Memorandum

To	Warren Ladbrook
Copy	Simon Leary
From	Chris Baker
Office	Queenstown Office
Date	9 July 2018
File	6-XQ074.01
Subject	Ladies Mile HIF Integrated Transport Assessment Amendment A - Detailed Analysis of Programme 3

1 Introduction

This memorandum serves as an addendum to the Ladies Mile HIF Integrated Transport Assessment (issued 29 June 2018). The intention of this addendum is to provide additional detail regarding the traffic impact of construction of the preferred Programme 3 (1,100 houses) at the Ladies Mile Housing Infrastructure Fund (HIF) site. Section 3.2 discusses the interventions required to achieve the Programme without traffic demands exceeding the capacity of Shotover Bridge.

The ITA focussed on delivery of Programme 2 (750 houses), which through traffic forecasting, was determined to be the largest development feasible without a step-change in public transport provision or an increase in river crossing capacity, both of which would require significant investment.

This memo provides more detail on the demand expected to be generated by Programme 3, and the steps required to enable development, keeping demand below the capacity of the Shotover Bridge.

2 Traffic Modelling Results

Further to the sensitivity tests presented in the ITA, this addendum introduces a vehicle occupancy parameter that is used to test the effect of a higher average number of people per vehicle on the corridor. Existing occupancy of private vehicles on the corridor has been surveyed at approximately 1.3 people per vehicle.

The Reference Case discussed in this section is the same set of base assumptions used in the ITA, except for the number of dwellings increasing to Programme 3. The assumptions are summarised in Table 1.

Table 1 Reference Case Parameters

Growth Rate	Low – SH6: 3.07%; Local: 1.15% Medium – SH6: 5.69%; Local: 1.72% High – SH6: 9.00%; Local: 2.30% Medium to Low – As Medium with SH6 growth tapering by 0.1% per year and local growth tapering by 0.05% per year	Growth rates for SH6 traffic were determined using data from counters on SH6. Growth rates for local traffic were determined from the 2018 build-out of Lake Hayes and Shotover Country and expected completion date.
Number of Dwellings	Programme 1: 450 lots Programme 2: 750 lots Programme 3: 1,100 lots Programme 4: 2,185 lots	Various proposals were put forward for different development sizes as part of the HIF DBC, ranging from realistic to more aspirational dwelling numbers. Road access to the site differs depending on the scale of development.
Construction Start	2020 2022 2024	Year in which construction begins – effect of background traffic by time of completion
Build Rate (dwellings/y)	75 100 125	Build rates were adopted based on observed rates at other local developments, cognisant that there is a finite supply of labour available locally.
Arthurs Point Diversion	0 – 20%	The effect of increasing the attractiveness of the route into Queenstown through Arthurs Point was examined as a way of reducing regional trips along Ladies Mile.
Trip Reduction Factor	0 – 20%	A trip reduction factor was used for a general sensitivity test of demands on the corridor.

2.1 Future Unconstrained Volumes

Figure 1 provides forecast corridor demands under Programme 3 (without any transport interventions) for different growth rates, build rates and vehicle occupancy. The forecast shows that baseline demand would likely exceed the existing bridge capacity of 1,600 veh/hr in 2020-2024, before development completion (black boxes).

A low-growth, high-occupancy scenario would result in 2,000 veh/hr crossing the Shotover Bridge in 2028, indicating that a 20% alternative mode share would produce sufficiently low volumes. However, people willing to shift to high-occupancy vehicles are most likely to be those transferring to public transport. As such, a combined higher occupancy and public transport mode share is considered unlikely. A high-growth, existing-occupancy scenario with 20% alternative mode share would see capacity reached in 2023.

Growth Rate	Programme	Units/year	Occupancy	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Medium to Low	Programme 3	125	1.3	1451	1499	1604	1708	1811	1913	2014	2114	2214	2312	2399	2438	2477	2516	2553	2590	2627
Low	Programme 3	125	1.3	1451	1479	1566	1652	1738	1825	1911	1998	2074	2151	2216	2235	2253	2272	2291	2309	2328
High	Programme 3	125	1.3	1451	1525	1657	1789	1921	2054	2186	2318	2430	2543	2644	2699	2754	2808	2863	2918	2972
Medium to Low	Programme 3	75	1.3	1451	1499	1581	1662	1742	1821	1898	1975	2051	2127	2202	2276	2350	2423	2495	2567	2627
Medium to Low	Programme 3	100	1.3	1451	1499	1593	1685	1777	1867	1956	2045	2132	2220	2306	2392	2477	2516	2553	2590	2627
Medium to Low	Programme 3	125	1.4	1347	1392	1494	1595	1694	1793	1891	1988	2085	2180	2264	2301	2337	2372	2407	2442	2476
Low	Programme 3	125	1.4	1347	1374	1458	1542	1627	1711	1795	1880	1955	2030	2094	2111	2129	2146	2163	2181	2198
High	Programme 3	125	1.4	1347	1416	1543	1670	1797	1923	2050	2177	2286	2395	2492	2543	2593	2644	2695	2746	2796
Medium to Low	Programme 3	75	1.4	1347	1392	1471	1548	1625	1700	1775	1849	1922	1995	2067	2138	2209	2280	2349	2419	2476
Medium to Low	Programme 3	100	1.4	1347	1392	1482	1571	1660	1747	1833	1919	2003	2088	2171	2254	2337	2372	2407	2442	2476
Medium to Low	Programme 3	125	1.5	1258	1299	1398	1496	1593	1689	1785	1879	1973	2066	2159	2251	2343	2434	2525	2568	2600
Low	Programme 3	125	1.5	1257	1282	1365	1447	1530	1612	1695	1778	1852	1926	2000	2074	2149	2223	2297	2371	2445
High	Programme 3	125	1.5	1258	1322	1444	1566	1689	1811	1933	2055	2161	2266	2360	2407	2455	2502	2549	2597	2644
Medium to Low	Programme 3	75	1.5	1258	1299	1375	1450	1523	1596	1668	1740	1810	1880	1950	2019	2087	2155	2223	2290	2356
Medium to Low	Programme 3	100	1.5	1258	1299	1387	1473	1558	1643	1726	1809	1891	1973	2054	2135	2215	2295	2374	2452	2530

*black boxes signify development completion date

Figure 1 Forecast Baseline Westbound Demand at Shotover Bridge (Without Transport Interventions)

2.2 Mode Shift Required

In order to develop the site to Programme 3 without traffic demand exceeding existing capacity, traffic modelling indicates that 40% of trips from Ladies Mile and Shotover Country/Lake Hayes Estate would need to be by modes other than car and a Park and Ride on SH6 would need to capture 20% of westbound regional traffic (Table 2). Note that different proportions of mode shift could achieve the same reduction in demand; those shown are considered the most realistic.

Implementing a Park and Ride would require significant investment and further investigation is needed to identify the optimum size and location for an appropriate facility. Based on international experience, a turn in rate of 1 in 5 vehicles (a mode shift of 20%) is likely to be achievable subject to the charging regime adopted and the level of priority afforded to the Park and Ride buses.

Achieving a mode shift of 40% for trips associated with the Ladies Mile is unlikely to be achievable without a step change in public transport provision (for example Mass Transit). The Reference Case is forecast to require a Mass Rapid Transit (MRT) scale solution by development completion. As explored in the ITA, due to the high costs involved and the complexity of construction, MRT solutions are typically only justifiable in dense urban areas where they serve significant populations. As such MRT solutions, including gondolas at Ladies Mile, were found to be uneconomical in the ITA.

Evidence from Europe and Australia indicates that the maximum mode shift achievable by coupling improvements to conventional public transport services with programmes of Travel Demand Management is around 15%.

Table 2 Traffic Demand Analysis Results for Proposed HIF Programmes

HIF Programme	Number of dwellings (year complete)	Forecast traffic above capacity at development completion	Mode Shift Required to Reduce Demand at Shotover Bridge to 1,600v/h		
			Ladies Mile	Shotover Country/Lake Hayes	SH6 Park and Ride
1	450 (2023)	285	15%	25%	0%
2	750 (2025)	508	15%	25%	20%
3	**1,100 (2028)**	**770**	**40%**	**40%**	**20%**
4	2,185 (2037)	1,570	50%	50%	40%

The capacity of the public transport network is unknown at this stage (this is expected to be an output of the Future Public Transport Demand Analysis project). However, significant improvements are likely to be required to achieve the figures above. Furthermore, a system with high capacity does not necessarily translate into high patronage; the service needs to provide an attractive alternative to private vehicles.

To summarise the analysis of Programme 3, it is anticipated that mode shift alone will be insufficient to prevent congestion on SH6 by the time the development is complete.

3 Outcomes

The modelling results above indicate that mode shift alone is unlikely to enable the development of 1,100 houses at Ladies Mile; capacity improvements are likely to be required. This section explores potential impacts and mitigations to enable the construction of Programme 3, cognisant of the corridor context insofar that capacity upgrades at the Shotover Bridge have the potential to migrate congestion downstream.

3.1 Potential Congestion

The assessment of the Ladies Mile HIF site is based on a capacity constraint of 1,600 veh/hr at the Shotover Bridge. The result of traffic flows exceeding capacity is delay and queueing. For the Programme 3 Reference Case (refer Table 1), average westbound delays are expected to reach 4 minutes with queues up to 1.5km in 2028 (development completion). In the absence of a detailed traffic model, delays have been approximated based on the volume in excess of 1,600 veh/hr, and as such refer to additional delay and queues rather than total delay and queue lengths.

It should be noted that a level of congestion can be consistent with encouraging uptake in more sustainable modes of transport; albeit this has to be managed carefully and weighed against the operational efficiency of the State Highway network. Key to improving alternative mode share is to provide a service that is more attractive than private vehicles. This typically results from a level of inconvenience for car travel (congestion, inconvenient parking, expensive fuel) as well as an efficient public transport service (fast, reliable, affordable).

The ITA focussed on the morning peak due to its higher volumes and the traffic impacts being centred on Ladies Mile. Morning peak congestion causes queueing on Ladies Mile itself, which provides storage without affecting key intersections on the network. In the evening peak, congestion is more likely to affect other intersections in Frankton with greater potential to create critical network issues. Recent surveys have indicated that the PM outbound peak hour traffic demand is similar to the inbound AM demand. It is therefore anticipated that similar levels of interventions to those indicated within the ITA would be required in the eastbound direction within Frankton Flats.

3.1.1 Peak Spreading

Peak spreading occurs when commuters change their behaviour to avoid driving at busy times. No detailed modelling of peak spreading has been undertaken in this analysis, but it could potentially enable levels of service be maintained across the Shotover Bridge through a longer peak period.

3.2 Capacity Improvements

Traffic forecasting has shown that demand is likely to exceed the capacity of the Shotover Bridge in 2025 as the development is built out (assuming transport interventions presented in the ITA). Improving transport choice through the strategy identified in the ITA will delay capacity being reached, but upgrades will be required at some stage.

High investment site-specific capacity upgrades, such as MRT, were dismissed in the ITA from an economics perspective. Broader highway capacity improvements are more likely to have an economic case as they provide benefits to more people.

It is acknowledged that the constraint at the Shotover River currently acts as a valve, metering traffic arriving in Frankton. Increasing capacity over the Shotover River will have a downstream impact, possibly negating investment by migrating congestion into Frankton.

A series of potential capacity improvements are discussed here. Any capacity improvements should be part of a wider network strategy.

3.2.1 High Occupancy Vehicle Lanes

Providing transit lanes or bus lanes on SH6 up to the Shotover Bridge would encourage a shift towards higher occupancy vehicles (HOV), thereby reducing traffic volumes. The solution would capitalise on existing congestion by creating a more attractive alternative to private vehicles. Extra lanes, or the conversion of existing traffic lanes for the use by high occupancy vehicles, could be provided in both directions on SH6, addressing both morning peak westbound and evening peak eastbound congestion. This solution avoids causing congestion downstream, which is likely to occur with general traffic capacity improvements.

High occupancy lanes are comparatively cheaper to other potential capacity improvements, and could be staged such that the lanes are extended across the Shotover River in a potential future bridge upgrade (Section 3.2.3). Any additional structure should provide active mode facilities to maximise the alternative mode share.

It should also be noted that increasing vehicle occupancy is a somewhat paradoxical solution in that a high-occupancy lane will itself become more congested as occupancy increases, thus reducing its effectiveness in managing demand.

3.2.2 Traffic Signals

Improvements to route capacity can be made without providing additional road space. Signals could tie in with the HOV lanes option to give priority to buses or high occupancy vehicles. Priority could be provided at intersections along the corridor and at a 'gate' at the Shotover Bridge.

Traffic signals also offer a method of metering the amount of traffic reaching the bottleneck or providing priority without the need for comparatively expensive capital works. Signalisation of intersections through Ladies Mile (on SH6) would provide control over traffic flows, spreading congestion across the corridor rather than it reaching unstable levels at a single bottleneck.

It is noted that NZ Transport Agency have indicated their disapproval of implementing signals on this relatively high-speed section of SH6. The area is planned to remain an 80km/h speed zone, within which traffic signals are less safe than the existing roundabouts. The Agency also has a duty to maintain efficiency on the highway and roundabouts have higher capacity in this speed environment.

3.2.3 Duplication of Shotover Bridge

A supplementary conventional river crossing would effectively double the general traffic capacity of the route. A new bridge would have the benefit of providing extra eastbound capacity, addressing concerns about congestion caused by the Shotover Bridge during the evening peak blocking key intersections.

However, there are capacity constraints to the west of the Shotover River that reduce the effectiveness of localised improvements. Single-lane sections of road to the east of Hawthorne Drive between Grant Road and SH6A, and within the road network within Frankton Flats, are medium-term constraints on corridor capacity, while Frankton Road is unlikely to have increased capacity in the long-term. Similarly, the destination of Frankton and its internal network does not have the capacity to cater to the resulting increase in demand.

Consequently, any duplication of the bridge would need to be focussed on increasing the capacity to move people (rather than vehicles), in the form of high-occupancy or public transport lanes (refer Section 3.2.1) and active mode provision.

Additionally, a new bridge is anticipated to be costly due to the long spans required across the width of the Shotover River, hilly terrain at potential landing sites and the presence of critical infrastructure.

3.2.4 New Route

Frankton is increasingly becoming the main regional destination for retail, commerce and services, while residential areas are increasingly being developed alongside SH6. As land use patterns around Queenstown change, the function of the state highway is becoming more access focussed. A new strategic route would increase overall network capacity and resilience by separating movement and access functions, allowing SH6 to cater to regional movement and another route to provide local access.

As with the other options requiring major investment, a new route is likely to be cost-prohibitive in the short term given the comparatively low traffic volumes currently present.

3.3 Arthur's Point Diversion

A Select Link Analysis indicates that the town centre is currently a destination for 30% of westbound traffic arriving at Arrow Junction, representing 155 veh/hr. Frankton is increasingly becoming the main destination for commuters. Similarly, the town centre is expected to be the destination for 30% of traffic generated by the Ladies Mile site, reducing to 17% by 2045.

Accounting for growth up to 2028, there is expected to be approximately 200 veh/hr travelling to the town centre from Arrow Junction. The number of trips from the Ladies Mile site to the town centre is expected to be approximately 130 veh/hr.

However, it is understood that a proportion of regional trips are already using this route (and therefore would not reduce demand at the Shotover Bridge) and that the additional distance will dissuade drivers from using the route. The diversion would be 37% longer than SH6 for regional traffic and 60% longer for Ladies Mile traffic. It is therefore expected that, in its existing condition (with safety and capacity issues), the route would not be used by Ladies Mile traffic and a maximum of 20% of regional traffic would use the route. The resulting reduction in volumes on SH6 would be negligible in relation to the capacity of the Shotover Bridge.

For the route to be a realistic option, travel time would have to be better than, or at least similar to, travel time experienced on SH6. Under existing conditions, there would need to be approximately 6 minutes average delay on SH6 (or corridor improvements to provide 6 minutes travel time savings) for the Malaghans Road option to be equitable. As congestion grows and travel times increase on SH6, an upgraded alternative route through Arthur's Point may become more practical. With Reference Case assumptions, this could reduce demand on SH6 by a maximum of 330 veh/hr (assuming all traffic into Queenstown uses the route), the equivalent of extending the capacity of Shotover Bridge by 3 years.

It should be noted that the existing alternative route would require significant upgrades to be suitable for higher traffic volumes and heavy vehicles. Additionally, the Edith Cavell bridge is currently a one-way bridge with minimal spare capacity in the peak hours.

4 Staging

Practical staging of the improvements required cannot be simplified to triggers based on completion of houses at Ladies Mile. The timing of upgrades is dependent on realisation of multiple variables, the most critical being background traffic growth. Staging is therefore presented in relation to years, based on stated assumptions.

Table 3 shows potential staging of interventions for the Reference Case, as well as sensitivities for higher background traffic growth and a lower Ladies Mile house build rate. Capacity improvements are expected to be required before completion of Programme 3 in all scenarios. If traffic growth continues at the observed 2-year rate (9%), all interventions are expected to be brought forward by 2 years, including capacity improvements by 2024. A slower build rate of Ladies Mile houses has negligible effect on the timing of improvements required as background traffic growth would continue at the same rate. The consequence of a slower build rate is higher traffic volumes by the time development is complete. The low background traffic growth rate is expected to enable improvements to be delayed by 2 years from the Reference Case.

Detailed staging of the required capacity improvements is not given as these will be influenced by wider network strategies outside the scope of this assessment. As discussed in Section 3.2, elements of capacity improvements could be staged and scaled according to demand, such as providing high occupancy lanes up to the Shotover Bridge before potential duplication of the bridge itself.

Table 3 Transport Intervention Triggers and Staging for Programme 3

	Timeframe	Reference Case - 125 houses/yr; 5.69% annual growth on SH	High Traffic Growth - 125 houses/yr; 9.00% annual growth on SH	Low Build Rate - 75 houses/yr; 5.69% annual growth on SH
Number of Dwellings (Year)	Prior to complete houses	Upgrade Howards Drive intersection to RAB	Upgrade Howards Drive intersection to RAB	Upgrade Howards Drive intersection to RAB
		Implement bus stops (detail in transport strategy)	Implement bus stops (detail in transport strategy)	Implement bus stops (detail in transport strategy)
		Build SH6 Underpass at Howards Drive	Build SH6 Underpass at Howards Drive	Build SH6 Underpass at Howards Drive
		Provide high quality walking and cycling connections	Provide high quality walking and cycling connections	Provide high quality walking and cycling connections
		Implement TDM Measures in Ladies Mile/Shotover Country	Implement TDM Measures in Ladies Mile/Shotover Country	Implement TDM Measures in Ladies Mile/Shotover Country
	2021	Provide frequent Ladies Mile bus service (60 minutes required for capacity; higher frequency required for satisfactory service)	Provide frequent Ladies Mile bus service (60 minutes required for capacity; higher frequency required for satisfactory service)	Provide frequent Ladies Mile bus service (60 minutes required for capacity; higher frequency required for satisfactory service)
		Provide Shotover Country/Lake Hayes bus at 30 minute frequency	Provide Shotover Country/Lake Hayes bus at 20 minute frequency	Provide Shotover Country/Lake Hayes bus at 30 minute frequency
		Provide bus priority on SH6	Provide bus priority on SH6	Provide bus priority on SH6
			Begin park and ride	
			Begin westbound transit lanes on SH6	
	2022	Increase Shotover Country/Lake Hayes bus to 20 minute frequency	Park and Ride in place (100 spaces) with buses at 20 minute frequency	Increase Shotover Country/Lake Hayes bus to 20 minute frequency
			Westbound transit lanes in place on SH6	
	2023	Increase Ladies Mile bus to at least 30 minute frequency	Increase Ladies Mile bus to at least 30 minute frequency	Begin park and ride
		Begin park and ride	Increase Shotover Country/Lake Hayes bus to 10 minute frequency	Begin westbound transit lanes on SH6
		Begin westbound transit lanes on SH6	Park and Ride in place (200 spaces) with buses at 10 minute frequency	
	2024	Park and Ride in place (100 spaces) with buses at 20 minute frequency	Capacity improvements in place	Park and Ride in place (100 spaces) with buses at 20 minute frequency
		Westbound transit lanes in place on SH6		Westbound transit lanes in place on SH6
		Increase Shotover Country/Lake Hayes bus to 10 minute frequency		Increase Shotover Country/Lake Hayes bus to 10 minute frequency
	2025	Park and Ride in place (200 spaces) with buses at 10 minute frequency		Park and Ride in place (200 spaces) with buses at 10 minute frequency
	2026	Capacity improvements in place		Capacity improvements in place
	2027			Increase Ladies Mile bus to at least 30 minute frequency

5 Conclusions

Based on the further analysis provided in this addendum, the following conclusions can be made:

- Construction of Programme 3 at the Ladies Mile HIF site will result in traffic volumes exceeding the 1,600 veh/hr approximate capacity of the Shotover Bridge before the development is complete.
- By investing in public transport, Park and Ride and active mode improvements, significant mode shift away from single occupancy car travel can be achieved. However, this is expected to be insufficient to reduce demand to levels below available capacity. As such, capacity upgrades are also likely to be required to enable construction of Programme 3.
- There are multiple options available to increase capacity at existing bottlenecks. However, increasing general traffic capacity at the Shotover Bridge will potentially migrate congestion to critical downstream sections of the network. Constructing a new bridge or an entirely new route are also considered expensive, long-term solutions.
- Adding supplementary high-occupancy vehicle lanes across the Shotover Bridge is expected to present a more cost-effective solution without causing congestion downstream. The option is expected to reduce demand across the Shotover Bridge by increasing vehicle occupancy as well as increasing capacity. Construction could be staged to meet demand by preceding the bridge upgrade with transit lanes on SH6 up to the bridge approaches.
- Lower cost options include traffic signals on SH6, which could be used to meter demand arriving at the Shotover Bridge to distribute delay and queues across the corridor. Signals could also be used to provide bus priority at the Shotover Bridge merge. However, the implementation of traffic signals on SH6 is unlikely to be favourable to NZTA on the grounds of safety and efficiency.
- The consequence of traffic demand exceeding capacity is flow breakdown occurring, which ultimately results in longer average delays. NZ Transport Agency has indicated its objective is to minimise the increase in traffic demands from significantly exceeding the capacity of the Shotover Bridge (1,600 veh/hr), though the amount of acceptable delay on SH6 is not currently defined. Furthermore, the effect of peak spreading has not been assessed in detail and could lead to levels of service being maintained across the Shotover Bridge through a longer peak period.
- Staging of required improvements cannot be tied exclusively to the number of houses built at Ladies Mile as it is dependent on the realisation of background traffic growth rates and the rate of building achieved at the Ladies Mile site. Capacity improvements are highly likely to be required before the construction of Programme 3 is complete.