Table of contents

1 Introduction 1
2 Description of Works 1
3 Construction Methodology and Programme 2
   3.1 Construction Methodology 2
      3.1.1 Dredging 2
      3.1.2 Replace Existing Revetment 3
      3.1.3 Boardwalk and Steps 3
      3.1.4 Wharewaka Structure 4
      3.1.5 Inner Harbour/Declamation 4
      3.1.6 Northern and Southern Event Spaces and Gardens 5
      3.1.7 Playground areas 5
      3.1.8 Pedestrian Underpass 5
   3.2 Construction Programme 5
4 Environmental and Construction Management Controls 6
   4.1 Public Access Limitations and Traffic Management 6
   4.2 Signage and Fencing 7
   4.3 Monitoring plan 7
   4.4 Silt Control – works in sea bed 7
   4.5 Silt Control – works on land 8
   4.6 Dust control 8
   4.7 Noise Control 8
5 Applicability 9
1 Introduction

Tonkin & Taylor has been commissioned to prepare a construction methodology for the Tauranga Waterfront Project as defined in the Refined Master Plan Summary Report, Draft 100817 (Master Plan) prepared by Wraight and Associates. We understand that the construction methodology will be used in support of resource consent applications for the project.

The construction methodology has been prepared based on our understanding of the scope of work described in the Master Plan, noting that the design is conceptual only, and no engineering design work has been completed. Brief descriptions of the various components of work are described in Section 2.

In order to describe the construction methodology, we have reviewed the available geotechnical data, commissioned a revision of the bathymetric data of the near shore, and considered a number of possible construction methods that could be employed to build the described works. The construction methodology proposed and expected construction periods are described in Section 3. Measures to mitigate environmental effects during construction are described in Section 4.

2 Description of Works

The works to be completed as part of the Waterfront Redevelopment Project have been divided into discrete sections and described below:

1. Dredging. In order to provide sufficient water depth at all tide conditions along the edge of the proposed boardwalk, an area of seabed in a strip approximately 15 -20m wide from the toe of the existing revetment needs to be dredged. The depth of dredging will vary from approximately 1.5m of cut at the toe of the existing revetment, tapering to zero at 15-20m out from the edge. The length along the water’s edge that will require dredging is approximately 250m giving an area to be dredged for this project of 5,000 m$^2$. The total volume to be dredged to reach finished levels is estimated at approximately 3,500m$^3$. Further dredging is also necessary to excavate to a greater depth for the toe berm of the replacement revetment structure – estimated volume approximately 7,500m$^3$.

2. Replace Existing Revetment. The existing revetment is considered to be at the end of its useful design life and a 250m length, fronting the proposed boardwalk, needs to be replaced as part of this project, together with a further 130m adjacent to Coronation Pier. Furthermore, the excavation at the toe of the revetment described above may cause instability and failure of the structure. Given the soft foundation conditions, and the depth required at the toe, a substantial toe berm is expected to be required along the full length to maintain stability of the revetment. The extent of the toe berm will be refined during detailed design.

3. Boardwalk and associated steps. The proposed boardwalk is approximately 230 m long and projects approximately 7 m out from the top of the existing revetment. The boardwalk is of timber construction and will need to be designed to support crowd loading. At present, no handrail is proposed. To enable the boardwalk to be constructed without a handrail at this location, there needs to be a minimum water depth of 1.5 m below Lowest Astronomical Tide level (LAT) (equivalent to -2.5m RL Moturiki Datum). A set of steps leading to the water’s edge are included near the southern end of the boardwalk. These may be constructed from timber or concrete.

4. Wharewaka structure. A Wharewaka (boathouse for storing waka) is proposed adjacent to the declamation and steps area. The Wharewaka is to project approximately 28 m out...
from the top of the existing revetment, and is to be constructed on a suspended timber deck supported on piles. Alternatively, the Wharewaka may be supported on a rock groyne structure.

5. Inner Harbour (Declamation). It is proposed to create a declamation at the southern end of the walkway with a maximum area of 300 m$^2$. The declamation is to have concrete steps down to the water on the southern and western side and a 4.5 m high vertical face on the northern side. A suspended section of the walkway crosses the mouth of the declamation. Again no handrail is proposed, so the declamation bed level will need to be at least 1.5 m below Chart Datum (approximately -2.5 m Moturiki Datum).

6. Event space and gardens. The northern event space and gardens are located adjacent to the walkway, in the location of the existing car parking area. They cover an area of approximately 6,000 m$^2$. The scheme plan indicates that all the existing tar seal surfacing will be removed and will be replaced by a grass surface with paved perimeter. The southern event space is an existing car park area south of the Kestrel jetty and north of the existing boat ramp.

7. Playground areas. Children’s playgrounds will be constructed in the vicinity of the proposed Coronation Pier.

8. Pedestrian Underpass. A pedestrian underpass will be provided under the railway line near the Harbourside Restaurant to connect the existing boardwalk to the southern end of the Strand.

3 Construction Methodology and Programme

3.1 Construction Methodology

3.1.1 Dredging

Dredging is required prior to work commencing for replacement of the revetment, excavation of the inner harbour/declamation area to provide sufficient water depth fronting the boardwalk. Dredging would be completed either from land or from a barge either using an excavator, or a cutter suction dredge. It is assumed at this stage that dredged material would be disposed on land; the location will depend on which dredging contractor wins the work, the nature of the dredged material and what other projects in the vicinity require fill material. For example, if sand is encountered the material may be added to the stockpile at Sulphur Point for later re-use, or it may be used for a beach re-nourishment project in the Tauranga Harbour, or carted to a construction site that requires fill. Some of the dredged material may also be reused for backfill prior to construction of the revetment. If soft silt is encountered it is likely that it will have to be disposed of to landfill.

The total volume of material to be removed by dredge is approximately 11,000m$^3$. The first 3,500m$^3$ will cut the bed level down to the finished level of -2.5 m RL (Moturiki Datum). Where the dredging extends below finished level, to facilitate the revetment construction, it will be necessary to place geotextile on the base of the excavation and backfill the dredged area with rock within a short period after completing the dredging (within hours). The rock fill forms the first stage of the new revetment described in Section 3.1.2.
3.1.2 Replace Existing Revetment

Approximately 380m of the revetment structure needs to be built. This will be undertaken in two stages. The first stage is to construct the toe berm which will be constructed underwater between RL-2.5 and -4.5. This is needed to maintain the stability of the revetment structure. It will be constructed by placing imported rock over a geotextile layer immediately following dredging of the area. The rock will either be placed from land or from an excavator operating off a barge. The volume of rock fill to be placed is estimated at 11,500 m$^3$.

The second stage is to remove the existing revetment structure to waste (or re-use elsewhere), cut the slope to the required profile, place geotextile, then place a rock filter layer, and rock armour to form the revetment. The extent of the excavation and backfill for the replacement revetment depends on the foundation option selected for the boardwalk and steps. There are two options being considered at this stage:

- Option 1 is to sub excavate below the revetment and backfill with rock to create a raft foundation on which short piles could be founded to support the boardwalk;
- Option 2 is to found the outer edge of the boardwalk on deep founded piles. Further geotechnical investigation and engineering design work is required to determine the most cost effective option.

For option 1, it is estimated that 21,000 m$^3$ of existing fill material will need to be excavated and carted off site, (this is additional to the dredging outlined above) with 5,000 m$^3$ being excavated and recomputed back into the new structure. An estimated volume of 12,000 m$^3$ of rock fill would be placed over geotextile, and short piles set into the rock fill with 6,000 m$^3$ of rock armour on the face of the new revetment. All of the second stage works would be completed using excavators and trucks with access via Dive Crescent. There may be some settlement issues with this option that may require a period of monitoring and possibly pre-loading before the boardwalk could be constructed. This period of monitoring could be in the order of 3 to 6 months.

For Option 2, 11,000 m$^3$ would need to be excavated and removed off site, deep piles installed (Section 3.1.3), 4,000m$^3$ of rock fill placed over geotextile, and 6,000 m$^3$ of rock armour placed.

3.1.3 Boardwalk and Steps

The boardwalk is a suspended timber structure which projects out over the water. The steps are intended to be concrete placed over fill. The geotechnical conditions present a number of challenges to the construction of these structures. Two construction options have been identified for the boardwalk. Both options will have the landward edge of the boardwalk founded on a concrete beam at the top of the revetment. For option 1 the outer edge would be supported on shallow piles on a raft foundation while option 2 would use deep piles. These options are discussed in Section 3.1.2 above.

Once the piles are installed the suspended timber structure can be constructed.

The deep pile option has some significant advantages over the raft foundation option. It requires significantly less earthworks, and will allow the walkway construction to proceed immediately after installation of piles and completion of the revetment. However the geotechnical information available at this stage indicates that some of the piles may need to be in excess of 25m deep. A final decision on the construction methodology to be adopted will be made once further investigation and design work has been undertaken.

The steps on the seaward side of the boardwalk are shown on the Master Plan as concrete steps constructed on fill. Due to the soft foundation conditions, this structure would be expected to undergo some settlement. The step structure will therefore need to be founded on piles to
prevent settlement. Rock fill would be placed behind and under the steps in stages as the step structure is built up in lifts. If fill is used directly below the steps and extensive stability berms will be required. Alternatively, the steps could be constructed from timber in a similar fashion to the boardwalk and founded on short piles supported by a rock fill raft. Another option would be to construct a rock fill raft and preload for say 3 to 6 months to minimise future settlement. Suspended precast concrete steps could then be constructed and supported off the rock fill raft, once the preload was removed.

3.1.4 Wharewaka Structure

The concept design for the Wharewaka structure consists of a wooden platform suspended on piles extending into the harbour similar to a small wharf or jetty. The western end of the structure would be founded on top of the new revetment. The south western edge of the structure forms the northern edge of the proposed inner harbour (declamation), where a vertical retaining wall is proposed. The inner harbour/declamation will need to be constructed prior to constructing the Wharewaka structure.

Deep piles will be required to support the eastern extent of the structure where it extends seaward of the revetment. These would be installed from a barge, with the timber platform being extended out from shore using cranes.

Once the floor structure is complete, the Wharewaka structure would be constructed using normal building construction techniques.

An alternative option has been considered where the Wharewaka platform is founded on a rock groyne extending into the harbour. The rock groyne would be subject to settlement due to soft foundation conditions. This would require pre-loading and a delay of several months between placing the fill, and building the Wharewaka structure during which time the settlement would be monitored.

3.1.5 Inner Harbour/Declamation

The northern edge of the inner harbour will be a 4.5m high vertical retaining wall, while the western and southern sides will be a series of concrete steps. Given the geotechnical conditions, design and construction of these structures will be complex. At this stage it is assumed that the walls will be gravity mass type walls on a raft foundation formed by a 3m depth of imported rock fill.

It will be necessary to dewater the excavation in order to construct these walls. This may be achieved by leaving the existing revetment and a strip of land in place while the inner harbour area is excavated and the foundations and walls constructed. However, the existing revetment and backfill is likely to be highly permeable and it is considered likely that it would be necessary to place a line of sheet piles across the entrance to the inner harbour to facilitate the dewatering, excavation, and retaining wall construction.

The inner harbour requires excavation of approximately 3,000 m$^3$ of existing fill off site, further excavation of 4,500 m$^3$ for later recompaction behind the retaining walls, 1,500 m$^3$ of imported rock fill to form the bed of the harbour and to provide a raft foundation for the retaining walls.

After the inner harbour walls are completed, the existing revetment and / or sheet piling would need to be removed from a barge or from the banks with a long reach digger, and the rock revetment structures merged in from the north and south to complete the new water’s edge.
3.1.6 **Northern and Southern Event Spaces and Gardens**

Construction of the event spaces will involve excavation and removal of the tarseal surfacing and some of the granular foundation material (estimated volume to remove 2,000 m$^3$). This will be followed by import of topsoil for the grass areas (1,200 m$^3$), and construction of paved areas (2,500 m$^2$). It is expected that grassed areas will have ready turf placed over the topsoil to minimise the period of exposed earth, and to make the areas usable sooner. There will also be areas of gardens to be developed, and trees to plant.

3.1.7 **Playground areas**

A playground will be added to the existing landscaped areas on the north side of the Wharf St entrance area. This will involve excavation of some existing paved areas or gardens, and import and construction of playground equipment, and suitable soft surfacing materials beneath the playground areas. An additional play scape will be added to the existing carp park area south of Wharf Street and north of Edgewater Fan. This will involve removal of the existing tar seal and some hardfill, and import of appropriate surfacing materials for the play scape, and playground equipment.

3.1.8 **Pedestrian Underpass**

One of the requirements for construction of the pedestrian underpass is that the railway line remains open. The construction method is expected to involve pre-casting the concrete underpass structure, assembling the structure beside the railway line on the Strand adjacent the site, then excavating the embankment, and sliding the structure under the railway line using a crane, followed immediately by backfilling around and over the structure. A wooden extension of the existing boardwalk would connect to the underpass entrance.

3.2 **Construction Programme**

It is expected that the Waterfront Project will be divided into stages and spread over a number of years. There are some practical constraints that will dictate the logical order of the works as follows:

- To minimise the impact of construction traffic on the central city area, the logical access point to the site is from Dive Crescent through the car park at the northern end of the site. It would therefore be logical to complete the Southern Events Space and southern play scape prior to proceeding with the northern playground, declamation, and revetment.

- Construction of the Inner Harbour, and replacement revetment will require a reasonably wide construction area to allow the excavation work to be completed, with space for construction traffic. It will therefore be necessary to complete these two components before the Northern Event Space is completed.

It is proposed that the construction works will be undertaken during periods of the year when there is less use of the waterfront reclamation and Strand areas, while also avoiding public holidays. It is proposed for the works to be restricted to be between the period following Easter to the Christmas School Holidays in early December of each year.
An estimate of the construction periods for various components of the project are listed below in the approximate order of construction.

1. Southern Event Spaces (4 weeks)
2. Playground areas (4 weeks). This could overlap with the Southern Events Space.
3. Install floating silt control booms (2 days).
4. Dredge to -2.5m RL along length of proposed works (3 weeks).
5. Dredge to -4.5 and place geotextile and rock to finished level (6 weeks).
6. Excavate existing revetment, place geotextile and new rip rap to form new revetment (4 weeks). This could overlap with task 3.
7. Install sheet piles across entrance to Inner Harbour (2 weeks)
8. Install dewatering equipment and dewater (2 weeks)
9. Excavation for Inner Harbour (3 weeks)
10. Backfill with rock to form raft foundation (1 week)
11. Retaining walls / steps and backfill (2 months)
12. Remove sheet piling and complete revetment at edges (2 weeks)
13. Place piles for boardwalk and Wharewaka structure (4 weeks). This would overlap and be coordinated with tasks 3 and 4.
14. Wharewaka structure and boardwalks.
15. Northern events space (4 weeks). Logically done last.
16. Pedestrian underpass (2 months) – could be done anytime.

4 Environmental and Construction Management Controls

There will be a range of environmental and construction management controls employed during the construction works to minimise the environmental effects of the works. These are described in the following sections.

4.1 Public Access Limitations and Traffic Management

It is expected that the work will be done in stages. Each stage will involve a construction contract that will define the contractor’s working area and site access. These will be designed to minimise the inconvenience to the public while maintaining a clear boundary between the construction site and public spaces for health and safety reasons. The contractors working area will include enough space for a contractor’s site office (typically the size of a large container) and lay down area for plant, equipment, and materials.

For the period of the works, access to the existing waterfront amenity areas and coastal marine area fronting the works may be restricted. As stated in Section 3.2 above the works are proposed to be undertaken outside high use periods i.e. no works will be undertaken from early December through to Easter of each year. The works however will be limited to discrete sections with controlled access continuing for the balance of the waterfront.

A Traffic Management Plan will be prepared in which the contractor will be required to minimise the impact on the CBD. It is expected that construction traffic will enter the site from Dive Crescent through the northern car park, with temporary access via the reclamation area to complete the Southern Events Area and playgrounds. Access will be maintained to the Edgewater Fan, Coronation Pier, and Kestral as part of the construction management plan for the southern
components of the project. This will be via controlled access points across the construction access route.

In regard to access from the coastal marine area a buffer zone around the works will be required to ensure that the plant and erosion and sediment controls are not compromised during the period of the works. Use of the existing jetty at Dive Crescent may be curtailed for a period of 4 to 5 weeks.

4.2 Signage and Fencing

Prior to the works being undertaken the Contractor shall install temporary fencing around the perimeter of the works to clearly define the construction site, and signs in prominent locations. The fencing shall exclude the public from the construction site. The signs shall be maintained throughout the period of the works and shall clearly display, as a minimum, the following information:

- The name of the project
- The main site Contractor
- A 24 hour contact telephone number for the Contractor. The telephone number is for the purpose of receiving complaints and information from the public about dust nuisance or any relevant problem that may occur during the period of the works.

4.3 Monitoring plan

Prior to the works being undertaken a comprehensive monitoring plan shall be prepared for each stage of works. The monitoring plan shall include the following:

- Details of the requirements of the resource consent conditions
- Details of any assessments/investigation required to be undertaken prior to the start of the works;
- Detail of inspection of erosion and sediment control measures during the period of the works;
- Details of any complaints received during the period of the works;
- Recording of any remedial works undertaken to the erosion and sediment controls;
- Details of any dust control measures undertaken

4.4 Silt Control – works in sea bed

During dredging works, the Contractor shall install a suitably floating site screen positioned approximately 50m down drift of the dredging works and extending up to, and approximately 50m seaward of the dredging location enclosing the area. In this way sediment disturbed and re-suspended into the water column will be trapped by the silt screen.

Prior to the tide changing direction the silt screen shall be re-deployed so that it is down-drift of the dredging operation for the new tidal direction. This will keep the up-drift side of the silt screen open to allow barge access to the dredging works. The Contractor shall develop an appropriate technique for collecting and redeploying the silt screen without discharging significant quantities of sediment to the water column.

Alternatively the Contractor may choose to completely enclose the dredged area in a floating silt screen and carry out the dredging utilising a long reach excavator either on land above the revetment or on a barge loading trucks for land disposal.
4.5 **Silt Control – works on land**

Sediment generated during earthworks and other construction activities will be controlled in general accordance with guidance from Environment Bay of Plenty’s *Erosion and Sediment Control Guidelines for Soil Disturbing Activities* (2001) or any subsequent amendments. An erosion and sediment control plan will be prepared for approval by EBOP prior to start of the works.

The construction methodology will be designed to minimise generation of silt. For example, it is expected that ready turf will be placed over the areas to be grassed immediately after topsoil is placed.

Stormwater and sediment controls proposed for the site during construction are expected to include silt fences around earthworks areas, and silt traps installed in stormwater catch pits.

The contractor will be required to control the spread of sediment from construction traffic by ensuring that traffic leaving the site has clean wheels. This may require wheel wash facilities.

4.6 **Dust control**

Dust generated during earthworks and other construction activities will be controlled in general accordance with guidance from Environment Bay of Plenty’s *Erosion and Sediment Control Guidelines for Soil Disturbing Activities* (2001) or any subsequent amendments, specifically Chapter 6.0. The Contractor shall be responsible for dust control at the site, and compliance with resource consent conditions. The provisions for dust control shall be incorporated into the erosion and sediment control plan for approval by EBOP prior to the start of the works.

Dust control measures may include the following:

- **Water application.** The Contractor shall have available onsite during the period of the works measures to control dust by fresh water application. The water application can be by either water cart or sprinkler system. The Contractor shall be responsible for sourcing the water. The water application shall be at a rate to control dust in general accordance with the provisions of the guidelines.
- **Dust suppressants.** The Contractor may only use dust suppressants with the approval of the Engineer. Dust suppressants shall be applied with the sprinkler or water cart to areas on which limited machinery movements will occur.
- **Surface stabilisation.** Surface stabilisation may include such measures as placing of geotextile or hydroseed, and would commonly be used in conjunction with sediment control measures.
- **Windbreak fencing.** Fencing adjacent to the earthworks area acts to reduce the wind speed at the ground surface thereby reducing dust generation.

The Contractor shall ensure that all subcontractors are aware of the conditions of the resource consent regarding the management of dust at the site. The Contractor shall on the identification of dust nuisance put measures in place to control the dust generation. This may include the use of control measures or ceasing of work which is causing the dust generation.

4.7 **Noise Control**

Noise generated during the period of the works shall meet the limits recommended in, and shall be measured and assessed in accordance with NZS 6803:1999 "Acoustics – Construction Noise", or any superseding codes of practice or standards.

To control the effects of noise the construction works shall be limited to between the hours of 7am to 7pm Monday to Friday or otherwise agreed with the Engineer and Tauranga City Council.
5 Applicability

This report has been prepared for the benefit of Tauranga City Council with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose without our prior review and agreement.

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