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technical note

PROJECT	**WAITEMATĀ HARBOUR WALKING AND CYCLING CONNECTION**
SUBJECT	**DEMAND AND ECONOMIC BENEFITS ASSESSMENT OF FERRY AND BUS OPTIONS**
TO	Out of scope **(WAKA KOTAHI),** Section 9(2)(a) **(COMMUTE)**
FROM	Section 9(2)(a)
REVIEWED BY	Section 9(2)(a)
DATE	18 FEBRUARY 2022 (UPDATED 22 MARCH 2022)

Flow Transportation Specialists (Flow) has been commissioned by Waka Kotahi the New Zealand Transport Agency (Waka Kotahi) to assess a number of walking and cycling connection options across Auckland's Waitematā Harbour. Our assessment has focused on

- each option's potential for cycling trips across the harbour
- each option's economic benefits
- benefit cost ratio, for select options.

The options being investigated include 3 potential new ferry/bus connections, 2 options that improve existing ferry services, in addition to 1 option that makes use of the existing Auckland Harbour Bridge (AHB). Each of these investment options would better link the lower North Shore to central Auckland, connecting Waka Kotahi's proposed Northern Pathway walking and cycling path to the city centre. The need for these connections has arisen since the previous proposal of a dedicated walking and cycling bridge across the Waitematā Harbour is no longer being considered.

Importantly, our assessment has focused on the potential for each investment option to cater to cycling trips. Our assessment does not consider the impacts each option may have on public transport trips[1].

1 THE FERRY AND BUS OPTIONS ASSESSED

Our assessment has considered 6 walking and cycling connection options provided by Waka Kotahi. Each of the 6 connection options includes the Akoranga to Sulphur Point section of Northern Pathway, in addition to a new or improved connection across the Waitematā Harbour

- Option 2F: a new ferry service between Sulphur Point (the southern extent of Waka Kotahi's proposed Northern Pathway) and Westhaven
- Option 2G: a new ferry service between Sulphur Point and North Wharf in the Wynyard Quarter

[1] Each of the 5 bus/ferry investment options may result in changes to the number of people walking, driving and/or busing to the ferry/bus terminals.

- Option 2H: increased frequencies of the existing Northcote to Downtown ferry service, as well as improved cycle-ferry transfer facilities
- Option 3D: increased frequencies of the existing Devonport to Downtown ferry service, as well as improved cycle-ferry transfer facilities
- Option 5E: a new bus service between the toll plaza on the Northern Motorway (close to the southern extent of Waka Kotahi's proposed Northern Pathway) and the Shelly Beach Road/Curran Street ramps (assumed to turn around via Onewa Road and Jervois Road)
- Option AHB: a new shared use path across the existing Auckland Harbour Bridge (AHB). Space for this facility is expected to be made by removing one or more traffic lane on the bridge. The resulting shared path is expected to be in the order of 3 m wide, which is relatively narrow given the level of demand anticipated. This width, and the proximity to motorway traffic, will have an impact on the quality of service provided to users, and on the capacity of the path.

2 HOW WE HAVE ASSESSED THE OPTIONS

We have used the Auckland Cycle Model (ACM) to estimate cross-harbour cycling trips for each of the options. The ACM estimates future cycling and e-bike demands, and responds to anticipated future changes in

- Infrastructure – the ACM recognises that people are more likely to ride bikes and e-bikes if quality cycle infrastructure is provided along their route
- Future e-bike uptake – the ACM assumes that over time, the accessibility of e-bikes will increase, giving more people the option to cycle more often, and greater distances
- Trip characteristics – the ACM recognises that shorter trips are more likely to be carried out on a bike, as are trips to work and school, and trips without steep gradients
- The underlying demand for travel – the ACM is informed by the regional transport model, being Auckland's Macro Strategic Model (MSM)
- Land use growth – the ACM is informed by Auckland Council's land use forecasts.

We have assessed each of the 6 options by considering the "generalised cost" of cross harbour cycling trips with each option. Generalised costs sum the monetised and non-monetised costs of a journey, and include the financial cost (fare) for the journey, waiting time, loading/unloading time, the actual journey time, as well as a "transfer penalty". The transfer penalty is a perceived time penalty due to the inconvenience of transferring between modes. The ACM uses time as a measure of generalised costs, with monetised costs converted to time using standard Waka Kotahi values of time[2].

The financial fare of each trip is the most significant component of the generalised cost, accounting for around 50%-70% of the total for each bus or ferry connection option. This is because our default assessment assumes the current ferry and bus fares would apply to the new/improved services: $5.66

[2] We have applied a weighted average of Waka Kotahi's standard values of time for cyclists of $12.52/hour, based on 80% commuting to work ($6.60/hr), 10% work travel purposes ($21.70/hr) and 10% other ($4.25/hr), and the December 2021 update factor of 1.59 (Monetised Benefits and Costs Manual, table 13)

for a ferry trip[3] and $4.11 for a bus trip[4]. Recognising this, we have sensitivity tested different fare structures.

Our assessment focuses on a 2028 forecast year, but we have also assessed a 2038 forecast to inform our economic evaluation of each option. Each forecast year assumes future improvements to Auckland's cycle network that are funded within the Regional Land Transport Plan (RLTP) have been completed. These include

- Completion of the Auckland Urban Cycleways programme
- Auckland Transport's proposed Lake Road improvements
- Auckland Transport's Pop-Up Protection programme of improvements to existing painted cycle lanes
- Funded components of the Connected Communities programme
- Completion of the Constellation to Albany section of Waka Kotahi's Northern Pathway.

We have compared the 6 options to a future Reference Case scenario that includes the above funded improvements from the RLTP, but excludes any new cross-harbour cycling connection, and excludes the Akoranga to Sulphur Point section of Northern Pathway.

3 RESULTS OF OUR ASSESSMENT

3.1 Estimated cycling demands

Table 1 presents our estimated daily cycle trips using each inner-harbour ferry or bus route, for each of the 6 connection options.

Table 1: Estimated daily cycle trips across Waitematā Harbour (new/improved route highlighted)

Connection option	2028					2038
	Northcote ferry	Bayswater ferry	Devonport ferry	New route	Total trips (all routes)	Total trips (all routes)
Reference case	90	70	200	n/a	350	390
2F: Sulphur Pt to Westhaven	30	90	120	260	510	600
2G: Sulphur Pt to Wynyard	0	90	120	350	560	680
2H: Northcote ferry	320	100	120	n/a	530	640
3D: Devonport ferry	120	70	200	n/a	390	440
5E: Toll plaza bus	20	80	120	370	590	700
AHB: Harbour bridge path [5]	0	0	60	2,600	2,600	3,400

[3] $5.66 per trip, being the weighted average of the existing inner harbour ferry fares of $5.40 with a Hop Card and $8.00 using cash, assuming a 90%/10% split

[4] $4.11 per bus trip, being the weighted average of the existing cross harbour bus fares of $3.90 with a Hop Card and $6.00 using cash, assuming a 90%/10% split

[5] No fare has been applied to the Auckland Harbour Bridge path test

Four of the investment options (2F, 2G, 2H and 5E) are predicted to result in very comparable outcomes, with 510-590 daily cycle trips across the harbour in 2028. Option 3D however (improvements to the Devonport ferry terminal and services), is not predicted to result in any significant increase in cyclists using the Devonport ferry. A small increase in cyclists using the Northcote ferry is predicted however – a result of the improved connections to this ferry terminal provided by the Akoranga to Sulphur Point section of Northern Pathway.

Our assessment of each option has relied on a series of assumptions for each cross-harbour connection option. We have sensitivity tested some of those key assumptions, including

- A lower quality transfer: the default assessment assumes a seamless integration between cycle and ferry, at a purpose built facility. This test considers the effects of a lower standard of transfer facility
- Akoranga to Constellation (A2C): the default assessment includes the Akoranga to Sulphur Point section of Northern Pathway with each new connection option, but not the onward connection from A2C. This sensitivity test considers the impact of including this section of Northern Pathway (completing the route from Sulphur Point to Albany)
- Low fare: the default assessment assumes the new connection will have a fare matching the existing inner harbour ferry/bus route fares. This sensitivity test considers the effects of reducing this fare to $2 per trip
- A combination of low fare and including A2C
- Zero fare: this sensitivity test considers the impact of a fare-free trip across the harbour
- A combination of zero fare and including A2C
- For option 2G, a range of sensitivity tests that additionally assume reduced, 20 minute ferry frequencies (all other options assume 10 minute frequencies).

The results are presented in Table 2. We note that the default assumptions and first 3 sensitivity tests all include a fare component for the ferry and bus options. This component is not relevant for the AHB path option, which is expected to be free.

Table 2: Estimated 2028 daily cycle trips on each option (all inner harbour trips combined) (default highlighted)

Connection option	Sensitivity test						
	Lower quality transfer	Default	With A2C	Low fare	Low fare and A2C	Zero fare	Zero fare and A2C
2F: Sulphur Pt to Westhaven	450	510	590	Not assessed			
2G: Sulphur Pt to Wynyard	470	560	650	1,400	1,500	1,900	2,100
2G: as above with reduced frequencies	not assessed	400	460	840	960	1,100	1,300
2H: Northcote ferry	450	530	590	Not assessed			
3D: Devonport ferry	380	390	430	Not assessed			
5E: Toll plaza bus	500	590	680	1,000	1,100	1,600	1,800
AHB: Harbour bridge path	Not assessed					2,600	3,000

The additional testing indicates that the cycling forecasts are highly sensitive to fares, with up to 1,900 daily cross-harbour cycle trips predicted if no fares are charged (without A2C). This level of sensitivity is understandable given the pricing of Auckland's inner harbour ferries, where a one-way ferry fare ($5.40 by Hop Card and $8.00 by cash) is equivalent to 26 to 38 minutes of travel time. Considered from another perspective, a return ferry fare ($10.80 by Hop Card and $16.00 by cash) is comparable to the cost of early bird car parking within the city centre.

The other sensitivity tests have a much lower impact on demand. Notably, the addition of the A2C section of Northern Pathway is predicted to add an additional 80-90 daily cycle trips across the harbour for options that provide a direct ferry/bus connection to Northern Pathway (2F, 2G and 5E, with standard fares charged). For options 2H and 3D, which do not provide a direct ferry connection to Northern Pathway, Akoranga to Constellation is predicted to have a smaller impact.

The cumulative effects of both A2C and removing fares is predicted to have a very significant impact on demands. For both options 2G and 5E, these cumulative effects are greater than the incremental effects of zero fares and A2C.

Reducing the ferry frequency for option 2G from 10 to 20 minutes is predicted to have a relatively significant impact on cross-harbour cycle trips. In this case, the reduced frequency means that users will not be able to 'turn up and forget' the timetable, and will instead have to start their trip earlier in order to be sure to catch a specific ferry, effectively extending their journey time. In practice, the reduced frequency makes the 2G service comparable to the existing Northcote ferry service, albeit with a better connection on the North Shore via Northern Pathway, and a less useful connection on the city side (for most trips to the city centre).

3.2 Estimated economic benefits

Table 3 overleaf presents the estimated economic benefits for each option, including for select sensitivity tests. The discounted benefits have been calculated over a 40-year evaluation period, assuming a 2½-year construction period beginning July 2023. Benefits assessed include

- health benefits for new cycle trips
- health benefits for new pedestrian trips on Northern Pathway
- perceived travel time savings for cyclists
- crash reduction benefits for cyclists (for cycle trips that divert onto Northern Pathway)
- general traffic reduction benefits (due to mode shift from private car travel to cycling)
- vehicle emissions benefits (due to mode shift from private car travel to cycling)
- wider economic benefits (agglomeration), in the case of the AHB scenarios.

As a point of reference, Table 3 also includes the estimated economic benefits of the previous W2A design that included a dedicated walking and cycling bridge across the Waitematā harbour Section 9(2)(j), assessed in August 2021). We have added to this figure the estimated benefits of the A2C project (Section 9(2)(j) , September 2020). This total Section 9(2)(j)) is somewhat conservative, as the collective benefits of both projects were never assessed, and are likely to be slightly higher than their sum.

Table 3: Estimated economic benefits

Connection option	Sensitivity test						
	Lower quality transfer	Default	With A2C	Low fare	Low fare and A2C	Zero fare	Zero fare and A2C
2F: Sulphur Pt to Westhaven	Not assessed	Section 9(2)(j)		Not assessed			
2G: Sulphur Pt to Wynyard	Not assessed	Section 9(2)(j)					
2G: Sulphur Pt to Wynyard with reduced frequencies	Not assessed	Section 9(2)(j)	Not assessed	Section 9(2)(j)	Not assessed		
2H: Northcote ferry	Not assessed	Section 9(2)(j)		Not assessed			
3D: Devonport ferry	Not assessed			Not assessed			
5E: Toll plaza bus	Not assessed	Section 9(2)(j)					
AHB: Harbour bridge path	Not applicable					Section 9(2)(j)	
Previous proposal: new walking and cycling bridge	Not applicable						

We note that option 3D (Devonport ferry) has estimated discounted benefits of Section 9(2)(j). This benefit is the result of completing the Akoranga to Sulphur Point section of Northern Pathway, rather than the result of any improvements to the Devonport ferry.

The estimated benefits for each of the other options can then be viewed in light of this Section 9(2)(j) benefit. Option 2F for example is predicted to result in Section 9(2)(j) in benefits: Section 9(2)(j) associated with the Akoranga to Sulphur Point section of Northern Pathway, and a further Section 9(2)(j) associated with the additional ferry link.

The economic benefits presented in Table 3 point to the incremental benefits of a series of potential investment steps. In the case of Option 2G (Sulphur Point to Wynyard Quarter), these incremental steps are:

- Section 9(2)(j) in benefits for the Akoranga to Sulphur Point section of Northern Pathway
- a further Section 9(2)(j) in benefit, should the new option 2G ferry route be provided (with standard fares charged but low ferry frequencies)
- a further Section 9(2)(j) in benefit, should the new ferry route have increased ferry frequencies
- a further Section 9(2)(j) in benefit should the new ferry route also be fare free
- a further Section 9(2)(j) in benefit, should the A2C section of Northern Pathway also be provided
- a further Section 9(2)(j) in benefit, should a constrained shared path be provided using an existing traffic lane on the existing harbour bridge, rather than the ferry route
- at least a further Section 9(2)(j) in benefit, should a high quality, dedicated walking and cycling connection be provided, rather than the above constrained shared path on the existing bridge.

The Section 9(2)(j) now assessed for a shared path on the existing harbour bridge, plus the remaining sections of Northern Pathway, falls comfortably below the estimated Section 9(2)(j) for the previously proposed dedicated bridge. Lower benefits are expected in this case due to the narrower path width now proposed, and the close proximity to motorway traffic. This is expected to result in less use overall, relative to the previously proposed new bridge.

3.3 Estimated benefit cost ratios

Table 4 presents the BCRs for select investment scenarios, based on the following cost estimates provided by Commute:

- Section 9(2)(j) capital costs for Wynyard to Akoranga. We have assumed a further 1% annual maintenance costs Section 9(2)(j) per year)
- Section 9(2)(j) capital costs for the Option 2G ferries and terminals, with a further Section 9(2)(j) annual operating and maintenance costs. These operating costs have been offset by the estimated fare revenue, for relevant scenarios
- Section 9(2)(j) capital costs for A2C. We have assumed a further 1% annual maintenance costs Section 9(2)(j) per year).

Table 4: Estimated benefit cost ratios – Option 2G (Sulphur Pt to Wynyard)

	Standard fare	Low fare	Zero fare
Without A2C	0.14	0.61	0.78
With A2C	0.30	0.56	0.67

We have assessed a range of sensitivity tests on the above BCRs, based on the low fare, without A2C scenario. Those sensitivity tests have included the implications of:

- reduced ferry frequencies (20 minute frequencies applied), allowing for 1 fewer ferry purchase and reduced operating costs
- 10% lower implementation costs for Sulphur Point to Akoranga, reflecting a value-engineered design
- P95 implementation costs for Sulphur Point to Akoranga Section 9(2)(j)
- a scenario where future changes to travel demands and/or infrastructure allows 2 lanes of the existing AHB to be dedicated to walking and cycling. This has been assumed to occur after the ferries have been operating for 15 years, when:
    - ferry and terminal operating and maintenance costs cease
    - ferry service benefits cease
    - ferry fare revenues cease
    - Section 9(2)(j) in capital costs are incurred to retrofit the existing AHB and its approaches
    - a wide, high quality walking and cycling path is provided. We have assumed annual benefits will be equal to those calculated previously for the dedicated walking and cycling across the Waitematā harbour (assessed in August 2021). Ie not the narrower, single-lane shared path assessed previously in this document

  this sensitivity test does not account for the cost of any wider intervention(s) needed to enable the 2 AHB lanes to be repurposed.
- capping growth in demand at 2038 (the final forecast year)
- lower/higher uptake in e-bikes and other forms of micro-mobility
- applying MBCM standard benefit rates for reductions in private vehicle travel. Our default assessment uses area-specific benefit rates for cross-harbour and lower North Shore car trips, developed using the Northern Corridor Improvements (NCI) SATURN models. The MBCM rate does not reflect the traffic congestion experienced locally on the approaches to the AHB, or how this congestion is expected to change over time
- higher/lower cycle demand estimates, reflecting wider levers that may affect cycle demands across the harbour, including changes to future fuel costs, car parking availability, car and/or public transport infrastructure, congestion charging, and extended investment in the wider cycle network, among other levers.

Table 5: Benefit cost ratio sensitivity tests – Option 2G (Sulphur Pt to Wynyard, low fare, without A2C)

	Low range	Default	High range
Reduced ferry frequencies	0.31	0.61	n/a
MBCM default decongestion rate	0.41		n/a
Growth capped from 2038	0.53		n/a
P95 implementation costs	0.58		n/a
-10% cost for Sulphur Pt to Wynyard	n/a		0.66
High/low e-bike uptake	0.54		0.67
±20% cycle demands	0.49		0.73
AHB path opens after 15 years	n/a		1.06

4 IMPORTANT CONSIDERATIONS TO OUR ASSESSMENT

it is important to recognise that there are significant uncertainties in our assessment. These arise from the inherent challenges in forecasting future cycling demands, particularly so for bus/ferry/bridge connections across the Waitematā Harbour. We elaborate on each of these below.

Non-cycling public transport trips

Our assessment has used the ACM to estimate each investment options' impact on cycling trips. To estimate pedestrian trips on the Akoranga to Sulphur Point section of Northern Pathway, we have drawn on estimates of pedestrian trips from previous assessments of the Northern Pathway corridor.

We have not however assessed the additional public transport demands that may result from the improved ferry/bus services. To varying degrees, each of the 5 investment options may result in increased public transport trips across the harbour, in turn generating economic benefits (walking health, road traffic reduction, emissions reduction and crash reduction benefits). Assessing these wider public transport related benefits would require assessing each option using Auckland Transport's regional public transport model, the MPTM.

Similarly, the sensitivity tests that consider a low-fare or zero-fare harbour crossing have not assessed the price distortions that this would introduce to the wider public transport network, and the effects this distortion may have on public transport patronage. A low-cost or free crossing would encourage some people to change their ferry route or mode, to make use of the cheaper service. In some cases, people may undertake entirely new trips using the low-cost/free service.

Uncertainties with generalised costs

We have assessed the generalised costs of each connection option, applying current values of time from Waka Kotahi's Monetised Benefits and Costs Manual, and current ferry/bus fares. We note however that the ACM was calibrated using ferry costs and values of time from 2013. In the time since, Waka Kotahi's values of time have increased 12%, while ferry fares have increased 30%-60%. As a result, there

is some uncertainty about how the ACM responds to changes in generalised costs for ferry and bus trips across the harbour.

Wider changes that affect cycling

ACM is unable to reflect changes to other modes of travel that indirectly affect the uptake of cycling. These include future changes in fuel costs, car parking costs or availability, general traffic congestion, public transport fares or road pricing. Each of these wider regional levers has the potential to affect the numbers of people who chose to cycle across the harbour, and elsewhere.

Tourism and recreational trips

Previous assessments of the walking and cycling potential across the Waitematā Harbour have considered the tourism and recreational potential. This has been necessary because previous proposals have been bridge connections across the harbour, which were expected to be fare free, but to also offer elevated views of the harbour and city, on a high-quality facility. A future ferry or bus connection is unlikely to have the same level of appeal, and the transfers required are unlikely to be used by sports-recreational cyclists. As a result, we have assumed there would be no significant recreation or tourist trips on any of the bus and ferry options assessed. This may not be the case should the ferry/bus connection be fare free, but our assessment has maintained this assumption to be consistent across all bus/ferry scenarios, and due to the uncertainty in estimating the recreational and tourist potential of a ferry or bus service.

Large scale behaviour change

There is greater uncertainty in the scenarios where higher demand potential is forecast. For the lowest demand scenarios, the bus and ferry demands predicted are not significantly different to the existing numbers of cyclists using ferries across the Waitematā Harbour, so there is a fair level of confidence that these forecasts are achievable. The highest demand forecasts however require widespread behaviour change among existing car and public transport users throughout the North Shore. There is a greater level of uncertainty in these scenarios, due to the large scale changes in travel behaviours required.

Off-peak bus/ferry frequencies

The ACM develops estimates of daily cycle trips based on modelled commuter peak periods, scaling these up to account for off-peak and weekend trips. In the case of the bus and ferry options, interpeak frequencies may be lower than the modelled, peak frequencies. As a result, off-peak and weekend bus/ferry demands may be proportionally lower than estimated. The scaling factors used to estimate daily cycle demands do not account for any off-peak reduction in quality of service.

Interchange facilities

Our modelling has assumed a very high quality of interchange facilities between cycling and bus/ferry services. This would typically include indoor waiting areas, seating, toilets, and facilities to top up Hop cards if fares are to be charged. Any lesser standard may result in lower demands than those forecast above.

Wider economic benefits

The 2021 economic evaluation of a new walking and cycling bridge across the Waitematā harbour included Section 9(2)(j) in annual agglomeration benefits. These benefits were associated with bringing the Takapuna Metropolitan Centre and Auckland City Centre 'closer together', and were developed by MRCagney in 2018.

We have not allowed for any agglomeration benefits for the bus/ferry options. For the AHB shared path option however, we have allowed for 50% of these agglomeration benefits Section 9(2)(j) per year, after applying current update factors). This acknowledges that the lower standard of path proposed will have reduced agglomeration effects, relative to the previously proposed dedicated bridge.

For the scenario where 2 AHB traffic lanes are removed after 15 years of operation, we have applied the full annual agglomeration benefit, reflecting the higher quality and capacity of this link.

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