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

Local authorities covered	Southend-on-Sea Borough Council

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

Part 1: Understanding the problem

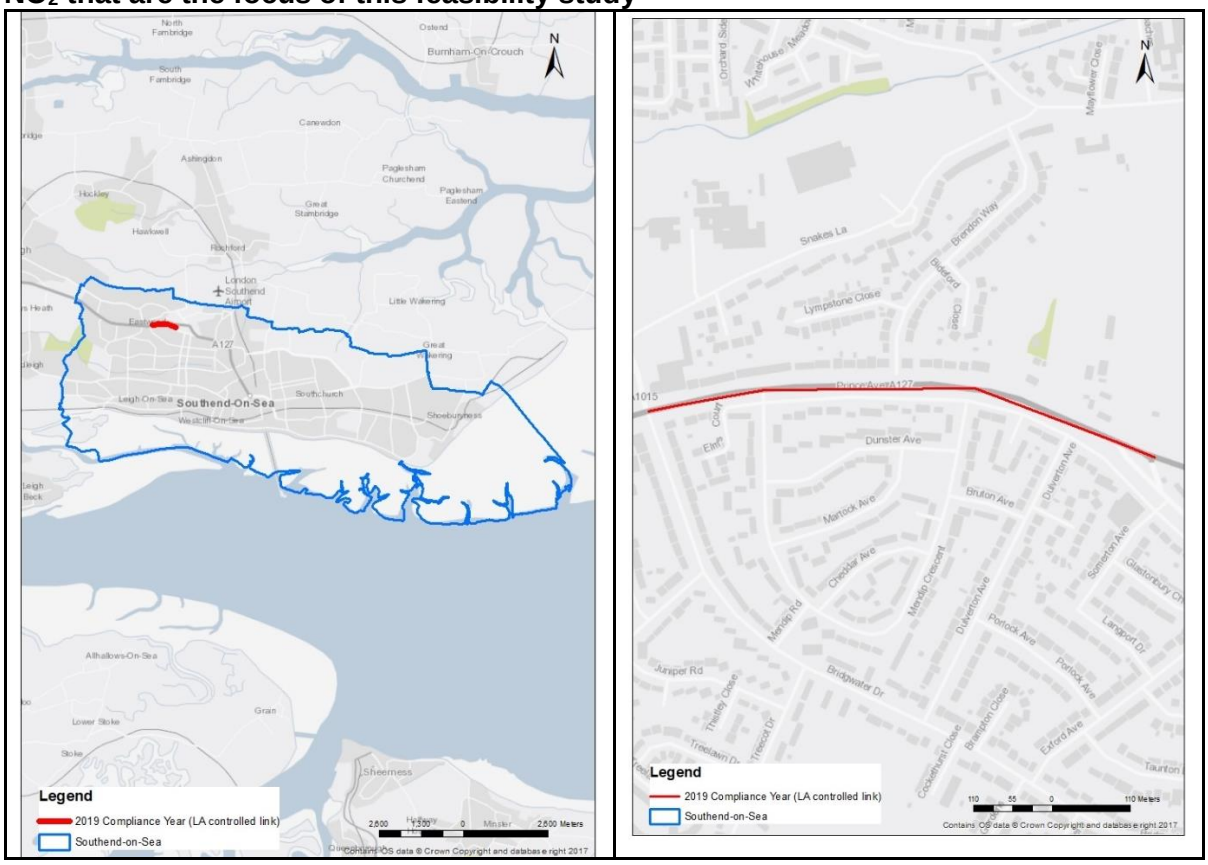
This section should set out background on the information about the road links projected to have exceedances in the PCM national model, in combination with source apportionment data, to provide a description of the severity of the NO2 exceedance and its possible sources and causes. It should set out the scale of the problem and the case for change. Maps and local data should be included. ***Each road link should be addressed in turn.***

Southend-on-Sea, like many areas across the UK, continues to experience areas of poor air quality. The Council has been highlighted by Defra as one of a number of Local Authorities where the UK's national air quality assessment has identified road links that are currently exceeding the annual mean nitrogen dioxide (NO_2) limit value, with exceedances predicted to continue into 2019.

The Council, along with 32 other Local Authorities, received a Ministerial Direction on the 23rd March 2018 to undertake a feasibility study into NO_2 compliance. This is the 'third wave' of Local Authorities charged with undertaking such a study. Previously 5 Local Authorities (the so called 'first wave') were directed to undertake a feasibility study, these were followed by a second wave of 23 Local Authorities directed to undertake a local study in 2017.

The UK's national air quality plan has identified the A127 within Southend-on-Sea Borough Council as in exceedance of the annual mean NO_2 Air Quality Directive Limit value. This road link covers a stretch of the A127 from the junction at Prince Avenue to the Kent Elms junction. A map of the road link highlighted as in exceedance within the UK's national air quality assessment is shown in Figure 1.

Figure 1: Map of Southend-on Sea Borough Council showing the non-compliant links for NO_2 that are the focus of this feasibility study



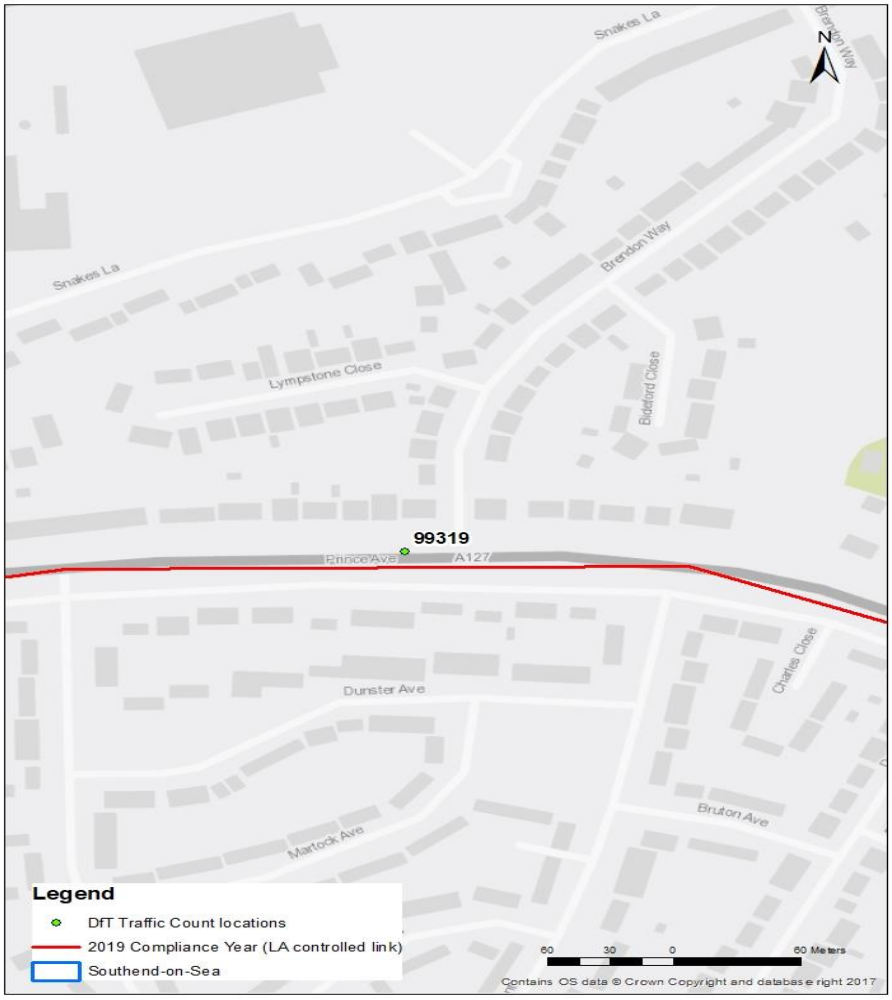
The concentrations of NO_2 along this road link is predicted to demonstrate compliance in 2019 (Table 1). In order to achieve compliance in 2018 the concentrations on link 99319 need to reduce by at least 2µg/m^3.

Table 1: Predicted concentrations of NO_2 on A127 road link for 2017 – 2021. Cells highlighted in red exceed the NO_2 limit value, while green cells show the road links are compliant. The A127 demonstrates compliance in 2019

Census ID of road link	2017	2018	2019	2020	2021
99319	44	42	40	38	36

The Department for Transport (DfT) have 1 traffic count location along the section of non-compliance with the NO_2 EU limit value. Census ID 99319 is located between the A1158 junction and the A1015 (Figure 2).

Figure 2: Location of DfT traffic count points along the non-compliant A127 road links



The DfT made the following traffic counts during the recent years at the count locations shown above (Table 2). It should be noted that the Defra national modelling used 2015 as the baseline. Projections into future years are based on national traffic growth factors and from 2015 to 2016 this was in the region of 2%. Traffic counts for Census ID 99319 show a reduction in traffic between 2015 and 2016 by ~1 %.

Table 2: Traffic counts at DfT sites along the A127 road links of interest for 2012 – 2016

Year	Total traffic	99319					
		PCL%	MCL%	Cars%	LGV%	HGV%	Bus%
2012	50234	0%	1%	80%	15%	4%	0%
2013	50096	0%	1%	80%	15%	4%	0%
2014	49673	0%	1%	80%	15%	4%	0%
2015	48090	0%	1%	78%	17%	4%	0%
2016	47800	0%	1%	76%	18%	4%	0%

Source apportionment information for the non-compliant road links was taken from the Defra PCM model (Table 3).

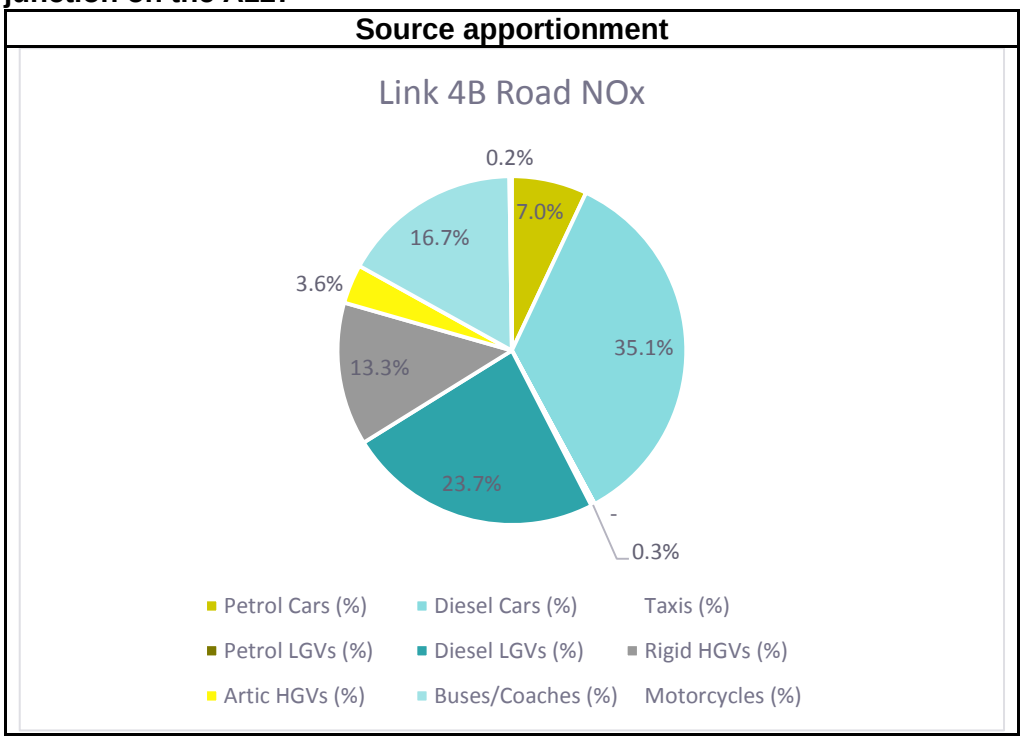
Diesel cars contribute the largest proportion of total NO_x from road sources, followed by diesel LGV's. A significant proportion (21 %) of the total NO_x concentrations are from non-traffic urban background sources. The A127 is the key route for vehicles to enter and leave the centre of Southend-on-Sea. The largest proportion of emissions is from cars (35 % of NOx concentrations) suggesting that these links are used for personal journeys including commuting to work places or leisure activities/shops located in the town centre. Many of the city-centre car parks (e.g. NCP car parks at Central Station, Royals Shopping Centre car park) used to access the town centre shops, railway and bus stations will primarily be accessed via the non-compliant road link on the A127. Please note that the source apportioned concentrations presented below may not add up to 100%, due to number rounding.

Table 3: Source apportionment for total NO_x (%) from Defra PCM model

Census ID	Regional BG	Urban BG (non-traffic)	Urban BG (traffic)	Diesel Cars	Petrol Cars	Diesel LGV	Petrol LGV	rHGV	aHGV	Bus
99319	7	6	8	28	7	23	0	13	4	3

Southend-on-Sea council has been proactive in improving air quality within the area of non-compliance and commissioned a detailed assessment of Kent Elms junction improvements. Part of this involved a detailed traffic survey, which was in turn used to calculate site specific source apportionment for the eastbound link from the Rayleigh Road/Prince Avenue junction. The source apportionment has been presented as both a pie chart and within table 4 below. However, the detailed assessment undertaken used the default fleet mix within the emission factor toolkit rather than local fleet composition data.

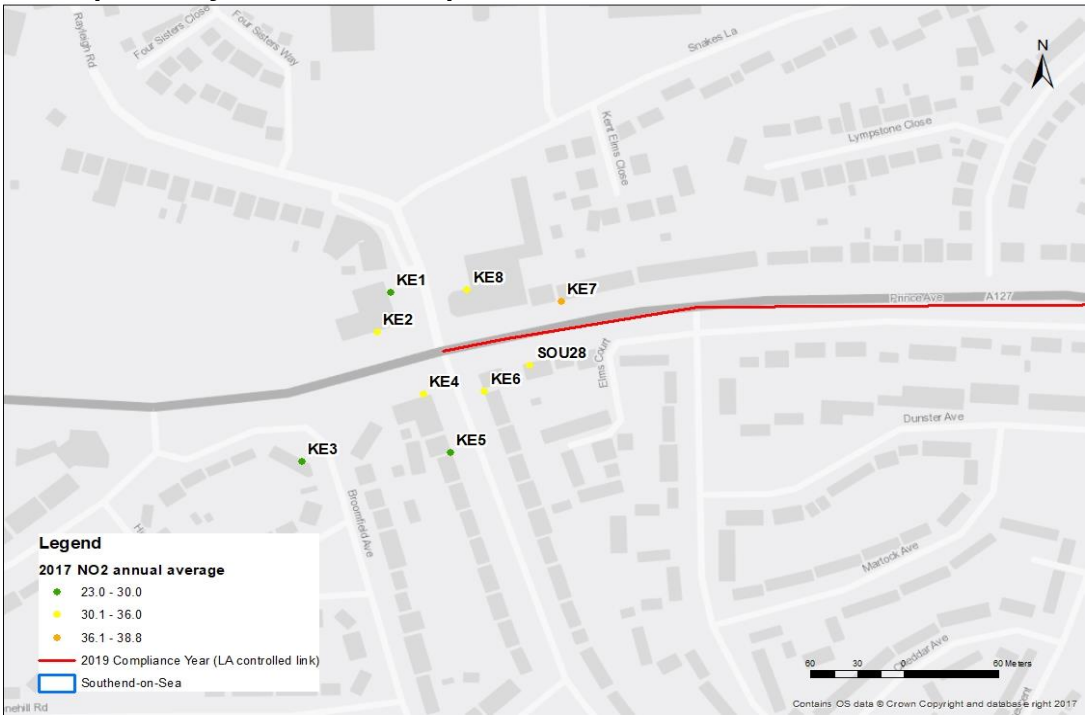
Figure 3: Source apportionment for total NO_x (%) from local modelling at Kent Elms junction on the A127



The source apportionment shows that diesel cars are the biggest contributors to NO_x emissions closely followed by emissions from diesel LGVs.

Southend-on-Sea Borough Council deployed nine monitoring locations within close proximity to the A127 links of interest – the maximum measured annual average concentration of 38.8 µg/m^3 (KE7) NO_2 during 2017, which is much lower compared to those concentrations predicted by Defra for 2017 (Figure 3).

Figure 4: Map showing Southend-on-Sea Borough Council NO_2 monitoring locations within close proximity of the non-compliant PCM link



This feasibility study aims to identify measures which could reduce the concentrations of NO_2 on this road link as quickly as possible with the objective of bringing forward compliance in the shortest possible time. This objective could be achieved by reducing the NO_2 concentration in 2018 by at least 2 µg/m^3.

Southend 2016 Baseline Modelling

Receptors

Receptors at 4m from the kerbside and greater than 25 metres from major junctions have been included for the modelling exercises in Part 4. 'Major Junctions' have been defined as roads where the PCM modelled links meet, the Kent Elms junction and A127/A1158 junction meet this criterion.

Traffic data

In June 2016 Southend-on-Sea Borough Council commissioned a traffic survey. Traffic counts were provided for 15-minute intervals over a 12-hour period (7am to 7pm). A coefficient was supplied which converts 12-hour annual average weekday traffic (AAWT) to 24-hour annual average daily traffic (AADT) and has been used with Traffic counts taken on traffic survey neutral days (weekdays during term-time).

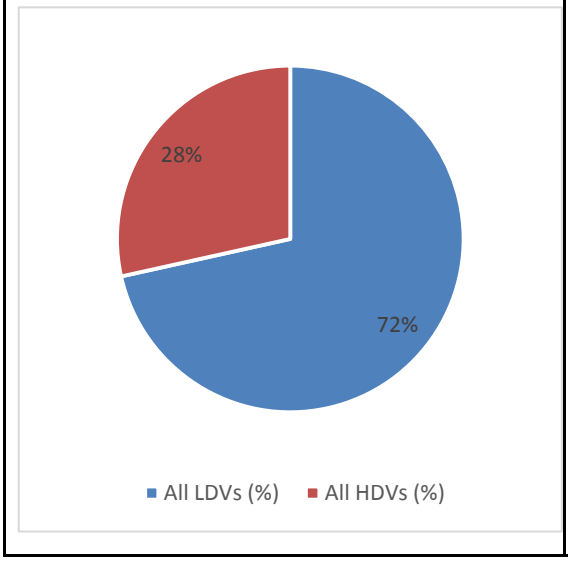
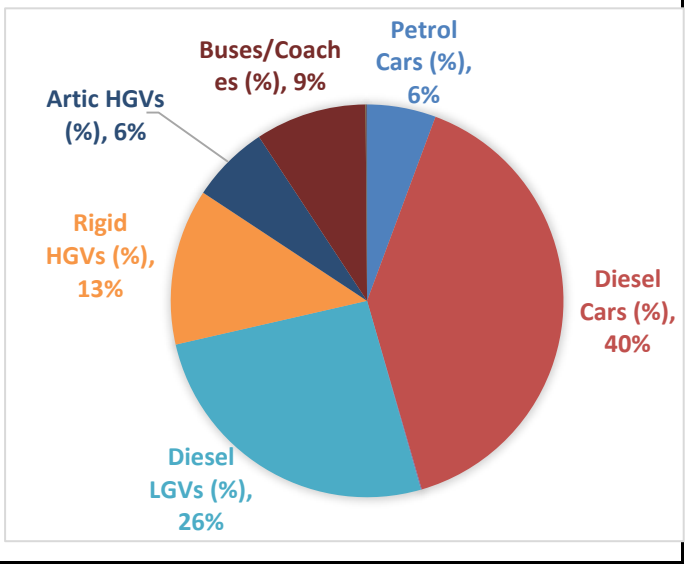
In the absence of measured speed data for June 2016, speed data was taken from a survey undertaken in 2015. At the time of writing there are no known road schemes that have altered speed between 2015 and 2016, as such the 2015 speed data is considered representative of 2016. Local air quality management technical guidance 16 (LAQM.TG (16)) was followed to apply reduced speeds for queues/congestion approaching junctions and roundabouts.

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

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

NOx emissions were estimated using the Defra's emission factor toolkit (EFT version 8.0.1) which is based on COPERT V emission factors. The road NOx emission source apportionment is provided in Figure 2.

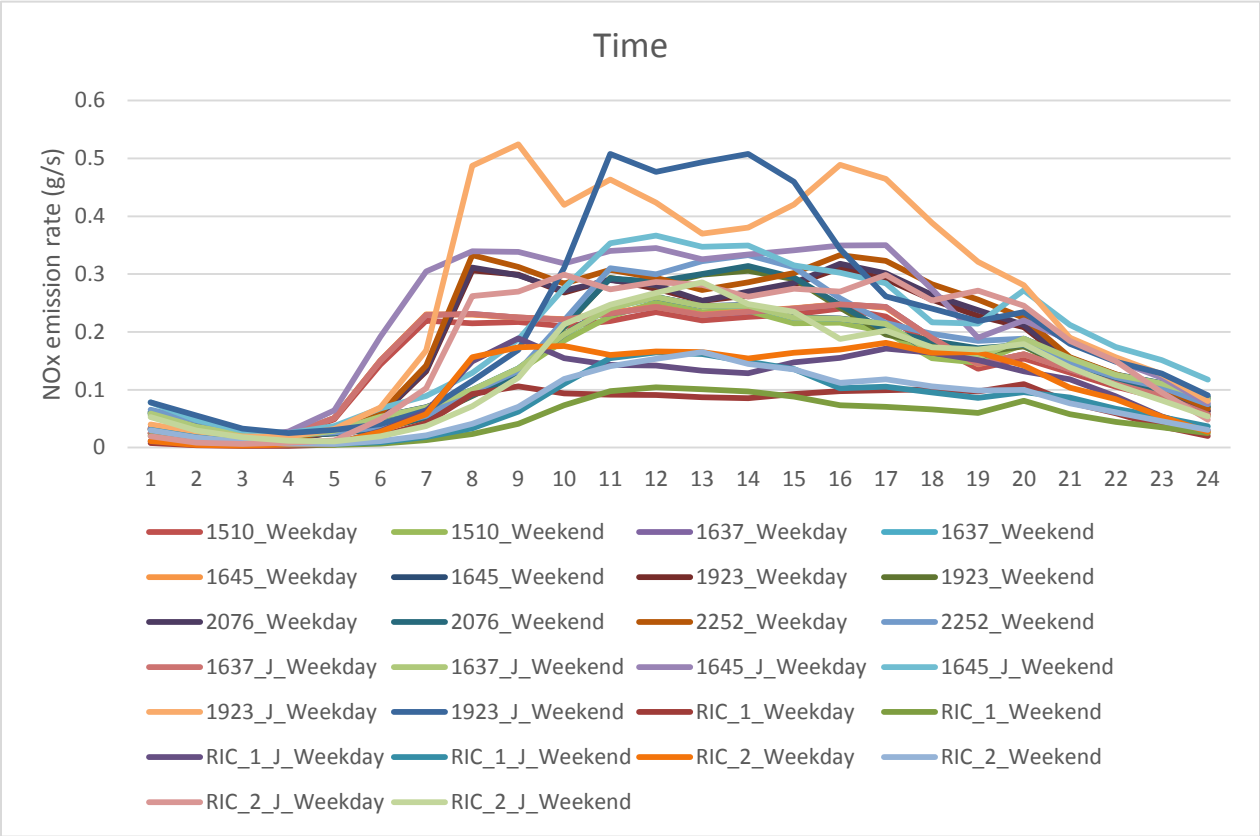
Figure 5: Average source apportionment across all the modelled road links

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

Diurnal profile

A diurnal profile has been included in the verification and additional scenarios, the 2016 diurnal profile is shown in Figure 6.

Figure 6: Diurnal profile for weekdays and weekends for each road link



As expected all roads show that emission rates are at their lowest between the off-peak period 23:00 – 07:00, with the greatest emissions occurring at 08:00 and 16:00.

Verification

LAQM.TG (16) guidance on verification was followed with a total of 8 monitoring locations being used in the process. The model was verified against oxides of nitrogen (NO_x) and Nitrogen Dioxide (NO_2) and the root mean square error, fractional bias and correlation coefficient were calculated to assess the model performance, a summary has been provided in Table 4.

Table 4: Dispersion Model Calibration Performance

Process in verification	No adjustment	With primary road NO_x adjustment
No. sites	**8**	**8**
Modelled NOx Roads v Monitored NOx Rd Factor	Na	1.555
Root Mean Square Error	**8.0**	**3.6**
Fractional Bias	0.3	0.1
Correlation Co-efficient	0.83	0.83
No with +-10%	0	6
No with +-25%	6	2

There was a tendency for the model to under-predict with a range of +3% through to -22% from the comparison of total modelled NO_2 to measured NO_2. There is a tendency to under-predict with and without adjustment, however adjustment improves agreement between modelled and

measured. As such it is considered that adjustment improves model performance and the factor 1.555 has been applied to modelled road NO_x at receptors.

2016 Baseline results

Figure 7 shows that the maximum predicted annual mean NO_2 concentration in 2016 is 41.4 $\mu g/m^3$.

Figure 7: 2016 baseline modelled concentrations

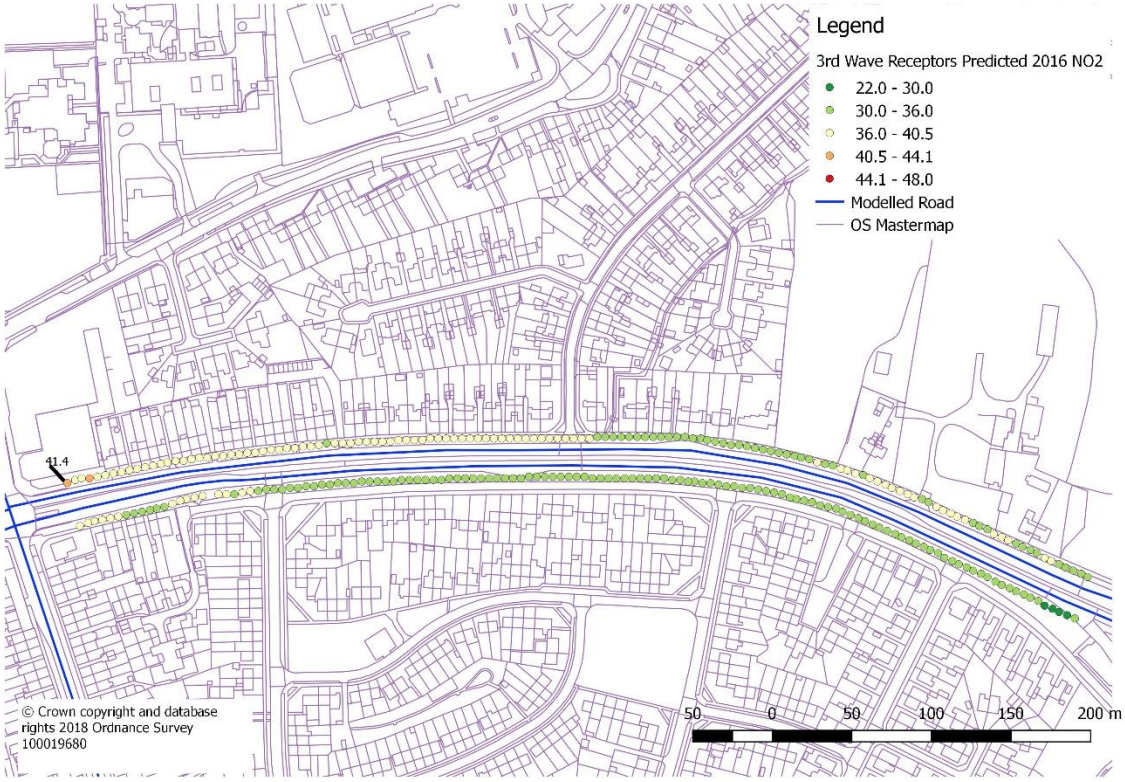
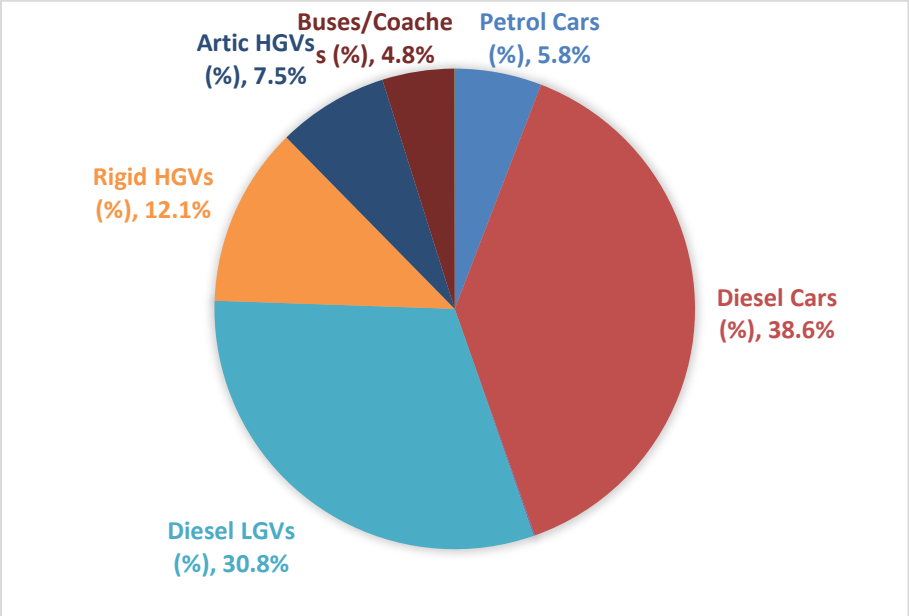


Figure 8: Source apportionment of link closest to receptor predicted to be in exceedance of the NO_2 annual average EU limit value



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

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

We have used the information gathered in Part 1 to identify a list of measures that have the potential to bring forward the year of compliance for the road links targeted in this work. The source apportionment data highlighted that cars, specifically diesels, are the main contributor to the non-compliance on A127, Prince Avenue followed by diesel LGVs. Therefore, we have included measures that will reduce emissions from these sources.

Committed measures

These are measures which are going to be implemented where air quality benefits are highly likely. However, the implementation has not yet been completed.

- A127 Kent Elms Corner junction improvements, likely to be completed in August 2018.
- Bus retrofits, under the Clean Bus Technology Fund.

New measures

These are measures which have not yet been granted planning permission or are speculative measures for consideration in the subsequent parts of this feasibility study.

Proposed within November 2017, Air Quality Action Plan

- Bell Junction, A127 improvement – scoping stage.
- Park and ride scheme into Southend town centre.
- Promote uptake of sustainable transport such as electric vehicles and installation of electric charging points.
- Southend intelligence hub – SMART city.
- Introduction of “green walls” and tree planting along specific sections of A127 where appropriate.

Additional measures for consideration in the long list

- Traffic signalling improvements.
- Low emission vehicle lease/salary sacrifice scheme to target the worst polluting vehicles (such as privately-owned diesel cars).
- Increase parking fares in city centre to encourage people to take public transport instead of their cars.
- Designated low emission parking areas to discourage more polluting vehicles to enter the city-centre car parks, or alternatively parking incentives such as reduced fares for low emission vehicles.
- Installation of more electric vehicle charging points within the city to promote use of these low emission vehicles. Creation and promotion of electric vehicle car clubs to improve the accessibility of electric vehicle to the public.
- Restrict delivery times to the city centre to prevent LGV and HGV (all or more polluting goods vehicles) deliveries during peak traffic times.
- Retrofit scheme for LGV, HGV or further consideration of buses to convert to low emission vehicle.

- Prioritise low emission vehicles at taxi ranks e.g. those at the station. Restrict Southend station drop off access.
- Public engagement promoting sustainable transport, including taking public transport, walking / cycling, and encouraging car-sharing.
- Encourage / facilitate home-working to reduce journeys into the city centre.
- Congestion charging.

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.

Introduction

Southend's part 3 report sets out the 2016 baseline results and which measures should be taken through to part 4. As such part 3 is divided into two sections:

1. Southend 2016 Baseline Dispersion Model; and
2. Short list of measures to be taken forward.

Short list of measures to be taken forward

On the 9th of May JAQU agreed with Southend-on-Sea suggested approach of taking forward two measures from the long list:

1. A127 Kent Elms Corner junction improvements, likely to be completed in August 2018; and
2. Bus retrofits, under the Clean Bus Technology Fund.

Kent Elms junction improvement is scheduled for completion in June 2018 and funding for Bus Retrofits has been approved. In addition, 2018 is the last year that non-compliance is predicted along this link in the PCM model with a 2 $\mu g/m^3$ decrease required to bring forward compliance. Taking this into account JAQU agreed that the air quality improvements associated with these two measures should be assessed to determine if compliance is brought forward before considering additional measures. If these two additional measures do not bring forward compliance then the 'long list' will be revisited.

Summary

The 2016 baseline model shows exceedances of only the NO_2 annual mean at Annex III B 1(a) 2008/50/EC Air Quality directive equivalent receptors. No exceedances are predicted at fixed habitation. Two measures are proposed for the part 4 stage of the assessment, which considers a junction improvement at Kent Elms and bus retrofits.

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.

Introduction

As mentioned in the summary of Part 3, a committed development (Kent Elms Junction improvement) and committed measure (Clean Bus Technology Fund) have been taken forward to part 4 to establish if there is still a risk of non-compliance after implementation. Part 4 presents findings from quantifying changes from the above measure/developments through dispersion modelling.

Traffic projection methodology

Traffic modelling was undertaken for the Kent Elms junction improvement which included traffic flows and speed for the peak periods; 07:00 – 10:00 am and 16:00 - 19:00 pm. A simple arithmetic mean was undertaken to establish the average hourly traffic flow for each period. Whereas a weighted average was carried out to calculate the average hourly speed. Detailed traffic flows were provided for the following vehicle types:

1. Car;
2. LGV;
3. OGV1 – Rigid heavy goods vehicles
4. OGV2 – Articulated heavy goods vehicles
5. PSV – Buses and coaches

This data enabled the calculation of an average hourly fleet mix for the am and pm traffic periods. The non-peak traffic flows were calculated by applying the coefficient for each road link between the combined am/pm for 2016 and 2018. The speed was assumed to be the same as the 2016 traffic survey during the inter-peak and off-peak, as free flowing conditions were observed, in addition the fleet mix was kept constant.

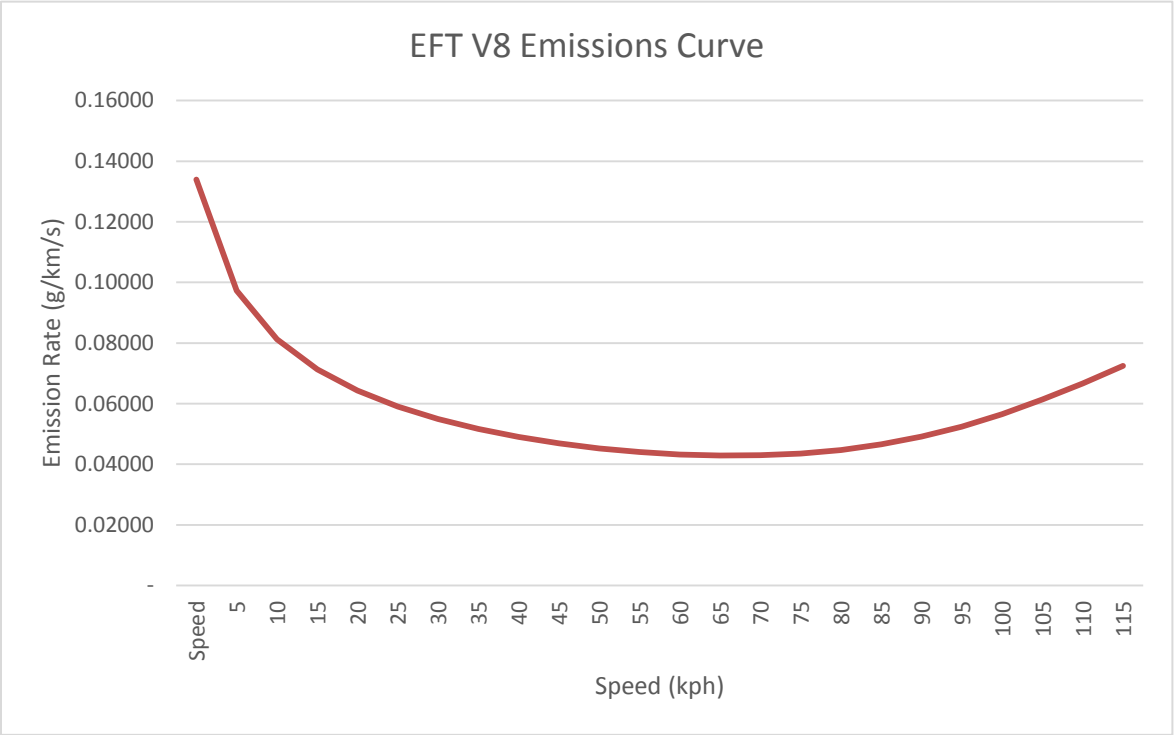
The traffic consultant's assessment year was 2021, whereas the opening year of the Kent Elms junction improvements is 2018. As such linear interpolation was undertaken between the 2016 observed traffic counts and the modelled 2021 traffic flows to establish traffic flows for 2018.

The net change in am and pm traffic flows were apportioned to the relevant hours and the coefficient of the combined am/pm DM to DS peak hour traffic flows were applied to inter-peak and off-peak hours.

2018 predicted concentrations without and with Kent Elms junction improvements

The same receptor presented within Figure 7 is predicted to experience the maximum concentrations in 2018, without the scheme these are predicted to be 36.7 µg/m^3. This is a reduction of 4.7 µg/m^3 between 2016 and 2018 and the main factors contributing to this decrease are the change in speed, from 37 to 58 kph in the am period. Traffic speeds in 2016 were reduced due to ongoing road works, resulting in the average speed of 37kph.There is a strong correlation with increasing speed and lower emission rates between 5kph through to 60kph, as shown in Figure 8. This does not reflect the actual traffic data used in the assessment but shows how emission rates change with a constant traffic flow and fleet mix, with only speed changing in 5 kph increments.

Figure 8 emission rate feedback with changes to speed



In addition to speed changes, fleet mix turnover to a cleaner fleet of vehicles has reduced emissions e.g. Table 5 shows a reduction in the proportion of cars within the EURO 4, 5 and 6 categories and an increase in EURO 6c.

Table 5 Change in car EURO categories between 2016 and 2018 in EFT V8 fleet projections

Euro Category	2016	2018
Pre-Euro 1	0%	0%
Euro 1	0%	0%
Euro 2	0%	0%
Euro 3	8%	4%
Euro 4	23%	16%
Euro 5	45%	35%
Euro 6	24%	20%
Euro 6c	0%	25%

A sensitivity test has been undertaken to establish what the predicted concentrations would be with the 2016 EURO fleet mix assumptions being applied to the 2018 without Kent Elms junction improvement scheme traffic data. This will help establish if there if there is a risk of non-compliance without any of the forecasted improvements in EURO vehicles. The same location identified in Figure 7 is predicted to experience the maximum concentration, with an annual mean of 40.2 µg/m^3.

There is 0.3 µg/m^3 decrease associated with the introduction of Kent Elms as there is a slight improvement in peak period vehicle speeds. As the Kent Elms junction improvement is in operation, the modelled concentrations from this scenario have been taken forward to Table 6 for comparison against the PCM projections.

Table 6: Comparison of PCM modelled concentrations against those from the feasibility study

Census ID of road link	PCM modelled 2018	With Kent Elms modelled 2018	With Kent Elms modelled 2018 sensitivity
99319	42	36.4	39.9

It can be seen in Table 6 that the PCM model projected that the annual mean NO_2 EU limit value would be exceeded in 2018, however the detailed local modelling demonstrates that this road link in Southend is within the annual mean EU limit value.

2018 with scheme and clean bus technology fund (CBTF)

The clean bus technology fund is likely to bring a minimum of 42 bus retrofits for Southend's service routes 25 and 7/8. These retrofits would bring the buses up to a EURO VI standard. Only service route 25 passes the non-compliance link, which from a review of travel lines website shows 92 buses using the A127 each day. However, confirmation has not been received on the number of buses which make up these 92 movements from the service operator, nor the proportion of service route 25 that will be retrofitted, given that the changes to fleet mix in 2018 and speed demonstrate compliance it has been decided not to quantify improvements associated with the CBTF. As such the modelled results do not contain any assumptions regarding the potential benefits of CBTF.

Conclusions

Observations from a 2016 traffic survey have been used which provide locally derived information on traffic volume, fleet mix (Car %, HDV % etc.) and speed to predict concentrations in a detailed dispersion model. This detailed dispersion model shows that Southend is non-compliant with the annual mean NO_2 EU limit value in 2016. However, a lower energy driving style observed in speeds for the Kent Elms junction improvement and a cleaner fleet projected for 2018 suggest that Southend will be compliant with the NO_2 annual mean EU limit value. The uptake of cleaner EURO standards were reviewed in the national fleet projections and 10% of diesel cars are estimated to shift between EURO 5 and 6. A sensitivity test was undertaken to establish the impact of using a 2016 EURO fleet mix upon the projected year of compliance, this also shows compliance with the annual mean limit value and reinforces the likelihood that Southend will be compliant.

In addition to a lower emission driving style, Southend have been awarded funding to retrofit a minimum of 42 buses to EURO VI, under the Clean Bus Technology Fund (CBTF). The retrofits will affect two service routes, one of which passes along the non-compliance link, and are anticipated to further reduce NO_2 concentrations along the non-compliance link. Due to uncertainties surrounding the proportion of buses along the A127 that will be retrofitted, the potential benefit of CBTF has not been included in the air quality modelling. This means that emissions from buses are likely to be over-represented. Dispersion modelling has been used to demonstrate that committed developments and measures in Southend will achieve compliance on PCM link (99319) with the EU limit value by 01/01/2019 i.e. it is predicted that the 2018 annual mean will be compliant.

Part 5: Setting out a preferred option

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

As the already committed Kent Elms junction improvement brings forward compliance, no additional measures are required and Part 5 is not applicable to this particular feasibility study.

Table 7: Summary of compliance status and measures for each road link

Road link	PCM identified link?	Summary of exceedance	Measures identified that could bring forward compliance	Costs and timeframe
99319	**Yes**	Updated baseline data using local modelled data shows the link is non-compliant in 2016, but is predicted to achieve compliance in 2018 with lower energy driving environment (speeds with lower NO_x emissions) and a cleaner fleet. 2016 data: 41.4 µg/m^3 2018 data: 36.4 µg/m^3	NA	NA