

Appendix B23 Technical Note 19: Scope Extension Beyond SH6/6A Intersection

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NZTA Contract 2018235 - F2Q SSBC & QTC DBC

Technical Note #19

4 February 2020

F2Q SSBC – Scope Extension Beyond SH6/6A Intersection

Executive Summary

This Technical Note is an update of the draft that was sent around for comment on 5 Nov 19. It indicates the need for, and scope of additional work on the highways in Frankton, to allow a comprehensive transport (primarily based around PT) solution to be developed for the transport Business Cases originally described as F2Q SSBC and QTC DBC.

This Technical Note now recognises the recent Government announcement concerning the Queenstown area elements of the New Zealand Upgrade Programme (NZUP). In the short term the overall business case work, including this Frankton scope extension, will continue unaltered up to and including the Stakeholder workshop (Workshop 5), which is considered a sensible hold point in the process. At this stage, the further assessments, reporting and decision making processes will be considered, and the necessary programme and/or delivery changes made, as necessary.

At this stage, notwithstanding the previous comment, the additional scope work fits into the recently updated programme that proposes a draft business case delivery date of 26 June, and presentation to the NZTA Board in November 2020.

Introduction

The current scope of Frankton to Queenstown Single Stage Business Case requires the investigation of increased capacity of SH6A (3 or 4 laning); localised widening; bus priority and supporting measures; and intersection improvements.

The combined investigation works of the F2Q SSBC and QTC DBC have indicated that a high proportion of person trips along SH6A must be by public transport in future years (up to 60% by 2048) to meet the movement requirements giving effect to the land use plan. In order to meet the PT mode targets, four options have been proposed for SH6A configuration and PT priority considering the scope elements in the first paragraph.

However, it is clear, through the investigation, that the level of service for public transport along the SH6A corridor is highly dependent on the operation of the SH6 links within Frankton Flats area. The current scope of work on its own cannot provide the comprehensive solutions that are needed to address the Queenstown Transport Business Cases problems and issues that have been identified.

A scope increase that investigates PT infrastructure improvements between the SH6/6A intersection, and the Shotover Bridge (and beyond to Ladies Mile), and Kawarau Falls Bridge is required. For clarification, the existing F2Q SSBC scope includes the whole of the SH6A corridor from Suburb Street to the SH6/SH6A roundabout, including improvements at this intersection (BP roundabout), but not additional items such as the Frankton bus hub (for example).

Background

The operation of the Frankton Road (SH6A) corridor has some dependence on the operation of both the Queenstown Town Centre and Frankton Flats transport networks, as the only direct link between the two activity centres.

Investigation has shown that total person-trips along the link are predicted to increase significantly. Measures developed by other ongoing Business Cases (TDM, Active Travel, Parking) will support a higher proportion of trips by non-private car modes, particularly public transport.

However, a significant demand for private car trips within the Wakatipu Basin network, and specifically along Frankton Road, which will lead to delay for all road-based modes, is still predicted.

At the Frankton end, the Grant Road to Kawarau Falls Bridge business case investigated improvements to the State Highway network, albeit not through to the Shotover Bridge and beyond. This project was put on hold towards the end of 2018, due to its overlap with the QTC and F2Q business cases – and the need for more analysis of the wider network to be undertaken in an integrated approach. The Frankton Flats masterplan has also been developed in the intervening period which will help inform the Frankton Flats transport investigation.

Consequently, it is likely that any improvement measures for SH6A developed through the F2Q business case will be limited in their effectiveness by poor integration of the Frankton Flats network, and limited controls on the SH6 intersections between the two bridges.

Proposing an Expanded Scope

In order to maximise public transport efficiency and reliability in the future network, the F2Q SSBC project has identified four options for public transport improvements along SH6A:

- Full priority – bus lanes in each direction throughout the corridor
- Partial priority – bus lanes along a number of specific sections of the corridor
- Targeted priority – bus lanes along a critical section (where delay is greatest) between SH6/SH6A and SH6A/Marina Drive
- Virtual priority – small scale improvements on the corridor, but greater reliance on traffic management in the wider network

All four options protect public transport operations along SH6A to a greater or lesser degree, the level of which is proportional to the infrastructure cost, land purchase cost, and buildability.

Transport modelling work has shown that the effectiveness of each of these options is dependent on the operation of four parts of the network:

- Queenstown Town Centre, inbound (westbound) journeys – affected by operation of the Town Centre network, which the QTC DBC is addressing. It is expected that the relative effectiveness of the four SH6A priority options will not be significantly different due to town centre actions.
- SH6A, between SH6/SH6A and SH6A/Marina Drive, both directions – due to the proposed signalisation of the SH6A/Marina Drive intersection (to improve access, safety and pedestrian provision), this section becomes the critical in the SH6A network, together with the operation of the SH6/SH6A intersection. This section is predicted to operate above capacity (in both directions) by 2028
- Shotover Bridge, outbound, (eastbound) journeys – the existing two-lane to one-lane merge point on the approach to the bridge (opposite Hardware Lane) is predicted to cause significant blocking in the PM peak in the future scenarios (is occurring now). Blocking will affect SH6 through to the SH6/SH6A intersection, and into Frankton Flats on Hawthorne Drive.
- Shotover Bridge and SH6/Stalker Road roundabout, inbound, (westbound) journeys – the existing two-lane to one-lane merge point on the westbound exit from the SH6/Stalker Road roundabout due to the single westbound lane on the bridge is predicted to cause significant

blocking back in the AM peak in the future. Some measures to protect public transport reliability have been identified by the RTI DBC.

As a result of the above, it is clear that the level of service for public transport along the SH6A corridor is highly dependent on the operation of the SH6 links within Frankton Flats, and the interactions at and through the intersection of SH6A and SH6. It is considered that in order to provide reliable and efficient public transport services across the Wakatipu Basin, improvements on SH6 within Frankton Flats (between the two bridges) should be developed as an integrated approach with the measures progressed for SH6A; that is, measures to protect public transport reliability are required on the SH6 links, and potentially along Hawthorne Drive (subject to new public transport services operating on Hawthorne Drive)

The main risks in not extending the scope are:

- The SH6A public transport priority option chosen as preferred is not the optimum (either insufficient priority resulting in poor public transport performance and lower modal shift, or over-scoped priority resulting in unnecessary capital cost)
- The effectiveness of SH6A priority is small in proportion to the public transport delay on the SH6 part of the network (i.e. priority is focussed in a less effective section of the network)
- Public transport delay on SH6 in Frankton Flats is high due to little infrastructure improvements, resulting in poor public transport performance and lower modal shift

Expanded scope details

The Grant Road to Kawarau Falls Bridge (GR2KFB) project was carried out at the DBC level, therefore many elements of this project will be applicable for the SH6 section between Kawarau Falls Bridge and the Grant Road roundabout. However, that assessment work was based on previous 2025 traffic demands (with minimal public transport share) – the updated 2028 (and 2048) traffic demand used in the QTC and F2Q work have significantly higher trip demand and require a significant public transport mode share.

Much of the GR2KFB analysis work will have to be re-confirmed. Nevertheless, it makes sense to absorb elements of the GR2KFB scope into an expanded scope for the F2Q business cases work:

- There are critical synergies between the operation of SH6A Frankton Road and SH6 Frankton Flats. An integrated approach would deliver the most optimal solution, including the sequencing of packages of work across the combined network
- The two bridges (Shotover and Kawarau Falls) are suitable cut-off points in terms of the scope of the network, as traffic is “naturally” constrained at these points.
- The parallel Queenstown Transport Modelling DBC covers the whole of the extended scope network (to the two bridges), and therefore no additional scope is required for this parallel piece of work. A separate model covers the Ladies Mile section (as was used for the evaluation of elements of the RTI DBC)

The exception is Ladies Mile (westbound) section due to inbound congestion on the approach to Shotover Bridge. This section should be considered in the extended scope to maintain network control, and consistency of approach and reliability for public transport services.

The table below sets out the scope of services that need to be carried out on the SH6 section between Kawarau Falls Bridge and Shotover Bridge, and out to Ladies Mile. Status flags show:

- **IN** – Within existing F2Q SSBC scope (no extra scope required)
- **PART** – Some minor extension of scope. These elements are part of the F2Q SSBC scope but have synergy with elements outside the F2Q corridor. Will need re-assessment and integration with the Frankton Flats network
- **EXTEND** – Additional scope to be added to the F2Q SSBC. Much of this work has been part of the GR2KFB or Frankton Masterplan projects, which will serve as a starting point
- **OUT** – Considered out of scope. These items are provided for clarity of information only

Location/Issue	F2Q/GR2KFB Status	Scope of Work	Status
Old Frankton and Frankton Village	Engagement with local community and concepts to prevent rat running and improve walking, cycling and parking presented to QLDC/NZTA. Assumed traffic management/traffic calming introduced to prevent north-south through trips (between Ross St and Gray Street)	Review TM measures in line with Frankton masterplan	Extend
SH6A/Marina to SH6/SH6A	Access was difficult out of the area particularly onto SH6A (Yewlett and McBride). No preferred option was determined, although most recent models closed Gray Street EB access to Kawarau Road, and SH6A/McBride Street was signalised	Develop Intersection and link design layouts,	In
		Determine various operational options depending on the PT priority level within the section	In
		Assess operation of each option (traffic model and qualitative assessment)	In
SH6/SH6A	Preferred option was for a signalised roundabout. However, this was predicated on the previous demands which have altered – although the total veh/h through the intersection are similar (new 2028 to old 2025), the turning movements have some significant variations	Re-assess Integration with access requirements to/from Frankton Village (Yewlett, McBride, Gray and Ross Streets) and BP/Terrace Junction	Part
		Re-assess Pedestrian and cycle desire lines, and integration with Active Modes DBC	In
		Re-assess requirement for land purchase (likely to still require golf course land, how does this feed into QEC and Frankton masterplans)	Part
		Re-assess capacity required given external network constraints, bus priority infrastructure and network control	Part
Frankton Bus Hub	A few arrangements were identified and tested, preferred was an expanded facility on the west side of Kawarau Road, similar in location to existing facility. Kawarau Road re-aligned to the east to provide sufficient space, and achieve better alignment into the upgrade intersection at SH6/SH6A	Re-assess location (east/west side of Kawarau Road, south side of Frankton-Ladies Mile Highway)	Extend
		Re-assess capacity (in terms of stands/movements)	Extend
		Re-assess use (local, regional and private)	Extend
		Re-assess access arrangement options – separate in/out or combined	Extend
		Re-assess internal arrangements (sawtooth, U-turns, drive-in etc)	Extend
		Consider requirements for private coaches	Extend
		Determine options to incorporate future potential gondola station	Extend

Location/Issue	F2Q/GR2KFB Status	Scope of Work	Status
QEC and Hansen Road	Some testing done on alternative access arrangements, but base assumption was a signalised intersection at SH6/Joe O'Connell Drive. Alternatives being investigated via QEC masterplan work, but likely that SH6/JOC would be retained, with signalisation for both safety and network management. Signalised T intersection preferred at Hansen Road (offset from Joe O'Connell Drive), discussed with the Grants (landowners) and in general agreement, but no hurry with recent District Plan review land zone (BMU) changes.	Re-assess pedestrian crossing requirements across SH6 – likely to still be as proposed in GR2KFB (underpass), but depends on crossing provisions at intersections either side (SH6/SH6A and SH6/Grant)	Extend
		Interaction/integration with QEC masterplan	Extend
		Re-test with latest demand sets and layouts	Extend
		Need contingency layout/operation test, if Hansen Road arm is maintained as existing	Extend
Airport	Had assumed existing terminal location, up to 3.2m passengers (at 2025)	Assumptions in the F2Q SSBC are currently the same as GR2KFB. Spatial Plan team considers that growth will continue through technological advances, e.g. quieter aircraft, increased aircraft capacity	In
		No consideration of alternative terminal locations and/or access arrangements	Out
Ross Street to Kawarau Falls	Fairly minor works through this section, relatively modest intersection works, northbound bus lane and improved ped/cycle crossings across SH6 (to reduce severance)	Likely to be similar to GR2KFB development work, although land use scenarios have pushed more growth to the south, which might increase stress at SH6/Lucas Place and SH6/Humphrey Street	Extend
		Incorporate improved linkages to Frankton Beach	Extend
		Need to refresh with direction from Frankton Masterplan	Extend
SH6/Humphrey Street	Layouts and operation assessed as part of GR2KFB work	Need to re-evaluate layout options for latest demand sets and test alignment with Frankton masterplan	Extend
Humphrey Street Link (SH6 to Lucas Pl)	Frankton Flats western access options. Scoped but no work progressed.	Consider, as likely to become critical in near future years.	Extend
SH6/Grant Road	Not in scope of existing work packages	Develop Intersection design layouts	Extend
		Determine various operational options for bus priority within each layout	Extend
		Assess operation of each option (traffic model and qualitative assessment)	Extend
SH6/Hawthorne Drive	Not in scope of existing work packages	Develop Intersection design layouts	Extend
		Determine various operational options for bus priority within each layout	Extend
		Assess operation of each option (traffic model and qualitative assessment)	Extend
SH6 – SH6/SH6A to Shotover Bridge	Proposed bus/HOV lanes between SH6/SH6A and SH6/Grant Road	Determine optimum corridor layout arrangement	Extend
		Consider bus v HOV lanes	Extend

Location/Issue	F2Q/GR2KFB Status	Scope of Work	Status
Frankton Flats (non SH) PT network	Not in scope of existing DBC work packages, although Frankton masterplan provides strategic direction PT network options developed as part of existing QTC/F2Q work	No consideration of operation of local roads within Frankton Flats, except at access points onto the SH (as set out in other tasks)	Out
		Consider bus stop requirements on SH6 sections	Extend
		Evaluate impact on PT movements of SH6 network control strategy and determine mitigation (if required)	Extend
Network Control Strategy	Not in scope of existing work packages	Provide higher level network control strategy to set out requirements in line with all the other (above tasks) in order to drive a strategic network solution	Extend
Ladies Mile	Rapid Targeted Interventions (RTI) DBC identified bus lane requirements on Stalker Road and SH6 westbound. Ladies Mile HIF DBC identified a roundabout at Howards Drive and pedestrian underpasses under SH6. Public transport patronage targets were also identified as hold points for residential development.	Reset and re-evaluate requirements to integrate with analysis of Frankton Flats sections of SH6	Extend
		Evaluate and future-proof requirements to integrate with future SH6/Howards Drive intersection improvements	Extend
		Evaluate and future-proof requirements to integrate with future Park and Ride site on Ladies Mile (predominantly access arrangements)	Extend
		Process • Pulling together previous design drawings from Ladies Mile HIF work for QLDC and RTI's and integrating them into a master drawing. • Updating the VISSIM model that we put together for the RTI's beyond the 2018 base year (as the Paramics model stops at the Shotover Bridge). • Analysis of Ladies Mile HIF mode share targets as determined by the NZTA Board August 2018 and how to achieve and monitor these mode share targets	

Impact on project delivery and programme

The programme recently issued (20 Jan 20) includes the above actions, hence the Workshop 5 date of 18 Mar, and the draft Business Case documentation of 26 Jun are not affected by this variation.

Impact of the NZUP Activities

The NZUP announced a \$90M package for the Queenstown area, including SH6A corridor improvements; Ladies Mile corridor improvements, Frankton Bus hub, and SH6 Grant Road to Kawarau Falls improvement. These projects comprise a significant proportion of the work that is being scoped as the Frankton scope extension to the Queenstown Business Cases work.

There is no change intended to the immediate process and programme for the Queenstown Business Cases, nor the Frankton Scope extension. All elements of the Queenstown and extended project scope will continue, up to and including the Stakeholder workshop (Workshop

5) on 18th March. The workshop is considered a sensible and pragmatic hold point in the Frankton scope extension.

Depending on the requirements to support / justify the NZUP, and the timeframes in which this will be required, it may be necessary to split the further assessment and reporting of the NZUP elements from the other parts of the expanded-scope business case, for early delivery. Should this be the case the extent, content and programme for the NZUP elements of this scope expansion will be reviewed and reported appropriately.

Further scope expansion

Based on the evolution of the QTC and F2Q projects since award in September 2018, it would be pragmatic to question whether further scope expansion, beyond the absorption of the GR2KFB project is likely.

In response, the two river bridges form natural boundary points for the transport business cases. The westbound approach to the Shotover Bridge is currently the only area outside these boundary limits and is intimately connected to functioning within the project area – and work here has partially been undertaken as part of the RTI package and is covered with the Ladies Mile scope addition above. It is therefore unlikely that the scope of investigation will extend beyond this.

The work on SH6 between the two bridges is intended to consider the Frankton network's intersections with the SH only. There is no intention at this stage to review or assess the Frankton Flat's internal network, but this is a possible scope expansion area should circumstance change (update airport terminal plans, general Frankton Plan changes). Our work will need to consider the location of a Frankton Hub, and if this impacts on local road elements, we will, by necessity, include this. Where none of those changes occur, the project will consider business-as-usual for Frankton Flats as allowed under the district plan, recognising that there is no comprehensive parking strategy for Frankton.

Conclusion

This Technical Note recommends and expansion to the F2Q SSBC scope by incorporation of the GR2KFB business case elements for SH6 between the two bridges, with an extension to Ladies Mile. This work is considered essential and fundamental to be able to deliver the treatments and solutions required as the objectives of the original QTC and F2Q business cases. The NZUP has indicated that elements of the Frankton scope expansion will be delivered within a specified timeframe – once the additional assessment and reporting activities to support this are understood, this Frankton Scope extension scope and programme will respond.

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NZTA Contract 2018235 - F2Q SSBC & QTC DBC

Technical Note #40

14 October 2020

Bus Priority Lane at Frankton Ladies Mile Highway / Stalker Road Corridors; Operation & Future Performance

Introduction

A strategic case has been developed to introduce improvements on Frankton Ladies Mile and Stalker Road through provision of bus lanes. Figure 1 below shows the location of proposed interventions (in Orange highlighted rectangle) to ease congestion on corridor. Blue and yellow lines indicate two existing bus routes.



Figure 1: Proposed location of bus lane (in Orange Box)

The strategic case for the bus lane project was established based on mode shift aspirations from private car to bus. The strategic case objectives are focussed on improving access through affordable travel choices that are convenient, comfortable and provide a genuine alternative to the financial burden of owning and operating a car.

Providing bus lanes enables bus services to bypass traffic congestion and therefore offer a faster and more reliable service for passengers. Faster and less congested journeys also help to lower bus operating costs, which are a function of the time that a vehicle requires to complete its journey and the fuel that is used.

The proposed project is for a construction of a westbound bus lane on State Highway 6 Ladies Mile, Queenstown.

This memo provides details about the traffic modelling for the proposed bus lane scheme for the Frankton Ladies Miles Highway and Stalker Road corridors. The objective of the modelling assessment is to

- Identify potential corridor wide impacts from the proposed bus lane
- To aid in any subsequent design refinements as deemed necessary

- Quantify travel time benefits/disbenefits along Frankton-Ladies Mile Highway corridor and joining links of Stalker Road and Howards Drive
- Analyse intersection performance at key intersections along Frankton-Ladies Mile Highway.

Ladies Mile Base Model

A VISSIM base year (2018) traffic model has already been developed by WSP for the project extent as shown in Figure 2 to be used for the purpose of option testing.



Figure 2: VISSIM Model Extent (Map Source: OpenStreetMap)

This model has been calibrated and validated for the AM peak (7:00 to 9:00 AM), Interpeak (11:00 am to 1:00 PM) and PM peak (4:00 to 6:00 PM) periods. This model is essentially a corridor model thus provides no route choice (this includes the link between Shotover Country and Lake Hayes Estate via Jones Avenue, which is not included in the model).

Future Network Changes

The road network used in the base model has been modified to provide a bus priority design improvement along the corridor.

Project Extent

The proposed bus lanes are upgrades on the existing sections Frankton-Ladies Mile Highway and Stalker Road:

- An additional westbound bus lane is proposed from Western side of the SH6 Frankton-Ladies Mile/Howards Drive intersection through to a merge point at Shotover Bridge
- On Stalker Road, a bus lane is proposed from Jones Avenue to State Highway 6 – note that this scheme is separate from the NZUP package which concerns infrastructure on SH6 only

The provision of these additional lanes is shown in Figure 3 below.

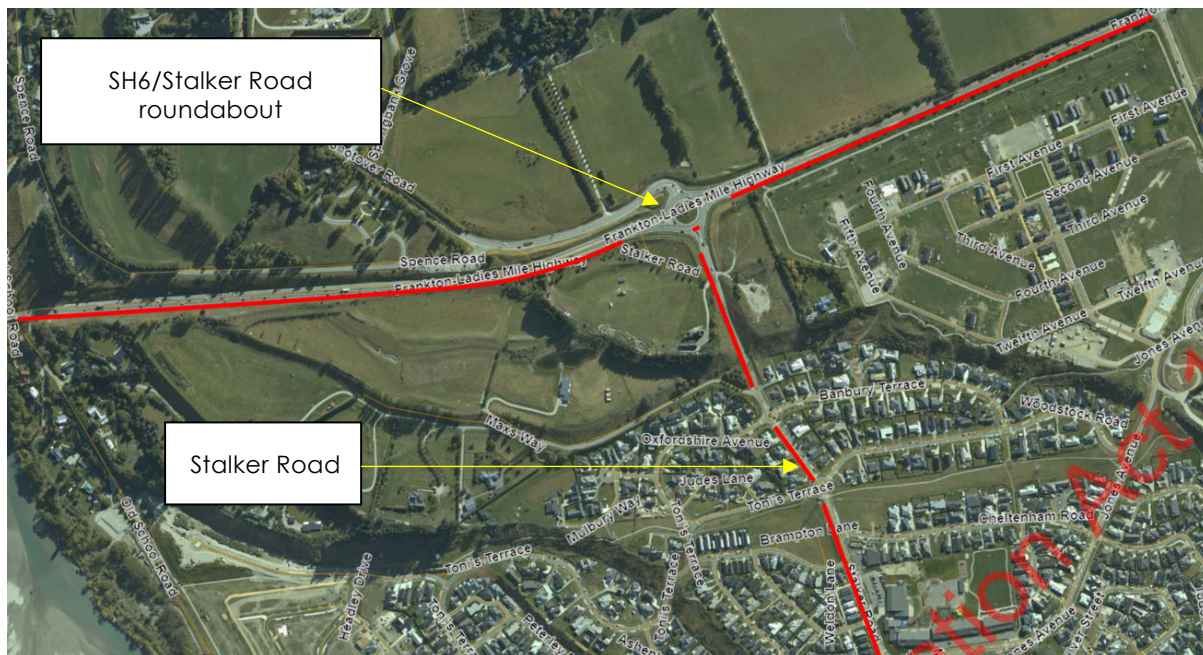


Figure 3: Sections of Proposed Bus Lane

In addition, the layout of the SH6/Stalker Road roundabout is amended (due to the addition of the westbound SH6 bus lane) to only provided a single westbound general traffic through lane, as shown in Figure 4. This allows traffic from Stalker Road heading towards the bridge to only yield to buses on the circulatory of the roundabout, and therefore there is improved throughput on this movement – this is also predicted to improve the operation of the downstream merge to a single lane, as the peaks of demand are removed (two ahead lanes heading to merge point simultaneously), and therefore delays the point at which flow breakdown at this merge point is reached.

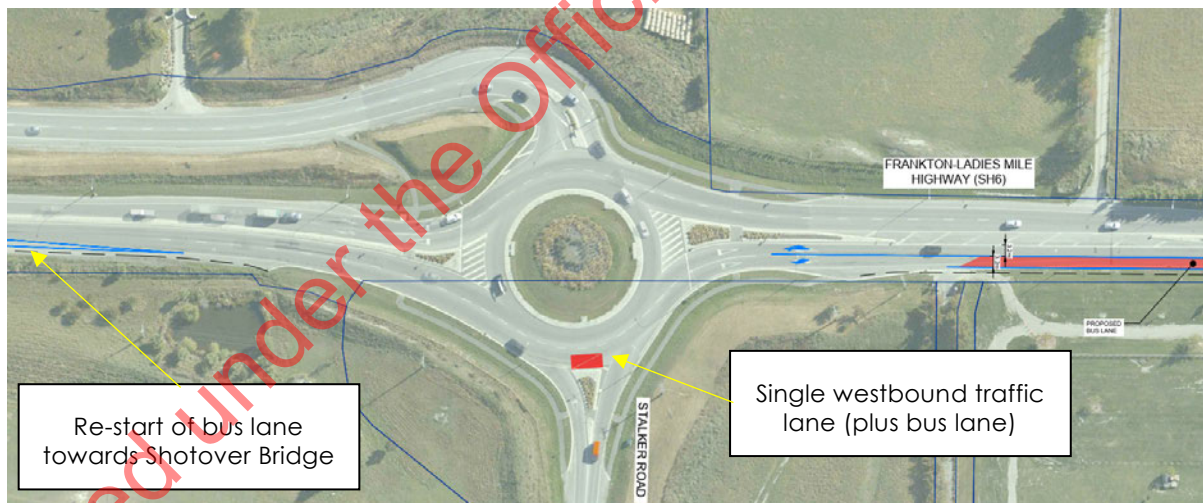


Figure 4: Proposed layout at SH6/Stalker Road roundabout

Also, it has been assumed that the existing SH6/Howards Drive roundabout is upgraded to a roundabout, in order to improve access via an additional fourth leg of the intersection to the land on the north side of SH6, earmarked as proposed residential development "Ladies Mile". A masterplan is presently being developed for this area – and so access arrangements to and from SH6 are subject to change.

It is also possible that a Park and Ride site will be built on the south-east corner of the intersection. The detailed operation of this site has not been included in the model, although traffic is assigned to and from site as predicted by the PT demand model. There is scope for additional bus lane provision on the south and/or east approaches to the roundabout – but this depends on the access and egress arrangements for buses moving through the Park and Ride site. The proposed arrangement (without Park and Ride site detail) is shown in Figure 5.



Figure 5: Proposed layout at SH6/Howards Drive roundabout

Demand

In terms of demand, the "NZUP Bus Max" scenario has been used for the proposed option scenario at three forecast years of 2018, 2028 and 2048 – the 2028 and 2048 years see a significant growth in general traffic trips compared to the (2018) base, with a larger still increase in public transport patronage, related to the wider package of transport network interventions planned as part of the DBC/SSBC work. As above, it has been assumed that an element of this traffic uses a Park and Ride site on the southern site of Ladies Mile.

Similarly for the without-NZUP scenarios, a Do Minimum set of demand flows were established, with has a lower PT share, and therefore higher general traffic demand.

Model Performance

Intersection average delay outputs have been analysed for key intersections along Frankton-Ladies Mile Highway and compared to Do Minimum model performance for the AM peak, Interpeak and PM peak periods. Bus and general vehicle travel times along Frankton-Ladies Mile Highway, Stalker Road and Howards Drive have also been extracted to assess potential travel time benefits from the bus priority measures.

Intersection Performance

The average delay and subsequent levels of service at the intersections of SH6/Howards Drive and SH6/Stalker Road have been analysed and compared between the base and bus priority design.

Delay ranges and colour indicators for each level of service classification adopted are shown in Table 1 below.

Table 1: Intersection Level of Service Delay Ranges

Level of Service (LOS)	Intersection Delay
A	<10
B	10-20
C	20-35
D	35-50
E	50-70
F	70-100
F+	>100

Base case (2018) Peak Intersection Performance

Overall performance of intersection in terms of LOS and volumes for the Base Case (2018) is shown in Figure 6 to Figure 8. In this scenario, no bus lanes are provided on any links, and the SH6/Howards Drive intersection is retained as a priority-controlled T-intersection (with no development on Ladies Mile, and no Park and Ride).

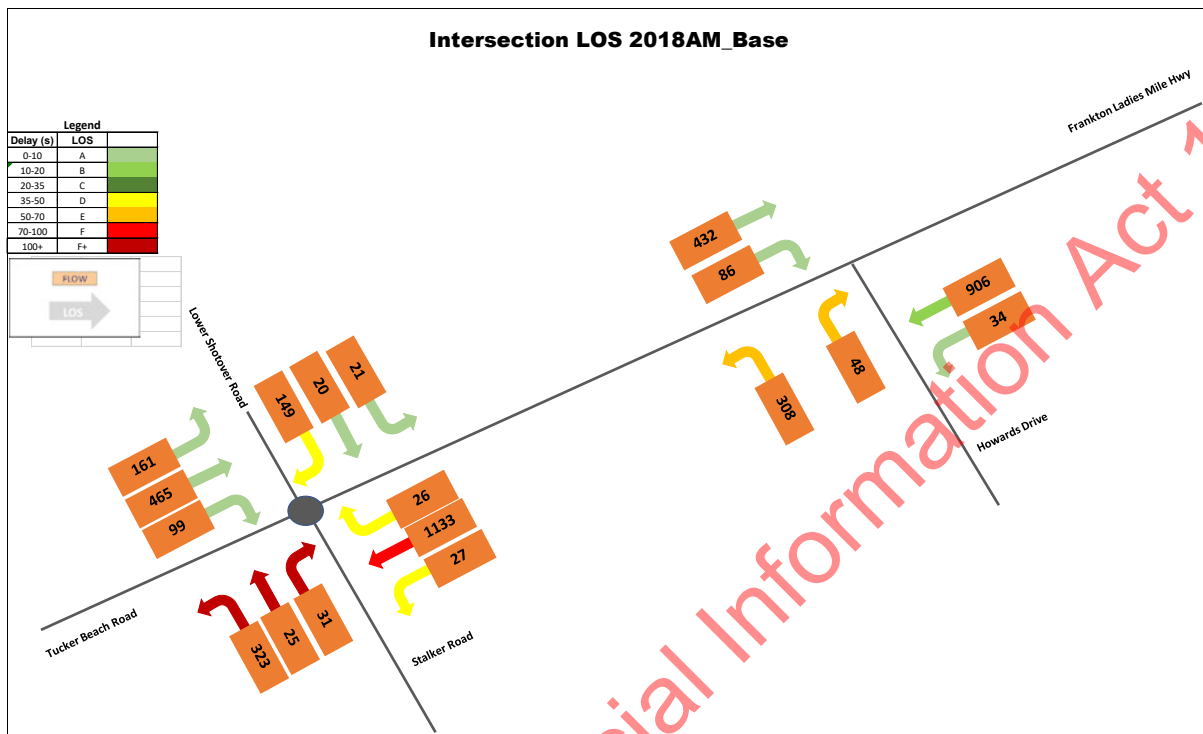


Figure 6: Intersection Volume and LOS - Base 2018 AM

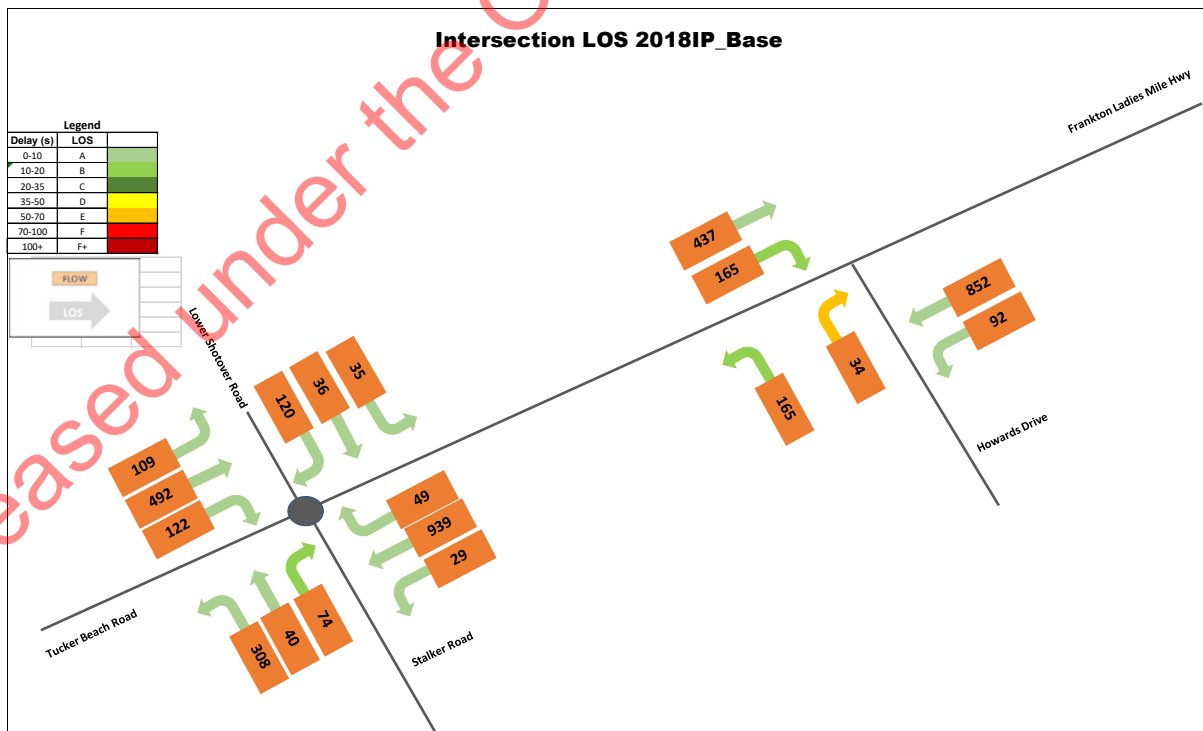


Figure 7: Intersection Volume and LOS - Base 2018 IP

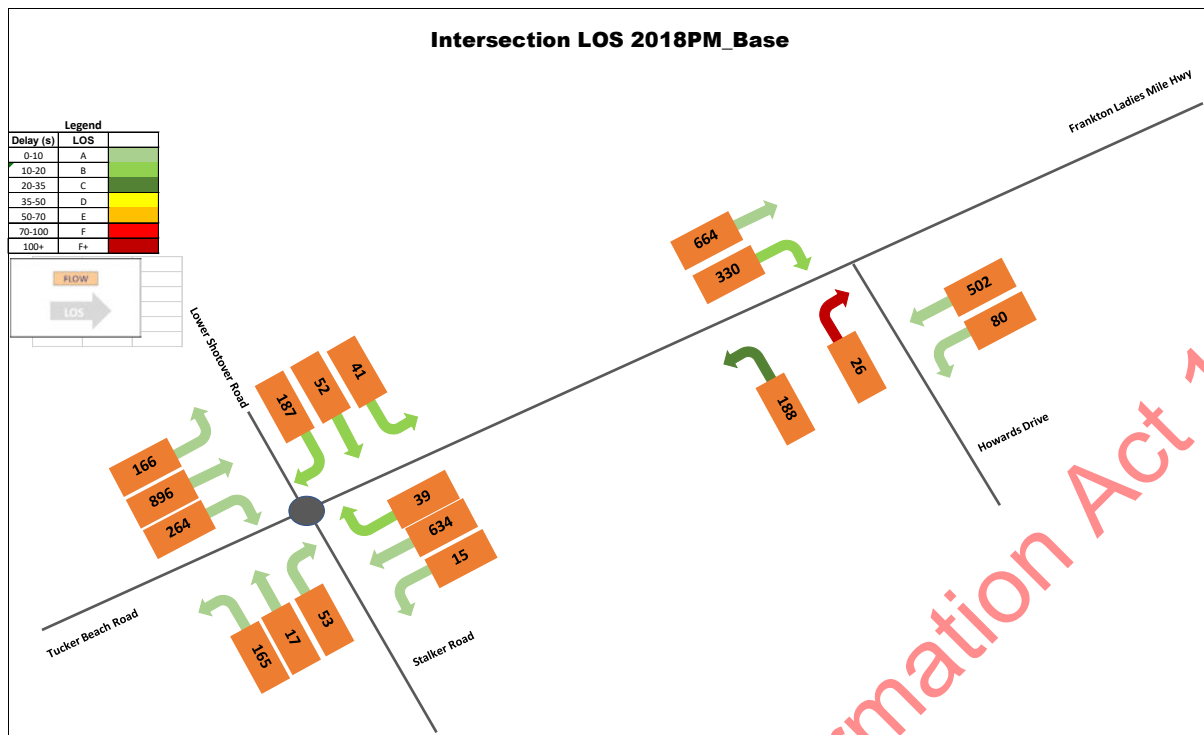


Figure 8: Intersection Volume and LOS - Base 2018 PM

The modelling results indicate that the morning peak is critical once westbound flows reach over around 1600-1700 vehicles per hour heading inbound towards the Shotover Bridge and the Tucker Beach Road intersection. This results in traffic on the northbound Stalker Road approach and westbound trips on SH6 experiencing significant delays. This is caused by the demand reaching a critical point at the merge point on the SH6 exit towards the bridge, resulting in slow moving traffic with a subsequent drop in capacity – which only recovers once the demand in the westbound movement has dropped below a lower threshold (allowing the merge to operate as a higher speed free-flow). The delay for the left turn from Stalker Road reaches up to an average of 2-3 minutes in the morning peak period – in reality, delay can be significantly greater (and less) than this level, depending on the exact time during the peak, and the time of the year. Lesser delays can also be experienced on the Howards Drive approach to SH6, either as a result of yielding to westbound mainline traffic, or due to queueing across the intersection in this westbound direction due to downstream blocking towards the bridge.

Performance of both intersections remain at an adequate level during the Interpeak and PM peak period, except for the right turn movement from Howards Drive. This movement can experience around 50 seconds delay during the Interpeak and 2 minutes delay during the PM peak, as it must yield to many other significant traffic movements at the existing priority controlled intersection.

Do Minimum Case – 2028 – Peak Intersection Performance

Overall performance of intersection in terms of LOS and volumes for Do Minimum Case (2028) is shown in Figure 9 to Figure 11. In this scenario, no bus lanes are provided on any links, but the SH6/Howards Drive intersection is upgraded to a four-arm roundabout to facilitate development on Ladies Mile. No Park and Ride site is provided.

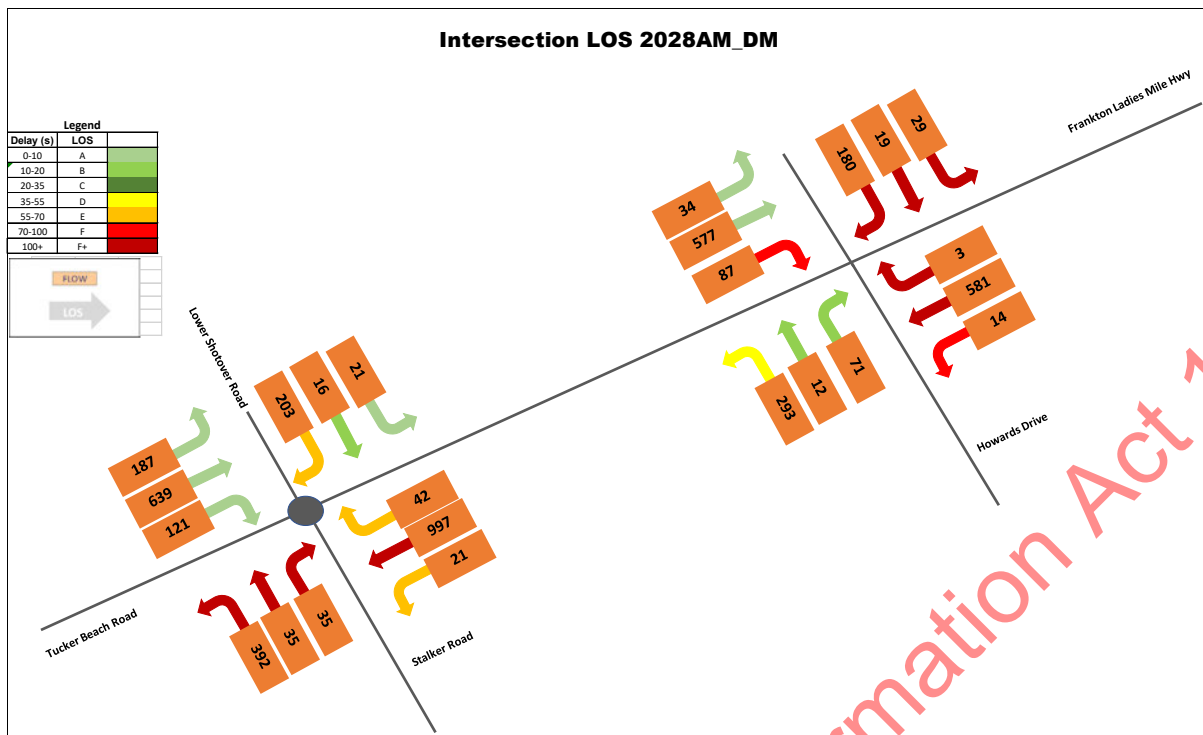


Figure 9: Intersection Volume and LOS - Do Min 2028 AM

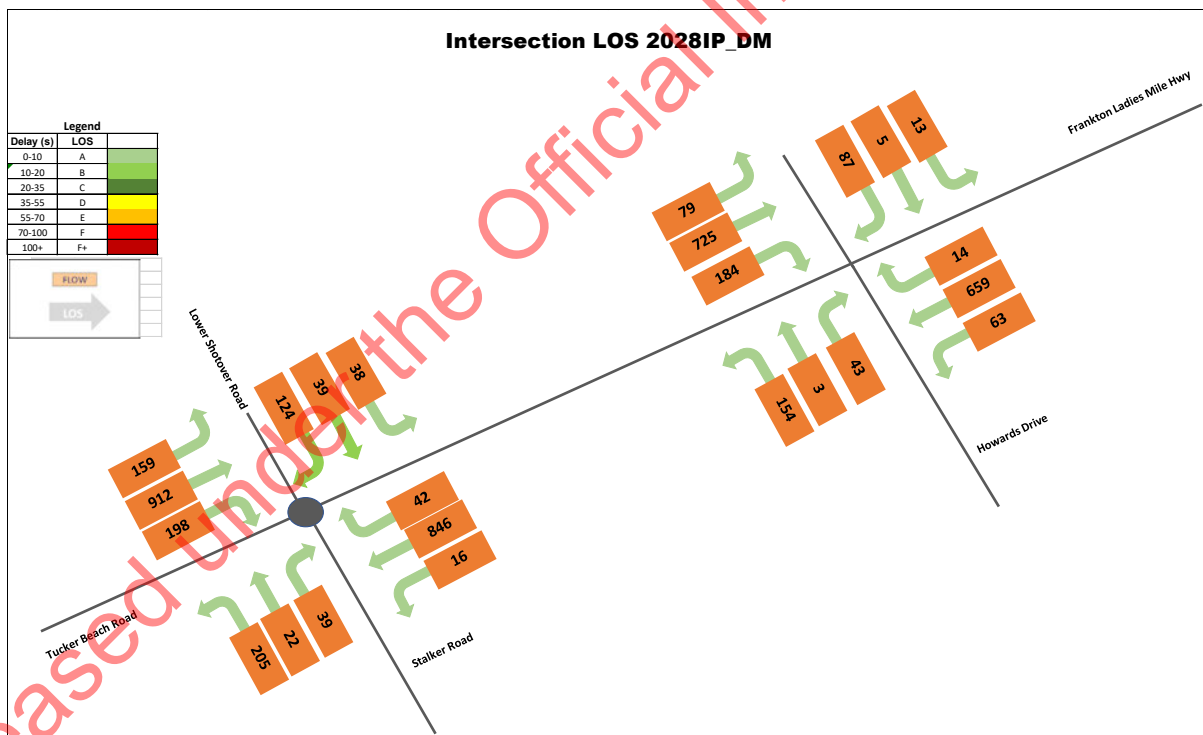


Figure 10: Intersection Volume and LOS - Do Min 2028 IP

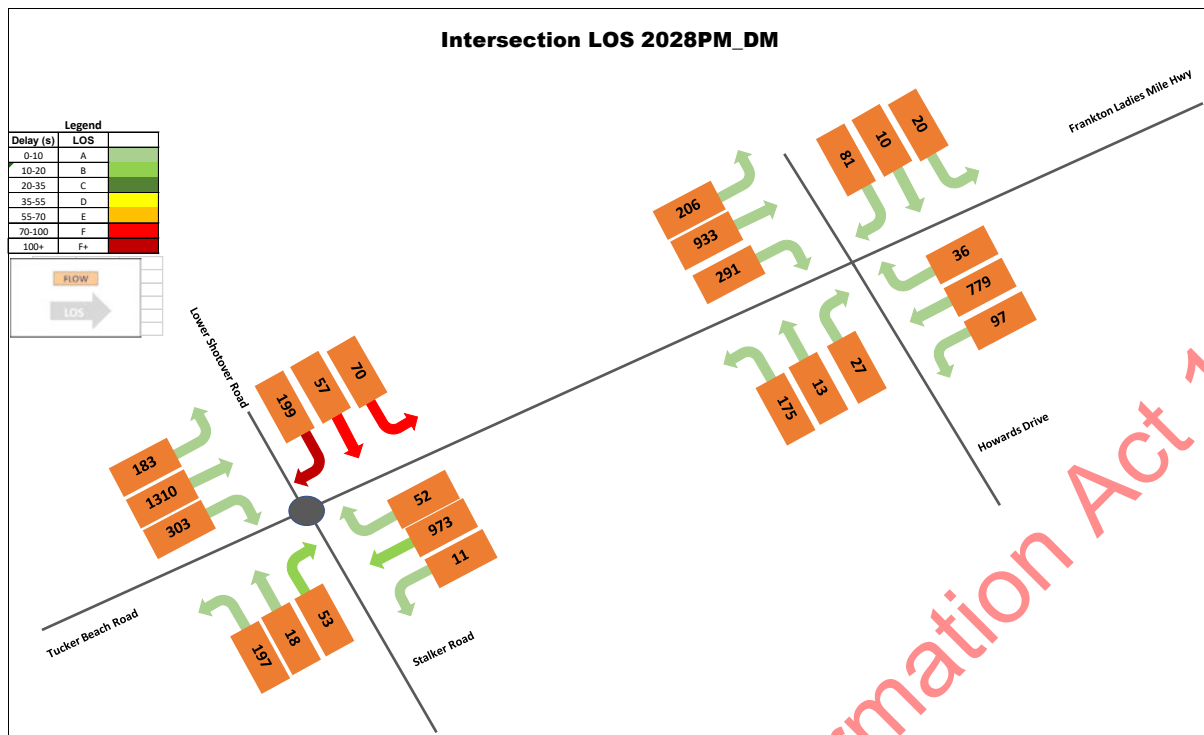


Figure 11: Intersection Volume and LOS - Do Min 2028 PM

The modelling results show significant deterioration in the performance of the intersections during the AM and PM peak periods.

In the AM peak period, the modelling results indicate significant delays for all movements at both intersections heading towards Shotover Bridge.

In the PM peak, the north approach of Lower Shotover Road at Stalker Road/Frankton-Ladies Mile Highway experiences delay of up to 2 minutes – this is due to the near constant flow of eastbound traffic approaching the intersection having passed over Shotover Bridge. Overall performance of the Inter peak model reflects an acceptable level of service at both intersections, due to the lower overall traffic volumes in this period.

Do Minimum Case – 2048 – Peak Intersection Performance

The performance indicators of intersections in terms of LOS and volumes for Do Minimum Case (2048) is shown in Figure 12 to Figure 14. In this scenario, no bus lanes are provided on any links, but the SH6/Howards Drive intersection is upgraded to a four-arm roundabout to facilitate development on Ladies Mile. No Park and Ride is provided.

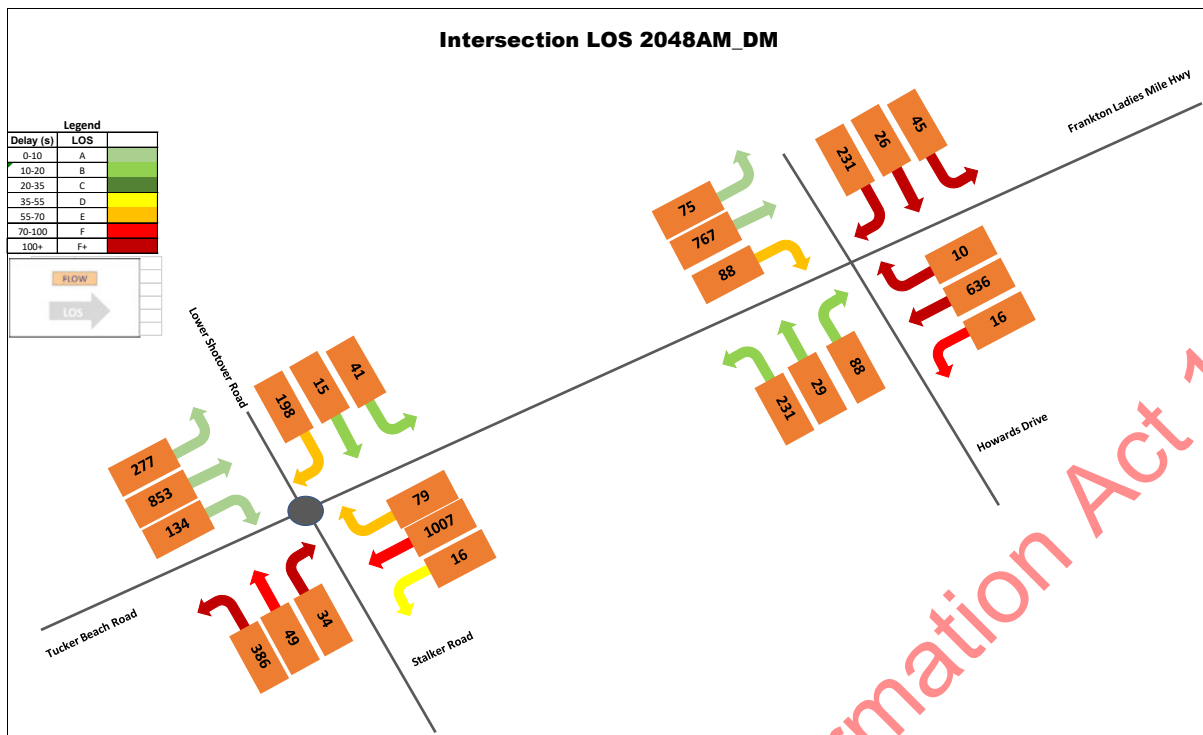


Figure 12: Intersection Volume and LOS - Do Min 2048 AM

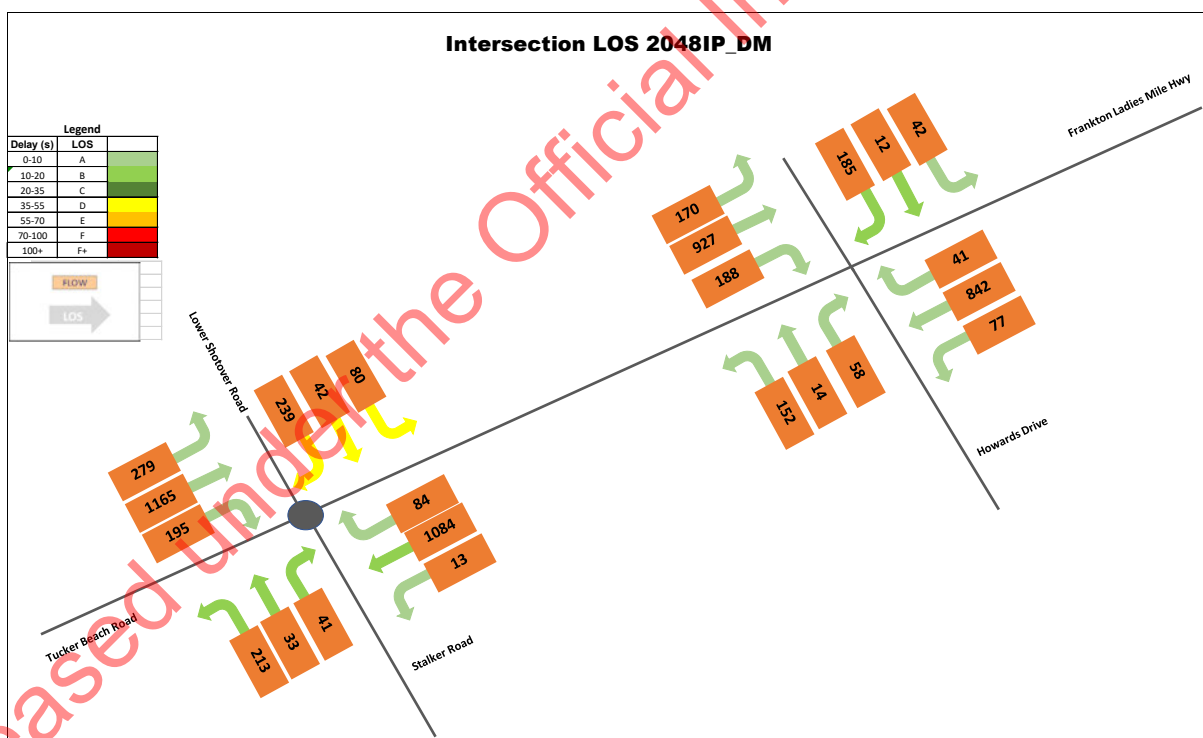


Figure 13: Intersection Volume and LOS - Do Min 2048 IP

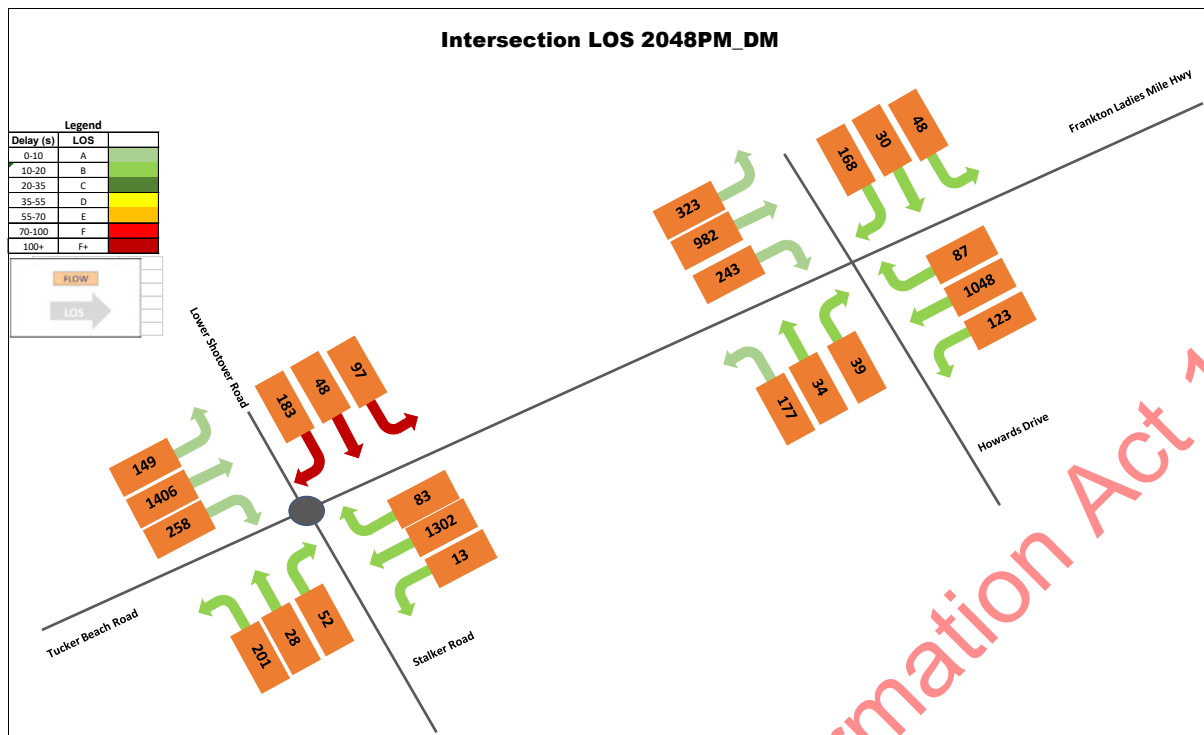


Figure 14: Intersection Volume and LOS - Do Min 2048 PM

The modelling results show further deterioration in the performance of the intersections during AM and PM peak periods.

Option Case 2018 NZUP – Peak Intersection Performance

The modelling results for option case 2018 NZUP in term of LOS and volumes are shown in Figure 15 to Figure 17. In this option, all bus lane sections are added, plus the Park and Ride site is included (plus the additional mode shift to PT that this intervention enables). The SH6/Howards Drive roundabout intersection is converted to a roundabout to better facilitate the westbound bus lane provision, although no traffic is assigned to the north leg (Ladies Mile development). In reality, the roundabout is unlikely to be provided until access/egress to development on the northern side of SH6 is required and/or the Park and Ride site is implemented.

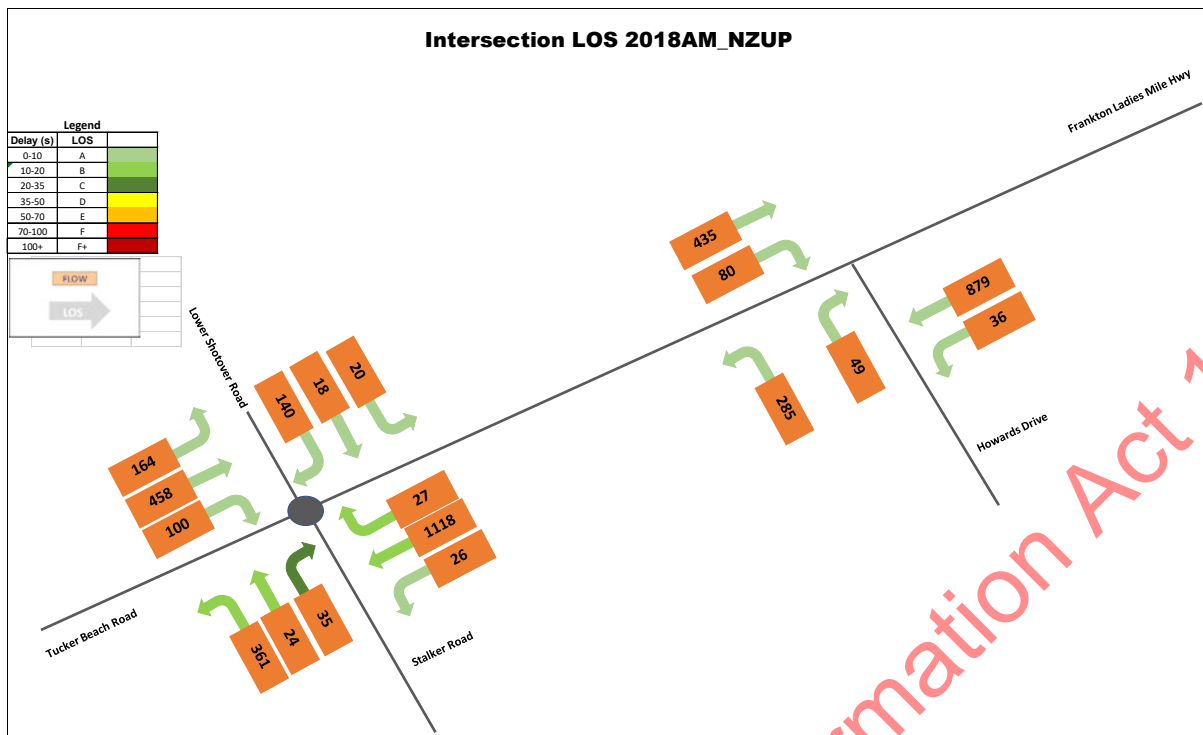


Figure 15: Intersection Volume and LOS - NZUP 2018 AM

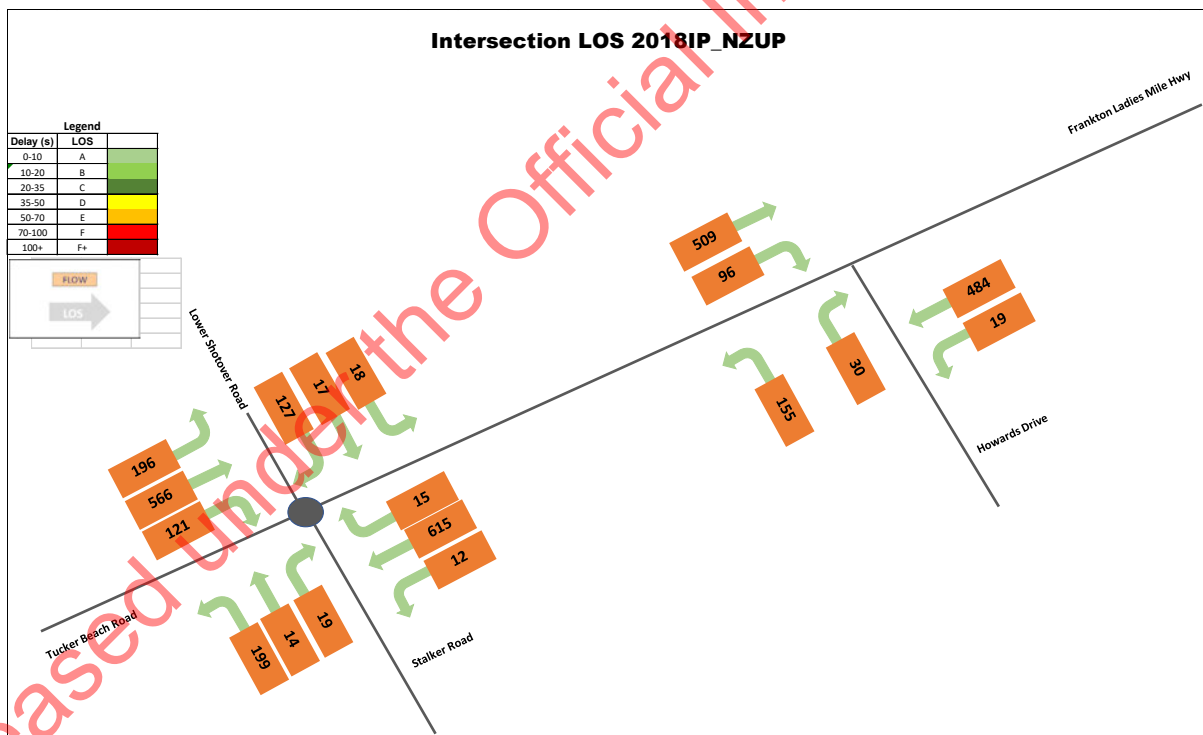


Figure 16: Intersection Volume and LOS - NZUP 2018 IP

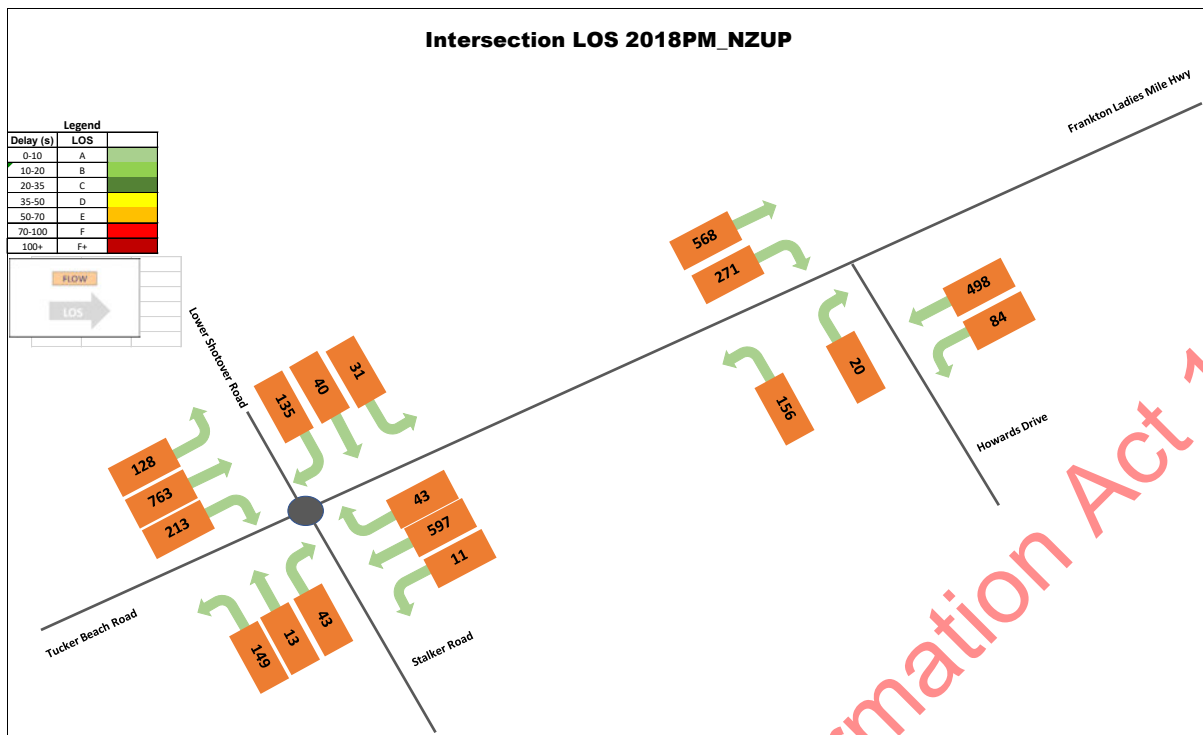


Figure 17: Intersection Volume and LOS - NZUP 2018 PM

The modelling results indicate improvements in performance for all peak periods. All movements of both intersections experience acceptable level of service C or better. In particular, in the AM peak period, the reconfiguring of the Stalker Road roundabout (to allow only one westbound general traffic ahead lane through the circulatory, plus a separate bus lane) results in improved performance of the downstream merge point as the peaks and troughs of demand are better managed – which allows the merge to operate more efficiently.

Option Case 2028 NZUP – Peak Intersection Performance

The modelling results for option case 2028 NZUP in term of LOS and volumes are shown in Figure 18 to Figure 20.

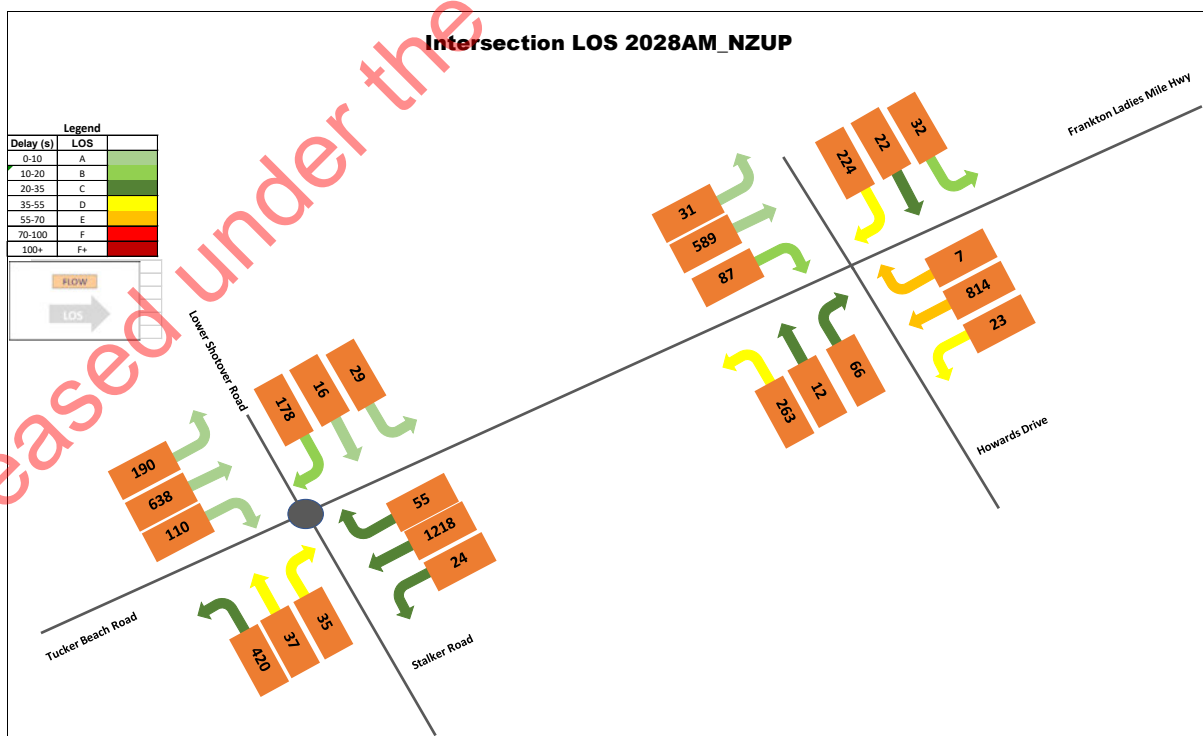


Figure 18: Intersection Volume and LOS - NZUP 2028 AM

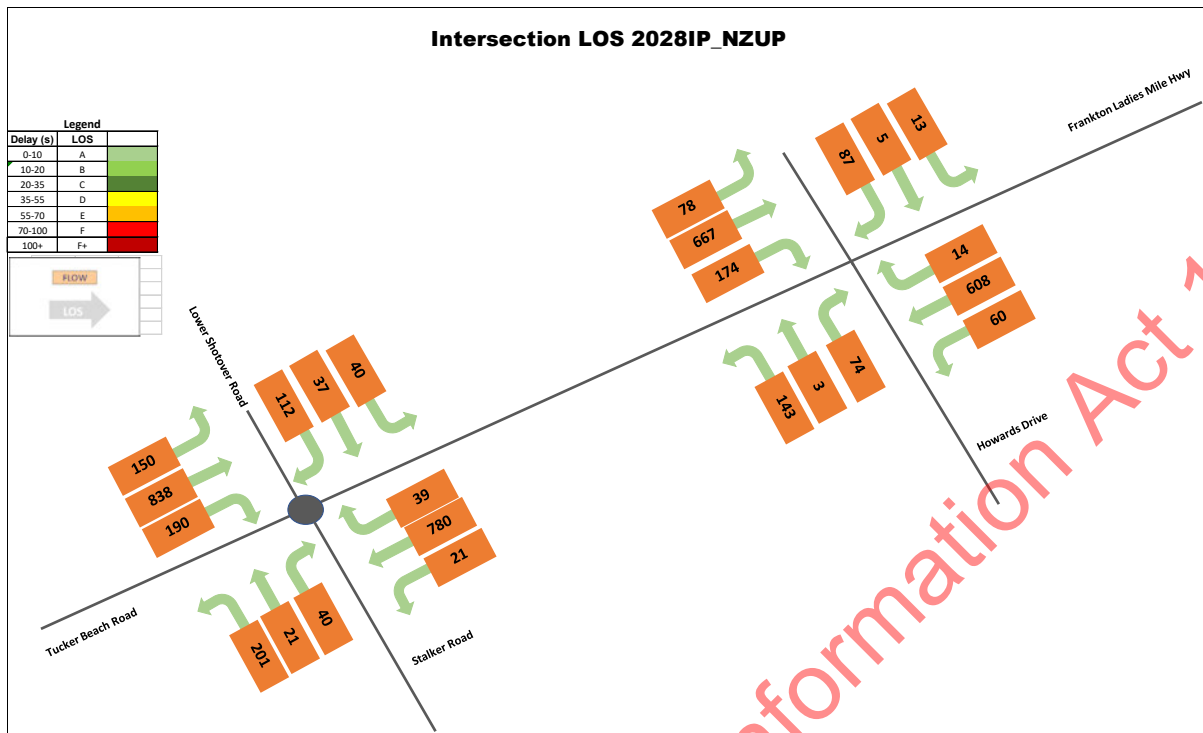


Figure 19: Intersection Volume and LOS - NZUP 2028 IP

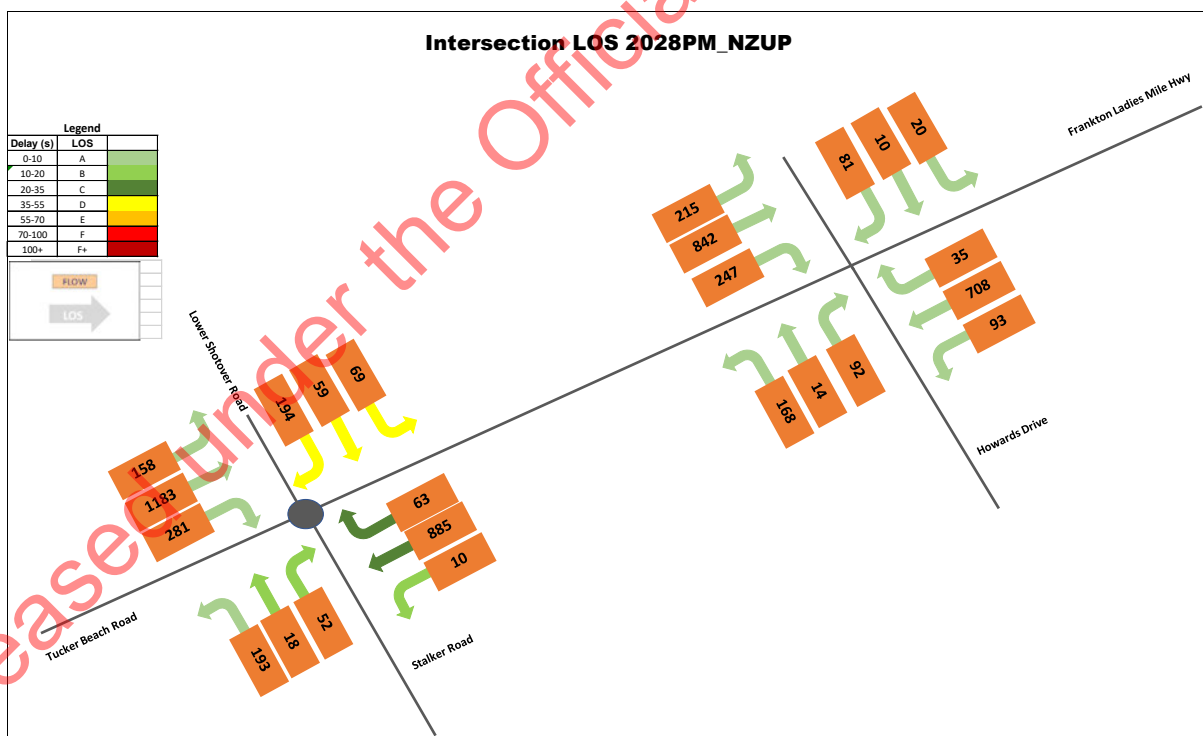


Figure 20: Intersection Volume and LOS - NZUP 2028 PM

The modelling results show LOS E for the right turn and through movements from the westbound approach to the Frankton-Ladies Mile Road/Howards Drive intersection in the AM peak period. The predicted performance for other movements during Interpeak and PM peak period remains at a satisfactory level.

Option Case 2048 NZUP – Peak Intersection Performance

The modelling results for option case 2048 NZUP in term of LOS and volumes are shown in Figure 21 to Figure 23.

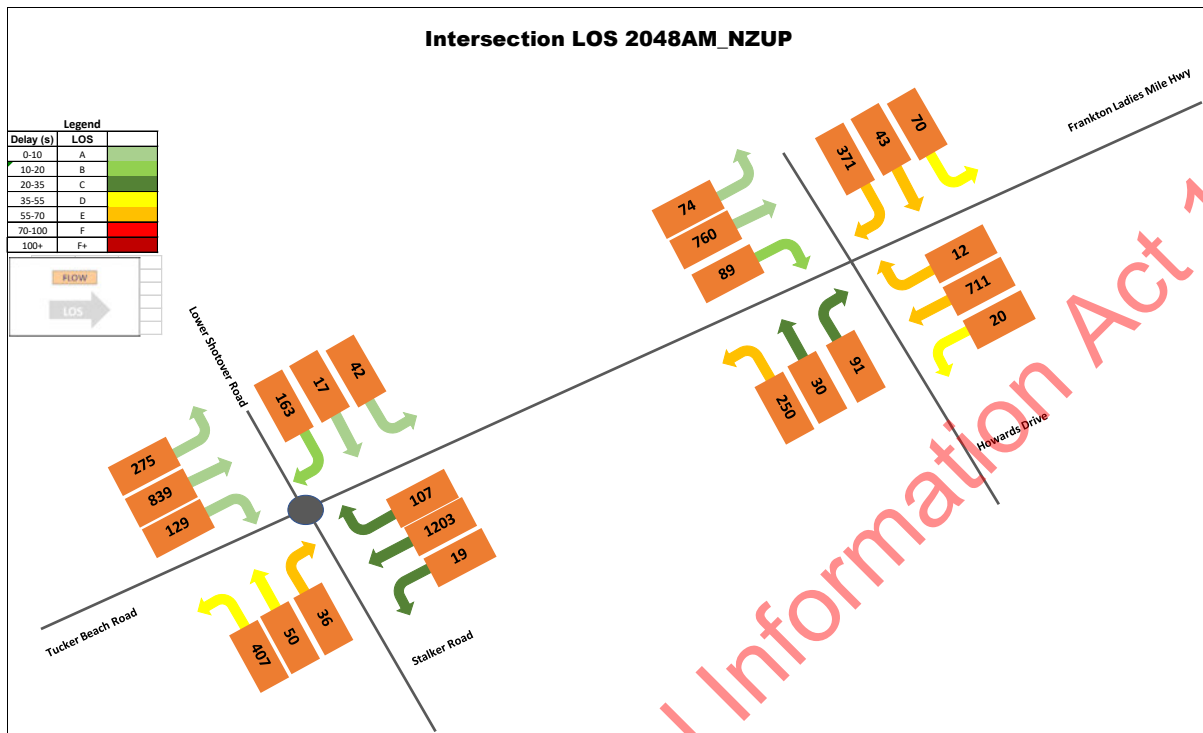


Figure 21: Intersection Volume and LOS - NZUP 2048 AM

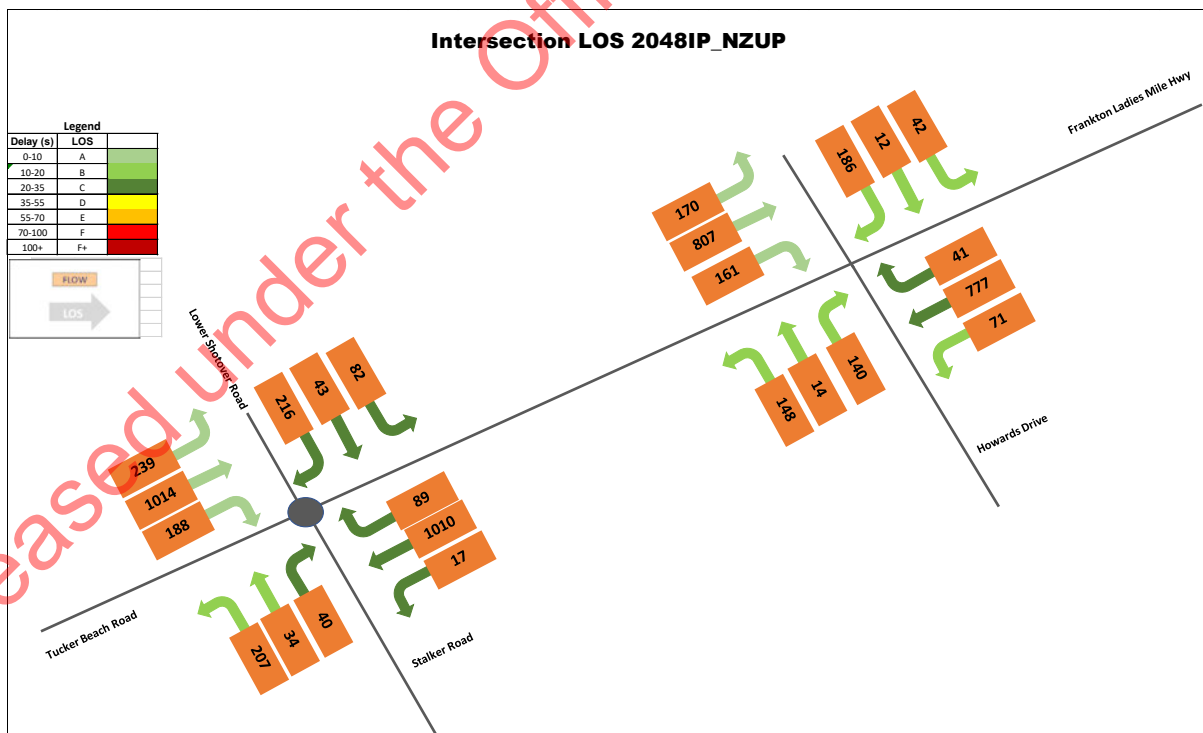


Figure 22: Intersection Volume and LOS - NZUP 2048 IP

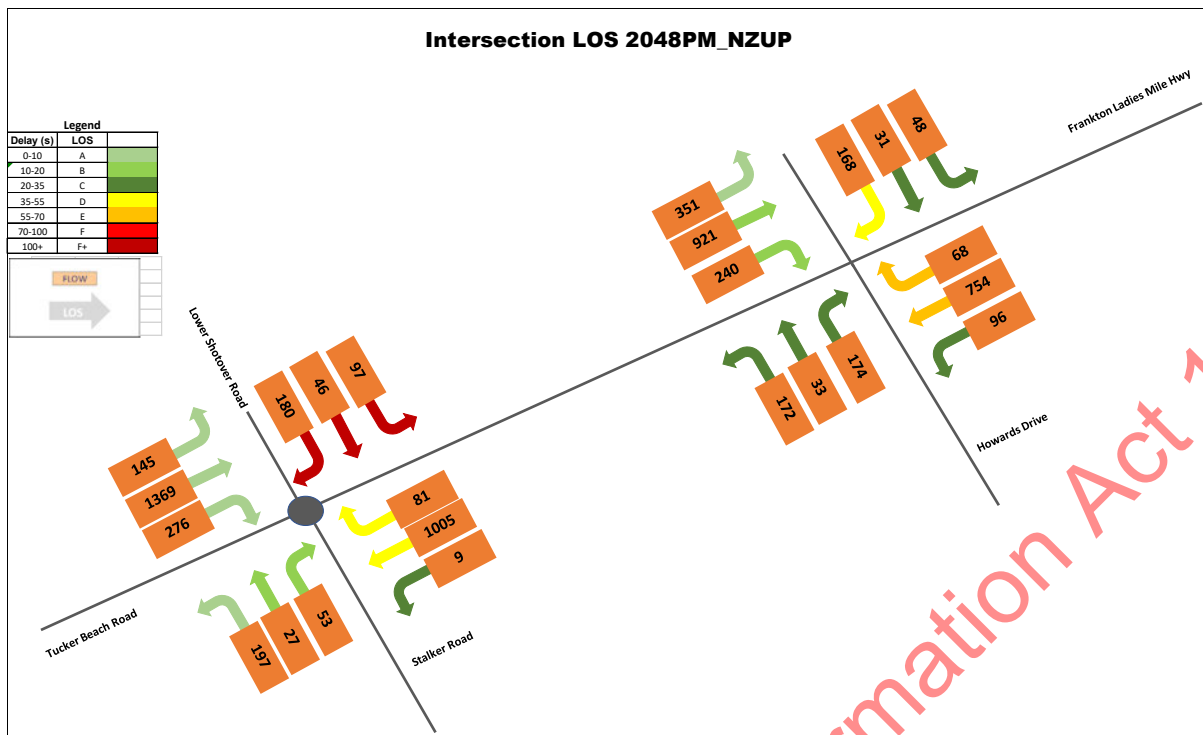


Figure 23: Intersection Volume and LOS - NZUP 2048 PM

In the AM peak period, the modelling results show LOS E for the movements heading towards Shotover Bridge at the Frankton-Ladies Mile Highway/Howards Drive intersection. The right turn movement from Stalker Road also shows level of service E.

In the PM peak period, the north approach of Lower Shotover Road is predicted to operate at LOS F. The through and right turn movements from the east approach of Frankton Ladies Mile Highway/Howards Road intersection show LOS E.

The modelling results show an acceptable level of service for the Interpeak period.

Travel Time Performance (General Vehicle and Bus)

The bus priority measures proposed as part of this project are intended to provide travel time benefits for buses along Frankton-Ladies Mile Highway and northbound Stalker Road. Travel time output has been obtained for all scenarios, for the routes shown in Figure 24.

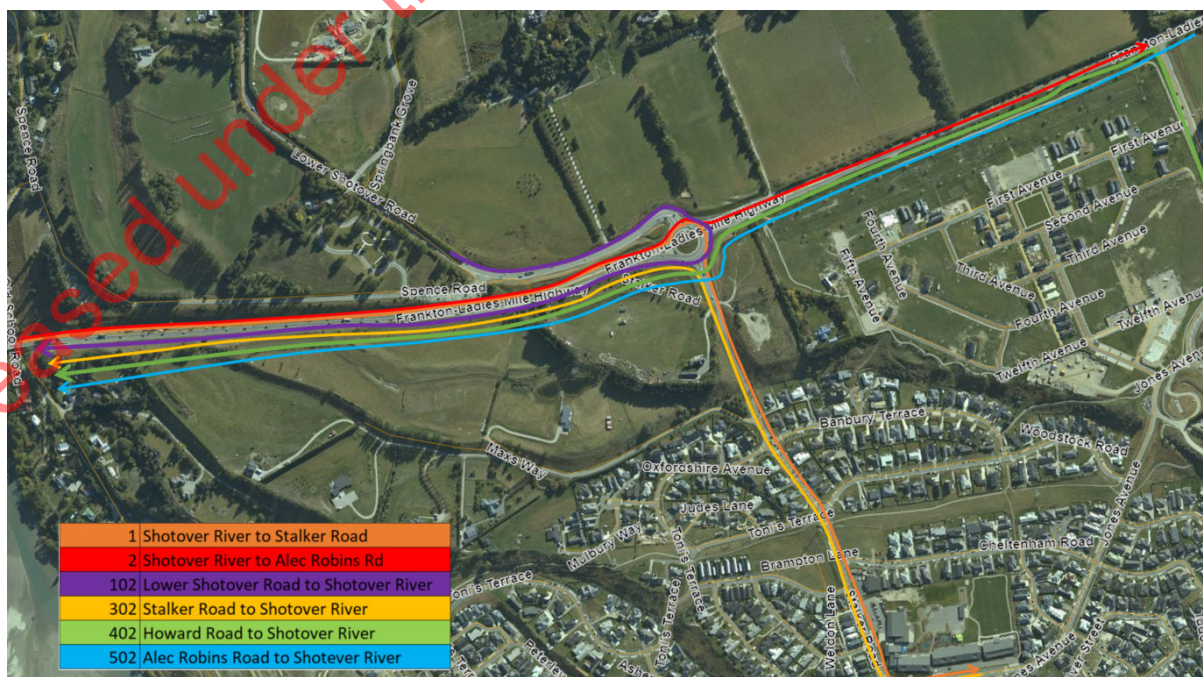


Figure 24: Travel Time Routes

Key travel time differences have been summarised in Table 2 for general traffic movements. Only inbound (westbound towards Shotover Bridge) routes are shown for general traffic, as outbound (eastbound) travel times are consistent across scenarios and years (there is little congestion or delay in the outbound direction across all scenarios and periods).

Table 2: Travel Time Comparison – General Traffic

From	To	AM Peak			Interpeak			PM Peak		
		DM	NZUP	Diff	DM	NZUP	Diff	DM	NZUP	Diff
2018										
Lower Shotover Road	Shotover Bridge	134	130	-4	91	119	28	108	133	25
Stalker Road		486	214	-272	205	240	35	197	199	2
Howards Drive		387	234	-153	221	268	47	224	209	-15
Alec Robins Road		372	280	-92	250	284	34	240	256	16
2028										
Lower Shotover Road	Shotover Bridge	175	144	-31	131	129	-2	272	171	-101
Stalker Road		556	243	-313	201	199	-2	203	201	-2
Howards Drive		496	369	-127	204	209	5	210	254	44
Alec Robins Road		1927	1162	-765	256	260	4	263	303	40
2048										
Lower Shotover Road	Shotover Bridge	180	143	-37	170	142	-28	1025	768	-257
Stalker Road		490	249	-241	209	208	-1	212	203	-9
Howards Drive		425	371	-54	213	297	84	226	359	133
Alec Robins Road		1793	1408	-385	269	375	106	295	1065	770

The comparison of Do Minimum scenarios shows a gradual increase in travel time along the corridor, particularly for trips originating from SH6 (east) in the AM peak period – this is reflective of congestion on the approach to Shotover Bridge. With the implementation of the NZUP package, general traffic journey times are reduced significantly, especially on the Stalker Road approach – this demonstrates that the scheme results in an improvement in operation of the approaches to the Shotover Bridge.

This also indicates that the Stalker Road bus lane provides little benefit in terms of bus travel time improvements, as the delay for traffic on Stalker Road has been significantly reduced by the other changes proposed at the SH6/Stalker Road roundabout. Whilst this does not demonstrate an immediate need for a bus lane on Stalker Road, the operation should be monitored – as the operation of the Frankton network gets busier towards 2028 and beyond, it is possible that queues will stretch back over Shotover Bridge and impact on movements on Ladies Mile. Whilst other elements of the NZUP package allow greater network management control within the Frankton Flats and SH6A parts of the network (to optimise network operation), a bus lane on Stalker Road would provide additional resilience in the wider network to provide reliability for bus services under such conditions when wider network operation breaks down.

In the PM peak at 2048, there is a detrimental effect of the NZUP scheme on westbound through movements. This is due to the prediction of high growth on this movement, as opposed to little growth on other movements towards Frankton – this means that the reduction of the westbound through movement to a single lane at the Stalker Road roundabout has a detrimental impact in this period. However, in the Do Minimum scenario, this greater throughput is likely to lead to downstream congestion within Frankton, with queues stretching back into the Ladies Mile portion of the corridor (as well as creating congestion for other movements around Frankton) – therefore, the NZUP package results in a means to gate westbound traffic movements towards Frankton and Queenstown, which will have downstream benefits in terms of network operation.

Table 3 shows the travel times predicted for bus routes – in this case, results are shown for all potential bus routes in both directions.

The bus travel time results show a similar pattern to those for general traffic, with significant travel time savings recorded in the AM peak period for inbound (westbound) bus journeys. As for general traffic, in the PM peak period at 2048, there is a detriment to bus travel times due to the queue of inbound general traffic stretching back beyond the start of the proposed SH6 inbound bus lane. At this time (i.e. by 2048), further bus lane sections may be required to provide a means for buses to bypass such queues – however, there is a greater level of uncertainty around the traffic levels at 2048, and so further measures are not investigated here (as the overall traffic demand levels may be relieved by greater bus patronage, TDM measures, a higher patronage on active modes, a lower post-COVID growth level etc).

Table 3: Travel Time Comparison – Public Transport

From	To	AM Peak			Interpeak			PM Peak		
		DM	NZUP	Diff	DM	NZUP	Diff	DM	NZUP	Diff
2018										
Shotover Bridge	Stalker Road	252	241	-11	247	241	-6	243	241	-2
	Alec Robins Road	272	279	7	273	272	-1	277	276	-1
Stalker Road	Shotover Bridge	462	240	-222	236	239	3	234	234	0
Alec Robins Road		397	297	-100	271	309	38	270	287	17
2028										
Shotover Bridge	Stalker Road	255	244	-11	242	240	-2	256	247	-9
	Alec Robins Road	282	277	-5	276	276	0	292	281	-11
Stalker Road	Shotover Bridge	560	242	-318	235	233	-2	235	235	0
Alec Robins Road		2069	925	-1144	288	290	2	293	295	2
2048										
Shotover Bridge	Stalker Road	257	248	-9	249	244	-5	261	261	0
	Alec Robins Road	286	286	0	289	284	-5	304	311	7
Stalker Road	Shotover Bridge	500	269	-231	239	235	-4	239	238	-1
Alec Robins Road		1861	1086	-775	295	312	17	317	812	495

Conclusions and Summary

This technical note has detailed an assessment of the operation of the corridor of Frankton Ladies Mile Highway and Stalker Road to evaluate impacts of Bus priority lanes.

The traffic modelling assessment has indicated the following:

- Both corridors are experiencing on-going congestion and this congestion will further increase in the future if no improvements commenced.
- The congestion will result increase in delay and travel times. The performance indicator shows that both intersections will experience LOS F on many key movements in 2028.
- Option results with the SH6 westbound bus lane implemented indicate improvements overall in performance of road corridors. Intersection level performance indicator depicts that an acceptable level of service can be maintained in 2028 under modelled demands. In 2048, congestion is expected but at a lower level compared to the Do Minimum, for both buses and general traffic.
- The northbound bus lane on Stalker Road has little impact on bus travel times – however, the need for such a scheme should be monitored. Whilst other elements of the NZUP package allow greater network management control within the Frankton Flats and SH6A parts of the network (to optimise network operation), a bus lane on Stalker Road would provide additional resilience in the wider network to provide reliability for bus services under such conditions when wider network operation breaks down.
- A travel time comparison shows significant corridor level benefits for both buses and general traffic in the inbound direction (and no change for outbound journeys).
- In the 2048 PM peak period, additional delay is experienced for both buses and general traffic on the inbound journey due to less efficient throughput in this direction from the scheme. At this time, extension of SH6 inbound bus lanes may be required (to prevent buses being delayed by traffic queues)

In summary, the modelling results indicate an improved corridor performance with the implementation of bus lanes and layout changes at the SH6/Stalker Road and SH6/Howards Drive roundabouts.

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Appendix B25 Queenstown Public Transport Network Options Multi Criteria Analysis

Released under the Official Information Act 1982

Evidence for Queenstown PT Network Options MCA

Investment Objectives:

Provides more efficient and reliable access for people and goods that:

- a) Sustainably manages high growth
- b) Reduces reliance on private vehicle travel
- c) Enables enhanced land use

Is adaptable to change and disruption

Enhances the liveability and quality of the natural & built environment

Enhances safety with a goal of vision zero

Transport Factors

Reduces reliance on private vehicle travel

Can achieve significant mode shift from private car

Evidence: Modelled demand. Figures below AM peak westbound demand for SH6A.

Low - low mode shift away from private car

Medium – medium mode shift away from private car

High – high mode shift away from private car

NOTE: These are total modes shares. Need to find increment over current mode share to measure mode shift. Active modes not fully represented. Walk/ cycle mode share assumed not to increase.

Existing mode share data distorted by relocation of high school to Frankton. Previously, high share of trips westbound on SH6A in AM peak on school buses.

Do-min achieves some mode shift (18% in 2028 and 27% in 2048) but assumed bus volumes can't meet 2028 demand. Note that this option assumes a high price of parking in the town centre.

Bus Max achieves 32% mode share at 2028 and 47% at 2048.

Trackless Tram achieves 31% mode share at 2028 and 44% at 2048.

Trackless Tram Max achieves 33% mode share at 2028 and 51% at 2048.

Gondola achieves 10% mode share at 2028 and 15% mode share with bigger mode share to bus with 21% in 2028 and 28% in 2048.

MRT Ferry achieves 8% mode share at 2028 and 10% mode share at 2048. In this scenario bus gets 18% in 2028 and 30% in 2048. The Kelvin Heights local ferry gets 1% at 2028 and 2% at 2048.

Note: B options for gondola & ferry not yet modelled. Models tend to underpredict connective networks & favour one-seat ride networks (cf. Panmure in Auckland). And models typically don't pick up well on mode attractiveness factors (cf. 20% year on year growth post EMUs in Auckland)

Sustainably manage growth

Fit for the future. Can meet demand for foreseeable future

Low - can manage present demand but with limited room for growth or limited resilience to disrupted operation

Medium – can meet demand in the medium term

High – can meet demand in the long term

Evidence: Vehicle capacities in modelling assumptions versus modelled demand.

Do Min can't meet 2028 demand. But of course, bus numbers could be increased to meet demand.

Bus Max can meet demand at 2048 but achieves lower mode shift than **trackless tram** which comes close to capacity in 2048 (but frequency & vehicle length of **Trackless Tram** can be expanded).

Gondola meets 2048 demand but lower mode shift than **Bus Max** & much less than **Trackless Tram**.

Ferry can meet demand but achieves very little mode shift.

Note: B options for gondola & ferry not yet modelled. Models tend to underpredict connective networks & favour one-seat ride networks (cf. Panmure in Auckland).

Resilience – Network Events Is adaptable to disruption

Low - vulnerable to short term and long-term network events

Medium - some resilience to high probability, low impact network events, limited to low probability, high impact events

High - some resilience to low probability, high impact network events as well as day to day disruption

Evidence: Network events such as crashes in the network and disruption to public transport network.

Do Min & Trackless Tram all provide localised priority but vulnerable to impact from crashes.

Bus Max & Trackless Tram provides full priority so would be less impacted by crashes.

Gondola and **Ferry** unimpacted by road congestion Weather impacts on ferries a few days a year when ferries wouldn't be able to get to Steamer Wharf & would need to terminate at Park Street. Some high wind days may impact on the **Gondola** depending on its alignment

Resilience – Natural Hazards
Is resilient to natural hazards

Low - vulnerable to short term and long-term natural hazards

Medium - some resilience to high probability, low impact natural hazards, limited to low probability, high impact natural hazards

High - some resilience to low probability, high impact natural hazards as well as day to day natural hazards

Evidence: Geotech evidence and the likelihood of natural hazards. Level of priority will be key determinant of day-to-day reliability but impacted by natural events/ crashes.

On road options **Do Min, Bus Max, Trackless Tram & Trackless Tram Max** all vulnerable to short term natural hazards such as snow and ice. On road options also vulnerable to slips, flooding and low probability, high impact seismic events

Gondola and **Ferry** relatively unimpacted by short term natural hazards.

Some high wind days may impact on the **Gondola** depending on its alignment.

Some lake roughness days, usually associated with high winds, may impact the **Ferry** a few days a year when the ferries wouldn't be able to traverse the main lake to get to Steamer Wharf and would need to terminate at Park Street.

Scoring considers how PT network would facilitate movement during a low probability, high impact natural hazards, based on reach and accessibility.

Advice from s 9(2)(a) *In terms of the natural hazard resilience of the PT Networks, they are all reasonably resilient to high probability low impact events, however the on-road options will be susceptible to snow and ice, particularly on gradients.*

In terms of low probability high impact events the on-road options will be susceptible to flooding, slips road breaking up (either flood or seismic induced). The gondola will be less susceptible to these events. Ferries should be okay and will likely be used for evacuation purposes, either to the airport if it's still open, or down to Kingston being the likely accessible route out of Queenstown, however that's assuming that there isn't a lake Tsunami and all the boats are at the bottom of the lake (which will likely wipe out the airport too).

If we are moving towards electrification of the vehicle fleet, it's highly likely that we won't have any electricity following a low probability high impact event. Queenstown also only carries about a days' worth of fuel, so this won't last long for internal combustion powered systems either, or we could be on our own for some time depending on how widespread the event is.

We should maybe consider rewording the resilience section as:

To look at network related events, such as car crashes, and other network impacts, although this possibly overlaps with reliability a little bit.

Adaptability to change, which is the future technology aspect that we'll need to cover as well.

Reliability Delivers an efficient and reliable service	Evidence: Assumed level of priority and/ or separation from traffic will determine reliability.
Low - mixed with traffic. Limited priority. Medium - some protection from traffic. Some priority. High - high protection from traffic. High priority or off-line.	Do Min is likely to perform poorly while Bus Max and trackless tram will have similar level of localised priority. Lower VOC ratios are a proxy for network reliability (closer to 100% indicates less reliability). Trackless Tram Max has full priority and likely to be a very reliable option, albeit at very high cost. Gondola and Ferry unimpacted by road congestion but Frankton Arm is very busy water space. Weather impacts on ferries a few days a year when it wouldn't be able to get to Steamer Wharf. Gondola & Trackless Tram Max the options most likely to provide close to 100% reliable travel times. Some high wind days may impact on this depending on the Gondola alignment.
End to end journey time Delivers a time efficient service	Evidence: Model outputs for each option. From BP Roundabout to Queenstown Town Centre.
Low - long average journey time relative to private car Medium - moderate journey time relative to private car High - short average journey time relative to private car	Note: This is a macro model across all vehicles, not individual travel times, hence is an average. Mode shift affects car travel times. No mode is faster than private car at either 2028 or 2048. Car travel times remain stable between 14-16 minutes in both 2028 and 2048. Ferry matches private car time in 2048 at 15 minutes each but impacted by access travel times. Bus Max and Trackless Tram Max perform best with 17-minute travel times versus 14 minutes for Trackless Tram Max and 15 minutes for Bus Max. Gondola is the slowest option at 22 minutes, due to its 18km/h speed, versus car at 16 minutes.
Towards Vision Zero Enhances safety with a goal of Vision Zero	Evidence: Reduced exposure by mode shift & evidence from similar improvements
Low – BAU/ slight improvement in safety for all road users Medium – some improvement in safety for all road users High – significant improvement in safety for all road users	Level of mode shift and reduction in VKT proxies change in exposure for all road user groups (although there is some shift in exposure – e.g. from car driver to pedestrian/ public transport customer). Added signalised intersections likely to improve safety for all modes. But ironically more congestion = slower travel speeds and more but less severe crashes. It's hard to differentiate between modes – Gondola and Ferry may be safer as they are off corridor options.
Modal Integration Good modal integration & convenient location	Evidence: Professional judgement and objective criteria, e.g. Modal connections seamless, including reference to and ride and active travel
Low - weak intermodal connections Medium – satisfactory intermodal connections High - excellent intermodal connections	All options have been developed as integrated networks and thought of as a whole network. Ferry and Gondola options have worst connections but work underway on B options to address this. Bus Max is largely one-seat ride network so has least requirement to connect.

Operational Flexibility Able to accommodate technological change	Evidence: Professional judgement and knowledge of modal characteristics.
---	--

Low - constrained operations, limited future options

Medium - some flexibility to modify operations in the future

High - significant flexibility to introduce different vehicle types or network operations

This is largely a function of mode type. **Ferry** may transition to electric **ferry**. **Gondola** is a fixed guideway technology (noting that this can be a strength). **Bus Max** can be a transition to **Trackless Tram** which is turn is relatively easily able to be repurposed.

Investment Objectives:

Provides more efficient and reliable access for people and goods that:

a) Sustainably manages high growth

b) Reduces reliance on private vehicle travel

c) Enables enhanced land use

Is adaptable to change and disruption

Enhances the liveability and quality of the natural & built environment

Enhances safety with a goal of vision zero

Community Factors

Resident/ Visitor experience: Enhances the liveability and quality of the natural and built environment.	Evidence: Jasmex professional judgement based on qualitative assessment of the modal options.
--	---

Low - functional and fit for purpose. Does what it says on the packet but no more.

Medium - has a certain attractiveness above BAU

High - wow factor that it is seen as a positive contribution to the Queenstown resident & visitor experience

Do Min reinforces car dependency and retains the negative amenity effects of traffic congestion.

Bus Max could have issues with bus platooning and impact of double-decker buses in the town centre

Trackless tram assessed as avoiding the problems of Bus Max and fit better in urban context.

Gondola assessed as both a negative (privacy; breaking Queenstown Hill ONL & recreational user experience) and a positive (exceptional arrival experience and passenger experience).

Ferry has negative impacts through the scale of land-side infrastructure and lack of mode shift meaning similar issues with car dominance on SH6A.

Capital Cost (capex)	Evidence: Benchmark costs for existing modes based on NZ comparators.
Low - high construction costs	Do min and Trackless Tram have very little construction cost. Can be run with existing Queenstown bus fleet - \$400,000 per single-decker bus for bus renewal.
Medium - medium construction costs	Bus Max and Trackless Tram have high construction costs full overall priority. Bus capex - \$800,000 for double-decker electric bus. Fleet of 44 buses = \$35.2 million. Estimated cost Bus Max - \$110 million excluding vehicles.
High - low construction costs	Trackless tram . Advice from Marie Verschuer. \$A3.6 million (\$NZ 3.75 million) per vehicle. Fleet of 24 required = \$NZ 90 million. \$A 2.24 m per terminal station (3 required – QTC, Ladies Mile, Jacks Point) = \$A 6.72m (\$NZ 7.0 m). Other stations at \$A 1.54 m each. Assuming 10 other stations = \$A 15.4 m (\$NZ 16.04 m) Depot = \$A 16.21 million (\$NZ 16.99 million). Estimated total = Trackless Tram Do Min \$212.3 million; Trackless Tram Do Max \$312.3 million Ferry and Gondola have high terminal and landside infrastructure construction costs, but Gondola has PPP potential – best option for private sector participation. Gondola : Information from Doppelmayr has costs of \$134.83 million for Queenstown to Frankton and an additional \$122.48 m for Frankton to Ladies Mile, totalling \$257.31 + \$2 million for traveller. Gondola B = \$134.83 million F2Q + \$10 million for airport trench. (New Lynn rail trench 900 metres = \$140 million in 2010 dollars) Gondola A = \$284.6 million Ballpark wharf costs for Frankton Beach Wharf for the Ferry option - \$3.2 million for the Hobsonville Point Ferry Wharf in Auckland. - \$5.9 million for the Half Moon Bay Ferry Wharf in Auckland Ballpark vessel (purchase) costs for the Ferry option -\$2 million based on cost of 24m Wanderer catamaran accommodating 180 pax for the Birkenhead ferry service. Four ferries to run 15-minute peak service + \$1 million for small ferry to Kelvin Height so \$9 million for Ferry fleet . Ballpark traveller costs for the Gondola and Ferry options - \$18 to \$53k (NZD) per length of traveller (generally reasonably short. assume around \$1 m for the traveller itself for the gondola + the cost of fully enclosing it – required for customer amenity and so that it can be insured (and that it doesn't rust). For the ferry assume \$2 million + the cost of fully enclosing it. Ferry A = \$44 million for terminals + \$9 million for ferries = \$51 million

Operational Cost (opex)	Evidence: Benchmark opex costs for existing modes based on NZ comparators.
Low - high operating costs Medium - medium operating costs High - low operating costs	Do min has lowest opex (commensurate with lowest benefits). Bus Max & Trackless Tram have higher but still moderate opex, but Trackless Tram has lower labour costs per pax. Bus Max and Trackless Tram operating costs assumed to be (based on Auckland PTOM benchmarks): - peak - \$100 per hour + \$4 per kilometre (capitalising peak bus vehicle cost - not trackless tram) - non-peak \$30 per hour + \$1.30 per kilometre Bus Max opex estimated at \$12.8 million per annum Trackless Tram opex estimated at \$11.6 million per annum Gondola – estimated at \$4.9 million per year for Frankton to Queenstown and \$3.7 million per annum for the wider network for gondola + \$10.2 million per annum for connecting bus network, totalling \$18.8 million per annum. Ferry has very high operating costs based on Auckland and international benchmarks, partly driven by fuel & crewing costs to meet Maritime NZ requirements. Typically, \$900 to \$1,000 per revenue hour. Ferry opex estimated at \$27.4 million per annum for ferry + \$8.8 million for supporting buses, totalling \$36.2 million per annum. – 1.4 million pax on Auckland services costing \$26.1 million per annum = \$18.60 per pax gross - Sydney 15.3 million pax on Sydney Ferries costing \$141 million per annum = \$A9.21 per pax gross - Vancouver 6.628 million pax on SeaBus costing \$9.65 million per annum = \$C1.45 per pax gross
Urban design and development Contributes to enhanced land use	Evidence: Advice from Jasmax based on assumptions around both mode, TOD potential & quality of infrastructure at stops/ stations.
Low - while functional, the network risks sterilising land use Medium - the mode supports BAU land use development High - the mode supports enhanced land use development	Do Min has lowest TOD potential simply because it's the least change over BAU. Bus Max and Trackless Tram have highest TOD potential on current zoning as there is wide distribution of stops – lots of lower-rise development but dispersed, not concentrated. Gondola could have TOD potential at hubs but not significant on current zoning. Ferry considered to have low potential at Frankton Beach due to zoning and airport restrictions.

Environmental Impact on natural environment/emissions	Evidence: Options with electric traction will outperform fossil fuels. Mode uptake and mode shift will generate a CO2 reduction figure; each mode will have a typical noise level; fossil fuel options will have tailpipe pollution. Also consider visual impacts.
Low - similar to BAU environmental impacts of transport Medium - some improvement to environment impacts High - significant improvements to environmental impacts	The degree of mode shift and the motive power of the modes are the key proxies here. Do Min & Ferry both have least mode share and fossil fuel motive power (at least in the short term). Gondola is electric as is are Bus Max & Trackless Tram options. Visual impacts most notable with the Gondola. The latter two achieve significant mode shift with Trackless Tram performing best of all.
Access for local communities	Evidence: Note some sensitivity to unknowns – e.g. Spatial Plan outcomes, the rate of future growth and final outcome for Ladies Mile.
Low - Little PT access improvement for local communities Medium - some improvements to access to the PT network High - significantly improved access to high quality PT for local communities on network	Do Min achieves very little change over BAU. Bus Max & Trackless Trams provide very frequent service on SH6A & further afield. Gondola by its nature only serves hubs but is integrated with the wider public transport network. Ferry has a small localised catchment at Frankton Beach & depends on wider network to feed it.
Construction Impacts	Evidence: Fairly well known for all options based on modal characteristics; impact (or lack thereof) on SH6A during construction. Primarily covering disruption to QTC and F2Q.
Low (good) - minimal disruption to wider network Medium - moderate but manageable disruption High (bad) - significant construction effects and disruption	Do Min performs well as it does the least (and achieves the least). Bus Max & Trackless Tram have significant construction impacts as they are on-corridor options on SH6A. Widening is more manageable than no widening, particularly for online Trackless Tram as the pavement needs to be significantly upgraded and takes up traffic lane. Gondola and Ferry options are off-corridor so have localised impacts at their construction sites but no direct impact.

**Alignment with Masterplan
Town Centre and Frankton**

Low - Poor consistency Masterplan outcomes

Medium - Positive contribution to Masterplan outcomes

High - High contribution to the Masterplan outcomes

Evidence: The Masterplans are, or soon will be, public documents where what they propose can readily be checked against.

Do Min performs poorly as it doesn't achieve the mode shift envisaged in the Queenstown Masterplan.

Bus Max achieves significant mode shift but risks creating issues in town centre (e.g. platooning) as bus demand is much higher than envisaged in the Queenstown Masterplan. Through-running service has been designed to mitigate town centre impacts. Frankton Orbital from Frankton Masterplan incorporated into this and all non- Do Min options.

Trackless Tram achieves very significant mode shift and could mitigate some of the potential town centre issues of the **Bus Max** option (as could a bi-articulated bus version of **Bus Max**)

Question of whether some or all of arterials needed to make **Bus Max & Trackless Tram** work in the town centre requires further work.

Gondola creates an unparalleled town centre arrival experience and reduces the number of buses needed in the town centre but significant mode shift needed to maximise these benefits through reducing traffic. At Frankton, an airport hub picks up on a Frankton Masterplan idea.

Ferry has big landside impacts at Frankton Beach which is challenging given the Frankton Masterplan aspiration to be better connected to the water that surrounds them on three sides. But **Ferry A** option picks up on Frankton Beach to Queenstown Airport move.

Investment Objectives:

Provides more efficient and reliable access for people and goods that:

a) Sustainably manages high growth

b) Reduces reliance on private vehicle travel

c) Enables enhanced land use

Is adaptable to change and disruption

Enhances the liveability and quality of the natural & built environment

Enhances safety with a goal of vision zero

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NZTA Contract 2018235 - F2Q SSBC & QTC DBC

Technical Note # 43

30 September 2020

Pedestrian / Cycle Crossings of SH6 in Frankton Area

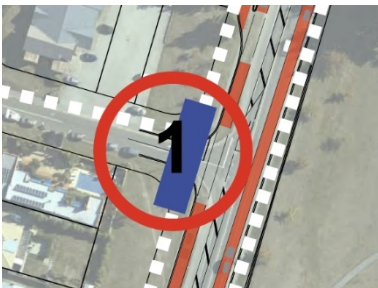
Purpose

The purpose of this document is to assess the pros and cons of different pedestrian and cycle crossing alternatives at the appropriate locations along SH6 between Ross St and Hardware Lane. The recommended solution informs the overall option (**Option A Roundabouts** or **Option B Conventional intersections**) that is assessed in the MCA.

The crossing alternatives are specific to each of the eleven identified crossing locations. Each location includes a range of alternatives from no crossings to signalised crossings, zebra crossings and grade separated crossings (underpasses and over passes).

Option A Roundabouts

Intersection 1 - Ross St



Alternatives considered: Signalised crossing / zebra crossing / raised table / no crossing

Recommended solution for this option: Zebra Crossing of Ross Street (due to level of pedestrian priority required and effect of signals on Kwarau Rd)

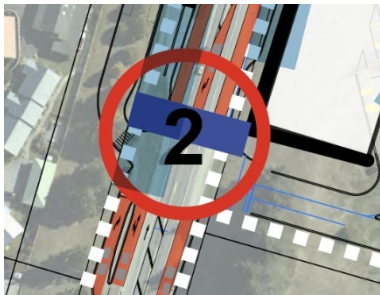
Pros:

- Signal or zebra crossing will provide safer crossings for peds and support connectivity along Kwarau Road and with PT Hub
- Signal or zebra will give some priority to pedestrian crossing

Cons:

- No dedicated crossing would create some safety and connectivity severance in the long term for pedestrians although it's a low volume road
- Signalised crossing would require Kwarau Rd intersection to be signalised with the traffic effects on the PT hub

Intersection 2 - PT Hub South



Alternatives considered: Signalised crossing / No crossing

Recommended solution for this option: Signalised crossing (due to pedestrian priority connection with PT Hub) and adjacent PT hub intersection

Dependent on bus hub operations (may be full or split crossing, still TBC)

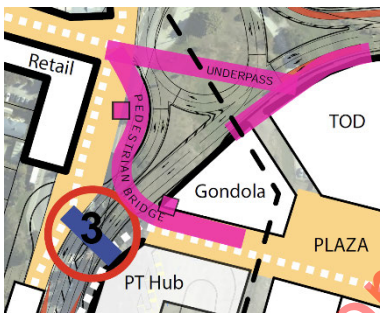
Pros:

- Signalised crossing will provide safe crossings for peds and cyclists and support prioritised pedestrian connectivity to PT hub and future emergency precinct
- Signalised crossing will give priority to pedestrians and cyclists.

Cons:

- No crossing will significantly restrict access to PT hub and other land uses, provide no LoS for peds and likely result in unsafe pedestrian crossing movements

Intersection 3 - SH6 Kawarau Rd



Alternatives considered: Signalised crossing / underpass (under roundabout) / pedestrian bridge (overpass) / no crossing

Recommended solution for this option:

Staggered signalised crossing (due to pedestrian priority connection with PT Hub)(underpass or overpass are not essential but could provide additional benefits)

Pros:

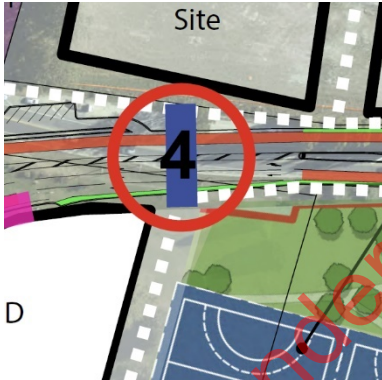
- Signalised crossing will provide safer crossing for peds and cyclists and support prioritised pedestrian connectivity to PT hub and future emergency precinct from Frankton shops. Ped signals support desire line between PT hub and Frankton Village
- Signalised crossing will give priority to pedestrians and cyclists across SH6 and manage the different demands as it is a high movement corridor
- Underpass will give good connectivity and provide a safe crossing for cyclists along Qtown trail and SH6 and provide direct offline route adjacent to SH6
- Over bridge has potential to 'stitch together' Frankton Village and PT hub and TOD development with good legibility and purpose.

Cons:

- No crossing option will significantly restrict access to PT hub and other land uses in the precinct and result in unsafe crossing by peds.
- Underpass does not connect directly from the Frankton Village to PT hub and hence grade crossing is also required to support this desire line.

- Signalised crossing is not as direct as the underpass for cyclist along SH6 however it does direct cyclists to engage with the landuse, activity and businesses within the TOD and PT hub at this key node on the wider journey when the expanded PT hub goes in in the future.
- Overpass will need 6.5m clearance over SH6 so significant height in bridge is required and long linear ramps would be prohibitive with space available (steps can be achievable).
- Grade separated routes would require lifts to provide accessible route or combined with ped signal crossing
- Underpass will require significant ramping at each end constraining the public realm and or development opportunities at ground level
- Underpass will have CPTED considerations especially for pedestrians after dark when there is less activity. Underpass is significantly long at 71m which will be difficult to provide 24hr passive or active surveillance within.
- Underpass does not provide pedestrian priority across SH6
- Signalised crossing will need to be staggered to allow traffic to flow however crossing times may not be longer than grade separated options as signalised crossing is shorter distance to cross and is more direct between landuse destinations
- Pedestrian bridge will not be suitable for cycle access as ramps are prohibitive

Intersection 4 - SH6 East of SH6/SH6a Intersection



Alternatives considered: Underpass / Signalised crossing / no crossing

Recommended solution for this option: Underpass (due to signal crossing constraints on traffic flow)

Pros:

- Signalised crossing will provide safer crossings for peds and cyclists and support prioritised pedestrian connectivity over SH6
- Underpass will allow free flowing traffic and relatively short crossing times.
- All crossings support the PT network and access to the PThub

Cons:

- No dedicated crossing would create safety and connectivity severance across SH6 in the long term for pedestrians and cyclists.
- Signalised crossing will have significant effect on traffic and PT operation at this location

- Underpass will have some CPTED considerations especially for pedestrians after dark when there is less activity. However, the relatively short distance and it not being a primary desire line without alternatives will reduce these effects.
- Underpass ramps will be constrained on the northern side with minimal land available within the road reserve. However potential ramp within private land could be established.
- Underpass does not provide pedestrian priority across SH6

Intersection 5 – SH6a



Alternatives considered: Signalised crossing / no crossing / ped refuge (existing)

Recommended solution for this option: Staggered signalised crossing

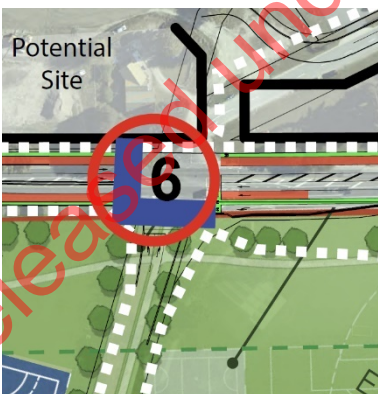
Pros:

- Signalised crossing will provide safer crossings for peds and cyclists and support prioritised pedestrian connectivity over SH6a within Frankton Village

Cons:

- No dedicated crossing would create safety and connectivity severance in the long term for pedestrians
- Staggered signal crossing will create longer wait times and restrictions for informal crossings are most likely required on both sides and within the central median

Intersection 6 – Joe O'Connell (Events Centre)



Alternatives considered: Signalised crossing / underpass / no crossing

Recommended solution for this option: Signalised crossing on west side + signalised crossing across Joe O'Connell

Pros:

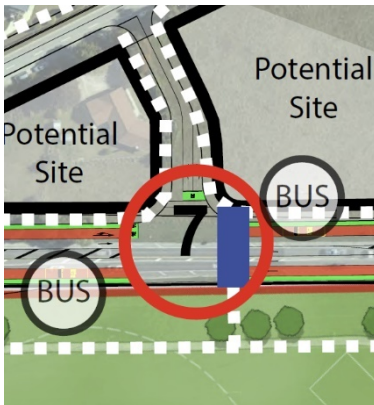
- Signalised crossing will provide safer crossings for peds and cyclists and support prioritised pedestrian connectivity over SH6 between future landuse and the Events Centre and recreation grounds

- Underpass will allow free flowing traffic and relatively short crossing times.

Cons:

- No dedicated crossing would create safety and connectivity severance in the long term for pedestrians between future landuse and the Events Centre and recreation grounds however intersection 7 can also provide this function.
- Underpass will have some CPTED considerations especially for pedestrians after dark when there is less activity and pedestrians may choose to cross unsafely at grade to avoid the underpass. However, the relatively short distance and it not being a primary desire line without alternatives will reduce these effects.
- Underpass does not provide pedestrian priority across SH6

Intersection 7 – New Hansen Road



Alternatives considered: Signalised crossing / underpass / no crossing

Recommended solution for this option: Staggered signalised crossing on west side + Signalised ped crossing on Hansen Road arm.

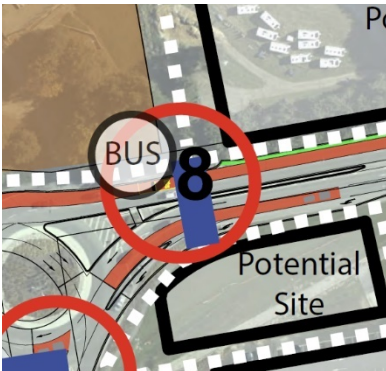
Pros:

- Signalised crossing will provide safer crossings for peds and cyclists and support prioritised pedestrian connectivity over SH6 between future landuse and the Events Centre and recreation grounds
- All crossings support the PT network and connection to bus stops
- Underpass will allow free flowing traffic and relatively short crossing times.

Cons:

- No dedicated crossing would create safety and connectivity severance in the long term for pedestrians between future landuse and the Events Centre and recreation grounds
- Underpass will have some CPTED considerations especially for pedestrians after dark when there is less activity and pedestrians may choose to cross unsafely at grade to avoid the underpass. However, the relatively short distance and it not being a primary desire line without alternatives will reduce these effects.
- Underpass does not provide pedestrian priority across SH6

Intersection 8 – Grant Rd



Alternatives considered: Signalised crossing / underpass / no crossing

Recommended solution for this option: Underpass preferred (due to transport effects)

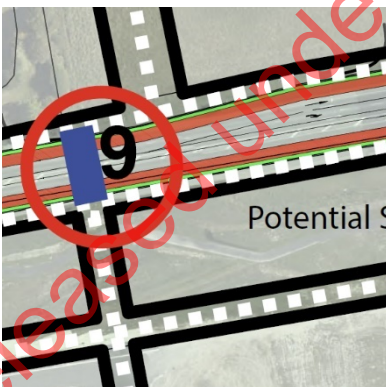
Pros:

- Signalised crossing will provide safer crossings for peds and cyclists and support prioritised pedestrian connectivity over SH6 between future landuse, but will significantly affect traffic.
- All crossings support the PT network and connection to bus stops
- Underpass will allow free flowing traffic and relatively short crossing times.

Cons:

- No dedicated crossing would create safety and connectivity severance across SH6 in the long term for pedestrians
- Underpass will have some CPTED considerations especially for pedestrians after dark when there is less activity and pedestrians may choose to cross unsafely at grade to avoid the underpass.
- Underpass does not provide pedestrian priority across SH6

Intersection 9 – Midblock



Alternatives considered: Signalised crossing / underpass / no crossing

Recommended solution for this option: Staggered signalised crossing (due to acceptable effect on transport operation and CPTED concerns for underpass) and ties in better with future proposed urban development along this midblock

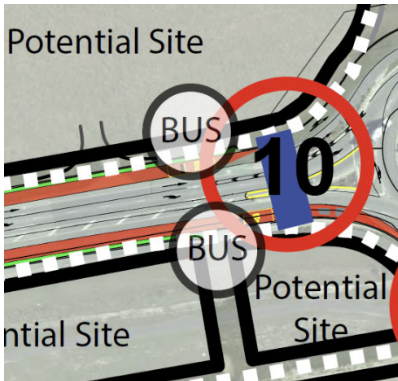
Pros:

- Signalised crossing will provide safer crossings for peds and cyclists and support prioritised pedestrian connectivity over SH6 between future landuse
- Underpass will allow free flowing traffic and relatively short crossing times.

Cons:

- No dedicated crossing would create safety and connectivity severance in the long term for pedestrians.
- Underpass will have some CPTED considerations especially for pedestrians after dark when there is less activity and pedestrians may choose to cross unsafely at grade to avoid the underpass.
- Underpass does not provide pedestrian priority across SH6

Intersection 10 – Hawthorne Dr



Alternatives considered: Signalised crossing / underpass / no crossing

Recommended solution for this option: Signalised crossing (due to acceptable effect on transport operation and CPTED concerns for underpass)

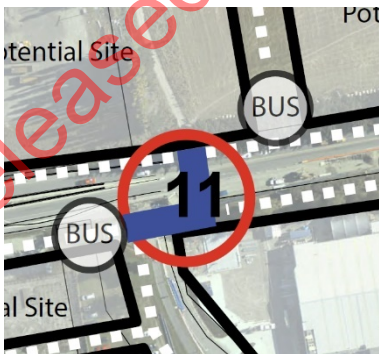
Pros:

- Signalised crossing will provide safe crossings for peds and cyclists and support prioritised pedestrian connectivity over SH6 between future landuse
- All crossings support the PT network and connection to bus stops

Cons:

- No dedicated crossing would create safety and connectivity severance in the long term for pedestrians
- Underpass will have some CPTED considerations especially for pedestrians after dark when there is less activity and pedestrians may choose to cross unsafely at grade to avoid the underpass.
- Underpass does not provide pedestrian priority across SH6
- Signalised crossing will affect the traffic operation

Intersection 11 – Hardware Lane



Alternatives considered: Signalised crossing / underpass / overpass / refuge (existing).

Recommended solution for this option: Overpass (due to signal crossing constraint on traffic flow and space unavailable for underpass)

Pros:

- Signalised crossing will provide safer crossings for peds and cyclists and support prioritised pedestrian connectivity over SH6 between future landuse

- Grade separation will allow free flowing traffic
- All crossings support the PT network and connection to bus stops

Cons:

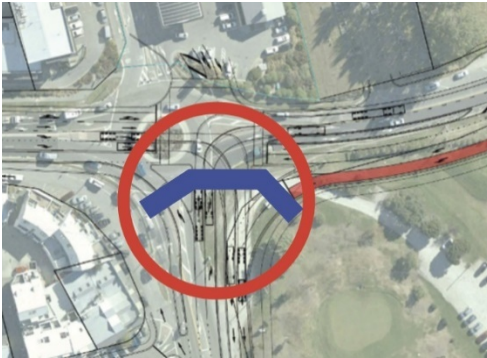
- No dedicated crossing would create safety and connectivity severance in the long term for pedestrians
- Overpass and underpass will require significant space for ramps and steps in constrained corridor.
- Overpass will need 6.5m clearance along SH so significant height in bridge is required and long linear ramps and steps would be prohibitive with space available so compact switch back style stair will be required. This won't provide cycle access.
- Peds and cyclist may choose not to take grade separated crossing and cross at grade unsafely
- Grade separated alternatives may not provide accessible routes unless lifts are installed.
- Grade separated alternatives do not provide pedestrian priority
- Underpass will have CPTED considerations especially after dark when there is less activity and pedestrians may choose to cross unsafely at grade to avoid the underpass.
- A significant number of underground services (water and sewer) and proximity of water pump station would preclude the construction of an underpass
- Signalised crossing will need to be staggered to allow traffic to flow and crossing times maybe longer than underpass alternative. And would need 2 traffic lanes in each direction, which isn't compatible with the rest of the design and would create issues at merges.
- Signalised crossing will have significant effect on traffic

Option B Conventional Intersections

Intersection 1 - Ross St (same as option A)

Intersection 2 - PT Hub South (same as option A)

Intersection 3 – SH6 Kawarau Rd



Alternatives considered: Signalised crossing at intersection and at PT Hub / underpass / no crossing

Recommended solution for this option: Signalised crossing although 3 phases

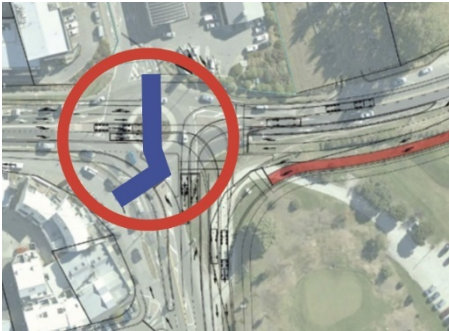
Pros:

- Signalised crossing will provide safe crossings for peds and cyclists and support prioritised pedestrian connectivity to PThub and future emergency precinct from Frankton shops. Ped signals support desire line between PThub and Frankton Village
- Signalised crossing will give good connectivity for pedestrians and cyclists across SH6
- Underpass will give good connectivity for cyclists along Qtown trail and SH6 and provide direct offline route adjacent to SH6
- All crossings support the PT network and access to the PThub

Cons:

- Signalised crossing has three phases and will create long crossing times and not give priority to pedestrian crossing.
- Grade separated routes would require lifts to provide accessible route or combined with ped signal crossing
- Underpass will require significant ramping at each end constraining the public realm and or development opportunities at ground level
- Underpass will have CPTED considerations especially for pedestrians after dark when there is less activity. Underpass is significantly long at 71m which will be difficult to provide 24hr passive or active surveillance within.
- Underpass does not provide pedestrian priority across SH6

Intersection 4 - SH6 East of SH6/Sh6a Intersection



Alternatives considered: Underpass / Signalised crossing / no crossing

Recommended solution for this option: Signalised crossing although two phases

Pros:

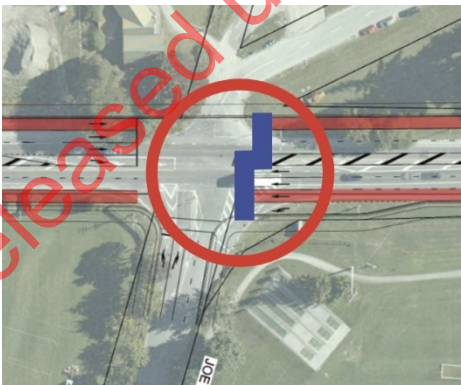
- Signalised crossing will provide safe crossings for peds and cyclists but significant wait times
- Underpass will allow free flowing traffic and relatively short crossing times.
- All crossings support the PT network and access to the PThub

Cons:

- No dedicated crossing would create safety and connectivity severance across SH6 in the long term for pedestrians and cyclists.
- Underpass will have some CPTED considerations especially for pedestrians after dark when there is less activity. However, the relatively short distance and it not being a primary desire line without alternatives will reduce these effects.
- Underpass ramps will be constrained on the northern side with minimal land available within the road reserve. However potential ramp within private land could be established.
- Underpass does not provide pedestrian priority across SH6

Intersection 5 – SH6a (same as option A)

Intersection 6 – Joe Oconnell



Alternatives considered: Signalised crossing / underpass / no crossing

Recommended solution for this option: Signalised crossing

Possibly full crossing instead of staggered TBC

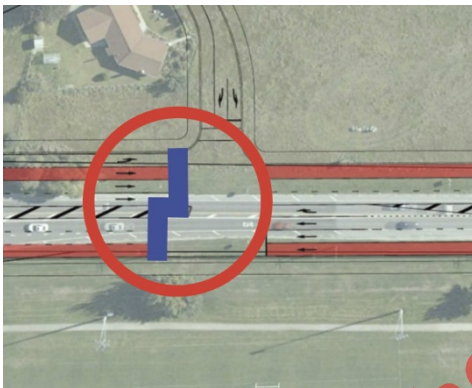
Pros:

- Signalised crossing will provide safe crossings for peds and cyclists and support prioritised pedestrian connectivity over SH6 between future landuse and the Events Centre and recreation grounds
- Underpass will allow free flowing traffic and relatively short crossing times.

Cons:

- No dedicated crossing would create safety and connectivity severance in the long term for pedestrians between future landuse and the Events Centre and recreation grounds however intersection 7 can also provide this function.
- Underpass will have some CPTED considerations especially for pedestrians after dark when there is less activity and pedestrians may choose to cross unsafely at grade to avoid the underpass. However, the relatively short distance and it not being a primary desire line without alternatives will reduce these effects.
- Underpass does not provide pedestrian priority across SH6

Intersection 7 – Hansen



Alternatives considered: Signalised crossing / underpass / no crossing

Recommended solution for this option: Signalised crossing (CPTED concerns for underpass)

Possibly full crossing instead of staggered TBC

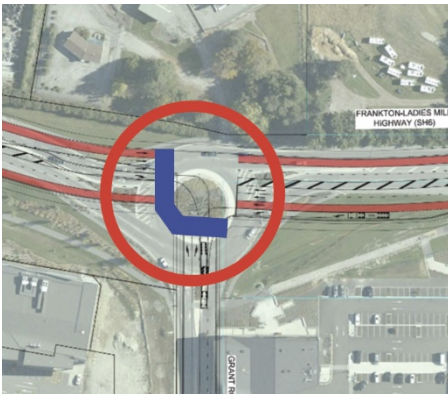
Pros:

- Signalised crossing will provide safer crossings for peds and cyclists and support prioritised pedestrian connectivity over SH6 between future landuse and the Events Centre and recreation grounds
- All crossings support the PT network and connection to bus stops
- Underpass will allow free flowing traffic and relatively short crossing times.

Cons:

- No dedicated crossing would create safety and connectivity severance in the long term for pedestrians between future landuse and the Events Centre and recreation grounds
- Underpass will have some CPTED considerations especially for pedestrians after dark when there is less activity and pedestrians may choose to cross unsafely at grade to avoid the underpass. However, the relatively short distance and it not being a primary desire line without alternatives will reduce these effects.
- Underpass does not provide pedestrian priority across SH6

Intersection 8 – Grant Rd



Alternatives considered: Signalised crossing / underpass / no crossing

Recommended solution for this option: Signalised crossing (CPTED concerns for underpass)

Need to confirm whether staggered or straight across, likely east side only

Pros:

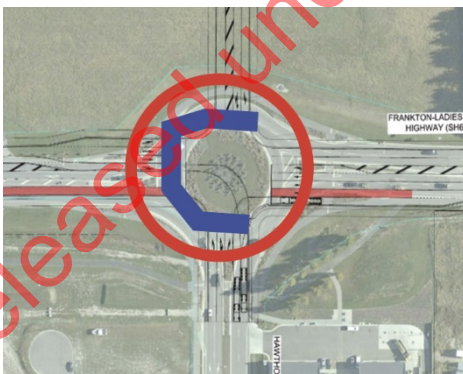
- Signalised crossing will provide safer crossings for peds and cyclists and support prioritised pedestrian connectivity over SH6 between future landuse
- All crossings support the PT network and connection to bus stops
- Underpass will allow free flowing traffic and relatively short crossing times.

Cons:

- No dedicated crossing would create safety and connectivity severance across SH6 in the long term for pedestrians
- Underpass will have some CPTED considerations especially for pedestrians after dark when there is less activity and pedestrians may choose to cross unsafely at grade to avoid the underpass..
- Underpass does not provide pedestrian priority across SH6

Intersection 9 – Midblock (not possible due to stacking traffic)

Intersection 10 – Hawthorne Dr



Alternatives considered: Signalised crossing / underpass / no crossing

Recommended solution for this option: Signalised crossing (CPTED concerns for underpass)

Need to confirm whether staggered or straight across, likely west side only

Pros:

- Signalised crossing will provide safe crossings for peds and cyclists and support prioritised pedestrian connectivity over SH6 between future landuse
- All crossings support the PT network and connection to bus stops

Cons:

- No dedicated crossing would create safety and connectivity severance in the long term for pedestrians
- Underpass will have some CPTED considerations especially for pedestrians after dark when there is less activity and pedestrians may choose to cross unsafely at grade to avoid the underpass.
- Underpass does not provide pedestrian priority across SH6

Intersection 11 – Hardware Lane (same as option A)

Prepared by:

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Senior Urban Designer/Associate Principal (Project Team)

Reviewed By:

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Project Team Leader

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