Bath Clean Air Plan

Bath and North East Somerset Council

G-BATH Highway Model Local Model Validation Report: Addendum: LGV and HGV Validation

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1. Introduction

Due to air quality exceedances Bath and North-East Somerset Council (BANES) has been directed by Defra to produce a Clean Air Plan to achieve air quality improvements in the shortest possible time. As part of the Plan, BANES is considering implementation of a Clean Air Zone (CAZ), possibly including both charging and non-charging measures. Jacobs has been commissioned by BANES to assess the available CAZ options in order to establish which will deliver compliance in the shortest possible time possible.

The existing G-BATH model will be used for the assessment of the CAZ measures. This model has been calibrated and validated in accordance with the WebTAG guidelines, however the Joint Air Quality Unit (JAQU) Evidence Guidance requires further clarification on the modelled fit of light and heavy goods vehicles, in terms of short screenlines using grouped counts.

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

2. Base Year Model - LMVR Summary

2.1 G-BATH model

The G-BATH model was updated by Mott MacDonald on behalf of BANES to assist in analysing the impacts of its strategies on improving access from the east of Bath. This work is reported in "Access to Bath from the East – Highway Model – Local Model Validation Report" in June 2015, from which the following summary is taken, as relevant context for the assessment of light and heavy goods vehicles.

Highway models have been developed in SATURN to represent the AM peak hour (08:00-09:00), an average hour in the inter-peak (10:00 – 16:00) and the PM peak hour (17:00 – 18:00) in an average Monday to Friday weekday in October 2014.

The existing 2006 SATURN G-Bath model was updated to the new base year of 2014. The development of the highway model relied on new surveys carried out in autumn 2014 including Road Side Interviews, automatic/manual traffic counts and manual classified turning counts across screenlines and cordons around the city. Additional data such as 2011 census journey to work and TrafficMaster data for 2013/2014 academic year were also used.

For the 2014 rebase of the G-Bath model seven journey time routes have been defined. Observed journey time data has been sourced from TrafficMaster subject to checks on the integrity of the dataset in each case.

Trip matrices have been prepared in line with current guidance based on both observed and synthetic data. Details of checks undertaken at key stages in the development of the matrices are presented in the report to ensure that the provenance of the matrices is maintained. Checks include analysis of the observed and synthetic matrices prior to merging and, subsequent to merging, comparisons with counts before applying matrix estimation. Detailed analyses of the effects of matrix estimation are also documented in line with current WebTAG guidance.

The SATURN model convergence meets WebTAG criteria in all time periods.

The model achieves a good level of flow calibration with results indicating a close match to observations on the calibration screenlines/cordons and for individual link/turning counts, with the required WebTAG criteria being met in all time periods for both all vehicles and cars.

Flow validation has been undertaken against independent data not used in calibration nor for the matrix building exercise. An assessment of the validation process shows that the model also achieves a good level of flow validation in each of the modelled time periods, meeting the WebTAG validation criteria in all case except one.

The validation of the model on the west side of the city has been affected by the partial closure of A431 Kelston Road, although this will not have much impact on the future assessment of a possible link road or P&R site on the east of the city.

The journey time validation is considered to be very good in all time periods with the model recreating journey times that are representative on key routes in the modelled area.

In conclusion, it is considered that the base year highway assignment models developed for the 2014 G-Bath transport model demonstrate a good representation of traffic behaviour in the study area and form a robust basis from which future year forecasts and option testing can be developed.

The G-BATH model also includes a PT assignment model and variable demand model, however it is the highway model that will be used as the primary means of assessing the CAZ measures.

2.2 Modelling of good vehicles

The G-BATH highway model has seven user classes of which two cover goods vehicles:

- Light goods vehicles (LGVs) - user class 6; and
- Heavy goods vehicles (HGVs) - user class 7.

In the assignment HGVs are factored to passenger car units by applying a factor of 2.3 to allow for the additional highway capacity used by HGVs compared with cars.

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 as referred to in 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 WebTAG M3.1. This also states however 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 G-BATH Highway Local Model 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

For the original calibration/validation carried out by Mott MacDonald six cordons and screenlines were used. As the A4 and RSI screenlines cover roads located to the east of Bath, the first four cordons on the list below were used for the goods vehicle validation as shown in Figure 3-1 to Figure.

- Bath Inner Cordon
- Bath Intermediate Cordon
- Bath RSI Cordon
- Bath Outer Cordon
  - A4 Screenline
  - RSI Screenline

The screenlines and cordons were segmented into smaller sections and counts grouped into a series of short screenlines as per Table 3-2 to compare observed and modelled LGV and HGV flows, in line with JAQU requirements and as referred to in TAG unit M3.1.

Table 3-2: Cordons & short screenlines

Cordon	Short Screenlines
Bath Inner	Inner - North
	Inner - South
	Inner - West
Bath Intermediate	Intermediate - East
	Intermediate - North
	Intermediate – North West
	Intermediate – South
	Intermediate – South West
Bath Outer	Outer - North
	Outer - South
	Outer - West
RSI Outer	RSI - North
	RSI - South
	RSI - West

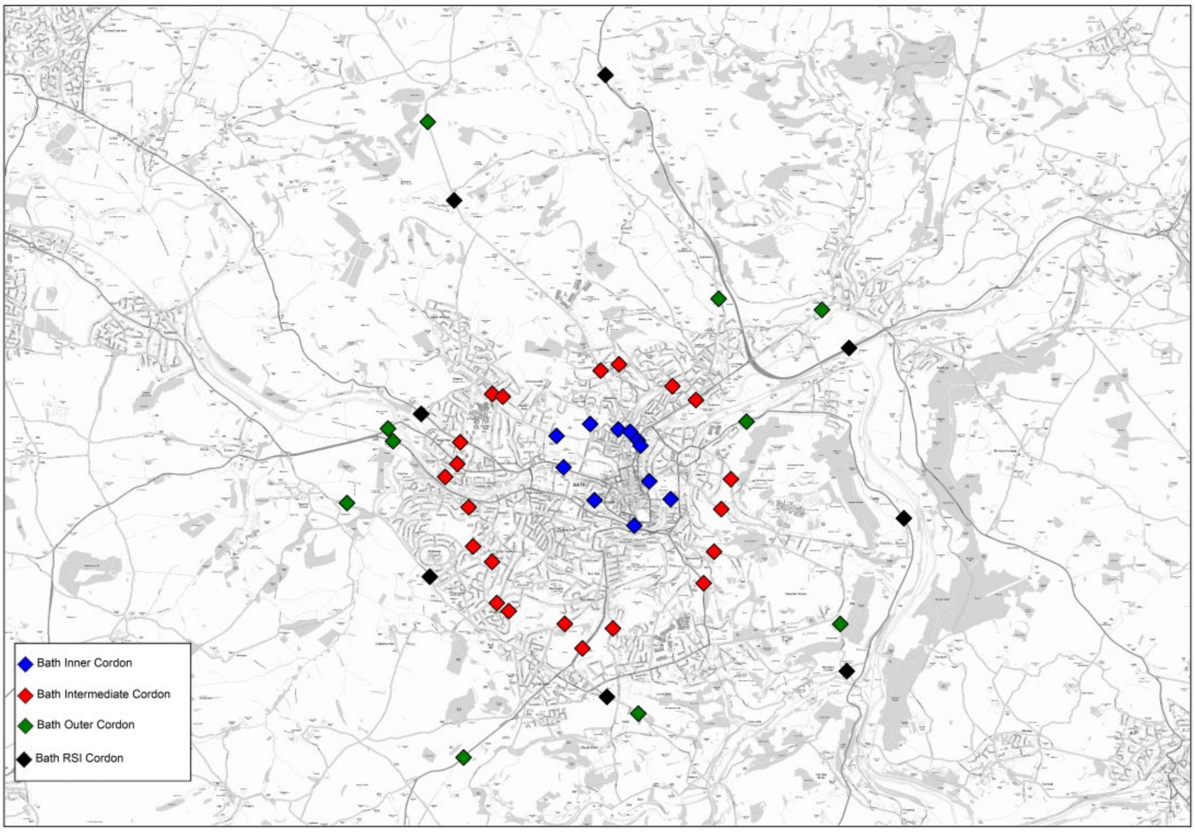

Figure 3-1: G-BATH cordons

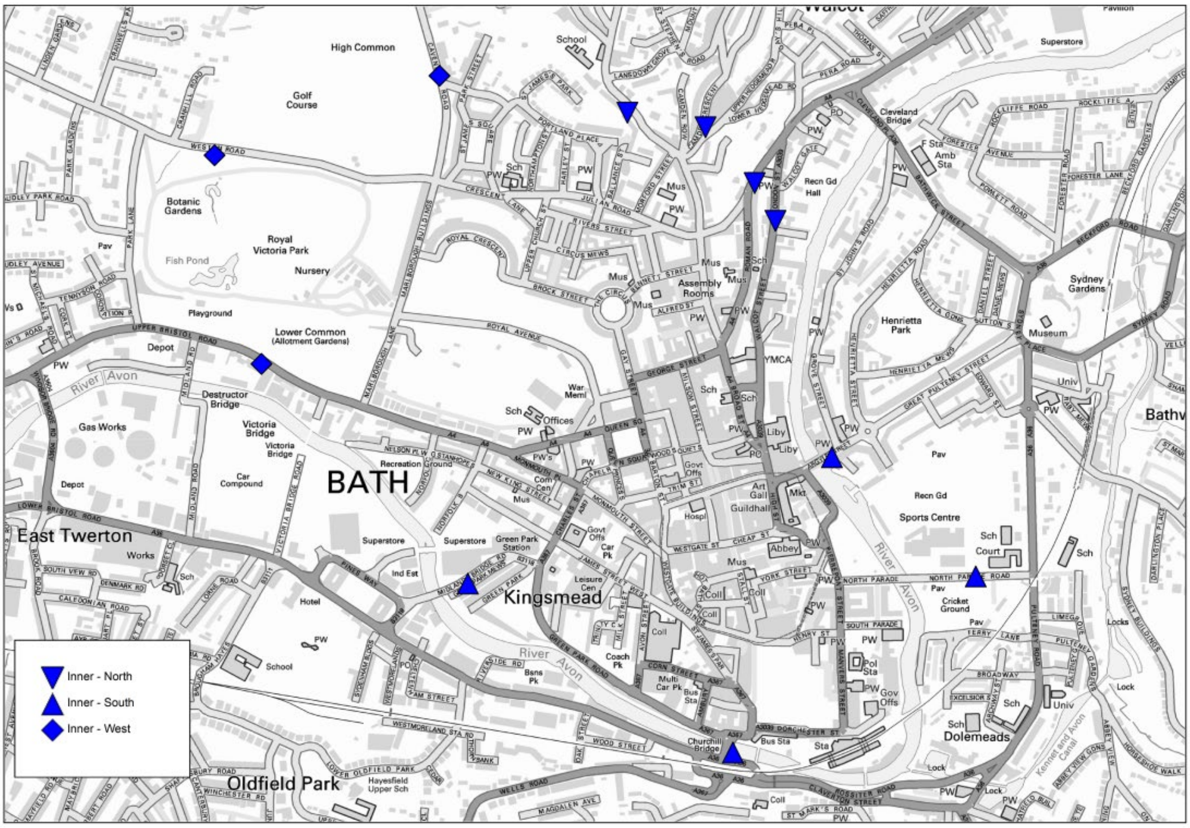

Figure 3-2: Bath Inner Cordon

Figure 3-3: Bath Intermediate Cordon

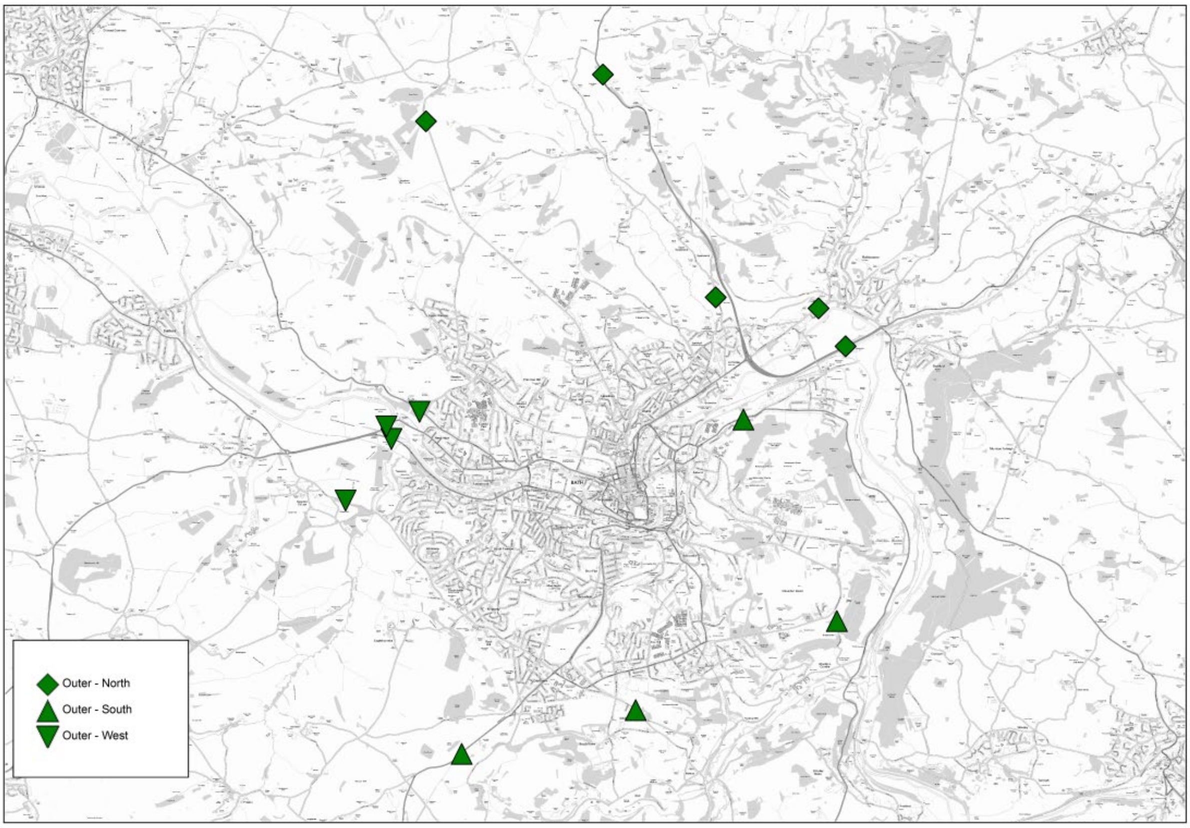

Figure 3-4: Bath Outer Cordon

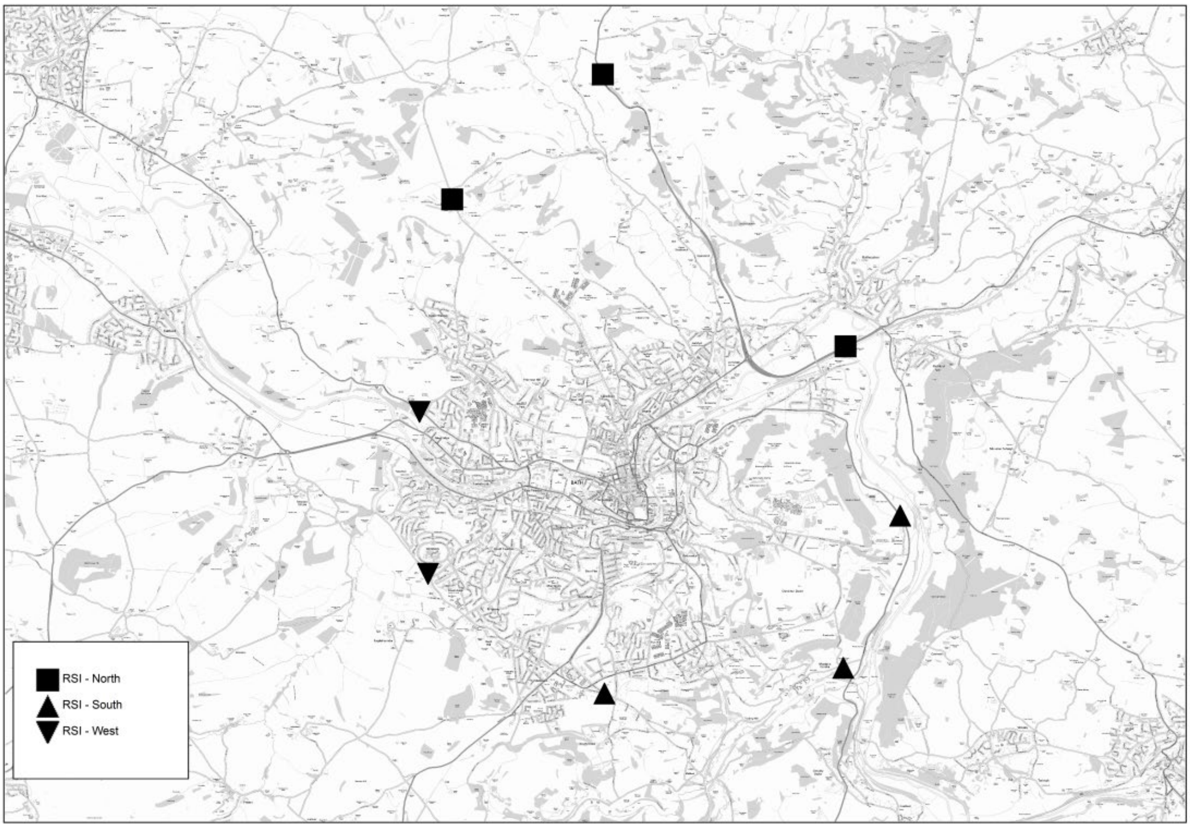

Figure 3-5: Bath RSI Cordon

4. Results

Table 4-1 to Table 4-3 show whether the short screenlines meet the WebTAG criteria for individual links in Table 3-1, in accordance with TAG M3.1 for light and heavy goods vehicles. The tables show observed count totals, modelled flow totals (in vehicles not PCUS), GEH and whether the modelled flows meet the link flow difference criteria for each short screenline. LGV, HGVs and HGVs after post processing of the modelled data is shown as the HGV modelled flows to not pass the GEH criteria.

Table 4-1: AM Peak short screenline validation

		Screenline meeting WebTAG criteria											
		LGVs				HGVs				HGVs (post adjustment)			
Short Screenline	No. of Counts	Observed Count	Modelled Flow	Link flow difference	GEH	Observed Count	Modelled Flow	Link flow difference	GEH	Observed Count	Modelled Flow	Link flow difference	GEH
Inner cordon - west: inbound	3	108	107	✓	0.07	12	7	✓	1.78	12	4	✓	2.80
Inner cordon - south: inbound	4	135	119	✓	1.47	32	69	✓	5.23	32	43	✓	1.75
Inner cordon - north: inbound	4	64	94	✓	3.41	28	37	✓	1.58	28	23	✓	1.02
Inner cordon - west: outbound	3	58	55	✓	0.35	8	10	✓	0.78	8	6	✓	0.58
Inner cordon - south: outbound	4	117	105	✓	1.14	23	48	✓	4.22	23	30	✓	1.30
Inner cordon - north: outbound	4	103	119	✓	1.47	34	45	✓	1.74	34	28	✓	1.14
Intermediate cordon - northwest: inbound	5	108	118	✓	0.91	20	43	✓	4.04	20	26	✓	1.29
Intermediate cordon - southwest: inbound	3	48	47	✓	0.05	4	6	✓	1.04	4	4	✓	0.01
Intermediate cordon - south: inbound	6	130	116	✓	1.25	23	47	✓	4.00	23	29	✓	1.10
Intermediate cordon - north: inbound	3	54	55	✓	0.18	16	3	✓	4.41	16	2	✓	4.86
Intermediate cordon - east: inbound	4	77	79	✓	0.21	39	106	✓	7.94	39	65	✓	3.72
Intermediate cordon - northwest: outbound	5	63	48	✓	2.03	24	25	✓	0.24	24	15	✓	1.89
Intermediate cordon - southwest: outbound	3	34	31	✓	0.46	7	3	✓	1.61	7	2	✓	2.32
Intermediate cordon - south: outbound	6	99	97	✓	0.26	25	37	✓	2.27	25	23	✓	0.34
Intermediate cordon - north: outbound	3	32	35	✓	0.42	18	5	✓	3.85	18	3	✓	4.61
Intermediate cordon - east: outbound	4	70	79	✓	1.03	35	111	✓	8.87	35	68	✓	4.61
Outer cordon - west: inbound	4	185	263	✓	5.21	37	105	✓	8.16	37	65	✓	3.97
Outer cordon - south: inbound	4	159	151	✓	0.65	41	74	✓	4.42	41	46	✓	0.77
Outer cordon - north: inbound	5	291	329	✓	2.13	98	243	×	11.14	98	150	✓	4.68
Outer cordon - west: outbound	4	115	138	✓	2.01	26	72	✓	6.53	26	44	✓	3.05
Outer cordon - south: outbound	4	98	110	✓	1.17	23	66	✓	6.44	23	40	✓	3.13
Outer cordon - north: outbound	5	204	227	✓	1.54	60	235	×	14.40	60	145	✓	8.37
RSI cordon - west: inbound	3	122	111	✓	1.05	25	59	✓	5.17	25	36	✓	1.96
RSI cordon - south: inbound	3	90	90	✓	0.00	26	56	✓	4.76	26	35	✓	1.61
RSI cordon - north: inbound	3	263	277	✓	0.86	87	232	×	11.50	87	143	✓	5.24
RSI cordon - west: outbound	3	70	71	✓	0.08	11	48	✓	6.75	11	30	✓	4.06
RSI cordon - south: outbound	3	68	68	✓	0.06	14	34	✓	4.17	14	21	✓	1.76
RSI cordon - north: outbound	3	184	198	✓	0.99	57	202	×	12.69	57	124	✓	7.03
% screenlines meet WebTAG criteria - :				100%	96%			86%	57%			100%	89%

Table 4-2: Interpeak short screenline validation

		Screenline meeting WebTAG criteria											
		LGVs				HGVs				HGVs (post adjustment)			
Short Screenline	No. of Counts	Observed Count	Modelled Flow	Link flow difference	GEH	Observed Count	Modelled Flow	Link flow difference	GEH	Observed Count	Modelled Flow	Link flow difference	GEH
Inner cordon - west: inbound	3	95	94	✓	0.10	6	3	✓	0.98	6	2	✓	2.11
Inner cordon - south: inbound	4	140	125	✓	1.29	20	60	✓	6.46	20	27	✓	1.64
Inner cordon - north: inbound	4	72	90	✓	1.96	21	38	✓	3.10	21	17	✓	0.90
Inner cordon - west: outbound	3	78	79	✓	0.07	6	5	✓	0.55	6	2	✓	1.94
Inner cordon - south: outbound	4	134	125	✓	0.81	17	42	✓	4.71	17	19	✓	0.59
Inner cordon - north: outbound	4	99	118	✓	1.90	22	47	✓	4.30	22	21	✓	0.09
Intermediate cordon - northwest: inbound	5	93	85	✓	0.77	12	25	✓	3.17	12	12	✓	0.05
Intermediate cordon - southwest: inbound	3	45	36	✓	1.36	3	1	✓	1.06	3	1	✓	1.66
Intermediate cordon - south: inbound	6	105	104	✓	0.19	17	35	✓	3.45	17	16	✓	0.33
Intermediate cordon - north: inbound	3	31	34	✓	0.39	5	5	✓	0.11	5	2	✓	1.50
Intermediate cordon - east: inbound	4	95	103	✓	0.81	28	124	✓	11.08	28	57	✓	4.45
Intermediate cordon - northwest: outbound	5	79	62	✓	1.98	19	34	✓	2.78	19	15	✓	0.98
Intermediate cordon - southwest: outbound	3	40	36	✓	0.62	7	4	✓	1.28	7	2	✓	2.41
Intermediate cordon - south: outbound	6	103	96	✓	0.69	20	36	✓	2.96	20	16	✓	0.89
Intermediate cordon - north: outbound	3	32	34	✓	0.37	7	4	✓	1.42	7	2	✓	2.60
Intermediate cordon - east: outbound	4	110	105	✓	0.53	30	101	✓	8.75	30	46	✓	2.54
Outer cordon - west: inbound	4	172	258	✓	5.87	22	67	✓	6.85	22	31	✓	1.76
Outer cordon - south: inbound	4	142	131	✓	0.97	32	73	✓	5.68	32	33	✓	0.23
Outer cordon - north: inbound	5	185	201	✓	1.12	64	196	×	11.64	64	89	✓	2.93
Outer cordon - west: outbound	4	143	166	✓	1.82	30	96	✓	8.35	30	44	✓	2.28
Outer cordon - south: outbound	4	129	110	✓	1.75	31	79	✓	6.49	31	36	✓	0.88
Outer cordon - north: outbound	5	210	216	✓	0.39	59	166	×	10.16	59	76	✓	2.09
RSI cordon - west: inbound	3	95	87	✓	0.81	15	44	✓	5.21	15	20	✓	1.06
RSI cordon - south: inbound	3	85	82	✓	0.35	22	49	✓	4.44	22	22	✓	0.01
RSI cordon - north: inbound	3	170	182	✓	0.90	57	183	×	11.54	57	83	✓	3.18
RSI cordon - west: outbound	3	95	82	✓	1.41	16	57	✓	6.75	16	26	✓	2.13
RSI cordon - south: outbound	3	76	74	✓	0.26	21	48	✓	4.73	21	22	✓	0.30
RSI cordon - north: outbound	3	188	192	✓	0.33	57	147	✓	8.94	57	67	✓	1.30
% screenlines meet WebTAG criteria - :				100%	96%			89%	54%			100%	100%

Table 4-3: PM peak short screenline validation

		Screenline meeting WebTAG criteria											
		LGVs				HGVs				HGVs (post adjustment)			
Short Screenline	No. of Counts	Observed Count	Modelled Flow	Link flow difference	GEH	Observed Count	Modelled Flow	Link flow difference	GEH	Observed Count	Modelled Flow	Link flow difference	GEH
Inner cordon - west: inbound	3	54	56	✓	0.22	5	3	✓	1.01	5	4	✓	0.86
Inner cordon - south: inbound	4	92	73	✓	2.05	20	30	✓	2.08	20	33	✓	2.55
Inner cordon - north: inbound	4	42	43	✓	0.20	22	18	✓	0.80	22	20	✓	0.42
Inner cordon - west: outbound	3	49	46	✓	0.36	11	8	✓	0.96	11	9	✓	0.71
Inner cordon - south: outbound	4	99	76	✓	2.42	28	26	✓	0.36	28	28	✓	0.09
Inner cordon - north: outbound	4	65	65	✓	0.00	40	23	✓	3.01	40	25	✓	2.60
Intermediate cordon - northwest: inbound	5	53	52	✓	0.14	11	19	✓	1.90	11	20	✓	2.27
Intermediate cordon - southwest: inbound	3	31	31	✓	0.02	3	2	✓	0.78	3	2	✓	0.67
Intermediate cordon - south: inbound	6	75	73	✓	0.26	11	20	✓	2.29	11	21	✓	2.67
Intermediate cordon - north: inbound	3	18	20	✓	0.36	5	1	✓	2.36	5	1	✓	2.29
Intermediate cordon - east: inbound	4	57	67	✓	1.31	28	64	✓	5.42	28	70	✓	6.09
Intermediate cordon - northwest: outbound	5	55	56	✓	0.19	27	27	✓	0.12	27	30	✓	0.58
Intermediate cordon - southwest: outbound	3	38	38	✓	0.03	10	3	✓	2.56	10	3	✓	2.42
Intermediate cordon - south: outbound	6	84	87	✓	0.30	23	18	✓	1.05	23	20	✓	0.67
Intermediate cordon - north: outbound	3	33	35	✓	0.35	15	5	✓	3.12	15	6	✓	2.94
Intermediate cordon - east: outbound	4	65	74	✓	1.07	26	74	✓	6.78	26	81	✓	7.48
Outer cordon - west: inbound	4	75	194	×	10.24	8	38	✓	6.34	8	42	✓	6.81
Outer cordon - south: inbound	4	85	90	✓	0.51	13	35	✓	4.42	13	38	✓	4.90
Outer cordon - north: inbound	5	136	171	✓	2.84	44	136	✓	9.66	44	148	×	10.60
Outer cordon - west: outbound	4	100	141	✓	3.73	24	66	✓	6.16	24	72	✓	6.82
Outer cordon - south: outbound	4	108	93	✓	1.54	33	52	✓	2.91	33	57	✓	3.53
Outer cordon - north: outbound	5	187	233	✓	3.13	55	176	×	11.28	55	192	×	12.34
RSI cordon - west: inbound	3	59	62	✓	0.35	9	25	✓	4.07	9	28	✓	4.48
RSI cordon - south: inbound	3	59	59	✓	0.02	13	30	✓	3.50	13	32	✓	3.96
RSI cordon - north: inbound	3	127	159	✓	2.65	37	135	✓	10.59	37	147	×	11.50
RSI cordon - west: outbound	3	75	82	✓	0.84	13	30	✓	3.66	13	32	✓	4.11
RSI cordon - south: outbound	3	62	61	✓	0.20	15	40	✓	4.68	15	44	✓	5.19
RSI cordon - north: outbound	3	168	188	✓	1.51	49	148	✓	10.05	49	162	×	11.03
% screenlines meet WebTAG criteria - :				96%	96%			96%	71%			86%	71%

Table 4-4 provides a summary of the above validation for short screenlines.

Table 4-4: LGV/HGV Validation Summary

	% of short screenlines meeting link flow difference criteria			% of short screenlines meeting GEH criteria		
	LGV	HGV	HGV (post adjustment)	LGV	HGV	HGV (post adjustment)
AM Peak	100%	86%	100%	96%	57%	89%
Interpeak	100%	89%	100%	96%	54%	100%
PM Peak	96%	96%	86%	96%	71%	71%

For the short screenlines, the validation is very good for LGVs with at least 96% of short screenlines passing both the GEH and flow difference criteria. For HGVs the validation is good for the flow difference criteria, with at least 86% of short screenlines passing the criteria, but not so good in relation to GEH. However, with a post processing adjustment of the HGV modelled flows, both the flow difference criteria and GEH improve for the AM and IP. The PM has a slight decrease in fit, as there is an imbalance of the HGV adjustments required for central Bath compared to the outskirts, so the central area was prioritized since this is where a CAZ is being considered.

It can be seen that closer to the centre of Bath the fit is better, i.e. for the intermediate and inner cordons. In particular, for the inner cordon short screenlines, the AM and IP results show just one short screenline which does not pass the GEH criteria in each of these time periods for the unadjusted HGVs. All inner cordon short screenlines in the AM and IP meet the flow difference criteria and all meet the GEH and flow difference criteria in the PM. With the post processing HGV adjustment, the inner cordon validation improves further.

Since the CAZ options now being considered relate to just the central area of Bath the HGV model fit is considered to be sufficient in the relevant part of the model. The post processing of HGV flows further improves the model fit and the robustness of the data to feed into the air quality modelling.

Furthermore, when comparing the number of HGVs to the total short screenline flow, observed and modelled, for all three time periods, the average observed proportion is 1.3-2.0% and he average modelled proportion is 2.8-5.5%. The results are summarised in Table 4-5 below.

Table 4-5: Proportion of HGV compared to Total Flow

	AM						IP						PM					
	Total Flow		HGVs		% HGV		Total Flow		HGVs		% HGV		Total Flow		HGVs		% HGV	
Short Screenline	Obs Count	Model Flow	Obs Count	Model Flow	Obs Count	Model Flow	Obs Count	Model Flow	Obs Count	Model Flow	Obs Count	Model Flow	Obs Count	Model Flow	Obs Count	Model Flow	Obs Count	Model Flow
Inner cordon - west:	1,576	1,517	12	7	0.8%	0.4%	1,000	1,005	6	3	0.6%	0.3%	1,285	1,291	5	3	0.4%	0.3%
Inner cordon - south:	1324	1327	32	69	2.4%	5.2%	1141	1154	20	60	1.7%	5.2%	1127	1053	20	30	1.7%	2.8%
Inner cordon - north:	1320	1528	28	37	2.1%	2.4%	1110	1098	21	38	1.9%	3.5%	1178	1163	22	18	1.9%	1.6%
Inner cordon - west:	1236	1223	8	10	0.6%	0.8%	1009	1026	6	5	0.6%	0.5%	1302	1277	11	8	0.8%	0.6%
Inner cordon - south: outbound	886	834	23	48	2.6%	5.8%	1005	1005	17	42	1.7%	4.2%	1193	1126	28	26	2.3%	2.3%
Inner cordon - north:	1691	1572	34	45	2.0%	2.9%	1265	1320	22	47	1.7%	3.6%	1693	1731	40	23	2.4%	1.3%
Intermediate cordon - northwest: inbound	1667	1601	20	43	1.2%	2.7%	1006	932	12	25	1.2%	2.7%	1098	981	11	19	1.0%	1.9%
Intermediate cordon - southwest: inbound	782	700	4	6	0.5%	0.9%	508	347	3	1	0.5%	0.3%	631	560	3	2	0.4%	0.3%
Intermediate cordon - south: inbound	2260	2135	23	47	1.0%	2.2%	1174	1156	17	35	1.5%	3.0%	1495	1473	11	20	0.7%	1.3%
Intermediate cordon - north: inbound	1113	1150	16	3	1.4%	0.2%	440	436	5	5	1.1%	1.1%	656	670	5	1	0.8%	0.2%
Intermediate cordon - east: inbound	1474	1461	39	106	2.6%	7.3%	1248	1214	28	124	2.2%	10.2%	1595	1618	28	64	1.7%	4.0%
Intermediate cordon - northwest: outbound	1047	694	24	25	2.2%	3.6%	1000	914	19	34	1.9%	3.7%	1529	1222	27	27	1.7%	2.2%
Intermediate cordon - southwest: outbound	527	373	7	3	1.3%	0.9%	518	323	7	4	1.3%	1.1%	800	459	10	3	1.2%	0.7%
Intermediate cordon - south: outbound	1426	1369	25	37	1.7%	2.7%	1119	1082	20	36	1.8%	3.3%	1829	1704	23	18	1.3%	1.1%
Intermediate cordon - north: outbound	749	762	18	5	2.4%	0.7%	419	411	7	4	1.8%	1.0%	964	1021	15	5	1.5%	0.5%
Intermediate cordon - east: outbound	1734	1681	35	111	2.0%	6.6%	1282	1197	30	101	2.4%	8.5%	1468	1527	26	74	1.8%	4.8%
Outer cordon - west:	2591	2231	37	105	1.4%	4.7%	1439	1472	22	67	1.5%	4.6%	1409	1687	8	38	0.6%	2.3%
Outer cordon - south:	2856	2726	41	74	1.4%	2.7%	1481	1434	32	73	2.2%	5.1%	1588	1548	13	35	0.8%	2.2%
Outer cordon - north:	4179	3718	98	243	2.3%	6.5%	1985	2030	64	196	3.2%	9.7%	2889	2752	44	136	1.5%	4.9%
Outer cordon - west: outbound	1732	1785	26	72	1.5%	4.0%	1568	1557	30	96	1.9%	6.2%	2398	2364	24	66	1.0%	2.8%
Outer cordon - south: outbound	1360	1475	23	66	1.7%	4.5%	1517	1462	31	79	2.0%	5.4%	2911	2578	33	52	1.1%	2.0%
Outer cordon - north: outbound	2569	2519	60	235	2.3%	9.3%	1963	1987	59	166	3.0%	8.4%	3235	3483	55	176	1.7%	5.0%
RSI cordon - west:	1608	1497	25	59	1.6%	3.9%	1049	1037	15	44	1.5%	4.2%	1337	1271	9	25	0.6%	2.0%
RSI cordon - south:	1677	1679	26	56	1.5%	3.4%	897	917	22	49	2.5%	5.3%	1047	1034	13	30	1.3%	2.9%
RSI cordon - north:	3206	3141	87	232	2.7%	7.4%	1697	1856	57	183	3.3%	9.9%	2527	2630	37	135	1.5%	5.1%
RSI cordon - west:	1161	1150	11	48	1.0%	4.2%	1070	1007	16	57	1.5%	5.7%	1764	1756	13	30	0.7%	1.7%
RSI cordon - south:	853	884	14	34	1.6%	3.8%	876	903	21	48	2.4%	5.4%	1545	1577	15	40	1.0%	2.5%
RSI cordon - north:	2229	2257	57	202	2.6%	8.9%	1702	1816	57	147	3.3%	8.1%	2809	3051	49	148	1.7%	4.9%

At the level of individual links, validation is good for both LGVs and HGVs with almost all the links meeting the flow criteria, and at least 80% meeting the GEH criteria. The post processed HGVs also show a marked improvement with at least 87% of links meeting GEH criteria. This is summarised in Tables Table 4-6Table 4-8 below.

These tables also show that whilst there are some fairly high percentage differences in total cordon HGV flows, due in part to the relatively low number of observed HGVs, the post adjustment HGV flows are much closer to observed flows, particularly for the inner cordon which is the part of the model that is most relevant for CAZ option testing. For the inner cordon modelled vs count bi-directional totals for post-adjustment flows are within 6% across all time periods.

Table 4-6: AM LGV/HGV Cordon and Link Validation Summary

Short Screenline	No. of Counts	LGVs Observed Count	LGVs Modelled Flow	LGVs % Difference	LGVs % Links Meet Flow	LGVs % Links Meet GEH	HGVs Observed Count	HGVs Modelled Flow	HGVs % Difference	HGVs % Links Meet Flow	HGVs % Links Meet GEH	HGVs (post adjustment) Observed Count	HGVs (post adjustment) Modelled Flow	HGVs (post adjustment) % Difference	HGVs (post adjustment) % Links Meet Flow	HGVs (post adjustment) % Links Meet GEH
Inner cordon - inbound	11	307	320	4%	100%	91%	72	113	57%	100%	91%	72	69	-3%	100%	91%
Inner cordon - outbound	11	279	279	0%	100%	100%	65	103	59%	100%	91%	65	64	-2%	100%	91%
Inner cordon - total	22	585	599	2%	100%	95%	137	216	58%	100%	91%	137	133	-3%	100%	91%
Intermediate cordon - inbound	21	416	414	0%	100%	100%	102	204	101%	100%	90%	102	126	24%	100%	100%
Intermediate cordon - outbound	21	298	289	-3%	100%	95%	108	181	67%	95%	86%	108	112	3%	95%	86%
Intermediate cordon - total	42	714	704	-1%	100%	98%	210	386	84%	98%	88%	210	238	13%	98%	93%
Outer cordon - inbound	13	635	743	17%	100%	92%	175	423	142%	100%	69%	175	260	49%	100%	92%
Outer cordon - outbound	13	418	475	14%	100%	100%	109	372	242%	100%	62%	109	229	110%	100%	85%
Outer cordon - total	26	1053	1217	16%	100%	96%	284	795	180%	100%	65%	284	490	72%	100%	88%
RSI cordon - inbound	10	476	478	1%	90%	90%	138	348	152%	100%	70%	138	214	55%	100%	90%
RSI cordon - outbound	10	322	336	4%	100%	100%	82	284	245%	100%	60%	82	175	113%	100%	90%
RSI cordon - total	20	798	815	2%	95%	95%	220	631	187%	100%	65%	220	389	77%	100%	90%
Total Over Cordons	220	6300	6670	6%	100%	97%	1702	4056	138%	99%	81%	851	1249	47%	99%	91%

Table 4-7: IP LGV/HGV Cordon and Link Validation Summary

Short Screenline	No. of Counts	LGVs Observed Count	LGVs Modelled Flow	LGVs % Difference	LGVs % Links Meet Flow	LGVs % Links Meet GEH	HGVs Observed Count	HGVs Modelled Flow	HGVs % Difference	HGVs % Links Meet Flow	HGVs % Links Meet GEH	HGVs (post adjustment) Observed Count	HGVs (post adjustment) Modelled Flow	HGVs (post adjustment) % Difference	HGVs (post adjustment) % Links Meet Flow	HGVs (post adjustment) % Links Meet GEH
Inner cordon - inbound	11	307	309	1%	100%	100%	47	102	120%	100%	82%	47	47	0%	100%	100%
Inner cordon - outbound	11	311	322	4%	100%	100%	45	94	110%	100%	91%	45	43	-4%	100%	100%
Inner cordon - total	22	618	631	2%	100%	100%	91	197	115%	100%	86%	91	89	-2%	100%	100%
Intermediate cordon - inbound	21	369	362	-2%	100%	100%	64	190	197%	100%	95%	64	86	35%	100%	95%
Intermediate cordon - outbound	21	365	334	-8%	100%	95%	84	178	113%	100%	95%	84	81	-3%	100%	100%
Intermediate cordon - total	42	734	696	-5%	100%	98%	148	368	149%	100%	95%	148	168	13%	100%	98%
Outer cordon - inbound	13	500	590	18%	100%	92%	117	337	187%	100%	77%	117	153	31%	100%	100%
Outer cordon - outbound	13	483	492	2%	100%	100%	119	341	186%	100%	62%	119	155	30%	100%	100%
Outer cordon - total	26	982	1082	10%	100%	96%	237	678	187%	100%	69%	237	309	30%	100%	100%
RSI cordon - inbound	10	350	351	0%	100%	100%	94	275	192%	100%	80%	94	125	33%	100%	100%
RSI cordon - outbound	10	359	348	-3%	100%	100%	93	252	170%	100%	70%	93	115	23%	100%	100%
RSI cordon - total	20	710	700	-1%	100%	100%	188	528	181%	100%	75%	188	240	28%	100%	100%
Total Over Cordons	220	6087	6216	2%	100%	98%	1327	3542	167%	100%	85%	663	806	21%	100%	99%

Table 4-8: PM LGV/HGV Cordon and Link Validation Summary

		Screenline meeting WebTAG criteria														
		LGVs					HGVs					HGVs (post adjustment)				
Short Screenline	No. of Counts	Observed Count	Modelled Flow	% Difference	% Links Meet Flow	% Links Meet GEH	Observed Count	Modelled Flow	% Difference	% Links Meet Flow	% Links Meet GEH	Observed Count	Modelled Flow	% Difference	% Links Meet Flow	% Links Meet GEH
Inner cordon - inbound	11	187	171	-8%	100%	100%	47	52	10%	100%	91%	47	56	20%	100%	91%
Inner cordon - outbound	11	212	187	-12%	100%	100%	79	57	-28%	100%	91%	79	62	-21%	100%	91%
Inner cordon - total	11	400	359	-10%	100%	100%	126	109	-14%	100%	91%	126	119	-6%	100%	91%
Intermediate cordon - inbound	21	234	242	4%	100%	100%	58	105	83%	86%	90%	58	115	99%	86%	90%
Intermediate cordon - outbound	21	275	290	5%	100%	100%	100	128	28%	90%	90%	100	139	39%	90%	90%
Intermediate cordon - total	42	509	532	5%	100%	100%	158	233	48%	88%	90%	158	254	61%	88%	90%
Outer cordon - inbound	13	297	456	54%	100%	85%	65	209	221%	92%	85%	65	228	249%	92%	85%
Outer cordon - outbound	13	396	467	18%	100%	100%	112	293	162%	100%	77%	112	320	185%	100%	77%
Outer cordon - total	26	692	922	33%	100%	92%	177	502	183%	100%	77%	177	548	209%	96%	81%
RSI cordon - inbound	10	246	280	14%	100%	100%	59	190	223%	100%	80%	59	207	252%	100%	80%
RSI cordon - outbound	10	305	331	9%	100%	100%	77	218	184%	100%	90%	77	238	209%	100%	80%
RSI cordon - total	20	550	611	11%	100%	100%	136	408	201%	100%	77%	136	445	228%	100%	80%
Total Over Cordons	209	4302	4847	13%	100%	98%	1193	2504	110%	94%	88%	596	1365	129%	95%	87%

5. Conclusion

The G-BATH model has been validated using the guidance, measures and criteria recommended in WebTAG M3.1.

The additional validation of goods vehicles set out in this note highlights the following:

- Based on the flow difference criteria both light and heavy goods vehicles meet the WebTAG acceptability guidelines with more than 85% of the short screenlines meeting the criteria;
- Based on GEH criteria light goods vehicles meet the acceptability guideline, while heavy goods vehicles fall short. This is, to some extent due to the low volumes of HGV traffic involved;
- In the central area of Bath, where CAZ options are now being considered, the modelled fit of HGVs is good in terms of both the flow difference and the GEH criteria; and
- A post processing adjustment to the HGV flows further improves the validation for the central area of Bath.

5.1 Way Forward

The LGV flow validation is considered to be good, 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 by using individual adjustment factors for each time period to yield more accurate total HGV volumes for the emissions calculations that are to be undertaken using the traffic model data. This will focus on the central area of Bath, where CAZ schemes are being considered, as presented in this note.