Reef Ecologic

Kanton Resource Use
Sustainability Plan (KRUSP)

Kanton Island Infrastructure
Assessment Report

256061-00-REP-001

Issue  |  15 September 2017
**Document Verification**

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<th>Job title</th>
<th>Kanton Resource Use Sustainability Plan (KRUSP)</th>
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<tr>
<td>Document title</td>
<td>Kanton Island Infrastructure Assessment Report</td>
</tr>
<tr>
<td>Document ref</td>
<td>256061-00-REP-001</td>
</tr>
<tr>
<td>Revision</td>
<td>Draft 1</td>
</tr>
<tr>
<td>Date</td>
<td>13 Jul 2017</td>
</tr>
<tr>
<td>Filename</td>
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<tr>
<td>Description</td>
<td>Draft for Client Review</td>
</tr>
<tr>
<td>Prepared by</td>
<td>Matthew Deane, Peter Kastrup, Peter Kastrup</td>
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<td>Revision</td>
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<td>15 Sep 2017</td>
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<td>Filename</td>
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The document has been verified and signed off by Matthew Deane, Peter Kastrup, and Peter Kastrup as indicated by their signatures.

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**Issue Document Verification with Document**: ✅
# Contents

1 Introduction 4
  1.1 Project Background 4
  1.2 History of the Island’s Infrastructure 4
  1.3 Arup Project Scope 5
  1.4 Limitations 5

2 Description of the Island Infrastructure 7
  2.1 Panoramic Inspection 8
  2.2 Kanton Port Infrastructure 8
  2.3 Kanton Airfield 12
  2.4 Road Between Port and Airfield 13

3 Site Inspection 15
  3.1 Condition Criteria Ratings 15
  3.2 Kanton Port Infrastructure 16
  3.3 Kanton Airfield Infrastructure 17
  3.4 Road Between Port and Airfield 18

4 Asset Management Strategies 19
  4.1 Discussion 19
  4.2 “Do the Minimum” Strategy 19
  4.3 Reactive Repair Strategy 20
  4.4 Preventative Strategy 20

5 Proposed Repair Strategy for Kanton Island Infrastructure 21
  5.1 General 21
  5.2 Kanton Port Infrastructure 21
  5.3 Kanton Airfield Infrastructure 28
  5.4 Road Between Port and Airfield 32
  5.5 Pre-Construction Topographic Survey of Existing Island Infrastructure 33

6 High Level Cost Estimate 34
  6.1 General 34
  6.2 Cost Estimate Assumptions 34
  6.3 Proposed Construction Staging 35
  6.4 Cost Estimate 37

7 Conclusion 40
Appendices

Appendix A
Marq Inspection Report (June 2017) - Kanton Port Infrastructure

Appendix B
High Level Cost Estimate Breakdown
Executive Summary

In May 2017, Arup was commissioned by Reef Ecologic (RE) to undertake inspection and condition reporting of the infrastructure located on Kanton Island in Kiribati.

The inspections included visual assessment and condition reporting on the following:

- Kanton port infrastructure including a steel sheet piled quayline wall, reinforced concrete seawall, steel piled jetty and a concrete vessel slipway;
- Kanton airfield infrastructure and remaining buildings;
- Existing road infrastructure between the port and airfield including a section of road located approximately 1km north of the port that failed at some point between 2014 and 2016 based on Google Earth satellite timeline imagery.

The site observations were undertaken by Arup between the 19th and 23rd June 2017 and were recorded and rated in accordance with the Queensland Department of Transport and Main Roads (DTMR) Structures Inspection Manual condition rating guidelines. Observations for the port infrastructure were compiled using Arup’s in-house Marq Capture iPad software.

In addition, Arup also captured high resolution images at each of the above island infrastructure locations as well as the bird islands and proposed tourist resort location on the southern side of the channel entrance. These images were compiled to produce a panoramic model which provides interactive 360 degree interface of images that capture the current (June 2017) infrastructure layout and condition. The link to this panoramic model is provided in Section 2.1.

A summary of the Arup site inspection findings for the above listed infrastructure were as follows:

<table>
<thead>
<tr>
<th>Port Infrastructure</th>
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<tbody>
<tr>
<td>Quayline Wall</td>
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<tr>
<td></td>
</tr>
<tr>
<td></td>
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<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>
### Reinforced Concrete Seawall
- The southern length of seawall is approximately 35m long with the southern-most 15m largely collapsed / failed;
- The northern length of seawall is approximately 40m long and is generally in fair to poor condition with longitudinal and vertical cracking and rust staining evident;
- At the northern end of the northern seawall there is exposed vertical reinforcement in the wall exhibiting significant corrosion in tidal zone.

### Jetty
- Currently there is no fixed access to the jetty from land only an unfixed temporary timber beam;
- The jetty is in poor condition with the timber deck largely missing and timber superstructure elements weathered and cracked.
- The three (3) sub-structural steel H-piles and cross head beams are heavily corroded and the five (5) original steel fender piles on the southern side of the jetty were severely corroded / largely missing above the water level.

### Vessel Slipway
- The existing barge ramp / vessel slipway concrete slab appears to be in fair condition given its age with no significant deterioration evident above the water line;
- Below the water line, the slab appears to be broken up around the toe. In addition, there was a significant amount of debris on the seabed around the toe and accretion of coral debris at the base of the ramp.

### Airfield Infrastructure
#### Airstrip, Taxiways and Terminal Area
- The airstrip, taxiways and terminal area coral based aggregate pavement was typically in fair condition with localised alligator cracking evident in areas;
- Vegetation was observed to be encroaching onto the sides of the airstrip and taxiways in many areas and vegetation roots appeared to be undermining / lifting the pavement in areas along the edges of the airstrip;
- The runway safety area at the eastern end is significantly overgrown with vegetation growing up through the pavement;
- Large coral fragments were observed on the runway safety area at the western end.

#### Buildings
- The storage / maintenance shed was in relatively good condition given its age however the base slab appeared to delaminating / spalling in areas and scattered debris / rubbish was observed throughout the shed;
The derelict WW II building appeared to be structurally sound and potentially re-usable with some minor repairs and clean-up of debris / rubbish.

### Existing Road Infrastructure

<table>
<thead>
<tr>
<th>Existing Road between the port and airfield</th>
</tr>
</thead>
<tbody>
<tr>
<td>- The coral based aggregate pavement surface was in variable condition with sporadic localised areas of cracking, potholing and pavement deterioration evident along the length;</td>
</tr>
<tr>
<td>- Vegetation was observed to be encroaching in many areas along the side of the road.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Failed Causeway</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Approximately 1km north of the port, a section of the road / causeway has failed and based on Google Earth Satellite Imagery, was washed away at some point between Nov 2014 and Jun 2016.</td>
</tr>
<tr>
<td>- The failed section of road is approximately 100m long along the current road alignment however the channel width narrows to the east of the failure to approximately 50m.</td>
</tr>
</tbody>
</table>

Based on the above inspection findings, Section 5 of this report outlines proposed / recommended repair strategies and options for each of the above infrastructure elements as well as suggested additional infrastructure requirements on the island to enable future proposed service and operation of the port and airfield on Kanton.

Section 6 of this report provides high level cost estimates, assumptions and recommended staging for the proposed repair and upgrade works detailed in Section 5. These cost estimates were prepared by Arup based on the following assumptions:

- All proposed repair and upgrade works are undertaken concurrently as part of a single construction project managed by a single Principal Contractor;

- Estimates include provision for all construction related costs including preliminaries (site establishment costs, temporary accommodation for construction staff, mobilisation / demobilisation of plant to the project site), construction equipment, materials and labour costs, contractor profit and overheads;

- Estimates include provision for engineering design fees for design and documentation of repair / upgrade works (7.5% of total construction cost provisional allowance);

- Estimates include provision for contract administration costs including tender document preparation, procurement and site phase management (15% of total construction cost provisional allowance);

- Estimates include provision for a 40% contingency allowance for unforeseen / unanticipated additional project related expenses in line with the Queensland Department of Transport and Main Roads Project Cost Estimating Manual guidance for Concept Level estimates.
1 Introduction

1.1 Project Background

In May 2017, Arup was engaged by Reef Ecologic (RE) to undertake inspection and condition reporting of the island infrastructure located on Kanton in the Phoenix Islands, Kiribati (refer Figure 1).

Kanton Island is the largest of the Kiribati Phoenix Islands and is planned to become the local administration centre for the Phoenix Islands Protection Area (PIPA, the world’s largest UNESCO World Heritage site and marine reserve). It is also the only inhabited island of the Phoenix Islands with a population of around 50 people, made up mainly of government care takers, PIPA employees and their families.

Arup’s infrastructure assessment scope forms part of a project to develop a Kanton Resource Use Sustainable Plan (KRUSP) commissioned by the PIPA implementation office for the Kiribati Ministry of Environment, Lands & Agricultural Development.

The purpose of the KRUSP is to ensure that this pristine environment is protected and the community engaged during the proposed economic, social and tourism development of the island.

![Figure 1: Kanton Island, Kiribati (Source: Getamap)](image)

1.2 History of the Island’s Infrastructure

The infrastructure on Kanton Island is understood to have been originally constructed by Pan American Airways between 1938–39 and was used by the airline as a stopover on its route from Hawaii to New Zealand. In 1941-42, during World War II, the United States Navy upgraded and extended the airfield, road
infrastructure and port to accommodate heavy bombers and larger cargo vessels\(^1\). The dredge spoil from the channel deepening is understood to have been placed at that time on the inside of the lagoon forming islands (now known as the Spam Islands and Bird Island) which now provide bird nesting habitats.

After the war, Pan American Airways continued to use Kanton Island as the main re-fueling station for trans-pacific flights until 1965 when direct trans-pacific long range flights were introduced\(^2\). It is understood that little to no maintenance to the island infrastructure has occurred post 1965.

1.3 Arup Project Scope

The scope of works undertaken by Arup and detailed in this report, included:

1. Desktop review of PIPA provided documents and reports;
2. Travel to Tarawa, Kiribati with Reef Ecologic to undertake project inception and consultation meetings with PIPA;
3. Travel to Kanton with Reef Ecologic to carry out inspections of the existing infrastructure as well as consultation with the local community to communicate and engage on the objectives and proposed outcomes of the project;
4. Provide high-level engineering advice and reporting on physical / geometry / sizing requirements and construction cost range for recommended repair / refurbishment of the Kanton Island port, airfield and buildings, vessel slipway and road infrastructure between the port and the airfield.

1.4 Limitations

This report has been prepared by Arup for Reef Ecologic and the Phoenix Islands Protection Area (PIPA) implementation office c/o Reef Ecologic and may only be used and relied upon by these parties. Arup otherwise disclaims responsibility to any person or entity other than Reef Ecologic or PIPA arising in connection with this report.

The opinions, conclusions and recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of this report. Accordingly, Arup cannot accept responsibility or obligation for events or changes including future deterioration to the inspected infrastructure occurring subsequent to the date that this report was prepared.

The observations recorded and detailed in this report are based on a visual inspection of accessible members of the above mentioned infrastructure only. Please note that areas or surfaces that were concealed or obstructed were not


inspected. Accordingly, this report is not a guarantee that defects and/or damage are not present in those inaccessible areas of the structures.

In addition, the following items were not inspected or commented upon in this report:

- Electrical services;
- Hydraulic services;
- Mechanical services;
- Fire services;
- Building code compliance;
- Occupational health and safety issues;
- Hazardous material;
- Operations and logistics including security, customs, quarantine, etc.;
- Provision for disabled access.
2 Description of the Island Infrastructure

Based on Arup’s inspection observations and review of previous documents and reports provided by PIPA, an overall summary of the existing Kanton Island infrastructure and locations is as follows (as illustrated in Figure 2):

- Port infrastructure including approximately 150m of sheet piled quayline wall, 75m of reinforced concrete seawall, a 12m long steel piled jetty and concrete vessel slipway;

- Airfield comprising taxiways, 2.4km airstrip and two (2) remaining buildings one of which is currently used for aviation fuel storage;

- Approximately 4.3km of road between the port and airfield including a ~100m long section of road / causeway that failed at some point between Nov 2014 and Jun 2016 (Source: Google Earth satellite timeline imagery).

Figure 2: Kanton Island Infrastructure Layout Plan (Source: Google Earth)
2.1 Panoramic Inspection

As a value-add to Reef Ecologic and PIPA, Arup also captured high resolution images at each of the above island infrastructure locations as well as the bird islands and proposed tourist resort location on the southern side of the channel entrance. These images were compiled to produce a panoramic model which provides an interactive 360 degree interface of images that capture the current (June 2017) infrastructure layout and condition. This model can be viewed online using Internet Explorer or Mozilla web browsers (note the link will not work using Google Chrome browser) at the following web address:


2.2 Kanton Port Infrastructure

2.2.1 General

Kanton port is located adjacent to the island channel into the lagoon which is understood to have been dredged to its current depth by the US Navy during WWII.

A general arrangement of the port infrastructure is illustrated in Figure 3 and a description of each of these structures is provided below.

![Figure 3: Kanton Port Infrastructure Layout (Source: Google Earth)](image)

2.2.2 Quayline Wall

The quayline wall is approximately 150m long as illustrated by the dashed red line in Figure 3. As shown in Figure 4, the wall comprises driven steel sheet piles...
capped by a reinforced concrete capping beam and supported by anchor tie rods spaced evenly along a steel waler / distributor beam around low water level. Attached to the sheet pile wall face in the tidal and splash zone are horizontal and vertical timber fender / rubbing elements which provide a buffer between vessel hulls and the sheet pile wall.

Several depth readings to seabed were taken along the berthing face of the quayline wall which ranged between 7m (at the southern end) to 11m (at the northern end) depth to approximate mean sea level (MSL).

![Sheet Piled Quayline Wall](image1)

**2.2.3 Reinforced Concrete Seawall**

There are two (2) lengths of reinforced concrete seawall located to the north and south of the sheet piled quayline wall. The southern length of seawall is approximately 35m with the southern-most 15m largely collapsed / failed. The northern length of seawall (shown below in Figure 5) is approximately 40m long.

![Reinforced Concrete Seawall (North)](image2)

Figure 4: Sheet Piled Quayline Wall

Figure 5: Reinforced Concrete Seawall (North)
2.2.4 Jetty

The jetty measures approximately 12m long by 2m wide and as shown in Figure 6, comprises a timber super-structure supported by three (3) steel H-piles and transverse steel crosshead beams. Currently there is no fixed access to the jetty from land only an unfixed temporary timber beam. The five (5) original steel fender piles on the southern side of the jetty were severely corroded / largely missing above the water level.

Figure 6: Jetty

2.2.5 Vessel Slipway

The vessel slipway or barge ramp (refer Figure 7) is located directly north of the jetty and is approximately 35m long by 10m wide. It is comprised of a concrete slab that extends several metres into the water to approximately Mean Low Low Water (MLLW) level.
2.2.6 Channel into the Lagoon

Five (5) depth readings were taken by Reef Ecologic within the channel into the lagoon. The readings were taken on Thursday 22\textsuperscript{nd} June at approximately 3pm (i.e. approximately MSL) on the incoming tide from outside of the channel entrance adjacent to the SS President Taylor wreck into the lagoon adjacent to the Port.

Depth reading measurements and approximate locations are provided below in Table 1.

Table 1: Channel Depth Readings and Approximate Locations

<table>
<thead>
<tr>
<th>Reading</th>
<th>Depth (m MSL (approx.))</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10.5m</td>
</tr>
<tr>
<td>2</td>
<td>10.7m</td>
</tr>
<tr>
<td>3</td>
<td>10.9m</td>
</tr>
<tr>
<td>4</td>
<td>10.2m</td>
</tr>
<tr>
<td>5</td>
<td>9.6m</td>
</tr>
</tbody>
</table>
2.3 **Kanton Airfield**

Kanton airfield is located at the north-west corner of the island and is understood to have been originally constructed by Pan American Airways between 1938–39 and upgraded during World War II by the United States Navy to accommodate heavy bombers.

A general arrangement of the airfield is illustrated in Figure 8 and a description of the existing infrastructure is provided below.

![Kanton Airfield Infrastructure Layout](source: Google Earth)

**Figure 8:** Kanton Airfield Infrastructure Layout (Source: Google Earth)

### 2.3.1 Airstrip, Taxiways and Terminal Area

The airstrip and taxiways comprise a coral based aggregate pavement, with a thin (estimated 25mm thick) asphalt concrete wearing course as shown in Figure 9.

The combined pavement surface area of the airstrip, taxiways and terminal area is approximately:

- Airstrip – 1.95km long x 47m wide = 91,650 m²;
- Runway safety area (western end) – 50m long x 47m wide = 2,350 m²;
- Runway safety area (eastern end) – 425m long x 47m wide = 19,975 m²;
- Taxiways & terminal area – 38,750 m²;
  - Total Estimated Airfield Pavement Area = 152,725 m²
2.3.2 Airfield Buildings

There are two (2) buildings at the airfield that are still intact. The storage / maintenance shed and a derelict WW II building as shown in Figure 8. Refer panoramic model link in Section 2.1 for external and internal images of these buildings. It is understood that the storage / maintenance shed is currently only used for aviation fuel storage.

2.4 Road Between Port and Airfield

2.4.1 Existing Road

There is an existing coral based aggregate pavement road that runs all the way around Kanton island however only the section between the airfield and the port (approximately 4.3km) is still in use.

2.4.2 Failed Causeway

Approximately 1km north of the port, a section of the road / causeway failed at some point between Nov 2014 and Jun 2016 based on Google Earth satellite timeline imagery. The failed section of road is approximately 100m long (length along current road alignment) however the channel width narrows to the east of the failure to approximately 50m as illustrated in Figure 10.
Figure 10: Failed Section of Existing Road / Causeway
3 Site Inspection

Site inspections of the above listed infrastructure were carried out by Arup during the week of the 19th – 23rd June 2017.

The site observations and investigation findings were recorded and rated in accordance with the Queensland Department of Transport and Main Roads (DTMR) Structures Inspection Manual condition rating criteria. Observations for the port infrastructure were compiled using Arup’s in-house Marq Capture iPad software.

3.1 Condition Criteria Ratings

3.1.1 General

Table 2 below provides details of the terminology used when describing individual element condition ratings outlined in this report (with the exception of the airfield pavement condition rating – refer Section 3.1.2 for further details).

This system is based on the condition rating criteria as specified in the Queensland Department of Transport and Main Roads Structures Inspection Manual and was adopted by Arup for this project to standardise and rationalise the observations for the inspected infrastructure and its individual components.

<table>
<thead>
<tr>
<th>State</th>
<th>Subjective Rating</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>GOOD (&quot;as new&quot;)</td>
<td>Free of defects with little or no deterioration evident</td>
</tr>
<tr>
<td>2</td>
<td>FAIR (monitoring required)</td>
<td>Free of defects affecting structural performance, integrity and durability. Deterioration of a minor nature in the protective coating and/or parent material is evident.</td>
</tr>
<tr>
<td>3</td>
<td>POOR (monitoring required)</td>
<td>Defects affecting the durability/serviceability, which may require monitoring and/or remedial action or inspection by a structural engineer. Component or element shows marked and advancing deterioration including loss of protective coating and minor loss of section from the parent material is evident. Intervention is normally required.</td>
</tr>
<tr>
<td>4</td>
<td>VERY POOR (remedial action required)</td>
<td>Defects affecting the performance and structural integrity, which require immediate intervention including an inspection by a structural engineer, if principal components are affected. Component or element shows advanced deterioration, loss of section from the parent material, signs of overstressing or evidence that it is acting differently to its intended design mode or function.</td>
</tr>
<tr>
<td>5</td>
<td>UNSAFE (immediate remedial Action required)</td>
<td>This state is only intended to apply to the “whole structure” rating. Structural integrity is severely compromised and the structure must be taken out of service until a structural engineer has inspected the structure and recommended the required remedial action.</td>
</tr>
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</table>
3.1.2 Airfield Pavement

The airfield pavement was assigned a visual surface condition rating in accordance with Table 4.2 of the Australian Government Airfield Pavement Maintenance Manual (APMM) (Rev E, Jan 2015)\(^3\).

3.2 Kanton Port Infrastructure

3.2.1 Above Water Inspection

3.2.1.1 Marq Inspection Report

The inspection of the Kanton Port infrastructure (refer Figure 3 for layout) was undertaken using “Marq Capture” – Arup’s internally developed iPad inspection software. Marq was used to provide a detailed record of observed defects encountered during the inspection of the above water components and can be found in the Arup Marq inspection report located in Appendix A.

All observations and condition ratings were in accordance with the criteria ratings defined in Section 3.1.

3.2.2 Underwater Inspection

Underwater photographs were taken by Reef Ecologic along the quayline wall. Inspection of these photographs indicate that:

- The steel sheet piles appeared to be in good condition below the low water mark with no apparent evidence of deterioration due to corrosion or mechanical damage – refer Figure 11 a);

- A significant amount of construction material offcuts and debris was observed on the seabed adjacent to the quayline wall – refer Figure 11 b).

Figure 11: Underwater Photographs of Quayline Wall

3.3 Kanton Airfield Infrastructure

3.3.1 Airstrip, Taxiways and Terminal Area

Inspection by Arup of the Kanton airfield airstrip, taxiways and terminal area pavement (refer Figure 8) in accordance with the Australian Government APMM, Jan 2015 found the following:

- The airstrip, taxiways and terminal area coral based aggregate pavement was typically in Fair condition with localised alligator or block cracking evident in areas – refer Figure 12 a);
- Vegetation was observed to be encroaching onto the sides of the airstrip and taxiways in many areas – refer Figure 12 b);
- Vegetation roots appeared to be undermining / lifting the pavement in areas along the edges of the airstrip - refer Figure 12 c);
- The runway safety area at the eastern end is significantly overgrown with vegetation growing up through the pavement - Figure 12 d);
- Large coral fragments were observed on the runway safety area at the western end.

Figure 12: Kanton Airfield Pavement Inspection Observations
3.3.2 Airfield Buildings

Inspection by Arup of the two (2) remaining buildings at the airfield found:

- The storage / maintenance shed to be in relatively good to fair condition given its age however the base slab appeared to delaminating / spalling in areas and scattered debris / rubbish was observed throughout the shed;
- The derelict WW II building as shown in Figure 8 appeared to be structurally sound and potentially re-usable with some minor repairs and clean-up of debris / rubbish.

Refer panoramic model link in Section 2.1 for external and internal images of both of these buildings.

3.4 Road Between Port and Airfield

3.4.1 Existing Road

Inspection by Arup of the existing coral based aggregate pavement road between the airfield and the port (approximately 4.3km) found:

- The coral based aggregate pavement surface was in variable (fair to poor) condition with sporadic localised areas of cracking, potholing and pavement deterioration evident along the length – refer Figure 13 a);
- Vegetation was observed to be encroaching in many areas along the side of the road – refer Figure 13 b).

Figure 13: Road Between Port and Airfield Inspection Observations
4 Asset Management Strategies

4.1 Discussion

In tropical environments, infrastructure is vulnerable to a variety of severe deterioration mechanisms and choosing the most appropriate asset management strategy to manage and extend the service life of assets requires careful consideration of a range of factors including:

- Choice of materials;
- Present and future maintenance budgets,
- Likely rates of deterioration,
- Costs of envisaged maintenance including disruption to services / downtime, etc.

Three (3) broad asset management strategies are presented and discussed below and illustrated in Figure 14 which shows the effect of maintenance and / or preventative measures on extending the service life of assets.

The discussion below is presented to provide context for the repair strategies and / or repair options presented for the Kanton Island infrastructure in Section 5 of this report.

Figure 14: Asset Life Cycle Management Strategies

4.2 “Do the Minimum” Strategy

The ‘Do the Minimum’ strategy (represented by the internal dashed line in Figure 14) primarily involves letting the structure deteriorate to the minimum intended performance (or intervention) level while undertaking a rigorous inspection regime to monitor the safe deterioration of the structure. This strategy typically
requires part or full replacement once an asset has reached the end of its useful life (i.e. the minimum intended performance level).

4.3 Reactive Repair Strategy

This asset management strategy involves reacting to defects only when they reach a critical level (represented by the solid line in Figure 14), thereby programming the repair expenditure to the latest critical point in time.

This is typically the most common strategy employed by asset owners for extending the life of their assets.

4.4 Preventative Strategy

This strategy is used to minimise (or prevent) as much as practicable, the need for regular or unscheduled repair and maintenance of the structure. This is typically achieved through preventative measures such as early implementation of identified repairs and maintenance such as cathodic protection or prevention, silane or siloxane surface treatments to concrete surfaces or addressing known defects and issues prior to a repair becoming critical i.e. moving forward actions, which may be planned for a later date, etc.
5 Proposed Repair Strategy for Kanton Island Infrastructure

5.1 General

Following on from the discussion provided in Section 4 and based on the site inspection observations and findings detailed in Section 3, Arup present the following proposed repair strategies and / or options for each of the inspected Kanton Island port, airfield and road infrastructure elements.

5.2 Kanton Port Infrastructure

5.2.1 Quayline Wall

5.2.1.1 Current Condition

The steel sheet piled quayline wall is approximately 150m long as illustrated by the dashed red line in Figure 3. The current condition of the quayline wall is summarised by the following key inspection observations:

- The steel sheet piles were exhibiting significant and widespread corrosion in the splash zone. The steel tie rod anchors and steel waler / distributor beam around low water level were missing in some areas along the wall and where missing, there were a number of holes evident in the sheet piles where the anchors were presumably previously located. In addition, a number of scour holes were observed in the backfill behind the wall indicating potential loss of material through the wall at these locations;

- Significant longitudinal cracking, localised rust staining and spalling deterioration was observed along the length of the quayline reinforced concrete capping beam;

- Timber fenders / walers elements along the front of the quayline were missing or damaged in most areas along the face. Where the timber was still intact, most was severely weathered, cracked / broken and steel fixing rods were protruding outwards of the berthing face which would cause damage to a berthing / moored ship;

- Several depth readings to seabed were taken along the berthing face of the quayline wall which ranged between 7m (at the southern end) to 11m (at the northern end) depth to approximate mean sea level (MSL);

- The steel sheet piles appeared to be in good condition below the low water mark with no apparent evidence of deterioration due to corrosion or mechanical damage;

- A significant amount of construction material offcuts and debris was observed on the seabed adjacent to the berthing face / quayline.
5.2.1.2 Repair Strategy Options

Noting the above key inspection findings and with reference to the discussion provided in Section 4, Arup propose the following repair options for the quayline wall as detailed in Table 3.

Table 3: Quayline Wall Refurbishment Options

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
<th>Relative Cost</th>
<th>Potential Risk of Structural Failure / Inadequate Performance of Asset</th>
<th>Expected Service Life (till major repairs or replacement are required)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Do the Minimum</td>
<td>Low</td>
<td>High</td>
<td>N / A</td>
</tr>
<tr>
<td></td>
<td>- Remove timber fenders / walers from quayline wall;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Install new mooring bollards and fenders.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Targeted Repairs / Replacement</td>
<td>Medium</td>
<td>Medium / Low</td>
<td>25 years +</td>
</tr>
<tr>
<td></td>
<td>- Remove timber fenders / walers from quayline wall;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Sandblast / remove sheet pile corrosion in tidal zone, locally strengthen sheet piles as required, install mesh and shotcrete facing to MLLW – refer Figure 15 for case study example;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Further underwater thickness testing of sheet piles to confirm if installation of galvanic cathodic protection is required;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Demolish and replace existing reinforced capping beam;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Install new mooring bollards and fenders.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Full Replacement</td>
<td>High</td>
<td>Low</td>
<td>50 years +</td>
</tr>
<tr>
<td></td>
<td>- Demolish and remove existing sheet piles and reinforced concrete capping beam down to approx. MLLW to allow installation of tie rods / anchors for new sheet pile wall;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Install new line of sheet piles and tie rods seaward of the existing quayline wall;</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
- Backfill wall and construct new RC capping beam;
- Install new mooring bollards and fenders.

Figure 15: Case study example of sheet pile rehabilitation using concrete facing in the tidal zone (Brisbane, 2009)

5.2.1.3 Recommended Repair Strategy

Noting the discussion and repair strategy options presented above, Arup recommend **Option 2 - Targeted Repairs / Replacement** as the preferred repair strategy for remediation of the quayline wall.

This recommendation is based on our understanding of the Client’s functional requirements for the port and availability of funding to undertake the necessary upgrade works. Note that to enable design of this rehabilitation option, additional ultrasonic thickness testing will be required in the tidal zone to confirm residual wall steel thicknesses and determine whether or not localised additional strengthening of the wall is required.

5.2.2 Reinforced Concrete Seawall

5.2.2.1 Current Condition

The two (2) lengths of reinforced concrete seawall are located to the north and south of the sheet piled quayline wall as illustrated by the yellow dashed lines in
Figure 3. The current condition of the reinforced concrete seawalls is summarised by the following key inspection observations:

- The southern length of seawall is approximately 35m long with the southern-most 15m section largely collapsed / failed. The remainder of the seawall is generally in fair to poor condition with longitudinal and vertical cracking and rust staining evident;

- The northern length of seawall is approximately 40m long and is also generally in fair to poor condition with longitudinal and vertical cracking and rust staining evident;

- At the northern end of the northern seawall there is exposed vertical reinforcement bars in the wall exhibiting significant corrosion deterioration in the tidal zone.

5.2.2.2 Recommended Repair Strategy

Given both sections of reinforced concrete seawall are not currently critical to the operation of the port, Arup recommend that at this stage, only the following minor repair works be undertaken to ensure the structural integrity of the seawall is not compromised in the short to medium term:

- In the zone where there is exposed vertical reinforcement in the wall exhibiting significant corrosion in tidal zone, it is recommended that localised concrete patch repairs be undertaken (i.e. all delaminated concrete be removed to past the level of reinforcement, corroded reinforcement be replaced as required and reinstatement of concrete cover with new high strength concrete or mortar.)

5.2.3 Jetty

5.2.3.1 Current Condition

The jetty is approximately 12m long and as shown in Figure 6, comprises a timber super-structure supported by three (3) steel H-piles and transverse steel crosshead beams. The current condition of the jetty is summarised by the following key inspection observations:

- Currently there is no fixed access to the jetty from land, only an unfixed temporary timber beam;

- The jetty is in poor condition with the timber deck largely missing and superstructure elements weathered and cracked.

- The three (3) sub-structural steel H-piles and cross head beams are heavily corroded;

- The five (5) original steel fender piles on the southern side of the jetty were severely corroded / largely missing above the water level.
5.2.3.2 Recommended Repair Strategy

Arup recommend the following repair strategy for the jetty:

- Given the poor condition of the jetty and fact that small vessels cannot berth freely at the jetty, Arup propose full demolition and replacement of the jetty with a new floating pontoon and gangway structure as per the example illustrated below in Figure 16. This type of structure would provide the functional advantage of allowing multiple small vessels to berth and moor at the pontoon at any tide.

![Example of Proposed Floating Pontoon and Gangway System](image)

Figure 16: Example of Proposed Floating Pontoon and Gangway System

5.2.4 Vessel Slipway

5.2.4.1 Current Condition

The vessel slipway or barge ramp is comprised of a concrete slab that extends into the water to approximately Mean Low Low Water (MLLW) level. The current condition of the vessel slipway / barge ramp is summarised by the following key inspection observations:

- Above the water line, the existing vessel slipway / barge ramp concrete slab appears to be in fair condition given its age with no significant deterioration evident;

- Below the water line, the slab appears to be broken up around the toe. In addition, there was a significant amount of debris on the seabed around the toe and seaward along the alignment where vessels would access the ramp;

- There is significant accretion of coral debris at the base of the ramp along the shore.
5.2.4.2 Repair Strategy Options

Noting the above key inspection findings and with reference to the discussion provided in Section 4, Arup propose the following repair options for the vessel slipway / barge ramp as detailed in Table 4.

Table 4: Vessel Slipway / Barge Ramp Refurbishment Options

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
<th>Relative Cost</th>
<th>Potential Risk of Structural Failure / Inadequate Performance of Asset</th>
<th>Expected Service Life (till major repairs or replacement are required)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Do the Minimum</td>
<td>Low</td>
<td>Medium / High</td>
<td>N / A</td>
</tr>
<tr>
<td></td>
<td>- Retain / re-use existing barge ramp slab;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Remove coral debris at base of ramp;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Remove broken sections of slab at toe and all debris / rubbish in vicinity of toe;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Construct new road pavement link at top of ramp to existing adjacent road.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Construct New Ramp</td>
<td>Medium / High</td>
<td>Low</td>
<td>50 years +</td>
</tr>
<tr>
<td></td>
<td>- Remove coral debris at base of ramp;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Remove broken sections of slab at toe and all debris / rubbish in vicinity of toe;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Construct new barge ramp reinforced concrete slab and scour protection (sides &amp; toe) over the existing barge ramp;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Construct new road pavement link at top of ramp to existing adjacent road.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
5.2.4.3  Recommended Repair Strategy

Noting the current condition of the existing barge ramp / vessel slipway and uncertainty around the long term functionality and serviceability of this asset, Arup recommend **Option 2 – Construct New Ramp** as the preferred repair strategy for the existing barge ramp / vessel slipway. Further to this recommendation, it should be noted that Option 1 does provide a feasible temporary short-term option for providing a roll on roll off (RORO) access point on to the island for heavy machinery and construction plant.

5.2.5  Channel & Berth Depths

Five (5) depth readings all ranging between 9.6m to 10.9m (to approx. MSL) were taken by Reef Ecologic within the channel into the lagoon. In addition, several depth readings to seabed were also taken along the berthing face of the quayline which ranged between 7m (at the southern end) to 11m (at the northern end) depth to approximate mean sea level (MSL).

Prior to design and construction of the proposed upgrade works, it is recommended that a hydrographic survey be commissioned for the zone illustrated in Figure 17. This survey would provide important data to inform future safe vessel navigation into the lagoon, port and southern channel entrance (including identification of subsea obstructions, debris, etc.) as well as suitable locations for future proposed fixed mooring points within the lagoon, engineering designs, etc.

In the interim, based on the depth readings taken by Reef Ecologic, and accounting for the 1.6 – 1.7m spring tidal range at Kanton Island \(^4\), the channel and berth / quayline zone (refer Figure 17, zone area highlighted (A)) should safely accommodate vessels of **maximum draft up to 6m** with sufficient under keel clearance at any given tide. Vessels that wish to navigate outside of this zone or vessels with a draft greater than 6m should be assessed and approved on a case by case basis by a qualified marine engineer.

\(^4\) NOAA Tide Prediction Table for Kanton Island (Station ID: TPT2855), 2017.
5.3 **Kanton Airfield Infrastructure**

Based on the observations as reported in Section 0 above, the following remedial actions / options are proposed for remediation of the Kanton airfield infrastructure.

5.3.1 **Airstrip, Taxiways and Terminal Area**

5.3.1.1 **Current Condition**

The current condition of the Kanton airstrip, taxiways and terminal area is summarised by the following key inspection observations:

- The airstrip, taxiways and terminal area coral based aggregate pavement was typically in fair condition with localised alligator or block cracking evident in areas;
- Vegetation was observed to be encroaching onto the sides of the airstrip and taxiways in many areas;
- Vegetation roots appeared to be undermining / lifting the pavement in areas along the edges of the airstrip;
- The runway safety area at the eastern end is significantly overgrown with vegetation growing up through the pavement;
• Large coral fragments were observed on the runway safety area at the western end.

5.3.1.2 Repair Strategy Options

Noting the above key inspection findings and with reference to the discussion provided in Section 4, Arup propose the following repair options for the airstrip, taxiways and terminal area as detailed in Table 4.

Table 5: Airstrip, Taxiways & Terminal Area Refurbishment Options

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
<th>Relative Cost</th>
<th>Potential Risk of Structural Failure / Inadequate Performance of Asset</th>
<th>Expected Service Life (till major repairs or replacement are required)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Do the Minimum</td>
<td>Low</td>
<td>Medium / High</td>
<td>5 years</td>
</tr>
<tr>
<td></td>
<td>- Remove all vegetation and root systems encroaching onto sides of airstrip, taxiways and terminal area;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Machine sweep existing airfield pavement to remove loose material;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Install line markings over existing pavement;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Install wind sock.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Chip Seal Overlay</td>
<td>Low / Medium</td>
<td>Low / Medium</td>
<td>25 years + (*)</td>
</tr>
<tr>
<td></td>
<td>- Remove all vegetation and root systems encroaching onto sides of airstrip, taxiways and terminal area;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Mill &amp; texturize existing pavement, install granular levelling layer and chip seal overlay for airstrip, taxiways and terminal area;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Install line markings;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Install wind sock.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Asphaltic Concrete Overlay</td>
<td>High</td>
<td>Low</td>
<td>25 years + (*)</td>
</tr>
<tr>
<td></td>
<td>- Remove all vegetation and root systems encroaching onto sides of airstrip, taxiways and terminal area;</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
- Mill & texturize existing pavement and install new 100mm asphaltic concrete overlay for airstrip, taxiways and terminal area – i.e. similar scope of works to 2015/16 upgrade of Bonriki airport in Tarawa.
- Install line markings;
- Install wind sock.

(*) Option 2 & 3 service life estimates assume regular maintenance is undertaken to maximise the pavement service life.

### 5.3.1.3 Recommended Repair Strategy

The choice of a preferred option will be primarily dependent on available funding for these works and the proposed design aircraft that will be operating at this airport and is therefore ultimately a decision for PIPA and other relevant project stakeholders. Noting this, based on our understanding of the Client’s functional requirements for the airport and likely availability of funding, Arup recommend either **Option 1** as preferred as a short term refurbishment option **AND** / OR **Option 2** as preferred as a long term refurbishment option for the airfield.

Furthermore, for Option 1, given the present condition of the runway very little to no maintenance for 50 years, it is highly likely to be structurally adequate in the short term for the typical light inter-island planes such as the De Havilland Twin Otter.

Note that each of the above options will require further in-situ testing of the airstrip pavement sub-grade to determine suitability for re-use as is or if upgrade of the sub-grade is required for landing the proposed design aircraft (to be confirmed during the design stage).

### 5.3.2 Airfield Buildings

#### 5.3.2.1 Current Condition

The current condition of the two (2) remaining buildings at the airfield is summarised by the following key inspection observations:

- The storage / maintenance shed was in relatively good condition given its age however the base slab appeared to delaminating / spalling in areas and scattered debris / rubbish was observed throughout the shed;
- The derelict WW II building as shown in Figure 8 appeared to be structurally sound and potentially re-usable with some minor repairs and clean-up of debris / rubbish.

#### 5.3.2.2 Recommended Repair Strategy

Arup recommend the following repair strategy for the airfield buildings:
• Clean out all internal rubbish and debris from the storage / maintenance shed and undertake concrete patch repairs or localised replacement of the slab where cracked and delaminated;

• PIPA to investigate potential re-use options for derelict WW II building otherwise Arup recommend to clean out all internal rubbish and debris and retain for heritage value.

5.3.3 Proposed Additional Airport Infrastructure

In addition to the above, Arup recommend that the following infrastructure is also provided at the airport to enable arrival and departure of passengers to the island.

5.3.3.1 Passenger Terminal Building

A small scale passenger terminal building will be required to offer a comfortable waiting/holding area for passengers. The design of the terminal building will need to consider the following as a minimum:

- Shelter from the environment including wind, rain, etc.;
- Capacity to accommodate passengers (equal to capacity of largest proposed aircraft to land at Kanton) to be further discussed by others;
- Appropriate level of seating;
- Natural light and ventilation;
- Optional provision of services including power, lighting, environmentally appropriate toilets (septic or other) facilities and water supply (if possible).

5.3.3.2 Aviation Fuel Storage Facilities

Permanent aviation fuel storage and pump facilities will be required at the airport to service incoming / outgoing aircraft. Provision of these facilities will require consideration of the following logistical factors:

- Aviation fuel will need to be stored in permanent tanks at the airport;
- Aviation fuel will need to be transported by truck (or other means) from fuel storage facilities located at the port;
- Fuel truck will be required on the island to transport fuel from the port to the airfield and to service aircrafts.
5.4    Road Between Port and Airfield

5.4.1    Existing Road

5.4.1.1    Current Condition

The current condition of the existing coral based aggregate pavement road that runs between the airfield and the port (approximately 4.3km) is summarised by the following key inspection observations:

- The coral based aggregate pavement surface was in variable (fair to poor) condition with sporadic localised areas of cracking, potholing and pavement deterioration evident along the length;
- Vegetation was observed to be encroaching in many areas along the side of the road.

5.4.1.2    Recommended Repair Strategy

Arup recommend the following repair strategy for the existing section of road between the port and airfield (Note: the road splits into two from the airport to just south of the Kanton village. Proposed upgrade works are for the eastern road only i.e. road that runs through the village):

- Remove all vegetation and root systems encroaching onto the existing road;
- Design and construct new chip seal overlay for full length of existing road alignment including new line-marking. Note that this option will require further testing of the road pavement sub-grade to determine suitability for re-use as is or if upgrade of the sub-grade is required for the proposed design vehicles (to be confirmed during the design stage).

5.4.2    Failed Causeway

5.4.2.1    Current Condition

Approximately 1km north of the port, a section of the road / causeway failed at some point between Nov 2014 and Jun 2016 based on Google Earth satellite timeline imagery. The failed section of road is approximately 100m long (length along current road alignment) however the channel width narrows to the east of the failure to approximately 50m as illustrated in Figure 10.

5.4.2.2    Recommended Repair Strategy

Arup recommend the following repair strategy for the failed causeway as illustrated in Figure 18 below:

- Clear vegetation and re-align road to the east;
• Design and construct new scour protection at abutments on each bank and ~50m long **single** lane (lowest cost option) bridge to span channel.

• **Note:** An alternative bridge option which should be assessed as part of the options analysis / engineering design phase may be to span the channel by reinstating the causeway incorporating a central drainage channel using precast culverts. This should be assessed further during the design phase based on consideration of factors including constructability, availability of materials, capital cost, etc.

Figure 18: Proposed Rectification Plan Layout for Failed Causeway Section

### 5.5 Pre-Construction Topographic Survey of Existing Island Infrastructure

Prior to design and construction of the proposed upgrade works, it is important to highlight that to enable engineering design and documentation of the proposed works, pre-construction topographic surveys of each of the proposed infrastructure upgrade sites will firstly be required.

It is therefore recommended that topographic surveys be commissioned upfront simultaneously with the hydrographic survey as discussed in Section 5.2.5 for the following existing landside infrastructure sites on the island:

• Port area including vessel slipway / barge ramp;
• Road between port and airfield including the section of failed causeway;
• Airfield.
6 High Level Cost Estimate

6.1 General

High level cost estimates have been compiled by Arup and are presented below in Section 6.3.2 for the repair strategies and options presented and detailed above in Section 5 of this report.

These estimates have been compiled using:

- Arup’s internal database of acquired recent construction rates for similar previous international and local projects including the Kiribati Road Rehabilitation Project (KRRP, 2013) and the Bonriki International Airport Upgrade Project (2015);

- Cost rates and location index factors provided by Australian and Pacific Island based Civil and Marine Contractors.

6.2 Cost Estimate Assumptions

The following assumptions and limitations should be noted when considering these cost estimates:

- The construction costs are high level indicative estimates only based on concept level quantity estimates and 2017 estimated construction cost rates.

- The estimates provided in Table 7 below assume all proposed repair and upgrade works are undertaken concurrently as part of a single construction project managed by one Principal Contractor i.e. the works assume one (1) single mobilisation of all required plant and equipment to Kanton. The estimates do not allow for the proposed works to be undertaken as separate projects by separate Contractors.

- The estimates provided in Table 7 below include provision for the following:
  - All construction related costs including preliminaries (site establishment costs, temporary accommodation for construction staff, mobilisation / demobilisation of plant to the project site), construction equipment, materials and labour costs, contractor profit and overheads;
  - Engineering design fees for design and documentation of repair / upgrade works (7.5% of total construction cost provisional allowance);
  - Contract administration costs including tender document preparation, procurement and site phase management (15% of total construction cost provisional allowance);
  - 40% contingency allowance for unforeseen / unanticipated additional project related expenses in line with the Queensland Department of
Transport and Main Roads Project Cost Estimating Manual guidance for Concept Level stage estimates\(^5\).

- Estimates **do not** include provision for escalation of rates for future planned works i.e. if works are scheduled after FY 17 / 18.
- Estimates **do not** include provision for costs associated with obtaining required statutory permits & approvals;
- Please note, our experience in the past with evaluating construction tenders involving marine works and in preparing cost estimates is that construction works of this type typically vary significantly due to a range of variables such as:
  - the relatively small number of marine & civil contractors capable of undertaking this type of remote work in the Pacific,
  - market fluctuations and current contractor work load,
  - specialist plant availability, risk appetite, etc.

Noting this, it is not uncommon for marine construction tender prices to vary in excess of 100% for the same scope of works.

### 6.3 Proposed Construction Staging

#### 6.3.1 Immediate Island Infrastructure Requirements

It is important to note that Arup’s scope as documented in this report was to inspect and assess the existing Kanton Island infrastructure and provide recommendations on the necessary upgrade works that would be required to enable aircraft and vessel operation and access to the island ports and operational access between these ports.

The cost estimates presented below in Section 6.3.2 assume that the proposed Kanton Island infrastructure upgrade works as presented and detailed above in Section 5 of this report are staged as per the methodology outlined in Table 6.

| Table 6: Proposed Pre-Construction and Construction Staging |
|---|---|---|
| **Stage** | **Infrastructure** | **Arup Report Reference** | **Description** |
| Pre-Construction Stage | | | |
| 1A | Channel & Berth | Section 5.2.5 | Commission hydrographic survey of port & channels into the lagoon |

### 6.3.2 Other Island Infrastructure

It is important to note that the above recommended infrastructure upgrades would comprise the first stage of required infrastructure works and capital spending on the island. Other island infrastructure requirements to enable future proposed development of the island will need to be assessed as part of the future stages of the island’s development. These infrastructure requirements are anticipated to include, but are not limited to:

- Power generation and associated distribution network;
- Communication services;
- Water supply and reticulation services;
- Waste treatment / sewerage services.

| 1B | Existing Landside Infrastructure | Section 5.5 | Commission topographic surveys of the following existing landside infrastructure:
- Port area including vessel slipway / barge ramp;
- Road between port and airfield including failed causeway;
- Airfield. |
| Construction Stage |
| 2 | Vessel Slipway / Barge Ramp | Section 5.2.4 | Undertake design and construction of upgrade works (Option 1 or 2) to the existing barge ramp to enable unloading of construction plant, equipment, materials onto Kanton Island for the proposed upgrade works. |
| 3 | Failed Causeway | Section 5.4.2 | Undertake design and construction of new bridge (piled or culvert type) over section of failed causeway to enable access of construction plant, equipment, materials to airfield & village. |
| 4A | Road Between Port and Airfield | Section 5.4.1 | Undertake simultaneously or staged design and construction of road, port and airfield upgrade works. |
| 4B | Port | Section 5.2 | |
| 4C | Airfield | Section 5.3 | |
Planning and implementation of the above infrastructure will need to be undertaken with consideration of the island’s future population growth, housing requirements, proposed tourism sites, etc.

6.4 Cost Estimate

6.4.1 Immediate Island Infrastructure Requirements

High level cost estimates are presented below in Table 7 for the repair strategies and options presented and detailed in Section 5 of this report and based on the costing assumptions and assumed staging detailed above.

Refer Appendix B for a detailed breakdown of these estimates.

Table 7: High Level Cost Estimate Summary

<table>
<thead>
<tr>
<th>Stage</th>
<th>Infrastructure</th>
<th>Description</th>
<th>Cost Estimate ($AUD)</th>
<th>Arup Recommended ($AUD)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Pre-Construction Stage</strong></td>
<td></td>
</tr>
<tr>
<td>1A</td>
<td>Channel &amp; Berth</td>
<td>Commission hydrographic survey of port &amp; channels into the lagoon</td>
<td>$0.15m</td>
<td>$0.15m</td>
</tr>
<tr>
<td>1B</td>
<td>Existing Landside Infrastructure</td>
<td>Commission topographic surveys of the following existing landside infrastructure: Port area including vessel slipway / barge ramp; Road between port and airfield including failed causeway; Airfield.</td>
<td>$0.15m</td>
<td>$0.15m</td>
</tr>
<tr>
<td></td>
<td><strong>Pre-Construction Stage Sub-total</strong></td>
<td></td>
<td>$0.3m</td>
<td>$0.3m</td>
</tr>
<tr>
<td></td>
<td><strong>Construction Stage</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Vessel Slipway / Barge Ramp</td>
<td>Option 1 – “Do the Minimum” Refer Section 5.2.4 for details.</td>
<td>$0.2m</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Option 2 – “Construct new ramp” Refer Section 5.2.4 for details.</td>
<td>$3.3m</td>
<td>$3.3m</td>
</tr>
<tr>
<td></td>
<td>Failed Causeway</td>
<td>Undertake design and construction of new bridge (piled or culvert) over section of failed causeway. Refer Section 5.4.2 for details.</td>
<td>$11.5m</td>
<td>$11.5m</td>
</tr>
<tr>
<td>---</td>
<td>-----------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------</td>
<td>--------</td>
<td>--------</td>
</tr>
</tbody>
</table>
| 4A | Road Between Port and Airfield | - Remove all vegetation and root systems encroaching onto the existing road;  
    - Design and construct new chip seal overlay for full length of existing road alignment including new line-marking.  
    Refer Section 5.4.1 for details. | $1.8m | $1.8m |
|   | Port Infrastructure | | | |
| 4B | Quayline Upgrade | Option 1 – “Do the Minimum”  
    Refer Section 5.2.1 for details. | $0.9m | - |
|   | | Option 2 – “Targeted Repairs / Replacement”  
    Refer Section 5.2.1 for details. | $7.0m | $7.0m |
|   | | Option 3 – “Full replacement”  
    Refer Section 5.2.1 for details. | $45.4m | - |
|   | Reinforced Concrete Seawall Repairs | Localised concrete patch repairs in the zone where there is exposed vertical reinforcement.  
    Refer Section 5.2.2 for details. | $0.2m | $0.2m |
|   | Jetty | Full demolition and replacement of the jetty with a new floating pontoon and gangway structure.  
    Refer Section 5.2.3 for details. | $3.4m | $3.4m |
|   | Airfield Infrastructure | | | |
| 4C | Airstrip, Taxiways & Terminal Area | Option 1 – “Do the Minimum”  
    Refer Section 5.3.1 for details. | $0.4m | $0.4m |
|   | | Option 2 – “Chip Seal Overlay” | $8.2m | - |
Refer Section 5.3.1 for details.

<table>
<thead>
<tr>
<th>Option 3 – “Asphaltic Concrete Overlay”</th>
<th>$26.4m</th>
<th>-</th>
</tr>
</thead>
</table>

Refer Section 5.3.1 for details.

<table>
<thead>
<tr>
<th>Buildings Upgrade / Repair</th>
<th>Refer Section 5.3.2 for details.</th>
<th>$0.2m</th>
<th>$0.2m</th>
</tr>
</thead>
</table>

Refer Section 5.3.3 for details.

<table>
<thead>
<tr>
<th>Additional Required Infrastructure (Provisional)</th>
<th>Refer Section 5.3.3.1 for details.</th>
<th>$1.9m</th>
<th>$1.9m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passenger Terminal Building</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aviation Fuel Storage</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Refer Section 5.3.3.2 for details.

<table>
<thead>
<tr>
<th>Aviation Fuel Storage</th>
<th>Refer Section 5.3.3.2 for details.</th>
<th>$1.2m</th>
<th>$1.2m</th>
</tr>
</thead>
</table>

**Total Budget Estimate for Recommended Repair & Upgrade Works**  
$31.2m

### 6.4.2 Other Island Infrastructure

Cost estimates for the planning and implementation of future additional infrastructure requirements on the island is not included within the scope of this report. Such estimates will need to be undertaken with consideration of the island’s future population growth, housing requirements, proposed tourism sites, etc.
Conclusion

In May 2017, Arup was commissioned by Reef Ecologic (RE) to undertake inspection and condition reporting of the infrastructure located on Kanton Island in Kiribati.

The inspections included visual assessment and condition reporting on the following:

- Kanton port infrastructure including a steel sheet piled quayline wall, reinforced concrete seawall, steel piled jetty and a concrete vessel slipway;
- Kanton airfield infrastructure and remaining buildings;
- Existing road infrastructure between the port and airfield including a section of road located approximately 1km north of the port that failed at some point between 2014 and 2016 based on Google Earth satellite timeline imagery.

The site observations were undertaken by Arup between the 19th and 23rd June 2017 and were recorded and rated in accordance with the Queensland Department of Transport and Main Roads (DTMR) Structures Inspection Manual condition rating guidelines. Observations for the port infrastructure were compiled using Arup’s in-house Marq Capture iPad software.

In addition, Arup also captured high resolution images at each of the above island infrastructure locations as well as the bird islands and proposed tourist resort location on the southern side of the channel entrance. These images were compiled to produce a panoramic model which provides interactive 360 degree interface of images that capture the current (June 2017) infrastructure layout and condition. The link to this panoramic model is provided in Section 2.1.

A summary of the existing infrastructure details and site inspection findings is detailed in Sections 2 and 3 of this report.

Based on the inspection findings, Section 5 of this report outlines proposed / recommended repair strategies and options for each of the above infrastructure elements as well as suggested additional infrastructure requirements on the island to enable future proposed service and operation of the port and airfield on Kanton.

Section 6 of this report provides high level cost estimates, assumptions and recommended staging for the proposed repair and upgrade works detailed in Section 5. These cost estimates were prepared by Arup based on the following assumptions:

- All proposed repair and upgrade works are undertaken concurrently as part of a single construction project managed by a single Principal Contractor;
- Estimates include provision for all construction related costs including preliminaries (site establishment costs, temporary accommodation for construction staff, mobilisation / demobilisation of plant to the project site), construction equipment, materials and labour costs, contractor profit and overheads;
- Estimates include provision for engineering design fees for design and documentation of repair / upgrade works (7.5% of total construction cost provisional allowance);

- Estimates include provision for contract administration costs including tender document preparation, procurement and site phase management (15% of total construction cost provisional allowance);

- Estimates include provision for a 40% contingency allowance for unforeseen / unanticipated additional project related expenses in line with the Queensland Department of Transport and Main Roads Project Cost Estimating Manual guidance for Concept Level estimates.
Appendix A

Marq Inspection Report (June 2017) - Kanton Port Infrastructure
Kanton Port Infrastructure Inspection

Observation Details

Job Number
256061-00

Address
Kanton Island, Kiribati

Observation Dates
19/06/2017 – 23/06/2017

Conditions of this Proforma
This report was prepared by Arup on behalf of the Client in connection with this project. It takes into account our client's particular instructions and requirements. This report is not intended for, and may not be relied on by, any third party and no responsibility is taken to any third party in relation to it.

Observation: Kanton Port Infrastructure Inspection
Obervation: Kanton Port Infrastructure Inspection
<table>
<thead>
<tr>
<th>Observation Longitude</th>
<th>Observation Latitude</th>
<th>Status</th>
<th>Element</th>
</tr>
</thead>
<tbody>
<tr>
<td>-171.74347563844</td>
<td>-2.80761058442556</td>
<td>Poor</td>
<td>Wall</td>
</tr>
</tbody>
</table>

**Material**
Concrete

**Defect Type**
Cracking (>0.5 mm)

**Quantity**
N / A

**Description**
RC wall generally in fair to poor condition- longitudinal cracking and minor rust staining & spalling evident
<table>
<thead>
<tr>
<th>Observation Longitude</th>
<th>Observation Latitude</th>
<th>Status</th>
<th>Element</th>
</tr>
</thead>
<tbody>
<tr>
<td>-171.714418307107</td>
<td>-2.80767692718916</td>
<td>Fair</td>
<td>Other</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Material</th>
<th>Defect Type</th>
<th>Quantity</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other</td>
<td>Other</td>
<td>2</td>
<td>m²</td>
</tr>
</tbody>
</table>

**Description**

2 x Scour holes behind wall

---

**Observation**: Kanton Port Infrastructure Inspection
### Observation: Kanton Port Infrastructure Inspection

#### A.4

<table>
<thead>
<tr>
<th>Observation Longitude</th>
<th>Observation Latitude</th>
<th>Status</th>
<th>Element</th>
</tr>
</thead>
<tbody>
<tr>
<td>-171.714196186673</td>
<td>-2.80754151754343</td>
<td>Poor</td>
<td>Beam/Girder</td>
</tr>
</tbody>
</table>

**Material**: Concrete  
**Defect Type**: Delamination/Spalling  
**Quantity**: N / A  
**Percentage/Proportion**: 80

**Description**: Significant longitudinal cracking and localised spalling evident in capping beam (channel entrance side)

<table>
<thead>
<tr>
<th>Observation Longitude</th>
<th>Observation Latitude</th>
<th>Status</th>
<th>Element</th>
</tr>
</thead>
<tbody>
<tr>
<td>-171.714211777013</td>
<td>-2.80754684005194</td>
<td>Very Poor</td>
<td>Other</td>
</tr>
</tbody>
</table>

**Material**: Steel  
**Defect Type**: Corrosion  
**Quantity**: 6  
**Unit**: No.  
**Percentage/Proportion**: 100

**Description**: All mooring bollards along wharf in very poor condition & require replacement
Observation: Kanton Port Infrastructure Inspection

A.5

Observation Longitude: -171.714168945487
Observation Latitude: -2.80740350950771
Status: Very Poor
Element: Other

Material: Steel
Defect Type: Corrosion
Quantity: 1
Unit: No.

Description:
Hydrant in very poor / derelict condition – recommend removal (if pavement area required for loading / unloading of vessels) or alternatively, if not, retain for heritage value.

A.6
<table>
<thead>
<tr>
<th>Observation Longitude</th>
<th>Observation Latitude</th>
<th>Status</th>
<th>Element</th>
</tr>
</thead>
<tbody>
<tr>
<td>-171.714182859447</td>
<td>-2.80754399020486</td>
<td>Fair</td>
<td>Deck/Slab</td>
</tr>
</tbody>
</table>

**Material**: Other  
**Quantity**: N/A  

**Description**  
Coral based aggregate pavement surface generally in fair to good condition – alligator cracking evident in areas

---

<table>
<thead>
<tr>
<th>Observation Longitude</th>
<th>Observation Latitude</th>
<th>Status</th>
<th>Element</th>
</tr>
</thead>
<tbody>
<tr>
<td>-171.714165592726</td>
<td>-2.80736918561422</td>
<td>Poor</td>
<td>Beam/Girder</td>
</tr>
</tbody>
</table>

**Material**: Concrete  
**Defect Type**: Delamination/Spalling  
**Quantity**: N/A  
**Percentage/Proportion**: 100%

**Description**  
Significant longitudinal cracking and localised rust staining and spalling evident in wharf capping beam (berthing face)

---

**Observation**: Kanton Port Infrastructure Inspection
### A.8

**Observation Longitude**  
-171.714217979621

**Observation Latitude**  
-2.80714664608502

**Status**  
Fair

**Element**  
Other

**Material**  
Steel

**Defect Type**  
Corrosion

**Quantity**  
7

**Unit**  
No.

**Description**  
Fuel tanks (stainless steel) still in fair condition - only tea staining evident on outer surface - may be possible to re-use for fuel storage. Chassis and axles (steel) in very poor condition.
### Observation

**Kanton Port Infrastructure Inspection**

<table>
<thead>
<tr>
<th>Observation Longitude</th>
<th>Observation Latitude</th>
<th>Status</th>
<th>Element</th>
</tr>
</thead>
<tbody>
<tr>
<td>-171.714227534991</td>
<td>-2.80706990976148</td>
<td>Very Poor</td>
<td>Other</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Material</th>
<th>Defect Type</th>
<th>Quantity</th>
<th>Percentage/Proportion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steel</td>
<td>Corrosion</td>
<td>N/A</td>
<td>100</td>
</tr>
</tbody>
</table>

**Description**

Bulk liquid bowser in very poor / derelict condition – recommend removal (if pavement area required for loading / unloading of vessels) or alternatively, if not, retain for heritage value.
### Observation

**Kanton Port Infrastructure Inspection**

<table>
<thead>
<tr>
<th>Observation Longitude</th>
<th>Observation Latitude</th>
<th>Status</th>
<th>Element</th>
</tr>
</thead>
<tbody>
<tr>
<td>-171.714382097285</td>
<td>-2.80656263698154</td>
<td>Poor</td>
<td>Wall</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Material</th>
<th>Defect Type</th>
<th>Quantity</th>
<th>Percentage/Proportion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete</td>
<td>Delamination/Spalling</td>
<td>N / A</td>
<td>30</td>
</tr>
</tbody>
</table>

**Description**

Significant longitudinal cracking and localised spalling evident in return wall / steel pile capping (northern face) and face adjacent to jetty.
**Observation Longitude**  
-171.714365836393

**Observation Latitude**  
-2.80655086040758

**Status**  
Poor

**Element**  
Other

**Material**  
Other

**Defect Type**  
Other

**Quantity**  
N/A

**Description**  
3 scour holes in pavement behind wall suggest material is being lost through the wall ie. suggests holes may be present in the sheet pile face

**Observation:** Kanton Port Infrastructure Inspection
<table>
<thead>
<tr>
<th>Observation Longitude</th>
<th>Observation Latitude</th>
<th>Status</th>
<th>Element</th>
</tr>
</thead>
<tbody>
<tr>
<td>-171.714522410344</td>
<td>-2.80650643632077</td>
<td>Poor</td>
<td>Other</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Material</th>
<th>Defect Type</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steel</td>
<td>Corrosion</td>
<td>N / A</td>
</tr>
</tbody>
</table>

**Description**
Jetty in poor condition - gangway missing, timber deck largely missing and superstructure elements weathered and cracked. 3 x Steel H beam piles and cross head beams heavily corroded. H-pile fenders severely corroded above water line.
<table>
<thead>
<tr>
<th>Observation Longitude</th>
<th>Observation Latitude</th>
<th>Status</th>
<th>Element</th>
</tr>
</thead>
<tbody>
<tr>
<td>-171.714452756729</td>
<td>-2.80643498059624</td>
<td>Poor</td>
<td>Wall</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Material</th>
<th>Defect Type</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete</td>
<td>Cracking (&gt;0.5 mm)</td>
<td>N / A</td>
</tr>
</tbody>
</table>

**Description**
RC wall generally in fair to poor condition- longitudinal and vertical cracking and rust staining evident
<table>
<thead>
<tr>
<th>Observation Longitude</th>
<th>Observation Latitude</th>
<th>Status</th>
<th>Element</th>
</tr>
</thead>
<tbody>
<tr>
<td>-171.71437824161</td>
<td>-2.80637525953614</td>
<td>Poor</td>
<td>Pile</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Material</th>
<th>Defect Type</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steel</td>
<td>Corrosion</td>
<td>100</td>
</tr>
</tbody>
</table>

**Description**
Widespread severe corrosion of sheet piles evident above water line

---

<table>
<thead>
<tr>
<th>Observation Longitude</th>
<th>Observation Latitude</th>
<th>Status</th>
<th>Element</th>
</tr>
</thead>
<tbody>
<tr>
<td>-171.71437824161</td>
<td>-2.80637525953614</td>
<td>Fair</td>
<td>Deck/Slab</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Material</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete</td>
<td>N / A</td>
</tr>
</tbody>
</table>

**Description**
Existing boat ramp / vessel slipway slab in fair condition given age.

---

**Observation:** Kanton Port Infrastructure Inspection
<table>
<thead>
<tr>
<th>Observation Longitude</th>
<th>Observation Latitude</th>
<th>Status</th>
<th>Element</th>
</tr>
</thead>
<tbody>
<tr>
<td>-171.714832959857</td>
<td>-2.80620921403431</td>
<td>Poor</td>
<td>Deck/Slab</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Material</th>
<th>Defect Type</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other</td>
<td>Other</td>
<td>N / A</td>
</tr>
</tbody>
</table>

**Description**
Accretion of coral debris at base of ramp - requires removal. Ramp continues down to approx MLLW but slab appears to be broken up at toe. A lot of debris on seabed around toe and seaward of toe.

---

**Observation:** Kanton Port Infrastructure Inspection
<table>
<thead>
<tr>
<th>Observation Longitude</th>
<th>Observation Latitude</th>
<th>Status</th>
<th>Element</th>
</tr>
</thead>
<tbody>
<tr>
<td>-171.71477118523</td>
<td>-2.80624081380927</td>
<td>Poor</td>
<td>Scour Protection</td>
</tr>
</tbody>
</table>

**Material**
Other

**Quantity**
N / A

**Description**
No scour protection on slipway edges - recommend grouted rock pitching be installed as part of barge ramp upgrade works.

---

A.18

<table>
<thead>
<tr>
<th>Observation Longitude</th>
<th>Observation Latitude</th>
<th>Status</th>
<th>Element</th>
</tr>
</thead>
<tbody>
<tr>
<td>N / A</td>
<td>N / A</td>
<td>Poor</td>
<td>Wall</td>
</tr>
</tbody>
</table>

**Material**
Concrete

**Defect Type**
Corrosion

**Quantity**
N / A

**Description**
Exposed vertical reinforcement in wall exhibiting significant corrosion in tidal zone

---

**Observation:** Kanton Port Infrastructure Inspection
### A.19

<table>
<thead>
<tr>
<th>Observation Longitude</th>
<th>Observation Latitude</th>
<th>Status</th>
<th>Element</th>
</tr>
</thead>
<tbody>
<tr>
<td>-171.717019630756</td>
<td>-2.777813673022</td>
<td>Poor</td>
<td>Pile</td>
</tr>
</tbody>
</table>

**Material**
Steel

**Defect Type**
Corrosion

**Quantity**
N / A

**Description**
Sheet piles exhibiting significant corrosion in splash zone. Timber fenders / walers missing on corner. Where timber is still in place, most is severely weathered, missing or cracked / broken and steel rods protrude which would cause damage to a berthing / moored ship

---

### A.20

---

**Observation:** Kanton Port Infrastructure Inspection
### Observation

**Kanton Port Infrastructure Inspection**

<table>
<thead>
<tr>
<th>Observation Longitude</th>
<th>Observation Latitude</th>
<th>Status</th>
<th>Element</th>
</tr>
</thead>
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<td>-171.717056846406</td>
<td>-2.77745136525741</td>
<td>Poor</td>
<td>Pile</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Material</th>
<th>Defect Type</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steel</td>
<td>Corrosion</td>
<td>N / A</td>
</tr>
</tbody>
</table>

**Description**

Sheet piles along berth face are exhibiting significant corrosion in splash zone. Timber fenders / walers missing in places. Where timber is still in place, most is severely weathered, missing or cracked / broken and steel rods protrude which would cause damage to a berthing / moored ship.

---

A.21

<table>
<thead>
<tr>
<th>Observation Longitude</th>
<th>Observation Latitude</th>
<th>Status</th>
<th>Element</th>
</tr>
</thead>
<tbody>
<tr>
<td>-171.717099175017</td>
<td>-2.7773659955736</td>
<td>Poor</td>
<td>Pile</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Material</th>
<th>Defect Type</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steel</td>
<td>Other</td>
<td>N / A</td>
</tr>
</tbody>
</table>

**Description**

Multiple holes observed in sheet pile face at bottom waler / anchor tie rods level (approx. Mean Low Water Neap (MLWN) level) likely allowing backfill material to escape through wall.

**Observation:** Kanton Port Infrastructure Inspection
<table>
<thead>
<tr>
<th>Observation Longitude</th>
<th>Observation Latitude</th>
<th>Status</th>
<th>Element</th>
</tr>
</thead>
<tbody>
<tr>
<td>-171.717139994886</td>
<td>-2.77729395311584</td>
<td>Poor</td>
<td>Pile</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Material</th>
<th>Defect Type</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steel</td>
<td>Other</td>
<td>N / A</td>
</tr>
</tbody>
</table>

**Description**

2 sheet piles driven out of alignment are protruding up to low water level currently making berthing not possible on this face.
Appendix B

High Level Cost Estimate
Breakdown
### Pre-Construction Stage

<table>
<thead>
<tr>
<th>Unit Rate ($ AUD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>150,000</td>
</tr>
<tr>
<td>150,000</td>
</tr>
<tr>
<td>100,000</td>
</tr>
</tbody>
</table>

### Construction Stage

<table>
<thead>
<tr>
<th>Quotation</th>
<th>Quay Ramp- Quantities</th>
<th>Airfield- Quantities</th>
<th>Road Upgrade- Quantities</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pavement</td>
<td>Terminal Building</td>
<td>Fuel Storage</td>
</tr>
<tr>
<td></td>
<td>Option 1</td>
<td>Option 2</td>
<td>Option 1</td>
</tr>
<tr>
<td>Quay Ramp</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hydrographic Survey</td>
<td>152.5</td>
<td>152.5</td>
<td>152.5</td>
</tr>
<tr>
<td>Topographic Survey</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Sub-total</td>
<td>300.00</td>
<td>300.00</td>
<td>300.00</td>
</tr>
<tr>
<td>RC Wall</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jetty</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Buildings</td>
<td></td>
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</tr>
<tr>
<td>Terminal Building</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Fuel Storage</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Sub-total</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Quayline Upgrade Works</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Remove existing timber fenders / walers</td>
<td>312.5</td>
<td>312.5</td>
<td>312.5</td>
</tr>
<tr>
<td>Remove existing mooring bollards</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Install new mooring bollards</td>
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<td>10</td>
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<tr>
<td>Sub-total</td>
<td>432.00</td>
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<td>432.00</td>
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<tr>
<td>Admiral Pile Wall</td>
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</tr>
<tr>
<td>Demolish existing jetty</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Install new floating pontoon and gangway</td>
<td>1,650.00</td>
<td>1,650.00</td>
<td>1,650.00</td>
</tr>
<tr>
<td>Sub-total</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Jetty Upgrade Works</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Remove coral debris at base of ramp</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Construct new pavement link at top of ramp to existing road</td>
<td>250</td>
<td>250</td>
<td>250</td>
</tr>
<tr>
<td>Install new barge ramp reinforced concrete slab and scour protection (sides &amp; toe) over existing barge ramp</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Sub-total</td>
<td>1,650.00</td>
<td>1,650.00</td>
<td>1,650.00</td>
</tr>
<tr>
<td>Airfield Runway, Taxiways &amp; Terminal Upgrade Works</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Remove all vegetation and root systems encompassing entire area of taxiways and taxiways</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Clean up and removal of building debris, rubbish, etc. (Provisional)</td>
<td>5950</td>
<td>5950</td>
<td>5950</td>
</tr>
<tr>
<td>Milling, texturizing and construction of new asphaltic concrete overlay for existing pavement</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Provision for line marking</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Sub-total</td>
<td>70,000</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Airfield Runway, Taxiway &amp; Terminal Upgrade Works</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Install / construct new passenger terminal building</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

| Sub-total | (71,300) | (71,300) | (71,300) | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |

### Road Upgrade

<table>
<thead>
<tr>
<th>Road Upgrade- Quantities</th>
<th>Quayline Barge Ramp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pavement</td>
<td>N/A</td>
</tr>
<tr>
<td>Terminal Building</td>
<td>N/A</td>
</tr>
<tr>
<td>Fuel Storage</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Sub-total: $105,000.00
## Installation/Construction of New Aviation Fuel Storage & Pump Facilities
- **Total cost:** $900,000.00

## Existing Road Upgrade Works
- **Total cost:** $894,187.50

## Initial Causeway Upgrade Works
- **Total cost:** $5,537,500.00

## Design
- **Total cost:** $5,957,500.00

## Grand Total Construct Estimate
- **Total cost:** $9,052,093.40

### Conversion to USD
- **Total cost:** $6,728,268.99

### Conversion to Pounds Sterling
- **Total cost:** £3,881,489.86