

Napier Ex Prison Retaining Wall Assessment

Geotechnical Design Review

Land Information New Zealand

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Title		Title	
Geotechnical Engineer		Technical Director – Ground Engineering	

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1 Introduction

1.1 Overview

Land Information New Zealand (LINZ) has engaged Aurecon New Zealand Limited (Aurecon) to undertake a geotechnical assessment and develop remedial designs for the retaining walls at the Napier Ex Prison site, located at 55 Coote Road, Napier.

Aurecon was previously engaged to develop concept remedial designs for multiple retaining walls (Group 1 - RW10, RW11, RW12, RW17 and Group 3 - RW19), identified as requiring remediation to improve stability (Aurecon ref: 520969 – Napier Ex Prison – Concept Design Report, dated 19 May 2023). Aurecon has recently been engaged to undertake the geotechnical investigations for the Group 1 retaining walls, which was completed in May 2024.

The work has been undertaken in accordance with signed Statement of Work dated 24 November 2021 and subsequent agreed variations V01 to V08. This report should be read as a whole and with Aurecon's Explanatory Statement presented in Section 1.4.

1.2 Previous Works

Aurecon has undertaken geotechnical assessment and works comprising site walkovers, retaining wall remedial assessment and surveys for LINZ on the Napier Ex Prison site since 2022 (see Concept Design Report Aurecon ref: 520969 – “*Napier Ex Prison – Concept Design Report*”, dated 19 May 2023).

1.3 Scope

The scope of geotechnical service undertaken by Aurecon for this report is as follows:

- Present the geotechnical investigation results at the site, completed in May 2024.
- Refine the geotechnical assessment of the retaining walls and review of the current concept remedial designs based on the investigation results.
- Prepare a Geotechnical Design Review report detailing the ground investigations and presenting the geotechnical design recommendations.

This report presents our additional updated assessment and revised geotechnical design recommendations and should be read in conjunction with the Concept Design Report.

1.4 Explanatory Statement

We have prepared this report in accordance with the brief as provided. The contents of the report are for the sole use of the Client and no responsibility or liability will be accepted to any third party. Data or opinions contained within the report may not be used in other contexts or for any other purposes without our prior review and agreement.

The recommendations in this report are based on site observations at specific locations with limited site coverage. Only a finite amount of information has been collected to meet the specific financial and technical requirements of the Client's brief and this report does not purport to completely describe all the site characteristics and properties. The nature and continuity of the ground across the site has been inferred using experience and judgment and it must be appreciated that actual conditions could vary from the assumed model.

Subsurface conditions relevant to construction works should be assessed by contractors who can make their own interpretation of the factual data provided. They should perform any additional tests as necessary for their own purposes.

Subsurface conditions, such as groundwater levels, can change over time. This should be borne in mind, particularly if the report is used after a protracted delay.

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2 Ground Investigation

2.1 General

Aurecon has undertaken a geotechnical investigation as outlined in the Variation of Services, V08, dated 26 March 2024. The objectives of the geotechnical assessment and investigations were to confirm the subsurface and groundwater conditions to allow refinement of the proposed concept remedial design.

2.2 2024 Aurecon Geotechnical Investigation

Intrusive geotechnical investigations were undertaken at the site by Griffith Drilling, primarily along the RW10 location to determine the retaining wall sizes, subsurface ground conditions, and depth to rock behind the wall. Drilling was undertaken between 6 and 10 May 2024 and was supervised by an Engineering Geologist from Aurecon. The investigation comprised 11 concrete coring, three horizontal machine boreholes and two vertical window sampler boreholes. A geotechnical investigation plan is present in Appendix A and the investigation logs are attached in Appendix B.

Interpretive geological cross sections through selected locations of the site have been undertaken based on the geotechnical investigation completed and are presented in Appendix A.

2.3 Ground Model

Based on the geotechnical investigation, a ground model has been developed for the retaining wall remedial design. The ground model presented in Table 2-1 describes the assumed ground conditions behind the retaining walls at the site. It is noted that the geotechnical investigation and subsequent analysis primarily focused on the ground conditions relevant to the retaining walls and therefore subsurface conditions beneath the prison buildings have not been assessed. Figure 2-1 provides an illustration of the previously assumed backfill thickness and current investigated interpretation of the backfill thickness layer.

Table 2-1. Inferred ground model at Napier Ex Prison site.

Geotechnical Unit	Assumed Horizontal Unit Thickness	Description
1	0.4m to 0.7m	Retaining Wall Stone Block ⁽²⁾
2	0m to 1.7m	Silty SAND to Silty GRAVEL (Retaining Wall Backfill)
3	~20m ⁽¹⁾ (beyond depth investigated)	Weathered LIMESTONE/SANDSTONE

Notes:

- (1) Assumed thickness of rock based on regional geology information.
- (2) Investigations indicate stone block at RW10 has a thicker top section compared to the bottom section.

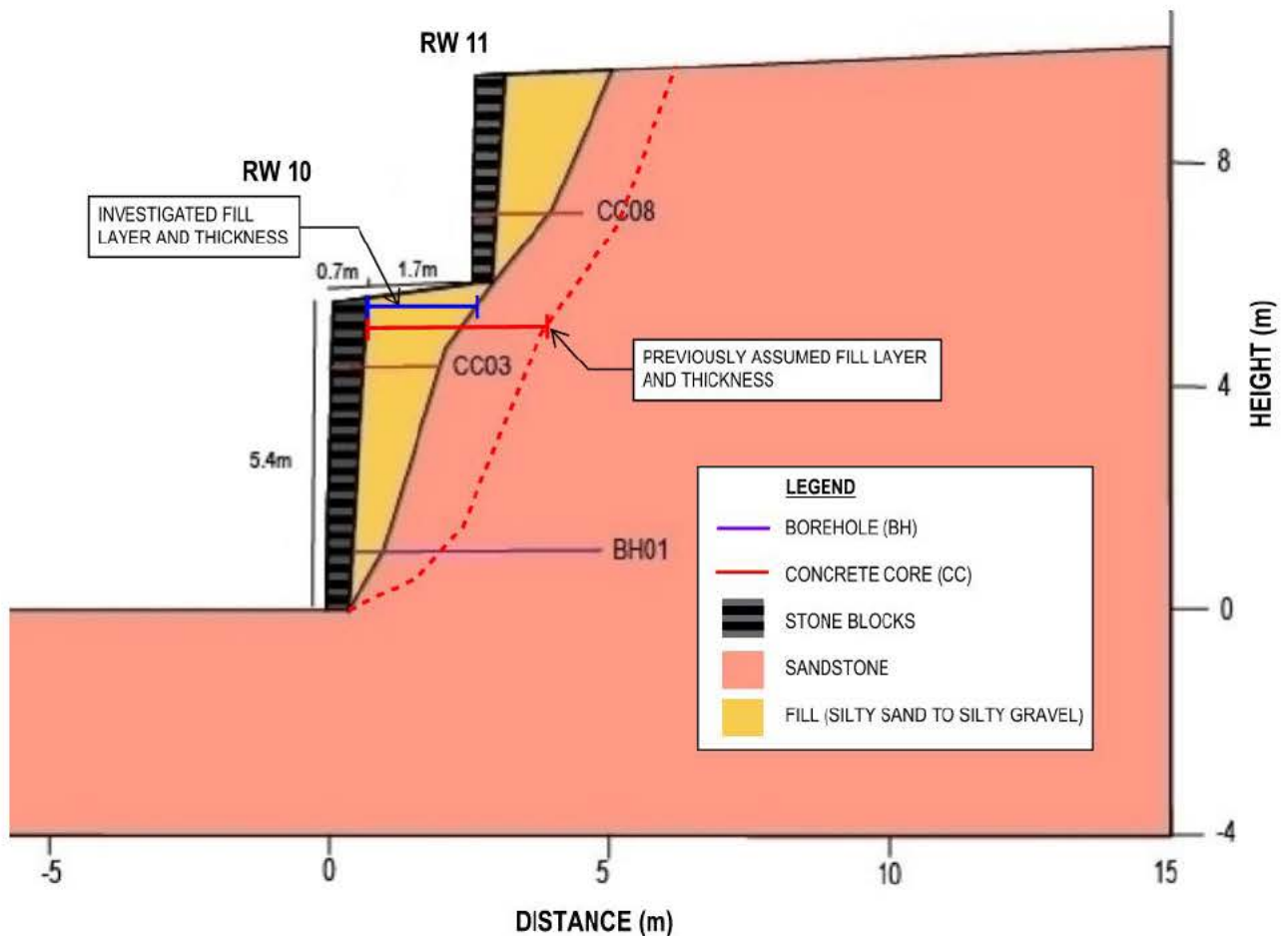


Figure 2-1. Illustration of the previously assumed (red dotted line) and current interpretation of fill thickness based on investigation of the retaining wall.

3 Risk and Condition Assessment

A two-stage geotechnical risk and condition assessment was previously prepared to determine the condition and consequence of failure for each of the 23 wall assets identified on site. Details of the risk assessment are presented in the memo (Aurecon ref: “*Napier Ex-Prison – Retaining Wall Assessment*”, dated 8 April 2022 and “*Napier Ex-Prison – Retaining Wall Assessment – Stage 2 Risk Assessment*”, dated 5 September 2022).

The September 2022 risk assessment anticipated that the retaining walls are unlikely to be a significant life safety risk under static conditions but will likely deteriorate and may lead to ongoing localised failure in the future. However, the walls are considered at risk of failure under adverse weather conditions and/or moderate seismic events.

The risk assessment for the retaining walls have been reviewed and the following is noted:

- The risk rating for **RW19** was previously considered a high risk to the prison building and services due to its deteriorating condition as the retaining wall was assumed to support soil beneath the access around the prison complex. The risk rating for RW19 has been reduced from high to moderate as the investigation revealed the presence of weathered sandstone material, approximately 2m from the face of the wall and its foundations are predominantly on weathered sandstone. Failure of RW19, if it occurred, is therefore considered to pose a lower risk to the prison building and life given the distance of the retaining wall from the prison building and neighbouring properties as well as the recent geotechnical investigation findings.
- For the remaining retaining walls, **RW10, RW11, RW12 and RW17**, the risk rating remains unchanged from that previously categorised. It should be noted that the critical risk rating for RW10 continues to be a very high risk under seismic conditions. Failure of RW10 has the potential to cause injury/death to people, damage to structures below, and undermine tiered wall system above RW10, with potentially cascading impacts.

4 Engineering Considerations

4.1 General

Aurecon has developed conceptual remedial designs for the Group 1, high-risk retaining walls (RW10, RW11, RW12 and RW17) at LINZ Napier Ex Prison site. The previous conceptual remedial designs for the Group 1 retaining walls incorporated soil nail stabilisation with a facing detail of either active mesh or waler beams. This section of the report presents the updated design recommendations, which have been refined based on the 2024 geotechnical investigations undertaken at the site.

4.2 Previous Remedial Design

4.2.1 Design Intent

The remedial design intent for Group 1 walls is to stabilise retaining walls RW10, RW11, RW12 and RW17 to minimise ongoing wall movements, provide additional capacity against overturning, and protect the public and prison structures from the potential wall failure.

4.2.2 Design Parameters and Assumptions

The previous Aurecon concept remedial design was based on the following key assumptions and parameters, as presented below:

- The retaining wall structure have been classified as an Importance Level 2 (IL2) structure. A design life of 50 years has been adopted for the remedial design works.
- The site is located in a high seismic risk region, with a published design acceleration of 0.55g and an earthquake magnitude, M_w , of 7.1 for a 1 in 500-year ultimate limit state (ULS) seismic event.
- There is no definitive information regarding the construction date of the retaining wall in relation to the 1931 M_w 7.7 Napier earthquake. Absence of visible earthquake damage repairs suggest that the wall may not have experienced a large seismic event.
- Masonry walls assumed to provide minimal support to the retained backfill material with limited retaining wall stability under both static and seismic loading scenarios.
- A layer (approximately 0m to 3.5m thick) of retained backfill material was assumed behind the retaining wall.
- A soil nail system will be used to increase wall stability and retention of the backfill material.
- A potential failure surface was assumed to run through silt backfill layer.

4.2.3 Conceptual Remedial Design

Aurecon has proposed two alternative soil nail arrangements and facing options, active mesh or waler beams, which are detailed in the conceptual remedial sketches (Aurecon ref: 520969-0000-SKT-GG-0001 to 0004, dated 23 January 2023).

The active mesh facing option will require denser pattern of soil nails, with soil nails installed at the top and bottom of the retaining wall to securely anchor the active mesh. The soil nails are arranged in a diamond pattern to provide resistance against debris falling between the walls and the mesh.

For the waler beam option, the soil nails and horizontal waler beams would be used to stabilise the retaining wall. Soil nails are installed in rows aligned with the waler beams, eliminating the need for top and bottom rows of soil nails and therefore requiring fewer soil nails than the active mesh facing option.

4.3 Proposed Remedial Design Recommendation

As presented in Section 2, the recent site geotechnical investigations identified that the backfill material behind the retaining walls is thinner than previously anticipated, with a maximum thickness of 1.7m instead of the initial estimate of 3.5m.

Given the reduced width of the backfill layer, and the presence of weathered sandstone/limestone material, the previous assumption of requiring soils nails for the overall wall stability under static conditions may not be necessary. This is because the weathered rock material behind the retaining wall has some inherent stability and is expected not to require a retaining wall to remain stable under static and seismic loads although small scale, defect-controlled fretting could potentially occur off the rock face, if exposed.

While the weathered rock material behind the wall may be generally stable, it is important to note that the retaining wall itself may not be sufficiently robust structurally and stable, particularly during seismic events. In addition, the granular backfill material is likely to be unstable under seismic conditions if there is no support by the wall.

Though the reduced backfill width may lessen the need for extensive soil nail reinforcement, it is still required to implement remedial measures to ensure the stability of the retaining wall and prevent potential wall collapse. The previously proposed soil nail design remains our preferred option, but the required nail length is likely to be shorter due to the reduced backfill width. Previous conceptual assessment indicated a minimum soil nail length of 9m. However, following the recent site investigation, a preliminary revised assessment estimates the reduced soil nail length to range between 4m to 6m, with a bonded length of 3m to 4m into rock.

Stormwater management is recommended to divert uncontrolled stormwater runoff from the face of the wall and limit excessive water pressure buildup (if any) behind the wall by collecting and discharge runoff in a controlled manner. The presence of existing tension cracks observed at the crest of retaining wall can create potential pathway for stormwater runoff infiltration. Therefore, it is recommended to backfill the cracks to limit water seepage and pore water pressure buildup behind the wall, which can lead to increased wall destabilising pressures. If design of stormwater management system is required, Aurecon should be contacted to provide advice with the installation works undertaken by a suitably qualified Contractor.

4.4 Neighbouring Properties

The Group 1 retaining walls (RW10, RW11, RW12 and RW17) are located along the Napier Ex Prison property boundary. The wall supports surficial ground below neighbouring properties as well as being above the prison site and its buildings. As presented in Section 3, the risk rating of the Group 1 retaining walls remains unchanged and they are still at risk of failure under a seismic event. Failure of Group 1 retaining walls will likely present a major risk to the prison buildings and may undermine parts of properties above the wall.

Previous design and risk assessments have assumed granular backfill behind the existing retaining walls. This backfill assumption has been confirmed with the completion of the site investigations, however thinner layers of backfill were identified than previously assumed (i.e. distance from rock face to wall reduced) as shown in Figure 2-1. These investigation findings may change the remedial design solution slightly but will unlikely change the consequences of the retaining wall failure.

Global instability, and failure of the backfill behind the retaining wall, is less of a hazard as the backfill is narrower than previously assumed with a reduced volume. However, it is anticipated that failure of the retaining walls will likely lead to movement of upper steepened surficial material behind the walls. While this movement might not directly undermine the foundations of neighbouring houses, it could indirectly impact the foundation integrity of ancillary structures through creeping and surficial material movement, particularly for RW11 and RW17 given the proximity to an existing pool and property boundary. Ongoing movement, erosion of neighbouring property area, and long-term instability issues are also expected with the failure of the Group 1 retaining walls.

4.5 Conclusion

Despite the reduced backfill, the required remedial work for the retaining wall is expected to remain extensive, similar to previous conceptual recommendations, as the existing retaining wall is likely to be structurally unstable, particularly during seismic events. It is anticipated that the failure of the retaining wall will likely compromise the stability of the supported neighbouring structures despite the investigation findings indicating reduced backfill volume.

To ensure the stability of the retaining wall, it is recommended to proceed with the remedial design and implementation of retaining works. While the extent of the work may be similar to the previous conceptual design, the soil nail lengths are anticipated to be shorter than previously scoped.

Additionally, implementing stormwater management measures is recommended to divert stormwater runoff from the retaining wall. Backfilling the existing tension cracks will also be required to limit further deterioration.

5 Ongoing Geotechnical Involvement

In addition to the design recommendations presented above, Aurecon recommends a geotechnical engineering is retained to:

- Refine and develop the detailed design of the soil nail system.
- Provide further detailed geotechnical design inputs and recommendations for remedial work at other retaining wall sites, if required.
- Observe the installation of trial soil nails and oversee load tests of soil nails to determine appropriate design grout/ground ultimate bond strength.

Appendix A

Geotechnical Investigation Plan and Cross Sections



LEGEND

- A-A'
- B-B'
- C-C'
- X Face Mapping
- Concrete Core BH
- Portable Rig BH
- Window Sampler BH
- Low Risk Rating
- Moderate Risk Rating
- High Risk Rating
- Very High Risk Rating

NOTES:


[1] Locations mapped using handheld GPS in the field, accurate to +/- 5m.

[2] Aerial imagery from LINZ Data Service (Creative Commons License).

Coordinate System: Transverse Mercator Date: 18/10/2024
File Location: C:\Users\jlayden\OneDrive\Downloads\Ex Napier Prison.ggz

REFERENCE DRAWINGS			REFERENCE MODELS				
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PREPARED BY



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CLIENT

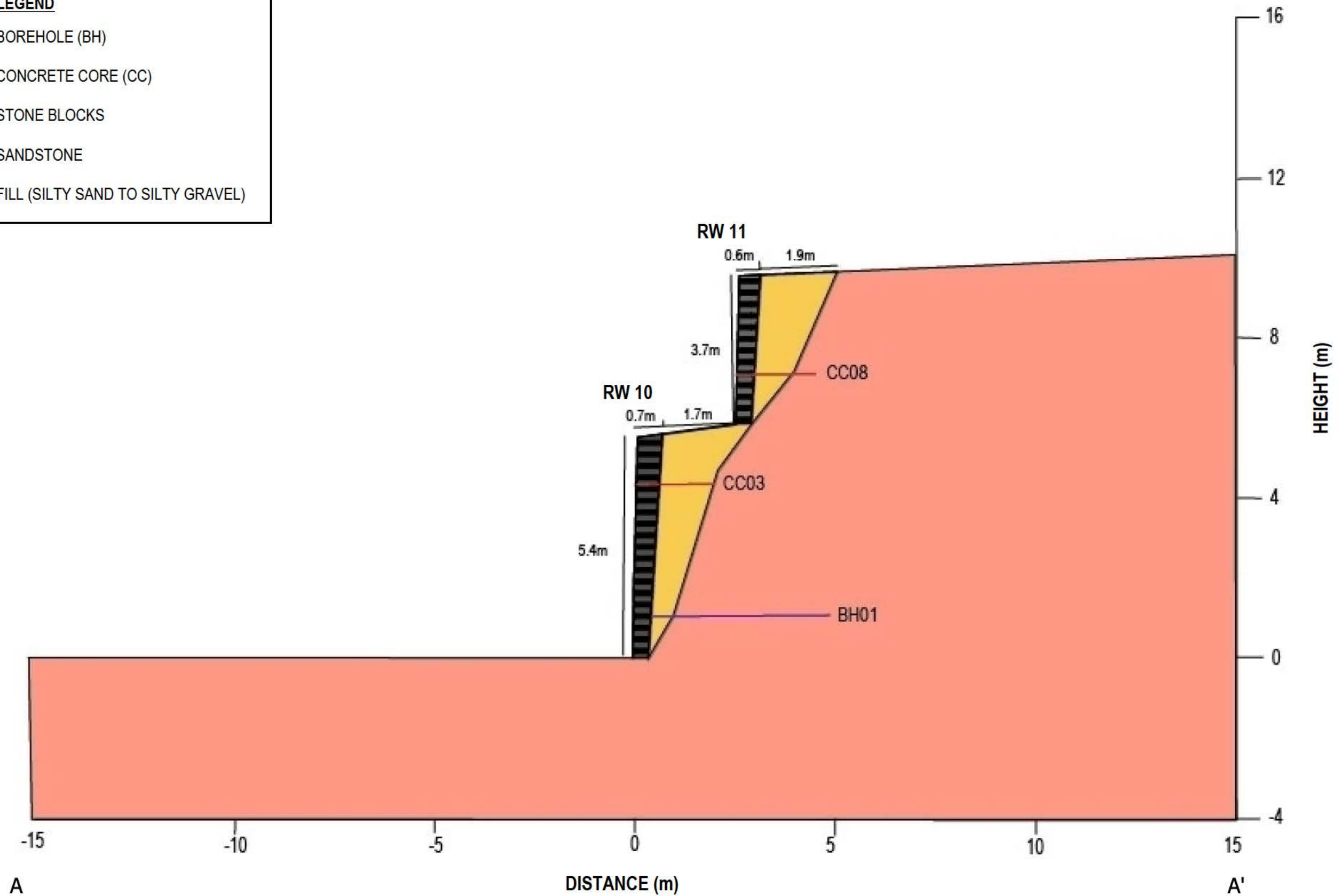


COORDINATE SYSTEM
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HEIGHT DATUM
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DESIGNED BY M van LITH		GEOTECHNICAL INVESTIGATION LOCATION PLAN			
STATUS	CODE	DOCUMENT CODE			
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DOCUMENT STATE	SCALE	SIZE	REFERENCE No.	REV	
FOR INFORMATION	SEE MAP SCALE	A3	SKT-GG-0001	A	

LEGEND	
	BOREHOLE (BH)
	CONCRETE CORE (CC)
	STONE BLOCKS
	SANDSTONE
	FILL (SILTY SAND TO SILTY GRAVEL)



Coordinate System: NZTM2000
File Location: C:\Users\Jayden.Neven\Downloads\Ex Napier Prison.qgz

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REV	DATE	REVISION DETAILS		REV	DRAWN	DESIGNED	VERIFIED	APPROVED
A	08-10-24	FOR INFORMATION		A	J NEVEN	M van LITH		

PREPARED BY: **aurecon**
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CLIENT: **Toitū Te Whenua Land Information New Zealand**





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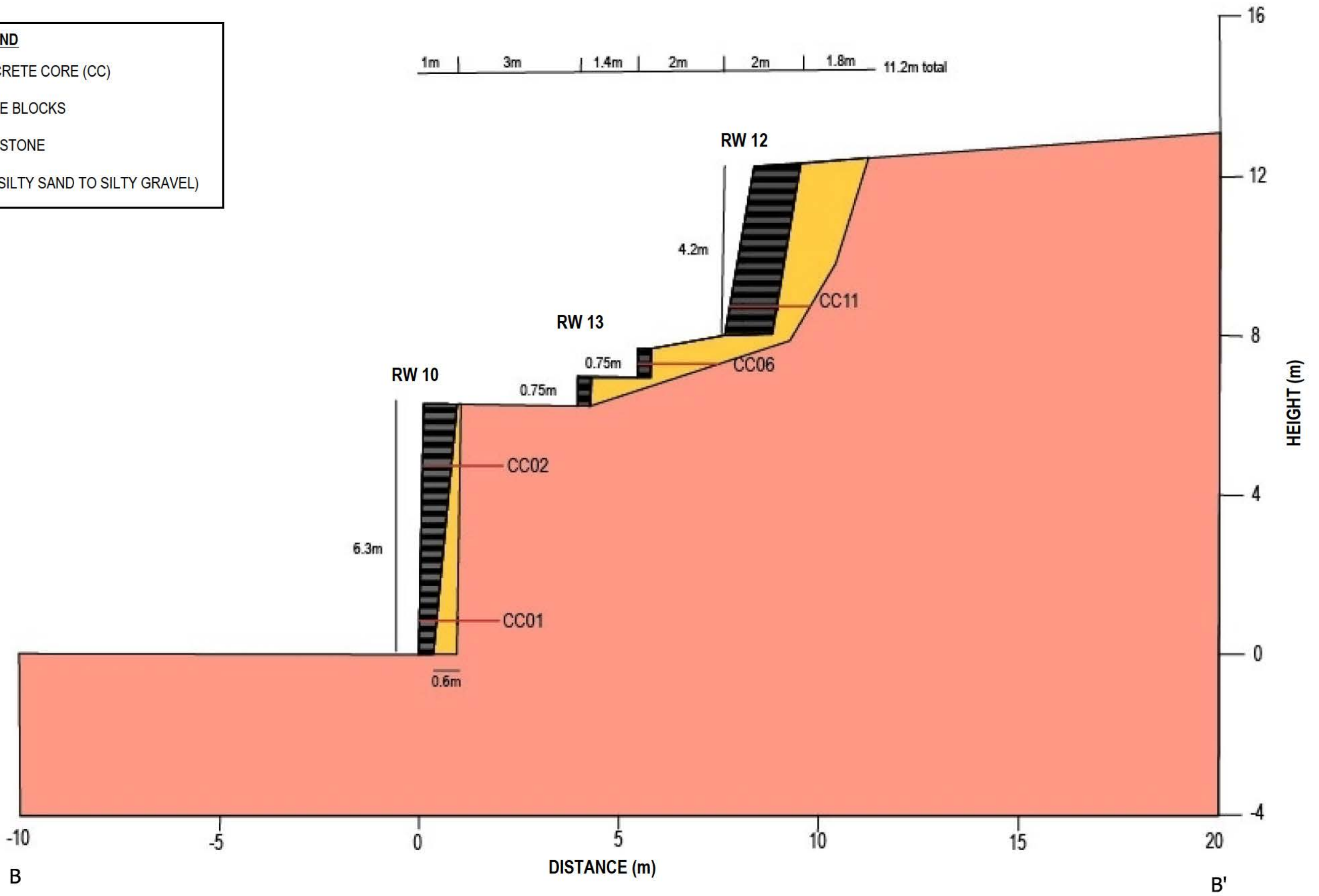
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DOCUMENT STATE: FOR INFORMATION					

LEGEND	
	CONCRETE CORE (CC)
	STONE BLOCKS
	SANDSTONE
	FILL (SILTY SAND TO SILTY GRAVEL)



Coordinate System: NZTM2000
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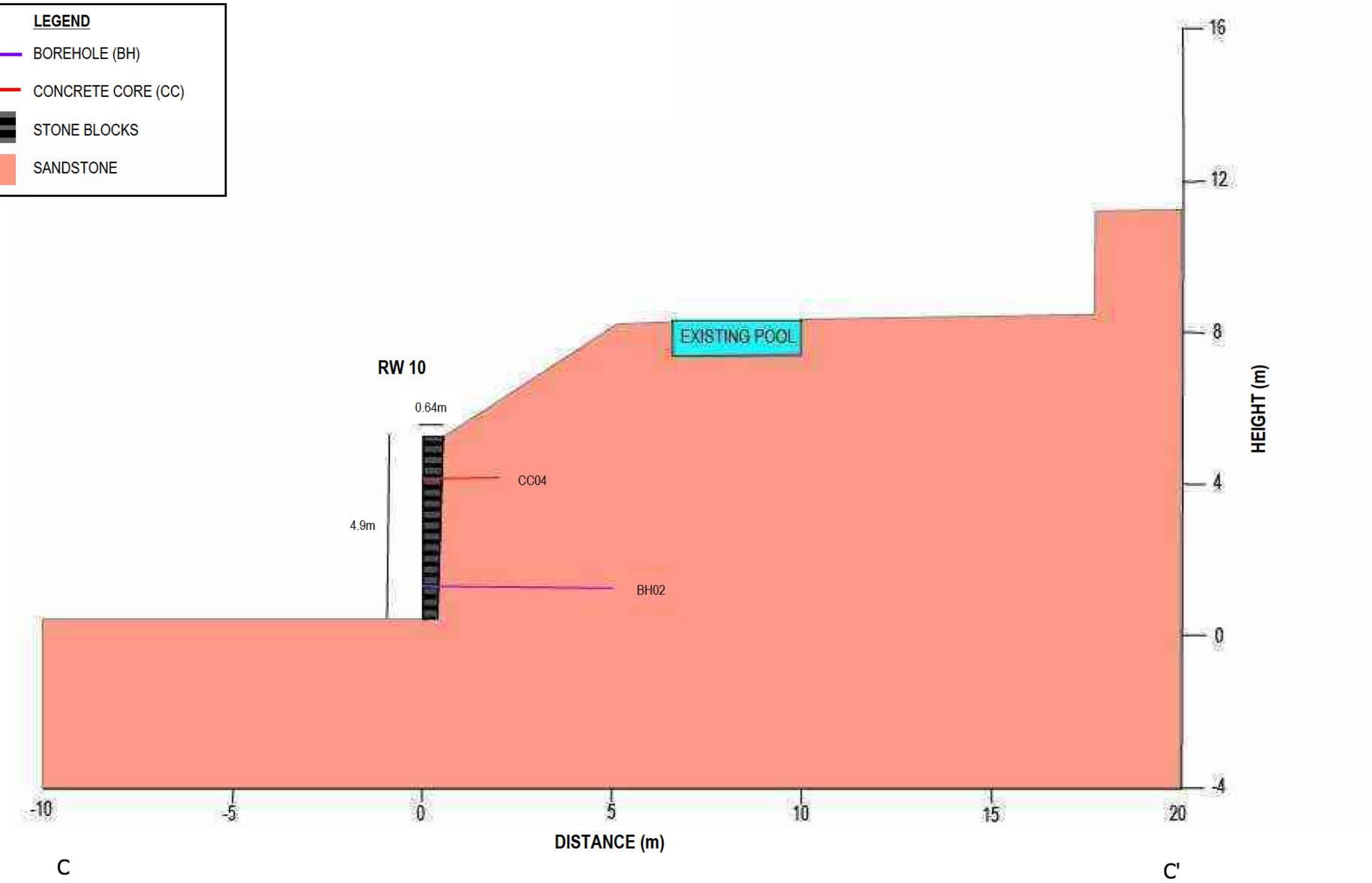
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DESIGNED BY: M van LITH		DOCUMENT CODE: 520969-W00001-SKT-GG-0003			
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Coordinate System: NZTM2000
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LEGEND

-  BOREHOLE (BH)
-  CONCRETE CORE (CC)
-  STONE BLOCKS
-  SANDSTONE



REFERENCE DRAWINGS			REFERENCE MODELS				
REV	DATE	REVISION DETAILS	REV	DRAWN	DESIGNED	VERIFIED	APPROVED
A	08-10-24	FOR INFORMATION	A	J NEVEN	M van LITH		

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DESIGNED BY: M van LITH		DOCUMENT CODE: 520969-W00001-SKT-GG-0004			
STATUS: STARTED	CODE: W1	SCALE: N.T.S.	SIZE: A3	REFERENCE No.: SKT-GG-0004	REV: A

Appendix B

Aurecon Investigation Logs

BOREHOLE INFORMATION Method: Rotary Core Conventional Equipment: Portable Horizontal Drill Rig Contractor: Griffiths Drilling	CO-ORDINATES: N/A Easting: 1937045.741m Northing: 5622070.571m Reduced level: N/A	Date started: 6/05/2024 Date completed: 10/05/2024 Inclination: 90° Azimuth: N/A	Logged by: JN Input by: JN Reviewed by: MVL Verified by: IM
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Method	R.L. (m)	Length (m)	Graphic Log	Material Description	Weathering/USC	Testing	TCR (%)	SCR (%)	RQD (%)	Fracture Log	Stratigraphy Defect Description Additional Notes	Installation
OB HQ			x x	0m: Stone Block						WS WS MS CS VCS ECS		
			X	0.4m: Core loss - wash out of soft residual soils.								
		1	.....	0.9m: Highly weathered, light brown SANDSTONE. Weak, undulating rough.	HW						0.9m: Mangaheia Group	
		2	.....	2m: Moderately weathered, dark brown SANDSTONE. Weak to moderate, undulating rough.	MW							
		3	.....								
		4	.....								
		5	.....								

REMARKS: End of borehole at 5m (Target Reached)
 [1] Horizontal co-ordinates recorded in field using handheld GPS, accurate to +/- 5m

Water Level Readings:
 Date Time | Hole Depth | Water Level
 No water level recorded

BOREHOLE INFORMATION Method: Rotary Core Conventional Equipment: Portable Horizontal Drill rig Contractor: Griffiths Drilling	CO-ORDINATES: N/A Easting: 1937080.973m Northing: 5622055.593m Reduced level: N/A	Date started: 6/05/2024 Date completed: 10/05/2024 Inclination: 90° Azimuth: N/A	Logged by: JN Input by: JN Reviewed by: MVL Verified by: IM
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Method	R.L. (m)	Length (m)	Graphic Log	Material Description	Weathering/USC	Testing	TCR (%)	SCR (%)	RQD (%)	Fracture Log	Stratigraphy Defect Description Additional Notes	Installation
OB HQ				0m: Stone Block						WSS WS MWS CS VCS ESS		
		1		0.4m: Sandy SILT, brown. Wet, loose, sand, fine to medium, sub rounded to sub angular	MI-SP						0.4m: Mangaheia Group	
		2		2.5m: SAND with some silt, dark brown. Wet, loose, sand: medium to coarse, sub angular.	SM							
		3		4.5m: Core loss								
		4										
		5										

REMARKS:
[1] Horizontal co-ordinates recorded in field using handheld GPS, accurate to +/- 5m

Water Level Readings:
Date Time | Hole Depth | Water Level
No water level recorded

BOREHOLE INFORMATION Method: Rotary Core Conventional Equipment: Portable Horizontal Drill rig Contractor: Griffiths Drilling	CO-ORDINATES: N/A Easting: 1937080.973m Northing: 5622055.593m Reduced level: N/A	Date started: 6/05/2024 Date completed: 10/05/2024 Inclination: 90° Azimuth: N/A	Logged by: JN Input by: JN Reviewed by: MVL Verified by: IM
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Method	R.L. (m)	Length (m)	Graphic Log	Material Description	Weathering/USC	Testing	TCR (%)	SCR (%)	RQD (%)	Fracture Log	Stratigraphy Defect Description Additional Notes	Installation
OB HQ		6		5m: Highly weathered brown SANDSTONE. Weak.	HW					WSS WS MWS CS VCS ESS		

End of borehole at 6m (Target Reached)

REMARKS:
 [1] Horizontal co-ordinates recorded in field using handheld GPS, accurate to +/- 5m

Water Level Readings:
 Date Time | Hole Depth | Water Level
 No water level recorded

BOREHOLE INFORMATION Method: Concrete Core Equipment: Concrete Drill Contractor: Dans Concrete Cutting	CO-ORDINATES: N/A Easting: 1937047.080m Northing: 5622091.168m Reduced level: N/A	Date started: 6/05/2024 Date completed: 10/05/2024 Inclination: 90° Azimuth: N/A	Logged by: JN Input by: JN Reviewed by: MVL Verified by: IM
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Method	R.L. (m)	Length (m)	Graphic Log	Material Description	Weathering/USC	Testing	TCR (%)	SCR (%)	RQD (%)	Fracture Log	Stratigraphy Defect Description Additional Notes	Installation	
CC	1	0m		0m: Stone Block						WSS WS MWS CS VCS ECS			
				0.4m: SAND with some shells, light brown. Very loose	SP							0.4m: Mangaheia Group	
				0.45m: Void									
				0.55m: Core loss - washout of soft soils									
	2			1m: Highly weathered, brown SANDSTONE with shells. Very weak.	HW						1m: Mangaheia Group		

End of borehole at 2m (Target Depth Reached)

REMARKS:
 [1] Horizontal co-ordinates recorded in field using handheld GPS, accurate to +/- 5m

Water Level Readings:
 Date Time | Hole Depth | Water Level
 No water level recorded

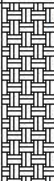

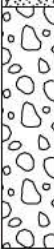

BOREHOLE INFORMATION Method: Concrete Core Equipment: Concrete Drill Contractor: Dans Concrete Cutting	CO-ORDINATES: N/A Easting: 1937047.080m Northing: 5622091.168m Reduced level: N/A	Date started: 6/05/2024 Date completed: 10/05/2024 Inclination: 90° Azimuth: N/A	Logged by: JN Input by: JN Reviewed by: MVL Verified by: IM
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Method	R.L. (m)	Length (m)	Graphic Log	Material Description	Weathering/USC	Testing	TCR (%)	SCR (%)	RQD (%)	Fracture Log	Stratigraphy Defect Description Additional Notes	Installation
CC				0m: Stone Block						WSS WS MWS CS VCS ESS		
				0.7m: Void 0.75m: Core loss - washout of soft soils								
	1			0.9m: Highly weathered, brown SANDSTONE. Very weak to weak, rough undulating.	HW						0.9m: Mangaheia Group	

End of borehole at 2.1m (Target Depth Reached)

REMARKS: [1] Horizontal co-ordinates recorded in field using handheld GPS, accurate to +/- 5m	Water Level Readings: Date Time Hole Depth Water Level No water level recorded
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BOREHOLE INFORMATION Method: Concrete Core Equipment: Concrete Drill Contractor: Dans Concrete Cutting	CO-ORDINATES: N/A Easting: 1937045.741m Northing: 5622070.571m Reduced level: N/A	Date started: 6/05/2024 Date completed: 10/05/2024 Inclination: 90° Azimuth: N/A	Logged by: JN Input by: JN Reviewed by: MVL Verified by: IM
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Method	R.L. (m)	Length (m)	Graphic Log	Material Description	Weathering/USC	Testing	TCR (%)	SCR (%)	RQD (%)	Fracture Log	Stratigraphy Defect Description Additional Notes	Installation
CC				0m: Stone Block						WSS WS MWS CS VCS ECS		
		1		0.6m: SAND with some gravels, brown. Very loose, sand: fine to medium, subrounded, gravel: grey, medium, angular to sub rounded,	SP						0.6m: Mangaheia Group	
		2		1.2m: Medium to coarse brown GRAVEL trace sand.	GW							
				2m: Highly weathered brown SANDSTONE. Weak.	HW							

End of borehole at 2.1m (Target Depth Reached)

REMARKS:
 [1] Horizontal co-ordinates recorded in field using handheld GPS, accurate to +/- 5m

Water Level Readings:
 Date Time | Hole Depth | Water Level
 No water level recorded

BOREHOLE INFORMATION Method: Concrete Core Equipment: Concrete Drill Contractor: Dans Concrete Cutting	CO-ORDINATES: N/A Easting: 1937066.392m Northing: 5622062.323m Reduced level: N/A	Date started: 6/05/2024 Date completed: 10/05/2024 Inclination: 90° Azimuth: N/A	Logged by: JN Input by: JN Reviewed by: MVL Verified by: IM
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Method	R.L. (m)	Length (m)	Graphic Log	Material Description	Weathering/USC	Testing	TCR (%)	SCR (%)	RQD (%)	Fracture Log	Stratigraphy Defect Description Additional Notes	Installation
CC			XXXXXX	0m: Stone Block						WS WS MWS CS VCS ECS		
		1	.....	0.5m: Moderately weathered, brown SANDSTONE. Weak	MW						0.5m: Mangaheia Group	
		2	.....	1.7m: Highly weathered, brown SANDSTONE. Very weak	HW							

End of borehole at 2m (Target Depth Reached)

REMARKS: [1] Horizontal co-ordinates recorded in field using handheld GPS, accurate to +/- 5m	Water Level Readings: Date Time Hole Depth Water Level No water level recorded
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BOREHOLE INFORMATION Method: Concrete Core Equipment: Concrete Drill Contractor: Dans Concrete Cutting	CO-ORDINATES: N/A Easting: 1937080.973m Northing: 5622055.593m Reduced level: N/A	Date started: 6/05/2024 Date completed: 10/05/2024 Inclination: 90° Azimuth: N/A	Logged by: JN Input by: JN Reviewed by: MVL Verified by: IM
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Method	R.L. (m)	Length (m)	Graphic Log	Material Description	Weathering/USC	Testing	TCR (%)	SCR (%)	RQD (%)	Fracture Log	Stratigraphy Defect Description Additional Notes	Installation
CC	1	0m		0m: Stone Block						WSS WS MWS CS VCS ECS	0.4m: Mangaheia Group	
				0.4m: Washout : Completely weathered brown SANDSTONE . Extremely weak (SAND with trace silt, fine to medium, rounded).	CW							
				1.5m: Moderately weathered, brown SANDSTONE. Weak.	MW							

End of borehole at 2m (Target Depth Reached)

REMARKS:
 [1] Horizontal co-ordinates recorded in field using handheld GPS, accurate to +/- 5m

Water Level Readings:
 Date Time | Hole Depth | Water Level
 No water level recorded

BOREHOLE INFORMATION Method: Concrete Core Equipment: Concrete Drill Contractor: Dans Concrete Cutting	CO-ORDINATES: N/A Easting: 1937043.797m Northing: 5622087.992m Reduced level: N/A	Date started: 6/05/2024 Date completed: 10/05/2024 Inclination: 90° Azimuth: N/A	Logged by: JN Input by: JN Reviewed by: MVL Verified by: IM
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Method	R.L. (m)	Length (m)	Graphic Log	Material Description	Weathering/USC	Testing	TCR (%)	SCR (%)	RQD (%)	Fracture Log	Stratigraphy Defect Description Additional Notes	Installation
CC		1		0m: Stone Block	SP					<small>WSS</small> <small>WS</small> <small>MWS</small> <small>CS</small> <small>VCS</small> <small>ESS</small>	0.3m: Mangaheia Group	
				0.3m: SAND with minor gravels, greyish brown. Sand: fine to medium, rounded. Gravel: fine to coarse, angular to sub angular.								
		2										

End of borehole at 2m (Target Depth Reached)

REMARKS: [1] Horizontal co-ordinates recorded in field using handheld GPS, accurate to +/- 5m	Water Level Readings: Date Time Hole Depth Water Level No water level recorded
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BOREHOLE INFORMATION Method: Concrete Core Equipment: Concrete Drill Contractor: Dans Concrete Cutting	CO-ORDINATES: N/A Easting: 1937043.482m Northing: 5622079.981m Reduced level: N/A	Date started: 6/05/2024 Date completed: 10/05/2024 Inclination: 90° Azimuth: N/A	Logged by: JN Input by: JN Reviewed by: MVL Verified by: IM
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Method	R.L. (m)	Length (m)	Graphic Log	Material Description	Weathering/USC	Testing	TCR (%)	SCR (%)	RQD (%)	Fracture Log	Stratigraphy Defect Description Additional Notes	Installation
CC	1	0m		0m: Stone Block								
				0.3m: Highly weathered, grey CONGLOMERATE. Weak, medium to coarse, rounded.	HW							0.3m: Mangaheia Group
				0.4m: Stone Block								
				0.6m: Highly weathered, grey CONGLOMERATE. Weak, medium to coarse, rounded.	HW							0.6m: Mangaheia Group
				1m: Moderately weathered, whitish grey LIMESTONE. Moderately strong.	MW							
2		1.4m		1.4m: Highly weathered, brown SANDSTONE. Weak.	HW							

End of borehole at 2m (Target Depth Reached)

REMARKS:
 [1] Horizontal co-ordinates recorded in field using handheld GPS, accurate to +/- 5m

Water Level Readings:
 Date Time | Hole Depth | Water Level
 No water level recorded

BOREHOLE INFORMATION Method: Concrete Core Equipment: Concrete Drill Contractor: Dans Concrete Cutting	CO-ORDINATES: N/A Easting: 1937044.937m Northing: 5622072.028m Reduced level: N/A	Date started: 6/05/2024 Date completed: 10/05/2024 Inclination: 90° Azimuth: N/A	Logged by: JN Input by: JN Reviewed by: MVL Verified by: IM
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Method	R.L. (m)	Length (m)	Graphic Log	Material Description	Weathering/USC	Testing	TCR (%)	SCR (%)	RQD (%)	Fracture Log	Stratigraphy Defect Description Additional Notes	Installation
CC	1	0m		0m: Stone Block						WS WS MWS CS VCS ECS	0.4m: Mangaheia Group	
				0.4m: WASHOUT- Silty SAND, brown. Very loose, fine to medum, rounded	SW-SM							
				1.5m: Highly weathered, brown SANDSTONE. Weak.	HW							
End of borehole at 2m (Target Depth Reached)												

REMARKS: [1] Horizontal co-ordinates recorded in field using handheld GPS, accurate to +/- 5m											
Water Level Readings: Date Time | Hole Depth | Water Level No water level recorded											

BOREHOLE INFORMATION Method: Concrete Core Equipment: Concrete Drill Contractor: Dans Concrete Cutting	CO-ORDINATES: N/A Easting: 1937041.610m Northing: 5622075.322m Reduced level: N/A	Date started: 6/05/2024 Date completed: 10/05/2024 Inclination: 90° Azimuth: N/A	Logged by: JN Input by: JN Reviewed by: MVL Verified by: IM
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Method	R.L. (m)	Length (m)	Graphic Log	Material Description	Weathering/USC	Testing	TCR (%)	SCR (%)	RQD (%)	Fracture Log	Stratigraphy Defect Description Additional Notes	Installation	
CC	1	0m		0m: CONCRETE.						WS WS MWS CS VCS ECS			
				1.4m: VOID									
				1.5m: WASHOUT - Silty SAND, brown. Very loose, fine to medium, rounded	SW-SM							1.5m: Mangaheia Group	
2				1.8m: Moderately weathered, whitish grey LIMESTONE. Moderately strong.	MW								

End of borehole at 2m (Target Depth Reached)

REMARKS:
 [1] Horizontal co-ordinates recorded in field using handheld GPS, accurate to +/- 5m

Water Level Readings:
 Date Time | Hole Depth | Water Level
 No water level recorded

BOREHOLE INFORMATION Method: Concrete Core Equipment: Concrete Drill Contractor: Dans Concrete Cutting	CO-ORDINATES: N/A Easting: 1937099.558m Northing: 5622080.315m Reduced level: N/A	Date started: 6/05/2024 Date completed: 10/05/2024 Inclination: 90° Azimuth: N/A	Logged by: JN Input by: JN Reviewed by: MVL Verified by: IM
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Method	R.L. (m)	Length (m)	Graphic Log	Material Description	Weathering/USC	Testing	TCR (%)	SCR (%)	RQD (%)	Fracture Log	Stratigraphy Defect Description Additional Notes	Installation
CC	1	0.25		0m: Stone Block	SW-SM					<small>WSS</small> <small>WS</small> <small>MWS</small> <small>CS</small> <small>VCS</small> <small>ES</small>	0.25m: Mangaheia Group	
				0.25m: Silty SAND brown. Very loose, Fine to coarse, subrounded. [Residual soil]								
	2											

End of borehole at 2m (Target Depth Reached)

REMARKS:
 [1] Horizontal co-ordinates recorded in field using handheld GPS, accurate to +/- 5m

Water Level Readings:
 Date Time | Hole Depth | Water Level
 No water level recorded

BOREHOLE INFORMATION		CO-ORDINATES: N/A		Date started: 6/05/2024		Logged by: JN	
Method: Concrete Core		Easting: 1937038.789m		Date completed: 10/05/2024		Input by: JN	
Equipment: Concrete Drill		Northing: 5622090.886m		Inclination: 90°		Reviewed by: MVL	
Contractor: Dans Concrete Cutting		Reduced level: N/A		Azimuth: N/A		Verified by: IM	

Method	R.L. (m)	Length (m)	Graphic Log	Material Description	Weathering/USC	Testing	TCR (%)	SCR (%)	RQD (%)	Fracture Log	Stratigraphy Defect Description Additional Notes	Installation
CC		1		0m: CONCRETE						WSS WS MWS CS VCS ESS		
		2		1.2m: GRAVEL with some sand, greyish brown. Loose, gravel; medium to coarse, sub rounded to rounded, sand; fine to coarse, rounded.	GP						1.2m: Mangaheia Group	

End of borehole at 2m (Target Depth Reached)

REMARKS:

[1] Horizontal co-ordinates recorded in field using handheld GPS, accurate to +/- 5m

Water Level Readings:

Date Time | Hole Depth | Water Level
No water level recorded

BOREHOLE INFORMATION		CO-ORDINATES: N/A		Date started: 6/05/2024		Logged by: JN	
Method: Windowless Sampler		Easting: 1937098.608m		Date completed: 10/05/2024		Input by: JN	
Equipment: Window Sampler and Hydrovac		Northing: 5622088.144m		Inclination: 90°		Reviewed by: MVL	
Contractor: Griffiths Drilling		Reduced level: N/A		Azimuth: N/A		Verified by: IM	

Method	R.L. (m)	Length (m)	Graphic Log	Material Description	Weathering/USC	Testing	TCR (%)	SCR (%)	RQD (%)	Fracture Log	Stratigraphy Defect Description Additional Notes	Installation	
WS		1		0m: Asphalt									
				0.1m: Sandy SILT trace shells, light brown. Medium dense, sand; fine to medium.	MI-SP							0.1m: TOPSOIL	
				0.6m: SILT trace sand, greyish white. Very fine, Sand; fine	ML							0.6m: Mangaheia Group	
				0.8m: Gravelly SILT, brown. Dense, gravel; fine to medium, angular									

1.6m:...Refusal
End of borehole at 1.6m (Effective Refusal)

REMARKS:
[1] Horizontal co-ordinates recorded in field using handheld GPS, accurate to +/- 5m

Water Level Readings:
Date Time | Hole Depth | Water Level
No water level recorded

BOREHOLE INFORMATION Method: Windowless Sampler Equipment: Window Sampler Contractor: Griffiths Drilling	CO-ORDINATES: N/A Easting: 1937092.108m Northing: 5622066.147m Reduced level: N/A	Date started: 6/05/2024 Date completed: 10/05/2024 Inclination: 90° Azimuth: N/A	Logged by: JN Input by: JN Reviewed by: MVL Verified by: IM
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Method	R.L. (m)	Length (m)	Graphic Log	Material Description	Weathering/USC	Testing	TCR (%)	SCR (%)	RQD (%)	Fracture Log	Stratigraphy Defect Description Additional Notes	Installation
WS				0m: Sandy SILT some rootlets, trace gravels, brown. Loose, gravels; medium to coarse, sub angular. Sand: fine to medium, rounded.	MI-SP					WS WS MWS CS CS VCS ES	0m: TOPSOIL	
		1		0.5m: SILT with trace sand, light brown. Loose, sand; fine	ML						0.5m: Mangaheia Group	
				1.2m: Clayey SILT with some sand, brownish white. Very stiff.	ML							
		2		1.9m: Gravelly SILT, light brown. Dense, gravel; fine to medium, sub rounded.	ML							
				2.25m: ...becomes massive [highly weathered brown SANDSTONE, extremely weak] 2.45m: ...Refusal	ML HW							

End of borehole at 2.5m (Effective Refusal)

REMARKS:
[1] Horizontal co-ordinates recorded in field using handheld GPS, accurate to +/- 5m

Water Level Readings:
Date Time | Hole Depth | Water Level
No water level recorded

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