## OBC Supplement – Technical Note – AC & TFS Comments

## Further Clarifications April 2019 – Taxi-Related Assumptions

## 1.      Introduction

This Technical Note collates and reports the various assumptions relating to black cabs and private hire vehicles and the appraisal of the impacts of the taxi fleet's responses to Sheffield & Rotherham Preferred Option for tackling their $NO_2$-related air quality problems.

This note provides additional clarification and context in respect to the costs and benefits associated with these responses.  It is designed to be a supporting document for the Outline Business Case which was generated by the Clean Air Zone Feasibility Study and submitted to the Joint Air Quality Unit (JAQU) in December 2018 and should therefore be read in conjunction with the main OBC.

This note contains the following sections:

- Sections 2 and 3 explain why the SCC/RMBC Preferred Option includes upgrading the black cab and car-based taxi fleets to ultra-low emission standards;
- Section 4 provides a detailed description of the relevant taxi-related assumptions used in the traffic emissions modelling of the Preferred Option (CAZ 3C$^+$) and the associated taxi-related cost assumptions; and
- Section 5 reports our emissions and air quality forecasts for the Preferred Option and various taxi-related sensitivity tests.

**Note that the full Preferred Option is required to achieve area-wide compliance and as a result, it should be considered as an integrated package, rather than as a list of stand-alone measures.  It is on this basis that it has been approved by the Cabinets in the two Authorities.**

**Terminology**

We use the term 'local taxis' to refer to the combination of London-style 'black cabs' and car-based vehicles which are licenced to provide either hackney carriage or private vehicle hire services in the Sheffield and Rotherham area.

This local taxi fleet is split into three sub-fleets, as follows:

- Sheffield 'Black Cabs' (predominantly providing Hackney Carriage services);
- Sheffield car-based taxis (predominantly providing Private Hire Vehicle services); and
- Rotherham taxis (predominantly car-based vehicles, providing a combination of Hackney Carriage and Private Hire Vehicle services).

There are currently negligible numbers of 'London black cab'-style vehicles in Rotherham's taxi fleet. Any that do exist are treated as part of the single combined Rotherham taxi fleet.

## 2. Justification for Improving the SCC & RMBC Taxi Fleets

**Overall Emissions from Local Taxis**

Analysis of the total $NO_X$ emissions predicted by the SRTM3b-based traffic & emissions model suggests that local taxis are responsible for around **5%** of the total $NO_X$ emissions from traffic inside the proposed central Sheffield CAZ (referred to as Charging Area 3 in the OBC documentation).

This analysis is based on splitting the modelled car traffic on each modelled link into private cars, car-based taxis and black cabs, using the average proportions observed in the local ANPR data for **six** geographic sectors (Central Sheffield, Suburban Sheffield, Rotherham, Parkway, Motorway and the outer 'buffer network').

This area-wide average approach therefore excludes the localised impacts of taxi ranks (i.e. higher concentrations of taxis on the streets leading to and from these ranks, idling behaviour at the ranks etc.).

In particular, there are known to be significant local air quality issues at the taxi rank which serves Sheffield's main rail station, caused by a combination of taxi emissions and emissions from the diesel trains serving the station. While these locations are excluded from the requirement to achieve the $40\mu g/m^3$ annual average limit value on $NO_2$ concentrations, they still represent a significant risk to local health, particularly to the taxi drivers who regularly use these ranks. However, as noted above, these taxi rank-related issues are not included in our modelling and appraisal, as JAQU have excluded these from the locations which SCC/RMBC need to achieve the relevant annual average $NO_2$-related air quality standard.

Sheffield's previous (2013) Low Emission Strategy Study included the collection and analysis some Real Driving Emissions (RDE) data, which highlighted that local taxis were often emitting significantly more pollution than would be expected based on their age/EURO category, presumably due to the much-higher-than-average total mileage of these vehicles.

The average ratio between observed and predicted emissions in 2013 suggested that Sheffield's hackney cabs were generating around **x1.7** more-than-expected $NO_X$ emissions, while the corresponding average value for private hire vehicles was close to **x2.5** more-than-expected $NO_X$ emissions.

The EFT does not include any uplift to take account of this 'high-mileage' phenomenon, so that our current EFT-based emissions modelling is likely to be under-estimating the contribution of taxis to the current $NO_X$ emissions. If analysis of up-to-date Real Driving Emission data were to confirm this pattern of higher-than-expected emissions from (vehicles registered as) taxis, then this would provide additional justification for tackling this subset of SCC/RMBC's traffic.

It would potentially be useful to analyse any recent RDE data which identifies car-based taxis as a separate vehicle class, to confirm whether taxis (in general) or Sheffield taxis (in particular) are still

emitting significantly-more $NO_X$ than would be expected, based on their size and EURO Class and, if so, to quantify this 'taxi emissions uplift' factor.

In the meantime, it is reasonable to assume that our current EFT-based analysis is probably under-estimating the amount of $NO_X$ emissions from SCC/RMBC's current taxi fleet and hence our Preferred Option will be under-estimating the benefits of removing these taxi emissions by moving to the proposed ULEV taxi standard.

**Emissions from Individual Vehicles**

In this section, we use the profile of trip frequencies observed during 2017 by Sheffield's network of permanent ANPR cameras to allow us to estimate how often different vehicles were seen at each camera location throughout 2017 and how this trip frequency pattern varies by vehicle type.

By aggregating these observations into frequency bands, from Low Frequency vehicles seen on less than one day per month up to High Frequency vehicles, seen passing the relevant camera location on more than two days per week on average), it is possible to estimate how many different vehicles would need to be upgraded to deliver a given level of improvement in the daily traffic passing each location.

Vehicle types with a low average value of trips-per-year frequency require many more individual vehicles to be upgraded to achieve a given %upgrade to daily traffic emissions than vehicle types where a small subset of vehicles each make numerous/e.g. daily trips per year. Similarly, it is much more efficient to upgrade a vehicle which make multiple/daily trips in the air quality problem area, than one which only visits the are once a month. The classic example of this is the difference between the bus fleet, where each vehicle makes multiple trips through Sheffield city centre each and every day, compared to the HGVs, where a similar volume of daily trips/emissions would require massively more individual vehicles to be upgraded, as most of these HGVs only visit the city centre once or twice per fortnight, at most.

ANPR data from the two ANPR clusters closest to Sheffield City Centre[1] (which are therefore the most-relevant for considering the trip frequency of vehicles entering the proposed central Sheffield CAZ area[2]) has been used to allocate vehicles observed throughout 2017 into four frequency bands (based on how many days per year each vehicle was spotted passing the camera cluster).

The results of this vehicle trip frequency analysis are summarised in the table below, where 'Cars Special' are the local taxis (black cabs and car-based vehicles licenced in Sheffield or Rotherham).

This table shows the disaggregation of the total set of non-compliant vehicles seen at each of the two locations during 2017, disaggregated into four frequency bands. The Low Frequency band contains all of the vehicles seen on less than 12 days throughout the year, Low-Medium (LM) is the set of vehicles see on between 12 and 51 days per year, Medium-High is the set seen on between 52

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[1] Sites 2 and 4 in the ANPR-based analysis reported in the SOC
[2] Referred to as Charging Area 3 in the OBC

and 100 days in the year and the High is the set of individual vehicles seen very regularly (on more two days per week) at the relevant location.

This analysis did not attempt to calculate the frequency of observations of vehicles at multiple camera locations, so that these frequency distributions are frequency of passing a specific location, rathe the annual frequency of all trips to the city centre. This simplification will tend to under-represent the trip frequency of vehicles (like taxis) which make multiple different journeys across the city centre, relative to, for example car commuters, whose trips patterns contain less day-to-day variation.

The key point here is the relative size of the different frequency bands between the various vehicle types, as it is this pattern that determines whether it is inefficient (lots of low frequency vehicles each making very few trips each per year) or efficient (lots of high frequency vehicles, so that each individual vehicle upgrade generates multiple days of emission reduction throughout the year.

Table 1 City Centre Trip Frequency of the Total Fleet Observed in 2017 by Vehicle Type

| Distribution of Annual NC Fleet (by vehicle type and trip frequency) - City Centre Average | | | | | | | |
|---|---|---|---|---|---|---|---|
| Trip Frequency | BUSES & COACHES | CARS Ordinary | CARS Special | GOODS - HEAVY (ARTIC) | GOODS - HEAVY (RIGID) | GOODS - LIGHT | All Vehicles |
| Low (<1 per month) | 56.6% | 71.0% | 14.6% | 89.0% | 74.8% | 71.8% | 70.7% |
| LM (<1 per week) | 25.1% | 21.2% | 25.5% | 9.9% | 19.9% | 21.8% | 21.3% |
| MH (1 < = x < 2 per week) | 7.3% | 5.0% | 20.4% | 0.8% | 3.6% | 4.5% | 5.0% |
| High (>2 per week) | 11.0% | 2.9% | 39.4% | 0.2% | 1.6% | 1.9% | 3.0% |

The key thing to note from this table is that the set of non-compliant local taxis which pass the two camera clusters throughout the year are much more likely to do so with medium-high and high frequency than any of the other vehicle types, suggesting that in response to a CAZ a) their owners are more likely than average to upgrade their vehicles and b) each taxi which is upgraded is likely to deliver a much more than average number of daily emission reduction benefits throughout the year.

The table below shows the average number of daily observations throughout the year for each 'bucket' of these frequency distributions.

Table 2 Average Observed Annual Trip Frequency (Days per Year) by Frequency Band

| | Average Number of Daily Sightings by Frequency Band | | | | | | |
|---|---|---|---|---|---|---|---|
| Trip Frequency | BUSES & COACHES | CARS Ordinary | CARS Special | GOODS - HEAVY (ARTIC) | GOODS - HEAVY (RIGID) | GOODS - LIGHT | All Vehicles |
| Low (<1 per month) | 3.0 | 2.9 | 4.6 | 2.6 | 2.9 | 2.9 | 2.9 |
| LM (<1 per week) | 24.9 | 23.4 | 26.6 | 21.5 | 22.9 | 23.3 | 23.4 |
| MH (1 < = x < 2 per week) | 74.4 | 72.1 | 76.4 | 67.4 | 71.3 | 71.2 | 72.2 |
| High (>2 per week) | 191.8 | 159.5 | 184.9 | 140.9 | 160.4 | 158.3 | 163.2 |

Multiplying these frequency profiles by the relevant average values for each of the four frequency bands allows us to estimate the frequency with which an 'average' vehicle of each type passes a given city centre camera cluster. So, for example the average trip frequency for the fleet of 'special cars' (i.e. taxis) seen throughout the year is (14.6% x 4.6) + (25.5% x 26.6) + (20.4% x 76.4) + (39.4% x 184.9) ≈96 days per year.

The results of this analysis are summarised in the Table below.

Table 3 Average Trip Frequency at City Centre Locations by Vehicle Type

| Vehicle Type | Days per Year (average) | Factor relative to Taxis) | =1/Factor |
|---|---|---|---|
| Private Cars | 15.1 | 0.16 | 6 |
| Taxis | 96.0 | 1.00 | 1 |
| Buses and Coaches | 34.5 | 0.36 | 3 |
| LGVs | 13.4 | 0.14 | 7 |
| Rigid HGVs | 11.9 | 0.12 | 8 |
| Articulated HGVs | 5.3 | 0.06 | 18 |
| All Vehicles | 15.5 | 0.16 | 6 |

These results suggest that the average local taxi passes a given city centre camera cluster around 96 days per year, which is x7 times more frequently than a typical LGV (@13.4 days per year), x8 times more frequently than a typical rigid HGV (@11.9 times per year) and x18 times more frequently than a typical articulated HGV (which passes a camera cluster less than six times per year).

Given that a EURO 4 black cab emits around the same $NO_X$ as an EURO IV LGV and around 1/10th of the NOX of a EURO IV articulated HGV, it is x7 times more effective to upgrade a typical taxi than a typical LGV and x1.8 times more effective to upgrade the taxi than the typical articulated HGV (though it may still be cost-effective to target goods vehicles which make significantly more than average numbers of trips into areas of poor air quality).

The 'cost-effectiveness' argument for upgrading the taxi fleet is strengthened even further if the costs of the relevant upgrades are considered, as it is significantly more expensive to replace a EURO IV **HGV** with a EURO VI one, than it is to replace a EURO 4 **taxi** with a ULEV one.

In addition, while we do not have any data about how long per day the various vehicles spend driving in different areas of Sheffield & Rotherham, it is reasonable to assume that a typical taxi spends longer per day driving in areas of poor air quality than a typical goods vehicle.  Therefore, in addition to taxis visiting the city centre on many more days per year than a typical goods vehicle, it is probable that they also spend much longer per day driving around in the areas of poor air quality on these days, adding even further to the relative cost-effectiveness of upgrading the local taxi fleet.

The final argument for tackling the local taxi fleet is that the local authorities have some ability to directly influence the relevant vehicle standards (via their local taxi licencing regulations).

The conclusion is therefore that the most cost-effective use of taxpayers' (&/or vehicle owners') money is to make the **local taxi fleet** as clean as possible, before targeting local goods vehicles (particularly those that make higher-than-average numbers of trips through the areas of poor air quality).

## 3.　Why ULEV, rather than EURO 6

In a separate Technical Note (attached as Appendix A) we show how the current version of DfT/Defra's Emissions Factor Toolkit (EFT) suggests that the $NO_X$ emissions from a Euro 6 London-style black cab is not predicted to be significantly lower than the corresponding emissions from the older Euro 4 model.

Assuming that is the case, then it is not sensible (from a $NO_X$ perspective) to spend taxpayers' or vehicle owner's money replacing the existing SCC black cab fleet with the latest EURO 6 diesel black cab vehicles.

In addition, because of the large number of miles driven across the SCC & RMBC areas by each taxi (black cabs and car-based), as discussed in the preceding section, it is worth getting these fleets of taxis as clean as possible, before turning attention to other fleets, which will typically spend considerably-less time than the taxis driving around in the air quality problem areas in the relevant town/city centres.

SCC/RMBC's Preferred Option (referred to as CAZ 3C$^+$ in the OBC) s therefore to upgrade as much of the relevant taxi fleets as possible to 'better-than-EURO 6' emissions standards.

For black cabs, this implies either replacing the existing diesel engines with a new LPG engine (referred to here as LPG Retro-fit) or replacing the vehicle with a new electric black cab.

For car-based taxis, the relevant ULEV standard includes a range of hybrid-electric and pure electric vehicles which have been accredited as meeting the relevant ULEV standard.

The ANPR data collected at 12 sites across Sheffield and Rotherham suggested that only 14% of local taxis observed by these camera clusters during 2017 would be compliant with a standard EURO 6-based CAZ, with the remaining 86% of the fleet having to be upgraded under both a standard CAZ C and the enhanced 'C$^+$' version.  However, the scale and nature of each required upgrade (e.g. to ULEV standards) is likely to cost more than a 'standard' CAZ C taxi upgrade (e.g. to a EURO 6 diesel).

It would be cost-effective to use the consultation process to persuade this 86% to avoid upgrading their vehicles to EURO 6 and potentially having to upgrade again (to ULEV) in a year's time. This 'CAZ C$^+$/ULEV' message should therefore be disseminated to all of the relevant taxi owners as soon as possible.

The cost of upgrading to ULEV (rather than EURO 6 diesel or older petrol) are likely to be higher, but these additional costs will be partially offset by the reduced running costs achieved by ULEV vehicles (and obviously, the avoidance of the daily CAZ charge, if the decision to adopt the ULEV 'C$^+$' standard is confirmed.

## 4.        Taxi-Related Funding Assumptions- Preferred Option

Due to the current age profile of the current taxi fleet (Private Hire and Hackney) 60% will need to change their vehicle by 2021 Q1 as they become beyond the age at which they can be licensed. Changes to licencing in Sheffield and Rotherham are proposed post FBC approval and in conjunction with incentive schemes, will aim to make these ULEV or retrofitted to compliant levels.

The remaining 40% then consider their responses to the introduction of a £10/day charge to enter the proposed central Sheffield CAZ.

Results from the local behavioural research suggests that if a £10/day CAZ was introduced in Sheffield City Centre around 84% of black cab owners would decide to either upgrade their vehicle (61%), leave the profession (16%) or operate their taxi service somewhere else (7%), with only 16% choosing to pay the £10/day charge to operate their current diesel black cab.

We have (conservatively) assumed that any trips that 'go away' would then be replaced by an equivalent number of taxi trips made by the new compliant vehicles and assume that the overall demand for taxi services and the associated amount of driver-only taxi miles, either looking for business or returning to a taxi rank, remains constant.

It could be argued that any reduction in the size if the local black cab fleet would reduce the number of driver-only miles required to meet the fixed level demand for taxi trips and any reduction in the total taxi fleet might also tend to reduce the total demand for black cab trips.

The assumption of no net reduction in black cab vehicle miles in the Preferred Option may therefore be slightly conservative.

The local research suggested that this upgrade would split roughly 2:1 between LPG retrofit and electric vehicles, so the emissions and air quality modelling which informed the December 2018 version of the Outline Business Case applied this split, by assuming 62.4% receiving the LPG retrofit and 31.2% upgrading to electric black cabs.

However, fleet information for SCC's black cab fleet, provided after the emissions modelling had been completed, suggested that only 140 of Sheffield's current fleet of black cabs (=17% of the total SCC black cab fleet) are modern enough to be suitable for the LPG Retrofit option. The Funding Model in the OBC submitted in December 2018 therefore assumed that these 140 black cabs would receive the LPG retrofit, with the remainder of the 94% being replaced by new electric vehicles

(subject to availability of these electric vehicles, suitable levels of incentives, provision of dedicated charging infrastructure etc.).

The most-recent round of emissions and air quality modelling now reflects the 17% LPG 'cap' within the assumed black cab fleet upgrade. However, in practice, one of the responses to the proposed CAZ may be (and from discussion with the trade, is likely to be) that black cab owners change to a newer black cab, which then allows them to opt for the LPG upgrade option, or an already converted LPG Black Cab. This suggests that the 17% LPG cap may be under-estimating the ultimate number of black cab owners who will go down this route, with a corresponding over-estimation of the number choosing the electric black cab option).

The net result is that the current Preferred Option currently assumes that around 94% (= 60% + 84% x 40%)of Sheffield's black cab fleet will be upgraded to ULEV in the Preferred Option, by mid-2021.

Sensitivity tests are also being undertaken, to explore the sensitivity of the air quality predictions to the assumptions regarding these taxi owner responses – see Section 5 below for details.

The bullet list below summarises the cost-related assumptions for the various taxi-related measures contained in the Preferred Option at the OBC submission stage (these are being developed and refined through to FBC):

- **Electric taxis for SCC (Early Measures Fund) – SCC**
  - Early Measures Funding £485k for electric taxi trial in Sheffield
- **Retrofitting SCC Black cabs to LPG – SCC**
  - Cost of retro-fitting SCC black cabs: £10k per vehicle
  - Proportion of fleet upgrading to LPG: 17% (=140 vehicles) – see the start of this section for the reasons behind this assumption;
  - Cost of measure: £10k x 140 = £1.4m
  - Type of measure offered: Grant
- **Providing incentives to taxis – SCC**
  - Grant for the following incentives E.g. Free Initial and subsequent Compliance Test; Free Initial and subsequent Licence; MyTaxi app; Standards upgrade (LPG); For electric vehicles 2-year MOT and £500 fuel charging points;
  - Includes £1k per black cab * 770 vehicles (*17% of fleet upgraded to LPG = 140 cabs plus 77% upgraded to ULEV through 0% loans = 630 cabs*) = £770k;
  - Plus £500 per car based taxi * 1,890 vehicles = £945k;
  - Cost of measure: £1,715k;
  - Type of measure: In-kind contribution;
- **Providing incentives to taxis – RMBC**
  - A range of grant incentives similar to above;
  - £250 per non ULEV car based taxi in Rotherham;
  - 60% of the 776 fleet of RMBC taxis (= 466) upgrade to ULEV;
  - Cost of measure: £116.5k (= £250 x 466);
  - Type of measure: In-kind contribution;
- **Implementing changes to taxi policy – RMBC**

- o £50k – to cover the costs of consulting on and introducing a change to Rotherham's Taxi Licensing Policy, to ensure consistency with the corresponding SCC policy;
- **Electric Taxi Charging infrastructure**
  - o The £650K package of Rapid Chargers for electric taxis in Sheffield, as detailed in a bid submitted to OLEV at the end of November 2018; and
  - o A further 2 x £650K follow-up package of rapid chargers for Sheffield taxis, when the rate of uptake of plug-in electric taxis in Sheffield and the use of the initial set of on-street rapid chargers by the 'early adopters' of the first wave of electric taxis in Sheffield is known.
- **Financial Management - Loans**
  - o The interest free loans are modelled over a 5-year repayment, with a 7% cost of capital which is assumed to cover the commercial interest charges and includes a provision for bad debt within the rate. The details of the calculation of the compound cost of providing this interest-free loan (based on the 7% per annum cost of finance) over the 5 years of the loan can be found in the Funding Model;
  - o Assumed re-sale value of a 'typical' SCC black cab - £5k (= £10k x 0.5 factor to reflect the potential loss of value of black cabs due to the introduction of CAZs in SCC and elsewhere across the UK);
  - o Cost of a new electric black cab - £55.6k;
  - o Cost of upgrading from existing to new ULEV - £50.6k (=£55.6K - £5k);
  - o 77%[3] of the 834-strong SCC black cab fleet upgrade to electric = 630 vehicles
  - o Black cab upgrade loan amount = £31,878k (= £50.6k x 630);
  - o **SCC Car based taxi to ULEV** upgrade cost per vehicle £19.8k (=£25K (ULEV) -£5.2K (assumed value of existing vehicle);
  - o 98% fleet upgrade = 1,890 vehicles;
  - o 100% of upgrades make use of an interest free loan;
  - o Total loan amount = £37,422k (=£19.8k x 1,890);
  - o **RMBC Car based taxi ULEV** upgrade:
  - o 60% fleet upgrade = 466 vehicles;
  - o 20% offered loan – the out-turn value of this % and the corresponding eligibility criteria used to determine who is offered a loan will need to be confirmed by the consultation with local PHV owners;
  - o Total Loan amount = £1,845k (=£19.8K x 466 x 0.2);
  - o **Total loans to taxi owners-** £71,145k (=£31,878k + £37,422k + £1,845k);
  - o Total cost of providing these taxi-related loans - **£12,450k** (see Funding Model for details of the calculation of the compound cost of these loans at 7% per annum)
  - o Type of measure: interest free loan.

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[3] =94% minus the 17% who can choose the LPG retrofit option

## 5.　　Taxi Sensitivity Test Results

A number of sensitivity tests relating to the proportion of taxis which get upgraded to ULEV (relative to the Preferred Option assumption based on the local behavioural research responses) have been/are being undertaken.

The results from these will be summarised in another Technical Note (OBC Clarification Modelling).

There are also ongoing considerations of the most cost-effective way to help deliver any given relevant level of taxi fleet upgrades, bearing in mind the arguments earlier in this note about how cost-effective it is to use upgrades to the high-frequency, high city centre mileage taxi fleet to deliver emissions reductions within central Sheffield.  These considerations are being informed by ongoing discussions/consultation with taxi owners/operators in Sheffield and Rotherham (and beyond).

This ongoing consultation (and the associated emissions and financial modelling etc.) may result in refinements to some of the taxi-related assumptions described in this note.  Any changes to these taxi-related assumptions will be set out in the FBC.

## 6.　　Concluding Remarks

In this note we have a) justified the focus of SCC/RMBC's Preferred Option on upgrading their local taxi fleets to become as clean as possible and b) set out the taxi-related cost assumptions used in our estimate of the funding required to deliver this Preferred Option.

The full Preferred Option has been carefully designed to achieve area-wide compliance with the $40\mu g/m^3$ of $NO_2$ limit value in the shortest possible time.  As a result, it should be considered as an integrated package, rather than as a list of stand-alone measures.  It is on this basis that it has been approved by both Sheffield City Council and Rotherham Metropolitan Borough Council.

While we have undertaken some local targeted behavioural research, we believe that further consultation (both statutory and additional in-depth) with the relevant taxi owners will be required before the FBC is finalised, to help refine the level of incentives required to achieve the level of fleet upgrades required to achieve compliance.  This additional consultation with taxi owners will inform and define the relevant components of the offer to taxi owners and the associated funding 'ask'. This additional consultation (including analysis of the relevant demographics of these taxi owners) will take place in time to inform the Final Business Case.

Should any further clarification on any aspect of the preferred option be required we would be happy to provide it. However, we hope that the further disaggregation of the individual measures, the breakdown of their cost, the explanation of how they have been appraised in our modelling, and the further information on the relative NOx reduction benefits arising that are included in this supplementary note, along with the information and evidence included in our Outline Business Case and other supporting documents are more than sufficient to enable you to support our Preferred CAZ 3C+ Option.

# APPENDIX A - EMISSION RATES FOR VARIOUS STANDARDS OF BLACK CAB ASSUMED IN THE EFT

## INFORMATION NOTE

## SHEFFIELD AND ROTHERHAM CLEAN AIR ZONES

### BLACK CAB NOX EMISSIONS

| IDENTIFICATION TABLE | |
|---|---|
| Project | Sheffield and Rotherham Clean Air Zones |
| Title of Document | Black Cab NO$_X$ Emissions |
| Type of Document | Information Note |
| Date | 03/06/2018 |

## 1.    INTRODUCTION

1.1.1    This note details the NOX emissions characteristics of Black Cabs as specified in the latest EFT (v8.01b) which has been made available for use on the Clean Air Zone (CAZ) studies. This is in turn consistent with COPERT 4v11.3.

1.1.2    It shows the emissions at various different speeds and also how the emissions change based on the Euro standard of the black cab.

1.1.3    It should also be noted that the content of this note is specifically describing black cabs and doesn't relate to car-based taxis or any other forms of private hire vehicles.  It also should not be confused with the term 'Hackney Carriage' which refers to a particular form of licensing agreement by a local authority (and which can be delivered by a combination of black cabs, 'standard' cars, people carriers, small minibuses etc).

## 2.    NO$_X$ EMISSIONS

### 2.1    Changes by EURO Standard

2.1.1    The figure below shows the NO$_X$ emissions in grams per Km for different Euro standards of taxi at 30mph (ie regular urban driving conditions)
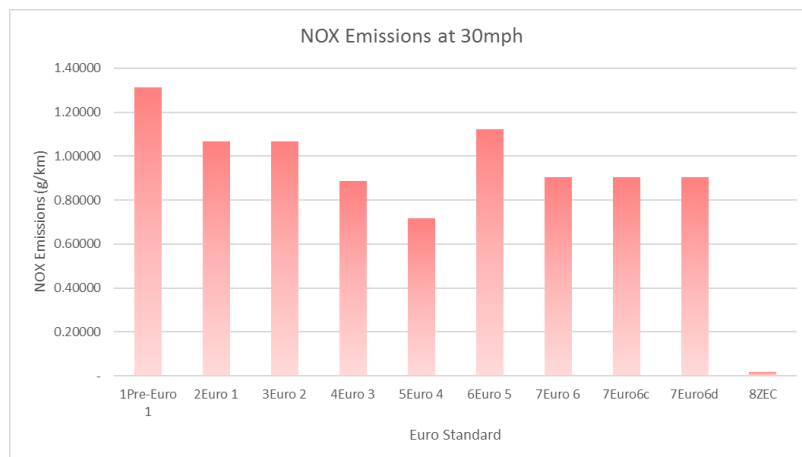
2.1.2    The main things to note are that the main EURO 6 categories are not significantly cleaner (from a $NO_X$ emissions perspective) at 30mph that any of the previous categories, apart from the very oldest (pre-EURO 1) and indeed are likely to emit more $NO_X$ per Km than a EURO 4 model.

2.1.3    Only when we reach the Zero Emission Cabs (ZEC) standard, do we see any significant reduction in $NO_X$ emissions from black cabs.

2.1.4    What this implies is that in a bid to improve Air Quality as a result of NOX emissions in urban areas there is no point trying to replace Euro 4 cabs with Euro 5 or Euro 6 cabs as it will not improve the situation[4], rather there should be a push to alternative fuels (LPG / Electric).

## 2.2    Speed Distribution by Euro Class

2.2.1    The chart below shows how the average $NO_X$ emissions per km of Black Cabs are predicted to vary with speed.



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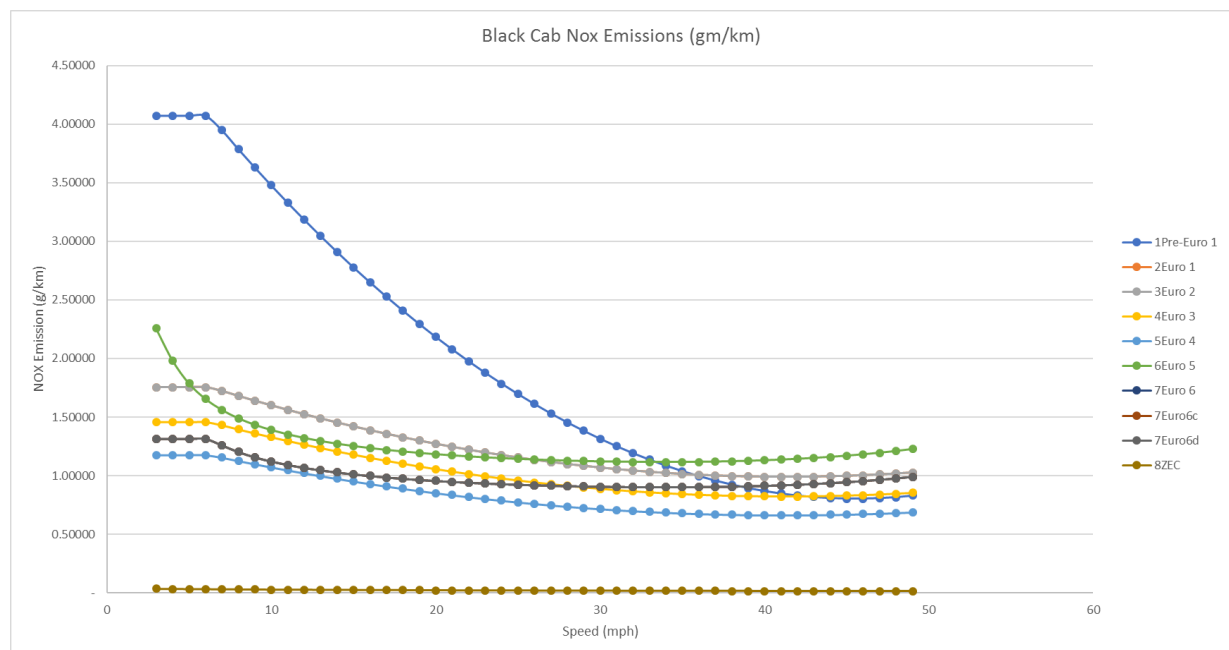
[4] Assuming the COPERT / EFT values are accurate

2.2.2    This shows that the emissions-speed curve is relatively flat for everything from EURO 1 onwards, but with the highest emissions always occurring at low speeds.  Therefore, one way of reducing emissions from Black Cabs would be to reduce the time they spend travelling at low speeds, for example in congested traffic conditions. This might be achieved by reducing the frequency with which Black Cabs get caught up in congestion, either by reducing the incidence of congestion on the network or by proving more priority measures for Black Cabs, where possible.

| APPROVAL | | | | | |
|---|---|---|---|---|---|
| **Version** | **Name** | | **Position** | **Date** | **Modifications** |
| **1** | Author | Chris Robinson | Associate | 20/05/2018 | |
| | Checked by | David Connolly | Director | 03/06/2018 | |
| | Approved by | David Connolly | Director | 03/06/2018 | |