

# Memorandum

|         |   |                                |                      |
|---------|---|--------------------------------|----------------------|
| To      | <b>Hugh Donaldson</b>                               | From                           | [REDACTED]           |
| Copy    | <b>Sarah Child, Tom Revell</b>                      | Reference                      | <b>520969</b>        |
| Date    | <b>2022-04-08</b>                                   | Pages<br>(including this page) | <b>5+ Appendices</b> |
| Subject | <b>Napier Ex-Prison – Retaining Wall Assessment</b> |                                |                      |

## 1 Introduction

Land Information New Zealand (LINZ) has engaged Aurecon New Zealand (Aurecon) to undertake a geotechnical assessment of all retaining walls at their site located at 55 Cootes Road, Napier. The site is a Napier City Council Heritage Site containing the old Napier Prison, and is currently being used as a tourist attraction. The site also comprises two residential properties that are currently occupied, 1 and 2/57 Cootes Road. Aurecon understands that LINZ was advised by the tenant that one of the retaining walls onsite was unstable and unfit for use and that there are several other retaining walls onsite that may require condition assessments.

Aurecon attended the site between 14 and 17 March 2022 to undertake a condition assessment for all retaining walls onsite. This memorandum details the findings from Aurecon's retaining wall condition assessments, undertaken in accordance with the agreed scope of works between LINZ and Aurecon, dated 2 July 2021. Our explanatory statement is included in Section 6 of this memorandum.

## 2 Assessment Summary

Aurecon attended the site between 14 and 17 March 2022 to undertake condition assessments for the onsite retaining walls. A total of 23 retaining walls were identified onsite during Aurecon's assessment, including retaining structures that make up the Napier Prison walls, walls along neighbouring property boundaries, walls along old walking tracks, and walls adjacent to onsite residential properties.

The majority of the retaining structures around the site were stone masonry gravity walls. While some brick masonry and mass concrete walls were observed, the majority of the walls assessed were "facing" walls, inferred to protect the cut natural soils from erosion and likely were not originally "designed". The natural soils being retained are inferred to be relatively stable when dry and protected from exposure and water infiltration, but are considered to be highly erodible when exposed. This instability and erodibility is evidenced by the slope failure that has occurred up slope of one of the retaining walls.

The condition of the retaining walls varied from "fair to severely deteriorated" condition (see Section 3 for descriptive terminology), with a large number of retaining structures onsite partially collapsed or with significant cracking observed in the face of the walls. Additionally, a large number of walls onsite were heavily vegetated and, in some instances, vegetation had caused damage and partial collapse of the walls. The presence of heavy vegetation also meant that some retaining structures could not be accessed or observed/identified. Additional walls beyond the 23 identified, may be present onsite, particularly along the north western property boundary and the eastern part of the site, down slope from the prison buildings.

A figure showing the approximate site location and indicative locations of all retaining walls assessed onsite is included in Appendix A. The condition assessment details for each retaining wall are tabulated in Appendix B, and photographs are included in Appendix C.

### 3 Condition Assessment Terminology

For our condition assessments, we have adopted general terminology to describe the condition of the retaining walls. Five terms are adopted, with their respective descriptions provided below. We note that the terminology provided does not account for wall “criticality”.

**Table 1 Retaining Wall Condition Assessment Terminology**

| Descriptive Terminology | Description/Example   |
|-------------------------|---|
| <b>Excellent</b>        | Wall is “like new”, free of any minor defects and weathering. Wall face and surrounding ground free of vegetation. Wall is fully functional, fit for purpose and generally newly constructed. Drainage systems are fully functional and properly protected from soil infiltration/clogging and blockages.   |
| <b>Good</b>             | Wall is free of minor defects but some minor/general weathering of wall elements visible, but does not compromise the wall integrity. Some minor vegetation may be present above or below the wall, but does not impact the stability of the wall or is protruding from the wall face. Wall is fully functional, fit for purpose but some minor maintenance may be required. Drainage systems are fully functional and generally free from soil infiltration/clogging and blockages.  |
| <b>Fair</b>             | Wall has some defects, such as hairline cracking, and is weathered. Vegetation may be present at the top and bottom of the wall but is not impacting the structural stability of the wall, some minor vegetation may be visible in the wall face but is not impacting the face stability. The wall is functional and generally fit for purpose, some minor repair work or strengthening may be required. Drainage is visible and free from blockages and vegetation growth; some soil may be present/visible but not enough to compromise the drainage system functionality.  |
| <b>Deteriorated</b>     | Wall contains defects that are or will compromise wall functionality or stability in the near future. Vegetation is present above, below and protruding from the face of the wall and is observed to be causing degradation/damage to the wall. The wall may no longer be fit for purpose and some local significant repairs may be required, such as fully replacing some wall elements and generally strengthening the wall structurally. Drainage is visible, but has been compromised with blockages, damage or vegetation growth and requires reinstatement/maintenance. |

| Descriptive Terminology      | Description/Example   |
|------------------------------|---|
| <b>Severely Deteriorated</b> | Wall is partially or fully collapsed in places with significant defects observed over the majority of the wall. Vegetation growth may be extensive and have damaged/dislodged structural or facing elements of the wall. The wall is not fit for purpose and requires demolition and reinstated or significant repairs/reconstruction to the majority of the wall. New design or significant strengthening is likely required to ensure future stability. No drainage visible or has been completely clogged/blocked and is no longer functional. |

#### 4 Remedial Works Recommendations

Based on our retaining wall assessments, the majority of the retaining walls onsite are old gravity masonry walls and are in a 'deteriorated to severely deteriorated' condition.

We note that areas and/or parts of the retaining structures observed onsite could not be assessed due to access restrictions and vegetation. Therefore, Aurecon's comments on remediation options is based solely on the parts of the walls that could be inspected. General comments regarding remedial works options for the onsite retaining walls are included in Appendix B, and basic descriptions of the terminology used are included in Table 2.

Table 2 Remedial Works Terminology

| Terminology | Description/Example   |
|-------------|---|
| Demolish    | Wall is beyond repair, and full replacement with a new and designed retaining wall is likely required.  |
| Repair      | Structural elements of the wall likely need to be replaced/repared. This may include replacing wall drainage, facing elements, or structural sections of the wall and re-pointing mortar. |
| Maintenance | Drainage needs to be unclogged and vegetation removed.  |

Although the majority of the retaining walls are in a deteriorate state, it is anticipated that under static conditions the walls are unlikely to fail but will continue to deteriorate, which may lead to ongoing localised failures. Therefore, there does not appear to be a life safety risk currently. However, under adverse weather and seismic conditions it is anticipated that walls will fail, which will pose a risk to any occupants. The exception to this is NAP-PRIS-RW10, where significant ground cracking was observed behind the wall, especially as this wall is located in an area that is exposed to public foot traffic (i.e. the prison/tourist site is located at the toe of this wall). We recommend that this wall is addressed immediately due to the potential life safety risk.

Geotechnical assessment of the walls stability under seismic loading is outside of the scope of works. But given the deteriorated condition and type of walls observed onsite, geotechnical stability assessments for critical walls is recommended, particularly given the recently updated NZGS/MBIE Guidelines - *Module 1: Overview of the Guidelines* (November 2021), which has significantly increased the recommended seismic hazard design levels for the Hawkes Bay region.

## 5 Further Geotechnical Involvement

Aurecon has undertaken a condition assessment for the retaining walls located at the LINZ site located at 55 Coote Road, Napier, also known as the old Napier Prison. These condition assessments have been undertaken in accordance with the agreed Aurecon scope of works.

Given the observed condition of the retaining walls onsite, significant repair work and further geotechnical assessments will be required to strengthen, repair and verify the future stability of the onsite retaining walls. We recommend that LINZ undertake the following:

- Geotechnical ground investigation to confirm the back fill, retained soils and founding soil conditions for detailed stability assessments.
- Retaining wall stability assessments under static and seismic loading conditions for all retaining walls onsite.
- Retaining wall strengthening design or re-design work for critical walls identified through further stability analysis.

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## 6 Explanatory Statement

The damage assessment of the retaining walls has been undertaken to assess the condition of the retaining walls. A detailed structural assessment has not been undertaken to assess the strength of the walls or to determine whether they comply with the relevant codes.

Aurecon has not made any assessment of the structural stability or safety with respect to earthquakes, which have the potential to further damage the walls and jeopardise the safety of the people and properties in the immediate vicinity of the walls.

This report is necessarily limited by the time available to carry out inspections. The report does not include defects that were not reasonably visible upon visual inspection, including defects in inaccessible places and latent defects.

While this report may assist the client in assessing whether the wall should be demolished or repaired, the decision is solely the responsibility of the client.

The review has been prepared by Aurecon at the request of the client and for the client's use. It is not possible to make a proper assessment of this review without a clear understanding of the terms of engagement, under which it has been prepared, including the scope of the instructions and the direction given to and the assumptions made by Aurecon. This report does not address issues which would need to be considered for another party should that party's particular circumstances, requirement and experience were known, and further, may make assumptions about matters of which the third party is not aware of. No responsibility of liability to any third party is accepted for any loss or damage whatsoever arising from the use of reliance on this report by any third party.

Without limiting any of the above, Aurecon liability, whether under the law of contract, tort, statute. Equity or otherwise, is limited as set in the terms of engagement with the client.

Prepared by,

Reviewed,



***Geotechnical Engineer***

***Lead Engineering Geologist***

### **Attached:**

*Appendix A – Indicative Retaining Wall Locations*

*Appendix B – Retaining Wall Assessment Table*

*Appendix C – Retaining Wall Photos*

# Appendix A

## Figures



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CLIENT

PRELIMINARY NOT FOR CONSTRUCTION

ALL DIMENSIONS APPROXIMATE ONLY

SCALE

SIZE

TITLE

SITE LOCATION PLAN



FIGURE

FIGURE 1

NTS

BY

J. MARTIN

REVIEWED

J. MUIRSON

REFERENCE

BACKGROUND IMAGE RETRIEVED FROM:  
[HTTP://WWW.GIS.NAPIER.GOV.T.NZ/INTRAMAPS80/DEFAULT.HTM?PROJECT=-NCC&MODULE=PROPERTY](http://www.gis.napier.govt.nz/intramaps80/default.htm?project=-NCC&module=PROPERTY)

PROJECT

NAPIER PRISON – RETAINING WALL ASSESSMENT

DATE

8 APRIL 2022

FIGURE No.

PROJECT  
520969

WBS  
000

TYPE  
FIG

DISC  
GE

NUMBER  
01

REV

**Legend**

- Fair Condition
- Deteriorated Condition
- Severely Deteriorated Condition
- Recent Slip Location



|         |  |  |                                 |          |              |      |            |  |     |      |      |        |     |
|---------|--|--|---------------------------------|----------|--------------|------|------------|--|-----|------|------|--------|-----|
| CLIENT  |  | PRELIMINARY NOT FOR CONSTRUCTION                   | ALL DIMENSIONS APPROXIMATE ONLY |          | SCALE        | SIZE | TITLE      | INDICATIVE RETAINING WALL LOCATIONS  |     |      |      |        |     |
| aurecon |  | Toitū Te Whenua<br>Land Information<br>New Zealand |                                 | FIGURE   | FIGURE 2     |      | NTS        | BACKGROUND IMAGE RETRIEVED FROM:<br><a href="http://www.gis.napier.govt.nz/intramaps80/default.htm?PROJECT=NCC&amp;MODULE=PROPERTY">HTTP://WWW.GIS.NAPIER.GOV.TZ/INTRAMAPS80/DEFAULT.HTM?PROJECT=NCC&amp;MODULE=PROPERTY</a> |     |      |      |        |     |
| PROJECT |  | NAPIER PRISON – RETAINING WALL ASSESSMENT          |                                 | REVIEWED | J. MUIRSON   |      | REFERENCE  |  |     |      |      |        |     |
|         |  |  |                                 | DATE     | 8 APRIL 2022 |      | FIGURE No. | PROJECT  | WBS | TYPE | DISC | NUMBER | REV |
|         |  |  |                                 |          |              |      |            | 520969   | 000 | FIG  | GE   | 02     | 0   |



# Appendix B Assessment Table



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| Wall Name    | Type  | Co-Ordinates <sup>(1)</sup>   | Wall Length | Max Height | Min Height | Thickness <sup>(2)</sup> | Wall Rake | Toe Slope <sup>(3)</sup> (°) | Head Slope <sup>(3)</sup> (°) | Adjacent Walls?              | Walls Above/Below?   | Condition Comments   | Preliminary Remediation Options <sup>(4)</sup> |
|--------------|---|---|-------------|------------|------------|--------------------------|-----------|------------------------------|-------------------------------|------------------------------|--|--|--|
| NAP-PRIS-RW1 | Stone Block/Gravity<br>Supports soil above site access  | Latitude:<br>-39.836246<br>Longitude:<br>176.9178287<br>(Co-ordinates in WGS system)  | 16m         | 2.7m       | 1.7m       | 250mm – 300mm            | 0         | 5                            | >45                           | NAP-PRIS-RW3                 | NAP-PRIS-RW2 (below).<br>NAP-PRIS-RW4 (below).<br>Accessway/driveway located at toe of wall.<br>Residential property located upslope of wall.            | Wall in severely deteriorated condition with loose blocks, partial collapse and bulging. Top of wall heavily vegetated.  | Demolish/repair<br>Maintenance                 |
| NAP-PRIS-RW2 | Stone Block/Gravity<br>Supports upslope site access driveway  | Latitude:<br>-39.4836052<br>Longitude:<br>176.9183655<br>(Co-ordinates in WGS system) | 38m         | 1.7m       | 0.5m       | 250mm – 300mm            | 0         | 0 - 5                        | 5 – 35                        | NAP-PRIS-RW21                | NAP-PRIS-RW1 (above)<br>Site access/driveway located above wall<br>Footpath and Coote Road at wall toe.  | Wall in severely deteriorated condition with bottom half of wall collapsed in places. Loose/dislodged blocks present and top of wall heavily vegetated.  | Demolish/repair<br>Maintenance                 |
| NAP-PRIS-RW3 | Stone Block/Gravity<br>(Inferred based on limited observations)<br>Supports soil above site driveway.       | Latitude:<br>-39.4838386<br>Longitude:<br>176.9185053<br>(Co-ordinates in WGS system) | 41m         | 3m         | 2m         | 250mm – 300mm            | 0         | 0 - 5                        | 30 - 45                       | NAP-PRIS-RW1<br>NAP-PRIS-RW5 | NAP-PRIS-RW2 (below).<br>NAP-PRIS-RW4 (below)<br>Site accessway/driveway located at toe of wall.<br>Residential property located upslope.                | Wall almost non-existent and inferred to have been a stone block wall that has almost completely collapsed over time. Heavily vegetated will some surficial soil failures.   | Re-instate.<br>Maintenance                     |
| NAP-PRIS-RW4 | Stone Block/Gravity<br>(inferred based on limited observations)<br>Supports edge of site driveway/access    | Latitude:<br>-39.4837045<br>Longitude:<br>176.9184094<br>(Co-ordinates in WGS system) | 71m         | 0.8m       | 0.6m       | 250mm – 300mm            | 0         | 20-35                        | 0                             | -                            | NAP-PRIS-RW2 (below).<br>NAP-PRIS-RW1, RW3 and RW5 (above).<br>Supports upslope driveway/accessway.  | Wall in severely deteriorated condition. Partially collapsed and eroded. Some areas appear to have completely been washed out and ground being supported by mesh fence down slope of wall. Some settlement of upslope driveway observed. | Demolish/repair.<br>Maintenance.               |
| NAP-PRIS-RW5 | Stone Block/Gravity<br>(inferred based on limited observations)<br>Supports soil above site driveway/access | E1937038<br>N5622180<br>(Co-ordinates in NZTM system)                                 | 16m         | 1.9m       | 1.5m       | 250mm – 300mm            | 0         | 0                            | >45                           | NAP-PRIS-RW3<br>NAP-PRIS-RW6 | NAP-PRIS-RW4 (below)<br>Site accessway/driveway located at toe of wall.<br>Residential property upslope of wall.   | Wall in fair condition with some displacement and bulging at one end of wall. Cracking in mortar observed and top of wall heavily vegetated.   | Repair<br>Maintenance                          |
| NAP-PRIS-RW6 | Stone Block/Gravity<br>(inferred based on limited observations)<br>Supports soil above site access/driveway | E1937042<br>N5622167<br>(Co-ordinates in NZTM system)                                 | 13m         | 1.6m       | 1.3m       | 250mm – 300mm            | 0         | 0                            | 30+ (benched slope)           | NAP-PRIS-RW5<br>NAP-PRIS-RW7 | NAP-PRIS-RW4 (below)<br>Site accessway/driveway located at toe of wall.<br>Apparent slip has occurred above wall and below upslope residential property. | Wall in fair condition and appears to have been constructed recently following the slip, which is inferred to have damaged the original wall. Some cracking of mortar already visible.   | Repair<br>Maintenance                          |

| Wall Name     | Type   | Co-Ordinates <sup>(1)</sup>                           | Wall Length | Max Height | Min Height   | Thickness <sup>(2)</sup>       | Wall Rake | Toe Slope <sup>(3)</sup> (°) | Head Slope <sup>(3)</sup> (°)          | Adjacent Walls?               | Walls Above/Below?  | Condition Comments   | Preliminary Remediation Options <sup>(4)</sup> |
|---------------|--|---|-------------|------------|--|--------------------------------|-----------|------------------------------|--|-------------------------------|---|--|--|
| NAP-PRIS-RW7  | Stone Block/Gravity<br>Supports soil above site parking area.  | E1937035<br>N5622136<br>(Co-ordinates in NZTM system) | 38.5m       | 4.2m       | 2m   | Unknown – likely 300mm approx. | 10        | 0 - 5                        | 15 – 25 (benched upslope)              | NAP-PRIS-RW6<br>NAP-PRIS-RW8  | NAP-PRIS-RW23 (below)<br>Site parking area located at toe of wall.<br>Heavily vegetated area and residential properties located upslope   | Parts of wall in deteriorated condition. Dislodged and loose blocks at top of wall where vegetation growth has occurred. Mortar eroded at toe. Roots observed through some drainage pipes.   | Remediate/repair.<br>Maintenance               |
| NAP-PRIS-RW8  | Concrete Block/Gravity.<br>End of wall has a concrete façade, with stone blocks behind.<br>Supports soil above site parking area, sheds and accessway to top of prison wall.                 | E1937048<br>N5622020<br>(Co-ordinates in NZTM system) | 15m         | 4.2m       | 3.5m<br>(above steps that are 1.1m above ground level) | Unknown – likely 300mm – 400mm | 10        | 0                            | 20 – 30 then possibly steeper.         | NAP-PRIS-RW7<br>NAP-PRIS-RW16 | Parking area and shed buildings located at toe of wall.<br>Access to top of prison wall also located at toe of wall.<br>Heavily vegetated area and residential properties located upslope | Wall in fair to deteriorated condition. Concrete façade at end of wall cracked and partially collapsed. Loose blocks observed behind façade.<br>Blocks at top of wall loose and dislodged due to vegetation. Cracking and partial mortar loss observed in wall face.                             | Remediate/repair<br>Maintenance.               |
| NAP-PRIS-RW9  | Stone Block/Gravity<br>(inferred based on limited observations)<br>Supports soil below site access and main prison wall. Onsite residential property/accommodation located downslope of toe. | E1937082<br>N5622112<br>(Co-ordinates in NZTM system) | 70m         | 3m         | 0.5m   | Unknown – likely 250mm – 300mm | 0         | 0 – 5                        | 5 – 30                                 | NAP-PRIS-RW18                 | Parking area and driveway located upslope. Main prison wall located upslope of wall.<br>Residential property/garage/parking located at toe of wall.                                       | Wall in severely deteriorated condition and not fully visible due to vegetation. Partially collapsed and significant bulging in wall. Some ground cracking in asphalt at top of wall possibly indicating ground movement from wall instability.  | Demolish/re-instate.                           |
| NAP-PRIS-RW10 | Brick/masonry gravity wall<br>(inferred based on limited observations)<br>Possible concrete façade.<br>Prison Wall.  | E1937073<br>N5622055<br>(Co-ordinates in NZTM system) | 68m         | 5.7m       | 5.5m   | 450mm approx.                  | 0         | 0                            | 5<br>(benched retaining walls upslope) | NAP-PRIS-RW17                 | NAP-PRIS-RW11<br>NAP-PRIS-RW12<br>NAP-PRIS-RW13<br>NAP-PRIS-RW15<br>NAP-PRIS-RW16<br>(above slope).<br>Prison site at toe of wall, including buildings and prison graveyard.              | Wall in varying condition over length, but generally fair to deteriorated. Significant ground cracking observed at top of wall over 20m length, cracks up to 300mm wide. Cracking and vegetation observed in façade. Some soil collapse behind wall observed, where alcove dug into toe of wall. | Repair<br>Maintenance                          |
| NAP-PRIS-RW11 | Concrete Block/Gravity<br>Supports soil below upslope neighboring properties.  | E1937059<br>N5622072<br>(Co-ordinates in NZTM system) | 28m         | 4m         | 1.3m   | Unknown – likely 300mm         | 5         | 0                            | 0 – 20+                                | NAP-PRIS-RW13                 | NAP-PRIS-RW12 (above)<br>NAP-PRIS-RW10 (below)<br>Residential property boundary located immediately upslope of wall in places.  | Wall generally in fair condition. Limited cracking observed in wall face, but top of wall heavily vegetated and not accessible. Possible cracking and displacement of concrete drain/channel at toe of wall.   | Maintenance.                                   |

| Wall Name     | Type  | Co-Ordinates <sup>(1)</sup>                              | Wall Length            | Max Height                                | Min Height                                | Thickness <sup>(2)</sup>   | Wall Rake | Toe Slope <sup>(3)</sup> (°) | Head Slope <sup>(3)</sup> (°) | Adjacent Walls?                | Walls Above/Below?   | Condition Comments   | Preliminary Remediation Options <sup>(4)</sup> |
|---------------|---|--|------------------------|---|---|--|-----------|------------------------------|-------------------------------|--------------------------------|--|--|--|
| NAP-PRIS-RW12 | Mass Concrete Gravity Wall (reinforced).<br>Supports soil below upslope neighboring properties.   | E1937045<br>N5622076<br>(Co-ordinates in NZTM system)    | 33m                    | 4.8m                                      | 3.5m                                      | Unknown, wall is tapered with thick end at base. Likely greater than 400mm | 10 - 15   | 0                            | Unknown                       | NAP-PRIS-RW14                  | NAP-PRIS-RW11<br>NAP-PRIS-RW13<br>(below)<br>Residential properties located at top of wall.            | Wall generally in fair condition. Localised cracking in some areas, vegetation growing over top of wall and through weeps/drain. Possible ground settlement at toe of wall.  | Repair.<br>Maintenance.                        |
| NAP-PRIS-RW13 | Block/Gravity (inferred based on limited observations)<br>Possibly old benched seating above prison wall.   | E1937046<br>N5622084<br>(Co-ordinates in NZTM system)    | 16m (TOP)<br>10m (BOT) | 1.4m (Benched Wall)                       | 0.7m                                      | Unknown – likely 250mm to 300mm  | 0         | 0                            | 0                             | NAP-PRIS-RW11<br>NAP-PRIS-RW15 | NAP-PRIS-RW10 (below)<br>NAP-PRIS-RW12 (above)   | Wall in fair to severely deteriorated condition. Cracking and dislodgement of blocks observed, likely due to vegetation growth. Indications of ground settlement below top wall. Significant ground cracking observed at toe of bottom wall. | Demolish and replace.<br>Maintenance.          |
| NAP-PRIS-RW14 | Stone Block/Gravity (inferred based on limited observations)<br>Supports soil below upslope neighboring properties.   | E1937038<br>N5622107<br>(Co-ordinates in NZTM system)    | 7m                     | 1.8m                                      | 1.3m                                      | Unknown – likely 250mm – 300mm   | 0         | 10 – 20                      | 10 - 20                       | NAP-PRIS-RW12                  | NAP-PRIS-RW16<br>NAP-PRIS-RW8<br>(below)<br>Residential property located upslope of wall.              | Wall difficult to observe due to vegetation/access but appears to be in generally deteriorated condition with some cracking in mortar between blocks.  | Repair.<br>Maintenance.                        |
| NAP-PRIS-RW15 | Stone Block/Gravity<br>Supports soil above path/access way to top of prison wall.   | E1937042<br>N5622099<br>(Co-ordinates in NZTM system)    | 7m                     | 1.8m                                      | 1m  | Likely 250mm   | 0         | 0                            | 0                             | NAP-PRIS-13                    | NAP-PRIS-RW10<br>NAP-PRIS-RW16<br>(below)<br>NAP-PRIS-RW12<br>(above)                                  | Wall in severely deteriorated condition. Partially collapsed in places with loose and dislodged blocks. Significant vegetation/root growth above and behind wall.  | Demolish/replace.<br>Maintenance.              |
| NAP-PRIS-RW16 | Stone Block and brick masonry gravity wall.<br>Supports soil above steps/access to top of prison wall.  | E1937042<br>N5622114<br>(Co-ordinates in NZTM system)    | 7m                     | 3.5m                                      | 0m  | Unknown – likely 250mm – 300mm   | 0         | 0 (steps)                    | 5 – 30                        | NAP-PRIS-RW7                   | NAP-PRIS-RW10<br>(below)<br>NAP-PRIS-RW15 and 13?<br>(above)<br>Supports access to top of prison wall. | Wall in fair to deteriorated condition. Some cracking observed between brick masonry and mortar eroded in places in stone block section. Loose stone blocks at top of wall. Stone blocks possibly re-mortared.                               | Repair.<br>Maintenance.                        |
| NAP-PRIS-RW17 | Stone Block/Gravity (inferred based on limited observations)<br>Section of wall appears to be unreinforced concrete east of stone block wall<br>Supports soil above prison site and below neighboring property. | -39.485050<br>176.919085<br>(Co-ordinates in WGS system) | 10m                    | 4.2m (stone wall)<br>1.9m (concrete wall) | 3.5m (stone wall)<br>0.7m (concrete wall) | Unknown – likely 250mm to 300m   | 0 - 5     | 0                            | Not visible, possibly 5 – 20  | NAP-PRIS-RW10                  | Prison site and buildings located at toe of wall.<br>Residential neighboring property upslope of wall. | Wall in fair to deteriorated condition. Some cracking observed between blocks and possible erosion of stone facing. Concrete wall appears to have been constructed recently/not original.  | Repair.<br>Maintenance.                        |

| Wall Name     | Type   | Co-Ordinates <sup>(1)</sup>   | Wall Length | Max Height   | Min Height | Thickness <sup>(2)</sup> | Wall Rake | Toe Slope <sup>(3)</sup> (°) | Head Slope <sup>(3)</sup> (°) | Adjacent Walls? | Walls Above/Below?   | Condition Comments  | Preliminary Remediation Options <sup>(4)</sup> |
|---------------|--|---|-------------|--|------------|--------------------------|-----------|------------------------------|-------------------------------|-----------------|--|---|--|
| NAP-PRIS-RW18 | Stone Block/Gravity<br>Tiered wall supporting soils upslope of residential house onsite.                   | E1937114<br>N5622134<br>(Co-ordinates in NZTM system)                                 | 23m         | 1.7m<br>(~2.7m total retained height for both tiers) | 1m         | 250mm – 300mm            | 0 - 5     | 0                            | 20 – 30                       | NAP-PRIS-RW9    | Residential house located at toe of wall.<br>Prison wall and access way located upslope of wall.   | Wall in severely deteriorated condition. Stone blocks are loose without mortar and deflecting, partial collapse of top tier wall.   | Demolish/reinstate                             |
| NAP-PRIS-RW19 | Stone Block/Gravity<br>Wall supporting soil beneath access around outside of Prison complex.               | Latitude:<br>-39.4847890<br>Longitude:<br>176.9193160<br>(Co-ordinates in WGS system) | 27m         | 2m approx.   | 1.4m       | 200mm – 300mm approx.    | 0         | 0                            | 30 – 45                       | -               | NAP-PRIS-RW20<br>(below)<br>Prison complex, including buildings, fencing and paths located upslope of wall.<br>Sump also present immediately behind wall.    | Wall in deteriorated condition. Some cracking observed in the face of the wall. Top of wall heavily vegetated with some trees growing immediately behind wall.  | Repair.<br>Maintenance.                        |
| NAP-PRIS-RW20 | Stone Block/Gravity<br>Supports soil upslope of old walking path from Marine Parade up to the Prison site. | Latitude:<br>-39.4849406<br>Longitude:<br>176.9192848<br>(Co-ordinates in WGS system) | 70m approx. | 1.5m   | 1.2m       | Likely 250mm – 300mm     | 0 – 5     | 0 – 5                        | 45                            | -               | NAP-PRIS-RW19<br>(above)<br>Old walking track located at toe of wall, followed by steep downward slope to Marine Parade                                      | Wall in severely deteriorated condition, eroded stone facing, cracking and partial collapse. Section of wall appears to have “blown out”, possibly due to a service rupture. Raw sewage bubbling up from sump at toe of wall and running down slope.<br><br>Leaking raw sewage will need to be fixed immediately as it poses a H&S issue. | Demolish/reinstate                             |
| NAP-PRIS-RW21 | Stone Block/Gravity<br>Running along the down slope property boundary parallel to Coote Road.              | Latitude:<br>-39.4839591<br>Longitude:<br>176.9191628<br>(Co-ordinates in WGS system) | 72m         | 2m   | 1.3m       | Likely 250mm – 300mm     | 0 – 5     | 0 – 5                        | 20 – 30                       | NAP-PRIS-RW2    | NAP-PRIS-RW4 (above)<br>Public footpath and Coote Road at toe of wall.   | Wall in fair to deteriorated condition. Cracking observed in places and mortar washed out over some sections of the wall. Some sections appear to have been re-mortared. Top of wall heavily vegetated with some vegetation coming through the face of the wall.  | Repair.<br>Maintenance.                        |
| NAP-PRIS-RW22 | Stone Block/Gravity<br>Running along the down slope property boundary parallel to the Marine Parade.       | Latitude:<br>-39.4850558<br>Longitude:<br>176.9196972<br>(Co-ordinates in WGS system) | 107m        | 2m   | 1.4m       | Likely 250mm – 300mm     | 0 – 5     | 0 – 5                        | 5 – 30                        | -               | Site slopes upwards behind wall to prison site and NAP-PRIS-RW19 and RW20.<br>Public footpath and Marine Parade located immediately adjacent to toe of wall. | Wall in fair to deteriorated condition. Some cracking in mortar and loose/dislodged top blocks in places. Drainpipes appear to have been asphalted over in some areas.  | Repair.<br>Maintenance.                        |
| NAP-PRIS-RW23 | Reinforced concrete, gravity wall.<br>Supporting soils beneath a tiered parking area.                      | Latitude:<br>-39.484372<br>Longitude:<br>176.918625<br>(Co-ordinates in WGS system)   | 20m         | 1.2m   | 0.5m       | 200mm approx.            | 0 – 5     | 0 – 5                        | 0 – 5                         | -               | NAP-PRIS-RW7 immediately in front of walls.<br>Site access and parking located around walls.   | Walls in deteriorated condition. Cracking and spalling observed in concrete with some exposed reinforcing steel observed. Top edging around wall had broken off in places.  | Demolish/reinstate                             |

Notes below

- (1) Co-ordinates taken from handheld GPS and therefore are approximate only. Indicated wall locations are shown on Figure 2 in Appendix A.
- (2) Wall thickness likely varies over the length and height of the retaining wall and has been inferred or estimated based on site observations, where measurements could not be taken. Actual thickness may vary from the presented values.
- (3) Toe and back slope angles are estimates based on site observations.
- (4) The preliminary remedial options are based on the observed condition of the retaining wall only. The decision to undertake and extent of any remedial works will need to be considered by the client.
- (5) Due to access restrictions and significant vegetation, more retaining walls may be present onsite that could not be observed/identified.

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# Appendix C

## Photos



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**'Retaining Wall – NAP-PRIS-01**



**Photo 1) NAP-PRIS-01 View**



**Photo 2) Loose, dislodged blocks.**



**Photo 3) Power box and services in front of wall.**



**Photo 4) Collapsed section of wall with visible root growth behind wall**



**Photo 5) Large displacement/gaps observed in wall. Note old tree root at toe of wall.**



**Photo 6) Site driveway/entrance showing PVC pipe outlet and erosion of soil/asphalt.**



**Retaining Wall – NAP-PRIS-02**



**Photo 1)** NAP-PRIS-02 View. Note possible ground cracking in road in front of wall.



**Photo 2)** Loose, dislodged blocks and partial collapse.



**Photo 3)** Loose blocks and partial collapse of wall.



**Photo 4)** Transition between NAP-PRIS-02 (right) and NAP-PRIS-21 (left).



**Photo 5)** Loose blocks, erosion and vegetation observed in wall face.



**Photo 6)** Inferred old stormwater channel observed in wall face.

**Retaining Wall – NAP-PRIS-03**



**Photo 1)** NAP-PRIS-03 view above site access/driveway.



**Photo 2)** Exposed soil face showing evidence of erosion.



**Photo 3)** Significant vegetation over face of wall/exposed soils. Note steep head slope.



**Photo 4)** Historical concrete stormwater channel (inferred) observed in front of wall.



**Photo 5)** Evidence of old block wall, which has collapsed and eroded.



**Photo 6)** Significant cracking and degradation of upslope concrete channel.

**Retaining Wall – NAP-PRIS-04**



**Photo 1) NAP-PRIS-04 view.**



**Photo 2) Partial collapse of wall with soil and rock pushing against fence.**



**Photo 3) Erosion of driveway/asphalt and "channel" completely filled with soil.**



**Photo 4) Soil in "channel" pushing against steel mesh fence.**



**Photo 5) Power box observed in front of wall.**



**Photo 6) Vegetation and partial collapse of wall.**

**Retaining Wall – NAP-PRIS-05**



**Photo 1)** NAP-PRIS-05 view.



**Photo 2)** NAP-PRIS-05 view. Note heavy vegetation above wall.



**Photo 3)** Retaining wall face and weep hole/drain



**Photo 4)** End of wall, drain pipe located at toe of wall.



**Photo 5)** Cracking observed in mortar between blocks.



**Photo 6)** Weep hole, possibly recently installed, clogged with soil.

**Retaining Wall – NAP-PRIS-06**



**Photo 1)** NAP-PRIS-06 view. Note recent slope failure and “new” construction of wall, also upslope residential property.



**Photo 2)** Cracked and missing mortar between blocks.



**Photo 3)** Benched slope covered with coconut matting following slip.



**Photo 4)** Interface between NAP-PRIS-07 (left) and NAP-PRIS-06 (right).



**Photo 5)** Coconut matting placed over slope following slip. Note protruding, broken services.



**Photo 6)** Wall face and drainage channel at toe of wall.

**Retaining Wall – NAP-PRIS-07**



**Photo 1)** NAP-PRIS-07 view.



**Photo 2)** NAP-PRIS-07 view. Note heavy vegetation at top of wall.



**Photo 3)** Cracking observed around blocks.



**Photo 4)** Cracking and broken drainage pipes observed.



**Photo 5)** Cracking at top of wall where heavy vegetation present. Root growth through drains.



**Photo 6)** Wall face and drainage holes.

**Retaining Wall – NAP-PRIS-08**



**Photo 1)** NAP-PRIS-08 view. Note sheds in front of wall and heavy vegetation above wall.



**Photo 2)** NAP-PRIS-08 view. Note heavy vegetation at top of wall.



**Photo 3)** Typical view of wall face.



**Photo 4)** Cracking and observed in wall face.



**Photo 5)** Cracking and vegetation growth through wall face.



**Photo 6)** Cracked and partially collapsed façade. Note prison wall on left.

**Retaining Wall – NAP-PRIS-09**



**Photo 1)** NAP-PRIS-09 view, note heavy vegetation and prison wall near top of wall.



**Photo 2)** Heavily vegetated wall face with loosely stacked blocks.



**Photo 3)** Loose blocks and partial wall collapse.



**Photo 4)** Concrete block section of NAP-PRIS-09.



**Photo 5)** Interface between loose stone section and concrete block section. Note large void.



**Photo 6)** Cracking of access way and rotation of fence at top of wall.



**Retaining Wall – NAP-PRIS-10**



**Photo 1)** NAP-PRIS-10 view. Interior prison wall.



**Photo 2)** Brick masonry at cracking observed at end of wall.



**Photo 3)** Vegetation and observed water seepage over wall face.



**Photo 4)** NAP-PRIS-10 view. Note picket fence area is the prison graveyard.



**Photo 5)** ~300mm wide ground cracks observed at the top of the wall.



**Photo 6)** Cracking and possible rotation observed at top of wall.

**Retaining Wall – NAP-PRIS-11**



**Photo 1)** NAP-PRIS-11 view. Located above NAP-PRIS-10.



**Photo 2)** Typical wall face observed. Note "square" holes are weep holes/wall drainage.



**Photo 3)** Heavy vegetation above top of wall.

**Retaining Wall – NAP-PRIS-12**



**Photo 1)** NAP-PRIS-12 view. Located along upslope property boundary.



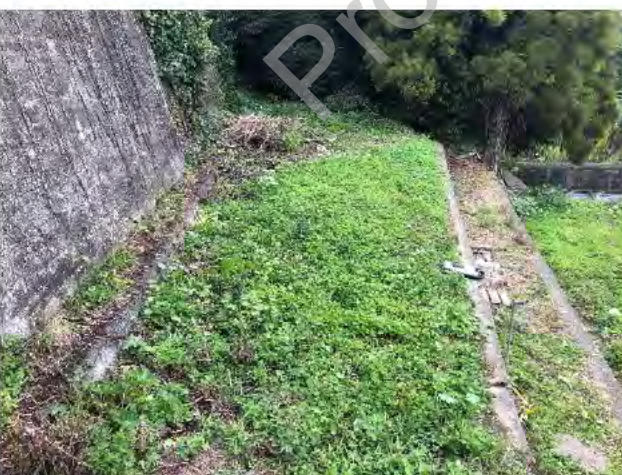
**Photo 2)** NAP-PRIS-12 view. Located along upslope property boundary.



**Photo 3)** Some cracking observed in wall face.



**Photo 4)** Vegetation growth over face.



**Photo 5)** Toe of wall. Note exposed lip of wall toe, possibly indicating some ground settlement.

**Retaining Wall – NAP-PRIS-RW13**



**Photo 1)** NAP-PRIS-RW13 view. Located below NAP-PRIS-RW12.



**Photo 2)** Drainage outlet at wall toe.



**Photo 3)** Ground cracking observed in front of wall (behind NAP-PRIS-RW10)



**Photo 4)** Loose/dislodged blocks observed.



**Photo 5)** Loose/dislodged blocks observed. Possible wall settlement resulting in "gap".



**Photo 6)** NAP-PRIS-RW13 view.

**Retaining Wall – NAP-PRIS-RW14**



**Photo 1)** NAP-PRIS-RW14 view. Located below neighbouring residential property.



**Photo 2)** Drainage pipe observed.

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**Retaining Wall – NAP-PRIS-RW15**



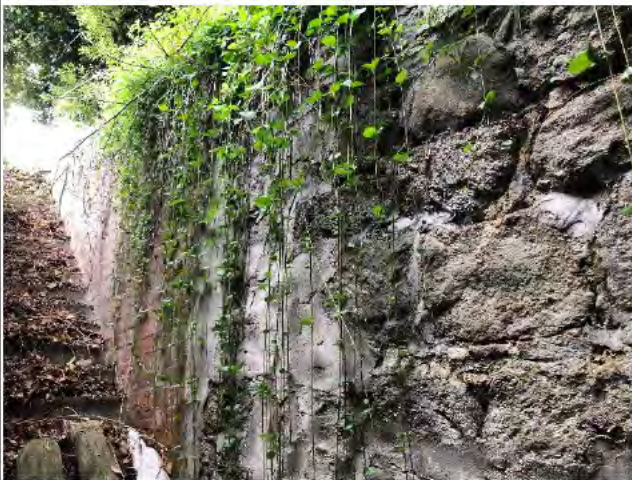
**Photo 1)** NAP-PRIS-RW15 view. Located adjacent to NAP-PRIS-RW13.



**Photo 2)** Loose blocks, heavy vegetation and partial collapse observed.

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**Retaining Wall – NAP-PRIS-RW16**



**Photo 1)** NAP-PRIS-RW16 view. Located adjacent to stairway/access to top of NAP-PRIS-RW10.



**Photo 2)** NAP-PRIS-RW16 view.



**Photo 3)** Vegetation observed at top of wall. Cracking and erosion of mortar and blocks.



**Photo 4)** Cracking observed in brick masonry.



**Photo 5)** Cracking observed at end of wall.



**Photo 6)** Cracking observed at base of wall.

**Retaining Wall – NAP-PRIS-RW17**



**Photo 1)** NAP-PRIS-RW17 view.



**Photo 2)** NAP-PRIS-RW17 view. Note concrete block wall appears to be recently constructed.



**Photo 3)** Cracking observed in wall face.



**Photo 4)** Mass concrete wall observed adjacent to NAP-PRIS-RW17.



**Photo 5)** Erosion of stone blocks and mortar observed.



**Photo 6)** Erosion of stone blocks and mortar observed.



**Retaining Wall – NAP-PRIS-RW18**



**Photo 1) NAP-PRIS-RW18 view.**



**Photo 2) NAP-PRIS-RW18 view, section used for landscaping.**



**Photo 3) NAP-PRIS-RW18 view. Located approximately 1.7m off house.**



**Photo 4) Top tier of wall almost completely collapsed.**



**Photo 5) Bulging of wall observed.**



**Photo 6) Loosely stacked rocks of wall face.**

**Retaining Wall – NAP-PRIS-RW19**



**Photo 1)** NAP-PRIS-RW19 view. Note steep toe slope.



**Photo 2)** NAP-PRIS-RW19 view. Located above NAP-PRIS-RW20.



**Photo 3)** Cracking observed in wall face.



**Photo 4)** Typical wall face condition.



**Photo 5)** Top of wall. Note edge of prison building shown on right.



**Photo 6)** Manhole observed immediately behind top of wall.

**Retaining Wall – NAP-PRIS-RW20**



**Photo 1) NAP-PRIS-RW20 view.**



**Photo 2) NAP-PRIS-RW20 view.**



**Photo 3) Cracking and partial collapse of wall observed.**



**Photo 4) Cracking and partial collapse of wall observed.**



**Photo 5) Raw sewage leaking from sump in front of wall.**



**Photo 6) Collapsed section of wall immediately upslope of sewage leak.**

**Retaining Wall – NAP-PRIS-RW21**



**Photo 1)** NAP-PRIS-RW21 view. Note Coote Road in foreground.



**Photo 2)** NAP-PRIS-RW21 view. Note Coote Road in foreground.



**Photo 3)** Cracking observed in wall face.



**Photo 4)** Cracking observed in wall face.



**Photo 5)** Section appears to have been re-mortared recently.



**Photo 6)** Section of wall appears to have been re-grouted recently.

**Retaining Wall – NAP-PRIS-RW22**



**Photo 1) NAP-PRIS-RW22 view. Note Marine Parade in foreground. Prison site/buildings upslope.**



**Photo 3) Loose blocks/mortar eroded between blocks.**



**Photo 4) Cracking observed between stone blocks.**



**Photo 5) Entrance way for old walkway upslope to prison site.**



**Photo 6) Old drainage pipes appear to have been recently asphalted over in places.**

**Retaining Wall – NAP-PRIS-RW23**



**Photo 1) NAP-PRIS-RW23 view. Parking terraces.**



**Photo 2) NAP-PRIS-RW23 view.**



**Photo 3) Cracking and top barrier broken off top of wall.**



**Photo 4) Cracking observed in wall face.**



**Photo 5) Erosion, wall collapse and broken top barrier.**



**Photo 6) Broken top barrier.**