APPENDIX M.

Operations and Maintenance Manual

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South Rockhampton Flood Levee
Rockhampton Regional Council
09-Apr-2019
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South Rockhampton Flood Levee

Concept Design Phase Operations and Maintenance Manual - 2019 Update

South Rockhampton Flood Levee

Concept Design Phase Operations and Maintenance Manual - 2019 Update

Client: Rockhampton Regional Council

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South Rockhampton Flood Levee

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Foreword

The South Rockhampton Flood Levee (SRFL) Operations and Maintenance (O&M) Manual should be read in conjunction with the SRFL Emergency Response Plan (AECOM, 2019).

Section 4.1.4 of The International Levee Handbook (CIRIA, 2013) states that a levee's O&M procedures should be defined during the design phase; **however the first version of the manual should not be issued until after completion of construction.**

It is noted that this document has been prepared at the Design phase of the project and is related only to the available information at the conclusion of concept design. This document, and the associated Emergency Response Plan document, will need to be further developed and finalised during subsequent stages of detailed design, construction and operation.

In addition, any changes to applicable regulations would trigger a review and update of this operations and maintenance manual. Additionally, all final approval documents and conditions should be included in this document and referenced in Section 2.1.1.

The current revision status of this manual is shown in Section 2.3.

1.0 Introduction

1.1 Overview

In October 2018, Rockhampton Regional Council (RRC) re-engaged AECOM Australia Pty Ltd (AECOM) to deliver concept, detailed design updates and support the obtainment of Statutory Approvals for the South Rockhampton Flood Levee (SRFL) project.

1.2 Location and Context

Rockhampton is a large regional city located on the Fitzroy River approximately 640 kilometres north of Brisbane. The Rockhampton Regional Council area has a population of some 80,000 people and is a major service centre for the wider Central Queensland region. In addition to serving a range of industries including agriculture and mining, Rockhampton provides a full range of retail, education, health, social, government and professional services to a broad catchment.

The wider Central Queensland region that Rockhampton services and supports is experiencing continuing growth in mining and resources sectors, including Liquid Natural Gas and coal mining in particular. As a consequence, interruptions to logistics and services resulting from flooding in Rockhampton impact to varying degrees on the broader region and its industries.

The Central Queensland region is a world ranked producer and exporter of black coal and a major centre for mineral processing. The region hosts the coal-bearing Bowen and Galilee basins and also produces gold, silver, limestone, coal seam gas, magnesite and gemstones. There are currently 50 coal mines, 25 mineral mines and 30 medium to large (>50 000 tonnes per year) extractive quarries operating in Central Queensland.

1.3 Flooding from Fitzroy River Events

The Fitzroy River, which flows through the city of Rockhampton in the state of Queensland, drains a catchment of approximately 142,000 km^2 and is one of the largest catchments on the east coast of Australia. The catchment extends from the Carnarvon Gorge National Park in the West to Rockhampton on the central Queensland coast and is predominantly dominated by agriculture (grazing, dry land cropping, irrigated cotton and horticulture) and by mining (coal, magnesite, nickel and historically gold and silver).

Due to its immense size and fan-like shape, the Fitzroy River catchment is capable of producing severe flooding following heavy rainfall events in any of its major tributaries. These are the Dawson, Nogoa-Mackenzie and Connors-Isaacs Rivers which rise in the eastern coastal ranges and the Great Dividing Range and join together about 100 kilometres west of Rockhampton. Major floods can result from either the Dawson or the Connors-Mackenzie River catchments. Significant flooding in the Rockhampton area can also occur from heavy rain in the local area below Riverslea.

Rockhampton is the largest urban centre in Central Queensland and is located approximately 60 kilometres from the mouth of the Fitzroy River at Keppel Bay. The Fitzroy River at Rockhampton and adjacent townships has a long and well documented history of flooding with flood records dating back to 1859. The highest recorded flood occurred in January 1918 and reached 10.11 metres (8.65m AHD) on the Rockhampton flood gauge.

It must be noted that extensive social and economic impacts are also experienced in more frequent, flood events. As examples:

- Low lying areas of Port Curtis and Depot Hill are inundated at a gauge height of 7.0m which is equivalent to the Minor Classification given by BOM.
- The Depot Hill community is isolated at a gauge height of 7.5m which is equivalent to the Moderate Classification given by BOM.
- The Bruce Highway at Lower Dawson Road is cut at a gauge height of approximately 8.4m.
- Low lying areas of Allenstown are inundated at a gauge height of 8.5m which is equivalent to the Major Classification given by BOM.

- Depot Hill and Port Curtis have been impacted by 33 historical flood events over 7.0m in gauge height since records commenced in 1859.
- There have been 17 historical flood events over a gauge height of 8.0m in which the Bruce Highway (Lower Dawson Road) has been cut.

1.4 The South Rockhampton Flood Levee

The SRFL project represents one of the most significant regional flood mitigation projects currently proposed in Queensland. The SRFL was identified as a Priority 1 Structural Mitigation Measure in the 1992 Rockhampton Flood Management Study (CMPS&F, 1992). Construction of the levee will significantly reduce flood damage and social impacts for a large portion of the urban area in South Rockhampton.

The SRFL will be approximately 8.74km long, running from the Rockhampton CBD in the north (Fitzroy Street and Quay Street), to Jellicoe Street and Port Curtis Road in the south, and Upper Dawson Road (Yeppen North) in the west (refer to Figure 1). It will consist of sections of earth embankment, crib wall, vertical flood wall and temporary demountable levee structures (component lengths are summarised in Table 1).

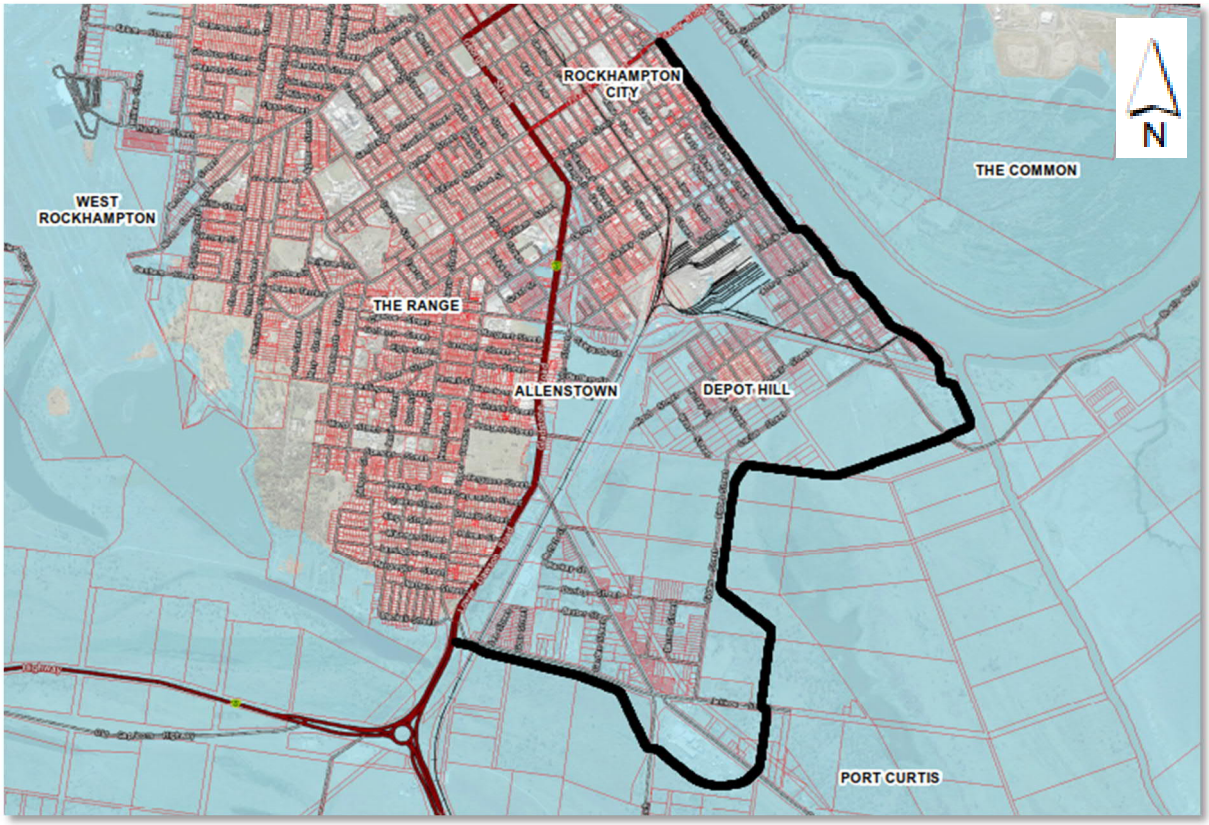


Figure 1 Location of the Proposed SRFL (Baseline Fitzroy River 1% AEP Flood Extents Shown)

The levee will incorporate flood gates on the major drainage channels and existing piped drainage networks that discharge outside the levee will be fitted with non-return devices to prevent river back-up. A system of landside drainage channels and three interior pump stations will discharge local catchment runoff should local rainfall events coincide with a regional Fitzroy River flood event.

Table 1 SRFL Component Lengths

Levee Type	Length (m)
Temporary Fully Demountable Wall	732
Composite Demountable / Permanent Levee Wall	967
Levee Emergency Spillway	420
Earth Embankment (incl. road ramps and gates)	5,892
Crib Retaining Wall	729
Total Levee Length	**8,740**

1.5 SRFL Components

1.5.1 Defined Flood Event and Levee Crest Levels

The levee will be constructed to 1% Average Exceedance Probability (AEP) or 100 year Average Recurrence Interval (ARI) flood immunity with 600 mm freeboard. This will be equivalent to a 9.89 m gauge level (post SRFL construction).

1.5.2 Typical Section

The proposed SRFL includes sections of earth embankment, crib wall, demountable wall, composite wall and spillway. Levee Types and typical sections are presented below.

1.5.2.1 Earth Embankment

The majority of the levee will consist of earth embankment. In order to increase immunity levels and provide freeboard, while optimising capital costs, a sheet pile (mild steel) is proposed at the top of the earth embankment.

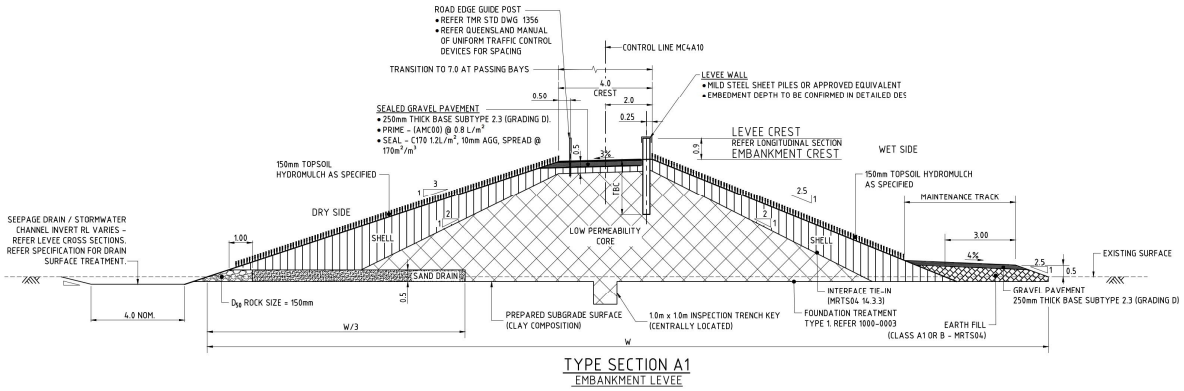
It is noted that levee geometry is often controlled by minimum safe operational requirements for emergency access, maintenance and rehabilitation activities. An access road has been incorporated into the levee crest to allow vehicular access. Vehicular access will be limited to Council staff for the purposes of inspection, maintenance, flood management and emergency works. Minimum requirements for crest and maintenance track widths and side slopes were determined based on these operational requirements. Requirements for turnouts, maintenance tracks, ramps and passing points have also been considered in the design.

The earth embankment has been designed with the following parameters:

- Height of the levee crest (including freeboard) ranges between 2.1 m and 5.9 m above the natural surface;
- The approximate maximum width of the levee at its base is 43 m and the crest is nominally 4 m wide to enable vehicle access for maintenance purposes;
- The earth embankment will consist of a clay core with a more granular outer shell. Soils suitable for the clay core of the levee should consist of low to medium plasticity clays or sandy clays with a Plasticity Index of 15 or less. For the outer shell, materials may consist of low plasticity clays, clayey sands or sandy clays with a Plasticity Index of 15 or less. If clay core material is abundant and cost effective, it is preferred if the entire earth embankment is constructed from the clay core material;
- Sand and gravel seepage drains will be required within the earthen levee structure to manage seepage through the embankment and prevent internal erosion;
- An overland seepage drainage channel has been provided on the dry side of the embankment to capture and transfer interior drainage and seepage flows;
- The embankment slopes will be nominally protected with grasses on both sides, however on the Wet Side, rock protection will be provided at locations where higher river / floodplain velocities increase the potential risk of scouring.

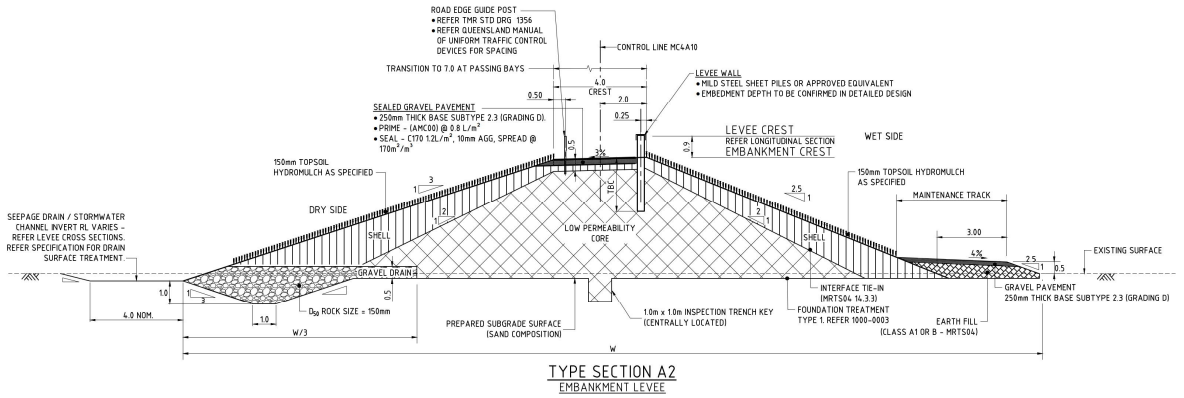
Four design geometries are proposed for the earthen embankment levees, as follows:

- Type A1 – This levee embankment will extend over ground conditions primarily consisting of surficial clay soils. The levee embankment geometry consists of a batter profile of 3H:1V (horizontal to vertical) on the dry side and 2.5H:1V on the wet side. Steel sheet piling will be installed along the levee crest and will extend 0.9m above the earth embankment crest level to provide freeboard. An internal sand filter near the toe of the landside of the levee was included to collect and manage internal and under-seepage flows (refer to Figure 2).
- Type A2 – This levee embankment will extend over ground conditions primarily consisting of sandy soils. The levee embankment geometry consists of a batter profile of 3H:1V (horizontal to vertical) on the dry side and 2.5H:1V on the wet side. Steel sheet piling will be installed along the levee crest and will extend 0.9m above the earth embankment crest level to provide freeboard. A trapezoidal gravel filter was included at the landside batter toe to collect internal and under-seepage flows (refer to Figure 3).
- Type A3 – The same cross section as A1, with the exception of riprap scour protection on the wet side embankment, including a toe trench for added stability (refer to Figure 4).
- Type A4 – The same cross section as A2, with the exception of riprap scour protection on the wet side embankment, including a toe trench for added stability (refer to Figure 5).



TYPE SECTION A1
EMBANKMENT LEVEE

Figure 2 Typical Section for Earth Embankment Type A1



TYPE SECTION A2
EMBANKMENT LEVEE

Figure 3 Typical Section for Earth Embankment Type A2

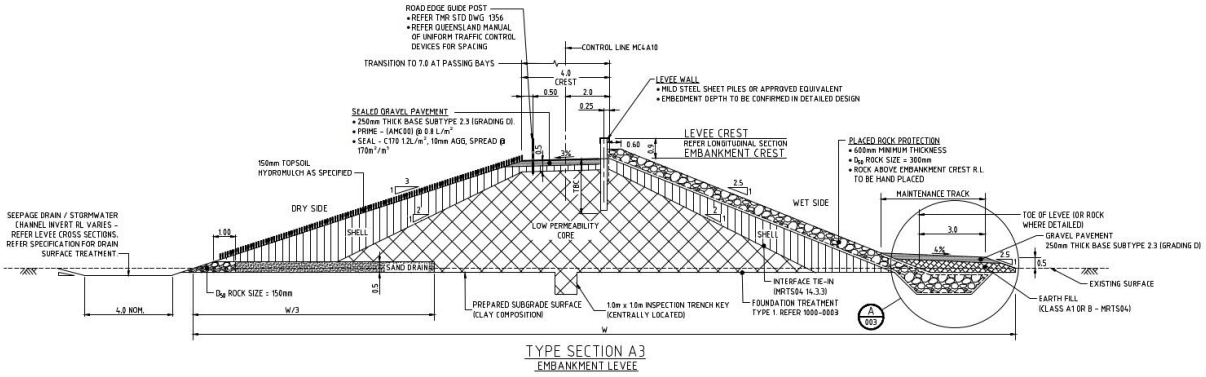


Figure 4 Typical Section for Earth Embankment Type A3

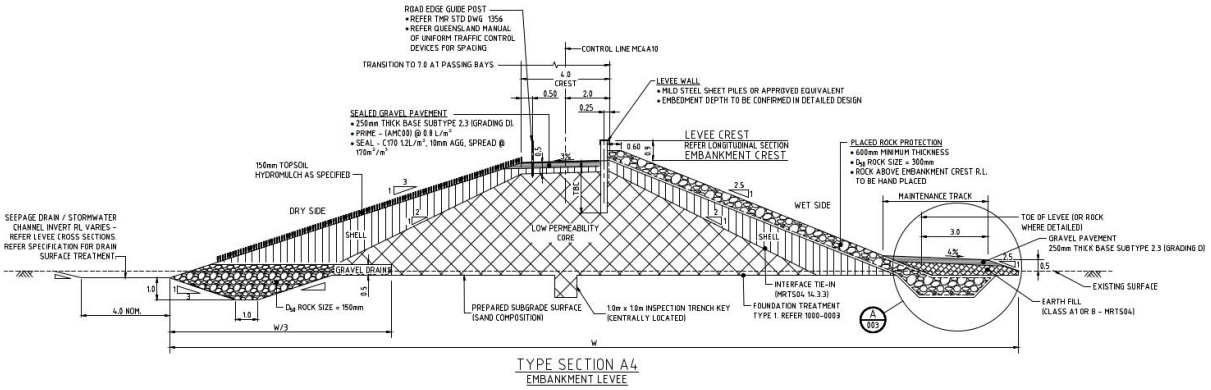


Figure 5 Typical Section for Earth Embankment Type A4

1.5.2.2 Crib Walls

Crib walls are utilised when there is not sufficient room for an earth embankment. Primarily the crib wall system has been adopted adjacent to the South Rockhampton Sewage Treatment Plant where there is only a small corridor between existing infrastructure and Gavial Creek; as well as adjacent the Old Gas Works (between the Fitzroy River top bank).

The Crib Wall has been designed with the following parameters:

- Height of the levee ranges between 2.1 m and 6 m above the natural surface;
- The approximate maximum width of the levee at its base is 20 m;
- The crib retaining wall on the Dry Side will be constructed utilising a proprietary retaining wall system;
- The earth embankment on the Wet Side will consist of clay core material. Soils suitable for the clay core of the levee should consist of low to medium plasticity clays or sandy clays with a Plasticity Index of 15 or less.
- Drainage (sand and gravel) will be required within the earthen levee structure to manage seepage through the embankment and prevent failure due to water pressure on the wet side of the crib wall.
- The embankment slopes will be nominally protected with grass however rock protection will be provided at locations where higher river velocities increase the potential risk of scouring.

A ConCrib system was proposed for the crib wall levees and is as follows:

- Type B1 – Proprietary crib wall system which extends to the full height of the levee crest (i.e. 1% AEP flood height plus 0.6m freeboard). The wet side embankment geometry consists of a batter profile of 4H:1V (horizontal to vertical) with riprap protection and toe trench (refer to Figure 6).

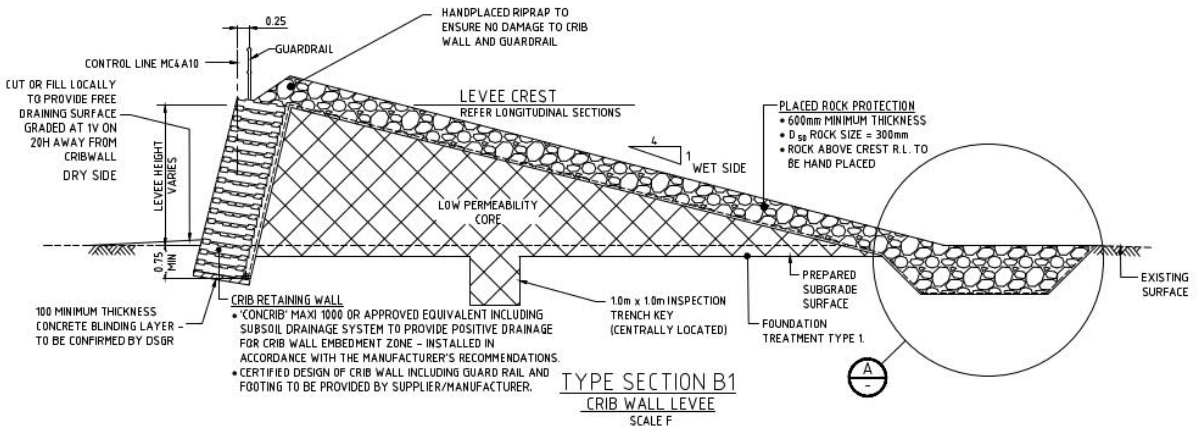


Figure 6 Typical Section for Crib Wall Type B1

1.5.2.3 Composite Flood Wall

Composite flood walls have been utilised where there is insufficient corridor available for an earth embankment and crib wall type levees. The composite flood walls are primarily located within the built up areas along Quay Street. The flood heights in these areas are expected to exceed those capable of being handled by a temporary fully removable levee system.

As the name suggests, the composite flood wall consists of two levee wall types:

- permanent concrete wall; and
- temporary demountable wall that is installed only when a flood event is likely.

It is noted that amendments to levee design guidelines has indicated that both I-Wall and T-Walls are required for the concrete walls. T-Walls are generally required when the concrete wall is greater than 1.2 m high and there is a risk of impact load, with I-Walls nominated for all other situations.

The composite walls range in height between 1.0 and 2.8 m with the demountable component taking up the top 900mm for I-Walls (Quay Street) and levee height greater than 1.2m for T-Walls (Wharf Street). The structural design of composite flood walls will be completed during Detailed Design.

In total, two different concrete floodwall type sections were adopted:

- Type C2 – Concrete I-Wall (height varies) incorporating a piled foundation with steel sheet piling to manage seepage. A demountable system (Flood Control International or equivalent) will be fixed to the top of the permanent stem wall prior to flood events. Reinforced concrete apron will be constructed on the dry side to mitigate overtopping scour risks and bollards (or guardrail) will be constructed along the dry side to prevent damage to the levee due to vehicular impacts (refer to Figure 7).
- Type C3 – 1.2m concrete T-Wall incorporating a piled foundation with steel sheet piling to manage seepage. A demountable system (Flood Control International or equivalent) will be fixed to the top of the permanent stem wall prior to flood events. Reinforced concrete apron will be constructed on the dry side to mitigate overtopping scour risks and bollards (or guardrail) will be constructed along the dry side to prevent damage to the levee due to vehicular impacts (refer to Figure 8).

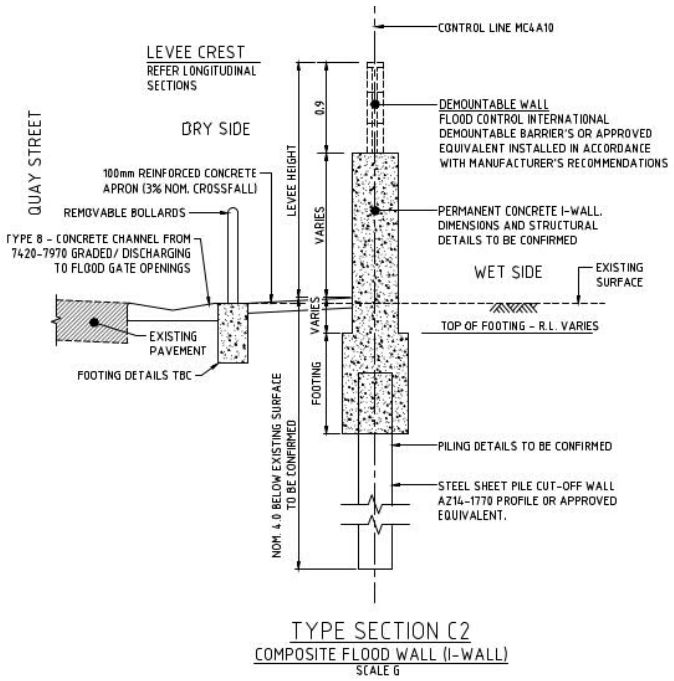


Figure 7 Typical Section for Concrete Wall Type C2

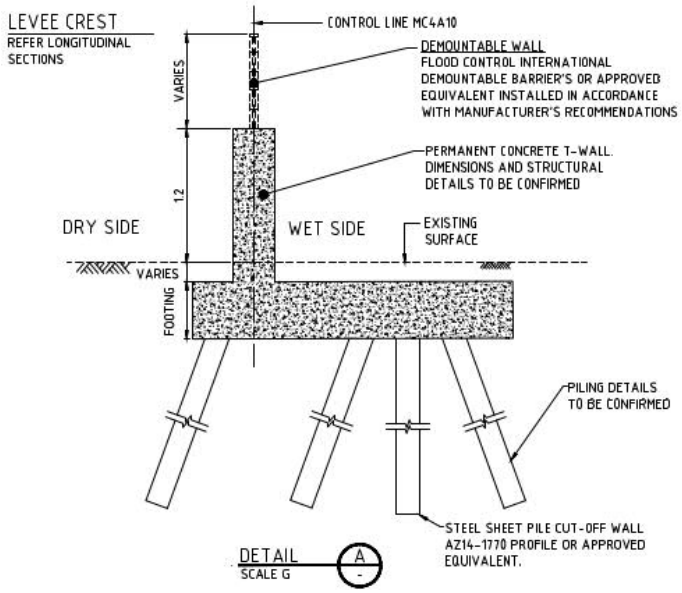


Figure 8 Typical Section for Concrete Wall Type C3

1.5.2.4 Temporary Levee

A temporary, fully removable levee system has been proposed along the main Central Business District section of Quay Street. Due to the lower flood heights and low flood velocities of the area, a temporary levee is feasible in this section of Quay Street from the Fitzroy Bridge to immediately south of Derby Street. A temporary levee in this location provides a range of benefits, including a negligible impact to the existing streetscape and heritage values associated with the area. Due to the relatively long flood warning time (up to a week), the erection of this barrier is deemed feasible.

Prior to an anticipated flood event, the temporary levee will be installed along Quay Street and will adjoin the Fitzroy River Bridge ("Old" Bridge). The design of the temporary barrier / bridge abutment connection will be completed by the barrier manufacturer / supplier.

Council has experience with temporary levees through the North Rockhampton Flood Mitigation Scheme and Rockhampton Airport Terminal in which Geodesign Flood Barriers were successfully prior to the 2017 Fitzroy River flood event.

1.5.2.5 Spillway

The SRFL spillway consists of a trapezoidal shaped low permeability core encased in a shell. The low permeability core has 1V:2H batter sloped and is laid on a prepared subgrade of clay composition. The wet side of the spillway has a 1V:2.5H batter slope and is protected by 0.6 m deep Rip Rap, while the dry side has a 1V:3H batter slope and is protected by 2 layers of 0.3 m Reno Mattress. The dry side of the spillway incorporates a sand drain and collection ditch, which is also protected by 2 layers of 0.3 m Reno Mattress.

The crest of the spillway embankment is to be constructed to a fixed elevation, 4 m wide and set to the 1% AEP flood level.

The purpose of the spillway is to allow for controlled flow into the leveed area at a level lower than the levee crest, to facilitate a balance in flood water surface elevations on either side of the levee where possible. The maximum height of the spillway above existing surface is approximately 4.2 m.

The Spillway Section is presented in Figure 9.

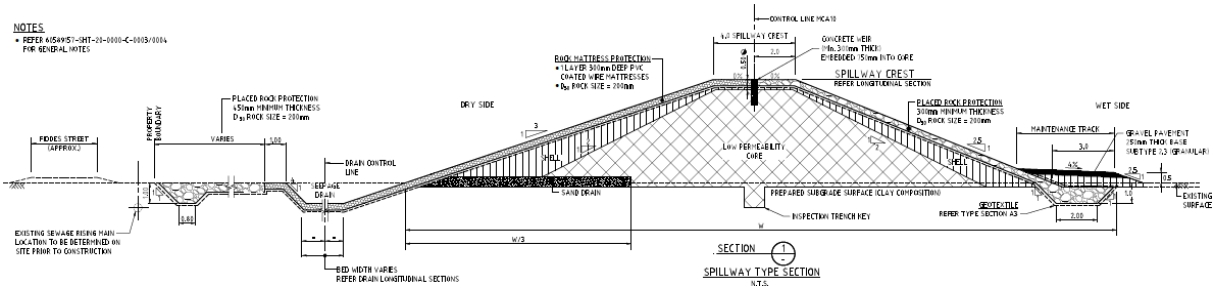


Figure 9 Spillway Type Section Fiddes St

1.5.3 Internal Drainage System

The internal drainage system of the SRFL incorporates a number of components that facilitate drainage of the internal area:

- Underground drainage infrastructure. This will operate as it currently does during local rainfall events. Backflow prevention devices have been fitted which will be closed to prevent Fitzroy River backflow in river flood events.
- Overland flowpaths. These are generally maintained through a combination of flood gates in the levee and culvert structures that allow flow through the levee when Fitzroy River levels are not elevated. Table drains are to be constructed inside the levee to facilitate drainage to outlets and pump stations.
- Three pump stations. These are to be constructed to provide drainage of the internal area of the levee system once the outlets of the underground drainage and culvert structures are closed and to assist gravity drainage during larger local catchment events.

1.5.4 Clear Zone

It is recommended that RRC implement a levee setback of 10m to limit encroachments (such as trees, power poles, etc.) on the SRFL. Installation of structures within this area shall be prohibited to minimise potential impacts on the levee foundations.

Elimination of unwanted flora within this area shall also be a priority.

2.0 Document Information

2.1 Purpose

The SRFL Operations and Maintenance (O&M) Manual should be read in conjunction with the SRFL Emergency Response Plan (AECOM, 2019).

The purpose of the **SRFL Operations and Maintenance Manual** is to inform RRC personnel of the correct operational procedures, required maintenance and appropriate management to ensure the continued viability and safety of the SRFL and associated infrastructure.

The purpose of the **SRFL Emergency Response Plan** is to detail the roles, responsibilities and actions to be taken preceding, during and following an emergency event. This may include a Fitzroy River flood event, an internal local catchment rainfall event, a catastrophic levee failure or other natural disasters such as earthquake.

2.1.1 Supporting Documents and Reference Materials

The following supporting documents form part of the total instructions:

- SRFL Emergency Response Plan (AECOM, 2019).
- The International Levee Handbook (CIRIA, 2013).
- Work Health and Safety Act 2011.
- Work Health and Safety Regulation 2011.
- Water Act 2007.
- QLD Levee Regulation and Guidelines for the Construction or Modification of Category 2 and 3 Levees.

2.2 Scope

This O&M Manual applies to the SRFL, and:

- Defines the responsibilities for the safety of the levee.
- Details procedures for regular and scheduled activities, to ensure these activities are completed in a safe and consistent manner.

2.3 Document Control and Review

Table 2 provides the revision status of this SRFL O&M Manual.

Table 2 Revision Status

Revision	Date	Description
A	September 2014	Original Issue - Design Phase O&M
B	March 2019	Updated Draft Design Phase O&M Manual (2019 Design)
C	April 2019	Concept Design Phase O&M Manual (2019 Design)

Table 3 lists the controlled SRFL O&M Manual copies which have been issued. Upon revision of the O&M, an updated copy is to be issued to all persons listed below.

Table 3 Controlled Copy List

Copy	Position	Location
1	RRC General Manager – Regional Services	Rockhampton
2	FRW Manager	Rockhampton
3	RRC Manager Infrastructure Planning	Rockhampton
4	RRC Coordinator Strategic Infrastructure	Rockhampton
5	FRW Coordinator Network Operations	Rockhampton
6	Manager Community Assets and Facilities	Rockhampton
7	Senior Infrastructure Planning Engineer	Rockhampton
8	RRC Manager Civil Operations	Rockhampton
9	Manager Capital Works	Rockhampton
10	Maintenance Engineer	Rockhampton

The Senior Infrastructure Planning Engineer shall keep a record of the distribution and location of all manuals.

The Senior Infrastructure Planning Engineer shall ensure that all copies are current and that duplicate (uncontrolled) copies are not used for the operation of the SRFL. Records shall be kept of the locations and status of each copy.

The O&M Manual shall be reviewed annually by RRC. Revisions shall be approved by the General Manager – Regional Services and shall include the Document Control Details and the Controlled Copy List.

Controlled copies of the manual shall have a water mark or stamp on each page clearly indicating that it is the original copy. All uncontrolled copies of the document shall not have this mark and shall alert users to the fact that the information contained in an uncontrolled document may not be current.

3.0 Personnel Training and Procedures

3.1 Administration and Responsibilities

The SRFL is owned and operated by Rockhampton Regional Council. The specific operation and maintenance of the SRFL pump stations and associated infrastructure is the responsibility of Fitzroy River Water, a commercial business unit of RRC.

The RRC General Manager – Regional Services is responsible for the implementation and revision of this O&M Manual. Roles and responsibilities for particular parties are detailed below.

3.1.1 Senior Infrastructure Planning Engineer (RRC)

Advise the Coordinator Strategic Infrastructure Planning and Coordinator Treatment and Water Supply before periods of absence from the Levee.

- Maintain Site Security.
- Conduct Site Induction for any New Staff.
- Undertake Routine monthly inspections and submit completed Inspection Check List to the Coordinator Strategic Infrastructure Planning and Coordinator Treatment and Supply.
- Report any Maintenance Requirements or unusual activity for consideration to Coordinator Strategic Infrastructure Planning and Coordinator Treatment and Supply.
- Ensure site activities are undertaken in accordance with relevant safety requirements.

3.1.2 Manager Community Assets and Facilities (RRC)

- Establish and Maintain Asset Management System for the SRFL with Coordinator Network Operations.
- Review Routine monthly inspections and Evaluate any Required Maintenance Works for RRC assets.
- Provide Maintenance Works Recommendations to the Manager Infrastructure Planning.
- Schedule Regular Maintenance of RRC assets.
- Ensure O&M Manual and Emergency Response Plan are reviewed annually with Coordinator Network Operations.

3.1.3 Coordinator Network Operations (FRW)

- Establish and Maintain Asset Management System for the SRFL with Coordinator Strategic Infrastructure Planning.
- Review Routine monthly inspections and evaluate any Required Maintenance Works for FRW assets.
- Provide Maintenance Works Recommendations to the Strategic Manager.
- Schedule Regular Maintenance of FRW assets.
- Ensure O&M Manual and Emergency Response Plan are reviewed annually with Manager Community Assets and Facilities.

3.1.4 Manager (FRW)

- Evaluate and Approve any Necessary Maintenance Tasks Recommended by the Coordinator Network Services.
- Ensure WH&S requirements and procedures are being followed.
- Arrange for periodic and comprehensive inspections by suitably qualified RPEQ engineer. Organise inspections in liaison with Manager Infrastructure Planning.

3.1.5 Manager Infrastructure Planning (RRC)

- Evaluate and Approve any Necessary Maintenance Tasks Recommended by the Manager Community Assets and Facilities.
- Ensure WH&S requirements and procedures are being followed.
- Arrange for periodic and comprehensive inspections by suitably qualified RPEQ engineer. Organise inspections in liaison with FRW Manager.

3.1.6 General Manager – Regional Services (RRC)

- Ensure Senior Infrastructure Planning Engineer, Manager Community Assets and Facilities, Coordinator Network Operations, FRW Manager and Manager Infrastructure Planning are conversant with the O&M Manual.
- Ensure O&M Manual is reviewed annually or when contact details for any parties have changed.
- Ensure the Safety Review is undertaken at maximum 20 year spacing.
- Authorise Public Access (where necessary).

The responsibility for coordination of emergency operations during high water events is detailed in the SRFL Emergency Response Plan.

3.2 Operator Training

3.2.1 General

At present, new staff receive a generic induction from the Council Safety Advisor. This induction is generic to all RRC staff and does not include any specific information regarding the SRFL.

If new staff are to be involved with either the operation or maintenance of the SRFL, they are to receive an informal site specific induction provided by RRC Senior Infrastructure Planning Engineer.

3.2.2 Formal Training

The SRFL operators are to undertake a formal training program which provides regular (annual) training session. Formal inductions are to be undertaken for all new operation staff which should:

- Ensure that new staff are introduced and conversant with this document and the Emergency Response Plan for the SRFL, including the location of where the documents are stored.
- Include details on other specific training required (i.e. Safety at Heights, Confined Space Entry, etc).
- Explain how regular levee inspections are conducted, including specific issues that should be noted.
- Explain general maintenance activities.
- Explain duties required under emergencies (if applicable) in reference to the Emergency Response Plan.

(Once a formal program is established it should be referred to or included in this manual).

3.2.3 Emergency Response Plan Testing

This Emergency Response Plan shall be periodically tested through the completion of simulated emergency event drills. These drills could be either field or desktop tests and should be used to refresh and train staff that are likely to be involved if an event occurs. Operational staff should participate in drills on a bi-annual basis.

Where larger scale drills require the coordination between the RRC, the Local Disaster Management Group, the SES, External Agencies and authorities, these exercises should be undertaken every five years.

4.0 Safety

4.1 Failure Analysis Report

Refer to the separate SRFL Failure Analysis Report (AECOM, 2019).

4.2 Levee Comprehensive Inspection

The SRFL is to undergo a Comprehensive Inspection every five years. The first of which should be instigated within two years of completion of SRFL construction. Further details of the comprehensive inspection are included in Section 6.1.

4.3 Levee Safety Review

The SRFL is to undergo a Safety Review at a maximum interval of every 20 years. Further details of the safety review are included in Section 6.1.

4.4 Public Health and Safety

All operation and maintenance activities shall be undertaken in accordance with:

- Work Health and Safety Act 2011.
- Work Health and Safety Regulation 2011.
- Water Act 2007.
- All applicable RRC Procedures.

4.4.1 Restricted Access

Public access to the SRFL is to be restricted by the installation of fences along the levee alignment, coupled with bollards (or the like) to block the entrance to access ramps.

Landowner private access to adjacent properties is to remain and is facilitated by access tracks and gate openings in the levee.

5.0 Operational Procedures

5.1 General

RRC is responsible for initiating operation of the SRFL. Refer to the SRFL Emergency Response Plan for specific details on:

- Procedural flow chart.
- Notification list.
- Operational responsibilities.
- Emergency operational procedures.
- Emergency events and actions.
- Emergency event reporting.

5.2 Culverts

The outlet of all culvert penetrations through the levee will be fitted with backflow prevention devices to prevent floodwaters from entering the leveed area. Manually controlled penstocks have been specified as the preferred backflow prevention device for the SRFL.

The penstocks are to remain fully open during non-flood conditions, allowing for passage of fauna and aquatic species during low flows.

When a Fitzroy River flood event is expected, the culvert outlet is to be inspected, cleared of all debris and the penstock valves are to be fully closed. They will remain fully closed until after the Fitzroy River flood event has receded.

5.3 Pump Stations

Pump station operation is based on the water level in the pump intake chamber. During automatic control the pumps will start (consecutively staged) when the water level reaches a defined level. The pumps will operate, discharging into the chamber and the outlet pipes via the pump discharge column until the water level in the pump intake chamber drops to the defined pump stop level. Pumps operate at a fixed speed with slight variation in flow depending on the water level / hydraulic conditions.

The design specifies the pumps to be powered by mains power connection to the Ergon network, with backup provided by permanent diesel generator sets (gen-sets) located on top of the levee and adjacent to the pump station. The gen-sets are to be automatically engaged if a power outage occurs.

Fuel storage and spillage containment provisions for the gen-sets shall be routinely checked during the operation of the pump station and during routine inspections. Refilling will be via a fuel truck under prolonged operation.

Screening is provided to the pump intake structure. Aperture of the screens is based on the allowable particle size passing the pumps. During operation of the pump station, debris from the channel may block the screen and periodic inspection and raking, particularly on start-up of the pumps, will need to be carried out to ensure that the hydraulic performance is not compromised. Access to the top of the screens is provided by the grated walkway above the 1% AEP flood level.

Should the pumps fail during operation, gravity flow may occur via the pump bypass supplied in the chamber; depending on the downstream conditions (i.e. should the river level be low enough). Similarly, gravity flow may supplement pumping should the required head differential be present.

5.4 Demountable Barriers

Demountable flood barriers constructed from galvanised steel and aluminium components have been specified for a number of levee sections, namely:

- From Fitzroy Street to Derby Street – Type Section C1 – Freestanding fully temporary demountable barrier.
- From Derby Street to Francis Street – Type Section C2 – Demountable barrier system mounted upon permanent concrete flood wall.
- From Wood Street to O'Connell Street – Type Section C2 - Demountable barrier system mounted upon permanent concrete flood wall.

Similarly, at the locations where the levee crosses existing roadways (with the exception of Port Curtis Road, Jellicoe Street and Quay Street which are being regraded), and where openings are required in a type C2 levee section, similar proprietary demountable barriers have been specified.

The intent of the demountable barrier is to be a "usually stored" system for erection only when flood warnings are received. This limits the impact on visual and public amenity along these sections of the levee.

The levee design has been based upon a nominal proprietary demountable barrier system -"Flood Control Technology Demountable Barrier System". The vendor of the system has provided concept details of a demountable barrier system consisting of unsupported spans of up to 2.7m to achieve maximum barrier design height of 1.24m.

The design documentation will nominate this system or an equivalent alternative system. Final design details of all foundations, connections, fixing and arrangements will need to be confirmed by the supplier when the actual barrier system is confirmed during the delivery of project.

When not deployed, the demountable barriers shall be stored, inspected, and maintained in accordance with the barrier supplier's recommendations and specifications. The storage location shall be nominated by RRC and shall consider security and accessibility of the barriers.

When required for deployment the barriers shall be transported and erected in accordance with the supplier's recommendations and specifications, including all connections, fixings, tie downs, sealants and the like.

5.5 Electrical

Performance specifications have been prepared for the power supply and electrical installations related to the Pump Stations at Fiddes Street, Main Drain and Hastings Deering. The design specifications will require that detailed operations and maintenance documentation will be prepared and submitted by the vendors / installers of the infrastructure as part of the construction contract.

5.6 Mechanical

Similarly, performance specifications and design details have been prepared for the mechanical installations related to the Pump Stations at Fiddes Street, Main Drain and Hastings Deering. The design specifications will require that detailed operations and maintenance documentation will be prepared and submitted by the vendors / installers of the infrastructure as part of the construction contract.

6.0 Maintenance Procedures

6.1 Inspections

6.1.1 Responsibility

The RRC Manager Infrastructure Planning is responsible for ensuring maintenance of the SRFL is completed. The specific maintenance of the SRFL pump stations and associated infrastructure is the responsibility of FRW Manager.

6.1.2 Routine Inspections

Frequency:	Monthly
Purpose:	To identify obvious physical defects and damage. To manually operate the pump stations.
Reporting:	A routine inspection checklist is to be developed, which shall be completed during each inspection. Completion of the inspection should be recorded in Council's maintenance recoding system (Mainpac or the like). Any observed defects or damage shall be reported to the levee owner immediately for action.
Undertaken By:	Field staff adequately trained on the levee design, operation and inspection requirements.

6.1.3 Periodic Inspection

Frequency:	Annually
Purpose:	To undertake routine inspection as noted above. To undertake field survey to identify any settlement or lateral movement. To undertake a condition assessment of the levee and infrastructure.
Reporting:	A periodic inspection checklist is to be developed, which shall be completed during each inspection in conjunction with the routine inspection checklist. Field survey is to be compared to the previous filed survey and a drawing is to be produced showing the extent, if any, of differences. Condition assessment report is to be prepared and submitted to the levee owner for review. Drill logs and testing results are to be reported to the levee owner (if conducted).
Undertaken By:	A suitably qualified and experienced surveyor. An experienced Engineer who is a Registered Professional Engineer Queensland (RPEQ). A suitably qualified and experienced geotechnical contractor (if required).

6.1.4 Comprehensive Inspection

Frequency:	Every Five Years
Purpose:	To undertake a periodic inspection as noted above. To fully review the levee safety management plan.
Reporting:	A comprehensive inspection checklist is to be developed, which shall be completed during each inspection. Comprehensive inspection report which details deficiencies, strategies for improvement and prioritisation of improvements.
Undertaken By:	An experienced Engineer who is a Registered Professional Engineer Queensland (RPEQ).

6.1.5 Safety Review

Frequency: Maximum of Every 20 Years

Purpose: To undertake a Comprehensive Inspection as noted above.
Systematic assessment of levee design and safety.

Reporting: Comprehensive inspection report.
Updated Failure Analysis report.
Detailed review of levee design including hydraulic, structural and geotechnical design.
Review of historical performance.
Review of current design standards in comparison to standards used during original design and construction.

Undertaken By: An experienced Engineer who is a Registered Professional Engineer Queensland (RPEQ).

6.1.6 Special Inspection

Frequency: Following the rectification of a defect (re-inspection).
Following any seismic activity in the region.
As Required

Purpose: Varies depending on the reason for the special inspection.

Reporting: To be determined, once the reason for the special inspection has been established.

Undertaken By: An experienced Engineer who is a Registered Professional Engineer Queensland (RPEQ).

6.1.7 High Water Event Monitoring and Post Event Inspection

For details of high water event monitoring requirements and details of the post event inspection, refer to the SRFL Emergency Response Plan (AECOM, 2019).

6.2 Maintenance

The inspection checklists and procedures, which are to be developed prior to completion of construction of the SRFL, will provide details of the maintenance activities summarised below.

6.2.1 Encroachments

Encroachments can be structures or activities not considered in the design of the levee that may have a negative impact on the structural integrity of the levee or limit the ability of the levee to mitigate flood risks. In addition, encroachments can also include activities or structures that impede proper and expedient use of access roads during levee operation.

Regular inspections of the levee and the levee easement shall include the monitoring for the following activities (amongst others):

Table 4 Encroachment Activities

Type	Example	Possible Effect
Improper excavation/removal of material	Borrow pit	Create instability leading to slope failure
Directional drilling	Prior to pipeline installation	May lead to seepage issues or fracture impermeable blanket
Pipework passing through the levee	Provision of drainage or services	May lead to seepage issues or fracture impermeable blanket
Super structures	House, staircase	Weaken levee foundations or vegetation cover
Sub structures	Swimming pools near levee toe	Increase the hydraulic gradient

Type	Example	Possible Effect
Material stockpiles	Fill material, soil	Impede access, trap debris
Debris	Fallen tree	Trap debris, temporary hydraulic control causing eddies along levee
Fences	Fenceline perpendicular to levee alignment	Trap debris, hydraulic control causing eddies along levee, impeding flow
Agricultural/horticultural activity	Tillage on levee and levee easement	Disturbs earthworks or allows establishment of inappropriate vegetation
Grazing/animal access	Cattle, sheep	Damage to vegetation cover, erosion
Root intrusion	Trees outside the levee zone of influent have tree roots that encroach within the zone	May lead to seepage issues or fracture impermeable blanket

All encroachment activity along the levee, levee easement and the clear zone (refer Section 1.5.4) shall be prohibited. However, proper permitting and recording of activities relating to land use within the levee, levee corridor and the levee clear zone shall be coordinated with local planning authorities. This will ensure an appropriate set back is maintained or, if an encroachment is unavoidable, proper consideration and mitigation of potential impacts to levee performance is given.

6.2.2 Vegetation

Vegetation management is a key aspect of levee maintenance as it requires continual and systematic control. The frequent nature of vegetation control also provides opportunity for rapid assessment of levee condition and assists in identifying maintenance issues.

6.2.2.1 Grass Cover

Grass cover is a highly cost effective way to protect the levee and levee easement from erosion caused by rainfall run off, channel flow and wave wash. Appropriate measures shall be undertaken to ensure grass cover is well established along the levee embankment and levee easement through the application of fertiliser and turf in areas where grass cover is patchy. It is likely that due to Rockhampton's climate, irrigation will be required to maintain adequate grass coverage.

Periodic mowing of the levee and levee easement is required to prevent weed infestation and the establishment of woody vegetation and to keep the length of the grass below 150mm. In addition, periodic mowing assists visual detection of any levee maintenance issue and provides an efficient manner by which regular monitoring of general levee condition may occur. Grass cover may be allowed to grow longer on the wet side of the levee during flood periods as longer grass will provide greater erosion protection, as long as routine inspections are altered to account for this.

It is not advisable to control grass cover via livestock grazing.

6.2.2.2 Removal

The presence of woody vegetation may impact levee stability and interfere with emergency operations during flood events. It is recommended that no woody vegetation be allowed to become established on the levee or within the levee easement for the reasons listed in Table 5.

Table 5 Potential Impacts of Woody Vegetation

Type	Possible Effect
Blowover/overturning	Removal of material such that external/internal erosion of slope instability may occur
Root penetration	Pathway for seepage or burrowing animals that may lead to external or internal erosion (i.e. seepage, piping)

Type	Possible Effect
Additional weight and wind loading	Slope instability (slip surfaces greater than extent of root penetration)
Scour flows	Causes eddies on external side leading to external erosion
Prevents establishment/growth of grass cover	Loss or absence of ground cover may lead to external erosion during flood events
Damage to erosion protection	Roots may loosen any erosion protection elements (*eg* riprap) leading to external erosion

If woody vegetation becomes established on the levee or within the levee easement, the following must occur:

- Tree/brush is to be cut down.
- Root structures removed in their entirety.
- All voids filled with impervious material and compacted in 150mm lifts.
- Fill material is to be compacted including the adjacent area within a two metre radius.
- Area is to be reseeded / laid with turf.

6.2.3 Debris

Should it be identified in the flow path, the removal of drift material after flood events as well as material accumulated outside of flood events (e.g. lawn clippings) shall occur as soon as required to:

- Prevent any damage to the grass cover.
- Prevent the deflection of flows towards the levee embankment causing scour/erosion.

Any material removed shall be deposited away from any flow path, preferably in a municipal landfill.

6.2.4 Burrowing Animals

The activities of burrowing animals have the potential to impact the structural integrity of the levee which may lead to impacts on the operational performance of the levee due to:

- Internal erosion, piping and seepage pathways.
- Mechanical weakening of the levee.
- Perforation of impermeable blanket.
- Areas of collapse/unevenness along the crest.
- Direct seepage.

If evidence of burrowing animals be noted, the following actions shall take place:

- Ensure all fauna has been humanely removed from the area and relocated.
- Excavate the area around the hole/burrow.
- All voids filled with impervious material and compacted in 150mm lifts.
- Fill material is to be compacted including the adjacent area within a two metre radius.
- Area is to be reseeded/ laid with turf.

Should the burrow be found to penetrate through impermeable blanket, the application of low pressure, flowable grout may be appropriate (e.g. 3:1 bentonite solution); provided piping is not an issue on the levee. This method can be employed via applying grout at low pressure to the lowest level of disturbance to force grout to travel upwards as gravity transmission may not fill all voids. It is recommended that specialist advice be sought to establish the most appropriate treatment.

6.2.5 Erosion

6.2.5.1 Types

Rill/Runoff

Embankment slopes become eroded from rainfall runoff dislodging and transporting material and leaves minor gullying of the levee surface that runs perpendicular to the crest alignment. This situation may also arise from events which lead to the overtopping of the levee crest. This situation can lead to failure of the levee slope and exposure of the levee core which can result in levee failure.

Wave Wash

During high water conditions, wave action at the waterline (and above) can erode terraces along the length of the levee on the wet side. This can lead to scour/beaching that reduces the cross-sectional area of the levee and may cause the levee to fail. This situation will usually arise after longer duration events and must be considered during post event inspections.

Scour

This situation develops below the waterline when current velocity is sufficient to cause the removal of levee material. It may lead to undermining of the external slope of the levee embankment at the toe. Once commenced, scour may develop rapidly, especially in areas where current velocity is expected to be high, such as, ramps, pipes and other structural penetrations of the levee prism or where obstructions to flow are present or develop (e.g. debris piles).

6.2.5.2 Location

Erosion forming on embankments (in particular at the transition between earth embankment and concrete structures) represent the potential for structural integrity to be affected and must be treated as high priority according to the technical notes provided on severity (refer below).

Erosion forming on internal banks of excavations, or natural ground leading to excavations represents a longer term issue in relation to siltation and reduction of capacity. As they do not represent a levee safety issue from the perspective of structural integrity, erosion of this type can be treated as a lower priority than erosion on embankments. The exception to this is where erosion forming may be in trafficked areas of levee operations, in this case, safety factors (not related to levee safety) should be considered by operational staff.

6.2.5.3 Severity and Repair

Once identified, the following actions shall take place to treat the affected area:

- Where gullies or rills develop to depths greater than 300 mm, these must be back filled and compacted with suitable material.
- Where gullies develop to depths greater than 500 mm, these shall be excavated out, benched, filled and re-compacted.
- Where rill erosion is an issue over large areas of an embankment, consideration should be given to table drains to direct flows to formal chute drains.
- Where gully erosion may develop or redevelop, such as in areas where flows concentrate, consideration should be given to providing formalised drainage that is sized and protected (rock or concrete lined) according to anticipated flow velocities.
- The affected area shall be ripped and backfilled with impervious material as detailed above.
- The fill material shall be placed in 150mm lifts and compacted.
- Area is to be reseeded / laid with turf, or erosion protection (e.g. riprap) placed in affected area to prevent recurrence.

In addition, the proper management and care of grass cover can enhance erosion resistance and increase levee resilience (see **Section 6.2.2.1**)

6.2.6 Depressions and Rutting

These features may develop as a result of settlement or recurrent passes along a path/track by vehicles, pedestrians or animals. It should be noted that there may be other causes leading to the development of these features and, once identified, measures shall be taken to prevent a recurrence.

If these features occur along the crest or slopes of the levee embankment or along the toe of the levee embankment, they may lead to ponding of water which increases the moisture content within the levee material and may lead to instability. In addition, ruts and depressions along vehicular access paths may limit the ability of emergency response teams to deploy equipment and thus provide an adequate response during high water events.

If during a routine inspection a rut or depression in the embankment batter, embankment crest or access track is noted to be greater than 150mm depth, the following actions shall occur:

- Remove pavement material or topsoil and grass sod and set aside for re-installation after remedial works have finished.
- Scarify material to facilitate ‘keying in’ of additional fill material.
- Add suitable material, preferably including high plasticity clays in 150mm lifts, ensuring moisture content is sufficient for adequate compaction.
- Compact fill layers (lifts) until there is a slight mound over the area of concern. This is to prevent further ponding and allow for settlement.
- Replace topsoil and grass sod, reseed/fertilise if necessary to encourage the return of suitable grass cover as quickly as possible.
- Monitor.

6.2.7 Settlement and Subsidence

Settlement and subsidence will reduce the levee’s height, reducing the design flood mitigation level. Settlement will arise from ground movement due to loading, whilst subsidence will occur due to the ground movement arising from a loss of foundation support.

Localised subsidence/settlement may be easily identified during routine inspections however gradual reductions in levee height will only be detected via regular survey. Field survey of the entire levee alignment shall be undertaken on an annual basis.

Repair

If settlement and / or subsidence is identified on any section of the levy embankment, specialist advice must be sought to determine the cause of the settlement / subsidence, and to determine appropriate remedial works that may be required.

6.2.8 Seepage

The design of the levee has quantified the expected seepage along the extent of the levee. Seepage control measures such as sheet piles and the like have been incorporated into the design where appropriate.

During a Fitzroy River flood event, the actual seepage should be monitored and compared with the design estimates, to validate the seepage performance of the levee relative to the seepage analysis undertaken at the time of design.

6.2.9 Slope Stability

Slope instability arises when the levee embankment can no longer support its own weight leading to downslope movement. This may be attributed to or caused by:

- Surface erosion.
- Toe erosion.
- Internal erosion.
- Over steepened slopes.

- Construction activity.
- Creep.
- Seismic activity.
- Saturated soils.

6.2.9.1 Indicators

Slumps

These appear as isolated areas on the face of the levee embankment where near surface or sub-grade has been exposed due to down slope movement. There is usually some evidence of rotational movement as well.

Slides

This situation is evidenced by the presence of a near vertical scarp face at the top of the slide section. This may occur at the crest and could cover a large area.

Tension Cracks

These may appear as either single or multiple cracks parallel to, and above the scarp of a slide or slump. They can be over a metre deep and as long as the slide. They are an indication that there has been movement of material down slope of the crack.

6.2.9.2 Severity and Repair

Most Urgent

The repair of slope instability requires urgent attention/repair when it:

- Affects the entire crest or a significant length of the levee.
- Impacts upon the crest level.
- Could reduce the levee cross-section.
- Appears during a high water event.

Less Urgent

- Where shallow slumping occurs over an extended period of time on either the internal or external embankments but not both concurrently.

Repair

Once identified, the following actions shall take place to treat the affected area:

- Remove slide/slump debris downslope and stockpile.
- Excavate around area to locate stable levee material.
    - If excavation exposes levee penetration (e.g. drainage pipe/culvert) or cannot locate stable levee material, obtain engineering advice on how to progress.
- If stable material is located, shape and level to obtain inward sloping surface.
- Scarify, moisture condition and re-compact exposed levee material.
- Backfill, bench and compact material into excavation in 150mm lifts to ensure optimum density.
- Perform testing to verify compaction and moisture content.
- Over build and cut back the slopes to desired geometry (do not use machinery tracks to compact).
- Vegetate (or armour) the slope to be consistent with adjacent slope.

6.2.10 Signage

Routine inspection of all signage shall be carried out to identify loss, damage or deterioration. Remedial maintenance and repair activities shall be undertaken as required.

6.2.11 Fences

The extent and type of security fencing, general fencing and gates is indicated on the design drawings. Routine inspection and maintenance activities shall be undertaken on all fencing to maintain the integrity and safe condition of the fencing. Maintenance activities must include, at a minimum:

- Removal of debris.
- Repair of any erosion issues.
- Post straightening.
- Wire tension checks.

6.2.12 Slope and Bank Rock Protection

The design incorporates placed rock protection of the levee batters in areas where the design analysis indicates that protection is required. Routine maintenance and inspection activities shall be undertaken to maintain the condition of the rock protection. Inspection must be undertaken after flood events to identify any damage incurred to the rock protection during the event.

The following maintenance activities are recommended:

- Removal of trash and unwanted debris from the area.
- Removal of accumulated sediment.
- Stabilisation of eroded and undercut areas.
- Removal of invasive weeds.
- Repair of dislodged or unstable rock.
- Repair of any damage caused by animal burrows, including holes and mounds.

6.2.13 River Bank Protection

The design incorporates rock protection along the Fitzroy River, Main Drain and Gavial Creek, where the levee is in close proximity to these watercourses. The rock protection is designed to provide bank stability. Routine maintenance and inspection activities shall be undertaken to maintain the condition of the rock protection. Inspection must be undertaken after flood events to identify any damage incurred to the rock protection during the event.

The following maintenance activities are recommended:

- Removal of trash and unwanted debris from the area.
- Removal of accumulated sediment.
- Stabilisation of eroded and undercut areas.
- Removal of invasive weeds.
- Repair of dislodged or unstable rock.
- Repair of any damage caused by animal burrows, including holes and mounds.

6.2.14 Culverts and Discharge Points

Various drainage structures are incorporated into the design to provide stormwater discharge flow from within the levied area. All culvert structures which pass through the levee are fitted with backflow prevention devices to prevent Fitzroy River floodwaters from passing through the structures and entering the area within the levee.

The backflow prevention devices have been specified as manually operated penstock valves. These valves are to remain in a fully open position during non-flood operations, only being closed once a Fitzroy River flood event has been forecast. Additionally, culvert structures are included at various locations inside the levee to facilitate internal longitudinal drainage along the levee.

Routine condition inspections and maintenance activities shall be undertaken on all valves in accordance with the supplier's recommendations and specification. This must include regular testing of the opening and closing mechanism of the valve. Routine structural inspections shall be undertaken on all concrete drainage structures to confirm the condition of the structures.

Routine maintenance and inspection work shall be undertaken to remove siltation and sedimentation from the culverts and the immediate upstream and downstream environment, remove blockages or debris that have the potential to impede the performance of the culverts or the penstock valves, and maintain vegetation as appropriate.

6.2.15 Vehicle Access Roads, Tracks, Ramps, Turn Arounds and Passing Areas

Sealed and unsealed roadways are incorporated into the design to provide access for light vehicles and small maintenance trucks adjacent to the wet side toe of the levee, and along the levee crest.

Routine inspections shall be undertaken to assess the condition of the various roads, ramps and tracks. Where required, regrading of unsealed surfaces shall be undertaken to maintain the surface in a safe and trafficable condition. Where required, top up pavement material shall be imported and incorporated into the existing pavements to maintain the surface in a safe and trafficable condition.

Routine maintenance of bitumen sealed pavement surfacing shall be undertaken as required to maintain the surface in a safe and trafficable condition.

Resealing of sealed bitumen surfacing generally shall be undertaken at intervals of 7 to 10 years, dependent upon the condition and recurrent maintenance requirements of the surface.

6.2.16 Open Drains

Routine inspections shall be undertaken on all open drains and swales associated with the levee to assess the condition of the drains.

Routine maintenance work shall be undertaken as required to de-silt and remove sedimentation from the drains, repair erosion, manage vegetation and re-grade to original lines.

6.2.17 Demountable Flood Barriers

Demountable flood barriers shall be stored and inspected in accordance with the supplier's specifications and recommendations. Maintenance and renewal activities related to the removable barriers shall be undertaken in accordance with the supplier's specifications and recommendations.

When deployed and in place, inspection and monitoring of the demountable barriers shall be undertaken in accordance with the supplier's specifications and recommendations.

6.2.18 Sheet Pile Wall

The sheet pile wall shall be inspected during routine inspections. Maintenance activities must include:

- Immediate rectification of any differential movement, cracking, damage or subsidence of the sheet piles.
- Removal of debris.
- Repair of scour or erosion issues.
- Removal of invasive weeds.
- Removal of graffiti.

6.2.19 Pump Stations

Routine maintenance activities on the pumps shall be carried out in accordance with the manufacturer's recommendations. Periodic running of the pump stations will be possible under manual operation to check the running and diagnostics of the pumps and running of the generator to ensure diesel does not become stale.

The removal of the pumps is achieved via removal of the discharge column top flange and lifting out via the lifting chains. Crane access is provided on the levee for the removal of the pumps. RRC will need to develop lifting plans and procedures for the removal of the pumps based on the actual loads and lifting conditions. Lifting components shall be checked and certified in accordance with the legislative requirements.

The performance of the pump station will rely on the screens generally being free from blockage. Debris including weed has the ability to block the screen under high pump flow conditions. Accordingly, routine preventative maintenance of screen blockage shall be carried out routinely in the form of drainage channel cleaning.

Annual inspections of the pump station must include the checking of the intake sump for sedimentation. Sump cleanout may be required infrequently and this would likely require temporary bunding / isolation of the inlet to the chamber and pump out of the sump.

Routine structural inspections of concrete and metal elements of the structure shall be carried out to check for corrosion, particularly on the walkway structures, grating, and screening.

6.2.20 Electrical and Control Infrastructure

Inspection and maintenance activities associated with electrical and control infrastructure shall be included in the routine inspection checklists and maintenance procedures, in accordance with the manufacturers specifications.

6.2.21 Concrete Structures, End Structures and Levee Transitions

Routine structural inspection of all concrete and metal elements of the end structures, transition structures, and ground beams and slabs shall be carried out to assess the structural condition of the structures and to identify any evidence of corrosion, cracking, degradation or structural duress.

Remedial maintenance and repair activities shall be undertaken as required to maintain the structural integrity and performance of the structures. Specialist advice shall be incorporated where required.

7.0 Decommissioning

Should the SRFL no longer be required, or if the design life has been reached, the levee owner may consider decommissioning the asset. This process would include the removal of parts of the levee structure and associated infrastructure, to make it incapable of diverting flood waters.

If decommissioning is proposed, the levee owner should prepare a Levee Safety Decommissioning Plan. The decommissioning plan should:

- Detail the extent of levee infrastructure to be removed, and any parts of the levee which are to remain.
- Detail the time sequence for the decommissioning.
- Address safety issues related with the decommissioning, including assessment of the altered hydraulic characteristics of the remaining levee (if the entire levee is not removed).

There will also be various environmental, economic and social issues which must be addressed in the decommissioning plan.

8.0 Opinion of Probable Costs - Maintenance

8.1 Overview

An Opinion of Probable Costs (OPC) – Maintenance for the first five years following construction of the levee has been prepared for the project and is presented in Appendix A.

The following assumptions and inclusions apply to the estimate:

- All costs in Australian Dollars;
- Base date of Estimate: November 2018;
- No escalation has been allowed for in the OPC – Maintenance;
- All work will be carried out by Council whose personnel live locally and all equipment required is available in Rockhampton;
- Pricing of the works have been based on in-house historical cost data as well as pricing obtained from hire rates from Regional Councils.

Appendix A

Opinion of Probable Costs (Maintenance)

AECOM

Rockhampton Regional Council
South Rockhampton Flood Levee
Operation and Maintenance (O&M) Plan
Opinion of Probable Costs (Maintenance)

Item	Description	Unit	Quantity	Rate	Year 1 Amount	Year 2 Amount	Year 3 Amount	Year 4 Amount	Year 5 Amount
1	**Inspections**								
(a)	Routine Inspections (Monthly)	Day	12	2000	$24,000	$24,000	$24,000	$24,000	$24,000
(b)	Periodic Inspections (Annual)	Day	1	2000	$2,000	$2,000	$2,000	$2,000	$2,000
(c)	Comprehensive Inspection (Five Yearly)								$30,000
2	**Vegetation Management**								
(a)	Monthly Mowing (Average)	Day	12	2800	$33,600	$33,600	$33,600	$33,600	$33,600
(b)	Woody Vegetation Removal (6-Monthly)	Day	2	2000	$4,000	$4,000	$4,000	$4,000	$4,000
(c)	Weed Removal/Management	Day	2	2000	$4,000	$4,000	$4,000	$4,000	$4,000
3	**Debris Management**	Day	6	2000	$12,000	$12,000	$12,000	$12,000	$12,000
4	**Embankment Maintenance**	Day	8	5000	$40,000	$40,000	$40,000	$40,000	$40,000
5	**Fences**	Day	0.5	2160	$1,080	$1,080	$1,080	$1,080	$1,080
6	**Levee Rock Protection**	Day	2	5000	$10,000	$10,000	$10,000	$10,000	$10,000
7	**Bank Rock Protection**	Day	2	5000	$10,000	$10,000	$10,000	$10,000	$10,000
8	**Valves**								
(a)	Cleaning of Silt from Chambers	Day	6	2800	$16,800	$16,800	$16,800	$16,800	$16,800
(b)	Operate Valves	Day	4	2000	$8,000	$8,000	$8,000	$8,000	$8,000
(c)	Maintenance of Valves	Day	4	2000	$8,000	$8,000	$8,000	$8,000	$8,000
9	**Open Drains**	Day	0.5	4500	$2,250	$2,250	$2,250	$2,250	$2,250
10	**Demountable Flood Barriers**	Day	1	5000	$5,000	$5,000	$5,000	$5,000	$5,000
11	**Vinyl Sheet Pile Wall**	Day	1	5000	$5,000	$5,000	$5,000	$5,000	$5,000
12	**Pump Stations (incl E, I & C)**								
(a)	Periodic Operation of Pump Station	Day	12	4800	$57,600	$57,600	$57,600	$57,600	$57,600
(b)	Cleaning of Silt	Day	6	2800	$16,800	$16,800	$16,800	$16,800	$16,800
(c)	Periodic Maintenance	Day	3	1500	$4,500	$4,500	$4,500	$4,500	$4,500
(d)	Maintenance of Detention Basin	Day	0.5	6000	$3,000	$3,000	$3,000	$3,000	$3,000
(e)	Fuel Storage Facility	Day	6	3300	$19,800	$19,800	$19,800	$19,800	$19,800
(f)	Consumables (power) Security lights etc.	Day	365	35	$12,775	$12,775	$12,775	$12,775	$12,775
(g)	Telemetry (maintenance)	Day	4	300	$1,200	$1,200	$1,200	$1,200	$1,200
(h)	Switchboards / smoke alarms	Day	4	800	$3,200	$3,200	$3,200	$3,200	$3,200
13	**Concrete Structures, End Structures and Levee Transitions**	Day	2	4800	$9,600	$9,600	$9,600	$9,600	$9,600
14	**Access Roads**	Day	4	4500	$18,000	$18,000	$18,000	$18,000	$18,000
15	**Project Management (incl RRC Asset Management Costs)**	10%			$33,221	$33,221	$33,221	$33,221	$36,221
16	**Contingency**	20%			$73,085	$73,085	$73,085	$73,085	$79,685
	YEARLY OPOCM (excl of GST)				**$438,511**	**$438,511**	**$438,511**	**$438,511**	**$478,111**
	FIVE YEAR TOTAL OPOCM (excl of GST)						**$2,232,153**		
	YEARLY AVERAGE OPOCM (excl of GST)						**$446,431**		

Please note that AECOM has no control over the cost of labour, materials, equipment or services furnished by others, neither has it control over contractors methods for determining prices, competitive bidding or market conditions. The opinion of probable cost produced by AECOM will therefore be provided on the basis of its best judgement as an experienced and qualified engineering consultant, familiar with the industry. We can therefore not guarantee that any tenders or actual costs will not vary from any opinion of probable costs provided by AECOM.