

## WAIMAKARIRI DISTRICT COUNCIL

### REPORT

**FILE NO:** GOV-26-01-07, CPR-04-04-01 / 150609090834


**REPORT TO:** Kaiapoi Community Board


**DATE OF MEETING:** 15 June 2015

**FROM:** Craig Sargison, Manager Community and Recreation

**SUBJECT:** Kaiapoi Riverbanks Projects : Bridge to Wharf Connection and Wharf Development

**SIGNED BY:**  
(for Reports to Council or Committees)

  
Department Manager

  
Chief Executive

---

#### 1. SUMMARY

- 1.1. The purpose of this report is for the Board to recommend to the Council its preferred option for:
  - 1.1.1. The development of a Kaiapoi Bridge to Wharf pedestrian linkage;
  - 1.1.2. The future development of the Kaiapoi Wharf
- 1.2. The report outlines options that have been considered by the Riverbanks Steering Group and recommends supporting the development of a tiered pedestrian access way as recommended by the Riverbanks Steering Group.
- 1.3. The report also recommends proceeding with the repair of the “new wharf” and the demolition of the “old wharf”.
- 1.4. The report notes that the Riverbanks Steering Group is still considering options for a pontoon development once the design details of the pedestrian linkage are finalised.

#### Attachments

- i. Riverbanks Plan with project areas delineated.
- ii. Kaiapoi Upstream Wharf – OPUS report.
- iii. Kaiapoi Bridge Flood Protection and Boardwalk Options – OPUS PowerPoint.

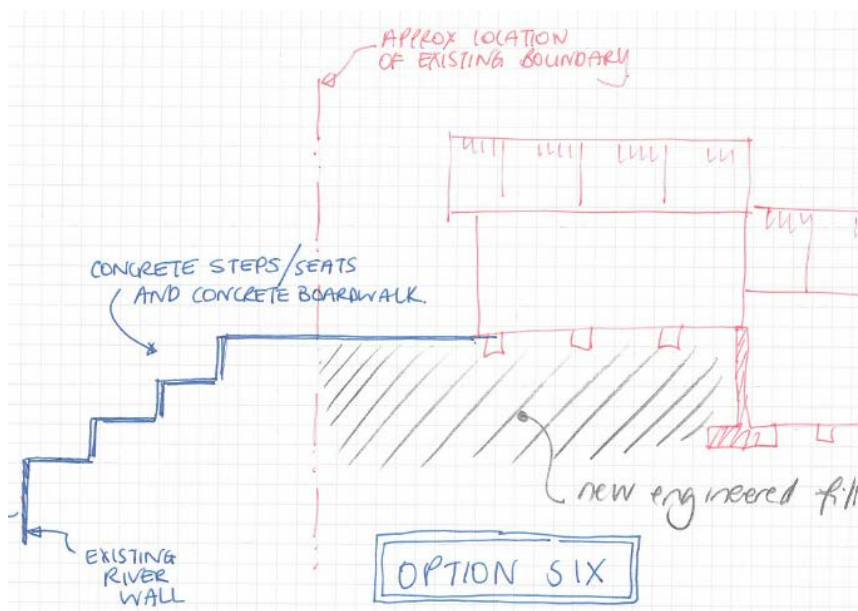
#### 2. RECOMMENDATION

**THAT** the Kaiapoi Community Board:

- (a) **Receives** report N<sup>o</sup> 150609090834.

**Recommends to Council:**

- (b) **Approves** staff progressing the detailed design and cost estimate for the connection between the Williams Street Bridge, the proposed commercial development on the former Hansen’s site and the Riverbank Walkway as per Option 6:



- (c) **Approves** staff progressing plans for the demolition of the old wharf and notes that a further report with cost estimates and methodology will be prepared for the Board's and Council's consideration.
- (d) **Approves** staff proceeding to get quotations for the repair of the upstream wharf (new wharf).
- (e) **Notes** that the first order cost estimates indicate that there could be a potential funding shortfall of \$330,000.
- (f) **Circulates** this report to the Kaiapoi Riverbanks Steering Group.

### 3. ISSUES AND OPTIONS

#### 3.1. Project scope

3.1.1. The area from the Williams Street Bridge to the Coast Guard involves several discrete but interrelated areas. For project scope clarity these have been separated into 8 projects.

- i. Railway Platform and Stopbank
- ii. Old Wharf
- iii. New Wharf
- iv. Wharf side siteworks
- v. Bridge tiered boardwalk
- vi. Walkway to boardwalk
- vii. Floating pontoon
- viii. Tuhoe Wharf

#### 3.2. Railway Platform and Stopbank

- 3.2.1. The current alignment of the stopbank is going to be retained but the height needs to be raised to provide adequate flood protection.
- 3.2.2. ECan will undertake the raising of the stopbank but the removal of the railway station platform roof and supports and the concrete foundation is the responsibility of WDC.
- 3.2.3. WDC will also be responsible for the reinstatement of the walkway and vehicle access to the wharf area.

### **3.3. Old Wharf**

- 3.3.1. This needs to be demolished as it is an unsafe structure and to repair it would involve a complete rebuild.
- 3.3.2. The Riverbanks Steering Group have discussed this and support the demolition of the old wharf.
- 3.3.3. OPUS are currently preparing plans for the demolition of the wharf as there will need to be some river bank stabilisation as part of the demolition.
- 3.3.4. Once the demolition plans are received staff will get a cost estimate from the QS for this work.
- 3.3.5. Note that it is intended to salvage the supporting beams and sleepers for potential re use in landscaping work around the riverbanks.

### **3.4. New Wharf**

- 3.4.1. This wharf had had the old cladding removed at the time of the September 2010 earthquake with a few planks of the new cladding installed.
- 3.4.2. The balance of the new cladding was on site ready for installation. Originally this recladding was also going to include some further remedial work but at the time as there was significant damage in and around the area and it was agreed that the priority was to get the new cladding installed.
- 3.4.3. Following the Kaiapoi Riverbanks Steering Group meeting held on 2 March 2015, WDC requested Opus to consider a 'Do Minimum' remedial solution to the upstream wharf structure.
- 3.4.4. A report has now been received from OPUS documenting their proposed 'Do Minimum' remedial solution together with a discussion on the residual risks associated with this proposal. (A copy of the full report is attached.)
- 3.4.5. Should the worst case occur and the wharf suffers complete collapse we believe the risk to life safety would be low based on the following:
  - Any boat moored to the wharf would be pushed out into the Kaiapoi river, the boat may end up on a lean depending on the strength of the connection of the boat to the wharf. However this is unlikely to pose a life safety hazard should people be on board the boat.
  - If the robustness of the connections of the deck of the wharf to the concrete piles is improved then OPUS expect the wharf structure to remain intact in the event of significant rotation of the wharf due to lateral spread. In this instance the deck is likely to have a considerable slope towards the land as has occurred in the past.
- 3.4.6. The following is a copy of the conclusions and recommendations in the OPUS report, and a copy of the full report is attached:
  - a) The 'upstream' Kaiapoi wharf suffered minor damage from the 4 September 2010 and 22 February 2011 earthquakes.
  - b) Based on the current condition of this wharf and its performance during the 4 September 2010 and 22 February 2011 earthquakes, we believe there is a low risk of complete collapse of this wharf in a future major earthquake.
  - c) As-built documentation showing foundation depths of the retaining wall and concrete piles are not available, and as we have not been able to confirm the post-earthquake condition of the below ground portions of these structures we are unable to completely rule out collapse of this wharf in a future major seismic event.

- d) Based on the current and future recreational use of this wharf we believe that, in the unlikely event that the wharf collapses during a major seismic event, as long as the deck remains attached to the piles that the wharf should not pose a life safety risk.
- e) The current 'upstream' wharf has a cable barrier to prevent vehicle access to the wharf. This barrier should be maintained for the remaining life of the wharf.
- f) The wharf may well be unserviceable following a future major earthquake, and may require demolition.
- g) We have proposed remedial works to the existing connection between the concrete piles and the hardwood capping beam and to replace the bolts between the stringers and the capping beam. These remedial works will improve the robustness of these critical connections for future seismic events.
- h) Because this is an older wharf we have provided a list of items that should be observed on a yearly basis with a detailed investigation undertaken every 5 years to check structural integrity.
- i) Although outside of the scope of this report, a number of timber stringers were noted to have significant decay and may require replacement in the near future.

3.4.7. Staff are in the process of getting a cost estimate for this work.

### **3.5. Bridge tiered walkway**

- 3.5.1. This provides pedestrian access from the Williams Street bridge to the Riverbanks Walkway.
- 3.5.2. This area was identified as a priority area for improvement to pedestrian access from the bridge. The demolition of the Bridge Tavern and the potential development of a new building has opened possibilities for enhancing the accessway and providing more of an inviting feature leading off the bridge and potentially connecting with new hospitality venues to be constructed on the old Bridge Tavern/Hansens Mall site.
- 3.5.3. The Riverbanks Steering Group has spent some time looking at options for this area that would also fit in with the proposed adjoining commercial development. One of the key factors in the deliberations has been the finished height of the stopbank. ECan have now confirmed that that section of stopbank does not need to be raised and can stay at its existing height.
- 3.5.4. After various discussions the Steering Group reviewed six options and an outline of these is attached to this report. (OPUS PowerPoint)
- 3.5.5. Option 1: Effectively was to have a grassed stopbank meeting the existing retaining wall. The key downside of this option is that there is no connection between the stop bank and the new commercial development.

This option was not supported by the Riverbanks Steering Group.

- 3.5.6. Option 2: Flood protection wall: this was the creation of a flood protection wall at the rear of the stop bank with a balcony cantilevered off the new commercial building. The key problem with this option was the restriction of the size of the balcony that could be provided – a maximum of 3 metres. Another significant issue was the lack of access to the river.

This option was not supported by the Riverbanks Steering Group



- 3.5.7. Option 3: Flood wall and river walkway: A variation on Option 2 with the difference being an additional boardwalk to give greater pedestrian access to the river. There is still the issue of the width of the balcony and the disconnect between the balcony and the river.

This option was not supported by the Riverbanks Steering Group

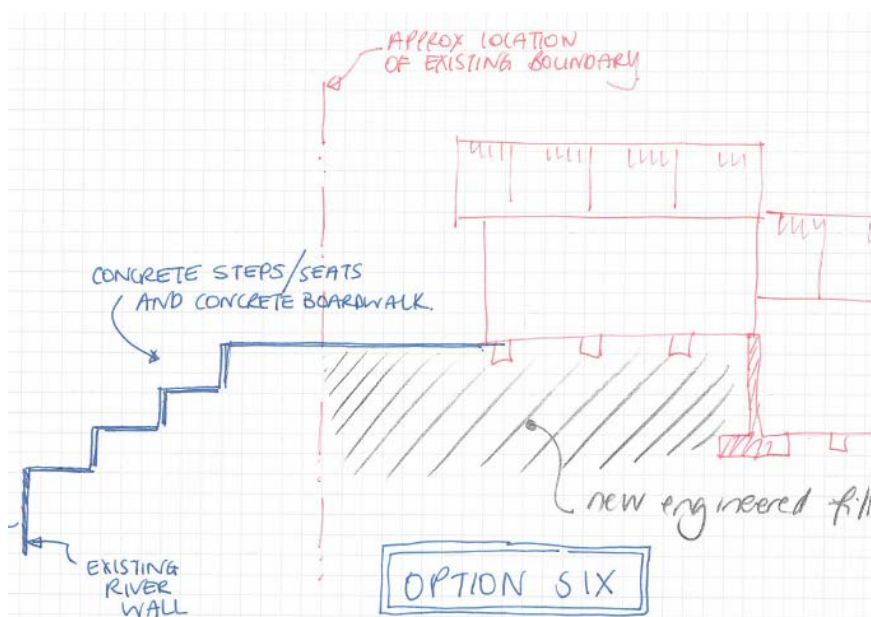
- 3.5.8. Option 4: Large Boardwalk and River piles: this option provides a large boardwalk (12–15 metres) and good access from the bridge. The key disadvantage is that the flood wall is likely to move in a seismic event and the flood protection element would be difficult to repair.

This option was not supported by the Riverbanks Steering Group

- 3.5.9. Option 5: Extend the stopbank. This option would involve extending the stopbank into the adjoining land which effectively means that the commercial building would move back further from the river.

This option was not supported by the Riverbanks Steering Group, nor the developer of the Commercial premises that would be affected if this option was pursued.

- 3.5.10. Option 6 : Extend the stopbank and step



- 3.5.11. This option involves creating a walkway from the bridge together with a series of wide steps down to the edge of the river. This has the advantages of providing good connectivity between the bridge, the walkway and the commercial development. It also creates the potential for a pontoon to be located on the river with easy pedestrian access to the bridge and the town centre.

This option was unanimously recommended by the Riverbanks Steering Group and also has the support of ECan.

- 3.5.12. Summary of indicative costs for each Option

Option 1	\$400,000 - \$600,000
Option 2	\$750,000 - \$1,000,000
Option 3	\$1,000,000 - \$1,500,000
Option 4	\$1,800,000 - \$2,300,000
Option 5	\$1,500,000 - \$2,000,000
Option 6	\$2,500,000 - \$3,000,000

### **3.6. Wharf side siteworks**

- 3.6.1. There will be a requirement to construct a new road accessway to the wharf side area.
- 3.6.2. This road access is necessary to provide access to both the upstream wharf and the Tuhoe Wharf and Coastguard.
- 3.6.3. The design of this will be worked through with the Riverbanks Steering Group and a design will be recommended by the Steering Group to the Kaiapoi Community Board.

### **3.7. Walkway to boardwalk**

- 3.7.1. Once the details of the boardwalk area from the Bridge is finalised the design of the stopbank walkway to link to the wharf area can be detailed.
- 3.7.2. This design will be worked through with the Riverbanks Steering Group prior to a recommendation being made to the Kaiapoi Community Board.

### **3.8. Floating Pontoon**

- 3.8.1. The recommended design for the bridge boardwalk area does facilitate the potential for a pontoon development to enable craft to anchor for short periods of time.
- 3.8.2. There are many options around the design of a pontoon and these will be worked through with the Riverbanks Steering Group prior to a recommendation being made to Kaiapoi Community Board.

### **3.9. Tuhoe Wharf**

- 3.9.1. While the Tuhoe Wharf has not been professionally assessed it does appear that the wharf does need some remedial work.
  - 3.9.2. This needs to be further discussed with the Tuhoe Trust and the Riverbanks Steering Group prior to a report being prepared for the Kaiapoi Community Board.
  - 3.9.3. At this stage it is prudent to make some provisional allowance for Council funding for some repair/strengthening work..
- 3.10. The Management Team/CE has reviewed this report and supports the recommendations.

## **4. COMMUNITY VIEWS**

- 4.1. All of the recommendations in this report are supported by the Riverbanks Steering Group but there has not been any other consultation undertaken.
- 4.2. It is recognised that each of the projects detailed in the report will need some form of community engagement and this will be discussed on a project by project basis with the Riverbanks Steering Group in the first instance.

## **5. FINANCIAL IMPLICATIONS AND RISKS**

- 5.1. The total Riverbanks Project budget is \$8,581,000 and the details of this are explained in the report (28 January) referred from Council. During the consideration of the LTP the Council resolved to leave the budget unchanged.

- 5.2. The following table summarises the Council approved budget as part of the 2014/15 Annual Plan process and this table was reconfirmed as part of the 2015/16 LTP Process:

Riverbanks Project	Approved budget as at 30 June 2014
Wharf	\$4,580,000
Recreation Area	\$808,000
Rowing Precinct	\$70,000
Marine Precinct landscaping	\$410,000
Murphy Park	\$713,000
Riverbank Enhancement – Earthquake Appeal Trust – see below	\$2,000,000
<b>TOTAL</b>	<b>\$8,581,000</b>

- 5.3. The following table is as approved by the Riverbanks Steering Group and has some more specific allocations for key areas of landscaping around the riverbanks, particularly at the four entrance ways to the walkway from the bridge. It also allows for landscaping of the section of riverbank and stop bank adjoining the new shared space on Raven Quay adjoining the Ruataniwha Kaiapoi Civic Centre complex.

1st Order Budget Requirements for CEAT Riverbanks Projects	
<b>Cure Boating Club Area</b>	
Stop Bank opposite Library	\$100,000
Area Around new Cure boating Club	\$190,000
<b>Informal Recreation Precinct</b>	
BMX track	\$310,000
General Landscaping	\$80,000
<b>4 x bridge Corners</b>	
North West Corner (War Memorial)	\$140,000
North East Corner (Trousselot)	\$150,000
South West Corner (Library)	\$20,000
South East Corner (Commercial Precinct)	\$120,000
<b>Riverbanks Walkway</b>	<b>\$640,000</b>
<b>Boat Ramp</b>	<b>\$250,000</b>
<b>Total Cost</b>	<b>\$2,000,000</b>

- 5.4. The following table provides a preliminary first order budget for the eight projects covered in this report. Note that this excludes general landscaping such as seats, lights, planting etc which has an allocation of \$410,000 – Marine Precinct Landscaping

	<b>First Order Cost Estimate</b>	<b>Source Of Estimate</b>
Railway platform and stopbank	\$50,000	Staff
Old Wharf	\$250,000	Staff
New Wharf	\$50,000	Staff
Wharf side siteworks	\$300,000	Staff
Bridge tiered boardwalk (Option 6)	\$3,000,000	OPUS
Walkway to boardwalk	\$120,000	Staff
Floating pontoon	\$400,000	Davis Langdon
Tuhoe Wharf	\$300,000	Staff
<b>Total</b>	<b>\$4,470,000</b>	

- 5.5. The following table summarises the available budget for this work:

Available budgets	
South East Corner (Commercial Precinct) ( CEAT Riverbanks)	\$120,000
Wharf	\$4,580,000
Total	\$4,700,000
Expenditure to date ( wharf budget including stopbank realignment)	\$560,305
Balance available	\$4,139,695

- 5.6. This indicates a potential budget shortfall of \$330,305.
- 5.7. These figures are very indicative and it is suggested that we proceed with detailed design for the bridge tiered boardwalk and then get quotations for undertaking the work. Similarly with the demolition of the old wharf and the repairs to the new wharf.
- 5.8. Once quotations have been received for these projects we will have a better understanding of the actual costs.
- 5.9. There is flexibility of design around the pontoons and we have not yet done any design work on the Tuhoe Wharf and neither has any design been done for landscaping so there is the potential to refine the cost estimates for those projects.
- 5.10. If after all of the cost estimates are received and if there is still a shortfall there would be options of scope change or exploring other budget sources such as the Kaiapoi Town Centre budget or of the Council making additional budget provision available.

## 6. **CONTEXT**

### 6.1. **Policy**

This matter is not a matter of significance in terms of the Council's Significance Policy.

### 6.2. **Legislation**

Building Act

### 6.3. **Community Outcomes**

- The Community's needs for health and social services are met.
- The range of community and recreation facilities meets the changing needs of our community.



Craig Sargison  
MANAGER, COMMUNITY AND RECREATION



# LEGEND

- |                         |                                       |  |  |                                      |   |
|-------------------------|---------------------------------------|--|--|--------------------------------------|---|
| 1. Railway Platform     | <span style="color: blue;">■</span>   | 4. Wharf Side Siteworks                            | <span style="color: magenta;">■</span> | 7. Floating pontoons (Future Option) | <span style="color: blue;">■</span>       |
| 2. Old Wharf Demolition | <span style="color: red;">■</span>    | 5. Bridge to Wharf Connection:<br>Tiered Boardwalk | <span style="color: green;">■</span>   | 8. Tuhoe Berth                       | <span style="color: lightgreen;">■</span> |
| 3. Wharf Repairs        | <span style="color: orange;">■</span> | 6. Walkway to Wharf                                | <span style="color: yellow;">■</span>  |                                      |   |

## Kaiapoi Wharf Connection to Bridge

04.06.15  
Not To Scale

Sheet 1 of 1

Dan Cameron  
Community Engagement Officer  
Waimakariri District Council



Ph: (03) 311 8902 ext 8459  
Mob: (021) 248 9972  
<http://www.waimakariri.govt.nz/>





**Opus International  
Consultants Ltd**  
Christchurch Office  
20 Moorhouse Avenue  
PO Box 1482, Christchurch Mail  
Centre, Christchurch 8140  
New Zealand

t: +64 3 363 5400  
f: +64 3 365 7858  
w: [www.opus.co.nz](http://www.opus.co.nz)

29 May 2015

Craig Sargison  
Manager, Community and Recreation  
Waimakariri District Council  
Private Bag  
215 High Street  
Rangiora

6-DP202.03

Dear Craig,

### **Kaiapoi Wharf: Upstream wharf remediation**

#### **1. Introduction**

Opus International Consultants (Opus) has been engaged by the Waimakariri District Council (WDC) to undertake a review of the existing upstream wharf and prepare a letter report of the current status of this section of the wharf together with a proposed remediation solution and the residual risks associated with this proposal.

Following the Kaiapoi Riverbanks Steering Group meeting held on 2 March 2015, WDC requested Opus to consider a 'Do Minimum' remedial solution to the upstream wharf structure. This letter report documents our proposed 'Do Minimum' remedial solution together with a discussion on the residual risks associated with this proposal

Opus undertook an inspection of the upstream wharf on 9 April 2013 at low tide and 14<sup>th</sup> April 2015 and we made use of the following documentation:

- Kaiapoi Wharf: Apportionment of Damage, 24 July 2013 (prepared by Opus);
- Kaiapoi Wharf Inspection Report, 12 August 2011 (prepared by MWH);
- Kaiapoi Wharf Inspection Report, 5 May 2011 (prepared by MWH);
- Works Consultancy Services Kaiapoi Wharf Inspection Report dated March 1995.

An additional inspection was carried out on 22 May 2013 to view test pits which were dug to investigate the presence and condition of the deadman anchors behind this wharf.



## **2. Methodology**

We have not proposed to undertake all earthquake repairs or to upgrade all structural elements where deterioration has been observed. Instead, for this 'Do Minimum' solution we have focused our consideration on the life safety aspects of the wharf structure and to do this we have taken the following approach:

- Understand both the gravity and seismic load paths and to understand the likely performance of the wharf during seismic events.
- Physical observation of the wharf, with consideration that this wharf has been through significant recent earthquake shaking including seismic events that initiated lateral spread.
- Ensure integrity of the load paths by modifying/replacing existing connections or by adding new connections where necessary.
- Continue to monitor the condition of the structure in the future.

It should be noted that an analysis to determine the level of redundancy in the principle structural members has not been carried out as part of this report. However, by inspection, the structure appears suitable for gravity loads.

## **3. Description of the upstream wharf structure**

The upstream wharf is a suspended wharf structure with an approximate area of 27m length by 4m width and comprises the following structural elements:

- a) A row of octagonal concrete piles at 3m centres along the wharf edge. Damage in the form of spalled concrete was observed at the top of most of the octagonal piles.
- b) A hardwood cap beam spanning longitudinally across the top of all the octagonal concrete piles;
- c) Steel plates are embedded into the concrete piles which are bolted to each side of the timber capping beam. There is surface rust on the plates and bolts.
- d) Concrete waler beams and precast facing panels on the landward side of the octagonal piles;
- e) An insitu concrete retaining wall approximately 1m behind the octagonal piles;
- f) Steel tie rods running from the octagonal piles into the insitu concrete retaining wall;
- g) A concrete sill beam bearing on the ground approximately 0.5m behind the back of the insitu concrete retaining wall. This beam was constructed in August-September 2010 and the contractor has confirmed that it was level when it was constructed;



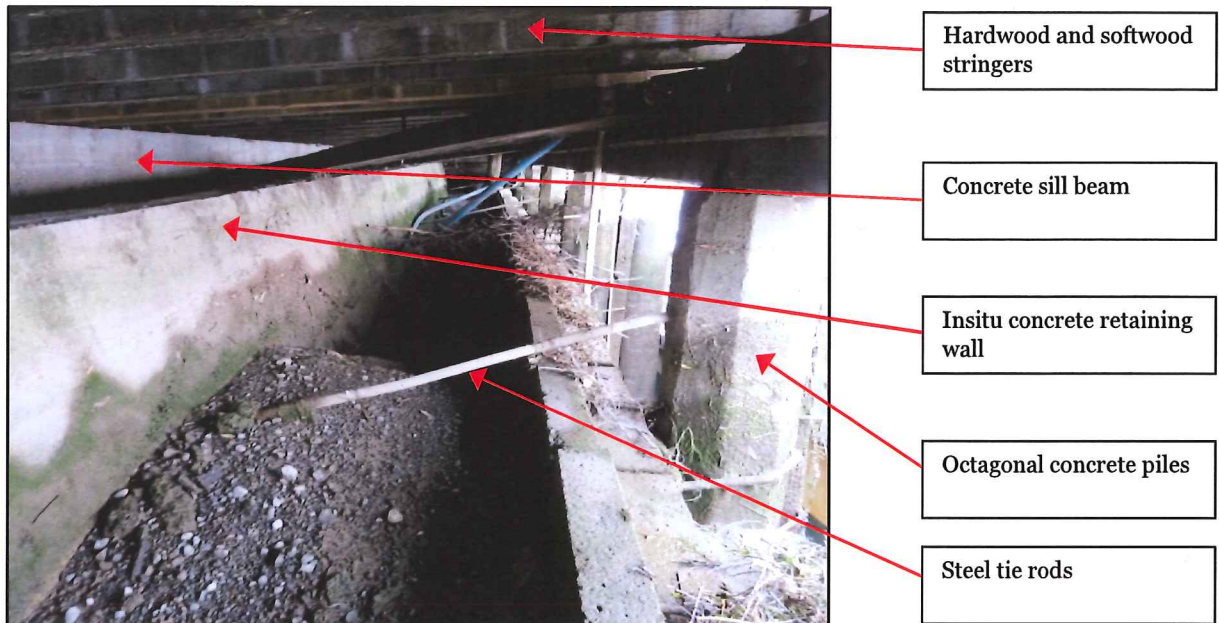
- h) Hardwood and softwood stringers spanning between the concrete sill beam and the hardwood cap beam, supporting softwood timber decking. This decking was installed at the same time the sill beam was constructed in 2010.
- i) Many of the softwood and hardwood stringers are split and/or decayed. We understand that the worst stringers were replaced in 2010, however further replacement of the stringers may be required in the near future.
- j) The stringers are connected to the new sill beam with one 5mm stainless steel Bowmac bracket (using M12 coach screws into the timber and M12 Dynabolts into the concrete beam).
- k) The stringers are connected to the hardwood capping beam with steel angle brackets and coach screws. The steel angles and screws shows signs of surface rust and some of the angles are bent.

A test pit up to 2.2m deep was dug immediately behind the wharf on 22 May 2013 in line with a steel tie rod. The tie rod was not located within the test pit, which leads us to the conclusion that the tie rods are anchored in the insitu concrete retaining wall.

General overview photos of the wharf are shown below.



**Photo A: Upstream wharf – general view**



**Photo B: Upstream wharf – below deck**

#### **4. Structural review of wharf**

The condition and extent of the below ground structural elements of this wharf are unknown. These are described below:

- The depth of founding of the main concrete retaining wall is unknown;
- The depth of embedment of the concrete piles into the river bed is unknown;
- We are unsure if the concrete piles are damaged below river bed level due to earthquake shaking, liquefaction and lateral spread.

Given that minor damage was observed to this wharf structure following 4<sup>th</sup> September 2010 and 22 February 2011 earthquakes, we expect there is a low risk of complete collapse of this wharf in a future major earthquake. However because we have not been able to confirm the below ground structures, collapse of the wharf cannot be completely ruled out during a future major earthquake.

This wharf is currently used to moor small boats and vehicle access onto the wharf is prevented with a physical barrier. In the future it is likely that at least one recreational boat will be moored to this wharf and the wharf may be used by the local community to fish the Kaiapoi river. Should the worst case occur and the wharf suffers complete collapse we believe the risk to life safety would be low based on the following:

- Any boat moored to the wharf would be pushed out into the Kaiapoi river, the boat may end up on a lean depending on the strength of the connection of the boat to the wharf. However this is unlikely to pose a life safety hazard should people be on board the boat.
- If we improve the robustness of the connections of the deck of the wharf to the concrete piles then we expect the wharf structure to remain intact in the event of



significant rotation of the wharf due to lateral spread. In this instance the deck is likely to have a considerable slope towards the land as has occurred in the past.

Physical investigation of the below ground structures could be undertaken to better understand the risk of collapse, however considerable cost would be incurred to do this, particularly to excavate around the concrete piles in the river, and given the performance of the wharf during the Canterbury earthquake sequence and low risk activities associated with the wharf we believe further investigations of this nature are unwarranted.

Whilst we believe that complete collapse of this wharf and risk to life safety during a future major earthquake is low, we do expect that the wharf may well be unserviceable and may require demolition following a future major earthquake that induces lateral spread at the wharf site.

#### Damage and Deterioration of the existing structure

As noted below we have observed some damage and deterioration of the existing structure:

##### a) Concrete piles and connection to hardwood capping beam

- Most of the concrete piles have spalled around the connection of the piles to the hardwood capping beam refer to photos 6 and 7 Appendix 1. This damage was also documented 20 years ago in the 1995 Works Consultancy Services condition report, a photo from this old report is included as photo 9 in Appendix 1 of this report.
- The spalling of the concrete piles does not appear to have deteriorated significantly in the last 20 years including the Canterbury Earthquake sequence.
- In addition to the spalled concrete, the steel plate connections have surface rust. We are unsure of the depth of the steel plates into the concrete piles and therefore we have some concern that the spalling may have significantly reduced the pull-out and shear capacity of the original pile/cap beam connection.

*Recommendation – Whilst the deterioration of the connection between the concrete piles and the hardwood capping does not appear to have deteriorated significantly in the last 20 years, this is a critical connection for the integrity of this structure in a future seismic event and therefore we recommend that the spalling is repaired and a new connection between the pile and capping beam is provided.*

##### b) Timber hardwood capping beam connection to timber stringers

- The connection between the capping beam and the stringers consists of a steel angle. The angle has surface rust but appears to be sound. A few of the angles were observed to be bent, refer to photo 8, Appendix 1.

*Recommendation – As this is also a critical connection for the integrity of this structure in a future seismic event we recommend that all existing coach screws are replaced with new through bolts and large washer plates and, where the angles are deformed, that the angle brackets are replaced.*

c) Concrete retaining wall

- A settlement crack was observed in the concrete retaining wall, refer photo 4, Appendix 1.
- The upstream edge of the retaining wall has cracked and spalled as observed in photos 1 and 2, Appendix 1. The concrete surrounding the tieback rod appears sound. The damage to the end of the retaining wall is unlikely to initiate global collapse of the wharf.

Recommendation – *Monitor condition of the cracks. Should the cracks deteriorate in the future, repair is likely to be required.*

## **5. Proposed Maintenance and Remedial Works**

As described in the previous section we recommend improving the connections between the concrete piles and the hardwood capping beam and the capping beam and the stringers. Schematic sketches of these remedial works are included in Appendix 2.

### Monitoring reference points

We recommend that a minimum of 4 survey marks are installed in the deck of the wharf. Initially these survey marks should be monitored every 2 months for at least 3 visits to provide baseline data, followed by a yearly survey or following significant seismic events. If movement of the wharf is recorded by this survey monitoring, a detailed structural investigation should be undertaken to check the integrity of the gravity and seismic load paths.

### Future maintenance works

We recommend that a yearly visual inspection (including survey point check) is undertaken of the wharf to ensure load paths remain viable and that every 5 years a detailed investigation is undertaken and the condition and deterioration is compared with previous observations and reported back to Council. The inspections would include observations of the following items:

- Inspect the condition of the concrete retaining wall, noting crack widths of existing cracks or the presence of new cracks.
- Inspect the connections between the stringers and sill beam.
- Inspect the condition of the timber stringers (some show signs of deterioration) and replace stringers as needed.
- Decking boards.
- Capping beam.
- Connection to, and the condition of, the fender/mooring piles.

## 6. Conclusions and Recommendations

- a) The 'upstream' Kaiapoi wharf suffered minor damage from the 4 September 2010 and 22 February 2011 earthquakes.
- b) Based on the current condition of this wharf and its performance during the 4<sup>th</sup> September 2010 and 22 February 2011 earthquakes, we believe there is a low risk of complete collapse of this wharf in a future major earthquake.
- c) As-built documentation showing foundation depths of the retaining wall and concrete piles are not available, and as we have not been able to confirm the post-earthquake condition of the below ground portions of these structures we are unable to completely rule out collapse of this wharf in a future major seismic event.
- d) Based on the current and future recreational use of this wharf we believe that, in the unlikely event that the wharf collapses during a major seismic event, as long as the deck remains attached to the piles that the wharf should not pose a life safety risk.
- e) The current 'upstream' wharf has a cable barrier to prevent vehicle access to the wharf. This barrier should be maintained for the remaining life of the wharf.
- f) The wharf may well be unserviceable following a future major earthquake, and may require demolition.
- g) We have proposed remedial works to the existing connection between the concrete piles and the hardwood capping beam and to replace the bolts between the stringers and the capping beam. These remedial works will improve the robustness of these critical connections for future seismic events.
- h) Because this is an older wharf we have provided a list of items that should be observed on a yearly basis with a detailed investigation undertaken every 5 years to check structural integrity.
- i) Although outside of the scope of this report, a number of timber stringers were noted to have significant decay and may require replacement in the near future.




Please don't hesitate to contact me should you wish to discuss the contents of this report.



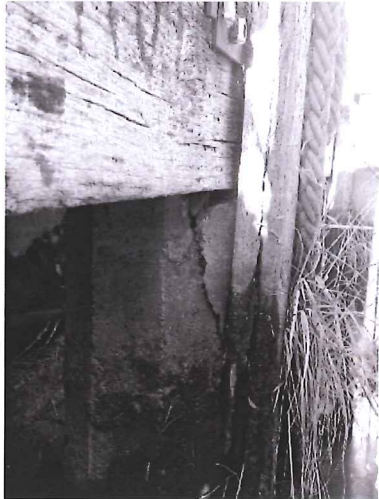
Yours sincerely,

Jan Stanway  
Principal Structural Engineer





## **APPENDIX A – PHOTOS**

<b>Upstream Wharf (photos taken 2013/2015)</b>		
<b>No.</b>	<b>Item Description</b>	<b>Photo</b>
<b>1.</b>	General view of the damaged retaining wall at the upstream end of the wharf.	 A photograph showing a concrete retaining wall with significant damage, including cracks and exposed rebar. The wall is situated at the upstream end of a wharf, with a blue structure visible in the background.
<b>2.</b>	Detailed view of the damaged retaining wall at the upstream end of the wharf.	 A close-up photograph of the damaged retaining wall, showing a large crack and exposed rebar. The wall is covered in green algae or moss.
<b>3.</b>	General view along the retaining wall.	 A photograph showing a long, straight concrete retaining wall extending along the length of the wharf. The wall is covered in green algae or moss.



4.	Detailed view of the settlement induced crack in the retaining wall.	
5.	Deterioration of a typical hardwood stringer (sitting on the concrete sill beam).	
6.	Spalling of concrete pile (10 May 2015).	



7.	Spalling of concrete pile (10 May 2015).	
8.	Damaged connection between hardwood capping beam and a stringer	





Upstream Wharf (photos taken 1995)		
No.	Item Description	Photo
9.	Spalling of concrete piles (21 February 1995).	
10.	Surface rust of connection between hardwood cap beam and timber stringers (21 February 1995).	

## **APPENDIX B – PROPOSED REMEDIATION SKETCHES**



# CALCULATION SHEET

Project/Task/File No: KAIAPOI WHARF

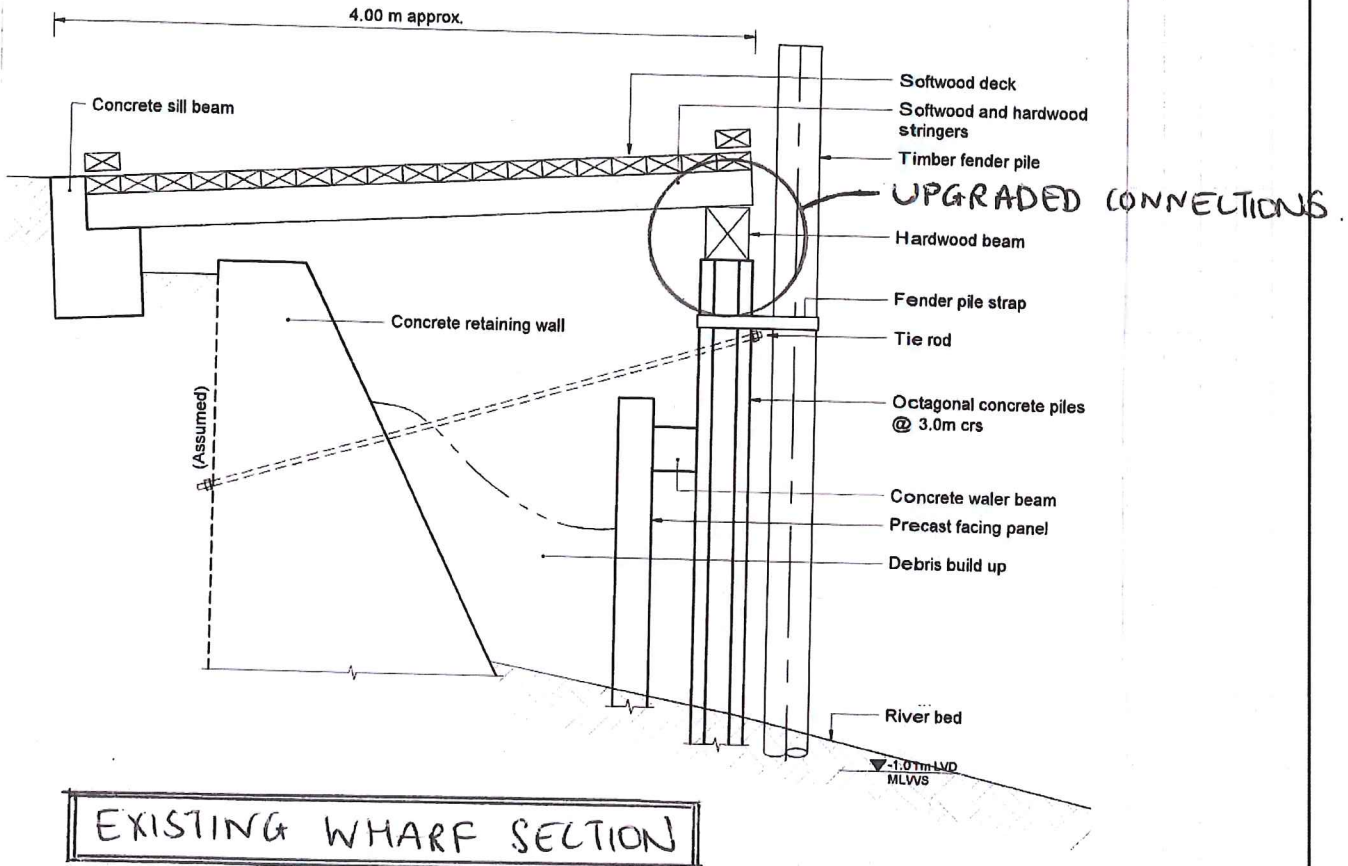
Sheet No 5101 of

Project Description: PRELIMINARY REMEDIAL SKETCHES

Office: CHCH.

Computed: JJ 28/05/15

Check: / /



# CALCULATION SHEET

Project/Task/File No: KAIAPOI WHARF

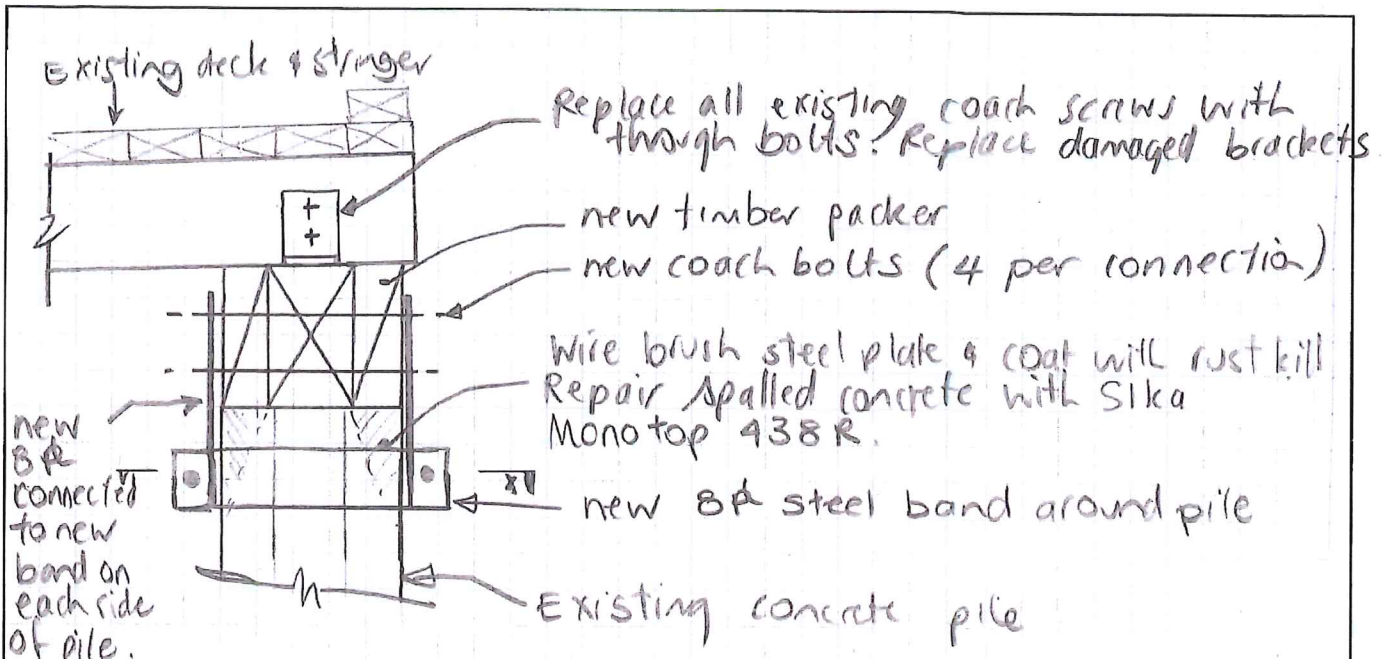
Sheet No SK02 of

Project Description: PRELIMINARY REMEDIAL SKETCHES

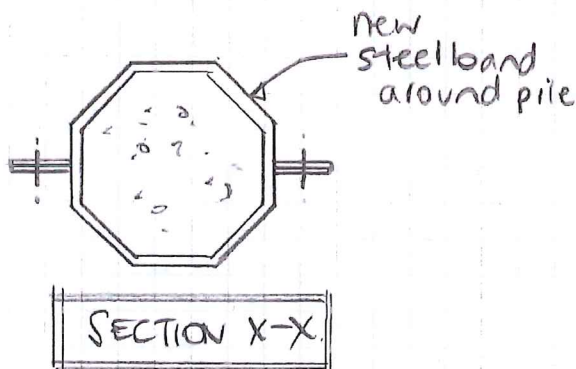
Office: CHCH

Computed: JS 29 05 / 15

Check: / /



CROSS SECTION THROUGH PILE / BEAM / STRINGER



---

# **Kaiapoi Bridge - Flood protection and Boardwalk Options**

*Jan Stanway*

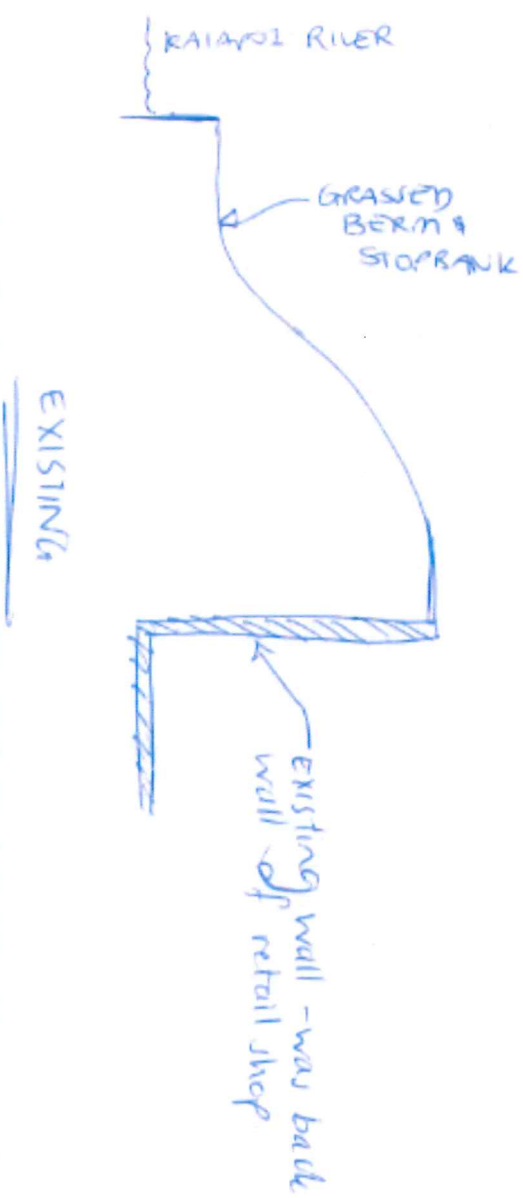
*Opus International Consultants, Christchurch*



## Existing

### Existing

- Wall at river
- Grassed stopbank
- Concrete retaining wall
- Retaining wall was part of old Hansen Mall development



## Option 1 – Complete the stopbank

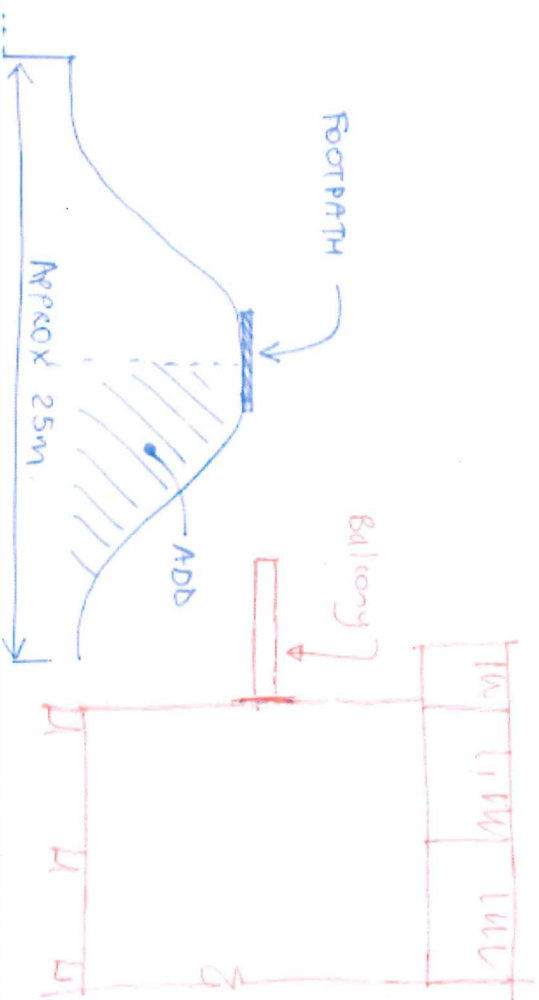
---

### Pros

- Easy maintenance
- Easy repair

### Cons

- No connection between stopbank & new development
- Balcony of development can not impede maintenance
- Loss of land to develop Hansens site



Indicative Cost \$400k - \$600k

## Option 2 – Flood protection wall

---

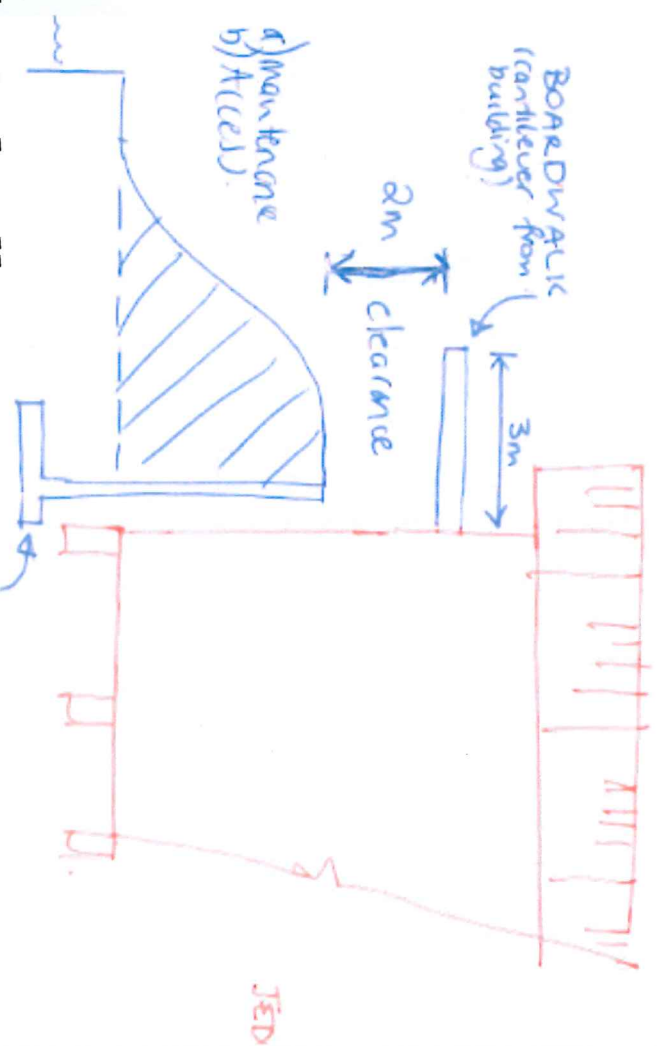
### Pros

- Proximity to river

### Cons

- Maintenance
- Height of balcony/boardwalk
- Extent of balcony/boardwalk limited

Indicative Cost \$750k - \$1million







OPUS

## Option 3 – Flood wall & river walkway

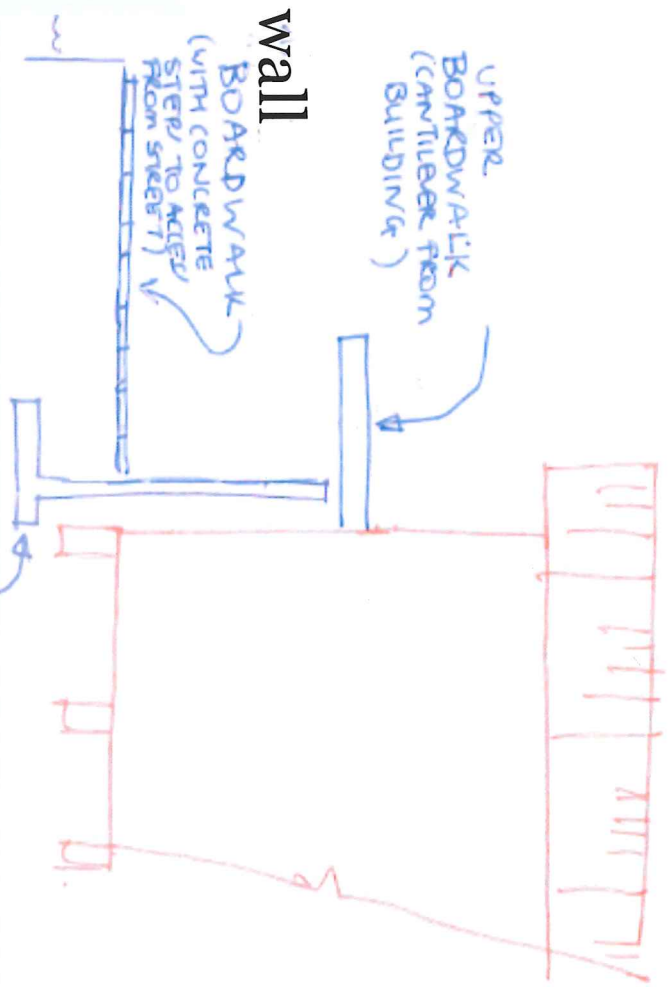
---

### Pros

- Balcony height
- Walkway along river
- Reduce load on river wall

### Cons

- Balcony width
- Flood wall likely to move in major eq event
- Flood protection more difficult to repair cf stopbank



Indicative Cost Estimate \$1m - \$1.5million

## Option 4 – Large boardwalk & river piles

---

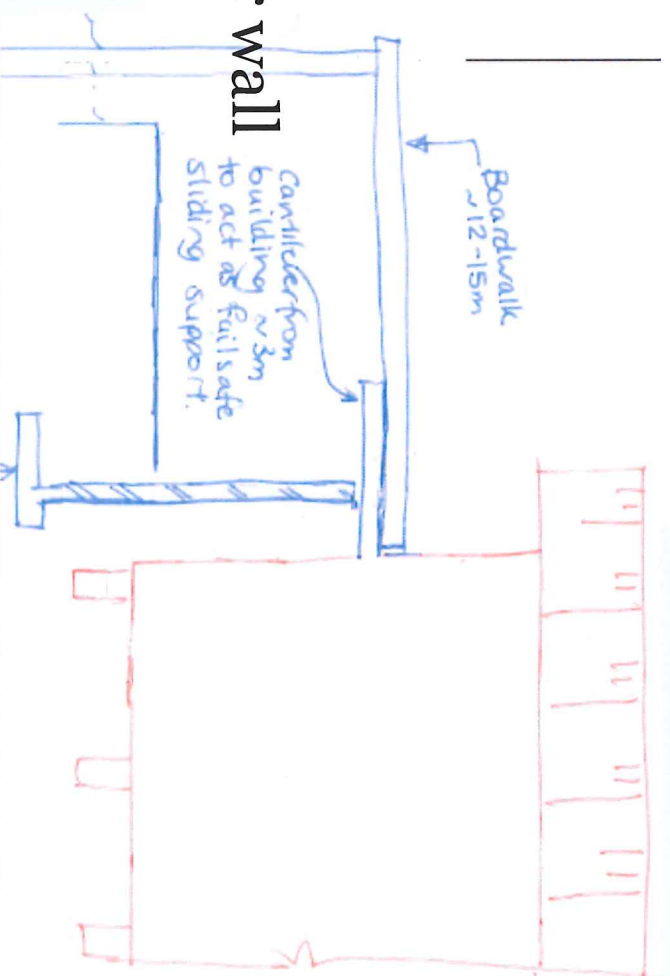
### Pros

- Boardwalk size
- Access from street
- Reduce load on river wall

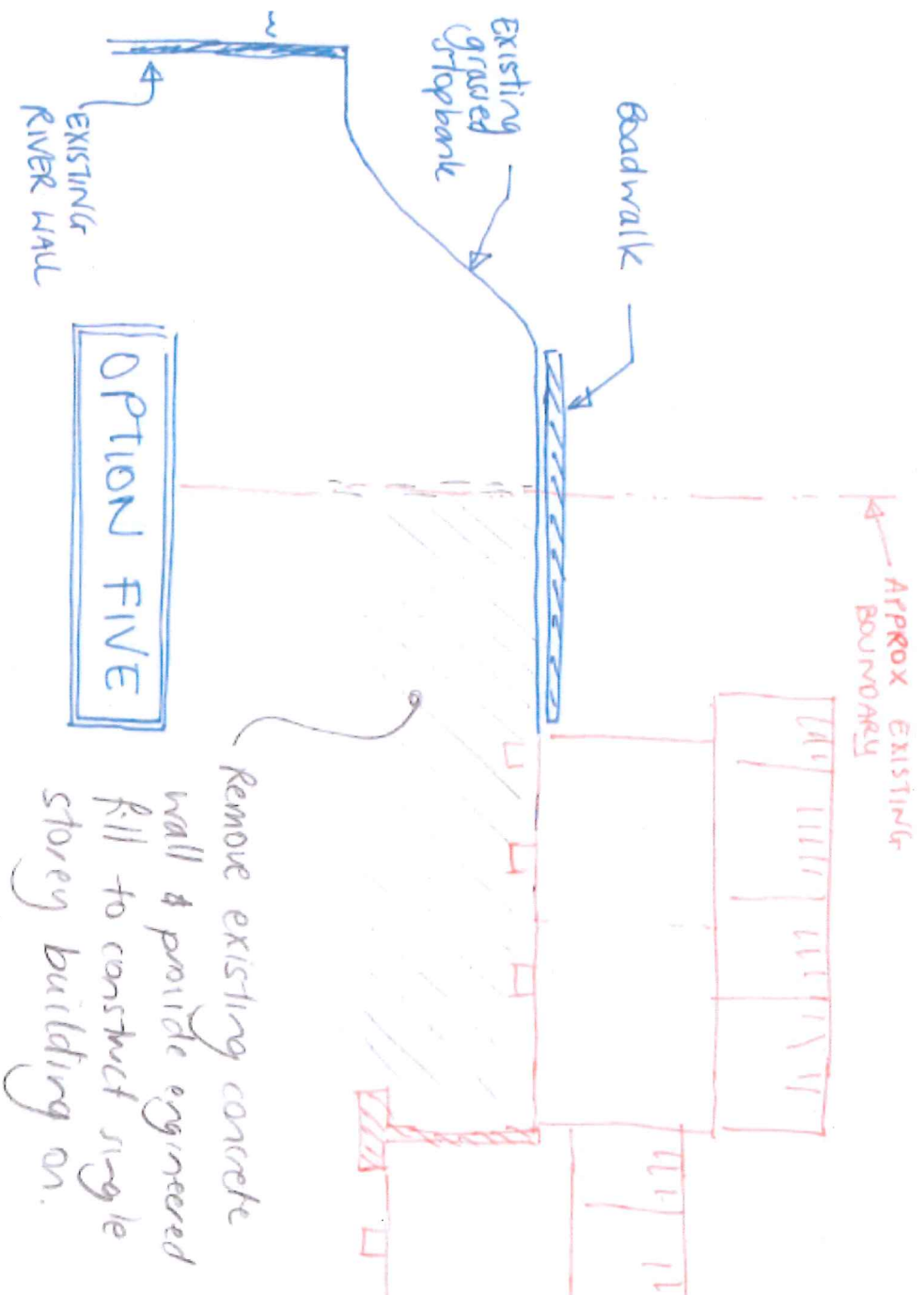
### Cons

- Failsafe support
- Flood wall likely to move in major eq event
- Flood protection more difficult to repair cf stopbank

Indicative Cost Estimate \$1.8m - \$2.3million



## Option 5 – Extend stopbank



## **Option 5 – Extend stopbank**

---

### **Pros**

- Boardwalk size
- Access from street
- Stopbank easily maintained and repaired

### **Cons**

- More load on existing river wall
- Slope stability analysis required

**Indicative Cost Estimate \$1.5m - \$2million**

## **Option 6 – Extend stopbank & steps**

---

### **Pros**

- Boardwalk size
- Access from street
- Flood protection easily restored

### **Cons**

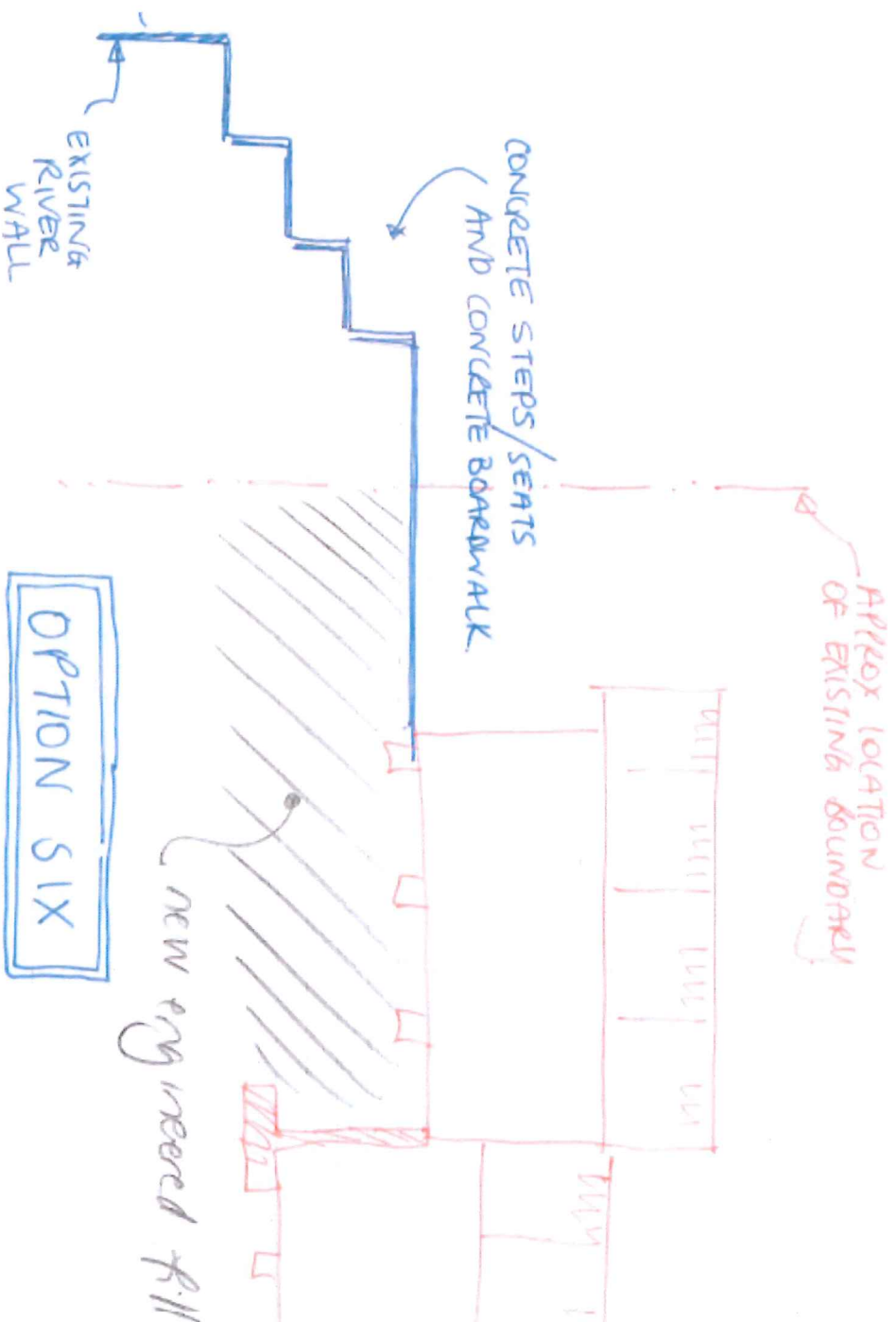
- Concrete steps likely to be damaged due to major eq
- More load on existing river wall
- Slope stability analysis required

**Indicative Cost Estimate \$2.5m - \$3million**



## Option 6 – Extend stopbank & Steps

---



## Summary of Options

---

Option	Description	Indicative Cost
1	Complete the stopbank, balcony on building	\$400k - \$600k
2	New flood wall, high balcony	\$750k - \$1m
3	New flood wall, river walkway, balcony on building	\$1m - \$1.5m
4	Large boardwalk between building and river piles	\$1.8m - \$2.3m
5	Extend stopbank	\$1.5m - \$2m
6	Extend stopbank & concrete steps	\$2.5m - \$3m