WAKA KOTAHI
NZ TRANSPORT AGENCY

Single stage business case

Auckland Harbour Bridge Shared Path

6 January 2020

Version 4.0

New Zealand Government

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NZ TRANSPORT AGENCY

New Zealand Government

More information

NZ Transport Agency
Published [month and year]

ISBN [number]

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Approved by		

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- the appropriate personnel have read, understood and agreed to the details of the project described in this document
- Any changes to the requirements approved for development and delivery by this business case must be subject to formal change control process.

Endorsement by

Date of Meeting	Decision	Chair signature

Document Control

Document version history

Date	Version	Author	Changes
4 August 2019	1.0	Neil Cree	Initial Confidential Draft
12 September 2019	1.1	Jill Skinner	Todd Webb feedback
30 September 2019	1.2	Neil Cree	Current working draft issued to NZTA for OIA purposes
18 October	1.3	JS/NC	Second Draft
29 October	2.1	JS/NC	Working edit
1 November	2.2	NC	3rd Draft for Peer Review
18 November	3.0	JS/NC	Final Draft
28 November	3.1	NC	Final Draft – updated costs
6 December	3.2	NC	Further edits
6 January 2020	4.0	NC	Further edits

Document review

Role	Name	Review status

Role identification

Project Manager:	Robert Strong
Project Sponsor:	Paul Glucina

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EXECUTIVE SUMMARY

In August 2018, the Government announced that cross-harbour walking and cycling will be fully funded by the Government if a detailed business case confirms the economics of the project. The funding is part of a $390 million package of investment in walking and cycling projects around the country over the three-year period 2018-2021.

With the NZ Transport Agency being requested to be the lead agency in the further development and delivery of a cross-harbour walking and cycling link, a business case has been developed which sets out the case for investment along with the economic assessment of a recommended option.

A cross-harbour walking and cycling link aligns with the Government and Auckland Council's strategic direction for transport. It has been clearly expressed through both the Auckland Transport Alignment Project and the Auckland Plan, and the project is included in both the Auckland RLTP and the National Land Transport Programme.

The investment logic underpinning the development of a cross-harbour walking and cycling link is summarised below. The problem statements and investment objectives were developed by the project team, in the context of the wider investment framework developed for the Auckland Cycling Programme (of which a cross-harbour walking and cycling link is a component).

Problem One	**Problem 2**
The lack of a cross-harbour cycling and walking connection limits mode choice for trips to and from the North Shore and Auckland's city centre resulting in it not effectively contributing to Auckland's transport system.	The lack of a safe and appropriate cycle and pedestrian connection across the Harbour Bridge is reducing the opportunities for residents and visitors to experience a world class harbour.
Investment Objective - Travel to work	**Investment Objective – Recreation/ Tourism**
Increase the mode share of walking and cycling travel to work trips across the Harbour Bridge from 0% to 3% by 2028 by completing the strategic missing walking and cycling link connecting the North Shore and Auckland's city centre.	Increase the number of daily walking and cycling recreation and tourism trips across the Harbour Bridge from 0 to 2,500 by 2028 by completing the iconic walking and cycling link connecting the North Shore and Auckland's city centre.

Twelve options were considered to address the problems and investment objectives outlined above, including the consented SkyPath option developed by the SkyPath Trust. Through a multi-criteria assessment process and subsequent option refinement the recommended option is a new 5m wide shared path built alongside the Auckland Harbour Bridge. This option will connect seamlessly with Westhaven walking and cycling routes and with the future SeaPath route, extending the shared path from Northcote Point to Akoranga and beyond. The path includes three observation decks to allow for views of Auckland and the Waitematā Harbour. These decks are up to 100 metres long and at their maximum 4.2metres wide (in addition to the 5m wide path). They are terraced down from the shared path to create a safe, sheltered seating area for cyclists and pedestrians alike.

The project will help deliver a world-class walking and cycling link between Auckland's city centre and Auckland's North Shore, with scope to further extend the corridor to the north. With potential to attract over 3,500 daily cyclist trips and 2,000 daily pedestrian trips by 2046, the link will change how Aucklanders get around the city. It will provide a viable and safe transport choice for people travelling to, from and within Auckland's North Shore, and will offer visitors and residents alike a unique opportunity to explore the harbour and surrounds.

Key project risks relate to property acquisition, associated with providing an elevated continuous route linking to SeaPath, and the usual challenges that arise during consenting. Whilst it is envisaged that much of the project can be consented by varying the existing SkyPath consents, new designations and consents will also be required to provide a continuous link. The consenting approach developed for the project proposes direct referral to the Environment Court.

The structure itself utilises traditional techniques and materials similar to the existing Auckland Harbour Bridge. As such, construction methodologies are relatively well known. However there remains the scope for innovation in design and delivery, and an Alliance model is therefore proposed for the delivery phase of the project.

The Transport Agency proposes the link will largely operate under the same conditions as those of the SkyPath consent, albeit there is no longer a requirement to control access in relation to crowding and load capacity. Allowance has been made within the project scope for physical and technological measures to operate the facility safely. However, a more detailed operational plan will need to be developed in the next stage of the project as part of pre-implementation planning.

The expected estimate of the project is $232.0m (P50) to $266.8m (P95) including project development, pre-implementation and Net Property Costs. s 9(2)(i) with whole of life maintenance and operating costs estimated to be circa $9m (Net present value).

The economic benefits of the project have been calculated to be $253.1m made up mostly of travel time, health and decongestion benefits (90%) with the remaining benefits made up of Agglomeration benefits ($23m NPV) and benefits from tourism ($2m NPV).

The Auckland Harbour Bridge Shared Path is a city-shaping piece of infrastructure which will close a significant gap in Auckland's walking and cycling network and minimise the barrier to cross-harbour active mode travel. Consequently, the project has been assessed as having a **very high** results alignment against the Transport Agency's Investment Assessment Framework, given the activity addresses a critical missing link in a strategic network or multi-modal interchange in Auckland (a major metro). Coupled with the Shared Path project's BCR (1.3), the overall priority for the activity is proposed to be rated 1, given its very high results alignment.

It is therefore recommended that the NZ Transport Agency approve $232.0m of funding for the next phases of the project, namely the pre-implementation, implementation and property acquisition phases for Option 10, a 5m wide shared path built on separate pier brackets attached to the existing bridge piers. The shared path will be positioned at the same level as the car deck of the main bridge and include three observation decks to allow for views of Auckland and the Waitematā Harbour. These decks are up to 100 metres long and at their maximum, 4.2 metres wide. They are terraced down from the shared path to create a safe, sheltered seating area for cyclists and pedestrians alike.

INTRODUCTION

This Detailed Business Case is for a shared walking and cycle pathway across the Auckland Harbour Bridge. This project forms part of a wider continuous shared path project linking Westhaven to Esmonde Road, Takapuna, with the remainder of the connection being delivered through the SeaPath project. In August 2018, the Government announced that cross-harbour walking and cycling will be fully funded by the Government if a detailed business case confirms the economics of the project. The funding is part of a $390 million package of investment in walking and cycling projects around the country over the three-year period 2018-2021.

This Detailed Business Case has been prepared which sets out the case for investment, along with the economic assessment of a recommended option and an implementation strategy for the next steps.

There have been investigations into how to provide a shared pathway access over the Auckland Harbour Bridge in 2001, 2006, 2007 and ongoing since 2011, when the SkyPath Trust was formed to advocate and lead the development of a walking and cycling facility. This led to resource consents being granted for SkyPath in 2016.

In parallel, the NZ Transport Agency and partners have been developing the case for investment in the SeaPath, a proposed four-kilometre shared walking and cycling path along the Northern Motorway corridor from the Auckland Harbour Bridge to Esmonde Road, Takapuna.

In developing the Business Case for the Auckland Harbour Bridge Shared Path, the Transport Agency has used existing relevant analysis prepared for the complementary detailed business case for SeaPath.

STRATEGIC CONTEXT

The Auckland context

Since 2010, Auckland's population has increased by over 250,000 with annual growth in excess of 40,000 people per annum, making it one of the fastest growing cities in the developed world. Statistics NZ projections suggest that over the next 30 years the population of Auckland could increase by up to one million more. The city centre is New Zealand's fastest growing residential neighbourhood, use of public transport has tripled since the mid 1990's and, most recently, Aucklanders are rapidly taking up cycling where quality infrastructure is provided.

However, the scale and pace of growth, coupled with a history of under-investment and insufficient housing construction means that Auckland faces significant transport and urban form challenges including:

- Poor travel choice beyond private vehicles, especially in lower income areas
- A near doubling of deaths and serious injuries on roads since 2012
- The need to reduce the transport system's environmental impact
- Enabling and supporting a rapid acceleration in the rate of housing construction
- The need for streets to play a growing role in creating vibrant and inclusive places

The critical role of transport in supporting a successful Auckland is recognised by Government and Auckland Council through the Government Policy Statement (GPS) on land transport[1] and the Auckland Plan[2]. Both the Government and Council have a shared view that investment in transport must deliver broad economic, social, environmental and cultural benefits to both Auckland and New Zealand by providing safe, reliable and sustainable access to opportunities by:

- Easily connecting people, goods and services to where they need to go
- Providing high quality and affordable travel choices for people of all ages and abilities
- Seeking to eliminate harm to people and the environment
- Supporting and shaping Auckland's growth
- Creating a prosperous, vibrant and inclusive city

Walking and cycling in Auckland

Auckland is one of the most car dominated cities in the world – in 2013 around 70 percent of all journeys to work were made by car[3], compared to only 4% by walking and a little under 1% by cycling.

Both Auckland Council and the Government recognise there are many opportunities for walking and cycling to play a more substantial role in improving access and contributing to an effective

[1] https://www.transport.govt.nz/multi-modal/keystrategiesandplans/gpsonlandtransportfunding/
[2] https://www.aucklandcouncil.govt.nz/plans-projects-policies-reports-bylaws/our-plans-strategies/auckland-plan/Pages/default.aspx
[3] Stats New Zealand, Census 2013

transport system for Auckland, and in recent years have increased investment into cycling in Auckland from under $20 million a year in 2013 to around $40 million in both 2016 and 2017.

The Auckland Transport Alignment Project 2018 (ATAP) strengthened this commitment by placing greater weight on public transport, walking and cycling to support the realisation of the city's environmental, health and growth outcomes. The resulting ATAP walking and cycling investment package, together with the Auckland Cycle Programme Business case has shaped the next ten years of investment priorities for cycling and walking across the city.

Auckland Regional Land Transport Plan 2018-2028[4] (RLTP) includes a ten year $685m walking and cycling programme aimed at increasing walking and cycling mode share and reducing deaths and serious injuries among pedestrians and cyclists. The programme includes $60 million per annum (or $600 million over the ten-year programme period) for network development funded by Auckland Transport and the NZ Transport Agency, together with $3.5 million per annum (or $35 million over ten years) on complementary initiatives.

Key initiatives proposed for investment include:

- a shared path across the Auckland Harbour Bridge;
- SeaPath (a complementary shared path between Esmonde Road and the Auckland Harbour Bridge) as well as broader walking/cycling programmes such as the Urban Cycleways Programme (to complete the programme which started in 2015 - for example completion of Glen Innes to Tamaki Drive shared path); and
- a targeted walking and cycling programme to achieve maximum impact for short trips to the city centre, public transport interchanges, schools, and local and metropolitan centres.

Figure 1 provides an overview of the three main 'spines' of the Auckland programme (North-west cycleway, Glen Innes-Tamaki and SeaPath/Auckland Harbour Bridge) to which future walking and cycling connections can feed into. All three spines interconnect through the CBD network.

[4] https://at.govt.nz/about-us/transport-plans-strategies/regional-land-transport-plan/

Figure 1 – Main spines of Auckland Cycling Programme

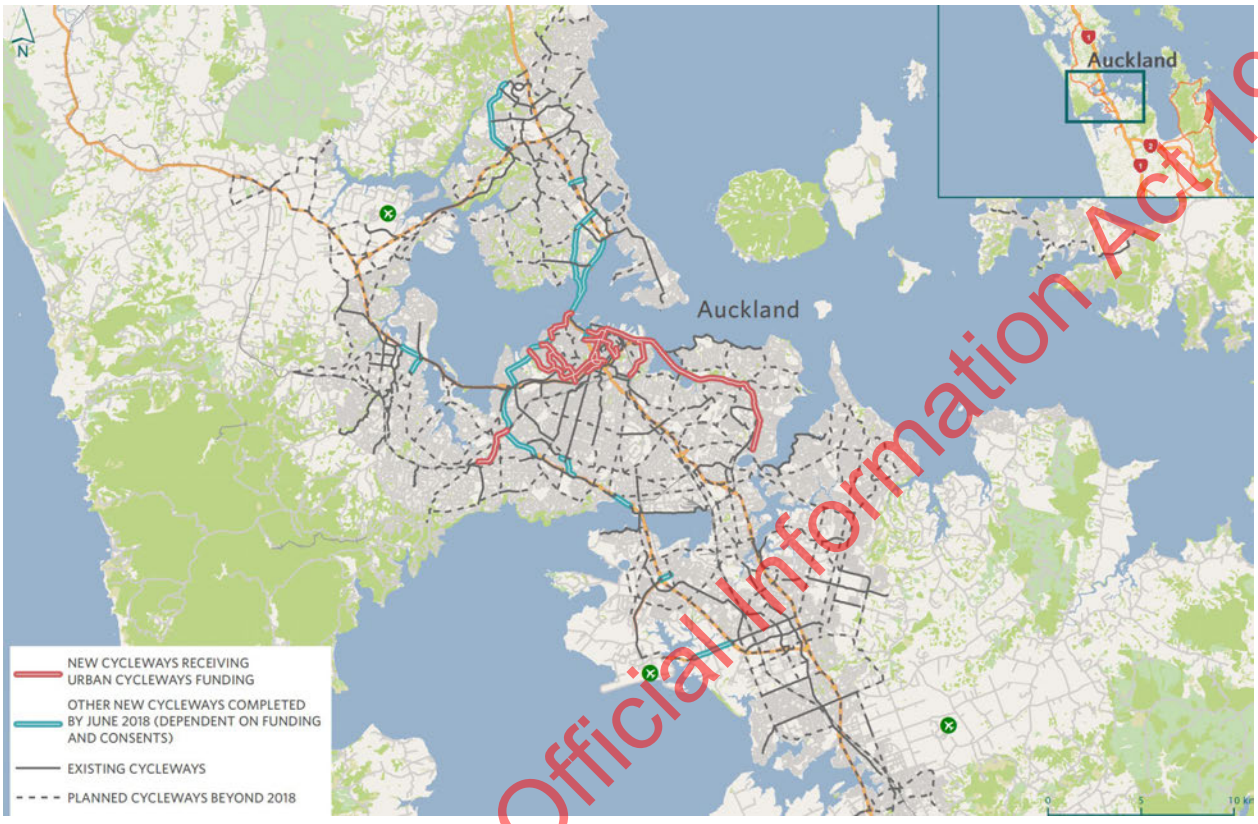
The walking and cycling programme in the RLTP was guided by the Auckland Cycling Programme Business Case (PBC)[5], which was approved by Auckland Transport and the NZ Transport Agency in 2017. Indicative network planning found that $600 million investment can deliver at least 150km of high-quality, safe cycling facilities and associated intersection upgrades. This will add to a network of approximately 380km of facilities, to provide a total network of approximately 530km of dedicated cycling facilities by 2028.

The PBC identified a number of focus areas for 'early construction starts' during the 2018-21 period, including network development in the city centre and Fringe linked to cross-harbour walking and cycling, and in selected suburban hubs including Mangere and Henderson. This will improve accessibility to major jobs and education centres, fill network gaps and build off recent investment.

[5] Auckland Cycling Programme Business Case, Auckland Transport, September 2017

Importance of a cross-harbour connection

This project seeks to complete an important missing cycling and walking link identified in the Auckland Cycle Network (ACN), which is illustrated in **Figure 2** below.



https://at.govt.nz/media/1152675/Proposed-Auckland-Cycle-Network.pdf

Figure 2 - Proposed Auckland cycle network

This link has been shown in legacy councils' cycling and walking documentation for over 15 years and has been consistently prioritised and ranked highly for its strategic importance in terms of increasing the modal share for cycling in Auckland because of the critical role a cycling and walking connection over the Waitematā Harbour would have.

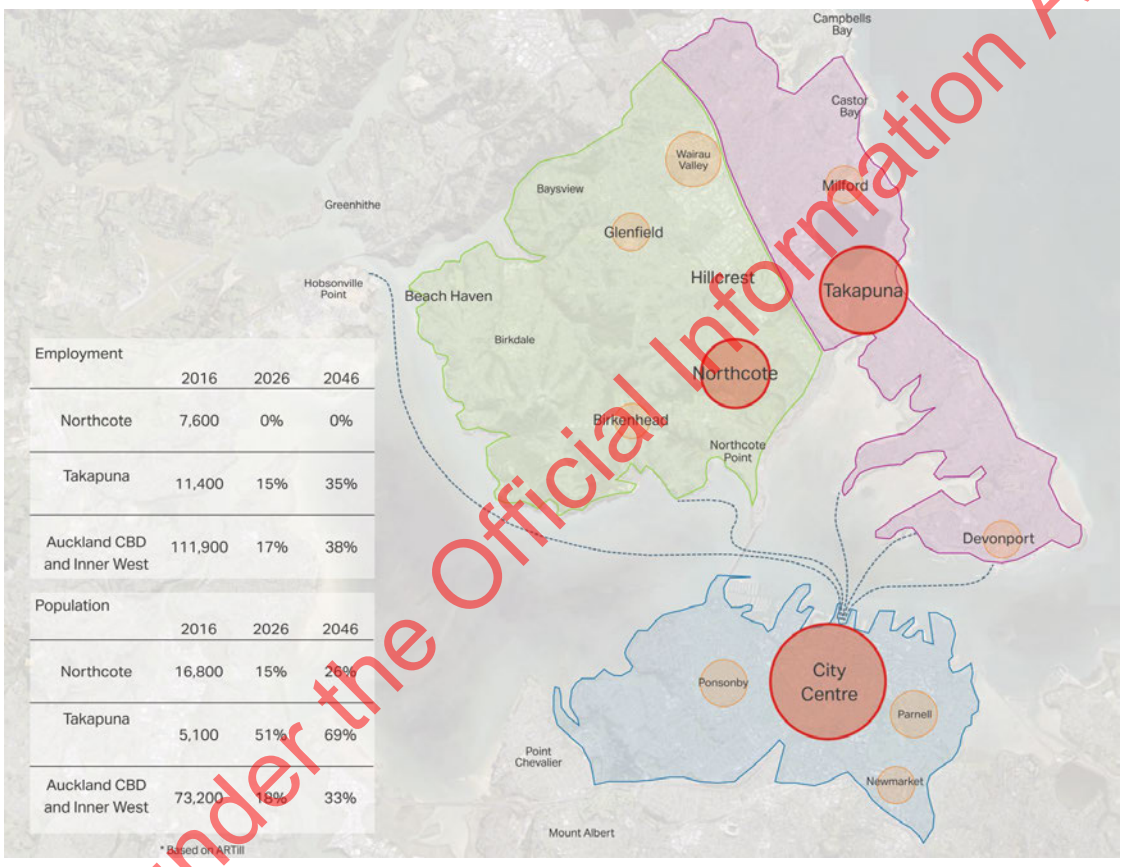
A key issue for cycling in Auckland is the lack of connected networks along key routes and, as noted above, completing networks is important to support transport or commuter cycling, as well as for pedestrian movement. A recent example of the impact of completing networks is with the opening of the LightPath which connects the Northwestern cycle way to the CBD and has seen a daily average of 841 cycle journeys across the link leading to an estimated 200% growth in people cycling on Nelson Street during weekdays. This issue is important to the discussion around a cycling and walking connection over the Waitematā Harbour because it is a key connector between the North Shore and the city centre or Isthmus area.

By providing a connected cycling and walking network, Auckland would significantly increase the active mode share as it becomes a valid transport choice for commuting. Developing a well-connected cycle network will also provide the community with improved access to recreational and

educational facilities such as parks, libraries and further education centres. A cycling and walking connection over the Waitematā Harbour would have a key role in this by providing connectivity between the city centre and the North Shore and is complementary to the SeaPath project.

Growth drivers and potential users

Both the city centre and Takapuna are identified as high urban growth areas with the proportion of working age (15-64) and over 65's expected to increase in the future. The growth in employment and residential population is expected to be concentrated in and around key business areas and existing metropolitan centres such as Takapuna, Akoranga, Northcote and the city centre and inner west suburbs as shown in **Figure 2** below.



Employment	2016	2026	2046
Northcote	7,600	0%	0%
Takapuna	11,400	15%	35%
Auckland CBD and Inner West	111,900	17%	38%

Population	2016	2026	2046
Northcote	16,800	15%	26%
Takapuna	5,100	51%	69%
Auckland CBD and Inner West	73,200	18%	33%

* Based on ART III

(Source: SeaPath Detailed Business Case)

Figure 3 - Forecast population and employment growth (30 year)

The population and employment figures above relate to the Northcote and Takapuna suburbs only, not the green and purple shaded areas (which have larger populations and offer more employment opportunities by comparison, as shown below).

Table 1 – Wider Area Population and Employment Data

Area (from Figure 2)	2016	2026	2046
Household Data			
Green	99,300	+6%	+11%
Purple	68,500	+15%	+31%
Employment Data			
Green	30,200	+1%	+3%
Purple	32,500	+10%	+30%

Both Takapuna and Northcote town centres are well located close to the Northern Busway, the Harbour Bridge and state highway network. The increased employment, residential growth and aging population will place additional pressure on the already congested transport network and particularly the harbour bridge.

Census data indicates that the average commuter trip in Auckland is around 11.8km and the average cycling trip length is 9.8km. This is equivalent to the distance between Takapuna and the city centre. Census commuting data indicates that there are around 3,500 people commuting within a 9km catchment of the northern landing of the Auckland Harbour Bridge, including trips to/from the city centre and lower North Shore. Of these, less than 100 people currently commute by bicycle.

The volume of commuters is likely to almost double over the next 30 years due to the expected high growth in population and employment in the area. These increases highlight the scale of potential commuter trips that could be made by bicycle across the Waitematā Harbour over the next 30 years. The catchment for commuter trips made by bicycle could also increase significantly with the continued growth in e-mobility (e.g. e-bikes, e-scooters etc). The average speed of E-bikes in the current market is around 23 km per hour. This speed is substantially faster than people cycling on unpowered bicycles and helps to address many barriers to cycling, including reducing physical exertion. People are also being attracted to E-bikes for the increase in distance that can be covered and the ease of carrying items for point-to-point trips. Potential E-bike users are also influenced by improved cycle infrastructure and an aging population is more likely to use E-bikes than unpowered bicycles.

The effect of E-bikes could increase the average commuter trip by bicycle to 12km (based on achieving an average speed of 23kph over 30 minutes). This would unlock large residential areas (c. 60% additional commuter trips to/from the city centre) to the north (Forest Hill, Crown Hill and Lake Pupuke) and south (Narrowneck and Seacliffe) of Takapuna that would be within 30 minutes cycle by E-bike of the city centre.

A cycling and walking connection over the Harbour Bridge will be the main cycling and walking link across the Waitematā Harbour, providing connectivity between businesses, suburbs and leisure facilities.

There is a clear need to complete the missing gap in the cycling and walking networks over the Waitematā Harbour.

Work completed to date

Investigations into the provision of walking and cycling access over the Auckland Harbour Bridge have been undertaken on behalf of various central and local government organisations in 2001, 2006 and 2007. At the time these investigations identified a number of technical constraints to the development of cross- harbour walking and cycling facilities[6] however, these matters have now been largely addressed by advances in structural engineering techniques and materials.

In 2011, the SkyPath Trust was formed to lobby for, and support, the development of a walking and cycling facility across the Waitematā Harbour. The Trust, with the support of consulting firms (including structural engineering firms and architects), developed the SkyPath concept design. As part of this work, several design options and locations on the Auckland Harbour Bridge were considered. For instance, it was identified that SkyPath should be attached under the eastern clip-on lane of the Harbour Bridge due to more capacity on that side. This capacity exists because heavy vehicles are generally travelling south (to the Port) empty.

Since 2011, Auckland Council, Auckland Transport and NZ Transport Agency have been working with the Trust on the feasibility of constructing and operating a walking and cycling facility on the Auckland Harbour Bridge.

In August 2011, the initial concept design for SkyPath was publicly launched. It was a steel structure with two or three viewing platforms (which were two storeys) and semi-transparent screening material. It would be a 4m wide shared pathway for cyclists and pedestrians.

Issues with loading weight across the central, and most critical, span of the Harbour Bridge meant that in 2012, aluminium (instead of steel) was proposed for this span. However, the Trust revised the design in mid-2013 with the use of a lighter design through the proposed use of composite material for the structure. That change was anticipated to reduce the self-weight by approximately 30%. The viewing deck's configuration and other materials also changed at the same time. It was at this stage that it was proposed there would be five viewing decks, 6m wide, with extra supports off the piers of the Harbour Bridge and the use of rods or louvres (rather than screening material) for the outside of the structure.

That design was taken forward into detailed concept design, for which resource consents were obtained. Key elements of the consented SkyPath concept include:

- a 4m wide walking and cycling pathway, which is approximately 1km long designed with viewing platforms
- pathway fixed to the underside of the eastern clip-on (southbound) of the Harbour Bridge, which will offer extensive views for users over the Waitematā Harbour and the city
- two architecturally designed landing points – one at Westhaven and one at Northcote Point
- compliance with relevant design standards and wheelchair friendly
- CCTV monitoring along the length of as well as having an active security presence.

[6] Auckland Waitematā Harbour Cyclist and Pedestrian Access Study, 2 October 2008, Maunsell/AECOM.

Investment priority

In August 2018, the Government announced that cross-harbour walking and cycling will be fully funded by the Government - if a detailed business case confirms the economics of the project. The funding is part of a $390 million package of investment in walking and cycling projects around the country over the next three years. The Government's announcement was based upon an understanding that the capital cost of the project was $67 million, with funding to come from the National Land Transport Fund.

For the project to be considered for funding from the National Land Transport Fund, the next stages of development were for the Agency to lead development of a public sector business case for the concept.

When assessed against the NZ Transport Agency's Investment Assessment Framework[7] the Shared Path project has a Very High results alignment. That is, the project is highly aligned to the outcomes sought from the Government Policy Statement in terms of safety, access and environment. This is due to the project addressing a critical missing link in a strategic network in a major metro (as defined by the Investment Assessment Framework). Subject to the cost benefit appraisal for the activity being greater than, or equal to, 1.0 the activity is considered the highest priority for funding.

Subject to the findings of this business case, there is a desire to proceed with delivering a cross-harbour facility as soon as practicable, as the first phase of delivering a shared path linking Westhaven to Esmonde Road.

[7] https://nzta.govt.nz/planning-and-investment/planning-and-investment-knowledge-base/2018-21-nltp-investment-assessment-framework-iaf/

PROBLEMS, OPPORTUNITIES AND CONSTRAINTS

Programme problems, opportunities and investment objectives

The Auckland Cycling Programme, of which cross-harbour walking and cycling is a component, identifies problems at the programme level and the benefits of overcoming these problems. It outlines the alignment to investment partners' strategies and goals and identifies other issues and constraints that may affect the programme.

The key problems identified at the programme level were:

- Problem 1: Cycling is perceived as unsafe and unattractive, resulting in it not effectively contributing to Auckland's transport system (45%)
- Problem 2: Relatively low levels of cycling and high dependence on private vehicles results in poor environmental, place and health outcomes (25%)
- Problem 3: The current transport system often fails to meet the needs of people using bikes, resulting in them being over-represented in deaths and serious injuries (30%).

The four potential benefits of addressing these problems at the programme level are:

- Benefit 1: Cycling plays a greater role in meeting Aucklanders' transport needs (30%)
- Benefit 2: Improved access to opportunities, particularly for people with low levels of transport choice (20%)
- Benefit 3: Improved environmental, place and health outcomes (20%)
- Benefit 4: Increased safety for people using bikes (30%)

These reflect the expected outcomes from investment in a cycle programme and are linked to five programme level investment objectives:

- Triple cycle mode share from 1% to 3% of total journey to work/education trips by 2028;
- Triple jobs and education opportunities accessible by short cycle trips for people with lower levels of transport choice by 2028
- Triple cycle volumes in dense activity centres by 2028
- Increase rates of participation in regular cycling activity from 13% to 25% by 2028
- Reduce deaths or serious injuries involving people using bikes by 20% by 2028

Activity level investment objectives

Activity specific objectives have been informed by the programme level problems, benefits and investment objectives. These aim to be well aligned with the programme but uniquely reflective of the goal of providing an Auckland Harbour Bridge Shared Path. Two investment objectives have been derived from two strategic problems as shown in **Table 2** below. This investment framework was developed by the project team, and informed by the programme level problems, benefits and investment objectives.

Demand forecasts developed for this business case have helped to refine both the problem statements and investment objectives outlined below. These forecasts predict 2,780 daily cyclist trips and 1,720 daily pedestrian trips for cross-harbour walking and cycling in 2026. By 2046, this is expected to increase to 3,750 daily cyclist trips and 2,050 pedestrian trips.

Further information on demand forecasts and associated assumptions is provided in **Appendix A: Demand Forecasts** and **Appendix B: Assumptions and Uncertainties Underpinning Demand Forecasts**.

Table 2 - Investment objectives

Problem 1		**Problem 2**
The lack of a cross-harbour cycling and walking connection limits mode choice for trips to and from the North Shore and Auckland's city centre resulting in it not effectively contributing to Auckland's transport system.		The lack of a safe and appropriate cycle and pedestrian connection across the Harbour Bridge is reducing the opportunities for residents and visitors to experience a world class harbour.
Investment Objective 1- Travel to work		**Investment Objective 2 – Recreation/ Tourism**
Increase the mode share of walking and cycling travel to work trips across the Harbour Bridge from 0% to 3% by 2028 by completing the strategic missing walking and cycling link connecting the North Shore and Auckland's city centre.		Increase the number of daily walking and cycling recreation and tourism trips across the Harbour Bridge from 0 to 2,500 by 2028 by completing the iconic walking and cycling link connecting the North Shore and Auckland's city centre.
KPIs		**KPIs**
Cross-harbour people throughput (peak hours): Number of pedestrians, cyclists, public transport boardings and motor vehicles (excl. public transport) multiplied by average number of people per vehicle		**Cross-harbour people throughput (weekday inter peak):** Number of pedestrians and cyclists
Cross-harbour people mode share (peak hours): Number of pedestrians, cyclists, public transport boardings and motor vehicles (excl. public transport) multiplied by average number of people per vehicle, expressed as percentages		**Cross-harbour people throughput (weekends):** Number of pedestrians and cyclists
Cross-harbour people throughput (peak hours): Number of pedestrians and cyclists		
Access – perception: User surveys of perception of safety and ease of walking and cycling		

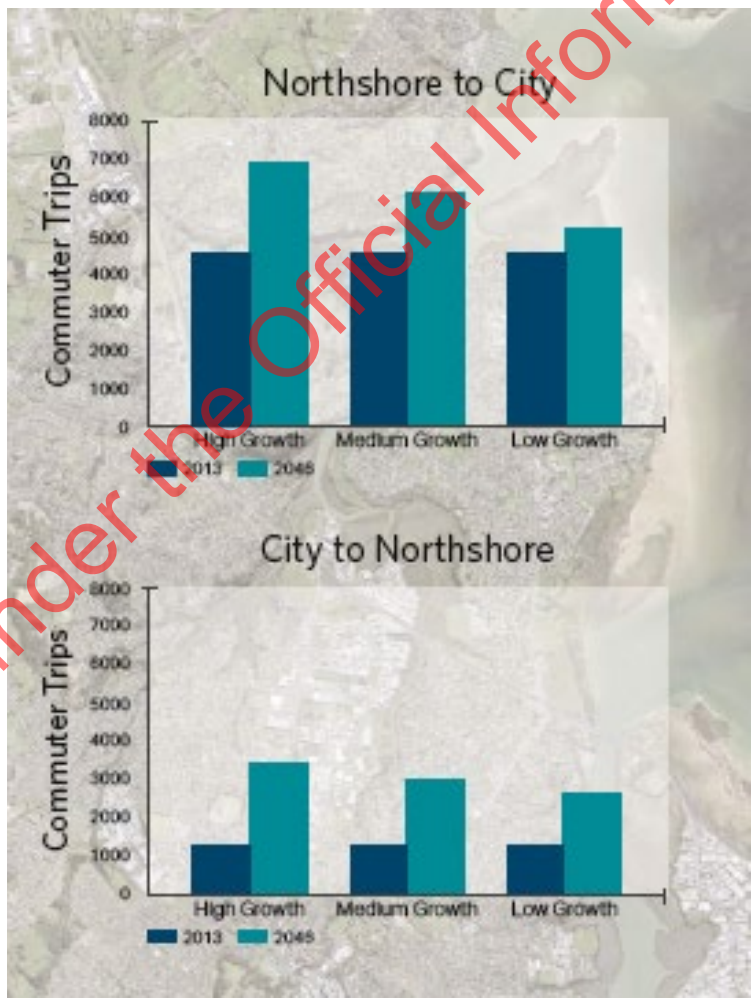
Problem/opportunity 1

The lack of a cross-harbour cycling and walking connection limits mode choice for trips to and from the North Shore and Auckland's city centre resulting in it not effectively contributing to Auckland's transport system.

Earlier chapters of this business case have explored the strategic importance of a cross-harbour walking and cycling connection to deliver the missing link in the walking and cycling network between the city centre and North Shore. This connection will provide an alternative to private car travel and public transport. As a result, any mode shift in favour of walking and cycling will provide additional capacity to the existing motorway.

The lower North Shore has a low level of walking and cycling currently but has been identified as an area with significant potential to serve short to medium distance trips, together with the city centre and inner west areas which abut the Auckland Harbour Bridge southern landing.

Census commuting data indicates that there are around 3,500 people commuting within a 9km catchment of the northern landing of the Auckland Harbour Bridge, including trips to/from the city centre and lower North Shore. Of these, less than 100 people currently commute by bicycle.



(Source: SeaPath Detailed Business Case)

Figure 4 – Current and future commuter trips between the North Shore and city

As noted earlier, the number of commuter trips in this area is likely to almost double over the next 30 years due to the expected high growth in population and employment in the area. With the growth in E-bikes, there is the potential for unlocking large residential areas to the north and south of Takapuna that would be within 30 minutes cycle by E-bike of the city centre.

Demand forecasts[8] developed for this business case predict 1,580 daily commuter pedestrian and cyclist trips in 2026 (on completion of the cross-harbour walking and cycling connection) increasing to 2,320 by 2046. The following forecast cycle to work mode shares are estimated in 2026:

- 2.2% for the Auckland region
- 2.6% for the Devonport-Takapuna Local Board area
- 2.3% for the Kaipatiki Local Board area

These mode share and demand forecasts are considered realistic, given the level of cycling infrastructure investment to 2026, that includes not only the proposed cross-harbour walking and cycling connection, but SeaPath, the Northcote Safe Routes, and completion of the Auckland Urban Cycleways Programme. The forecasts have been informed by population and employment growth estimates, together with patronage data on other significant Auckland cycleways (including the existing causeway section of Tamaki Drive).

(Source: SeaPath Detailed Business Case)

Figure 5 - Cycle catchment analysis from Northcote Point

[8] Cross-harbour Walking & Cycling – Transport Modelling and Economic Benefit Evaluation, Flow Transportation Specialists (December 2018).

Problem/opportunity 2

The lack of a safe and appropriate cycle and pedestrian connection across the Harbour Bridge is reducing the opportunities for residents and visitors to experience a world class harbour.

Proposals to build new walking and cycling bridges often cite additional recreation and tourism as an expected development benefit. However, there is little robust analyses that quantifies the level of uplift in tourism. Work undertaken by MR Cagney[9] in preparation for this business case identified a business case for a proposed Rotherhithe pedestrian bridge in London, which illustrates common practices. That is, it states that it expects the Rotherhithe bridge will attract visitors who will "bring considerable additional economic benefits," but does not attempt to quantify these benefits.[10]

From MR Cagney's review of global examples, there are several key factors that influence the effectiveness of walking and cycling bridge infrastructure as a tourist attraction, including:

- **Iconic design.** Iconic architectural destinations such as the Golden Gate Bridge in San Francisco draw hundreds of thousands of walkers and cyclists per year as a premier tourist attraction.[11]
- **Views of the city.** Visibility of the city is often a key reason for attracting tourists, particularly as pedestrians.
- **Connectivity to existing walking, cycling, and tourist infrastructure.** For example, the pedestrian and cyclist Millennium Bridge in London – a popular tourist destination in its own right – connects tourist destinations including St. Paul's Cathedral and the Tate Gallery.

A new walking and cycling link across the Waitematā Harbour will provide an attractive walking and cycling environment with striking city and harbour views. It would be well connected through existing walking and cycling infrastructure to the popular tourist neighbourhoods of Wynyard Quarter and the Viaduct Basin. A cross-harbour shared path will form part of a cohesive and continuous waterfront walking and cycling route connecting SeaPath, the Westhaven Boardwalk, the Wynyard Quarter, Te Wero Bridge, Quay Street and Tamaki Drive. This presents leveraging opportunities for walking and cycling tourism along the waterfront rather than an isolated cross-harbour tourist attraction.

The value of proximity to inner city tourist neighbourhoods is significant in the context of Auckland's thriving tourism industry. The central city attracts large visitor numbers, with around 300,000 cruise ship passengers passing through the Ports of Auckland cruise ship terminals annually[12]. Over half of the region's commercial accommodation capacity is in the central city[13], with key central city tourist attractions continuing to draw significant visitors (e.g. 931,000 visitors to Auckland Museum in 2017/18 and 155,000 visitors to the NZ Maritime Museum in 2015/16).

[9] Wider economic benefits of a new walking and cycling link across the Waitematā Harbour, MR Cagney

[10] https://www.sustrans.org.uk/sites/default/files/file_content_type/sustrans_thames_cycle_bridge_chapter_2_business_case_web.pdf

[11] http://goldengatebridge.org/visitors/

[12] Heart of the City website – Cruise tourism's contribution to the New Zealand economy 2017, Market Economics Consulting report for the New Zealand Cruise Association, August 2017

[13] MBIE commercial Accommodation Monitor June 2019 – Auckland (table 6.1)

The substantial growth forecast in Auckland tourism[14], together with the proximity of the Harbour Bridge to the inner-city tourist neighbourhoods, would indicate there is potential to generate latent demand for recreational and tourist trips across the Waitematā Harbour.

As part of their analysis of cycle demands and cycle user benefits, Flow Transportation Specialists, estimated the number of recreational and tourist trips that a new walking and cycling link may attract. They drew primarily on a comparison with the San Francisco Golden Gate Bridge, adjusted for differences between the Auckland and San Francisco contexts.

Based on this analysis, Flow Transportation Specialists suggest that a cross-harbour walking and cycling connection could result in approximately 2,370 recreational user trips and 550 tourism trips per day in 2026 growing to 4,240 combined recreational and tourism trips by 2046.

This is a small share of Auckland's tourists at around 1%, which seems plausible. Research cited by MR Cagney[9] shows that around 0.5% of international and domestic tourists currently participate in cycle touring. However, it is noted this forecast could be conservative considering anticipated tourism growth in Auckland.

[14] By 2025 4.1m international visitors are expected annually, with significant increases expected in cruise ship visits (171 visits - up more than 50% on current levels) and overnight guest stays (10.2million, an increase of nearly 40%). Source: Destination Auckland 2025, Auckland Tourism, Events and Economic Development

OPTIONS ASSESSMENT

Through a two stage multi-criteria assessment process, completed with input from a range of technical experts, a long list of twelve options was reduced to four. A recommended option was then identified through further analysis and assessment.

The assessment criteria included alignment with investment objectives, implementability considerations and an assessment of effects.

Options identified

Twelve options were identified and assessed as described below and shown in **Appendix C: Long-List Options**.

Option 1: Underslung option (as designed by the SkyPath Trust)

An underslung shared path is supported off the eastern box girder. Option 1 is the base option for comparison with other options. The option is constructed of a prefabricated Fibre Reinforced Polymer (FRP) structure. The shared path is 4m wide and is open on the eastern edge with anti-throw screens built in.

Option 2A: Deck level shared use path with structural widening (on southbound box)

A deck level 4m wide shared path created by narrowing existing traffic lanes and constructing a 1.9m wide pedestrian extension onto the existing structure.

Option 2B: Separate deck level walking and cycleway

A 2.5m walkway on the eastern box girder and a 2.5m cycleway on the western box girder are supported on the existing cross girders with an additional steel extension to the box girder cantilevers. Traffic lanes are reduced to 3.35m wide (from 3.65m) with a new traffic barrier separating SH1 from pedestrians and cyclists.

Option 3: Shared path on extension bridge lane

A 4m shared path on the outer lane of the eastern extension bridge replaces one traffic lane, with a new traffic barrier separating SH1 from pedestrians and cyclists.

Option 4: Shared path on truss bridge lane

A 3.5m shared path on the outer lane of the truss bridge replaces a traffic lane, with a new traffic barrier separating SH1 from pedestrians and cyclists.

Option 5: Shared path inside box girder

A 4m shared path inside the east extension bridge on a new deck constructed in the box girder structure.

Option 6: Separated low level walkway and cycleway beneath extension bridges

A 2.5 m walkway on the east and a 2.5m cycleway on the west sides suspended below the box girders pass between the trestle legs on each pier.

Option 7: Low level shared path through truss

A 4m shared path suspended below the truss which passes through interior bracing members.

Option 8: High level shared path above truss overarch

A 4m shared path supported on frames above the truss structure above SH1. The shared path passes over the top of the truss overarch at the navigation span.

Option 9: Independent shared path structure on pier brackets

A separate 4m shared path supported on a new structure spanning between supports on southbound pier brackets.

Option 10: Independent shared path structure on concrete piers

A separate 4m shared path supported on a new structure spanning between supports fixed to southbound concrete piers.

Option 11: Totally independent shared path bridge on new foundations

A separate bridge carrying a 4m shared path on new foundations and piers aligned with existing bridge piers.

Multi-criteria assessment framework process

A two stage multi-criteria assessment (MCA) process was selected as the preferred method of options assessment.

Stage 1 was an initial screening of options to identify a reasonably practicable short list to which a more detailed MCA was applied.

Initial screening - long list to short-list assessment

Because Option 1, the underslung option, was already consented (developed by the SkyPath Trust), the initial screening process of the long list options was carried out against criteria which focussed on the most significant differentiators between options relative to Option 1. The process focused on six key criteria:

- Alignment with the overarching project investment objectives:
    - Increasing the mode share of walking and cycling travel to work trips across the Harbour Bridge
    - Increasing the number of walking and cycling recreation and tourism trips across the Harbour Bridge
- Constructability – the ease of construction of an option (e.g. simple or complex) and the risks posed during construction and design. The risks include risks to road users and contractors' personnel, potential damage to existing infrastructure, potential unforeseen circumstances leading to scope creep, and design complexity. The criterion also relates to the expected construction programme e.g. an extended construction programme would result in a prolonged impact on road users during construction
- The requirements for additional strengthening – the extent of strengthening of the Auckland Harbour Bridge required to support an option resulting from the increased loads imposed on the Bridge. The areas on the Auckland Harbour Bridge that may require

strengthening include the truss bridge, box girders, piers, pier brackets or localised structural elements.

- Consentability - the likelihood that an option may be granted necessary resource consents, taking into consideration the consented SkyPath Trusts option (Option 1), and the significance of any likely effects. This criterion considers the scale of consenting, for instance whether the existing SkyPath resource consents can be used, or an amendment made, rather than applying for a new resource consent or if a new consent(s) is likely to be needed.
- Operational impacts – the impact on the current level of service of State Highway 1 (SH1). The assessment is based on the long-term impact on traffic on SH1, such as a reduction in the current number of lanes or restrictions on the use of some lanes due to issues relating to loading or safety. The criterion relates to both the Auckland Harbour Bridge and its approaches.
- Impact on harbour use - the impact of an option on the existing clearance below the Harbour Bridge for marine vessels and restrictions that may be imposed on the navigation channel.

A rating system was proposed where each option either positively impacts the criterion (green), negatively impacts the criterion (red), or is neutral (orange, neither achieves nor detracts from the criterion). A summary of the rating system is provided in **Table 3** below. Weighting of the criteria against each other was not proposed at this stage. A review of the advantages and disadvantages of the shortlisted options was carried out to identify the option or options to be taken forward based on the balance of pros and cons.

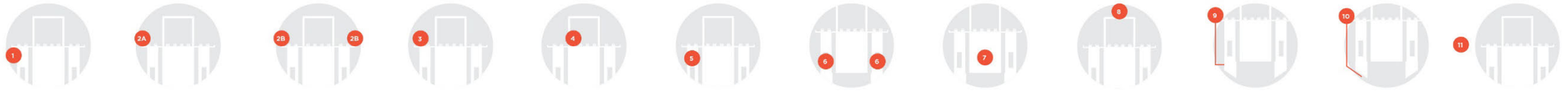
Table 3 – Initial screening rating system

	Negative Impact	Neutral Impact	Positive Impact
Investment objectives	Unlikely to contribute positively to the investment objective	Would make some contribution to the investment objective	Would contribute positively towards the investment objective
Constructability	Extensive construction risks, complexity, extended temporary restrictions	Typical construction risks, complexity, minor temporary restrictions	Low construction risks, complexity, no temporary restrictions
AHB Strengthening	Complex or extensive strengthening required	Minor strengthening required such as minor/simple works or confined to a localised area	Little to no strengthening required
Consentability	Significant impacts on environment, and/or likely changes to resource consents makes updated resource consents difficult to obtain	Minor additional impacts on environment, amendment to existing consent required	No or improved impacts, existing consent can be used

	Negative Impact	Neutral Impact	Positive Impact
Operational Impacts	Major reduction in the level of service of SH1, loss of capacity	Little / minor change to the level of service of SH1	No change to the level of service of SH1
Impact on Harbour Use	Critically reduces the current clearance / harbour use	Very minor change in clearance / current harbour use	Options that result in no change to the current harbour use

A summary of the initial long list assessment is shown in **Table 4** below. In addition to the rating system detailed above, it includes a black rating for any elements that were deemed to include fatal flaws.

Table 4 - Long list assessment



	Option 1 Underslung option*	Option 2A Deck level shared use path with structural widening (on southbound box)	Option 2B Separate deck level walkway & cycleway	Option 3 Shared path on extension bridge lane	Option 4 Shared path on truss bridge lane	Option 5 Shared path inside box girder	Option 6 Separate low level walkway and cycleway beneath extension bridges	Option 7 Low level shared path through truss	Option 8 High level shared path above truss overarch	Option 9 Independent shared path structure on pier brackets	Option 10 Independent shared path structure on concrete piers	Option 11 Totally independent shared path bridge on new foundations
INVESTMENT OBJECTIVES												
Increase the mode share of walking and cycling travel to work trips across the Harbour Bridge												
Increase the number of walking and cycling recreation and tourism trips across the Harbour Bridge												
IMPLEMENTABILITY												
Constructability												
Additional Strengthening												
Consentability												
Operational impacts												
ASSESSMENT OF EFFECTS												
Impact on harbour use												
SHORTLISTING OUTCOME												
	Take Forward	Take Forward	Discarded	Take Forward	Discarded	Discarded	Discarded	Discarded	Discarded	Discarded	Take Forward	Discarded
DISCUSSION												
	Involves the use of a highly specialised material and has a high level of design complexity Construction is high risk as this is proposed to be undertaken from the road level Extensive strengthening of the box girder is required Resource consents have already been granted Users would have to be managed to maintain service levels on SH1	Construction on one side of the AHB. Load limitations unlikely. Strengthening required but is limited/not complex Barrier construction staging is complex therefore high impact on customers Potential further RMA approvals or amendments to approvals required to enable walking and cycling Reductions to traffic lane widths to 3.2m Users would have to be managed to maintain service levels on SH1	Construction on both sides of the AHB, which could be done concurrently. Load limitations required. Strengthening required but is limited. Not complex Barrier construction staging is complex therefore high impact on customers Potential further RMA approvals or amendments to approvals required to enable walking and cycling Reductions in traffic lane widths to 3.35m	Easy to construct No strengthening required Potential further RMA approvals or amendments to approvals required to enable walking and cycling Significant impact on people carrying capacity of the AHB	Approaches are difficult to construct, complex sequencing No strengthening required Potential further RMA approvals or amendments to approvals required to enable walking and cycling Significant impact on people carrying capacity of the AHB	Infeasible to construct and would lead to significant loss in the structural capacity of the AHB if diaphragms are removed	High risk during construction especially with regards to the main 250m span Would reduce the clearance under the AHB significantly	High risk during construction especially with regards to the main 250m span Would reduce the clearance under the AHB significantly	High construction risk with numerous lane closures required Major strengthening would be required for the truss bridge/overarch to carry additional loads. Capacity limits mean this option would be infeasible. In terms of loading, this option would be approximately equivalent to an additional traffic lane on the truss bridge, which is currently at capacity	Complex strengthening of the pier brackets required In terms of loading, this option would be approximately equivalent to an additional traffic lane on the pier bracket which is currently at capacity	Difficult to construct, mainly with work from the harbour below Minor strengthening of piers only required New resource consents or amend SkyPath resource consents	New piers in the Waitematā Harbour would require coastal resource consents, which would likely be very hard to secure There would be minor changes in the current harbour use due to additional new piers

KEY

- Positive impact
- Neutral impact
- Negative impact
- Fatal flaw
- Not assessed due to fatal flaw or sum of negative impacts

*As designed by the SkyPath Trust

Outcome of long list assessment

Options 4-9 were discarded from further consideration as they contained fatal flaws. Option 2B was also discarded at this point as the benefits are largely similar to Option 2A but Option 2B requires duplicate paths on both sides of the Auckland Harbour Bridge with associated costs including duplication of safety barriers and customer facilities. It would also require new consents on the western side as this is clearly outside of the footprint of the consented SkyPath option as designed by the SkyPath Trust. These issues are not as complex for Option 2A.

Option 10 was taken forward as it was felt to perform well from delivering to the objectives of the project and was one of only two options which would not require some form of operational management associated with load capacity risk. Option 11 was the other option, however, a new completely separate structure within the harbour was deemed to have a significant consenting risk when there is a feasible option (Option 10) which could achieve the same objectives with lesser impact.

Therefore, four options were taken forward for further assessment from the long list based on the balance of pros and cons from the assessment and consideration of key areas around alignment to objectives, implementability and value for money. The four options taken forward were:

- Underslung option as developed by the SkyPath Trust (Option 1);
- A deck level shared use path with structural widening on the southbound box (Option 2A);
- A shared path on the southbound extension bridge lane (Option 3); and
- An independent shared path structure connected to the southbound concrete piers (Option 10).

SHORTLIST EVALUATION

A detailed MCA analysis of the shortlisted options was undertaken by the project team and Transport Agency specialists against more detailed sub-criteria covering the investment objectives, implementability, effects of the options and value for money. Unlike the approach taken for the long list assessment, status quo (i.e. do nothing) provided the baseline for comparing options.

The assessment against each criterion is included in **Appendix D: Shortlist MCA**[15] and summarised below, with further information contained in Flow's technical report (refer footnote 8 for details).

Option 1: Underslung option (as designed by the SkyPath Trust)

Option 1 provides a significant increase in pedestrian and cycling capacity over the status quo although demand will need to be increasingly managed due to the width of the facility and increased levels of crowding, coupled with load carrying capacity constraints (see below). The option is largely sheltered from the weather. However, there will be noise and vibration from overhead traffic which could undermine the user experience.

Patronage forecasts predict 4,500 daily trips in 2026 and 935 hourly trips during the busiest peak hour (95th percentile weekday). Austroads design guidance recommends minimum widths for shared use paths of 4.5m, although widths of greater than 4.5m may be warranted to mitigate additional safety concerns associated with walking/cycling on a gradient and associated downhill speeds of cyclists. As such, there is a risk that this 4m option cannot safely accommodate potential demand and access controls may be required.

Because Option 1 is supported from the existing southbound box girder, it affects the girder's load-carrying capacity. As such, Option 1 would require ongoing monitoring and assessment of the impacts on loading on the Harbour Bridge, with potential operational constraints put in place on the pedestrian/cycle crossing and southbound traffic lanes in the future.

Option 1 relies on a modern material called 'fibre reinforced polymer' (FRP). This material has not been used in bridge structures elsewhere to the extent proposed (for reference, it is more commonly used in boat building). As such, there are several engineering/constructability complexities and uncertainties with Option 1. The whole of life implications of this option are also unknown, although the Agency's engineering consultants consider that the design life of Option 1 will be substantially shorter than for Option 10 (approximately 50 years versus 100 years).

Whilst Option 1 is already consented by the SkyPath Trust[16], the Agency's engineering advice is that the design would need to be altered to enable delivery of a technically achievable scheme. The extent of the design changes are likely to be sufficient that variations to the consents would be needed, pursuant to s127 of the Resource Management Act 1991 (RMA) – at the very least a change to the conditions is likely to be required to change the references in conditions to any substitute plans. Importantly, if the proposal removed the constraints on access numbers, a change of condition would be needed and the effects of such a change would need to be assessed as part of the s127 application. The Transport Agency would also need to hold those existing

[15] Option 3 is not included in Appendix C as it was discarded before the multi-criteria assessment following more detailed consideration and modelling of operational impacts on cross-harbour movements
[16] It is understood the SkyPath Trust resource consents have been transferred to Auckland Council.

consents (these may be transferred to the Agency, by the consent holder, under the relevant provisions of the RMA).

Option 2A: Separate deck level walkway and cycleway

Whilst Option 2A provides a significant increase in pedestrian and cycling capacity over the status quo, walking/cycling user numbers would need to be restricted. Traffic lane width reductions on the two southbound lanes of the Harbour Bridge would impact traffic capacity. The user experience would be less pleasant than for Options 1 and 10, being directly adjacent to live vehicle lanes, exposed to the elements, and subject to associated noise, vibration and pollutants.

As part of the shortlist evaluation process, operational analysis was undertaken by Flow Transportation Specialists to understand the implications of reducing lane widths on the Harbour Bridge to accommodate a shared facility (relative to capacity reductions proposed under Option 3).

Option 2A is predicted to result in negligible changes in network operations, overall, relative to the status quo however, the economic effects of this alternative configuration have been assessed, to quantify general traffic travel time, vehicle operating cost, and congestion (driver frustration) disbenefits. These benefit streams have been capped beyond 2036.

The resulting discounted traffic disbenefits have been estimated to be $113 million, discounted over the 40-year evaluation period. Whilst not a fatal flaw, this is a significant disbenefit of Option 2A. Notably:

- The $113m disbenefit outweighs the project benefits for the worst-case economic scenario tested, of $76m. There is the possibility that Option 2A would deliver zero, or negative, project benefits.
- The $113m in disbenefit was based on zeroing the effect after 2036, as it was assumed the Additional Waitematā Harbour Crossing (AWHC) would make the reduced capacity on the existing Harbour Bridge redundant. If the AWHC was not built by 2036, or its form is limited to public transport, that disbenefit would be higher.

Option 2A also involves widening the existing deck so that it extends further over the coastal marine area (CMA), and altering the landings, on the land at either end. The resulting design would extend beyond the consented footprint and potentially give rise to effects outside the envelope of the existing SkyPath resource consents (or potentially not considered in the granting of those consents). While this option would require increased occupation of the CMA, the adverse effects associated with the proposed increase would be minimal. In particular, the support structures for the shared path would be attached to the Bridge and would largely not extend below sea level, therefore the implications on coastal processes, ecology and navigation/safety are likely to be negligible.

Notwithstanding the above, it is understood the primary points of contention in the original resource consent application were around the effects on the respective landing sites at Northcote Point and Westhaven. Because Option 2A is at deck level (compared to the consented Option 1 which is an underslung structure), it is likely to require an amendment to the consented design and location of the northern landing – due to engineering constraints and user experience requirements. A new landing site is likely to impact Stokes Point Reserve in Northcote Point, which has recognised heritage value.

This option is connected to the existing southbound box girder and will almost certainly affect the girder's load-carrying capacity at some point in the future. As such, Option 2A would require ongoing monitoring and assessment of the impacts on loading on the Auckland Harbour Bridge. There will be operational constraints (e.g. limiting access numbers) put in place on the pedestrian/cycle crossing and potentially limitations on traffic lanes on the southbound Auckland Harbour Bridge box girder in the future.

Option 3: Shared path on extension bridge lane

Option 3 provides a significant increase in pedestrian and cycling capacity over the status quo. However, the operational analysis carried out by Flow Transportation Specialists (as referenced under Option 2) demonstrated that where a Bridge lane is dedicated to walking and cycling, this reduces capacity on all forms of cross-harbour movement, including freight and public transport, creating a significant impact on the transport system.

The assessment of Option 3 included options for operating the Harbour Bridge in different configurations to minimise those impacts, as outlined below:

- Scenario 1: Devote one traffic lane for walking and cycling, and operate the remaining lanes in a four/three configuration during the peaks, with three southbound lanes in the inter peak;
- Scenario 2: Devote one lane for walking and cycling, and operate the remaining lanes in a five/two configuration during the peaks, with three southbound lanes in the inter peak.

The analysis indicated that Scenario 2 was predicted to have significantly greater overall network impacts than Scenario 1, due to the widespread redistribution of traffic across the network in the former. However, no scenario provided an appropriate balance of safe levels of service for all users. This finding was considered to be a fatal flaw, and no further analysis was completed on Option 3 under the MCA shortlisting process.

Option 10: Independent shared path structure on concrete piers

Option 10 provides a significant increase in pedestrian and cycling capacity over the status quo without affecting existing traffic capacity.

Unlike Option 1, Option 10 does not connect to the existing southbound Harbour Bridge box girder and does not affect the girder's load-carrying capacity. There would be no requirement to limit users or place future restrictions on traffic using the Harbour Bridge as a result of providing a walking and cycling connection. Option 10 would not require further strengthening of the southbound box girder, which would be complex, cause disruption to road users and would limit options for future strengthening. However, Option 10 would require modification to the existing pier structures, and it likely that some strengthening, and repair works will be required.

Option 10 has a better user experience than Options 1 and 2, from a traffic noise and vibration perspective. This is because it is an independent bridge structure supported on separate box columns attached to the Harbour Bridge piers. As a result, users will not be subject to the significant vertical movement caused by vehicular traffic crossing the eastern extension of the Auckland Harbour Bridge. Enhanced viewing platforms would provide a better user experience for visitors.

Option 10 uses materials and technology akin to the existing Auckland Harbour Bridge box girders, which are known, tried and tested, with an enduring design life of approximately 100 years (noting potential engineering complexity with attaching the structure to the Auckland Harbour Bridge piers).

There are consenting risks associated with Option 10. Whilst Option 10 shares some similar characteristics with Option 1 (such as following the same alignment), some design and operational details differ, including the method of structural support with the consequence of capacity constraints changing. The Transport Agency would need to hold the existing consents to vary them. Subject to the consents being transferred, a s127 change of conditions could be sought, which would mean only the effects of the changes to conditions changes would be considered, not effects of the shared path activity as a whole. New Notices of Requirement to designate and authorise land use activities beyond Stokes Point to 9 Princes Street (the northern-most extent of the project) would also be required.

Recommended option

The conclusion from considering the relative merits and disbenefits of the options, as identified in the MCA, coupled with consideration of the timing for implementation and indicative costs and benefits of the options, is that Option 10 (an independent shared path structure supported on the southbound concrete piers) is recommended.

Whilst there are consenting risks associated with Option 10, when compared to other options assessed, it rated the highest against a number of detailed sub-criteria outlined in Appendix C, including user experience and safety, perception of safety and ease of walking and cycling, residual risk and urban design and landscape. The remainder of the Business Case discusses the future refinement and assessment of Option 10 and sets out the financial, commercial and management cases for this option.

RECOMMENDED OPTION

The proposed scope of the recommended option is outlined below, which forms the basis of the financial, commercial and management cases.

The recommended option, Option 10, has undergone further refinement particularly in relation to path width and position; indicative landing design and integration with SeaPath. Feedback obtained from mana whenua, stakeholders and the wider community during the development of the business case has been integral to the process of design refinement.

Option Description

The Transport Agency's long-term intent is to deliver a transformational, world-class walking and cycling link between Auckland's city centre and Takapuna, with scope to further extend the link to the north. With potential to attract over 3,500 daily cyclist trips and 2,000 daily pedestrian trips by 2046, the link will change how Aucklanders get around the city. It will provide a viable and safe transport choice for people travelling to, from and within Auckland's North Shore, and will offer visitors and residents alike a unique opportunity to explore the harbour and surrounds.

In order to deliver the link, a new shared path will be built alongside the Auckland Harbour Bridge, which will connect seamlessly with Westhaven walking and cycling routes in the city and with the future SeaPath route, extending from Northcote Point to Akoranga and beyond. Multiple entry and exit points will be provided at key locations, including Westhaven, Northcote Point, Onewa Road and Esmonde Road in Takapuna.

Figure 6 – Extents of the Auckland Harbour Bridge Shared Path

The Auckland Harbour Bridge section of the shared path will extend from Westhaven in the city to Sulphur Beach (Northcote Point). The shared path will be built on separate pier brackets attached to the east side of the existing Auckland Harbour Bridge piers, and will be positioned at the same level as the car deck of the main bridge. This differs to the original Option 10, which was positioned below deck-level. The decision to relocate the path to Harbour Bridge deck-level was driven by engineering and design factors. This change is expected to have negligible impact on user experience, given the separation of the pathway from live traffic lanes, and the provision of screening from traffic noise and visual distraction.

At five metres wide, the recommended option is wider than the four-metre-wide options assessed in the short list. This will allow for separation between walkers and cyclists, improving both safety and customer experience. It improves levels of service for customers on the day of opening and provides greater resilience for future demand. Further discussion on the pros and cons of a 5m versus a 4m wide option is contained in **Appendix F: Design Refinement - Pathway Width**.

The path includes three observation decks to allow for views of Auckland and the Waitematā Harbour (as shown below). These decks are up to 100 metres long and at their maximum, 4.2 metres wide. They are terraced down from the shared path to create a safe, sheltered seating area for cyclists and pedestrians alike.

The shared path has been designed with a sculptural form that is broadly aligned with the existing Bridge extension. Architectural lighting will be used at night to highlight key features.

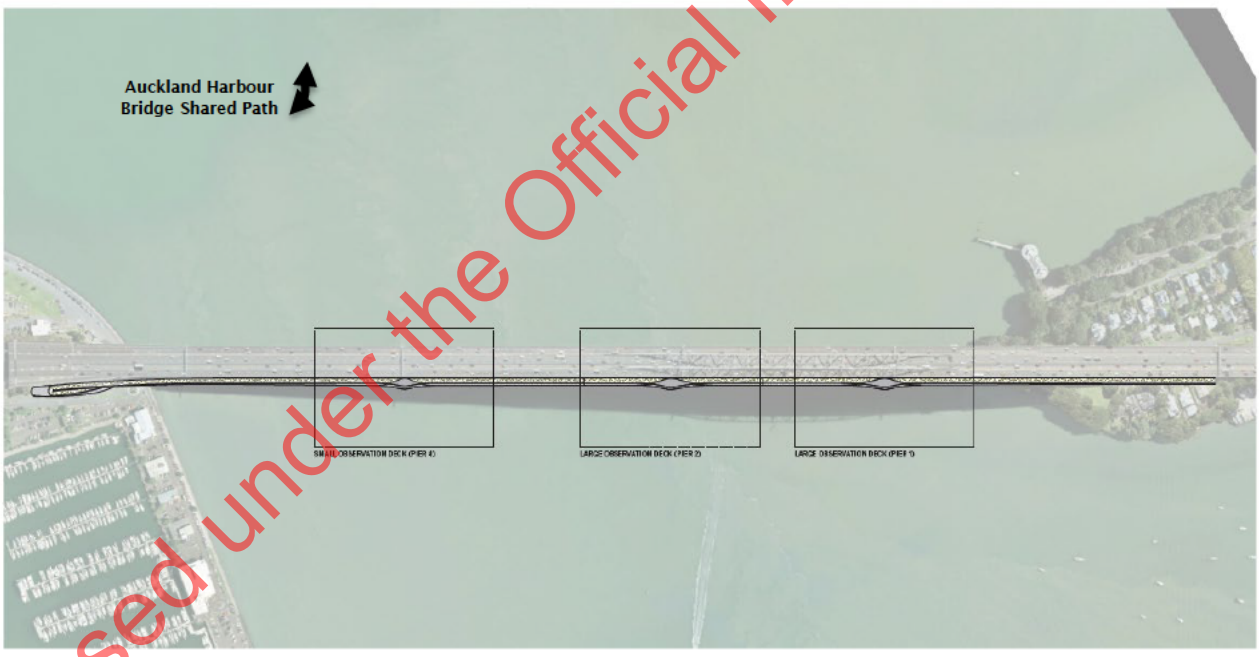


Figure 7 – Proposed Observation Decks

Through option refinement, several landing configurations at the northern end were considered as an alternative to the SkyPath's consented northern landing. Alternatives were required because the decision to relocate the path to deck-level created a number of engineering complexities with the consented design and significantly compromised user experience (due to increased ramp steepness etc).

Ramps located in the vicinity of 9 Princes Street and Sulphur Point Boat Ramp are preferred as they balance addressing resident concerns with maximising safe access to the facility for users. A summary of the northern landing locations and configurations considered is provided in **Appendix E: Design Refinement – Northern Landing Design and Location**.

Further work on the optimal design of an access ramp and wider urban design improvements in the vicinity of 9 Princes Street will need to be undertaken during the pre-implementation phases of the project. This will include a targeted engagement programme to ensure the views of iwi, affected residents, landowners and key stakeholders are understood and appropriately considered in the design process. The likely cost of this work, including the engagement programme, has been included in the project cost estimates.

In the meantime, two concept designs (indicative only) have been explored for Princes Street in the development of the Business Case, to demonstrate the overall feasibility of a solution and for the purpose of providing a suitably robust cost estimate, as shown in the figures below.

The scope of this Detailed Business Case precludes the extension of the shared path beyond 9 Princes Street but is designed to facilitate a seamless deck level shared path through to Shelly Beach and SeaPath. The continuation of the shared path to Shelly Beach/ Sulphur Point Boat Ramp (including associated costs) forms part of the scope of work for the SeaPath project.

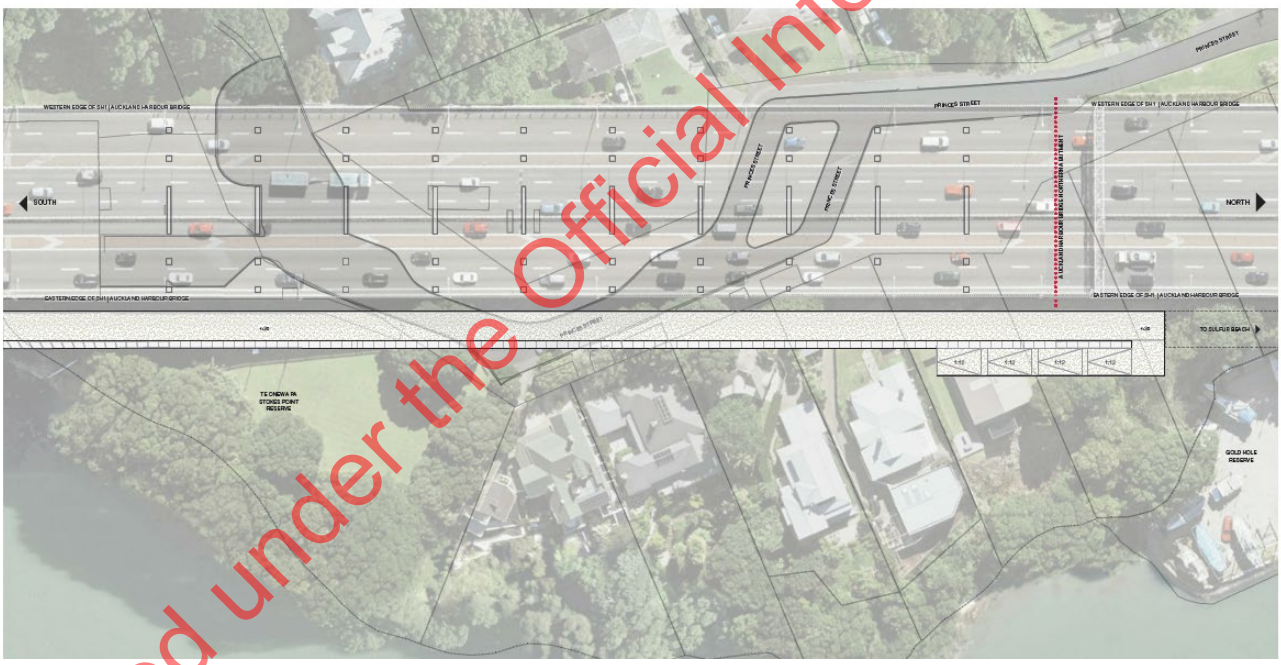


Figure 8 – Indicative landing Option 1 in vicinity of 9 Princes St, Northcote Point

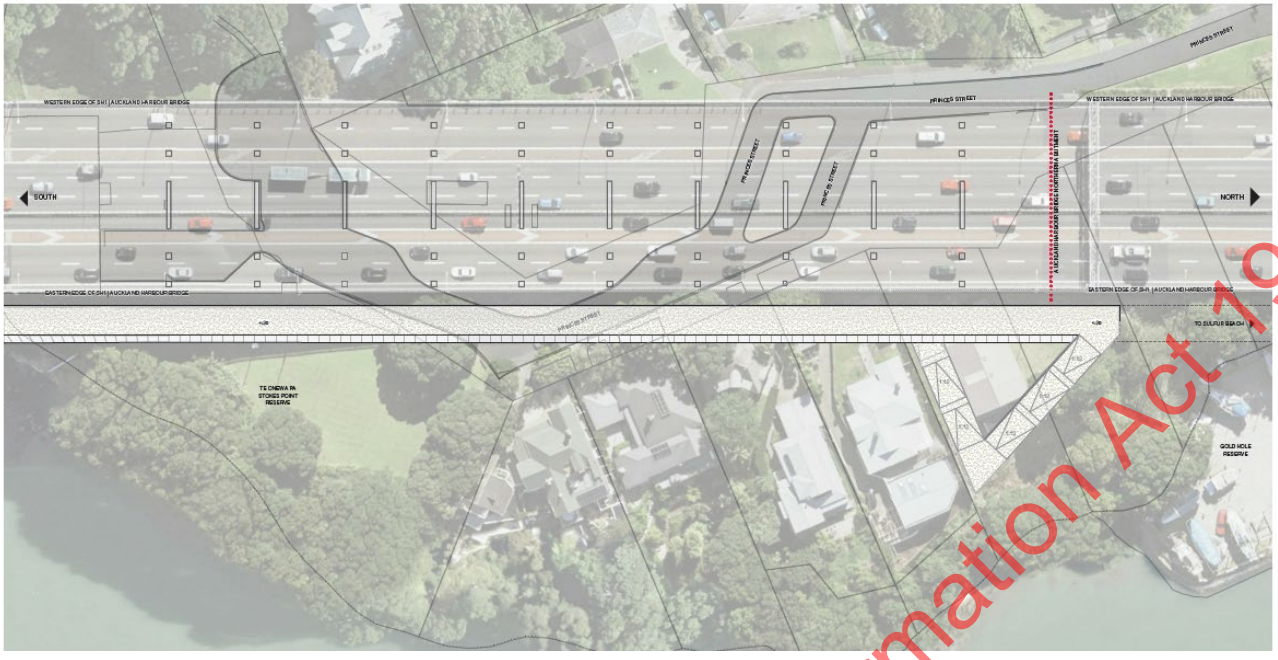


Figure 9 – Indicative landing Option 2 in vicinity of 9 Princes St, Northcote Point

The southern landing is proposed to extend across Curran St and descend to ground level near the Curran St / Westhaven Drive intersection.

Figure 10 – Indicative southern landing at Westhaven Drive

In developing the recommended option, the potential role and scope of technology has been considered in relation to supporting operations and maintenance or enhancing customers experience. Technology options are proposed which support several operational dimensions, including speed management, personal safety, benefit monitoring, capacity control and mode shift outcomes. Further details are outlined in **Appendix G: Integrated Technology**.

Operating the facility

An Operations Plan will be developed by the Transport Agency and its pre-implementation supplier in the pre-implementation phase of the project and will include as a minimum:

- Management techniques to address safety and security for users
- The provision of traffic management measures
- A signage and wayfinding strategy
- A media strategy
- Processes for ongoing liaison with the community;
- Processes for ongoing liaison with the key stakeholders of Auckland Council, Auckland Transport, and Panuku Development Auckland;
- Provision of a feedback register which records feedback from the surrounding community and how these matters have been addressed

The recommended option will not be tolled. Whilst tolling was considered in the initial investigations it was subsequently discounted due to the lack of an engineering need and the desire to maximise the opportunities to facilitate cross-harbour walking and cycling.

Maintaining the shared path facility

The recommended option has known maintenance requirements that apply to steel bridges, similar to the maintenance tasks of the existing Harbour Bridge. Typical maintenance activities include:

- Regular inspection inside and outside the box girder
- Replacement of lights
- Maintenance of electrical equipment such as audio-visual equipment, CCTV and security systems
- Maintenance of accessways and gates
- Re-instatement of deck surfacing.

In addition, there are some long-term maintenance activities that occur approximately every 15-25 years such as:

- Re-painting
- Replacement of bearings
- Replacement of expansion joints.

New maintenance gantries are required to provide access to the outside of the steel structure for inspection and maintenance. The existing gantries on the eastern side of the Auckland Harbour Bridge extension bridge could be modified to provide access to the western side of the new structure and to allow access to deck level of the Auckland Harbour Bridge.

Asset management

It is anticipated that the new structure would be maintained by the same maintenance contractors that maintain the existing Auckland Harbour Bridge. This would mean additional asset management duties for the established team, but may provide economies of scale compared to a stand-alone bridge.

The proximity of the new bridge to the existing box girder will make maintenance more difficult in some places, particularly maintenance to pier brackets that are located inside the new structure with a 1m gap allowed for access. Access arrangements for these spaces will need to be provided as part of the delivery of the asset. It is proposed that the spaces with restricted access would be fully re-painted before construction of the new bridge.

Performance against project objectives

Increase the mode share of walking and cycling travel to work trips across the Harbour Bridge from 0% to 3% by 2028 by completing the strategic missing walking and cycling link connecting the North Shore and Auckland's city centre

The recommended option's performance in promoting mode share for active modes is in line with the travel to work goals of the wider Auckland Cycling Programme. Total cross-harbour mode share by walking and cycling (not just travel to work) is forecast to be approximately 1.5% of daily people crossing the Auckland Harbour Bridge in 2026, (the year for which traffic model forecast information is available) which broadly aligns with the target year in the project objectives (ie 2028). Whilst this would appear to be low, these figures need to be considered within the context of the thousands of cross-harbour people trips every day, on one of the nation's busiest nationally strategic high-volume state highways. When travel to work trips between North Shore (south of SH18) and the city centre/Inner West are analysed, it is predicted that the shared path leads to cycling making up 4% of travel to work trips.

2026 and 2046 forecast demands are outlined in **Table 5**.

Table 5 – Forecast Daily Trips on Proposed Shared Path

Trip Type		2026 Forecast	2046 Forecast
Pedestrians (all purposes)	Utility & Recreation	1,400	2,050
	Tourism	320	440
Cyclist	Utility	1,020	1,500
	Recreation	1,530	2,250
	Tourist	230	320
Total		**4,500**	**6,560**

For the purpose of the Business Case, mode share by purpose has not been calculated, but this would be possible later through post project monitoring.

Increase the number of daily walking and cycling recreation and tourism trips across the Harbour Bridge from 0 to 2,500 by 2028 by completing the iconic walking and cycling link connecting the North Shore and Auckland's city centre

As can be seen above in **Table 5**, the recommended option is aligned to recreational and tourism forecasts developed for the project. In this regard, performance against Objective Two is somewhat self-fulfilling. The most significant uncertainty is in relation to tourism trips. However, tourism as a percentage of total forecast demand is relatively small.

Customer Feedback

The Transport Agency used a range of engagement methods during the Business Case preparation including:

- one-on-one meetings with residents
- site walk overs with interested groups
- community 'pop-up' events
- a consultation process about the connections on both sides of the Harbour Bridge
- briefings to key parties, such as local politicians

Two rounds of community engagement enabled the Transport Agency to share updates on the project and collect feedback, which has informed the Business Case and will feed into the pre-implementation phase.

Table 6 – Summary of Community Engagement

Overview	Purpose	Outcomes
July 2019 Two 'popup' events held Advertising via: • 2,000 newsletters • Project webpage • Media release • Information via local boards and schools	Meet the team and provide feedback on the AHB Shared Path plans to date. This engagement provided an opportunity to talk about the Transport Agency's proposed design of the shared path – being wider to allow for safe walking and cycling, designed at the same level as cars on the Harbour Bridge and three viewing platforms	General feedback, ideas and concerns regarding the project were shared – see below. A key topic of interest was the northern and southern landings and possible arrangements for access.
August/September 2019 Three 'popup' events held and an online submission form available on the project webpage Advertising via:	Provide feedback on the two preferred options for north and south landings. Option 1: Ramps Option 2: Lifts and Stairs	472 responses were received with a majority expressing excitement and urgency for work to begin soon. Most respondents favoured the ramp connection over the lift and stairs option. However,

Overview	Purpose	Outcomes
• Over 600 e-newsletters • Information to 20 local schools • 300 flyers to local businesses and community centres • Social media • Media release		feedback was also provided on how the design could be amended to improve user experience. Particularly focusing on the ramp turning points and safety. Feedback noted that lifts and stairs could cause congestion, safety and cost-effectiveness issues due to wait times, accessibility issues for cyclists, lift breakdown and high maintenance costs.

Constructability

The proposed form of steel box girder structure is regularly constructed around the world, although the scale and complexity of the Shared Path project is not very common in New Zealand.

An outline programme for construction has been considered and it is estimated a construction period of 24-30 months is required. The pier concrete work would be carried out first while procurement of steelwork was underway.

Modifying the existing pier structures has inherent risks associated with the condition of the old concrete and strengthening and repair works will be required. Connection of the new pier brackets to the piers is potentially the most complex site operation, with access platforms required around each pier for several months. Temporary works for Piers 5 and 6 include installation of coffer dams below water level, which will include particularly challenging operations. Construction of new foundations in the harbour would be a potential method of mitigating construction risk but would create additional consenting risks. Erection of box girder segments will be carried out using large barge-mounted cranes. Although the superstructure will be fabricated off-site, the continuous steel box girders require a considerable amount of on-site welding which requires safe access and containment to prevent debris from falling into the harbour.

Several potential alternative construction methodologies have been identified for further investigation in the pre-implementation stage; the Transport Agency will consider the environmental effects of those alternatives, to ensure a holistic approach is taken to balancing construction complexity, cost and overall effects.

Consenting

The recommended option will require statutory approvals under the RMA. Provided the Transport Agency holds the resource consents originally obtained by the SkyPath Trust, the recommended option may be able to be authorised in part by a s127 RMA variation of consent conditions, which will help to reduce consenting risk. Following further design, the environmental effects of the recommended option will be fully assessed as part of the consenting phase. Further public engagement and public participation in the consenting process will assist the Transport Agency in

determining how any adverse environmental effects could be mitigated. Further discussion of the consenting strategy is contained in the Management Case.

Property impacts

There are potential property requirements associated with providing the deck level shared path between Stokes Point Reserve and No. 9 Princes Street, affecting up to 6 titles. At this early stage of project development there is uncertainty with respect to construction and operational impacts, consequently, a conservative approach has been adopted for the purpose of considering the property impacts of the project for the purpose of the Detailed Business Case.

s 9(2)(i)

Given the desired delivery timelines for the project it is proposed to approach each of the landowners on a willing seller / willing buyer basis, with compulsory acquisition processes being an option in the future. The project staging and costings developed for the DBC factor in the timing of property acquisition and associated risks.

Safety in design

A safety in design (SiD) workshop was held with designers, the Auckland Harbour Bridge Alliance, and the risk manager and asset managers to identify risks and mitigation measures that can be put in place through design. The SiD process assessed construction, operation and maintenance phases of the project and identified respective owners of the risks at each stage.

Construction stage risks identified included the potential for contractors to drop loads or plant to impact the Harbour Bridge with mitigation plans for control of crane lifts and isolation of marine vessels during construction. Residual construction risks will be allocated to contractors to mitigate, through safe working methods to be identified in Construction Management Plans.

Operational risks assessed included the potential for conflict between modes on the bridge, and for pedestrians/cyclists exposed to vehicular traffic at the landings. Mitigation measures such as delineation, barriers and speed control systems for bikes are proposed to be developed in the pre-implementation phase. Security of bridge users was addressed, with measures such as CCTV and security staff proposed, although the facility has the advantage of passive surveillance by motorway users.

Risks associated with maintenance include falls from height over water and safe access provisions are to be designed into the Shared Path bridge for inspection and painting crews.

It is intended that the SiD register will remain a live document that informs each stage of project development.

Operability

While the AHB Shared Path does not have any impacts on the operation of SH1 over the Harbour Bridge (as assessed in the MCA), it would have several extra operational requirements over and above that required for shorter, more standard footbridges. A key operational requirement will be for opening and closing the gates to the public in the event of emergencies for example. This will require CCTV and warnings to evacuate the bridge prior to any closing of the gates. CCTV surveillance is also proposed for security purposes and monitoring of the CCTV system will be necessary.

There is no requirement for ticketing the facility, however, it is proposed to maintain a system for counting the number of users, applying similar technology to that used at railway stations. These systems can be used to activate gates in the event of emergencies or overcrowding. This system would also require monitoring. Other smart systems integrated into the design for operation of the Shared Path, such as speed controls, messaging systems or automated lighting displays would have operational requirements none of which are particularly unique or complex or pose any particular risk to the project. Operational planning will be developed as part of the pre-implementation stage of the project.

Complementary investments

Auckland Transport has an ongoing programme of investment in walking and cycling infrastructure with a particular focus on connecting the east of the city into the core cycle network spine through Glen Innes to Tamaki (GI2T) shared path which forms a key strategic link in Auckland's cycle network. The GI2T shared path project will provide a key connection for pedestrians and people on bikes from the eastern suburbs into the city, creating a "spine" to which future walking and cycling connections can feed into, matching those from the west (NW Cycleway) and the north (proposed SeaPath/AHB Shared Path). **Figure 11** below shows these spines in the context of future investment.

Figure 11 – Key cycleway spines & priority investment areas

The strategic cycling network shown above is interconnected through the CBD cycling network to Northshore, East Auckland and West Auckland. There are several cycleways which forms the CBD network which is part of the Urban Cycling Programme (UCP).

The cycling projects which form the CBD network and their current delivery status are shown in **Figure 12**.

Source: Auckland Transport

Figure 12 – CBD network projects and delivery status

Project risks

Project risks have been identified and monitored in accordance with NZ Transport Agency risk management practices and guidance and its risk management manual (Z/44). Risk management is a dynamic process throughout the life of the project. The key to managing risks lies in the assessment of the impact and level of disruption the risk will impose on the project. The key risks associated with the management and delivery of this project at this time are outlined below.

Table 7 – Key risks

Risk Type	Risk	Treatment
Stakeholder	The perceived impacts of the project such as visual impacts, proximity to private property, concerns around parking and noise could affect ongoing support for the project.	Ongoing engagement with stakeholders to understand concerns and continue to explore avenues to minimise impacts on neighbours
Financial	There is a risk that funding is insufficient for the project due to assumptions included in the estimate being incorrect; error or omission; Change in market conditions; Lack of availability of Contractors who have experience in working on this type of project.	Cost estimates have been developed in accordance with NZTA standards (SM014 and Z/44) and independently assessed through a parallel estimate.
Design	There is a risk that design development identifies adverse load effects on existing AHB piers and foundations that require significant modification to the proposed design. The consequence of this risk is that	Ongoing Specimen Design to utilise latest seismic spectra, wind load testing data, and computer modelling techniques to quantify risk and establish

Risk Type	Risk	Treatment
	there may be additional consenting requirements, creating delay associated with the further design.	feasibility of proposed solution prior to RFP phase.
Construction	There is a threat that unforeseen issues are discovered with piers during construction such as Alkali-Silica Reaction. A potential cause of this risk is that incorrect as-built information or insufficient investigation completed. The consequence of the threat is the project cannot be constructed in accordance with the resource consent / building consent with associated Project delays, negative media coverage and additional cost.	Project team to carry out detailed investigation of bridge foundations and piers to confirm as-built information and condition early in design.
Construction	There is a threat that the proposed methodology to construct from sea level is perceived to be unsafe and creates health and safety hazards to the public and harbour users.	Ongoing engagement and consultation with key stakeholders to present methodology and identify and resolve issues early. Communication with the public via open days, media coverage and consultation to present construction methodology.
Operations	There are ongoing operational risks associated with providing a safe and appropriate environment for users associated with monitoring and policing the facility, keeping customers informed and managing safe access.	An Operations Plan will be developed as part of the pre-implementation phase

ECONOMIC ANALYSIS

Economic assessment

Methodology

The economic benefit evaluation has been based on Simplified Procedures 11 (SP11) from the New Zealand Transport Agency's Economic Evaluation Manual (EEM). Recognising however that SP11 is intended for evaluating projects with capital costs under $5 million, and that SP11 contains a number of simplistic approximations, the SP11 procedures have been extended, primarily by using the 2026 and 2046 Auckland Cycling Model (ACM) to inform a full economic procedure, rather than using SP11's default demand estimation tool. SP11 has been used for the analysis of the shared path as there are presently no more complex methodologies defined for assessing walking and cycling projects within the EEM.

Cycling benefits for intermediate years have been interpolated from the two forecast years. This differs from SP11, which typically considers only a single opening year, and applies a growth rate for cyclist predictions to future years. In this way, the methodology used is more robust.

The project has been assessed with a 40-year evaluation period. A two-year construction period beginning in January 2021 has been assumed, during which time no benefits accrue, followed by a 38-year benefit period.

The economic evaluation has been carried out using the EEM's most recent update factors (1 December 2018), including:

- 1.21 for walking, cycling and public transport benefits
- 1.50 for travel time cost savings
- 1.07 for vehicle operating cost savings
- 1.06 for crash costs.

Benefit Streams

The following benefit streams have been assessed for the recommended option:

- Cyclist Travel Time Benefits – calculated using the EEM's SP11 and informed by ACM outputs
- Health Benefits for Cyclists – calculated using a modified procedure developed from the EEM's SP11, informed by ACM outputs
- Health Benefits for Pedestrians – calculated using the EEM's SP11 and informed by ACM outputs
- Safety Benefits – assumed to be negligible
- Road Traffic Reduction Benefits – calculated using standard economic evaluation procedures to quantify vehicle travel time, congestion and operating cost benefits, informed by the Northern Corridor Improvements SATURN models
- Agglomeration Benefits – provided by MR Cagney
- Tourism Benefits – provided by MR Cagney

- Traffic Disbenefits – calculated using standard economic evaluation procedures to quantify vehicle travel time, congestion and operating cost benefits, informed by the Northern Corridor Improvements SATURN models
- Tolling Benefits – calculated using standard economic evaluation procedures to aggregate tolling revenue over time.

Further detail on each of the above benefit streams is provided in the Cross-harbour Walking and Cycling Connection, Transport Modelling and Economic Evaluation Report[8].

Table 8 presents the total discounted benefits predicted for the proposed cross-harbour shared path.

Table 8 – Summary of predicted project benefits

Benefit stream	Discounted Benefit
Cyclist travel time cost savings	$12.3 million
Health benefits for cyclists	$143.0 million
Health benefits for pedestrians	$19.1 million
Safety benefits	nil for default option
Road traffic reduction benefits (decongestion)	$53.7 million
Agglomeration benefits	$23.0 million
Tourism benefits	$2.0 million
Tolling benefits	nil for default option
Road traffic disbenefits	nil for default option
Total Benefits	**$253.1 million**

Wider economic benefits

The potential wider economic benefits, or WEBs, arising from the Shared Path, have been assessed. WEBs refer to the impacts of transport improvements on economic productivity and output that are additional to benefits that accrue directly to transport users. In particular, the following two mechanisms by which the project may generate wider economic benefits have been considered:

- Supply-side improvements, such as agglomeration economies that arise due to better connections between firms and workers and which increase the productivity of those agents
- Increases in tourism demand that may increase the amount of economic activity occurring in New Zealand

Supply-side improvements

WEBs have not traditionally been measured for walking and cycling projects. However, this project is likely to support some WEBs, such as improved agglomeration economies and increased labour supply benefits, as it provides a new link between the city centre and lower North Shore that runs parallel to a congested bridge and a busway that is likely to reach capacity in coming decades.

A literature review suggests that walking and cycling improvements have the potential to contribute to agglomeration economies, but there are no mode-specific specific methods that are widely used to value these impacts. Hence, methods from the NZ Transport Agency's Economic Evaluation Manual have been used to analyse the potential for supply-side improvements to productivity or economic output.

The following table summarises our estimates of overall agglomeration benefits arising from the project. We estimate an annual impact of roughly $1.5 million in the 2026 model year, which translates into around $23 million in whole-of-life benefits if agglomeration benefits are constant throughout the project period.

Benchmarks against other projects for which WEBs have been calculated suggests that this is a realistic estimate.

Table 9 – Agglomeration benefits

Outcome	Annual impacts (2026)	Present value impacts (6%, 40-year period, assuming constant benefits in future years)
Central estimate	$1,530,000	$23.0 million
Low estimate: excludes benefits in model zones with low impacts on EJD or GDP	$970,000	$14.5 million
High estimate: higher share of cyclists are commuting	$2,020,000	$30.4 million
High estimate: 0.8% real productivity growth per annum	$1,700,000	$25.5 million

Note: Present value estimates do not incorporate growth in transport user benefits or congestion in future years and should be considered conservative.

Increases in tourism demand

Some of the people using a new walking and cycling link will be tourists, either international or New Zealand. If the project attracts additional international tourists that would not have otherwise visited New Zealand or encourages some people to stay longer or spend more, then it may increase total economic activity in New Zealand.

The *Economic Evaluation Manual* does not include standard methodologies for valuing these impacts. Through a review of the literature and available data on the economic impacts of tourism in New Zealand an appropriate approach has been developed. The analysis considers crowding out (in which added tourist activity results in a reduction of other economic activity), multiplier

effects (as spending flows through the economy), and additionality (whether international tourists would have visited regardless). It also considers how an uplift in economic activity relates to net improvements to aggregate national wellbeing.

The following table summarises the estimated tourism-related benefits arising from the project. The central estimate is a net tourism-related economic benefits of $2.0 million in present value terms. These benefits are estimated to be around one-tenth the magnitude of agglomeration economies arising from the project. However, there is a wide sensitivity range on this estimate, reflecting uncertainties about additionality and visitor profile.

At first glance, these estimates seem low: we would expect 131,400 annual tourists to generate much more spending and economic activity. This activity is undoubtedly of *local* importance: it will support economic and cultural vitality along Auckland's waterfront. However, much of that activity is likely to be diverted from other locations in New Zealand, and hence does not represent a *national* economic gain. As our analysis is national in scope, we have not delved deeply into local impacts, although we note that they may be an important consideration for local decision-makers, such as Auckland Council.

Table 10 – Tourism-related benefits

Scenario	Annual benefits (2026)	Present value benefits (40-year period, 6% discount rate)
Central estimate	$140,700	$2,000,000
High end of sensitivity range	$407,300	$5,791,000
Low end of sensitivity range	$23,800	$319,000

Note: For purposes of calculating present value impacts, we have assumed a 2022 opening year for the new facility.

Project Costs

Estimated project costs have been supplied by the Transport Agency. The Net Present Value (NPV) capital costs for the recommended option are shown in **Table 11**.

Table 11 – Summary of NPV Capital Costs ($m)

Description	NPV
s 9(2)(i)	
Operations & Maintenance	$8.8m
s 9(2)(i)	

Benefit Cost Ratio

The BCR for the recommended option is presented in **Table 12**.

Table 12 – Benefit Cost Ratio (NPV $m)

Description	NPV
NPV Benefits	$253.1m
NPV Costs	s 9(2)(i)
Benefit / Cost Ratio	1.3

Cost/Benefit variability

Sensitivity tests using NZ Transport Agency standard variables have been undertaken and presented in **Table 13** below.

Table 13 – Standard Sensitivity Tests

	Discounted Benefits	Discounted Costs	BCR
8% discount rate	s 9(2)(j)		1.0
+20% costs			1.1
Default			1.3
-20% costs			1.6
4% discount rate			1.7

In addition to the above, a series of sensitivity tests have been run on the economic assessment, focussing on the larger benefit streams of the Project. The sensitivity tests investigate the impacts of:

- Changes in forecast demands due to:
  - Faster/slower land use growth
  - The effects should the full Auckland Cycle Network (ACN) be completed by 2046
  - Varying the factor used to develop estimates of daily cyclists
  - The effect of a large future uptake in e-bikes (this test has also reduced health and environment benefits for cyclists by 50%, reflecting the motorised nature of these cycle trips40)
  - The effect should SeaPath not be constructed
  - The effects should tourist numbers be 50% lower or higher than forecast
  - Faster/slower growth in pedestrian trips beyond 2026 (2.2% assumed in the default analysis, 0% and 3% sensitivity tested)
- Changes to the assumptions used to assess general traffic decongestion – the default assumption is that new active mode trips across the harbour transfer from car, bus and ferry trips in proportion to each mode's overall cross-harbour mode share. This

sensitivity test considers the effects if bus and ferry users are 50% more likely to transfer than car travellers

- Related to the above, higher and lower car diversion rates have been tested, with the default 2026 peak period car diversion rate of 0.31 varied to test a low rate of 0.10 and a high rate of 0.60.
- Assuming a shorter average new cycle trip length across the Waitematā – the default calculation of health and environment benefits for cyclists applies the average new trip length forecast by the ACM (8.9 km, the approximate distance from Takapuna to the city centre). This test assumes a 50% reduction in this length (4.5 km, the approximate distance from Onewa Road to Ponsonby)
- The effects of various tolling scenarios being applied
- The effects should future changes in micro mobility, such as e-scooters, reduce the health benefits of new pedestrian trips
- The effect should the EEM's default SP11 calculation be used to assess cyclist health benefits (applying health benefits only on the facility itself)
- The effect should the EEM's default decongestion rate be used ($1.89 per vehicle-km removed)
- The effect should a higher or lower proportion of predicted pedestrian trips on the facility be 'new' trips that generate health benefits; the default assessment assumed 50%, and the sensitivity tests consider 25% and 75%
- The effect should the average cycle trip length for domestic tourists reduce from the assumed 3km to 1.5km (e.g. Westhaven Marina to Northcote Point) or increase to 4.5km (e.g. Queen Street to Northcote Point).
- Including crash costs according to the conservative methodology used by Transport for New South Wales.

The results of the sensitivity tests are presented below.

Table 14 – Option Benefit – Sensitivity Tests

Sensitivity Test Scenario	Discounted Project Benefits
EEM SP11 default cyclist health benefits	$134 million
Reduced new cycle trip length (-50%)	$184 million
Tolling all users, $2 per trip	$205 million
EEM default decongestion rate	$214 million
SeaPath not being constructed	$219 million
Low car diversion rate (0.10 in 2026 peak periods)	$220 million
Higher proportion of new users transferring from buses/ferries	$227 million
Tolling all users, $1 per trip	$229 million

Sensitivity Test Scenario	Discounted Project Benefits
Conservative crash cost assessment	$232 million
Low daily cyclist factor (2.0)	$234 million
Low land use growth (-20%)	$241 million
Reduced pedestrian health benefits due to e-scooter use (-50%)	$244 million
Reduced proportion of pedestrian trips being new trips (25%)	$246 million
Reduced tourist numbers (-50%)	$248 million
Low growth in pedestrian trips (0% per annum beyond 2026)	$250 million
Shorter average domestic tourist cycle trip (1.5 km)	$252 million
Default Benefits	**$253.1 million**
High growth in pedestrian trips (3% per annum beyond 2026)	$256 million
Longer average domestic tourist cycle trip (4.5 km)	$256 million
Tolling tourists only, $1 per trip	$256 million
Tolling tourists only, $2 per trip	$259 million
Increased tourist numbers (+50%)	$259 million
Increased proportion of pedestrian trips being new trips (75%)	$261 million
High land use growth (+20%)	$268 million
Full Auckland Cycle Network by 2046	$270 million
High daily cyclist factor (3.1)	$307 million
High car diversion rate (0.60 in 2026 peak periods)	$327 million
High future uptake in e-bikes	$331 million

The economic evaluation of the proposed Shared Path has been found to be most sensitive to changes involving tolling, e-bikes, and the calculation of cyclist health and traffic decongestion benefits.

IAF Assessment

The Auckland Harbour Bridge Shared Path is a city-shaping piece of infrastructure that will close a significant gap in Auckland's walking and cycling network and minimise the barrier to cross-harbour active mode travel. Consequently, the project has been assessed as having a **very high** results alignment given the activity addresses a critical missing link in a strategic network or multi-modal interchange in Auckland (a major metro). Coupled with the projects BCR (1.3), the overall priority for the activity is proposed to be rated 1 given its very high results alignment.

COMMERCIAL CASE

Purpose of this section

The primary focus of this section is to summarise an assessment of potential contractors and operators' ability to deliver and maintain the project. It particularly focuses on the specialist skills required with respect to using new materials, and the significant construction safety risks associated with working over the Waitematā Harbour.

Market analysis

It is envisaged that several NZ-based contractors have the capability to fabricate and construct the proposed Auckland Harbour Bridge Shared Path. The majority of the Auckland Harbour Bridge Shared Path spans the harbour, and therefore, much of the construction work would be carried out from barges, with supply boats to deliver materials and equipment. The type of plant and equipment required is available in New Zealand and is used for projects, such as the AC36 and Ports of Auckland wharf extensions.

Steel fabrication could be carried out by overseas suppliers to cater for the large quantities of welded steel sections, and this may be a cost-effective method of procurement.

After the consenting stage it is expected that some form of early contractor involvement would be likely for a project of this size to limit project risk. This form of procurement would allow the contractor to input the relevant expertise into construction methodology and programme, to validate the assumptions made before proceeding to detailed design.

Procurement Plan

From a delivery perspective, the Auckland Harbour Bridge Shared Path is deemed to be relatively complex, with increased scope for innovation, a need for flexibility and greater Transport Agency involvement, and a definite need for early engagement with the contracting industry. SeaPath, by comparison, is relatively simple and lower risk.

While both the Auckland Harbour Bridge Shared Path and SeaPath projects have different histories, construction challenges, risks and timelines, they are intimately related and reliant on each other to deliver their respective project benefits. Due to this, a combined procurement approach has been adopted by the NZ Transport Agency in anticipation of the Business Case being approved.

SeaPath pre-implementation activities have already been procured competitively and therefore it is proposed to extend the scope of that commission to include pre-implementation activities for the Auckland Harbour Bridge Shared Path.

When considering the possible options for procuring physical works, the two projects have been assessed using the Transport Agency's Procurement model selection matrix. The outcome of this assessment recommends a traditional delivery model for SeaPath and a more collaborative style of delivery model for the Auckland Harbour Bridge Shared Path, as illustrated in **Figure 13**.

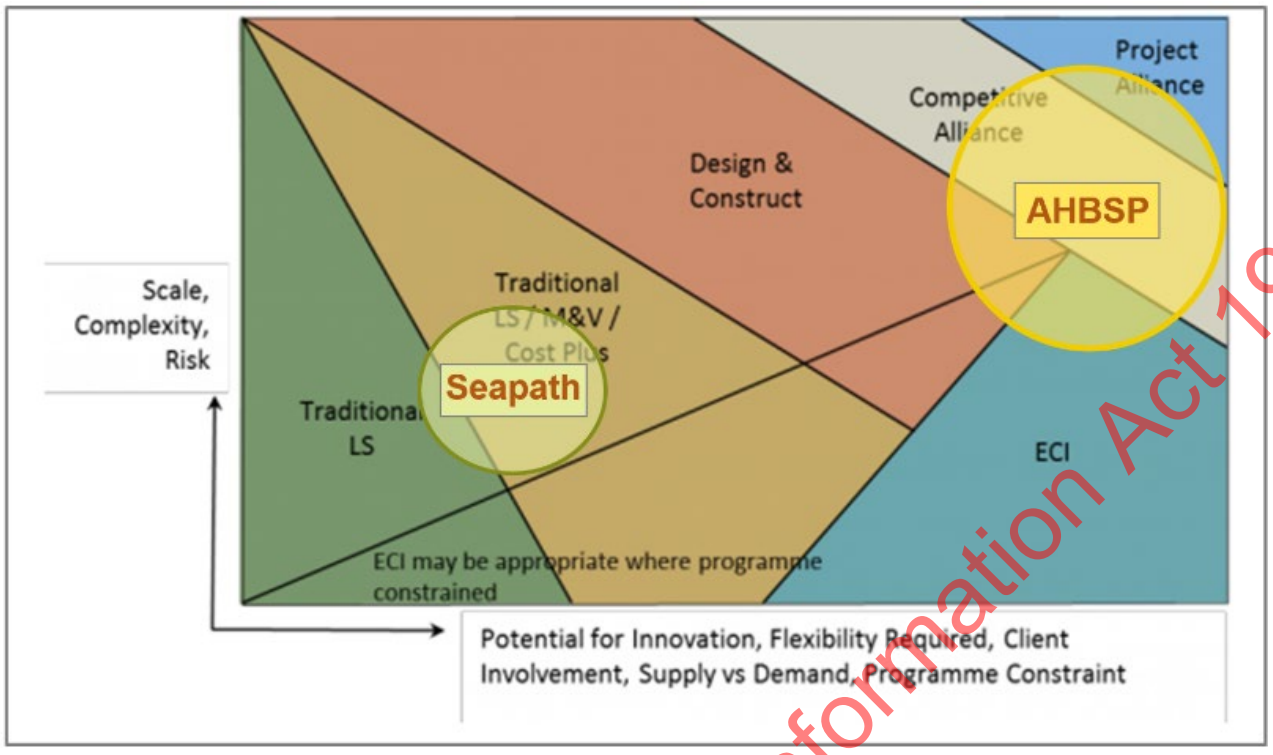


Figure 13 - Delivery Model selection

For the Shared Path, a collaborative style model that allows for early contractor involvement in the detailed design is recommended, i.e. Early Contractor Involvement (ECI) and Alliance models. A Hybrid Alliance type model is preferred. This model is designed to retain the commercial benefits of a competitive process while ensuring focus on the quality of outcomes. Under a Hybrid Alliance model an allowed budget or target cost is specified, and the evaluation focuses on qualitative factors offered within the specified budget. This model is well suited to the shared path project because it provides the benefits of an Alliance with the commercial focus of a target cost constraint.

FINANCIAL CASE

The purpose of this section is to outline the following:

- Cost assumptions: It identifies the capital expenditure and operating assumptions used;
- Project revenues and cashflow: discusses any potential project revenues; and
- The whole-of-life cost of the project

Design and construction assumptions

The cost of the proposed Shared Path bridge is greatly influenced by the construction methodology and programme for implementing the works. The supply of fabricated box girder segments and reinforced concrete materials for the piers forms a relatively small proportion of the cost compared to provision of access and temporary works to carry out the installation. Therefore, in order to provide a basis for cost estimation, a construction methodology, installation sequence and programme for the works was developed.

A programme of 24 -30 months was assumed. This includes approximately 12 months for pier strengthening and substructure fabrication and installation, and 12 months for superstructure installation.

It is assumed that a large New Zealand-based contractor will carry out the work with fabrication of steelwork in New Zealand.

Construction will be carried out over water to avoid impacting operation of State Highway 1, and it is assumed that steel will be transported to site by sea. Large barge mounted cranes are required for erection of steelwork. These cranes come at very high hire rates, so assumptions on durations for installation of the main members were made. It was assessed that only one large crane was required to meet the programme.

A coffer dam solution was proposed for Piers 5 and 6 for works below high tide level. As discussed above there are inherent risks associated with this methodology and alternative independent piers could save time and money if authorised by resource consents. It is assumed that temporary piles for support of box girder sections will be required. The project is, however, at feasibility/concept design stage. Therefore, further design development and early involvement of contractors in the design process is required to validate the assumptions made on methodology and programme.

s 9(2)(i) [redacted] The Net Present Value (NPV) of operating and maintenance costs is anticipated to be approximately $9m s 9(2)(i) [redacted]

Project revenues

Tolling is not proposed for the Auckland Harbour Bridge Shared Path and no revenue streams are envisaged.

Cost estimate

A concept design cost estimate extends to 9 Princes Street and is based on the assumed construction methodology and programme outlined above. The financial analysis for the project has been developed in accordance with the Transport Agency's Cost Estimation Manual (SM014).

The Shared Path proposal has a pre-implementation/implementation cost in the range of $232.0m (P50)-$266.8m (P95).

Table 15 shows the capital cost estimate for the project in base year values ($2019) and do not account for inflation or discounting.

Table 15 – Pre-Implementation / Implementation costs for the recommended option (P50)

Cost Source	Total expected project cost
Pre-implementation	
Project Development	s 9(2)(i)
Pre-Implementation	
Total expected pre-implementation costs	
Implementation	
Physical Works	
Implementation Fees	
Total expected implementation costs	
s 9(2)(i)	
Project Expected Estimate:	**$232,000,000**

This cost estimate includes the following:

- Design fees and NZ Transport Agency-managed costs
- Temporary works
- Piling
- Substructure
- Pier brackets
- Approach structures
- Environmental compliance
- Provisional sums for service relocation, urban design, smart systems, maintenance gantries and dampers
- Contractor's Preliminary and General costs and margins
- 25% Contingency

The cost estimate excludes:

- Lighting and replacement of Vector lights on the Harbour Bridge
- GST
- Escalation

Funding options

The Project has been included in the National Land Transport Programme (NLTP) 2018-21. **Table 16** outlines the proposed investment allocation to a cross-harbour shared path, whilst **Table 17** outlines the current and proposed cashflow associated with the project.

Table 16 – NLTP 2018-21 Programme Allocation ($m)

Project phase	NLTP Proposed (exc. NZTA Admin @ 2.6%)	Recommended P50	Difference
Pre-implementation	s 9(2)(i)		
Implementation			
Total			

Table 17 – NLTP 2018-21 Cashflow ($m)

Year	2019/20	2020/21	2021/22	2022/23	2023/24	Total
NLTP	s 9(2)(i)					
Recommended						
Difference						

The table above shows that the cost estimate for funding, not yet approved for the project, within the NLTP is far less than what is required for the recommended option. This will need updating and funding availability considered within the context of the overall affordability of the activity class.

The current intention is for this project to be funded from the National Land Transport Fund (NLTF) through the Transport Agency. However, given the significant difference in the current and proposed cashflows, the Transport Agency will need to carefully consider NLTF cashflow management issues. As previously noted, it is unlikely that tolling would offer any significant financial benefits in this context, given it could compromise demand for the shared path (and the lack of engineering benefits to support tolling).

Alternative funding sources such as the Tourism Infrastructure Fund and the International Visitor Conservation and Tourism Levy have been considered and discounted due to the scope of these funds (either targeting regional tourism development or system wide strategic investments) not being relevant to the shared path project.

s 9(2)(i)

MANAGEMENT CASE

Governance structure and project roles

This project will be developed and delivered by the Transport Agency. The Transport Agency has rigorous policies, plans and processes for delivering transport infrastructure projects in New Zealand, which are to be followed unless otherwise specified in this Management Case.

Project implementation will be led by the Transport Agency as the project sponsor, and design and construction will be undertaken by its contractors and partners.

Table 19 outlines provisional key roles in the pre-implementation and implementation phases. For all decision making, the Transport Agency's significance policy (and associated delegations) apply.

Table 19 – Key project roles

Role	Delegate
Project Sponsor	Paul Glucina
Project Director	Jennifer Hart
Project Manager	Kevin Stevens
Project Advisor	Robert Strong
Planning	Deepak Rama
Environmental	Rebekah Pokura-Ward
Cycling Design	Simon Kennett
Urban Design	Sam Bourne
Property Acquisition	Mike Forrest
Stakeholder/Relationships	Jen Scott / Grace Chicken
Structures and Retaining Walls	Barry Wright
Geotechnical Engineering	Stuart Finlan
Safety, Geometric, Design Departures	James Hughes
Safety, Signing Strategy	Mark Newsome
Structures, Assets / Maintenance & Operations	Carol Ma / Ben Sherriff
Heritage and Archaeological	Ann Neill
Investment Assurance	Todd Webb

Implementation programme

An indicative programme which is the basis of the Financial and Management Case is outlined below.

Table 20 – Project programme

Activity	Completion Date
NZTA Board Approval of Detailed Business Case	Q4 2019
RFP for Shared Path Alliance issued	Q2 2020
Apply for RMA statutory approvals	Q2 2020
Shared Path Alliance established	Q3 2020
Consent decisions received and construction commencement	Q1 2021#

- Best case and subject to consenting process outcomes

Consenting strategy

The Environment Court granted resource consents on 15 December 2016 for a shared path across the Harbour Bridge connecting Westhaven and Northcote Point (known as SkyPath). The SkyPath consents were approved on a publicly notified basis and are currently held by Auckland Council.

The Transport Agency is concurrently investigating its SeaPath project, which comprises a shared walking and cycling path link from Northcote Point to Esmonde Rd. A Detailed Business Case has been completed for SeaPath (including a concept design) and further design and detailed optioneering is currently underway. At Northcote Point, the southern extent of SeaPath, the concept design commences with a ramp in the road reserve under the Harbour Bridge, near, but not directly connected to, the SkyPath/AHBSP ramp.

It is desirable to connect the Auckland Harbour Bridge Shared Path and SeaPath directly to form one continuous pathway, which would provide an integrated link from Westhaven through to Esmonde Road, with connections to the local network.

The project will require a range of statutory approvals as outlined below.

Under the Resource Management Act (RMA), statutory approvals are required for the continuous pathway. The following strategy outlines the approvals required.

The recommended consenting strategy for the continuous path between Westhaven and 9 Princes Street is to apply for the following suite of statutory approvals as a single package:

- **A change to the SkyPath consent** conditions (under section 127 RMA) for the 'SkyPath' consents (land use, coastal permit and discharge of contaminants to land or water from land) to authorise the Harbour Bridge section from Westhaven to Stokes Point (as noted above);
- A new **Notice of Requirement** to designate and authorise land use activities in the Northcote Point area from Stokes Point to the vicinity of 9 Princes Street, ('**NoR1**');
- A new **Notice(s) of Requirement** to designate and authorise land use activities for the remainder of the land sections from 9 Princes Street to Esmonde Road (SeaPath section), including a new ramp at Princes Street ('NoR2+');
- New **regional consents** required e.g. earthworks, vegetation management, stormwater discharge

Given the significant public interest in the SkyPath Project, together with the continuous path concept, public notification of this suite of NoRs and consent applications is recommended.

Section 127 change to SkyPath consent conditions

A s127 change to consent conditions would limit the assessment of effects to the effects of the proposed changes, as opposed to the effects of the Bridge section in its entirety.

The proposed design and operational changes will require variations to condition 1 of the SkyPath consents to substitute updated design plans and technical reports. Some other changes to operational conditions will be required as a result of the Transport Agency operating the path. Changes to conditions of consent may also be required as a result of changes in adverse effects or new adverse effects that have not previously been assessed.

Continuous dedicated path

The Transport Agency's preference is to continue the elevated path from the Bridge section to connect with the proposed SeaPath, with ramp access in the vicinity of 9 Princes Street (via NoR2), rather than the ramp under the Bridge in the s127 application. s 9(2)(i)

Direct Referral

As an important project to Auckland, the Shared Path will likely attract high volumes of public and political interest. To expedite the consenting process, it is anticipated that the application documents will be lodged with Auckland Council and direct referral to the Environment Court be sought. This process involves the Environment Court hearing all the applications in a single hearing, rather than a Council hearing and then an Environment Court hearing, if there are appeals. Rights of appeal of the Environment Court decision to the High Court are limited to points of law.

Operational planning

An operational plan for the Auckland Harbour Bridge Shared Path will be developed by the NZ Transport Agency and its pre-implementation supplier as part of the next phase.

In addition to the matters outlined on page 47, the Plan will include consideration of elements such as:

- Managing opening and closing of the facility
- Events management
- Emergency planning
- Speed management
- Optimal whole of life considerations
- Stakeholder and community feedback

Cost management

Financial management shall be undertaken in accordance with the relevant Transport Agency procedures. As a minimum the consultant/contractor shall provide the following information in each month of the respective contract(s) for the Transport Agency Project Manager to update internal financial systems (e.g. SAP) and to support its claims:

- Budgeted cashflow (baseline and risk adjusted baseline)
- Value of work completed in the preceding month and contract to date (including rates and quantities for all items within the contract)
- Forecast value of work completed and revised cashflow through to project completion
- Exception reports outlining the reasons for not meeting any financial targets

The proposed target performance measure on a monthly basis is that the claim should be within +/- 5% from the previous month's forecast, and within the boundary of the cash flow set in the risk adjusted baseline programme.

Stakeholder engagement

The development of a Communications and Engagement Plan will form the starting point for ongoing engagement.

Mana Whenua

Mana Whenua hold strong cultural associations with the project area and have been active participants in identifying areas of cultural significance and informing design development. The project team is working with mana whenua to identify an artist of their choice to ensure that iwi aspirations are embodied in the design as early as possible.

Mana Whenua engagement is ongoing, mainly through the Transport Agency's monthly hui, workshops, site visits and project days. Cultural recognition throughout the development of the project, including naming, is sought and will be explored in more detail during the next phase.

Strategic Advisory Group

A Strategic Advisory Group has been established with Bike Auckland and the SkyPath Trust. In the next phase it is anticipated that the Group will be focused on helping the Agency to optimise the path for users.

Community Liaison Group

Given the high level of interest from a range of groups and individuals in the project, it is planned to establish a Community Liaison Group framework in the next phase of the project. The framework will likely reflect the different interests of various groups and establish a process for people to work together and interface with each other in areas of common interest. This forum is required by the SkyPath resource consent conditions.

Property owners

The Transport Agency will continue to work with property owners in Northcote Point and the wider Northcote area as the project moves forward.

Key stakeholders

In addition to the stakeholders engaged in development of the Business Case, as the design progresses in more detail, additional stakeholders are likely to become more actively involved in the project. Specific issues already raised by stakeholders will be explored in more detail.

Memoranda of Understanding with Auckland Council, Auckland Transport and Panuku

A series of MoUs will be established with partner agencies to formalise working arrangement to support delivery of project outcomes. It is expected these MoUs will be formalised in the next phase of work.

Wider community / future users

There is high interest in this project and the SeaPath project from the wider community and future users, and it is intended to continue to seek feedback and to provide information.

Change control and issues management

A change control and issues register shall operate as an extension to the risk register and track issues as they arise. It is anticipated that a change control and issues management process will be included in the contract documents for the project.

Change control and issues management will be undertaken in accordance with:

- The Transport Agency's Significance Policy
- The Transport Agency's Corporate Risk Management Policies
- Conditions of contract for project specific issues

Each issue shall be logged in an issues register, which includes the following information:

- Title and description of the issue
- Date raised
- Status (open, escalated, transferred to risk register, resolved)
- Primary impact area for the issue (project, personnel, health and safety, corporate risk, stakeholder management etc.)
- Delegated authority for closing out the issue (in accordance with the project management structure)
- Whether the issue is a project specific issue or other issue
- Level of significance (in accordance with the Transport Agency's Significance Policy)
- Whether the issue requires transferring to the project Risk Register
- Remedial action proposed to address the issue
- Date that the issue has been resolved

Benefits realisation and lessons learnt

Table 21 below sets out a potential monitoring regime to assess the benefits of the Project. It is anticipated that this will be refined in the pre-implementation stages as technology options for monitoring and operations are refined.

Table 21 – Post Project Monitoring Regime

Investment Objective	KPI	Potential Monitoring Regime
Increase the mode share of walking and cycling travel to work trips across the Harbour Bridge from 0% to 3% by 2028 by completing the strategic missing walking and cycling link connecting the North Shore and Auckland's city centre.	Cross-harbour People throughput (peak hours): Number of pedestrians, cyclists, public transport boardings and motor vehicles (excl. public transport) multiplied by the average number of people per vehicle	Ongoing through automatic vehicle / pedestrian / cycle counters.
	Cross-harbour people mode share (peak hours): Number of pedestrians, cyclists, public transport boardings and motor vehicles (excl. public transport) multiplied by the average number of people per vehicle, expressed as percentages	Ongoing through automatic vehicle / pedestrian / cycle counters.
	Cross-harbour people throughput (peak hours): Number of pedestrians and cyclists	Ongoing through automatic pedestrian / cycle counters.
	Access – perception: User surveys of perception of safety and ease of walking and cycling	Annual assessment of the cycle facility as part of AT's Quality of Service tool
Increase the number of daily walking and cycling recreation and tourism trips across the Harbour Bridge from 0 to 2,500 by 2028 by completing the iconic walking and cycling link connecting the North Shore and Auckland's city centre	Cross-harbour people throughput (weekday inter peak): Number of pedestrians and cyclists	Ongoing through automatic vehicle / pedestrian / cycle counters.
	Cross-harbour people throughput (weekends): Number of pedestrians and cyclists	Ongoing through automatic vehicle / pedestrian / cycle counters.

Post-implementation and review

Lessons learned reviews will be undertaken at agreed times throughout the respective contracts and as part of the close-out reports for the project. It will be the responsibility of the Transport Agency project managers to complete these reviews with the respective suppliers.

CONCLUSION – SUMMARY OF RECOMMENDATIONS

The Auckland Harbour Bridge Shared Path Detailed Business Case has confirmed the investment case for a new continuous walking and cycling link between Takapuna and Auckland's city centre. It will be a city-shaping piece of infrastructure, which will close a significant gap in Auckland's walking and cycling network and minimise the barrier to cross-harbour active mode travel.

With potential to attract over 3,500 daily cyclist trips and 2,000 daily pedestrian trips by 2046, the link will provide a viable and safe transport choice for people travelling to, from and within Auckland's North Shore, and will offer visitors and residents alike a unique opportunity to explore the harbour and surrounds.

The project has been assessed as having a **very high** results alignment against the Transport Agency's Investment Assessment Framework, and consequently has the highest possible funding priority.

It is therefore recommended that the NZ Transport Agency approve $232.0m of funding for the next phases of the project, namely the pre-implementation, implementation and property acquisition phases for Option 10, a 5m wide shared path built on separate pier brackets attached to the existing bridge piers. The shared path will be positioned at the same level as the car deck of the main bridge and include three observation decks to allow for views of Auckland and the Waitematā Harbour. These decks are up to 100 metres long and at their maximum, 4.2 metres wide. They are terraced down from the shared path to create a safe, sheltered seating area for cyclists and pedestrians alike.

APPENDIX A: DEMAND FORECASTS

Land use and patronage forecasts

Analysis undertaken by Flow Transportation Limited for this Business Case has demonstrated strong demand for cycling and walking across the Waitematā Harbour for commuting, recreational and tourism purposes.

Land use forecasts adopted are Auckland Council's "Scenario I11" forecast, aggregated across the areas of Northcote, Takapuna and the CBD/inner west. This land use scenario is consistent with assumptions adopted for neighbouring cycle connections and for ATAP.

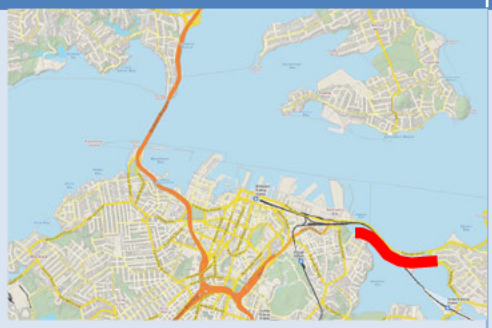
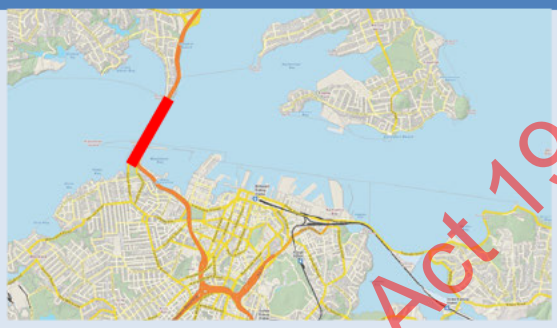
Table 22 - Scenario I11 Land Use Forecasts (predicted growth from 2016 in brackets) Area

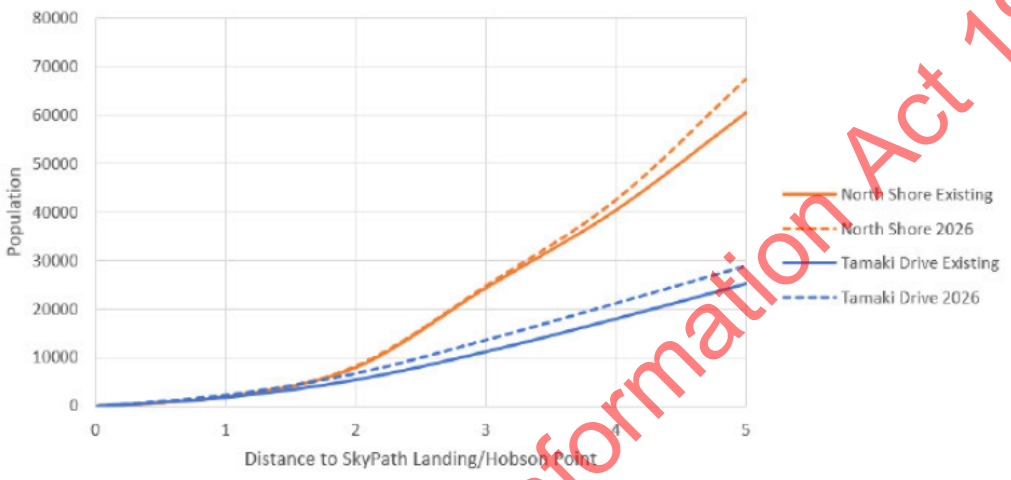
Area	Population			Employment (FTE jobs)		
	2016	2026	2046	2016	2026	2046
Northcote	16,800	19,800 (+18%)	22,800 (+36%)	7,600	7,600 (-)	7,700 (+1%)
Takapuna	5,100	10,500 (+106%)	16,700 (+227%)	11,400	13,400 (+18%)	17,500 (+54%)
Auckland CBD & Inner West	73,200	89,100 (+22%)	109,300 (+49%)	111,900	134,400 (+20%)	180,100 (+61%)

Population growth is predicted to occur within all three areas and employment growth is predicted within Takapuna and the CBD/inner west. Long term growth (i.e. to 2046) is predicted for Takapuna and the CBD/inner west.

The evaluation draws significantly on the comparisons between the proposed cross-harbour facility, and the existing causeway section of Tamaki Drive. These comparisons are presented below.

Table 23 - Auckland Harbour Bridge and Tamaki Drive comparisons

	Tamaki Drive Causeway (Hobson Point to Judges Bay)	Auckland Harbour Bridge
Location		
General description	1.6 km coastal route across Hobson Bay	1.3 km coastal route across Waitematā Harbour
Use	Popular with utility and recreational cyclists and pedestrians.	Expected to be popular with utility and recreational cyclists and pedestrians, as well as tourists.
Connections	• City connections: • Harbour side route to city centre, via Quay Street cycleway • Steep uphill routes to Parnell, via St Stephens Avenue (pedestrians only) or via St Georges Bay Road	• City connections: • Harbour side route to city centre, via Westhaven Boardwalk shared use path • Steep uphill route to Ponsonby, via Curran Street
	Eastern connections: • Inland local road route to Orakei, via Ngapipi Road (and in future via Glen Innes to Tamaki Drive shared use path) • Coastal route to Eastern Bays, via Tamaki Drive	Northern connection: • Inland local road route to Northcote, via Northcote Safe Routes • Coastal route to Takapuna, via proposed SeaPath shared use path
Key Distances	From Hobson Point: • 1.4 km to Parnell Baths • 2.9 km walk to Parnell via St Stephens Avenue • 3.5 km cycle to Parnell via St Georges Bay Road • 3.7 km to city centre (Queen Street/ Customs Street)	From Northern Landing: • 1.3 km to southern landing • 2.9 km to Wynyard Quarter • 3.1 km to Ponsonby (Three Lamps) • 4.4 km to city centre (Queen Street/ Customs Street)

	Tamaki Drive Causeway (Hobson Point to Judges Bay)	Auckland Harbour Bridge
Adjacent Land Uses	Very few – Auckland Outboard Boat Club, mini-golf course and pedestrian footbridge to St Stephens Avenue on southern side	None (harbour both sides)
Residential catchment	Figure 1: Tamaki Drive and Northern Auckland Harbour Bridge Residential Catchments 	
Active Mode Infrastructure	Two existing shared use paths, both approximately 2.5 m wide. Generally poor standard with uneven surface due to tree roots, low branches, street furniture and pinch points. Future two-way separated cycleway proposed by Auckland Transport.	Proposed shared use path, minimum 4 m width.

The existing and forecast 2026 residential populations within 5 km radii of the Hobson Point landing of Tamaki Drive, and of the northern landing of the Auckland Harbour Bridge are shown in the figure above. Both the Tamaki Drive causeway and the Auckland Harbour Bridge have very comparable residential catchments for pedestrian trips (i.e. within one to two km). In terms of cycling catchments however (i.e. within five km), the proposed cross-harbour walking and cycling connection would have a residential catchment approximately double that of the Tamaki Drive causeway. Despite this, the existing Tamaki Drive causeway provides a very useful comparison to the proposed cross-harbour walking and cycling connection, with the only significant differentiator being the residential catchments.

Pedestrians

Given the similarities between the proposed cross-harbour walking and cycling connection and the existing Tamaki Drive causeway, the two facilities are anticipated to operate with comparable pedestrian demands. Manual surveys of pedestrians on Tamaki Drive and four shared path sites across Auckland have been used to factor counts into annual average daily pedestrians, allowing for corrections in both weather and seasonality.

The resulting estimated 2018 annual average daily pedestrian volume on Tamaki Drive is 1,190 daily pedestrian trips. The same 'existing' pedestrian demands have been assumed to apply to a walking and cycling facility across the Auckland Harbour Bridge, if it were available today, factored by relevant differences in catchment.

From the land use data presented earlier, very little land use growth is anticipated within a 2 km radius of the proposed northern landing of the cross-harbour walking and cycling link. Significant growth is forecast however near the southern landing as shown below.

Table 24 - Auckland Harbour Bridge Southern Landing Land Use Catchments

Area	Population			Employment		
	2016	2026	Growth	2016	2026	Growth
1 km radius of landing	1,035	1,203	+16%	1,584	1,582	-
2 km radius of landing	7,073	8,851	+25%	26,106	34,598	+33%

The southern landing is predicted to experience land use growth of up to 33% to 2026. A 20% increase has been estimated to apply to the 2018 pedestrian demands above, to give estimated 2026 demands of 1,720 pedestrian trips per day. Future growth beyond 2026 has been set at 2.2% per annum (linear increase), based on the forecast growth in cycle trips on the facility.

Cyclists

The Auckland Cycle Model has been used to develop estimates of average weekday peak period cyclist trips (both utility and recreational trips). The Auckland Cycle Model estimates future cycling demand and:

- Reflects predicted land use (according to Auckland Council's scenario I11 land use forecasts)
- Reflects cyclists' route choice – with cyclists generally opting to travel via a slightly longer route if it provides a higher standard of infrastructure, or less adverse gradients
- Reflects realistic cycling trip lengths – with longer trips less likely to be undertaken by bicycle than shorter trips, with a probability distribution applied that is based on the existing Auckland cycle trip length distribution
- Reflects realistic cycle trip types – with trip types such as home-to-work and home-to-education more likely to be undertaken by bicycle than trip types such as trips for employer's business
- Is responsive to changes in cycle infrastructure (in terms of both demands and trip assignment), in that high-quality cycle infrastructure between any two nodes will result in more trips between those nodes being undertaken by bicycle, than a scenario with poorer quality cycle infrastructure
- Reflects both utility and recreational cyclist components, but not tourist trips.

The model was built to represent a 2013 base year, and a 2016 forecast model has also been developed that includes all cycling infrastructure constructed between March 2013 and July 2016

and is informed by the Auckland Macro Strategic Model (MSM, previously the Auckland Regional Transport Model, ART).

The model represents morning and evening peak period (two hour) cyclist demands for each forecast year. Estimates of daily cyclist demands have been derived by factoring the morning and evening peak period forecasts in order to replicate the off-peak and weekend profiles currently observed on Tamaki Drive and anticipated to similarly apply to a future cross-harbour walking and cycling connection.

The following figure illustrates the predicted average annual daily cyclist trips (utility and recreational trips).

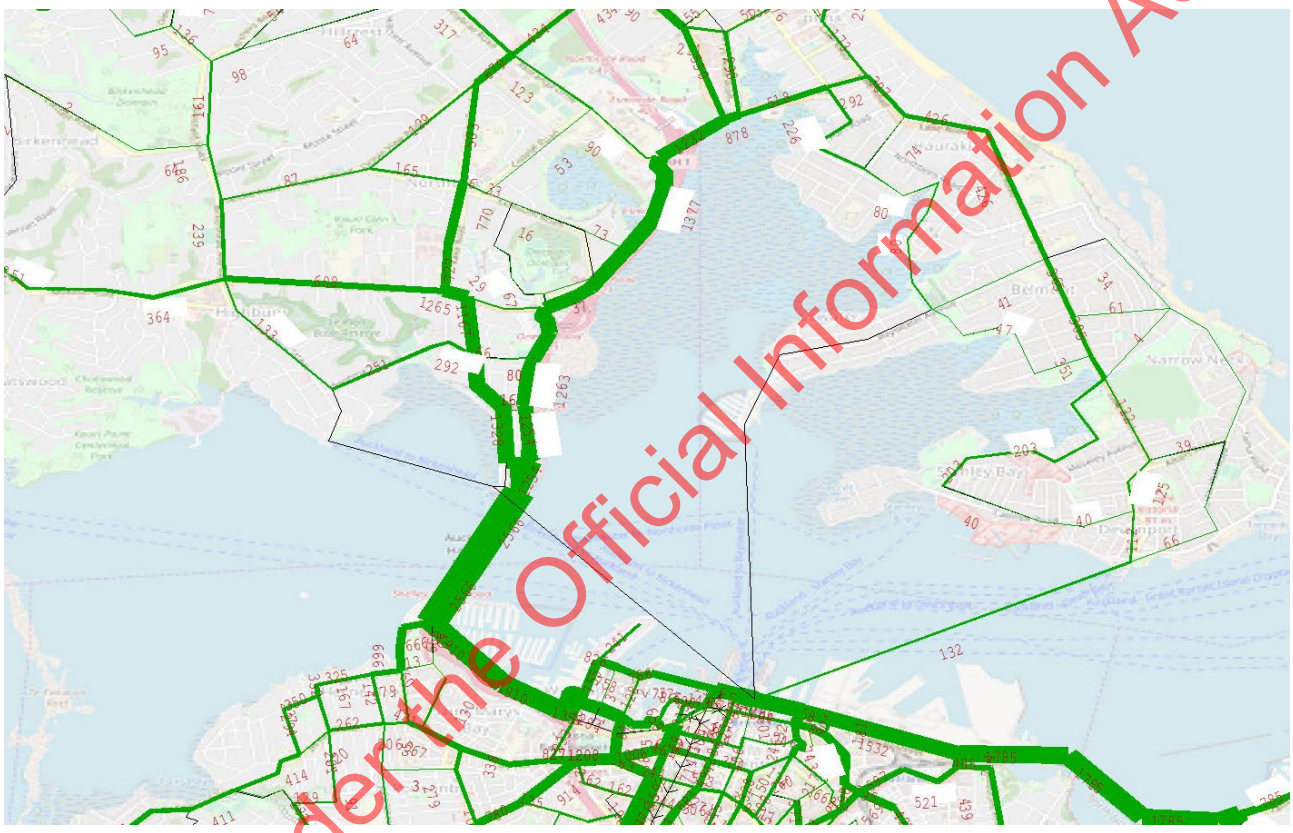


Figure 14 - 2026 Forecast daily cycle trips (utility and recreational trips)

Approximately 2,780 daily cyclist trips are forecast on the proposed cross-harbour walking and cycling connection in 2026. Of these, 40% or 1,020 trips are estimated to be utility trips (i.e. mostly commuter trips likely to be making return trips, therefore 510 people) and 1,530 are estimated to be recreational trips.

The existing mode share for commute to work trips by bicycle in the Auckland region is in the order of 1%[17], and this reflects the lack of appropriate cycle infrastructure at the time of the 2013 census. In terms of Auckland Council Local Board areas, the Kaipatiki Local Board has one of

[17] New Zealand Census, 2013

Auckland's lowest existing cycle to work mode shares, at 0.7%. Conversely, the Devonport-Takapuna Local Board has an existing cycle to work mode share of 2.1% – one of Auckland's highest. Higher mode shares, in the order of 4%, were recorded locally at the Census Area Unit level, notably in Devonport, Takapuna, Grey Lynn, Pt Chevalier and Mt Eden.

On completion of a cross-harbour walking and cycling connection, the following forecast cycle to work mode shares are estimated in 2026:

- 2.2% for the Auckland region
- 2.6% for the Devonport-Takapuna Local Board area
- 2.3% for the Kaipatiki Local Board area.

These forecast mode shares are considered realistic, given the level of cycle infrastructure investment to 2026, that includes not only the proposed cross-harbour walking and cycling connection, but SeaPath, the Northcote Safe Routes, and completion of the Auckland Urban Cycleways Programme.

The above 2,780 daily cyclist trips forecast across the proposed cross-harbour walking and cycling connection in 2026 can be benchmarked against existing, historic and forecast daily cyclist volumes on other significant Auckland cycleways. This comparison is presented below.

Table 25 - Comparison of demand estimates with other Auckland cycle routes

Cycleway	2013 Average Daily Cyclists	2017		2026 Forecasts	
		Average Daily Cyclists	Annual Growth 2013-2017	Forecast Average Daily Cyclists	Forecast Annual Growth 2017-2026
Cross-harbour Connection	n/a	n/a	n/a	2,780	n/a
Tamaki Drive	1,100	1,250	3%	1,900	6%
Quay Street totem	660[18]	820	6%	1,500	9%
Northwestern Cycleway	400	750	22%	1,050	4%

The above comparisons show that while the forecast 2,780 daily cyclist trips on the proposed cross-harbour walking and cycling connection is high relative to existing counts on Auckland's major cycle routes, it is a sensible estimate relative to the future forecasts for these other routes. Understandably the forecast for the cross-harbour connection is higher than the forecasts for Tamaki Drive and the Northwestern Cycleway, as the proposed facility will be the only cycling connection to the North Shore other than the Upper Harbour Bridge. By contrast, the Northwestern Cycleway has multiple alternative parallel corridors, while Tamaki Drive serves a smaller catchment.

[18] Estimate of daily cyclists, based on weekday peak period and weekend morning manual surveys

Finally, it is noted that Tamaki Drive currently accommodates some 1,250 average daily cyclist trips. The proposed facility will provide access to approximately double the residential catchment within a 5 km radius, relative to the Tamaki Drive causeway, and will share many other contributing features. It follows that approximately 2,500 daily cyclist trips could be expected on the proposed cross-harbour walking and cycling facility, before accounting for any land use growth (i.e. double the existing 1,250 cyclist trips using Tamaki Drive). This suggests the estimated 2,780 daily cyclist trips using the proposed facility in 2026 is a conservative assessment.

Sensitivity Testing of Demand

A series of demand sensitivity tests have been undertaken on the utility and recreational cyclist component of the proposed facility's demand estimates. The sensitivity tests investigate the impacts of:

- The effect on the project, should SeaPath not be constructed
- The effect on the project, should various tolls be applied to all pedestrians and cyclists
- Faster/slower land use growth, relative to the I11 default forecasts
- The effect of a large future uptake in e-bikes resulting in a higher proportion of long trips being undertaken by bicycle[19]

Varying the factor used to develop estimates of daily cyclists; the default factor used is 2.3, with a low value of 2.0 (the factor observed on the Northwestern Cycleway), and a higher value of 3.1 (being the observed factor on Great North Road).

The results of the sensitivity tests are presented below.

Table 26 - Sensitivity tests of cyclist demand estimates

Sensitivity Test Scenario	Forecast 2026 Daily Cycle Trips
Tolling: $2 per trip	1,550
Tolling: $1 per trip	2,000
SeaPath not being constructed	2,150
Lower daily cyclist factor (2.0)	2,200
20% slower land use growth	2,500
Default 2026 Daily Cyclists	2,550
20% faster land use growth	2,600
Higher daily cyclist factor (3.1)	3,400
High uptake in e-bikes	4,500

[19] This test doubles the likelihood of trips over 5.0 km in length being carried out by bicycle, with smaller increases to short trips. The resulting forecast 2026 average Auckland cycle trip length increases from 5.0 km to 5.5 km.

The forecast number of daily cyclists on the proposed facility is very insensitive to changes in land use growth, but is very sensitive to assumptions around tolling, and to the potential effect of e-bikes. The latter has the potential to significantly increase the use of the facility, as e-bikes would make relatively long distance, cross-harbour cycle trips more accessible for more people.

Demand forecast comparisons

The forecast 2,780 daily cyclist trips and the 1,720 daily pedestrian trips for cross-harbour walking and cycling have been benchmarked against existing cyclist volumes on significant international bridges. This comparison is presented below.

Table 27 - International walking/cycling crossings comparisons

International Example	Similarities	Differences
Golden Gate Bridge, San Francisco 5,500 daily pedestrians 4,000 daily cyclists[20]	Broadly similar urban population to Auckland. Very popular tourist and recreational activity. Similar climate. No alternative active mode routes available, except ferry.	2.7 km long, approximately twice the length of the Auckland Harbour Bridge. Greater distance to CBD than SkyPath. Better connecting cycling facilities than Auckland. No significant population on northern landing, and little within 2 km of southern landing. Little use by utility cyclists. Greater international tourist status.
Story Bridge, Brisbane 2,280 people daily[21]	Similar urban population to Auckland. Comparable densities to Auckland. Popular tourist activity. Comparable in length. Comparable waterfront cycleway network.	Closer to CBD than SkyPath. Smaller catchment area Multiple parallel bridges to the west (Go Between Bridge, William Jolly Bridge, Victoria Bridge, Kurilpa Bridge).
Sydney Harbour Bridge 3,500 daily pedestrians[22] 1,750 daily cyclists[23]	Popular tourist activity. Comparable length. Similarly connects CBD to North Shore. No alternative routes available, except ferry. Comparable cycle network to Auckland.	Higher density than Auckland. Greater international tourist status. Business districts situated on both landings.
ANZAC Bridge, Sydney 1,200 daily cyclists[24]	Popular tourist activity. Comparable spiral approach ramps to those proposed for the	Higher density than Auckland, although relatively little land use close to western landing. Shorter span – approximately 800 m. Much smaller catchment – bridge

[20] August to October 2015 data, supplied by Golden Gate Bridge Highway & Transportation District

[21] 1st January 2016 to 31st December 2016 data, supplied by Brisbane City Council, Infrastructure Division
[22] 1.3 million annual pedestrians quoted by email by New South Wales Roads and Maritime Services
[23] Cycling statistics; Roads and Maritime Services, Government of New South Wales; March 2016.
[24] Cycling statistics; Roads and Maritime Services, Government of New South Wales; March 2016

International Example	Similarities	Differences
	consented SkyPath option. Similar proximity to CBD.	spans small inlet, with multiple inland routes available approximately 1 km to the south.
Brooklyn Bridge, New York 2,300 daily cyclists[25]	Popular tourist activity. Comparable length.	Higher density than Auckland, but much smaller catchment area. More developed connecting cycling infrastructure. Colder winter climate. Multiple parallel bridges (Manhattan Bridge is approximately 400 m to the east; see below).
Manhattan Bridge, New York 4,600 daily cyclists	Comparable length.	Higher density than Auckland. More developed connecting cycling infrastructure. Colder winter climate. Multiple parallel bridges (see Brooklyn Bridge above).
Forth Road Bridge, Scotland 600 people daily (July – November 2018)[26]	No alternative active mode routes available, except ferry.	2.5km long, approximately twice the length of the Auckland Harbour Bridge. Lower population density on both landings. No Business District within proximity of bridge. Not identified as a popular tourist activity. Colder climate.

[25] Daily average across April and May 2018, New York City Department of Transport
[26] 16th July 2018 to 6th November 2018 data, supplied by Forth Estuary Transport Authority

APPENDIX B: ASSUMPTIONS AND UNCERTAINTIES UNDERPINNING DEMAND FORECASTS

Reference case

The 2026 Reference Case includes:

- The proposed Northcote Safe Routes (a combination of shared use paths and on street cycle facilities on Northcote Road, Lake Road and Queen Street)
- New cycle on-street cycle infrastructure on Princes Street and Alma Street in Northcote Point, connecting the Northcote Safe Routes project to the Waitematā Harbour Bridge
- Completion of the Auckland Urban Cycleways programme, which includes a network of cycle infrastructure within the city centre and inner suburbs, including connections to the Waitematā Harbour Bridge
- The Transport Agency's proposed cycle infrastructure included in the Northern Corridor Improvements project, which include shared paths parallel to SH1 (Oteha Valley Road to Constellation Drive) and SH18 (SH1 to Albany Highway)

In addition to the 2026 assumptions above, the 2046 reference case includes limited future cycle infrastructure projects that while not committed, are considered the 'bare minimum' level of ongoing cycle investment over the next 30 years. If no further background investment was assumed, this would unrealistically limit the long-term connectivity of the proposed cross-harbour shared path. Infrastructure in the 2046 reference case includes:

- A future shared use path parallel to SH1, from Constellation Drive to Esmonde Road
- Within the west of the North Shore, cycle infrastructure on Glenfield Road, Mokoia Road, Waipa Street and Birkdale Road (either a quality shared path or protected cycle lanes), connecting with the existing shared path on Onewa Road
- Within the east, cycle infrastructure around Lake Pupuke (Kitchener Road, Hurstmere Road and Killarney Street, to the same standard as above), connecting with existing shared paths on Fred Thomas Drive and Esmonde Road
- The Auckland Cycle Network (ACN) long-term network of cycle infrastructure contains significantly more investment than described above, with dedicated cycle infrastructure on all arterial routes and parallel to all motorways and rail corridors. Sensitivity tests were undertaken with the full ACN completed and is discussed further in section 13.6.

The above assumptions are consistent with the Auckland Cycling Programme Business Case and the SeaPath Detailed Business Case.

Micro-mobility

The demand forecasts presented in Appendix A are estimates only, and like all future forecasts they come with uncertainty associated with input assumptions, methodology limitations and future unknowns. Mention should be made however of the future of 'micro mobility', and the risks and opportunities this may present to the above forecasts. Micro mobility is a term used to group recent new technologies in small scale, motorised travel including e-bikes, e-scooters and other modes.

Approximately 20% of existing pedestrians along Tamaki Drive, when surveyed in November 2018 were wheeled pedestrians. Many of these were on e-scooters, either privately owned or rented through an e-scooter app. This is a significant finding, given Lime e-scooters had only launched in Auckland one month prior, and e-scooters have only been commercially available for a short number of years.

There is significant uncertainty around the future of e-scooters and their ongoing use on Auckland's footpaths and cycleways. Indeed, Lime e-scooters and other dockless operators have been banned in a small number of cities internationally, including Madrid, and have had restrictions imposed in others such as San Francisco. Maximum speeds have been suggested in New Zealand and elsewhere. Their current popularity within central Auckland may be somewhat due to the novelty factor, but equally may be the start of an increasing trend.

The extremely rapid rise of this technology should be considered a signal that the future of micro mobility – be that e-scooters or some other future technology – is rapidly changing. This may particularly be the case for relatively long-distance active mode trips, such as those across any future cross-harbour walking and cycling connection. It may be that future micro mobility options make walking or cycling trips across the harbour less attractive, and indeed make short car, bus or ferry trips across the harbour less attractive. This may have the effect of reducing the overall demand on the proposed facility but would more likely increase demand. A possible implication of this scenario, however, is that if more trips on the proposed facility are motorised rather than self-propelled, fewer people will benefit from the health benefits of physical exercise. The effects of this on the project's economic evaluation have been assessed in a sensitivity test.

Clearly, there is significant uncertainty surrounding the future of micro mobility, and this presents both risk and opportunity to the project.

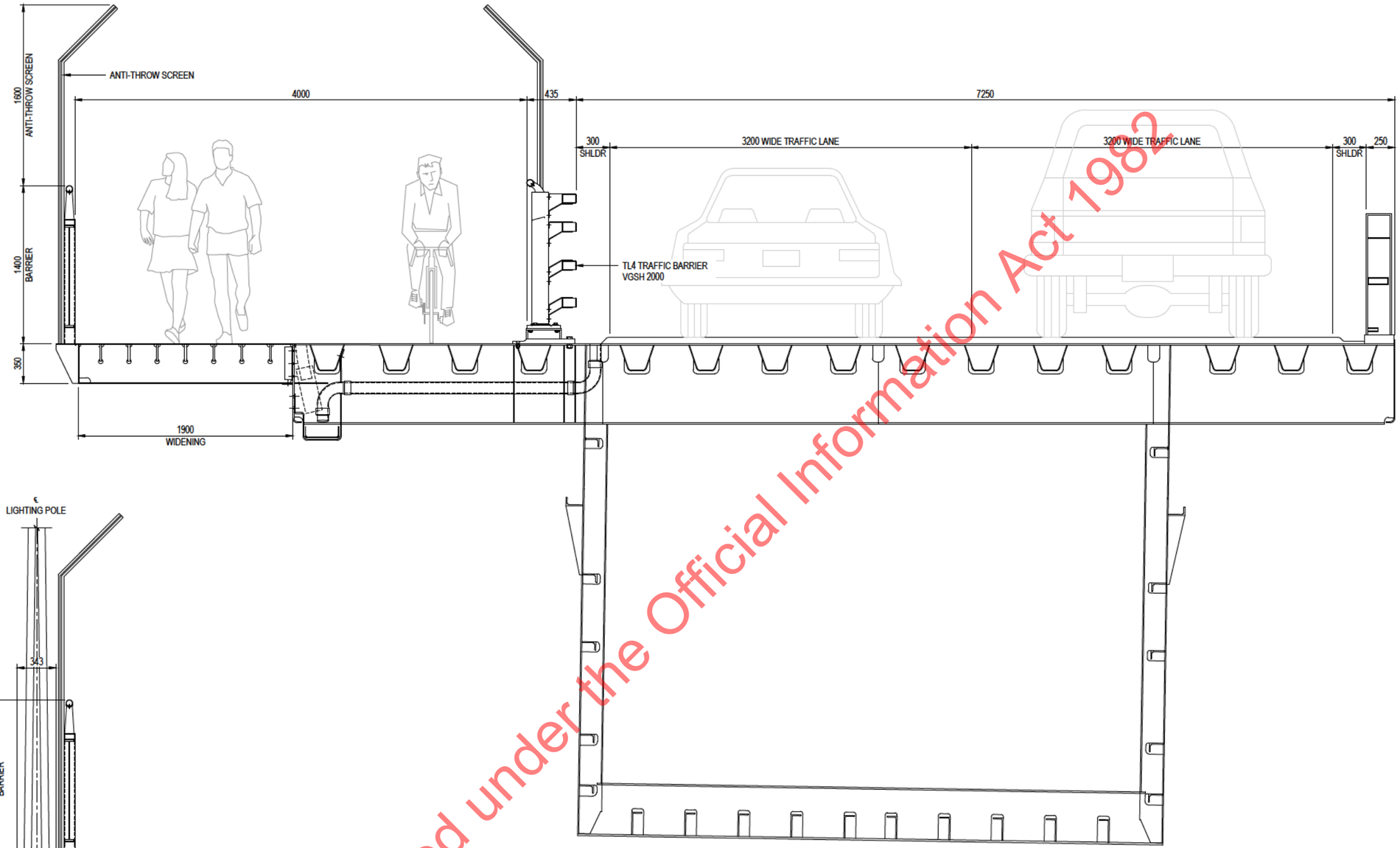
APPENDIX C: LONG-LIST OPTIONS

Option 1: Underslung option (as designed by the SkyPath Trust)

An underslung shared path is supported off the eastern box girder. The option is constructed of a prefabricated Fibre Reinforced Polymer (FRP) structure. The shared path is 4m wide and is open on the eastern edge with anti-throw screens built in.

NOTES:

1. 3 No. DECK TROUGH SPLICE REPAIRS REQUIRED, INCLUDING NECESSARY RE-SURFACING.



1 - CROSS SECTION - OPTION 2A - DECK LEVEL SHARED USE PATH WITH WIDENING
1:20

2 - VARIATION AT LIGHT POST LOCATION
1:20

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No.	Revision	By	Chk	Appd	Date
A	ISSUED FOR INFORMATION	PN	WP		

Drawing Originator: Auckland Harbour Bridge (NZ Transport Agency Waka Kotahi)

Original Scale (A1) 1:50
Reduced Scale (A3) 1:100

Design	W. Pank		Approved For Construction*
Drawn	P. Noble		
Dsg Verifier			
Dwg Check			Date

* Refer to Revision 1 for Original Signature

Client: NZ TRANSPORT AGENCY WAKA KOTAHI

Project: AUCKLAND HARBOUR BRIDGE WALKING & CYCLING

Title: OPTION 2A DECK LEVEL SHARED USE PATH WITH WIDENING

Discipline: STRUCTURAL ENGINEERING

Drawing No.: 3910806-SE-221

Rev.: A

Document No.: 3910806-SE-221.DWG

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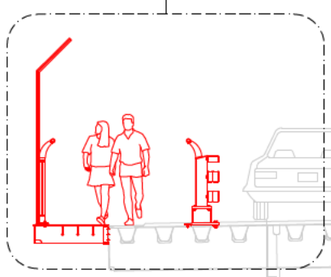
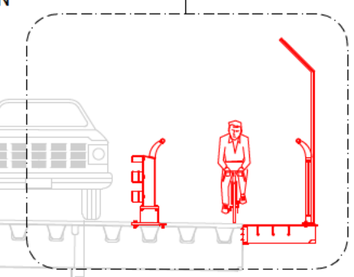
ON DECK OPTION WITH EXTENSION

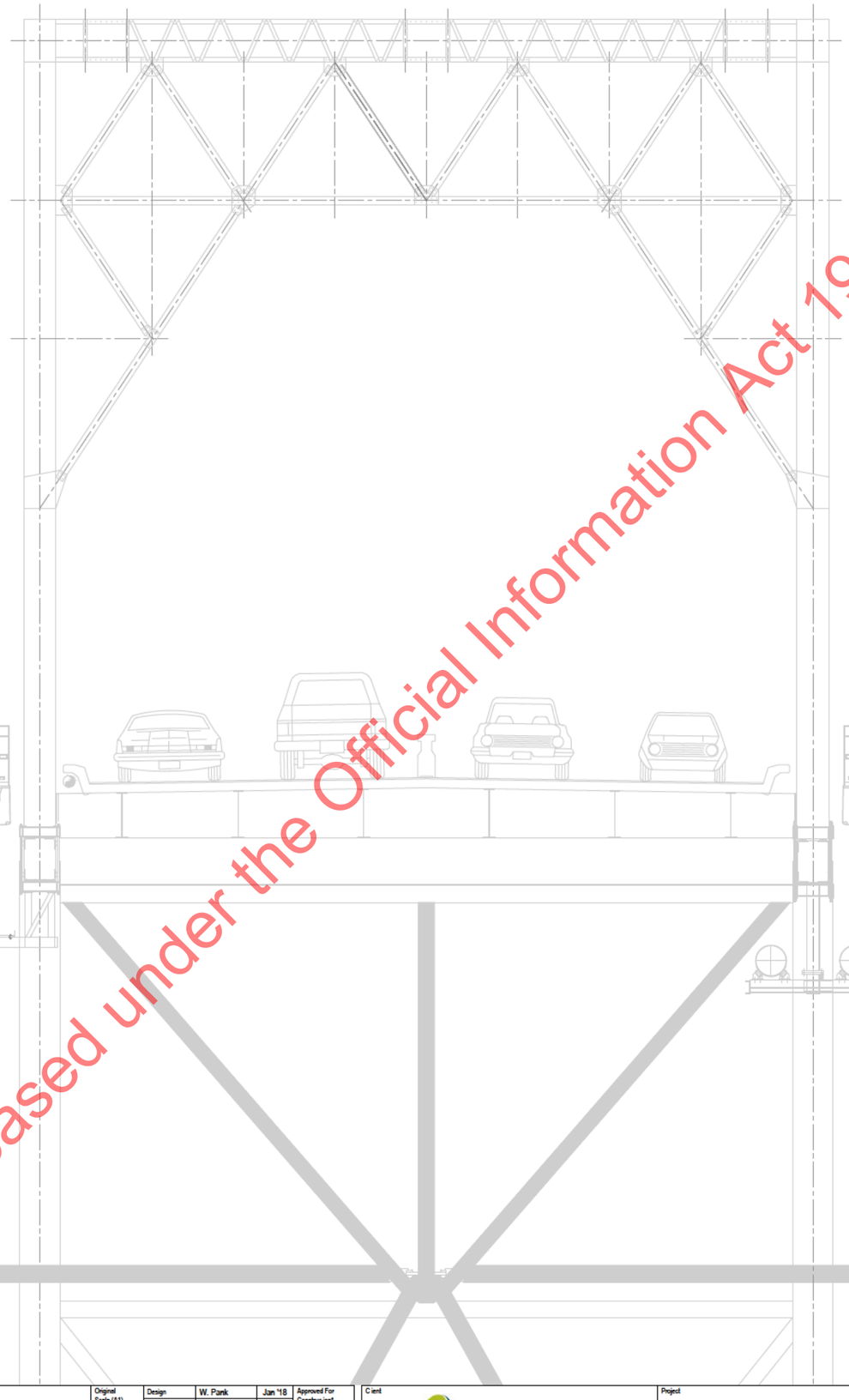
EAST EXTENSION



ON DECK OPTION WITH EXTENSION

WEST EXTENSION





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No.	Revision	By	Chk	Appd	Date
A	ISSUED FOR INFORMATION	PN	WP		JAN '18

Drawing Originator: NZ Transport Agency — Auckland Harbour Bridge, Part of Auckland Motorways

Original Scale (A1) 1:50	Design	W. Pank	Jan '18
Reduced Scale (A3) 1:100	Drawn	P. Noble	Jan '18
	Dsg Verifier		
	Dwg Check		

Approved For Construction* Date

* Refer to Revision 1 for Original Signature

Client: NZ TRANSPORT AGENCY WAKA KOTAHI

Project: AUCKLAND HARBOUR BRIDGE

Title: SHARED USE PATH OPTIONS OPTION 2B

Discipline: STRUCTURAL ENGINEERING

Drawing No.: 3910806-SE-202 Rev.: A

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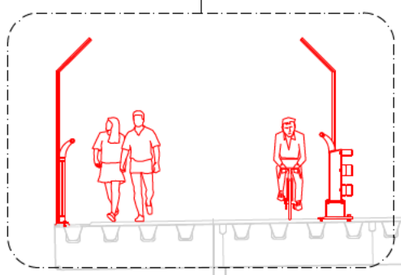

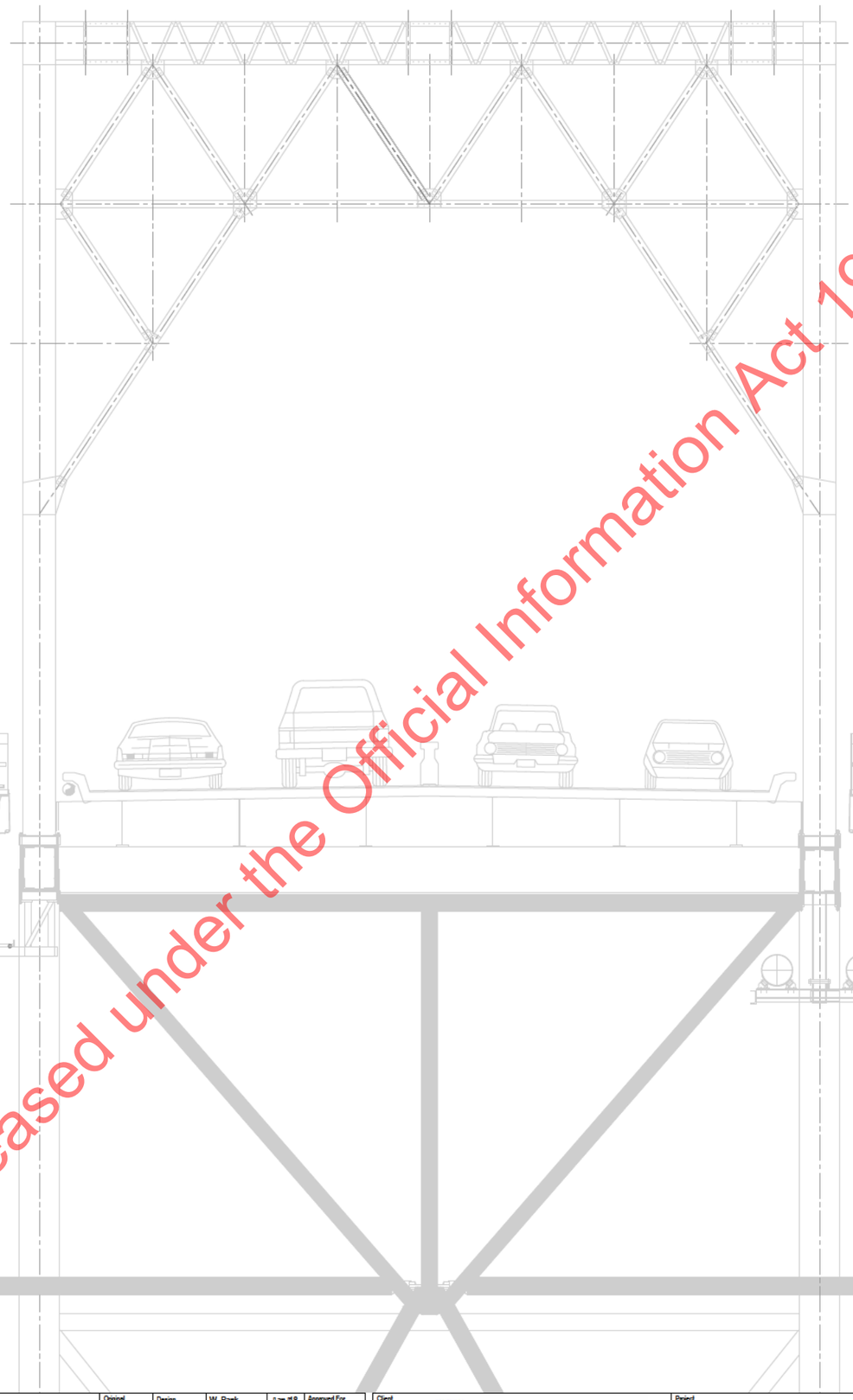

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No.	Revision	By	Chk	Appd	Date
A	ISSUED FOR INFORMATION	PN	WP		JAN 2018

Drawing Originator: Auckland Harbour Bridge — Part of Auckland Motorways

Original Scale (A1): 1:50
Reduced Scale (A3): 1:100

Design	W. Pank	8 Jan 2018	Approved For Construction*
Drawn	P. Noble	8 Jan 2018	
Dsg Verifier			
Dwg Check			Date

* Refer to Revision 1 for Original Signature

Client: NZ TRANSPORT AGENCY WAKA KOTAHI

Project: AUCKLAND HARBOUR BRIDGE

Title: SHARED USE PATH OPTIONS OPTION 3

Discipline: STRUCTURAL ENGINEERING

Drawing No.: 3910806-SE-203

Rev.: A

Document No. 3910806-SE-203.DWG

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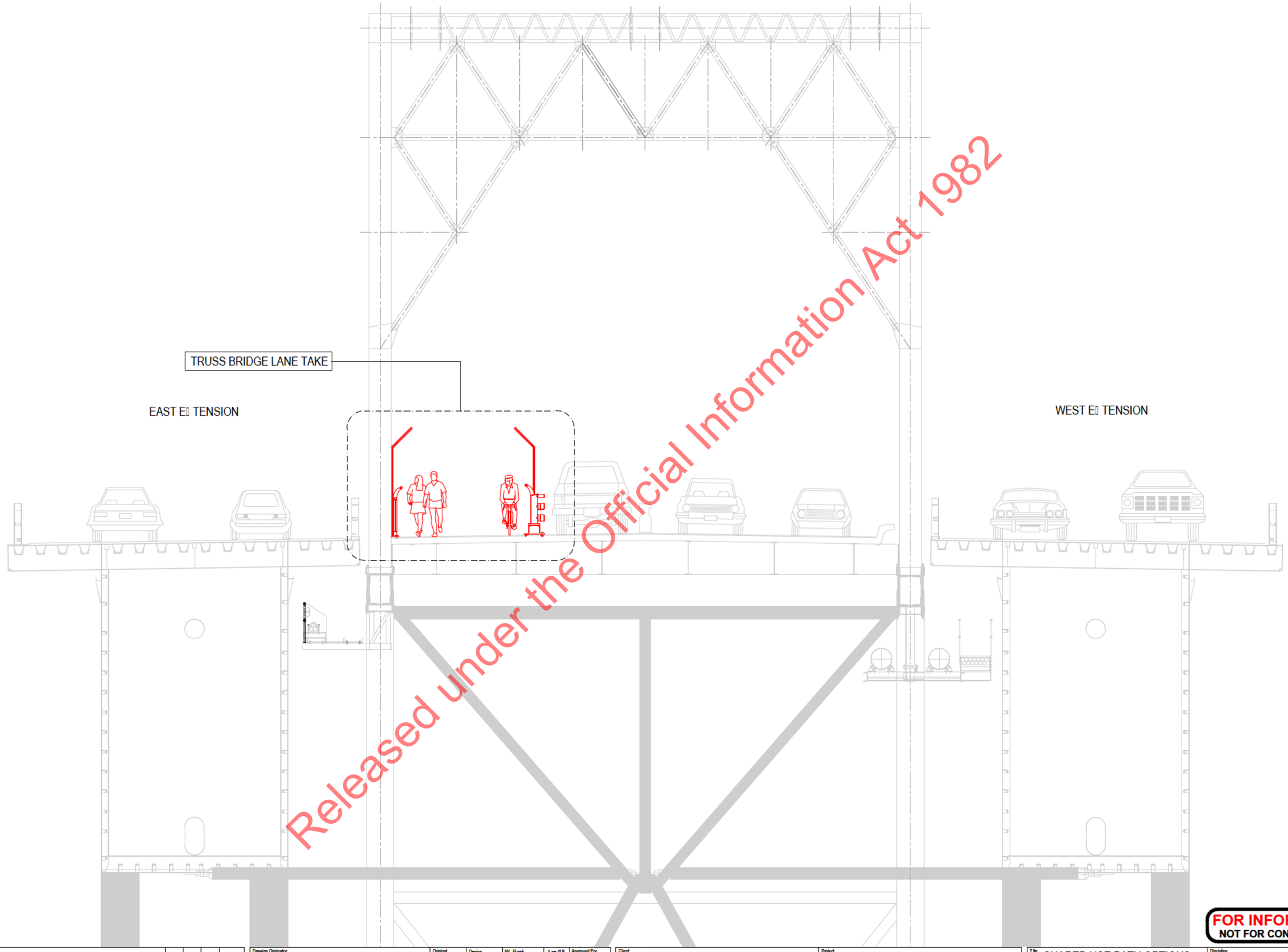

No.	Revision	By	Chk	Appd	Date
A	ISSUED FOR INFORMATION	PN	WP		8 AN 18

Drawing Originator: Auckland Harbour Bridge — Port of Auckland Motorways

Original Scale (A1) 1:50
Reduced Scale (A3) 1:100

Design	W. Pank	8 Jan 18
Drawn	P. Noble	8 Jan 18
Dsg Verifier		
Dwg Check		

Approved For Construction* Date

* Refer to Revision 1 for Original Signature

Client: NZ TRANSPORT AGENCY WAKA KOTAHI

Project: AUCKLAND HARBOUR BRIDGE

Title: SHARED USE PATH OPTIONS OPTION 4

Discipline: STRUCTURAL ENGINEERING

Drawing No.: 3910806-SE-204

Rev.: A

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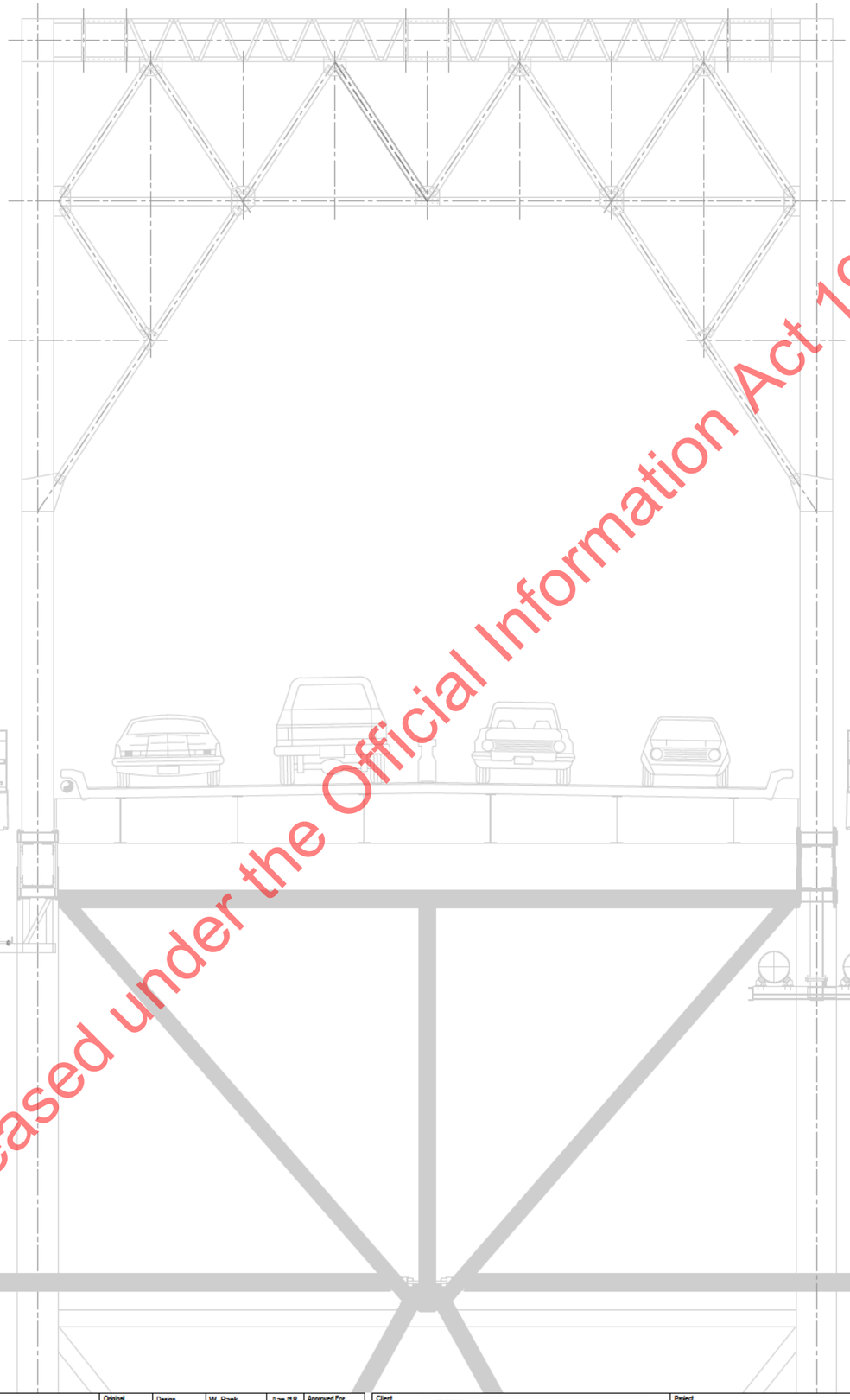

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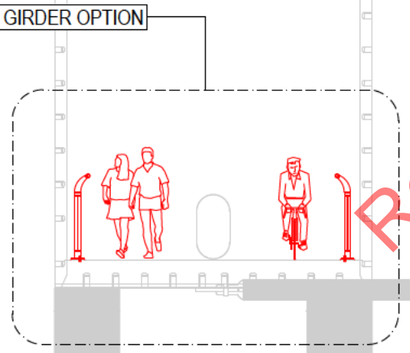

No.	Revision	By	Chk	Appd	Date
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Drawing Originator: Auckland Harbour Bridge — Port of Auckland Motorways

Original Scale (A1) 1:50
Reduced Scale (A3) 1:100

Design	W. Pank	8 Jan 2018	Approved For Construction*
Drawn	P. Noble	8 Jan 2018	
Dsg Verifier			
Dwg Check			Date

* Refer to Revision 1 for Original Signature

Client: NZ TRANSPORT AGENCY WAKA KOTAHI

Project: AUCKLAND HARBOUR BRIDGE

Title: SHARED USE PATH OPTIONS OPTION 5

Discipline: STRUCTURAL ENGINEERING

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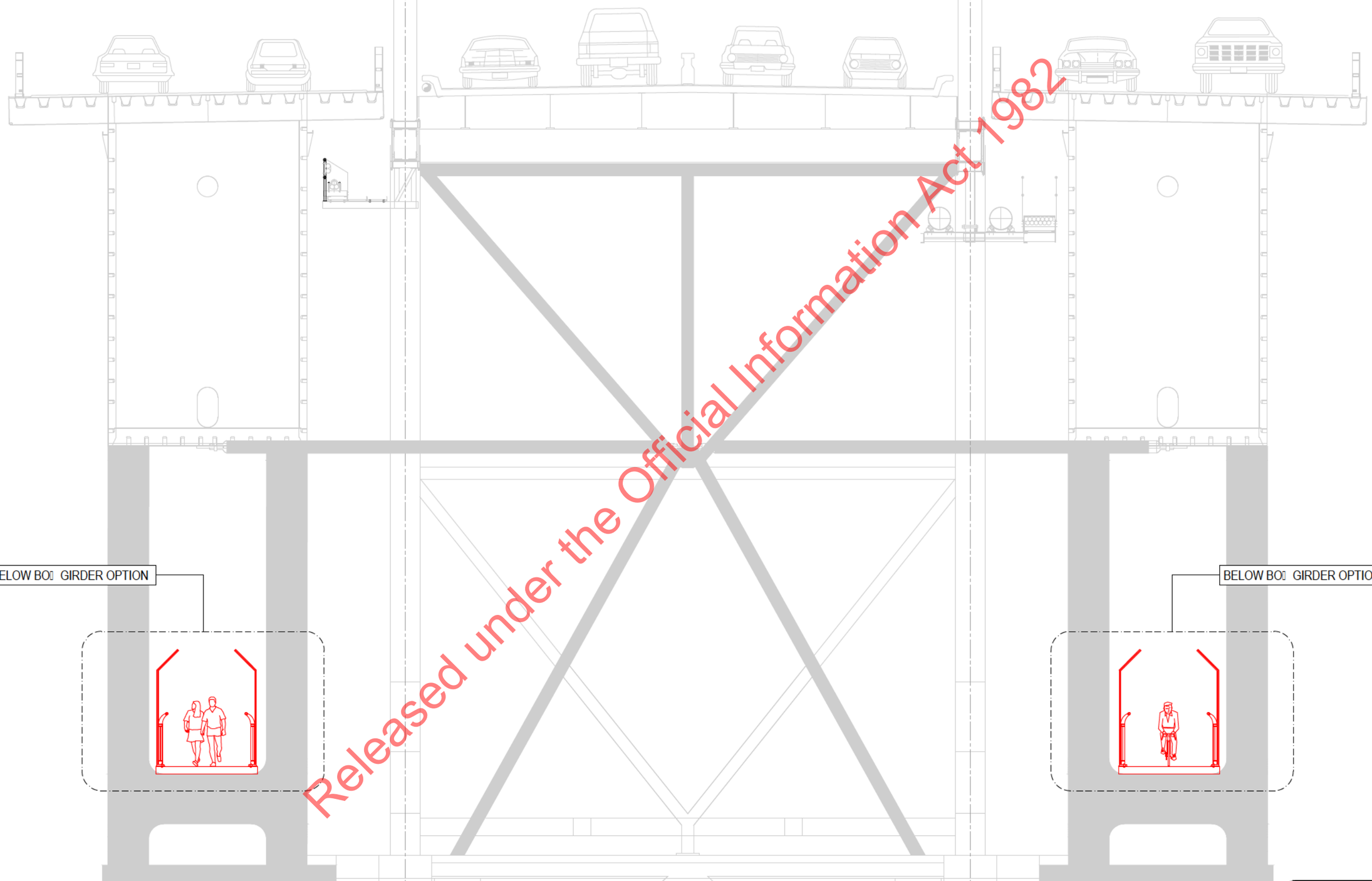

BELOW BO□ GIRDER OPTION

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No.	Revision	By	Chk	Appd	Date
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Drawing Originator: Auckland Harbour Bridge — Port of Auckland Motorways

Original Scale (A1) 1:50
Reduced Scale (A3) 1:100

Design	W. Pank	8 Jan 2018	Approved For Construction*
Drawn	P. Noble	8 Jan 2018	
Dsg Verifier			
Dwg Check			Date

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Client: NZ TRANSPORT AGENCY WAKA KOTAHI

Project: AUCKLAND HARBOUR BRIDGE

Title: SHARED USE PATH OPTIONS OPTION 6

Discipline: STRUCTURAL ENGINEERING

Drawing No.: 3910806-SE-206

Rev.: A

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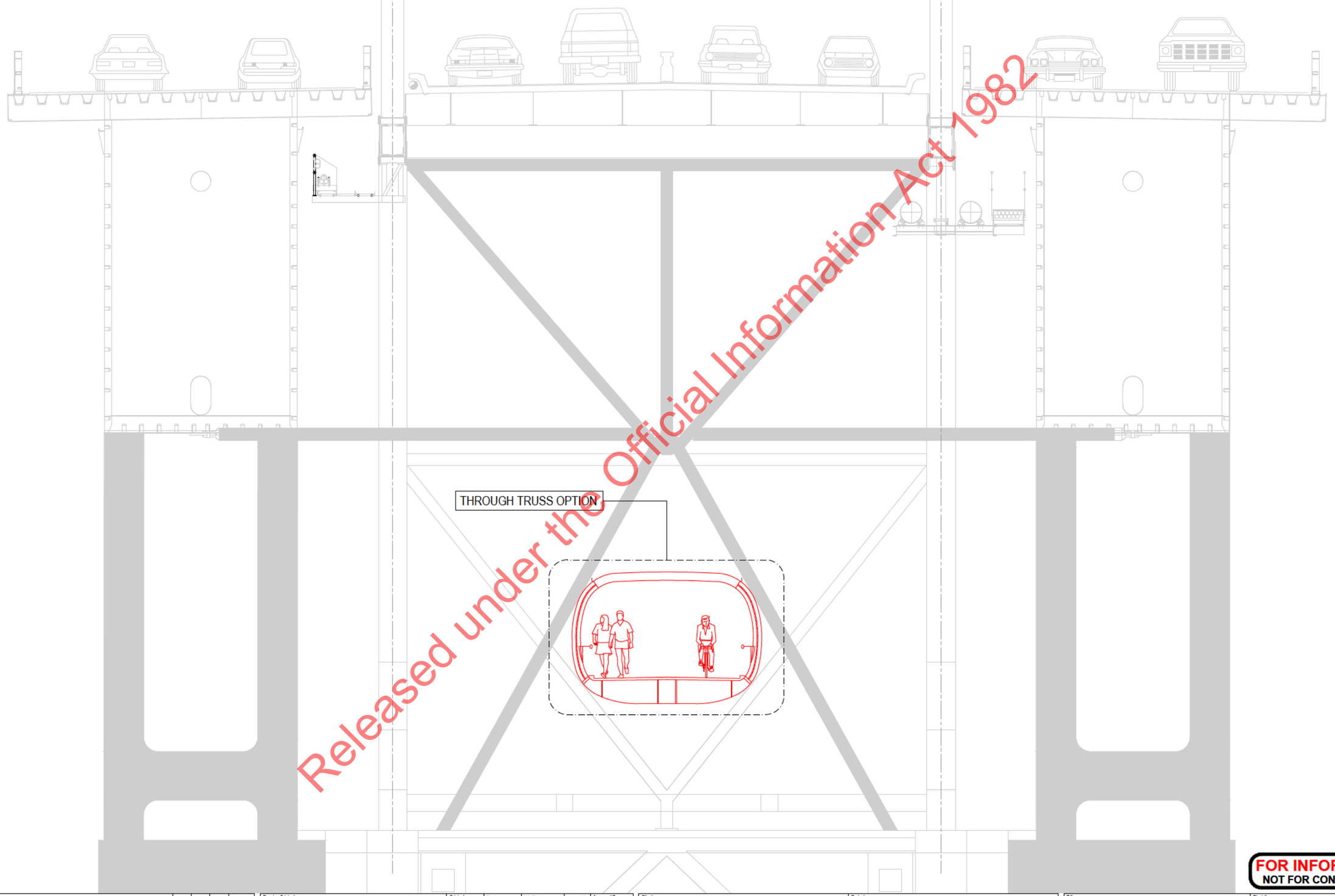

No.	Revision	By	Chk	Appd	Date
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Drawing Originator: Auckland Harbour Bridge

Original Scale (A1) 1:50
Reduced Scale (A3) 1:100

Design	W. Pank	8 Jan 18
Drawn	P. Noble	8 Jan 18
Dsg Verifier		
Dwg Check		

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* Refer to Revision 1 for Original Signature

Client: NZ TRANSPORT AGENCY WAKA KOTAHI

Project: AUCKLAND HARBOUR BRIDGE

Title: SHARED USE PATH OPTIONS OPTION 7

Discipline: STRUCTURAL ENGINEERING

Drawing No.: 3910806-SE-207

Rev.: A

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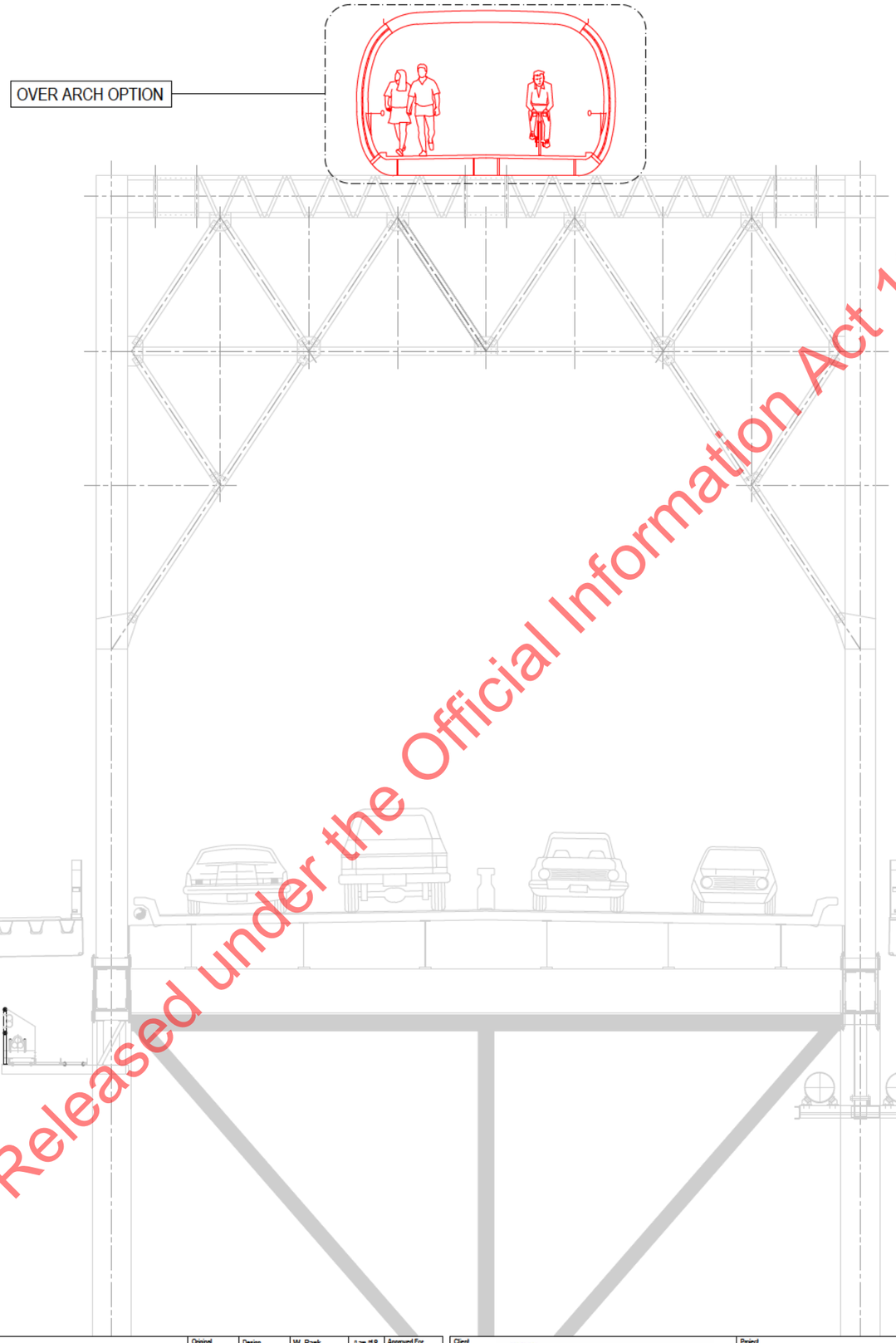

No.	Revision	By	Chk	Appd	Date
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Drawing Originator: Auckland Harbour Bridge — Part of Auckland Motorways

Original Scale (A1) 1:50
Reduced Scale (A3) 1:100

Design	W. Pank	8 Jan 18	Approved For Construction*
Drawn	P. Noble	8 Jan 18	
Dsg Verifier			
Dwg Check			Date

* Refer to Revision 1 for Original Signature

Client: NZ TRANSPORT AGENCY WAKA KOTAHI

Project: AUCKLAND HARBOUR BRIDGE

Title: SHARED USE PATH OPTIONS OPTION 8

Discipline: STRUCTURAL ENGINEERING

Drawing No.: 3910806-SE-208 Rev. A

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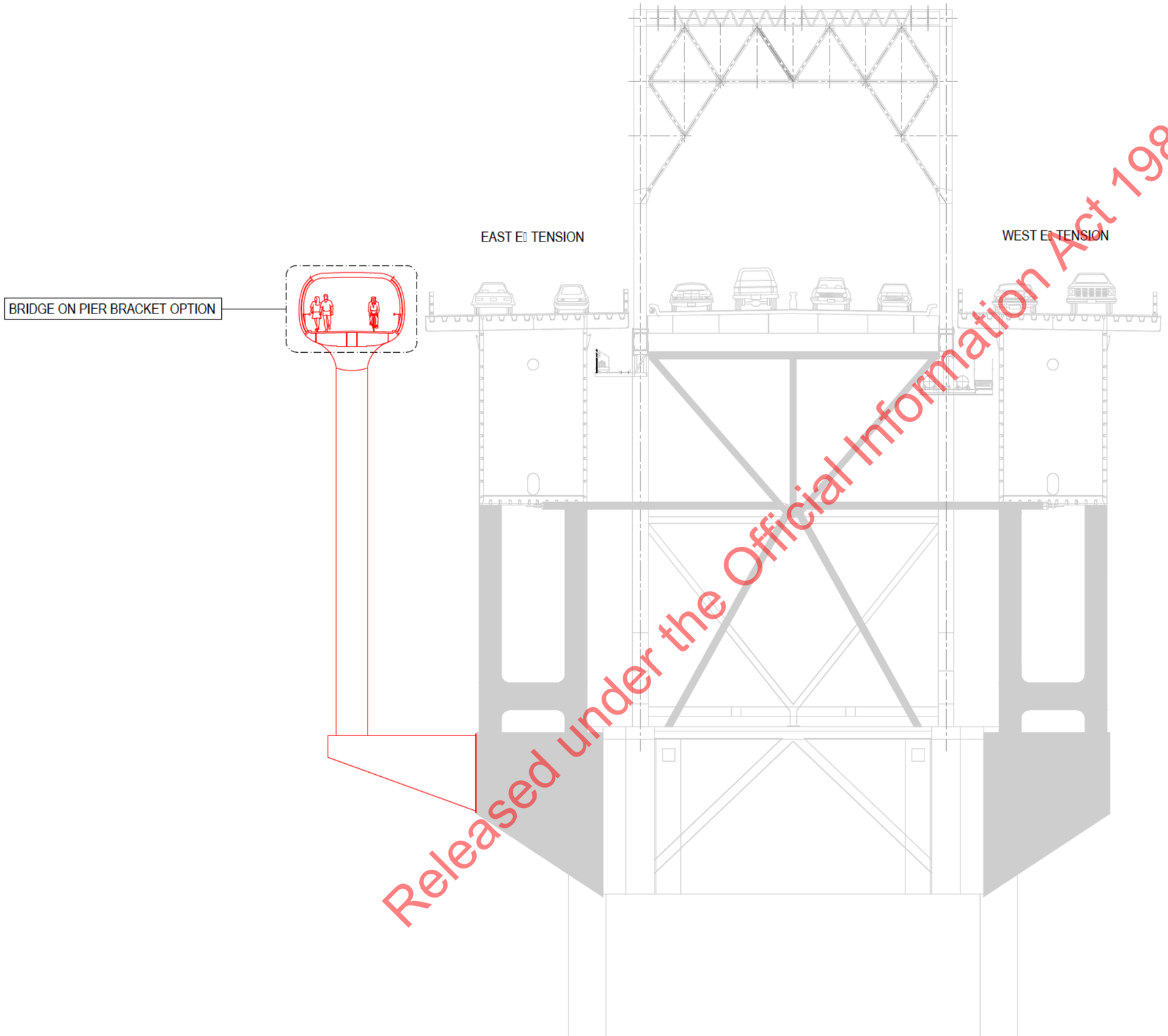

No.	Revision	By	Chk	Appd	Date
A	ISSUED FOR INFORMATION	PN	WP		8 AN 218

Drawing Originator: Auckland Harbour Bridge — Port of Auckland Motorways

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	Drawn	P. Noble	8 an 218
Reduced Scale (A3) 1:200	Dsg Verifier		
	Dwg Check		

Approved For Construction* Date

* Refer to Revision 1 for Original Signature

Client: NZ TRANSPORT AGENCY WAKA KOTAHI

Project: AUCKLAND HARBOUR BRIDGE

Title: SHARED USE PATH OPTIONS OPTION 9

Discipline: STRUCTURAL ENGINEERING

Drawing No.: 3910806-SE-209 Rev.: A

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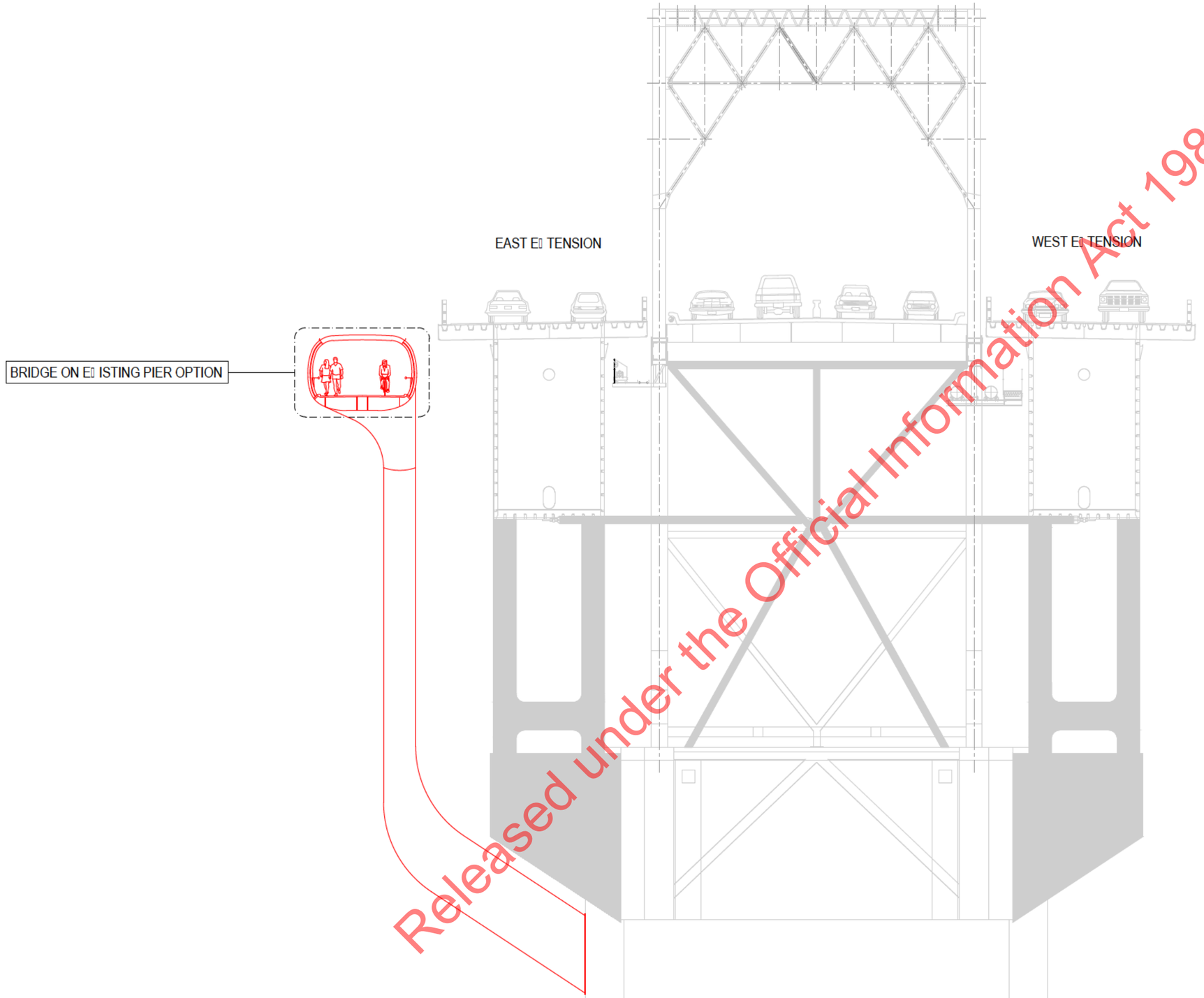

No.	Revision	By	Chk	Appd	Date
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Drawing Originator: Auckland Harbour Bridge — Part of Auckland Motorways

Original Scale (A1) 1:100
Reduced Scale (A3) 1:200

Design	W. Park	8 an 218	Approved For Construction*
Drawn	P. Noble	8 an 218	
Dsg Verifier			
Dwg Check			Date

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Client: NZ TRANSPORT AGENCY WAKA KOTAHI

Project: AUCKLAND HARBOUR BRIDGE

Title: SHARED USE PATH OPTIONS OPTION 10

Discipline: STRUCTURAL ENGINEERING

Drawing No.: 3910806-SE-210

Rev.: A

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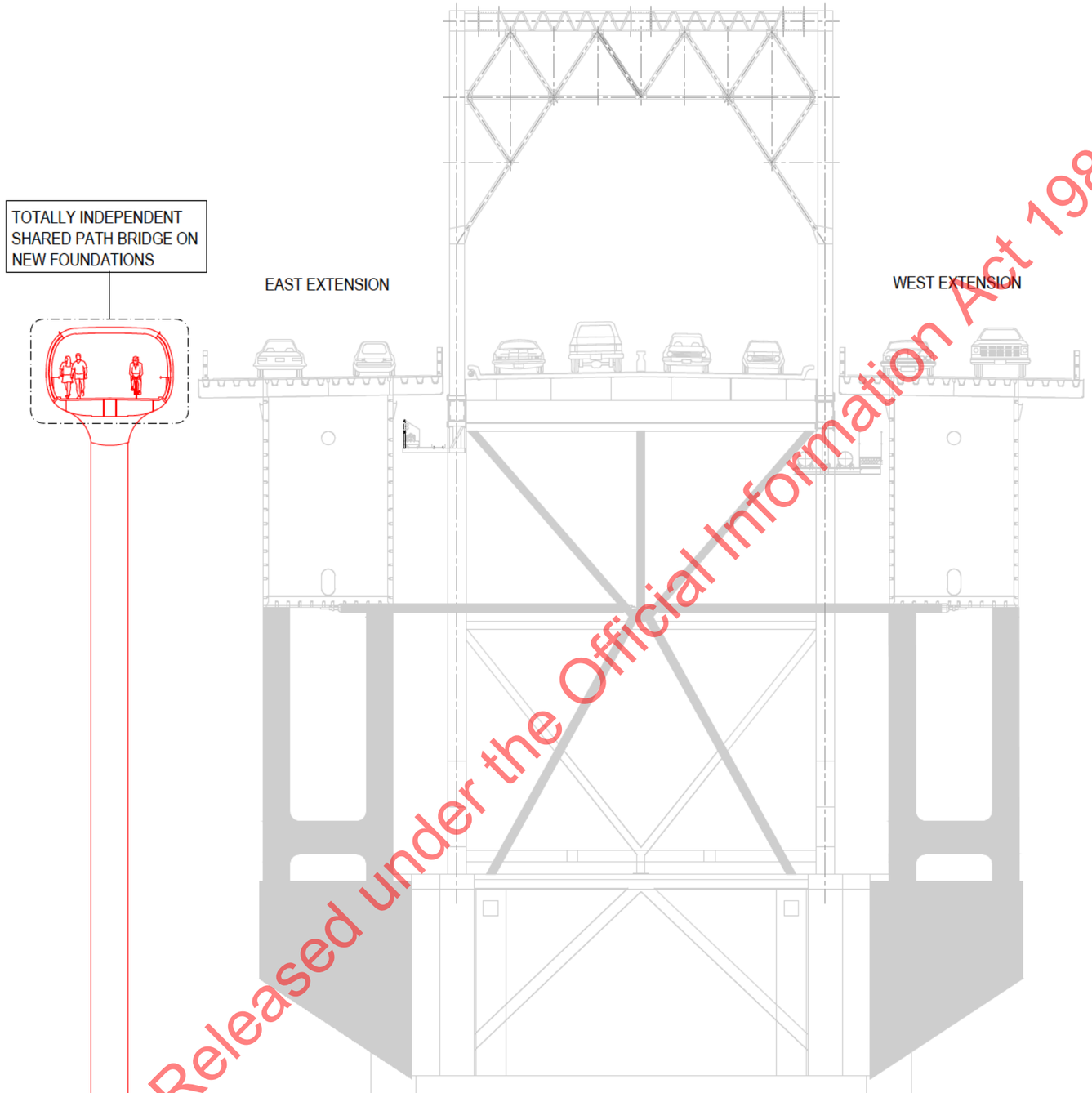

No.	Revision	By	Chk	Appd	Date
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Drawing Originator: NZ Transport Agency — Auckland Harbour Bridge, Part of Auckland Motorways

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Reduced Scale (A3) 1:200	Drawn	P. Noble	Jan '18
	Dsg Verifier		
	Dwg Check		

Approved For Construction* Date

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Client: NZ TRANSPORT AGENCY WAKA KOTAHI

Project: AUCKLAND HARBOUR BRIDGE

Title: SHARED USE PATH OPTIONS OPTION 11

Discipline: STRUCTURAL ENGINEERING

Drawing No.: 3910806-SE-212 Rev.: A

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APPENDIX D: SHORTLIST MCA

Criteria	Sub-criteria	Option 1: Underslung Option (as designed by SkyPath Trust)		Option 2A: Separate deck level walkway & cycleway		Option 10: Independent shared path structure on concrete pier	
		Score	Comments	Score	Comments	Score	Comments
Investment Objective 1 – Increase mode share of walking & cycling travel to work trips	Cross-harbour people throughput (peak hour)	3	Walking and cycling link provides significant increase in peak hour capacity, without affecting existing traffic capacity. Estimated to be 490 peds/cyclists per hour in during the commuter peak in 2026.	2	Walking and cycling link provides significant increase in peak hour capacity, estimated to be 490 peds/cyclists per hour in during the commuter peak in 2026. Existing southbound traffic capacity in evening peak reduced by approximately 200 vehicles per hour however net increase approximately 270 people per hour.	3	Walking and cycling link provides significant increase in peak hour capacity, without affecting existing traffic capacity. Estimated to be 490 peds/cyclists per hour during the commuter peak in 2026. Whilst there is the potential to allow up to 5m width the assessment is based on a 4m width option.
	Cross-harbour people mode share (peak hour)	2	Increases peak period cycling mode share of cross-harbour trips in 2026 from 0.2% to 1.2%	2	Increases peak period cycling mode share of cross-harbour trips in 2026 from 0.2% to 1.2%. Negligible difference due to reduced southbound evening peak traffic capacity.	2	Increases peak period cycling mode share of cross-harbour trips in 2026 from 0.2% to 1.2%. Whilst there is the potential to allow up to 5m width the assessment is based on a 4m width option.
	Cross-harbour walkers & cyclists (peak hour)	2	Estimated to result in 490 peds/cyclists per hour during the commuter peaks in 2026. 4m width may not adequately cater for estimated 95th percentile commuter peak demand of 935 users/hour.	2	Estimated to result in 490 peds/cyclists per hour during the commuter peaks in 2026. 4m width may not adequately cater for estimated 95th percentile commuter peak demand of 935 users/hour.	2	Estimated to result in 490 peds/cyclists per hour during the commuter peaks in 2026. Potential to allow up to 5m width would adequately cater for estimated 95th percentile commuter peak demand of 935 users/hour, however assessment based on 4m width option.

Criteria	Sub-criteria	Option 1: Underslung Option (as designed by SkyPath Trust)		Option 2A: Separate deck level walkway & cycleway		Option 10: Independent shared path structure on concrete pier	
		Score	Comments	Score	Comments	Score	Comments
	Perception of safety and ease of walking & cycling	-2	Located under the box girder, out of sight of drivers (no passive surveillance from a CPTED perspective). Users will experience traffic vibration of the box girder.	-2	Visible to drivers, but next to live motorway traffic (SH1). User will experience traffic vibration of the box girder	-1	Potential for passive surveillance from drivers. Users will not experience traffic vibration.
Investment objective 2 – Increase walking & cycling for recreation & tourism	Cross-harbour walkers and cyclists (weekday interpeak)	2	Estimated to result in 210 peds/cyclists per hour during the weekday interpeak period in 2026. 4m width would adequately cater for estimated 95th percentile weekday interpeak demand of 595 users/hour but would provide fewer recreational/tourist opportunities.	2	Estimated to result in 210 peds/cyclists per hour during the weekday interpeak period in 2026. 4m width would adequately cater for estimated 95th percentile weekday interpeak demand of 595 users/hour but would provide fewer recreational/tourist opportunities.	2	Estimated to result in 210 peds/cyclists per hour during the weekday interpeak period in 2026. Potential to allow up to 5m width would adequately cater for estimated 95th percentile weekday interpeak demand of 595 users/hour, and would provide more recreational/tourist opportunities, however assessment based on 4m width option.
	Cross-harbour walkers and cyclists (weekends)	2	Estimated to result in 550 peds/cyclists during the weekend peak hour in 2026. 4m width would adequately cater for estimated 95th percentile weekend peak demand of 775 users/hour but would provide fewer recreational/tourist opportunities.	2	Estimated to result in 550 peds/cyclists during the weekend peak hour in 2026. 4m width would adequately cater for estimated 95th percentile weekend peak demand of 775 users/hour but would provide fewer recreational/tourist opportunities.	2	Estimated to result in 550 peds/cyclists during the weekend peak hour in 2026. Potential to allow 5m width would adequately cater for estimated 95th percentile weekend peak demand of 775 users/hour, and would provide more recreational/tourist opportunities, however assessment based on 4m width option.

Criteria	Sub-criteria	Option 1: Underslung Option (as designed by SkyPath Trust)		Option 2A: Separate deck level walkway & cycleway		Option 10: Independent shared path structure on concrete pier	
		Score	Comments	Score	Comments	Score	Comments
	User experience	1	A cross-harbour facility to support recreational tourism and the facility will be largely sheltered from the weather. However, there will be noise and vibration from overhead traffic which could undermine the user experience coupled with limited space to separate movement activities from observation experiences.	0	Lower level of service - adjacent to live traffic lanes and exposure to the elements. Very noisy and potentially above recognised acceptable noise limits. Subject to traffic vibration. Unsheltered, exposed to the elements. No viewing platforms.	2	Large generous sheltered viewing platforms which will enhance the user experience. There will be some vehicle noise, but the positioning next to existing Bridge will allow noise screens to be provided. Limited vibration as not attached to the existing box girder.
Implementability	Technical – Engineering degree of difficulty	-2	Complex design and strengthening with numerous engineering uncertainties/challenges. Use of new materials and connection to AHB over the length of the structure (FRP).	-1	Relatively simple/standard steel design and strengthening. Strengthening is limited compared to Option 1.	-1	Connection to the existing AHB concrete pier is complex with limited mitigations.
	Construction complexity - Degree of risk and uncertainty with design and delivery	-2	High risk due to new and untested materials for bridges. Also need to strengthen the AHB box girder.	-1	Relatively straight forward steel construction. Construction methodology/sequence for replacement of the edge barrier will be complex. Extensive traffic management.	-1	Steelwork involves normal construction processes. Connection to existing AHB concrete pier is complex. Limited traffic management required; some marine/harbour management required.

Criteria	Sub-criteria	Option 1: Underslung Option (as designed by SkyPath Trust)		Option 2A: Separate deck level walkway & cycleway		Option 10: Independent shared path structure on concrete pier	
		Score	Comments	Score	Comments	Score	Comments
	Statutory planning – Consenting factors - e.g. time/cost/process	0	Consented already. Variation to consents may be required for design tweaks but likely non notified if environmental effects of the variation are less than minor.	-2	New design and location (extension of deck width), therefore new consents required with associated consenting risk - delay, cost, adverse publicity & opposition.	-2	New design therefore new consents are likely required with associated consenting risk - delay, cost, adverse publicity & opposition. If new design falls within the consented footprint and effects envelopes of existing SkyPath consents, a variation to SkyPath consents may be possible. This would also be subject to NZTA holding the SkyPath consents.
	Safety in Design - safety developed in design process, safety considerations and risks in design and build	0	Restricted work spaces. Working at heights.	-1	Construction of barriers is adjacent to live traffic. Restricted work spaces. Working at heights.	0	Restricted work spaces. Working at heights.
	Maintenance – Factors affecting the ability to maintain the option and the AHB.	-2	Requires painting at regular intervals. Affects existing AHB maintenance gantry. Can access the AHB box girder for inspection/maintenance.	1	Least increase in maintenance requirements and access is available via the existing gantry (with modification if required). Facility can be used for access to maintain/inspection the AHB.	0	Specific gantry required for maintenance purposes of this option (maintenance AHB itself will not be affected).
	Operations – Load capacity and fire life safety constraints affecting the ability to operate the option	-2	Requirement for access control to manage total user numbers due to load restrictions. Requirements for security and surveillance given location below box girder cantilever. Emergency egress more challenging to	-1	Requirement for access control to manage total user numbers due to load restrictions. Barrier strike may require temporary closure of facility. Unlikely to require the same level of security or surveillance	0	Monitoring of user numbers required for incidents and events but not full access control for day to day use. Separation from existing AHB is a benefit as limited/no impact on AHB maintenance and operations.

Criteria	Sub-criteria	Option 1: Underslung Option (as designed by SkyPath Trust)		Option 2A: Separate deck level walkway & cycleway		Option 10: Independent shared path structure on concrete pier	
		Score	Comments	Score	Comments	Score	Comments
			safely achieve due to location below box girder.		as Option 1. Relatively straightforward to maintain.		
	Residual risk - Scale of residual engineering / operating risks after mitigation to the AHB	-3	Capacity (number of users) will almost certainly be reduced over time as traffic loads increase. This risk is very difficult to mitigate, would require restrictions on the number of users or traffic. Unknown material behaviour (FRP)	-3	Capacity (number of users) will be reduced over time as traffic loads increase. This risk is very difficult to mitigate, would require restrictions on the number of users or traffic.	2	Capacity (number of users) will not be limited over time, separate from traffic loads. Potentially need to manage crowd loading in the long term.
	WOL Maintenance Costs	-2	More difficult to maintain due to access. Replacement of FRP elements which are bespoke is costly. 50-year design life.	0	Less structure to maintain, not complex. Like existing AHB maintenance activities.	-1	More structure to maintain. 100-year design life.
	Time to deliver	0	Estimated 1 yr. consent amendments, 9mnths design, 2yr construction	-2	Estimated 2 yr. consent, 9mnths design, 2yr construction	-2	Estimated 2 yr. consent (new consents or variation to SkyPath consents), 9mnths design, 2yr construction
	Property – Land use impacts	0	No significant difference in property impacts between the three options	0	No significant difference in property impacts between the three options	0	No significant difference in property impacts between the three options
Assessment of Effects	Cultural – Impacts on cultural and mana whenua values	0	No significant difference between options. Landings either side highly significant to Iwi.	0	No significant difference between options. Landings either side highly significant to Iwi	0	No significant difference between options. Landings either side highly significant to Iwi
	User safety – To what extent will the option enhance safety for different types of transport users	0	Mix of tourism and commuter walking and cyclists could increase the risk of collision and injury in a relatively confined space	-1	Distraction impacts and narrowing of Harbour Bridge live lanes has the potential to impact overall user safety	1	Enhanced separation of tourism and commuting users through build outs and enhanced viewing platforms reduces the risk of conflict and potential injury.

Criteria	Sub-criteria	Option 1: Underslung Option (as designed by SkyPath Trust)		Option 2A: Separate deck level walkway & cycleway		Option 10: Independent shared path structure on concrete pier	
		Score	Comments	Score	Comments	Score	Comments
	Human Health – Does the option impact on human health?	2	Promotes active modes but with some exposure to emissions, noise, and vibration	1	Promotes active modes but location adjacent to live traffic lanes results in potential higher exposure to emissions, noise, and vibration	2	Promotes active modes but with some exposure to emissions, noise, and vibration
	Heritage & Archaeology – Does the option impact on the heritage values of the AHB?	0	Minor effect on heritage values of AHB as well integrated on AHB structure. Effect of landings on archaeological /Landings at either end	0	Minor effect on heritage values of AHB as widening on clip-on. Effect of landings on archaeological /Landings at either end	-1	Minor-moderate effect on heritage values of AHB. Pier brackets impact on visual balance and heritage context of AHB
	Coastal – Does the option impact on the coastal environment?	0	Consented already. Tucked underneath clip-on	0	New consent Coastal occupation permit. Impact of widened deck	-1	Pier bracket 6 located in CMA (but not in seabed). Possible impact on coastal processes and navigation. New consent Coastal occupation permit.
	Natural character, outstanding natural features/landscapes – what is the impact?	0	SkyPath design already consented and integrates well into AHB. Impact of landings same for all options	0	Visual impact of widened deck may be visible from some locations. Impact of landings same for all options	-1	Visual impact of pier brackets - changes visual balance of AHB. Impact of landings same for all options
	Terrestrial Ecology – Does the option impact on the terrestrial ecology of the natural environment?	0	Impact at landings same for all options	0	Impact at landings same for all options	0	Impact at landings same for all options
	Urban design & landscape – Urban design considerations and landscaping	1	Design integrates well with underside of AHB clip-on.	-1	Adjacent to live traffic lanes and exposure to the elements. Difficult to mitigate through urban design	2	High levels of service (compared to other options) and design features including viewing platforms, possible wider deck

Criteria	Sub-criteria	Option 1: Underslung Option (as designed by SkyPath Trust)		Option 2A: Separate deck level walkway & cycleway		Option 10: Independent shared path structure on concrete pier	
		Score	Comments	Score	Comments	Score	Comments
	required for the option?						
	Social – Does/could the option affect accessibility for the public?	2	Public and political expectation that consented option will be delivered quickly, as already consented. Load restrictions necessary and level of service diminishes over time.	2	Lower level of service - adjacent to live traffic lanes and exposure to the elements. Not as attractive or accessible for wider groups	3	If within scope of existing consents, likely to be strongly supported due to improved level of service and design life - potentially wider path, viewing platforms, no load restrictions, and more accessible to a wider range of users.
	Economics – How does the option impact economic growth? How does the option enhance the development potential of adjacent land/attract jobs/help existing business?	3	Likely to have a positive impact on economic outcomes. Separation between facility users and traffic lanes and space for viewing platforms makes it more attractive for recreational and tourist trips.	2	Positive impacts anticipated but less than other options due to proximity to existing traffic lanes undermining the experience - thus generating fewer economic benefits from added tourism. However, the option will generate the same improvements in walking/cycling accessibility as the other options. Hence, similar levels of modelled agglomeration benefits but with the negative agglomeration benefits associated with the requirement for narrowed traffic lanes.	3	Likely to have a positive impact on economic outcomes. Separation between facility users and traffic lanes and space for viewing platforms, which will make them more attractive for recreational and tourist trips.

Criteria	Sub-criteria	Option 1: Underslung Option (as designed by SkyPath Trust)		Option 2A: Separate deck level walkway & cycleway		Option 10: Independent shared path structure on concrete pier	
		Score	Comments	Score	Comments	Score	Comments
	Value for money	Not Scored	No verification of costs were possible, however the project was reported to have a capital cost of $65m in 2015.	-2	No detailed costings have been prepared for this option. However preliminary estimates of travel disbenefits suggests there is a possibility that Option 2A would deliver zero or negative project benefits ie $113m discounted traffic disbenefits would outweigh estimated project benefits s 9(2)	1	Initial estimates of the benefits of the facility suggest that the costs are unlikely to exceed the scale of benefits envisaged and positive value for money overall is envisaged.

APPENDIX E: DESIGN REFINEMENT – NORTHERN LANDING DESIGN AND LOCATION

Irrespective of the longer-term priority to establish a continuous link between Westhaven and Akoranga, the value of a northern landing (or landings) is recognised by several stakeholders. It would provide benefits in terms of catchment potential, connectivity with the Northcote Point ferry terminal and local businesses, together with local community access and recreation opportunities. These benefits were recognised by some during public engagement on the Business Case, but were tempered by concerns about the location and execution of any proposed northern landings/connections, particularly from property owners in the vicinity of the proposed sites.

Through option refinement, several landing configurations at the northern end were considered (in addition to the direct connection to SeaPath):

A. One landing only - in the vicinity of Sulphur Beach Boat Ramp (i.e. similar location as expected connection point to SeaPath)

B. One landing in the vicinity of Sulphur Beach Boat Ramp and one landing in the vicinity of 9 Princes Street

C. One landing in the vicinity of Sulphur Beach Boat Ramp and one landing in the vicinity of Stokes Point Reserve

A landing in the vicinity of the Sulphur Point Boat Ramp, in the approximate location where the Auckland Harbour Bridge Shared Path will connect with SeaPath, will provide direct access to local recreation opportunities and connectivity with local cycleways (particularly the Northcote Safe Cycle Route). It is expected that the principle of a local connection at this point will be further explored in the pre-implementation phase of the SeaPath project.

It is considered that these opportunities could be further enhanced by providing a second landing towards the southern end of Northcote Point. This would, amongst other things, provide a direct link with the ferry terminal, enhance local catchment potential and connectivity with local businesses.

Whilst a landing in the vicinity of Stokes Point Reserve has already been consented in the SkyPath proposal, further analysis concluded that landings under the Harbour Bridge (i.e. in vicinity of the Reserve) are likely to be perceived as less safe for customers, and have less potential to create visual amenity and architectural character, compared to the 9 Princes Street option. Steeper gradients would be required for a landing near Stokes Point Reserve, which could compromise the customer experience, particularly for tourists and recreational users, and create speed conflicts between users.

Furthermore, amenity, cultural and heritage impacts on Te Onewa Pa and the Stokes Point Reserve (including a significant Pohutukawa tree) are likely to be greater the closer the connection is to the Reserve.

Consideration was also given to an elevator and stair system versus ramps and landings. Whilst the elevator/stair system is potentially appealing on the grounds of customer experience, particularly for tourist or recreational users, it was discounted due to considerations relating to the ongoing maintenance and operational costs. Concerns were also raised about the potential for adverse impacts on heritage, cultural and archaeological values of Stokes Point Reserve.

On balance, it is considered that the 9 Princes Street ramp connection (in addition to the Sulphur Point connection) provides a more enduring and effective solution and is more likely to be acceptable to residents and wider stakeholders. Indicative concept designs for Princes St are shown in **Figure 8** and **Figure 9**, with further work on the optimal design expected to be completed during the pre-implementation phase.

APPENDIX F: DESIGN REFINEMENT - PATHWAY WIDTH

5 metre versus 4 metre option

Through option refinement the recommended option now includes for a 5m wide shared path as opposed to the 4m option from the short-listing process.

Further discussion on the costs and benefits of a 5m versus a 4m option are contained in the following section including:

- Capacity constraints and levels of service
- Customer feedback
- Cost impacts
- Implications for consenting

Capacity and levels of service

The proposed Option 10 has been amended to include a shared path with 5m clear width between barriers. The 5m wide option has greater capacity than a 4m wide option and significantly improves safety by separating cyclists from pedestrians. There is potential for conflict between fast-moving bikes and people on foot in a 4m wide facility particularly due to the length (over 1km) and 5% gradient. The risk of conflict between cyclists and pedestrians is exacerbated by the number of recreational users and tourists estimated to use the facility.

Austroads produces a design guide[27] offering recommended widths for shared use paths as a function of pedestrian and cyclist volumes, shown in **Figure 15** and **Figure 16**. The recommended widths shown in these tables have been developed based on a desirable Level of Service (LOS) for cyclists, defined as twelve or fewer delayed passing instances per hour. The estimated 2026 95th percentile weekday and weekend peak hour demands are overlaid on these figures.

[27] Cycling Aspects of Austroads Guides; Austroads; August 2013

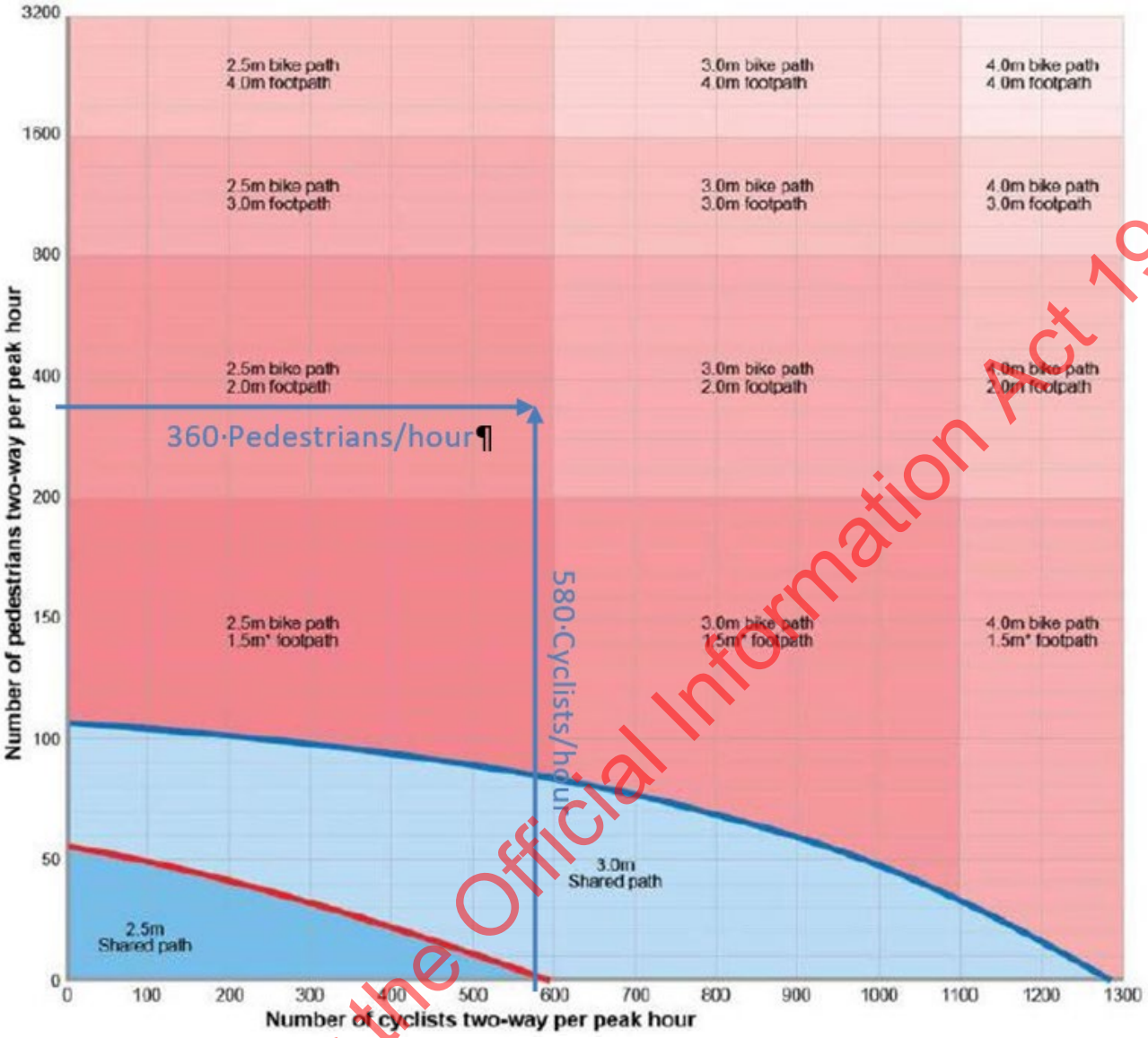

Figure 15 – Austroads shared path design width, 75/25 directional split

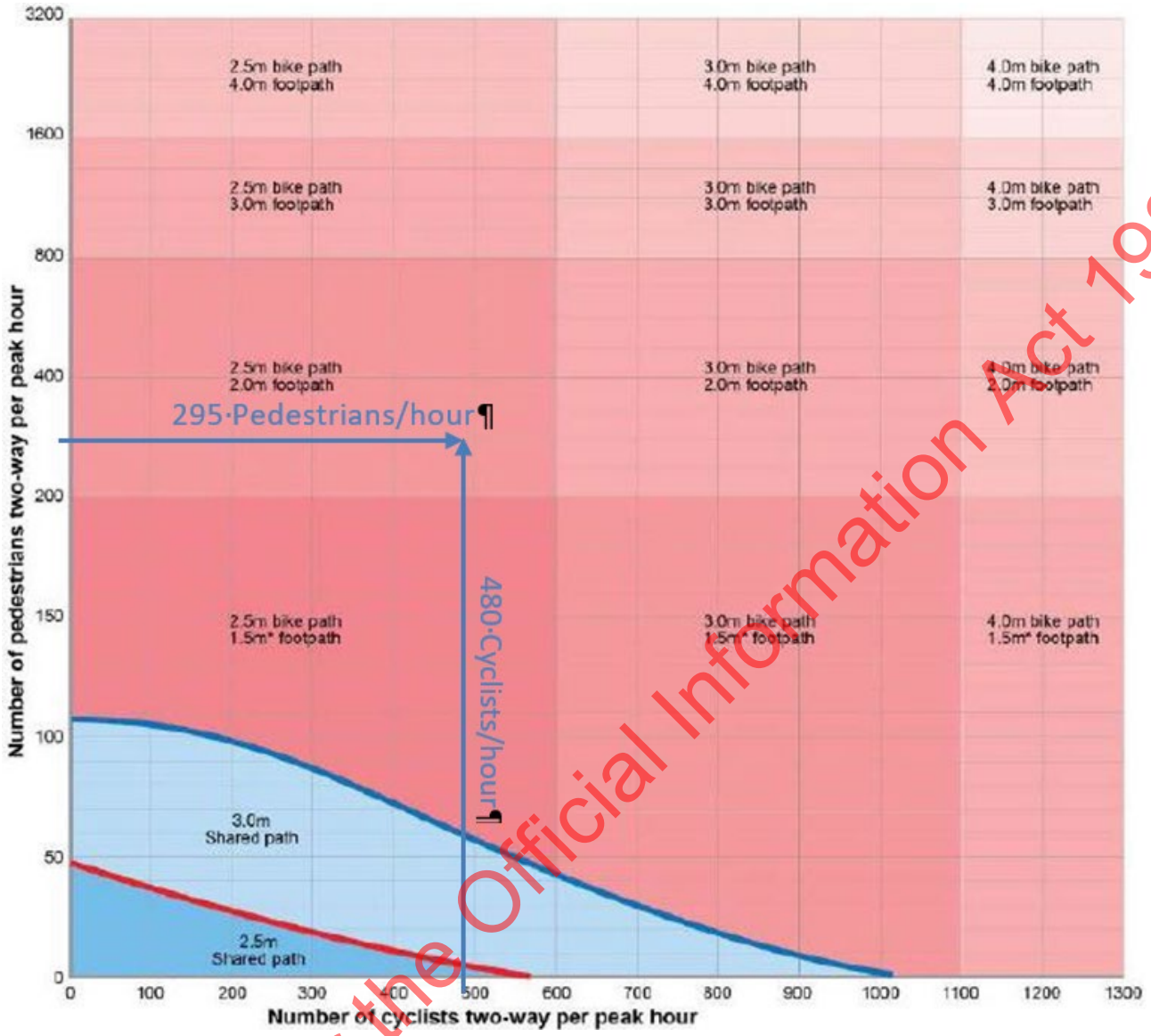

Figure 16 – Austroads Shared Path Design Width, 50/50 Directional Split

Applying this method to the 2026 weekend peak hour demands of 480 cyclist trips and 295 pedestrian trips, as well as the 50/50 weekend directional split, Austroads recommends a facility width of 4.5 m. The 2026 weekday peak hour demands of 580 cyclist trips and 360 pedestrian trips, and the estimated 70/30 directional split, similarly results in a recommended facility width of 4.5 m.

It is noted that the Austroads method does not account for the gradient of the Auckland Harbour Bridge, and cyclists may require more space when traversing gradients, whether this is downhill and faster or uphill and more unstable.

Other documents referred to in the Transport Agency's National Cycle Network Design Guidance do not provide design widths for shared path facilities with anticipated demands as high as the proposed cross-harbour facility.

Analysis has been undertaken to estimate if the Austroads LOS criteria may be exceeded, for different shared path widths. **Figure 17** below illustrates this, showing the predicted demand on the 99th percentile hour (i.e. demand is predicted to be exceeded on approximately 90 occasions per year). This demand has been shown as a shaded band, showing a range of ±20% demand estimates in 2026, rising to ±40% in 2046; this reflects the uncertainty in forecasting pedestrian and cycle demands, particularly longer term. Also plotted on this figure are the approximate demand thresholds for 4 m and 5 m wide paths, above which the LOS would fall below the Austroads LOS criteria.

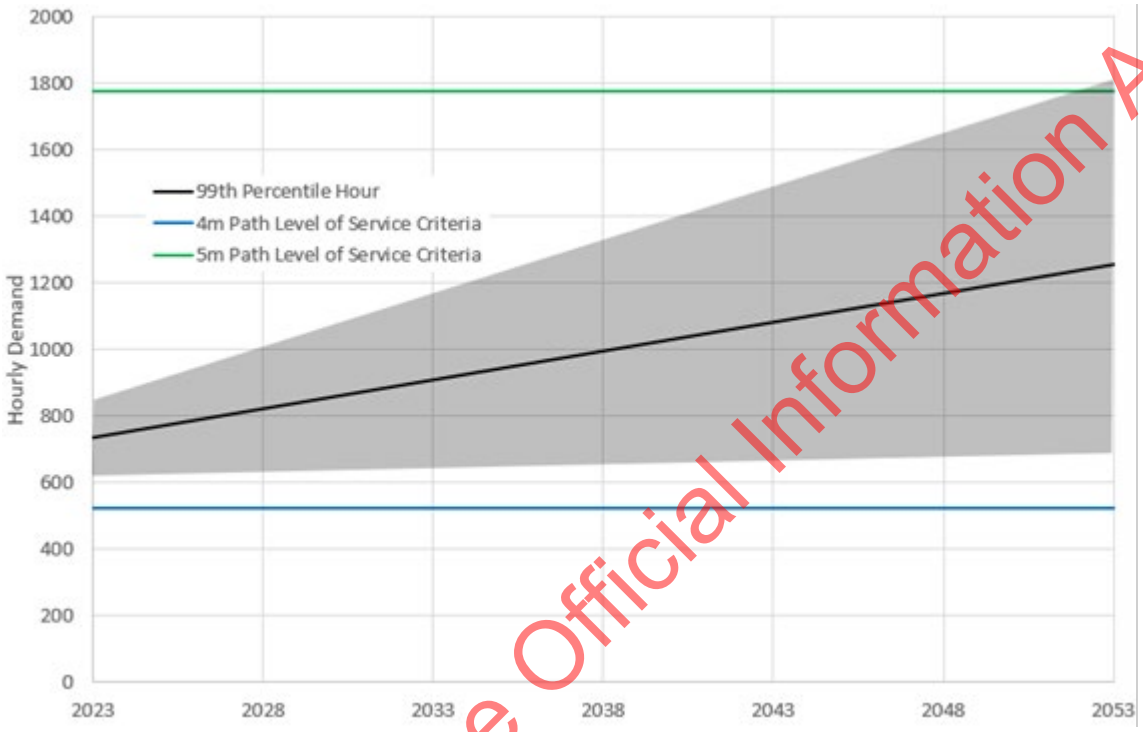

Figure 17 – Shared Path Peak Demand vs LOS Criteria

The forecast peak demands on the facility are predicted to exceed the Austroads LOS criteria for a 4m wide path (i.e. the LOS criteria would be exceeded on more than 90 occasions per year). When considering a wide range in demand estimates (the shaded grey area in **Figure 17**), this is expected to remain the case longer term, with these occasions potentially increasing significantly. Demands are however predicted to remain below the LOS threshold for a 5 m path, even when considering the upper range demand estimates.

The following figures illustrate the frequency per year that the proposed cross-harbour shared path is predicted to exceed the level of service criteria. The first of these in **Figure 18** illustrates the frequency in terms of the number of hours per year (from a total of 8,760 hours each year). The second in **Figure 19** illustrates the frequency in terms of the number of days per year (i.e. the number of days where the LOS or capacity criteria are predicted to be exceeded at least once that day).

In these figures, shaded bands have been used to illustrate the forecast demand range of ±20% in 2026 and ±40% in 2046, reflecting the uncertainty in the predicted demands.

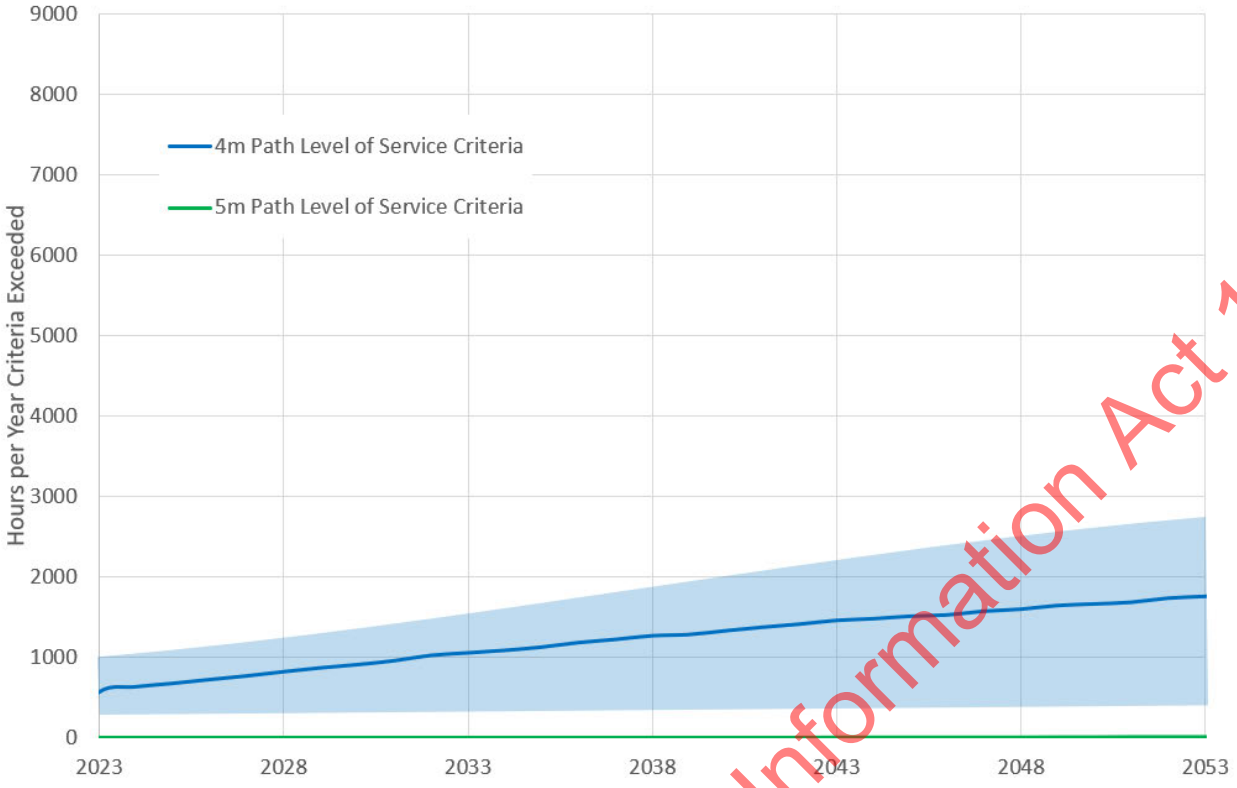

Figure 18 – Hours per year LoS criteria exceeded

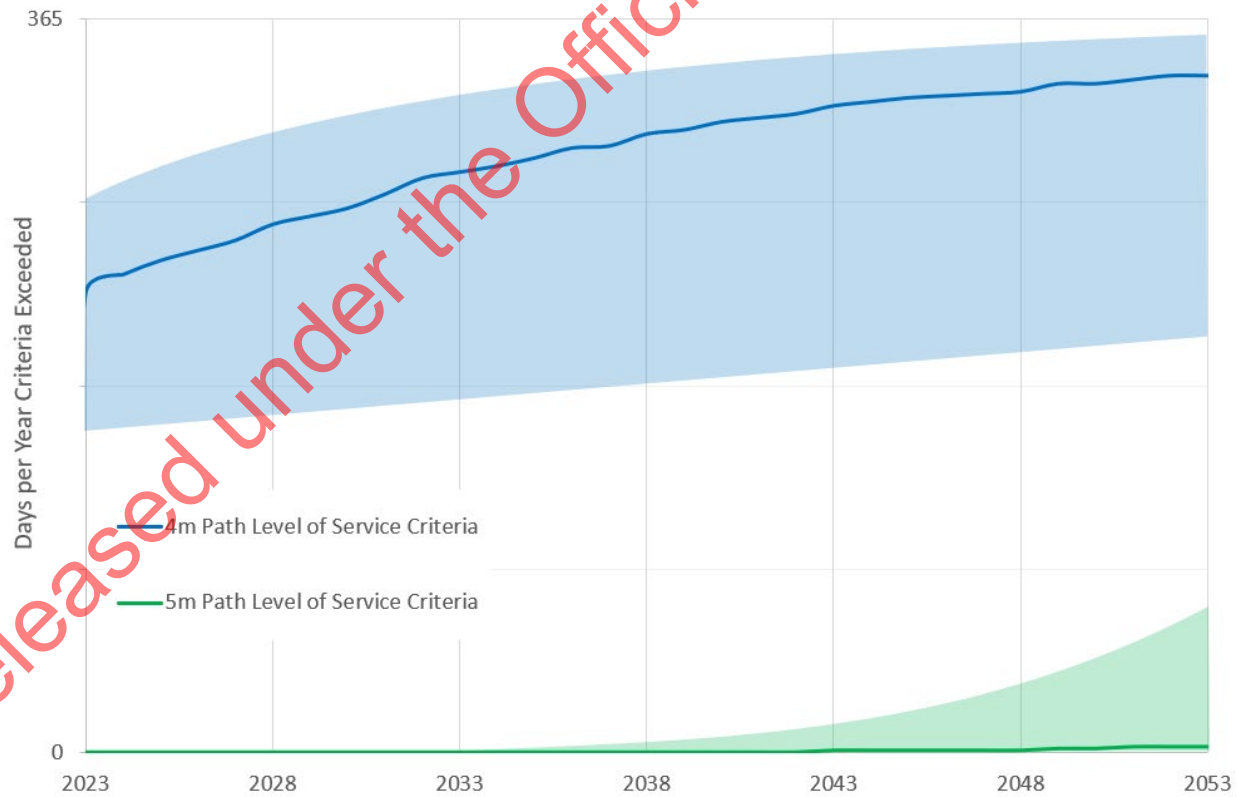

Figure 19 – Days per year LoS criteria exceeded

Firstly, it is clear from the above figures that the assumed ranges in demand estimates result in considerable future uncertainty in how the LoS criteria will affect the proposed facility. This is evident in the width of the coloured bands in the figures above.

Nonetheless, the above figures illustrate that:

- a 4 m wide shared path is predicted to fall below Austroads' LoS criteria during busy periods, potentially affecting many hours and days per year
- a 5 m wide shared path is generally predicted to comply with Austroads' LoS design criteria, only exceeding it infrequently beyond 2035 and only in the upper demand estimate range.

Customer feedback

The 5m wide shared path is preferred over a 4m width by stakeholders such as Bike Auckland because it has the potential to separate walking and cycling by providing a 3m lane for cyclists and 2m for pedestrians. However other stakeholders felt that a shared space is safer as it creates a lower speed environment overall. It is expected that the issue of separation will need to be considered further in the next phase of the business case process.

Cost impacts

Providing for a 5m wide shared path has cost disadvantages over a 4m wide shared path and applies more load effects to the existing piers. Additional land is also required for wider approach structures at Northcote Point and Westhaven, although there is space available to construct a 5m wide structure.

Consenting considerations of a 5-metre option

The move to a 5m wide facility versus a 4m wide facility, whilst not assessed in detail, is likely to raise additional environment effects associated with overlooking and shading impacts of the path on neighbouring properties between Stokes Point Reserve and No. 9 Princes Street.

APPENDIX G: INTEGRATED TECHNOLOGY

In developing the recommended option, the potential role and scope of technology has been considered in relation to supporting operations and maintenance or enhancing customers experience. The table below outlines the options considered and incorporated into the scope of the project.

Table 28 – Technology options incorporated into the scope of the project

Service	Service Description	Included (Yes/No)	Additional rationale for inclusion/exclusion (where necessary)
Risk of harm through differential speeds			
User segregation	Physical delineation through engineering solution such as raised kerb with widths to be determined	Yes	Reducing the potential conflict between pedestrians and cyclists due to speed differential should be considered.
	Variable widths to respond to tidal flows using smart studs in the shared path.	No	Operational forecasts for a 5m shared path suggest that there will be no requirement for variable widths
Speed management	Speed calming measures such as rumble strips & signage	Yes	The potential speed differential between pedestrians and cyclists should be reduced.
Speed monitoring & enforcement	Speed monitoring through point-to-point via CCTV & machine vision (no personally identifiable information collected)	Yes	Monitoring speed differentials will allow the risk to be monitored and escalated as needed.
	Speed indicators	No	To be considered as part of visual warnings below.
	Visual/ audio warnings and/or notification of on-site personnel	Yes	The facility should have the capability to incorporate later (under a separate business case) should monitoring demonstrate a requirement.
Personal Safety			
Monitor	Incident detection via CCTV & machine vision, panic buttons (or emergency phone help stations as per bus stations) with audio link to TOC	Yes	Customers perception of safety is important. As a relatively long structure, the ability of users to obtain assistance will also be important.
Deter	adequate lighting and absence of concealment options (e.g. behind pillars etc)	Yes	CIPTED requirement for good design. (Zero additional cost beyond core design)
Respond	Audio warning, Notifying on-site personnel & police	Yes	Included in 'Monitor' above.
Benefits Monitoring			
Users	CCTV: counting & classification of users	Yes	Contributes to effective benefits realisation

Service	Service Description	Included (Yes/No)	Additional rationale for inclusion/exclusion (where necessary)
	Tourist user survey	Yes	Periodic cost undertaken and funded as part of ongoing operations
Capacity Control			
Monitor	Monitoring: in-/out- counts & CCTV machine vision	Yes	With a 5m corridor capacity constraints are unlikely, however, capability should be incorporated within the context of emergency closures and benefits monitoring.
Manage	Audio warning, closing the crossing to further entry. Exit only. (also applicable for emergencies)	Yes	
Emergencies			
Medical	Defibrillation units in strategic locations	Yes	Access for medical emergencies could be constrained and take some time to respond. Would require trained personnel to be available. Included within the DBC and to be reviewed in pre-implementation.
	Buggy with essential supplies	Yes	
Other / Evacuation	Audio warning, closing the crossing to further entry. Exit only. (also applicable for emergencies)	Yes	Safety and orderly evacuation in an emergency is essential. Given the length of the structure the safest egress may not be apparent and could be the furthest exit point.
	Escape arrows that can be changed to show exit direction	Yes	
Mode Shift			
Inter-modality	Ensuring good connections to other modes & visible connection information (e.g. VMS arrival times of connecting services)	Yes	Infrastructure for intermodal connections to be included in the core design. However, customer information services (VMS) are proposed here.
	Provision of shared cycle & micro-mobility options at either end of the crossing	No	Assumed to be proposed and delivered by commercial operators
	Bus service from Westhaven to the city.	No	Service proposals independent of DBC and subject to commercial considerations.
Customer experience	Water stations at key locations	Yes	Given the distance from alternative facilities this is considered an essential service and considered in core design
	Toilets at southern/northern landing	No	Existing facilities exist and are proposed by other projects.
	Improved 4G/5G coverage	Yes	Improves overall safety in addition to enhancing the customer experience
	Free Wi-Fi & tourist information via mobile app in exchange for customer insights	No	Provision enabled but service subject to separate commercial considerations separate from the DBC.
	Mobile apps and Incentives based on opt-in "customer loyalty" scheme	No	Subject to separate commercial considerations separate from the DBC.

Service	Service Description	Included (Yes/No)	Additional rationale for inclusion/exclusion (where necessary)
Structural Monitoring			
Monitor	Embedded fibre & IoT sensors	Yes	Effective and safe monitoring of the structure
Environmental			
Sustainability	Solar panels integrated as part of new structure	Yes	Carbon neutral options to support climate change outcomes

APPENDIX H: s 9(2)(j)

APPENDIX I: BUSINESS CASE REVIEWS AND AUDITS

As part of the development of the business case, and to support the investment assurance process, several discreet reviews and audits have been undertaken to improve the confidence in the project.

Structural Peer Review (ARCADIS)

A peer review of the design of the shared path structure has been carried out by Arcadis in the UK. Members of the peer review team have international expertise in this type of steel box girder structure and knowledge of the AHB structures from previous peer reviews. Initial comments from the peer reviewer have identified similar risks associated with the long-span bridges and mitigation measures as highlighted by the design team including the following:

Aerodynamic response to wind: the potential for susceptibility to wind-induced vibrations to be investigated in wind tunnel testing.

Pedestrian-induced vibration: this is critical to the comfort of users and mitigation is a detailed investigation of the synchronous pedestrian response which is likely to require the installation of multiple damping devices and controls on people numbers in major events.

Construction of Pier 5 and 6: these will be difficult to construct because of their height relative to sea level.

Safety audits

A safety audit has been undertaken with no significant findings. The NZ Transport Agency is in the process of preparing its response to audit with accepted recommendations proposed to be integrated into the next phase of the project.

Parallel estimate (Bond CM)

A parallel estimate was carried out by Bond CM who used the quantities supplied by the design team, but independently estimated programme, construction methodology and material supply rates. After reconciliation the parallel estimate agreed closely with the cost estimate.

DBC Peer Review (Commute)

A peer review of the DBC has been undertaken by Commute including a detailed consideration of the multi-criteria assessment of the long and short-listed options. Overall the review concluded that the DBC reads well and tells a compelling story of the process undertaken, the results of this process and the way forward. Recommendations with respect to providing greater clarity of option selection and funding have been incorporated into the final DBC.

Other Peer Review

In addition to the above EY has completed a review[28] of both the wider economics analysis developed by MR Cagney[9] and the demand forecasting and modelling work undertaken by Flow[8].

EY's peer review of the wider economic benefits concluded that:

> *"The methodological approach undertaken by MR Cagney reflects a reasonable application of standard methodologies and practices. Overall, conservative assumptions have been applied in the absence of specific information.*
>
> *The authors have disclosed areas where uncertainties are present and further work may be needed to refine estimates.*
>
> *The authors may wish to consider some restructuring* [of their report] *in terms of how the information is presented, in order to make it easier for the reader to understand key calculations that are specifically related to the project."*

In relation to the demand forecasting and economic benefit evaluation, EY's peer review concluded:

> *"The methodological approach undertaken by Flow, reflects a reasonable application of standard methodologies and practices in most instances. The authors have applied formulae and parameters as per contained in the Economic Evaluation Manual (EEM) guidance, when applicable.*
>
> *While some parameters may carry some level of uncertainty (for example, there is little evidence available on the effect of e-scooters over cycling demand given that this mode is fairly new), the authors have conducted sensitivity assessments to provide confidence that the overall results are not likely to change significantly given changes in these parameters.*
>
> *The authors may wish to consider updating these parameters once more evidence becomes available to refine the assessment."*

[28] Peer Review: economic benefits of a cross-harbour walking and cycling link (including wider economic benefits – WEBS), EY, June 2019