NZ TRANSPORT AGENCY

MacKays to Peka Peka Expressway

File Note

By:	Graham Bell	**Date:**	30 October 2012
Subject:	KTM2 Base Model Revisions – Summary of Impacts	**Our Ref:**	3391248

1 Introduction

The KTM2 traffic model developed for the M2PP project was refined for use on the PP2O project, resulting in KTM Version 2.1 (KTM2.1).

This note outlines a summary of the traffic-related impacts of the network revisions made to the KTM2 Base Model in the context of **Task 1** of the "KTM2 Updates for PP2O" work package and will cover the following topics:

- KTM2 network revisions
- Traffic-related impacts in and around the Otaki area (peak hour traffic volumes and travel times)
- Traffic-related impacts in the M2PP area (peak hour traffic volumes)
- Conclusions

The main objective of **Task 1** is to improve the existing KTM2 base model validation (network speeds and travel times) in and around the Otaki area whilst maintaining the integrity of the previous validation in the MacKays to Peka Peka (M2PP) area. Reference should be made to the original KTM2 Model Validation Report, "*MacKays to Peka Peka SATURN Model Validation Report, July 2011,"* for full details of the model structure and specification.

2 KTM2 Network Revisions

Following analysis of observed and modelled travel times (from both Opus' PP2O traffic model and KTM2) between Peka Peka Road and Waitohu Valley Road, it was determined that it would be appropriate to update the roundabout configuration at SH1 / Mill Road and adjust the model to reflect the pedestrian crossing just north of Arthur Street on SH1 to better match the observed travel time data.

Analysis of the survey data[1] on SH1 through Otaki indicated that the KTM2 modelled link speeds for the sections Waerenga Road to Mill Road and Mill Road to Waitohu Valley Road were well reflected, with the delay at the Mill Road roundabout and / or Arthur Street pedestrian crossing being under represented. This was likely to be the reason for the differences between observed and modelled overall travel time between Peka Peka and Waitohu Valley Road.

Mill Road Roundabout

The roundabout saturation flows were updated to be in line with the geometrically constrained capacities (equivalent to SATURN saturation flows) calculated in Opus' SIDRA model. This included modelling 'flares' on the roundabout approaches from SH1 north and SH1 south which, previously, KTM2 did not include. **Table 2.1** below outlines the new capacities.

Table 2.1 New 2010 Base Year Roundabout Entry / Exit Capacity

Approach	Road Name	Lane Number	Old Capacity (pcus/hr)	New Capacity (pcus/hr)
South East	Rahui Road	1	1,200	800
North East	SH1 North	1 (with 90m flare) 2	1,800	2,400
North West	Mill Road	1	1,400	800
South West	SH1 South	1 (with 50m flare) 2	1,800	2,200

The revised capacities were complemented by adjusting the number of lanes on the left-turn from SH1 South into Mill Road in KTM2, i.e. reducing from two to one to bring in line with current conditions. An aerial photo of the current roundabout layout is shown below as well as the modelled representation, with saturation flows, in **Figure 2.1**.

[1] Collected by Opus

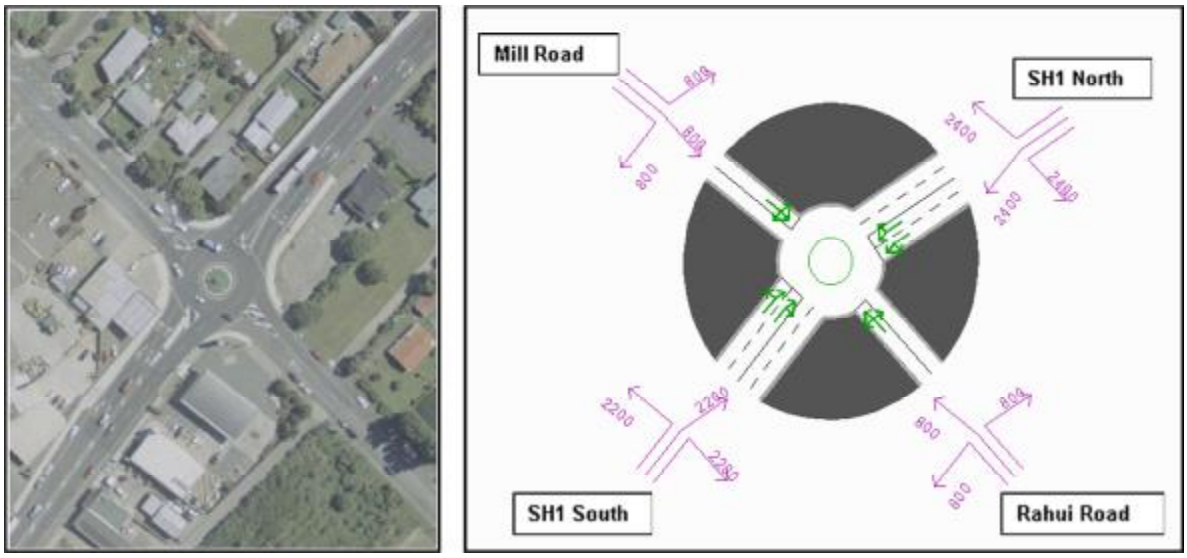

Figure 2.1 Roundabout Layout

Arthur Street Pedestrian Crossing

KTM2 has no physical representation of the Arthur Street pedestrian crossing (zebra crossing) but it is likely the average effects of the pedestrian crossing are modelled implicitly though the use of the speed-flow curves. However, an actual node was deemed more appropriate since the cycle time could then be reduced to reflect the increased 'calling' and delay in the inter-peak period as suggested by the travel time survey data. An actual node has been implemented to reflect the pedestrian crossing and calibrated to the travel time survey data.

The improved representation of the pedestrian crossing has resulted in additional delay for traffic on SH1 just north of Arthur Street, as shown below, to better match the observed travel time data.

- AM and PM Peak hours – 3 seconds in the northbound and southbound directions
- Average Inter-peak hour – 13 seconds in the northbound direction and 12 seconds in the southbound direction

The larger delay experienced in the average inter-peak hour is likely to be reflective of the increased pedestrian activity during this time of the day; shopping and leisure trips for example.

The overall travel time effect on the road section between Waerenga Road and Waitohu Valley Road, once the pedestrian crossing is in place (KTM2.1), is shown below in **Tables 2.2** and **2.3**.

Table 2.2 SH1, Northbound, Pedestrian Crossing Travel Time Impacts

Northbound	Observed Travel Time (secs)	KTM2 Travel Time (secs)	KTM2 vs Observed (secs)	KTM2.1 Travel Time (secs)	KTM2.1 vs Observed (secs)
AM Peak Hour	107	104	-3	107	0
Ave. Inter-Peak Hour	121	103	-18	116	-5
PM Peak Hour	106	104	-2	107	+1

It can be seen from the table above, there is an improvement in the modelled travel time northbound between Waerenga Road and Waitohu Valley Road in KTM2.1, most notably in the average inter-peak hour. The AM Peak hour illustrates KTM2.1 reflects the observed time through this section of SH1 in Otaki town centre, whilst the PM peak hour is slightly slower than the observed.

Table 2.3 SH1, Southbound, Pedestrian Crossing Travel Time Impacts

Southbound	Observed Travel Time (secs)	KTM2 Travel Time (secs)	KTM2 vs Observed (secs	KTM2.1 Travel Time (secs)	KTM2.1 vs Observed (secs)
AM Peak Hour	110	104	-6	107	-3
Ave. Inter-Peak Hour	115	103	-12	115	0
PM Peak Hour	116	104	-12	106	-10

Table 2.3 above shows some modest improvements in the modelled travel time southbound between Waitohu Valley Road and Waerenga Road in KTM2.1, once again most notably in the average inter-peak hour; KTM2.1 matches the observed travel time. The KTM2.1 AM and PM peak hour, albeit closer to the observed, underestimates the travel time on this section of SH1 in Otaki town centre.

It is likely that additional delay added into KTM2.1 for the AM and PM peak hours would benefit southbound travel times and provide a closer match to the observed data, however this would be at the expense of the northbound direction which would be adversely affected.

These additional delays at the Arthur Street pedestrian crossing have resulted in improved modelled travel times through Otaki town centre, and across the whole Peka Peka Road to Waitohu Valley Road (north of Otaki) route, which is discussed further in **Section 3**.

File Note

The two network revisions discussed in this section have given rise to a new version of KTM2, namely **KTM version 2.1**.

3 Otaki Traffic-related Impacts

The section outlines the traffic-related impacts of the KTM2 network revisions on the Otaki road network area, covering traffic volumes as well as travel times on SH1 through Otaki town centre between Waitohu Valley Road and Waerenga Road.

Traffic Volumes

As expected, given the nature of changes made, there are minor differences in base year modelled traffic volumes (circa 20-50 pcus/hr) in the Otaki area when comparing KTM2 and KTM2.1 and this trend is seen across all three time periods.

These differences relate to re-routing effects, primarily as a result of the improved representation of the Arthur Street pedestrian crossing (zebra crossing) to better reflect the observed travel time data. This is shown in **Figure 3.1** below.

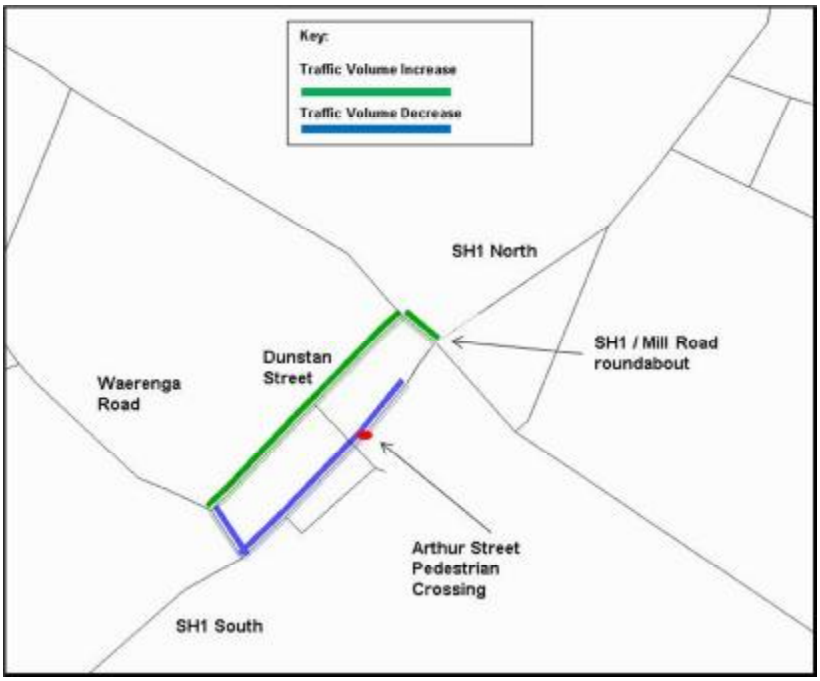

Figure 3.1 Re-routing Effects[2]

It can be seen from **Figure 3.1**, there is an element of traffic which previously, in KTM2, travelled along Waerenga Road towards SH1 and turned left onto SH1 towards the Mill Road roundabout but now uses Dunstan Street as an alternative in KTM2.1.

Given the level of traffic using Mill Road (volume over capacity (V/C) circa 15%) and Dunstan Street having ample available capacity (V/C circa 5% - 10%), Dunstan Street provides a more attractive route for some traffic using Waerenga Road and travelling to SH1 north rather than encountering the pedestrian crossing, and hence associated delays, just north of Arthur Street on SH1.

Furthermore, SH1 is the busiest road though Otaki and hence there are larger delays associated with the left-turn from Waerenga Road into SH1 compared with the left-turn from Waerenga Road into Dunstan Street.

The magnitudes of these re-routing effects are considered to be minor and in line with expectations.

Analysis of other road links in the Otaki area illustrated negligible difference.

[2] Due to differences in network links at the SH1 / Mill Road roundabout between KTM2 and KTM2.1, there are gaps in the traffic volume difference plot. Hence the blue line should extend towards and meet the green line at the Mill Road roundabout.

Travel Times

Figures 3.2 to 3.5 overleaf illustrate KTM2 and KTM2.1 modelled travel times with a comparison against observed travel times through Otaki town centre between Waerenga Road and Waitohu Valley Road (north of Otaki).

The key headline(s) for each figure is summarised below.

Figure 3.2 – KTM2 Northbound

The KTM2 modelled travel times are quicker than the observed in all three time periods between Waerenga Road and Waitohu Valley Road. This demonstrates KTM2 modelled speeds are on average faster through Otaki town centre in the northbound direction.

Figure 3.4 – KTM2 Southbound

The KTM2 modelled travel times are more in line with the observed through Otaki town centre in the southbound direction from Waitohu Valley Road to the Mill Road roundabout. South of the Mill Road roundabout to Waerenga Road, KTM2 exhibits quicker travel times in all three time periods when comparde with the observed data.

Figure 3.3 – KTM2.1 Northbound

It can be seen from **Figure 3.3**, KTM2.1 travel times are more in line with the observed data from Waerenga Road to Waitohu Valley Road. The improvements made to the modelled network, i.e. improved Mill Road roundabout configuration and implementation of the pedestrian crossing (zebra crossing) on SH1 just north of Arthur Street, have had a positive impact on modelled travel times.

Figure 3.5 – KTM2.1 Southbound

This figure demonstrates an improvement in travel times in the southbound direction bewteen Waitohu Valley Road and Waerenga Road, and once again, more in line with the observed data. The main improvement is shown in the travel times south of Mill Road roundabout to Waerenga Road, hence the delays asscoiated with the roundabout and Arthur Street pedestrian crossing are now more reflective in the KTM2.1 model.

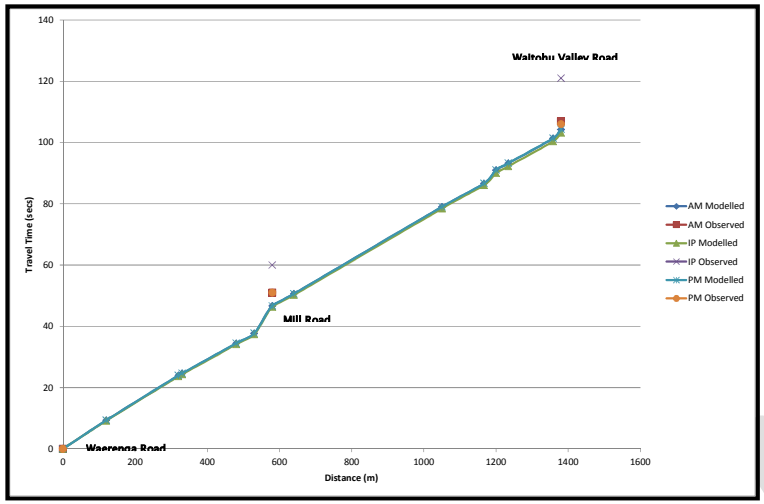

Figure 3.2 KTM2 Northbound, Waerenga Road to Waitohu Valley Road

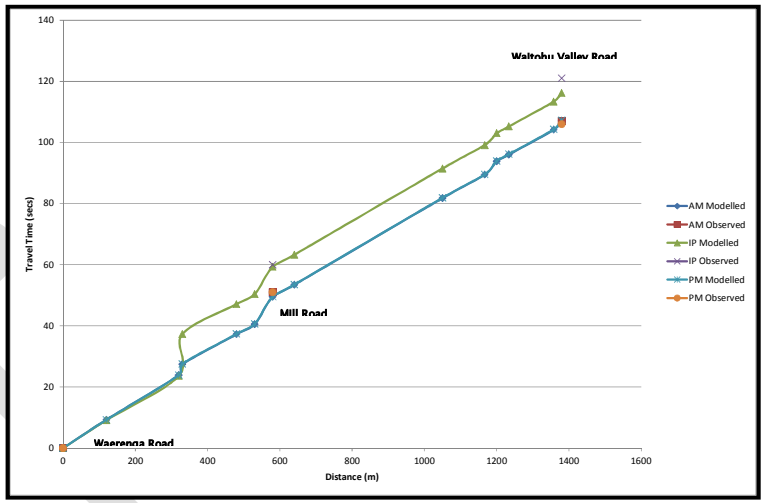

Figure 3.3 KTM2.1 Northbound, Waerenga Road to Waitohu Valley Road

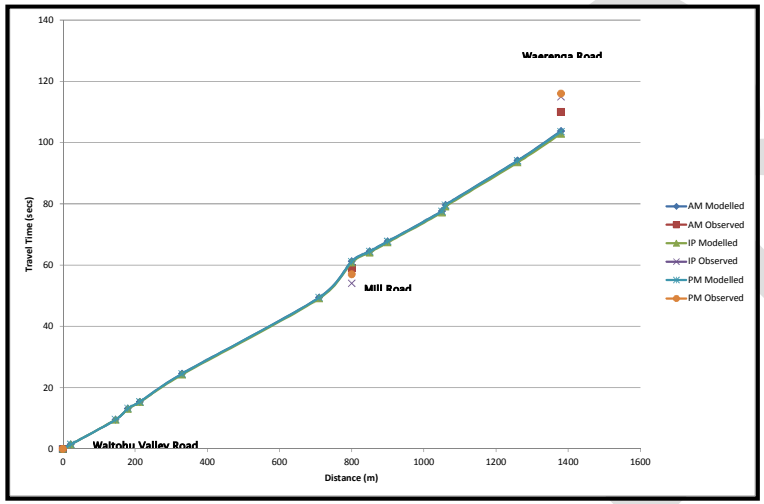

Figure 3.4 KTM2 Southbound, Waitohu Valley Road to Waerenga Road

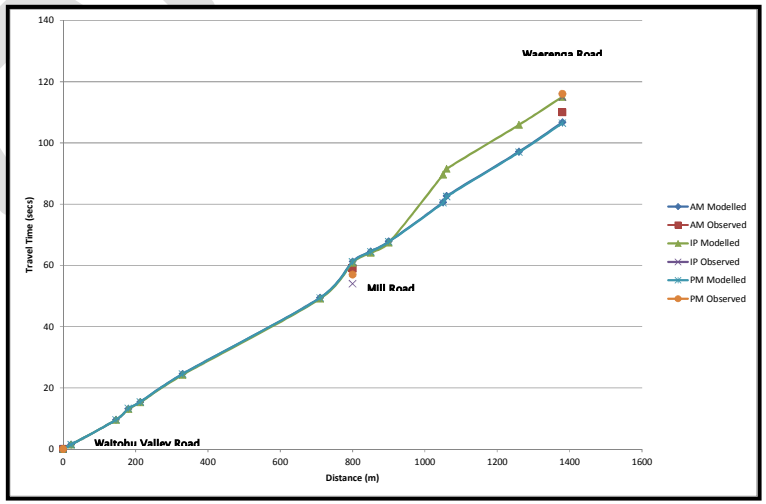

Figure 3.5 KTM2.1 Southbound, Waitohu Valley Road to Waerenga Road

4 M2PP Traffic-related Impacts

As mentioned in the introduction section, one of the key drivers in improving the validation of the KTM2 model in and around Otaki is to retain the integrity of the previous base year model validation in the M2PP area. This section therefore outlines the impacts of the changes in the M2PP area.

The tables presented here are consistent with those outlined in **Section 6** of the Traffic Modelling Report (TMR) and cover:

- 2010 AM Peak hour traffic volumes on SH1, Southbound
- 2010 PM Peak hour traffic volumes on SH1, Northbound
- 2010 Daily traffic volumes on local roads, two-directional

Figure 4.1 shows the location from which base year traffic volumes have been extracted.

Figure 4.1 Location of Traffic Volumes obtained from SH1

Tables 4.1 and 4.2 below show the effects of the KTM2 model revisions, and hence extracted from the KTM2.1 model, on AM and PM peak hour traffic volumes.

Table 4.1 Base Year (2010) AM Peak Hour Vehicle Flows on SH1 (1 hour, Southbound)

		AM Peak hour (8am-9am)		
	Location[3]	KTM2	KTM2.1	Difference
1	South of Peka Peka Road	700	700	0
2	South of Te Moana Road	1,300	1,300	0
3	South of Otaihanga Road	1,100	1,100	0
4	South of Kāpiti Road	1,300	1,300	0
5	South of Poplar Avenue	1,200	1,200	0

Table 4.2 Base Year (2010) PM Peak Hour Vehicle Flows on SH1 (1 hour, Northbound)

		PM Peak hour (5pm-6pm)		
	Location	KTM2	KTM2.1	Difference
1	South of Peka Peka Road	800	800	0
2	South of Te Moana Road	1,400	1,400	0
3	South of Otaihanga Road	1,200	1,200	0
4	South of Kāpiti Road	1,600	1,600	0
5	South of Poplar Avenue	1,600	1,600	0

It can be seen from the tables above there is no material change in the locations on SH1 between Peka Peka Road (in the north) and Poplar Avenue (in the south) between KTM2 and KTM2.1. This demonstrates the network revisions, as outlined **Section 2**, have had no impact on the previous validation in the M2PP. It must be noted, however, the traffic volumes have been rounded to the nearest 100 vehicles so it is likely there will be some minor differences without rounding.

The same conclusion has been drawn from traffic volumes extracted from local roads between MacKays and Peka Peka. This is shown in **Table 4.3** below.

[3] Locations 6 -8 indicated on the map are on the proposed M2PP Expressway therefore not relevant in the 2010 base year.

Figure 4.2 Location of Traffic Volumes obtained from Local Roads

Table 4.3 Base Year (2010) Daily Flow (Vehicles) on Local Roads (two-directional)

		Daily Vehicle Flow		
	Location	KTM2	KTM2.1	Difference
1	Poplar Ave, East of Matai Road	2,500	2,500	0
2	Matai Rd, South of Raumati Road	4,300	4,300	0
3	Raumati Rd, West of Rimu Rd	13,000	13,000	0
4	Rimu Rd, South of Kāpiti Road	19,600	19,600	0
5	Kāpiti Rd, West of SH1	16,200	16,200	0
6	Kāpiti Rd, West of Arawhata Road	24,900	24,900	0
7	Kāpiti Rd, West of Te Roto Drive	15,600	15,600	0
8	Arawhata Rd, North of Kāpiti Road	7,800	7,800	0
9	Te Roto Dr, North of Kāpiti Road	10,300	10,300	0
10	Realm Dr, North of Guildford Drive	2,900	2,900	0
11	Mazengarb Rd, East of Guildford Drive	5,300	5,300	0
12	Ratanui Rd, North of Mazengarb Road	7,200	7,200	0

	Location	Daily Vehicle Flow		
		KTM2	KTM2.1	Difference
13	Otaihanga Rd, West of SH1	6,500	6,500	0
14	Te Moana Rd, West of SH1	10,700	10,700	0
15	Te Moana Rd, West of Walton Avenue	5,200	5,200	0
16	Park Ave, North of Te Moana Road	1,800	1,800	0
17	Paetawa Rd, South of Peka Peka Road	900	900	0
18	Peka Peka Rd, West of SH1	1,100	1,100	0

With no changes in modelled traffic volumes and hence no re-routing effects, differences in travel times have not been reported.

5 Conclusions

This note has outlined the network revisions to the KTM2 model, which have formed **KTM2.1**, and the associated traffic effects (traffic volumes and travel times) in and around the Otaki area and the M2PP area.

The improvements to the network travel times through Otaki town centre, and hence the overall travel time route along SH1 from Waitohu Valley Road (north of Otaki) to Peka Peka Road, have illustrated minor re-routing effects in Otaki town centre and negligible traffic volume differences on other road links in the Otaki area as expected.

In the M2PP area, the revisions have had no impact[4] on traffic volumes on key points along SH1 as well as on selected local roads between MacKays Crossing and Peka Peka.

It is therefore concluded the objective of **Task 1** of the 'KTM2 Updates for PP2O' work package has been met.

[4] For presentation purposes the traffic volumes have been rounded to the nearest 100 vehicles. It is likely there will be some minor differences without rounding but this is not likely to change the conclusion drawn here.

File Note

Date	19 July 2012
Project No	ZB01263
Subject	**Review of the Kapiti Traffic Model (KTM) update**

1. Introduction

This note documents a review of the following file note received from Graham Bell (Beca) by email on Wednesday 18th July 2012

- "KTM2 Base Model Revisions - Summary of Impacts", Ref 3391248

This was supplemented by the following files received from Graham Bell (Beca) by email on Friday 13th July 2012:

Pre re-validation

- AM_Summaries_v30.xlsx
- IP_Summaries_v30.xlsx
- PM_Summaries_v30.xlsx

Post re-validation

- AM_Summaries_KTM2.1.xlsx
- IP_Summaries_KTM2.1.xlsx
- PM_Summaries_KTM2.1.xlsx

As part of the review process, there has been ongoing dialogue via phone and email between Graham Bell and Darren Fidler (SKM), including a draft revision of this document being supplied to Beca, in order to streamline the review process. Specific data in emails referred to in this document are the pedestrian crossing signal times:

- AM / PM Peak hours – 50s green; 10s red
- Average Inter-peak hour – 30s green; 30s red. .

This note utilises the same chapter headings as the Beca file note for ease of reference.

In summary, it is considered that the updated validated KTM2 models are considered appropriate for model outputs to be used for an economic analysis of the proposed Peka Peka to Otaki section of the Northern RoNS without adversely impacting upon the suitability of the model for the assessment of the Mackays to Peka Peka section of the Northern RoNS.

It is noted that the pedestrian signal timings at Arthur Street may have a reasonable impact on travel times as volumes on SH1 increase and so sensitivity tests around

appropriate timings for a puffin crossing (as opposed to a zebra crossing in the base) are recommended.

2. KTM2 Network Revisions

The network revisions described to more closely reflect the average speed through Otaki on SH1 are considered appropriate.

The signal timings used for the Arthur Street pedestrian crossing appear reasonable for a zebra crossing where there is no limit to the number of times that the crossing can effectively be "called". It is recommended however that now that this crossing is a puffin crossing which is likely to have a more limited impact on traffic that it is coded with an appropriate minimum cycle time and crossing red time.

3. Otaki Traffic-related Impacts

The impacts on traffic volumes as a result of the network changes are considered negligible. It is recommended that if traffic levels on Dunstan Street change significantly in the future then the route choice of these vehicles are checked. Given that Dunstan Street is currently at V/C of approximately 10%, the impact of any additional traffic is likely to be insignificant.

The incorporation of delay at the Arthur Street pedestrian crossing has brought the travel times on this section of SH1 in line with observed data. The explicit modelling of the crossing as an intersection delay is considered more appropriate than reflecting this delay through a link speed flow relationship.

4. M2PP Traffic-related Impacts

From the data presented, as expected there are negligible changes between KTM2 and KTM2.1.

5. Conclusions

It is considered that the updated validated KTM2 models are considered appropriate for model outputs to be used for an economic analysis of the proposed Peka Peka to Otaki section of the Northern RoNS without adversely impacting upon the suitability of the model for the assessment of the Mackays to Peka Peka section of the Northern RoNS.

It is noted that the pedestrian signal timings at Arthur Street may have a reasonable impact on travel times as volumes on SH1 increase and so sensitivity tests around the level of this impact are recommended.

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File Note

By:	Graham Bell	**Date:**	31 October 2012
Subject:	KTM2.1 Forecasting – Summary of Impacts	**Our Ref:**	3391248

1 Introduction

This file note outlines a high-level summary of model inputs and assumptions, traffic demands and network performance for the newly created KTM2.1 2021 forecast traffic assignment model.

The forecast model has been developed in the context of **Tasks 2 & 3** of the "KTM2 Updates for PP2O" work package for use by Opus International Consultants (Opus) in their transport appraisal of the Peka Peka to Otaki (PP2O) Expressway. As such, the analysis presented in this note is focussed on the Peka Peka to Otaki corridor.

As KTM2.1 model developers, and not appraisers of the Expressway, the role of the Alliance is to provide Opus with the necessary model inputs and outputs to inform their transport appraisal. Opus have copies of the models and it is expected that the comprehensive AEE-style analysis of the transport effects of the PP2O Expressway will be undertaken and reported by Opus.

The topics which will be covered in this note are:

- Section 2 – Model Inputs and Assumptions
  - Networks, Land Use and Policy
  - Otaki Riverbank Development
  - 2021 Do Minimum and Option Matrices
- Section 3 – Generalised Costs of Travel
- Section 4 – Network Performance Analysis
  - 'Global' Network Statistics
  - Overall Effects on Traffic Flows
  - Journey Times on Selected Routes
- Section 5 – Conclusions

2 Model Inputs and Assumptions

This section describes the key inputs and assumptions used to create the 2021 forecasts in the regional (WTSM) and Project assignment model (KTM2.1).

2.1 Forecast Years

The KTM2.1 model obtains future demand forecasts from the updated (2011 base) WTSM model, rather than the original (2006 base) WTSM model used for KTM2. The updated WTSM and KTM2.1 operate under three forecast years, i.e. 2021, 2031 and 2041, which differs from the years used in KTM2 (2010, 2016 and 2026). Only a high level analysis of the KTM2.1 2021 model outputs are detailed in this note,

2.2 Time Periods

The WTSM model covers the following three time periods for a 'typical' average weekday[1]:

- AM peak – 7am to 9am;
- Inter-peak – 2hr average of 9am to 4pm; and
- Evening peak – 4pm to 6pm.

Holiday and weekend peaks are not directly assessed because there are no available regional models for such periods, and such periods only occur a few times per year and are fairly variable. The travel benefits of the Project in such periods are included through the aggregating process that calculates annual benefits, rather than directly from a model for such periods.

As with the original KTM2, the KTM2.1 traffic model operates with 1-hour long validated peak hours, together with a 1-hour long pre-peak hour that enables delays and suppressed traffic at the end of the pre-peak hour to be 'passed through' to the peak hour assignment. This method ensures that delays are well represented at the start of each peak hour.

During the development of the KTM2 traffic model for the M2PP project, traffic count data across the AM peak and PM peak 2-hour time periods was used to split the WTSM demand appropriately between the Project model pre-peak and peak hours. This same split was assumed for KTM2.1. The time periods for a 'typical' average weekday are as follows:

[1] A 'typical' average weekday covers 'neutral' months of the year (i.e. outside of holiday periods) and excludes weekends. Factors which could influence 'typical' traffic flows and patterns during times of data collection, such as adverse weather conditions, road works etc, are generally avoided.

- AM pre-Peak – 7am to 8am (un-validated);
- AM Peak – 8am to 9am (validated);
- Inter-Peak – 1hr average of 9am to 4pm (validated);
- PM pre-Peak – 4pm to 5pm (un-validated); and
- PM Peak – 5pm to 6pm (validated).

2.3 Vehicle Types

As per KTM2, KTM2.1 assigns two vehicle types to the road network. These are:

- Cars/LCVS combined; and
- HCVs

2.4 WTSM Assumptions

The following sub-section details the specific WTSM (2011-based) inputs and assumptions that have been used in terms of networks, land use and policy.

2.4.1 Do Minimum Assumptions

The Do Minimum scenario represents the minimum investment needed in the study corridor to maintain operations and hence represents the 'no Project' case. It is however assumed to include new Projects and upgrades outside of the study area, and these assumptions are assumed to be common to both the 'no Project' and 'Project' scenarios.

Reference should be made to Greater Wellington Regional Council's (GWRC) technical note "*TN23 Future Year Base Networks and Services FINAL, August 2012*" for a full list of road and public transport infrastructure assumptions that have been used for the regional demand model.

All Wellington RoNS schemes are assumed to be in the Do Minimum networks with the exception of the Peka Peka to Otaki Expressway. Therefore, the only differences between the Do Minimum and Option network is the Peka Peka to Otaki Expressway. See **Table 2.1** below.

Table 2.1 Do Minimum WTSM RoNS Traffic Schemes

RoNS Traffic Scheme	2021	2031	2041
Otaki to north of Levin[2]	×	✓	✓

[2] It is understood Otaki to north of Levin is not in the WTSM modelled area but presumably acting as an external route zone. As such, the presence of that project is not expected to have much impact on the WTSM demands.

Peka Peka to Otaki (PP2O)	×	×	×
MacKays to Peka Peka (M2PP)	✓	✓	✓
Linden to MacKays (Transmission Gully)	×	✓	✓
Ngauranga to Aotea Quay (NtAQ)	✓	✓	✓
Terrace Tunnel Duplication	×	✓	✓
Basin Reserve	✓	✓	✓
Airport to Mt Victoria Tunnel	×	✓	✓
Other	**2021**	**2031**	**2041**
Petone to Grenada link road	×	✓	✓

2.4.2 Option Networks

The following was assumed for the Option networks:

- 2021 – Do Minimum plus Peka Peka to Otaki Expressway;
- 2031 – Do Minimum plus Peka Peka to Otaki Expressway; and
- 2041 – Do Minimum plus Peka Peka to Otaki Expressway.

2.4.3 Land Use

The WTSM land use forecasts that have been used in creating the KTM2.1 forecast traffic demand matrices are outlined below. The forecasts presented are specific to the KTM2.1 modelled area, i.e. covering the Kāpiti Coast District.

Growth forecasts are presented for population, households and employment in **Table 2.2** covering the "Medium" growth scenario. These datasets, in particular population, are the key drivers in determining the demand for travel.

Table 2.2 WTSM Land Use Forecasts for KTM2.1 Modelled Area

Year	Population	% Growth cf. 2011	Households	% Growth cf. 2011	Employment	% Growth cf. 2011
2011	49,085	-	20,283	-	15,206	-
2021	54,022	10%	23,056	14%	16,242	7%
2031	58,854	20%	25,539	26%	17,047	12%
2041	62,732	28%	27,608	36%	18,170	19%

It can be seen from **Table 2.2** the growth in the number of households between 2011 and 2041 is consistently greater than the growth in population during the same period. This is likely due to a number of demographic reasons such as:

- An increasing percentage of the population forecast to be at or above retirement age in the future (and assumed to be in 1 or 2 person dwellings);
- Reduced birth rates; and
- An increase in the number of single parent families and people living alone.

This divergence trend between household and population growth rates in the future is an acknowledged trend across the western world and within New Zealand[3].

Figures 2.1-2.3 illustrate this growth on an area-specific basis for internal model zones only, i.e. no external route zone growth is presented in the figures.

2.4.4 Area-specific Growth Forecasts

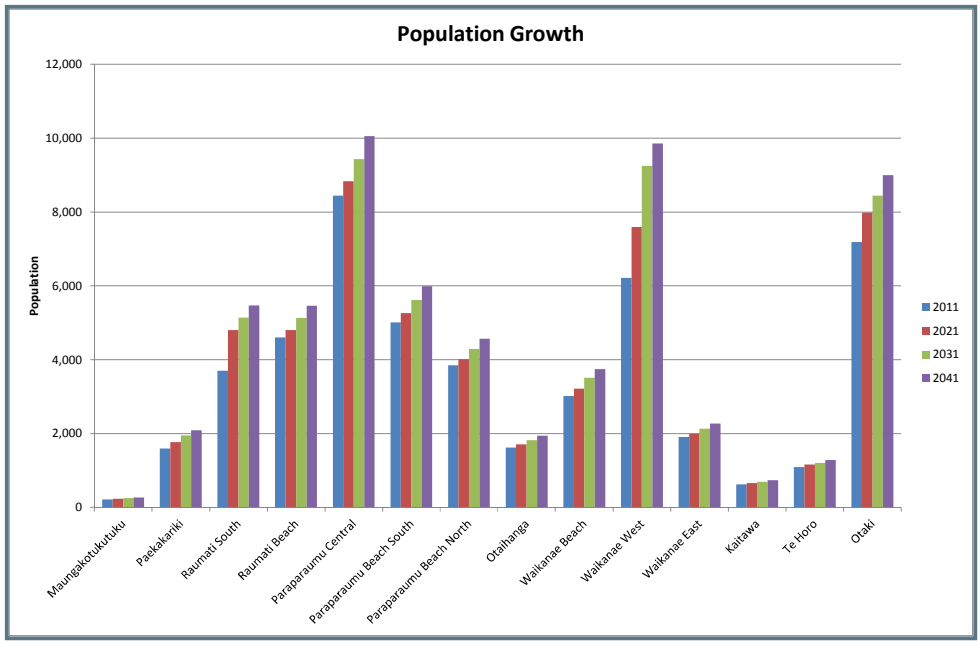


Figure 2.1: Population Growth by Area

It can be seen from **Figure 2.1** the largest population centres are Paraparaumu, Waikanae and Otaki. Population numbers for these areas are forecast to increase over time and this positive trend is consistent with the forecasts used in KTM2. Furthermore, all other areas show an increase in population over time with the principal centres showing the largest increase, in particular Waikanae.

[3] http://www.stats.govt.nz/browse_for_stats/population/estimates_and_projections/demographic-trends-2009/chapter9.aspx

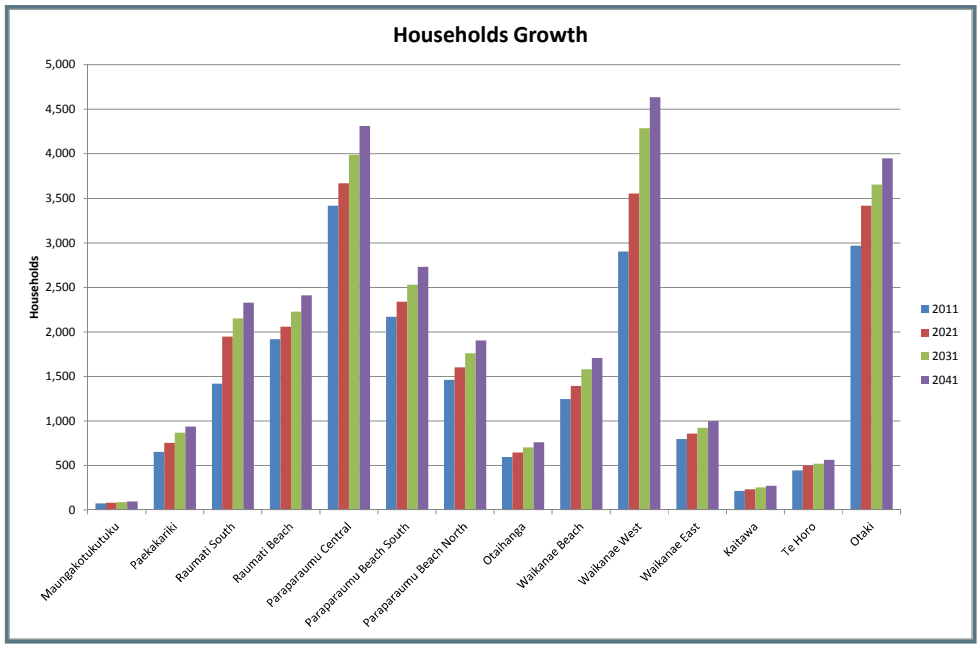


Figure 2.2: Households Growth by Area

Figure 2.2 shows a similar trend to that shown for population growth. Paraparaumu, Waikanae and Otaki are the principal centres and as expected these areas show the largest number of households within the modelled area. The figure also shows positive growth in all areas, with Maungakotukutuku, Kaitawa and Te Horo showing the least amount of growth over the thirty year horizon.

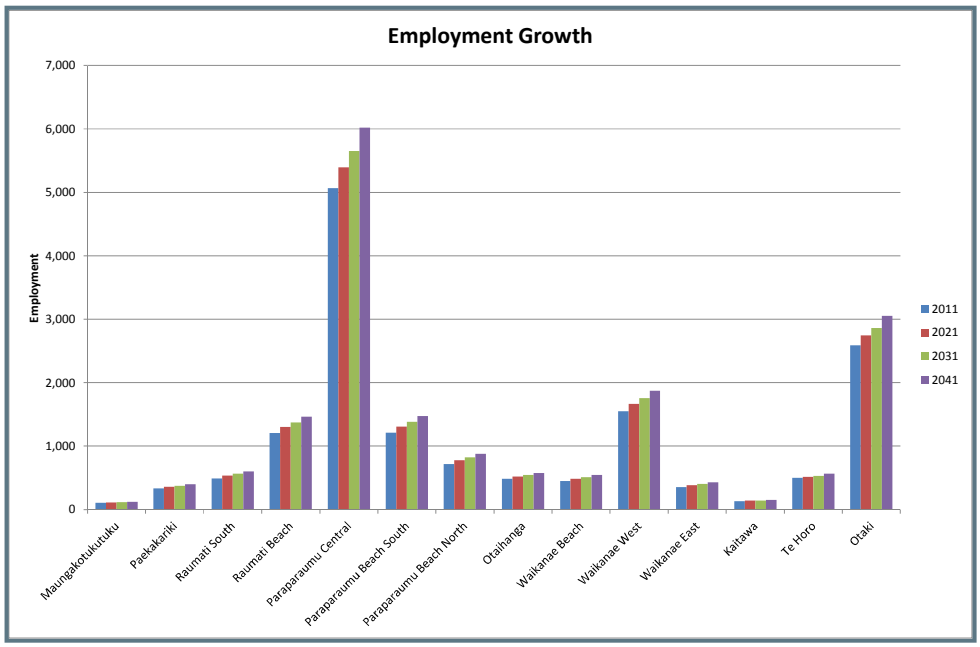


Figure 2.3: Employment Growth by Area

It can be seen from **Figure 2.3** the largest employment centre is Paraparaumu Central with Waikanae West and Otaki the other dominant employment areas. All other areas are broadly similar in terms of size and projected growth. Once again, like population and household growth, all areas, with the exception of Maungakotukutuku and Kaitawa which are effectively flat-lining, experience positive growth over the thirty year horizon.

Figures 2.1 to 2.3 have outlined WTSM demographic growth on an area-specific basis throughout the KTM2.1 modelled area; this growth being a key driver in determining trips on the road network. Given the strategic level in which WTSM operates, it is unlikely that WTSM will be reflecting trips to and from more detailed developments in the region, such as the Riverbank development in Otaki. With this in mind, the level of trip making to and from the Riverbank development has been adjusted to reflect the detailed natured that is not captured in WTSM. Trip generation assumptions and traffic volume output associated with this development are outlined later in this section.

2.4.5 Fuel Price

Reference should be made to Greater Wellington Regional Council's (GWRC) technical note "*TN15 Input Parameters, August 2012*."

2.4.6 Travel Demand Management

Reference should be made to **Section 4** of Greater Wellington Regional Council's (GWRC) technical note "*TN23 Future Year Base Networks and Services FINAL, August 2012*."

2.5 Project Assignment Model Assumptions

2.5.1 Land Use

The land use is identical between the Option and Do Minimum versions of the Project model. A variable trip matrix method has been used to model the impacts of induced traffic, and consequently the Do Minimum trip matrices will differ from the Option trip matrices. The variable trip matrix approach is described in more detail in **Chapter 5** and **Appendix G** of the M2PP "*Traffic Modelling Report, December 2011*."

2.5.2 Do Minimum Networks

Although the Project assignment model uses broadly the same network assumptions as the WTSM model, it also includes additional smaller scale local Projects. Reference should be made to **Section 4** of the M2PP "*Traffic Modelling Report, December 2011*" for more details.

2.6 Otaki Riverbank Development

Opus provided the Alliance with trip generation data for the Riverbank development, situated directly to the north of the river and accessed off Riverbank Road. This data is current and was used in previous work relating to this project.

In order to incorporate this information into KTM2.1 the following method was used which remains consistent with the M2PP KTM2 model:

- Factor down trip generation figures by 50% for Riverbank, to ensure consistency with the 'Composite' growth approach used for other known development within Kāpiti District;
- Assuming that the development will be complete by 2031, 59% has been assumed to be complete by 2021. In the absence of more up-to-date details surrounding the likely 'phasing' of the development, this has been simply calculated from linearly interpolating between the assumed 34% completion by 2016 and 84% completion by 2026 (as used in KTM2); and
- The distribution of new cars/LCVs and HCV trips was taken from the existing trip distribution found in Zone 180. This zone having similar land-use characteristics.

Table 2.3 below shows the number of trips added to the 2021 traffic demand matrices (Do Minimum and Option) to account for the Riverbank development (using the 'Composite' growth approach).

Table 2.3 Trip Generation for Riverbank Development, 2021

	Inbound			Outbound		
Time Period	Cars/LCVs	HCVs (veh)	Total	Cars/LCVs	HCVs (veh)	Total
AM Peak Hour	60	13	**73**	26	7	**32**
Average Inter-peak Hour	28	14	**42**	28	14	**42**
PM Peak Hour	28	7	**35**	58	13	**71**
All day	364	135	**499**	364	135	**499**

2.7 2021 Do Minimum and Option Matrices

Each modelled time period has a corresponding Do Minimum (without Expressway) and Option (with Expressway) matrix, split by vehicle type, i.e. Cars/LCVs combined and HCVs.

As previously mentioned, a variable trip matrix method has been used to model the impacts of induced traffic, and consequently the Do Minimum trip matrices will differ from the Option trip matrices.

In order to gain an understanding of the effects of the variable demand procedures, the total Car/LCV traffic demand for both the Do Minimum and Option scenarios have been compressed to a 13-sector system; sector system shown in **Figure 2.4.**

Tables 2.4 to 2.6 show the total Car/LCV traffic demand differences. Sector-to-sector movements which illustrate a change (positive or negative) are highlighted; blue for positive, red for negative.

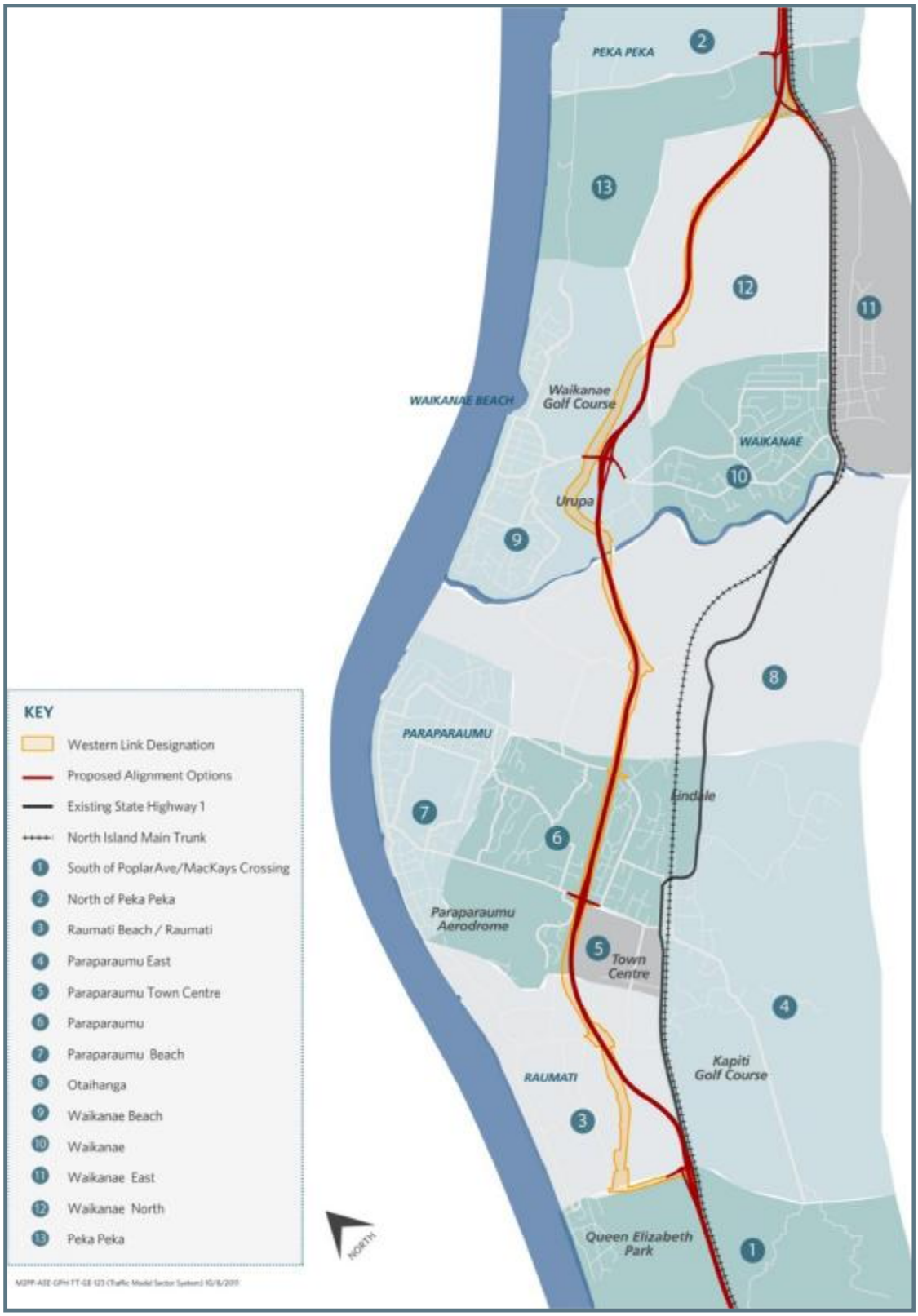


Figure 2.4: 13-Sector System

Table 2.4 Total Car/LCV Traffic Demand Differences, AM Peak Hour, 2021 Option cf. Do Minimum

	South of Poplar Avenue / MacKays Crossing	North of Peka Peka	Raumati Beach / Raumati	Paraparaumu East	Paraparaumu Town Centre	Paraparaumu	Paraparaumu Beach	Otaihanga	Waikanae Beach	Waikanae	Waikanae East	Waikanae North	Peka Peka	**Total**
South of Poplar Avenue / MacKays Crossing	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
North of Peka Peka	0%	-2%	1%	1%	0%	-1%	0%	1%	-2%	0%	0%	-1%	0%	-1%
Raumati Beach / Raumati	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Paraparaumu East	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Paraparaumu Town Centre	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Paraparaumu	0%	-1%	0%	-1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Paraparaumu Beach	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Otaihanga	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Waikanae Beach	0%	-2%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Waikanae	0%	0%	0%	0%	0%	0%	0%	-1%	0%	0%	-1%	0%	0%	0%
Waikanae East	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Waikanae North	0%	-1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Peka Peka	0%	-2%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Total	0%	-1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Table 2.5 Total Car/LCV Traffic Demand Differences, Inter-peak hour, 2021 Option cf. Do Minimum

	South of Poplar Avenue / MacKays Crossing	North of Peka Peka	Raumati Beach / Raumati	Paraparaumu East	Paraparaumu Town Centre	Paraparaumu	Paraparaumu Beach	Otaihanga	Waikanae Beach	Waikanae	Waikanae East	Waikanae North	Peka Peka	**Total**
South of Poplar Avenue / MacKays Crossing	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
North of Peka Peka	0%	-2%	2%	2%	1%	0%	2%	1%	-2%	0%	0%	-1%	-5%	-2%
Raumati Beach / Raumati	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Paraparaumu East	0%	2%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Paraparaumu Town Centre	0%	-1%	0%	0%	0%	0%	0%	0%	-1%	0%	0%	0%	0%	0%
Paraparaumu	0%	-1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Paraparaumu Beach	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Otaihanga	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Waikanae Beach	0%	-3%	0%	0%	0%	0%	0%	-1%	0%	0%	0%	0%	0%	0%
Waikanae	0%	0%	0%	0%	0%	0%	0%	-1%	0%	0%	0%	0%	0%	0%
Waikanae East	0%	0%	0%	0%	0%	0%	0%	0%	0%	-1%	0%	-1%	0%	-1%
Waikanae North	0%	-2%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Peka Peka	0%	-3%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Total	0%	-2%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	-1%	0%

Table 2.6 Total Car/LCV Traffic Demand Differences, PM Peak hour, 2021 Option cf. Do Minimum

	South of Poplar Avenue / MacKays Crossing	North of Peka Peka	Raumati Beach / Raumati	Paraparaumu East	Paraparaumu Town Centre	Paraparaumu	Paraparaumu Beach	Otaihanga	Waikanae Beach	Waikanae	Waikanae East	Waikanae North	Peka Peka	**Total**
South of Poplar Avenue / MacKays Crossing	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
North of Peka Peka	0%	-2%	2%	1%	1%	0%	1%	1%	-2%	0%	1%	-1%	-4%	-1%
Raumati Beach / Raumati	0%	1%	0%	-1%	0%	1%	0%	0%	-1%	0%	0%	-1%	0%	0%
Paraparaumu East	0%	1%	0%	0%	0%	2%	1%	0%	-1%	0%	0%	-1%	0%	0%
Paraparaumu Town Centre	0%	-1%	0%	-1%	0%	1%	1%	0%	-2%	0%	0%	-1%	-1%	0%
Paraparaumu	-1%	-1%	1%	3%	3%	2%	0%	0%	-1%	0%	0%	0%	0%	1%
Paraparaumu Beach	-1%	1%	0%	2%	3%	1%	0%	0%	0%	0%	0%	0%	0%	1%
Otaihanga	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Waikanae Beach	0%	-2%	1%	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Waikanae	0%	-1%	0%	0%	0%	0%	0%	-1%	0%	0%	0%	0%	0%	0%
Waikanae East	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Waikanae North	0%	-1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Peka Peka	0%	-2%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Total	0%	-1%	0%	0%	1%	1%	0%	0%	0%	0%	0%	0%	-1%	0%

It can be seen from **Tables 2.4 to 2.6** there is, on the whole, a small reduction (circa 1%-2%) in the number of Car/LCV trips to and from the North of Peka Peka sector to all other sectors between Peka Peka and MacKays Crossing in the Option demand matrices when compared to the Do Minimum. This is somewhat counter-intuitive.

As will be discussed next in **Section 3** however, the reductions in the Option demand are related to reduced connectivity for a selection of modelled zones north of Peka Peka Road and south of SH1 Otaki River crossing resulting in travel cost changes (increases) and subsequent demand changes.

3 Generalised Costs of Travel

With the introduction of the proposed Expressway, some local road movements between Peka Peka Road and the SH1 Otaki River crossing experience increases in generalised cost of travel; this is most prevalent in the Inter-Peak and PM time periods as can be seen above in **Tables 2.5 and 2.6**. The main reasons for this are outlined below.

Three existing local road intersections with SH1 in the Te Horo and Otaki Gorge areas will become longer once the Expressway is in place. This is mainly due to the existing SH1 effectively becoming more of a local road because strategic through-trips currently using SH1 are likely to 'switch' onto the proposed Expressway. The existing SH1 will lie just west of the Expressway and hence accessibility will also decrease to areas east of the Expressway.

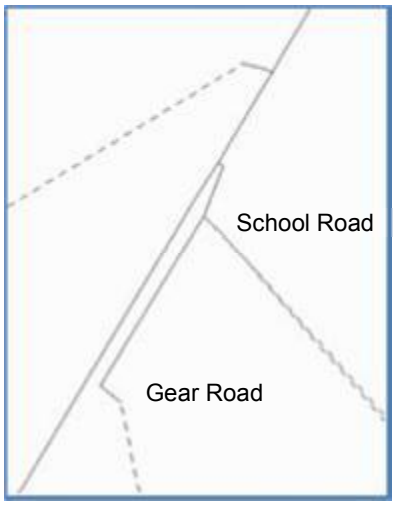
The three intersections which will be affected are:

- SH1 / School Road (Gear Road) in Te Horo;
- SH1 / Old Hautere Road; and
- SH1 / Otaki Gorge Road, just south of the Otaki Gorge.

In the Base and Do Minimum scenarios, these intersections are 'priority' which branch off to the east of SH1. With the Expressway in place (Option network), the current direct access to SH1 from School Road, Old Hautere Road and Otaki Gorge Road, will become longer since these roads will essentially be extended, passing over the Expressway and existing SH1. This is shown below in **Figure 3.1**.

The existing travel times between Gear Road / School Road intersection and the access point to the existing SH1 increases from **9 seconds** in the Do Minimum to **105 seconds** in the Option scenario.

Do Minimum, SH1 / School Road



Option (with Expressway), SH1 / School Road

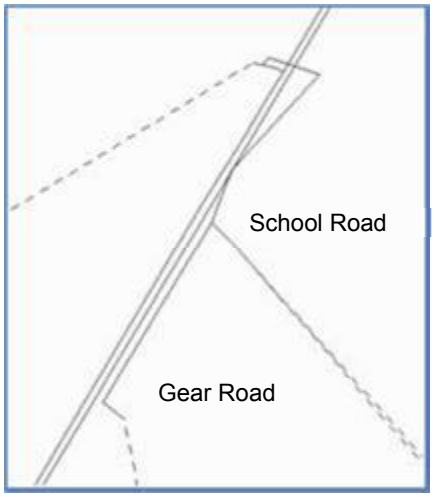
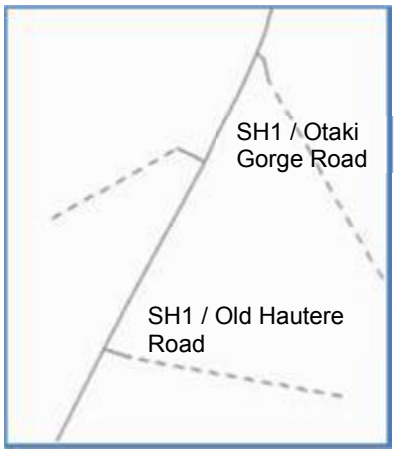


Figure 3.1 SH1 / School Road Connectivity, Do Minimum and Option Scenarios

Likewise, the travel times from Old Hautere Road to the existing SH1 goes from **2 seconds** in the Do Minimum to **104 seconds** in the Option scenario. The connectivity differences are shown below in **Figure 3.2**.

Do Minimum, SH1 / Old Hautere Road



Option (with Expressway), SH1 / Old Hautere Road

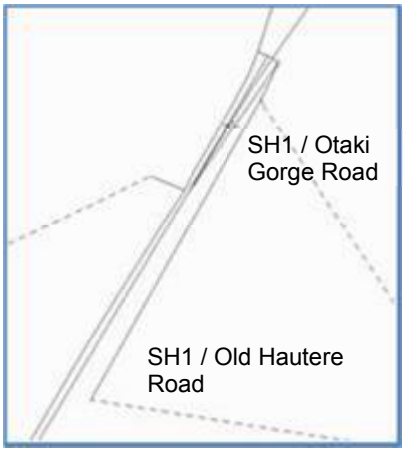


Figure 3.2 SH1 / Old Hautere Road Connectivity, Do Minimum and Option Scenarios

Therefore, in both cases, there is a measurable increase in distance and travel time to access SH1 for trips to and from these roads when comparing the Do Minimum and Option scenarios. This contributes to the increase in generalised cost for such movements once the Expressway is in place.

4 Network Performance Analysis

This section provides an overview of the 2021 network conditions covering 'global' network statistics, overall effects on traffic volumes including daily traffic volumes on key links north and south of Otaki, and journey times.

4.1 Global Network Statistics

Tables 4.1 to 4.3 show the following 'global' network characteristics for each modelled time period:

- Traffic demand;
- Travel Time;
- Vehicle Kilometres;
- Transient delays[4];
- Over-capacity delays[5]; and
- Average simulation network speed.

The scenarios for which this information is presented are:

- Base Year (2010);
- Do Minimum (2021); and
- Option (2021).

Differences between the two future scenarios and the Base are presented to give an indication of the extent to which traffic conditions change between the Base year and future year scenarios.

Table 4.1 AM Peak Hour Network Statistics

Item	Vehicle Class	2010 Base	2021 Do Minimum	% Do Minimum cf. Base	2021 Option	% Option cf. Base
Demand (pcus)	Cars/LCVs	11,272	13,831	23%	13,793	22%
	HCVs	1,494	1,790	20%	1,790	20%
Travel Time (pcu.hrs)	Cars/LCVs	1,173.3	1,343.9	15%	1,342.1	14%
	HCVs	185.2	261.4	41%	262.1	42%
Vehicle KMs	Cars/LCVs	70,261	83,137.9	18%	84,165.4	20%

[4] Transient delays (or queues) correspond to the time spent queuing during the red phase by vehicles which then depart during the green phase.

[5] Over-capacity delays (or queues) correspond to turning movements in excess of capacity where a permanent queue builds up and is unable to clear in a single cycle.

(pcu.km)	HCVs	12,130.1	19,716	63%	19,996.7	65%
Transient Delays (pcu.hrs)	Cars/LCVs	167.9	199.4	19%	194.3	16%
	HCVs	23.8	25.1	5%	24.1	1%
Over-capacity Delays (pcu.hrs)[6]	Cars/LCVs	1.3	0	<100%	0	<100%
	HCVs	0.1	0	<100%	0	<100%
Average Network Speed (kph)	Cars/LCVs	59.9	61.9	3%	62.7	5%
	HCVs	65.5	75.4	15%	76.3	16%

Table 4.2 Inter-peak Network Statistics

Item	Vehicle Class	2010 Base	2021 Do Minimum	% Do Minimum cf. Base	2021 Option	% Option cf. Base
Demand (pcus)	Cars/LCVs	9,645	11,782	22%	11,751	22%
	HCVs	1,412	1,723	22%	1,723	22%
Travel Time (pcu.hrs)	Cars/LCVs	886.1	1,076.4	21%	1,073.5	21%
	HCVs	167.9	242.6	44%	243.5	45%
Vehicle KMs (pcu.km)	Cars/LCVs	54,211.5	63,947.6	18%	64,714.4	19%
	HCVs	11,390.7	18,194.9	60%	18,469.1	62%
Transient Delays (pcu.hrs)	Cars/LCVs	115.1	176.5	53%	171.8	49%
	HCVs	18.9	23.9	26%	22.9	21%
Over-capacity Delays (pcu.hrs)[7]	Cars/LCVs	0	4.1	>100%	3.8	>100%
	HCVs	0	0.2	>100%	0.2	>100%

[6] The AM peak Base Year over-capacity delay is associated with the Poplar Avenue / SH1 priority intersection at the southern end of the model. The right-turn delay from Poplar Avenue onto SH1 and heading south is 3 minutes. In the 2021 forecast year, this is where the M2PP Expressway southern 'tie-in' lies, in both the Do Minimum and Option scenarios, and the Poplar Avenue / SH1 intersection becomes a roundabout. With the effect of the Expressway removing traffic from the existing SH1 and the roundabout coming into effect, this reduces the turn delay for this movement to a few seconds and hence no over-capacity delay in the 2021 Do Minimum.

[7] The Inter-Peak Do Minimum and Option over-capacity delay is related to the Kāpiti Road / Rimu Road intersection. A test was carried out which increased the green time for the right-turn from Kāpiti Road into Rimu Road by 7 seconds (stage 2) and reduced the left-turn from Kāpiti Road into Rimu Road (stage 1) by 7 seconds. The results of this test removed the over-capacity delay and made minor changes to link flows. It was concluded that there was no merit in re-running and re-issuing the assigned forecast networks because the changes in network flows were very minor, both in the immediate vicinity and further afield. Therefore, for consistency purposes, the network statistics presented in **Tables 4.1 - 4.3** relate to the assignments which Opus are using in their transport assessment and **not** the results of this test.

Average Network Speed (kph)	Cars/LCVs	61.2	59.4	-3%	60.3	-1%
	HCVs	67.8	75.0	11%	75.8	12%

Table 4.3 PM Peak Network Statistics

Item	Vehicle Class	2010 Base	2021 Do Minimum	% Do Minimum cf. Base	2021 Option	% Option cf. Base
Demand (pcus)	Cars/LCVs	12,439	15,178	22%	15,180	22%
	HCVs	941	1,163	24%	1,163	24%
Travel Time (pcu.hrs)	Cars/LCVs	1,336.2	1,462.1	9%	1,457.9	9%
	HCVs	106.2	178.5	68%	180	69%
Vehicle KMs (pcu.km)	Cars/LCVs	77,614.3	90,070.4	16%	91,268	18%
	HCVs	6,516.9	13,725.7	111%	13,940	114%
Transient Delays (pcu.hrs)	Cars/LCVs	208.9	226.7	9%	217.8	4%
	HCVs	16.1	16.8	4%	16.1	0%
Over-capacity Delays (pcu.hrs)	Cars/LCVs	0	0	0%	0	0%
	HCVs	0	0	0%	0	0%
Average Network Speed (kph)	Cars/LCVs	58.1	61.6	6%	62.6	8%
	HCVs	61.4	76.9	25%	77.4	26%

The following can be concluded from the tables above:

- The demand change between the Base and future Do Minimum is around 23% at a matrix level for car and HCVs across all three time periods;
- The levels of total demand assigned to the Do Minimum and Option networks are effectively the same. This demonstrates the in-elastic nature of the elastic assignment procedures and demonstrates the road assignment is more akin to a fixed-trip assignment;
- The level of transient delays increase dramatically between the Base and Do Minimum, signifying increased levels of congestion;
- The Option results in a reduction in delays and a slight decrease in travel times; and
- The Option results in improved average network speeds.

The conclusions drawn here are in line with expectations.

4.2 Overall Effects on Traffic Flows

Figure 4.1 and **Figure 4.2** show the predicted changes in daily traffic volumes between the Do Minimum and Option in 2021 in and around Otaki and along the PP2O corridor

respectively. Positive (green) shows where the traffic is predicted to increase compared to the Do Minimum with negative (blue) indicating where traffic is expected to decrease.

It is not possible to present comparisons where the network differs. Therefore, in this instance, flows along the Expressway (which would be positive) cannot be displayed. What can be seen is the magnitude of the change in volumes along SH1 as a result of opening the Expressway.

These diagrams are provided to show an overview of the changes in traffic volumes across the network. 2021 daily traffic volumes on key roads are shown in **Table 4.5**.

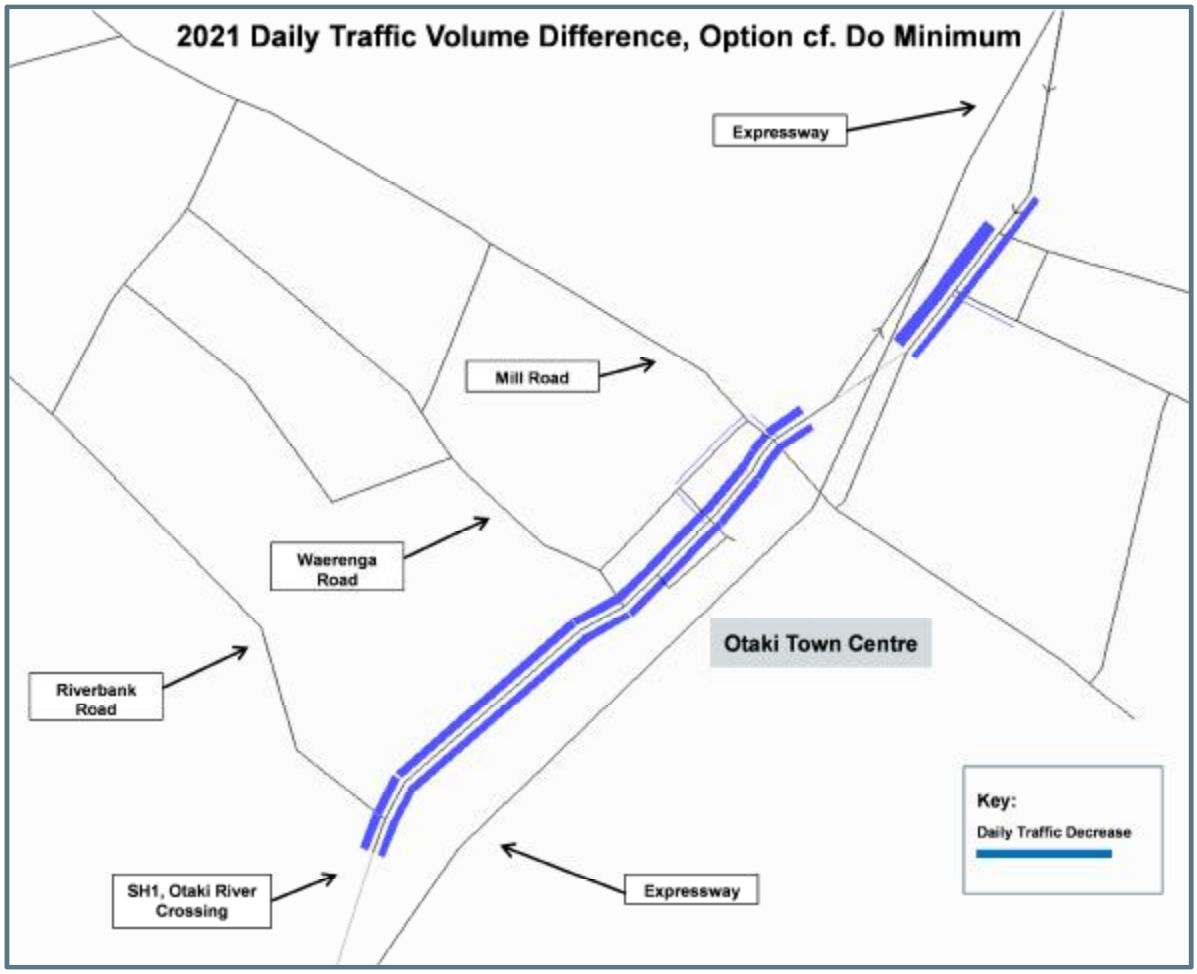


Figure 4.1 2021 Daily Traffic Volume Difference in Otaki, Option cf. Do Minimum

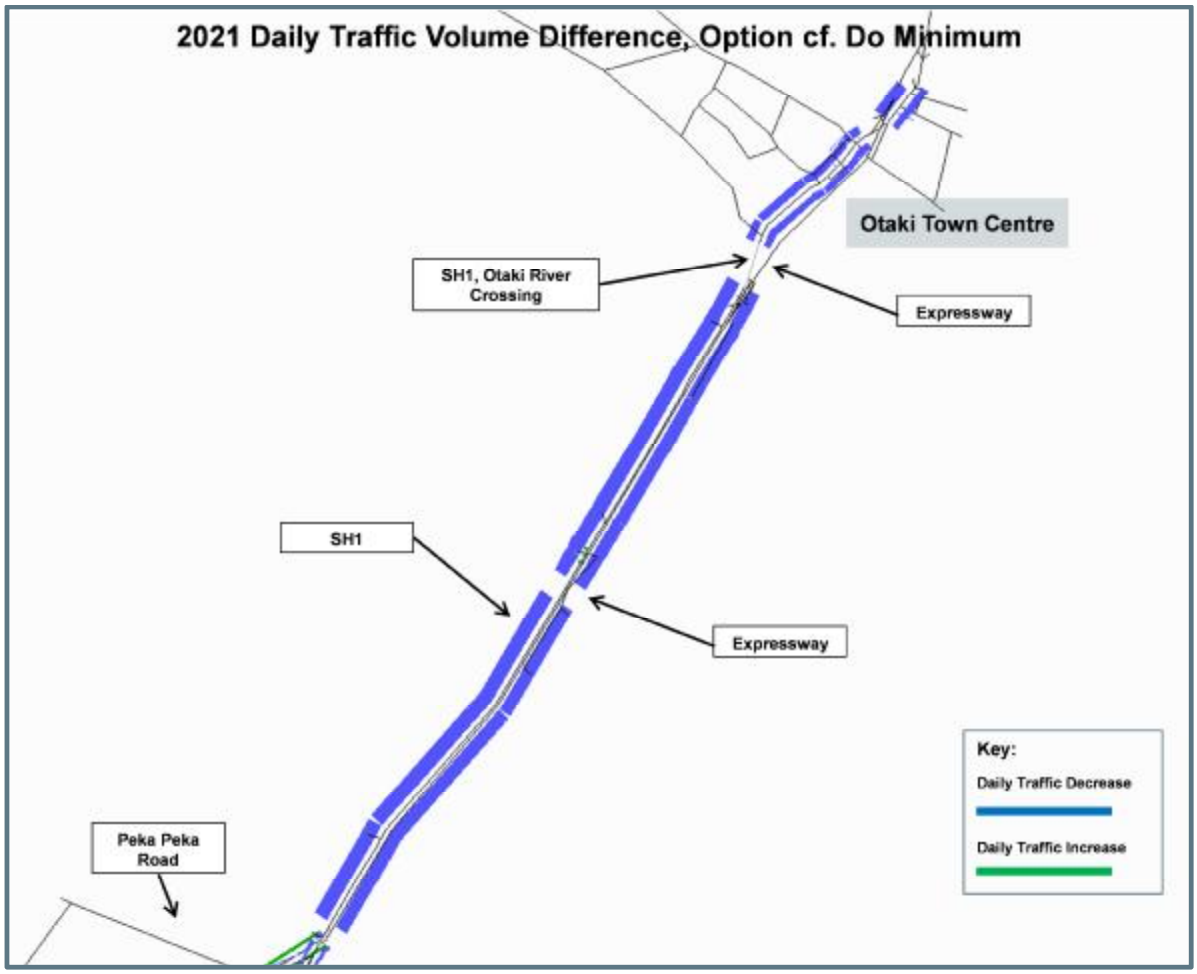


Figure 4.2 2021 Daily Traffic Volume Difference along PP2O Corridor, Option cf. Do Minimum

4.3 Daily Traffic Volumes

Daily volumes have been calculated for five key links within the study area and are presented in **Table 4.5**. The five locations are:

- SH1, just north of Peka Peka Road;
- SH1, just south of Otaki (SH1, Otaki River crossing);
- SH1, north of Otaki (Taylors Road);
- Expressway, just north of Peka Peka Road; and
- Expressway, just south of Otaki (Otaki River crossing).

Factors to translate from peak hour modelled volumes to daily are listed below in **Table 4.4** and these were created during the development of M2PP KTM2 model. A more detailed note describing their derivation can be found in **Appendix** C of the M2PP "*Traffic Modelling Report, December 2011*."

Table 4.4 Daily Factors (Car/LCVs and HCVs)

Modelled Hour	Car/LCVs	HCVs
AM Peak Hour	1.86	1.76
Average Inter-peak Hour	9.93	13.57
PM Peak Hour	1.99	2.5

Table 4.5 Daily Traffic Volumes, 2021

Direction	Location	Base (2010)	Do Minimum	%Diff DM cf. Base	Option	% Diff Option cf. DM
NB	SH1, just north of Peka Peka Road	8,300	10,700	29%	2,100	-80%
	SH1, Otaki River Crossing	7,200	9,500	32%	4,800	-49%
	SH1, just north of Taylors Road	6,000	7,400	23%	7,500	1%
	Expressway, just north of Peka Peka Road	0	0	-	8,600	-
	Expressway, Otaki River Crossing	0	0	-	4,800	-
SB	SH1, just north of Peka Peka Road	7,600	9,500	25%	1,900	-80%
	SH1, Otaki River Crossing	7,100	9,000	27%	4,900	-46%
	SH1, just north of Taylors Road	5,600	7,100	27%	7,200	1%
	Expressway, just north of Peka Peka Road	0	0	-	7,700	-
	Expressway, Otaki River Crossing	0	0	-	4,200	-
Combined	SH1, just north of Peka Peka Road	15,900	20,200	27%	4,000	-80%
	SH1, Otaki River Crossing	14,300	18,500	29%	9,700	-48%
	SH1, just north of Taylors Road	11,600	14,500	25%	14,700	1%
	Expressway, just north of Peka Peka Road	0	0	-	16,300	-
	Expressway, Otaki River Crossing	0	0	-	9,000	-

The following comments can be drawn from **Table 4.5**:

- Daily traffic volumes (combined directions) increase between 25% and 29% between the Base and Do Minimum scenarios;
- SH1, just north of Taylor Road shows a 25% increase in daily traffic volume (combined directions) between the Base and the 2021 Do Minimum; the Option effectively results in parity at this location (+1%) when compared to the Do Minimum;
- The Option results in an 80% reduction in daily traffic volume along SH1 just north of Peka Peka Road and a 48% reduction along SH1 at the Otaki River crossing, with traffic diverting onto the Expressway; and
- Effectively parity is shown when the combined volumes on SH1 and the Expressway, both at Peka Peka Road and Otaki River Crossing, are analysed for the Do Minimum and Option. This further demonstrates the in-elastic nature of the elastic assignment procedures.

Figure 4.3 below displays the 2010 and 2021 data graphically, showing an increase in traffic between the base year (2010) and the 2021 Do Minimum, followed by a reduction between the 2021 Do Minimum and Option as a result of the opening of the Expressway.

This trend however is not evident on SH1 just north of Taylors Road and this is because the Expressway northern 'tie-in' is situated just south of this location. Hence, the network effectively returns to the Do Minimum state at this location.

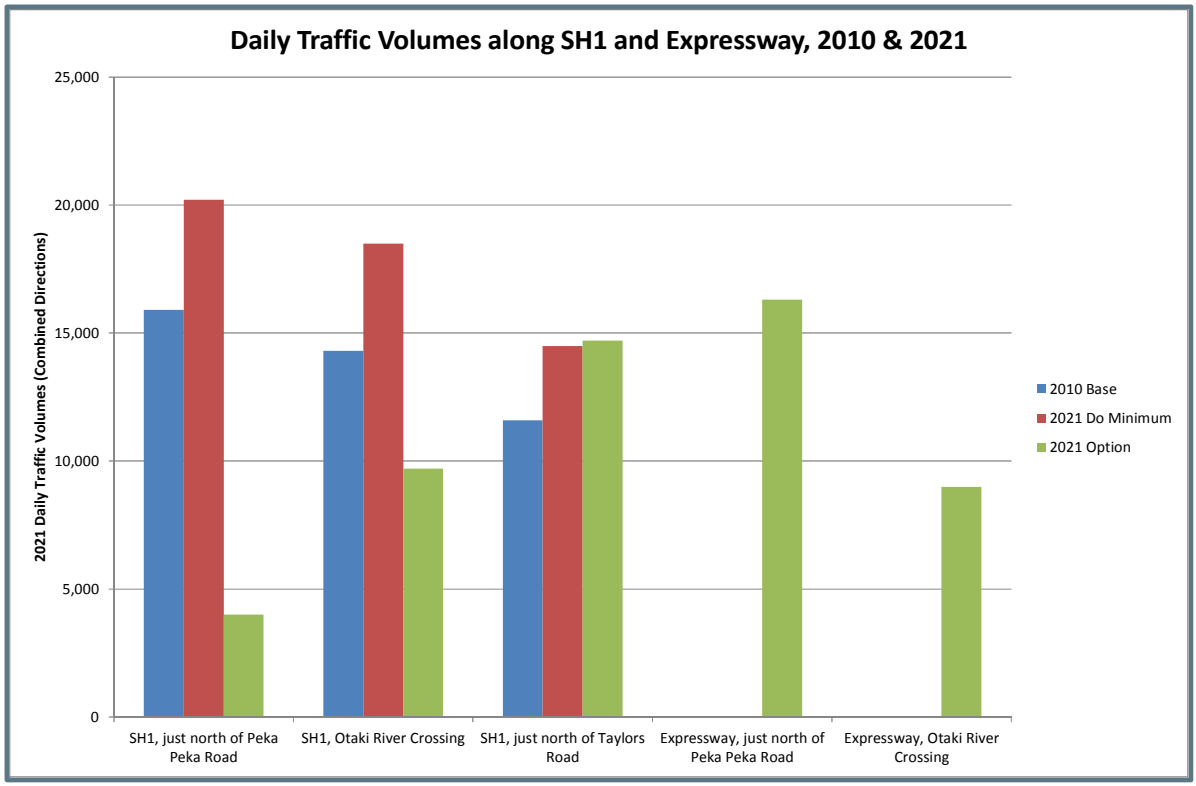


Figure 4.3 Daily Traffic Volumes (combined directions), 2010 & 2021

The trends in daily traffic volumes shown above are in line with expectations.

4.4 Journey Times on Selected Routes

Journey times along the following two parallel routes have been extracted for all scenarios in order to understand the effects of (a) increased traffic demand over time, (b) the effect of the Expressway on SH1 journey times, and (c) the benefit of the using the Expressway over SH1:

- Existing SH1 – Taylors Road (Otaki) to Peka Peka Road; and
- Proposed Expressway – Taylors Road (Otaki) to Peka Peka Road

Table 4.6 Journey Time (minutes) Summary, 2010 & 2021

Time Period	Direction	Route	Base (2010)	Do Minimum	Option
AM Peak	NB	SH1	9.6	9.8	9.3
		Expressway	-	-	7.8
	SB	SH1	9.6	11.6	9.7
		Expressway	-	-	9.4
Inter Peak	NB	SH1	9.7	9.7	9.4
		Expressway	-	-	7.8
	SB	SH1	9.7	11.3	9.8
		Expressway	-	-	9.4
PM Peak	NB	SH1	9.7	10	9.3
		Expressway	-	-	7.8
	SB	SH1	9.6	11.3	9.7
		Expressway	-	-	9.4

The following comments can be made from **Table 4.6**:

- There is an increase in journey time between the Base and Do Minimum scenarios with the exception of the SH1 route, northbound in the Inter-Peak time period;
- The Option results in decreased journey times along SH1 (both directions) when compared to the Do Minimum – an effect of the 'switch' in traffic onto the Expressway;
- The Expressway results in a journey time saving of approximately 1.5 minutes in the northbound direction and across all time periods compared with the parallel SH1 route when solely looking at the Option; and
- The Expressway results in a journey time saving of approximately half a minute in the southbound direction and across all time periods compared with the parallel SH1 route when solely looking at the Option. The reason for the reduced journey time savings in

the southbound direction is because of the network configuration/layout at the M2PP northern 'tie-in' at Peka Peka Road. Traffic in the southbound direction (coming from north of Peka Peka Road) must travel a further 1.6km to reach Peka Peka Road.

On the whole, the trends in travel times and magnitude in travel time savings are in line with expectations. However, it is acknowledged that the Do Minimum Inter-Peak northbound SH1 journey time appears counter-intuitive.

5 Conclusions

This note has documented a high-level summary of model inputs and assumptions, traffic demands and network performance for the newly created KTM2.1 2021 forecast traffic assignment model, covering:

- Networks, Land Use and Policy;
- Otaki Riverbank Development;
- 2021 Do Minimum and Option Matrices;
- Generalised Costs of Travel;
- Overall Effects on Traffic Flows; and
- Journey Times of Selected Routes.

The key conclusions drawn from the analysis are:

- Reductions in trips to and from the North of Peka Peka sector to all other sectors between Peka Peka and MacKays Crossing in the Option demand matrices are related to worsened connectivity for a selection of modelled zones north of Peka Peka Road and south of SH1 Otaki River crossing;
- Outside the PP2O corridor, over-capacity delays are associated with the Poplar Avenue / SH1 priority intersection at the southern end of the model and the Kāpiti Road / Rimu Road intersection, each of which have negligible impact on the PP2O corridor;
- The levels of total demand assigned to the Do Minimum and Option networks are effectively the same. This demonstrates the in-elastic nature of the elastic assignment procedures and demonstrates the road assignment is more akin to a fixed-trip assignment;
- The Option results in an 80% reduction in daily traffic volume along SH1 just north of Peka Peka Road and a 48% reduction along SH1 at the Otaki River crossing, with traffic diverting onto the Expressway;
- The Option results in decreased journey times along SH1 (both directions) when compared to the Do Minimum – an effect of the 'switch' in traffic onto the Expressway; and
- The Expressway results in a journey time saving of approximately 1.5 minutes in the northbound direction and half a minute in the southbound direction across all time periods compared with the parallel SH1 route when solely looking at the Option.

Based on the agreed inputs and assumptions, and the review and analysis presented in this report, the 2021 Do Minimum and Option forecasts are considered robust and plausible for the PP2O Expressway project.

File Note

Date	26 September 2012
Project No	ZB01263
Subject	**Review of the Kapiti Traffic Model (KTM) update**

1. Introduction

This note documents a review of the following file note received from Graham Bell (Beca) by email on Thursday 20th September 2012

- "KTM2.1 Forecasting Process", Ref 3391248

This was supplemented by the following files received from Graham Bell (Beca) by email on Thursday 9th August 2012:

- AM_Summaries_KTM2.1.xlsx
- IP_Summaries_KTM2.1.xlsx
- PM_Summaries_KTM2.1.xlsx

As part of the review process, there has been ongoing dialogue via phone and email between Graham Bell and Darren Fidler (SKM) in order to streamline the review process. Information from these emails that is referred to in this note is appended to this document.

This note utilises the same chapter headings as the Beca file note for ease of reference.

In summary, it is considered that the updated KTM2.1 SATURN model is suitable for the assessment of the likely impacts of the Peka Peka to Otaki Expressway.

2. Overview of Base Model Performance

Applying the KTM2 "correction" matrix to the KTM2.1 prior matrix has produced a satisfactory level of base year model validation. The count outliers are predominantly outside the core area of interest of the model, away from SH1. The exception to this is SH1 southbound in the AM peak at Taylors Road where the model is approximately 400vph high (an issue raised in an email to Beca on 26th July 2012, appended to this note in **Appendix A**). It appears as though the cause of this issue is a large increase in flow in the updated WTSM 2011 model, as the equivalent location in KTM2 has a modelled flow closely reflecting the observed count, and the correction matrix changes the modelled flows here by ~20vph.

This overestimation of the model flows down to the Mill Road roundabout where the updated WTSM prior matrices result in an overestimation of flows by approximately 200vph straight through on SH1 and 200vph right onto Mill Road.

There is very limited growth for these movements between 2021 and 2031 in the model forecasts and the KTM2 base correction matrix is relatively small. The KTM2.1 has been demonstrated to be consistent with WTSM forecasts which are the accepted sources of traffic forecasts in this area.

3. WTSM Demographic Forecasts

It is noted that the growth forecasts are generally proportional to the base year values, that is, the percentage growths appear relatively constant with low absolute growth in areas with low base year populations, and higher growth in areas with high base year populations.

4. Forecasting Methodology and Processes

The production of future year matrices from WTSM growth is generally consistent with KTM2 and considered appropriate. The HCV process differs from KTM2, but given the generally small proportion of HCVs, and the uncertainty of HCV growth from WTSM, the impacts of this change in methodology are unlikely to impact upon the suitability of the model for robustly reflecting overall traffic volumes in the area.

5. Otaki Riverbank Development

The treatment of the Otaki Riverbank development is considered appropriate. The hourly trip generation rates are unlikely to have a significant impact upon network operation and so the risk of using existing distribution patterns (as opposed to updating land use inputs in WTSM) is considered low.

6. WTSM and KTM2.1 Traffic Demands

The tables provided demonstrate that the integrity of the WTSM demand forecasts has generally been retained in KTM2.1. Of note is the significant difference between WTSM HCV forecasts and those used in KTM2.1. As noted in Section 4, this is not considered a significant issue given the proportion of HCVs of total traffic volumes. It should be noted however that should HCV volumes be critical, for example, for intersection or pavement design, then sensitivity testing should be undertaken as appropriate.

7. Future Network Conditions

The future year network conditions appear sensible, with apparent anomalies in the model outputs explained appropriately within the text or subsequent emails (appended to this document in **Appendix B**. This includes:

- Misreporting of changes less than 100% in Tables 7.1 to 7.3.
- Explanation of the change in overcapacity delays between 2010 and 2021.
- Minor changes in distance on the existing SH1 between 2010 and 2021.

As a result of these anomalies, it is considered that any outputs used from the model in the immediate vicinity of the Rimu Road / Kapiti Road intersection should be used with reference to the sensitivity test carried out at this intersection.

It is noted that the distances on the existing SH1 have been coded incorrectly in either the 2010 base or 2021 models. This appears to make a difference of a maximum of approximately 24 seconds (southbound in the AM peak) with a more typical difference of 5-10 seconds. It should be clearly documented what quantum of this travel time reduction is due to incorrect distance coding and what is due to schemes included in the DM which may relieve congestion on the existing SH1 (as appears to be the case in the AM peak. Note that this review has not included a full model audit where quantities such as road lengths have been checked.

8. Conclusions

It is considered that the KTM2.1 SATURN model is suitable for the assessment of the likely impacts of the Peka Peka to Otaki Expressway.

Note that a number of minor issues have been raised in this review which are not considered significant and the risk of these issues fundamentally impacting upon the robustness of the model are considered low. The sensitivity tests suggested are considered sensible to provide additional information regarding the likely impacts of assumptions made within the forecasting methodology.

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Appendix A: SKM comments on KTM2.1

Hi Graham,

Based on the information provided, I'd agree that you still have a robust basis for forecasting from your 2010 models.

I would caveat this with saying that you should confirm the likely reasons for any large flow outliers (for example the 400+ difference in the AM peak) to confirm if that's an expansion of a 2006 issue or due to development coming on line out of kilter with the assumed 1% p.a. growth to ensure that this is captured somewhere in the future matrices appropriately. This is of course if these large outliers are of any consequence to the final model outcomes (which I assume you will cover in the reporting?)

Thanks

Darren

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Appendix B: Email correspondence Tuesday 25th September 2012

Hi Darren –

Response to your bullets below, with each taken in turn:

- I have adjusted the note accordingly.
- The AM peak Base Year over-capacity delay is associated with the Poplar Avenue / SH1 priority intersection at the southern end of the model. The right-turn delay from Poplar Avenue onto SH1 and heading south is 3 minutes. In the 2021 forecast year, this is where the M2PP Expressway southern tie in lies, in both the Do Minimum and Option scenarios, and the Poplar Avenue / SH1 intersection becomes a roundabout. With the effect of the Expressway removing traffic from the existing SH1 and the roundabout coming into effect, this reduces the turn delay for this movement to a few seconds and hence no over-capacity delay in the 2021 Do Minimum. The Base Year SH1 southbound flow at this intersection is circa 1200 pcus/hr in the AM peak and 800 pcus/hr in the PM peak. In the 2021 Do Minimum, the AM peak SH1 southbound flow is circa 600 pcus/hr and 400 pcus/hr in the PM peak, with the combined flow on SH1 and Expressway being greater in 2021 than the Base Year.
- It has been noted that there are some discrepancies in modelled distance between the Base and Do Minimum, i.e. the Do Minimum distance along the route as a whole is slightly shorter than that modelled in the Base. In order to create the Do Minimum networks, we used the KTM2 Do Minimum as its basis and removed the PP2O Expressway. In doing so, some errors have crept in and have been missed in the review. I shall make a comment along those lines in the note.
- I have adjusted the note accordingly.

Let me know if this makes sense (bullet 2) and / or if you need anything else.

Cheers,

Graham.

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From: Fidler, Darren (SKM) [mailto:DFidler@globalskm.com]
Sent: Monday, 24 September 2012 4:49 p.m.
To: Graham Bell
Subject: KTM2.1

Hi Graham,

Just about done with the review but got a couple of queries to avoid another formal review iteration:

- Table 7.1, 2 and 3: some of the % differences should read >100% and some 100% (they're all currently <100%)
- Table 7.1: over capacity delays reduce to 0 in the 2021 models, why? Where are they in the 2010 base?
- Table 7.4: why is the 2021 DM quicker than the 2011 base? Worth a comment.
- Comments on Table 7.6: Point 2, I'd replace "Option Scenarios" with "2021 scenarios" as the growth is related to time, not the option

If you could flick me an email responding to these then I'll refer to the email rather than a complete reissue and I won't need to leave any questions in the review. Give me a call if any of the above isn't clear.

Cheers,

Darren

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