Arthurs Vale Creek Fencing and Rehabilitation Project 2020

Summary of project methodology and delivery

June – September 2020

s 22(1)(a)(ii) - Commonwealth Heritage Manager

Contents

1.1 Project Initiation

A project was required to enable conservation and environmental improvement to the main watermill creek running through Arthurs Vale from the Mill Dam to Pier Street Bridge, feeding into the Kingston Common and marsh before flowing into Emily Bay. The creek has suffered extensive damage and erosion from cattle. More recently the creek has been the subject of pollution concerns.

The Conservation Landscape Masterplan 2019, 6.2.2. calls for us to;

"*Revegetate creeks to enhance ecological diversity and water quality."*

"Revegetate Watermill creek and the drainage channels in Kingston Common to improve water quality.

1.2 Location

1.KAVHA site at Kingston Norfolk Island – Creek and works are located in Area M

2.Water Mill Creek course since 1935 to the present running from Water Mill Dam through Kingston and under Pier Street Bridge showing fence line in red

1.3 Historical Context

The agricultural area at Arthurs Vale is of high significance. The area was settled from 1788 after the arrival of Lt. Phillip Gidley King and convict settlers and marines from Port Jackson, just weeks after the landing of the First Fleet in Australia. Arthurs Vale was cleared and used for agricultural production within weeks of the founding of the new colonial settlement. This marks Arthurs Vale out as one of the earliest surviving Australian agricultural landscapes. It is still in use for agricultural activity today as it was in the 18th Century.

A section of the channel stream still runs on its 1790s alignment today and can be seen along with a faint field boundary system, as in George Raper's 1790s map. The map shows the Government farm, field boundaries and plantations in the valley. The remains of the convict built road and causeway cross from the south to north of the valley across the creek.

Arthurs Vale area retains many of the aspects of the earlier pastoral landscape and is significant as a surviving early Australia agricultural landscape still presented and used by livestock as it was in the 1780s. Its conservation and management is a key priority within the 2019 Conservation Landscape Masterplan

3.Maintenance using hand tools in the 1930s

Historically the creek through Arthurs Vale was maintained as a relatively narrow culvert. The creek was cleared using hand tools as seen in the photograph above thought to date from the inter war period. Location of this image is the lower section of creek running down to Pier Street with the Commissariat Store in the background and Government House seen on its promontory in the distance.

1.4 Objective

Cattle currently roam freely through Kingston and the KAVHA site.

Cattle on Norfolk are licensed to individual owners but they herd together across the public open spaces and verges on island with their movement largely unchecked. Kingston including Arthurs Vale and Kingston Common contains one of the largest open grazing areas on the island.

The recent drought event in 2019 and early 2020 demonstrated the extent to which KAVHA watercourses provide one of the few open sources of water on island for livestock. Rainfall in

January was just 3mm and the lowest on record for Norfolk Island. The erosion of the creek banks and beds has become extensive and uncontrolled as cattle access the creek for water. The water course is also suffering additional pollution impact from cattle access to the creek bed. The lack of alternative water sources such as water troughs in an area with free roaming cattle is also a significant issue. Current use is not sustainable.

Livestock management and access issues needed to be addressed alongside conservation requirements for the creek and valley outlined in the CMP 2019.

1.5 Methodology and Construction

Funding was secured at year end and Department of Environment, Marine Parks also contributed funding support to ensure the creek was secured from livestock and rehabilitated as part of measures to restrict contamination of the Marine Park environment. The fencing work was subject to competitive contract tender on island.

A timber post and wire fence was specified to restrict cattle access to the creeks and waterways of the Arthurs Vale area. The 2016 Heritage Management Plan 8.2.2 supports the intervention, stating;

"*The introduction of additional fencing will be avoided, except where fencing or walling is required for conservation….*"

The timber wire strainer posts chosen are manufactured for our use on Norfolk Island are radially split harvested and seasoned native hardwood timber. In their triangular cross section and roughhewn appearance, they resemble metal wedge and axe spit timber posts that would have been commonly used in the KAVHA area historically.

The main straining posts are round native hardwood with a traditional notched timber brace.

The site was walked by the contractor, KAVHA works Manager and the Conservation Manager and the post holes set out to minimise impact on the landscape as much as practical and to avoid known features of the landscape.

The posts are set within 500mm deep radially bored post holes along the edge of the creek set approximately 5m from the creek centre line. Further up the Creek this distance has been extended to allow for a greater planting of endemic flora species to the margins of the waterway.

The excavations proceeded carefully under inspection by the Commonwealth Heritage Manger and the KAVHA works Manager.

Post holes were all dug mechanically due to the known soil conditions and depth of deposited soil over earlier archaeological layers. The soil uncovered through to 500mm at every excavation point is friable alluvial sediment and clays deposited in a uniform layer as a result of regular flooding events in the valley.

1.6 Record of Site works and Archaeology

4.Uniform alluvial soil with clay like constituency when compressed

With two exceptions there was no evidence seen of field working (ploughing) or historical agriculture activity, nor any artefacts or inclusions within a uniform layer of rich agricultural topsoil.

The only exceptions were the two post holes at the midpoint of the valley adjacent to the old convict road crossing from south to north, post four and post five from the middle concrete bridge parapet to the west, at David (Didds) Evans access road. These two holes carried no finds, but the soil did contain some small loose stone and aggregate material consistent with the causeway although in no discernible layers. (see image This was all that was the most that was uncovered in the post holes.

5. Post 5 lower creek west showing very small mortar stone, bedding over old causeway crossing

1.7 Record of Fencing Installation

The fencing was strained with electrified cable as a stock fence. The whole fence design has been provided to allow rehabilitation of the creek and ultimate removal should that be required.

6.Lower Creek drainage channel fenced and gated

Access gates have been provided to allow for maintenance of the creek bank, stream bed and endemic planting.

7.main channel to Pier Street showing widening from original interwar photograph

Bottom section of Arthurs Vale to Pier Street the day of completion 14/9/20 Photograph shows erosion of the bank and weed infestation including water hyacinth.

8.Installation of the radially cut traditional posts for the fence.

9.Uniform alluvial soils in post holes

All post holes demonstrate the thickness and uniformity of the alluvial topsoil. No stone was encountered during the excavation of post holes. No stratigraphy or layers were noticeable within the post hole edges.

The final straight run of post holes at Windmill Creek into Pier Street Bridge were all waterlogged at the time of excavation. Holes were uniformly holding water at 300mm depth. Posts were bedded in a weak dry concrete mix due to conditions to ensure stability and longevity.

10. Cattle Trough at Pier Street on caste base

A shallow depression was created to take a caste 4m x 3m concrete slab located on the edge of the common behind the pier Street causeway stone parapet.

Excavation was minimal encountering surface tree roots and turf sward and no finds were recorded. The slab was reinforced and can be lifted and removed if required. Tanks are pre-caste and can also be removed. Water connection was supervised by the SDA manager to an existing water supply on Pier Road.

11. At the midpoint of the Valley adjacent to the bridge and roadway to David (Didds) Evans farm, the Creek Boundary is already showing evidence of growth with the restriction of grazing.

12.Misdpoint of creek at access road fencing installed looking south

13. Top section of Creek below Water Mill Dam, Fence line with newly planted endemic plants sources from the National Park Nursery.

14. Ongoing erosion of banks by cattle accessing the creek for water, damage exacerbated by storm water flow scour, increasing the depth of the creek bed and further eroding its banks

15.Fencing of drainage tributary upper area of creek near dam showing native planting

1.8 Summary

Fencing installation was completed on 14th September 2020. The fence is doing the job it was intended to do with early indications that cattle area now excluded, sufficiently watered and endemic species are now regenerating.

Endemic species planting will continue through early spring with wedding and watering ongoing to ensure establishment.

Installation of leaky weirs will be undertaken by KAVHA team during Spring and Summer as the creek bed dries out due to contamination concerns for staff working in proximity to the creek water.

Recent flood events have shown high levels of coliforms and pollutants associated with failing sewage systems. This is a problem being rectified within KAVHA but one which requires governmental intervention and funding outside of the KAVAH area but within its catchment. This work is currently being investigated with a long term upgrade to the Island sewage system being scoped for costing and delivery.

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Department of Infrastructure, Transport, Regional Development, and Communications

27 October 2020

Kingston and Arthurs Vale Historic Area: Safety Investigation Works

Design Report

Kingston and Arthurs Vale Safety Investigation Works

Design Report

Client: Department of Infrastructure, Transport, Regional Development and Communications

ABN: 86 267 354 017

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27-Oct-2020

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Quality Information

Document	Kingston and Arthurs Vale Historic Area: Safety Investigation Works
Ref	60615424
Date	27-Oct-2020
Prepared by	s 47F
Reviewed by	s 47F

Revision History

Rev	Revision Date	Details	Authorised	
			Name/Position	Signature
A	05-Dec-2019	Draft for Review	s 47F	
B	03-Feb-2020	Draft for Review		
C	06-May-2020	Draft for Review		
D	05-June-2020	Final Issue		
E	26-August-2020	Final Issue – REO (Southern Column) steel rod solution added		
F	27-October-2020	Final Issue – Civil Hospital (Timber Option)		

Table of Contents

Introduction

Structure of this Report

The Project outputs are documented in two Reports, this Design Report, and a Cost Estimate Report. Figure 1 identifies the report hierarchy.

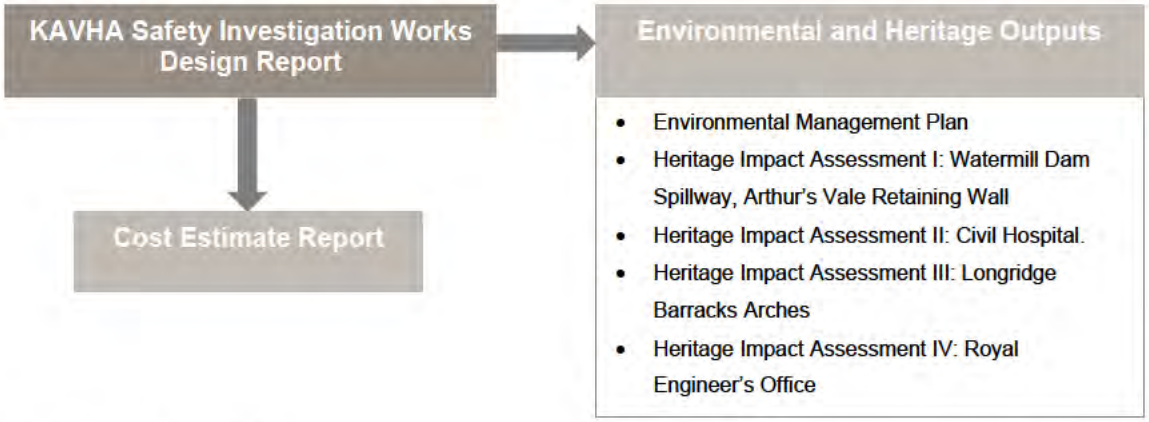


Figure 1. Report Hierarchy

The remainder of the project outputs is structured to include an Environmental Management Plan and Heritage Impact Assessments for the following sites: Civil Hospital, Arthur's Vale Retaining Wall, Royal Engineer's Office (REO) Entry Portico, Longridge Barracks Arches, and the Watermill Dam Spillway.

Project Overview

Following receipt of the Kingston and Arthur's Vale Historic Area Safety Hazard Scoping Study Draft Report (GML, May, 2018), AECOM Australia Pty Ltd (AECOM) were commissioned by the Department of Infrastructure, Transport, Regional Development and Communications (DITRDC) to develop a 50% design report (AECOM 2018) to support the delivery of design work to address a number of the "very high risk" structural hazards identified in the GML Draft Report. As a follow on to that commission AECOM has been engaged to develop tender level design for five of the six sites with the Bounty Street Bridge works being developed to Concept Level.

This report outlines AECOM's approach, methodology, and findings including design work to a tender level of detail accompanied by a P80 level cost estimate for the five sites and the concept work for Bounty Street Bridge as summarised in Table 1.

Site inspections were undertaken by experienced engineers and remediation option(s) have been provided and summarised in the table below for the individual sites.

The Watermill Dam Spillway was added to the scope of design works but is not a priority safety hazard. As such it is understood that the mitigation measures may be considered as part of future projects.

Table 1 Recommended mitigation measures

Location	Issue	Recommended Mitigation Measures
Civil Hospital	Unstable gable wall structure and signs of cracking.	OPT-01 – Install composite timber and steel bracing to the inside of the two gable ends. OPT-02 – Install structural timber roof framing and columns to depict the original roof profile. Connect the framing back to the existing gables as required and fully brace.

Location	Issue	Recommended Mitigation Measures
		OPT-03 – Reroof the building. This is an option for cost comparison and is not supported by heritage advice.
Arthur's Vale Retaining Wall	Lateral movement, rotation of wall, horizontal cracks.	Exclude vehicles from the rear of the wall (Complete). Install earth bunding to the upstream side of the retaining wall to redirect stormwater flows, subject to stream water flows. Install subsoil drains, eco pits and refurbish the exiting scupper drains to discharge into Watermill Creek.
Bounty Street Bridge	Structural issues such as tilting, cracking, settlement and sedimentation.	Temporarily close the bridge to vehicular traffic (Complete). Provide coffer dams up and down stream of the bridge subject to stream flows to enable inspections (Complete). Dewater the works area between the coffer dams and undertake engineering and geotechnical inspections (Complete). Undertake the works in parallel with the lowering of the water level within the Watermill Dam spillway works. This will manage the flows into/at the coffer dams (N/A).
Longridge Barracks Arches	Structural issues (tilting/cracking), foundation overstress	Install structural bracing columns to the rear of the arches to resist wind and earthquake forces. Install supporting foundations to underpin the existing foundations.
Royal Engineer's Office (REO) Entry Portico	Structural cracks, rotation of the Portico to the west (away from the main structure) and decayed northern column capital and stone base of the REO Portico.	Deconstruct and rebuild the portico roof after tying the gable back to the rear of the portico. Removal of the existing timber props after the southern column has been strengthened by inserting a steel rod through the column core. Replacing the eroded capping stone on the northern column and rectifying displaced stonework adjacent the REO entry doorway.
Watermill Dam Spillway	Water passing under the base slab of the spillway with associated risk of scour and erosion. Silting of the dam. Erosion of the rendered upstream face of the dam wall.	Dewater/ lower the water in the dam to allow for desilting and spillway remediation works. Install a low flow pipe so that the spillway is not continuously in use. Install a concrete cut off wall at the top end of the spillway to prevent further water ingress under the spillway slab. Apply a new render coating to the upstream dam face. Consider scour protection measures at the spillway discharge point subject to funding.

Kingston and Arthur's Vale Historic Area is listed on the World Heritage List (WHL), National Heritage List (NHL), Commonwealth Heritage List (CHL) and the Norfolk Island Heritage Register (NIHR) (Table 2). WHL, NHL and CHL places are all protected under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), while the NIHR places are protected under the *Norfolk Island Heritage Act 2002*. Consequently, works to elements within KAVHA, including the Civil Hospital, Retaining Wall, Bounty Street Bridge, REO and Watermill Dam, need to be managed in accordance with national and local legislation.

The Longridge Arches are located out of the WHL KAVHA area but is separately identified on the CHL and under the *Norfolk Island Heritage Act 2002*.

In Australia, best practice principles for meeting heritage management requirements are provided by the *Australia ICOMOS Charter for Places of Cultural Significance, The Burra Charter*, 2013 (Burra Charter) (ICOMOS (Australia), 2013). Further guidance for the WHL Kingston and Arthur's Vale Historic Area (KAVHA), is provided by the *Kingston and Arthur's Vale Historic Area Heritage Management Plan* (HMP) prepared by Godden Mackay Logan (GML) in 2016 (Godden Mackay Logan Pty Ltd, 2016). Additionally, the draft *Kingston and Arthur's Vale Historic Area (KAVHA) Archaeological Zoning and Management Plan* (Extent Heritage Pty Ltd, 2019) has been consulted when considering the potential archaeological impacts.

These management documents were used to provide a preliminary assessment of the heritage risk posed by the proposed works, and to formulate potential management measures. In addition to the potential management measures provided for each scope of work, it is recommended that the Department develop and implement an interpretation/communication strategy during the approvals and construction phase. The aim of the interpretation/communication strategy would be to communicate to visitors and the local community the positive heritage outcomes associated with the conservation works.

Table 2 Summary heritage listings

Place	WHL	NHL	CHL	NIHR
Kingston and Arthur's Vale Historic Area	106209	105962	105606	Listed
Longridge Arches	Not listed	Not listed	105623	Listed

1.0 Engineering Design Basis

1.1 Engineering Services Scope

The engineering scope and provisions consist of the remediation and construction to supporting elements to the nominated structures within the KAVHA precinct. The works pertaining to the structural design includes the:

- Bounty Street Bridge – settlement and remediation;
- Royal Engineer Office – Portico structure stability;
- Civil Hospital – Gable stability and support;
- Arthurs Vale Retaining Wall – drainage and stormwater redirection;
- Watermill Dam – spillway remediation and desilting; and
- Longridge Arches – installation of support columns and foundations strengthening.

1.2 Standards and Regulatory Requirements

The structures shall be designed in accordance with the following regulations and Australian and New Zealand Standards.

1.2.1 Australian Standards

Table 3: Australian Standards

Ref No.	Title / Description
Standards	
Nation Construction Code Series	Building Code of Australia Class 2 to Class 9 Buildings
AS/NZS 1170.0:2002	Structural design actions - Part 0: General principles
AS/NZS 1170.1:2002	Structural design actions - Part 1: Permanent, imposed and other actions
AS/NZS 1170.2:2002	Structural design actions - Part 2: Wind actions
AS 1170.4-2007	Structural design actions - Part 4: Earthquake actions in Australia
AS 1397-2011	Continuous hot-dip metallic coated steel sheet and strip - Coatings of zinc and zinc alloyed with aluminium and magnesium
AS 2159-1995	Piling - Design and installation
AS 3600-2018	Concrete structures
AS 3700-2001	Masonry structures
AS 4100-1998	Steel structures
AS 4678-2002	Earth-retaining structures

1.3 Design Criteria

1.3.1 Design Approach

The proposed elements to support the existing structures are designed with due consideration to several key criteria:

- Cost and economy of construction;
- Accessibility of materials required for construction;
- Use of material and construction types to minimise construction program and maximise off site fabrication;
- Use of local materials and labour where reasonably practical and where it presents value for money;
- Adaptability and suitability of the selected construction methodologies to each of the sites including soil salinity, coastal and varying geotechnical profiles and cyclonic/ seismic loading;
- Readily adaptable to future maintenance or requirements for modifications/additions; and
- Consider durability requirements of materials and finishes.

1.3.2 Loading Criteria

The minimum design loadings used for this project are described in sections 1.3.2.1 and 1.3.2.2.

1.3.2.1 Wind Loading Criteria

The following criteria, taken from the Australian Standard AS 1170.2-2007: Structural design actions - Part 2: Wind actions, have been used to determine the site-specific wind loads:

- Importance Level: 2 (Normal structure);
- Return Period: 1:100 years;
- Design Life: 50 years (for new works);
- Wind Region B (Norfolk Island);
- Terrain Category: 2;
- Topographical multiplier (Mt): 1;
- Shielding (Ms): 1;
- Ultimate design wind speed (Vu): 48 (m/sec); and
- Serviceability design wind speed (Vs): 37 (m/sec).

It is not considered necessary for any detailed wind studies to be carried out.

1.3.2.2 Earthquake Loading Criteria

In addition to the wind loading criteria, the supporting elements have been designed for earthquake loading commensurate to the location and susceptibility for the site.

Importance Level 2 (normal structure) has been adopted for the existing structures.

The following criteria, taken from the Australian Standard AS 1170.4-2007: Structural design actions - Part 4: Earthquake Actions in Australia have been used to determine the site-specific earthquake requirements as follows:

- Importance Level: 2; and
- Height of structure <12m.

This criterion results in an Earthquake design category I which is the lowest design category provided in the Standard.

1.3.3 Durability

The exposure classification used for designing structural durability in accordance with the relevant Australian standards is as follows:

- External: B2 (Coastal - within 1km of the coast);
- Piles and Footings: Subject to geotechnical advice though assumed as “non-aggressive”; and
- Timber: In exposed conditions timber will require replacement during the nominal 50-year design life.

2.0 Civil Hospital

2.1 Engineering Proposals

2.1.1 Scope of Works

The requirement is to stabilise the gable walls of the ruin against reasonably foreseeable wind and seismic loads. Options have been developed that achieve this outcome with a range of complexities, costs and heritage outcomes and these are described in the following sections.

2.1.2 Option 1 - Diagonal Timber Braces

This option involves installing simple diagonal timber braces against the gable walls. The braces would be supported on mass concrete footings poured on top of the existing ground surface to minimise impact on below ground archaeological deposits.

Similar braces have been used on Quality Row to brace lower height walls as shown in Figure 2.

The construction uses large format timber sections and galvanised steel connector plates. The plates would be supplied from the mainland but the timbers could be locally sourced subject to value management of cost versus life span. Any eventual timber replacement would involve unbolting and replacement without the need for temporary propping or specialist skills.

Consideration was given to using steel braces similar to what have been proposed for the Longridge Arches but as these require intrusive footings the option was not developed for the Civil Hospital site due to archaeological constraints.

Figure 2 Existing timber braces on Quality Row.

2.1.3 Option 2 – Roof Outline

This option involves constructing the outline of the original roof profile and using that to brace the walls. No roof cladding is proposed, and the roof outline would consist of major roof timbers only. The structural framing would not necessarily mimic the original construction but would follow the profile of the original roof. It would be an evolution from Option1 in that it would provide a level of interpretation of the original building as opposed to a utilitarian wall brace and because of this is the preferred option with project stakeholders.

An example of a similar system is shown below in Figure 3.

The more complex shapes in this option would require a higher level of construction skill than Option 1. A timber and a structural steel version were evaluated, and the timber version was chosen for a number of reasons including availability of materials and local trades. In the cost report the timber version is referred to as option 2B and the steal version is referred to as option 2. Maintenance would

require some scaffolding for access and the appropriate trade skills, but not specialist trades or equipment.

Figure 3 Wall bracing that interprets the original form

2.1.4 Option 3 – Reroofing

This option involves reroofing the building with a roof that closely matches the original form and uses materials that are agreed from a heritage perspective. It is understood that the building may have been roofed with thatch, shingles and corrugated sheeting at various times and this option would require the selection of a roof type that best matched the heritage interpretation desired for the reconstruction. Some work would probably be required to the stonework to facilitate a reroofing approach.

This option has been developed for a cost comparison exercise however engineering details have not been prepared.

2.2 Heritage Considerations

2.2.1 Background and significance

The Civil Hospital was built on the foundations of a First Settlement building. From 1830 until around 1832, the hospital was appropriated as a residence for the Superintendent of Agriculture's, following the presumed destruction of his original house (Wilson & Davies, 1980:105). On the completion of the Superintendent of Agriculture's new residence at Longridge, the hospital was renovated and converted into the Civil Hospital. The thatch roof was shingled and the kitchen, dead house and privy were added. The works were completed in 12 months. The Civil Hospital was a continual source of complaint, but limited further works were undertaken prior to the closure of the Second Settlement. During the Third Settlement, the building fell into disrepair, although the western wing remained roofed in the early 1900s. In the 1960s small sections of damaged internal walls were demolished, the parapets were trimmed level or in stepped lines, doorways were repaired and "broken end walls" were built up to "reasonably plumb faces" (Wilson & Davies, 1980:105).

The 1988 Conservation Management Plan provides the following historical, architectural and archaeological significance for the Civil Hospital:

> "It is one of the principal historic elements of the Penal (Second) Settlement of the Place. It is one of the small group of elements of the Place which relate directly to the housing and treatment of convicts during the Second Settlement period and from which the historical infamy of the Place is derived. It is one of a group of buildings which, because of their ruinous state, contributes to the evocative historic character of the Place. Its courtyard plan form, still evident, is a rare and interesting hospital plan dating from the mid-nineteenth century. It is a potential source of valuable archaeological information about the element and its history during the Second and Third Settlement periods."
>
> (Clive Lucas Stapleton and Partners, 1988:Vol.2b)

2.2.2 Archaeological potential

The draft Archaeological Zoning and Management Plan (AZMP) identifies the Civil Hospital as having high archaeological potential (Extent Heritage Pty Ltd, 2019). In order to assist in the management of the archaeological potential of KAVHA, Extent has created Zones – the Civil Hospital falls into Zone 1, meaning in addition to the high archaeological potential, the site has been identified as having high research potential and significance.

The draft AZMP outlines the following requirements for archaeological works as they may relate to the remediation of the Civil Hospital:

- 7.2.1 – "any proposed development within the site should aim to avoid or minimise the impact on the archaeological resource, by addressing the implications of the potential impact from the initial design and site planning stages. Examination of options and their level of impact to determine the outcome with the least harmful effect would be paramount. Avoidance of impact should be a priority."
  - A sub-point states: "In situations where development impacts are unavoidable (for example, due to safety or other overarching requirements), procedures outlined in principle guideline 7.3 should be followed" (Extent Heritage Pty Ltd, 2019:91);
    - The works would fall into this category.
  - Further sub-points to section 7.2.1 include the following requirements;
    - Obtain professional advice, as relevant, with respect to the assessment of proposed change/development and consider alternative courses of action,
    - Ensure that all proposed actions are assessed against the policies and recommendations included in this AZMP,
    - Actions that may result in adverse archaeological impacts must be identified and assessed a[s] part of a formal impact assessment process,

- The impact of any proposed intervention that has the potential to adversely affect the heritage value of an archaeological resource must be assessed at the earliest possible time, preferably at the concept or planning stage, in order to have the opportunity to develop a less invasive alternative. The assessment must be refined, as necessary, during subsequent stages of the development design phase as more detail becomes available, and
- The level of effort and detail of assessment should reflect the degree of potential impact and the significance of the value of the affected archaeological resource.

- Section 7.3 outlines the required archaeological investigation. For sites within Zone 1, such as the Civil Hospital, the "management process should include retention in situ and avoidance of ground disturbance works whenever possible. Other archaeological interventions may include methodologies such as test excavation, monitoring or full investigation with conservation" (Extent Heritage Pty Ltd, 2019:93).

In summary, protection of the archaeological potential of the area will need to be incorporated into the design process by selecting options that minimise impacts. Where impacts are unavoidable, an archaeological research design and methodology should be developed to ensure the impacts are mitigated in an appropriate manner.

2.2.3 Heritage Impacts

2.2.3.1 Option 01

Option 01 consists of inserting a timber and steel frame within one 'room' in the northern wing of the Civil Hospital. Option 01 complies with the HMP in that the Civil Hospital would remain a ruin, while stabilising the structure. The Option would include direct physical impacts to the remaining walls through the insertion of through bolts in at least eight locations.

The positive outcomes of Option 01 would include:

- Visitor access is retained; and
- An evocative ruin would be retained within the landscape.

The constraints of Option 01 would include:

- Direct physical impacts to fabric of significance; and
- No interpretation built into the stabilisation works, and separate interpretation may be considered.

2.2.3.2 Option 02

Option 02 consists of inserting columns to which a 'ridge beam' and 'rafters' are connected. The rafters are connected to the walls of the Civil Hospital through the provision of clamps over the top of the walls. The 'rafters' would follow the roof pitch indicated by the gable shape but would not mimic the original and unknown roof framing, providing an element of interpretation.

The positive outcomes of Option 02 would include:

- No direct physical impacts to fabric of significance. Works are fully reversible;
- Visitor access is retained;
- An evocative ruin would be retained within the landscape; and
- Interpretation of the former roof line would be integrated into the stabilisation works in a sympathetic, minimalist way.

2.2.3.3 Option 03

The Australian Heritage Council (2013:28) acknowledges that sometimes "there is a desire or a need that brings a place back to life", which may not return the building to a previous use but could incorporate a new use or activity. The current endorsed Heritage Management Plan for KAVHA contains the following policies on ruins within Section 8.3.4 (Godden Mackay Logan Pty Ltd, 2016:83):

- Ruins will be conserved, managed and interpreted in accordance with the principles and approach in Ruins: A guide to conservation and management (Australian Heritage Council, 2013);
- Reconstruction and restoration of ruins will be avoided unless essential for physical conservation or approved interpretation programs; and
- Standing ruins will be interpreted using devices that are designed to make them 'come alive again' so as to enhance visitor appreciation, enjoyment and understanding, and avoid significant physical impacts or reconstruction.

Within this context, the proposal to roof sections of the Civil Hospital is not supported within the HMP, although it would assist in the physical conservation and could be integrated into an approved interpretation program. Additionally, there is insufficient documentary evidence around some areas, for example, the truss system and internal lining (ceiling) of the Civil Hospital, to allow for the reconstruction.

Option 03 is not supported on heritage grounds.

The positive outcomes of Option 03 would include:

- Visitor access retained;
- Interpretation of former roof integrated into the stabilisation works; and
- Creation of weatherproof space that may be used for interpretation or similar activities.

The constraints of Option 03 would include:

- Not supported by the HMP;
- Would require an EPBC Act referral; and
- Direct physical impacts to fabric of significance.

2.3 Environmental Considerations

The environmental impacts and mitigation measures are presented in the following table and exclude heritage impact assessment.

Table 4. Environmental Impacts and Mitigation and Management Measures – Civil Hospital

Works	Potential Environmental Impact	Mitigation and Management Measures
Option 1 Minor footing work with minimal ground disturbance Installation of composite timber and steel bracing to the inside of the two gable ends.	No major environmental impact. Waste generated from construction works causing nuisance or being unsightly. Minor noise and dust from work to attach bracing to the two gable ends. This option has the least environmental impact.	Design and use prefabricated materials to minimise waste generation on site. Avoid, reuse or recycle waste materials as best practicable. Provide receptacles for construction waste collection and regularly dispose waste at a disposal site approved by the local authority. Maintain the worksite in a clean and tidy condition at all times. Restrict work to normal working hours.
Option 2 Minor footing work with minimal ground disturbance Installation of timber roof framing and columns to depict the original roof profile. Strut framing back to the existing gables as required and fully brace.	No major environmental impact. Impacts of waste, dust and noise are greater than Option 1. Moderate volume of site generated waste materials by using a structural timber frame. Minor indirect impacts such as emissions from steel manufacture and transport for the steel brackets connection the timber members. Area will be out of bounds for visitors to the heritage item due to the more extensive work required. Enhances the heritage value of the heritage item as it provides an opportunity to improve the interpretive value via depicting the original roof profile.	Same as Option 1.
Option 3 Potential footing work Construction of a new wall and rectification of existing load bearing structures to support a new roof that complies with heritage requirements.	No major environmental impact. The greatest volume and types of construction waste materials would be generated including excavated material from footings, concreting works, off cuts from structural works, roof tiles, paint and construction waste. Impacts of waste, dust and noise are greater that Options 1 and 2. Indirect impacts such as emissions from transportation may be the highest of any option. A larger construction lay down area would also be required.	Same as Option 1 but catering for the highest volume and types of construction waste materials. Manage and dispose of hazardous waste materials such as waste paint, glue, adhesives and hazardous chemicals in accordance with legislative and local requirements. Provision of laydown and access routes away from sensitive areas.

Works	Potential Environmental Impact	Mitigation and Management Measures
	The heritage item would need to be cordoned off and out of bounds for visitors. Enhances the heritage value of the heritage item as it improves the interpretive value via reconstruction of original roof.	

3.0 Arthur's Vale Retaining Wall

3.1 Engineering Proposals

The requirement is to direct overland stormwater flows away from the rear of the wall because water is entering the rear of the wall and eroding soil from behind the wall. This soil erosion is creating stability issues for the rough stone walls.

The previous investigations identified two water sources that are impacting the walls and require diversion:

- Flow from the courtyard to the rear of the Civil Hospital, and
- Flow from further up the ridge that is following a 4WD track – refer Figure 4

Figure 4 Stormwater route

The proposed works involves construction of an earth bund to redirect the flow path shown in Figure 4 so that the water enters Watermill Creek via a path that is away from the wall. In addition, a subsoil drain would be installed along the rear of the wall with outlets connected to two of the existing stone outlets within the wall. This will collect surface flows from the embankment and flat area behind the wall as well as the outflows from the Civil Hospital courtyard that currently flow into this area. The drain would be located approximately 2m behind the wall to provide clearance during construction. The connection between the subsoil drain and the existing outlets would require heritage approval and care during construction.

Barriers were installed in 2019 to exclude vehicles from the area behind the wall.

3.2 Heritage Considerations

3.2.1 Background and Significance

The retaining wall is associated with Mill Road, a First Settlement road. Mill Road fell into disuse and was abandoned during the Third Settlement. It is unclear from the available documentation when the retaining wall was constructed, but it was reconstructed in 1969, particularly the portion adjacent to the Civil Hospital (Clive Lucas Stapleton and Partners, 1988:Vol 2b; Wilson & Davies, 1980:84). The retaining wall and area to the rear is significant as evidence of the complex of roads, bridges and gradings constructed during the First and Second Settlements.

3.2.2 Archaeological potential

The retaining wall sits within an area designated as Zone 1 within the Archaeological Zoning and Management Plan. It is anticipated the area may yield information relating the surface of Mill Road. The archaeological management polices outlined in Section 2.2.2 will apply to the proposed works associated with the retaining wall, that is, where impacts are unavoidable, an archaeological research design and methodology should be developed to ensure the impacts are mitigated in an appropriate manner.

3.2.3 Heritage Impacts

The proposed works would involve excavation through an area identified as holding high archaeological potential and significance and would include some visual impacts associated with the drainage gravel exposed along the pit at the surface. There would be no direct physical impacts to heritage fabric of importance associated with the retaining wall as the additional drains will connect to existing drainage holes in the walls.

The proposal includes the mounding of gravel over the line of the drains. This would have a negative visual impact as the gravel will contrast sharply with the surrounding grass. The visual cue associated with the services would be a negative impact on the aesthetic significance of KAVHA.

The archaeological impacts can be mitigated as per Section 3.2.2. The visual impacts could be mitigated through the provision of a gravel surface along the length of the retaining wall in this vicinity. This would have the additional benefit of interpreting the former Mill Road. In other respects, the works meet the policies outlined in the HMP.

3.3 Environment Considerations

The environmental impacts and mitigation measures are presented in the following table and exclude heritage impact assessment.

Table 5. Environmental Impacts and Mitigation and Management Measures - Arthur's Vale Retaining Wall

Works	Potential Environmental Impact	Mitigation and Management Measures
Construction of an earth bund located uphill of the retaining wall to funnel surface water flows away from the retaining wall in a westward direction and into Watermill Creek. Construction of an agricultural drain located 1.5m – 2.0m behind the retaining wall to collect water flows not diverted by the earth bund. Water collected from the agricultural drain is to be directed into existing drains placed in the retaining wall. Installation of subsoil drains, eco pits and refurbish the exiting scupper drains to discharge into Watermill Creek.	Erosion and sedimentation from earthworks including excavation of the agricultural drain, stockpiling earth material and construction of the earth bund. Diverted surface water and contaminated runoff adversely impacting water quality of receiving waterbodies. Improper management/ disposal of spoil impacting water quality of receiving waterbodies. Vehicles moving around the rear of the wall may impact the heritage item.	Establish and implement an Erosion and Sedimentation Plan (ESCP) that has been endorsed by a Professional Engineer and approved by the local authority. Schedule the works in the dry season as best practicable. Install silt fences around the toe of stockpiled earth materials to prevent contaminated runoff entering waterbodies. Reuse excavated material from construction of the agricultural drain to construct the earth bund. Use local materials for construction as best practicable. Revegetate the earth bund and exposed areas using suitable methods to establish turf within 2 weeks of completion of the works. Trucks transporting earth and other materials to/from the site to be covered. Any spilled materials shall be cleaned without undue delay. Excess soil/mud removed from vehicle wheels prior to exiting site. Disposal of excess earth material to a disposal site approved by the local authority. Exclude vehicles from the rear of the wall.

4.0 Bounty Street Bridge

4.1 Engineering Proposals

An engineering report was prepared by Hughes Trueman Consulting engineers in 2010 that outlined a scope of monitoring, investigation and possible remediation works to stabilise the condition of the bridge. Inspections in 2020 by AECOM confirmed the recommendations contained in the Hughes Trueman report.

The scope of works undertaken as part of this project to date include:

- Condition inspection of the bridge following construction of a coffer dam to the downstream face and dewatering;
- Geotechnical investigation to determine likely foundation conditions for the bridge; and
- Preparation of costed concept plans for remediation / stabilisation of the bridge.

4.1.1 Inspection Works

The works undertaken for the inspection phase consisted of the construction of an earth fill coffer dam immediately downstream of the bridge and dewatering to provide access to the bridge soffit and areas that are normally below the waterline and geotechnical investigations of the bridge foundation material.

These works were undertaken at the end of January 2020 and are shown in Figure 5 and Figure 6.

Figure 5 Construction of Coffer Dam

Figure 6 Dewatering Prior to Inspections

The inspection revealed that significant erosion of the stone arch has occurred and in some locations the erosion has reduced the arch thickness by approximately two thirds. This is shown in Figure 7 below.

Figure 7 Stone Erosion

There is also significant erosion to stone in the bridge abutments and to the concrete lintel that was installed in the eastern abutment approximately 40-50 years ago -refer Figure 8. An almost identical photo is contained in the Hughes Trueman report from 2010 (Figure 9) and this reveals that there has been considerable erosion in the last decade.

Figure 8 Stone Abutment and Lintel Erosion

Figure 9 2010 Photo from Hughes Trueman

This degree of stone erosion, in combination with the approximate 1.2m foundation settlement on the northern side, has significantly reduced the capacity of the bridge to safely support loads, and in particular, vehicular traffic. The condition of the bridge is such that we are unable to provide it with a load rating or expected remaining design life.

Due to the current known condition of the bridge and the possibility of unknown structural deterioration below the level of the current investigation it is our recommendation that the bridge be closed to both vehicular and pedestrian traffic until remediation works can be completed.

Closure of the bridge is recommended to protect the public and the bridge and closure should be completed as soon as is reasonably practical.

4.1.2 Geotechnical Investigations

An experienced geotechnical engineer from ACT Geotechnical Engineers undertook investigations adjacent each bridge abutment. These consisted of Push Tube boreholes to a depth of 2m and Dynamic Cone Penetrometer (DCP) testing to depths of approximately 3.7m, which was the limit of the equipment.

The DCP testing indicates the subsurface profile within the boreholes comprise alluvial soils of moisture-affected, loose to medium dense and firm to stiff, silty clay and silty clayey sand to at least 3.7m depth. It is assessed that these alluvial soils would have an allowable bearing pressure of less than 100kPa and is unsuitable as a foundation to support bridge loads, particularly with respect to long term settlement. The foundation does not appear to have failed in bearing (the ultimate bearing capacity has not been exceeded), but it does appear that excessive settlement has occurred.

A copy of the geotechnical report in included in Appendix D

4.1.3 Stabilisation Concept

The severe erosion of the stone structure of the bridge means that a simple repair solution is not feasible. The bridge will need to be supported by a new structure constructed under the soffit to provide it with a reasonable service capacity and life. In addition, the stone will need protection from further degradation caused by contact with the creek water.

Options for supporting the bridge include converting it to a piped culvert by inserting a pipe under the bridge and filling between it and the bridge with a structural material such as concrete or constructing

a reinforced concrete arch against the bridge soffit to support the stonework. The piped culvert option will constrict the channel to the point that an additional pipe may need to be installed adjacent the bridge. This option is not preferred due to the significant heritage impact.

It is proposed that the reinforced concrete arch option be adopted for further design development and a concept for this option is shown below in Figure 10 and in Appendix C

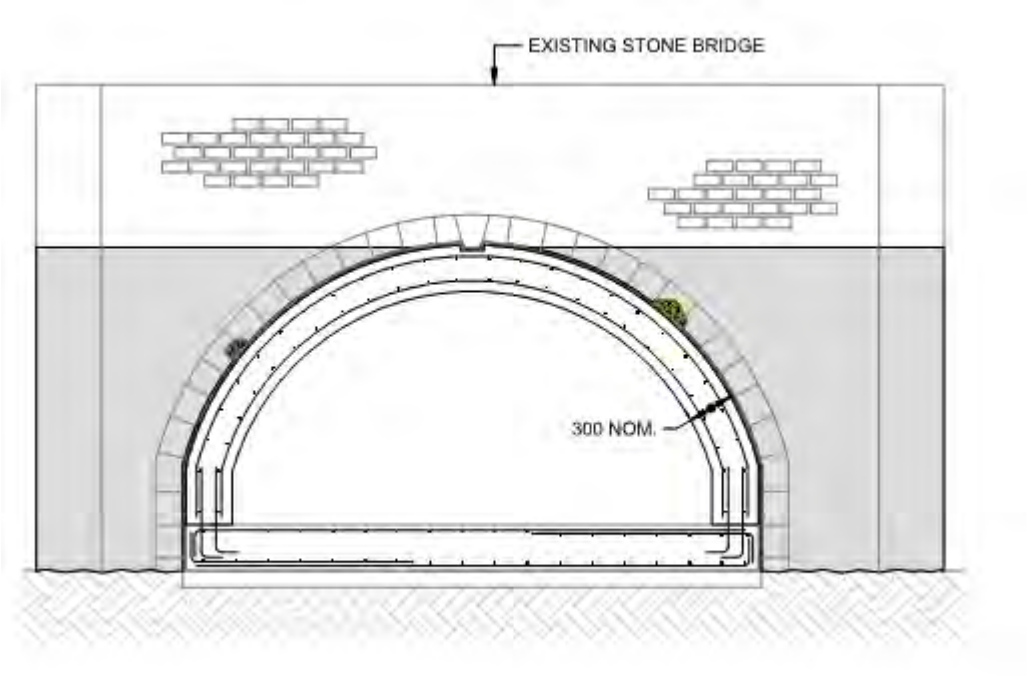


Figure 10 New Concrete Arch Option

It is proposed that lime mortar render be investigated further as a means of protecting the stone from further deterioration due to contact with the creek water. This lime mortar render would be applied to the arch soffit prior to constructing the concrete arch and also to the face of the abutment walls. The abutment walls may need re-rendering at regular intervals as the creek water will eventually dissolve the render. Reference is made to the Watermill Dam wall lining erosion and loss of compo render from below the water line of Bounty Bridge as evidence.

A better understanding of the water properties at the bridge is required before the render and concrete solutions can be completed, particularly with respect to its pH levels.

4.2 Heritage Considerations

4.2.1 Background and Significance

The Bounty Street bridge was constructed in 1835 under the administration of Major Joseph Anderson. Bounty Street itself was constructed in the early 1830s to allow for the movement of troops between the Old Military Barracks and the Prisoners' Barracks, but followed an earlier, First Settlement, route across the swamp (Clive Lucas Stapleton and Partners, 1988:Vol 2b; Wilson & Davies, 1980:85,88). The 1988 CMP provides the following statement of significance:

> "It is one of a small number of stone bridges with architectural treatment and highly finished to survive from the early nineteenth century in Australia. It has a fine example of a stone voussoir arch.
>
> It·is one of the small group of buildings, civil engineering works and landscape features at the Place which are substantially intact to the period of Second Settlement. It is one of the architectural and picturesque landscape elements at the Place built during the administration of Major Joseph Anderson which are of substantial art history interest.
>
> It is one of a number of elements which collectively demonstrate the state and development of industrial and engineering technology at the Place during the early to mid-nineteenth century."
>
> (Clive Lucas Stapleton and Partners, 1988:Vol 2b)

4.2.2 Archaeological potential

The bridge sits within an area designated as Zone 1 within the Archaeological Zoning and Management Plan. The archaeological management polices outlined in Section 2.2.2 will apply to the works associated with the preparation for the insertion of the coffer dam, that is, where impacts are unavoidable, an archaeological research design and methodology should be developed to ensure the impacts are mitigated in an appropriate manner. It is anticipated that the archaeological potential within the creek is low – it is thought to have been excavated in the past to remove sediment build-up.

4.2.3 Heritage Impacts

The impacts associated with the proposed rectification works will involve intervention to fabric of heritage significance. As an item of significance within a World Heritage, National and Commonwealth Listed site, the works are likely to trigger a referral under the *Environmental Protection and Biodiversity Conservation Act 1999*. The following is recommended:

- Consultation should be undertaken with the Commonwealth department with responsibility for administering the heritage functions within the EPBC Act;
- A heritage consultant with relevant experience be consulted during the development of the detailed design. The consultant should have experience in the interaction between concrete and lime-based mortars. The objective is to minimise impacts to heritage fabric and significance during the design phase; and
- A Heritage Impact Assessment, which addresses the Significant Impact Guidelines 1.1 and 1.2 (Department of Sustainability Environment Water Population and Communities, 2013; Department of the Environment, 2013), the KAVHA HMP and KAVHA AZMP should be prepared and submitted in support of the referral.

4.3 Environmental Considerations

The environmental impacts and mitigation measures are presented in the following table and exclude heritage impact assessment. It is assumed the bridge will have been closed to traffic as per recommendations from engineering reports.

Table 6. Environmental Impacts and Mitigation and Management Measures - Bounty Street Bridge

Works	Potential Environmental Impact	Mitigation and Management Measures
Provide coffer dams up and down stream of the bridge. Dewater the works area to allow for engineering and geotechnical inspection. Minor manual excavation of creek bed to facilitate engineering and geotechnical inspection (if required). Conduct water quality testing of the creek water (by DITRDC). Conduct an archaeological assessment of the instream alluvium in the vicinity of the Bridge and adjacent stream banks.	Uncontrolled dewatering resulting in silt laden discharge polluting downstream receiving waterbodies. Improper management of excavated spoil from the creek bed resulting in contaminated runoff polluting receiving waterbodies. Uncontrolled removal of the coffer dam causing a surge of contaminated water (including sediment and sewage) flowing down the creek and adversely impacting the water quality of receiving waterbodies, including at Emily Bay. Temporary impact to aquatic ecology due to construction of earth coffer dams and dewatering the works area. Health impact to workers exposed to surface water and/or sediment contaminated with sewage. Impact to archaeological heritage items from excavation of the creek bed.	Undertake the works in parallel with lowering the water level within Watermill Dam spillway works to manage flows onto/ at the coffer dams. This will manage the flows into/at the coffer dams (see below). Construct the earth coffer dam upstream of the work area to allow water to flow out of the work area prior to installation of the lower coffer dam. Schedule the works in the dry season as best practicable. Establish and implement an ESCP that has been endorsed by a Professional Engineer and approved by the local authority. Use uncontaminated clay material to construct the coffer dams. Dewatering of the coffer dam will be carried out using pumps placed near the surface of the water to avoid stirring up bottom sediments and pumping sediment laden water downstream. Dewatering release options and discharge standards will be discussed with the local authority prior to finalisation of the ESCP. Desilted material will be placed in a bunded area and dried before being transported to and disposed of at a disposal area approved by the local authority. Trucks transporting desilted materials will be kept covered. Any spilled materials will be cleaned without undue delay. Creek bed assessed for erosion or need for vegetation reinstatement prior to decommissioning the coffer dam. Consider using desilted material for landscaping or forestry where there is low risk of pollution if practicable. Workers coming into contact with Watermill Creek water/ sediment will use suitable PPE and implement good personal hygiene practices to safeguard against microbial hazards from sewage. Implement mitigation and management measures recommended in the *Biodiversity Assessment of Native Aquatic Fauna (Eel and Shrimp).*

5.0 Longridge Arches

5.1 Engineering Proposals

The arches currently have a lean towards the south of approximately 200mm and previous engineering investigations have identified stability issues under wind and seismic loading as well as excessive rotation of the foundations that is probably the result of overstressing of the foundation material.

The proposed works are focused on installing a structural steel frame behind the stone arches which will provide resistance to wind and seismic forces and underpinning to the southern edge of the foundations to minimise future rotation of the foundations.

The structural steel frame has been detailed so that its visual presence is minimised and can incorporate the non-symmetric arrangement of arches and window openings– refer Figure 11. The frame would need to be fabricated and galvanised on the mainland and would require a crane for erection.

Once the frame has been installed the underpinning works can proceed safely and involve the construction of two reinforced concrete bored piers per column of approximately 300 to 450 mm in diameter to support the southern edge of the arch foundations. The final detailing of the underpinning may require adjustment to suit the actual foundations that would be uncovered during the construction works. Flexible detailing has been incorporated in the design to facilitate reasonable site adjustment following excavation and on-site coordination between the design engineers and the construction team.

Figure 11 Arch and window misalignment

5.2 Historical Considerations

5.2.1 Background and Significance

Longridge Arches are all that remain of the prisoner's barracks shown on a 1846 plan of the Longridge Agricultural Settlement drawn by W.T. Mountney (Mountney, 1846). The following Statement of Significance is taken from the CHL entry:

> "The ruined building known as The Arches, at Longridge, dates from the 1840s and is historically highly significant. It is directly associated with the Second Settlement of Norfolk Island, when the Island became a prison for re-offending convicts. It is this harsh period which predominates in the Australian public's perception of Norfolk's history. Longridge was a major agricultural station on the Island at the time, and the building, constructed toward the end of the Second Settlement, was evidently an important part of the station's agricultural infrastructure. (Criterion A.4) (Themes: 2.3 Coming to Australia as a punishment, 3.5 Developing primary production, 3.14 developing an Australian engineering and construction industry)
>
> The building, with its substantial stone walling and its ten large arches and other openings, is of a scale and design which is intriguing as it reflects a level of extravagance not often seen in penal settlements. (Criterion B.2)
>
> The ruined building, on account of its large size and dramatic appearance and its ability to evoke a sense of the past in onlookers, is of notable aesthetic value in the Longridge landscape."
>
> (Department of the Environment and Energy, 2004)

5.2.2 Archaeological potential

As Longridge Arches sits outside of KAVHA, the Archaeological Zoning and Management Plan does not cover this area. Given the general lack of understanding of the building, it is suggested that the archaeological research potential is high. An archaeological research design and methodology should be prepared and implemented prior to onsite construction works commencing if excavation is to extend 300 mm below current ground surface.

5.2.3 Heritage Impacts

The proposed works consist of inserting a steel frame on the northern side of the southern wall. The Option would include direct physical impacts to the remaining walls through the insertion of through bolts to tie the frame to the fabric. There is no HMP against which to assess the impacts of the proposed works, but the general principle of conserving and retaining the extant fabric with minimal impact is in line with the *Burra Charter*

The positive outcomes would include:

- Visitor access retained;
- An evocative ruin would be retained within the landscape;
- The Arches are stabilised with minimal impact to the fabric; and
- Potential to learn more about the site through the archaeological investigations.

The constraints would include:

- No interpretation built into the stabilisation works. Separate interpretation may be considered; and
- Direct physical impacts to fabric of significance.

5.3 Environment Considerations

The environmental impacts and mitigation measures are presented in the following table and exclude heritage impact assessment.

Table 7. Environmental Impacts and Mitigation and Management Measures - Longreach Arches

Works	Potential Environmental Impact	Mitigation and Management Measures
Installation of supporting foundations to underpin the existing foundations. Installation of temporary bracing to stabilise the arched wall during the underpinning of the footings. Installation of structural bracing columns to the rear of the arches to resist wind and earthquake forces.	No major environmental impact. Waste generated from construction works causing nuisance or being unsightly. Minor noise and dust from work to attach bracing to the structure.	Design and use prefabricated materials to minimise waste generation on site. Avoid, reuse of recycle waste materials as best practicable. Provide receptacles for waste collection and regularly dispose waste at a disposal site approved by the local authority. Maintain the worksite in a clean and tidy condition at all times. Schedule noisy work activities to mitigate impacts on the residents in the surrounding area.

6.0 Royal Engineer Office (REO) Portico

6.1 Overview

AECOM understand that the portico of the REO was impacted by a vehicle, although the date of this incident is not clear. The REO sustained damage that resulted in the replacement of the northern column of the portico, but the southern column was retained, and precautionary timber props were installed adjacent to the column. It is understood the props were installed due to concerns about possible cracking in the column.

The gable end of the portico roof has an outward lean and is susceptible to damage from seismic loads. Tying the gable back to the rear of the portico structure is proposed to provide sufficient seismic resistance.

Purcell (2017:19) indicates that the northern column is of Bondi sandstone, although there is no indication of whether the southern column is of the same material.

In 2018, the Department engaged GML Heritage to prepare a scoping study of safety hazards for KAVHA (GML Heritage Pty Ltd, 2018). GML recommended that a structural engineer assess the portico roof structure and check the condition of the columns (GML Heritage Pty Ltd, 2018:53).

The Department engaged AECOM to undertake an initial assessment (AECOM Australia Pty Ltd, 2018). The structural assessment identified two areas of possible cracking at the top and bottom of the southern column. These appeared as grooves within the painted surface of the column. However, as the columns are covered in acrylic paint, the significance of the grooves could not be determined. AECOM recommended the removal of the paint to determine the cause of the grooves and, depending on what a visual inspection determines, potentially drilling a 5 mm diameter hole into the area to determine the depth of the cracking, if present.

6.2 Methodology of Works

In order to determine the best practice long-term conservation for the columns, AECOM undertook paint sampling of two locations at the grooves and one location on the plinth at the column top (Figure 12, Figure 13). These samplings allowed for a determination of historic record of the paint/lime wash and enabled the suspected cracks to be uncovered and inspected.

Paint sampling at each location was undertaken as follows:

- Prepare a sample jar by placing an amount of cotton wool in the bottom. Place a piece of cling wrap on top of the cotton wool that is enough in size to fold over the top of the sample;
- Using a scalpel, cut through the paint layers to the substrate and lift a section of the paint layers that is at least 5mm by 5mm, preferably 10mm by 10mm;
- Place the sample on the cling wrap in the jar and fold cling wrap over the top of the sample;
- Gently place enough cotton wool on top of the sample to stop movement during transportation that may result in the sample crumbling; and
- Seal sample jar.

Figure 12 Paint Sample 1

Figure 13 Paint Sample 2

Paint at the lower groove was removed with a paint stripper. The top groove was drilled to review its depth and characteristics (Figure 14, Figure 15).

Figure 14 Lower Groove

Figure 15 Upper Groove with Drill Hole

The inspections indicated that there is no cracking apparent in the locations that were highlighted as areas of concern. The drill hole was undertaken to a depth of 20-25mm of depth. The hole was inspected for further cracking through the depth of the drill hole. There was no indication of a visible crack extending through the column. The paint removal and hole indicated that the column has been constructed using local calcarenite rock and not imported sandstone.

From previous experience, it appears that the 'cracking' is consistent with a natural defect within the mined and sculpted rock. This type of defect may result in a shear plane failure, which could occur without warning (for example, movement or slippage) leading to a sudden and complete failure of the column. Given the unfavourable orientation of the defect (diagonally across the column) and the unknown structural properties of the calcarenite material it is not reasonable to assign a structural capacity to the column.

Due to the nature of the rock and the unpredictability of shear plane failures and internal fractures, an option from an engineering perspective is to replace the column and preserve it for historical and heritage purposes and install a new stone column. This would enable the temporary timber columns to be removed and the structure to free stand once again, but the new column would likely be constructed from sandstone due to the limited availability of calcarenite stone.

If the column material is determined to have sufficient heritage significance to warrant its retention, then it is recommended that an alternative support mechanism be provided so that failure of the column would not result in collapse of the portico. The simplest form of this alternative support would be the existing timber props either side of the stone column. Two props are required due to the lintels supporting the front and side of the portico. The size of the props could be reduced by using steel in lieu of timber, but they would still be visually intrusive.

Further options to strengthen the column were investigated including wrapping the defect affected zones with a carbon fibre band or inserting a stainless-steel rod longitudinally through the column for its full height. Both options would allow the timber props to be removed and the strengthened column to safely support the portico weight. The steel rod solution has been endorsed as the preferred methodology due to its reduced visual impact and a contractor with previous experience has been identified. It is likely that the solution will involve coring a nominal 50mm diameter hole through the centre of the column and grouting a nominal 33mm diameter stainless-steel rod into the column. Given the specialist nature of the works it is recommended that the detailed repair methodology be developed in conjunction with the Contractor, AECOM's engineers, and heritage team.

Coring the centre of the column is not without risk and an experienced contractor must be selected to undertake the works and risks managed by developing an agreed Work Methodology.

An extension of the southern column strengthening would be to reconstruct the northern column using the saved portions that remain on site and using the steel rod technology to provide it with structural adequacy. Portions of the column may not be salvageable and may need replacement with new stone segments, subject to advice from the Contractor and agreement between the KAVHA Commonwealth Heritage Manager, and AECOM heritage and structural teams. Again, the viability of this is best resolved in conjunction with the Contractor. If the original northern column cannot be reinstated, then the works will include replacement of the existing eroded cap stone with a more durable stone type. It is understood the original stone cap is held on-Island and could be reinstated.

An indicative construction sequence for the portico gable bracing is to disassemble the portico roof covering and expose the internal roof structure for inspection and assessment. A gable bracing detail would then be designed by AECOM engineers and installed by the contractor and the portico roof reinstated. The eroded stone plinth at the top of the northern column would be replaced at this time with a more durable stone and the works would also include adjustments to remedy the issue of the current columns being slightly different lengths. Finally, the loose stonework at the REO entry doorframe would be reset and make good.

This indicative construction sequence has been documented as a procedure for the contractor to follow and is included as Appendix E.

The GML Safety Hazard Scoping Study also identified the stone base under the columns and its bearing on the foundation material as a potential arear of concern. The site investigations revealed that both columns share a calcarenite flagstone as their foundation. This stone is approximately 75mm

thick, almost the full length of the portico long and is as wide as the portico. The stone is in reasonable condition for its age and appears to be uncracked. Given the site location the flagstone is likely supported by sand and the bearing stresses from the portico weight are low. The site investigations did not reveal signs of distress to the foundation material or the flagstone and it was concluded that no remedial works are required to this part of the portico at this time.

It is recommended that the grass and soil level around the flagstone be maintained at a level that is above the base of the flagstone to prevent sand from being washed out from underneath it.

6.3 Heritage Considerations

6.3.1 Background and Significance

The REO was constructed in 1850 and completed in early 1851 as the office of the Royal Engineer on the site of the old carpenter's shop. Initially consisting of a central passage and two rooms, additions were made later in 1851 to add two rear rooms and the portico. In 1897 the building was appropriated for the police constable. It later became the residence of the Signal Maker between 1919 and 1948, with some alterations made for the purpose. Conservation works were carried out in 1982/3 (Clive Lucas Stapleton and Partners, 1988:Vol 2c).

The contribution of the REO to the broader site has not been individually assessed. However, the structure is specifically mentioned as contributing to the historical and representative significance of the site, which demonstrates the transportation of convicts, secondary punishment as part of the convict system and the administration of the system. The REO would directly contribute to the administration of the convict transportation system. In addition, it contributes to the aesthetic qualities.

6.3.2 Archaeological potential

No excavation is proposed as part of the works and therefore archaeological potential is not a consideration for the works association with the REO.

6.3.3 Heritage Impacts

The investigations to determine the nature and extent of the defect have suggested that the fabric of the column is calcarenite, rather than sandstone, as was anticipated. This suggests that the column is original, dating to 1851. As original fabric, the column makes a strong contribution to the integrity of the building. The removal of the column would have a negative impact on the significance of the REO through the removal of original, significant fabric. However, the retention of the supporting timber props is not a long-term solution as it does:

- not form a long-term solution. The long-term preservation of the REO as a whole building must be taken into consideration – the column must not be retained at the expense of the significance of the building as a whole;
- result in on-going maintenance and structural integrity investigations and considerations, which may have financial implications; and
- result in long-term negative visual impacts to the heritage significance of the site as a whole and the REO more specifically. This impact is a particular consideration given the prominence of the REO within the site and it being identified within the Statement of Significance as making a specific contribution to the aesthetics of KAVHA.

The proposed works to tie the portico to the building may place the column at additional risk of failure through the increased activity in the area and the removal and replacement of the loads associated with the portico roof structure. Given the following considerations, there are three options:

- Replace the column;
- Use a carbon fibre and epoxy wrap to support the column, such as SikaWrap; or
- Strengthen the existing column through the insertion of a stainless-steel rod.

As discussed above, the column is significant and original fabric and its retention will maintain the integrity of the REO. Replacement of the column is therefore not the preferred option in the first instance. SikaWrap would have a long-term (permanent) visual impact on the column and reduce the

ability of the calcarenite to breath naturally thereby accelerating the deterioration of the stone and is also therefore not preferred. It is acknowledged that drilling the column to insert the stainless-steel rod may result in the loss of the column. It is the preferred option despite the risks, on the following basis:

- The original fabric is retained, thereby preserving the integrity and authenticity of the REO; and
- The option would not result in visual alterations to a building with high aesthetic significance.

Should the column fail during drilling and the column requires replacement, the following recommendations are made:

- Detailed design for the new column should take into consideration Article 22.1 and 22.2 of *The Burra Charter* to ensure the new work is readily identifiable without detracting from the significance of the REO.
- Careful consideration of Article 18 of *The Burra Charter* is required to ensure the balance between restoration and reconstruction is right.
- Bondi sandstone does not appear to preserve well on Norfolk Island. Consideration of a more durable stone, given the environmental conditions, should be undertaken.
- Based on Purcell (2017) and the HPM, it is AECOM's understanding that there is no written policy regarding a suitable replacement material for calcarenite. A holistic policy for KAVHA would need to be determined in order to select a suitable replacement material. The policy would need to take into consideration;
  - Availability,
  - Workability,
  - Durability, and
  - Ability to be interpreted under Article 22.2 of *The Burra Charter*.
- AECOM would require the Department to provide an indication of the suggested replacement material in advance of detailed design. Consideration will also need to be given to the final finish of the columns.

6.4 Environment Considerations

The environmental impacts and mitigation measures are presented in the following table and exclude heritage impact assessment.

Table 8. Environmental Impacts and Mitigation and Management Measures - Royal Engineering Office

Works	Potential Environmental Impact	Mitigation and Management Measures
Removal of the existing timber props. Deconstruction and rebuilding the portico including tying the gable back to the rear of the portico and possible replacement of the original column to support the portico. The dismantled components of the portico would be temporarily laid out and stored on site. Note: The works will be carried out while the REO remains in service.	Dust, noise and vibration due to construction works causing nuisance to employees/visitors of and to the REO. Temporary closure of the entrance causing nuisance to employees/visitors. Unsafe walkway and unmarked entrance causing nuisance and a safety risk to persons entering the REO. Possible hazardous materials/waste from deconstruction work (i.e. asbestos or lead paint). Waste generated from construction works causing nuisance or being unsightly. Siting of temporary compound/lay down area causing nuisance to employees/visitors of and to the REO.	Properly seal off the worksite from the work area within the building with suitable acoustic hoarding to effectively mitigate against dust and noise. Cordon off the entrance and provide safe alternative walkways with clear signage to guide employees/visitors to the temporary entrance of the REO. The contractor will conduct a HAZMAT assessment prior to the work and manage any hazardous materials in accordance with relevant legislative requirements and best management practices. Provide receptacles for waste collection and regularly dispose of waste at a disposal site approved by the local authority. Maintain the worksite in a clean and tidy condition at all times. Consult the management of the REO and the local authority prior to selecting the temporary compound area, planning alternative walkways and hoarding. Carry out works during daytime working hours only.

7.0 Watermill Dam Spillway

7.1 Overview

AECOM undertook visual inspections of the dam spillway to confirm that water is passing underneath the spillway and to determine the source of the water and possible remediation measures.

These inspections confirmed that the dam overflow is currently passing under the concrete spillway and has the potential to erode the dam wall. The water appears to be entering via the construction joint between the concrete lining to the dam upper face and the spillway slab. It can be heard passing under the slab and is exiting into the downstream creek at some point on the downstream face of the spillway.

It was not possible to determine the depth of any erosion under the spillway slab but given the potential for erosion to the dam wall it is recommended that works be undertaken to remedy the spillway.

Figure 16 Upstream end of spillway

Figure 17 Downstream end of spillway

During the spillway investigations it was noted that the render lining to the upstream face of the dam wall has been eroded by contact with the dam water. Refer to Figure 18. It is understood that the wall lining has been regularly reapplied to prevent water seeping through the relatively porous soil that forms the dam wall. At the time of inspection there was no sign of water seeping through the dam, so the render appears to be still effective, but it is due for a fresh render coat to maintain the watertightness of the wall.

Figure 18 Eroded dam lining

7.2 Proposed Works

The long-term solution should include the following features:

- Demolish the spillway, inspect the subgrade and remediate as required;
- Reconstruct the spillway to provide a more water-resistant joint between the dam wall lining and the spillway slab;
- Install a piped low flow device so that the nominal water level of the dam is slightly below the spillway / wall junction. This would involve a lowering of the dam water level but only by a relatively insignificant amount. It is noted that the current water level is below the spillway invert due to the leak;
- Install additional rip rap scour protection to the downstream end of the spillway as it is currently ending in a steep slope; and
- Re-render the upstream face of the dam wall to maintain its watertightness.

Should current funding not be available to enable the full scope to be undertaken then a reduced scope of works could include:

- Install a concrete cut off wall behind the existing dam wall lining at the start of the spillway. This would be nominally 600mm wide and be of sufficient depth and width to significantly reduce water flow under the spillway. Excavation for this would reveal the extent of erosion under the spillway at this location and could inform the decision about the need to remediate the entire spillway length; and
- Install a piped low flow device to divert the current flow from under the spillway.

The spillway remediation and scour protection to the downstream end of the spillway could be deferred until condition audits indicated a more immediate need for the works.

7.3 Heritage Considerations

7.3.1 Background and significance

A dam is thought to have been constructed around 1795 in the present location as Watermill Dam, when the watermill was erected during the First Settlement (Wilson & Davies, 1980:21). Wilson & Davies (1980:152) appear to indicate that the First Settlement dam was overridden by the Second Settlement dam (the present dam) with a stone lining built in 1837. It has been suggested that the Second Settlement dam removed the remains of the earlier dam “except possibly earthworks” (Otto Cserhalmi & Partners, 2002:111). It is unclear when the current concrete spillway was inserted. Wilson & Davies (1980:152) and Otto Cserhalmi & Partners (2002:110) indicate that works were undertaken to another dam in the area in 1908-1910 and 1969 before it fell into disrepair. This second dam is located to the north of the extant dam. The materials indicate that the concrete dates to the modern period, but may sit directly on or adjacent to the 1837 stone lining.

The HMP indicates that Watermill Dam is of significance as an element of one of only two surviving pre-1840 watermill complexes. The complex contributes to an understanding of convict diet during the Second Settlement and is one of the few places that has “notable associations with the Pitcairn people’s occupation pre 1945” (Clive Lucas Stapleton and Partners, 1988:135).

7.3.2 Archaeological potential

The spillway sits within an area designated as Zone 1 within the Archaeological Zoning and Management Plan. As the relationship between the modern concrete spillway and the 1837 stone lining is unknown, there is potential for evidence of the stone lining to be located during the proposed works. The archaeological management polices outlined in Section 2.2.2 will apply to the works associated with the remediation works, that is, where impacts are unavoidable, an archaeological research design and methodology should be developed to ensure the impacts are mitigated in an appropriate manner.

7.3.3 Heritage Impacts

The concrete spillway is of modern construction, but within a highly significant area and potentially directly adjacent to fabric dating to the Second Settlement. Archaeological potential has been identified within the spillway area, triggering the need for preparation of an archaeological research design and methodology prior to works commencing.

The GML HMP is the current standard by which proposed works are assessed. Section 8.3.6 of the HMP relates to ‘Other Structures’, including dams. The policies indicate that dams:

- are to be conserved and managed as part of the cultural heritage fabric of the KAVHA site;
- have a conservation policy prepared for individual significant historic structures within the KAVHA site;
- works that include works to significant historic structures will be consistent with the principles and practices of the Burra Charter; and
- original fabric will be retained, repaired and stabilised, in preference to the introduction of replacement fabric (Godden Mackay Logan Pty Ltd, 2016:110).

In Section 8.5.3, the HMP specifies that the “significant traditional agricultural use of Watermill Valley, including the use of the dam, will be continued” (Godden Mackay Logan Pty Ltd, 2016:114).

The proposed works are assessed against the relevant policies from the HMP in Table 9.

Table 9 Assessment of Watermill Dam Spillway works against HMP policies

HMP Policy	Assessment
Conserved and managed as part of the cultural heritage fabric of the KAVHA site.	The proposed works indicate that the dam is being conserved and managed.
A conservation policy will be prepared for individual significant historic structures within the KAVHA site.	Relevant conservation policy should be included in the Heritage Impact Assessment prepared following 100% design.
All works to significant historic structures will be consistent with the principles and practices of the *Burra Charter.*	To ensure the proposed works are consistent with the *Burra Charter,* the following recommendations are made: • the rip rap material should be locally sourced to ensure it blends with the local environment; • visible concrete should be minimised; and • low flow pipe should be concealed.
Original fabric will be retained, repaired and stabilised, in preference to the introduction of replacement fabric.	The concrete proposed for removal is not original. During works, if early or original fabric is uncovered, contingencies for the retention of this fabric should be put in place. Section 8.4.1 of the HMP states that there needs to be a willingness to make changes during works when archaeological features are encountered.
Significant traditional agricultural use of Watermill Valley, including the use of the dam, will be continued	Repair of the dam will allow for the continuation of this significant use.
The archaeological resources of the KAVHA site will be managed to retain their cultural heritage values and realise their research potential.	Archaeological potential has been identified within the spillway area, triggering the need for the preparation of an archaeological research design and methodology prior to works commencing.

The proposed works are broadly compatible with the heritage significance of the item. Detailed design should address the matters raised in Table 9.

7.4 Environment Considerations

The environmental impacts and mitigation measures are presented in the following table and exclude heritage impact assessment.

Table 10. Environmental Impacts and Mitigation and Management Measures - Watermill Dam

Works	Potential Environmental Impact	Mitigation and Management Measures
Dewatering/ lowering the water in the dam and carry out sediment removal (manually) to allow for further inspection at the inlet side to the spillway to determine the point of water ingress beneath. Recommissioning and rebuilding the Watermill Dam spillway with appropriate sub base preparation and stabilisation prior to pouring of new concrete spillway. Installation of rocks at spillway outlet to prevent scouring and erosion.	Impact on water quality downstream due to reduction in retention time and absorption by aquatic vegetation of sewage discharged from sources upstream of the project site. Temporary impact to wetland ecology due to dewatering and desilting work. Contaminated runoff from desilted material (sediment and sewage) causing water pollution of receiving waterbodies, including Emily Bay. Health impact to workers exposed to water/ sediment contaminated with sewage.	Establish and implement an ESCP that has been endorsed by a Professional Engineer and approved by the local authority. The work will be scheduled to be carried out during the dry season. Consider naturalizing the spillway by reusing concrete from demolition of the existing spillway and locally available rocks. Dewatering of the dam will be carried out using pumps placed near the surface of the water to avoid stirring up bottom sediments and pumping sediment laden water from the dam. Dewatering release options and acceptable water quality discharge limits will be discussed with the local authorities prior to finalisation of the ESCP. Dewatering will be carried out only to the level required to reconstruct the spillway. Desilted material will be placed in a bunded area and dried before being transported to and disposed of at a disposal area approved by the local authority. Trucks transporting desilted materials will be kept covered. Any spilled materials shall be cleaned without undue delay. Reuse concrete material from demolition of the existing spillway for construction of the new spillway. Consider using desilted material for landscaping or forestry where there is low risk of pollution if practicable. Workers coming into contact with Watermill Creek water/ sediment will use suitable PPE and implement good personal hygiene practices to safeguard against microbial hazards from sewage. Assessment and potential reinstatement of aquatic and semi aquatic vegetation. Implement mitigation and management measures recommended in the Biodiversity Assessment of Native Aquatic Fauna (Eel and Shrimp).

8.0 General Environmental Considerations

8.1 General Environmental Mitigation and Measures

Table 11 shows the mitigation measures that are applicable to all works and excludes heritage impact assessment.

Table 11: Environmental Impacts and Mitigation and Management Measures for all works

Works	Potential Environmental Impact	Mitigation and Management Measures
General construction works.	Overall environmental impacts: Dust, noise, vibration, erosion and sedimentation, water quality, waste management, etc. Heritage items closed and being not available to visitors/ tourists.	Consult the local authority during development of CEMP, traffic management plans, ECSP, waste management plans and incorporate the latest site-specific requirements. Minimise the area and duration of cordoning off heritage items and minimise safety risk and inconvenience to the public/ tourists throughout the works. Fence/ cordon off all work sites and provide safety signage to ensure public safety throughout the works. Prior to the commencement of construction, all contractors would be inducted on the key project environmental risks, procedures, mitigation measures and conditions of approval. Areas disturbed as part of the works would be reinstated to its original condition as best practicable. Construction work areas are to be cordoned off, stabilised and kept in a clean and tidy condition throughout the works. No trees or shrubs are to be removed as part of the works without prior approval from the authorities. The selected temporary compound/ lay down area, temporary compound and work site does not involve clearing of any vegetation. In the event of any tree becoming damaged during construction, the Contractor would immediately notify the authorities. The Contractor(s) shall prepare a Health and Safety Management Plan for the works. Safe Work Method Statements (SWMS) shall be prepared for all works and permits shall be obtained for high risk works such as working at height and/ or deep excavation. Establish and implement a stakeholder communication plan/ procedure including complaints handling in consultation with the local authority. Maintain, inspect and service construction plant to minimise the risk of leakage/ spillage of fuel/ lubricating/ hydraulic oils. Provide suitable and adequate emergency response equipment commensurate with the risk of pollution from plant, substances and the works.

8.2 Construction Environmental Management Plan

The CEMP shall take into consideration the proposed construction methodology and site-specific details in consultation with the local authority. The outline of contents for the CEMP is provided below.

1.0 Introduction	**6.5 Traffic and Access**
1.1 Project Overview	6.5.1 Activities and Impacts
1.2 Scope and Purpose	6.5.2 Objectives
1.2.1 Scope	6.5.3 Management Strategy and Actions
1.2.2 Objectives / Purpose of this Plan	**6.6 Visual amenity**
1.3 Stakeholders	6.6.1 Activities and Impacts
2.0 Tasks and Responsibilities	6.6.2 Objectives
2.1 Environmental Management Plan	6.6.3 Management Strategy and Actions
3.0 Environmental Objectives	**6.7 Odour Control**
3.1 Environmental Objectives and Targets	6.7.1 Activities and Impacts
4.0 EMP Framework / Statutory Requirements	6.7.2 Objectives
4.1 Management Framework	6.7.3 Management Strategy and Actions
4.2 Roles and Responsibilities	6.7.4 Monitoring
4.3 Legislative and Planning framework	**6.8 Dust Control**
4.3.1 EPBC Act 1999	6.8.1 Activities and Impacts
4.4 State legislation and planning instruments	6.8.2 Objectives
4.5 Local Planning requirements	6.8.3 Management Strategy and Actions
4.5.1 Induction and Training	6.8.4 Monitoring
5.0 Risk Assessment	**6.9 Noise**
5.1 Risk Assessment Process	6.9.1 Activities and Impacts
6.0 Management Measures	6.9.2 Objectives
6.1 Overview	6.9.3 Management Strategy and Actions
6.2 Biodiversity	6.9.4 Monitoring
6.2.1 Activities and Impacts	**6.10 Cultural Heritage**
6.2.2 Objectives	6.10.1 Activities and Impacts
6.2.3 Management Strategy and Actions	6.10.2 Objectives
6.2.4 Monitoring	6.10.3 Management Strategy and Actions
6.3 Stormwater	6.10.4 Monitoring
6.3.1 Activities and Impacts	7.0 Communications and Consultation
6.3.2 Objectives	7.1 Key contacts for the project
6.3.3 Management Strategy and Actions	7.2 Consultation with Stakeholders
6.3.4 Monitoring	8.0 Emergency and Incident Management
6.4 Waste and Sediment Management	8.1 Emergency Management
6.4.1 Activities and Impacts	8.2 Incident Management
6.4.2 Objectives	
6.4.3 Management Strategy and Actions	
6.4.4 Monitoring	

Other factors that should be considered in preparing the CEMP include:

- Sewage and stormwater pollution of Watermill Dam, Watermill Creek and at Emily Bay has been occurring from upstream sources for a considerable period prior to this project (AECOM 2018). Aspects that warrant consideration include;
  - Sediment management: Sediment in Watermill Dam and Watermill Creek is known to be contaminated with sewage and urban runoff and needs to be properly managed during excavation, drying, transportation and disposal at a location approved by the local authority.
  - Worker health and safety: Workers coming into contact with contaminated water/ sediment at the Watermill Dam and/or Watermill Creek would be exposed to health hazards and need to use suitable PPE and implement good personal hygiene practice.
- The REO would remain in service throughout the works and therefore the works should be carried out in a manner not to hinder normal operations;
- Monitoring of water quality in Watermill Creek would be carried out by DITRDC and would need to be coordinated with the works of the appointed contractor;
- A biodiversity assessment of native aquatic fauna (Eel and shrimp) in Watermill Dam and Creek is currently being carried out by a specialist and recommended mitigation and management measures (if any) shall inform the CEMP and be adhered to; and
- The CEMP for the works packages within KAVHA shall conform to the requirements stipulated in the KAVHA CMP.

8.3 Planning Requirements

Development Approvals (DA) are not required under the *Planning Act 2002* where the use or development is permitted as of right for the land zone, or where the use or development is carried out in accordance with any conditions and standards specified in the Plan. However, a DA is required where works are located within a Heritage Overlay, noting that there is potential for exemption from a DA where the works are being carried out under a heritage management plan or conservation management plan.

Section 28 of the *Heritage Act 2002* states that for a DA that is in relation to or is likely to affect a heritage item, a heritage impact statement has to be prepared. The form and content of the heritage impact statement shall be directed by the Minister. The Minister may also require the applicant prepare, in relation to that item, a conservation management plan. Where there is this requirement, the DA shall not be determined until the conservation management plan is approved for the heritage item or the Minister withdraws the requirement.

9.0 References

AECOM Australia Pty Ltd. (2018). *Kingston and Arthurs Vale Safety Hazard Investigations: 50% Concept Design Report - Very High-Risk Items*. Canberra: Unpublished report for Department of Infrastructure, Regional Development and Cities.

Australian Heritage Council. (2013). *Ruins: A Guide to Conservation and Management*. Canberra, ACT. Retrieved from http://www.environment.gov.au/system/files/resources/e4e0fb1f-2553-4a3c-b454-2f7d630cdd6a/files/ruins.pdf

Clive Lucas Stapleton and Partners. (1988). *Kingston and Arthur's Vale Historic Area (KAVHA) Norfolk Island Conservation Management Plan: Vol. 2C - Conservation and Development Guidelines for Place Generally, Areas, Buildings, Built Features, Landscape Items and Vegetation*. Sydney: Unpublished report for Department of Administrative Services, Australian Construction Services.

Department of Sustainability Environment Water Population and Communities. (2013). *Significant Impact Guidelines 1.2: Actions on, or impacting upon, Commonwealth Land and Actions by Commonwealth Agencies*. Canberra: Department of Sustainability Environment Water Population and Communities.

Department of the Environment. (2013). *Matters of National Environmental Significance, Significant Impact Guidelines 1.1*. Canberra, ACT: Australian Government.

Department of the Environment and Energy. (2004). Arched Building, Longridge, Rocky Point Rd, Longridge, EXT, Australia. Retrieved November 28, 2019, from http://www.environment.gov.au/cgi-bin/ahdb/search.pl?mode=place_detail;search=place_name%3DLongridge%3Bstate%3DEXT%3Bkeyword_PD%3Don%3Bkeyword_SS%3Don%3Bkeyword_PH%3Don%3Blatitude_1dir%3DS%3Blongitude_1dir%3DE%3Blongitude_2dir%3DE%3Blatitude_2dir%3DS%3Bin

Extent Heritage Pty Ltd. (2019). *Kingston and Arthur's Vale Historic Area (KAVHA) Archaeological Zoning and Management Plan (draft)*. Prepared for the Department of Infrastructure, Regional Development and Cities.

GML Heritage Pty Ltd. (2018). *Kingston and Arthur 's Vale Historic Area Safety Hazard Scoping Study*. Sydney: Unpublished report for Department of Infrastructure, Regional Development and Cities.

Godden Mackay Logan Pty Ltd. (2016). *Kingston and Arthur's Vale Historic Area Heritage Management Plan*. Report to the Australian Government.

ICOMOS (Australia). (2013). *The Burra Charter: The Australia ICOMOS Charter for Places of Cultural Significance*. Burwood, Victoria: Australia ICOMOS.

Mountney, W. T. (1846). *Plan of Longridge Station Norfolk Island 1846*. Held by State Records of NSW. Call no. D Z/ Ca 84/12. Retrieved from http://digital.sl.nsw.gov.au/delivery/DeliveryManagerServlet?embedded=true&toolbar=false&dps_pid=IE3745358

Otto Cserhalmi & Partners. (2002). *Kingston & Arthurs Vale Historic Area: Cultural landscape overview (Draft)*. Sydney: Unpublished report for the KAVHA Management Board.

Purcell. (2017). *Kingston & Arthur's Vale Historic Area Norfolk Island Condition and Conservation Report*. Sydney: Unpublished report for Department of Infrastructure, Regional Development and Cities.

Wilson, G., & Davies, M. (1980). *Norfolk Island: Archaeological Survey Kingston-Arthur's Vale Region*. Canberra: Prepared for the Department of Housing and Construction.

Appendix A

Tender Drawings

ISO A1 594mm x 841mm

KAVHA STRUCTURAL ASSESSMENT
NORFOLK ISLAND

STRUCTURAL DRAWING LIST

S000	COVER SHEET AND DRAWING LIST
S001	GENERAL NOTES - SHEET 1
S002	GENERAL NOTES - SHEET 2
S003	CIVIL HOSPITAL - OPTION 01
S004	CIVIL HOSPITAL SECTIONS - OPTION 01
S005	CIVIL HOSPITAL - OPTION 02
S006	CIVIL HOSPITAL SECTIONS - OPTION 02 SHEET 1
S007	CIVIL HOSPITAL SECTIONS - OPTION 02 SHEET 2
S008	CIVIL HOSPITAL SECTIONS - OPTION 02 SHEET 3
S010	ARTHUR VALE RETAINING WALL
S100	LONGRIDGE ARCH
S105	LONGRIDGE ARCH SECTIONS - SHEET 1
S200	WATERMILL DAM

NOT FOR CONSTRUCTION

AECOM

PROJECT

KAVHA
STRUCTURAL
ASSESSMENT

CLIENT

DEPARTMENT OF
INFRASTRUCTURE,
TRANSPORT, REGIONAL
DEVELOPMENT &
COMMUNICATIONS
Prepared for:

CONSULTANT

AECOM Australia Pty. Ltd.
A.B.N. 20 093 846 925
www.aecom.com

TENDER

PROJECT MANAGEMENT INITIALS

s 47F

DESIGNER	CHECKED	APPROVED

ISSUE/REVISION

I/R	DATE	DESCRIPTION
C	08.04.2020	ISSUED FOR TENDER
B	02.04.2020	ISSUED FOR TENDER
A	06.12.2019	ISSUED FOR INFORMATION

KEY PLAN

PROJECT NUMBER

60615424

SHEET TITLE

COVER SHEET AND
DRAWING LIST

SHEET NUMBER

60615424-DRG-0000

Last Saved: 15/10/2020 11:45:10 AM
Filename: C:\Users\ganih\Documents\Timber Option 20_04_02_60615424-MOD-ST-CENTRAL_R19_Heru.Gani.rvt

GENERAL NOTES

G1. THESE DRAWINGS ARE TO BE READ IN CONJUNCTION WITH ARCHITECT'S AND OTHER CONSULTANT'S DRAWINGS AND SPECIFICATIONS AND SUCH OTHER WRITTEN INSTRUCTIONS AS MAY BE ISSUED DURING THE COURSE OF THE CONTRACT.

G2. IF IN DOUBT, VERIFY WITH THE RELEVANT PARTY AS NECESSARY.

G3. REFER ANY DISCREPANCY, AMBIGUITY, OMISSION OR INCONSISTENCY TO THE CONTRACT ADMINISTRATOR BEFORE PROCEEDING WITH THE WORK.

G4. DO NOT OBTAIN DIMENSIONS BY SCALING THE STRUCTURAL ELEMENTS.

G5. VERIFY ALL SETTING OUT DIMENSIONS WITH THE CONTRACT ADMINISTRATOR.

G6. SETTING OUT DIMENSIONS SHALL BE VERIFIED ON SITE BY THE CONTRACTOR PRIOR TO CONSTRUCTION/FABRICATION, WHO SHALL BE RESPONSIBLE FOR THEIR CORRECTNESS.

G7. MATERIALS AND WORKMANSHIP SHALL COMPLY WITH THE BUILDING CODE OF AUSTRALIA (BCA), THE APPROPRIATE AUSTRALIAN STANDARDS, THE BY-LAWS AND ORDINANCES OF THE RELEVANT BUILDING AUTHORITIES EXCEPT WHERE VARIED BY THE CONTRACT DOCUMENTS.

G8. DIMENSIONS ARE IN MILLIMETRES AND LEVELS ARE IN METRES UNLESS NOTED OTHERWISE.

G9. WORKS SHALL BE CARRIED OUT IN ACCORDANCE WITH ALL WORKCOVER REQUIREMENTS AND THE WORK HEALTH AND SAFETY ACT AND THE WORK HEALTH AND SAFETY REGULATION.

G10. CONSTRUCTION SHALL NOT COMMENCE UNTIL THE RELEVANT CONSTRUCTION CERTIFICATE IS ISSUED BY THE PRINCIPAL CERTIFYING AUTHORITY.

G11. SERVICES SHOWN ON DRAWINGS ARE INDICATIVE ONLY. PRIOR TO THE COMMENCEMENT OF CONSTRUCTION WORKS, THE CONTRACTOR IS TO IDENTIFY ALL EXISTING SERVICES. ANY DAMAGES TO THE EXISTING SERVICES ARE TO BE RECTIFIED AT THE CONTRACTOR'S EXPENSE.

G12. DURING CONSTRUCTION, IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO ENSURE THAT THE STRUCTURES AND EXCAVATIONS ARE MAINTAINED IN A SAFE AND STABLE CONDITION AT ALL TIME AND NO PART IS TO BE OVERSTRESSED. THE CONTRACTOR SHALL DEVELOP WORK METHOD STATEMENTS FOR ALL ERECTION OF STRUCTURAL STEEL/FORMWORK/DEMOLITION/EXCAVATION/TILT PANELS ETC. AND PROVIDE TEMPORARY WORKS SUCH AS BRACING, PROPPING AND SHORING ETC. TO KEEP THE WORKS AND EXCAVATIONS STABLE AND FREE FROM WATER AT ALL TIMES. THE CONTRACTOR IS TO ENGAGE AN NPER REGISTERED STRUCTURAL ENGINEER TO DESIGN AND CERTIFY THE TEMPORARY WORKS.

G13. REDUCED LEVELS AND GRID DIMENSIONS SHOWN IN THESE DRAWINGS ARE APPROXIMATE ONLY AND ARE FOR THE SOLE PURPOSE OF ASSISTING THE STRUCTURAL DOCUMENTATION. THEY MUST NOT BE USED FOR CONSTRUCTION. REFER TO ARCHITECT'S DRAWINGS FOR ALL CONSTRUCTION REDUCED LEVELS.

G14. ALL PROPRIETARY PRODUCTS ARE TO BE INSTALLED STRICTLY IN ACCORDANCE WITH MANUFACTURER'S WRITTEN RECOMMENDATIONS UNLESS NOTED OTHERWISE.

G15. ALL DISTURBED AREAS NOT SUBJECTED TO NEW WORKS SHALL BE REINSTATED TO THEIR EXISTING CONDITION BY THE CONTRACTOR AT THE COMPLETION OF WORKS TO THE SATISFACTION OF THE RESPONSIBLE AUTHORITY.

G16. ALL PENETRATIONS THROUGH SLABS AND BEAMS SHALL BE APPROVED BY THE CONTRACT ADMINISTRATOR PRIOR TO COMMENCEMENT OF WORK.

G17. THE DRAWINGS MAY NOT SHOW ALL DETAILS OF FIXTURES, INSERTS, SLEEVES, OPENINGS ETC. REQUIRED BY THE VARIOUS TRADES. ALL SUCH DETAILS, INCLUDING RECESSES AND CHASES, ARE TO BE APPROVED BY THE CONTRACT ADMINISTRATOR BEFORE PROCEEDING WITH THE CONSTRUCTION.

G18. NON-LOAD BEARING ELEMENTS SHALL BE KEPT CLEAR OF THE STRUCTURAL SOFFIT BY AN ALLOWANCE DETERMINED FROM SPAN/250 OR CANTILEVER/125 BUT NOT LESS THAN 20mm UNLESS NOTED OTHERWISE ON THE DRAWINGS. CONSTRUCTION OF ANY MASONRY WALLS OR OTHER PERMANENT LOADING MUST NOT BE BUILT ON CONCRETE SLABS OR BEAMS UNTIL SUPPORTING FORMWORK HAS BEEN REMOVED. HOWEVER, PROPS AND FORMWORK SHALL NOT BE REMOVED BEFORE THE MINIMUM TIME SPECIFIED. DISTRIBUTE MASONRY ON SLAB ADJACENT TO ITS FINAL POSITION PRIOR TO CONSTRUCTING WALLS. ALL UNREINFORCED MASONRY WALLS ARE TO BE SEPARATED FROM ABUTTING CONCRETE WITH TWO LAYERS OF SUPER ALCOR.

G19. WHERE STRUCTURAL INSPECTIONS ARE REQUIRED FOR CERTIFICATION, THE INSPECTIONS ARE TO BE PERFORMED BY THE STRUCTURAL ENGINEER, THE CONTRACTOR IS REQUIRED TO ALLOW TIME FOR THE STRUCTURAL ENGINEER TO INSPECT AT THE FOLLOWING POINTS: COMPLETED EXCAVATION, FORMWORK, REINFORCEMENT, MEMBRANES AND EMBEDMENT PRIOR TO PLACING CONCRETE, COMPLETED ERECTED STRUCTURAL ELEMENTS PRIOR TO PLACING COVERING (UNLESS COVERED BY AS1684 RESIDENTIAL TIMBER-FRAMED CONSTRUCTION).

G20. A MINIMUM OF 48 HOURS NOTICE IS REQUIRED FOR INSPECTION. ALL WORKS TO BE INSPECTED MUST BE COMPLETED PRIOR TO THE TIME OF INSPECTION.

G21. INSPECTIONS DO NOT RELIEVE THE CONTRACTOR OF RESPONSIBILITY FOR THE COMPLETENESS AND CORRECTNESS OF THEIR WORKS.

G22. INSPECTIONS WILL BE PERIODIC AND REPRESENTATIVE AND WILL NOT NECESSARILY BE MADE OF ALL WORKS. THE CONTRACTOR IS TO ADVISE THE ENGINEER OF ALL WORK COMPLETION, BUT ELECTION TO INSPECT OR OTHERWISE WILL BE AT THE ENGINEER'S DISCRETION. THE CONTRACTOR IS TO ALLOW TIME AND PROVIDE SITE ACCESS FOR THE INSPECTIONS TO TAKE PLACE AND IS TO HAVE A RESPONSIBLE SITE SUPERVISOR AVAILABLE TO RECEIVE ANY COMMENT OR DIRECTION FROM THE INSPECTING PARTY.

G23. WHERE STRUCTURAL ELEMENTS ARE DESIGNED AND CERTIFIED BY OTHER PARTIES, THE BUILDER SHALL OBTAIN WRITTEN CERTIFICATION, PRIOR TO PROCEEDING WITH ANY CONSTRUCTION WHICH MAY PREVENT INSPECTION OR REMEDIAL WORKS BEING UNDERTAKEN TO THESE ITEMS.

CONCRETE NOTES

C1. ALL CONCRETE WORKMANSHIP AND MATERIALS SHALL BE IN ACCORDANCE WITH AS3600:2009, AS2870:2011 AND THE SPECIFICATION.

C2. CONCRETE QUALITY AND REQUIRED PROPERTIES OF CONCRETE SHALL BE IN ACCORDANCE WITH AS1379:2007.

C3. SURFACE FINISH AND FORMWORK IS TO BE IN ACCORDANCE WITH THE SAI FORMWORK CODE AS3610:1995 EXCEPT WHERE SPECIFIED OTHERWISE. CONCRETE EXPOSED TO VIEW IN THE FINAL PROJECT IS TO BE CLASS FINISH AND CLASS FINISH ELSEWHERE.

C4. CONCRETE REQUIREMENTS AS SHOWN IN TABLE BELOW UNLESS NOTED OTHERWISE ON THE DRAWINGS. NO "BRECCIA" TYPE AGGREGATE IS TO BE USED.

MEMBER LOCATION	EXPOSURE CLASSIFICATION	CONCRETE STRENGTH f'c (MPa) AT 28 DAYS	CONCRETE CLASS	SLUMP AT SITE +/- 15mm	NOM. MAX. AGGREGATE SIZE (mm)	MAX. 56 DAY SHRINKAGE x10^{-6}	REQUIRED COVER (mm)
BORED PIERS	**A2**	**32**	**N**	80	20	-	**75**
DEADMAN ANCHORS	**B2**	**25**	**N**	80	20	-	**40**
MASS CONCRETE	**-**	**15**	**N**	80	20	-	**40**
THRUST BLOCK	**-**	**15**	**N**	80	20	-	**40**
PILE CAPS	**A2**	**32**	**N**	80	20	-	-
				80	20		
				80	20		
				80	20		
				80	20		
				80	20		

C5. NORMAL CLASS CONCRETE SHALL HAVE CEMENT OF TYPE GENERAL PURPOSE BLENDED CEMENT (GP) OR FOR THE ELEMENTS MARKED "*" (GREEN CONCRETE) ALL CEMENT TO BE GENERAL BLEND, GB (SLAG) [EQUIVALENT OF 70% TYPE GP, PLUS 30% GROUND GRANULATED BLAST FURNACE SLAG] PLUS 25% FLY ASH.

C6. THE CONTRACTOR IS TO SEEK APPROVAL FROM THE STRUCTURAL ENGINEER IN WRITING IF ANY ADMIXTURES TO BE USED IN THE CONCRETE MIX. CALCIUM CHLORIDE WILL NOT BE PERMITTED AND SHALL NOT BE USED UNDER ANY CIRCUMSTANCES.

C7. ALL CONCRETE SHALL BE SUBJECT TO PROJECT ASSESSMENT AND TESTING TO AS1379:2007.

C8. MECHANICALLY VIBRATE CONCRETE IN THE FORM TO GIVE MAXIMUM COMPACTION WITHOUT SEGREGATION OF THE CONCRETE.

C9. CURE CONCRETE AS REQUIRED BY SECTION 17 OF AS3600:2009 AND AS SET OUT IN THE SPECIFICATION.

C10. IN THE DRAWINGS, THE BEAM DEPTH IS WRITTEN FIRST AND INCLUDES SLAB THICKNESS IF ANY.

C11. STRIP FOOTING DEPTHS ARE WRITTEN FIRST FOLLOWED BY WIDTH.

C12. UNLESS SHOWN ON THE DRAWINGS, THE LOCATION OF ALL CONSTRUCTION JOINTS SHALL BE SUBMITTED TO THE CONTRACT ADMINISTRATOR FOR REVIEW.

C13. NO CHASES OR HOLES GREATER THAN 150mm DIAMETER, OR EMBEDMENT OF PIPES GREATER THAN 40mm DIAMETER OTHER THAN THOSE SHOWN ON THE STRUCTURAL DRAWINGS SHALL BE MADE IN THE CONCRETE SLABS. FOR ALL OTHER CONCRETE MEMBERS, NO PENETRATIONS, CHASES OR EMBEDMENT SHALL BE MADE WITHOUT PRIOR APPROVAL BY THE STRUCTURAL ENGINEER.

C14. EXACT SIZE AND LOCATION OF PENETRATIONS ARE TO BE OBTAINED FROM WORKSHOP DRAWINGS PRIOR TO SCHEDULING OF REINFORCEMENT, AND ARE NOT TO EXCEED DIMENSIONS WHERE SHOWN ON THE STRUCTURAL DRAWINGS. LIAISE WITH ALL TRADES FOR FINAL PENETRATION SETOUT.

C15. DO NOT PLACE CONDUITS, PIPES AND THE LIKE WITHIN COVER CONCRETE. CONDUITS CAST INTO CONCRETE MEMBERS SHALL BE SPACED AT MAXIMUM DISTANCE POSSIBLE AND UNDER NO CIRCUMSTANCES CLOSER THAN A CLEAR SPACING OF TWICE THE LARGER CONDUIT DIAMETER FROM PARALLEL REINFORCEMENT OR ANY OTHER CONDUIT.

C16. SLURRY USED TO LUBRICATE CONCRETE PUMP LINES IS NOT TO BE USED IN ANY STRUCTURAL MEMBERS.

C17. CONCRETE SIZES AS DRAWN ARE MINIMUM AND DO NOT INCLUDE APPLIED FINISHES.

C18. UNLESS NOTED OTHERWISE, ALL SLABS CAST ON GROUND REQUIRE 50mm THICK COMPACTED FREE DRAINING SAND BEDDING WITH A 0.2mm POLYTHENE MEMBRANE.

C19. GENERALLY, DRAWINGS ARE DETAILED IN ACCORDANCE WITH THE PRINCIPLES SET OUT IN THE CONCRETE INSTITUTE OF AUSTRALIA (CIA) "REINFORCEMENT DETAILING HANDBOOK" OF 2010.

C20. ALL FORMED EXPOSED EDGES AND RE-ENTRANT CORNERS SHALL BE CHAMFERED OR FILLETED 15mm UNLESS NOTED OTHERWISE ON THE ARCHITECTURAL OR STRUCTURAL DRAWINGS. REFER TO ARCHITECT'S DRAWINGS AND SPECIFICATION FOR ALL FALLS IN SLAB, REGLETS AND CHAMFERS ETC. PROVIDE DRIP GROOVES AT ALL EXPOSED EDGES, COVER TO BE MAINTAINED.

C21. THE FACE OF ALL CONCRETE WHICH HAS REINFORCEMENT PROJECTING FROM IT AND AGAINST WHICH NEW CONCRETE IS TO BE CAST, IS TO BE THOROUGHLY MECHANICALLY SCABBLED, FULLY EXPOSING THE AGGREGATE MATRIX.

CHEMICAL & MECHANICAL ANCHOR NOTES

CA1. "CHEMSETS" DENOTES RAMSET GRADE 5.8 HOT DIPPED GALVANISED STUDS FIXED WITH RAMSET CHEMSET REO 502 WITH THE FOLLOWING MINIMUM EMBEDMENT:

M12 CHEMSETS - 110mm EMBEDMENT UNO
M16 CHEMSETS - 125mm EMBEDMENT UNO
M20 CHEMSETS - 150mm EMBEDMENT UNO
M24 CHEMSETS - 160mm EMBEDMENT UNO

CA2. "CHEMSET MAXIMA CAPSULES" DENOTES RAMSET CHEMSET MAXIMA SPIN CAPSULES WITH STUDS AND EMBEDMENTS AS DEFINED IN NOTE CA1.

CA3. "TRUBOLTS" DENOTES RAMSET TRUBOLT HOT DIPPED GALVANISED STUD ANCHORS WITH THE FOLLOWING MINIMUM EMBEDMENT:

M12 TRUBOLTS - 80mm EMBEDMENT UNO
M16 TRUBOLTS - 110mm EMBEDMENT UNO
M20 TRUBOLTS - 135mm EMBEDMENT UNO

CA4. "CHEMSET 101 ANCHORS" DENOTES RAMSET GRADE 5.8 HOT DIPPED GALVANISED STUDS, FIXED WITH AN EFFECTIVE DEPTH OF 64mm INTO EXTRUDED BRICK OR HOLLOW CONCRETE BLOCK, USING THE MANUFACTURER'S SLEEVES/SIEVES AND RAMSET CHEMSET INJECTION 101.

CA5. ALL ANCHORS ARE TO BE FIXED IN ACCORDANCE WITH THE MANUFACTURER'S WRITTEN RECOMMENDATIONS. IN PARTICULAR ENSURE HOLES ARE CLEAN OF DUST PRIOR TO INSTALLATION OF CHEMICAL ANCHORS.

CA6. CONTRACTOR IS TO LOAD TEST 5% OF CHEMICAL ANCHORS AT RANDOM TO MANUFACTURER NOMINATED PROOF LOAD FOLLOWING INSTALLATION. IF ANY ANCHORS FAIL TESTING, LOAD TEST 100% OF REMAINING CHEMICAL ANCHORS.

CA7. DESIGN HAS BEEN CARRIED OUT USING THE PRODUCTS ABOVE. PRODUCTS MAY BE SUBSTITUTED SUBJECT TO ENGINEER'S APPROVAL.

REINFORCEMENT NOTES

R1. SYMBOLS ON DRAWINGS FOR GRADE AND STRENGTH OF REINFORCEMENT ARE:

N DENOTES GRADE D500N HOT-ROLLED DEFORMED REINFORCEMENT BAR TO AS/NZS 4671:2001.
SL DENOTES GRADE 500L WELDED WIRE REINFORCEMENT MESH TO AS/NZS 4671:2001.
L DENOTES GRADE D500L STEEL REINFORCEMENT TO AS/NZS 4671:2001.
R DENOTES GRADE 250R PLAIN ROUND BAR REINFORCEMENT TO AS/NZS4 671:2001.
TM DENOTES HARD DRAWN STEEL TRENCH MESH, GRADE 500L TO AS/NZS 4671:2001.

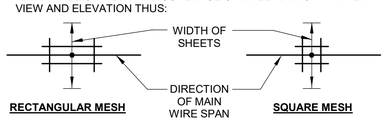
R2. BAR NOTATION GIVES THE FOLLOWING INFORMATION IN THIS ORDER:

NO OF BARS; GRADE; BAR SIZE (mm); SPACING (mm, IF REQUIRED); PLACING INFORMATION. E.G. 20N16-200 BTM.

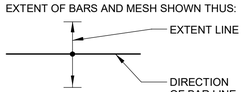
R3. MESH NOTATION GIVES THE FOLLOWING INFORMATION IN THIS ORDER:

SL OR RL SYMBOL; AS REFERENCE NUMBER IF STANDARD MESH OR SPECIAL CODE IF NON-STANDARD MESH; PLACING INFORMATION. E.G. RL918 TOP.

R4. MAIN WIRES OF MESH AND COVERAGE OF SHEETS SHOWN IN PLAN VIEW AND ELEVATION THUS:



R5. EXTENT OF BARS AND MESH SHOWN THUS:



R6. REINFORCEMENT IS REPRESENTED DIAGRAMMATICALLY AND NOT NECESSARILY IN TRUE PROJECTION.

R7. REINFORCEMENT DIMENSIONS SHALL NOT BE SCALED.

R8. SPLICE REINFORCEMENT ONLY AT LOCATIONS SHOWN IN THE DRAWINGS. LAP LENGTH SHALL COMPLY WITH AS3600:2009.

REINFORCEMENT SHALL NOT BE SPLICED EXCEPT WHERE SHOWN IN THE DRAWINGS. IF SPLICES ARE NOT INDICATED IN THE DRAWINGS, SUITABLE LOCATIONS SHALL BE PROPOSED FOR WRITTEN APPROVAL BY STRUCTURAL ENGINEER. THE SPLICED LENGTH OF BARS SHALL BE AS GIVEN IN THE FOLLOWING TABLE, EXCEPT WHERE OTHER DIMENSIONS ARE STATED ON THE ACTUAL DETAIL:

TYPE OF MEMBER	TENSILE LAP LENGTH (mm) FOR GRADE 500N DEFORMED BARS.							
	N10	N12	N16	N20	N24	N28	N32	N36
SLAB OR WALL (WITH 300mm OR LESS DEPTH OF CONCRETE BELOW THE BAR) AND ALL VERTICAL BARS	400	500	750	1000	1250	1500	1800	2200
SLAB OR WALL (WITH GREATER THAN 300mm OF CONCRETE BELOW THE BAR)	500	650	1000	1300	1600	1950	2300	2800

EMBEDMENT LENGTHS FOR STARTER BARS AND SPLICE LENGTHS FOR COLUMN BARS SHALL BE AS GIVEN IN THE FOLLOWING TABLE, EXCEPT WHERE OTHER DIMENSIONS ARE STATED ON THE ACTUAL DETAIL. THE DIMENSIONS IN THE TABLE ALSO INDICATE OVERALL ANCHORAGE (DEVELOPMENT) LENGTHS FOR STARTER / DOWEL BARS. ANY COGS USED SHALL BE DETAILED AS PER AS3600:2009.

BAR SIZE (mm)	SPLICE LENGTH (mm)	NUMBER OF FITMENTS AT COLUMN BAR CRANK
N10	400	1-R10
N12	500	1-R10
N16	650	1-R10
N20	800	2-R10
N24	1000	1-N12
N28	1150	2-N12
N32	1300	3-N12
N36	1450	3-N12

R9. REINFORCEMENT SHALL BE BENT COLD IN ACCORDANCE WITH AS3600:2009 EXCEPT WHERE APPROVED BY THE CONTRACT ADMINISTRATOR. NO REBENDING SHALL BE PERMITTED UNLESS APPROVED BY THE CONTRACT ADMINISTRATOR.

R10. WHERE LAP IS SPECIFIED, MESH SHALL BE LAPPED SUCH THAT THE TWO OUTERMOST WIRES LAP WITH THOSE OF THE OTHER SHEET AS SHOWN:

ALL LAPS ARE TO BE WIRED TOGETHER AT 1000 CRS.

REINFORCEMENT NOTES (CONT')

R11. ALL REINFORCEMENT IS TO BE ACCURATELY POSITIONED, ADEQUATELY SUPPORTED, AND THEN INSPECTED BY THE CONTRACT ADMINISTRATOR BEFORE ANY CONCRETE IS PLACED.

R12. WELDING OF REINFORCEMENT INCLUDING TACK-WELDING FOR FIXING PURPOSES SHALL COMPLY WITH AS3600:2009 AND AS1554.3:2008. WELDING IS PERMITTED ONLY WHERE SHOWN IN THE DRAWINGS OR WHERE OTHERWISE APPROVED BY THE CONTRACT ADMINISTRATOR.

R13. WHERE NO REINFORCEMENT IS SHOWN ON THE DRAWINGS AT RIGHT ANGLES TO THE MAIN REINFORCEMENT, PLACE N12-300 TRANSVERSE TO THE REINFORCEMENT SHOWN TO SUIT THE BAR LAYING SEQUENCE. ALL OPENINGS AND RE-ENTRANT CORNERS IN THE CONCRETE SHALL HAVE 2N12 BARS x 1200 LONG TOP AND BOTTOM DIAGONALLY ACROSS THE CORNER.

R14. FIRST SLAB BAR IS TO BE POSITIONED MAX. 100mm FROM FACE OF BEAMS, RC WALLS AND SLAB THICKENINGS PARALLEL TO BAR. FIRST TIE TO BE PLACED MAX. 50mm FROM FACE OF COLUMN OR SUPPORTING WALL UNDER.

R15. FIX 2N16 TRIMMER BARS AROUND OPENINGS IN EACH (TOP/BOTTOM) FACE OF MEMBER AND EXTENDING 750mm BEYOND THEIR CROSS-OVER POINT.

R16. REINFORCEMENT SHALL NOT BE CUT, BENT OR HEATED ON SITE WITHOUT THE CONTRACT ADMINISTRATOR'S PRIOR APPROVAL. DO NOT CUT REINFORCEMENT ON SITE TO CLEAR PENETRATIONS. DISPLACE REINFORCEMENT SLIGHTLY AS NECESSARY. MAINTAIN COVER DURING POUR.

R17. ALL REINFORCEMENT SHALL BE FIRMLY SUPPORTED ON PLASTIC OR CONCRETE CHAIRS. UNLESS NOTED OTHERWISE, MAXIMUM CENTRES OF SUPPORTING CHAIRS SHALL BE 600mm FOR FABRIC, 600mm FOR BARS UP TO 12mm DIAMETER, 900mm FOR BARS 16mm AND GREATER. REINFORCEMENT SHALL BE SECURELY TIED WITH GALVANISED WIRE TIES AND ALL TIE ENDS SHALL BE TURNED INTO THE MEMBER CLEAR OF THE COVER ZONE.

R18. REFER TO THE CONCRETE NOTES FOR THE COVER TO REINFORCEMENT NEAREST THE CONCRETE SURFACE. UNLESS NOTED OTHERWISE ON DRAWINGS.

R19. THE REQUIRED COVER SHALL BE MAINTAINED TO ALL PIPES, CONDUITS, REGLETS, DRIP GROOVES ETC.

R20. UNLESS NOTED OTHERWISE SLAB REINFORCEMENT AT SUPPORTING WALLS AND SLAB REINFORCEMENT BARS SHALL EXTEND 100mm ONTO SUPPORTING WALLS, WITH 50% OF BOTTOM BARS COGGED TO ACHIEVE ANCHORAGE AT SIMPLY SUPPORTED ENDS. MESH IN SLABS SHALL EXTEND 100mm ONTO SUPPORTING WALLS AND INCLUDE AT LEAST ONE CROSS WIRE.

LEGEND/ABBREVIATIONS

ABBREVIATION	DESCRIPTION
HORIZ	HORIZONTAL
VERT	VERTICAL
CENTRAL	CENTRALLY PLACED
CRS	CENTRES
T or TOP	TOP or TOP FACE
B or BTM	BOTTOM or BOTTOM FACE
T&B	TOP & BOTTOM
NF	NEAR FACE
FF	FAR FACE
INTF	INTERNAL FACE
EXTF	EXTERNAL FACE
EF	EACH FACE
EW	EACH WAY
EQ	EQUAL
NSOP	NOT SHOWN ON PLAN
NSOE	NOT SHOWN ON ELEVATION
UNO	UNLESS NOTED OTHERWISE
TYP	TYPICAL
CL	CENTRE LINE
PL	PLATE
SV	SIZE VARIES
STG	STAGGERED
N/S	NEAR SIDE
F/S	FAR SIDE
B/S	BOTH SIDES
U/S	UNDER SIDE
L	LENGTH/LONG
W	WIDTH/WIDE
H	HEIGHT/HIGH
D	DEPTH/DEEP
NOM	NOMINAL
REQ'D	REQUIRED
REINF	REINFORCEMENT
OPP	OPPOSITE
SIM	SIMILAR
GA	GENERAL ARRANGEMENT
PT	POST TENSION
DRG	DRAWING
NTS	NOT TO SCALE
LV	LENGTH VARIES
ABR	ALTERNATE BAR REVERSED
MAX	MAXIMUM
MIN	MINIMUM
CONT	CONTINUOUS

NOT FOR CONSTRUCTION

AECOM

PROJECT

KAVHA STRUCTURAL ASSESSMENT

CLIENT

DEPARTMENT OF INFRASTRUCTURE, TRANSPORT, REGIONAL DEVELOPMENT & COMMUNICATIONS
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TENDER

PROJECT MANAGEMENT INITIALS

DESIGNER	CHECKED	APPROVED
S/47F		

ISSUE/REVISION

I/R	DATE	DESCRIPTION
C	08.04.2020	ISSUED FOR TENDER
B	02.04.2020	ISSUED FOR TENDER
A	06.12.2019	ISSUED FOR INFORMATION

KEY PLAN

PROJECT NUMBER

60615424

SHEET TITLE

GENERAL NOTES - SHEET 1

SHEET NUMBER

60615424-DRG-S001

STRUCTURAL STEELWORK NOTES

S1. DESIGN, FABRICATION AND ERECTION:
DESIGN CONFORMS TO AS4100:1998, AS/NZS 4600:2005 AND AS2327.1:2003 AS APPROPRIATE.

FABRICATION AND ERECTION SHALL BE CARRIED OUT IN ACCORDANCE WITH THE PROVISION OF AS4100:1998 AND AS3828:1998, AS APPROPRIATE.

S2. SETTING OUT DIMENSIONS SHALL BE VERIFIED ON SITE BY THE CONTRACTOR WHO SHALL BE RESPONSIBLE FOR THEIR CORRECTNESS.

S3. THE CONTRACTOR SHALL PROVIDE AND LEAVE IN PLACE UNTIL PERMANENT BRACING ELEMENTS ARE CONSTRUCTED SUCH TEMPORARY BRACING AS IS NECESSARY TO STABILISE THE STRUCTURE DURING ERECTION.

S4. UNLESS OTHERWISE NOTED ALL MATERIAL SHALL BE:
- GRADE 250 HOT-ROLLED PLATES COMPLYING WITH AS/NZS 3678:2011
- GRADE 300 HOT-ROLLED UB, UC, PFC, TFC, TFB, EA, UA AND FLATS COMPLYING WITH AS/NZS 3679.1:2010
- GRADE 300 WB, WC COMPLYING WITH AS/NZS 3679.2:2010
- GRADE 350 RHS, SHS, CHS COMPLYING WITH AS1163:2009

S5. WELDING:
WELDING IS TO BE CARRIED OUT IN ACCORDANCE WITH AS/NZS 1554.1:2011, AS/NZS 1554.2:2003.

WELDING CONSUMABLES TO BE E48XX OR W50X UNLESS NOTED OTHERWISE.

ALL WELDS TO BE 6mm CONTINUOUS FILLET WELD (CFW) SP CATEGORY UNLESS NOTED OTHERWISE.

ALL BUTT WELDS TO BE FULL PENETRATION BUTT WELD (FPBW) AND TO BE SP CATEGORY UNLESS NOTED OTHERWISE.

INSPECTIONS TO BE CARRIED OUT TO AS/NZS 1554.1:2011 UNLESS NOTED OTHERWISE IN THE DRAWINGS OR SPECIFICATION. MINIMUM EXTENT OF NON-DESTRUCTIVE EXAMINATION (NDE) SHALL BE AS FOLLOWS:

EXTENT OF NON-DESTRUCTIVE EXAMINATION (%)				
WELD CATEGORY	VISUAL MEANS		OTHER MEANS	
	VISUAL SCANNING	VISUAL EXAMINATION	MAGNETIC PARTICLE (FOR FILLET WELD)	RADIOGRAPHY OR ULTRASONIC (FOR BUTT WELD)
GP	100	15	2	-
SP	100	50	10	10

S6. BOLTS, NUTS AND WASHERS:
STEEL BOLTS, NUTS AND WASHERS SHALL COMPLY WITH THE RESPECTIVE STANDARDS AS APPROPRIATE.

DESIGNATION:
4.6/S REFERS TO GRADE 4.6 COMMERCIAL BOLTS TO AS1111:2000, TIGHTENED TO A SNUG TIGHT CONDITION TO AS4100:1998.

8.8/S REFERS TO GRADE 8.8 HIGH STRENGTH STRUCTURAL BOLTS TO AS1252:1996, TIGHTENED TO A SNUG TIGHT CONDITION TO AS4100:1998.

8.8/TB REFERS TO GRADE 8.8 HIGH STRENGTH STRUCTURAL BOLTS TO AS1252:1996, FULLY TENSIONED TO AS4100:1998 AS A BEARING TYPE JOINT.

8.8/TF REFERS TO GRADE 8.8 HIGH STRENGTH STRUCTURAL BOLTS TO AS1252:1996 FULLY TENSIONED TO AS4100:1998 AS A FRICTION JOINT WITH CONNECTING SURFACES LEFT UNCOATED.

S7. CONNECTIONS:
ALL DETAILS, GAUGE LINES, ETC. WHERE NOT SPECIFICALLY SHOWN ARE TO BE IN ACCORDANCE WITH AISC DESIGN CAPACITY TABLES FOR STRUCTURAL STEEL AND ASI STANDARDISED STRUCTURAL CONNECTIONS.

ALL PLATES TO BE 10mm THICK, EX-STANDARD SQUARE EDGE FLATS UNLESS NOTED OTHERWISE.

ALL BOLTS TO BE GRADE 8.8/S UNLESS NOTED OTHERWISE.
ALL BOLTS TO BE GALVANISED M20 UNLESS NOTED OTHERWISE.

ALL HOLD-DOWN BOLTS SHALL BE GRADE 4.6 TO AS1111:2000 AND HOT DIP GALVANISED AFTER FABRICATION UNLESS NOTED OTHERWISE.
ALL HOLD-DOWN BOLTS TO BE M20 UNLESS NOTED OTHERWISE.

ALL CAST-IN FERRULES AND MASONRY ANCHORS TO BE PASSIVATED ZINC COATED. ALL GALVANISED COMPONENTS TO BE CAST INTO CONCRETE MUST BE PASSIVATED.

ALL CAST-IN HD BOLTS ARE TO BE ALIGNED WITHIN STUD WALLS AND SURVEYED PRIOR TO CASTING OF SLAB TO ENSURE SETOUT ACCURACY. FOLLOWING CONFIRMATION OF SETOUT, TACK WELD BOLTS TO REINFORCEMENT MAT TO SECURE.

MINIMUM CONNECTION DETAILS SHALL CONSIST OF 2M20 8.8/S BOLTS AND 10mm CLEAT PLATE UNLESS NOTED OTHERWISE.

SLOTTED HOLES, WHERE 8.8/TF BOLTS ARE USED IN SLOTTED HOLES, A SPECIAL WASHER OR COVER PLATE, NOT LESS THAN 8mm THICK, IS TO BE USED TO COMPLETELY COVER THE SLOTTED HOLE IN ACCORDANCE WITH AS4100:1998.

ALL BOLT HOLES 2mm OVERSIZE UNLESS NOTED OTHERWISE. HOLES FOR HD BOLTS 6mm OVERSIZE. OVERSIZE HOLES FOR HD BOLTS WILL REQUIRE OVERSIZE WASHERS UNDER NUTS.

UNLESS OTHERWISE SPECIFIED, SHEAR STUDS SHALL BE WELDED 19mm DIAMETER HEADED STUDS WITH ALL WORKMANSHIP AND MATERIALS IN ACCORDANCE WITH AS1554.2:2003.

STRUCTURAL STEELWORK NOTES (CONT')

S8. PURLINS AND GIRTS:
PURLINS AND GIRTS SHALL BE BASED ON BLUESCOPE LYSAGHT'S "LYSAGHT ZED AND CEE PURLINS AND GIRTS - USER GUIDE", OR OTHER SECTIONS APPROVED BY THE CONTRACT ADMINISTRATOR, COMPLYING WITH AS1397:1993, AND A MINIMUM GALVANISED COATING OF Z350 (350g/m²).

CLEAT CONNECTIONS ARE TO BE IN ACCORDANCE WITH AISC STANDARDISED CONNECTIONS OR MANUFACTURER'S RECOMMENDATIONS UNLESS NOTED OTHERWISE. BOLTING AND BRIDGING TO BE IN ACCORDANCE WITH MANUFACTURER'S RECOMMENDATIONS.

THE NUMBER OF PURLINS SHOWN IS INDICATIVE ONLY, IT IS THE CONTRACTOR'S RESPONSIBILITY TO ENSURE THE CORRECT NUMBER OF PURLINS ARE USED TO SATISFY SPACING REQUIREMENTS.

AT DIAGONAL RIDGES AND VALLEYS, FIX 2/100x70x2.5 COLD FORMED ANGLE PURLINS TO SUPPORT DIAGONAL CUT EDGE OF ROOF SHEETING, UNLESS DETAILED OTHERWISE.

ALL ROOF RAFTERS TO INCLUDE FLY BRACING EVERY SECOND PURLIN UNLESS NOTED OTHERWISE.

S9. PROFILED STEEL DECKING:
PROFILED STEEL DECKING SHALL BE BASED ON BLUESCOPE LYSAGHT BONDEK, OR OTHER SECTION APPROVED BY THE CONTRACT ADMINISTRATOR, COMPLYING WITH AS1397:2011, GRADE G550 AND A MINIMUM GALVANISED COATING OF Z350 (350g/m²).

S10. CORROSION PROTECTION:
CLEANING AND PAINTING OF STRUCTURAL STEELWORK (INTERNAL):
- ABRASIVE BLAST CLEAN TO CLASS 2 1/2
- ONE COAT OF 'INTERPRIME 198' OR APPROVED EQUIVALENT
- MINIMUM DRY FILM THICKNESS OF 0.075mm

CLEANING AND PAINTING OF STRUCTURAL STEELWORK:
- ABRASIVE BLAST CLEAN TO CLASS 2
- ONE COAT PRIMER (GREY) MINIMUM DRY FILM THICKNESS OF 0.05mm
- ONE COAT (SELECTED COLOUR) TO A DRY FILM THICKNESS OF 0.04mm

THE FOLLOWING STEELWORK SHALL BE HOT DIP GALVANISED AFTER FABRICATION TO AS4680:2006 WITH A MINIMUM AVERAGE ZINC COATING MASS OF 600g/m²:
- ALL COLD FORM SECTIONS
- PLATE/ANCHOR ROD ASSEMBLIES CAST INTO CONCRETE
- ALL MEMBERS BUILT INTO BRICK OR BLOCKWORK
- ALL EXTERNAL STEELWORK

FOR CONCRETE ENCASED STEELWORK, PAINTING SHALL EXTEND 100mm INTO THE CONCRETE. THE REMAINDER OF THE ENCASED STEELWORK SHALL BE UNPAINTED AND FREE OF LOOSE RUST, LOOSE MILLSCALE, DIRT, OIL AND GREASE.

ALL STRUCTURAL STEELWORK BELOW GROUND TO BE ENCASED BY N25 CONCRETE 75mm ALL ROUND, UNLESS NOTED OTHERWISE.

CONCRETE ENCASED STEELWORK SHALL BE WRAPPED WITH SL41 MESH, UNLESS OTHERWISE SHOWN.

S11. SHOP DRAWINGS:
THE STEEL FABRICATOR IS TO PROVIDE THE CONTRACT ADMINISTRATOR WITH 1 HARD COPY OF WORKSHOP DRAWINGS FOR REVIEW BEFORE FABRICATION IS STARTED, ALLOWING A MINIMUM OF 5 WORKING DAYS FOR REVIEW COMMENTS TO BE MADE.

S12. GROUT THICKNESS UNDER BASE PLATES SHALL BE MINIMUM 30mm UNLESS NOTED OTHERWISE.

S13. BASE PLATES SHALL BE GROUTED AFTER MEMBER IS LEVELLED AND PLUMBED, AND BEFORE MEMBER IS SUBSTANTIALLY LOADED. GROUT SHALL BE APPROVED PROPRIETARY FLOWABLE NON-SHRINKING PORTLAND CEMENT GROUT, PROPORTIONED AND USED IN ACCORDANCE WITH THE MANUFACTURER'S INSTRUCTIONS WITH A MINIMUM 28-DAYS COMPRESSIVE STRENGTH OF 40MPa.

S14. THE CONTRACTOR SHALL PROVIDE ALL CLEATS AND DRILL ALL HOLES NECESSARY FOR FIXING STEEL, TIMBER OR OTHER ELEMENTS TO STEEL WHETHER OR NOT DETAILED ON THE DRAWINGS.

S15. THE ENDS OF ALL HOLLOW SECTIONS ARE TO BE SEALED WITH NOMINAL THICKNESS PLATES AND CONTINUOUS SEAL WELD UNLESS NOTED OTHERWISE, WITH 'BREATHER' HOLES IF MEMBERS ARE TO BE HOT DIP GALVANISED.

S16. STIFFENER PLATES WHERE DETAILED ARE TO BE PLACED ON BOTH SIDES OF WEB TO UB's AND UC's.

S17. ALL HOLES IN PLATES AND STEEL MEMBERS SHALL BE DRILLED. EXCEPT FOR PURLINS AND GIRT HOLES WHICH MAY BE PUNCHED.

S18. WHERE DETAILS PREVENT THE NORMAL INSTALLATION OF CFW's, GRIND THE EDGE OF THE MEMBER TO FACILITATE THE INSTALLATION.

S19. CAMBER TO BE AS NOTED ON THE DRAWINGS.

S20. ALL COLUMNS TO INCLUDE FLY BRACING EVERY SECOND GIRT UNLESS NOTED OTHERWISE.

PILING NOTES

P1. ALL PILING IS TO BE IN ACCORDANCE WITH SAI PILING CODE AS2159:2009.

P2. REFER GEOTECHNICAL INFORMATION NOTE FOR SITE INVESTIGATION INFORMATION.

P3. PILING IS TO BE DESIGNED, CONSTRUCTED AND CERTIFIED IN ACCORDANCE WITH THE SPECIFICATION AND REQUIREMENTS SET OUT ON THE DRAWINGS. DETAILS OF EACH PILE TYPE AND CAPACITY ARE TO BE SUBMITTED TO THE SUPERINTENDENT AS REQUIRED BEFORE ANY PILING IS COMMENCED.

P4. PILES ARE TO BE DESIGNED FOR 50 YEAR STRUCTURAL LIFE AND CERTIFIED BY MANUFACTURER.

P5. SPLICES SHALL BE CAPABLE OF TRANSMISSION OF FULL MOMENT AND AXIAL CAPACITY OF PILE BETWEEN SECTIONS. SPLICES SHALL BE CONSTRUCTED TO MANUFACTURER'S DETAIL AND REFERENCED IN MANUFACTURER SUPPLIED CERTIFICATION.

P6. PILES ARE TO BE FOUNDED IN **500kPa** MATERIAL.

P7. PILES ARE TO BE MINIMUM **3.0m** IN LENGTH.

P8. EACH PILE IS TO BE CONSTRUCTED WITHIN A TOLERANCE OF 75mm OF THE LOCATION SHOWN ON THE PLAN, AND WITHIN 1 IN 100 FOR VERTICALLY OR BETTER.

P9. PILE REINFORCEMENT IS TO EXTEND **500mm** ABOVE CUT OFF LEVEL, AND IS NOT TO BE BENT OVER.

TIMBER NOTES

T1. ALL TIMBER USED FOR STRUCTURAL PURPOSES IS TO:
- COMPLY WITH THE PROVISIONS OF THE RELEVANT AUSTRALIAN STANDARDS.
- BE ASSIGNED A STRESS GRADE BY EITHER VISUAL STRESS GRADING, MACHINE STRESS GRADING OR MACHINE PROOF GRADING.
- BE GRADED UNDER THE AUTHORITY OF A RECOGNISED QUALITY ASSURANCE PROGRAM, VIZ CYPRESS QUALITY ASSURANCE PROGRAM, AUSTRALIAN HARDWOOD QUALITY CONTROL, PINE QUALITY ASSURANCE PROGRAM.
- BE SEASONED TIMBER UNLESS NOTED OTHERWISE.

T2. EXCEPT AS APPROVED BELOW, ALL TIMBER USED FOR STRUCTURAL PURPOSES SHALL BE BRANDED AND THE BRAND SHALL CONTAIN THE FOLLOWING INFORMATION:
- THE GRADE IN TERMS OF AN "F" OR "MGP" RATING E.G. F11 OR MGP10.
- THE METHOD OF GRADING IF OTHER THAN VISUAL STRESS GRADING. E.G. MACHINE STRESS GRADING "MSG" OR MACHINE PROOF GRADING "PROOF" OR "PG" OR "MGP".
- IF SEASONED, THE WORD "SEASONED" OR THE LETTER "S".
- A NAME, INITIALS, LOGO OR NUMBER WHICH INDICATES THE SOURCE OF GRADING.
- THE CERTIFICATION TRADE MARK OF THE RELEVANT ASSURANCE PROGRAM.

T3. WHERE TIMBER IS SPECIFIED TO BE FINISHED WITH A CLEAR OR SEMI-TRANSPARENT STAIN FOR EXPOSED AND/OR DECORATIVE APPLICATION, CERTIFICATION OF GRADE, ETC. MAY BE PROVIDED BY A SIGNED CERTIFICATE OR ADHESIVE STICKER INCLUDING INFORMATION SIMILAR TO THAT REQUIRED FOR A BRAND ABOVE.

T4. ALL PLYWOOD USED FOR STRUCTURAL PURPOSES SHALL BE BRANDED WITH THE PLYWOOD ASSOCIATION OF AUSTRALIA (PAA) TEST MARK AND MANUFACTURED IN ACCORDANCE WITH THE RELEVANT AUSTRALIAN STANDARDS AND UNDER THE PAA QUALITY.

T5. STRESS GRADE AND JOINT GROUP OF TIMBER SHALL BE IN ACCORDANCE WITH THE TIMBER FRAMING SCHEDULES ON THE DRAWINGS.

T6. LAMINATED TIMBER MEMBERS SHALL BE OF SIZE, TYPE (MANUFACTURER), AND STRESS GRADE AS NOTED IN THE TIMBER FRAMING SCHEDULES UNLESS NOTED OTHERWISE AND APPROVED BY THE ENGINEER.

T7. ALL STEEL BOLTS, STRAPS, RODS, FRAMING ANCHORS CONNECTOR PLATES ETC. NOTED AS GALVANISED SHALL HAVE A MINIMUM CORROSION PROTECTION ZINC COATING OF 275 g/m². POST ANCHOR BRACKETS AND ASSOCIATED BOLTS SHALL BE HOT DIP GALVANISED WITH A MINIMUM COATING OF 600 g/m². FITMENTS NOTED AS STAINLESS STEEL SHALL BE GRADE 316 UNLESS NOTED OTHERWISE.

T8. CHEMICAL AND MECHANICAL ANCHOR EMBEDMENTS, AS NOTED ON THE DRAWINGS, ARE TO BE THE EMBEDMENT INTO THE STRUCTURAL ELEMENT AND ARE TO EXCLUDE THE DEPTH OF ANY APPLIED FINISHES.

T9. ALL STEEL PLATES TO BE 8mm STAINLESS STEEL (316) UNLESS NOTED OTHERWISE.

T10. ALL BOLTS, NUTS, WASHERS AND PLATES TO EXTERNAL TIMBERWORK TO BE STAINLESS STEEL (316) UNLESS NOTED OTHERWISE (NOT APPLICABLE TO MASONRY ANCHORS OR CAST-IN BOLTS). ALL BOLTS, NUTS, WASHERS AND PLATES TO INTERNAL (WITHIN ENCLOSED BUILDING) TIMBERWORK TO BE GRADE 4.6/S HOT DIPPED GALVANISED UNLESS NOTED OTHERWISE.
- BOLTS IN STEEL PLATES SHALL PROVIDE A SNUG FIT I.E. NOT GREATER THAN 0.5mm LARGER THAN THE BOLT DIAMETER.
- WASHERS TO TIMBER: M12 BOLTS - 55 DIA. x 3mm THICK, M16 BOLTS - 65 DIA. x 3mm THICK, M20 BOLTS - 75 DIA. x 5mm THICK, M24 BOLTS - 85 DIA. x 6mm THICK. AT THE END OF THE DEFECTS LIABILITY PERIOD ALL BOLTED CONNECTIONS THROUGHOUT THE ENTIRE PROJECT MUST BE RE-TIGHTENED.

T11. BOTTOM AND TOP PLATES ARE TO BE 75 x 50 F14 HW UNLESS NOTED OTHERWISE. STUDS ARE TO BE 75 x 38 F14 HW AT 450 MAX. CRS. UNLESS NOTED OTHERWISE. 1 ROW OF NOGGING IS REQUIRED FOR WALLS UP TO 2700 HIGH. 2 ROWS OF NOGGING ARE REQUIRED FOR WALLS BETWEEN 2700-3000 HIGH.

T12. ALL STUD FRAMING TO BE CONSTRUCTED IN ACCORDANCE WITH AS1684.2:2010 AND PAA PLYWOOD WALL BRACING DESIGN MANUAL.

T13. ALL CLOUTS FOR NAILING OF CROSS BRACING STEEL STRAPPING ARE TO BE 30 x 2.8mm GALVANISED FLAT HEAD NAILS.

T14. STRAPPING TO BE NATIONAL 30 x 0.8mm STEEL GALVANISED AND CONTINUOUSLY HOLED.

T15. BRACING WALLS SHALL HAVE FULL HEIGHT ANCHOR RODS AT EACH END AND SHALL COMPLY WITH PART 13 & 14 OF THE BUILDING CODE OF AUSTRALIA.

T16. BRACING WALLS ARE TO BE FIXED TO THE CEILING FRAME OVER IN ACCORDANCE WITH THE DETAILS SHOWN IN FIGURE 9.4.2 (ii) AND (vi) OF AS1684.2:2010 USING M10 BOLTS, THE SCHEDULE INDICATES THE NUMBER OF FIXINGS PER WALL.

T17. THE ROOF FRAMING PLAN SHOWS TIE DOWN ANCHOR RODS ONLY. PROVIDE ADDITIONAL ANCHOR RODS WHERE REQUIRED BY THE BRACING WALLS.

EXCAVATION MONITORING NOTES

EM1. PRIOR TO EXCAVATION AT ANY BOUNDARY, SURVEY MONITORING POINTS SHALL BE ESTABLISHED ON THE TOP OF WALL AT 5m INTERVALS AROUND THE EXCAVATION.

EM2. THE X, Y AND Z COORDINATES SHALL BE PROVIDED TO THE ENGINEER EVERY SECOND DAY DURING THE PROCESS OF THE WORKS.

TIMBER TRUSS NOTES

TT1. ALL WORKMANSHIP AND MATERIALS SHALL BE IN ACCORDANCE WITH AS1720.1:2010. REFER ARCHITECTURAL, STRUCTURAL AND OTHER CONSULTANT'S DRAWINGS AND SPECIFICATIONS.

TT2. THE ROOF TRUSS MANUFACTURER IS RESPONSIBLE FOR THE DESIGN, DOCUMENTATION, FABRICATION AND ERECTION OF THE ROOF FRAMING AND TRUSSES FOR INTEGRATION WITH THE REST OF THE STRUCTURE. THE TIMBERWORK TO BE DESIGNED AND CONSTRUCTED THAT COVERS ROOF BATTENS, CEILING BATTENS AND ASSOCIATED BRACING, EXCEPT THAT OF MINIMUM BATTEN SIZES AND SPACING WHERE SHOWN ON THE ARCHITECTURAL OR STRUCTURAL DRAWINGS MUST NOT BE REDUCED. ALL FIXINGS TO TOP PLATES MUST BE DESIGNED AND CONSTRUCTED BY ROOF TRUSS MANUFACTURER. FOR DIMENSIONAL SET OUT AND FINAL DIMENSION LAYOUT OF WALLS, REFER ARCHITECTURAL DRAWINGS. REFER STRUCTURAL DRAWINGS FOR LOAD BEARING BLOCKWORK.

TT3. ROOF TRUSSES MUST BE DESIGNED TO SUIT BASIC PERMISSIBLE WIND PRESSURE IN ACCORDANCE WITH THE GENERAL LOADING NOTES. ALL APPROPRIATE PRESSURE COEFFICIENTS, INCLUDING LOCAL FACTORS, TO DETERMINE ROOF AND WALL LOADS MUST BE USED IN ACCORDANCE WITH AS1170.2:2011. USE INTERNAL PRESSURE COEFFICIENT IN ACCORDANCE WITH THE GENERAL LOADING NOTES.

TT4. THE TRUSSES MUST PROVIDE A FULLY BRACED ROOF AND CEILING DIAPHRAGM CAPABLE OF CARRYING ALL DESIGN WIND, DEAD AND LIVE LOADS AND INCLUDE TRANSMISSION OF BRACING LOADS TO LOAD BEARING/BRACING WALLS SHOWN ON ROOF FRAMING PLANS. BRACING CALCULATION MUST INCLUDE WIND FORCES FROM ALL CONTRIBUTING WALL HEIGHTS. TRUSS DESIGN MUST INCLUDE DOCUMENTATION OF CONNECTION OF ALL BRACING FORCES (IN ADDITION TO UPLIFT FORCES) INTO THE TOP PLATE SHOWN ON STRUCTURAL DRAWINGS. DIAPHRAGM ACTION OF THE TRUSSES ROOF SYSTEMS ARE AN ESSENTIAL COMPONENT OF STABILITY IN ALL BUILDINGS. DESIGN ROOF TRUSSES FOR ADDITIONAL DEAD AND LIVE LOADS TO THOSE REQUIRED BY AS1170.0:2002 AS SHOWN ON ARCHITECTURAL DRAWINGS AND GIVEN IN SPECIFICATIONS.

TT5. FOR TRUSSES ADJACENT TO GABLE ENDS, BOLT TOP AND BOTTOM CHORDS OF TRUSSES TO BLOCKWORK USING HOT DIPPED GALVANISED M12 CHEMSETS AT 600 CRS. THROUGHOUT (NOTE BOLTS TO BE INSTALLED AFTER ROOFING IS COMPLETE). FOR BOLTING TO HOLLOW BLOCKS USE 'RAMSET' CHEMICAL INJECTION SYSTEM AND SLEEVES.

TT6. IN ADDITION TO THE NOMINATED PERMANENT BRACING, PROVIDE ANY ADDITIONAL BRACING REQUIRED TO MAINTAIN THE STABILITY OF THE TRUSSES AT ALL STAGES OF ERECTION AND ADDITIONAL PERMANENT BRACING REQUIRED FOR STRUCTURAL SUFFICIENCY OF THE TRUSS SYSTEM.

TT7. ALL METAL FIXINGS, STRAPS AND CONNECTORS SHALL BE HOT DIPPED GALVANISED.

TT8. ALL TRUSSES TO BEAR ON 100 WIDE x 75 DEEP F14 HW PLATES FIXED TO TOP OF BLOCKWALLS. CONNECTION 100 x 75 PLATE TO BLOCKWORK WILL BE INCLUDED IN THE STRUCTURAL DRAWINGS.

TT9. DESIGN OF ALL TIMBER TRUSS AND ASSOCIATED WORK MUST BE PERFORMED AND CERTIFIED BY AN NPER REGISTERED PROFESSIONAL ENGINEER EXPERIENCED IN THIS TYPE OF CONSTRUCTION. SUBMIT ALL TIMBER DOCUMENTATION TO THE CONTRACT ADMINISTRATOR FOR REVIEW PRIOR TO FABRICATION.

TT10. SPAN TRUSSES ONLY BETWEEN THE NOMINATED SUPPORTING WALLS AND LINTELS SHOWN ON STRUCTURAL ROOF FRAMING PLANS.

TT11. THE CONTRACTOR IS TO LIAISE WITH THE WALL FRAME MANUFACTURER WITH RESPECT TO TRUSS LAYOUTS AND LOCATIONS OF ANY CONCENTRATIONS OF ROOF LOAD (E.G. GIRDER TRUSS LOCATIONS).

TT12. PROVIDE 100 x 50 BINDER TO ALL TRUSS BOTTOM CHORDS CONTINUOUS FOR FULL LENGTH OF BUILDING AND AT 2400 MAX. CRS. ALONG THE BOTTOM CHORDS.

NOT FOR CONSTRUCTION

AECOM

PROJECT

KAVHA STRUCTURAL ASSESSMENT

CLIENT

DEPARTMENT OF INFRASTRUCTURE, TRANSPORT, REGIONAL DEVELOPMENT & COMMUNICATIONS
Prepared for:

CONSULTANT

AECOM Australia Pty. Ltd.
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TENDER

PROJECT MANAGEMENT INITIALS

s 47F

DESIGNER	CHECKED	APPROVED

ISSUE/REVISION

I/R	DATE	DESCRIPTION
C	08.04.2020	ISSUED FOR TENDER
B	02.04.2020	ISSUED FOR TENDER
A	06.12.2019	ISSUED FOR INFORMATION

KEY PLAN

PROJECT NUMBER

60615424

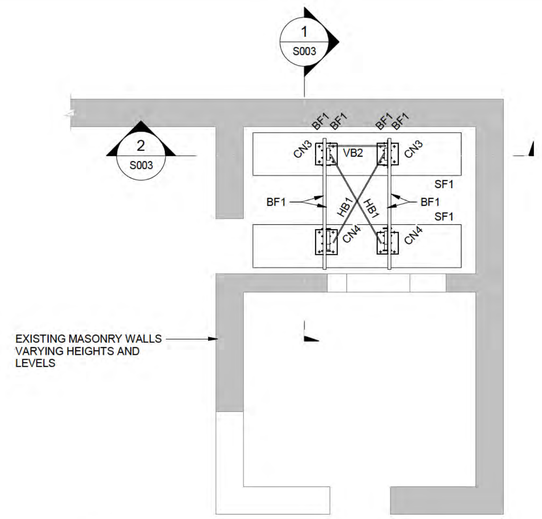
SHEET TITLE

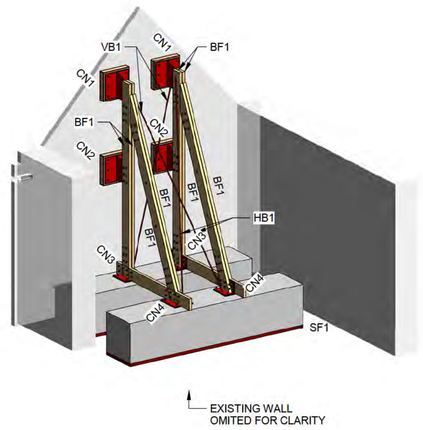
GENERAL NOTES - SHEET 2

SHEET NUMBER

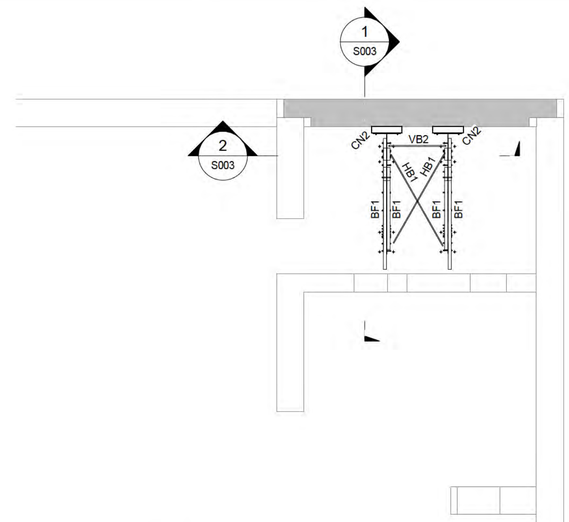
60615424-DRG-S002

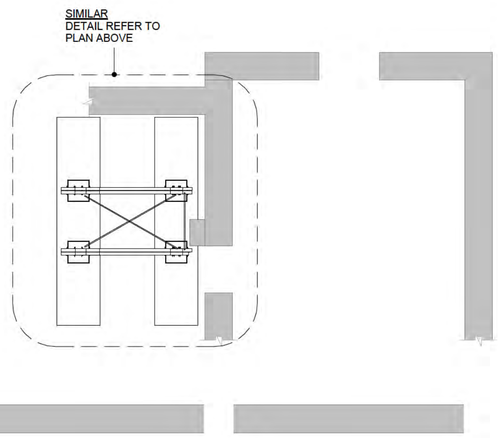
ISO A1 594mm x 841mm

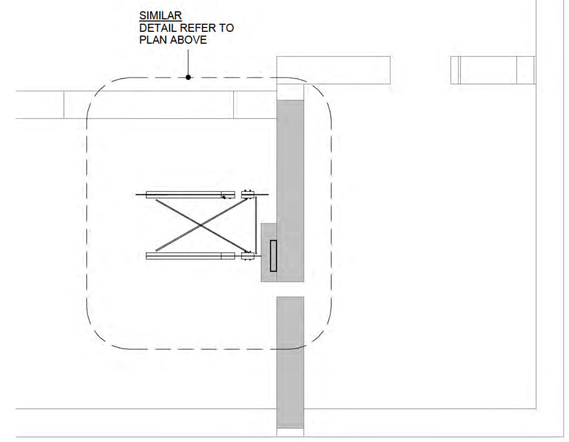




3D VIEW - BRACE WALL - OPTION 01





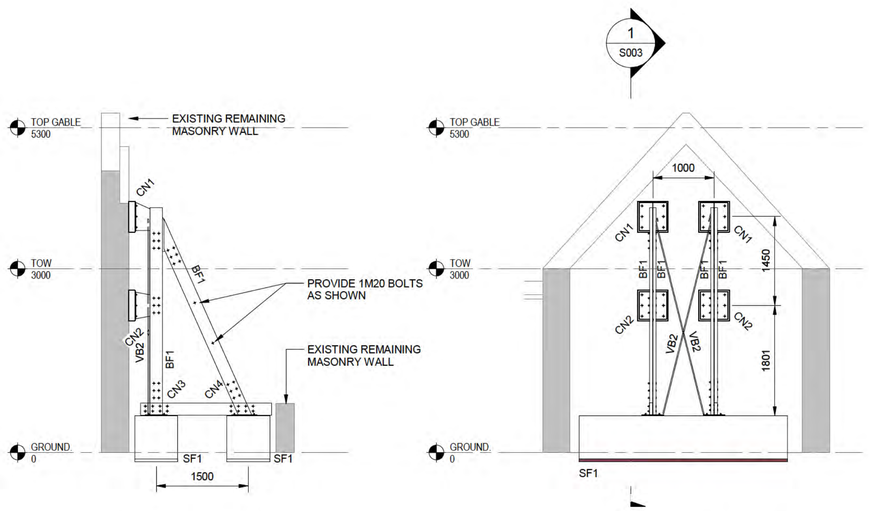


GROUND LEVEL ARRANGEMENT PLAN - OPTION 01

Scale: 1 : 50

GENERAL ARRANGEMENT PLAN +2m ABOVE GROUND - OPTION 01

Scale: 1 : 50



1 | SECTION S003 Scale: 1 : 50

2 | SECTION S003 Scale: 1 : 50

STRIP FOOTING SCHEDULE - OPTION 01				
MARK	SIZE (D)	SIZE (W)	REINFORCEMENT	COMMENTS
SF1	700	700	4N20 TOP & BTM WITH N12-300 TIES	STRIP FOOTING - 3400 LONG

FRAMING SCHEDULE - OPTION 01.		
MARK	SIZE	COMMENTS
BF1	250x75 F7	TIMBER BRACING FRAME
HB1	16Ø ROD WITH TURNBUCKLE	HORIZONTAL BRACING
VB2	16Ø ROD WITH TURNBUCKLE	VERTICAL BRACING

STEEL CONNECTION SCHEDULE - OPTION 01.	
MARK	COMMENTS
CN1	TIMBER PACKER WITH 12 END PLATE + 8 SHAPED CLEAT PLATE - REFER TO DETAIL
CN2	TIMBER PACKER WITH 12 END PLATE + 8 SHAPED CLEAT PLATE - REFER TO DETAIL
CN3	8 SHAPED CLEAT PLATE + 12 BASE PLATE - REFER TO DETAIL
CN4	8 SHAPED CLEAT PLATE + 12 BASE PLATE - REFER TO DETAIL

- ALL STEELWORK TO BE HOT DIP GALVANISED (TYPICAL)
- ALL TIMBER TO BE H3 TREATED AGAINST INSECT AND FUNGUS ATTACK

NOT FOR CONSTRUCTION

AECOM

PROJECT

KAVHA STRUCTURAL ASSESSMENT

CLIENT

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Prepared for:

CONSULTANT

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TENDER

PROJECT MANAGEMENT INITIALS

s 47F

DESIGNER	CHECKED	APPROVED

ISSUE/REVISION

C	08.04.2020	ISSUED FOR TENDER
B	02.04.2020	ISSUED FOR TENDER
A	06.12.2019	ISSUED FOR INFORMATION
I/R	DATE	DESCRIPTION

KEY PLAN

PROJECT NUMBER

60615424

SHEET TITLE

CIVIL HOSPITAL
OPTION 01 - BRACING FRAME

SHEET NUMBER

60615424-DRG-S003

Last Saved: 14/10/2020 2:33:33 PM
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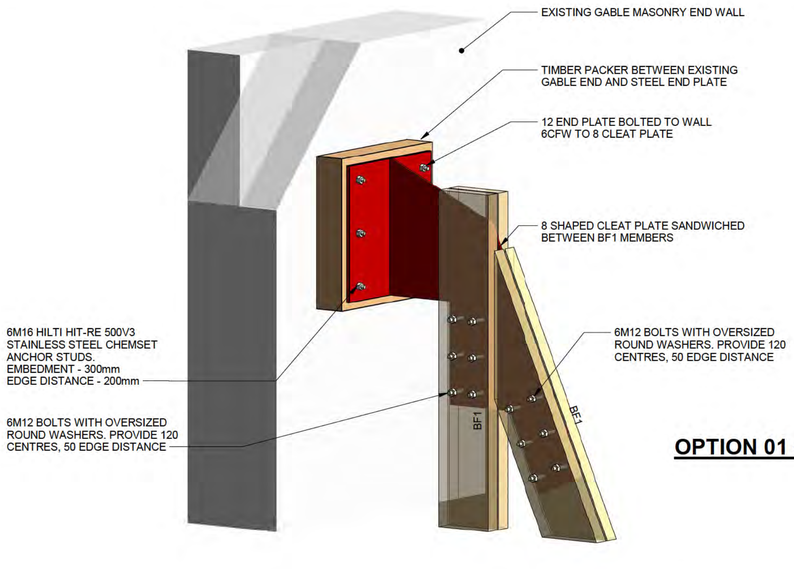
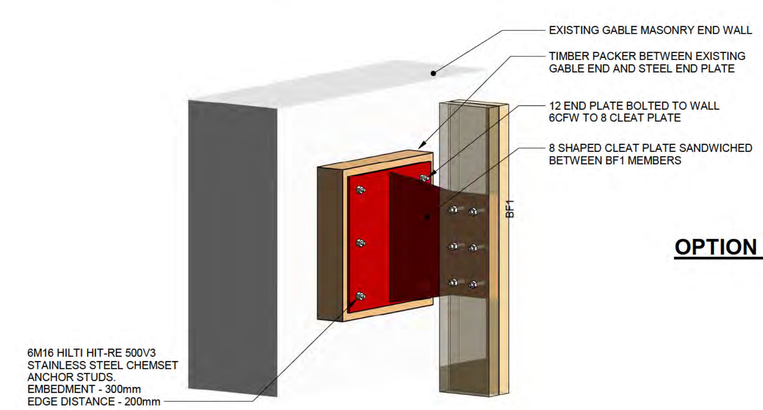


OPTION 01 - CONNECTION TYPE CN1



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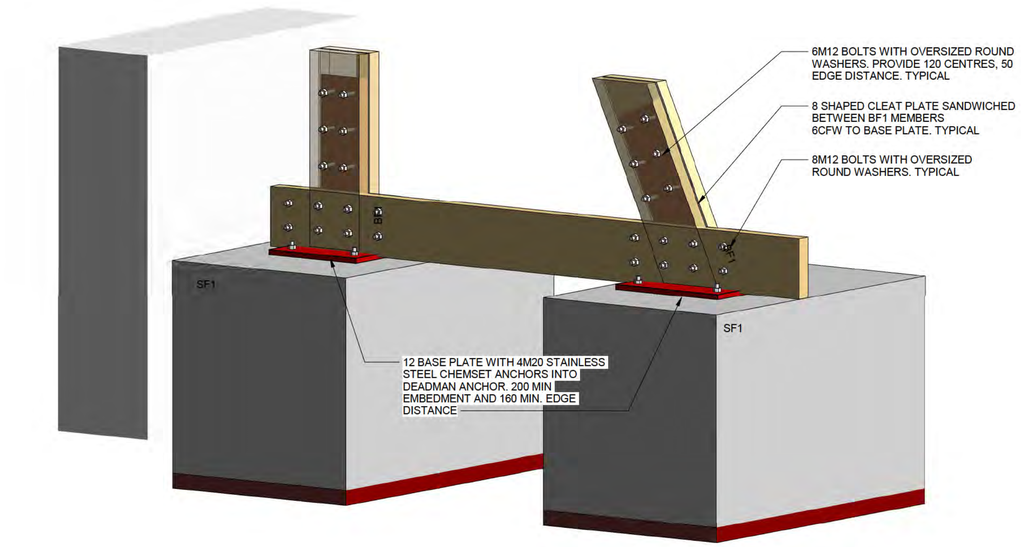

OPTION 01- CONNECTION TYPE CN3

OPTION 01 - CONNECTION TYPE CN4

STRIP FOOTING SCHEDULE - OPTION 01				
MARK	SIZE (D)	SIZE (W)	REINFORCEMENT	COMMENTS
SF1	700	700	4N20 TOP & BTM WITH N12-300 TIES	STRIP FOOTING - 3400 LONG

FRAMING SCHEDULE - OPTION 01.		
MARK	SIZE	COMMENTS
BF1	250x75 F7	TIMBER BRACING FRAME
HB1	16Ø ROD WITH TURNBUCKLE	HORIZONTAL BRACING
VB2	16Ø ROD WITH TURNBUCKLE	VERTICAL BRACING

STEEL CONNECTION SCHEDULE - OPTION 01.	
MARK	COMMENTS
CN1	TIMBER PACKER WITH 12 END PLATE + 8 SHAPED CLEAT PLATE - REFER TO DETAIL
CN2	TIMBER PACKER WITH 12 END PLATE + 8 SHAPED CLEAT PLATE - REFER TO DETAIL
CN3	8 SHAPED CLEAT PLATE + 12 BASE PLATE - REFER TO DETAIL
CN4	8 SHAPED CLEAT PLATE + 12 BASE PLATE - REFER TO DETAIL

- ALL STEELWORK TO BE HOT DIP GALVANISED (TYPICAL)
- ALL TIMBER TO BE H3 TREATED AGAINST INSECT AND FUNGUS ATTACK

NOT FOR CONSTRUCTION

AECOM

PROJECT

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TENDER

PROJECT MANAGEMENT INITIALS

s 47F

DESIGNER	CHECKED	APPROVED

ISSUE/REVISION

I/R	DATE	DESCRIPTION
C	08.04.2020	ISSUED FOR TENDER
B	02.04.2020	ISSUED FOR TENDER
A	06.12.2019	ISSUED FOR INFORMATION

KEY PLAN

PROJECT NUMBER

60615424

SHEET TITLE

CIVIL HOSPITAL
OPTION 01 - 3D VIEWS

SHEET NUMBER

60615424-DRG-S004

Last Saved: 15/10/2020 11:30:18 AM
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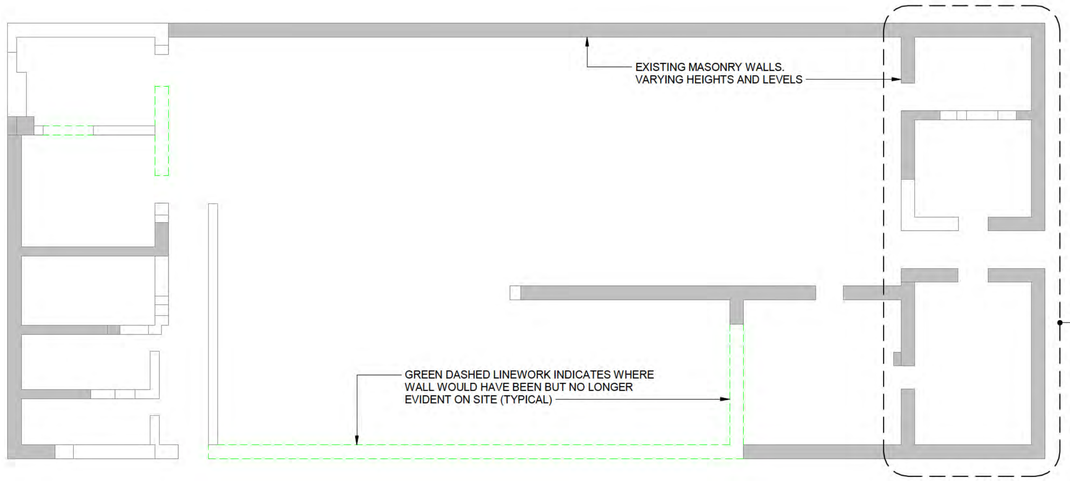
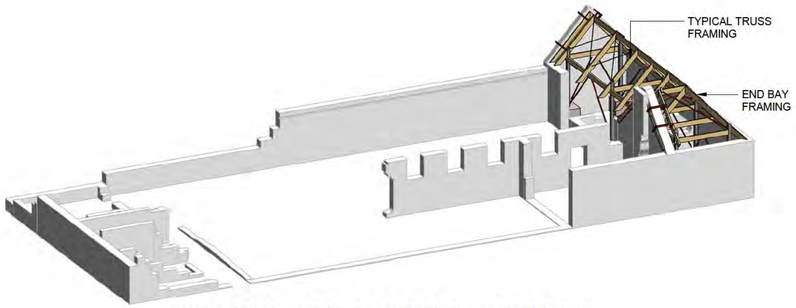
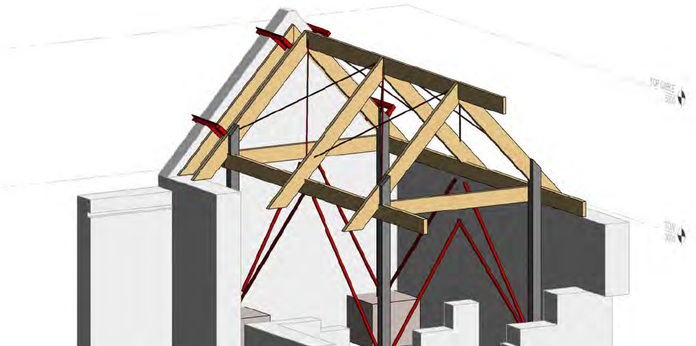


GROUND LEVEL SITE PLAN

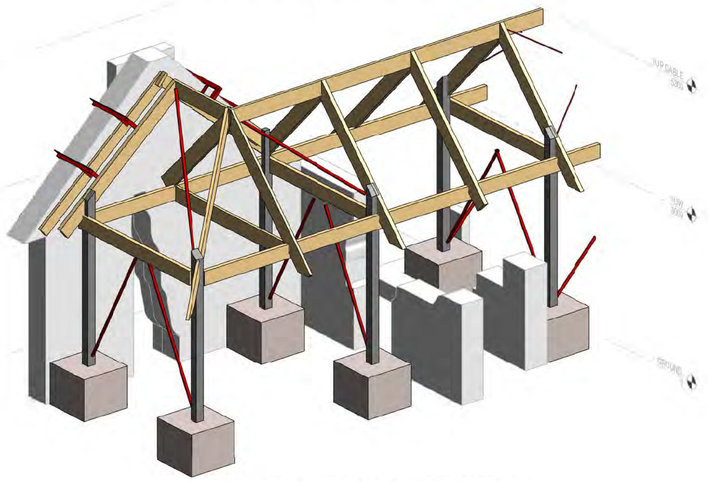
Scale: 1 : 100



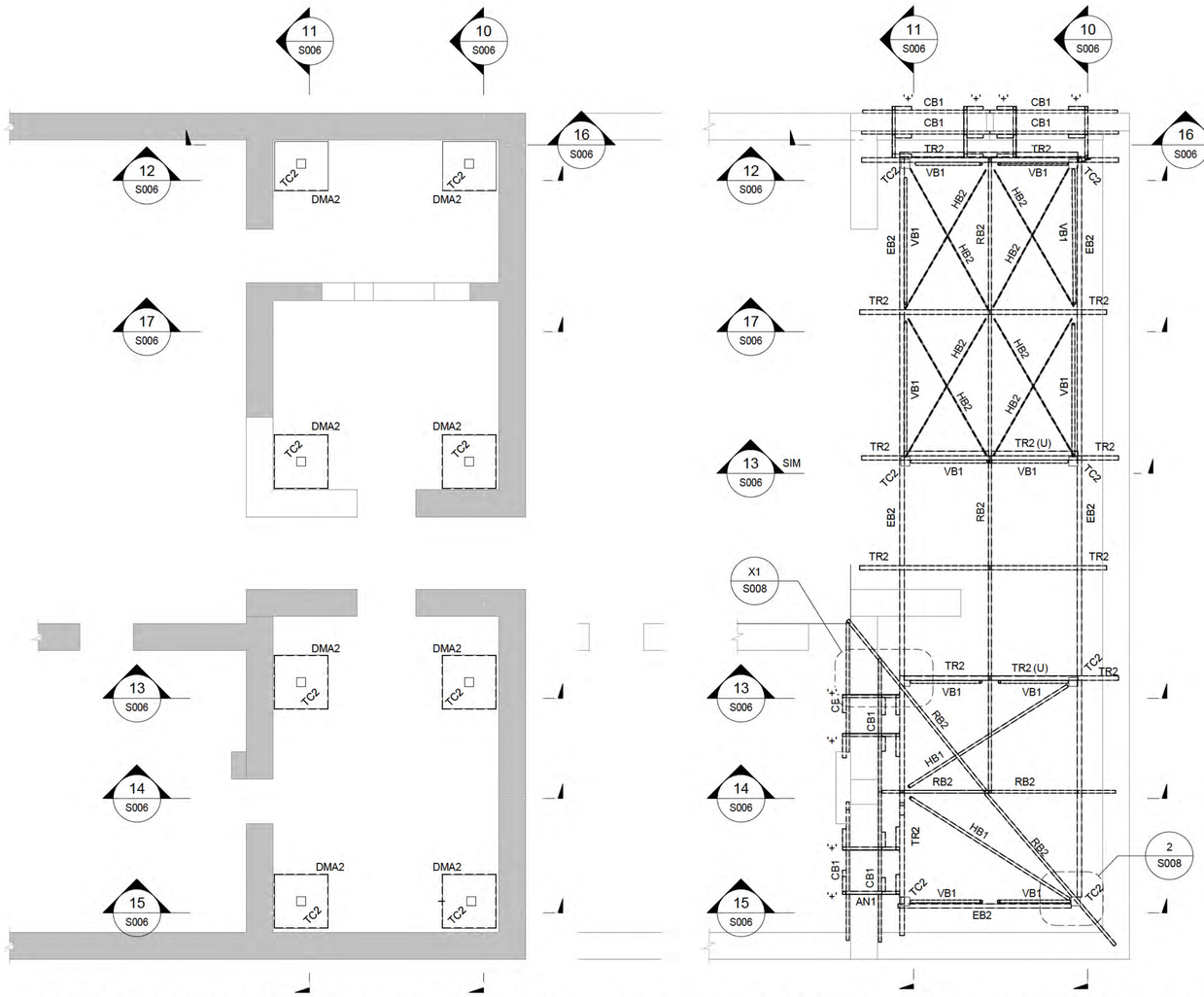
3D VIEW - CIVIL HOSPITAL - OPTION 02



3D VIEW - TYPICAL TRUSS FRAME



3D VIEW - TYPICAL TRUSS FRAME



GROUND LEVEL ARRANGEMENT PLAN - OPTION 02

Scale: 1 : 50

GENERAL ARRANGEMENT PLAN +2m ABOVE GROUND - OPTION 02

Scale: 1 : 50

NOTE :
1. REFER TO SECTIONS FOR TYPICAL CLAMPING DETAIL AS NOTED THUS ON PLAN '+'

DEADMAN ANCHOR SCHEDULE - OPTION 02

MARK	SIZE (W)	SIZE (L)	SIZE (D)	COMMENTS
DMA2	900	900	750	DEADMAN ANCHORS EMBED 100MIN INTO EXISTING GROUND

IF THE DEADMAN FOOTING CAN BE CONSTRUCTED FULLY IN THE GROUND THEN CONVERT TO 800x800x800 AND CHANGE VB1 TO 48.3x5.4 CHS

- ALL STEELWORK TO BE HOT DIP GALVANISED (TYPICAL)
- ALL TIMBER TO BE H3 TREATED AGAINST INSECT AND FUNGUS ATTACK

FRAMING SCHEDULE - OPTION 02

MARK	SIZE	COMMENTS
AN1	65x65x8 EA	CLAMPING FRAME
CB1	200x50 F7	CLAMPING BEAM
EB2	250x75 F7	TIMBER EDGE BEAM
HB1	48.3x4.0 CHS	ROOF BRACING
HB2	16Ø ROD WITH TURNBUCKLE	ROOF BRACING
RB2	275x50 F7	RAFTER BEAM
TC2	150x150 F7	TIMBER COLUMN
TR2	250x75 F7	TIMBER RAFTER BEAM
VB1	48.3x4.0 CHS	VERTICAL BRACING

0 1250 2500 mm
1:50

0 2500 5000 mm
1:100

NOT FOR CONSTRUCTION

AECOM

PROJECT

KAVHA STRUCTURAL ASSESSMENT

CLIENT

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TENDER

PROJECT MANAGEMENT INITIALS

s47F

DESIGNER	CHECKED	APPROVED

ISSUE/REVISION

I/R	DATE	DESCRIPTION
D	23.10.2020	ISSUED FOR TENDER
C	08.04.2020	ISSUED FOR TENDER
B	02.04.2020	ISSUED FOR TENDER
A	06.12.2019	ISSUED FOR INFORMATION

KEY PLAN

PROJECT NUMBER

60615424

SHEET TITLE

CIVIL HOSPITAL
OPTION 02 - TRUSS FRAME

SHEET NUMBER

60615424-DRG-S005

Last Saved: 15/10/2020 11:42:16 AM
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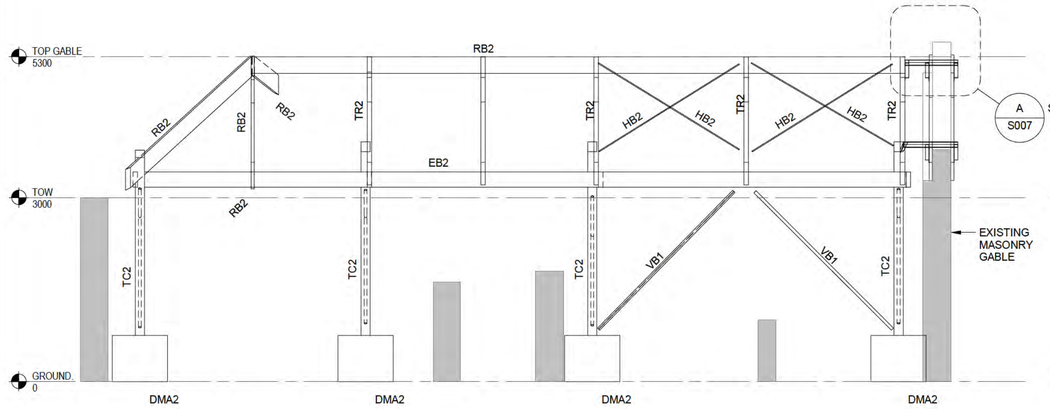

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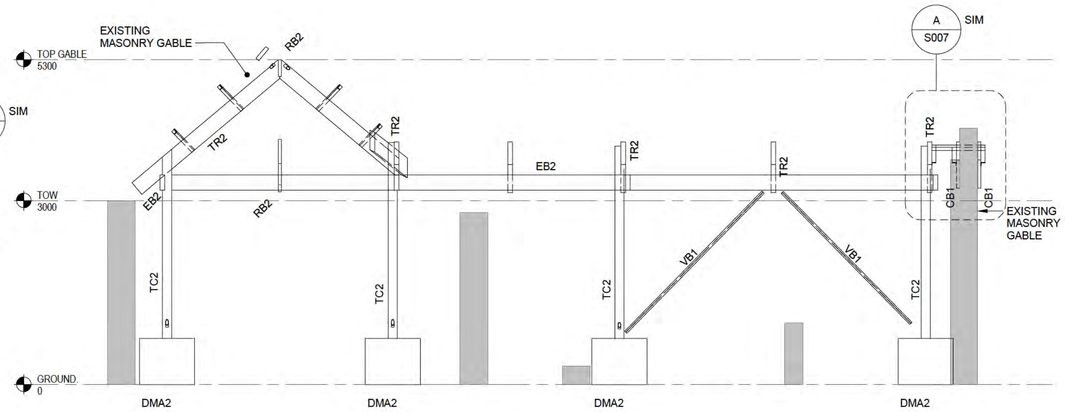

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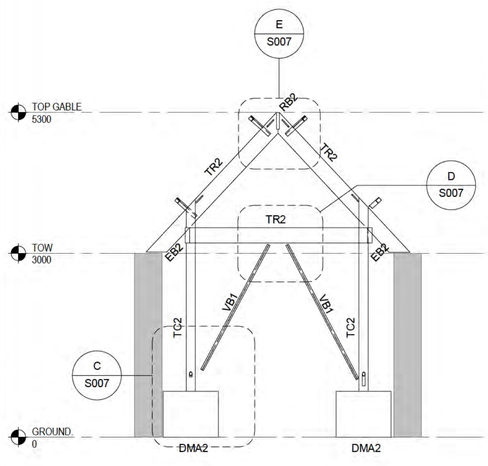

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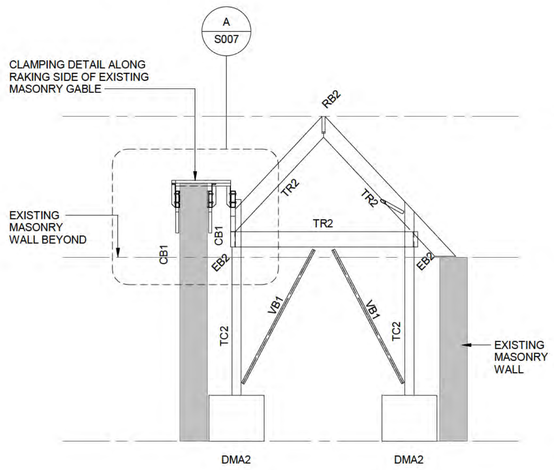

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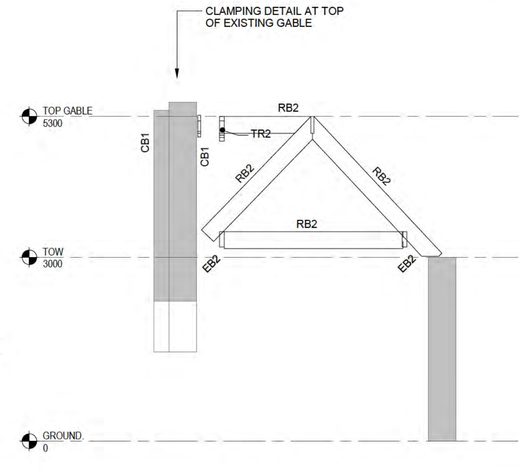

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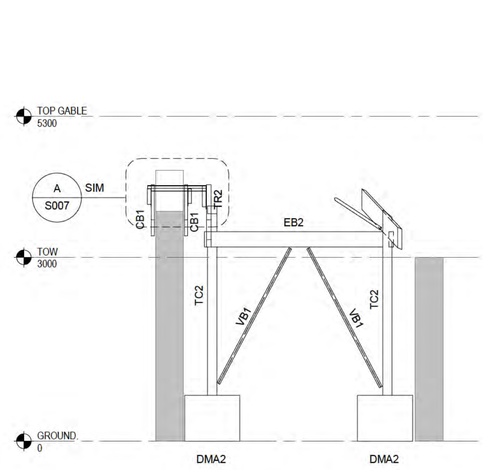

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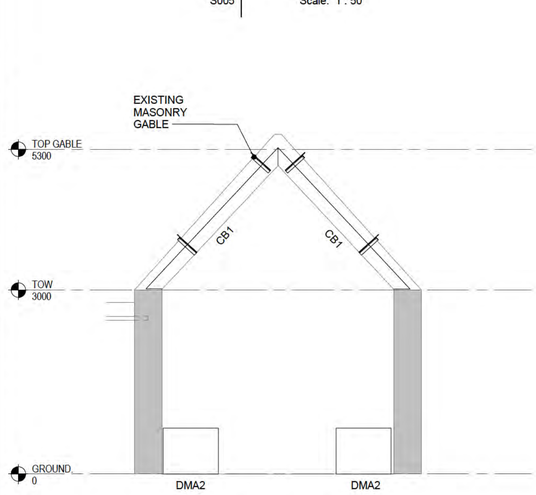
S005 Scale: 1 : 50



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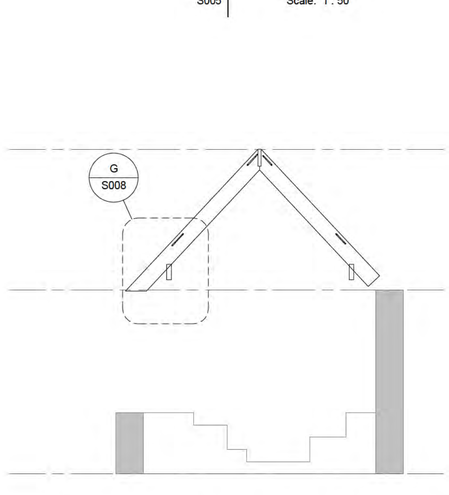

17 SECTION
S005 Scale: 1 : 50

0 1250 2500 mm
1:50

NOT FOR CONSTRUCTION

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KAVHA STRUCTURAL ASSESSMENT

CLIENT

DEPARTMENT OF INFRASTRUCTURE, TRANSPORT, REGIONAL DEVELOPMENT & COMMUNICATIONS
Prepared for:

CONSULTANT

AECOM Australia Pty. Ltd.
A.B.N. 20 093 846 925
www.aecom.com

TENDER

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s 47F

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C	08.04.2020	ISSUED FOR TENDER
B	02.04.2020	ISSUED FOR TENDER
A	06.12.2019	ISSUED FOR INFORMATION

KEY PLAN

PROJECT NUMBER

60615424

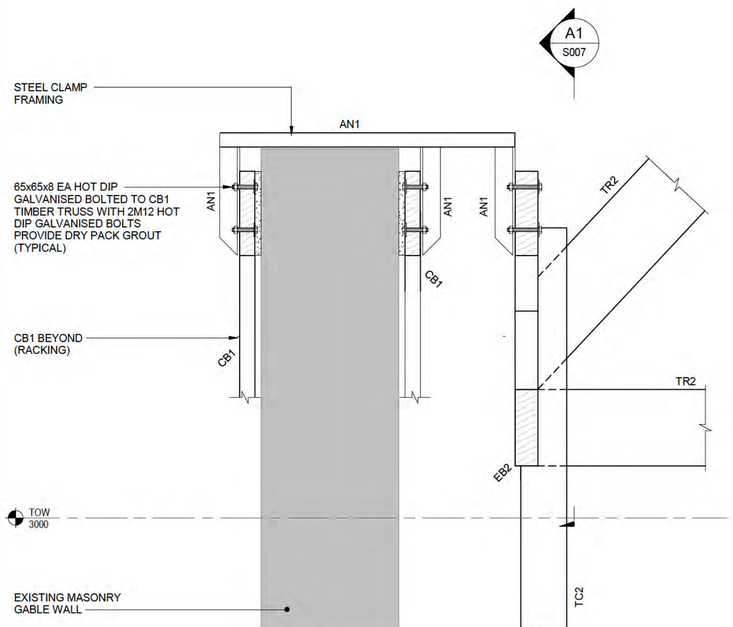
SHEET TITLE

CIVIL HOSPITAL
OPTION 02 SECTIONS - SHEET 1

SHEET NUMBER

60615424-DRG-S006

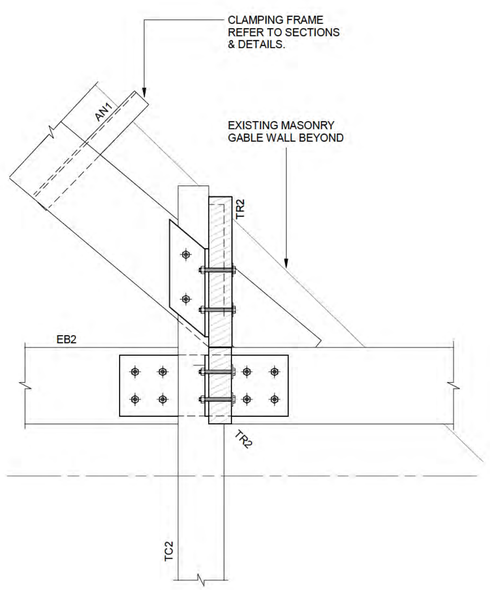
ISO A1 594mm x 841mm



TYPICAL CLAMPING DETAIL ALONG RAKING GABLE EDGE

AS INDICATED ON PLAN THUS '+'

A DETAIL S006 Scale: 1 : 10



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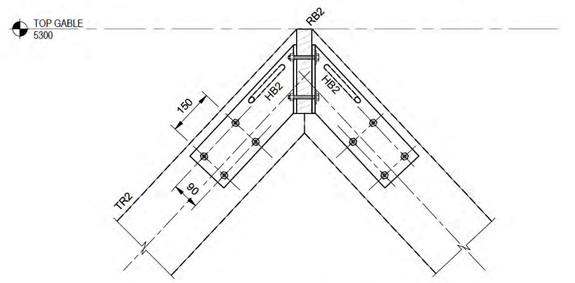

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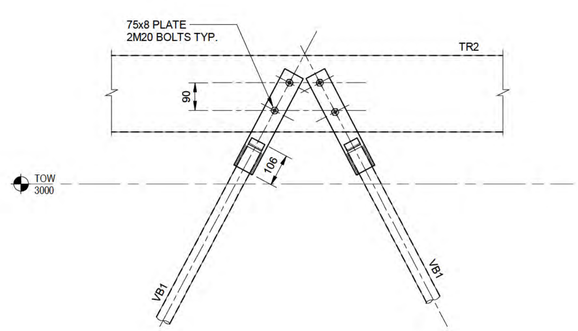

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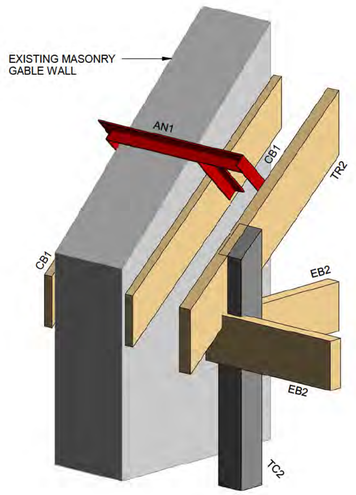
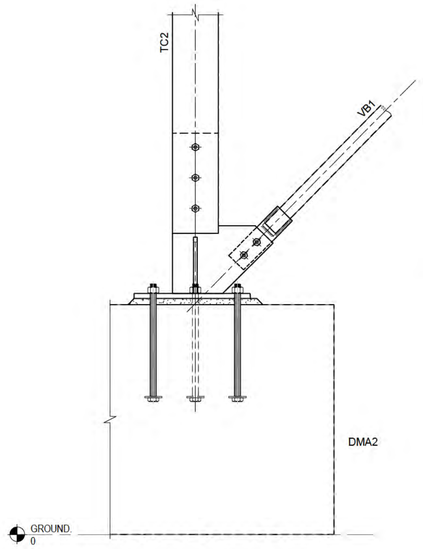


CLAMPING DETAIL ALONG RAKING GABLE EDGE

Scale: N.T.S.



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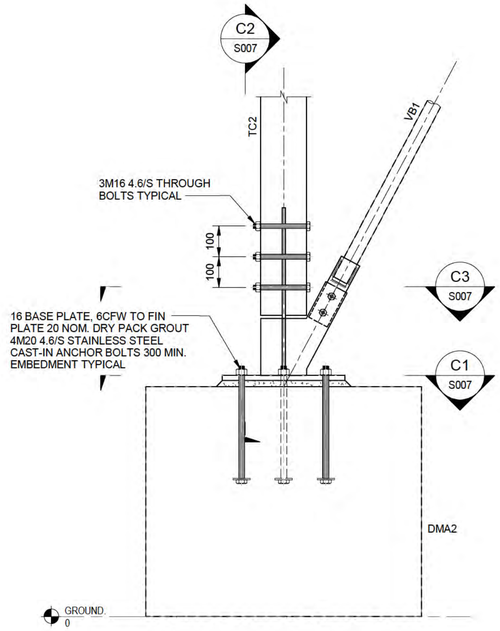
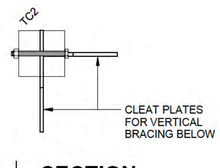


TC2 TO DMA2 BASEPLATE DETAIL

C DETAIL S006 Scale: 1 : 10



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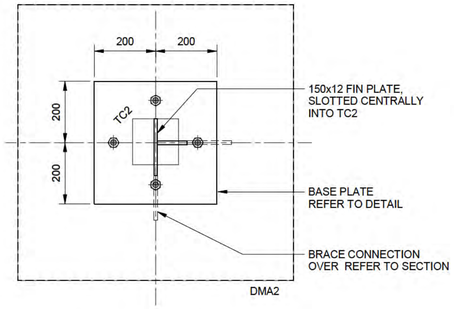

C1 SECTION S007 Scale: 1 : 10

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1:10

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KEY PLAN

PROJECT NUMBER

60615424

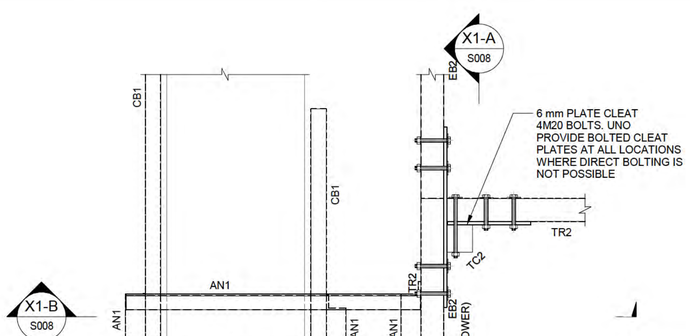
SHEET TITLE

CIVIL HOSPITAL
OPTION 02 SECTIONS - SHEET 2

SHEET NUMBER

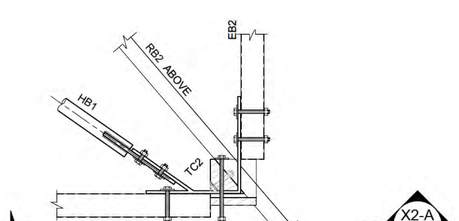
60615424-DRG-S007

NOT FOR CONSTRUCTION



X1 DETAIL

S005 Scale: 1 : 10



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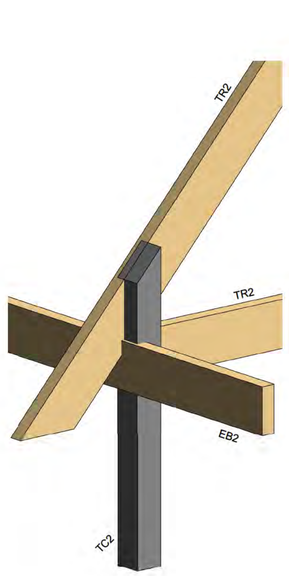
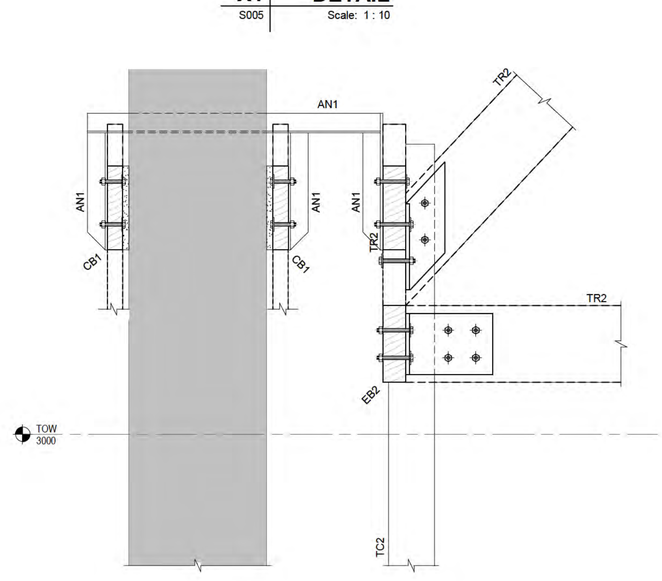
S005 Scale: 1 : 10



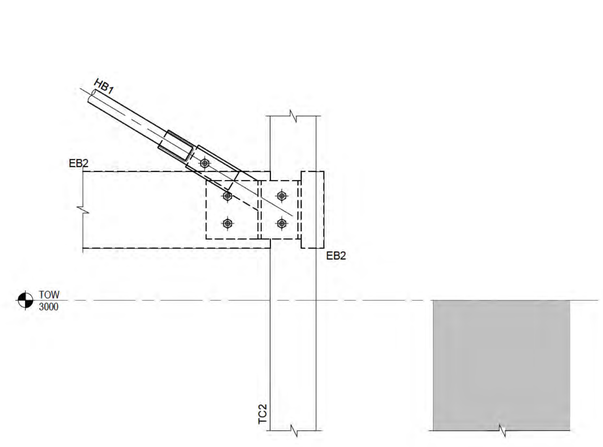
TYPICAL COLUMN TO TRUSS

Scale: N.T.S.



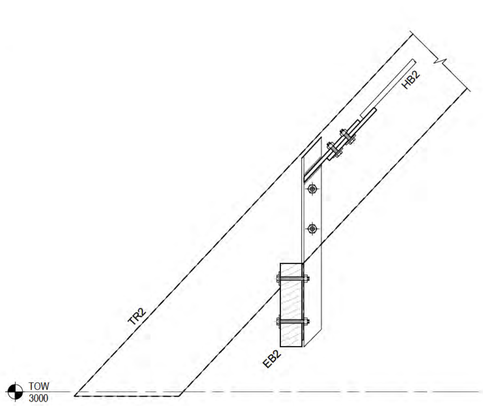
X1-B SECTION

S008 Scale: 1 : 10



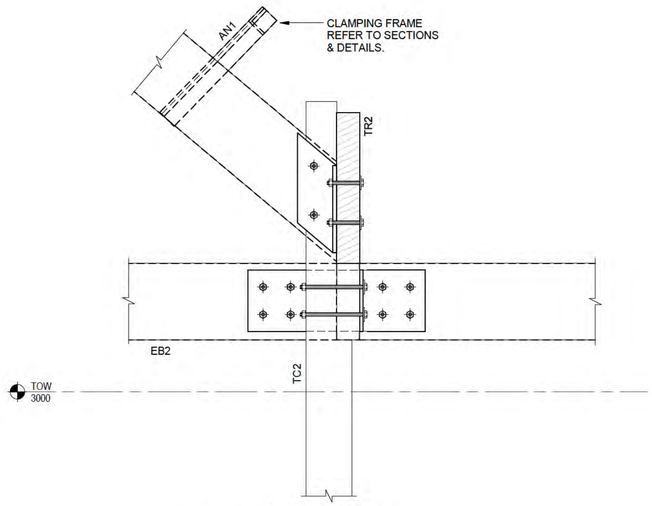
X2-A SECTION

S008 Scale: 1 : 10



G DETAIL

S006 Scale: 1 : 10



X1-A SECTION

S008 Scale: 1 : 10

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KEY PLAN

PROJECT NUMBER

60615424

SHEET TITLE

CIVIL HOSPITAL
OPTION 02 SECTIONS - SHEET 3

SHEET NUMBER

60615424-DRG-S008

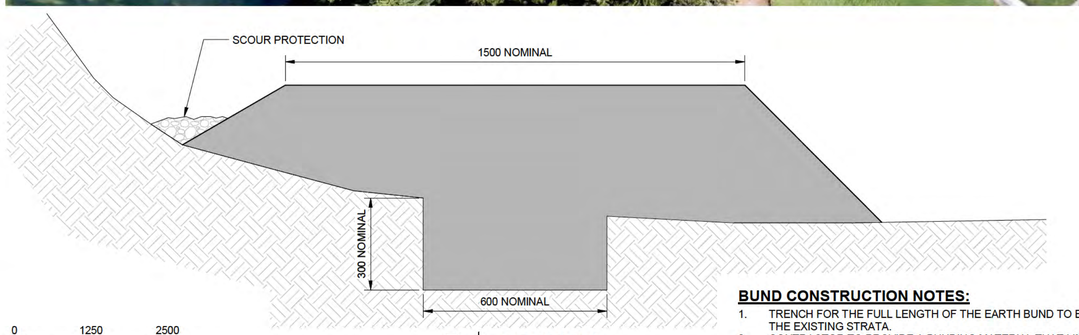
ISO A1 594mm x 841mm

ARTHURS VALE RETAINING WALL PLAN

Scale: N.T.S.

SUBSOIL AND ECO DRAIN CONSTRUCTION:

1. EXCAVATE BEHIND THE EXISTING WALL. ENSURE THAT THE EXISTING DRAIN OUTLETS ARE NOT DAMAGED.
2. CONTRACTOR TO CLEAN AND OPEN EXISTING DRAIN IN ORDER TO ALLOW FREE WATER FLOW.
3. CONTRACTOR TO EXCAVATE TRENCH BACKWARD FROM RL OF EXISTING DRAIN INLET TO LOCATION OF ECO PIT AT AN APPROPRIATE RL IN ORDER TO PROVIDE ADEQUATE FALL FOR AGG DRAIN.
4. EXCAVATE ECO DRAINS TO EXTEND 2000MM FROM BACK OF WALL TO CLOSEST EDGE (AS SHOWN ON PLAN).
5. CONNECT THE ECO DRAIN UPSTREAM OF THE LOWEST EXISTING WALL DRAIN VIA A 160MM DIA SLOTTED AND SLEEVED AGG DRAIN.
6. BACKFILL AGG DRAIN TRENCH WITH 75MM BALAST ROCK TO TOP OF TRENCH ALLOWING FOR MOUNDING AT THE TOP TO REDUCE SETTLEMENT.
7. CONTRACTOR TO ENSURE THAT THE FALL TO THE AG DRAIN IS AT A MIN 1-1.5% GRADE TO ENSURE ADEQUATE DRAINAGE VELOCITY.



B | SECTION — S010 — Scale: 1 : 10

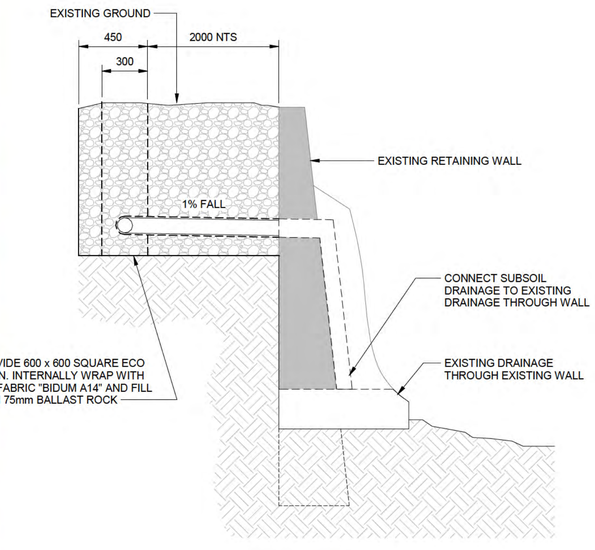
TYPICAL EARTH BUND SECTION

BUND CONSTRUCTION NOTES:

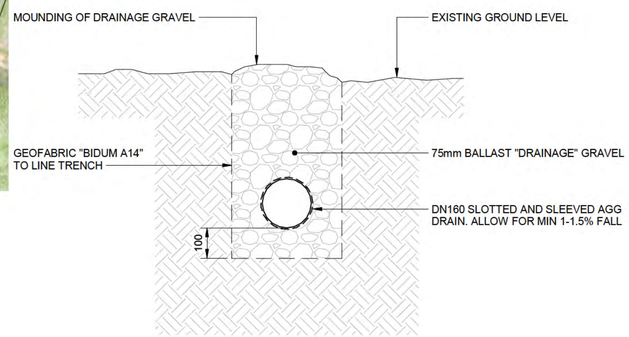
1. TRENCH FOR THE FULL LENGTH OF THE EARTH BUND TO ENABLE A KEY INTO THE EXISTING STRATA.
2. CONTRACTOR TO PROVIDE A BUNDING MATERIAL THAT LIMITS PERMEABILITY AND SCOUR.
3. SCOUR PROTECTION TO BE PROVIDED AT FOOT OF BUND. SMALL-MEDIUM SIZED COBBLES TO BE PLACED AT TOE OF BUND AND TRACKED INTO THE STRATA.
4. THE BUND IS TO BE CONSTRUCTED IN SUCH A WAY THAT THE WATER MIGRATING FROM THE UPSTREAM HILL IS DEFLECTED AWAY FROM THE RETAINING WALL AS ILLUSTRATED ON THE PLAN VIA DIRECTIONAL ARROWS.
5. GRASS DISTURBED AREAS AND MAKE GOOD AT EXTENTS OF WORKS.

GENERAL NOTES:

1. ALL WORKS DONE WITHIN THE KAVHA PRECINCT ARE TO BE UNDERTAKEN WITH DIRECT SUPERVISION OF EITHER AN ARCHEOLOGIST OR HERITAGE CONSULTANT OR A COMBINATION OF THE TWO PENDING THE APPROVED HERITAGE IMPACT STATEMENT AND ALSO ANY TRIGGERS UNDER THE LOCAL AUTHORITY OR COMMONWEALTH REQUIREMENTS.
2. ENSURE THAT ALL WORKS ARE DONE IN ACCORDANCE WITH THE REGULATORY AUTHORITY APPROVALS.



A | SECTION — S010 — Scale: 1 : 20



C | SECTION — S010 — Scale: 1 : 10

TYPICAL SUBSOIL DRAIN SECTION

0 1250 2500 mm — 1:50

0 250 500 mm — 1:10

NOT FOR CONSTRUCTION

AECOM

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KEY PLAN

PROJECT NUMBER

60615424

SHEET TITLE

ARTHURS VALE RETAINING WALL

SHEET NUMBER

60615424-DRG-S010

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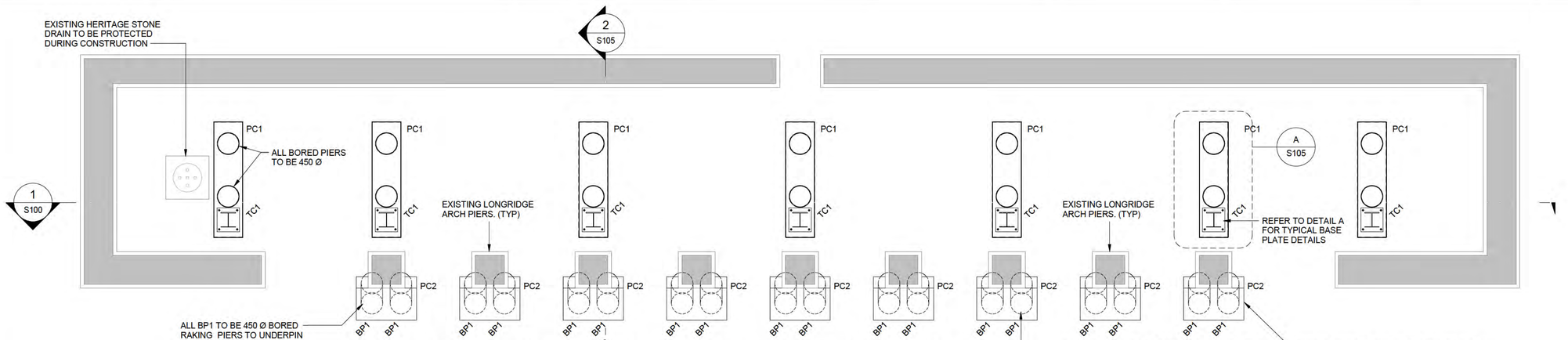
ISO A1 594mm x 841mm

EXISTING HERITAGE STONE DRAIN TO BE PROTECTED DURING CONSTRUCTION

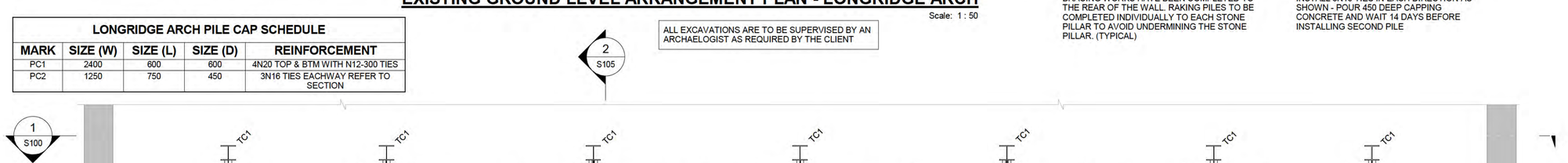


EXISTING GROUND LEVEL ARRANGEMENT PLAN - LONGRIDGE ARCH

Scale: 1 : 50

LONGRIDGE ARCH PILE CAP SCHEDULE				
MARK	SIZE (W)	SIZE (L)	SIZE (D)	REINFORCEMENT
PC1	2400	600	600	4N20 TOP & BTM WITH N12-300 TIES
PC2	1250	750	450	3N16 TIES EACHWAY REFER TO SECTION

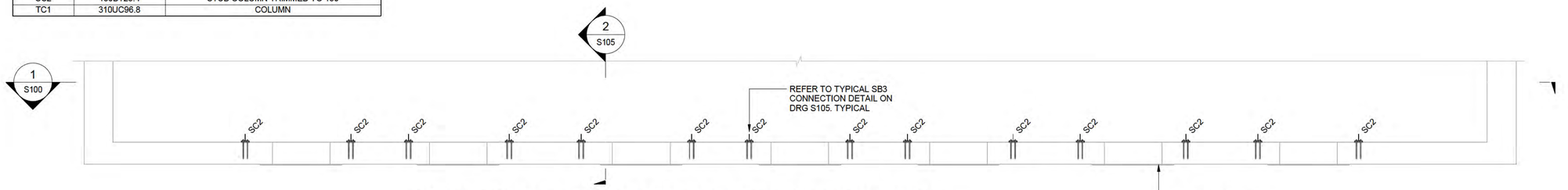
ALL EXCAVATIONS ARE TO BE SUPERVISED BY AN ARCHAEOLOGIST AS REQUIRED BY THE CLIENT



MID HEIGHT LEVEL GENERAL ARRANGEMENT PLAN

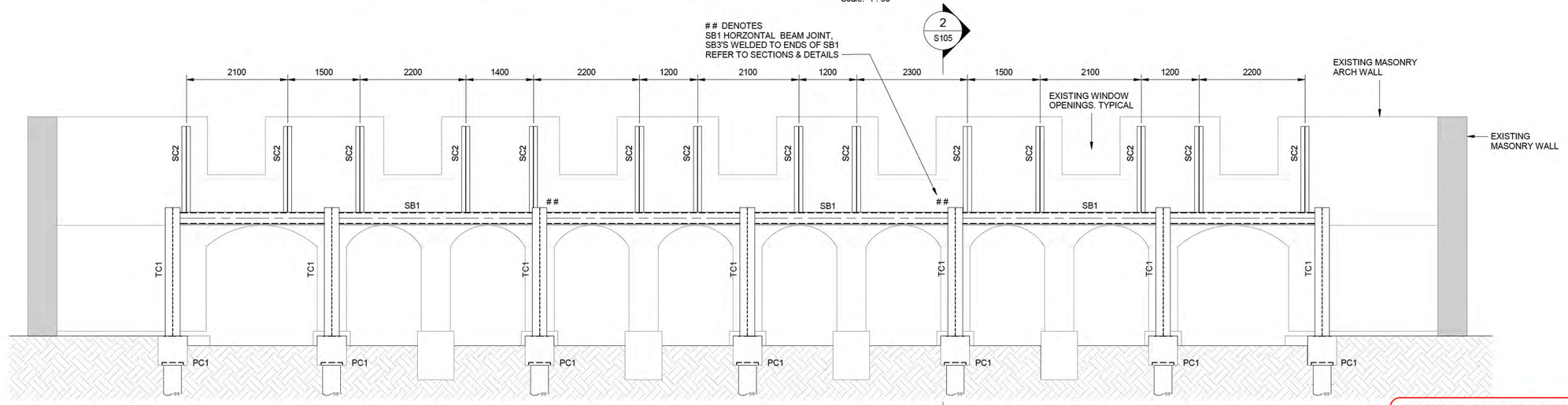
Scale: 1 : 50

LONGRIDGE ARCH FRAMING SCHEDULE		
MARK	SIZE	COMMENTS
SB1	250x150x12.5 RHS	STEEL BEAM
SB2	250UB37.3	STUB BEAM
SB3	250 PFC	STUB BEAM
SC2	180BT28.4	STUB COLUMN TRIMMED TO 150
TC1	310UC96.8	COLUMN



TOP OF ARCH LEVEL ARRANGEMENT PLAN - LONGRIDGE ARCH

Scale: 1 : 50



0 1250 2500 mm
1:50

1 SECTION

S100 Scale: 1 : 50

NOT FOR CONSTRUCTION

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KEY PLAN

PROJECT NUMBER

60615424

SHEET TITLE

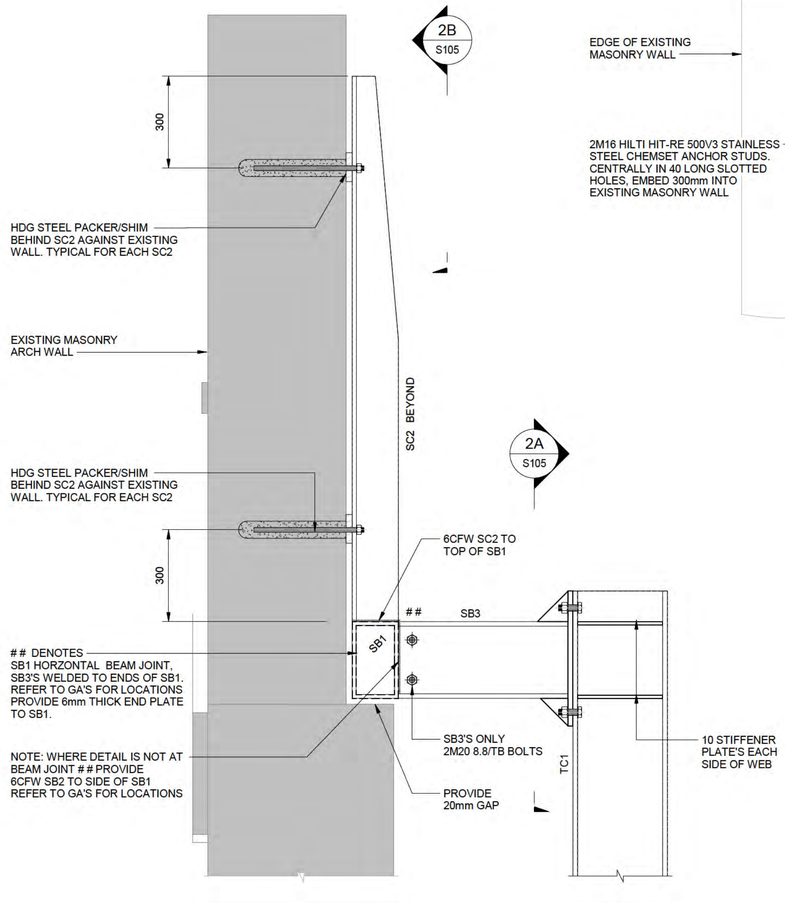
LONGRIDGE ARCH PLANS

SHEET NUMBER

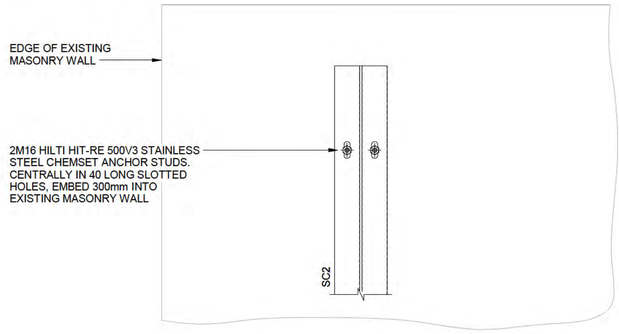
60615424-DRG-S100

Last Saved: 14/10/2020 2:44:32 PM
Filename: C:\Users\gamih\Documents\Timber Option 20_04_02_60615424-MOD-ST-CENTRAL_R19_Heru.Gani.rvt

ISO A1 594mm x 841mm

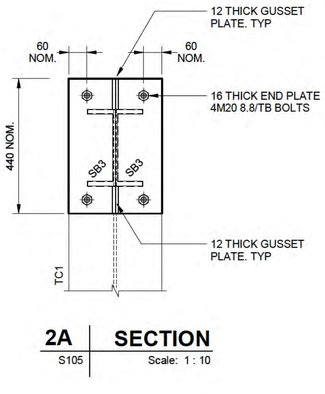


2 | SECTION
S100 | Scale: 1 : 10

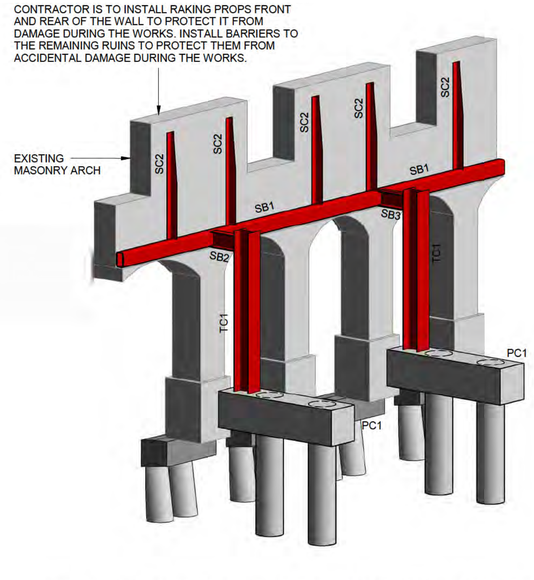


TYPICAL SB2 CONNECTION DETAIL

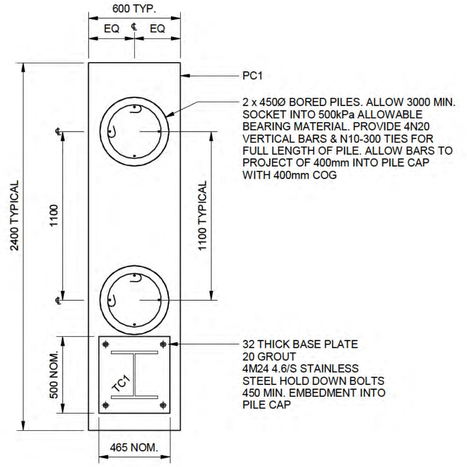
2B | SECTION
S105 | Scale: 1 : 10



2A | SECTION
S105 | Scale: 1 : 10



3D VIEW - TYPICAL SUPPORT STEELWORK FRAMING



TYPICAL PC1 PLAN DETAIL

A | DETAIL
S100 | Scale: 1 : 20

0 500 1000 mm
1:20

0 250 500 mm
1:10

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KEY PLAN

PROJECT NUMBER

60615424

SHEET TITLE

LONGRIDGE ARCH SECTIONS - SHEET 1

SHEET NUMBER

60615424-DRG-S105

Last Saved: 14/10/2020 2:44:34 PM
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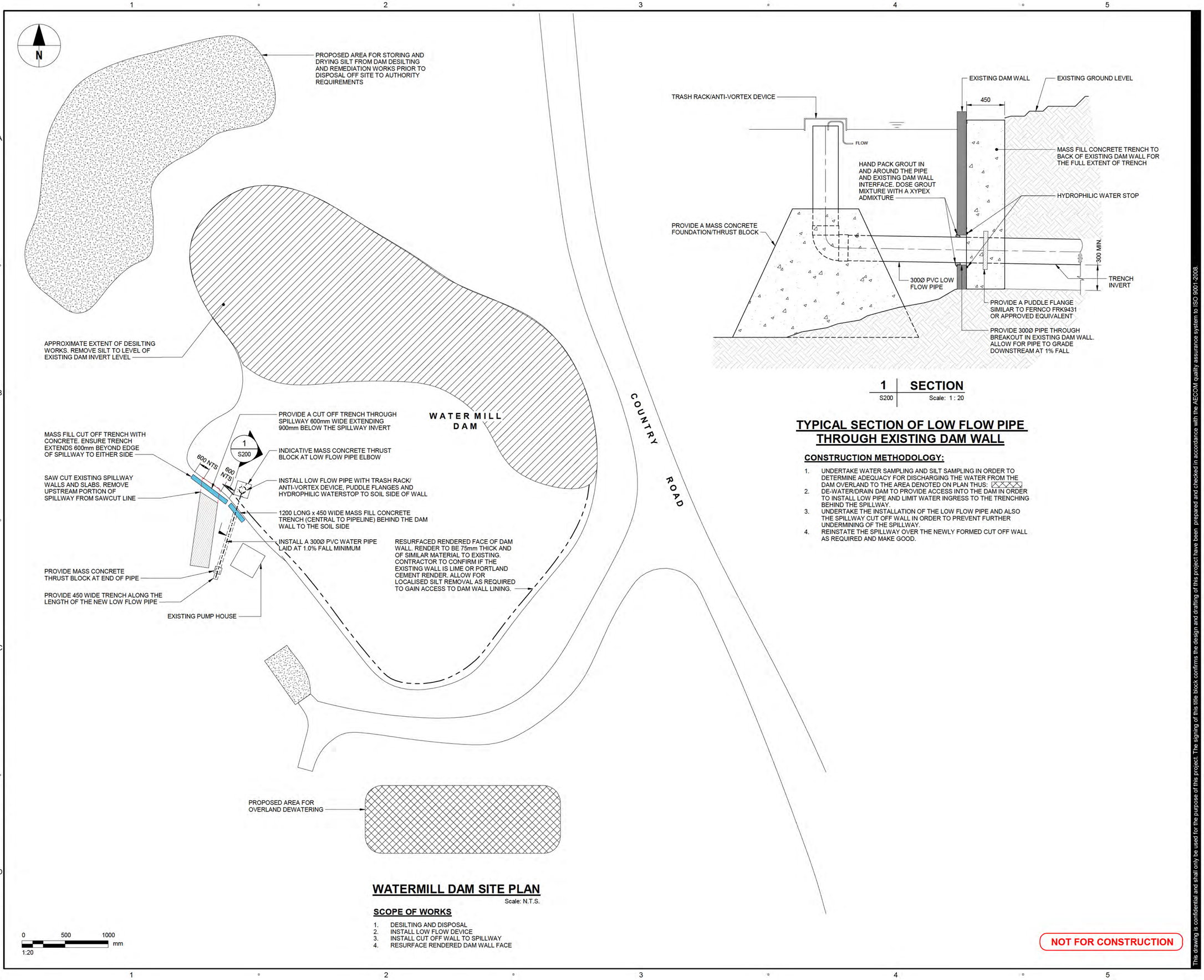

WATERMILL DAM SITE PLAN

Scale: N.T.S.

SCOPE OF WORKS

1. DESILTING AND DISPOSAL
2. INSTALL LOW FLOW DEVICE
3. INSTALL CUT OFF WALL TO SPILLWAY
4. RESURFACE RENDERED DAM WALL FACE

1 | SECTION
S200 | Scale: 1 : 20

TYPICAL SECTION OF LOW FLOW PIPE THROUGH EXISTING DAM WALL

CONSTRUCTION METHODOLOGY:

1. UNDERTAKE WATER SAMPLING AND SILT SAMPLING IN ORDER TO DETERMINE ADEQUACY FOR DISCHARGING THE WATER FROM THE DAM OVERLAND TO THE AREA DENOTED ON PLAN THUS:
2. DE-WATER/DRAIN DAM TO PROVIDE ACCESS INTO THE DAM IN ORDER TO INSTALL LOW PIPE AND LIMIT WATER INGRESS TO THE TRENCHING BEHIND THE SPILLWAY.
3. UNDERTAKE THE INSTALLATION OF THE LOW FLOW PIPE AND ALSO THE SPILLWAY CUT OFF WALL IN ORDER TO PREVENT FURTHER UNDERMINING OF THE SPILLWAY.
4. REINSTATE THE SPILLWAY OVER THE NEWLY FORMED CUT OFF WALL AS REQUIRED AND MAKE GOOD.

0 500 1000 mm
1:20

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I/R	DATE	DESCRIPTION
D	08.04.2020	ISSUED FOR TENDER
C	02.04.2020	ISSUED FOR TENDER
B	20.02.2020	ISSUED FOR INFORMATION
A	06.12.2019	ISSUED FOR INFORMATION

KEY PLAN

PROJECT NUMBER

60615424

SHEET TITLE

WATERMILL DAM

SHEET NUMBER

60615424-DRG-S200

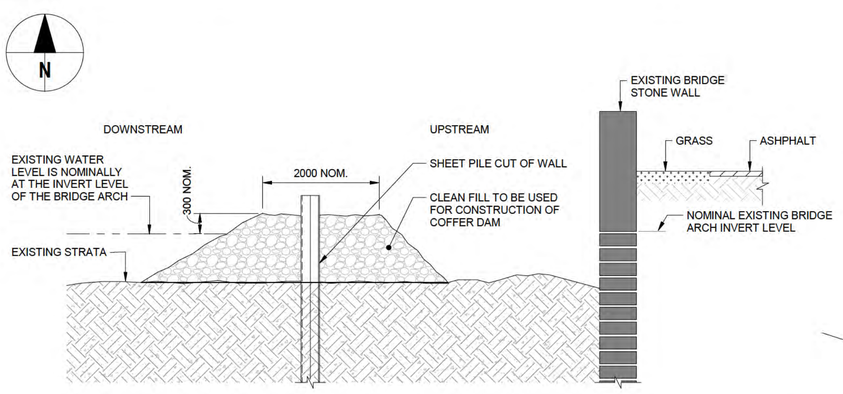
Appendix B

Risk Register

							Likelihood						
							Selected Likelihood	Likelihood %	Selected Consequence override	Assessed Risk Level			
Risk Description	**Consequence**	**Risk Treatment Strategies (RTS)**	**Risk Action Assigned To**	**Date**	**Risk Status**	**Comments**	**Selected Likelihood**	**Likelihood %**	**Consequence**	**Assessed Risk Level**	**Best Case**	**Most Likely Case**	**Worst Case**
Approvals - Departmental and Government - Poor quality products (Design reports, Business Case) result in approvals for capital expenditure being delayed	Delay in achieving approval to expend capital funds resulting in additional escalation.	Documentation to be provided with sufficient time for DIRDC reviews and endorsement by sponsor and other agencies.	Design Team and DIRDC	Throughout development phase	Open		Unlikely	20%	Moderate	M	1 month delay	2 month delay	4 month delay
Scope Definition - Insufficient definition or understanding of scope	Delay in development of design resulting in additional escalation	Confirm requirement. DSC to engage with users as part of design process	Contractor/Design Team	Throughout design	Open		Unlikely	20%	Minor	L	$5,000 increase in capital cost	$30,000 increase in capital cost	$60,000 increase in capital cost
Commercial and Financial Limited construction market resulting in a change in costs Inclusion of local participation requirements increases costs	Cost overruns	Appoint a DSC with competent Cost Planner.DIRDC to do independent checks (using existing data). Monitor construction market in lead up to appointment of contractor/sub contractors	DIRDC	Throughout development phase	Open		Unlikely	20%	Moderate	M	$10,000 increase in capital cost	$150,000 increase in capital cost	$200,000 increase in capital cost
Hazardous Materials Removal Discovery of asbestos, heavy metals or other contaminants resulting in increased costs not covered by the contract (Latent conditions)	Cost for removal, treatment and/or storage of material	Conduct site surveys and testing during design. Review existing documentation including contamination surveys.	DIRDC	Throughout construction	Open		Unlikely	20%	Minor	L	$5,000 increase in capital cost	$30,000 increase in capital cost	$60,000 increase in capital cost
Approvals - Environment Discovery of listed species results in extended process for environment and heritage approval	Delay in development of design resulting in additional escalation and costs associated with compensatory planting	Conduct site surveys during design. Review existing documentation including existing EIR.	Contractor/Design Team	Up to 5% MPFR	Open		Rare	10%	Minor	L	1 month delay	2 month delay	4 month delay
Approvals - Heritage Known and possible heritage issues including Indigenous and European heritage result in the need for additional studies	Delay in development of design resulting in additional escalation	Conduct site surveys during design. Review existing documentation including existing EIR. Self Refer under EPBC-Act	Contractor/Design Team	Throughout design phase	Open		Possible	50%	Minor	M	1 month delay	2 month delay	4 month delay
Construction Delay Local requirements and remote site constraints may delay works	Delay in construction resulting in additional escalation	Engagement with local community to identify critical periods	DIRDC	Throughout construction	Open		Possible	50%	Minor	M	1 month delay	3 month delay	6 month delay
Construction Delay - Heritage Find Discovery of a heritage item during construction	Delay in construction resulting in additional escalation	Heritage advicsor on site	DIRDC	Throughout construction	Open		Possible	50%	Insignificant	L	1 month delay	2 month delay	4 month delay
Weather Extreme weather events delay works and incurring damage with resulting repairs	Delay and additional construction cost	Programing earthworks construction outside of the peak storm season	Contractor	Throughout construction	Open		Rare	10%	Minor	L	1 month delay	2 month delay	4 month delay
Reliance on Other Projects Interdependencies between projects and constrained availability of resources causes delay.	Delay and additional construction cost	Liaise with NI Council to coordinate projects	DIRDC	Up to commencing design	Open		Rare	10%	Minor	L	1 month delay	2 month delay	4 month delay
Council Approvals NI Council delays building approvals	Delay and additional construction costs	Liaise with NI Council to maintain a good relationship	DIRDC	Up to commencing construction	Open		Rare	10%	Minor	L	1 month delay	2 month delay	3 month delay
Unathorised pollution event Discharge or pollution from construction activities affecting offsite locations	Fines and costs for remediation/repair	Soil and erosion controls. Water management	Contractor/Design Team	Throughout construction	Open		Rare	10%	Major	M	$5,000 costs	$20,000 costs	$50,000 costs for remediation
Unintentional damage to heritage building/element during construction	damage, possibly irreparable, to a heritage item	construction management plan that includes protective measures	DIRDC / Contrator	Throughout construction	Open		Unlikely	20%	Moderate	M	$10,000 increase in capital cost	$150,000 increase in capital cost	$200,000 increase in capital cost

Appendix C

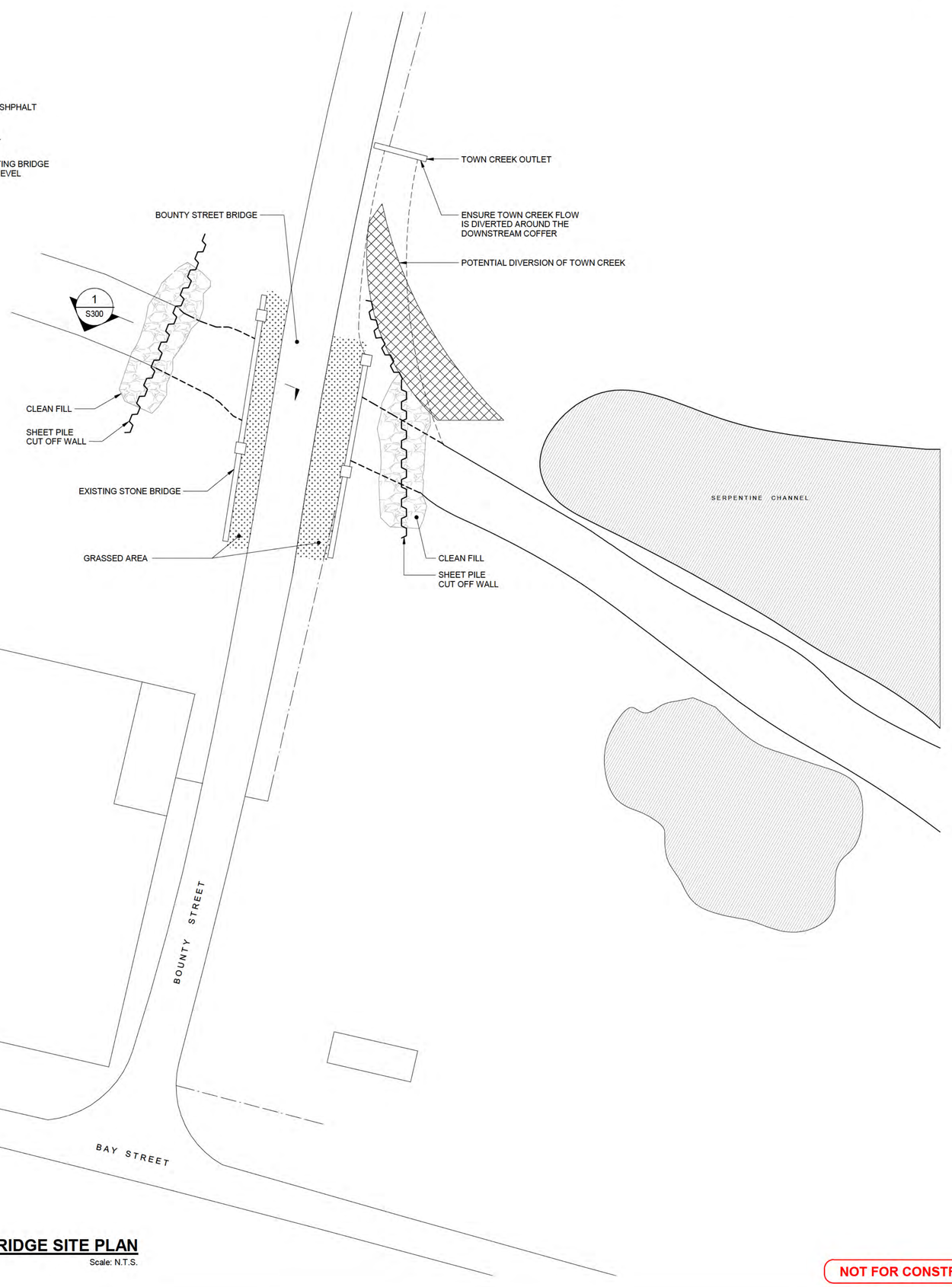
Bounty Street Bridge Investigation Drawings



TYPICAL COFFER DAM DETAIL

COFFER DAM CONSTRUCTION NOTES:

1. ONLY CLEAN FILL IS TO BE PLACED IN THE WATERWAY.
2. THE COFFER DAM LOCATIONS ARE INDICATIVE ONLY. CONTRACTOR IS TO MAKE THEIR OWN ASSESSMENT AS TO SPACE REQUIRED ADJACENT TO THE BRIDGE TO UNDERTAKE THE WORKS.
3. THE CONTRACTOR IS TO SUBMIT A DIMENSIONED DRAWING SHOWING THE PROPOSED COFFER DAMS SETOUT FOR APPROVAL PRIOR TO CONSTRUCTION.
4. THE CONTRACTOR IS TO ALLOW FOR ANY DIVERSION PUMPS NECESSARY TO DIVERT WATER FLOWS AROUND THE SITE FOR THE DURATION OF THE WORKS.
5. SHEET PILING INSTALLATION IS TO BE UNDERTAKEN IN A WAY THAT DOES NOT DAMAGE THE BRIDGE.
6. SHEET PILING AND COFFER DAMS ARE TO BE REMOVED AT COMPLETION AND STREAM PROFILE RETURNED TO EXISTING CONDITIONS.
7. THE CONTRACTOR IS TO MAKE GOOD ANY DISTURBED AREAS AT COMPLETION AND GRASS TO MATCH EXISTING.
8. THE CONTRACTOR IS RESPONSIBLE FOR OBTAINING ANY REQUIRED AUTHORITY APPROVALS AND FOR ANY WATER TESTING ETC. THAT MAY BE REQUIRED BY THEIR SWMS



BOUNTY STREET BRIDGE SITE PLAN

Scale: N.T.S.

0 625 1250 mm
1:25

NOT FOR CONSTRUCTION

AECOM

PROJECT

KAVHA STRUCTURAL ASSESSMENT

CLIENT

DEPARTMENT OF INFRASTRUCTURE, TRANSPORT, REGIONAL DEVELOPMENT & COMMUNICATIONS
Prepared for:

CONSULTANT

AECOM Australia Pty. Ltd.
A.B.N. 20 093 846 925
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DRAFT FOR TENDER

PROJECT MANAGEMENT INITIALS

s 47F

DESIGNER	CHECKED	APPROVED

ISSUE/REVISION

I/R	DATE	DESCRIPTION
C	08.04.2020	ISSUED FOR TENDER
B	02.04.2020	ISSUED FOR TENDER
A	06.12.2019	ISSUED FOR INFORMATION

KEY PLAN

PROJECT NUMBER

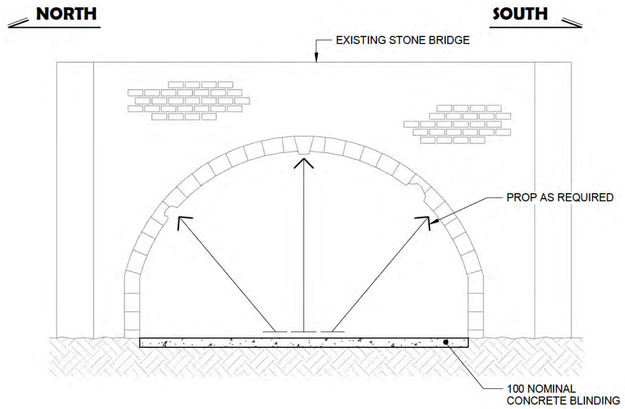
60615424

SHEET TITLE

BOUNTY STREET BRIDGE PLAN

SHEET NUMBER

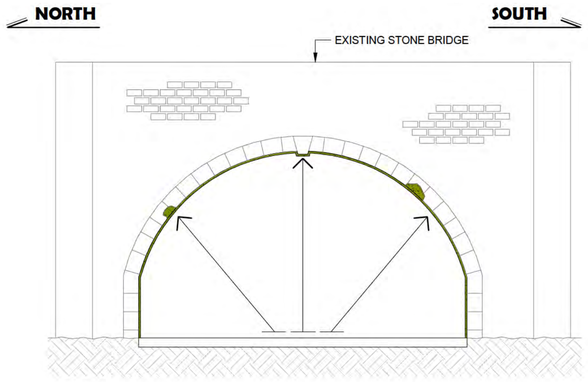
60615424-DRG-S300



CONSTRUCTION SEQUENCE - STAGE 1

EXCAVATION:

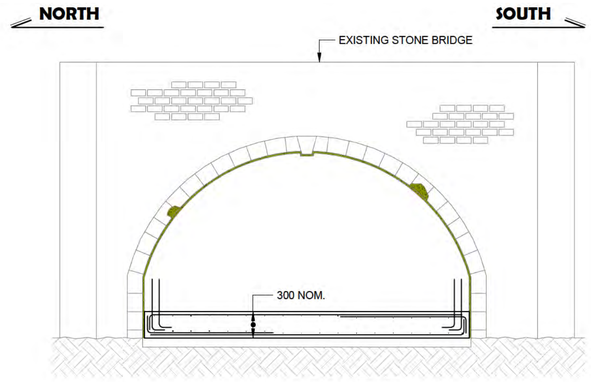
1. EXCAVATE TO A FIRM SOUND BASE UNDER THE ARCH. THIS IS EXPECTED TO BE ALLUVIAL SOILS AND NOT ROCK. DISPOSE OF SOIL TO AUTHORITY APPROVALS.
2. THE BASE IS TO MATCH THE R.L. OF THE BRIDGE FOUNDATIONS. R.L. UNKNOWN.
3. OVER EXCAVATE AND INSTALL A NOMINAL 100 THICK CONCRETE BLINDING LAYER AS A WORKING PLATFORM.
4. THE WORKS MAY NEED TO PROGRESS IN STAGES FROM THE UPSTREAM TO DOWNSTREAM TO SUIT CONTRACTORS SWMS AND/OR CONSTRUCTION METHODOLOGY.
5. ALLOW TO PROP AS REQUIRED BY SWMS.



CONSTRUCTION SEQUENCE - STAGE 2

POINT AND RENDER ARCH SOFFIT:

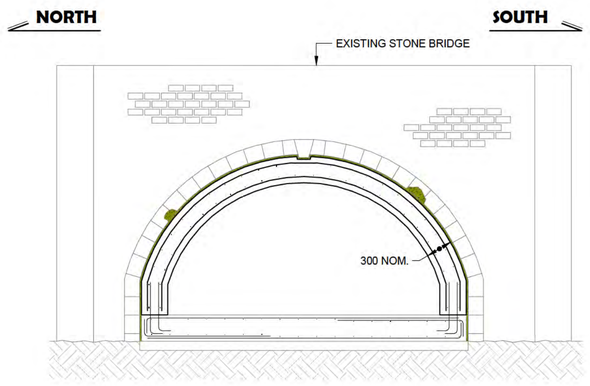
1. CLEAN MUD FROM STONE WITH POTABLE WATER.
2. FILL ERODED STONE WITH HYDRAULIC LIME MORTAR.
3. TO BE CONFIRMED:
   - STONE SEALING SURFACE TREATMENT
   - MORTAR COMPOSITION
   - MORTAR APPLICATION LIMITATIONS/METHODOLOGY
4. APPLY A 50 THICK HYDRAULIC LIME MORTAR RENDER TO THE ARCH SOFFIT.



CONSTRUCTION SEQUENCE - STAGE 3

POUR FOUNDATION:

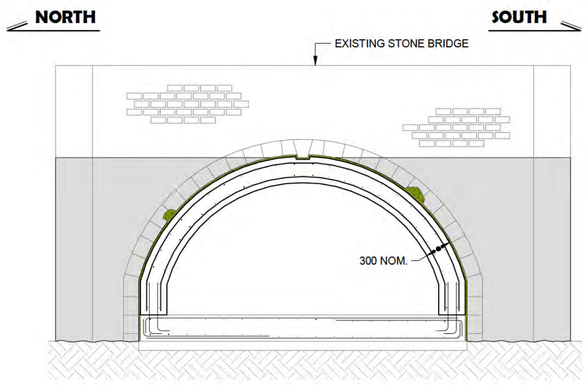
1. FORM, REINFORCE AND POUR FOUNDATION SLAB WITH WALL STARTER BARS FOR THE FULL WIDTH OF THE BRIDGE.
2. CONCRETE TO BE S40 GRADE AND CONFORMING WITH THE RMS SPECIFICATION FOR A 100 YEAR DESIGN LIFE.
3. REINFORCEMENT - CONSIDER NON-METALLIC FOR INCREASED DURABILITY.



CONSTRUCTION SEQUENCE - STAGE 4

CONSTRUCT CONCRETE LINING:

1. REINFORCE, FORM AND POUR CONCRETE LINING TO THE ARCH.
2. CONCRETE TO BE POURED THROUGH ACCESS HOLES CUT INTO THE TOP OF THE ARCH AT REGULAR INTERNALS.
3. THE CONTRACTOR TO SUBMIT METHODOLOGY FOR APPROVAL ON HOW ENTRAPPED AIR WILL BE ELIMINATED FROM THE TOP OF THE ARCH.
4. CONCRETE LINING TO BE SET BACK 300 NOMINAL FROM THE UPSTREAM FACE OF THE BRIDGE.
5. CONCRETE LINING TO REPLACE THE CONCRETE LINTEL ON THE DOWNSTREAM FACE OF THE BRIDGE.



CONSTRUCTION SEQUENCE - STAGE 5

REMEDIATE BRIDGE SIDES:

1. POINT STONEWORK TO ALL SIDES OF THE BRIDGE BELOW THE WATER LEVEL (SHOWN HATCHED ABOVE) WITH HYDRAULIC LIME MORTAR AFTER CLEANING WITH POTABLE WATER
2. PERMISSIBLE TO REPLACE SEVERELY ERODED STONE WITH APPROVED EQUIVALENT STONE IF INSTALLED UNDER THE DIRECT SUPERVISION OF A STONEMASON THAT IS EXPERIENCED WITH HERITAGE STONEWORK.
3. REMOVE EXISTING PORTLAND CEMENT RENDER FORM ALL FACES OF THE BRIDGE (UPSTREAM BOTH FACES. DOWNSTREAM BOTH FACES FOR THE FULL LENGTH OF THE STONE WALLS) WITHOUT DAMAGING THE UNDERLYING STONE AND REPLACE WITH LIME MORTAR.
4. SET THE EXISTING CAPPING STONES IN PLACE USING LIME MORTAR.

AECOM

PROJECT

KAVHA STRUCTURAL ASSESSMENT

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CONSULTANT

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DRAFT FOR TENDER

PROJECT MANAGEMENT INITIALS

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B	08.04.2020	ISSUED FOR TENDER
A	02.04.2020	ISSUED FOR TENDER

KEY PLAN

PROJECT NUMBER

60615424

SHEET TITLE

BOUNTY STREET BRIDGE CONSTRUCTION SEQUENCE

SHEET NUMBER

60615424-DRG-S301

NOT FOR CONSTRUCTION

Appendix D

Geotechnical Report

ACT Geotechnical Engineers Pty Ltd

Appendix D

AECOM

SETTLEMENT OF BRIDGE ABUTMENT

BOUNTY STREET, KINGSTON, NORFOLK ISLAND

FOUNDATION MOVEMENT - GEOTECHNICAL INVESTIGATION REPORT

FEBRUARY 2020

ACT Geotechnical Engineers

ACT Geotechnical Engineers Pty Ltd
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11 February 2020
Our ref: s 47F /C10484
AECOM
Via email: s 47F @aecom.com

Attention: s 47F

SETTLEMENT OF BRIDGE ABUTMENT – BOUNTY STREET, KINGSTON, NORFOLK ISLAND

FOUNDATION MOVEMENT - GEOTECHNICAL INVESTIGATION REPORT

1 INTRODUCTION

At the request of AECOM, ACT Geotechnical Engineers Pty Ltd carried out a geotechnical investigation to assess foundation movement of a bridge abutment on Bounty Street, in Kingston, Norfolk Island.

It is understood that the bridge abutment on the northern side has experienced settlement of up to 1.2m. The bridge is a stone arch bridge, built by convicts in about 1830, and is within the Kingston and Arthur's Vale Historic Area (KAVHA), which is a UNESCO World Heritage Site.

The aim of the investigation was to:

i) Identify subsurface conditions including the extent and nature of any fill materials, natural soil profile, as well as determining the foundation material of the existing bridge footings.
ii) Provide engineering logs of the boreholes, including a plan showing locations.
i) Conduct Dynamic Cone Penetrometer (DCP) testing to assess the relative density of the soil profile
iii) Identify potential cause(s) of the foundation movement and bridge subsidence.
iv) Provide recommendations to prevent future subsidence.

2 SITE DESCRIPTION & GEOLOGY

2.1 Site Description

The site is located on Bounty Street, within the Kingston and Arthur's Vale Historic Area (KAVHA), in Norfolk Island. The Bounty Street Bridge is located approximately halfway along Bounty Street, between Quality Row and Bay Street. Figure 1 shows the site locality.

The site is located on the relatively flat flood-plain of Watermill Creek, which drains E/SE through the Kingston and Arthur's Vale Historic Area, into Emily Bay. At the time of investigation, the Watermill Creek channel was thickly covered in bull rushes, and the water level in the creek was above the top of the arch of the bridge. Some of the bull rushes on either side of the bridge had recently been removed to allow better access to the bridge abutments. The flood-plain of the creek is low-lying (the top of the arch of the bridge is reportedly below high tide level), and the surrounding area shows signs of long-term water-logging. A recent aerial photo of the site is presented in Figure 2, which shows the site layout. Photos taken at the time of the investigation are shown in Figures 3 to 7.

The Bounty Street Bridge is a stone arch bridge, built by convicts in about 1830. The arch is 4.2m wide, and is an elliptical shape. It is understood that flood waters caused damage to the eastern face of the bridge, and the arch on that side was replaced by a flat lintel.

2.2 Geology

The geology of Norfolk Island was summarised in the Bureau of Mineral Resources (BMR) Bulletin 234 "The hydrogeology of Norfolk Island, South Pacific Ocean", by R. S. Abell and A. C. Falkland, in 1988.

The Bounty Street Bridge site is documented to be covered in Quaternary age alluvial deposits, associated with Watermill Creek. These alluvial deposits are underlain by Quaternary age, cross-bedded and massive calcarenite, with interbedded, black, carbonacoues, lagoonal clay and Norfolk Aeolianite (fossil dune sand), overlying basalt bedrock.

Calcarenite is a type of limestone that is composed predominantly, more than 50 percent, of detrital (transported) sand-size (0.0625 to 2 mm in diameter), carbonate grains. The grains consist of sand-size grains of either corals, shells, pellets, fragments of older limestones and dolomites, other carbonate grains, or some combination of these.

The dip of the cross-bedding indicates that the calcarenite was laid down by southerly winds, partly re-worked by currents, during a low sea level stand in the Late Quaternary. A sequence of younger massive beach rock, derived in part from the underlying aeolianite by erosion and re-deposition, also contain basalt pebbles and fragments of algae and coral.

3 INVESTIGATION METHODS

The field investigation was carried out on 28 January 2020, comprising two (2) boreholes designated 1A and 2A, to determine the subsurface profile. Borehole 1A was drilled adjacent to the southern abutment of the bridge, while borehole 2A was drilled adjacent to the northern abutment (both on the western, upstream side of the bridge). The borehole locations are shown on Figure 2. The boreholes were drilled using a push-tube sampler, and were drilled to the limit of the equipment (2m depth).

Given that the water level in Watermill Creek was above the top of the arch of the bridge, the boreholes were drilled on the bank of the creek, as close as possible to the bridge abutment. This high water level also prevented a visual inspection of the existing bridge footings and foundation material.

The subsurface profile was visually logged in accordance with the Unified Soil Classification System (USCS). The borehole logs are included in Appendix D(1), and a copy of the USCS and definitions of terms used in this report are included in Appendix D(2).

A visual inspection of the bridge was conducted on 28 January 2020, to assess the location, type, and severity of the cracking and settlement.

To determine the relative density of the foundation soils at the bridge abutments, Dynamic Cone Penetrometer (DCP) tests were undertaken in accordance with AS1289.6.3.2 "Determination of the penetration resistance of a soil – 9kg dynamic cone penetrometer test". The results of the tests are shown on the borehole logs and are summarised in Section 4.3.

4 INVESTIGATION RESULTS

4.1 Subsurface Conditions

Borehole 1A was drilled adjacent to the southern abutment of the bridge, while borehole 2A was drilled adjacent to the northern abutment (both on the western, upstream side of the bridge). These boreholes found a similar subsurface profile, as follows:

Geological Profile	Depth Interval	Description
TOPSOIL	0m to 0.2m/0.3m	CLAYEY SILTY SAND; fine to medium sand, low plasticity fines, dark brown, grass roots, dry, loose.
ALLUVIAL SOILS	0.2m/0.3m to >2m	SILTY CLAYEY SAND & SILTY CLAY; low and medium plasticity fines, fine to coarse sand, brown, black, some organic matter and roots, dry to moist, becoming wet below 0.8m/1.2m depth, loose to medium dense and firm to stiff.

Similar subsurface profiles were encountered at both abutments, and there did not appear to be any obvious reason why the abutment at the northern end had subsided more in comparison to the southern end. It should be noted that the boreholes were drilled from the top edge of the creek bank, and the foundation of the bridge is estimated to be about 1.5m/2m below this depth.

Bedrock was not encountered within the 3.2m/3.6 investigation depth of the boreholes and DCP tests. Based on the topography, geology, and degree of settlement that has occurred, it is estimated that loose to medium dense and firm to stiff alluvial soils could extend to 5m/10m depth, underlain by calcarenite bedrock.

At the time of investigation, the water level in Watermill Creek was above the top of the arch of the bridge, and it has been indicated that the top of the arch of the bridge is below high tide level. Therefore, permanent groundwater is expected to correspond closely to the sea levels in nearby Emily Bay/Slaughter Bay, and could rise when there are significant flows along Watermill Creek. Permanent groundwater was encountered at 0.8m/1.2m depth in the investigation boreholes, and the foundations soils were wet/saturated.

4.2 Visual Assessment of Cracking/Settlement

A visual inspection of the exposed stone sides of the bridge was conducted on 28 January 2020. On the western side of the bridge, there is a large vertical crack located just to the south of the arch. This crack suggests that the bridge has cracked in half due to rotation (subsidence) of at least one of the abutments. A visual comparison of levels indicates that the northern abutment has settled/subsided by a considerable amount. From the horizontal, this settlement/subsidence is about 1.2m, although this assumes that the bridge was built level in the first place. The road pavement over the bridge is bitumen-sealed, with no obvious signs of cracking or subsidence. Based on this, it appears that the settlement/subsidence of the northern abutment probably occurred a long time ago (probably within about 20 years of the bridge being constructed).

4.3 Dynamic Cone Penetrometer (DCP) Testing

To determine the relative density of the foundation soils at the bridge abutments, Dynamic Cone Penetrometer (DCP) tests were taken in accordance with AS1289.6.3.2 "Determination of the penetration resistance of a soil – 9kg dynamic cone penetrometer test". It should be noted that the DCP tests were conducted from the top edge of the creek bank, and the foundation of the bridge is estimated to be about 1.5m/2m below this depth.

Depth below ground surface (mm)	DCP 1A	DCP 2A
100mm	3	3
200mm	4	3
300mm	4	2
400mm	2	2
500mm	1	3
600mm	1	2
700mm	2	3
800mm	2	2
900mm	3	2
1000mm	4	3
1100mm	5	4
1200mm	6	3
1300mm	6	3
1400mm	7	3
1500mm	7	3
1600mm	8	3
1700mm	1	3
1800mm	1	3
1900mm	1	4
2000mm	3	4
2100mm	2	4
2200mm	2	4
2300mm	3	4
2400mm	2	3
2500mm	3	3
2600mm	2	4
2700mm	2	4
2800mm	2	4
2900mm	3	4
3000mm	3	4
3100mm	4	3
3200mm	4	4
3400mm		3
3500mm		3
3600mm		3
3700mm		3

The DCP testing indicates the subsurface profile within boreholes 1A and 2A to comprise alluvial soils of moisture-affected, loose to medium dense and firm to stiff, silty clay and silty clayey sand to at least 3.7m depth. It is assessed that these alluvial soils would have an allowable bearing pressure of less than 100kPa, and is unsuitable as a foundation to support bridge loads. The foundation does not appear to have failed in bearing (the ultimate bearing capacity has not been exceeded), but it does appear that excessive settlement has occurred.

5 DISCUSSION

5.1 Potential Cause(s) of Foundation Subsidence

Based on the pattern of the cracking and a visual comparison of levels, it appears that the northern abutment has settled/subsided by up to 1.2m (assuming that the bridge was built level in the first place). However, it is likely that the settlement/subsidence of the northern abutment occurred a long time ago (probably within about 20 years of the bridge being constructed).

The borehole and DCP tests on both ends of the bridge found the foundation material of the bridge abutments to comprise alluvial soils of moisture-affected, loose to medium dense and firm to stiff, silty clay and silty clayey sand. These alluvial soils are not a suitable foundation for a bridge, and would have a bearing pressure of less than 100kPa. The foundation does not appear to have failed in bearing (the ultimate bearing capacity has not been exceeded), but it does appear that excessive settlement has occurred.

Similar subsurface profiles (both in material type and consistency/relative density) were encountered at both abutments, and there did not appear to be any obvious reason why the abutment at the northern end had subsided more in comparison to the southern end. There could be reasons for this (especially foundation preparation during construction or deeper alluvial soils at this location), and it is likely that both abutments have settled/subsided over time, however, the northern side has settled/subsided by a greater degree.

It is assessed that the settlement/subsidence of the bridge has been caused by foundation subsidence (and/or differential settlement between the two abutments) due to the settlement of the loose, moisture-affected alluvial soils under the foundation.

5.2 Remediation Options

To limit further subsidence/settlement of the foundation and consequential damage to the bridge, it is recommended that the foundation under both abutments of the bridge is stabilised. Given that traditional underpinning would be expensive and require extensive excavation (which could also result in further undermining and settlement of the bridge), it is recommended that a non-invasive ground improvement method is used, such as “Terefirm”.

“Terefirm” is an expanding resin that is injected into the soil below the bridge foundation, which densifies the soil, and improves the strength, stiffness, and bearing capacity of the soil. The method involves driving injecting tubes into the ground through small penetrations at regular intervals. The expanding resin is then injected into the soil under the bridge to create a resin-soil mix. During the process, the low-viscosity resin both permeates the soil (to a limited extent) and also penetrates weak zones within the soil profile.

It is recommended that a specialist contractor be engaged to further advise on the best method, technique, and type of resin that would suit this situation and soil conditions. The resin injection could be done to an extent that it lifts the foundation and bridge up. However, at this point, it is advised that the bridge is not lifted back up to its original alignment, as this may cause further damage to the bridge structure. The stabilisation should be conducted to a degree that it ensures that future settlement and damage does not occur.

To check that the foundation improvement/stabilisation has worked effectively, it is recommended that a geotechnical engineer conduct post-stabilisation DCP testing. Ideally, this should be conducted within a day or two of the resin injecting, so that if required, further injecting can be carried out while the equipment is still mobilised on site.

Should you require any further information, please contact our office.

Yours faithfully

ACT Geotechnical Engineers Pty Ltd

s 47F

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Director

Senior Geotechnical Engineer

FIEAust CPEng Eng Exec NER RPEQ APEC Engineer IntPE(Aust)

AECOM
BOUNTY STREET BRIDGE – NORFOLK ISLAND
SITE LOCALITY

ACT Geotechnical Engineers Pty Ltd	**C10484**	**FIGURE 1**

AECOM
BOUNTY STREET BRIDGE – NORFOLK ISLAND
AERIAL PHOTOGRAPH & LOCATION OF BOREHOLE

ACT Geotechnical Engineers Pty Ltd	C10484	FIGURE 2

Photo 1 – 28/1/2020 – View of the Bounty Street Bridge, looking NW. The subsidence of the northern abutment can be seen clearly.

AECOM
BOUNTY STREET BRIDGE – NORFOLK ISLAND
SITE PHOTO

ACT Geotechnical Engineers Pty Ltd	**C10484**	**FIGURE 3**

Photo 2 – 28/1/2020 – View of the Bounty Street Bridge, looking SE. The subsidence of the northern abutment can be seen clearly.

AECOM
BOUNTY STREET BRIDGE – NORFOLK ISLAND
SITE PHOTO

ACT Geotechnical Engineers Pty Ltd	**C10484**	**FIGURE 4**

Photo 3 – 28/1/2020 – View of the site looking NE.

AECOM
BOUNTY STREET BRIDGE – NORFOLK ISLAND
SITE PHOTO

ACT Geotechnical Engineers Pty Ltd	**C10484**	**FIGURE 5**

Photo 4 – 28/1/2020 – View of the site looking NW.

AECOM
BOUNTY STREET BRIDGE – NORFOLK ISLAND
SITE PHOTO

ACT Geotechnical Engineers Pty Ltd	**C10484**	**FIGURE 6**

Photo 5 – 28/1/2020 – View of the site looking east.

AECOM
BOUNTY STREET BRIDGE – NORFOLK ISLAND
SITE PHOTO

ACT Geotechnical Engineers Pty Ltd	**C10484**	**FIGURE 7**

APPENDIX D(1)

Borehole Logs 1A and 2A

Borehole Log

1A

BR002

"Ā/FĀ"

.>CAD4Q ?A.LN

Y/JĀD/6 ."= &

17L YA. 4 BO: BC'AD.A ĀCDĀB4CW2CLD
:L OD4@B47AA4Ā:7 W AĀ[ĀL7S L>UĀCB?D'

>/-*2,/)ĀĀ00Ā70</32

./99*3Ā>0T09U(2ĀU)/;)
?)K90ĀS3/+R032,-*9
:0*3,)KĀĀ60

AX8,<+0)2Ā4(<0Ā5RĀ8J0ĀB*+<903
M/90Ā',*+0203Ā=++

B*+<905		*5,)K	'0<2R N02305	W3*<R >/K	O6B6B6	N*203,*9Ā'05-3,<2,/)HB28-283 B/ ,9Ā4<0QĀ*192-,2,Ā3Ā1*32-90ĀR *3*-20352-5H ./9 83Ā80-/) G*3,Ā) GĀ,)/ 3Ā/ + </) 0) 2ĀH N/ ,5Ā30HĀB28-283	/)5,520)-(/3 709*2,T0 '0)5,2(	S,09G 4052 7058925	W0/9/K,-*9 13/F9
					BN	.> ?@A@BG4@B?D'EĀB,0Ā2Ā- 0G8+ Ā5*)GH9 ; Ā-9 52-,,2(ĀF,05HĀG1Ā3';) HĀG2 3 / 2HA06	>LL BA	'1; Ā	4L 1BL G
			=6Ā		B.	BG4@Ā> ?@A@B?D'EĀB,0Ā2Ā/ * 30Ā5*)GH9 ; Ā-9 52-,,2(ĀF,05HĀ2;) HĀG2/Ā / ,526	>LL BA	! " " !	?>>OPCON
			=6%		.>	B?D'@ ĀBG4@Ā >?@ĀF,0Ā2Ā/ * 30Ā5*)GH9 ; Ā-9 52-,,2(ĀF,05HĀG1Ā3';) HĀ / ,526	NA' CON 'A DBA	! Ā	
	▽		1.0 "6		.>	BG4@Ā> ?@Ā- 0G8+ Ā-9 52-,2(HĀ2-I HĀ2K) ,-Ā+* 20ĀA)GĀ / 2HĀ;026	NA' CON 'A DBA	# $ $ % % & " " " Ā	
			2.0			: L7AML >AĀĀA7 NCO?4A'Ā? 4Ā+		! ! Ā ! Ā ! ! ! Ā Ā	
			3.0						
			4.0						

>/KK0GĀ:(ĀĀQĀĀNY '*20ĀĀQĀĀ!&Z"Z!= .R0-I0GĀ:(ĀĀQ '*20ĀĀQ

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Borehole Log

:/30R/90 ĀD/6	2A
BR002	"Ā/FĀ"
Y/JĀD/6	."= &

.>CAD4Q ?A.LN

17L YA. 4 BO: BC'AD.A ĀCDĀRB4CW4CLD :L OD4@ĀB47AA 4Ā:7 CW AĀ[ĀL7S L>U ĀCB?D'

>/-*2,/)ĀĀĀĀ00Ā70</32

./99*3Ā>0T09ĀĀĀĀU)/;_)
?)K90ĀS3/+Ā032,-*9ĀĀĀ
:0*3,)KĀĀĀĀ60

AX8,<+0)2Ā4(<0ĀĀĀ85RĀĀJ0ĀB*+<903
M/90Ā',*+0203ĀĀĀ=++

B*+<905		*5,)K	'0<2R N02305	W3*<R- >/K	O6B6B6	N*203,*9Ā'05-3,<2,/)HĀ28-283	./5,520)-(/3 709*2,T0 '0)5,2(	S,09G 4052 7058925	W0/9/K,-*9 13/F9
			=6		BN	.> ?@A@ĀBC4@ĀB?D'EĀF,0Ā2Ā 0G8+ Ā5*)GĀ9 ; Ā9 52-,2(ĀF,05HĀ3 Ā3;) ĀK3' 55 3 / 25HĀ06	>LL BA	Ā Ā	4L 1BL G
			=6		B.	BC4@Ā> ?@A@ĀB?D'EĀF,0Ā2Ā/ * 30Ā5*)GĀ9 ; Ā9 52-,2(ĀF,05HĀ3/;) HĀ32/Ā / ,526	>LL BA	! ! Ā ! Ā !	?>>OPCN
	∇		=6		.>	BC4@Ā> ?@Ā 0G8+ Ā9 52-,2(HĀ3-I HĀ3K) ,-Ā*20Ā)G3/ 25HĀ,026	NA' CN 'A DBA	! Ā Ā Ā Ā Ā Ā Ā Ā	
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			3.0					Ā Ā Ā Ā Ā	
			4.0						

>/KK0GĀ:(ĀĀĀĀY	"*20ĀĀĀĀĀ!&Z"Z!=	.R0-I0GĀ:(ĀĀQ	"*20ĀĀQ

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APPENDIX D(2)

Definitions of Geotechnical Engineering Terms

DESCRIPTION AND CLASSIFICATION OF SOILS

The methods of description and classification of soils used in this report are based on the Australian Standard 1726 – 1993, Geotechnical site investigations. In general, descriptions cover the following properties – soil type, colour, secondary grain size, structure, inclusions, strength or density and geological description.

Soil types are described according to the predominating particle size, qualified by the grading of other particles present (e.g. sandy clay) on the following basis:

Classification	**Particle Size**
Clay	Less than 0.002mm
Silt	0.002mm to 0.06mm
Sand	0.06mm to 2.00mm
Gravel	2.00mm to 60.00mm
Cobbles	60mm (63mm) to 200mm
Boulders	>200mm

Soils are also classified according to the Unified Soil Classifications System which is included in this Appendix. Rock types are classified by their geological names.

Cohesive soils are classified on the basis of strength either by laboratory testing or engineering examination. The terms are defined as follows:

Consistency	**Shear Strength su(kPa) (Representative Undrained Shear)**	
Very soft	< 12	<2 (~SPT "N")
Soft	12 - 25	2-4
Firm	25 - 50	4-8
Stiff	50 – 100	8-15
Very Stiff	100 – 200	15-30
Hard	> 200	>30

Non-cohesive soils are classified on the basis of relative density, generally from the results of in-situ standard penetration tests as below:

Term	**Relative Density (%)**	**SPT Blows/300mm 'N'**
Very loose	< 15	<4
Loose	15-35	4-10
Medium dense	35-65	10-30
Dense	65-85	30-50
Very Dense	>85	>50

SAMPLING

Sampling is carried out during drilling to allow engineering examination (and laboratory testing where required) of soil or rock.

Disturbed samples taken during drilling provide information on colour, type, inclusions and depending upon the degree of disturbance, some information on strength and structure.

Undisturbed samples are generally taken by one of two methods:

1. Driving or pushing a thin walled sample tube into the soil and withdrawing with a sample of soil in a relatively undisturbed state.

2. Core drilling using a retractable inner tube (R.I.T.) core barrel.

Such samples yield information on structure and strength in additions to that obtained from disturbed samples and are necessary for laboratory determination of shear strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils.

Details of the type and method of sampling are given in the report.

PENETRATION TESTING

The relative density of non-cohesive soils is generally assessed by in-situ penetration tests, the most common of which is the standard penetration test. The test procedure is described in Australian Standard 1289 “Testing Soils for Engineering Purposes” Testing Soils for Engineering Purposes” – Test No. F3.1.

The standard penetration test is carried out by driving a 50mm diameter split tube penetrometer of standard dimensions under the impact of a 63 kg hammer having a free fall of 750mm.

The “N” value is determined as the number of blows to achieve 300mm of penetration (generally after disregarding the first 150mm penetration through possibly disturbed material). The results of these tests can be related empirically to the engineering properties of the soil.

The test is also used to provide useful information in cohesive soils under certain conditions, a good quality disturbed sample being recovered with each test. Other forms of in situ testing are used under certain conditions and where this occurs, details are given in the report.

DEFINITIONS OF ROCK, SOIL, AND DEGREES OF CHEMICAL WEATHERING

GENERAL DEFINITIONS – ROCK AND SOIL

ROCK In engineering usage, rock is a natural aggregate of minerals connected by strong and permanent cohesive forces.

Note: Since "strong" and "permanent" are subject to different interpretations, the boundary between rock and soil is necessarily an arbitrary one.

SOIL In engineering usage, soil is a natural aggregate of mineral grains which can be separated by such gentle mechanical means as agitation in water, can be remoulded and can be classified according to the Unified Soil Classification System. Three principal classes of soil recognized are:

Residual soils: soils which have been formed in-situ by the chemical weathering of parent rock. Residual soil may retain evidence of the original rock texture or fabric or, when mature, the original rock texture may be destroyed.

Transported soils: soils which have been moved from their places of origin and deposited elsewhere. The principal agents of erosion, transport and deposition are water, wind and gravity. Two important types of transported soil in engineering geology and materials investigations are:

Colluvium – a soil, often including angular rock fragments and boulders, which has been transported downslope predominantly under the action of gravity assisted by water. The principle forming process is that of soil creep in which the soil moves after it has been weakened by saturation. It may be water borne for short distances.

Alluvium – a soil which has been transported and deposited by running water. The larger particles (sand and gravel size) are water worn.

Lateritic soils: soils which have formed in situ under the effects of tropical weathering include all reddish residual and non residual soils which genetically form a chain of material ranging from decomposed rock through clay to sesqui-oxide rich crusts. The term does not necessarily imply any compositional, textural or morphological definition; all distinctions useful for engineering purposes are based on the differences in geotechnical characteristics.

ROCK WEATHERING DEFINITIONS

Extremely Weathered (EW)	Rock substance affected by weathering to the extent that the rock exhibits soil properties, i.e. it can be remoulded and can be classified according to the Unified Classification System, but the texture of the original rock is still evident.
Highly Weathered (HW)	Rock substance affected by weathering to the extent that limonite staining or bleaching affects the whole of the rock substance and other signs of the chemical or physical decomposition are evident. Porosity and strength may be increased or decreased compared to the fresh rock usually as a result of iron leaching or deposition. The colour and strength of the original fresh rock substance is no longer recognisable.
Moderately Weathered (MW)	Rock substance affected by weathering to the extent that staining extends throughout the whole of the rock substance and the original colour of the fresh rock is no longer recognisable.
Slightly Weathered (SW)	Rock substance affected by weathering to the extent that partial staining or discolouration of the rock substance, usually by limonite, has taken place. The colour and texture of the fresh rock is recognisable.
Fresh (Fr)	Rock substance unaffected by weathering.

The degrees of rock weathering may be gradational. Intermediate stages are described by dual symbols with the prominent degree of weathering first (e.g. EW-HW).

The various degrees of weathering do not necessarily define strength parameters as some rocks are weak, even when fresh, to the extent that they can be broken by hand across the fabric, and some rocks may increase in strength during the weathering process.

Fresh drill cores of some rock types, such as basalt and shale may disintegrate after exposure to the atmosphere due to slaking, desiccation, expansion or contraction, stress relief or a combination of any of these factors.

AN ENGINEERING CLASSIFICATION OF SEDIMENTARY ROCKS

This classification system provides a standardised terminology for the engineering description of the sandstone and shales in the Sydney area, but the terms and definitions may be used elsewhere when applicable. Where other rock types are encountered, such as in dykes, standard geological descriptions are used for rock types and the same descriptions as below are used for strength, fracturing and weathering.

Under this system rocks are classified by Rock Type, Strength, Stratification Spacing, Degree of Fracturing and Degree of Weathering. These terms do not cover the full range of engineering properties. Descriptions of rock may also need to refer to other properties (e.g. durability, abrasiveness, etc) where these are relevant.

ROCK TYPE DEFINITIONS

ROCK TYPE	DEFINITION
Conglomerate:	More than 50% of the rock consists of gravel sized (greater than 2mm) fragments.
Sandstone:	More than 50% of the rock consists of sand sized (0.06 to 2mm) grains.
Siltstone:	More than 50% of the rock consists of silt-sized (less than 0.06mm) granular particles and the rock is not laminated.
Claystone:	More than 50% of the rock consists of silt or clay sized particles and the rock is not laminated.
Shale:	More than 50% of the rock consists of silt or clay sized particles and the rock is laminated.

Rocks possessing characteristics of two groups are described by their predominant particle size with reference also to the minor constituents, e.g. clayey sandstone, sandy shale.

STRATIFICATION SPACING

Term	Separation of Stratification Planes
Thinly Laminated	< 6mm
Laminated	6mm to 20mm
Very thinly bedded	20mm to 60mm
Thinly bedded	60mm to 0.2m
Medium bedded	0.2m to 0.6m
Thickly bedded	0.6m to 2m
Very thickly bedded	> 2m

DEGREE OF FRACTURING

This classification applies to diamond drill cores and refers to the spacing of all types of natural fractures along which the core is discontinuous. These include bedding plane partings, joints and other rock defects, but exclude known artificial fractures such as drilling breaks.

Term	Description
Fragmented:	The core is comprised primarily of fragments of length less than 20mm, and mostly of width less than the core diameter
Highly Fractured:	Core lengths are generally less than 20mm – 40mm with occasional fragments.
Fractured:	Core lengths are mainly 30mm – 100mm with occasional shorter and longer section.
Slightly Fractured:	Core lengths are generally 300mm – 1000mm with occasional longer sections and occasional sections of 100mm – 300mm.
Unbroken:	The core does not contain any fracture.

ROCK STRENGTH

Rock strength is defined by the Point Load Strength Index (Is 50) and refers to the strength of the rock substance in the direction normal to the bedding. The test procedure is described by the International Society of Rock Mechanics.

Term	Point Load Index Is(50) MPa	Field Guide	Approx qu MPa*
Extremely Weak:	0.03	Easily remoulded by hand to a material with soil properties.	0.7
Very Weak:	0.1	May be crumbled in the hand. Sandstone is “sugary” and friable.	2.4
Weak:	0.3	A piece of core 150mm long x 50mm dia. May be broken by hand and easily scored with a knife. Sharp edges of core may be friable and break during handling.	7
Medium Strong:	1	A piece of core 150mm long x 50mm dia. can be broken by hand with considerable difficulty. Readily scored with knife.	24
Strong: (SW)	3	A piece of core 150mm long x 50mm dia. core cannot be broken by unaided hands, can be slightly scratched or scored with knife.	70
Very Strong (SW)	10	A piece of core 150mm long x 50mm dia. may be broken readily with hand held hammer. Cannot be scratched with pen knife.	240
Extremely Strong (Fr)	>10	A piece of core 150mm long x 50mm dia. is difficult to break with hand held hammer. Rings when struck with a hammer.	>240

The approximate unconfined compressive strength (qu) shown in the table is based on an assumed ration to the point load index of 24:1. This ratio may vary widely.

Unified Soil Classification System (Metricated)
Data for Description Indentification and Classification of Soils

DESCRIPTION

MAJOR DIVISIONS				Group Symbol	Graphic Symbol	TYPICAL NAME	DESCRIPTIVE DATA
COARSE GRAINED SOILS	More than 50% by dry mass, less than 60mm is greater than 0.06mm.	GRAVELS	More than 50% of coarse grains are greater than 2.0mm	GW		Well graded gravels and gravel-sand mixtures, little or no fines	Give typical name, indicate approximate percentages of sand and gravel, maximum size, angularity, surface condition and hardness of the coarse grains, local or geological name and other pertinent descriptive information, symbols in parenthesis. For undisturbed soils add information on stratification, degree of compactness, cementation, moisture conditions and drainage characteristics. EXAMPLE: Silty Sand, gravelly, about 20% hard, angular gravel particles, 10mm maximum size, rounded and sub angular sand grains coarse to fine, about 15% non-plastic fines with low dry strength, well compacted and moist in place, light brown alluvial sand, (SM)
				GP		Poorly graded gravels and gravel-sand mixtures, little or no fines	
		GRAVELLY SOILS		GM		Silty gravels, gravel-sand-silt mixtures	
				GC		Clayey gravels gravel-sand-clay mixtures	
		SANDS	More than 50% of coarse grains are greater than 2.0mm	SW		Well graded sands and gravelly sands, little or no fines	
				SP		Poorly graded sands and gravelly sands, little or no fines	
		SANDY SOILS		SM		Silty sand, sand-silt mixtures	
				SC		Clayey sands, sand-clay mixtures	
FINE GRAINED SOILS	More than 50% by dry mass, less than 60mm is less than 0.06mm	Liquid Limit less than 50%		ML		Inorganic silts, very fine sands, rock flour, silty or clayey fine sands.	Give typical name, indicate degree and character of plasticity, amount and maximum size of coarse grains, colour in wet condition, odour if any, local or geological name and r pertinent descriptive information, symbols in parenthesis. For undisturbed soil add information on structure, stratification, consistancy in undisturbed and remoulded states, moisture and drainage conditions. EXAMPLE Clayey Silt, brown, low plasticity, small percentage of fine sand, numerous vertical root-holes, firm and dry in place, ML (ML).
				CL		Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.	
				OL		Organic silts and organic silty clays of low plasticity	
		Liquid Limit more than 50%		MH		Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts.	
				CH		Inorganic clays of high plasticity, fat clays.	
				OH		Organic clays of medium to high plasticity.	
				PT		Peat muck and other highly organic soils.	

FIELD IDENTIFICATION

Determine approximate percentages of material over 60mm size, maximum size, shape, surface texture, hardness of material, geological description identify on estimated percentage mass of the various fractions.

0.06mm is about the smallest particle visible to the naked eye

COARSE GRAINED SOILS — More than half of the material less than 60mm is larger than 0.06mm

GRAVELS AND SANDS

GRADATIONS		NATURE OF FINES	DRY STRENGTH	Group Symbol
GOOD	Wide range in grain size	"Clean" materials (not enough fines to band coarse grains)	None	GW
POOR	Predominantly one size or range of sizes			GP
GOOD TO FAIR	"Dirty" materials (Excess of fines)	Fines are non-plastic (1)	None to medium	GM
		Fines are plastic (1)		GC
GOOD	Wide range in grain size	"Clean" materials (not enough fines to band coarse grains)	None	SW
POOR	Predominantly one size or range of sizes			SP
GOOD TO FAIR	"Dirty" materials (Excess of fines)	Fines are non-plastic (1)	None to medium	SM
		Fines are plastic (1)		SC

FINE GRAINED SOILS — More than half of the material less than 60mm is less than 0.06mm

SILT AND CLAY FRACTION
Fraction smaller than 0.20mm AS sieve size

DRY STRENGTH	DILATANCY	TOUGHNESS	Group Symbol
None to low	Quick to slow	None	ML
Medium to high	None to very slow	Medium	CL
Low to medium	Slow	Low	OL
Low to medium	Slow to none	Low to medium	MH
High to very high	None	High	CH
Medium to high	None to very slow	Low to medium	OH

Readily identified by colour, odour, spongy feel and generally by fibrous texture — PT*

LABORATORY CLASSIFICATION

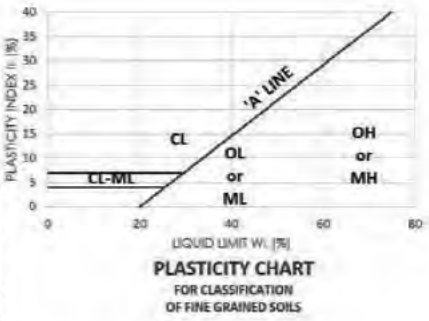
Use the gradation curve of material passing 60mm for classification of fractions according to criteria given under 'Major Division'.

% (2) < 0.06mm	PLASTICITY OF FINE FRACTION			NOTES
0-5	-	>4	Between 1 and 3	1. Identify Fines by the method given for fine grained soils.
0-5	-	Fails to comply with above		2. Borderline classifications occur when the percentage of fines (fraction smaller than 0.06mm size) is greater than 5% and less than 12%.
12-50	Below 'A' line and Ip >7	-	-	Borderline classifications require the use of dual symbols eg SP-SM GW-GC
12-50	Above 'A' line and Ip > 7	-	-	
0-5	-	>6	between 1 and 3	
0-5	-	Fails to comply with above		
12-50	Below 'A' line or Ip < 4	-	-	
12-50	Above 'A' line and Ip > 7	-	-	

More than 50% passing 0.06mm

Below 'A' line
Above 'A' line
Below 'A' line
Below 'A' line
Above 'A' line
Below 'A' line

*Effervescence with H2O2



PLASTICITY CHART
FOR CLASSIFICATION
OF FINE GRAINED SOILS

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Limitations in the Use and Interpretation of this Geotechnical Report

Our Professional services were performed, our findings obtained, and our recommendations prepared in accordance with generally accepted engineering principles and practices. This warranty is in lieu of all other warranties, either expressed or implied.

The geotechnical report was prepared for the use of the Owner in the design of the subject development and should be made available to potential contractors and/or the Contractor for information on factual data only. This report should not be used for contractual purposes as a warranty of interpreted subsurface conditions such as those indicated by the interpretive borehole and test pit logs, cross- sections, or discussion of subsurface conditions contained herein.

The analyses, conclusions and recommendations contained in the report are based on site conditions as they presently exist and assume that the exploratory bore holes, test pits, and/or probes are representative of the subsurface conditions of the site. If, during construction, subsurface conditions are found which are significantly different from those observed in the exploratory bore holes and test pits, or assumed to exist in the excavations, we should be advised at once so that we can review these conditions and reconsider our recommendations where necessary. If there is a substantial lapse of time between conducting this investigation and the start of work at the site, or if conditions have changed due to natural causes or construction operations at or adjacent to the site, this report should be reviewed to determine the applicability of the conclusions and the recommendations considering the changed conditions and time lapse.

The summary bore hole and test pit logs are our opinion of the subsurface conditions revealed by periodic sampling of the ground as the test holes progressed. The soil descriptions and interfaces between strata are interpretive and actual changes may be gradual.

The bore hole and test pit logs and related information depict subsurface conditions only at the specific locations and at the particular time designated on the logs. Soil conditions at the other locations may differ from conditions occurring at these bore hole and test pit locations. Also, the passage of time may result in a change in the soil conditions at these test locations.

Groundwater levels often vary seasonally. Groundwater levels reported on the boring logs or in the body of the report are factual data only for the dates shown.

Unanticipated soil conditions are commonly encountered on construction sites and cannot be fully anticipated by merely taking soil samples, bore holes or test pits. Such unexpected conditions frequently require that additional expenditures be made to attain a properly constructed project. It is recommended that the Owner consider providing a contingency fund to accommodate such potential extra costs.

This firm cannot be responsible for any deviation from the intent of this report including, but not restricted to, any changes to the scheduled time of construction, the nature of the project or the specific construction methods or means indicated in this report: nor can our company be responsible for any construction activity on sites other than the specific site referred to in this report.

Appendix E

REO Portico Stabilisation Works

AECOM Imagine it. Delivered.

KAVHA Safety Investigation Works
Department of Infrastructure, Transport, Regional Development and Communications
26-Aug-2020
Spec No. 01

REO Portico Stabilisation Works

Appendix E: Structural and Heritage Specifications

Specification No.: 01

Client: Department of Infrastructure, Transport, Regional Development and Communications

ABN: 86 267 354 017

Ref	60615424 p:\cbr\60615424\500_deliv\501_tender report\appendix e - reo portico stabilisation\reo portico stabilisation specification_rod.docx
Date	26-Aug-2020
Prepared by	s 47F
Reviewed by	s 47F

Revision History

Rev	Revision Date	Details	Authorised	
			Name/Position	Signature
AC	02-Apr-2020	For Review	s 47F	
B	05-June-2020	Final Issue		
C	19-Aug-2020	Final Issue - REO - Southern Column strengthening methodology changed to steel rod solution		

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Table of Contents

1.0 Main Section Title

1.1 Background

The Royal Engineers Office (REO) building is located within the Kingston and Arthur's Vale Historic Area, which is listed on the World Heritage List (WHL), National Heritage List (NHL), Commonwealth Heritage List (CHL) and the Norfolk Island Heritage Register (NIHR). The site is managed by the Department of Infrastructure, Transport, Regional Development and Communications (the Department).

The REO was constructed in 1850 and completed in early 1851 as the office of the Royal Engineer on the site of the old carpenter's shop. Initially consisting of a central passage and two rooms, additions were made later in 1851 to add two rear rooms and the portico. In 1897, the building was appropriated for the police constable. It later became the residence of the Signal Maker between 1919 and 1948, with some alterations made for the purpose. Conservation works were carried out in 1982/3 (Clive Lucas Stapleton and Partners, 1988:Vol 2c).

The contribution of the REO to the broader site has not been individually assessed. However, the structure is specifically mentioned as contributing to the historical and representative significance of the site, which demonstrates the transportation of convicts, secondary punishment as part of the convict system and the administration of the system. The REO would directly contribute to the administration of the convict transportation system. In addition, it contributes to the aesthetic qualities.

Figure 1 REO

1.2 Heritage Requirements

In Australia, best practice principles for meeting heritage management requirements are provided by the *Australia ICOMOS Charter for Places of Cultural Significance, The Burra Charter*, 2013 (Burra Charter) (ICOMOS (Australia), 2013).

Further guidance for the WHL Kingston and Arthur's Vale Historic Area (KAVHA), is provided by the *Kingston and Arthur's Vale Historic Area Heritage Management Plan* (HMP) prepared by Godden Mackay Logan (GML) in 2016 (Godden Mackay Logan Pty Ltd, 2016).

The REO portico works are to be completed in accordance with the above documents. The works are to be undertaken by a Contractor that is experienced in heritage works and an experienced heritage stonemason is to be part of the site team and to have direct responsibility for all the works.

1.3 Preparation Works

Prior to commencing the actual portico stabilisation works, the Contractor is required to complete the following:

1. Asbestos investigation of the portico with a focus on the roofing material, membranes and sealants. If the roof material is determined to be an asbestos containing material (ACM) the contractor is to remove and dispose of the ACM in accordance with the local authority requirements. The replacement roof is to be of the same form to the existing and new materials agreed with the KAVHA Commonwealth Heritage Manager prior to the works commencing.
2. Dilapidation report – a dilapidation report for the REO portico and building is to be completed and approved by the Department's on-Island heritage specialist prior to the works commencing.
3. Stakeholder consultation – the contractor is to prepare a stakeholder management plan and manage the stakeholders during the works. The principle stakeholders include the REO occupants, the Department's on-Island heritage specialist, adjacent building occupants and precinct users. The final stakeholder list will be confirmed by the Department.
4. Building Access and Continuity Plan– an alternative access point to the building is to be agreed with the building occupants and maintained for the duration of the works.
5. Site establishment plan and local authority approvals.

2.0 Required Outcomes

2.1 Description

The works contained in this specification are to address the items raised in the *Kingston and Arthur's Vale Historic Area Safety Hazard Scoping Study Draft Report* (GML, May, 2018) that are specific to the REO Portico. The required outcome is an increase in the structural adequacy of the portico to a reasonable acceptable level and hence a corresponding decrease in the perceived safety risk associated with the portico.

The scope of works includes the following required outcomes:

1. Stabilisation of the gable end of the portico roof,
2. Strengthening of the southern stone column
3. Replacement of the stone capping to the northern stone column, and
4. Stabilisation of the stonework to the portico doorway.

Each of these items are described in detail in the following sections.

2.2 Portico Gable Stabilisation

The stone gable to the portico roof currently has an outward facing lean and poses an unacceptable safety risk with respect to lateral loads, such as high winds or seismic events (refer Figure 2 and Figure 3). The gable is supported on corbelled stonework that projects significantly beyond the face of the supporting columns.

Figure 2 REO Portico Side View

Figure 3 REO Portico Front View

The required outcome is to restrain the gable from falling forward by tying the top of the gable back to the supporting stone lintels as shown in Figure 4

Figure 4 Gable tie back

The anticipated methodology for achieving this outcome is as follows:

1. Obtain lengths of stainless-steel angle and stainless-steel masonry anchors and store on Island. Angles to be 65EA6 and anchors to be M8, M10 and M12 Trubolts of various lengths and stainless-steel chemical anchors of similar sizes that are compatible with fixing to stone.

Obtain access to a suitable stainless-steel fabricator on the Island to manufacture the brackets following roof opening up works and final advice from the Project Engineer.

2. Install temporary diagonal propping to the face of the gable to ensure it remains in place during the works.
3. Remove the roof behind the gable and expose the roof structure.
4. Document the roof structure of the portico and obtain inspection and confirming advice from the Project Engineer regarding detailing for the bracing.
5. Fabricate and install the bracing as per the Project Engineers written instructions.
6. Reinstate the roof.

2.3 Southern Column Strengthening

The southern stone column has diagonal stone defects at the top and at the base of the column (refer Figure 5 and Figure 6). The defects are natural joints or layers within the rock mass from which the column was quarried. Due to the diagonal orientation of the defects, they present a structurally unacceptable defect and requires strengthening. The selected strengthening methodology is by insertion of a stainless steel through the centre of the column for its full height and grouting it in place.

The rod has been sized at nominally 33mm diameter stainless steel and this will require a nominal 50mm diameter core hole through the column to provide for an 8mm grout annulus. The final rod size, grade and grouting methodology is to be resolved via detailed discussions with the contractor as it will be influenced by the available tools and methodologies.

Figure 5 Column defect (top)

Figure 6 Column defect (bottom)

The anticipated methodology for achieving this outcome is as follows:

1. Engage a contractor who is experienced with inserting steel strengthening rods into heritage stone columns and develop a detailed Work Methodology that includes review of options for undertaking the works with the column insitu, on-island, but removed from the REO or transporting the column to the contractors workshop off-island.
2. Submit the written methodology and details of all proposed materials for Project Engineer and Heritage Team endorsement prior to ordering materials.
3. Co-ordinate the column strengthening works with the other REO activities.
4. Following the methodology and installer endorsement install the column strengthening in strict accordance with the manufacturers written methodology and repaint the column to match the existing paint finish and colour or a colour to be advised.
5. At completion of the works, and with the endorsement of the Project Engineer, remove the two adjacent timber columns from the portico and remove them from site.

2.4 Capping Stone Replacement

The capping stone to the northern column is severally eroded and requires replacement – refer Figure 7. There are two options available to rectify this issue and these need to be evaluated with the Contractor who will be undertaking the southern column strengthening works and the final option agreed by the Department.

Option 1

Re-use the available parts of the original northern column and reconstruct the column with the inclusion of a central strengthening rod as per the southern column. This may require replacing parts of the column with new stone segments, subject to the advice from the Contractor. Inclusion of new segments will require heritage consultation and approval.

Option 2

The replacement stone is to be of the same plan dimensions as the existing stone on the top of the southern column and the thickness is to be modified to reasonably allow for the fact that the two columns are of slightly different heights, and the aim is to have the gable lintel be level at the completion of the works.

The replacement stone is to be cut from locally sourced calcarenite stone (not sandstone) with the completed stone to have similar working marks on its surface to the existing southern capping stone. A surface of the stone is to be permanently engraved with the date of installation in a visible, but not obvious, location so that the stone can be identified as a replacement. It is suggested the date be on the inside vertical face, but to be confirmed in consultation with the KAVHA Commonwealth Heritage Manager and the heritage stonemason.

Ensure there is even and consistent bearing between the new stone and the column under and lintel over.

The replacement stone is to be approved by the KAVHA Commonwealth Heritage Manager before installation and the completed works are to be to their satisfaction.

Figure 7 Eroded capping stone

2.5 Doorway Stonework Stabilisation

The entry door to the REO has a displaced stone that is deforming the door frame and the stone is to be reset and the door frame adjusted.

The stone is to be reset into its original position and, if necessary, pinned with stainless steel, carbon fibre or similar approved corrosion resistant material. A lime-based mortar is to be used when resetting the stone and reinstating the damaged render immediately adjacent the stone.

Realign and fix the doorframe so that the door swings and closes to the satisfaction of the KAVHA Commonwealth Heritage Manager. Repaint as required to match the existing.

Figure 8 Displaced stonework

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03-Nov-2020

Bounty Street Bridge

Heritage Impact Assessment

Bounty Street Bridge

Heritage Impact Assessment

Client: Department of Infrastructure, Transport, Regional Development, and Communications

ABN: 86 267 354 017

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03-Nov-2020

Job No.: 60635354

AECOM in Australia and New Zealand is certified to ISO9001, ISO14001 AS/NZS4801 and OHSAS18001.

Quality Information

Document	Bounty Street Bridge 60635354
Ref	p:\cbr\60635354\500_deliverables\502_deliverable_hia\final\60635354-aec-hia-bounty st bridge.docx
Date	03-Nov-2020
Prepared by	s 47F
Reviewed by	s 47F

Revision History

Rev	Revision Date	Details	Authorised	
			Name/Position	Signature
A	20-Jul-2020	Draft for client review	s 47F	
B	26-August-2020	Draft for client review		
C	03-November-2020	Final Issue		

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1.0 Introduction

AECOM Australia Pty Ltd (AECOM) has been engaged by the Commonwealth Department of Infrastructure, Transport, Regional Development and Communications to undertake a heritage impact assessment (HIA) to address remediation works at the Bounty Street Bridge within Kingston and Arthurs Vale Historic Area (KAVHA) on Norfolk Island. Remediation works have been identified as required to as the Bridge is currently closed to vehicular and pedestrian traffic following engineering advice that indicated the Bridge was likely to collapse within five to 50 years and that given the state of the bridge, no load rating could be provided. The works comprise the installation of a structural concrete arch on to which the stone arch may eventually collapse and allow the route to stay open.

The EPBC Act requires actions on Commonwealth land (Section 26) and actions undertaken by a Commonwealth agency such as the Department (Section 28) to be assessed for the likelihood that these actions will have a significant impact on the environment. This HIA fulfils this obligation.

1.1 Site ownership

The elements covered by this HIA sit on land owned by the Commonwealth of Australia.

1.2 Heritage status

A search has been undertaken of the relevant heritage registers on 09 June 2020 (Section 2.0). KAVHA is identified on statutory and non-statutory heritage registers as indicted in Table 1.

Table 1 Heritage status - summary of search results of relevant heritage registers

Heritage Register	Listing
World Heritage Register	106209
National Heritage Register	105962
Commonwealth Heritage Register	105606
Register of the National Estate (non-statutory)	103650 & 13637
Norfolk Island Heritage Register	Listed

1.3 Site location

The Site identification information is presented in Table 2

Table 2 Site Identification Details

Item	Details
Site Owner	Commonwealth of Australia, as represented by the Department of Infrastructure, Transport, Regional Development and Communications
Site Address	Bounty Street
Legal Description	Crown Land Reserve
Zoning	Conservation

1.4 Objectives

The EPBC Act requires that actions on Commonwealth land (Section 26) and actions undertaken by a Commonwealth agency (Section 28) are to be assessed for the likelihood that these actions will have a significant impact on the environment, including heritage values. The provisions of these sections apply to the Department and the proposed remediation works. Within this context, the objectives of this report are to:

- Determine the potential impacts arising from the proposed works on the identified significance of the Bounty Street Bridge and the overall KAVHA site;
- Provide guidance regarding the management and protection of the identified heritage significance during the works through the provision of mitigation measures.

1.5 Methodology

In order to achieve the objectives of the HIA, the following scope of work was undertaken:

- Liaise with the engineers during the development of options to minimise heritage impacts;
- Completed a search of relevant heritage registers and previous reports to determine the significance of the elements and the overall KAVHA site.
- As there is no significance assessment, using the EPBC Act heritage criteria, of the contribution of the Bounty Street Bridge to the KAVHA site and as an individual item, prepare an assessment against the criteria under the EPBC Act;
- Analyse the potential for the identified significance to be impacted by the proposed remediation, using the Department of the Environment (2013) *Significant Impact Guidelines 1.1* and Department of Sustainability Environment Water Population and Communities (2013) *Significant Impact Guidelines 1.2*;

The *Significant Impact Guidelines 1.1* lays out the criteria to determine whether there is a real chance or possibility that the action will have a significant impact on World Heritage values. These include if the action will:

- permanently remove, destroy, damage or substantially alter the fabric of a World Heritage property;
- extend, renovate, refurbish or substantially alter a World Heritage property in a manner which is inconsistent with relevant values;
- permanently remove, destroy, damage or substantially disturb archaeological deposits or artefacts in a World Heritage property;
- involve activities in a World Heritage property with substantial and/or long-term impacts on its values;
- involve construction of buildings or other structures within, adjacent to, or within important sight lines of, a World Heritage property which are inconsistent with relevant values; and
- make notable changes to the layout, spaces, form or species composition in a garden, landscape or setting of a World Heritage property which are inconsistent with relevant values.

In conjunction with the *Significant Impact Guidelines 1.1,* reference has been made to the UNESCO World Heritage Guidelines *Guidance on Heritage Impact Assessments for Cultural World Heritage Places* (ICOMOS 2011). The following items of guidance are of relevance to this assessment:

- 4-7: While the Outstanding Universal Values (OUV) are an essential starting point, they are sometimes not detailed enough to enable an impact assessment. The attributes (significance) may need to be more specifically defined during the assessment.
  - This is undertaken in Section 5.0.
- 5-8: The significance of the effect of change – i.e., the overall impact - on an attribute is a function of the importance of the attribute and the scale of change. This can be summarized for each attribute described using the following descriptors. As change or impacts may be adverse or beneficial, there is a nine-point scale with “neutral” as its centre point:
  - Major beneficial - A beneficial change to key historic building elements that contribute to the heritage value such that the resource is totally altered. A beneficial comprehensive change to its setting.
  - Moderate beneficial - A beneficial change to many key historic building elements, such that the resource is significantly modified. A beneficial change to the setting of an historic building, such that it is significantly modified.
  - Minor beneficial - A beneficial change to key historic building elements, such that the asset is slightly different. A beneficial change to setting of an historic building, such that it is noticeably changed.
  - Negligible beneficial - A slight beneficial change to historic building elements or setting that hardly affect it.
  - Neutral - No change to fabric or setting.
  - Negligible adverse - A slight adverse change to historic building elements or setting that hardly affect it.
  - Minor adverse - An adverse change to key historic building elements, such that the asset is slightly different. An adverse change to setting of an historic building, such that it is noticeably changed.
  - Moderate adverse - An adverse change to many key historic building elements, such that the resource is significantly modified. An adverse change to the setting of an historic building, such that it is significantly modified.
  - Major adverse - An adverse change to key historic building elements that contribute to the heritage value such that the resource is totally altered. An adverse comprehensive change to its setting.
    - The above nine-point scale is used to assess the impacts in Section 6.0.
- 5-10: The report will need to show the impact assessment for each OUV attribute.
  - This is undertaken in Section 6.5.1
- 5-11: Proposals should be tested against existing policy frameworks
  - This is undertaken against the Significant Impact Guidelines and the non-statutory considerations outlined in Section 2.2 in Section 6.5.1
- 5-13: Benefits and adverse effects must be very carefully considered.
  - The benefits and adverse effects are outlined in Section 6.5.1

1.6 Assumptions and Limitations

The purpose of this review is to identify and assess the potential impacts to the identified historic heritage values within the Site. It should be noted that the identification of potential values within this document is based only on a desktop review and site inspection. AECOM also cannot guarantee that the base data (Australian Heritage Database) is free from error and as such accepts no responsibility for any resultant errors and any damage or loss which may follow to any person or party.

Predictions have been made within this report about the probability of subsurface archaeological materials occurring within the Site, based on surface indications and environmental contexts. However, it is possible that materials may occur in areas without surface indications and in any environmental context.

A summary of the statutory requirements regarding historical heritage is provided in Section 2.0. The summary is provided based on the experience of the authors with the heritage system in Australia and does not purport to be legal advice. It should be noted that legislation, regulations and guidelines change over time and users of the report should satisfy themselves that the statutory requirements have not changed since the report was written.

1.7 Authorship

This heritage assessment has been prepared by s 47F (Principal Heritage Specialist). Technical and quality assurance review was undertaken by s 47F (Principal Heritage Specialist).

2.0 Legislation

2.1 Statutory considerations

2.1.1 Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth)

The EPBC Act defines 'environment' as both natural and cultural environments and therefore includes Aboriginal and non-Aboriginal historical cultural heritage items. Under the Act, protected heritage items are listed on the National Heritage List (NHL) (items of significance to the nation) or the Commonwealth Heritage List (CHL) (items belonging to the Commonwealth or its agencies). These two lists replaced the Register of the National Estate (RNE). The RNE has been suspended and is no longer a statutory list; however, it remains as an archive.

The heritage registers mandated by the EPBC Act have been consulted; Kingston and Arthurs Vale Historic Area is listed on the NHL and the CHL as well as the World Heritage List.

Under Part 9 of the EPBC Act, any action that is likely to have a significant impact on a matter of national environmental significance (MNES) (known as a controlled action under the Act), may only progress with approval of the ministry responsible for the EPBC Act. An action is defined as a project, development, undertaking, activity (or series of activities), or alteration. An action will also require approval if:

- It is undertaken on Commonwealth land and will have or is likely to have a significant impact on the environment on Commonwealth land; and
- It is undertaken by the Commonwealth and will have or is likely to have a significant impact.

The EPBC Act requires actions on Commonwealth land (Section 26) and actions undertaken by a Commonwealth agency such as the Department (Section 28) to be assessed for the likelihood that these actions will have a significant impact on the environment.

2.2 Non-statutory considerations

2.2.1 Kingston and Arthurs Vale Historic Area Heritage Management Plan

Section 316 of the EPBC Act requires the preparation of a Heritage Management Plan (HMP) to manage the identified World Heritage Values. The current HMP was prepared in 2016 by Godden Mackay Logan Pty Ltd. The HMP lays out policies to direct the conservation of the heritage values. Works within KAVHA should adhere to the policies. The proposed remediation works are assessed against the HMP policies in Section 6.0.

2.2.2 Kingston and Arthurs Vale Historic Area Cultural Landscape Plan

The interaction between the natural landscape and the human modifications creates a cultural landscape with management requirements that are different to the built structures and archaeological potential. A Cultural Landscape Plan has been prepared to ensure the cultural landscape is conserved.

2.2.3 Kingston and Arthurs Vale Historic Area Archaeological Zoning and Management Plan

In recognition of the vast archaeological resource contained within KAVHA, an Archaeological Zoning and Management Plan (AZMP) has been prepared (Extent Heritage Pty Ltd 2020) to assist in the identification of areas of archaeological potential and the management of archaeology during proposed works. The AZMP has been consulted and the policies referenced and recommended as appropriate in Section 6.0.

The draft Archaeological Zoning and Management Plan (AZMP) identifies Arthurs Vale Retaining Wall and a portion of the Watermill Dam as having high archaeological potential (Extent Heritage Pty Ltd 2020). In order to assist in the management of the archaeological potential of KAVHA, Extent has created Zones – the Bounty Street Bridge falls into Zone 1, meaning in addition to the high archaeological potential, the site has been identified as having high research potential and significance.

Section 7.2.1 of the draft AZMP outlines the following requirements for archaeological works as they may relate to the proposed works, together with a statement regarding how the project has responded to the requirement:

- "any proposed development within the site should aim to avoid or minimise the impact on the archaeological resource, by addressing the implications of the potential impact from the initial design and site planning stages. Examination of options and their level of impact to determine the outcome with the least harmful effect would be paramount. Avoidance of impact should be a priority."
  - The works have been designed to avoid impacts to areas of known potential, which will be further refined onsite during the miro-siting of the proposed sheet pile coffer dam.
- A sub-point states: "In situations where development impacts are unavoidable (for example, due to safety or other overarching requirements), procedures outlined in principle guideline 7.3 should be followed" (Extent Heritage Pty Ltd, 2019:91).
  - The works would fall into this category.
- Obtain professional advice, as relevant, with respect to the assessment of proposed change/development and consider alternative courses of action.
  - Refer to Section 6.3 to see the other options considered.
- Ensure that all proposed actions are assessed against the policies and recommendations included in this AZMP.
  - This section, together with Section 6.0 assesses the proposal against the AZMP.
- Actions that may result in adverse archaeological impacts must be identified and assessed a[s] part of a formal impact assessment process.
  - This HIA has identified and mitigated the potential adverse archaeological impacts.
- The impact of any proposed intervention that has the potential to adversely affect the heritage value of an archaeological resource must be assessed at the earliest possible time, preferably at the concept or planning stage, in order to have the opportunity to develop a less invasive alternative. The assessment must be refined, as necessary, during subsequent stages of the development design phase as more detail becomes available.
  - The archaeological significance and potential of the area was identified prior to the design development, which enabled the impacts to be minimised from the outset.
- The level of effort and detail of assessment should reflect the degree of potential impact and the significance of the value of the affected archaeological resource.
  - This has been noted within the mitigations in Section 6.7.
- Section 7.3 outlines the required archaeological investigation. For sites within Zone 1, the "management process should include retention in situ and avoidance of ground disturbance works whenever possible. Other archaeological interventions may include methodologies such as test excavation, monitoring or full investigation with conservation" (Extent Heritage Pty Ltd, 2019:93).
  - Development and implementation of an archaeological research design and methodology has been identified as a mitigation measure.

In summary, protection of the archaeological potential of the area will need to be incorporated into the design process by selecting options that minimise impacts. Where impacts are unavoidable, an archaeological research design and methodology should be developed to ensure the impacts are mitigated in an appropriate manner.

2.2.4 The Burra Charter

The Burra Charter: The Australian ICOMOS charter for places of cultural significance (ICOMOS (Australia) 2013) sets a standard of practice for those who provide advice, make decisions about, or undertake works to places of cultural significance including owners, managers and custodians. The Charter provides specific guidance for physical and procedural actions that should occur in relation to significant places. A copy of the charter can be accessed online at http://icomos.org/australia.

3.0 Historical background

3.1 Introduction

A historical account outlining the broader occupation and use of the site can be found in the HMP (Godden Mackay Logan Pty Ltd 2016). Norfolk Island's history is made up of four distinct phases:

- Polynesian settlement (c.1150 to c1450)
- First (Colonial) settlement (1788 to 1814)
- Second (Penal) settlement (1825 to 1855)
- Third (Pitcairn) settlement (1856-present).

The known activities in the vicinity of the Bounty Street Bridge takes in Second and Third Settlement activity.

3.2 Watermill Creek and Town Creek

During the First Settlement, Watermill Creek (also known as Swamp Creek) was canalised, forming a straight line before diverting around the north of Chimney Hill and from there into Emily (or Turtle) Bay. On abandonment of the settlement, this drain was blocked, but was reopened in the first three months of 1829. The creek was renamed as Watermill Creek during the second penal settlement period.

On 8 May 1834 flooding occurred along Watermill Creek, which seems to have occurred due to a storm surge. The flooding resulted in the collapse of a 10 foot stone wall drain, probably in the vicinity of Chimney Hill or Emily Bay as there are no known walls within the Swamp Precinct (Wilson and Davies 1980, Volume 2:42).

Commandant Major Joseph Anderson, to rectify the issue, ordered that Watermill Creek be diverted through a tunnel within Chimney Hill. At the same time, Town (or Soldier's Gully) Creek was diverted into a vaulted drain that started to the north of the parade ground and ran along the eastern side of Bounty Street, terminating at the Bounty Street Bridge (Figure 1).

3.3 Bounty Street Bridge

Bounty Street was constructed in the early 1830s to allow for the movement of troops between the Old Military Barracks and the Prisoners' Barracks. Higginbotham states that "It was a strategic route, essential for the maintenance of law and order in the Penal Settlement" (Edward Higginbotham & Associates Pty Ltd 2010:4). Bounty Street cuts through two First Settlement allotments and the site of the first hospital (Edward Higginbotham & Associates Pty Ltd 2010:4).

In association with the diversions to Watermill and Town Creeks following the 1834 flooding, the bridge crossing Watermill Creek was rebuilt in 1835. The form of the earlier crossing, whether it was a ford or timber/stone bridge is unknown.

In undertaking the construction, provision of long, narrow water tanks was included where the drain carrying Town Creek intersected with the Bridge (Figure 2). Wilson and Davies (1980, Volume 2:88) surmise that the tanks were used to supply water to the Prisoners' Compound to the south, with a pump and steps installed at the northern end to assist in gaining access to the water.

Major Anderson was replaced as Commandant by Major Bunbury. Bunbury oversaw the removal of the Serpentine, on the grounds that the water flow was inadequate (Wilson and Davies 1980:Volume 1:89), but there are no secondary sources relating to modifications made to the Bounty Street Bridge or the tanks. It is assumed that the Bridge and tanks continued to operate unchanged throughout the remainder of the Second Settlement

It is assumed that Bounty Street and the Bridge were put back into use during the Third Settlement, as it continues to be used today. It is unclear when the tanks fell out of use, but it was likely to be during the Third Settlement period.

Based on physical evidence, it is believed that the Bridge was rendered with concrete during the 1960s. Norfolk Island residents related that the Bounty Street Bridge was used as a convenient location to park and fill a water truck. Sometime in the 1970s, while the truck was filling on the Bridge,

the arch on the eastern side of the Bridge collapsed. Repairs were made by inserting an asphalt lintel, which has restricted the flow of water under the Bridge.

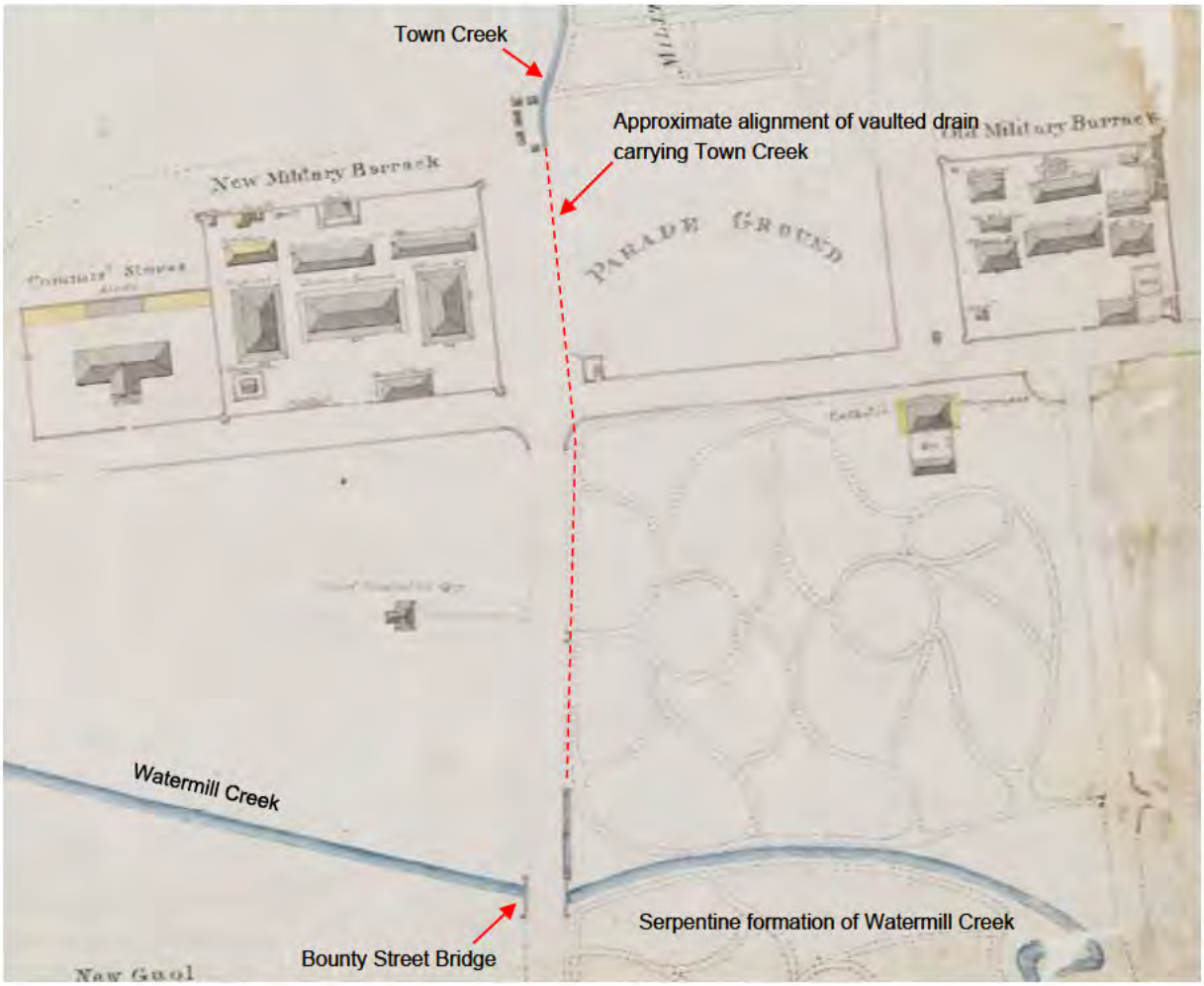


Figure 1 **Excerpt from 'Plan of the Settlement Norfolk Island taken Oct.r 1838' Geo. F.W. Bordes. Source: State Library of New South Wales, Call no. NSL M Z/M4 819.2/1838/1. Available online at http://digital.sl.nsw.gov.au/delivery/DeliveryManagerServlet?embedded=true&toolbar=false&dps_pid=IE3535292. Annotations added by AECOM**

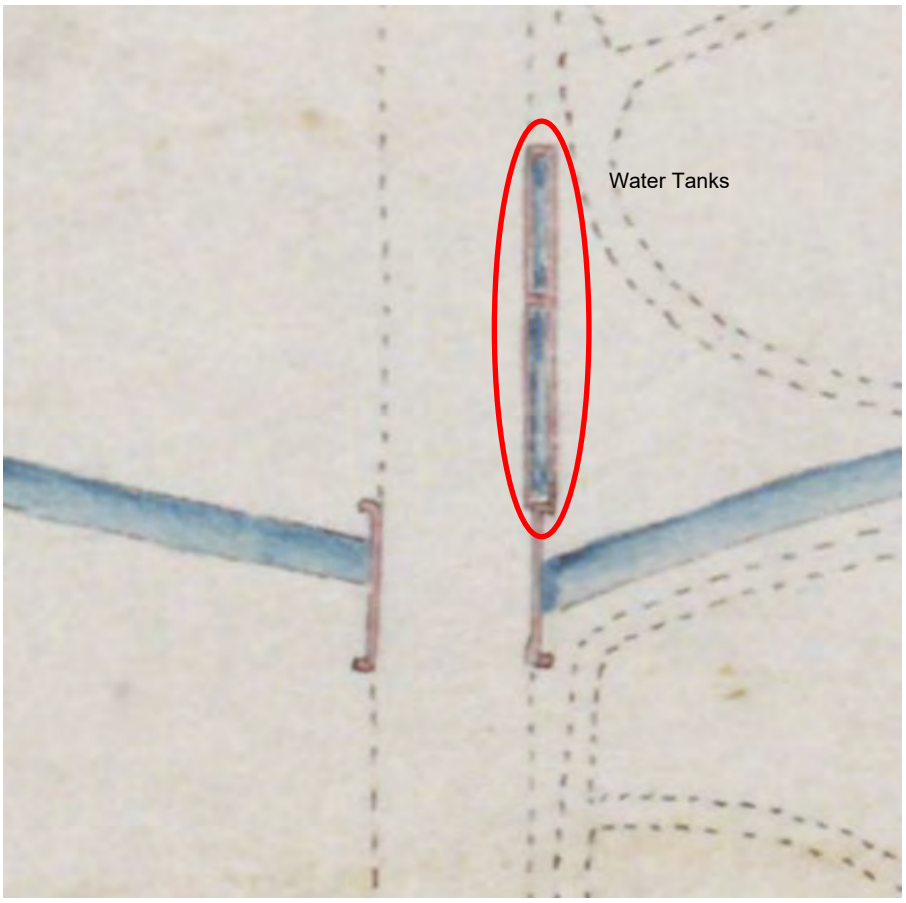


Figure 2 **Excerpt from 'Plan of the Settlement Norfolk Island taken Oct.r 1838' Geo. F.W. Bordes. Source: State Library of New South Wales, Call no. NSL M Z/M4 819.2/1838/1. Available online at http://digital.sl.nsw.gov.au/delivery/DeliveryManagerServlet?embedded=true&toolbar=false&dps_pid=IE3535292. Annotations added by AECOM**

4.0 Site Description

4.1 Setting

KAVHA is located on the southern side of Norfolk Island. The Island rises out of the Pacific Ocean with sharp, dramatic coastal cliffs, broken on the southern side of the Island by the only coastal area. KAVHA consists of this coastal lowland area, set against the backdrop of steep hills. The hills within KAVHA crest at the 90 metre contour. The site is incised by Arthur's Vale (also known as Watermill Valley) on its western extent and Stockyard Valley to the east. The lowland coastal area, known as Kingston, is one of the largest flat areas on the Island with direct ocean access via Slaughter Bay. Laid upon this geographical context, are four layers of historical development as outlined in Section 3.0.

As a consequence of Kingston being one of the largest flat areas on the Island, it was the focus of nineteenth-century development on the Island during the First and Second Settlements and the initial phase of the Third Settlement. As a result, Kingston contains a considerable group of nineteenth-century Georgian buildings in association with substantial ruins, archaeological features and landscape modifications. The site layout is centred on three principal elements:

- Kingston Pier, with a group of associated structures.
- Quality Row, which includes the principal administrative buildings of the convict settlement. The formal arrangement of these buildings provides geometric structure in sharp contrast to the undulating topographic setting.
- Government House and Reserve, which sits aloof atop Dove Hill, but is visually connected from Kingston Pier and Quality Row.

These elements are connected spatially and visually against the dramatic backdrop of the hills, with Arthur's Vale and Stockyard Valley providing portal frames to the west and east of the site respectively. The largely undeveloped nature of Arthur's Vale, Stockyard Valley and the hills below the 90 metre contour, contribute to the bucolic character of the site.

The early reports assigned each feature within KAVHA an alpha numeric code, with the alpha corresponding to the precinct in which the feature resides (Precincts A to N) and a sequential number. Where possible, this alpha numeric code has been included at first mention to allow for cross-referencing.

Sitting between the Kingston Pier Precinct (Precinct H)/Prisoners' Compound (Precinct G) and Quality Row (Precinct D) is the Swamp Precinct (Precinct F). The Swamp Precinct provides a visual and spatial separation between the structures associated with the Kingston Pier/Prisoners' Compound and Quality Row precincts. Bounty Street (F18) transects the Swamp Precinct, being a structural element within what now appears to be an undeveloped portion of the site. It is important, however, to remember that the Swamp Precinct holds the archaeological remains of soldier's huts and similar that formerly lined the northern side of Watermill Creek (eg. F12, F13, F15, F16, F16A). Historically, the visual separation between the two sets of precincts would not have been as pronounced.

The Swamp Precinct is a gentle swale between the foreshore and the higher ground along Quality Row (D23). Watermill Creek (F3) runs in an easterly direction through the Precinct. The route of Watermill Creek was altered during the First Settlement, being channelized into a reasonably straight line, with a slight change in angle at Pier Street (F8) to the north west and at Bounty Street.

Bounty Street runs roughly perpendicular to Watermill Creek and forms a low causeway through the swale of the swamp (Plate 1). The Bounty Street Bridge fords the channelized Watermill Creek. The flow of Watermill Creek is slowed by bulrushes and other aquatic plants growing within the Creek.

Plate 1 View north east across the Swamp Precinct with at centre of image. View north east.

4.2 Bounty Street Bridge

Bounty Street Bridge (F18A) has been comprehensively described by Higginbotham and Hughes Trueman (Edward Higginbotham & Associates Pty Ltd 2010, Hughes Truman Pty Ltd 2010). The following relies heavily on the description contained within these reports, augmented by additional research and updated with observations made by AECOM structural engineer Alan Schmierer during investigations in January 2020.

Bounty Street Bridge carries a single asphalted lane, with grassed verges on either side. The wing walls of the bridge are constructed primarily of calcarenite (limestone). The wing walls terminate with square posts, projecting slightly beyond the width of the Bridge. A shorter retaining type wall is evident on the southern side of the Bridge, which extends for a short distance to the south. The gabled coping stones are missing on the west side wall, except in one small section on the short retaining type wall. The integrity of the coping stones on the eastern side is almost complete.

The arch facing on the western side is constructed of dressed sandstone. Higginbotham (2010:9) notes that the arch is similar in construction and quality to that on the main entrance of the Prisoners Barracks (G5A). The arch facing on the eastern side appears to have been partially lost, being replaced with an asphalt-like lintel during the 1970s. Hughes Trueman (2010:6) report that the eastern side has been remodelled into a rectangular opening. As a result of these modifications, the opening on the eastern side is approximately 1.9 metres wide, compared to the inlet on the western side, which is approximately 4.2 metres wide (Hughes Trueman 2010:6). It was surmised that this was probably severely inhibiting the water flow under the Bridge.

The arch soffit is constructed of calcernite, with the exception of the keystones, which appear to be sandstone. The calcernite shows significant signs of erosion in a honeycomb manner, Hughes Trueman (2010:6) reported that the depth of erosion on the soffit was “in excess of 100mm”, while on the abutments the erosion was “in excess of 600mm”. The condition of the Bridge can be considered to be poor. Hughes Trueman (2010:) identified the Bridge had settled as a single unit, tipping and

rotating to the north, probably as a result of “inadequate bearing material and in particular on the north end and the east side” and possibly exacerbated by the entrance of water from Town Creek at a high velocity. AECOM identified that this settlement was in the order of 1.2 metres, assuming the Bridge was built level) and observed that the sectional loss of stonework through erosion had progressed significantly. On the basis of the observations, AECOM was unable to provide a load rating or an expected remaining design life and recommended that the Bridge be closed to vehicular and pedestrian traffic, which was achieved in March 2020.

Plate 2 **View north east of western side of the Bounty Street Bridge. Note bulrushes. AECOM, 2020.**

Plate 3 **View north along the western side of the Bounty Street Bridge. Note coping stones are missing.**

Plate 4 **View west showing western wall of the Bounty Street Bridge. Note crack in parapet wall. AECOM 2020.**

Plate 5 **Detail of western arch of the Bounty Street Bridge prior to dewatering. AECOM 2020.**

Plate 6 **View east showing eastern wall of the Bounty Street Bridge. Note the presence of the majority of the coping stones. AECOM, 2020.**

Plate 7 **View north along Bounty Street showing eastern wall of Bridge. AECOM, 2020.**

Plate 8 **View south-south-west showing eastern wall of the Bounty Street Bridge. Note the patched area where the arch has been amended. AECOM, 2020.**

Plate 9 **Soffit erosion near western arch. AECOM, 2020.**

Plate 10 **Calcarenite arch with sandstone keystone showing differential erosion within soffit. Hughes Trueman (2010:14)**

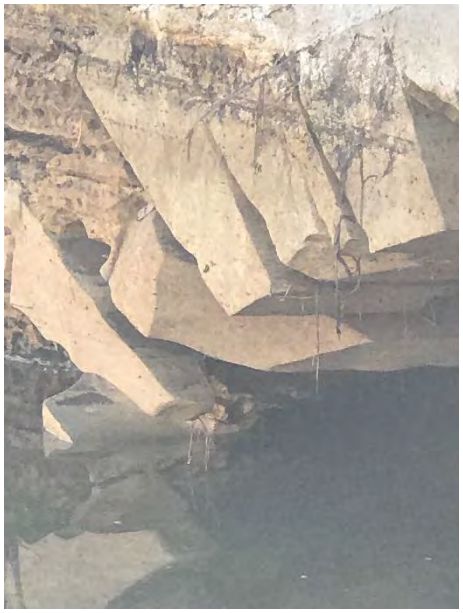


Plate 11 **Sandstone arch facing on western wall of the Bounty Street Bridge. AECOM, 2020.**

4.3 Archaeological Potential

Evidence of occupation by Polynesians on Norfolk Island is currently limited to the site at Emily Bay, with historical references to indications of Polynesian activity at the head of Watermill Valley. Given the extent of modification to the land surface within the vicinity of the Bounty Street Bridge, it is considered unlikely, although not impossible, that further evidence of Polynesians would be encountered at this location.

Two reports have been identified that address the archaeological potential of the Bounty Street Bridge: Bairstow (1985) and Higginbotham (2010).

In 1985 Bairstow undertook archaeological investigations associated with trenching for a new electrical and telephone cables and water pipe between the New Military Barracks (D16) and what is now the Sirius Museum, formerly the Protestant Church (G5F). The trench crossed Quality Row and proceeded along the western side of Bounty Street, over the Bounty Street Bridge directly adjacent to the western parapet wall and thus on to the Protestant Church. Bairstow made the following relevant discoveries and conclusions:

- “The excavation revealed three, possibly four road levels…There was sufficient admixture of large and small calcarenite rubble to show that these principles [those of road making laid down by Macadam] had been followed” (Bairstow, 1985:9).
- Bairstow (1985:8) identified a well-built drain on the western side of Bounty Street – the opposite side to the drain known from the plans (see Section 3.3). This drain is noted, but would not be impacted by the project.
- Excavations adjacent to the parapet wall “disclosed details of construction no longer visible by reason of the surface rendering of the bridge wall” (Bairstow, 1985:10). Bairstow goes on to suggest that the normal process of bridge construction may not have been followed as the piers appear to have limited structural importance with the bridge seeming to have been “built as two superimposed arches” (Bairstow, 1985:11). This was somewhat conjectural, based on the limited archaeological excavation.
- “The road has been built up above the level of the surrounding swamp. While some fill would have been needed to ensure an all-weather road, the gentle gradient to and across the bridge suggests a recent build-up for motor traffic rather than Second Settlement fill for horses or men” (Bairstow, 1985:66).

The course of Watermill Creek has been significantly altered. Higginbotham (2010) indicates that the course of the Creek originally ran closer to the southern side of the Swamp Precinct and the Prisoners' Compound. Higginbotham went on to postulate that the Bounty Street Bridge may have been constructed on the intended, revised course and following completion of the Bridge, the creek was diverted under the Bridge. It is assumed that the Creek banks were not lined with stone, but were battered earth, as evident now. Following Anderson's redesign of the Creek course, Banbury later changed the course again to more closely follow its present alignment within the immediate vicinity of the eastern side of the Bounty Street Bridge. Again, it is considered that the Creek bank was not formalised, but was of battered earth. It is possible that evidence of the differing channel cuttings may be preserved as differences in soil composition or as cuts through the stratigraphy. Additionally, there is some potential for artefacts relating to the Second Settlement period to be included within the cuttings adjacent to the Creek bank.

In summary, it is considered that the archaeological potential within the Bounty Street Bridge area is high, with potential evidence relating to the former channels of Watermill Creek, the water tanks (F15B) and artefact deposits likely to be evident in this area. The archaeological features have the potential to answer questions about:

- coring has the potential to extend our understanding of the three to four road surfaces identified by Bairstow;
- the nature and extent of the water tanks on the north eastern side of the Bridge;
- former location of the channel containing Watermill Creek and its various amendments over time; and
- construction method of the Bridge, particularly clarifying the hypothesis put forward by Bairstow.

5.0 Assessment of significance

5.1 Assessment of significance

The Bounty Street Bridge sits within the WHL area, but has not been assessed for its individual contribution to the WHL, National, Commonwealth or local heritage values. Consideration of development and use within KAVHA must be made in reference to the endorsed significance values of the four listings. The endorsed significance values can be found in the following locations:

- World Heritage List - https://whc.unesco.org/en/decisions/3995
- National Heritage List – http://www.environment.gov.au/cgi-bin/ahdb/search.pl?mode=place_detail;place_id=105962
- Commonwealth Heritage List - http://www.environment.gov.au/cgi-bin/ahdb/search.pl?mode=place_detail;place_id=105606
- Norfolk Island Heritage Register - http://www.norfolkisland.gov.nf/sites/default/files/docs/planandbuild/NIPlan/Heritage%20Register.pdf

To enable a robust assessment of the potential impacts, it is important to understand the individual significance of the element to the broader site. This is in line with guidance item 4-7 within *Guidance on heritage Impact Assessments for Cultural World Heritage* (ICOMOS 2011), which indicates that further significance assessment may be necessary to determine the impacts. A significance assessment, against the EPBC Act criteria has Table 3. This assessment is based in the significance assessment within the 1988 Conservation Management Plan:

> "It is one of a small number of stone bridges with architectural treatment and highly finished to survive from the early nineteenth century in Australia. It has a fine example of a stone voussoir arch.
>
> It is one of the small group of buildings, civil engineering works and landscape features at the Place which are substantially intact to the period of Second Settlement. It is one of the architectural and picturesque landscape elements at the Place built during the administration of Major Joseph Anderson which are of substantial art history interest.
>
> It is one of a number of elements which collectively demonstrate the state and development of industrial and engineering technology at the Place during the early to mid-nineteenth century."
>
> (Clive Lucas Stapleton and Partners, 1988:Vol 2b)

Table 3 Assessment of the Bounty Street Bridge's significance under EPBC significance criteria

Criterion	Historic
Criterion A *The place has significant heritage value because of the place's importance in the course or pattern of Australia's natural or cultural history*	**MET (contributory)** This road was formalised during the Second Settlement. The Bounty Street Bridge, together with the Pier Street Bridge, forms part of the infrastructure projects undertaken during the Second Settlement period and thereby directly contributes to the National heritage significance under this criterion as evidence of the "planning and operation of a nineteenth century penal settlement" (Department of Agriculture Water and the Environment 2007). As the Bounty Street Bridge required significant convict labour to complete, it is evidence of the work performed as part of their punishment. Attributes: Alignment of road Form and stonework of Bridge.
Criterion B *The place has significant heritage value because of the place's possession of uncommon, rare or endangered aspects of Australia's natural or cultural history.*	**MET** The Bounty Street Bridge is one of only a few intact, serviceable convict built bridges in Australia, along with the Richmond (1825), Ross (1836) and Red (1838) Bridges in Tasmania and Lennox Bridge, Glenbrook (1832-1833), Lansdowne Bridge (1833-1836) and Lennox Bridge, Parramatta (1836-1839). It is comparable in date to the Ross, Red and Landsdowne Bridges. The intact nature of the structure, together with the stone voussoir arch contribute to the rare significance of the Bounty Street Bridge. Additionally, the integration of water tanks and a pump to provide water to the Prisoners' Compound on the north eastern side of the Bridge is believed to be a rare attribute. No comparable examples could be identified. Attributes: Stonework and intactness Evidence of the water tanks, if extant

Criterion	Historic
Criterion C *The place has significant heritage value because of the place's potential to yield information that will contribute to an understanding of Australia's natural or cultural history.*	**MET** The Bounty Street Bridge meets this criterion. Questions regarding the bridge construction techniques and methodology in relation to the base of the bridge have been raised by engineers. An understanding of the construction methodology used in relation to the preparation of the base, whether via excavation of a diversion channel to lower the water level or by compacting rock rubble into the mud, may assist with future conservation efforts. Water holding tanks on the north eastern parapet wall are no longer evident, but archaeological evidence may still exist sub-surface. Archaeological investigation has the potential to determine the nature and purpose of these structures, if extant.
Criterion D *The place has significant heritage value because of the place's importance in demonstrating the principal characteristics of:* *i. A class of Australia's natural or cultural places; or* *ii. A class of Australia's natural or cultural environments.*	**MET (Contributory)** The Bounty Street Bridge contributes to the National representative significance of KAVHA as an element within the body of infrastructure relating to the Second Settlement period. Bounty Street was formed to provide a direct link between the military barracks and the prisoners' compounds and can therefore demonstrate the "physical layout, governance arrangements, the management and control of convicts, and the functional arrangements associated with [the] settlement" (Department of Agriculture Water and the Environment 2007). Attributes: Alignment, form and stonework
Criterion E *The place has significant heritage value because of the place's importance in exhibiting particular aesthetic characteristics valued by a community or cultural group.*	**MET (Contributory)** The Bounty Street Bridge contributes to the National aesthetic significance of KAVHA. Sitting within the (now) undeveloped Swamp Precinct and bridging Watermill Creek, the Bounty Street Bridge contributes to the bucolic character of KAVHA. The form of the arch has been identified as holding art history interest due to its elongated form. Attributes: Setting, form of arch, stonework

Criterion	Historic
Criterion F *The place has significant heritage value because of the place's importance in demonstrating a high degree of creative or technical achievement at a particular period*	**MET** KAVHA is not identified as meeting this criterion. The longitudinally flat arch, of the Bounty Street Bridge demonstrates some creative and technical achievement. The shape is distinctly different to the Roman arch seen typically in other convict era structures. The shape indicates the work of an engineer and/or stonemason with a firm grasp of their craft. The integration of the water tanks into the western wing wall and fed by the vaulted drain of Town Creek is a creative solution to assist in accessing water.
Criterion G *The place has significant heritage value because of the place's strong or special association with a particular community or cultural group for social, cultural or spiritual reasons.*	**MET (Contributory)** Indirectly, the Bounty Street is of social significance to the people of Norfolk Island as it provides one of the two access routes through to the foreshore and the primary beach on the Island at Emily Bay.
Criterion H *The place has significant heritage value because of the place's special association with the life or works of a person, or group of persons, of importance in Australia's natural or cultural history.*	**MET** The Bounty Street Bridge is associated with the life and works of Major Joseph Anderson, the Commandant who oversaw construction, and with the currently unnamed convicts who undertook the manual labour.
Criterion I *The place has significant heritage value because of the place's importance as part of Indigenous tradition*	**NOT MET** The Bounty Street Bridge is not part of an Indigenous tradition. This criterion is not met.

5.2 Statement of significance

The following statements of significance summarises the significance of the Bounty Street Bridge.

The Bounty Street Bridge is of Commonwealth and local historical, rarity, representative, aesthetic, technical and social significance (criteria a, c, d, e, f and g). The Bounty Street Bridge contributes to these criteria at a National level.

The Bounty Street Bridge forms part of the infrastructure projects undertaken during the Second Settlement period and thereby directly contributes to the National historical, representative and associative heritage significance (criterion a, d and g) as evidence of the "planning and operation of a nineteenth century penal settlement" (Department of Agriculture Water and the Environment 2007). In this instance, the planning of the Bridge's construction is associated with Major Joseph Anderson, Commandant during the construction (criterion d). As the Bounty Street Bridge required significant convict labour to complete, it is evidence of the work performed as part of their punishment and is associated with convicts as a group of people (criterion d). Bounty Street was formed to provide a direct link between the military barracks and the prisoners' compounds and can therefore demonstrate the "physical layout, governance arrangements, the management and control of convicts, and the functional arrangements associated with [the] settlement" (Department of Agriculture Water and the Environment 2007) as assessed under criterion d.

The Bounty Street Bridge is one of only a few intact, serviceable convict-built bridges in Australia. The intact nature of the structure, together with the stone voussoir arch contribute to the rare significance (criterion b) of the Bounty Street Bridge.

The Bounty Street Bridge contributes to the National aesthetic significance of KAVHA under criterion e. Sitting within the (now) undeveloped Swamp Precinct and bridging Watermill Creek, the Bounty Street Bridge contributes to the bucolic character of KAVHA. The form of the arch has been identified as holding art history (aesthetic) interest due to its elongated form, which also holds some technical significance (criterion f). The integration of the water tanks into the western wing wall and fed by the vaulted drain of Town Creek is a creative solution to assist in accessing water (criterion f), the archaeological investigation of the area could yield further information regarding the utilisation of water resources during the Second Settlement period.

The Bounty Street Bridge is of some social significance (criterion g) to the people of Norfolk Island as it provides one of the two access routes through to the foreshore and the primary beach on the Island at Emily Bay.

6.0 Heritage Impact Assessment

6.1 Purpose

The objective of a HIA is to evaluate and explain how the proposed remediation works would affect the heritage value of the Bounty Street Bridge and the broader KAVHA site. A HIA should also address how the heritage value of the site/place can be conserved or maintained, or preferably enhanced by the proposed works.

6.2 Description of proposed activity

The proposed works involves the construction of a concrete supporting arch. It is predicted the stone arch will fail in time and will come to rest on the concrete supporting arch.

Key features of the proposal are:

- Installation of coffer dam made of earth bund and sheet piles upstream and downstream of the Bridge, dewatering and desilting
- Temporary diversion of Town Creek flow and pumping to maintain flow in Watermill Creek
- Construction of concrete lining reinforcement works

6.2.1 Coffer Dam and diversion of Town Creek

Installation of the coffer dam would involve:

- Determine a safe distance from the bridge to install sheet piles, noting archaeological advice.
- Construct a soil berm across the floodway to allow the piling rig to have access to the centre of the site.
- Use a bypass pump to maintain safe water levels.
- Install sheet piles through the soil berm either by impact driving or vibrodriving, as determined by the contractor. In the area of archaeological sensitivity between Town Creek and the water tanks, a soil and/or concrete berm would be used to stop the flow of water from Town Creek into Watermill Creek. Water from Town Creek would be allowed to flow over the ground surface to find a natural course to re-join Watermill Creek east of the coffer dam.
- Complete Bridge works.
- Remove sheet piles.
- Remove soil berm.

6.2.2 Reinforcement Works

The construction sequence consists of the following stages:

- Stage 1 – Excavation
  - Excavate to a firm, sound base under the arch that matches the Reduced Level (RL) of the Bridge foundations. This is expected to be alluvial soils, rather than rock, based on the geotechnical investigations. Soil will be disposed of off-site and in line with the relevant approvals.
  - Over excavate to install a nominal 100 mm thick concrete binding layer as a working platform.
  - Prop arch of Bridge as required.

- Stage 2 – Point and render arch soffit
  - Clean bridge walls and soffit to remove mud and loose debris using potable water.
  - Fill eroded stone with hydraulic lime mortar.
  - Retention of concrete lintel on downstream (eastern) face as evidence of the history of the Bounty Street Bridge.
  - Apply a 50 mm thick hydraulic lime mortar render to the arch soffit.
- Stage 3 – Pour foundation
  - Construct the form, reinforce with fibreglass starter bars for the full width of the bridge. Form to be set back 300 mm from the upstream (western) face.
  - Pour concrete conforming with S40 grade and New South Wales Roads and Maritime Safety specification for a 100 year design life.
- Stage 4 – Construct concrete lining
  - Construct form and place fibreglass reinforcement bars.
  - Pour concrete through access holes in deck of bridge and remediate access holes.
- Stage 5 – Remediate bridge sides.
  - Remove existing Portland cement render from all faces of the Bridge and the wing walls.
  - Identify and replace severely eroded stones, like-for-like (ie, locally sourced calerinite or sandstone as identified in Stage 2).
  - Repoint stonework with lime mortar. Hydraulic lime mortar to be used below the water line and natural hydrated lime mortar above the water line.
  - Set existing coping stones in place using lime mortar.

6.3 Options Assessment

Three options were assessed before selecting the preferred option. The options are laid out in *Kingston and Arthurs Vale Safety Investigation Works: Design Report* (AECOM Australia Pty Ltd 2020). The options assessment considered the heritage impacts. The preferred option was selected as balancing the engineering requirements against the heritage impacts. The options and the heritage constraints are outlined briefly below.

6.3.1 Option 01 – Do nothing

Option 01 would have seen no works been undertaken. In the do nothing scenario, it was estimated that the Bridge would collapse in between five to 50 years. This option was rejected as not fulfilling the Australian Government's obligations to protect and conserve the physical fabric of a listed World, National and Commonwealth heritage site. It also does not comply with the *Burra Charter* conservation principles of safeguarding significance, which includes averting the risk of collapse (Article 2.4) or with ensuring the on-going use of the Bridge, which has been identified as contributing to the significance of the structure (Section 5.0).

6.3.2 Option 02 – Culvert Conversion

Option 02 consists of inserting two 1500 mm concrete pipes and infilling of the surrounding area with concrete. This option was rejected as not being sensitive to the heritage values of the Bridge. The culvert conversion does not respect the existing fabric and therefore does not comply with Article 3 of the *Burra Charter* – by converting the Bridge to a culvert the design intent of the structure would be distorted (Article 3.2).

6.3.3 Option 03 – Structural Steel Arch

Option 03 consisted of inserting a structural steel frame to support the arch. This option was not progressed based on cost and constructability considerations. The frame would need to be fabricated on the mainland, which would have posed challenges and have significant cost implications, and given the environment may not meet the required design life. Additionally, the interaction with the potential acid-sulphate soils was considered. The option would also require the steel arch to be bolted or in some way connected to the stonework and would therefore have a direct impact.

6.3.4 Option 04 – Structural Concrete Arch

Option 04 consisted of inserting a concrete support to hold the arch. This option was selected on the basis that the concrete would withstand the potential acid-sulphate soils, little preparation of materials off-Island would be required and the heritage impacts could be minimised. Key to the minimisation of heritage impacts was the proposal to install a layer of lime mortar between the Bounty Street Bridge and the structural concrete arch. The lime mortar would form a sacrificial layer between the original and new fabric and make the works reversible, in line with Article 15 of the *Burra Charter.*

Consideration of the incompatibility of concrete in contact with natural materials like calcerinite and sandstone was also considered. While it is true that concrete forms an impervious barrier to water that can result in rising damp in the adjacent natural materials thereby speeding their deterioration, it was considered that as the natural stone of the Bounty Street Bridge is usually waterlogged by the water of Watermill Creek, this cautionary principle was not applicable. In the intertidal zone, the lime mortar layer between the original and new fabric could act as a sacrificial layer, but it is considered that there are sufficient paths for evaporation through the natural stone that the introduction of concrete was unlikely to significant impact on the deterioration of the stonework.

6.3.5 Other Considerations

Other considerations taken into account during the design process and the reasons why they were discarded are outlined below:

- Use of lime mortar to create structural arch.
  - The structural abilities of lime mortar are not sufficient to provide the required load ratings.
- Underpinning of the Bounty Street Bridge.
  - The Bounty Street Bridge appears to be stable and has settled to a point of homeostasis within its environment.
  - Underpinning is therefore not warranted as further settlement is not considered likely.
  - Underpinning is invasive, and would not provide strength to the eroded stone arch. The stone arch would still require structural support.
- Stone repair and/or replacement.
  - Due to the location and extent of the deteriorated stone, the Bridge would need to be de-constructed from the top, stone replaced and the upper parts of the Bridge reconstructed. These are highly invasive works that would impact on the integrity of the Bridge and have a high cost implication.

6.4 Impact Assessment

Table 4 assesses the magnitude of the impacts of the proposed works on the significance of KAVHA, as defined in the NHL listing, and against the individual significance of the item as assessed in Section 5.1. The impact assessment grading follows the *Guidance on Heritage Impact Assessments for Cultural World Heritage Places* (ICOMOS 2011).

The works are proposed to ensure the stability of the Bounty Street Bridge and allow it to reopen to vehicular and pedestrian traffic. The associated impacts would consist of:

- Ground disturbance at the creek banks for installation of the sheet pile coffer dam. This area is considered to have high archaeological potential and significance. These works have the potential to impact:
  - Evidence of the previous creek alignments; and
  - The water tanks appended to the north eastern wing wall of the Bounty Street Bridge.
- Damage through vibration during installation of the sheet pile coffer dam and/or drilling through the deck and stone soffit to pour the concrete.
- Nominal excavation under the Bounty Street Bridge arch for the insertion of the concrete footings and arch. This area is considered to have low archaeological potential.
- Construction of a structural concrete arch. The impacts relate to the introduction of new materials.
- Drilling six 150 mm through the deck of the Bounty Street Bridge, including through the stone soffit, to pour the concrete.
- Removal of existing concrete render;
- Hydraulic lime mortar render below the water level; and
- Natural lime mortar render above the water level.

Table 4 Impact assessment against EPBC Act criteria

Criterion	Bounty Street Bridge
Criterion A *The place has significant heritage value because of the place's importance in the course or pattern of Australia's natural or cultural history* KAVHA is outstanding as a convict settlement spanning the era of convict transportation to eastern Australia. It is a cultural landscape comprising a large group of buildings from the convict era, some modified during the Pitcairn period (the third settlement), substantial ruins and standing structures, archaeological remains, landform and landscape elements. KAVHA is of outstanding national significance in demonstrating the role of the penal systems and changes in penal philosophy in the Australian colonies from 1788-1855. KAVHA is important for its role in the evolution of the colonies of both Van Diemen's Land and New South Wales. The buildings, archaeological remains and landforms of the First Settlement illustrate British convict settlement at the beginning of European occupation of Australia. The design and layout, buildings, archaeological remains, engineering works and landscaping of the KAVHA Second Settlement (1825-1855) demonstrate the planning and operation of a nineteenth century penal settlement with a very high degree of integrity. KAVHA is an outstanding example of a place of severe punishment. It was purposefully established to be the extreme element in the overall convict management system. Its aim was to create fear and prevent crime and re-offending. It became known as 'hell in paradise' for its brutal and sadistic treatment of inmates and this reputation spread beyond the colonies to Britain and ultimately served to fuel the anti-transportation debate. The Second Settlement buildings and archaeological remains of the convict establishment, the New Gaol, the Prisoners' Barracks, and the Crankmill demonstrate the harshness and severity of the treatment of convicts.	**Minor Beneficial** The Bounty Street Bridge has been assessed as contributing to the historical significance of KAVHA as an intact infrastructure project of the Second Settlement period completed by convict labour. The insertion of the structural concrete arch will introduce new modern material to the Bridge, however, the works would preserve the Bridge *in situ*, and reopen pedestrian and vehicle access.
Criterion B *The place has significant heritage value because of the place's possession of uncommon, rare or endangered aspects of Australia's natural or cultural history.*	**Minor Beneficial** The Bounty Street Bridge is considered to be a rare convict-built bridge in active use. Returning the bridge to vehicular and pedestrian traffic is considered to be minor beneficial

Criterion	Bounty Street Bridge
Kingston and Arthurs Vale Historic Area (KAVHA) is uncommon as a place where a distinctive Polynesian/European community has lived and practised their cultural traditions for over 150 years. Aspects of the Third Settlement period including the artefacts, archives, Pitcairn language and ongoing use of the Cemetery are of national significance.	impact through the retention of the significance under this criterion.
Criterion C *The place has significant heritage value because of the place's potential to yield information that will contribute to an understanding of Australia's natural or cultural history.* The KAVHA artefact collections, the buildings in their landscape setting, the archaeological remains and the documentary records have significant potential to contribute to understanding the living and working conditions of convicts, the military and civil establishment, women and children, and changes in penal practice and philosophy during the span of convict transportation. KAVHA has research potential to yield information on pre-European Polynesian culture, exploration and settlement patterns.	**Minor Adverse** The excavation to allow for the installation of the sheet pile coffer dam has the potential to disturb evidence of the previous alignment of the Watermill Creek channel and the water tanks adjacent to the north eastern wing wall. An Archaeological Research Design and Methodology should be prepared and implemented to manage the residual risk. The existing HMP recommends the reinstatement of the serpentine alignment of Watermill Creek. The archaeological investigations should consider what information may be collected to assist in the potential future implementation of this recommendation. However, avoiding impacts should be the priority. Implementation of the above mitigation measures would reduce the impact to **Neutral**
Criterion D *The place has significant heritage value because of the place's importance in demonstrating the principal characteristics of:* *iii. A class of Australia's natural or cultural places; or* *iv. A class of Australia's natural or cultural environments.* (Abridged) KAVHA demonstrates the principal characteristics of a longstanding penal settlement in its physical layout, governance arrangements, the management and control of convicts, and the functional arrangements associated with settlement. It has substantial ruins, standing structures and archaeological sub-surface remains related to its operation as a place of primary incarceration and early settlement, as a place of secondary punishment and finally as a place spanning both incarceration and secondary punishment.	**Negligible Beneficial** The Bounty Street Bridge assists visitors in understanding the functional arrangements and separation of the military and prisoner accommodation. Re-opening the Bridge to vehicular and pedestrian traffic will assist in the maintenance and retention of the National significance held under this criterion.
Criterion E	**Negligible Adverse**

Criterion	Bounty Street Bridge
The place has significant heritage value because of the place's importance in exhibiting particular aesthetic characteristics valued by a community or cultural group. KAVHA is outstanding for its picturesque setting, historic associations, part ruinous configuration and subsequent lack of development. The aesthetic qualities of the landscape have been acknowledged since the First Settlement, forming the subject matter of an artistic record that has continued to the present. Elements that contribute to the aesthetic qualities of the place include the sea, reef and islands, historic graves, Quality Row buildings, the New Gaol and prisoner's barracks in a ruinous state, and the extent of the nineteenth century buildings. The picturesque landscape setting, with its domestic scale and agricultural character, is valued for the contrast it represents between the horror of the past and the charm of the present. KAVHA is outstanding for its views across the site, within the site, from the site to the seascape, and views of the site in its landscape setting.	The Bounty Street Bridge has been assessed as contributing to the aesthetic qualities of KAVHA and for the form of the arch, now only evident on the western elevation. The insertion of the structural concrete arch would preserve the arch and the Bridge more broadly, thereby allowing it to continue to contribute to the bucolic character of KAVHA. Due to the water level and being set back 300 mm behind the arch facings, the structural concrete arch will be largely invisible most of the time.
Criterion F *The place has significant heritage value because of the place's importance in demonstrating a high degree of creative or technical achievement at a particular period*	**Negligible beneficial** KAVHA is not assessed as holding significance against this criterion, however, the Bridge does hold some significance under this criterion for the longitudinally flat arch shape and the integration of the water tanks into the western wing wall and fed by the vaulted drain of Town Creek is a creative solution to assist in accessing water. The preservation of the structure, particularly the longitudinally flat arch, will perpetuate the significance of the Bridge under this criterion. It is anticipated that there will be no direct impacts to the water tanks, which will be avoided during construction.
Criterion G *The place has significant heritage value because of the place's strong or special association with a particular community or cultural group for social, cultural or spiritual reasons.* KAVHA was the landing place of the Pitcairn Islanders in 1856. Their descendants today comprise nearly a third of Norfolk Island's population. They value KAVHA as a	**Negligible beneficial** The proposed works would enable the on-going use of the Bridge by vehicular and pedestrian traffic. The route to Emily Bay has some significance to the Norfolk Island people.

Criterion	Bounty Street Bridge
place of special significance because it has been continually and actively used as a place of residence, work, worship and recreation. KAVHA is valued by the Norfolk Island residents for being a place of traditional and ongoing uses, including the continuity of a working waterfront at the Landing Pier; the centre of Norfolk Island administration; continuing religious worship at All Saints Church and the community's burial place at the cemetery; areas for recreation and sports; and as the cultural centre with cultural and social events, museums and archaeological sites.	
Criterion H *The place has significant heritage value because of the place's special association with the life or works of a person, or group of persons, of importance in Australia's natural or cultural history*. KAVHA is significant for its association with Lt Philip Gidley King RN in successfully establishing the First Settlement on Norfolk Island at the KAVHA site which contributed to the survival of the infant colony of New South Wales. KAVHA is significant for its association with Alexander Maconochie who formulated and applied most of the principles on which modern penology is based during the period he was Superintendent of Norfolk Island.	**Minor adverse** The Bounty Street Bridge, together with the Pier Street Bridge and other swamp improvements is associated with the life and works of Major Joseph Anderson and the convicts who undertook the labour. The installation of the structural concrete arch will result in impacts to the fabric that relates to these associations.
Criterion I *The place has significant heritage value because of the place's importance as part of Indigenous tradition*	KAVHA is not assessed as holding significance against this criterion.

6.5 Impact Summary

The following sections assess the impacts according the mandated guidelines.

6.5.1 Significant Impact Guidelines Impact Assessment

Table 5 outlines the remediation works against the impact parameters for World Heritage identified in the *Significant Impact Guidelines 1.1* (Department of the Environment 2013:17).

Table 5 Heritage impact assessment

Impact. Is there a real chance or possibility that the action will:	Discussion
permanently remove, destroy, damage or substantially alter the fabric of a World Heritage property	**YES** The proposed works include the introduction of significant amounts of new fabric. While these will largely be invisible once works are complete, the addition of the structural concrete arch is considered to substantially alter the Bounty Street Bridge. In addition, approximately six 150 mm cores would be drilled through the deck and soffit of the Bridge to allow the concrete to be poured. This would not be visible, but does constitute a direct impact to significant fabric
extend, renovate, refurbish or substantially alter a World Heritage property in a manner which is inconsistent with relevant values	**NO** The works are not inconsistent with the World Heritage values, in that the works are designed to prolong the life of the Bounty Street Bridge in operable condition.
permanently remove, destroy, damage or substantially disturb archaeological deposits or artefacts in a World Heritage property	**POSSIBLE** The Archaeological Zoning and Management Plan has identified the area as being of high archaeological potential and significance. The excavation associated with installation of the concrete footings under the Bounty Street Bridge arch has limited potential to expose artefacts or features, having been previously heavily disturbed by desilting. The installation of the sheet pile coffer dam has the potential to destroy or obscure evidence of the previous channels associated with Watermill Creek. The diversion of Town Creek and, to a lesser degree, the installation of the sheet pile coffer dam may impact on the water tank on the north eastern side of the Bounty Street Bridge. The requirements of the Archaeological Zoning and Management Plan would be implemented to manage the identified impacts.

Impact. Is there a real chance or possibility that the action will:	Discussion
involve activities in a World Heritage property with substantial and/or long-term impacts on its values	**NO** The proposed works are not considered to impact on the OUV, as assessed in Section 6.5.2.
involve construction of buildings or other structures within, adjacent to, or within important sight lines of, a World Heritage property which are inconsistent with relevant values	**NO** The proposed works will place a structure within an important sight line, however, once water levels are reinstated following the removal of the coffer dam, the structural concrete arch will not be visible except on close inspection from particular angles.
make notable changes to the layout, spaces, form or species composition in a garden, landscape or setting of a World Heritage property which are inconsistent with relevant values	**NO** The works would not result in a change to the layout, spaces or form of the landscape. Retention of the Bounty Street Bridge in operable condition will in fact preserve the layout.

6.5.2 Impact assessment against World Heritage Outstanding Universal Values

Table 6 assesses the impacts of the proposed remediation works against the Outstanding Universal Values. The following assessment fulfils the requirements for such an assessment outlined in item 5-10 of *Guidance on Heritage Impact Assessments for Cultural World Heritage Places* (ICOMOS 2011).

Table 6 Impact assessment against Outstanding Universal Values

Value	Assessment
Criterion (iv): The Australian convict sites constitute an outstanding example of the way in which conventional forced labour and national prison systems were transformed, in major European nations in the 18th and 19th centuries, into a system of deportation and forced labour forming part of the British Empire's vast colonial project. They illustrate the variety of the creation of penal colonies to serve the many material needs created by the development of a new territory. They bear witness to a penitentiary system which had many objectives, ranging from severe punishment used as a deterrent to forced labour for men, women and children, and the rehabilitation of the convicts through labour and discipline.	**NO** While the Bounty Street Bridge supports the OUV, the works are conservation works, aimed at preserving the fabric that contributes to the OUV.
Criterion (vi): The transportation of criminals, delinquents, and political prisoners to colonial lands by the great nation states between the 18th	**NO**

Value	Assessment
and 20th centuries is an important aspect of human history, especially with regard to its penal, political and colonial dimensions. The Australian convict settlements provide a particularly complete example of this history and the associated symbolic values derived from discussions in modern and contemporary European society. They illustrate an active phase in the occupation of colonial lands to the detriment of the Aboriginal peoples, and the process of creating a colonial population of European origin through the dialectic of punishment and transportation followed by forced labour and social rehabilitation to the eventual social integration of convicts as settlers.	The Bounty Street Bridge demonstrates the active occupation of KAVHA by convicts, particularly the forced labour undertaken as part of their rehabilitation, however, the works will not negatively impact on this OUV as the Bridge will be conserved in the long-term.

6.6 Heritage Management Plan

The HMP contains a vast number of policies and assessment of the remediation works has therefore been limited to consideration against the policies in Section 8.3.1 – Fabric Conservation and Section 8.3.6 – Other Structures (Godden Mackay Logan Pty Ltd 2016:107, 110). This HIA complies with the impact assessment requirements within Section 8.6.8.

Table 7 Assessment of remediation works against fabric conservation policies in the Heritage Management Plan

Policy	Assessment
Section 8.3.1 – Fabric Conservation	
All works to significant buildings, structures or ruins within the KAVHA site will be consistent with the principles and practices of the Burra Charter.	The works have been designed using the Burra Charter principles. The options assessment selected the option that minimised direct impacts to the significant fabric, the potential to impact on the area of archaeological potential and significance. Where direct impacts have been unavoidable, being the cores to allow for the pouring of the concrete, these have been located in areas that are not conspicuous and are not generally visible to the public, being the soffit. The remediation works are aimed at preserving KAVHA, as defined under the Burra Charter.
Best practice standards will be implemented for the conservation of significant fabric within the KAVHA site.	The final design of the works had input by a suitably qualified heritage specialist to ensure that best practices have been maintained throughout this process.
Conservation projects will involve appropriately skilled and trained professionals and tradespeople.	Evaluation of the tenders received will involve consideration of the skills and training of the tradespersons.

Policy	Assessment
	This HIA has been prepared by s 47F a historic heritage specialist with 18 years' experience.
Resources will be made available to enable works to be undertaken so that the heritage values of the KAVHA site are conserved.	The proposed works are in direct response to this policy.
Activities and actions that may impact on significant heritage fabric will be avoided. Fabric conservation will respect the historic layering of individual buildings, structures and ruins.	The proposed works are avoiding direct impacts to the masonry by supporting the Bounty Street Bridge from underneath. The layering of the Bridge's history is being respected by leaving the concrete lintel, installed during the 1970s, in place. The works are principally designed to maintain the integrity of significant fabric through required conservation works.
The authenticity and integrity of historic buildings, structures and objects will be conserved to enhance the appreciation and understanding of heritage values.	The authenticity and integrity of the Bounty Street Bridge were foremost in considerations of the options. The structural concrete arch had minimal intervention to maintain the authenticity and integrity, while allowing the Bridge to be re-opened to vehicular and pedestrian traffic.
Remaining unaltered original finishes and materials will be preserved and not changed. Conservation works will be prioritised to address unstable or deteriorated fabric first.	The methodology for the removal of the unsympathetic concrete render will address the interface between the concrete and potential underlying original finishes.
Accurate records of all physical works within the KAVHA site will be maintained and updated as required, both digitally and in hard copy.	The successful tenderer will be obliged to maintain records of works undertaken.
Required approvals, including planning approval from the Norfolk Island administration, will be obtained prior to commencement of works within the KAVHA site.	Required approvals will be obtained prior to commencement of works.
Intrusive and incompatible fabric will be removed as and when appropriate.	The works include the removal of unsympathetic concrete render and the reinstatement of the original lime mortar finish.
Section 8.3.6 – Other Structures	
Other historic structures – including dams, bridges, seawalls, roads, culverts and drainage systems – will be conserved and managed as part of the cultural heritage fabric of the KAVHA site.	The proposed works to the Bounty Street Bridge indicate that this policy is being enacted by the Department through active works to preserve the Bridge.

Policy	Assessment
A conservation policy will be prepared for individual significant historic structures within the KAVHA site.	This HIA has assessed the significance of the Bounty Street Bridge and identified that preserving the integrity and authenticity of the Bridge is to guide the conservation of the structure.
All works to significant historic structures will be consistent with the principles and practices of the Burra Charter.	The options assessment, outlined in Section 6.3, indicates that the *Burra Charter* was actively employed during the option selection process. The following aspects of the works are aligned with the Burra Charter: • Article 3 – Cautious Approach - • Article 5&6 – Burra Charter Process – the works have been developed on a firm understanding of the significance of the Bounty Street Bridge as an individual item and its contribution to KAVHA • Article 7 – Use – where the use is part of significance, the use should be retained. The works would allow the Bridge to be reopened to vehicular and pedestrian traffic and thereby preserve significance of use. • Article 15 – Change – where change is necessary the change should be guided by the significance and reversible. This article leads to the alteration of the proposed works to include a lime mortar lining between the original stone and the new structural concrete arch to allow the concrete to be reversible. • Article 17 – Preservation – preservation should not obscure the evidence of its construction or use. The installation of the structural concrete arch would obscure the construction soffit, but would allow the Bridge to be re-opened. As the soffit is not normally visible, the trade-off is warranted. • Article 22 – New Work – the new work will be readily identifiable as new through the construction techniques and materials. • Article 23 – Conserving Use – the works will allow the Bridge to be re-opened to vehicle and pedestrian traffic thereby conserving the use of the structure. • Article 27 – Managing Change – adjustments have been made to the structural concrete arch to minimise the impacts and the existing fabric has been retained.

Policy	Assessment
Original fabric will be retained, repaired and stabilised, in preference to the introduction of replacement fabric.	The original fabric of the Bounty Street Bridge has been prioritised in the development of the structural concrete arch. While replacement fabric is not proposed, new fabric will be introduced. Given the significant sectional loss of stone through erosion, it has been deemed necessary to stabilise the surface of the soffit through the introduction of lime mortar in quantities that were not part of the original design as well as concrete. The lime mortar will enable the concrete to be reversible with minimal damage to the original fabric.
Section 9.2 Heritage Conservation	
Implement recommendations of the Bounty Street Bridge Structural Report	AECOM consulted the 2010 Bounty Street report, which informed the development of the proposed design solution.

6.7 Mitigation Measures

Table 4 identified some adverse impacts associated with the proposed works. The following mitigation measures are proposed to reduce or remove the identified impacts:

- Once de-watering of the Watermill Creek has been accomplished, an archival recording of the Bounty Street Bridge should be completed prior to construction works commencing. The archival recording should include a laser scan and photographic recording.
- The works involve excavation within areas identified in the Archaeological Zoning and Management Plan as Zone 1. An archaeological research design and methodology would need to be prepared and implemented. Archaeological works should be carried out before and in conjunction with the construction works by a suitably qualified archaeologist and in consultation with the KAVHA Commonwealth Heritage Manager (CHM). At the conclusion of works, an Archaeological Excavation Report would be prepared outlining the results of all investigation works.
- The location of the coffer dam should be determined on site, in conjunction with the CHM and Project Archaeologist. Preference is to avoid impacts to potential archaeological deposits, but where these are unavoidable, the research questions should be directed towards gathering information that could be used in the future to implement the recommendation in the HMP that the serpentine form of Watermill Creek be reinstated.
- Access holes to allow pouring of concrete through the deck of the Bounty Street Bridge are to be examined by the CHM and Project Archaeologist to identify previous surfaces, if present.
- Vibration is to be limited to those specified in the German DIN 4150 for category 3 structures during the construction works. The contractor is to submit a methodology for the works, particularly the installation of the sheet pile coffer dam and the drilling to allow the pouring of the concrete, that will ensure compliance and consider whether monitoring equipment is required for compliance.
- Propping of bridge during construction should avoid drilling holes into the stone.
- Cleaning of the mud from the Bridge during construction must not involve high-pressure cleaning. Water pressure is to be limited to 7,000psi or less. The method should be tested to ensure suitability and altered if it is found to cause undue damage.
- Reconstruction of the downstream (eastern) face of the bridge should be undertaken by a stonemason with experience in reconstructing historical structures. The stones should be marked in an unobtrusive location with the year or other similar marker to differentiate the original and new works, as specified under the *Burra Charter.*
- Calcarenite for stone replacement, if necessary, should be sourced from Norfolk Island, if possible.
- Source of the sandstone extant within the Bridge should be analysed and the replacement stones sourced from the same location, if possible and if necessary.
- Method for removing concrete render that will identify and protect remnant original finishes is to be submitted by the contractor for approval.
- Original finishes, if found, are to direct the final finish of the Bounty Street Bridge above the water line.
- Any coping stones found during excavation under the bridge should be placed back into position on the bridge parapet, if they are in suitable condition.
- Options to minimise the number of cores in the bridge should be explored.

7.0 Summary and Recommendations

The Commonwealth Department of Infrastructure, Transport, Regional Development and Communications are seeking to undertake remediation works to the Bounty Street Bridge within Kingston and Arthurs Vale Historic Area (KAVHA) on Norfolk Island. The works can be defined as preservation work, as defined by the Burra Charter, as the objective of the work is to retard the deterioration of significant fabric and allow the Bounty Street Bridge to be re-opened to vehicular and pedestrian traffic. The works consist of the installation of a structural concrete arch to support the Bounty Street Bridge, following engineering assessment that the structure was likely to collapse within five to 50 years.

The Bounty Street Bridge has been identified as contributing to the heritage significance of KAVHA, as listed on the NHL, CHL and local heritage registers. The structure also contributes to the World Heritage OUV in an indirect manner.

The remediation works have been developed through an options process, with input from a heritage specialist at each stage. This process has served to select the option that limits impacts to the masonry fabric, archaeological potential and significance of the Bounty Street Bridge. An assessment of the impacts indicates that the proposal has a minor adverse impact, but includes the introduction of new and modern materials that will partially obscure the construction of the Bridge. The works have been designed to be reversible, through the insertion of a lime mortar lining between the original and new fabric, allowing the concrete to be removed at a later date with limited or no damage to the original fabric.

The following mitigation measures are recommended:

- Once de-watering of the Watermill Creek has been accomplished, an archival recording of the Bounty Street Bridge should be completed prior to construction works commencing. The archival recording should include a laser scan and photographic recording.
- The works involve excavation within areas identified in the Archaeological Zoning and Management Plan as Zone 1. An archaeological research design and methodology would need to be prepared and implemented. Archaeological works should be carried out before and in conjunction with the construction works by a suitably qualified archaeologist. At the conclusion of works, an Archaeological Excavation Report would be prepared outlining the results of all investigation works.
- The location of the coffer dam should be determined on site, in conjunction with the Project Archaeologist. Preference is to avoid impacts to potential archaeological deposits, but where these are unavoidable, the research questions should be directed towards gathering information that could be used in the future to implement the recommendation in the HMP that the serpentine form of Watermill Creek be reinstated.
- Access holes to allow pouring of concrete through the deck of the Bounty Street Bridge are to be examined by archaeologist to identify previous surfaces, if present.
- Vibration is to be limited to those specified in the German DIN 4150 for category 3 structures during the construction works. The contractor is to submit a methodology for the works, particularly the installation of the sheet pile coffer dam and the drilling to allow the pouring of the concrete, that will ensure compliance and consider whether monitoring equipment is required for compliance.
- Propping of bridge during construction should avoid drilling holes into the stone.
- Cleaning of the mud from the Bridge during construction must not involve high-pressure cleaning. Water pressure is to be limited to 7,000psi or less. The method should be tested to ensure suitability and altered if it is found to cause undue damage.
- Reconstruction of the downstream (eastern) face of the bridge should be undertaken by a stonemason with experience in reconstructing historical structures. The stones should be marked in an unobtrusive location with the year or other similar marker to differentiate the original and new works, as specified under the *Burra Charter.*

- Calerinite for stone replacement, if necessary, should be sourced from Norfolk Island, if possible.
- Source of the sandstone extant within the Bridge should be analysed and the replacement stones sourced from the same location, if possible and if necessary.
- Method for removing concrete render that will identify and protect remnant original finishes is to be submitted by the contractor for approval.
- Original finishes, if found, are to direct the final finish of the Bounty Street Bridge above the water line.
- Any coping stones found during excavation under the bridge should be placed back into position on the bridge parapet, if they are in suitable condition.
- Options to minimise the number of cores in the bridge should be explored.

8.0 References

AECOM Australia Pty Ltd 2020 Kingston and Arthurs Vale Safety Investigation Works: Design Report. Canberra, Unpublished report prepared for Department of Infrastructure, Transport, Regional Development and Communications.

Bairstow, D. 1985 Bounty Street Supply Line Excavation: KAVHA Archaeological Report 18. Sydney, Unpublished report for the Commonwealth Department of Housing and Construction.

Clive Lucas Stapleton and Partners 1988 Kingston and Arthur's Vale Historic Area (KAVHA) Norfolk Island Conservation Management Plan: Vol. 2C - Conservation and Development Guidelines for Place Generally, Areas, Buildings, Built Features, Landscape Items and Vegetation. Sydney, Unpublished report for Department of Administrative Services, Australian Construction Services.

Department of Agriculture Water and the Environment 2007 Kingston and Arthurs Vale Historic Area, Quality Row, Kingston, EXT, Australia. Retrieved 7 July 2020 < http://www.environment.gov.au/cgi-bin/ahdb/search.pl?mode=place_detail;search=place_name%3DKingston%3Bstate%3DEXT%3Bkeyword_PD%3Don%3Bkeyword_SS%3Don%3Bkeyword_PH%3Don%3Blatitude_1dir%3DS%3Blongitude_1dir%3DE%3Blongitude_2dir%3DE%3Blatitude_2dir%3DS%3Bin_ >.

Department of Sustainability Environment Water Population and Communities 2013 Significant Impact Guidelines 1.2: Actions on, or impacting upon, Commonwealth Land and Actions by Commonwealth Agencies.

Department of the Environment 2013 Matters of National Environmental Significance, Significant Impact Guidelines 1.1. Canberra, ACT, Australian Government.

Edward Higginbotham & Associates Pty Ltd 2010 Archaeological assessment of proposed works to the bridge, Bounty Street, Kingston, Norfolk Island. Sydney, Unpublised report for Kingston and Arthurs Vale Historic Area.

Extent Heritage Pty Ltd 2020 Kingston and Arthur's Vale Historic Area (KAVHA) Archaeological Zoning and Management Plan. Prepared for the Department of Infrastructure, Regional Development and Cities.

Godden Mackay Logan Pty Ltd 2016 *Kingston and Arthur's Vale Historic Area Heritage Management Plan*. Report to the Australian Government.

Hughes Truman Pty Ltd 2010 Structural Report: Bounty Street Bridge Kingston & Arthur's Vale Historic Area, Norfolk Island. Sydney, Unpublished report for Kingston and Arthurs Vale Historic Area.

ICOMOS 2011 Guidance on Heritage Impact Assessments for Cultural World Heritage Places. Paris.

ICOMOS (Australia) 2013 The Burra Charter: The Australia ICOMOS Charter for Places of Cultural Significance. Burwood, Victoria, Victoria, Australia ICOMOS.

Wilson, G. and M. Davies 1980 Norfolk Island: Archaeological Survey Kingston-Arthur's Vale Region. Canberra, Prepared for the Department of Housing and Construction.

Appendix A

Drawings

ISO A1 594mm x 841mm

BOUNTY STREET BRIDGE DETAILED DESIGN
NORFOLK ISLAND

BOUNTY STREET BRIDGE SUPPORT STRUCTURE

BOUNTY STREET BRIDGE SUPPORT STRUCTURE DRAWING LIST		
60615424	310	COVER SHEET AND DRAWING LIST
60615424	311	BOUNTY STREET BRIDGE SUPPORT GENERAL NOTES - SHEET 1
60615424	313	BOUNTY STREET BRIDGE SITE PLAN AND COFFER DAM DETAILS
60615424	314	BOUNTY STREET BRIDGE SUPPORT TYPICAL BRIDGE LIME MORTAR DETAIL
60615424	315	BOUNTY STREET BRIDGE SUPPORT STRUCTURE GENERAL ARRANGEMENT PLAN
60615424	320	BOUNTY STREET BRIDGE SUPPORT STRUCTURE REINFORCEMENT LAYOUT

NOT FOR CONSTRUCTION

AECOM

PROJECT

Bounty Street Bridge
Detailed Design
NORFOLK ISLAND

CLIENT

DEPARTMENT OF INFRASTRUCTURE, TRANSPORT, REGIONAL DEVELOPMENT & COMMUNICATIONS
Prepared for:

CONSULTANT

AECOM Australia Pty. Ltd.
A.B.N. 20 093 846 925
www.aecom.com

100% DESIGN

PROJECT MANAGEMENT INITIALS

DESIGNER	CHECKED	APPROVED
s 47F		

ISSUE/REVISION

I/R	DATE	DESCRIPTION
B	06.10.2020	100% DESIGN
A	10.08.2020	30% DESIGN

KEY PLAN

PROJECT NUMBER

60615424

SHEET TITLE

COVER SHEET & DRAWING LIST
BOUNTY STREET BRIDGE SUPPORT

SHEET NUMBER

60615424-DRG-310

Last Saved: 6/10/2020 2:42:26 PM
Filename: C:\Users\gamh\Documents\60615424-MOD-ST-CENTRAL_R19_Heru.Gani.rvt

ISO A1 594mm x 841mm

GENERAL NOTES

G1. THESE DRAWINGS ARE TO BE READ IN CONJUNCTION WITH ARCHITECT'S AND OTHER CONSULTANT'S DRAWINGS AND SPECIFICATIONS AND SUCH OTHER WRITTEN INSTRUCTIONS AS MAY BE ISSUED DURING THE COURSE OF THE CONTRACT.

G2. IF IN DOUBT, VERIFY WITH THE RELEVANT PARTY AS NECESSARY.

G3. REFER ANY DISCREPANCY, AMBIGUITY, OMISSION OR INCONSISTENCY TO THE CONTRACT ADMINISTRATOR BEFORE PROCEEDING WITH THE WORK.

G4. DO NOT OBTAIN DIMENSIONS BY SCALING THE STRUCTURAL ELEMENTS.

G5. VERIFY ALL SETTING OUT DIMENSIONS WITH THE CONTRACT ADMINISTRATOR.

G6. SETTING OUT DIMENSIONS SHALL BE VERIFIED ON SITE BY THE CONTRACTOR PRIOR TO CONSTRUCTION/FABRICATION, WHO SHALL BE RESPONSIBLE FOR THEIR CORRECTNESS.

G7. MATERIALS AND WORKMANSHIP SHALL COMPLY WITH THE BUILDING CODE OF AUSTRALIA (BCA), THE APPROPRIATE AUSTRALIAN STANDARDS, THE BY-LAWS AND ORDINANCES OF THE RELEVANT BUILDING AUTHORITIES EXCEPT WHERE VARIED BY THE CONTRACT DOCUMENTS.

G8. DIMENSIONS ARE IN MILLIMETRES AND LEVELS ARE IN METRES UNLESS NOTED OTHERWISE.

G9. WORKS SHALL BE CARRIED OUT IN ACCORDANCE WITH ALL WORKCOVER REQUIREMENTS AND THE WORK HEALTH AND SAFETY ACT AND THE WORK HEALTH AND SAFETY REGULATION.

G10. CONSTRUCTION SHALL NOT COMMENCE UNTIL THE RELEVANT CONSTRUCTION CERTIFICATE IS ISSUED BY THE PRINCIPAL CERTIFYING AUTHORITY.

G11. SERVICES SHOWN ON DRAWINGS ARE INDICATIVE ONLY. PRIOR TO THE COMMENCEMENT OF CONSTRUCTION WORKS, THE CONTRACTOR IS TO IDENTIFY ALL EXISTING SERVICES. ANY DAMAGES TO THE EXISTING SERVICES ARE TO BE RECTIFIED AT THE CONTRACTOR'S EXPENSE.

G12. DURING CONSTRUCTION, IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO ENSURE THAT THE STRUCTURES AND EXCAVATIONS ARE MAINTAINED IN A SAFE AND STABLE CONDITION AT ALL TIME AND NO PART IS TO BE OVERSTRESSED. THE CONTRACTOR SHALL DEVELOP WORK METHOD STATEMENTS FOR ALL ERECTION OF STRUCTURAL STEEL/FORMWORK/DEMOLITION/EXCAVATION/TILT PANELS ETC. AND PROVIDE TEMPORARY WORKS SUCH AS BRACING, PROPPING AND SHORING ETC. TO KEEP THE WORKS AND EXCAVATIONS STABLE AND FREE FROM WATER AT ALL TIMES. THE CONTRACTOR IS TO ENGAGE AN NPER REGISTERED STRUCTURAL ENGINEER TO DESIGN AND CERTIFY THE TEMPORARY WORKS.

G13. REDUCED LEVELS AND GRID DIMENSIONS SHOWN IN THESE DRAWINGS ARE APPROXIMATE ONLY AND ARE FOR THE SOLE PURPOSE OF ASSISTING THE STRUCTURAL DOCUMENTATION. THEY MUST NOT BE USED FOR CONSTRUCTION. REFER TO ARCHITECT'S DRAWINGS FOR ALL CONSTRUCTION REDUCED LEVELS.

G14. ALL PROPRIETARY PRODUCTS ARE TO BE INSTALLED STRICTLY IN ACCORDANCE WITH MANUFACTURER'S WRITTEN RECOMMENDATIONS UNLESS NOTED OTHERWISE.

G15. ALL DISTURBED AREAS NOT SUBJECTED TO NEW WORKS SHALL BE REINSTATED TO THEIR EXISTING CONDITION BY THE CONTRACTOR AT THE COMPLETION OF WORKS TO THE SATISFACTION OF THE RESPONSIBLE AUTHORITY.

G16. ALL PENETRATIONS THROUGH SLABS AND BEAMS SHALL BE APPROVED BY THE CONTRACT ADMINISTRATOR PRIOR TO COMMENCEMENT OF WORK.

G17. THE DRAWINGS MAY NOT SHOW ALL DETAILS OF FIXTURES, INSERTS, SLEEVES, OPENINGS ETC. REQUIRED BY THE VARIOUS TRADES. ALL SUCH DETAILS, INCLUDING RECESSES AND CHASES, ARE TO BE APPROVED BY THE CONTRACT ADMINISTRATOR BEFORE PROCEEDING WITH THE CONSTRUCTION.

G18. NON-LOAD BEARING ELEMENTS SHALL BE KEPT CLEAR OF THE STRUCTURAL SOFFIT BY AN ALLOWANCE DETERMINED FROM SPAN/250 OR CANTILEVER/125 BUT NOT LESS THAN 20mm UNLESS NOTED OTHERWISE ON THE DRAWINGS. CONSTRUCTION OF ANY MASONRY WALLS OR OTHER PERMANENT LOADING MUST NOT BE BUILT ON CONCRETE SLABS OR BEAMS UNTIL SUPPORTING FORMWORK HAS BEEN REMOVED. HOWEVER, PROPS AND FORMWORK SHALL NOT BE REMOVED BEFORE THE MINIMUM TIME SPECIFIED. DISTRIBUTE MASONRY ON SLAB ADJACENT TO ITS FINAL POSITION PRIOR TO CONSTRUCTING WALLS. ALL UNREINFORCED MASONRY WALLS ARE TO BE SEPARATED FROM ABUTTING CONCRETE WITH TWO LAYERS OF SUPER ALCOR.

G19. WHERE STRUCTURAL INSPECTIONS ARE REQUIRED FOR CERTIFICATION, THE INSPECTIONS ARE TO BE PERFORMED BY THE STRUCTURAL ENGINEER, THE CONTRACTOR IS REQUIRED TO ALLOW TIME FOR THE STRUCTURAL ENGINEER TO INSPECT AT THE FOLLOWING POINTS: COMPLETED EXCAVATION, FORMWORK, REINFORCEMENT, MEMBRANES AND EMBEDMENT PRIOR TO PLACING CONCRETE, COMPLETED ERECTED STRUCTURAL ELEMENTS PRIOR TO PLACING COVERING (UNLESS COVERED BY AS1684 RESIDENTIAL TIMBER-FRAMED CONSTRUCTION).

G20. A MINIMUM OF 48 HOURS NOTICE IS REQUIRED FOR INSPECTION. ALL WORKS TO BE INSPECTED MUST BE COMPLETED PRIOR TO THE TIME OF INSPECTION.

G21. INSPECTIONS DO NOT RELIEVE THE CONTRACTOR OF RESPONSIBILITY FOR THE COMPLETENESS AND CORRECTNESS OF THEIR WORKS.

G22. INSPECTIONS WILL BE PERIODIC AND REPRESENTATIVE AND WILL NOT NECESSARILY BE MADE OF ALL WORKS. THE CONTRACTOR IS TO ADVISE THE ENGINEER OF ALL WORK COMPLETION, BUT ELECTION TO INSPECT OR OTHERWISE WILL BE AT THE ENGINEER'S DISCRETION. THE CONTRACTOR IS TO ALLOW TIME AND PROVIDE SITE ACCESS FOR THE INSPECTIONS TO TAKE PLACE AND IS TO HAVE A RESPONSIBLE SITE SUPERVISOR AVAILABLE TO RECEIVE ANY COMMENT OR DIRECTION FROM THE INSPECTING PARTY.

G23. WHERE STRUCTURAL ELEMENTS ARE DESIGNED AND CERTIFIED BY OTHER PARTIES, THE BUILDER SHALL OBTAIN WRITTEN CERTIFICATION, PRIOR TO PROCEEDING WITH ANY CONSTRUCTION WHICH MAY PREVENT INSPECTION OR REMEDIAL WORKS BEING UNDERTAKEN TO THESE ITEMS.

CONCRETE NOTES

C1. ALL CONCRETE WORKMANSHIP AND MATERIALS SHALL BE IN ACCORDANCE WITH AS3600:2009, AS2870:2011 AND THE SPECIFICATION.

C2. CONCRETE QUALITY AND REQUIRED PROPERTIES OF CONCRETE SHALL BE IN ACCORDANCE WITH AS1379:2007.

C3. SURFACE FINISH AND FORMWORK IS TO BE IN ACCORDANCE WITH THE SAI FORMWORK CODE AS3610:1995 EXCEPT WHERE SPECIFIED OTHERWISE. CONCRETE EXPOSED TO VIEW IN THE FINAL PROJECT IS TO BE CLASS FINISH **3** AND CLASS **3** FINISH ELSEWHERE.

C4. CONCRETE REQUIREMENTS AS SHOWN IN TABLE BELOW UNLESS NOTED OTHERWISE ON THE DRAWINGS. NO "BRECCIA" TYPE AGGREGATE IS TO BE USED.

MEMBER LOCATION	EXPOSURE CLASSIFICATION	CONCRETE STRENGTH f'c (MPa) AT 28 DAYS	CONCRETE CLASS	SLUMP AT SITE +/- 15mm	NOM. MAX. AGGREGATE SIZE (mm)	MAX. 56 DAY SHRINKAGE x10^{-6}	REQUIRED COVER (mm)
BOUNTY BRIDGE SLAB	**C1**	**50**	**GP****	80	20	**600**	**70 (UNO)**
BOUNTY BRIDGE ARCH	**C1**	**50**	**GP****	80	20	**600**	**70**
				80	20		

** SEE ADDITIONAL CONCRETE NOTES ON DRAWING No. DRG-0320

C5. NORMAL CLASS CONCRETE SHALL HAVE CEMENT OF TYPE GENERAL PURPOSE BLENDED CEMENT (GP) OR FOR THE ELEMENTS MARKED "*" (GREEN CONCRETE) ALL CEMENT TO BE GENERAL BLEND, GB (SLAG) [EQUIVALENT OF 70% TYPE GP, PLUS 30% GROUND GRANULATED BLAST FURNACE SLAG] PLUS 25% FLY ASH.

C6. THE CONTRACTOR IS TO SEEK APPROVAL FROM THE STRUCTURAL ENGINEER IN WRITING IF ANY ADMIXTURES TO BE USED IN THE CONCRETE MIX. CALCIUM CHLORIDE WILL NOT BE PERMITTED AND SHALL NOT BE USED UNDER ANY CIRCUMSTANCES.

C7. ALL CONCRETE SHALL BE SUBJECT TO PROJECT ASSESSMENT AND TESTING TO AS1379:2007.

C8. MECHANICALLY VIBRATE CONCRETE IN THE FORM TO GIVE MAXIMUM COMPACTION WITHOUT SEGREGATION OF THE CONCRETE.

C9. CURE CONCRETE AS REQUIRED BY SECTION 17 OF AS3600:2009 AND AS SET OUT IN THE SPECIFICATION.

C10. IN THE DRAWINGS, THE BEAM DEPTH IS WRITTEN FIRST AND INCLUDES SLAB THICKNESS IF ANY.

C11. STRIP FOOTING DEPTHS ARE WRITTEN FIRST FOLLOWED BY WIDTH.

C12. UNLESS SHOWN ON THE DRAWINGS, THE LOCATION OF ALL CONSTRUCTION JOINTS SHALL BE SUBMITTED TO THE CONTRACT ADMINISTRATOR FOR REVIEW.

C13. NO CHASES OR HOLES GREATER THAN 150mm DIAMETER, OR EMBEDMENT OF PIPES GREATER THAN 40mm DIAMETER OTHER THAN THOSE SHOWN ON THE STRUCTURAL DRAWINGS SHALL BE MADE IN THE CONCRETE SLABS. FOR ALL OTHER CONCRETE MEMBERS, NO PENETRATIONS, CHASES OR EMBEDMENT SHALL BE MADE WITHOUT PRIOR APPROVAL BY THE STRUCTURAL ENGINEER.

C14. EXACT SIZE AND LOCATION OF PENETRATIONS ARE TO BE OBTAINED FROM WORKSHOP DRAWINGS PRIOR TO SCHEDULING OF REINFORCEMENT, AND ARE NOT TO EXCEED DIMENSIONS WHERE SHOWN ON THE STRUCTURAL DRAWINGS. LIAISE WITH ALL TRADES FOR FINAL PENETRATION SETOUT.

C15. DO NOT PLACE CONDUITS, PIPES AND THE LIKE WITHIN COVER CONCRETE. CONDUITS CAST INTO CONCRETE MEMBERS SHALL BE SPACED AT MAXIMUM DISTANCE POSSIBLE AND UNDER NO CIRCUMSTANCES CLOSER THAN A CLEAR SPACING OF TWICE THE LARGER CONDUIT DIAMETER FROM PARALLEL REINFORCEMENT OR ANY OTHER CONDUIT.

C16. SLURRY USED TO LUBRICATE CONCRETE PUMP LINES IS NOT TO BE USED IN ANY STRUCTURAL MEMBERS.

C17. CONCRETE SIZES AS DRAWN ARE MINIMUM AND DO NOT INCLUDE APPLIED FINISHES.

C18. UNLESS NOTED OTHERWISE, ALL SLABS CAST ON GROUND REQUIRE 50mm THICK COMPACTED FREE DRAINING SAND BEDDING WITH A 0.2mm POLYTHENE MEMBRANE.

C19. GENERALLY, DRAWINGS ARE DETAILED IN ACCORDANCE WITH THE PRINCIPLES SET OUT IN THE CONCRETE INSTITUTE OF AUSTRALIA (CIA) "REINFORCEMENT DETAILING HANDBOOK" OF 2010.

C20. ALL FORMED EXPOSED EDGES AND RE-ENTRANT CORNERS SHALL BE CHAMFERED OR FILLETED 15mm UNLESS NOTED OTHERWISE ON THE ARCHITECTURAL OR STRUCTURAL DRAWINGS. REFER TO ARCHITECT'S DRAWINGS AND SPECIFICATION FOR ALL FALLS IN SLAB, REGLETS AND CHAMFERS ETC. PROVIDE DRIP GROOVES AT ALL EXPOSED EDGES, COVER TO BE MAINTAINED.

C21. THE FACE OF ALL CONCRETE WHICH HAS REINFORCEMENT PROJECTING FROM IT AND AGAINST WHICH NEW CONCRETE IS TO BE CAST, IS TO BE THOROUGHLY MECHANICALLY SCABBLED, FULLY EXPOSING THE AGGREGATE MATRIX.

FOOTING NOTES

F1. FOOTINGS HAVE BEEN DESIGNED FOR AN ALLOWABLE BEARING PRESSURE OF **75kPa** FOOTING TO BE FREE FROM DELETERIOUS MATERIAL AND SOFT ZONES OR AS SHOWN ON THE FOOTING DRAWINGS, FOUNDED ON RESIDUAL SOIL/ENGINEERED FILL. THE CONTRACTOR SHALL ENGAGE AN NPER GEOTECHNICAL ENGINEER TO VERIFY THAT
THE GROUND AT EACH FOOTING IS CAPABLE OF CARRYING THIS PRESSURE.

F2. ALL FOOTING EXCAVATIONS SHALL BE CLEANED OF LOOSE MATERIAL AND WATER PRIOR TO CASTING FOOTINGS.

F3. REFER TO THE FOLLOWING GEOTECHNICAL REPORTS:
i) REPORT No.: **JM/C10484** DATED: **11/02/20** BY: **ACT GEOTECHNICAL ENGINEERS PTY. LTD.**

F4. UNLESS OTHERWISE NOTED ON THE DRAWINGS, LOCATE ALL PIPES, RETAINING WALLS AND EXCAVATIONS OUTSIDE A **45°** ZONE OF INFLUENCE FROM THE BOTTOM EDGE OF THE FOOTING.

EXCAVATION MONITORING NOTES

EM1. PRIOR TO EXCAVATION AT ANY BOUNDARY, SURVEY MONITORING POINTS SHALL BE ESTABLISHED ON THE TOP OF WALL AT 5m INTERVALS AROUND THE EXCAVATION.

EM2. THE X, Y AND Z COORDINATES SHALL BE PROVIDED TO THE ENGINEER EVERY SECOND DAY DURING THE PROCESS OF THE WORKS.

REINFORCEMENT NOTES

R1. SYMBOLS ON DRAWINGS FOR GRADE AND STRENGTH OF REINFORCEMENT ARE:

- N DENOTES GRADE D500N HOT-ROLLED DEFORMED REINFORCEMENT BAR TO AS/NZS 4671:2001.
- SL DENOTES GRADE 500L WELDED WIRE REINFORCEMENT MESH TO AS/NZS 4671:2001.
- L DENOTES GRADE D500L STEEL REINFORCEMENT TO AS/NZS 4671:2001.
- R DENOTES GRADE 250R PLAIN ROUND BAR REINFORCEMENT TO AS/NZS4 671:2001.
- TM DENOTES HARD DRAWN STEEL TRENCH MESH, GRADE 500L TO AS/NZS 4671:2001.

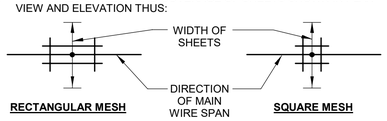
R2. BAR NOTATION GIVES THE FOLLOWING INFORMATION IN THIS ORDER:

NO OF BARS; GRADE; BAR SIZE (mm); SPACING (mm, IF REQUIRED); PLACING INFORMATION. E.G. 20N16-200 BTM.

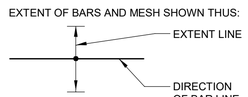
R3. MESH NOTATION GIVES THE FOLLOWING INFORMATION IN THIS ORDER:

SL OR RL SYMBOL; AS REFERENCE NUMBER IF STANDARD MESH OR SPECIAL CODE IF NON-STANDARD MESH; PLACING INFORMATION. E.G. RL918 TOP.

R4. MAIN WIRES OF MESH AND COVERAGE OF SHEETS SHOWN IN PLAN VIEW AND ELEVATION THUS:



R5. EXTENT OF BARS AND MESH SHOWN THUS:



R6. REINFORCEMENT IS REPRESENTED DIAGRAMMATICALLY AND NOT NECESSARILY IN TRUE PROJECTION.

R7. REINFORCEMENT DIMENSIONS SHALL NOT BE SCALED.

R8. ALL REINFORCEMENT IS TO BE ACCURATELY POSITIONED, ADEQUATELY SUPPORTED, AND THEN INSPECTED BY THE CONTRACT ADMINISTRATOR BEFORE ANY CONCRETE IS PLACED.

FORMWORK NOTES

FW1. FORMWORK SHALL COMPLY WITH AS3610:1995.

FW2. THE DESIGN, CONSTRUCTION AND PERFORMANCE OF THE FORMWORK, FALSEWORK AND BACK-PROPPING SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR. THE CONTRACTOR SHALL ENGAGE A STRUCTURAL ENGINEER TO CERTIFY ALL FORMWORK, FALSEWORK AND BACK-PROPPING DESIGN. THE CONTRACTOR SHALL SUBMIT PROPOSALS FOR FORMWORK, FALSEWORK AND BACK-PROPPING AND REMOVAL OF FORMWORK TO THE CONTRACT ADMINISTRATOR FOR COMMENT AT COMMENCEMENT OF JOB.

FW3. RESHORING IS NOT PERMITTED.

FW4. STRIPPING OF FORMWORK SHALL COMPLY WITH SECTION 19.6 OF AS3600:2009.

FW5. FORMED CONCRETE SURFACES SHALL HAVE FINISHES IN ACCORDANCE WITH AS3610:1995 AS SPECIFIED BY THE CONTRACT ADMINISTRATOR.

FW6. ALL HOLES LEFT BY FORM TIE BOLTS SHALL BE FILLED WITH MORTAR MATCHING THE SURFACE COLOUR OF THE FINISHED SURFACE.

FW7. IN MULTI-STOREY CONSTRUCTION PROPPING MAY BE REQUIRED TO EXTEND A NUMBER OF LEVELS BELOW THE FLOOR BEING CAST. REMOVAL OF PROPS TO AVOID DISTRESS TO PREVIOUSLY CAST FLOORS SHALL BE PLANNED AND PROGRAMMED. RESHORING OR BACK-PROPPING PROPOSALS SHALL BE SUBMITTED FOR APPROVAL BY THE CONTRACT ADMINISTRATOR.

FW8. FORMWORK MAY BE STRIPPED AFTER 7 DAYS, BUT BEAMS AND SLABS MUST REMAIN PROPPED FOR 21 DAYS. FOR MULTISTOREY BUILDINGS, SEE SPECIFIC BACK-PROPPING REQUIREMENTS.

LOADING NOTES

L1. ALL LOADINGS HAVE BEEN ASSESSED IN ACCORDANCE WITH AS1170.0:2002 AND THE NATIONAL CONSTRUCTION CODE (NCC)

L2. THE STRUCTURAL COMPONENTS IN THESE DRAWINGS HAVE BEEN DESIGNED FOR THE FOLLOWING LOADINGS:

FLOOR USAGE / DESCRIPTION	PERMANENT ACTIONS	IMPOSED ACTIONS	
	SUPERIMPOSED DEAD LOAD (kPa)	UNIFORM LIVE LOAD (kPa)	CONCENTRATED ACTIONS (kN)
T44 BRIDGE LOADING		**12.5kN/m UDL**	**96kN**
SOIL LOADING	**20kN/m3**		

LEGEND/ABBREVIATIONS

ABBREVIATION	DESCRIPTION
HORIZ	HORIZONTAL
VERT	VERTICAL
CENTRAL	CENTRALLY PLACED
CRS	CENTRES
T or TOP	TOP or TOP FACE
B or BTM	BOTTOM or BOTTOM FACE
T&B	TOP & BOTTOM
NF	NEAR FACE
FF	FAR FACE
INTF	INTERNAL FACE
EXTF	EXTERNAL FACE
EF	EACH FACE
EW	EACH WAY
EQ	EQUAL
NSOP	NOT SHOWN ON PLAN
NSOE	NOT SHOWN ON ELEVATION
UNO	UNLESS NOTED OTHERWISE
TYP	TYPICAL
CL	CENTRE LINE
PL	PLATE
SV	SIZE VARIES
STG	STAGGERED
N/S	NEAR SIDE
F/S	FAR SIDE
B/S	BOTH SIDES
U/S	UNDER SIDE
L	LENGTH/LONG
W	WIDTH/WIDE
H	HEIGHT/HIGH
D	DEPTH/DEEP
NOM	NOMINAL
REQ'D	REQUIRED
REINF	REINFORCEMENT
OPP	OPPOSITE
SIM	SIMILAR
GA	GENERAL ARRANGEMENT
PT	POST TENSION
DRG	DRAWING
NTS	NOT TO SCALE
LV	LENGTH VARIES
ABR	ALTERNATE BAR REVERSED
MAX	MAXIMUM
MIN	MINIMUM
CONT	CONTINUOUS

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AECOM

PROJECT

Bounty Street Bridge
Detailed Design
NORFOLK ISLAND

CLIENT

DEPARTMENT OF INFRASTRUCTURE, TRANSPORT, REGIONAL DEVELOPMENT & COMMUNICATIONS
Prepared for:

CONSULTANT

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A.B.N. 20 093 846 925
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100% DESIGN

PROJECT MANAGEMENT INITIALS

S 47F

DESIGNER	CHECKED	APPROVED

ISSUE/REVISION

I/R	DATE	DESCRIPTION
B	06.10.2020	100% DESIGN
A	10.08.2020	30% DESIGN

KEY PLAN

PROJECT NUMBER

60615424

SHEET TITLE

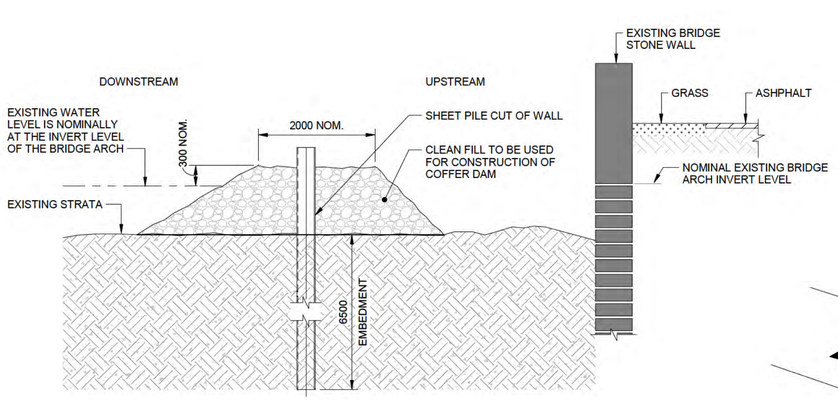
BOUNTY STREET BRIDGE
SUPPORT STRUCTURE
GENERAL NOTES - SHEET 1

SHEET NUMBER

60615424-DRG-311

Last Saved: 6/10/2020 2:42:26 PM
Filename: C:\Users\gamh\Documents\60615424-MOD-ST-CENTRAL_R19_Heru.Gani.rvt

ISO A1 594mm x 841mm



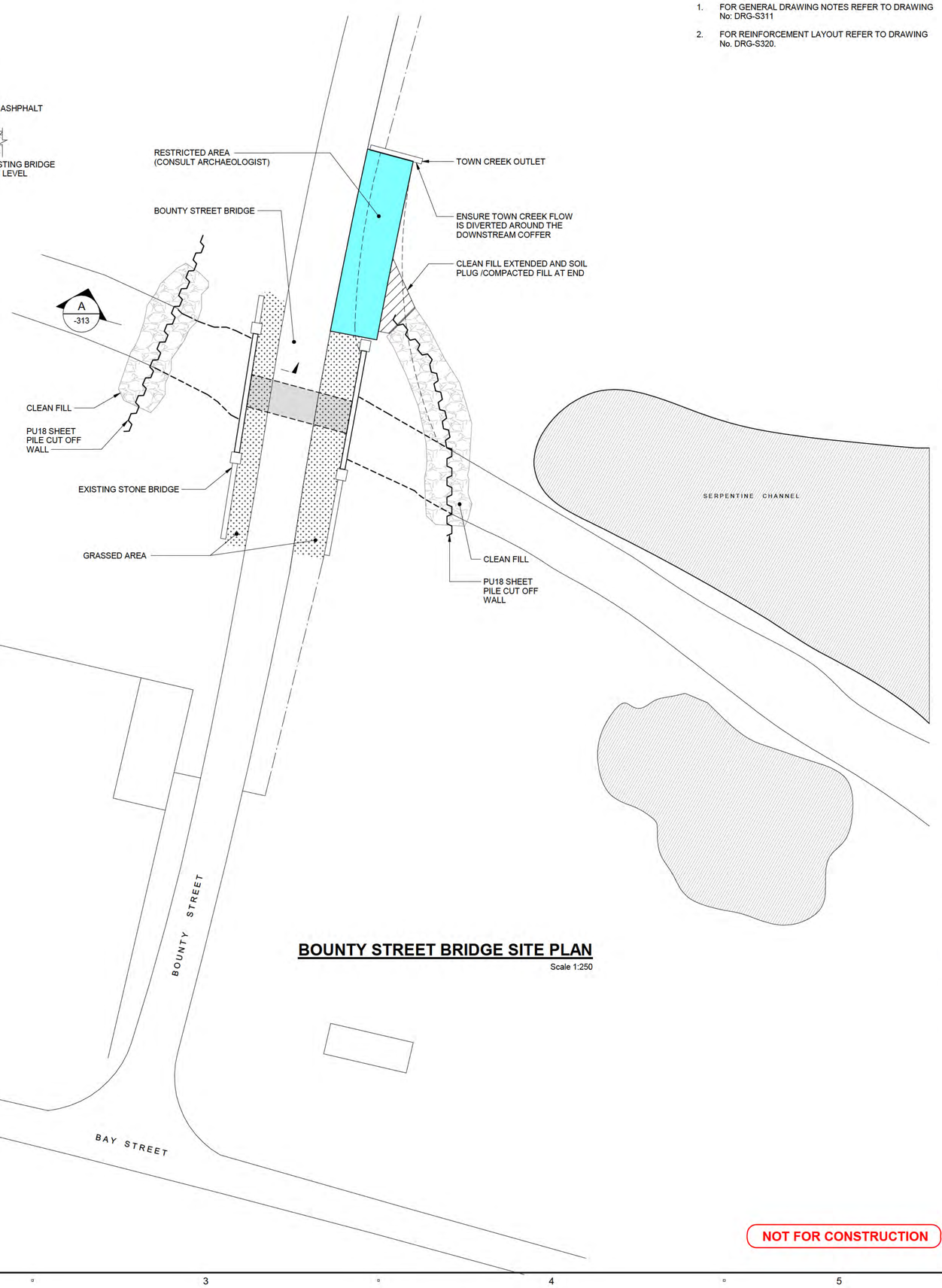
TYPICAL COFFER DAM DETAIL

A -313 SECTION
Scale: 1 : 50

COFFER DAM CONSTRUCTION NOTES:

1. ONLY CLEAN FILL IS TO BE PLACED IN THE WATERWAY.
2. THE COFFER DAM LOCATIONS ARE INDICATIVE ONLY. CONTRACTOR IS TO MAKE THEIR OWN ASSESSMENT AS TO SPACE REQUIRED ADJACENT TO THE BRIDGE TO UNDERTAKE THE WORKS.
3. CONTRACTOR TO WORK WITH ARCHAEOLOGIST TO DETERMINE SUBTERRANEAN ARTEFACT LOCATIONS AND TOWN CREEK DIVERSION
4. THE CONTRACTOR IS TO SUBMIT A DIMENSIONED DRAWING SHOWING THE PROPOSED COFFER DAMS SETOUT FOR APPROVAL PRIOR TO CONSTRUCTION.
5. THE CONTRACTOR IS TO ALLOW FOR ANY DIVERSION PUMPS NECESSARY TO DIVERT WATER FLOWS AROUND THE SITE FOR THE DURATION OF THE WORKS.
6. THE CONTRACTOR IS TO ALLOW FOR VIBRATION MONITORING AROUND THE BRIDGE
7. SHEET PILING INSTALLATION IS TO BE UNDERTAKEN IN A WAY THAT DOES NOT DAMAGE THE BRIDGE.
8. SHEET PILING AND COFFER DAMS ARE TO BE REMOVED AT COMPLETION AND STREAM PROFILE RETURNED TO EXISTING CONDITIONS.
9. THE CONTRACTOR IS TO MAKE GOOD ANY DISTURBED AREAS AT COMPLETION AND GRASS TO MATCH EXISTING.
10. THE CONTRACTOR IS RESPONSIBLE FOR OBTAINING ANY REQUIRED AUTHORITY APPROVALS AND FOR ANY WATER TESTING ETC. THAT MAY BE REQUIRED BY THEIR SWMS

NOTES
CONTRACTOR TO SUBMIT DETAILED WORK METHODOLGY FOR REVIEW PRIOR TO COMMENCING WORK.



BOUNTY STREET BRIDGE SITE PLAN
Scale 1:250

0 6250 12500 mm
1:250

0 1250 2500 mm
1:50

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PROJECT

Bounty Street Bridge Detailed Design NORFOLK ISLAND

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Prepared for:

CONSULTANT

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100% DESIGN

PROJECT MANAGEMENT INITIALS

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DESIGNER	CHECKED	APPROVED

ISSUE/REVISION

I/R	DATE	DESCRIPTION
B	06.10.2020	100% DESIGN
A	10.08.2020	30% DESIGN

KEY PLAN

PROJECT NUMBER
60615424

SHEET TITLE
BOUNTY STREET BRIDGE SITE PLAN AND COFFER DAM DETAIL

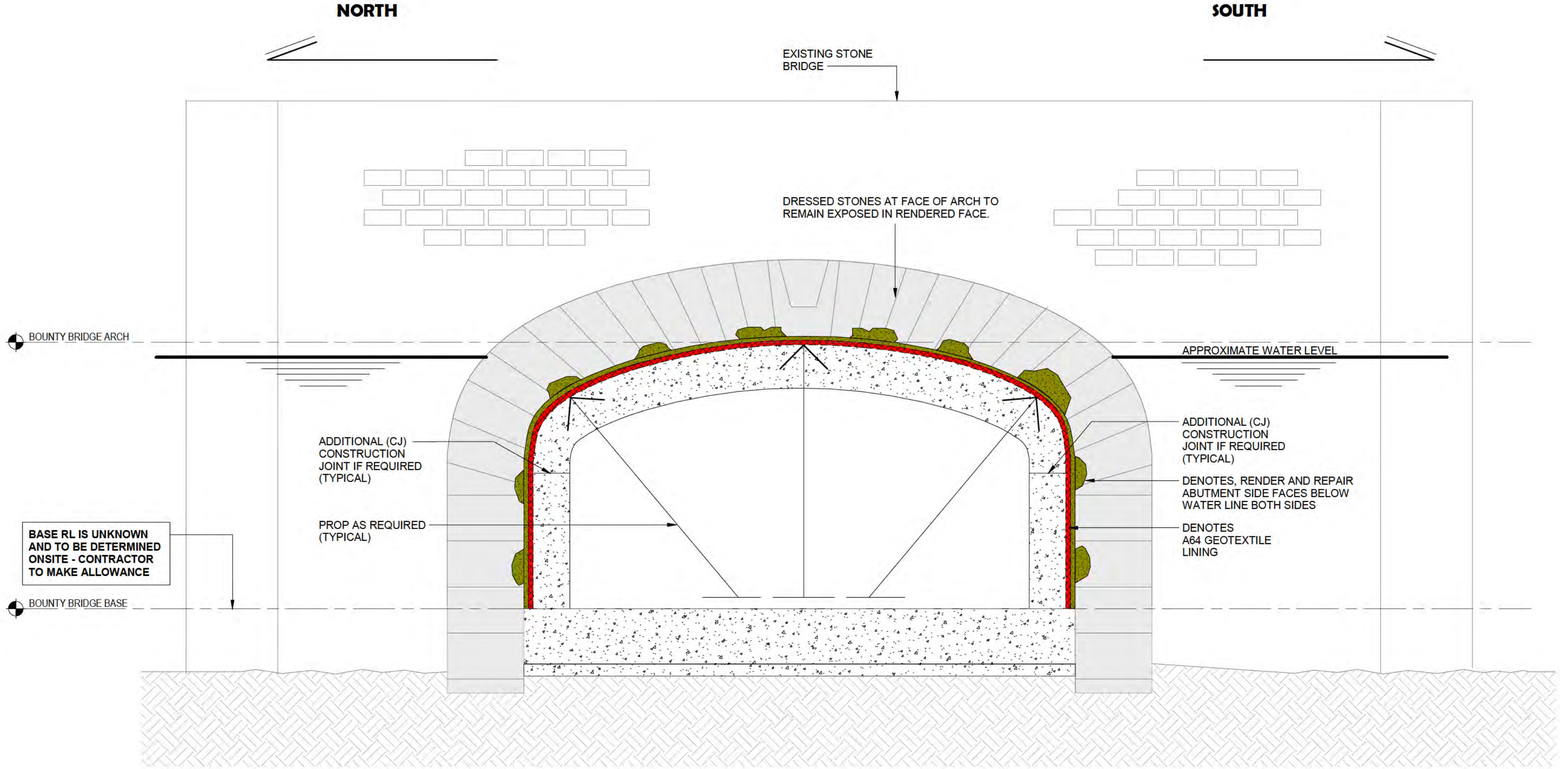
SHEET NUMBER
60615424-DRG-313

Last Saved: 6/10/2020 2:42:27 PM
Filename: C:\Users\ganh\Documents\60615424-MOD-ST-CENTRAL_R19_HeruGani.rvt

ISO A1 594mm x 841mm

NOTE:

1. FOR GENERAL DRAWING NOTES REFER TO DRAWING No: DRG-S311
2. FOR REINFORCEMENT LAYOUT REFER TO DRAWING No. DRG-S320.



TYPICAL BRIDGE LIME MORTAR DETAIL

SCALE 1:20

POINT AND RENDER ARCH SOFFIT & SIDE WALLS OF BRIDGE BELOW WATER LINE

LIME MORTAR NOTES

- CONTRACTOR TO ENSURE ADEQUATE PROPPING OF THE EXISTING ARCH FOR SAFETY BEFORE RENDER WORK COMMENCES.
- EXPOSED FACES AT EITHER END OF THE BRIDGE TO HAVE GAPS POINTED WITH LIME BASED RENDER SOURCED BY CONTACTING THE LOCAL KAVHA WORKS CREW REPRESENTATIVE TO ALLOW FEATURE STONES TO REMAIN VISIBLE.
- AREAS WITH LARGE VOIDS ARE TO BE INFILLED WITH LOCAL CALCARENITE STONE AND THE DESIGN LIME MORTAR MIX APPLICABLE TO THE SAND USED.
- SIDE WALLS AND ARCH SOFFIT TO HAVE 20MM THICK COVER ABOVE REINSTATED STONE LEVEL.
- REMOVE ANY LOOSE OR DRUMMY MATERIAL. EXISTING RENDER THAT IS SOUND CAN REMAIN.
- PROPERLY MATURED (AT LEAST 3 MONTHS) SAND-SLAKED LIME OR LIME PUTTY TO BE USED (HYDRATED LIME IS NOT APPROVED).
- TO BE THOROUGHLY MIXED USING A METHOD THAT FORCES THE MIX TOGETHER E.G. FORCED-ACTION SCREED MIXER.
- MORTAR MIX RATIO FOR IMPORTED (SHARP) SAND 1 PART LIME : 2.5 PARTS OF WASHED, SHARP, WELL GRADED SAND FREE OF IMPURITIES : 0.1 PARTS GROUND GRANULATED BLAST FURNACE SLAG (GGBFS).
- MORTAR MIX RATIO FOR LOCAL (BEACH WORN) SAND 1 PART LIME : 2 PARTS OF WASHED, WELL GRADED SAND FREE OF IMPURITIES : 0.1 PARTS GROUND GRANULATED BLAST FURNACE SLAG (GGBFS).
- MORTAR TO BE APPLIED BETWEEN 5°C AND 30°C.
- BACKING RODS ARE NOT TO BE USED.
- PRE WET AREA TO BE POINTED WITH LIME WATER FOR 3 DAYS BEFORE WORK COMMENCES TO PREVENT SUCTION BY THE SUBSTRATE.
- MORTAR TO BE APPLIED IN LAYERS UP TO 20MM THICK ALLOWING 3 DAYS MOIST CURING BETWEEN CONSECUTIVE LAYERS.
- MOIST CURE FOR 7 DAYS IMMEDIATELY AFTER POINTING HAS BEEN COMPLETED, FOLLOWED BY 7 DAYS CONTROLLED DRYING (FORMWORK, PROPPING, GEOTEXTILE AND REINFORCEMENT FOR THE CONCRETE ARCH CAN BE INSTALLED DURING THIS PERIOD).
- THE CONCRETE ARCH CAN BE POURED AFTER 14 DAYS ENSURING SURFACES ARE THOROUGHLY WETTED TO PREVENT SUCTION BY THE SUBSTRATE. IF THE ARCH HAS NOT BEEN POURED, MOIST CURING MUST BE MAINTAINED UNTIL EITHER THE ARCH IS POURED OR 7 DAYS HAS ELAPSED.
- PROTECT POINTED WORK FROM WIND AND SUN TO AVOID RAPID DRYING FOR A MINIMUM OF 4 WEEKS AFTER PLACEMENT.

GEOTEXTILE ARCH LINING NOTES

- BIDIM A64 OR APPROVED EQUIVALENT GEOTEXTILE ATTACHED TO THE UNDERSIDE OF THE POINTED EXISTING ARCH WITH NON-CORROSIVE FIXINGS ALLOWING 300MM MIN. LAP BETWEEN ADJACENT EDGES.
- STORAGE AND HANDLING OF GEOTEXTILE AS PER MANUFACTURER RECOMMENDATIONS.

0 500 1000 mm
1:20

NOT FOR CONSTRUCTION

AECOM

PROJECT

Bounty Street Bridge
Detailed Design
NORFOLK ISLAND

CLIENT

DEPARTMENT OF INFRASTRUCTURE, TRANSPORT, REGIONAL DEVELOPMENT & COMMUNICATIONS
Prepared for:

CONSULTANT

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100% DESIGN

PROJECT MANAGEMENT INITIALS

DESIGNER	CHECKED	APPROVED
s 47F		

ISSUE/REVISION

I/R	DATE	DESCRIPTION
B	06.10.2020	100% DESIGN
A	10.08.2020	30% DESIGN

KEY PLAN

PROJECT NUMBER

60615424

SHEET TITLE

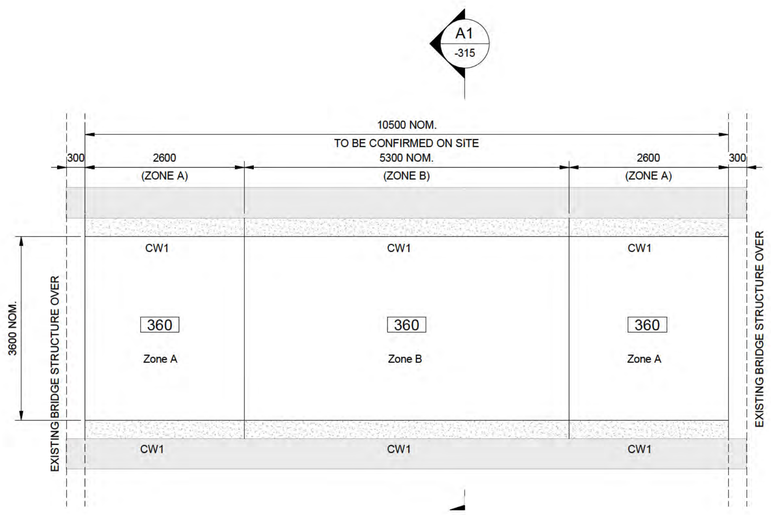
BOUNTY STREET BRIDGE SUPPORT TYPICAL BRIDGE LIME MORTAR DETAIL

SHEET NUMBER

60615424-DRG-314

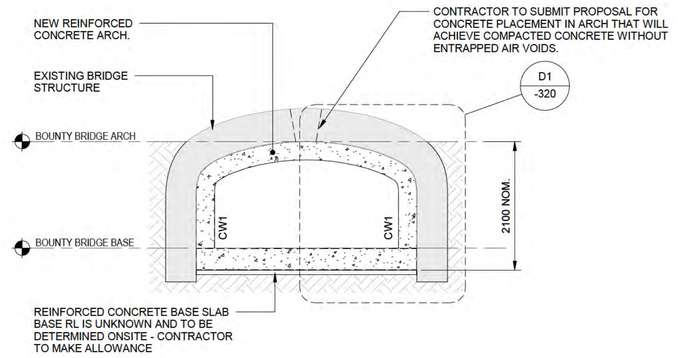
Last Saved: 6/10/2020 2:42:27 PM
Filename: C:\Users\gianh\Documents\60615424-MOD-ST-CENTRAL_R19_HeruGani.rvt

ISO A1 594mm x 841mm



GENERAL ARRANGEMENT PLAN - BOUNTY STREET BRIDGE BASE

Scale: 1 : 50



A1 -315 | **SECTION** | Scale: 1 : 50

NOTE:

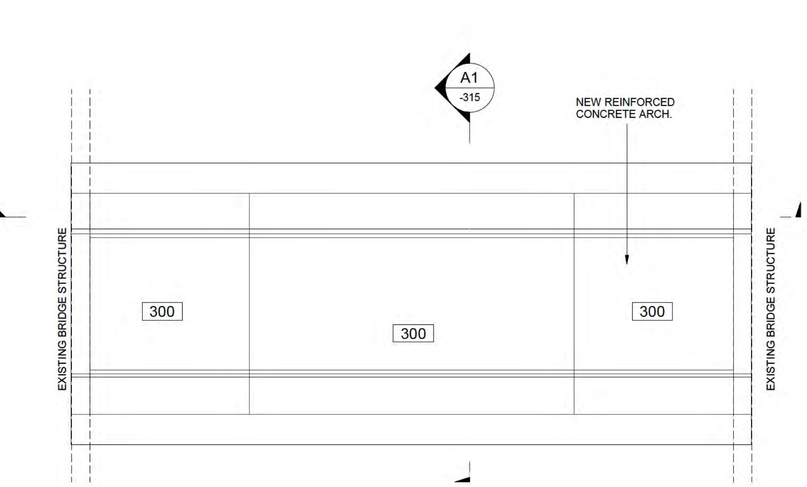
1. FOR GENERAL DRAWING NOTES REFER TO DRAWING No: DRG-S311
2. FOR REINFORCEMENT LAYOUT REFER TO DRAWING No. DRG-S320.

ADDITIONAL CONCRETE NOTES

- 80mm THICK 15MPa BLINDING LAYER BENEATH BASE SLAB
- MIN. COVER 70mm UNO
- 360mm THK BOTTOM SLAB
- 300mm THK ARCH AND WALL
- 50MPa F'c
- TYPE GP CEMENT MIN. CONTENT 420kg/m^3 MAX. CONTENT 500kg/m^3
- CEMENT MIX 30% GP / 70% SLAG
- MAX. WATER-CEMENT RATIO 0.4
- MIN. MOIST CURE FOR 14 DAYS
- CARE TO BE TAKEN IN PLACEMENT AND COMPACTION
- A64 GEOTEXTILE OR APPROVED EQUIVALENT TO BE FIXED TO POINTED SOFFIT PRIOR TO POURING ARCH.

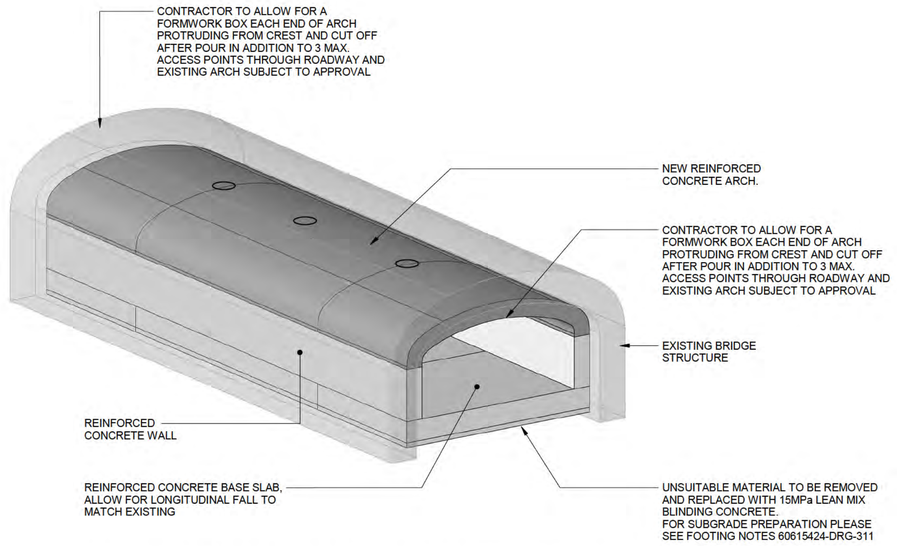
RC WALL SCHEDULE

MARK	THICKNESS (mm)	REINFORCEMENT	COMMENTS
CW1	300	REFER TO DRAWING 60615424-DRG-320	



GENERAL ARRANGEMENT PLAN - BOUNTY STREET BRIDGE ARCH

Scale: 1 : 50



BOUNTY STREET BRIDGE SUPPORT STRUCTURE

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KEY PLAN

PROJECT NUMBER

60615424

SHEET TITLE

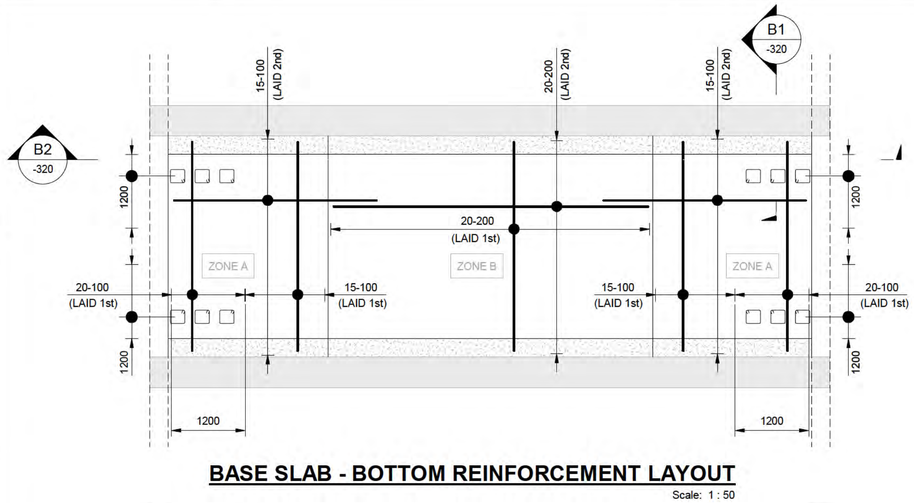
BOUNTY STREET BRIDGE
SUPPORT STRUCTURE
GENERAL ARRANGEMENT PLAN

SHEET NUMBER

60615424-DRG-315

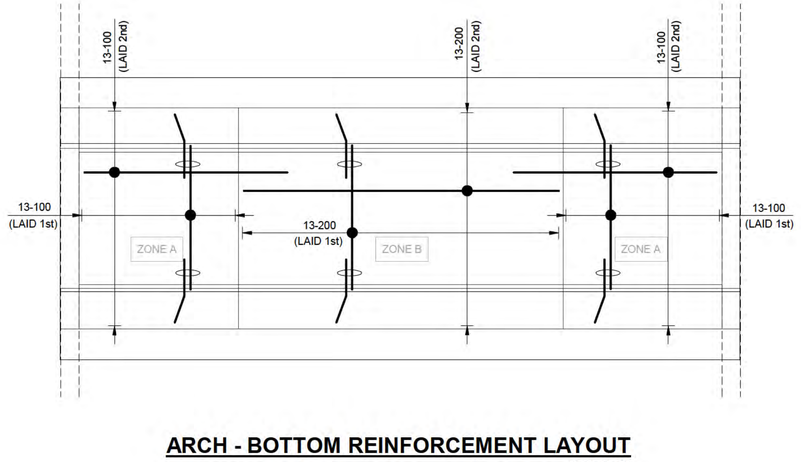
NOT FOR CONSTRUCTION

ISO A1 594mm x 841mm



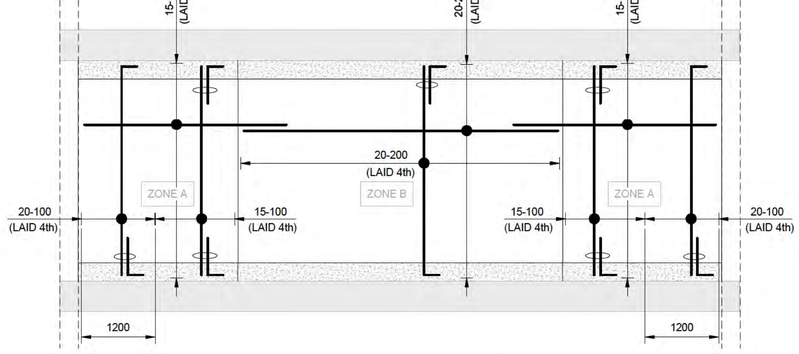
BASE SLAB - BOTTOM REINFORCEMENT LAYOUT

Scale: 1 : 50



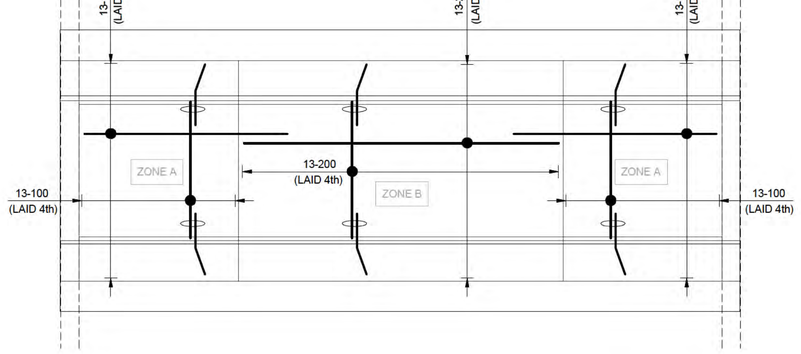
ARCH - BOTTOM REINFORCEMENT LAYOUT

Scale: 1 : 50



BASE SLAB - TOP REINFORCEMENT LAYOUT

Scale: 1 : 50



ARCH - TOP REINFORCEMENT LAYOUT

Scale: 1 : 50

NOTE:

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2. FOR REINFORCEMENT LAYOUT REFER TO DRAWING No. DRG-S320.

ADDITIONAL CONCRETE NOTES

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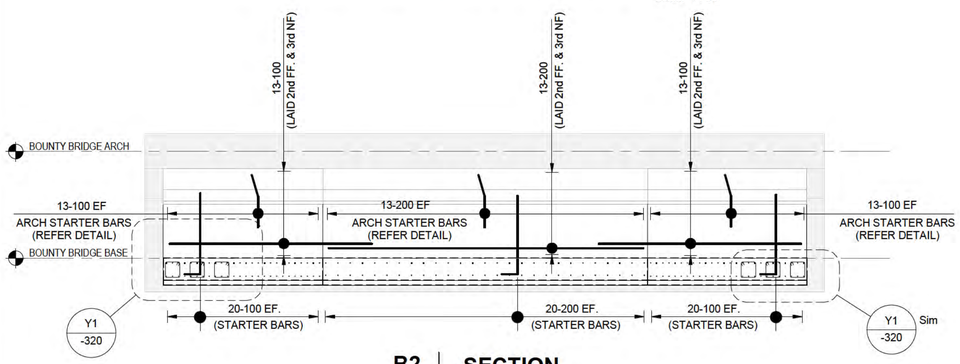
- MIN. COVER 70mm UNO
- 360mm THK BOTTOM SLAB
- 300mm THK ARCH AND WALL
- 50MPa F'c
- TYPE GP CEMENT MIN. CONTENT 420kg/m^3 MAX. CONTENT 500kg/m^3
- CEMENT MIX 30% GP / 70% SLAG
- MAX. WATER-CEMENT RATIO 0.4
- MIN. MOIST CURE FOR 14 DAYS
- CARE TO BE TAKEN IN PLACEMENT AND COMPACTION
- A64 GEOTEXTILE OR APPROVED EQUIVALENT TO BE FIXED TO POINTED SOFFIT PRIOR TO POURING ARCH.

GFRP SPECIFIC NOTES

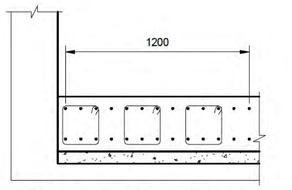
- TUF-BAR 60 OR APPROVED EQUIVALENT
- INSTALL IN STRICT ACCORDANCE WITH MANUFACTURER SPECIFICATIONS
- PROTECT GFRP BARS AGAINST:
  - UV RADIATION
  - HIGH TEMPARATURE
  - DAMAGING CHEMICALS
- LIFT BUNDLES OF BARS WITH CARE
- DO NOT SHEAR BARS WHEN CUTTING
- STORE BARS IN A CLEAN ENVIRONMENT
- CABLE TIES TO BE USED FOR FIXING
- PLASTIC BAR CHAIRS TO BE USED AT 600 MAX CTS
- REINFORCEMENT TIED DOWN TO PREVENT FLOATATION
- CARE MUST BE TAKEN WHEN VIBRATING TO AVOID DAMAGE TO GFRP
- BENDS/HOOKS MAY NOT BE FABRICATED ONSITE APART FROM FLEX CURVE REINFORCEMENT
- LAP SPLICES ONLY
- OIL, GREASE AND DIRT TO BE REMOVED FROM BARS PRIOR TO PLACEMENT

GFRP REINFORCEMENT LAP LENGTHS

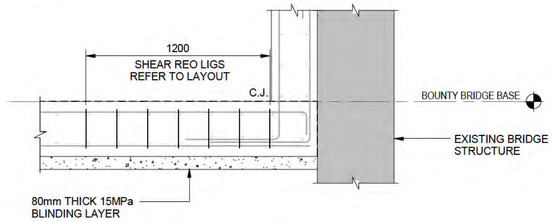
BAR SIZE	LAP LENGTH (mm)
13	500
15	700
20	800



B2 | SECTION -315 Scale: 1 : 50



Y1 | DETAIL -320 Scale: 1 : 20



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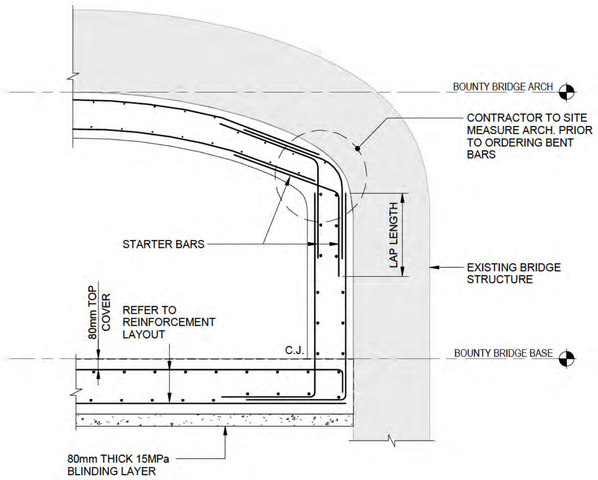

D1 | DETAIL -315 Scale: 1 : 20

0 500 1000 mm 1:20

0 1250 2500 mm 1:50

NOT FOR CONSTRUCTION

AECOM

PROJECT

Bounty Street Bridge
Detailed Design
NORFOLK ISLAND

CLIENT

DEPARTMENT OF INFRASTRUCTURE, TRANSPORT, REGIONAL DEVELOPMENT & COMMUNICATIONS
Prepared for:

CONSULTANT

AECOM Australia Pty. Ltd.
A.B.N. 20 093 846 925
www.aecom.com

100% DESIGN

PROJECT MANAGEMENT INITIALS

s.47F

DESIGNER	CHECKED	APPROVED

ISSUE/REVISION

I/R	DATE	DESCRIPTION
B	06.10.2020	100% DESIGN
A	10.08.2020	30% DESIGN

KEY PLAN

PROJECT NUMBER

60615424

SHEET TITLE

BOUNTY STREET BRIDGE
SUPPORT STRUCTURE
REINFORCEMENT LAYOUT

SHEET NUMBER

60615424-DRG-320

Last Saved: 6/10/2020 2:42:32 PM
Filename: C:\Users\ganih\Documents\60615424-MOD-ST-CENTRAL_R19_Heru.Gani.rvt

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5000 Channel Highway, Gordon, Tas. 7150 • P.O. Box 79, Middleton, Tas. 71
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PREPARED	s 47F	21/11/20	DETAILS NORFOLK ISLAND	PAGE 2 of
CHECKED		/ /	EMILY'S BAY BRIDGE	JOB No. 2020/

SITE: SAND, UNKNOWN IF FILLED OVER TIME TO ROAD LEVEL.

BRIDGE: CHANNEL VIEWED, ROCK WALLS PARTLY UNDERMINED. UNDERSIDE OF BRIDGE ARCH INSPECTED. ROCKS APPEAR TO BE QUITE IRREGULAR IN SHAPE, DETERIORATED, AND OFTEN WITH LARGE GAPS BETWEEN ROCKS.

IT IS NOT OBVIOUS HOW FINE MATERIAL OVERLYING THE ARCH IS PREVENTED FROM FALLING THROUGH THE GAPS IN THE ROCKS.

PROPOSED SOLUTION: PROVIDE A CONCRETE SLAB SPANNING THE CULVERT AND THE EXISTING ARCH BRIDGE OVER THE OPEN CULVERT.

THE SLAB IS TO BEAR EITHER SIDE OF THE BRIDGE.

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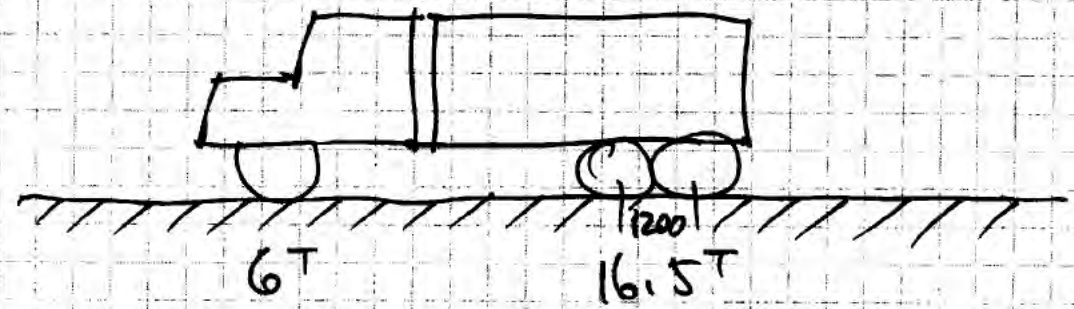
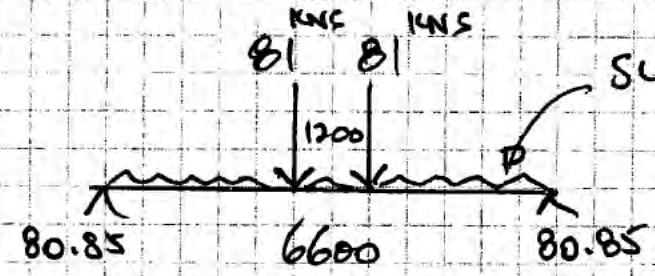
CHECKED		/ /	EMILY'S BAY BRIDGE.	JOB No. 2020/328.

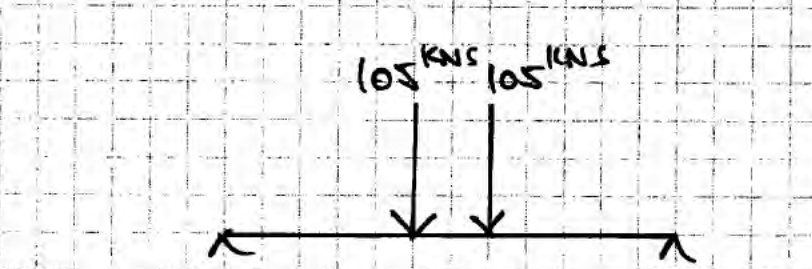
NOTE: LOADS ARE NOT BRIDGE DESIGN LOADS

ASSUME STANDARD NSW VEHICLE (AUSTROAD)

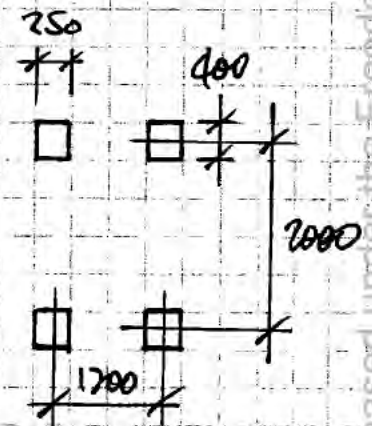




APPLY IMPACT FACTOR = 1.3



LL. 105 KNS
DL. ~81 KNS
186 KNS



WHEEL LOAD LAYOUT

ASSUME 4M WIDE SLAB.
250mm THICK.

$$UBM_{SS} = 1.2(0.85 \times 4 \times 24.5)\,6.6^2/8 + 1.5(105 \times 2.7)$$ (INCLUDES IMPACT)

$$= 1.2 \times 133.40 + 1.5 \times 284.073$$

$$= 160.08 + 426.11$$

$$= 586.193 \text{ KN.M.}$$

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PREPARED	s 47F	21/11/20	DETAILS NORFOLK ISLAND	PAGE of
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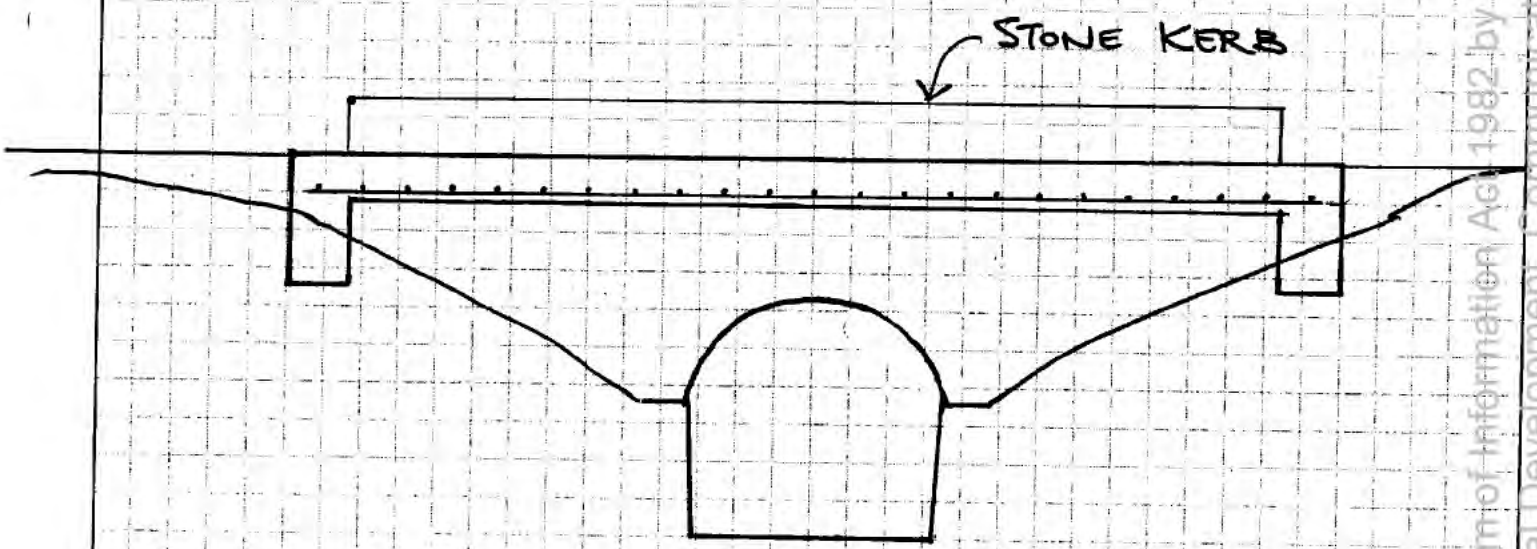

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PREPARED	s 47F	21 / 11 / 20	DETAILS NORFOLK ISLAND	PAGE of
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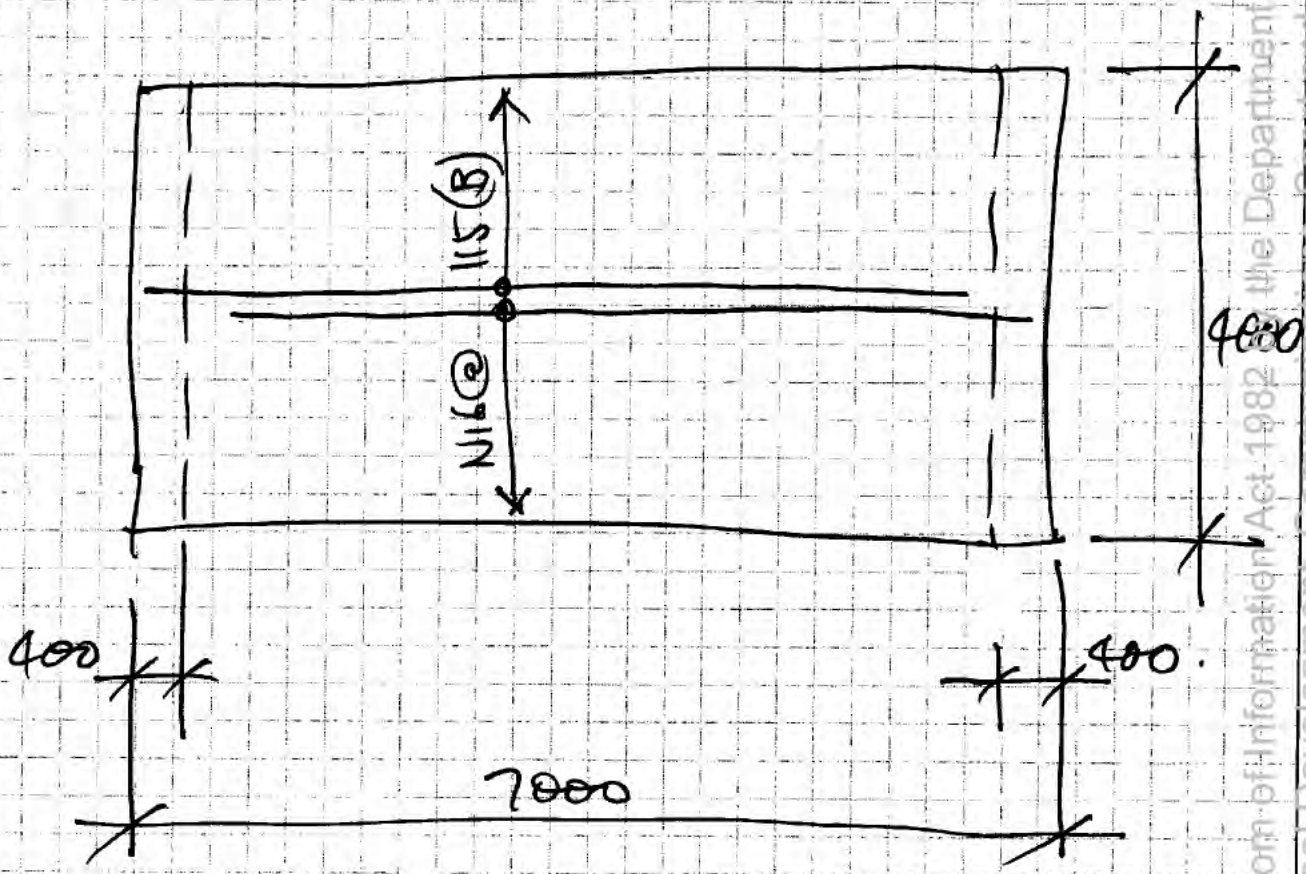

BRIDGE SLAB PLAN.

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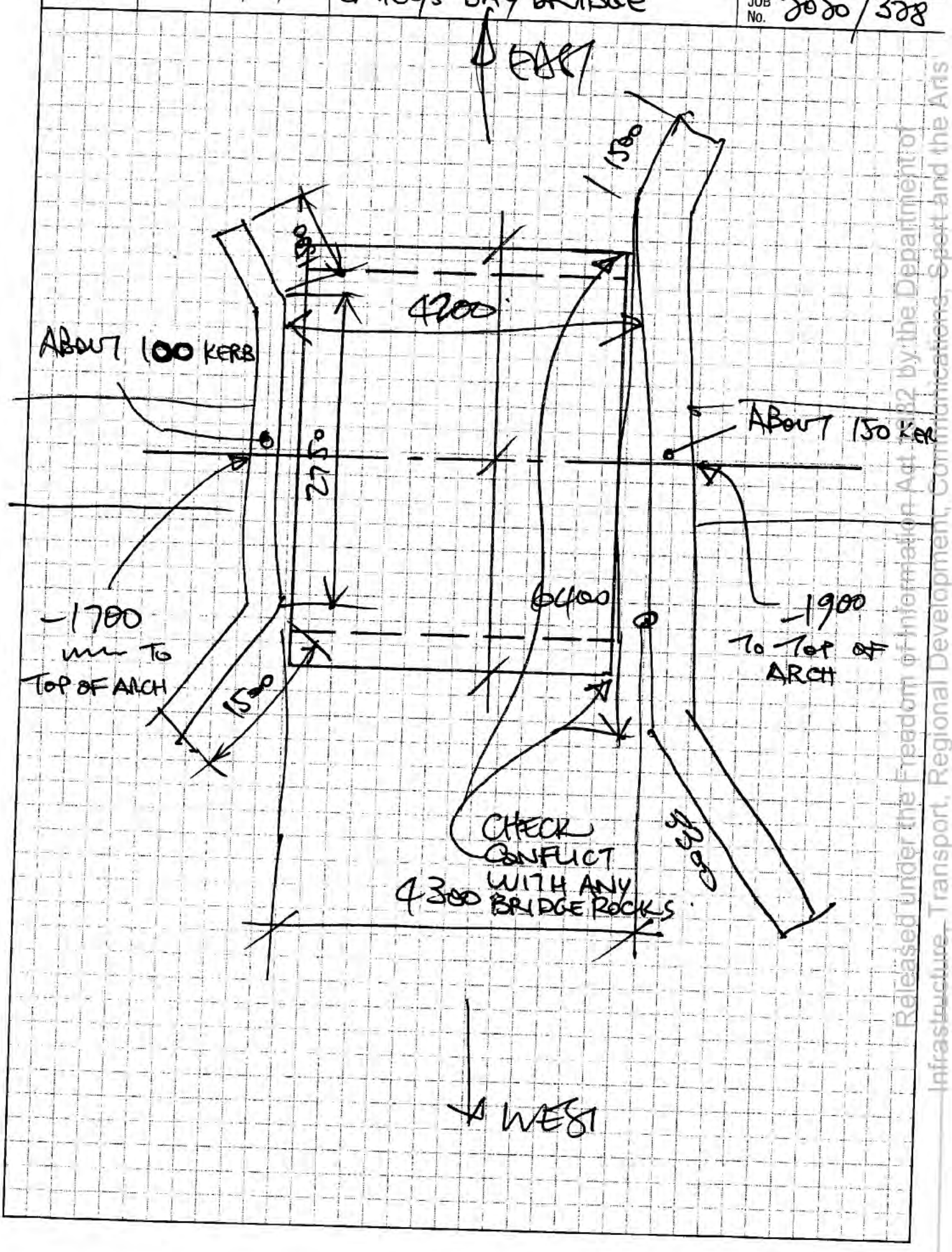

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PREPARED	s 47F	21/11/20	DETAILS NORFOLK ISLAND	PAGE of
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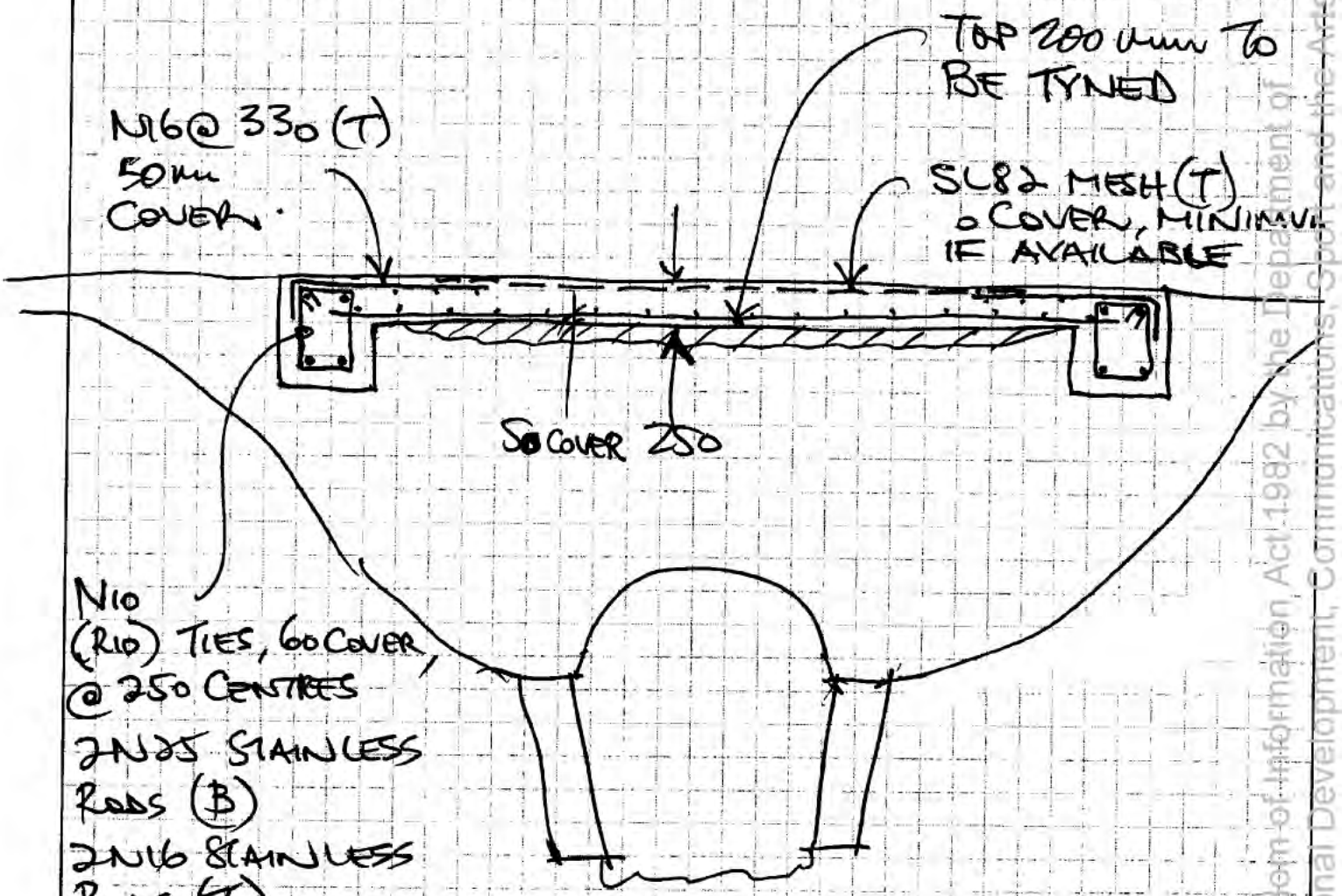

CHECK: $d = 192\text{mm}$ i.e. $\frac{\text{SPAN}}{d} = \frac{6600}{192} = 34.38$

$D = 250\text{mm}$ i.e. $\frac{\text{SPAN}}{D} = \frac{6600}{250} = 26.40$

'ANCON' STAINLESS STEEL, RIBBED, IS AT LEAST 500 MPa YIELD STRENGTH. (WEBSITE).

* CHECK N.I. SUPPLIER *

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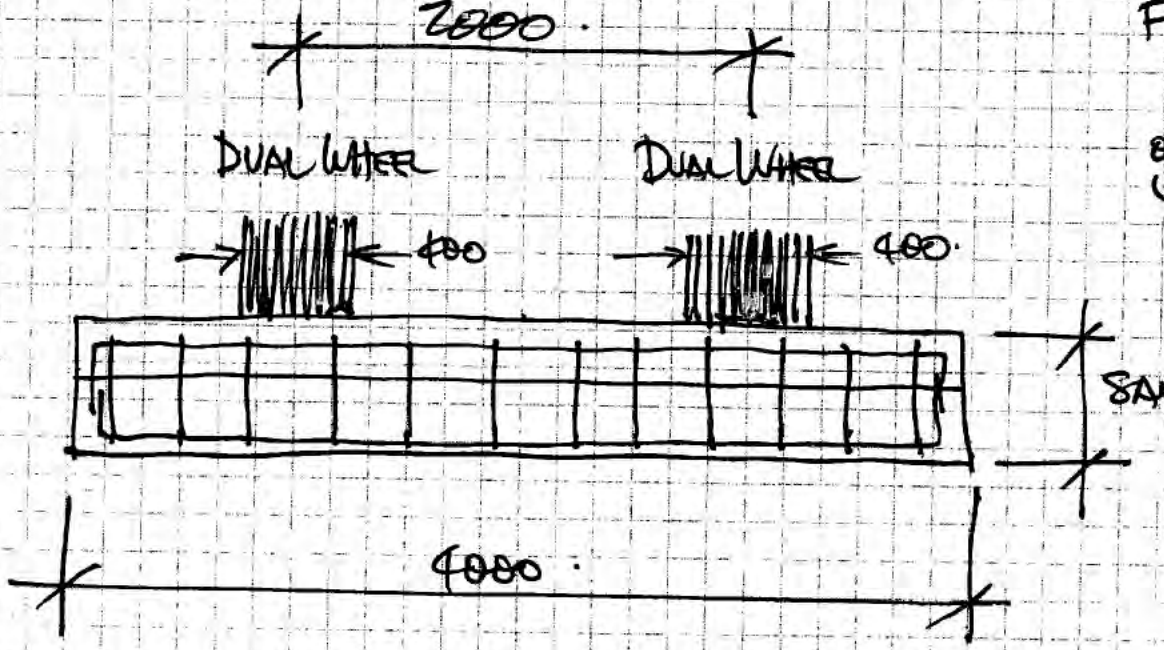
PREPARED	s 47F	21/11/20	DETAILS NORFOLK ISLAND	PAGE of
CHECKED		/ /	EMILY'S BAY BRIDGE	JOB No. 2020/338

CHECK BEARING UNDER END BEAMS.

BEARING AREA = 4 x 0.4
= 1.6 M^2

ASSUME 125 kPa BEARING

BEARING CAPACITY = 1.6 x 125 kPa.
= 200 kNs > ACTUAL LOAD = 186 kNs INCLUDING IMPACT FACTOR 1.30. ON LIVE LOAD



N16 @ 200 → ULTIMATE CAPACITY = 90.98 x 4
= 363.92 kN.M.

N16 @ 100 → ULTIMATE CAPACITY = 172 x 4
= 688 kN.M.

∴ N16 @ 115 → ULTIMATE CAPACITY = 607 kN.M.

∴ N16 @ 125 → ULTIMATE CAPACITY = 564 kN.M.

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1st December, 2020
Project No.2020/328

s 22(1)(a)(ii)
Infrastructure,
Norfolk Island.
s 22(1)(a)(ii) @infrastructure.gov.au

Dear Sir,

RE: EMILYS BAY BRIDGE, NORFOLK ISLAND – VEHICULAR LOADING REPORT.

The writer viewed the Emilys Bay bridge last week and noted the longitudinal cracking in the bitumen paving over the bridge.

The northern side stone wall was inspected and the cracks noted and photographed. It was during this inspection that the underside of the bridge arch was inspected and the poor nature of the original rocks forming the arch was noted and the large gaps between the rocks, allowing fines to fall out of the soils above the arch. The best arch rocks were at the southern end which had apparently been reconstructed in the past due to an earlier failure.

It should be noted that the cracking did not appear to be very fresh but, in the writer's opinion, rather the result of a gradual loss of fine material under the pavement due to a combination of wheel loads and vibration from traffic.

There is no potholing or holes visible in the bitumen pavement.

The proposed reinforced concrete remedial slab will transfer the loads to either side of the bridge and, by tyning the subgrade over the bridge prior to the pouring of the slab, remove any direct traffic loads and vibration onto the stone arch bridge in the future.

INTERIM LOAD LIMITS:

It is considered a prudent risk management step to limit loads to normal passenger vehicles, i.e. 2.5 TONNES load limit, in conjunction with a 5KPH speed limit.

This will allow utilities and normal large SUV's to use the road and bridge to access Emilys Bay.

In conjunction with the load limit, the pavement over the bridge should be inspected daily and any change in the cracking or any other indications be immediately notified for further directions.

Please advise if you require any additional information at this stage.

Yours faithfully,
s 47F

AECOM Imagine it. Delivered.

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ABN 20 093 846 925

Memorandum

To	s 22(1)(a)(ii)	Page	17
CC	s 47F		
Subject	Assessment of leaky weir options at Chimney Hill and Pier Street Bridge Location		
From	s 47F		
File/Ref No.		Date	19-Mar-2021

1.0 Overview

The Department of Infrastructure, Transport, Regional Development, and Communications (DITRDC) has commissioned AECOM to deliver an additional high-level assessment of weir options at Chimney Hill and Pier Street Bridge Location, as nominated in Brendon Christian's email dated 19th February 2021. The key outcomes sought from the Department for these additional options, as nominated by Elizabeth Coonan on 3rd March 2021 are:

- confirmation of weir heights and inundation extents for weir options at Chimney Hill and upstream of Pier Street Bridge;
- confirmation of weir extents to ensure weirs do not extend over surrounding roadways; and
- provision of cost estimates for the weir options noting the Department construction budget is limited to $250,000.

2.0 Civil Assessment

AECOM undertook a desktop assessment to validate the DITRDC inundation extents using the weir elevations and locations as nominated by DITRDC. Four weir locations and elevations were investigated:

Chimney Hill weirs at:

- RL 3.45 m AHD
- RL3.95 m AHD

Pier Street Bridge weirs at:

- RL 4.1 m AHD
- RL 4.6 m AHD

The desktop assessment was completed using publicly available CSIRO (2019) LiDAR topographical information, with contour increments of 1m. The data is relatively coarse and levels between the LiDAR contour range have been interpolated using 12d Model software.

DITRDC provided images of anticipated inundation extents in their email from 19th February 2021. These images (Figures 1, 3, 5 and 7) are copied below for reference. Based on the AECOM desktop assessment, the DITRDC inundation extents using these weir locations and levels, align with AECOM findings. This is represented in the following images (Figures 2, 4, 6 and 8). The other figures and images referenced refer to the Option Analysis Report from AECOM dated 24th February 2021 (the Report).

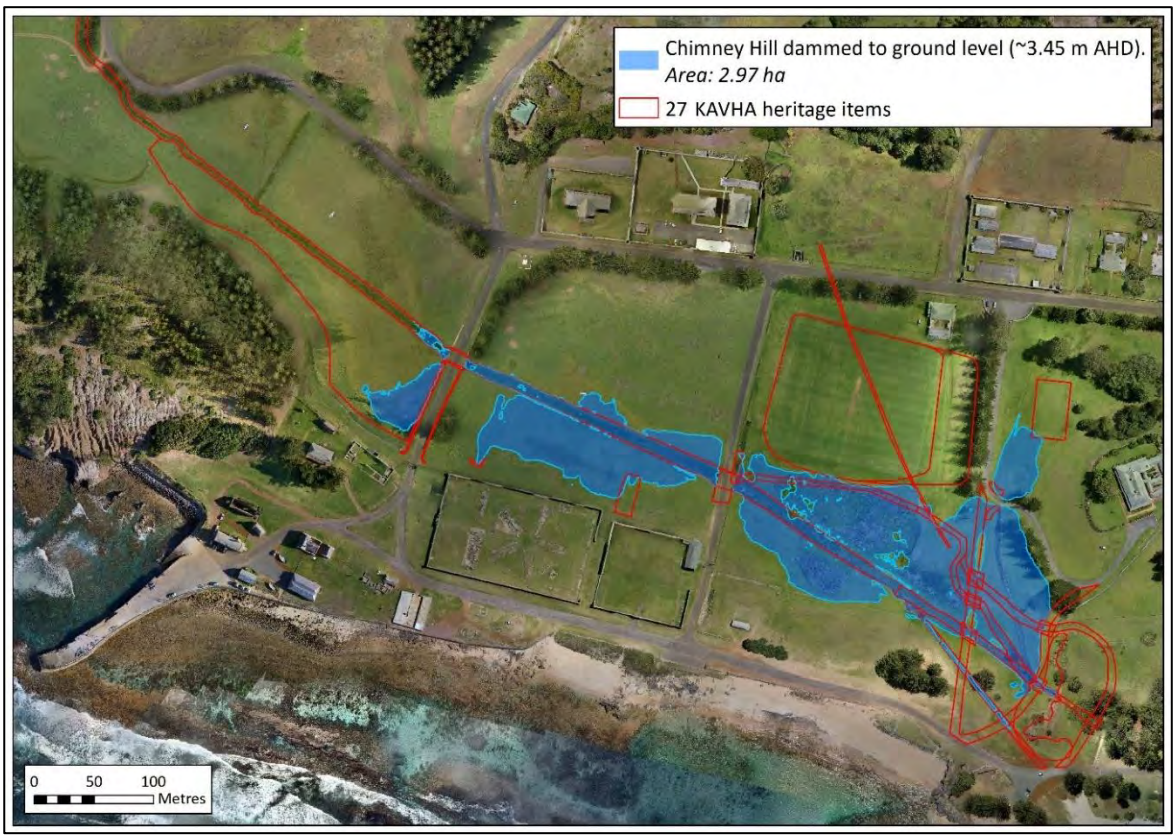

Figure 1 DITRDC inundation at Chimney Hill weir at RL 3.45m AHD

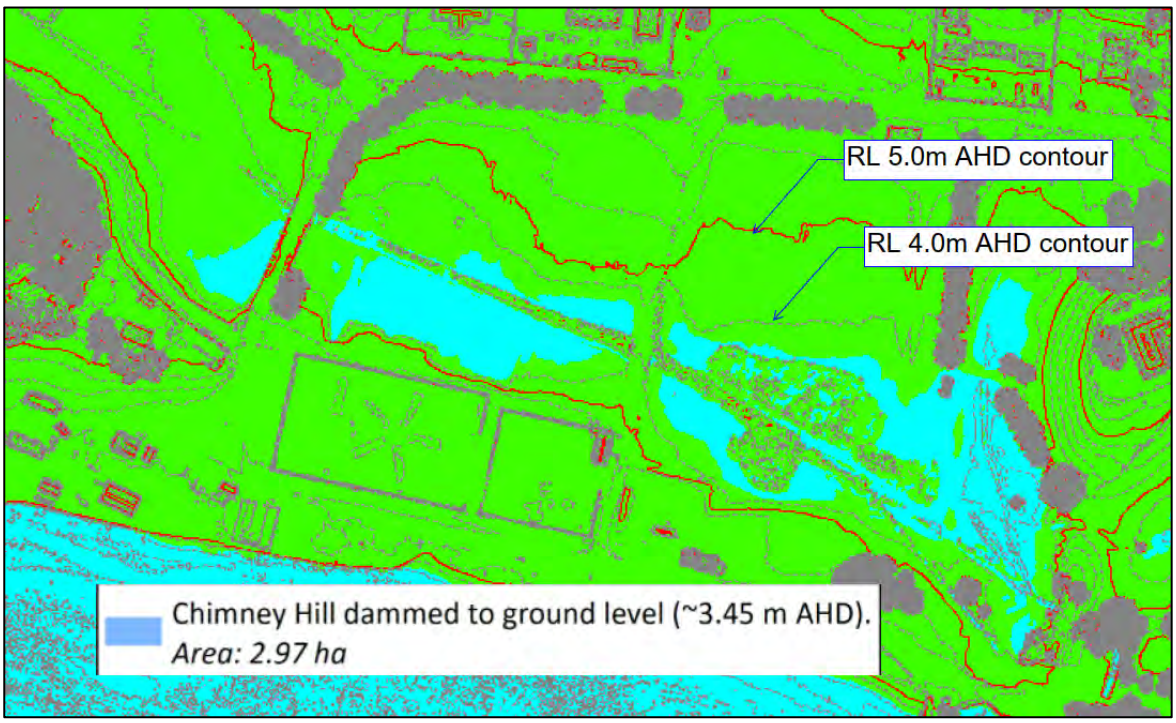

Figure 2. AECOM assessment of inundation at Chimney Hill Weir at RL 3.45 m AHD

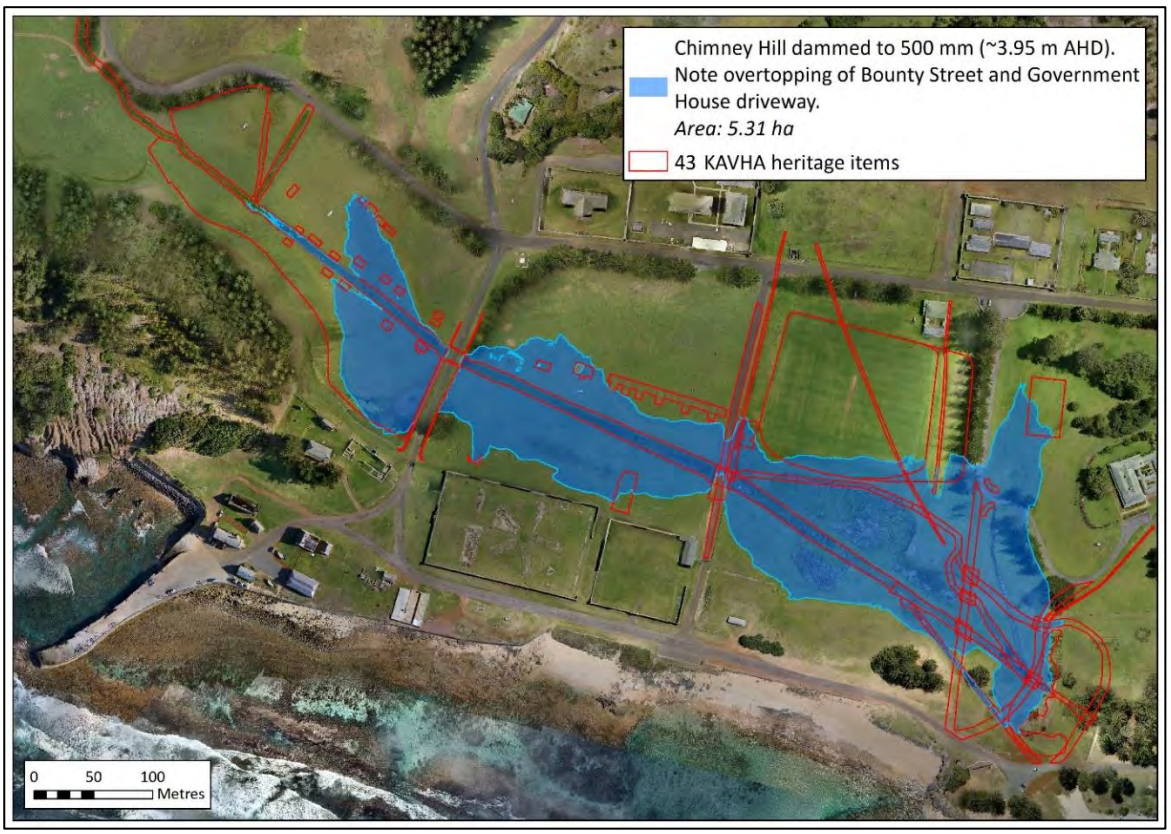

Figure 3 DITRDC inundation at Chimney Hill Weir at RL 3.95m AHD

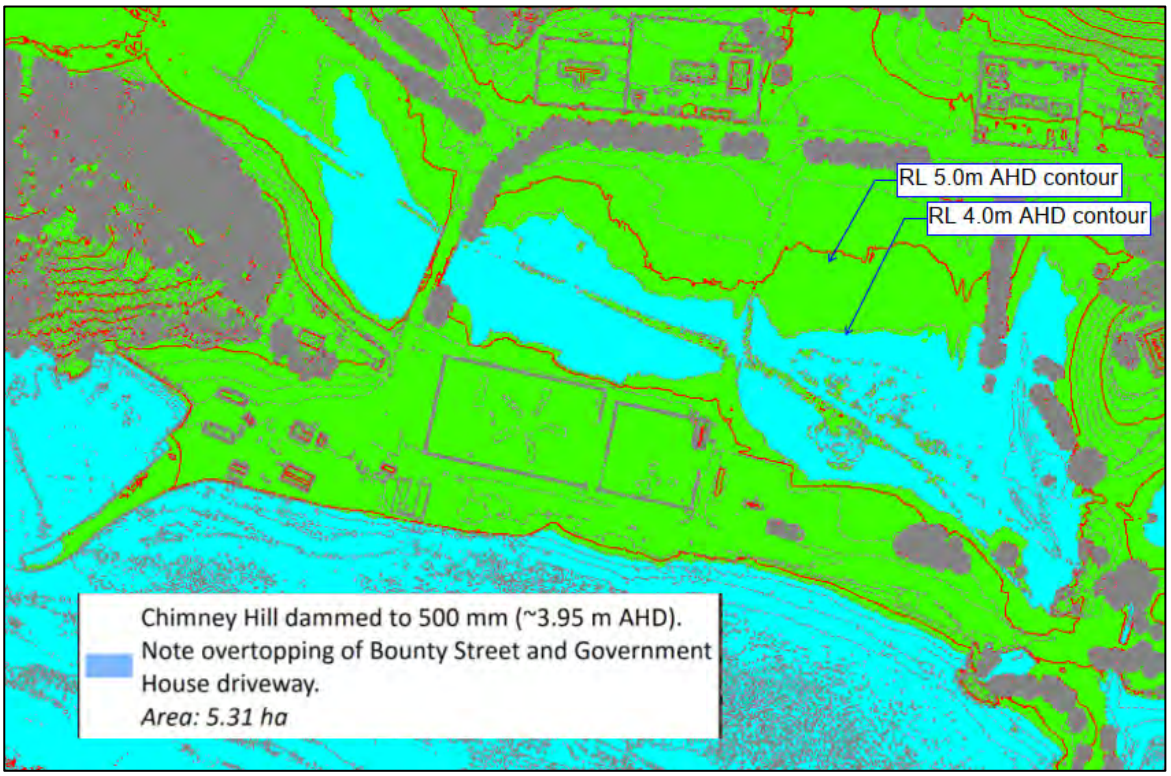

Figure 4. AECOM assessment of inundation at Chimney Hill Weir at RL 3.95 m AHD

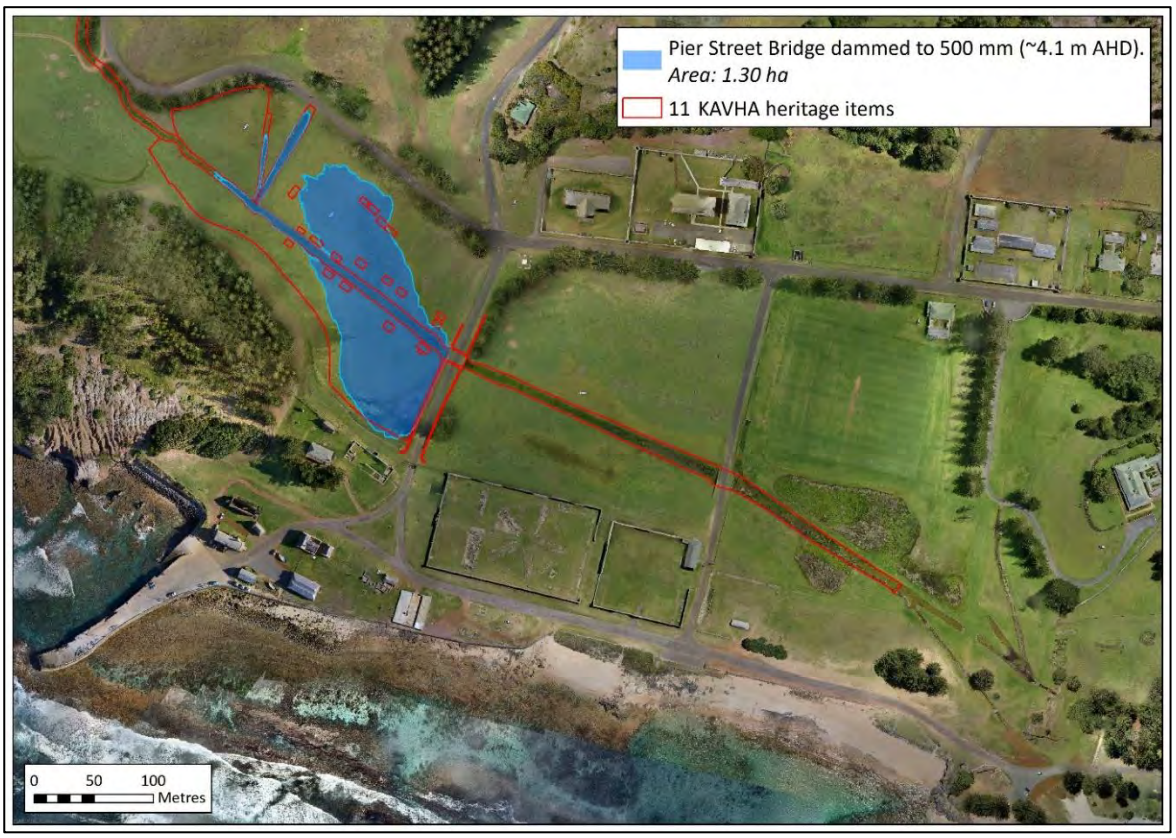

Figure 5. DITRDC inundation at Pier Street Bridge Weir at RL 4.1 m AHD

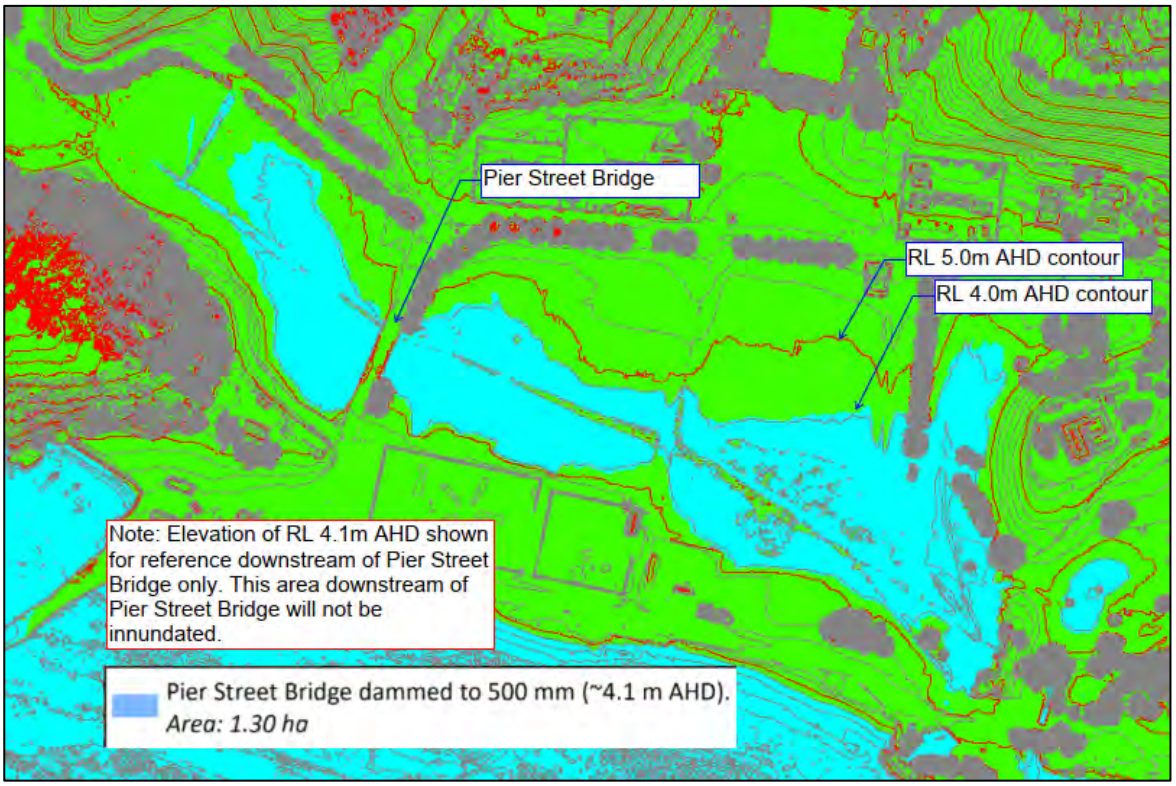

Figure 6. AECOM assessment of inundation at Pier Street Bridge Weir at RL 4.1 m AHD

Figure 7. DITRDC inundation at Pier Street Bridge Weir at RL 4.6 m AHD

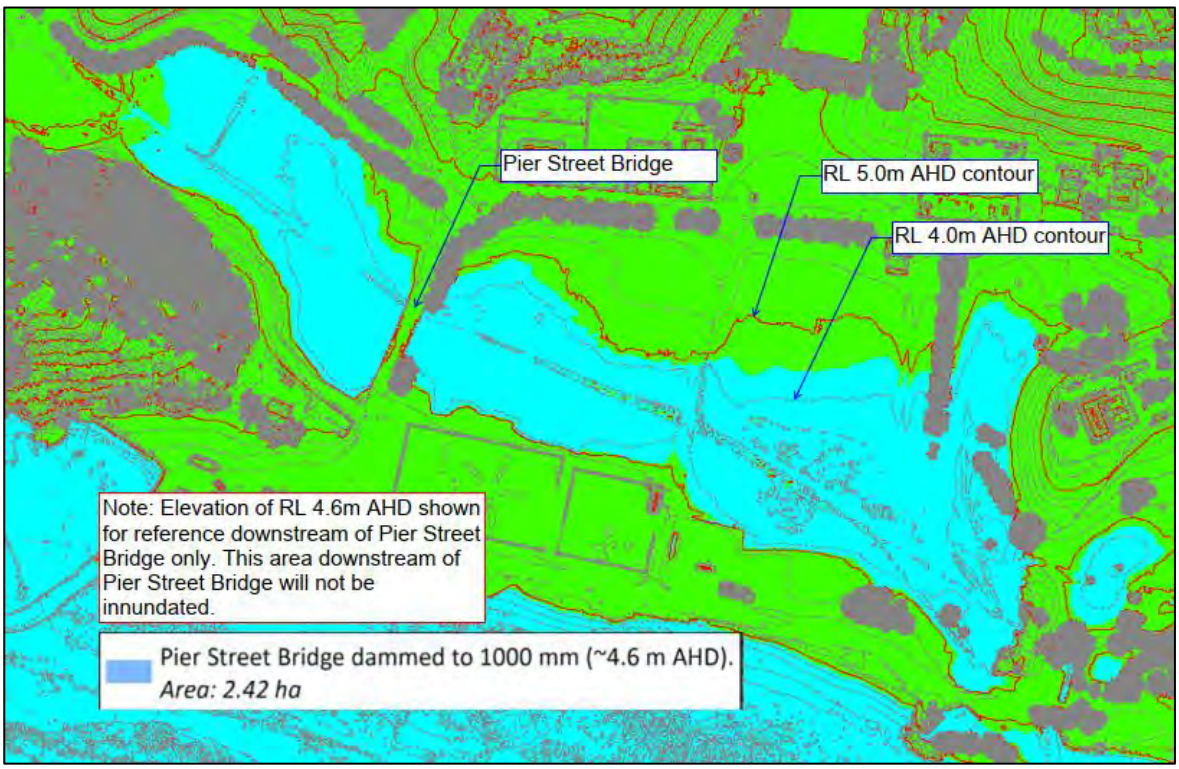

Figure 8. AECOM assessment of inundation at Pier Street Bridge Weir at RL 4.6 m AHD

AECOM Imagine it. Delivered.

2.1 Chimney Hill Weirs

The weir profile parameters and location associated with the inundation for the Chimney Hill options are described below in Figure 9 and Figure 10 . DITRDC requested confirmation that none of the weirs will extend onto or block existing roads to vehicle traffic. Based on the LiDAR data used as part of this assessment, none of the weirs will extend onto existing roadways. However, the inundation extents caused by the weirs do overtop the existing Bounty Street roadway.

Of note, the weir lengths have been approximated from LiDAR data and aerial imagery. The extents are considered conservative and could be refined further with feedback from site measurements and/or provision of survey data for the site areas.

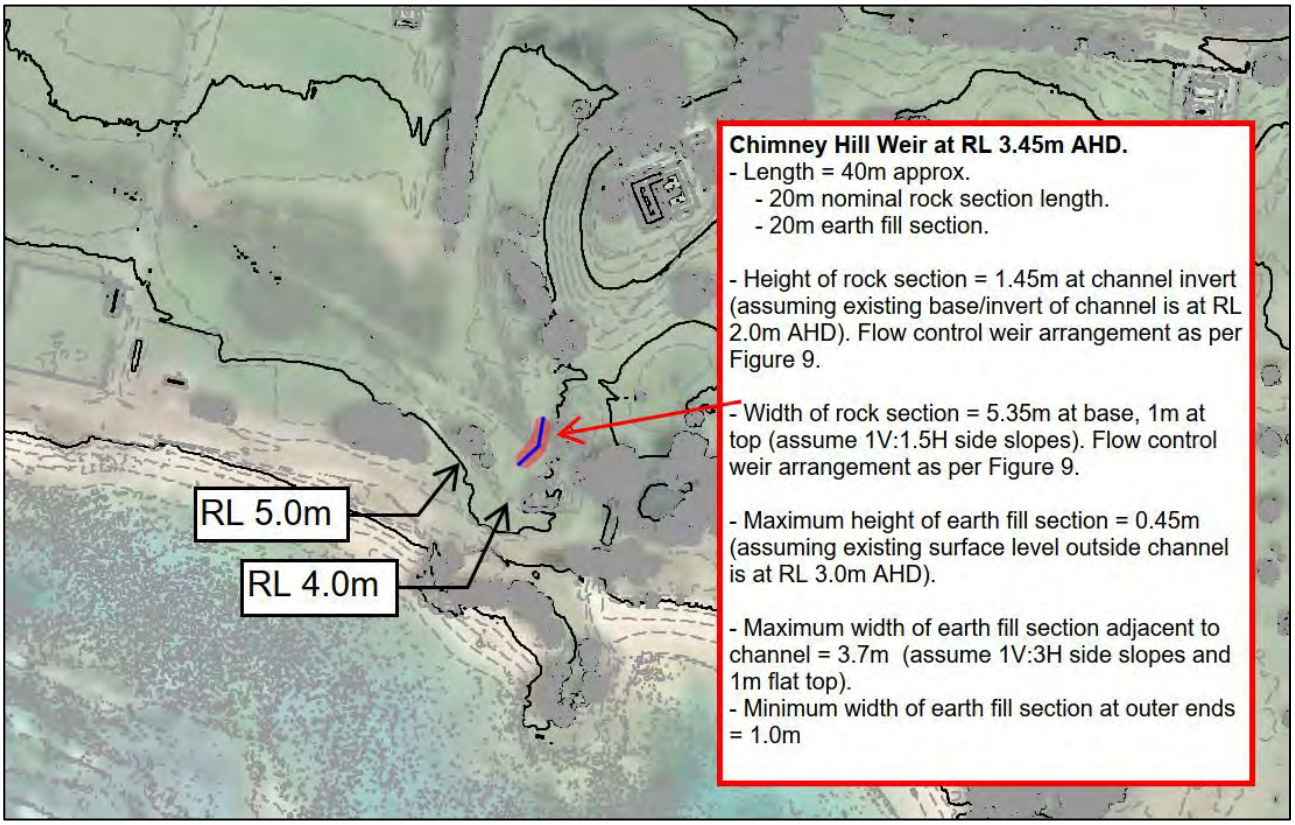

Figure 9. Chimney Hill Weir at RL 3.45m AHD

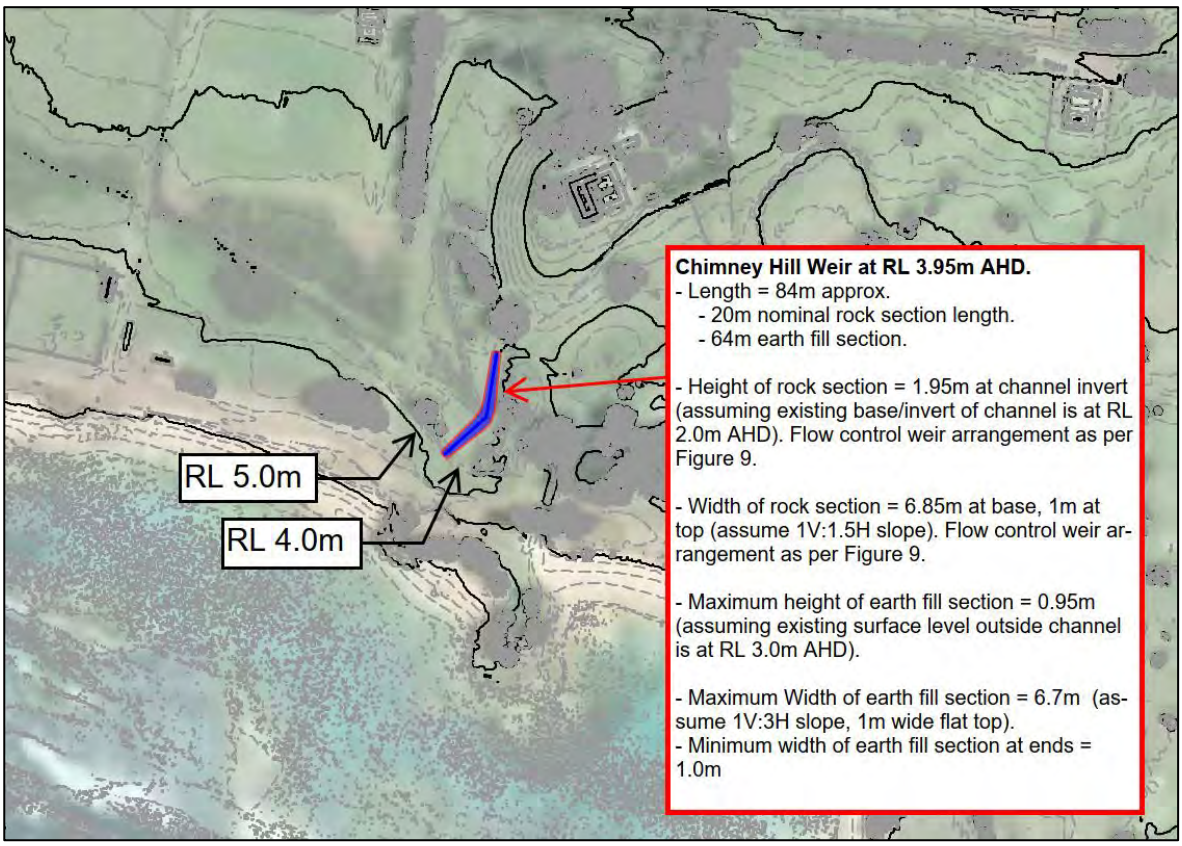

Figure 10. Chimney Hill Weir at RL 3.95 m AHD

2.2 Pier Street Bridge Weir at RL 4.1 m AHD

With the exception of the low-flow channel which passes under the bridge at Pier Street, the existing surface levels along the western road edge of Pier Street Bridge are generally above an elevation of RL 4.1 m AHD. In effect, the existing road is acting as a weir. Therefore, the use of a weir would encompass primarily the low-flow channel and potentially only a small section either side of the low-flow channel. The design will be similar to the 'Flow Control Weir' shown in Figure 9 of the Report.

The location of this weir option should be adjacent to the Pier Street bridge, offset approximately 2.75 m (central) on the upstream side, such that the toe of the weir base is adjacent to the bridge footings.

For the purpose of defining weir profile parameters and to inform cost estimates, the same assumptions adopted in Figure 9 of the Report have been applied. The use of LiDAR data is not sufficient to provide accurate geometric detail for the small low-flow channel section, hence a nominal length of 20 m has been applied. Based on this nominal length the following weir properties apply:

- length = 15 m approximate (Rock fill material and minor earth fill outside low-flow channel)
- flow control weir arrangement as per Figure 9 of the Report.
- height of rock section = 1.6 m at channel invert (assuming existing base/invert of channel is at RL 2.5 m AHD).
- width of rock section = 5.5 m at base, 1 m at top (assume 1V:1.5H side slopes).
- height of earth fill section outside channel = 0.2 m, assume existing surface levels outside of low-flow channel is RL 3.9 m AHD.
- width of earth fill section outside channel = 1 m constant.

- the earth fill section may not be required, pending confirmation of site levels, or may be achieved through localised earthworks as part of the construction. An earth fill section estimate is provided to ensure suitability of cost estimates.

Of note, the weir lengths have been approximated from LiDAR data and aerial imagery. The extents are considered conservative and could be refined further with feedback from site measurements and/or provision of survey data for the site areas.

2.3 Pier Street Bridge Weir at RL 4.6m AHD

The location of this weir option should be adjacent to the Pier Street bridge, offset approximately 3.65 m (central) on the upstream side, such that the toe of the weir base is adjacent to the bridge footings.

Similar to the weir at RL 4.1 m AHD (Section 2.2 above), the western edge of the Pier Street Bridge is operating as a weir at an elevation of RL 4.6 m AHD also, with only the low-flow channel set at a lower elevation along this road edge. Based on adopting a nominal 20 m length as per Section 2.1.1, the following weir properties apply:

- length = 15 m approximate (Rock fill material)
- flow control weir arrangement as per Figure 9 of the Report.
- height of rock section = 2.1 m at channel invert (assuming existing base/invert of channel is at RL 2.5m AHD).
- width of rock section = 7.3 m at base, 1m at top (assume 1V:1.5H side slopes).
- maximum height of earth fill section = 0.7 m, assume existing surface levels outside of low-flow channel is RL 3.9 m AHD.
- maximum width of earth fill section = 5.2 m, assuming 1V:3H, 1m wide flat top
- minimum width of earth fill section = 1 m.
- The earth fill section may not be required, pending confirmation of site levels, or may be achieved through localised earthworks as part of the construction. An earth fill section estimate is provided to ensure suitability of cost estimates.

Of note, the weir lengths have been approximated from LiDAR data and aerial imagery. The extents are considered conservative and could be refined further with feedback from site measurements and/or provision of survey data for the site areas.

2.4 Inundation Volumes

The volume of water that will pond upstream of the four proposed weirs has been estimated using the LiDAR data and use of 12d software. The approximate volumes are measured between the existing surface topography and the crest elevation of each of the weirs. The volumes are considered approximate as the LiDAR data is relatively coarse, along with instances where LiDAR survey has picked up tops of trees rather than ground surface. These volumes can be refined following detailed survey pickup in next phase of the Project.

- Chimney Hill Weir at RL 3.45m AHD. Volume = 4,900m3
- Chimney Hill Weir at RL 3.95m AHD. Volume = 23,300m3
- Pier St Bridge Weir at RL 4.1m AHD. Volume = 3,800m3
- Pier St Bridge Weir at RL 4.6m AHD. Volume = 13,000m3

3.0 Approvals

3.1 Commonwealth Approvals

A referral is required under the *Environmental Protection and Biodiversity Act 1999* (EPBC Act) if actions may result in significant impact to:

- national environmental matters (threatened species and communities, heritage)
- the whole of environment if the action is undertaken by the Commonwealth or on Commonwealth land

The determination of significance is based on the receiving environment and EPBC guidance documents. The triggers are independent of each other. A self-assessment can be undertaken to consider if there is likely to be a significant impact. For this project, there is a need for the regulator to consider the balance between improvement of marine waters and potential impacts to heritage values.

Impact from a Commonwealth perspective

It is not likely that there are threatened species or communities that would be impacted from the works. From a whole of environment perspective, the works have the potential for minor change in the vegetation species and population. This will likely result in changes of exotic and endemic species that will be localised and have little difference on the functions of the ecological system. Some trees will have greater inundation frequency which may affect their longevity and health. There is potential for increased heritage impact from a greater frequency in inundation, as well as increased risk of damage to ruins and foundations.

Impacts to Commonwealth marine areas are likely to be positive as a result of the works. With the intention of the works to reduce nutrient and contaminant loading through increasing holding time and microbial activity, there will be an improvement to the groundwater and surface water discharge to the bay.

It is unlikely that these impacts would be considered significant under the EPBC Act.

3.2 Local Approvals

All uses, developments and activities on land identified under the Kingston and Arthur's Vale Historic Area (KAVHA) heritage overlay may only be carried out with development approval (even if allowed for under the land use zone as per the tables of use or development in the Norfolk Island Plan).

Exemption is possible where the activities are undertaken under an approved conservation management plan, public reserves or other plan, or where a council executive member is satisfied that the activity would not adversely affect the heritage significance of any land. Works are proposed in Precincts A and F under the KAVHA Heritage Management Plan.

If a Development Application is required, an analysis of the environmental impacts will be required. The depth of the analysis may range from a description of the environment through to an Environmental Impact Statement as provided for in the local regulations.

Impact from a local approval perspective

There is a Management Plan for KAVHA as well as a Cultural Landscape Management Plan. There is a potential for impact to KAVHA through a greater frequency of inundation compared to existing conditions that are considered outside the management principles outlined in the conservation plans.

4.0 SWOT Analysis

A Strengths-Weaknesses-Opportunities-Threats (SWOT) analysis was conducted for weirs located at Chimney Hill and Pier Street Bridge. The following options were assessed part of the SWOT analysis:

Chimney Hill

The following weirs installed in-stream were assessed at Chimney Hill:

- a weir at RL 3.45 m AHD; and
- a weir at RL 3.95 m AHD.

Pier Street Bridge

The following options were considered upstream of the Pier Street Bridge:

- a weir at RL 4.1 m AHD; and
- a weir at RL 4.6 m AHD.

4.1 SWOT Analysis

The SWOT analysis for Chimney Hill is presented in Table 1, and for the Pier Street Bridge in Table 2. For both sites, a comparison between the weir options at differing heights was conducted.

The SWOT analyses for both sites are very similar, with the main difference being the Chimney Hill weir has the potential to treat a larger quantity of water, but also to impact a larger footprint than the Pier Street Bridge weir.

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Table 1 SWOT analysis for leaky weir options at Chimney Hill

	Weir at `3.45 m AHD)	Weir at `3.95 m AHD)
Strengths	Increased temporary storage of runoff allowing for increased filtration after rain events – captures large amount of annual runoff volume, which is then treated by the wetlands. Likely that this option is the most cost effective of the leaky weirs due to the flat topography – the most water would be detained for the relative size of the structure. Increasing filtration of water lowers the risk of water pollution downstream.	Diminishing returns on water treatment because only not all events would fill the storage capacity provided by the larger weir
Weaknesses	Landscape will change with increasing wetness. The margins of the wetlands are expected to expand towards the extent of inundation. Potential increased maintenance of bounty street pavement.	Landscape change expected to be greater in intensity (i.e. more wetland plant species will grow) and extent (cover a larger area). Increased maintenance of Bounty Street pavement.
Opportunities	Wetlands are typically considered an attractive landscape feature, and increased water filtration likely to be welcomed by the community.	No additional advantages in addition to the smaller weir.
Threats	Approvals may not be required on the basis that the works are small in the vicinity of the channel area and are not likely to increase the extent of flooding far beyond what it is currently experienced, although flooding will be more frequent. Earth bunds extend 10 m either side of the stream banks Area inundated is 2.97 ha.	Approvals may be required based on the larger extent of works or the larger extent of flooding impacts adjacent to areas of heritage importance (roads, paths, bridges, archaeological site, trees). Earth bunds extend 32 m either side of the stream banks Area inundated is 5.31 ha.

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Table 2 SWOT analysis for leaky weir options at Pier Street Bridge

	Weir at 4.1 m AHD)	Weir at 4.6 m AHD)
Strengths	Complementary to the design intent of the Chimney Hill weir downstream. Increased temporary storage of runoff allowing for increased filtration after rain events – captures more of the mean annual runoff volume, which is then treated by the wetlands. Least impact to downstream pavements and bridges. Increasing filtration of water lowers the risk of water pollution downstream.	Diminishing returns on water treatment because only rare events would be fully captured by a larger weir. Less impact to downstream pavements and bridges compared to Chimney Hill Options
Weaknesses	Landscape will change with increasing wetness. The margins of the wetlands are expected to expand towards the extent of inundation.	Landscape change expected to be greater in intensity (i.e. more wetland plant species will grow) and extent (cover a larger area)
Opportunities	Wetlands are typically considered an attractive landscape feature, and increased water filtration likely to be welcomed by the community.	
Threats	Approvals may not be required on the basis that the works are small in the vicinity of the channel area and are not likely to increase the extent of flooding far beyond what it is currently experienced, although flooding will be more frequent. Area inundated is 1.30 ha	Approvals may be required based on the extent of works or the extent of impacts adjacent to areas of heritage importance (roads, paths, bridges, archaeological site, trees). Area inundated is 2.42 ha

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4.2 Summary of SWOT Analysis

The impacts of the higher weirs are similar for both sites. In summary, the larger, higher weirs would lead to a greater depth, frequency and duration of inundation of the surrounding areas. Potential impacts are:

- Impacts to trafficability of paths and bridges
- Impacts to sports field
- Inundation of heritage sites
- Potential to damage existing mature trees.

Discussion with on-island staff has indicated that these risks may be low for the following reasons:

- The landscape drains by infiltration into the soil, in addition to surface runoff. Observations of existing flooding have noted that flood waters typically drain within a day or two.
- Norfolk pines often grow in the vicinity of streams and high groundwater and are probably resilient to periods of inundation.

Further, the wetland extent has increased over the last 15 years due to the growth of the vegetation within the channel. Therefore, an increase in extent of wetlands is likely acceptable to the community and may be considered to not be contrary with the cultural heritage management plan.

Approvals Risk

The greatest identified threat for these options is the potential for the project to require an approval (and subsequent impact assessment) in order to proceed. Any requirement for approvals may prevent the project from being implemented before the wet season. The requirement for approvals (local) is dependent on the extent of potential impacts, as described in 3.2:

> Exemption is possible where the activities are undertaken under an approved conservation management plan, public reserves or other plan, or **where an executive member (council) is satisfied that the activity would not adversely affect the heritage significance of any land.**

Based on the SWOT analysis, the extent of impacts associated with the lower weirs is considered minimal because:

- The extent of inundation would not differ very much from the current inundation extent associated with larger rain events, although the lower weirs would result in an an increase in frequency of inundation.
- The earthworks associated with the leaky weir smaller and do not extend as prominently beyond the stream banks as the larger weirs.

Therefore, the lower weirs for both Chimney Hill and the Pier Street Bridge sites are not likely to require Commonwealth or local approval, whereas the larger weirs may require at least a local approval.

Extent of Works

A larger weir may trigger approvals based on the extent of works or the extent of impacts adjacent to areas of heritage importance. For example:

- **Earthworks extent:** The larger rock weir and area of earthworks extending more prominently beyond the top of the stream bank is a more substantial change to the landscape, extending further from the top of the stream banks.
- **Landscape impacts:** Estimates for inundation extent associated with the larger weir show that heritage features and functions of the landscape may be compromised *i.e.* paths, mature trees, sports fields, bridges could be inundated. Since the wetlands are already a prominent feature of the open areas of KAVHA, a minor increase in wetland areas associated with the smaller weirs may be compatible with the management of this area, but substantial changes may trigger a review.

- **Landscape** functions could be compromised. Rationale is as follows:
  - On-Island observations are that currently the wetlands overflow 2-3 times per year. This frequency would increase with a weir in place.
  - Discussion with on-island staff has indicated that the landscape drains by infiltration, in addition to overland flow, and turf areas are likely to drain within 1-2 days after flooding. Therefore, soils may be saturated for 1 to 2 days after rain.
  - If the frequency of inundations increases, soils in frequently inundated areas may be too boggy for maintenance mowing to continue in these areas. Hand trimming may be required to keep grasses under control for 1-2 years while the landscape evolves to a marsh ecosystem. Hand weeding and supplementary planting of target species may be required. Kikuyu grass can be difficult to control in wet situations due to its vigorous growth habit.
- **Bridges:** The larger weir is predicted to lead to more frequent flooding of the bridges. If the bridge foundations are normally saturated, then impacts may be minor. However, the Bounty Street Bridge is already subject to subsidence, noting that there is a proposed project to support the bridge structure. A further assessment on the geotechnical risks are presented in the following section.

Geotechnical Risks

The geotechnical risks for the weir options were considered in the SWOT analysis and are summarised below:

Chimney Hill Weir RL 3.45 m

Whilst this option does not cause over topping of the Bounty Street, the maximum water levels will still be within 0.5 m from the top of pavement levels in the vicinity of the Bounty Street Bridge. This may induce wetting and drying cycles within the pavement subgrade and this could potentially increase the pavement deterioration, resulting in increased pavement maintenance. As for the existing Bounty Street Bridge, AECOM recommended that this bridge be closed to vehicular and pedestrian traffic until remediation works are carried out; due to its dilapidated state (refer to AECOM letter dated 10 February and Bounty Street Bridge Detailed Design report dated 03 November 2020). If this weir option is adopted, the remedial works design should be reviewed for adequacy against the anticipated changes in conditions i.e. slight increase in design water level and increased frequency of inundation

Chimney Hill Weir RL 3.95 m

This option causes over topping of the Bounty Street, and would potentially increase the pavement deterioration, resulting in increased pavement maintenance. Other comments provided for Chimney Hill Weir RL 3.45 m are also applicable for this option.

Pier Street Weir RL 4.1 m

From a geotechnical perspective, this option has the least impact out of the four options considered in this report. This is primarily due to Pier Street road embankments already acting as a “weir” and the top of weir level being slightly less than top of pavement levels in the vicinity of the bridge.

Pier Street Weir RL 4.6 m

From a geotechnical perspective, this option has less impact on the downstream pavements and bridges as compared to Chimney Hill Options.

5.0 Preliminary Cost Estimates

This Preliminary Order of Cost Estimate for the Weir Options has been prepared for DITRDC for the proposed stormwater mitigation works located at Norfolk Island.

We understand and acknowledge that DITRDC has a preliminary budget of approx. $250,000 for the works to construct two weirs, one at each location. Given the current design and scope, it would be unlikely to meet that budget if construction of two weirs go ahead. As design is currently only at concept stage, there are opportunities to value manage scope to meet budget.

No allowance has been made for GST. Please note the inclusions, exclusions and assumptions made in preparing the estimate listed in the detailed cost breakdown.

Summary of cost listed in the table below.

Table 3 Estimated Cost Summary

Description	Construction Cost ($)	* Client Cost ($)	Contingency (30%)	Total ($)
Chimney Hill Weir RL 3.45m - 40m	204,414	Excluded	61,586	**266,000**
Chimney Hill Weir RL 3.95m - 84m	348,734	Excluded	104,266	**453,000**
Pier Street Bridge Weir RL 4.1m - 15m	164,782	Excluded	49,218	**214,000**
Pier Street Bridge Weir RL 4.6m - 15m	194,171	Excluded	57,829	**252,000**

** Client cost is currently an allowance and it covers for the department's administration, supervision, travel, legal, media and any PR cost, general expenses and any other costs incurred by the department relating to this project.*

Detailed cost breakdown is attached with this memo in Appendix A.

6.0 Summary of Outcomes and Recommendations

The civil assessment validated that the inundation extents of the four weir options, based on LiDAR data, and as nominated by DITRDC are correct. The geometric parameters of the weirs (i.e. length, width, height) have also been estimated to inform quantities for the construction cost estimate. Lastly, the civil assessment confirmed that based on LiDAR and aerial imagery the weirs do not extend onto existing roadways.

The SWOT analyses gave similar results for both sites. The main difference being the downstream Chimney Hill weir has the potential to treat a larger quantity of water, but also to impact a larger footprint than the upstream Pier Street Bridge weir.

Based on the SWOT analysis, the extent of impacts associated with the lower weirs at each site is considered to be minimal compared to the higher weirs. This is because the lower weirs create an area of inundation that would perhaps be similar to the extent of flooding currently experienced, although would be inundated more frequently, and the earthworks associated with the lower leaky weir options is less intrusive and does not extend as far beyond the stream banks. Therefore, the lower weirs for both Chimney Hill and the Pier Street Bridge sites may not require approval, whereas the larger weirs have the potential for greater impacts and consequently have a higher possibility of requiring approvals (or not gaining exemptions).

It is acknowledged that the higher leaky weir options retain larger volumes of water. However, these options have greater impacts on the landscape than the smaller weir structures, therefore it is likely to trigger a requirement for approvals. This would result in delays in the implementation of a solution in the short term.

AECOM recommends that the lower weir can be installed at Chimney Hill to mitigate runoff stormwater pollutants impacting the Emily Bay. This option allows for temporary storage of runoff increasing filtration after rain events. It is likely that no significant approvals will be required on the basis that the works are small in the vicinity of the channel area and are not likely to increase the extent of flooding far beyond what it is currently experienced. Further, this leaky weir treats a larger volume of water in comparison to the lower weir at Pier St Bridge for a cost that is approximately equal to the funds available.

7.0 References

AECOM. (2021). *Water Quality Improvements in Emily Bay, Options Analysis Report.*

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Appendix A

Preliminary Order of Cost Estimate Report

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Project : Norfolk Island

Cost Plan : Water Quality Improvement Works Emily Bay

Revision : Initial

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PROJECT SUMMARY

Item	Description	Quantity	Unit	Rate	Total
	NORFOLK ISLAND				
	STORMWATER MITIGATION WORKS				
	Leaky Weir Options at Chimney Hill and Pier Street Bridge				
1	Chimney Hill Weir at RL 3.45m AHD	1	Item	266,000.14	266,000
2	Chimney Hill Weir at RL3.95m AHD	1	Item	452,999.84	453,000
3	Pier Street Bridge Weir at RL4.1 AHD	1	Item	213,999.95	214,000
4	Pier Street Bridge Weir at RL4.6 AHD	1	Item	251,999.63	252,000
	Notes, Inclusions and Exclusions:				
	- Head contractor's preliminaries including overhead and margin at 30%				
	- No allowance for traffic and crowd management				
	- No allowance for environmental management, plan and execution				
	- No locality factor, assume local labour, plant and material available				
	- No allowance for the effects / impacts of Covid-19				
	- No allowance for detail design and investigation works (Geotech, survey, heritage, etc.)				
	- Minor allowance for make good works to existing				
	- Excludes consultant (heritage, structural, civil, etc.) supervision during construction				
	- No allowance for client's cost				
	- Contingency allowance at 30%				
	- No allowance for escalation				
	- No allowance for Goods and Services Tax (GST)				
	- Estimate excludes out of hours work				
	- No allowance to divert existing services				
	- Estimates assumes work will be competitively tendered				
	- No allowance to remove contaminated or hazardous materials				
	- No allowance for any structural upgrade works				
	- No allowance for any architural feature				
	- No allowance for any upgrades to road, bridges or provisions for any road furniture				
	- No allowance for major landscaping and improvement works				
	- No allowance for any external services (lighting, etc.)				
	AECOM in Australia and New Zealand is certified to ISO9001, ISO14001 AS/NZS4801 and OHSAS18001.				

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Chimney Hill Weir at RL 3.45m AHD

Item	Description	Quantity	Unit	Rate	Total
	SUMMARY CHIMNEY HILL WEIR RL3.45m				
	Total length approx. 40m @ max 1.45m high, 20m nominal rock and 20m earth fill section				
1	Construct weir RL3.45m	1	Item	147,241.50	147,242
2	Allowance to make good existing	1	Item	10,000.00	10,000
	Allowance for maintenance				Excluded
3	Preliminaries and Overheads	30	%	157,241.50	47,172
	Subtotal Construction Cost - Chimney Hill Weir at RL3.45m				**204,414**
	Detail Design and Documentation				Excluded
	Escalation				Excluded
	DIRDC Administration Costs				Excluded
4	Contingency	30	%	204,413.95	61,324
5	Rounding	1	Item	262.00	262
	TOTAL - Chimney Hill Weir at RL3.45m				**266,000**
	TOTAL NET CONSTRUCTION COST				**266,000**

Project : Norfolk Island

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Chimney Hill Weir at RL 3.45m AHD

Item	Description	Quantity	Unit	Rate	Total
	Construct weir RL3.45m				
	Breakdown Construct Chimney Hill Weir RL3.45m				
	Preparation Works				
1	Allow for temporary shoring and removal at completion (PROVISIONAL)	1	Item	15,000.00	15,000
2	Allowance for dewatering (Provisional)	1	Item	10,000.00	10,000
3	Allowance to excavate and remove existing ground condition to establish working area - 40m	1	Item	20,000.00	20,000
	Rock Section - 20m				
4	Rock - 1.45m high	92	m3	300.00	27,623
5	Low strength concrete - 250mm high	27	m3	840.00	22,470
6	Front end loader	40	Hrs	150.00	6,000
7	Labour - 2 men x 5 days each	80	Hrs	70.00	5,600
8	Geofabric	200	m2	65.00	13,000
	Earth Filled Section - 20m				
9	Imported fill	21	m3	60.00	1,269
10	Excavator including operator	32	Hrs	150.00	4,800
11	Labour - 2men x 4 days	64	Hrs	70.00	4,480
12	Geofabric	200	m2	65.00	13,000
13	Allowance for hydroseeding / turf	200	m2	20.00	4,000
	Total				**147,242**

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Chimney Hill Weir at RL3.95m AHD

Item	Description	Quantity	Unit	Rate	Total
	SUMMARY CHIMNEY HILL WEIR RL3.95m				
	Total length approx. 84m @ max 1.95m high, 20m nominal rock and 64m earth fill section				
1	Construct weir RL3.95m	1	Item	258,257.30	258,257
2	Allowance to make good existing	1	Item	10,000.00	10,000
	Allowance for maintenance				Excluded
3	Preliminaries and Overheads	30	%	268,257.30	80,477
	Subtotal Construction Cost - Chimney Hill Weir at RL3.95m				**348,734**
	Detail Design and Documentation				Excluded
	Escalation				Excluded
	DIRDC Administration Costs				Excluded
4	Contingency	30	%	348,734.49	104,620
5	Rounding	1	Item	-355.00	-355
	TOTAL - Chimney Hill Weir at RL3.95m				**453,000**
	TOTAL NET CONSTRUCTION COST				**453,000**

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Chimney Hill Weir at RL3.95m AHD

Item	Description	Quantity	Unit	Rate	Total
	Construct weir RL3.95m				
	Breakdown Construct Chimney Hill Weir RL3.95m				
	Preparation Works				
1	Allow for temporary shoring and removal at completion (PROVISIONAL)	1	Item	15,000.00	15,000
2	Allowance for dewatering (Provisional)	1	Item	10,000.00	10,000
3	Allowance to excavate and remove existing ground condition to establish working area - 80m	1	Item	40,000.00	40,000
	Rock Section - 20m				
4	Rock - 1.95m high	153	m3	300.00	45,923
5	Low strength concrete - 250mm high	34	m3	840.00	28,770
6	Front end loader	48	Hrs	150.00	7,200
7	Labour - 2 men x 6 days each	96	Hrs	70.00	6,720
8	Geofabric	200	m2	65.00	13,000
	Earth Filled Section - 64m				
9	Imported fill	234	m3	60.00	14,045
10	Excavator including operator	80	Hrs	150.00	12,000
11	Labour - 2men x 4 days	160	Hrs	70.00	11,200
12	Geofabric	640	m2	65.00	41,600
13	Allowance for hydroseeding / turf	640	m2	20.00	12,800
	Total				**258,257**

Project : Norfolk Island

Cost Plan : Water Quality Improvement Works Emily Bay

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Pier Street Bridge Weir at RL4.1 AHD

Item	Description	Quantity	Unit	Rate	Total
	SUMMARY PIER BRIDGE RL4.1m				
	Total length approx. 15m @ max 1.6m high, rock fill material and minor earthworks				
1	Construct flow control RL4.1m	1	Item	96,755.00	96,755
2	Allowance for minor earth shaping to suit rock section	1	Item	10,000.00	10,000
3	Allowance to protect existing structure / surrounding	1	Item	10,000.00	10,000
4	Allowance to make good existing	1	Item	10,000.00	10,000
	Allowance for maintenance				Excluded
5	Preliminaries and Overheads	30	%	126,755.00	38,027
	Subtotal Construction Cost - Pier Bridge at RL4.1m				**164,782**
	Detail Design and Documentation				Excluded
	Escalation				Excluded
	DIRDC Administration Costs				Excluded
6	Contingency	30	%	164,781.50	49,434
7	Rounding	1	Item	-216.00	-216
	TOTAL - Pier Bridge at RL4.1m				**214,000**
	TOTAL NET CONSTRUCTION COST				**214,000**

Project : Norfolk Island

Cost Plan : Water Quality Improvement Works Emily Bay

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Pier Street Bridge Weir at RL4.1 AHD

Item	Description	Quantity	Unit	Rate	Total
	Construct flow control RL4.1m				
	Breakdown Construct Flow Control RL4.1m				
	Preparation Works				
1	Allow for temporary shoring and removal at completion (PROVISIONAL)	1	Item	15,000.00	15,000
2	Allowance for dewatering (Provisional)	1	Item	10,000.00	10,000
3	Allowance to excavate and remove existing ground condition to establish working area - 15m	1	Item	12,000.00	12,000
	Rock Section - 15m				
4	Rock - 1.6m high	78	m3	300.00	23,400
5	Low strength concrete - 250mm high	21	m3	840.00	17,325
6	Front end loader	32	Hrs	150.00	4,800
7	Labour - 2 men x 4 days each	64	Hrs	70.00	4,480
8	Geofabric	150	m2	65.00	9,750
	Total				**96,755**

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Pier Street Bridge Weir at RL4.6 AHD

Item	Description	Quantity	Unit	Rate	Total
	SUMMARY PIER BRIDGE RL4.6m				
	Total length approx. 15m @ max 2.1m high, rock fill material and minor earthworks				
1	Construct flow control RL4.6m	1	Item	119,362.50	119,363
2	Allowance for minor earth shaping to suit rock section	1	Item	10,000.00	10,000
3	Allowance to protect existing structure / surrounding	1	Item	10,000.00	10,000
4	Allowance to make good existing	1	Item	10,000.00	10,000
	Allowance for maintenance				Excluded
5	Preliminaries and Overheads	30	%	149,362.50	44,809
	Subtotal Construction Cost - Pier Bridge at RL4.6m				**194,171**
	Detail Design and Documentation				Excluded
	Escalation				Excluded
	DIRDC Administration Costs				Excluded
6	Contingency	30	%	194,171.25	58,251
7	Rounding	1	Item	-423.00	-423
	TOTAL - Pier Bridge at RL4.6m				**252,000**
	TOTAL NET CONSTRUCTION COST				**252,000**

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Pier Street Bridge Weir at RL4.6 AHD

Item	Description	Quantity	Unit	Rate	Total
	Construct flow control RL4.6m				
	Breakdown Construct Flow Control RL4.6m				
	Preparation Works				
1	Allow for temporary shoring and removal at completion (PROVISIONAL)	1	Item	15,000.00	15,000
2	Allowance for dewatering (Provisional)	1	Item	10,000.00	10,000
3	Allowance to excavate and remove existing ground condition to establish working area - 15m	1	Item	12,000.00	12,000
	Rock Section - 15m				
4	Rock - 2.1m high	131	m3	300.00	39,218
5	Low strength concrete - 250mm high	27	m3	840.00	22,995
6	Front end loader	32	Hrs	150.00	4,800
7	Labour - 2 men x 5 days each	80	Hrs	70.00	5,600
8	Geofabric	150	m2	65.00	9,750
	Total				**119,363**