Panmure Roundabout: Future-Proofing Auckland's Transport Vision

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Abstract

The reconstruction of Auckland's Panmure Roundabout is a vital component to realising the ambitious goals of the Auckland - Manukau Eastern Transport Initiative (AMETI), New Zealand's largest, non NZTA- directed transport project. The roundabout currently serves as a bottleneck for vehicles passing through southeast Auckland but is also a high crash area and major severance to the surrounding community of Panmure. The redesign of this single junction will enable the development of a number of significant transport and land use initiatives in the area; including the construction of a long-planned, Transit Oriented Development adjacent to the Panmure train station and New Zealand's first segregated, urban arterial busway. The redesigned intersection will safely accommodate all transport modes, unlike the current roundabout, and include several innovative features to integrate the at-grade, rapid bus network.

Phil Harrison and Dan Ross from Opus International Consultants will discuss the strategic context and technical challenges behind this innovative redesign; including why it matters and why it works.

Introduction

The Panmure roundabout is a major component of the Auckland Manukau Eastern Transport Initiative (AMETI) project, which is focused upon delivering an integrated multi-modal transport system that supports population and economic growth in east Auckland (including the former Auckland City and Manukau City Council areas). This involves providing more and better transport choices and aims to significantly enhance the safety, quality and attractiveness of passenger transport and walking and cycling modes while recognising that not all transport demand can be accommodated by these modes alone.

Planning for the AMETI scheme began in 2005 and its project objectives are:

- Provide for sustainable movement of people, goods and services in a modern, planned and integrated manner;
- Provide connectivity between communities and businesses;
- Promote economic development and the economic and social well-being of communities;
- Provide for Auckland's growth needs;
- Promote good urban design: a sense of place, physical safety and environmental sensitivity, and
- Address travel demand requirements.

The AMETI project includes the following major components as shown in Figure 1:

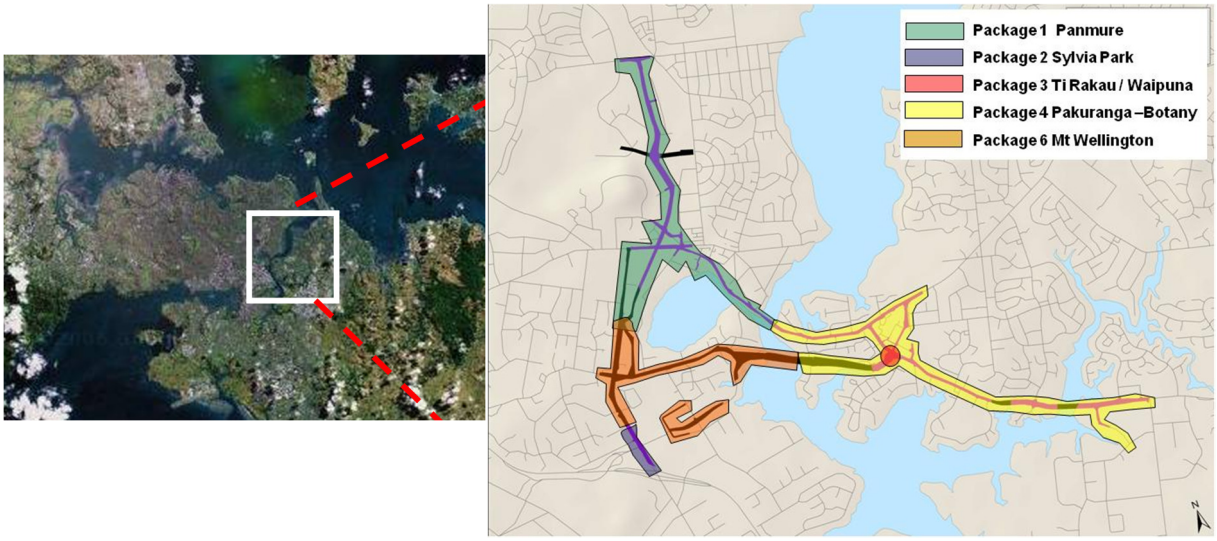

Figure 1 – Overall AMETI Concept of Works

- A new 4-lane arterial road between Mt Wellington Highway and Merton Road;
- Widening of Mt Wellington Highway between SH1 and Triangle Road to a "liveable arterial";
- High quality bus priority between Botany and Panmure and along Mt Wellington Hwy, and
- Capacity enhancements to South Eastern Arterial and Waipuna Road, including grade-separated intersections at Reeves Road, Waipuna Road and Carbine Road.

This paper discusses the context and challenges to the roundabout's redesign as well as the strategies employed by the design team to overcome those challenges and protect the amenity for full pedestrian network access.

Context

Panmure lies on the eastern branch of the Auckland rail network and also at the western end of the proposed Rapid Transit Network (RTN) corridor serving Manukau, East Tamaki, Botany and Pakuranga which, in the short and medium term, will be bus-based (Figure 2).

Figure 2 – Auckland High-Quality Public Transport Plan

Panmure Scheme Stage Proposal

A Scheme Assessment for the Panmure package of the AMETI project was completed in 2009 and the scheme was divided into three phases of implementation:

- Phase 1: New road connecting Mt Wellington Highway with Morrin Road
- Phase 2: Panmure roundabout reconstruction and Panmure Busway – replacement of existing roundabout with signalised intersection and urban, arterial busway to Botany via the Panmure Bridge. The redesign will be made possible by the construction of the Phase 1 road, which will remove 40% of the roundabout's current traffic.
- Phase 3: Extension of Phase 1 road to Merton Road

The three phases are shown in Figure 3.

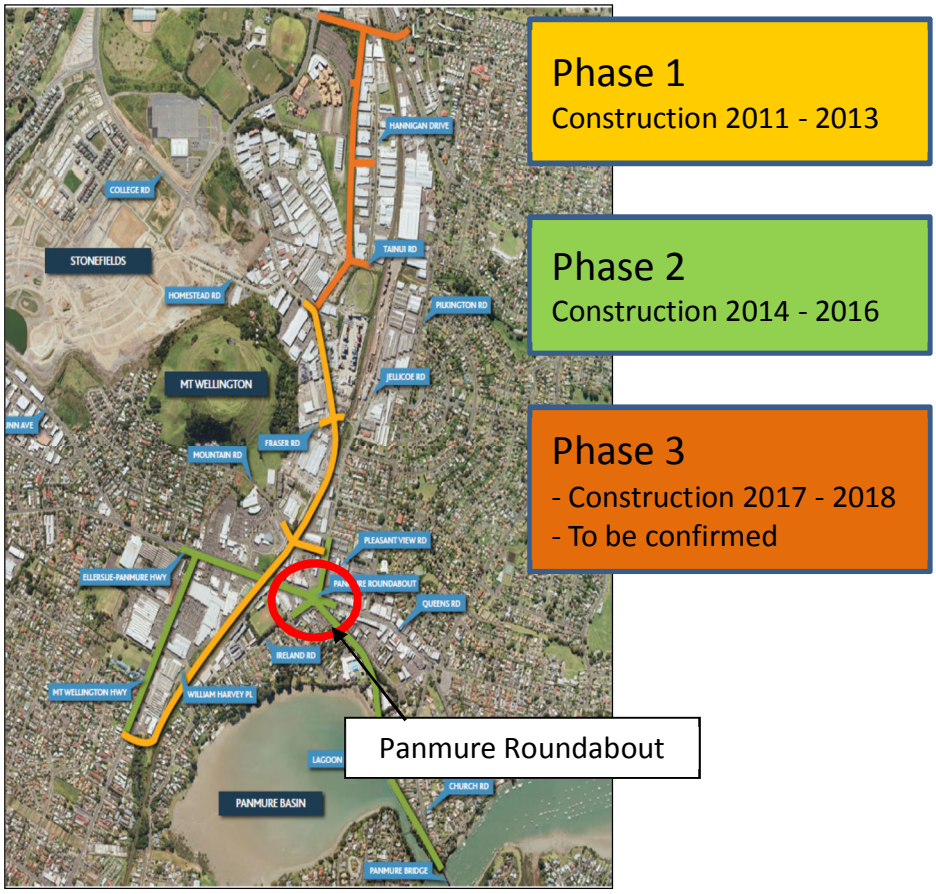

Figure 3 – Panmure Area Works Phases

Panmure Roundabout

The roundabout forms a critical junction in east Auckland with significant site constraints and 40,000 vehicles per day. It is sited 1km west of the northernmost bridge over the Tamaki River and halfway between the Panmure Basin and Mount Wellington Domain. Geographic constraints, in addition to the historic development of the local road network, force almost all traffic within southeast Auckland to pass through the roundabout.

The redesign of the intersection is one of the fundamental elements of the entire AMETI project. Council and AMETI Planners have long identified the existing roundabout as a hindrance to improved traffic and land use outcomes in southeast Auckland. The new roundabout will advance local AMETI and Council objectives by:

- Enhancing connectivity – The current roundabout is a major obstacle to pedestrian movement;
- Providing a safer environment – The roundabout is currently one of the highest crash areas in Auckland;
- Prioritising public transport – The roundabout currently has no bus prioritisation; and
- Reducing congestion and increasing productivity – The current roundabout experiences major congestion which constrains productivity.

Among the most crucial objectives of the redesign is the provision of pedestrian crossing amenities. At present, the four crossing points (Figure 4) which do exist are indirect and do not adhere to any pedestrian desire paths. For example, a pedestrian travelling from the intersection of Mountain Road and Ellerslie Panmure Highway (EPH) to the intersection of Queens Road and Jellicoe Road must walk 195m though the desire path distance is only 80m.

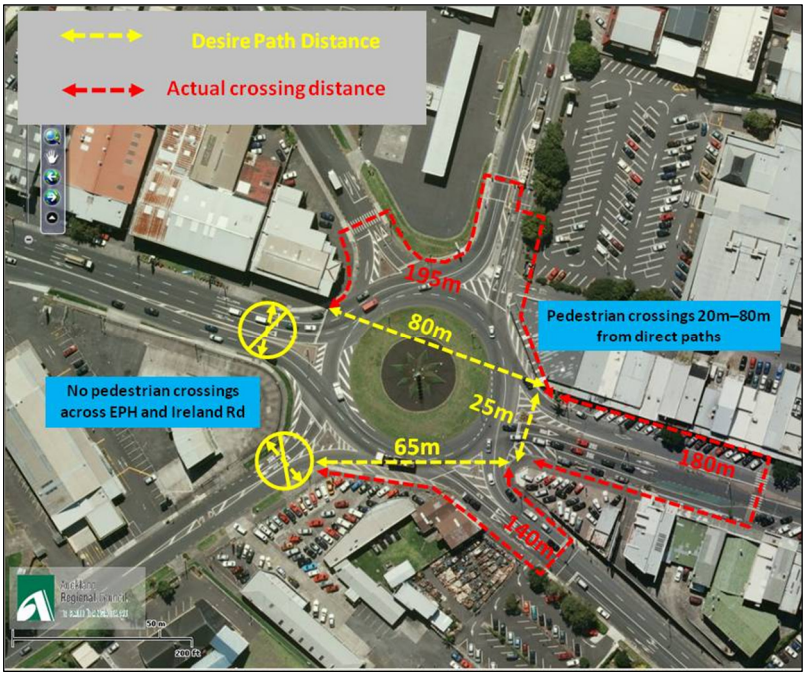

Figure 4 – Pedestrian Crossing Paths Across the Roundabout

A 2010 study of the roundabout and town centre area demonstrated a significant catchment for pedestrians that do not or cannot currently access the town centre by any other means than private car. Several information days have confirmed that many individuals will drive across the roundabout rather than walk simply because of poor-quality pedestrian provision.

Previous Designs

Several redesign concepts have been proposed since AMETI's 2005 inception which have resulted in a firm set of design principles that address community concerns and strategic constraints. The redesign has always sought a balance between retaining as much existing network connectivity as possible while providing the project sponsors' main strategic objectives. This was achieved by:

1. Securing the strategic requirements to achieve a desired concept and
2. Refining operations through development of options.

Early and extensive feedback from local residents and business operators quickly demonstrated that any redesign must maintain most existing connections. Furthermore, the Auckland Regional Transport Authority (ARTA) established that the principle transport route would be Lagoon Drive-EPH, rather than Queens Road – EPH, which is the current priority alignment. Later, ARTA determined that the corridor would need to provide a greater level of passenger transport amenity than planned.

The earliest redesign concepts were developed from the project sponsors' strategic objectives that partially sought to simplify movements by removing one or more of its six approaches. Reducing the number of intersection approaches would free up more green time for the newly-prioritised movements and provide greater intersection capacity. These were then submitted to public review via a series of Information Days where local preferences were gauged.

Two of these early concepts, shown in Figure 5, attempted to achieve this by removing the Ireland Road and Jellicoe Road approaches from the intersection. While these concepts managed to improve intersection capacity, they were opposed by local residential and business stakeholders who insisted on maintaining access to and from those north-south approaches.

Figure 5 – 2006 Redesign Concepts

Based largely on publicly-identified constraints, further designs in 2008 and 2009 attempted to retain as many existing movements as possible while realigning the intersection for Lagoon Drive – EPH priority. While these concepts successfully addressed lessons from the previous round of designs, they were difficult to manage from both an operations and safety perspective.

Agreed Concept

The general concept shown on the left of Figure 6 was adopted as the option which best aligned with locally-identified requirements, the redesign's strategic objectives and the most technically sound design. Most of the existing movements continued to be provided, it realigned the movement priority from Queens Road to Lagoon Drive and it provided for pedestrian movements across all legs along reasonably direct desire paths.

Though this concept achieved most of the strategic requirements, there were still two major issues to resolve. These are outlined and expanded upon further below:

- In 2009 ARTA upgraded the corridor from a QTN to an RTN. The kerbside bus lanes were no longer sufficient for the designed level of public transport provision required, and
- It needed refined capacity analysis to analyse pedestrian-induced delays.

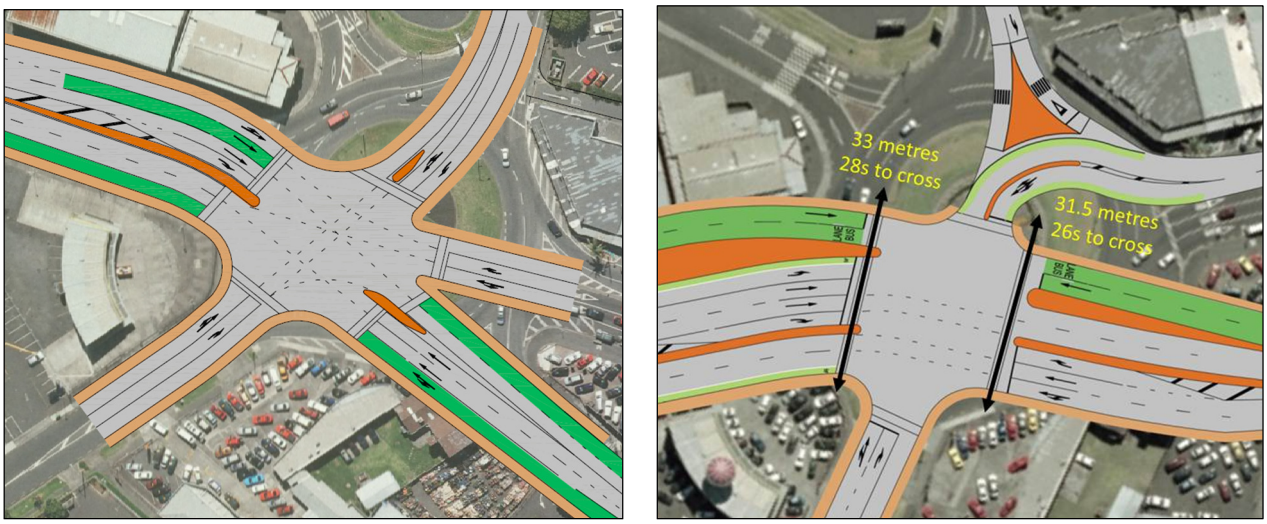

Figure 6 – Approved Strategic Concept, Pre Busway (left) and Post Busway (right)

1. Panmure Busway and Rapid Transit Networks (RTN)

In 2008 ARTA commissioned McCormick Rankin Cagney to produce a Bus Staging and Implementation Study for the AMETI project, in particular for the corridor between Panmure and Manukau. This study (McCormick Rankin Cagney 2009) utilised the Auckland Regional Council's Auckland Passenger Transport (APT) model to forecast patronage growth along the RTN corridor between 2016 and 2041.The report forecast AM peak "inbound" bus patronage on the section between Pakuranga and Panmure to be about 3,300 passengers per hour in 2016 and 6,700 per hour in 2041. The report noted that the threshold for the installation of an RTN facility is about 1,800 patrons per hour and therefore the corridor should be reclassified as an RTN. At this point, buses carry as many patrons as normal travel lanes and require a separate facility to minimise conflicts and delays.

What is an RTN?

An RTN is the highest level of passenger transport amenity provided in Auckland. In ARTA's 2006-2016 Passenger Transport Network Plan (PTNP), an RTN is defined as:

- "…a high frequency, high quality service operating on "transport spines" that does not get held up by road traffic congestion", and
- "…fast, high frequency service in its own right of way where it is unaffected by traffic congestion."

The designation of the EPH-Lagoon corridor as an RTN resulted in the design team reconsidering the operational suitability of the kerbside bus lanes. Because kerbside lanes are shared with left-turning vehicles and subject to limited operation hours and other vehicle conflicts, they could not adequately accommodate the newly-forecast patronage figures.

Revised Busway Concept

In response to this new condition, the design team created the Panmure Busway, a 1.2km dedicated busway proposed to run along the north side of Ellerslie Panmure Highway and Lagoon Drive from Forge Way in the west to Panmure Bridge in the east. The updated roundabout concept shown in Figure 6 shows how this was integrated into the redesign. Though busway traffic will not be entirely separated from the roadway infrastructure (it is still subject to signals), all conflicting movements, including driveways, are removed.

The concept on the left of Figure 6 differs from the right concept in the merging of the previous north (Jellicoe Road) approach into the northeastern (Queens Road) approach. This change was enacted to provide greater east-west priority for vehicle movements, including the busway, and to reduce conflicting movements.

2. Modelling for Pedestrians

With the general intersection concept approved, its operational feasibility needed confirmation. The design team assumed that additional changes would be required upon confirmation of further testing results and development of options. The most challenging of these refinements was the inclusion of pedestrian crossings at all legs in a manner which minimised vehicle delays.

As stated previously, one of the main redesign objectives was to provide pedestrian crossings as close to footpath-connecting desire paths as possible. However, the Lagoon and EPH crossings are between 31.5m and 33m long (Figure 6). At an assumed pedestrian walking speed of 1.2m/sec, and including a minimum 5s 'green phase' for pedestrians, the total amount of time required for the pedestrian phase across these legs is between 30s and 35s. When the signal time required for the north and south leg pedestrian phases, Ireland Road, Queens Road and EPH/Lagoon Drive right turn phases are added in, the 'priority' east-west movements (including the RTN Busway) are only provided with 10s – 20s per

120s cycle. This is insufficient amount of time to process the average peak period flows on the EPH and Lagoon Drive approaches and would result in larger queues and delay times than are currently experienced. The design team accepted a level of reduced vehicle capacity to provide full pedestrian mobility and other redesign objectives, but the amount of remaining time for the heaviest east-west movements was deemed unacceptable.

Further Refinements and Testing

The most obvious compromise to reduce the impacts of the EPH and Lagoon Drive crossing distances was to stagger them. By dividing the pedestrian crossing time into more than one phase, vehicle delays across the priority alignment are reduced.

The intersections new, main alignment processes not only the east and-westbound vehicles, but an entirely separate path for buses. The stagger pens' location could not overcomplicate or unduly restrain these movements and still had to be accommodated within the designation constraints on the north and south sides of the roads. Three different forms of staggered crossings were tested in SIDRA using inputs taken from established, larger area SATURN models and compared for site constraints and operational performance.

Option 1 – A 2-stage stagger located between the general traffic and Busway lanes
Option 2 – A 3-stage stagger across EPH and 2-stage across Lagoon
Option 3 – An alternative 2-stage stagger across EPH with pen located between e/b left and e/b through lanes

Options 1 and 3 are shown in Figure 7. Pedestrian staggered crossings were recognised as not ideal from a pedestrian's perspective, but the decision to include them was rationalised as a compromise required for the feasibility of the pedestrian crossings given standard NZTA funding parameters and a vast improvement over the current situation.

Option 1 – Vehicle Lane / Busway Stagger Point
This testing option reduced the initial pedestrian crossing distance by approximately 8.5m on both sides of the roadway and reduces main alignment vehicle delays by only 7 seconds compared with the single crossing phase.

Figure 7 – Option 1 (left) and Option 3 (right)

Option 2 – 3-staged pedestrian crossing across EPH

This option kept the same staggered crossing point across Lagoon Drive. Across EPH, staggered points were posited within the eastbound and westbound general vehicle lane median as well as the median between eastbound vehicles and the busway. This option was not draughted, but was modelled to simulate the impacts of three separate, 8m – 16m long crossing stages.

Option 3 – Alternative 2-stage crossing

This option was developed as a compromise. It produces two staggered crossings of closer to equal length than in Option 1 but with less complexity and fewer steps than Option 2. This option is made possible by the fact that the eastbound left turn lane will often run separately from the through (car and bus) movements. Unlike Option 1, this pedestrian phase is not therefore always dependent on a red phase for the dominant east-west vehicle movements.

Evaluation

The options were evaluated based on their feasibility constraints and relative operational performance. As shown in Table 1 and Table 2, Option 2 provided the best overall intersection performance from a capacity perspective. This is not surprising, as it produces the shortest vehicle delays. However, this option had several design drawbacks which eliminated it from further consideration:

- It would require an extra 2.0m of carriageway width for a 2nd stagger area, and
- It would require additional signal infrastructure and complicate the crossing.

Had the SIDRA results been more heavily in favour of Option 2 it may have been further considered. However, relative to options 1 and 3, it does not provide adequate vehicle benefits to compensate for the extra burden to pedestrians, extra infrastructure requirements and additional width needed.

Table 1 – Redesign Options Performance Criteria, AM Peak

	AM peak 2009	AM peak 2026		
Measure	Existing Roundabout	Option 1	Option 2	Option 3
Deg. Saturation (v/c)	1.109	0.909	0.873	0.876
Average delay (s)	54.5	49.5	46.0	47.6
95% queue distance (m)	536.7	221.6	193.3	198

Table 2 – Redesign Options Performance Criteria, PM Peak

	PM peak 2009	PM peak 2026		
Measure	Existing Roundabout	Option 1	Option 2	Option 3
Deg. Saturation (v/c)	1.089	0.918	0.847	0.871
Average delay (s)	33.9	54.6	48.2	50.3
95% queue distance (m)	277.8	247.5	221.5	227.1

Between the remaining options, Option 3 performs better and was the preferred option. Compared even to existing (2009) performance criteria, it has a lower peak-period vehicle/capacity ratio, shorter queuing distances and fewer vehicle delays in the AM peak.

Next Steps

The Final Design of Panmure Phase 2 will be delivered in mid 2012 and a funding package to NZTA assembled upon the completion of the remaining busway works in Pakuranga. Compared against the 'Do Minimum' scenario, the redesign provides obvious additional benefit to all modal users. These benefits will be thoroughly documented for the entire busway corridor and a positive BCR will enable ongoing funding priority for this crucial AMETI phase. Land take and consents will be acquired throughout 2013 and construction is tentatively scheduled to run from 2014 to 2015.

Summary

The reconstruction of the Panmure Roundabout is a critical element of AMETI. Project sponsors have long acknowledged that the roundabout's existing crash rate, vehicle delay, pedestrian and cyclist severance and overall inefficiency cannot continue.

The redesign process has been accomplished in two stages. To address local and operational requirements, the design team first developed a general design concept based on local input and sponsor requirements. Afterwards, the concept was refined to provide a suitable compromise between pedestrian, cyclist, car and bus capacity requirements. The result is a beneficial and highly feasible design which will be included in a 2012 funding application.

BIBLIOGRAPHY

Auckland Regional Transport Authority. (2006). Passenger Transport Network Plan 2006-2016.
McCormick Rankin Cagney. (2008). Bus Staging and Implementation Study, AMETI Corridor 2016-2041.