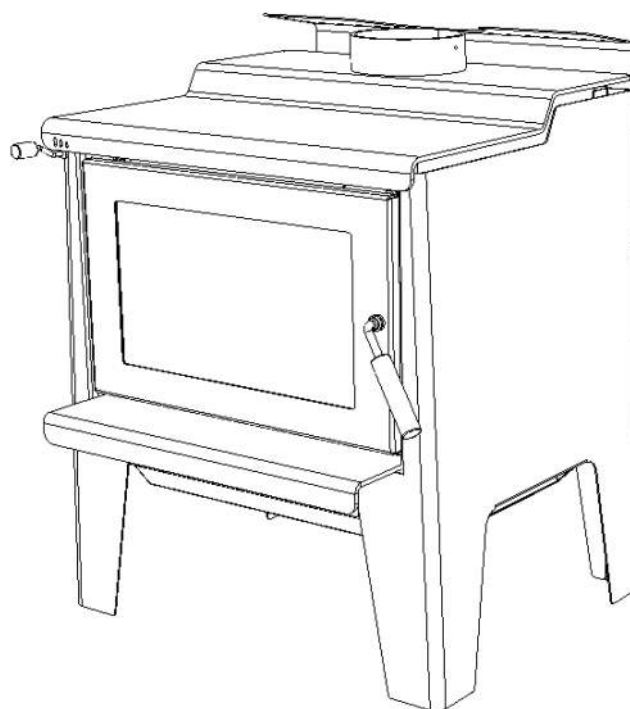
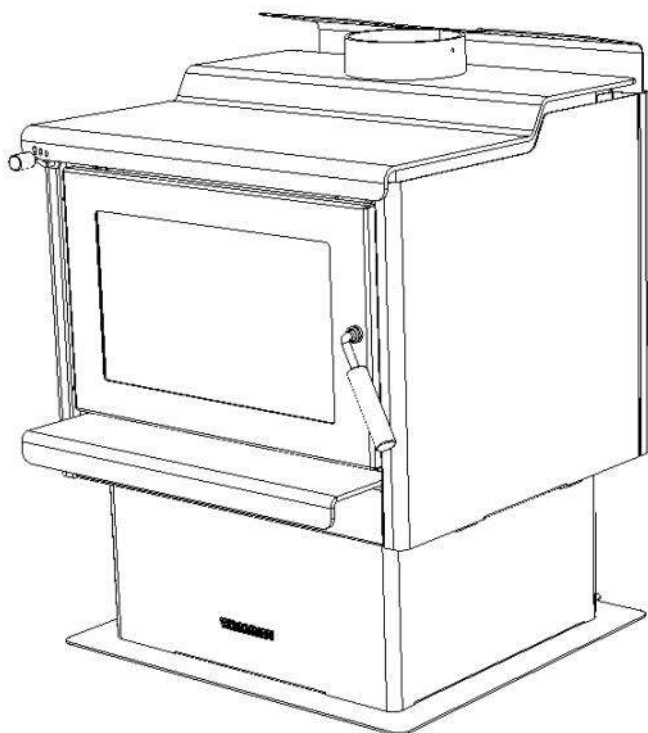




WOODSMAN

Specifications, Installation and Operating Instructions for the: Coleridge & Coleridge Legs



Ultra Low Emission Burner

KEEP THESE INSTRUCTIONS FOR FUTURE REFERENCE

Proudly Manufactured By:



Harris Home Fires
41 Braddon St
Addington
Christchurch 8024
New Zealand
Email sales@hhf.co.nz

P O Box 4043
Christchurch 8140
New Zealand

Phone 03 366 1796
Freephone 0800 3661796

Testing and Certification

MODEL	AS/NZS 2918:2001	CM1.6 (ULEB)	AS/NZS 4012:2014	AS/NZS 4013:2014	Authorisation Number
Coleridge & Coleridge Legs	Complies	—	66.3%	0.49g/kg	211398
Coleridge & Coleridge Legs	Complies	28.6mg/MJ	—	—	211399

Warnings

- Your appliance and flue system should not be modified in any way without the approval of the manufacturer.
- Any modification of the appliance that has not been approved in writing by the testing authority is considered as breaching the conditions of the Serene certification and could be considered unsafe.
- This appliance is not intended for use by persons (including children) with reduced physical, sensory or mental capabilities, or lack of experience and knowledge, unless they have been given supervision or instruction concerning use of the appliance by a person responsible for their safety.
- Do not leave children un-attended near a fire and keep them well away from the fire when in use. Supervise young children to ensure that they do not play with the appliance.
- Do not use flammable liquids or aerosols to start or rekindle the fire. Also do not use or store such flammable materials in the vicinity of this appliance when it is operating.
- The use of some types of preservative-treated wood as a fuel can be hazardous and is prohibited.
- Always keep clothing, firewood, furnishing and other combustible materials at a safe distance from the fire.
- Do not touch any part of the fire other than the door handle and the air control when in use as all other parts can be extremely hot.
- Cracked/broken door glass, makes the installation unsafe. Do not operate the fire with cracked glass.
- Do not use the fire if there is a malfunction, a suspicion of breakage or unusual noises. Contact your nearest Woodsman dealer or Harris Home Fires.
- This appliance should be operated & maintained at all times as per instructions given in this manual.

Failure to follow above warnings, cautionary measures and instruction given in this installation and operation manual will void the warranty of this product.

Before You Install

The installation of any solid fuel burner requires a Building Consent prior to installation commencing. We recommend the installation of a Woodsman solid fuel burner or flue system be undertaken by the holder of a current SFAIT (Solid Fuel Appliance Installation Technician) qualification issued by the NZHHA (NZ Home Heating Association Inc.).
www.nzhha.co.nz

Before Your First Light Up

- Ensure that your appliance has received a Code of Compliance from your local council building inspector.
- Ensure that your installer has sealed all the flue joints as per the installation instructions.
- Check to make sure that all the internal parts (bricks, baffles and air tubes) are properly in place and have not been moved during transit or installation.
- Be aware that when you first light the fire, there will be visible smoke that will come off the paint for approximately 30 to 60 minutes. This is quite normal and is the paint going through the final baking on process. The fire should be fully loaded with wood and run at the high setting for this time. We recommend that you light your fire at a suitable time of day where the area can be ventilated by opening doors and windows and disable any smoke alarms that may be affected.
- Read the lighting instructions in this document.

Before You Use

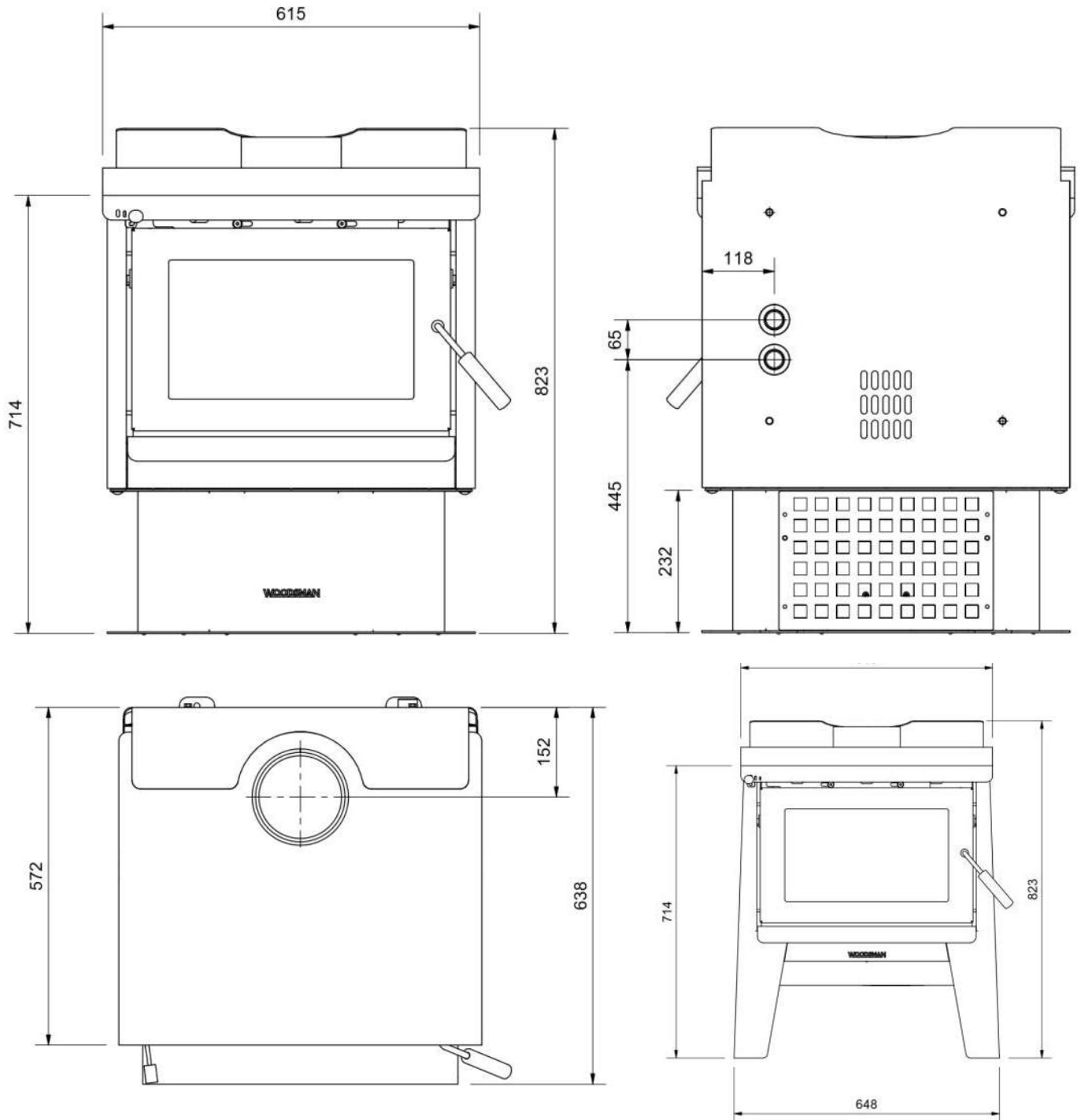
It's important to note that modern clean air wood burners are different from older, non clean air approved burners. They operate differently and have different levels of maintenance. It is important to understand these differences to ensure that your fire operates efficiently, hassle free and you are doing your part to keep the air clean.

- Lighting your fire properly is important to ensure that the rest of the burn is clean and efficient.
- Your clean air approved burner has some consumable parts that your old fire probably didn't have.
- What type of wood you burn, its quality and how you burn it has a big impact on burn efficiency, air quality and the life of the consumable parts.

Please have a careful read of the rest of this manual to familiarise yourself with the best practises for using, maintaining and enjoying your Woodsman fire.

It's also important to be aware that a wood stove is a hands on and practical appliance. It requires user maintenance on a regular basis and you need to be prepared to perform the tasks listed in the guide. If you are not able or confident in performing these tasks, please contact a service agent.

Dimensions



Minimum Safe Installation Clearances to COMBUSTIBLE Materials

As tested to AS/NZS 2918:2001 by Spectrum Laboratories, Test report number 0583

Technical Requirements

Floor protector:

Ash Hearth, any non-combustible material of any thickness

Flue Shield:

1200mm high with flue deflector fitted

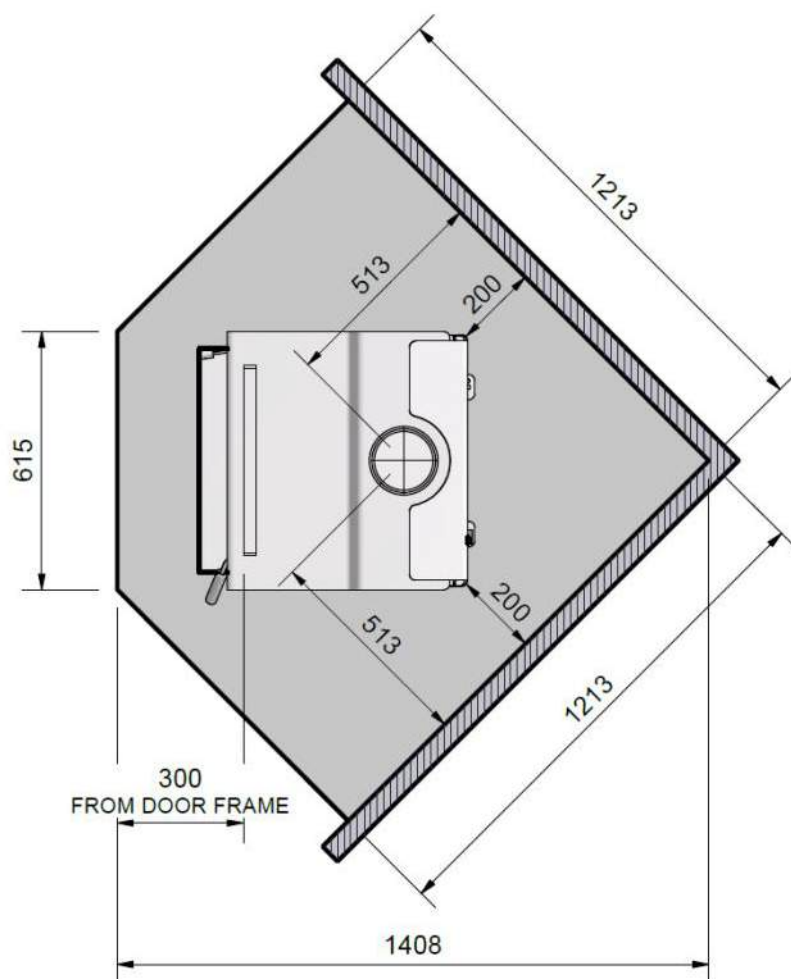
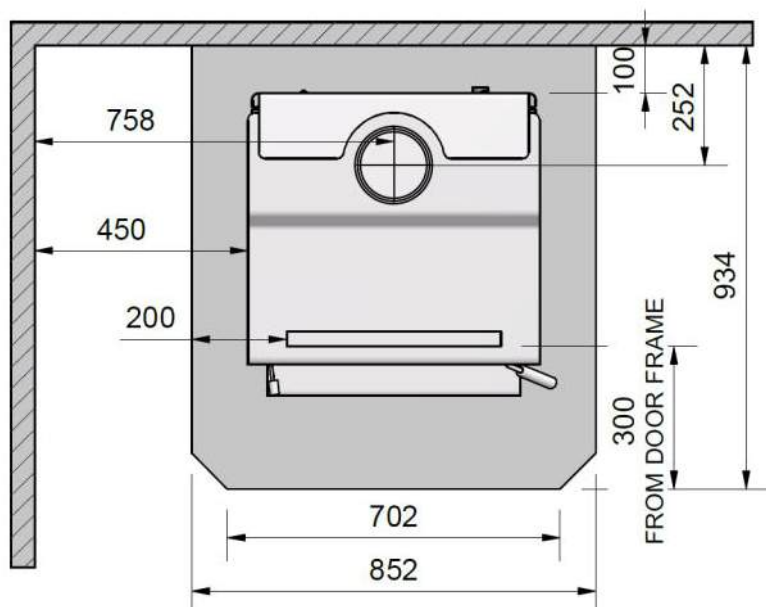
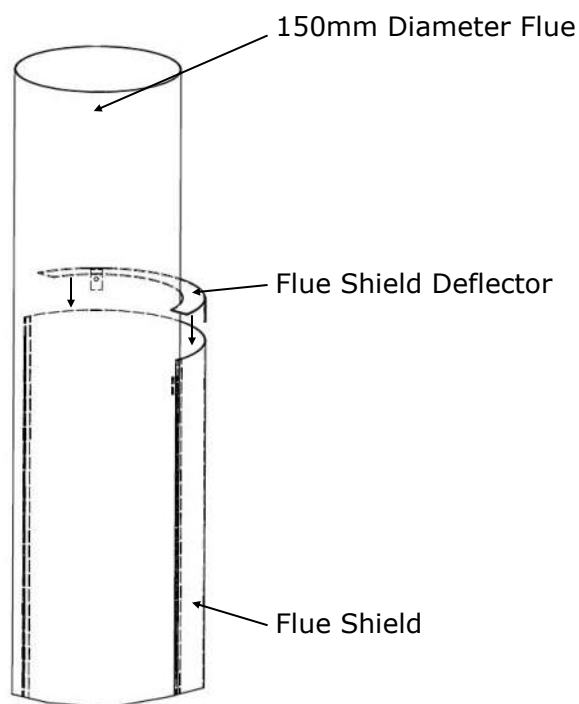
Flue Shield Deflector

WARNING

This part is required to be installed on the listed models with ALL types of flue kits. Failure to do so, may cause the ceiling to over heat. The part is located in the fire itself and not the flue kit packaging.

To fit the heat shield deflector:

- Place the deflector on top of the heat shield and ensure no large gaps
- Fix in place by securing the tabs with rivets to the heat shield



Ceiling Heights

All Woodsman free standing fires have been tested and approved to AS/NZ 2918:2001 App B with a ceiling height of 2.4m and with the factory flue shield fitted in the below configurations. In some cases, the top of the flue shield terminates within 600mm of the ceiling height (refer to AS/NZ 2918:2001 **4.5.2**) but all ceiling temperatures did not exceed the allowable limit in these cases and are therefore able to be installed. Reports are available on request for Councils.

If the ceiling height is less than 2.4m, then heat shielding is required as per AS/NZ 2918:2001 Table 3.2

Sealing Flue Joins

IMPORTANT

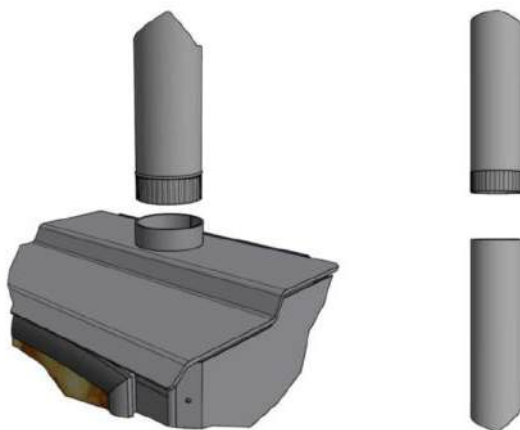
All Flue Joins Are Required To Be Sealed Using Flue Cement

It is extremely important that ALL flue joins are sealed at the time of installation using flue cement or a suitable exhaust cement.

If flue joins are not sealed properly, it can lead to performance issues with the fire such as;

- Lower heat output of the fire, due to decreased performance
- Blocked flue
- Smoke coming out the door when open, due to decreased suction
- Hard to light

The formation of soot and creosote will not seal the flues, especially on the lower lengths, as the high temperatures inhibit its formation.



Any issues that arise as a result of the flues not being sealed, are not covered by the warranty and are not the responsibility of the manufacturer.

It is the installer's responsibility to ensure that this is done at the time of installation.

Installation Instructions

We recommend this appliance be installed by a trained and NZHHA qualified installer.

Warning: the appliance and flue system shall be installed in accordance with AS/NZS 2918:2001 and the appropriate requirements of relevant building code/codes.

Warning: appliances installed in accordance with this standard shall comply with the requirements of CM1.6 where required by the regulatory authority, i.e. the appliance shall be identifiable by a compliance plate with the marking "Tested to CM1.6".

Caution: mixing of appliance or flue system components from different sources or modifying the dimensional specification of components may result in hazardous conditions. Where such action is considered, the manufacturer should be consulted in the first instance.

Caution: cracked and broken components e.g. glass panels or ceramic tiles, may render the installation unsafe.

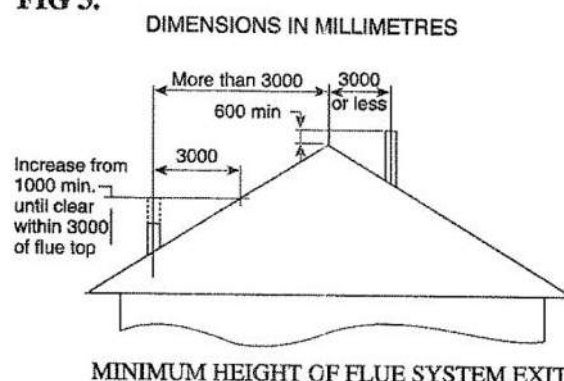
- Maintain a clearance of at least 1 metre between front of the appliance and building structure or any other substantial immovable object.
- Your appliance shall be seismically restrained, including the floor protector using the provided holes or brackets. The restraints should be sufficient enough to resist a seismic loading equal to 0.4 times the mass of the appliance. We recommend a minimum of 8mm dynabolts on concrete floors and 8mm coach screws for wooden floors, of appropriate length.

Minimum Flue Height

The top of the flue system should be at least 600mm above the highest point of the roof ridgeline, if the point of intersection of the flue system and the roofline is less than 3 metres from the ridgeline horizontally.

If the point of intersection of the flue system and the roofline is greater than 3 metres horizontally, the top of the flue system shall be at least 1 metre above the point of intersection with the roofline. (refer FIG 3)

FIG 3.



These are considered to be **minimum dimensions**, and depending on local conditions, **taller flue system heights may be required for satisfactory performance. The total flue height should be no less than 4.6m from the level of the floor protector.**

Flue Installation Detail

Your Woodsman appliance should be installed with a HeatSaver Flue System.

A HeatSaver Flue System is available from all authorised Woodsman dealers throughout New Zealand.

Use of a flue system other than a genuine HeatSaver Flue System may affect the safety of the installation, and may affect your warranty.

Insist on a genuine HeatSaver Flue System.

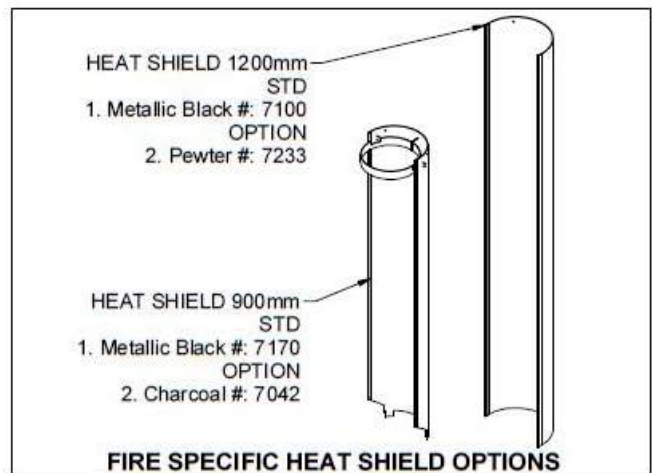
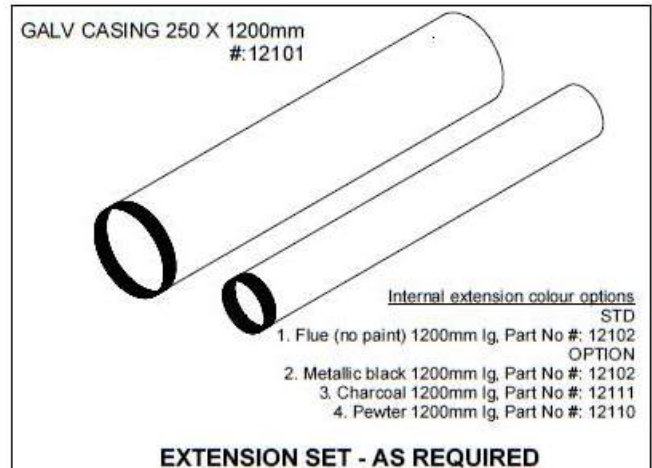
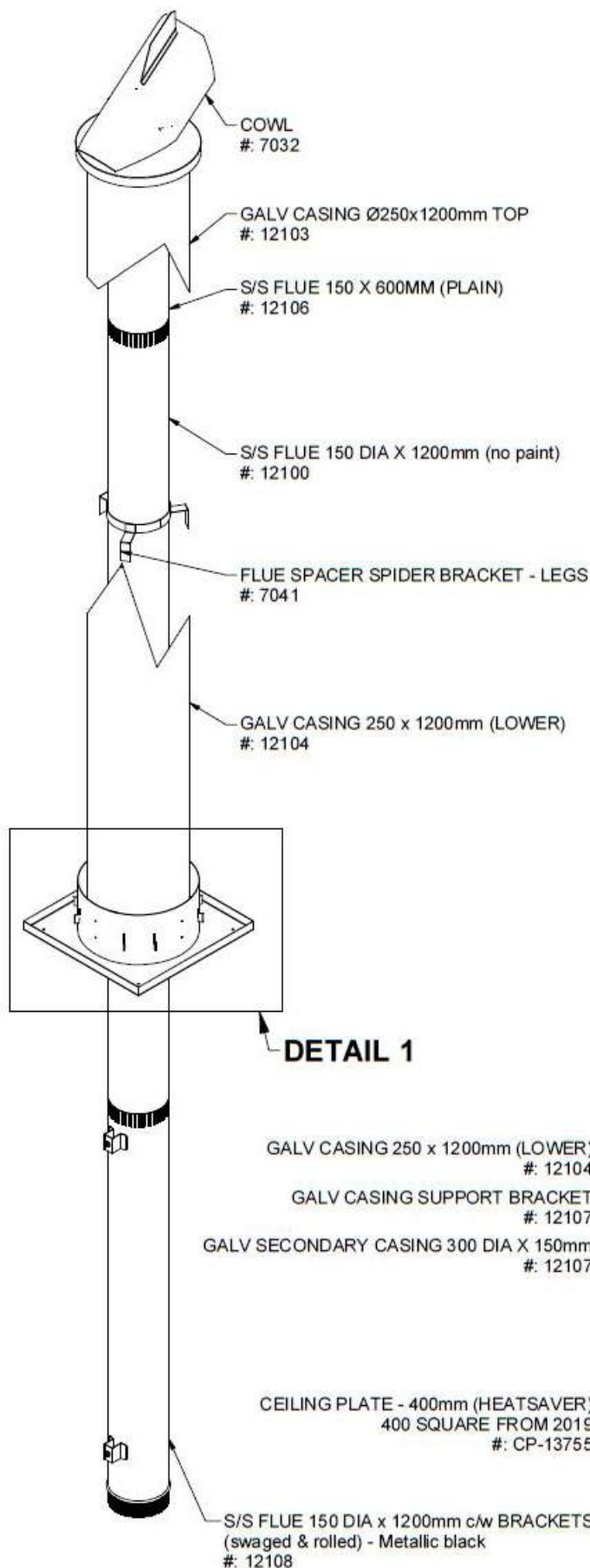
HeatSaver Flue Kit Installation



INSTALLATION INSTRUCTIONS

- This HeatSaver flue system is tested and certified to AS/NZS 2918:2001 Appendix F, which means it is approved for use on all solid fuel appliances with a flue diameter of 150mm.
- A copy of the Laboratory Test Certificate for this HeatSaver Flue System is included as part of these Installation Instructions, (refer to paperwork with flue kit).
- Installation of any solid fuel appliance should only be carried out by suitably trained and qualified personnel.
- Position the stove to the desired position, always ensuring that the manufacturer's minimum clearances to combustibles are complied with.
- Check that there are no roofline ridges or valleys in the way, or if they cannot be avoided, that the installer knows how to weatherproof the penetration and reinstate the full strength of the structure.
- At the ceiling level, construct a square frame of 300mm x 300mm internal dimensions and cut away the ceiling materials from the inside of this frame.
- Lower the 300mm flue pipe casing into this frame and nail in place when the bottom edge is 25mm below the ceiling level and the 8 nail holes provided are touching the timber frame.
- Check all 4 locating brackets are securely in place and drop 250mm diameter lower casing in place. This will naturally settle so it protrudes 25mm below the ceiling.
- Make roof penetration, assemble and fit required flue length and install with upper casing. Secure all joins with at least 3 stainless steel rivets or self tapping screws.
- Frame and brace upper installation as required and flash the roof to shield penetration.
- Fit ceiling plate to ceiling.
- When trimming the stainless steel flue length, ensure the flue is flush with the casing at the top. If it is higher than the casing, the cowl can not be fitted correctly.
- Fix the bottom section of the HeatSaver Columbia Cowl in place and ensure that it is firmly down on top of the casing. Then attach top section by bending tab away from the shaft to allow the top section to slide down onto the washer. Bend tab back in place once done. Do not over bend tab so that it touched the shaft. See page 6
- Secure the flue to the fire, drill through flue neck on fire and secure with 2 to 3 s/s screws or rivets.
- All flue joints should be sealed using a flue cement.
- Ensure a 25mm clearance from the 250mm diameter casing to any combustible material.

HEAT SAVER II FLUE KIT

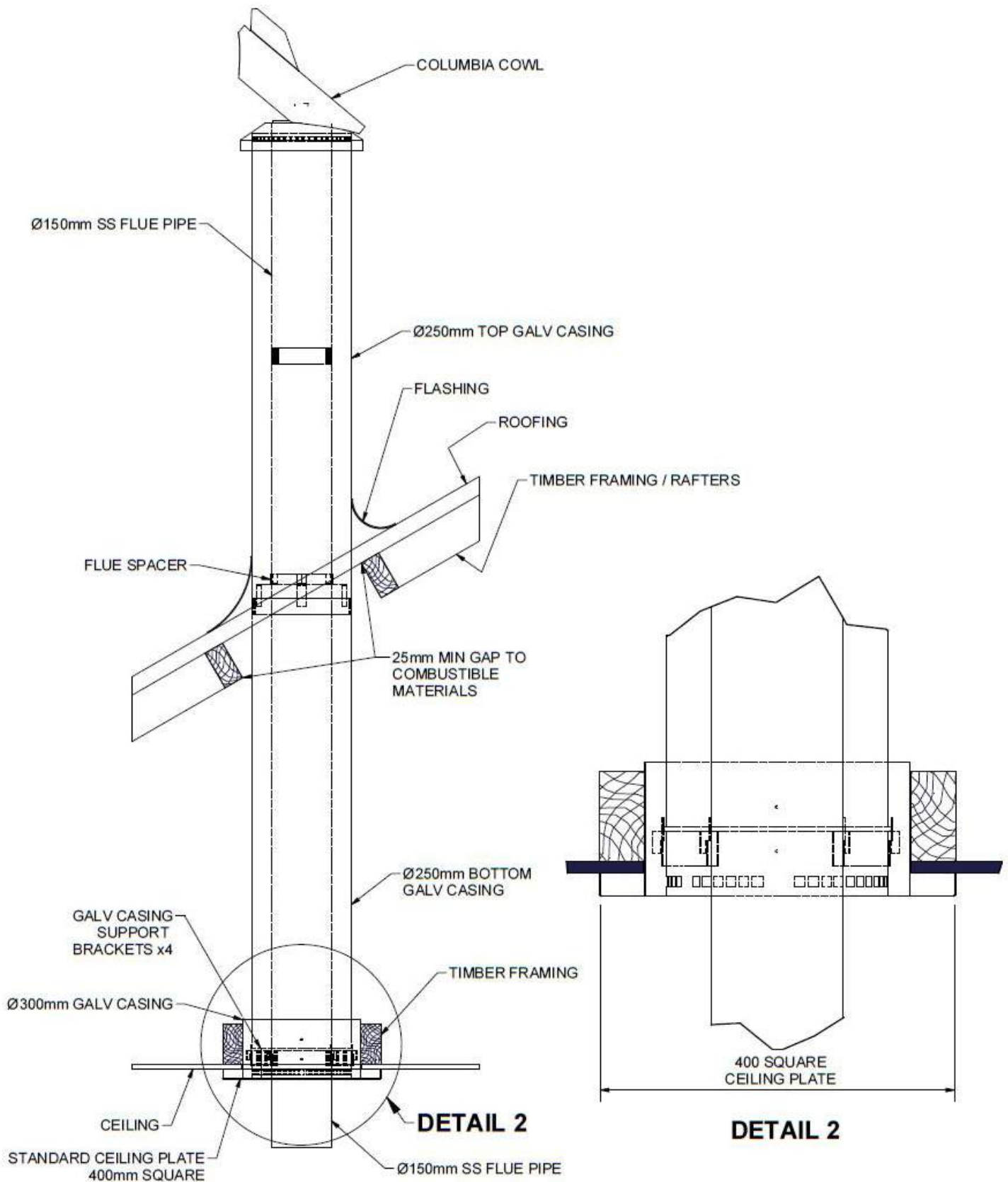


RURAL FLUE c/w DAMPER & HEAT SHIELD BRACKETS
Metallic Black #12134
Pewter #12145

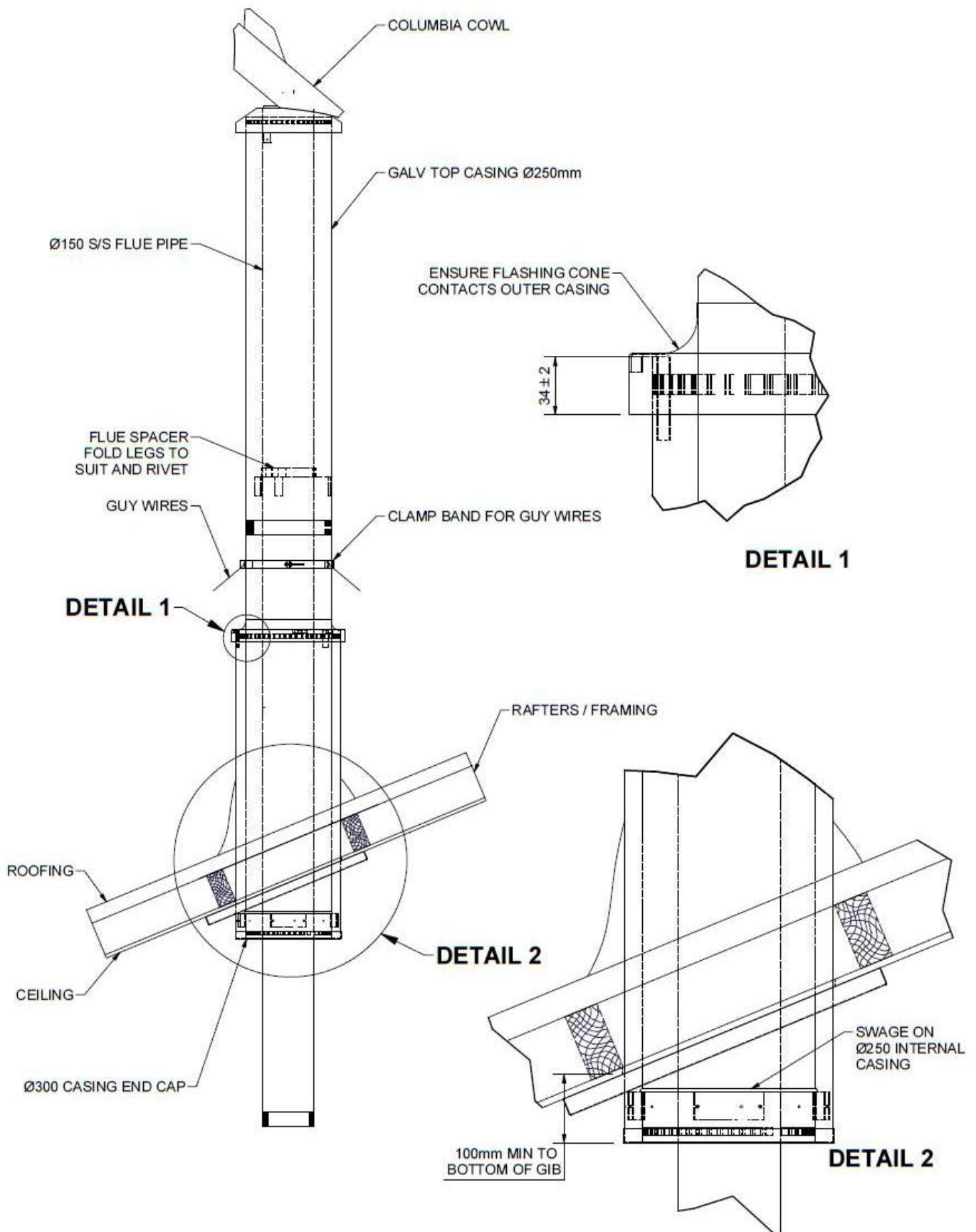
RURAL FLUE OPTION

DETAIL 1

Standard Ceiling



No Cavity (Requires Sloping Ceiling Kit)



HeatSaver Flue Kit Certificate



P.O. Box 687, NELSON,
NEW ZEALAND

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Report 09/1943

January 27th, 2009

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Customer: W.H. Harris Ltd.
41 Braddon St.
P.O. Box 4043
CHRISTCHURCH

P701/1

COPY

Accreditation

Laboratory Registration Number 395

This laboratory is accredited by International Accreditation New Zealand (IANZ). The tests reported herein have been performed in accordance with the terms of our accreditation. This accreditation does not extend to any opinions or any interpretations of test results contained in this report.



IANZ has a Mutual Recognition Arrangement (MRA) with the National Association of Testing Authorities (NATA), Australia, such that both organizations recognize accreditations by IANZ and NATA as being equivalent. Users of test reports are recommended to accept test reports in the name of either accrediting body.

Compliance Certificate

Appliance: HeatSaver 150 mm Diameter Flue Kit

Test Standard: AS/NZS2918:2001 Appendix F

Full Report: 02/749R

(The full report contains the information on the test methods, details of the appliance tested and the results of the test)

This report:

Prepared by: W. S. Webley

W S Webley

Approved by: W. S. Webley

W S Webley

Release Date:

2/3/09

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Lighting Procedure

It is important to follow these steps to ensure the fire will operate as intended and to ensure a clean and efficient light up.

What you will need:

- A. Approximately 16 pieces of kindling wood, about 1kg in weight (total)
- B. 4 x pieces of small sized wood (**intermediate load 1**), approximately 300mm in length, 1.2kg in weight (total)
- C. 4 x pieces of medium sized wood (**intermediate load 2**), approximately 300mm in length, 2.5kg in weight (total)
- D. 3 x natural fire lighter cubes
- E. Matches



Important: Ensure installation instructions have been adhered to before lighting the appliance.

Reminder: For your comfort, it is advised that you light your first fire with the windows open to allow the escape of paint fumes. This will normally happen for the first 30 to 60 minutes of the first burn. Ensure the fire is run at a high temperature during this period.



D
Natural fire lighters

Step 1. Loading the wood for lighting

Place the 4 pieces of small wood (intermediate load 1) across the bottom.

Then stack the 16 pieces of kindling wood in a 'cross stack' style on top of the intermediate load 1 with the 3 fire lighters placed on top of the kindling wood as shown.

Lighting Procedure Continued



Step 2. Light the fire lighter cubes

Light the 3 fire lighter cubes. Once the fire lighters have caught well alight, the main door can be fully shut.



30 mins



Step 3. Load intermediate load 2 (4 pieces)

After approximately 30 minutes (or when the fire has burned down to red embers with minimal yellow flame), the fire is ready for the next load.



Load the '**intermediate load 2**' onto the embers and close the door.

Lighting Procedure Continued



30 mins

Step 4. Regular loading

After approximately 30 minutes, your fire is ready for regular loading of wood. It is recommended that you use a minimum 3 to 4 pieces of wood when reloading your fire.

Reloading Procedure

It is important to note that when and how you reload your fire is important. Please follow these steps when reloading.

The door should not be opened until the wood inside has burned down to red embers and large yellow flames are minimal. The goal is to burn your wood in cycles for the cleanest and most efficient burn.

- If the fire has been on low, turn the fire onto the high setting for 5 minutes before reloading.
- Place the wood in the 'front to back' orientation, and ensure that the size of wood is appropriate for your firebox.
- Do not overfill your fire box with wood. You should fill your firebox only to about 2/3 capacity, approximately 2 to 4 pieces depending on the size.
- Allow the wood to burn right down to large red embers with minimal yellow flame before repeating the process.

Appropriate Firewood

Your Woodsman wood fire is designed to burn logs from trees which would typically be sourced from a reputable wood merchant as firewood.

The most common species is radiata pine, which is a soft wood. Other common species of wood like macrocarpa are also appropriate to use and some hard woods like eucalyptus (bluegum) can also be used.

The size of the wood will vary, but the typical length should be from 200mm to 350mm and the diameter around 100mm to 150mm.

The wood should be appropriately seasoned, which will depend on how it is stored, but the moisture content should be below 25% before use.

Your Woodsman wood fire is NOT designed to burn anything other than typical firewood as stated above, at the risk of damaging your firebox and voiding the warranty.

Do not burn, treated wood, building off cuts, drift wood, rubbish, garden waste, coal, old man pine (or other very resinous woods) or anything other than typical fire wood. If you need further clarification on a fuel, please contact Woodsman or your retailer before using it.

Creosote Formation

A small intense fire is preferable to a large smouldering one, to reduce the amount of creosote. When wood is burned slowly it produces tar and other organic vapours, which combine with expelled vapour to form creosote. These creosote vapours condense in the relatively cool flue of a slow burning fire. As a result, creosote residue accumulates on the flue. When ignited, this creosote makes an extremely hot fire.

The flue should be checked at least every 2 months, during the burning season, to determine if a creosote build up has occurred. If this is the case, it should be removed by a chimney sweep to reduce the risk of an unexpected flue fire.

Your appliance has been designed to produce low levels of creosote at high and low settings.

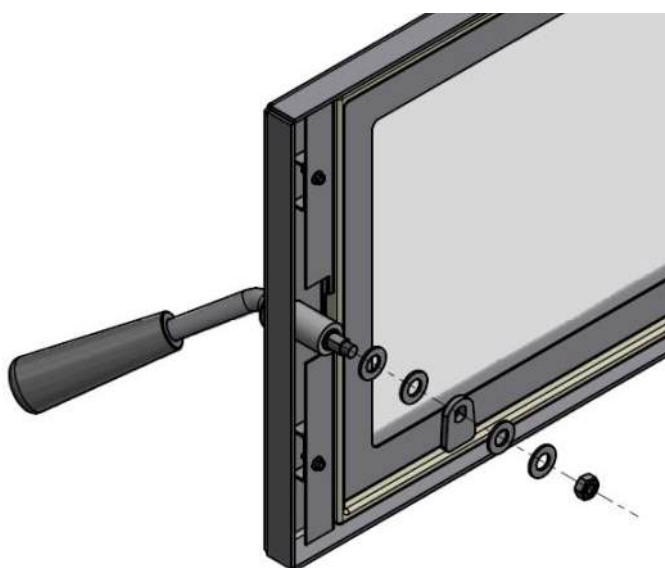
In the event of a chimney fire, close the firebox door, fully close the heat control, vacate the premises and call the fire service.

Storage of Fuel

Do not store fuel within installation clearances or within the space required for refuelling or ash removal. Wood should always be stored in a dry place out of the rain. We recommend your wood be seasoned for at least 6 months before use. Dry wood also burns hotter and more efficient than wet wood.

Door Catch Adjustment

From time to time, your door catch may need to be adjusted to ensure a tight seal. The seal in the door is a fibreglass door rope and will compress over time. To adjust the door catch, undo the nut on the door assembly and redistribute the 4 washers to either tighten or loosen the catch. The door rope will need to be replaced during the life of the fire and you may need to loosen the catch at that time.



Caring for your Fire & Maintenance

Door Glass

- Ensure logs are not too long for the depth of the firebox. Do not attempt to close the door if a log is protruding from the front of the firebox opening.
- A broken glass is caused by the door being closed onto a full firebox or logs not correctly placed into the fire.
- Wiping your glass regularly with the provided glass cleaner wipe when cold will keep the glass clean. The wipe is designed to be used dry and buff the glass clean.

Door Rope

- The door rope will need to be replaced from time to time. When replacing the rope or if the door rope becomes loose, press the door rope firmly back into the retainer. Flue cement or maniseal may be needed to help keep it in place.

Cleaning the Outside of the Fire

- Woodsman fires are finished in a high temperature paint. Only use a damp cloth (no chemicals) when cleaning the outside of the fire. If any scratches occur, you can easily touch up the fire with an aerosol can of matching paint. This is available from your retailer or Harris Home Fires.

Cleaning the Flue

- Keeping your flue clean is important. We recommend that you have your chimney swept at least once a year. A blocked flue not only effects the performance of the fire, but can also be a hazard as you are susceptible to chimney fires.
- Poor quality and wet wood will increase the number of times you will need to clean the flue. Good quality wood is important.

Cowl Maintenance

- Your Columbia Cowl is fitted with a Teflon Sleeve to reduce noise and wear. The Teflon Sleeve may need to be replaced over the life of the fire and should be checked during an annual service or when the flue is cleaned. If the shaft is dry and dirty, it should be cleaned back to a bare metal finish and a thin layer of graphite or high temperature grease applied before replacing the Teflon Sleeve.
- Older versions of the Columbia Cowl do not have a Teflon Sleeve and require re-greasing one to two times a year

Ash Level

- It is important to maintain a 2 - 3cm level of ash in the bottom of the fire for insulation purposes. But do not let the level get too high as you run the risk of logs and coals falling out of the fire. You also get less wood in the firebox.

Consumables

Some parts of your Woodsman fire are considered consumable. They are designed to be replaced as they will degrade over time. The life of the consumables will vary depending on;

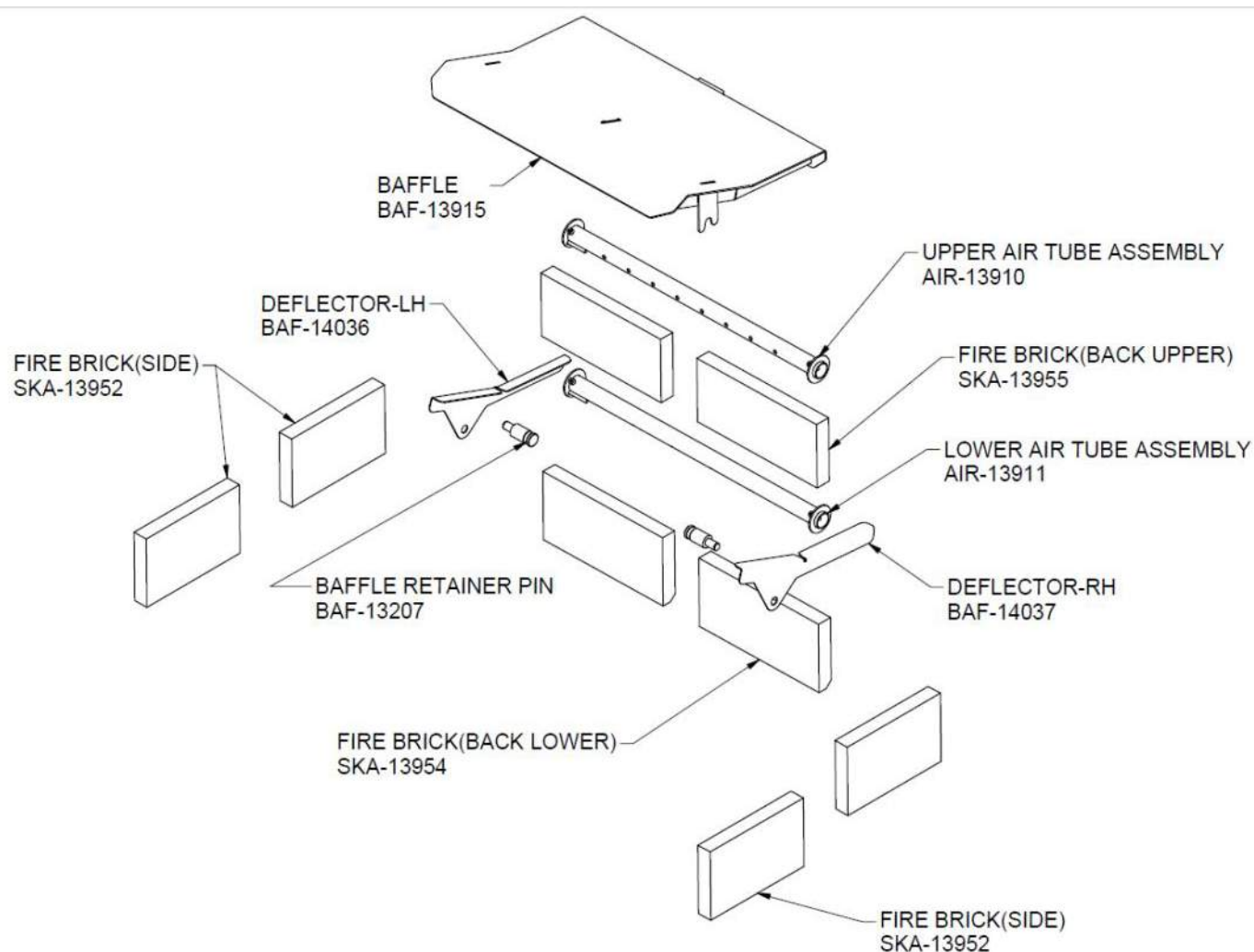
- Frequency of use. How often is the fire used?
- Rate of burn. Is the fire burning on low or high the majority of time?
- Type of fuel. Some woods are much harsher than others.
- Level of ash.

General items that are considered consumables:

- Baffles
- Fire bricks
- Air tubes
- Glass seals and door ropes

It is very important that you replace these parts when they show sign of wear. They effect how the fire runs and you may increase your fuel consumption or lower your efficiency if not replaced, and can in some cases, damage the firebox. It is generally obvious once a part is in need of replacement. Steel components may split or large holes may appear and fire bricks may disintegrate. Fire bricks that are cracked but still remain in place are completely safe to use and only need to be replaced when they no longer remain in place. A cracked fire brick may still last years of use.

We recommend you check your fire visually several times a year for damaged components.



Trouble Shooting

My fire won't turn down

The first thing to be aware of is that some new clean air fires do not shut down like old fires. Old fires used to shut all the way off and the wood would just smolder.

Other reasons for this problem may be:

- Consumable parts have burned out and needs replacing, visually check.
- Door seal is not sealing properly and may need replacing. Take a thin strip of news paper, close the door on it at various spots, if the paper can be easily pulled out, then either a new door rope is needed or door latch needs adjusting by redistributing the washers on the door latch.

There is rust on my fire

Rust appearing on your fire can only occur when moisture or water is present and has began to oxidize the steel.

- Identify where the water or moisture has come from and fix the problem.
- Lightly sand the effected area and use matching Woodsman aerosol high temperature paint to touch up.

My glass is dirty

Your glass can get dirty easily if you use poor quality or wet wood or spend a lot of time with the fire on the low setting.

- Give the fire a good hot run on the high setting to burn off the residue on the door
- If that fails, there are special cleaners especially for this purpose or oven cleaner works well. Do not get chemicals on the paint work.

My fire smokes when I open the door

There are many reasons which may cause this symptom and it is often a process of elimination to remedy the problem.

- Your flue length may be too short. Even though it may be of legal length, every installation is different and you may require an additional length of flue.
- Your flue may be blocked, have the flue looked at.
- The baffle may not be in place correctly, visually check to see if it has moved.
- You may need a cowl like the Columbia cowl to help encourage draw, especially where there are environmental problems like high winds.
- Your flue may be getting too cold. If the flue gases get too cold, they can struggle to be exhausted and when the door is opened, they find it easier to exit via the door than the flue. If you suspect your flue is getting cool, turn the fire up onto high for a few minutes before reloading, this will increase the temperature of the flue and increase the flue draught.
- Check that the installer has sealed **ALL** the flue joints and there are no gaps which will leak air into the flue, reducing the draw.

The paint has been damaged

Paint finishes are not as durable as enameled finishes, but they are extremely quick and easy to touch up and the fire can look new in minutes.

- If damage has occurred to the paint, lightly sand the effected area and touch up using Woodsman High Temperature Paint.

My fire seems to be performing poorly, not burning well on high

If your fire doesn't seem to burn well at the high level, check the following:

- Negative pressure, make sure there are no extraction devices like fans creating a negative pressure in the home.
- The flue length is long enough.
- The wood is dry.
- The flue is clean.



WOODSMAN

Coleridge Warranty

15 Year Firebox Warranty 2 Year Parts Warranty

Your Woodsman Coleridge fire is warranted for a period of 2 year to the original purchaser, from the date of purchase, against defective materials and workmanship which includes the firebox and all parts.

If a part defect occurs, return the part to the retailer or directly to Harris Home Fires along with a copy of the retailers receipt and a replacement part will be sent at no cost. The parts warranty does not cover the cost of fitting and replacing parts. Bricks that are cracked, but remain in place do not need to be replaced and are not covered by warranty.

If a firebox defect occurs, either contact the retailer or Harris Home Fires and it will be repaired or replaced at our discretion with all costs covered.

This warranty does not cover damage caused by mishandling, misuse, failure to follow the manufacturer's installation and operating instructions, or work done by others, such as installers, or plumbers etc. The manufacturer shall not be responsible for site conditions such as insufficient draught, downdraughts, or routine servicing and adjustments.

Damage caused by the failure to replace consumables like air tubes, baffles and fire bricks or not burning the recommended fuel, may void the warranty.

Your Woodsman Coleridge firebox is then covered by a further 8 year warranty against defective materials and workmanship during normal domestic use.

In the case of a claim after the second year, this warranty covers the cost of replacement or repair at the manufacturer's discretion and includes freight, painting and all required refurbishment.

Your Woodsman Coleridge is then covered by a further 5 year warranty on the fire box against defective materials and workmanship during normal domestic use.

In the case of a claim after the first 10 years, It shall be the owner's responsibility and expense to have the fire disconnected and ready for pickup from onsite or another suitable location or deliver the WOODSMAN fire to either the dealer from whom it was purchased or directly to Harris Home Fires. Harris Home Fires will pick-up, repair and refurbish the fire, including painting as necessary and deliver the fire back to the customer.



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Christchurch 8140
New Zealand

Phone 03 366 1796
Freephone 0800 3661796
Fax 03 366 1795



Erosion and Sediment Control Guidelines for Small Sites



Erosion and Sediment Control Guideline for Small Sites

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6.	Provide stabilised all-weather access
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8.	Control erosion of the site
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10.	Control sediment at the foot of the site
11.	Control sediment at the foot of the site
12.	Stockpiles and building materials within the sediment control zone
13.	Connect all downpipes as soon as possible
14.	Manage litter and building waste – especially concrete
15.	Manage litter and building waste – especially concrete
16.	Promptly stabilise service trending & Maintain and carefully decommission control measures and stabilise the site

Why do small sites need erosion and sediment control?

The construction of buildings/houses on individual lots usually starts after the bulk earthworks for urban development have been completed. Ground disturbance for buildings is on a much smaller scale, but the cumulative impact from these small sites can be considerable: in some cases they may discharge as much sediment as the bulk earthworks phase. Because reticulated stormwater systems are usually installed and operational, they provide an efficient hydraulic conveyance for sediment-laden stormwater from the building site to the receiving environment.

This guide aims to provide simple, effective and realistic advice on how to adopt control methods to ensure the best site protection. By making a few simple changes to your site and daily practices, you will be contributing to a pollution free environment for us all, to enjoy both now and in the future.



The lack of effective controls on a site caused this discharge of sediment into the Cashmere Stream.

What are the benefits of good water and soil management on small sites?

Effective onsite management of soil erosion and water pollution provides many benefits, including:

- Reduced average construction time
- Reduced clean-up costs
- All-weather site access
- Better public image
- Improved wet-weather working conditions
- Improved drainage and reduced site wetness
- Fewer problems with mud and dust
- Reduced stockpile losses
- Better-looking and more marketable sites
- Fewer public complaints.

What are the effects of uncontrolled erosion on small sites?

The effects of uncontrolled erosion and sediment runoff from small sites can include:

- Damage to the building site and structural damage to retaining walls, building foundations, underground services and other structures
- Safety problems when soil, litter and debris are washed onto roads and intersections
- Blocked gutters and stormwater reticulation, soakage and treatment systems, creating flooding and increased council maintenance costs
- Loss of good topsoil
- Pollution of receiving waters resulting in loss of aquatic habitat and reduced biodiversity.

In addition to sediment, other waste from building sites is also transported via the stormwater system directly into rivers and streams from incorrect operation and/or clean-up of:

- Concreting
- Concrete or brick cutting
- Bricklaying
- Brick cleaning
- Plastering
- Tiling
- Painting.

Environmental Law

In New Zealand the Resource Management Act (1991) is the law that protects our environment. It clearly states that every person is responsible for ensuring that their activities and those of their employees do not contribute to pollution of our environment.

Specifically, it is illegal to allow any substance to enter water either directly, through the stormwater system or via the contamination of land without prior authorisation from Environment Canterbury.

Environment Canterbury is committed to caring for our environment and is responsible for both helping the residents of our region to prevent pollution and enforcing the Resource Management Act as necessary.

Breaches of the Resource Management Act 1991 may result in:

- fines under section 15 of the Resource Management Act 1991 (ranging from \$750 to \$1000)
- the prosecution of individuals and/or companies under the Resource Management Act (1991) or (fines of thousands of dollars or prison sentences for serious offences)

Building Act

Many District and City Councils are now requiring erosion and sediment control plans to be submitted as part of any building or resource consent process.

Failure to comply with these requirements may result in failed building inspections, which means time delays with the inspection process and additional costs as a result of follow-up visits from compliance officers and building inspectors. Ongoing non-compliance could result in enforcement action being taken by the District or City Council.

Sequence of work

Following the simple steps below will help developers, builders and tradesmen protect the environment as they do their work:

1. Take a smart approach to multi-lot developments for developers and builders (if applicable)
2. Pre-construction planning and site layout
3. Provide stabilised all-weather access
4. Control water at the top of the site
5. Control erosion of the site
6. Control sediment at the foot of the site
7. Put all stockpiles and building materials within the sediment control zone
8. Connect all downpipes as soon as possible
9. Manage litter and building wastes – especially concrete
10. Promptly stabilise service trenching
11. Maintain and carefully decommission control measures and stabilise the site.

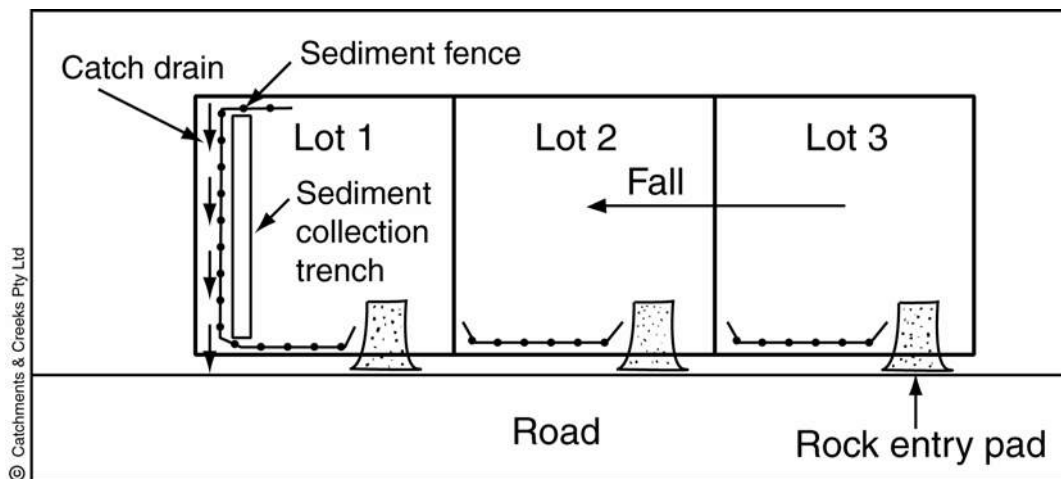
1. Take a smart approach to multi-lot developments for developers and builders

We suggest that developers plan and complete the construction of building platforms and any retaining walls on each lot before sale: this delivers economies of scale and allows use of the erosion and sediment control practices provided for the bulk earthworks phase. It also means that builders only have to disturb each site for footings and access, not major building excavations.

Where builders are managing more than one lot, think ahead about site layout. This will allow you to:

- Design the home to suit the land type: for example, use piers and footings or construct pole homes on steep slopes rather than building slab-on-ground
- Use combined erosion and sediment controls for all the lots, where they are together, to save on time and materials (see figure 1)
- Use signage to inform subcontractors of their presence and purpose.

Figure 1 **Muliti-lot approach**

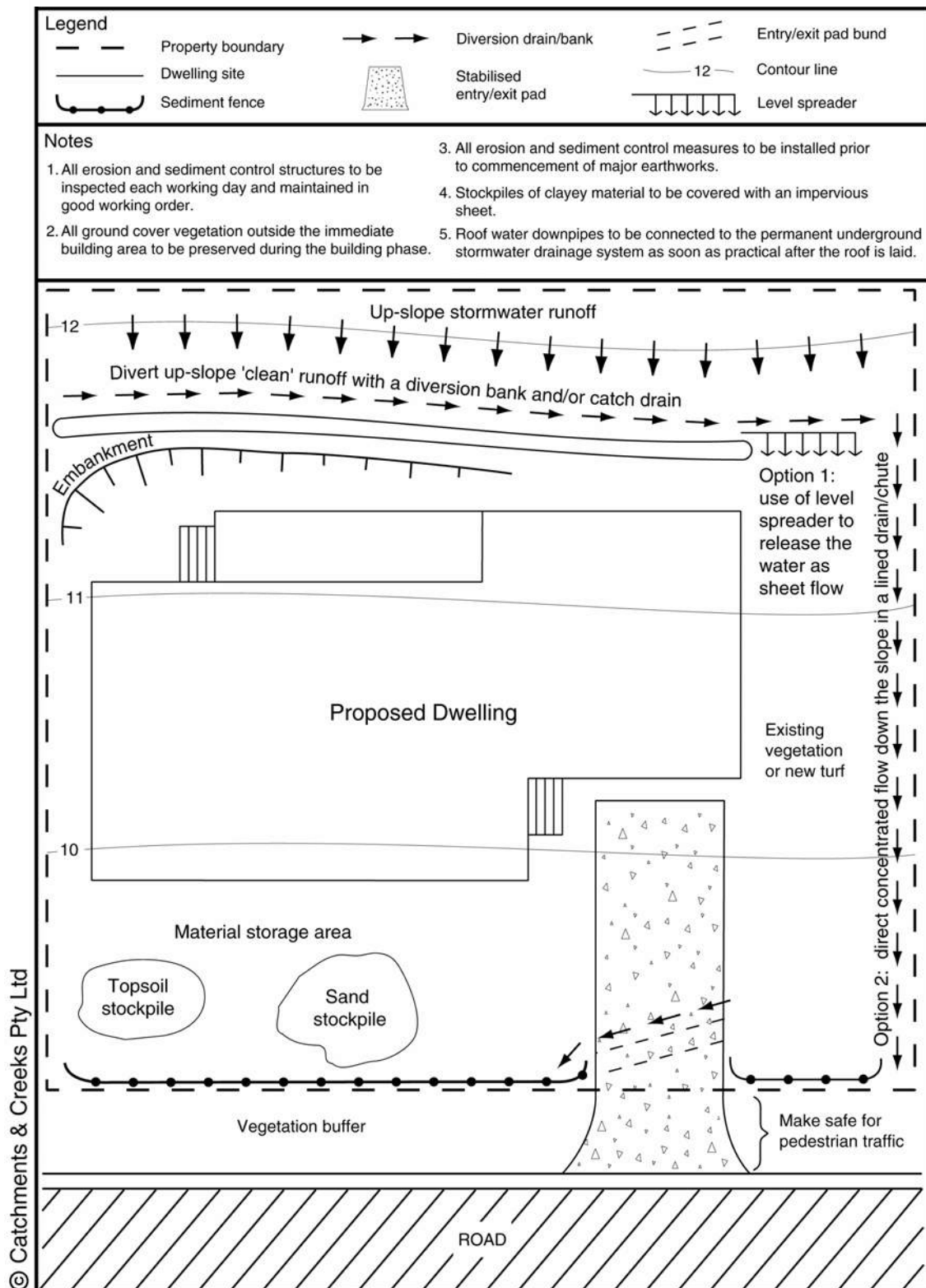


2. Pre-construction planning and site layout

When planning the site layout, think about building location and earthworks needed as this will minimise the number of erosion and sediment controls required on each lot and their interference with the building process. Simple measures could include:

- Minimise site re-contouring and keep earthworks to an absolute minimum: only start them immediately before you start building
- Maintain as much grass cover as possible and install temporary fences to define 'no go' areas that are not to be disturbed
- Direct stormwater flows around the building area and any exposed soils (see step 3)
- Avoid long, steep, unstable driveways; plan to stabilise them as soon as they are constructed and preferably before starting to build (see step 4)
- Allow room for sediment controls (see step 5)
- Do not use exposed aggregate concrete in areas where the wash-off cannot be adequately contained or removed: concrete is lethal to fish even in tiny concentrations (see step 9)
- Prepare an erosion and sediment control plan before starting any earth-disturbing activities (see the example in figure 2). This plan should define a sediment control zone beyond which no soil should be disturbed
- Include in the plan places where tool and paint washing, brick, tile or masonry cutting and water-cooling activities can be done where they will not cause runoff into stormwater systems: aim to contain all wastewater within the site boundaries by locating these tasks on a permeable surface or uphill of an infiltration or, where appropriate, a service trench
- Tell staff and subcontractors not to park on the footpath, grass verge or swale, where they will damage services and track dirt onto the road
- Make sure all subcontractors and tradesmen are fully aware of their requirements and individual responsibilities under this plan: if you document this, it will greatly reduce your liability in the event of any pollution complaints.

Figure 2 Example erosion and sediment control plan for a small site



3. Provide stabilised all-weather access

Local residents often complain about muddy roads when builders start work. Protect your site and stop this source by following the steps below:

- Restrict entry/exit to one stabilised location: this may not be where the driveway will ultimately be
- Wherever practical, extend the stabilised entry right up to the building
- Manage the entry/exit point so that sediment is not tracked offsite: use an aggregate, recycled concrete or rock apron placed over a needle-punched geotextile fabric membrane (see figure's 3 and 4).
- Where the entry/exit area slopes towards the road, install a diversion hump across the stabilised area to direct stormwater runoff to the side for treatment by a sediment fence or sandbag trap.

Figure 3 Typical stabilised all-weather site access

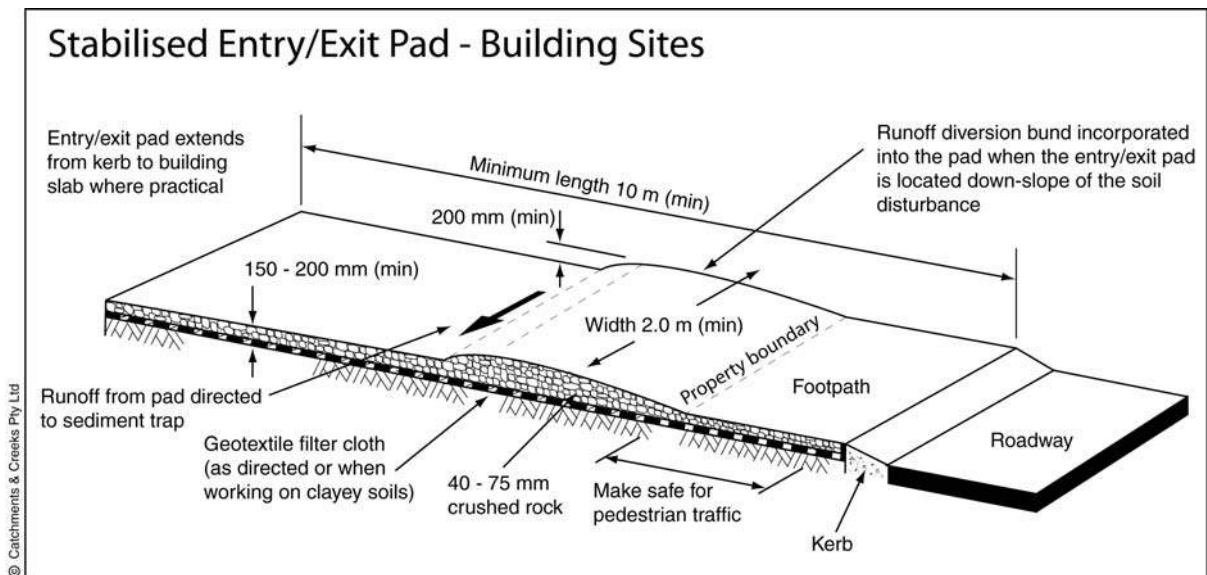
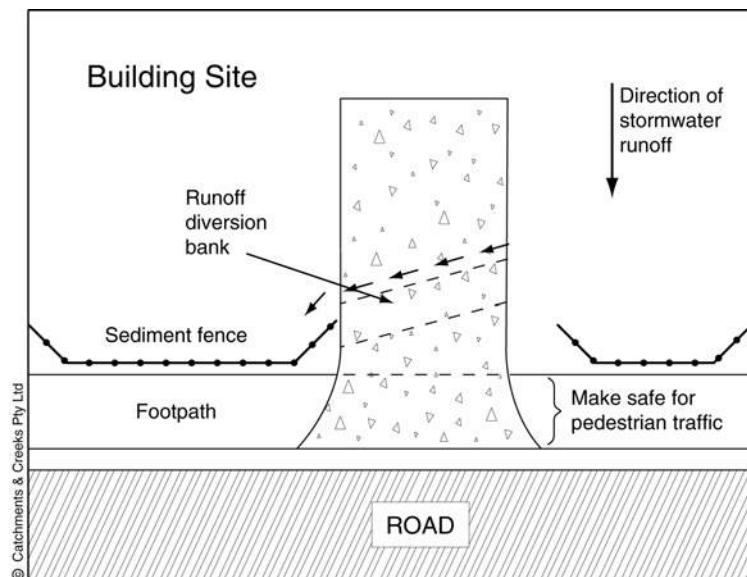


Figure 4 Typical stabilised all-weather site access – PLAN VIEW



4. Control water at the top of the site

Look at figure 6 for ideas on managing the fall of the land and stormwater runoff, to help you plan the layout of your site's erosion and sediment controls.

Keeping water out of your works is a cost-effective site-management tool. Consider the following points:

- Where practical, divert stormwater from above the site around the disturbed area (see figure 5 for a typical diversion channel)
- Steep diversion drains may require a temporary lining of geotextile fabric
- Discharge diverted stormwater onto stable areas; for example, well-vegetated lawn or berms
- Don't divert it onto neighbouring properties unless you have the landowner's written permission
- Direct water away from the site entry/exit point, to prevent it from eroding and thus becoming a source of sediment runoff.

Figure 5 Stormwater diversion channel

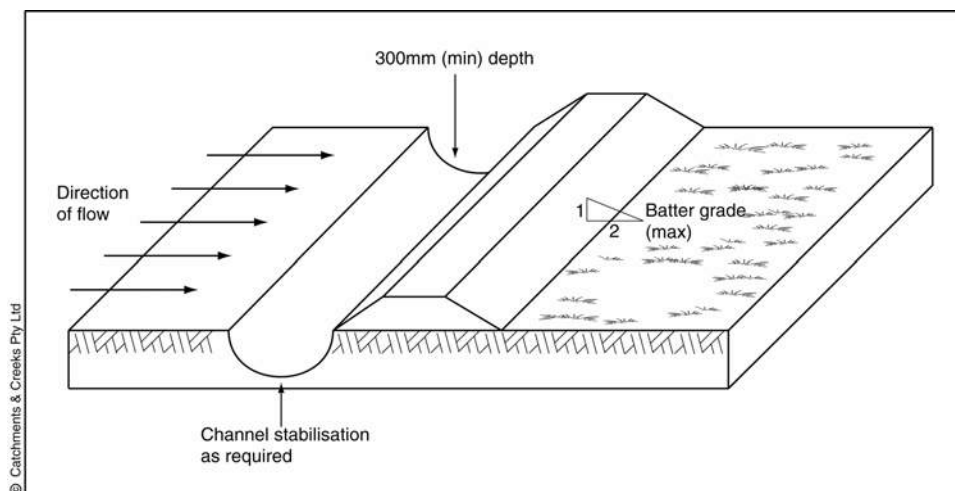
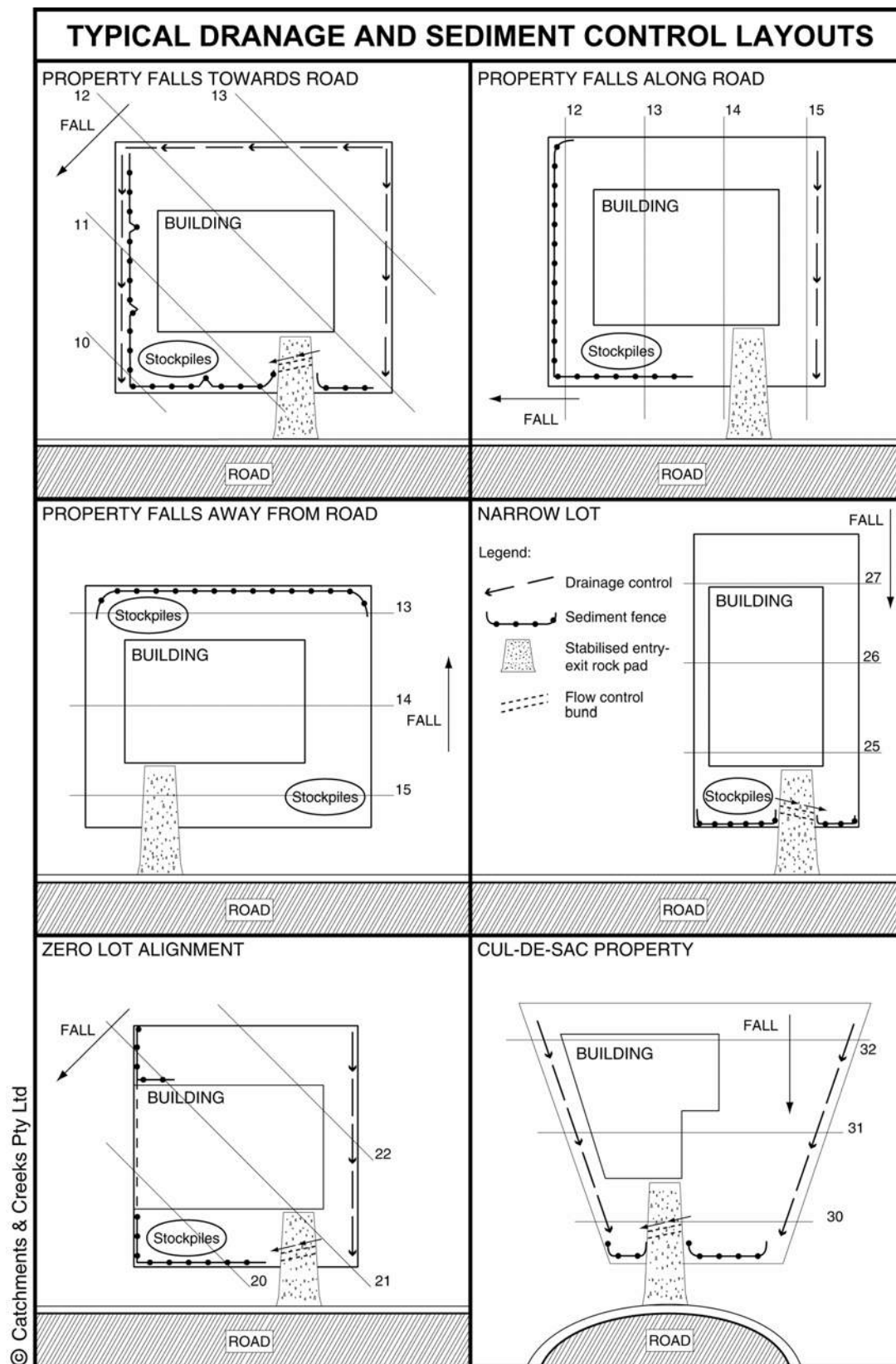


Figure 6 Typical erosion and sediment control layouts



5. Control erosion of the site

It is essential to minimise rates of soil loss from rain impact, shallow sheet flows and wind. Consider the following points:

- Minimise disturbance, earthworks should be limited to the minimum required and should only start immediately before building
- Where practical, maintain kerb vegetation in a healthy and uniform state during the building process (refer figure 7) to minimise erosion and to help filter any sediment
- On soils with a high erosion risk, and on steep sites when there is a delay in building works or site rehabilitation, erosion control blankets can be used to minimise soil erosion from the impacts of raindrops or overland flow (see figure 8)
- Vegetation promotion/suppression blankets are also suitable when revegetating slopes steeper than 4(H):1(V), unless well anchored turf is used
- All ground disturbed by the building activity should be quickly and progressively stabilised (for example, by revegetating) so that it can no longer act as a source of sediment. Turfing is the most effective form of site stabilisation. Grass seeding or hydro-seeding may also be used.

Figure 7 Maintained Grass Area to Reduce Erosion

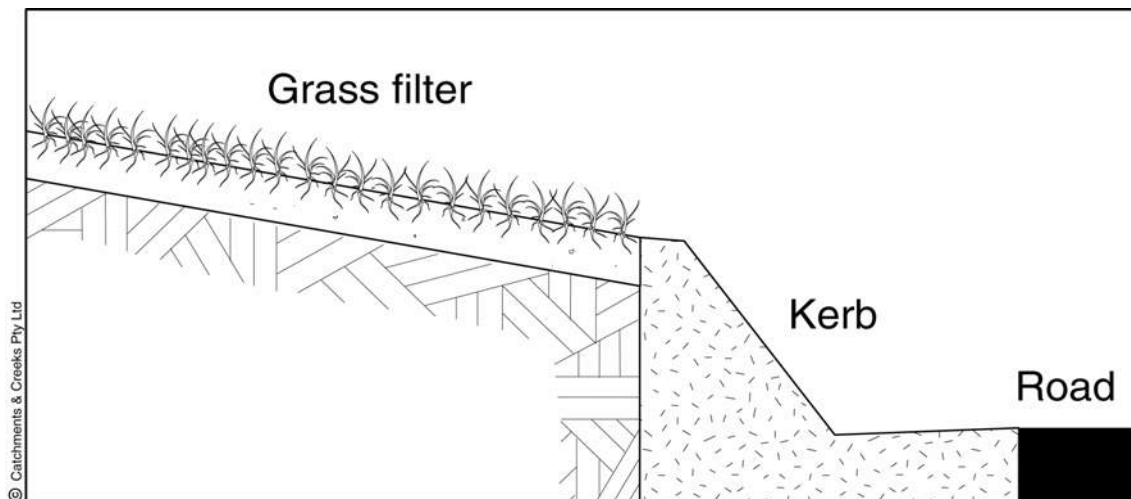
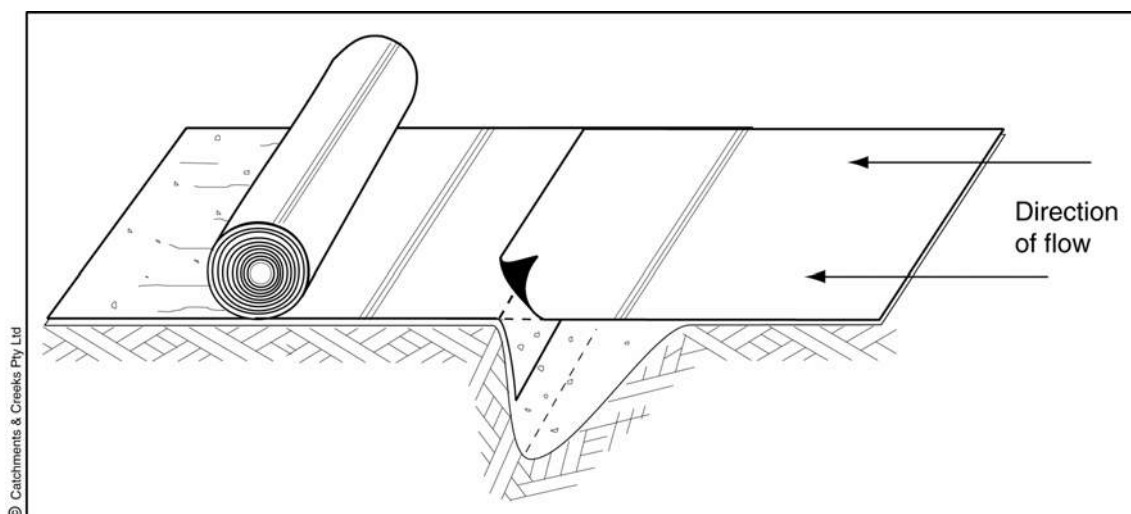


Figure 8 Erosion control blanket installation



6. Control sediment at the foot of the site

Follow the steps below to keep sediment on your site and stop overspill onto public areas:

- Retain any existing grass cover adjacent to the footpath or kerb and channel (as explained in section 5) and make sure vehicles don't drive over it
- Use sediment fences and decanting earth bunds to control and capture sediment in stormwater (For public safety and efficient sediment control, keep sediment fences within the property boundaries unless you have council approval to use public land for these.)

The most efficient sediment barrier for building sites is usually a specifically manufactured geotextile sediment fence. The use of filter cloth or shade cloth is not permitted. A properly constructed sediment fence may be all that is required for sediment control on a properly managed flat building site (refer figure 9).

Sediment fences

Sediment fences should be located downslope of the disturbance, and ideally along a line of constant land level to prevent concentration of stormwater runoff. Where this cannot be achieved, sections of sediment fence should have 'returns' directed up slope for 1-2 metres to control concentration of stormwater run-off.

In areas where it is impractical to bury the lower edge of the sediment fence, the lower 200 mm (min) portion of the fabric should be placed on the ground up slope of the fence and buried under a 100 mm (min) layer of coarse aggregate, 20-40 mm - refer figure 10).

Figure 9 Sediment fence construction details

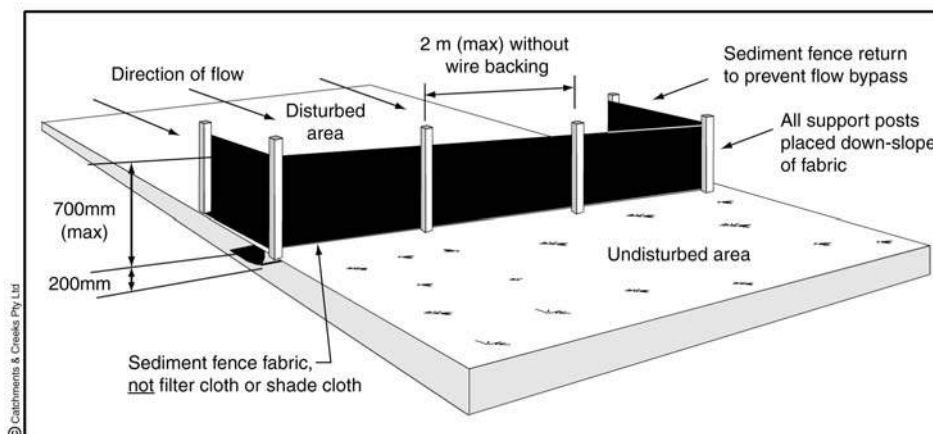
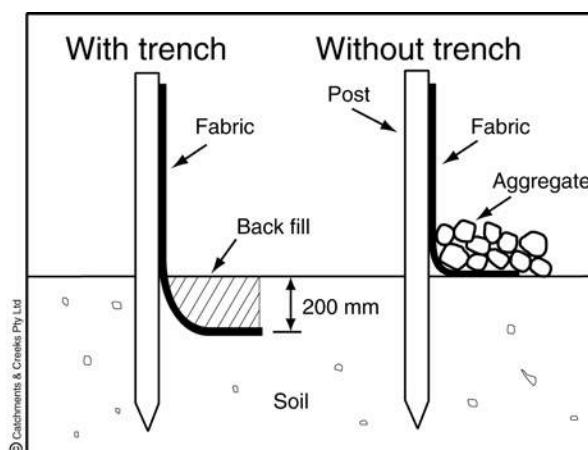


Figure 10 Alternative sediment fence installations (with and without a trench)

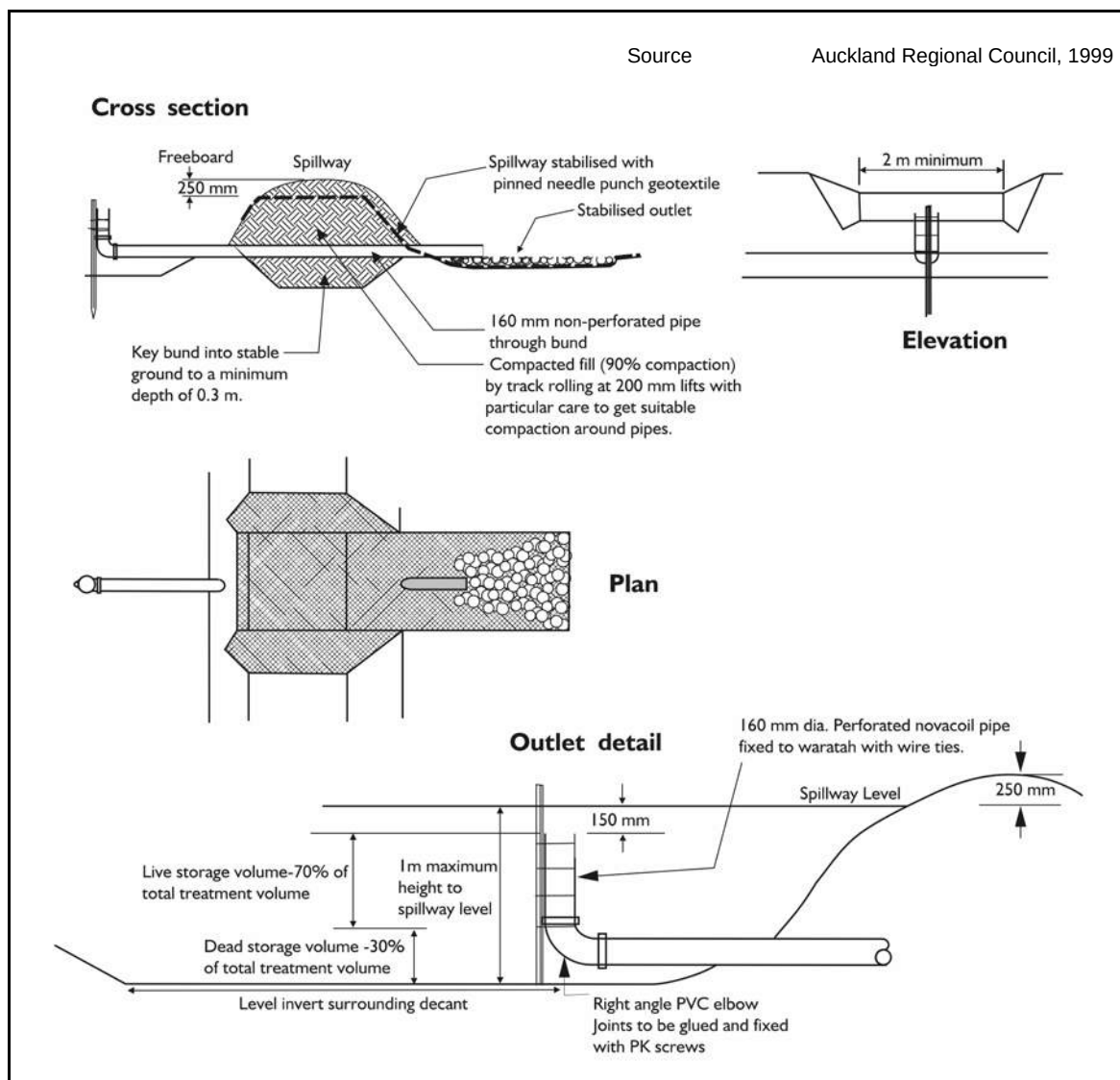


Decanting Earth Bunds (DEB)

DEBs capture slightly finer soil particles than sediment fences, earth bunds control and detain runoff, allowing sediment to settle out. However, they can be outflanked unless well constructed.

- Construct DEBs across slopes and near the edges of the site. The bund can be constructed using soils from the site if suitable (refer to figure 11 for construction details).
- Don't use perforated drainage pipe through the DEB embankment, discharge to bare land, or install them above unstable slopes as seepage may exacerbate land instability.

Figure 11 Decanting earth bund and snorkel upstand



Sump Inlet Protection

- If necessary place control measures around stormwater sump inlets (refer figure 12 and figure 13) to keep sediment out of the public stormwater network and receiving environment.

Figure 12 Flat site - sump inlet protection

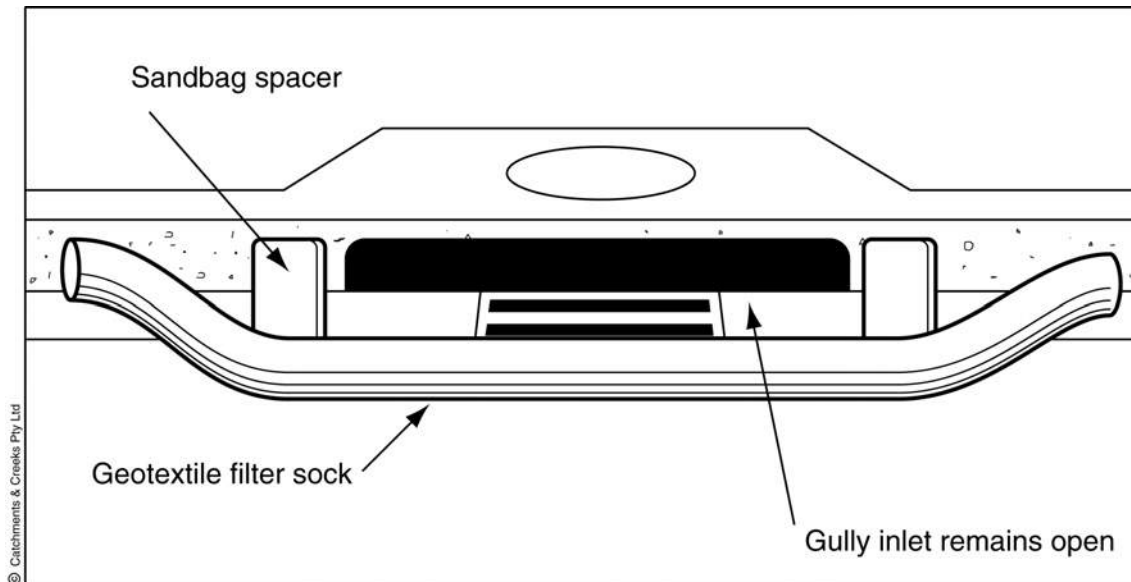
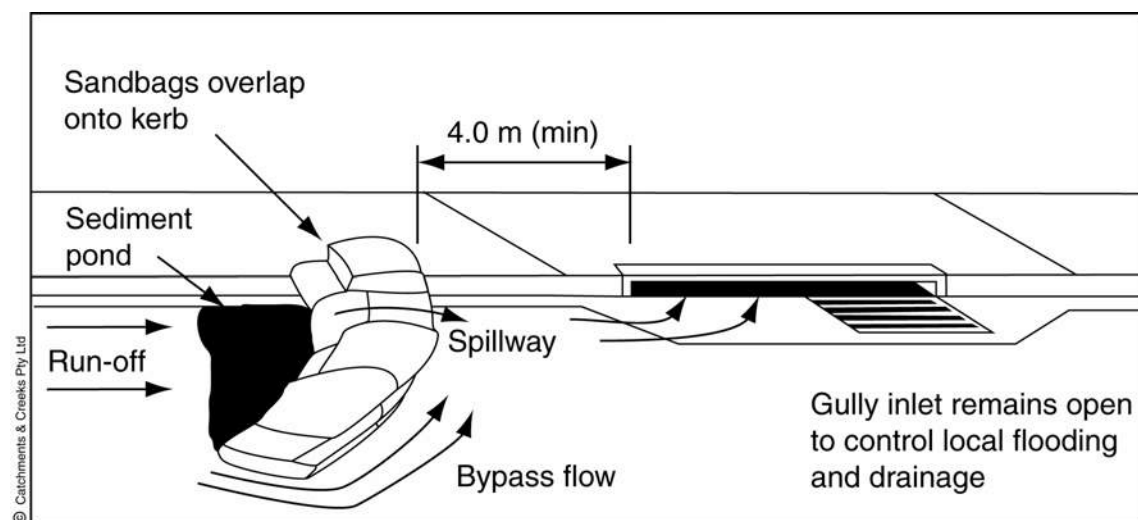


Figure 13 Hillside site - sump inlet protection

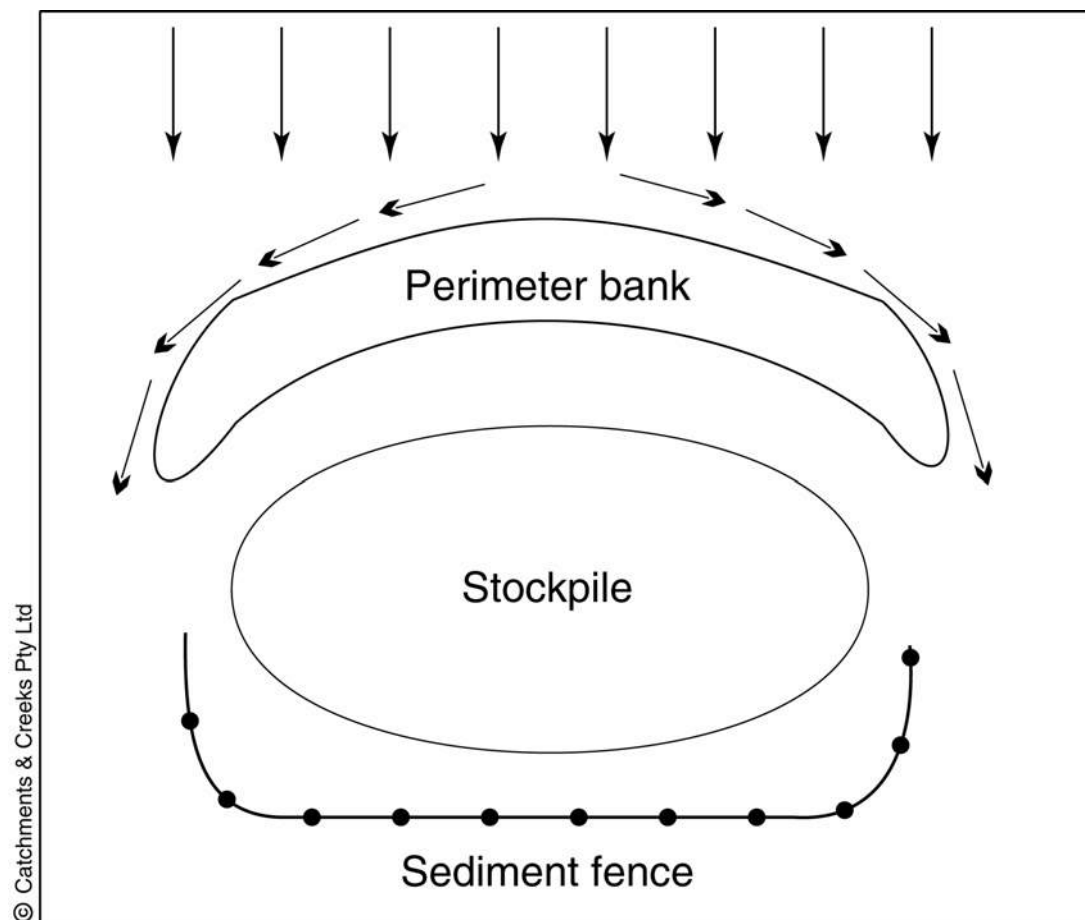


7. Stockpile and building waste sediment control

The sediment control zone should be incorporated into your erosion and sediment control plan or for specific stockpile sediment control (refer to figure 14). Follow the steps below to keep potential sources of sediment and other contaminants within your sediment control zone:

- Keep stockpiles and building materials off the footpath and out of road reserve (and definitely out of the roadside kerb and channel)
- Keep stockpiles and building materials out of any existing or proposed public reserve areas, in order to prevent filling of areas reserved for ponding and overland flow in storms or loss of infiltration capacity due to soil compaction
- Keep all stockpiles and building materials within a sediment control zone behind the sediment barrier
- Do not put stockpiles in any overland flow path or within 1m of a hazard area such as roadside water tables, stormwater inlets, paved footpaths or driveways
- Minimise soil loss, runoff and dust problems by covering stockpiles with waterproof covers such as geotextile fabric
- Do not stockpile excessive volumes of loose soil material onsite. Limit the amount to what is needed at any one time
- Remove surplus material from the site as soon as work is completed
- Advise all site workers, subcontractors and delivery drivers of their responsibilities for responsible placement and management of building materials and stockpiles and make them aware that they will have to pay for any damage they do to site controls.

Figure 14 Stockpile and building waste sediment control



8. Connect all downpipes early

Early connection of roof water to the stormwater system will reduce site wetness, erosion and sediment runoff. Experience shows this reduces downtime after storms and shortens the building construction period.

Take advantage of these benefits by:

- Installing temporary or permanent downpipes as soon as gutters are put up
- Connecting them into the stormwater system before putting the roof on.



Permanent downpipes installed and connected into the stormwater system prior to the roof cover installation.



Temporary downpipes connected into the stormwater system with stabilised all-weather access. However the sediment fence needs urgent maintenance.

9. Manage litter and building wastes – especially concrete

Follow the steps below to reduce unsightly litter and prevent pollutants getting into stormwater and water bodies:

- Store all hard waste in a way that prevents material loss caused by wind or water
- Store smaller materials such as litter in covered bins or mini-skips
- Retain waste and clean up from 'wet trades' on the site and contain it within the sediment control zone in an evaporation pit lined with black plastic or other approved storage container
- Never let liquid waste from 'wet trades' into the stormwater system
- Remove accidental spills of soil or other materials from the road, kerb and channel or any location outside the sediment control area:
 - I. Immediately if it's raining or likely to rain during the day
 - II. At least upon completion of the day's work (even if rainfall is unlikely during the night) using a broom and shovel instead of hosing to clean hard surfaces
- Following storms, inspect the road reserve and sediment barriers and clean them out without damaging them, so as to preserve the sediment retention capacity.



The site above shows sediment fencing along low side of site, with end returns to hold water and sediment. Building materials are stored within sediment control zone with a stabilised all-weather access and a turf filter strip behind kerb and channel.



This site is an example of excessive surplus material stockpiled onsite with a sand stockpile outside the sediment control zone, in kerb and channel. The sediment fence also requires urgent maintenance.

9. Concrete

Concrete is lethal to fish and other stream life, even in tiny concentrations. Follow the steps below to manage concrete washings, concrete cutting wastewater and runoff from exposed aggregate concrete surfaces.

Concrete washings and concrete cutting wastewater

Fully contain concrete waste washed from trucks and mixer units onsite and store where it cannot be washed from the site, harming the environment. If cooling water is needed or washing needs to be carried out onsite, ensure that there is no discharge into the environment by:

- Diverting all runoff to a grassed or unsealed area where it can soak into the ground (refer figure 15 for example)
- Blocking a receiving drain and pumping the wastewater to an area where it can evaporate or soak into the ground
- Washing the fines off freshly laid concrete onto grass at the side, not into the stormwater drainage system.

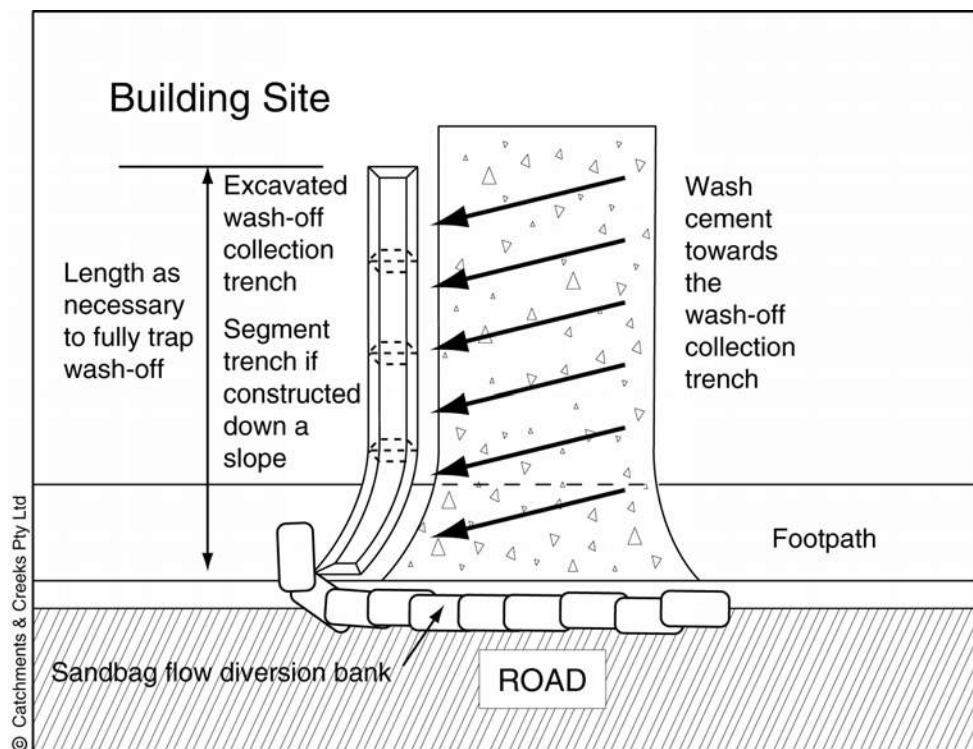
Exposed aggregate concrete surfaces

It is important to prepare exposed aggregate surfaces without allowing cement residue to flow into stormwater drains or waterways:

- Where practical, wash cement residue onto pervious surfaces or fully contain it within temporary sediment dams created from tightly stacked sandbags
- When suitably dry, shovel cement residue into a waste disposal bin
- Cement residue or wastewater runoff should never be washed into the roadside gutter.

This may make it impractical on some sites for exposed aggregate driveways to be constructed. In such cases, it is better to use an alternative driveway finish.

Figure 15 Managing concrete washdown runoff



10. Promptly stabilise service trenching

Prevent trenches from becoming a source of sediment by following the steps below:

- Where possible co-ordinate all the service connections to the building so they can use a single trench
- Avoid trenching in areas where water flow is likely to concentrate
- Alternatively, try to schedule work to periods when rainfall is lowest
- Trenching must not be open for any longer than three days
- Don't open trenches when there is a high risk of storms
- Put soil on the uphill side of the trench to divert water away from the trench line
- Pump water from trenches and excavations to a tank for appropriate offsite disposal or to a sediment retention facility. Keep the intake off the bottom to minimise pumping sediment
- Promptly backfill and compact the trench to a level at least 75–100mm above the adjoining ground level, to allow for some subsidence and prevent the trench becoming a water channel and eroding out
- Put a low soil bund along the uphill side of the trench to divert water out of the backfill (this can be flattened later)
- Immediately reinstate any sediment controls that may have been removed or damaged during trenching operations.

11. Maintain and carefully decommission control measures and stabilise the site

The site manager (owner, builder or builder's representative) must check the operation of all erosion, sediment and water management works on a daily basis and initiate immediate repair, maintenance or modification as required:

- Controls should be cleaned out if they become more than 20% full of sediment, and this sediment can be re-spread over the works area
- Remove all accidental spills of soil or other materials onto the road or gutter at the end of each day's work
- Sweep materials from the road, not washing them down the nearest stormwater inlet
- Hold subcontractors and delivery drivers responsible for any damage caused through their actions or negligence
- Decommission your controls with care – that way you can save money by reusing materials like silt fencing, waratahs and straw bales on the next job
- Revegetate or otherwise stabilise the site.

Acknowledgements

Environment Canterbury would also like to thank the Christchurch City Council for its contribution towards the development of this guideline.

If you require more detailed information about the principles of erosion and sediment control measures, or are undertaking earthworks for a large earthwork development please refer to the Erosion and Sediment Control Guideline – A better way of managing earthworks and the environment (CRC 2007).

This material has been sourced from the following publications:

Hawkesbury-Nepean Catchment Management Trust, 2000. *Guidelines for Erosion and Sediment Control on Building Sites* (Booklet)

Brisbane City Council, Undated. *Best practice for the control of stormwater pollution from building sites* (Brochure and Fact Sheets).

Canterbury Regional Council. 2007. *Erosion and Sediment Control Guideline – A better way of managing earthworks and the environment*, Environment Canterbury,
Auckland Regional Council, *Erosion and Sediment Control on Construction Sites – Site management for permitted activities*, undated



ENGCO
Consulting Engineers

Title: Structural Renovation,
Address: 32 Nicholls Street, Richmond, Christchurch
Part: Structural Plans
Engco Reference: 20749
Date: 21.12.2020
Engineer: SP

GENERAL

Contacts:

EngCo Consulting: ph. 03 366 7955
Project Engineer: Simon Parkes
simon@engco.co.nz
027 5310 755

These drawings shall be read in conjunction with the Architectural and other consultant's drawings/ specifications.

Refer to the Preliminary and General Clauses of these Specifications and to the General Conditions of Contract which shall be equally binding on all trades.

Do not scale from these drawings, refer any discrepancies to the architect/engineer.

INSPECTIONS

Please ensure that a minimum of 48hrs notice is given for all inspections required.

CONSTRUCTION MONITORING SCHEDULE		
Inspection Stage	Purpose of inspection	Estimated number required
Bearing check	Confirm Soil Conditions	One
Post Hole Pre-pour	Confirm pile cover etc	One per pour
Pre-Line	Checking of all member sizes & fixings Checking of bracing hold downs (prior to any structure being concealed)	One

1.0 General

All materials and workmanship shall comply with the New Zealand Building Code.

The Contractor shall supply the Engineer with a copy of any Consent Conditions and amendments to the Consent Documents, prior to commencing construction.

Under no circumstances shall the Contractor substitute or delete structural elements or products without the written approval of the Engineer.

The Contractor shall check and verify all dimensions on site prior to commencing works.

The Contractor shall comply with the requirements of the Health and Safety at Work Act 2015, and shall be responsible for all personnel entering the site and adjoining the site, where their safety is affected by the construction.

All hand sketches produced by ENGCO are conditional; whereby the architect is to ensure that all details fit within the building envelope.

If in doubt ask, Engco ph 03 366 7955

2.0 Excavation

In accordance with the Geotechnical Investigation Report by KGA (Ref: K200202). All Piles to be founded on at ~0.5m below existing ground level, with an ultimate bearing capacity of no less than 150kPa. Sketched details may require amending once excavation is complete and the end bearing capacity is confirmed by the Engineer.

3.0 Concrete & Reinforcing

All reinforcing steel shall comply with AS/NZS4671 and be manufactured using the micro-alloy process.

Reinforcing bars have the following designation on the structural details:

- D = Grade 300E deformed bar
- R = Grade 300E Round bar
- H = Grade 500E deformed bar
- HR = Grade 500E Round bar

Reinforcement shall be placed and fastened in accordance with NZS 3109. Support for reinforcing shall allow for chairing at a maximum of 900mm centres each way.

Cut and bend bars using proper bending tools to avoid notching and to the requirements of NZS 3109. Do not re-bend bars.

Secure reinforcement adequately with tying wire and place accurately, supported adequately and secured against displacement when concreting. Bend tying wire back well clear of the formwork.

All concrete work is to be compacted as defined in Section 7.6 of NZS 3109:1997.

Compact by vibration of the concrete to expel entrapped air and until settlement of the concrete is visibly evident over all areas of the surface.

Maintain vibration until settlement ceases and coarse aggregate at the surface is embedded.

Reinforcing laps shall be 70 times the diameter of the bar unless noted otherwise on the structural details.

All concrete work shall comply with the provisions of NZS 3109 "Specification for Concrete Construction.

All concrete to be used shall have a 28 day compressive strength of 25 MPa.

Concrete production shall be in accordance with the requirements of NZS 3104:2003 "Concrete Production - High Grade and Special Grade", unless otherwise approved in writing by the Engineer. All concrete must be supplied by a high or special graded plant as defined in NZS 3104:2003. No additives are to be included in the mix design without the written approval of the Engineer.

4.0 Timber

All timber sizes are actual minimum dried sizes.

Timber Framing: Species, grade and in service moisture content to NZS 3602, NZBC B2/AS1 and treatment to NZS 3640, NZBC B2/AS1. Structural grade (SG) to NZS 3604, NZS 3622 with properties to NZS 3603.

Nails: Type to NZS 3604, section 4, Durability, and of the size and number for each particular types of joint as laid down in the nailing schedules of NZS 3604, sections 6-10.

Bolts and screws of engineering and/or coach type complete with washers, to the requirements of NZS 3604, section 4, Durability, and of the number and form required for each particular junction to NZS 3604, sections 6-10.

Timber Connectors and Fixings for each particular joint the connectors and fixings as noted on the drawings. Comply with the requirements of the manufacturer, NZS 3604, section 4, Durability, and of the number and form required for each particular junction to NZS 3604, sections 6-10.

For interior timber, treated with copper-based timber preservatives (H3.2 or higher), use a minimum of hot-dipped galvanized steel fixings and fasteners. For exterior timber, timber in damp areas and timber subject to occasional wetting, use only stainless-steel fixings and connectors.

Protect all timber against damage and from inclement weather. Ensure that any variation in moisture content is kept to a minimum, before and after erection and before enclosure.

Execution to comply with NZS 3604, except as varied in this specification. Execution to include those methods, practices and processes contained in the unit standards for the National Certificate in Carpentry and the National Certificate in Joinery (cabinetry, exterior joinery, stairs).

5.0 Structural Steel

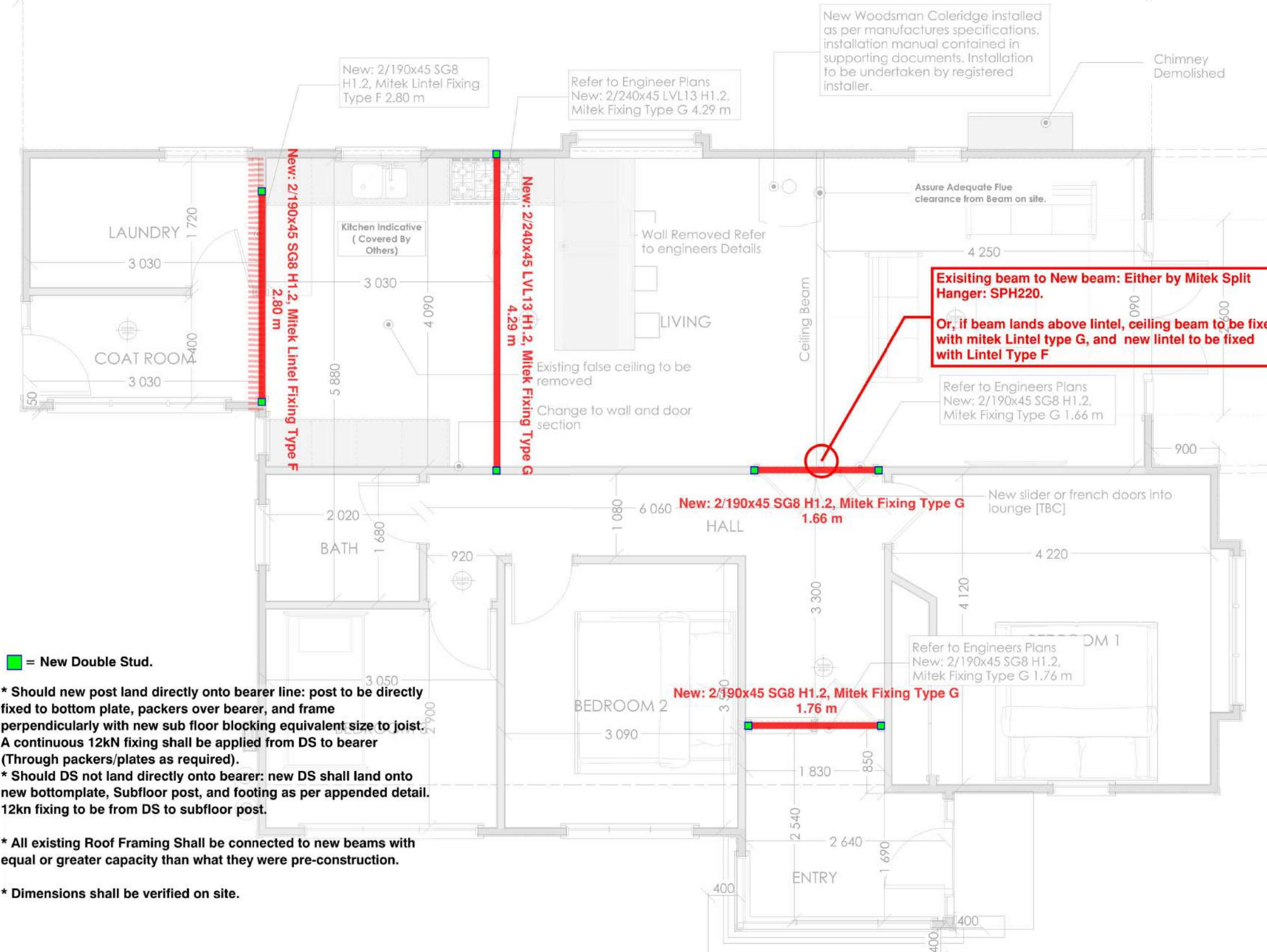
All structural steel shall be in accordance with NZS 3404. All steel is to have the following minimum yield strengths:

- RHS = 350 MPa
- Angles = 300 MPa
- Plate = 300 MPa
- Flats = 300 MPa

Welding personnel shall be qualified in accordance with Clause 4.11 of AS / NZS 1554.1 2011 or AN/NZS 1554.5 2011, as appropriate.

All steelwork is to have 14dia. holes spaced at 900crs, for bolting to adjacent timber framing.

External steelwork is to have a 'PUR5" coating system complying with AS/NZS2312.2004, and requires maintenance after 25 years of exposure.



■ = New Double Stud.

* Should new post land directly onto bearer line: post to be directly fixed to bottom plate, packers over bearer, and frame perpendicularly with new sub floor blocking equivalent size to joist. A continuous 12kN fixing shall be applied from DS to bearer (Through packers/plates as required).

* Should DS not land directly onto bearer: new DS shall land onto new bottomplate, Subfloor post, and footing as per appended detail. 12kn fixing to be from DS to subfloor post.

* All existing Roof Framing Shall be connected to new beams with equal or greater capacity than what they were pre-construction.

* Dimensions shall be verified on site.

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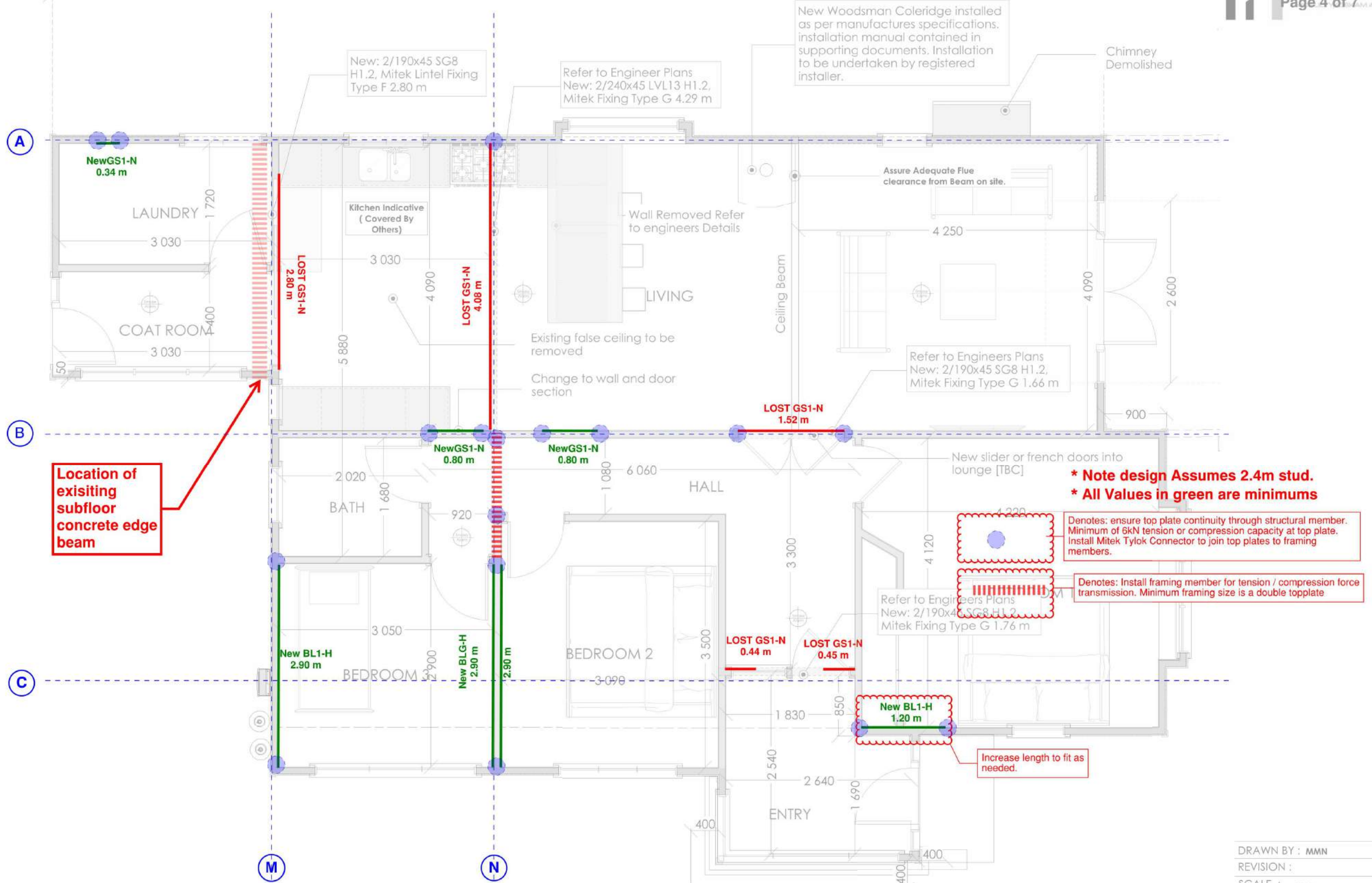


32 Nicholls Street
Richmond, Christchurch

Roof Framing Plan

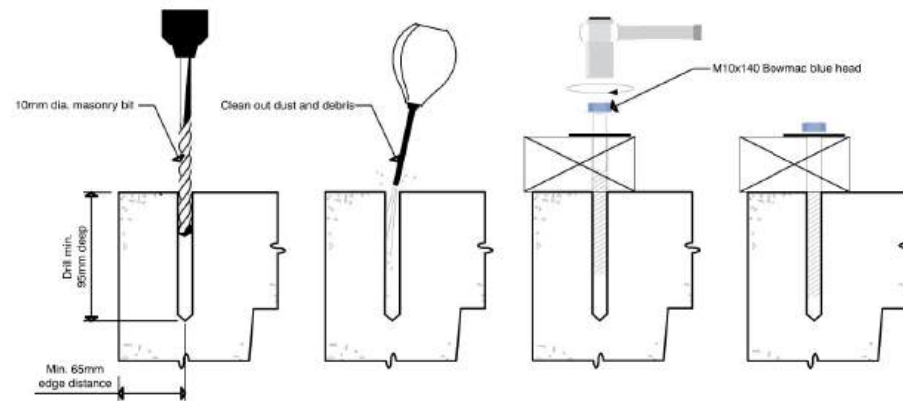
Revisions	Date	For
1	2020/10/21	For Consent

design	S. Parkes	no	20749
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No substitution of Bowmac blue head bolt without prior approval by the Engineer



Installation Procedure

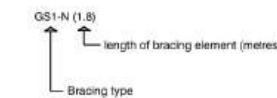
Use a 10mm diameter masonry bit for concrete fixing and an 8mm diameter bit for timber fixing

BRACING KEY

All bracing to comply with the requirements of:
- NZS 3604: 2011
- Winstone Wallboards "Gib Bracing Systems" Manual August 2016

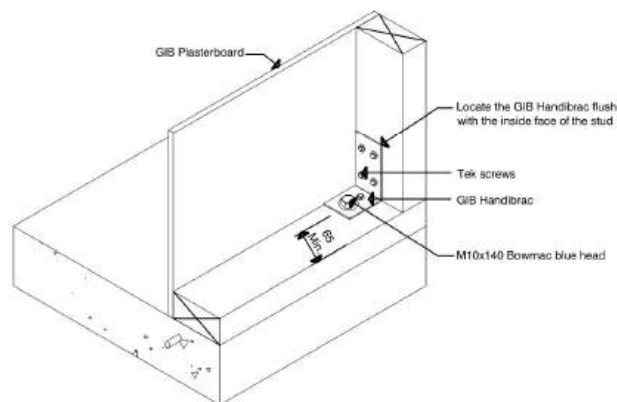
Bracing element lengths are minimum only.
Actual wall lengths may vary (refer to Architect wall dimensions)

Ensure bracing elements are installed to the side to which they are noted.

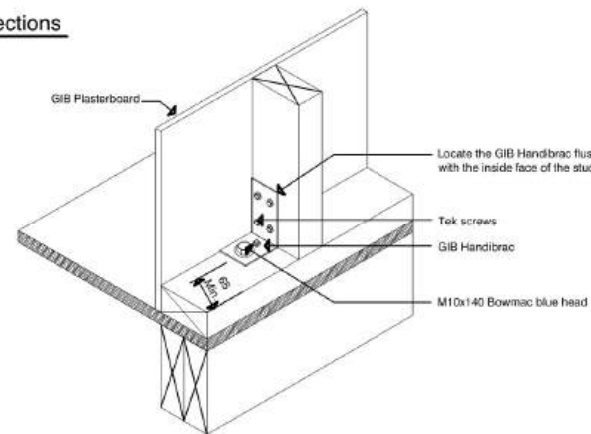


GIB Handibrac Connections

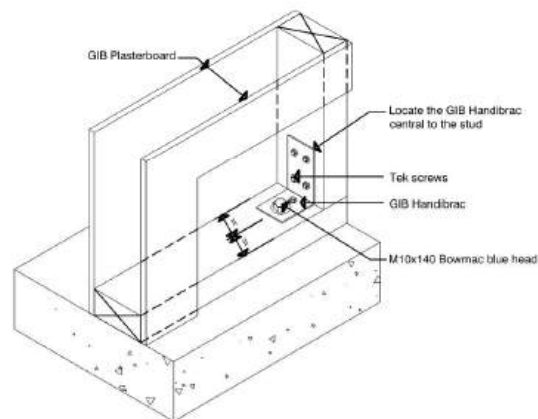
1:100



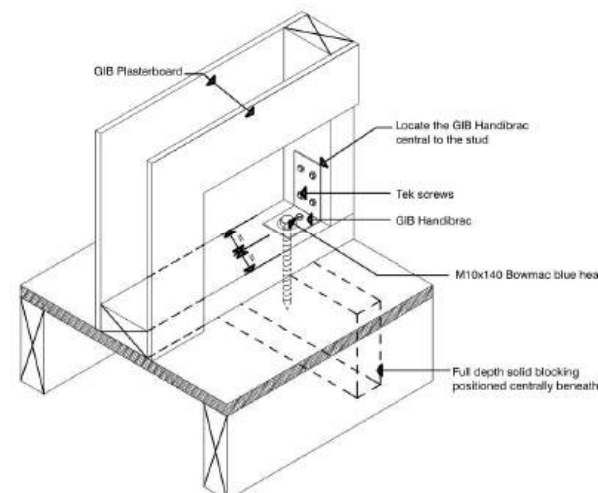
Concrete Floor for External Walls



Timber Floor for External Walls



Concrete Floor for Internal Walls



Timber Floor for Walls between Joists

GIB - STANDARD

- GS1-N Standard 10mm or 13mm GIB Plaster Board (Refer Architectural requirements) on one face fixed horizontal or vertical. Refer to Gib. Systems Manual or Gib. Site Guide, for all fixing requirements.
- GS2-N Standard 10mm or 13mm GIB Plaster Board (Refer Architectural requirements) on both faces fixed horizontal or vertical. Refer to Gib. Systems Manual or Gib. Site Guide, for all fixing requirements.
- GSF-H Standard 10mm or 13mm GIB Plaster Board on internal face fixed vertical or horizontal. 7mm min. ECOPLY (H3 treated) on exterior face (fix ply below building wrap). GIB. HANDIBRAC hold-down brackets M12 bolt bottom plate to slab. Refer to Gib. Systems Manual or Gib. Site Guide, for all fixing requirements.

PLYWOOD

- EP1 7mm min. ECOPLY (H3 treated) on one face fixed below building wrap. Gib HANDIBRAC hold down brackets M12 bolt bottom plate to slab. Refer to Carter Holt Harvey Manual for all fixing requirements
- EP2 7mm min. ECOPLY (H3 treated) on both faces fixed below building wrap. Gib HANDIBRAC hold down brackets M12 bolt bottom plate to slab. Refer to Carter Holt Harvey Manual for all fixing requirements
- EP3 7mm min. ECOPLY (H3 treated) on one face fixed below building wrap. Refer to Carter Holt Harvey Manual for all fixing requirements. GIB. BRACELINE on internal face fixed vertical or horizontal. GIB. HANDIBRAC hold-down brackets M12 bolt bottom plate to slab. Refer to Gib. Systems Manual or Gib. Site Guide, for all fixing requirements.

GIB - BRACELINE

- BL1-H GIB. BRACELINE on one face fixed horizontal or vertical. GIB. HANDIBRAC hold-down brackets M12 bolt bottom plate to slab. Refer to Gib. Systems Manual or Gib. Site Guide, for all fixing requirements.
- BLG-H GIB. BRACELINE on one face Standard 10mm or 13mm GIB Plaster Board on the other face. GIB. HANDIBRAC hold-down brackets M12 bolt bottom plate to slab. Refer to Gib. Systems Manual or Gib. Site Guide, for all fixing requirements.
- BLP-H GIB. BRACELINE on internal face fixed vertical or horizontal. 7mm min. ECOPLY (H3 treated) on exterior face (fix ply below building wrap). GIB. HANDIBRAC hold-down brackets M12 bolt bottom plate to slab. Refer to Gib. Systems Manual or Gib. Site Guide, for all fixing requirements.

PLYWOOD - Barrier

- EPB1 7mm min. ECOPLY BARRIER (factory coated) on one face. (Use S/S nails instead of galv. if within seaspray zone, also additional nailing maybe required for high wind zones.) Gib HANDIBRAC hold down brackets M12 bolt bottom plate to slab. Refer to Carter Holt Harvey Manual for all fixing requirements
- EPB3 7mm min. ECOPLY BARRIER (factory coated) on one face. (Use S/S nails instead of galv. if within seaspray zone, also additional nailing maybe required for high wind zones.) Refer to Carter Holt Harvey Manual for all fixing requirements
- EPB5 7mm min. ECOPLY BARRIER (factory coated) on one face. (Use S/S nails instead of galv. if within seaspray zone, also additional nailing maybe required for high wind zones.) Gib HANDIBRAC hold down brackets M12 bolt bottom plate to slab. Refer to Carter Holt Harvey Manual for all fixing requirements
- EPB6 7mm min. ECOPLY BARRIER (factory coated) on one face. (Use S/S nails instead of galv. if within seaspray zone, also additional nailing maybe required for high wind zones.) Standard 10mm or 13mm GIB Plaster Board on internal face fixed vertical or horizontal. Refer to Gib. Systems Manual or Gib. Site Guide, for all fixing requirements.

OS' BRACE RAP WALL BRACING SYSTEM

Refer to IBS Building Products Design and Installation Manual for all Fixing Requirements.

- OSB/1 SYSTEM 1:
OSB - 300 m.m. x 2440 m.m. wall
GIB HandiBrac fixing 30x2.5 Galv. Clouts or 45x2.5 S/S Annular grooved nails.
- OSB/2 SYSTEM 2:
OSB - 1200 m.m. x 2440 m.m. wall
25 x1.0 m.m. Strap fixing 30x2.5 Galv. Clouts or 45x2.5 S/S Annular grooved nails.
- OSB/3 SYSTEM 3:
OSB - 1200 m.m. x 2440 m.m. wall
GIB HandiBrac fixing 30x2.5 Galv. Clouts or 45x2.5 S/S Annular grooved nails.
- OSB/4 SYSTEM 4:
OSB - 2400 m.m. x 2440 m.m. wall
GIB HandiBrac fixing 30x2.5 Galv. Clouts.

LINTEL FIXING SCHEDULE ALTERNATIVE TO TABLE 8.14 & FIGURE 8.12 NZS 3604:2011

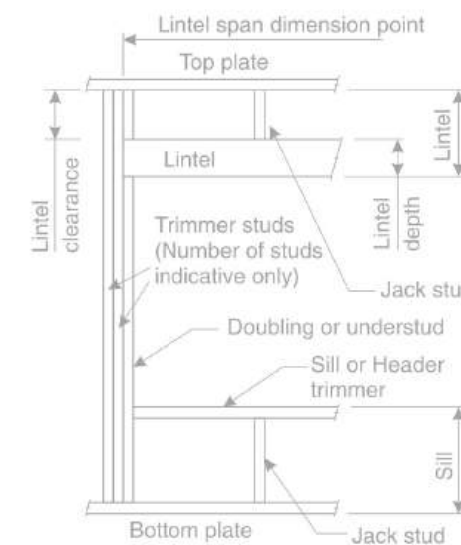
NOTE:

- ★ All fixings are designed for vertical loads only. Dead loads include the roof weight and standard ceiling weight of 0.20 kPa.
- ★ Refer to Table 8.19 NZS 3604:2011 for nailing schedule to resist horizontal loads.
- ★ These fixings assume the correct choice of rafter/truss to top plate connections have been made.
- ★ All fixings assume bottom plate thickness of 45mm maximum. Note: TYLOK options on timber species.
- ★ Wall framing arrangements under girder trusses are not covered in this schedule.
- ★ All timber selections are as per NZS 3604:2011.

SELECTION CHART FOR LINTEL FIXING

Lintel Span	Loaded Dimension (See Fig. 1.3 NZS 3604:2011)	Light Roof					Heavy Roof				
		Wind Zone					Wind Zone				
		L	M	H	VH	EH	L	M	H	VH	EH
0.7	2.0	E	E	E	E	F	E	E	E	E	E
	3.0	E	E	E	F	F	E	E	E	E	F
	4.0	E	E	F	F	F	E	E	F	F	F
	5.0	E	F	F	F	G	E	E	F	F	F
	6.0	E	F	F	G	G	E	E	F	F	G
0.9	2.0	E	E	F	F	F	E	E	E	F	F
	3.0	E	E	F	F	F	E	E	E	F	F
	4.0	E	E	F	F	F	E	E	F	F	F
	5.0	E	F	F	F	G	E	E	F	F	F
	6.0	E	F	F	G	G	E	E	F	F	G
1.0	2.0	E	E	F	F	F	E	E	E	E	F
	3.0	E	E	F	F	F	E	E	E	F	F
	4.0	E	F	F	F	G	E	E	F	F	F
	5.0	E	F	F	G	G	E	E	F	F	G
	6.0	E	F	F	G	G	E	E	F	F	G
1.2	2.0	E	E	F	F	F	E	E	E	F	F
	3.0	E	E	F	F	F	E	E	F	F	F
	4.0	E	F	F	G	G	E	E	F	F	G
	5.0	E	F	F	G	G	E	E	F	F	G
	6.0	F	F	G	G	H	E	E	F	G	G
1.5	2.0	E	E	F	F	F	E	E	E	F	F
	3.0	E	F	F	F	G	E	E	F	F	F
	4.0	E	F	F	G	G	E	E	F	F	G
	5.0	F	F	G	G	H	E	E	F	G	G
	6.0	F	F	G	H	H	E	E	F	G	H
2.0	2.0	E	F	F	F	G	E	E	F	F	F
	3.0	E	F	F	G	G	E	E	F	F	G
	4.0	F	F	G	G	H	E	E	F	G	G
	5.0	F	G	G	H	H	E	E	F	G	H
	6.0	F	G	G	H	H	E	E	F	G	H
2.4	2.0	E	F	F	G	G	E	E	F	F	G
	3.0	F	F	G	G	H	E	E	F	G	G
	4.0	F	F	G	H	H	E	E	F	G	H
	5.0	F	G	G	H	H	E	E	F	G	H
	6.0	F	G	H	H	-	E	E	F	G	H
3.0	2.0	E	F	F	G	G	E	E	F	F	G
	3.0	F	F	G	H	H	E	E	F	G	H
	4.0	F	G	G	H	H	E	E	F	G	H
	5.0	F	G	H	H	-	E	E	F	G	H
	6.0	F	G	H	-	-	E	E	F	G	H
3.6	2.0	F	F	G	G	H	E	E	F	G	G
	3.0	F	F	G	H	H	E	E	F	G	H
	4.0	F	G	H	H	-	E	E	F	G	H
	5.0	F	G	H	-	-	E	E	F	G	H
	6.0	G	H	H	-	-	E	E	F	H	-
4.2	2.0	F	F	G	G	H	E	E	F	G	G
	3.0	F	G	H	H	-	E	E	F	G	H
	4.0	F	G	H	-	-	E	E	F	G	H
	5.0	G	H	H	-	-	E	E	F	H	-
	6.0	G	H	-	-	-	E	E	F	H	-
4.5	2.0	F	F	G	H	H	E	E	F	G	H
	3.0	F	G	H	H	-	E	E	F	G	H
	4.0	F	G	H	-	-	E	E	F	G	H
	5.0	G	H	-	-	-	E	E	F	H	-
	6.0	G	H	-	-	-	E	E	F	H	-
4.8	2.0	F	F	G	H	H	E	E	F	G	H
	3.0	F	G	H	H	-	E	E	F	G	H
	4.0	F	G	H	-	-	E	E	F	G	H
	5.0	G	H	-	-	-	E	E	F	H	-
	6.0	G	H	-	-	-	E	E	F	H	-

DEFINITIONS

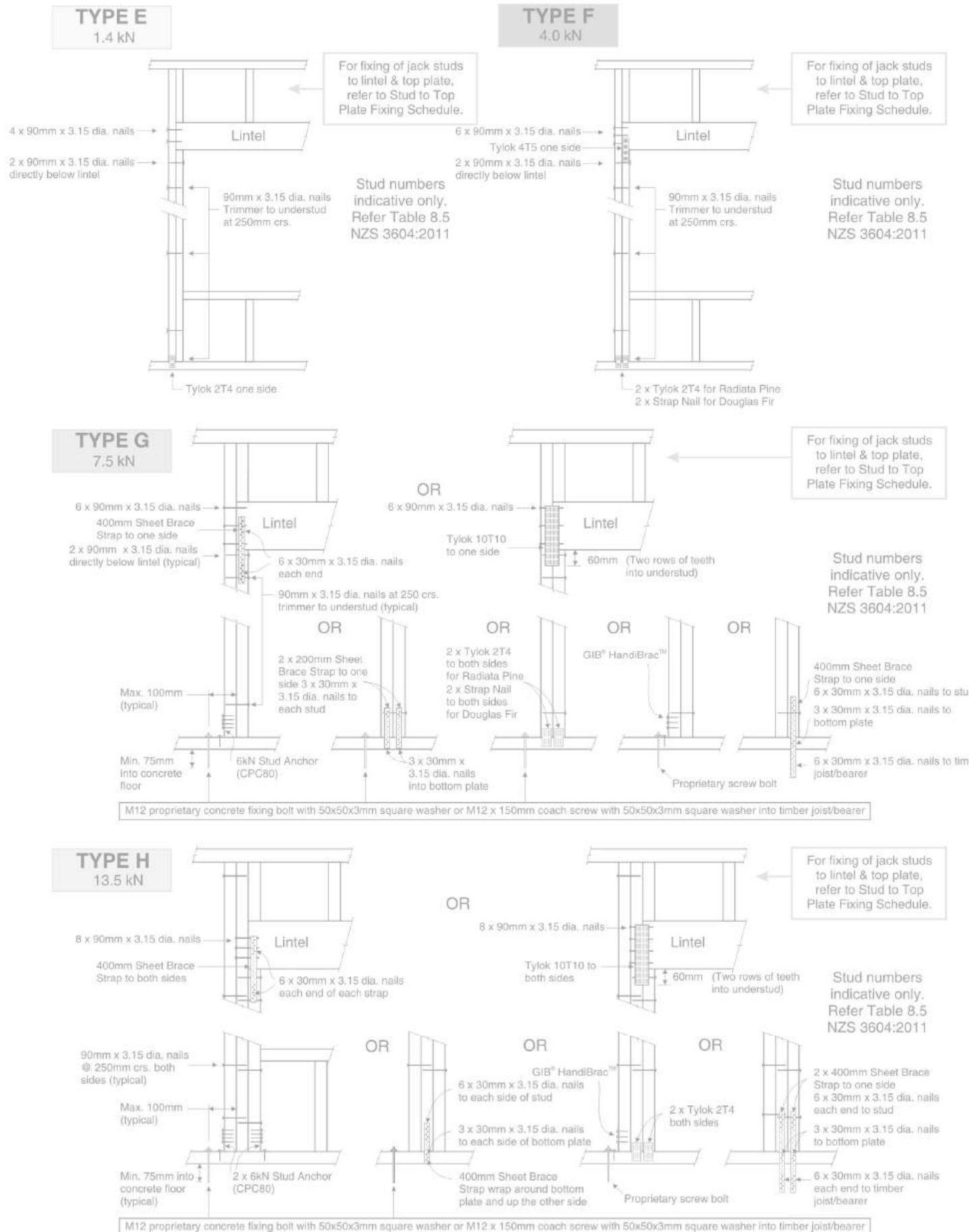


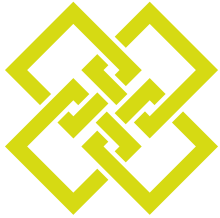
Lintel Supporting Girder Trusses:

Roof Tributary Area	Light Roof					Heavy Roof				
	Wind Zone					Wind Zone				
	L	M	H	VH	EH	L	M	H	VH	EH
8.6 m²	G	G	H	G	G	H	G	G	H	H
11.6 m²	G	H	H	G	G	H	G	G	H	H
12.1 m²	G	H	H	G	H	H	G	H	H	H
15.3 m²	H	H	-	G	H	H	H	H	-	-
19.1 m²	H	-	-	G	H	-	H	H	-	-
20.9 m²	H	-	-	H	H	-	H	H	-	-
21.8 m²	H	-	-	H	-	-	H	-	-	-
34.3 m²	-	-	-	H	-	-	H	-	-	-

Notes:

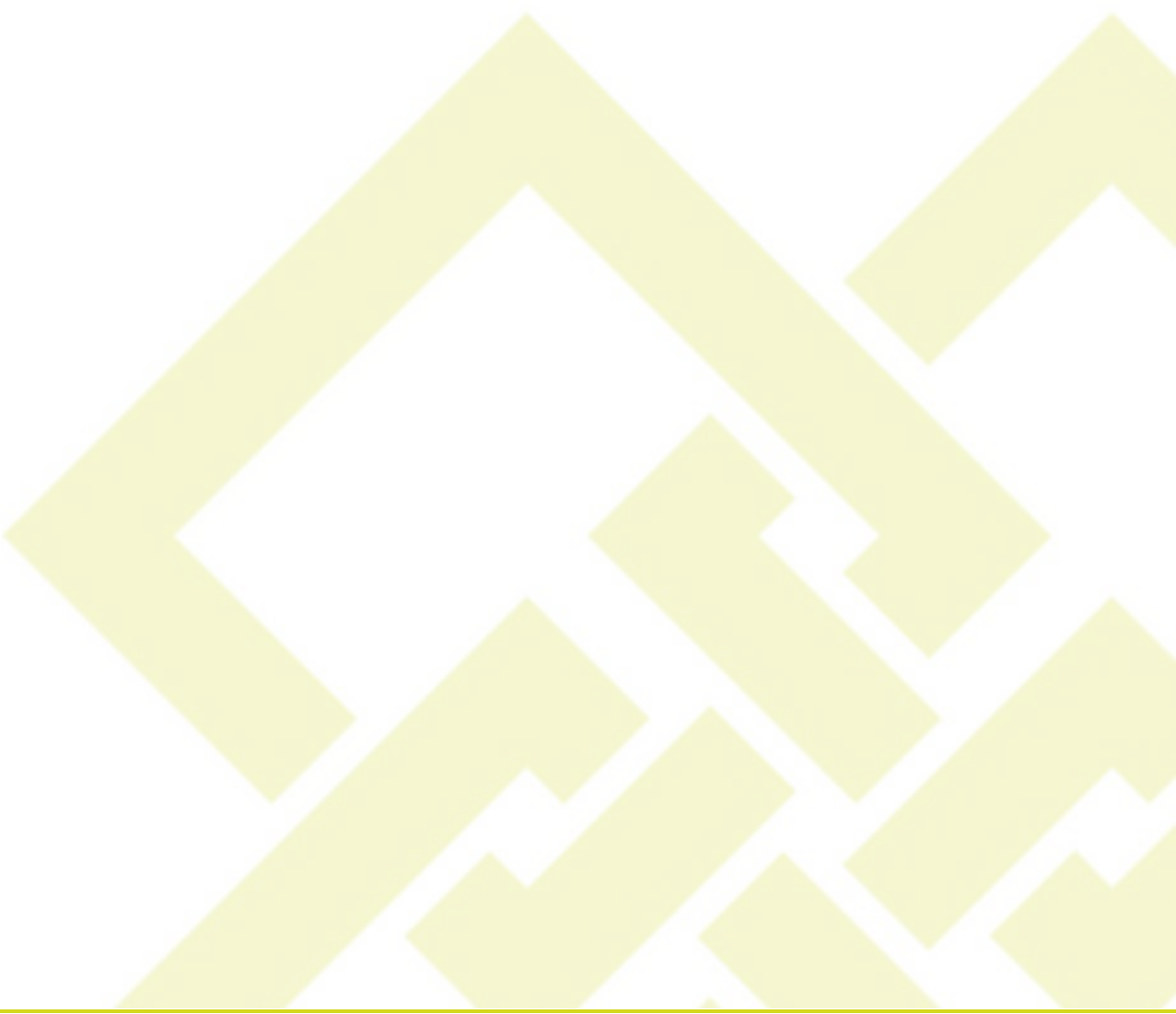
- 1) Roof Tributary Area = approx. 1/2 x (Total roof area on girder and rafter trusses supported by lintel)
- 2) Assumed girder truss is at mid-span or middle third span of lintel
- 3) Use similar fixings for both ends of lintel
- 4) All other cases require specific engineering design





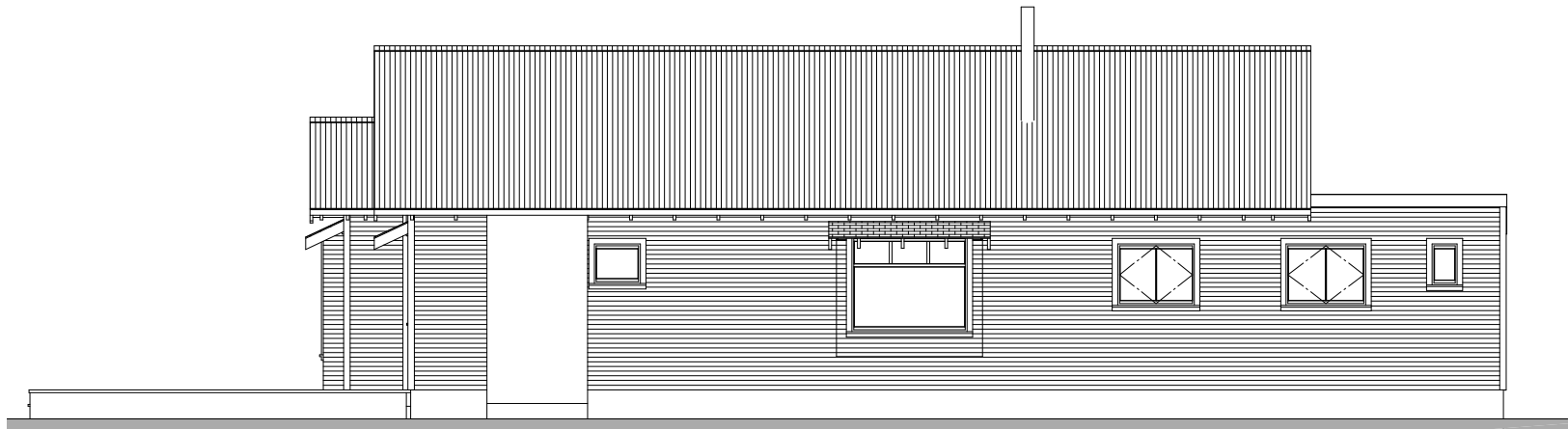
ENGCO
Consulting Engineers

**Title: Structural Renovation,
Address: 32 Nicholls Street, Richmond, Christchurch
Part: Structural Design Notes
Engco Reference: 20749
Date: 21.12.2020
Engineer: SP**





1.0	Project Description & Construction
-An existing light weight timber framed dwelling, on type B foundation (internal piled with concrete perimeter foundation). House has been subject to 'Jack and pack' re-levelling and the perimeter has been subject to repair. The structural design by Engco is not relating to the repair work and is considered renovation only. This includes three new roof beams (and associated footings), and review and design of revocation bracing plans.	
1.1	Location
32 Nicolls Street, Richmond Christchurch	
2.0	Specific Engineering Elements (Covered by PS-1)
Engco responsible for the following items (as indicated on the Engco Structural Plans) - New Foundations directly supporting new beams. - New Beams and posts - New bracing associated with renovations only.	
3.0	Site Description & Geotech Summary
- Corrected Ultimate Bearing Capacity (UBC) greater than 140kPa is available from a depth of 0.5mbgl for releveing pads based on the Stockwell's correction method and Cook Costello's Bearing Letter (12 October 2020). - This is based on KGA Geotechnical Engineering Investigation (9 April 2020). - The Ground Water Table (GWT) was encountered at 2.0mbgl during shallow investigation. -The site may be classified as 'sufficiently tested' for an SLS earthquake event. Liquefaction analyses indicates TC2 site classification, however high soil variability in the area and shallow liquefaction means KGA agree TC3 classification is appropriate. Liquefaction susceptibility is 'moderate' to 'severe' (for ULS). Both lateral movement and lateral stretch risk is considered 'minor to moderate'.	
4.0	Foundation Description
-Piles have been checked to comply with the following excerpt from geotechnical Report: "localised piles may be replaced in a 'like-for-like' basis if they exhibit excessive tilting or settlement, provided any replacement piles are designed for an ultimate unfactored bearing capacity of 150 kPa and are founded no deeper than 0.5 m bgl, with a maximum width of 0.5 m."	
4.1	Loads
- Roof 0.41kPa (conservative assumed trib area loading) - Live: 0.25kpa (roof) - Wind: -1.2kpa (roof) - EQ Loads All bracing capacity is replaced on a like for like basis. All existing walls are assumed to be providing 50BU/m bracing capacity.	
5.0	Means of Compliance
- Timber floor, framing and subfloor bracing – AS1, VM1 (NZS3603, NZS3604, NZS1170) - Foundations - VM1 (NZS 3101 & NZS3604)	

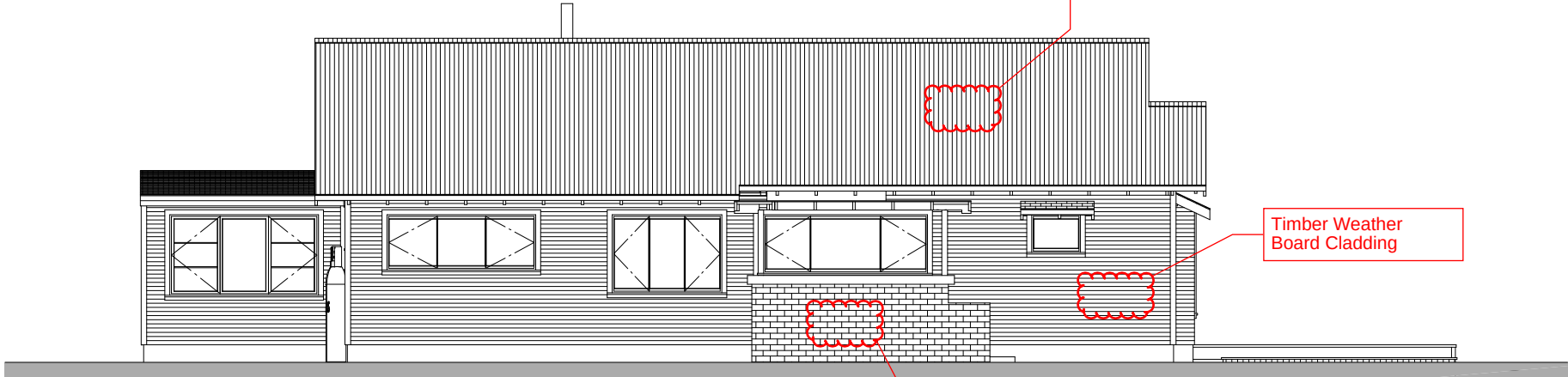


Elevation 1
SCALE: 1:100 (Dimensions to be confirmed on site)

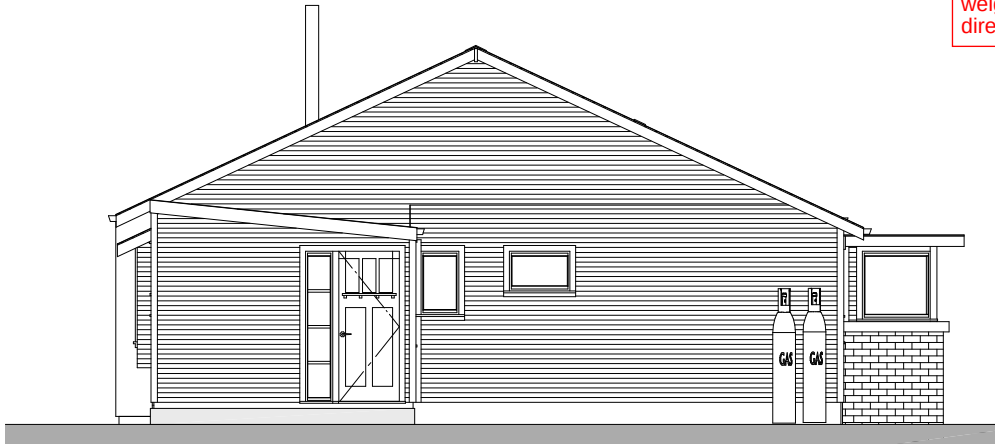


Elevation 2
SCALE: 1:100 (Dimensions to be confirmed on site)

Risk Matrix	Elevations				North			
	Low	Medium	High	Very High	Sub-Totals	Sub-Totals	Sub-Totals	Sub-Totals
Wind Zone	0	0	1	2	0	0	0	0
No of Stories	0	1	2	4	0	0	0	0
Roof / Wall Intersections	0	1	3	5	0	0	0	0
Eaves Width	0	1	2	5	0	0	0	0
Envelope Complexity	0	1	3	6	1	1	1	1
Deck Balconies	0	2	4	6	0	0	0	0
Total risk score and rating: Low ,Medium,High or Very High					1	1	1	1



Elevation 3
SCALE: 1:100 (Dimensions to be confirmed on site)



Elevation 4
SCALE: 1:100 (Dimensions to be confirmed on site)

ISSUE :
32 Nicholls Street,
Richmond, Christchurch
8013

Construction Draft

All Renders Indicative

DRAWN BY : MMN
REVISION :
SCALE : 1:100 @A3
PAGE TITLE : Existing Elevations

P: 0226005008 E: mike@moadesign.nz
 P: 027 5565005 E: rob@moadesign.nz
SMOKE ALARM

Smoke Alarms must be fitted and working correctly. They must be located within 3m of sleeping areas and in all areas required to pass through to get to a safe place. They may be battery operated and are not required to be interconnected. In addition they shall be provided with a hush facility having a minimum duration of 60 seconds.

Smoke alarms shall have a test facility located on the smoke alarm (readily accessible to building occupants). Smoke alarms shall be listed or approved by a recognized authority as complying with at least one of: UL 217, ULC S531, AS 3786, BS 5446 Part 1. Existing lengths of dead-end paths are less than 24m long.

Demolition Notes

Before commencing work, carry out a thorough survey and examination building structure in order to ensure the extent, sequence and technique and method of demolition proposed can be safely and efficiently carried out.

Builder to ensure all service water / Electrical etc Utility operator to be contacted to disconnect service and remove fitting and equipment.

Material to be re-salvage to be discussed with homeowner before commencement of works.

Take all precaution necessary to minimize nuisance caused by dirt, rubbish and water

All Work to comply with the Health and Safety Employment act 1992 in general and the OSH document: "Approved code of practice for demolition section 1.2"

 ISSUE :
 32 Nicholls Street,
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 8013

Construction Draft

All Renders Indicative

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REVISION :

SCALE : 1:50

@A3

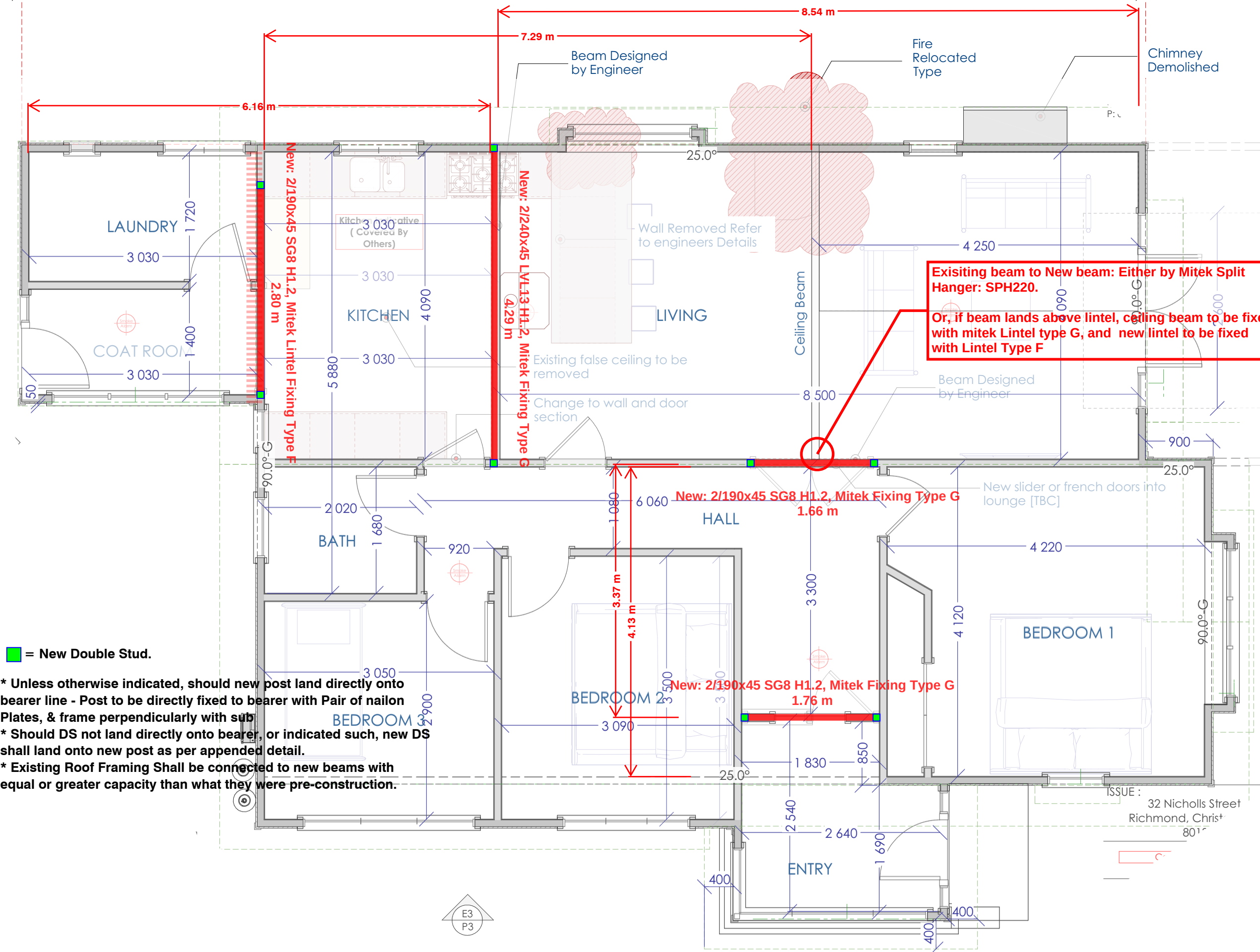
PAGE TITLE : Existing Plans

PAGE :

A-04

DATE PRINTED
October 2020

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 = New Double Stud.

- * Unless otherwise indicated, should new post land directly onto bearer line - Post to be directly fixed to bearer with Pair of nailon Plates, & frame perpendicularly with sub
- * Should DS not land directly onto bearer, or indicated such, new DS shall land onto new post as per appended detail.
- * Existing Roof Framing Shall be connected to new beams with equal or greater capacity than what they were pre-construction.



Existing Ground Floor Plan

SCALE: 1:50 (Dimensions to be confirmed on site)

A	: new	0.3m GS1-N added	: $+0.3*50 = +15\text{BU}$	: No change	: no change required
B	: Lost	1.5m GS1-N	: $-1.5*50 = -75\text{Bu}$	: $60\text{Bu/m} * 0.8 * 2 = 96\text{BU added}$	: 2x 0.8 GS1-N element added
C	: Lost	$2 * 0.45\text{m GS1N}$	: $-2 * 0.45 * 50 = -45\text{BU}$	: $90\text{Bu/m} * L = L * 50 + 2 * 0.45 * 50$	: L=1.2m to reline to 90Bu/m
M	: Lost	2.8m GS1-N	: $-2.8 * 50 = -140\text{Bu}$	: $100\text{Bu/m} * L = L * 50 + 2.8 * 50$	: L=2.8m to reline to 100Bu/m
N	: Lost	4m GS1-N	: $-4 * 50 = -200\text{Bu}$	: $120\text{Bu/m} * L = L * 50 + 4 * 50$	: L=2.9m to reline to 120Bu/m

They must be located within 3m of sleeping areas and in all areas required to pass through to get to a safe place.

They may be battery operated and are not required to be interconnected. In addition they shall be provided with a hush facility having a minimum duration of 60 seconds.

Smoke alarms shall have a test facility located on the smoke alarm (readily accessible to building occupants). Smoke alarms shall be listed or approved by a recognized authority as complying with at least one of: UL 217, ULC S531, AS 3786, BS 5446 Part 1 Existing lengths of dead-end paths are less than 24m long

Demolition Notes

Before commencing work, carry out a thorough survey and examination building structure in order to ensure the extent, sequence and technique and method of demolition proposed can be safely and efficiently carried out.

**Builder to ensure all service water /
Electrical etc Utility operator to be
contacted to disconnect service and
remove fitting and equipment.**

Material to be re-salvage to be discussed with homeowner before commencement of works.

Take all precaution necessary to minimize nuisance caused by dirt , rubbish and water

All Work to comply with the Health and Safety Employment act 1992 in general
an the OSH document: "Approved code of practice for demolition section 1.2"

ISSUE : 32 Nicholls Street,
Richmond, Christchurch
8013

Construction Draft

All Renders Indicative

DRAWN BY : MMN

REVISION :

SCALE : 1:50

A3

PAGE TITLE : Existing Plans

PAGE :

A-04

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October 2020

Wednesday, 28

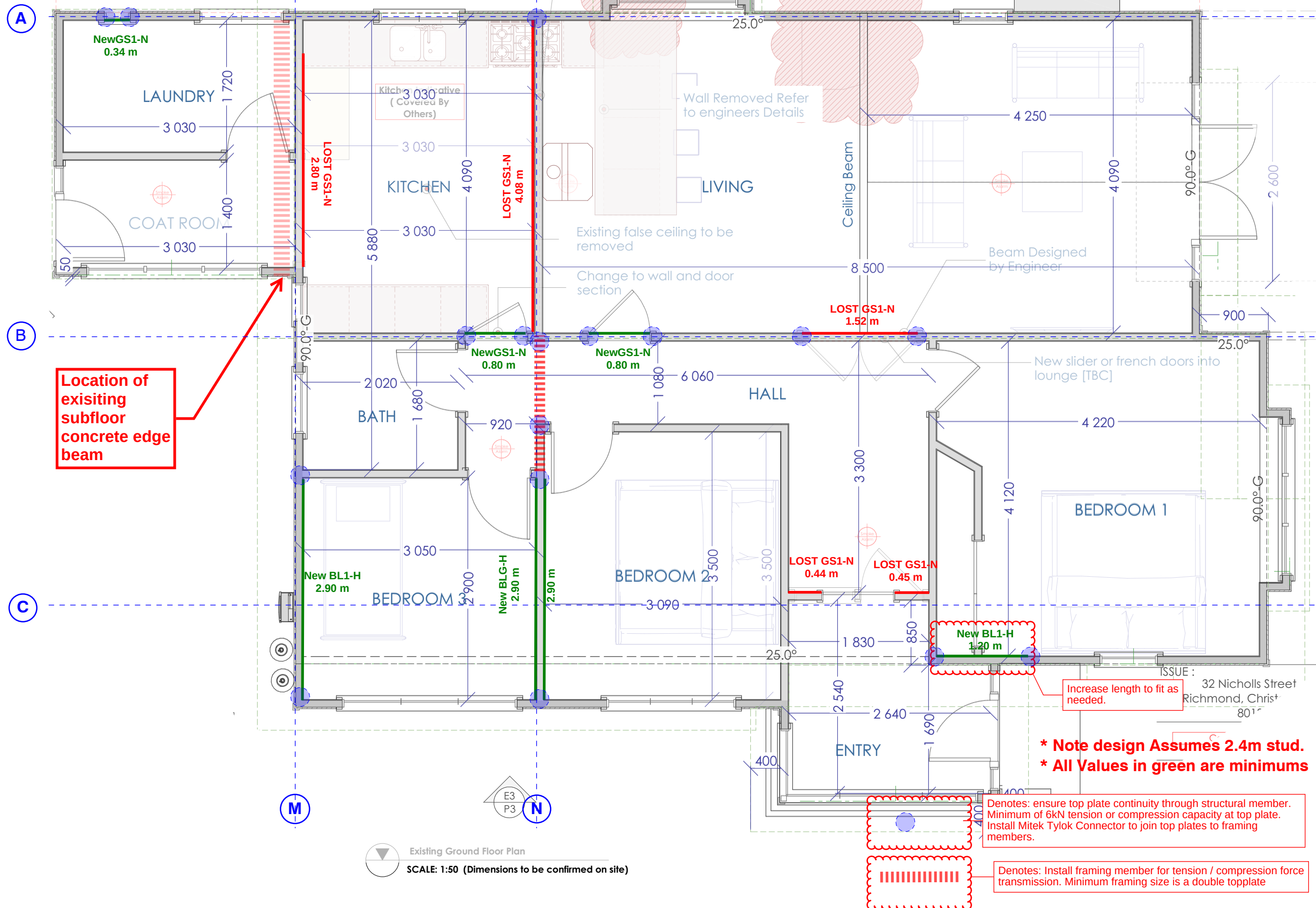


Table 1: GIB® Standard Plasterboard Bracing Unit ratings

Type	Minimum Length (m)	Lining	Other Requirements	BU/m	
				W	EQ
GS1-N	0.4	GIB® Standard Plasterboard one side	N/A	50	55
	1.2			70	60
GS2-N	0.4	GIB® Standard Plasterboard both sides	N/A	70	65
	1.2			95	85
GSP-H	0.4	GIB® Standard Plasterboard one side plywood the other	Panel hold-down fixings	100	115
	1.2			150*	150*

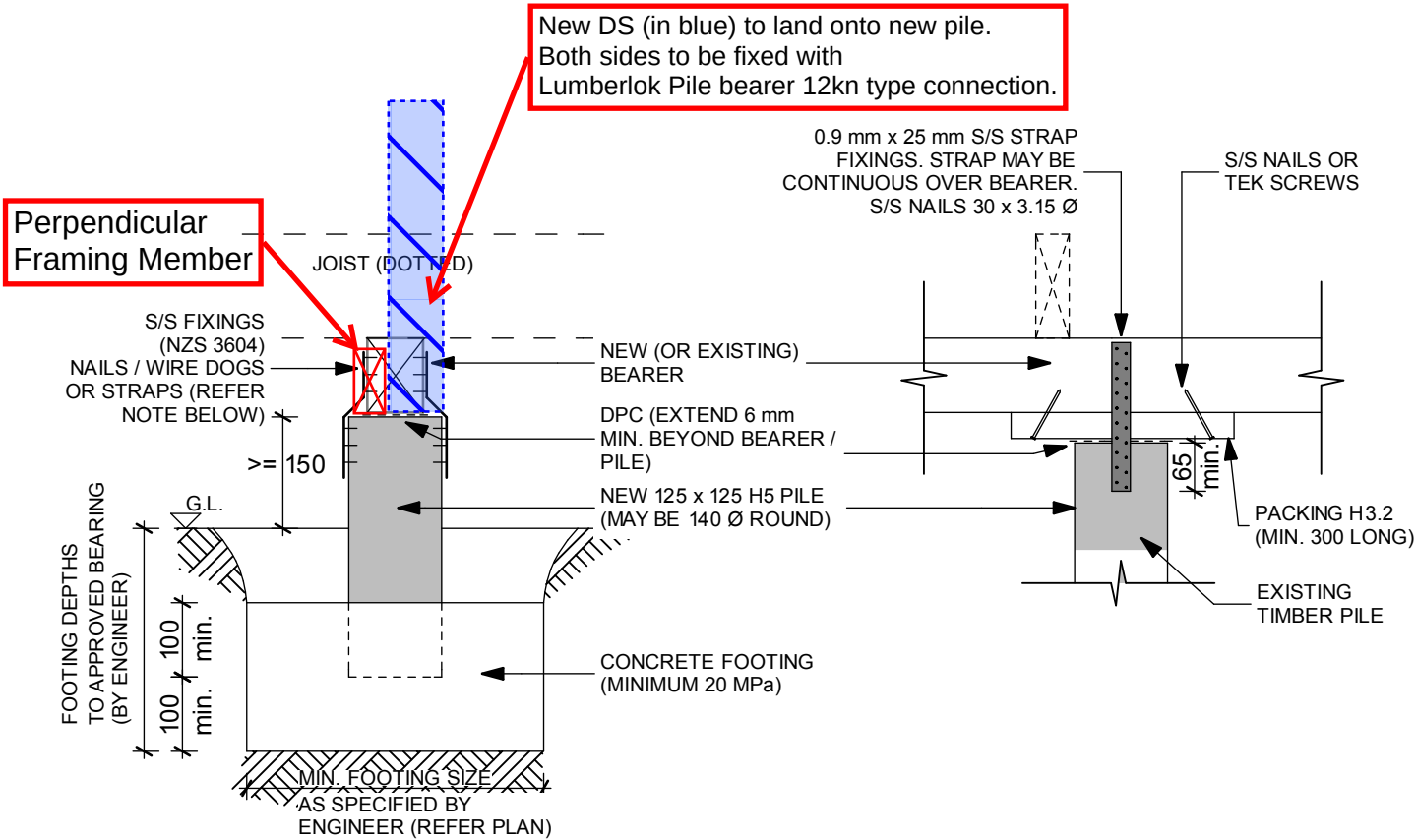
Table 2: GIB Braceline® Bracing Unit ratings

Type	Minimum Length (m)	Lining	Other Requirements	BU/m	
				W	EQ
BL1-H	0.4	GIB Braceline® one side	Panel hold-down fixings	90	100
	1.2			125*	105
BLG-H	0.4	GIB Braceline® one side GIB® Standard Plasterboard the other	Panel hold-down fixings	110	115
	1.2			150*	145*
BLP-H	0.4	GIB Braceline® one side plywood the other	Panel hold-down fixings	135*	135*
	1.2			150*	150*

Note: The BU/m ratings for GIB EzyBrace® systems are responsibly conservative. Using the GIB EzyBrace® software will deliver higher ratings than using the manual tables.

*** Timber Floors** – A limit of 120 BU/m for NZS 3604:2011 timber floors applies unless specific engineering ensures that uplift forces generated by elements rated higher than 120 BU/m can be resisted by floor framing.

*** Note design Assumes 2.4m stud**



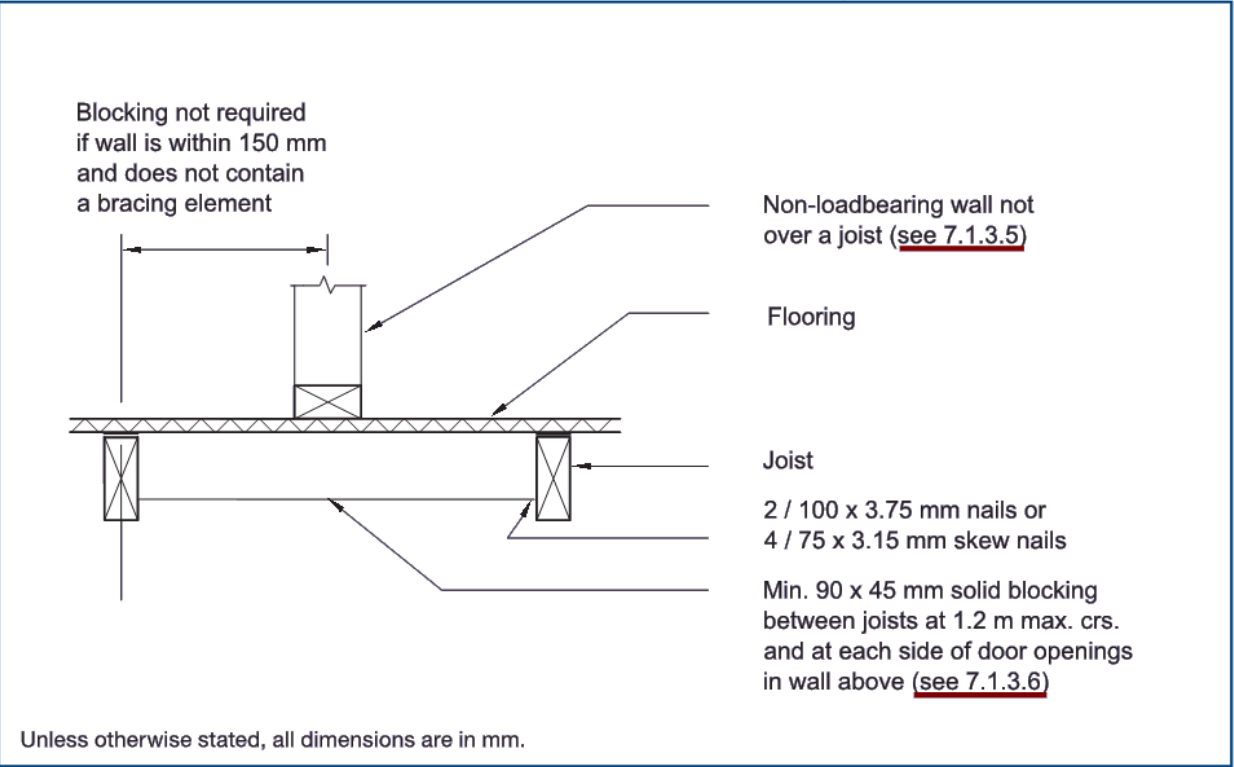
**NEW TIMBER PILE & BEARER
FIXINGS**
MUST BE S/S FIXINGS TO COMPLY WITH
NZS 3604

NOTE :
PILE / BEARER FIXING BY NZS 3604 : 2011

- 2 S/S WIRE DOGS AND
2 S/S 100 x 4 min Ø SKEWED NAILS
(1 WIRE DOG & NAIL EACH FACE OF BEARER)
- 140 MIN. DIAMETER TIMBER PILE (H5) MAY BE USED
IN LIEU OF 125 x 125.

**NEW TIMBER PILE TO BEARER &
PACKING TO EXISTING PILES**

SCALE 1 : 10



Should a non-load bearing wall have bracing: ensure blocked beneath wall bottom plate between adjacent structure.

Typical Blocking below walls containing Bracing.



The building is founded on a concrete ring foundation with internal piles. This corresponds to 'Type B1' structure in MBIE Guidance terms. A timber deck has been constructed post-CES on the western elevation, refer Figure 1. There is also a slab-on-ground [S.o.G] patio area on the eastern elevation (related to a historic "games room")



Figure 1: West elevation; deck added and paving constructed since the earthquakes.

Alterations to the building are highlighted in Figure 2. Post-earthquake refurbishment is extensive – these areas have been broadly identified in Figure 2 also.

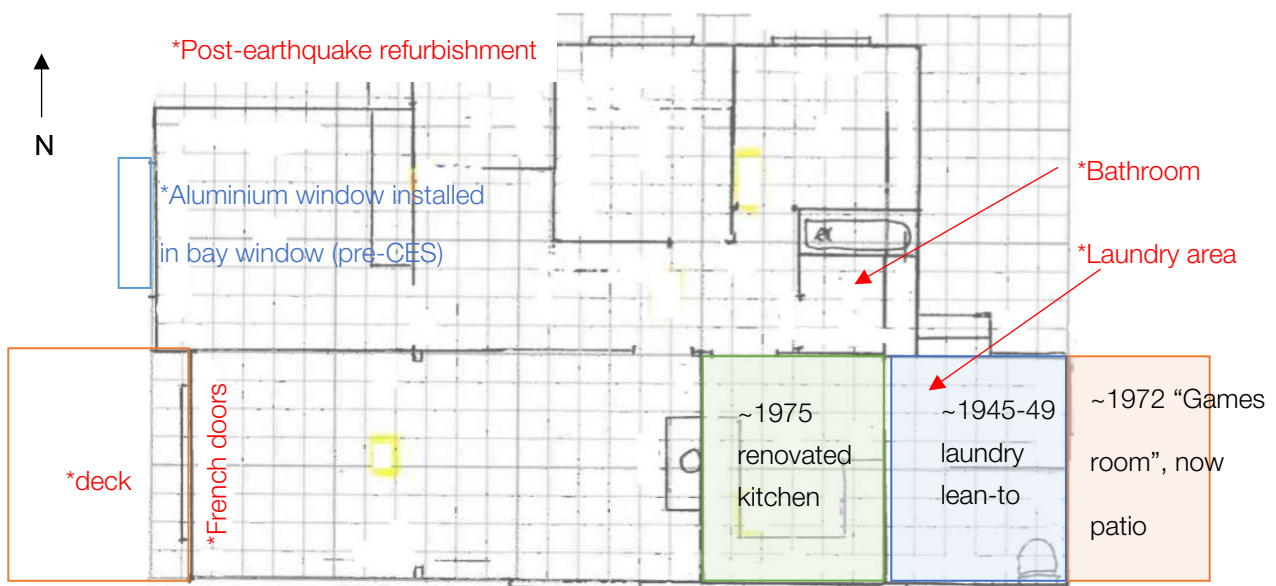


Figure 2: Building floor plan showing additions/alterations



3.3 Other Structures

The double garage appears to be constructed ~1972; replacing the original single-bay garage which was built against the northern boundary. Foundations are slab-on-ground [S.o.G], Type C1. We observed the garage exterior and a limited extent of the interior. The foundation and structure appear to be in fair condition.

4 Observations and Structural Damage

4.1 Levels and Verticality

Floor levels were recorded across the ground floor and results are displayed in Appendix A (results have been adjusted for differing floor coverings). The measurements taken showed:

- An overall floor level differential of ~74mm over the dwelling footprint.
- Floor slopes exceed 1:200 in many areas
- There are 'low areas' in central and eastern parts of the house.

Ceiling levels were also recorded, as well as for sills, lintels, beams and other fixtures such as benches and mantelpieces as illustrated in Appendix A. Several areas of ceiling have been altered and or renovated.

Wall verticality checks were carried out, using a self-levelling laser, at features such as the hinge ends of doors and internal corners of framed walls.

4.2 Observations and Damage

BMC inspected the property (including subfloor and roof space) on 11 March 2020 and noted the following observations/damage.

4.2.1 Dwelling

No#	Photo	Comments
1.		Northwest View: Exterior timber weatherboard cladding on timber framed walls, with corrugated roof and concrete ring foundation.



5.3 Site Specific Geotechnical Information

KGA Geotechnical have provided a geotechnical investigation report, Ref: K200202-1 dated 09th April 2020. We recommend the reader refer to this report as our comments are only intended as a summary for the purpose of identifying an appropriate structural repair strategy.

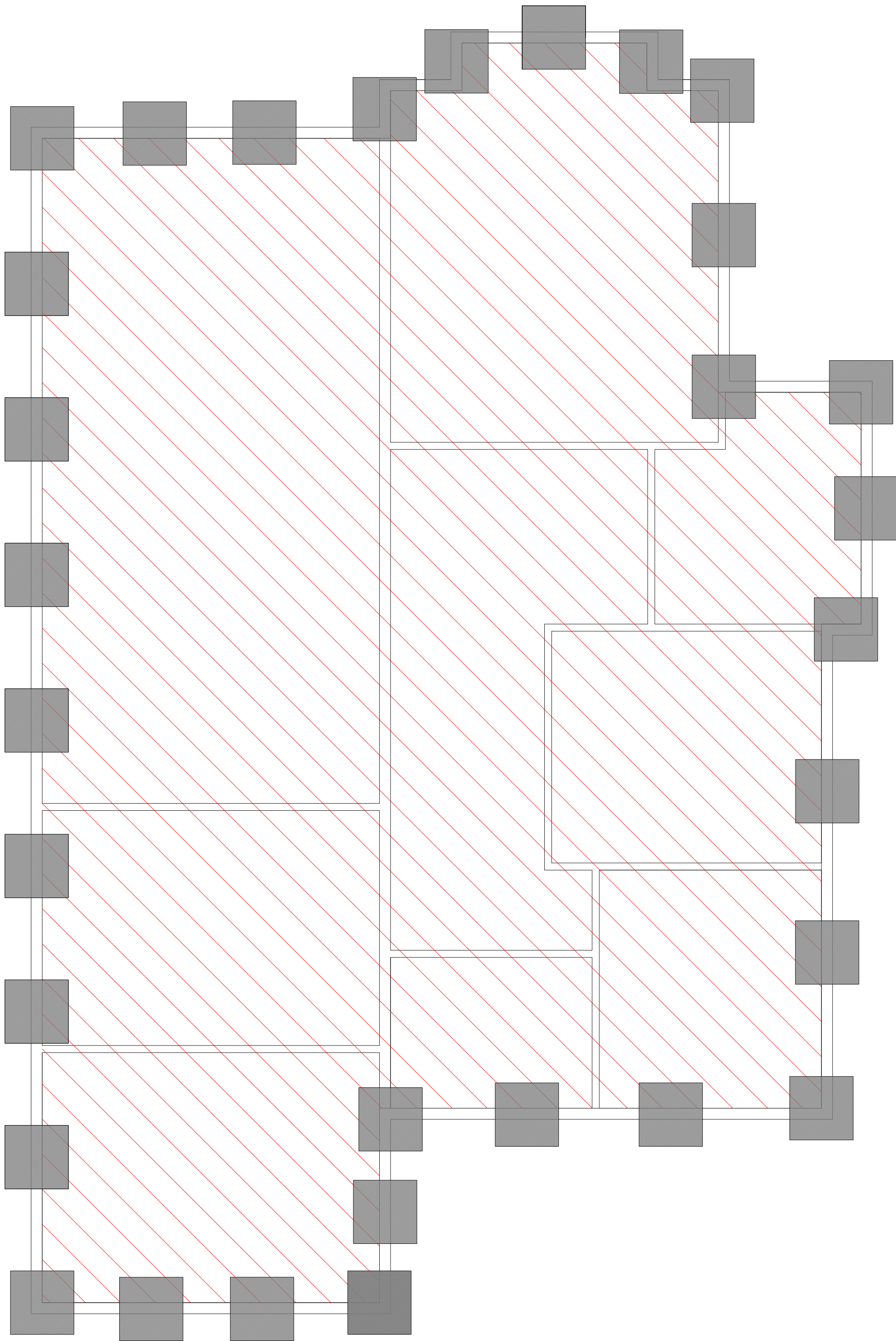
- Testing undertaken by KGA included four hand augers (and Scala Penetrometer testing), two trial pits and a CPT. Up to 0.8 m of topsoil was observed, with sub-surface ground conditions copied in the table below:

Geotechnical Unit	Depth to Base (m)	Description	Scala Penetrometer Reading (blows per 100mm)	CPT q_t Value (MPa)	SPT N value (blows per 300mm)
1 TOPSOIL/ FILL	0.3 – 0.8	Organic silt with some sand and trace rootlets	-	-	-
2 SILT	* 4.0	Silt with minor to some sand sand**	0 – 8	0.3 – 6.3	0 – 4.0
3 * SAND	20.5+	Inferred medium dense to dense sand with minor gravel in places	-	5 – 40+	15 – 50+

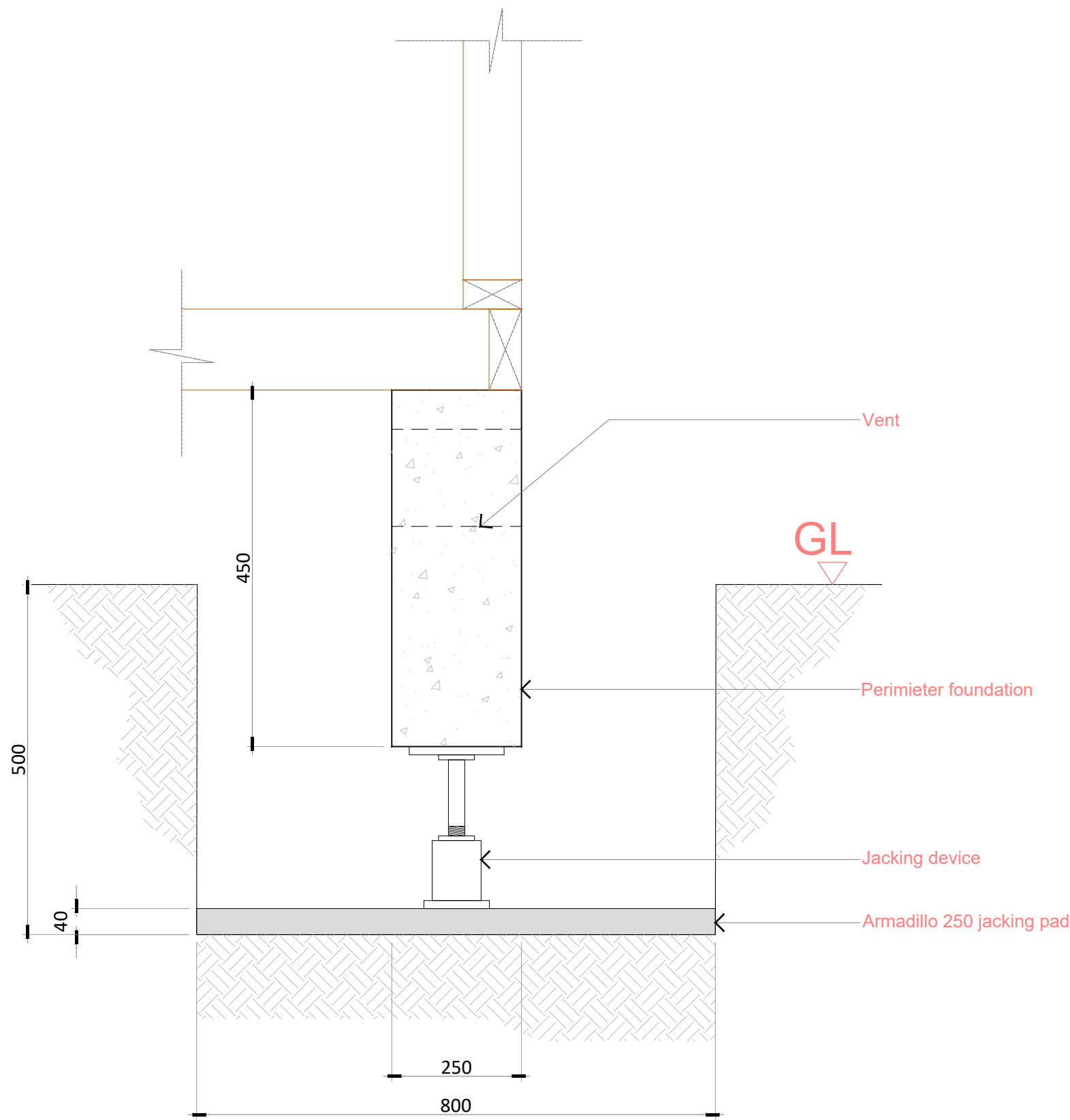
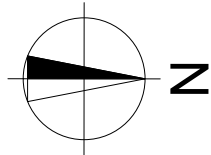
* Unit and/or depth interpreted from CPT-01, BH18210 & BH_18216

** Trace to minor fibrous organics and tree roots were encountered in all hand augers between 1.4m bgl to at least 3.0m bgl

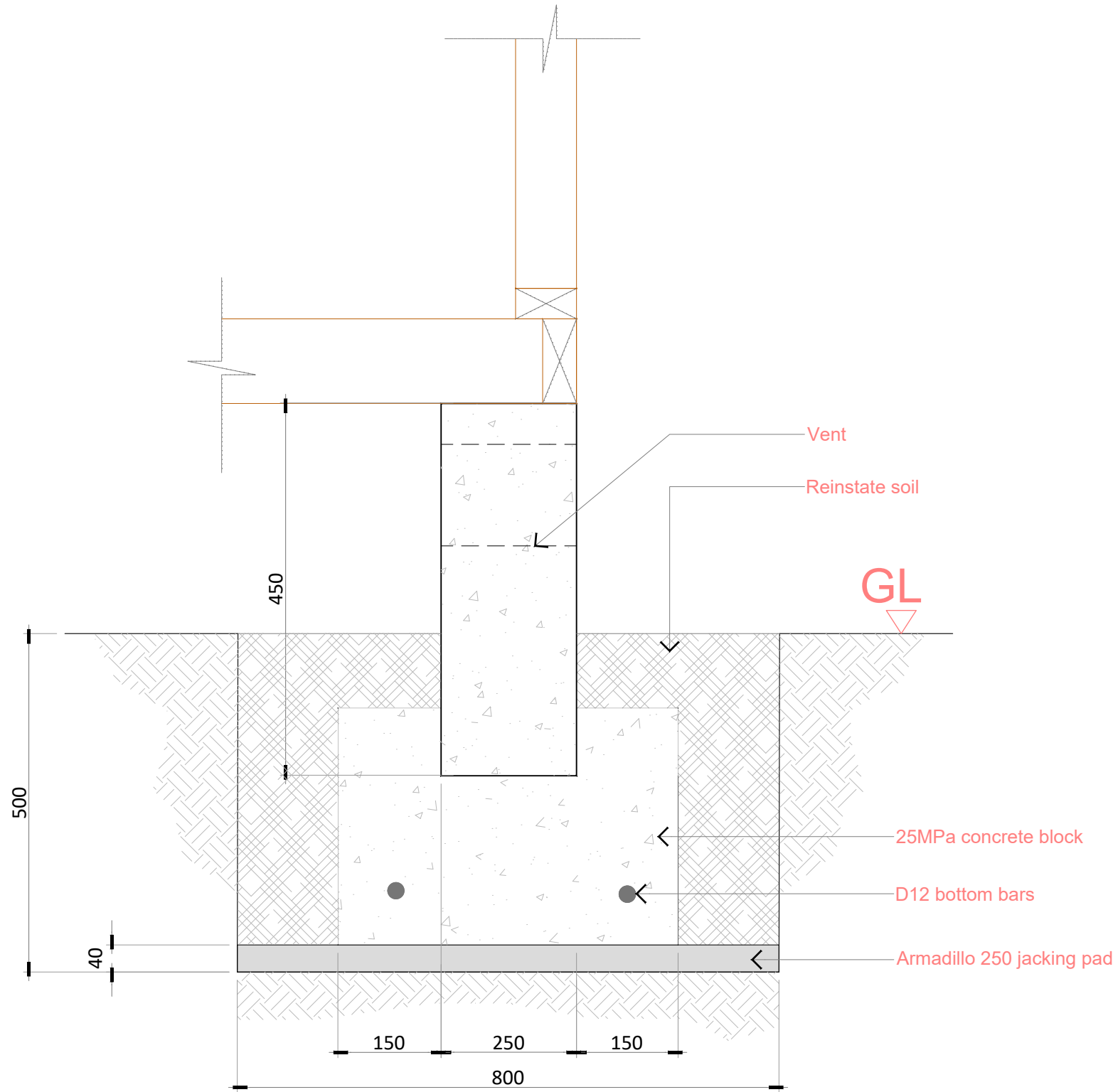
- The existing perimeter foundation bears ~0.1–0.2 m bgl onto topsoil/fill. Below topsoil, there is an ultimate unfactored bearing capacity of 150 kPa. Groundwater table can vary between 0.6–2 m bgl.
- The site may be classified as ‘sufficiently tested’ for an SLS earthquake event. Liquefaction analyses indicates TC2 site classification, however high soil variability in the area and shallow liquefaction means KGA agree TC3 classification is appropriate. Liquefaction susceptibility is ‘moderate’ to ‘severe’ (for ULS). Both lateral movement and lateral stretch risk is considered ‘minor to moderate’.
- “Due to the presence of shallow liquefiable material, we recommend relevelling the dwelling by overpinning the perimeter footing and internal shallow piles.”*
- “Shallow piles may be re-levelled using jacking and packing methodology as per MBIE Guidance”*
- “localised piles may be replaced in a ‘like-for-like’ basis if they exhibit excessive tilting or settlement, provided any replacement piles are designed for an ultimate unfactored bearing capacity of 150 kPa and are founded no deeper than 0.5 m bgl, with a maximum width of 0.5 m.”*
- “We note that we cannot ascertain whether the ground cracking occurred before the CES resulting in static settlement prior to being exacerbated by the high ground shaking, or following the CES.”*
- “If replacement foundations are required, the most suitable foundation option would be a TC3 Type 2A-150 foundation solution of section 15.4 of the MBIE Guidance.”*



FOUNDATION RELEVELLING PLAN
SCALE 1:40 @ A1



FOUNDATION JACKING DETAIL
SCALE 1:40 @ A1



FOUNDATION RELEVELLING BLOCK DETAIL
SCALE 1:40 @ A1

GENERAL

1. COOK COSTELLO STRUCTURAL DRAWINGS ARE NOT SHOP DRAWINGS. SHOP DRAWINGS ARE THE RESPONSIBILITY OF THE CONTRACTOR.
2. ALL DISCREPANCIES SHALL BE REFERRED TO THE ARCHITECT,CONSULTANT OR THE ENGINEER BEFORE PROCEEDING WITH WORK.
3. SETTING OUT, NIBS, REBATES, SET-DOWN & THE LIKES ARE AS PER ARCHITECTURAL DRAWINGS. COOK COSTELLO ACCEPTS NO RESPONSIBILITY WHEN NO DRAWINGS HAVE BEEN PROVIDED.
4. ALL DIMENSIONS RELEVANT TO SETTING OUT AND OFF-SITE WORK SHALL BE VERIFIED BY THE CONTRACTORS BEFORE WORK SHALL BE VERIFIED BY THE CONTRACTORS BEFORE CONSTRUCTION AND FABRICATION IS COMMENCED. THE ENGINEER'S DRAWINGS SHALL NOT BE SCALED.
5. DURING CONSTRUCTION, THE CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTAINING THE STRUCTURE IN A STABLE CONDITION & ENSURE NOT PART SHALL BE OVERSTRESSED UNDER CONSTRUCTION ACTIVITIES. THIS INCLUDES ALL EXISTING STRUCTURES FORMING PART OF, OR AFFECTED BY, THE WORKS.
6. IF DURING CONSTRUCTION, ANY PART OF THE WORKS SHOW SIGNS OF DISTRESS, EXCESSIVE DEFLECTION, CONFLICT OF COMPONENTS OR OTHER PROBLEMS, THE CONTRACTORS SHALL IMMEDIATELY NOTIFY THE ENGINEER, WHO SHALL INVESTIGATE & ISSUE SUCH INSTRUCTION AS ARE CONSIDERED NECESSARY.
7. CONTRACTOR SHOULD VERIFY THAT ALL CONSTRUCTION DRAWINGS ARE THE LATEST VERSION.
8. ALL DIMENSIONS SHOULD BE VERIFIED ON SITE PRIOR TO COMMENCING ANY WORK.
9. COMPLY WITH ALL WORKSAFE NZ AND ONSITE HEALTH AND SAFETY REQUIREMENTS AT ALL TIMES.
10. COOK COSTELLO ACCEPT NO LIABILITY FOR UNAUTHORIZED CHANGES FROM THE DETAILS AND INFORMATION CONTAINED IN THESE DRAWINGS.
11. THESE DRAWINGS AND DESIGN ARE COPYRIGHT AND REMAIN THE PROPERTY OF COOK COSTELLO.
12. PAD LOCATIONS ARE INDICATIVE ONLY. PAD SIZE TO BE 800 x 800 x 40mm ARMADILLO 250 JACKING PAD @ 1.9m max crs.
13. PADS TO BE PLACED >=0.5mbgl, ON CONFIRMATION OF UBC 140kPa.

LEGEND

- Indicative location of 800 x 800 x 40mm Armadillo jacking pads at 1.9m crs around perimeter foundation.
- Area to be relevelled via 'Jack and Pack' methodology. Internal jack spacing should not exceed the existing bearer span.

B			
A			
REV		DRAWN	APP



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PROJECT DETAILS:

PROPOSED RELEVELLING PLAN
32 NICHOLLS STREET
RICHMOND, CHRISTCHURCH

TITLE:
RELEVELLING PLAN & DETAILS

DATE CREATED	12/10/2020	CCL REF. No.	12445-388
DRAWN	AB	DESIGNED	AB
SCALE	AS SHOWN @ A1	APPROVED	PF
DWG NUMBER	S101	STATUS	FOR EXEMPTION
		REVISION	

DO NOT REPRODUCE WITHOUT WRITTEN AUTHORITY

3. DESIGN ASSUMPTIONS

1. Preparation of proposed jacking design based on MBIE and HNZ Mechanical Lift System to jack and level foundation system.
2. Dimensions are approximate.
3. The perimeter foundation is considered unreinforced based on the age of the dwelling with reference to www.renovate.org.nz. The perimeter beam is assumed to have cross-sectional dimensions of 200 x 300mm. The size of the beam needs to be verified at the site before commencing the work. If the dimensions are found to be smaller than those assumed, the contractor should contact Cook Costello for further advice).
4. Based on the dwelling age, the compressive strength of the concrete is assumed to be 17.5MPa.
5. The concrete strength for the existing perimeter foundation is an assumption only and no specific testing has been carried out to confirm this compressive strength. Given the age of the dwelling, there is a chance that the perimeter foundation may sustain cracking damage. The contractor should take all reasonable steps to keep the perimeter foundation undamaged and stable during re-leveling process. In the case of significant cracking, the foundation will require full or partial replacement.
6. Building materials obtained from BMC Residential Structural Assessment Report (20 May 2020).
7. Live load will not exist for jacking case i.e. use load combination of 1.35G.

4. DESIGN RECOMMENDATIONS

1. Maximum extent of lift will be less than 100mm.
2. Utilise 0.8 x 0.8 x 0.04m jacking pads at a depth of 0.5mbgl.
3. Maximum spacing of internal jacking points along the bearer line should not exceed the existing bearer span.
4. Maximum spacing for lifting points are presented in Table 1.

Table 1: Summary of Lifting Requirements

Foundation Element	Maximum Jack Spacing (m)	Corresponding Pad Centres (m)
Type B Ring Beam	1.9	1.9

5. Existing wall cladding to remain during lift.
6. Alternate excavation is to be performed for relevelling pad.
7. A corrected Ultimate Bearing Capacity (UBC) greater than 140kPa is available from a depth of 0.5mbgl for relevelling pads based on the Stockwell's correction method and Cook Costello's Bearing Letter (12 October 2020). This is based on KGA Geotechnical Engineering Investigation (9 April 2020). The Ground Water Table (GWT) was encountered at 2.0mbgl during shallow investigation.

Design Basis for new foundations

FIELD TESTING LOCATION PLAN

Sheet: 1

Ground Level: 4.7

Date: 24/03/20



Client:
Batchelar McDougall Consulting.

Project:
Geotechnical Investigation.

Location:
32 Nicholls Street, Richmond.

Coordinates (NZTM):
E 1,572,105.53 N 5,181,826.69

Key:



Hand Auger and Scala Location



Scala Location



Cone Penetrometer location

Cone Penetrometer location and
Piezometer installation point

Borehole Location



Trial Pit



Red Line indicates property boundary



HADCP sourced from NZGD



CPT sourced from NZGD



DCP sourced from NZGD



Borehole sourced from NZGD



Notes: 1. Locations and features and exploratory holes approximate only.
2. Aerial photograph sourced from Google Earth.

3. Co-ordinates may not be a true representation of the site plans locations and are only accurate to +/- 1m.
4. Not to scale.

HAND AUGER AND SCALA LOG						Job No.:	K200202																			
Client: Batchelar McDougall Consulting. Project: Geotechnical Investigation. Location: 32 Nicholls Street, Richmond. Coordinates: E 1572105.3, N 5181831.8						Ground Level: 4.7						Hole No.: HA01/SP01														
												Date: 24/03/2020														
												Logged By: ASL														
												Sheet: 2A														
RL	Subsurface Conditions	Depth (m)	Groundwater	Geological Unit	Graphic Log	Scala Penetrometer (blows / 50mm)																				
4.65	BARK.			FL		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					
4.4	Organic SILT, some sand, trace rootlets, light brown, dry, non-plastic, slow-dilatancy; sand, fine to medium; organics, amorphous.			BURIED TOPSOIL		1																				
					1																					
					1																					
					2																					
					1																					
4	Fine SAND, minor silt, light brown with orange staining. Loose, moist, poorly graded.	0.5				2																				
						1																				
						1																				
						1																				
						1																				
3.8	SILT, trace to minor sand, light grey with orange mottling, moist, low-plasticity, non-dilatant; sand, fine.					2																				
						1																				
						1																				
						1																				
						1																				
3.6	Fine SAND, some silt, grey with orange staining. Loose, moist to wet, poorly graded.	1.0				0																				
						1																				
						1																				
						1																				
						1																				
3.5	SILT, some sand, light grey with orange mottling, moist to wet, non-plastic, slow-dilatancy; sand, fine.					0																				
						1																				
						1																				
						1																				
						1																				
3.4	Fine SAND, some silt, bluish grey. Very loose, wet to saturated, poorly graded.					0																				
						1																				
						0																				
						0																				
						0																				
2.7	SILT, some sand, bluish grey, wet, non-plastic, slow-dilatancy; sand, fine.	1.5				0																				
						0																				
						0																				
						0																				
						1																				
						0																				
						1																				
						1																				
						1																				
						1																				
2.5	WOOD, some silt, grey, saturated.	2.0				2																				
						1																				
						2																				
						2																				
						2																				
2.1	Silty PEAT, grey to brown, wet to saturated; peat, fibrous.	2.5				3																				
						2																				
						3																				
						3																				
						3																				
1.7	SILT, trace sand, grey, wet to saturated, low-plasticity, non-dilatant; sand, fine.					4																				
						4																				
						4																				
						5																				
						5																				

Notes & Abbreviations

Soils logged in accordance with 'The guidelines for the classification and description of soil and rock for engineering purposes' December 2005, NZGS. Co-ordinates are in NZTM unless otherwise specified.

Water

- ▼ Standing Water Level
 ▽ Water Level At Time Of Drilling
 ⇐ Out Flow ⇨ In Flow

Shear Vane

- Corrected as per NZGS Guidelines
 Vane No.:
 UTP = Unable To Penetrate
 + = Peak Exceeded
 - = No Result

Other Comments



HAND AUGER AND SCALA LOG						Job No.: K200202															
Client: Batchelar McDougall Consulting. Project: Geotechnical Investigation. Location: 32 Nicholls Street, Richmond. Coordinates: E 1572116.3, N 5181831.9						Hole No.: HA02/SP02															
						Date: 24/03/2020															
						Logged By: GA															
						Sheet: 2B															
						Ground Level: 4.8															
RL	Subsurface Conditions	Depth (m)	Groundwater	Geological Unit	Graphic Log	Scala Penetrometer (blows / 50mm)															
4.3	Organic SILT, some sand, trace rootlets, brown, moist, non-plastic, slow-dilatancy; sand, fine to medium; organics, amorphous. 0.20m: rootlets absent.			TOPSOIL		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		
					2	3	4	5	6	7	8	9	10	11	12	13	14	15			
					3	4	5	6	7	8	9	10	11	12	13	14	15				
					4	5	6	7	8	9	10	11	12	13	14	15					
					5	6	7	8	9	10	11	12	13	14	15						
4	SILT, minor sand, light brown, moist, non-plastic, non-dilatant; sand, fine. 0.60m: orange mottling. 0.70m: some sand, moist to wet, slow-dilatancy.					0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		
					2	3	4	5	6	7	8	9	10	11	12	13	14	15			
					3	4	5	6	7	8	9	10	11	12	13	14	15				
					4	5	6	7	8	9	10	11	12	13	14	15					
					5	6	7	8	9	10	11	12	13	14	15						
3.5	Sandy SILT, brownish grey with orange mottling, moist to wet, non-plastic, dilatant; sand, fine to medium.					0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		
					2	3	4	5	6	7	8	9	10	11	12	13	14	15			
					3	4	5	6	7	8	9	10	11	12	13	14	15				
					4	5	6	7	8	9	10	11	12	13	14	15					
					5	6	7	8	9	10	11	12	13	14	15						
1.8	SILT, some sand, brownish grey with orange mottling, moist, non-plastic, slow-dilatancy; sand, fine to medium. 1.40m: trace fibrous organics, brownish grey. 1.80m: minor partly decomposed wood. 1.90m: moist to wet. 2.10m: wood absent. 2.40m: trace tree roots, wet. 2.80m: trace charcoal. 3.00m: End of hole, (target depth).			SPRINGSTON FORMATION (TERRESTRIAL)		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		
					2	3	4	5	6	7	8	9	10	11	12	13	14	15			
					3	4	5	6	7	8	9	10	11	12	13	14	15				
					4	5	6	7	8	9	10	11	12	13	14	15					
					5	6	7	8	9	10	11	12	13	14	15						
					6	7	8	9	10	11	12	13	14	15							
					7	8	9	10	11	12	13	14	15								
					8	9	10	11	12	13	14	15									
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					10	11	12	13	14	15											
					11	12	13	14	15												
					12	13	14	15													
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Notes & Abbreviations

Soils logged in accordance with 'The guidelines for the classification and description of soil and rock for engineering purposes' December 2005, NZGS. Co-ordinates are in NZTM unless otherwise specified.

Water

- ▼ Standing Water Level
 ▽ Water Level At Time Of Drilling
 ⇐ Out Flow ⇨ In Flow

Shear Vane

Corrected as per NZGS Guidelines
 Vane No.:
 UTP = Unable To Penetrate
 + = Peak Exceeded
 - = No Result

Other Comments



Job No.: **K200202**

Hole No.: HA03/SP03

Date: 24/03/2020

Logged By: GA

Sheet:	2C
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[illegible]

Notes & Abbreviations

Soils logged in accordance with 'The guidelines for the classification and description of soil and rock for engineering purposes' December 2005. NZGS. Co-ordinates are in NZTM unless otherwise specified.

Water	Shear Vane	Other Comments
▼ Standing Water Level	Corrected as per NZGS Guidelines	
▽ Water Level At Time Of Drilling	Vane No.:	
	UTP = Unable To Penetrate	
	+ = Peak Exceeded	
↰ Out Flow ↷ In Flow	- = No Result	



Page 17 of 21
Job No.: K200202

Hole No.: HAS04/SP04

Date: 24/03/2020

Logged By: GA

Sheet:	2D
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Sheet:	2D
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RL	Subsurface Conditions	Depth (m)	Groundwater	Geological Unit	Graphic Log	Scala Penetrometer (blows / 50mm)															
						0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
4.3	Organic SILT, some sand, trace rootlets, brown, dry to moist, non-plastic, slow-dilatancy; sand, fine to medium; organics, amorphous. 0.10m: minor partly decomposed wood. 0.20m: moist, wood absent.			TOPSOIL			1														
4.2	Sandy SILT, light brown, moist, non-plastic, dilatant; sand, fine to medium.						1														
	SILT, some sand, brownish grey with grey mottling, moist, non-plastic, slow-dilatancy; sand, fine.	0.5					1														
							1														
							1														
							1														
							1														
							1														
							1														
	1.00m: reddish orange mottling.	1.0					1														
	1.10m: minor sand, grey with orange mottling, moist to wet, non-dilatant.						1														
							1														
							1														
							1														
							1														
							1														
	1.60m: mottling absent.	1.5					1														
	1.70m: orange mottling.						1														
							2														
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Notes & Abbreviations

Soils logged in accordance with 'The guidelines for the classification and description of soil and rock for engineering purposes' December 2005. NZGS. Co-ordinates are in NZTM unless otherwise specified.

Water	Shear Vane	Other Comments
▼ Standing Water Level ∇ Water Level At Time Of Drilling ↙ ↘ Out Flow In Flow	Corrected as per NZGS Guidelines Vane No.: UTP = Unable To Penetrate + = Peak Exceeded - = No Result	Hand auger terminated at a depth of 2.80m below ground level due to obstruction from deck structure.



Engco Consulting
Simply Supported Beam Spreadsheet



Job: 32 nicholls Road
Beam: beam 4 - Grid C
Description: Conservative Trib Width

Job No: 20705
Date: 21/12/2020
Designer: SP

Beam Geometry & Material Properties

Span =	1700 mm	depth =	190 mm	I =	51.4x10 ⁶ mm ⁴	φ =	0.8
Trib Width =	2065 mm	width =	90 mm	E =	6.7 GPa	k2 (creep) =	2
Dry or Wet?	Dry	# of elements =	2	fb =	14.0 MPa		
Material =	SG8	Beam Weight =	0.08 kN/m	fs =	3.8 MPa	Ss/Su =	0.38
Top flange restraint length =	2400 mm			k _g (positive bending) =	1.000	Ws/Wu =	0.69
Bottom flange restraint length =	2400 mm			k _g (negative bending) =	1.000		

Beam Use (short-term, long-term & combination factors from table 4.1)		ψ _s	ψ _L	ψ _c
Roof beam	UDL	0.7	0	0
All other roofs	Point Load	1	0	0

Uniformly distributed Loads

	Area Load	Line Load	Combined UDL
G =	0.41 kPa		0.93 kN/m
Q =	0.25 kPa		0.52 kN/m
Su =	0.63 kPa		1.30 kN/m
Wu (uplift) =	-1.20 kPa		-2.48 kN/m

Concentrated Loads

	Point Load	Distance from end
G =	3.4 kN	850 mm
Q =	2.0 kN	
Su =	4.9 kN	
Wu (uplift) =	-9.4 kN	

Serviceability Load Combinations: Deflection checks

SLS Cases	Effective UDL	pt. load	Deflections	Limits	Reactions
k2G	1.85 kN/m	6.85 kN	2.62 mm	Span/ 649	G = 2.50 kN
Q	0.52 kN/m	1.96 kN	0.74 mm	Span/ 2283	Q = 1.42 kN
Ws	-1.71 kN/m	-6.49 kN	-2.47 mm	Span/ 689	Su = 3.57 kN
Ss	0.49 kN/m	1.88 kN	0.71 mm	Span/ 2384	Wu (uplift) = -6.81 kN
k2G + ψ _s Q	2.21 kN/m	8.81 kN	3.31 mm	Span/ 513	
k2 (G + ψ _L Q)	1.85 kN/m	6.85 kN	2.62 mm	Span/ 649	
k2G + Ws (up)	0.14 kN/m	0.36 kN	0.15 mm	Span/ 11134	
k2G + Ss + ψ _c Q	2.34 kN/m	8.73 kN	3.33 mm	Span/ 510	
Vibration check					Only req. for floor beams

Ultimate Load Combinations: Strength checks

ULS Cases	UDL	pt. load	M*	V* (reactions)	k1	φMn	φVn
1.35G	1.25 kN/m	4.63 kN	2.42 kNm	3.37 kN	0.6	3.64 kNm	20.79 kN
1.2G + 1.5Q	1.88 kN/m	7.05 kN	3.68 kNm	5.13 kN	0.8	4.85 kNm	27.72 kN
1.2G + Su + ψ _c Q	2.41 kN/m	9.05 kN	4.72 kNm	6.57 kN	0.8	4.85 kNm	27.72 kN
0.9G + Wu	-1.65 kN/m	-6.32 kN	-3.28 kNm	-4.56 kN	1	-6.06 kNm	34.66 kN
G+0.4Q	1.13 kN/m	4.21 kN	4.72 kNm	6.57 kN	1	6.06 kNm	34.66 kN

Hold Down fixing: **Mitek Type G** 7.50 kN

Designer notes

Beam Required: 190 x 90 SG8

Engco Consulting
Simply Supported Beam Spreadsheet



Job: 32 nicholls Road
Beam: beam 4 - Grid C
Description: Conservative Trib Width

Job No: 20705
Date: 21/12/2020
Designer: SP

Beam Geometry & Material Properties

Span =	1650 mm	depth =	190 mm	I =	51.4x10 ⁶ mm ⁴	φ =	0.8
Trib Width =	1700 mm	width =	90 mm	E =	6.7 GPa	k2 (creep) =	2
Dry or Wet?	Dry	# of elements =	2	fb =	14.0 MPa		
Material =	SG8	Beam Weight =	0.08 kN/m	fs =	3.8 MPa	Ss/Su =	0.38
Top flange restraint length =	2400 mm			k _g (positive bending) =	1.000	Ws/Wu =	0.69
Bottom flange restraint length =	2400 mm			k _g (negative bending) =	1.000		

Beam Use (short-term, long-term & combination factors from table 4.1)		ψ _s	ψ _L	ψ _c
Roof beam	UDL	0.7	0	0
All other roofs	Point Load	1	0	0

Uniformly distributed Loads

	Area Load	Line Load	Combined UDL
G =	0.41 kPa		0.78 kN/m
Q =	0.25 kPa		0.43 kN/m
Su =	0.63 kPa		1.07 kN/m
Wu (uplift) =	-1.20 kPa		-2.04 kN/m

Concentrated Loads

	Point Load	Distance from end
G =	3.4 kN	825 mm
Q =	2.0 kN	
Su =	4.9 kN	
Wu (uplift) =	-9.4 kN	

Serviceability Load Combinations: Deflection checks

SLS Cases	Effective UDL	pt. load	Deflections	Limits	Reactions
k2G	1.55 kN/m	6.85 kN	2.30 mm	Span/ 719	G = 2.35 kN
Q	0.43 kN/m	1.96 kN	0.65 mm	Span/ 2535	Q = 1.33 kN
Ws	-1.41 kN/m	-6.49 kN	-2.16 mm	Span/ 765	Su = 3.35 kN
Ss	0.41 kN/m	1.88 kN	0.62 mm	Span/ 2647	Wu (uplift) = -6.39 kN
k2G + ψ _s Q	1.85 kN/m	8.81 kN	2.91 mm	Span/ 567	
k2 (G + ψ _L Q)	1.55 kN/m	6.85 kN	2.30 mm	Span/ 719	
k2G + Ws (up)	0.14 kN/m	0.36 kN	0.14 mm	Span/ 11851	
k2G + Ss + ψ _c Q	1.96 kN/m	8.73 kN	2.92 mm	Span/ 565	
Vibration check	Only req. for floor beams				

Ultimate Load Combinations: Strength checks

ULS Cases	UDL	pt. load	M*	V* (reactions)	k1	φMn	φVn
1.35G	1.05 kN/m	4.63 kN	2.26 kNm	3.18 kN	0.6	3.64 kNm	20.79 kN
1.2G + 1.5Q	1.57 kN/m	7.05 kN	3.44 kNm	4.82 kN	0.8	4.85 kNm	27.72 kN
1.2G + Su + ψ _c Q	2.00 kN/m	9.05 kN	4.41 kNm	6.18 kN	0.8	4.85 kNm	27.72 kN
0.9G + Wu	-1.34 kN/m	-6.32 kN	-3.06 kNm	-4.27 kN	1	-6.06 kNm	34.66 kN
G+0.4Q	0.95 kN/m	4.21 kN	4.41 kNm	6.18 kN	1	6.06 kNm	34.66 kN

Hold Down fixing: **Mitek Type G** 7.50 kN

Designer notes

Beam Required: 190 x 90 SG8

Engco Consulting
Simply Supported Beam Spreadsheet



Job: 32 nicholls Road
Beam: beam 4 - Grid C
Description: Conservative Trib Width

Job No: 20705
Date: 21/12/2020
Designer: SP

Beam Geometry & Material Properties

Span =	4300 mm	depth =	240 mm	I =	103.7x10 ⁶ mm ⁴	φ =	0.8
Trib Width =	3645 mm	width =	90 mm	E =	13.2 GPa	k ₂ (creep) =	2
Dry or Wet?	Dry	# of elements =	2	fb =	48.0 MPa	k ₂₄ =	0.867
Material =	LVL13	Beam Weight =	0.10 kN/m	fs =	4.6 MPa	Ss/Su =	0.38
Top flange restraint length =	2400 mm	k ₈ (positive bending) =	0.998	Ws/Wu =	0.69		
Bottom flange restraint length =	2400 mm	k ₈ (negative bending) =	0.998				

Beam Use (short-term, long-term & combination factors from table 4.1)	UDL	ψ _s	ψ _L	ψ _c
Roof beam		0.7	0	0
All other roofs	Point Load	1	0	0

Uniformly distributed Loads

	Area Load	Line Load	Combined UDL
G =	0.41 kPa		1.59 kN/m
Q =	0.25 kPa		0.91 kN/m
Su =	0.63 kPa		2.30 kN/m
Wu (uplift) =	-1.20 kPa		-4.37 kN/m

Concentrated Loads

	Point Load	Distance from end
G =	0.0 kN	1000 mm
Q =	0.0 kN	
Su =	0.0 kN	
Wu (uplift) =	0.0 kN	

Serviceability Load Combinations: Deflection checks

SLS Cases	Effective UDL	pt. load	Deflections	Limits	Reactions
k ₂ G	2.39 kN/m	0.00 kN	7.78 mm	Span/ 553	G = 3.43 kN
Q	0.91 kN/m	0.00 kN	2.96 mm	Span/ 1451	Q = 1.96 kN
Ws	-3.02 kN/m	0.00 kN	-9.82 mm	Span/ 438	Su = 4.94 kN
Ss	0.87 kN/m	0.00 kN	2.84 mm	Span/ 1515	Wu (uplift) = -9.40 kN
k ₂ G + ψ _s Q	3.03 kN/m	0.00 kN	9.85 mm	Span/ 437	
k ₂ (G + ψ _L Q)	2.39 kN/m	0.00 kN	7.78 mm	Span/ 553	
k ₂ G + Ws (up)	-0.63 kN/m	0.00 kN	-2.04 mm	Span/ 2107	
k ₂ G + Ss + ψ _c Q	3.26 kN/m	0.00 kN	10.61 mm	Span/ 405	
Vibration check	Only req. for floor beams				

Ultimate Load Combinations: Strength checks

ULS Cases	UDL	pt. load	M*	V* (reactions)	k ₁	φMn	φVn
1.35G	2.15 kN/m	0.00 kN	4.97 kNm	4.63 kN	0.6	17.22 kNm	31.80 kN
1.2G + 1.5Q	3.28 kN/m	0.00 kN	7.58 kNm	7.05 kN	0.8	22.96 kNm	42.39 kN
1.2G + Su + ψ _c Q	4.21 kN/m	0.00 kN	9.73 kNm	9.05 kN	0.8	22.96 kNm	42.39 kN
0.9G + Wu	-2.94 kN/m	0.00 kN	-6.79 kNm	-6.32 kN	1	-28.70 kNm	52.99 kN
G+0.4Q	1.96 kN/m	0.00 kN	9.73 kNm	9.05 kN	1	28.70 kNm	52.99 kN

Hold Down fixing: **Mitek Type G** 7.50 kN

Designer notes

Beam Required: 240 x 90 LVL13

Engco Consulting
Simply Supported Beam Spreadsheet



Job: 32 nicholls Road
Beam: beam 4 - Grid C
Description: Conservative Trib Width

Job No: 20705
Date: 21/12/2020
Designer: SP

Beam Geometry & Material Properties

Span =	2800 mm	depth =	190 mm	I =	51.4x10 ⁶ mm ⁴	φ =	0.8
Trib Width =	3050 mm	width =	90 mm	E =	6.7 GPa	k2 (creep) =	2
Dry or Wet?	Dry	# of elements =	2	fb =	14.0 MPa		
Material =	SG8	Beam Weight =	0.08 kN/m	fs =	3.8 MPa	Ss/Su =	0.38
Top flange restraint length =	2400 mm			k _g (positive bending) =	1.000	Ws/Wu =	0.69
Bottom flange restraint length =	2400 mm			k _g (negative bending) =	1.000		

Beam Use (short-term, long-term & combination factors from table 4.1)		ψ _s	ψ _L	ψ _c
Roof beam	UDL	0.7	0	0
All other roofs	Point Load	1	0	0

Uniformly distributed Loads

	Area Load	Line Load	Combined UDL
G =	0.41 kPa		1.33 kN/m
Q =	0.25 kPa		0.76 kN/m
Su =	0.63 kPa		1.92 kN/m
Wu (uplift) =	-1.20 kPa		-3.66 kN/m

Concentrated Loads

	Point Load	Distance from end
G =	0.0 kN	1000 mm
Q =	0.0 kN	
Su =	0.0 kN	
Wu (uplift) =	0.0 kN	

Serviceability Load Combinations: Deflection checks

SLS Cases	Effective UDL	pt. load	Deflections	Limits	Reactions
k2G	2.66 kN/m	0.00 kN	6.17 mm	Span/ 454	G = 1.86 kN
Q	0.76 kN/m	0.00 kN	1.77 mm	Span/ 1581	Q = 1.07 kN
Ws	-2.53 kN/m	0.00 kN	-5.86 mm	Span/ 477	Su = 2.69 kN
Ss	0.73 kN/m	0.00 kN	1.70 mm	Span/ 1651	Wu (uplift) = -5.12 kN
k2G + ψ _s Q	3.19 kN/m	0.00 kN	7.41 mm	Span/ 378	
k2 (G + ψ _L Q)	2.66 kN/m	0.00 kN	6.17 mm	Span/ 454	
k2G + Ws (up)	0.13 kN/m	0.00 kN	0.31 mm	Span/ 9072	
k2G + Ss + ψ _c Q	3.39 kN/m	0.00 kN	7.87 mm	Span/ 356	
Vibration check					Only req. for floor beams

Ultimate Load Combinations: Strength checks

ULS Cases	UDL	pt. load	M*	V* (reactions)	k1	φMn	φVn
1.35G	1.79 kN/m	0.00 kN	1.76 kNm	2.51 kN	0.6	3.64 kNm	20.79 kN
1.2G + 1.5Q	2.74 kN/m	0.00 kN	2.68 kNm	3.83 kN	0.8	4.85 kNm	27.72 kN
1.2G + Su + ψ _c Q	3.52 kN/m	0.00 kN	3.45 kNm	4.92 kN	0.8	4.85 kNm	27.72 kN
0.9G + Wu	-2.46 kN/m	0.00 kN	-2.41 kNm	-3.45 kN	1	-6.06 kNm	34.66 kN
G+0.4Q	1.63 kN/m	0.00 kN	3.45 kNm	4.92 kN	1	6.06 kNm	34.66 kN

Hold Down fixing: **Mitek Type F** 4.00 kN

Designer notes

Beam Required: 190 x 90 SG8



New Zealand
Institute of Architects
Incorporated



Building Code Clause(s) **B1**

PRODUCER STATEMENT – PS1 – DESIGN

(Guidance on use of Producer Statements (formerly page 2) is available at www.engineeringnz.org)

ISSUED BY: The Engineering Company Ltd (ENGCO)
(Design Firm)

TO: Anne Wilkins
(Owner/Developer)

TO BE SUPPLIED TO: Christchurch City Council
(Building Consent Authority)

IN RESPECT OF: Structural Alterations of residential dwelling
(Description of Building Work)

AT: 32 Nicholls Street,
(Address)

Town/City: Richmond, Christchurch
(Address) **LOT** **DP** **SO**

We have been engaged by the owner/developer referred to above to provide:
Structural engineering design for proposed renovations at the address above.

.....
(Extent of Engagement)

services in respect of the requirements of Clause(s) **B1** of the Building Code for:

☐ All or ☒ Part only (as specified in the attachment to this statement), 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 **VM1/AS1** or
(verification method/acceptable solution)

☐ Alternative solution as per the attached schedule.....

The proposed building work covered by this producer statement is described on the drawings titled:

.....and numbered;
together with the specification, and other documents set out in the schedule attached to this statement.

On behalf of the Design Firm, and subject to:

- (i) Site verification of the following design assumptions **Please see attached addendum**
(ii) All proprietary products meeting their performance specification requirements;

I believe on reasonable grounds that a) the building, if constructed in accordance with the drawings, specifications, and other documents provided or listed in the attached schedule, will comply with the relevant provisions of the Building Code and that b), the persons who have undertaken the design have the necessary competency to do so. I also recommend the following level of construction monitoring/observation:

☐ CM1 ☒ CM2 ☐ CM3 ☐ CM4 ☐ CM5 (Engineering Categories) or ☐ as per agreement with owner/developer (Architectural)

I, **Julian Addington** am: ☒ CPEng **1019730** # ☐ Reg Arch #
(Name of Design Professional)

I am a member of: ☒ Engineering New Zealand ☐ NZIA and hold the following qualifications: **BE(hons), CMEngNZ, CPEng**

The Design Firm issuing this statement holds a current policy of Professional Indemnity Insurance no less than \$200,000*.

The Design Firm is a member of ACENZ: ☐

SIGNED BY: Julian Addington (Signature).... *Julian Addington*
(Name of Design Professional)

ON BEHALF OF The Engineering Company Ltd (ENGCO) Date **21/ 12/ 2020**
(Design Firm)

Note: This statement shall only be relied upon by the Building Consent Authority named above. Liability under this statement accrues to the Design Firm only. The total maximum amount of damages payable arising from this statement and all other statements provided to the Building Consent Authority in relation to this building work, whether in contract, tort or otherwise (including negligence), 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.
THIS FORM AND ITS CONDITIONS ARE COPYRIGHT TO ACENZ, ENGINEERING NEW ZEALAND AND NZIA

ADDENDUM TO PRODUCER STATEMENT – PS1 – DESIGN

ISSUED BY:	<u>The Engineering Company Ltd</u> (Design Firm)
TO BE SUPPLIED TO:	<u>Christchurch City Council</u> (Building Consent Authority)
IN RESPECT OF:	<u>Structural Housing Renovation</u> (Description of Building Work)
AT:	<u>32 Nicholls Street, Richmond, Christchurch</u> (Address)

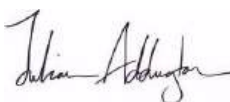
In respect of the requirements of Clause(s) B1 of the Building Code for **part only** (as specified in the attachments to this statement) of the proposed building work.

On behalf of the Design Firm, and subject to:

- (i) Site verification (by a suitably qualified geotechnical engineer) that the geotechnical conditions are as described in the Geotechnical report by KGA (Ref: K200202).
- (ii) Engco shall be responsible for conducting the structural inspections required in order to issue a PS4 on completion, in accordance with the attached inspection schedule.
- (iii) All proprietary products meeting their performance specification requirements.

I, Julian Addington, am a Chartered Professional Engineer, CPEng#1019730, and am a Member of Engineering New Zealand. The Engineering Company Ltd holds a current policy of Professional Indemnity Insurance no less than \$200,000*.

Signed by J J Addington, BE(hons), CPEng, CMEngNZ, Dip, Eng (Mech)
 on behalf of The Engineering Company Ltd, Unit 2, First Floor, 596 Ferry Rd, Woolston, Christchurch


 (signature)

Date: 21 December 2020

Note: This statement shall only be relied upon by the Building Consent Authority named above. Liability under this statement accrues to the Design Firm only. The total maximum amount of damages payable arising from this statement and all other statements provided to the Building Consent Authority in relation to this building work, whether in contract, tort or otherwise (including negligence), is limited to the sum of \$200,000.

Schedule of Engineering Inspections	
Inspection Stage	Purpose of Inspection
Excavation	Confirm soil condition is as per the geotechnical report
Prepour	Once all reinforcing is placed and chaired
Preline	Witness all beams/fixings

It is the contractor's responsibility to notify **The Engineering Company Ltd** 48 hours (office@engco.co.nz) before engineering inspections are required. The total number of inspections will depend upon the construction methodology and staging. Additional inspections from those listed above may be required upon conditions found on site. See also, local territorial authority requirements for construction monitoring.

Memorandum from licensed building practitioner: Certificate of design work

Section 45 and Section 30C, 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: 32 Nicholls Street

Suburb: Richmond

Town/City: Christchurch

Postcode:

THE OWNER

Name(s): Anne Wilkins

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 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 memoranda 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, Julian Addington ~~carried out~~ / supervised the following design work that is restricted building work

PRIMARY STRUCTURE: B1

Design work that is restricted building work	Description	Carried out/ supervised	Reference to plans and specifications
<i>Tick (✓) if included</i> <i>Cross (✗) if excluded</i>	<i>[If appropriate, provide details of the restricted building work]</i>	<i>[Specify whether you carried out this design work or supervised someone else carrying out this design work]</i>	<i>[If appropriate, specify references]</i>

Primary structure

All RBW Design work relating to B1	(✗)		() Carried out () Supervised	
Foundations and subfloor framing	(✓)	<i>Shallow foundation system</i>	() Carried out (✓) Supervised	As shown on Engco Plans, Dated 21.12.2020, Sheets S00.00 – S00.05.
Walls	(✓)	<i>New brace walls</i>	(✓) Carried out (✓) Supervised	
Roof	(✓)	<i>New Beams</i>	() Carried out (✓) Supervised	
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.

Note: continue on another page if necessary.

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
<i>[List relevant clause numbers of building code]</i>	<i>[Specify nature of waiver or modification of building code]</i>

Note: continue on another page if necessary.

ISSUED BY

Name: J J Addington, CPEng	LBP or Registration number: 1019730
The practitioner is a: () Design LBP () Registered architect (✓) Chartered professional engineer	
Design Entity or Company (optional): The Engineering Company Ltd	
Mailing address (if different from below):	
Street address / Registered office: 2/596 Ferry Rd	
Suburb: Woolston	Town/City: Christchurch
PO Box/Private Bag:	Postcode: 8023
Phone number: 03 366 7955	Mobile:
After Hours:	Fax:
Email address: Julian@engco.co.nz	Website:

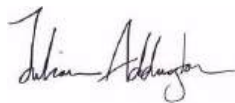
DECLARATION

I Julian Addington *[name of practitioner]*, LBP,

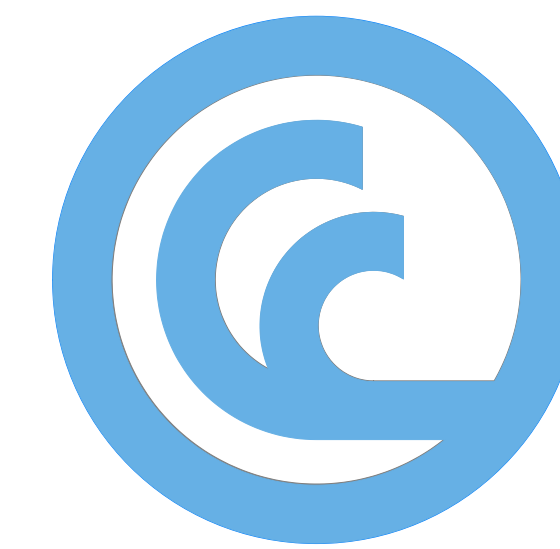
state that I have applied the skill and care reasonably required of a competent design professional in carrying out or supervising the Restricted Building Work (RBW) described in this form, and that based on this, I also state that the RBW:

- 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:



Date: 21 December 2020



cook | costello

**PROPOSED RELEVELLING PLAN
32 NICHOLLS STREET
RICHMOND, CHRISTCHURCH**

FOR CONSENT

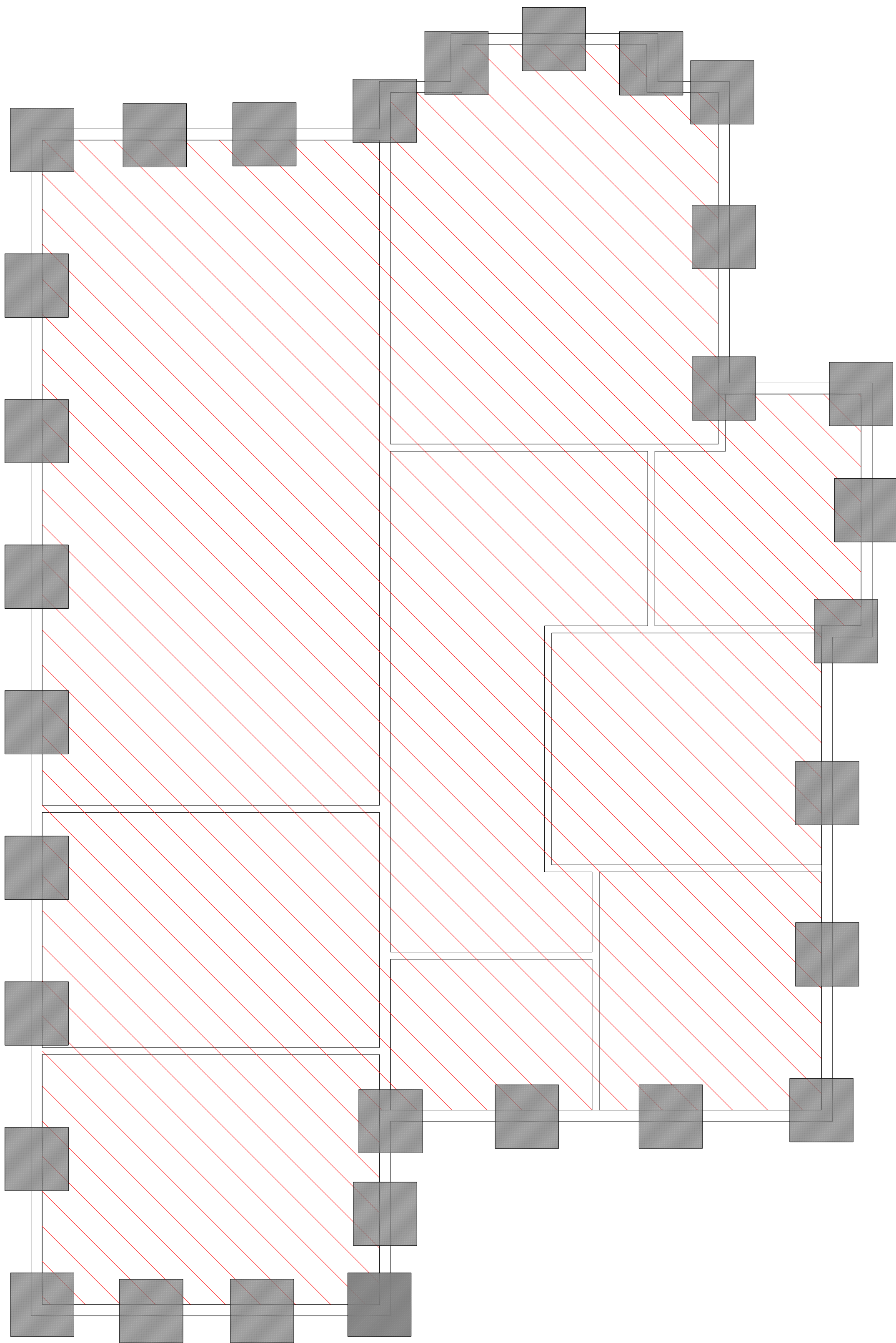
JOB NO:12445-388

DATE: 12/10/2020

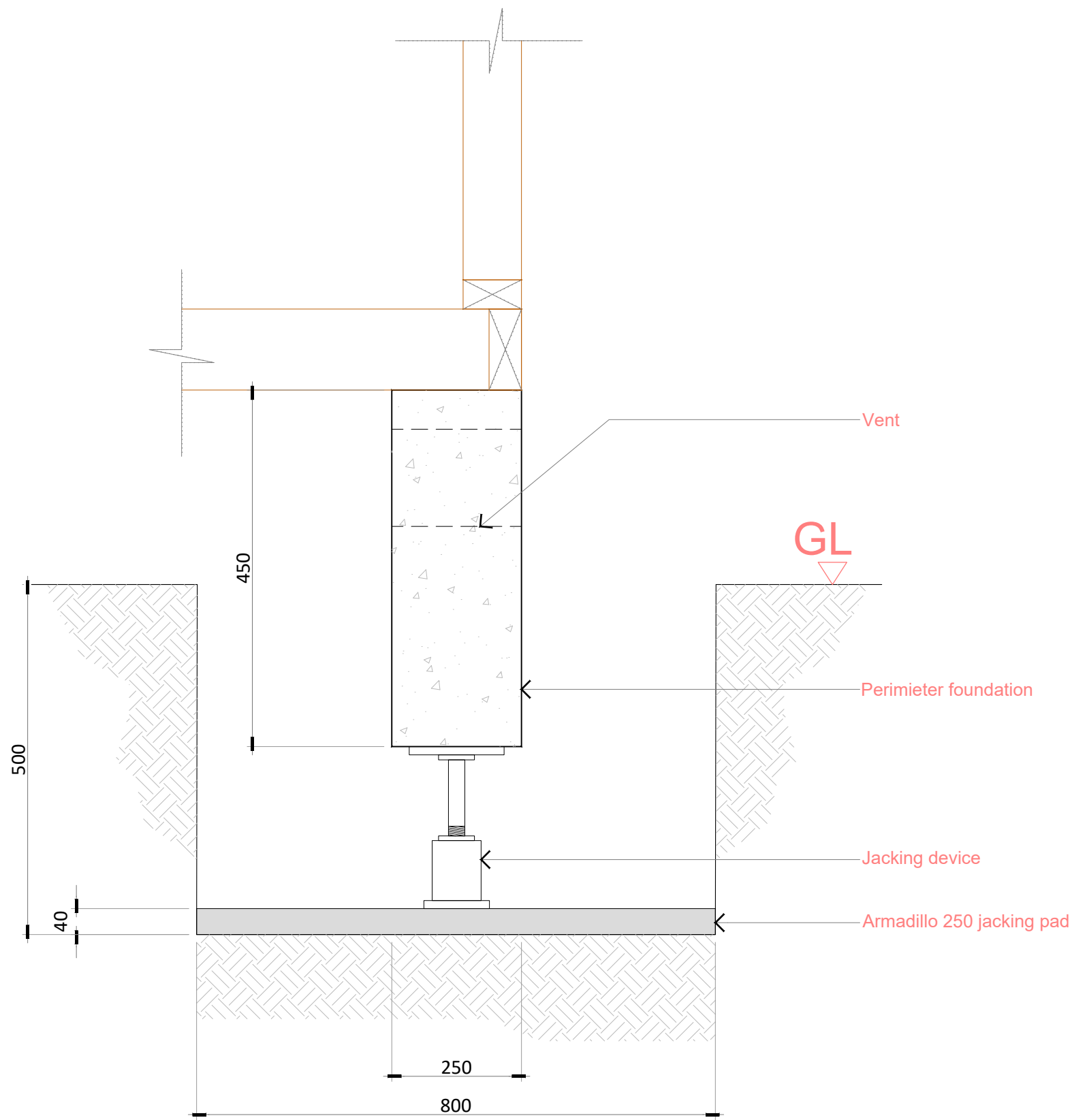
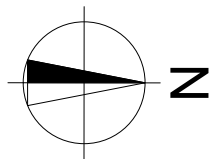
ISSUE: A

Sheet List		
Sheet Number	REV.	Sheet Name
S101		RELEVELLING PLAN & DETAILS

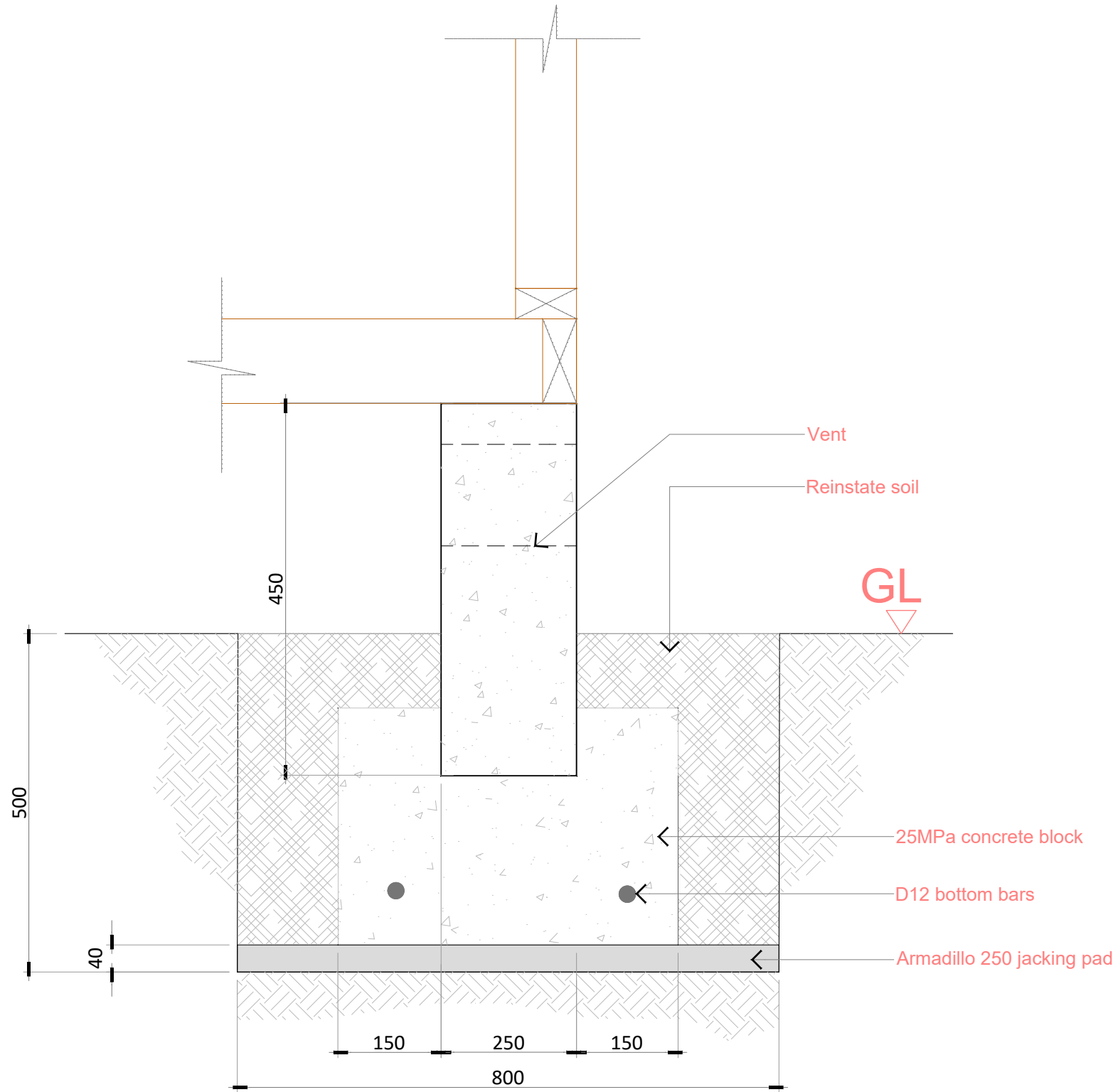
COOK COSTELLO - CHRISTCHURCH
18B BIRMINGHAM DRIVE
CHRISTCHURCH
P: 03 365 5960 / E: office.chch.co.nz / W: coco.co.nz



FOUNDATION RELEVELLING PLAN
SCALE 1:40 @ A1



FOUNDATION JACKING DETAIL
SCALE 1:40 @ A1



FOUNDATION RELEVELLING BLOCK DETAIL
SCALE 1:40 @ A1

- GENERAL**
- COOK COSTELLO STRUCTURAL DRAWINGS ARE NOT SHOP DRAWINGS. SHOP DRAWINGS ARE THE RESPONSIBILITY OF THE CONTRACTOR.
 - ALL DISCREPANCIES SHALL BE REFERRED TO THE ARCHITECT, CONSULTANT OR THE ENGINEER BEFORE PROCEEDING WITH WORK.
 - SETTING OUT, NIBS, REBATES, SET-DOWN & THE LIKES ARE AS PER ARCHITECTURAL DRAWINGS. COOK COSTELLO ACCEPTS NO RESPONSIBILITY WHEN NO DRAWINGS HAVE BEEN PROVIDED.
 - ALL DIMENSIONS RELEVANT TO SETTING OUT AND OFF-SITE WORK SHALL BE VERIFIED BY THE CONTRACTORS BEFORE WORK SHALL BE VERIFIED BY THE CONTRACTORS BEFORE CONSTRUCTION AND FABRICATION IS COMMENCED. THE ENGINEER'S DRAWINGS SHALL NOT BE SCALED.
 - DURING CONSTRUCTION, THE CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTAINING THE STRUCTURE IN A STABLE CONDITION & ENSURE NOT PART SHALL BE OVERSTRESSED UNDER CONSTRUCTION ACTIVITIES. THIS INCLUDES ALL EXISTING STRUCTURES FORMING PART OF, OR AFFECTED BY, THE WORKS.
 - IF DURING CONSTRUCTION, ANY PART OF THE WORKS SHOW SIGNS OF DISTRESS, EXCESSIVE DEFLECTION, CONFLICT OF COMPONENTS OR OTHER PROBLEMS, THE CONTRACTORS SHALL IMMEDIATELY NOTIFY THE ENGINEER, WHO SHALL INVESTIGATE & ISSUE SUCH INSTRUCTION AS ARE CONSIDERED NECESSARY.
 - CONTRACTOR SHOULD VERIFY THAT ALL CONSTRUCTION DRAWINGS ARE THE LATEST VERSION.
 - ALL DIMENSIONS SHOULD BE VERIFIED ON SITE PRIOR TO COMMENCING ANY WORK.
 - COMPLY WITH ALL WORKSAFE NZ AND ONSITE HEALTH AND SAFETY REQUIREMENTS AT ALL TIMES.
 - COOK COSTELLO ACCEPT NO LIABILITY FOR UNAUTHORIZED CHANGES FROM THE DETAILS AND INFORMATION CONTAINED IN THESE DRAWINGS.
 - THESE DRAWINGS AND DESIGN ARE COPYRIGHT AND REMAIN THE PROPERTY OF COOK COSTELLO.
 - PAD LOCATIONS ARE INDICATIVE ONLY. PAD SIZE TO BE 800 x 800 x 40mm ARMADILLO 250 JACKING PAD @ 1.9m max crs.
 - PADS TO BE PLACED $\geq 0.5\text{mbgl}$, ON CONFIRMATION OF UBC 140kPa.

- LEGEND**
- Indicative location of 800 x 800 x 40mm Armadillo jacking pads at 1.9m crs around perimeter foundation.
 - Area to be relevelled via 'Jack and Pack' methodology. Internal jack spacing should not exceed the existing bearer span.

B			
A			
REV		DRAWN	APP



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Whangarei | Auckland | Wellington | Christchurch

PROJECT DETAILS:
PROPOSED RELEVELLING PLAN
32 NICHOLLS STREET
RICHMOND, CHRISTCHURCH

TITLE:
RELEVELLING PLAN & DETAILS

DATE CREATED	12/10/2020	CCL REF. No.	12445-388
DRAWN	AB	DESIGNED	AB
SCALE	AS SHOWN @ A1	APPROVED	PF
DWG NUMBER	S101	STATUS	FOR EXEMPTION
REVISION			

Memorandum from licensed building practitioner: Certificate of design work

Section 45 and Section 30C, Building Act 2004

THE BUILDING

Street address:	32 Nicholls Street		
Suburb:	Richmond		
Town/City	Christchurch	Postcode:	8013

THE OWNER/CLIENT

Name(s):	Nicky Cottam		
Mailing address:	As above		
Suburb:	PO Box/Private Bag:		
Town/City:	Postcode:		
Phone number:	027 503 2763	Email address:	nick@propertyadvisory.co.nz

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 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 memoranda 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 **Paul Ferguson** supervised the following design work that is restricted building work:

Design work that is restricted building work	Description	Carried out/supervised	Reference to plans and specifications
<i>Tick (✓) if included Cross (X) if excluded</i>	<i>[If appropriate, provide details of the restricted building work]</i>	<i>[Specify whether you carried out this design work or supervised someone else carrying out this design work]</i>	<i>[If appropriate, specify references]</i>

Primary structure B1

All RBW Design work relating to B1	☐	☐ Carried out ☐ Supervised	
Foundations and subfloor framing	☒	☐ Carried out ☒ Supervised	Refer to CCL 2015 Ltd Drawing, Ref: Job No: 12445-388, Sheet S101
Walls	☐	☐ Carried out ☐ Supervised	
Roof	☐	☐ Carried out ☐ Supervised	

Columns and beams	☐		☐ Carried out ☐ Supervised	
Bracing	☐		☐ Carried out ☐ Supervised	
Other	☐		☐ Carried out ☐ Supervised	

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	

FIRE SAFETY SYSTEMS: C1 – C6

Emergency warning systems, evacuation and fire service operation systems, suppression or control systems, or 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.

Note: continue on another page if necessary.

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
<i>[List relevant clause numbers of building code]</i>	<i>[Specify nature of waiver or modification of building code]</i>

Note: continue on another page if necessary.

ISSUED BY

Name: Paul Ferguson	LBP or Registration number: 1030477
The practitioner is a: ☐ Design LBP ☐ Registered architect ☒ Chartered professional engineer	
Design Entity or Company (optional):	CCL 2015 Ltd
Mailing address (if different from below):	
Street address / Registered office: 18B Birmingham Drive	
Suburb: Middleton	Town/City: Christchurch
PO Box/Private Bag:	Postcode: 8024
Phone number: 03 365 5960	Mobile:
After Hours:	Fax:
Email address:	Website: www.coco.co.nz

DECLARATION

I, **Paul Ferguson**, 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:



Date:

12 October 2020

PRODUCER STATEMENT – PS1 – DESIGN

(Guidance on use of Producer Statements (formerly page 2) is available at www.engineeringnz.org)

ISSUED BY:	CCL 2015 Limited (Design Firm)	CCL Job No: 12445-388	Issue A
TO:	Nicky Cottam		
TO BE SUPPLIED TO:	Christchurch City Council		
IN RESPECT OF:	Lifting pad design for foundation releve		
AT:	32 Nicholls Street, Richmond		
Town/city:	Christchurch	LOT: 56	DP: 5913 SO:

We have been engaged by the **owner** referred to above to provide **specific structural design** services in respect of the requirements of Clause(s) **B1 Structure** of the Building Code for:

All ☐ or ☒ Part only (as specified in the attachment to this statement), 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: **B1/VM1** or ☐ Alternative solution as per the attached schedule.

The proposed building work covered by this producer statement is described on the drawings titled:

Proposed Foundation Relevelling for 32 Nicholls Street and numbered **12445-388: Sheet S101** together with the design report, and other documents set out in the schedule attached to this statement.

On behalf of the Design Firm, and subject to:

- (i) Site verification of the following design assumptions: **140kPa UBC at 0.5mbgl for relevelling pads as described in the Bearing Letter prepared by Cook Costello, dated 12 October 2020.**
- (ii) All proprietary products meeting their performance specification requirements;

I **believe on reasonable grounds** that a) the building, if constructed in accordance with the drawings, specifications, and other documents provided or listed in the attached schedule, will comply with the relevant provisions of the Building Code and that b) the persons who have undertaken the design have the necessary competency to do so.

I also recommend the following level of construction monitoring/observation:

☐ CM1 ☒ CM2 ☐ CM3 ☐ CM4 ☐ CM5 or ☐ as per agreement with owner/developer.

I, **Paul Ferguson** am ☒ CPEng No. **1030477**. I am a Member of ☒ Engineering New Zealand and hold the following qualifications: **BA BAI (Hons), CPEng 1030477, CMEngNZ**. The Design Firm issuing this statement holds a current policy of Professional Indemnity Insurance no less than \$200,000*. The Design Firm is a member of ACE☒

SIGNED BY: **Paul Ferguson**

ON BEHALF OF **CCL 2015 Ltd (Design Firm)**



(Signature)

Date: 12 October 2020

Note: This statement shall only be relied upon by the Building Consent Authority named above. Liability under this statement accrues to the Design Firm only. The total maximum amount of damages payable arising from this statement and all other statements provided to the Building Consent Authority in relation to this building work, whether in contract, tort or otherwise (including negligence), 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.

THIS FORM AND ITS CONDITIONS ARE COPYRIGHT TO ACENZ, IPENZ AND NZIA

INSPECTION SCHEDULE

PROJECT:	Lifting pad design for foundation releve
AT:	32 Nicholls Street, Richmond
TO BE SUPPLIED TO:	Christchurch City Council
CCL JOB NUMBER:	12445-388 Issue A
DESIGN ENGINEER DETAILS:	Alex Bowen, alex@coco.co.nz , 021 656 716

We confirm that CCL 2015 Ltd have been engaged to undertake construction monitoring of the specific engineering design items to an Engineering New Zealand/ACENZ CM 2 level and propose to undertake at least the following site inspections:

No.	Inspection Description	No. of Inspection(s)
1	Stripped Ground inspection. To confirm the bearing capacity of stripped ground and setting out.	1
2	Pre-pour Inspection. To check the compliance of reinforcement details and general arrangement prior to pouring underpin beam.	1

Notes:

- This Site Inspection Schedule is to be read in conjunction with the attached PS1 – Producer Statement Design and consented drawings.
- The above items of inspection are the minimum required to enable **CCL 2015 Ltd** to issue a PS4 – Producer Statement Construction Review for the specific engineering design items. Issuance of PS4 is dependent on the satisfactory completion of the specified works, and only issued for the work which has been inspected and found to be in compliance with the structural documentation. **Non-consented work or no exemption application approved by Council will result to non-issuance of PS4. A letter will be provided instead which confirms the construction monitoring is as per design recommendations by CCL.**
- 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.
- The Contractor/Builder is to provide **CCL 2015 Ltd** at least 2 full working days' notice of the requirement for geotechnical and/or structural inspection. CCL engineer will not undertake any site inspection without a copy of the consented drawings. The above timeframes are indicative, the Engineer and Contractor are to agree the timing of inspection prior to work commencing on site.
- 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.
- 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.
- For engineering enquiries related to this project, please contact Alex Bowen, alex@coco.co.nz, 021 656 716 or our Christchurch office on 03 365 5960.

Action	Name	Signature	Date
Prepared by:	Alex Bowen Structural Engineer BE (Hons), MEngNZ		08/10/2020
Reviewed by:	Carlos Valencia Intermediate Structural Engineer M.Eng, MEngNZ, MPICE		09/06/2020
Approved by:	Paul Ferguson Chartered Structural BA BAI (Hons), CPEng 1030477, CMEngNZ		12/10/2020

Foundation Repair Design Report

32 Nicholls Street, Richmond, Christchurch

For: Nicky Cottam c/o Smartlift Systems Limited

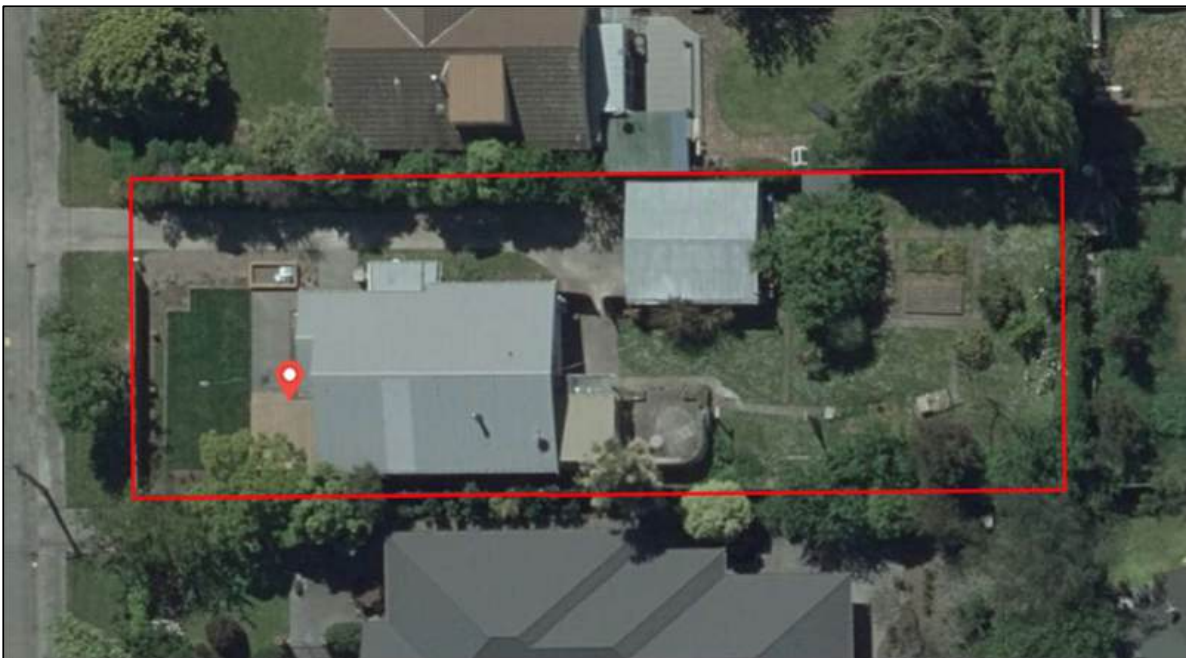


*Photo from ArcGIS

cook | costello

Consulting Engineers

12 October, 2020

Cook Costello Project Number: 12445-388

1. PROPERTY DETAILS

Property Type:	Single storey dwelling
Ground Floor Area (approx.):	130m ²
Dwelling Foundation Type:	Concrete slab (Type C)
Dwelling Ground Floor Cladding Type:	Light weight cladding
Dwelling Roof Type:	Light weight roofing
Dwelling Age:	1920s

2. REPAIR SUMMARY

Cook Costello have been engaged to provide a foundation releveling plan for the dwelling located at 32 Nicholls Street, Richmond, Christchurch. The following documents were referred to by Cook Costello to design the foundation releveling plan:

- KGA Geotechnical Engineering Investigation (9 April 2020)
- BMC Residential Structural Assessment Report (20 May 2020)
- Cook Costello Bearing Letter (12 October 2020)

The design undertaken is subject to the limitations outlined in Section 5. The foundation of the main dwelling at the property is proposed to be relevelled using mechanical lift off Armadillo jacking pads for the perimeter beam foundation and jacking and packing methods for internal piles and bearers. Armadillo jacking pads are a proprietary product consisting of a 0.8 x 0.8 x 0.04m plastic pad. These will be placed beneath the existing perimeter foundation and jacks will be used to lift the foundation back to level. The Armadillo pads will be spaced at 1.9m centres beneath the perimeter strip footing. One jack should be used per pad. Maximum spacing of internal jacking points along the bearer line should not exceed the existing bearer span.

Target levels will be performance based and releveling should cease if releveling threatens to compromise the structure's serviceability. Doors, windows and services should be monitored carefully during the releveling process.

A corrected Ultimate Bearing Capacity (UBC) greater than 140kPa is available from a depth of 0.5mbgl for releveling pads based on the Stockwell's correction method and Cook Costello's Bearing Letter (12 October 2020). This is based on KGA Geotechnical Engineering Investigation (9 April 2020). The Ground Water Table (GWT) was encountered at 2.0mbgl during shallow investigation.

3. DESIGN ASSUMPTIONS

1. Preparation of proposed jacking design based on MBIE and HNZ Mechanical Lift System to jack and level foundation system.
2. Dimensions are approximate.
3. The perimeter foundation is considered unreinforced based on the age of the dwelling with reference to www.renovate.org.nz. The perimeter beam is assumed to have cross-sectional dimensions of 200 x 300mm. The size of the beam needs to be verified at the site before commencing the work. If the dimensions are found to be smaller than those assumed, the contractor should contact Cook Costello for further advice).
4. Based on the dwelling age, the compressive strength of the concrete is assumed to be 17.5MPa.
5. The concrete strength for the existing perimeter foundation is an assumption only and no specific testing has been carried out to confirm this compressive strength. Given the age of the dwelling, there is a chance that the perimeter foundation may sustain cracking damage. The contractor should take all reasonable steps to keep the perimeter foundation undamaged and stable during re-leveling process. In the case of significant cracking, the foundation will require full or partial replacement.
6. Building materials obtained from BMC Residential Structural Assessment Report (20 May 2020).
7. Live load will not exist for jacking case i.e. use load combination of 1.35G.

4. DESIGN RECOMMENDATIONS

1. Maximum extent of lift will be less than 100mm.
2. Utilise 0.8 x 0.8 x 0.04m jacking pads at a depth of 0.5mbgl.
3. Maximum spacing of internal jacking points along the bearer line should not exceed the existing bearer span.
4. Maximum spacing for lifting points are presented in Table 1.

Table 1: Summary of Lifting Requirements

Foundation Element	Maximum Jack Spacing (m)	Corresponding Pad Centres (m)
Type B Ring Beam	1.9	1.9

5. Existing wall cladding to remain during lift.
6. Alternate excavation is to be performed for relevelling pad.
7. A corrected Ultimate Bearing Capacity (UBC) greater than 140kPa is available from a depth of 0.5mbgl for relevelling pads based on the Stockwell's correction method and Cook Costello's Bearing Letter (12 October 2020). This is based on KGA Geotechnical Engineering Investigation (9 April 2020). The Ground Water Table (GWT) was encountered at 2.0mbgl during shallow investigation.

5. LIMITATIONS

This report has been prepared for the benefit of Smartlift Systems Ltd as our client with respect to design undertake as defined in the summary. It shall not be relied upon for any other purpose. The reliance by other parties on the information or opinions contained in this report shall, without our prior review and agreement in writing, be at such parties' sole risk.

Opinions and judgments expressed herein are based on our understanding and interpretation of current regulatory standards and should not be construed as legal opinions. Where opinions or judgments are to be relied on, they should be independently verified with appropriate legal advice. Any recommendations, opinions, or guidance provided by Cook Costello in this report are limited to technical engineering requirements and are not made under the Financial Advisers Act 2008.

Cook Costello have performed the services for this project in accordance with the standard agreement for consulting services and current professional standards for environmental site assessment. No guarantees are either expressed or implied.

This design is aimed to reinstate the foundation to a level (or as level as practicable) state. This design does not aim to negate or 'design out' pre-existing issues with static foundation settlements. If static settlement issues existed with the foundation previously, it is highly likely that those issues will remain following any releveling works.

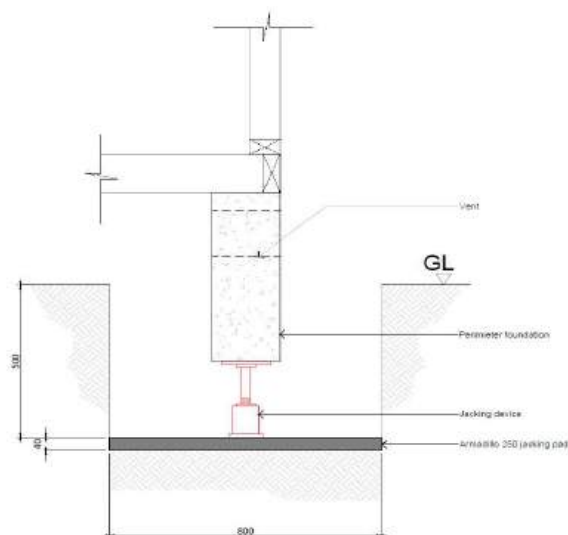
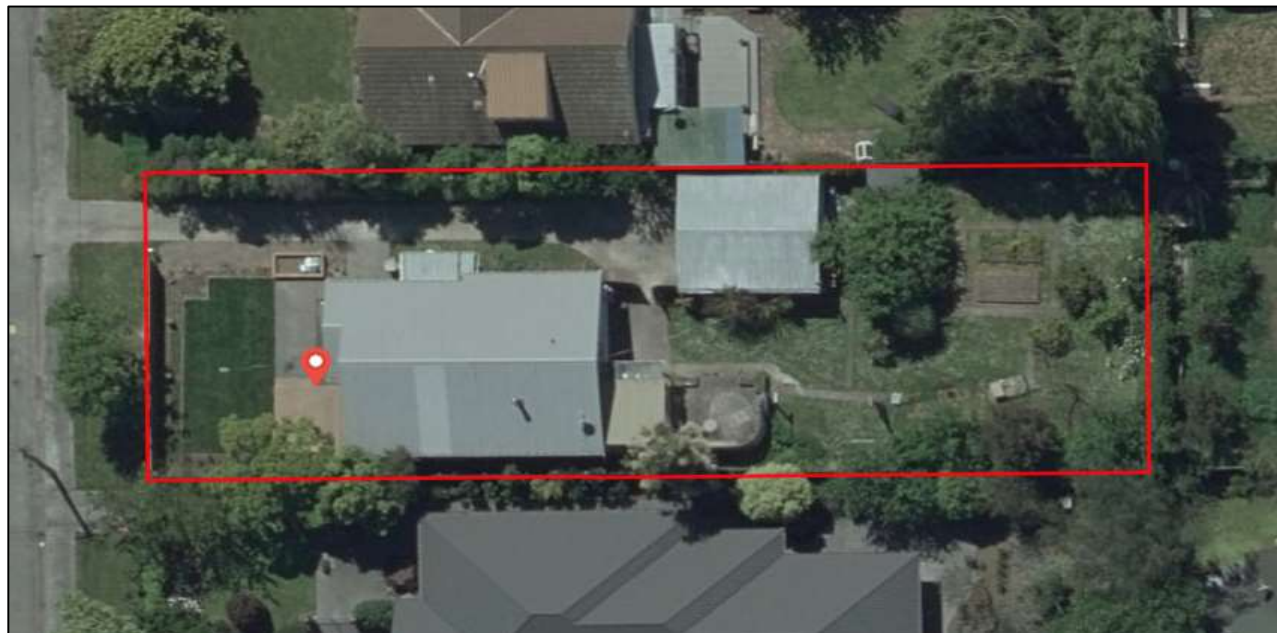
There is no investigation which is thorough enough to preclude the presence of materials at the site which presently, or in the future, may be considered hazardous. Because regulatory evaluation criteria are constantly changing, concentrations of contaminants present and considered to be acceptable now may in the future become subject to different regulatory standards which cause them to become unacceptable and require further remediation for this site to be suitable for the existing or proposed land use activities.

This report is generally appropriate for engineering use for five years; however, it should be considered that future seismic events may change design parameters and as a result a new assessment of the site may be necessitated. It is recommended that if an interpretive report is more than two years old, or the proposed building that the report originally applied to has changed significantly, (e.g., layout, height, weight of building materials, foundation loads etc.) and/or design loadings have changed (e.g., design PGA levels), then the report is reviewed by the geotechnical engineer for current applicability.

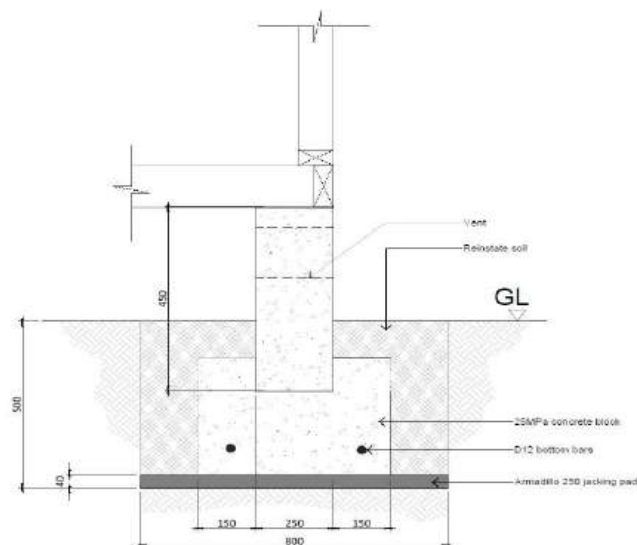
Action	Name	Signature	Date
Prepared by: 	Alex Bowen Structural Engineer BE (Hons), MEngNZ		08/10/2020
Reviewed by: 	Carlos Valencia Structural Engineer M.Eng, MEngNZ, MPICE		09/06/2020
Approved by: 	Paul Ferguson Chartered Structural Engineer BA BAI (Hons), CPEng 1030477, CMEngNZ		12/10/2020
Status	Final		

6. CALCULATIONS

Date:	12/10/20	
Engineer:	AB (Prepared), CV (Reviewed), PF (Approved)	
Job Number:	12445-388	
Address:	32 Nicholls Street, Richmond - Type B	



FOUNDATION JACKING DETAIL
SCALE 1:40 @ A1



FOUNDATION RELEVELLING BLOCK DETAIL
SCALE 1:40 @ A1

Summary

Perimeter

Pads

800x800x40mm Armadillo Pads

Jack Spacing

1900mm max

Underpin

2xD16

Date:	12/10/20	 cook costello
Engineer:	AB (Prepared), CV (Reviewed), PF (Approved)	
Job Number:	12445-388	
Address:	32 Nicholls Street, Richmond - Type B	

Assumptions

Based on MBIE and HNZ mechanical lift system
Dimensions approximate
Maximum lift to be less than 100mm for timber floor
No live load for jacking case (1.35G)

General details

Ultimate bearing	140	kPa	<i>from Cook Costello's Geotechnical letter</i>
Floor type	Timber		
Number of storeys	1		
Firewalls	None		

Current footing

Steel (top)	None	
Steel (bottom)	None	
Steel (shear)	None	
Width (B)	200	mm
Depth (D)	300	mm
f _c	17.5	MPa

Floor

Timber floor

Cladding

Roof	Light (eg Corrugated iron)
Walls	Light (eg Weatherboards)

Perimeter Pads

<u>Armadillo Pad</u>			
Width	0.8	m	One jack per pad
Depth	40	mm	
Spacing of jacks	1.9	m	
Corresponding pad spacing	1.9	m	
Internal spacing of pads	2	m	
f _c	25	MPa	
Armadillo Jacking Pad 250 (250 kN Capacity when loaded as designed)			

Underpin

Depth (MBIE diff=100mm)	150	mm
Steel	D16	x 2
Width (B+150mm)	350	mm
25MPa underpin with 2xD16 (75mm cover)		

Loadings

G _{roof}	0.40	kPa
G _{cladding}	0.40	kPa
G _{footing}	1.44	kN/m
G _{floor}	0.52	kPa
G _{pad}	0.61	kN

Tributary's

Roof tributary width	3.35	m	<i>(Assumed joists spaced at 2m)</i>
Ground floor width	1.00	m	
Wall height	2.4	m	
Internal wall height	2.4	m	

Date:	12/10/20	
Engineer:	AB (Prepared), CV (Reviewed), PF (Approved)	
Job Number:	12445-388	
Address:	32 Nicholls Street, Richmond - Type B	

Loads on perimeter

Footing	1.44	kN/m
Ground floor dead load	0.52	kN/m
Ground floor wall load	0.96	kN/m
Roof dead load	1.34	kN/m
G	4.26	kN/m
1.35G (lifting)	5.75	kN/m

Demands

Footing during lift ($wl^2/8$)
(simply supported)

M*	2.60	kNm
V*	5.46	kN

Pads (1.35G)

P*	11.76	kN
----	-------	----

Perimeter Relevel (Unreinforced)

Moment Capacity

$$f_{yc} = 0.36 \sqrt{f'_c}$$

direct tensile strength of concrete NZS3101 5.2.6

f'_c	17.50	MPa
f_{yc}	1.51	MPa
$Z = (bh^2)/6$	0.003	m ³
ϕ	0.60	
ϕM	2.71	kNm

Assumptions only

(tension plain concrete)

> M* 2.60 kNm

Section capacity is sufficient

Shear Capacity

$$V_c = v_c A_{cv}$$

$$v_c = k_d k_a v_b$$

ϕ	0.75	
v_b	0.84	
k_a	1.00	
k_d	1.00	
v_c	0.84	MPa
A_{cv}	0.06	m ²
ϕV_c	37.65	kN

(max agg 20mm or more)

> V* 5.46 kN

Concrete shear capacity is sufficient

Bearing

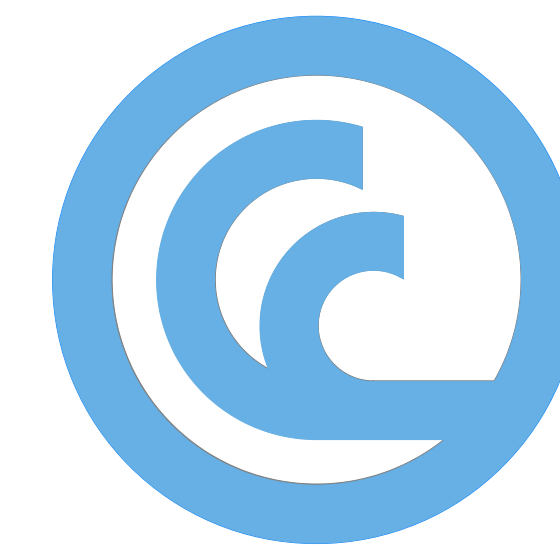
P*	11.76	kN
A	0.64	m ²
P*/A	18.4	kPa

< B 140.0 kPa

Soil bearing capacity is sufficient

F.o.S 7.6

7. FOUNDATION JACKING PLANS



cook | costello

**PROPOSED RELEVELLING PLAN
32 NICHOLLS STREET
RICHMOND, CHRISTCHURCH**

FOR EXEMPTION

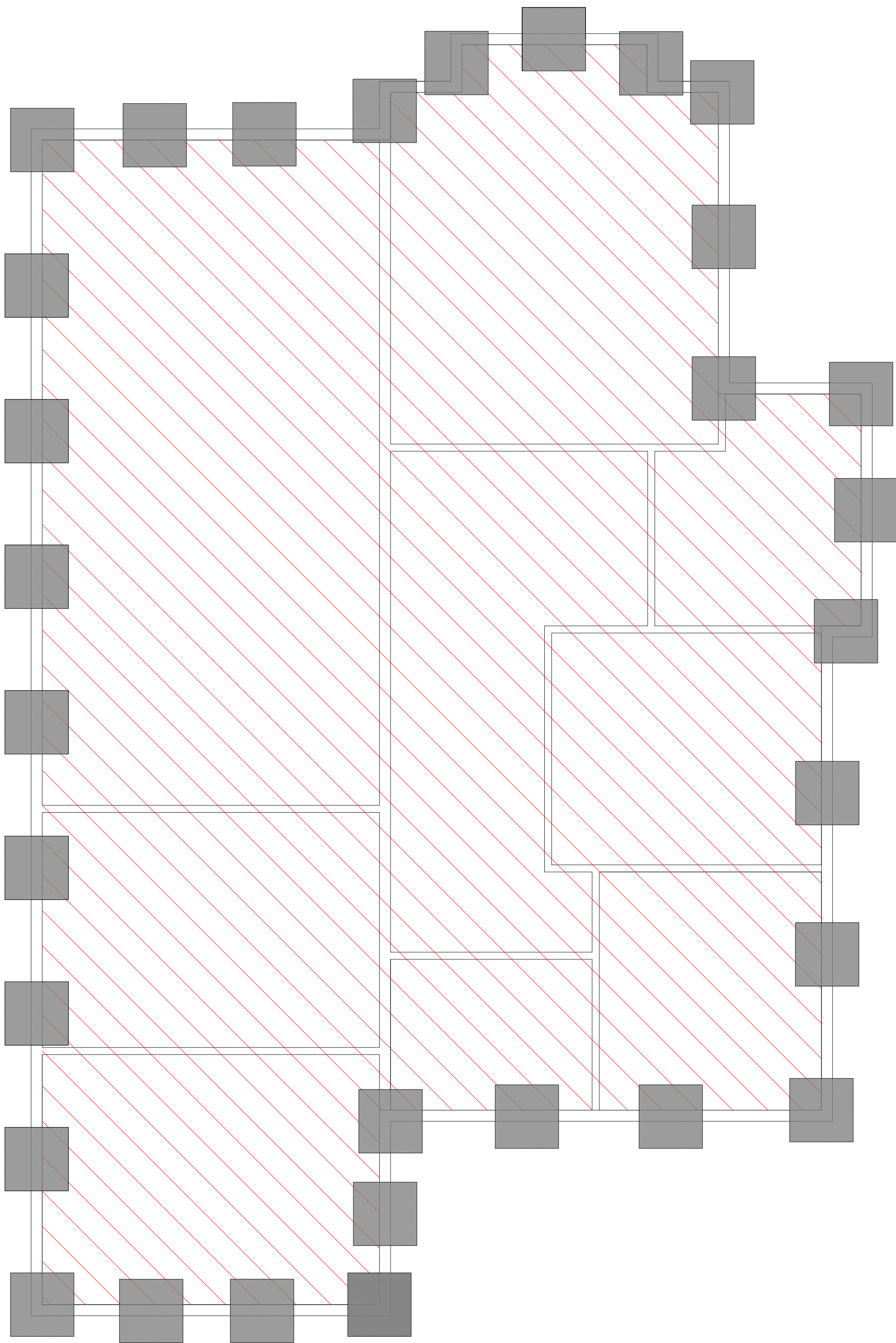
JOB NO:12445-388

DATE: 12/10/2020

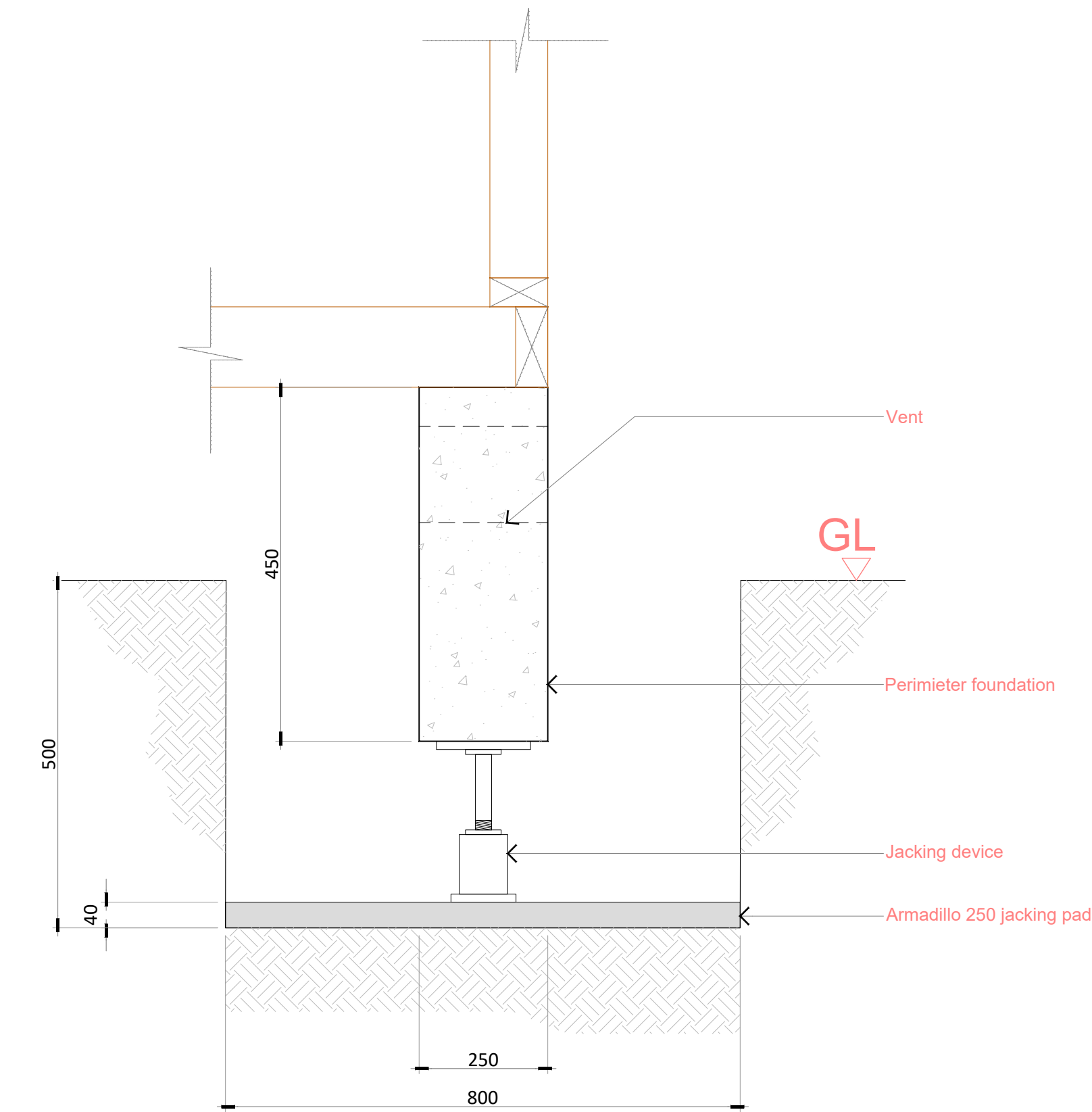
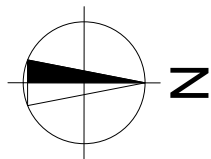
ISSUE: A

Sheet List		
Sheet Number	REV.	Sheet Name
S101		RELEVELLING PLAN & DETAILS

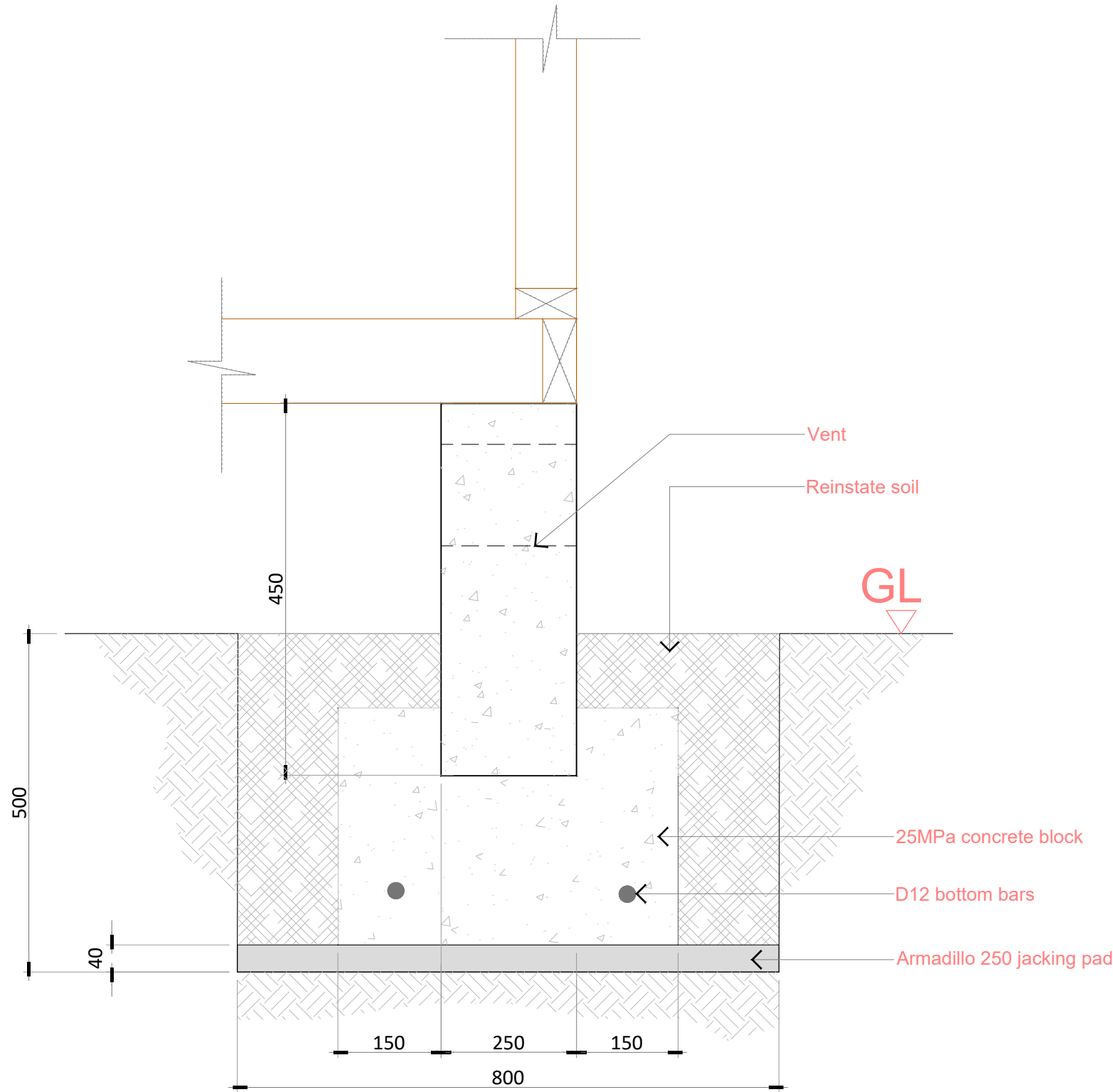
COOK COSTELLO - CHRISTCHURCH
18B BIRMINGHAM DRIVE
CHRISTCHURCH
P: 03 365 5960 / E: office.chch.co.nz / W: coco.co.nz



FOUNDATION RELEVELLING PLAN
SCALE 1:40 @ A1



FOUNDATION JACKING DETAIL
SCALE 1:40 @ A1



FOUNDATION RELEVELLING BLOCK DETAIL
SCALE 1:40 @ A1

- GENERAL**
- COOK COSTELLO STRUCTURAL DRAWINGS ARE NOT SHOP DRAWINGS. SHOP DRAWINGS ARE THE RESPONSIBILITY OF THE CONTRACTOR.
 - ALL DISCREPANCIES SHALL BE REFERRED TO THE ARCHITECT,CONSULTANT OR THE ENGINEER BEFORE PROCEEDING WITH WORK.
 - SETTING OUT, NIBS, REBATES, SET-DOWN & THE LIKES ARE AS PER ARCHITECTURAL DRAWINGS. COOK COSTELLO ACCEPTS NO RESPONSIBILITY WHEN NO DRAWINGS HAVE BEEN PROVIDED.
 - ALL DIMENSIONS RELEVANT TO SETTING OUT AND OFF-SITE WORK SHALL BE VERIFIED BY THE CONTRACTORS BEFORE WORK SHALL BE FABRICATED. THE ENGINEER'S DRAWINGS SHALL NOT BE SCALED.
 - DURING CONSTRUCTION, THE CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTAINING THE STRUCTURE IN A STABLE CONDITION & ENSURE NOT PART SHALL BE OVERSTRESSED UNDER CONSTRUCTION ACTIVITIES. THIS INCLUDES ALL EXISTING STRUCTURES FORMING PART OF, OR AFFECTED BY, THE WORKS.
 - IF DURING CONSTRUCTION, ANY PART OF THE WORKS SHOW SIGNS OF DISTRESS, EXCESSIVE DEFLECTION, CONFLICT OF COMPONENTS OR OTHER PROBLEMS, THE CONTRACTORS SHALL IMMEDIATELY NOTIFY THE ENGINEER, WHO SHALL INVESTIGATE & ISSUE SUCH INSTRUCTION AS ARE CONSIDERED NECESSARY.
 - CONTRACTOR SHOULD VERIFY THAT ALL CONSTRUCTION DRAWINGS ARE THE LATEST VERSION.
 - ALL DIMENSIONS SHOULD BE VERIFIED ON SITE PRIOR TO COMMENCING ANY WORK.
 - COMPLY WITH ALL WORKSAFE NZ AND ONSITE HEALTH AND SAFETY REQUIREMENTS AT ALL TIMES.
 - COOK COSTELLO ACCEPT NO LIABILITY FOR UNAUTHORIZED CHANGES FROM THE DETAILS AND INFORMATION CONTAINED IN THESE DRAWINGS.
 - THESE DRAWINGS AND DESIGN ARE COPYRIGHT AND REMAIN THE PROPERTY OF COOK COSTELLO.
 - PAD LOCATIONS ARE INDICATIVE ONLY. PAD SIZE TO BE 800 x 800 x 40mm ARMADILLO 250 JACKING PAD @ 1.9m max crs.
 - PADS TO BE PLACED >=0.5mbgl, ON CONFIRMATION OF UBC 140kPa.

LEGEND	
	Indicative location of 800 x 800 x 40mm Armadillo jacking pads at 1.9m crs around perimeter foundation.
	Area to be relevelled via 'Jack and Pack' methodology. Internal jack spacing should not exceed the existing bearer span.

B		
A		
REV		DRAWN APP



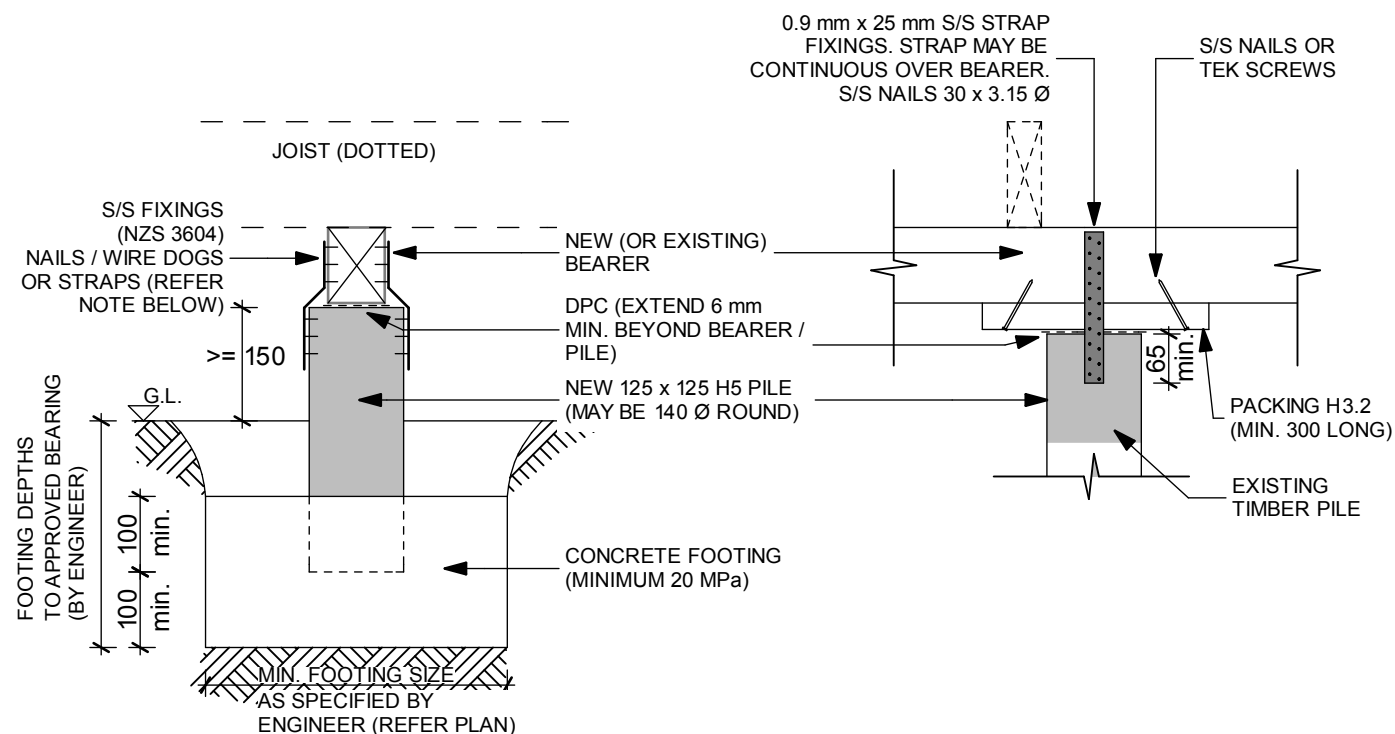
www.coco.co.nz
Whangarei | Auckland | Wellington | Christchurch

PROJECT DETAILS:
PROPOSED RELEVELLING PLAN
32 NICHOLLS STREET
RICHMOND, CHRISTCHURCH

TITLE: RELEVELLING PLAN & DETAILS		
DATE CREATED 12/10/2020	CCL REF. No. 12445-388	
DRAWN AB	DESIGNED AB	APPROVED PF
SCALE AS SHOWN @ A1	STATUS FOR EXEMPTION	
DWG NUMBER S101	REVISION	

DO NOT REPRODUCE WITHOUT WRITTEN AUTHORITY

8. SMARTLIFT SYSTEMS STANDARD DETAILS (TYPE B)



NEW TIMBER PILE & BEARER FIXINGS

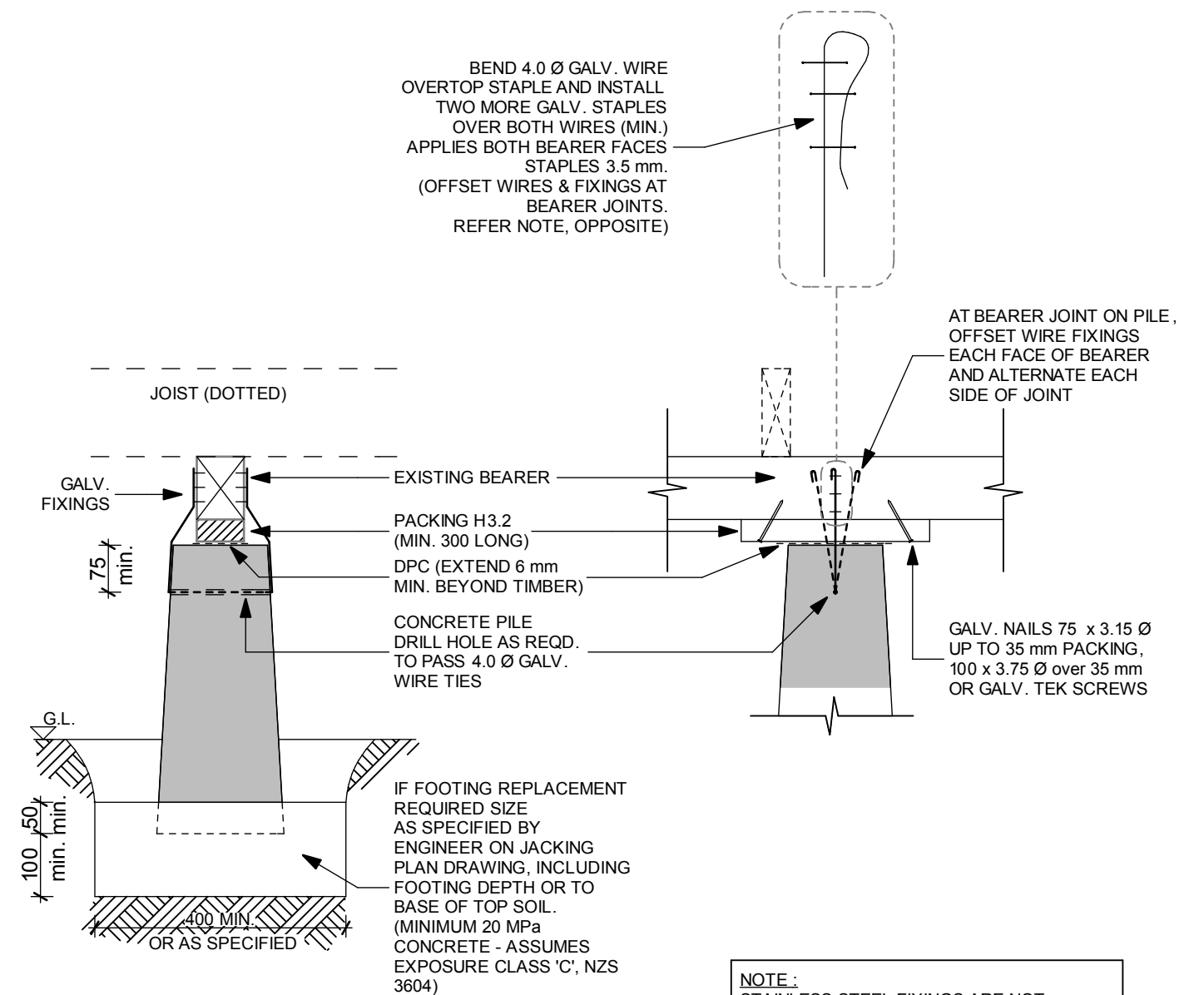
MUST BE S/S FIXINGS TO COMPLY WITH NZS 3604

NOTE:
PILE / BEARER FIXING BY NZS 3604 : 2011

- 2 S/S WIRE DOGS AND 2 S/S 100 x 4 min Ø SKEWED NAILS (1 WIRE DOG & NAIL EACH FACE OF BEARER)
- 140 MIN. DIAMETER TIMBER PILE (H5) MAY BE USED IN LIEU OF 125 x 125.

NEW TIMBER PILE TO BEARER & PACKING TO EXISTING PILES

SCALE 1 : 10



NOTE:
STAINLESS STEEL FIXINGS ARE NOT REQUIRED FOR CONCRETE PILE / BEARER FIXINGS.

CONCRETE PILE / BEARER FIXINGS

SCALE 1 : 10

THIS DRAWING IS COPYRIGHT

SMARTLIFT SYSTEMS STANDARD DETAILS

FOR TIMBER SUBFLOOR REMEDIATION (TYPE B)

MAY 2018

1 : 10

04 (A3)



SMARTLIFT SYSTEMS Limited
Craig Burrell
600 Marshlands Road
Christchurch, New Zealand

Ph: (03) 928 2695
Mob: 022 627 1002
Email: info@smartlift.net.nz
Web: www.smartlift.net.nz

9. SAFETY IN DESIGN

Safety In Design Report

Project Number: 12445-388
 Date of Issue: 12/10/2020

Project Address: 32 Nicholls Street, Christchurch
 Client: Nicky Cottam

Description of Works: Foundation relevel via mechanical lift c/o Smartlift Systems Ltd

This report has been prepared to provide information on the health and safety aspects of the design undertaken by Cook Costello for the above mentioned works.

For the above design, Cook Costello has conducted a risk assessment. The purpose of this risk assessment is to identify the hazards associated with the design during its design life (construction, use, maintenance, deconstruction). For these hazards, the risk has been assessed and the potential control measures have been identified (together with the parties best placed to implement those control measures). These are included in the attached risk register. Below is the general guidelines that Cook Costello have used to assess these risks.

Term Definition	Example of Effect	Control Measures	
Minor:	Minor injury/illness or minimal damage	EFFECTIVENESS 	Most Eliminate
Significant:	Significant injury/illness or significant damage		Substitute
Serious:	Permanent disability/illness or partial building failure		Isolate
Critical:	Fatality or standard building failure		Engineering
Disastrous:	Multiple fatalities or major/multiple building failure		Administrative
			Least Use PPE

The attached risk register reflects Cook Costello's current understanding of the project during the design-stage. It is intended to be used to assist in developing a project specific safety plan with the relevant parties (contractors, project managers, etc.). It is not intended to replace the need for these additional documents nor be used to monitor that the identified control measures have been implemented. The hazards on the site will still need to be managed by the relevant parties (contractors, etc.).

Approved on behalf of Cook Costello

Prepared By:

Reviewed By:




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Paul Ferguson
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SAFETY IN DESIGN- RISK REGISTER

Project Number: 12445-388
 Project Address: 32 Nicholls Street, Christchurch
 Scope of Works: Foundation releval via mechanical lift

First Issue Date: 12/10/2020 Issued to: Nicky Cottam
 Revision Issue Date: Revision Number:
 Completed By: AB Responsible Engineer: PF

Most Likely Consequence	Likelihood Of Consequence				
	5. Very Likely	4. Good Chance	3. Likely	2. Unlikely	1. Very Unlikely
A. Disastrous	Extreme	Extreme	Extreme	Extreme	High
B. Critical	Extreme	Extreme	Extreme	High	High
C. Serious	Extreme	High	High	Moderate	Moderate
D. Significant	High	High	Moderate	Low	Low
E. Minor	Moderate	Moderate	Low	Low	Low


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Scope of Works:				ASSESS HAZARD			ASSESS CONTROLS					ACTION NOTES					
ID	Risk Source (Hazard)	Event	Consequence	Persons Affected	Likelihood	Consequence	Risk Rating	Control Measure (Risk Treatment)	Likelihood	Consequence	Risk Rating	Risk Owner	Action/Comment	Action Owner	Date and Time	Status (Open/Closed)	
1	Public accessing site during construction	Access to construction site	Injury to public due to site hazards	All stakeholders	2. Unlikely	D. Significant	Low	Security fencing and signage to be erected by the contractor for duration of construction works	1. Very Unlikely	E. Minor	Low	Contractor, property owner					
	2	Structural failure	Sides of excavation collapse during excavation works	Potential injury or death to person	Contractors, anyone on site	3. Likely	C. Serious	High	Ensure sides of excavations are battered back as per specifications	1. Very Unlikely	C. Serious	Moderate	Contractor, property owner				
	3	Structural failure	Building not constructed to specifications	Structural failure and loss of support of structure	Occupants, property owners	2. Unlikely	A. Disastrous	Extreme	Engineer to inspect subgrade, prepour and finished product. Materials certificates and PS3's to be provided for PS4	1. Very Unlikely	B. Critical	High	Engineer, contractor				
	4	Services	Damaging services during construction	Injury and loss of service from damaging of services	Contractors, anyone on site	3. Likely	D. Significant	Moderate	Services to be identified by contractor prior to excavation and concrete cutting	1. Very Unlikely	D. Significant	Low	Contractor, property owner				
	5	Component failure	Inadequate support of structural elements during construction	Failure / collapse of component causing injury	Contractors, anion on site	3. Likely	C. Serious	High	Contractor to ensure adequate temporary supports in place, engineer to design elements that allow pre-fabrication off-site where possible	1. Very Unlikely	B. Critical	High	Contractor, Engineer building/ component owner				
	6	Falling objects	Falling objects during construction	Injury or death to anyone below	Contractors, anyone in site	3. Likely	C. Serious	High	Contractor to ensure adequate safety plans in place during construction	3. Likely	D. Significant	Moderate	Contractor				
	7	Structural degradation	Loss of strength from degradation due to durability concerns	Structural failure and loss of support of structure	Public, building owner	1. Very Unlikely	E. Minor	Low	Building owner / occupants to ensure building is regularly maintained	1. Very Unlikely	E. Minor	Low	Property owner				
	8	Working at heights	Fall from height	Potential injury death to someone	Contractors, anion on site	3. Likely	B. Critical	Extreme	Use work equipment or other measures to prevent falls where work at height cannot be avoided. Avoid working in adverse conditions	2. Unlikely	B. Critical	High	Contractor				
	9	Serviceability failure	Inadequate support/propping of structure during construction	Failure/collapse causing injury	Contractors, anyone on-site	3. Likely	C. Serious	High	Contractor to ensure adequate temporary supports in place; if necessary. If using scaffolding, ensure the scaffolds has the current tag and should be erected by specialist contractor	1. Very Unlikely	C. Serious	Moderate	Contractor, property owner				
	10	Waste Contamination	Improper waste collection	Serious injury or illness	Contractors, anyone on-site, neighbouring properties	3. Likely	C. Serious	High	Make sure disposal of any materials (including hazardous substance) is properly contained to avoid contaminating surrounding properties	1. Very Unlikely	E. Minor	Low	Contractor, property owner				
11																	
12																	
13																	
14																	
15																	
16																	
17																	

10. GEOTECHNICAL REPORT

Cook Costello Job No. 12445-388

Monday, 12 October 2020

Attention: Smartlift Systems Ltd

RE: Static Bearing Capacity Assessment, 32 Nicholls Street in Richmond, Christchurch

Cook Costello have been engaged by Nicky Cottam c/o Smartlift Systems Ltd, to confirm the static bearing capacity in support of a relevel design for the dwelling at 32 Nicholls Street in Richmond, Christchurch.

1. Geotechnical Report

A geotechnical report has been completed at the site by KGA Geotechnical (09/04/2020). As part of the report, four Hand Auger (HA) and four Scala Penetrometer (SP) tests were undertaken on 24/03/2020. The soil profile at the site generally consists of TOPSOIL, underlain by interbedded SAND and SILT, underlain by PEAT. Groundwater was encountered at 2.7->3.0mbgl during shallow testing.

2. Static Bearing Capacity Correction

Cook Costello have performed a static bearing capacity correction using Stockwell's method based on a 0.8x0.8m Armadillo lifting pad (See Appendix 1), using data presented in the KGA Geotechnical report. For the purpose bearing capacity analysis, the groundwater has been assumed to be present at 2.0mbgl based on the shallow ground investigations along with the GNS median water table elevations.

Based on this, a corrected static ultimate bearing capacity of 140kPa can be obtained at 0.5mbgl in the SAND. This bearing capacity provides a factor of safety (F.o.S) of >3.0 against the expected demand of approximately 18kPa.

3. Conclusion

- A static ultimate bearing capacity of 140kPa can be relied upon for the Armadillo releveling pads at a depth of 0.5mbgl.
- The static ultimate bearing capacity will be confirmed on site prior to placing the Armadillo pads.



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Graduate Geotechnical Engineer
BSc, PMEG



Akram Kawa
Chartered Professional Engineer
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Appendix 1: Bearing Capacity Correction

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Allowable Bearing Capacity using Stockwells Method (1977)



Bearing Capacity in SAND and non-plastic SILT soils

Scala blows/100mm	blows/100mm =	1
mm/blow		100 mm
Depth of bottom of footing below ground, H	H =	0.5 m
Width of footing, B	B =	0.8 m
Ground water table depth, GWT	GWT =	2 m bgl
Considering vibrational effects?	y/n =	no

From Scala results (mm/blow)	100 mm
Allowable bearing capacity (uncorrected form Figure 2)	$q_a = 36$ kPa

Soil Classification (from Figure 2)

Uniform loose



(a) Correction for Depth (of strip footing)

Allowable Bearing capacity modified for depth	$q_a = 59$ kPa
Ultimate Bearing capacity Strip Footing	$q_u = 176$ kPa



(b) Correction for Width (of strip footing)

Allowable Bearing capacity modified for depth of strip footing	$q_a = 47$ kPa
Ultimate Bearing capacity modified for depth	$q_u = 140$ kPa



(c) Correction for Saturated conditions effects

Allowable Bearing capacity modified for width	$q_a = 47$ kPa
Ultimate Bearing capacity modified for width	$q_u = 140$ kPa



(c) Correction for Vibrational effects

Allowable Bearing capacity modified for vibrational effects	$q_a = 47$ kPa
Ultimate Bearing capacity modified for vibrational effects	$q_u = 140$ kPa

Appendix 2: KGA Geotechnical Report (09/04/2020)

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K200202-1

9 April 2020

**Geotechnical Engineering Investigation
Proposed Development
32 Nicholls Street
Richmond
Christchurch**

Prepared For:

Batchelar McDougall Consulting
PO Box 9440
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REPORT ISSUE AUTHORISATION

Geotechnical Engineering Investigation

Proposed Development

32 Nicholls Street

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Prepared by:

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Senior Geotechnical Engineer

Authorised by:

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Abilio Nogueira

MSc (Engineering Geology)
Director

EXECUTIVE SUMMARY

Geotechnical Engineering Investigation

Proposed Development

32 Nicholls Street

Richmond

Christchurch

SUB-SOIL CONDITIONS	Lithology	The sub-surface conditions comprise topsoil and fill to 0.8m bgl atop silt and sand to at least 20m bgl	
	Soil Classification as per NZS 1170.5:2004	Class 'D' (deep or soft soil sites)	
	Groundwater Depth	Encountered at an average depth of approximately 2.7m depth	
	Bearing Capacity	An ultimate unfactored bearing capacity of 150kPa was found below topsoil/fill.	
SEISMIC ASSESSMENT	Vertical Displacement under Earthquake Ground Motions (Index Value)	SLS	ULS
		30 – 40	65
	Liquefaction Severity Number (LSN) Index Value	SLS	ULS
		17	32
	Horizontal Movement	Lateral Spreading	Lateral Stretch
		Minor to moderate (up to 300mm)	Minor to moderate (up to 100mm)
	Seismic Technical Categorisation	MBIE	TC3
		Site Specific	TC3
FOUNDATION OPTIONS	Dwelling Foundation Repair: - Due to the presence of shallow liquefiable material, we recommend relevelling the dwelling by overpinning the perimeter footing and internal shallow piles. - Piles may be re-levelled using jacking and packing methodology as per the MBIE Guidance Appendix A.1.1.2, Option 1: Jacking and packing methodology. - We recommend that all piles within the central part of the dwelling in the location of the significant desiccation cracking are replaced following remediation of the ground cracks. - If the structural engineer deems necessary, localised piles may be replaced in a 'like-for-like' basis if they exhibit excessive tilting or settlement, provided any replacement piles are designed for an ultimate unfactored bearing capacity of 150kPa and are founded no deeper than 0.5m bgl, with a maximum width of 0.5m. - All unsuitable material such as topsoil and fill must be removed and replaced with engineered hardfill. - All water leaks should be appropriately repaired to prevent ongoing water ponding. A Damp Proof Membrane (DPM) should be installed to reduce the risk of water damage in future. - Any desiccation cracks should be filled with compacted native soils or grout.		
	Replacement Foundation Solution - If replacement foundations are required, the most suitable foundation option would be a TC3 Type 2A-150 foundation solution of section 15.4 of the MBIE Guidance. - This consists of a standard NZS 3604:2011 type foundation with timber support piles supported by a 150mm reinforced concrete ground underslab founded on a 600mm gravel raft.		
REPORT DISTRIBUTION	A full copy of this report must be provided to all relevant parties involved in the project. This should include, but not be limited to, owner, architectural designers, engineers (civil and structural) and the earthworks/building contractor.		

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Attachments:

Sheet 1	Site Plan
Sheets 2A – 2F	Hand Auger, Scala Penetrometer and Hand Dug Trial Pit Logs
Sheet 3	Cone Penetrometer Test Log

Appendix A:	Third Party Documents
Appendix B:	Site Photographs
Appendix C:	Background Information Documents
Appendix D:	Liquefaction Analyses

1. INTRODUCTION

At the instruction of Batchelar McDougall Consulting (BMC), we have undertaken a geotechnical engineering investigation on the property at 32 Nicholls Street in Richmond, Christchurch. The work was carried out in accordance with our Agreement dated 11 March 2020.

As part of the ground investigation, we have undertaken a detailed site and environs walkover inspection, and referenced available information from the New Zealand Geotechnical Database (NZGD), Environment Canterbury (ECan) and Christchurch City Council (CCC) websites. We have conducted a shallow subsurface investigation comprising hand auger boreholes and associated Scala penetrometer tests as well as deep testing in order to assess ground conditions and likely behaviour of the ground, as well as to provide guidance on foundation repair design for the proposed development of the site.

The investigation was carried out with reference to the Ministry of Business, Innovation & Employment (MBIE) Guidance - Version 3, dated December 2012 - "Repairing and rebuilding houses affected by the Canterbury earthquakes" and subsequent updates.

This report presents our findings and conclusions. It has been prepared in the context of providing geotechnical information for use in assessing options for the foundation repair, and for use in structural design as part of a Building Consent application.

2. SITE DESCRIPTION

The property is legally described as Lot 56, DP 5913 and has an area of 852m². The property is rectangular in shape and is located on the east side of Nicholls Street. It is otherwise bounded by residential properties, as shown on our Site Plan, attached as Sheet 1. The site is located approximately 210m southwest of St Albans Creek. The site and nearby surroundings are near level.

3. EXISTING STRUCTURE AND PROPOSED DEVELOPMENT

3.1 Existing Structure

The property is currently occupied by a single storey dwelling in the west portion of the site and a standalone garage located adjacent to the northern property boundary. The dwelling has timber cladding, metal roofing, and a timber floor founded on a concrete perimeter foundation and shallow internal piles (foundation type B1 of the MBIE Guidance). The dwelling has an extension adjoining the dwelling to the east which has the same construction type as the dwelling. There is also a thick concrete deck adjoining the extension to east; it is unknown if the deck is connected to the extension. The garage has lightweight cladding and roofing and is founded on a concrete slab-on-grade floor (foundation type C1 of the MBIE Guidance).

3.2 Proposed Development

Based on communication with BMC, we understand that the dwelling suffered damage during the Canterbury Earthquake Sequence (CES). We understand that it is proposed to repair the dwelling and the most suitable foundation repair solution will be based on the conclusions of this geotechnical report.

4. BACKGROUND INFORMATION

4.1 Sources Consulted

The following third party information sources were consulted and referred to in this report:

- BMC
- Cavity Critter Report
- New Zealand Geotechnical Database (NZGD)
- Environment Canterbury (ECan)
- Christchurch City Council (CCC)

A summary of our understanding of the information contained in the reports is presented below. We note that all the information is intended to present facts contained in third party sources and does not constitute interpretation or endorsement by KGA.

4.2 BMC

We have been provided with floor level survey by BMC (ref: 2002-2888, dated: 25 March 2020), this shows a maximum differential floor level of 74mm across the dwelling, with the floors generally sloping down towards the centre and eastern part of the dwelling. The floor level survey shows many areas with floor slopes greater than 1:200. Levels of the ceilings, lintels, sills and fixtures were also recorded; BMC note that the ceilings have been altered. For reference, the floor level survey is provided in Appendix A.

Based on communication with BMC, we understand the following:

- The dwelling was constructed circa 1920.
- The concrete perimeter foundation is unreinforced.
- The concrete driveway appears original.
- There is a masonry fence pillar on the northwest corner of the porch which tilts towards the north. BMC state that rotation of the fence pillar appears linked to ground/foundation movement.
- Adjacent to the fence pillar a gap appears to have opened between the entrance step and porch.
- There is an opening crack at the junction between the masonry fence at the porch and dwelling.
- Many of the cracks in the perimeter foundation are likely shrinkage cracks which may have been exacerbated by the CES.
- There is mortar beneath one of the vent grills which is intact across the top of a foundation crack, indicating that it is a shrinkage crack.
- On the northern elevation of the dwelling, there is a dip in the weatherboards and the foundation. This corresponds with a low area on the floor level survey.
- The piles appear original with no evident damage.
- Some of the piles have been packed and some bearers have been notched.
- Some of the weatherboards have been replaced.

4.3 Cavity Critter Report

We have been provided with a Cavity Critter Report for the property (dated: 7 November 2019) which shows the following:

- The perimeter foundation comprises rubble concrete containing large aggregate and brick.
- Significant desiccation cracking is present in the subfloor ground. Some of the cracks radiate away from the pile foundations
- Cracks to the perimeter foundation on all elevations.
- Subsidence/depression beneath the northeast portion of the dwelling.
- Rot, mold and borer under the porch in the northern elevation.
- Piles comprise concrete cast in jerry cans and are not connected to the bearers.
- Bearers have been notched in several locations.

Based on KGA review, it appears that most of the ground cracking is within the central section of the dwelling where larger floor level differences were recorded on the BMC floor level survey. We note that no cavity critter photos were provided within the extension subfloor.

4.4 New Zealand Geotechnical Database (NZGD) & Environment Canterbury (ECan)

The NZGD website was searched for geotechnical information in the form of relevant well/borehole logs and CPT data. Two borehole logs and three Cone Penetrometer Tests (CPTs) were found in the vicinity of the property. These logs are reproduced in Appendix C, and are referenced further in Section 7.1 of this report. We also found two EQC groundwater monitoring points within 30m of the site

The ECan website indicates that the site is overlaying a “Coastal Confined Gravel Aquifer.” According to GNS Science, the median depth to the water table ranges from 0m to 2m below ground level (bgl).

A summary of aerial photography and field observations, as well as the Peak Ground Acceleration (PGA) experienced on the site during the major earthquake events of the Canterbury Earthquake Sequence (CES) is given in Table 1. We have also scaled the PGA to a magnitude 7.5 event to be able to compare the recorded PGA to the ULS and SLS values recommended in the MBIE Guidance ($PGA_{7.5}(ULS)=0.35g$, $PGA_{7.5}(SLS)=0.13g$).

For the magnitude scaling factor assessment, it is important to note that the 13 June and 23 December 2011 aftershocks each comprised two separate earthquakes. In both cases, the second of the two earthquakes was the more damaging, but the first earthquake is inferred to have caused elevated pore water pressure and increase the susceptibility for liquefaction to occur. To take the two earthquakes into consideration for modelling purposes, the Tonkin & Taylor Liquefaction Vulnerability Study considers the second earthquake with an increased magnitude to include the effects of the first one. The design earthquake magnitude for each event is presented in Table 1, and a copy of the Property Summary Report is included in Appendix C.

Table 1: Summary Desk Study Information

	September 2010 (M 7.1)	February 2011 (M 6.2)	June 2011 (M 6.0)	December 2011 (M 5.9)
Aerial Photography Liquefaction Interpretation (KGA)	Minor observed liquefaction ejecta	Moderate to severe observed liquefaction ejecta	Moderate observed liquefaction ejecta	No observed liquefaction ejecta
Aerial Photography Liquefaction Interpretation (EQC)	Minor observed liquefaction	Moderate to severe observed liquefaction	Moderate to severe observed liquefaction	No observed liquefaction
Ground Observations (EQC)	Minor ground cracking but no observed ejected liquefied material	No lateral spreading but minor to moderate quantities of ejected material	No lateral spreading but minor to moderate quantities of ejected material (Nicholls Street)	Not mapped
Mapped Ground Cracks	- A crack <10mm wide trending northeast to southwest through the northeast corner of the dwelling. - Numerous cracks up to 10mm wide in the vicinity of the dwelling. - Mapped ground cracks are shown in Appendix C.			
Lidar Cumulative Vertical Displacement*	290mm subsidence			
Horizontal Ground Movement**	400mm ±400mm west			
Groundwater Depth (m)***	1.6	1.6	1.3	1.2
PGA (g)	0.20	0.41	0.24	0.25
Scaled PGA_{7.5} (g)****	0.18	0.29	0.17	0.17

* To February 2012, tectonic vertical changes excluded, may be subject to Lidar accuracy limit

** Horizontal Ground Movement – “Local” (Observed – Tectonic)

*** Interpreted from the “Property Summary Report”

**** Scaled to M7.5 using Idriss and Boulanger recommendations (2008)

4.5 Christchurch City Council (CCC) – Flooding Risk

According to the flood data provided by the CCC, the property is not within a CCC District Plan Flood Management Area. There are currently no recommended Finished Floor Level Requirements and CCC notes that no flooding is predicted in a 1 in 200 year flood event. The CCC should be contacted directly to comment on the floor level requirement, as a full flood risk assessment is outside the scope of this report.

4.6 Environment Canterbury (ECan) – Listed Land Use Register

Environment Canterbury has identified sites where hazardous activities and industries have been located throughout Canterbury, and maintains the Listed Land Use Register (LLUR) database which alerts about potential contamination before site works commence. After consultation of the database regarding these sites, the following information was obtained: “The Listed Land Use Register does not currently have any information about a Hazardous Activities and Industries List site on this land parcel.” The relevant extracts from the LLUR are presented in Appendix C.

In light of the existing information, we consider that no further investigation into ground contamination is needed. However, due to the limited extent of our investigation, we cannot guarantee that contamination is not present. During the excavation for foundations, consideration should be given to the observation of the excavated soils and alert for any evidence of contamination.

5. SITE OBSERVATIONS

During our site walkover on 11 March 2020, the following was noted, as shown in the site photographs provided in Appendix B:

- Cracks were observed on the north, east and south elevation of the perimeter foundation; cracks were up to 7mm wide.
- The owner reported there are many cracks in the western elevation of the perimeter foundation; this is obstructed by a timber deck and lavender bushes; however the Cavity critter report confirms foundation perimeter cracking in all elevations.
- There is a concrete driveway adjacent to the northern property boundary. The driveway has several cracks up to 5mm wide.

- There is a brick porch founded on a concrete perimeter foundation adjoining the dwelling to the north. The perimeter foundation of the porch contains a repaired crack approximately 50mm wide.
- On the northern elevation, east of the porch, the perimeter has an approximately 8mm wide crack beneath the vent. The perimeter foundations appear to dip down towards the vent.
- The gutters and downpipes on the northern elevation of the garage have rusted through.
- A concrete deck adjoins the eastern extension to the east.
- Adjacent to the southern elevation a trench was excavated to repair a broken earthenware pipe.

6. GEOLOGY

The published geology of the Christchurch urban area shows the site is underlain by the Yaldhurst Member of the Springston Formation. The Springston Formation was deposited during the Holocene epoch ($\leq 10,000$ years old), and has accumulated the inland margin of the Christchurch Formation. The Springston Formation contains postglacial fluvial channel and overbank sediments resulting in the deposition of well-sorted gravels, sands and silts sourced from the Southern Alps. Due to the movement of the Waimakariri River channels, the deposits appear as fan shaped wedges or localised lenses, creating extensive layers with varying thicknesses.

The Yaldhurst Member is the most recent deposit of the Springston Formation and was deposited just above the present Waimakariri River flood level during the last 3000 years. It contains three distinct lithological units; alluvial sand and silt overbank deposits; historic river flood channels containing silts, sands and alluvial gravel; and peat deposits.

7. GROUND INVESTIGATION

7.1 Existing Ground Investigation

A search of the ECan and NZGD websites identified two machine boreholes and three CPTs. We considered these tests relevant, and the CPT data was used in our liquefaction analyses. The investigation logs are reproduced in Appendix C, and the data referenced in more detail in Table 2.

Table 2: NZGD Data

NZGD Test Reference	Source	Source Reference	Test Type	Probe Depth (m)	Approx. Distance From Site (m)
CPT_4452	Brown Bros	RCH-POD03-CPT68	CPT	20.1	25 SW
CPT_71765	Eliot Sinclair	CPT-01	CPT	10.0	40 NE
CPT_36965	Coffey	CPTU1	CPT	7.9	50 N
BH_18210	Tonkin & Taylor	BH006	BH	20.5	25 SW
BH_18216	Tonkin & Taylor	PDCPT074	BH	6.5	60 E

We also note two groundwater monitoring piezometers as per below:

- INST_535 located approximately 20m southwest from the site. The piezometer standpipe is to a depth of 4m bgl and monitored from 28 September 2011 to 20 October 2015.
- INST_18210 located approximately 20m southwest from the site. The piezometer is to a depth of 7.5mbgl and monitored from 8 October 2012 to 20 October 2015.

7.2 Current Ground Investigation

In order to supplement the existing ground information, further project specific deep and shallow ground investigation for subsoil identification and bearing capacity purposes was undertaken. The subsurface conditions on site were explored by drilling four hand auger boreholes (HA01 to HA04), performing four Scala penetrometer tests (SP01 to SP04) within the borehole locations, as well as two hand dug trial pits (HTP-01 to HTP-02) and one cone penetrometer test (CPT-01) as shown in Table 3. The shallow drilling services were provided by KGA on 19 March 2020, with the CPT undertaken by Ground Investigation Ltd on the same date. A description of the testing is given in the following sections.

Table 3: Schedule of Exploratory Holes

Test Type	Test Ref.	Depth (m)	Reason for Termination	Date of Test
Hand Auger	HA01	3.0	Target depth	19/03/2020
	HA02	3.0	Target depth	
	HA03	3.0	Target depth	
	HA04	3.0	Target depth	
Scala Penetrometer	SP01	3.0	Target depth	19/03/2020
	SP02	3.0	Target depth	
	SP03	3.0	Target depth	
	SP04	3.0	Target depth	
HTP	HTP-01	0.3	Target depth	19/03/2020
	HTP-02	0.3	Target depth	
CPT	CPT-01	10.1	Target depth	19/03/2020

The exploratory borehole locations were selected to provide representative indications of the subsurface ground conditions within the area being assessed. The locations of the exploratory holes are indicated on our Site Plan, attached as Sheet 1.

7.3 Scala Penetrometer Tests and Hand Auger Boreholes

The Scala penetrometer probe consists of a hand operated dynamic cone penetrometer and is used to evaluate the penetration resistance of a soil. A 9kg hammer weight is dropped over a distance of 510mm driving a 20mm diameter cone into the ground. The number of hammer blows is recorded for each 50mm of penetration. Testing is in accordance with Test 6.5.2:1988 of NZS 4402.

Hand auger boreholes were drilled in conjunction with the Scala penetrometer testing using a 50mm diameter hand auger and a soil description log in accordance with the NZGS Guidelines "Field description of soil and rock" is presented for each borehole. Scala Penetrometer testing was carried out at nominal 1.0m depth intervals with hand auger boreholes drilled over the Scala test points to the same depth to reduce the friction on the rod for subsequent testing.

The hand auger boreholes and Scala penetrometer tests were scheduled to be taken to 3.0m depth or to a depth where effective refusal was reached, whichever was shallower. The logs of the hand auger boreholes and Scala penetrometer probes are provided as Sheets 2A to 2D.

7.4 Hand Dug Trial Pits

The hand dug trial pits were excavated using a shovel at selected points around the perimeter foundation beam. The hand excavation was advanced carefully adjacent to the foundation beam so as not to cause damage to the foundation beam and extended to the underside of the footing. A steel rod was then pushed underneath the foundation beam to confirm that the concrete does not extend deeper in the centre of the foundation beam than at the exterior. Ground conditions encountered within the hand dug pits are included as Sheets 3A to I3B

7.5 Cone Penetrometer

The CPT work was undertaken by Ground Investigation Ltd with a 1.1 tonne Pagani TG63-150, using a cone of 10cm² cross-sectional area, and a 150cm² friction sleeve area. Continuous measurement of pore water pressure was undertaken during testing (u₂). Tests were undertaken in accordance with A.S.T.M. Standard D 5778-12 procedure. The test target depth was to a minimum depth of 10m or refusal, whichever came first. The CPT log is attached as Sheet 3.

7.6 Subsurface Conditions

The subsurface ground conditions encountered are briefly described and summarised in Table 4. For a full detailed description, reference should be made to the borehole logs, attached as Sheets 2A to 2D. In order to prepare a subsurface model of the site, the subsurface conditions encountered have been inferred between our boreholes. It must be accepted that the conditions are likely to vary between each borehole location, particularly when the distance between boreholes is large.

Table 4: Subsurface Conditions

Geotechnical Unit		Depth to Base (m)	Description	Scala Penetrometer Reading (blows per 100mm)	CPT q_t Value (MPa)	SPT N value (blows per 300mm)
1	TOPSOIL/ FILL	0.3 – 0.8	Organic silt with some sand and trace rootlets	-	-	-
2	SILT	* 4.0	Silt with minor to some sand sand**	0 – 8	0.3 – 6.3	0 – 4.0
3	* SAND	20.5+	Inferred medium dense to dense sand with minor gravel in places	-	5 – 40+	15 – 50+

* Unit and/or depth interpreted from CPT-01, BH18210 & BH_18216

** Trace to minor fibrous organics and tree roots were encountered in all hand augers between 1.4m bgl to at least 3.0m bgl

We note that a near surface soft silt layer was encountered between 1.3m to 1.7m within the CPT, and then between 2.3m to 3.1m depth.

7.7 Groundwater

Groundwater was encountered at 2.7m depth during our site testing. This is significantly deeper than the GNS water levels inferred in Section 4.3 and the water levels from the NZGD Property Summary Report values, provided in Table 1. Based on the nearby groundwater monitoring piezometers discussed in Section 7.1 above, the groundwater table varied between 0.6m and 2m over the five-year period monitored but generally within the upper 1m depth. Groundwater levels can and will vary with changes in weather patterns, particularly following periods of prolonged wet or dry weather and our measurement after a long dry summer probably reflects the lower groundwater level at the site.

7.8 Foundation Embedment Depth

Based on observations made within the hand dug trial pits, the concrete perimeter footing is founded at a depth of 0.2m on the north elevation of the dwelling to 0.1m bgl on the south elevation of the dwelling. At each location, the footing appears to have been founded in topsoil/fill. The founding depth of the internal piles is not known. HTP-01 on the northern elevation of the perimeter foundation exposed a crack beneath one of the vents. The crack width was approximately 8mm at the vent, tapering to approximately 3mm wide at the base of the perimeter foundation.

8. LIQUEFACTION ASSESSMENT

8.1 General

Liquefaction analyses were completed for both SLS and ULS design criteria, using the CPT data referenced in Table 2 and 3. Calculations were performed over the full investigation depth and the MBIE 'Index' depth of 10.0m.

This section presents two parameters commonly used to assess the liquefaction vulnerability; the liquefaction induced settlements and the Liquefaction Severity Number (LSN).

The seismic design requirements adopted for use in the analyses are defined in Part C of the MBIE Guidelines "Repairing and rebuilding houses affected by the Canterbury earthquakes" with the recent update regarding Boulanger & Idriss (2014) liquefaction analysis methodology. These are:

- Buildings of normal use (Importance Level 2).
- Deep or soft soil sites (Class D).
- Magnitude M7.5 EQ event and peak Ground Acceleration (PGA) of 0.13g and magnitude M6.0 EQ event and peak Ground Acceleration (PGA) of 0.19g for annual exceedance probabilities of 1/25 (SLS1 and SLS2) – considering the highest calculated total volumetric strain from either scenario adopted.
- Magnitude M7.5 EQ event and 0.35g for annual exceedance probabilities of 1/500 (ULS).
- Boulanger and Idriss (2014) methodology for liquefaction triggering.
- Zhang et al. (2002) volumetric densification calculation.

The in situ groundwater level was considered to exist at 1.0m bgl and the groundwater level during earthquake used for the calculation was assumed to exist at 0.5m bgl.

8.2 Calculated Settlement

We have analysed the CPT data using the current software 'CLiq' and a copy of the output from the analyses has been included within Appendix D. The software includes for normalisation of the data for overburden pressure and is considered to provide improved indications of liquefaction potential. The results are presented in Table 5.

Table 5: Liquefaction Induced Global Settlements Analysis Results

Test	Calculation Limit Depth (m)	Calculated Vertical Settlement (mm)		
		SLS1	SLS2	ULS
CPT-01	Full/MBIE Index (10.0)	30 (TC2)	40 (TC2)	65 (TC2)
CPT_4452	MBIE Index (10.0)	50 (TC2)	60 (TC3)	105 (TC3)
	Full Depth (20.1)	115	135	270
CPT_36965	Full Depth (7.9)	25	50	95
CPT_71765	Full/MBIE Index (10.0)	50 (TC2)	60 (TC3)	85 (TC2)

Under seismic demands, the above calculated settlements for the general area fall within TC2/TC3 categorisation as defined by the MBIE Guidance. The onsite CPT indicate a behaviour consistent with a TC2 site. Based on the onsite CPT, the analyses suggest that the silt between 3.2m and 4.4m bgl are liquefiable under SLS seismic events. Whereas under ULS level seismic events, a 0.7m thick layer below 0.5m, a thin layer at 2m bgl and a layer between 6.5m to 7.2m bgl will also be liquefiable. We note that other surrounding CPTs generally indicate varying behaviour; from a near surface liquefiable layer SLS level conditions for CPT_4452 to 5m thick liquefiable layer below 0.5m under ULS conditions in CPT_36956. We therefore consider that the ground conditions around the site could be variable with the degrees of liquefaction potential.

Post-earthquake general observations show that the empirical calculation of the settlement is uncertain with perhaps a $\pm 50\%$ margin to the numbers given in Table 5. We therefore recommend that engineering judgment is applied when interpreting the computed settlements.

We point out that the settlements presented in Table 5 describe the settlements of the ground not occupied by a building, occurring due to dissipation of excess pore water pressure generated during earthquake shaking. Additional settlements may also occur due to yield of the liquefied soils under foundation loading, soil loss of volume (liquefaction ejecta) and lateral spreading, but these components are very difficult to predict. Subsurface conditions may vary across the site, making accurate prediction of future settlements even more difficult.

8.3 Liquefaction Severity Number (LSN)

The Liquefaction Severity Number (LSN) is a calculated parameter developed by Tonkin & Taylor (on behalf of the Earthquake Commission) in 2013 for use in Christchurch and presented in more detail in the Liquefaction Vulnerability Study report (T&T, 2013).

Unlike the settlement parameter, the LSN assessment includes for the thickness of the non-liquefiable crust (largely controlled by depth to groundwater level) and depth at which the liquefaction will occur. We have analysed the CPT data using the current software 'CLiq' and the calculated LSN values are presented in Table 6.

Table 6: Liquefaction Severity Number (LSN) values at MBIE index

Test	LSN values		Key to LSN Values	
	SLS2	ULS	LSN Values	Expression of Liquefaction
CPT-01	17	32	0 – 10	Little to none
CPT_4452	33	50+	10 – 20	Minor
CPT_36965	19	49	20 – 30	Moderate
CPT_71765	15	20	30 – 40	Moderate to severe
			40 – 50	Major
			50+	Severe

Based on the onsite CPT, the LSN values presented in Table 6 refer to a land performance with 'minor' expression of liquefaction expected for SLS level events, and 'Moderate to Severe' expression of liquefaction for ULS level events.

8.4 Cyclic Softening Potential

There is a tendency for very soft to soft or sensitive clays and silts to undergo cyclic softening (loss of shear strength and stiffness) as a result of strong shaking. According to the onsite CPT profile, the soft soils in the upper 4.0m bgl could be prone to cyclic softening during a strong seismic event. The cyclic softening of those soils is likely to contribute to additional seismic induced settlements i.e. site settlements are expected to be greater than those presented in Table 5 above. Robertson (2015) indicates that volumetric strains are typically 0.5% in clay-like soils, indicating that additional settlements could occur in these layers.

9. SITE DESIGNATION AND POTENTIAL FOR LATERAL SPREADING

The site is classified as Class “D” – (Deep or soft soil) for structural purposes in the New Zealand design standards (NZS 1170.5:2004).

EQC mapping from the NZGD indicated minor liquefaction was observed following the September event, moderate to severe liquefaction was observed following the February and June events and no liquefaction was observed following the December event. Our aerial photograph interpretation generally agrees; however, only a moderate amount of liquefaction was observed following the June 2011 Canterbury Earthquake.

The site experienced M_w 7.5 scaled peak ground accelerations (PGAs) of 0.17g to 0.29g, as per Table 1. Therefore, it may be classified as ‘sufficiently tested’ for an SLS event according to Section 13.5 of the MBIE Guidance document (a level of shaking more than 170% of design SLS).

The inferred lateral movement from LiDAR (NZGD) indicates that the site has experienced 400mm ($\pm$ 400mm) of horizontal movement to the west during the CES. Ground observations by the EQC for the February and June 2011 earthquakes indicate the site was not subject to lateral spreading. A ground crack up to 10mm was mapped onsite and numerous other ground cracks up to 10mm wide were mapped in the vicinity of the site. Based on these considerations, we believe site presents potential for minor to moderate global lateral movement (up to 300mm) and lateral stretch (up to 100mm) of the ground across the site.

The site is situated in a TC3 area as per the MBIE mapping available on the NZGD. Although our liquefaction analysis based on the onsite CPT only calculated liquefaction induced vertical settlements in line with TC2 categorisation, there are predicted liquefiable layers in the upper 2m bgl under ULS seismic demands. Furthermore, the nearby CPTs indicate potential for high ground variability in the area and the aerial photograph analysis observed moderate to severe liquefaction ejecta around the property following the main events of the CES which confirms shallow liquefaction vulnerability. The February and June events were generally similar to an intermediate level of shaking (between SLS and ULS) with the February 2011 shaking slightly less than an equivalent ULS level event. Based on the above, we agree that a TC3 classification (as per the MBIE Guidance) is appropriate for the site under SLS and ULS level seismic demands.

10. SITE SETTLEMENT MECHANISMS

10.1 Measured Settlements

According to the floor level survey by BMC, a maximum differential floor level of 72mm is present across the dwelling, with the floors generally sloping down towards the centre and eastern portion of the dwelling.

We have conducted liquefaction back analysis of the onsite CPT, based on the event specific groundwater levels and PGAs provided in Table 1. The analyses of CPT-01 indicate total settlements of 145mm were calculated within the upper 10.1m of the soil column for the major events of the CES, as per Table 7. We note that the LiDAR cumulative vertical displacement for the property as presented on the Property Summary Report recorded 290mm subsidence, which is more than our cumulative calculated settlements. We consider that our assessment is calculating less settlement relative to the LiDAR survey because our calculations are limited to the upper 10m depth with more settlements expected in the soils below. Although we note that the accuracy for LiDAR vertical measurements is also $\pm 100\text{mm}$.

Table 7: Calculated Settlements (mm) from Main CES Events

	September 2010	February 2011	June 2011	December 2011	Total Settlement (mm)
CPT-01	30	45	35	35	145

The soft soils in the upper 4.0m bgl may also be prone to cyclic softening as a result of strong seismic shaking, leading to larger observed settlement.

There is evidence of water damage in the subfloor in the form of desiccation cracks, as shown in the Cavity Critter report. The desiccation cracks are likely the result of leak episodes to the subfloor or flooding event. Based on our approximate overlay of the cavity critter areas with significant ground cracking and BMC floor level surveys, we consider that the low floor level surveys generally correlate well with areas of significant ground cracking and/or depressions.

We note that HA03 and HA04 near the southern elevation of the dwelling encountered topsoil up to 0.8m bgl. As the foundation embedment depth is very shallow and the perimeter beam is founded in topsoil, any soil softening as a result of saturated soils will likely have had a significant effect on foundation performance under static and seismic demands. In soft areas there is also potential for ratcheting of the foundation under high ground shaking.

Due to presence of soft soils in the upper 4m depth and a thick concrete deck to the east of the extension, it is possible that some of the localised settlement towards the eastern end of the deck could have increased under static conditions due to presence of the deck.

Based on these considerations, we consider that most of the measured vertical floor level variations across the units are likely the result of settlement of the isolated piles within the areas weakened by the large ground cracks as well as liquefaction induced settlement. We note that we cannot ascertain whether the ground cracking occurred before the CES resulting in static settlement prior to being exacerbated by the high ground shaking, or following the CES. Notwithstanding the above, we consider that there is an element of static settlement based on the nature of underlying soils plus founding material for the perimeter footing and construction related settlement. However, we note that it is not possible to apportion the amount of settlement relative to each mechanism.

11. GEOTECHNICAL CONSIDERATIONS FOR REPAIR

11.1 Geotechnical Considerations

Based on our investigation results and observations, the following recommendations should be considered for the proposed repair:

- Topsoil and fill were identified to 0.8m depth at investigation points.
- An ultimate unfactored bearing capacity of 150kPa may be considered into natural soil below the topsoil and fill. Localised weaker areas may be encountered around the site such as indicated in HA/SP01.
- The local groundwater level was encountered at 2.7m depth within our hand auger boreholes, following a long dry summer. Nearby data indicates that the groundwater variation is generally between 0.6m and 1m bgl.
- According to our assessment, the property is likely to behave as equivalent to a TC3 site as defined in the MBIE Guidance document for residential sites.

Taking into account the above constraints, we recommend that the following are considered for foundation repair design:

11.2 Dwelling Foundation Repair Solution

Based on the above, and provided that the structural engineer deems the dwelling suitable for relevelling, we have no objections to relevelling the dwelling from a geotechnical perspective provided all the cracks towards the centre of the dwelling are remediated prior to any localised pile replacements, as the observed floor level variations appear to be mainly influenced by the ground cracking. Due to the potential presence of shallow liquefiable layers, we consider a relevelling strategy comprising 'overpinning' perimeter footings to be more appropriate compared to an underpinning strategy.

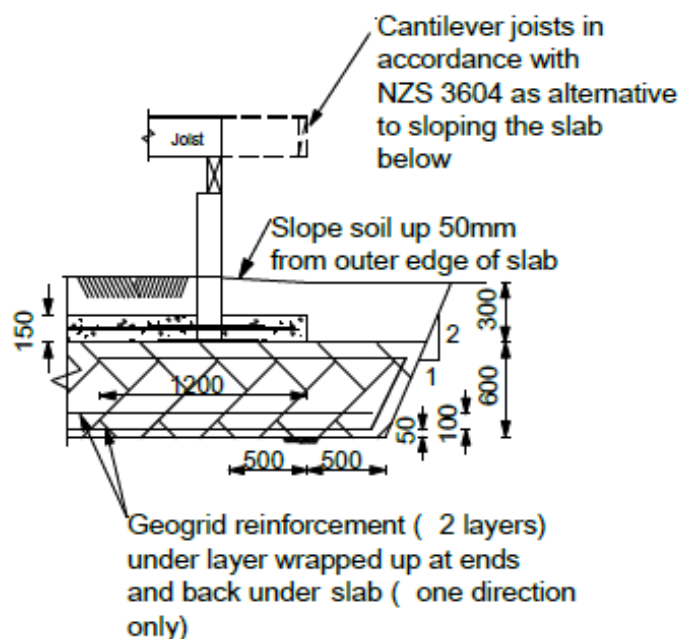
We also note the following which must be adhered to for any repair works:

- The internal shallow piles outside the areas with significant ground cracking may be relevelled using jacking and packing methodology as per MBIE Guidance A.1.1.1, Option 1: Jacking and packing methodology.
- We recommend that all piles within the central part of the dwelling with significant cracking are replaced following remediation of the ground cracks.
- If the structural engineer deems necessary, localised piles may be replaced 'like-for-like' if they exhibit excessive tilting or settlement.
- Any replacement piles should be no deeper than 0.5m bgl and a maximum width of 0.5m to minimise the potential for static settlements.
- Localised topsoil and fill were encountered up to 0.8m bgl. All unsuitable material such as topsoil and fill must be removed and replaced with suitably compacted engineered hardfill.
- Following relevelling works, we expect that future seismic behaviour will be no worse to that observed in the past.
- Care should be undertaken to avoid any future water leaks to prevent ongoing water ponding which is likely to lead to ongoing static settlements and further ground cracking.
- A Damp Proof Membrane (DPM) should be installed to reduce the risk of water damage/desiccation cracks formation in future.
- Desiccation cracks should be filled with compacted native soils and/or grout.

11.3 Replacement Foundation Solution

If replacement of the foundations are required, the most suitable foundation option would be a TC3 Type 2A-150 Foundation of the MBIE guidance - Part C, Section 15.4. This consists of a standard NZS 3604:2011 type foundation with timber support piles supported by a 150mm reinforced concrete ground underslab founded on a 600mm gravel raft (see Figure 1 below). This slab is sufficiently reinforced to support vertical liquefaction induced settlements up to 100mm at SLS and lateral stretch up to 500mm. This solution will ensure that all the shallow unsuitable soils are removed and replaced with a reinforced gravel raft. It is expected that relevering of the floor after an earthquake event can be achieved by packing the tops of the settled timber piles. The MBIE Guidance 'pre-designed' solution requires a minimum bearing capacity of 200kPa below the gravel raft, which is assumed at foundation depth after compaction of the reinforced gravel raft.

Figure 1: Detail of TC3 Type 2A-150 Foundation (MBIE Guidance Clarifications and Updates to the Residential Guidance – Issue 5, April 2014)



12. LIMITATIONS

Our report was prepared in line with the current MBIE Guidance. To satisfy the requirements of the Building Code and the New Zealand Standard “NZS 1170 - Structural Design Actions”, foundations must be designed so that the building must remain functional under SLS level loads; minor damage is acceptable provided the damage is readily repairable, and the building does not collapse under ULS level loads, but could suffer moderate to significant structural damage.

Desk study data was obtained from several investigation and modelling study sources made available to the public and engineering industry post the Canterbury earthquake sequence. Acknowledgment is given regarding the free use of the New Zealand Geotechnical Database, Christchurch City Council and Environment Canterbury websites. The data is used in good faith and no responsibility can be taken for the accuracy or completeness of the data.

Our report was prepared in the context defined in Section 1.0 and must not be relied upon by any other party other than that for whom it was prepared and their project team. It has been compiled with respect to the brief given to us, and must not be relied upon in any other context or recreated for any other purpose. We point out that our conclusions are based on desk study material, a visual surface inspection of the site, third party investigation data from nearby sites and discrete exploratory hole positions. Ground conditions may vary between investigation points.

REFERENCES

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ATTACHMENTS

FIELD TESTING LOCATION PLAN

Job No.: K200202

Sheet: 1

Ground Level: 4.7

Date: 24/03/20

Client:
Batchelar McDougall Consulting.

Project:
Geotechnical Investigation.

Location:
32 Nicholls Street, Richmond.

Coordinates (NZTM):
E 1,572,105.53 N 5,181,826.69

Key:



Hand Auger and Scala Location



Scala Location



Cone Penetrometer location



Cone Penetrometer location and
Piezometer installation point



Borehole Location



Trial Pit



Red Line indicates property boundary



HADCP sourced from NZGD



CPT sourced from NZGD



DCP sourced from NZGD



Borehole sourced from NZGD



Notes: 1. Locations and features and exploratory holes approximate only.
2. Aerial photograph sourced from Google Earth.

3. Co-ordinates may not be a true representation of the site plans locations and are only accurate to +/- 1m.
4. Not to scale.

Job No.: K200202

Client: Batchelar McDougall Consulting.

Project: Geotechnical Investigation.

Location: 32 Nicholls Street, Richmond.

Coordinates: E 1572105.3, N 5181831.8

Ground Level: 4.7

Hole No.: HA01/SP01

Date: 24/03/2020

Logged By: ASL

Sheet:	2A
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[illegible]

Notes & Abbreviations

Soils logged in accordance with 'The guidelines for the classification and description of soil and rock for engineering purposes' December 2005. NZGS. Co-ordinates are in NZTM unless otherwise specified.

Water	Shear Vane	Other Comments
▼ Standing Water Level	Corrected as per NZGS Guidelines	
∇ Water Level At Time Of Drilling	Vane No.:	
	UTP = Unable To Penetrate	
	+ = Peak Exceeded	
↵ Out Flow ↗ In Flow	- = No Result	



HAND AUGER AND SCALA LOG

Job No.: K200202

Client: Batchelar McDougall Consulting.

Hole No.: HA02/SP02

Project: Geotechnical Investigation.

Date: 24/03/2020

Location: 32 Nicholls Street, Richmond.

Logged By: GA

Coordinates: E 1572116.3, N 5181831.9

Ground Level: 4.8

Sheet: 2B

RL	Subsurface Conditions	Depth (m)	Groundwater	Geological Unit	Graphic Log	Scala Penetrometer (blows / 50mm)
4.3	Organic SILT, some sand, trace rootlets, brown, moist, non-plastic, slow-dilatancy; sand, fine to medium; organics, amorphous. 0.20m: rootlets absent.	0.5		TOPSOIL		0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
4	SILT, minor sand, light brown, moist, non-plastic, non-dilatant; sand, fine. 0.60m: orange mottling. 0.70m: some sand, moist to wet, slow-dilatancy.					
3.5	Sandy SILT, brownish grey with orange mottling, moist to wet, non-plastic, dilatant; sand, fine to medium.	1.0				
1.8	SILT, some sand, brownish grey with orange mottling, moist, non-plastic, slow-dilatancy; sand, fine to medium. 1.40m: trace fibrous organics, brownish grey. 1.80m: minor partly decomposed wood. 1.90m: moist to wet. 2.10m: wood absent. 2.40m: trace tree roots, wet. 2.80m: trace charcoal. 3.00m: End of hole, (target depth).	1.5 2.0 2.5		SPRINGSTON FORMATION (TERRESTRIAL)		

Notes & Abbreviations

Soils logged in accordance with 'The guidelines for the classification and description of soil and rock for engineering purposes' December 2005, NZGS. Co-ordinates are in NZTM unless otherwise specified.

Water
 Standing Water Level
 Water Level At Time Of Drilling
 Out Flow In Flow

Shear Vane
 Corrected as per NZGS Guidelines
 Vane No.:
 UTP = Unable To Penetrate
 + = Peak Exceeded
 - = No Result

Other Comments



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Job No.: K200202

Hole No.: HA03/SP03

Date: 24/03/2020

Logged By: GA

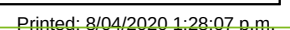
Sheet:	2C
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Sheet:	2C
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Notes & Abbreviations

Other Comments

- Corrected as per NZGS Guidelines
Vane No.:
UTP = Unable To Penetrate
+ = Peak Exceeded
- = No Result



Job No.: K200202

Hole No.: HAS04/SP04

Date: 24/03/2020

Logged By: GA

Sheet:	2D
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Sheet:	2D
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[illegible]

Soils logged in accordance with 'The guidelines for the classification and description of soil and rock for engineering purposes' December 2005, NZGS. Co-ordinates are in NZTM unless otherwise specified.

Water	Shear Vane	Other Comments
▼ Standing Water Level ∇ Water Level At Time Of Drilling ↙ ↘ Out Flow In Flow	Corrected as per NZGS Guidelines Vane No.: UTP = Unable To Penetrate + = Peak Exceeded - = No Result	Hand auger terminated at a depth of 2.80m below ground level due to obstruction from deck structure.





HTP-01



HTP-02

HAND TEST PIT LOG

Job No.: K200202

Client: Batchelar McDougall Consulting.

Hole No.: HTP-01

Project: Geotechnical Investigation.

Date: 24/03/2020

Location: 32 Nicholls Street, Richmond.

Logged By: ASL

Coordinates: E 1572114.5, N 5181822.1

Ground Level: 4.8

Sheet: 3A

RL	Subsurface Conditions	Depth (m)	Groundwater	Geological Unit	Graphic Log	Scala Penetrometer (blows / 50mm)															
	SILT, some sand, brownish grey, moist, non-plastic, slow-dilatancy; sand, fine.					0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
4.55	0.20m: Depth to base of dwelling foundation.		Groundwater Not Encountered	SPRINGSTON FORMATION (TERRESTRIAL)																	
	0.25m: End of hole, (target depth).	0.5																			

Notes & Abbreviations

Soils logged in accordance with 'The guidelines for the classification and description of soil and rock for engineering purposes' December 2005, NZGS. Co-ordinates are in NZTM unless otherwise specified.

Water	Shear Vane	Other Comments
▼ Standing Water Level	Corrected as per NZGS Guidelines	Hand test pit excavated to determine depth to dwelling foundation.
▽ Water Level At Time Of Drilling	Vane No.:	
↰ Out Flow ↲ In Flow	UTP = Unable To Penetrate	
	+ = Peak Exceeded	
	- = No Result	



Printed: 8/04/2020 1:28:14 p.m.

HAND TEST PIT LOG

Job No.: K200202

Client: Batchelar McDougall Consulting.

Hole No.: HTP-02

Project: Geotechnical Investigation.

Date: 24/03/2020

Location: 32 Nicholls Street, Richmond.

Logged By: ASL

Coordinates: E 1572114.0, N 5181831.8

Ground Level: 4.7

Sheet: 3B

RL	Subsurface Conditions	Depth (m)	Groundwater	Geological Unit	Graphic Log	Scala Penetrometer (blows / 50mm)															
4.5	SILT, some sand and organics, trace rootlets, brown, dry to moist, non-plastic, slow-dilatancy; sand, fine to medium; organics, amorphous. 0.10m: Depth to base of dwelling foundation.		Groundwater Not Encountered	FILL/TOPSOIL		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	0.20m: End of hole, (target depth).	0.5																			

Notes & Abbreviations

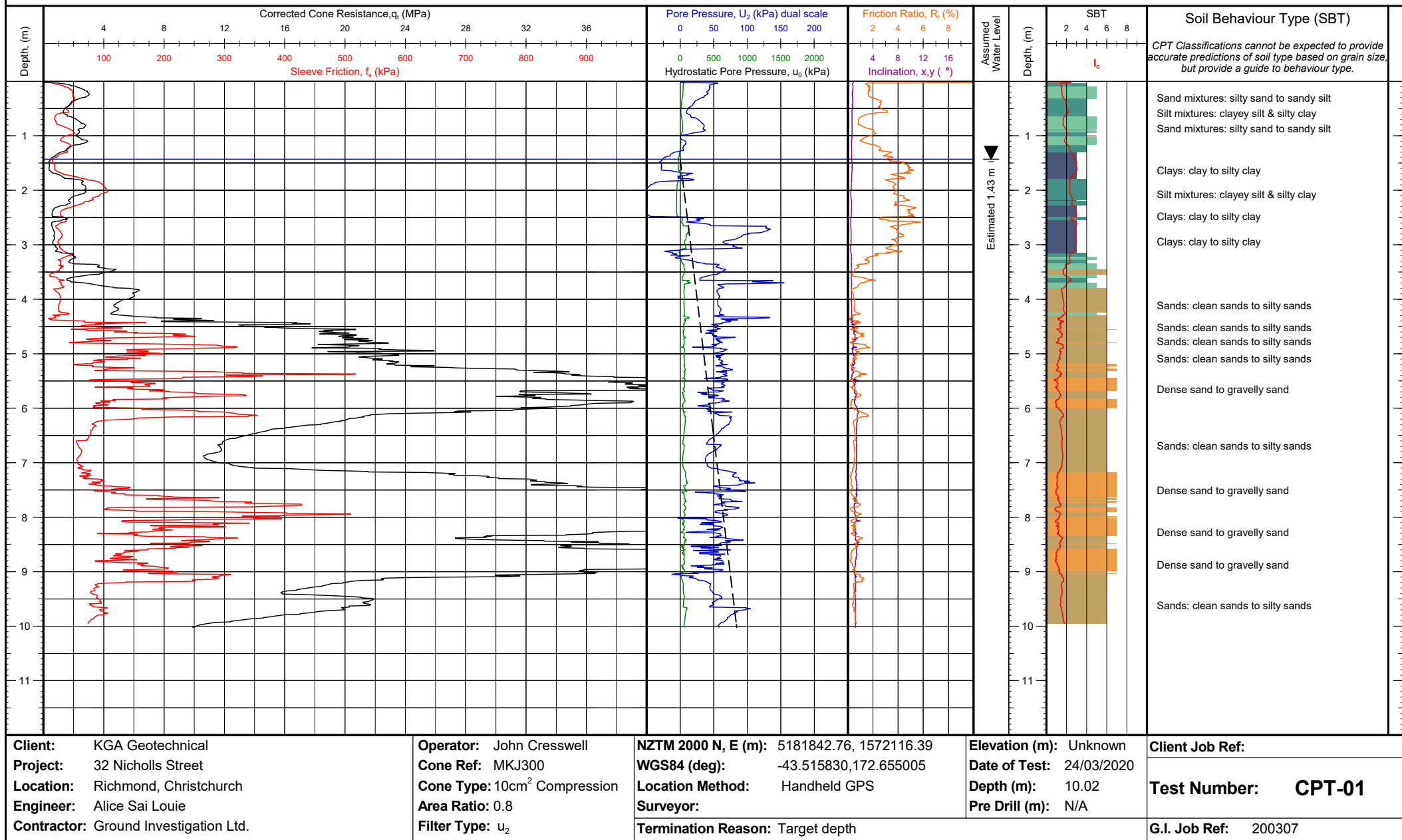
Soils logged in accordance with 'The guidelines for the classification and description of soil and rock for engineering purposes' December 2005, NZGS. Co-ordinates are in NZTM unless otherwise specified.

Water	Shear Vane	Other Comments
▼ Standing Water Level	Corrected as per NZGS Guidelines	Hand test pit excavated to determine depth to dwelling foundation.
∇ Water Level At Time Of Drilling	Vane No.:	
↔ Out Flow ▷ In Flow	UTP = Unable To Penetrate	
	+ = Peak Exceeded	
	- = No Result	

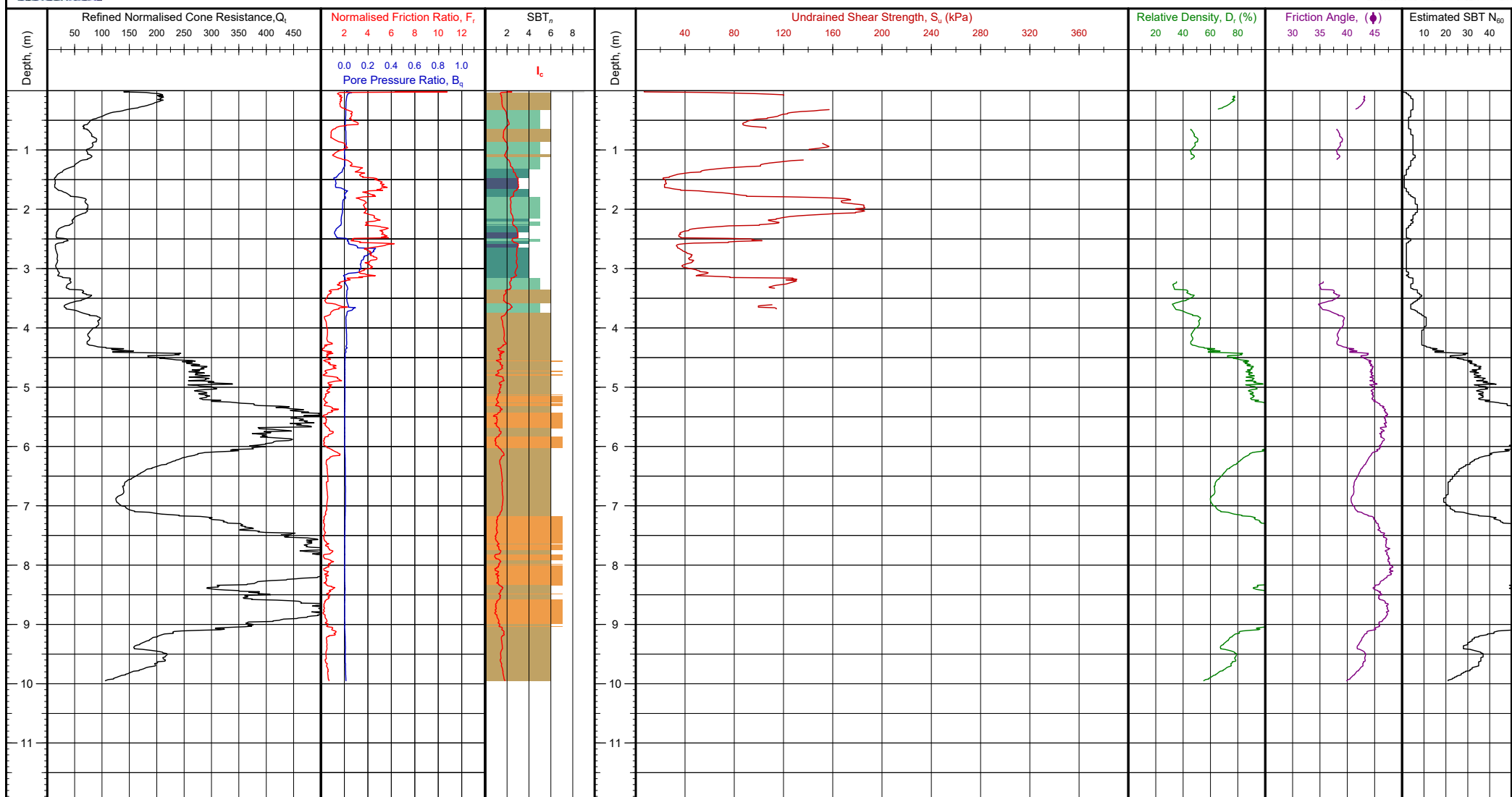


Printed: 8/04/2020 1:28:17 p.m.

CONE PENETRATION TEST (CPT) LOG



CPT PARAMETER LOG



Client: KGA Geotechnical
Project: 32 Nicholls Street
Location: Richmond, Christchurch
Engineer: Alice Sai Louie
Contractor: Ground Investigation Ltd.

Soil Behaviour Type SBT_n - Robertson et al. 1990

0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine grained	6	Sands: clean sands to silty sands
2	Organic: Organic clay/silt, peat	7	Dense sand to gravelly sand
3	Clay: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff silt/clay

Notes and Limitations:

Data shown on this report has been assessed to provide a basic interpretation in terms of Soil Behaviour Type (SBT) and various geotechnical soil and design parameters using methods published in P.K. Robertson and K.L. Cabel (2010), Guide to Cone Penetration Testing for Geotechnical Engineering, 4th Edition. The interpretations are presented only as a guide for geotechnical use and should be carefully reviewed by the user. Ground Investigation Ltd. does not warrant the correctness or applicability of any of the geotechnical soil and design parameter shown and does not assume any liability for any use of the results in any design or review. The user should be fully aware of the techniques and limitations of any method used to derive data shown in this report.

Client Job Ref:

Test Number: CPT-01

G.I. Job Ref: 200307

CPT ZEROS AND DRIFT

200307

Cone Reference	CPT Name	Push Number	Tip Resistance			Local Friction			Pore Pressure		
			Initial (MPa)	Final (MPa)	Difference (kPa)	Initial (MPa)	Final (MPa)	Difference (kPa)	Initial (MPa)	Final (MPa)	Difference (kPa)
MKJ300	CPT-01	1	20.928	20.912	-15.6	0.2671	0.2674	0.3	2.8301	2.8244	-5.7

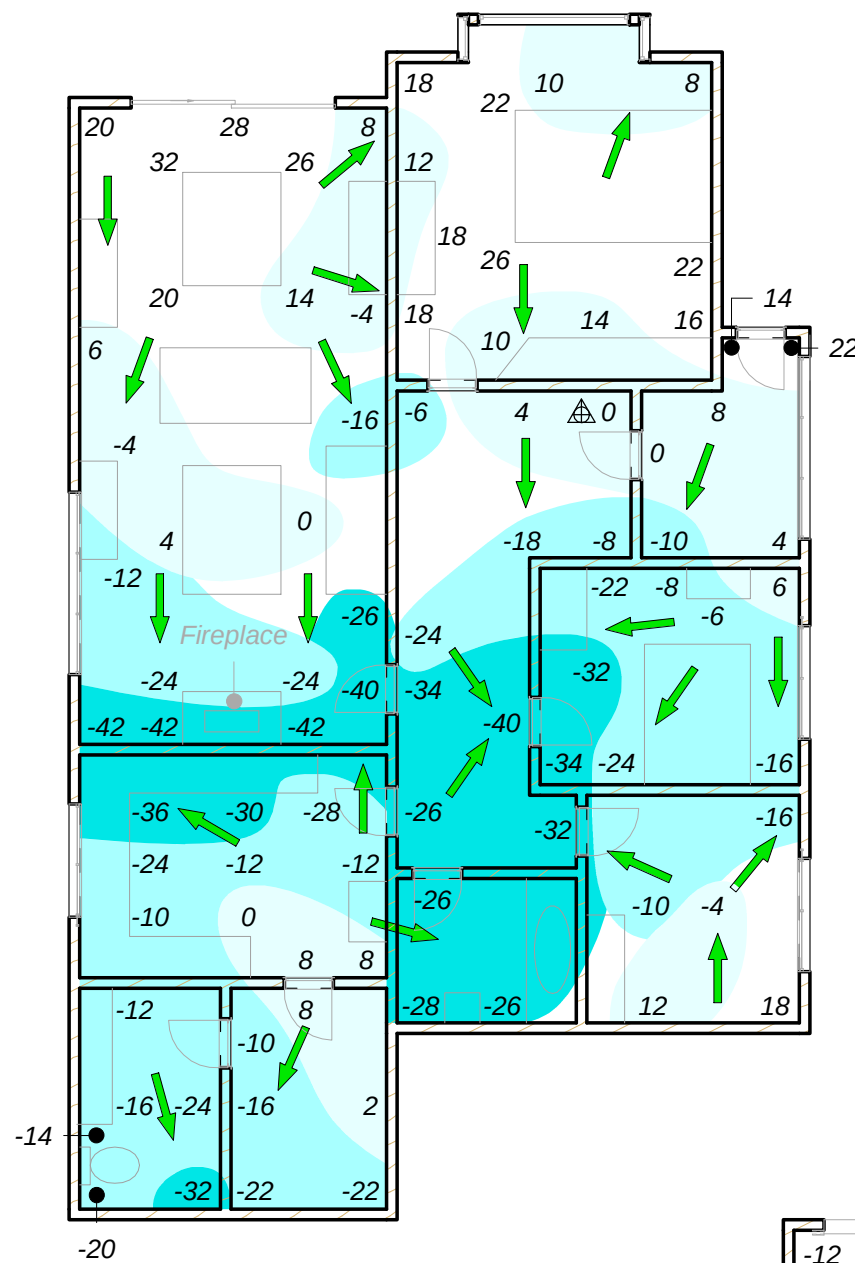
Client: KGA Geotechnical
Project: 32 Nicholls Street

Location: Richmond, Christchurch
Engineer: Alice Sai Louie

Note: Zero difference colour-coded based on application classes following ISO 22476-1:2012. Blue indicates Class 1, green Class 2, orange Class 3 and red Class 4. Grey represents if a test is below Class 4.

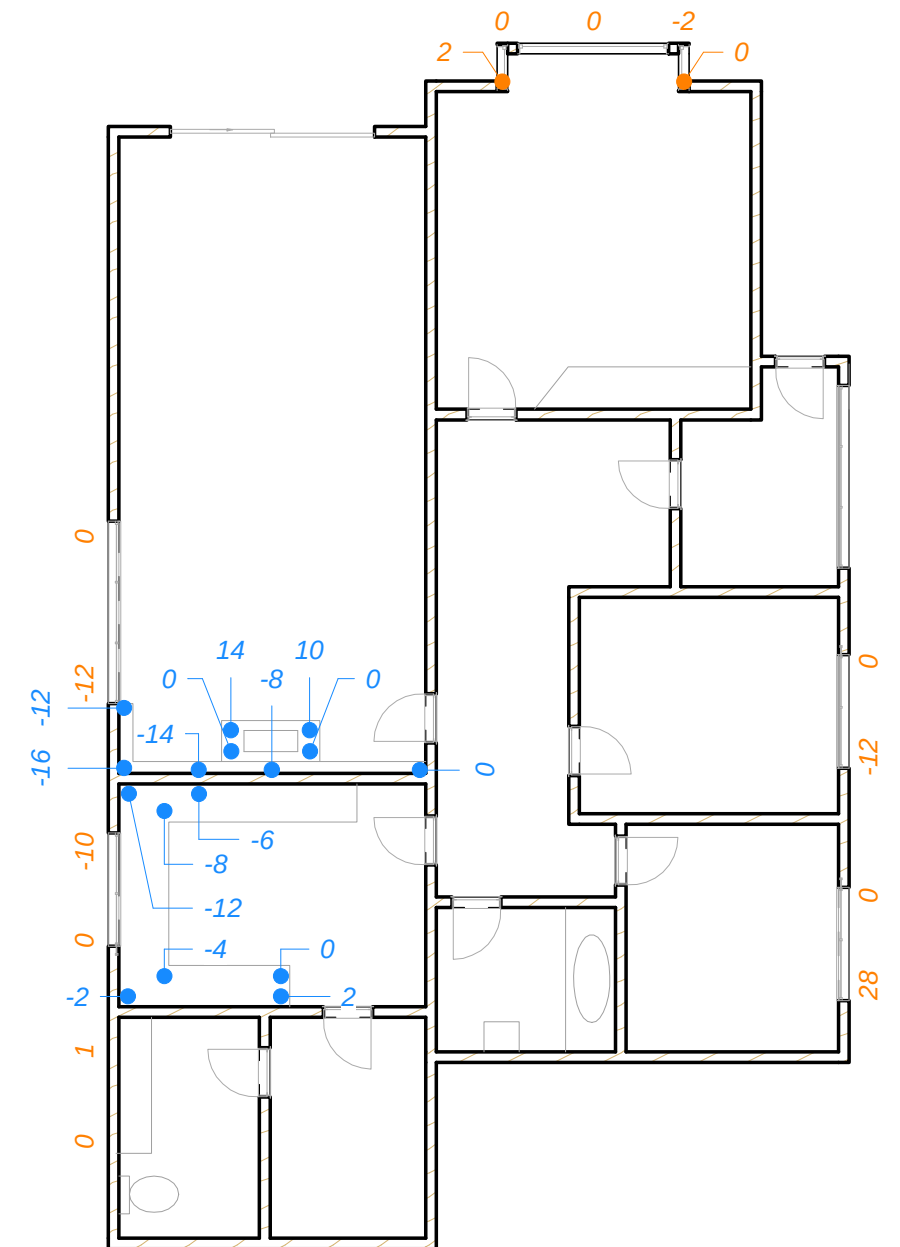
APPENDIX A

Third Party Documents



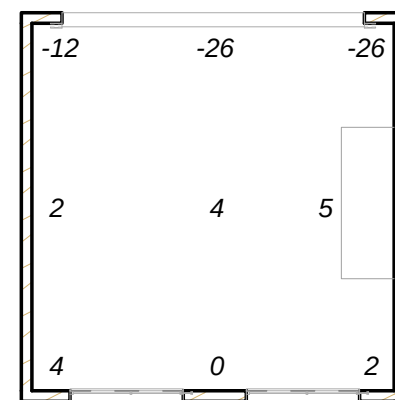
- Floor levels have been adjusted for floor coverings
- Dimensions and site layout are approximate only
- Refer to BMC RSA report for details

0	Adjusted Floor Levels		Datum
0	Adjusted Window Sill Levels		Floor Slope > 1:200
0	Adjusted Bench Levels		'A Bit Low'
0	Ceiling Levels		'Low'
3	Verticalities		'Lower'

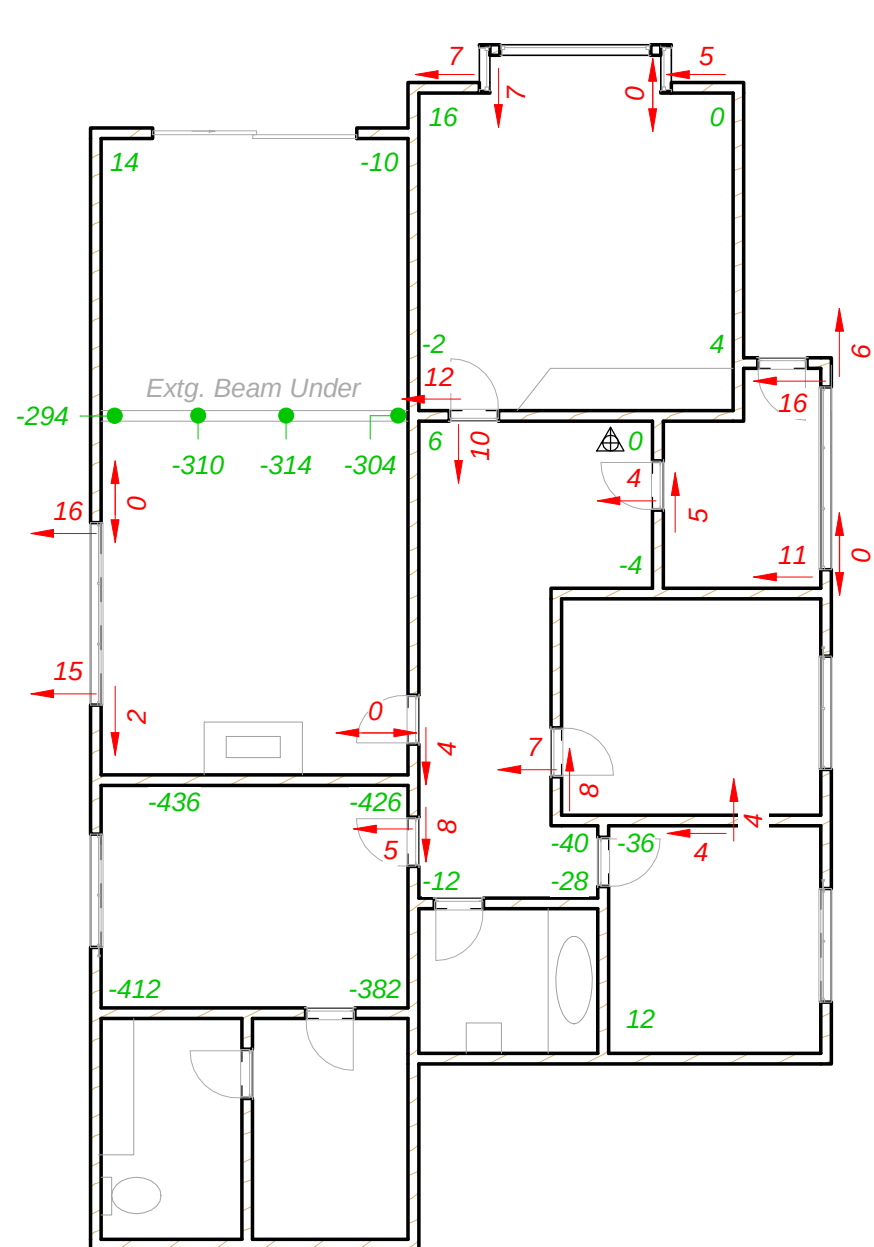


Scale 1 : 100 @ A3

Scale 1 : 100 @ A3



			Project Title 32 Nicholls Street, Richmond Christchurch	Drawing Name Floor Levels Plan	BMC BATCHELAR MCDUGALL CONSULTING STRUCTURAL & CIVIL ENGINEERS Level 3, 99 Ardmore Street, Wanaka, 9343, Tel : (03) 443 4531	Drawn By		JX	
						Scale @ A3		As indicated	
						Project Number	Sheet No.	Revision	
P1	25.03.20	Preliminary				2002-2888	S1-01	P1	
Rev	Date	Amendment							
			The copyright of this drawing belongs to BMC Ltd						



NOTES

- Floor levels have been adjusted for floor coverings
- Dimensions and site layout are approximate only
- Refer to BMC RSA report for details

LEGEND

-  Datum
-  Ceiling Levels
-  Verticalities

3

Ceiling & Verticality Plan

Scale 1 : 100 @ A3

PRELIMINARY

			Project Title 32 Nicholls Street, Richmond Christchurch	Drawing Name Ceiling Levels Plan	BMC BATCHELAR MCDOUGALL CONSULTING STRUCTURAL & CIVIL ENGINEERS Level 3, 99 Ardmore Street, Wanaka, 9343, Tel : (03) 443 4531	Drawn By		JX	
						Scale @ A3		As indicated	
						Project Number		Sheet No.	Revision
P1	25.03.20	Preliminary				2002-2888		S1-02	P1
Rev	Date	Amendment							
							The copyright of this drawing belongs to BMC Ltd		

APPENDIX B

Site Photographs

Aerial Photograph, September 2011



Notes:

1. Aerial photograph sourced from NZ Geotechnical Database

Aerial Photograph, February 2011



Notes:

1. Aerial photograph sourced from NZ Geotechnical Database

Aerial Photograph, June 2011



Notes:

1. Aerial photograph sourced from NZ Geotechnical Database

Site Photographs:



The dwelling



The driveway



The porch



Repaired crack on the porch



The extension and concrete deck

APPENDIX C

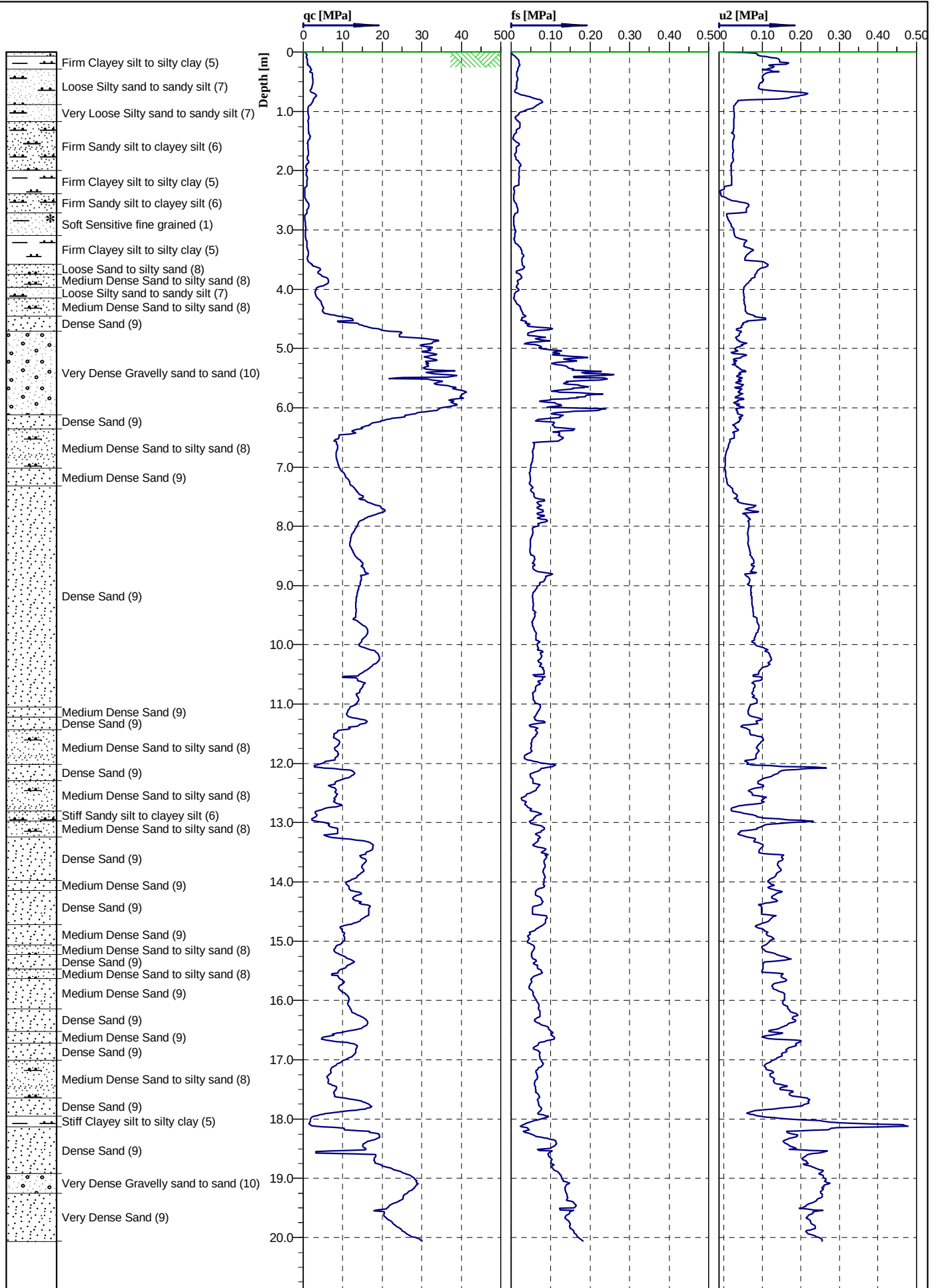
Background Information Documents

Nearby Data



Notes:

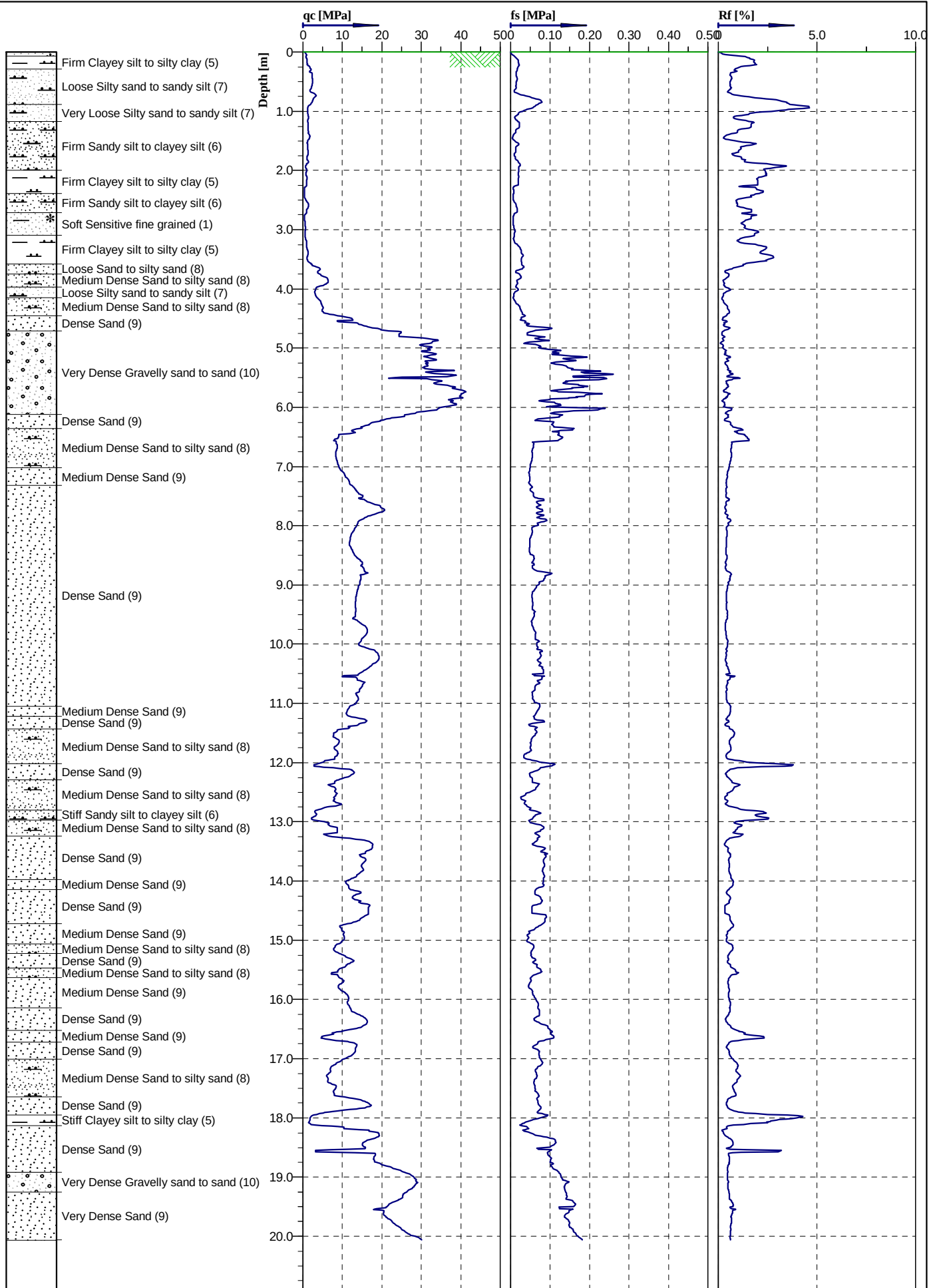
1. Aerial photograph sourced from NZ Geotechnical Database



Cone No: 4467
Tip area [cm²]: 10
Sleeve area [cm²]: 150

Location: 28 NICHOLLS STREET	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test no: CPT68
Project ID:	Client: EARTHQUAKE COMMISSION	Date: 7/17/2012	Scale: 1 : 85
Project: RCH-POD03-CPT68		Page: 1 OF 3	Fig:
		File:	

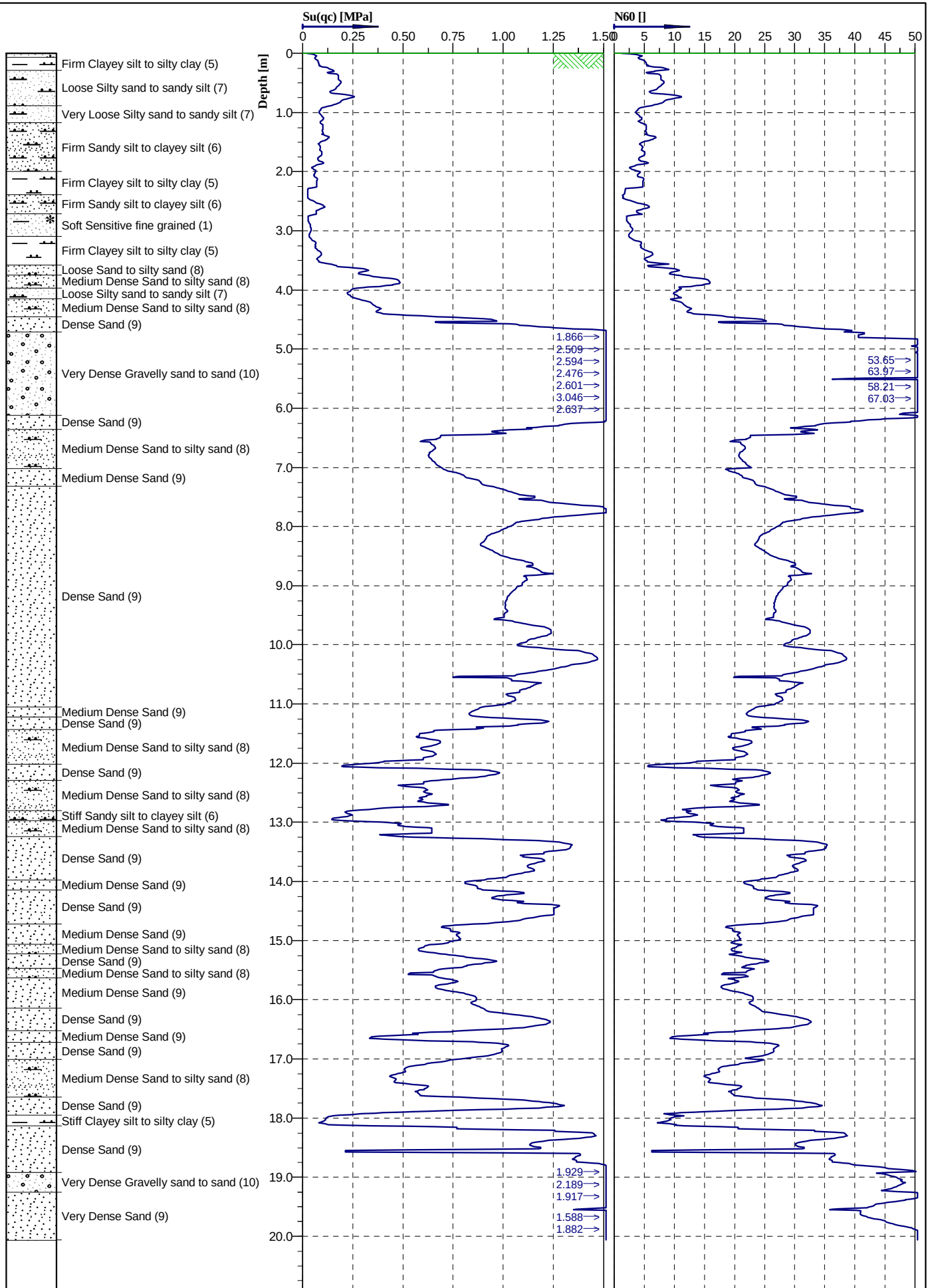
28 NICHOLLS ST, CPT 1.091



BROWN BROS
DRILLING

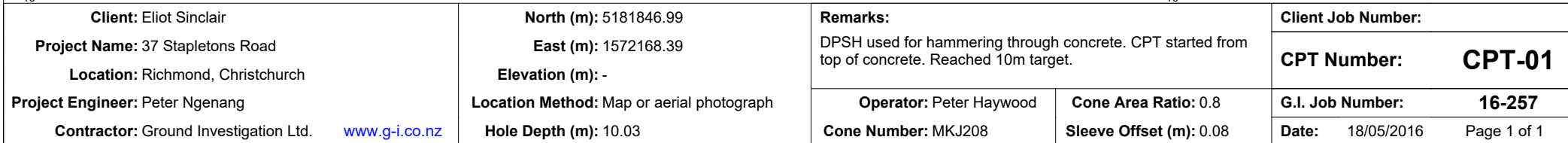
Cone No: 4467
Tip area [cm²]: 10
Sleeve area [cm²]: 150

Location: 28 NICHOLLS STREET	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test no: CPT68
Project ID:	Client: EARTHQUAKE COMMISSION	Date: 7/17/2012	Scale: 1 : 85
Project: RCH-POD03-CPT68		Page: 2 OF 3	Fig:
		File:	



Cone No: 4467
Tip area [cm²]: 10
Sleeve area [cm²]: 150

Location: 28 NICHOLLS STREET	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test no: CPT68
Project ID:	Client: EARTHQUAKE COMMISSION	Date: 7/17/2012	Scale: 1 : 85
Project: RCH-POD03-CPT68		Page: 3 OF 3	Fig:
		File:	



Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	R&W (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K _σ applied:	Yes
Earthquake magnitude M _w :	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

	1. Sensitive fine grained		4. Clayey silt to silty		7. Gravely sand to sand
	2. Organic material		5. Silty sand to sandy silt		8. Very stiff sand to
	3. Clay to silty clay		6. Clean sand to silty sand		9. Very stiff fine grained

1



TONKIN & TAYLOR LTD

BOREHOLE LOG

BH No: RCH-POD03-BH006

Hole Location: 28 Nicholls Street

SHEET 1 OF 3

PROJECT: CHCH TC3 GEOTECHNICAL INVESTIGATIONS						LOCATION: RICHMOND						JOB No: 52003.000								
CO-ORDINATES: 5743409.6 mN 2482095.89 mE						DRILL TYPE: Rotary						HOLE STARTED: 27/9/12								
R.L.: 4.88 m						DRILL METHOD: HQT/Std SPT						HOLE FINISHED: 27/9/12								
DATUM: NZMG, MSL (CCC 20/01/12 Datum -9.043m)						DRILL FLUID: LP2000						DRILLED BY: Pro-Drill								
LOGGED BY: EC-EB						CHECKED: CMS														
GEOLOGICAL						ENGINEERING DESCRIPTION														
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.	FLUID LOSS	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	R.L. (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MOISTURE CONDITION	WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	COMPRESSIVE STRENGTH (MPa)	DEFECT SPACING (mm)	SOIL DESCRIPTION		
																		ROCK DESCRIPTION		
																			Soil type, minor components, plasticity or particle size, colour.	
																			Substance: Rock type, particle size, colour, minor components.	
																			Defects: Type, inclination, thickness, roughness, filling.	
TOPSOIL											ML	M							SILT with minor organics, minor sand and trace rootlets, dark brown, moist, low plasticity. Organics are amorphous and fibrous (rootlets). Sand is fine to medium. 0.1m- amorphous organics absent.	
YALDHURST MEMBER OF THE SPRINGSTON FORMATION (ALLUVIAL)			77	HQT		*FC@1.5m PL@1.5m 0/1//0/1/1/2 N=4			1										0.9 to 1.0m- some fibrous organics.	
									2										1.15 to 1.5m- no recovery.	
			100	SPT			B		3			W	F						1.5m- firm, wet.	
									4											
			100	HQT					5		SM			L					Silty fine to medium SAND, grey, loose, wet, poorly graded.	
						1/0/2/1/2/1/ N=6	B		6										2.6m- trace fibrous organics (wood fragments)	
			100	SPT					7											
			100	HQT					8											
			100	SPT		2/2/2/3/2/3// 3/3/3/4/3/3/ 5/3/4/4/4/5 N=44			9					D					Silty fine to medium SAND with minor gravel, grey, dense, wet, poorly graded. Gravel is fine to medium, subrounded.	
									10										5.0 to 6.3m- no recovery.	
CHRISTCHURCH FORMATION (MARINE/ ESTUARINE)			16	HQT					11										6.3m- fines washed away during drilling process.	
			0	SPT		2/2/2/3/2/3// 3/3/3/4/3/3/ 3/4/3/4/3/3 N=39			12										6.5 to 7.8m- no recovery.	
			24	HQT					13											
			100	SPT		2/1/2/2/1/2// 3/2/2/2/2/2/ 2/3/3/2/3/3 N=29			14		SP			MD					Fine to medium SAND with minor silt, grey, medium dense, wet, poorly graded.	
			71	HQT					15										9.2 to 9.5m- no recovery.	
		100	SPT			*FC@9.5m 6/7/1/7/8/9/12 N=36	B		16					D					9.5m- dense.	

Log Scale 1:50

BORELOG-TC3 720016 RCH-POD03.GPJ 15-Apr-2013



TONKIN & TAYLOR LTD

BOREHOLE LOG

BH No: RCH-POD03-BH006
Hole Location: 28 Nicholls Street

SHEET 2 OF 3

PROJECT: CHCH TC3 GEOTECHNICAL INVESTIGATIONS										LOCATION: RICHMOND										JOB No: 52003.000																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
CO-ORDINATES: 5743409.6 mN 2482095.89 mE										DRILL TYPE: Rotary										HOLE STARTED: 27/9/12																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
R.L.: 4.88 m										DRILL METHOD: HQT/Std SPT										HOLE FINISHED: 27/9/12																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
DATUM: NZMG, MSL (CCC 20/01/12 Datum -9.043m)										DRILL FLUID: LP2000										DRILLED BY: Pro-Drill																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
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GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.										FLUID LOSS	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	R.L. (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MOISTURE CONDITION	WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	COMPRESSION STRENGTH (MPa)	DEFECT SPACING (mm)	SOIL DESCRIPTION Soil type, minor components, plasticity or particle size, colour. ROCK DESCRIPTION Substance: Rock type, particle size, colour, minor components. Defects: Type, inclination, thickness, roughness, filling.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											
CHRISTCHURCH FORMATION (MARINE/ ESTUARINE)			70	HQTT		4/6//6/6/8/8 N=28																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																</

T-T DATATEMPLATE-SPT.GDT reb

Log Scale 1:50

BORELOG-TC3 720016 RCH-POD03.GPJ 15-Apr-2013



PROJECT: CHCH TC3 GEOTECHNICAL INVESTIGATIONS										LOCATION: RICHMOND										JOB No: 52003.000																			
CO-ORDINATES: 5743409.6 mN 2482095.89 mE										DRILL TYPE: Rotary										HOLE STARTED: 27/9/12																			
										DRILL METHOD: HQT/Std SPT										HOLE FINISHED: 27/9/12																			
R.L.: 4.88 m																				DRILLED BY: Pro-Drill																			
DATUM: NZMG, MSL (CCC 20/01/12 Datum -9.043m)										DRILL FLUID: LP2000										LOGGED BY: EC-EB CHECKED: CMS																			
GEOLOGICAL															ENGINEERING DESCRIPTION																								
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.					FLUID LOSS	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	R.L. (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MOISTURE / WEATHERING CONDITION	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	COMPRESSIVE STRENGTH (MPa)	DEFECT SPACING (mm)	SOIL DESCRIPTION Soil type, minor components, plasticity or particle size, colour. ROCK DESCRIPTION Substance: Rock type, particle size, colour, minor components. Defects: Type, inclination, thickness, roughness, filling.																		
CHRISTCHURCH FORMATION (MARINE/ ESTUARINE)							100	SPT		6/10//12/15/1 //6 for 25mm N>50					SP	W	VD						Fine to medium SAND with minor silt and trace gravel, grey, very dense, wet, poorly graded. Gravel is fine, subrounded.																
																							End of borehole at 20.45mbgl (target depth)																
												-16	21												21-														
												-17	22												22-														
												-18	23												23-														
												-19	24												24-														
												-20	25												25-														
												-21	26												26-														
												-22	27												27-														
												-23	28												28-														
												-24	29												29-														
												-25	30																										



PROJECT: CHCH TC3 GEOTECHNICAL INVESTIGATIONS				LOCATION: RICHMOND				JOB No: 52003.000														
CO-ORDINATES: 5743464.44 mN 2482188.48 mE				DRILL TYPE: Roto-Sonic				HOLE STARTED: 30/10/12														
R.L.: 4.24 m				DRILL METHOD: PQDT/Auto SPT				HOLE FINISHED: 30/10/12														
DATUM: NZMG, MSL (CCC 20/01/12 Datum -9.043m)				DRILL FLUID: LP2000				DRILLED BY: Pro-Drill														
								LOGGED BY: MOSS-NA CHECKED: BMcD														
GEOLOGICAL				ENGINEERING DESCRIPTION																		
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.				FLUID LOSS	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	R.L. (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MOISTURE / WEATHERING CONDITION	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	COMPRESSION STRENGTH (MPa)	DEFECT SPACING (mm)	SOIL DESCRIPTION Soil type, minor components, plasticity or particle size, colour. ROCK DESCRIPTION Substance: Rock type, particle size, colour, minor components. Defects: Type, inclination, thickness, roughness, filling.		
TOPSOIL												4		ML	M						SILT with trace organics and rootlets, dark brown, moist, low plasticity. Organics are amorphous.	
YALDHURST MEMBER OF THE SPRINGSTON FORMATION (ALLUVIAL)						67	PQDT		*ATP@1.5m FC@1.5m 0/0/0/0/0/0 N=0			1		MH							SILT with minor sand and trace organics, greyish brown, moist, high plasticity. Sand is fine to medium. Organics are amorphous. 0.8m- brown mottled orange. 1.0 to 1.5m- no recovery.	
						100	SPT				B		2		ML	W	VS				1.5m- grey, very soft.	
						100	PQDT		*ATP@3.0m FC@3.0m 0/0/0/0/1/1 N=2			3				S					SILT with minor sand and trace organics, dark brown, very soft, wet, low plasticity. Sand is fine to medium. Organics are amorphous and fibrous. 2.2 to 2.5m- some amorphous organics 2.5m- trace rootlets 2.7m- grey. 3.0m- soft.	
						100	PQDT				B		4		GW		VL					Sandy fine to medium GRAVEL with minor silt, grey, subrounded, very loose, wet, well graded. Sand is fine to coarse. 4.5m- loose.
CHRISTCHURCH FORMATION (MARINE/ ESTUARINE)						100	SPT		1/0/0/0/1/0// 1/1/0/1/1/1/ 1/1/1/0/1/1 N=10			5		SP		L					Fine to medium SAND with trace silt, grey, loose, wet, poorly graded.	
						100	PQDT		*FC@6.0m 3/2//3/4/5/7 N=19			6				MD					6.0m- medium dense.	
												7									End of borehole at 6.45mbgl.	
												8										
												9										
												10										

Crack Map



LLUR Extract:

Listed Land Use Register (LLUR)

Search

32 Nicholls Street, Richmond, Christchurch City

(Having trouble finding your address?)



Environment Canterbury Regional Co.

OVERVIEW

FINDING YOUR ADDRESS

SEARCH SUMMARY

Thank you for your enquiry.

The Listed Land Use Register does not currently have any information about a Hazardous Activities and Industries List site on this land parcel.

If you would like a property statement, please fill in your details below.

Records Found

No records found.

Property Search Results

	Legal Description	Titles	Valuation No	
32 NICHOLLS STREET				
1	Lot 56 DP 5913	C8398/44	2234078400	

New Zealand Geotechnical Database: Property Summary Report

General Property Information

Property Address	32 Nicholls St		
QPID #	1207110	Suburb	Richmond
Valuation Reference No	22340/78400	DPID #	
Legal Description	LOT 56 DP 5913		
Easting (NZTM)	1572113	Northing (NZTM)	5181827
CERA Zone	Green	MBIE Technical Category	TC3

Liquefaction Observations

Earthquake	4 Sept 2010	22 Feb 2011	13 June 2011
Liquefaction Observed [from aerial photos]	Minor	Moderate to Severe	Moderate to Severe
Ground Surface Observation Category	Minor Liquefaction	Moderate Liquefaction	Refer to Road Map

Discrepancies are possible between observations from aerial photography and ground based observations. Refer to notes 1 & 2.

Property Surface Elevation from LiDAR Surveys (m LVD37)

Survey Dates	Pre Quake	5 Sep 2010	8 Mar-30 May 2011	18 Jul - 3 Sep 2011	17 - 18 Feb 2012
Maximum Elevation	5.63	5.24	5.02	5.05	5.00
95 percentile	5.44	5.09	4.95	4.93	4.86
Mean Elevation	5.17	4.96	4.87	4.83	4.75
5 percentile	4.99	4.87	4.79	4.74	4.64
Minimum Elevation	4.92	4.83	4.74	4.62	4.51

Refer to note 3.

Cumulative Property Elevation Changes from LiDAR Surveys (m LVD37)

Period: Pre Quake -	to 5 Sep 2010	to 30 May 2011	to 3 Sep 2011	to 18 Feb 2012
Surface Change	- 0.21	- 0.31	- 0.35	- 0.43
Other Change	- 0.20	- 0.19	- 0.21	- 0.29
Tectonic Change	- 0.01	- 0.11	- 0.14	- 0.14

Refer to note 3.

Interpolated Ground Water Surface Elevation at the time of each Earthquake (m LVD37)

Earthquake	Sep 2010	Feb 2011	Jun 2011	Dec 2011
Surface Elevation	3.35	3.31	3.58	3.55

For back analysis purpose only. Refer to note 4.

Design Ground Water Surface Elevations (m LVD37)

	Median surface	Median with surrogates	85 percentile offset	15 percentile offset
Surface Elevation	3.41	3.51	0.20	- 0.31

Refer to note 5.

APPENDIX D

Liquefaction Analyses

LIQUEFACTION ANALYSIS REPORT

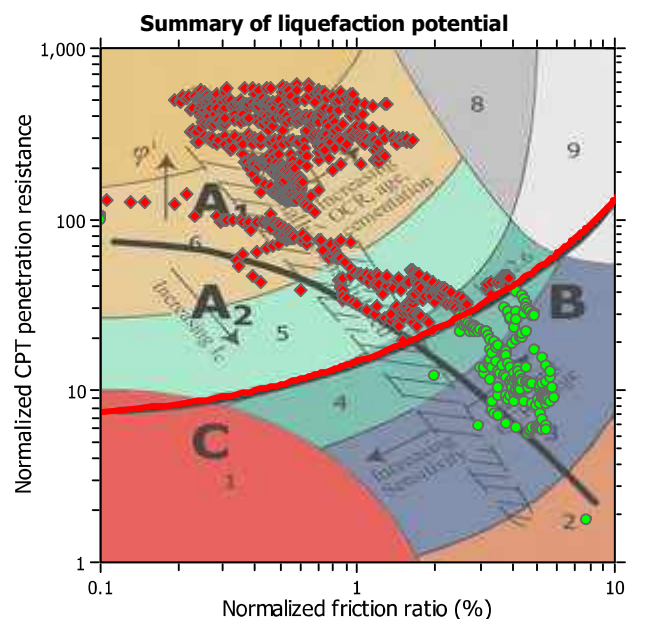
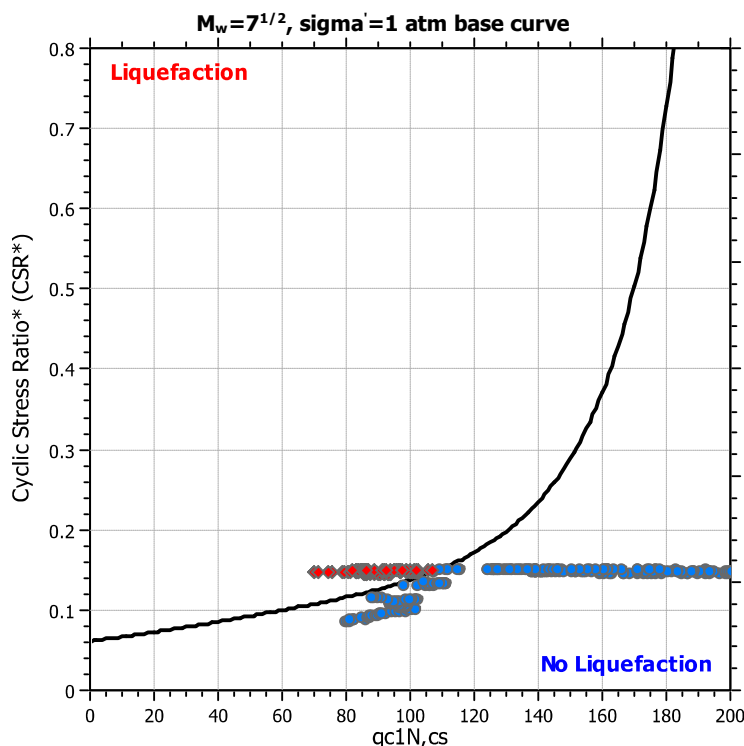
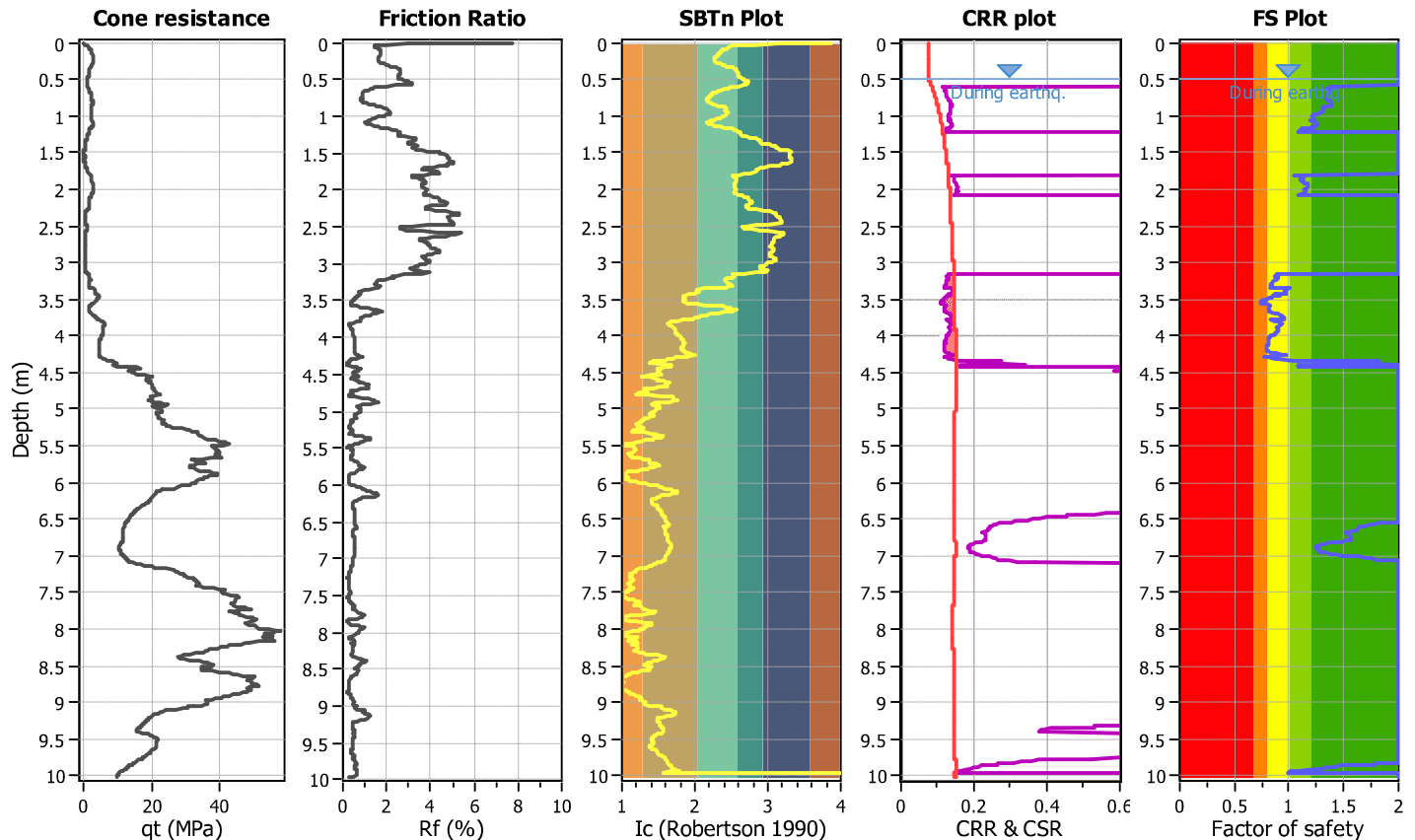
Project title : K200202

Location : 32 Nicholls Street

CPT file : CPT-01

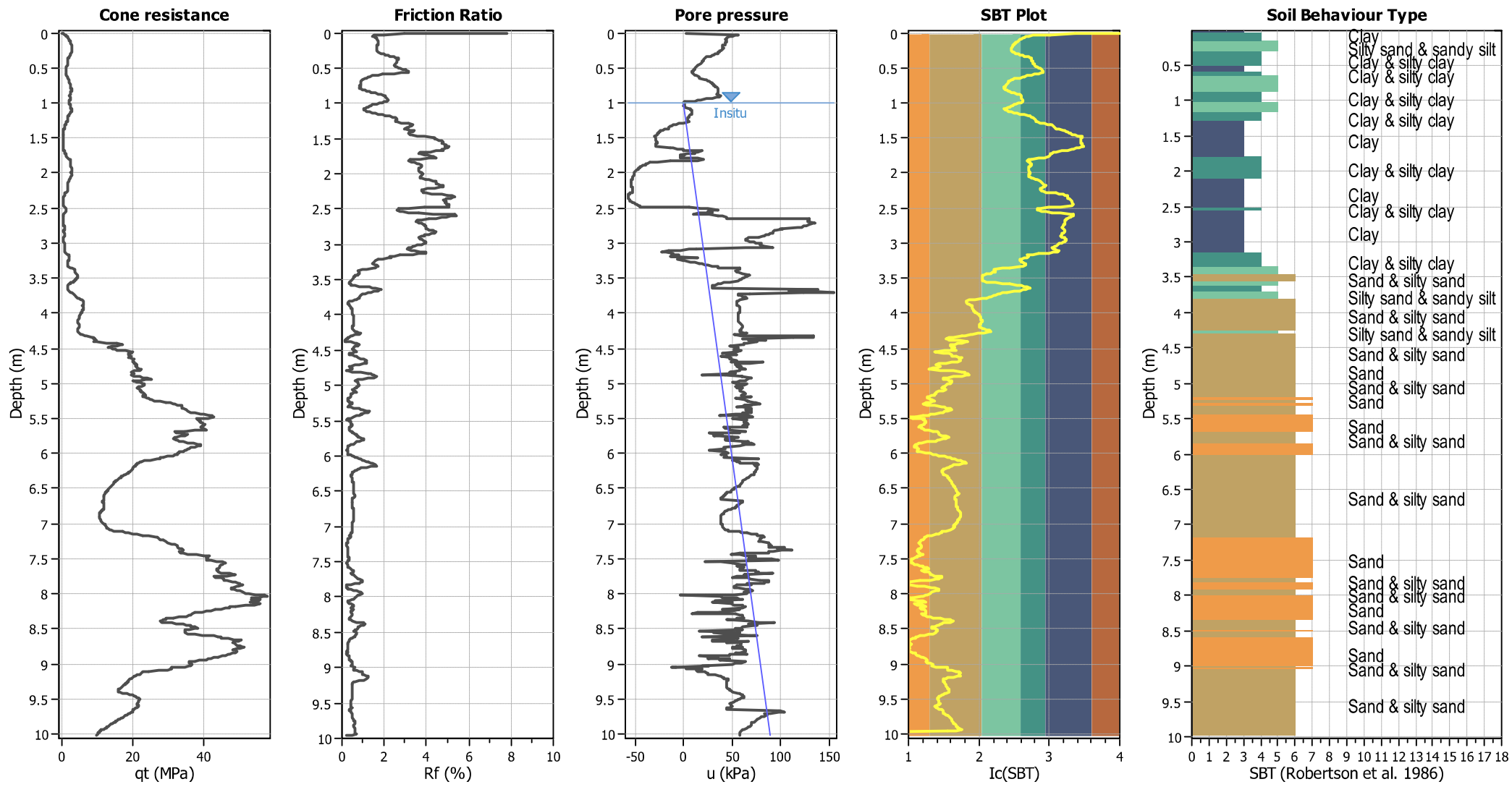
Input parameters and analysis data

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Fines correction method:	B&I (2014)	G.W.T. (earthq.):	0.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w :	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method
Peak ground acceleration:	0.13	Unit weight calculation:	Based on SBT	K_g applied:	Yes		



Zone A₁: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A₂: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

CPT basic interpretation plots



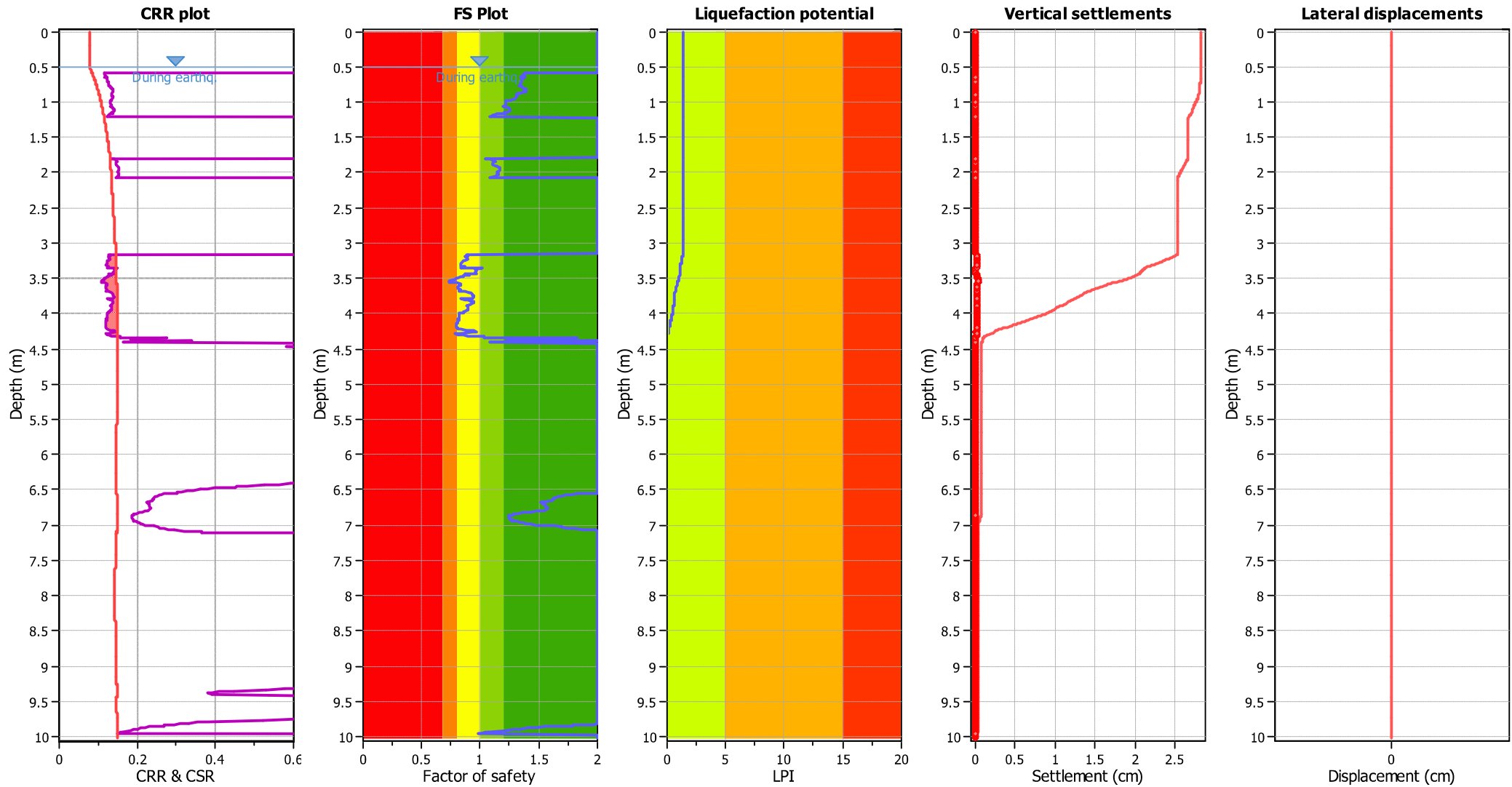
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K ₀ applied:	Yes
Earthquake magnitude M _w :	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

SBT legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K ₀ applied:	Yes
Earthquake magnitude M _w :	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

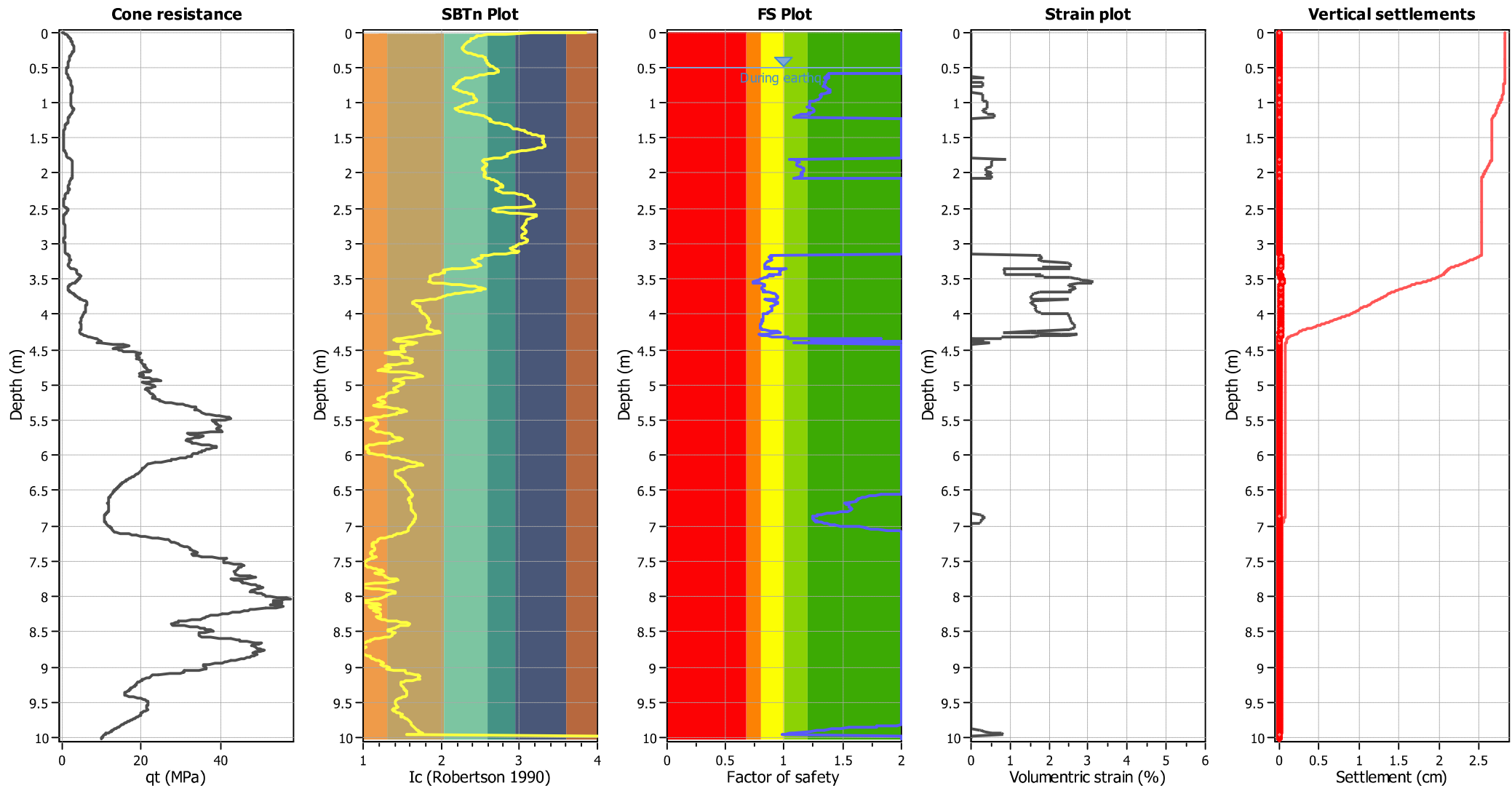
F.S. color scheme

Red	Almost certain it will liquefy
Orange	Very likely to liquefy
Yellow	Liquefaction and no liq. are equally likely
Green	Unlike to liquefy
Dark Green	Almost certain it will not liquefy

LPI color scheme

Red	Very high risk
Orange	High risk
Yellow	Low risk

Estimation of post-earthquake settlements



Abbreviations

- qc: Total cone resistance (cone resistance qc corrected for pore water effects)
- Ic: Soil Behaviour Type Index
- FS: Calculated Factor of Safety against liquefaction
- Volumetric strain: Post-liquefaction volumetric strain

LIQUEFACTION ANALYSIS REPORT

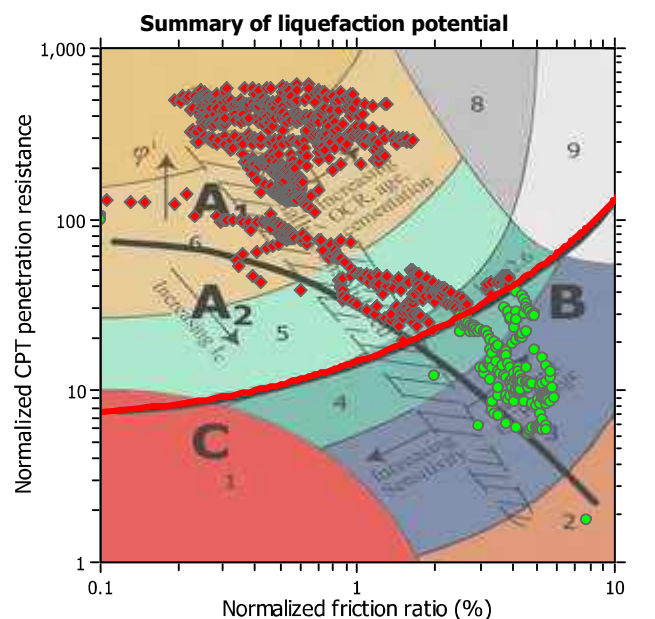
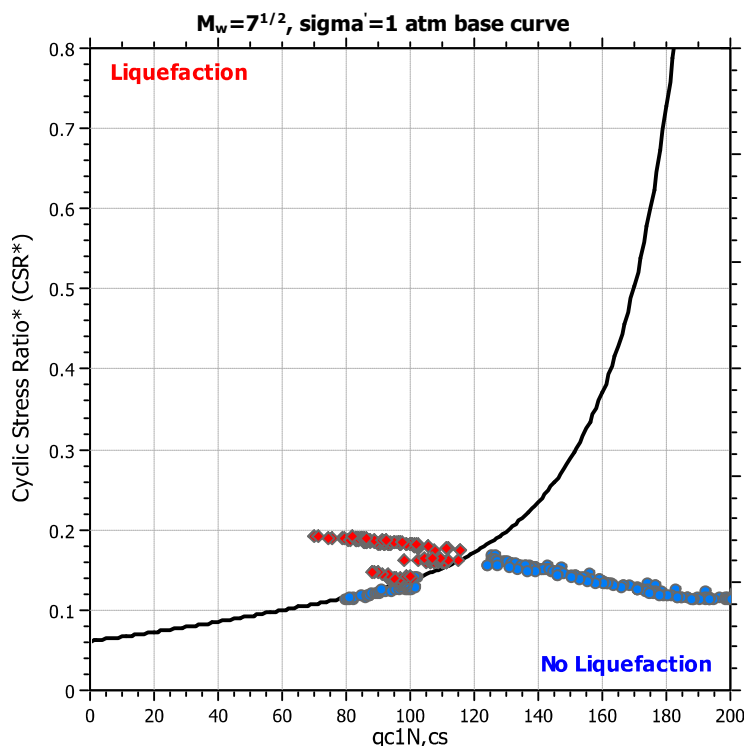
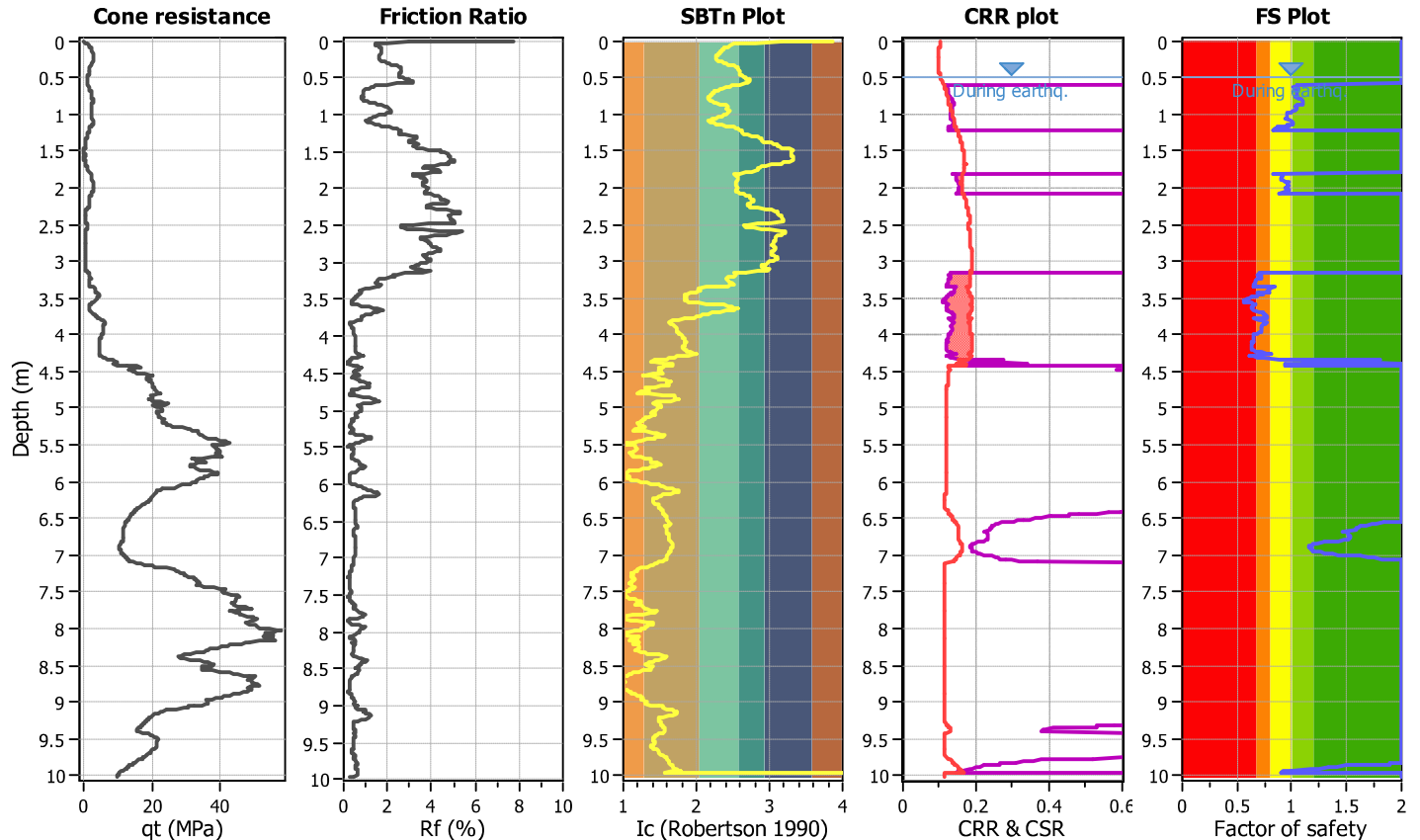
Project title : K200202

Location : 32 Nicholls Street

CPT file : CPT-01 SLS2

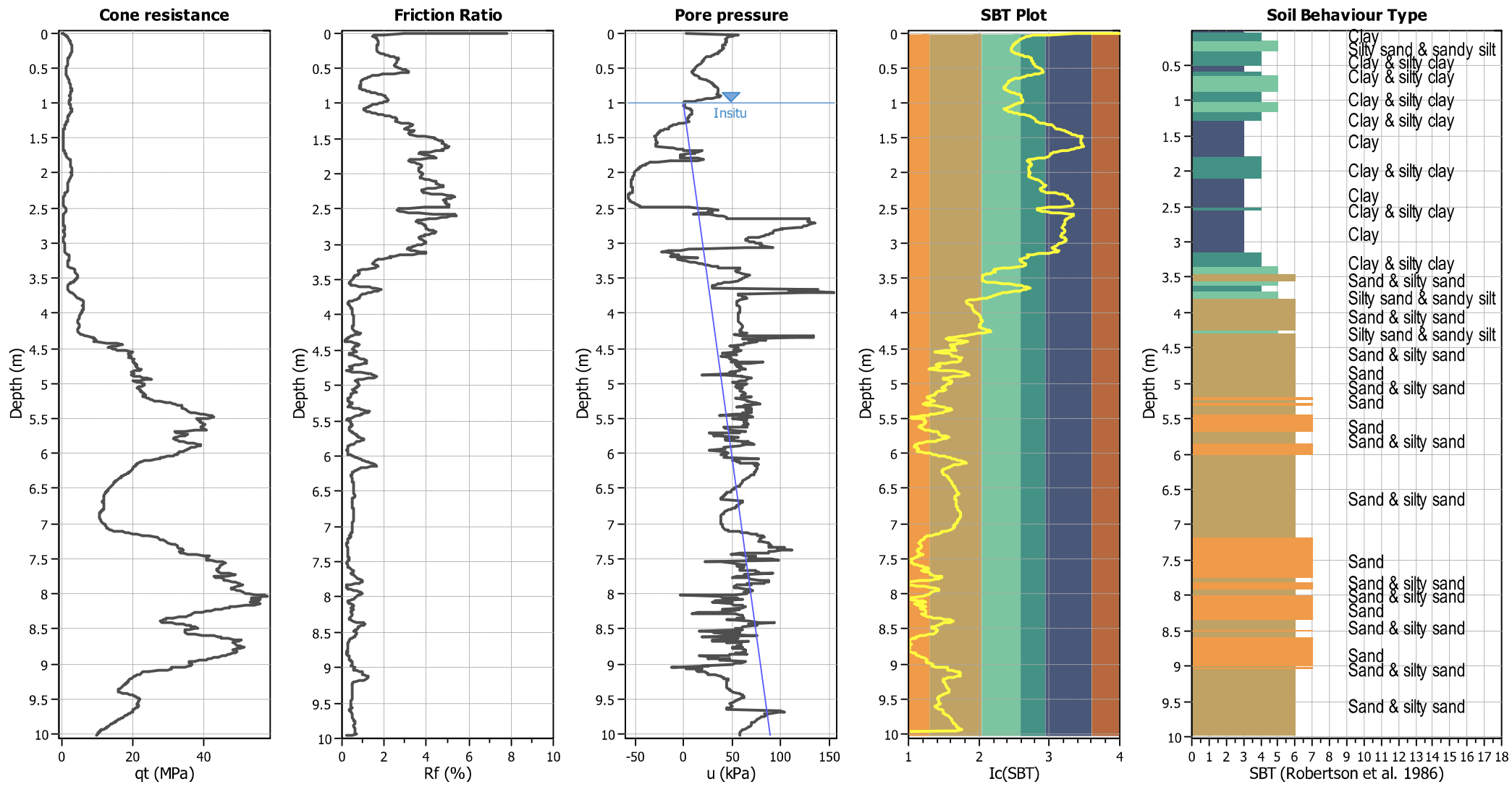
Input parameters and analysis data

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Fines correction method:	B&I (2014)	G.W.T. (earthq.):	0.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	MSF method:	N/A
Earthquake magnitude M_w :	6.00	Ic cut-off value:	2.60	Trans. detect. applied:	No		
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_g applied:	Yes		



Zone A₁: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A₂: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

CPT basic interpretation plots

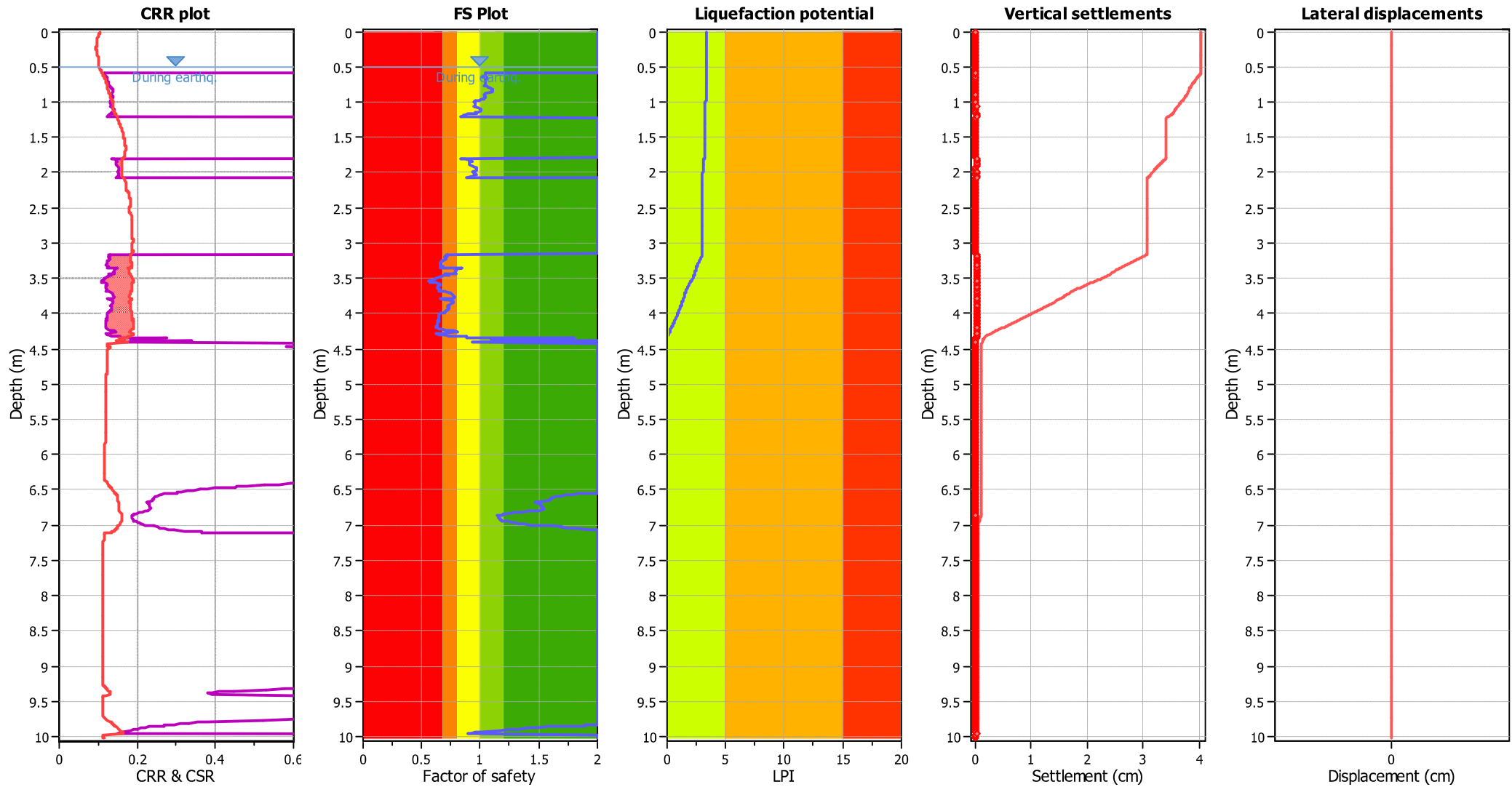


Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K ₀ applied:	Yes
Earthquake magnitude M _w :	6.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

SBT legend		
1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K _o applied:	Yes
Earthquake magnitude M _w :	6.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

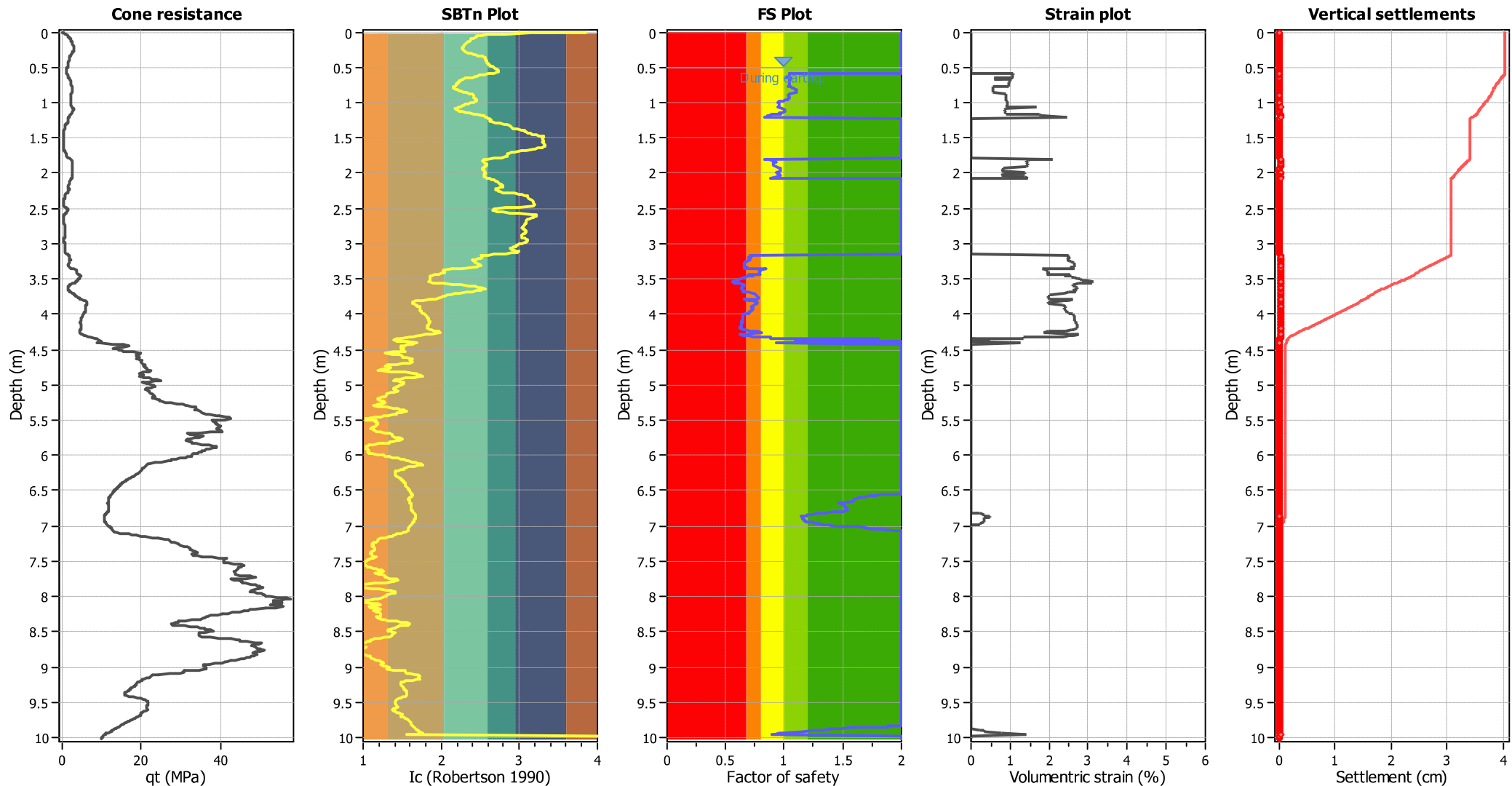
F.S. color scheme

Red	Almost certain it will liquefy
Orange	Very likely to liquefy
Yellow	Liquefaction and no liq. are equally likely
Green	Unlike to liquefy
Dark Green	Almost certain it will not liquefy

LPI color scheme

Red	Very high risk
Orange	High risk
Yellow	Low risk

Estimation of post-earthquake settlements



Abbreviations

- qc: Total cone resistance (cone resistance qc corrected for pore water effects)
- Ic: Soil Behaviour Type Index
- FS: Calculated Factor of Safety against liquefaction
- Volumetric strain: Post-liquefaction volumetric strain

LIQUEFACTION ANALYSIS REPORT

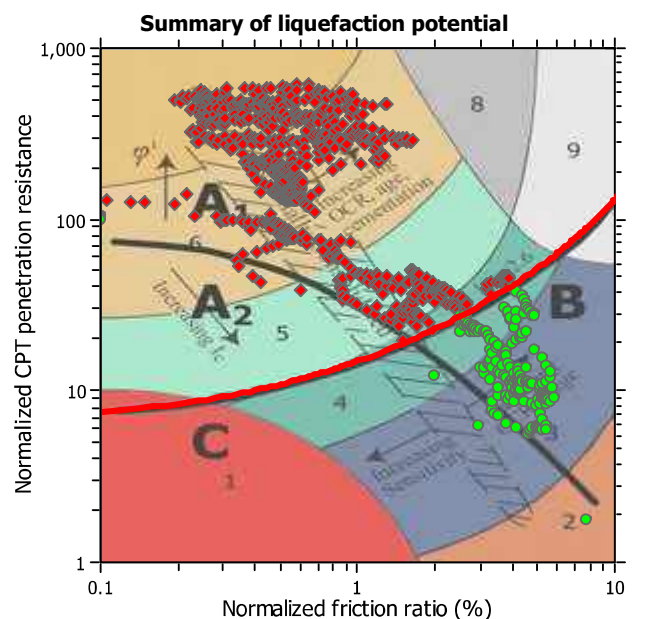
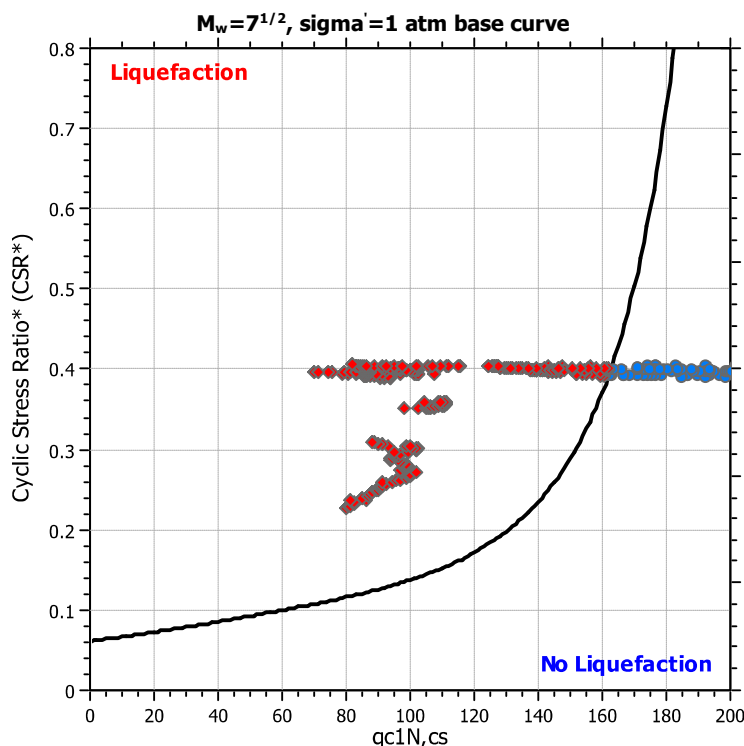
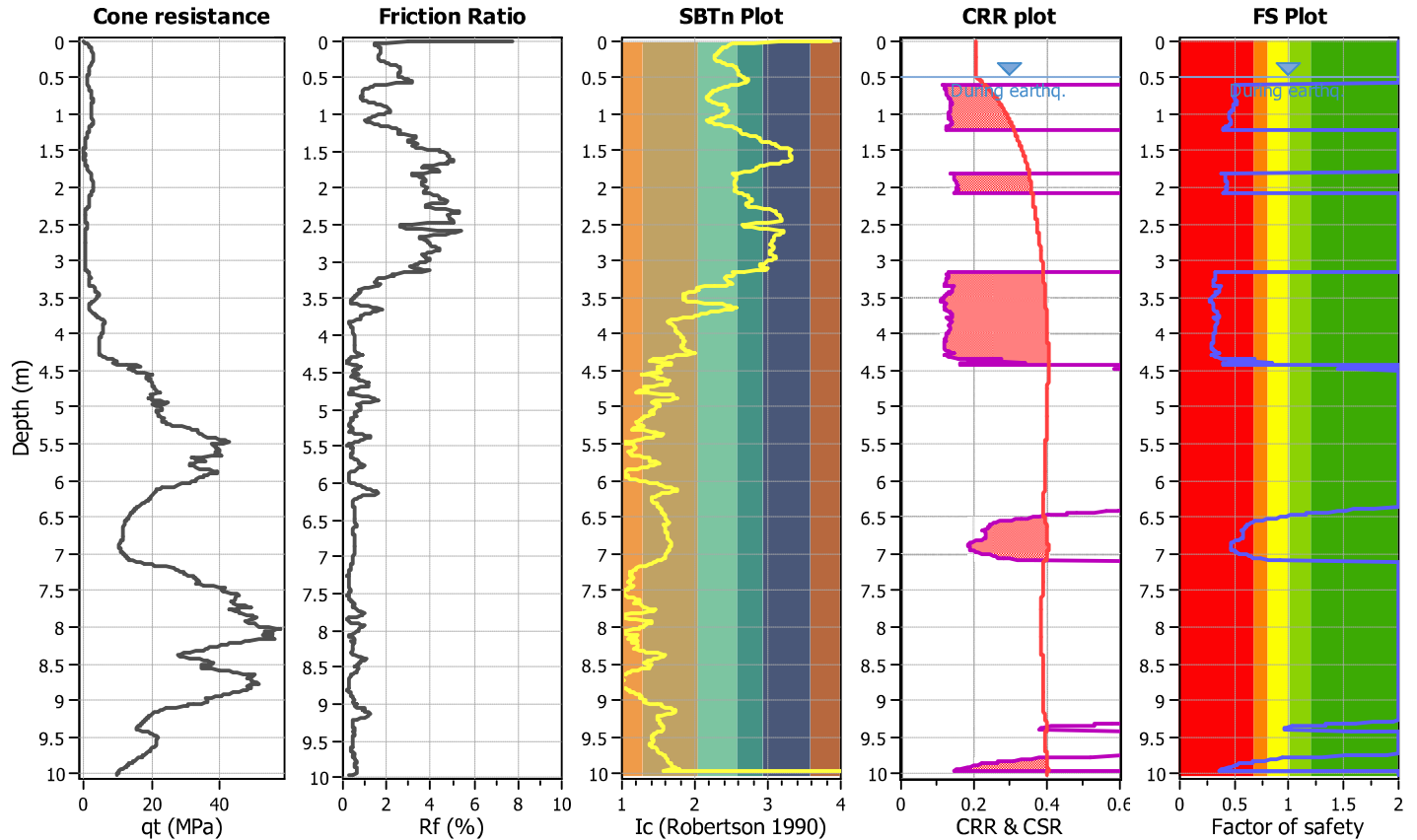
Project title : K200202

Location : 32 Nicholls Street

CPT file : CPT-01 ULS

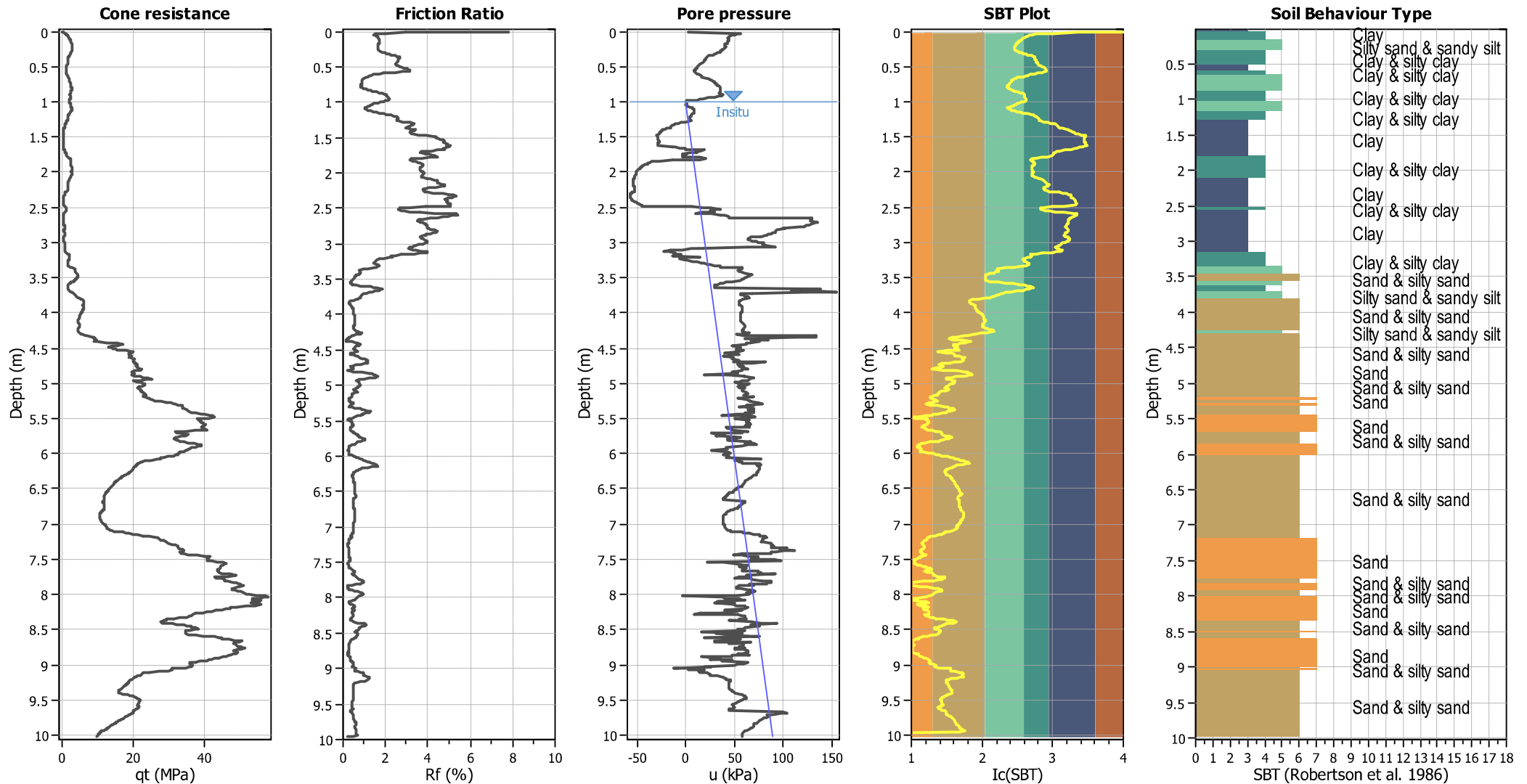
Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	0.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w :	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method
Peak ground acceleration:	0.35	Unit weight calculation:	Based on SBT	K_g applied:	Yes		



Zone A₁: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A₂: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

CPT basic interpretation plots



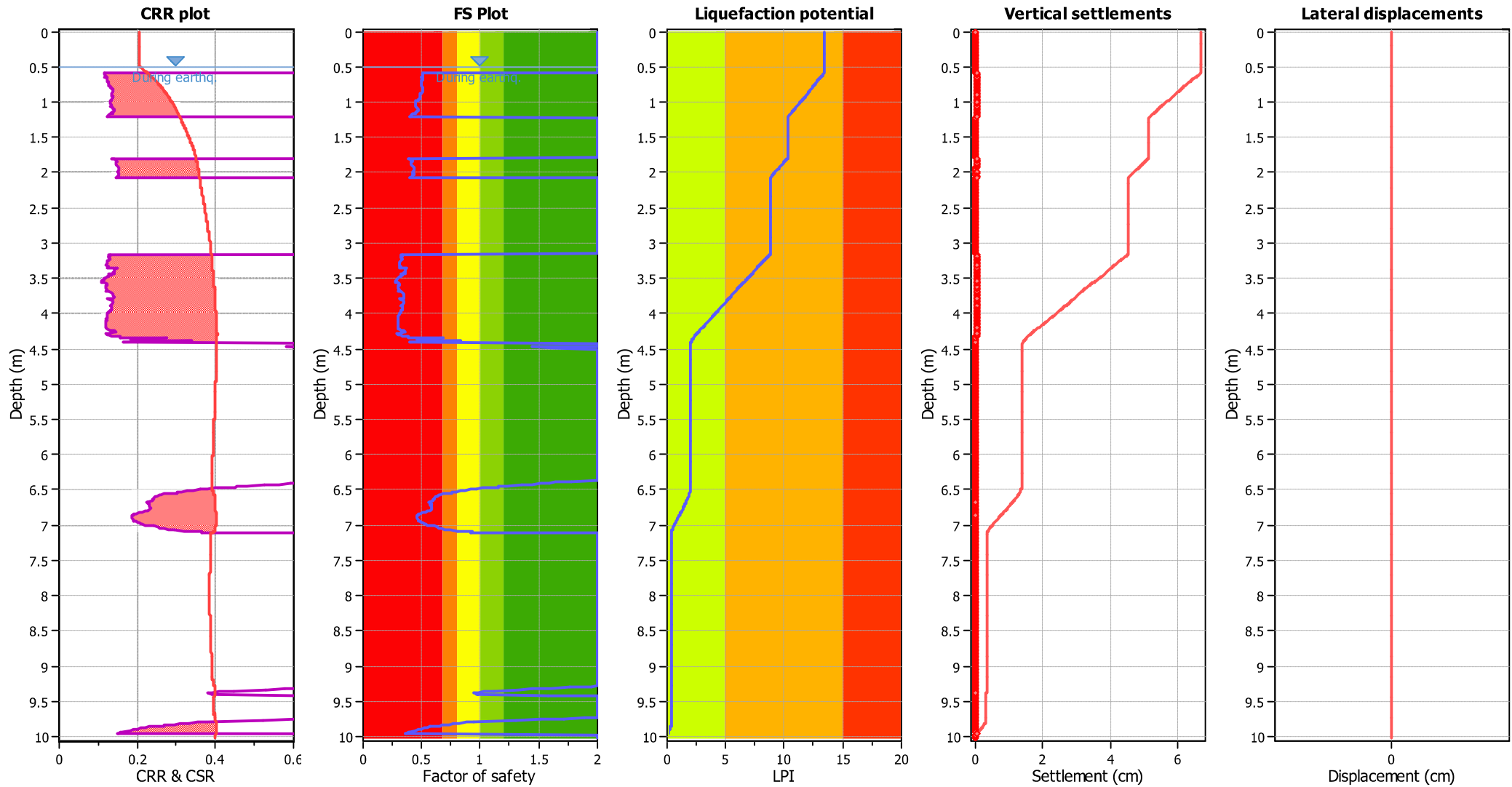
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Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on I_c value	I_c cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w :	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

SBT legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (earthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K ₀ applied:	Yes
Earthquake magnitude M _w :	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

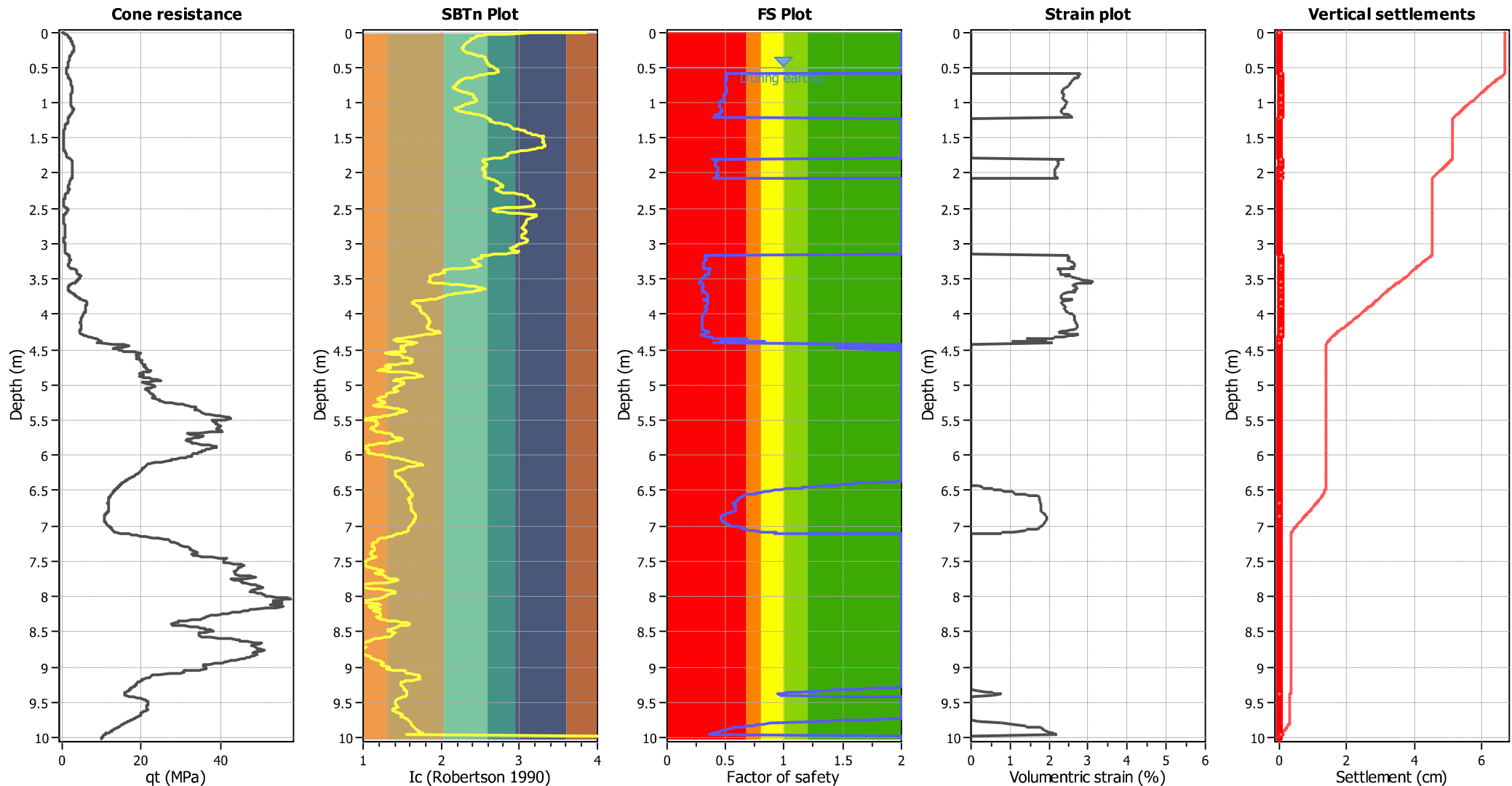
F.S. color scheme

Red	Almost certain it will liquefy
Orange	Very likely to liquefy
Yellow	Liquefaction and no liq. are equally likely
Green	Unlike to liquefy
Dark Green	Almost certain it will not liquefy

LPI color scheme

Red	Very high risk
Orange	High risk
Yellow	Low risk

Estimation of post-earthquake settlements



Abbreviations

- q_t : Total cone resistance (cone resistance q_c corrected for pore water effects)
- I_c : Soil Behaviour Type Index
- FS: Calculated Factor of Safety against liquefaction
- Volumetric strain: Post-liquefaction volumetric strain

LIQUEFACTION ANALYSIS REPORT

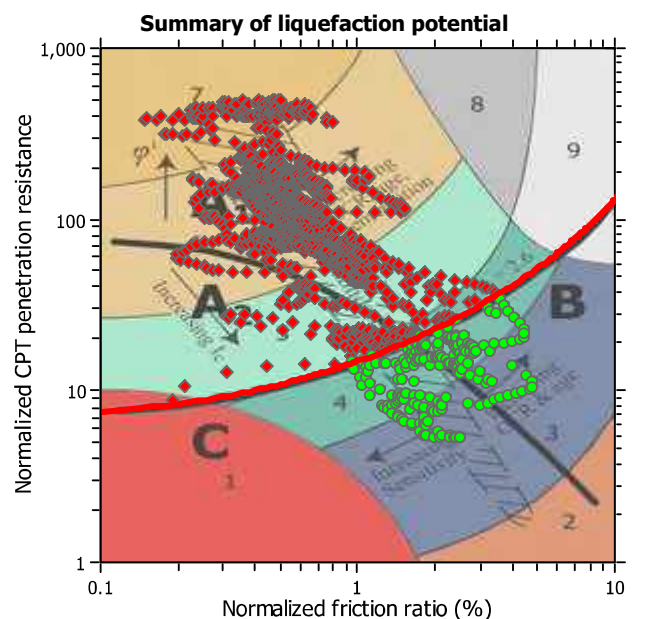
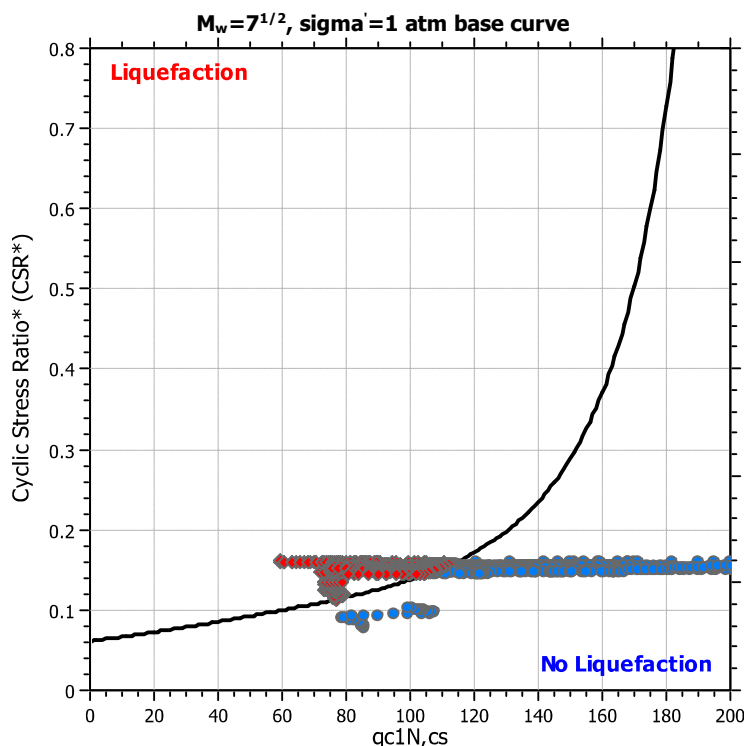
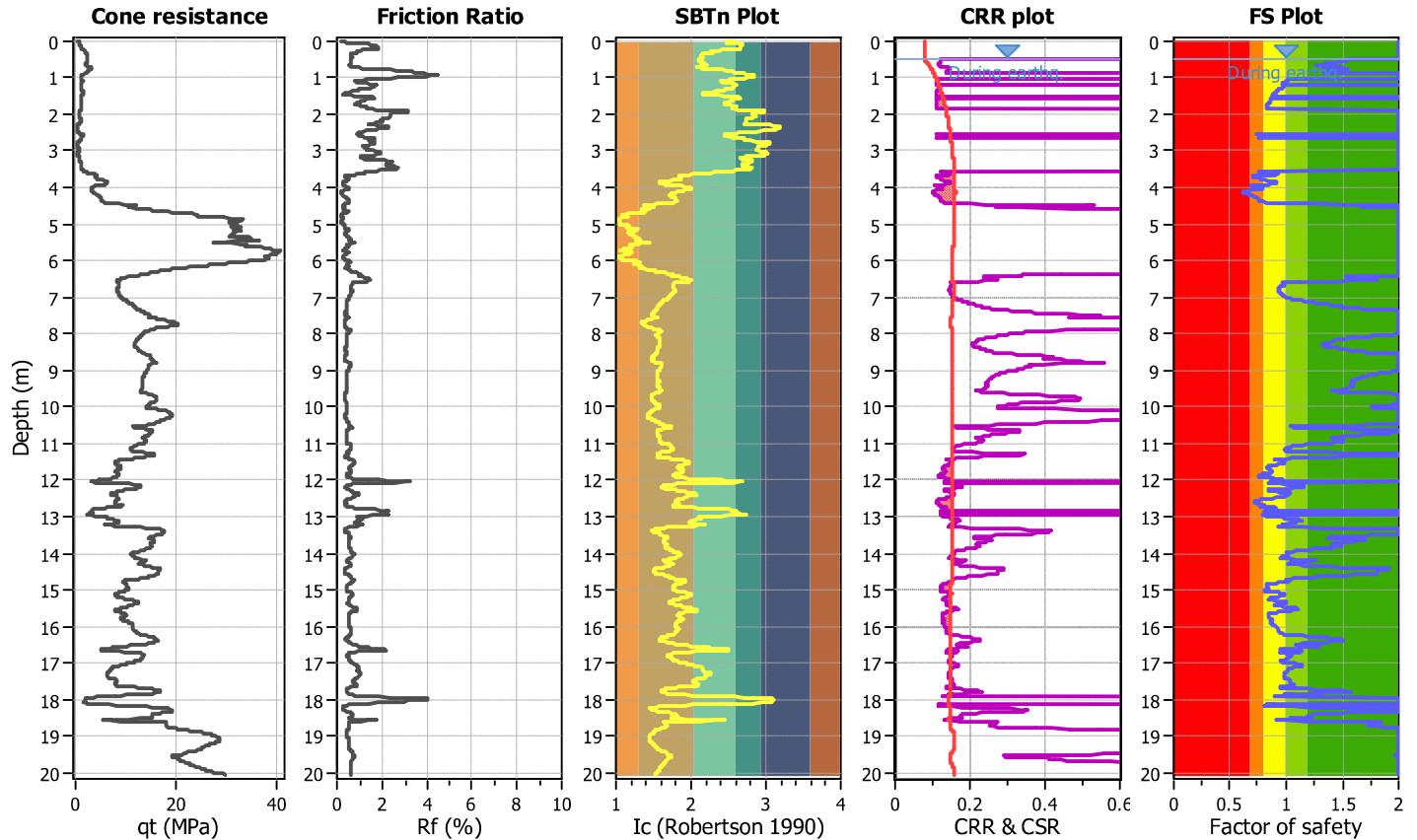
Project title : K200202

Location : 32 Nicholls Street

CPT file : CPT_4452 SLS1

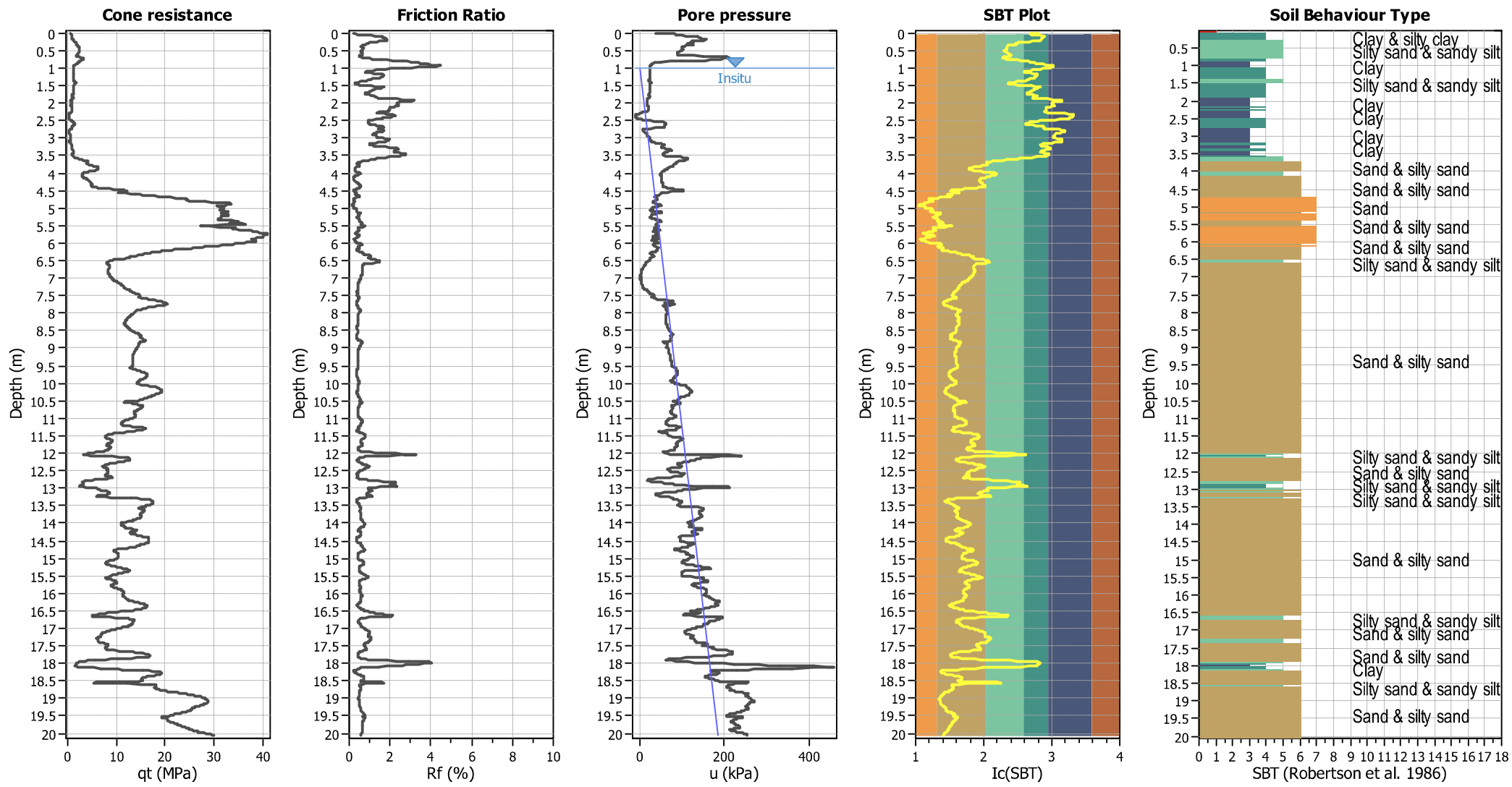
Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	0.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w :	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method
Peak ground acceleration:	0.13	Unit weight calculation:	Based on SBT	K_g applied:	Yes		



Zone A₁: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A₂: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

CPT basic interpretation plots



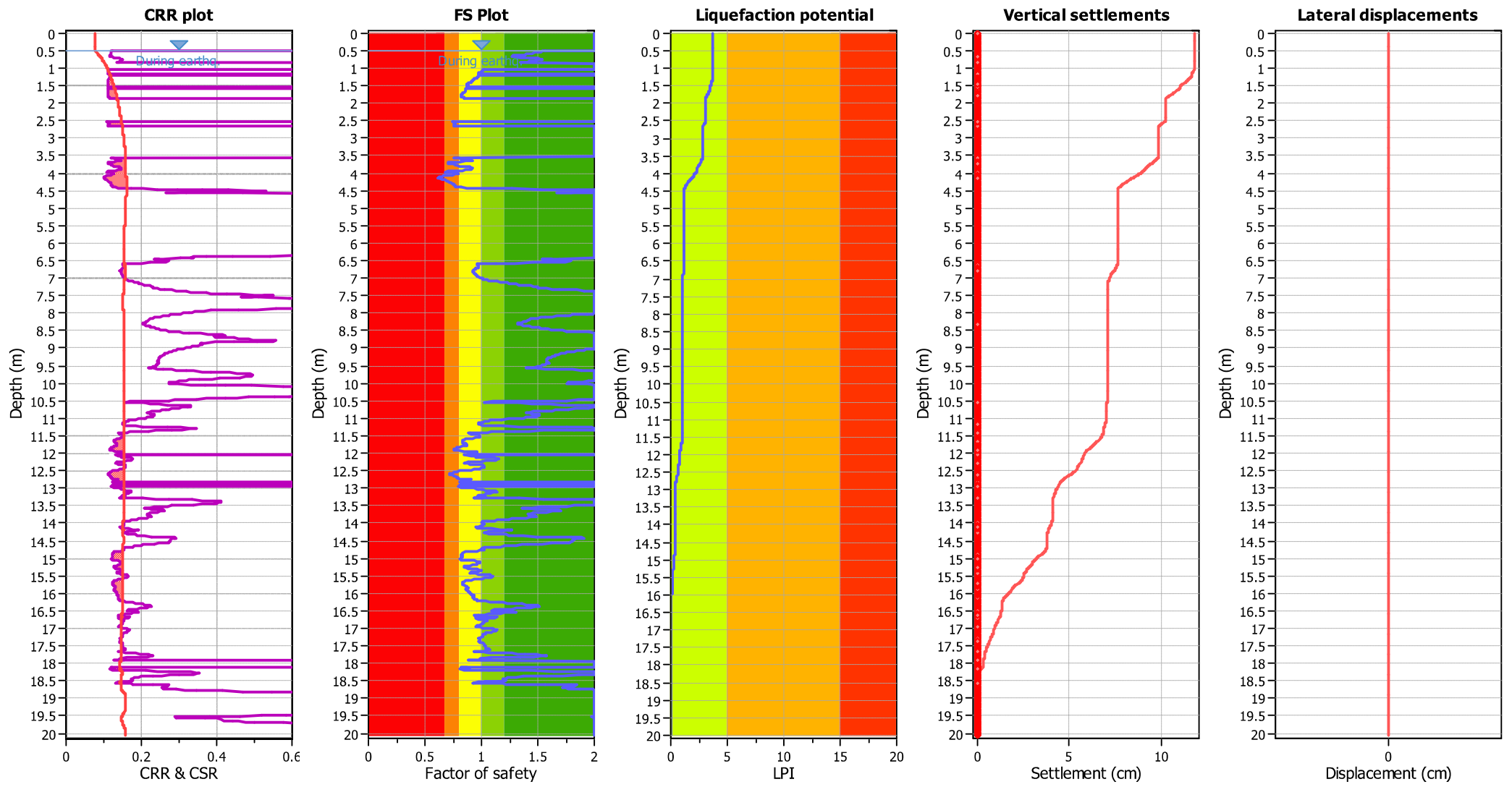
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K _g applied:	Yes
Earthquake magnitude M _w :	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

SBT legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (earthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K _s applied:	Yes
Earthquake magnitude M _w :	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

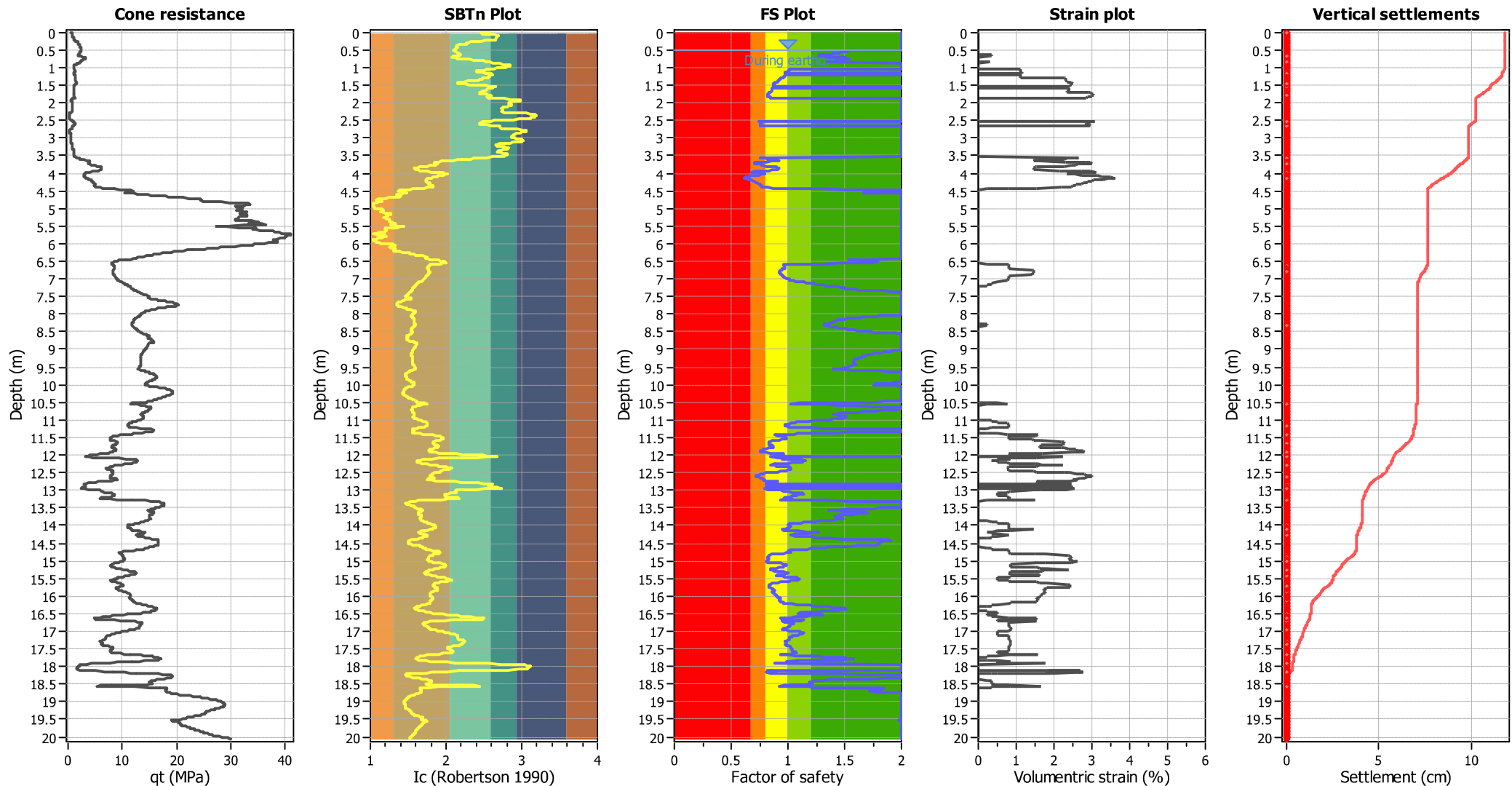
F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

Estimation of post-earthquake settlements



Abbreviations

- q_c: Total cone resistance (cone resistance q_c corrected for pore water effects)
- I_c: Soil Behaviour Type Index
- FS: Calculated Factor of Safety against liquefaction
- Volumetric strain: Post-liquefaction volumetric strain

LIQUEFACTION ANALYSIS REPORT

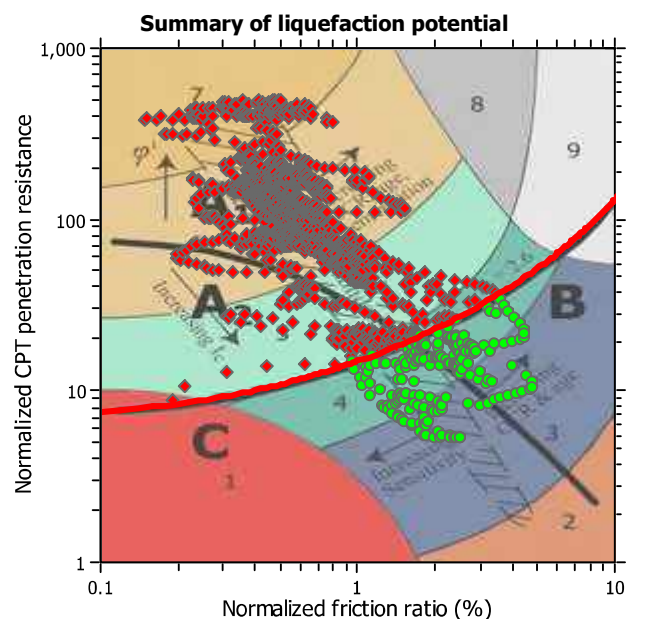
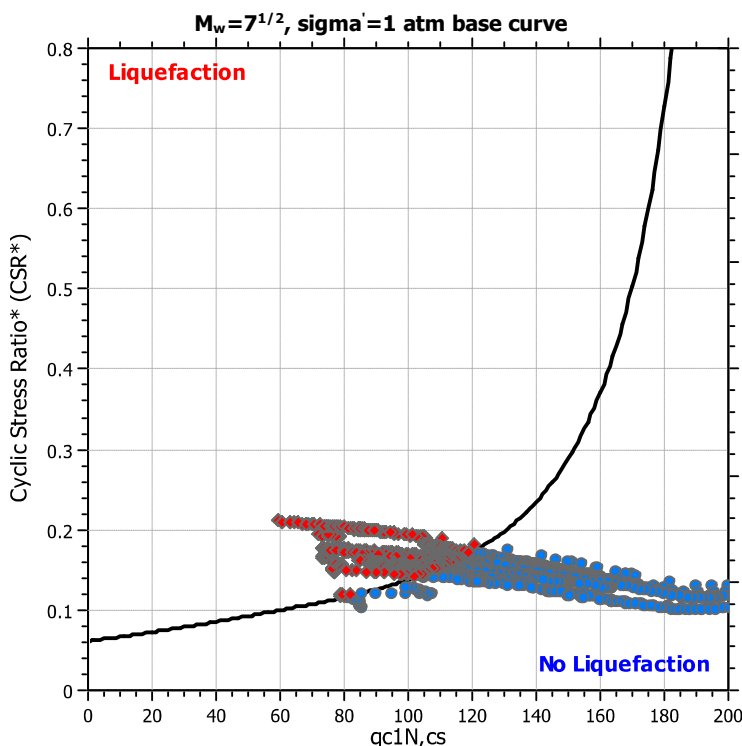
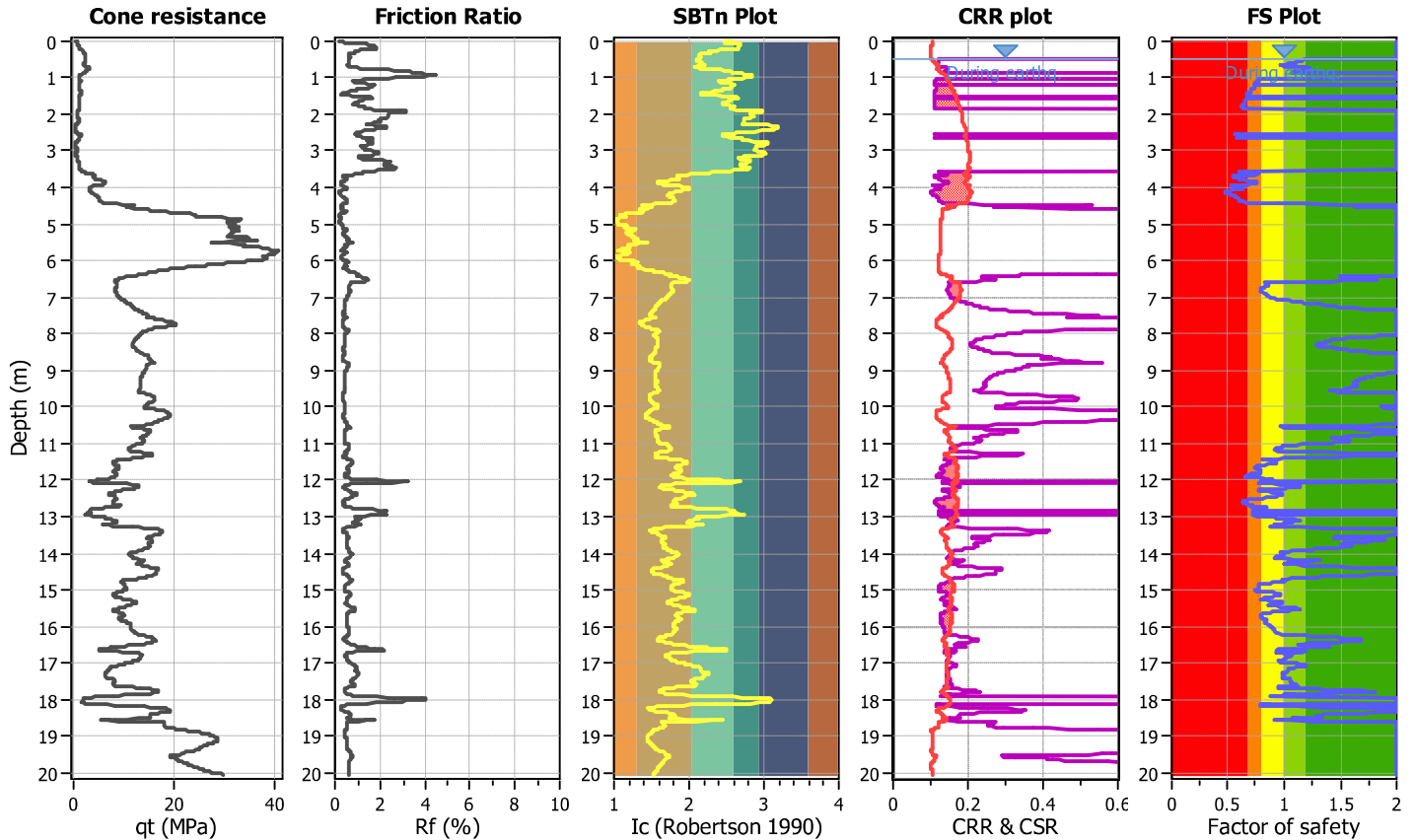
Project title : K200202

Location : 32 Nicholls Street

CPT file : CPT_4452 SLS2

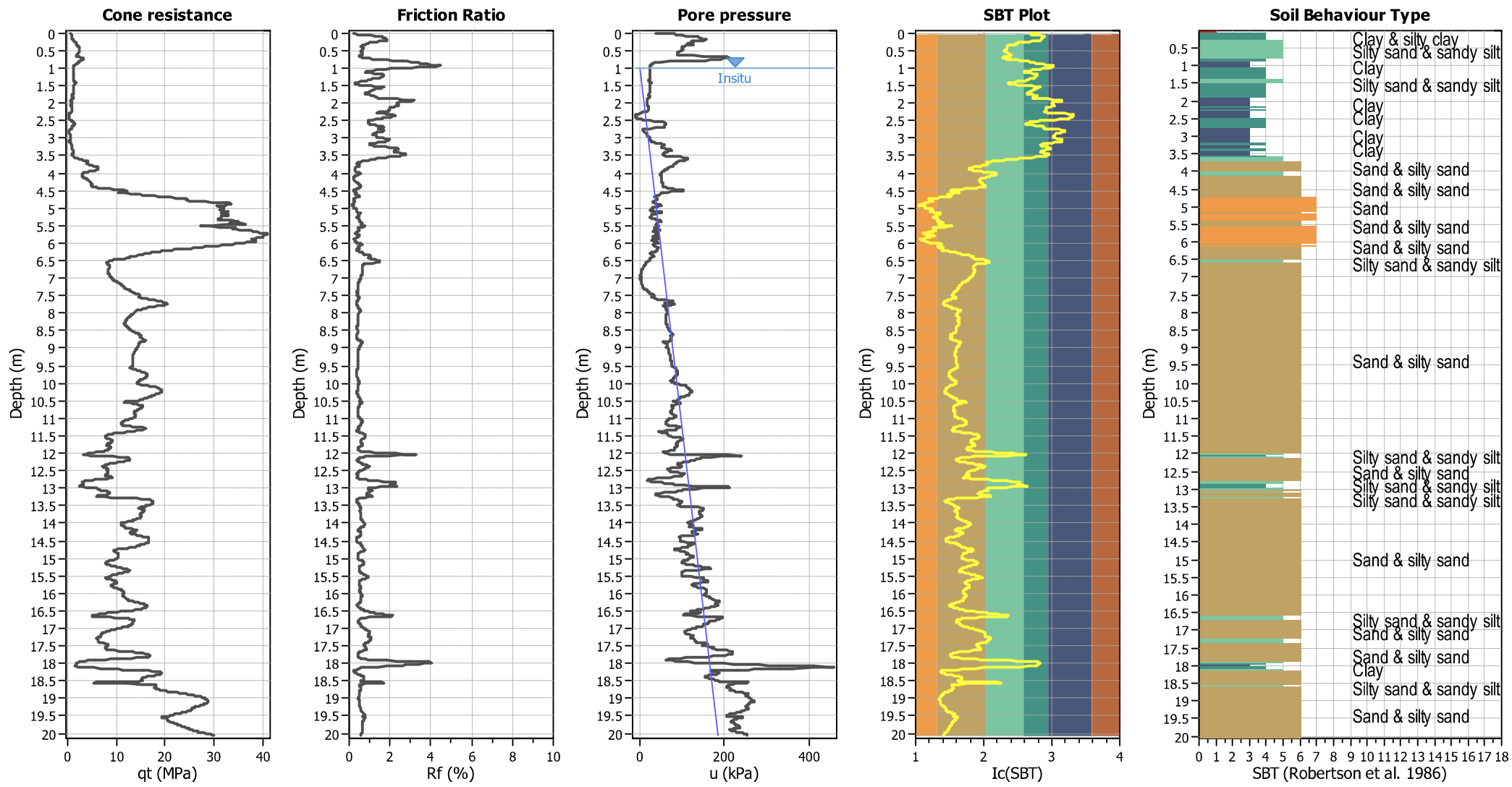
Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	0.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w :	6.00	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_g applied:	Yes		



Zone A₁: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A₂: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
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Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

CPT basic interpretation plots



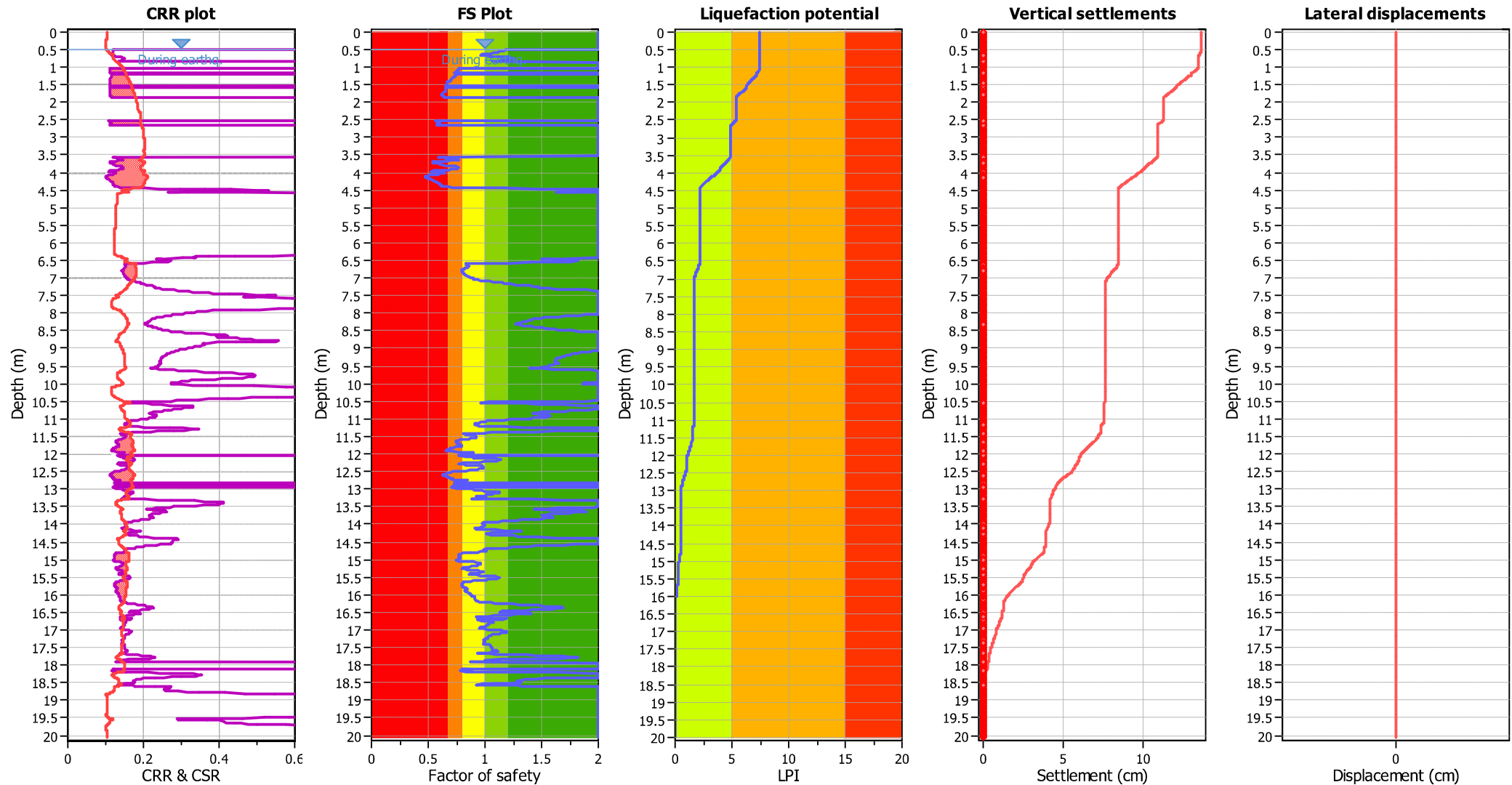
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K _g applied:	Yes
Earthquake magnitude M _w :	6.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

SBT legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_p applied:	Yes
Earthquake magnitude M_w :	6.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

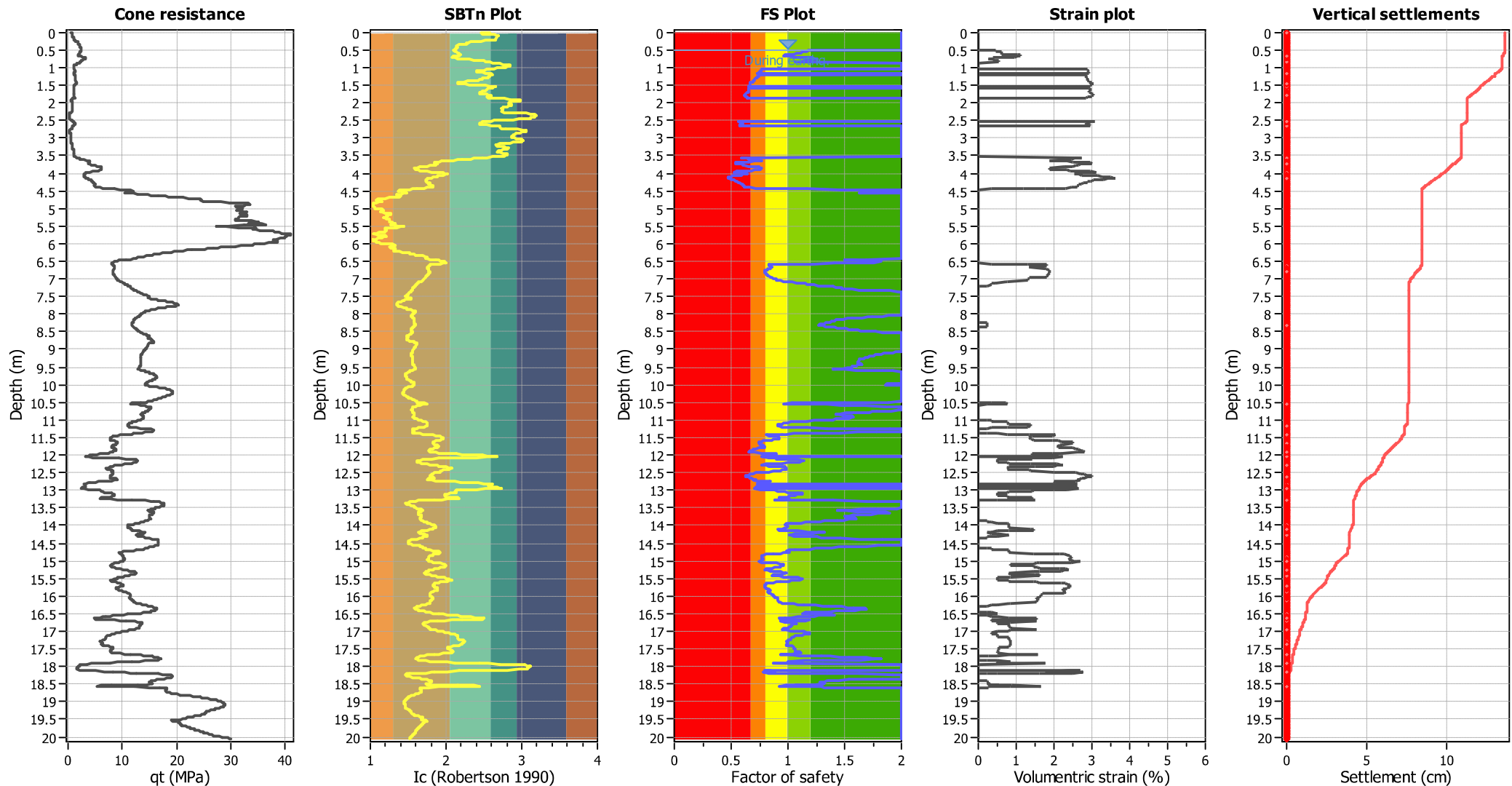
F.S. color scheme

■	Almost certain it will liquefy
■	Very likely to liquefy
■	Liquefaction and no liq. are equally likely
■	Unlike to liquefy
■	Almost certain it will not liquefy

LPI color scheme

■	Very high risk
■	High risk
■	Low risk

Estimation of post-earthquake settlements



Abbreviations

- qc: Total cone resistance (cone resistance qc corrected for pore water effects)
- Ic: Soil Behaviour Type Index
- FS: Calculated Factor of Safety against liquefaction
- Volumetric strain: Post-liquefaction volumetric strain

LIQUEFACTION ANALYSIS REPORT

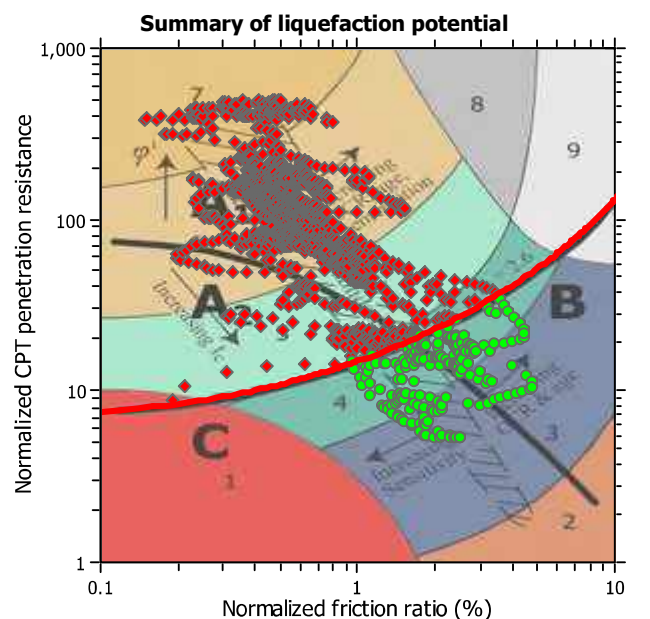
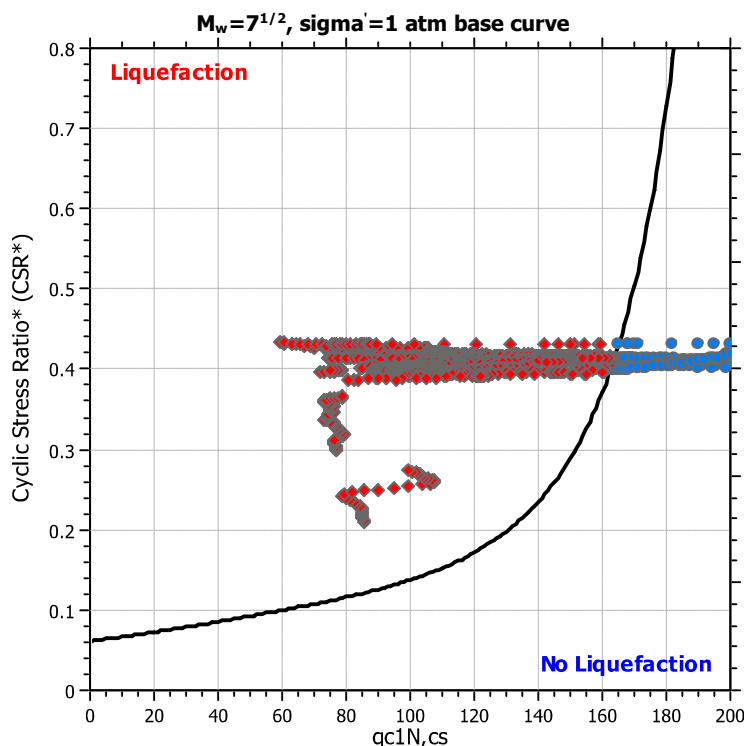
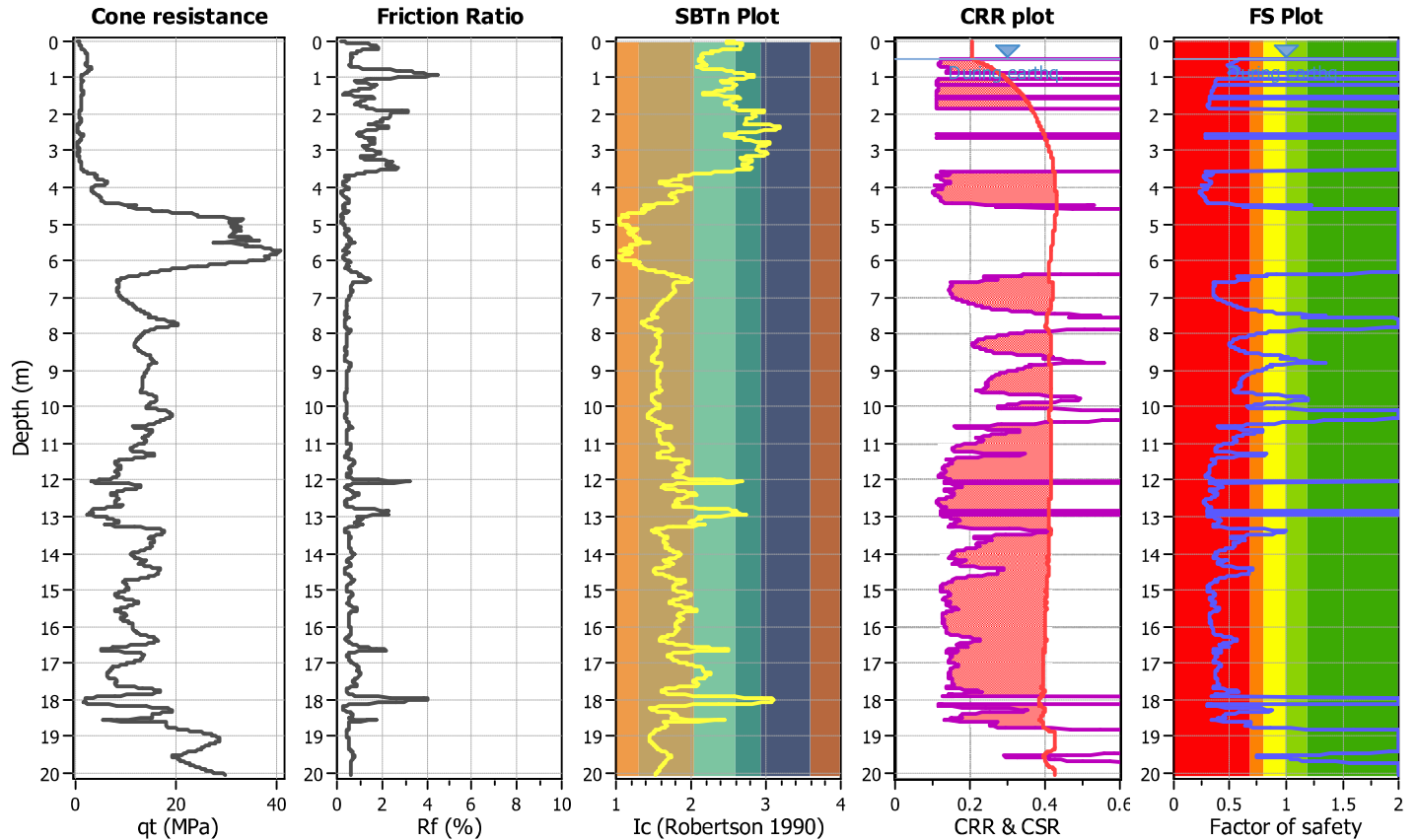
Project title : K200202

Location : 32 Nicholls Street

CPT file : CPT_4452 ULS

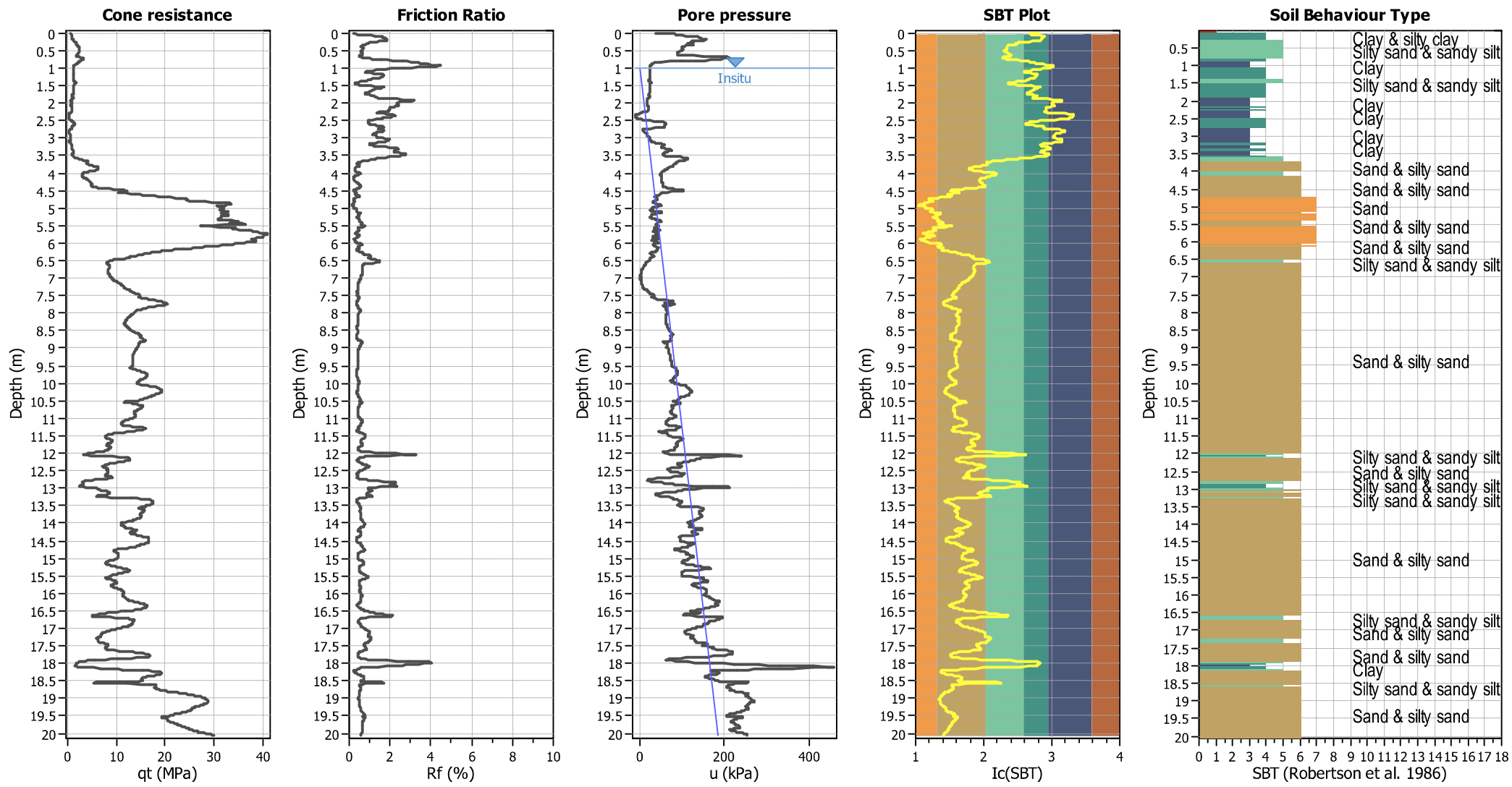
Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	0.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w :	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method
Peak ground acceleration:	0.35	Unit weight calculation:	Based on SBT	K_g applied:	Yes		



Zone A₁: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A₂: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

CPT basic interpretation plots

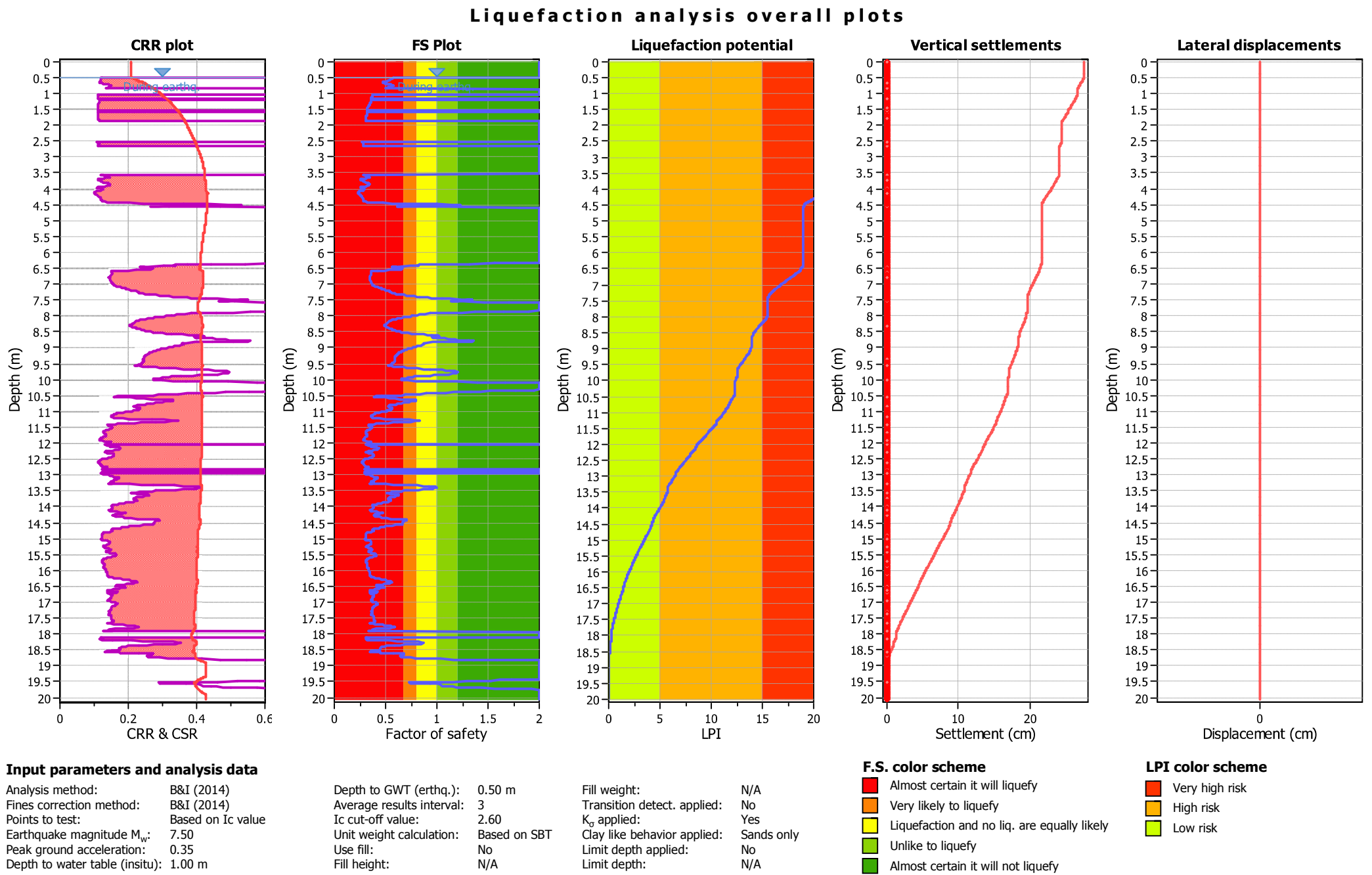


Input parameters and analysis data

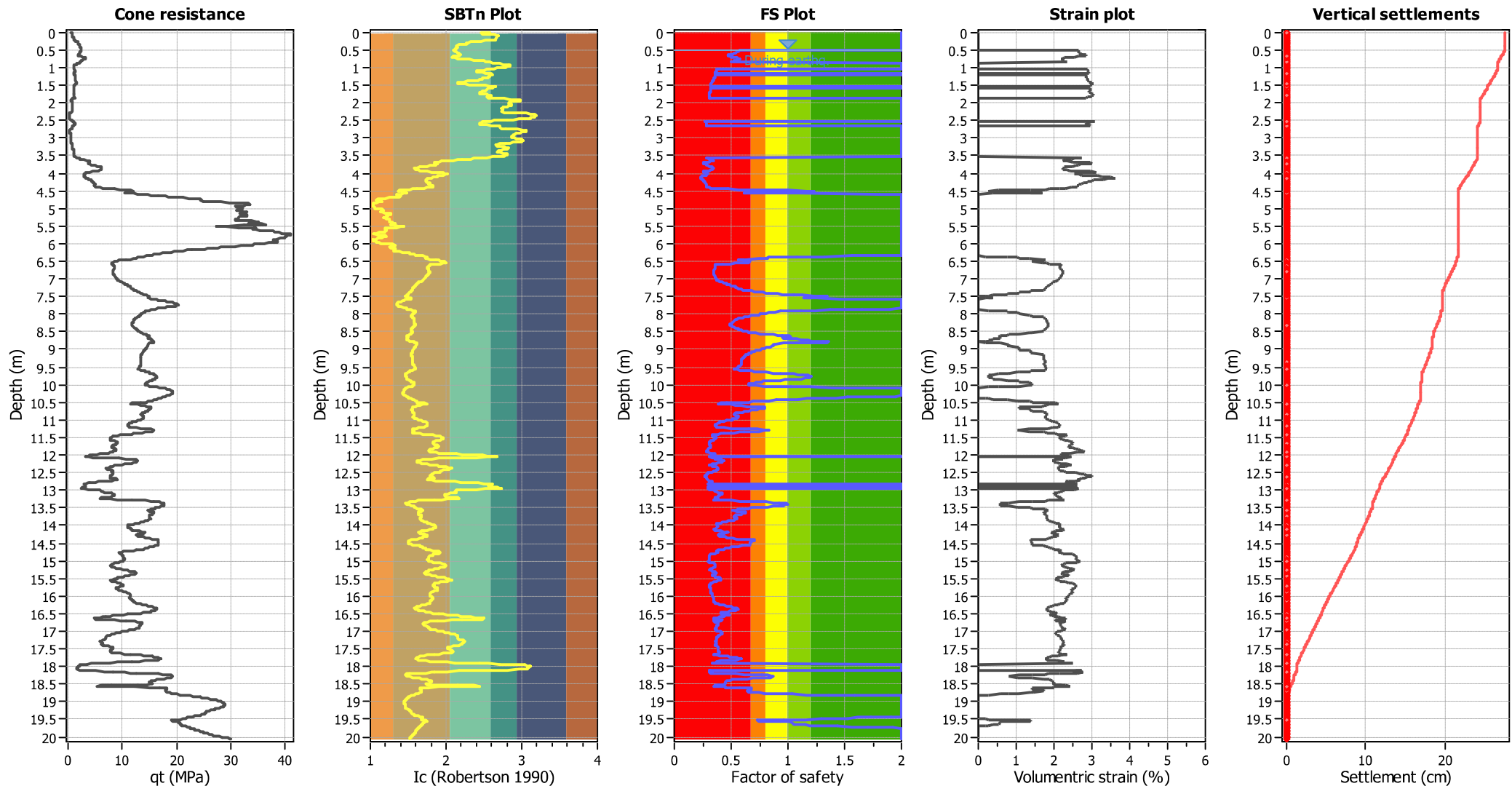
Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K _g applied:	Yes
Earthquake magnitude M _w :	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

SBT legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained



Estimation of post-earthquake settlements



Abbreviations

- qc: Total cone resistance (cone resistance qc corrected for pore water effects)
- Ic: Soil Behaviour Type Index
- FS: Calculated Factor of Safety against liquefaction
- Volumetric strain: Post-liquefaction volumetric strain

LIQUEFACTION ANALYSIS REPORT

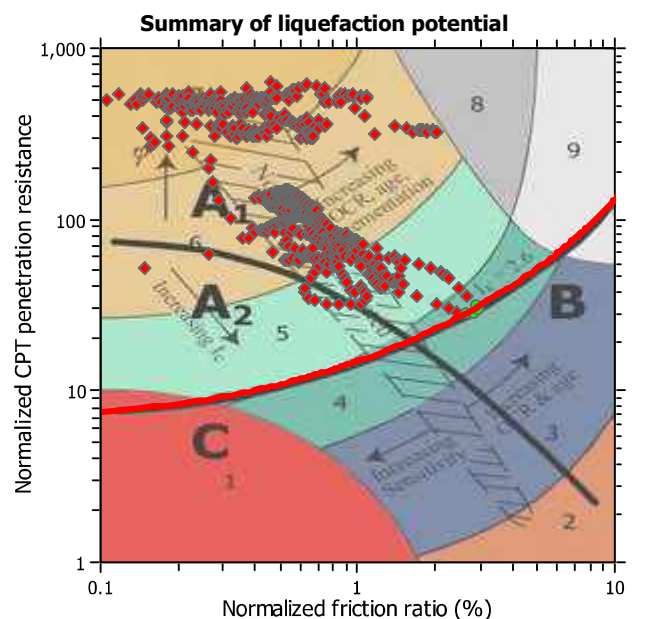
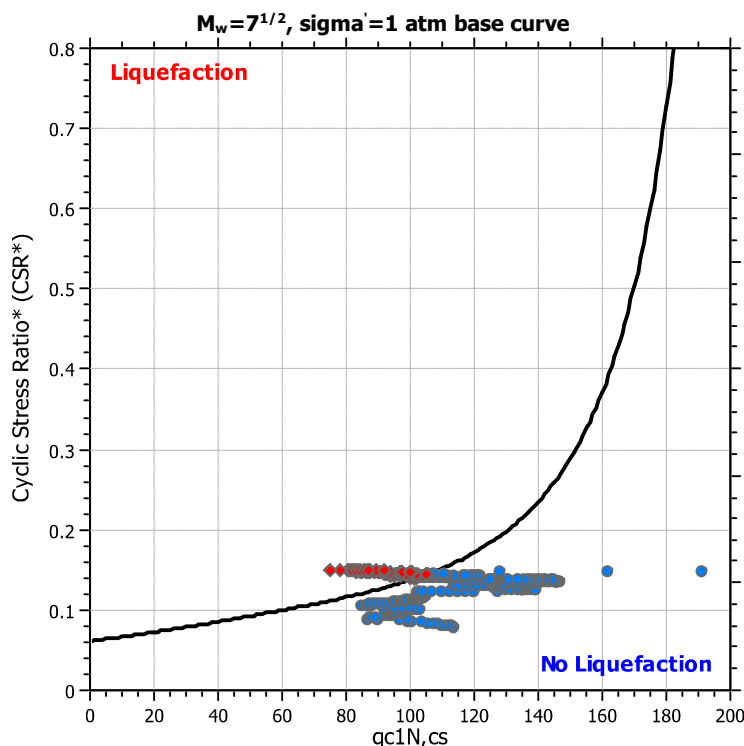
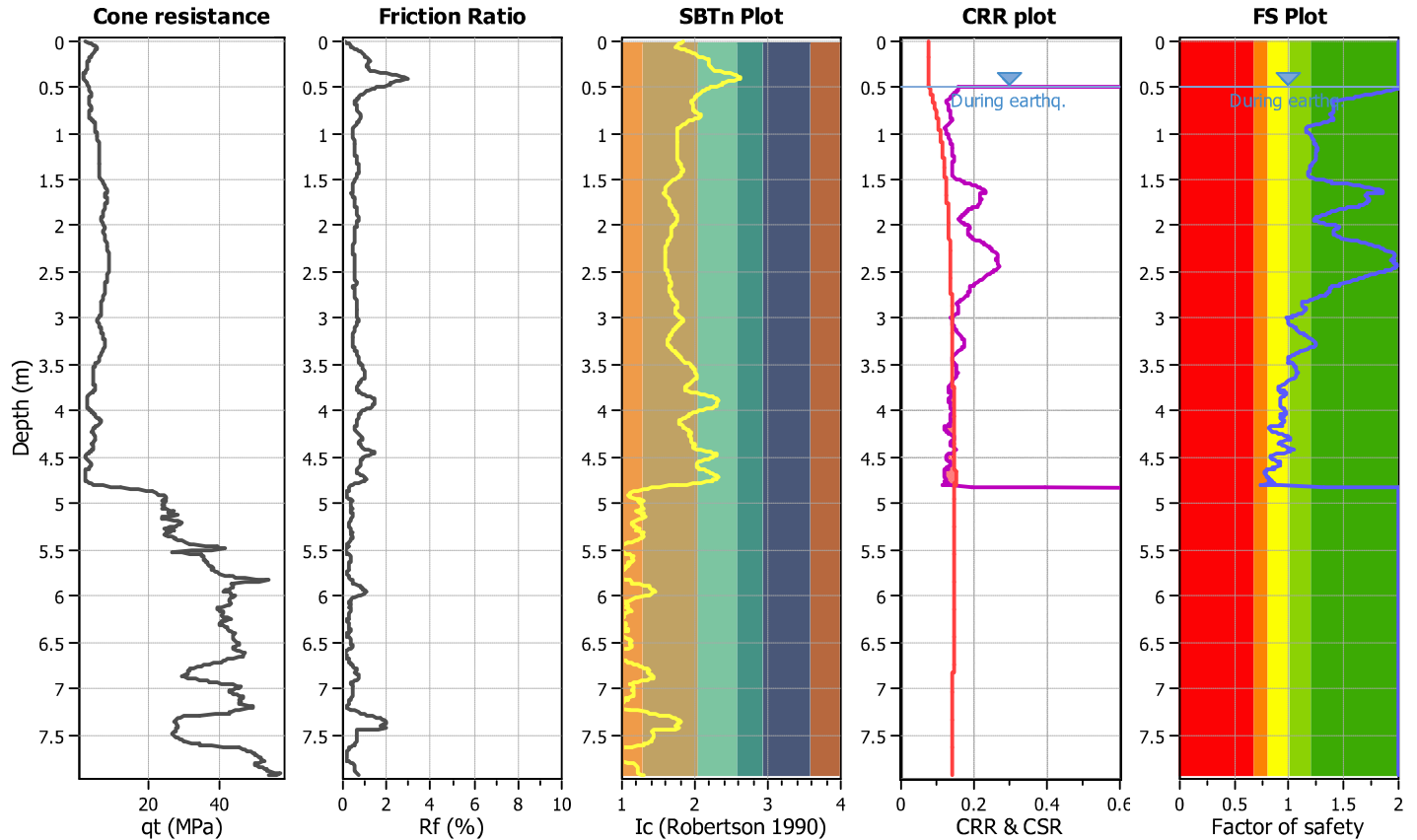
Project title : K200202

Location : 32 Nicholls Street

CPT file : CPT_36965 SLS1

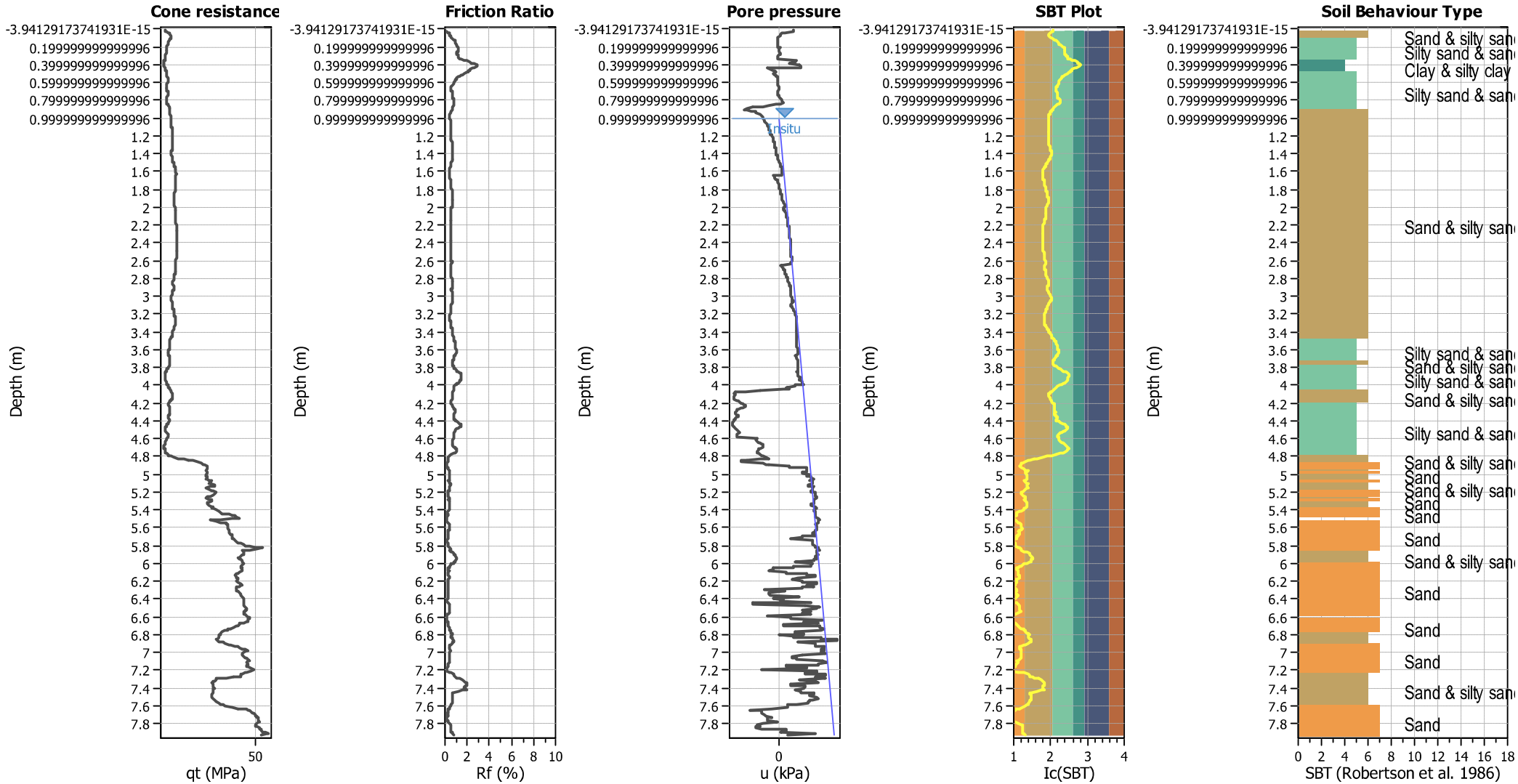
Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	0.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w :	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method
Peak ground acceleration:	0.13	Unit weight calculation:	Based on SBT	K_g applied:	Yes		



Zone A₁: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A₂: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
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Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

CPT basic interpretation plots

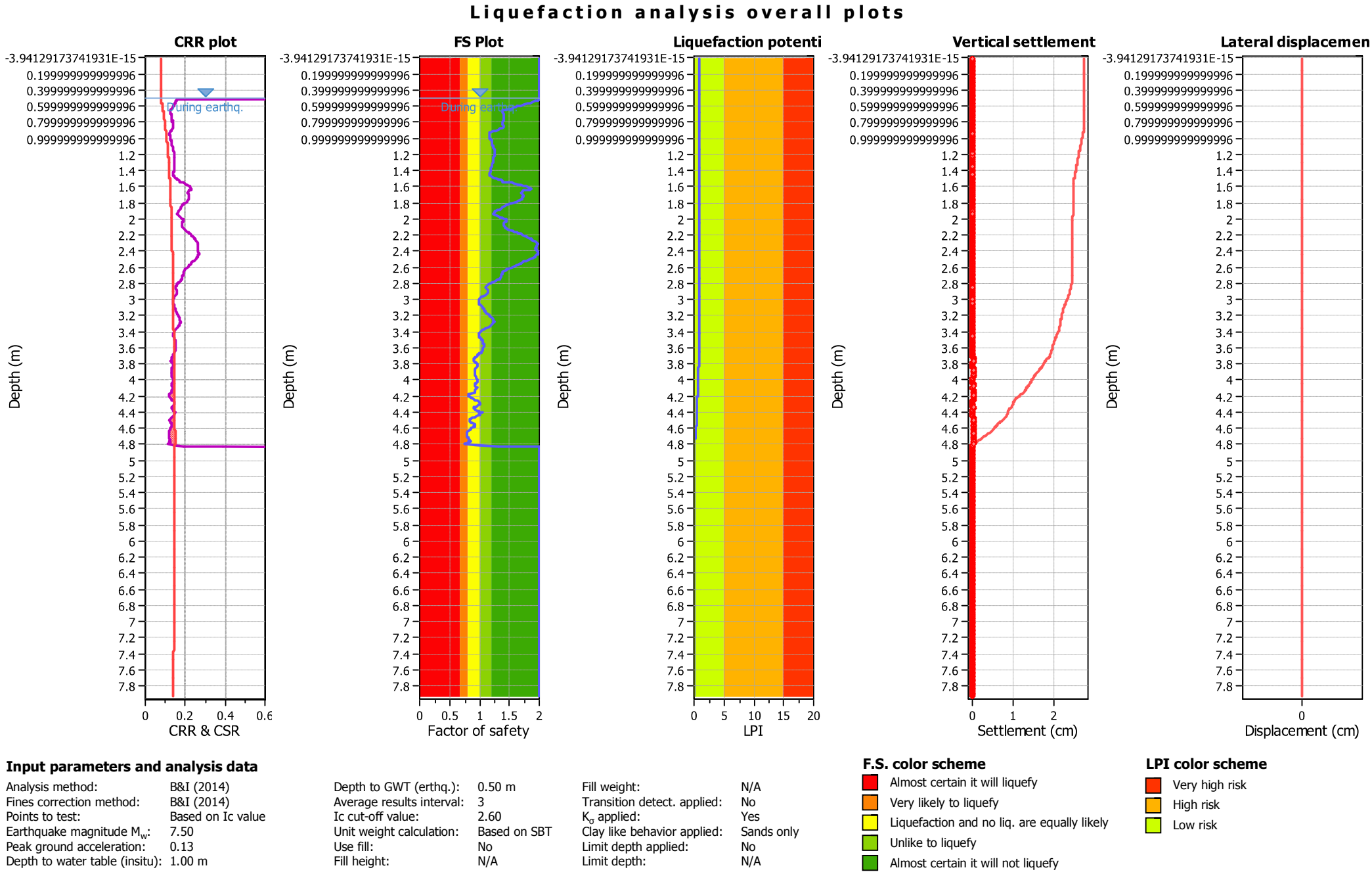


Input parameters and analysis data

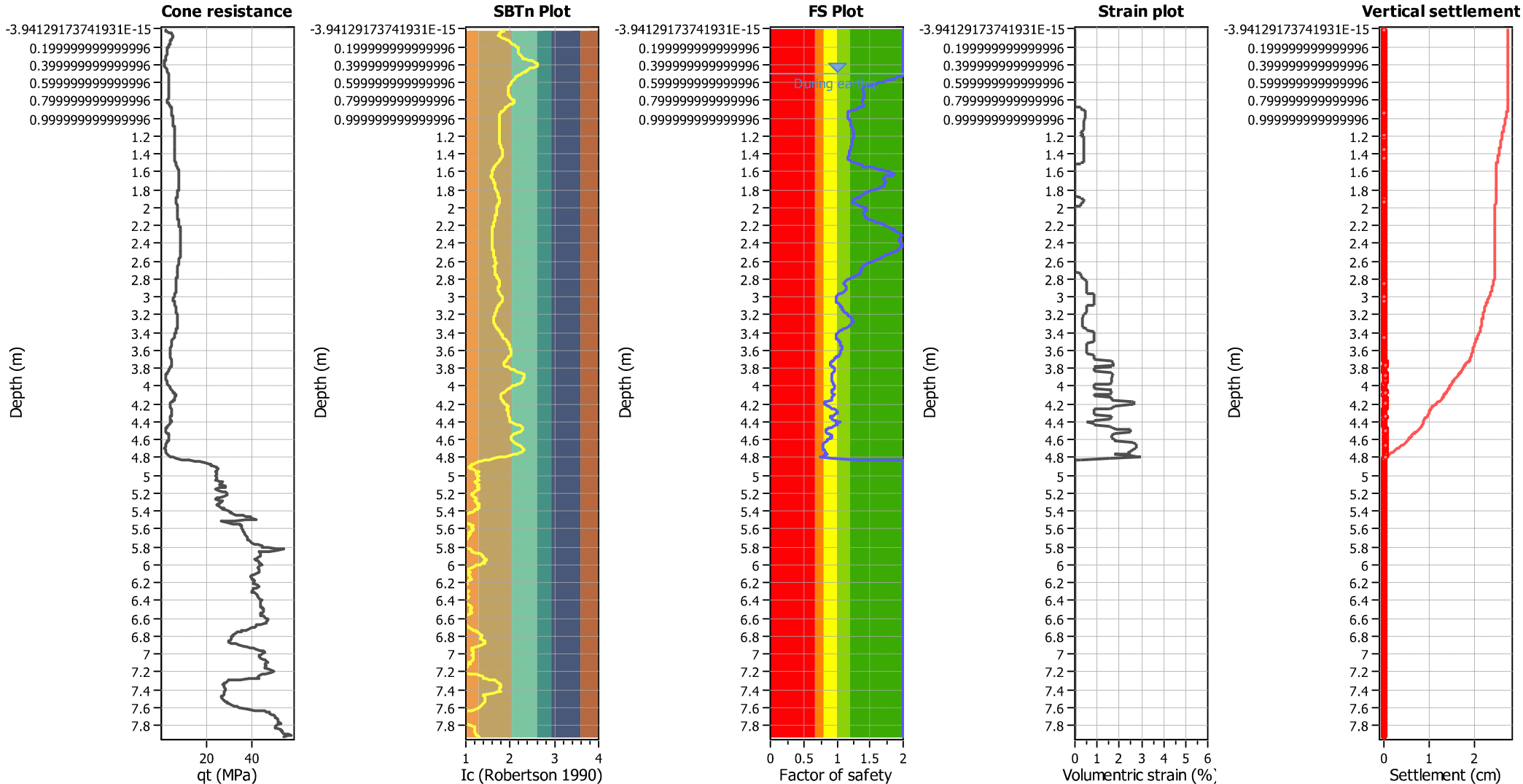
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Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K ₀ applied:	Yes
Earthquake magnitude M _w :	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

SBT legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
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3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained



Estimation of post-earthquake settlements



Abbreviations

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- I_c: Soil Behaviour Type Index
- FS: Calculated Factor of Safety against liquefaction
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LIQUEFACTION ANALYSIS REPORT

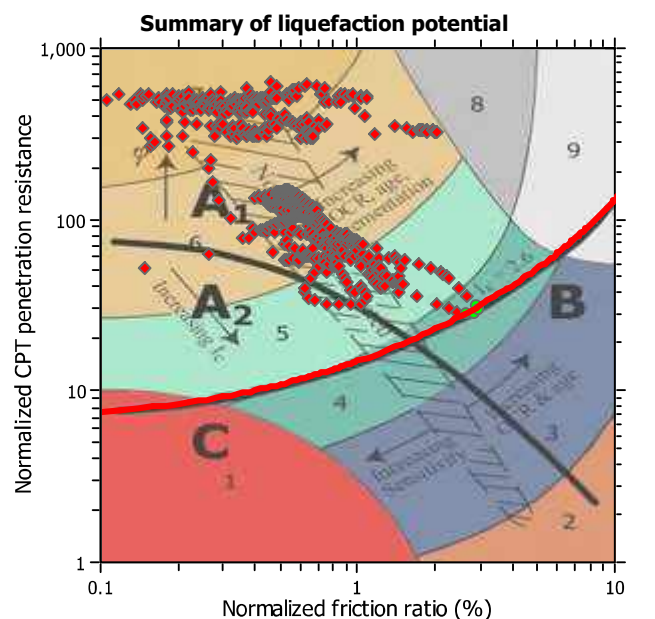
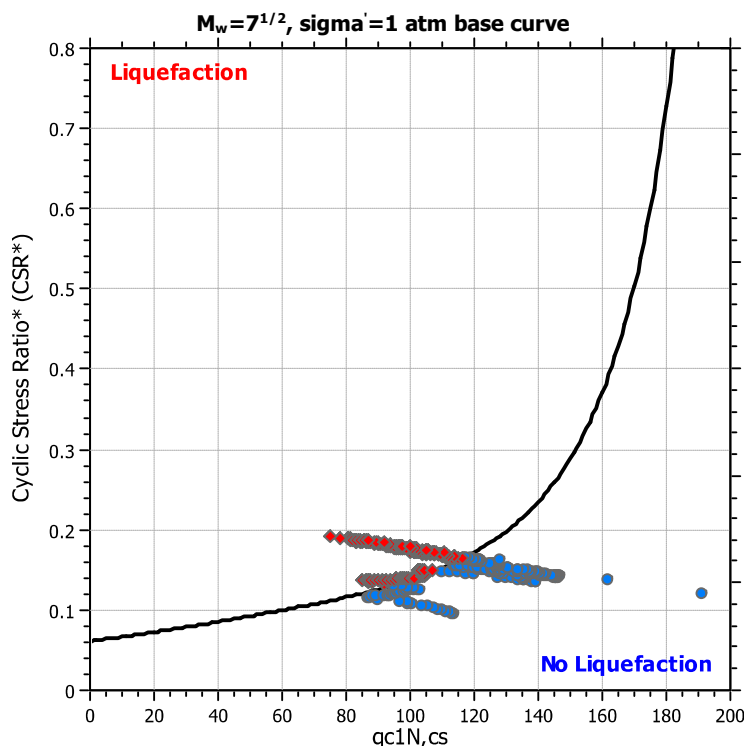
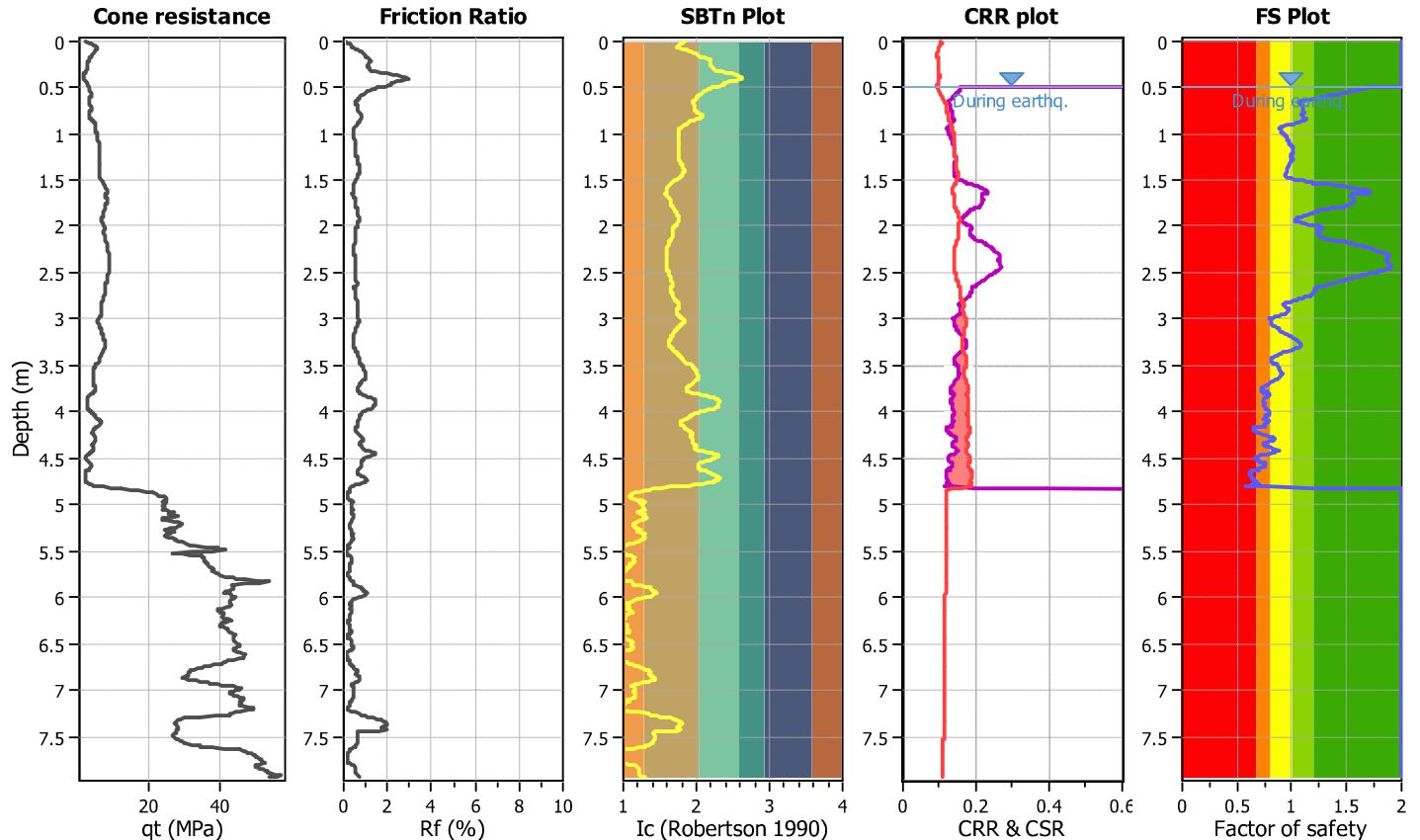
Project title : K200202

Location : 32 Nicholls Street

CPT file : CPT_36965 SLS2

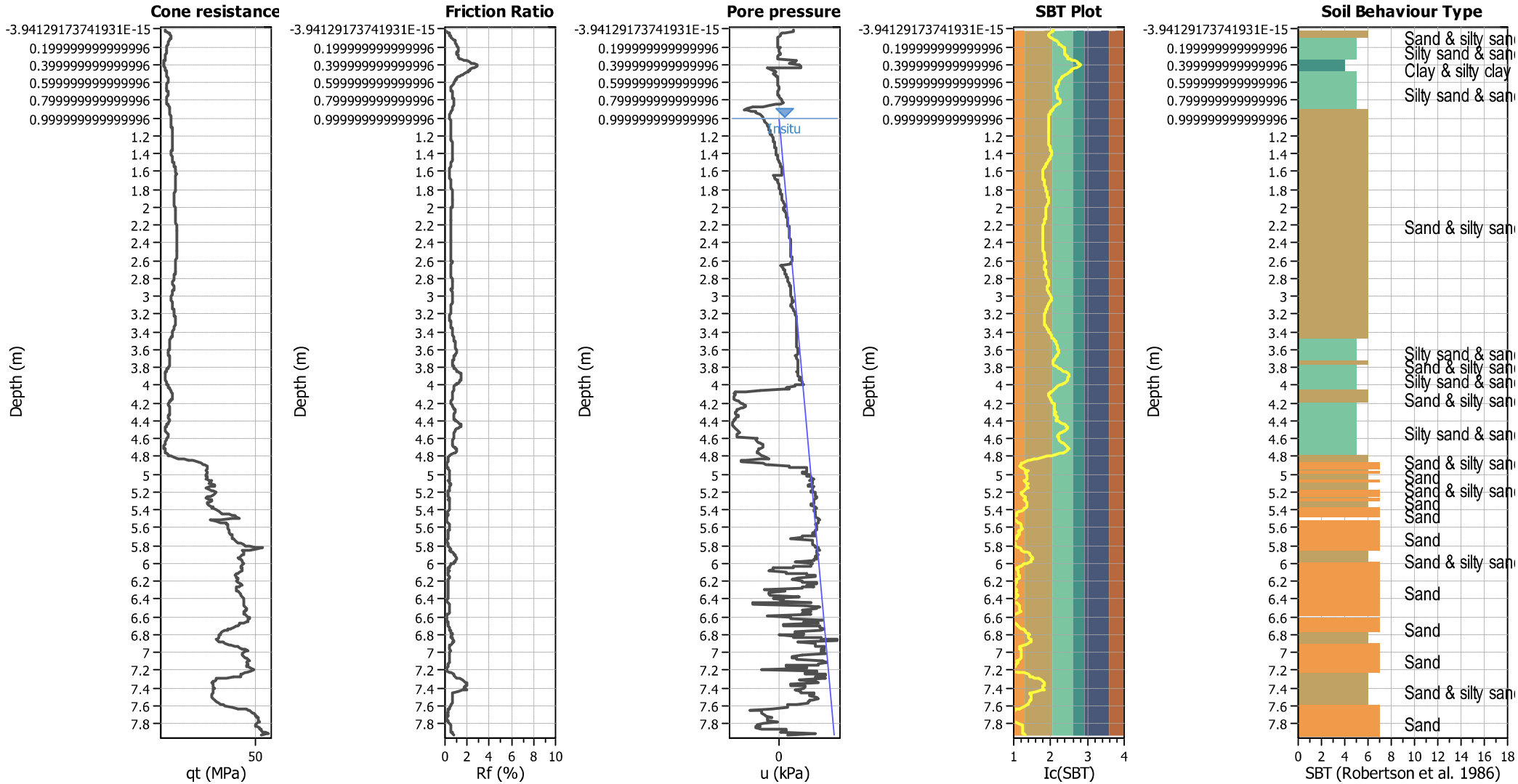
Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	0.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	MSF method:	N/A
Earthquake magnitude M_w :	6.00	Ic cut-off value:	2.60	Trans. detect. applied:	No		
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_g applied:	Yes		



Zone A₁: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A₂: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

CPT basic interpretation plots

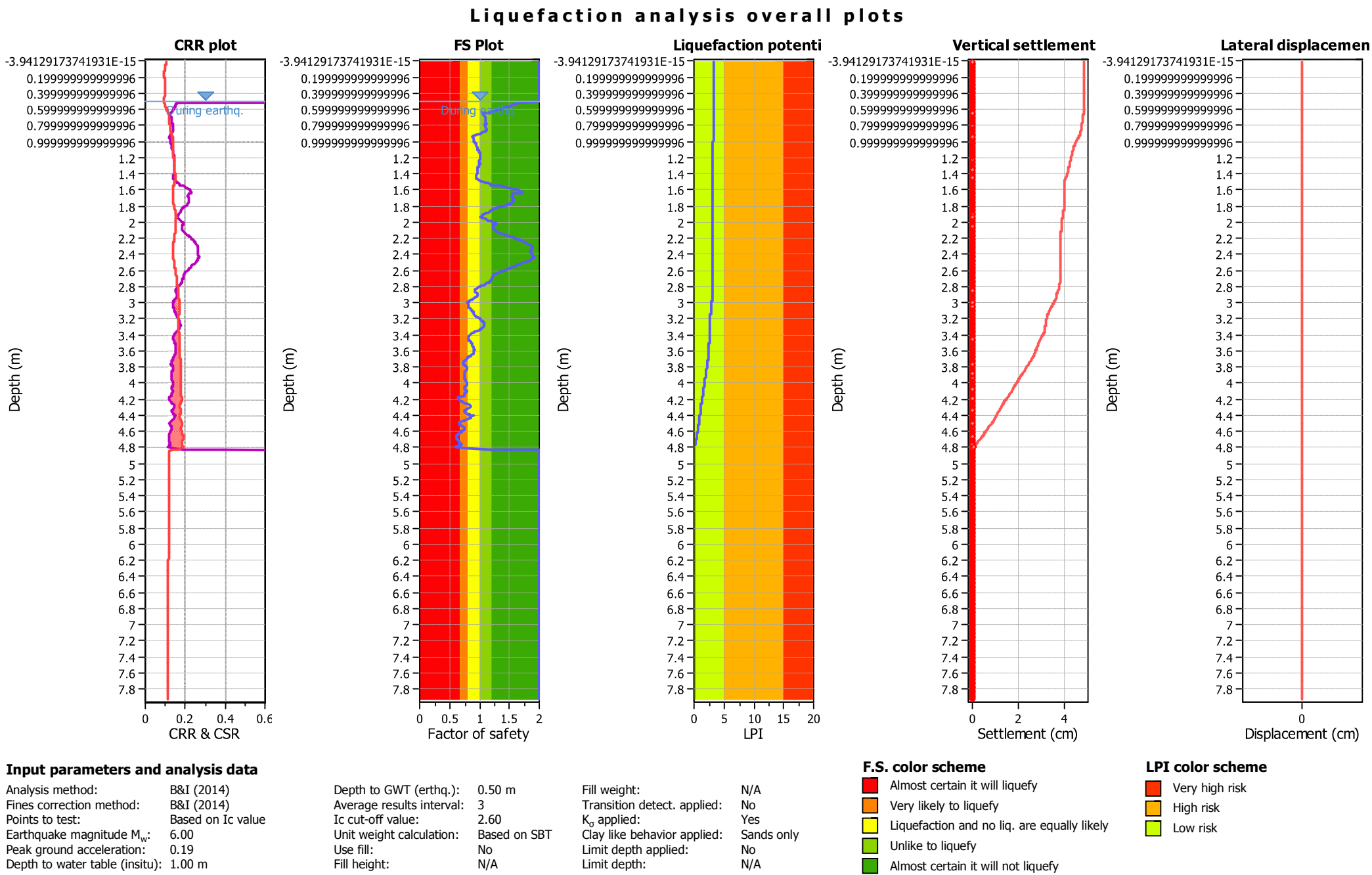


Input parameters and analysis data

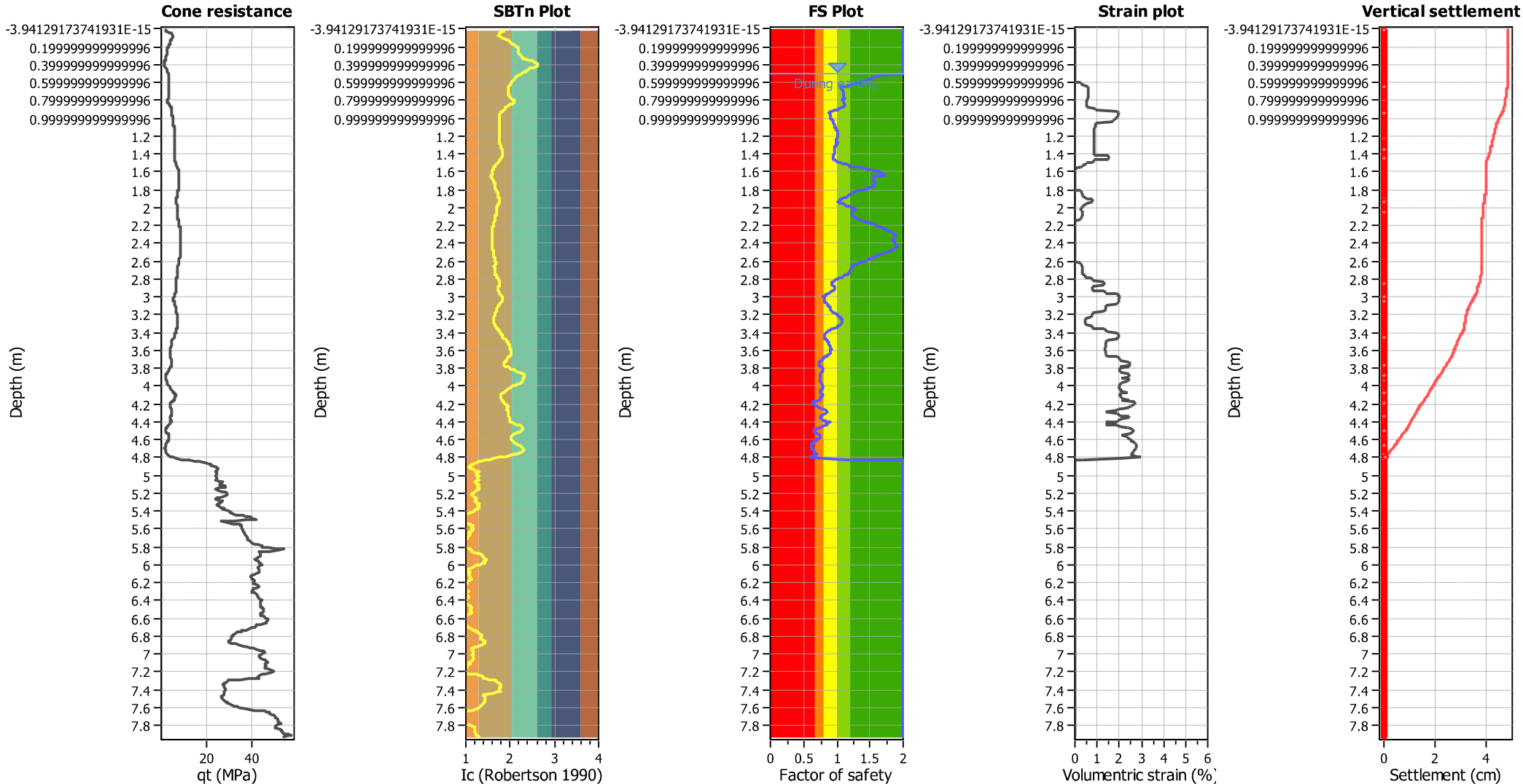
Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K ₀ applied:	Yes
Earthquake magnitude M _w :	6.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

SBT legend

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Estimation of post-earthquake settlements



Abbreviations

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- I_c: Soil Behaviour Type Index
- FS: Calculated Factor of Safety against liquefaction
- Volumetric strain: Post-liquefaction volumetric strain

LIQUEFACTION ANALYSIS REPORT

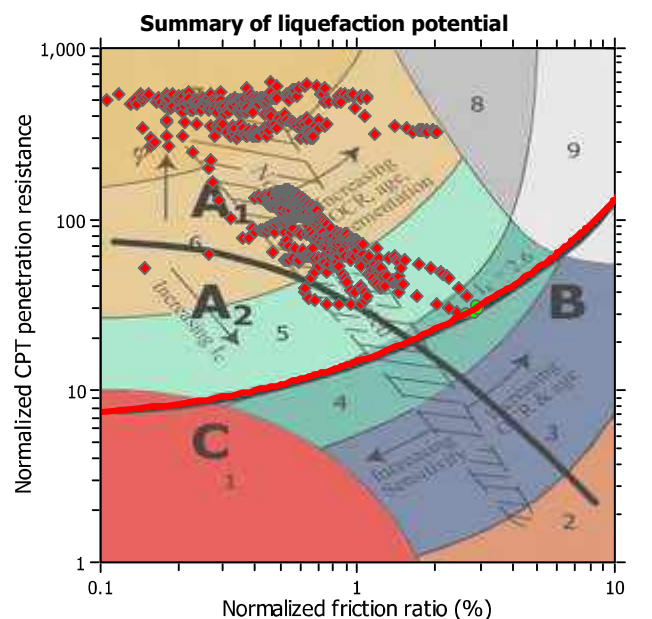
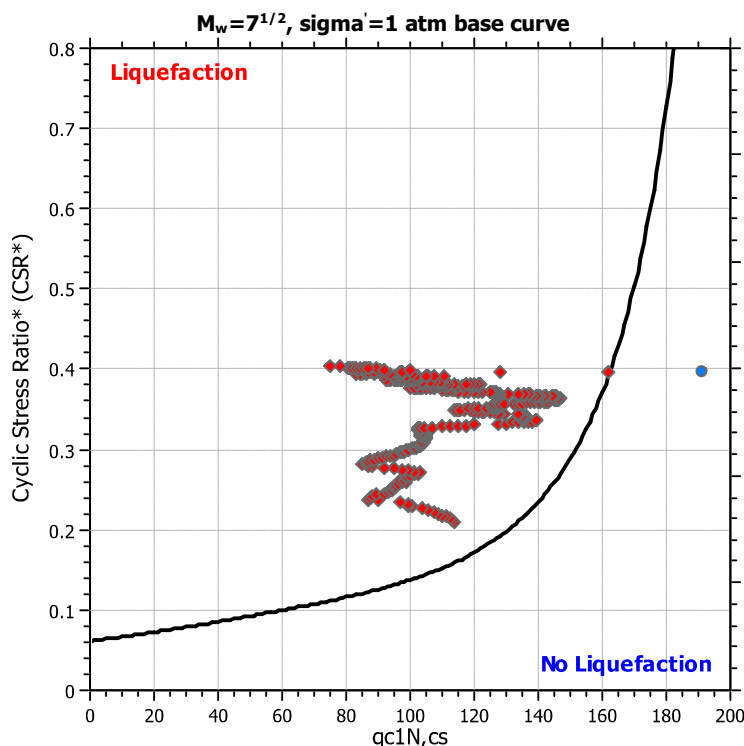
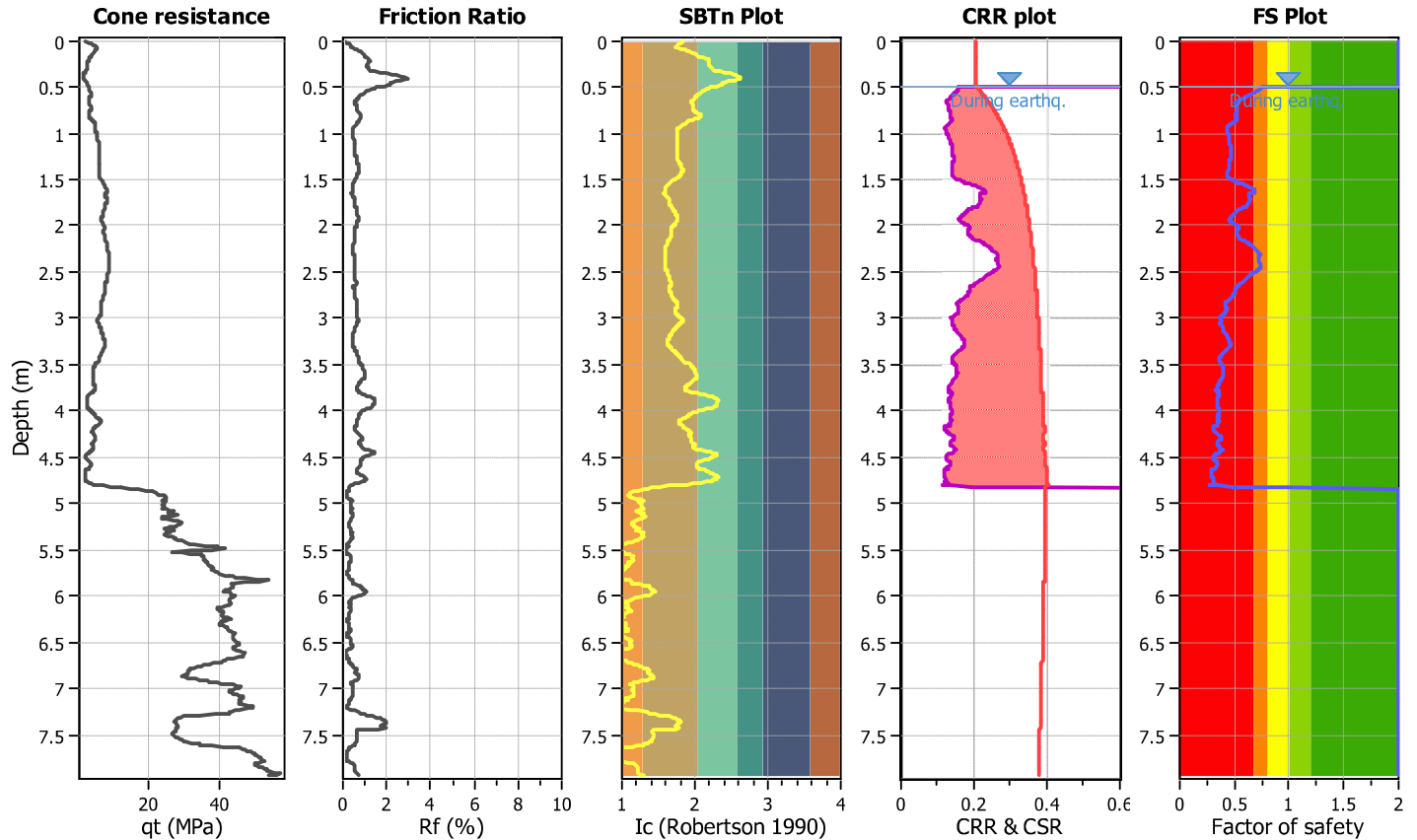
Project title : K200202

Location : 32 Nicholls Street

CPT file : CPT_36965 ULS

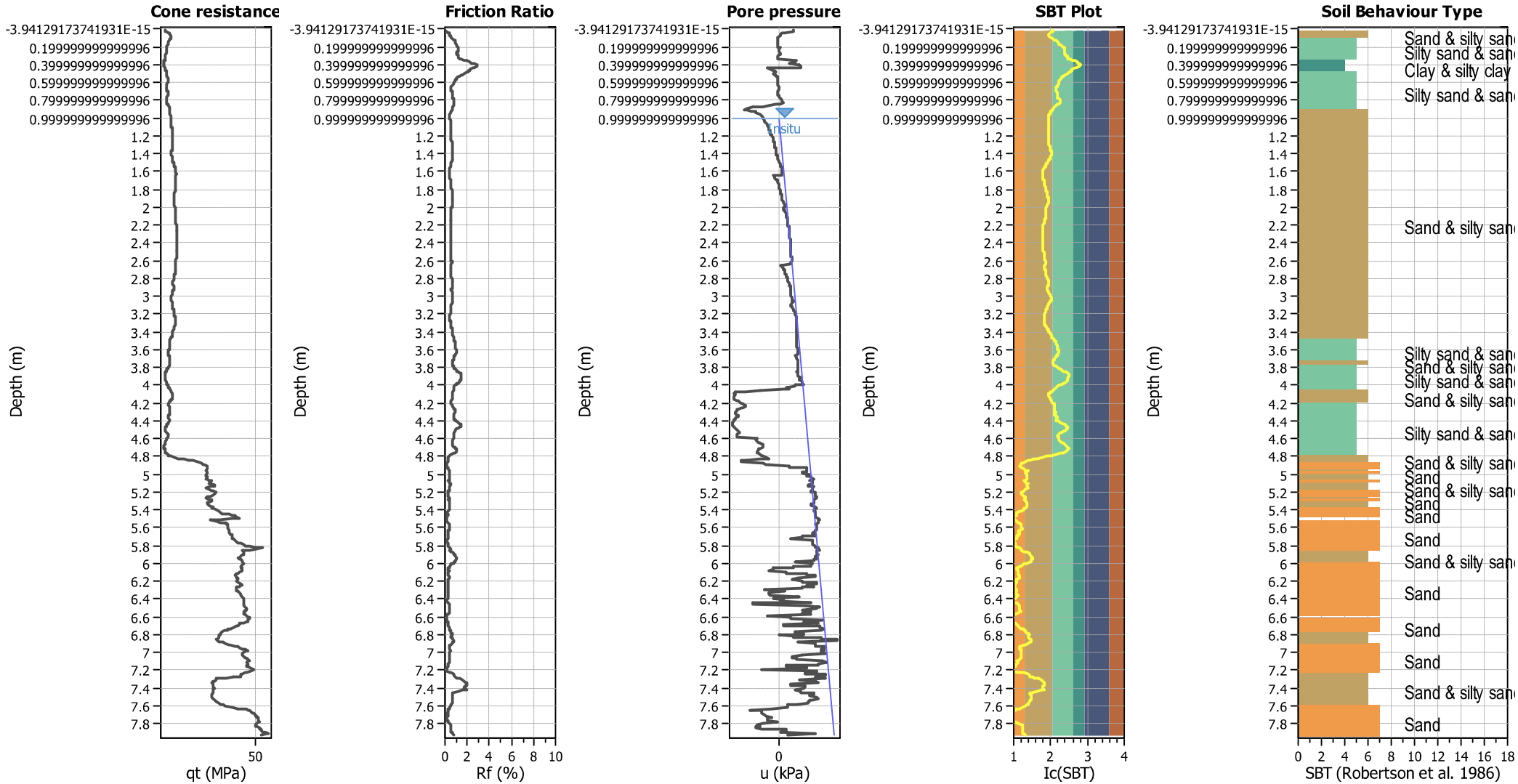
Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	0.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	MSF method:	N/A
Earthquake magnitude M_w :	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	No		
Peak ground acceleration:	0.35	Unit weight calculation:	Based on SBT	K_g applied:	Yes		



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Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

CPT basic interpretation plots

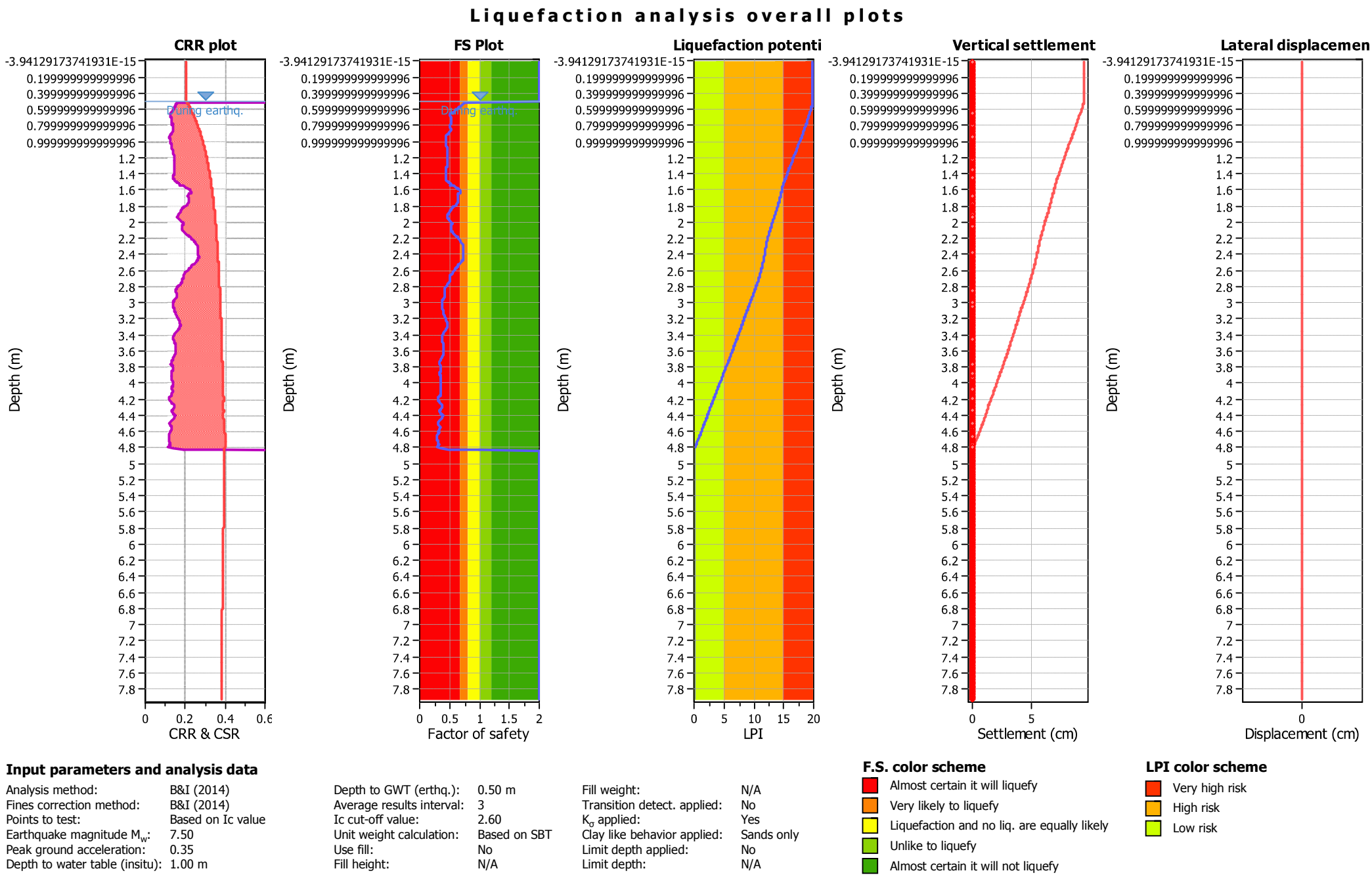


Input parameters and analysis data

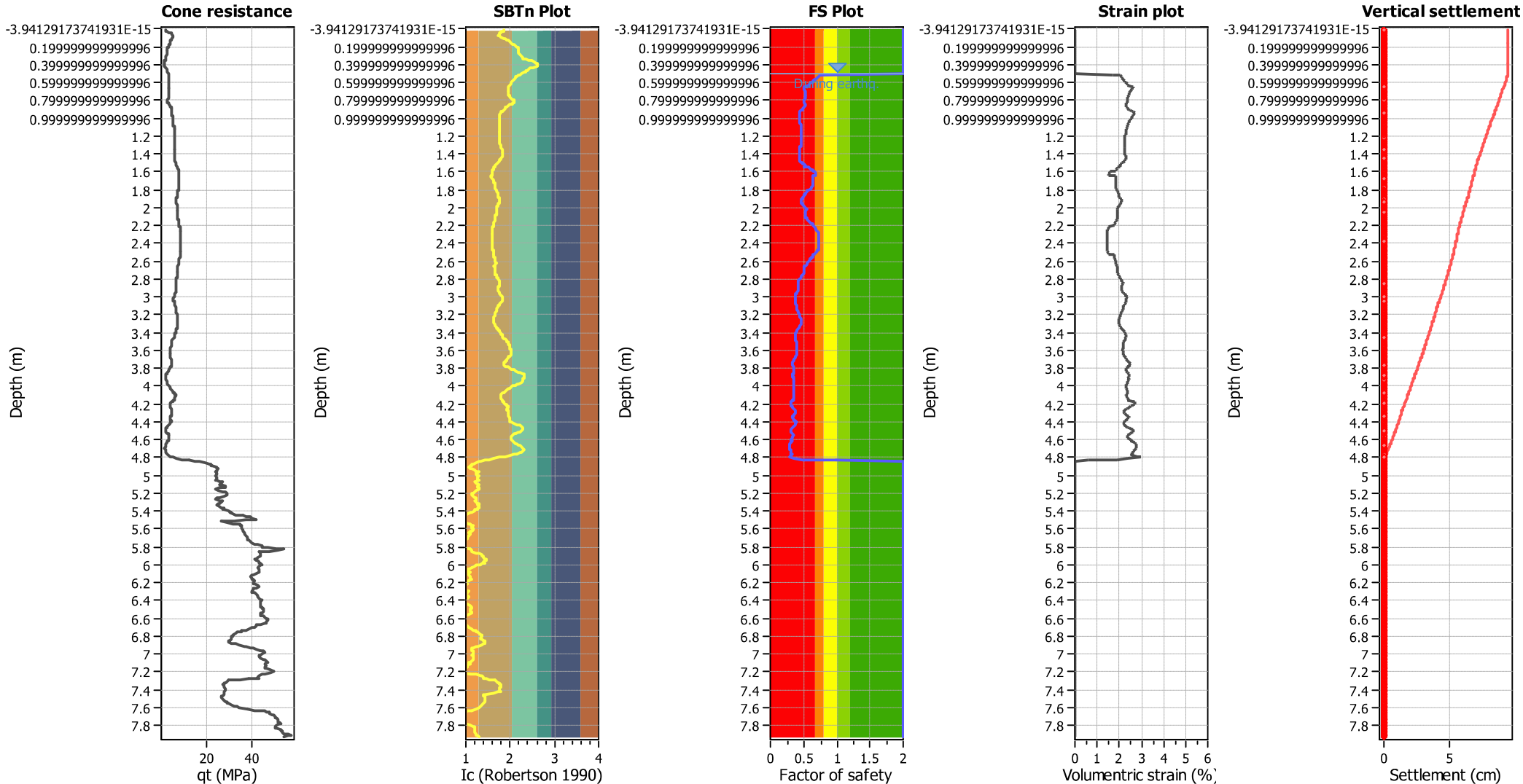
Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K ₀ applied:	Yes
Earthquake magnitude M _w :	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

SBT legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained



Estimation of post-earthquake settlements



Abbreviations

- q_t: Total cone resistance (cone resistance q_c corrected for pore water effects)
- I_c: Soil Behaviour Type Index
- FS: Calculated Factor of Safety against liquefaction
- Volumetric strain: Post-liquefaction volumetric strain

LIQUEFACTION ANALYSIS REPORT

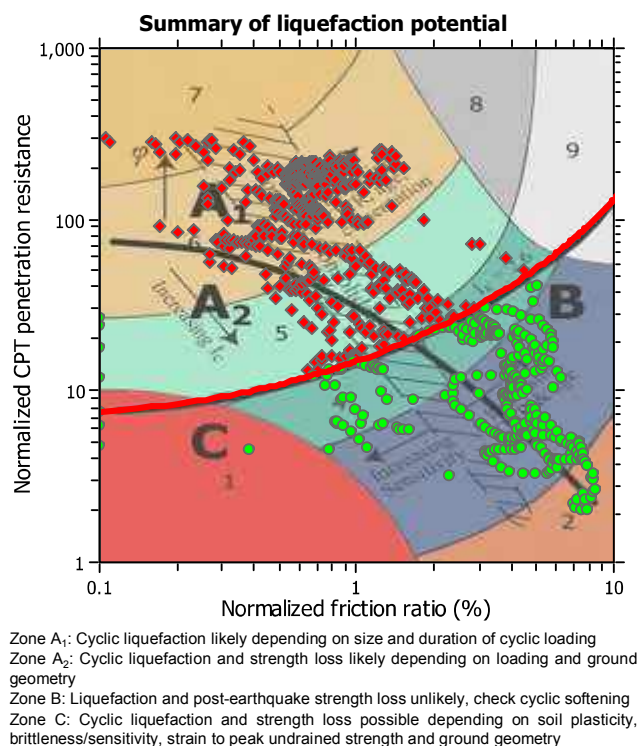
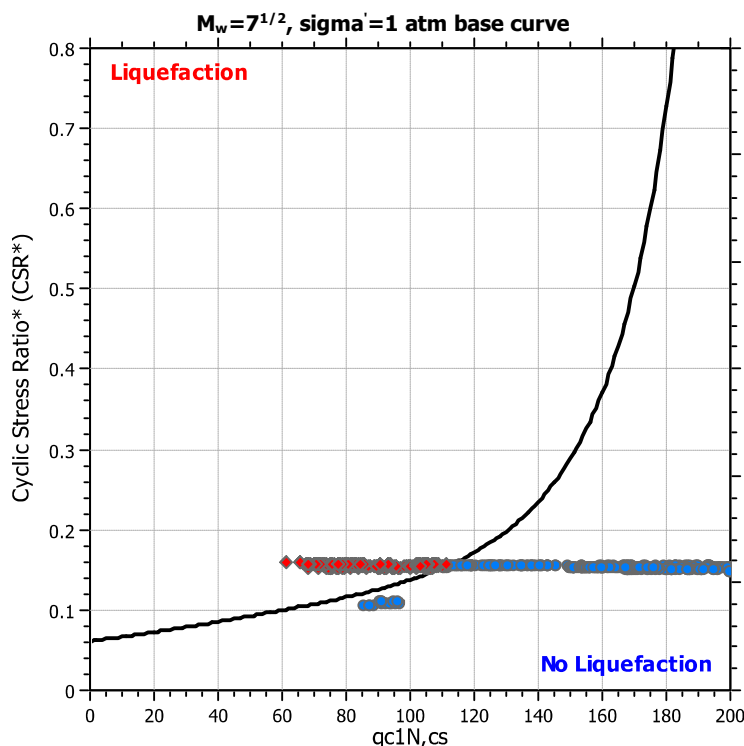
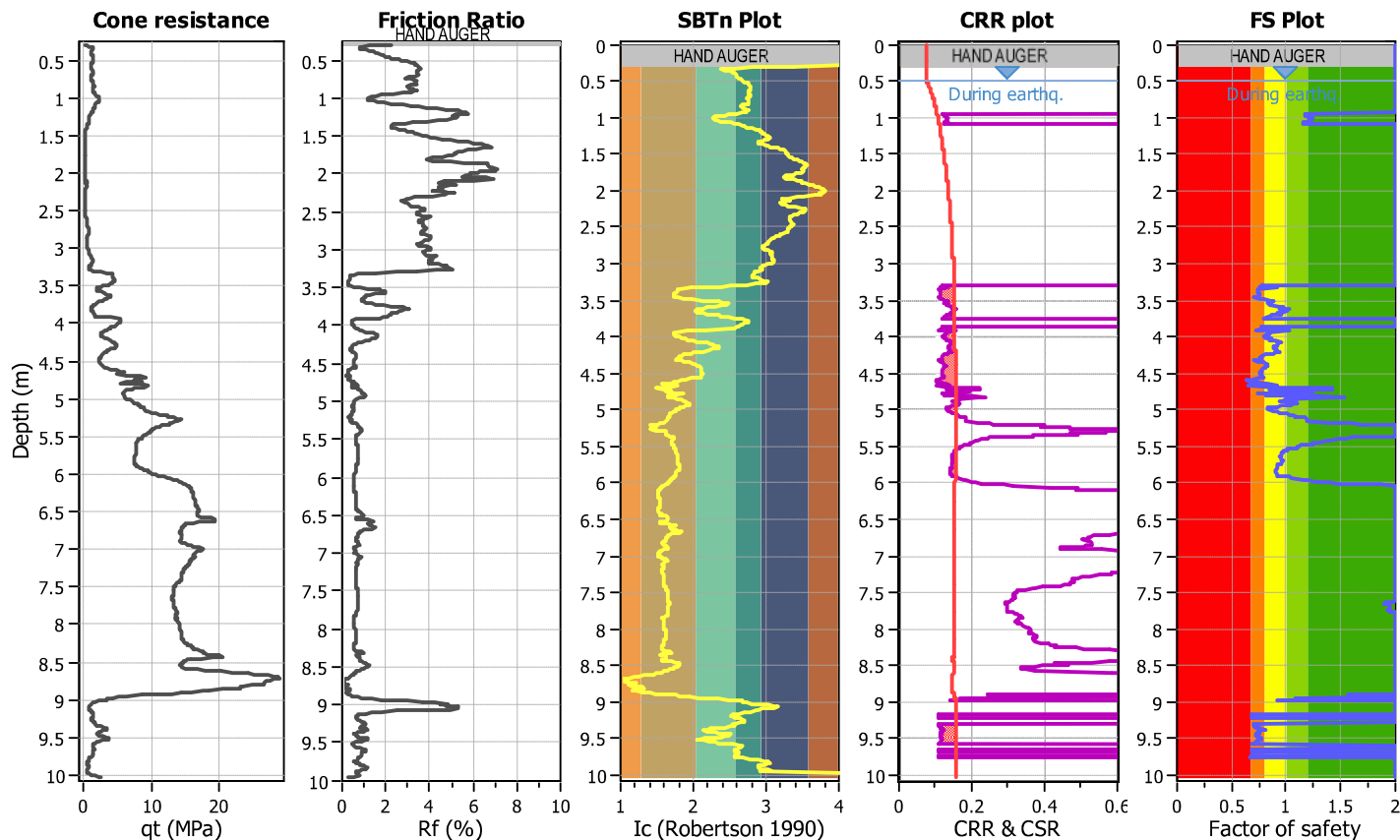
Project title : K200202

Location : 32 Nicholls Street

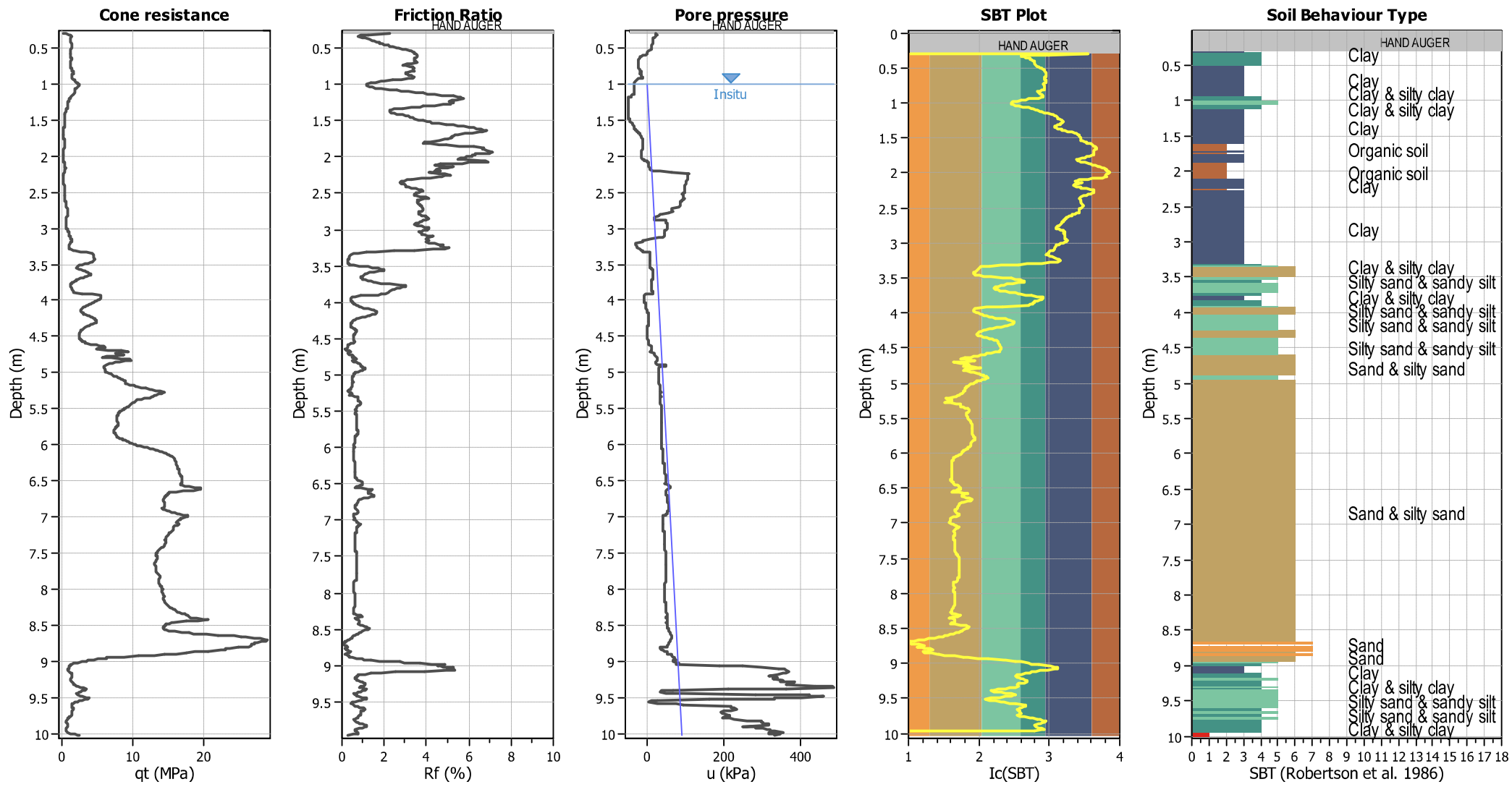
CPT file : CPT_71765 SLS1

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	0.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w :	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method
Peak ground acceleration:	0.13	Unit weight calculation:	Based on SBT	K_g applied:	Yes		



CPT basic interpretation plots



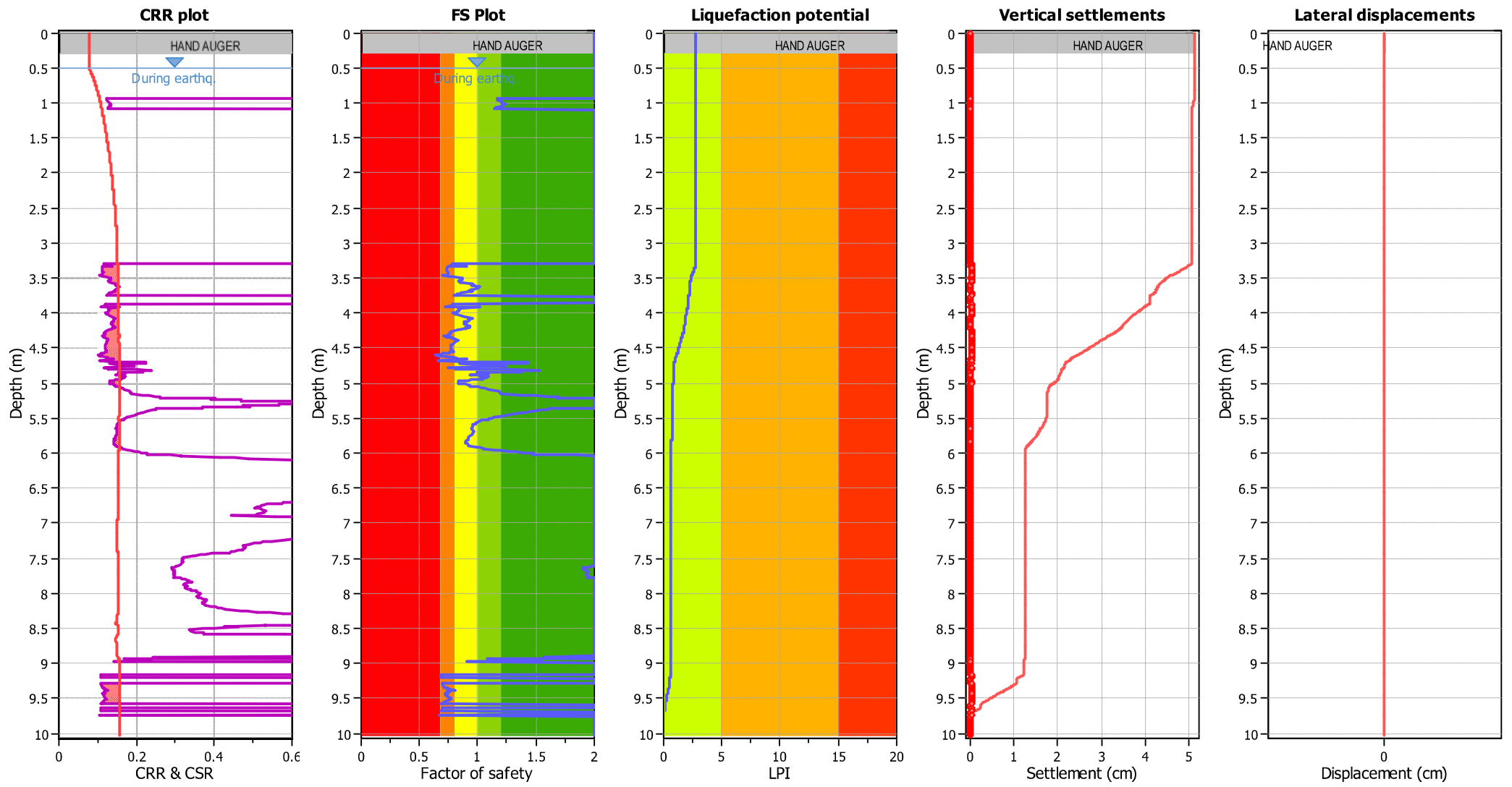
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K ₀ applied:	Yes
Earthquake magnitude M _w :	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

SBT legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (earthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K ₀ applied:	Yes
Earthquake magnitude M _w :	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

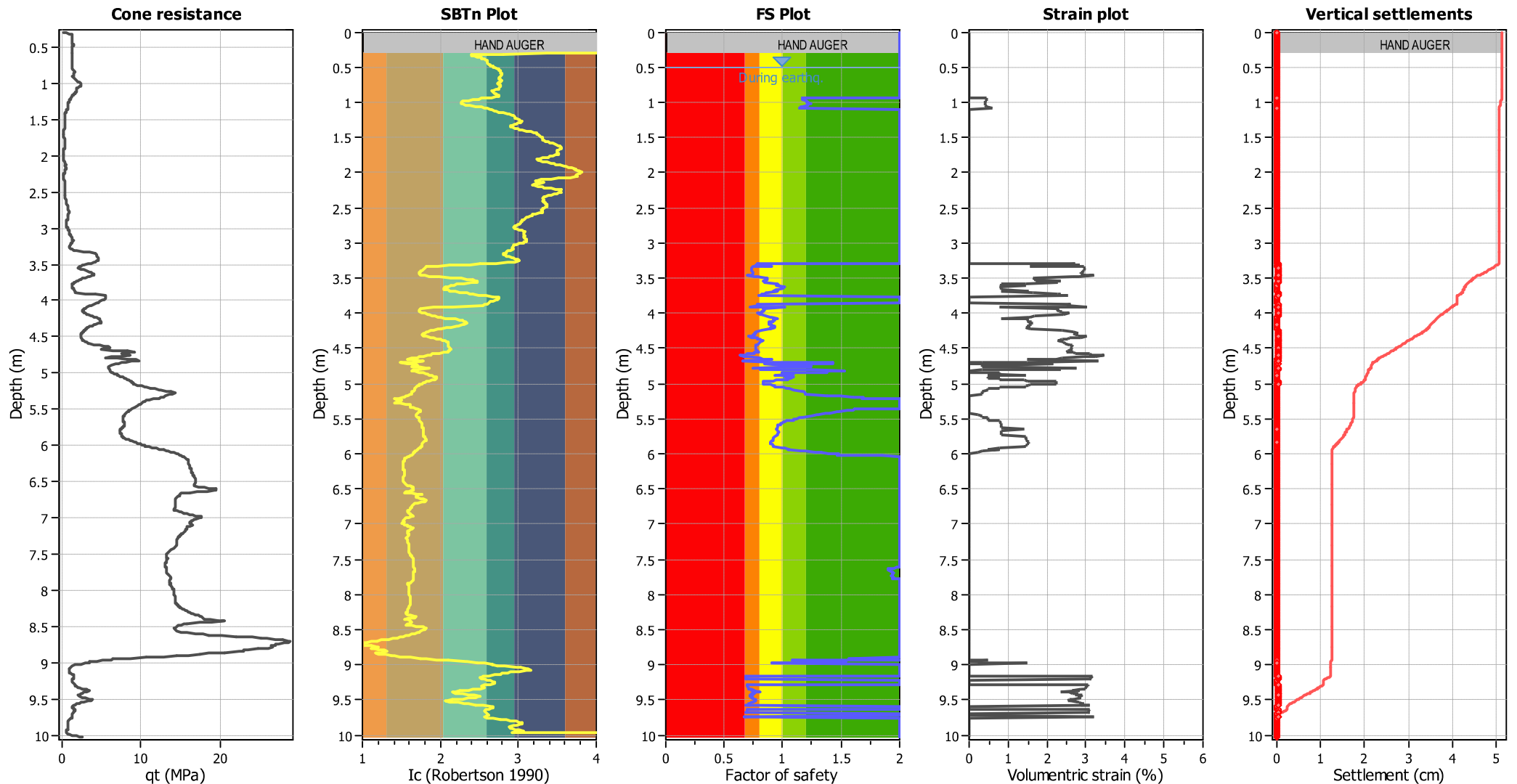
F.S. color scheme

Red	Almost certain it will liquefy
Orange	Very likely to liquefy
Yellow	Liquefaction and no liq. are equally likely
Green	Unlike to liquefy
Dark Green	Almost certain it will not liquefy

LPI color scheme

Red	Very high risk
Orange	High risk
Yellow	Low risk

Estimation of post-earthquake settlements



Abbreviations

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- Ic: Soil Behaviour Type Index
- FS: Calculated Factor of Safety against liquefaction
- Volumetric strain: Post-liquefaction volumetric strain

LIQUEFACTION ANALYSIS REPORT

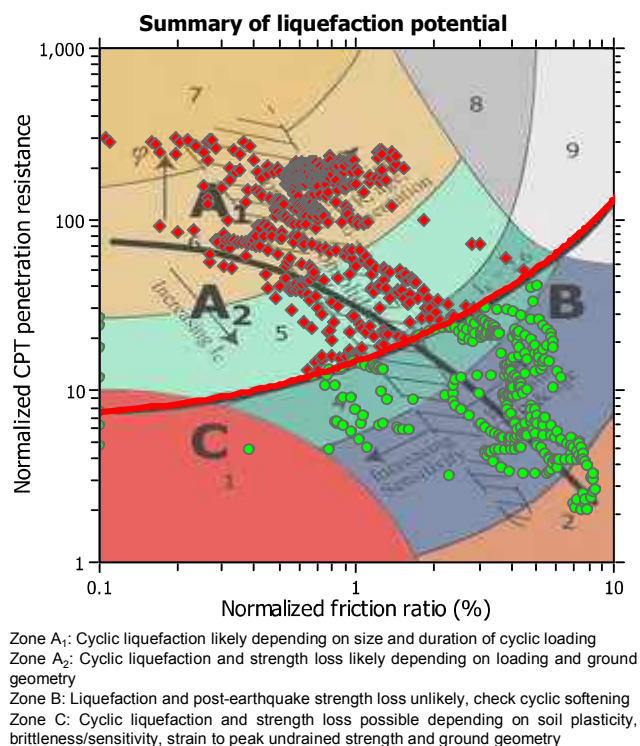
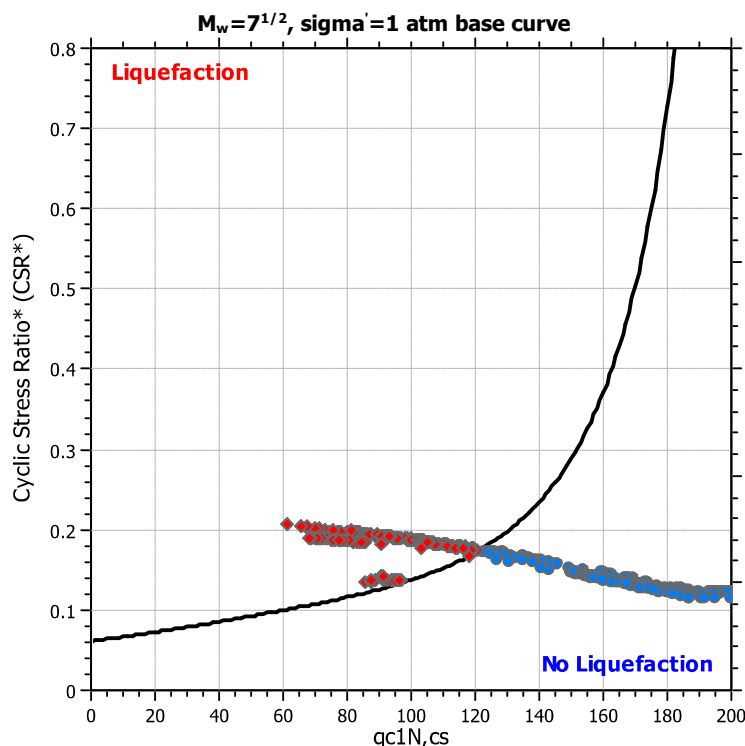
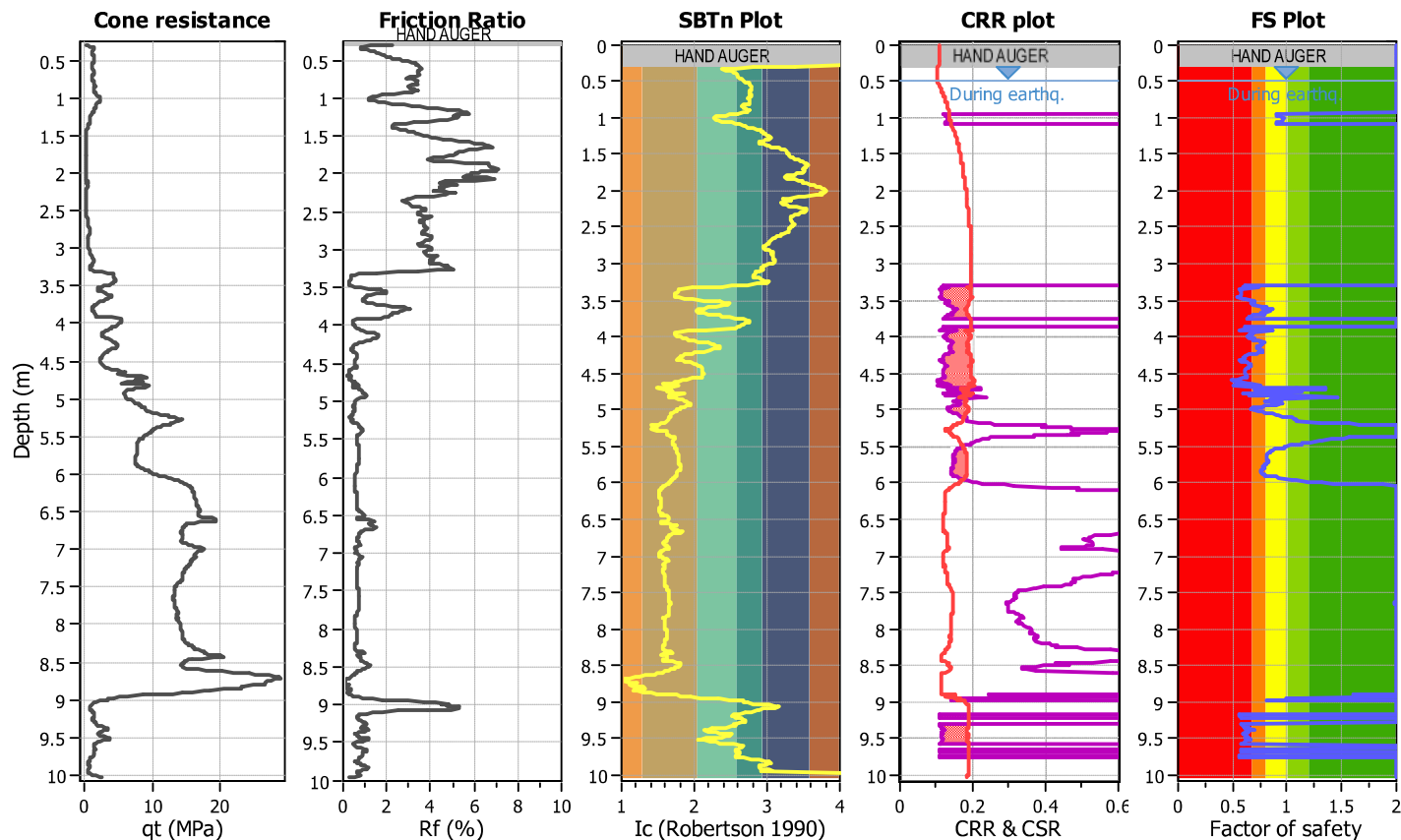
Project title : K200202

Location : 32 Nicholls Street

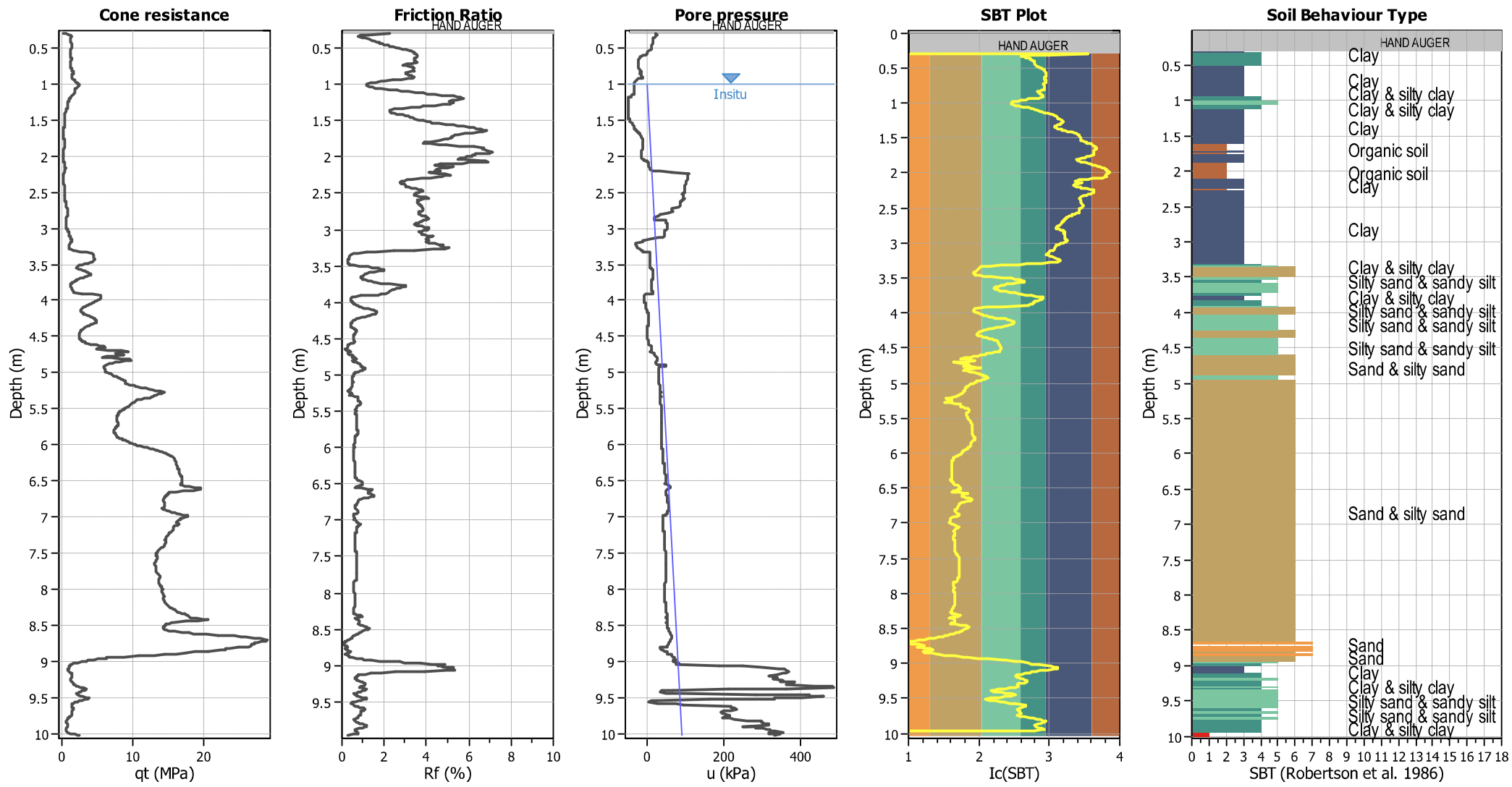
CPT file : CPT_71765 SLS2

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	0.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w :	6.00	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_g applied:	Yes		



CPT basic interpretation plots

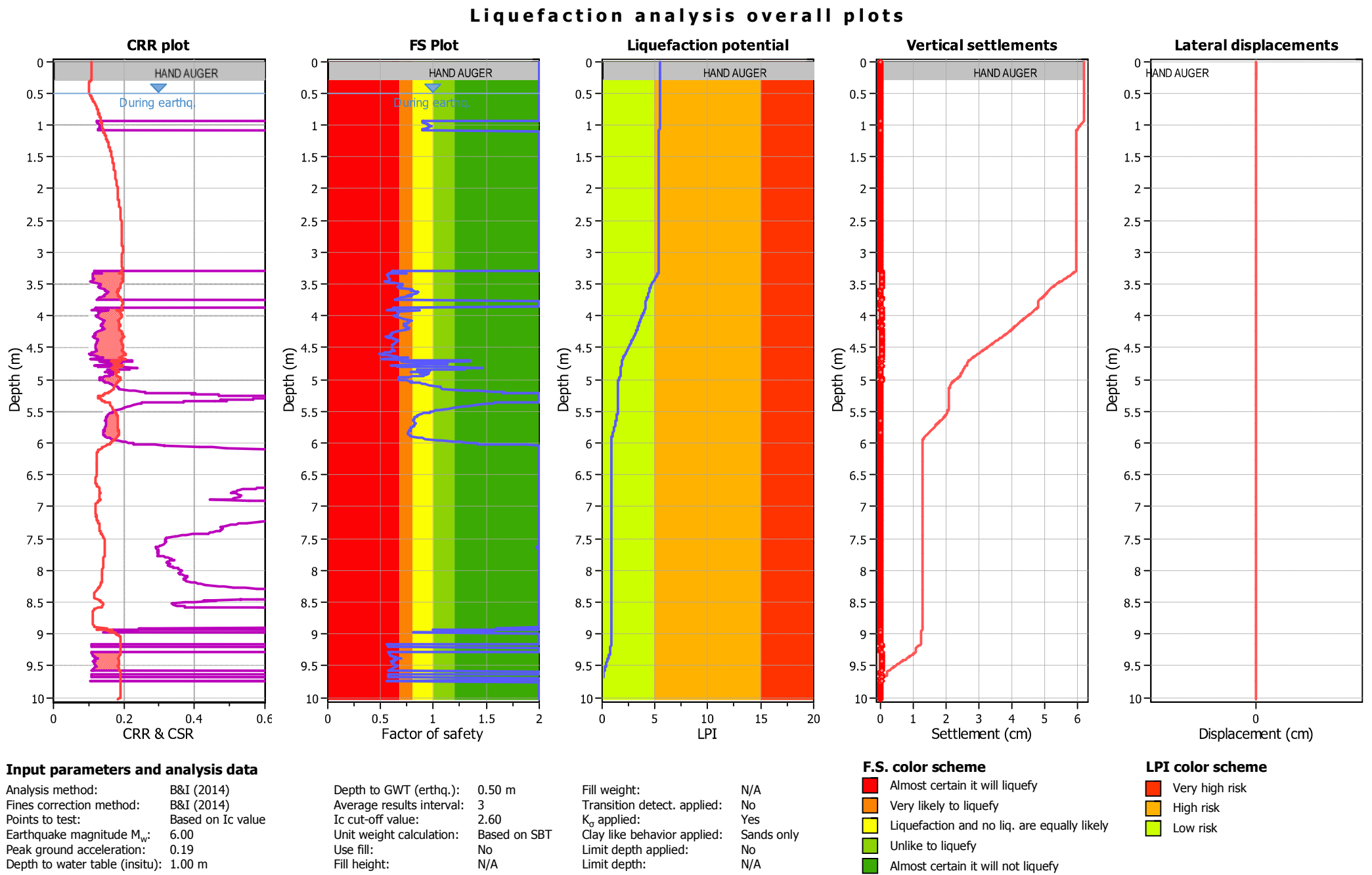


Input parameters and analysis data

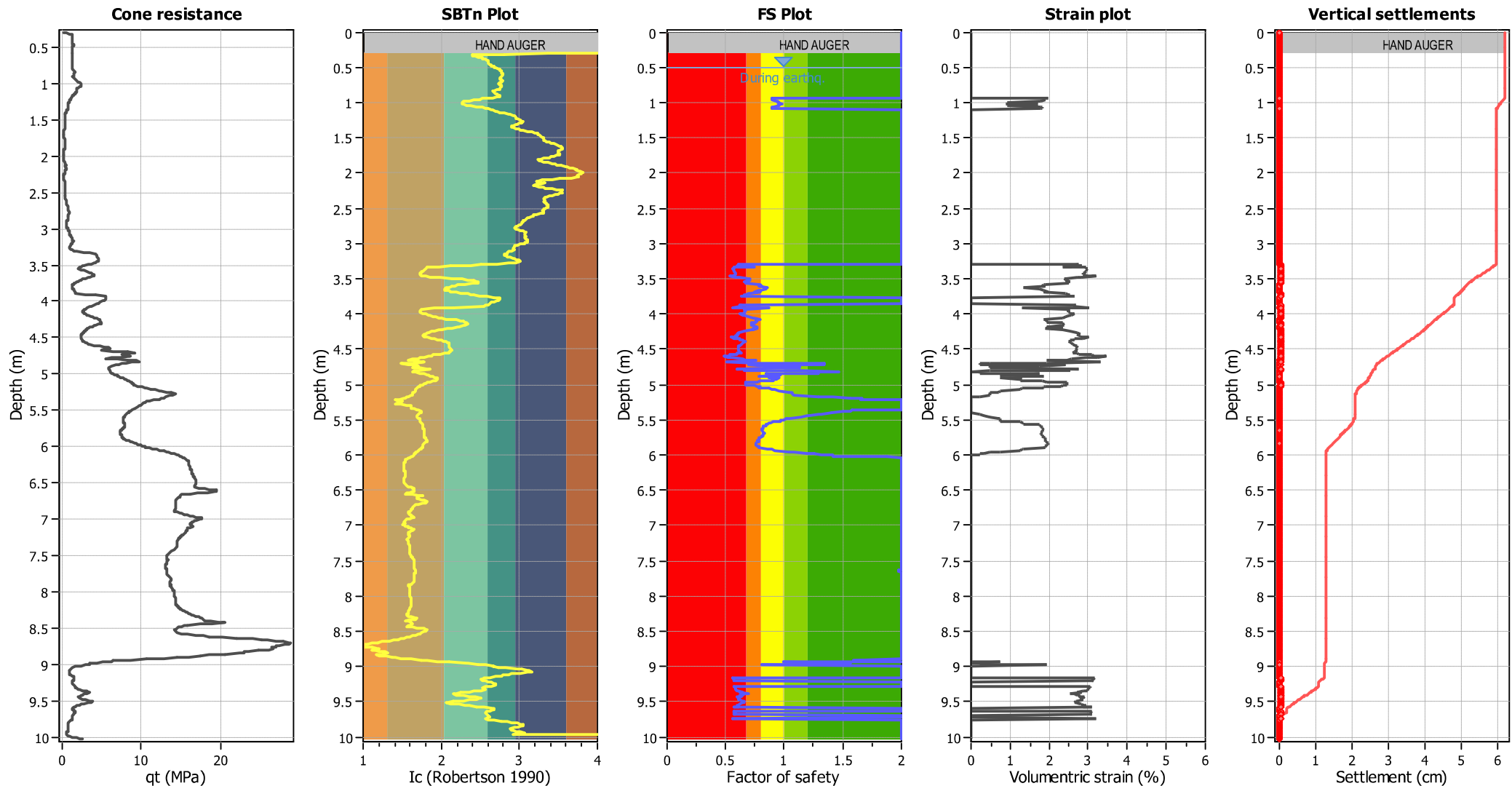
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Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K ₀ applied:	Yes
Earthquake magnitude M _w :	6.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

SBT legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
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Estimation of post-earthquake settlements



Abbreviations

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LIQUEFACTION ANALYSIS REPORT

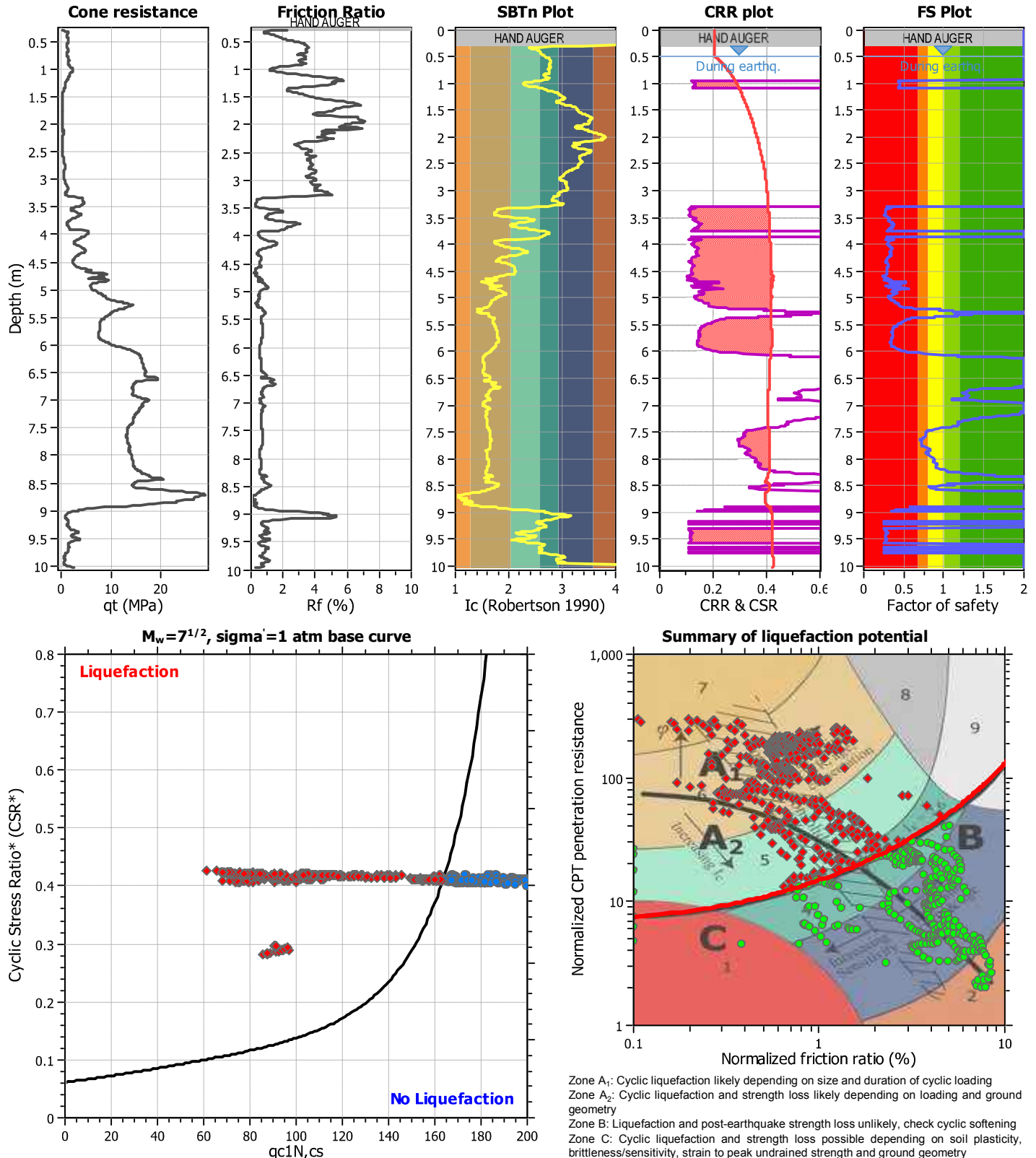
Project title : K200202

Location : 32 Nicholls Street

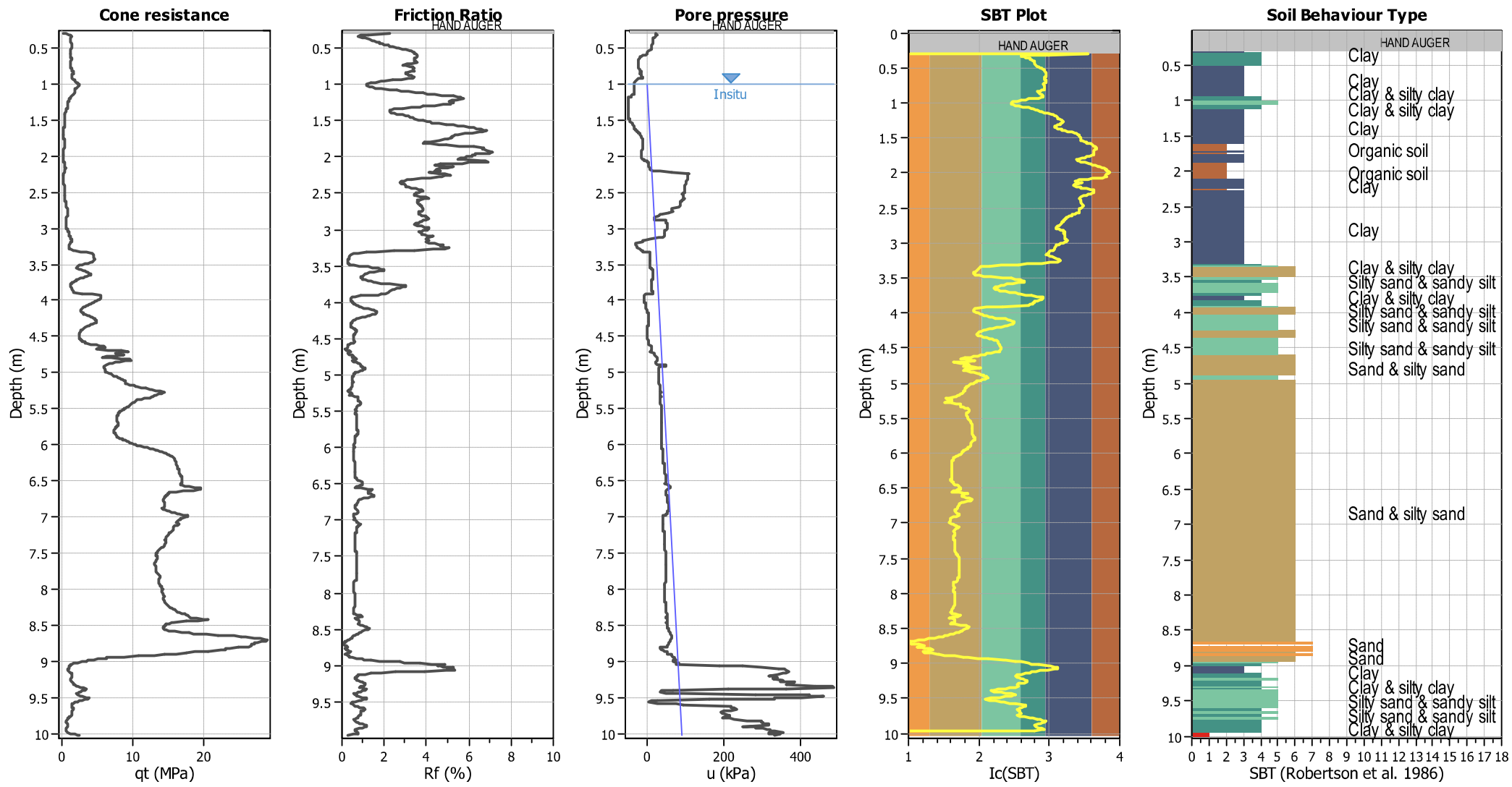
CPT file : CPT_71765 ULS

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	0.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w :	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method
Peak ground acceleration:	0.35	Unit weight calculation:	Based on SBT	K_g applied:	Yes		



CPT basic interpretation plots

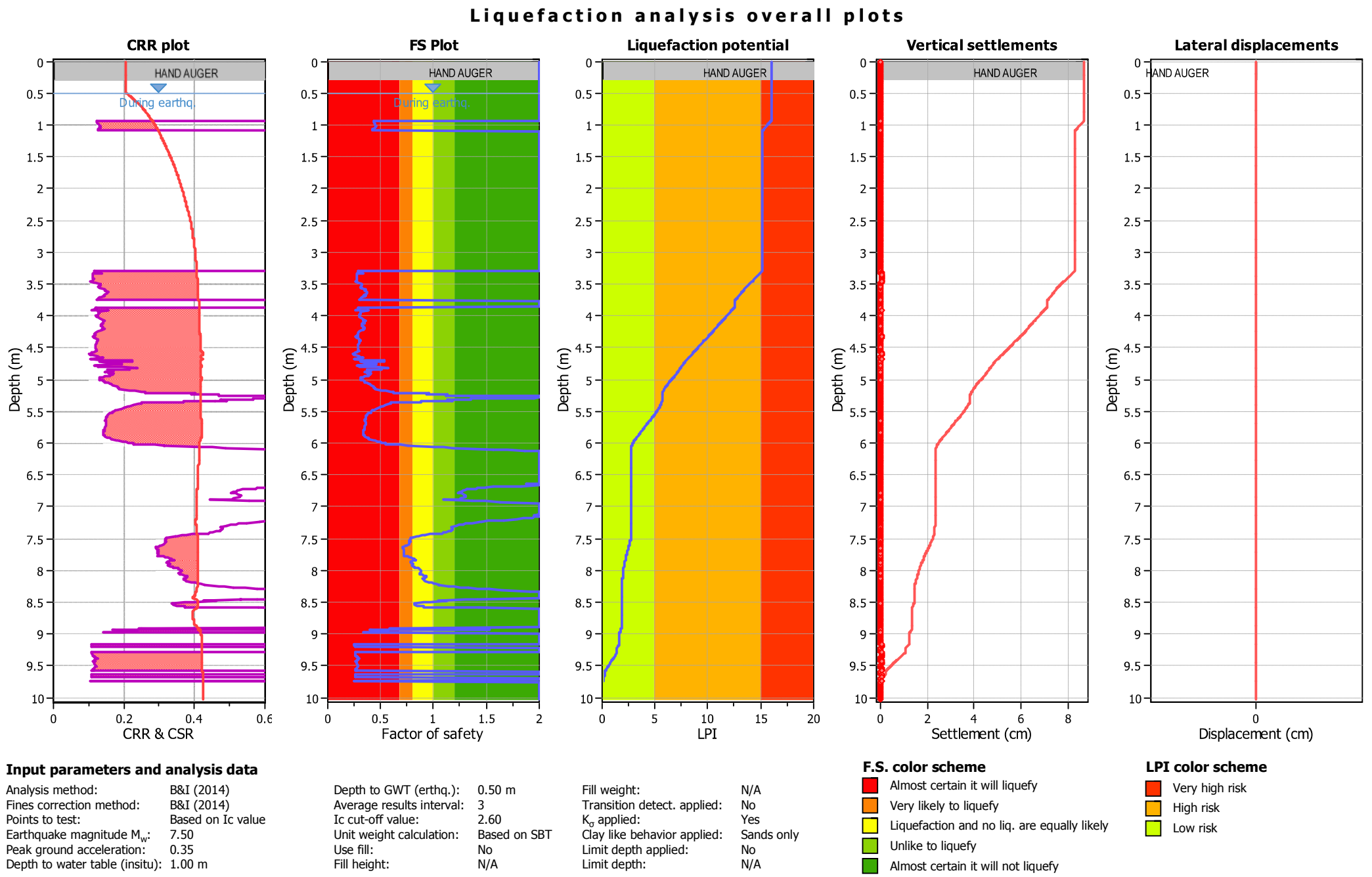


Input parameters and analysis data

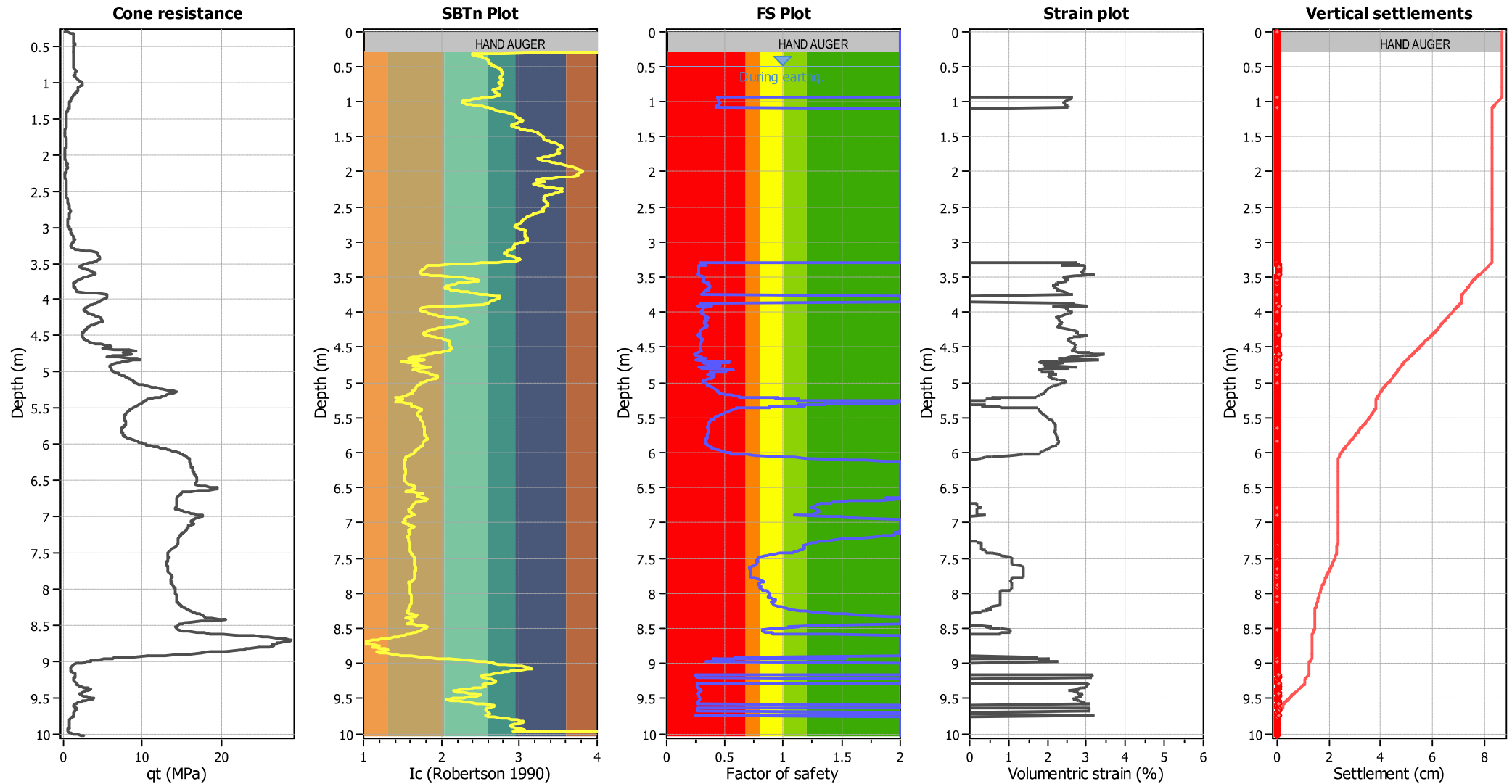
Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K ₀ applied:	Yes
Earthquake magnitude M _w :	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

SBT legend

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Estimation of post-earthquake settlements



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