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PRACTICE PAPER

DEVELOPMENT OF A TRANSIT LANE NETWORK FOR AUCKLAND

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ABSTRACT

In Auckland as in most growing cities across the world, there is a need to enable the safe and efficient movement of people across the network and city. This can no longer solely be in the form of moving cars, but more and more through enabling more people to get from A to B be it in the same number of cars and or buses. Auckland Transport has developed a process whereby the most efficient means of getting people from A to B can be assessed and implemented in a consistent manner across the Auckland network, resulting in lane configurations on key corridors that align with strategic direction and yet best suit current operational patterns and demands This process is captured in the Auckland Transport Code of Practice (ATCOP Chapter 5.1) and is the basic stepping blocks for establishing clearways, T2 or T3 transit lanes or Bus Lanes on the Auckland network.

For Auckland there is an ambitious target to roll out 45km of bus/transit lanes across the road network over three years. We are currently in year two! An enlightening journey taking Auckland into the future.

INTRODUCTION

In Auckland as in most growing cities across the world, there is a need to enable the safe and efficient movement of people across the network and city. This can no longer solely be in the form of moving cars. With increasing demand for travel and limited opportunities for increasing capacity within urban areas, there is a need to make more effective use of the available road space. An effective approach is to introduce bus and transit lanes on key routes.

The Bus and Transit Lane Review: Planning and Implementation Model for Auckland, July 2011 document produced by Auckland transport was endorsed for application by the Auckland Transport Board in July 2011. This has since been adopted into the Auckland Transport Code of Practice (ATCOP Chapter 5.1) and is the basic stepping blocks for establishing clearways, T2 or T3 transit lanes or Bus Lanes on the Auckland network.

The overall objective is to ensure that all bus and transit lanes introduced effectively enhance the overall performance of the particular route, and that these conform closely to standard templates, no matter who has completed the design or where they are located within the Auckland region.

The document set out to establish two key elements related to bus and transit lanes; namely:

- A policy that aligns with strategic planning objectives and provides an analytical basis for the implementation of bus and transit lanes for the Auckland region;
- Standard templates for bus and transit lanes, generic to all locations, to be used for bus and transit lanes across the Auckland region.

This presentation describes part of this journey; in particular why the need for an analytical approach and how it has been applied for the implementation of bus and transit lanes on the network.

For Auckland there is an ambitious target to roll out 45km of bus/transit lanes across the road network over three years. We are currently in year two, and on an enlightening journey taking Auckland into an efficient and sustainable future.

WHY – SETTING THE SCENE

The adopted policy provides both transparency and guidance to the implementation of appropriate bus or transit lanes, and looks to balance current traffic operations with strategic aspirations, without unduly compromising either. The policy includes assessment criteria and a decision flow diagram developed to simplify the assessment process, with a purpose to better inform decision-making around the performance of bus and transit lanes. This has been further developed into an assessment tool that allows for assessment and sensitivity testing to be undertaken.

Future growth is inevitable, and economic growth can be supported and enhanced through an effective and reliable transport system. Auckland is currently home to 33% of NZ's population, increasing at 1.5% per annum, and is expected to comprise 40% of NZ's population by 2041.

International research shows successful, modern nations are sustained by prosperous and successful cities. Successful cities in turn require transport networks and systems that move people and goods as effectively and efficiently as possible, and in a way that is sustainable going forward. In terms of people movement, this translates to an effective and efficient public transport (PT) system that is able to accommodate the future demands of a growing city.

The Auckland Plan is the city's leading strategic document, and the Integrated Transport Programme (ITP) has been developed by Auckland Transport and the New Zealand Transport Agency (NZTA) in collaboration with Auckland Council to give effect to the Auckland Plan's vision. The Plan includes a number of outcomes, transformational shifts and strategic directions that are directly relevant to Auckland's transport system. The ITP's strategic framework was also developed in reference to the Government Policy Statement on Land Transport Funding (GPS). The GPS 2015 sets out central government's outcomes and priorities for the land transport sector. Its overarching goal for transport is –

"To contribute to an effective, efficient, and safe land transport system in the public interest".

Based on the GPS 2015, a land transport system is:

- effective where it moves people and freight where they need to go in a timely manner
- efficient where it delivers the right infrastructure and services to the right level at the best cost
- safe where it reduces the harms from land transport
- in the public interest where it supports economic, social, cultural and environmental wellbeing.

In response to these strategic requirements of Auckland Council and central government, the ITP proposes two major strategies to meet the priorities in the Auckland Plan. These are the:

- Management of transport as One System and,
- Development of a transport programme to 2041 (using a four staged intervention process).

The One System approach provides for the management and planning of transport networks with land use development as outlined in the Auckland Plan, and together with the four staged intervention process will result in:

- Better use of existing transport networks
- Better alignment of transport provision with changing patterns of land use and demand
- A safer, more resilient national and regional network, where a greater range of resources and options is available to deal with unexpected events or future changes
- Better alignment of effort between network providers and elimination of overlap and duplication

While much has been achieved in recent years to improve the capacity and safety of Auckland's transport networks, the system remains highly reliant on a heavily used road network and demand for travel is expected to increase significantly as the city's population grows rapidly.

Looking ahead 40-50 years, Auckland's transport system will require a PT network that can carry at least 200 million passenger trips annually between regional centres, at high frequencies with reliable travel times. The Auckland Plan sets challenging patronage targets, while transport modelling for the Integrated Transport Programme highlights the critical importance of dramatically improving Auckland's PT network to avoid future gridlock.

To achieve these objectives, the Rapid Transit Network (RTN) is to be expanded and greater ease of travel for PT on several key arterials is to be provided particularly on the PT Frequent Service Network. By having regional routes comprising only general vehicle lanes, means that the people movement capability remains relatively capped and limited. With road widening opportunities largely limited, increased efficiency of the available road space can best be achieved by increased PT patronage and increased vehicle occupancies.

Enabling greater ease of travel for these higher occupant modes through the implementation of bus and transit lanes, significantly enhances the road network efficiency in terms of the movement of people through the network. It is in this context that bus and transit lanes are both beneficial and necessary, both now and into the future.

WHERE DO WE START

Increased road network efficiencies would generally be required where there are current or expected deficiencies. This may be routes with or without PT services. In terms of the latter, typical experience is that travel times increase with increased demand, resulting in diminishing efficiencies as travel speeds drop below optimal capacity speeds. Where these routes include PT services, the deficiencies are further compounded with buses generally travelling at even lower speeds, unless some priority measures are implemented.

One of the key strategies identified in the ITP is the development of a principal PT network to efficiently accommodate PT demand into the future. This would in turn enable a more efficient transport system. In broad terms, the PT network comprises the following elements:

- Rapid Transit Network (RTN), which consists of the rail network and the Northern Busway,
- PT Frequent Service Network (FSN) comprising extensive bus networks with high frequency of services throughout the day,
- Connector PT Network, providing area-wide coverage and connecting to the RTN and/or the FSN
- Local Connector Network (LCN), primarily local bus services.

The main implications would be for in-corridor bus services especially on the FSN which is quite extensive and is likely to need priority measures. Similarly, some Connector services and peak-only services on specific corridors may also warrant priority measures.

On PT emphasis routes, it is anticipated that bus lanes will be implemented at some stage in the future, if not already present. In the longer term, it is likely that a significant number of primary arterials will have bus or transit lanes, given the higher people carrying capacity of these lanes.

HOW DO WE BEGIN – ASSESSMENT

With increasing demand for travel and limited opportunities for increasing capacity within urban areas in Auckland, there is increasing pressure to ensure that effective use of the available capacity on the road network is made. This is particularly relevant with respect to the introduction of bus lanes, since the related road network or road corridor efficiency is not always apparent to road users and the general public. It is therefore important to apply a methodology that attempts to demonstrate the appropriate bus or transit lane configuration for a particular road corridor that looks to optimise corridor efficiency.

The following four criteria are used to enable an appropriate assessment to guide decision-making in this regard. It is important to understand that calculations in this respect are not straight forward, due to at times complex variations in traffic patterns and composition that are induced with the implementation of bus or transit lanes.

Firstly, a shift in modal split can take place and the extent thereof varies depending on the characteristics of the affected traffic and the particular network. Secondly, there is commonly a shift in travel patterns, resulting in additional traffic being attracted and/or diverted to alternative routes in the immediate road network. Localised traffic modelling can greatly assist in this process.

Either way, some assumptions and sensitivity testing regarding the extent of modal shift and induced traffic related to an alternative bus or transit lane configuration, is necessary.

Notwithstanding the above, the following assessment criteria are applied, and the assessment process can be facilitated by applying the decision flow diagram that follows.

1. Alignment with Strategic Transport Plans and the Network Operating Plan (NOP)

Given the underlying objective to enable an effective PT system and transport system as a whole, there is a requirement to refer to strategic transport planning objectives and strategies for Auckland. This captured in the Network Operating Plan (NOP), and so efficient provision for public transport is sought on key PT routes.

This effectively implies that corridors identified as part of FSN and Connector network are likely to have bus lanes at some point. However, the timing thereof will be dependent on the efficiency of the corridor and current operational performance of PT.

2. Characteristics of the Route

The NOP considers the current and planned PT routes; however a key consideration is the number of buses on the route. In broad terms, where there are 15 or more buses per hour on a route, 'special treatment' for buses on this route would be likely to be needed.

In terms of the provision of bus lanes, it becomes increasingly justifiable as the number of buses on a corridor increases to 20 or more buses per hour during the peak and most likely a necessity should there be 25 or more buses per hour. This in any event plays itself out in the corridor productivity assessment to follow.

Where a route is not on the FSN and it is becoming increasingly congested, road widening may not always be practical or desirable. The only means of increasing efficiency/productivity would be through the use of a T2 or T3 lane, as appropriate.

Measurement and reporting of the performance of the Auckland network in terms of corridor productivity has been adopted by Auckland Transport and Auckland Council in recognition of the fact that reducing travel times for vehicles will not always be achievable, whereas increasing people-movement efficiency is possible.

The latter in essence relates to the corridor productivity assessment discussed in this presentation, and forms an important driver for the development of a Bus and Transit Lane Network for Auckland.

3. Analytical Assessment – Two Main Components

3.1 Travel time or Level of Service (LOS)

Travel time by mode, or travel speed, which is related to Level of service (LOS), is an important factor to consider. The Association of Australian and New Zealand Road Transport and Traffic Authorities (AUSTROADS), and the Highway Capacity Manual provide guidance on the level of service (LOS) for urban and suburban arterial roads with interrupted traffic flow conditions.

These are described and categorised in terms of travel speed as follows:

Level of Service (LOS)	General description	Average travel speeds
A	Generally free flow traffic conditions. Vehicles are unimpeded in manoeuvring in the traffic stream, with little travel delays.	90% or above the free flow speed (or sign-posted speed limit)
B	Relatively unimpeded operation. Manoeuvring in the traffic stream is only slightly restricted and travel delay is low.	70% to 89% of the sign-posted speed limit.
C	Stable operating conditions but with manoeuvring becoming more restricted and motorists experience some driver discomfort and delays.	50% to 69% of the sign-posted speed limit.
D	Conditions border on becoming unstable with increased delay and lower travel speeds. Manoeuvring is becoming difficult.	33% to 49% of the sign-posted speed limit.
E	Conditions are unstable and characterised by queuing and significant delays with further reduced travel speeds. Manoeuvring is very restricted. Stop-go conditions are typical.	20% to 33% of the signposted speed
F	Conditions are characterised by excessive congestion and delays with very low travel	Less than 20% of the sign-posted speed limit.

Table 1: Level of Service for Urban and Suburban Arterial Roads

Based on the NOP and work undertaken by Auckland Transport around the development of an overall network performance framework, it is desirable to enable a LOS of B or C for buses on PT network routes. This LOS depicts acceptable conditions with only moderate delays and therefore relatively favourable conditions during operation.

A key consideration relating to LOS is the travel time reliability. A LOS B or C is also desired for buses on the FSN in terms of reliability.

Consequently, where buses experience a poor LOS on an identified FSN or Connector route, bus lanes may be necessary to improve the LOS for PT movement on this route. Alternatively, should the LOS be acceptable, there may be no need to introduce bus lanes at this stage.

In this regard, increased efficiency for the route through the implementation of a T2 or T3 transit lane may be an option and may therefore be considered.

In terms of the NOP and overall network performance framework, general traffic and freight on arterial routes should ideally operate at LOS C or D (or better) during the peaks. This is based on resultant excessive delays and inefficiencies that would otherwise occur under more congested conditions associated with a LOS E and F. In such instances, there may be scope to increase corridor efficiency/productivity through the introduction of a transit lane, particularly in conjunction with a car-pooling strategy for the route.

3.2 Corridor Productivity or Efficiency

Corridor productivity of the route is defined by AUSTROADS as the product of speed and vehicular flow. A high productivity is achieved if both speed and flow are maintained near maximum values. AT have expanded on this measure and translate productivity in terms of people movement. This in turn is a better alignment with GPS 2015, Auckland Plan and the ITP.

A second important factor in this regard is expressing corridor productivity as an average by lane. This highlights the efficiency of people movement no merely based on how many people a corridor can carry, but how efficiently in terms of road space it does so.

Corridor productivity is therefore calculated by multiplying the number of person trips with travel speed, expressed as an average by lane for the corridor. As such, the higher the number of person trips accommodated by lane per hour, or the higher the corridor productivity, then the more efficiently the route is operating.

AUSTROADS suggest that a value of approximately 31,000veh-km/h per lane be used as a benchmark to reflect favourable corridor productivity or efficiency of an arterial corridor. This value relates to a speed of 35km/h (LOS B) and a vehicular flow of 900veh/lane.

This translates to 38,000person-km /h per lane, when applying an average occupancy of 1.2 persons per vehicle.

This measure expressed as people movement productivity reveals the benefit of increased average vehicle occupancies, increased movement of T2, T3-related vehicles and bus movements.

With many arterials operating at capacity (LOS E with speeds lower than 35km/h), increased demand with no change in vehicle occupancy is likely to exacerbate traffic breakdown conditions, resulting in the potential lowering of the current productivity ceiling of corridors, and therefore the network. On the upside though, by enabling transit and bus lanes where appropriate, the ceiling is significantly raised enabling even the ‘ideal benchmark’ of 38,000person-km/h per lane to be exceeded.

By way of comparison, 20 buses travelling at the same average speed, with occupancies of 55 passengers per bus, surpasses this productivity benchmark, and demonstrates the significant potential buses have in exponentially increasing productivity along a corridor.

Another way of describing this is to note that the efficiency of a bus lane with 20 well-occupied buses will always be greater than the alternative of allowing that lane to be filled with traffic.

As an example, Dominion Road currently carries 34 buses in the morning peak hour. With the addition of a further 6 buses, the bus lane on Dominion Road will have the potential to operate at a productivity or efficiency, of double the 38,000 person-km/hour per lane benchmark. To achieve the same productivity without the bus lane, there would effectively need to be two additional general lanes added to the Dominion Road cross-section.

More importantly, the corridor productivity assessment of alternative bus or transit lane configurations provides a very useful and informative means of comparison.

Furthermore, the potential capacity of various alternative lane configurations is now also able to be assessed, and can highlight the potential to increase the efficiency of a corridor that have well patronised bus or transit lanes.

Important factors in considering alternative lane configurations for a given corridor are:

- Determining likely travel speeds of traffic streams under alternative lane configurations
- Understanding what the corridor capacity is
- Understanding the likely changes to traffic composition under the alternative lane configurations.

Through observation there has been some understanding gained. With respect to travel speeds, traffic modelling outputs or documented Speed-Flow curves can be used to assist in this process. Generally, travel speeds on a route vary based on specific conditions and characteristics of the route ranging from lane widths, road-side friction, road geometry, road environment, traffic signal density and traffic flow conditions of adjacent lanes. In general terms, travel speeds decrease with increased number of vehicles in the lane, increasingly so as volumes increase beyond 250 vehicles per lane.

The latter is further affected by the capacity of the corridor, which tends to be largely determined by intersection capacity. In these instances, a bus or transit lane effectively functions as queue-jumping mechanism. An added complication is that the higher the use of the bus or transit lane, the greater the adverse impact on the adjacent general lane.

By way of example, changing the bus lane on Tamaki Drive to a T2 lane in 2010, resulted in a 5 to 10% increase in T2 traffic, with a similar reduction in single occupancy vehicle traffic over the peak hour, and indicated an attraction of some additional T2 vehicles from adjacent routes of the network. Most noticeably however was that travel speed on the general lane reduced significantly by 8 to 10 km/h.

Comparison of the corridor productivity for the existing lane configuration against alternative proposed arrangements therefore highlights which arrangement is more efficient.

Of particular significance for PT network routes, is the comparison of the efficiency of a bus lane to that which could be achieved by a T2 or T3 lane. If the bus lane performs well in terms of number of buses and patronage, implementation or continued operation of the bus lane will be comfortably justified.

On the other hand, if corridor productivity for a bus lane is lower than that for a T2 or T3 lane, this generally highlights under-performance of the bus lane or PT corridor, primarily associated with low bus frequencies, low patronage and poor operations in terms of travel times achieved on the route.

Under these circumstances, three options are recommended:

- Look at ways of improving bus operations or patronage – so that it operates as an efficient PT emphasis route,
- Review the PT network status of the route, and address the route as a general vehicle emphasis route, or
- Consider a T2 or T3 transit lane, provided the bus LOS is retained at B or C. This effectively achieves the primarily objective of PT emphasis or PT network routes, which is to provide relative ease of travel for PT on these routes, whilst affording additional benefit to higher-occupant vehicles on the corridor.

For general lane situations, the lane configuration resulting in the higher corridor productivity can be considered for implementation. This is particularly the case when comparisons of alternative bus or transit lane configurations exhibit a marked increase in corridor productivity, preferably a difference of 10% or more in relation to the benchmark, between the alternative configurations. A difference in corridor productivity of less than 5% is considered insufficient to justify a change from the current lane configuration, unless additional drivers support a change.

Undertaking additional surveys is recommended to ensure that the outcomes of the assessment are sufficiently robust and representative of typical traffic conditions for the route. When assessing alternative configurations, sensitivity testing of key parameters is also recommended to confirm the implied outcomes, given the sensitivity of the analyses to fluctuations in travel speeds, traffic compositions and occupancies. In doing so, a relatively consistent and constructive approach to operating the road network would be attained.

4 Road Safety

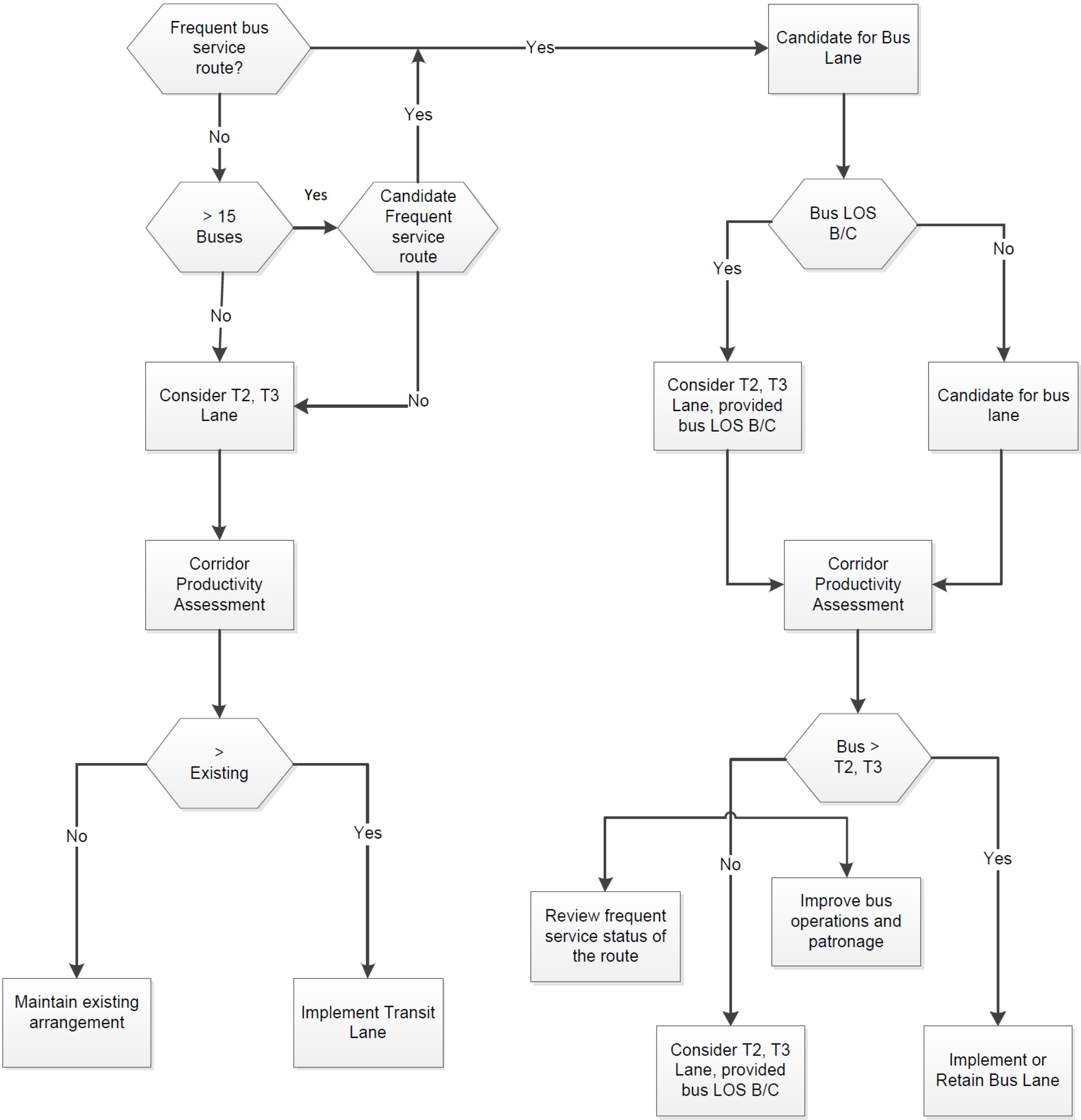
Road safety continues to be a key consideration – albeit potentially generic, and potentially primarily related to lane widths and intersection treatments. Higher speeds and increased traffic volumes on a transit lane may be a concern, particularly with regards to cyclist safety, although research to date has not shown this to be a real concern.

This falls outside the scope of this presentation.

DECISION FLOW DIAGRAM

The assessment criteria can be combined into the following decision flow diagram, to simplify and align decision making to balance current traffic operations with strategic aspirations, without unduly compromising either.

Initial direction is therefore provided by the strategic emphasis of the route, and is carried through the assessment analyses.



CURRENT PRACTISE IN AUCKLAND

At present, corridor productivity assessments are undertaken on an annual basis across all bus and transit lanes on the Auckland network. Reasons for this are two-fold:

- Confirm that the existing lane arrangement for the corridor is still appropriate
- Highlight which corridors have opportunity for improvement, and are to be more closely monitored.

The corridor productivity approach has been the primary measure considered. With the new FSN roll-out currently underway, there is now additional focus on the LOS performance of the FSN in terms of both travel time and travel time reliability, given that these measures are key elements for a successful PT system.

THE NEW APP

With Auckland's ambitious target to roll out 45km of bus/transit lanes across the road network over three years, there is a need to run through these assessments on a regular basis. Given the increased demand for these assessments, AT have developed an app that enables differing lane arrangements to be assessed in terms of corridor productivity or efficiency.

CONCLUSION

Development of a Bus and Transit Lane Network for Auckland is providing Auckland and opportunity to better enable the safe and efficient movement of people across the network and city.

The current ceiling in the form of moving people in cars is able to be lifted more and more through enabling more people to get from A to B albeit in the same number of vehicles and buses. This process seeks the most efficient means of getting people from A to B, enabling a consistent approach that aligns with strategic direction and best suits current operational demands.

With a target to roll out 45km of bus/transit lanes across the road network over three years, this is more palatable with such a process in place. We are currently in year two and the enlightening journey continues.