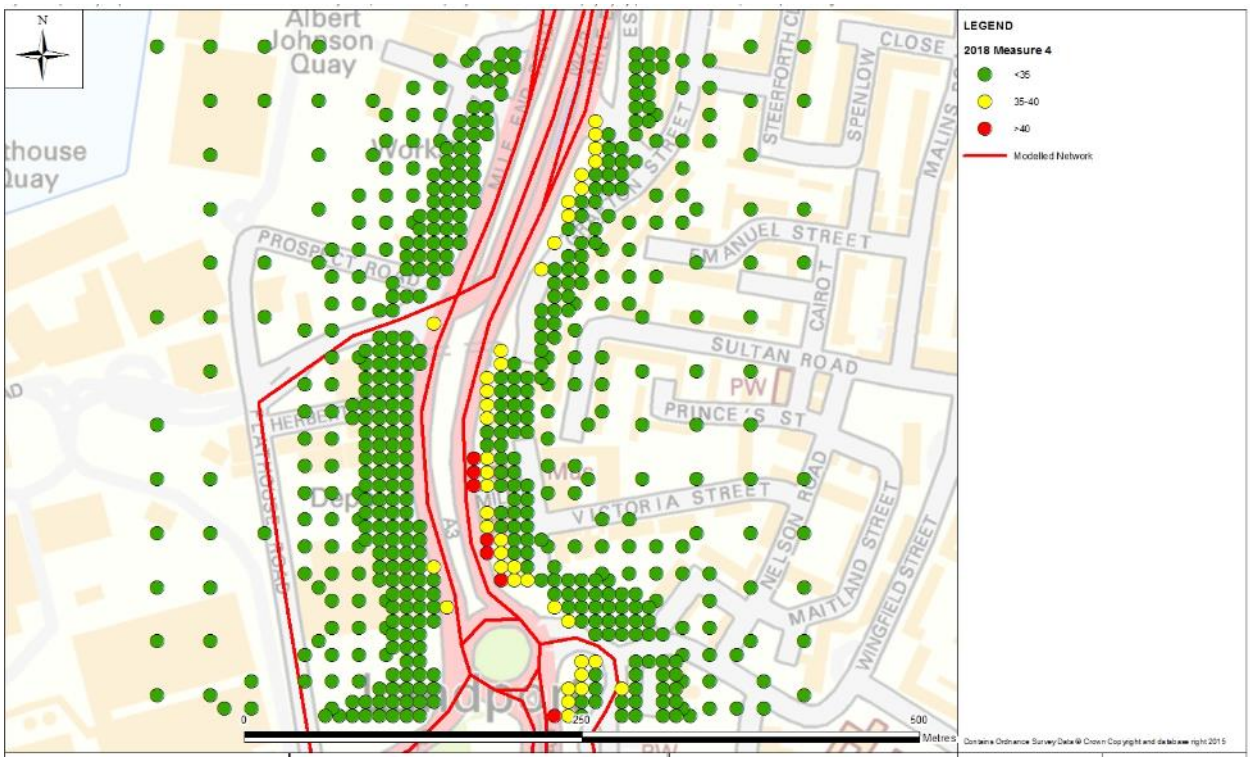
New Measure 4: Promote / Encourage the Uptake of Cleaner Vehicles

The Mayor of London's Air Quality Action Matrix suggests 2.5% electric cars within the London vehicle fleet could be achievable by 2020. Combined with people switching from conventional petrol and diesel-fuelled cars, there is potential for low-emissions vehicles to make significant penetration into the vehicle fleet.

The rollout of new EV charging infrastructure in Portsmouth is expected to increase EV ownership and use in the city. Furthermore, new car sales data suggests that fewer diesel vehicles are being purchased and replaced by more hybrid, plug-in hybrid, and other low-emissions vehicles. It is not clear to what extent the adoption of electric and low emissions vehicles will be in Portsmouth. Consequently, a scenario of replacing 5% of conventional cars with 1% electric cars and 4% plug-in hybrid petrol cars has been assessed.

In this scenario, annual NOx emissions on road link 48196 are predicted to reduce by 3.8%, from 4,796 kg/year to 4,615 kg/year. The maximum predicted annual mean NO_2 concentration for 2018 with the implementation of this new measure alone is 42.5 µg/m^3, which is a 4% reduction compared to the base situation. For this measure, there are 7 locations within 50m of the road link with concentrations above the EU Limit Value, as shown in Figure 10.

Figure 10 Modelled NO_2 concentration – Link 48196 – Measure 4 (2018)



Promoting and encouraging the uptake of cleaner vehicles alone is therefore not sufficient to bring compliance forward to 2018.

The maximum predicted annual mean NO_2 concentrations for this measure for 2019 is 41.5 µg/m^3. In 2019, 3 receptors within 50m of the road link are predicted to remain in exceedance with the implementation of this measure. The highest modelled concentration in 2020 is 39.4 µg/m^3, which is compliant.

New Measure 4: Sensitivity Test

The scenario assessed above of replacing 5% of conventional cars with 1% electric cars and 4% plug-in hybrid petrol cars is seen as a challenging target. Therefore, a sensitivity test has been carried out assuming the replacement 3.5% of conventional cars with 0.5% electric cars and 3% plug-in hybrids.

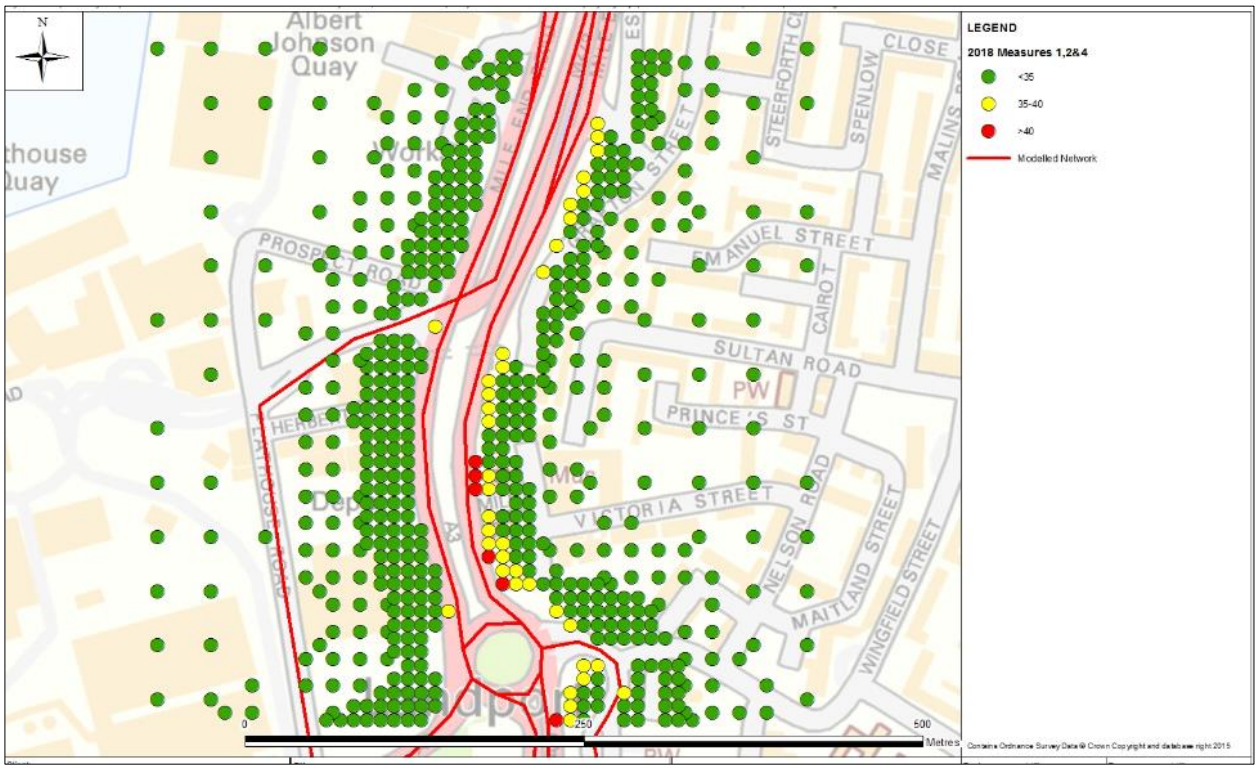
The maximum predicted annual mean NO_2 concentrations for this measure for 2019 is 41.7 µg/m^3. In 2019, 3 receptors within 50m of the road link are predicted to remain in exceedance with the implementation of this measure. The highest modelled concentration in 2020 is 39.7 µg/m^3, which is compliant.

Combined New Measures 1, 2 and 4

The combined influence of the bus retrofitting, reducing private car use measures and promoting/encouraging the uptake of cleaner vehicles on annual NOx emissions on road link 48196 is predicted to be a 9.7% reduction, from 4,796 kg/year to 4,331 kg/year.

The maximum predicted annual mean NO_2 concentration for 2018 with the implementation of these three measures is 42.3 µg/m^3 at a receptor within 4m of the roadside; this is a 4% reduction compared to the base situation. For this combined scenario, there remain 6 locations within 50m of the road link with concentrations above the EU Limit Value as shown in Figure 11.

Figure 11 Modelled NO_2 concentration – Link 48196 – Measure 1, 2 and 4 (2018)



A combination of bus retrofitting, reducing private car use measures and promoting/encouraging the update of cleaner is therefore not sufficient to bring compliance forward to 2018.

The maximum predicted annual mean NO_2 concentration for these combined measures for 2019 is 40.4 µg/m^3. These results indicate that this combination of measures could bring forward compliance to 2019, as 40.4 µg/m^3 is rounded down to 40 µg/m^3. The highest modelled concentration in 2020 is 38.5 µg/m^3, which is compliant.

Combined New Measures 1, 2 and 4: Sensitivity Test

A sensitivity test has been carried for the combined new measures assuming the lower replacement rate of 3.5% of conventional cars with 0.5% electric cars and 3% plug-in hybrids.

The maximum predicted annual mean NO_2 concentrations for this measure for 2019 and 2020 are 40.6 µg/m^3 and 38.8 µg/m^3, respectively. In 2019, 1 receptor within 50m of the road link is predicted to remain in exceedance with the implementation of this measure. The highest modelled concentration in 2020 is 38.8 µg/m^3, which is compliant.

Road Link 18114

Base Situation

The base situation includes an updated traffic fleet compared to that assumed in Defra's PCM model. This base model takes into account the existing measures listed in Table 14 as per the model assumptions in Table 26.

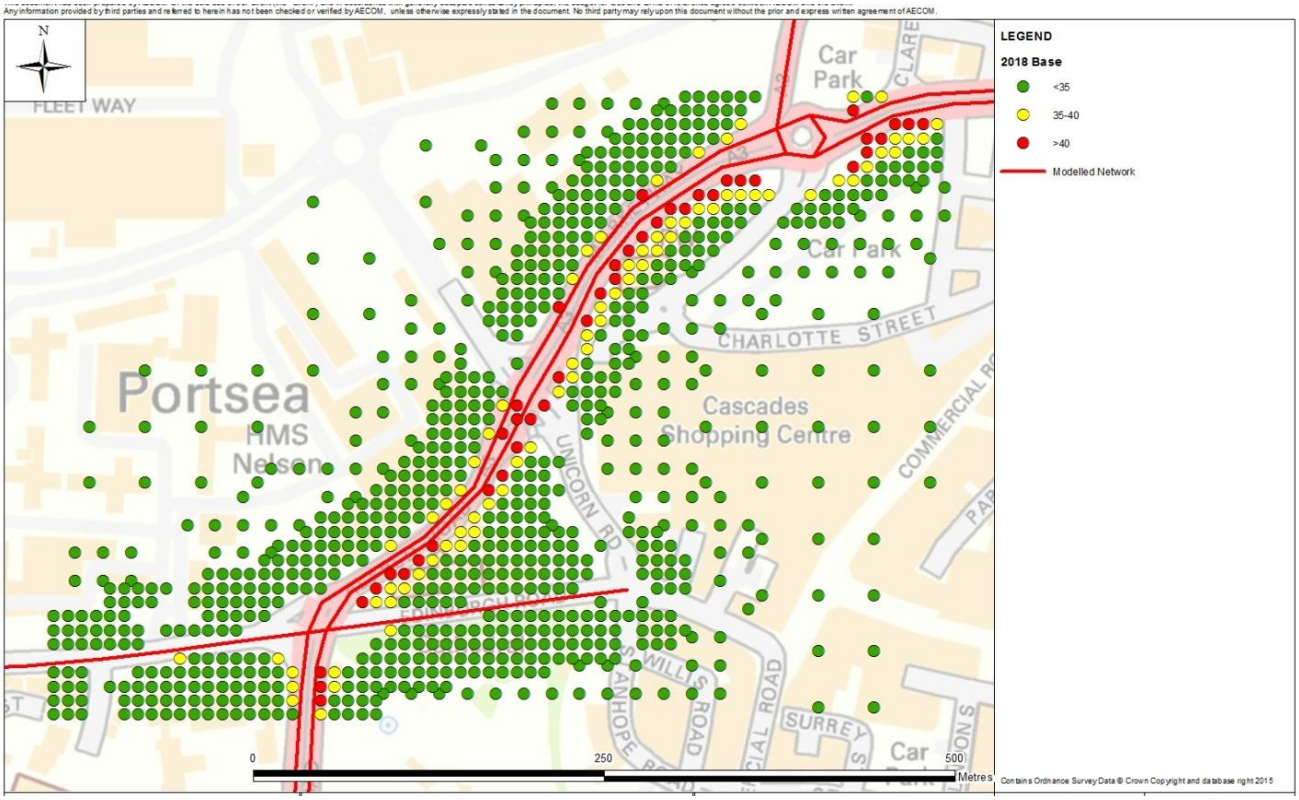
On the basis of NOx emissions calculations using the EFT, it is estimated that total link emissions for road link 18114 will be 3,448 kg/year in 2017 and 3,243 kg/year in 2018. The total link NOx emissions for 2018 are 9.9% lower compared to the PCM estimates, due to the effect of changes implemented since 2015.

Table 25 Emission Factors Toolkit Inputs and Annual Link Emissions for Road Link 18114 in 2017 and 2018

	2017	**2018**
Source ID	18114	18114
Road Type	Urban (not London)	Urban (not London)
Traffic flow	39753	39985
% Petrol car	48.3	47.3
% Diesel car	39.4	40.3
% Taxi (black cab)	0	0
% LGV	10.2	10.3
% Rigid HGV	1.0	1.0
% Articulated HGV	0.4	0.4
% Bus / coach	0.7	0.7
% Motorcycles	0	0
Speed (km/h)	24.0	24.0
No. of hours	24	24
Link Length	0.48	0.48
Total Link Emissions (kg/year)	3,448	3,243

The maximum verified annual mean NO_2 concentration for this link in 2018, predicted using ADMS-Roads, is 49.2 µg/m^3 at a receptor located at a pedestrian crossing at the junction with Unicorn Road. Of the 904 modelled receptor points that are within 50 metres of this road link, 41 locations are predicted to be above the EU Limit Value, as shown in Figure 12.

Figure 12 Modelled NO_2 concentration – Link 18114 – 2018 Base



Therefore, it is expected that road link 18114 will remain in exceedance of the EU Limit Value of 40 µg/m^3 in 2018. Model predictions for 2019 to 2022, inclusive show that this link is still predicted to exceed the limit; compliance is predicted to be achieved in 2023. The highest modelled concentrations by year are:

- 2019: 48.3 µg/m^3
- 2020: 45.9 µg/m^3
- 2021: 43.8 µg/m^3
- 2022: 41.3 µg/m^3
- 2023: 39.2 µg/m^3

A number of further new measures from the shortlist developed in Part 3 have therefore been assessed to identify if any of these have the potential to bring forward compliance to an earlier year.

New Measure 1: Bus retrofitting

To assess the effect of bus retrofitting on NOx emissions, the same assumptions have been made for road link 18114 as for road link 48196 i.e. that all pre-Euro VI buses and coaches are retrofitted (see Table 24). A summary of assumptions for this measure is given in Table 26.

The effect of a bus retrofitting scheme is a 3.3% reduction in annual NOx emissions on road link 18114 from 3,243 kg/year to 3,135 kg/year. The maximum predicted annual mean NO_2 concentration for 2018 with the implementation of this new measure is

47.7 µg/m^3, which is a 3% reduction compared to the base situation. With this measure, there are 30 locations within 50m of the roadside that have concentrations above the EU Limit Value, as indicated in Figure 13.

Figure 13 Modelled NO_2 concentration – Link 18114 – Measure 1 (2018)

The bus retrofitting measure alone is therefore not sufficient to bring compliance forward to 2018.

The maximum predicted annual mean NO_2 concentrations for years 2019 to 2022, inclusive for this measure are:

- 2019: 47.2 µg/m^3
- 2020: 44.9 µg/m^3
- 2021: 43.0 µg/m^3
- 2022: 40.7 µg/m^3

In 2019, 17 receptors within 50m of the road link is predicted to remain in exceedance with the implementation of this measure. In 2020, 9 receptors are predicted to remain in exceedance and in 2021, 5 receptors are in exceedance. In 2022, only 1 receptor is predicted to be in exceedance. These results indicate that this measure alone is not sufficient to bring forward compliance.

New Measure 2: Package of Measures Aimed at Reducing Private Car Use

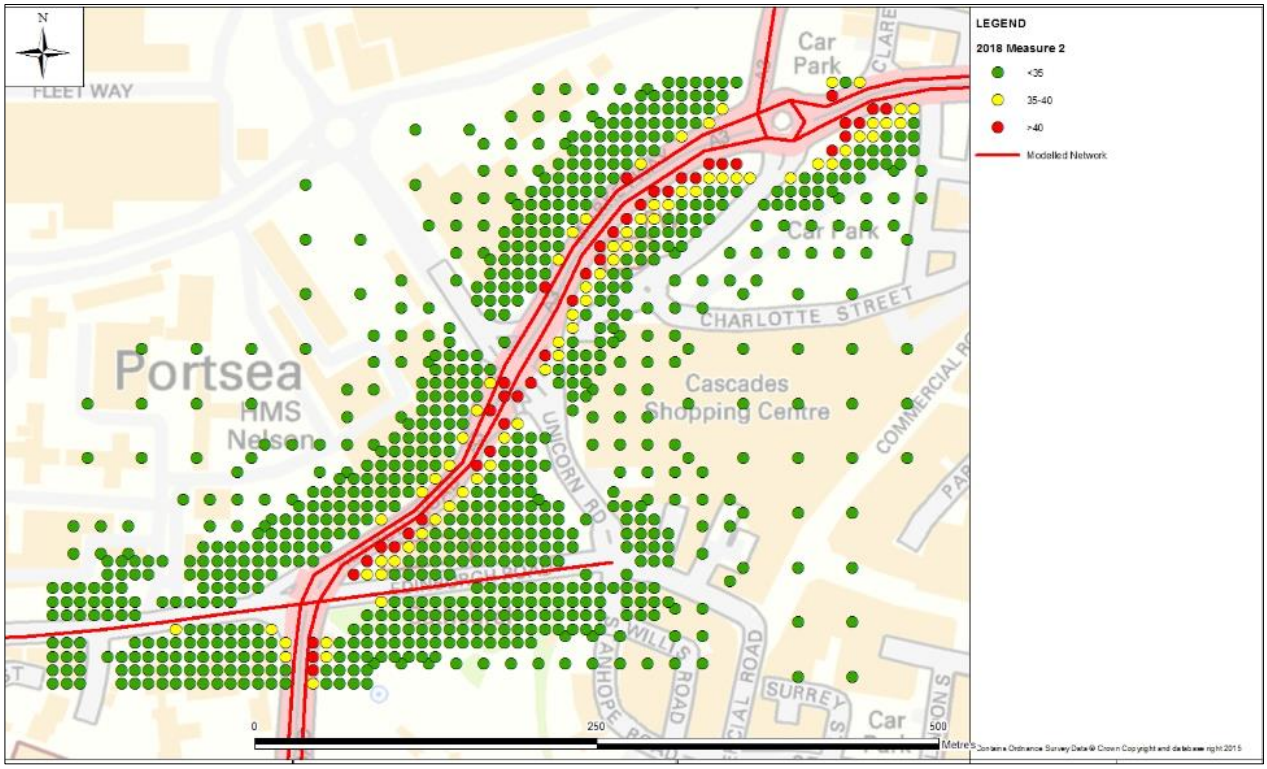
A significant proportion of vehicle movements on road link 18114 are associated with commuter traffic, which leads to congestion during peak times and low average speeds. To assess the potential impact of reducing private car use, the same assumptions have

been made for road link 18114 as were made for road link 48196 i.e. a 2% reduction in car traffic and 1% increase in average vehicle speed. A summary of assumptions for this measure is given in Table 26.

In the reduced private car use scenario, annual NOx emissions on road link 18114 are predicted to reduce by 1.7%, from 3,243 kg/year to 3,188 kg/year. The combined influence of the bus retrofitting and reducing private car use measures on annual NOx emissions on road link 181114 is predicted to be a 5% reduction, from 3,243 kg/year to 3,081 kg/year.

The maximum predicted annual mean NO_2 concentration for 2018 with the implementation of this new measure is 48.7 µg/m^3, which is a 1% reduction compared to the base situation. There are 41 locations within 50m of the roadside with predicted concentrations above the EU Limit Value, as shown in Figure 14.

Figure 14 Modelled NO_2 concentration – Link 18114 – Measure 2 (2018)



Reducing car use alone is therefore not sufficient to bring compliance forward to 2018.

The maximum predicted annual mean NO_2 concentrations for years 2019 to 2022, inclusive for this measure are:

- 2019: 47.9 µg/m^3
- 2020: 45.5 µg/m^3
- 2021: 43.4 µg/m^3
- 2022: 40.9 µg/m^3

In 2019, 23 receptors within 50m, of the road link is predicted to remain in exceedance with the implementation of this measure. In 2020, 12 receptors are predicted to remain in exceedance and 7 receptors in 2021. In 2022, only 1 receptor is predicted to be in exceedance. These results indicate that this measure alone is not sufficient to bring forward compliance.

New Measure 3: Promotion of Park-and-Ride

Evidence from Oxford and Leicestershire Park-and-Ride schemes suggests that a facility of around 800-1000 parking spaces can contribute to a reduction of up to 500 car journeys per day. The Portsmouth Park-and-Ride facility has 665 parking spaces, which at capacity would represent around 400 car journeys per day.

Based on the most recent patronage figures, the Park-and-Ride currently operates at around 80% of capacity. It is estimated that 90% could be achieved through promoting and publicising the Park-and-Ride, which would roughly equate to the removal of around 40 cars per day, which would otherwise use the M275 into Portsmouth. This represents a reduction of 0.1% of cars on road link 18114 and so would make negligible difference to annual NOx emissions on this link.

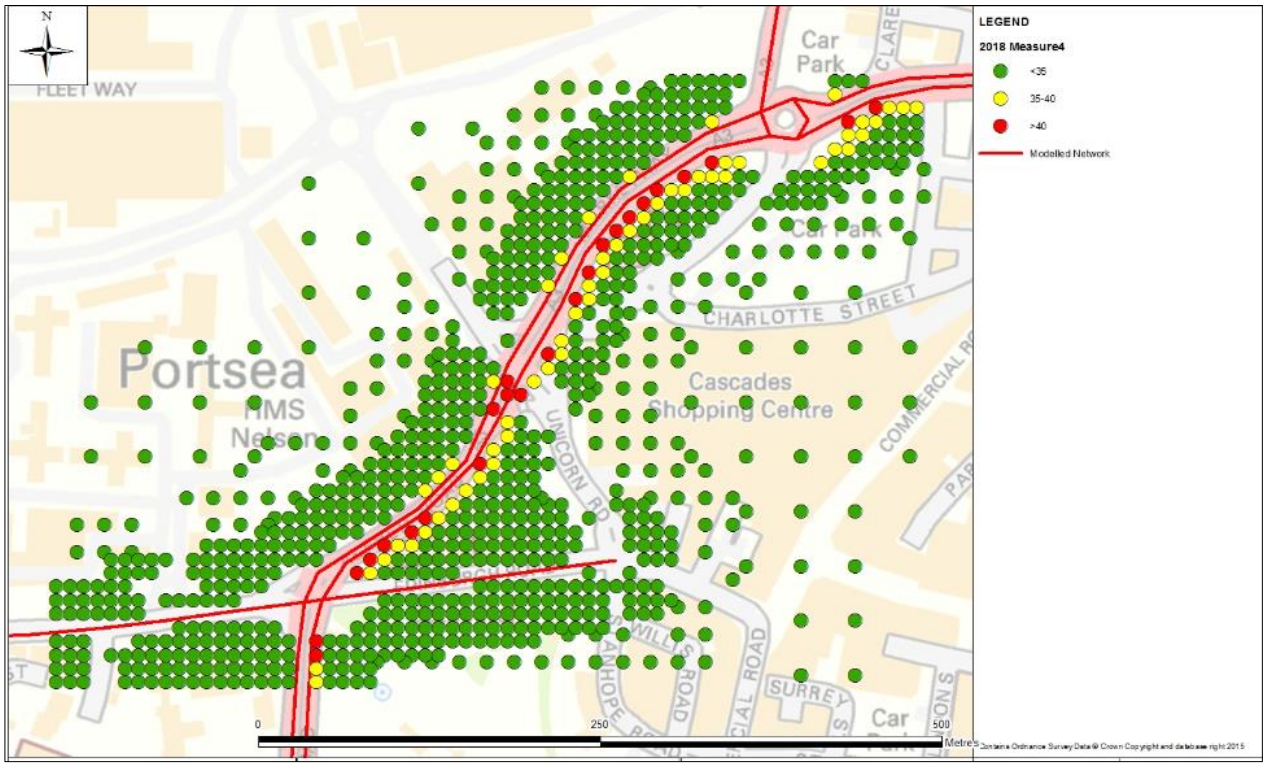
New Measure 4: Promote / Encourage the Uptake of Cleaner Vehicles

The Mayor of London's Air Quality Action Matrix suggests 2.5% electric cars within the London vehicle fleet could be achievable by 2020. Combined with people switching from conventional petrol and diesel-fuelled cars, there is potential for low-emissions vehicles to make significant penetration into the vehicle fleet. A summary of assumptions for this measure is given in Table 26.

The rollout of new EV charging infrastructure in Portsmouth is expected to increase EV ownership and use in the city. Furthermore, new car sales data suggests that fewer diesel vehicles are being purchased and replaced by more hybrid, plug-in hybrid, and other low-emissions vehicles. It is not clear to what extent the adoption of electric and low emissions vehicles will be in Portsmouth. Consequently, a scenario of replacing 5% of conventional cars with 1% electric cars and 4% plug-in hybrid petrol cars has been assessed.

In this scenario, annual NOx emissions on road link 18114 are predicted to reduce by 3.8%, from 3,243 kg/year to 3,117 kg/year. The maximum predicted annual mean NO_2 concentration for 2018 with the implementation of this new measure is 46.9 $\mu g/m^3$, which is a 5% reduction compared to the base situation. With this measure, there are 24 locations with concentrations above the EU Limit Value.

Figure 15 Modelled NO_2 concentration – Link 18114 – Measure 4 (2018)



Promoting and encouraging the uptake of cleaner fuelled vehicles is therefore not sufficient to bring compliance forward to 2018.

The maximum predicted annual mean NO_2 concentrations for years 2019 to 2022, inclusive for this measure are:

- 2019: 47.4 µg/m^3
- 2020: 45.1 µg/m^3
- 2021: 43.0 µg/m^3
- 2022: 40.6 µg/m^3

In 2019, 20 receptors within 50m of the road link are predicted to remain in exceedance with the implementation of this measure. In 2020, 11 receptors are predicted to remain in exceedance and 7 receptors in 2021. In 2022, only 1 receptor is predicted to be in exceedance. These results indicate that this measure alone is not sufficient to bring forward compliance.

New Measure 4: Sensitivity Test

The scenario assessed above of replacing 5% of conventional cars with 1% electric cars and 4% plug-in hybrid petrol cars is seen as a challenging target. Therefore, a sensitivity test has been carried out assuming the replacement 3.5% of conventional cars with 0.5% electric cars and 3% plug-in hybrids.

The maximum predicted annual mean NO_2 concentrations for years 2019 to 2022, inclusive for this measure are:

- 2019: 47.7 µg/m^3
- 2020: 45.4 µg/m^3
- 2021: 43.3 µg/m^3
- 2022: 40.9 µg/m^3

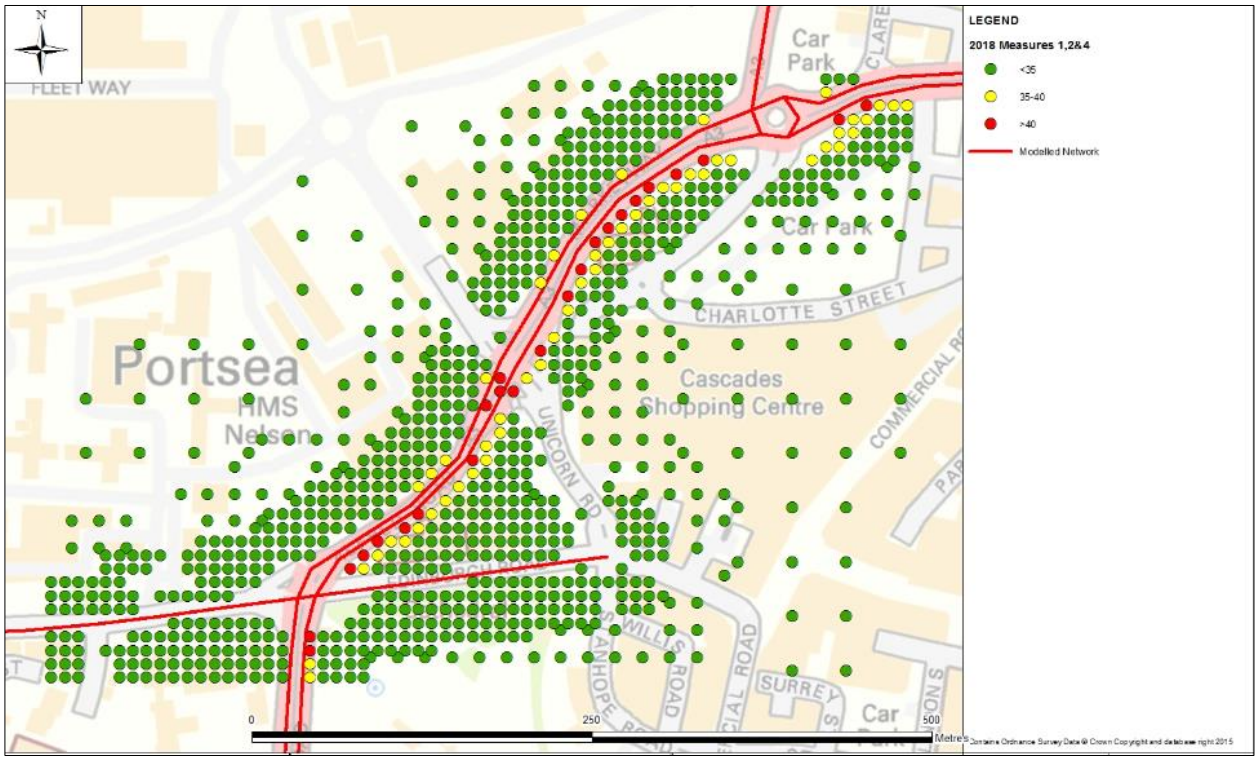
In 2019, 22 receptors within 50m of the road link are predicted to remain in exceedance with the implementation of this measure. In 2020, 12 receptors within 50m of the road link are predicted to remain in exceedance and 7 receptors in 2021. In 2022, only 1 receptor is predicted to be in exceedance. These results indicate that this measure alone is not sufficient to bring forward compliance.

Combined New Measures 1, 2 and 4

The combined influence of the bus retrofitting, reducing private car use measures and promoting/encouraging the update of cleaner vehicles on annual NOx emissions on road link 18114 is predicted to be an 8.9% reduction, from 3,243 kg/year to 2,954 kg/year.

The maximum predicted annual mean NO_2 concentration for 2018 with these three measures is 46.6 µg/m^3, which is a 5% reduction compared to the base situation. For this combined scenario, there are 24 locations with concentrations above the EU Limit Value, as indicated in Figure 16.

Figure 16 Modelled NO_2 concentration – Link 18114 – Measure 1, 2 and 4 (2018)



A combination of bus retrofitting, reducing private car use measures and promoting/encouraging the update of cleaner is therefore not sufficient to bring compliance forward to 2018.

The maximum predicted annual mean NO_2 concentrations for years 2019 to 2022, inclusive for this combination of measures are:

- 2019: 46.1 µg/m^3
- 2020: 43.9 µg/m^3
- 2021: 42.0 µg/m^3
- 2022: 39.7 µg/m^3

In 2019, 11 receptors within 50m of the road link are predicted to remain in exceedance with the implementation of this combination of measures. In 2020, 8 receptors within 50m of the road link are predicted to remain in exceedance, and 3 receptors are predicted to exceed in 2021. With this combination of measures, compliance would be brought forward by one year, to 2022.

Combined New Measures 1, 2 and 4: Sensitivity Test

A sensitivity test has been carried for the combined new measures assuming the lower replacement rate of 3.5% of conventional cars with 0.5% electric cars and 3% plug-in hybrids.

The maximum predicted annual mean NO_2 concentrations for years 2019 to 2022, inclusive for this combination of measures are:

- 2019: 46.4 µg/m^3
- 2020: 44.2 µg/m^3
- 2021: 42.2 µg/m^3
- 2022: 40.0 µg/m^3

In 2019, 12 receptors within 50m of the road link are predicted to remain in exceedance with the implementation of this combination of measures. In 2020, 9 receptors within 50m of the road link are predicted to remain in exceedance and 3 receptors in 2021. With this combination of measures, compliance would be brought forward by one year, to 2022.

Assumptions

The assumptions underpinning the modelling to estimate NO_x emissions and NO_2 concentration changes as presented in Part 4 are summarised in Table 26. This table also presents information on the evidence, sources or rationale behind each assumption.

Table 26 Model Assumptions

Scenario	Assumption	Evidence
Base situation	All measures in place since PCM modelling carried out. Traffic flows interpolated from 2015 to base year	Traffic flows by vehicle type taken from 2017 Source Apportionment Study. Data interpolated to the relevant year based on available model and count data from 2015 and 2020.

Scenario	Assumption	Evidence
	Assumed national vehicle fleet for urban areas as per EFT as no further information available. 2017 background concentration from urban background monitoring site (C4). Monitored background concentrations projected for future years based on predicted reductions in Defra's background maps	These forecast flows take into account existing measures in the LTP.
Measure 1 – Retrofitting bus/coach fleet	Modification of the fleet in the EFT by assuming pre-Euro VI buses and coaches are retrofitted with SCRRF and EGR (see Table 24). The proportions of vehicles in each Euro standard remain the same as no new vehicles purchased. Background concentrations as per the base situation No change in traffic flow or speeds.	There is no information on the actual bus fleet in Portsmouth. It is acknowledged that bus operators will not be able upgrade the fleet with new vehicles within this timeline, so it is assumed that the 578 buses and coaches in Portsmouth could be retrofitted by securing bus voluntary partnerships and funding.
Measure 2 – Reducing private car travel	It is assumed that if the measures contribute to a 20% reduction in car flows at peak hours, then this corresponds to an approximate 2% reduction in AADT car flows and a 1% increase in average speed (due to reduced congestion). Background concentrations as per the base situation No change in vehicle Euro standard composition.	Research from DfT suggests that a basic travel plan can achieve 3-5% reduction in employee car travel. Evidence from 20 larger organisations suggests that car use was reduced by 18%.[2] An overall reduction of 20% from the introduction of a number of travel plans and related packages to reduce private car use. It is assumed that the majority of measures would affect peak hour travel; this impact has been distributed across the day. Based on the observed diurnal traffic profiles, this is estimated to result in a conservative reduction of 2% of car travel and an increase in average speed on the road links of 1%.
Measure 3 – Promoting P&R	Reduction in flow of cars by 0.1% on both road links. Background concentrations as per the base situation No change to average speed or	The current Park and Ride operates at 80% capacity (532 spaces of the 665 available). If active promotion was able to improve patronage, potentially up to 90% capacity (up to 600 spaces), there may be an additional 50-70 cars using this facility each day. Given most cars

[2] DfT. Making Travel Plans Work – lessons from UK case studies.

Scenario	Assumption	Evidence
	vehicle Euro standard composition.	will use the M275 and A3 to travel into the centre, a conservative estimate of 40 fewer cars on these road links is therefore assumed. Based on the number of cars travelling on the roads included in this study (Table 23 and Table 25), the changes in flow are less than 0.1%. Evidence from Park and Ride's operating in Oxford, Leicester and Winchester has been sought when considering potential impacts on P&R schemes on private car use.
Measure 4 and Measure 4b – Promoting uptake of cleaner vehicles	Modification of the fleet in the EFT to assume that 5% of the diesel cars are replaced by 1% electric cars and 4% plug in hybrid cars applied to the fleet. Background concentrations as per the base situation No change in traffic flow or speed.	The fleet in the EFT assumed for the baseline has 41.9% petrol cars, 37.5% diesel cars, 2.6% hybrids and plug-in hybrids and 0.2% electric cars. Evidence in London suggests that by 2025, 2.5% of the car fleet could be electric. By installing EV charging points and offering free parking for electric vehicles this could bring this target forward to 2020.[3] The current fleet assumed in Central London in the EFT has 0.2% electric cars and 2.6% hybrids so is not dissimilar to that assumed in Portsmouth. Based on the work that PCC are doing to promote electric vehicles through their grant programme and roll-out of EV infrastructure, an optimistic assumption of 1% of the fleet to be electric and 4% plug in hybrid cars has been applied. As a sensitivity test, a more conservative estimate has been run assuming 0.5% electric and 3% plug-in hybrid cars.

[3] Mayor of London LLAQM Borough Air Quality Action Matrix available at https://www.london.gov.uk/sites/default/files/air_quality_action_matrix.pdf

Part 5: Setting out a preferred option

Portsmouth City Council has carried out a Targeted Feasibility Study for two road links (Census IDs 48196 and 18114) that were identified in Defra's PCM as being in exceedance of the EU Limit Value for NO_2. Data from the PCC's monitoring network and local air quality model have been used to update the baseline data from the PCM modelling. The updated baseline data indicates that without intervention road link 48196 will achieve compliance in 2020 – one year earlier than the PCM predictions. For road link 18114, in the absence of intervention, compliance is predicted to be achieved in 2023, more than two years later than PCM predictions.

PCC has explored a range of measures that could potentially bring forward the achievement of compliance for these road links, i.e. meeting Defra's primary critical success factor. From our long list of measures, four measures were taken forward for detailed appraisal. From these shortlisted measures, measure 3 to promote park and ride is not considered to meet this success factor, but the following measures have been identified as deliverable within the relevant timeframes and therefore offering the best opportunity to bring forward compliance and meet this success factor:

- Bus retrofitting to upgrade all pre-Euro VI buses.
- A package of measures to reduce private car use. It is anticipated that 2% reduction in private vehicle traffic and 1% increase in average vehicle speed is achievable.
- Promoting the uptake of cleaner vehicles. PCC has tested an ambitious target of replacing 5% of conventional-fuelled cars with 1% electric cars and 4% plug-in hybrids, along with a lower replacement rate of 3.5% comprising 0.5% electric cars and 3% plug-in hybrids.

Whilst none of these measures alone is sufficient to bring forward compliance, implementing all three measures is predicted to bring forward compliance from 2020 to 2019 for road link 48196 and from 2023 to 2022 for road link 18114, thereby achieving the primary critical success factor. It is therefore concluded that although there is not one single preferred option, all three measures should be pursued as far as is possible. PCC is already committed to measures to reduce private car use and promoting the uptake of cleaner vehicles through existing funding sources.

There are a number of secondary critical success factors that need to be considered for these options, including;

- Does it deliver value for money?
- Are the options affordable in terms of all financial costs?
- Are there likely to be distributional impacts on key groups of people?
- Are there any wider air quality impacts?
- What commercial or capability limitations might hinder implementation?
- Are the options achievable in the timeframe and with available resources?
- Will there be any displacement impacts on other roads?

A tabulated summary of the Targeted Feasibility Study findings for these two road links is shown in Table 27, and a summary of the individual measures against the primary and secondary critical success factors is provided below.

Of the assessed shortlisted measures, bus retrofitting and encouraging the uptake of low emission cars are predicted to be similar in their effectiveness in terms of reductions in NOx emissions and NO_2 concentrations, and thereby reduce exposure most quickly. Reducing private vehicle use would have smaller beneficial impacts with respect to NOx emissions and NO_2 concentrations.

New Measure 1: Bus Retrofitting

In 2018, bus retrofitting would reduce NOx emissions from road link 48196 by 4.3% and from road link 18114 by 3.3%. The estimated reductions in NO_2 concentrations in 2018 for the bus retrofitting measure relative to the base case are 2% and 3% at worst case receptor locations along road links 48196 and 18114, respectively. In 2019, there would be a 2% reduction in NO_2 concentration on both links. By 2020, road link 48196 would be compliant without this measure in place. For road link 18114, in 2020 and 2021 there would reductions in NO_2 concentrations of 2% compared to the base case and 1% in 2022, which is not sufficient to achieve compliance. By 2023, road link 18114 is predicted to become compliant without this intervention.

In terms of economic impacts and value for money, PCC has consulted the two major public service bus operators in Portsmouth (First Group and Stagecoach) in relation to bus retrofitting. First Group currently has 120 buses that operate in the Portsmouth area; 20 vehicles are Euro III, 3 vehicles are Euro IV, 73 vehicles are Euro V and 24 vehicles are Euro VI. Nineteen of the 20 Euro III vehicles are due to be replaced with Euro VI vehicles within the next 12 months. The remaining 77 pre-Euro VI buses could be retrofitted. First Group estimates that the cost of retrofitting would be in the region of £15,000 per vehicle and that once mobilised, there are the resources available to ensure that up to 4 buses can be retrofitted per week. For buses that operate on the 2 road links covered by this study, there are approximately 108 buses that could be retrofitted. The total cost of retrofitting all the buses on these routes is therefore £1,620,000. These costs are considered to be high given that the measure alone is not sufficient to bring forward compliance. Funding would also need to be sought to build this into the bus operators' ongoing vehicle replacement programme.

Bus retrofitting would not only benefit these road links, but would also have strategic, wider air quality benefits as the retrofitted vehicles will travel along other roads in the city and may also be used on other bus routes. There would be no anticipated traffic displacement impacts due to this measure or disproportionate effects.

New Measure 2: Package of Measures Aimed at Reducing Private Car Use

In 2018, assuming a 2% reduction in car traffic and 1% increase in average speed, NOx emissions are estimated to reduce by 1.7% on both road links; NO_2 concentrations in 2018 are predicted to reduce by 1% compared to the base case. Similar impacts are expected in

each future model year. This measure alone is not sufficient to achieve compliance on either road link.

In order to try to reduce private car use, PCC will commence a programme of workplace travel planning in autumn 2018, continuing into early 2019. This will involve the Council's consultants visiting businesses to provide information and advice to employers and employees on reducing their reliance on private cars and choosing alternative transport options. PCC plan to target 7 large businesses within or close to the city's AQMAs. Funding of up to £2,000 per business is being made available to support the development of effective workplace travel plans. This will be funded through the Air Quality Grant Programme.

A Personal Journey Plan initiative for residents is being run between 21st and 25th August 2018 in the Fratton area. This will feature a mixture of door-knocking and on-street events at shopping centres etc. where residents will be able to receive information and advice from the Council. Alongside this initiative, PCC representatives will be carrying out a 'walk-through' of AQMA No. 6 (London Road / Fratton Road) to give information to businesses and residents on air quality issues, and what they can do to help improve air quality.

In terms of the secondary critical success factors, the total cost of these types of measures will depend on the number of businesses involved and promotional activities conducted by PCC. To date, PCC has received a total funding of £450,000 through the Air Quality Grant programme, a proportion of which has been allocated for these activities. In addition to the estimated reductions in NO_2 concentrations alongside the compliance road links, it is likely that this measure would reduce car traffic on other roads in the city, resulting in wider air quality benefits. Furthermore, this measure would not cause disbenefits due to traffic displacement. In terms of economic costs and potential air quality benefits, this measure is considered to offer value for money.

New Measure 4: Promote / Encourage the Uptake of Cleaner Vehicles

A switch of 5% conventional cars to 1% electric vehicles and 4% plug-in hybrids would reduce NOx emissions by 3.8% and 3.9% from road link 48196 and 18114, respectively. The estimated reductions in NO_2 concentrations in 2018 with this measure relative to the base case are 1% and 3% for road links 48196 and 18114, respectively. In 2019, the estimated reduction is 2% for both links relative to the base case. Similar reductions are predicted for road link 18114 in 2020, 2021 and 2022, although these reductions are not sufficient to achieve compliance. A lower target of 0.5% electric vehicles and 3% plug-in hybrids would have a slightly lower benefit with respect to NO_2 concentrations on both road links.

Encouraging the uptake of low-emission vehicles – in particular electric vehicles – will be supported by PCCs roll-out of EV charging points later in 2018. PCC have an off-street trial of fast charging points in 3 PCC-owned car parks. There are also 2 charging points at Park-and-Ride. The charging points at Seafront Esplanade car park and Isambard Brunel

car park have already been installed; the third, at Clarence Pier car park is due to be installed soon. The on-street residential charging point scheme will result in the installation of approximately 50 charging points at 30 locations with identified demand. These are expected to be installed before the end of 2018. PCC received 75% grant funding of £100,000 from the Office of Low Emission Vehicles (OLEV) for this scheme. Depending on the success of this scheme, PCC will look to further expand the network of charging points. It is likely that PCC will include plans to upgrade its own vehicle fleet with lower-emissions vehicles in the forthcoming updated Air Quality Action Plan. PCC will also be working with local businesses with large vehicle fleets to provide advice on options for upgrading their vehicles to lower-emissions alternatives through their work funded through the Air Quality Grant programme.

It is expected that PCC would need to continue these programmes to achieve the lower target of 3.5% electric and plug-in hybrid vehicles entering the fleet within the expected timeframe. However, at this stage, the economic costs and resources required to do extend these programmes are unknown. In addition to the benefit of reducing NO_2 concentrations on the compliance links, there would be wider air quality impacts across the city, due to the reduction of petrol or diesel fuelled vehicles in the fleet. There would be no issues of traffic displacement under this measure, and no disbenefits on specific groups of people.

Table 27 Summary of Portsmouth City Council's Targeted Feasibility Study

Road link	**PCM identified link?**	**Summary of exceedance**	**New measures identified that could bring forward compliance**	**Costs and timeframes of implementing new measures**
Census ID 48196	Yes – this link was identified as having an exceedance in the national PCM model	The national PCM modelling predicted that compliance would be achieved in 2021. We have updated the baseline data using local modelling data, which shows the link will achieve compliance in 2020. Summary of NO_2 concentration predictions from our modelling: 2018: 44 µg/m^3 2019: 42 µg/m^3 2020: 40 µg/m^3	Measures that have happened since 2015 have been identified but these have not been sufficient to bring forward compliance. New measures have been identified that could bring forward compliance on this road link. These are: • Bus retrofitting • Package of measures to reduce private car use • Promoting the uptake of cleaner	Our recommended measures that bring forward compliance are bus retrofitting and measures to reduce private car use and promoting the uptake of cleaner vehicles. **Bus retrofitting** is estimated to cost £15,000 per bus. Based on an estimate that 108 buses in use in Portsmouth are eligible for retrofit / upgrade that operate on these road links, this

Road link	PCM identified link?	Summary of exceedance	New measures identified that could bring forward compliance	Costs and timeframes of implementing new measures
			vehicles Individually, none of these measures are likely to bring forward compliance. However, in combination, these new measures could bring forward compliance to 2019.	would be a cost of £1.62 million. We think that up to 50 vehicles could be retrofitted in 2018, and 100 vehicles could be retrofitted in 2019. This will require buy-in from the main bus operators, First Bus and Stagecoach. **Measures to reduce private vehicle use** are estimated to cost less than £500,000. This will be distributed across workplace travel plans, personal journey plans, school travel plans and improvements to cycling infrastructure to encourage active travel. Most of the funding for these measures has been secured through the Air Quality Grant Programme. **Promoting the uptake of cleaner vehicles** will be achieved through the installation and publicising of 50 new slow on-street electric vehicle charging points and an additional 30 (with identified demand) throughout the city as well as fast charging points in three car parks and

Road link	PCM identified link?	Summary of exceedance	New measures identified that could bring forward compliance	Costs and timeframes of implementing new measures
				the Park and Ride car park. PCC has received 75% grant funding of £100,000 from OLEV for the installation of off-street charging points. PCC will also be working with local businesses with large vehicle fleets to provide advice on reducing emissions from their operations through converting to low-emissions vehicles and greener driving techniques.

Road link	PCM identified link?	Summary of exceedance	New measures identified that could bring forward compliance	Costs and timeframes of implementing new measures
Census ID 18114	Yes – this link was identified as having an exceedance in the national PCM model	The national PCM modelling predicted that compliance would be achieved in 2020. We have updated the baseline data using local modelling data, which shows the link will achieve compliance in 2023. Summary of NO_2 concentration predictions from our modelling: 2018: 49 µg/m^3 2019: 48 µg/m^3 2020: 46 µg/m^3 2021: 44 µg/m^3 2022: 41 µg/m^3 2023: 39 µg/m^3	Measures that have happened since 2015 have been identified but these have not been sufficient to bring forward compliance. New measures have been identified that could bring forward compliance on this road link. These are as above for road link 48196. Individually, none of these measures are likely to bring forward compliance. However, in combination, these new measures could bring forward compliance to 2022.	

Overall, it is expected that the combination of all three appraised measures bring forward compliance on both road links by one year. In the case of road link 48196, this would be from 2020 to 2019 and for road link 18114, from 2023 to 2022.

PCC is already committed to measure 2 to reduce private car use and measure 4 to promote the uptake of cleaner vehicles through existing funding sources. Measure 1, to retrofit buses to meet the Euro VI emission standard, would require further consultation with the bus operators to fully understand the costs and benefits of a scheme.

All three measures would have wider secondary benefits on air quality across the city due to the anticipated improvements to overall vehicle fleet and flows. In terms of the economic impact and financial cost, measure 1 to retrofit buses is considered to be high, compared to the costs to pursue measures 2 and 4, but this measure has potentially greater impacts in terms of reducing NO_2 concentrations.