Waikato Regional Transport Model

2013 Base Model Validation Update

Technical Note 37

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2013 Base Model Validation Update

Technical Note 37

Quality Assurance Statement

Prepared by:

Liqi Chen

Project Transportation Planner

Checked and Approved for Issue by:

Julie Ballantyne

Director

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PO Box 8615, Riccarton, Christchurch 8440
New Zealand

P: +64 3 348-3215

www.tdg.co.nz

Table of Contents

1. Introduction

In 2016, Hamilton City Council further reviewed the existing WRTM 2013 base network and proposed a list of changes, with the aim of improving the operational performance of the model. TDG has applied the changes and undertaken an assessment of the impact of the changes on the model validation. This assessment takes account of relevant criteria within the NZ Transport Agency "Transport Model Development Guidelines".

To deliver this check cost-effectively, this technical note does not contain the full validation of the 2013 base model, but compares key tables for the original and updated base models.

2. 2013 Base Network Update

The 2013 WRTM base network has been reviewed by Hamilton City Council (HCC) and a list of network changes supplied. Google Earth was then used to determine the exact year that the network changes were built. **Table 1** summarises the changes specified by HCC for inclusion in the 2013 base road network. These changes are classified into four categories: intersection control upgrades, speed changes, lane changes, and new roads. The review using Google Earth indicated that some network changes were actually built subsequent to 2013. These changes will not be included in the 2013 base network, but will be included in future year networks. **Table 1** therefore shows the total number of changes specified, and those not included. **Table 2** expands on the changes that were not included, and provides the rationale.

Changes Type	Number of Changes Specified	Changes Not Included	Comments
Intersection Control	31	4	Mainly upgrades from Give Way to Roundabout within residential areas and new development sites
Speed Change	45	0	Most of these speeds had been adjusted for previous local validation purposes. These validation changes have been reset and the overall model validation reconfirmed.
Lane Change	11	1	Mainly applies to intersection approaches which are not coded in the network (but are coded in the intersection files)
New/Missing Roads	6	2	Includes new links within development sites or slip lanes that had been omitted

Table 1: 2013 Base Network Changes Summary

Road Intersection	Change Type	Comment
Bankwood Rd - Clarkin Rd	Intersection Control	Updates were not included in model year 2013, checked against Google Earth which showed Priority in Dec 2013 and roundabout by Jul 2014
Clarkin Rd - Heaphy Terrace	Intersection Control	Updates were not included in model year 2013, checked against Google Earth which showed Priority in Dec 2013 and roundabout by Jul 2014
Queens - Killarney	Intersection Control	"Change in priority layout" was not included in 2013 model year, checked against Google Earth. Change in priority occurred sometime between Apr and Jun 2015.
Lake Road - Queens Ave Intersection	Intersection Control	Change in priority layout was not included in 2013 model year, checked against Google Earth. Roundabout constructed between Mar and Apr 2015.
Victoria Street (Northbound)	Link lane	Checked against model signal file, the lane change was already included in signal files. No further edits necessary to reflect third lane in 2013.
Te Manatu Dr - Chalgrove	Missing Link	Updates were not included in model year 2013, checked

Road Intersection	Change Type	Comment
Rd (And links around the area)		against Google Earth which showed Chalgrove under construction in July 2014
Morrinsville - Cobham Dr	Missing Slip-lane	The slip-lane was not included in 2013 model year, checked against Google Earth which showed the slip-lane was not built in Sep 2015, but was by Dec 2015

Table 2: Summary of Requested Changes that have not been Included in the 2013 Base Network

3. 2013 Base Model Validation - Screenlines and Link Counts

The updated road network has been incorporated in the 2013 WRTM and the modelled traffic flows compared with the observed link count dataset at link and screenline level. The various outputs are summarised below for the updated network and the original calibrated/validated model. The focus is comparing the original output to those from the updated network. However the targets are reported and these are sourced from the NZ Transport Agency Transport Model Development Guidelines ("Guidelines"). The outputs provided are by screenline, link count, and R-squared values for link counts.

3.1 Screenline Counts

In total there are 20 screenlines in each of the three peak periods making 120 directional screenlines.

Table 3 summarises the percentage differences on the screenlines (modelled verses observed) for the original 2013 delivered model and the updated network. Although the percentage differences for the updated base model are outside the target validation criteria, they are still relatively similar to the original model outputs.

Total Directional Screenline Counts	Target	Original AMP	Updated AMP
Screenlines within 5%	70%	55%	60%
Screenlines within 10%	80%	83%	86%
Total Directional Screenline Counts	**Target**	**Original INP**	**Updated INP**
Screenlines within 5%	70%	48%	45%
Screenlines within 10%	80%	76%	69%
Total Directional Screenline Counts	**Target**	**Original PMP**	**Updated PMP**
Screenlines within 5%	70%	57%	55%
Screenlines within 10%	80%	74%	79%

Table 3: Screenline Comparison Summary – Percentage Differences

The AM peak performs slightly better, the interpeak slightly worse, and the PM peak marginally worse at the "within 5%" criteria but better for "within 10%". The results from the updated model are not significantly different from the original model and were therefore considered acceptable.

Table 4 summarises the GEH values for total (light plus heavy) vehicles' directional flows across screenlines. The updated base model produces similar results to the original base model, and both models significantly exceed the GEH criteria specified in the Guidelines.

Total Directional Count Across Screenline	Target	Original AMP	Updated AMP
GEH<5.0 (% of screenlines)	60%	86%	86%
GEH<7.5 (% of screenlines)	75%	98%	100%
GEH<10.0 (% of screenlines)	90%	100%	100%
Total Directional Count Across Screenline	**Target**	**Original INP**	**Updated INP**
GEH<5.0 (% of screenlines)	60%	81%	76%
GEH<7.5 (% of screenlines)	75%	95%	93%
GEH<10.0 (% of screenlines)	90%	98%	100%
Total Directional Count Across Screenline	**Target**	**Original PMP**	**Updated PMP**
GEH<5.0 (% of screenlines)	60%	74%	76%
GEH<7.5 (% of screenlines)	75%	88%	90%
GEH<10.0 (% of screenlines)	90%	98%	98%

Table 4: Screenline Comparison Summary - GEH

3.2 Individual Link Counts

Table 5 summarises the GEH results for the individual directional link counts on screenlines. Clearly, both models have produced similar results and also exceeded the target validation criteria in the Guidelines.

Individual Directional Link Count on Screenlines	Target	Original AMP	Updated AMP
GEH<5.0 (% of Counts)	65%	85%	83%
GEH<7.5 (% of Counts)	75%	93%	93%
GEH<10.0 (% of Counts)	85%	98%	97%
GEH<12.0 (% of Counts)	95%	98%	98%
Individual Directional Link Count on Screenlines	**Target**	**Original INP**	**Updated INP**
GEH<5.0 (% of Counts)	65%	83%	82%
GEH<7.5 (% of Counts)	75%	95%	93%
GEH<10.0 (% of Counts)	85%	98%	98%
GEH<12.0 (% of Counts)	95%	99%	99%
Individual Directional Link Count on Screenlines	**Target**	**Original PMP**	**Updated PMP**
GEH<5.0 (% of Counts)	65%	80%	79%
GEH<7.5 (% of Counts)	75%	94%	93%
GEH<10.0 (% of Counts)	85%	98%	98%
GEH<12.0 (% of Counts)	95%	98%	99%

Table 5: Link Count Comparison Summary - GEH

Table 6 summarises the total vehicle R-squared for modelled verses observed volumes. Both models show a good overall fit of modelled volumes to surveyed counts, and exceed the target criteria in all three peak periods.

Observed vs Modelled Count Comparison R^2	Target	Original AMP	Updated AMP
R Squared Value	0.85	0.97	0.97
Observed vs Modelled Count Comparison R^2	**Target**	**Original INP**	**Updated INP**
R Squared Value	0.85	0.94	0.94
Observed vs Modelled Count Comparison R^2	**Target**	**Original PMP**	**Updated PMP**
R Squared Value	0.85	0.95	0.94

Table 6: Link Count Comparison Summary – R^2

4. 2013 Base Model Validation - Travel Times

The ability of the model to replicate observed travel times on journey time routes has also been assessed. Again, the focus has been comparing the original and updated model outputs, rather than reworking all of the validation tables. There are separate journey times for Hamilton City and the region, and these are reported in turn in the following two sections. In total, sixteen directional Hamilton travel time routes and thirty directional regional routes are reported.

4.1 Hamilton Travel Time Routes

Table 7 summarises the travel time comparison between the original and updated models. The difference in modelled travel time is reported for each peak period, followed by the percentage difference between modelled and observed for the original and updated models. The results demonstrate that the travel times are very similar between the two versions of the models, with changes in travel time less than one minute except for three cases: HCC Route 3 NB in the AM peak; WRTM Route 1 NB in the AM peak; and WRTM Route 2 EB in the PM peak respectively. Modelled travel times on both WRTM Route 1 NB and WRTM Route 2 EB in the updated model have improved in terms of replicating observed. Routes where the updated model has moved further away from observed are in red for the percentage difference in the table below while those that have improved are in green. Note that the red figures do not necessarily mean that the validation criteria have not been achieved.

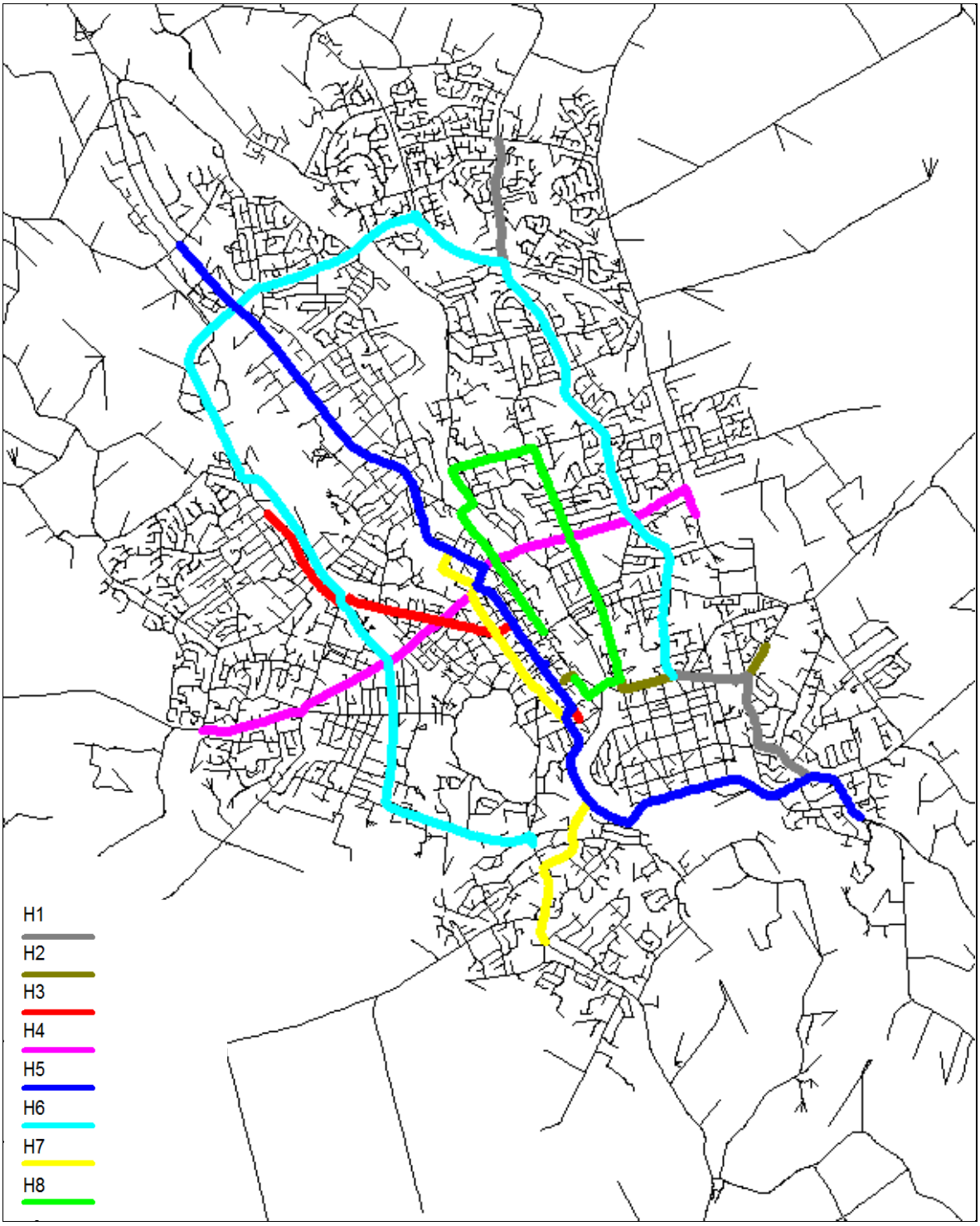
Journey Routes	Modelled Travel Time (Updated - Original) (mins)			Travel Time % Difference (Against Observed)					
	AMP	INP	PMP	AMP		INP		PMP	
	Difference	Difference	Difference	Original	Updated	Original	Updated	Original	Updated
HCC Route 1 NB	0.14	-0.11	-0.70	-6.4%	-5.6%	-0.9%	-1.6%	-3.4%	-7.5%
HCC Route 1 SB	0.22	-0.28	-0.61	-14.7%	-13.5%	2.6%	0.8%	-0.6%	-4.3%
HCC Route 2 EB	-0.04	-0.09	-0.32	-15.1%	-15.7%	-8.6%	-10.2%	-17.0%	-20.6%
HCC Route 2 WB	-0.08	-0.05	-0.03	-8.4%	-9.4%	-15.1%	-15.8%	-3.7%	-4.1%
HCC Route 3 NB	1.04	0.88	0.25	5.9%	15.8%	13.5%	22.5%	5.0%	7.1%
HCC Route 3 SB	0.93	0.81	-0.04	-23.9%	-17.5%	-1.6%	5.6%	2.2%	1.9%
HCC Route 4&5 EB	0.10	0.13	0.19	-10.9%	-10.2%	-7.8%	-6.9%	-26.0%	-24.9%
HCC Route 4&5 WB	0.03	0.27	-0.16	-26.4%	-26.2%	-0.2%	2.0%	-3.5%	-4.8%
WRTM Route 1 NB	-1.23	-0.20	-0.19	4.9%	-0.6%	20.4%	19.3%	5.7%	5.0%
WRTM Route 1 SB	-0.08	-0.01	0.02	14.7%	14.3%	8.3%	8.2%	-4.0%	-3.9%
WRTM Route 2 EB	-0.54	-0.45	-1.54	N/A	N/A	N/A	N/A	9.9%	4.9%
WRTM Route 2 WB	0.81	-0.12	-0.96	N/A	N/A	N/A	N/A	3.3%	0.1%
WRTM Route 4&5 NB	-0.50	-0.82	0.10	-8.7%	-12.9%	5.3%	-2.5%	-11.2%	-10.3%
WRTM Route 4&5 SB	0.62	-0.02	0.45	-12.3%	-7.1%	-0.8%	-1.0%	-11.0%	-7.3%
WRTM Route 6 NB	-0.36	-0.27	-0.36	1.7%	-0.6%	9.2%	7.2%	10.2%	8.2%
WRTM Route 6 SB	-0.55	-0.14	-0.22	0.7%	-2.7%	8.3%	7.3%	-4.5%	-5.7%

Table 7: Travel Time Comparison Summary - Hamilton Travel Times Differences

Table 8 shows modelled verses observed times on the journey routes compared against the NZ Transport Agency validation criteria. Both the morning peak and interpeak results have deteriorated marginally in the updated model, although the drop in percentage only relates to one route. The largest difference between the two models is on Route 3 between Anglesea Street and Avalon Drive. Network changes have been incorporated in this area with speeds on Lincoln Street changed from 80 km/h to 60 km/h and Avalon Drive from 60 km/h to 50 km/h. Adopting the actual speed limits in this area has marginally impacted on the model's ability to reproduce observed travel times and meet the validation criteria. For any assessments in this localised area, minor amendments to the network may be warranted to adjust the model to replicate observed.

Total Journey Time Route Comparison	Target	Original AMP	Updated AMP
Within 15% or 1 minute (% of Routes)	80%	79%	71%
Total Journey Time Route Comparison	***Target***	***Original INP***	***Updated INP***
Within 15% or 1 minute (% of Routes)	80%	79%	71%
Total Journey Time Route Comparison	**Target**	**Original PMP**	**Updated PMP**
Within 15% or 1 minute (% of Routes)	80%	81%	81%

Table 8: Travel Time Comparison Summary - Hamilton Travel Time – Validation Criteria



Hamilton Surveyed Travel Time Routes – All Routes

1

4.2 Waikato Regional Travel Time Routes

Table 9 summarises the travel time comparison between the original and updated models. Again, the difference in modelled travelled time is reported for each peak period, followed by the percentage difference between modelled and observed for the original and updated models. The results are almost identical in the two model versions. Routes where the model has moved further away from observed are in red in the table below while those that have improved are in green. Note that the red figures do not necessarily mean that the validation criteria have not been achieved.

Journey Routes	Modelled Travel Time (Updated - Original) (mins)			Travel Time % Difference (Against Observed)					
	AMP	INP	PMP	AMP		INP		PMP	
	Difference	Difference	Difference	Original	Updated	Original	Updated	Original	Updated
R1EB SH2	0.0	-0.2	-0.3	0.73%	0.72%	-2.10%	-2.25%	1.61%	1.32%
R1WB SH2	0.0	-0.1	-0.1	0.78%	0.75%	-1.85%	-1.92%	2.41%	2.35%
R2aNB SH1	-0.5	-0.5	-0.4	0.75%	-0.21%	1.33%	0.28%	5.15%	4.45%
R2aSB SH1	-0.3	-0.3	-0.3	2.23%	1.68%	1.44%	0.88%	2.93%	2.43%
R2cNB SH1	0.0	-0.1	-0.1	-7.28%	-7.33%	-7.33%	-7.99%	-6.75%	-7.77%
R2cSB SH1	0.0	-0.1	-0.1	-7.00%	-7.03%	-5.97%	-6.77%	-3.95%	-5.21%
R2dNB SH1	0.0	0.0	0.0	-6.84%	-6.85%	-7.11%	-7.17%	-6.05%	-5.95%
R2dSB SH1	0.0	0.0	0.0	-9.14%	-9.15%	-10.31%	-10.34%	-9.75%	-9.82%
R3aNB SH1B	0.0	-0.1	-0.1	2.78%	2.79%	2.80%	2.40%	3.59%	3.16%
R3aSB SH1B	0.0	-0.1	-0.1	2.35%	2.36%	2.54%	1.96%	2.95%	2.41%
R3bNB SH1B	0.0	-0.1	-0.2	-6.29%	-6.29%	-5.77%	-6.88%	-4.71%	-6.06%
R4EB SH29	0.0	0.0	-0.2	5.43%	5.42%	4.54%	4.47%	6.34%	6.00%
R4WB SH29	0.0	0.0	0.0	2.51%	2.51%	2.66%	2.63%	3.96%	3.94%
R5NB SH1	0.0	0.0	0.0	-3.26%	-3.28%	-3.26%	-3.30%	-2.57%	-2.58%
R5SB SH1	0.0	0.0	0.0	-0.16%	-0.21%	-0.37%	-0.41%	0.08%	0.00%
R6NB SH32	0.0	0.0	0.0	1.70%	1.70%	1.66%	1.64%	1.71%	1.70%
R6SB SH32	0.0	-0.1	-0.1	-0.28%	-0.28%	-0.19%	-0.29%	0.00%	-0.10%
R7NB SH1	0.0	0.0	0.0	0.79%	0.79%	1.56%	1.59%	4.74%	4.71%
R7SB SH1	0.1	0.1	0.0	0.57%	0.83%	0.21%	0.41%	1.75%	1.76%
R8NB SH1	0.0	0.0	0.0	-2.98%	-2.98%	-2.64%	-2.70%	-2.55%	-2.63%
R9NB SH5	0.0	-0.1	-0.3	-2.26%	-2.24%	-1.96%	-2.04%	-0.61%	-0.93%
R9SB SH5	0.0	0.1	-0.2	-3.07%	-3.06%	-3.57%	-3.46%	-2.71%	-3.01%
R10aNB SH27	0.0	0.0	0.0	5.56%	5.56%	5.51%	5.51%	5.79%	5.79%
R10aSB SH27	0.0	0.0	0.0	6.20%	6.20%	6.12%	6.05%	6.22%	6.22%
R10bNB SH27	0.0	0.0	0.0	-4.85%	-4.85%	-4.94%	-4.93%	-4.14%	-4.11%
R10bSB SH27	0.0	-0.1	-0.1	-8.54%	-8.54%	-8.61%	-8.78%	-8.12%	-8.28%
R11aNB SH3	0.0	0.0	0.0	-1.90%	-1.90%	-2.40%	-2.50%	-1.95%	-2.06%
R11aSB SH3	0.0	-0.1	-0.1	-0.75%	-0.76%	-0.03%	-0.29%	1.07%	0.72%

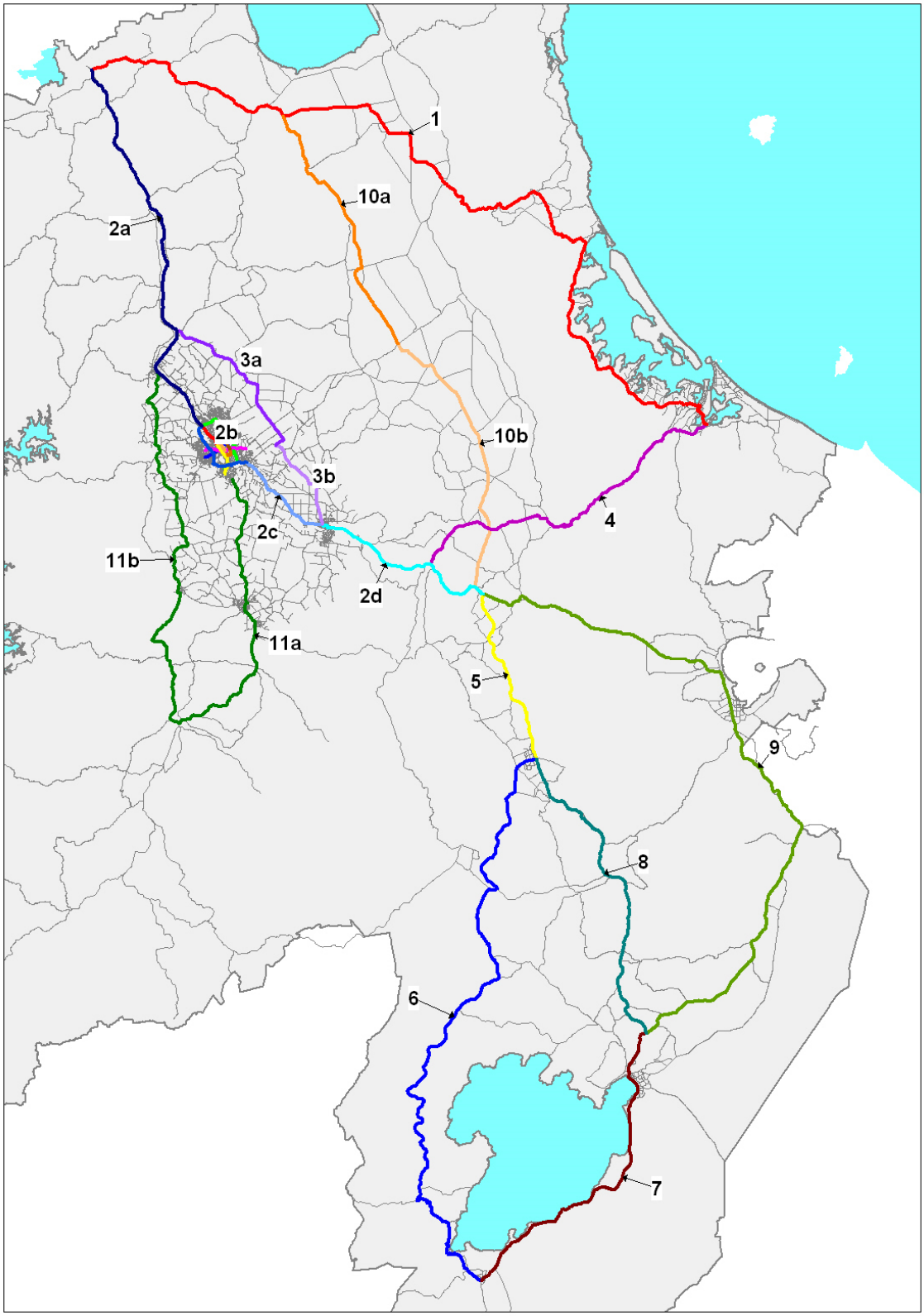
Journey Routes	Modelled Travel Time (Updated - Original) (mins)			Travel Time % Difference (Against Observed)					
	AMP	INP	PMP	AMP		INP		PMP	
	Difference	Difference	Difference	Original	Updated	Original	Updated	Original	Updated
R11bNB SH39	0.0	0.0	0.0	1.73%	1.73%	1.51%	1.51%	1.78%	1.78%
R11bSB SH39	0.0	-0.1	-0.1	-2.85%	-2.88%	-2.54%	-2.82%	-2.17%	-2.41%

Table 9: Travel Time Comparison Summary - Waikato Regional Travel Time Routes Differences

Table 10 shows modelled verses observed times on the regional journey routes compared against the NZ Transport Agency validation criteria. All peak periods exceed the validation criteria, with 100% matching the target for the suggested tolerances.

Total Journey Time Route Comparison	Target	Original AMP	Updated AMP
Within 15% or 1 minute (% of Routes)	80%	100%	100%
Total Journey Time Route Comparison	**Target**	**Original INP**	**Updated INP**
Within 15% or 1 minute (% of Routes)	80%	100%	100%
Total Journey Time Route Comparison	**Target**	**Original PMP**	**Updated PMP**
Within 15% or 1 minute (% of Routes)	80%	100%	100%

Table 10: Travel Time Comparison Summary – Waikato Regional Travel Time – Validation Criteria



Regional Surveyed Travel Time Routes in Waikato Study Area (R1-R11B)

2

5. Implications for Local Validation

Based on the validation checks at screenlines and for travel times, the updated 2013 base model produces similar results as the original base. Further analysis was undertaken to investigate the implications of the network changes in local areas that are not covered by the model validation checks (i.e. where there are no screenlines or travel time routes). There are some noteworthy volume differences between the two versions of the base model which are summarised below. Note that there are no traffic counts in the model dataset for these areas, so the fact that the traffic flows have changed may represent a larger difference to observed or it could be an improvement. These locations are merely highlighted as they represent a change associated with the edits provided.

Avalon Drive

- The modelled speed on Avalon Drive was changed from 60 km/h to the posted speed limit of 50 km/h and various roundabouts at cross-roads were incorporated. The impact of this is that the modelled volumes have dropped significantly in the updated 2013 base model. The extra travel time results in more traffic using adjacent local streets, including Ellicott Road, Magnolia Crescent and Livingstone Avenue.

Lincoln Street

- The modelled speed was changed from 80 km/h to the posted 60km/h. As a result, traffic volumes on Lincoln Street have dropped while more traffic has shifted onto Massey Street.

Howell Avenue

- Howell Avenue's modelled speed was changed from 35km/h to the posted speed limit of 50 km/h. As a result, traffic on Cambridge Road has significantly decreased with increased flows on Howell Avenue.

As highlighted above, these changes may or may not represent an improvement in replicating observed – it is not possible to conclude without conducting a detailed assessment with a significantly greater number of traffic counts. For any project assessments in the vicinity of these locations, local area checks are therefore recommended.

6. Conclusion

Further changes to the 2013 network have been incorporated at the request of HCC. The results from the model including these changes (referred to as "updated") have been compared with the delivered calibrated/validation 2013 base model ("original"). The ability of the model to replicate traffic volumes, at link and screenline level, and travel times has been evaluated, with a focus on the difference between the original and updated models.

In terms of traffic volumes, the updated model replicates the observed validation dataset to very similar tolerances as the original model. For all three peak periods, the model exceeds the targets in terms of the GEH at both link and screenline level. For percentage differences on screenlines, the updated model does not quite achieve the validation targets although it is very similar to the original model. The differences are not considered significant for a strategic model.

For travel times, the modelled time has changed by less than a minute on all but three routes – two of which are an improvement in terms of replicating observed. The travel time analysis does indicate a marginal deterioration for the AM peak and interpeak based on the overall validation criteria, but it is worth noting that this only relates to one journey route performing slightly worse. This is not considered significant for a strategic model.

The changes to the network have resulted in some localised changes in volume and route choice. Local validation is therefore recommended for any projects in the vicinity of Avalon Drive, Lincoln Street, and Howell Avenue.

Overall, as the changes to the 2013 network produce results very similar to the original model, it is recommended that the amended 2013 network be adopted.