Sheffield & Rotherham Clean Air Plan Full Business Case 2023 Modelling Addendum

FBC Final
Date Issued: 12th April 2022

Document Controls

Document Approval				
Version Number:	FBC Final			
Prepared by:	Chris Robinson (SYSTRA), Ogo Osammor (SCC),Julie Kent (RMBC)	Date:	28/02/2022	
Checked by:	David Connolly (SYSTRA), Amanda Cosgrove (SCC)	Date:	06/04/2022	
Approved by:	Tom Finnegan-Smith (SCC), Tom Smith (RMBC)	Date:	06/04/2022	

Revision History	
Version	**Nature of Revision**
Feb 22	Initial Draft
FBC Final	Final Formatted Version for FBC

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Section 1 Introduction

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1 Introduction

Delivery of the Sheffield and Rotherham Clean Air Plan (CAP) commenced in 2021, with delivery of the road schemes required in Rotherham for compliance and contract award of the supplier for the Clean Air Zone (CAZ) implementation in Sheffield.

At the point of our draft full Business case submission in December 2021, the forecast timescale for the charging Clean Air Zone (CAZ) within Sheffield to go live was in the Autumn of 2022. The Full Business Case (FBC) and modelling undertaken assumed this go-live date. The installation programme developed for the FBC has confirmed that the earliest possible date that the CAZ can go-live will be early 2023. Therefore, the predicated year in which compliance will be achieved is now 2023 calendar year.

The CAZ delivery programme slippage will largely impact only on the Sheffield element of the Clean Air Plan (CAP); the Rotherham highway schemes should still be delivered on time within 2022, so an air quality benefit should still be felt at the key locations within that Authority. However, compliance in Rotherham is in part dependent on deployment of Clean Air Fund monies in respect of bus upgrades and retrofit. As such compliance in 2022 could be affected by the length of time to receive approval on our suite of revised CAF measures (expected in May 2022), which are to be managed by Sheffield City Council across the full CAP area, and the associated mobilisation period to launch them, which is current expected in early Summer 2022.

Given that the programme slippage is approximately 2 – 3 months, and that the FBC and supporting evidence has been fully completed on the basis of a 2022 go-live date, it was agreed with JAQU that undertaking new modelling and analysis to inform a full update of all FBC documents at this late stage in the Business Case development would cause significant delay. It was agreed that, alternatively a Baseline and Preferred Option scheme model would be run for 2023 to confirm that the same conclusions were reached. This addendum therefore sets out the details of runs of the transport model and the AIRVIRO dispersion model for 2023.

These new Baseline and Preferred option tests would include any additional changes (highways, development, fleet churn etc) anticipated between 2022 and 2023. These include any changes in Rotherham. Whilst the physical schemes in Rotherham are likely to have been completed it is essential to understand the impacts of the later CAZ 'go live' date within Rotherham too.

Full economic analysis and sensitivity testing have not been done for 2023.

Section 2 Transport Model

2   Transport Model

This section describes the modelling undertaken within SCRTM1 to develop both a 2023 Baseline and a 2023 version of the Preferred Option. It includes the schemes added, the changes in compliance levels and some basic results from those model runs.

2.1   Scheme Included

A number of developments and schemes are due to come online in both Rotherham and Sheffield between 2022 and 2023 (with opening times staggered between late 2022 and mid-2023). Some of these are close to key non-compliant baseline locations or are of a scale that they could affect compliance. Those which have been included in these model runs to reflect a mid-2023 situation are as follows:

- Additional year of demand / development changes – based on an extra year interpolation of the uncertainty log (which follows a linear trend from the Base Year and 2024 in Sheffield and Rotherham). The biggest increases are in Sheffield City Centre and along Parkway corridor which has the impact of slightly increasing travel across the area;
- Road schemes coming online in Sheffield:
  - Housing Zone North development associated traffic measures;
  - Cross City Bus traffic management schemes in place including bus gate in Arundel Gate (this was included as partial scheme in 2022 PO);

  It is expected that the impact on air quality of these schemes in Sheffield will be minimal and also highly localized
- Schemes coming online in Rotherham:
  - A631 Rotherham to Maltby Bus Corridor;
  - Magna Tram-Train stop;
  - Taylors Lane Roundabout;
  - Doncaster Road, Dalton Roundabout;

  As with Sheffield it is expected that the impacts on air quality of these Rotherham schemes will be small and will be localized. They are not in locations which will adversely impact compliance in Rotherham;
- Completed Parkway widening scheme, this will have a significant impact on the Parkway (but it is predicted to remain compliant at valid locations) but it will also pull traffic away from other roads improving the situation there, particularly in the lower Don Valley; and
- Additional year of fleet churn – i.e., PO 2022 + 1year extra fleet change (mainly affects cars)

In accordance with the JAQU position, no changes to bus services arising from the Coronavirus pandemic are included, nor are any observed changes in traffic volumes or patterns.

These schemes have been included in both the Baseline for 2023 and the Preferred Option. The Preferred Option test includes the same scheme elements as the 2022 version.

2.2 Compliance Splits

The tables below show the compliant splits for 2023 in both the Baseline and the Preferred Options, showing slight improvements in the fleet due to the background churn, with some fleets showing larger improvements (e.g., taxi due to existing licence policy and buses due to ongoing upgrade process)

Table 1 – Baseline Compliance Splits

	2022	**2023**
Car	79.0%	81.0%
LGV	61.6%	69.3%
MGV	76.9%	82.8%
HGV	92.7%	95.4%
Black Cab	21.0%	35.0%
PHV	65.7%	75.8%
Bus	79.3%	84.5%

The change in compliance of the key fleets in the Preferred Option improves slower than the Baseline as the Preferred Option is essentially just bringing forward those upgrades. The Preferred Option compliance splits for 2023 are shown below.

Table 2 – Preferred Option Compliance Splits

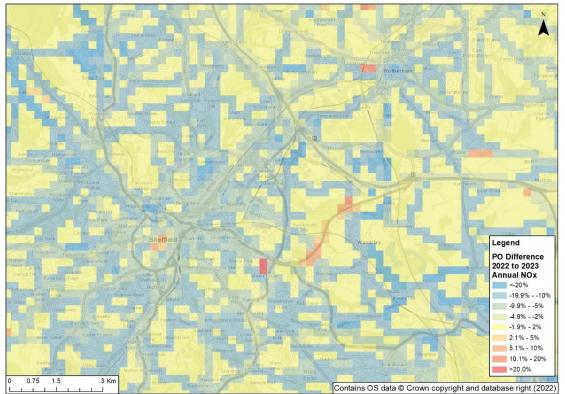|	**2022**	**2023**
Car	79.0%	81.0%
LGV	76.6%	81.3%
MGV	96.1%	97.1%
HGV	98.8%	99.2%
Black Cab	90.3%	97.3%
PHV	97.9%	98.5%
Bus	100.0%	100.0%

Results

The table below shows the change in NO_X tailpipe emissions compared to the Base Year model for 2022 and 2023 in both the Baseline test and the Preferred Option. The 2022 numbers are the same as those presented in the T4 report. In nearly all cases the 2023 numbers represent an improvement on the 2022, due to a further year of fleet churn, and as such compliance at those locations which were shown to be achieved by the scheme in AQ3, will remain compliant. The only two locations where that is not the case are:

- Arundel Gate Interchange – where the Preferred Option banks most of the improvements in 2022 (through 100% bus upgrade) and so changes to 2023 are very small; and
- A630 where the widening scheme is fully online by 2023 and hence increases NO_X, but as shown in the next section this does not affect compliance. This also has the impact of reducing NO_X tailpipe emissions elsewhere.

Table 3 – 2022 and 2023 - Changes in Tailpipe NOX Emissions from 2017 Base Year

	2022		2023	
	Baseline	CAZ C	Baseline	CAZ C
Arundel Gate Interchange	-45%	-75%	-51%	-75%
Hatherley Road, Rotherham	-30%	-33%	-34%	-36%
Rawmarsh Hill	-24%	-37%	-30%	-39%
Sheffield Parkway (A630)	-32%	-44%	-35%	-42%
A630 Parkway - Rotherham	-30%	-38%	-34%	-38%
ASDA A630	-30%	-34%	-35%	-47%
A631 East Bawtry Road, Whiston Crossroads	-29%	-30%	-33%	-36%
Wortley Road (227), Rotherham	-26%	-34%	-31%	-36%
Kirkstead Road, Rotherham	-27%	-28%	-30%	-31%
Fullwood Rd Post Office (Broomhill Forum)	-30%	-40%	-36%	-44%
463 Queens Road - A61	-35%	-43%	-39%	-48%
Winster Road (A61 Hillsborough)	-33%	-33%	-38%	-39%
R60 (152 Fitzwilliam Road)	-29%	-32%	-34%	-35%
Wicker (Kelham Island)	-29%	-62%	-51%	-63%
Shoreham Street	-38%	-58%	-44%	-60%
Wales (Wales Roadside Automatic)	-27%	-30%	-31%	-41%
Western Bank/Clarkson Road	-21%	-40%	-26%	-49%
Pond Street Interchange	-69%	-88%	-75%	-89%
A61 - Chesterfield Road - Meersbrook Park	-34%	-43%	-39%	-49%
Derwent Crescent (Brinsworth and Catcliffe)	-27%	-28%	-30%	-31%
Brightside Lane (Jenkin Road) (LSTF)	-31%	-35%	-36%	-40%
Droppingwell Road, Rotherham	-30%	-32%	-35%	-39%
Duke Street	-37%	-63%	-45%	-68%
Fenton Road, Rotherham	-50%	-49%	-54%	-54%
Derek Dooley Way	-10%	-27%	-16%	-33%
Sheaf Street	-34%	-43%	-39%	-48%
Sheffield Road (M1 34S)	-24%	-22%	-28%	-28%
St Mary's Rd	-40%	-38%	-44%	-52%
Attercliffe common	-33%	-31%	-38%	-38%
Shalesmoor	-37%	-49%	-41%	-51%
St Mary's Rd	-25%	-38%	-30%	-40%
Derek Dooley Way	-28%	-43%	-33%	-48%
Bellows road	-45%	-25%	-49%	-30%
Barber's avenue	-35%	-34%	-39%	-40%
(A61) Penistone Road	-31%	-36%	-36%	-41%

The figure below shows the same data on a geographical basis across the study area. This shows that across the majority of the region the emissions fall as we get a further year of fleet churn. There are increases on the A630 Parkway as noted above, along with

some very localised increases due to the scheme changes detailed, but it is not expected that these will impact on the likelihood of achieving compliance.

Figure 1 – Changes in Tailpipe NOX in Preferred Option (2023 versus 2022)

Section 3 Air Quality Model

3 Air Quality Modelling

This section describes the air quality model results from both the 2023 Baseline and 2023 Preferred Option. These runs of the AIRVIRO model have been undertaken to ensure that the scheme is still required in 2023 and that the Preferred Option still delivers compliance.

3.1 Results

The tables below show the results of the 2023 Baseline and Preferred Option and compare those to the Base Year and the PO values for 2022. These tables include both the numbers for Sheffield and Rotherham areas. The tables just show those sites with concentration of over 35.0µg/m^3 in the Base Year in order to avoid this note being overwhelmed with data.

The first table shows the results using Version 6.1 of the NOX to NO$_2$ calculator and includes the anti-idling factors in the results for Arundel Gate. It shows that everywhere in Rotherham and Sheffield becomes? compliant in the 2023 Preferred Option, but that without the scheme there would still be non-compliances (.i.e.. in the Baseline). In most locations the situation improves compared with 2022, but in one or two locations there are slight increases in annual mean NO$_2$ but nothing that would affect compliance.

Table 4 – Concentrations using NO$_X$ to NO$_2$ Calculator Version 6.1

Sheffield Roads

No.	Road	Census ID	Nr 1437 2017 Base Year	Nr 1517 2022 Baseline	Nr 1526 2022 Preferred Option	NR 1550 2023 Baseline	Nr 1548 2023 Preferred Option
72	C710 Arundel Gate	n/a	**61.1**	**47.8**	38.3	**45.5**	37.7
47	Sheaf Str station side	60030	**49.0**	36.4	32.4	34.1	31.2
77	Orphanage Rd / Barnsley Rd	n/a	**49.0**	37.2	35.7	34.9	33.2
39	Shoreham Street	48805	**48.0**	36.8	33.4	34.7	31.9
75	Arundel Gate, Stoddart Bldg	n/a	**48.0**	**42.0**	32.2	39.5	31.1
25	Sheffield Rd (M1 34S)	37441	**46.3**	36.0	36.1	34.1	33.7
12	Brightside Lane	17718	**45.6**	35.1	34.2	33.4	31.9
74	Arundel Gate, Gallery	n/a	**45.0**	35.0	28.2	33.1	28.1
19	Attercliffe Road	27393	**44.6**	34.5	33.8	32.6	31.7
48	Shoreham Street	75194	**43.7**	33.4	30.0	31.6	29.1
8	Suffolk Road	8758	**43.3**	32.8	29.2	31.0	28.2
67	Derek Dooley Way	81236	**43.0**	36.3	32.4	34.2	30.4
69	Savile Street	81238	**42.0**	34.8	31.3	32.7	29.1
15	Penistone Road	18546	**41.3**	30.6	29.9	28.7	27.8
49	Suffolk Road	75195	**41.1**	31.7	27.7	29.7	26.0
54	Wicker	76044	**41.0**	30.1	27.3	28.7	26.3
2	Attercliffe Road	7380	40.4	30.9	29.9	29.2	27.9
34	Meadowhall Road	47826	40.3	31.7	31.4	30.3	29.7

No.	Road					
10	Chesterfield Road	16581	39.1	30.4	28.5	28.6	26.8
28	Attercliffe Common	38549	39.1	30.0	30.2	28.3	28.1
76	Arundel Gate/Surrey Str	n/a	39.0	32.8	29.8	31.0	28.6
13	Burngreave Road	17728	39.0	28.3	23.2	26.6	22.7
14	Hoyle Street	17809	38.7	29.1	28.9	27.3	27.2
52	Fornham Street	75198	38.7	28.1	25.6	26.5	24.1
22	Queens Road	27857	38.4	30.0	28.2	28.3	26.8
31	Bramall Lane	47393	38.0	29.0	27.2	27.4	25.9
53	Matilda Street	75199	38.0	29.3	26.6	27.6	25.5
11	Bawtry Road	17332	37.9	28.3	28.1	26.9	26.4
27	Hawke Street	37902	37.0	28.0	28.1	26.5	26.2
38	Greenland Road	48804	37.0	28.3	28.2	26.9	26.2
40	Moorfields	56608	37.0	28.8	26.1	27.1	24.6
9	Penistone Road	16580	36.0	26.4	25.6	24.7	23.8
55	Derek Dooley Way Nr Capita	76046	36.0	28.8	26.0	27.1	24.4
62	Shalesmoor	81162	36.0	30.2	27.6	28.4	26.3
45	Barnsley Road	57875	35.7	27.2	26.2	25.5	24.5
36	Upper Hanover Street	47860	35.3	27.7	25.7	26.1	24.5
42	Savile Street	56863	35.2	27.7	25.5	26.1	23.9
26	Queens Road	37898	35.1	27.1	24.7	25.5	23.4
66	Leppings Lane	81230	35.0	28.6	27.9	26.9	25.7

Table 5 – Concentrations using NO$_X$ to NO$_2$ Calculator Version 6.1

Rotherham Roads

No.	Road	Census ID	Nr 1437 2017 Base Year	Nr 1517 2022 Baseline	Nr 1526 2022 Preferred Option	NR 1550 2023 Baseline	Nr 1548 2023 Preferred Option
	Parkway	**73910**	**48.4**	**43.1**	**40.4**	**41.3**	40.3
	Rawmarsh Hill	**17339**	**50.2**	**41.3**	**39.2**	39.2	37.4
	Fitzwilliam Road	**58395**	**46.7**	**41.9**	**40.1**	39.7	38.4
	Wortley Road	**77552**	**51.6**	**41.2**	39.4	40.0	39.5
	M1	**36007**	**51.7**	39.0	38.9	38.2	38.1
	A631	**47409**	**40.9**	37.3	36.7	36.3	35.7
	A618	**77548**	35.0	22.8	22.4	21.7	21.3
	A630	**77554**	36.3	28.2	27.2	27.3	26.3
	A630	**17805**	39.7	35.3	34.7	33.6	33
	A631	**17807**	38.6	30.8	29.1		
	A6123	**17808**	38.7	29.5	28.5	27.8	26.8
	A6021	**27799**	39.6	30.6	29.8	29.6	28.8
	A631	**27396**	**44.4**	32.1	31.6	31.1	30.6
	A6123	**37868**	38.8	29.0	28.4	28.1	27.5
	A629	**38673**	**42.3**	31.6	30.4	30.4	29.2

	A631	**56055**	39.6	30.5	29.8	29.6	28.9
	A630	**57857**	38.7	31.1	31.1	30.4	30.4
	A6123	**60033**	37.4	27.6	27.3	27.0	26.7
	A633	**60034**	38.5	31.5	29.9	30.5	28.9
	A631	**7382**	40.2	32,0	31.5	30.6	30.1
	A6178	**73907**	36.1	27.8	27.9	26.8	26.9
	A631	**73908**	**43.5**	33.6	32.9	32.8	32.1
	A630	**7750**	**43.4**	33.0	31.4	31.2	29.6
	A6021	**7973**	38.8	29.5	28.8	28.5	27.8
	A6023	**80807**	40.2	32.5	31.8	31.7	31.0
	A6109	**8590**	35.5	28.3	27.7	27.3	26.7
	A630	**28002**	38.9	29.9	29.1	28.8	28.0

Section 4 Conclusions

4 Conclusions

The CAZ implementation slippage that has occurred means that the earliest the charging zone can go-live is early in 2023, therefore the earliest possible year of compliance for of the Sheffield and Rotherham Clean Air Plan is now 2023.

The model runs undertaken for the forecast 2023 Baseline and with the Preferred Option in place have taken into consideration all additional developments and schemes which are predicted to come online by mid-2023, i.e. for completeness, predict future concentrations of nitrogen dioxide annual mean.

The results from the air quality modelling show that there will still be a need for the scheme due to non-compliances in the 2023 Baseline and that the Preferred Option produces compliance everywhere. In addition, in most locations there is an additional improvement in air quality due to extra months of fleet churn.

Note: Doing nothing is not an option and delivering the CAZ C is the only option tested as it is the scheme we are currently Directed to implement and is the only scheme which can be delivered in this timescale. In essence the early 2023 go live date is effectively a c.3-4 month slippage from our previous programme for delivering our CAZ C scheme and the analysis in this addendum confirms that action is still required.

The conclusion is that this scheme is still the correct one to take forward in order to achieve compliance in the shortest possible time. The impacts of the Preferred Option on NO_2 concentrations when compared to the Baseline are largely the same as in 2022 with some small, localized variations due to new schemes and developments.