Bristol Clean Air Plan

LGV/HGV Validation Technical Note

January 2019

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Contents

1. Introduction

1.1 Overview

Poor air quality is the largest known environmental risk to public health in the UK[1]. Investing in cleaner air and doing more to tackle air pollution are priorities for the EU and UK governments, as well as for Bristol City Council (BCC). BCC has monitored and endeavoured to address air quality in Bristol. Despite this, Bristol has ongoing exceedances of the legal limits for Nitrogen Dioxide (NO_2) and these are predicted to continue until 2022 without intervention.

In 2017 the government published a UK Air Quality Plan for Nitrogen Dioxide[2] setting out how compliance with the EU Limit Value for annual mean NO_2 will be reached across the UK in the shortest possible time. Due to forecast air quality exceedances, BCC, along with 27 other Local Authorities, was directed by Minister Therese Coffey (Defra) and Minister Jesse Norman (DfT) in 2017 to produce a Clean Air Plan (CAP). The Plan must set out how BCC will achieve sufficient air quality improvements in the shortest possible time. In line with Government guidance BCC is considering implementation of a Clean Air Zone (CAZ), including both charging and non-charging measures, in order to achieve sufficient improvement in air quality and public health.

Jacobs has been commissioned by BCC to produce an Outline Business Case (OBC) for the delivery of the CAP; a package of measures which will bring about compliance with the Limit Value for annual mean NO_2 in the shortest time possible in Bristol. The OBC assesses the shortlist of options set out in the Strategic Outline Case, and proposes a preferred option including details of delivery. The OBC forms a bid to central government for funding to implement the CAP.

This technical note reports on the light and heavy goods vehicle link flow validation.

[1] Public Health England (2014) Estimating local mortality burdens associated with particular air pollution. https://www.gov.uk/government/publications/estimating-local-mortality-burdens-associated-with-particulate-air-pollution
[2] https://www.gov.uk/government/publications/air-quality-plan-for-nitrogen-dioxide-no2-in-uk-2017

2. Base Year Model

In 2013, BCC commissioned CH2M (now Jacobs) to update the existing GBATS model, primarily to assess the MetroWest scheme. The updated model is called the GBATS4 Metro Model (GBATS4M). The GBATS4M model consists of:

- A Highway Assignment Model representing vehicle based movements across the Greater Bristol area for a 2013 autumn weekday morning peak hour (08:00-09:00), an average inter-peak hour (10:00-16:00) and an evening peak hour (17:00-18:00);
- A Public Transport (PT) Assignment Model representing bus and rail based movements across the same area and time periods; and
- A five-stage multi-modal incremental Variable Demand Model (VDM) that forecasts changes in trip frequency and choice of main mode, time period of travel, destination, and sub-mode choice, in response to changes in generalised costs across the 12-hour period (07:00 – 19:00).

The full model validation is set in OBC-22 Model Validation Report (T2) in Appendix Ei of the OBC. A summary of the highway model validation is provided below as relevant context for the assessment of light and heavy goods vehicles.

2.1 Highway Model

The GBATS4M highway model included an update of the trips to/from the city centre with roadside interview data. The model has been validated using the guidance, measures and criteria recommended in WebTAG M3.1. The following comparisons between modelled and observed data have been reported in OBC-22 Model Validation Report (T2):

- Total flows for cordons and screenlines, lights and all vehicles;
- Traffic Flows on individual links, lights and all vehicles; and
- Journey times (both cruise and net) for a range of key routes.

The analysis shows that the three models meet the WebTAG acceptability guidelines:

- Regarding matrix estimation changes;
- For traffic flows on links across the total cordon and screenlines and at the individual calibration, and independent validation sites; and
- For journey times.

All three models (AM, inter-peak and PM) achieve acceptable levels of convergence and are stable based on delay/cost.

3. Base Year Model – LGV and HGV Validation

The light and heavy goods vehicles have not previously been validated separately, as traffic flows on individual links and screenlines have been validated against the number of cars and the total number of vehicles.

For this note, a check has been undertaken of the validation of goods vehicles on a series of short screenlines in accordance with WebTAG M3.1 Section 9.3.1.

It should be noted that JAQU, as outlined in the Evidence Package section 2.1.2, require that all reasonable efforts are made to bring the transport model as close as reasonably possible to WebTAG validation criteria. In instances where models would require significant update, JAQU will not require all WebTAG guidance on validation to be followed where impacts of any shortcomings can be overcome elsewhere in the analysis.

3.1 Validation Criteria and Acceptability Guidelines

Highway model validation acceptability guidelines are specified in TAG M3.1. However, TAG M3.1 states that a model can still be deemed as ‘fit for purpose’ if it does not meet these guidelines, and indeed if they are met that the model is not automatically deemed so. If these criteria cannot be fully met, the importance of the relevant locations to overall model validation and assessment of proposed schemes should be reviewed to ensure the model is still fit for purpose.

The validation criteria and acceptability guidelines as specified in TAG M3.1 are shown in Table 3.1 below. The observed flow and screenline flow criteria have been applied to “all vehicles” and “cars/LGVs” in the validation report. Hence the need for additional checks relating to goods vehicles in this note.

Table 3.1 – WebTAG Acceptability Guidelines

Criteria and Measure		Acceptability Guideline	
Flow Difference Criteria			
1	Total screenline flows (normally > 5 links) to be within +/- 5%	All (or nearly all) screenlines	
2	Observed (individual) link flow < 700vph	Modelled flow within +/- 100vph	> 85% of links
	Observed (individual) link flow 700 to 2700vph	Modelled flow within +/- 15%	> 85% of links
	Observed (individual) link flow > 2700vph	Modelled flow within +/- 400vph	> 85% of links
GEH Criteria			
3	GEH statistic for individual link flows <5		> 85% of links
Journey Time Validation			
4	Modelled times along routes should be within 15% (or 1 minute, if higher)		> 85% of links

The GEH statistic, included in Table 3.1, is used as an indicator of the extent to which the modelled flows match the corresponding observed flows. This is recommended in the guidelines contained in TAG M3.1 and is defined as:

$$GEH = \sqrt{\frac{(M - C)^2}{0.5(M + C)}}$$

Where:

M = modelled flow; and

C = observed flow.

3.2 Screenlines and Cordons

A wide range of traffic counts, forming a number of calibration and validation screenlines and cordons, across the area were conducted during development of the model in 2013. Screenlines and cordons were selected to capture all the major trip movements. The screenlines were designed to be sufficiently long to show the quality of the matrix and the cordons were intended to be suitably ‘watertight’ and include all main roads in the network that intersect them.

The calibration screenlines and cordons were the Inner, South, East, North West Inner, River and Railway sections of the city as shown in Figure 3.1. The validation screenlines and cordons were the Outer, Middle and North-West Outer and North-East sections as shown in Figure 3.2.

Figure 3.1- Calibration Traffic Count Cordons and Screenlines

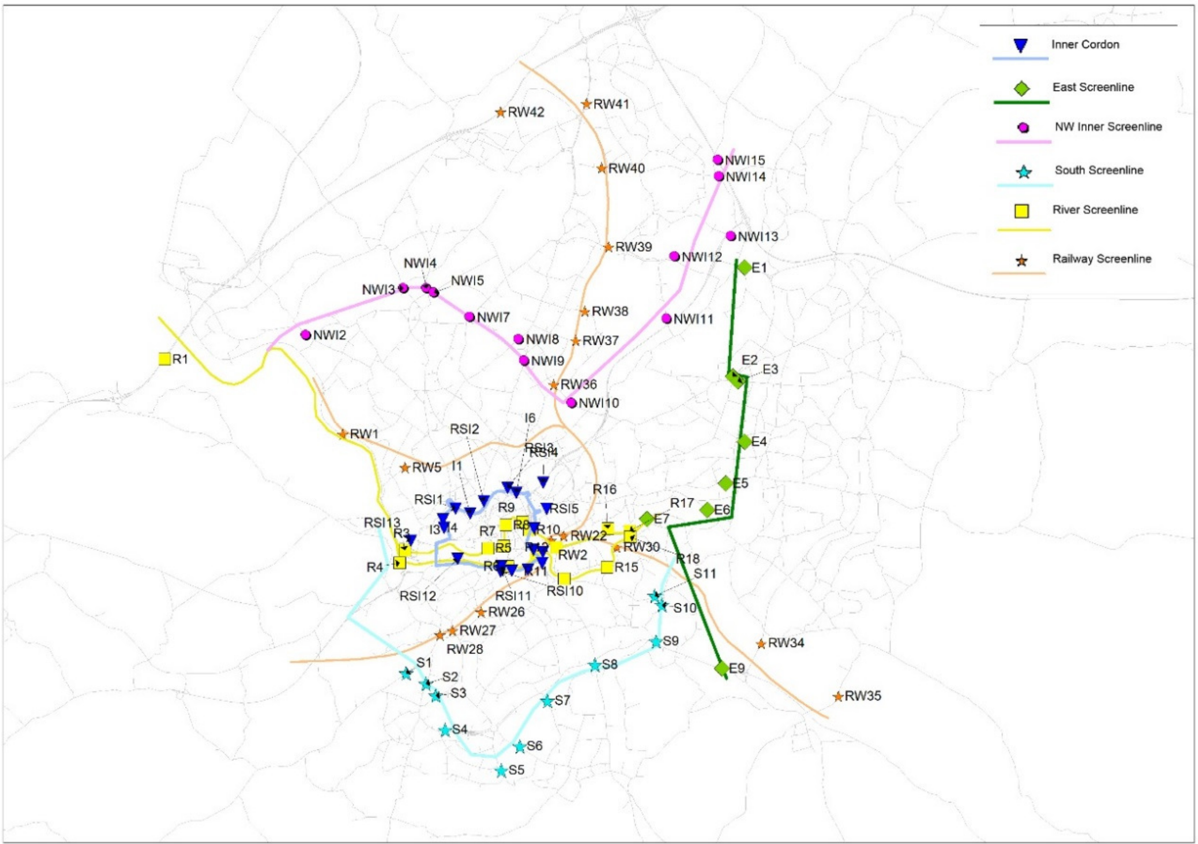
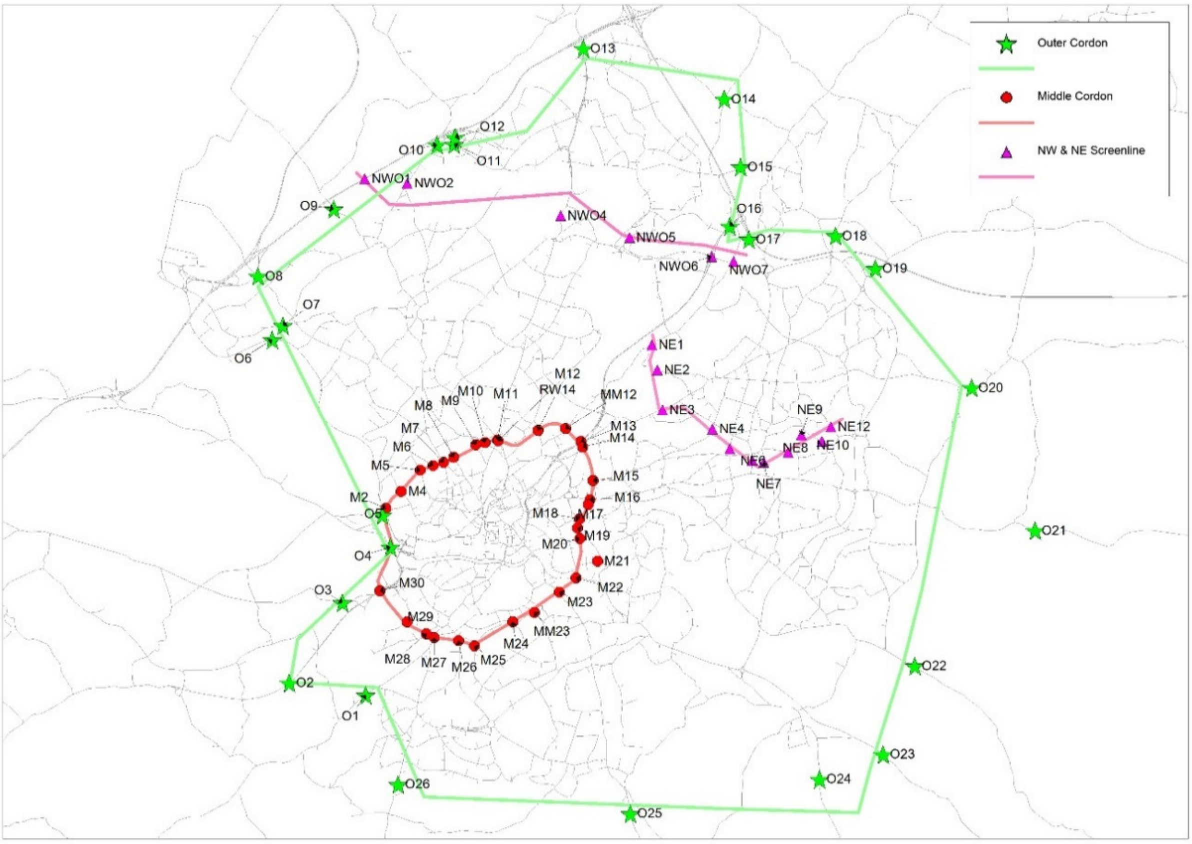


Figure 3.2- Validation Traffic Count Cordons and Screenlines



The screenlines and cordons were segmented into smaller sections and counts grouped into a series of short screenlines to compare observed and modelled LGV and HGV flows.

3.3 Results

Tables 3.2 (AM), 3.3 (IP) and 3.4 (PM) present the percentage of short screenlines that meet the flow difference and GEH criteria for each screenline or cordon, in Table 3.1, in accordance with TAG M3.1.

Table 3.2 – AM Peak Short Screenlines Flow Calibration/Validation Summary

Screenlines and Cordon		No. short screenlines	LGVs		HGVs		Total Good Vehicles	
			% Links GEH (PCUs)	% link flow difference (PCUs)	% Links GEH (PCUs)	% link flow difference (PCUs)	% Links GEH (PCUs)	% link flow difference (PCUs)
Calibration total		62	88%	93%	63%	82%	73%	77%
Calibration Cordons & Screenlines	Inner (In)	8	100%	100%	75%	100%	88%	100%
	Inner (Out)	8	88%	100%	88%	100%	88%	100%
	East (In)	3	100%	100%	33%	100%	100%	100%
	East (Out)	3	67%	100%	100%	100%	100%	100%
	NW Inner (In)	4	75%	75%	75%	75%	75%	75%

Screenlines and Cordon		No. short screenlines	LGVs		HGVs		Total Good Vehicles	
			% Links GEH (PCUs)	% link flow difference (PCUs)	% Links GEH (PCUs)	% link flow difference (PCUs)	% Links GEH (PCUs)	% link flow difference (PCUs)
	NW Inner (Out)	4	50%	50%	75%	75%	25%	25%
	South (In)	3	100%	100%	67%	67%	100%	100%
	South (Out)	3	100%	100%	67%	100%	67%	67%
	River (WBSB)	7	100%	100%	57%	71%	71%	57%
	River (EBNB)	7	86%	86%	29%	57%	57%	57%
	RW (SB)	6	100%	100%	20%	40%	40%	60%
	RW (NB	6	83%	83%	83%	83%	83%	67%
Validation total		64	80%	94%	52%	81%	73%	83%
Validation and Cordons & Screenlines	Outer (In)	12	100%	100%	67%	83%	75%	92%
	Outer (Out)	12	92%	100%	33%	75%	83%	83%
	Middle (In)	11	64%	73%	36%	64%	64%	73%
	Middle (Out)	11	64%	100%	45%	73%	73%	82%
	NW Outer (In)	4	100%	100%	75%	100%	100%	100%
	NW Outer (Out)	4	100%	100%	75%	100%	100%	75%
	NE (In)	5	80%	100%	80%	100%	60%	80%
	NE (Out)	5	40%	80%	40%	100%	40%	80%
All		**126**	**84%**	**94%**	**57%**	**81%**	**73%**	**80%**

Table 3.3 – Inter Peak Short Screenlines Flow Calibration/Validation Summary

Screenlines and Cordon		No. short screenlines	LGVs		HGVs		Total Good Vehicles	
			% Links GEH (PCUs)	% link flow difference (PCUs)	% Links GEH (PCUs)	% link flow difference (PCUs)	% Links GEH (PCUs)	% link flow difference (PCUs)
Calibration total		62	80%	87%	75%	88%	77%	80%
Calibration Cordons & Screenlines	Inner (In)	8	100%	100%	88%	100%	100%	100%
	Inner (Out)	8	100%	100%	75%	88%	63%	88%
	East (In)	3	67%	100%	67%	100%	100%	100%
	East (Out)	3	67%	67%	67%	100%	100%	100%
	NW Inner (In)	4	75%	75%	75%	75%	50%	50%
	NW Inner (Out)	4	75%	75%	50%	75%	50%	25%
	South (In)	3	67%	67%	100%	100%	67%	67%
	South (Out)	3	33%	33%	100%	100%	33%	33%
	River (WBSB)	7	71%	86%	71%	86%	71%	71%
	River (EBNB)	7	71%	100%	57%	71%	86%	86%
	RW (SB)	6	100%	100%	100%	100%	100%	100%
	RW (NB	6	83%	67%	67%	67%	83%	83%
Validation total		64	77%	93%	60%	83%	75%	82%
Validation and Cordons & Screenlines	Outer (In)	12	100%	100%	55%	73%	82%	82%
	Outer (Out)	12	100%	100%	64%	91%	82%	82%
	Middle (In)	11	55%	82%	55%	82%	64%	73%
	Middle (Out)	11	55%	82%	82%	91%	82%	82%
	NW Outer (In)	4	100%	100%	33%	67%	100%	100%
	NW Outer (Out)	4	100%	100%	33%	33%	67%	67%
	NE (In)	5	60%	100%	40%	100%	40%	80%
	NE (Out)	5	60%	100%	80%	100%	80%	100%
All		**126**	**78%**	**90%**	**68%**	**86%**	**76%**	**81%**

Table 3.4 – PM Peak Short Screenlines Flow Calibration/Validation Summary

Screenlines and Cordon		No. short screenlines	LGVs		HGVs		Total Good Vehicles	
			% Links GEH (PCUs)	% link flow difference (PCUs)	% Links GEH (PCUs)	% link flow difference (PCUs)	% Links GEH (PCUs)	% link flow difference (PCUs)
Calibration total		62	92%	95%	53%	83%	85%	88%
Calibration Cordons & Screenlines	Inner (In)	8	100%	100%	75%	100%	88%	100%
	Inner (Out)	8	100%	100%	75%	100%	88%	100%
	East (In)	3	67%	100%	33%	100%	100%	100%
	East (Out)	3	67%	67%	0%	67%	100%	100%
	NW Inner (In)	4	75%	75%	50%	50%	100%	100%
	NW Inner (Out)	4	75%	75%	50%	50%	75%	75%
	South (In)	3	100%	100%	33%	100%	100%	100%
	South (Out)	3	67%	100%	33%	100%	100%	100%
	River (WBSB)	7	100%	100%	86%	86%	86%	86%
	River (EBNB)	7	100%	100%	43%	57%	57%	57%
	RW (SB)	6	100%	100%	40%	80%	60%	60%
	RW (NB	6	100%	83%	50%	83%	100%	83%
Validation total		64	70%	88%	58%	81%	84%	89%
Validation and Cordons & Screenlines	Outer (In)	12	100%	100%	42%	75%	83%	83%
	Outer (Out)	12	75%	83%	75%	92%	100%	100%
	Middle (In)	11	45%	82%	55%	82%	91%	91%
	Middle (Out)	11	55%	73%	36%	55%	73%	82%
	NW Outer (In)	4	100%	100%	50%	100%	100%	100%
	NW Outer (Out)	4	100%	100%	50%	75%	75%	75%
	NE (In)	5	40%	100%	100%	100%	100%	100%
	NE (Out)	5	60%	80%	80%	100%	40%	80%
All		**126**	**81%**	**91%**	**56%**	**82%**	**85%**	**89%**

Considering the GEH validation set out in Tables 3.2 to 3.4 the calibration/validation of LGVs is reasonable, with between 78-84% of short screenlines meeting WebTAG GEH criteria in each time period. For HGVs between 56-68% of short screenlines meet the criteria. The WebTAG link flow difference criteria results show that the calibration/validation of LGVs is good with between 90-94% of screenlines meeting WebTAG criteria in each time period. For HGVs between 81-86% of screenlines meet the criteria.

It should be noted that if the individual link flows were taken into consideration, then the calibration and validation of the light and heavy goods vehicles looks slightly better. Tables 3.5 (AM), 3.6 (IP) and 3.7 (PM) present a summary of the individual link flow calibration/validation. These show 86-87% of links meet GEH criteria and 98-99% of links meet the flow difference criteria for LGVs. For HGVs, around 70% of links meet the GEH criteria and 92-94% meet the flow difference criteria.

Table 3.5 – AM Peak Link Flow Calibration/Validation Summary

Screenlines and Cordon	No. Links	LGVs		HGVs		Total Good Vehicles	
		% Links GEH (PCUs)	% links DMRB flow (PCUs)	% Links GEH (PCUs)	% links DMRB flow (PCUs)	% Links GEH (PCUs)	% links DMRB flow (PCUs)
Calibration total	164	88%	99%	73%	93%	82%	94%
Validation total	146	84%	99%	62%	92%	75%	92%
All	**310**	**86%**	**99%**	**68%**	**93%**	**78%**	**93%**

Table 3.6– Inter Peak Link Flow Calibration/Validation Summary

Screenlines and Cordon	No. Links	LGVs		HGVs		Total Good Vehicles	
		% Links GEH (PCUs)	% links DMRB flow (PCUs)	% Links GEH (PCUs)	% links DMRB flow (PCUs)	% Links GEH (PCUs)	% links DMRB flow (PCUs)
Calibration total	164	83%	99%	79%	97%	82%	95%
Validation total	146	86%	99%	71%	94%	79%	92%
All	**310**	**87%**	**99%**	**72%**	**94%**	**81%**	**93%**

Table 3.7 – PM Peak Link Flow Calibration/Validation Summary

Screenlines and Cordon	No. Links	LGVs		HGVs		Total Good Vehicles	
		% Links GEH (PCUs)	% links DMRB flow (PCUs)	% Links GEH (PCUs)	% links DMRB flow (PCUs)	% Links GEH (PCUs)	% links DMRB flow (PCUs)
Calibration total	164	86%	100%	66%	95%	84%	96%
Validation total	146	83%	97%	71%	90%	84%	96%
All	**310**	**86%**	**98%**	**72%**	**92%**	**83%**	**95%**

To explore the model fit further for HGVs, Tables 3.8 to 3.10 show the short screenline results for the inner and middle cordon for the AM, inter-peak and PM respectively, as they represent the closest data to the inner and middle CAZ boundaries. To aid interpretation, the GEH values are presented as negative where model flows are lower than the observed flow.

Table 3.8 – AM Short Screenline Results – Inner and Middle Cordon HGVs

Sub-cordon	No. of links	HGV			
		Observed	Model	GEH	DMRB Link Flow
Inner Cordon					
Tyndalls - inbound	3	180.7	84.3	-8.4	y
St Pauls - inbound	3	124.6	143.1	1.6	y
Old Market - inbound	2	71.6	68.3	-0.4	y
Temple Meads - inbound	2	163.8	79.5	-7.6	y
Bath Rd - inbound	3	95.3	57.8	-4.3	y
Bedminster - inbound	3	120.0	112.5	-0.7	y
Hotwells - inbound	1	93.6	103.5	1.0	y
Clifton - inbound	2	10.7	3.3	-2.8	y
Inbound *	19	860.3	652.2	75%	100%
Tyndalls - outbound	3	131.3	63.8	-6.8	y
St Pauls - outbound	3	175.0	180.6	0.4	y
Old Market - outbound	2	69.0	75.6	0.8	y
Temple Meads - outbound	2	49.8	71.0	2.7	y
Bath Rd - outbound	3	159.0	222.3	4.6	y
Bedminster - outbound	3	88.0	71.0	-1.9	y
Hotwells - outbound	1	136.5	85.5	-4.8	y
Clifton - outbound	2	5.3	6.4	0.4	y
Outbound *	19	814.0	776.2	88%	100%
Both directions *	38	1674.3	1428.4	81%	100%
Middle Cordon					
Clifton - inbound	4	207.5	223.6	1.1	y
Cotham - inbound	3	7.6	16.0	2.4	y
A38 - inbound	2	295.0	64.8	-17.2	n
Ashley Hill - inbound	2	27.9	75.7	6.6	y
M32 corridor - inbound	2	340.4	208.5	-8.0	n
Lawrence Hill - inbound	3	157.2	58.4	-9.5	y
Spine Rd - inbound	5	649.5	498.6	-6.3	n
Totterdown - inbound	3	69.5	60.0	-1.2	y
Parsons St - inbound	3	206.8	190.0	-1.2	y
Ashton Vale - inbound	2	78.5	15.7	-9.1	y
A370 - inbound	1	285.0	108.1	-12.6	n
Inbound *	30	2325	1519	36%	64%
Clifton - outbound	4	281.0	227.1	-3.4	y
Cotham - outbound	3	10.2	57.0	8.1	y
A38 - outbound	2	367.1	56.1	-21.4	n
Ashley Hill - outbound	2	22.9	53.9	5.0	y
M32 corridor - outbound	2	393.7	329.0	-3.4	y
Lawrence Hill - outbound	3	61.2	20.3	-6.4	y
Spine Rd - outbound	5	595.2	376.1	-9.9	n
Totterdown - outbound	3	156.6	202.6	3.4	y
Parsons St - outbound	3	300.7	143.4	-10.6	n
Ashton Vale - outbound	2	29.1	11.1	-4.0	y
A370 - outbound	1	164.9	132.2	-2.7	y
Outbound *	30	2382	1609	45%	73%
Both directions *	60	4707	3128	41%	68%

Table 3.9 – IP Short Screenline Results – Inner and Middle Cordon HGVs

Sub-cordon	No. of links	HGV Observed	Model	GEH	DMRB Link Flow
Inner Cordon					
Tyndalls - inbound	3	112.4	50.3	-6.9	y
St Pauls - inbound	3	186.4	233.6	3.3	y
Old Market - inbound	2	50.3	69.3	2.4	y
Temple Meads - inbound	2	117.6	70.7	-4.8	y
Bath Rd - inbound	3	166.6	201.3	2.6	y
Bedminster - inbound	3	166.8	163.7	-0.2	y
Hotwells - inbound	1	83.5	51.1	-3.9	y
Clifton - inbound	2	5.6	9.0	1.3	y
Inbound *	19	889.2	849.0	88%	100%
Tyndalls - outbound	3	113.5	78.9	-3.5	y
St Pauls - outbound	3	202.0	266.1	4.2	y
Old Market - outbound	2	53.9	53.1	-0.1	y
Temple Meads - outbound	2	52.5	104.5	5.9	y
Bath Rd - outbound	3	214.4	355.0	8.3	n
Bedminster - outbound	3	105.0	84.4	-2.1	y
Hotwells - outbound	1	54.8	27.6	-4.2	y
Clifton - outbound	2	3.0	18.8	4.8	y
Outbound *	19	799.0	988.4	75%	88%
Both directions *	38	1688.2	1837.4	81%	94%
Middle Cordon					
Clifton - inbound	4	246.8	308.5	3.7	y
Cotham - inbound	3	12.3	6.3	-2.0	y
A38 - inbound	2	216.1	30.2	-16.8	n
Ashley Hill - inbound	2	29.2	25.7	-0.7	y
M32 corridor - inbound	2	343.8	382.9	2.1	y
Lawrence Hill - inbound	3	94.3	81.6	-1.4	y
Spine Rd - inbound	5	485.5	366.3	-5.8	n
Totterdown - inbound	3	90.0	174.7	7.4	y
Parsons St - inbound	3	188.0	273.9	5.7	y
Ashton Vale - inbound	2	58.4	24.8	-5.2	y
A370 - inbound	1	139.7	123.4	-1.4	y
Inbound *	30	1904	1798	55%	82%
Clifton - outbound	4	265.3	278.8	0.8	y
Cotham - outbound	3	10.6	5.5	-1.8	y
A38 - outbound	2	205.0	29.2	-16.2	n
Ashley Hill - outbound	2	22.0	19.2	-0.6	y
M32 corridor - outbound	2	433.9	399.2	-1.7	y
Lawrence Hill - outbound	3	96.8	46.0	-6.0	y
Spine Rd - outbound	5	546.8	450.2	-4.3	y
Totterdown - outbound	3	145.2	142.8	-0.2	y
Parsons St - outbound	3	273.0	286.5	0.8	y
Ashton Vale - outbound	2	43.8	44.2	0.1	y
A370 - outbound	1	178.1	141.2	-2.9	y
Outbound *	30	2221	1843	82%	91%
Both directions *	60	4125	3641	68%	86%

Table 3.10 – PM Short Screenline Results – Inner and Middle Cordon HGVs

Sub-cordon	No. of links	HGV			
		Observed	Model	GEH	DMRB Link Flow
Inner Cordon					
Tyndalls - inbound	3	69.2	6.1	-10.3	y
St Pauls - inbound	3	77.9	93.8	1.7	y
Old Market - inbound	2	12.5	11.0	-0.5	y
Temple Meads - inbound	2	118.9	108.7	-1.0	y
Bath Rd - inbound	3	60.6	125.9	6.8	y
Bedminster - inbound	3	63.0	42.8	-2.8	y
Hotwells - inbound	1	40.3	19.0	-3.9	y
Clifton - inbound	2	4.1	0.8	-2.1	y
Inbound *	19	446.5	408.0	75%	100%
Tyndalls - outbound	3	66.2	42.7	-3.2	y
St Pauls - outbound	3	60.2	10.4	-8.4	y
Old Market - outbound	2	14.6	19.4	1.2	y
Temple Meads - outbound	2	31.7	126.5	10.7	y
Bath Rd - outbound	3	72.4	71.6	-0.1	y
Bedminster - outbound	3	121.2	139.5	1.6	y
Hotwells - outbound	1	147.0	99.4	-4.3	y
Clifton - outbound	2	1.8	1.2	-0.5	y
Outbound *	19	515.0	510.7	75%	100%
Both directions *	38	961.5	918.7	75%	100%
Middle Cordon					
Clifton - inbound	4	256.1	38.0	-18.0	n
Cotham - inbound	3	2.5	10.0	3.0	y
A38 - inbound	2	169.3	26.3	-14.5	n
Ashley Hill - inbound	2	0.0	11.8		y
M32 corridor - inbound	2	81.3	120.1	3.9	y
Lawrence Hill - inbound	3	52.9	26.1	-4.3	y
Spine Rd - inbound	5	327.9	239.8	-5.2	y
Totterdown - inbound	3	63.2	38.2	-3.5	y
Parsons St - inbound	3	156.7	76.1	-7.5	y
Ashton Vale - inbound	2	41.4	46.8	0.8	y
A370 - inbound	1	111.8	16.7	-11.9	y
Inbound *	30	1263	650	55%	82%
Clifton - outbound	4	119.2	87.0	-3.2	y
Cotham - outbound	3	0.0	17.3		y
A38 - outbound	2	152.8	18.0	-14.6	n
Ashley Hill - outbound	2	5.1	6.5	0.6	y
M32 corridor - outbound	2	134.6	80.2	-5.3	y
Lawrence Hill - outbound	3	151.5	32.0	-12.5	n
Spine Rd - outbound	5	475.5	207.1	-14.5	n
Totterdown - outbound	3	84.1	84.9	0.1	y
Parsons St - outbound	3	293.6	108.8	-13.0	n
Ashton Vale - outbound	2	35.6	10.3	-5.3	y
A370 - outbound	1	290.1	98.4	-13.8	n
Outbound *	30	1742	750	36%	55%
Both directions *	60	3005	1400	45%	68%

Tables 3.11 (AM), 3.12 (IP) and 3.13 (PM) present a summary of the HGV calibration/validation for each of the cordons and screenlines throughout Bristol.

Table 3.11 – AM Peak Screenline and Cordon Calibration/Validation Summary

Screenlines and Cordon	No. of Counts	HGVs			
		Observed	Modelled	% difference	GEH
Inner (In)	21	344	261	-24%	4.79
Inner (Out)	21	326	310	-5%	0.85
Inner (Total)	42	670	571	-15%	3.95
East (In)	8	224	152	-32%	5.25
East (Out)	8	186	161	-13%	1.87
East (Total)	16	409	313	-24%	5.08
NW Inner (In)	13	620	702	13%	3.21
NW Inner (Out)	13	602	668	11%	2.64
NW Inner (Total)	26	1221	1371	12%	4.15
South (In)	11	220	183	-17%	2.60
South (Out)	11	193	207	8%	1.05
South (Total)	22	413	391	-5%	1.10
River (WBSB)	16	838	819	-2%	0.64
River (EBNB)	16	924	743	-20%	6.27
River (Total)	32	1762	1562	-11%	4.90
Railway (SB)	17	971	740	-24%	7.91
Railway (NB)	16	322	282	-12%	2.31
Railway (Total)	33	1293	1022	-21%	7.98
Outer (In)	26	993	847	-15%	4.80
Outer (Out)	26	834	903	8%	2.33
Outer (Total)	52	1827	1750	-4%	1.82
Middle (In)	30	930	608	-35%	11.62
Middle (Out)	30	953	644	-32%	10.95
Middle (Total)	60	1883	1251	-34%	15.96
NW Outer (In)	6	528	508	-4%	0.91
NW Outer (Out)	6	565	563	0%	0.06
NW Outer (Total)	12	1093	1071	-2%	0.67
NE (In)	12	126	141	12%	1.35
NE (Out)	12	111	121	9%	0.95
NE (Total)	24	237	263	11%	1.63
Total	614	21,381	18,868	-12%	17.72

Table 3.12 – Inter Peak Screenline and Cordon Calibration/Validation Summary

Screenlines and Cordon	No. of Counts	HGVs			
		Observed	Modelled	% difference	GEH
Inner (In)	21	356	340	-5%	0.86
Inner (Out)	21	320	395	24%	4.01
Inner (Total)	42	675	735	9%	2.25
East (In)	8	233	197	-15%	2.44
East (Out)	8	249	205	-18%	2.92
East (Total)	16	482	403	-17%	3.79
NW Inner (In)	13	552	647	17%	3.90
NW Inner (Out)	13	554	699	26%	5.81
N WInner (Total)	26	1105	1346	22%	6.88
South (In)	11	234	258	10%	1.56
South (Out)	11	237	244	3%	0.43
South (Total)	22	471	502	7%	1.42
River (WBSB)	16	900	894	-1%	0.19
River (EBNB)	16	929	1,002	8%	2.36
River (Total)	32	1828	1896	4%	1.57
Railway (SB)	17	830	754	-9%	2.71
Railway (NB)	16	343	335	-2%	0.43
Railway (Total)	33	1173	1088	-7%	2.51
Outer (In)	26	873	787	-10%	2.96
Outer (Out)	26	807	937	16%	4.41
Outer (Total)	52	1679	1724	3%	1.09
Middle (In)	30	762	719	-6%	1.56
Middle (Out)	30	888	737	-17%	5.30
Middle (Total)	60	1650	1456	-12%	4.91
NW Outer (In)	6	512	500	-2%	0.53
NW Outer (Out)	6	520	595	14%	3.19
NW Outer (Total)	12	1033	1096	6%	1.94
NE (In)	12	105	130	24%	2.32
NE (Out)	12	106	150	41%	3.83
NE (Total)	24	211	279	32%	4.37
Total	614	20,404	20,773	2%	2.57

Table 3.13 – PM Peak Screenline and Cordon Calibration/Validation Summary

Screenlines and Cordon	No. of Counts	HGVs			
		Observed	Modelled	% difference	GEH
Inner (In)	21	179	163	-9%	1.18
Inner (Out)	21	206	204	-1%	0.12
Inner (Total)	42	385	367	-4%	0.88
East (In)	8	117	70	-40%	4.87
East (Out)	8	179	59	-67%	10.98
East (Total)	16	296	129	-56%	11.45
NW Inner (In)	13	331	356	7%	1.32
NW Inner (Out)	13	337	445	32%	5.43
NW Inner (Total)	26	669	800	20%	4.86
South (In)	11	152	83	-45%	6.35
South (Out)	11	158	70	-56%	8.23
South (Total)	22	310	153	-51%	10.30
River (WBSB)	16	509	443	-13%	3.02
River (EBNB)	16	470	572	22%	4.48
River (Total)	32	978	1015	4%	1.15
Railway (SB)	17	479	341	-29%	6.81
Railway (NB)	16	215	158	-27%	4.19
Railway (Total)	33	693	498	-28%	7.99
Outer (In)	26	516	483	-6%	1.47
Outer (Out)	26	497	424	-15%	3.38
Outer (Total)	52	1012	907	-10%	3.41
Middle (In)	30	505	260	-49%	12.54
Middle (Out)	30	697	300	-57%	17.77
Middle (Total)	60	1202	560	-53%	21.63
NW Outer (In)	6	319	249	-22%	4.17
NW Outer (Out)	6	269	382	42%	6.28
NW Outer (Total)	12	588	631	7%	1.75
NE (In)	12	66	54	-18%	1.53
NE (Out)	12	58	101	74%	4.82
NE (Total)	24	124	155	25%	2.65
Total	614	12,392	10,279	-17%	19.85

4. Conclusion

The model has been validated using the guidance, measures and criteria recommended in TAG M3.1. The additional validation of goods vehicles set out in this note highlights the following:

- LGVs are generally well calibrated/validated on both the short screenline level and an individual link level screenlines and cordons;
- HGVs do not pass the WebTAG guidance for GEH statistics, but are close for the link flow difference criteria for the short screenlines and pass when each link is looked at individually;
- For both light and heavy goods vehicles, where WebTAG guidance is not met, the modelled flows are under assigned in some locations, over assigned in others; and
- The middle cordon relates closely to the medium CAZ boundary and the inner cordon relates closely to the small CAZ boundary.The calibration/validation of HGVs for the inner cordon is deemed more important than the middle cordon due the location of the compliance exceedances within Bristol. The HGV fit along the inner cordon is better than the middle cordon.

5. Way Forward

The LGV flow validation is considered to be satisfactory, and so no further adjustments will be made to the modelled LGV flows for the purpose of this assessment.

The HGV validation is considered good enough to not require adjustments to the model itself. However, a 'post processing' adjustment of modelled HGV flows will be undertaken. Where there are discrepancies between HGV modelled and observed flows these are not consistently too high or too low, but vary according to location. Hence, the post processing of HGV flows will be undertaken at locations of significance, to adjust any discrepancies in the modelled flows in accordance with the survey data. This will be undertaken on a link basis including related upstream / downstream links near to locations with count data. The adjustments will based on a set of link-specific factors identified for each location in the base model which will also be applied to the future baseline and scheme test models to ensure that any over- or under-representation of HGVs in the base model will be correctly adjusted for in terms of background growth and scheme impacts.