



CONGESTION MONITORING – THE NEW ZEALAND EXPERIENCE

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Abstract

New Zealand appears to be experiencing significant and increasing traffic congestion problems. This is particularly the case in Auckland where it has been estimated that the economic cost is in excess of \$1 billion.

This paper discusses the introduction of congestion monitoring in New Zealand in an attempt to quantify the extent and location of traffic congestion.

The methodology used was the Austroads approach with some adaptation for New Zealand conditions.

The results of the first year's surveys in Auckland and Wellington are discussed. Some problems that have been experienced in undertaking the surveys are commented on, as are possible future steps to overcome the problems.

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1. INTRODUCTION

In early 2002 Transit New Zealand, together with the Regional Councils decided to introduce travel time performance indicators (congestion monitoring) in Auckland and Wellington. There had been a long history of travel time surveys undertaken by Transit, but these did not include a congestion measure. The methodology adopted for the monitoring was the Austroads Travel Time Performance Measures. The results contribute to transportation modelling. The results are also made available to the Ministry for the Environment as part of the Environmental Indicators for Transport. This paper discusses the steps taken to introduce the monitoring, issues encountered and results so far.

2. ESTABLISHMENT OF SURVEY

The methodology measures Actual Travel Time on a representative sample of a network. By following the Austroads methodology, combining the Actual Travel Time and Nominal Travel Time (based on travel at the speed limit) Indicators allows calculation of a congestion indicator.

The major intent of the survey is to permit year-on-year monitoring of changes in congestion. The detailed data and the congestion maps also provide a picture of the pattern of congestion over the network.

Travel time is not necessarily a measure of congestion. Delay during a journey can be caused by a number of things, for example, poor weather conditions, accidents, road works, congestion, driving habits of other drivers. Congestion is only one cause of travel delay. Therefore travel time is seen as an *indicator*, rather than a *measure* of traffic congestion. Although when measured across a network over a number of days the main cause of delay is likely to be congestion.

The first surveys to produce the indicators were undertaken in Auckland in March 2002 and in Wellington in May 2002. The surveys were designed by Transit, the Regional Councils and specialist traffic and statistical consultants.

The sample of the Auckland and Wellington road network to be monitored was decided upon by Transit and the relevant Regional Council. This sample included State Highways, Motorways and Regional Arterials, and was seen as providing a representative sample of the road networks. The sample includes many of the most heavily travelled commuter routes so that a 'real' indication of network congestion could be produced.

For the surveys, the Actual Travel Times (ATT) were recorded for each link over five days (Monday to Friday) in each of the AM and PM peak periods and the Inter-peak period, giving a total of 15 survey runs for each link (five per period).

3. SURVEY SAMPLE

The nature of the Auckland and Wellington road networks and traffic flows are very different. Auckland has more motorway. Much of its commuter traffic travels on the motorways but there is also significant cross-town traffic. Wellington has more state highways and a very limited length of motorway. Most Wellington commuter traffic travels to or from the Central Business District.

Table 1.

Auckland Congestion Indicator Survey Sample

Road Type	Total Length (km)	Monitored Length (km)	Monitored Percentage
Motorway	123	86	70%
State Highway	28	27	100%
Regional Arterial	308	134	44%

The Auckland sample contains a high proportion of the motorway and state highway routes and less than half of mainly cross-town regional arterials routes. In Auckland the monitored network comprises 20 relatively short routes, which are spread across the urban area.

Table 2.

Wellington Congestion Indicator Survey Sample

Road Type	Total Length (km)	Monitored Length (km)	Monitored Percentage
Motorway	17.6 km	17.6 km	100%
State Highway	221.6 km	100.2 km	45%
Regional Arterial	155.3 km	32.7 km	21%

The Wellington sample comprises three end-to-end routes through the Central Business District and one outer route. (The Wellington routes are Waikanae to Wellington Airport, Upper Hutt to Wellington Airport, Wellington Railway Station to Island Bay and Porirua to Seaview). A number of urban arterials eg Karori to Courtney Place are also included.

4. RESULTS OF THE SURVEYS

The summary results of the surveys are:

Table 3: Summary of Auckland Travel Time Performance Indicators

Indicator	Period	Comparison of Results		
		March 2002	Nov 2002	March 2003
Mean Travel Speed	AM Peak	38.4 km/h	32.7 km/h	29.8 km/h
	Interpeak	51.6 km/h	46.7 km/h	47.9 km/h
	PM Peak	41.9 km/h	36.3 km/h	35.6 km/h
	All Day	43.3 km/h	37.7 km/h	36.4 km/h
Nominal Travel Speed		67.8 km/h	64.4 km/h	64.4 km/h
Congestion Indicator (CGI)	AM Peak	0.59 mins delay/km	0.75 mins delay/km	0.96 mins delay/km
	Interpeak	0.10 mins delay/km	0.15 mins delay/km	0.13 mins delay/km
	PM Peak	0.33 mins delay/km	0.50 mins delay/km	0.63 mins delay/km
	All Day	0.36 mins delay/km	0.49 mins delay/km	0.61 mins delay/km
Variability of Travel Time	AM peak	23%	25%	35%
	Interpeak	14%	16%	20%
	PM Peak	21%	28%	30%
	All Day	21%	25%	29%

Table definitions:

- The *Actual Travel Speed* is calculated by dividing the actual travel time (from the surveys) by the length of the network.
- The *Travel at Speed Limit* represents the time taken to travel the network at the posted speed limit divided by the length of the monitored network.
- The *Congestion Indicator* is presented in minutes of delay per kilometre of travel and represents a measure of delay in the network (Actual travel time minus Speed Limit Travel Time divided by distance travelled). A CGI of zero therefore represents uncongested freeflow conditions, while the more severely congested a link is the higher the CGI.
- The *Variability of Travel Time* is a measure of the range of Actual Travel Time results and is used to monitor the reliability of travel times. This measure is expressed as a percentage of the average travel time.

Table 3 shows significant congestion on the Auckland motorways and state highways in the AM peak, and lesser, though still significant, congestion in the PM peak. There is little congestion on these roads in the interpeak period. For regional arterials there is significant congestion in the AM and pPM peaks and noticeable congestion in the interpeak period.

The comparison between the March 2002 and November 2003 shows a decrease in mean travel speed and increase in congestion. Part of the change may be due to seasonal factors, but it is likely that the addition of some urban arterials has resulted in a higher degree of congestion being recorded. The November 2002 survey provides a more representative measure of the conditions facing Auckland motorists.

The March 2003 survey shows a further significant decrease in mean travel speed and increase in congestion in comparison with both the March 2002 and November 2002 surveys. This is discussed later.

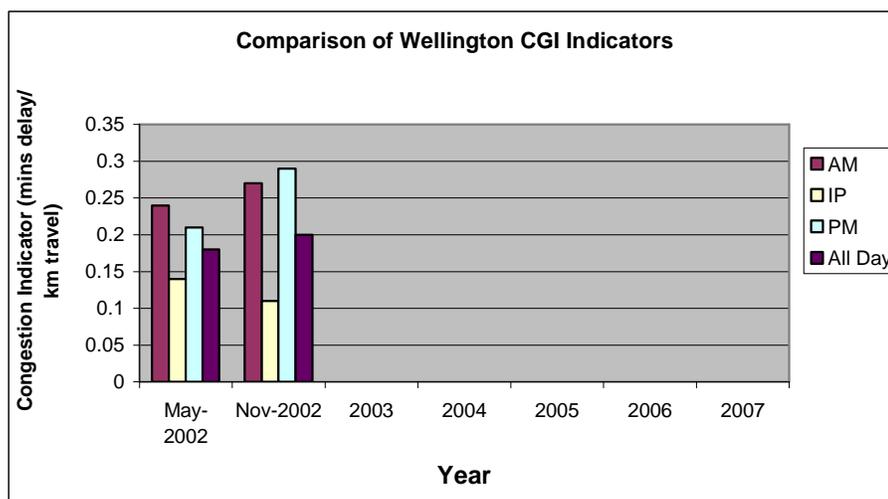
Sample congestion maps for both Auckland and Wellington are annexed to this paper.

Table 4: Summary of Wellington Travel Time Performance Indicators

Indicator	Period	Comparison of Results		
		May 2002	Nov 2002	May 2003
Mean Travel Speed	AM Peak	56.7 km/h	55.3 km/h	47.10 km/h
	Interpeak	63.2 km/h	65.4 km/h	59.6 km/h
	PM Peak	57.7 km/h	53.9 km/h	49.6 km/h
	All Day	59.1 km/h	57.7 km/h	51.6 km/h
Nominal Travel Speed		79.6 km/h	78.0 km/h	77.8 km/h
Congestion Indicator (CGI)	AM Peak	0.24 mins delay/km	0.27 mins delay/km	0.44 mins
	Interpeak	0.14 mins delay/km	0.11 mins delay/km	0.16 mins
	PM Peak	0.21 mins delay/km	0.29 mins delay/km	0.32 mins
	All Day	0.18 mins delay/km	0.20 mins delay/km	0.32 mins
Variability of Travel Time	AM peak	20%	16%	13%
	Interpeak	15%	5%	4%
	PM Peak	18%	21%	12%
	All Day	17%	14%	9%

The Wellington survey indicated, on average, relatively low levels of congestion on the Wellington motorway (CGI 0.26 May2003) and state highways (CGI 0.37 May 2003) throughout the day. But higher levels of congestion (CGI 0.60 May 2003) on the surveyed regional arterials throughout the day.

The table shows that there were small decreases in average actual travel speeds and conversely an increase in the congestion indicators between May 2002 and November 2002. These may be due, in part, to seasonal variations. Measured congestion increased further in the May2003 survey. All the latter increase was on the motorway and state highway sectors.



5. ISSUES ARISING

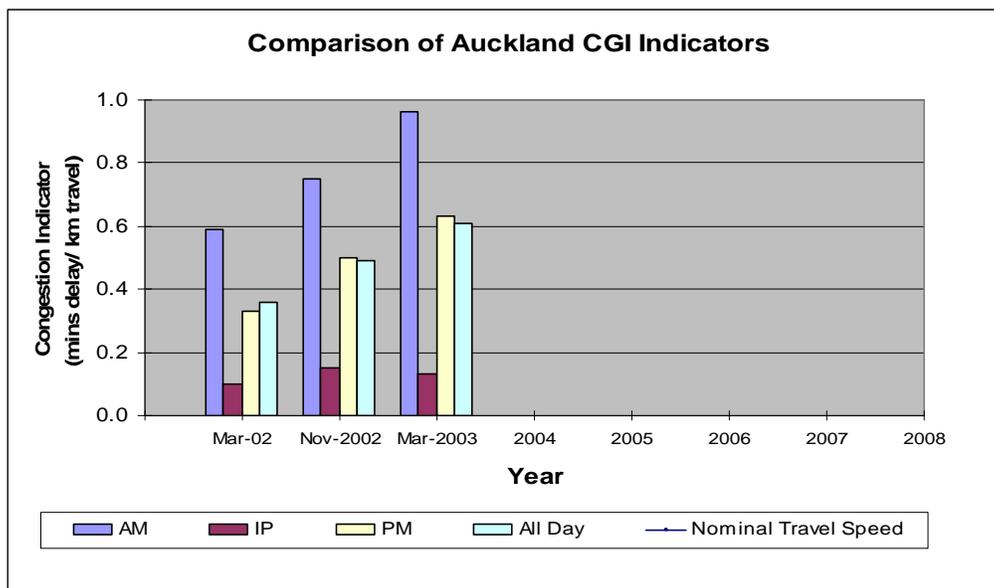
Average Actual Travel Speed and Congestion Indicator maps were produced for Auckland and Wellington for each survey. From the Wellington maps for the first survey, it was clear that a number of congestion 'pinch points' had not been identified. These included points such as the Paremata roundabout and the Ngauranga Gorge. It was realised that because of the relatively short peak period in Wellington the congestion 'pinch points' were not being identified. The AM peak runs, for that survey, began at 7:30am and 8:30 am and the survey car was travelling through the 'pinch points' before or after the congestion period. To capture the 'pinch points' for the November 2002 survey, the start time was staggered through the week. For example, on Monday start at 7:00am, on Tuesday at 7:30am etc. The same approach was applied to the PM peak survey. This sample method captured the 'pinch points' which can be seen marked on the map at Appendix B. It may also have resulted in a small increase in overall congestion being recorded.

After the initial surveys were completed it was decided that there was an under-representation of urban arterials in the Auckland and Wellington monitored networks. Based on an analysis of vehicle kilometres on both the motorways/state highways and the arterials, nine new routes were added to the Auckland survey and 2 new routes to the Wellington survey. While adding routes does affect the ability to compare surveys and obtain trends it was felt that the addition was necessary to obtain a representative sample.

For Auckland the weightings used to combine the peak period into the 'all day' indicator were revised. For some roads, mainly local roads, the traffic volume data and peak data was patchy. The current weightings are based on ATMS readings from a number of state highways.

6. AUCKLAND MARCH 2003 SURVEY

The March 2003 survey does provide an absolute measure of congestion in Auckland in the survey week. It cannot, however, be used as a comparator for the earlier surveys.

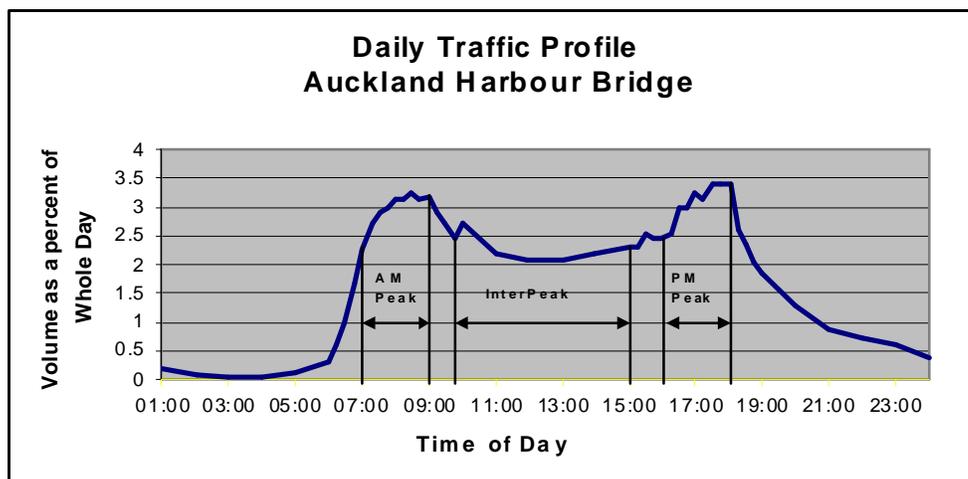


In essence the degree of congestion in Auckland in March 2003 has defeated the methodology being used. The Austroads methodology requires that the time of the start of a run in any survey should not vary by more than +/- 10 minutes. This enables the results of different surveys to be fairly compared to identify trends. The survey in Auckland uses 10 floating cars. Each car undertakes a number of sequential inward and outward runs. Congestion was at such a level in March 2003 that the cars were unable to reach the start of a number of subsequent runs within the allowed time period.

Why was congestion recorded in Auckland so much higher in March 2003 than in the previous surveys? There are a number of contributing factors:

- the construction work at the Central Motorway Junction with reduced lane widths is having wider network effects on the Northern and Northwestern Motorways and on Auckland City arterials;
- road flooding and a number of accidents occurred in the survey period;\
- the start time of the survey was moved from 7:00am to 7:30am, as it was felt that the earlier survey was starting in the 'shoulder' of the AM peak;
- March may not be the best month for a survey. 'March madness' occurs with the return of the tertiary institutes, which causes a significant spike in travel flows. In excess of 20,000 extra students in or close to the central business district have a dramatic effect on flows and particularly speed. This tends to settle down as students get into the routine of their studies.
- it appears that the Auckland network is critically loaded and relatively small incidents can have disproportionately large effects. In March 2003 a number of incidents occurred within the survey period. This is reflected in the variability of travel times. In table 3 above the AM variability increased from 23% to 35% over the three surveys and the All Day variability increased from 21% to 29%.

7. HARBOUR BRIDGE TRAFFIC PROFILE



Note: The graphs are in of volume **per half hour** as a percent of whole day. The measured volumes are two way flows. The peak period used now are slightly different to those in the chart. The morning (AM) peak period runs from 6:30am to 10:30am, the Interpeak (IP) Period from 10:30am to 3pm and the Evening (PM) peak period from 3pm to 7pm.

The extent of the Auckland AM and PM peaks is shown in the daily traffic profile for the Auckland Harbour Bridge. The Harbour Bridge is carrying substantial traffic volumes from about 6.30am until 7:00pm. This is typical of a level of congestion where travel on heavily used (and frequently congested) roads actually becomes almost constant throughout the day.

8. NEXT STEPS

The Wellington survey appears to be performing well and delivering consistent data. The survey as it is now established appears to provide a sound basis for future comparisons.

For Auckland the picture is somewhat different. The current survey methodology does not provide a suitable basis for inter-period comparisons.

Before the next survey is undertaken a workshop will be held to analyse the methodology as it applies to Auckland. This will consider issues such as:

- should the survey techniques be varied. For example should the number of floating cars be doubled and a different technology such as GPS be adopted. Increasing the number of cars would increase costs but the GPS technology may offset some of the cost increase;
- should the start time remain at 7:30am or be moved back to 7:00am; and

- should the survey be moved away from March (a peak congestion month) to April. This would measure congestion at the 85th percentile month rather than at the 100th percentile month.

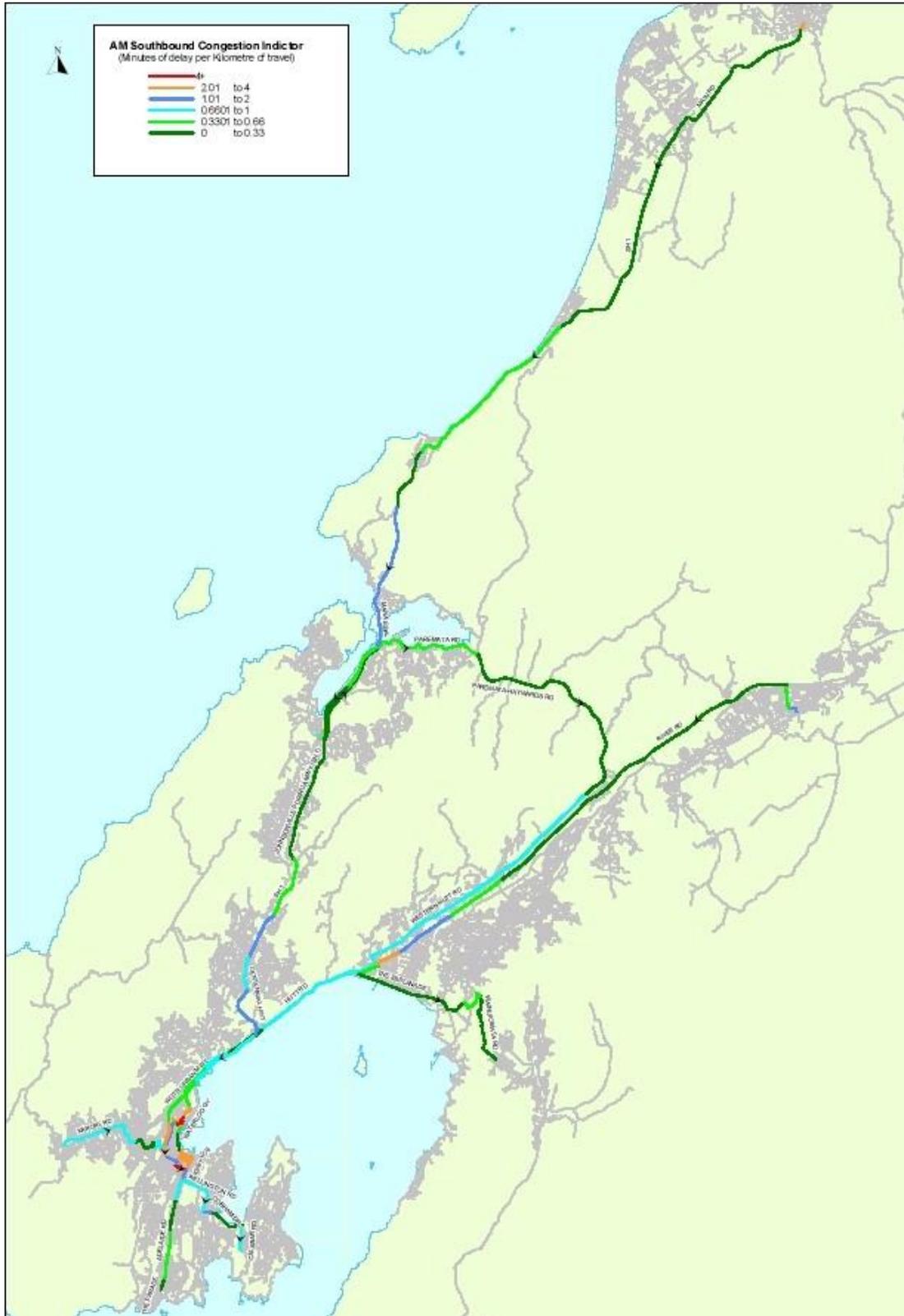
9. CONCLUSION

The Congestion Indicator Survey has been established in New Zealand in Auckland and Wellington.

It shows relatively moderate levels of congestion in Wellington and relatively high levels in Auckland.

The survey in Wellington appears to be performing robustly. In Auckland the relatively high level of congestion will require some further developments in the survey techniques.

The surveys have produced a clearer view of congestion issues and will provide a good base for future trend analysis.



Wellington AM Southbound CGI May 2003



Auckland AM Inbound CGI March 2003