Sheffield & Rotherham Clean Air Plan Full Business Case
Local Plan Transport Model Validation Report (T2)

April 2022

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Version	**Nature of Revision**
V-1_FBC	Comprehensive revision at FBC to reflect use of newly available model SCRTM1
FBC Final	Final formatted version for FBC submission

Contents

Section 1 Introduction

1.1 Context

1.1.1 In 2017, the UK Government named Sheffield and Rotheram as one of 29 areas in England containing locations where the annual average concentrations of Nitrogen Dioxide (NO_2) exceed statutory limits. The two Councils were tasked with developing a strategy which would ensure that their Council areas became, and remained, compliant with this statutory limit 'in the shortest possible time'.

1.1.2 Outline Business Case (OBC) was submitted to JAQU in December 2018 and the Full Business Case (FBC) will be submitted to JAQU in the coming weeks, before the end of 2021.

1.2 Overview of this Document

1.2.1 This report was first prepared as part of the evidence submission for the Outline Business Case (OBC) but has now been comprehensively updated and resubmitted as part of the Full Business Case (FBC).

1.2.2 This document is the Transport Model Validation Report (T2) which explains how the models used to assess the Sheffield and Rotherham Clean Air Plan were validated against real-world data. In accordance with the requirements set out for the "Evidence Package" by JAQU this report includes details of:

1.2.3 Updates made specifically for this study to the base year models.

- A comparison between observed and modelled fleet composition, traffic flows, journey time and traffic pattern within the study area.
- Maps illustrating the locations at which real-world data was collected.
- An explanation of the method used for fleet composition forecasts (if not based on the Emissions Factor Toolkit).
- A present year validation (if the model is more than 5 years old); and
- An assessment of impacts if the model does not meet the Department for Transport (DfT) Transport Analysis Guidance (TAG) requirements in the study area.

1.3 Choice of Transport Model

1.3.1 Text At the outset of the study in 2017, several alternative strategic transport modelling options were considered by Sheffield City Council (SCC) and Rotherham Metropolitan Borough Council (RMBC). An approach was required which could deliver the required evidence base that would be as robust as possible, without jeopardising the ability to deliver the study within challenging timescales.

1.3.2 For these reasons, despite its underlying base year dating from 2002/3, the initial case was developed using an updated and rebased (2017) version of the Sheffield & Rotherham Transport Model (SRTM3B) as it was the best and most recent model available at the point when the modelling work started. The evidence contained within the Outline Business Case was submitted on this basis.

1.3.3 However, in parallel to the feasibility work for the Clean Air Plan starting, a new multi-modal transport model was being developed for South Yorkshire Mayoral Combined

Authority (SYMCA), formerly Sheffield City Region Combined Authority (SCRCA), based on a brand new observed data. Containing a base year observed travel representation of 2016, this model was completed in 2019 and has now been used to confirm the robustness of earlier work relating to the Clean Air Plan.

1.3.4 The Full Business Case has been informed by modelling undertaken using this new model - the Sheffield City Region Transport Model (SCRTM1). This T2 document has therefore been comprehensively revised from that submitted at OBC and now describes the suitability of the new transport model SCRTM1 for this work, rather than the older model SRTM3B that was described in earlier versions. Comparative air quality model forecasts have been run using both models to check the robustness of the study results.

1.4 Structure of this Document

1.4.1 The remainder of this document is structured as follows:

- Section 2 provides an overview of the SCRTM1 model system.
- Section 3 provides details of the data used, and results of, the validation of the SCRTM1 base year models.
- Section 4 provides a discussion on the SCRTM1 validation standards reached and the model's fitness for purpose.

1.4.2 It should be read in conjunction with the SCRTM1 Local Model Validation Report (LMVR) which is a supporting document to T1 (T1-SD02). In addition to that report the individual count flow calibration and validation is presented in T1-SD04.

Section 2 Sheffield City Region Transport Model (SCRTM1)

2.1 Introduction

2.1.1 SCRCA commissioned AECOM and SYSTRA to develop a new multi-modal transport model, consistent with the principles set out in Department for Transport (DfT) Transport Analysis Guidance (TAG). The spatial coverage of the new model was larger than that of SRTM3B, which focussed on travel to, from and within the districts of Sheffield and Rotherham[1] . The new model SCRTM1 contains detailed representation of all trip making throughout the Sheffield City Region, which includes all the authorities in South Yorkshire. New data collection was commissioned as required to supplement existing available datasets.

2.1.2 The new Sheffield City Region Transport Model (SCRTM1) comprises a bespoke variable demand model (VDM) and highway and public transport supply models, with a base year representation of travel of 2016. The highway assignment model is implemented in Atkins SATURN software and the public transport assignment model in Citilabs CUBE Voyager software. The overall structure of the model is shown in Figure 1.

2.1.3 The SCRTM1 implementation adopts the 'Standard Model' recommended by TAG Unit M1, Paragraph 4.2. The demand model produces an estimate of demand based on land-use and perceived transport cost changes (incorporating changes in values of time, fuel cost, fuel efficiency, and highway congestion). The transport costs are produced by the assignment models which in turn are dependent on the demand. This inter-dependency is resolved by iterating between the demand and assignment models until a converged situation is reached.

[1] In SRTM3B, through modelled area traffic using the M1 was included in the model.

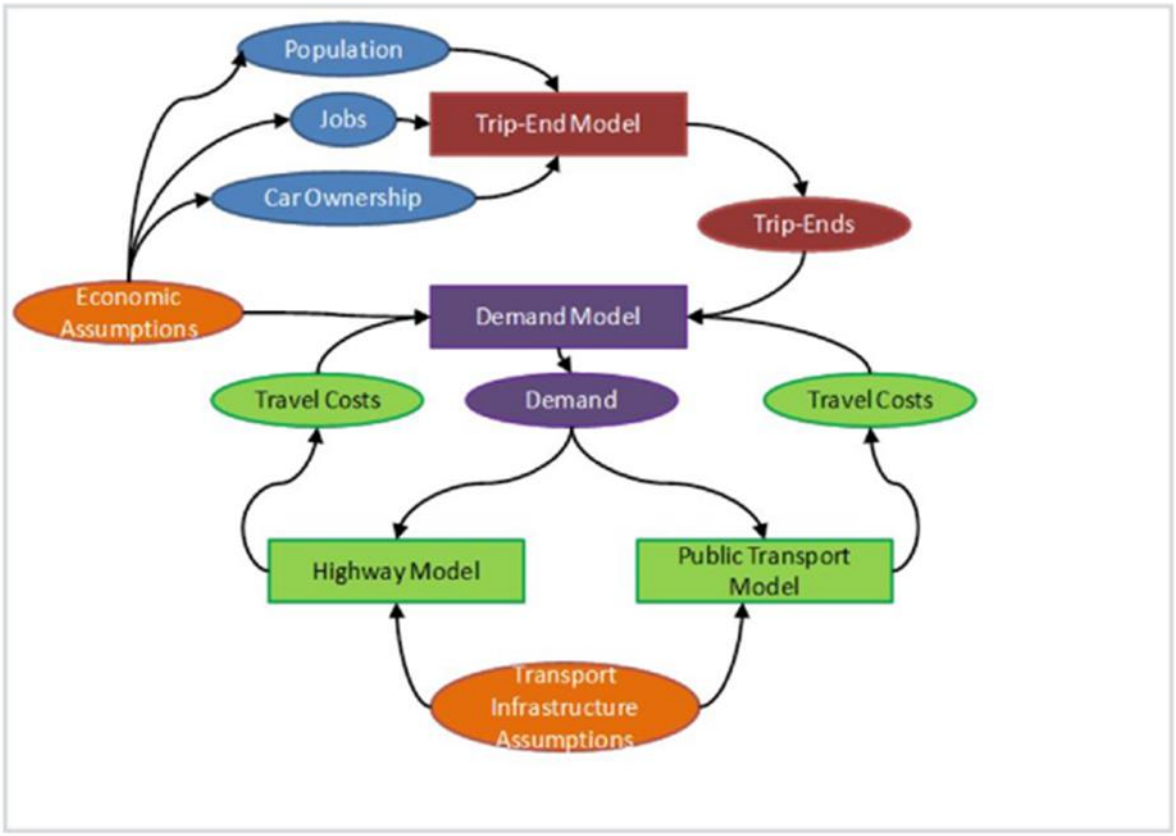

Figure 1. SCRTM1 Model Structure

2.1.1 The model was specifically developed with three schemes in mind:

- Sheffield Supertram infrastructure and rolling stock renewal scheme;
- Assess the innovation Corridor development are and associated highway scheme situated between Sheffield City Centre and Meadowhall; and
- Assess the Pan Northern Connectivity Scheme, improving road links between Barnsley and Doncaster.

2.1.2 Whilst the focus of the model validation was in the areas most impacted by the schemes listed above, the model can also be used to assess other schemes and policies as required. To this end, in addition to the scheme above, SCRTM1 has had been used to assess Local Plans, Clean Air Plans, and the Transforming Cities Fund bid. The base model validation and forecasting reports have received considerable scrutiny from DfT, in relation to the Supertram and Innovation Corridor Business Cases in particular.

2.1.3 In summary, the SCRTM1 has been used to develop the modelling and appraisal for the Clean Air Plan Full Business Case because it is now the best available tool for the task, rather than SRTM3B which was originally constructed from very much older underlying data and was used in developing the Strategic Outline and Outline Business Cases.

2.1.4 The primary reasons for this conclusion are:

- SCRTM1 is a multi-modal model with detailed geographical coverage across Sheffield, Rotherham and more broadly South Yorkshire.
- SCRTM1 has been developed in adherence to the principles set out in DfT TAG and having been scrutinised by DfT has been used to develop OBCs for other major schemes in Sheffield and Rotherham.
- SCRTM1 has been built with considerable 2016 observed data from, including:

  - Mobile phone data;
  - Roadside intercept surveys;
  - Automatic traffic and manual turning counts;
  - Trafficmaster journey time data;
  - Electronic Ticket Machine data for bus and Supertram;
  - Onboard bus and Supertram surveys;
  - Onboard bus passenger counts and boarding/alighting counts at Supertram stops;
  - Rail station matrix data from the Office for Rail and Road (ORR);
  - Boarding and alighting counts at rail stations.
- The highway and public transport assignment models have a good level of validation in the key areas of interest for the Clean Air Plan, namely within Sheffield and Rotherham.

2.2 SCRTM1 Geographical Coverage

2.2.1 SCRTM1 has been developed to cover the whole of Great Britain, with its main focus being on trips that have an origin, destination, or route that passes through the Sheffield City Region. Initially a task was undertaken to define which parts of the model should be included in the Fully Modelled and External Areas. The extent of the fully modelled area is displayed below in Figure 2, with the remaining areas throughout Great Britain classified as External.

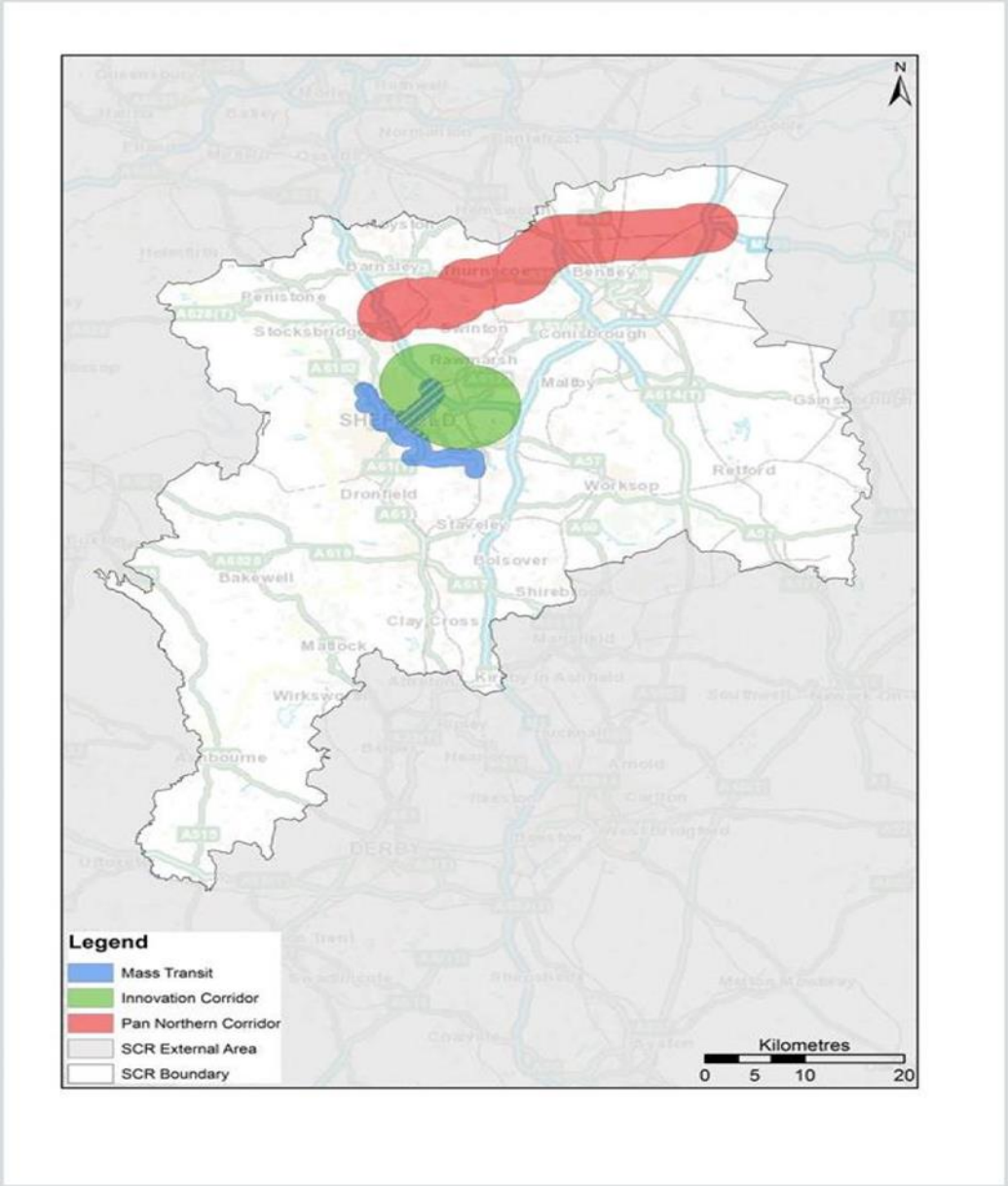

Figure 2. Definition of Model areas, including the three 'Detailed Modelled Areas'

2.2.2 The Fully Modelled Area is slightly larger than the SCR area, enabling the model to be capable of modelling a range of schemes in any part of the SCR. This also accounts for any schemes that are near to the SCR boundary, and any potential rerouting being accounted for within the Fully Modelled Area, rather than in the External Area.

2.2.3 Within the Fully Modelled Area an Area of Detailed Modelling was defined. This coincides with the area of influence of the three schemes that the model was initially developed to assess. Given the importance of the Area of Detailed Modelled, which includes substantial portions of Sheffield and Rotherham, additional work was undertaken to ensure that these areas are as close as possible to TAG validation standards.

2.3 Highway Assignment Model

2.3.1 The SCRTM1 highway assignment models are implemented in the Atkins SATURN software. Base year models representing travel in 2016 were developed using a wide

range of observed data included mobile phone, roadside interviews and volumetric traffic data. A new network representation was created with detailed SATURN simulation junction coding across the whole of the Sheffield City Region. Matrix Estimation was used to calibrate the demand matrices and a good level of validation.

2.3.2 The traffic matrices contained in the original SCRTM1 were segmented in to six user classes. These are:

- car – commuting;
- car – business;
- car – other;
- light goods vehicles;
- medium goods vehicles; and
- heavy goods vehicles.

2.3.3 There are three models, reflecting the different travel conditions and traffic volumes on an average weekday between Tuesday and Thursday in October 2016. The three time periods are:

- morning peak 08:00-09:00.
- inter peak average hour between 10:00-16:00.
- evening peak 17:00-18:00.

2.3.4 The network structure of SCRTM1 was derived by combining six existing models; SYSTM+, Sheffield and Rotherham Transport Model, Sheffield AIMSUN Model, Barnsley Transport Model, Doncaster Transport model, and the Chesterfield Traffic Model. Given the number of different models combined to build SCRTM1, it was inevitable that there would be differing levels of detail and coding approaches taken for each. A detailed process of combining the models was required, as well as a comprehensive checking process to ensure the models were brought together in a good way and as further refinements were made.

2.3.5 The following guidelines were followed to ensure that the network structure remained as comprehensive as possible throughout the entire fully modelled area, without losing the calibration work undertaken on the original models:

- All motorways are included;
- All A roads are included;
- Most B roads have been included, particularly where they represent a likely route between two zones;
- Minor roads have been included where they provide a plausible ‘rat run’ or where they are required to link centroid connectors to main roads;
- As we wished for a consistent highway and public transport network then links were added to represent bus and tram routes where required; and
- ‘Rat runs’ have been perceived as being minor, typically residential streets, used by drivers during peak periods to avoid congestion on main roads.

2.3.6 Within the fully modelled area (within the SCR boundary) the highway network has been coded using simulation detail, with buffer detail being used in the external model areas.

2.3.7 Simulation network uses information about the number of lanes, saturation flow for each turn, which turns are permitted in each lane, phases and stages for signalised junctions. Speeds on some of the links will depend on the vehicle demand. Delay at junctions will depend on the demand flow for a movement and, where appropriate, the volume of the conflicting flow.

2.3.8 Buffer detail means that no junction information is included other than which roads are connected where. Buffer links give a fixed speed and a distance, with no capacity restraint applied. There is no junction delay, so this must be taken account of in the buffer link speeds.

2.3.9 Having combined the various existing networks, the resulting network structure is shown in Figure 3 and Figure 4. Within the fully modelled area (within the SCR boundary) the highway network has been coded using simulation detail, with buffer detail being used in the external model areas.

2.3.10 Simulation network uses information about the number of lanes, saturation flow for each turn, which turns are permitted in each lane, phases and stages for signalised junctions. Speeds on some of the links will depend on the vehicle demand. Delay at junctions will depend on the demand flow for a movement and, where appropriate, the volume of the conflicting flow.

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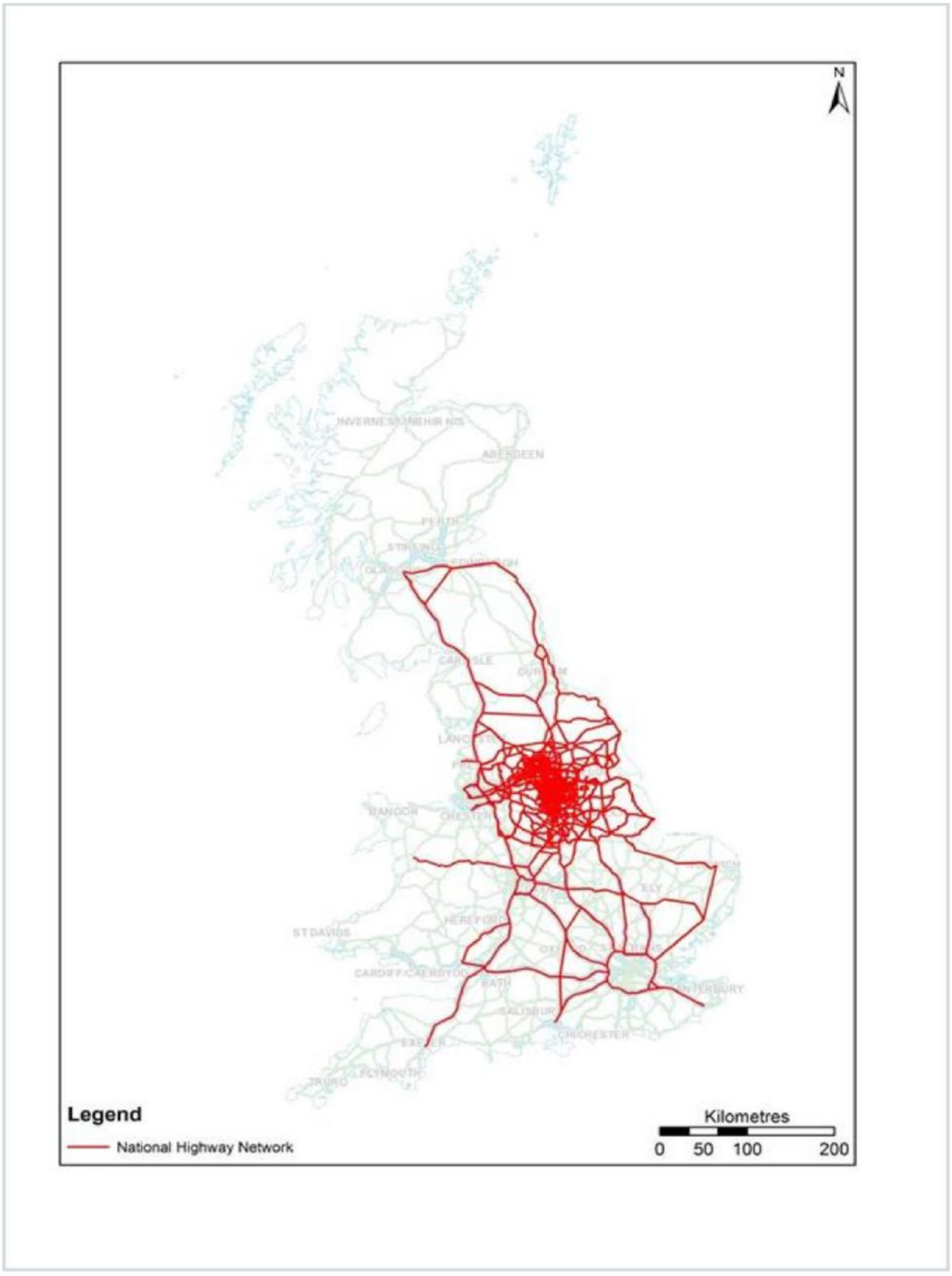

Figure 3. National highway network structure

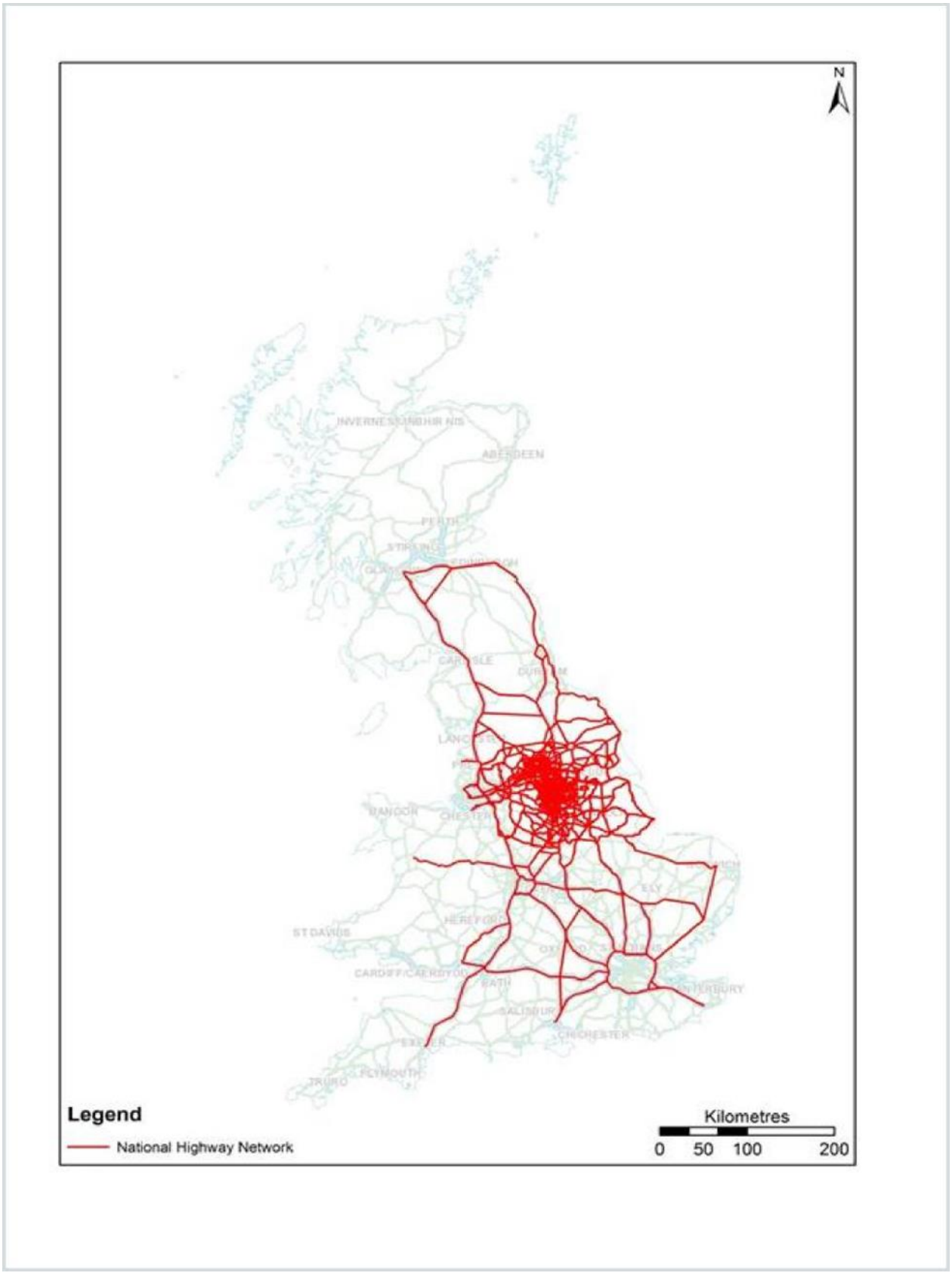

Figure 4. Sheffield City Region highway network structure

2.4 Public Transport Assignment Model

2.4.1 The SCRTM1 public transport assignment models are implemented in the Citilabs Voyager software, and include bus, rail and Supertram. Base year models representing travel in 2016 were developed using a wide range of observed data included electronic ticket machine data, onboard travel surveys, onboard passenger counts, station entry/exit information. A new network representation was derived from the updated from that used within the highway assignment models, with additional links representing Supertram, rail and walk access links being added. Matrix Estimation was used to calibrate the demand matrices and a good level of validation achieved.

2.4.2 The public transport assignment models have a single user class, with separate models produced for the same three time periods as the highway assignment models.

Section 3 SCRTM1 Base Model Validation

3.1 Introduction

3.1.1 This chapter describes the validation of SCRTM1 base year models and includes maps of where the data sets were collected and what they were used for.

3.1.2 The rest of this chapter is arranged under the following headings:

- highway model updates;
- highway model validation;
- public transport updates; and
- public transport model validation.

3.1.3 This section should be read in conjunction with the SCRTM1 Local Model Validation Report (LMVR) which is a **supporting document to T1 (T1-SD02).**

3.2 Highway Model Updates

3.2.1 Whereas it was necessary to undertake a significant update to the previous model SRTM3B as part of the current study due to the age of the underlying observed data it was constructed from, no such update was required to SCRTM1 as it had just recently been built to represent travel for a 2016 base year with newly acquired observed travel data, with a particular focus on achieving a good level of validation in the area of interest required for this study.

3.2.2 A brief review was undertaken of SCRTM1 base year assignment models, with particular reference to the locations of the known emissions hotspots, as indicated in Figure 5. In particular, parts of the highway network around known emissions hotspots were reviewed in terms of:

- Traffic flows and speeds in the highway assignment models;
- Journey times, junction and link capacities, link lengths and speed flow curves; and
- Bus lanes, traffic signal timings, and bus flows.

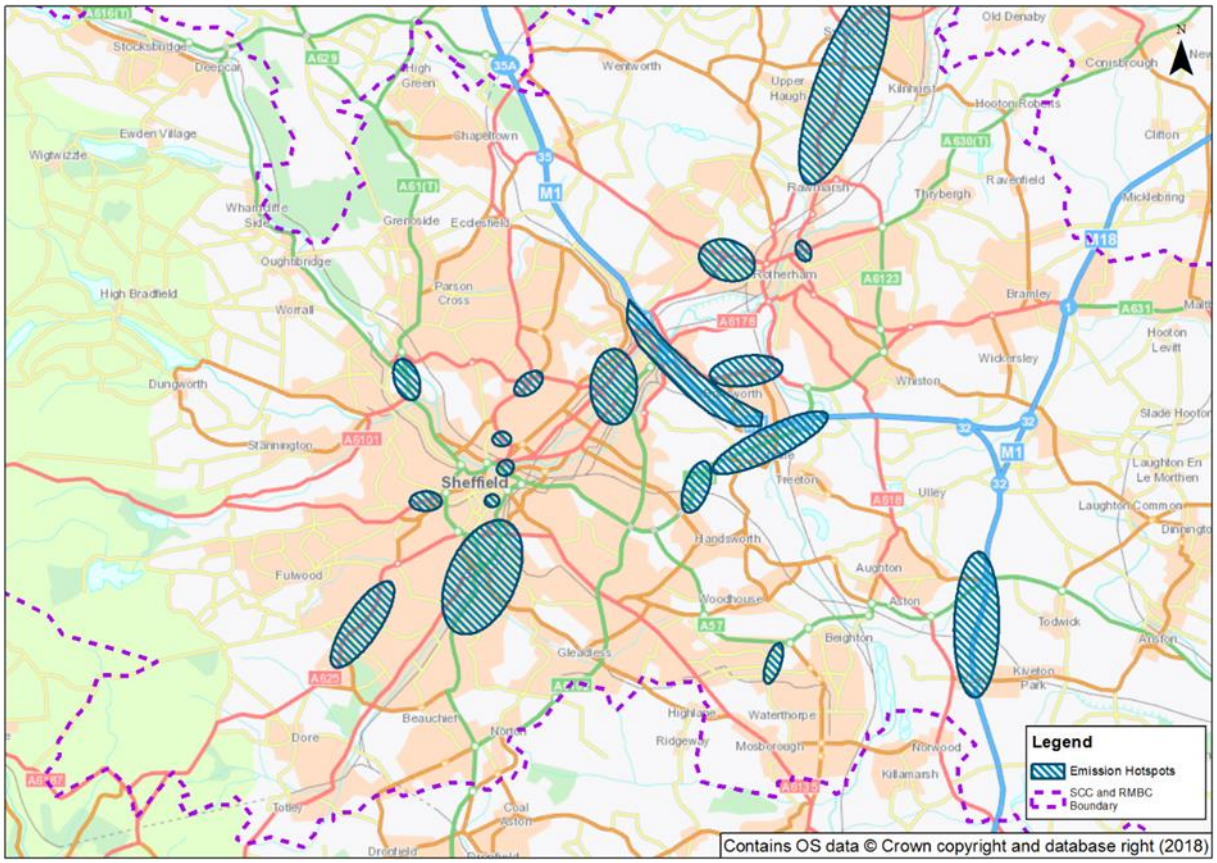

Figure 5. Location of Emission Hotspots

3.3 Highway Model Validation

Traffic Flow Validation

3.3.1 A very extensive set of traffic flow data was available for calibrating and validating these models, which included manual and automatic traffic counts. Figure 6 below shows the counts sites across Sheffield City Region for which count data remained once it had been appropriately cleaned, including those on the motorway network.

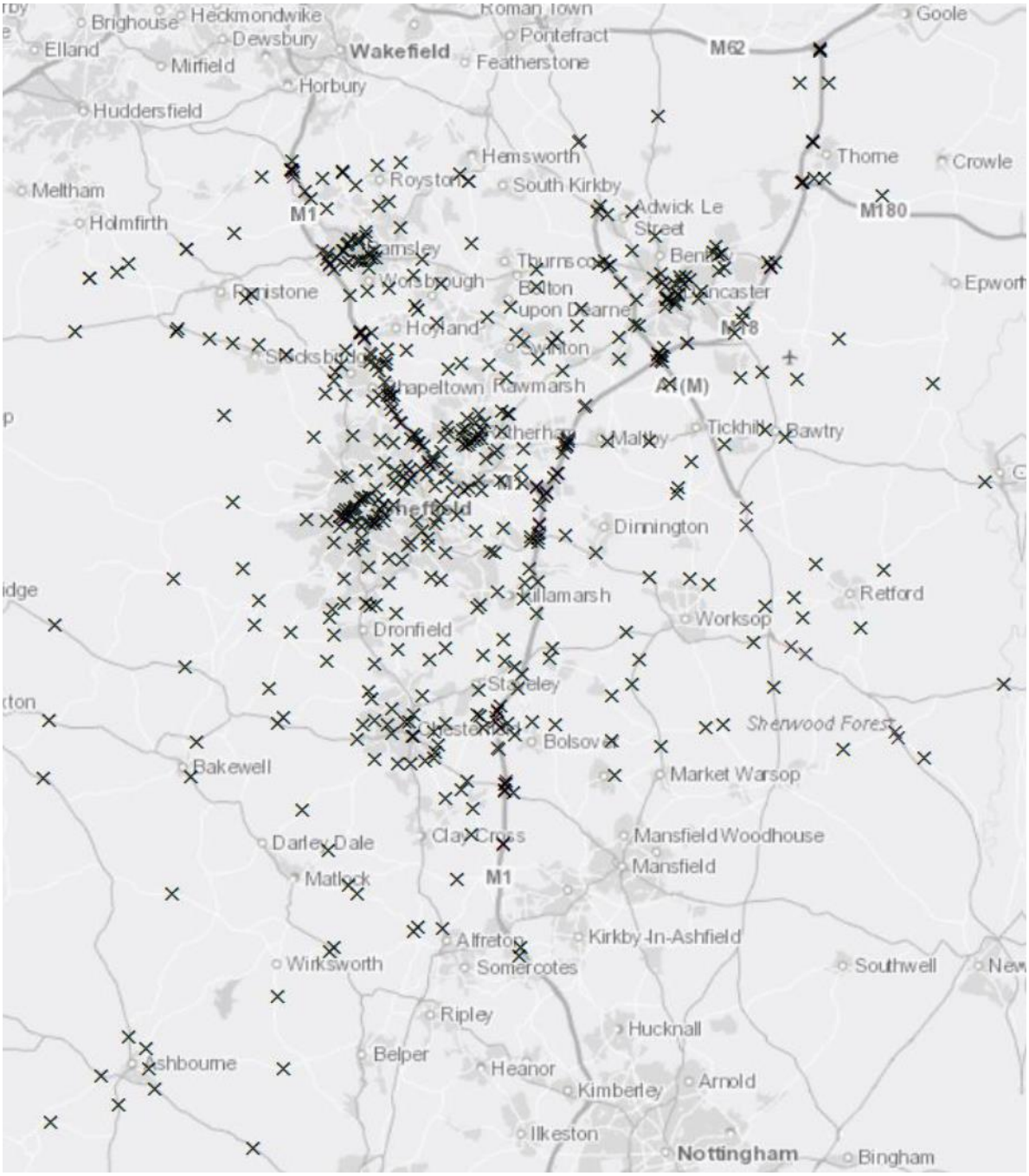

Figure 6. Count site locations across SCR used in SCRTM1

3.3.2 Figure 7 below shows the screenlines developed to calibrate and validate the model specifically for the Innovation Corridor scheme. The study area of that scheme covered much of Sheffield and Rotherham districts, which coincides with the same area covered by the Clean Air Plan. Green lines in the figure are calibration screenlines and red lines are validation.

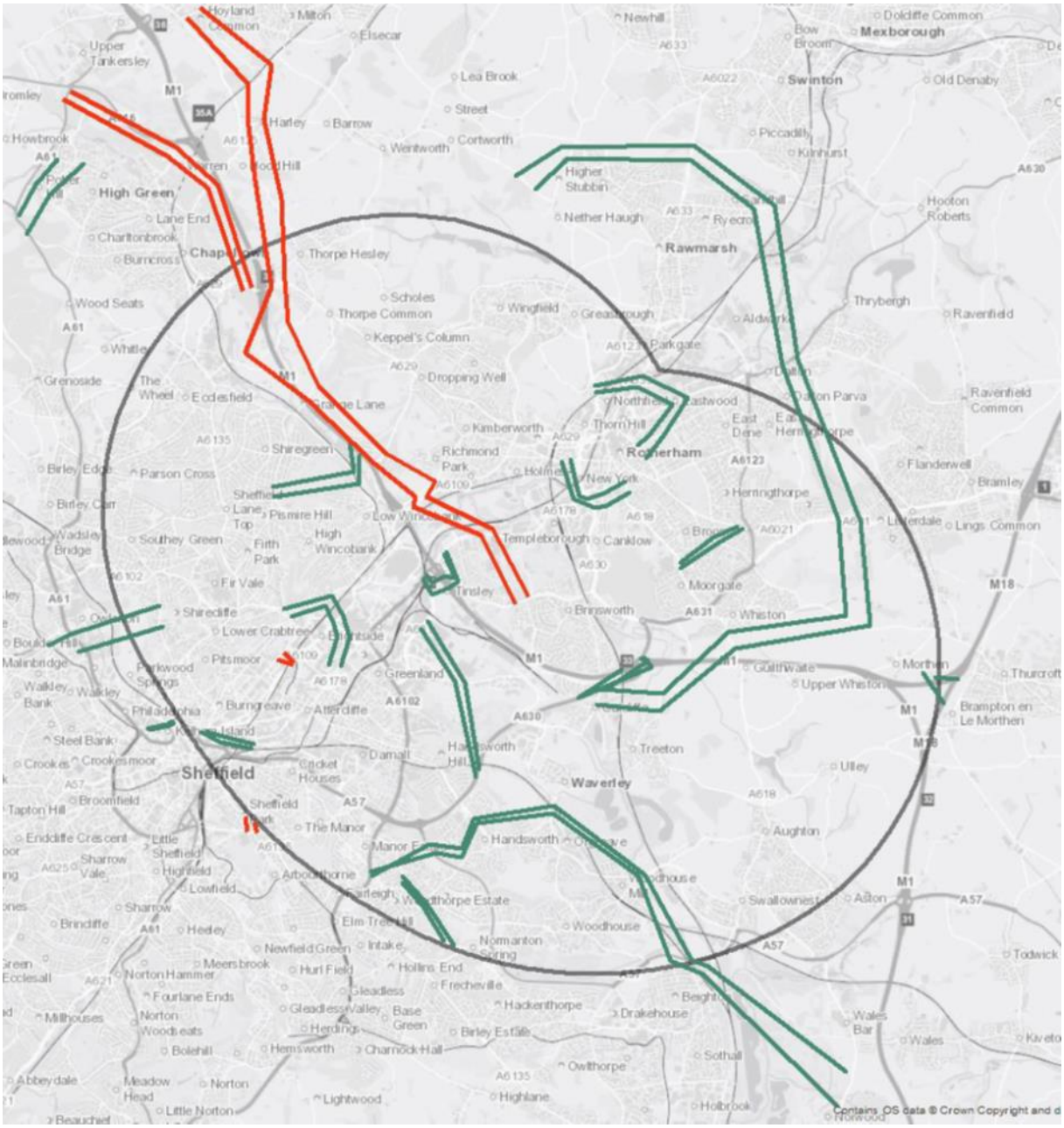

Figure 7. Screenlines within the Innovation Corridor Study – covering much of Sheffield and Rotherham

3.3.3 Figure 8 below shows the screenlines developed to calibrate and validate the model specifically for the Supertram Renewal study. These overlap with the area validated for the Innovation Corridor scheme and covers Sheffield City Centre and the south-west of the City. Again these represent a good coverage of the areas of particular focus in the Clean Air Plan.

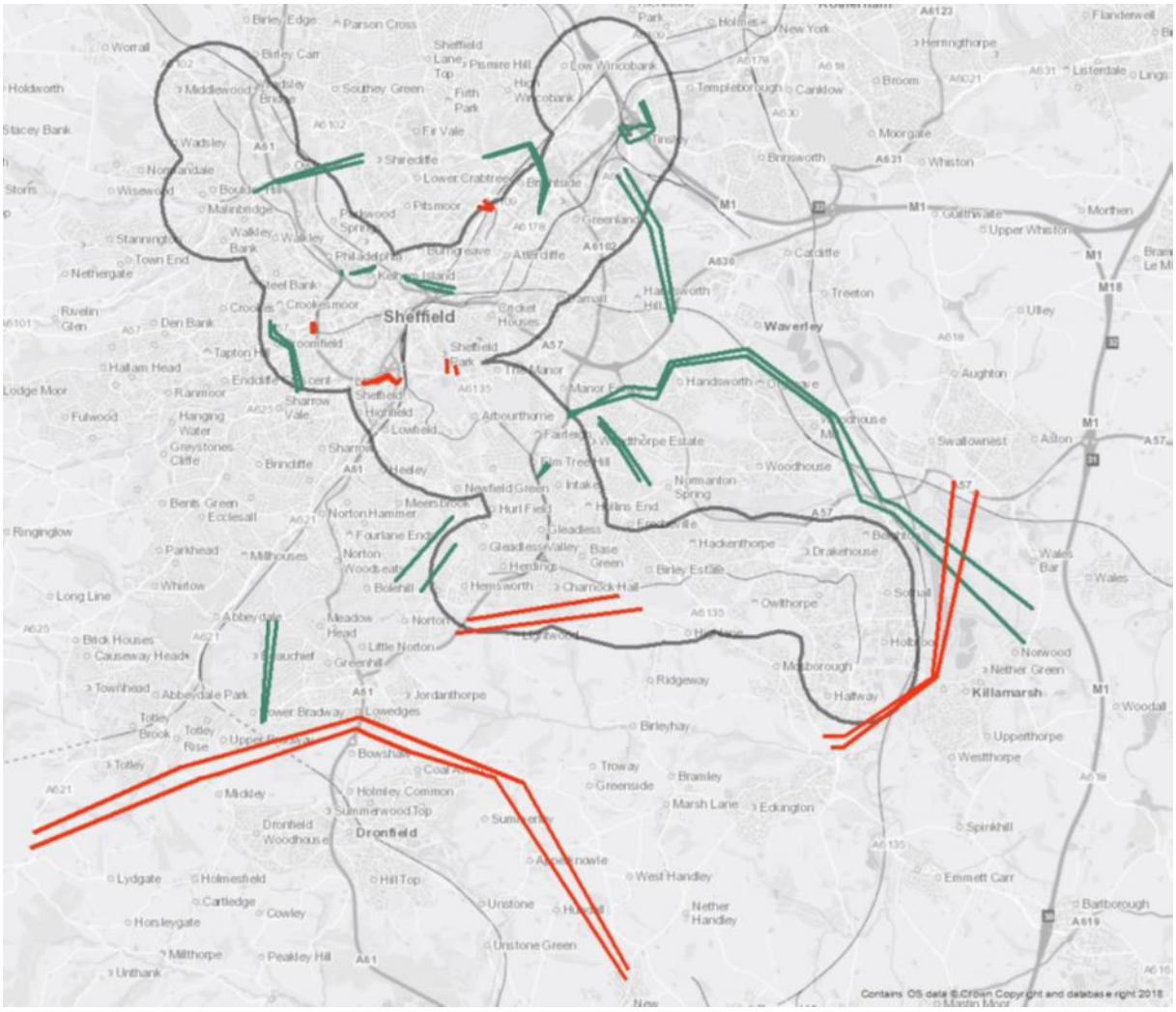

Figure 8. Screenlines for Supertram (Mass Transit) Renewal scheme

3.3.4 Table 1 and Table 2 set out the percentage of count sites passing the relevant TAG criteria for modelled to observed flows comparisons, for the calibration sites and the validation sites respectively. As would be expected the overall performance is better for the calibration sites (sites for which data is input to the matrix estimation process) than the validation sites. Nonetheless, for both the Mass Transit and Innovation Corridor scheme areas the validation site comparisons are very good. The reduced level of validation across the whole model reflects the focus of the validation exercise, which critically for the Clean Air Plan work put a high level of importance on achieving a good validation across the Sheffield and Rotherham districts.

3.3.5 The TAG criteria for passing calibration criteria is shown in the table below.

TAG Calibration and Validation Criteria

Criteria	Description of Criteria	Guideline
1	Individual flows within 100 veh/h of counts for flows less than 700 veh/h	> 85% of cases
	Individual flows within 15% of counts for flows from 700 to 2,700 veh/h	
	Individual flows within 400 veh/h of counts for flows more than 2,700 veh/h	
2	GEH < 5 for individual flows	> 85% of cases

3.3.6 For the SCRTM1 mode the majority of these criteria for both calibration and validation counts, which is a very good level of validation given the fully modelled area covers the whole of Sheffield City Region. The tables below show the results for Car and All Vehicles as presented in the SCRTM1 Local Model Validation Report (LMVR).

Table 1. Calibration Count Sites within TAG criteria

% of COUNT SITES PASSING CRITERIA	MORNING PEAK All vehicles	MORNING PEAK Cars	INTER PEAK All Vehicles	INTER PEAK Cars	EVENING PEAK All Vehicles	EVENING PEAK Cars
Mass Transit	89%	91%	89%	93%	85%	88%
Innovation Corridor	88%	93%	93%	97%	90%	91%
All SCRTM1	82%	84%	88%	91%	82%	82%

Table 2. Validation Count Sites within TAG criteria

% of COUNT SITES PASSING CRITERIA	MORNING PEAK All vehicles	MORNING PEAK Cars	INTER PEAK All Vehicles	INTER PEAK Cars	EVENING PEAK All Vehicles	EVENING PEAK Cars
Mass Transit	82%	84%	78%	84%	78%	84%
Innovation Corridor	88%	90%	100%	100%	88%	90%
All SCRTM1	69%	71%	77%	81%	71%	73%

LGV and HGV validation

3.3.7 The SCRTM1 LMVR does not present details on the calibration and validation of highway counts, so additional analysis has been undertaken as part of the Clean Air project. The table below shows the equivalent data to that shown above for HGV and LGV vehicle classes. As can be seen there is a very good match with TAG criteria (although it should be noted that in general HGV vehicles are very slightly low.

Table 3. Calibration Count Sites within TAG criteria (HGV and LGV)

% of COUNT SITES PASSING CRITERIA	MORNING PEAK HGV	MORNING PEAK LGV	INTER PEAK HGV	INTER PEAK LGV	EVENING PEAK HGV	EVENING PEAK LGV
Mass Transit	97%	97%	98%	96%	99%	96%
Innovation Corridor	96%	99%	98%	98%	99%	97%

All SCRTM1	93%	95%	94%	97%	98%	96%

Table 4. Validation Count Sites within TAG criteria (HGV and LGV)

% of COUNT SITES PASSING CRITERIA	MORNING PEAK HGV	MORNING PEAK LGV	INTER PEAK HGV	INTER PEAK LGV	EVENING PEAK HGV	EVENING PEAK LGV
Mass Transit	98%	94%	98%	90%	100%	98%
Innovation Corridor	100%	100%	100%	100%	100%	100%
All SCRTM1	89%	90%	90%	91%	92%	95%

Screenline calibration

3.3.8 The following table summarises the proportion of screenlines which pass TAG criteria within each of the core calibration areas. Between them the Innovation Corridor Area and the Mass Transit area encapsulate all the key areas for the Clean Air Zone and as can be seen from the table each of these sets of screenline are well calibrated. More detail on these results can be found in supporting document SD01 (Sections 12 and 13).

Table 5. Screenline Sites Passing Criteria

% of COUNT SITES PASSING CRITERIA	MORNING PEAK All vehicles	MORNING PEAK Cars	INTER PEAK All vehicles	INTER PEAK Cars	EVENING PEAK All vehicles	EVENING PEAK Cars
Mass Transit	91%	84%	97%	95%	94%	92%
Innovation Corridor	92%	87%	100%	100%	96%	100%

3.3.9 TAG Unit M3.1 para 4.2.6 says good vehicles will generally need to be reported for short screenlines using grouped counts which have sufficiently small confidence intervals. No screenline results are available for HGV or LGV's within the LMVR. The CAZ team do have access to some of the data behind the calibration but would be an onerous task to created screenlines, especially as the individual count calibration is good as noted in section 3.3.7.

Journey Time Validation

3.3.10 Observed journey time information was derived for a large number of routes across Sheffield City Region from the TrafficMaster dataset. The journey time routes are shown in Figure 9. In particular there are journey time routes for the key roads in both Sheffield and Rotherham which are expected to be Air Quality problem locations in 2022.

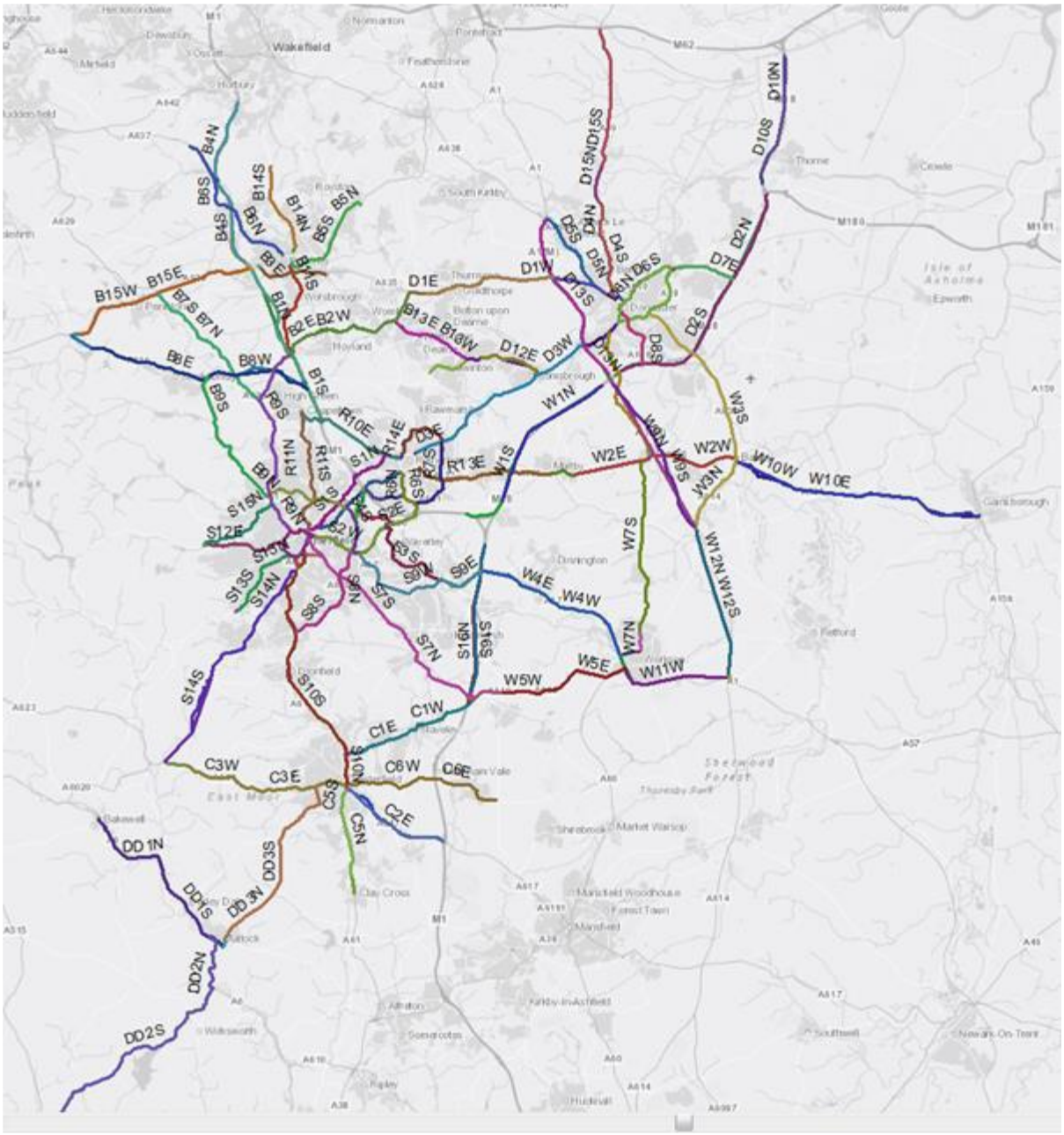

Figure 9. Journey Time Routes across the whole of SCR

3.3.11 As shown in Table 3 the model compares well against journey time observations. This is particularly good for the inter-peak hour where >85% is achieved in all scheme areas and across the whole fully modelled area.

Table 6. Journey Time Validation

Scheme Area	Number of journey time routes	Morning peak % Pass	Inter Peak % Pass	Evening Peak % Pass
Mass Transit	46	80%	87%	83%
Innovation Corridor	54	89%	89%	85%

ALL SCRTM1	150	82%	92%	80%

3.3.12 In summary, the SCRTM1 highway assignment models have a good level of count and journey time validation – this is especially across the districts of Sheffield and Rotherham and on the specific Mass Transit and Innovation Corridor areas which align well with the areas under consideration for the Clean Air Plan.

3.4 AQ Hotspots

3.4.1 The tables below show the calibration at the Air Quality areas of greatest concern. These have been identified based on the Target Determination process as described in TD1 and AQ2. For each Census ID location, where the Base Year concentrations are above 39.0 and where a calibration of validation count is located at that point or nearby the GEH statistic[2] has been reported in the table below. Where no calibration data was available at the location or nearby that census ID point is not included.

Table 7. AM Convergence at AQ Hotspots (GEH)

Census id	Road ID	2017 Concen-tration	AM Car: Dir 1	AM Car: Dir 2	AM HGV: Dir 1	AM HGV: Dir 2	AM LGV: Dir 1	AM LGV: Dir 2
58395	A630	51.60	1.04	1.17	1.76	1.65	1.09	0.07
77552	A629	46.70	2.07	0.69	0.39	0.09	0.09	0.13
37441	A6178	46.30	0.80	0.37	5.46	3.04	2.28	0.24
27396	A631	44.40	1.40	1.75	0.09	0.12	0.11	0.25
73908	A631	43.50	1.92	4.43	0.91	0.43	0.03	0.24
81238	A6109	42.00	2.21	0.79	0.41	0.00	0.71	0.19
7380	A6178	40.40	8.16	9.72	1.45	4.44	2.71	3.56
80807	A6023	40.20	0.04	0.30	0.07	0.34	0.09	0.27
27799	A6021	39.60	0.94	0.26	0.00	0.11	0.16	0.36
16581	A61	39.10	0.24	1.64	2.19	0.10	0.15	0.14
17332	A631	37.90	0.64		5.40		4.05	
60033	A6123	37.40	1.27	1.66	0.05	0.82	0.14	0.25
37902	A6102	37.00	0.54	0.48	1.12	0.10	0.98	0.22
73910	A630	36.40	2.78	3.00	0.66	1.06	0.15	0.25
28868	A631	34.00	1.35	0.40	1.73	1.20	0.03	0.01

[2] https://en.wikipedia.org/wiki/GEH_statistic

Table 8. Inter-Peak Convergence at AQ Hotspots (GEH)								
Census id	Road ID	2017 Concen-tration	IP Car: Dir 1	IP Car: Dir 2	IP HGV: Dir 1	IP HGV: Dir 2	IP LGV: Dir 1	IP LGV: Dir 2
58395	A630	51.60	3.46	2.50	1.21	1.29	0.16	1.66
77552	A629	46.70	0.15	0.09	0.17	0.11	0.33	0.05
37441	A6178	46.30	0.16	1.05	3.90	2.93	0.04	0.08
27396	A631	44.40	0.31	0.25	0.0 caveta 3	0.32	0.02	0.16
73908	A631	43.50	0.56	0.85	0.06	0.13	0.06	0.10
81238	A6109	42.00	0.69	0.08	0.08	0.17	0.41	0.11
7380	A6178	40.40	8.27	9.51	4.62	5.02	3.96	4.66
80807	A6023	40.20	0.10	0.32	0.11	0.02	0.06	0.05
27799	A6021	39.60	0.64	0.09	0.76	0.88	0.00	0.00
16581	A61	39.10	0.05	0.72	1.66	0.06	0.08	0.16
17332	A631	37.90	0.85		0.91		0.37	
60033	A6123	37.40	0.65	0.30	0.07	0.84	0.04	0.08
37902	A6102	37.00	0.08	0.39	0.22	0.59	0.14	0.07
73910	A630	36.40	1.26	0.79	0.58	0.42	0.01	0.13
28868	A631	34.00	0.01	0.22	0.07	0.12	0.04	0.11

Table 9. PM Convergence at AQ Hotspots (GEH)								
Census id	Road ID	2017 Concen-tration	PM Car: Dir 1	PM Car: Dir 2	PM HGV: Dir 1	PM HGV: Dir 2	PM LGV: Dir 1	PM LGV: Dir 2
58395	A630	51.60	4.14	0.12	0.39	0.42	1.23	1.32
77552	A629	46.70	1.19	0.14	0.10	0.05	0.08	0.05
37441	A6178	46.30	2.01	1.25	0.25	3.28	1.39	0.41
27396	A631	44.40	0.54	1.81	0.12	0.08	0.03	0.13
73908	A631	43.50	2.85	0.69	0.32	0.11	0.04	0.52
81238	A6109	42.00	0.07	0.42	0.06	0.03	0.04	0.10

7380	A6178	40.40	6.23	4.24	1.10	1.43	0.42	0.75
80807	A6023	40.20	0.19	0.09	0.08	0.08	0.04	0.03
27799	A6021	39.60	3.03	1.26	5.10	0.01	0.00	0.02
16581	A61	39.10	0.75	0.11	0.72	0.17	0.62	0.36
17332	A631	37.90	3.97		0.49		0.62	
60033	A6123	37.40	0.02	1.22	0.62	0.04	0.26	0.02
37902	A6102	37.00	0.80	1.28	0.01	0.18	0.46	1.53
73910	A630	36.40	2.18	1.66	0.27	0.04	3.75	0.01
28868	A631	34.00	0.86	1.73	1.44	0.04	0.05	0.08

3.4.2 It is clear that the calibration at the majority of these sites is very good, particularly for goods vehicles. Note: The only one which shows up as having GEH values greater than 5 (less well validated) is census ID location 7380, which is on the Attercliffe Road and is expected to have sufficient head room in compliance in 2022 that it is not expected that the slightly worse calibration at this location will be material.

3.4.3 For those locations which were found to have non-compliances in 2017 through the Target Determination process, but do not have calibration or validation data close by it is clearly not possible to say how the model performs at those exact locations. However, the good levels of validation in the screenlines give us confidence in the ability of the model to robustly forecast traffic at these locations.

3.4.4 However, due the importance of Sheffield City Centre for the purposes of the Clean Air study, some additional analysis has been done to assess the level of validation in that area. The table below shows the proportion of counts inside or within 1km of the proposed charging zone (see T4 report for details) within different GEH bands. For HGV and LGV over 89% validate with a GEH of less than 5.0 in all time periods, which represents a very good level of calibration.

Table 10. Calibration and Validation Sites around Sheffield City Centre									
GEH	AM Car	AM HGV	AM LGV	IP Car	IP HGV	IP LGV	PM Car	PM HGV	PM LGV
<5	79%	98%	95%	75%	96%	89%	70%	100%	93%
<10	14%	2%	4%	18%	4%	11%	21%	0%	7%
>10	7%	0%	2%	7%	0%	0%	9%	0%	0%
Max	17.16	5.17	10.93	14.43	5.90	6.52	17.97	4.11	5.89
Count	112	112	112	112	112	112	112	112	112

3.4.5 Of the handful of links with a GEH greater than 10 all bar one are on roads which have low flow and generally not proximate to any of the main locations of interest. Just one is of note, at Chatham Road, approaching Bridgehouses Roundabout on the Sheffield Inner Ring Road (IRR). This has values >10 for cars in all time periods, special care should therefore be taken to ensure there is sufficient headroom in compliance at IRR locations close to this in forecasting.

3.4.6 In general, the above analysis demonstrates that the model has a very good level of validation around the key locations at which interventions are proposed (see T4 for detail), but noting that some locations data is not available.

3.5 Public Transport Updates

3.5.1 No further updates were required to the SCRTM1 public transport assignment base models as part of the Clean Air Plan study. This was because the models already achieved a good level of validation for a 2016 base year, having been developed specifically to assess the Mass Transit Renewal scheme which impacts public transport use across Sheffield and Rotherham – the same area as for the Clean Air Plan.

3.6 Public Transport Model Validation

3.6.1 Comprehensive observed count data sets were collected to calibrate and validate the SCRTM1 public transport assignment models. The bus count dataset is shown in Figure 10 below, which includes a cordon around both Sheffield and Rotherham town centres.

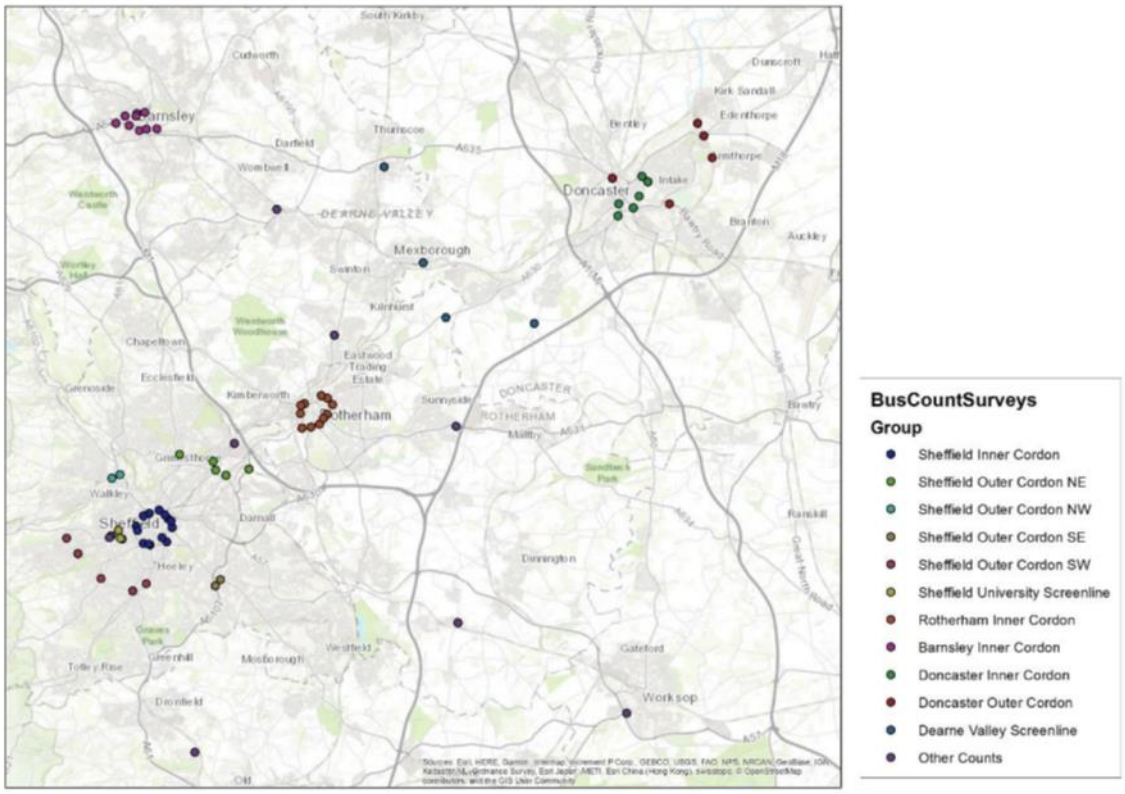

Figure 10. Locations of Bus Occupancy Passenger Counts

3.6.2 The locations of the rail station entry and exit counts are shown in Figure 11.

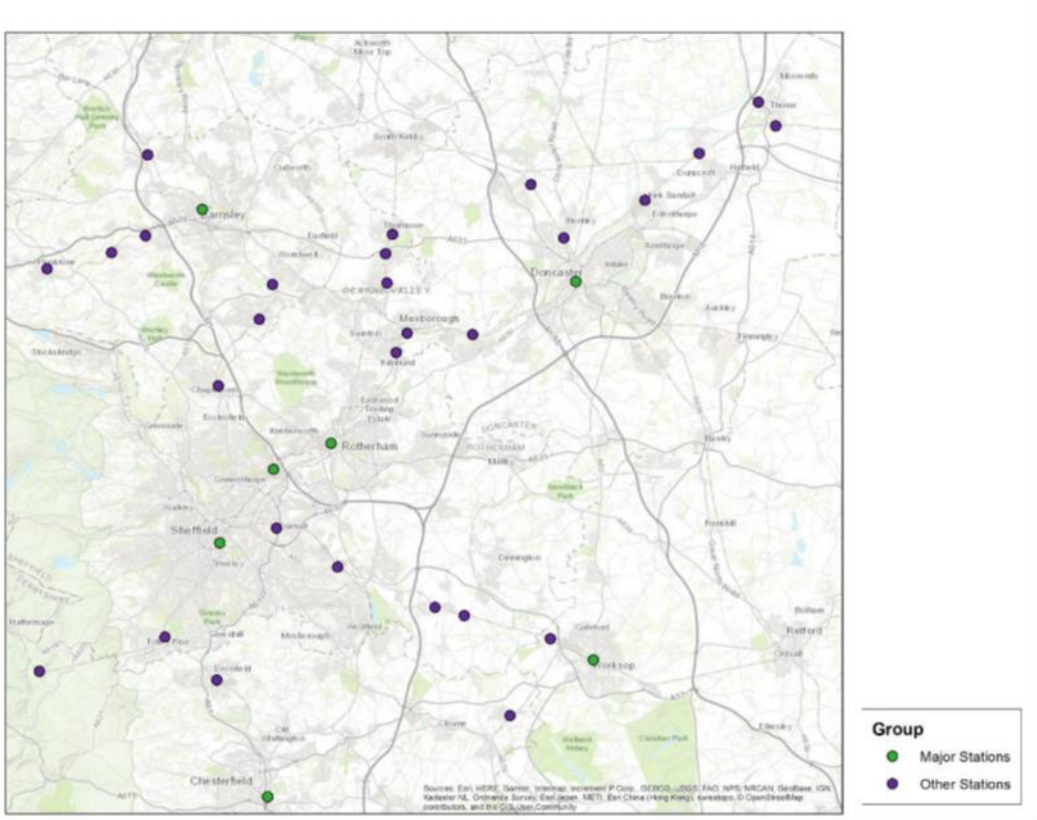

Figure 11. Location of Rail Station Entry and Exit Counts

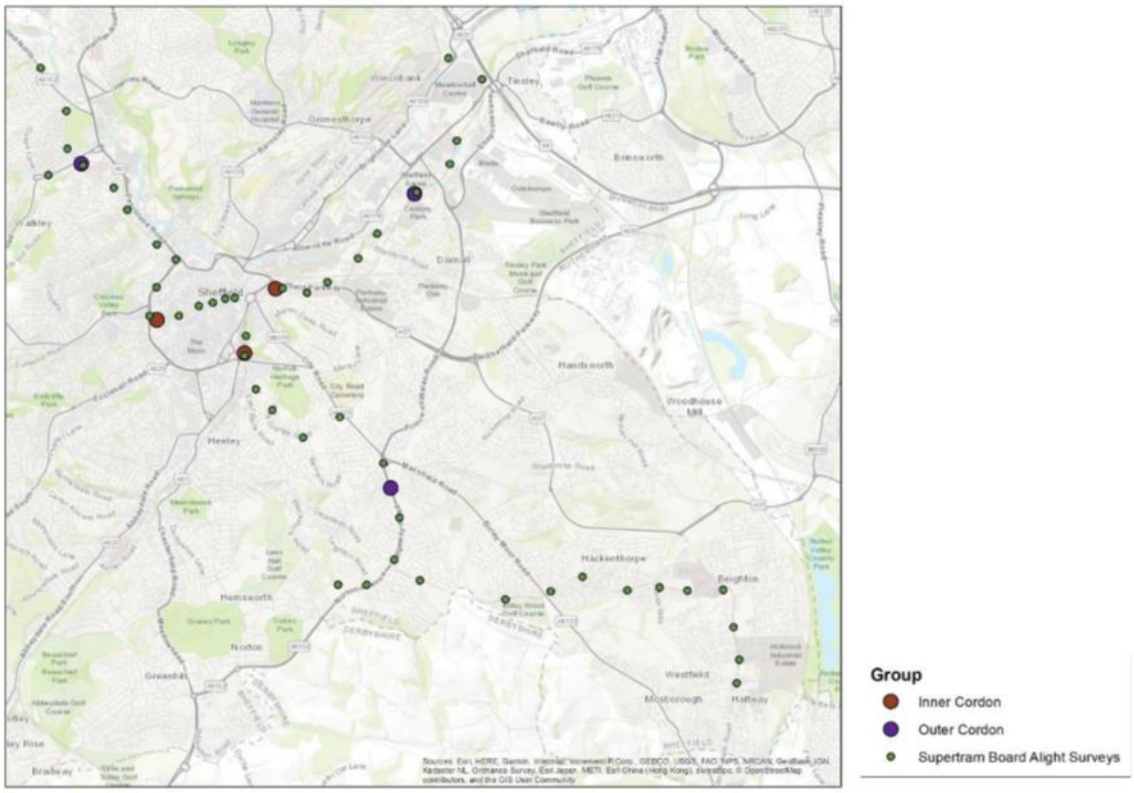

Figure 12. Supertram Boarding and Alighting Counts

3.6.3 Matrix estimation was used to improve the fit of modelled passenger flows to the observed count data. The Local Model Validation Report (LMVR) produced for SCRTM1 shows a

good level of validation for all the key areas, including Sheffield and Rotherham, for each of bus, rail and Supertram and in all time periods.

3.6.4 For bus, the validation across cordons is very good, with 89% of cordons within 5% of observed flows a further 8% within 5-15% and only two (3%) cordon/direction/time period combinations being greater than 15% away from the observed flows. Of the individual flows, 98% are within the guidelines, with 1% high and 1% low (by more than 25%). In the interpeak and PM peak all modelled flows greater than 150 are within 25% of observed counts.

3.6.5 For rail, the validation is very good in all locations, with 89% of station/groups/time period/direction combinations within 5% and a further 9% within 5-15%. There is only one site outside 15% of the observed value, which is Barnsley interpeak boardings.

3.6.6 For Supertram, the validation is very good with 63% within 5% of observed counts, and the remainder within 5-15%. 98% of counts greater than 150 are within 15%, while 2% are lower and none are higher. All sections perform well in all time periods.

3.6.7 In summary, the SCRTM1 public transport assignment models have a good level of count and journey time validation in both Sheffield and Rotherham, with very good levels of validation in the core areas covered by the Clean Air Plan.

Section 4 USING SCRTM1 TO MODEL THE CLEAN AIR PLAN

4.1 Introduction

4.1.1 SCRTM1 was built in accordance with the principles set out in DfT TAG, with a base year validation of 2016. It has received considerable scrutiny by DfT in accordance with the major scheme bids for Mass Transit Renewal and Sheffield Innovation Corridor. The highway assignment models have a good level of comparison between modelled and observed flows and journey times. The validation is especially good in the scheme study areas, which cover the same area as the Clean Air Plan i.e. Sheffield and Rotherham districts.

4.1.2 Our conclusions are that SCRTM1 now forms an appropriate base year dataset and forecasting tool with which to assess the clean air plan. This is why we have switched to using SCRTM1 for the Full Business Case submission.

4.2 ANPR Hotspot Data

4.2.1 There was an additional data set available for use in the Clean Air Plan study that was not used in the SCRTM1 development. This was Automatic Number Plate Recognition (ANPR) data, which was used to identify fleet characteristics of traffic across Sheffield and Rotherham, primarily in terms of engine type and age of fleet. This data was collected over a full 12-month period in 2019 and was used to segment highway travel demand matrices into compliant and non-compliant vehicle types. The locations of these camera hotspots are shown in Figure 13.

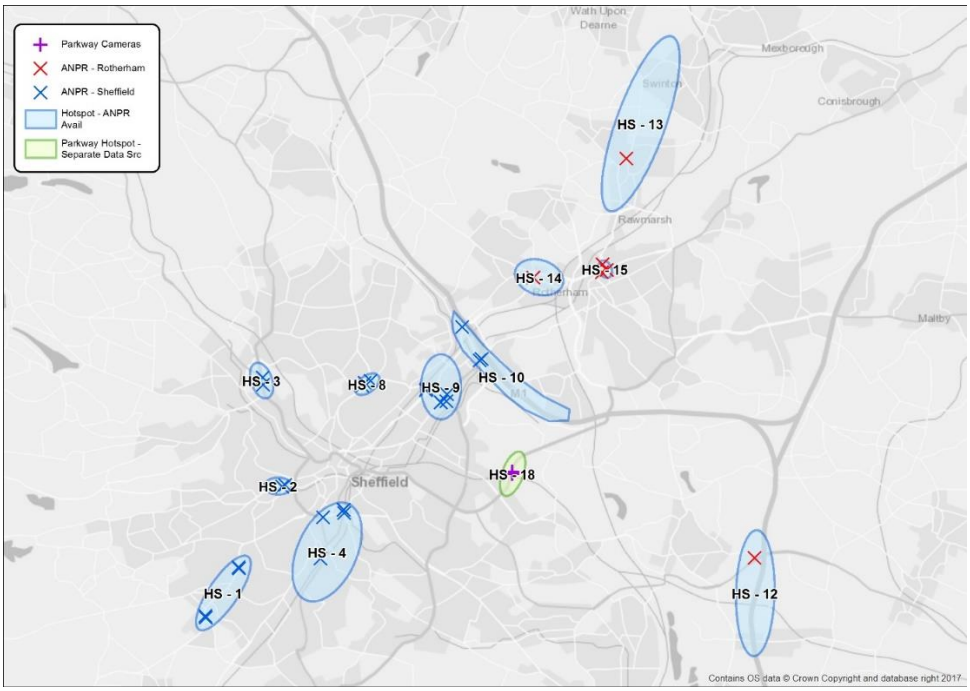

Figure 13. Location of Emission Hotspot ANPR Camera Clusters

4.2.2 The ANPR data was not used in the validation process in the end as it was found that whilst it was good at predicting the fleet composition it underestimates the traffic flow by around 20%-30%, which means it is not usable for validation purposes. The ANPR data only measures one pass per day and hotspot. If a car passes two cameras in a hotspot

one day, it is only counted once. So, if there are two cameras recoding inbound and outbound traffic and if someone is commuting along that route, the car is only counted as one pass per day. Hence why this cannot be used in validation.

4.3 Final Conclusions

4.3.1 This report has described the validation of the base year SCRTM1 assignment model in relation to available observed count data and demonstrated that the models are appropriate for modelling the Clean Air Plan. No specific updates were required to the base year models for the purposes of this study as they were already validated to a high standard across the Sheffield and Rotherham districts. A present year validation was not required because the base year of SCRTM1 was 2016.

4.3.2 ANPR data was made available for this study and used to segment model matrices into compliant and non-compliant vehicle types. Fleet composition forecasts were informed by the Emissions Factor Toolkit