Far North District Council

Te Kaunihera o Tai Tokerau ki te Raki

AGENDA

Supplementary Reports
Extraordinary Council Meeting

Monday, 9 May 2022

Time: **3:00 pm**

Location: **Virtually via Microsoft Teams**

Membership:

Mayor John Carter - Chairperson
Cr Ann Court
Cr David Clendon
Cr Dave Collard
Cr Felicity Foy
Cr Mate Radich
Cr Rachel Smith
Cr Kelly Stratford
Cr Moko Tepania
Cr John Vujcich

Te Paeroa Mahi / Order of Business

5 REPORTS

5.2 1A SEAVIEW ROAD, PAIHIA - APPROVAL TO GRANT EASEMENT ON LOCAL PURPOSE ESPLANADE RESERVE UNDER THE RESERVES ACT 1977

File Number: **A3701981**

Author: **Carla Ditchfield, Legal Services Officer**

Authoriser: **Andy Finch, General Manager - Infrastructure and Asset Management**

TAKE PŪRONGO / PURPOSE OF THE REPORT

The purpose of this report is to seek Council approval to grant an easement under the Reserves Act 1977 on Local Purpose Esplanade Reserve, to address an imminent safety risk to a dwelling at 1A Seaview Road, Paihia. The easement is required to accept necessary reinforcing works to support a dwelling currently at risk of further damage.

WHAKARĀPOPOTO MATUA / EXECUTIVE SUMMARY

- Application EBC-2022-1188/0 has been submitted to Council to address setback from boundaries, sunlight and water setback
- The application involves the construction of 2 x retaining walls at 1A Seaview Road, Paihia (Lot 2 DP 124280 – NA72C/345 Freehold)
- The retaining walls will strengthen the foundations of the dwelling at 1A Seaview Road, Paihia.
- Stabilising the dwelling has become critical (according to Bay of Islands Planning)
- One of the reinforcing retaining walls encroaches on Local Purpose Esplanade Reserve, Lot 3 DP 124280
- The Reserves Act 1977 provides a mechanism for Council to consider approving the granting of an easement to accept the encroachment proposed by EBC-2022-1188/0 application.
- Under the Reserves Act 1977 it is for Council to consider approving the granting of an easement to accept the encroachment on Local Purpose Esplanade Reserve (Lot 3 DP 124280) for the purpose outlined.

TŪTOHUNGA / RECOMMENDATION

That Council approve the granting of an easement pursuant to section 48(1)(f) of the Reserves Act 1977 on Local Purpose Esplanade Reserve Lot 3 DP 124280 for the purpose of accepting works proposed and applied for pursuant to application EBC-2022-1188/0 affecting 1A Seaview Road, Paihia.

1) TĀHUHU KŌRERO / BACKGROUND

An application for resource consent EBC-2022-1188/0 attaching to 1A Seaview Road, Paihia (Lot 2 DP 124280) to build 2 x retaining walls has been received. Please refer to attachments A through F for expert opinion as to why the works under EBC-2022-1188/0 is considered necessary and urgent.

1A Seaview Road, Paihia (Lot 2 DP 124280) is contiguous to Local Purpose Esplanade Reserve Lot 3 DP 124280. Application EBC-2022-1188/0 outlines that one of the two retaining walls encroaches on the aforementioned Reserve.

The applicant has requested that Council consider accepting the encroachment for the purpose of the retaining wall so as to support and strengthen the foundations of the dwelling at 1A Seaview Road, Paihia.

The appropriate legal mechanism for Council consideration in accepting such encroachment is by granting easement under the Reserves Act 1977. Section 48(1)(f) states:

Section 48(1) *Subject to subsection (2) and to the Resource Management Act 1991, in the case of reserves vested in an administering body, the administering body, with the consent of the Minister and on such*

conditions as the Minister thinks fit, may grant rights of way and other easements over any part of the reserve for— …….

***(f)** providing or facilitating access or the supply of water to or the drainage of any other land not forming part of the reserve or for any other purpose connected with any such land.*

In accordance with section 48(3), public notification is not required if the Reserve is not likely to be materially altered or permanently damaged and the rights of the public (in respect of the reserve) are not likely to be permanently affected by the establishment and lawful exercise of the easement.

In accordance with section 48(1) and the subsequent Minister of Conservation's 2013 instrument of delegation for Territorial Authorities, a Territorial Authority as an administering body of a reserve, maintains the delegated authority (by the Minister of Conservation) to grant easements pursuant to section 48(1) of the reserves Act 1977.

Therefore, Council can consider and approve to grant easement under the Reserves Act 1977 for the purpose of encroachment in this instance, should it see fit to do so.

2) MATAPAKI ME NGĀ KŌWHIRINGA / DISCUSSION AND OPTIONS

Option 1 – Approve to grant easement for the purpose of encroachment of retaining wall and works under EBC-2022-1188/0 on Local Purpose Esplanade Reserve Lot 3 DP 124280.

Option 2 – Not approve to grant easement for the purpose of encroachment of retaining wall and works under EBC-2022-1188/0 on Local Purpose Esplanade Reserve Lot 3 DP 124280.

Take Tūtohunga / Reason for the recommendation

Option 1 – Approve to grant easement for the purpose of encroachment of retaining wall on Local Purpose Esplanade Reserve Lot 3 DP 124280. Refer to attachments A through F for expert opinion as to why the retaining wall is urgent and necessary. Should Council consider the construction of the retaining wall under EBC-2022-1188/0 necessary, section 48(1) of the Reserves Act 1977 provides Council with the legal mechanism to accept and legalise the encroachment of the works.

3) PĀNGA PŪTEA ME NGĀ WĀHANGA TAHUA / FINANCIAL IMPLICATIONS AND BUDGETARY PROVISION

None. Cost of easement, easement agreement and registration will be incurred by the applicant/landowner.

ĀPITIHANGA / ATTACHMENTS

1. **Bay of Islands Planning – Resource Consent application supporting report 6 April 2022 - A3702180**
2. **Northland Geotech Specialists - Geotechnical Design Report for Landslip Mitigation - 11 March 2022 - A3702188**
3. **WSP - Claim for Natural Disaster (Landslip) Damage 1A Seaview Road, Paihia - June 2021 - A3702191**
4. **Revised Plan 1A Seaview Road Survey Lot DP 124280 - A3702199**
5. **Map identifying property boundary and retaining wall encroachment - A3702200**
6. **Photos - A3702201**

Hōtaka Take Ōkawa / Compliance Schedule:

Full consideration has been given to the provisions of the Local Government Act 2002 S77 in relation to decision making, in particular:

1. A Local authority must, in the course of the decision-making process,
   a) Seek to identify all reasonably practicable options for the achievement of the objective of a decision; and
   b) Assess the options in terms of their advantages and disadvantages; and
   c) If any of the options identified under paragraph (a) involves a significant decision in relation to land or a body of water, take into account the relationship of Māori and their culture and traditions with their ancestral land, water sites, waahi tapu, valued flora and fauna and other taonga.
2. This section is subject to Section 79 - Compliance with procedures in relation to decisions.

He Take Ōkawa / Compliance Requirement	**Aromatawai Kaimahi / Staff Assessment**
State the level of significance (high or low) of the issue or proposal as determined by the Council's Significance and Engagement Policy	Low.
State the relevant Council policies (external or internal), legislation, and/or community outcomes (as stated in the LTP) that relate to this decision.	Reserves Act 1977.
State whether this issue or proposal has a District wide relevance and, if not, the ways in which the appropriate Community Board's views have been sought.	
State the possible implications for Māori and how Māori have been provided with an opportunity to contribute to decision making if this decision is significant and relates to land and/or any body of water. State the possible implications and how this report aligns with Te Tiriti o Waitangi / The Treaty of Waitangi.	
Identify persons likely to be affected by or have an interest in the matter, and how you have given consideration to their views or preferences (for example – youth, the aged and those with disabilities).	
State the financial implications and where budgetary provisions have been made to support this decision.	None. Any cost to be incurred by the landowner.
Chief Financial Officer review.	Yes.

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6 April 2022

District Services Department
Far North District Council
John Butler Centre
Kerikeri

Attention: Ms Hannah Kane.

Dear Hannah,

Re: Proposed retaining wall – 1 A Seaview Road, Paihia

I refer to your Section 92 Request and message of 18 March 2022 regarding our client's application to establish a retaining wall. For completeness we have updated the AEE to address the matters raised along with the revised design and methodology to remedy the situation.

Our client, Jane Banfield, seeks resource consent to establish two retaining walls to strengthen the foundations of her dwelling house at 1A Seaview Road, Paihia. Strengthening the foundations is required because the original structure was designed inappropriately for the location as noted within the NGS Report … " *foundations of the lower level adjacent to the slip area are typically shallow and not designed to resist slope movement, except for the single 3m deep underpinning pile shown under the terrace [2000 alterations]. To the south-west, where there is no lower level adjacent to the slope, a cantilevered concrete slab dating from approximately 1978 exists with plans showing it is supported by approx 1200 deep piles* ".

The retaining walls will give support to the foundations. One section of the lower wall cross the common boundary of land owned by the Far North District Council. Janes property is located within the 'the '**Residential Zone**' and the adjoining land vested as Esplanade Reserve is zoned '**Conservation**.'

Consent is required for the following reasons.

- Setback from Boundaries;
- Sunlight;
- Water setback.

Overall, the application is a **Discretionary Activity.**

With regard to the application itself the issue of stabilising the dwelling house has become critical. EQC have assessed the damage culminating in an approved claim which is indicative of the seriousness and urgency of the situation. Resolution of the situation which Council began over 12 months ago following heavy rain. Further heavy rain this winter , which is very common , may precipitate the side of the home being undermined and breaking away. As detailed within the application and supporting documents any further delay in undertaking the work will more than likely have disastrous consequences. As such we ask that the application be processed expeditiously.

Please do not hesitate to contact me should you require any further information. Communications with Mr Rob Stewart, Assets Department, have been undertaken in working through this project by reason of work being undertaken in Councils reserve land.

Yours faithfully,

Jeff Kemp
Principal Consultant

1. INTRODUCTION

The applicant, Jane Banfield, seeks resource consent to strengthen the foundations of The Banfield family's dwelling house, on their property located at 1A Seaview Road, Paihia. The proposed retaining walls will provide support to foundations. The existing foundations were the subject of an approved Building Permit, yet have been assessed by the Geotech engineers as … *not of a type and standard appropriate for a dwelling on the crest of a coastal cliff'.*

The application site is legally described as Lot 2 DP 124280 with an area of 1106m2 and the adjoining Council property, Lot 3 DP 124280, vested as Esplanade Reserve . A copy of the Certificate of Title for Lot 2 is attached within **Appendix A.**

The residential site contains an existing dwelling which is located at the end of a small promontory and enjoys elevated views across the Te Haumi estuary and the waters of the Kawakawa River. Access is attained via an existing concrete drive which extends from State Highway 11.

The site adjoins an Esplanade Reserve along the eastern and southern boundaries, which separates the site from the Coastal Marine Area. This Reserve, Lot 3 DP 124280, is covered in coastal vegetation and has received spoil as a result of the ground slippage.

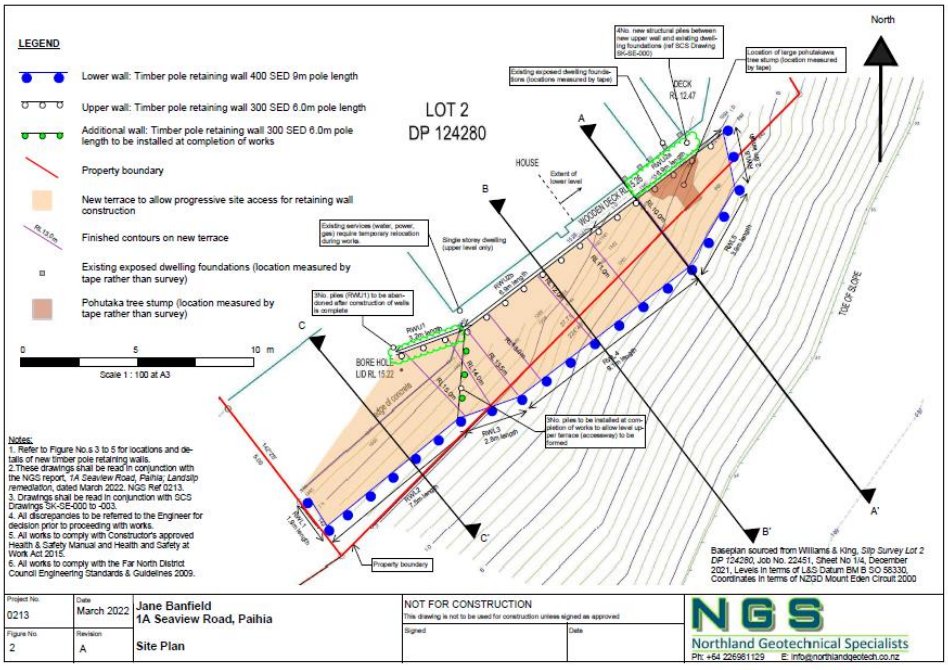
Figure 1 – Prover Aerial

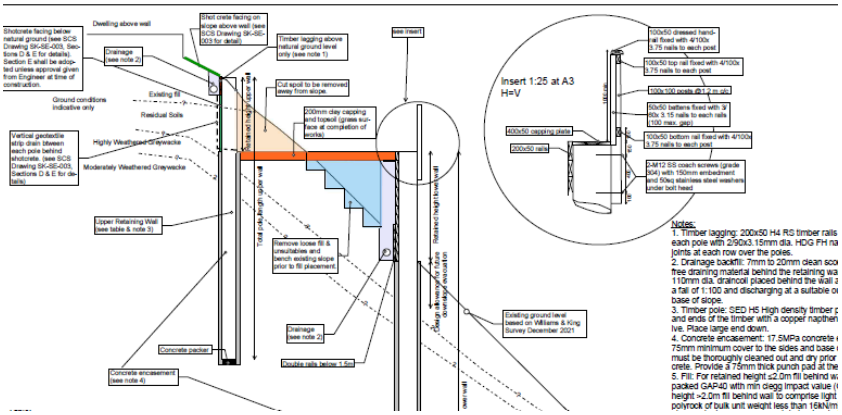
2. RECORD OF TITLE

The site Record of Title is attached at **Appendix A.** There are a number of easements which are not affected by this application.

3. DESCRIPTION OF THE PROPOSAL

The supporting documents from Northland Geotechnical Specialists, Cook Costello Limited and WSP provide substantive engineering information on the proposal which can be summarised as the construction of two retaining walls. The upper wall runs parallel close to the dwelling house at a maximum height of 2.2m, and the lower wall is set away from the dwelling and for part of its length crosses over the common boundary [the lower wall] into land owned by Council, at a maximum height of 2.6m. The upper wall adjoining the dwelling is 17.0m long and the lower wall is 19.81m in length. A balustrade is proposed along the outer edge of the lower retaining wall.





Minimal earthworks associated with the building foundations are required for the proposal as these are set into the existing ground. Within the Banfield property , the volume of earthworks is 52.9m3 fill and 12/7m3 of cut. Within Council's reserve there is 23.0m3 of fill and no cut. These volumes sit well below the thresholds within both zones.

4. REASONS FOR CONSENT

The Far North District Plan Zone Maps depict Janes site as **Residential** and the Esplanade Reserve as **Conservation.** No other special resource features apply to the two properties.

Figure 2 - Zoning of the site (FN Maps)

The following Table assesses the proposed retaining walls against the relevant District Plan standards.

Table 1 – Residential / Conservation Zone Performance Standards

Performance Standard	Residential Zone Comment	Conservation Zone Comment	
Rule 7.6.5.1.1 Relocated Buildings	Not a relocated building. **Permitted Activity**	9.7.5.1.1 Purpose of Buildings	The installation of the retaining wall assists with maintaining the integrity of the steep slope and the vegetation cover which contribute to the conservation values of site. The establishment of the retaining wall will allow the replanting of the area to complement the surrounding coastal

			vegetation. The applicant has offered this to Council in communications to date. The wall is of the same elk as retaining walls along the Paihia to Opua walkway. These walls sustain the land to limit the slipping of the bank areas. **Permitted Activity**
Rule 7.6.5.1.2 Residential Intensity	N/a.	N/a	
Rule 7.6.5.1.3 Scale of Activities	N/a.	9.7.5.1.2	N/a
Rule 7.6.5.1.4 Building Height	The proposed building height is less than the 8m permitted maximum height. **Permitted Activity**	9.7.5.1.3	The wall is less than 8m in height. **Permitted Activity**
Rule 7.6.5.1.5 Sunlight	The proposed retaining wall is within the threshold and does not comply as a Permitted Activity, but will comply with the 3.0m threshold. **Restricted Discretionary Activity**	9.7.5.1.4	At the common boundary [RWL3] the retaining wall is approximately 2.6m in height. **Restricted Discretionary Activity**
Rule 7.6.5.1.6 Stormwater Management	Total proposed retaining wall is sitting under the curtilage of the dwelling foundations and overhangs. **Permitted Activity**	9.7.5.1.5	The surface area of the wall is less than 10% of the site area [2717m2] **Permitted Activity**
Rule 7.6.5.1.7 Setback from Boundaries	The proposed retaining wall will be within the 1.2m setback from the other property boundaries. **Restricted Discretionary Activity**	9.7.5.1.10	There is no applicable setback rule.
Rule 7.6.5.1.8 Screening for Neighbours – Non-Residential Activities	N/a	9.7.5.1.6	N/a.
Rule 7.6.5.1.9 Outdoor Activities	N/a.		
Rule 7.6.5.1.10 Visual Amenity	N/a.		
Rule 7.6.5.1.11 Transportation	N/a.		N/a.
Rule 7.6.5.1.12 Site Intensity – Non-Residential Activities	N/a.		

Rule 7.6.5.1.13 Hours of Operation – Non-Residential Activities	N/a.		
Rule 7.6.5.1.14 Keeping of Animals	N/a.	9.7.5.1.7	N/a.
Rule 7.6.5.1.15 Noise	N/a.	9.7.5.1.8	N/a.
Rule 7.6.5.1.16 Helicopter Landing Area	N/a.	9.7.5.1.9	N/a.
Rule 7.6.5.1.17 Building Coverage	The retaining wall is with the curtilage of the existing dwelling house. **Permitted Activity**	9.7.5.1.11	The wall surface area is less than the 8% threshold. **Permitted Activity**

Table 2 – District Wide Performance Standards

Section 12.3 Soils and Minerals		
12.3.6.1.1	Excavation and/or filling, excluding mining and quarrying, in the Rural Production zone or Kauri Cliffs zone	N/a.
12.3.6.1.2	**Permitted Standard (Residential)** Excavation, and/or filling, excluding mining and quarrying, on any site in the Residential, Industrial, Horticultural Processing, Coastal Residential and Russell Township Zones is permitted, provided that: a. Does not exceed 200m³ in any 12-month period per site; and b. It does not involve a cut or filled face exceeding 1.5m in height i.e. the maximum permitted cut and fill height may be 3m. **(Conservation)** 300m3.	Minimal earthworks associated with the construction of the retaining walls and both are engineered designed. The limits are less than 200m3 and 300m3. **Permitted Activity**
12.7.6.1.1	**Setback from CMA – 30m setback**	Both retaining walls sit within the 30.0m setback.

The proposal exceeds the sunlight rule within the Conservation Zone rules and exceeds the setback from boundary and sunlight rules as a Restricted Discretionary Activity with the Residential Zone. In addition, the walls are within 30.0m of the CMA requiring consent as a Discretionary Activity. Overall, the proposal falls to be considered as a '**Discretionary Activity**' by reason of the transgression of these rules.

5. STATUTORY CONSIDERATIONS

Section 104B of the Resource Management Act (RMA) governs the determination of applications for discretionary activities:

104B Determination of applications for discretionary or non-complying activities

After considering an application for a resource consent for a discretionary activity or non-complying activity, a consent authority—

(a) may grant or refuse the application; and

(b) if it grants the application, may impose conditions under section 108.

Applications for Discretionary Activities may be granted or refused and if granted, may be subject to conditions of consent. A decision on a Discretionary Activity application is subject to the matters set out in Section 104.

Section 104 specifies that subject to Part 2, consent authorities have regard to the following matters when considering whether to grant or refuse an application for resource consent.

(a) *any actual and potential effects on the environment of allowing the activity; and*

(ab) any measure proposed or agreed to by the applicant for the purpose of ensuring positive effects on the environment to offset or compensate for any adverse effects on the environment that will or may result from allowing the activity; and

(b) any relevant provisions of –

(i) a national environment standard:

(ii) other regulations:

(iii) a national policy statement: and

(iv) a New Zealand Coastal Policy Statement:

(v) a regional policy statement or proposed regional policy statement:

(vi) a plan or proposed plan; and

(c) any other matter the consent authority considers relevant and reasonably necessary to determine the application."

In the determination of this application, those considerations include the actual and potential effects of an activity on the environment, the relevant provisions of the New Zealand Coastal Policy Statement (NZCPS), the Northland Regional Policy Statement (or other relevant statutory document), the Far North District Plan and any other matter the consent authority considers relevant and reasonably necessary to determine the application.

The National Environmental Standard for Assessing and Managing Contaminates in Soil to Protect Human Health is not considered to be applicable, as the site is bush covered and has not been previously developed. The National Environmental Standard for Freshwater is also not considered applicable as the matters covered by this document are not affected by the proposal.

The following assessment addresses all of the relevant considerations under s104 of the RMA.

6.2 ASSESSMENT OF EFFECTS ON THE ENVIRONMENT

1. The RMA definition of 'Environment' includes:
   (a) *Ecosystems and the constituent parts, including people and communities; and*
   (b) *All natural and physical resources; and*
   (c) *Amenity values; and*
   (d) *The social, economic, aesthetic, and cultural conditions which affect the matters stated in paragraphs (a) to (c) of this definition or which are affected by those matters.*

The definition of 'Environment' also includes the concept of a 'future state of the environment' where the environment as it currently exists might be modified by permitted activities and by resource consents that have been granted, and where it appears likely that those consents will be implemented. In respect of this application, the existing environment is a bush covered vacant lot within a predominantly invisible coastal location, within the coastal environment as defined in the NZCPS and the Northland Regional Policy Statement. The Residential Zone enables high density residential activity that includes dwellings subject to specific building design criteria, associated vehicle access, and car parking. This property and the surrounding residential area can be serviced by Councils reticulated infrastructure.

The RMA meaning of 'effect' includes:

3 Meaning of effect

In this Act, unless the context otherwise requires, the term **effect** includes—
(a) any positive or adverse effect; and
(b) any temporary or permanent effect; and
(c) any past, present, or future effect; and
(d) any cumulative effect which arises over time or in combination with other effects—
regardless of the scale, intensity, duration, or frequency of the effect, and also includes—
(e) any potential effect of high probability; and
(f) any potential effect of low probability which has a high potential impact.

For this application, the potential adverse effects to be assessed are those both temporary and permanent that arise from aspects of the proposal that have been identified as requiring resource consent, and broadly captured under Part 2 of the RMA. Positive effects also require consideration. In respect of this application, positive effects include the wellbeing of the applicant to ensure the existing dwelling avoids any future damage through ground subsidence.

Setback from Boundary Effects

The retaining wall is a building by definition and is required to sit at the property boundary due to the physical constraints along with being able to attain the necessary engineering design parameters. The wall is engineered designed and is effectively a large fence along a common boundary. The proposed

retaining wall is screened by vegetation on the adjoining Esplanade Reserve, and this will be enhanced through planting offered by the applicant. The wall is located in an elevated position and not visible from the street or whilst walking along the edge of the CMA. The existing character and form of the locale will be maintained, and the wall has no effect upon the outlook and privacy of adjacent properties. Overall adverse effects associated with this breach are considered minimal to non-existent.

Sunlight Effects

The affected parties are assessed as the applicant and Council. Given the ownership of the land, the topographical features, and in ability to access the immediate area of the retaining walls it is considered there will be no effects off site or on either property owner. Both parties are considered to benefit from the establishment of the retaining walls with mitigation of effects readily attained through planting offered by the applicant.

CMA setback

Both retaining walls sit within 30.0m of the CMA. This in its own account has no effect upon the functioning of the CMA and cannot be avoided by reason of the presence of the existing dwelling house. There is nothing to suggest the walls in the location sought has any effect beyond the property boundary.

Overall it is considered, given the context of the activity, the location and the existing environment the effects created through a breach of the setback and sunlight rule are internalised and of benefit to the applicant and Council.

STATUORY PLAN CONSIDERATIONS

New Zealand Coastal Policy Statement 2010

The New Zealand Coastal Policy Statement 2010 [NZCPS 2010] contains objectives and policies designed to achieve the sustainable management purpose of the Resource Management Act in respect of New Zealand's coastal environment. It is relevant to this application to the extent that the lower order regional and district plans must give effect to the NZPCS where any subdivision, use or development of land or coastal areas involving the coastal environment is proposed.

As the activity involves the use of land for residential purposes that is within the regionally identified coastal environment, it is subject to any regulatory provisions relevant to the management of that environment. Even though the site is partially within an area defined as 'High Natural Character' the proposed development is outside this area. The size and scale of the proposal is such that it does not require any further consideration of the NZCPS and can be adequately managed in terms of district level regulations.

Northland Regional Policy Statement

The subject site is within the Northland region and is subject to the governing objectives and policies of the operative Northland Regional Policy Statement (operative May 2016). With respect to any identified features, the site is within the Coastal Environment boundary.

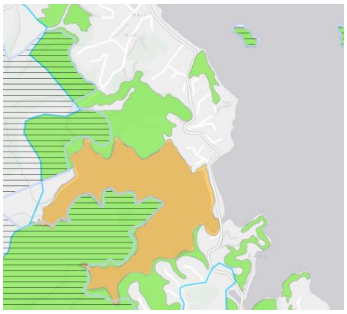


Figure 5 – Northland Regional Policy Statement Maps

Of statutory relevance to this proposal are regional objectives and policies relating to water quality (particularly coastal water) and the protection of the coastal environment's natural character.

With respect to the water quality, stormwater is managed to ensure coastal water quality in this area will not be adversely affected during the construction period.

Overall, it is considered that the proposal would not be inconsistent with the Northland Regional Policy Statement.

Operative Far North District Plan

The District Plan provisions of relevance to this application are the objectives and policies for the Urban environment and Residential zone.

The District Plan Urban Environment is comprised of three urban sub-zones that includes the Residential Zone, the Commercial Zone, and the Industrial Zone. These zones provide for distinctively different urban environments, the Residential Zone provides for the most intensive residential development within the urban environment. The application site is located within an established residential environment near the coast on site sizes enabled by the Residential Zone.

District Plan Objectives and Policies

The relevant objectives and policies of the Plan are those related to the Urban Environment, Residential Zone, Conservation Zone and District Wide matters including natural and physical resources.

The proposed activity is not altering the density to those prevailing at present within this area (Objective 7.6.3.1). The proposed development is facilitating the presence of an existing residential dwelling, ensuring the anticipated effects are anticipated and comparable with other properties within this zone (Objective 7.6.3.2).

The proposal also complies with the relevant residential zone policies and has no demand on Council's reticulated services (Policy 7.6.4.2, 7.6.4.3). The proposed retaining wall enables safe occupation of the dwelling which provides housing in an effective and efficient manner along with creating effects associated with a typical single residential unit (Policy 7.6.4.4 and 7.6.4.6). The proposed retaining wall ensures adequate access to sunlight and daylight on adjoining sites and has no influence on the privacy for the inhabitants of adjoining properties.

The retaining wall is considered to facilitate the protection of conservation values and the physical and natural resources [Objective 9.7.3.1] and sustains the conservation values of the site without adverse effects on the surrounding environment prescribed under Objective 9.7.3.2. The installation of the wall maintains and enhances the existing conservation values through mitigating the acceleration of the coastal slope slipping into the CMA [Policy 9.7.4.1] . There are no adverse effects on the conservation values of the site, and it has no adverse effects on the surrounding area as prescribed by Policy 9.4.4.2. The establishment of the wall attains Policy 9.7.4.5 by reason it does not degrade nor diminish total biodiversity or ecological functioning of the values in the site. In the contrary it will ensure the biodiversity and ecological values are not going to be lost through the land and vegetation slipping away.

Overall, it is considered the proposal gives effect to the applicable objectives and policies.

Applicable Assessment Criteria

Assessment criteria within the District Plan are assessed below.

11.2 Building Height, Scale and Sunlight Assessment Criteria

(a) *The extent to which adjacent properties will be adversely affected in terms of visual domination, overshadowing, loss of privacy and loss of access to sunlight and daylight.*

The affected adjoining property on the southern boundary is reserve and covered in vegetation. It is considered that in the context of the activity and the location, there will be no adverse effects associated with the proposal.

(b) *The ability to mitigate any adverse effects by way of increased separation distances between buildings or the provision of landscaping and screening.*

Mitigation of the wall will be attained through the replanting of the area as offered by the applicant. This will increase the biodiversity and ecological values which have been lost to date though the land slipping.

(c) *The extent of the building area and the scale of the building and the extent to which they are compatible with both the built and natural environments in the vicinity.*

The proposed retaining wall has been designed to meet the engineering parameters to ensure stability of the ground. The proposal will fit within the vegetated environment and is a common activity found in the both zones.

(d) The spatial relationship between the new building and adjacent residential units, and the outdoor space used by those units.

As previously mentioned, the proposed retaining wall is located on the southern boundary which is shared with a vacant bush covered property. There are no residential units adjoining.

(e) The nature of the activity to be carried out within the building and its likely generated effects.

The proposed retaining wall will provide support to the existing dwelling house. The likely effects centre on the construction methodology and control of storm water during construction. These effects are embodied within the supporting information.

7.6.5.3.7 Setback from Boundaries Assessment Criteria

(a) the extent to which the proposal is in keeping with the existing character and form of the street or road, in particular with the external scale, proportions and buildings on the site and on adjacent sites;

The retaining wall is unlikely to be visible from public locations save the adjoining Esplanade Reserve , which is in real terms inaccessible.

(b) the extent to which the building(s) intrudes into the street scene or reduces outlook and privacy of adjacent properties;

As previously mentioned, the nature of the proposed retaining wall will not adversely effect the street scene or outlook and privacy of adjacent properties.

(c) the extent to which the buildings restrict visibility for vehicle manoeuvring;

The proposed retaining wall does not effect this.

(d) the ability to mitigate any adverse effects on the surrounding environment, for example by way of street planting;

The applicant has offered to plant and landscape the area around the two retaining walls. This will assist with water containment along with creating a natural appearance.

(e) for Lot 1 DP 28017, Lot 1 DP 46656, Lot 1 DP 404507, and Lot 1 DP 181291, Lot 2 DP 103531, Lot 1 DP 103531, Lot 2 DP 58333 and Pt Lot 1 DP 58333 (and any sites created as a result of a subdivision of these lots) and sites having frontage with Kerikeri Road between its intersection with SH10 and Cannon Drive:

i. the scale of the buildings;

ii. the extent of setback from Kerikeri Road and Cobham Road;

iii. the visual appearance of the site from the Kerikeri Road and Cobham Road frontage;

iv. the extent to which the building(s) are in harmony with landscape plantings and shelter belts;

N/A.

(f) the extent to which the buildings and their use will impact on the public use and enjoyment of adjoining esplanade reserves and strips and adjacent coastal marine areas.

The retaining walls will not affect the public use and enjoyment of the reserve given the area is not accessible to the public. The use of the esplanade will in fact be enhanced by reason it will mitigate the propensity for the slip to increase in size and slide into the CMA. In such event it will affect the ability for the public to gain access along the CMA.

12.7.7 Setback from CMA

(a) the extent to which the activity may adversely affect cultural and spiritual values;

There is nothing to suggest the retaining wall would effect these values.

(b) the extent to which the activity may adversely affect wetlands;

N/a.

(c) the extent to which the activity may exacerbate or be adversely affected by natural hazards;

The retaining walls will be sustaining the stability of the slope to reduce the likelihood of the house subsiding and reserve land slipping into the CMA.

(d) the potential effects of the activity on the natural character and amenity values of lakes, rivers, wetlands and their margins or the coastal environment;

Given the context of this location it is not considered the retaining walls will cause any adverse effect upon these values.

(e) the history of the site and the extent to which it has been modified by human intervention;

This has been discussed in the attached reports.

(f) the potential effects on the biodiversity and life supporting capacity of the water body or coastal marine area or riparian margins;

The establishment of the retaining walls is anticipated to enhance these factors and will improve the quality of the coastal water and access along the CMA .

(g) the potential and cumulative effects on water quality and quantity, and in particular, whether the activity is within a water catchment that serves a public water supply;

Water within the CMA will be improved through the reduction of silt being received.

(h) the extent to which any proposed measures will mitigate adverse effects on water quality or on vegetation on riparian margins;

Landscaping and planting is proposed around the retaining walls.

(i) whether there are better alternatives for effluent disposal;

N/a.

(j) the extent to which the activity has a functional need to establish adjacent to a water body;

The technical reports clearly demonstrate the need for the retaining walls.

(k) whether there is a need to restrict public access or the type of public access in situations where adverse safety or operational considerations could result if an esplanade reserve or strip were to vest.

There is no need to restrict public access except at the time of construction. However it is considered impractical for the public to access the reserve at this location.

6. PART 2

Purpose

The proposal can promote the sustainable management of natural and physical resources on site, as current and future owners and users of the land are able to provide for their social, cultural and economic wellbeing and their health and safety. It will maintain the reserve as a vegetated slope and enable the continued access along the foreshore within the CMA.

The proposal will sustain the presence of the dwelling house on the property and the land within the esplanade reserve. Air, water, soil, and ecosystems are not assessed as being adversely affected by this development whereupon the effects on the environment are not anticipated to be more than minor.

Matters of National Importance

There is nothing to suggest the activity would be in conflict with the matters of National Importance.

Other Matters

The development will result in an efficient use of resources with no effects beyond the property boundaries and there will be no adverse impacts on local ecosystems.

Council has sought response to issues which may arise in allowing the retaining wall to be established in the reserve. These items relate to the following as underlined. The comments in *italics* have been provided by the consulting engineer.

- That structure does not benefit the public use of the reserve – noting the reserve is essentially a bush covered cliff.

  The preceding information has demonstrated the presence of the wall is in fact attaining the purpose of the conservation zone. The consulting engineer has also added -*We consider these works to be for the most part entirely neutral – neither providing public benefit or cost. This slope is not an area that people tend to access. The bush covered cliff is of low quality scrubby bush. With appropriate planting the style of vegetation could be improved and benefit public use*.

  To place into perspective Jane Banfield has provided the following observations and comments as follows - " The current vegetation cover in the subject area is predominately weed species including Chinese Privet, Wild Ginger, Jasmine and Japanese Cherry. The Banfield family proposes to replant the remediated area with native species including Pohuehue, Kowhai (winter food for kereru, caterpillars for shining cuckoo), Pohututkawa, Ngaio as well as Harakeke. If approved by the Council, we would like to offer to extend this revegetation to include the Reserve area below, interplanting with further native species. Once well established, this could allow for the gradual removal of privet and other weed spp. Furthermore, the intent is for pest control to be commenced by our family across this area as part of a wider neighbourhood initiative to interconnect this Seaview coastal lowland zone with the pest control work done in the Opua State Forest.

- If this is allowed to occur, then where does the liability fall:

- For future maintenance of the retaining wall structure and associated drainage?

  This would become the responsibility of the applicant and can be sanctioned via a Licence to Occupy and the appropriate legal documents. Alternatively as was suggested by Rod Stewart it would be more appropriate if a boundary adjustment was undertaken which then would make the applicant responsible by reason of land ownership.

- If the house suffers subsidence in the future.

  Works are being completed to prevent any damage to the house. Also, the terraced construction will provide easy access to leading edge foundations should any maintenance be required in the future.

- For remediation of the balance of the reserve area that will be affected during construction e.g. temporary construction access area?

The lower piles form the boundary of the construction area. Works have been deliberately designed to have access through the property rather than through the reserve and so the balance of the reserve area will not be affected.

- Will drilling or thumping a row of new piles in that location de-stabilise the rest of the foreshore cliff and Council ends up with a similar issue faced by Auckland Council with those Northshore cliffs collapsing and endangering the public?

  Of note – this is not a cliff, it is a slope of a much lower height and gradient than those referenced on the North Shore and with no public walkway at the base (wider foreshore) so the risk is inherently lower to start with. The proposed works will further reduce public risk as their purpose is to stabilise the slope and dwelling.

7. CONCLUSION

This application seeks a Discretionary resource consent to construct two retaining walls within the Residential and Conservation Zone. The assessment of effects on the environment concludes that for the reasons outlined in the application, the effects of undertaking this proposal will be no more than minor on the surrounding environment.

The proposal was considered to be consistent with the purpose of the National Environmental Standard for Assessing and Managing Contaminates in Soil to Protect Human Health and the National Environmental Standard for Freshwater.

No currently gazetted National Policy Statements including the NZ Coastal Policy Statement were considered to be undermined by this development

The Regional Policy Statement for Northland was also reviewed as part of this application. The proposal was considered to be consistent with the aims of this document.

In terms of the operative Far North District Plan, the proposal was assessed against the objectives and policies for the Urban Environment in general, the Residential and Conservation Zone, with the conclusion that it is generally compatible with the aims of the District Plan as expressed through those relevant objectives and policies.

The relevant assessment criteria within the District Plan were also considered, the conclusions reached being that the proposal fulfilled the relevant criteria when assessed within the context of the outcomes the rules aim to achieve.

In terms of the potential adverse effects being minor or more than minor, it is considered that there are no directly affected parties to this proposal as all effects can be adequately mitigated.

An assessment of Part II of the Act has also been completed with the proposal generally able to satisfy this higher order document also.

We look forward to receiving acknowledgment of the application and please advise if any additional information is required.

Jeff Kemp
Principal Consultant

NGS
Northland Geotechnical Specialists

GEOTECHNICAL DESIGN REPORT FOR LANDSLIP MITIGATION

Location	1A Seaview Road, Paihia
Client	Jane Banfield
NGS Ref	0213
Date	11 March 2022
Report prepared by	Rebekah Buxton
Authorised for NGS by	David Buxton

Table of Contents

1. Introduction & Scope

Northland Geotechnical Specialists Ltd (NGS) was engaged by Jane Banfield to undertake subsoil investigations, assess landslip movement and provide a design of landslide remediation works at 1A Seaview Road, Paihia. The scope of works comprises:

1) Visual assessment of damage;
2) Review of investigation completed by others;
3) Undertake subsurface investigations;
4) Geomorphic assessment of the site and surrounding area from LiDAR terrain models and historic aerial photographs;
5) Stability modelling to assess the landslip and remedial design measures;
6) Retaining wall analysis to design remedial works; and
7) Preparation of design drawings for the proposed terraced retaining walls.

This report is suitable to support a Building Consent application to Far North District Council (FNDC).

2. Background

A landslide has occurred on the subject property located adjacent to the southern side of the dwelling and the southern property boundary. The landslide occurred in February 2021 during intense rainfall in the Bay of Islands area. It is proposed to construct a system of two retaining walls to stabilise the land supporting the dwelling and reinstate the amenity of the land to the south of the dwelling. The lower (southernmost) retaining wall will facilitate creation of a stable platform from which to construct the upper (northernmost) wall. Underpinning of exposed and inadequate foundations is proposed as part of this works. The work will allow for extension of the existing concrete surfaced accessway further to the south. SCS Structures has completed the structural component of this design work. This report and drawings should be read in conjunction with the SCS Drawings SK-SE-000 to -003.

3. Site Description

3.1. Property Description

The subject property is legally described as Lot 2 DP 124280 and covers an approximate area of 1105m^2. The site is and irregular pentagon in shape, being approximately rectangular at the southern end with dimensions of approximately 28m (E-W), 26m along the eastern boundary, 31m along the western boundary and extending to a triangular point centrally at the northernmost point at a maximum length of 47m.

The property has a total change in elevation of approximately 7m with a maximum elevation of centrally on the eastern boundary and a minimum in the north eastern corner of the site. The property has two distinct typically level terraces. The elevation drops steeply beyond the property boundaries to both the east (up to 40°) and south (up to 45°) towards the foreshore.

The property is accessed by a long driveway from Seaview Road at the southwestern corner. The property is bound by a vacant, grassed site (formerly a hotel) to the west, neighbouring residential properties to the far north and the foreshore to the east and south. The land to the north, east and south is vegetated with trees.

The dwelling with attached deck on the eastern side is located at the southern end of the site and has been constructed over several additions and alterations varying between one to three levels.

The landslide which occurred in February 2021 is located at the eastern end of the southern edge of the dwelling on the steep slope to the south. The landslide is steep and shallow (<1m deep). Shallow dwelling foundations have been exposed. A large tree to the west of the slip has previously been cut down, with the remaining tree stump also causing tension in the area around the foundations. (Ref Photo 1 below).

Photo 1: View to west along southern edge of dwelling showing exposed shallow foundation (right) and tree stump (left)

A walkover of the foreshore indicates outcrops of slightly to moderately weathered intact greywacke rock are present at the base of the slopes, as shown in Photo 2, below.

Photo 2: View to east along the base of the southern slope

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3.2. Existing Dwelling Foundations

The dwelling onsite has been developed in several phases, with extensions to, then significant renovations of, the original dwelling. Along the southeast side of the dwelling, where the slip and proposed retaining walls are located, the foundations appear to have been constructed in four or five phases with the original dwelling having been set back from the slope. A brief description of the dwelling, based on plans and calculations held on the FNDC property file is below.

The original dwelling onsite was constructed around or soon after 1975. Dwelling plans are not held on the FNDC file however structural engineering design calculations[1] indicate the main structural form. The dwelling was of two-level concrete construction with the lower level being a part basement and having an upslope concrete block retaining wall. The upper level has a unispan type floor, including a cantilevered terrace. A garage was attached to the upper level of the dwelling with an on-grade floor, upslope of the concrete retaining wall. The roof was of a flat nature with timber truss construction. The original dwelling appears to have been set back from the landslip area. The main dwelling structural form is shown in Figure 3-1 below.

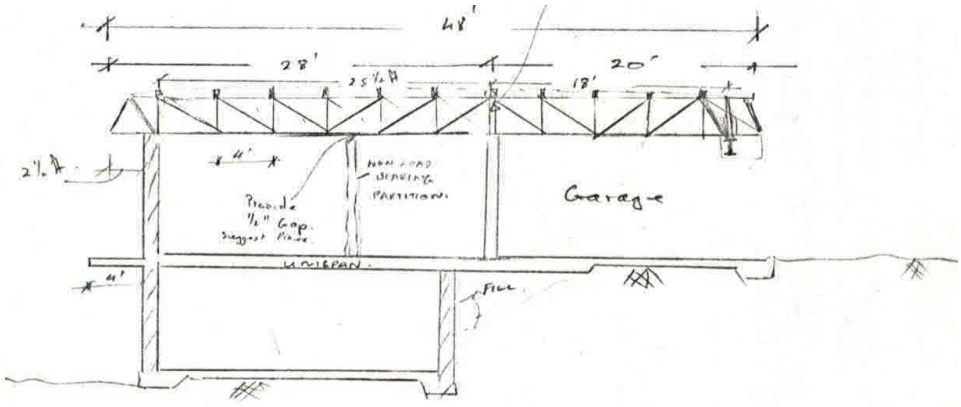

Figure 3-1: Main dwelling form from 1975 structural design calculations. The section is a SW-NE direction.

Plans from 1978[2] indicate the original garage may have been converted to a living space and a new garage was constructed to the southeast of the original garage. The new garage floor has been designed to cantilever out over the top of the slope to the east of the dwelling, with a footing supported by a row of min. 1200mm deep piles. This new garage forms the structure directly adjacent to the southern portion of the slope. The design cross section is shown in Figure 3-2 below.

[1] Tapper Cotter Brown and Partners, Noon House, Structural Calculations & Design Certificate, September 1975.
[2] Proposed Garage for Mr and Mrs N Noon off Seaview Rd in Paihia, Feb 1978, Brown & Thompson Consulting Engineers, Plans, elevations and structural details.

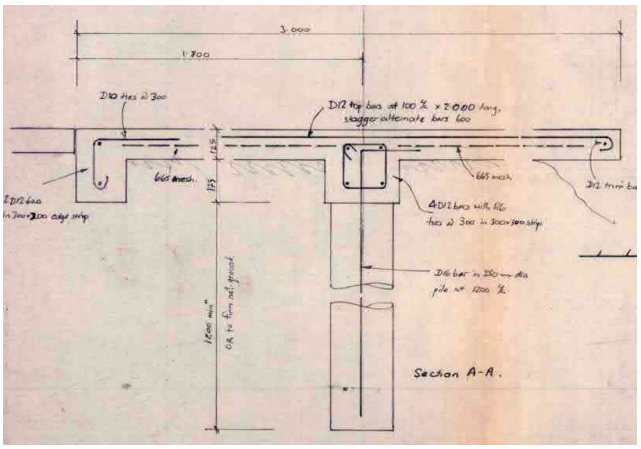

Figure 3-2: 1978 garage floor and foundation details. The cantilevered portion of floor overhangs the southern portion of the slope where new retaining walls are proposed.

Plans from 1983[3] indicate a new upper-level study was added directly above the slip area. The upper level study was of timber construction. A concrete floor slab with shallow footings is shown below, separated from the main dwelling structure. This extension likely forms the foundations directly above the slip area which are most at risk. The 1983 plans don't show the slope proximity and it is inferred the extension extended onto the slope area, with foundations likely amended onsite. The cross section through the extension is shown in Figure 3-3 below.

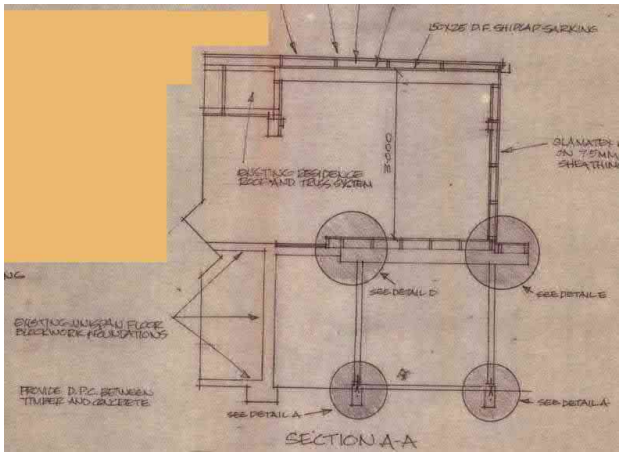

Figure 3-3: 1983 extension to form an upper-level study. The section is directly above the slip area however the section does not show the slope. The outer (right side of section) foundations extend over the slope crest and were likely adapted onsite.

Plans from 2001[4] indicate the dwelling was significantly renovated with new decks/terraces and new architectural facades. As part of this work the lower level of the extension in Figure 3-3 has been converted to a studio, the gap between the dwelling and 1983 ground slab infilled to form a new hall

[3] Proposed Study for Mr and Mrs Couch off Seaview Road in Paihia, sheets 1 to 3, March 1983,
[4] Architectural Design, Banfield House Alteration, Paihia, July 2001, 5 Pages, Stamped approved by FNDC BC 20020208.

and a new lower-level area constructed to the south, forming a new bathroom. The lower-level terrace to the north has also been re-constructed. The layout of the extensions/renovations of the lower level directly above the slope/slip area are shown in Figure 3-4 below.

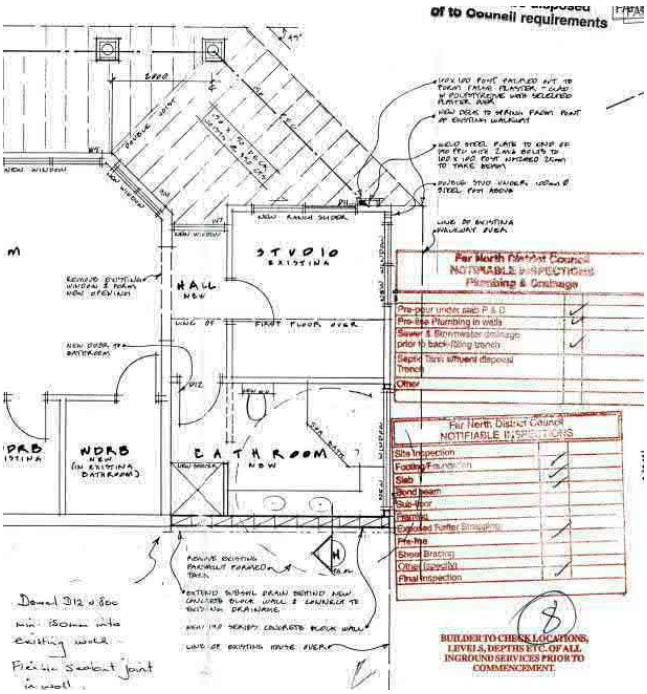

Figure 3-4: 2001 plan of extensions/renovations. The slip and proposed retaining walls are immediately to the right of the building footprint. The Studio appears to be the 1983 extension floor slab. The bathroom is of new construction, including extending the concrete block retaining wall. The new bathroom floor slab, directly above the slope, is shown as having a 200 wide footing extending 400 into solid bearing elsewhere in the drawing set.

A sketched structural detail[5] from 2001 suggests a single 3m deep 400mm diameter pile may have been installed to the northeast of the studio and under the terrace shown in Figure 3-4.

Based on the information in the FNDC property file it appears foundations of the lower level adjacent to the slip area are typically shallow and not specifically designed to resist slope movement, except for the single 3m deep underpinning pile shown under the terrace. To the southwest, where there is no lower level adjacent to the slope, a cantilevered concrete slab dating from approximately 1978 exists with plans showing it is supported by approx. 1200mm deep piles.

[5] Fraser Thomas Ltd, underpinning detail, signed by Roger Toplis 10/08/01

4. Geological Conditions

4.1. Published Geology

The published geology[6] indicates that the subject property is underlain by Waipapa Group Sandstone and Siltstone. This typically comprises massive- to thin-bedded, lithic volcaniclastic metasandstone and argillite with tectonically enclosed basalt, chert and siliceous argillite. The Waipapa Group is considered to be basement terrane and the main rock type is likely to be greywacke.

The published geology is shown in Figure 4-1 below, noting that the coastal boundary is offset in this location.

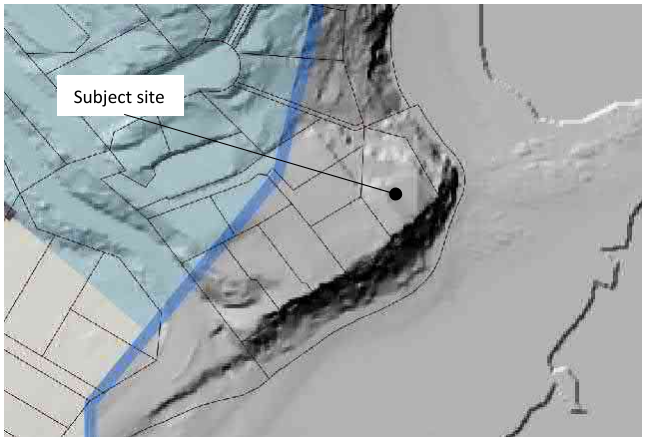

Figure 4-1 – Published Geology[6] on 2018 NRC LiDAR DEM

4.2.2 Aerial Photograph Review

Review of historic aerial photographs and present day images[7] has been completed, as well as a selection in stereopairs.

- In 1953 the properties to the west of the subject site have been developed. The subject site is tree covered and undeveloped. There are some large trees along the southern slope.
- By 1972 the subject site has been cleared across the central and northern area. A cleared track is visible across the northern end of the property leading down to the beach. The structure present in1953 on the property to the west of the site has been removed and new structures. The existing access way from Seaview Road is visible along the southern end of the neighbouring properties. The accessway does not yet extend to the subject property.
- By 1981 the dwelling on the subject property has been constructed on the south eastern corner of the site above the steep slopes. Some landscaping of the area to the north of the

[6] Edbrooke, S.W.; Brook, F.J. (compilers) 2009: Geology of the Whangarei area. Institute of Geological & Nuclear Sciences 1:250,000 geological map 2. 1 sheet + 68 p. Lower Hutt, New Zealand. GNS Science.

[7] Historical Photographs sourced from Retrolens.nz, photographs dated 1953, 1972, and 1981. Google Earth pro aerial photography dating between 2004 and 2021.

dwelling has been completed. The structure to the west of the subject property has been extended to the north.

- In 2004 the footprint of the subject dwelling has been altered with extensions to both the west and south east. The structures on the neighbouring properties on the west of the site have been completely removed and replaced with a hotel complex development including carpark and swimming pool.
- By 2016 the western neighbouring property has been cleared and is in grass. There is little change noted between the 2016 and present day images.

There is little observed movement of the slopes to the south or east of the property however tree cover has obscured visibility.

Photo 3a: Crown_209_546_75, 1953

Photo 3b: Crown_3406_4482_25, 1972

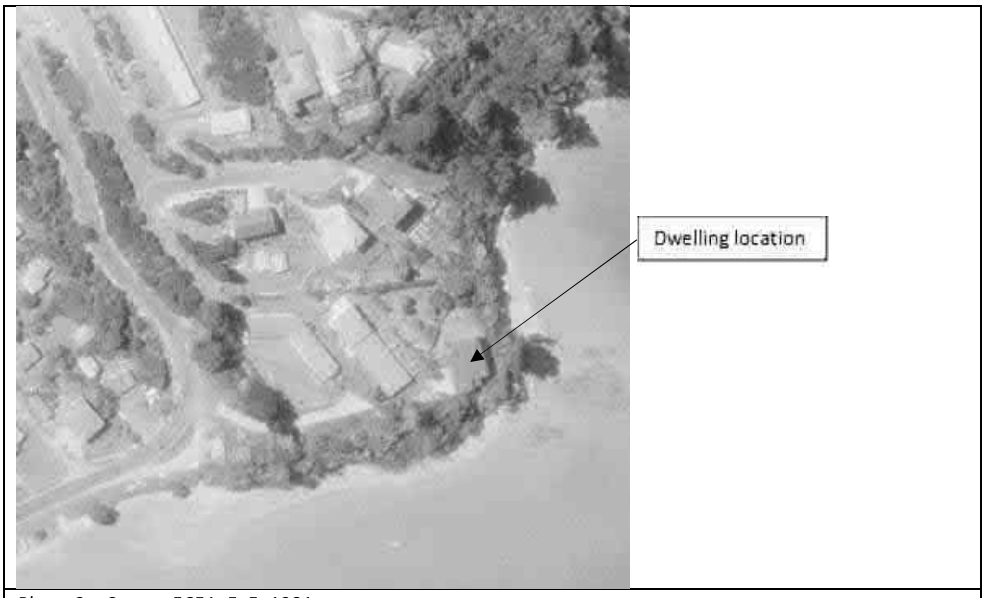

Photo 3c: Crown_5651_F_5, 1981

Photo 3d: Google Earth Pro – historical imagery 2004

4.2. Site Investigations

4.2.1. Previous Investigation (Cook Costello 2021)

Investigations were completed by Cook Costello/Geocivil in July and August 2021.The investigations are presented in the Cook Costello Geotechnical Factual Report[8] and Land Damage Assessment Report[9]. Investigations comprised:

- 7No. Hand augered boreholes (HA2 – HA8) to 0.6m – 2.2m depth
- 9No. Scala Penetrometer tests (SP1 – SP8 & SP6a) to effective refusal (>10 scala blows/50mm penetration)
- One machine drilled borehole (MBH01) to a depth of 11.5m. SPT measurements were taken at regular intervals down the depth of the borehole. An inclinometer was installed in the borehole on completion.

Previous Cook Costello investigation locations are shown on *Figure 101 – Site Investigation Plan* presented in Appendix A. Cook Costello investigation logs are presented in Appendix B.

4.2.2. Recent Investigation (NGS 2022)

Recent site investigations were completed by a geotechnical engineer from NGS on 13 January 2022. The investigations comprised two hand augered boreholes (HA9 – HA10) with scala penetrometer testing completed from the base of the borehole to effective refusal (>20 scala blows/100mm penetration).

The exposed dwelling foundations along the southern side of the dwelling were probed with a gum spear to ascertain existing embedment depth.

Investigation locations are indicated on *Figure 101 – Site Investigation Plan* in Appendix A, and recent hand augered borehole logs are presented in Appendix B.

4.3. Subsoil Conditions

Fill was identified beneath the site next to the dwelling (HA9) to a depth of 0.8m. The fill comprised loose, reworked, likely site won, residual soils.

Beneath the fill, and in the other hand augered boreholes the site is underlain by residual soils of greywacke comprising silty clay/clayey silt with occasional trace sand and gravel and trace organics (rootlets) in the upper layers. The residual soils are typically stiff to hard, orange-brown, moist and of low plasticity. Undrained shear strength measurements in the residual soils are typically between 90-200kPa with one outlier of 45kPa at a depth of 0.5m in HA4. One SPT test conducted at a depth of 1.5m in MBH01 returned a value of N=17. A void was identified at a depth of 1.1 – 1.5m in HA4 and loose/"voidy" material was inferred in HA9 to a depth of 1.8m. It is inferred that this is a tension zone in the area of the felled tree identified in Section 3 (ref Photo 1), above.

The investigations indicate a weathering profile of greywacke decreasing with depth. Scala penetrometer measurements increased with depth from the base of the hand augered boreholes to

[8] Cook Costello report for Jane Banfield, *Geotechnical Factual Report; 1A Seaview Road, Paihia*, Project Number: 16057-001, Date: 11/01/2022.
[9] Cook Costello report for Jane Banfield, *Land Damage Assessment; 1A Seaview Road, Paihia*, Project Number: 16057-001, Date: 06/10/2021.

effective refusal to the scala (>10 scala blows/50mm penetration and >20 scala blows/100mm penetration). Refusal to the scala is inferred to be at the approximate depth of change from highly to moderately weathered greywacke. SPT results typically increased with depth to N>50 from a depth of 8m. N>50 is inferred to be at the approximate depth of change from moderately weathered to slightly weathered/unweathered greywacke.

4.4. Groundwater

Groundwater was not identified during or on completion of the investigations.

5. Remediation Design

5.1. General

The nature and continuity of the subsoil conditions onsite have been inferred from nine hand augered boreholes, 10 scala penetrometer tests and one machine drilled borehole at discrete locations. Two of the hand augered boreholes and scala penetrometer tests were undertaken by NGS with the rest completed by others. It must be appreciated that actual subsoil conditions could differ from those inferred. If the subsoil conditions differ in any way from those described in this report is it essential that we be contacted.

5.2. Design Philosophy

The landslide is occurring on an over steepened slope with dwelling loads and fill placed at the crest, in shallow residual soils of the Waipapa Formation (Greywacke). The absence of settlement damage to the dwelling suggests that dwelling foundations have not been undermined by the landslide however the soils providing passive support have evacuated downslope, exposing the foundations. Furthermore the foundations are not of a type and standard appropriate for a dwelling on the crest of a coastal cliff. A large tree near the crest of the slope and in proximity to foundations has recently been felled. The stump is still present and the soil in the area is seen to be in tension with voids forming as the organic material decomposes and the tree pulls away. Access to the site limits the size of plant and construction materials. Accordingly, the following design philosophy has been adopted:

1) The landslide is assessed to be shallow based on visual observations, subsoil investigations showing increasing strength and decreasing weathering with depth, and the occurrence immediately following an extreme rainfall event. Although some of the movement may have occurred unnoticed over a longer period.
2) The site investigation clearly indicates better material is present with increasing depth.
3) A system of two terraced retaining walls has been selected. The lower wall will provide global stability to the site and retain some imported fill immediately behind it to provide a level area to improve amenity and safety and allow progressive construction access. The upper wall will be constructed in close proximity to the southern wall of the dwelling to provide passive support to the exposed foundations as well as limit the required height of the lower wall. The foundations will be underpinned as the construction advances (design undertaken by others).
4) Construction will commence at the level concrete accessway at the south western corner of the property to prepare a stable and level platform. Construction will progress to the east along the length of the walls as a stable platform is formed to construct the next length.

5) The existing felled tree stump shall be removed as part of the construction works. The void this creates should be backfilled with appropriate, well compacted fill material. The methodology of removing the tree stump requires construction of both the lower and upper wall and likely burial of the tree stump to allow construction of the full length of wall and underpinning prior to removal. Over excavation of the upper wall to account for the stump removal has been assessed in this zone.
6) The lower wall has been designed to tolerate an additional 1.0m retained height to account for future evacuation of soils downslope of the wall. This allows for complete evacuation of all residual soil (based on depth of soil in HA10) and the assessed coastal regression (Ref Section 5.4, below).
7) The landslip surface is within the residual soils. Back analysis of the assumed pre landslide slope was undertaken using the Rocscience software Slide 2.0. Soil/rock parameters were selected from the back analysis and correlations with the measured in-situ strengths during investigation.
8) Pile retaining wall analysis (Wallap) has been used to assess pile structural actions and check the adopted minimum pile embedment provides adequate passive resistance.
9) Minimum design Factor of Safety (FoS) values of 1.5 for static/design groundwater, 1.3 for elevated groundwater and 1.1 for seismic have been adopted.
10) The concrete accessway is to be extended from its present location to the boundary. As such there will be no upper wall. This results in a larger retained height at this end of the wall. In the case of future evacuation of soils in front of the wall due to coastal regression the resulting estimated deflection is greater than typically acceptable and the factor of safety about the pile toe is slightly less than the criteria adopted along the rest of the wall chainage. This is considered to be generally acceptable due to the offset from the dwelling. If in the future, the downslope evacuation of soils or deflection at the top of the wall is realised anchoring of the pile head or other remediation may be adopted at that stage.
11) To facilitate the extension of the accessway, the three western most upper wall piles will be abandoned and three extra piles linking the western ends of the two walls will be constructed at completion of the works to form the level accessway.

5.3. Site Seismic Characteristics

In accordance with NZS 1170.0[10] the residential dwelling and supporting structures is considered to be an Importance level 2 (IL2) structure. Return periods for limit state design events for an IL2 structure are Serviceability Limit State (SLS) 1/25 years and Ultimate Limit State (ULS) 1/500 years. Based on the subsoil conditions observed the site is considered to be a Class C- shallow site in accordance with NZS 1170.5[11]. This classification is based on the identification of greywacke rock at shallow depths.

Ground motion inputs from Table A1 of the NZGS/MBIE Earthquake Geotechnical Engineering Practice Module 1 have been adopted for the purpose of geotechnical assessment within this report and are summarised in Table 5-1.

[10] Standards New Zealand, 2004. Structural Design Actions Part 0: General Principles. NZS 1170.0:2002
[11] Standards New Zealand, 2004. Structural Design Actions Part 5: Earthquake Actions. NZS 1170.5:2004

Table 5-1: Site seismic parameters

Design Level	Annual probability of exceedance	Peak Ground Acceleration (PGA)	Earthquake Magnitude (Mw)
SLS	1 in 25 years	0.03	5.8
ULS	1 in 500 years	0.13	5.8
Minimum seismicity[1]	Less than 1 in 500 years	0.19	6.5
Notes 1	Minimum level of seismicity for design is recommended in areas of low seismicity and comprises a magnitude 6.5 earthquake at 20km distance		

In accordance with NZGS/MBIE Earthquake Geotechnical Engineering Practice Module 6, Table 5-2, the retaining walls presented in this report are considered to be Case 3: Downslope and supporting building foundations. As such, the PGA for pseudo-static design of retaining walls is reduced by a factor (W_d) of 0.5, i.e. $PGA_{min\ seismicity}$ of 0.095g is adopted. This factor accepts that some displacement under a seismic design scenario is typically acceptable.

5.4. Coastal Regression

The greywacke foreshore will gradually retreat due to coastal erosion, resulting in slips on the slopes above. The rate of foreshore regression is not readily apparent from review of aerial photographs dating from 1951 (i.e. 71 years ago) due to tree cover of the slopes however it does not indicate rapid coastal erosion. The rate of foreshore regression is limited by both the strength of the greywacke rocks and the lower energy coastal environment given the relatively sheltered setting of the southern slope (i.e. it is not exposed to open ocean). No significant preferential erosion features likely to accelerate average coastal regression rates (e.g. sea caves) were observed. An average long-term coastal regression of 1.0m per 100 years is considered appropriate for the southern slope. We note that coastal regression is not consistent and slope regression often occurs as intermittent landslip events rather than as a continuous process.

An assessed regression line is presented on *Figure SA-1: Section A – Coastal Regression*. The regression line assumes:

1. Coastal regression of 1.0m.
2. A long-term stable slope angle of approximately 45˚ (i.e. approximately parallel to the existing slope).

5.5. Numerical Slope Stability Analysis

Numerical slope stability analysis has been undertaken on Section A through the main body of the landslide (Section A, Ref *Figures SA & 2*, attached). The analysis was undertaken using the software package *Slide*-2018.8.031 provided by RocScience. The topography has been developed based on the site survey completed by Williams & King[12].

Groundwater has been modelled using an R_u coefficient for the less permeable residual soils and highly weathered greywacke. This develops a porewater pressure profile specific to each slip surface and is appropriate for the short term perched (transient) pore water pressures that are expected to develop following rainfall onsite and the groundwater flow conditions that will result due to the sloping topography. Groundwater in the moderately weathered greywacke is modelled by a piezometric surface at the assumed interface between the highly weathered and moderately

[12] Williams & King, *Slip Survey Lot 2 DP124280, Jane Banfield, Paihia*. Job No. 22451; File: Slip Survey, Sheet No. 1/4. Dated Dec 21.

weathered greywacke. The seismic case is considered to occur under design groundwater conditions.

The soil parameters adopted for wall design have been derived based on the site investigation and through back analysis of the existing landslide. The soil parameters are presented in Table 5-2 below.

Table 5-2: Soil parameters from back analysis

Parameter	Fill	Residual soils	Highly weathered Greywacke	Moderately weathered Greywacke
Unit weight (kN/m^3)	18	18	19	20
Drained cohesion, c' (kPa)	2	6	10	20
Friction angle, ϕ' (deg)	28	32	34	37
R_u Coefficient[a]	0.05 [0.2]	0.1 [0.3]	0.05 [0.2]	N/A

Notes a Ru value for design groundwater [elevated groundwater]

The soil parameters determined from the back analysis were adopted for design of the wall at Sections A, B and C (Refer *Figures 2 – Site Plan, SA – Section A, SB – Section B & SC – Section C*). Results of the stability analyses are given in Table 5-3 below. A 10kPa surcharge was applied upslope of the upper wall to model loads arising from the dwelling and long term live load, noting that proposed underpinning works will minimise some of this applied load.

Table 5-3: Stability Analysis Results

Design Case		FoS	Target FoS	OK?
Section A	Back analysis	0.92	1.0	Yes
	Design Groundwater	1.61	1.5	Yes
	Elevated Groundwater	1.46	1.3	Yes
	Seismic	1.23	1.1	Yes

Notes a Design, Groundwater, Elevated Groundwater and Seismic analyses completed for 2No piles: Upper wall - 4m length force upper wall, and Lower wall - 5m length. Shear force selected to force failure below toe of walls.

Results from the stability analysis are presented in Appendix C.

5.6. Wall Design

Geotechnical design of the wall has been undertaken using the software package *Wallap* Version 6.06, provided by Geosolve.

Three sections, A, B & C, along the chainage of the walls have been analysed. The sections are shown on Figure 2 – Site Plan and Figures SA, SB & SC presented in Appendix A.

Section A: Used for back analysis (ref Section 5.5 above). Retention in front of double level dwelling. Lowest point on lower wall resulting in maximum combined retained height. Underpinning of inadequate dwelling foundations above upper wall. Removal of tree stump between upper and lower walls resulting in potential over excavation of upper wall.

Section B: Retention in front of single (upper) level dwelling.

Section C: Lower wall only forming machine access from existing driveway to construction area. Maximum retained height for lower wall.

The following additional parameters as well as those shown in Table 5-2 were used in the wall analysis. The wall-soil interface friction value has been adopted as ⅔ϕ on the active side and ⅓ϕ on the passive side.

Table 5-3: Additional soil parameters for wall design

Parameter	Light weight fill	Fill/ Loose soils	Residual soils	Highly weathered Greywacke	Moderately weathered Greywacke
Unit weight (kN/m^3)	16	18	18	19	20
Drained cohesion, c' (kPa)	0	1	6	10	20
Friction angle, ϕ' (deg)	42	30	30	34	37
Modulus of Elasticity, E'(MPa)	20	20	25	50	200
Poisson's ratio	0.2	0.2	0.3	0.2	0.2

Surcharges are applied in the model to account for the dwelling, construction loads and the effect of the upper wall on the lower. Three design cases for the lower wall have been assessed:

a) Short term load condition of 13T excavator applying asymmetrical surcharge behind the lower retaining wall (i.e. during pile holes excavation and construction with higher loads on one track). k_1 (timber strength duration factor) in bending and shear capacity of timber pile = 1.0.
b) Medium term load condition of 13T excavator stationary above lower retaining wall. k_1 factor in bending and shear capacity of timber pile = 0.8.
c) Long term post construction conditions with 2.5kPa live load above the lower retaining wall. k_1 factor in bending and shear capacity of timber pile = 0.6.

Section A

The design staging for analysis of the Section A lower wall is as follows:

0. Model set up includes 9m deep pile modelled as a 400mm diameter SED timber pile spaced at 1.3m c/c (2.5xD). A groundwater level within the moderately weathered Greywacke is adopted. The soil profile from the stability model is adopted.
1. Apply surcharge at RL 10.0m located 3.66m behind top of wall to model the upper retaining wall.
2. Apply surcharge at RL 10.0m located 4.5m behind top of wall to model additional soil above upper wall, beneath dwelling and dwelling dead load.
3. Apply load at RL 8.67m (i.e. 2/3 retained height below top of wall) to model water pressure.
4. Excavate to RL 8.0m (i.e. 2.0m deep excavation) to existing ground level.

5 & 6. Apply surcharge representing load case a).
7 & 8. *Remove surcharge representing load case a).*
9 & 10. Apply surcharge representing load case b).
11 & 12. *Remove surcharge representing load case b).*
13. Apply surcharge representing load case c).

14. Excavate to RL 7.0m (i.e. an additional 1.0m evacuation of soils of downslope soils over the long term).
15. Apply load at RL 8.67m (i.e. 2/3 retained height below top of wall) to model seismic load.

The design staging for analysis of the Section A upper wall is as follows:

0. Model set up includes 6.0m deep pile modelled as a 300mm diameter SED timber pile spaced at 1.0m c/c. A groundwater level within the moderately weathered Greywacke is adopted. The soil profile from the stability model is adopted.
1. Apply surcharge at RL 12.47m immediately behind the wall to model the dwelling.
2. Apply load at RL 10.82m (i.e. 2/3 retained height below top of wall) to model possible transient water pressure.
3. Excavate to RL 10.0m (i.e. 2.47m deep excavation).
4. Excavate to RL 9.0m (i.e. potential over excavation during removal of tree stump).
5. Fill behind wall to RL 10.0m.
6. Apply load at RL 10.82m (i.e. 2/3 retained height below top of wall) to model seismic load.

Section B

The design staging for analysis of the Section B lower wall is as follows:

0. Model set up includes 9m deep pile modelled as a 400mm diameter SED timber pile spaced at 1.3m c/c (2.5xD). A groundwater level within the moderately weathered Greywacke is adopted. The soil profile from the stability model is adopted.
1. Apply surcharge at RL 11.7m located 3.66m behind top of wall to model the upper retaining wall.
2. Apply surcharge at RL 11.7m located 3.66m behind top of wall to model slope aboe retaining wall.
3. Apply surcharge at RL 11.7m located 5.8m behind top of wall to model additional soil above upper wall, beneath dwelling and dwelling dead load.
4. Apply load at RL 10.37m (i.e. 2/3 retained height below top of wall) to model water pressure.
5. Excavate to RL 9.7m (i.e. 2.0m deep excavation) to existing ground level.

6 & 7. Apply surcharge representing load case a).

8 & 9. *Remove surcharge representing load case a).*

10 & 11. Apply surcharge representing load case b).

12 & 13. *Remove surcharge representing load case b).*

14. Apply surcharge representing load case c).
15. Excavate to RL 8.7m (i.e. an additional 1.0m evacuation of soils of downslope soils over the long term).
16. Apply load at RL 10.37m (i.e. 2/3 retained height below top of wall) to model seismic load.

The design staging for analysis of the Section B upper wall is as follows:

0. Model set up includes 6.0m deep pile modelled as a 300mm diameter SED timber pile spaced at 1.0m c/c. A groundwater level within the moderately weathered Greywacke is adopted. The soil profile from the stability model is adopted.
1. Apply surcharge at RL 13.3m immediately behind the wall to model the dwelling.
2. Apply surcharge at RL 13.3m immediately behind the wall to model the slope above the wall.
3. Apply load at RL 12.23m (i.e. 2/3 retained height below top of wall) to model possible transient water pressure.

4. Excavate to RL 11.7m (i.e. 1.6m deep excavation).
5. Apply load at RL 12.23m (i.e. 2/3 retained height below top of wall) to model seismic load.

Section C

The design staging for analysis of the Section C wall is as follows:

0. Model set up includes 9m deep pile modelled as a 400mm diameter SED timber pile spaced at 1.25m c/c. A groundwater level within the moderately weathered Greywacke is adopted. The soil profile from the stability model is adopted. Lightweight fill (i.e. scoria, γ=16kN/m^3) is modelled behind the wall.
1. Apply load at RL 13.63m (i.e. 2/3 retained height below top of wall) to model water pressure.
2. Excavate to RL 12.62m (i.e. 2.6m deep excavation) to existing ground level.

3 & 4. Apply surcharge representing load case a).
5 & 6. *Remove surcharge representing load case a).*
7 & 8. Apply surcharge representing load case b).
9 & 10. *Remove surcharge representing load case b).*

11. Apply surcharge representing load case c).
12. Excavate to RL 11.62m (i.e. an additional 1.0m evacuation of soils of downslope soils over the long term).
13. Apply load at RL 13.63m (i.e. 2/3 retained height below top of wall) to model seismic load.

The analysed shear force and bending moment loads for each design scenario are shown in Table 5-4 below. Expected top of wall displacements are also provided however it should be noted that the majority of deflection will be experienced under construction loads only. A load factor of 1.5 has been applied to the design loads.

Table 5-4: Pile design loads

			Lower wall[a]			Upper wall[b]
			Load case a)Short term	Load case b)Medium term	Load case c)Long term	
Section A	Design load based on output from Wallap	V* (kN/pole)	65.3	64.7	53.8 [36.0]	65.6 [46.5]
		M* (kNm/pole)	130.7	129.9	112.9 [75.8]	58.7 [41.9]
	Timber Pole Capacity (with appropriate k_1 value)	ϕV_n (kN/pole)	237.5	190.0	142.5 [237.5]	93.7 [156.2]
		ϕM_n (kNm/pole)	188.8	151.1	113.3 [188.8]	59.6 [98.0]
	Top of wall deflection (mm)		106	38	41 [0]	23 (54[e]) [58]
Section B	Design load based on output from Wallap	V* (kN/pole)	94.4	66.3	64.5 [39.7]	7.2 [6.3]
		M* (kNm/pole)	135.5	93.4	121.1 [75.5]	4.4 [3.8]
	Timber Pole Capacity (with appropriate k_1 value)	ϕV_n (kN/pole)	237.5	190.0	165.6[c] [237.5]	80.2 [133.6]
		ϕM_n (kNm/pole)	188.8	151.1	136.7[c] [188.8]	47.8 [79.7]
	Top of wall deflection (mm)		44	45	27 [28]	4 [5]
Section C	Design load based on output from Wallap	V* (kN/pole)	43.9	43.9	87.7 [69.8]	N/A
		M* (kNm/pole)	95.6	95.0	121.9 [97.8]	N/A
	Timber Pole Capacity (with appropriate k_1 value)	ϕV_n (kN/pole)	237.5	190.0	171.2[c] [237.5]	N/A
		ϕM_n (kNm/pole)	188.8	151.1	142.1[c] [188.8]	N/A
	Top of wall deflection (mm)[f]		74	42	42 [25]	N/A

Notes
- a Lower wall: 400mm SED timber poles at 1.3m c/c
- b Upper wall: 300mm SED timber poles at 1.0m c/c
- c An increase in diameter of 6mmm per m length has been allowed.
- d Figure in square brackets denotes seismic loading case
- e Over excavation deflection during tree stump removal, likely conservative as water pressure and live load surcharge applied during over excavation in analysis.
- f Excessive deflection and FoS<2.0 with long term drop out in front of wall. Potential to anchor wall in the future if this is seen to occur.
- g Lower wall deflection likely to occur during construction reducing its long term impact

The retaining wall analysis (Wallap) output and timber pole capacity design spreadsheets are presented in Appendix D.

Factor of safety at toe of wall decreases below 2.0 (Burland-Potts) and deflection at Section C (retaining accessway) is considered to be excessive during long term drop out in front of the wall due to coastal regression. Should drop out in front of the wall be observed to be occurring in the future, remediation could include installing anchors at the top of the piles to limit this deflection. The deflection of the wall is not considered to influence dwelling support.

5.7. Dwelling underpinning design

Vertical support of the eastern portion of the southern wall of the dwelling is not considered to be adequate. Underpinning piles have been designed to support this length of the dwelling. Design of the underpinning works has been completed by SCS Structures Ltd and the SCS drawings are attached in Appendix G. The structural underpinning works shall be undertaken in conjunction and concurrently with the remedial works presented in this report.

5.8. Safety in Design

The proposed retaining walls involve work on an existing landslide, significant retained heights with potential falls of up to 2.6m. The constructor shall ensure onsite worker safety and prevention of damage to the existing dwelling at all times.

Construction shall begin on a stable area on the accessway in the south western corner of the site. Construction shall be progressed eastwards along the wall chainage, ensuring the formed working platform is stable before progressing. The lower retaining wall has been designed assuming an excavator of 13T or less is used. The design surcharge should not be exceeded.

Excavation and retaining walls shall be subject to a specific job safety analysis (JSA) including but not limited to, restrictions during wet weather, delineation of unsafe/no entry zones, use of safety fencing and pre-entry inspections of any cut faces by site staff.

Cuts of up to 1.6m are required adjacent to the existing dwelling. The dwelling foundations have been deemed inadequate and support of the dwelling shall be maintained at all times. The upper wall will be constructed by top down methodology. No cutting down in front of the dwelling shall be undertaken prior to the pile be installed. Soil arching will be relied on during construction. Shotcrete facing below natural ground level shall be applied following construction of the walls.

6. Applicability

This report has been prepared for the soil use of our client, Jane Banfield and the Far North District Council with respect to Building Consent application for the particular brief and on the terms and conditions agreed with our client. It may not be used or relied on (in whole or in part) by anyone else, or for any other purpose or in any other contexts, without out prior written agreement.

The nature and continuity of the subsoil conditions onsite have been inferred from visual observations and two hand augered boreholes, as well as seven hand augered boreholes, nine scala penetrometer tests and one machine drilled boreholes (undertaken by others). It must be appreciated that actual subsoil conditions could differ from those inferred. If the subsoil conditions differ in any way from those described in this report it is essential that Northland Geotechnical Specialists Ltd be contacted.

Report prepared by:

Rebekah Buxton
Geotechnical Engineer, BE Civil (Hons), MEngNZ

Authorised for Northland Geotechnical Specialists Limited by:

David Buxton
Geotechnical Engineer, BE Civil (Hons), CPEng, CMEngNZ

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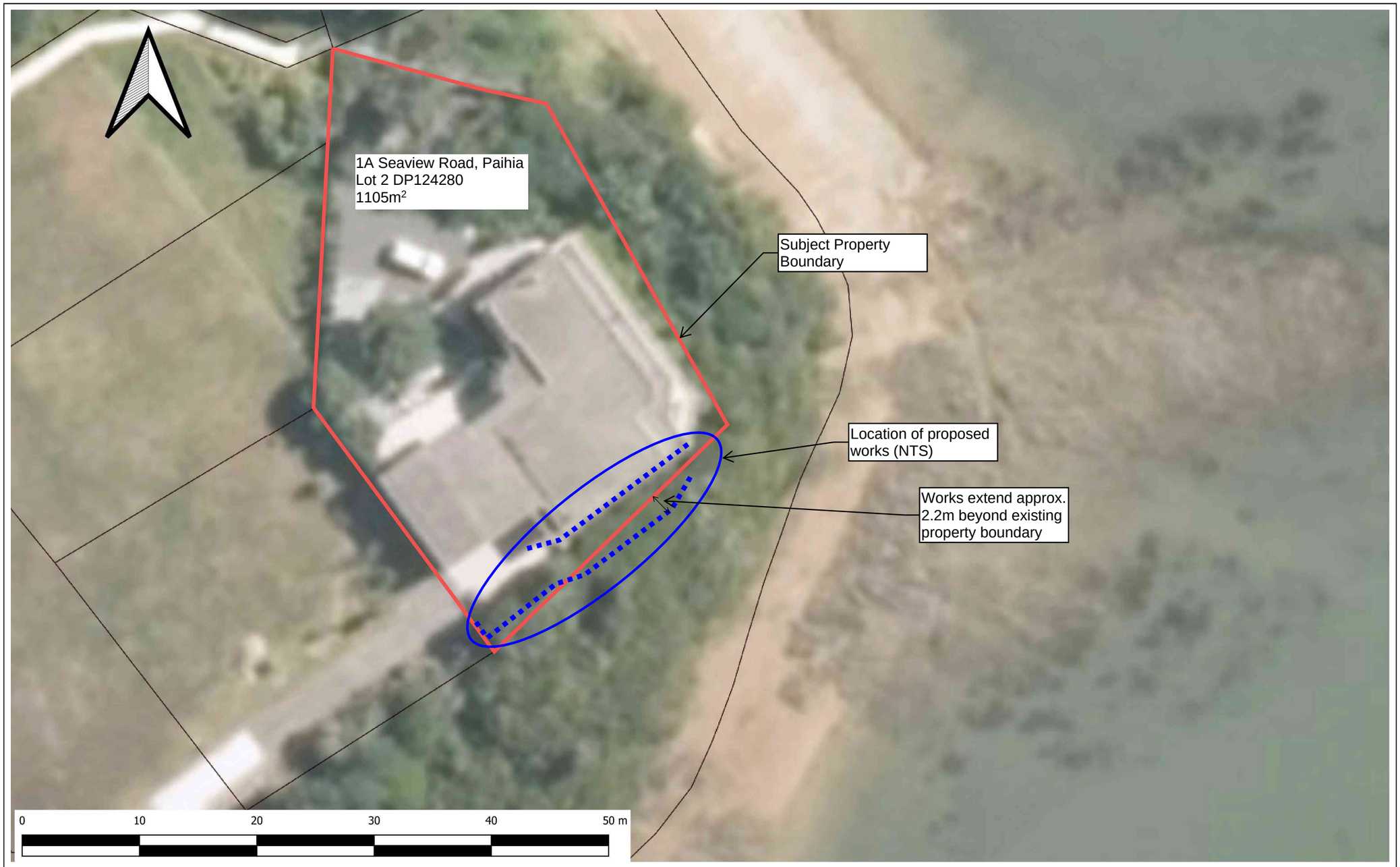
Appendix A:

A1. Construction Drawings

- NGS Figure 1 – Location Plan
- NGS Figure 2 – Site Plan
- NGS Figure 3 – Lower Wall Set Out
- NGS Figure 4 – Retaining Wall Elevation – Lower Wall
- NGS Figure 5 – Retaining Wall Elevation – Upper Wall
- NGS Figure 6 – Typical Section
- NGS Figure SA – Section A
- NGS Figure SB – Section B
- NGS Figure SC – Section C

A2. Not for construction drawings

- NGS Figure 101 – Site investigation Plan
- NGS Figure SA-1 – Section A Coastal Regression



NGS Northland Geotechnical Specialists
www.northlandgeotech.co.nz

NOTES:
Aerial Imagery: LINZ, Northland 0.4m Rural Aerial Photos (2014-2016) CC by 4.0.

This figure is not for construction unless signed as approved
Approved: DS Button Date: 11/03/2014

CLIENT **Jane Banfield**
PROJECT **Landslip Remediation**
LOCATION **1A Seaview Road, Paihia**
TITLE **Location Plan**

Scale 1:300 @ A3

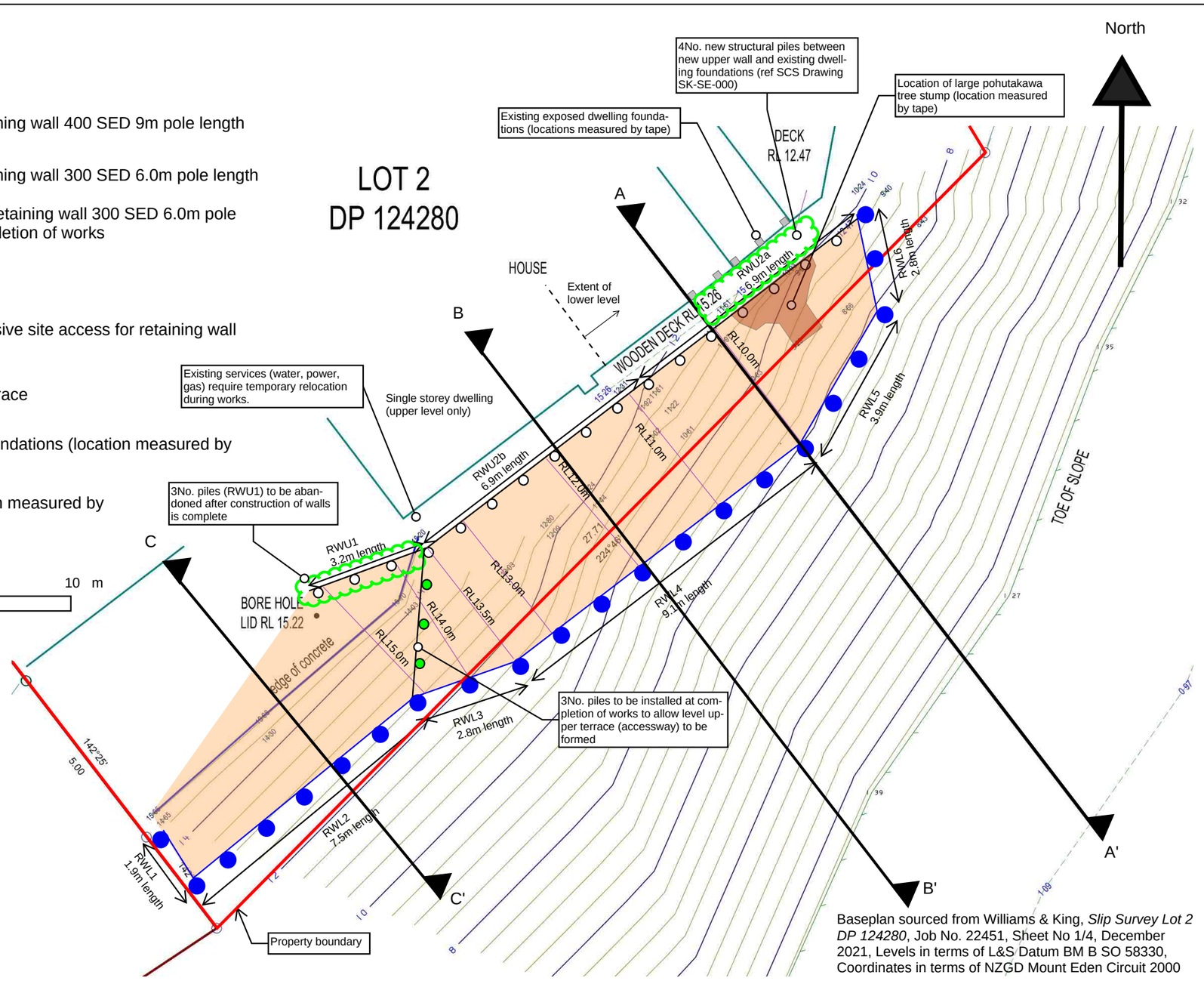
Project No. **NGS 0213**
Date **17/02/2022**
By **RB**
Figure No. **1**
Revision **0**

LEGEND

- Lower wall: Timber pole retaining wall 400 SED 9m pole length
- Upper wall: Timber pole retaining wall 300 SED 6.0m pole length
- Additional wall: Timber pole retaining wall 300 SED 6.0m pole length to be installed at completion of works
- Property boundary
- New terrace to allow progressive site access for retaining wall construction
- RL13.0m — Finished contours on new terrace
- Existing exposed dwelling foundations (location measured by tape rather than survey)
- Pohutaka tree stump (location measured by tape rather than survey)

0 5 10 m

Scale 1 : 100 at A3



Notes:
1. Refer to Figure No.s 3 to 5 for locations and details of new timber pole retaining walls.
2. These drawings shall be read in conjunction with the NGS report, *1A Seaview Road, Paihia; Landslip Remediation*, dated March 2022. NGS Ref 0213.
3. Drawings shall be read in conjunction with SCS Drawings SK-SE-000 to -003.
4. All discrepancies to be referred to the Engineer for decision prior to proceeding with works.
5. All works to comply with Constructor's approved Health & Safety Manual and Health and Safety at Work Act 2015.
6. All works to comply with the Far North District Council Engineering Standards & Guidelines 2009.

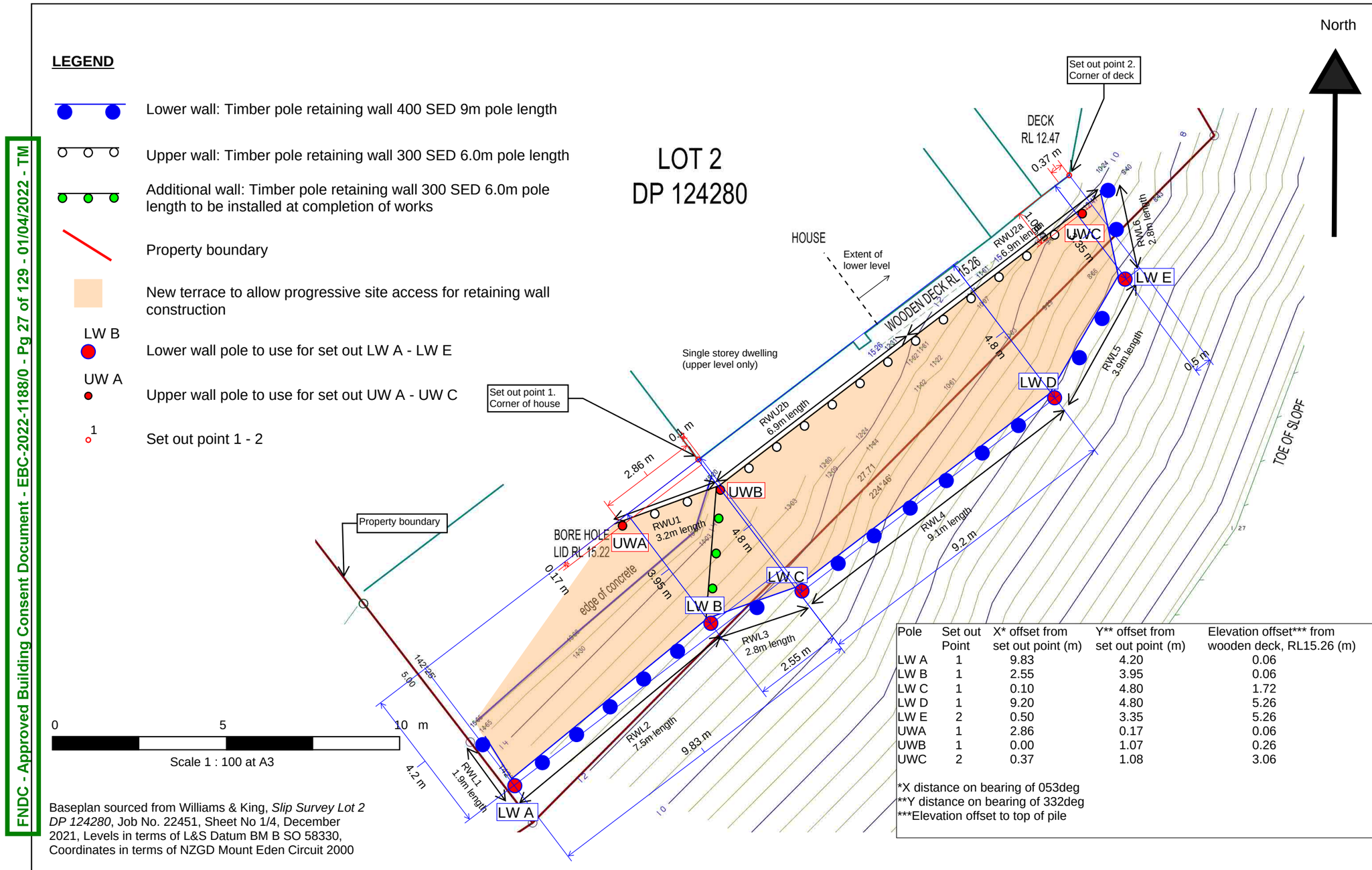
Baseplan sourced from Williams & King, *Slip Survey Lot 2 DP 124280*, Job No. 22451, Sheet No 1/4, December 2021, Levels in terms of L&S Datum BM B SO 58330, Coordinates in terms of NZGD Mount Eden Circuit 2000

Project No.	Date	**Jane Banfield** **1A Seaview Road, Paihia**	FOR CONSTRUCTION This drawing is not to be used for construction unless signed as approved	
0213	March 2022		Signed: DS Button	Date: 11/03/2021
Figure No. 2	Revision A	**Site Plan**		

NGS Northland Geotechnical Specialists
Ph: +64 226981129 E: info@northlandgeotech.co.nz

LEGEND

- Lower wall: Timber pole retaining wall 400 SED 9m pole length
- Upper wall: Timber pole retaining wall 300 SED 6.0m pole length
- Additional wall: Timber pole retaining wall 300 SED 6.0m pole length to be installed at completion of works
- Property boundary
- New terrace to allow progressive site access for retaining wall construction
- LW B — Lower wall pole to use for set out LW A - LW E
- UW A — Upper wall pole to use for set out UW A - UW C
- 1 — Set out point 1 - 2



Pole	Set out Point	X* offset from set out point (m)	Y** offset from set out point (m)	Elevation offset*** from wooden deck, RL15.26 (m)
LW A	1	9.83	4.20	0.06
LW B	1	2.55	3.95	0.06
LW C	1	0.10	4.80	1.72
LW D	1	9.20	4.80	5.26
LW E	2	0.50	3.35	5.26
UWA	1	2.86	0.17	0.06
UWB	1	0.00	1.07	0.26
UWC	2	0.37	1.08	3.06

*X distance on bearing of 053deg
**Y distance on bearing of 332deg
***Elevation offset to top of pile

Baseplan sourced from Williams & King, *Slip Survey Lot 2 DP 124280*, Job No. 22451, Sheet No 1/4, December 2021, Levels in terms of L&S Datum BM B SO 58330, Coordinates in terms of NZGD Mount Eden Circuit 2000

Project No.	Date		
0213	March 2022	**Jane Banfield** **1A Seaview Road, Paihia**	FOR CONSTRUCTION This drawing is not to be used for construction unless signed as approved
Figure No.	Revision		Signed / Date
3	0	**Retaining Wall Set Out**	DS Button — 11/03/2021

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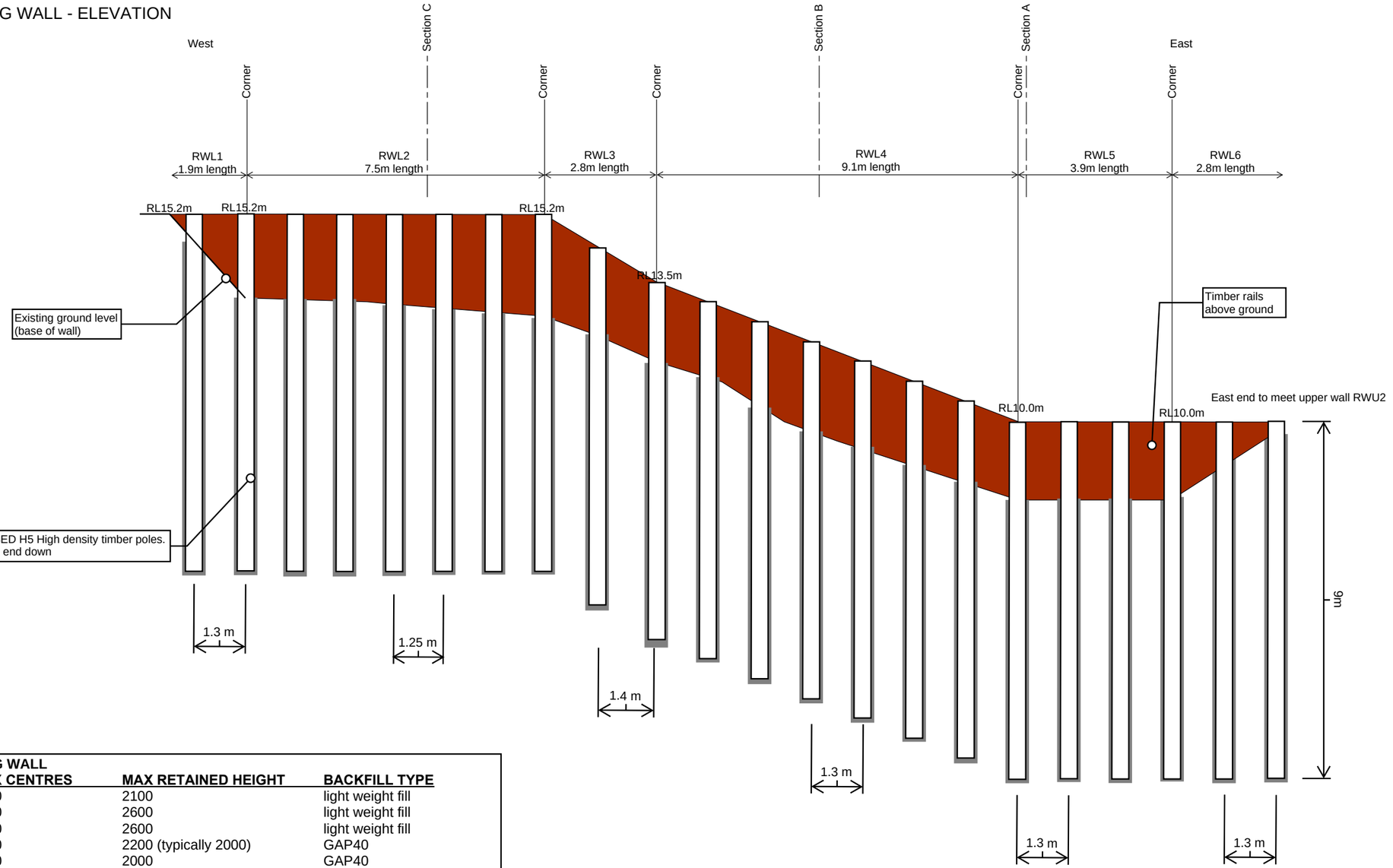
LOWER RETAINING WALL - ELEVATION
1:100 at A3 H=V



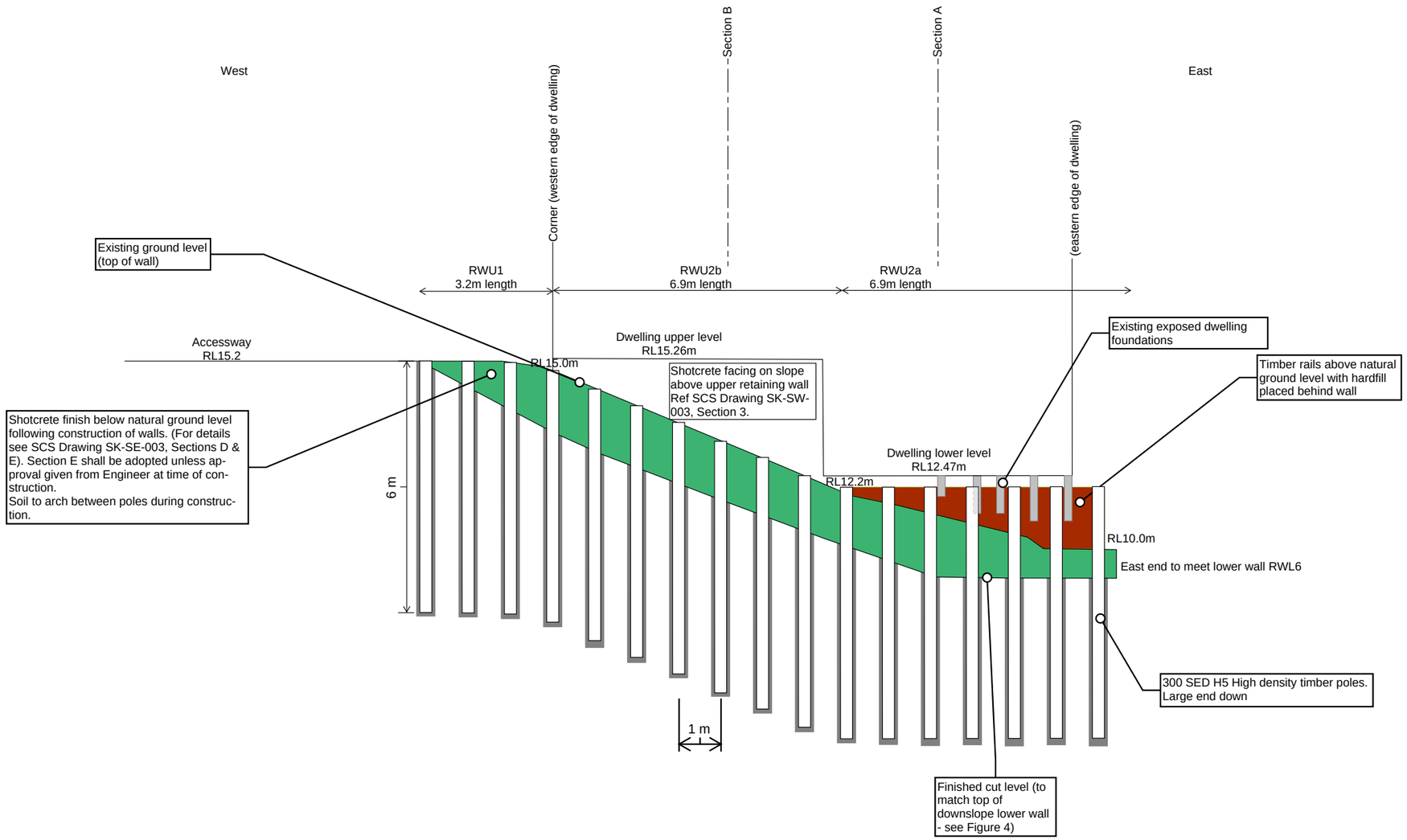
Table

LOWER RETAINING WALL

SECTION	MAX CENTRES	MAX RETAINED HEIGHT	BACKFILL TYPE
RWL1	1300	2100	light weight fill
RWL2	1250	2600	light weight fill
RWL3	1400	2600	light weight fill
RWL4	1300	2200 (typically 2000)	GAP40
RWL5	1300	2000	GAP40
RWL6	1300	2000	GAP40

Project No. 0213	Date March 2022	**Jane Banfield** **1A Seaview Road, Paihia**	FOR CONSTRUCTION This drawing is not to be used for construction unless signed as approved	NGS Northland Geotechnical Specialists Ph: +64 226981129 E: info@northlandgeotech.co.nz
Figure No. 4	Revision 0	**Retaining Wall Elevation - Lower Wall**	Signed DS Button	Date 11/03/2021

UPPER RETAINING WALL - ELEVATION
1:100 at A3 H=V



Project No. 0213	Date March 2022	**Jane Banfield** **1A Seaview Road, Paihia**	FOR CONSTRUCTION This drawing is not to be used for construction unless signed as approved	NGS Northland Geotechnical Specialists Ph: +64 226981129 E: info@northlandgeotech.co.nz
Figure No. 5	Revision 0	**Retaining Wall Elevation - Upper Wall**	Signed DS Button / Date 11/03/2021	

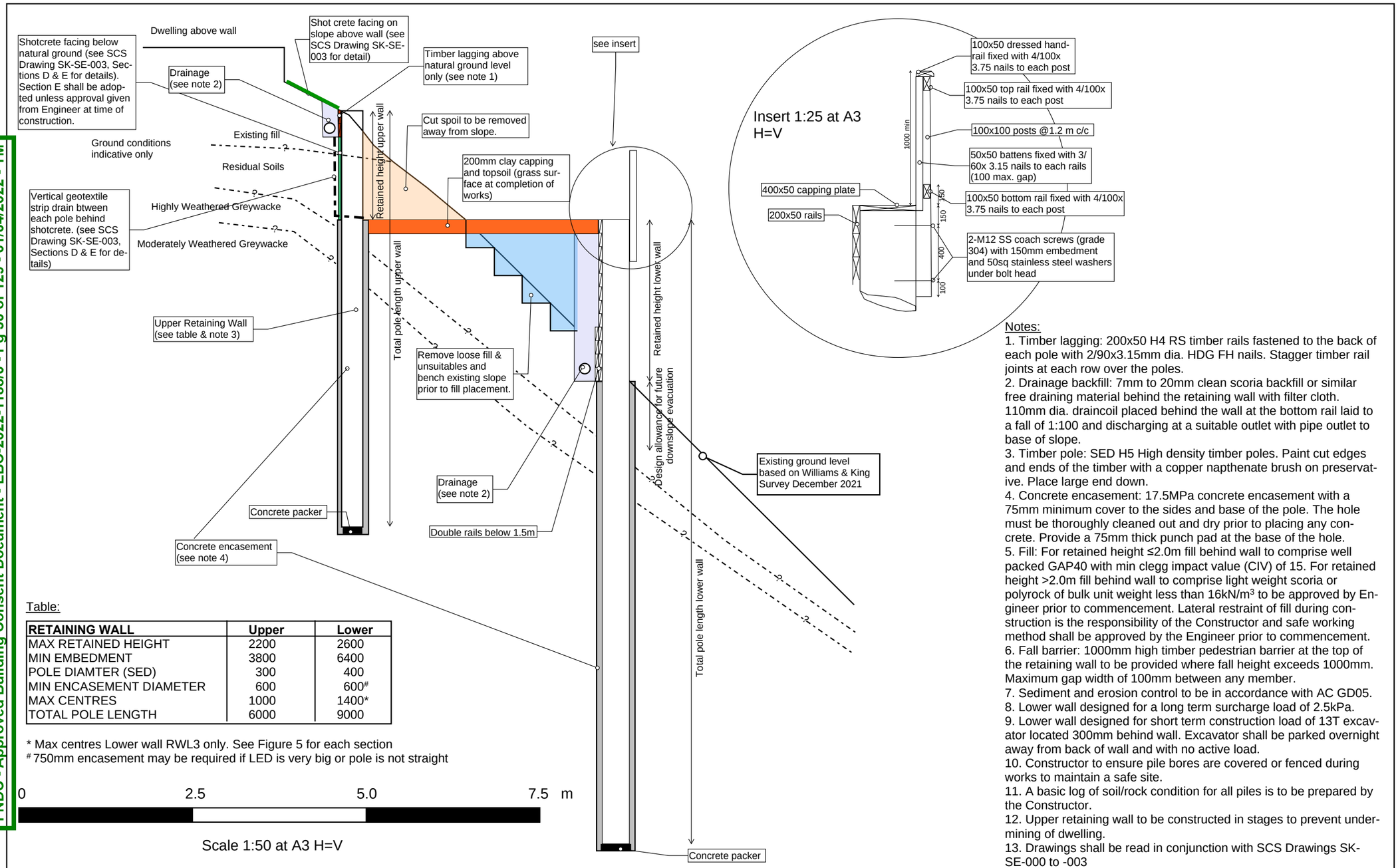


Table:

RETAINING WALL	Upper	Lower
MAX RETAINED HEIGHT	2200	2600
MIN EMBEDMENT	3800	6400
POLE DIAMTER (SED)	300	400
MIN ENCASEMENT DIAMETER	600	600#
MAX CENTRES	1000	1400*
TOTAL POLE LENGTH	6000	9000

* Max centres Lower wall RWL3 only. See Figure 5 for each section

750mm encasement may be required if LED is very big or pole is not straight

Scale 1:50 at A3 H=V

Notes:

1. Timber lagging: 200x50 H4 RS timber rails fastened to the back of each pole with 2/90x3.15mm dia. HDG FH nails. Stagger timber rail joints at each row over the poles.
2. Drainage backfill: 7mm to 20mm clean scoria backfill or similar free draining material behind the retaining wall with filter cloth. 110mm dia. draincoil placed behind the wall at the bottom rail laid to a fall of 1:100 and discharging at a suitable outlet with pipe outlet to base of slope.
3. Timber pole: SED H5 High density timber poles. Paint cut edges and ends of the timber with a copper napthenate brush on preservative. Place large end down.
4. Concrete encasement: 17.5MPa concrete encasement with a 75mm minimum cover to the sides and base of the pole. The hole must be thoroughly cleaned out and dry prior to placing any concrete. Provide a 75mm thick punch pad at the base of the hole.
5. Fill: For retained height ≤2.0m fill behind wall to comprise well packed GAP40 with min clegg impact value (CIV) of 15. For retained height >2.0m fill behind wall to comprise light weight scoria or polyrock of bulk unit weight less than 16kN/m^3 to be approved by Engineer prior to commencement. Lateral restraint of fill during construction is the responsibility of the Constructor and safe working method shall be approved by the Engineer prior to commencement.
6. Fall barrier: 1000mm high timber pedestrian barrier at the top of the retaining wall to be provided where fall height exceeds 1000mm. Maximum gap width of 100mm between any member.
7. Sediment and erosion control to be in accordance with AC GD05.
8. Lower wall designed for a long term surcharge load of 2.5kPa.
9. Lower wall designed for short term construction load of 13T excavator located 300mm behind wall. Excavator shall be parked overnight away from back of wall and with no active load.
10. Constructor to ensure pile bores are covered or fenced during works to maintain a safe site.
11. A basic log of soil/rock condition for all piles is to be prepared by the Constructor.
12. Upper retaining wall to be constructed in stages to prevent undermining of dwelling.
13. Drawings shall be read in conjunction with SCS Drawings SK-SE-000 to -003

Project No.	Date			
0213	March 2022	**Jane Banfield** **1A Seaview Road, Paihia**	FOR CONSTRUCTION This drawing is not to be used for construction unless signed as approved	NGS Northland Geotechnical Specialists Ph: +64 226981129 E: info@northlandgeotech.co.nz
Figure No.	Revision		Signed DS Button / Date 11/03/2021	
6	0	**Typical Section**		

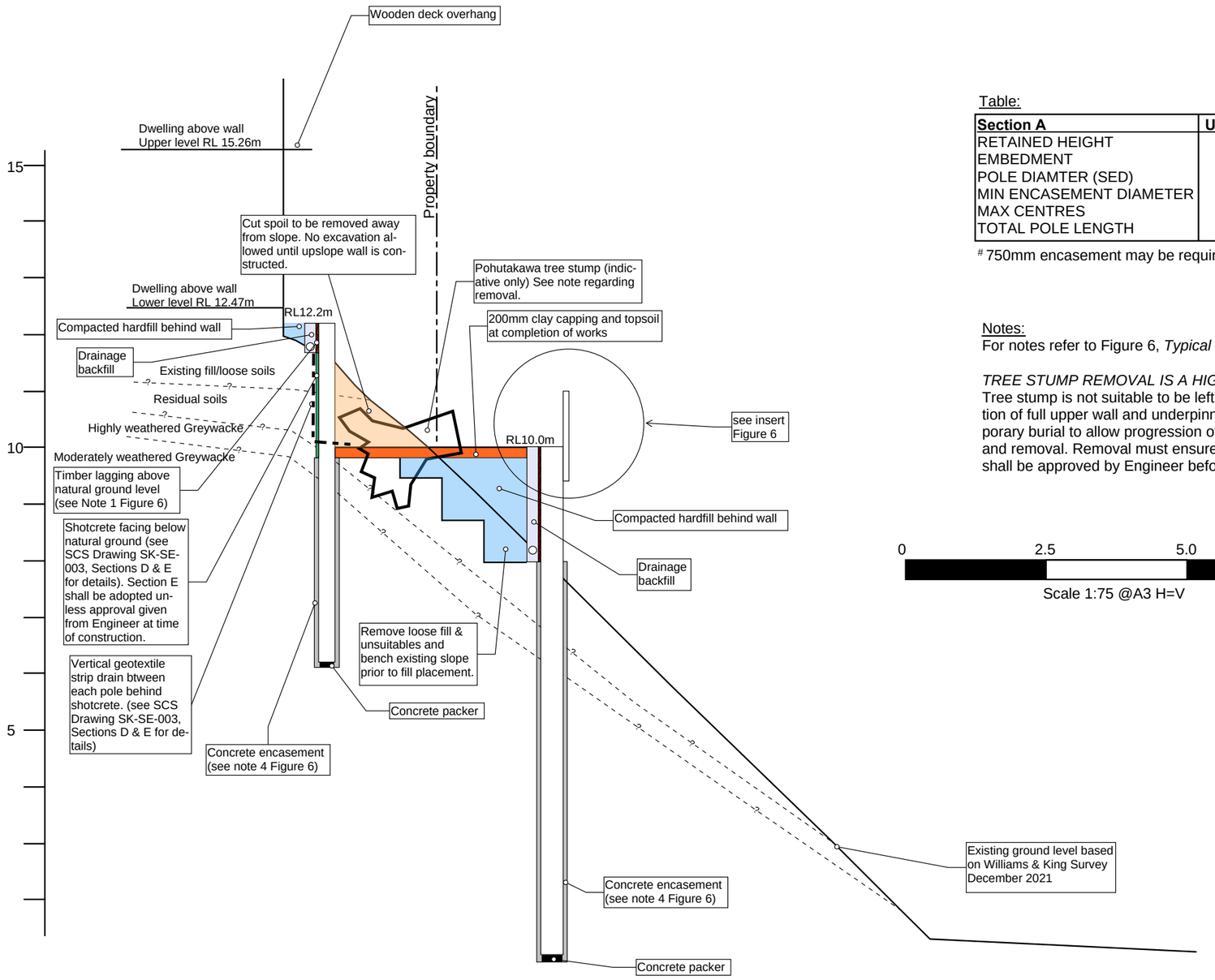


Table:

Section A	Upper (RWUa)	Lower (RWL4&5)
RETAINED HEIGHT	2200	2000
EMBEDMENT	3800	7000
POLE DIAMTER (SED)	300	400
MIN ENCASEMENT DIAMETER	600	600#
MAX CENTRES	1000	1200
TOTAL POLE LENGTH	6000	9000

750mm encasement may be required if LED is very big or pole is not straight

Notes:
For notes refer to Figure 6, *Typical Section* and SCS Drawings SK-SE-000 to -003

TREE STUMP REMOVAL IS A HIGH RISK ACTIVITY FOR DWELLING
Tree stump is not suitable to be left in place and shall be removed after construction of full upper wall and underpinning works is complete. This may require temporary burial to allow progression of wall construction and subsequent exposure and removal. Removal must ensure no loss of support to the dwelling. The method shall be approved by Engineer before commencing.

0 2.5 5.0 7.5 m

Scale 1:75 @A3 H=V

Project No.	Date			
0213	March 2022	**Jane Banfield** **1A Seaview Road, Paihia**	FOR CONSTRUCTION This drawing is not to be used for construction unless signed as approved	
Figure No.	Revision		Signed	Date
SA	0	**Section A**	DS Button	11/03/2021

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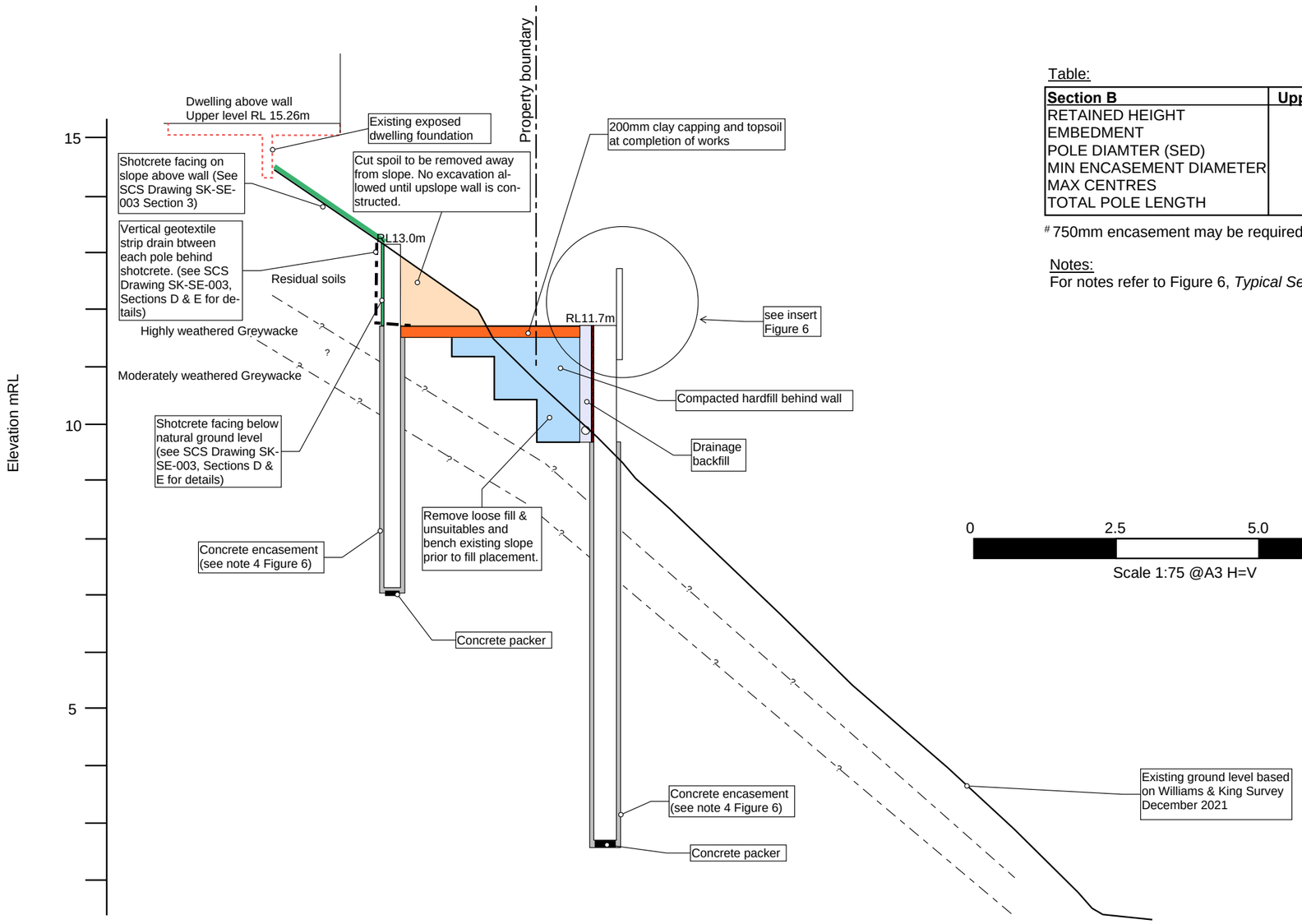

Table:

Section B	Upper (RWU2b)	Lower (RWL4)
RETAINED HEIGHT	1450	2200 (typically 2000)
EMBEDMENT	4550	6800
POLE DIAMTER (SED)	300	400
MIN ENCASEMENT DIAMETER	600	600#
MAX CENTRES	1000	1300
TOTAL POLE LENGTH	6000	9000

750mm encasement may be required if LED is very big or pole is not straight

Notes:
For notes refer to Figure 6, *Typical Section* and SCS Drawings SK-SE-000 to -003

Project No. 0213	Date March 2022	**Jane Banfield** **1A Seaview Road, Paihia**	FOR CONSTRUCTION This drawing is not to be used for construction unless signed as approved	NGS Northland Geotechnical Specialists Ph: +64 226981129 E: info@northlandgeotech.co.nz
Figure No. SB	Revision 0	**Section B**	Signed DS Button / Date 11/03/2021	

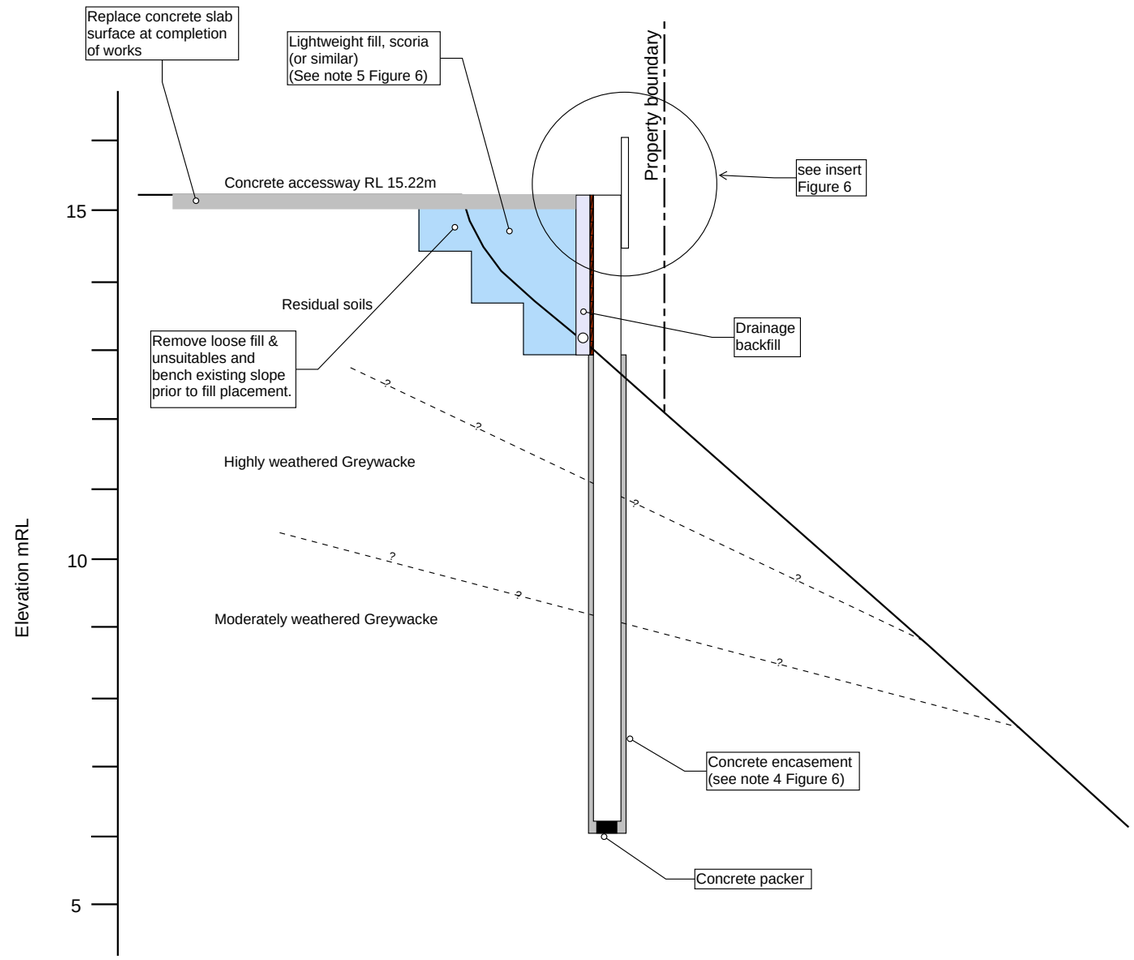

Table:

Section C	Lower (RWL2)
RETAINED HEIGHT	2600
EMBEDMENT	6400
POLE DIAMTER (SED)	400
MIN ENCASEMENT DIAMETER	550
MAX CENTRES	1250
TOTAL POLE LENGTH	9000

Notes:
For notes refer to Figure 6, *Typical Section* and SCS Drawings SK-SE-000 to -003

0 2.5 5.0 7.5 m

Scale 1:75 @A3 H=V

Project No.	Date			
0213	March 2022	**Jane Banfield** **1A Seaview Road, Paihia**	FOR CONSTRUCTION This drawing is not to be used for construction unless signed as approved	
Figure No.	Revision		Signed	Date
SC	0	**Section C**	DS Button	11/03/2021

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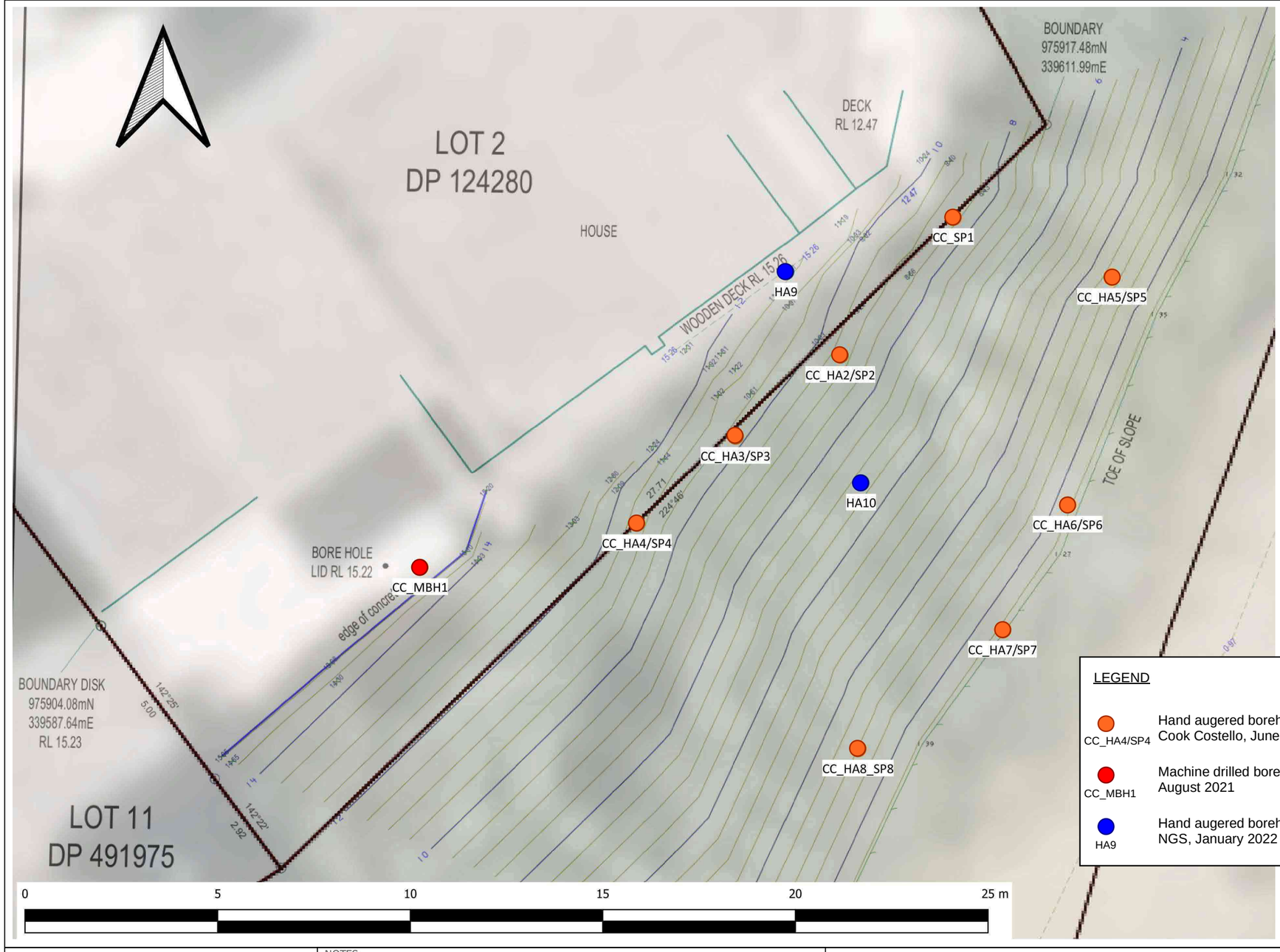


NGS
Northland Geotechnical Specialists
www.northlandgeotech.co.nz

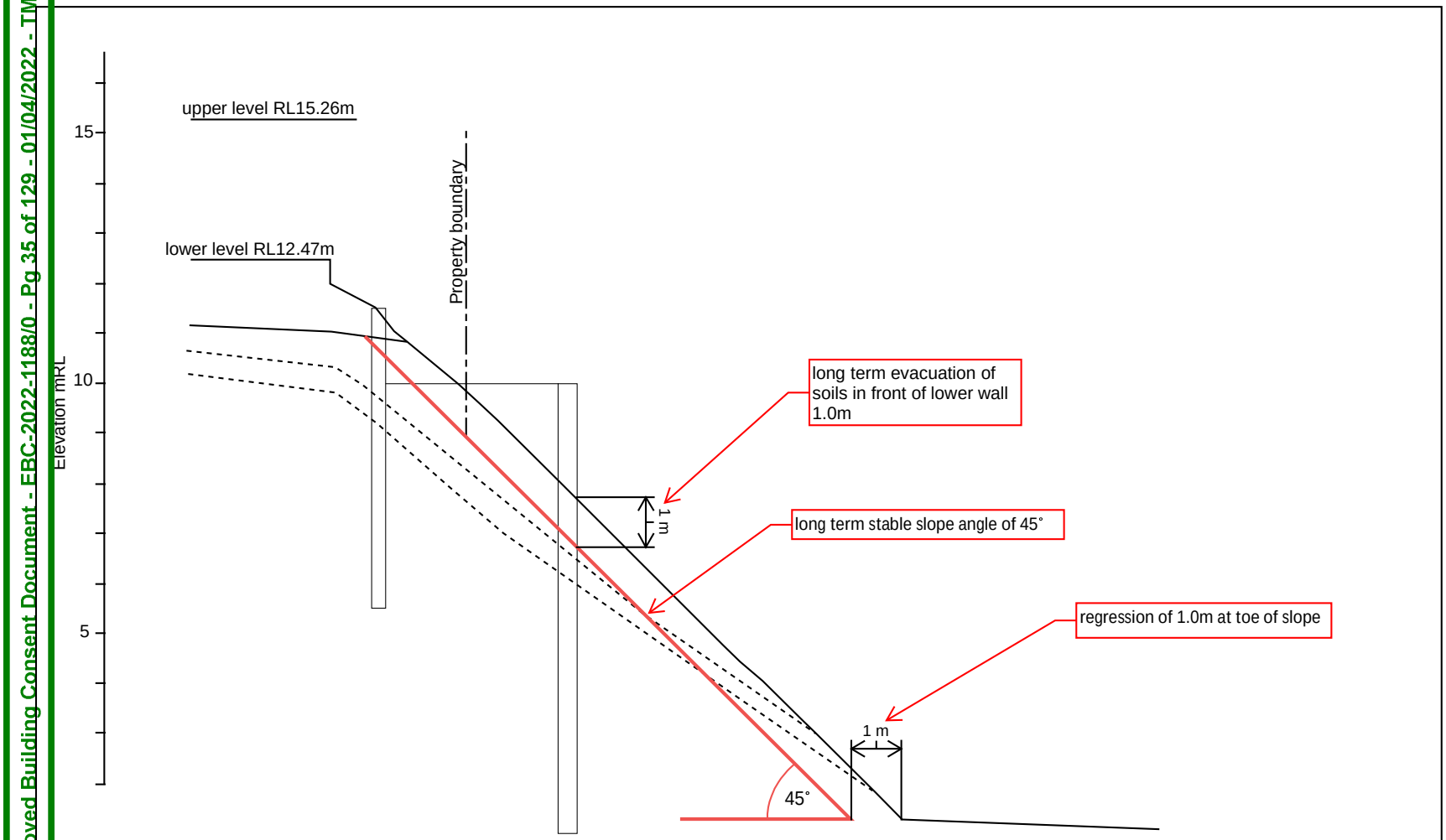
NOTES:
Base plan sourced from Williams & King, Slip Survey Lot 2 DP 124280, JOab No. 22451, Sheet No 1/4, December 2021, Levels in terms of L&S Datum BM B SO 58330, Coordinates in terms of NZGD Mount Eden Circuit, 2000.

This figure is not for construction unless signed as approved
Approved: Date:

CLIENT **Jane Banfield**
PROJECT **Landslip Remediation**
LOCATION **1A Seaview Road, Paihia**
TITLE **Site investigation plan**

Scale 1:100 @ A3

Project No. **NGS 0213**
Date **23/02/2022**
By **RB**
Figure No. **101**
Revision **0**



Project No. 0213	Date Feb 2022	**Jane Banfield** **1A Seaview Road, Paihia**	NOT FOR CONSTRUCTION This drawing is not to be used for construction unless signed as approved	NGS Northland Geotechnical Specialists Ph: +64 226981129 E: info@northlandgeotech.co.nz
Figure No. SA-1	Revision 0	**Section A - Coastal regression**	Signed / Date	

Appendix B: Site Investigation Logs

B1. Recent investigations (NGS)

- Hand auger borehole logs (HA9-HA10)

B2. Historical investigations (Cook Costello)

- Hand auger borehole logs (HA2 -HA8)
- Scala penetrometer logs (SP1 – SP8)
- Machine drilled borehole log (MBH1)

HAND AUGER LOG

NGS Northland Geotechnical Specialists

HOLE NO.: HA9
JOB NO.: 0213

CLIENT: Jane Banfield
PROJECT: Geotechnical assessment for landslide remediation

SITE LOCATION: 1A Seaview Road, Paihia
CO-ORDINATES: 1700034mE, 6093978mN
ELEVATION: Ground
START DATE: 13/01/2022
END DATE: 13/01/2022
LOGGED BY: DB

MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)	DEPTH (m)
Orange and light grey. Dry; friable. Residual soils fill. 0.5m: Brown, white chips. 0.8m: voids zone - tension from tree?	0.0 – 0.8
Silty CLAY; orange and light grey. Stiff, moist to dry, low plasticity; loose/void feel to auger - tension zone. 1.8m: harder to auger	0.8 – 1.8
SILT, with some clay; light grey and orange. Hard, moist, low plasticity; Highly weathered Greywacke.	1.8 – 2.2
Target lithology. Hard to auger. Dry on completion. EOH: 2.20m	2.2

SCALA PENETROMETER (Blows / 100mm)

Depth (m)	Blows
2.2–2.3	8
2.3–2.4	13
2.4–2.5	15
2.5–2.6	16
2.6–2.7	15
2.7–2.8	18
2.8–2.9	18
2.9–3.0	18
3.0–3.1	17
3.1–3.2	18
3.2–3.3	23 >>

VANE SHEAR STRENGTH (kPa) — Vane: NGS Vane 2 - 19mm

Approx. depth (m)	Values
0.8	108 / 5
1.2	113 / 7
1.6	161 / 44
1.8	UTP / -
2.0	UTP / -

WATER: Groundwater Not Encountered

REMARKS

loose slip/free fall debris to 1.8m then competent residual/HW GW

WATER
- Standing Water Level
- Out flow
- In flow

INVESTIGATION TYPE
- [x] Hand Auger
- [ ] Test Pit

Page 1 of 1

NGS Northland Geotechnical Specialists

HAND AUGER LOG

HOLE NO.: HA10

JOB NO.: 0213

CLIENT: Jane Banfield

PROJECT: Geotechnical assessment for landslide remediation

SITE LOCATION: 1A Seaview Road, Paihia

CO-ORDINATES: 1700036mE, 6093974mN

ELEVATION: Ground

START DATE: 13/01/2022

END DATE: 13/01/2022

LOGGED BY: DB

UNIT	MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)	SAMPLES	DEPTH (m)	LEGEND	SCALA PENETROMETER (Blows / 100mm)	VANE SHEAR STRENGTH (kPa) Vane: NGS Vane 2 - 19mm Values	WATER
	Clayey SILT; brown. Very stiff to hard, dry; friable (likely low - high plasticity), common roots.		0.0 – 0.5			UTP / -	Groundwater Not Encountered
	SILT, with some clay; light grey and orange. Very stiff to hard, dry; friable.		0.5 – 1.0			167 / 18; UTP / -	
	Refusal to auger. EOH: 1.00m		1.0		12		
			1.1		20		
			1.2		20		
			1.3		28 >>		
			1.4		27 >>		
			1.5		13		
			1.6		21 >>		
			1.7		25 >>		
			1.8		26 >>		

REMARKS

WATER

- Standing Water Level
- Out flow
- In flow

INVESTIGATION TYPE

- [x] Hand Auger
- [ ] Test Pit

Page 1 of 1

GEO CIVIL
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AUGERHOLE LOG

166 Bank Street,
Whangarei,
M:0276565226
E:info@geocivil.co.nz

Lab Job No.: 8020-1863 **Borehole No.:** HA2/SP2 **Sheet:** 1 of 1
Client: Cook Costello **Hole Depth:** 2.70 m
Job: Geotechnical Investigation **Coordinates:** **Date:** 24/06/21
Report No.: W21-870 **Location:** 1a Seaview Road, Paihia **Ground Level:**
Client Ref. No.: 16057

Unit	Geological Interpretation (In accordance with NZGS 2005)	UCS	Legend	Depth (m)	Water	Relative Density	Vane Shear Strength (kPa) / Scala Penetrometer (NZS4402: 1988 Test 6.5.2 - Procedure 2, blows / 50mm)	Blows	Peak	Residual	Samples
	Silty TOPSOIL, traces of rootlets, traces of subangular gravels up to 10mm, dark brown, moist, low to moderate plasticity.	OL	TS	0.0	Groundwater Not Encountered	-		2			
	Clayey SILT, traces of rootlets, traces of fine sands, traces of subangular gravels up to 10mm, brown with orangey mottling, moist, low to moderate plasticity	ML						2			
				0.5				2	154/29		
	Colour Change: dark brown	ML						3			
	SILT, some clay, friable, brown with orangey mottling, traces of gravels up to 10mm, low plasticity.	ML		1.0				3	99/11		
	Colour change: brown with grey-orangey mottling.	ML						2			
				1.5				2	256+		
								1			
								3	256+		
				2.0				2			
								3			
								3			
								4			
								3			
								5			
								8			
								8			
								9			
								9			
				2.5				15			
	E.O.B, no retrieval at 2.2m										

Remarks
S -35.71821
E 174.32225

Note: All Scala Penetrometer readings taken below 1.5m from start depth are outside the scope of this test
Note: Scala Penetrometer interpretation is not endorsed

Water
Standing Water Level
Out flow
In flow

Investigation Type
☐ Hand Auger
☑ Hand Auger + Scala (DCP)

Contractor:	Equipment:	Recorded By:	Laboratory Technician:	Approved Signatory:
Geocivil	Hand Auger and Scala	J.H Recorded Date: 24/06/2021	Alex Millar	Sean Kokich

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166 Bank Street,
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Lab Job No.: 8020-1863 **Borehole No.:** HA3/SP3 **Sheet:** 1 of 1
Client: Cook Costello **Hole Depth:** 3.65 m
Job: Geotechnical Investigation **Coordinates:** **Date:** 06/07/21
Report No.: W21-870 **Location:** 1a Seaview Road, Paihia **Ground Level:**
Client Ref. No.: 16057

Unit	Geological Interpretation (In accordance with NZGS 2005)	UCS	Legend	Depth (m)	Water	Relative Density
	Clayey TOPSOIL, traces of rootlets, traces of sands, dark brown, moist, moderate plasticity	OL	TS	0.0		
	CLAY, some silt, traces of angular gravels upto 6mm, traces of rootlets and roots, traces of fine to coarse sands, moist, brown, moderate plasticity	CH		0.5		
	Clayey SILT, minor fine sands, traces of highly weathered gravels, red/brown, moist, moderate plasticity	MH		1.0		-
	Colour Change: darker red	MH		1.5	Groundwater Not Encountered	
	End of borehole (no retrieval)			2.0		
				2.5		
				3.0		
				3.5		

Vane Shear Strength (kPa)
Tested in accordance with NZGS Aug 2001
25 50 75 100 125 150 175 200 225

Scala Penetrometer
NZS4402: 1988 Test 6.5.2 - Procedure 2
(blows / 50mm)
5 10 15 20 Blows

Peak ● Residual ○

Samples: 129/17; 162/8; 108/29; 210+

Remarks
S -35.29231
E 174.10010

Note: All Scala Penetrometer readings taken below 1.5m from start depth are outside the scope of this test
Note: Scala Penetrometer interpretation is not endorsed

Water
Standing Water Level
Out flow
In flow

Investigation Type
☐ Hand Auger
☑ Hand Auger + Scala (DCP)

Contractor:	Equipment:	Recorded By:	Laboratory Technician:	Approved Signatory:
Geocivil	Hand Auger and Scala	J.H/A.B/J.A	Alex Millar	Sean Kokich
		Recorded Date: 6/07/2021		

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Lab Job No.: 8020-1863 **Borehole No.:** HA4/SP4 **Sheet:** 1 of 1
Client: Cook Costello **Hole Depth:** 2.55 m
Job: Geotechnical Investigation **Coordinates:** **Date:** 06/07/21
Report No.: W21-870 **Location:** 1a Seaview Road, Paihia **Ground Level:**
Client Ref. No.: 16057

Unit	Geological Interpretation (In accordance with NZGS 2005)	UCS	Legend	Depth (m)	Water	Relative Density
	Clayey TOPSOIL, traces of rootlets, traces of sands, dark brown, moist, moderate plasticity	OL	TS			
	CLAY, some silt, minor fine-coarse sand, orangish brown, moist, moderate plasticity	CH				
	CLAY, some silt, minor fine gravels (upto 10mm), traces of sands, brown, moist, low plasticity	CL		0.5		
	SILT, minor fine gravels upto 5mm, some clay, traces of sand, brown, dry-moist, low plasticity	ML				
	CLAY, some silt, minor fine gravels (upto 10mm), traces of sands, brown, moist, low plasticity	CL		1.0	Groundwater Not Encountered	
	Extremely weathered rock, light brown					
	Void		VOID			
	Extremely weathered rock, light brown			1.5		
	End of Borehole (too firm to dig)					
				2.0		
				2.5		

Vane Shear Strength (kPa) Tested in accordance with NZGS Aug 2001

Scala Penetrometer NZS4402: 1988 Test 6.5.2 - Procedure 2 (blows / 50mm)

Blows: 4 3 1 1 1 2 1 1 1 1 2 2 1 2 1 2 2 3 5 3 3 3 4 3 3 4 5 7 5 4 5 5 5 5 5 5 5 6 4 4 6 6 6 5 3 4 6 10 11 11 12

Peak / Residual: 45/38; 210+

Samples

Remarks
S -35.29210
E 174.10011

Note: All Scala Penetrometer readings taken below 1.5m from start depth are outside the scope of this test
Note: Scala Penetrometer interpretation is not endorsed

Water
- Standing Water Level
- Out flow
- In flow

Investigation Type
- ☐ Hand Auger
- ☑ Hand Auger + Scala (DCP)

Contractor:	Equipment:	Recorded By:	Laboratory Technician:	Approved Signatory:
Geocivil	Hand Auger and Scala	J.H/A.B/J.A Recorded Date: 6/07/2021	Alex Millar	Sean Kokich

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Lab Job No.: 8020-1863 **Borehole No.:** HA5/SP5 **Sheet:** 1 of 1
Client: Cook Costello **Hole Depth:** 3.50 m
Job: Geotechnical Investigation **Coordinates:** **Date:** 06/07/21
Report No.: W21-870 **Location:** 1a Seaview Road, Paihia **Ground Level:**
Client Ref. No.: 16057

Unit	Geological Interpretation (In accordance with NZGS 2005)	UCS	Depth (m)
	Clayey TOPSOIL, traces of rootlets, dark brown, damp, moderate plasticity	OL	0.0
	Clayey SILT, traces of rootlets, traces of fine to coarse sands, damp, brown with red/brown streaking, moderate plasticity	CH	
	End of Borehole (no retrieval)		0.5

Legend: TS

Water: Groundwater Not Encountered

Relative Density: -

Vane Shear Strength (kPa) — Tested in accordance with NZGS Aug 2001
25 50 75 100 125 150 175 200 225
Peak: 210+ Residual

Scala Penetrometer — NZS4402: 1988 Test 6.5.2 - Procedure 2 (blows / 50mm)
5 10 15 20 Blows

Samples

Remarks
S -35.29240
E 174.10019

Note: All Scala Penetrometer readings taken below 1.5m from start depth are outside the scope of this test
Note: Scala Penetrometer interpretation is not endorsed

Water
Standing Water Level
Out flow
In flow

Investigation Type
☐ Hand Auger
☑ Hand Auger + Scala (DCP)

Contractor:	Equipment:	Recorded By:	Laboratory Technician:	Approved Signatory:
Geocivil	Hand Auger and Scala	J.H/A.B/J.A	Alex Millar	Sean Kokich
		Recorded Date: 6/07/2021		

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Lab Job No.: 8020-1863 **Borehole No.:** HA6/SP6 **Sheet:** 1 of 1
Client: Cook Costello **Hole Depth:** 1.60 m
Job: Geotechnical Investigation **Coordinates:** **Date:** 06/07/21
Report No.: W21-870 **Location:** 1a Seaview Road, Paihia **Ground Level:**
Client Ref. No.: 16057

Unit	Geological Interpretation (In accordance with NZGS 2005)	UCS	Legend	Depth (m)	Water	Relative Density	Vane Shear Strength (kPa) / Scala Penetrometer (NZS4402: 1988 Test 6.5.2 - Procedure 2, blows / 50mm)	Blows	Peak	Residual	Samples
	Clayey TOPSOIL, traces of rootlets, traces of angular gravels upto 10mm, damp, dark brown, moderate plasticity	OH	TS T	0.0	Groundwater Not Encountered	-		1			
	Clayey SILT, traces of angular gravels upto 8mm, traces of rootlets, traces of fine to coarse sands, damp, brown, moderate plasticity.							0			
								0			
								1			
								2			
								2			
								1			
								2			
								1			
				0.5				1	90/20		
								1			
								1			
								0			
								2			
		MH						10			
								13			
								13			
				1.0					87/20		
				1.5					123/23		
	End of Borehole (no retrieval)										

Remarks

S -35.29241
E 174.10022

Note: All Scala Penetrometer readings taken below 1.5m from start depth are outside the scope of this test
Note: Scala Penetrometer interpretation is not endorsed

Water
- Standing Water Level
- Out flow
- In flow

Investigation Type
- ☐ Hand Auger
- ☑ Hand Auger + Scala (DCP)

Contractor:	Equipment:	Recorded By:	Laboratory Technician:	Approved Signatory:
Geocivil	Hand Auger and Scala	J.H/A.B/J.A	Alex Millar	Sean Kokich
		Recorded Date: 6/07/2021		

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Lab Job No.: 8020-1863 **Borehole No.:** HA7/SP7 **Sheet:** 1 of 1
Client: Cook Costello **Hole Depth:** 2.10 m
Job: Geotechnical Investigation **Coordinates:** **Date:** 06/07/21
Report No.: W21-870 **Location:** 1a Seaview Road, Paihia **Ground Level:**
Client Ref. No.: 16057

Unit	Geological Interpretation (In accordance with NZGS 2005)	UCS	Legend	Depth (m)	Water	Relative Density
	Clayey TOPSOIL, traces of rootlets, dark brown, slightly damp, low plasticity	OL	TS			
	Clayey SILT, traces of rootlets, traces if angular gravels upto 10mm, traces of fine to coarse sands, brown, damp, low to moderate plasticity	ML		0.5	Groundwater Not Encountered	-
	End of Borehole (no retrieval)			1.0		
				1.5		
				2.0		

Vane Shear Strength (kPa)
Tested in accordance with NZGS Aug 2001
25 50 75 100 125 150 175 200 225

Scala Penetrometer
NZS4402: 1988 Test 6.5.2 - Procedure 2
(blows / 50mm)
5 10 15 20

Blows	Peak	Residual	Samples
0			
0			
0			
1			
1			
1			
1			
1			
1			
1	138/29		
1			
1			
1			
1			
1			
0			
1			
1			
1			
2			
3			
2			
3			
2			
2			
3			
3			
4			
2			
4			
4			
4			
5			
6			
8			
6			
4			
5			
5			
4			
3			
7			
15			

Remarks
S -35.29243
E 174.10025

Note: All Scala Penetrometer readings taken below 1.5m from start depth are outside the scope of this test
Note: Scala Penetrometer interpretation is not endorsed

Water
- Standing Water Level
- Out flow
- In flow

Investigation Type
- [ ] Hand Auger
- [x] Hand Auger + Scala (DCP)

Contractor:	Equipment:	Recorded By:	Laboratory Technician:	Approved Signatory:
Geocivil	Hand Auger and Scala	J.H/A.B/J.A	Alex Millar	Sean Kokich
		Recorded Date: 6/07/2021		

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Whangarei,
M:0276565226
E:info@geocivil.co.nz

Lab Job No.: 8020-1863 **Borehole No.:** HA8/SP8 **Sheet:** 1 of 1
Client: Cook Costello **Hole Depth:** 1.60 m
Job: Geotechnical Investigation **Coordinates:** **Date:** 06/07/21
Report No.: W21-870 **Location:** 1a Seaview Road, Paihia **Ground Level:**
Client Ref. No.: 16057

Unit	Geological Interpretation (In accordance with NZGS 2005)	UCS	Legend	Depth (m)	Water	Relative Density	Vane Shear Strength (kPa) / Scala Penetrometer NZS4402: 1988 Test 6.5.2 - Procedure 2 (blows / 50mm)	Blows	Peak	Residual	Samples
	Silty TOPSOIL, minor rootlets, dark brown, moist, low plasticity	OL	TS			-		0			
	Silty CLAY, traces of rootlets, brown, moist, low plasticity	CL						0			
	Clayey SILT, minor fine to coarse sands, minor highly weathered gravels, extremely weak, subrounded upto 10mm, brown with light grey mottling, moist, low plasticity	ML		0.5	Groundwater Not Encountered			0 0 0 1 2 2 2 1 2 1 2 2 3 3 3 5 4 3 2 3 2 1 1 2 3 6 12 12	193/18		
	End of Borehole (too firm to dig)			1.0 1.5							

Remarks

S -35.29251
E 174.10016

Note: All Scala Penetrometer readings taken below 1.5m from start depth are outside the scope of this test
Note: Scala Penetrometer interpretation is not endorsed

Water
- Standing Water Level
- Out flow
- In flow

Investigation Type
- ☐ Hand Auger
- ☑ Hand Auger + Scala (DCP)

Contractor:	Equipment:	Recorded By:	Laboratory Technician:	Approved Signatory:
Geocivil	Hand Auger and Scala	J.H/A.B/J.A Recorded Date: 6/07/2021	Alex Millar	Sean Kokich

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Printed: 19/07/2021 12:30:59 pm

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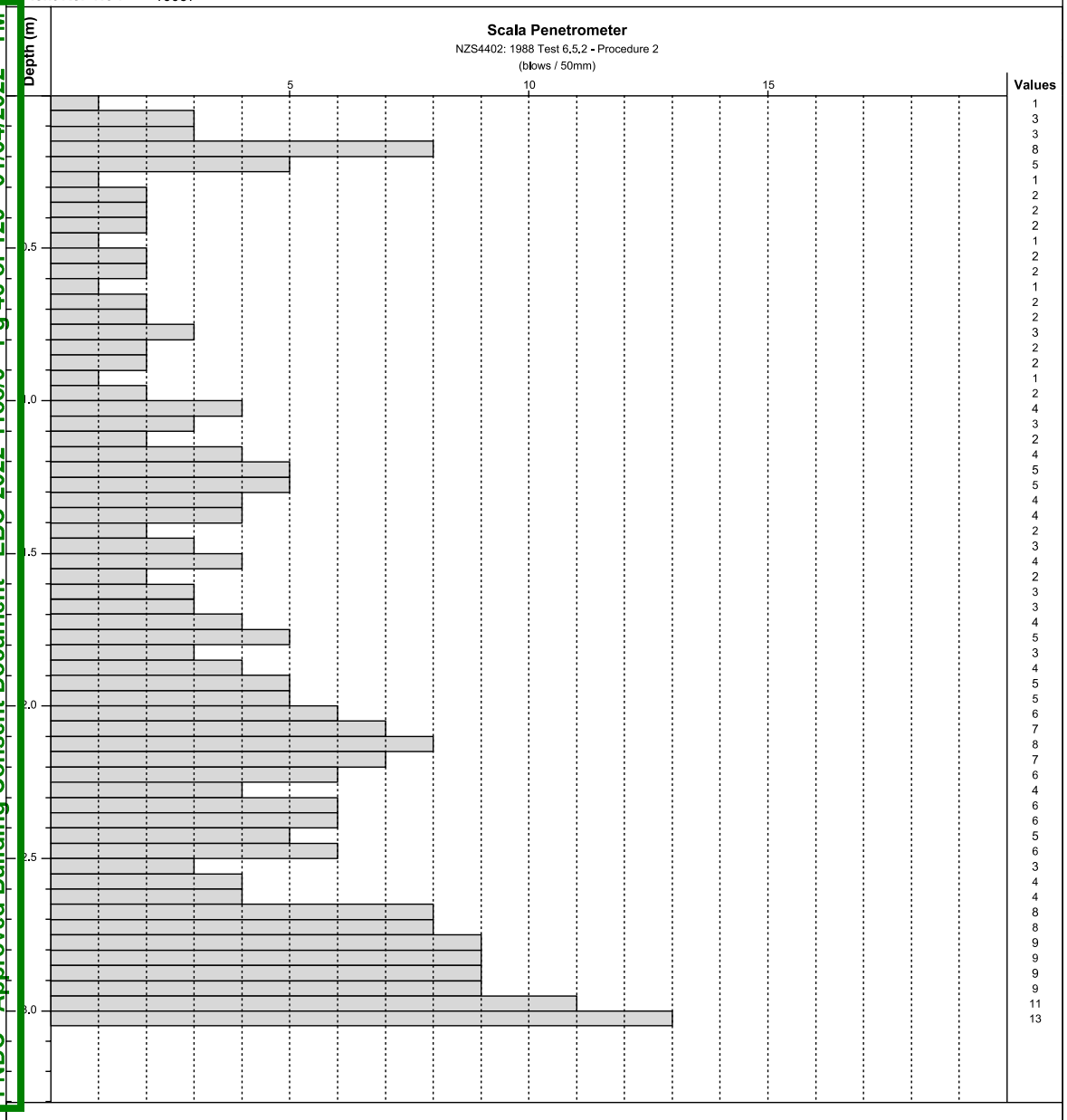
TEST RIGHT • BUILD RIGHT

DYNAMIC CONE PENETROMETER TEST

166 Bank Street,
Whangarei,
M:0276565226
E:info@geocivil.co.nz

Lab Job No.:	**8020-1863**	**Test No.:**	**SP1**	**Sheet:**	1 of 1
Client:	Cook Costello	**Hole Depth:**	3.05 m		
Job:	Geotechnical Investigation	**Coordinates:**		**Date:**	06/07/21
Report No.:	W21-870	**Location:**	1a Seaview Road, Paihia	**Ground Level:**	
Client Ref. No.:	16057				



Remarks

S -35.29241
E 174.10022

Investigation Type

☑ Scala (DCP)

Note: All Scala Penetrometer readings taken below 1.5m from start depth are outside the scope of this test
Note: Scala Penetrometer interpretation is not endorsed

Contractor:	Equipment:	Recorded By:	Laboratory Technician:	Approved Signatory:
Geocivil	Scala Penetrometer	J.H/A.B/J.A Recorded Date: 6/07/2021	Alex Millar	Sean Kokich

Printed: 19/07/2021 12:30:59 pm

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TEST RIGHT • BUILD RIGHT

DYNAMIC CONE PENETROMETER TEST

166 Bank Street,
Whangarei,
M:0276565226
E:info@geocivil.co.nz

Lab Job No.:	**8020-1863**	**Test No.:**	**SP6a**	**Sheet:**	1 of 1
Client:	Cook Costello	**Hole Depth:**	0.55 m		
Job:	Geotechnical Investigation	**Coordinates:**		**Date:**	06/07/21
Report No.:	W21-870	**Location:**	1a Seaview Road, Paihia	**Ground Level:**	
Client Ref. No.:	16057				

Remarks

S -35.29241
E 174.10022

Investigation Type

☑ Scala (DCP)

Note: All Scala Penetrometer readings taken below 1.5m from start depth are outside the scope of this test
Note: Scala Penetrometer interpretation is not endorsed

Contractor:	Equipment:	Recorded By:	Laboratory Technician:	Approved Signatory:
Geocivil	Scala Penetrometer	J.H/A.B/J.A Recorded Date: 6/07/2021	Alex Millar	Sean Kokich

Produced with CORE-GS by Geroc

Printed: 19/07/2021 12:30:59 pm

Page 10 of 11

cook | costello

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BOREHOLE LOG AND TEST SHEET

NZGS December 2005

Ref.: 16057-001
Client: Jane Banfield
Date: 03&04/08/2021
Borehole No.: MBH01
Location: 1A Seaview Road, Pahia
Drilling Method: Machine Borehole

Page: 1
Tested by: ProDrill
Logger: HJ
Checked: HJ
Date Checked: 6/08/2021

Depth (mbgl)	Legend	Soil Description	Recovery	SPT
0.0 – 0.2		Concrete		
0.3 – 0.5		Silty CLAY with some gravel, orange & brown, stiff, moist, high plasticity, gravel is fine, strong & sub-rounded		
0.6 – 1.0		Silty CLAY with some shells, orange & dark brown, stiff, moist, high plasticity		
1.1 – 2.0		Gravelly CLAY (residual soil), light grey, brown & orange mottle, stiff, moist, high plasticity, gravels are fine-medium, orange with some light grey, extremely weak, subangular	100%	2/2/4/4/4/5 N = 17
2.1 – 2.3		Pushtube Sample		
2.4 – 2.7		Gravelly CLAY (residual soil), light grey, brown & orange mottle, stiff, moist, high plasticity, gravels are fine-medium, orange with some light grey, extremely weak, subangular		
2.8 – 3.0		Pushtube Sample		3/4/5/4/3/5 N = 17
3.1 – 3.5		Completely weathered, massive, grey, orange & dark brown SILTSTONE, extremely weak; Discontinuities: extremely closely spaced, tight aperture, randomly oriented		

Remarks

Topsoil
Fill
Clay
Silt
Sand
Gravel
Concrete
Rock

cook | costello

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BOREHOLE LOG AND TEST SHEET

NZGS December 2005

Ref.: 16057-001
Client: Jane Banfield
Date: 03&04/08/2021
Borehole No.: MBH01
Location: 1A Seaview Road, Pahia
Drilling Method: Machine Borehole

Page: 1
Tested by: ProDrill
Logger: HJ
Checked: HJ
Date Checked: 6/08/2021

Depth (mbgl)	Legend	Soil Description	Recovery	SPT
3.5		Completely weathered, massive, grey, orange & dark brown SILTSTONE, extremely weak; Discontinuities: extremely closely spaced, tight aperture, randomly oriented		
3.6				
3.7				
3.8				
3.9				
4.0				
4.1				
4.2				
4.3				
4.4				
4.5				3/3/4/6/10/11 N = 31
4.6				
4.7				
4.8				
4.9				
5.0			100%	
5.1		Highly weathered, massive, grey, orange & dark brown SILTSTONE, extremely weak; Discontinuities: extremely closely spaced, tight aperture, randomly oriented		
5.2				
5.3				
5.4				
5.5				
5.6				
5.7				
5.8				
5.9				
6.0				
6.1				
6.2				
6.3				
6.4				
6.5				4/4/4/6/7/11 N = 28
6.6				
6.7				
6.8			33%	
6.9				
7.0				

Remarks 1 m core loss from 6.5 - 8.0 m (highly fractured)

Topsoil
Fill
Clay
Silt
Sand
Gravel
Peat
Rock

cook | costello

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BOREHOLE LOG AND TEST SHEET

NZGS December 2005

Ref.: 16057-001
Client: Jane Banfielc
Date: 03&04/08/2021
Borehole No.: MBH01
Location: 1A Seaview Road, Pahi
Drilling Method: Machine Borehole

Page: 1
Tested by: ProDrill
Logger: HJ
Checked: HJ
Date Checked: 6/08/2021

Depth (mbgl)	Legend	Soil Description	Recovery	SPT
7.0 – 9.9		Highly weathered, massive, grey, orange & dark brown SILTSTONE, extremely weak; Discontinuities: extremely closely spaced, tight aperture, randomly oriented	100%	8/8/12/12/11/13/14 for 65 mm N = 50+
8.5 – 9.0		Moderately weathered, massive, grey, orange & dark brown SILTSTONE, extremely weak; Discontinuities: extremely closely spaced, tight aperture, randomly oriented, 1 joint set with approx 70 degree inclination, closely spaced, slickensided planar		
9.4 – 9.5		Moderately weathered, massive, grey, orange & dark brown SILTSTONE, extremely weak; Discontinuities: extremely closely spaced, tight aperture, randomly oriented		12/20/20/20/10 for 45 mm N = 50+
9.6 – 10.0		Moderately weathered, massive, grey, orange & dark brown SILTSTONE, extremely weak; Discontinuities: extremely closely spaced, tight aperture, randomly oriented, 2 joint sets intersecting at approx 45 degrees, very closely to closely spaced		

Remarks:

Topsoil
Fill
Clay
Silt
Sand
Gravel
Peat
Rock

cook | costello

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BOREHOLE LOG AND TEST SHEET

NZGS December 2005

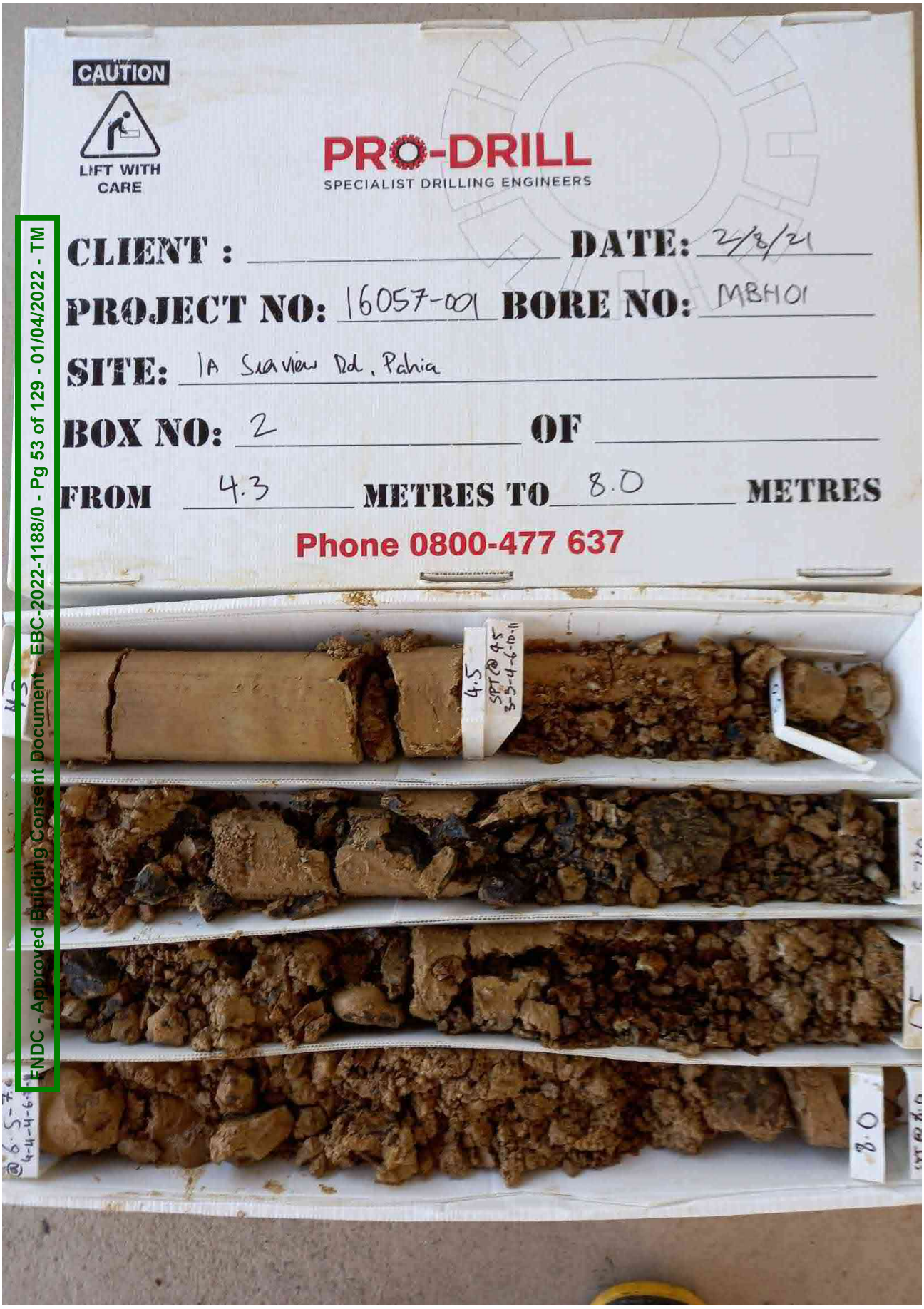
Ref.: 16057-001
Client: Jane Banfielc
Date: 03&04/08/2021
Borehole No.: MBH01
Location: 1A Seaview Road, Pahi
Drilling Method: Machine Borehole

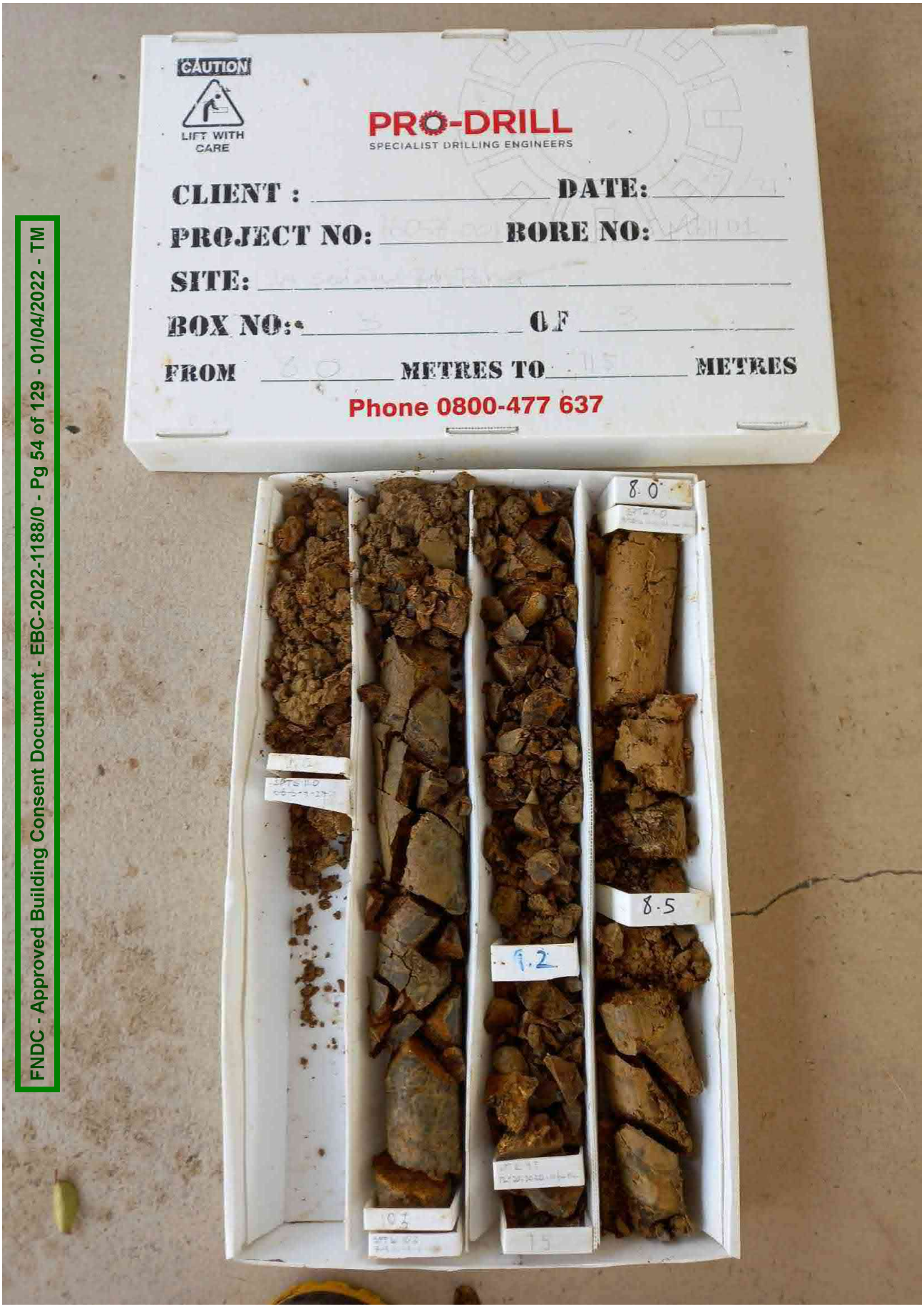
Page: 1
Tested by: ProDrill
Logger: HJ
Checked: HJ
Date Checked: 6/08/2021

Depth (mbgl)	Legend	Soil Description	Recovery	SPT
10.0		Moderately weathered, massive, grey, orange & dark brown SILTSTONE, extremely weak; Discontinuities: extremely closely spaced, tight aperture, randomly oriented, 2 joint sets intersecting at approx 45 degrees, very closely to closely spaced	100%	7/9/10/9/9/10 N = 38
10.1				
10.2				
10.3				
10.4		Highly weathered, massive, grey, orange & dark brown SILTSTONE, extremely weak; Discontinuities: extremely closely spaced, tight aperture, randomly oriented	50%	
10.5				
10.6				
10.7				
10.8				
10.9				
11.0				6/6/5/9/27/9 for 20 mm N = 50+
11.1		Highly weathered, massive, grey, orange & dark brown SILTSTONE, extremely weak; Discontinuities: extremely closely spaced, tight aperture, randomly oriented	No recovery	
11.2				
11.3				
11.4				
11.5		Moderately weathered, SILTSTONE (inferred based on final SPT)		
		End of Borehole at 11.5 mbgl		

Remarks:

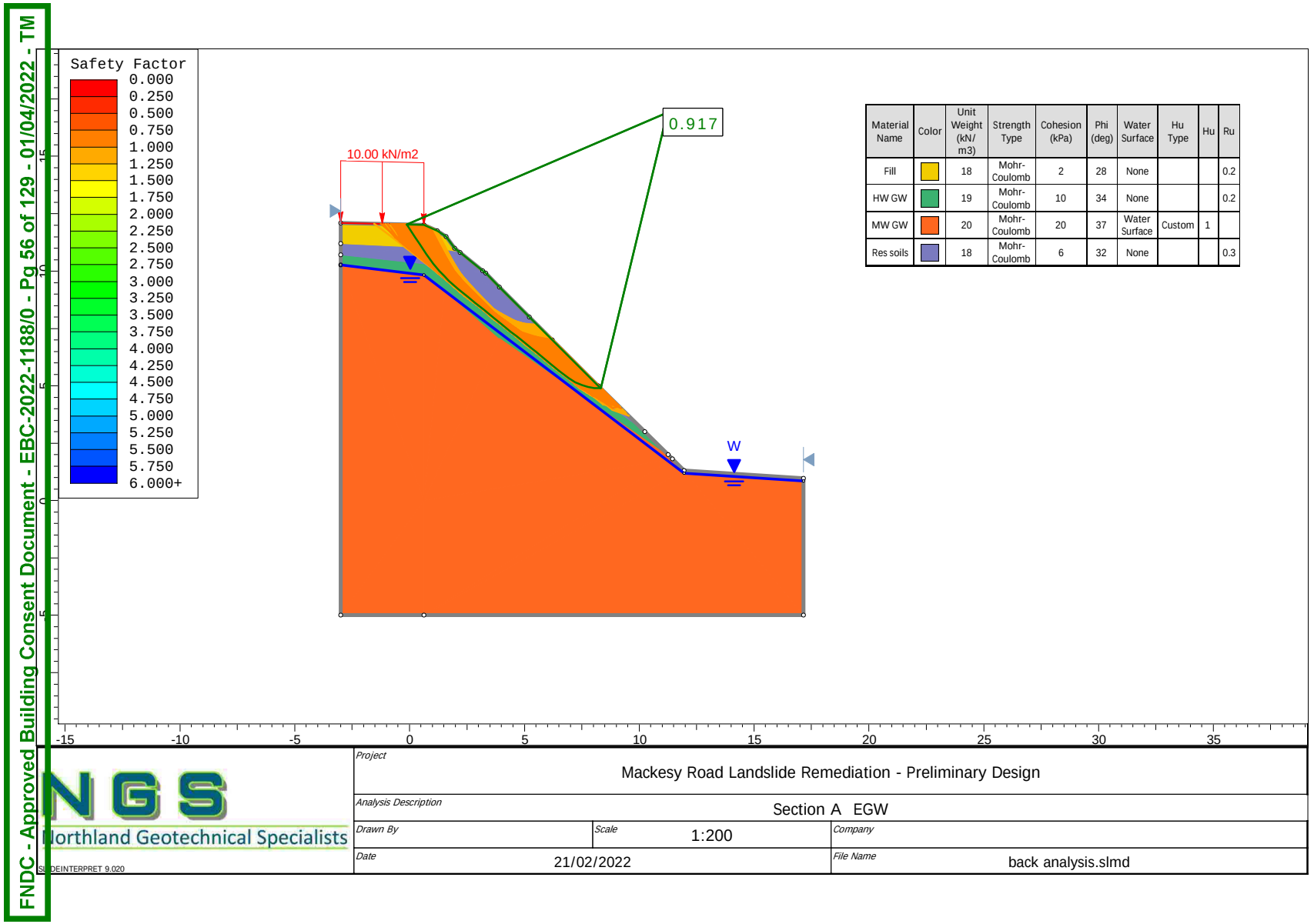
Topsoil
Fill
Clay
Silt
Sand
Gravel
Peat
Rock

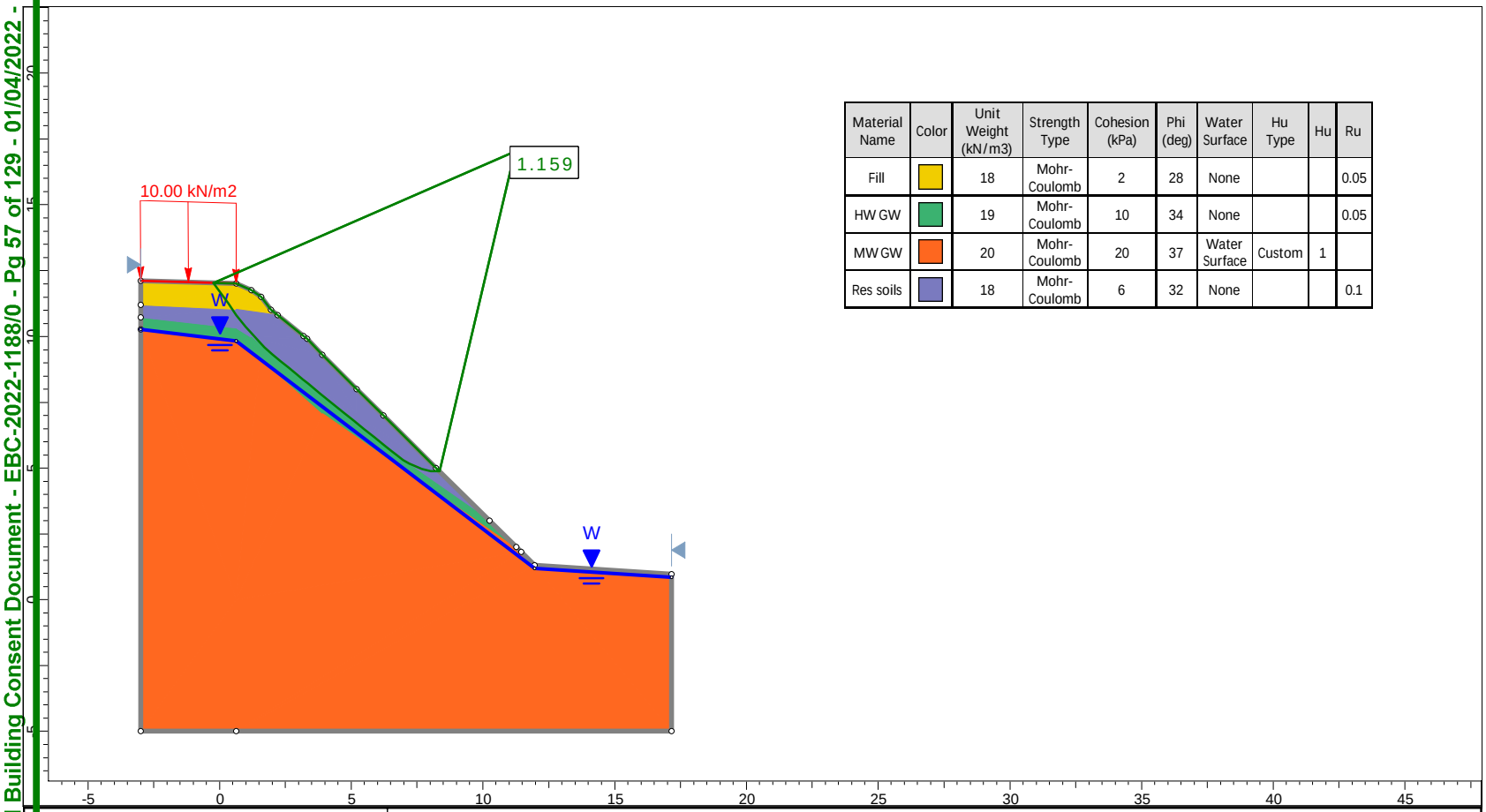




Appendix C: Stability Analysis Results

- Back analysis
  - Design Groundwater
  - Elevated Groundwater
- Wall design
  - Design Groundwater
  - Elevated Groundwater
  - Seismic


FNDC - Approved Building Consent Document - EBC-2022-1188/0 - Pg 56 of 129 - 01/04/2022 - TM
Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
10.00 kN/m2
0.917
W
Material Name | Color | Unit Weight (kN/m3) | Strength Type | Cohesion (kPa) | Phi (deg) | Water Surface | Hu Type | Hu | Ru
Fill | 18 | Mohr-Coulomb | 2 | 28 | None | | | 0.2
HW GW | 19 | Mohr-Coulomb | 10 | 34 | None | | | 0.2
MW GW | 20 | Mohr-Coulomb | 20 | 37 | Water Surface | Custom | 1 |
Res soils | 18 | Mohr-Coulomb | 6 | 32 | None | | | 0.3
-15 -10 -5 0 5 10 15 20 25 30 35
NGS Northland Geotechnical Specialists
SLOPE/INTERPRET 9.020
Project
Mackesy Road Landslide Remediation - Preliminary Design
Analysis Description
Section A EGW
Drawn By
Scale
1:200
Company
Date
21/02/2022
File Name
back analysis.slmd

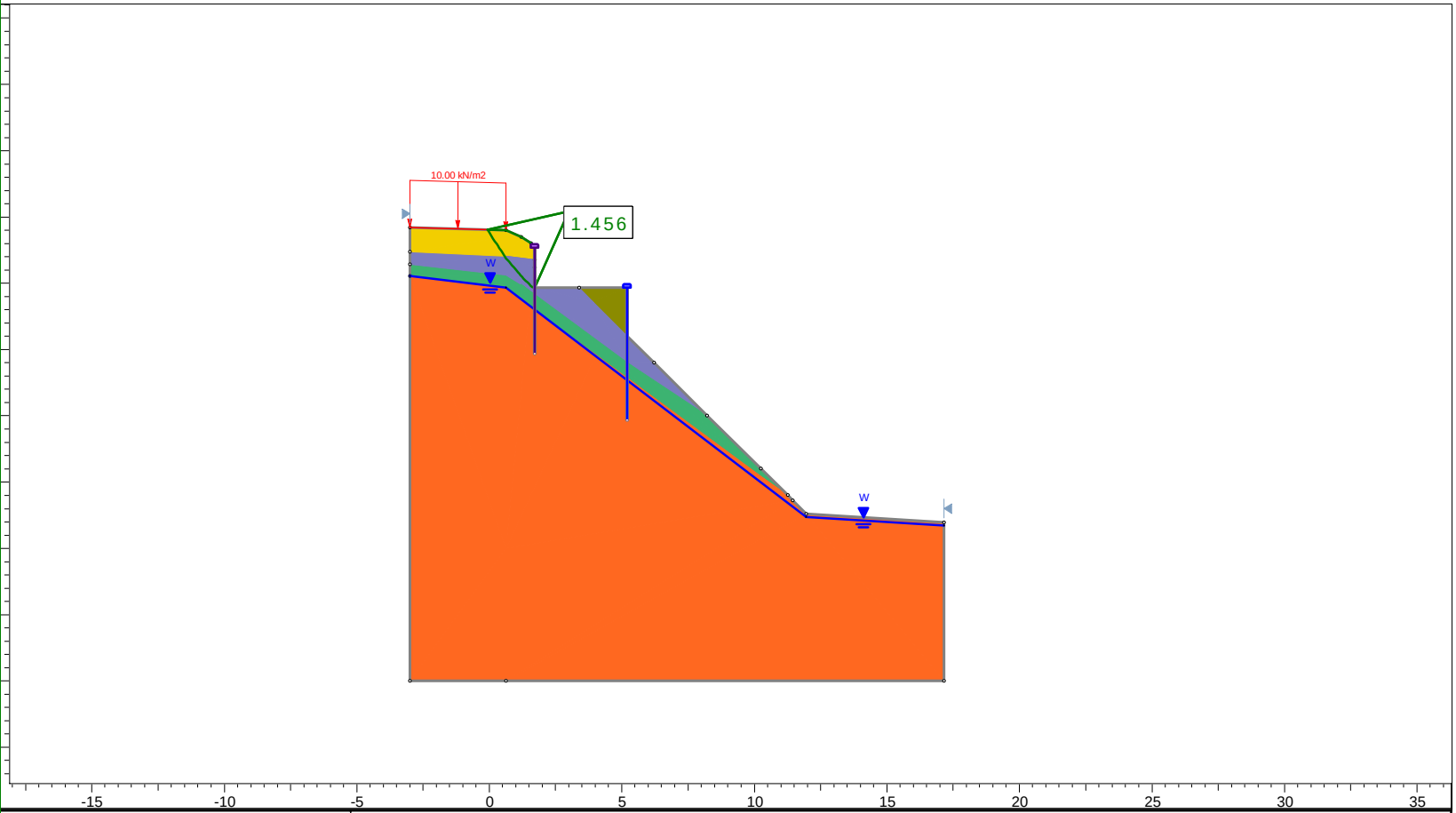


Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	Hu	Ru
Fill		18	Mohr-Coulomb	2	28	None			0.05
HW GW		19	Mohr-Coulomb	10	34	None			0.05
MW GW		20	Mohr-Coulomb	20	37	Water Surface	Custom	1	
Res soils		18	Mohr-Coulomb	6	32	None			0.1

NGS Northland Geotechnical Specialists

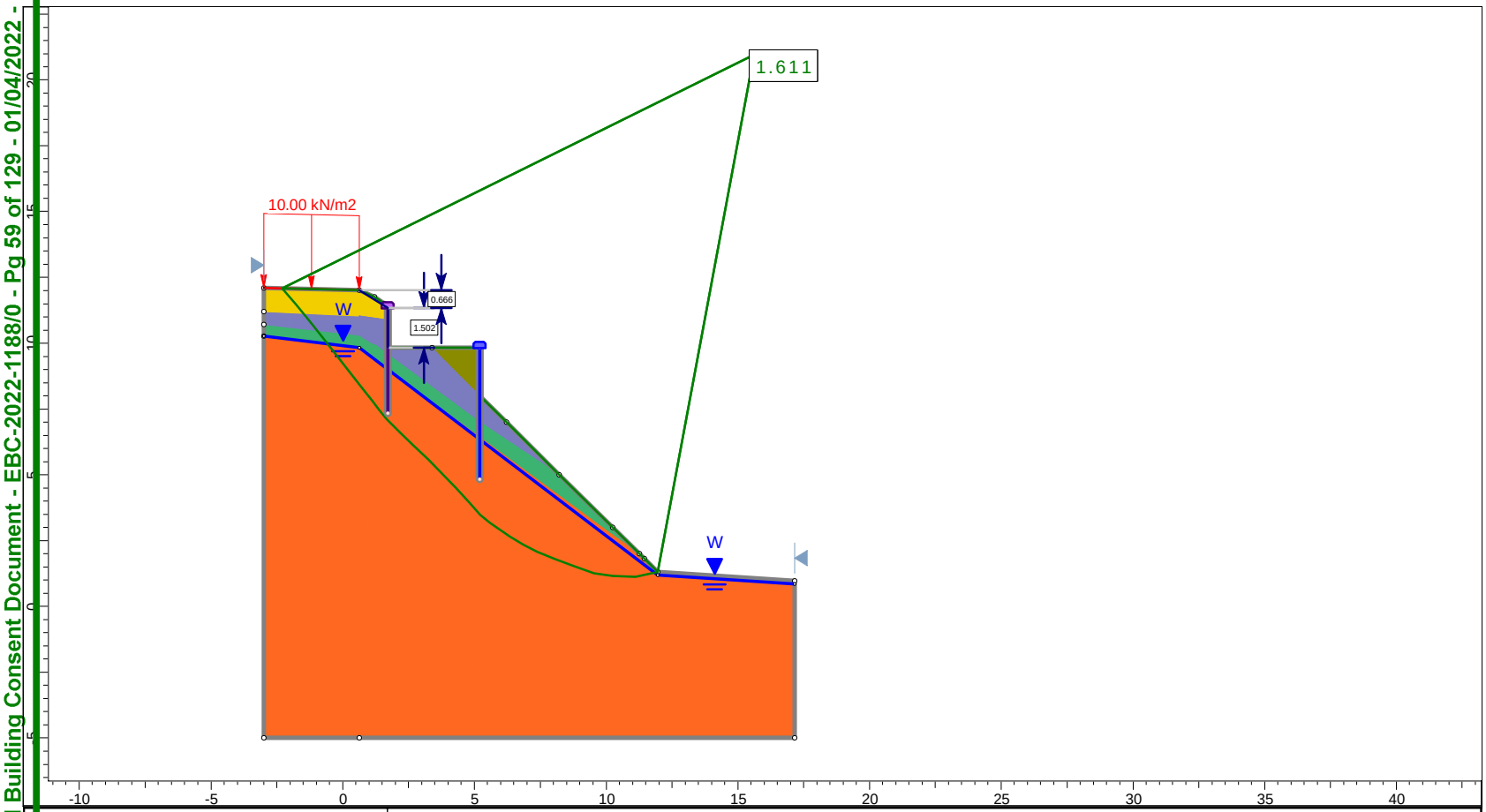
SLOPEINTERPRET 9.020

Project	Mackesy Road Landslide Remediation - Preliminary Design		
Analysis Description	Section A DGW		
Drawn By		Scale 1:200	Company
Date	21/02/2022		File Name back analysis.slmd



NGS Northland Geotechnical Specialists	Project: Mackesy Road Landslide Remediation - Preliminary Design		
	Analysis Description: wall design EGW		
	Drawn By:	Scale: 1:200	Company:
	Date: 21/02/2022		File Name: back analysis.slmd

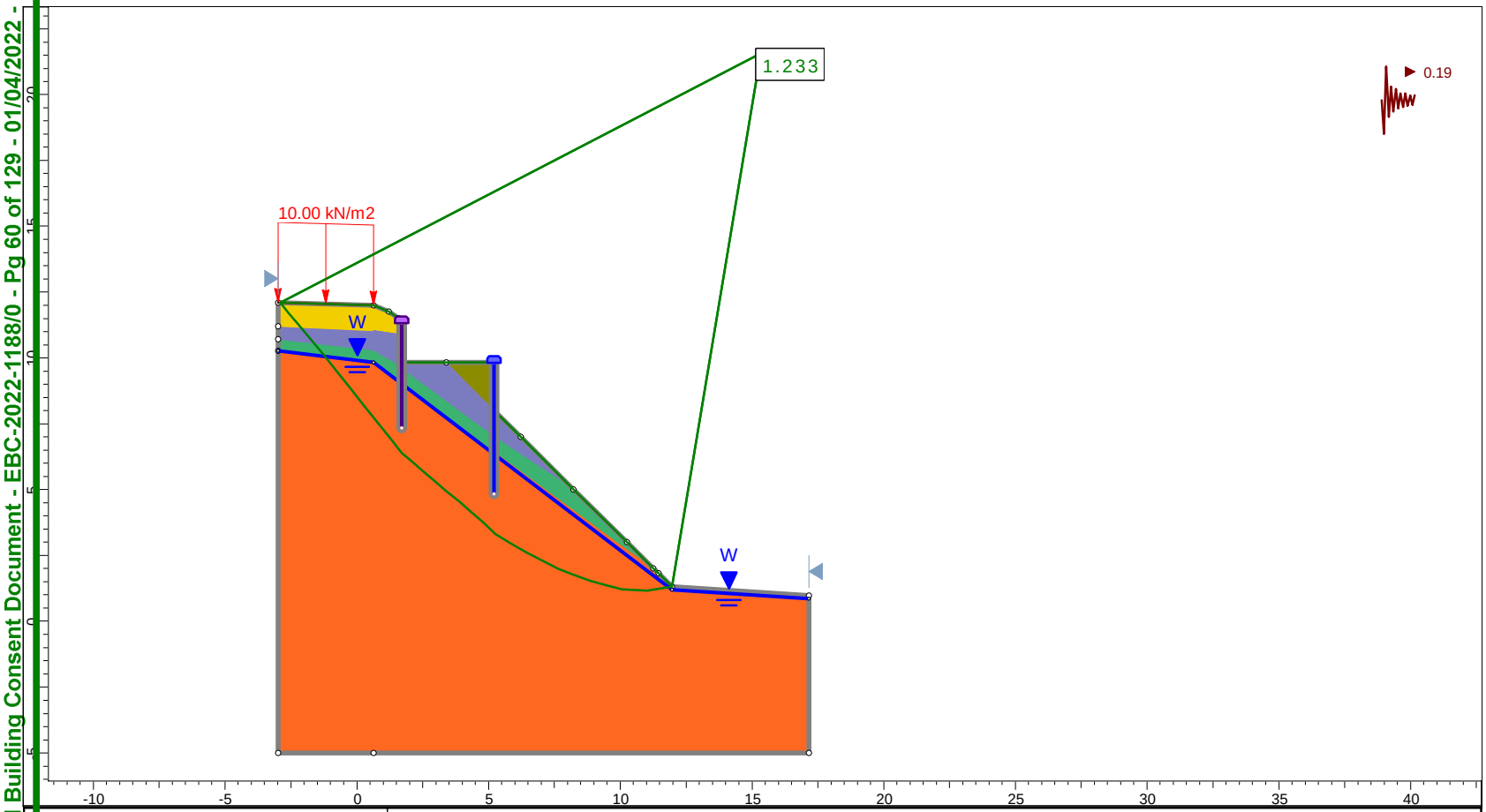
SLOPEINTERPRET 9.020



NGS Northland Geotechnical Specialists

SLOPEINTERPRET 9.020

Project	Mackesy Road Landslide Remediation - Preliminary Design		
Analysis Description	wall design DGW		
Drawn By		Scale 1:200	Company
Date	21/02/2022		File Name back analysis.slmd



NGS Northland Geotechnical Specialists

SLOPEINTERPRET 9.020

Project	Mackesy Road Landslide Remediation - Preliminary Design		
Analysis Description	wall design Seismic		
Drawn By		Scale 1:200	Company
Date	21/02/2022		File Name back analysis.slmd

Appendix D: Retaining Wall Analysis

- Wallap Output
  - Section A: Lower wall
  - Section A: Upper wall
  - Section B: Lower wall
  - Section B: Upper wall
  - Section C: Lower wall
- Timber Pole Capacity Spreadsheet (x17)

NORTHLAND GEOTECHNICAL SPECIALISTS | Sheet No.
Program: WALLAP Version 6.06 Revision A51.B69.R55 | Job No. 0213
Licensed from GEOSOLVE | Made by : RB
Data filename/Run ID: Section_A-lowerwall |
1A Seaview Road | Date: 9-03-2022
Section A - lower wall | Checked :

Units: kN,m

INPUT DATA

SOIL PROFILE

Stratum no.	Elevation of top of stratum	Soil types Left side	Right side
1	10.00	1 Back Fill	1 Back Fill
2	8.00	2 Res soils	2 Res soils
3	7.00	3 HW Greywacke	3 HW Greywacke
4	6.47	4 MW Greywacke	4 MW Greywacke

SOIL PROPERTIES

No.	Soil type -- Description (Datum elev.)	Bulk density kN/m3	Young's Modulus Eh,kN/m2 (dEh/dy)	At rest coeff. Ko (dKo/dy)	Consol state. NC/OC (Nu)	Active limit Ka (Kac)	Passive limit Kp (Kpc)	Cohesion kN/m2 (dc/dy)
1	Back Fill	18.00	20000	0.470	OC (0.200)	0.283 (1.241)	3.960 (5.127)	1.000d
2	Res soils	18.00	25000	0.470	OC (0.300)	0.260 (1.185)	4.448 (5.518)	6.000d
3	HW Greywacke	19.00	50000	0.440	OC (0.200)	0.237 (1.131)	5.023 (5.965)	10.00d
4	MW Greywacke	20.00	200000	0.398	OC (0.200)	0.207 (1.052)	6.100 (6.768)	20.00d
5	Existing fill	18.00	15000	0.530	OC (0.300)	0.309 (1.299)	3.543 (4.783)	2.000d

Additional soil parameters associated with Ka and Kp

No.	Soil type ------- Description	--- parameters for Ka --- Soil friction angle	Wall adhesion coeff.	Back-fill angle	--- parameters for Kp --- Soil friction angle	Wall adhesion coeff.	Back-fill angle
1	Back Fill	30.00	0.667	0.00	30.00	0.333	0.00
2	Res soils	32.00	0.667	0.00	32.00	0.333	0.00
3	HW Greywacke	34.00	0.667	0.00	34.00	0.333	0.00
4	MW Greywacke	37.00	0.667	0.00	37.00	0.333	0.00
5	Existing fill	28.00	0.667	0.00	28.00	0.333	0.00

GROUND WATER CONDITIONS

Density of water = 10.00 kN/m3

	Left side	Right side
Initial water table elevation	1.00	1.00

Automatic water pressure balancing at toe of wall : No

WALL PROPERTIES

Type of structure = Fully Embedded Wall
Elevation of toe of wall = 1.00
Maximum finite element length = 0.50 m
Youngs modulus of wall E = 1.2100E+07 kN/m2
Moment of inertia of wall I = 9.6660E-04 m4/m run
E.I = 11696 kN.m2/m run
Yield Moment of wall = Not defined

HORIZONTAL and MOMENT LOADS/RESTRAINTS

Load no.	Elevation	Horizontal load kN/m run	Moment load kN.m/m run	Moment restraint kN.m/m/rad	Partial factor (Category)
1	8.67	4.910	0	0	N/A
2	8.67	2.520	0	0	N/A

SURCHARGE LOADS

Surcharge no.	Elev.	Distance from wall	Length parallel to wall	Width perpend. to wall	Surcharge kN/m2 Near edge	Far edge	Equiv. soil type	Partial factor/ Category
1	10.00	3.66(L)	100.00	20.00	44.46	=	2	N/A
2	10.00	4.50(L)	100.00	20.00	20.00	=	2	N/A
3	10.00	0.00(L)	100.00	3.66	2.50	=	0	N/A
4	10.00	0.30(L)	3.00	0.60	35.00	=	0	N/A
5	10.00	2.70(L)	3.00	0.60	35.00	=	0	N/A
6	10.00	0.30(L)	3.00	0.60	53.00	=	0	N/A
7	10.00	2.70(L)	3.00	0.60	17.00	=	0	N/A

Note: L = Left side, R = Right side

CONSTRUCTION STAGES

Construction stage no.	Stage description
1	Apply surcharge no.1 at elevation 10.00
2	Apply surcharge no.2 at elevation 10.00 No analysis at this stage
3	Apply load no.1 at elevation 8.67
4	Excavate to elevation 8.00 on RIGHT side Toe of berm at elevation 1.00 Width of top of berm = 0.10 Width of toe of berm = 7.00
5	Apply surcharge no.7 at elevation 10.00
6	Apply surcharge no.6 at elevation 10.00
7	Remove surcharge no.7 at elevation 10.00 No analysis at this stage
8	Remove surcharge no.6 at elevation 10.00 No analysis at this stage
9	Apply surcharge no.5 at elevation 10.00
10	Apply surcharge no.4 at elevation 10.00
11	Remove surcharge no.5 at elevation 10.00 No analysis at this stage
12	Remove surcharge no.4 at elevation 10.00 No analysis at this stage
13	Apply surcharge no.3 at elevation 10.00
14	Excavate to elevation 7.00 on RIGHT side Toe of berm at elevation 1.00 Width of top of berm = 0.10 Width of toe of berm = 6.00
15	Apply load no.2 at elevation 8.67

FACTORS OF SAFETY and ANALYSIS OPTIONS

Stability analysis:
Method of analysis - Burland-Potts
Factor on passive for calculating wall depth = 2.00
Passive limit pressures calculated by Wedge Stability

Parameters for undrained strata:
Minimum equivalent fluid density = 5.00 kN/m3
Maximum depth of water filled tension crack = 0.00 m

Bending moment and displacement calculation:
Method - 2-D finite element model
Open Tension Crack analysis? - No
Soil arching modelled? - No
Non-linear Modulus Parameter (L) = 10.00 m

Boundary conditions:
Length of wall (normal to plane of analysis) = 20.00 m

Width of excavation on Left side of wall = 20.00 m
Width of excavation on Right side of wall = 20.00 m

Distance to rigid boundary on Left side = 20.00 m
Distance to rigid boundary on Right side = 20.00 m
Elevation of rigid lower boundary = -10.00

Lower rigid boundary at elevation -10.00 - Rough
Rigid boundary on Left side - Smooth
Rigid boundary on Right side - Smooth
Wall / soil interface - Smooth

OUTPUT OPTIONS

Stage no.	Stage description	Output options: Displacement / Bending mom. / Shear force	Active, Passive pressures	Graph. output
1	Apply surcharge no.1 at elev. 10.00	Yes	Yes	Yes
2	Apply surcharge no.2 at elev. 10.00	No	No	No
3	Apply load no.1 at elev. 8.67	No	No	No
4	Excav. to elev. 8.00 on RIGHT side	Yes	Yes	Yes
5	Apply surcharge no.7 at elev. 10.00	Yes	Yes	Yes
6	Apply surcharge no.6 at elev. 10.00	Yes	Yes	Yes
7	Remove surcharge no.7 at elev. 10.00	No	No	No
8	Remove surcharge no.6 at elev. 10.00	No	No	No
9	Apply surcharge no.5 at elev. 10.00	Yes	Yes	Yes
10	Apply surcharge no.4 at elev. 10.00	Yes	Yes	Yes
11	Remove surcharge no.5 at elev. 10.00	No	No	No
12	Remove surcharge no.4 at elev. 10.00	No	No	No
13	Apply surcharge no.3 at elev. 10.00	Yes	Yes	Yes
14	Excav. to elev. 7.00 on RIGHT side	No	Yes	No
15	Apply load no.2 at elev. 8.67	Yes	Yes	Yes
*	Summary output	Yes	-	Yes

NORTHLAND GEOTECHNICAL SPECIALISTS | Sheet No.
Program: WALLAP Version 6.06 Revision A51.B69.R55 | Job No. 0213
Licensed from GEOSOLVE | Made by : RB
Data filename/Run ID: Section_A-lowerwall |
1A Seaview Road | Date: 9-03-2022
Section A - lower wall | Checked :

Units: kN,m

Summary of results

STABILITY ANALYSIS of Fully Embedded Wall according to Burland-Potts method
Factor of safety on nett available passive
Passive limit pressures calculated by Wedge Stability

Stage No.	G.L. Act.	G.L. Pass.	Strut Elev.	FoS for toe elev. = 1.00: Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 2.000	Wall Penetration	Direction of failure
1	10.00	10.00	---	Conditions not suitable for FoS calc.				
2	10.00	10.00		No analysis at this stage				
3	10.00	10.00	Cant.	124.570	4.80	***	***	L to R
4	10.00	8.00	Cant.	3.372	1.18	2.80	5.20	L to R
5	10.00	8.00	Cant.	3.346	1.18	2.78	5.22	L to R
6	10.00	8.00	Cant.	2.403	1.19	1.69	6.31	L to R
7	10.00	8.00		No analysis at this stage				
8	10.00	8.00		No analysis at this stage				
9	10.00	8.00	Cant.	3.320	1.18	2.76	5.24	L to R
10	10.00	8.00	Cant.	2.635	1.19	2.01	5.99	L to R
11	10.00	8.00		No analysis at this stage				
12	10.00	8.00		No analysis at this stage				
13	10.00	8.00	Cant.	3.159	1.18	2.60	5.40	L to R
14	10.00	7.00	Cant.	2.351	1.13	1.76	5.24	L to R
15	10.00	7.00	Cant.	2.238	1.14	1.53	5.47	L to R

Legend: *** Result not found

NORTHLAND GEOTECHNICAL SPECIALISTS | Sheet No.
Program: WALLAP Version 6.06 Revision A51.B69.R55 | Job No. 0213
Licensed from GEOSOLVE | Made by : RB
Data filename/Run ID: Section_A-lowerwall |
1A Seaview Road | Date: 9-03-2022
Section A - lower wall | Checked :

Units: kN,m

Summary of results

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall

Analysis options

Length of wall perpendicular to section = 20.00m
2-D finite element model. Soil arching not modelled.
Soil deformations are elastic until the active or passive limit is reached
Passive limit pressures calculated by Wedge Stability
Open Tension Crack analysis - No
All soil moduli were factored to take account of
3-D effects due to the finite length of wall:
Modulus factors - Left side = 1.04
Right side = 1.03

Rigid boundaries: Left side 20.00 from wall Smooth boundary
Right side 20.00 from wall Smooth boundary
Lower rigid boundary at elevation -10.00 Rough boundary

Bending moment, shear force and displacement envelopes

Node no.	Y coord	Displacement maximum m	Displacement minimum m	Bending moment maximum kN.m/m	Bending moment minimum kN.m/m	Shear force maximum kN/m	Shear force minimum kN/m
1	10.00	0.108	0.000	0.0	-0.0	0.0	0.0
2	9.50	0.098	0.000	0.9	-0.1	2.8	-0.6
3	9.09	0.089	0.000	2.7	-0.5	5.2	-1.5
4	8.67	0.081	0.000	5.3	-1.3	14.0	-2.5
5	8.34	0.074	0.000	10.4	-0.7	17.9	-0.2
6	8.00	0.067	0.000	16.8	-0.2	22.3	-0.2
7	7.50	0.057	0.000	28.4	-0.2	24.7	-0.0
8	7.00	0.048	0.000	41.3	-0.1	26.5	0.0
9	6.74	0.043	0.000	48.2	-0.0	24.9	0.0
10	6.47	0.039	0.000	54.4	0.0	21.9	0.0
11	5.99	0.032	0.000	63.2	0.0	14.3	-0.5
12	5.50	0.025	0.000	67.0	0.0	3.9	-12.9
13	5.00	0.020	0.000	61.7	0.0	0.0	-21.4
14	4.50	0.016	0.000	50.4	0.0	0.0	-33.5
15	4.00	0.013	0.000	34.4	0.0	0.0	-27.9
16	3.50	0.011	0.000	22.0	-0.0	0.0	-19.6
17	3.00	0.010	0.000	14.7	-0.0	0.0	-11.2
18	2.50	0.008	0.000	10.7	-0.0	0.0	-6.5
19	2.00	0.007	0.000	8.0	-0.0	0.0	-5.8
20	1.50	0.006	0.000	4.8	-0.0	0.0	-7.9
21	1.00	0.005	0.000	0.0	-0.0	0.0	-1.8
22	0.88	0.005	0.000	0.0	0.0	0.1	-0.0
23	-0.56	0.004	0.000	0.0	0.0	0.0	-0.2
24	-2.00	0.002	0.000	0.0	0.0	0.1	-0.1
25	-4.00	0.001	0.000	0.0	0.0	0.1	-0.1
26	-6.00	0.001	0.000	0.0	0.0	0.2	-0.1
27	-8.00	0.001	0.000	0.0	0.0	0.3	-0.0
28	-10.00	0.000	0.000	0.0	0.0	0.1	-0.0

Run ID. Section_A-lowerwall | Sheet No.
1A Seaview Road | Date: 9-03-2022
Section A - lower wall | Checked :

Summary of results (continued)

Maximum and minimum bending moment and shear force at each stage

Stage no.	Bending moment maximum kN.m/m	elev.	Bending moment minimum kN.m/m	elev.	Shear force maximum kN/m	elev.	Shear force minimum kN/m	elev.
1	0.2	5.99	-0.2	7.50	0.6	6.47	-0.2	8.00
2	No calculation at this stage							
3	0.7	6.47	-1.3	8.67	2.4	8.67	-2.5	8.67
4	32.5	5.99	-0.0	1.00	14.9	7.00	-19.6	5.00
5	32.9	5.99	-0.0	1.00	15.1	7.00	-19.9	5.00
6	67.0	5.50	-0.0	1.00	26.5	7.00	-33.5	4.50
7	No calculation at this stage							
8	No calculation at this stage							
9	66.3	5.50	-0.0	1.00	25.2	7.00	-33.2	4.50
10	66.6	5.50	-0.0	1.00	26.1	7.00	-33.2	4.50
11	No calculation at this stage							
12	No calculation at this stage							
13	66.3	5.50	-0.0	1.00	25.4	7.00	-33.1	4.50
14	57.9	5.50	-0.0	1.00	24.5	7.00	-27.6	4.00
15	58.3	5.50	-0.0	1.00	25.6	7.00	-27.7	4.00

Maximum and minimum displacement at each stage

Stage no.	Displacement maximum m	elev.	Displacement minimum m	elev.	Stage description
1	0.000	-0.56	0.000	10.00	Apply surcharge no.1 at elev. 10.00
2	No calculation at this stage				Apply surcharge no.2 at elev. 10.00
3	0.000	9.09	0.000	10.00	Apply load no.1 at elev. 8.67
4	0.038	10.00	0.000	10.00	Excav. to elev. 8.00 on RIGHT side
5	0.039	10.00	0.000	10.00	Apply surcharge no.7 at elev. 10.00
6	0.106	10.00	0.000	10.00	Apply surcharge no.6 at elev. 10.00
7	No calculation at this stage				Remove surcharge no.7 at elev. 10.00
8	No calculation at this stage				Remove surcharge no.6 at elev. 10.00
9	0.105	10.00	0.000	10.00	Apply surcharge no.5 at elev. 10.00
10	0.106	10.00	0.000	10.00	Apply surcharge no.4 at elev. 10.00
11	No calculation at this stage				Remove surcharge no.5 at elev. 10.00
12	No calculation at this stage				Remove surcharge no.4 at elev. 10.00
13	0.105	10.00	0.000	10.00	Apply surcharge no.3 at elev. 10.00
14	0.108	10.00	0.000	10.00	Excav. to elev. 7.00 on RIGHT side
15	0.108	10.00	0.000	10.00	Apply load no.2 at elev. 8.67

```
NORTHLAND GEOTECHNICAL SPECIALISTS                          | Sheet No.
Program: WALLAP  Version 6.06  Revision A51.B69.R55         | Job No.    0213
                          Licensed from GEOSOLVE            | Made by :    RB
Data filename/Run ID: Section_A-upperwall                   |
1A Seaview Road                                             | Date: 9-03-2022
Section A-upper wall                                        | Checked :
-------------------------------------------------------------------------------
                                                      Units: kN,m
```

INPUT DATA

SOIL PROFILE

Stratum no.	Elevation of top of stratum	Soil types Left side	Right side
1	11.50	5 Existing fill	5 Existing fill
2	10.82	2 Res soils	2 Res soils
3	9.54	3 HW Greywacke	3 HW Greywacke
4	8.90	4 MW Greywacke	4 MW Greywacke

SOIL PROPERTIES

No.	Soil type -- Description (Datum elev.)	Bulk density kN/m3	Young's Modulus Eh,kN/m2 (dEh/dy)	At rest coeff. Ko (dKo/dy)	Consol state. NC/OC (Nu)	Active limit Ka (Kac)	Passive limit Kpc)	Cohesion kN/m2 (dc/dy)
1	Back Fill	18.00	20000	0.470	OC (0.200)	0.283 (1.241)	3.960 (5.127)	1.000d
2	Res soils	18.00	25000	0.470	OC (0.300)	0.260 (1.185)	4.448 (5.518)	6.000d
3	HW Greywacke	19.00	50000	0.440	OC (0.200)	0.237 (1.131)	5.023 (5.965)	10.00d
4	MW Greywacke	20.00	200000	0.398	OC (0.200)	0.207 (1.052)	6.100 (6.768)	20.00d
5	Existing fill	18.00	15000	0.530	OC (0.300)	0.309 (1.299)	3.543 (4.783)	2.000d

Additional soil parameters associated with Ka and Kp

No.	Soil type ------- Description	--- parameters for Ka --- Soil friction angle	Wall adhesion coeff.	Back-fill angle	--- parameters for Kp --- Soil friction angle	Wall adhesion coeff.	Back-fill angle
1	Back Fill	30.00	0.667	0.00	30.00	0.333	0.00
2	Res soils	32.00	0.667	0.00	32.00	0.333	0.00
3	HW Greywacke	34.00	0.667	0.00	34.00	0.333	0.00
4	MW Greywacke	37.00	0.667	0.00	37.00	0.333	0.00
5	Existing fill	28.00	0.667	0.00	28.00	0.333	0.00

GROUND WATER CONDITIONS

Density of water = 10.00 kN/m3

	Left side	Right side
Initial water table elevation	1.83	1.83

Automatic water pressure balancing at toe of wall : No

WALL PROPERTIES

```
                    Type of structure = Fully Embedded Wall
                Elevation of toe of wall =  7.30
            Maximum finite element length =  0.30 m
                 Youngs modulus of wall E = 1.2100E+07 kN/m2
              Moment of inertia of wall I = 3.9760E-04 m4/m run
                                      E.I = 4811.0 kN.m2/m run
                   Yield Moment of wall = Not defined
```

HORIZONTAL and MOMENT LOADS/RESTRAINTS

Load no.	Elevation	Horizontal load kN/m run	Moment load kN.m/m run	Moment restraint kN.m/m/rad	Partial factor (Category)
1	10.82	7.480	0	0	N/A
2	10.82	3.840	0	0	N/A

SURCHARGE LOADS

Surch-arge no.	Elev.	Distance from wall	Length parallel to wall	Width perpend. to wall	Surcharge kN/m2 Near edge	Surcharge kN/m2 Far edge	Equiv. soil type	Partial factor/ Category
1	12.47	0.90(L)	100.00	20.00	20.00	=	N/A	N/A

Note: L = Left side, R = Right side

CONSTRUCTION STAGES

Construction stage no.	Stage description
1	Fill to elevation 12.47 on LEFT side with soil type 1
2	Change EI of wall to 4811.0 kN.m2/m run Yield moment not defined Reset wall displacements to zero at this stage
3	Apply surcharge no.1 at elevation 12.47
4	Apply load no.1 at elevation 10.82
5	Excavate to elevation 10.00 on RIGHT side
6	Excavate to elevation 9.00 on RIGHT side
7	Fill to elevation 10.00 on RIGHT side with soil type 1
8	Apply load no.2 at elevation 10.82

FACTORS OF SAFETY and ANALYSIS OPTIONS

Stability analysis:
- Method of analysis - Burland-Potts
- Factor on passive for calculating wall depth = 2.00

Parameters for undrained strata:
- Minimum equivalent fluid density = 5.00 kN/m3
- Maximum depth of water filled tension crack = 0.00 m

Bending moment and displacement calculation:
- Method - 2-D finite element model
- Open Tension Crack analysis? - No
- Soil arching modelled? - No
- Non-linear Modulus Parameter (L) = 6.000 m

Boundary conditions:
- Length of wall (normal to plane of analysis) = 20.00 m
- Width of excavation on Left side of wall = 20.00 m
- Width of excavation on Right side of wall = 20.00 m
- Distance to rigid boundary on Left side = 20.00 m
- Distance to rigid boundary on Right side = 20.00 m
- Elevation of rigid lower boundary = 0.00
- Lower rigid boundary at elevation 0.00 - Rough
- Rigid boundary on Left side - Smooth
- Rigid boundary on Right side - Smooth
- Wall / soil interface - Smooth

OUTPUT OPTIONS

Stage no.	Stage description	Output options: Displacement / Bending mom. / Shear force	Active, Passive pressures	Graph. output
1	Fill to elev. 12.47 on LEFT side	No	No	No
2	Change EI of wall to 4811.0kN.m2/m run	No	No	No
3	Apply surcharge no.1 at elev. 12.47	Yes	Yes	Yes
4	Apply load no.1 at elev. 10.82	No	No	No
5	Excav. to elev. 10.00 on RIGHT side	Yes	Yes	Yes
6	Excav. to elev. 9.00 on RIGHT side	Yes	Yes	Yes
7	Fill to elev. 10.00 on RIGHT side	Yes	Yes	Yes
8	Apply load no.2 at elev. 10.82	Yes	Yes	Yes
*	Summary output	Yes	-	Yes

NORTHLAND GEOTECHNICAL SPECIALISTS | Sheet No.
Program: WALLAP Version 6.06 Revision A51.B69.R55 | Job No. 0213
Licensed from GEOSOLVE | Made by : RB
Data filename/Run ID: Section_A-upperwall |
1A Seaview Road | Date: 9-03-2022
Section A-upper wall | Checked :

Units: kN,m

Summary of results

STABILITY ANALYSIS of Fully Embedded Wall according to Burland-Potts method
Factor of safety on nett available passive

Stage No.	G.L. Act.	G.L. Pass.	Strut Elev.	FoS for toe elev. = 7.30: Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 2.000: Toe elev.	Wall Penetr-ation	Direction of failure
1	12.47	11.50	Cant.	25.902	7.90	10.85	0.65	L to R
2	12.47	11.50		No analysis at this stage				
3	12.47	11.50	Cant.	21.165	7.85	10.72	0.78	L to R
4	12.47	11.50	Cant.	13.959	7.88	10.57	0.93	L to R
5	12.47	10.00	Cant.	4.598	7.69	8.29	1.71	L to R
6	12.47	9.00	Cant.	2.260	7.57	7.43	1.57	L to R
7	12.47	10.00	Cant.	3.661	7.67	7.94	2.06	L to R
8	12.47	10.00	Cant.	3.220	7.68	7.81	2.19	L to R

NORTHLAND GEOTECHNICAL SPECIALISTS | Sheet No.
Program: WALLAP Version 6.06 Revision A51.B69.R55 | Job No. 0213
Licensed from GEOSOLVE | Made by : RB
Data filename/Run ID: Section_A-upperwall |
1A Seaview Road | Date: 9-03-2022
Section A-upper wall | Checked :

Units: kN,m

Summary of results

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall

Analysis options

Length of wall perpendicular to section = 20.00m
2-D finite element model. Soil arching not modelled.
Soil deformations are elastic until the active or passive limit is reached
Open Tension Crack analysis - No

Rigid boundaries: Left side 20.00 from wall Smooth boundary
Right side 20.00 from wall Smooth boundary
Lower rigid boundary at elevation 0.00 Rough boundary

Bending moment, shear force and displacement envelopes

Node no.	Y coord	Displacement maximum m	Displacement minimum m	Bending moment maximum kN.m/m	Bending moment minimum kN.m/m	Shear force maximum kN/m	Shear force minimum kN/m
1	12.47	0.058	0.000	0.0	-0.0	0.0	0.0
2	12.24	0.055	0.000	0.0	0.0	0.0	0.0
3	12.00	0.051	0.000	0.0	0.0	0.2	0.0
4	11.75	0.047	0.000	0.1	0.0	0.7	0.0
5	11.50	0.043	0.000	0.4	0.0	1.7	0.0
6	11.33	0.040	0.000	0.8	0.0	2.5	0.0
7	11.16	0.037	0.000	1.3	0.0	3.6	-0.7
8	10.99	0.035	0.000	2.0	0.0	4.8	-1.8
9	10.82	0.032	0.000	2.9	0.0	17.6	-2.6
10	10.66	0.029	0.000	5.8	0.0	18.1	-0.3
11	10.50	0.027	0.000	8.7	0.0	18.7	-0.7
12	10.25	0.023	0.000	13.6	0.0	20.1	-0.7
13	10.00	0.019	0.000	18.8	0.0	21.8	-0.2
14	9.77	0.016	0.000	24.0	0.0	21.8	0.0
15	9.54	0.013	0.000	28.9	0.0	22.1	0.0
16	9.27	0.010	0.000	34.3	0.0	23.2	-9.5
17	9.00	0.008	0.000	39.9	0.0	24.9	-13.2
18	8.90	0.007	0.000	41.9	0.0	19.2	-13.3
19	8.65	0.005	0.000	41.0	0.0	0.0	-25.4
20	8.40	0.004	0.000	29.2	0.0	0.0	-46.5
21	8.10	0.003	0.000	15.5	0.0	0.0	-36.8
22	7.80	0.003	0.000	7.1	0.0	0.0	-22.0
23	7.55	0.002	0.000	2.9	0.0	0.0	-14.2
24	7.30	0.002	0.000	0.0	-0.0	0.0	-2.6
25	7.23	0.002	0.000	0.0	0.0	0.0	-0.0
26	6.61	0.002	0.000	0.0	0.0	0.0	-0.0
27	6.00	0.001	0.000	0.0	0.0	0.0	-0.0
28	4.80	0.001	0.000	0.0	0.0	0.0	-0.0
29	3.60	0.001	0.000	0.0	0.0	0.0	-0.0
30	2.40	0.000	0.000	0.0	0.0	0.0	-0.0
31	1.20	0.000	0.000	0.0	0.0	0.0	0.0
32	0.00	0.000	0.000	0.0	0.0	0.0	0.0

Run ID. Section_A-upperwall | Sheet No.
1A Seaview Road | Date: 9-03-2022
Section A-upper wall | Checked :

Summary of results (continued)

Maximum and minimum bending moment and shear force at each stage

Stage no.	Bending moment maximum kN.m/m	elev.	Bending moment minimum kN.m/m	elev.	Shear force maximum kN/m	elev.	Shear force minimum kN/m	elev.
1	0.9	8.90	0.0	12.47	1.4	11.50	-1.0	8.40
2	No calculation at this stage							
3	1.4	8.90	0.0	12.47	2.1	9.54	-1.5	8.40
4	1.9	8.90	0.0	12.47	4.9	10.82	-2.6	10.82
5	20.9	9.54	-0.0	12.47	17.9	10.00	-18.6	8.65
6	39.2	8.65	-0.0	12.47	24.9	9.00	-43.7	8.40
7	39.1	8.65	-0.0	12.47	24.2	9.00	-43.7	8.40
8	41.9	8.90	-0.0	12.47	22.3	9.00	-46.5	8.40

Maximum and minimum displacement at each stage

Stage no.	Displacement maximum m	elev.	Displacement minimum m	elev.	Stage description
1	0.002	12.47	0.000	12.47	Fill to elev. 12.47 on LEFT side
2	Wall displacements reset to zero				Change EI of wall to 4811.0kN.m2/m run
3	0.001	12.47	0.000	12.47	Apply surcharge no.1 at elev. 12.47
4	0.001	12.47	0.000	12.47	Apply load no.1 at elev. 10.82
5	0.023	12.47	0.000	12.47	Excav. to elev. 10.00 on RIGHT side
6	0.054	12.47	0.000	12.47	Excav. to elev. 9.00 on RIGHT side
7	0.054	12.47	0.000	12.47	Fill to elev. 10.00 on RIGHT side
8	0.058	12.47	0.000	12.47	Apply load no.2 at elev. 10.82

NORTHLAND GEOTECHNICAL SPECIALISTS | Sheet No.
Program: WALLAP Version 6.06 Revision A51.B69.R55 | Job No. 0213
Licensed from GEOSOLVE | Made by : RB
Data filename/Run ID: Section_B-lowerwall |
1A Seaview Road | Date: 9-03-2022
Section B - lower wall | Checked :

Units: kN,m

INPUT DATA

SOIL PROFILE

Stratum no.	Elevation of top of stratum	Soil types Left side	Right side
1	11.70	1 Back Fill	1 Back Fill
2	9.70	2 Res soils	2 Res soils
3	8.40	3 HW Greywacke	3 HW Greywacke
4	7.40	4 MW Greywacke	4 MW Greywacke

SOIL PROPERTIES

No.	Soil type -- Description (Datum elev.)	Bulk density kN/m3	Young's Modulus Eh,kN/m2 (dEh/dy)	At rest coeff. Ko (dKo/dy)	Consol state. NC/OC Nu)	Active limit Ka (Kac)	Passive limit Kpc)	Cohesion kN/m2 (dc/dy)
1	Back Fill	18.00	20000	0.470	OC (0.200)	0.283 (1.241)	3.960 (5.127)	1.000d
2	Res soils	18.00	25000	0.470	OC (0.300)	0.260 (1.185)	4.448 (5.518)	6.000d
3	HW Greywacke	19.00	50000	0.440	OC (0.200)	0.237 (1.131)	5.023 (5.965)	10.00d
4	MW Greywacke	20.00	200000	0.398	OC (0.200)	0.207 (1.052)	6.100 (6.768)	20.00d
5	Existing fill	18.00	15000	0.530	OC (0.300)	0.309 (1.299)	3.543 (4.783)	2.000d

Additional soil parameters associated with Ka and Kp

No.	Soil type ------- Description	--- parameters for Ka --- Soil friction angle	Wall adhesion coeff.	Back-fill angle	--- parameters for Kp --- Soil friction angle	Wall adhesion coeff.	Back-fill angle
1	Back Fill	30.00	0.667	0.00	30.00	0.333	0.00
2	Res soils	32.00	0.667	0.00	32.00	0.333	0.00
3	HW Greywacke	34.00	0.667	0.00	34.00	0.333	0.00
4	MW Greywacke	37.00	0.667	0.00	37.00	0.333	0.00
5	Existing fill	28.00	0.667	0.00	28.00	0.333	0.00

GROUND WATER CONDITIONS

Density of water = 10.00 kN/m3

	Left side	Right side
Initial water table elevation	1.83	1.83

Automatic water pressure balancing at toe of wall : No

WALL PROPERTIES

Type of structure = Fully Embedded Wall
Elevation of toe of wall = 2.70
Maximum finite element length = 0.50 m
Youngs modulus of wall E = 1.2100E+07 kN/m2
Moment of inertia of wall I = 9.6660E-04 m4/m run
E.I = 11696 kN.m2/m run
Yield Moment of wall = Not defined

HORIZONTAL and MOMENT LOADS/RESTRAINTS

Load no.	Elevation	Horizontal load kN/m run	Moment load kN.m/m run	Moment restraint kN.m/m/rad	Partial factor (Category)
1	10.37	4.910	0	0	N/A
2	10.37	2.520	0	0	N/A

SURCHARGE LOADS

Surch-arge no.	Elev.	Distance from wall	Length parallel to wall	Width perpend. to wall	Surcharge kN/m2 Near edge	Far edge	Equiv. soil type	Partial factor/ Category
1	11.70	3.66(L)	100.00	20.00	28.80	=	2	N/A
2	11.70	5.80(L)	100.00	20.00	52.40	=	2	N/A
3	11.70	3.66(L)	100.00	2.14	0.00	21.60	2	N/A
4	11.70	0.00(L)	3.66	100.00	2.50	=	0	N/A
5	11.70	0.30(L)	3.00	0.60	35.00	=	0	N/A
6	11.70	2.70(L)	3.00	0.60	35.00	=	0	N/A
7	11.70	0.30(L)	3.00	0.60	53.00	=	0	N/A
8	11.70	2.70(L)	3.00	0.60	17.00	=	0	N/A

Note: L = Left side, R = Right side
A trapezoidal surcharge is defined by two values:
N = at edge near to wall, F = at edge far from wall

CONSTRUCTION STAGES

Construction stage no.	Stage description
1	Apply surcharge no.1 at elevation 11.70
2	Apply surcharge no.2 at elevation 11.70 No analysis at this stage
3	Apply surcharge no.3 at elevation 11.70
4	Apply load no.1 at elevation 10.37
5	Excavate to elevation 9.70 on RIGHT side Toe of berm at elevation 2.70 Width of top of berm = 0.10 Width of toe of berm = 7.00
6	Apply surcharge no.6 at elevation 11.70
7	Apply surcharge no.5 at elevation 11.70 No analysis at this stage
8	Remove surcharge no.5 at elevation 11.70 No analysis at this stage
9	Remove surcharge no.6 at elevation 11.70 No analysis at this stage
10	Apply surcharge no.7 at elevation 11.70
11	Apply surcharge no.8 at elevation 11.70
12	Remove surcharge no.7 at elevation 11.70 No analysis at this stage
13	Remove surcharge no.8 at elevation 11.70 No analysis at this stage
14	Apply surcharge no.4 at elevation 11.70
15	Excavate to elevation 8.70 on RIGHT side Toe of berm at elevation 2.70 Width of top of berm = 0.10 Width of toe of berm = 6.00
16	Apply load no.2 at elevation 10.37

FACTORS OF SAFETY and ANALYSIS OPTIONS

Stability analysis:
Method of analysis - Burland-Potts
Factor on passive for calculating wall depth = 2.00
Active limit pressures calculated by Wedge Stability

Parameters for undrained strata:
Minimum equivalent fluid density = 5.00 kN/m3
Maximum depth of water filled tension crack = 0.00 m

Bending moment and displacement calculation:
Method - 2-D finite element model
Open Tension Crack analysis? - No
Soil arching modelled? - No
Non-linear Modulus Parameter (L) = 9.000 m

Boundary conditions:
Length of wall (normal to plane of analysis) = 20.00 m

Width of excavation on Left side of wall = 20.00 m
Width of excavation on Right side of wall = 20.00 m

Distance to rigid boundary on Left side = 20.00 m
Distance to rigid boundary on Right side = 20.00 m
Elevation of rigid lower boundary = -10.00

Lower rigid boundary at elevation -10.00 - Rough
Rigid boundary on Left side - Smooth

Rigid boundary on Right side - Smooth
Wall / soil interface - Smooth

OUTPUT OPTIONS

Stage no.	Stage description	Output options: Displacement Bending mom. Shear force	Active, Passive pressures	Graph. output
1	Apply surcharge no.1 at elev. 11.70	Yes	Yes	Yes
2	Apply surcharge no.2 at elev. 11.70	No	No	No
3	Apply surcharge no.3 at elev. 11.70	Yes	Yes	Yes
4	Apply load no.1 at elev. 10.37	No	No	No
5	Excav. to elev. 9.70 on RIGHT side	Yes	Yes	Yes
6	Apply surcharge no.6 at elev. 11.70	Yes	Yes	Yes
7	Apply surcharge no.5 at elev. 11.70	No	No	No
8	Remove surcharge no.5 at elev. 11.70	No	No	No
9	Remove surcharge no.6 at elev. 11.70	No	No	No
10	Apply surcharge no.7 at elev. 11.70	No	No	No
11	Apply surcharge no.8 at elev. 11.70	Yes	Yes	Yes
12	Remove surcharge no.7 at elev. 11.70	No	No	No
13	Remove surcharge no.8 at elev. 11.70	No	No	No
14	Apply surcharge no.4 at elev. 11.70	Yes	Yes	Yes
15	Excav. to elev. 8.70 on RIGHT side	Yes	Yes	Yes
16	Apply load no.2 at elev. 10.37	Yes	Yes	Yes
*	Summary output	Yes	-	Yes

NORTHLAND GEOTECHNICAL SPECIALISTS | Sheet No.
Program: WALLAP Version 6.06 Revision A51.B69.R55 | Job No. 0213
Licensed from GEOSOLVE | Made by : RB
Data filename/Run ID: Section_B-lowerwall |
1A Seaview Road | Date: 9-03-2022
Section B - lower wall | Checked :

Units: kN,m

Summary of results

STABILITY ANALYSIS of Fully Embedded Wall according to Burland-Potts method
Factor of safety on nett available passive
Active limit pressures calculated by Wedge Stability

Stage No.	--- G.L. --- Act.	Pass.	Strut Elev.	FoS for toe elev. = 2.70 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 2.000 Toe elev.	Wall Penetr -ation	Direction of failure
1	11.70	11.70	---	Conditions not suitable for FoS calc.				
2	11.70	11.70		No analysis at this stage				
3	11.70	11.70	---	Conditions not suitable for FoS calc.				
4	11.70	11.70	---	Conditions not suitable for FoS calc.				
5	11.70	9.70	Cant.	3.711	2.82	5.98	3.72	L to R
6	11.70	9.70	Cant.	3.591	2.82	5.85	3.85	L to R
7	11.70	9.70		No analysis at this stage				
8	11.70	9.70		No analysis at this stage				
9	11.70	9.70		No analysis at this stage				
10	11.70	9.70	Cant.	2.393	2.84	3.84	5.86	L to R
11	11.70	9.70	Cant.	2.368	2.84	3.78	5.92	L to R
12	11.70	9.70		No analysis at this stage				
13	11.70	9.70		No analysis at this stage				
14	11.70	9.70	Cant.	3.447	2.82	5.73	3.97	L to R
15	11.70	8.70	Cant.	2.135	2.79	3.13	5.57	L to R
16	11.70	8.70	Cant.	2.032	2.79	2.80	5.90	L to R

NORTHLAND GEOTECHNICAL SPECIALISTS | Sheet No.
Program: WALLAP Version 6.06 Revision A51.B69.R55 | Job No. 0213
Licensed from GEOSOLVE | Made by : RB
Data filename/Run ID: Section_B-lowerwall |
1A Seaview Road | Date: 9-03-2022
Section B - lower wall | Checked :

Units: kN,m

Summary of results

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall
Analysis options
Length of wall perpendicular to section = 20.00m
2-D finite element model. Soil arching not modelled.
Soil deformations are elastic until the active or passive limit is reached
Active limit pressures calculated by Wedge Stability
Open Tension Crack analysis - No
All soil moduli were factored to take account of
3-D effects due to the finite length of wall:
Modulus factors - Left side = 1.04
Right side = 1.03

Rigid boundaries: Left side 20.00 from wall Smooth boundary
Right side 20.00 from wall Smooth boundary
Lower rigid boundary at elevation -10.00 Rough boundary

Bending moment, shear force and displacement envelopes

Node no.	Y coord	Displacement maximum m	Displacement minimum m	Bending moment maximum kN.m/m	Bending moment minimum kN.m/m	Shear force maximum kN/m	Shear force minimum kN/m
1	11.70	0.083	0.000	0.0	0.0	0.0	0.0
2	11.35	0.077	0.000	0.3	-0.0	5.8	-0.3
3	11.00	0.071	0.000	4.2	-0.2	12.9	-1.0
4	10.68	0.065	0.000	8.9	-0.6	15.7	-1.7
5	10.37	0.060	0.000	14.1	-1.3	23.4	-2.5
6	10.04	0.054	0.000	22.0	-0.6	26.8	-0.2
7	9.70	0.048	0.000	31.6	-0.2	30.6	-0.3
8	9.20	0.039	0.000	46.5	-0.3	27.2	-0.3
9	8.70	0.032	0.000	59.2	-0.4	25.0	0.0
10	8.40	0.027	0.000	65.3	-0.3	24.5	0.0
11	7.90	0.021	0.000	69.5	-0.1	17.4	-5.1
12	7.40	0.016	0.000	64.7	0.0	12.9	-17.0
13	6.95	0.012	0.000	60.3	0.0	0.0	-48.4
14	6.50	0.010	0.000	47.2	0.0	0.0	-39.2
15	6.00	0.008	0.000	28.1	0.0	0.0	-31.9
16	5.50	0.006	0.000	15.3	0.0	0.0	-18.9
17	5.00	0.005	0.000	9.2	0.0	0.0	-8.9
18	4.50	0.005	0.000	6.4	0.0	0.0	-4.4
19	4.00	0.004	0.000	4.9	-0.0	0.0	-2.9
20	3.50	0.003	0.000	3.5	-0.0	0.0	-3.3
21	3.10	0.003	0.000	2.0	-0.0	0.0	-4.4
22	2.70	0.003	0.000	0.0	-0.0	0.0	-1.2
23	2.58	0.003	0.000	0.0	0.0	0.0	-0.0
24	1.29	0.002	0.000	0.0	0.0	0.0	-0.2
25	0.00	0.001	0.000	0.0	0.0	0.0	-0.2
26	-2.00	0.001	0.000	0.0	0.0	0.0	-0.2
27	-4.00	0.001	0.000	0.0	0.0	0.0	-0.1
28	-6.00	0.000	0.000	0.0	0.0	0.1	-0.1
29	-8.00	0.000	0.000	0.0	0.0	0.1	-0.0
30	-10.00	0.000	0.000	0.0	0.0	0.0	0.0

Run ID. Section_B-lowerwall | Sheet No.
1A Seaview Road | Date: 9-03-2022
Section B - lower wall | Checked :

Summary of results (continued)

Maximum and minimum bending moment and shear force at each stage

Stage no.	Bending moment maximum kN.m/m	elev.	minimum kN.m/m	elev.	Shear force maximum kN/m	elev.	minimum kN/m	elev.
1	0.1	6.95	-0.2	8.70	0.5	7.40	-0.2	9.70
2	No calculation at this stage							
3	0.3	6.95	-0.4	8.70	0.9	7.40	-0.3	9.70
4	0.4	7.40	-1.3	10.37	2.4	10.37	-2.5	10.37
5	19.3	8.40	-0.0	2.70	12.6	9.70	-12.4	6.95
6	19.4	8.40	-0.0	2.70	12.6	9.70	-12.5	6.95
7	No calculation at this stage							
8	No calculation at this stage							
9	No calculation at this stage							
10	69.5	7.90	-0.0	2.70	30.6	9.70	-48.4	6.95
11	69.5	7.90	-0.0	2.70	30.6	9.70	-48.4	6.95
12	No calculation at this stage							
13	No calculation at this stage							
14	66.8	7.90	-0.0	2.70	27.7	9.70	-46.6	6.95
15	62.1	7.40	-0.0	2.70	24.2	8.70	-33.2	6.50
16	62.9	7.40	-0.0	2.70	25.0	8.70	-33.1	6.50

Maximum and minimum displacement at each stage

Stage no.	Displacement maximum m	elev.	minimum m	elev.	Stage description
1	0.000	9.20	0.000	11.70	Apply surcharge no.1 at elev. 11.70
2	No calculation at this stage				Apply surcharge no.2 at elev. 11.70
3	0.000	-2.00	0.000	11.70	Apply surcharge no.3 at elev. 11.70
4	0.000	10.68	0.000	11.70	Apply load no.1 at elev. 10.37
5	0.017	11.70	0.000	11.70	Excav. to elev. 9.70 on RIGHT side
6	0.017	11.70	0.000	11.70	Apply surcharge no.6 at elev. 11.70
7	No calculation at this stage				Apply surcharge no.5 at elev. 11.70
8	No calculation at this stage				Remove surcharge no.5 at elev. 11.70
9	No calculation at this stage				Remove surcharge no.6 at elev. 11.70
10	0.072	11.70	0.000	11.70	Apply surcharge no.7 at elev. 11.70
11	0.072	11.70	0.000	11.70	Apply surcharge no.8 at elev. 11.70
12	No calculation at this stage				Remove surcharge no.7 at elev. 11.70
13	No calculation at this stage				Remove surcharge no.8 at elev. 11.70
14	0.072	11.70	0.000	11.70	Apply surcharge no.4 at elev. 11.70
15	0.082	11.70	0.000	11.70	Excav. to elev. 8.70 on RIGHT side
16	0.083	11.70	0.000	11.70	Apply load no.2 at elev. 10.37

Run ID. Section_B-lowerwall | Sheet No.
1A Seaview Road | Date: 9-03-2022
Section B - lower wall | Checked :

Summary of results (continued)

NORTHLAND GEOTECHNICAL SPECIALISTS | Sheet No.
Program: WALLAP Version 6.06 Revision A51.B69.R55 | Job No. 0213
Licensed from GEOSOLVE | Made by : RB
Data filename/Run ID: Section_B |
1A Seaview Road | Date: 9-03-2022
Section B | Checked :

Units: kN,m

INPUT DATA

SOIL PROFILE

Stratum no.	Elevation of top of stratum	Soil types Left side	Right side
1	11.70	1 Back Fill	1 Back Fill
2	9.70	2 Res soils	2 Res soils
3	8.40	3 HW Greywacke	3 HW Greywacke
4	7.40	4 MW Greywacke	4 MW Greywacke

SOIL PROPERTIES

No.	Soil type -- Description (Datum elev.)	Bulk density kN/m3	Young's Modulus Eh,kN/m2 (dEh/dy)	At rest coeff. Ko (dKo/dy)	Consol state. NC/OC Nu)	Active limit Ka (Kac)	Passive limit Kpc)	Cohesion kN/m2 (dc/dy)
1	Back Fill	18.00	20000	0.470	OC (0.200)	0.283 (1.241)	3.960 (5.127)	1.000d
2	Res soils	18.00	25000	0.470	OC (0.300)	0.260 (1.185)	4.448 (5.518)	6.000d
3	HW Greywacke	19.00	50000	0.440	OC (0.200)	0.237 (1.131)	5.023 (5.965)	10.00d
4	MW Greywacke	20.00	200000	0.398	OC (0.200)	0.207 (1.052)	6.100 (6.768)	20.00d
5	Existing fill	18.00	15000	0.530	OC (0.300)	0.309 (1.299)	3.543 (4.783)	2.000d

Additional soil parameters associated with Ka and Kp

No.	Soil type ------- Description	--- parameters for Ka --- Soil friction angle	Wall adhesion coeff.	Back-fill angle	--- parameters for Kp --- Soil friction angle	Wall adhesion coeff.	Back-fill angle
1	Back Fill	30.00	0.667	0.00	30.00	0.333	0.00
2	Res soils	32.00	0.667	0.00	32.00	0.333	0.00
3	HW Greywacke	34.00	0.667	0.00	34.00	0.333	0.00
4	MW Greywacke	37.00	0.667	0.00	37.00	0.333	0.00
5	Existing fill	28.00	0.667	0.00	28.00	0.333	0.00

GROUND WATER CONDITIONS

Density of water = 10.00 kN/m3

	Left side	Right side
Initial water table elevation	1.83	1.83

Automatic water pressure balancing at toe of wall : No

WALL PROPERTIES

Type of structure = Fully Embedded Wall
Elevation of toe of wall = 2.70
Maximum finite element length = 0.50 m
Youngs modulus of wall E = 1.2100E+07 kN/m2
Moment of inertia of wall I = 9.6660E-04 m4/m run
E.I = 11696 kN.m2/m run
Yield Moment of wall = Not defined

HORIZONTAL and MOMENT LOADS/RESTRAINTS

Load no.	Elevation	Horizontal load kN/m run	Moment load kN.m/m run	Moment restraint kN.m/m/rad	Partial factor (Category)
1	10.37	4.910	0	0	N/A
2	10.37	2.520	0	0	N/A

SURCHARGE LOADS

Surch-arge no.	Elev.	Distance from wall	Length parallel to wall	Width perpend. to wall	Surcharge kN/m2 Near edge	Surcharge kN/m2 Far edge	Equiv. soil type	Partial factor/ Category
1	11.70	3.66(L)	100.00	20.00	28.80	=	2	N/A
2	11.70	5.80(L)	100.00	20.00	52.40	=	2	N/A
3	11.70	3.66(L)	100.00	2.14	0.00	21.60	2	N/A
4	11.70	0.00(L)	3.66	100.00	2.50	=	0	N/A
5	11.70	0.30(L)	3.00	0.60	35.00	=	0	N/A
6	11.70	2.70(L)	3.00	0.60	35.00	=	0	N/A
7	11.70	0.30(L)	3.00	0.60	53.00	=	0	N/A
8	11.70	2.70(L)	3.00	0.60	17.00	=	0	N/A

Note: L = Left side, R = Right side
A trapezoidal surcharge is defined by two values:
N = at edge near to wall, F = at edge far from wall

CONSTRUCTION STAGES

Construction stage no.	Stage description
1	Apply surcharge no.1 at elevation 11.70
2	Apply surcharge no.2 at elevation 11.70 No analysis at this stage
3	Apply surcharge no.3 at elevation 11.70
4	Apply load no.1 at elevation 10.37
5	Excavate to elevation 9.70 on RIGHT side Toe of berm at elevation 2.70 Width of top of berm = 0.10 Width of toe of berm = 7.00
6	Apply surcharge no.6 at elevation 11.70
7	Apply surcharge no.5 at elevation 11.70 No analysis at this stage
8	Remove surcharge no.5 at elevation 11.70 No analysis at this stage
9	Remove surcharge no.6 at elevation 11.70 No analysis at this stage
10	Apply surcharge no.7 at elevation 11.70
11	Apply surcharge no.8 at elevation 11.70
12	Remove surcharge no.7 at elevation 11.70 No analysis at this stage
13	Remove surcharge no.8 at elevation 11.70 No analysis at this stage
14	Apply surcharge no.4 at elevation 11.70
15	Excavate to elevation 8.70 on RIGHT side Toe of berm at elevation 2.70 Width of top of berm = 0.10 Width of toe of berm = 6.00
16	Apply load no.2 at elevation 10.37

FACTORS OF SAFETY and ANALYSIS OPTIONS

Stability analysis:
Method of analysis - Burland-Potts
Factor on passive for calculating wall depth = 2.00
Active limit pressures calculated by Wedge Stability

Parameters for undrained strata:
Minimum equivalent fluid density = 5.00 kN/m3
Maximum depth of water filled tension crack = 0.00 m

Bending moment and displacement calculation:
Method - 2-D finite element model
Open Tension Crack analysis? - No
Soil arching modelled? - No
Non-linear Modulus Parameter (L) = 9.000 m

Boundary conditions:
Length of wall (normal to plane of analysis) = 20.00 m

Width of excavation on Left side of wall = 20.00 m
Width of excavation on Right side of wall = 20.00 m

Distance to rigid boundary on Left side = 20.00 m
Distance to rigid boundary on Right side = 20.00 m
Elevation of rigid lower boundary = -10.00

Lower rigid boundary at elevation -10.00 - Rough
Rigid boundary on Left side - Smooth

Rigid boundary on Right side - Smooth
Wall / soil interface - Smooth

OUTPUT OPTIONS

Stage no.	Stage description	Output options: Displacement, Bending mom., Shear force	Active, Passive pressures	Graph. output
1	Apply surcharge no.1 at elev. 11.70	Yes	Yes	Yes
2	Apply surcharge no.2 at elev. 11.70	No	No	No
3	Apply surcharge no.3 at elev. 11.70	Yes	Yes	Yes
4	Apply load no.1 at elev. 10.37	No	No	No
5	Excav. to elev. 9.70 on RIGHT side	Yes	Yes	Yes
6	Apply surcharge no.6 at elev. 11.70	Yes	Yes	Yes
7	Apply surcharge no.5 at elev. 11.70	No	No	No
8	Remove surcharge no.5 at elev. 11.70	No	No	No
9	Remove surcharge no.6 at elev. 11.70	No	No	No
10	Apply surcharge no.7 at elev. 11.70	No	No	No
11	Apply surcharge no.8 at elev. 11.70	Yes	Yes	Yes
12	Remove surcharge no.7 at elev. 11.70	No	No	No
13	Remove surcharge no.8 at elev. 11.70	No	No	No
14	Apply surcharge no.4 at elev. 11.70	Yes	Yes	Yes
15	Excav. to elev. 8.70 on RIGHT side	Yes	Yes	Yes
16	Apply load no.2 at elev. 10.37	Yes	Yes	Yes
*	Summary output	Yes	-	Yes

NORTHLAND GEOTECHNICAL SPECIALISTS | Sheet No.
Program: WALLAP Version 6.06 Revision A51.B69.R55 | Job No. 0213
Licensed from GEOSOLVE | Made by : RB
Data filename/Run ID: Section_B |
1A Seaview Road | Date: 9-03-2022
Section B | Checked :

Units: kN,m

Summary of results

STABILITY ANALYSIS of Fully Embedded Wall according to Burland-Potts method
Factor of safety on nett available passive
Active limit pressures calculated by Wedge Stability

Stage No.	--- G.L. --- Act.	Pass.	Strut Elev.	FoS for toe elev. = 2.70 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 2.000 Toe elev.	Wall Penetr -ation	Direction of failure
1	11.70	11.70	---	Conditions not suitable for FoS calc.				
2	11.70	11.70		No analysis at this stage				
3	11.70	11.70	---	Conditions not suitable for FoS calc.				
4	11.70	11.70	---	Conditions not suitable for FoS calc.				
5	11.70	9.70	Cant.	3.711	2.82	5.98	3.72	L to R
6	11.70	9.70	Cant.	3.591	2.82	5.85	3.85	L to R
7	11.70	9.70		No analysis at this stage				
8	11.70	9.70		No analysis at this stage				
9	11.70	9.70		No analysis at this stage				
10	11.70	9.70	Cant.	2.393	2.84	3.84	5.86	L to R
11	11.70	9.70	Cant.	2.368	2.84	3.78	5.92	L to R
12	11.70	9.70		No analysis at this stage				
13	11.70	9.70		No analysis at this stage				
14	11.70	9.70	Cant.	3.447	2.82	5.73	3.97	L to R
15	11.70	8.70	Cant.	2.135	2.79	3.13	5.57	L to R
16	11.70	8.70	Cant.	2.032	2.79	2.80	5.90	L to R

NORTHLAND GEOTECHNICAL SPECIALISTS | Sheet No.
Program: WALLAP Version 6.06 Revision A51.B69.R55 | Job No. 0213
Licensed from GEOSOLVE | Made by : RB
Data filename/Run ID: Section_B |
1A Seaview Road | Date: 9-03-2022
Section B | Checked :

Units: kN,m

Summary of results

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall
Analysis options
Length of wall perpendicular to section = 20.00m
2-D finite element model. Soil arching not modelled.
Soil deformations are elastic until the active or passive limit is reached
Active limit pressures calculated by Wedge Stability
Open Tension Crack analysis - No
All soil moduli were factored to take account of
3-D effects due to the finite length of wall:
Modulus factors - Left side = 1.04
Right side = 1.03

Rigid boundaries: Left side 20.00 from wall Smooth boundary
Right side 20.00 from wall Smooth boundary
Lower rigid boundary at elevation -10.00 Rough boundary

Bending moment, shear force and displacement envelopes

Node no.	Y coord	Displacement maximum m	Displacement minimum m	Bending moment maximum kN.m/m	Bending moment minimum kN.m/m	Shear force maximum kN/m	Shear force minimum kN/m
1	11.70	0.083	0.000	0.0	0.0	0.0	0.0
2	11.35	0.077	0.000	0.3	-0.0	5.8	-0.3
3	11.00	0.071	0.000	4.2	-0.2	12.9	-1.0
4	10.68	0.065	0.000	8.9	-0.6	15.7	-1.7
5	10.37	0.060	0.000	14.1	-1.3	23.4	-2.5
6	10.04	0.054	0.000	22.0	-0.6	26.8	-0.2
7	9.70	0.048	0.000	31.6	-0.2	30.6	-0.3
8	9.20	0.039	0.000	46.5	-0.3	27.2	-0.3
9	8.70	0.032	0.000	59.2	-0.4	25.0	0.0
10	8.40	0.027	0.000	65.3	-0.3	24.5	0.0
11	7.90	0.021	0.000	69.5	-0.1	17.4	-5.1
12	7.40	0.016	0.000	64.7	0.0	12.9	-17.0
13	6.95	0.012	0.000	60.3	0.0	0.0	-48.4
14	6.50	0.010	0.000	47.2	0.0	0.0	-39.2
15	6.00	0.008	0.000	28.1	0.0	0.0	-31.9
16	5.50	0.006	0.000	15.3	0.0	0.0	-18.9
17	5.00	0.005	0.000	9.2	0.0	0.0	-8.9
18	4.50	0.005	0.000	6.4	0.0	0.0	-4.4
19	4.00	0.004	0.000	4.9	-0.0	0.0	-2.9
20	3.50	0.003	0.000	3.5	-0.0	0.0	-3.3
21	3.10	0.003	0.000	2.0	-0.0	0.0	-4.4
22	2.70	0.003	0.000	0.0	-0.0	0.0	-1.2
23	2.58	0.003	0.000	0.0	0.0	0.0	-0.0
24	1.29	0.002	0.000	0.0	0.0	0.0	-0.2
25	0.00	0.001	0.000	0.0	0.0	0.0	-0.2
26	-2.00	0.001	0.000	0.0	0.0	0.0	-0.2
27	-4.00	0.001	0.000	0.0	0.0	0.0	-0.1
28	-6.00	0.000	0.000	0.0	0.0	0.1	-0.1
29	-8.00	0.000	0.000	0.0	0.0	0.1	-0.0
30	-10.00	0.000	0.000	0.0	0.0	0.0	0.0

Run ID. Section_B | Sheet No.
1A Seaview Road | Date: 9-03-2022
Section B | Checked :

Summary of results (continued)

Maximum and minimum bending moment and shear force at each stage

Stage no.	Bending moment maximum kN.m/m	elev.	minimum kN.m/m	elev.	Shear force maximum kN/m	elev.	minimum kN/m	elev.
1	0.1	6.95	-0.2	8.70	0.5	7.40	-0.2	9.70
2	No calculation at this stage							
3	0.3	6.95	-0.4	8.70	0.9	7.40	-0.3	9.70
4	0.4	7.40	-1.3	10.37	2.4	10.37	-2.5	10.37
5	19.3	8.40	-0.0	2.70	12.6	9.70	-12.4	6.95
6	19.4	8.40	-0.0	2.70	12.6	9.70	-12.5	6.95
7	No calculation at this stage							
8	No calculation at this stage							
9	No calculation at this stage							
10	69.5	7.90	-0.0	2.70	30.6	9.70	-48.4	6.95
11	69.5	7.90	-0.0	2.70	30.6	9.70	-48.4	6.95
12	No calculation at this stage							
13	No calculation at this stage							
14	66.8	7.90	-0.0	2.70	27.7	9.70	-46.6	6.95
15	62.1	7.40	-0.0	2.70	24.2	8.70	-33.2	6.50
16	62.9	7.40	-0.0	2.70	25.0	8.70	-33.1	6.50

Maximum and minimum displacement at each stage

Stage no.	Displacement maximum m	elev.	minimum m	elev.	Stage description
1	0.000	9.20	0.000	11.70	Apply surcharge no.1 at elev. 11.70
2	No calculation at this stage				Apply surcharge no.2 at elev. 11.70
3	0.000	-2.00	0.000	11.70	Apply surcharge no.3 at elev. 11.70
4	0.000	10.68	0.000	11.70	Apply load no.1 at elev. 10.37
5	0.017	11.70	0.000	11.70	Excav. to elev. 9.70 on RIGHT side
6	0.017	11.70	0.000	11.70	Apply surcharge no.6 at elev. 11.70
7	No calculation at this stage				Apply surcharge no.5 at elev. 11.70
8	No calculation at this stage				Remove surcharge no.5 at elev. 11.70
9	No calculation at this stage				Remove surcharge no.6 at elev. 11.70
10	0.072	11.70	0.000	11.70	Apply surcharge no.7 at elev. 11.70
11	0.072	11.70	0.000	11.70	Apply surcharge no.8 at elev. 11.70
12	No calculation at this stage				Remove surcharge no.7 at elev. 11.70
13	No calculation at this stage				Remove surcharge no.8 at elev. 11.70
14	0.072	11.70	0.000	11.70	Apply surcharge no.4 at elev. 11.70
15	0.082	11.70	0.000	11.70	Excav. to elev. 8.70 on RIGHT side
16	0.083	11.70	0.000	11.70	Apply load no.2 at elev. 10.37

Run ID. Section_B | Sheet No.
1A Seaview Road | Date: 9-03-2022
Section B | Checked :

Summary of results (continued)

NORTHLAND GEOTECHNICAL SPECIALISTS | Sheet No.
Program: WALLAP Version 6.06 Revision A51.B69.R55 | Job No. 0213
Licensed from GEOSOLVE | Made by : RB
Data filename/Run ID: Section_C-lowerwall |
1A Seaview Road | Date: 9-03-2022
Section C - lower wall | Checked :

Units: kN,m

INPUT DATA

SOIL PROFILE

Stratum no.	Elevation of top of stratum	Soil types Left side	Right side
1	15.22	6 light weight fill	6 light weight fill
2	12.84	2 Res soils	2 Res soils
3	11.00	3 HW Greywacke	3 HW Greywacke
4	9.15	4 MW Greywacke	4 MW Greywacke

SOIL PROPERTIES

No.	Soil type -- Description (Datum elev.)	Bulk density kN/m3	Young's Modulus Eh,kN/m2 (dEh/dy)	At rest coeff. Ko (dKo/dy)	Consol state. NC/OC (Nu)	Active limit Ka (Kac)	Passive limit Kpc (Kpc)	Cohesion kN/m2 (dc/dy)
1	Back Fill	18.00	20000	0.470	OC (0.200)	0.283 (1.241)	3.960 (5.127)	1.000d
2	Res soils	18.00	25000	0.470	OC (0.300)	0.260 (1.185)	4.448 (5.518)	6.000d
3	HW Greywacke	19.00	50000	0.440	OC (0.200)	0.237 (1.131)	5.023 (5.965)	10.00d
4	MW Greywacke	20.00	200000	0.398	OC (0.200)	0.207 (1.052)	6.100 (6.768)	20.00d
5	Existing fill	18.00	15000	0.530	OC (0.300)	0.309 (1.299)	3.543 (4.783)	2.000d
6	light weight fill	16.00	20000	1.917	OC (0.200)	0.163 (0.000)	8.766 (0.000)	

Additional soil parameters associated with Ka and Kp

No.	Soil type ------- Description	--- parameters for Ka --- Soil friction angle	Wall adhesion coeff.	Back-fill angle	--- parameters for Kp --- Soil friction angle	Wall adhesion coeff.	Back-fill angle
1	Back Fill	30.00	0.667	0.00	30.00	0.333	0.00
2	Res soils	32.00	0.667	0.00	32.00	0.333	0.00
3	HW Greywacke	34.00	0.667	0.00	34.00	0.333	0.00
4	MW Greywacke	37.00	0.667	0.00	37.00	0.333	0.00
5	Existing fill	28.00	0.667	0.00	28.00	0.333	0.00
6	light weight fill	42.00	0.667	0.00	42.00	0.333	0.00

GROUND WATER CONDITIONS

Density of water = 10.00 kN/m3

	Left side	Right side
Initial water table elevation	1.83	1.83

Automatic water pressure balancing at toe of wall : No

WALL PROPERTIES

Type of structure = Fully Embedded Wall
Elevation of toe of wall = 6.22
Maximum finite element length = 0.50 m
Youngs modulus of wall E = 1.2100E+07 kN/m2
Moment of inertia of wall I = 9.6660E-04 m4/m run
E.I = 11696 kN.m2/m run
Yield Moment of wall = Not defined

HORIZONTAL and MOMENT LOADS/RESTRAINTS

Load no.	Elevation	Horizontal load kN/m run	Moment load kN.m/m run	Moment restraint kN.m/m/rad	Partial factor (Category)
1	13.63	6.950	0	0	N/A
2	13.63	3.570	0	0	N/A

SURCHARGE LOADS

Surcharge no.	Elev.	Distance from wall	Length parallel to wall	Width perpend. to wall	Surcharge kN/m2 Near edge	Far edge	Equiv. soil type	Partial factor/ Category
1	15.22	0.30(L)	3.00	0.60	35.00	=	N/A	N/A
2	15.22	2.70(L)	3.00	0.60	35.00	=	N/A	N/A
3	15.22	0.30(L)	3.00	0.60	53.00	=	N/A	N/A
4	15.22	2.70(L)	3.00	0.60	17.00	=	N/A	N/A
5	15.22	0.00(L)	3.00	5.00	5.00	=	N/A	N/A

Note: L = Left side, R = Right side

CONSTRUCTION STAGES

Construction stage no.	Stage description
1	Apply load no.1 at elevation 13.63
	The effect of strut/anchor stiffness at this elevation
	will be included while applying this load
2	Excavate to elevation 12.62 on RIGHT side
	Toe of berm at elevation 6.22
	Width of top of berm = 0.10
	Width of toe of berm = 6.40
3	Apply surcharge no.3 at elevation 15.22
4	Apply surcharge no.4 at elevation 15.22
5	Remove surcharge no.3 at elevation 15.22
	No analysis at this stage
6	Remove surcharge no.4 at elevation 15.22
	No analysis at this stage
7	Apply surcharge no.1 at elevation 15.22
8	Apply surcharge no.2 at elevation 15.22
9	Remove surcharge no.1 at elevation 15.22
	No analysis at this stage
10	Remove surcharge no.2 at elevation 15.22
	No analysis at this stage
11	Apply surcharge no.5 at elevation 15.22
12	Excavate to elevation 11.62 on RIGHT side
	Toe of berm at elevation 6.22
	Width of top of berm = 0.10
	Width of toe of berm = 5.40
13	Apply load no.2 at elevation 13.63

FACTORS OF SAFETY and ANALYSIS OPTIONS

Stability analysis:
Method of analysis - Burland-Potts
Factor on passive for calculating wall depth = 2.00

Parameters for undrained strata:
Minimum equivalent fluid density = 5.00 kN/m3
Maximum depth of water filled tension crack = 0.00 m

Bending moment and displacement calculation:
Method - 2-D finite element model
Open Tension Crack analysis? - No
Soil arching modelled? - No
Non-linear Modulus Parameter (L) = 9.000 m

Boundary conditions:
Length of wall (normal to plane of analysis) = 20.00 m

Width of excavation on Left side of wall = 20.00 m
Width of excavation on Right side of wall = 20.00 m

Distance to rigid boundary on Left side = 20.00 m
Distance to rigid boundary on Right side = 20.00 m
Elevation of rigid lower boundary = -10.00

Lower rigid boundary at elevation -10.00 - Rough
Rigid boundary on Left side - Smooth
Rigid boundary on Right side - Smooth
Wall / soil interface - Smooth

OUTPUT OPTIONS

Stage no.	Stage description	Output options: Displacement Bending mom. Shear force	Active, Passive pressures	Graph. output
1	Apply load no.1 at elev. 13.63	No	No	No
2	Excav. to elev. 12.62 on RIGHT side	No	No	No
3	Apply surcharge no.3 at elev. 15.22	No	No	No
4	Apply surcharge no.4 at elev. 15.22	Yes	Yes	Yes
5	Remove surcharge no.3 at elev. 15.22	No	No	No
6	Remove surcharge no.4 at elev. 15.22	No	No	No
7	Apply surcharge no.1 at elev. 15.22	Yes	Yes	Yes
8	Apply surcharge no.2 at elev. 15.22	Yes	Yes	Yes
9	Remove surcharge no.1 at elev. 15.22	No	No	No
10	Remove surcharge no.2 at elev. 15.22	No	No	No
11	Apply surcharge no.5 at elev. 15.22	Yes	Yes	Yes
12	Excav. to elev. 11.62 on RIGHT side	No	No	No
13	Apply load no.2 at elev. 13.63	Yes	Yes	Yes
*	Summary output	Yes	-	Yes

NORTHLAND GEOTECHNICAL SPECIALISTS | Sheet No.
Program: WALLAP Version 6.06 Revision A51.B69.R55 | Job No. 0213
Licensed from GEOSOLVE | Made by : RB
Data filename/Run ID: Section_C-lowerwall |
1A Seaview Road | Date: 9-03-2022
Section C - lower wall | Checked :

Units: kN,m

Summary of results

STABILITY ANALYSIS of Fully Embedded Wall according to Burland-Potts method
Factor of safety on nett available passive

Stage No.	G.L. Act.	G.L. Pass.	Strut Elev.	FoS for toe elev. = 6.22 Factor of Safety	FoS for toe elev. = 6.22 Moment equilib. at elev.	Toe elev. for FoS = 2.000 Toe elev.	Wall Penetr -ation	Direction of failure
1	15.22	15.22	Cant.	87.208	10.59	***	***	L to R
2	15.22	12.62	Cant.	2.980	6.39	7.87	4.75	L to R
3	15.22	12.62	Cant.	2.345	6.40	6.93	5.69	L to R
4	15.22	12.62	Cant.	2.329	6.40	6.90	5.72	L to R
5	15.22	12.62		No analysis at this stage				
6	15.22	12.62		No analysis at this stage				
7	15.22	12.62	Cant.	2.525	6.39	7.24	5.38	L to R
8	15.22	12.62	Cant.	2.486	6.39	7.18	5.44	L to R
9	15.22	12.62		No analysis at this stage				
10	15.22	12.62		No analysis at this stage				
11	15.22	12.62	Cant.	2.744	6.39	7.57	5.05	L to R
12	15.22	11.62	Cant.	1.835	6.36	***	***	L to R
13	15.22	11.62	Cant.	1.711	6.36	***	***	L to R

Legend: *** Result not found

NORTHLAND GEOTECHNICAL SPECIALISTS | Sheet No.
Program: WALLAP Version 6.06 Revision A51.B69.R55 | Job No. 0213
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Data filename/Run ID: Section_C-lowerwall |
1A Seaview Road | Date: 9-03-2022
Section C - lower wall | Checked :

Units: kN,m

Summary of results

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall
Analysis options
Length of wall perpendicular to section = 20.00m
2-D finite element model. Soil arching not modelled.
Soil deformations are elastic until the active or passive limit is reached
Open Tension Crack analysis - No
All soil moduli were factored to take account of
3-D effects due to the finite length of wall:
Modulus factors - Left side = 1.04
Right side = 1.03

Rigid boundaries: Left side 20.00 from wall Smooth boundary
Right side 20.00 from wall Smooth boundary
Lower rigid boundary at elevation -10.00 Rough boundary

Bending moment, shear force and displacement envelopes

Node no.	Y coord	Displacement maximum m	Displacement minimum m	Bending moment maximum kN.m/m	Bending moment minimum kN.m/m	Shear force maximum kN/m	Shear force minimum kN/m
1	15.22	0.151	0.000	0.0	-0.0	0.0	0.0
2	14.86	0.141	0.000	0.4	-0.0	1.2	-0.2
3	14.50	0.132	0.000	1.3	-0.2	2.6	-0.9
4	14.07	0.120	0.000	3.3	-0.8	4.6	-2.0
5	13.63	0.108	0.000	6.2	-1.9	15.0	-3.4
6	13.24	0.097	0.000	12.4	-0.8	17.1	0.0
7	12.84	0.086	0.000	19.8	-0.0	20.2	0.0
8	12.62	0.080	0.000	24.4	0.0	21.5	0.0
9	12.12	0.068	0.000	35.0	0.0	23.3	0.0
10	11.62	0.055	0.000	46.5	0.0	27.3	-0.1
11	11.31	0.048	0.000	55.0	0.0	27.0	-0.1
12	11.00	0.042	0.000	63.4	0.0	26.7	-0.1
13	10.50	0.032	0.000	74.6	0.0	16.2	-12.5
14	10.00	0.024	0.000	80.7	0.0	6.7	-19.8
15	9.57	0.019	0.000	81.5	0.0	0.0	-17.4
16	9.15	0.015	0.000	78.8	0.0	0.0	-15.5
17	8.82	0.012	0.000	67.2	0.0	0.0	-58.2
18	8.50	0.011	0.000	46.1	0.0	0.0	-58.8
19	8.00	0.009	0.000	23.6	0.0	0.0	-31.8
20	7.50	0.007	0.000	13.4	0.0	0.0	-14.4
21	7.00	0.006	0.000	8.4	0.0	0.0	-9.9
22	6.61	0.006	0.000	4.5	0.0	0.0	-10.7
23	6.22	0.005	0.000	0.0	-0.0	0.0	-2.8
24	6.10	0.005	0.000	0.0	0.0	0.0	0.0
25	5.05	0.004	0.000	0.0	0.0	0.1	0.0
26	4.00	0.003	0.000	0.0	0.0	0.1	0.0
27	2.00	0.001	0.000	0.0	0.0	0.1	0.0
28	0.00	0.001	0.000	0.0	0.0	0.2	0.0
29	-2.00	0.000	0.000	0.0	0.0	0.2	0.0
30	-4.00	0.000	-0.000	0.0	0.0	0.2	0.0
31	-6.00	0.000	-0.000	0.0	0.0	0.2	0.0
32	-8.00	0.000	0.000	0.0	0.0	0.2	0.0
33	-10.00	0.000	0.000	0.0	0.0	0.0	0.0

Run ID. Section_C-lowerwall | Sheet No.
1A Seaview Road | Date: 9-03-2022
Section C - lower wall | Checked :

Summary of results (continued)

Maximum and minimum bending moment and shear force at each stage

Stage no.	Bending moment maximum kN.m/m	elev.	minimum kN.m/m	elev.	Shear force maximum kN/m	elev.	minimum kN/m	elev.
1	0.5	11.62	-1.9	13.63	3.6	13.63	-3.4	13.63
2	32.8	11.00	-0.0	15.22	15.1	12.62	-15.1	10.00
3	52.5	10.50	-0.0	15.22	21.4	12.62	-24.3	8.82
4	53.1	10.50	-0.0	15.22	21.5	12.62	-25.0	8.82
5	No calculation at this stage							
6	No calculation at this stage							
7	52.8	10.50	-0.0	15.22	21.0	12.62	-24.9	8.82
8	52.8	10.50	-0.0	15.22	21.0	12.62	-25.0	8.82
9	No calculation at this stage							
10	No calculation at this stage							
11	52.5	10.50	-0.0	15.22	20.3	12.62	-24.8	8.82
12	67.7	10.00	-0.0	15.22	23.7	11.62	-50.0	8.82
13	81.5	9.57	-0.0	15.22	27.3	11.62	-58.8	8.50

Maximum and minimum displacement at each stage

Stage no.	Displacement maximum m	elev.	minimum m	elev.	Stage description
1	0.000	14.07	-0.000	-6.00	Apply load no.1 at elev. 13.63
2	0.044	15.22	0.000	15.22	Excav. to elev. 12.62 on RIGHT side
3	0.079	15.22	0.000	15.22	Apply surcharge no.3 at elev. 15.22
4	0.080	15.22	0.000	15.22	Apply surcharge no.4 at elev. 15.22
5	No calculation at this stage				Remove surcharge no.3 at elev. 15.22
6	No calculation at this stage				Remove surcharge no.4 at elev. 15.22
7	0.080	15.22	0.000	15.22	Apply surcharge no.1 at elev. 15.22
8	0.080	15.22	0.000	15.22	Apply surcharge no.2 at elev. 15.22
9	No calculation at this stage				Remove surcharge no.1 at elev. 15.22
10	No calculation at this stage				Remove surcharge no.2 at elev. 15.22
11	0.079	15.22	0.000	15.22	Apply surcharge no.5 at elev. 15.22
12	0.124	15.22	0.000	15.22	Excav. to elev. 11.62 on RIGHT side
13	0.151	15.22	0.000	15.22	Apply load no.2 at elev. 13.63

Timber Pole Capacity

Title	**1A Seaview Road, Paihia. Section A - Lower wall Long Term**	Job no	0213
		Date	9/03/2022
Design by	RB		
Checked			

Chosen Size	400	mm
spacing	1.3	m
$M_{(Wallap)}$ =	57.9	kNm/m
$V_{(Wallap)}$ =	27.6	kN/m
Depth to max moment	4.5	m
Depth to max shear	6	m
Increase in dia./metre	0	mm
Load Factor	1.5	Seismic = 1 otherwise = 1.5
deflection	41	mm

Bending and Shear only (no Axial)

Shear Capacity

f_s =	3.5	MPa
k_1 =	0.6	duration
k_{20} =	1	shaved
k_{21} =	0.9	steamed
ϕ =	0.8	
V* =	**53.8**	kNm/pole
ϕ Vn =	**142.5**	
Check ϕ Vn > V*	**OK**	

Moment Capacity

E =	12.1	GPa = E
f_b =	52	MPa
k_1 =	0.6	duration
k_{20} =	0.85	shaved
k_{21} =	0.85	steamed
ϕ =	0.8	
M* =	**112.9**	kNm/pole
ϕ Mn =	**113.3**	
Check ϕ Mn > M*	**OK**	

SED Size mm	Diameter (at max moment) mm	Diameter (at max shear) mm	As m2	I m^4	I/m m^4/m	Z m^3	ϕ Mn / pole kNm	ϕ Vn / pole kNm
100	100	100	0.006	4.909E-06	3.776E-06	9.817E-05	1.8	8.91
125	125	125	0.009	1.198E-05	9.219E-06	1.917E-04	3.5	13.92
150	150	150	0.013	2.485E-05	1.912E-05	3.313E-04	6.0	20.04
175	175	175	0.018	4.604E-05	3.541E-05	5.262E-04	9.5	27.28
200	200	200	0.024	7.854E-05	6.042E-05	7.854E-04	14.2	35.63
225	225	225	0.030	1.258E-04	9.677E-05	1.118E-03	20.2	45.09
250	250	250	0.037	1.917E-04	1.475E-04	1.534E-03	27.7	55.67
275	275	275	0.045	2.807E-04	2.160E-04	2.042E-03	36.8	67.35
300	300	300	0.053	3.976E-04	3.059E-04	2.651E-03	47.8	80.16
325	325	325	0.062	5.477E-04	4.213E-04	3.370E-03	60.8	94.07
350	350	350	0.072	7.366E-04	5.666E-04	4.209E-03	75.9	109.10
375	375	375	0.083	9.707E-04	7.467E-04	5.177E-03	93.4	125.25
400	400	400	0.094	1.257E-03	9.666E-04	6.283E-03	113.3	142.50

Timber Pole Capacity

Title	**1A Seaview Road, Paihia. Section A - Lower wall Med Term**	Job no	0213	Design by	RB
		Date	9/03/2022	Checked	

Chosen Size	400	mm
spacing	1.3	m
$M_{(Wallap)}$ =	66.6	kNm/m
$V_{(Wallap)}$ =	33.2	kN/m
Depth to max moment	4.5	m
Depth to max shear	5.5	m
Increase in dia./metre	0	mm
Load Factor	1.5	Seismic = 1 otherwise = 1.5
deflection	38	mm

Bending and Shear only (no Axial)

Shear Capacity

f_s =	3.5	MPa
k_1 =	0.8	duration
k_{20} =	1	shaved
k_{21} =	0.9	steamed
ϕ =	0.8	
V* =	**64.7**	kNm/pole
ϕ Vn =	**190.0**	
Check ϕ Vn > V*	**OK**	

Moment Capacity

E =	12.1	GPa = E
f_b =	52	MPa
k_1 =	0.8	duration
k_{20} =	0.85	shaved
k_{21} =	0.85	steamed
ϕ =	0.8	
M* =	**129.9**	kNm/pole
ϕ Mn =	**151.1**	
Check ϕ Mn > M*	**OK**	

SED Size mm	Diameter (at max moment) mm	Diameter (at max shear) mm	As m2	I m^4	I/m m^4/m	Z m^3	ϕ Mn / pole kNm	ϕ Vn / pole kNm
100	100	100	0.006	4.909E-06	3.776E-06	9.817E-05	2.4	11.88
125	125	125	0.009	1.198E-05	9.219E-06	1.917E-04	4.6	18.56
150	150	150	0.013	2.485E-05	1.912E-05	3.313E-04	8.0	26.72
175	175	175	0.018	4.604E-05	3.541E-05	5.262E-04	12.7	36.37
200	200	200	0.024	7.854E-05	6.042E-05	7.854E-04	18.9	47.50
225	225	225	0.030	1.258E-04	9.677E-05	1.118E-03	26.9	60.12
250	250	250	0.037	1.917E-04	1.475E-04	1.534E-03	36.9	74.22
275	275	275	0.045	2.807E-04	2.160E-04	2.042E-03	49.1	89.81
300	300	300	0.053	3.976E-04	3.059E-04	2.651E-03	63.7	106.88
325	325	325	0.062	5.477E-04	4.213E-04	3.370E-03	81.0	125.43
350	350	350	0.072	7.366E-04	5.666E-04	4.209E-03	101.2	145.47
375	375	375	0.083	9.707E-04	7.467E-04	5.177E-03	124.5	167.00
400	400	400	0.094	1.257E-03	9.666E-04	6.283E-03	151.1	190.00

Timber Pole Capacity

Title	**1A Seaview Road, Paihia. Section A - Lower wall Short Term**	Job no	0213	Design by	RB
		Date	9/03/2022	Checked	

Chosen Size	400	mm
spacing	1.3	m
$M_{(Wallap)}$ =	67	kNm/m
$V_{(Wallap)}$ =	33.5	kN/m
Depth to max moment	4.5	m
Depth to max shear	5.5	m
Increase in dia./metre	0	mm
Load Factor	1.5	Seismic = 1 otherwise = 1.5
deflection	106	mm

Bending and Shear only (no Axial)

Shear Capacity

f_s =	3.5	MPa
k_1 =	1	duration
k_{20} =	1	shaved
k_{21} =	0.9	steamed
ϕ =	0.8	
V* =	**65.3**	kNm/pole
ϕ Vn =	**237.5**	
Check ϕ Vn > V*	**OK**	

Moment Capacity

E =	12.1	GPa = E
f_b =	52	MPa
k_1 =	1	duration
k_{20} =	0.85	shaved
k_{21} =	0.85	steamed
ϕ =	0.8	
M* =	**130.7**	kNm/pole
ϕ Mn =	**188.8**	
Check ϕ Mn > M*	**OK**	

SED Size mm	Diameter (at max moment) mm	Diameter (at max shear) mm	As m2	I m^4	I/m m^4/m	Z m^3	ϕ Mn / pole kNm	ϕ Vn / pole kNm
100	100	100	0.006	4.909E-06	3.776E-06	9.817E-05	3.0	14.84
125	125	125	0.009	1.198E-05	9.219E-06	1.917E-04	5.8	23.19
150	150	150	0.013	2.485E-05	1.912E-05	3.313E-04	10.0	33.40
175	175	175	0.018	4.604E-05	3.541E-05	5.262E-04	15.8	45.46
200	200	200	0.024	7.854E-05	6.042E-05	7.854E-04	23.6	59.38
225	225	225	0.030	1.258E-04	9.677E-05	1.118E-03	33.6	75.15
250	250	250	0.037	1.917E-04	1.475E-04	1.534E-03	46.1	92.78
275	275	275	0.045	2.807E-04	2.160E-04	2.042E-03	61.4	112.26
300	300	300	0.053	3.976E-04	3.059E-04	2.651E-03	79.7	133.60
325	325	325	0.062	5.477E-04	4.213E-04	3.370E-03	101.3	156.79
350	350	350	0.072	7.366E-04	5.666E-04	4.209E-03	126.5	181.84
375	375	375	0.083	9.707E-04	7.467E-04	5.177E-03	155.6	208.74
400	400	400	0.094	1.257E-03	9.666E-04	6.283E-03	188.8	237.50

Timber Pole Capacity

Title	**1A Seaview Road, Paihia. Section A- Lower wall Seismic**	Job no	0213	Design by	RB
		Date	9/03/2022	Checked	

Chosen Size	400	mm
spacing	1.3	m
$M_{(Wallap)}$ =	58.3	kNm/m
$V_{(Wallap)}$ =	27.7	kN/m
Depth to max moment	4.5	m
Depth to max shear	6	m
Increase in dia./metre	0	mm
Load Factor	1	Seismic = 1 otherwise = 1.5
deflection	0	mm

Bending and Shear only (no Axial)

Shear Capacity

f_s =	3.5	MPa
k_1 =	1	duration
k_{20} =	1	shaved
k_{21} =	0.9	steamed
ϕ =	0.8	
V* =	**36.0**	kNm/pole
ϕ Vn =	**237.5**	
Check ϕ Vn > V*	**OK**	

Moment Capacity

E =	12.1	GPa = E
f_b =	52	MPa
k_1 =	1	duration
k_{20} =	0.85	shaved
k_{21} =	0.85	steamed
ϕ =	0.8	
M* =	**75.8**	kNm/pole
ϕ Mn =	**188.8**	
Check ϕ Mn > M*	**OK**	

SED Size mm	Diameter (at max moment) mm	Diameter (at max shear) mm	As m2	I m^4	I/m m^4/m	Z m^3	ϕ Mn / pole kNm	ϕ Vn / pole kNm
100	100	100	0.006	4.909E-06	3.776E-06	9.817E-05	3.0	14.84
125	125	125	0.009	1.198E-05	9.219E-06	1.917E-04	5.8	23.19
150	150	150	0.013	2.485E-05	1.912E-05	3.313E-04	10.0	33.40
175	175	175	0.018	4.604E-05	3.541E-05	5.262E-04	15.8	45.46
200	200	200	0.024	7.854E-05	6.042E-05	7.854E-04	23.6	59.38
225	225	225	0.030	1.258E-04	9.677E-05	1.118E-03	33.6	75.15
250	250	250	0.037	1.917E-04	1.475E-04	1.534E-03	46.1	92.78
275	275	275	0.045	2.807E-04	2.160E-04	2.042E-03	61.4	112.26
300	300	300	0.053	3.976E-04	3.059E-04	2.651E-03	79.7	133.60
325	325	325	0.062	5.477E-04	4.213E-04	3.370E-03	101.3	156.79
350	350	350	0.072	7.366E-04	5.666E-04	4.209E-03	126.5	181.84
375	375	375	0.083	9.707E-04	7.467E-04	5.177E-03	155.6	208.74
400	400	400	0.094	1.257E-03	9.666E-04	6.283E-03	188.8	237.50

Timber Pole Capacity

Title	**1A Seaview Road, Paihia. Section A - Upper Wall Long term**	Job no	0213	Design by	RB
		Date	28/02/2022	Checked	

Chosen Size	300	mm
spacing	1	m
$M_{(Wallap)}$ =	39.1	kNm/m
$V_{(Wallap)}$ =	43.7	kN/m
Depth to max moment	3.82	m
Depth to max shear	4.07	m
Increase in dia./metre	6	mm
Load Factor	1.5	Seismic = 1 otherwise = 1.5

Bending and Shear only (no Axial)

Shear Capacity

f_s =	3.5	MPa
k_1 =	0.6	duration
k_{20} =	1	shaved
k_{21} =	0.9	steamed
ϕ =	0.8	
V* =	**65.6**	kNm/pole
ϕ Vn =	**93.7**	
Check ϕ Vn > V*	**OK**	

Moment Capacity

E =	12.1	GPa = E
f_b =	52	MPa
k_1 =	0.6	duration
k_{20} =	0.85	shaved
k_{21} =	0.85	steamed
ϕ =	0.8	
M* =	**58.7**	kNm/pole
ϕ Mn =	**59.6**	
Check ϕ Mn > M*	**OK**	

SED Size mm	Diameter (at max moment) mm	Diameter (at max shear) mm	As m2	I m^4	I/m m^4/m	Z m^3	ϕ Mn / pole kNm	ϕ Vn / pole kNm
100	123	124	0.009	1.121E-05	1.121E-05	1.823E-04	3.3	13.79
125	148	149	0.013	2.350E-05	2.350E-05	3.177E-04	5.7	19.88
150	173	174	0.018	4.389E-05	4.389E-05	5.076E-04	9.2	27.10
175	198	199	0.023	7.532E-05	7.532E-05	7.611E-04	13.7	35.42
200	223	224	0.030	1.212E-04	1.212E-04	1.088E-03	19.6	44.86
225	248	249	0.037	1.854E-04	1.854E-04	1.496E-03	27.0	55.41
250	273	274	0.044	2.723E-04	2.723E-04	1.996E-03	36.0	67.07
275	298	299	0.053	3.867E-04	3.867E-04	2.596E-03	46.8	79.85
300	323	324	0.062	5.338E-04	5.338E-04	3.306E-03	59.6	93.74
325	348	349	0.072	7.193E-04	7.193E-04	4.135E-03	74.6	108.74
350	373	374	0.083	9.494E-04	9.494E-04	5.092E-03	91.8	124.86
375	398	399	0.094	1.231E-03	1.231E-03	6.186E-03	111.6	142.09
400	423	424	0.106	1.570E-03	1.570E-03	7.426E-03	133.9	160.43

Timber Pole Capacity

Title	**1A Seaview Road, Paihia. Section A - Upper Wall Med term (overexcavation)**	Job no	0213	Design by	RB
		Date	28/02/2022	Checked	

Chosen Size	300	mm
spacing	1	m
$M_{(Wallap)}$ =	39.2	kNm/m
$V_{(Wallap)}$ =	63.7	kN/m
Depth to max moment	3.57	m
Depth to max shear	4.07	m
Increase in dia./metre	6	mm
Load Factor	1.5	Seismic = 1 otherwise = 1.5

Bending and Shear only (no Axial)

Shear Capacity

f_s =	3.5	MPa
k_1 =	0.8	duration
k_{20} =	1	shaved
k_{21} =	0.9	steamed
ϕ =	0.8	
V* =	**95.6**	kNm/pole
ϕ Vn =	**125.0**	
Check ϕ Vn > V*	**OK**	

Moment Capacity

E =	12.1	GPa = E
f_b =	52	MPa
k_1 =	0.8	duration
k_{20} =	0.85	shaved
k_{21} =	0.85	steamed
ϕ =	0.8	
M* =	**58.8**	kNm/pole
ϕ Mn =	**78.4**	
Check ϕ Mn > M*	**OK**	

SED Size mm	Diameter (at max moment) mm	Diameter (at max shear) mm	As m2	I m^4	I/m m^4/m	Z m^3	ϕ Mn / pole kNm	ϕ Vn / pole kNm
100	121	124	0.009	1.067E-05	1.067E-05	1.757E-04	4.2	18.38
125	146	149	0.013	2.256E-05	2.256E-05	3.082E-04	7.4	26.51
150	171	174	0.018	4.239E-05	4.239E-05	4.945E-04	11.9	36.13
175	196	199	0.023	7.307E-05	7.307E-05	7.440E-04	17.9	47.23
200	221	224	0.030	1.180E-04	1.180E-04	1.066E-03	25.6	59.81
225	246	249	0.037	1.810E-04	1.810E-04	1.469E-03	35.3	73.88
250	271	274	0.044	2.664E-04	2.664E-04	1.963E-03	47.2	89.43
275	296	299	0.053	3.790E-04	3.790E-04	2.557E-03	61.5	106.46
300	321	324	0.062	5.239E-04	5.239E-04	3.260E-03	78.4	124.98
325	346	349	0.072	7.069E-04	7.069E-04	4.081E-03	98.1	144.99
350	371	374	0.083	9.342E-04	9.342E-04	5.030E-03	121.0	166.48
375	396	399	0.094	1.212E-03	1.212E-03	6.116E-03	147.1	189.45
400	421	424	0.106	1.548E-03	1.548E-03	7.348E-03	176.7	213.91

Timber Pole Capacity

Title	**1A Seaview Road, Paihia. Section A - Upper Wall Seismic**	Job no	0213	Design by	RB
		Date	28/02/2022	Checked	

Chosen Size	300	mm
spacing	1	m
$M_{(Wallap)}$ =	41.9	kNm/m
$V_{(Wallap)}$ =	46.5	kN/m
Depth to max moment	3.57	m
Depth to max shear	4.07	m
Increase in dia./metre	6	mm
Load Factor	1	Seismic = 1 otherwise = 1.5

Bending and Shear only (no Axial)

Shear Capacity

f_s =	3.5	MPa
k_1 =	1	duration
k_{20} =	1	shaved
k_{21} =	0.9	steamed
ϕ =	0.8	
V* =	**46.5**	kNm/pole
ϕ Vn =	**156.2**	
Check ϕ Vn > V*	**OK**	

Moment Capacity

E =	12.1	GPa = E
f_b =	52	MPa
k_1 =	1	duration
k_{20} =	0.85	shaved
k_{21} =	0.85	steamed
ϕ =	0.8	
M* =	**41.9**	kNm/pole
ϕ Mn =	**98.0**	
Check ϕ Mn > M*	**OK**	

SED Size mm	Diameter (at max moment) mm	Diameter (at max shear) mm	As m2	I m^4	I/m m^4/m	Z m^3	ϕ Mn / pole kNm	ϕ Vn / pole kNm
100	121	124	0.009	1.067E-05	1.067E-05	1.757E-04	5.3	22.98
125	146	149	0.013	2.256E-05	2.256E-05	3.082E-04	9.3	33.14
150	171	174	0.018	4.239E-05	4.239E-05	4.945E-04	14.9	45.16
175	196	199	0.023	7.307E-05	7.307E-05	7.440E-04	22.4	59.03
200	221	224	0.030	1.180E-04	1.180E-04	1.066E-03	32.0	74.76
225	246	249	0.037	1.810E-04	1.810E-04	1.469E-03	44.2	92.35
250	271	274	0.044	2.664E-04	2.664E-04	1.963E-03	59.0	111.78
275	296	299	0.053	3.790E-04	3.790E-04	2.557E-03	76.9	133.08
300	321	324	0.062	5.239E-04	5.239E-04	3.260E-03	98.0	156.23
325	346	349	0.072	7.069E-04	7.069E-04	4.081E-03	122.7	181.24
350	371	374	0.083	9.342E-04	9.342E-04	5.030E-03	151.2	208.10
375	396	399	0.094	1.212E-03	1.212E-03	6.116E-03	183.8	236.82
400	421	424	0.106	1.548E-03	1.548E-03	7.348E-03	220.8	267.39

Timber Pole Capacity

Title	**1A Seaview Road, Paihia. Section B- Lower wall Long term**	Job no	0213	Design by	RB
		Date	9/03/2022	Checked	

Chosen Size	400	mm
spacing	1.3	m
$M_{(Wallap)}$ =	62.1	kNm/m
$V_{(Wallap)}$ =	33.1	kN/m
Depth to max moment	4.3	m
Depth to max shear	5.2	m
Increase in dia./metre	6	mm
Load Factor	1.5	Seismic = 1 otherwise = 1.5
deflection	27	mm

Bending and Shear only (no Axial)

Shear Capacity

f_s =	3.5	MPa
k_1 =	0.6	duration
k_{20} =	1	shaved
k_{21} =	0.9	steamed
ϕ =	0.8	
V* =	**64.5**	kNm/pole
ϕ Vn =	**165.6**	
Check ϕ Vn > V*	**OK**	

Moment Capacity

E =	12.1	GPa = E
f_b =	52	MPa
k_1 =	0.6	duration
k_{20} =	0.85	shaved
k_{21} =	0.85	steamed
ϕ =	0.8	
M* =	**121.1**	kNm/pole
ϕ Mn =	**136.7**	
Check ϕ Mn > M*	**OK**	

SED Size mm	Diameter (at max moment) mm	Diameter (at max shear) mm	As m2	I m^4	I/m m^4/m	Z m^3	ϕ Mn / pole kNm	ϕ Vn / pole kNm
100	126	131	0.010	1.229E-05	9.457E-06	1.955E-04	3.5	15.33
125	151	156	0.014	2.538E-05	1.953E-05	3.367E-04	6.1	21.73
150	176	181	0.019	4.689E-05	3.607E-05	5.334E-04	9.6	29.24
175	201	206	0.025	7.980E-05	6.139E-05	7.949E-04	14.3	37.87
200	226	231	0.031	1.276E-04	9.816E-05	1.130E-03	20.4	47.61
225	251	256	0.039	1.942E-04	1.494E-04	1.549E-03	27.9	58.46
250	276	281	0.047	2.840E-04	2.185E-04	2.060E-03	37.1	70.43
275	301	306	0.055	4.019E-04	3.091E-04	2.672E-03	48.2	83.51
300	326	331	0.065	5.531E-04	4.254E-04	3.395E-03	61.2	97.70
325	351	356	0.075	7.434E-04	5.718E-04	4.238E-03	76.4	113.00
350	376	381	0.086	9.790E-04	7.531E-04	5.210E-03	94.0	129.42
375	401	406	0.097	1.267E-03	9.744E-04	6.321E-03	114.0	146.95
400	426	431	0.110	1.614E-03	1.241E-03	7.579E-03	136.7	165.60

Timber Pole Capacity

Title	**1A Seaview Road, Paihia. Section B- Lower wall Med term**	Job no	0213	Design by	RB
		Date	9/03/2022	Checked	

Chosen Size	400	mm
spacing	1.3	m
$M_{(Wallap)}$ =	47.9	kNm/m
$V_{(Wallap)}$ =	34	kN/m
Depth to max moment	3.8	m
Depth to max shear	4.75	m
Increase in dia./metre	0	mm
Load Factor	1.5	Seismic = 1 otherwise = 1.5
deflection	45	mm

Bending and Shear only (no Axial)

Shear Capacity

f_s =	3.5	MPa
k_1 =	0.8	duration
k_{20} =	1	shaved
k_{21} =	0.9	steamed
ϕ =	0.8	
V* =	**66.3**	kNm/pole
ϕ Vn =	**190.0**	
Check ϕ Vn > V*	**OK**	

Moment Capacity

E =	12.1	GPa = E
f_b =	52	MPa
k_1 =	0.8	duration
k_{20} =	0.85	shaved
k_{21} =	0.85	steamed
ϕ =	0.8	
M* =	**93.4**	kNm/pole
ϕ Mn =	**151.1**	
Check ϕ Mn > M*	**OK**	

SED Size mm	Diameter (at max moment) mm	Diameter (at max shear) mm	As m2	I m^4	I/m m^4/m	Z m^3	ϕ Mn / pole kNm	ϕ Vn / pole kNm
100	100	100	0.006	4.909E-06	3.776E-06	9.817E-05	2.4	11.88
125	125	125	0.009	1.198E-05	9.219E-06	1.917E-04	4.6	18.56
150	150	150	0.013	2.485E-05	1.912E-05	3.313E-04	8.0	26.72
175	175	175	0.018	4.604E-05	3.541E-05	5.262E-04	12.7	36.37
200	200	200	0.024	7.854E-05	6.042E-05	7.854E-04	18.9	47.50
225	225	225	0.030	1.258E-04	9.677E-05	1.118E-03	26.9	60.12
250	250	250	0.037	1.917E-04	1.475E-04	1.534E-03	36.9	74.22
275	275	275	0.045	2.807E-04	2.160E-04	2.042E-03	49.1	89.81
300	300	300	0.053	3.976E-04	3.059E-04	2.651E-03	63.7	106.88
325	325	325	0.062	5.477E-04	4.213E-04	3.370E-03	81.0	125.43
350	350	350	0.072	7.366E-04	5.666E-04	4.209E-03	101.2	145.47
375	375	375	0.083	9.707E-04	7.467E-04	5.177E-03	124.5	167.00
400	400	400	0.094	1.257E-03	9.666E-04	6.283E-03	151.1	190.00

Timber Pole Capacity

Title	**1A Seaview Road, Paihia. Section B- Lower wall Short term**	Job no	0213	Design by	RB
		Date	9/03/2022	Checked	

Chosen Size	400	mm
spacing	1.3	m
$M_{(Wallap)}$ =	69.5	kNm/m
$V_{(Wallap)}$ =	48.4	kN/m
Depth to max moment	3.8	m
Depth to max shear	4.75	m
Increase in dia./metre	0	mm
Load Factor	1.5	Seismic = 1 otherwise = 1.5
deflection	44	mm

Bending and Shear only (no Axial)

Shear Capacity

f_s =	3.5	MPa
k_1 =	1	duration
k_{20} =	1	shaved
k_{21} =	0.9	steamed
ϕ =	0.8	
V* =	**94.4**	kNm/pole
ϕ Vn =	**237.5**	
Check ϕ Vn > V*	**OK**	

Moment Capacity

E =	12.1	GPa = E
f_b =	52	MPa
k_1 =	1	duration
k_{20} =	0.85	shaved
k_{21} =	0.85	steamed
ϕ =	0.8	
M* =	**135.5**	kNm/pole
ϕ Mn =	**188.8**	
Check ϕ Mn > M*	**OK**	

SED Size mm	Diameter (at max moment) mm	Diameter (at max shear) mm	As m2	I m^4	I/m m^4/m	Z m^3	ϕ Mn / pole kNm	ϕ Vn / pole kNm
100	100	100	0.006	4.909E-06	3.776E-06	9.817E-05	3.0	14.84
125	125	125	0.009	1.198E-05	9.219E-06	1.917E-04	5.8	23.19
150	150	150	0.013	2.485E-05	1.912E-05	3.313E-04	10.0	33.40
175	175	175	0.018	4.604E-05	3.541E-05	5.262E-04	15.8	45.46
200	200	200	0.024	7.854E-05	6.042E-05	7.854E-04	23.6	59.38
225	225	225	0.030	1.258E-04	9.677E-05	1.118E-03	33.6	75.15
250	250	250	0.037	1.917E-04	1.475E-04	1.534E-03	46.1	92.78
275	275	275	0.045	2.807E-04	2.160E-04	2.042E-03	61.4	112.26
300	300	300	0.053	3.976E-04	3.059E-04	2.651E-03	79.7	133.60
325	325	325	0.062	5.477E-04	4.213E-04	3.370E-03	101.3	156.79
350	350	350	0.072	7.366E-04	5.666E-04	4.209E-03	126.5	181.84
375	375	375	0.083	9.707E-04	7.467E-04	5.177E-03	155.6	208.74
400	400	400	0.094	1.257E-03	9.666E-04	6.283E-03	188.8	237.50

Timber Pole Capacity

Title	**1A Seaview Road, Paihia. Section B- Lower wall Seismic**	Job no	0213	Design by	RB
		Date	9/03/2022	Checked	

Chosen Size	400	mm
spacing	1.2	m
$M_{(Wallap)}$ =	62.9	kNm/m
$V_{(Wallap)}$ =	33.1	kN/m
Depth to max moment	4.3	m
Depth to max shear	5.2	m
Increase in dia./metre	0	mm
Load Factor	1	Seismic = 1 otherwise = 1.5
deflection	28	mm

Bending and Shear only (no Axial)

Shear Capacity

f_s =	3.5	MPa
k_1 =	1	duration
k_{20} =	1	shaved
k_{21} =	0.9	steamed
ϕ =	0.8	
V* =	**39.7**	kNm/pole
ϕ Vn =	**237.5**	
Check ϕ Vn > V*	**OK**	

Moment Capacity

E =	12.1	GPa = E
f_b =	52	MPa
k_1 =	1	duration
k_{20} =	0.85	shaved
k_{21} =	0.85	steamed
ϕ =	0.8	
M* =	**75.5**	kNm/pole
ϕ Mn =	**188.8**	
Check ϕ Mn > M*	**OK**	

SED Size mm	Diameter (at max moment) mm	Diameter (at max shear) mm	As m2	I m^4	I/m m^4/m	Z m^3	ϕ Mn / pole kNm	ϕ Vn / pole kNm
100	100	100	0.006	4.909E-06	4.091E-06	9.817E-05	3.0	14.84
125	125	125	0.009	1.198E-05	9.987E-06	1.917E-04	5.8	23.19
150	150	150	0.013	2.485E-05	2.071E-05	3.313E-04	10.0	33.40
175	175	175	0.018	4.604E-05	3.837E-05	5.262E-04	15.8	45.46
200	200	200	0.024	7.854E-05	6.545E-05	7.854E-04	23.6	59.38
225	225	225	0.030	1.258E-04	1.048E-04	1.118E-03	33.6	75.15
250	250	250	0.037	1.917E-04	1.598E-04	1.534E-03	46.1	92.78
275	275	275	0.045	2.807E-04	2.339E-04	2.042E-03	61.4	112.26
300	300	300	0.053	3.976E-04	3.313E-04	2.651E-03	79.7	133.60
325	325	325	0.062	5.477E-04	4.564E-04	3.370E-03	101.3	156.79
350	350	350	0.072	7.366E-04	6.138E-04	4.209E-03	126.5	181.84
375	375	375	0.083	9.707E-04	8.089E-04	5.177E-03	155.6	208.74
400	400	400	0.094	1.257E-03	1.047E-03	6.283E-03	188.8	237.50

Timber Pole Capacity

Title	**1A Seaview Road, Paihia. Section B - Upper wall long term**	Job no	0213
		Date	4/03/2022
		Design by	RB
		Checked	

Chosen Size	300	mm
spacing	1	m
$M_{(Wallap)}$ =	2.9	kNm/m
$V_{(Wallap)}$ =	4.8	kN/m
Depth to max moment	2.6	m
Depth to max shear	1.6	m
Increase in dia./metre	0	mm
Load Factor	1.5	Seismic = 1 otherwise = 1.5

Bending and Shear only (no Axial)

Shear Capacity

f_s =	3.5	MPa
k_1 =	0.6	duration
k_{20} =	1	shaved
k_{21} =	0.9	steamed
ϕ =	0.8	
V* =	**7.2**	kNm/pole
ϕ Vn =	**80.2**	
Check ϕ Vn > V*	**OK**	

Moment Capacity

E =	12.1	GPa = E
f_b =	52	MPa
k_1 =	0.6	duration
k_{20} =	0.85	shaved
k_{21} =	0.85	steamed
ϕ =	0.8	
M* =	**4.4**	kNm/pole
ϕ Mn =	**47.8**	
Check ϕ Mn > M*	**OK**	

SED Size mm	Diameter (at max moment) mm	Diameter (at max shear) mm	As m2	I m^4	I/m m^4/m	Z m^3	ϕ Mn / pole kNm	ϕ Vn / pole kNm
100	100	100	0.006	4.909E-06	4.909E-06	9.817E-05	1.8	8.91
125	125	125	0.009	1.198E-05	1.198E-05	1.917E-04	3.5	13.92
150	150	150	0.013	2.485E-05	2.485E-05	3.313E-04	6.0	20.04
175	175	175	0.018	4.604E-05	4.604E-05	5.262E-04	9.5	27.28
200	200	200	0.024	7.854E-05	7.854E-05	7.854E-04	14.2	35.63
225	225	225	0.030	1.258E-04	1.258E-04	1.118E-03	20.2	45.09
250	250	250	0.037	1.917E-04	1.917E-04	1.534E-03	27.7	55.67
275	275	275	0.045	2.807E-04	2.807E-04	2.042E-03	36.8	67.35
300	300	300	0.053	3.976E-04	3.976E-04	2.651E-03	47.8	80.16
325	325	325	0.062	5.477E-04	5.477E-04	3.370E-03	60.8	94.07
350	350	350	0.072	7.366E-04	7.366E-04	4.209E-03	75.9	109.10
375	375	375	0.083	9.707E-04	9.707E-04	5.177E-03	93.4	125.25
400	400	400	0.094	1.257E-03	1.257E-03	6.283E-03	113.3	142.50

Timber Pole Capacity

Title	**1A Seaview Road, Paihia. Section B - Upper wall seismic**	Job no	0213	Design by	RB
		Date	4/03/2022	Checked	

Chosen Size	300	mm
spacing	1	m
$M_{(Wallap)}$ =	3.8	kNm/m
$V_{(Wallap)}$ =	6.3	kN/m
Depth to max moment	2.6	m
Depth to max shear	1.6	m
Increase in dia./metre	0	mm
Load Factor	1	Seismic = 1 otherwise = 1.5

Bending and Shear only (no Axial)

Shear Capacity

f_s =	3.5	MPa
k_1 =	1	duration
k_{20} =	1	shaved
k_{21} =	0.9	steamed
ϕ =	0.8	
V* =	**6.3**	kNm/pole
ϕ Vn =	**133.6**	
Check ϕ Vn > V*	**OK**	

Moment Capacity

E =	12.1	GPa = E
f_b =	52	MPa
k_1 =	1	duration
k_{20} =	0.85	shaved
k_{21} =	0.85	steamed
ϕ =	0.8	
M* =	**3.8**	kNm/pole
ϕ Mn =	**79.7**	
Check ϕ Mn > M*	**OK**	

SED Size mm	Diameter (at max moment) mm	Diameter (at max shear) mm	As m2	I m^4	I/m m^4/m	Z m^3	ϕ Mn / pole kNm	ϕ Vn / pole kNm
100	100	100	0.006	4.909E-06	4.909E-06	9.817E-05	3.0	14.84
125	125	125	0.009	1.198E-05	1.198E-05	1.917E-04	5.8	23.19
150	150	150	0.013	2.485E-05	2.485E-05	3.313E-04	10.0	33.40
175	175	175	0.018	4.604E-05	4.604E-05	5.262E-04	15.8	45.46
200	200	200	0.024	7.854E-05	7.854E-05	7.854E-04	23.6	59.38
225	225	225	0.030	1.258E-04	1.258E-04	1.118E-03	33.6	75.15
250	250	250	0.037	1.917E-04	1.917E-04	1.534E-03	46.1	92.78
275	275	275	0.045	2.807E-04	2.807E-04	2.042E-03	61.4	112.26
300	300	300	0.053	3.976E-04	3.976E-04	2.651E-03	79.7	133.60
325	325	325	0.062	5.477E-04	5.477E-04	3.370E-03	101.3	156.79
350	350	350	0.072	7.366E-04	7.366E-04	4.209E-03	126.5	181.84
375	375	375	0.083	9.707E-04	9.707E-04	5.177E-03	155.6	208.74
400	400	400	0.094	1.257E-03	1.257E-03	6.283E-03	188.8	237.50

Timber Pole Capacity

Title	**1A Seaview Road, Paihia. Section C- Lower wall Long term**	Job no	0213	Design by	RB
		Date	9/03/2022	Checked	

Chosen Size	400	mm
spacing	1.2	m
$M_{(Wallap)}$ =	67.7	kNm/m
$V_{(Wallap)}$ =	48.7	kN/m
Depth to max moment	5.22	m
Depth to max shear	6.4	m
Increase in dia./metre	6	mm
Load Factor	1.5	Seismic = 1 otherwise = 1.5
deflection	42	mm

Bending and Shear only (no Axial)

Shear Capacity

f_s =	3.5	MPa
k_1 =	0.6	duration
k_{20} =	1	shaved
k_{21} =	0.9	steamed
ϕ =	0.8	
V* =	**87.7**	kNm/pole
ϕ Vn =	**171.2**	
Check ϕ Vn > V*	**OK**	

Moment Capacity

E =	12.1	GPa = E
f_b =	52	MPa
k_1 =	0.6	duration
k_{20} =	0.85	shaved
k_{21} =	0.85	steamed
ϕ =	0.8	
M* =	**121.9**	kNm/pole
ϕ Mn =	**142.1**	
Check ϕ Mn > M*	**OK**	

SED Size mm	Diameter (at max moment) mm	Diameter (at max shear) mm	As m2	I m^4	I/m m^4/m	Z m^3	ϕ Mn / pole kNm	ϕ Vn / pole kNm
100	131	138	0.011	1.460E-05	1.217E-05	2.223E-04	4.0	17.06
125	156	163	0.016	2.931E-05	2.443E-05	3.750E-04	6.8	23.78
150	181	188	0.021	5.306E-05	4.422E-05	5.852E-04	10.6	31.61
175	206	213	0.027	8.895E-05	7.412E-05	8.622E-04	15.5	40.56
200	231	238	0.033	1.405E-04	1.171E-04	1.215E-03	21.9	50.62
225	256	263	0.041	2.119E-04	1.766E-04	1.653E-03	29.8	61.79
250	281	288	0.049	3.074E-04	2.562E-04	2.186E-03	39.4	74.08
275	306	313	0.058	4.322E-04	3.602E-04	2.822E-03	50.9	87.48
300	331	338	0.067	5.915E-04	4.929E-04	3.571E-03	64.4	101.99
325	356	363	0.078	7.913E-04	6.594E-04	4.441E-03	80.1	117.62
350	381	388	0.089	1.038E-03	8.649E-04	5.443E-03	98.2	134.36
375	406	413	0.101	1.338E-03	1.115E-03	6.586E-03	118.8	152.21
400	431	438	0.113	1.699E-03	1.416E-03	7.878E-03	142.1	171.18

Timber Pole Capacity

Title	**1A Seaview Road, Paihia. Section C- Lower wall Medium Term**	Job no	0213	Design by	RB
		Date	9/03/2022	Checked	

Chosen Size	400	mm
spacing	1.2	m
$M_{(Wallap)}$ =	52.8	kNm/m
$V_{(Wallap)}$ =	24.4	kN/m
Depth to max moment	5.65	m
Depth to max shear	6.72	m
Increase in dia./metre	0	mm
Load Factor	1.5	Seismic = 1 otherwise = 1.5
deflection	0	mm

Bending and Shear only (no Axial)

Shear Capacity

f_s =	3.5	MPa
k_1 =	0.8	duration
k_{20} =	1	shaved
k_{21} =	0.9	steamed
ϕ =	0.8	
V* =	**43.9**	kNm/pole
ϕ Vn =	**190.0**	
Check ϕ Vn > V*	**OK**	

Moment Capacity

E =	12.1	GPa = E
f_b =	52	MPa
k_1 =	0.8	duration
k_{20} =	0.85	shaved
k_{21} =	0.85	steamed
ϕ =	0.8	
M* =	**95.0**	kNm/pole
ϕ Mn =	**151.1**	
Check ϕ Mn > M*	**OK**	

SED Size mm	Diameter (at max moment) mm	Diameter (at max shear) mm	As m2	I m^4	I/m m^4/m	Z m^3	ϕ Mn / pole kNm	ϕ Vn / pole kNm
100	100	100	0.006	4.909E-06	4.091E-06	9.817E-05	2.4	11.88
125	125	125	0.009	1.198E-05	9.987E-06	1.917E-04	4.6	18.56
150	150	150	0.013	2.485E-05	2.071E-05	3.313E-04	8.0	26.72
175	175	175	0.018	4.604E-05	3.837E-05	5.262E-04	12.7	36.37
200	200	200	0.024	7.854E-05	6.545E-05	7.854E-04	18.9	47.50
225	225	225	0.030	1.258E-04	1.048E-04	1.118E-03	26.9	60.12
250	250	250	0.037	1.917E-04	1.598E-04	1.534E-03	36.9	74.22
275	275	275	0.045	2.807E-04	2.339E-04	2.042E-03	49.1	89.81
300	300	300	0.053	3.976E-04	3.313E-04	2.651E-03	63.7	106.88
325	325	325	0.062	5.477E-04	4.564E-04	3.370E-03	81.0	125.43
350	350	350	0.072	7.366E-04	6.138E-04	4.209E-03	101.2	145.47
375	375	375	0.083	9.707E-04	8.089E-04	5.177E-03	124.5	167.00
400	400	400	0.094	1.257E-03	1.047E-03	6.283E-03	151.1	190.00

Timber Pole Capacity

Title	**1A Seaview Road, Paihia. Section C- Lower wall Short term**	Job no	0213	Design by	RB
		Date	9/03/2022	Checked	

Chosen Size	400	mm
spacing	1.2	m
$M_{(Wallap)}$ =	53.1	kNm/m
$V_{(Wallap)}$ =	24.4	kN/m
Depth to max moment	4.72	m
Depth to max shear	6.4	m
Increase in dia./metre	0	mm
Load Factor	1.5	Seismic = 1 otherwise = 1.5
deflection	74	mm

Bending and Shear only (no Axial)

Shear Capacity

f_s =	3.5	MPa
k_1 =	1	duration
k_{20} =	1	shaved
k_{21} =	0.9	steamed
ϕ =	0.8	
V* =	**43.9**	kNm/pole
ϕ Vn =	**237.5**	
Check ϕ Vn > V*	**OK**	

Moment Capacity

E =	12.1	GPa = E
f_b =	52	MPa
k_1 =	1	duration
k_{20} =	0.85	shaved
k_{21} =	0.85	steamed
ϕ =	0.8	
M* =	**95.6**	kNm/pole
ϕ Mn =	**188.8**	
Check ϕ Mn > M*	**OK**	

SED Size mm	Diameter (at max moment) mm	Diameter (at max shear) mm	As m2	I m^4	I/m m^4/m	Z m^3	ϕ Mn / pole kNm	ϕ Vn / pole kNm
100	100	100	0.006	4.909E-06	4.091E-06	9.817E-05	3.0	14.84
125	125	125	0.009	1.198E-05	9.987E-06	1.917E-04	5.8	23.19
150	150	150	0.013	2.485E-05	2.071E-05	3.313E-04	10.0	33.40
175	175	175	0.018	4.604E-05	3.837E-05	5.262E-04	15.8	45.46
200	200	200	0.024	7.854E-05	6.545E-05	7.854E-04	23.6	59.38
225	225	225	0.030	1.258E-04	1.048E-04	1.118E-03	33.6	75.15
250	250	250	0.037	1.917E-04	1.598E-04	1.534E-03	46.1	92.78
275	275	275	0.045	2.807E-04	2.339E-04	2.042E-03	61.4	112.26
300	300	300	0.053	3.976E-04	3.313E-04	2.651E-03	79.7	133.60
325	325	325	0.062	5.477E-04	4.564E-04	3.370E-03	101.3	156.79
350	350	350	0.072	7.366E-04	6.138E-04	4.209E-03	126.5	181.84
375	375	375	0.083	9.707E-04	8.089E-04	5.177E-03	155.6	208.74
400	400	400	0.094	1.257E-03	1.047E-03	6.283E-03	188.8	237.50

Timber Pole Capacity

Title	**1A Seaview Road, Paihia. Section C- Lower wall Seismic**	Job no	0213	Design by	RB
		Date	9/03/2022	Checked	

Chosen Size	400	mm
spacing	1.2	m
$M_{(Wallap)}$ =	81.5	kNm/m
$V_{(Wallap)}$ =	58.2	kN/m
Depth to max moment	5.65	m
Depth to max shear	6.72	m
Increase in dia./metre	0	mm
Load Factor	1	Seismic = 1 otherwise = 1.5
deflection	25	mm

Bending and Shear only (no Axial)

Shear Capacity

f_s =	3.5	MPa
k_1 =	1	duration
k_{20} =	1	shaved
k_{21} =	0.9	steamed
ϕ =	0.8	
V* =	**69.8**	kNm/pole
ϕ Vn =	**237.5**	
Check ϕ Vn > V*	**OK**	

Moment Capacity

E =	12.1	GPa = E
f_b =	52	MPa
k_1 =	1	duration
k_{20} =	0.85	shaved
k_{21} =	0.85	steamed
ϕ =	0.8	
M* =	**97.8**	kNm/pole
ϕ Mn =	**188.8**	
Check ϕ Mn > M*	**OK**	

SED Size mm	Diameter (at max moment) mm	Diameter (at max shear) mm	As m2	I m^4	I/m m^4/m	Z m^3	ϕ Mn / pole kNm	ϕ Vn / pole kNm
100	100	100	0.006	4.909E-06	4.091E-06	9.817E-05	3.0	14.84
125	125	125	0.009	1.198E-05	9.987E-06	1.917E-04	5.8	23.19
150	150	150	0.013	2.485E-05	2.071E-05	3.313E-04	10.0	33.40
175	175	175	0.018	4.604E-05	3.837E-05	5.262E-04	15.8	45.46
200	200	200	0.024	7.854E-05	6.545E-05	7.854E-04	23.6	59.38
225	225	225	0.030	1.258E-04	1.048E-04	1.118E-03	33.6	75.15
250	250	250	0.037	1.917E-04	1.598E-04	1.534E-03	46.1	92.78
275	275	275	0.045	2.807E-04	2.339E-04	2.042E-03	61.4	112.26
300	300	300	0.053	3.976E-04	3.313E-04	2.651E-03	79.7	133.60
325	325	325	0.062	5.477E-04	4.564E-04	3.370E-03	101.3	156.79
350	350	350	0.072	7.366E-04	6.138E-04	4.209E-03	126.5	181.84
375	375	375	0.083	9.707E-04	8.089E-04	5.177E-03	155.6	208.74
400	400	400	0.094	1.257E-03	1.047E-03	6.283E-03	188.8	237.50

Appendix E: Producer Statement

- PS1 – Design
- Certificate of Design Work
- Construction Monitoring Schedule
- Durability Statement

PRODUCER STATEMENT – PS1
DESIGN

BUILDING CODE CLAUSE(S): B1 **JOB NUMBER:** 0213
ISSUED BY: Northland Geotechnical Specialists Ltd
(Engineering Design Firm)
TO: Mrs Jane Banfield
(Owner/Developer)
TO BE SUPPLIED TO: Far North District Council
(Building Consent Authority)
IN RESPECT OF: Terraced retaining wall construction
(Description of Building Work)
AT: 1A Seaview Road, Paihia
(Address, Town/City)
LEGAL DESCRIPTION: Lot 2, DP 124280 **N/A** ☐

We have been engaged by the owner/developer referred to above to provide *(Extent of Engagement)*:
Design of a system of two terraced retaining walls for landslide remediation
in respect of the requirements of the Clause(s) of the Building Code specified above for Part only , as specified in the Schedule, of the proposed building work.

The design carried out by us has been prepared in accordance with:

- ☐ Compliance documents issued by the Ministry of Business, Innovation & Employment *(Verification method/acceptable solution)* and/or;
- ☑ Alternative solution as per the attached Schedule.

The proposed building work covered by this producer statement is described on the drawings specified in the Schedule, together with the specification, and other documents set out in the Schedule.

On behalf of the Engineering Design Firm, and subject to:

- Site verification of the following design assumptions: Ground conditions .
- All proprietary products meeting their performance specification requirements;

I believe on reasonable grounds that:

- the building, if constructed in accordance with the drawings, specifications, and other documents provided or listed in the Schedule, will comply with the relevant provisions of the Building Code and that;
- the persons who have undertaken the design have the necessary competency to do so.

I recommend the CM 3 level of **construction monitoring**.

I *(Name of Engineering Design Professional)* David Buxton , am:

- ☑ CPEng number 1010928

and hold the following qualifications BE Civil (Hons)

The Engineering Design Firm holds a current policy of Professional Indemnity Insurance no less than $200,000
The Engineering Design Firm Choose one a member of ACE New Zealand.

SIGNED BY *(Name of Engineering Design Professional)*: David Buxton
(Signature below):

DS Buxton

ON BEHALF OF *(Engineering Design Firm)*: Northland Geotechnical Specialists Ltd Date: 9/03/2022

Note: This statement has been prepared solely for the Building Consent Authority named above and shall not be relied upon by any other person or entity. Any liability in relation to this statement accrues to the Engineering Design Firm only. As a condition of reliance on this statement, the Building Consent Authority accepts that the total maximum amount of liability of any kind arising from this statement and all other statements provided to the Building Consent Authority in relation to this building work, whether in tort or otherwise, is limited to the sum of $200,000.

This form is to accompany **Form 2 of the Building (Forms) Regulations 2004** for the application of a Building Consent.

SCHEDULE to PS1

Please include an itemised list of all referenced documents, drawings, or other supporting materials in relation to this producer statement below:

NGS Report for Jane Banfield, "Geotechnical Design report for Landslip Mitigation", NGS Ref 0213, dated March 2022

NGS Figures 1 - 6, SA, SB & SC.

SCS Drawings, SK-SE-000 to -003, dated March 2022

GUIDANCE ON USE OF PRODUCER STATEMENTS

Information on the use of Producer Statements and Construction Monitoring Guidelines can be found on the Engineering New Zealand website
https://www.engineeringnz.org/engineer-tools/engineering-documents/producer-statements/

Producer statements were first introduced with the Building Act 1991. The producer statements were developed by a combined task committee consisting of members of the New Zealand Institute of Architects (NZIA), Institution of Professional Engineers New Zealand (now Engineering New Zealand), Association of Consulting and Engineering New Zealand (ACE NZ) in consultation with the Building Officials Institute of New Zealand (BOINZ). The original suite of producer statements has been revised at the date of this form to ensure standard use within the industry.

The producer statement system is intended to provide Building Consent Authorities (BCAs) with part of the reasonable grounds necessary for the issue of a Building Consent or a Code Compliance Certificate, without necessarily having to duplicate review of design or construction monitoring undertaken by others.

PS1 DESIGN Intended for use by a suitably qualified independent engineering design professional in circumstances where the BCA accepts a producer statement for establishing reasonable grounds to issue a Building Consent;

PS2 DESIGN REVIEW Intended for use by a suitably qualified independent engineering design review professional where the BCA accepts an independent design professional's review as the basis for establishing reasonable grounds to issue a Building Consent;

PS3 CONSTRUCTION Forms commonly used as a certificate of completion of building work are Schedule 6 of NZS 3910:2013 or Schedules E1/E2 of NZIA's SCC 2011[2]

PS4 CONSTRUCTION REVIEW Intended for use by a suitably qualified independent engineering construction monitoring professional who either undertakes or supervises construction monitoring of the building works where the BCA requests a producer statement prior to issuing a Code Compliance Certificate.

This must be accompanied by a statement of completion of building work (Schedule 6).

The following guidelines are provided by ACE New Zealand and Engineering New Zealand to interpret the Producer Statement.

Competence of Engineering Professional
This statement is made by an engineering firm that has undertaken a contract of services for the services named, and is signed by a person authorised by that firm to verify the processes within the firm and competence of its personnel.

The person signing the Producer Statement on behalf of the engineering firm will have a professional qualification and proven current competence through registration on a national competence-based register such as a Chartered Professional Engineer (CPEng).

Membership of a professional body, such as Engineering New Zealand provides additional assurance of the designer's standing within the profession. If the engineering firm is a member of ACE New Zealand, this provides additional assurance about the standing of the firm.

Persons or firms meeting these criteria satisfy the term "suitably qualified independent engineering professional".

Professional Indemnity Insurance
As part of membership requirements, ACE New Zealand requires all member firms to hold Professional Indemnity Insurance to a minimum level.

The PI Insurance minimum stated on the front of this form reflects standard practice for the relationship between the BCA and the engineering firm.

Professional Services during Construction Phase
There are several levels of service that an engineering firm may provide during the construction phase of a project (CM1-CM5 for engineers[3]). The building Consent Authority is encouraged to require that the service to be provided by the engineering firm is appropriate for the project concerned.

Requirement to provide Producer Statement PS4
Building Consent Authorities should ensure that the applicant is aware of any requirement for producer statements for the construction phase of building work at the time the building consent is issued as no design professional should be expected to provide a producer statement unless such a requirement forms part of the Design Firm's engagement.

Refer Also:

1 Conditions of Contract for Building & Civil Engineering Construction NZS 3910: 2013
2 NZIA Standard Conditions of Contract SCC 2011
3 Guideline on the Briefing & Engagement for Consulting Engineering Services (ACE New Zealand/Engineering New Zealand 2004)
4 PN01 Guidelines on Producer Statements

www.acenz.org.nz
www.engineeringnz.org

engineering new zealand

CERTIFICATE OF DESIGN WORK
MEMORANDUM FROM LICENSED BUILDING PRACTITIONER

Section 30C and Section 45, Building Act 2004

The Building

Street address	1A Seaview Road		
Suburb	Paihia	**Town/city**	Bay of Islands
Postcode	0200	**Building consent no.**	

The Owner

Name(s)	Jane Banfield		
Email	accommodationatthebeach@gmail.com	**Phone**	0220183366
Address	1A Seaview Road, Paihia		

Basis for providing this memorandum

I am providing this memorandum in my role as the **specialist** designer who carried out or supervised specific Primary structure elements of restricted building work (RBW) design work as described in this memorandum. Other designers will provide memoranda covering the remaining RBW design work. Refer also to the attached PS1.

Identification of restricted building work (RBW) design work

I, David Buxton carried out or supervised the following RBW design work:

Primary structure: B1

Design work that is RBW	Description (as required) and reference to plans and specifications	Carried out or supervised
Foundations and subfloor framing ✕		
Retaining walls ✕	2No. timber pole retaining walls as per NGS plans and report Ref 0213, Figures 1 - 6, SA, SB & SC	Supervised
Beams ✕		
Portal ✕		
Bracing ✕		
Other (primary) ✕		

Note: SED = Elements subject to Specific Engineering Design outside of the scope of NZS3604:2011, unless otherwise noted.

DS Button

Initial _____ **Date** 9/03/2022

Waivers and modifications

Are waivers or modifications of the Building Code required?

If yes, please provide details of the waivers or modifications:

Building Code clause	Waiver/modification required

Issued by

Name	David Buxton	**Design entity/company**	Northland Geotechnical Specialists
Chartered status	CPEng	**Chartered no.**	1010928
Email	david@northlandgeotech.co.nz	**Website**	www.northlandgeotech.co.nz
Phone (daytime)	0226981129	**Phone (after hours)**	0226981129
Mobile			
Postal address	558 Crane Road, RD1 Kamo, Whangarei 0185		
Physical address	558 Crane Road, Kauri, Whangarei		

Declaration

I, David Buxton, LBP state that I have applied the skills and care reasonably required of a competent design professional in carrying out or supervising the RBW described in this memorandum and that based on this, I certify that the RBW described in this memorandum:

- complies with the Building Code; or
- complies with the Building Code subject to any waiver or modification of the Building Code described in this memorandum.

Signature  **Date** 09/03/2022

engineering new zealand

CONSTRUCTION MONITORING SCHEDULE
RESIDENTIAL

Schedule of inspections for

Address 1A Seaview Road, Paihia

We confirm that NGS have been engaged to undertake construction monitoring of the specific engineering design items to an Engineering New Zealand/ACENZ CM level and propose to undertake at least the following site inspections:

No.	Item of inspection	Timeframe
	(Delete any that do not apply)	
1	Timber poles	Pre-pour
2	Ground conditions of excavated pile holes	Pre-pour
3	Pre start meeting to confirm methodolody	Pre-start
4	Daily monitoring of floor level using zip level	Daily until directed otherwise by Engineer

Notes:

a) The above items of inspection are the minimum required to enable NGS to issue a PS4 – Producer Statement Construction Review for the specific engineering design items.

b) The above items of inspection do not cover work constructed in accordance with NZS 3604:2011, for which inspections are to be undertaken by the Building Consent Authority.

c) The Contractor/Builder is to provide NGS at least 24 hours' notice of the requirement for an inspection. The above timeframes are indicative, the Engineer and Contractor are to agree the timing of inspection prior to work commencing on site.

d) A copy of this inspection schedule is to be held on site during the works, and the Contractor/Builder is to provide reasonable and safe access to enable works to be inspected according to the schedule.

e) The above schedule does not necessarily represent the actual number of inspections to be undertaken. The number of inspections will depend on the construction method, sequence of the works and whether or not unforeseen conditions or difficulties are encountered on site.

Northland Geotechnical Specialists

Project Ref: 0213
4 March 2022

To the Building Official
Far North District Council
New retaining walls to remediate landslide at 1A Seaview Road, Paihia

Compliance with Building Code Clause B2 – Durability

The purpose of this letter is to demonstrate how compliance with Clause B2 (Durability) of the Building Code will be achieved for the above project. We can confirm that for specifically designed structural elements that are included within our design documentation:

Material	Means of compliance	Details
Structural Timber	B2/AS1	Timber treatment has been selected in accordance with 1A of B2/AS1

Yours faithfully,
David Buxton, Geotechnical Engineer, CPEng

For and on behalf of
Northland Geotechnical Specialists Limited

Applicability

This Letter has been prepared solely for the benefit of our client Jane Banfield and the Far North District Council with respect to Building Consent application for which it has been prepared. The recommendations and opinions in this report are limited to the purpose stated within the report. Northland Geotechnical Specialists take no liability for use of any matter in this report by any other party without prior review and agreement in writing. Any other party using this report does so entirely at their own risk.

File: ngs durability_1a seaview road

Northland Geotechnical Specialists Limited
W: www.northlandgeotech.co.nz **E**: info@northlandgeotech.co.nz **P**: +64 226981129

Appendix F: Property Title

- Title: Lot 1 DP 42205

RECORD OF TITLE
UNDER LAND TRANSFER ACT 2017
FREEHOLD

Search Copy

R.W. Muir
Registrar-General
of Land

Identifier **NA72C/345**

Land Registration District **North Auckland**

Date Issued 07 February 1990

Prior References
NA66A/532

Estate Fee Simple

Area 1103 square metres more or less

Legal Description Lot 2 Deposited Plan 124280

Registered Owners
Jane Barbara Banfield as to a 1/2 share
Jane Barbara Banfield and TW Trustees 2011 Limited as to a 1/2 share

Interests

A54171 Building Line Restriction

Appurtenant hereto is a right of way created by Transfer A69583

The easements created by Transfer A69583 are subject to Section 37 (1) (a) Counties Amendment Act 1961

C099389.2 Resolution pursuant to Section 321(3)(c) Local Government Act 1974 - 7.2.1990 at 11.07 am

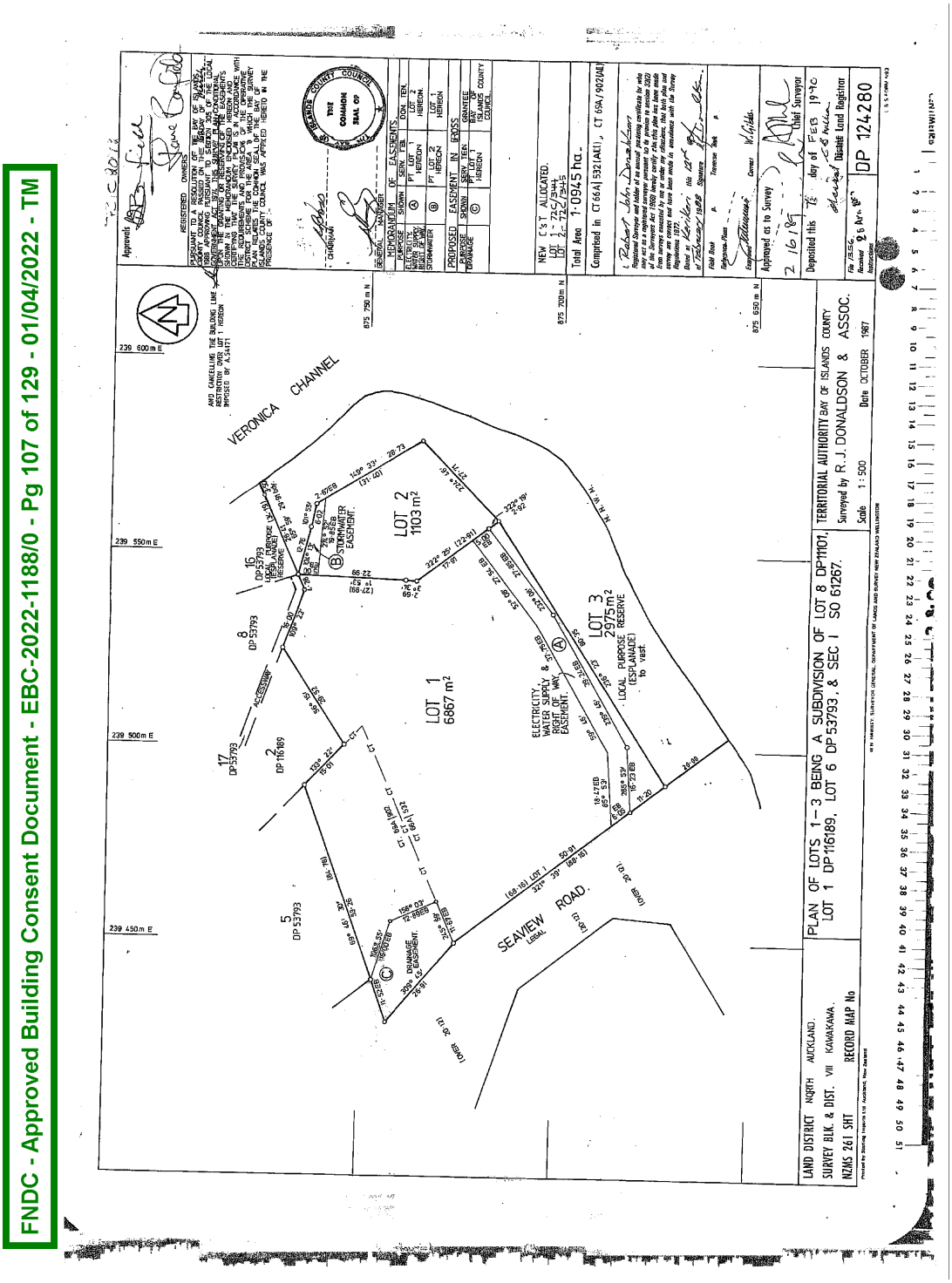
Subject to a stormwater right over part marked B on DP 124280 specified in Easement Certificate C099389.5 - 7.2.1990 at 11.07 am

Appurtenant hereto is a right of way and to electricity and water supply rights specified in Easement Certificate C099389.5 - 7.2.1990 at 11.07 am

The easements specified in Easement Certificate C099389.5 are subject to Section 309 (1) (a) Local Government Act 1974

11407705.1 Subject to conditions pursuant to Section 461(1) Local Government Act 1974 and certifying that a private drain passes through Lot 1 on DP 124280 and serves the within land - 5.4.2019 at 4:05 pm

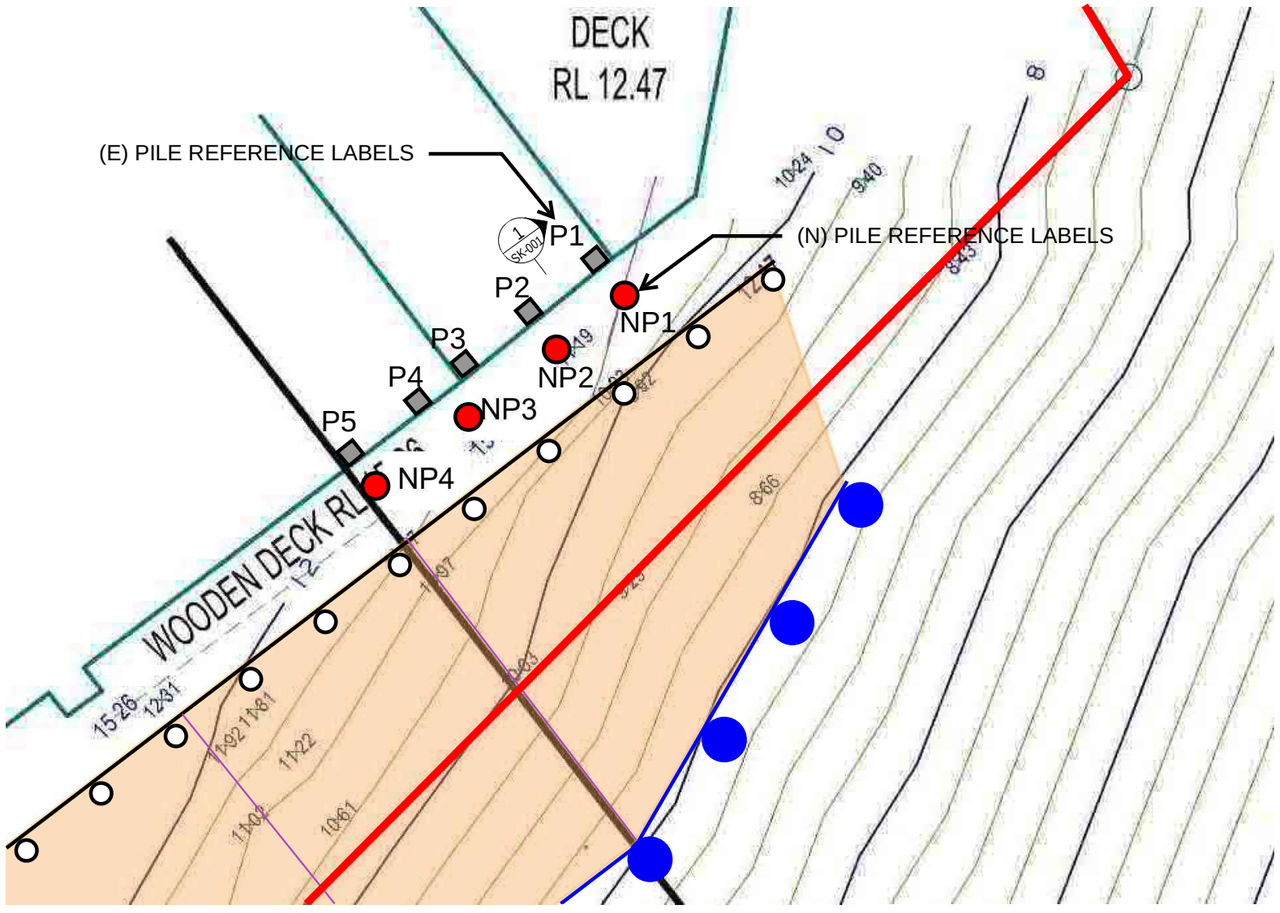
Identifier **NA72C/345**



Appendix G: Structural Design Package

- SCS Structures Ltd Drawings SK-SE-000 to -003
- Structural Calculation Report
- PS1 – Design
- Certificate of Design Work

NOTE: BACKGROUND TAKEN FROM NGS LTD DRAWINGS



EXISTING CONCRETE PILE

NEW CONCRETE PILE

(PILES SHOWN INDICATIVELY ON GENERAL LAYOUT PLAN)

1 - GENERAL LAYOUT PLAN

1:50 A3

4No. OFF NEW 450mm DIAM BORED CONCRETE UNDERPINNING PILES. SEE DETAILS AND SECTION VIEWS ON SK-SE-001 TO 002.

NOTES:

1.0 GENERAL NOTES
- 1.1 - All dimensions are in mm
- 1.2 - All dimensions shall be verified on site by the Contractor prior to fabrication / or construction commencing.
- 1.3 - Structural drawings shall be read in conjunction with the drawings of other Consultants (e.g. Architect, Geotech)

2.0 TEMPORARY WORKS
- 2.1 - The Contractor shall be responsible for the design & procurement of any temporary works should these be required such as propping or temporary working platform or formwork.

7.0 DRILL IN CONCRETE ANCHORS
- 7.1 - Contractor is to locate all existing reinforcement at fixing locations by x-ray or scanner prior to any drilling.
- 7.2 - No existing reinforcement to be cut or damaged.
- 7.3 - Pilot drill all holes as added precaution.

9.0 CONSTRUCTION NOTES
- 9.1 - Any discrepancies, unexpected conditions exposed on site, or structural details missing shall be referred to the engineer for resolution.
- 9.2 - The Contractor shall keep the engineer abreast of progress on site to enable inspections of completed work.
- 9.3 - All levels & dimensions to be confirmed on site by the Contractor.
- 9.4 - Refer to NGS Ltd Geotech drawings for all retaining wall requirements, locations, sizes & set out of retaining.
- 9.5 - Do not use the structural drawings for set out dimensions. Contractor to carry out site measurements.
- 9.6 - All works to comply with the Contractor's Health & Safety Manual and the Health & Safety at Work Act 2015.
- 9.7 - Contractor's proposed methodology and sequencing for installation of reinforced concrete underpinning piles to be submitted to the engineer for review and approval prior to commencing the work.

FOR BUILDING CONSENT

FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
1	FOR BUILDING CONSENT & CONSTRUCTION	SCS			10.03.22
B	PRELIMINARY ISSUE	SCS			4.03.22
A	FOR REVIEW & COMMENT	SCS			3.03.22

Drawing Originator: SCS STRUCTURES

Original Scale (A1): AS NOTED | Reduced Scale (A3): | Design: SCS | Drawn: | Dsg Verifier: | Dwg Check: | * Refer to Revision 1 for Original Signature

Client: JANE BANFIELD

Project: FOUNDATION REMEDIAL WORKS
1A SEAVIEW RD, PAIHIA

Title: GENERAL ARRANGEMENT

Discipline: STRUCTURAL

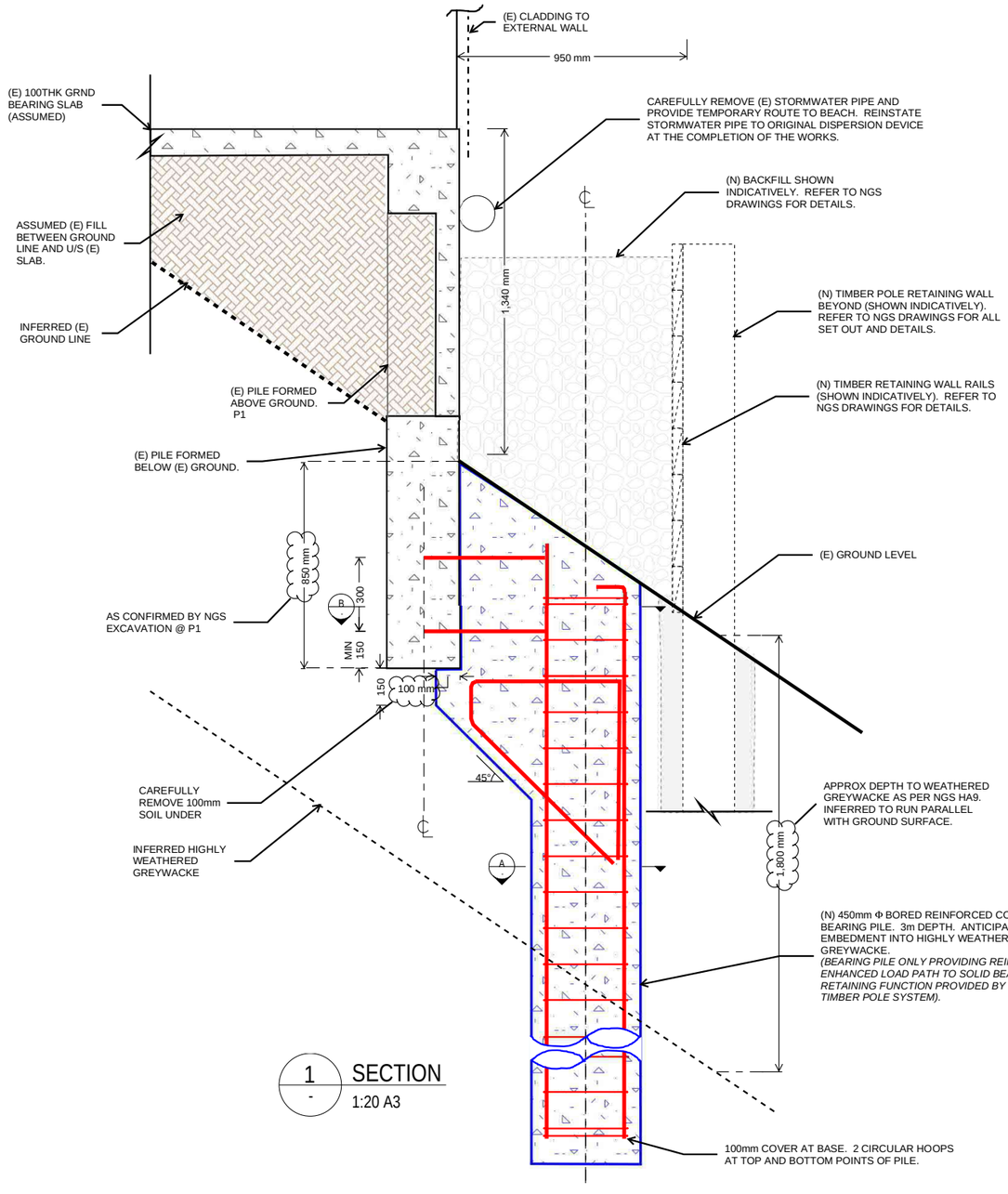
Drawing No.: SK-SE-000

Rev.: 1

DO NOT SCALE

IF IN DOUBT ASK.

BL:EBEAM



FOR BUILDING CONSENT

FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
1	FOR BUILDING CONSENT & CONSTRUCTION	SCS			10.03.22
A	FOR REVIEW & COMMENT	SCS			3.03.22

Drawing Originator: SCS STRUCTURES

Original Scale (A1) / Reduced Scale (A3): AS NOTED

Design: SCS; Drawn; Dsg Verifier; Dwg Check

* Refer to Revision 1 for Original Signature

Client: JANE BANFIELD

Project: FOUNDATION REMEDIAL WORKS 1A SEAVIEW RD, PAIHIA

Title: STRUCTURAL DETAIL SHEET 1

Discipline: STRUCTURAL

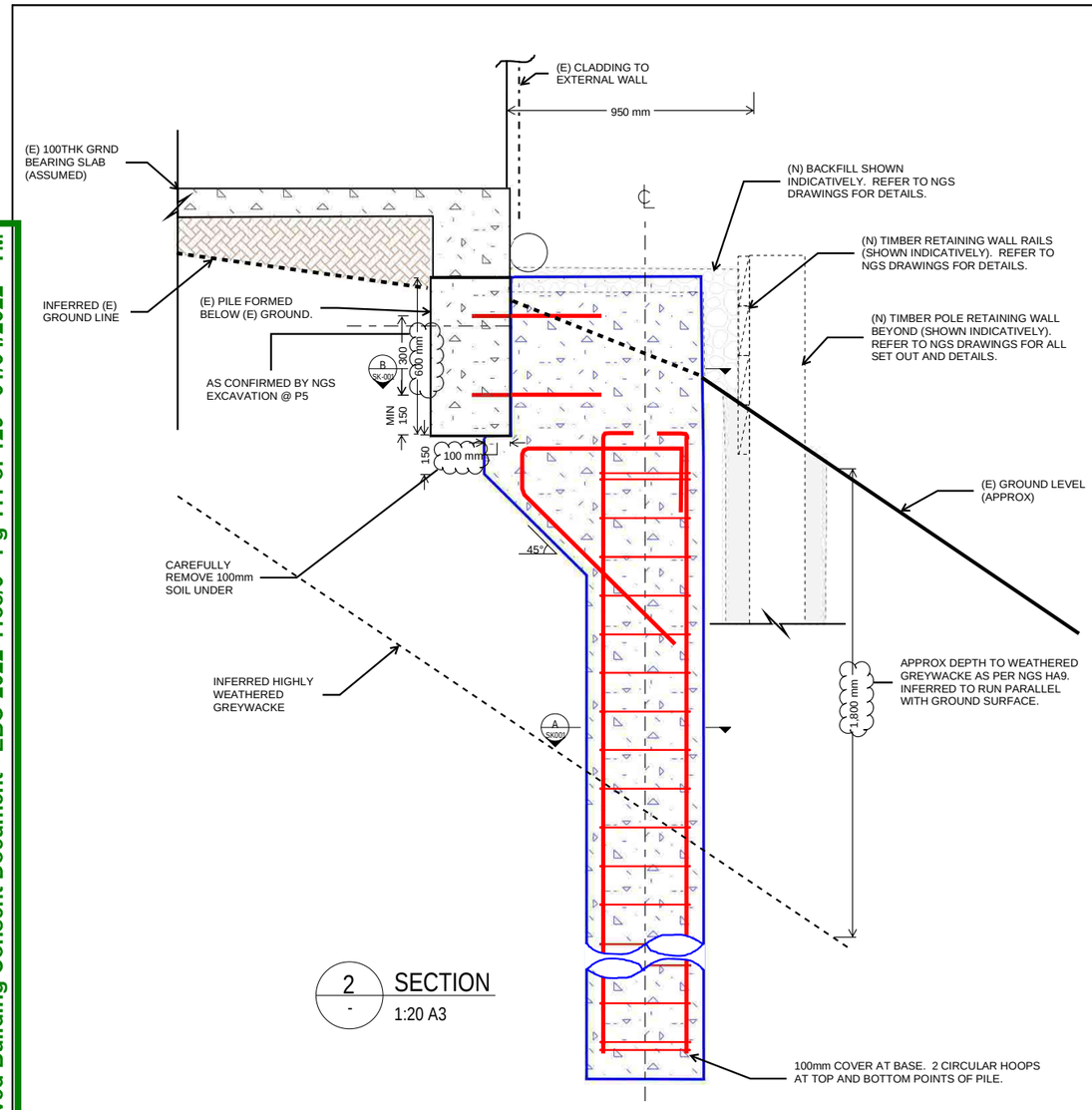
Drawing No.: SK-SE-001

Rev.: 1

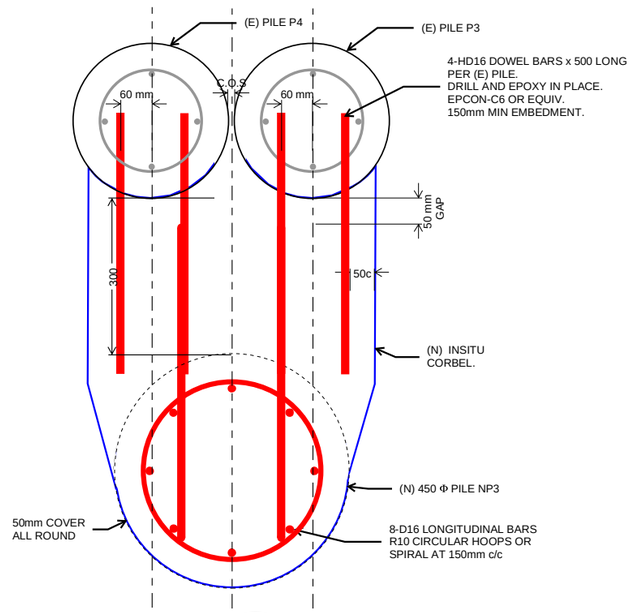
BLUEBEAM

DO NOT SCALE

IF IN DOUBT ASK.



2 - SECTION
1:20 A3



C - SECTION
1:10 A3

FOR BUILDING CONSENT
FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
1	FOR BUILDING CONSENT & CONSTRUCTION	SCS			10.03.22
A	FOR REVIEW & COMMENT	SCS			3.03.22

Drawing Originator: SCS STRUCTURES

Original Scale (A1) / Reduced Scale (A3): AS NOTED
Design: SCS
Drawn:
Dsg Verifier:
Dwg Check:
* Refer to Revision 1 for Original Signature

Client: JANE BANFIELD

Project: FOUNDATION REMEDIAL WORKS
1A SEAVIEW RD, PAIHIA

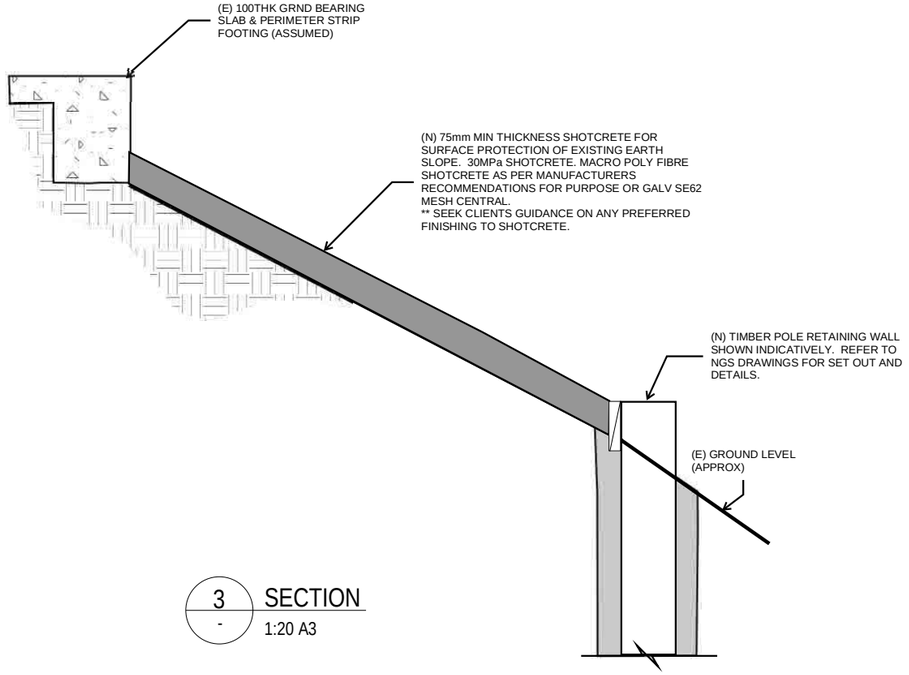
Title: STRUCTURAL DETAIL SHEET 2

Discipline: STRUCTURAL
Drawing No.: SK-SE-002
Rev.: 1

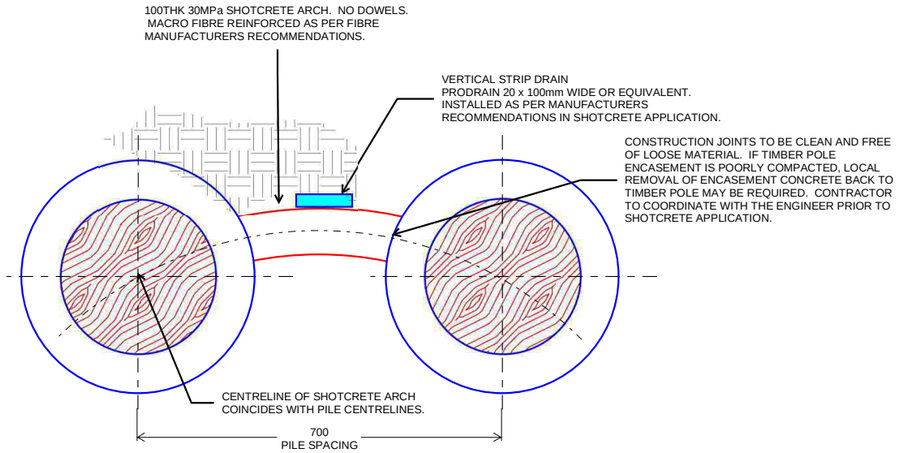
BL LEE AM

DO NOT SCALE

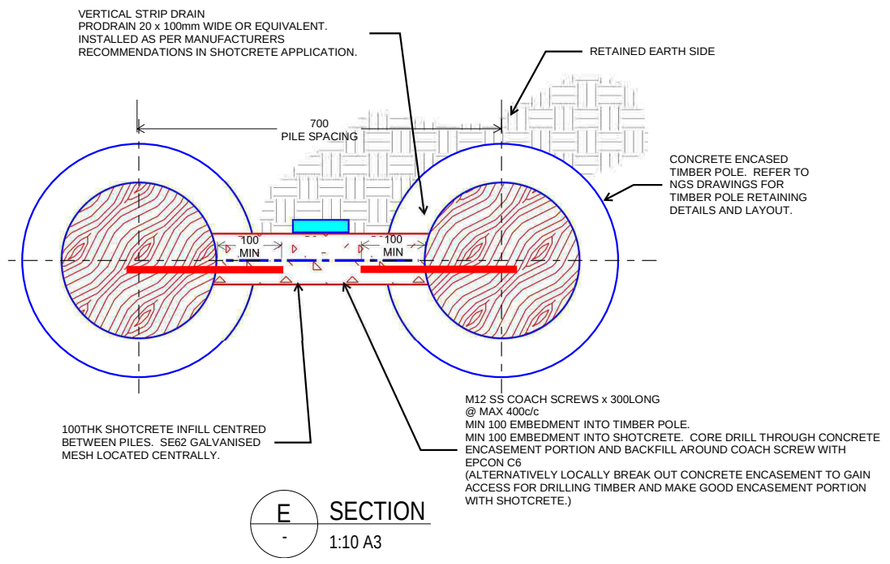
IF IN DOUBT ASK.



3 - SECTION
1:20 A3



D - SECTION
1:10 A3



E - SECTION
1:10 A3

FOR BUILDING CONSENT
FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
1	FOR BUILDING CONSENT & CONSTRUCTION	SCS			10.03.22
A	FOR REVIEW & COMMENT	SCS			3.03.22

Drawing Originator: SCS STRUCTURES

Original Scale (A1) / Reduced Scale (A3): AS NOTED
Design: SCS | Drawn | Dsg Verifier | Dwg Check
* Refer to Revision 1 for Original Signature

Client: JANE BANFIELD

Project: FOUNDATION REMEDIAL WORKS
1A SEAVIEW RD, PAIHIA

Title: STRUCTURAL DETAIL SHEET 3

Discipline: STRUCTURAL
Drawing No.: SK-SE-003
Rev.: 1

BLUEBEAM

DO NOT SCALE

IF IN DOUBT ASK.

STRUCTURAL CALCULATION REPORT

FOUNDATION REMEDIAL WORKS
1A SEAVIEW ROAD, PAIHIA
JANE BANFIELD

Prepared by

SCS STRUCTURES

3/03/2022

SCS STRUCTURES

Job Number: 1845 Date 2/03/2022

Job Name: 1A SEAVIEW RD, PAIHIA

Subject: FOUNDATION REMEDIAL WORKS

By: SCS Page No: of

DESCRIPTION:

Following the occurrence of a slip in close proximity to the existing dwelling at 1A Seaview Rd, Paihia, and subsequent geotechnical investigations by Northland Geotechnical Specialists (NGS), SCS Structures Ltd (SCS) was engaged to assist with the NGS design solution by covering specialist structural input for reinforced concrete underpinning and shotcrete stabilising works.

SCS Structures carried out an initial site visit on 26/01/22 which incorporated a high level visual assessment of parts of the dwelling. No obvious signs of movement were observed during this initial site walkover. No assessment of the building condition in general or compliance with current building code was attempted.

The presence of an old dead Pohutukawa tree stump was observed in close proximity to the existing foundations within the zone of influence of the slip. The NGS geotechnical inspection suggests that tension cracking was present in the soil profile above the tree stump and that some rotation at the base of the stump may have caused this. This raised concerns about the vertical load carrying load path of the adjacent existing foundations to solid bearing material in the vacinity of this stump. NGS locally hand excavated to expose the depth of existing piles. Some loose soil was found and it appeared that there was a gap under the pile P1. The existing piles are noted to be of varying depths and appear to consist of what was a fully embedded length cast against the soil surrounding the hole dug for the pile, and then an upper formed square or rectangular segment extending up to slab or perimeter strip footing level. The gap between formed piles above ground was lined with some sort of RC lining wall assumed to be 100mm thk. It is assumed that fill material was placed on top of the existing ground, retained by the lining wall and pile extensions to create the formation level for the adjacent ground floor slab.

Therefore it was concluded that as part of the overall land stabilisation & ground retention works being carried out by NGS that SCS would provide design and details for a reinstated and strengthened vertical load path to competent bearing strata (Highly Weathered Greywacke) for the existing piles labelled P1-P5.

SCS STRUCTURES

Job Number: 1845 Date 2/03/2022

Job Name: 1A SEAVIEW RD, PAIHIA

Subject: FOUNDATION REMEDIAL WORKS

By: SCS Page No: of

DESIGN PHILOSOPHY:

1. New RC piles are bearing piles only to reinstate and enhance the vertical load path to the competant highly weathered greywacke. Ground retention to be provided by NGS tiered retaining wall system.

2. 4 new RC piles proposed. 1 in front of each existing pile except at existing piles P3& P4 which are located right next to ea other. Here just one new pile will suffice.

3. New piles to be 450mm diam bored concrete piles taken down 3.0m below existing ground level. This is on the basis that depth to top of highly weathered greywacked in NGS hand auger location HA9 was 1.8m, and then we anticipate 1.2m of embedment into they highly weathered greywacke.

4. Underpinning detail to be developed to allow transfer of vertical load from existing piles to the new piles through a continuous robust load path.

5. Due to physical and geometrical constraints it is assumed that the new underpinning piles will be eccentric to the existing piles. Therefore a bridging element will be needed to tie the existing and new piles together and the new piles will need to be designed for the induced moment due to this eccentricity.

6. Design life of new underpinning piles = 50yrs

SHOTCRETE

5. Two conditions of shotcrete required.

(5.1) When existing ground is excavated in front of the new NGS 'upper retaining wall' the soil is expected to arch adequately between piles in the short term, but to protect against long term case and frittering of this vertical soil face a shotcrete detail is proposed to act between the new permanent piles.

(5.2) Part way along the building between the seaward corner and the carpark area the building footprint steps back at ground level. This creates a new condition where there is a slope of exposed existing soil above the top of the new NGS upper retaining wall and the edge of the existing foundation. This soil slope is currently showing signs of frittering and for the long term protection against erosion of the slope which could ultimately undermine the existing footing it is proposed to protect this slope with a shotcrete lining.

SCS STRUCTURES

Job Number: 1845 Date 2/03/2022
Job Name: 1A SEAVIEW RD, PAIHIA
Subject: FOUNDATION REMEDIAL WORKS
By: SCS Page No: of

PILE DESIGN:

DESIGN LOADINGS:

Loadings calculated as per NZS1170

Imposed Load Allowances: NZS 1170.1:2002
Residential floor load = 1.5kPa
Residential deck load = 2.0kPa
Roof access for maintenance = 0.25kPa

Dead Load Allowances:

Lightweight roof = 0.5kPa
External wall = 0.5kPa x 5m = 2.5kN/m (Ground to roof)
Lightwt timber floor = 0.5kPa (Sunroom floor at L1)
L1 partitions allowance = 0.5kPa

L0 slab = 0.11*24 = 2.64kPa
L0 Floor finishes = 20mm x 24 = 0.48kPa
L0 partitions allowance = 0.5kPa

Allowance for SW of (E) perimeter strip footing = 0.2*0.3m*24 = 1.44kN/m
Allowance for SW of (E) pile = 0.3*0.3m*24* 2.25m long = 4.86kN
Allowance for SW of (E) lining wall = 0.1m*24*1.4m = 3.36kN/m

Floor trib width allowance to (E) strip footing =2.5m allowance
(E) strip footing / lining wall trib width allowance = 1m

Dead load demand allowance per new underpinning pile:
G = (5.12kPa x 2.5m*1m) + (2.5*1m) + (4.8*1m) + 4.86 = 25kN

Live load demand allowance per new underpinning pile:
Q = (1.5kPa *2.5m*1m * 2 levels) = 7.5kN

LOAD COMBINATIONS
1.2G+1.5Q = 41kN
1.35G = 34kN

DURABILITY
Exposure category A2 to NZS3101 table 3.1 = Surfaces in contact with the ground (in non-aggressive soils).
Min cover as per Table 3.6 = 30mm for 30MPa concrete A2, 50yr design life.
Choose 50mm cover.

SCS STRUCTURES

Job Number: 1845 Date 2/03/2022
Job Name: 1A SEAVIEW RD, PAIHIA
Subject: FOUNDATION REMEDIAL WORKS
By: SCS Page No: of

PILE DESIGN:

450mm diam bored insitu RC piles
Ag = 0.15e6mm2
As min = 0.8% * Ag = 1272mm2 (CL14.3.6.5)
Try D16 longitudinal bars
Min number of bars = 1272 /201 = 6.33 bars

M* = 41kN * 0.7m = 30kNm ULS
ΦMn = 75kNm with 8-D16's longitudinal steel, R10 links at 200c/c, 50mm cover all round, 30MPa normal concrete.

M*/Capacity = 30/75 = 40% utilisation < 100% Therefore OK

See GEN-COL calculation below.

Gen-Col
Analysis of Reinforced Concrete Columns
Licensed to: SESOC

Job number (or name): 1 Seaview Rd, Paihia
Column number:

User name : OEM

Concrete properties:
Rectangular stress block as defined by NZS 3101:2006.
Concrete cylindrical compressive strength = 30.0 MPa
Concrete compression stress coefficient, a1 = 0.85
Compression zone depth coefficient, B1 = 0.85
Concrete maximum strain = 0.0030

Steel properties:
Steel modulus of elasticity = 200 000 MPa
Steel yield strength = 300.0 MPa

Dimensions of the column section:
Circular section.
Diameter = 450.0 mm
Clear cover to ties = 50.0 mm

Results:
Load combination number 1 :
Strength reduction factor, Phi = 0.85
Phi Axial load = 0.8 kN, Phi Mx = 74.7 kNm, Phi My = 0.0 kNm
Required reinforcement ratio = 0.01011, Required reinforcement area = 1607.1 mm2
Initial reinforcement ratio = 0.01010, Initial reinforcement area = 1605.5 mm2
Initial reinforcement ratio scaled by = 1.0000
Moment ratio = 0.00000, Target moment ratio = N/A
Skew angle = 0.0 degrees, NA depth = 78.1 mm
Force (unfactored) carried by concrete = 400.5 kN
Force (unfactored) carried by reinforcement = -399.6 kN
Axial load eccentricity: ex = 0.0 mm, ey = 93375.0 mm

The analysis has been finished.

SCS STRUCTURES

Job Number: 1845 Date 2/03/2022

Job Name: 1A SEAVIEW RD, PAIHIA

Subject: FOUNDATION REMEDIAL WORKS

By: SCS Page No: of

PILE DESIGN:

Check shear in pile: CL10.3.10.5
Adopt min steel = R10's at 150mm c/c, OK by inspection

PILE BEARING

450 diam pile OK by inspection for ULS demand of 41kN

CHECK DOWEL BARS

Design reduced ultimate concrete edge shear capacity, ϕV_{urc}

$$\phi V_{urc} = \phi V_{uc} * X_{vc} * X_{vd} * X_{va} * X_{vn} * X_{vs}$$

Try HD16 rebar dowels x 500long with EPCON C6 with 150mm embedment

Phi.Vuc = 12kN (e = 90mm)
Xvc = 0.91 (for fc'=30MPa)
Xvd = 2.0
Xva = 0.7 (e = 90, a = 120)
Xvn = 0.84 (n = 4, a/e = 1.33)
Xvs = 1.0 (not corner)

Therefore, Phi.Vurc = 12.8kN * 4 anchors = 51kN > 41 ULS Demand OK

Therefore adopt 450mm Φ bored reinforced concrete piles
6-D16 longitudinal bars, R10 links @ 150c/c, 30MPa Normal concrete

use 4-HD16 dowel bars x 500long. Drill and epoxy with 150mm embedment EPCON C6 or equivalent.

One new pile per existing pile, except at (E) P3 & P4 which are paired up next to each other.

SCS STRUCTURES

Job Number: 1845 Date 2/03/2022

Job Name: 1A SEAVIEW RD, PAIHIA

Subject: FOUNDATION REMEDIAL WORKS

By: SCS Page No: of

SHOTCRETE DESIGN:

Check to span between timber poles in timber retaining walls.

LOADING:
At rest earth pressure = 11.5kPa (given)

SPAN:
Max span = 700mm face of pole to face of pole.

DEMAND:
Take 400mm wide strip
M* = 11.5*0.4*0.7*0.7/8 = 0.28kNm

phi =	0.85						alpha1	0.85	
fy =	500	MPa					beta1	0.85	
f'c =	30	MPa					Moment redistribution =	0	(0.2 = 20%)
b =	400	mm				Does element contribute to lateral strength of structure =		N	Y or N
D =	100	mm					min As to 9.3.8.2.1 =	0.0028	
cover =	50	mm					reduced min As to 9.3.8.2.3 =	0.001032	1 = N/A
d =	46.95	mm							
Tension reinforcement									
Bar size	6.1	mm diam	min reinf ratio =	0.00103	0.10%	*Reduced MIN As to 9.3.8.2.3*			
1 bar area	29.2	mm2	max reinf ratio =	0.017734	1.77%				
# bars	2	bars in tension							
As =	58	mm2	reinf ratio =	0.0031	0.31%	**STEEL RATIO OK**			
Phi.Mn =	1.1	kNm							
M* =	0.28	kNm	25% Utilisation						

V* =		1.61	kN		
Shear Capacity =					
ka =	0.85	*Conservative assuming <10mm aggregate*			
kn =	1.00	*Ignore axial effects (compression is beneficial)*			
kd =	1.00	*Is Av > Av min*	N	Y or N	
pw =	0.003				
vb =	0.101	SQRT(fc') =	0.55	MPa	
	Shear area, Av=		18780	mm2	*allowing for cover*
		vc =	0.79	MPa	
		Vc =	14.9	kN	
		phiVc =	11.1	kN	**14% Utilisation**

Demand per M12 coach screw = 1.6kN ULS with coach screws at 400c/c
OK by inspection. Use 300mm long with 100mm embedment into shotcrete.
Long coach screw to penetrate timber pole and some variability in concrete encasement anticipated.

Therefore 100thk, min 30MPa shotcrete ok for bending with SE62 mesh central for max 700mm span.

From: Rebekah Buxton <rebekah@northlandgeotech.co.nz>
Sent: Monday, 28 February 2022 3:55 PM
To: sam@fns.co.nz
Subject: RE: lateral earth pressure for shotcrete design

Sorry Sam, We are changing section part way. At this end of the wall we are making it 300SEDs at 1m c/c so pile face to face spacing is 700mm. Please ignore previous email below.
No change to lateral pressure.

From: Rebekah Buxton
Sent: Monday, 28 February 2022 3:32 pm
To: sam@fns.co.nz
Subject: lateral earth pressure for shotcrete design

Based on maximum depth of shotcrete of 1.60m with 250SED piles at 1.0m c/c.
Maximum lateral at rest earth pressure = 11.5kPa, pile face to pile face spacing 750mm.
Can you show a vertical strip drain detail.
Thanks

AT REST EARTH PRESSURE GIVEN

Kind Regards

Rebekah Buxton
Geotechnical Engineer, MEngNZ

Northland Geotechnical Specialists
M: 022 304 1171 **W**: www.northlandgeotech.co.nz

NGS
Northland Geotechnical Specialists

PRODUCER STATEMENT – PS1
DESIGN

BUILDING CODE CLAUSE(S): B1 **JOB NUMBER:** 1845
ISSUED BY: SCS Structures Ltd
(Engineering Design Firm)
TO: Jane Banfield
(Owner/Developer)
TO BE SUPPLIED TO: Far North District Council
(Building Consent Authority)
IN RESPECT OF: Foundation remedial works
(Description of Building Work)
AT: 1A Seaview Road
(Address, Town/City)
LEGAL DESCRIPTION: Lot 2 DP 124 280 **N/A** ☐

We have been engaged by the owner/developer referred to above to provide *(Extent of Engagement)*:
structural engineering design
in respect of the requirements of the Clause(s) of the Building Code specified above for Part only , as specified in the Schedule, of the proposed building work.

The design carried out by us has been prepared in accordance with:

- ☑ Compliance documents issued by the Ministry of Business, Innovation & Employment *(Verification method/acceptable solution)* B1/VM4 and/or;
- ☐ Alternative solution as per the attached Schedule.

The proposed building work covered by this producer statement is described on the drawings specified in the Schedule, together with the specification, and other documents set out in the Schedule.

On behalf of the Engineering Design Firm, and subject to:

- Site verification of the following design assumptions: Subsoil conditions are as expected.
- All proprietary products meeting their performance specification requirements;

I believe on reasonable grounds that:

- the building, if constructed in accordance with the drawings, specifications, and other documents provided or listed in the Schedule, will comply with the relevant provisions of the Building Code and that;
- the persons who have undertaken the design have the necessary competency to do so.

I recommend the CM 4 level of **construction monitoring**.

I *(Name of Engineering Design Professional)* Sam Chapman-Smith , am:

- ☑ CPEng number 230 257

and hold the following qualifications B.E.(Hons) Civil

The Engineering Design Firm holds a current policy of Professional Indemnity Insurance no less than $200,000
The Engineering Design Firm is not a member of ACE New Zealand.

SIGNED BY *(Name of Engineering Design Professional)*: Sam Chapman-Smith
(Signature below):

ON BEHALF OF *(Engineering Design Firm)*: SCS Structures Ltd Date: 10/03/2022

Note: This statement has been prepared solely for the Building Consent Authority named above and shall not be relied upon by any other person or entity. Any liability in relation to this statement accrues to the Engineering Design Firm only. As a condition of reliance on this statement, the Building Consent Authority accepts that the total maximum amount of liability of any kind arising from this statement and all other statements provided to the Building Consent Authority in relation to this building work, whether in tort or otherwise, is limited to the sum of $200,000.

This form is to accompany **Form 2 of the Building (Forms) Regulations 2004** for the application of a Building Consent.

SCHEDULE to PS1

Please include an itemised list of all referenced documents, drawings, or other supporting materials in relation to this producer statement below:

SK-SE-000 rev 1
SK-SE-001 rev 1
SK-SE-002 rev 1
SK-SE-003 rev 1

GUIDANCE ON USE OF PRODUCER STATEMENTS

Information on the use of Producer Statements and Construction Monitoring Guidelines can be found on the Engineering New Zealand website
https://www.engineeringnz.org/engineer-tools/engineering-documents/producer-statements/

Producer statements were first introduced with the Building Act 1991. The producer statements were developed by a combined task committee consisting of members of the New Zealand Institute of Architects (NZIA), Institution of Professional Engineers New Zealand (now Engineering New Zealand), Association of Consulting and Engineering New Zealand (ACE NZ) in consultation with the Building Officials Institute of New Zealand (BOINZ). The original suite of producer statements has been revised at the date of this form to ensure standard use within the industry.

The producer statement system is intended to provide Building Consent Authorities (BCAs) with part of the reasonable grounds necessary for the issue of a Building Consent or a Code Compliance Certificate, without necessarily having to duplicate review of design or construction monitoring undertaken by others.

PS1 DESIGN Intended for use by a suitably qualified independent engineering design professional in circumstances where the BCA accepts a producer statement for establishing reasonable grounds to issue a Building Consent;

PS2 DESIGN REVIEW Intended for use by a suitably qualified independent engineering design review professional where the BCA accepts an independent design professional's review as the basis for establishing reasonable grounds to issue a Building Consent;

PS3 CONSTRUCTION Forms commonly used as a certificate of completion of building work are Schedule 6 of NZS 3910:2013 or Schedules E1/E2 of NZIA's SCC 2011[2]

PS4 CONSTRUCTION REVIEW Intended for use by a suitably qualified independent engineering construction monitoring professional who either undertakes or supervises construction monitoring of the building works where the BCA requests a producer statement prior to issuing a Code Compliance Certificate.

This must be accompanied by a statement of completion of building work (Schedule 6).

The following guidelines are provided by ACE New Zealand and Engineering New Zealand to interpret the Producer Statement.

Competence of Engineering Professional
This statement is made by an engineering firm that has undertaken a contract of services for the services named, and is signed by a person authorised by that firm to verify the processes within the firm and competence of its personnel.

The person signing the Producer Statement on behalf of the engineering firm will have a professional qualification and proven current competence through registration on a national competence-based register such as a Chartered Professional Engineer (CPEng).

Membership of a professional body, such as Engineering New Zealand provides additional assurance of the designer's standing within the profession. If the engineering firm is a member of ACE New Zealand, this provides additional assurance about the standing of the firm.

Persons or firms meeting these criteria satisfy the term "suitably qualified independent engineering professional".

Professional Indemnity Insurance
As part of membership requirements, ACE New Zealand requires all member firms to hold Professional Indemnity Insurance to a minimum level.

The PI Insurance minimum stated on the front of this form reflects standard practice for the relationship between the BCA and the engineering firm.

Professional Services during Construction Phase
There are several levels of service that an engineering firm may provide during the construction phase of a project (CM1-CM5 for engineers[3]). The building Consent Authority is encouraged to require that the service to be provided by the engineering firm is appropriate for the project concerned.

Requirement to provide Producer Statement PS4
Building Consent Authorities should ensure that the applicant is aware of any requirement for producer statements for the construction phase of building work at the time the building consent is issued as no design professional should be expected to provide a producer statement unless such a requirement forms part of the Design Firm's engagement.

Refer Also:

1 Conditions of Contract for Building & Civil Engineering Construction NZS 3910: 2013
2 NZIA Standard Conditions of Contract SCC 2011
3 Guideline on the Briefing & Engagement for Consulting Engineering Services (ACE New Zealand/Engineering New Zealand 2004)
4 PN01 Guidelines on Producer Statements

www.acenz.org.nz
www.engineeringnz.org

Form 2A

Memorandum from licensed building practitioner: Certificate of design work

Section 30C or 45, Building Act 2004

Please fill in the form as fully and correctly as possible.
If there is insufficient room on the form for requested details, please continue on another sheet and attach the additional sheet(s) to this form.

THE BUILDING			
Street address:	1A Seaview Road		
Suburb:	Paihia		
Town/City:	Paihia	Postcode:	0200

THE OWNER(S)			
Name(s):	Jane Banfield		
Mailing address:	P O Box 417, Paihia, 0247		
Suburb:	Paihia	PO Box/Private Bag:	417
Town/City:	Paihia	Postcode:	0247
Phone number:	022 018 3366	Email address:	accommodationatthebeach@gmail.com

BASIS FOR PROVIDING THIS MEMORANDUM

I am providing this memorandum in my role as the: Please tick the option that applies ✓

- ○ **sole** designer of all of the RBW design outlined in this memorandum – I carried out all of the RBW design work myself – no other person will be providing any additional memoranda for the project
- ○ **lead** designer who carried out some of the RBW design myself but also supervised other designers – this memorandum covers their RBW design work as well as mine, and **no other** person will be providing any additional memoranda for the project
- ○ **lead** designer for all but specific elements of RBW – this memorandum only covers the RBW design work that I carried out or supervised and the **other** designers will provide their own memorandum relating to their specific RBW design
- ✓ **specialist** designer who carried out specific elements of RBW design work as outlined in this memorandum – other designers will be providing a memorandum covering the remaining RBW design work

IDENTIFICATION OF DESIGN WORK THAT IS RESTRICTED BUILDING WORK (RBW)

I Sam Chapman-Smith carried out / supervised the following design work that is restricted building work

PRIMARY STRUCTURE: B1

Design work that is RBW	Description of RBW	Carried out or supervised	Reference to plans and specifications
Tick ✓ if included. Cross ☒ if excluded	If appropriate, provide details of the RBW	Tick ✓ whether you carried out this design work or supervised someone else carrying out this design work	If appropriate, specify references
All RBW design work relating to B1 ☒		○ Carried out ○ Supervised	
Foundations and subfloor framing ✓	Reinforced concrete underpinning piles, and shotcrete infill between selected new retaining wall piles.	✓ Carried out ○ Supervised	SCS Structures Ltd Drawings: SK-SE-000 to 003 rev 1.

Design work that is RBW	Description of RBW	Carried out or supervised	Reference to plans and specifications
Tick ✓ if included. Cross ✗ if excluded	If appropriate, provide details of the RBW	Tick ✓ whether you carried out this design work or supervised someone else carrying out this design work	If appropriate, specify references
Walls ☒		○ Carried out ○ Supervised	
Roof ☒		○ Carried out ○ Supervised	
Columns and beams ☒		○ Carried out ○ Supervised	
Bracing ☒		○ Carried out ○ Supervised	
Other ☒		○ Carried out ○ Supervised	

Design work that is RBW	Description of RBW	Carried out or supervised	Reference to plans and specifications
Tick ✓ if included. Cross ✗ if excluded	If appropriate, provide details of the RBW	Tick ✓ whether you carried out this design work or supervised someone else carrying out this design work	If appropriate, specify references
EXTERNAL MOISTURE MANAGEMENT SYSTEMS: E2			
All RBW design work relating to E2 ☒		○ Carried out ○ Supervised	
Damp proofing ☒		○ Carried out ○ Supervised	
Roof cladding or roof cladding system ☒		○ Carried out ○ Supervised	
Ventilation system (for example, subfloor or cavity) ☒		○ Carried out ○ Supervised	
Wall cladding or wall cladding system ☒		○ Carried out ○ Supervised	
Waterproofing ☒		○ Carried out ○ Supervised	
Other ☒		○ Carried out ○ Supervised	

Design work that is RBW	Description of RBW	Carried out or supervised	Reference to plans and specifications
Tick ✓ if included. Cross ✗ if excluded	If appropriate, provide details of the RBW	Tick ✓ whether you carried out this design work or supervised someone else carrying out this design work	If appropriate, specify references
FIRE SAFETY SYSTEMS: C1 - C6			
Emergency warning systems Evacuation and fire service operation systems ☒ Suppression or control systems Other		○ Carried out ○ Supervised	

Note: The design of fire safety systems is only restricted building work when it involves small-to-medium apartment buildings as defined by the Building (Definition of Restricted Building Work) Order 2011.

WAIVERS AND MODIFICATIONS

Waivers or modifications of the Building Code are required. ✓ Yes ○ No

If Yes, provide details of the waivers or modifications below:

Clause	Waiver/modification required
List relevant clause numbers of building code	Specify nature of waiver or modification of building code required
B2	We are not able to cover Clause B2 as there is no effective verification method for B2 contained within the Building Code. However, we supply this letter to confirm that for the structural elements shown in our documentation: Concrete – Concrete strength and covers have been selected in accordance with Section 3 of NZS 3101:Part 1, and Section 4.5 of NZS 3604:2011 as applicable.
	Exposed Steel Connection Hardware - to NZS3604 exposure classification Zone C

ISSUED BY

Name and contact details of the licensed building practitioner who is licensed to carry out or supervise design work that is restricted building work.

Name: Sam Chapman-Smith	LBP or Registration number: 230 257
The practitioner is a: ◯ Design LBP ◯ Registered architect ✓ Chartered professional engineer	
Design Entity or Company (optional): SCS Structures Ltd	
Mailing address (if different from below):	
Street address/Registered office:	
Suburb:	Town/City: Kerikeri
PO Box/Private Bag: PO Box 871	Postcode: 0245
Phone number:	Mobile: 027 702 2008
After hours:	Fax:
Email address: sam@scsstructures.co.nz	Website: www.scsstructures.co.nz

DECLARATION

I Sam Chapman-Smith LBP, state that I have applied the skill and care reasonably required of a competent design professional in carrying out or supervising the Restricted Building Work (RBW) described in this form, and that based on this, I also state that the RBW:

- Complies with the building code, or
- Complies with the building code subject to any waiver or modification of the building code recorded on this form

Signature: SRES

Date: 10/03/2022

1 June 2021

WSP Whangarei
125A Bank Street
PO Box 553
Whangarei 0140
New Zealand

The Earthquake Commission (EQC)
PO Box 38 600
Wellington Mail Centre
Wellington 5045

Dear Sir/Madam,

Ref: EQC/2021/001295
WSP Ref: 5-C37NB.01 (/026)

Claim for Natural Disaster (Landslip) Damage;

1a Seaview Road, Paihia

EQC Ref: EQC/2021/001295

1 Introduction

WSP was engaged by the Earthquake Commission (EQC) to assess the damage and / or imminent risk to 1a Seaview Road ("the property") due to a natural disaster (landslip) event. The EQC customer is Jane Banfield and the event in question occurred following a heavy rainfall on or around the 14th February 2021. A claim was made to EQC and an inspection was carried out by WSP on the 29th April 2021.

The visit was undertaken to determine whether physical loss or damage to insured property has occurred as a direct result of the natural disaster and whether further damage is imminent. This report summarises the outcome of the inspection and subsequent assessment.

2 Site Description

The property is legally described as Lot 2 DP 124280 and has an area of 1103m^2. The property sits on Haumai Point. On the west of the property is level ground at about RL 14.75m. In other directions, the ground slopes away to a Local Purpose Reserve. The surrounding Local Purpose Reserve slopes at a typical slope of 1:1 to the north east and south east to the sea.

The main property access is through a shared driveway to the dwelling at the southern end of the property.

The published geology of the property indicates underlying Waipapa Group sandstone and siltstone. This material is primarily greywacke rock.

Council files show the house was designed in 1975 with substantial alterations in 2000/2001. The room immediately above the slip was built between 1983 and 2000, originally used as laundry and converted to a study in 2000/2001. Plans of the foundations of this room were not identified in the council plans.

The EQC claim considered in this report relates to a landslip resulting from the storm event on the 14th February 2021. Material has evacuated below the house along the south eastern wall.

Piles were visible which appeared to have been poured against ground and subsequently exposed. It was not apparent over what timeframe the exposure occurred. No cracking was apparent in the piles or the concrete at the base of the exterior wall.

Access to the damaged area is from a concrete pad parking area at the top of the slope, through a half round timber fence. From the fence the ground slopes steeply down to the damaged area and steeply away from the house. The area is vegetated. Photographs of the access are provided in Appendix A photographs 1 – 4

Our findings have been summarised below with reference given to site photographs in Appendix A photographs 5 – 8 and the figures presented in Appendix B. Photographs of the entire area were not able to be obtained due to difficult access and the area being covered by black plastic.

The location and extent of the damage is shown on the attached figures and photographs. The conclusions and recommendations in this report are based on a visual walkover assessment of the site. It must be appreciated that subsurface conditions may vary from those inferred in this report. Property boundaries and topographical contours are based on LINZ and Far North District Council information overlain on aerial imagery.

3 Property Damage

The damage to the property consists of a landslip in the ground adjacent to the house, causing the below.

- Evacuation of insured land (11 m^2; 6 m^3)

Appendix B Figure 1 shows the land damage location and extent for the site. Figure 2 shows the evacuation in elevation.

4 EQC Considerations

WSP considers the damage bullet-pointed above to be natural disaster damage (landslip) as defined by the Earthquake Commission Act 1993 (EQC Act).

5 Imminent Risk

We consider that within 12 months (under normal rainfall conditions) and as a direct result of the landslip movement that has occurred there is imminent risk of damage to EQC insured property. Movement is likely to include regression of the slip scarp and damage to the structure due to the unsupported foundations. Appendix B Figure 1 shows the estimated regression. The risk is quantified as:

- Imminent risk of 5.5m^2 (3 m^3) additional evacuation of insured land.
- Settlement of the beam above the evacuated land, resulting in settlement damage to the room above. The estimated affected floor area is 20m^2.

6 Conceptual Remedial Works

The information in the following section is provided solely to EQC for claim settlement purposes. The conceptual works are for EQC cost estimation only, to enable EQC to assess the likely costs of repairing the damaged insured property and the cost of preventing damage to insured property that is considered imminent as a direct result of the natural disaster that has occurred. The conceptual scope of works, and drawings, are NOT FOR CONSTRUCTION.

A conceptual remedial works solution that reinstates the damaged area to a similar condition and removes the imminent risk threat to insured property is a 6.0m long in ground wall which would comprise the following:

- Prepare the temporary access and working platform for a mini auger rig to work within the available working space (approximate width 1.5m max). Ensure the stability and bearing capacity of the working area;
- Bore 450mm hole for the installation of 225SED post. The first in-ground pile to be installed is the eastern corner whereby the propagated soil evacuation from the building wall is observed;
- Install thirteen 6m long 225mm diameter timber piles at 500mm centres, 0.5m offset from the front face of dwelling. Grout the hole with minimum 17 MPA concrete.
- The post dimension and length as shown on Fig. 3 is indicative. Should greywacke be encountered at a shallow depth during auguring, installation can be terminated with an embedment of 300mm inside the greywacke stratum;
- Complete the installation of thirteen in-ground piles and reinstate the existing ground.

These works accommodate the requirements of the EQC Act 1993 and are considered appropriate in terms of cost effectiveness and constructability. An alternative solution could be more appropriate for the customer and wider property (beyond EQC insured land). It may be possible to implement an alternative solution and this solution could be investigated following settlement of the claim.

We estimate the cost (excluding GST) to design and consent the proposed solution will be as follows:

Engineering site investigations	$5,000
Engineering design and drawings	$3,500
Survey	$1,500
Building/Resource Consents	$1,500
Construction Monitoring	$1,500
Construction	TBA*
TOTAL (Excluding GST)	$13,000 + construction cost

*The construction cost estimate for the proposed solution will be provided by an EQC cost estimator.

The below table is used to represent any likely construction issues for cost estimation purposes

Table 1 Evaluation of Construction Issues

Construction Issues	Easy	Moderate	Hard	N/A
Construction Access			✓	
Earthworks required			✓	
Constructability/Reinstatement			✓	

Resource consent may be required for the construction and this should be confirmed with the Local Authority prior to any remedial works being undertaken.

All remedial solutions should consider safety in design. Any construction works should be undertaken in a safe and appropriate manner, including the allowance for all necessary protection and temporary stabilisation works as required to ensure the safety of all persons working or present on-site during construction.

7 Summary of Information

The summary of information is based on the findings and recommendations contained in the previous sections of this report.

Table 1 Summary of Information

Is this Natural Disaster damage?	Yes (Landslip)
Land within 8 m of dwelling or appurtenant structures	Yes
Area of land **damaged** Evacuated Inundated	 11 m^2; 6 m^3 Nil
Area of land at **imminent risk** Evacuated New Inundation Re-Inundation Cosmetic damage to garage cladding	 5.5m^2; 3 m^3 Nil Nil Nil
Main accessway within 60m of dwelling	N/A
Retaining Walls supporting or protecting insured buildings and/or land located within 60m of dwelling or appurtenant structures	N/A
Dwelling & appurtenant structures	
Imminent Risk of damage	Yes - 20m^2 floor area
Services within 60m of Dwelling or Appurtenant Structure	N/A
Bridges or Culverts situated on insured land	N/A
Conceptual Remedial Works:	
Install 6m deep 6.0m long in ground wall comprising 13 nos 225mm SED timber piles	$13,000 + construction costs* (excluding GST)

*To be assessed by an EQC cost estimator

8 Applicability

This report was produced for EQC for the sole purpose of assisting EQC to determine whether it has any liabilities under the Earthquake Commission Act 1993 and it may not be relied upon in other contexts or for any other purpose, or by any person other than EQC, without prior written agreement.

Yours Sincerely
On behalf of WSP

Compiled by:

Richard Pearson
Senior Civil Engineer

Approved for release by:

Aaron George
Principal Geotechnical Engineer

9 Appendix

- Appendix A – Site Photographs 1-8
- Appendix B – Figures 1-3

Appendix A

Photographs

Photographs 1-8 – 1a Seaview Rd, Paihia

Photo 1: View at carparking area at top of access. Access through red circled area.
Photo 2: Photo repeated from Natural Disaster Event Assessment Report showing access to slip from top of access.

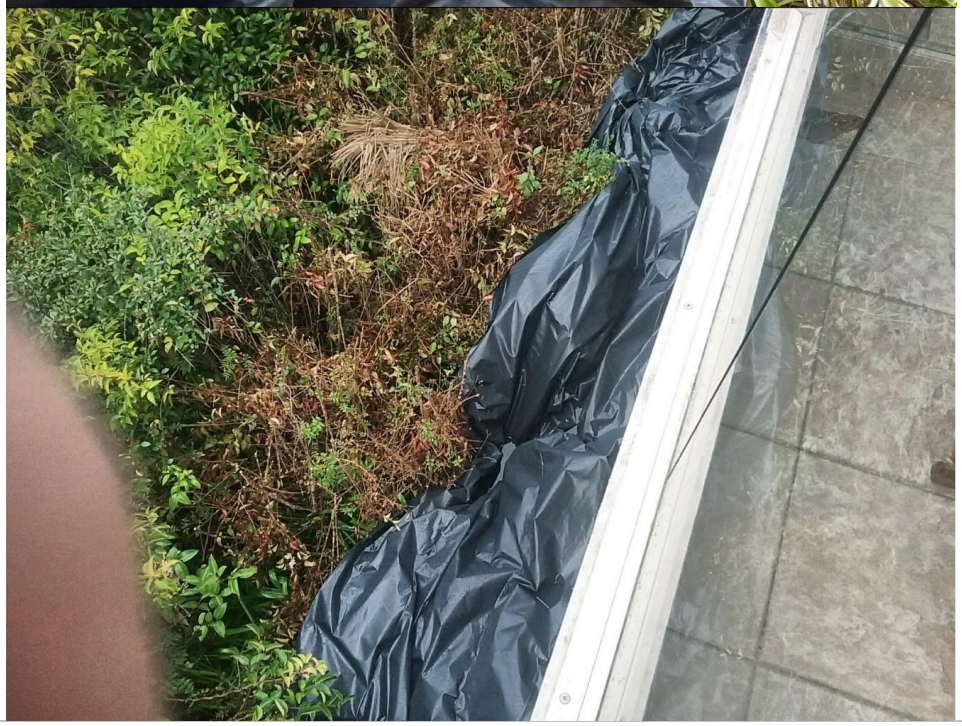


Photo 3: General elevation of slip area showing potential working area.
Photo 4: View of slip area from above.

Photo 5: Western end where ground level is at concrete beam level
Photo 6: Exposed pile #1

Photo 7: Exposed pile #2 & 3 showing scarp
Photo 8: Exposed pile #2 & 3 showing uncontrolled fill under deck on right. Rebar in foreground is monitoring peg from demolition of neighbouring hotel.

Appendix B

Figures

WSP
100 Beaumont St
Westhaven
Auckland 1010

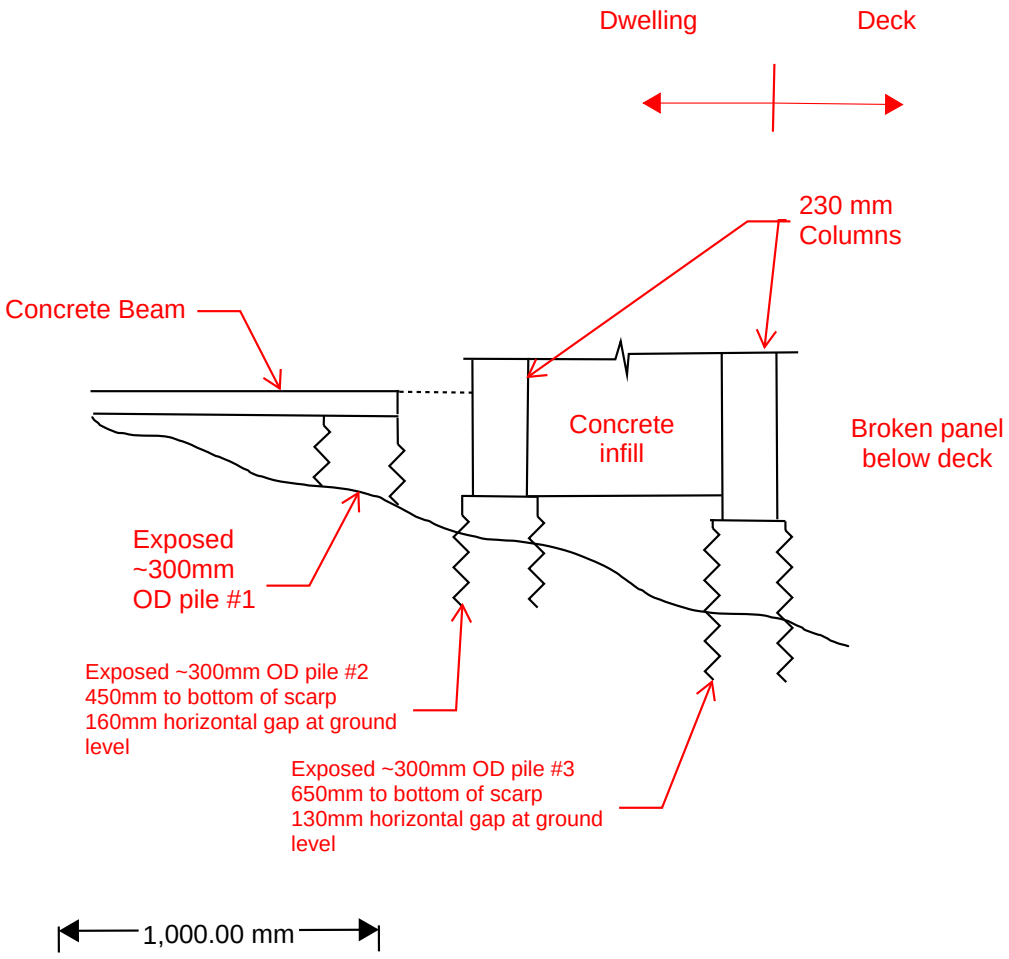
Project	Job number
1a Seaview Road, Paihia	5-C37NB.01
Description	**Revision**
Figure 1 - Land Damage and Imminent Risk Sketch	001
Drawn by / RP	**Checked by** / AG	**Date** / 24/05/21

Far North District Council
Te Kaunihera o Tai Tokerau ki te Raki

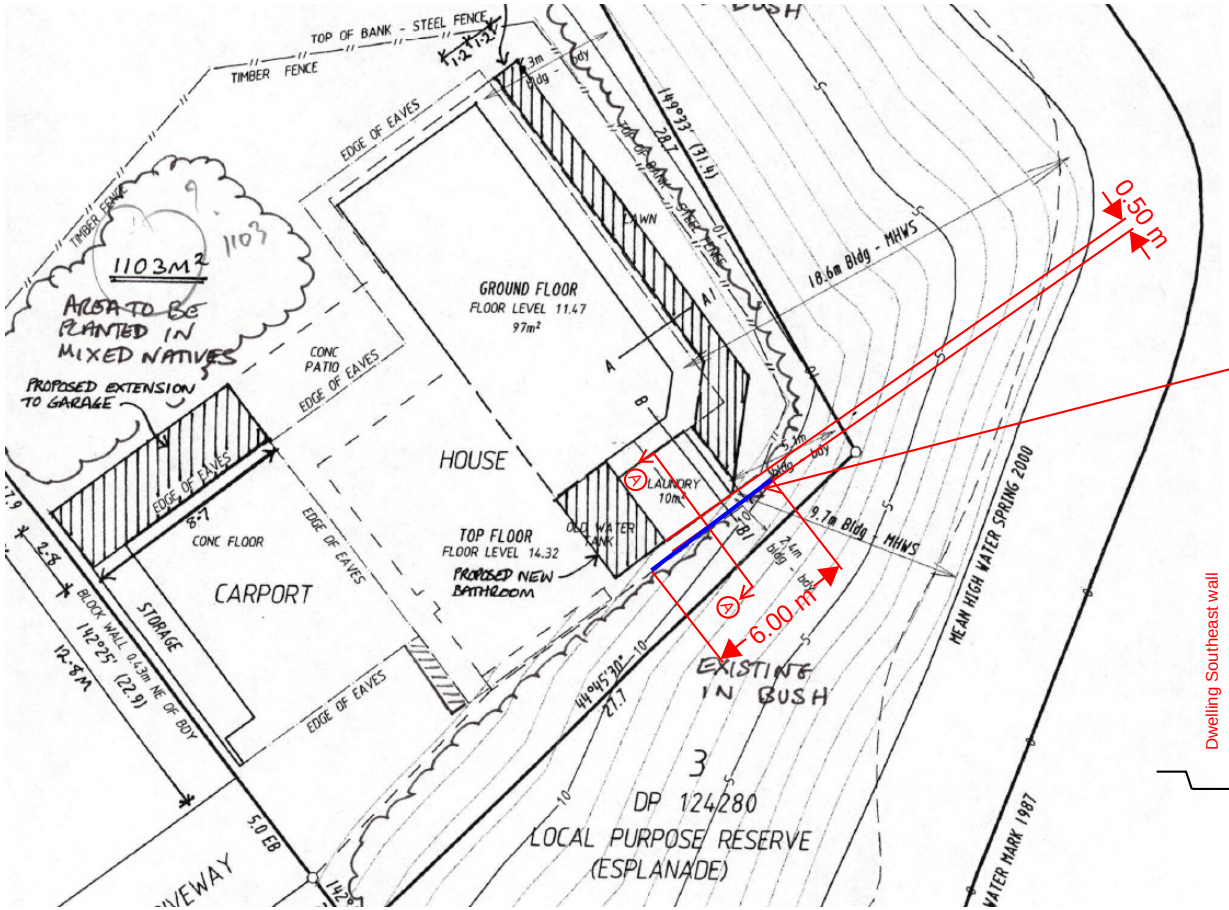
0 10 20 30 m

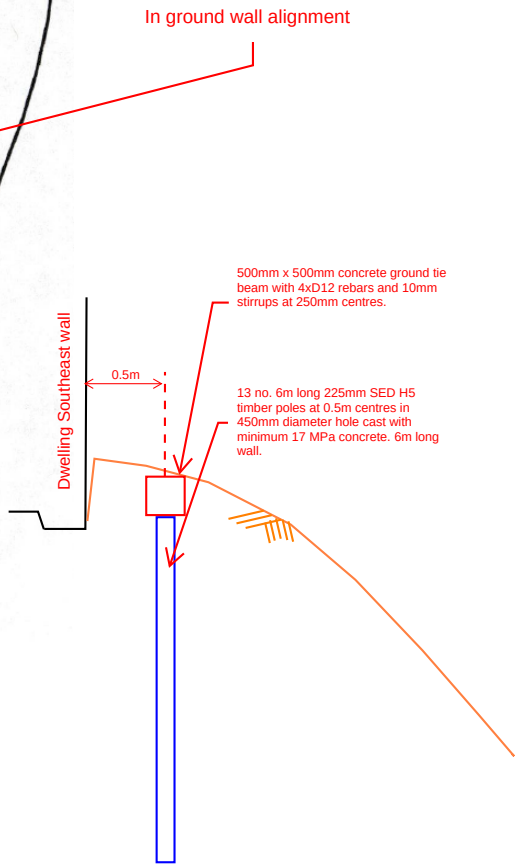
Projection NZTM2000. Datum NZGD2000. Scale:1:282

DISCLAIMER:
While the Far North District Council strives to keep the data in this service current, it may not be the most recent or most accurate data available. No reliance on the information contained on this map by any person is permitted. FNDC will not be liable for any omissions or errors of information contained on this map. FNDC recommends that persons seek specific advice on individual properties from FNDC and other specialist organisations which may hold more up to date or accurate information.



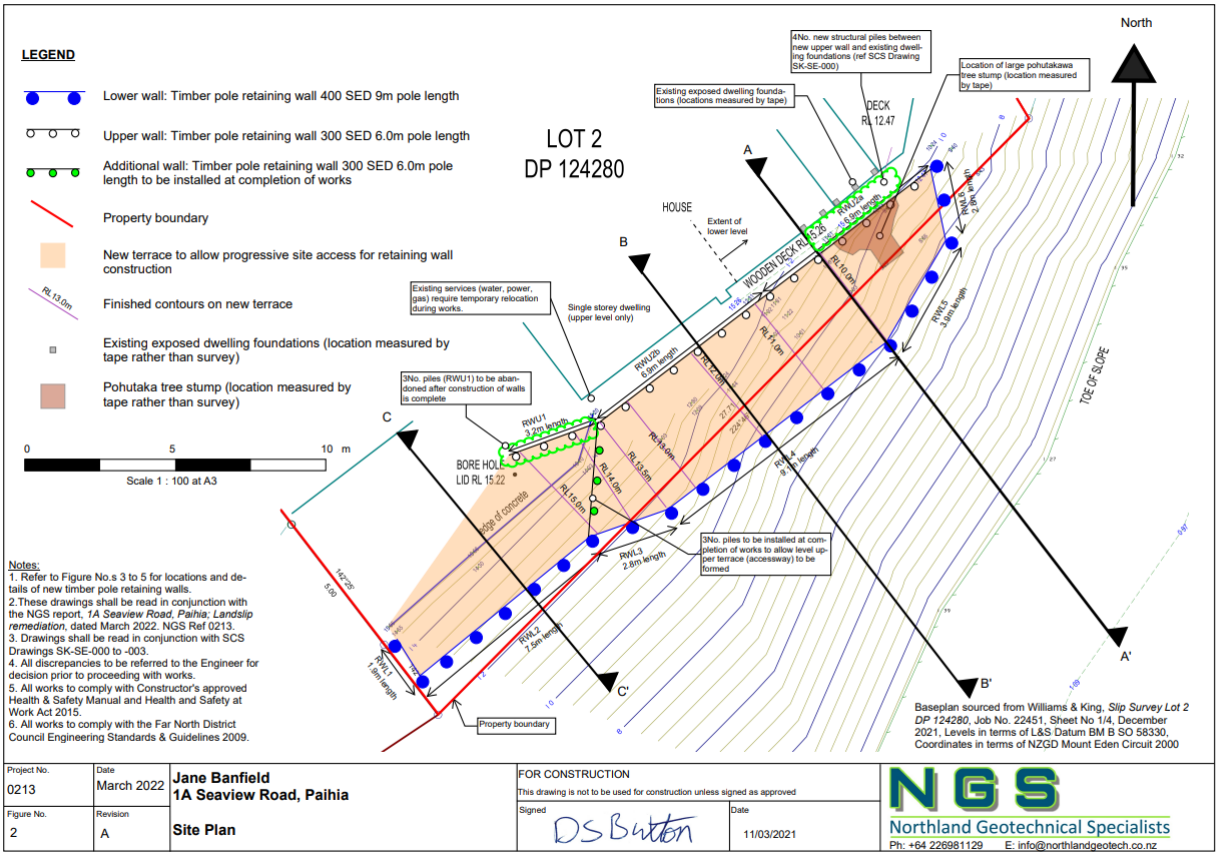
WSP 100 Beaumont St Westhaven Auckland 1010	Project 1a Seaview Road, Paihia		Job number 5-C37NB.01
	Description Figure 2 - Elevation		Revision 001
	Drawn by RP	Checked by AG	Date 06/05/21

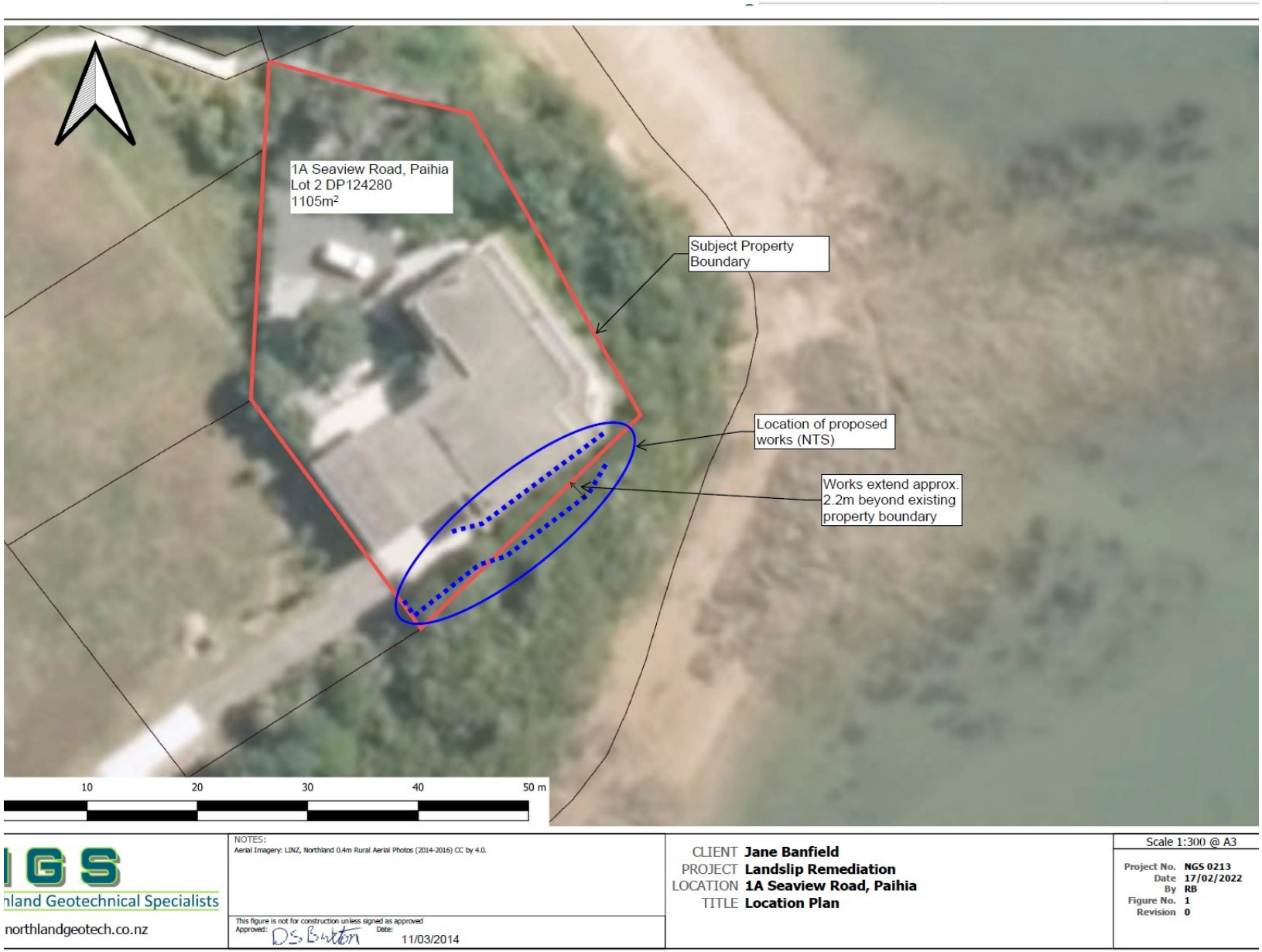




Section A-A (not to scale)

WSP 125A Bank St Whangarei 0110 Mansfield Terrace Service Lane	Project 1a Seaview Road, Paihia		Job number 5-C37NB.01
	Description Figure 3 - Proposed Remedial Works		Revision 001
	Drawn by DW	Checked by AG	Date 06/05/21


LEGEND
Lower wall: Timber pole retaining wall 400 SED 9m pole length
Upper wall: Timber pole retaining wall 300 SED 6.0m pole length
Additional wall: Timber pole retaining wall 300 SED 6.0m pole length to be installed at completion of works
Property boundary
New terrace to allow progressive site access for retaining wall construction
Finished contours on new terrace
Existing exposed dwelling foundations (location measured by tape rather than survey)
Pohutaka tree stump (location measured by tape rather than survey)
0 5 10 m
Scale 1 : 100 at A3
LOT 2
DP 124280
North
HOUSE
DECK
RL 12.47
Extent of lower level
WOODEN DECK RL 12.26
Single storey dwelling (upper level only)
Existing services (water, power, gas) require temporary relocation during works.
Existing exposed dwelling foundations (locations measured by tape)
4No. new structural piles between new upper wall and existing dwelling foundations (ref SCS Drawing SK-SE-000)
Location of large pohutakawa tree stump (location measured by tape)
3No. piles (RWU1) to be abandoned after construction of walls is complete
BORE HOLE
LID RL 15.22
edge of concrete
3No. piles to be installed at completion of works to allow level upper terrace (accessway) to be formed
TOE OF SLOPE
Property boundary
A
A'
B
B'
C
C'
Notes:
1. Refer to Figure No.s 3 to 5 for locations and details of new timber pole retaining walls.
2.These drawings shall be read in conjunction with the NGS report, 1A Seaview Road, Paihia; Landslip remediation, dated March 2022. NGS Ref 0213.
3. Drawings shall be read in conjunction with SCS Drawings SK-SE-000 to -003.
4. All discrepancies to be referred to the Engineer for decision prior to proceeding with works.
5. All works to comply with Constructor's approved Health & Safety Manual and Health and Safety at Work Act 2015.
6. All works to comply with the Far North District Council Engineering Standards & Guidelines 2009.
Baseplan sourced from Williams & King, Slip Survey Lot 2 DP 124280, Job No. 22451, Sheet No 1/4, December 2021, Levels in terms of L&S Datum BM B SO 58330, Coordinates in terms of NZGD Mount Eden Circuit 2000
Project No. 0213
Date March 2022
Jane Banfield
1A Seaview Road, Paihia
Figure No. 2
Revision A
Site Plan
FOR CONSTRUCTION
This drawing is not to be used for construction unless signed as approved
Signed DS Button
Date 11/03/2021
NGS
Northland Geotechnical Specialists
Ph: +64 226981129 E: info@northlandgeotech.co.nz


1A Seaview Road, Paihia
Lot 2 DP124280
1105m²
Subject Property Boundary
Location of proposed works (NTS)
Works extend approx. 2.2m beyond existing property boundary
10
20
30
40
50 m
NOTES:
Aerial Imagery: LINZ, Northland 0.4m Rural Aerial Photos (2014-2016) CC by 4.0.
This figure is not for construction unless signed as approved
Approved:
Date: 11/03/2014
northlandgeotech.co.nz
CLIENT Jane Banfield
PROJECT Landslip Remediation
LOCATION 1A Seaview Road, Paihia
TITLE Location Plan
Scale 1:300 @ A3
Project No. NGS 0213
Date 17/02/2022
By RB
Figure No. 1
Revision 0

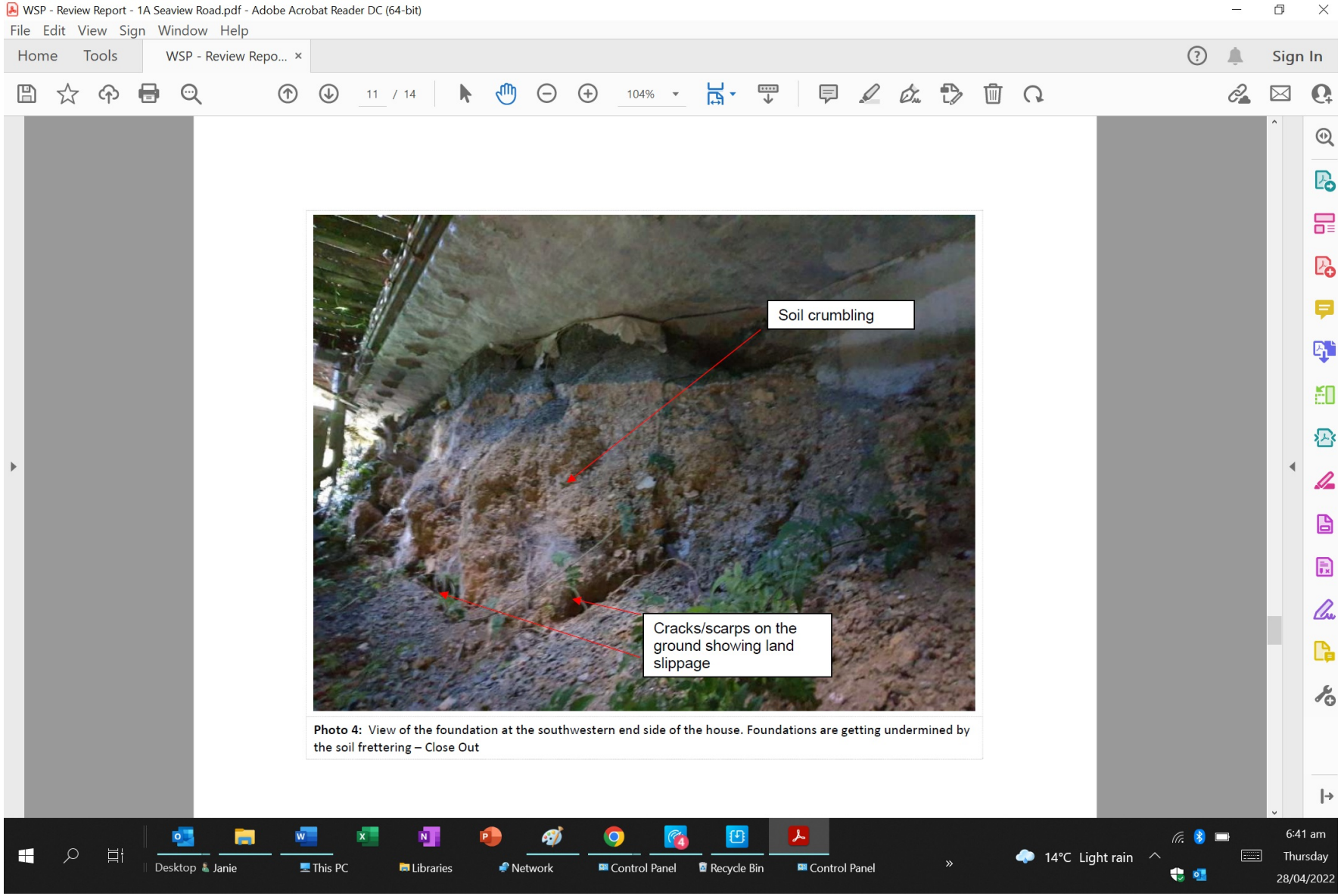


Photo 4: View of the foundation at the southwestern end side of the house. Foundations are getting undermined by the soil frettering – Close Out

WSP - Review Report - 1A Seaview Road.pdf - Adobe Acrobat Reader DC (64-bit)

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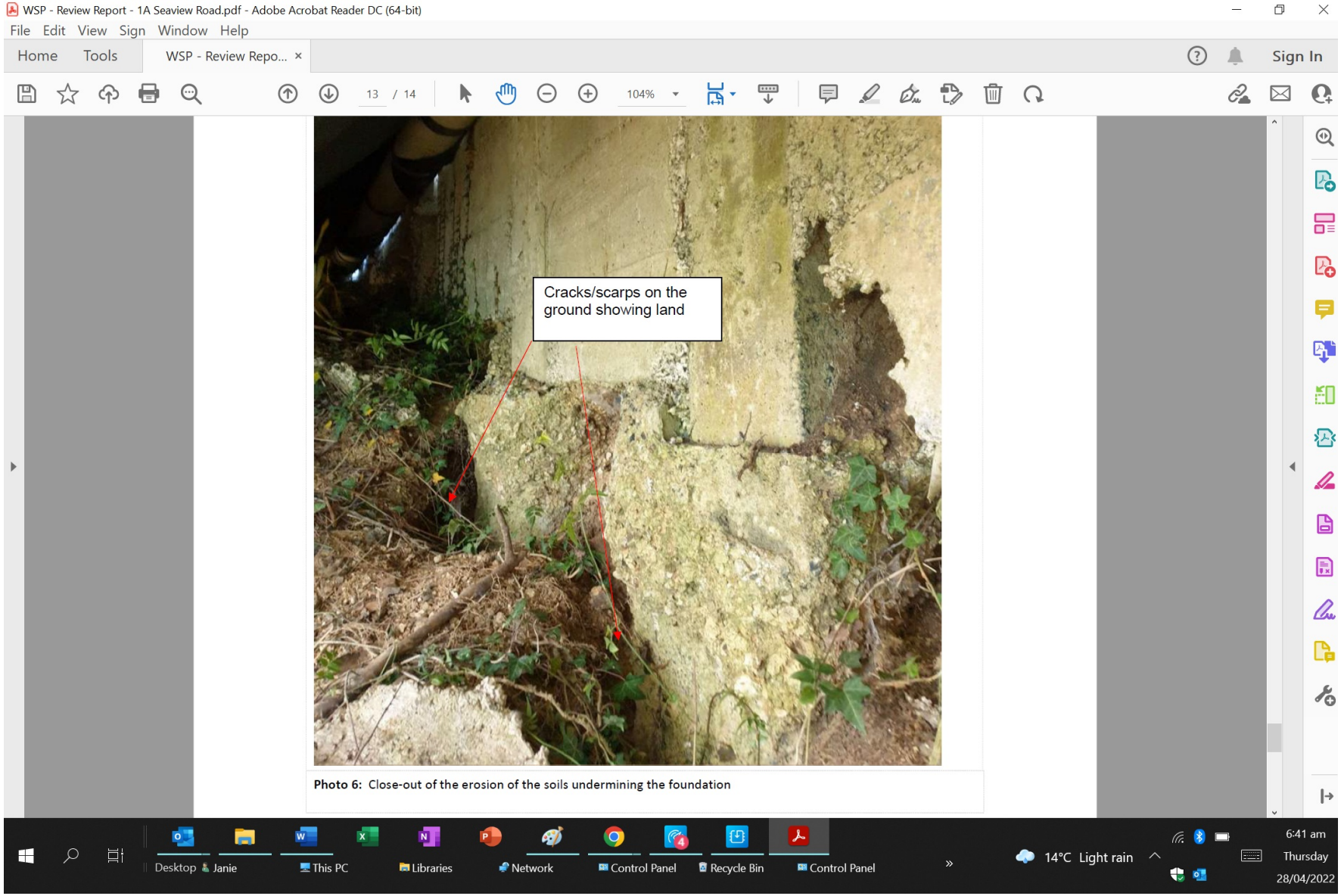
Photo 5: Close-out of the erosion of the soils undermining the foundation

Desktop Janie This PC Libraries Network Control Panel Recycle Bin Control Panel

14°C Light rain 6:41 am Thursday 28/04/2022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104%
Cracks/scarps on the ground showing land
Photo 6: Close-out of the erosion of the soils undermining the foundation
Desktop Janie
This PC
Libraries
Network
Control Panel
Recycle Bin
Control Panel
14°C Light rain
6:41 am
Thursday
28/04/2022