Post Project Review

Wynyard Crossing Bridge Remediation

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Version History

Version	Date	Details	By	Reviewed By
0	30/01/2025	Draft for Comment – Part 1	M. Paterson	F. Robertson
0.1	04/02/2025	Part 2 - Draft for Internal Review	M. Paterson	F. Robertson
0.2	11/02/2025	Part 2 – Draft for Internal Review	M. Paterson	C. Jensen
1	17/02/2025	Final Document Issued (Part 1 & Part 2)	M. Paterson	F. Robertson
2	17/03/2025	Changes made to reflect additional information and clarifications provided by Eke Panuku.	M. Paterson	F. Robertson / A. Williams
2.1	18/03/2025	Incorporation of clarifications to address queries raised by Eke Panuku.	M. Paterson	F. Robertson
2.2	30/04/2025	Incorporation of clarifications to address queries raised by Wider Project Team.	J. Jones	F . Robertson

Contents

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1 Introduction

The purpose of this report is to provide a post-project review for the Wynyard Crossing Bridge Remediation. It is split into two parts as outlined below:

- **Part 1: Causes and Contributing Factors to Bridge being Removed From Service** – Outline causes and contributing factors that lead to the bridge being removed from service and any lessons learnt and/or recommendations to improvement for future asset management.
- **Part 2: Project Delivery Review** – A post-project review of the capital project outlining performance in respect to project goals, specifically scope, programme, cost and quality.

Part 1: Causes and Contributing Factors to Bridge being Removed From Service

1 Executive Summary

Part 1 of this post-project review examines the causes and contributing factors that led to the Wynyard Crossing Bridge being removed from service for remediation.

In late-2023 and early-2024, a series of faults and issues were identified, causing significant reliability and safety concerns that resulted in the bridge being taken out of service. The decision to remove the bridge from service was based on the cumulative impact of multiple issues encountered in late 2023 and early 2024 which created a lack in confidence in the overall reliability and safe operation of the bridge. Removing the bridge from service was a justifiable action to ensure safety and allow for an efficient and comprehensive overhaul and refurbishment of the critical components.

Considering long lead times for replacement parts, Eke Panuku decided to integrate these critical repairs with planned coating and structural maintenance planned for 2024 which required substantial downtime in the bridge's operation. Even without the issues and faults experienced in late 2023 and early 2024, a long closure would have been required to complete planned structural and coatings maintenance in the order of at least four months. Eke Panuku's decision to take the bridge out of operation mitigated risks of further disruption or breakdown of the bridge in the period leading up to the remedial works.

The faults and issues experienced in late-2023 and early-2024 were found to result from inadequate maintenance and asset management strategies that failed to detect or prevent the issues through regular maintenance and inspections. It should be noted that although maintenance was found to be inadequate, there were extensive efforts to maintain and understand the condition of the asset. This can be demonstrated by multiple inspections and reports, along with not insignificant expenditure on maintenance. Faults and issues which caused the bridge to be removed from service were compounded by and contributed to by aspects that existed from day one of bridge operation, including but not limited to completeness of O&M manuals and preventative maintenance plans, operational aspects of the design and a mismatch between intended frequency of operation and operation in reality.

The bridge is unique due to being a double lifting bascule bridge that incorporates mechanical, hydraulic, electrical, and structural components. An operable bridge of this level of complexity demands specialist expertise to satisfy its unique operational and maintenance requirements. Taking responsibility for a unique asset like this is not a business-as-usual function for Eke Panuku, noting that the required specialist expertise would be a rare capability for any local authority or CCO to hold. Eke Panuku recognised the need for specialist expertise and believed that appropriate specialists had been engaged but, following the bridge being removed from service, it became readily apparent that this was not the case.

It is recommended to ensure that the person(s) and organisation responsible for the asset possess the best fit and requisite expertise for managing the specific asset (having regard to it nature and type) and careful consideration should be given to the engagement of required external experts and the letting of maintenance contracts. This should include ensuring these engagements are properly scoped and briefed to ensure sufficient expertise is retained and required outcomes are met.

It is recommended that a more detailed and fit for purpose Asset Management Plan (AMP) is developed for the bridge to inform preventative maintenance plans. An AMP was in place for the bridge as part of the broader Waterfront Asset Portfolio as of 2021, however, at this point in time the AMP was guided by the strategy to replace the bridge in 2023. While attempts prior to 2021 to secure funding to replace the bridge had been unsuccessful, the mindset was that the bridge was temporary with an overall plan, although delayed, to replace the bridge. When a decision was made not to replace the bridge, a condition assessment was completed in April 2021 to inform a revised AMP specifically for the bridge. Earliest versions of this AMP were provided in the second half of 2023. Due to the limited record keeping, both the Condition Assessment in 2021

and AMP produced in 2023 had significant shortcomings and found to be inadequate in preventing faults and issues which caused the bridge to be removed from service.

It is recommended that a more detailed and fit for purpose preventative maintenance plan is developed for the bridge. Although preventative maintenance plans were in place prior to the bridge being removed from service, they did not fully cover all bridge components and all Original Equipment Manufacturer (OEM) recommendations. Preventative maintenance plans need to consider the bridge holistically and ensure all OEM maintenance requirements are met and should take a risk-based approach to mitigate risks of bridge breakdowns.

2 Introduction

2.1 Purpose

The purpose of Part 1 of this review is to summarise causes and contributing factors as to why the Wynyard Crossing Bridge was required to be removed from service for a period to conduct bridge remediation works.

2.2 Background

The Wynyard Crossing Bridge, a double lifting leaf bascule bridge, was constructed in 2011 with the intention of it being a short-term solution. When originally installed, the bridge was actuated via a hydraulic powered winch. To address reliability issues in 2020, the winch was converted from a hydraulically operated winch to a regenerative electric drive unit.

From late-2023 through to early-2024 a series of faults were encountered with the bridge. A decision was made to remove the bridge from service due to safety risks caused by faults and issues and concerns about ongoing reliability. Due to long lead times of replacement parts, a decision was made to coincide the critical repairs with the paint and structural repairs that were already planned for later in 2024 and required significant down time.

It is understood that maintenance had been carried out over the years by a number of contractors, in recent years prior to the bridge's removal from service, mechanical and electrical maintenance had been conducted by Mac Group and Highway Electrical respectively. Several condition assessment reports had also been produced by other third parties (as summarised in Table 1 below). The purpose of the below table is to demonstrate the engagement of specialists and inspections undertaken leading up to the issues identified in late-2023. It should be noted that routine inspections and preventative maintenance occurred alongside this.

Table 1: Schedule of Prior Inspections and Recommendations (non-exhaustive)

Consultant / Contractor	Date	Report Details (Legend: Title; Scope or Brief; *Key Findings*)	RCP Comments
Beca	14/5/2013	*Bridge and components generally found to be in good working condition*	
Opus	12/8/2014	*Excess wear on the trunnion and cheek plates believed to be caused by the bridge being out of alignment. 4 options proposed, Option 2 chosen: replace damaged components and not address the alignment issue.* *Reinforcing plate and pin design adjusted slightly compared to the original to allow for the potential unalignment."*	Can confirm these works were completed, once bridge was removed from service it was determined construction methodology was followed but included a bronze bush. Condition of connection was inspected and found to be in good condition.
TBS Group	19/9/2017	Maintenance Assessment for Extended Life Assessment of options and costs to maintain the bridge including lighting, control systems, mech components and protective coating.	Report only recommended a small number of upgrades (~60k) to see though 2021 America's Cup, some of these were known to be completed. Recommendations for extended life (~$1m) were likely not

Consultant / Contractor	Date	Report Details (Legend: Title; Scope or Brief; *Key Findings*)	RCP Comments
		Bridge and systems in sound condition but to ensure reliability electromechanical components should be replaced or fully refurbished. *Coatings on the bridge generally performing well apart from under the deck and the machine house.* *One off cost for coatings $235k with annual maintenance costs of $25,500* *Recommendation to turn the winch drum over so the wire runs onto the bottom of the drums, requires the fitting of a roller for the rope to sit on as it approaches the winch* *$398k for mechanical plant refurb* *$323k from Highway Electrical for electrical and control systems* *Life to be extended indefinitely requires an estimated $954k investment with ongoing maintenance of $23,700/annum*	completed, based on items which would be evident.
Beca	10/6/2019	Condition Assessment Assess structural condition to provide an update to 2017 assessment. To provide recommendations to maintain the structure until 2023. *Piles were moderate condition but no remedials due to the 2023 date. It was noted that the extent and severity of corrosion had progressed since 2017 assessment.* *Minor patches of corrosion listed across the structure* *Chipping in the deck surfacing showing signs of corrosion on the deck plate* *Fender pile cap missing* *Balustrade dowel joints failed* *Recommended undertaking monitoring inspections every 2 years*	It is understood that these recommendations were on the basis that the bridge was going to be replaced in 2023.
SRG Global	8/4/2020	Wynyard Crossing Resilience Enhancement *Bridges failures at this point were build-up of deposits of hydraulic oil damaging pumps and motors and the installation of a larger diameter cable than the winch and sheaves were designed for. The cable was replaced, and winch and sheaves repaired, not seen as significant ongoing risk.* *Options to rectify were replace hydraulic system or swap to a new variable speed electric drive. An electric motor system was installed as per the recommendation. The hydraulic system was left in place to reduce outage time of the bridge* *Original design life of 7 years, operating for 8.5 years when report written* *Well defined inspection and maintenance regime* *16-week lead time for items from Italy*	The design documentation to suggest that the 7-year design life statement is correct in this report.
Resolve Group	April 2021	Condition Assessment Report Assessment of the current condition which will form part of an overall asset management plan. *Condition assessment report, Table 1 gives a summary of bridge components and life expectancy.*	This report was compiled to inform a revised AMP and SPM update.
Mac Group	6/5/2022	Mac Group visual inspection report *Rainwater contaminated with hydraulic oil from redundant system* *Remove existing redundant hydraulic system* *Bilge pump not plumbed correctly and sensor needs adjusting*	

Consultant / Contractor	Date	Report Details (Legend: Title; Scope or Brief; *Key Findings*)	RCP Comments
		Roller under bridge worn so cables rubbing on bridge structure *Overspray from the rocol wire on gratings, walls and dripping to the areas below* *Multiple areas of the guards have corroded* *General areas of corrosion across the steel structure and cable trays* *Build-up of old grease on trunnion pins, backstay and pulley assembly* *Engine room hatch asphalt has worn and corroding* *Damaged packers between the bridge and wharf connection* *Backstay not fully extending* *Sliding mechanism worn out due to lack of lubrication* *Westend engine beam not supported*	
NZ Corrosion Services	12/06/2023	NZ Corrosion condition assessment/remedial recommendation *Visual inspection and magnetic dry film thickness gauge inspection* *Concern over the topside weld of the piles and corrosion to the underdeck beam supports. Structural engineer to review for structural integrity.* *Galvanic corrosion occurring in several locations where stainless steel is in direct contact with other metals* *Repairs proposed are for spot repairs due to the majority of the paint being in good condition. Being carried out with mechanical surface prep to reduce costs and hazards compared to abrasive blasting process. Based on paint system being PUR 5.*	

3 Issues and Faults

A summary of the series of issues and faults that led up to the bridge being taken out of service in March 2024 are listed in Table 2 below.

It is noted that this list is not exhaustive and does not reflect the volume of faults and maintenance callouts. It should also be noted that, based on discussions with specialists involved at the time and Eke Panuku staff, there were other faults that occurred during the same period, of which full records have not been provided or do not exist. The combination of these faults and other issues created a lack of confidence in the reliability and overall safety of the bridge's operation, which in turn contributed to the decision to remove the bridge from service on the 14th March 2024.

Table 2 - Timeline of 2023/2024 Issues and Faults

Date	Issue/Fault
November 2023	Intermittent issues with electric brake on eastern lifting leaf appear causing brake to stick and inhibit bridge movements disrupting bridge operations.
22 January 2024	Faulty brake relay issue identified causing motor brakes to not release causing system faults and the bridge to not operate.
25 January 2024	Shifted to single leaf operation where possible because of brake issues on eastern lifting leaf. Western also checked, ok but wear was present.
28 January 2024	During manual operation lock pins were not retracted properly causing damage to bridge, no disruption to operation.
19 February 2024	Brake linings replaced on eastern lifting leaf. This partially resolved issues, some intermittent issues continue, replacement brake assemblies were on order.
February 2024	Brevinni (OEM supplier of winch) consulted, Brevinni informs that winch units have not been maintained or refurbished, unknown condition. Note it is highly unlikely that maintenance was completed by others due to a lack of a spare winch and the likely need for support from Brevinni to undertake such maintenance and refurbishment.
13 March 2024	Western lifting leaf, issue appeared with wire rope jumping, wire rope inspection completed by rope supplier. Wire rope failed inspection.
14 March 2024	Wire rope replaced; issue persists on western leaf.
	Decision made to take bridge out of service until repairs/refurbishment can be completed.

From the above items, three critical issues and faults can be identified as the catalyst for the bridge being removed from service on the 14th of March 2024. These are summarised in Table 3 and further explained within.[1]

Table 3 – Critical Issues and Fault

Issue/Fault	Details
Electric Brake Fault (eastern lifting leaf)	Intermittent issues with brake on eastern lifting leaf appear, causing electric brake to stick and inhibit bridge movements disrupting bridge operations.

[1] Based on discussions with representative from Resolve Group

Winch Drum Issue (western lifting leaf)	Rope jumping issue
General Winch Condition (both sides)	Brevinni (OEM supplier of winch) informed that winch units had not been maintained or refurbished, unknown condition.

3.1 Electric Brake Faults

It is important to note that the bridge winches are fitted with two brakes. There is a hydraulically actuated brake on the winch drum and an electrically actuated brake, outboard of the electric motor, which was added when the hydraulic drive unit was replaced with an electric drive in 2020. Excessive wear was detected on the electric brake.

In November 2023, issues with the electric brake sticking and not releasing on the eastern span were encountered. This led to the inspection of brake linings which found the brake linings to be significantly worn to the point of steel on steel. New brake linings were ordered. Until brake linings could be replaced, single span lifts were undertaken wherever possible on the western span leaving the eastern span in the down position unless vessel size dictated otherwise.

Issues with the electric brake persisted once the brake linings were replaced, this was understood to be due to damage to the brake housing assembly because of excessive wear. A replacement brake housing was ordered to replace the faulty unit, this was later fitted as part of the refurbishment of the bridge.

3.2 Winch Drum Issues

It is understood that the winches were fully refurbished when the drums were replaced in 2019 and again in 2021 , but no records could be found evidencing this. Notwithstanding, the wire rope was replaced as part of attempted repairs prior to the bridge being removed from service to exclude wire rope damage or wear as a cause, but on testing with a new winch rope fitted, the winch drum groove issue remained.

In March 2024, the west span encountered an issue with the rope jumping on the winch rope drum. The rope was not tracking on the winch drum groove correctly, resulting in the winch rope double layering itself instead of being in the correct groove. As a consequence, the rope would momentarily 'correct' itself, resulting in the winch rope jumping back down into the correct groove. There were concerns around this jumping motion which created a shock loading and potential damage to wire rope and other bridge and winch components.

3.3 Winch Condition

In February 2024, Brevinini (the OEM supplier of the winch) stated that the winch units had never been serviced causing some concern around the overall reliability of the winch. This included the hydraulic brake unit which provided some redundancy to the electric brake unit. Note it is highly unlikely that maintenance was completed by others due to a lack of a spare winch and the likely need for support from Brevinni to undertake such maintenance and refurbishment.

4 Decision to Remove Bridge from Service

The series of issues and faults and the uncertainty relating to thecondition of the winches created a lack of confidence in the reliability and safe operation of the bridge which in turn drove Eke Panuku to make the decision to remove the bridge from service.

Short of refurbishment of the winch, no alternative solutions to the wire rope jumping issue were apparent. Without resolving this wire rope jumping issue, the only way to operate the bridge safely would have been via single span lifts on the eastern side which had ongoing electric brake issues and a winch of unknown condition, both of which posed their own risks.

As discussed above, in addition to these key issues, there was also a series of other faults and issues encountered in late 2023 and early 2024. Based on discussions with Eke Panuku staff who were involved in the bridge at this time, clear reasons

and causes for these issues and faults was not adequately provided by the relevant specialists and contractors, leaving Eke Panuku without assurance that these faults and issues were being sufficiently addressed by specialists and contractors so as to prevent their recurrence and/or address the risks posed by the faults and issues. The cumulative effect of these issues and the uncertainty associated with their appropriate remediation created a lack of confidence in the reliable and safe operation of the bridge.

5 Potential Causes and Contributing Factors of Issues and Faults

Likely causes and contributing factors of the identified issues and faults are summarised in the Table 4 below and further explained within this section.

Table 4 - Potential Causes and Contributing Factors

Issue / Fault	Type	Cause/ Factor	Description
Brake Issues	Likely Root Cause	Manual Operation	When the bridge was originally configured, it was not configured to allow for semi-automatic operation of single spans i.e. the only way to lift a single span is in a fully manual mode which created the risk of operator error (understandable) and could have led to excessive brake wear. It is understood that manual operation became more frequent and routine when issues were arising meaning single span lifts were required. Standard Operating Procedures and O&M Manuals didn't reflect this particular risk.
	Possible root/contributing cause	Hold brake being used to decelerate bridge	The electric brake is designed as a hold brake, if the electric drive unit was correctly setup the drive unit would slow bridge movement down and then the brake applied, if done incorrectly the brake could have been applied too early resulting in excessive wear.
	Contributing Factor	O&M Manuals not updated post winch drive replacement/upgrade	Requirements to check brake pad linings was not included in O&M manuals and O&M manuals were never updated post upgrade to electric drive unit.
	Contributing Factor	Lack of Preventative Maintenance	O&M manuals were not updated when winch drive unit was replaced with electric drive unit. Preventative maintenance checklists did not include specific checks on brake pad linings.
	Contributing Factor	Inadequate management of upgrades/modifications	Closeout process of project to make modifications to drive setup should have captured need to update O&M manuals and maintenance requirements.
	Contributing Factor	Lack of critical spares	No critical spares held, thus delays in fitting replacement linings which resulted in use of manual single lifts until repair could be implemented.
Winch Rope Drum Tracking	Likely root cause / contributing factor	Age of winch drive	Winch had been in service for approx. 13 years, it is likely that the age of the winch drive coupled with lack of tension roller led to wear of winch drum grooves.
	Contributing factor	Lack of level wind / tension roller	It is likely that the root cause of this issue is excessive wear of the rope drum grooves (this can only be confirmed by checking wear of winch drum grooves which had been removed prior to RCP involvement). The original Mechanical and Hydraulic Spec specified that a tension roller was to be fitted which may have minimised wear and mitigated the issue.

	Possible Root Cause	Misalignment of sheave leading to winch drum wear	Maintenance report from TBS Group in 2017 references an issue with the alignment of the last sheave feeding into the winch drum. If this was not remedied, or wear/damage caused a repeat of this issue it could have led to excessive wear of the winch drum.
	Possible contributing Factor	Manual operation	It is possible that use of manual mode may have contributed to excessive wear, this cannot be confirmed.
	Contributing factor	Incomplete O&M Manuals	O&M manuals did not include maintenance requirements for winches or OEM manuals for the winch (based on copies of O&M manuals provided).
	Contributing factor	Lack of thorough preventative maintenance which covered all bridge components	Although preventative maintenance checklists existed, they did not include specific checks on the winch drum or specifically the grooves.
	Contributing factor	Undetected Wear	Regular inspections of the winch don't appear to have been undertaken as such wear was not detected. Regular inspections are assumed to not be undertaken due to gaps in preventative maintenance schedules which did not cover all bridge components.
	Contributing factor	Lack of critical spares	Lack of critical spares meant that winch units couldn't be removed from service for inspection/refurbishment as they approached their design life.
Unknown condition of winch unit due to lack of maintenance	Likely Root Cause	No maintenance conducted	No evidence of specific maintenance of winch units
	Contributing factor	Winch OEM manuals not included in O&M Manuals	Not included in copy of O&M manual provided.
	Contributing factor	Lack of critical spares	No critical spares, spare winch unit to facilitate significant maintenance without significant disruption to bridge operation.
	Contributing factor	Maintenance personnel	Multiple parties completing maintenance, unclear scope and extent of maintenance, no single person/entity responsible for holistic maintenance.

5.1 Electric Brake Issue

The brake issue observed in late-2023 is attributed to wear that may have resulted from various factors.

There is no evidence that the brake linings were ever inspected or replaced as part of routine preventative maintenance. The only check mentioned in servicing checklists relating to brakes was to check that the brakes were engaging. A risk-based holistic approach to preventative maintenance would likely have highlighted the issue that a brake failure would create and led to the development of appropriate maintenance strategies, including holding of spares and routine checks of brake linings for wear.

There is no evidence that a change management process was implemented when the bridge was changed from hydraulic to electric drive which included the install of the electric brakes in question. A proper change management process would have addressed required changes to O&M Manuals, Preventative Maintenance Plans and critical spares holdings to reflect changes made to bridge components. This would likely have prevented this issue from progressing such that it became a contributing reason for taking the bridge out of service.

Manual operations may have contributed to increased wear. When the bridge was originally installed, it wasn't designed for semi-automatic operation of single spans, meaning the only way to lift a single span was manually. This created the potential

for additional brake wear due to the stop/start actions associated with manual operation. The original design did not accommodate the necessary operational mode. Manual operation became more common and routine when issues with the bridge emerged, necessitating manual single span lifts. The Standard Operating Procedures and O&M Manuals did not address this specific risk, nor did they provide guidance on when manual mode should be utilised. In summary, limitations with the original bridge design contributed to issues leading to the bridge being removed from service.

5.2 Winch Rope Drum Tracking Issue

Replacement of the wire rope precluded rope wear or rope damage as a cause. The root cause of this issue is most likely due to excessive wear of the rope drum grooves. How the wear occurred remains unclear, it is possible that this is due to normal expected wear due to age alone or in conjunction with other contributing factors.

The original Mechanical and Hydraulic Specification specified the need for a tension roller. It is possible that a tension roller may have either limited wear and/or mitigated the issue with misfeeding of the wire rope on the winch drum. As part of the 2024 refurbishment, a level wind unit was fitted which guides the wire rope onto the grooved winch drum in the correct position. A level wind may have also prevented this issue, but regular maintenance and inspection of winch grooves would still have been required.

A 2017 TBS Group report identified excessive wear on the west winch rope, necessitating frequent replacements. A possible cause of this excessive rope wear was a misaligned sheave, but a lack of maintenance records make it unclear if this issue was remediated. If the misalignment of the last sheave was not remediated it is possible that it contributed to wear of the winch drum grooves. This could explain why the winch rope drum tracking issue occurred only on the west winch. However, the issue appearing only on the west could be due to more frequent use of the western lifting leaf caused by brake issues on the eastern one, or simply by chance. Given time, the problem might have eventually shown up on the east lifting leaf as well had the bridge not been removed from service.

5.3 Overall Winch Condition Issue

There is no evidence that preventative maintenance in accordance with the OEM manual had been performed on the winches. This is evidenced by commentary from the original supplier (Brevinni) in February 2024 and a lack of any mention around of specific checks on the winches in the mechanical maintenance schedule provided. No reports showing regular preventative maintenance were provided so it is unclear if any concerns around the winch condition had ever been raised. It appears that preventative maintenance practices immediately prior to the bridge being removed from service were limited in nature and did not cover all components of the bridge. It is unlikely that refurbishment or maintenance of winches would have been possible without a spare winch or severe disruption to bridge operation.

A 2017 report from TBS made recommendations, “given the importance of the ongoing reliability to the winching system it is strongly recommended to refurbish both units by building a complete new winch and hydraulic power pack and changing this out for one of the existing units which could then been fully refurbished and installed on the other side with this unit then being fully refurbished to give a complete spare hydraulic winch”. It is possible that this recommendation was not followed at the time due to the equipment being relatively new, no substantive issues with the winch being experienced and coupled with the expectation that the bridge was eventually going to be replaced with a more permanent structure. A spare winch however would have helped deal with the winch condition and drum tracking issue by providing an option to swap out the affected winch.

An asset management plan should have been in place which recognised the criticality and age of certain components and set appropriate plans to address components that were approaching obsolescence and/or required replacement or full overhaul and refurbishment. An AMP was in place for the bridge as part of the broader Waterfront Asset Portfolio, as of 2021 the AMP was guided by the plans to replace the bridge in 2023 and was extremely brief in terms of specific plans for the bridge aside from replacement.

When a decision was made not to replace the bridge, a condition assessment was completed in April 2021 to inform a revised AMP specifically for the bridge, of which first revisions were provided in the second half of 2023. The quality of the update of the AMP appears to have been compromised due to inadequate record keeping on the bridge, limiting visibility of past maintenance and issues. This 2023 AMP did not recognise the criticality of the winch itself or its age, this is evidenced by it being lumped in with all other mechanical components (the winch is not identified as a specific component) and simply

recommends “to maintain in accordance with the mechanical maintenance manual” which did not include any maintenance requirements for the winch or the winch OEM Manual.

Despite the 2023 AMP referencing the TBS report from 2017, recommendations from this report were not covered in the 2023 AMP, specifically the recommendation to procure a spare winch to provide a full spare and allow winches to be refurbished. The 2023 AMP is based solely on a condition report by Resolve Group in 2021 and a maintenance report by Mac Group in 2022.

The time which elapsed between the condition inspection in 2021 and first versions of a specific AMP for the bridge in 2023 seem excessive. However, it is noted that full implementation of the 2023 AMP, at any point of time, would have been unlikely to have prevented the winch issues which contributed to the bridge being removed from service in 2024 as the AMP was not fit for purpose (for the reasons outlined earlier in this section).

6 Discussion and Further Commentary

Could the bridge have been returned to service earlier by remedying the faults and issues that triggered the bridge to be removed from service?

On review of the causes of the bridge's closure, it is possible that it could have been returned to service earlier by fixing the initial faults and issues, but it would likely have led to a continuation of ongoing operational issues, increased remediation costs as well as necessitating an acceptance of ongoing risks. There are a few scenarios in which this could have occurred:

- Scenario 1: As the wire rope jumping issue only existed on the western side, there was potential to only resolve the brake issue on the eastern side and then operate under single span operation. However, this would have created additional risk to the passage of larger vessels, particularly in high wind conditions and may have resulted in further brake wear due to manual operation.
- Scenario 2: Resolve brake issues and find interim solutions to the winch drum tracking issue.

In both scenarios there was still a potential issue relating to the unknown condition of the winches. This unknown risk could have only been resolved through removal and a thorough overhaul of the winches offsite. Additionally, there were other unspecified issues that were experienced during the same period which contributed to the lack of confidence in bridge operation. In any case the bridge was taken out of service in March 2024 and removal of bridge elements for structural refurbishment started in July 2024 there would have been limited benefit, if any, in the form of the bridge being out of service for a shorter period if repairs were possible

What maintenance and inspections had been undertaken?

Regular maintenance was performed on parts of the bridge, but it appears there was no comprehensive or fit for purpose asset management strategy (despite AMPs being developed) which considered component age and as a result, evolving maintenance needs.

Various third parties conducted multiple inspections from 2013 to 2023, but these inspections were limited and did not sufficiently address the issues that led to the bridge being taken out of service.

Despite efforts to seek external guidance, the scope of these inspections by external parties tended to be limited and the objectives potentially unclear. For example, if the objective had been to identify the risks posed and determine the refurbishment or replacement needed for the bridge, aligning with a true Asset Management Strategy, then the results of the inspections might have differed.

7 Recommendations

From the issues identified and a consideration of potential root causes and contributing factors, several recommendations can be made to prevent a repeat of issues and improve asset reliability.

Table 5 - Recommendations

Lesson / Recommendation	Detail
1. Have semi-automatic operation for single span lifts to eliminate manual operations.	Manual operations lead to excessive brake wear due to the way the bridge needs to be operated in manual mode. Note: These changes have been made as part of the upgrade and refurbishment project.
2. Ensure critical spares are held	Spare winch assembly required to allow for periodic routine overhaul of winch and deal with unexpected issues which will in turn prevent extended unplanned downtime.
3. Develop sound Preventative Maintenance Strategies in accordance with OEM manuals for all components and parts of the bridge	Ensure preventative maintenance strategies are developed for all components of the bridge.
4. Ensure singular person/entity is responsible for all bridge maintenance	If multiple parties are engaged to complete maintenance - the interfaces between the parties and clear delineation of roles and responsibilities need to be managed to ensure bridge is fully maintained with no gaps.
5. Ensure end of life strategies are developed for bridge components, with maintenance / overhaul requirements baked into preventative maintenance and asset management plans	As components approach end of life, preventative maintenance and asset management strategies are required to ensure timely changeout/overhaul of components to ensure ongoing reliability.
6. Ensure O&M Manuals and Preventative Maintenance Plans are updated to reflect changes made to bridge components and operation	If changes are made, asset management and preventative maintenance plans need to be updated to ensure correct maintenance is undertaken.
7. Ensure a risk-based approach to asset/preventative maintenance is put in place so risks are well understood.	A risk-based approach would have identified single points of failure, long lead items (which should have been held as critical spares) and highlighted the need for regular inspections and preventive maintenance on critical bridge components.
8. Ensure maintenance records are kept	Ensure maintenance records are kept so issues encountered, maintenance performed, and issues raised can be accessed and reviewed as appropriate.
9. Review best entity for managing an asset of this type	Asset is complex and requires specific skill set for ongoing maintenance and operation, entity that manages this asset needs to have necessary skill and knowledge to manage the asset noting that unlikely that this skill set is possessed by any CCO thus need to ensure appropriate specialists are engaged to support.
10. Ensure appropriate specialists are engaged and engagements are well briefed and scoped to ensure desired outcomes are achieved.	Ensure specialists engaged have appropriate skillset and track record. Ensure specialists engagement is well scoped including desired outcomes to ensure that deliverables meet requirements, specifically recommendations outlined in this report.

8 Conclusion

The decision to remove the bridge from service was based on the cumulative impact of multiple issues encountered in late 2023 and early 2024 which created a lack in confidence in the overall reliability of the bridge. In particular, issues with winch brakes and winch drum wire rope tracking presented risks to the safe operation of the bridge, risks exacerbated by the uncertain condition of the winches which required offsite overhauls.

Considering these safety and reliability concerns and the need for structural refurbishment, removing the bridge from service was a justifiable action to ensure safety and allow for an efficient and comprehensive overhaul and refurbishment of the critical components. It should be noted that keeping the bridge operational would have likely led to further breakdowns and disruption to service and it would not have been possible to keep the bridge operational while these works were undertaken.

Overall, although regular maintenance and inspections were conducted, there were shortcomings in the preventative maintenance and asset management strategy, particularly in regard to aging bridge components. The limited scope and unclear objectives of inspections and the absence of a comprehensive preventative maintenance plan to address the wear and potential failure of critical components contributed to the bridge being taken out of service. Addressing these deficiencies in the future will require the implementation of a thorough preventative maintenance plan and asset management plan that considers the entire lifecycle of the bridge components. This would include maintaining an inventory of critical spare parts. This approach aims to mitigate similar issues, extend the service life of the bridge, and reduce downtime and operational interruptions.

Part 2: Project Delivery Review

1 Executive Summary

The project objective was to deliver a refurbished bridge, with scope covering the entirety of bridge elements including structural, coatings, mechanical, and electrical to ensure future reliability and trouble-free operation without the need for further significant or disruptive works. An initial target date of Labour Weekend 2024 was set for returning the bridge to service but this was set prior to fully defining scope and resultant programme and as such was understood to be aspirational and was not publicly communicated. An absolute no later than Christmas 2024 date was set for returning the bridge to service.

This Post Project Review covers the period that RCP were the Project Managers from April 2024 to December 2024 following the bridge being removed form service in March 2024. At the point in time RCP became involved, the scope and methodology had not been determined. The overall project process from April 2024 to December 2024 covered a broad range of tasks which included, but were not limited to, determination of project scope, evaluation of potential methodologies, procurement, business casing, delivery and commissioning. RCP were only responsible for the capital project and thus this report excludes mitigating measures and operational expenditure for which they were not responsible.

When evaluating project performance, it is important to consider the complexity of this project. Complexity was created by the status of the project in April 2024 where project scope or methodology had not been defined. Complexity was also created by the nature of the works; they were not only multi-disciplinary but extensive in terms of scope and labour requirements coupled with their location in a busy coastal environment with multiple stakeholders.

The primary project objectives of programme and quality were met. The Wynyard Crossing Bridge was returned to service on 13 December 2024 with only minor scope omissions and defects. These scope omissions did not affect operation and could be completed post return to service with minimal impact. A review of programme shows targeted date of Labour weekend was not realistic given the final scope, and the return to service date of 13 December was a significant achievement with little opportunity to improve this date. It should be highlighted that HEB, the lead contractor performed admirably to return the bridge to service by the 13 December. They demonstrated a strong ability to adhere to the programme and to mitigate potential delays to the programme caused by issues encountered, including the incorporation of additional mechanical and electrical scope following contract award.

Although cost was considered important, it was considered a secondary objective. An original budget for the project was set at $7.04m and was later revised to $10.63m once the full extent of corrosion repairs and mechanical and electrical scope was determined midway through the project. Time constraints influenced the establishment of the project budget prior to understanding the full scope and influenced the use of incumbent contractors by the client. Notwithstanding, there are learnings from the project that could have improved communication and awareness of risks posed by these constraints.

2 Introduction

2.1 Purpose

This section of the Post Project Review examines the project to identify any issues and challenges encountered, their causes, and resulting lessons learnt and opportunities for improvement. It focuses on the bridge refurbishment and return to service, and excludes other activities, such as alternative transport options assessments, temporary bridge options, and co-ordination with other projects.

2.2 Background

This review covers the period from April 2024 to December 2024, when RCP managed the project. It also examines prior actions and conditions that affected project delivery.

At the point where RCP were engaged, the bridge had already been taken out of service with both spans in the vertical position and the procurement of long lead items for mechanical and electrical items underway. Removal of engine room equipment and minor bridge components had commenced, this included removal of winch ropes, gates, backstays, guarding, rope sheaves and anti-climb panels. Preliminary discussions with a coatings contractor were underway around methodology and costs for the remediation of coatings. This created some challenges in picking up the project.

At the point in time of RCPs engagement, the project scope, budget and programme had not been clearly defined but the overall project objective and timeframe expectations were able to be communicated to the RCP project team. Initial tasks included, but were not limited to, identifying and documenting the Principals Requirements, considering planning constraints, considering possible alternative methodologies, possible locations for offsite works and procurement strategies.

This project can be described as complex due to the multidisciplinary natures of multiple workstreams, covering structural and coatings, mechanical, hydraulic, electrical and automation and controls all while located in a challenging waterfront environment with multiple stakeholders. The extent of remediation and refurbishment works should also be highlighted, requiring over 36,000 contractor hours being undertaken in the period July-December 2024.

3 Project Objective

The project's primary objective was to refurbish and return the bridge to service by a target date of Labour Weekend 2024, or at the latest by Christmas 2024. The scope of the refurbishment was to resolve mechanical, electrical, hydraulic, structural, and coating issues, ensuring the bridge remained reliable without major repairs for 15 years. This objective was documented in the 'Wynyard Crossing Bridge Remediation Principals Requirements' and agreed upon with Eke Panuku.

3.1 Project Overview

RCP were engaged in April 2024 following the bridge being removed from service in March 2024. Early efforts focussed on confirming project objectives and tendering a main contract for refurbishment of coatings.

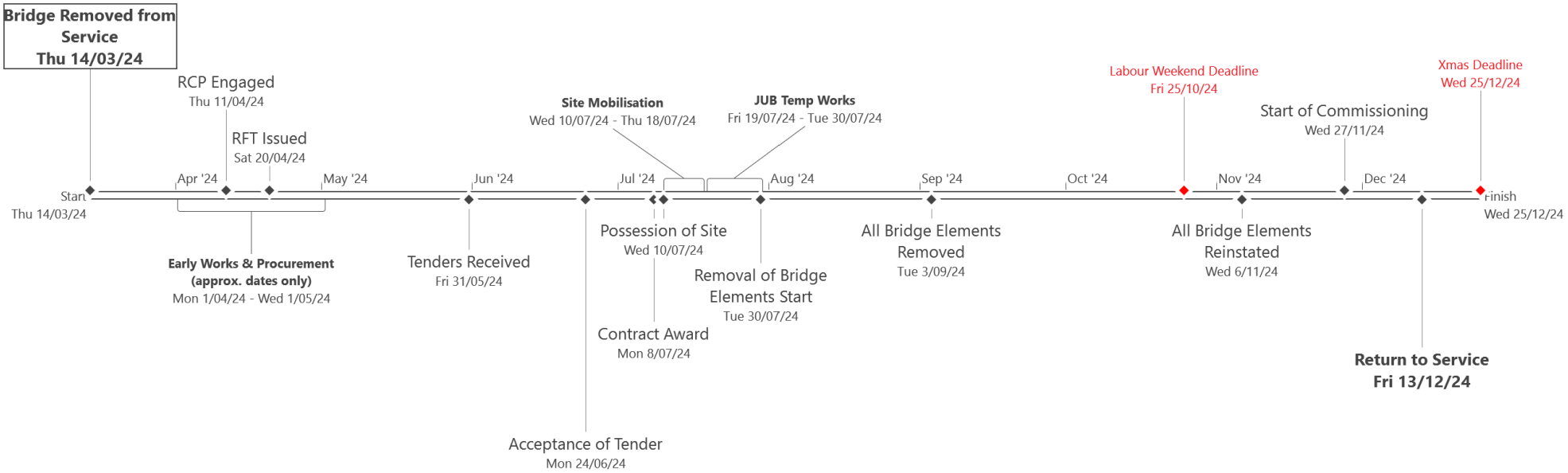
A coatings contractor had been involved prior to RCP's involvement and had been working on a methodology which involved scaffolding the bridge in situ to complete remediation of coatings. A tender for the main works was issued but the RFT was purposely agnostic around the methodology in order to solicit innovation and programme improvements from the market. Only one conforming tender was received at the end of the tender period (end of May 2024) and this Tender was accepted on 24 June following detailed evaluation.

In parallel with the tender process an assessment of construction methodology (in situ scaffold versus an offsite methodology) was completed, with this assessment being led by RCP. Although more expensive, the option to remove bridge components was more favourable due to several other criteria such as reduced H&S, environmental, quality and programme risks and was a critical decision to meeting the programme.

Predating RCP's involvement, incumbent mechanical and electrical (M&E) contractors had been involved in the procurement of long lead items necessary for overhaul of M&E items. For this reason, this scope was not included in the main works tender, but the intent was to vary in the M&E scope once defined into the main contract to prevent a situation of having multiple contracts and the co-ordination issues that that would entail.

Main contract works started on 10 July 2024, with a period required for site mobilisation, jack up barge mobilisation and setup. The removal of the first components of the bridge commenced on 30 July. All bridge items were removed by 3 September 2024 and were placed on Wynyard Wharf for refurbishment (blast and paint and structural steel repairs) before being reinstated, M&E equipment reinstalled, and commissioning completed.

A conscious decision was made by Eke Panuku to retain incumbent M&E contractors due to their prior knowledge of the bridge, current issues and the need to proceed with the procurement of long lead items to meet timeline pressures.


Bridge Removed from Service
Thu 14/03/24
RCP Engaged
Thu 11/04/24
RFT Issued
Sat 20/04/24
Site Mobilisation
Wed 10/07/24 - Thu 18/07/24
JUB Temp Works
Fri 19/07/24 - Tue 30/07/24
Labour Weekend Deadline
Fri 25/10/24
Xmas Deadline
Wed 25/12/24
Start of Commissioning
Wed 27/11/24
Apr '24
May '24
Jun '24
Jul '24
Aug '24
Sep '24
Oct '24
Nov '24
Dec '24
Start
Thu 14/03/24
Finish
Wed 25/12/24
Early Works & Procurement (approx. dates only)
Mon 1/04/24 - Wed 1/05/24
Tenders Received
Fri 31/05/24
Possession of Site
Wed 10/07/24
Contract Award
Mon 8/07/24
Removal of Bridge Elements Start
Tue 30/07/24
All Bridge Elements Removed
Tue 3/09/24
All Bridge Elements Reinstated
Wed 6/11/24
Return to Service
Fri 13/12/24
Acceptance of Tender
Mon 24/06/24

4 Programme Review

4.1 Project Initiation

RCP was initially contacted in early April 2024, with an initial briefing conducted on 8 April. By 11 April, a fee proposal and scope of services were provided and approved, and a handover process commenced.

A "Plan on a Page" was swiftly developed and delivered on 18 April, outlining RCP's approach and programme for consultation with Eke Panuku. This plan mapped a path to confirm the Principal's Requirements, clarify the scope of works and consenting requirements, develop a delivery programme and obtain internal approvals to achieve the project's objective of having a bridge operational by Labour Weekend 2024.

The dates outlined in the "Plan on a Page" are detailed in Table 6, with achievement status noted.

Table 6 - Project Initiation Programme Summary

Deliverable	Planned Date (according to initial plan on a page)	Actual Date	Status
Principal's Requirements	End of April 2024	29 April 2024	
Construction Optioneering	End of April 2024	5 May 2024	
Resource Consent Submitted / Approved (to allow for night works at bridge location)	Mid-May 2024 / Mid-June 2024	Early July	
Business Case Approval	Mid-June 2024	Business case presented to PSG for approval 10 June	
RFT issued	Specific dates not specified	20 April	
Tenders received	Specific dates not specified	31 May 2024	
Contract Award	Specific dates not specified	24 June 2024 – Acceptance of Tender 8 July 2024 – Contract Award	
Start of Contract Works (site possession)	Specific dates not specified	26 July 2024	
Return to Operation	Labour Weekend 2024	13 December 2024	

Early performance against the initial Plan on a Page was good. However, it lacked sufficient detail about the steps for procurement (tender, tender evaluation, tender award, contract award, site possession) which were critical for project delivery. Despite this, the rapid tendering of works meant the omission did not negatively affect the programme. Including these details would have clarified the impact of procurement on the project timeline and might have revealed earlier that returning to service by Labour Weekend 2024 was unfeasible. Resource Consent submission to enable night works was behind schedule but was dependent on construction methodology and noise report, and in any case, works starting were ultimately not dependent on a Resource Consent approval.

4.2 Main Contract Works

The main contract works were tendered without the structural repairs and mechanical and electrical scope incorporated. This was due to time constraints and the fact that structural/corrosion repairs could not be determined or scoped. Also, M&E scope resided with incumbent M&E contractors and the process to confirm this scope, programme and cost implications was ongoing.

The agreed contract programme (excluding the aforementioned scope) reflected a completion date of 6 November 2024. However, it was recognised that this programme did not include the entirety of project scope and expectations around the

return to service were set around a December date. Following contract award, the focus was placed on confirming the scope and programme for M&E works and structural repairs to confirm the overall programme to return to service.

Overall, the performance against the programme for the main contract works was commendable. HEB, the main contractor, performed admirably in terms of adhering to the programme and were proactive in reducing durations and mitigating delays. Issues which caused delay to the programme are listed in Table 7, for the most part these issues were relatively minor in nature when considering the overall programme, with the contractor able to make up lost time elsewhere in the programme and through additional working hours or through resequencing of works.

Table 7 – Issues encountered on main contract works

Issue	Details	Response / Impact	Learning / Comments
Delay to first span removal due to no resource consent (RC) approval for night works	First removal was planned for night works which needed a RC to mitigate impact to berth holders, RC not received in time resulting in rescheduling of works during normal working hours.	Works postponed a day for works to be co-ordinated and communicated.	Night works were likely not beneficial due to the stand-down time required for workers.
Stripped Capped screws	Cap screws within the mac-alloy bar assembly were found to be stripped, delays due to time required to drill out and remove.	Additional work to remove resulting in some delay to leaf removal.	Even if this issue was recognised earlier, it was unlikely to reduce the programme impact.
Breakdown of contractor's crane	Broken strands in crane cable resulted in delays while replaced.	Delay to barge movement while repairs carried out. No overall impact to programme as contractor was able to make up time elsewhere.	Regular inspections required to ensure that issues are identified early so repairs can be planned rather than unplanned if possible. Noting that there is no suggestion in this case that lack of inspections lead to this issue.
Higher than expected weights	Weights were higher than expected when first main span was removed.	Additional items which could be removed from the span were removed to reduce weight, caused some delay to programme but contractor was able to make up time through additional hours.	All weights to be double checked by structural engineer, particularly when approximate weights are lifting the SWL of lifting equipment, consider cost implications of increased crane capacity to counter risks. In this case it was unlikely the risk/delay would have outweighed additional crane costs due to duration of hire period.
Paint cure requirements on engine room	Differing options between coatings supplier and applicator meant that paint curing time was under-estimated. Additional time in programme required for curing.	Re-sequencing of works to mitigate time lost. Some mechanical works were completed in the engine rooms on the wharf to make use of time that would have otherwise wasted.	In this case it was fortunate that this was caught by the third-party inspector, ensure ITPs are completed for all paint systems and use cases and use of third-party inspectors.
Back span mix-up	Back spans were mixed up on re-install.	Resulted in programme delay of approx. 1 day.	Require traceability of components and site measure all components prior to installation to double check correct components are being reinstalled.

Issue	Details	Response / Impact	Learning / Comments
Late delivery of light fixtures	Late delivery of strip lighting.	Resequencing of works to allow for strip lighting to be reinstalled in situ utilising the JUB. This resulted in higher costs.	Allow for some programme float for possible late delivery, ensure contingency plans are in place for late delivery.
Cheek plate issue	Un-documented modification to trunnion cheek plates meant that lifting leaf's could not be removed without destructive disassembly.	Section of main chord was removed to allow for removal and was refitted with a bolted connection.	More thorough inspections prior to works may have identified issue sooner expediting works to removed but wouldn't have alleviated the issue completely. Records of modifications/works on the bridge could have also helped identify the issue sooner.

The contract programme was updated during project to reflect changes in scope (M&E and structural repairs), changes in sequencing to address issues that arose, and opportunities identified. A summary of the Programme Revisions is outlined in Table 8.

Table 8 - Contractual Programme Revisions

Revision	Date Issued	Completion Date	Details / Changes
Rev 0	8 July 2024	6 November 2024	Original contract programme, excluded M&E and structural repairs
Rev 1	12 August 2024	6 November 2024	Tracking programme, no change to completion dates
Rev 2			Revision never provided
Rev 3	5 September 2024	19 December 2024	Structural repairs included along with M&E scope
Rev 4	2 November 2024	18 December 2024	Tracking programme and programme sequencing modified to show delay associated with additional curing time requirement on engine rooms.
Rev 5	10 November 2024	11 December 2024	Tracking programme

Performance against the original contractual programme and revised programme, inclusive of structural repairs, is outlined in Table 9. Reinstallation of spans was completed by 6 November ahead of the revised programme dates (inclusive of structural repairs), due to improvements in programme made during the reinstall of structural elements.

Table 9 – Summary of Main Contract Works Programme

Activity	Planned Date (Original Contract Programme REV01)	Planned Date (Revised Programme REV03)	Actual Date	Variance	Commentary
Removal of First Bridge Span (Western Lifting Leaf)	01/08/2024	NC	05/08/2024	+4	Delay due to RC constraints, rescheduling required.

Activity	Planned Date (Original Contract Programme REV01)	Planned Date (Revised Programme REV03)	Actual Date	Variance	Commentary
All bridge elements removed	05/09/2024	NC	03/09/2024	-2	Improvement on programme made
First Engine Room Reinstated	13/09/2024	4/10/2024	08/10/2024	+25	Engine rooms were installed late due to longer than anticipated time frames for coating works (due to underestimation in contract programme), required structural repairs and additional curing time requirements. Some of the delay time was utilised for mechanical fitout thus mitigating overall impact of delays.
Last Bridge Element Reinstated	21/10/2024	18/11/2024	06/11/2024	+16	Delay due to additional corrosion repair (20 days impact) scope not included in original contract and underestimated timeframes for engine room recoating, overall impact mitigated by time savings found in reinstallation programme.

4.3 Impact of Scope Changes to Programme

4.3.1 Structural Repairs

The scope and programme implications of structural repairs were not known until bridge components were removed and high-pressure water blasting was completed. Once the first bridge element was removed and structural repairs scoped, a programme for structural repairs could be developed based on findings from the first bridge element.

Extent of structural repairs were not insignificant, the total planned duration of structural repairs for all bridge elements totalled 46 days. However, due to the sequencing of works and prioritising repairs on critical path elements, structural repairs only added 20 working days to the critical path of the original programme, resulting in a revised date for all bridge elements to be reinstated by 18 November 2024 (compared with original contract programme date of 21 October 2024).

Structural repairs took longer than anticipated due to extent of works unable to be accurately estimated. There was limited ability to complete structural repairs any quicker as resourcing and work hours were maximised.

The duration of structural repairs had limited impact on the overall programme as all elements, except for the engine rooms, were not on the critical path and had sufficient float to absorb the additional works. All bridge elements were reinstated on 6 November, well ahead of the revised programme by almost two weeks. This was achieved through capitalising on opportunities recognised in the reinstallation programme.

4.3.2 Mechanical Scope

Following a detailed review of scope post award and after disassembly of the bridge, a programme developed between HEB and Mac Group put the duration of mechanical reinstallation works of 22 days for each side of the bridge. This was incorporated in the Rev 03 programme.

The mechanical contractor in this case performed ahead of the programme completing works in 9 days for each side of the bridge. Ability for the mechanical contractor to complete works ahead of schedule was aided in part by an opportunity to complete works ahead of schedule at Wynyard Wharf before engine rooms were reinstated. This opportunity was a result of a delay to engine room reinstatement due to paint curing requirements. This opportunity was able to be capitalised on due to availability of resources and equipment availability.

The early completion of the mechanical works did not result in an earlier return to service date for the bridge. Due to the time required for delivery of electrical components to site, these works could not commence immediately following the completion of the mechanical works.

Table 10 - Mechanical Scope Programme Duration Summary

Activity	Planned Duration (days)	Actual Duration	Variance (working days)
Mechanical Reinstallation Works – West Span	22	9	-13
Mechanical Reinstallation Works – East Span	22	9	-13

Table 11 - Mechanical Scope Programme Milestone Summary

Milestone	Planned Date (Rev 04)	Actual Date	Variance (working days)
Mechanical Install Start (at bridge location)	9/10/2024	10/10/2024	1

4.3.3 Electrical Scope

Electrical components were not delivered to site according to programme dates agreed early on during the project. If the components had been delivered on schedule, it would have likely resulted in an improvement of approximately 3-5 days in the return to service date, as opportunities created by the completion of other work streams could have been capitalised upon.

Electrical installation in situ was programmed for 10 days but works exceeded this duration, lasting 18 days. Strip lighting also arrived late, due to a failure of the third-party supplier to deliver on time, necessitating resequencing of work and some impact to overall electrical install programme.

Table 12 - Electrical Programme Duration Summary

Activity	Planned Duration	Actual Duration	Variance	Comments
Electrical Installation	10 days	18 days	8 days	Extended duration due to late delivery of light fixtures which then had to be installed in-situ and underestimation of install tasks.

Table 13 - Electrical Milestones Programme Summary

Milestone	Planned Date	Actual Date	Variance (working days)	Comments
Delivery of Panels to site	7/10/2024	4/11/2024	20	Delivery of panels late to site despite agreement on delivery dates due to sub-contractors' ability to complete on time.
Electrical Installation Start (in-situ works)	30/10/2024	4/11/2024	4	Due to late delivery of panels
Electrical Installation Finish	20/11/2024	27/11/2024	5	Behind schedule due to late delivery of panels and longer duration to complete works.

4.4 Commissioning

The original contract programme included 5 days for commissioning, but this did not fully appreciate/reflect the scope of mechanical and electrical works and thus commissioning requirements. The third revision of the programme included a revised 10-day period for commissioning, which reflected the understood scope and commissioning requirements which were only able to be fully understood part-way through the project.

Commissioning started on 27 November, well ahead of planned date of 4 December within revision 3 of the programme. This was due to mechanical works being completed ahead of schedule. Commissioning could have commenced even earlier if the electrical install was able to be started ahead of schedule when the opportunity arose. In review, no opportunities were identified to complete commissioning any faster than what was completed.

Table 14 - Commissioning Programme Duration Summary

Activity	Planned Duration	Actual Duration	Variance
Commissioning (excluding training)	10 days	10 days	0

Table 15 – Commissioning Milestones Programme Summary

Milestone	Planned Date (Rev 03 Programme)	Actual Date	Variance (working days)
Commissioning Start	4/12/2024	27/11/2024	-6
Commissioning Finish	18/12/2024	10/12/2024	-7
Return to Service	18/12/2024	13/12/2024	-4

5 Budget Review

5.1 Initial Budget

A capital expenditure budget was set out in the business case presented on 10 June 2024 totalling $7.704m. This budget was built up based on the following main components:

- **Main Works Contract Price** - tendered price from the main contractor for coating works including removal and reinstallation.
- **Costs to Date** - understood costs incurred to date on early works completed by incumbent contractors.
- **Long Lead Mechanical and Electrical Components** – based on quoted price of long lead items.
- **Structural Repairs** - high-level allowance based on estimated hours of anticipated corrosion repairs.
- **Reinstallation of M&E Equipment** - provisional sums based on the assumption that scope was limited to reinstallation of M&E equipment.

A breakdown of the original budget included in the business case is summarised in Table 16. Line items with zero values are shown for completeness and ease of reference with further discussion.

Table 16 – Summary of Project Budget

	Value ($)
CONSULTANCY	**533,995**
CONSENTS	-
DELIVERY	**5,927,260**
MAIN CONTRACT / STRUCTURAL	4,857,260
Contract Award Value	4,797,260
Miscellaneous Repairs	-
Additional Inspections	-
Structural Steel Repairs	60,000
Structural Modifications	-
Additional Coating Scope	-

Additional Corrosion Protection	-
Additional JUB Hire	-
MECHANICAL	750,000
Early Works and Procurement	600,000
Mechanical Modifications	-
Mechanical Reinstall	150,000
ELECTRICAL	320,000
Electrical Component Replacement	100,000
Electrical Reinstall & Commissioning	220,000
MISC. / OTHER COSTS	-
INTERNAL RESOURCES	**238,073**
CONTINGENCY	**1,004,899**
Contingency - General	1,004,899
Contingency - Acceleration	-
TOTAL	**7,704,228**

5.2 Timeline of Changes to Project Budget

Due to realisation of costs associated with structural repairs and balance of M&E works, the project budget required an increase in late September 2024. With the physical works commencing in July 2024, and due to challenges experienced with soliciting a confirmation of costs from incumbent contractors, this increase in budget could only be recognised from late August / early September. Table 17 summarises the budget, estimated cost at completion and costs to date to demonstrate the short time frames involved in this project.

Table 17 – Timeline of project costs and budget changes

	June 2024	July 2024	August 2024	September 2024	October 2024	November 2024	December 2024
Budget	$7.704m			$10.63m			
Estimate at Completion (EAC)	$6.700m	$6.700m ($5.993m excl. M&E and structural repairs)	$8.108m	$9.689m	$9.881m	$10.209m	
Costs to Date	$0.740m	$1.774m	$3.185m	$5.644m	$6.832m	$10.024m	
Forecast Contract Value	$4.913m	$4.982m	$6.308m	$7.697m			
Commentary - Costs	Business Case Presented to PSG		Lift in forecast contract value and EAC to reflect understanding of structural repair works	M&E Quotes submitted for Approval (18/9) Revised budget confirmed and presented to Board			
Commentary – Status of Works	Enabling works by incumbent contractors underway.	Main Contract Works Started	Structural Repairs to lifting leaf's complete, resulting in an updated estimate of total structural repair costs for the remainder of bridge elements.		Coating Works Completed Span Reinstallation Commenced Mechanical Reinstall Works Commence	Electrical Reinstall Works Commence	Works completed, return to service.

5.3 Changes to Project Budget

Key changes to the project budget are detailed in Table 18 and further discussed below.

- **Structural Repair Work**
    - The initial budget included $4.9m for the required structural repair work, which increased to $5.7m.
    - The full extent of corrosion only became known once the bridge was dismantled and high-pressure water- and abrasive blasting was underway, allowing full inspection of the steel structure.
    - Sub-standard welds and previous repairs were also discovered once the old protective paint coating was fully removed. These were remediated as part of this project. There have been numerous condition assessments done on the bridge in previous years, however the full extent of the corrosion could only be understood while the bridge was dismantled and could be fully inspected.
    - In reflection, due to the high levels of uncertainty regarding the final scope of this item and limited ability to assess the scope of works prior to commencement, a separate contingency should have been applied to the project budget rather than being covered by a general project contingency. A specialist technical advisor may have been useful in assisting with an assessment of potential corrosion remediation scope and determining an appropriate contingency.
- **Mechanical and Electrical Work**
    - The original business case made provision for $1.1m for required M&E work on the assumption that early works and procurement had identified the full scope of necessary repairs and replacement, with only reinstallation and commissioning of M&E components remaining.
    - However, the urgent and unplanned nature of early work in the programme meant that a more comprehensive scoping wasn't immediately possible. As such, the degree of potential cost risk associated with M&E work was not fully appreciated at the time of developing the original budget.
    - Additionally, early in the project, a decision was made to progress work that could be done as quickly as possible using the incumbent contractors. The benefits of speed, their historic knowledge and experience working on the bridge outweighed the potential benefits of delaying work to procure a new contractor. This may have had a financial cost implication, as it wasn't possible to fully test the market for other contractors that may have proposed lower pricing. It also created challenges with integrating the M&E workstream with the ongoing structural workstream, resulting in a significant amount of time coordinating work between the incumbent M&E contractor with the main contractor. Despite challenges, integrating M&E works into the main contract was vital to delivering the programme at the consequence of cost.
    - The scope, pricing and integration programme were updated following the dismantling of the bridge and thorough inspection of its M&E components, resulting in the M&E budget increasing to $3m. This included full replacement and upgrades of all electrical panels, hardware, software and lighting, except for the drives, motors and winches, which were refurbished as part of the early works and procurement.
    - Although subcontractors were asked to provide early budget estimates to assist with early identification of cost risk, these were not provided. In reflection, additional pressure could have been applied to receive these estimates, although it should be noted that there were communication issues with M&E contractors meaning that despite additional attempts that this information may still not have been forthcoming.
    - Owing to the lack of a detailed scope, which the incumbent contractors held, it was not possible to ask others to provide estimates of costs. In hindsight with a full understanding of M&E scope it may have been prudent to run a separate RFQ process, including the incumbent contractors (drawing a line at items which had been pre-procured, which could subsequently be Principal free issued) to provide a full refurbishment of mechanical and electrical systems which then could have been novated to the main contractor. However, this would have been difficult considering that in efforts to demonstrate progress the incumbent contractors had been instructed to and had already begun removing components from the bridge. With this situation in place, it made it difficult to convince other contractors of the intent to award works to anyone but the incumbent contractors and make it particularly difficult for other contractors to pick up the works. This would have attracted a significant price premium.

COMMERCIAL IN CONFIDENCE

Table 18 summarises the changes to the project budget outlined above.

Table 18 - Changes to the project budget

	Original budget (Jun '24)	Revised Budget (Sept '24)	Difference
CONSULTANCY	**533,995**	**532,265**	**1,730**
CONSENTS	-	**15,283**	**15,283**
DELIVERY	**5,927,260**	**8,786,892**	**2,859,632**
MAIN CONTRACT / STRUCTURAL	4,857,260	5,705,019	847,759
Contract Award Value	4,797,260	4,903,383	106,123
Miscellaneous Repairs	-	114,898	114,898
Additional Inspections	-	79,208	79,208
Structural Steel Repairs	60,000	357,666	297,666
Structural Modifications	-	67,313	67,313
Additional Coating Scope	-	15,000	15,000
Additional Corrosion Protection	-	45,000	45,000
Additional JUB Hire	-	122,551	122,551
MECHANICAL	750,000	1,797,169	1,047,169
Early Works and Procurement	600,000	1,044,517	444,517
Mechanical Modifications	-	106,943	106,943
Mechanical Reinstall	150,000	645,710	495,710
ELECTRICAL	320,000	1,239,800	919,800
Electrical Component Replacement	100,000	982,800	882,800
Electrical Reinstall & Commissioning	220,000	257,000	37,000
MISC. / OTHER COSTS	-	44,904	44,904
INTERNAL RESOURCES	**238,073**	**134,192**	**103,882**
CONTINGENCY	**1,004,899**	**1,162,004**	**157,105**
Contingency - General	1,004,899	662,804	342,095
Contingency - Acceleration	-	499,200	499,200
TOTAL	7,704,228	10,630,636	3,107,066

5.4 Commentary

The following is a summary of key comments around cost and budget:

- **Contingency Allowances** – in hindsight, the original contingency allowances were insufficient given the risk associated with unknown scope of corrosion repairs, M&E contracting arrangements and other items which had not been fully scoped. The application of item-specific contingency would have been a more appropriate method to manage cost risk for high-risk items.
- **Cost Reporting** – More regular and increased levels of communication around cost risks and the potential for cost escalation could have provided benefit to the project governance group. This would have included clear communication around works that needed to be instructed without confirmation of costs (e.g. corrosion repairs) due to the nature of works and time constraints
- **Use of Contingency** – clearer processes regarding the expenditure of contingency could have assisted in removing surprises around movement in project budget.
- **Time constraints and incumbent contractors** – these were factors that impacted the project budget due to reduced commercial tension in the procurement processes and scope uncertainty ahead of business case approval and prior to award of the main contractor.

COMMERCIAL IN CONFIDENCE

- **Timing of Project Management Support** – at the time of RCP's engagement, some early works were underway, and the procurement of key materials had commenced. As a result, there was a lack of full visibility of actual costs incurred to date and committed to, resulting in an underestimation at the time the initial budget was set.

6 Scope and Quality

The project objective was to provide a refurbished bridge, resolving reliability issues to ensure trouble free operation for another 15 years without requiring significant maintenance or upgrades which would impact normal bridge operation. Achievement against these objectives is detailed below:

- **Structural Repairs and Coating Remediation** – full coating replacement was completed with 15-year warranty provided for warrantable surfaces.
- **Electrical/Mechanical Scope** - mechanical and electrical scope covered refurbishment of all bridge components with a couple of notable exceptions and quality issues which are detailed in section 6.1.

It is critical that effective asset management plans and preventative maintenance plans are developed and implemented to ensure that this objective is met post-delivery.

6.1 Post Return to Service Issues

Several issues have been experienced post-commissioning which did exist prior to project works and were not adequately addressed through the project as they highlighted very late in project delivery by the incumbent contractors. These issues caused minimal disruption to bridge operation and could be accurately described as system faults rather than breakdowns.

- **Faults with pedestrian gates**- as the pedestrian gates had been removed during the early works by incumbent contractors and due to the lack of as built drawings, it was deemed not possible to plan for modifications to remedy long standing faults until the bridge and gates were reassembled. As a result, numerous faults occurred with the gates post-commissioning, but these were able to be managed via contingency plans.
- **Faults with hydraulic locking pins** - hydraulic locking pins lock the two halves of the bridge together when in the down position. Sensors detect the extended and retracted position, issues existed with both positions.
    - **Extended Position** - A pre-existing issue existed with the sensors which detected the engaged position of the hydraulic cylinders. The sensors and mountings were modified as part of the works and additional redundancy was added using dual sensors. The incumbent contractors carried out modifications without providing details for review or approval. Post commissioning faults on a single sensor were detected, but do not prevent the bridge from operating when a single sensor malfunctions. These sorts of faults have been common post commissioning but do not impact the bridge operation. However, continual reliance of system redundancy is not ideal and needs remediation.
    - **Retracted Position** - This sensor arrangement was also modified to remedy historic issues by incumbent contractors and involved, similarly to the extended position sensors, a redundant sensor. An issue occurred prior to the Christmas break where the striker for detecting the retracted position of the cylinder rotated with normal movements of the cylinder and pin connection meaning both sensors failed to detect the retracted position, resulting in a bridge fault that prevented the bridge from lifting. An interim modification has been made to prevent this issue from reoccurring. Works are underway to revise the sensor arrangement to prevent ongoing faults and improve reliability.

In addition, new issues were encountered, which similarly could be described as faults as opposed to breakdowns due to minimal impact to bridge operation.

- **Overheating of HMI PC** – in the first week of operation an issue was experienced where the HMI (human machine interface) PC was slow to respond to commands, resulting in significant operational issues with the bridge. The issue was found to be a temperature setpoint which automatically slowed the PC once reached to protect itself. The root cause of this was found to be due to an operator running the HVAC system in the bridge hut far above normally expected ranges. Additional cooling to the operator pedestal will be fitted as an additional protection measure.

COMMERCIAL IN CONFIDENCE

- **Operating Speed of HMI screens** – although this did not create an issue in which the bridge could not be operated, it created some concern amongst operators resulting in callouts as the screen appeared to be frozen or unresponsive. Root cause of this issue is currently being investigated, and an interim solution is being worked on to provide feedback to the operators to indicate system is still operational.
- **Hydraulic Leaks** - Hydraulic Leaks were found on the locking cylinder (western side only) due to faulty fittings associated with the use of original components. This resulted in a low hydraulic alarm. These were resolved through replacement of old fittings which had been re-used.
- **Failure of new light fixtures** – post install and testing of strip lighting, additional light fixtures failed necessitating further replacements.

7 Risk Management

Risks were identified at project inception and regular risk review meetings were carried out which assisted in informing methodologies, project programme and budget. Key risks identified at the outset of the project are outlined below. In most cases these risks were adequately managed and had no detrimental impact to the project.

Table 19 – Key Project Risks Identified at the beginning of the project (note this is not a full list of project risks)

Risk	Details	Commentary on Management of Risk
Delivery of long lead items	Late delivery of long leads could delay re-install/commissioning of bridge	Except for some light fixtures all long lead items were delivered on time.
Extent of maintenance works	Scope of maintenance works needed to be confirmed	High priority was put on confirming scope.
Bridge leaf alignment	Concerns were about re-assembly of the bridge and having alignment of components on reinstallation.	Risk was managed through thorough planning of methodology which included surveying of all key connection points for re-assembly.
Failure of bridge in down position	Risk of bridge failing during commissioning, or post commissioning process in the down position, leading to disruption to the passage of vessels	Additional contingency measures put in place to recover if failure occurred. Staged commissioning to minimise risks through thorough testing of parts of the bridge prior to full operation.
Quality	Deliverables not meeting project objectives	Coatings risk managed through ensuring coating spec met requirements, third party inspection and ensuring coating systems were warrantable.
Environmental	Works, particularly blasting and painting having negative effects on environment in the form of contamination	Alternative methodology evaluated instead of in-situ option to reduce risk
Resource Consent	Restrictive conditions for the works taking place in situ	Alternative methodology evaluated to mitigate this risk.
Noise	Impact to local stakeholders from blasting activities	Alternative methodology evaluated and selected to mitigate this risk.
Impact to marina operations	Disruption to passage of vessels	Actively managed barge movements and activities to minimise impacts to stakeholders.

COMMERCIAL IN CONFIDENCE

Weather	High winds, cold temperatures which could impact crane/barge and painting activities respectively	Weather caused few issues to the programme and did not eventuate, except for 1-2 days where movements had to be delayed due to high winds.

A key learning is that additional risks relating to incumbent contractors, although acknowledged, were underestimated and may have been more effectively mitigated through specific plans developed to address contractor capabilities and expectations.

The risk associated with varying the incumbent contractors scope under the main contractor was also underestimated. Interface issues existed between the main contractor and incumbent subcontractors which lead to delays in establishing the full scope and cost of mechanical and electrical scope. Despite trying to manage this interface between incumbent contractors and the main contractor, there were apparent issues with differing expectations and ways of working between the parties. If these risks were better identified, there may have been an opportunity to pro-actively manage the risks to reduce and/or eliminate issues.

8 Health & Safety

Near Misses and Incidents which occurred on this project are outlined in Table 20. The main contractor (HEB) conducted and provided copies of their own audits, additionally RCP completed site inspections which identified issues early to prevent near misses and incidents.

A large number of hours were logged on this project by the main contractor and their sub-contractors (actual number of hours pending confirmation). Notably, no incidents or near misses were directly associated with high risk works on this project. In reflection, H&S risks were well managed around high-risk activities, with the ancillary and more minor activities experiencing incidents.

Table 20 - Near Misses and Incidents

Incident Type	Description of Incident	Learnings
Near Miss / Minor Property Damage	Fire from hot works – a minor fire resulted from dunnage smouldering post hot works on Wynyard Wharf.	Incident investigation found that hot works permits were not closed daily meaning that areas were not checked 30 minutes post hot works for any potential hot spots that could result in a fire developing at the end of works each day.
LTI/MTI	Slip/fall from vehicle resulting in serious injury to worker while exiting a work vehicle.	Additional measures put in place to improve slip resistance of surfaces.
Near Miss	Boats entering channel during JUB movements resulting from poor communication.	Clear communication required with direct check ins between contractor and bridge hut operator before the start of any operations which required channel closures.
Near Miss	Security issues – members of public entering hoarded bridge area due to hoarding gates not being secured.	Specific end of shift checks with one person responsible for checking site security at the end of each day.

COMMERCIAL IN CONFIDENCE

9 Stakeholder Engagement & Communications

9.1 External to Eke Panuku

9.1.1 Channel Closures

External communications were managed directly by Eke Panuku based on information and guidance provided by RCP. It was appreciated that impacts to berth holders needed to be minimised and tightly managed. A conscious effort was made to clearly articulate the planned works and potential impacts, 3D modelling software was utilised to illustrate jack up barge movements and extent of work areas which impinged on the normal navigable channel.

Issues arose when the timing of barge movements was imprecise resulting in understandable frustration from stakeholders, as a result it was recognised that certainty was more important than reducing the potential window of disruption. For future movements, communications changed to windows of potential disruption with a maximum duration, e.g. disruption between 10am – 2pm, max disruption of one hour.

In reflection, the words "channel closure" was over-used and could have been reserved for activities where channel closures were required for more than just jack up barge movements and extended periods of time as these could be treated as vessel movements.

9.2 Internal to Eke Panuku

Weekly meetings were held with a wide range of internal Eke Panuku stakeholders. Progress Reports were issued monthly which included cost reporting. Additional programme updates resulting from weekly programme meetings were issued weekly towards the end of the project. Updates around commissioning progress were provided via email every 1-2 days to key internal stakeholders.

10 Successful Initiatives

Table 21 outlines some successful initiatives which were undertaken in the project which enhanced project outcomes.

Table 21 - Successful Initiatives

Initiative	Details
Change to coating specification	Initial coating specification would not have been provided with a warranty due to risks associated with condition of original coating systems. Changing the coating specification to a full blast and repaint allowed for warrantable coating system.
Change to Construction Methodology	Changing to a methodology that utilised a jack up barge (JUB) to remove the items from site, instead of an in-situ paint repair successfully mitigated environmental risks including those associated with noise and dust to close neighbours and enabled improved quality assurance and provided programme benefits by allowing for bridge elements to be worked on simultaneously.
Additional Corrosion Protection Measures	Unexpected areas were identified as potential locations where crevice corrosion would occur. This resulted in additional treatment of these areas providing an improved coating life where coating warranties would not cover imperfections/crevices in the substrate.
Third Party Quality Inspection	Third party inspection of coating preparation ensured quality of coating systems and enabled several QA issues to be proactively identified.
Use of Containerised Encapsulation	Initial plans were to use scaffold and shrink wrapped for encapsulation of bridge elements for blasting and painting. In an early challenge of a tendered programme, the main contractor

	came up with an alternative methodology utilising shipping containers and pre-built structures to create encapsulation, removing time from the programme.
Modified testing and commissioning process in recognition of potential brake testing issue	In a risk assessment of commissioning plans, a risk was recognised around load testing of brakes. As a result, an alternative methodology was developed utilising the JUB to test the bridge brakes under controlled conditions.
Use of CM Builder	Demonstration of staging through 3D modelling software provided a useful method for communicating impacts to the navigable channel with stakeholders.
Programme Focus	Separate progress meetings were setup to focus purely on programme, focussing on progress, risks to programme and potential opportunities to reduce programme.
Commissioning and Handover Plan	A commissioning and handover plan was developed to clearly articulate the commissioning methodology, roles and responsibilities and risks and their controls. Details and conditions of handover were outlined, which included pre-requisites for handover including documentation requirements to ensure there was agreement well in advance prior to handover to avert any potential delays to handover.

11 Missed Opportunities

Table 22 outlines the missed opportunities that became apparent throughout the project and should be considered in similar projects moving forward.

Table 22 - Missed Opportunities

Missed Opportunities	Details
Value Engineering of Hydraulic Powerpacks	In reflection, the hydraulic power pack selected for the eastern span likely exceeds the necessary performance requirements. A value engineering exercise may have enabled a refinement of the scope and specification as the hydraulic power pack only services the hydraulic brake on the eastern span. However, due to reliance on recommendation from incumbent contractor and time pressures, this opportunity was not able to be capitalised on.
Weld Repairs to Handrails	Based on the final extent of work involved with the weld repairs and modifications required to handrails, it may have been more efficient to fully replace certain sections. As soon as handrails had been blasted, the scope of handrail repairs required should have been confirmed/verified and assessed against alternative options to compare cost/time implications.
Span Supporting Rods (Mac-Alloy Bars)	Replacement of the Mac-Alloy bars were excluded from the original scope as they were not identified as needing replacement and did not involve significant down time to replace. On removal, the condition of the Mac-Alloy bars was found to feature cosmetic level corrosion. Had this been recognised earlier, replacements could have been sourced and replaced as part of the works, saving some minimal disruption in the future.
Painting Rework for M&E	Late addition/changes to brackets and fixings resulted in re-work of already painted surfaces. This was a result of incumbent contractor selection and their limited ability to provide all details in a timely manner coupled with the way works were varied into the main contract.

COMMERCIAL IN CONFIDENCE

12 Challenges and Obstacles

Table 23 lists out challenges and obstacles experienced during works from which experience provides learnings for future projects of a similar nature and/or where shortcomings have been identified which may have had an impact on project outcomes.

Table 23 - Challenges and obstacles during works

Category	Challenge/Obstacle	Detail
Planning and Consents	Costal Marine Area (CMA) Restrictions	Without a Resource Consent, activities in the coastal marine area (CMA) are restrictive. For context noise limits are significantly lower than for works occurring in adjacent areas (e.g. north wharf) and restrictions on temporary structures which are more onerous than in non-CMA areas.
	Resource Consent approval for night works at bridge location not received in time	The original plan was to carry out channel closures during night hours to minimise disruption. Because the consent was not received in time these works were changed to daytime hours. In hindsight, because of maximum working hours/stand down time requirements doing these channel closures may have created delay to the programme to such an extent the reduction in impact to stakeholders wasn't warranted. This is due in part because closure requirements were not as extensive as initially anticipated.
Stakeholders	Scheduled sailings of commercial vessels	Scheduled sailings had to be accounted for, and allowances made around planned barge movements. In most cases these could be accounted for, in the odd exception, alternative berthing arrangements could be made.
	Communication with berth holders / stakeholders around channel closures	Refer to section on Stakeholder Communication
Incumbent Sub-Contractors	Interface issues between main contractor and subcontractors leading delays to establishing full scope and cost of mechanical and electrical scope.	Despite trying to manage interface between incumbent contractors and the main contractor, there were apparent issues with differing expectations and ways of working between the two parties which resulted in delays in incumbent contractors confirming scope and associated costs.
	Commercial competency	It took some time to agree commercial terms between the main contractor and incumbent sub-contractors due to the latter's unfamiliarity in operating under contractual conditions present in a NZS3910 contract. This included the mechanical sub-contractor having an expectation to be able to complete works on a time and cost basis rather than a lump sum basis.
	Competency in developing project programmes	Significant time was taken to develop programmes for mechanical and electrical programmes. In the end, this was driven almost exclusively by the main contractor with minimal input from incumbent sub-contractors in the form of providing durations for activities.
	Competency in developing planned solutions	Incumbent subcontractors were used to far more informal ways of working, specifically when it came to oversight, review and approval of proposed solutions/changes to specific issues. As such details of proposed fixes were not provided for review prior to implementation. Despite pressing for details, in many cases details of proposed solutions were not provided which prevented full review of proposed changes which resulted in some issues that possibly could have been mitigated.
	Lack of commercial tension	Lack of commercial tension was created by sole sourcing via incumbent contractors. This coupled with time constraints created by project urgency

COMMERCIAL IN CONFIDENCE

		and delays from trust issues between contractors meant that ultimately, costs were more than likely higher than what may have been achieved in a competitive tendering/quoting process. It was not possible, without suffering delays to the programme, to create this commercial tension.
	Late addition of M&E bracket requirements resulting in rework	Late additions/changes to brackets and mounting required rework to paint resulting in additional costs and programme input.
Corrosion	Unknown scope of corrosion repairs	The extent of corrosion was not known until high pressure water blasting and abrasive blasting was completed. This created risk to both programme and budget. Once the first bridge element was completed, estimates of cost and time could be applied to the balance of works.
	Extensive corrosion throughout handrails	The extent of corrosion in the handrails was far more extensive than originally anticipated.
Issues with original construction	Counterweight frame weld detail	The original welding detail on the counterweight connection was not up to standard and had suffered corrosion because of an apparent site weld not receiving adequate corrosion protection. This necessitated a repair which required a section of decking plate being removed and subsequent repair to the decking surface.
	Substandard welds	Substandard welds from original construction were found.
	Penetration detail through main chords	Penetrations for services through main chords as part of original construction required remediation due to corrosion and future corrosion risk.
Minor & Miscellaneous	Missing anti-climb mounting brackets	Some anti-climb panels were removed by incumbent contractors ahead of main contract works. When panels were about to be re-installed many fittings were found to be missing, presumed damaged during removal or lost by the incumbent contractor.
	Late delivery of strip lighting	Late delivery of strip lighting fixtures resulted in resequencing of works and extended JUB duration.
	Faulty strip lighting	On initial testing of strip lighting, multiple light fittings were found to be faulty. These were ultimately replaced by the supplier. Additional light fittings also failed post install and testing.
Training and Handover	Quality of existing training documents	The quality of existing training documents meant that new training documents needed to be developed to ensure an appropriate level of training was carried out prior to the return to service.
	Variability in competency of bridge hut operators	Competency of operators varied greatly, tailored training and support should have been provided to operators based on pre-existing experience and competency, this was able to be addressed during training but ultimately did result in more callouts post-commissioning from less experienced/confident operators.

COMMERCIAL IN CONFIDENCE

13 Lessons Learnt

Table 24 below summarises the lessons learned through this project, these are a combination of learnings resulting from the general project experience, opportunities missed, successful initiatives and specific shortcomings identified.

Table 24 – Lessons learnt

Category	Lesson Learnt	Recommended Action
Procurement	The positive benefits of utilising incumbent contractors can be outweighed by performance issues and less than favourable outcomes. Ensure risks are appropriately managed.	Carry higher risk contingency to reflect reduced commercial tension and time constraints. Ensure risks/benefits are fully considered and documented prior to any decision, ensure risks of any decision made are added to risk register and actively managed/mitigated.
	Accelerated procurement processes can result in reduced interest and lower quality responses.	Invest in early communication with tenderers and provide as much time as reasonably possible for responses.
	Varying in scope of M&E into an existing contract presents issues around quality/performance requirements.	Where possible, include M&E scope within original procurement process.
Programme	Programme focussed meetings provided an opportunity to proactively identify and mitigate risks, identify acceleration opportunities and enable timely updates on programme to client.	Establish a dedicated weekly programme meeting in the final few months of time critical projects.
	Use of visual programme summary tools provided the ability to effectively communicate a complex programme to multiple stakeholders.	Adopt supplementary programme tools to aid visual communication.
	Incumbent and small contractors may not have the capability or suitable skills to programme their section of works accurately.	Selection of contractors needs to be aligned with project outcomes, in this case time constraints and inherent knowledge by incumbent contractors governed the decision to utilise incumbent contractors. However, risks could have been better recorded, and mitigation strategies put in place to better manage if possible.
	Robust management of long lead and critical items.	Ensure robust management processes are in place for long lead and critical items to enable issues to be identified and mitigated earlier.
Risk	Incumbent contractors were a known risk, but detailed or specific risks were not identified or managed.	Don't underestimate the detail within high-risk contractors/suppliers. Specific risks around programme, cost, quality and scope should be considered and actively managed within risk register.
Budget / Cost	Budget accuracy is critical from inception.	Ensure the project budget includes appropriate risk contingency for the "known" and "unknown" risks, with key assumptions disclosed.
	Ensure clear and effective communication about project risks and potential cost escalation.	Incorporate into reporting.
Scope/Quality	Early works created complications to works further down the track, avoid unless critical to project objectives.	Early works should be restricted to works which only have a demonstrable benefit to project programme or outcomes.

	Expectations for review/approval of modifications should have been clearly set. Incumbent contractors struggled to adhere to good practice of providing details for approval prior to implementation. Risk should have been explicitly identified and expectations more clearly communicated.	Ensure adequate processes are in place.
Stakeholder	Communications with berth-holders and bridge hut operators could have been improved.	Use of the words channel closure should have been limited to activities where channel closures were necessary for tasks over and above JUB and tug movements, particularly where movements/interruptions were minimal. Improved communications plan from the outset to ensure bridge hut operators were conversant with plans to eliminate issues with miscommunication, required direct line of communication between hut operators and contractors prior to the start of works.
Planning / Resource Consent	Constrained work hours in CMA limited productivity (severe compared to adjoining areas).	Seek flexible working hours and noise constraints in Consents when working on time and cost sensitive projects.
	There is a Resource Consent requirement for temporary structures in CMA and activities more restricted than other areas (40 days).	Avoid work in the CMA where possible by working offsite or prefabrication.
Training & Handover	The range of operator competency can lead to varying levels of ability, particularly when addressing routine faults and issues.	Ensure training is tailored and support provided according to pre-existing capability and experience, this was addressed at the time during the project, but further improvements could have been made if better planned for.

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