25 YEARS LATER: WHAT HAS CHANGED?

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Abstract

Imagine going back in time 25 years and being able to show the planners, engineers, and funding parties exactly what the future would look like.

While we don't yet have the technology for time travel, we do have ability to look back and ask what could have been done differently, what was effective, and what (if anything) has changed.

This paper takes recently rediscovered congestion information from the 1980s and compares it with today to ask, what has changed? We compare the travel times for key commuter routes to the city; identify changes to travel times to assess how well investment has managed growth in demand on these strategic routes. We then extrapolate these findings to identify a **60%** average increase in travel times to the city since 1986, resulting from the shortfall between supply and demand.

We calculate that this equates to commuters into the CBD spending an additional **3.5 million hours** stuck in traffic each year.

Lastly, we invite the reader to ask, will we look back 25 years from now and wish we had a time travel machine to come back and tell us what we should have done differently?

1 Background and Introduction

The inspiration for this paper came as a result of a rather thorough spring cleaning exercise, which revealed, among other things, same ancient floppy disks from a bygone era. These floppy discs were contained prized treasures, a glimpse of Auckland as it was over 25 years ago; private vehicle travel time data for 1986. These travel times had been compiled using a 1980s spreadsheet device (something called a "typewriter"). Having found a rare device for reading floppy disks and an intern willing to manually type the data into a spreadsheet, we were able to begin unlocking their secrets. The basic idea of a floating vehicle survey has not changed in 25 years, and even though we now use GPS, GIS, SQL, Google-earth, Excel, proprietary software scripts and various other fancy programmes, the basic principle of a travel time survey from A to B has not changed, and so we can compare the 1986 data to floating vehicle surveys from 2012, with only a few caveats and assumptions. Perhaps the single most interesting question this 'time capsule' would reveal is "what has changed?" How well has growth in demand been managed?

2 Travel Time Source Data 1986 AND 2012

The data for 1986 was sourced from the Auckland Regional Authority report "*Auckland Arterial Road Network – Analysis of Congestion*", dated 12/11/1986 (Drager, 1986) and hereafter referred to as "the 1986 Report." The data from this report was collected using a "stop watch and clipboard" version of the floating vehicle surveys in Sept/Oct 1985 and in February 1986. The report does not identify if there was seasonal variance for travel times in the 1980s.

The 2012 data was collated from the *Auckland Travel Time Performance Monitoring Report, March 2012* (Sakib, 2012), hereafter referred to as the "2012 data." This NZTA / Auckland Council survey is part of an NZTA-led nationwide biannual congestion monitoring programme. The data is collected from survey vehicles driving set routes at set start times, with GPS observing the location at one second intervals. Routes have been collated from both data sources by aggregating route segments with a common origin and destination. The sorts of tools we take for granted now (GIS, SQL mapping software, etc.) were still in the realms of science fiction in the 1980s, so there is likely to be some margin of error for the 1986 data.

The routes created for this analysis were compiled with the intent of comparing delay for typical commuter trips. For each route, the distances were <4% between the two data sets. While there may have been changes to road layout, much of this difference is likely due to rounding errors for the 1986 data.

When making comparisons between the two data sets, we make the assumption that both data sets are robust and representative of typical congestion for their year. With regard to the data for more recent data, construction activities have affected most surveys and 2012 was no exception, with roadworks affecting results on SH16 and around the AMETI project area. Congestion relating from roadworks construction activity in Auckland reached its peak in 2009 and has since been dropping. As a result, the 2012 results are preferable for comparison than the results of the last couple of years, but construction may still have an impact on some of the routes chosen. While the 1986 report mentioned a number of proposed projects and studies, no mention was found of roadworks affecting the results.

The March 2012 surveys also encountered rain during two of the survey days, which can increase congestion; however rain is relatively common during the Auckland surveys. No mention could be found of the weather during the 1986 surveys.

2.1 Route Coverage

The historic data was compared with current surveys to identify common origin and destinations for trips into Auckland central. Nine routes have been identified, including a mix of state highways and major arterials. An effort has been made to select routes that would be familiar to commuters. **Figure 1** shows a map of the nine routes.

Figure 1 Map of Routes Used in Analysis

As can be seen from **Figure 1**, the study routes for comparison are as follows:

1) SH1 Northern Motorway: from Albany to the City
2) SH1 Southern Motorway (northbound from Mt Wellington to the CMJ)
3) Henderson to the City (Nelson Street off) via the SH16 Northwestern Motorway
4) Henderson to SH16/Waterview via Great North Road / Rata Street
5) Dominion Road from Mt Rokill suburb/Mt Albert Road to Newton Road)
6) Great South Road Manukau to Otahuhu (northbound from Puhinui Rd to Mangere Road)
7) Manukau Road, Pah Road, Broadway (from Onehanga /Herd Road to Khyber Pass)
8) St Johns to the city (Aipirana Ave to SH16 The Strand via Kepa Road and Tamaki Drive)
9) Howick to the Southern Motorway via Ellerslie-Panmure Highway

These routes provided a good cross section of commuter trips into the city. It would have been helpful to also include the SH20 Manukau Harbour Crossing and the Pakuranga Highway Tamaki Estuary crossing; however, it was problematic to find a common origin-destination for a route >4km in length.

Figure 2 below provides an illustration of what this coverage looks like on a 1986 road map of Auckland (sourced from the 1986 Report).

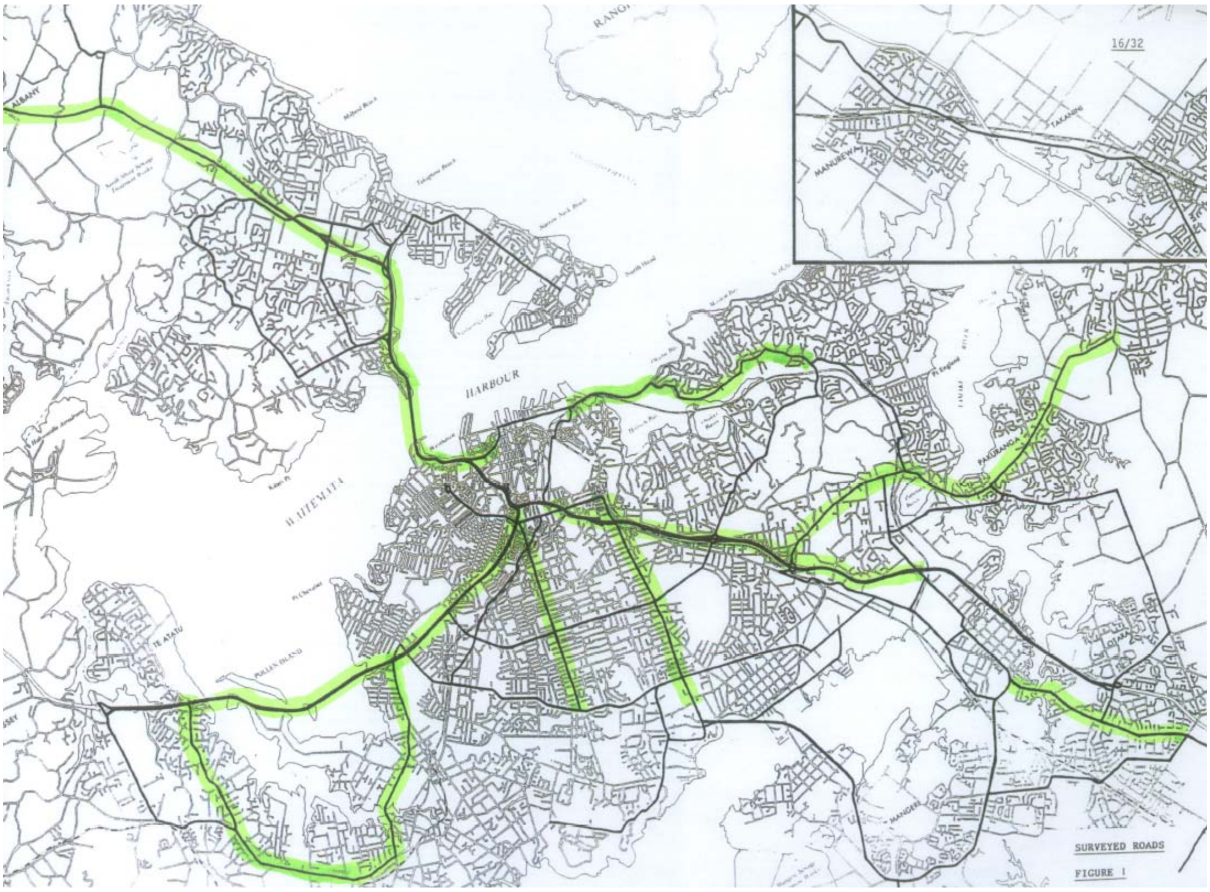

Figure 2 1986 Auckland road network, including analysis coverage (green)

2.2 Regional Change 1986 to 2012

The following sections include not only a comparison of travel times, but also descriptions of how specific routes have changed since 1986. At a network level, there are two striking features that can be observed from **Figure 2**. The first relates to the significant expansion of urban sprawl since 1986. There has been significant green-fields development, as evidenced by the increase in local road network since the 1986 map; Albany, Hobsonville, Henderson, Mangere, Tamaki, etc. The second striking observation is how little the strategic network has changed. Most of the significant changes are in the CMJ and the Western Ring Route (SH18 and SH20), most of which relate to investment within the last 10 years. The only other major network changes since the 1986 map are the extension of the Northern Motorway (ALPURT) and the South Eastern Arterial (SEART).

The Auckland network then, as now, is defined by key topographical constraints, most noticeably the Waitemata, Tamaki, and Mangere crossings to the Auckland Isthmus. The Central Motorway Junction (CMJ) provides man-made constraints not only as a significant axis for traffic travelling to and passing the central city, but also as a virtual moat around the central city itself, constraining growth of the CBD, creating issues of severance and complicating local road access to the city. In the 2000s, significant investment in the CMJ has increased capacity and improved connectivity between the state highway approaches. These topographical constraints have been the focus of significant investment and no doubt will continue to be a key feature of planning and funding in the future.

The 1986 Report makes several recommendations for operational improvements of arterial road corridors, mainly relating to installing traffic signals, or installing SCATS to existing signals with fixed timings. Then, as now, road operators understood the benefit of improved signal coordination.

In the1980s SCATS coverage was limited, but expanding. It is now region wide. SCATS provides the recently formed Joint Traffic Operations Centre with some flexibility for improving signal coordination and reducing delays on arterial corridors. The 1986 Report also occasionally suggests the use of Traffic Officers to direct traffic during peak periods, as a cheaper alternative than installing traffic signals. While JTOC work closely with the police to manage incidents, it is hard to imagine a current road operator asking for police resources to direct traffic as an alternative to traffic signals.

The 1986 Report contains no mention of any form of public transport, an area often overlooked in Auckland since the removal of tram lines in the 1950s. However, public transport has also seen significant investment in the 2000s. This includes the re-opening of the Britomart railway station. Following its removal in the 1950s, Auckland lost its only railway station in the central city, making it impossible for rail to provide a useful destination for most commuters (the now closed station in Parnell involved a steep 20 minute walk to Queen Street). The railway station was restored in 2003, enabling commuter train services to return to the city. Since this initial catalyst, commuter services have been restored from almost non-existent, antiquated Victorian stations have been rebuilt (and provided with lighting), and funding is currently underway to electrify the network, which will result in faster, quieter journeys with less fuel emissions, as already enjoyed by commuters in Wellington.

Data analysed from the Auckland Transport Annual Patronage Survey 2012 identifies that the Auckland rail network carries about 26,000 passengers a day, or roughly 200,000 passenger km each weekday. The survey identifies the difference between scheduled and actual arrival times at Britomart to be on average 2 minutes different, meaning that rail trips are more predictable than Auckland's notoriously variable road travel times. A comparison of trip times in this report identifies that equivalent rail trips are generally similar in duration to those of private vehicles.

Bus services have also seen a significant increase in investment. The completion of the Northern Busway providing a rapid transit level of service, without the need for existing railway. The Busway takes around 5,000 vehicles off the roads each day, while providing customers with a journey time half that of private vehicles.

2.3 Chosen Performance Metrics

The following measures have been used to assess change 1986 relative to 2012:

- Travel Time (the time to complete the route)
- Average Travel Speed (average speed along the route)
- Change to Travel Time (i.e. additional delay faced by today's commuters)
- Change to average travel speed (essentially, change to level of service)
- Difference between peak and interpeak speeds for each data set (to assess the effects of peak loading)
- Change to peak loading characteristics (i.e. how much the difference between peak and interpeak delay has increased over time)
- Increase in delay per km travelled

This last measure is similar to the Austroads Congestion Indicator value (CGI). However, to calculate the CGI, one must know the speed limits, and this information is not available for the 1986 data set. Instead, we can assess additional delay per km travelled between the two data sets. This delay can then be aggregated to get an impression of how much longer a 'typical' journey would take now, relative to 1986.

3 Travel Time Comparisons: 1986 to 2012

3.1 Route One: SH1 Northern Motorway

Table 1 below indicates the result of the comparison between 1986 and 2012 data.

Table 1 Route One: SH1 Northern Motorway: Albany to the City

	AM 1986	IP 1986	Peak delay 1986	AM 2012	IP 2012	Peak delay 2012	Am Diff	IP Diff	Peak delay diff
Time (s)	1362	735	627	**2297**	830	1467	**935**	95	840
Time (m)	23	12	10	**38**	14	24	**15.6**	1.6	14.0
Speed (km/h)	41	75	-35	**24**	67	-43	**-16.6**	-8.6	-7.9
Route length 2012 (km):			15.3		**Additional Delay (min/km):**		**1.01**	0.1	0.9

The first route selected for comparison is the SH1 Northern Motorway, from Albany to the city, a distance of just over 15km. The historic data pre-dates the ALPURT projects that extended the SH1 Northern Motorway to Puhoi. The route starts in Albany, on what is now SH17, with a southern terminus at the intersection of Fanshawe Street and Nelson Street.

3.1.1 Route One: SH1 Northern Motorway Comparison

Since1986, the urban boundaries have not substantially changed, but the North Shore and Orewa / Whangaparaoa suburbs have undergone significant intensification and green-fields development, placing significant additional demand on the Northern Motorway. To cater for this, the Northern Motorway has seen significant investment since 1986. The Harbour bridge now operates with a 5 lane /3 lane peak tidal flow, capacity has been upgraded through the Esmonde Road and Onewa Road interchanges, the Northern Busway now provides a significant number of commuters rapid bus transit services along the Northern Motorway to the city, and ramp signals have been installed to reduce the impact of slow moving traffic merging onto the motorway causing flow breakdown during peak periods. The $340M Victoria Park Tunnel opened in 2012, to increase capacity in the bottleneck between the Harbour Bridge and the CMJ.

Despite this investment, in March 2012, the average AM travel times from Albany to the city were fairly close to double that of 1986, with a travel time of 38 minutes in the AM peak (an increase of almost 17 minutes, or roughly 1 minute per km travelled) and 14 minutes in the interpeak. The average speeds in 2012 were 24km and 67km/h respectively (down 17km/h and 9km/h respectively).

The change in AM travel times/speeds illustrates the impact of urban fringe development on the corridor. Each new car added on the city fringe results in an additional vehicle the entire length of the corridor.

Interestingly, the 1986 Report recommends introducing ramp signals as a means of improving operational capacity on the Northern Motorway. While ramp signals have since been introduced, it was not until the 2008.

The completion of the grade-separated Rapid Transit Northern Busway in 2008 has provides an attractive option for commuters seeking congestion relief. Services run between Albany and the central city every 3 minutes during the AM peak and are scheduled to take 17 minutes to Britomart, about half that of private vehicle travel times in March 2012.

3.2 Route Two: SH1 Southern Motorway

This route covers the SH1 Southern Motorway, northbound from Mt Wellington to the Nelson Street off-ramp. The Southern Motorway has seen significant investment over the last 5-10 years. At the time of the 1986 Report, the northbound approach to the city consisted of two lanes. The geographic constraints north of Gillies Ave have meant that northbound capacity remains relatively constrained, however, an additional lane has been added since the 1986 Report. The route remains the busiest section of road in the country, and has seen significant growth in demand as Auckland has grown rapidly south and east through green-fields developments. Investment includes capacity increases through CMJ and the addition of ramp signals to reduce the impact of slow moving traffic merging onto the motorway during peak periods.

Table 2 Route Two: SH1 Southern Motorway (northbound from Mt Wellington to CMJ)

	AM 1986	IP 1986	Peak delay 1986	AM 2012	IP 2012	Peak delay 2012	Am Diff	IP Diff	Peak delay diff
Time (s)	542	443	99	**1068**	500	568	**526**	57	469
Time (m)	9	7	2	**18**	8	9	**8.8**	1.0	7.8
Speed (km/h)	65	80	-15	**33**	71	-38	**-32.2**	-9.1	-23.1
Route length 2012 (km):			9.8		**Additional Delay (min/km):**		**0.89**	0.10	0.79

3.2.1 Route Two: SH1 Southern Motorway Comparison

In 1986, the travel on SH1 from Mt Wellington to the central city took around 9 minutes in the AM peak. In 2012 this doubled to 18 minutes as average speeds halved to 33 km/h. As with the Northern Motorway, there has been very little drop in travel times during the interpeak, as much of the motorway has spare capacity during the interpeak period.

The change since 1986 represents an extra 0.9 minutes delay per km travelled in the AM peak. For commuters heading into the city from the south and east of the Auckland region, this change is significant. For a typical commuter travelling into the city from Manukau or Flatbush, twice this route distance is travelled every morning, so the total increase in delay along this corridor may be even more significant than this study is able to illustrate.

3.3 Route Three: Henderson to the City via SH16 Northwestern Motorway

Route three involves a typical route from Auckland's western suburbs, from Henderson, Te Atatu Road / Edmonton Road to the SH16 Northwestern Motorway, and then along SH16 to the CBD Nelson Street off ramp. Investment along the route includes the ramp signals and significant increase in mainline and intersection capacity, including increasing the western approach to the CMJ to five lanes.

Table 3 Route Three: Henderson to the City via SH16 Northwestern Motorway

	AM 1986	IP 1986	Peak delay 1986	AM 2012	IP 2012	Peak delay 2012	Am Diff	IP Diff	Peak delay diff
Time (s)	1226	702	524	**1397**	799	598	**171**	97	74
Time (m)	20	12	9	**23**	13	10	**2.9**	1.6	1.2
Speed (km/h)	42	74	-32	**37**	65	-28	**-5.2**	-9.0	3.8
Route length 2012 (km):			14.5		**Additional Delay (min/km):**		**0.2**	0.11	0.09

3.3.1 Route Three: Henderson to the City Comparison

The results for Route Three were perhaps the most surprising, in that there has been little change. The 1986 AM travel times were 20 minutes, increasing only slightly to 23 minutes in 2012. These findings are likely a combination of factors: lack of capacity in 1986 (as evidence by low speeds), significant investment along the corridor and potentially road works during the 2012 may have also played a part. The March 2012 survey results were influenced by roadworks at Lincoln Road. This bottleneck may have had the effect of metering traffic from the northwestern suburbs onto the study corridor.

3.4 Route Four: Henderson to SH16 / Waterview via Great North Road

Starting at the same intersection as Route Three, Route Four follows an alternative local road route, running roughly parallel to SH16 until the Waterview/Great North Road interchange. At this point, a commuter could either join SH16 or continue along Great North Road to the city. The comparison route terminates here as the 1986 survey did not include the northern portion of Great North Road.

Table 4 Route Four: Henderson to SH16 / Waterview via Great North Road / Rata Street

	AM 1986	IP 1986	Peak delay 1986	AM 2012	IP 2012	Peak delay 2012	Am Diff	IP Diff	Peak delay diff
Time (s)	1087	610	477	**2601**	923	1678	**1514**	313	1201
Time (m)	18	10	8	**43**	15	28	**25.2**	5.2	20.0
Speed (km/h)	33	59	-26	**14**	39	-25	**-19.3**	-20.1	0.7
Route length 2012 (km):			10.0		**Additional Delay (min/km):**		**2.52**	0.52	2.00

3.4.1 Route Four: Henderson to SH16 / Waterview Comparison

This route has shown a significant increase in congestion, with travel times increasing from 18 minutes to 43 minutes for the 10km route, or an additional 2.5 minutes per km as compared to 1986. The average speed for the route has fallen to just 14km/h, although it should be noted that this average speed does not represent typical mid-block speeds, as much of this extra delay will at intersections.

3.5 Route Five: Dominion Road

Route Five consists of the main commuter portion of Dominion Road, from Mt Albert Road to Newton Road. This route was once one of Auckland's major tram lines. The side roads along Dominion road are closely spaced, typically <100m apart, as the corridor reflects a transit oriented design that involved what was then considered quite high density housing along a public transport corridor. As a result, commercial retail emerged the entire length of the route to service customers boarding and alighting trams, with a very short walk to/from surrounding neighbourhoods. This continuous 'strip mall' was never designed with significant car use in mind, as a result, there has been a live debate for decades as to how to balance the competing desires of residents, shop owners, bus passengers, private vehicle commuters, etc, within quite a narrow road corridor.

Until recently, the northern portion of this route was 70km/h, although it is not entirely grade-separated. The speed limit was recently reduced to 60km/h with the installation of traffic signals at Piwakawaka Street, which connects Dominion Road to Newton Road (the 70km/h portion explains the 1986 IP speed of >50km/h).

After trams were removed from Auckland in the 1950s, a plan developed to convert Dominion Road into a motorway. This would have involved the destruction of all of the commercial buildings along the route. Public opposition led to the plan being shelved, but not before a significantly over-engineered, three level, grade separated interchange was built at the intersection of New North Road and Dominion Road, adding to the significant severance caused by the CMJ.

The route is still significant to public transport, carrying 2.2 million bus passengers a year (Peter M, 2013), and is designated as part of the “QTN” Quality Transport Network in the Auckland passenger Transport Network Plan (ARTA 2006).

Table 5 Route Five: Dominion Road

	AM 1986	IP 1986	Peak delay 1986	AM 2012	IP 2012	Peak delay 2012	Am Diff	IP Diff	Peak delay diff
Time (s)	443	316	127	**559**	488	71	**116**	172	-56
Time (m)	7	5	2	**9**	8	1	**1.9**	2.9	-0.9
Speed (km/h)	39	55	-16	**31**	35	-4	**-8.1**	-19.3	11.2
Route length 2012 (km):			4.8		**Additional Delay (min/km):**		**0.40**	0.60	-0.19

3.5.1 Route Five: Dominion Road Comparison

The most significant finding for this corridor is that IP conditions have gone from free flow to congestion levels very similar to peak periods.

The corridor includes peak hour bus lanes. While there has been some debate about the allowing cars to travel on these bus lanes, a study undertaken by Beca in 2010 identified that the average speed for buses on the bus lanes was significantly slower than cars in the general use lanes, meaning that car occupants would not benefit from such a change. The study also found that more than half the commuters travelling on the corridor in the AM peak travel by bus, and as a result, the productivity of the corridor could best be increased by improving the public transport travel speeds (Vallyon, 2009).

3.6 Route Six: Great South Road, Otahuhu

Great South Road was an obvious choice for comparison as it runs parallel to the Southern motorway and forms a local road alternative. However, the 1986 data has coverage gaps so the study route was for a common origin and destination between Puhinui Road and

Mangere Road. This short stretch connects the southern suburbs to the Auckland Isthmus at Otahuhu, as an alternative to the parallel Southern Motorway. The route is a mixture of commercial and residential land use, with a 60km/h speed in places.

Given the limitations and constraints along this corridor, the investment focus has been on the adjacent Southern Motorway, with significant recent investment in capacity and connectivity through the Princes Street, Highbrook Drive and Tamaki Road interchanges.

Table 6 Route Six: Great South Road Otahuhu (Puhinui Rd to Mangere Road)

	AM 1986	IP 1986	Peak delay 1986	AM 2012	IP 2012	Peak delay 2012	Am Diff	IP Diff	Peak delay diff
Time (s)	568	288	280	**598**	574	24	**30**	286	-256
Time (m)	9	5	5	**10**	10	0	**0.5**	4.8	-4.3
Speed (km/h)	29	58	-28	**28**	29	-1	**-1.5**	-28.7	27.2
Route length 2012 (km):			4.6		Additional Delay (min/km):		**0.11**	1.03	-0.93

3.6.1 Route Six: Great South Road Otahuhu Comparison

In 1986, the AM average travel speed was just 29km/h, half that of the interpeak. As with Dominion Road, the AM peak is similar, but the IP now has similar levels of congestion as the AM peak period.

3.7 Route Seven: Manukau Road, Pah Road, Broadway

This route is one of the major north-south arterial corridors in the Auckland Isthmus and a key link in the signposted route between the central city and the Auckland Airport. It is also one of the city's former tram routes, and as a result, much of the route has similar properties to the parallel Dominion Road corridor, in that it includes established retail and difficulties in balancing the priorities of adjacent land owners, private vehicle commuters and public transport. Over the past few years, there have been operational changes, including removing some car parks and improving signal coordination. As with Dominion Road, the route is part of the QTN (ARTA 2006).

Table 7 Route Seven: Manukau Road, Pah Road, Broadway

	AM 1986	IP 1986	Peak delay 1986	AM 2012	IP 2012	Peak delay 2012	Am Diff	IP Diff	Peak delay diff
Time (s)	637	415	222	**1001**	694	307	**364**	279	85
Time (m)	11	7	4	**17**	12	5	**6.1**	4.7	1.4
Speed (km/h)	31	47	-16	**19**	28	-9	**-11.1**	-18.9	7.8
Route length 2012 (km):			5.4		Additional Delay (min/km):		**1.12**	0.86	0.26

3.7.1 Route Seven Comparison: Manukau Road, Pah Road, Broadway

This route has seen a significant increase in delay in both AM and IP periods. Interpeak congestion in 2012 was higher than the AM peak congestion in 1986. This increase in congestion represents an additional delay of roughly 1 minute per km additional delay in both periods.

3.8 Route Eight: St Johns to the CBD

Route eight provides access to the central city for suburbs directly east of the central city; Glendowie, Glen Innes, Meadowbank, etc. The route starts slightly north of the Glen Innes train station. It then follows key arterial roads to Tamaki Drive and to the eastern edge of the CBD at SH16 The Strand, adjacent to the Ports of Auckland. This is predominantly a commuter route from the eastern isthmus dormitory suburbs to the CBD. By 1986, these suburbs were already well established; however, the area has seen some land use intensification.

Table 8 Route Eight: St Johns to the CBD (Aipirana Ave to The Strand)

	AM 1986	IP 1986	Peak delay 1986	AM 2012	IP 2012	Peak delay 2012	Am Diff	IP Diff	Peak delay diff
Time (s)	580	470	110	**675**	599	76	**95**	129	-34
Time (m)	10	8	2	**11**	10	1	**1.6**	2.2	-0.6
Speed (km/h)	45	55	-10	**38**	43	-5	**-6.3**	-11.8	5.6
Route length 2012 (km):			7.2		**Additional Delay (min/km):**		**0.22**	0.30	-0.08

3.8.1 Route Eight: St Johns to the CBD Comparison

As with other arterial corridors included in this study, interpeak delay has grown faster than that of the AM peak period, with the interpeak delay in 2012 being very similar to that of the AM peak in 1986.

3.9 Route Nine: Howick to SH1 via Ellerslie-Panmure Highway

While Route Eight provides access to the Eastern suburbs of the Auckland Isthmus, Route Nine provides access to suburbs east of the Tamaki Estuary, which divides the Auckland Isthmus from the eastern suburbs of Howick, Pakuranga and Botany Downs, etc. The route starts at the eastern end of Pakuranga Highway, and follows the length of Pakuranga Road, crossing the Tamaki Estuary at Lagoon Drive, and then Ellerslie-Panmure Highway to the SH1 Southern Motorway.

Access to Auckland's eastern suburbs has always been problematic. The route starts 20km from the city centre, but there is neither railway nor motorway access despite rapid expansion of green-fields development throughout eastern and south eastern Auckland. Commuters therefore have to traverse >10km of busy arterial roads (about the same distance as between Wellington centre and Petone) to reach the already heavily congested Southern Motorway. While an Eastern Motorway has been proposed and has been a key mayoral election issue, the designation of such a motorway has never been agreed. Instead, the current Auckland Manukau Eastern Transport Initiative, AMETI, seeks to improve connectivity to the Eastern suburbs, with increases to bus and road capacity, with a project area spanning the Tamaki Estuary and including Mt Wellington, Panmure and Pakuranga. The project is New Zealand's largest ever non-state highway / local road project, set for completion in 2019 (Auckland Transport 2013).

Table 9 Route Nine: Howick Central to SH1 via Ellerslie-Panmure Highway

	AM 1986	IP 1986	Peak delay 1986	AM 2012	IP 2012	Peak delay 2012	Am Diff	IP Diff	Peak delay diff
Time (s)	1005	693	**312**	1847	923	924	**842**	230	612
Time (m)	17	12	**5**	31	15	15	**14.0**	3.8	10.2
Speed (km/h)	39	57	**-18**	21	43	-22	**-18.0**	-14.3	-3.7
Route length 2012 (km):			**11.0**		**Additional Delay (min/km):**		**1.27**	0.35	0.93

3.9.1 Howick Central to SH1 Comparison

In 2012, travel times on this route almost doubled to 31 minutes for the AM peak and 15 minutes in the interpeak. This represents an additional 1.3 minutes delay per km travelled for the AM peak to reach the SH1 Southern Motorway, with a further 10km to travel to reach the central city.

It should be noted that the results for March 2012 were affected by early works for the AMETI project. However, as the AMETI portfolio of projects will likely cause some disruption through to 2019, the 2012 results are considered a fair comparison for assessing current travel times. The 1986 Report mentions three planned projects; the South Eastern Arterial (which significantly improves east-west connectivity across SH1 but did not yet exist) and two that do not appear to have been built; “the round the mountain link” and a flyover between Ti Rakau Drive and Pakuranga Highway.

4 Context – Auckland's ever-growing population

The key distinguishing feature of Auckland relative to the rest of New Zealand is not only its significant share of population and taxation, but the sustained and on-going population growth of the city. This is not a recent trend, but one that has spanned over a century, and should therefore be a common consideration for all discussion of investment in the city. Planning for the city now should include serious consideration of the growth in population over the next 25 years, just as it should have been a consideration 25 years ago. To put this into context,

Table 10 below provides population growth across New Zealand from 1986 to 2011 (25 years) (Newell and Press, 1993).

Table 10 Growth in Usually Resident Population: 1986 to 2011 (25 years)

Region	Population 1986	Population 2011	Change	% Change	Average change per year
Northland region	122,600	158,300	35,700	29.1%	1,428

Region	Population 1986	Population 2011	Change	% Change	Average change per year
Auckland region	**871,200**	**1,486,000**	**614,800**	**70.6%**	**24,592**
Waikato region	319,500	413,000	93,500	29.3%	3,740
Bay of Plenty region	189,200	277,100	87,900	46.5%	3,516
Gisborne region	45,600	46,600	1,000	2.2%	40
Hawke's Bay region	138,900	155,300	16,400	11.8%	656
Taranaki region	108,100	109,700	1,600	1.5%	64
Manawatu-Wanganui	221,200	232,400	11,200	5.1%	448
Wellington region	390,800	487,700	96,900	24.8%	3,876
West Coast region	34,000	32,900	-1,100	-3.2%	-44
Canterbury region	425,300	560,700	135,400	31.8%	5,416
Otago region	177,600	209,900	32,300	18.2%	1,292
Southland region	103,700	94,900	-8,800	-8.5%	-352
New Zealand	**3,263,300**	**4,405,300**	**1,142,000**	**35.00%**	**45,681**

As indicated by Table 10, Auckland's population has grown by **615,000** people or **70%** since 1986. Not only has Auckland's growth resulted in a significant increase in numbers in absolute terms, but the growth rate itself has outstripped every other region. Since the historic travel time data was collected in 1986, Auckland's population has grown by an average of almost 25,000 people per year. The growth in Auckland represents **53%** the total growth for New Zealand; as a result, the effectiveness in managing Auckland's growth is nationally significant.

5 Findings and their Significance

5.1 General Findings

Given Auckland's population growth, it is perhaps not surprising that one would see some increase in travel time delay. When comparing the road network of 1986 to that of 2012 it is striking how little has changed in terms of the strategic network. With the exception of the Western Ring Route, the CMJ port links, SEART and the Northern Busway rapid transit corridor, there has been very little new development in terms of new transportation corridors.

However, the level of delay is also significant. For every route there was an increase in both AM and interpeak congestion. The scale of this increase differed from route to route, but was observed in all locations. For the arterial corridors, there was a significant decrease in interpeak travel speeds, as increased demand, intensification and peak spread have increased interpeak travel times. This increase in interpeak travel times was not as significant for the motorway routes. This suggests that investment to relieve peak loading has resulted in spare capacity during the interpeak period. The findings relating to interpeak arterial corridor delay also suggests that there may be significant benefits in continued operational investment specifically looking at off-peak signal timings and coordination.

The strategic network is heavily influenced by topographic bottlenecks such as the Waitemata, Tamaki and Mangere crossings. Public transport must also negotiate these topographic bottlenecks, and – as with private vehicles – have the additional constraints accessing the CBD; Fanshawe Street, Symonds Street, the Britomart railway station and the Newmarket rail interchange do not have the capacity to infinitely absorb new passenger vehicle trips to cater for future urban growth. Growth in Auckland will have significant consequence if not managed.

5.2 Average Increase in Delay (based on available data)

For the nine routes studied in this paper, the average increase in delay was found to be **0.93 minutes per km** travelled (**76.55 minutes** total increase in delay across **82.72km** of surveyed routes). It should be noted that this is not the total observed delay on the routes, but merely the difference between the travel times observed in 1986 and again in 2012 for the same routes (i.e. the change in delay).

5.3 Significance

From this comparison of travel times, it is possible to extrapolate the available results to work out a very high level idea of the scale of additional delay for the region. As can be seen from **Figure 2**, the survey routes cover most of the major access points to the central city. If one assumes that the nine routes travelled are therefore representative of region wide trends for trips to the city, it is possible to extrapolate to work out how significant the increase in delay is for the region.

The average distance weighted additional delay was 0.93 minutes per km from 1986 to 2012. While this may not seem like a large number, it soon starts to add up. The scale of the additional congestion can be worked out by comparing the additional delay to the number of vehicles affected.

Transport modelling suggests an average trip length of 11km in the AM peak. Data collected to calibrate the regional models, identified more than 75,000 private vehicles travel into the Auckland Isthmus during the AM peak period, i.e. cross the Isthmus screen lines. (Note, this differs from the total number of trips for the region, in that it only includes trips into the Auckland Isthmus, only the AM peak, and it does not include public transport).

This provides us with the following calculations:

- Average increase in delay of 0.93min/km since 1986 (based on available travel time comparisons)
- Modelled average trip length of 11km
- Average increase of 0.93 minutes x 11km = 10.23 minutes additional delay per vehicle (1986 times relative to 2012 for the same driven routes)
- 75,722 private vehicles travel into the Isthmus during AM peak (2006 observed) x 10.23 minutes = 774,636 minutes additional delay per AM peak
- The 1986 Report suggests the delay it observes is representative of 267 commuter work days. 774,636 minutes x 267 AM peak periods = 206,827,828 minutes, or **3,447,130 hours** additional delay per year based on current level of service & delay as compared to that of 1986.

This figure of roughly **3.5 million hours of additional delay**, provides a very rough idea of the quantum of increase in delay for private vehicle commuters travelling into the central city over the past 26 years. (Note: this is not the total delay for commuters, but the service difference since 1986).

Essentially, this a quantifiable means of assessing the networks decline in level of service to commuters across the 26 year period. This difference is the result of growth in demand overtaking the means to manage the demand – e.g. through investment in capacity, public transport alternatives and ability to manage demand through land use planning, etc. It should be noted also that this is a comparison over a 25 year period. The latest Auckland congestion monitoring report suggests that delay across the region has generally improved over the last few years, so if the comparison had been undertaken in 2005 (for instance) the results might have been an even higher increase in delay.

5.4 Could things be worse?

When observing this increase in delays, one could imagine it is the result of a linear pattern doomed to continue until cars stop moving altogether. This is particularly easy to imagine given the findings that population has increased by **70%** and the average travel times observed in this study have increased by **60%,** suggesting a close correlation.

However, Auckland's average travel speed trends are not as simple as a straight linear progression. While investment in Auckland dropped significantly in 1980s and throughout the 1990s, the last 10 years have seen significant investment in roads and public transport. As major projects have come online, the network benefits have often be suppressed by roadworks relating to the next major project. Activity across the network peaked in 2009 and has started to scale back, giving us an opportunity to begin to see the effects of this investment. **Figure 3** shows this high level trend from the 2012 report (Sakib, 2012) (note; this predates full completion of the Victoria Park Tunnel project).

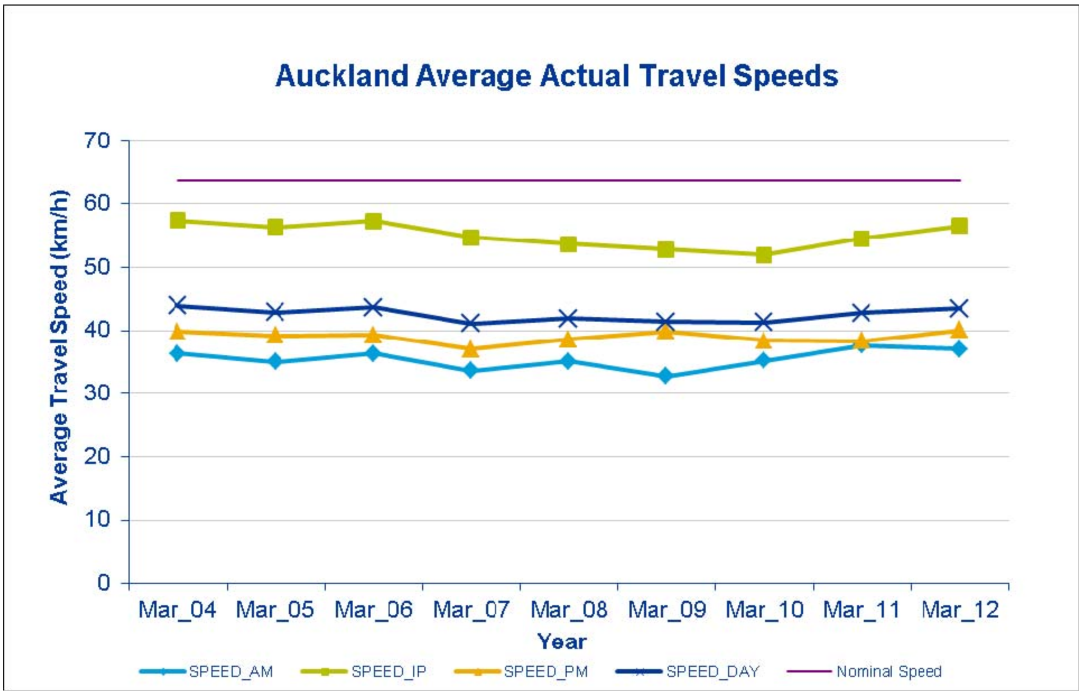

Figure 3 Average Travel Speed Trends in Auckland

As can be seen in **Figure 3**, the result of this investment is that the network level average speed results have remained relatively stable and have actually increased in recent years, i.e. congestion has dropped, particularly in the interpeak period as a result of investment in state highways (arterial speed trends have not seen improvement). Auckland's population growth rate is not expected to slow in the next 25 years. As discussed earlier, Auckland's population grew by 615,000 since 1986, representing a 70% increase in population, but also representing 53% of the nation's increase in population. The New Zealand National

Infrastructure Plan, released by Treasury, suggests that by 2031, Auckland's population will have grown by a further 575,000 people to almost 2 million people (Treasury 2011). So this continued growth cannot be ignored.

6 Conclusions

A comparison of travel times between 1986 and 2012 indicates that, for the routes identified, there is an average increase in delay of **0.93 minutes per km** in the AM peak period and **0.33 minutes/km** in the interpeak. While this may not seem like a lot, to put this into context, the average AM travel time for the studied routes has increased by **60%.**

Based on comparison with modelled trip distance estimates, this suggests an increase in delay of roughly **3.5 million additional hours of delay** per year for commuters heading into Auckland city during the morning commute. This comparison is based on a number of assumptions, including that differences between the two data sets, such as collection methodology, roadworks, seasonal variance, etc, are negligible. This figure also omits trips to other Auckland employment centres, which likely will also have seen an increase in delay (i.e. the 3.5 million hours is only part of the total additional delay for the region). It is also interesting to note that much of this increase in delay has occurred on arterial corridors, with investment in the state highways offsetting much of the growth in demand.

However, it could be worse. Recent investment in the network; public transport, increased capacity and operational improvements (TDM and J-TOC) has offset some of the neglect of the 1980s and 1990s, leading to a recent increase in the region's average travel times. And that these benefits may continue to accrue. These findings suggest that investment in the state highway network has offset growth in demand; with much of the additional delay occurring on arterials. The region's focus on improving operations (sweating the assets) could continue to derive further benefits, particularly if looking at off-peak signal timings and coordination to offset some of the growth in urban arterial delay.

When one considers the observation that Auckland's population is expected to grow by a further **575,000** people before **2031**, the importance of supporting Auckland's transportation needs over the next 25 years cannot be overstated. Failure to invest in the network, manage growth, and provide higher utilisation through public transport alternatives, will inevitably place further strain on a network constrained by topography. Given the significance of Auckland's share of the population, economy, population growth, and its role as the first location that most overseas visitors and migrants see of New Zealand, supporting Auckland's growth is as much a matter of national importance as of local importance.

The question we should be asking is what would happen if we repeat this exercise again in 25 years? Will we be pleased with the results?

REFERENCES

ARTA (2006), *Auckland Passenger Transport Network Plan*, Auckland Regional Transport Authority, Auckland

Auckland Transport (2013), *AMETI* http://www.aucklandtransport.govt.nz/improving-transport/ameti/future-development/Pages/default.aspx

DRAGER, W (1986): *Auckland Arterial Road Network Analysis of Congestion,* Auckland Regional Authority, Auckland

M, Peter (2013): *Auckland Transport Blog,* http://transportblog.co.nz/tag/dominion-road/

NEWELL, James and PRESS, David (1993) *A Report on Recent and Projected Social and Residential Development Trends in the Wellington Region*, Wellington Regional Council

SAKIB, Morsalin (2012): *Auckland Traffic Systems Performance Monitoring Report March 2012*, Beca, Auckland

The Treasury (2011), *The National Infrastructure Plan 2011,* Treasury, Wellington

VALLYON, Chris (2009): *ARTA Corridor Utilisation Pilot Study*, Beca, Auckland