WAKA KOTAHI NZ TRANSPORT AGENCY

NZ UPGRADE PROGRAMME GOVERNANCE GROUP PAPER

Northern Pathway Westhaven to Akoranga Scope Change

Meeting Date	13 November 2020
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Pages	16
	In confidence

Purpose

This paper seeks approval to change previously defined scope and updates the Group on the potential impact.

Recommendations

It is recommended that the Group:

- **Notes** the Bridge Component Specimen Design was found unfeasible and that any option where the existing bridge or its foundations support a pathway are deemed to be unfeasible.
- **Approves** that an independent structure be pursued as the only feasible solution.
- **Approves** a scope change to investigate independent structure options that can unlock benefits additional to that of walking and cycling.
- **Notes** that an independent structure can unlock benefits and improve time and cost certainty.
- **Notes** that the indicative project outturn cost range for a five-meter-wide bridge pathway and a four-metre-wide land pathway is $500 to 600 million. This is significantly higher than the funding allocation of $360 million.
- **Notes** that this direction change will also result in a significant deviation from the NZUP Establishment Report scope.
- **Notes** that the recommendation exceeds the interim thresholds for cost and scope endorsed by the Governance Group and what has been socialised with the Oversight Group.

Strategic relevance

The Westhaven to Akoranga section of the Northern Pathway will provide a seamless dedicated walking and cycling link between Auckland's City Centre and the North Shore and is of high strategic importance to the completion of the Auckland cycling network.

Ministerial approval was granted on 12 May 2020 for the Waka Kotahi Board to have delegation to advance procurement activities for five early NZUP projects, including NPW2A.

Summary

An Interim Project Alliance (**IPA**) was established to progress the project from specimen design level to consent lodgement.

A bridge component specimen design and land component concept design produced by Beca were handed to the IPA as the scope basis. This scope is consistent with that outlined in the Establishment Report.

The corresponding cost estimate at the time of IPA commencement indicated that the project would require significant additional funding.

The IPA embarked on a cost scope challenge to not only test the constructability of the design, but also to investigate improvements that could be made The IPA considered scope changes to reduce risk, improve benefits and reduce costs in parallel to progressing the Beca design.

The cost scope challenge considered many alternatives and followed a process that shortlisted five potential alternative solutions for the bridge component. Comparatively feasible alternatives to the land component were also investigated. These are not discussed in this paper since several options are feasible, all with cost impact relatively minor.

The bridge alternatives were extensively evaluated. Two alternatives would be supported off the existing bridge whilst the other three on independent foundations in the harbour.

Summary findings were:

	Feasibility	Risk to existing bridge	Technical Certainty	Day to day user experience and safety	Potential for Benefit Improvements	Outturn Cost Estimate Range NZD million
Specimen Design	No	Extreme	Low	Good	Limited	500 - 600
Existing Bridge Widening	No	Very High	Low	Poor	None	250 - 350
Existing Truss Support	No	Extreme	Very Low	Good	Poor	insufficient estimation information
Independent Tr ss Span	Yes	None	High	Good	High	510 - 590
Independent Arch Span	Yes	None	High	Good	High	510 - 590
Independent Box Girder	Yes	None	High	Good	High	520 - 600

The IPA estimated the specimen design to cost significantly more than the previous estimate due to construction methodology, scope clarity, temporary land rental and P&G differences. An independent structure is expected to cost less than the specimen design.

The Specimen Design, Bridge Widening and Truss support options were deemed unfeasible due to the risk posed to the existing bridge. The Widening Option will reduce general traffic lane widths and presented poor user experience outcomes.

The independent structure shape or form did not indicate much differences between options. Either can be developed in consultation with specialists moving forward.

It is believed that further benefits can be unlocked should the width, shape and form of the structure be explored. This change in scope does however exceed the interim thresholds for the NZUP programme, in that this would represent a change to the scope set out in the Establishment Report.

The IPA has gathered significant momentum since established and can immediately explore options that may present additional value when considering an independent structure.

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Background

The project extends from Westhaven at the southern end of the Auckland Harbour Bridge through to Akoranga Drive and ultimately links to the next section of pathway Akoranga to Constellation Drive (see Attachment 1). In January 2020, the Government announced it would provide $360M to directly fund the Westhaven to Akoranga section of the Northern Pathway as part of NZUP.

The objectives of this project are to:

- increase the number of those walking and cycling to work across the Auckland Harbour Bridge from 0–3% of daily trips by 2028
- increase the number of daily walking and cycling recreation and tourism trips across the Auckland Harbour Bridge from 0 to 2,500
- increase the total number of walking and cycling trips between Esmonde Road and the Auckland Harbour Bridge to 1 500 by 2046
- improve transport system capacity
- improve access to community assets and the natural and built environment
- increase the number of households with access to the natural environment and community assets between Esmonde Road and the Auckland Harbour Bridge by walking and cycling

The scope for this project as outlined in the Establishment Report described the project as *'about five metres wide and attached as clip-on to the existing Auckland Harbour Bridge piers.'*

From January 2020 up to August 2020 the project developed a specimen bridge and a concept land component design. These designs were handed to the IPA to progress.

Figure 1: Bridge Component Specimen Design

Figure 2: Land Component Concept Design

The IPA was established on 1 September 2020 under the Interim Project Alliance Agreement (IPAA) with the following objectives:

- provide an environment for the further project development in parallel with obtaining the necessary statutory approvals.
- obtain a high level of confidence, in respect of both capital expenditure and ongoing operation and maintenance, that costs have been optimised.
- encourage innovation to optimise the project.
- facilitate the development of a high-performance team, innovative thinking, transformational leadership, and a high-performance culture which will continue throughout the duration and the term of the Project Alliance Agreement (PAA).
- facilitate the provision of further information regarding Waka Kotahi's requirements for the project; and
- facilitate the continuity of the Alliance process through to the implementation of the PAA.

An IPA team with significant momentum is presently established.

Key issues

Unfeasible Bridge Component Specimen Design

The IPA undertook a detailed review of the Bridge Component Specimen Design to identify any additional risks and opportunities. The review focused on key parts of the design philosophy, constructability, and cost requirements of the specimen design.

Beca had noted that there may be significant technical risks that the IPA may not be able to resolve in subsequent design phases. Beca had identified substructure elements of the bridge specimen design as areas of concern.

Subsequently, the IPA identified two significant areas of concern being the constructability of the pier brackets and the design of tie downs which were designed to counter-balance the eccentric load demands from addition of the Pathway.

Pier Brackets

Precast concrete pier brackets were proposed to transfer the load into the existing concrete pier walls, avoiding the highly concentrated areas behind the existing box girder extension pier brackets.

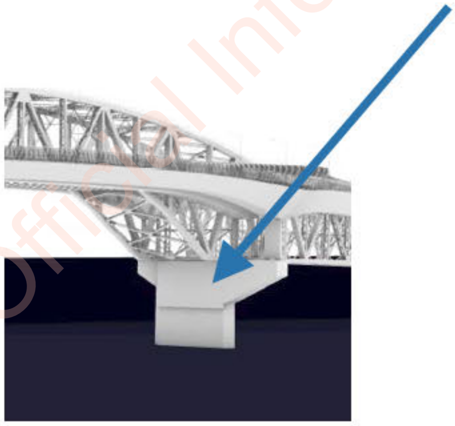


Figure 3: Pier bracket in section and as final view

From a constructability point of view the following issues were identified:

- Coffer dams at Pier 5 and 6 would have been required;
- Overhead restrictions are complex and there is a risk of accidental damage to the existing bridge;
- Significant volumes of marine sediment would need to be excavated posing an environmental challenge;
- The required drilling may impact on the resilience of the existing structure;
- The existing walls' ability to tolerate the pressure associated with grouting the cavity between the brackets and the wall is challenging to quantify;
- Access into the existing piers will require permanent modification to the rocker slab;
- Cross struts which are required between the walls of the piers will weigh more than 300kg; and
- Manual manipulation and temporary support requirements will need to be confirmed as there is no potential for crane assistance due to the space and headroom constraints.

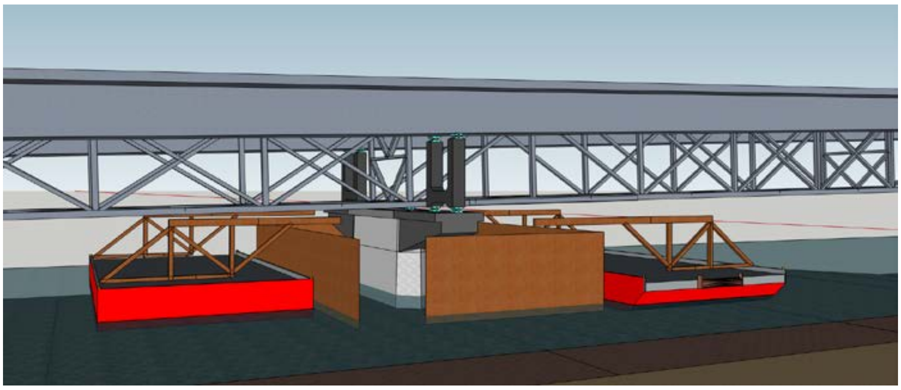


Figure 4: Low height under truss bridge restricts coffer-dam walls

Tie Downs

Ground Investigation results indicated that the assumed rock strength was lower than anticipated and a potential fault line was identified on the western side.

Consequently, Beca updated the specimen design to require four numbered inclined pre-stressed 'tie-down' tendons on the west side of each pier to counter balance the eccentric load demands from addition of the Pathway.

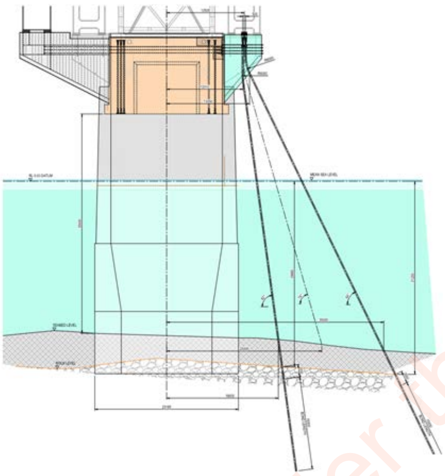


Figure 5: Tie Downs - Overturning Restraints

This design element contradicts the original design philosophy constraint of no permanent works in the CMA (Coastal Marine Area). Other issues associated with this design element include:

- The location of the tendons makes them extremely susceptible to accidental or deliberate damage. The risk of ship impact may require mitigation in the form of onerous protection barriers for the tendons that will result in further work in the CMA; and
- There are significant design unknows with regards to the current pier and existing structure condition as well as the exact location of support elements. Current geotechnical knowledge under the piers is limited.

Furthermore, there is a high potential for scope creep during detailed design to ensure the designs for the Pier Brackets and the Ties Downs are fit for purpose.

Given that the Pier Bracket and Tie Down designs will require further extensive risk mitigation, the Specimen Design was summarised as unfeasible due to:

- Risk of extensive additional implementation cost.
- Technical integrity risk to existing bridge structure.
- Consenting risk due to visual effects and works in the CMA.
- Added health and safety construction risk; and
- Environmental risks due to extensive sediment removal.

Supporting another structure on the existing bridge is not recommended

It was established that the existing bridge is at capacity to support the current loads. Any addition to the bridge structure will require pier strengthening outside of the current scope mandate.

It became apparent that although the current bridge condition remains sound information is insufficient to support an additional pathway design that can:

- ensure that the long-term integrity of the bridge is not negatively affected.
- be of the magnitude required to achieve positive user experience.
- ensure that wind loads do not push the foundations beyond acceptable limits.
- avoid pier strengthening with a risk of damaging the existing structure; and
- avoid pier strengthening with a risk of works in the CMA

In summary, adding to the existing bridge cannot be done without adding significant risk.

Independent structure feasibility

During the scope cost challenge, the IPA investigated several alternatives to the specimen design for the bridge component of the project. The shortlist options were:

- Existing Bridge Widening (supported by existing bridge)
- Existing Truss Support Route (supported by existing bridge)
- Independent structure – Truss Span Configuration
- Independent structure – Arch Span Configuration
- Independent structure – Box Girder Span Configuration

The Existing Truss Support Route and the Existing Bridge Widening solutions both add significant risk to the existing structure. These two options were however considered for a period during the cost scope challenge and then later abandoned due to the previously mentioned risks of being supported by the existing structure. Only the Widening option was estimated, the Truss option did not have enough information at the time.

Below is an outline of each of the options.

Specimen Design

This option is the Beca Specimen Design. The IPA evaluated this to gain an understanding of the relative difference between options when compared.

Figure 6: Specimen Design

Existing Bridge Widening

This option is an existing bridge supported alternative, which provides the minimum provision of a pathway, using the existing superstructure without a reduction in the number of traffic lanes.

The option provides a 4m wide path immediately adjacent to the existing carriageway through a continuous 1.90m flange widening of the existing East (Southbound) box girder. This is in conjunction with transfer of the existing traffic barrier and a reduction of width of the existing traffic lanes to 3.2m.

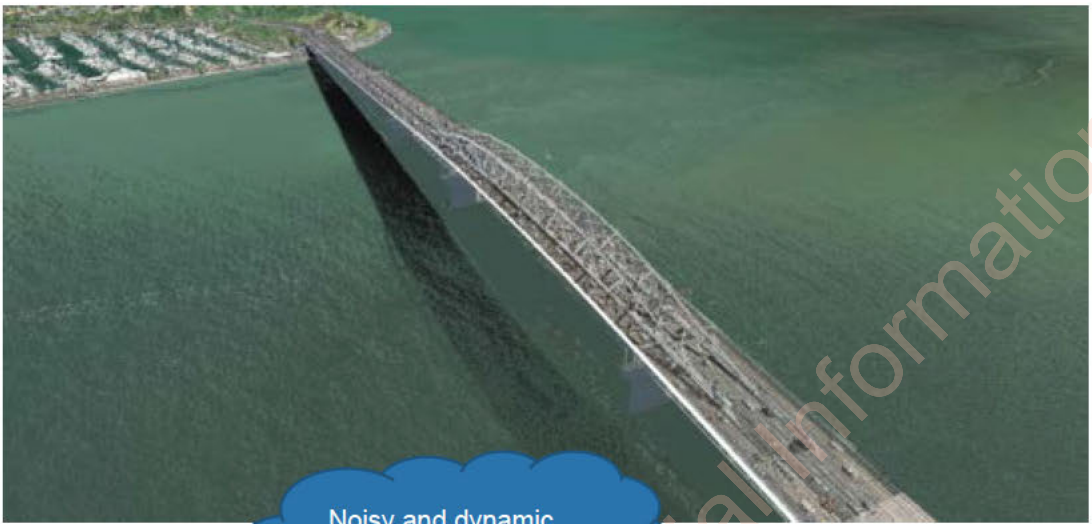
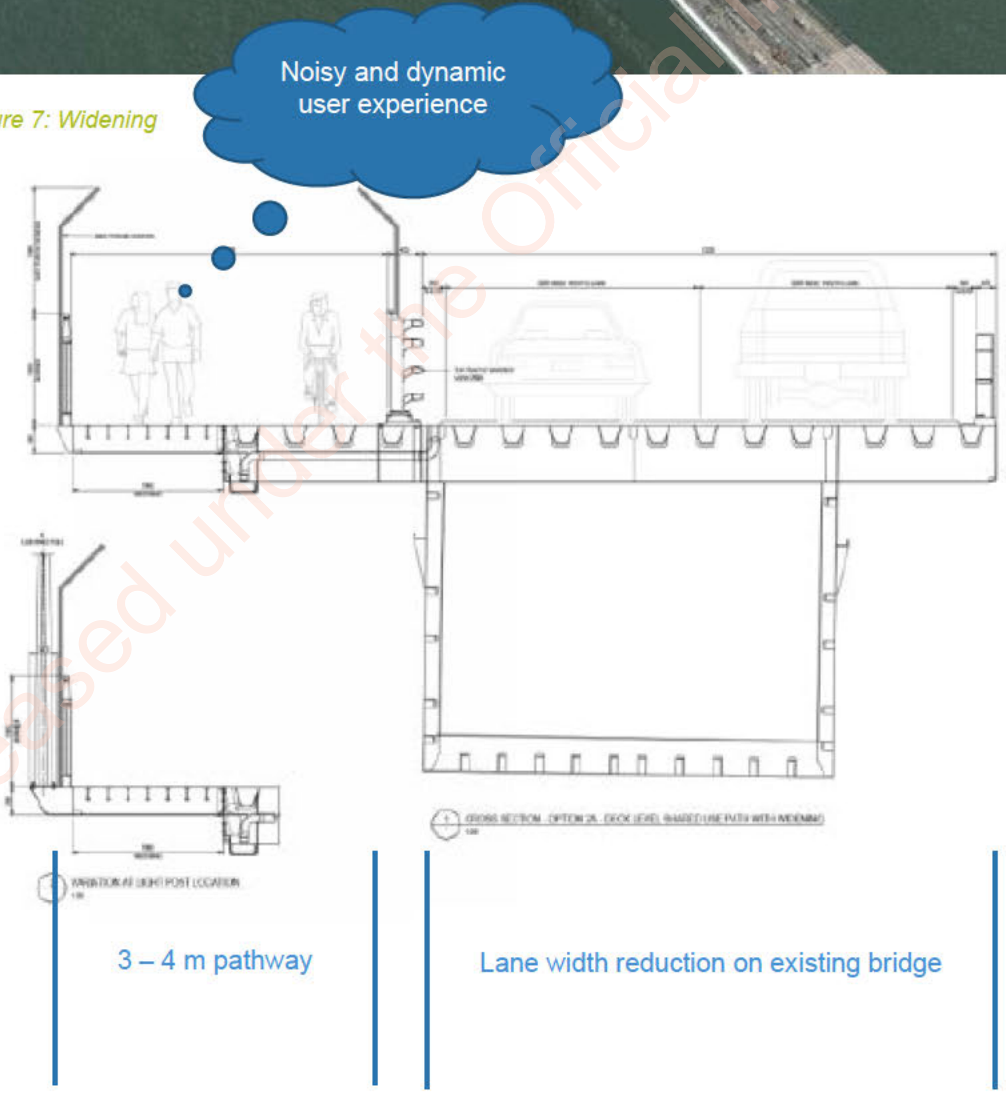


Figure 7: Widening



Existing Truss Support Route

This option consists of a modular suspended steel structure that is directly supported by the existing bridge truss superstructure. The pathway is generally positioned under the existing bridge and weaves through the truss. Note the final route is to be determined to maximise user amenity, while minimising impact on the existing bridge.

Figure 8: Truss Support

Independent structure – Truss Span Configuration

This option is based on an independent structure with separate foundations. It replaces the proposed box girder span in the specimen design with a tapered steel truss throughout. The truss top chord has been positioned at 3.5m above deck level to maximise structural efficiency, match the proposed soffit of the specimen design, and maintain navigation clearances at mid-span.

Figure 9: Truss Span

Independent structure – Arch Span Configuration

This option is based on an independent structure with separate foundations. It replaces the proposed box girder span in the specimen design with a 170m long network arch over the navigation channel. Two cantilever spans are implemented at Piers 1 and 2 to enable a reduced length for Span 2. The approach spans consist of underslung tapered truss elements that match the depth of the existing bridge profile at the piers, reducing in section depth towards the centre of the span to optimise the efficiency of the section.

Figure 10: Arc Span

Independent structure – Box Girder Span Configuration

This option is based on an independent structure with separate foundations. It maintains the box girder span configuration as per the specimen design. However due to changes in the span articulation, optimisation of the box girder section may be possible.

Figure 11: Box Girder

The five options were evaluated and ranked compared to one another in a non-price attribute review.

Given that the Suspended Truss option was discontinued due to risk and a lack of information it became apparent that an independent structure option would be the most feasible.

There were marginal differences between the types of independent structures.

The IPA recommended:

- not to proceed with the specimen design nor any other option supported by the existing AHB structure; and
- the development of an independent structure in partnership with mana whenua and in consultation with key stakeholders.

The project team requests approval that an independent structure be pursued as the only feasible solution.

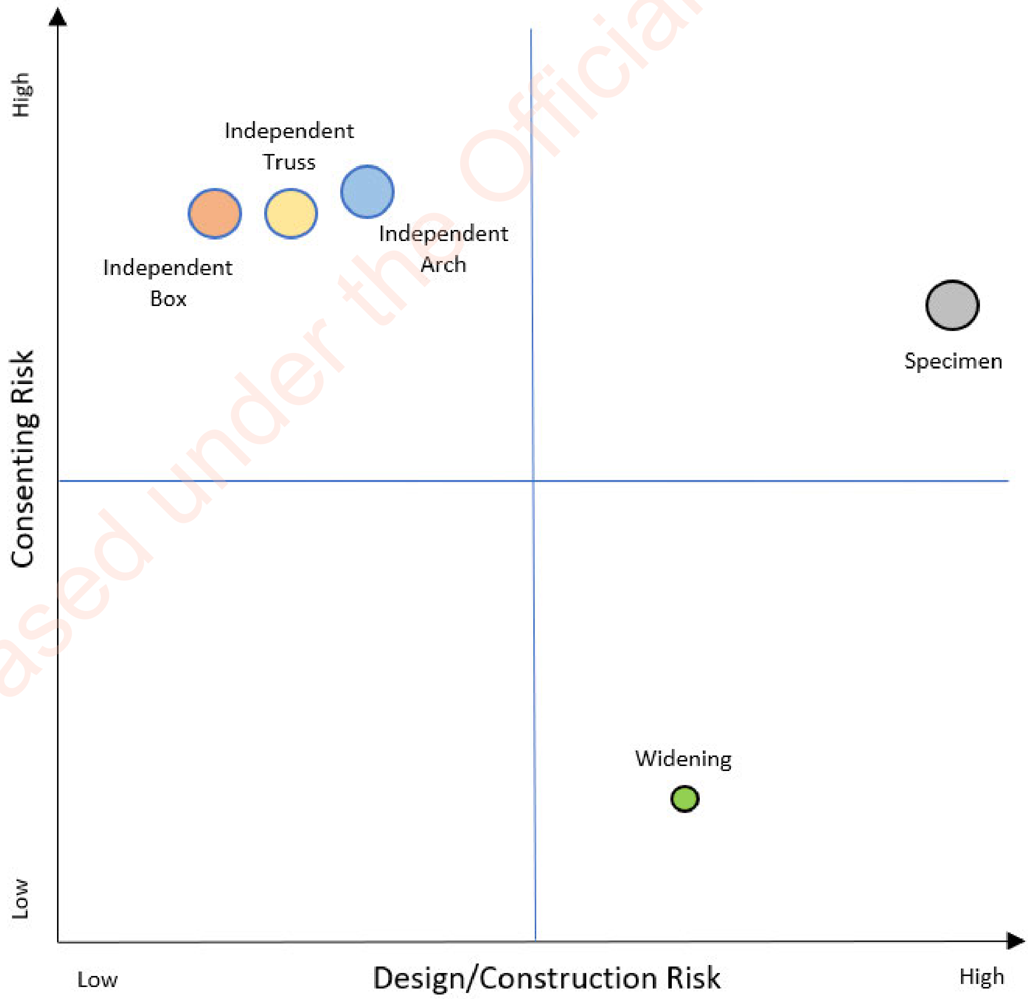
Independent structure certainty

The options were compared to one another in a risk review and ranked.

Apart from during the consent period of the project, an independent structure option presents the least risk.

The key independent structure risks compared to the Specimen Design risks shows:

Consenting	**Similar** (both require work in the CMA)
Cost	**Lower** (less design input unknowns, less construction constraints, no brownfield or current bridge operational constraints)
Schedule	**Lower** (less design input unknowns, less construction constraints, no brownfield constraints)
Quality	**Lower** (no residual impact on the existing bridge, know design inputs)
Health and Safety	**Lower** (less constrained working environment, known and tested construction methods, no operational impact on existing bridge)



After risk analysis, it became evident that the integrated risk profile with the specimen design or any other design that is connected to the bridge far exceeds that of an independent structure.

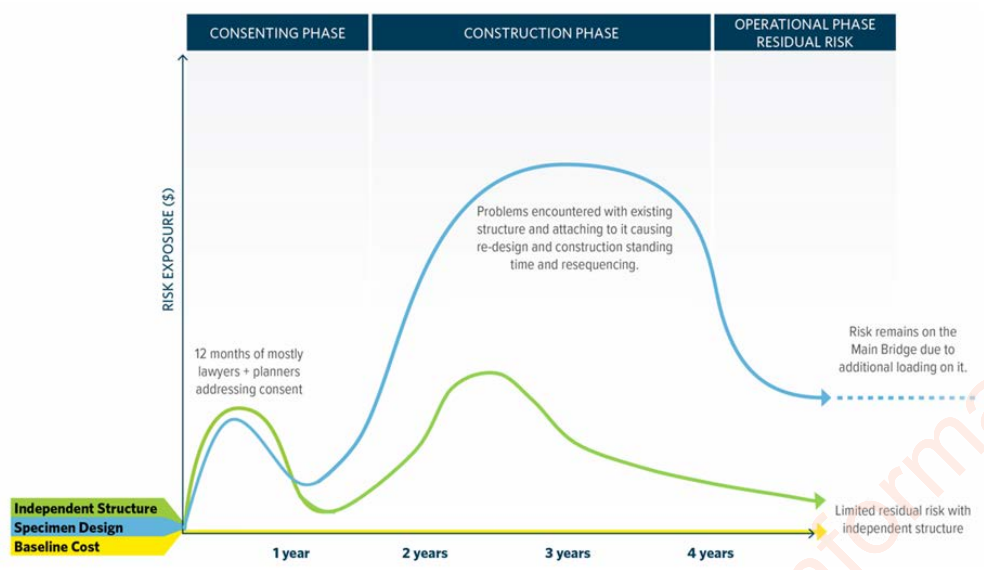


Figure 12: Asset Resilience Risk Comparison

Project outturn costs

The IPA did a first principle cost estimate for the specimen design as well as the alternative options.

The suspended truss option was not estimated due to lack of information being available.

A cost reconciliation exercise is in progress to establish estimation differences. The IPA is working with Beca and Bond CM who produced the previous estimates. Preliminary indications of difference are due to construction methodology, scope clarity, temporary land rental and P&G differences

A similar independent (5m wide) structure is expected to cost less than the specimen design and present less risk. (the main reasons for this are construction methodology related items such as; rigging space under the current structure, proximity to operational traffic, constrained working space in existing piers)

	Outturn Cost Estimate Range NZD million
Specimen Design	500 - 600
Existing Bridge Widening	250 - 350
Existing Truss Support	insufficient estimation information
Independent Truss Span	510 - 590
Independent Arch Span	510 - 590
Independent Box Girder	520 - 600

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