southland MUSEUM AND ART GALLERY

NIHO O TE TANIWHA

Options Report

CONFIDENTIAL

November 2020

Invercargill CITY COUNCIL

STRONG THINKERS. GET RESULTS.

THE BUILDING INTELLIGENCE GROUP®

Contents

Appendices

Version History

Version	Name	Date
V.1.1 Final	Tess Browne	25 November 2020

1. INTRODUCTION

Background and Context

The Southland Museum and Art Gallery Niho o te Taniwha (referred to as the Pyramid in this report) was closed to the Public in 2018 due to its status as an Earthquake Prone Building. Consequently, the Invercargill City Council (ICC) engaged a project team to complete a report detailing the work and costs associated with re-opening the Pyramid. This report explores the options and identifies possible scenarios for ICC to consider in relation to the Pyramid.

Note: The option to strengthen the Pyramid to 100% NBS was not pursued further as it was deemed too complex from a construction perspective with a high cost premium and reduced building flexibility.
Note: Tim Walker Report relates to content in the Tim Walker Associates Strategic Review Reinventing the Southland Museum 2019.

2. EXECUTIVE SUMMARY

Current Position

Prior to its closure, SMAG operated from a building referred to as the Pyramid. The Pyramid is made up of 4 different buildings that have been built in and around each other from 1942 through to a major redevelopment in 1990 to create the current three – level, pyramid shaped structure with a gross floor area of approximately 4,572m2 and a total height of 22m. We note:

- The building sits below 34% NBS and is deemed earthquake prone. The main structural challenge is that each of the buildings behaves and moves independently of each other and in an earthquake event, the buildings will crash into each other causing significant damage
- Over the years maintenance and refurbishment works have been deferred while a decision was made on the building's future. These works are significant and have been addressed in this report to ensure Council has a clear understanding of the issues

Our Approach

The project team was initially appointed to identify the minimum requirements to achieve seismic compliance enabling the Pyramid to re-open. On appointment, the team completed a site inspection in late August 2020. We then went through an information gathering phase where we reviewed all previous reports prepared for the building to identify information gaps and agree the scope of work. Through this process, items identified included:

- **Importance Level 3**. The Pyramid needs to achieve Importance Level 3 seismic resilience as it is a structure that may contain crowds, have contents of high value to the community or pose a risk to large numbers of people in proximity
- **100%NBS**. A strengthening option to 100% NBS for the Pyramid was requested but could not be achieved due to design and ground conditions along with prohibitive costs
- **Refurbishment.** Over the years, work has been deferred and the general appearance internally is of the building being tired and old
- **Building Services.** Across the board, buildings services are nearing their end of life and there are inadequate environmental controls within spaces for the Collection which do not meet current museum standards.
- **Operating Costs.** Operating costs are in the Pyramid will be high due to the inefficient and poor condition of building services.
- **Information technology** services are inadequate and not aligned with modern buildings
- **Layouts.** Floor plans have been adjusted over time to address the changing needs of the museum which has compromised interior layouts and circulation
- **Roof.** Despite maintenance work, the roof continues to leak
- **Storage.** There are serious issues with storage and access to storage including larger items which cannot be easily moved
- **Service Access.** Service access is difficult, there is no loading bay therefore the delivery, removal and setting up of exhibition space is difficult

Noting the above comments, we agreed the scope of work would be to assess a range of options from the minimum works to re-open the building (seismic strengthening only) through to full refurbishment of the Pyramid along with options for a replacement building. These options address costs and proposed timeframes to complete and are summarised below:

Option	Option A – 34% NBS and Minimum Refurbishment	Option B – 67% NBS and Minimum Refurbishment	Option C – 67% NBS and Full Refurbishment	Option D – New Build (Location TBC) as per existing floor area	Option E – New Build (location TBC) as per Tim Walker floor area
Makes the Building Safe?	**Address's immediate life safety issues**	**Significantly improves immediate life safety**	**Significantly improves immediate life safety**	**Yes**	**Yes**
Deliver a Resilient Building?	**Low level of seismic resilience** Highly likely building will be damaged and need internal repair after a significant earthquake. Demolition could be inevitable	**Moderate level seismic of resilience** Reduces but does not remove likelihood of future building closures after a significant earthquake	**Moderate level of seismic resilience** Reduces but does not remove likelihood of future building closures after a significant earthquake	**High level of seismic resilience** Reduced risk of building closure after a significant earthquake	**High level of seismic resilience** Reduced risk of building closure after a significant earthquake
Address Deferred Refurbishment including building services?	**NO** Refurbishment limited to areas of the building where strengthening work will be required	**No** Refurbishment limited to areas of the building where strengthening work will be required	**Yes**	**Yes**	**Yes**
Improves accessibility?	**Minor Improvement** Comply with building code only (ANARP)	**Minor improvement** Comply with building code only (ANARP)	**Significant improvement** Could be constraints with existing building	**Yes** Best practice standards	**Yes** Best practice standards
Future proofs the museum service?	**No** Strengthening work will impact current layout to accommodate new structural requirements	**No** Strengthening work will impact current layout to accommodate new structural requirements	**Significant Improvement** but there may be compromises in layout to accommodate new structure requirements	**Yes**	**Yes**
Address's Roof Issues?	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Address's storage concerns?	**No**	**No**	**Minor Improvement** Could make storage more efficient through design solutions	**Moderate Improvement** New building layout will ensure efficient design which could resolve current storage issues	**Yes**
Estimated Cost	**$25.3M**	**$26.6M**	**$52.5M**	**$75.4M**	**$85.5M**
Timeframes	**27 Months**	**27 Months**	**37 Months**	**48 Months** *potential to be longer in a different location to the Pyramid	**48 Months** *potential to be longer in a different location to the Pyramid

Key considerations

- Option A and B enable the Pyramid to be re-opened but the current building issues associated with deferred maintenance / end of life services will continue to be problematic and funding will have to be set aside to stage the works over a number of years which will be disruptive. This is the cheapest option with the shortest timeframe but delivers the least optimal outcome.
- Option C provides a moderate level of building resilience and address's refurbishment / building services requirements. This option is mid-range in terms of cost and programme.
- Option D and E will provide Council with a purpose built, seismically resilience building future proofed museum however it comes with the highest cost and longest timeframe for delivery.

Next Steps

Once a preferred option has been identified a design and service level brief will be required to ensure the building is developed will align with Councils vision for the future museum

The brief will set the vision for the project and inform the next phases of procurement, design development, construction, and fitout to ensure the projects objectives are met

Establishment of a project governance structure will be critical to support development of the design and service brief.

3. THE PROJECT BRIEF

Structural Strengthening and Minimum Refurbishment Works (Option A and B)

At the outset of the project, the brief was clear – identify the minimum requirements to re-open SMAG whilst achieving seismic compliance with New Building Standards.

Under this option, scope was limited to the following areas:

- Exploration of structural strengthening options to achieve 34, 67 or 100% NBS. The NBS % is a rating given to a building expressed as a percentage of New Building Standards (NBS) achieved based on an assessment of the seismic performance. It is relation to the performance of a new building on the same site with respect to life safety. The three % values are industry adopted limits which help categorise buildings int three risk profiles:
    - <33% is High Risk
    - Between 33 and 67 is Moderate Risk
    - Greater than 67% is Low Risk
- Geotechnical investigations to understand ground conditions and existing foundations
- Refurbishment works required to remediate areas of the building that were strengthened only, no further refurbishment / betterment work was to be considered
- Compliance with the Building Code as any strengthening work would trigger a building consent, specifically:
    - Fire Safety
    - Emergency egress
    - Accessibility

The project team was instructed **NOT** to consider the following factors when assessing this option:

- Any architectural changes to improve the existing layout
- Full refurbishment of the building. Refurbishment limited to the areas impacted by strengthening works only
- Replacement of the existing building services beyond localised areas impacted by the strengthening works. No consideration of Whole of Life Costs or ongoing maintenance requirements for the building's services
- Improved vertical access via stairs and lifts
- Changes to the current environmental control system
- IT upgrade
- Acoustic improvements
- Compliance with Museum Standards
- New Exhibition space

67% NBS and Full Refurbishment / New Build (Option C, D, and E)

Once the project team completed an assessment of options A and B, ICC expanded the project brief and requested the team consider the following possibilities:

- Structurally strengthen the Pyramid to 67% NBS and complete a full refurbishment of the building to incorporate all the exclusions previously listed
- Demolish the Pyramid Building and construct a replacement building with the same area as the current museum (4,572 sqm). In terms of location, the construction cost difference between building on the same footprint as the Pyramid or at a new location in Invercargill was marginal. However, there are some nuances around remaining in the current location versus moving to a new location which are discussed further in the report (Section 5, Options Analysis)
- Demolish the Pyramid building and construct a replacement building with the same footprint identified in the Tim Walker report (5,300 sqm). In terms of location, the construction cost difference between building on the footprint of the Pyramid or at a new location in Invercargill was marginal. However, there are some nuances around remaining in the current location versus moving to a new location which are discussed further in the report (Section 5, Options Analysis)

Under option C, D and E, the items excluded from the original brief now been allowed for and the costs associated with Options C, D and E are comprehensive and would future proof the building

Key Considerations

Factors considered when assessing each of the options above included:

- **Life Safety**. Is the building safe to occupy?
- **Building resilience.** Following an earthquake, is the structural strengthening sufficient to enable the building to re-open with minimal repairs
- **Deferred Maintenance.** Resolution of existing building issues including HVAC, electrical and IT
- **Improved Accessibility.** Does the work provide improved accessibility access?
- **Building Flexibility**. Does the work future proof the building and provide opportunities for a 21st century space?
- **Roof Issues**. Will the work improve the issues with the roof and ongoing leaks?
- **Storage**. Will the work address storage problems?

4. DESIGN

The project team comprised of:

- The Building Intelligence Group – Project Managers
- Holmes Consulting - Structural Engineers
- Engeo – Geotechnical Engineers
- Rider Levett Bucknell – Quantity Surveyors
- Warren and Mahoney – Architectural Services
- Powell Fenwick – Building Services (Mechanical, Electrical, Fire)

Structural Remediation

Holmes Consulting was appointed to assess the Pyramid and provide a structural solution summarised below as follows:

Strengthening to 34% and 67% NBS

- The structural analysis confirmed the Pyramid building can be strengthened to 34 and 67% NBS. Strengthening will include new reinforced concrete walls, new reinforced concrete foundation beams and new connections to the ceiling diaphragm. The primary differences between the 34% and 67% schemes is the 67% scheme will require:
    - Additional concrete walls and foundation beams
    - Increased first and second floor concrete slab diaphragm strengthening

Please refer to Holmes Consulting Structural Report (Appendix A) for detailed engineering information including proposed location of new walls and foundations.

Strengthening to 100% NBS

- Achieving 100% NBS seismic rating would involve significant modifications to the strengthening scheme proposed for the Pyramid that would have serious implications on the functionality of the building.
- In addition, geotechnical analysis has noted that liquefaction of the ground below the building could become an issue as ground shaking approaches 100%NBS. To achieve 100% NBS on the Pyramid, its likely ground improvement or significant foundation work would be required under the building.
- Taking the structural and geotechnical factors into account, the option to strengthen the Pyramid to 100% NBS was not pursued further as it was deemed too complex from a construction perspective with a high cost premium and reduced building flexibility.

Pyramid Cladding Structure

As part of the seismic assessment of the Pyramid structure a deficiency in the snow loading capacity of the steel frame was identified. Addressing these deficiencies is mandatory to comply with the snow loading section of the NZ Building Code. To address the snow loading deficiency, the scope of work is invasive and will include:

- New SHS strut members around equal angle x-bracing around the base of the Pyramid steel frame
- Base plate connection strengthening of the existing steel frame to the concrete perimeter frame
- Removal of the Pyramid cladding will be required to provide access to strengthen these connections. Replacement of new roofing material has been included within the cost estimates

Geotechnical

Engeo Consulting was appointed to complete geotechnical investigations. Their findings are included at Appendix B and summarised as follows:

- Current foundation conditions including type and bearing capacity of existing foundations
- Liquefaction susceptibility assessment
- Geotechnical parameters for design of new foundations to support structural strengthening works

Work completed by Engeo include observation of two test pits to a depth of 2.0-2.5m and monitoring of Cone Penetrometer Tests to depths between 7.1 – 7.5m and their findings concluded:

- Liquefaction is unlikely at 34% NBS and very minor liquefaction anticipated at 67% NBS. Liquefaction will be a consideration at 100% NBS.
- Foundation conditions are reasonably good, and they will not drive the structural design

Architectural

Warren and Mahoney were appointed to provide a scope of architectural and interior refurbishment that would be required for 34% and 67% NBS only. Their scope assumed the current museum layout was to remain unchanged and museum displays and BOH layouts were not altered. They were limited to identification of:

- Refurbishment works required in areas of the building where structural strengthening was to occur
- Compliance with NZ Building Code in particular accessibility, fire and upgrades associated with those services.

Please refer to Warren and Mahoney's report at Appendix C which identifies refurbishment works required as a result of the structural strengthening works. The output from these reports has been incorporated into the cost estimates for these options.

Under options C, D and E it should be noted Warren and Mahoney did not provide any architectural input into their preparation. Option C has been prepared using the information from option A and B and square meter rates were used for option D and E

Building Services Design

Powell Fenwick, the Building Services Engineers have prepared a design memo addressing fire compliance, mechanical and electrical requirements (see Appendix D+E). Under fire compliance the report identifies the work required to comply with NZ Building Code. The building services memo identifies work required to address NZ Building Code requirements and also identifies additional work required to address "fit for purpose" issues.

It should be noted sustainable design principles have not been considered for option A and B but the estimates for option C, D and E do allow for some sustainable design principles to be explored.

5. OPTION ANALYSIS

The Pyramid building is earthquake prone and while not functionally obsolete, presents significant operational and financial challenges. While some of these challenges have been considered earlier in this report, we provide additional context around the options presented relevant to these challenges.

Option A – 34% NBS and Minimal Refurbishment

Under this option the building would be strengthened to 34% NBS allowing it to re-open. This option address's the structural issues of highest concern but given the low seismic resilience the building is likely to be damaged and in need of significant repair or demolition after an earthquake.
The strengthening work required would include:

- Installation of additional foundations and structural walls to support the building
- Tying of existing floors together and connecting them to new walls
- Strengthening of the roof frame and replacement of the roof material
- Upgrade to the fire safety system to comply with the NZ Building Code
- Improved accessibility compliance (ANARP)
- Refurbishment limited to areas where structural walls occurred – ceilings and floors

Advantages	Disadvantages
Lowest cost option	34% NBS - Low level building resilience – could be a risk remediation work required to the building following an earthquake
New roof which will address ongoing maintenance issues	Minimum refurbishment works – building will look and feel the same following an earthquake. No future proofing
	Will not address historic issues associated with access, storage, HVAC system, accessibility, IT
	Will not meet museum standards for storage collection
	Once building is open, work will continually be required to maintain building services
	Significant cost to only achieve 34% NBS with minimal refurbishment work
	Structural remediation projects are inherently risky and have a higher risk of cost blowouts.

Option B – 67% NBS and Minimal Refurbishment

Under this option the building would be strengthened to approximately 67% New Building Standard. This option addresses the structural issues of highest concern and increases the buildings ability to withstand an earthquake. It will also reduce the repair requirements to the building following an earthquake.
The strengthening work required would include:

- Installation of new foundations and structural walls to support the building.
- Tying existing floors together and connecting them to new walls (over and above the 34% option)
- Removal of all brickwork from the 1940's building
- Strengthening of the roof frame and replacement of the roof material
- Upgrade to the fire safety system to comply with the NZ Building Code
- Improved accessibility compliance (ANARP)
- Refurbishment limited to areas where structural walls occurred – ceilings and floors

Advantages	Disadvantages
Higher NBS rating and increased building resilience	Minimum refurbishment works – building will look and feel the same following an earthquake. No future proofing
New roof which will address ongoing maintenance issues	Increase to number of structural walls which could potentially impact functionality of layout
	Will not address historic issues associated with access, storage, HVAC system, accessibility, IT
	Will not meet museum standards for storage collection
	Once building is open, work will continually be required to maintain building services
	Significant cost to only achieve 67% NBS with minimal refurbishment work
	Structural remediation projects are inherently risky and have a higher risk of cost blowouts

Option C- 67% NBS and Full Refurbishment

Under this option the building would be strengthened to 67% New Building Standard and fully refurbished throughout. The structural works would be as per the information presented under Option B and the refurbishment scope would include:

- Full interior refurbishment including replacement of the Café
- Replacement of the existing Heating Ventilation and Air Conditioning System – upgrade would include compliance with museum standards
- Replacement of electrical services including new lighting throughout
- Upgrade to Fire Protection System
- Improved vertical circulation including new stairs and accessible lift
- Full IT upgrade
- New exhibition fitout
- New furniture, fittings and equipment (FF+E)
- General future proofing and durability

Advantages	Disadvantages
Higher NBS rating and increased building resilience	Increase to number of structural walls could potentially impact functionality of layout this but should be resolvable through design however compromises may be required
New roof which will address ongoing maintenance issues	Availability of storage is identified as an issue for staff. The refurbished building would be the same size as the existing building therefore storage may continue to be problematic
Fully refurbished building which will address all existing issues including access, HAVAC, accessibility. IT.	Structural remediation and refurbishment projects are inherently risky and have a much higher chance of cost blowouts.
New exhibition fitout and FFE	

Option D - Demolish Pyramid Building - Replacement Building with the same area as Existing Museum

No design information has been prepared for this option. Costs have been developed on a sqm basis and assume a "mid-range" level of construction and fitout. As costs for both options are identical, they have been grouped together but there are some nuances highlighted as follows:

1

Demolish the Pyramid and construct a new building on the same footprint at Queens Park

- This option assumes the existing Pyramid would be demolished and a replacement building positioned within the existing footprint. The Park Site Reserves Management Act allows for this option to be implemented and it would comply with the District Plan.

Advantages	Disadvantages
100% NBS rating to Importance Level 3 Standard. High level of building resilience	Demolition works can be risky and there can be unforeseen costs associated with environmental issues such as asbestos/contaminated ground
New building will be designed efficiently to reflect requirements of a 21st century museum	Could potentially be ongoing storage issues as the floor area is not increasing but this could be resolved through design
None of the constraints associated with refurbishing an existing building	

2

Demolish the Pyramid and construct a new building in the CBD

- For the purposes of this option, it is assumed a new building would be located within the Priority Redevelopment area of the CBD which includes the Invercargill Central Development.
- A museum would be considered a communal activity under the District Plan and thereby permitted in the City Centre but subject to compliance with specific design standards.
- **Should this option be taken forward, we would strongly recommend ICC undertake some initial space and location planning to determine suitability of site options for this activity.**

Advantages	Disadvantages
100% NBS rating to Importance Level 3 Standard. High level of building resilience	Demolition works can be risky and there can be unforeseen costs associated with environmental issues such as asbestos / contaminated ground
New building will be designed efficiently to reflect requirements of a 21st Century museum	Potential design constraints associated with a CBD development which would need to be tested before committing to this option
None of the constraints associated with refurnishing an existing building	Could potentially be ongoing storage issues as the floor area is not increasing but this could be resolved through design

Option E - Demolish Pyramid Building and Replacement Building with the Floor Area identified in the Tim Walker Report

No design information has been prepared for this option. Costs have been developed on a sqm basis and assume a "mid-range" level of construction and fitout. As costs for both options are identical, they have been grouped together but there are some nuances highlighted as follows:

1

Demolish the Pyramid and construct a new building on a larger footprint at Queens Park

- This option assumes the existing Pyramid would be demolished and a replacement building positioned within the same area as the existing building. The Park Site Reserves Management Act allows for this option to be implemented and an amendment has been introduced to extend the existing footprint. This option will comply with the District Plan.

Advantages	Disadvantages
100% NBS rating to Importance Level 3 Standard. High level of building resilience	Demolition works can be risky and there can be unforeseen costs associated with environmental issues
New building will be designed efficiently to reflect requirements of a 21st century museum	Increased building footprint results in increased construction costs – requirement for additional floor area should be stress tested
None of the constraints associated with refurbishing an existing building	

2

Demolish the Pyramid and construct a new building in the CBD

- For the purposes of this option, it is assumed a new building would be located within the Priority redevelopment area of the CBD which includes the Invercargill Central development.
- A museum would be considered a communal activity under the District Plan and thereby permitted in the City Centre. Albeit subject to compliance with specific design standards.
- **Should this option be taken forward, we would strongly recommend ICC undertaken some initial space and location planning to determine suitability of site options for this activity.**

Advantages	Disadvantages
100% NBS rating to Importance Level 3 Standard. High level of building resilience	Demolition works can be risky and there can be unforeseen costs associated with environmental issues
New building will be designed efficiently to reflect requirements of a 21st Century museum	Potential design constraints associated with the CBD development which would need to be tested before committing to this option
None of the constraints associated with refurnishing an existing building	Increased building footprint results in increased construction costs – requirement for additional floor area should be stress tested

6. COST ANALYSIS

Cost estimates for each option have been prepared by Rider Levett Bucknell (RLB) and is included at Appendix F. Please also refer to RLB's exclusions associated with each option.

General Commentary

- Across all options, an allowance of $4.5M has been identified to address collection storage requirements for the existing collection. This allowance is untested and should be viewed as an indicative figure only until the scope is resolved
- Option A, B and C carry a high proportion of risk due to the nature of refurbishment works. To address this, the quantity surveyor has accounted for risk in their estimate and project contingencies, but further design work will need to be carried out to verify the figures presented. The next phase of design will need to focus on the refurbishment component of option C as the structural costs are more clearly understood.
- Under option D and E, the quantity surveyor has estimated the project using "medium range" sqm rates.
- Option C, D and E have an allowance for Museum fitout, Furniture Fittings and Equipment and IT upgrades. The allowances have been benchmarked by RLB based on recent experience, but the scope could be refined once the brief becomes clearer
- **Under option D and E should Council decide to relocate from Queens Park, purchase price for land will need to be a consideration and is currently excluded**
- Costs have been escalated to Quarter 4 2024, should the project extend beyond that period additional costs will be incurred
- All prices are exclusive of GST

Summary of Capital Costs

A summary of the development costs associated with each option are detailed below and further analysis is provided in the sections below.

	Option A – 34% NBS and Minimum Refurbishment	Option B – 67% NBS and Minimum Refurbishment	Option C – 67% NBS and Full Refurbishment	Option D – New Build (Location TBC)	Option E – New Build as per Tim Walker area
Gross Floor Area	4,572 sqm	4,572 sqm	4,572 sqm	4,572 sqm	5,300 sqm
Capital Cost	$25.36M	$26.67M	$52.52M	$75.48M	$85.5M

Option A – 34% NBS and Minimal Refurbishment

Item	Total
Construction Works	$13.31M
Temporary Storage	$4.5M
Market Escalation (Q4 2024)	$1.35M
Professional Fees	$2.75M
Local Authority Charges	$450K
Contingency	$3M
TOTAL	**$25.36M**

Option B – 67% NBS and Minimal Refurbishment

Item	Total
Construction Works	$14.19M
Temporary Storage	$4.5M
Market Escalation (Q4 2024)	$1.43M
Professional Fees	$2.9M
Local Authority Charges	$450K
Contingency	$3.2M
TOTAL	**$26.67M**

Option C – 67% NBS and Full Refurbishment

Item	Total
Construction Works	$26.69M
Specialist Fitout Works	$7.9M
Temporary Storage	$4.5M
Market Escalation (Q4 2024)	$2.45M
Professional Fees	$4.6M
Local Authority Charges	$620K
Contingency	$5.76M
TOTAL	**$52.52M**

Option D - Demolish Pyramid Building - Replacement Building with the same area as Existing Museum

Item	Total
Construction Works	$36.38M
Specialist Fitout Works	$7.9M
Temporary Storage	$4.5M
Market Escalation (Q4 2024)	$5.37M
Professional Fees	$7.8M
Local Authority Charges	$950K
Contingency	$12.58M
TOTAL	**$75.48M**

Option E - Demolish Pyramid Building and Replacement Building with the Floor Area identified in the Tim Walker Report

Item	Total
Construction Works	$41.74M
Specialist Fitout Works	$9.13M
Temporary Storage	$4.5M
Market Escalation (Q4 2024)	$6.09M
Professional Fees	$8.76M
Local Authority Charges	$1.08K
Contingency	$14.26M
TOTAL	**$85.56M**

7. INDICATIVE TIMEFRAMES

To assist with decision making, indicative timeframes have been provided for each option and are summarised below:

Option A and B

- Option A and B are grouped together and have the shortest timeframe of all options (2 years and 3 months).
- The shorter timeframe is because no refurbishment work is proposed therefore a reduced design period is envisaged as there would be minimal engagement with stakeholder groups

Option C

- The programme proposed for option C is 3 years. This extension to option a and b reflects the refurbishment works to the building.
- Key to achieving this timeframe would be the establishment of a project governance process and stakeholder management plan to clearly understand design and service level requirements enabling design to progress. Well understood project approval gateways will also be critical.

Option D and E

The timeframe proposed for option D and E is 4 years. This may seem long, but a new building introduces additional steps including:

- Resolution of design options (no constraints associated with existing building) to ensure a more functional, fit-for-purpose and future proofed museum
- Demolition of the Pyramid (if the museum remains at Queens Park) before construction can commence on a new building
- Resolution of design requirements / interface with other buildings / projects if the museum moved into the CBD
- Should the Museum move to another location there could also be a risk the programme could extend beyond 48 months as a new site will need to be identified which could slow the overall process

Option	A	B	C	D	E
Designs	8 months	8 months	11 months	14 months	14 months
Tendering & Consenting	4 months	4 months	4 months	4 months	4 months
Construction	15 months	15 months	21 months	28 months	28 months
Duration	27 months	27 months	37 months	46 months	46 months

General

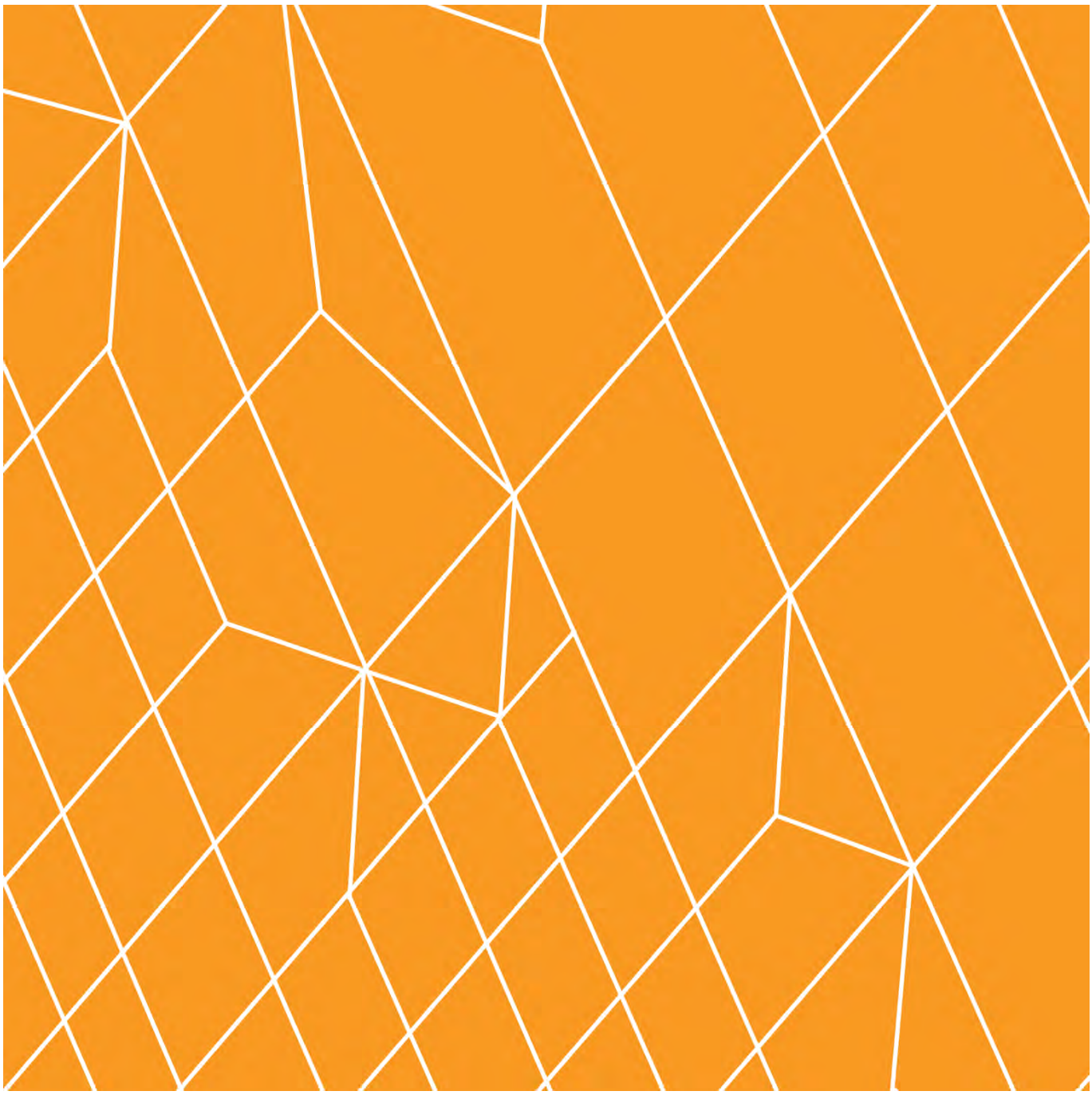
It is assumed, the museum collection will be removed from the Pyramid and relocated into storage in parallel with design development under each of the options provided. This will be critical to maintaining programme and Council should not overlook this package of work as it will be time consuming.

8. NEXT STEPS

Once a preferred option has been identified a design and service level brief will be required to ensure the building to be developed will align with Council vision for the future museum

The brief will set the vision for the project and inform the next phases of procurement, design development, construction, and fitout to ensure the projects objectives are met

Establishment of a project governance structure will be critical to support development of the design and service brief.



Southland Museum & Art Gallery

108 Gala Street
Queens Park
Invercargill 9810

Seismic Strengthening Options Summary Report

Holmes Consulting

Revision 1
13 November 2020
140859.13

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Report
Southland Museum & Art Gallery - Seismic Strengthening Options Summary Report

Prepared For:
Invercargill City Council

Date: 13 November 2020
Project No: 140859.13
Revision No: 1

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Report Issue Register

DATE	REV. NO.	REASON FOR ISSUE
13/11/2020	1	Information

CONTENTS

1 INTRODUCTION

Holmes Consulting LP have been engaged by Invercargill City Council to conduct a detailed structural review of the Southland Museum and Art Gallery building in Invercargill.

The extent of work to date has involved:

- A detailed review of the available existing structural drawings and reports
- Observations of the exposed structure via a site visit and further visual observations available from the provided Matterport scan
- Assessing the capacity of the existing building
- Providing high level strengthening schemes targeting 34, 67 and 100% NBS seismic capacity

2 LIMITATIONS

Findings presented as a part of this project are for the sole use of Invercargill City Council in its evaluation of the subject properties. The findings are not intended for use by other parties, and may not contain sufficient information for the purposes of other parties or other uses.

Our observations have been visual only and are limited to representative samples. Our observations have been restricted to structural aspects only. Waterproofing elements, electrical and mechanical equipment, fire protection and safety systems, service connections, water supplies and sanitary fittings have not been inspected or reviewed, and secondary elements such as windows and fittings have not generally been reviewed.

Our professional services are performed using a degree of care and skill normally exercised, under similar circumstances, by reputable consultants practicing in this field at this time. No other warranty, expressed or implied, is made as to the professional advice presented in this report.

3 BUILDING AREAS

For our assessment and strengthening schemes we have addressed the building as 3 separate areas:

- the original 1940s building
- the combination of the 1988 and 1960s sections of the building which encapsulates the 1940s building
- the lightweight pyramid cladding structure which covers all the building areas

Refer to Figure 1 for a depiction of the respective building areas.

This division of building areas has been chosen following the decision to keep the 1940s structure seismically separated from the rest of the building. The 1960s and 1988 areas of the building are flexible frame structures which behave differently to the stiffer 1940s wall structure. The floor levels of the 1940s section of the building do not align with the rest of the structure which would make connecting the 1940s section to the rest of the building problematic. This led to the decision to keep these sections of the building seismically separated.

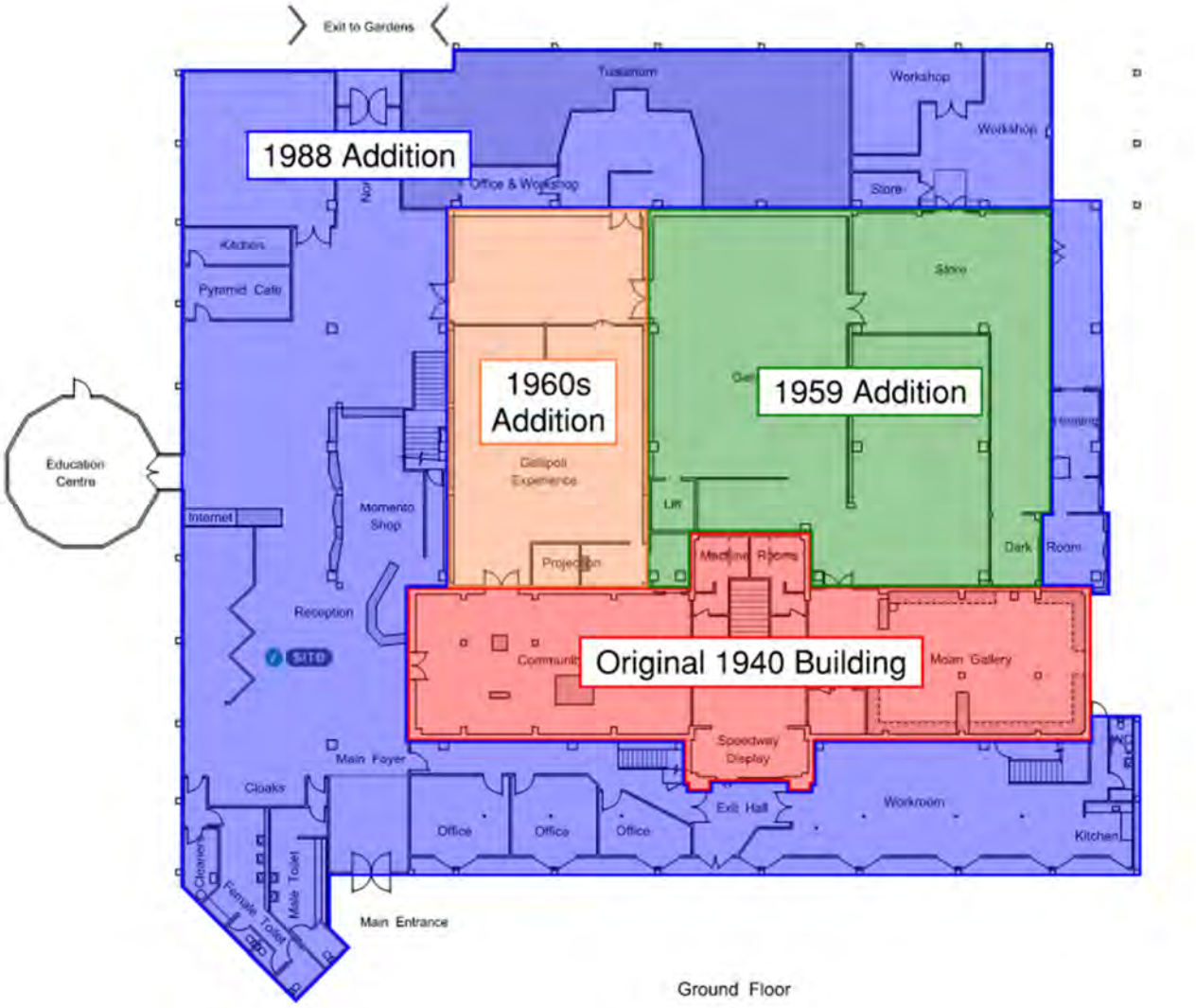


Figure 1 - Designation of building areas at ground floor

4 1940S SECTION

The 1940s section of the building is the oldest section. It is a 2-storey reinforced concrete frame and wall structure. It has a timber framed roof which is supported by reinforced concrete walls and columns. It has a reinforced concrete floor at the suspended first-floor level and a suspended timber floor at ground level. The building is founded on concrete pad footings located under the concrete walls.

Seismic loads are transmitted by the timber roof and the first-floor concrete diaphragm to the perimeter reinforced concrete walls which then provide the lateral load resisting system.

The building is clad with an external layer of brick veneer and it is unknown how well this has been connected to the reinforced concrete structure.

4.1 34% NBS Strengthening Scheme

The 1940s building was assessed using the NZSEE Seismic Assessment Guidelines (2017) and found to have a seismic capacity of less than 34% NBS.

To achieve 34% NBS seismic strength the following strengthening works are required:

- New reinforced concrete walls cast against the interior face of the existing walls throughout the building at both levels
- New reinforced concrete foundation beams under the majority of the perimeter walls and central lobby / stair area
- Strengthening of the first-floor concrete slab – details to be confirmed but will likely involve drilling and epoxying and/or chasing and grouting reinforcing bars into the concrete slab
- New reinforced concrete overlay to the first-floor concrete slab at the east and west ends of the building
- New flat plywood ceiling diaphragm at the underside of the existing timber roof members
- New steel collector beams / straps to connect the new plywood ceiling diaphragm to the new concrete walls
- Either fixing the existing brick veneer to the new existing reinforced concrete walls with Helifix brick ties or similar, or the removal of the brick veneer. The extent of this can be modified with some areas of the veneer fixed and others removed as desired.

Refer to the appended structural sketches SSK11-15 for the 34%NBS seismic strengthening scheme plans.

4.2 67% NBS Strengthening Scheme

To achieve 67% NBS seismic strength the following strengthening works in addition to or modifying the 34% NBS scheme are required:

- Removal of the brick veneer around the building permitter to reduce the seismic weight of the building
- Either remove the existing brick / concrete parapet to roof level or brace it back into the roof with new steel bracing structure

Refer to the appended structural sketches SSK16-20 for the 67%NBS seismic strengthening scheme plans.

4.3 100% NBS Strengthening Scheme

The aim of achieving 100% NBS seismic strengthening was not pursued in the same level of detail as 34% and 67% NBS as it would involve significant modifications to the strengthening scheme. A plywood roof diaphragm would not provide adequate capacity and steel bracing or similar would be required. Additionally, all existing walls would need to be braced to accommodate out-of-plane (face loading) demands.

Initial geotechnical analysis has noted that liquefaction of the ground below the building could become an issue as ground shaking approaches 100%NBS. The %NBS strength of the building is dependent on the ground conditions and it is likely that ground improvement or significant foundation works would be required to achieve a seismic strength of 100%NBS accounting for the liquefaction risk.

5 1988 AND 1960S SECTION

In the 1960s an addition was made to the existing 1940s structure. This addition was constructed using reinforced concrete frames with a concrete Double Tee floor at the first floor. The structure was founded on concrete pad foundations. This addition was not connected to the 1940s structure but was constructed with a nominal 50mm (to be confirmed) separation between the buildings.

In 1988 a larger addition was constructed. This addition encapsulated the existing 1940s and 1960s buildings by constructing a reinforced concrete frame structure around the existing building. A new Rib-and-Timber concrete floor was added to the north-east area where a structure had been constructed in 1959 but was removed as part of this 1988 addition. A new concrete Rib-and-Timber floor was added at the second-floor level that extended over the existing 1940s and 1960s roofs.

The 1988 construction was tied into the 1960s addition, but seismic separations were maintained around the 1940s building, effectively leaving the 1940s building as an independent structure inside the rest of the building.

5.1 34% NBS Seismic Strengthening Scheme

The 1988 and 1960s sections of the building were assessed using the NZSEE Seismic Assessment Guidelines (2017) and found to have a seismic capacity of less than 34% NBS.

To achieve 34% NBS seismic strength the following strengthening works are required:

- New reinforced concrete walls cast between the existing concrete frames throughout the building at both levels. The location of these walls has been chosen to minimise disruption to the current operable space
- New reinforced concrete foundation beams under all new concrete walls
- Removal of the existing infill walls in the north gallery space at the ground floor level
- Tying of the 1960s Double Tee reinforced concrete first-floor slab to the surrounding concrete frames and 1988 Rib-and-Timber concrete floor slab
- Localised chasing of a steel plate or reinforcing bars around the existing stair void in the 1960s first floor slab
- New concrete collector beams to the first and second floor slabs between the concrete ribs / Double Tee webs
- New concrete collector beam to the perimeter of the building cast above and tied into the existing perimeter frame
- Investigation and potential widening of the existing seismic separation between the 1988 and 1940s areas of the building

Refer to the appended structural sketches SSK6, 7 and 21-23 for the 34%NBS seismic strengthening scheme plans.

5.2 67% NBS Seismic Strengthening Scheme

To achieve 67% NBS seismic strength the following strengthening works in addition to or modifying the 34% NBS scheme are required:

- Additional concrete walls and accompanying foundation beams throughout the building
- Increased first and second floor concrete slab diaphragm strengthening

Details of the diaphragm strengthening are to be confirmed. The extent of the strengthening required will be dependent on calculations that are completed during the Developed Design phase of the project.

Refer to the appended structural sketches SSK24-25 for the 34%NBS seismic strengthening scheme plans.

5.3 100% NBS Seismic Strengthening Scheme

The 100% NBS seismic strengthening scheme was not pursued for the 1960s/1988 section of the building in detail as the overall building capacity would be limited by the 1940s section of the building as the lowest seismic rating for a building area must be used for the whole building.

Additional reinforced concrete walls and foundations would likely be required if 100% NBS seismic strengthening were to be pursued. Significant additional strengthening to the first and second floor concrete slab diaphragms would be required.

As with the 1940s section of the building, the strength of the 1960s/1988 section would also be dependent on the liquefaction risk at near 100%NBS ground shaking levels. The foundations for this area of the building are localised reinforced concrete pads under the columns which may be susceptible to differential settlements should liquefaction occur. To achieve 100%NBS seismic strength it is likely that ground improvement and / or strengthening the foundations with connecting beams between the existing pads would be required.

6 PYRAMID CLADDING STRUCTURE

As part of the 1988 construction work a lightweight pyramid shaped cladding roof structure was constructed over the full building envelope. This structure is constructed with lightweight cladding panels which are supported on a steel frame. The steel frame is supported by the reinforced concrete perimeter frame constructed in 1988.

6.1 Strengthening Scheme

As part of the seismic assessment of the pyramid structure a deficiency in the snow loading capacity of the steel frame was identified. Addressing these deficiencies is mandatory to comply with the snow loading section of the Building Code. The benefit of completing this work is that the seismic strength of the pyramid steel support frame becomes greater than 100% NBS.

To address the snow loading deficiency the following strengthening work is required:

- New SHS strut members and equal angle x-bracing around the base of the pyramid steel frame
- Base plate connection strengthening of the existing steel frame to the concrete perimeter frame. Removal of the pyramid cladding will be required to provide access to be able to strengthen these connections between the steel frames and the concrete perimeter frame.

A new lightweight cladding system is being considered as part of the architectural works for the pyramid. To accommodate the change in cladding system new steel purlins will be required to support the cladding and span over the existing steel frame.

Refer to the appended structural sketches SSK08-09 for the seismic strengthening scheme plans.

7 CONCLUSION

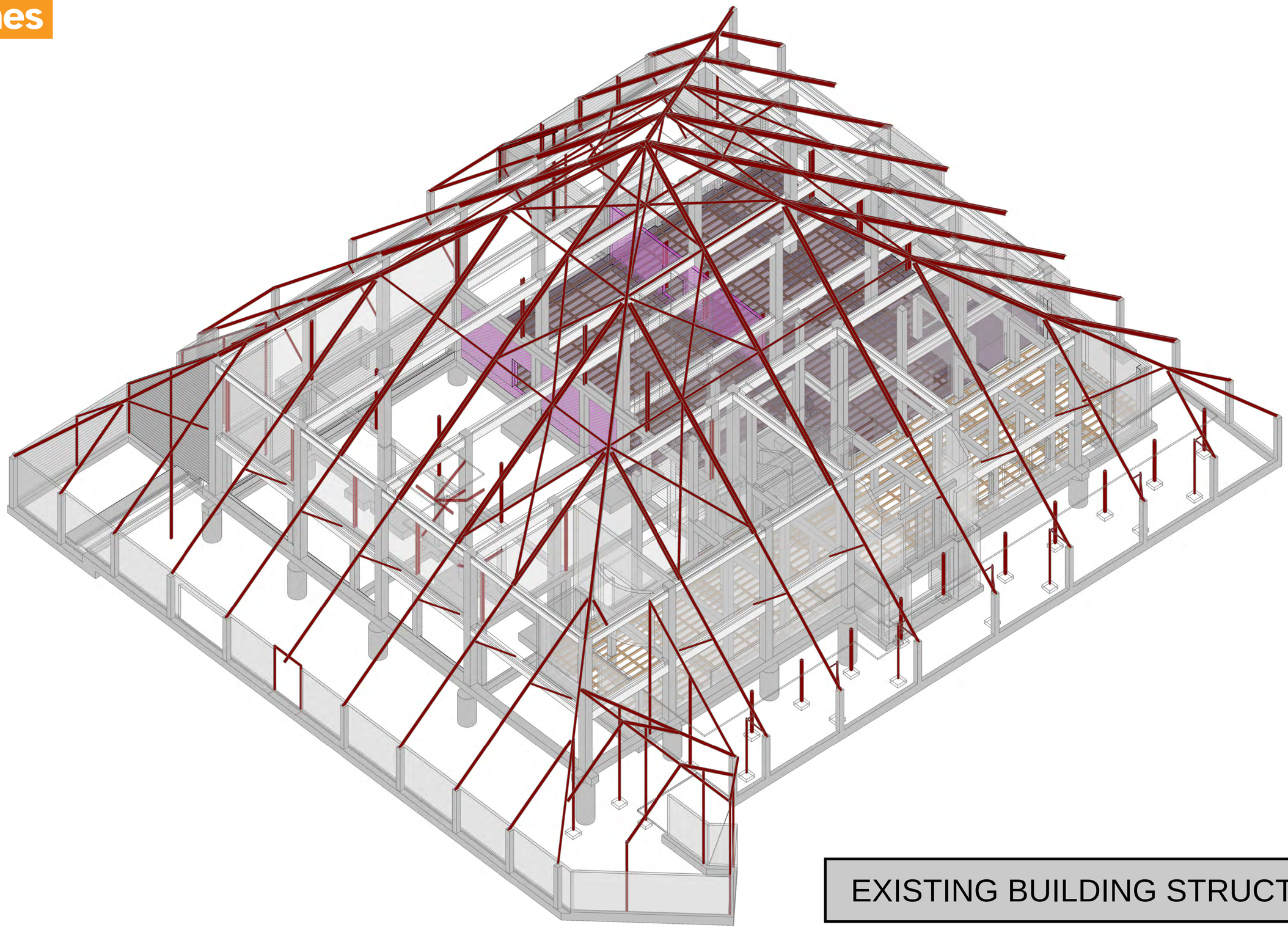
Preliminary options have been presented in this report for achieving 34% NBS and 67% NBS seismic strengthening for the Southland Museum and Art Gallery in Invercargill. During the consultation process the investigation of 100% NBS seismic strengthening was discontinued due to the step change in the amount of structural strengthening required and potential geotechnical issues with liquefaction.

We typically recommend our clients consider strengthening to at least 67%NBS, although we appreciate the final decision depends on a number of factors. The information we have provided in this report will help to inform this decision, but the level of seismic strengthening chosen is at the discretion of Invercargill City Council.

Our strengthening design is currently at a Preliminary Design level of detail. This has confirmed the major structural components and given descriptions of the likely detail. To achieve a Building Consent and For Construction documents we will need to progress the design through the Developed and Detailed Design stages.

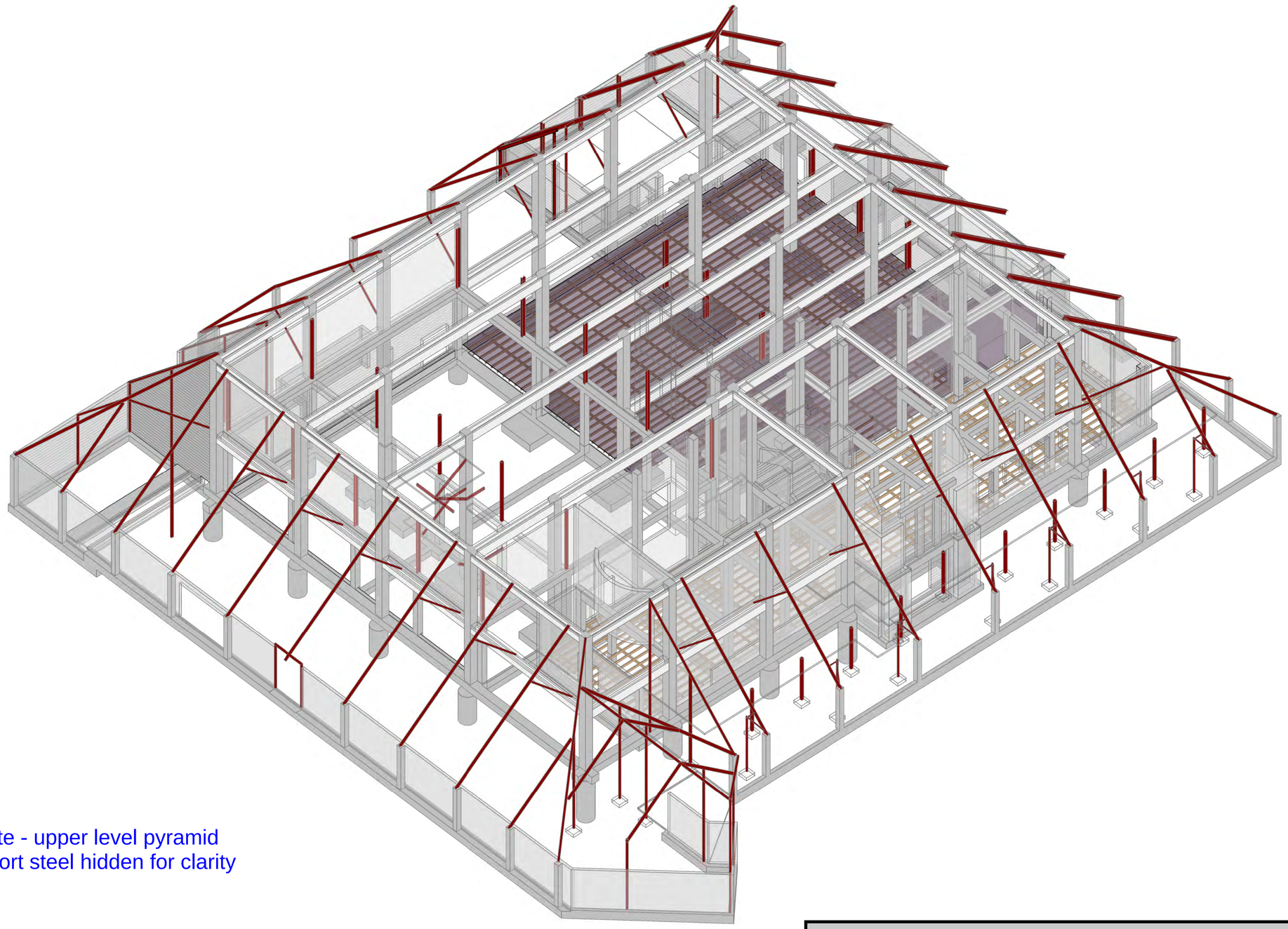
Appendix A - Seismic Strengthening Sketches

Holmes



EXISTING BUILDING STRUCTURE

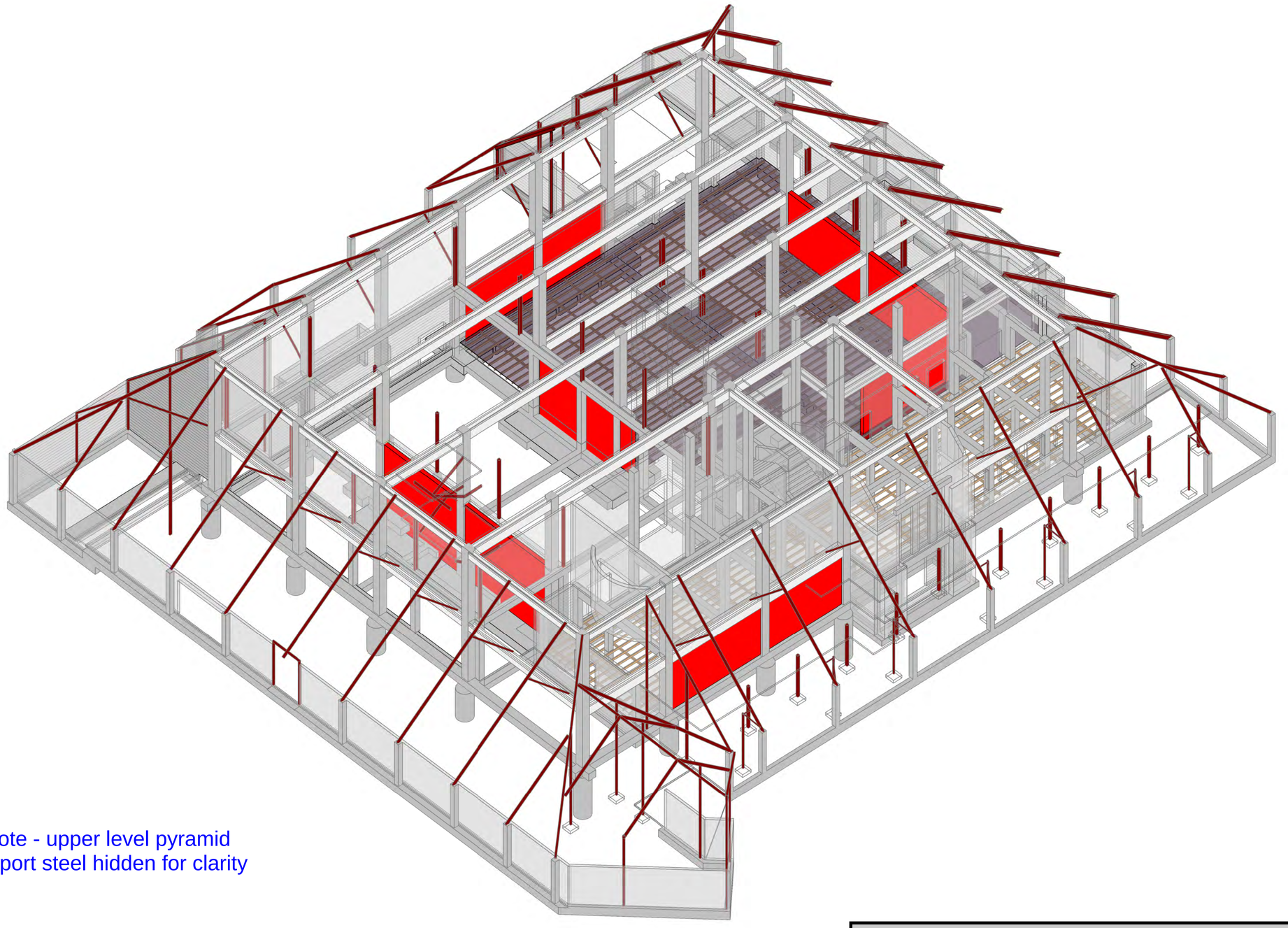
Holmes



Note - upper level pyramid
support steel hidden for clarity

STAGE 1 - REMOVAL OF 1959 WALLS

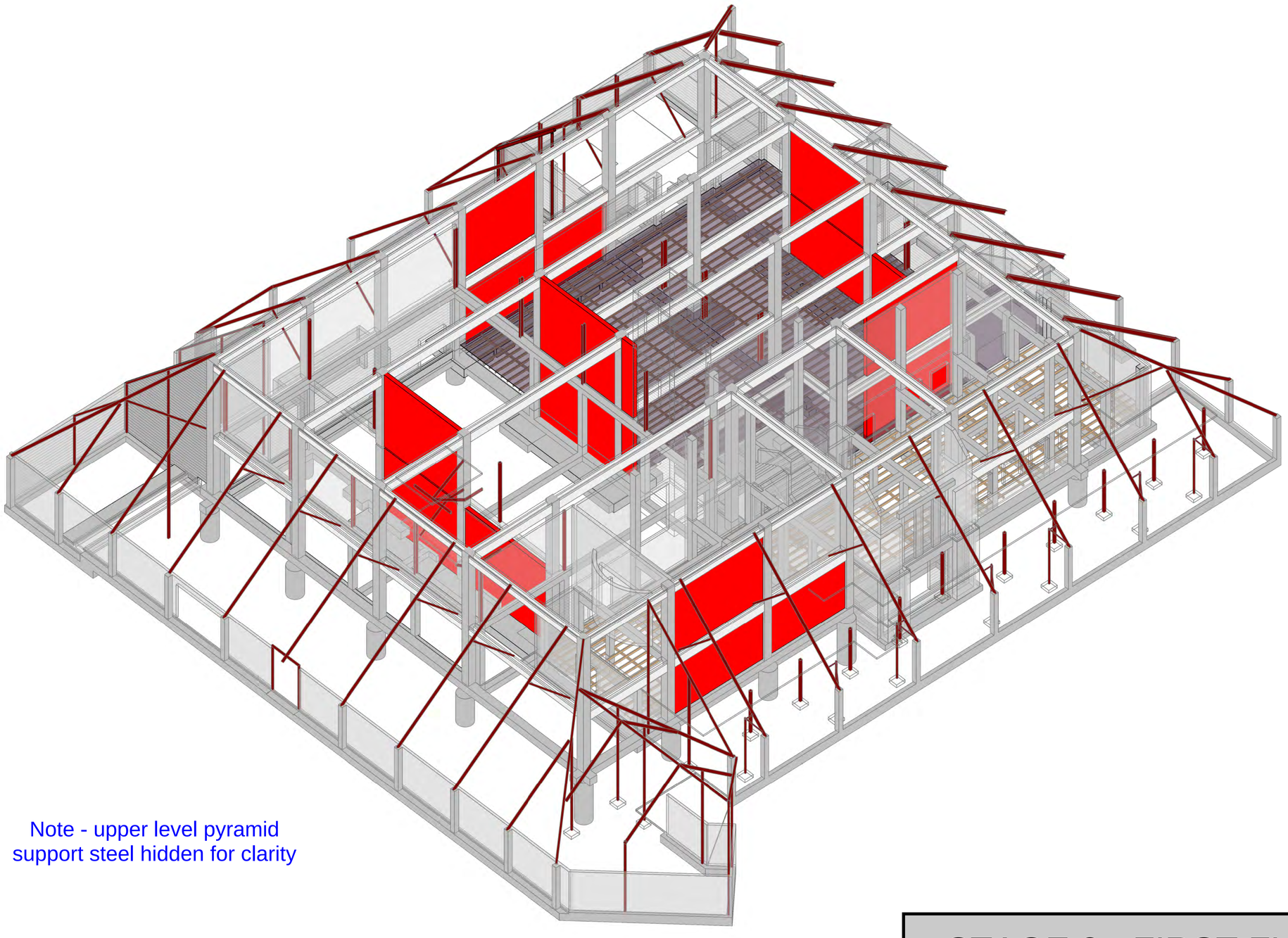
Holmes



Note - upper level pyramid
support steel hidden for clarity

STAGE 2 - GROUND FLOOR WALLS

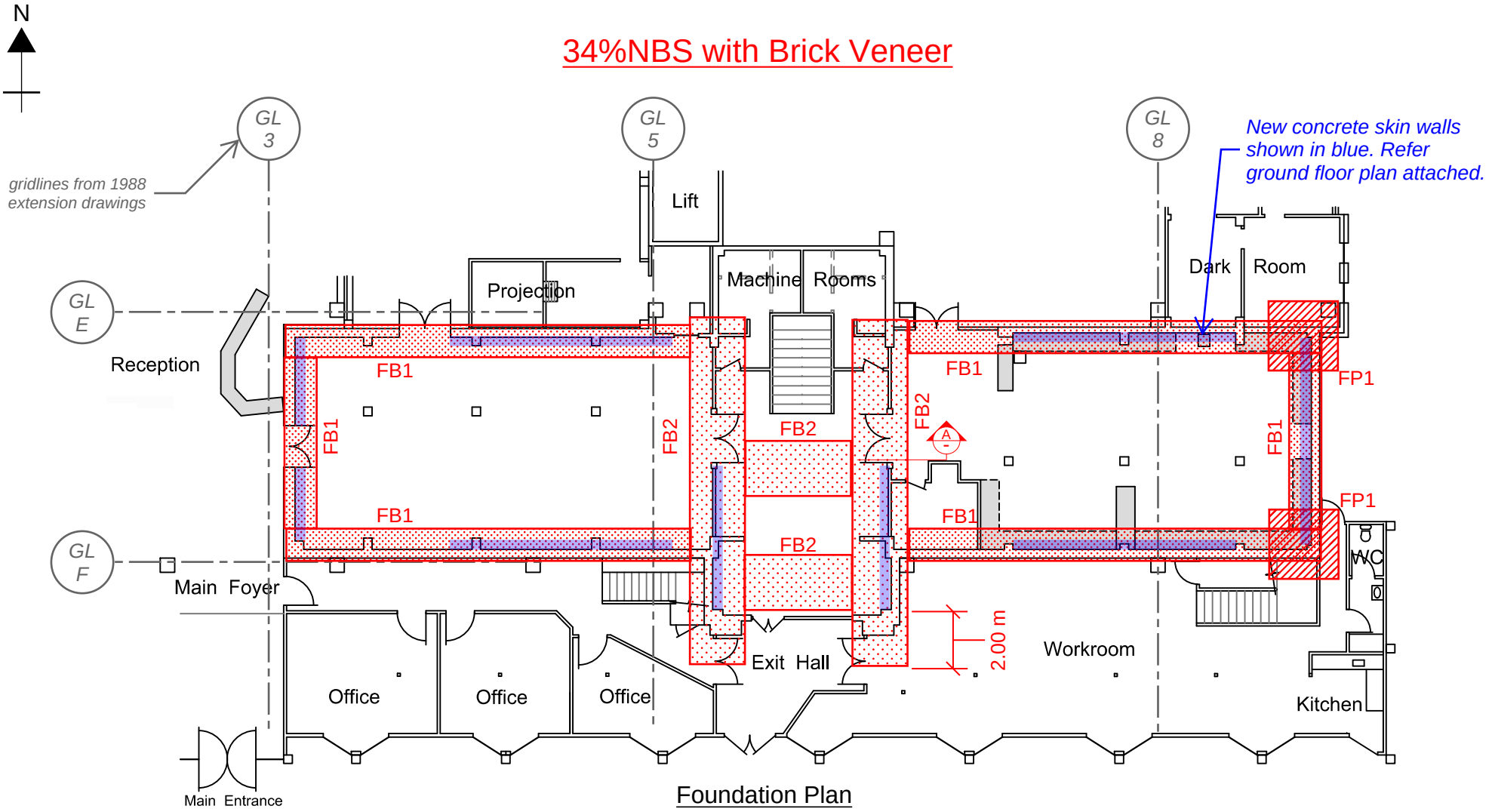
Holmes



Note - upper level pyramid
support steel hidden for clarity

STAGE 3 - FIRST FLOOR WALLS

34%NBS with Brick Veneer



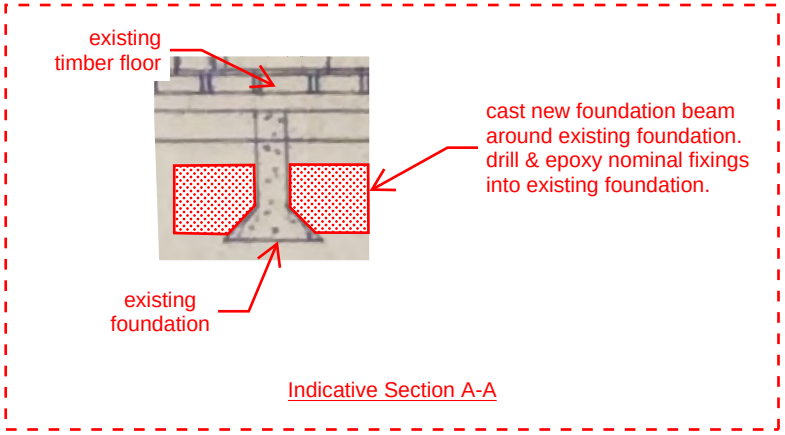
Foundation Plan

Legend:

FP1 - 2500x2500x600 deep insitu concrete foundation pad. Allow for 120kg/m³ reinforcing.

FB1 - 1200x600 deep insitu concrete foundation beam. Allow for 110kg/m³ longitudinal reinforcing and 35kg/m³ stirrup reinforcing.

FB2 - 2000x600 deep insitu concrete foundation beam. Allow for 100kg/m³ longitudinal reinforcing and 35kg/m³ stirrup reinforcing.



Indicative Section A-A

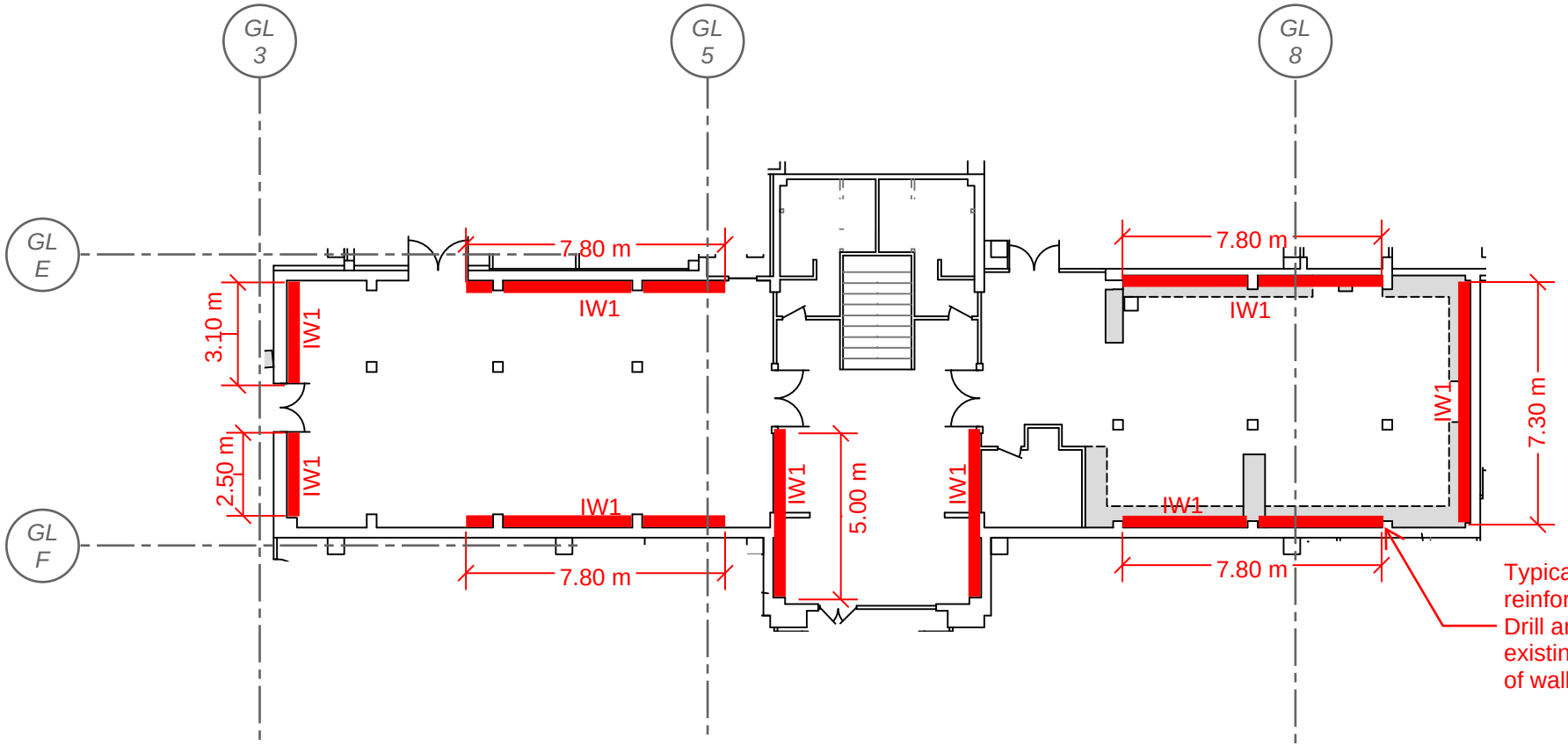
Holmes

PROJECT: Southland Museum Redevelopment

JOB NO: 140859.13 DATE: 14/10/2020

SSK: 11 REV: 1

34%NBS with Brick Veneer



N

Legend:

IW1 - 200 thick insitu concrete skin wall.
Allow for 120kg/m³ reinforcing.

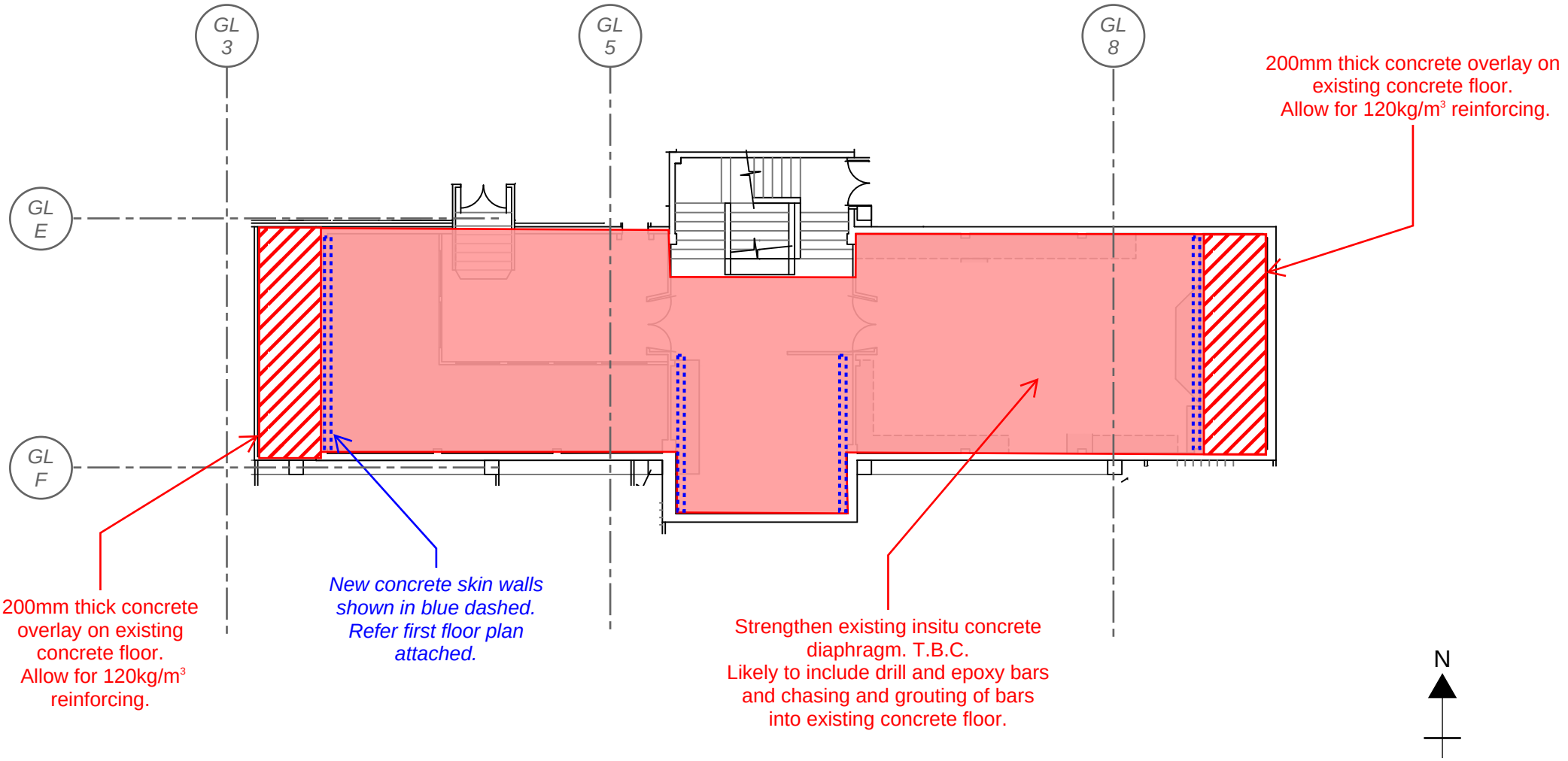
Ground Floor Plan

Note:
Fix existing brick veneer to existing concrete wall. e.g. Helifix fasteners or drill and epoxy threaded rod at 400crs e.w. Alternatively, remove brick veneer.

Holmes

PROJECT: Southland Museum Redevelopment
JOB NO: 140859.13 DATE: 14/10/2020
SSK: 12 REV: 1

34%NBS with Brick Veneer



First Floor Concrete Diaphragm Plan

Note:
Fix existing brick veneer to existing concrete wall. e.g. Helifix fasteners or drill and epoxy threaded rod at 400crs e.w. Alternatively, remove brick veneer.

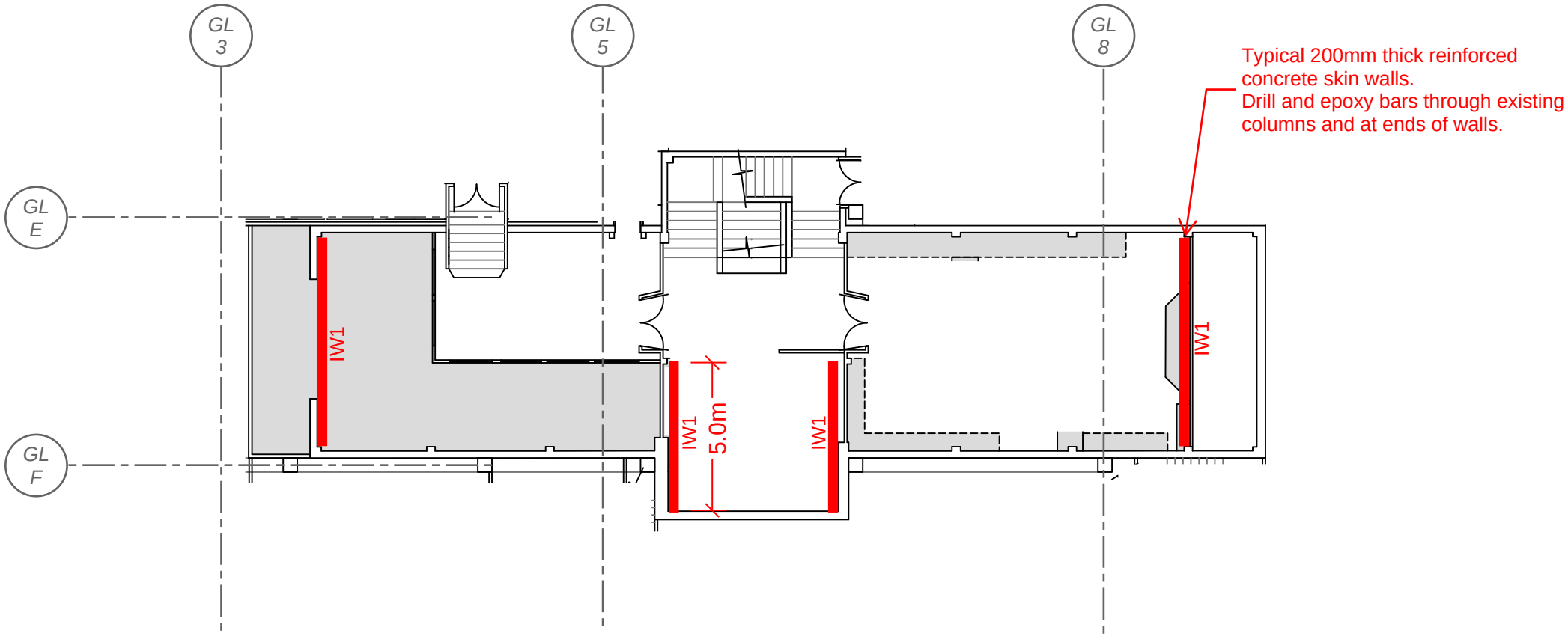
Holmes

PROJECT: Southland Museum Redevelopment

JOB NO: 140859.13 DATE: 14/10/2020

SSK: 13 REV: 1

34%NBS with Brick Veneer



Legend:

IW1 - 200 thick insitu concrete skin wall.
Allow for 120kg/m³ reinforcing.

First Floor Walls Plan

Note:
Fix existing brick veneer to existing concrete wall. e.g. Helifix fasteners or drill and epoxy threaded rod at 400crs e.w. Alternatively, remove brick veneer.

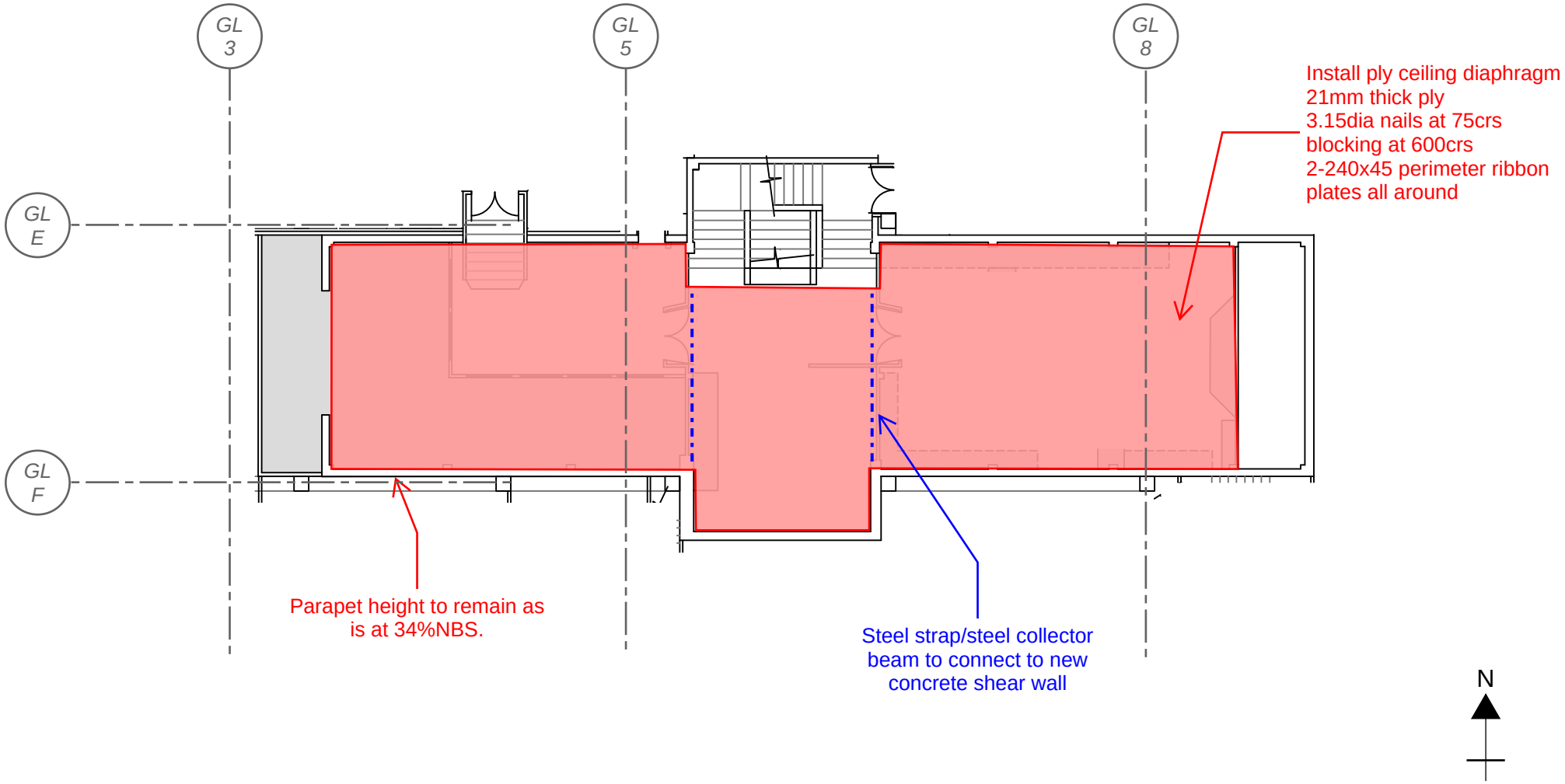
Holmes

PROJECT: Southland Museum Redevelopment

JOB NO: 140859.13 DATE: 14/10/2020

SSK: 14 REV: 1

34%NBS with Brick Veneer



Roof Plan

Note:
Fix existing brick veneer to existing concrete wall. e.g. Helifix fasteners or drill and epoxy threaded rod at 400crs e.w. Alternatively, remove brick veneer.

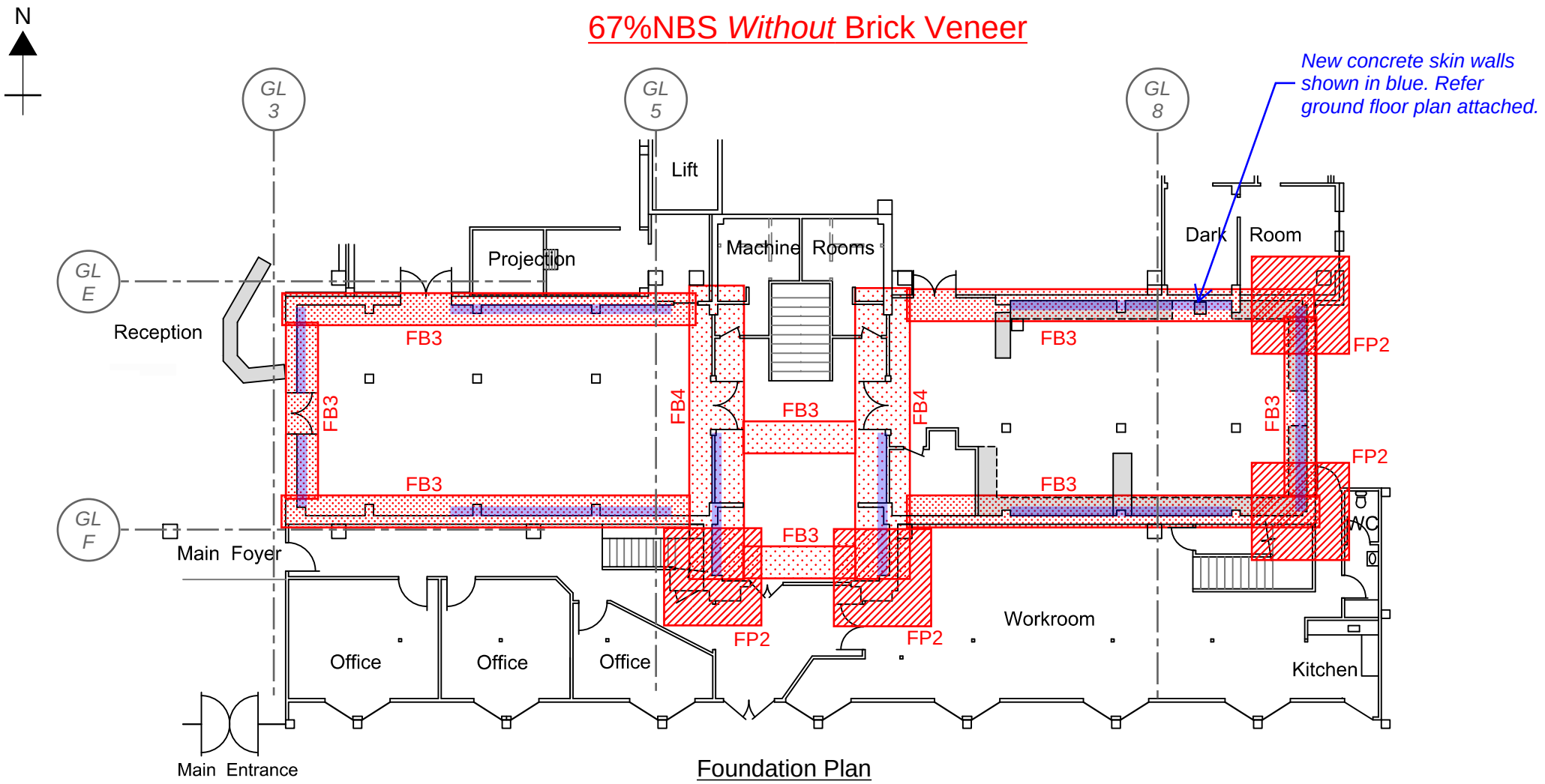
Holmes

PROJECT: Southland Museum Redevelopment

JOB NO: 140859.13 DATE: 14/10/2020

SSK: 15 REV: 1

67%NBS *Without* Brick Veneer



Foundation Plan

Legend:

FP2 - 3500x3500x1000 deep insitu concrete foundation pad. Allow for 120kg/m^3 reinforcing.

FB3 - 1200x800 deep insitu concrete foundation beam. Allow for 100kg/m^3 longitudinal reinforcing and 35kg/m^3 stirrup reinforcing.

FB4 - 2000x1000 deep insitu concrete foundation beam. Allow for 100kg/m^3 longitudinal reinforcing and 35kg/m^3 stirrup reinforcing.

Note:
Existing brick veneer to be removed.

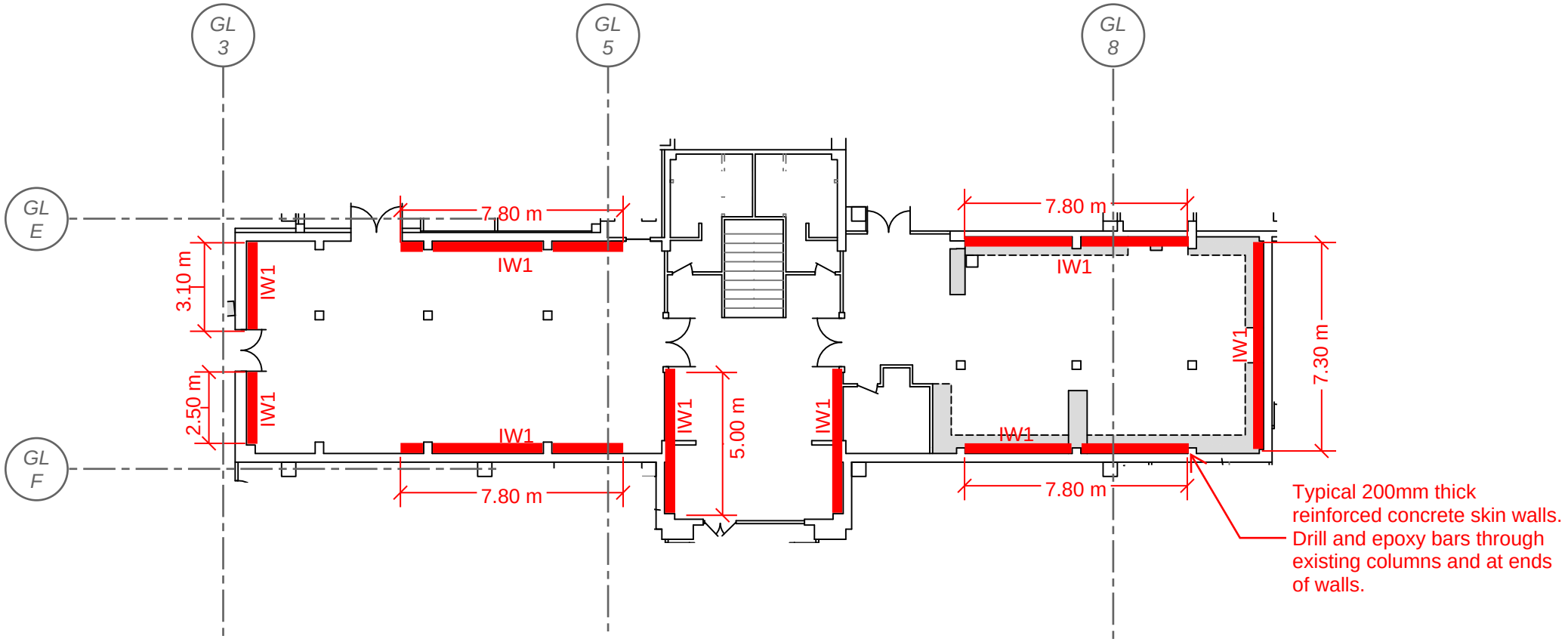
Holmes

PROJECT: Southland Museum Redevelopment

JOB NO: 140859.13 DATE: 14/10/2020

SSK: 16 REV: 1

67%NBS *Without* Brick Veneer



N

Legend:

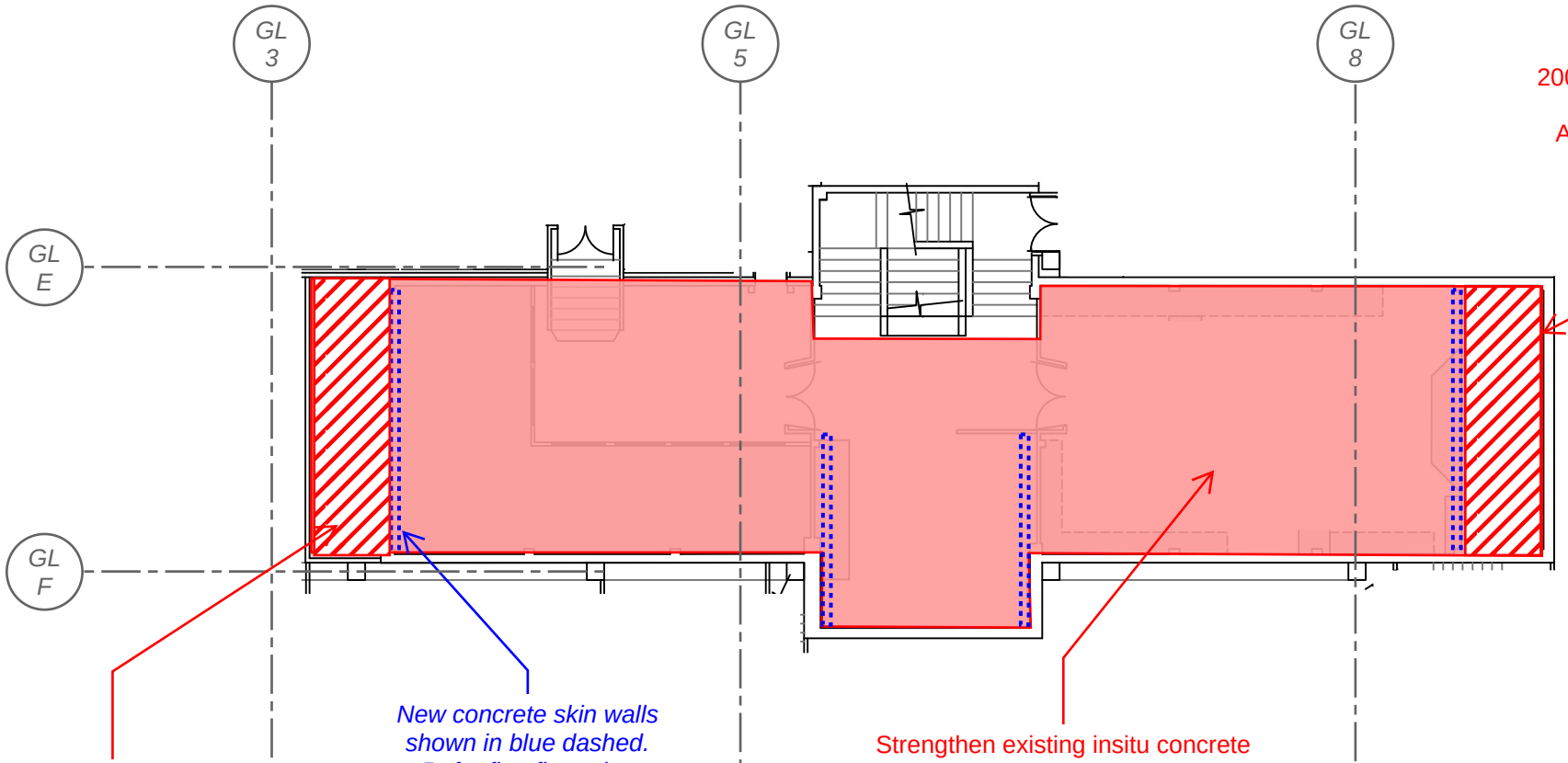
IW1 - 200 thick insitu concrete skin wall.
Allow for 140kg/m³ reinforcing.

Note:
Existing brick veneer to be removed.

Ground Floor Plan

PROJECT: Southland Museum Redevelopment
JOB NO: 140859.13 DATE: 14/10/2020
SSK: 17 REV: 1

67%NBS *Without* Brick Veneer



Note:
Existing brick veneer to be removed.

First Floor Concrete Diaphragm Plan

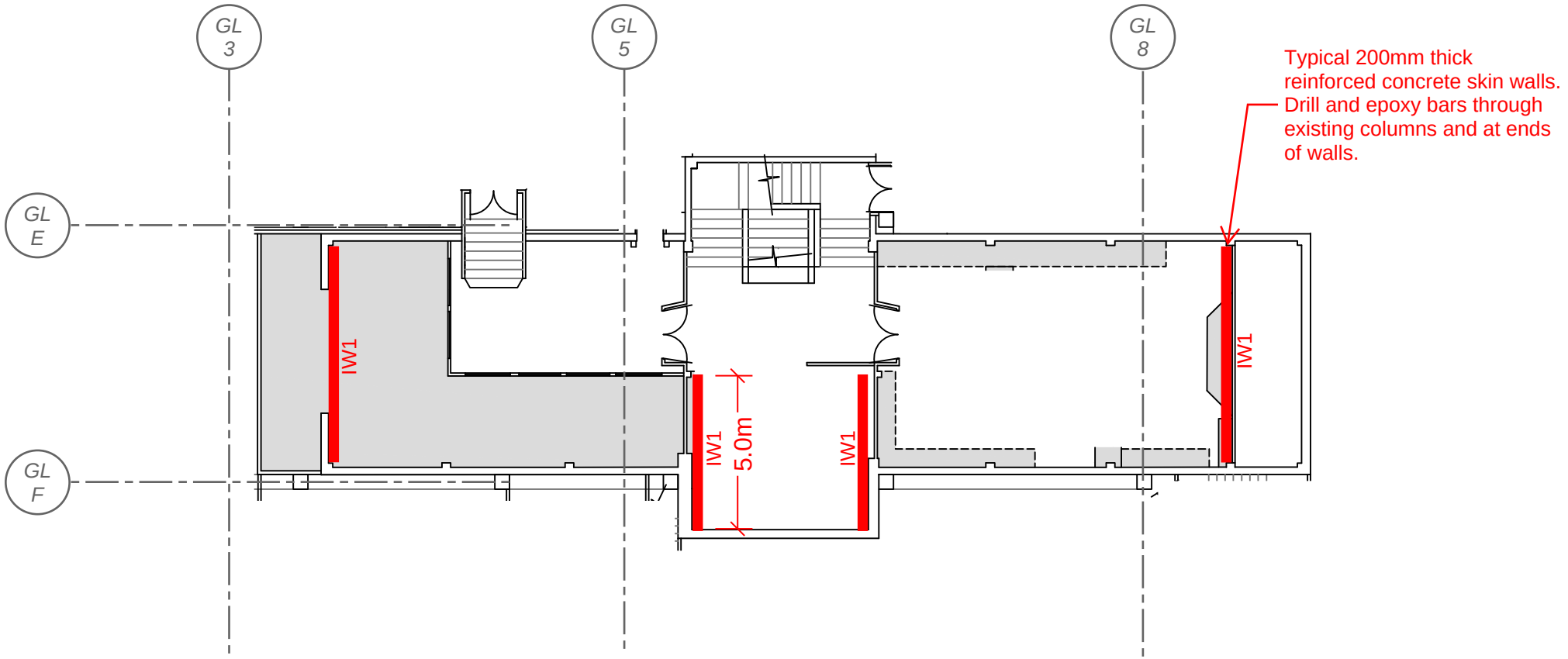
Holmes

PROJECT: Southland Museum Redevelopment

JOB NO: 140859.13 DATE: 14/10/2020

SSK: 18 REV: 1

67%NBS *Without* Brick Veneer



N

Legend:

IW1 - 200 thick insitu concrete skin wall.
Allow for 140kg/m³ reinforcing.

First Floor Walls Plan

Note:
Existing brick veneer to be removed.

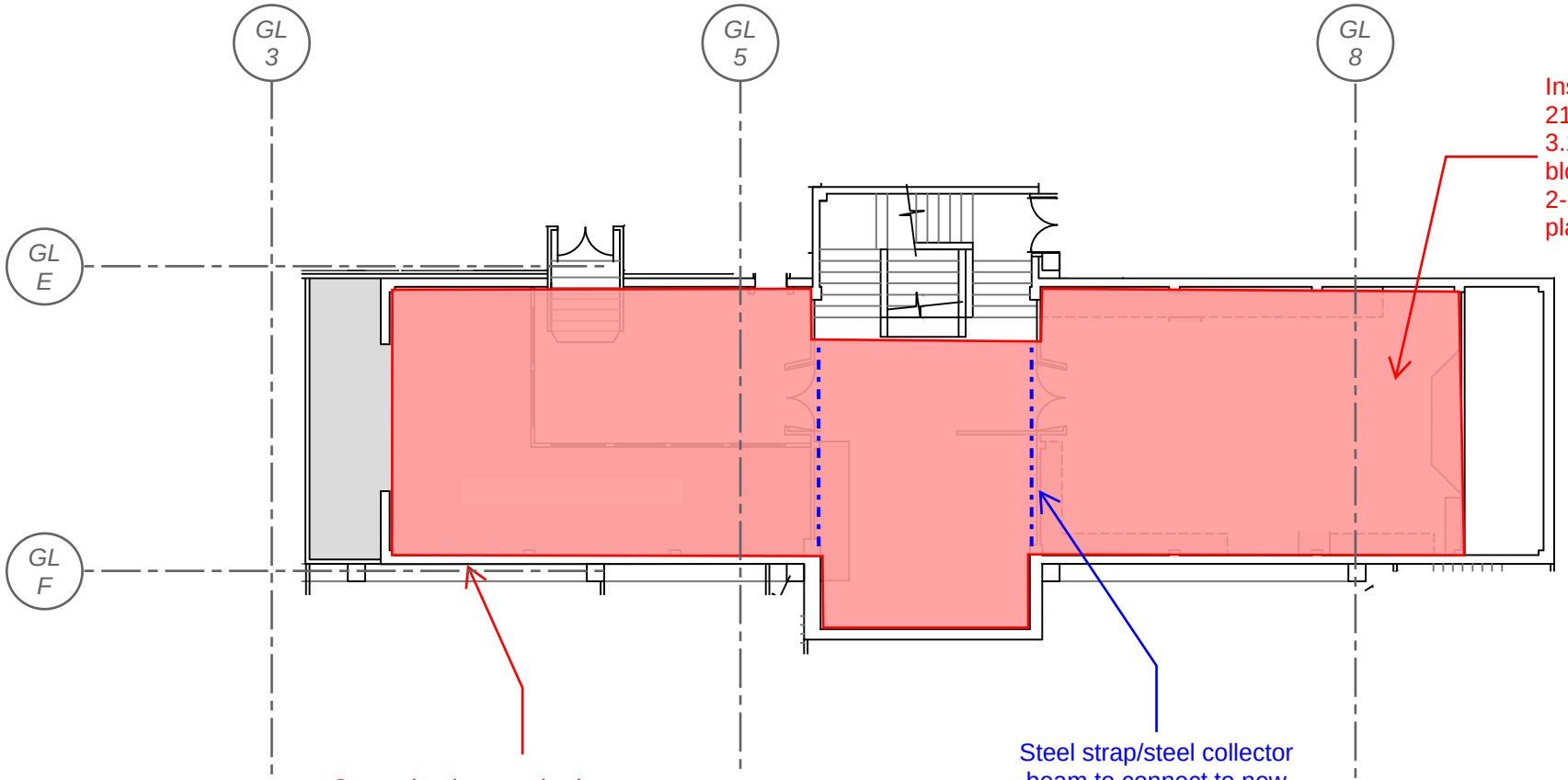
Holmes

PROJECT: Southland Museum Redevelopment

JOB NO: 140859.13 DATE: 14/10/2020

SSK: 19 REV: 1

67%NBS *Without* Brick Veneer



Note:
Existing brick veneer to be removed.

Roof Plan

PROJECT: Southland Museum Redevelopment

JOB NO: 140859.13 DATE: 14/10/2020

SSK: 20 REV: 1

DO NOT SCALE IF IN DOUBT ASK

Location of 250mm thick insitu concrete walls
Wall reinforcing content - allow for 140kg/m³

0.6m deep insitu concrete foundation beams under new concrete walls. Typically extends 1m beyond the column at each end of the wall.

For 34%NBS total beam width = 2m

Allow for 70 kg/m3 longitudinal reinforcing
55 kg/m3 stirrups

Wall on Grid B shifted to allow for egress route

clouded walls to be removed to open up the space and remove a structural weakness

These foundations shown are in addition to the 1940s building new foundations. The foundations for the 2 buildings will likely be cast as one in this area but for pricing purposes the cost of each should be added together.

Foundation 34% Seismic Strengthening Scheme

EXISTING 100 THICK CONCRETE SLAB F.C.L. -0.50

EXISTING TIMBER FLOOR F.F.L. 0.00

100 THICK CONC. SLAB WITH 665 MESH ON O.P.M. F.C.L. 0.00

EXISTING TIMBER FLOOR FFL 0.00

EXISTING CONCRETE FLOOR SLAB

STAIRWAY 1

STAIRWAY 2

UNDERPIN 2000 LONG STRIP UNDER FOOTING REFER TO G17

Typical extension from column at ends of walls 1,000 mm

600 Sq. THICKENING

20mm RECESS IN CONCRETE SLAB.

SAW CUT OR FORMED CONC. JOINT

1500 x 1000 x 400 DEEP FOOTING

1200 x 1200 x 400 DEEP FOOTING

KEY
150 ϕ uPVC PIPE FOR SUBFLOOR VENTING

The provisions of the Invercargill City Council Bylaws override anything that is inconsistent in this Specification & must be complied with.

No.	AMENDMENTS	Date	Initial

Royds Garden Consulting Engineers & Planners

Royds Garden Limited
Christchurch, Dunedin, Invercargill, Balclutha, Alexandra, Queenstown, Oamaru, Timaru, Greymouth, Blenheim, Palmerston North

F.B.	Initials	Date		Initials	Date
SURV			TR.		
DGN	MJH/FLH	Dec 05	CH.		
DR.	GWK	Dec 05	APP.		

CLIENT: SOUTHLAND MUSEUM & AND ART GALLERY TRUST BOARD

JOB NAME: BUILDING REDEVELOPMENT STAGE 1

TITLE: FOUNDATION PLAN (LEVEL 1)

SCALES: 1:100

6582 — 1

PROJECT: Southland Museum & Art Gallery
JOB NO: 140859.13 DATE: 16/10/2020
SSK: 06 REV: 4

ORIGINAL SIZE mm

DO NOT SCALE IF IN DOUBT ASK

Location of 250mm thick insitu concrete walls
Wall reinforcing content - allow for 140kg/m³

Location of 250mm thick insitu concrete walls below stopping at this level

New concrete collector beam cast between ribs and webs of TT floor units - refer to SSK-022 for indicative detailing
Allow to drill and epoxy reinforcing through any existing columns or beams on these lines

Allow to tie the buildings together along the length of grids 2,5 and B at this level as indicated.

Indicative tie options might be to cut slots into the slabs and grout in bars over the gap. Alternatively, drill and epoxy bars between the beams on each side of the gap. Size and spacing of fixings TBC at detailed design.

If an existing gap exists between the beams / slabs this will need to be filled with grout.

Allow to connect new wall to existing beam by drilling and epoxying through the existing beam along the length of the wall below

Allow to chase in a steel flat bar bolted onto the slab or grout in new reinforcing bars - details TBC at detailed design

NOTES
SEATINGS- INTERSPAN PLANKS 60mm
SHELL BEAMS 30mm
REFER TO STATIC DETAILS SHEETS 6582 - 13 & 14
FLOOR LIVE LOAD - 4KPa
REFER TO "R" DETAILS FOR HOLDING DOWN BOLTS

First Floor 34% Seismic Strengthening Scheme

No.	AMENDMENTS	Date	Initial

Royds Consulting Engineers & Planners
Royds Consulting Ltd
Christchurch, Dunedin, Invercargill, Balclutha, Alexandra, Queenstown, Oamaru, Timaru, Greymouth, Blenheim, Palmerston North

F.B.	Initials	Date		Initials	Date
SURV			TR		
DGN	MJH TLH	DEC 88	CH		
DR	GK	DEC 88	APP	MJH	2-89

CLIENT: SOUTHLAND MUSEUM AND ART GALLERY TRUST BOARD

JOB NAME: BUILDING REDEVELOPMENT STAGE 1

TITLE: FIRST FLOOR SLAB (LEVEL 2)

SCALES: 1:100

6582 - 2

Holmes

PROJECT: Southland Museum & Art Gallery
JOB NO: 140859.13 DATE: 16/10/2020
SSK: 07 REV: 4

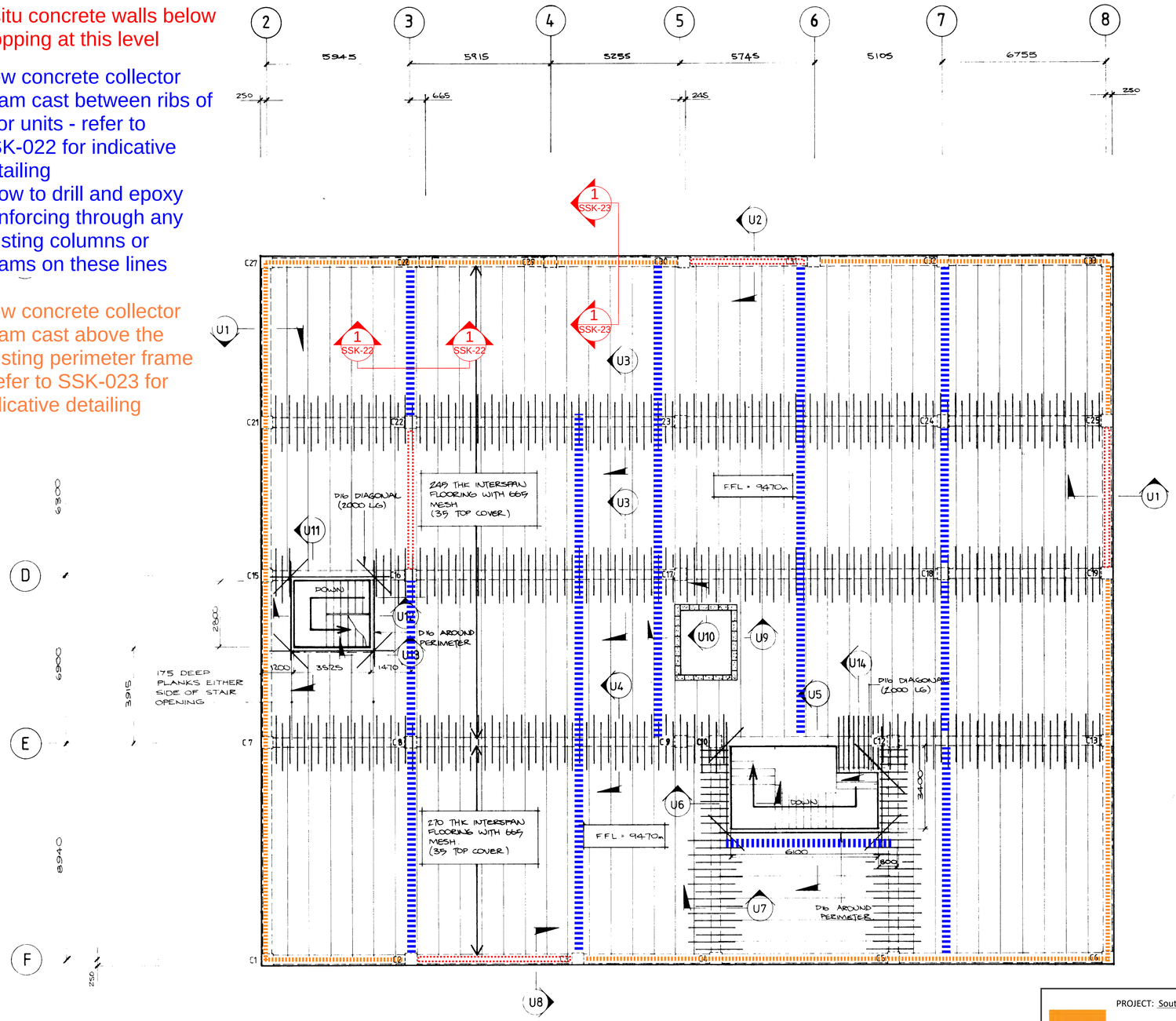
ORIGINAL SIZE mm

DO NOT SCALE IF IN DOUBT ASK

Location of 250mm thick insitu concrete walls below stopping at this level

New concrete collector beam cast between ribs of floor units - refer to SSK-022 for indicative detailing
Allow to drill and epoxy reinforcing through any existing columns or beams on these lines

New concrete collector beam cast above the existing perimeter frame - refer to SSK-023 for indicative detailing



NOTES

SEATINGS :- INTERSPAN UNITS ~ 50mm
SHELLBEAMS ~ 30mm

REFER TO STAIR DETAILS SHEETS 6582 - 13 & 14

FLOOR LIVE LOAD - 4 KPa

REFER TO "R" DETAILS FOR HOLDING DOWN BOLTS

2nd Floor 34% Seismic Strengthening Scheme

Holmes

PROJECT: Southland Museum & Art Gallery
JOB NO: 140859.13 DATE: 16/10/2020
SSK: 021 REV: 4

No.	AMENDMENTS	Date	Initial

Royds Consulting Engineers & Planners

Royds Garden Limited
Christchurch Dunedin Invercargill
Balclutha Alexandra Queenstown
Oamaru Timaru Greymouth
Blenheim Palmerston North

F.B	Initials	Date		Initials	Date
SURV			TR		
DGN	M.J.H	Dec 88	CH		
DR	N.C.S	Dec 88	APP	M.J.H.	2-89

CLIENT: SOUTHLAND MUSEUM & ART GALLERY TRUST BOARD

JOB NAME: BUILDING REDEVELOPMENT STAGE 1

TITLE: 2ND FLOOR PLAN (LEVEL 3)

SCALES: 1:100

6582 - 3

ORIGINAL SIZE mm 0 10 30 50 100 150 200 300

Holmes

Project Name: Southland Museum and Art Gallery

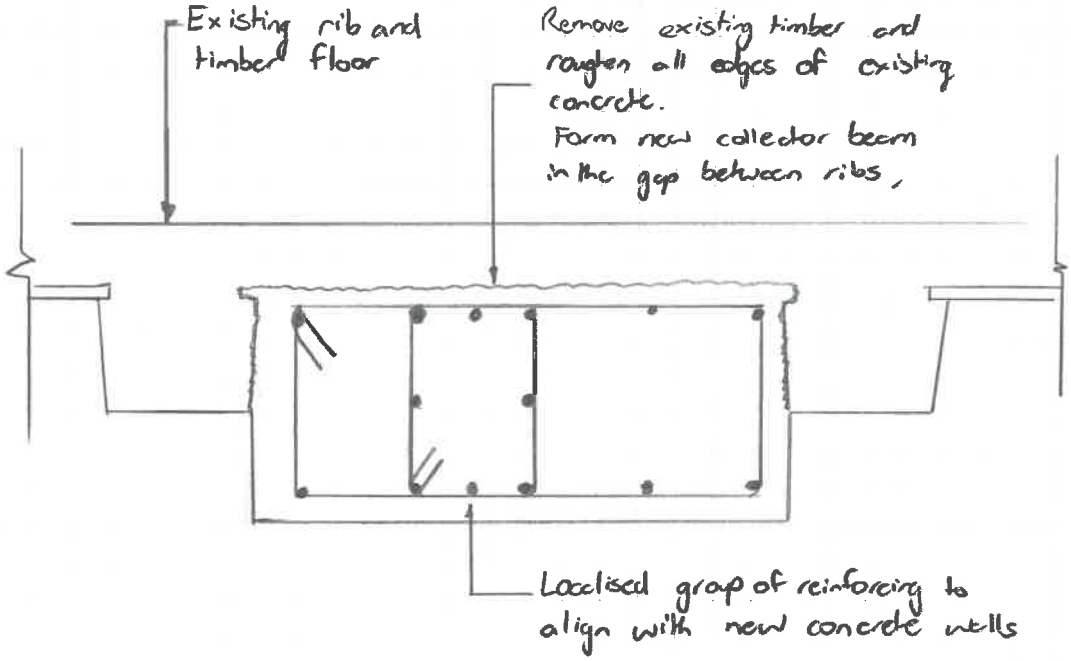
Project No: 140859.13

Author: MAH

Revision: 1

Date: 16/10/20

No: SSk-022



TYPICAL CONCRETE COLLECTOR BEAM BETWEEN RIBS

- Indicative, for pricing only
- Sizes and reinforcing quantities TBC in detailed design
- Detail will be similar for between existing TT units between grids 2-5 at first suspended level

Holmes

Project Name: Southland Museum and Art Gallery

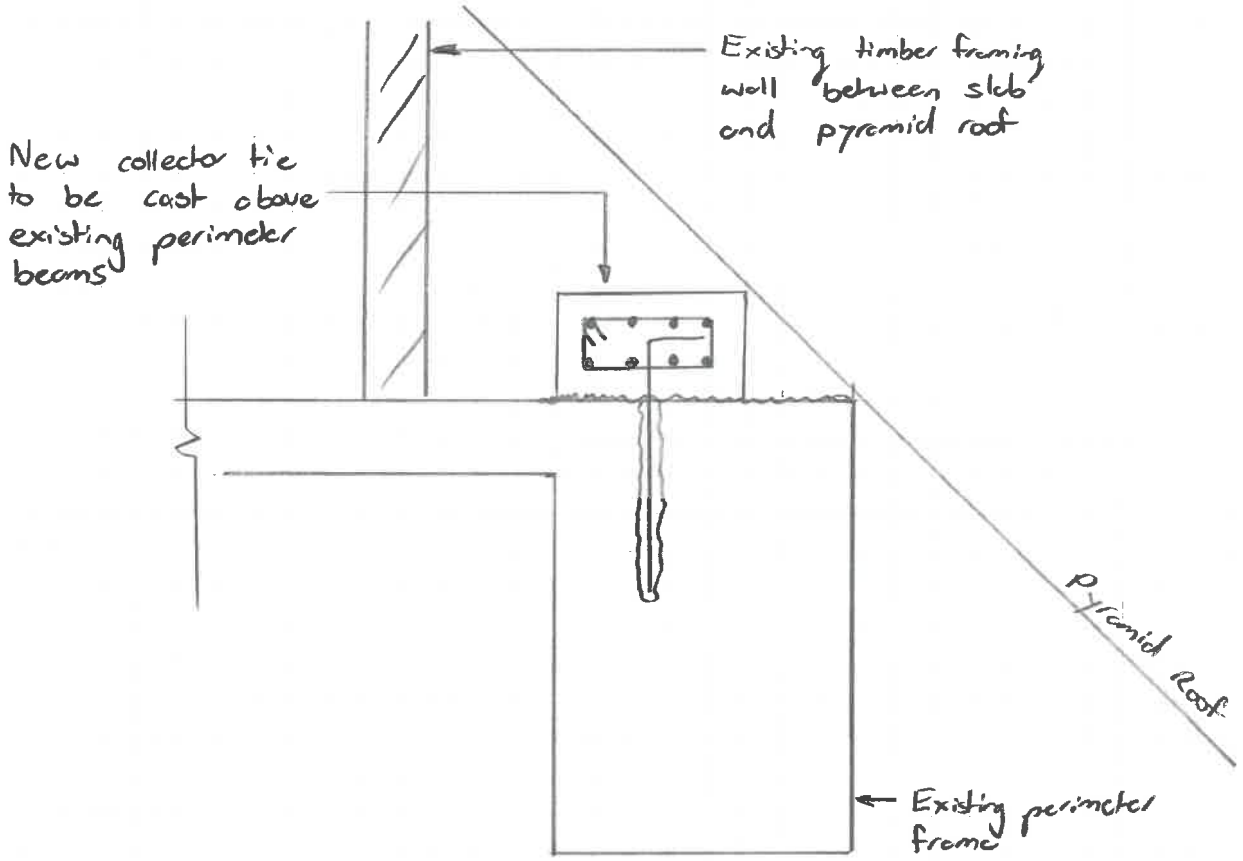
Project No: 140859.0

Author: MAH

Revision: 1

Date: 16/10/20

No: SSk-023



TYPICAL CONCRETE COLLECTOR TIE AROUND PERIMETER

- Indicative design for pricing only
- Allow to drill + epoxy the new tie into the existing beams

DO NOT SCALE IF IN DOUBT ASK

Location of 250mm thick insitu concrete walls
Wall reinforcing content - allow for 140kg/m³

0.6m deep insitu concrete foundation beams under new concrete walls. Typically extends 1m beyond the column at each end of the wall.

For 67%NBS total beam width = 3m

Allow for 70 kg/m3 longitudinal reinforcing
55 kg/m3 stirrups

clouded walls to be removed to open up the space and remove a structural weakness

Remove the existing wall at this location and replace with new structural wall

These foundations shown are in addition to the 1940s building new foundations. The foundations for the 2 buildings will likely be cast as one in this area but for pricing purposes the cost of each should be added together.

Typical extension from column at ends of walls 1,000 mm

EXISTING 100 THICK CONCRETE SLAB F.C.L. -0.50

EXISTING TIMBER FLOOR F.F.L. 0.00

100 THICK CONC. SLAB WITH 665 MESH ON O.P.M. F.C.L. 0.00

EXISTING TIMBER FLOOR FFL 0.00

EXISTING CONCRETE FLOOR SLAB

STAIRWAY 1

STAIRWAY 2

UNDERPIN 2000 LONG STRIP UNDER FOOTING REFER TO G17

SAW CUT OR FORMED CONC JOINT

600 SQ THICKENING

20mm RECESS IN CONCRETE SLAB.

KEY
150 ϕ uPVC PIPE FOR SUBFLOOR VENTING

1500.1000.400 DEEP FOOTING

1200.1200.400 DEEP FOOTING

The provisions of the Invercargill City Bylaws override anything that is inconsistent in this Specification must be complied with.

Foundation 67% Seismic Strengthening Scheme

No.	AMENDMENTS	Date	Initial

Royds Consulting Engineers & Planners

Royds Garden Limited
Christchurch Dunedin Invercargill
Balclutha Alexandra Queenstown
Oamaru Timaru Greymouth
Blenheim Palmerston North

F.B	Initials	Date		Initials	Date
SURV			TR.		
DGN	MJH/FLH	Dec 05	CH.		
DR.	GWK	Dec 05	APP		

CLIENT: SOUTHLAND MUSEUM & AND ART GALLERY TRUST BOARD

JOB NAME: BUILDING REDEVELOPMENT STAGE 1

TITLE: FOUNDATION PLAN (LEVEL 1)

SCALES: 1:100

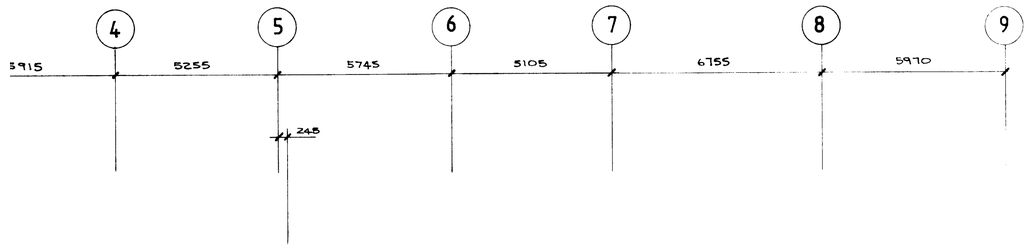
PROJECT: Southland Museum & Art Gallery
JOB NO: 140859.13 DATE: 29/10/2020
SSK: 24 REV: 1

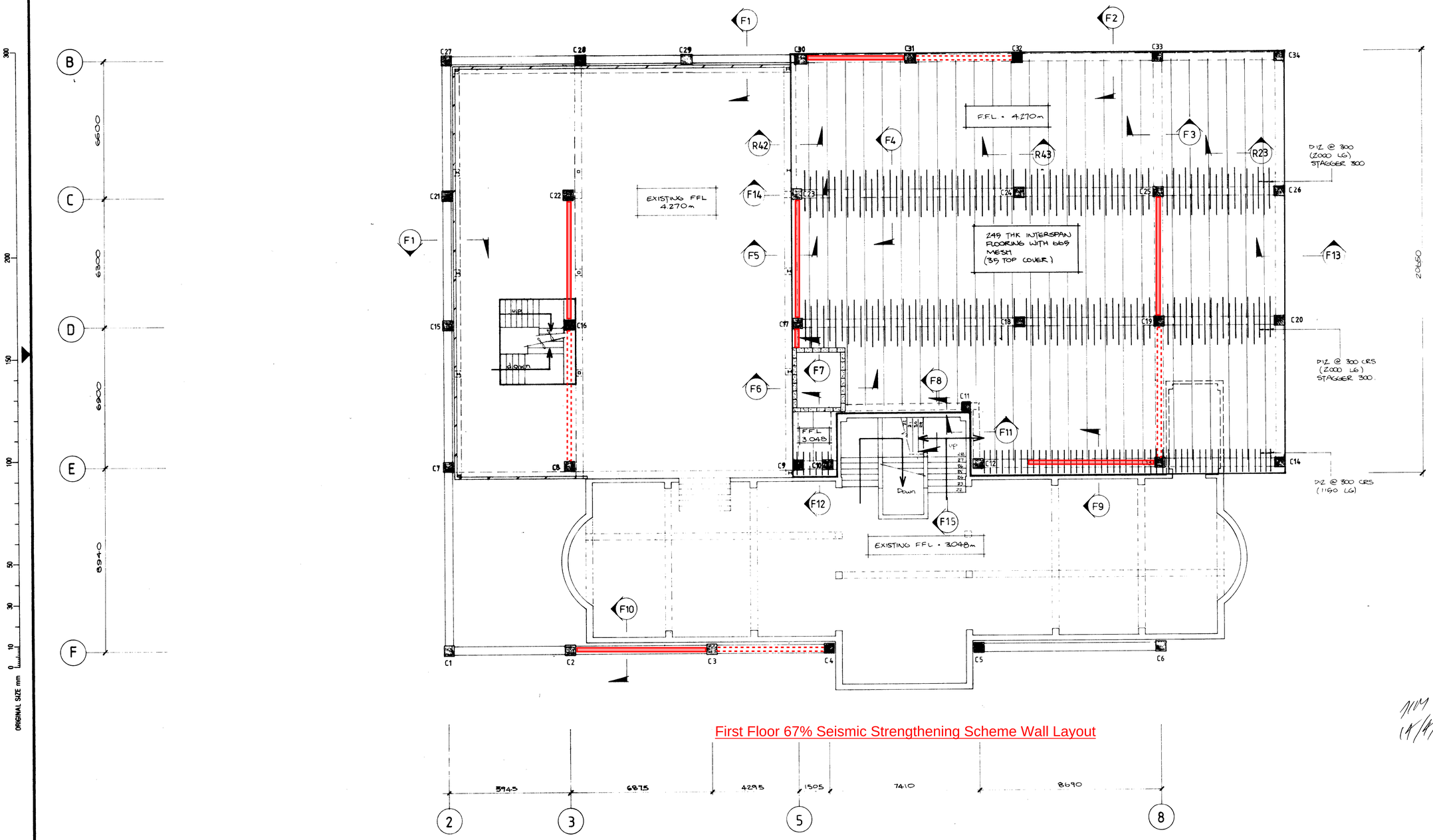
6582 — 1

DO NOT SCALE IF IN DOUBT ASK

Location of 250mm thick insitu concrete walls
Wall reinforcing content - allow for 140kg/m³

Location of 250mm thick insitu concrete walls below stopping at this level





NOTES

SEATINGS- INTERSPAN PLANKS 60mm
SHELL BEAMS 30mm

REFER TO STATIC DETAILS SHEETS 6582 - 13 & 14

FLOOR LIVE LOAD - 4KPa

REFER TO "R" DETAILS FOR HOLDING DOWN BOLTS

First Floor 67% Seismic Strengthening Scheme Wall Layout

No.	AMENDMENTS	Date	Initial

Royds Consulting Engineers & Planners

Royds Garden Limited
Christchurch, Dunedin, Invercargill
Balclutha, Alexandra, Queenstown
Oamaru, Timaru, Greymouth
Blenheim, Palmerston North

F.B.	Initials	Date		Initials	Date
SURV.			TR		
DGN.	MJH	DEC 88	CH		
DR.	C.K.	DEC 88	APP	MJH.	2-89.

CLIENT: SOUTHLAND MUSEUM AND ART GALLERY TRUST BOARD

JOB NAME: BUILDING REDEVELOPMENT STAGE 1

TITLE: FIRST FLOOR SLAB (LEVEL 2)

SCALES: 1:100

6582 - 2

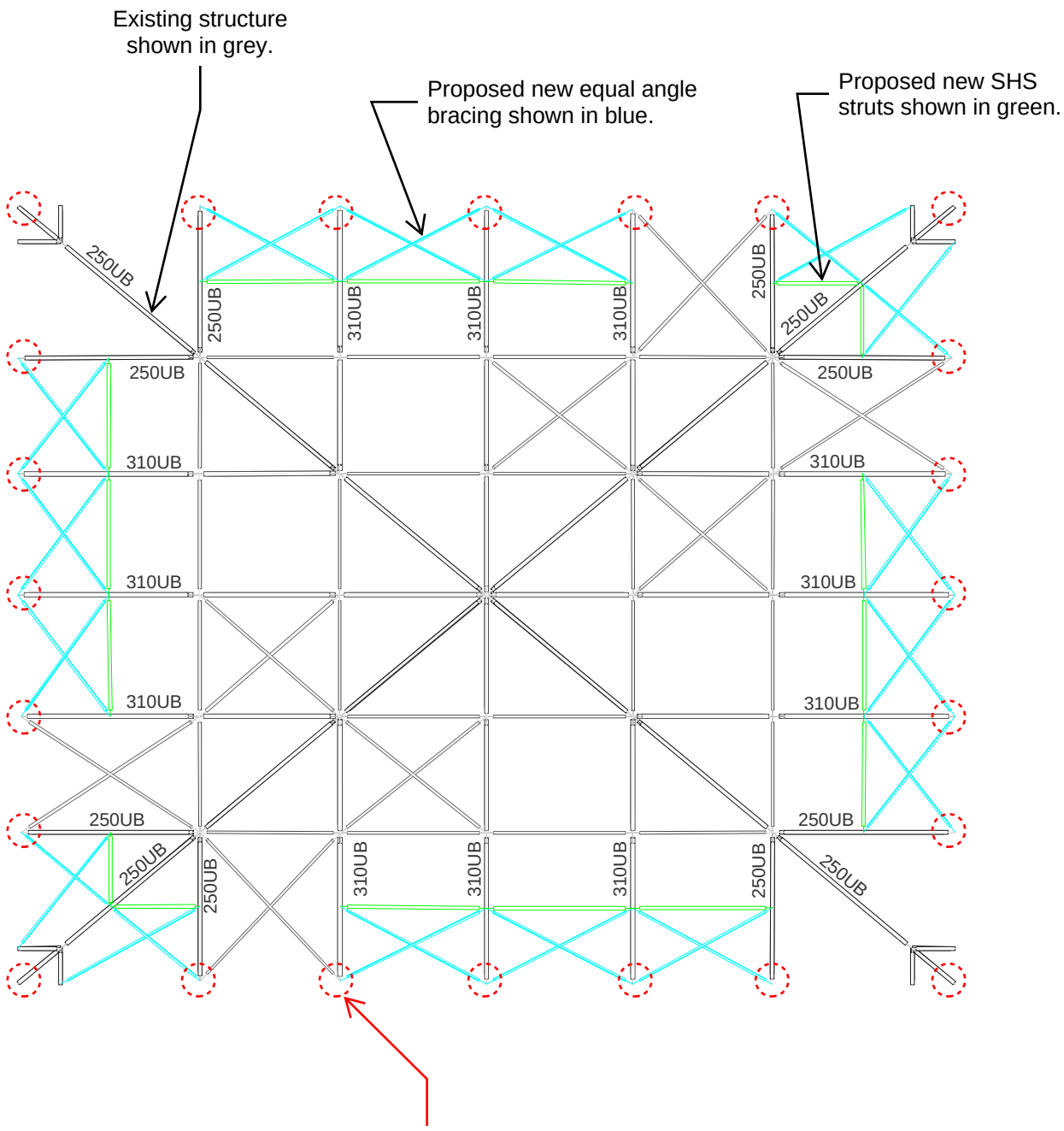
Holmes

PROJECT: Southland Museum & Art Gallery

JOB NO: 140859.13 DATE: 29/10/2020

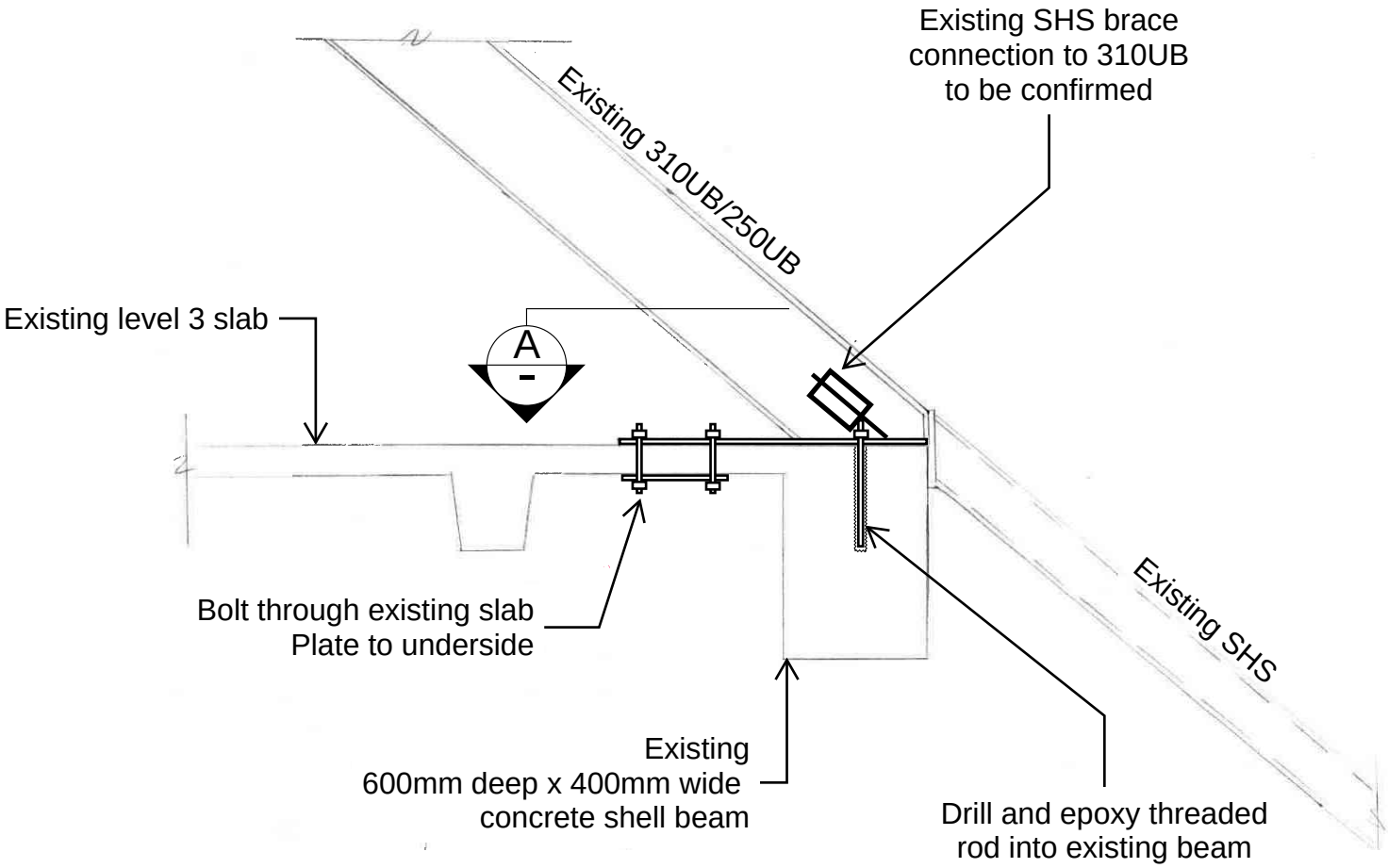
SSK: 25 REV: 1

ORIGINAL SIZE mm

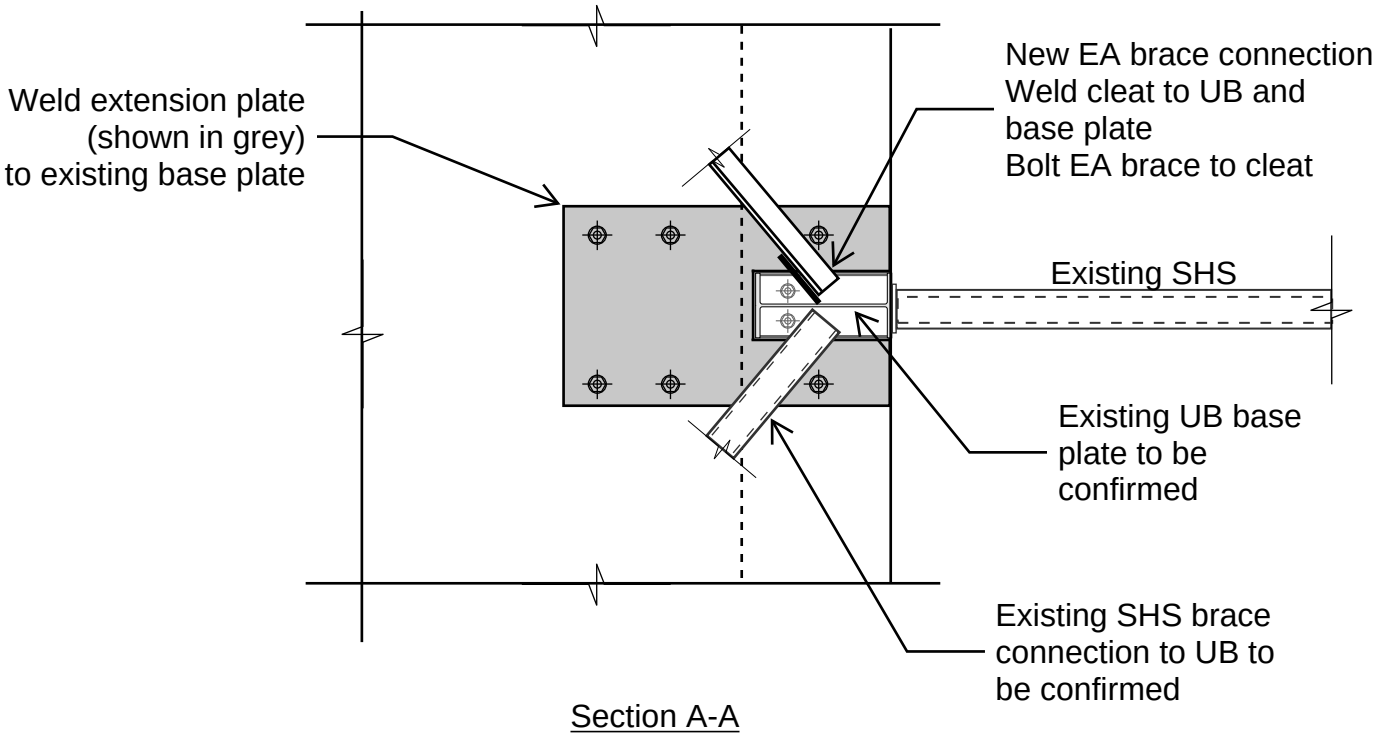


Plan of Proposed Strengthening of Pyramid Structure

Holmes	PROJECT: Southland Museum & Art Gallery
	JOB NO: 140859.13 DATE: 29/09/2020
	SSK: 08 REV: 1



Section through proposed strengthened 310UB/250UB base plate



Section A-A

Holmes	PROJECT: Southland Museum & Art Gallery
	JOB NO: 140859.13 DATE: 29/09/2020
	SSK: 09 REV: 1

ENGEO
Celebrating 10 YEARS IN NZ

Southland Museum and Art Gallery - Geotechnical Investigation

108 Gala Street

Queens Park

Invercargill

Submitted to:

Invercargill City Council
C/- The Building Intelligence Group
173 Spey Street
Invercargill 9810

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Frankton
Queenstown 9371
P +64 3 328 9012
www.engeo.co.nz

23.11.2020
17651.000.000_01

ACENZ

Contents

Tables

Figures

Appendices

ENGEO Document Control:

Report Title	Southland Museum and Art Gallery - Geotechnical Investigation Queens Park			
Project No.	17651.000.000	Doc ID	01	
Client	Invercargill City Council	Client Contact	C/- Tess Browne (TBIG)	
Distribution (PDF)	The Building Intelligence Group			
Date	Revision Details/Status	WP	Author	Reviewer
29/10/2020	DRAFT	JT	BC / SM	NC
23/11/2020	Revision 0	JT	BC / SM	AW

1 Introduction

ENGEO Ltd has been engaged by The Building Intelligence Group (TBIG) on behalf of the Invercargill City Council (ICC) to undertake a geotechnical investigation at the Southland Museum and Art Gallery (SMAG) in Invercargill (herein referred to as 'the site'). The purpose of the geotechnical investigation is to support an options assessment for earthquake strengthening of the SMAG building. ENGEO understands the building has been closed to the public due to earthquake risk since 2018.

Based on discussions with TBIG and the wider project team, our scope of work is to investigate the current foundation conditions, including the type and bearing capacity of existing foundations, provide geotechnical parameters for design of new foundations and to undertake a liquefaction susceptibility assessment. This scope will inform an options analysis for the degree of earthquake strengthening for the SMAG structure.

Investigations, analysis and reporting have been carried out in accordance with our revised proposal and signed agreement dated 14 August 2020 (ENGEO, 2020).

2 Project Background

The SMAG was first opened in 1942. Several additions and alterations were subsequently added, including a major redevelopment in 1990. Architectural drawings for the 1990 redevelopment (dated 14 April 1989) indicate that the SMAG, in its current design is a three-level, pyramid-shaped structure with a footprint of approximately 2,220 m^2 and a total height of approximately 24 m.

Opus International Consultants Ltd (Opus) - now WSP New Zealand Ltd., completed an engineering review of the structure in 2013. Opus later reviewed these findings, including a Detailed Seismic Assessment (DSA), following changes made to the Building Act in July 2017 (Opus, 2017). The 2017 DSA reiterated the findings of the original 2013 assessment, in that the SMAG has a seismic capacity of <34% New Building Standard (NBS). Consequently, the building was classified as being earthquake-prone. This was attributed to the deficiencies found in the design and construction of the building, primarily relating to how the additions and alterations interact with one-another under lateral seismic loading.

The SMAG was closed to the public in 2018. Consequently, the ICC have requested an options assessment to determine the following:

- Cost estimates to strengthen the building to 34% and67%. This includes the methodology required to complete the works and the extent of refurbishments required.
- A comparison cost to construct a new building to 100% NBS.
- The compromises ICC will have to make if they simply strengthen the building and do not take the opportunity to make cosmetic changes as per the 2019 Tim Walker report (Tim Walker Associates, 2019).

This report by ENGEO supports the wider options assessment report requested by the ICC.

3 Site Description

The site is located at 108 Gala Street within the Queens Park area, Invercargill. It is legally described as Lot 3 DP 308322 (Appendix 1, Figure 1). The site currently comprises the pyramid-shaped SMAG building with an observatory attached on the western side, as well as associated parking and accessways. The site is approximately 0.49 ha in total area. Topography is typically flat-lying at an approximate elevation of 16 m RL. The Waihopai River is located approximately 1.2 km to the west of the site.

4 Background Geotechnical Information

4.1 Published Geology

Published geological maps of the area indicate that the site is anticipated to be underlain by Holocene-aged, unconsolidated gravel and sand deposits in alluvial terraces (**Error! Reference source not found.**) (Turnbull & Allibone, 2003).

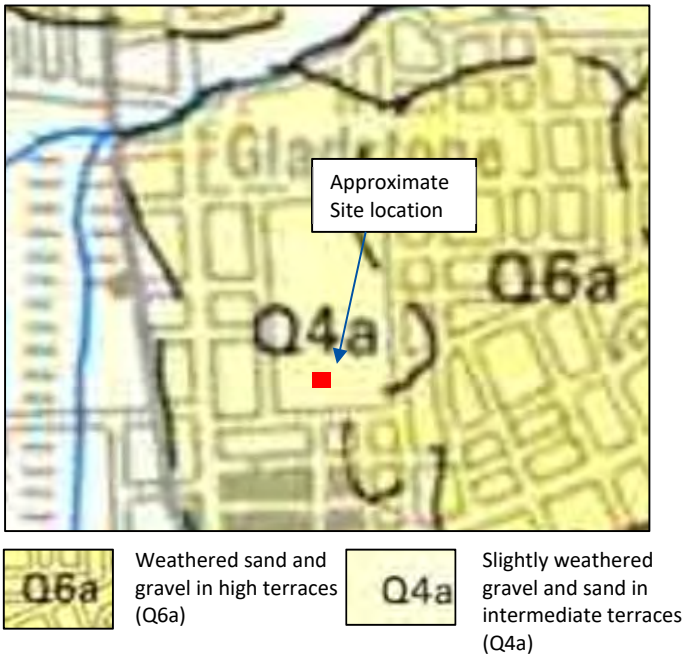

Figure 1: Published Geological Map of the Area (image modified from Turnbull & Allibone, 2003)

Basement bedrock in this area is mapped as sandstone and mudstone of the Murihiku Terrane and is expected to be located at significant depths.

4.2 New Zealand Geotechnical Database

There are several locations of historical geotechnical investigation approximately 500 - 800 m from the site. ENGEO have reviewed geological logs for these, available on the New Zealand Geotechnical Database (NZGD). While this information can be useful in categorizing the regional surficial geology, it is important to acknowledge that due to spatial variability it cannot be relied upon for site-specific assessment or design.

We have summarised the relevant information obtained from the NZGD below:

- Fill is widespread across the Invercargill area from surface, typically to depths between 1 - 3 m. Fill types can include sandy gravels, reworked topsoil, refuse, sandy silts and also reclaimed soils in the vicinity of the Waihopai River.
- Underlying fills and / or the surficial topsoil in some central areas is a firm to stiff silt and / or clay deposit that has weathered to a yellow brown colour. This is interpreted to be of alluvial genesis, deposited in a lower energy environment to the underlying alluvial sands and gravels (Section 4.1 and below)
- A sequence of medium dense to very dense alluvial sands and gravels lie beneath the majority of the Invercargill area, typically from depths of between 3 – 5 m to depths in excess of 10 – 15 m.

Field data published in the NZGD are included in Appendix 2.

4.3 Previous Geotechnical Investigations

As part of the Request for Proposal (RFP) issued by the ICC for the SMAG options assessment, factual data from two well logs undertaken on the SMAG site were provided to ENGEO. These boreholes were drilled to a depth of 6 m using rotary drilling techniques. These boreholes were not drilled using geotechnical sampling methods nor were they logged accordingly. While the exact location of the boreholes is unknown, material descriptions are generally consistent with third party data from the NZGD (Section 4.2).

Borehole logs are included in Appendix 2.

5 Site Investigations

5.1 Overview

ENGEO completed site investigations on 9 September and 6 October 2020 comprising the following:

- Observation of two Test Pits (TP) to depths between 2.0 – 2.5 m.
- Monitoring of two Cone Penetrometer Tests (CPTs) to depths between 7.1 – 7.5 m.
- Completion of Dynamic Cone Penetrometers (DCPs) at each TP location.

TPs were logged in accordance with the New Zealand Geotechnical Society (NZGS) field-description of soil and rock guidelines. Grab samples were collected in TPs by ENGEO and tested for grain size analyses and Atterberg Limits (both per NZS 4402:1986) by Central Testing Laboratories. CPTs were completed by Ground Investigation Ltd with the results supplied to ENGEO.

Summary investigation data is included in Table 1 below.

Table 1: Summary Investigation Information

Investigation ID	Latitude[1]	Longitude[1]	Elevation (m RL)[2]	Investigation Depth (m bgl)[3]	DCP Depth (m bgl)[3]
SM-ENG20-TP01	-46.40537	168.3533	16	2.5	2.0
SM-ENG20-TP02	-46.40503	168.35377	16	2.0	2.0
SM-ENG20-CPT01	-46.40523	168.35409	16	7.1	N/A
SM-ENG20-CPT02	-46.40533	168.35331	16	7.5	N/A

Notes:

[1] Investigation locations were surveyed using a GIS application on mobile device with a typical accuracy of +/- 3 – 4.5 m.

[2] No high resolution elevation data for the Invercargill area is available. Elevation is estimated from low resolution contours with an accuracy of +/- 3 m.

3. bgl refers to 'below ground level', the level of ground surface at the time of the site investigation.

Investigations were located to avoid underground services and existing access-ways. Locations are shown in Appendix 1, Figure 1. TP logs (including DCPs) are included in Appendix 3, with CPT logs in Appendix 5.

ENGEO attempted to excavate test pits immediately adjacent to existing shallow foundations. The intention of this methodology was to inform the bearing depth, type and geometry of the structures foundations at the edge of the existing building and estimate current bearing pressures. Buried utilities and surface infrastructure prevented the safe excavation of test pits against the existing building footings and their bearing depth and geometry remains uncertain.

5.2 Surficial Geology

Test pit observations identified a surficial layer of uncontrolled granular fill on the northern and western sides of the site. This unit was found to a depth of 0.4 m and included a layer of deteriorated asphalt at approximately 0.3 m. TP02, undertaken on the northern side of the site, encountered a firm topsoil to a depth of 0.2 m with re-worked organic fill materials beneath. These materials comprised topsoil and fibrous organics with layers of gravel, refuse and burn-off waste.

Underlying the organics and fill materials, ENGEO observed a grey, alluvial silt and clay containing trace organics. This unit graded into a yellow brown alluvial silt that was stiff to very stiff and was observed to the termination depth of 2.0 m in both TPs.

Two grab samples were tested for grain size analyses (via sieve) and Atterberg limits from each TP. Results indicate the fines content of tested samples is >92%. One sample from TP02 was shown to be a high plasticity clay and the remainder were indicated to be low plastic clays with plasticity indices varying from 7 to 23, although on the silt/clay boundary. Laboratory results generally agree with the Soil Behavior Type (Robertson et al. 1986) inferred in the CPT data (Section 5.1). Laboratory results are included in Appendix 4.

Although not observed in TPs, the two CPTs and the two historic boreholes (Section 4.3) indicate that from between approximately 2.0 and 2.5 m bgl the alluvial silt and clay grades into a silty sand unit, likely characterised by interbedded layers of silt and sand. The CPTs and historic boreholes suggest

this unit is likely stiff / medium dense. Underlying this unit from a depth of approximately 4.5 m, CPTs and historic boreholes identified a medium dense to dense sandy gravel. This unit was encountered to the termination depth of investigations.

A summary of interpreted surficial geology beneath the site is presented in Table 2 below.

Table 2: Typical Subsurface Geology

Geological Unit	Typical Depth (m bgl)	Typical Material Description	Density / Consistency[1]
Topsoil[2]	0.0 - 0.2	Organic silt, dark brown	Firm
Granular Fill (uncontrolled)[3]	0.0 – 0.4	Sandy fine to coarse gravel, grey	Tightly packed
Alluvium (fine-grained) [4]	0.4 – 4.5	Silt, some sand to sandy (sand content increasing with depth)	Firm / Stiff
Alluvium (coarse-grained)	4.5 – 7.0 +	Sand and gravel	Dense to very dense

Notes:

1. Density is estimated from results of DCP and SPT testing. DCP testing in medium to coarse gravels is not always representative due to the potential for the DCP to bounce on individual clasts providing an inaccurate representation.
2. Topsoil and organic fill was only observed on the northern side of the site.
3. Granular fill was only observed on the eastern and western sides of the site.
4. Within this unit, a 0.4 m to 0.8 m thick layer of clayey silt/silty clay was encountered from 3.6m (CPT1), and 4.6 m (CPT2) depth.

The geology encountered during investigations is broadly consistent with the published literature and data obtained from the surrounding area (Sections 4.1 & 4.2).

5.3 Groundwater

Seepage was observed from 0.9 and 1.5 m depth in TP01 and TP02, respectively. Groundwater had risen (and stabilized) to 1.0 m bgl in TP01 by the time the TP had been completed (see TP01 log, Appendix 3). Additionally, the two CPTs estimated groundwater to be at 1.0 and 1.6 m bgl.

Based on the observations made during investigations, it is likely that the site groundwater level is approximately 1.0 – 2.0 m bgl. This is consistent with investigations ENGEO have undertaken in the Invercargill area and the anticipated regional groundwater table (per NZGD investigations, Section 4.2).

Interpretation of groundwater observations should be done with caution. The potential exists for perched water and seasonal fluctuations in levels. Should groundwater data be critical to design of new foundations, further investigation of groundwater elevations should be considered.

6 Seismic Hazard

6.1 Soil Classification

Based on the investigation information available, specifically the absence of information on the depth to bedrock, we consider the soil classification in line with NZS 1170.5:2004 to be 'Class D – Deep or Soft Soil Sites' for the purpose of seismic design.

6.2 Ground Shaking

The SMAG is classified as an Importance Level 3 building. According to NZS 1170.5:2004, Importance Level 3 buildings are required to be designed to resist earthquake shaking with an annual probability of exceedance of 1/1000 (i.e. 1000 year return period). This is the ultimate limit state (ULS) design seismic loading. Structures are expected to retain their structural integrity during the ULS earthquake, and not collapse or endanger life.

Furthermore, Importance Level 3 buildings should sustain little or no structural damage under a serviceability limit state (SLS) design load case, which is based on earthquake shaking with a 25 year return period.

Peak horizontal ground accelerations (a_{max}) have been calculated in accordance with MBIE / NZGS Module 1 (2016) using the following formula:

a_{max} = $C_{0,1000}$ R f g / 1.3

$C_{0,1000}$ = 0.26 for Invercargill (Commentary to the NZTA Bridge Manual (2018) Table C6.1)

R = 1.3 for a 1000 year return period event (NZS1170.5) (ULS)

= 0.25 for a 25 year return period event (NZS1170.5) (SLS)

f = 1.0 for Class D

Thus a_{max} = 0.26 x 0.25 x 1 / 1.3 = 0.05 g (SLS)

= 0.26 x 1.3 x 1 / 1.3 = 0.26 g (ULS)

Note: This ULS a_{max} value represents 100% NBS. For ULS at 34 and 67% NBS, a_{max} is equal to 0.09 and 0.18 g respectively.

The effective earthquake magnitude can be taken as 6.1 for the Invercargill area.

6.3 Seismic Liquefaction Assessment

Soil liquefaction occurs when a saturated or partially saturated soil substantially loses strength and stiffness in response to an applied stress such as shaking during an earthquake or other sudden change in stress condition, in which material that is ordinarily a solid behaves like a liquid. A detailed liquefaction analysis was performed using the results of CPTs, utilising the method recommended by Boulanger and Idriss (2014) to determine the susceptibility of the subsoils to liquefaction and the method recommended by Zhang et al. (2002) to calculate vertical settlements.

A groundwater level of 1 m bgl was utilised for the liquefaction assessment.

The results of the liquefaction assessment indicate the following:

- No liquefaction is predicted under SLS conditions or 34% NBS ULS conditions.
- Some liquefaction is likely to occur in the alluvial units between 1.5 – 5.0 m bgl under 67 and 100% NBS ULS seismic loading, if saturated. Some cyclic softening of the clayey soils may also occur.

- Vertical settlement is predicted to be less than 15 mm under ULS seismic loading in all design load cases.

The analysis considers volumetric strain and does not account for ground loss due to ejecta. Owing to the shallow liquefiable layers and potentially liquefiable material below the groundwater table, sand boil formation and ejecta are likely to occur at the site under ULS shaking. Therefore, building settlements may exceed those calculated in the above analysis during ULS shaking.

In terms of the NZGS / MBIE guidelines (NZGS / MBIE, 2016), the expected level of liquefaction to occur corresponds to a Performance Level 'L0 - Insignificant' under SLS and 34% NBS loading and 'L2 – Moderate' under 67 and 100 % NBS ULS loading.

A summary of our analysis results are presented in Table 3.

Table 3: Summary of liquefaction analysis

Investigation identifier	Calculated Vertical Settlement (mm)			
	SLS M6.1, 0.05 g	34% NBS ULS M6.1, 0.09 g	67% NBS ULS M6.1, 0.18 g	100% NBS ULS M6.1, 0.26 g
SM-ENG20-CPT01	Negligible	Negligible	5	10
SM-ENG20-CPT02	Negligible	Negligible	10	15

Settlements due to seismic liquefaction are estimated from free field estimates. Given the configuration and geometry of the existing building foundations are uncertain (Section 5.1), ENGEO has not completed an analysis of punching shear during a seismic event and the likelihood of a punching failure is anticipated to be low and not warrant further consideration. However, punching mechanisms should be considered during detailed design for new foundation elements.

The full liquefaction assessment results are presented in Appendix 5.

7 Geotechnical Recommendations

ENGEO developed a generalised ground model for the site to provide geotechnical parameters for design. This ground model is outlined in Table 4. We understand that these parameters may be used by the structural engineer to assess both static and seismic load cases.

Table 4: Generalised Ground Model and Soil Properties

Generalised Depth Range[1]	Soil Type	Unit Weight (kN/m^3)	Relative Density, (%)	Undrained Shear Strength (kPa)	Poisson Ratio	Static Young's Modulus (MPa)[2]	Degraded Shear Modulus (MPa) (~0.1 to 0.5% strain) [2]
0.5 m to 2 m	Silt / Clay	17	-	50	0.40	15	4
2 m to 4 m	Sand / Silt	17	60	-	0.35	50	14

Generalised Depth Range[1]	Soil Type	Unit Weight (kN/m^3)	Relative Density, (%)	Undrained Shear Strength (kPa)	Poisson Ratio	Static Young's Modulus (MPa)[2]	Degraded Shear Modulus (MPa) (~0.1 to 0.5% strain) [2]
4 m to 4.5 m	Clay	17	-	80	0.40	25	6
5 m to 10 m	Sand / Gravel	18	80 +	-	0.35	100	28

[1]These are generalised depths. Actual depth and thickness of each layer encountered varied across investigation locations.

[2]Due to the uncertainty involved in estimating these parameters we recommend a range from 50% to 200% of the recommended value be checked where these parameters are used in design.

The provided Young's Modulus and shear modulus values are "static" or "degraded" values associated with shear strains on the order of 0.1 to 0.5%. We consider these parameters are generally suitable for use in both static and seismic assessments, acknowledging that under dynamic loading where shear strains are very low they are likely underestimating actual values.

ENGEO understand the project assessment for different building performance levels (Section 2) will require both assessment of existing foundation beams, and designing new foundation elements to support potential earthquake strengthening of the overall structure.

ENGEO recommend the following subgrade modulus values for a range of foundation beam widths, and a foundation beam depth of 0.5m. Due to the uncertainty in estimating these parameters we recommend checking a range of values 50% to 200% of the values presented in Table 5 in sensitivity analyses.

Table 5: Subgrade Modulus Values

Foundation Beam Width (Depth of 0.5m)	Recommended Subgrade Modulus, k_s
0.5 m	35 kPa/mm
1.0 m	40 kPa/mm
1.5 m	40 kPa/mm
2.0 m	35 kPa/mm
2.5 m	30 kPa/mm
3.0 m	25 kPa/mm

Recommended bearing capacities and strength reduction factors are presented in Table 6.

Table 6: Recommended Ultimate Bearing Capacities

Foundation Beam Type	Foundation Beam Width (Depth of 0.5m)	Ultimate Geotechnical Bearing Capacity	Strength Reduction Factors
Existing Foundation Elements	Up to 1.0 m wide	200 kPa[1]	All Load Combinations – 1[1]
New Foundation Elements	Up to 1.0 m wide	120 kPa[1]	SLS Loads – 0.33 ULS Loads – 0.5
	1.0 m to 1.5 m wide	200 kPa	
	Greater than 1.5 m wide	300 kPa	

[1]The different values recommended for similar sized existing and new foundation elements reflect the different approaches (outlined in Part C4 of MBIEs Seismic assessment of existing buildings guidance) for assessment versus design. The value provided for existing foundations represents a "best-estimate" or probable value while the value for new foundation elements represents a lower bound or reliable value for design.

It may be possible to refine (and likely increase) recommended bearing capacities with a better understanding of the existing foundation geometry and foundation performance to date (given this currently remains uncertain, Section 5.1). If the provided capacities are driving the foundation design we recommend additional work be carried out to further investigate the existing foundation depths and widths.

ENGEO recommend the in situ surficial soils are suitable for shallow foundations following the removal of any uncontrolled fill and / or organic material.

8 References

Boulanger, R.W., Idriss, I.M. (2014). CPT and SPT based liquefaction triggering procedures. Center for Geotechnical Modelling. Report No. UCD/CGM-14/01.

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MBIE / NZGS (2016). Earthquake geotechnical engineering practice. Rev 0.

Opus International Consultants Ltd. (2017). Southland Museum and Art Gallery, Detailed Seismic Assessment – Review changes to the Building Act July 2017.

Tim Walker Associates (2019). Strategic Review: Reinventing the Southland Museum.

Turnbull, I. M., Allibone, A. H. (2003). Geology of the Murihiku area. Institute of Geological & Nuclear Sciences 1:250 000 geological map 20. Lower Hutt, New Zealand. Institute of Geological & Nuclear Sciences.

Zhang, G., Robertson, P.K., Brachman, R.W.I. (2002). Estimating liquefaction-induced ground settlements from CPT for level ground. Canadian Geotechnical Journal. 39: 1168 – 1180.

9 Limitations

i. We have prepared this report in accordance with the brief as provided. This report has been prepared for the use of our client, Invercargill City Council, their professional advisers and the relevant Territorial Authorities in relation to the specified project brief described in this report. No liability is accepted for the use of any part of the report for any other purpose or by any other person or entity.

ii. The recommendations in this report are based on the ground conditions indicated from published sources, site assessments and subsurface investigations described in this report based on accepted normal methods of site investigations. Only a limited amount of information has been collected to meet the specific financial and technical requirements of the client's brief and this report does not purport to completely describe all the site characteristics and properties. The nature and continuity of the ground between test locations has been inferred using experience and judgement and it should be appreciated that actual conditions could vary from the assumed model.

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

iv. This Limitation should be read in conjunction with the Engineering NZ/ACENZ Standard Terms of Engagement.

v. This report is not to be reproduced either wholly or in part without our prior written permission.

We trust that this information meets your current requirements. Please do not hesitate to contact the undersigned on (03) 328 9012 if you require any further information.

Report prepared by

Sam Murray, MEngNZ
Senior Geotechnical Engineer

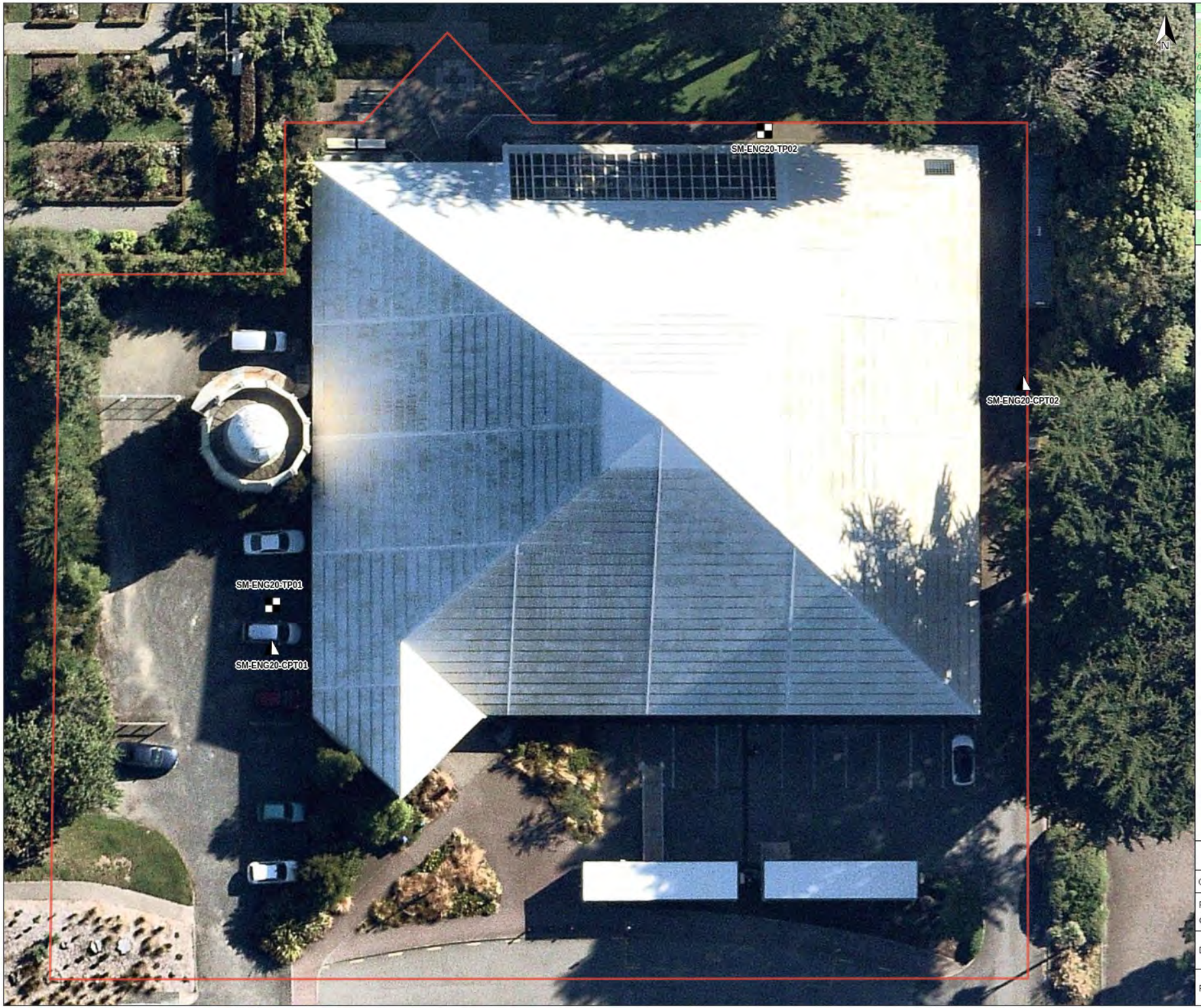
Bradley Cosgrove
Engineering Geologist

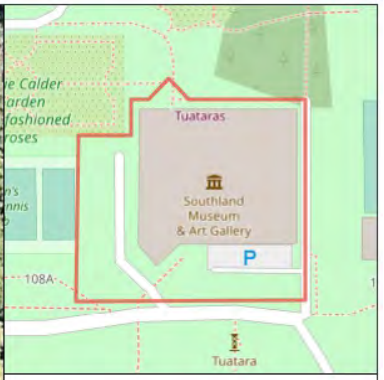
Report reviewed by

Neil Charters, CMEngNZ (CPEng)
Principal Geotechnical Engineer

APPENDIX 1:

Site Map





Legend

- Site Boundary
- Cone Penetration Test
- Test Pit

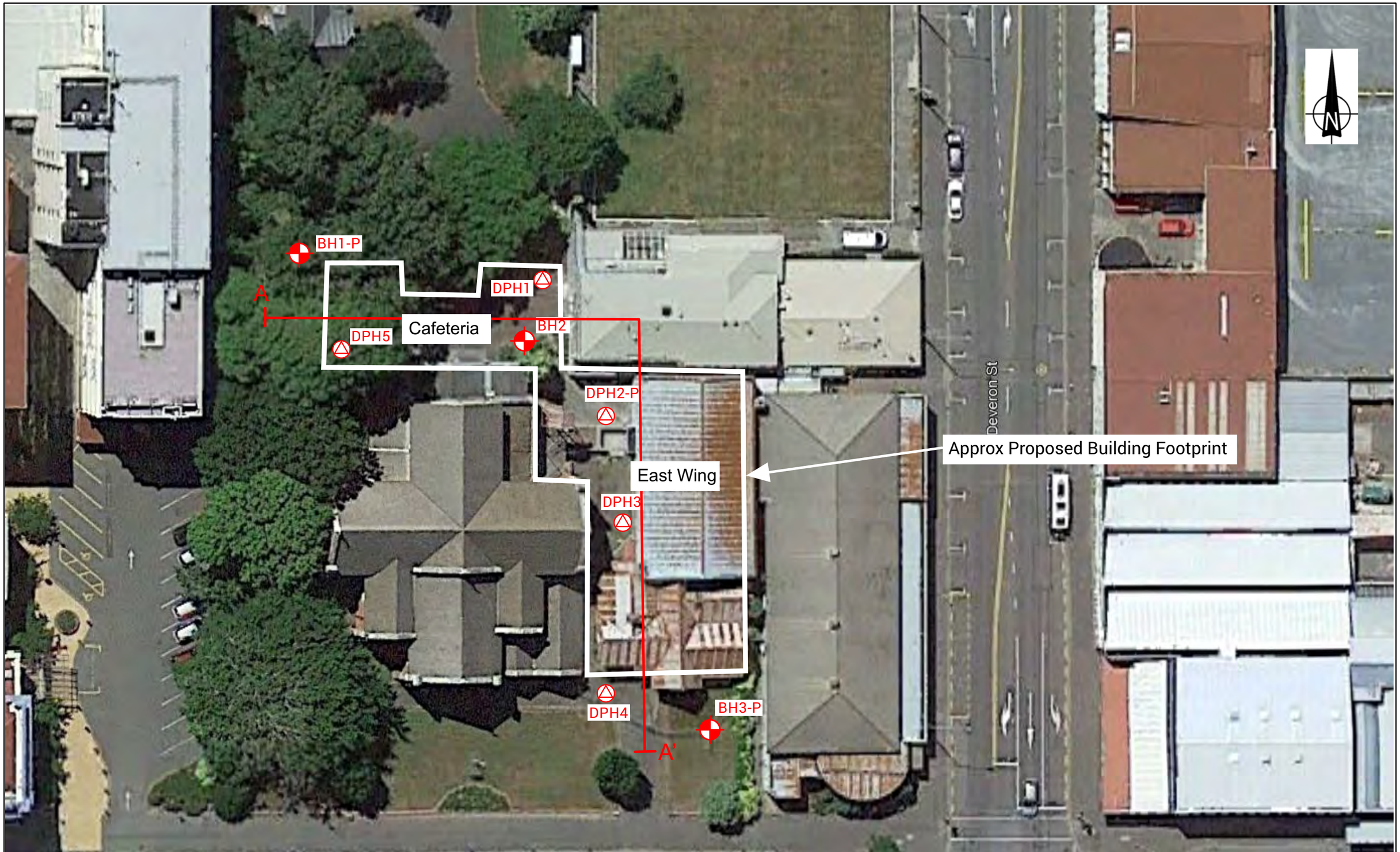
5 m

ENGEO

Title: Site Investigation Plan		
Client: Invercargill City Council		Figure No: 1
Project: Southland Museum and Art Gallaery	Drawn: BC	
Date: 20-11-2020	Checked: SM	Size: A4
Proj No: 17651		Version: 2.0

APPENDIX 2:

Third Party Geotechnical Data



Key

DPH1 = Dynamic Probe Heavy Test (DPH)

P = Permanent Piezometer Installed

BH = Sonic Borehole

Scale 1:400

0 4 8 12 16 20 (m)

CADFILE:	Site Plan.xar	DRAWN	MB	07/2019
SCALE: (AT A3 SIZE)	AS SHOWN	DRAFTING CHECKED	FAW	07/2019
PROJECT No.:	190061.01	APPROVED	CEM	07/2019

GEOSOLVE ENGINEERING CONSULTANTS

GEOTECHNICAL WATER RESOURCES PAVEMENTS

Southern Institute of Technology
Centre for Creative Industries
108 Tay Street, Invercargill
Site Plan

FIG No: FIGURE 1 REV. 1

NZGD ID: BH_136474

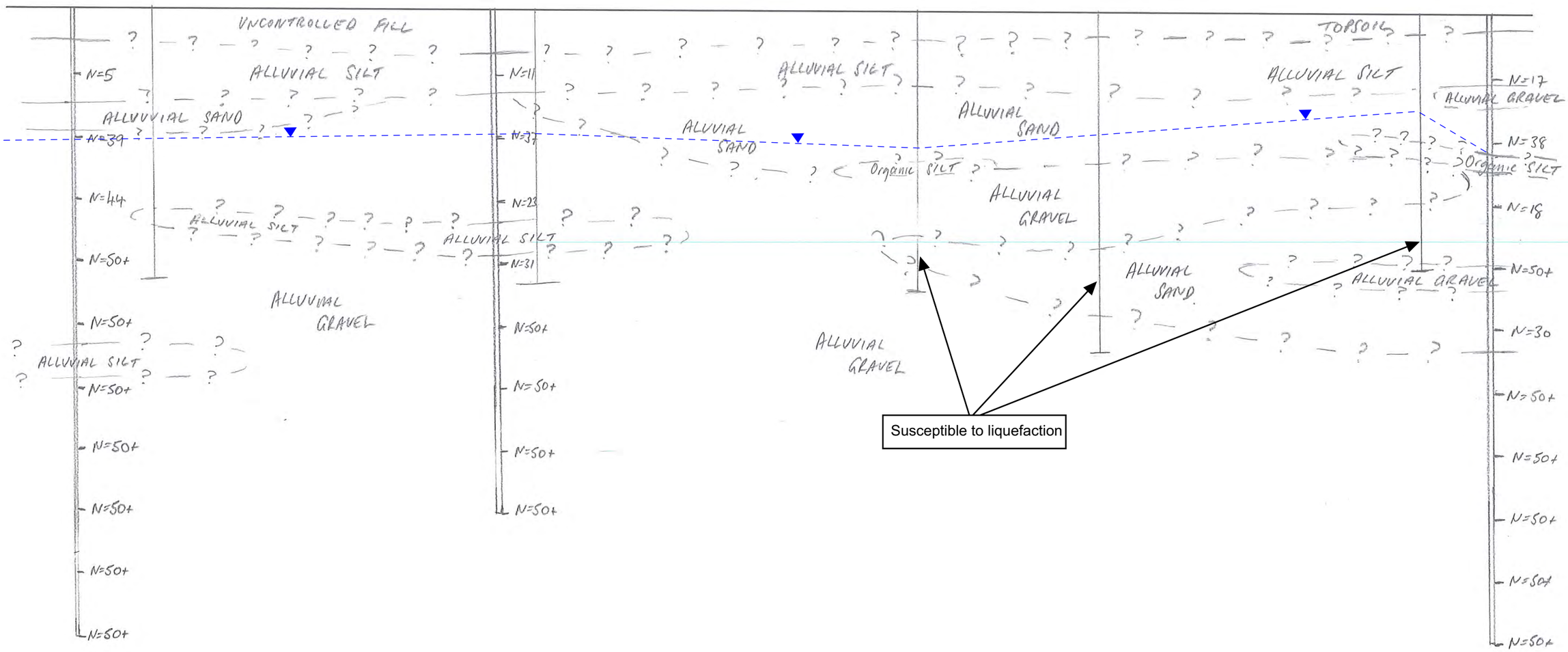
A

A'

Cafeteria
Approx. Building Footprint

East Wing
Approx. Building Footprint

BH1 6m N | DPH5 3m S | BH2 2m S | DPH1 5m N | DPH2 4m W | DPH3 3m W | DPH4 4m W | BH3 7m E



Key

— = Observed geological contact

— ? — = Inferred geological contact

⊥ = DPH refusal

_ _▼_ _ = Measured Water Level

Horizontal Scale 1:250
0 5 10 (m)

Vertical Scale 1:100
0 1 2 3 4 5 (m)

CADFILE:	Site Plan.xar	DRAWN	MB	07/2019
SCALE: (AT A3 SIZE)	AS SHOWN	DRAFTING CHECKED	FAW	07/2019
PROJECT No.:	150214.02	APPROVED	CEM	07/2019

GEOSOLVE ENGINEERING CONSULTANTS
GEOTECHNICAL · WATER RESOURCES · PAVEMENTS

Southern Institute of Technology
Centre for Creative Industries
108 Tay Street, Invercargill
Cross Section A-A'

FIG No: FIGURE 2 | REV. 1

NZGD ID: BH_136474

GEOSOLVE

DRILLHOLE LOG

DRILLHOLE No: BH01 SHEET 1 OF 2

PROJECT: St Johns Church Site Investigation JOB No: 19066 LOCATION: 108 Tay St, Invercargill HOLE LOCATION: See site plan

CO-ORDINATES mN 4849664 (NZTM) mE 1742841 3m accuracy

DIRECTION: 0

ANGLE FROM HORIZ.: 90°

DRILL TYPE: HD900 Sonic

DATUM: Ground Level

R.L. GROUND: 0 m

R.L. COLLAR: 0 m

HOLE STARTED: 12/07/2019

HOLE FINISHED: 13/07/2019

DRILLED BY: [illegible]

LOGGED BY: mb CHECKED: MTW

GEOLOGICAL UNIT	DESCRIPTION OF CORE (SOIL: Classification, colour, consistency / density, moisture, plasticity)	Sampling Method	Core Recovery (%)	Moisture Condition	Strength/Density Classification	RL (m) / Depth (m)	Graphic Log	Drillers Notes	TESTING (Hammer Efficiency: 84.6%, Borehole Diameter: 125mm, Liner: N/A)	Water Loss (%)	Water Level	Casing	Installation	Core Box
FILL/ TOPSOIL	0.0m: Organic SILT with minor rootlets and grass, trace gravel and concrete. Brown, soft, moist. Non plastic. Sand fine to coarse. Gravel fine to coarse, rounded.	Sonic	100%	Moist	Soft	0								
ALLUVIAL SILT	0.7m: SILT with trace sand, gravel and organics. Yellow brown mottled orange, brown, moist. Non plastic. Sand fine to coarse. Gravel fine, subrounded-rounded. Coarse amphibolite recovered.	Sonic / SPT	100%	Moist	Firm	1			SPT @ 1.5m 1, 0, 1, 2, 1, 1 N=5					1
ALLUVIAL SAND	1.8m: SILT with minor sand and trace gravel. Grey mottled orange and black, brown moist. LP. Sand fine to coarse. Gravel fine, subrounded. HW ultramafics.													
	2.3m: Extremely fine to coarse SAND with some silt. Light grey, moist-wet. Sand fine to coarse, rounded quartz.	Sonic	100%	Moist-Wet										
ALLUVIAL GRAVEL	2.9m: Sandy fine to coarse GRAVEL with some silt. Grey orange mottled, brown, saturated. Well graded. Sand fine to coarse. Silt non plastic. Gravel rounded.	SPT	100%	Saturated	Medium Dense				SPT @ 3.0m 6, 12, 10, 9, 9, 11 N=39					2
	4.2m: grades more fine to medium	Sonic / SPT	100%						SPT @ 4.5m 7, 10, 12, 12, 10, 9 N=44					
	5.3m: Silty, Sandy fine to coarse GRAVEL. Dark grey mottled orange, white, dry-wet, plastic, moist. Sand fine to coarse. Gravel rounded to subrounded, mainly quartz.	Sonic / SPT	100%		Very Dense				SPT @ 6.0m 9, 11, 12, 17, 9 N=50+ 85mm remaining					3
ALLUVIAL SILT	8.0m: Clayey, Sandy SILT. Grey mottled orange and white, very stiff, saturated. Sand fine to coarse (mainly fine to medium). Gravel rounded mono (silica & calcite).	Sonic	100%	Saturated	Very Stiff				SPT @ 7.5m 7, 22, 25, 17, 8 N=50+ 120mm remaining					
ALLUVIAL GRAVEL	8.8m: Sandy fine to coarse GRAVEL with some silt. Grey mottled orange, very dense, saturated. Gravel rounded to subrounded. Sand fine to coarse.	Sonic / SPT	100%		Very Dense				SPT @ 9.0m 14, 16, 24, 26 160mm remaining N=50+					4

COMMENTS: ALL SPT 'N' VALUES ARE UNCORRECTED

Survey Method:

Log Scale 1:50

NZGD ID: BH_136474

GEOSOLVE

DRILLHOLE No: BH01

DRILLHOLE LOG

SHEET 2 OF 2

PROJECT:	JOB No: 190061.01	LOCATION: 108 Tay St, Invercargill	HOLE LOCATION: See site plan
CO-ORDINATES mN 4849644 mE 1242841 (NZTM) 3m accuracy	DRILL TYPE: HG 900 Sonic		HOLE STARTED: 12/07/2019
	DATUM: Ground Level		HOLE FINISHED: 13/07/2019
DIRECTION: 0°	R.L. GROUND: 0 m		DRILLED BY: HEIGHTS DRILLING
ANGLE FROM HORIZ.: 90°	R.L. COLLAR: 0 m		LOGGED BY: MB CHECKED:

Column headings: GEOLOGICAL UNIT; DESCRIPTION OF CORE (SOIL: Classification, colour, consistency / density, moisture, plasticity); Sampling Method; Core Recovery (%); Moisture Condition; Strength/Density Classification; RL (m); Depth (m); Graphic Log; Drillers Notes; TESTING (Hammer Efficiency: 69.4%, Borehole Diameter: 125mm, Liner:); Water Loss (%); Water Level; Casing; Installation; Core Box

Geological Unit	Description of Core	Sampling Method	Core Recovery (%)	Moisture Condition	Strength/Density	Depth (m)	Testing	Installation	Core Box
ALLUVIAL GRAVEL	10.20 Silty sandy fine to coarse GRAVEL. Yellow/orange mottled, very dense, saturated, well graded. Gravel subrounded to rounded, [illegible] mainly. Sand fine to coarse. Cemented areas	SONIC / SPT	100% / N/A	SATURATED	VERY DENSE	10–11	SPT @ 10.5m 9,28,62,8 N=50+ 215mm remaining	Pea gravel / filter	5
	11.5 Sandy fine to coarse GRAVEL with some silt. Grey mottled orange, very dense, saturated, well graded. Gravel subrounded to rounded. Sand fine to coarse. Clasts mainly quartz. 12.2 - Red orange mottled, trace [illegible] [illegible] 12.2-12.4m. Rare [illegible] (COM [illegible]) Sand lenses	SONIC / SPT	100% / N/A	SATURATED	VERY DENSE	11–13	SPT @ 12.0m 27,23 N=50+ 300mm remaining		
		SONIC / SPT	100% / 100		VERY DENSE	13–14	SPT @ 13.5m 25,25 N=50+ 335mm remaining		6
		SONIC / SPT	100% / 100	SATURATED		14–15	SPT @ 15.0m 17,33 N=50+ 310mm remaining		7
	End of hole 15.10m - Target depth					15.10			

COMMENTS: ALL SPT 'N' VALUES ARE UNCORRECTED

Survey Method:

Log Scale 1:50

NZGD ID: BH_136474

Beca

BOREHOLE No: BH01

MACHINE BOREHOLE LOG

SHEET 1 of 5

PROJECT: Dee Street Hotel — JOB NUMBER: 5320381

SITE LOCATION: Refer Site Plan (Dee St - Don St) — CLIENT: The Invercargill Licensing Trust

CIRCUIT: NZTM — BOREHOLE LOCATION:

COORDINATES: N 4,849,791 m — R L: 27 m — COORDINATE ORIGIN: hhGPS

E 1,242,448 m — DATUM: MSL — ACCURACY: ±5m

DRILLING						IN-SITU TESTS							
FLUID LOSS	DAILY WATER LEVEL	CORE RECOVERY	METHOD	CASING	RQD	SV	τ (kPa)	SPT 'N'	SAMPLES	DEPTH (m)	GRAPHIC LOG	SOIL / ROCK DESCRIPTION	GEOLOGICAL UNIT	R L (m)
									DBH1-0.4	0.0		Asphalt.		
		0 %	VE							0.5		Fine to coarse sandy fine to coarse GRAVEL; dark brownish grey; moist; non-plastic. Gravel; angular to sub-rounded; unweathered; basalt chips, brick fragments.	Fill	26.5
										1.0				26.0
										1.5				25.5
										2.0				25.0
										2.5				24.5
	25/06/2018 5:30:00 p.m.	89 %	SPT					1 2 2 4 4 3 N=13		3.0		Medium dense, silty fine to coarse sandy fine to coarse GRAVEL; light grey; moist; non-plastic (matrix). Gravel: rounded to well rounded; weathered; quartz.		24.0
		100 %	Sonic							3.5		Medium dense, fine to coarse sandy fine to coarse GRAVEL, trace silt; light grey; moist; non-plastic (matrix). Gravel: rounded to well rounded; weathered; quartz.	Quaternary Alluvium	23.5
										4.0		4.30m, grey mottled orange		23.0
		76 %	SPT					2 2 3 3 7 7 N=20		4.5		4.80m, light orange mottled grey		22.5

DATE STARTED: 25/6/18 — DRILLED BY: McNeill Drilling

DATE FINISHED: 25/6/18 — EQUIPMENT: Sonic

LOGGED BY: DD — DRILL METHOD: Sonic/SPT/VE

SHEAR VANE No: — DRILL FLUID: Water

DIAMETER/INCLINATION: -/ 90°

COMMENTS:
Coordinates were determined using a hand held GPS. Elevations were obtained from Google Earth. Borehole terminated at target depth. Groundwater encountered at 3.2m below ground level. SPT hammer efficiency = 87.8%.

FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS SEE KEY SHEET

A4 Scale 1:25

BECA LIB 1.07.4.GLB Log BECA MACHINE BOREHOLE 5320381 - ILT - DEE ST HOTEL.GPJ <<DrawingFile>> 30/07/2018 09:55 8.30.004 Datgel Lab and In Situ Tool - DGD | Lib: Beca 1.07.4 2016-01-15 Prj: Beca 1.07 2014-12-16

Beca

BOREHOLE No: BH01

MACHINE BOREHOLE LOG

SHEET 2 of 5

PROJECT: Dee Street Hotel — JOB NUMBER: 5320381

SITE LOCATION: Refer Site Plan (Dee St - Don St) — CLIENT: The Invercargill Licensing Trust

CIRCUIT: NZTM — BOREHOLE LOCATION:

COORDINATES: N 4,849,791 m, E 1,242,448 m — R L: 27 m, DATUM: MSL — COORDINATE ORIGIN: hhGPS, ACCURACY: ±5m

DRILLING: FLUID LOSS	DRILLING: DAILY WATER LEVEL	DRILLING: CORE RECOVERY	DRILLING: METHOD	DRILLING: CASING	DRILLING: RQD	IN-SITU TESTS: SV	IN-SITU TESTS: τ (kPa)	IN-SITU TESTS: SPT 'N'	SAMPLES	DEPTH (m)	GRAPHIC LOG	SOIL / ROCK DESCRIPTION	GEOLOGICAL UNIT	R L (m)
		100 %	Sonic							5.5		Medium dense, fine to coarse sandy fine to coarse GRAVEL, trace silt; light orange mottled grey; moist; non-plastic (matrix). Gravel: rounded to well rounded; weathered; quartz.		21.5
												5.50m, dark orange mottled grey		
		89 %	SPT					2 3 8 8 12 14 N=42		6.0		from 6.00m, dense		21.0
		100 %	Sonic							6.5		6.50m, light orange, oxidisation		20.5
		82 %	SPT					9 10 12 9 7 9 N=37		7.5		7.50m, dark orange	Quaternary Alluvium	20.0 19.5
		100 %	Sonic							8.0		"Dense", fine to coarse gravelly fine to coarse SAND; dark orange; moist; non-plastic. Gravel: rounded to well rounded; weathered; quartz.		19.0
										8.5				18.5
		78 %	SPT					6 9 18 20 12 N=50+ for 200mm		9.0		"Dense" fine to coarse sandy fine to coarse GRAVEL; dark orange mottled grey; moist; non-plastic (matrix). Gravel: rounded to well rounded; weathered; quartz.		18.0
		100 %	Sonic							9.5		from 9.00m, very dense		17.5

DATE STARTED: 25/6/18 — DRILLED BY: McNeill Drilling

DATE FINISHED: 25/6/18 — EQUIPMENT: Sonic

LOGGED BY: DD — DRILL METHOD: Sonic/SPT/VE

SHEAR VANE No: — DRILL FLUID: Water

DIAMETER/INCLINATION: -/ 90°

COMMENTS:
Coordinates were determined using a hand held GPS. Elevations were obtained from Google Earth. Borehole terminated at target depth. Groundwater encountered at 3.2m below ground level. SPT hammer efficiency = 87.8%.

FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS SEE KEY SHEET

A4 Scale 1:25

BECA LIB 1.07.4.GLB Log BECA MACHINE BOREHOLE 5320381 - ILT - DEE ST HOTEL.GPJ <<DrawingFile>> 30/07/2018 09:55 8.30.004 Datgel Lab and In Situ Tool - DGD | Lib: Beca 1.07.4 2016-01-15 Prj: Beca 1.07 2014-12-16

Beca

BOREHOLE No: BH01

MACHINE BOREHOLE LOG

SHEET 3 of 5

PROJECT: Dee Street Hotel — JOB NUMBER: 5320381

SITE LOCATION: Refer Site Plan (Dee St - Don St) — CLIENT: The Invercargill Licensing Trust

CIRCUIT: NZTM — BOREHOLE LOCATION:

COORDINATES: N 4,849,791 m — R L: 27 m — COORDINATE ORIGIN: hhGPS

E 1,242,448 m — DATUM: MSL — ACCURACY: ±5m

DRILLING: FLUID LOSS	DRILLING: DAILY WATER LEVEL	DRILLING: CORE RECOVERY	DRILLING: METHOD	DRILLING: CASING	DRILLING: RQD	IN-SITU TESTS: SV	IN-SITU TESTS: τ (kPa)	IN-SITU TESTS: SPT 'N'	SAMPLES	DEPTH (m)	GRAPHIC LOG	SOIL / ROCK DESCRIPTION	GEOLOGICAL UNIT	R L (m)
		100 %	Sonic							10.5		Very dense, fine to coarse sandy fine to coarse GRAVEL; dark orange mottled grey; moist; non-plastic (matrix). Gravel: rounded to well rounded; weathered; quartz.		16.5
		78 %	SPT					4 3 13 19 18 N=50+ for 220mm						
		100 %	Sonic							11.0		Very dense, fine to coarse gravelly fine to coarse SAND; dark orange; moist; non-plastic. Gravel: rounded to well rounded; weathered; quartz.		16.0
										11.5				15.5
		89 %	SPT					5 6 10 10 10 10 N=40		12.0		Dense, fine to coarse sandy fine to coarse GRAVEL; dark orange; moist; non-plastic (matrix). Gravel: rounded to well rounded; weathered; quartz. Oxidisation.	Quaternary Alluvium	15.0
		100 %	Sonic							12.5				14.5
										13.0				14.0
		89 %	SPT					5 8 9 9 9 9 N=36		13.5		Dense, fine to coarse SAND; some gravel; light orange mottled grey; moist; non-plastic. Gravel: rounded to well rounded; weathered; quartz. Oxidisation.		13.5
		100 %	Sonic							14.0				13.0
										14.5		Dense, fine to coarse gravelly fine to coarse SAND; light orange mottled grey; moist; non-plastic. Gravel: rounded to well rounded; weathered; quartz. Oxidisation.		12.5
								9						

DATE STARTED: 25/6/18 — DRILLED BY: McNeill Drilling

DATE FINISHED: 25/6/18 — EQUIPMENT: Sonic

LOGGED BY: DD — DRILL METHOD: Sonic/SPT/VE

SHEAR VANE No: — DRILL FLUID: Water

DIAMETER/INCLINATION: -/ 90°

COMMENTS:
Coordinates were determined using a hand held GPS. Elevations were obtained from Google Earth. Borehole terminated at target depth. Groundwater encountered at 3.2m below ground level. SPT hammer efficiency = 87.8%.

FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS SEE KEY SHEET

A4 Scale 1:25

BECA LIB 1.07.4.GLB Log BECA MACHINE BOREHOLE 5320381 - ILT - DEE ST HOTEL.GPJ <<DrawingFile>> 30/07/2018 09:55 8.30.004 Datgel Lab and In Situ Tool - DGD | Lib: Beca 1.07.4 2016-01-15 Prj: Beca 1.07 2014-12-16

Beca

BOREHOLE No: BH01

MACHINE BOREHOLE LOG

SHEET 4 of 5

PROJECT: Dee Street Hotel — JOB NUMBER: 5320381

SITE LOCATION: Refer Site Plan (Dee St - Don St) — CLIENT: The Invercargill Licensing Trust

CIRCUIT: NZTM — BOREHOLE LOCATION:

COORDINATES: N 4,849,791 m, E 1,242,448 m — R L: 27 m, DATUM: MSL — COORDINATE ORIGIN: hhGPS, ACCURACY: ±5m

FLUID LOSS	DAILY WATER LEVEL	CORE RECOVERY	METHOD	CASING	RQD	IN-SITU TESTS: SV	IN-SITU TESTS: τ (kPa)	IN-SITU TESTS: SPT 'N'	SAMPLES	DEPTH (m)	GRAPHIC LOG	SOIL / ROCK DESCRIPTION	GEOLOGICAL UNIT	R L (m)
		56 %	SPT					17 21 29 N=50+ for 150mm		15.5		Very dense, fine to coarse sandy fine to coarse GRAVEL; dark brownish orange; moist; non-plastic (matrix). Gravel: rounded to well rounded; weathered; quartz.	Quaternary Alluvium	11.5
		100 %	Sonic							16.0		15.65m, light greyish orange		11.0
		67 %	SPT					7 9 9 11 11 12 N=43		16.5		from 16.50m, medium dense		10.5
		100 %	Sonic						DBH1-17.1	17.0		Medium dense, silty fine to coarse SAND; dark orange streaked black; moist, non-plastic.		10.0
												Stiff, silty CLAY; dark brown streaked black; moist; high plasticity.		
									DBH1-17.8	17.5		Very stiff, LIGNITE; black; moist; non-plastic.		9.5
		98 %	SPT					3 6 8 8 9 11 N=36		18.0		Medium dense, fine to coarse SAND, some silt; dark grey speckled black; moist; non-plastic.	Gore Lignite Measures	9.0
												18.20m, saturated		
		100 %	Sonic							18.5				8.5
										19.0		Very stiff, LIGNITE, some clay; black; moist; non-plastic.		8.0
		100 %	SPT					3 3 6 6 11 15 N=38	DBH1-19.5	19.5		Dense, fine to coarse SAND, some silt, trace clay; dark grey; moist; non-plastic.		7.5
												19.80m, light grey		
												19.90m, some gravel. Gravel: rounded to well rounded; weathered; quartz.		

DATE STARTED: 25/6/18 — DRILLED BY: McNeill Drilling

DATE FINISHED: 25/6/18 — EQUIPMENT: Sonic

LOGGED BY: DD — DRILL METHOD: Sonic/SPT/VE

SHEAR VANE No: — DRILL FLUID: Water

DIAMETER/INCLINATION: -/ 90°

COMMENTS:
Coordinates were determined using a hand held GPS. Elevations were obtained from Google Earth. Borehole terminated at target depth. Groundwater encountered at 3.2m below ground level. SPT hammer efficiency = 87.8%.

FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS SEE KEY SHEET

A4 Scale 1:25

BECA LIB 1.07.4.GLB Log BECA MACHINE BOREHOLE 5320381 - ILT - DEE ST HOTEL.GPJ <<DrawingFile>> 30/07/2018 09:55 8.30.004 Datgel Lab and In Situ Tool - DGD | Lib: Beca 1.07.4 2016-01-15 Prj: Beca 1.07 2014-12-16

Beca

BOREHOLE No: BH01

MACHINE BOREHOLE LOG

SHEET 5 of 5

PROJECT: Dee Street Hotel — JOB NUMBER: 5320381

SITE LOCATION: Refer Site Plan (Dee St - Don St) — CLIENT: The Invercargill Licensing Trust

CIRCUIT: NZTM — BOREHOLE LOCATION:

COORDINATES: N 4,849,791 m, E 1,242,448 m — R L: 27 m, DATUM: MSL — COORDINATE ORIGIN: hhGPS, ACCURACY: ±5m

DRILLING: FLUID LOSS	DRILLING: DAILY WATER LEVEL	DRILLING: CORE RECOVERY	DRILLING: METHOD	DRILLING: CASING	DRILLING: RQD	IN-SITU TESTS: SV	IN-SITU TESTS: τ (kPa)	IN-SITU TESTS: SPT 'N'	SAMPLES	DEPTH (m)	GRAPHIC LOG	SOIL / ROCK DESCRIPTION	GEOLOGICAL UNIT	R L (m)
		100 %	Sonic							20.5		Dense, fine to coarse gravelly fine to coarse SAND, trace silt; light grey; moist; non-plastic. Gravel: rounded to well rounded; weathered; quartz.		6.5
		49 %	SPT					6 17 36 14 N=50+ for 90mm		21.0		Very dense, fine to coarse sandy fine to coarse GRAVEL; light grey; moist; non-plastic (matrix). Gravel: rounded to well rounded; weathered; quartz.		6.0
		100 %	Sonic							21.5				5.5
										22.0				5.0
		42 %	SPT					14 25 25 Bounce for 5mm		22.5			Gore Lignite Measures	4.5
		100 %	Sonic							23.0				4.0
										23.5				3.5
		36 %	SPT					21 31 30 Bounce for 20mm		24.0				3.0
										24.5		END OF LOG @ 24.45 m		2.5

DATE STARTED: 25/6/18 — DRILLED BY: McNeill Drilling

DATE FINISHED: 25/6/18 — EQUIPMENT: Sonic

LOGGED BY: DD — DRILL METHOD: Sonic/SPT/VE

SHEAR VANE No: — DRILL FLUID: Water

DIAMETER/INCLINATION: -/ 90°

COMMENTS:
Coordinates were determined using a hand held GPS. Elevations were obtained from Google Earth. Borehole terminated at target depth. Groundwater encountered at 3.2m below ground level. SPT hammer efficiency = 87.8%.

FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS SEE KEY SHEET

A4 Scale 1:25

BECA LIB 1.07.4.GLB Log BECA MACHINE BOREHOLE 5320381 - ILT - DEE ST HOTEL.GPJ <<DrawingFile>> 30/07/2018 09:55 8.30.004 Datgel Lab and In Situ Tool - DGD | Lib: Beca 1.07.4 2016-01-15 Prj: Beca 1.07 2014-12-16

Beca

BOREHOLE No: BH02

SHEET 1 of 5

MACHINE BOREHOLE LOG

PROJECT: Dee Street Hotel — JOB NUMBER: 5320381

SITE LOCATION: Refer Site Plan (Dee St - Don St) — CLIENT: The Invercargill Licensing Trust

CIRCUIT: NZTM — BOREHOLE LOCATION:

COORDINATES: N 4,849,779 m — R L: 27 m — COORDINATE ORIGIN: hhGPS

E 1,242,487 m — DATUM: MSL — ACCURACY: ±5m

DRILLING: FLUID LOSS	DRILLING: DAILY WATER LEVEL	DRILLING: CORE RECOVERY	DRILLING: METHOD	DRILLING: CASING	DRILLING: RQD	IN-SITU TESTS: SV	IN-SITU TESTS: τ (kPa)	IN-SITU TESTS: SPT 'N'	SAMPLES	DEPTH (m)	GRAPHIC LOG	SOIL / ROCK DESCRIPTION	GEOLOGICAL UNIT	R L (m)
		0 %	VE							0.0		Concrete		
										0.5		Fine to coarse sandy silty CLAY, minor fine to medium gravel; light brownish orange; moist; low plasticity. Gravel: angular to sub-rounded; unweathered; basalt chips. Whole and partial bricks / fragments evident.	Fill	26.5
										1.0				26.0
										1.5				25.5
		100 %	Sonic							2.0		"Loose" silty fine to coarse gravelly fine to coarse SAND, some clay; dark reddish brown; moist; non-plastic. Gravel: angular to sub-rounded; unweathered; basalt chips and rounded to well rounded; weathered; quartz.		25.0
										2.5		"Loose" fine to coarse gravelly fine to coarse SAND, some silt; light grey speckled white; moist; non-plastic. Gravel: rounded to well rounded; weathered; quartz.		24.5
	28/06/2018 10:30:00 a.m.	91 %	SPT					1 2 3 4 5 6 N=18		3.0		from 3.00m, medium dense 3.10m, oxidisation		24.0
										3.5		Medium dense, fine to coarse SAND, some silt; light grey mottled orange; moist; non-plastic.	Quaternary Alluvium	23.5
		100 %	Sonic							4.0		Medium dense, fine to coarse sandy fine to coarse GRAVEL, minor silt; light grey mottled orange; moist; non-plastic (matrix). Gravel: rounded to well rounded; weathered; quartz. Oxidisation.		23.0
		89 %	SPT					3 5 6 7 8 8 N=29		4.5		4.50m, light brownish orange		22.5

DATE STARTED: 28/6/18 — DRILLED BY: McNeill Drilling

DATE FINISHED: 28/6/18 — EQUIPMENT: Sonic

LOGGED BY: DD — DRILL METHOD: Sonic/SPT/VE

SHEAR VANE No: — DRILL FLUID: Water

DIAMETER/INCLINATION: -/ 90°

COMMENTS:
Coordinates were determined using a hand held GPS. Elevations were obtained from Google Earth. Borehole terminated at target depth. Groundwater encountered at 2.8m below ground level. SPT hammer efficiency = 87.8%.

FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS SEE KEY SHEET

A4 Scale 1:25

BECA LIB 1.07.4.GLB Log BECA MACHINE BOREHOLE 5320381 - ILT - DEE ST HOTEL.GPJ <<DrawingFile>> 30/07/2018 09:55 8.30.004 Datgel Lab and In Situ Tool - DGD | Lib: Beca 1.07.4 2016-01-15 Prj: Beca 1.07 2014-12-16

Beca

BOREHOLE No: BH02

MACHINE BOREHOLE LOG

SHEET 2 of 5

PROJECT: Dee Street Hotel — JOB NUMBER: 5320381

SITE LOCATION: Refer Site Plan (Dee St - Don St) — CLIENT: The Invercargill Licensing Trust

CIRCUIT: NZTM — BOREHOLE LOCATION:

COORDINATES: N 4,849,779 m, E 1,242,487 m — R L: 27 m, DATUM: MSL — COORDINATE ORIGIN: hhGPS, ACCURACY: ±5m

DRILLING: FLUID LOSS	DRILLING: DAILY WATER LEVEL	DRILLING: CORE RECOVERY	DRILLING: METHOD	DRILLING: CASING	DRILLING: RQD	IN-SITU TESTS: SV	IN-SITU TESTS: τ (kPa)	IN-SITU TESTS: SPT 'N'	SAMPLES	DEPTH (m)	GRAPHIC LOG	SOIL / ROCK DESCRIPTION	GEOLOGICAL UNIT	R L (m)
		100 %	Sonic							5.5		Medium dense, fine to coarse sandy fine to coarse GRAVEL, minor silt; light brownish orange; moist; non-plastic (matrix). Gravel: rounded to well rounded; weathered; quartz. Oxidisation. 5.15m, light reddish brown 5.50m, dark reddish brown	Quaternary Alluvium	21.5
		53 %	SPT					7 10 7 7 13 21 N=48		6.0		from 6.00m, very dense		21.0
		100 %	Sonic							6.5		6.50m, light brownish grey		20.5
		69 %	SPT					8 9 10 11 12 12 N=45		7.0				20.0
		100 %	Sonic							7.5				19.5
										8.0		8.20m, light greyish brown		19.0
										8.5				18.5
		47 %	SPT					9 13 29 21 N=50+ for 150mm		9.0		9.00m, light brownish orange speckled grey		18.0
		100 %	Sonic							9.5		Very dense, fine to coarse gravelly fine to coarse SAND, some silt; light brownish orange; moist; non-plastic. Gravel: rounded to well rounded; weathered; quartz.		17.5

DATE STARTED: 28/6/18 — DRILLED BY: McNeill Drilling

DATE FINISHED: 28/6/18 — EQUIPMENT: Sonic

LOGGED BY: DD — DRILL METHOD: Sonic/SPT/VE

SHEAR VANE No: — DRILL FLUID: Water

DIAMETER/INCLINATION: -/ 90°

COMMENTS:
Coordinates were determined using a hand held GPS. Elevations were obtained from Google Earth. Borehole terminated at target depth. Groundwater encountered at 2.8m below ground level. SPT hammer efficiency = 87.8%.

FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS SEE KEY SHEET

A4 Scale 1:25

Beca

BOREHOLE No: BH02

SHEET 3 of 5

MACHINE BOREHOLE LOG

PROJECT: Dee Street Hotel — JOB NUMBER: 5320381

SITE LOCATION: Refer Site Plan (Dee St - Don St) — CLIENT: The Invercargill Licensing Trust

CIRCUIT: NZTM — BOREHOLE LOCATION:

COORDINATES: N 4,849,779 m — R L: 27 m — COORDINATE ORIGIN: hhGPS

E 1,242,487 m — DATUM: MSL — ACCURACY: ±5m

DRILLING: FLUID LOSS	DAILY WATER LEVEL	CORE RECOVERY	METHOD	CASING	RQD	IN-SITU TESTS: SV	τ (kPa)	SPT 'N'	SAMPLES	DEPTH (m)	GRAPHIC LOG	SOIL / ROCK DESCRIPTION	GEOLOGICAL UNIT	R L (m)
		100 %	Sonic							10.5		Very dense, fine to coarse gravelly fine to coarse SAND, some silt; light brownish orange; moist; non-plastic. Gravel: rounded to well rounded; weathered; quartz. 10.10m, light reddish brown		16.5
		38 %	SPT					9 17 21 29 N=50+ for 145mm						
		100 %	Sonic							11.0				16.0
										11.5		11.40m, light reddish grey		15.5
		36 %	SPT					6 14 19 20 11 N=50+ for 170mm		12.0		Very dense, fine to coarse sandy fine to coarse GRAVEL, minor silt; light brownish orange speckled grey; moist; non-plastic (matrix). Gravel: rounded to well rounded; weathered; quartz.	Quaternary Alluvium	15.0
		100 %	Sonic							12.5		Very dense, fine to coarse gravelly fine to coarse SAND, some silt; light grey speckled orange; moist; non-plastic. Gravel: rounded to well rounded; weathered; quartz.		14.5
										13.0		Very dense, fine to coarse SAND, some gravel; light grey speckled orange; moist; non-plastic. Gravel: rounded to well rounded; weathered; quartz.		14.0
												Very dense, fine to coarse gravelly fine to coarse SAND, trace silt; light greyish orange; moist; non-plastic. Gravel: rounded to well rounded; weathered; quartz. Oxidisation.		
		89 %	SPT					2 4 8 11 12 11 N=42		13.5		from 13.50m, dense Dense, fine to coarse SAND, some gravel; light reddish orange speckled white; moist; non-plastic. Gravel: rounded to well rounded; weathered; quartz.		13.5
		100 %	Sonic							14.0		13.95m, trace gravel		13.0
										14.5		Dense, fine to coarse sandy fine to medium GRAVEL, trace silt; light reddish orange; moist; non-plastic (matrix). Gravel: rounded to well rounded; weathered; quartz.		12.5
								10				14.70m, light brownish grey speckled white, oxidisation		

DATE STARTED: 28/6/18 — DRILLED BY: McNeill Drilling

DATE FINISHED: 28/6/18 — EQUIPMENT: Sonic

LOGGED BY: DD — DRILL METHOD: Sonic/SPT/VE

SHEAR VANE No: — DRILL FLUID: Water

DIAMETER/INCLINATION: -/ 90°

COMMENTS:
Coordinates were determined using a hand held GPS. Elevations were obtained from Google Earth. Borehole terminated at target depth. Groundwater encountered at 2.8m below ground level. SPT hammer efficiency = 87.8%.

FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS SEE KEY SHEET

A4 Scale 1:25

BECA LIB 1.07.4.GLB Log BECA MACHINE BOREHOLE 5320381 - ILT - DEE ST HOTEL.GPJ <<DrawingFile>> 30/07/2018 09:55 8.30.004 Datgel Lab and In Situ Tool - DGD | Lib: Beca 1.07.4 2016-01-15 Prj: Beca 1.07 2014-12-16

Beca

BOREHOLE No: BH02

MACHINE BOREHOLE LOG

SHEET 4 of 5

PROJECT: Dee Street Hotel — JOB NUMBER: 5320381

SITE LOCATION: Refer Site Plan (Dee St - Don St) — CLIENT: The Invercargill Licensing Trust

CIRCUIT: NZTM — BOREHOLE LOCATION:

COORDINATES: N 4,849,779 m, E 1,242,487 m — R L: 27 m, DATUM: MSL — COORDINATE ORIGIN: hhGPS, ACCURACY: ±5m

DRILLING: FLUID LOSS	DAILY WATER LEVEL	CORE RECOVERY	METHOD	CASING	RQD	IN-SITU TESTS: SV	τ (kPa)	SPT 'N'	SAMPLES	DEPTH (m)	GRAPHIC LOG	SOIL / ROCK DESCRIPTION	GEOLOGICAL UNIT	R L (m)
		49 %	SPT					18 15 25 10 N=50+ for 160mm		15.5		Very dense, fine to coarse sandy fine to medium GRAVEL, trace silt; light brownish grey speckled white; moist; non-plastic (matrix). Gravel: rounded to well rounded; weathered; quartz. Oxidisation.		11.5
		100 %	Sonic									15.70m, light brownish orange, oxidisation		
										16.0		Very dense, fine to coarse SAND, minor silt, trace fine to coarse gravel; light brownish orange; moist; non-plastic. Gravel: rounded to well rounded; weathered; quartz.	Quaternary Alluvium	11.0
		87 %	SPT					3 11 17 27 6 N=50+ for 160mm		16.5		Very dense, fine to coarse sandy fine to coarse GRAVEL, some silt; light brownish orange; moist; non-plastic (matrix). Gravel: rounded to well rounded; weathered; quartz.		10.5
												16.35m, minor clay; dark reddish orange; low plasticity		
		100 %	Sonic							17.0		Stiff, silty CLAY, trace fine sand; dark reddish orange streaked black; moist; high plasticity.		10.0
												17.00m, black		
										17.5		Very stiff, LIGNITE; black; moist; non-plastic.		9.5
		87 %	SPT					2 6 9 12 14 14 N=49		18.0		Medium dense, fine to coarse SAND; dark brownish grey; moist; non-plastic.		9.0
												from 18.00m, dense	Gore Lignite Measures	
		100 %	Sonic							18.5		Stiff, silty CLAY, trace fine sand; dark greyish black; moist; high plasticity.		8.5
												Very stiff, LIGNITE, some clay; black; moist; non-plastic.		
										19.0		Stiff, silty CLAY, trace fine sand; light grey streaked black; moist; high plasticity.		8.0
		60 %	SPT					3 5 7 9 9 9 N=34	DBH2-19.4	19.5		Dense, fine to coarse SAND, trace clay; dark grey; moist; non-plastic.		7.5

DATE STARTED: 28/6/18 — DRILLED BY: McNeill Drilling

DATE FINISHED: 28/6/18 — EQUIPMENT: Sonic

LOGGED BY: DD — DRILL METHOD: Sonic/SPT/VE

SHEAR VANE No: — DRILL FLUID: Water

DIAMETER/INCLINATION: -/ 90°

COMMENTS:
Coordinates were determined using a hand held GPS. Elevations were obtained from Google Earth. Borehole terminated at target depth. Groundwater encountered at 2.8m below ground level. SPT hammer efficiency = 87.8%.

FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS SEE KEY SHEET

A4 Scale 1:25

BECA LIB 1.07.4.GLB Log BECA MACHINE BOREHOLE 5320381 - ILT - DEE ST HOTEL.GPJ <<DrawingFile>> 30/07/2018 09:55 8.30.004 Datgel Lab and In Situ Tool - DGD | Lib: Beca 1.07.4 2016-01-15 Prj: Beca 1.07 2014-12-16

Beca

BOREHOLE No: BH02

MACHINE BOREHOLE LOG

SHEET 5 of 5

PROJECT: Dee Street Hotel — JOB NUMBER: 5320381

SITE LOCATION: Refer Site Plan (Dee St - Don St) — CLIENT: The Invercargill Licensing Trust

CIRCUIT: NZTM — BOREHOLE LOCATION:

COORDINATES: N 4,849,779 m — R L: 27 m — COORDINATE ORIGIN: hhGPS

E 1,242,487 m — DATUM: MSL — ACCURACY: ±5m

DRILLING: FLUID LOSS	DRILLING: DAILY WATER LEVEL	DRILLING: CORE RECOVERY	DRILLING: METHOD	DRILLING: CASING	DRILLING: RQD	IN-SITU TESTS: SV	IN-SITU TESTS: τ (kPa)	IN-SITU TESTS: SPT 'N'	SAMPLES	DEPTH (m)	GRAPHIC LOG	SOIL / ROCK DESCRIPTION	GEOLOGICAL UNIT	R L (m)
										20.5		Dense, fine to coarse SAND, trace clay; dark grey; moist; non-plastic.		
		100 %	Sonic									Very dense, fine to coarse sandy fine to coarse GRAVEL; light grey; moist; non-plastic (matrix). Gravel: rounded to well rounded; weathered; quartz.		6.5
		49 %	SPT					7 14 23 Bounce for 5mm		21.0				6.0
		100 %	Sonic							21.5				5.5
		69 %	SPT					8 41 30 Bounce for 35mm		22.0			Gore Lignite Measures	5.0
		100 %	Sonic							22.5				4.5
		53 %	SPT					5 24 26 Bounce for 15mm		23.0				4.0
										23.5				3.5
										24.0				3.0
										24.5		END OF LOG @ 24.45 m		2.5

DATE STARTED: 28/6/18 — DRILLED BY: McNeill Drilling

DATE FINISHED: 28/6/18 — EQUIPMENT: Sonic

LOGGED BY: DD — DRILL METHOD: Sonic/SPT/VE

SHEAR VANE No: — DRILL FLUID: Water

DIAMETER/INCLINATION: -/ 90°

COMMENTS:
Coordinates were determined using a hand held GPS. Elevations were obtained from Google Earth. Borehole terminated at target depth. Groundwater encountered at 2.8m below ground level. SPT hammer efficiency = 87.8%.

FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS SEE KEY SHEET

A4 Scale 1:25

BECA LIB 1.07.4.GLB Log BECA MACHINE BOREHOLE 5320381 - ILT - DEE ST HOTEL.GPJ <<DrawingFile>> 30/07/2018 09:55 8.30.004 Datgel Lab and In Situ Tool - DGD | Lib: Beca 1.07.4 2016-01-15 Prj: Beca 1.07 2014-12-16

Beca

BOREHOLE No: BH03

MACHINE BOREHOLE LOG

SHEET 1 of 5

PROJECT: Dee Street Hotel — JOB NUMBER: 5320381

SITE LOCATION: Refer Site Plan (Dee St - Don St) — CLIENT: The Invercargill Licensing Trust

CIRCUIT: NZTM — BOREHOLE LOCATION:

COORDINATES: N 4,849,745 m — R L: 26 m — COORDINATE ORIGIN: hhGPS

E 1,242,507 m — DATUM: MSL — ACCURACY: ±5m

DRILLING: FLUID LOSS	DRILLING: DAILY WATER LEVEL	DRILLING: CORE RECOVERY	DRILLING: METHOD	DRILLING: CASING	DRILLING: RQD	IN-SITU TESTS: SV	IN-SITU TESTS: τ (kPa)	IN-SITU TESTS: SPT 'N'	SAMPLES	DEPTH (m)	GRAPHIC LOG	SOIL / ROCK DESCRIPTION	GEOLOGICAL UNIT	R L (m)
	27/06/2018 10:00:00 a.m.	0 %	VE						DBH3-0.6	0.5		Concrete	Fill	25.5
										1.0		"Soft" fine to coarse sandy silty CLAY, minor fine to medium gravel; light brownish orange; moist; high plasticity. Gravel: angular to sub-rounded; unweathered; basalt chips, brick fragments.		25.0
		100 %	Sonic							1.5		"Loose" clayey fine to coarse sandy fine to coarse GRAVEL, minor silt, minor clay; light brownish orange; moist; non-plastic. Gravel; angular to sub-rounded; unweathered; basalt chips, brick fragments.		24.5
										2.0		1.70m, light greyish orange		24.0
										2.5		2.00m, gravel: rounded to well rounded; weathered; quartz.		23.5
		78 %	SPT					2 3 5 4 5 5 N=19		3.0		2.50m, light grey Medium dense, silty fine to coarse SAND, minor fine to coarse gravel; light grey speckled white; moist; non-plastic. Gravel: rounded to well rounded; weathered; quartz.	Quaternary Alluvium	23.0
		100 %	Sonic							3.5		Medium dense, fine to coarse sandy fine to coarse GRAVEL, minor silt; light grey speckled white; moist; non-plastic (matrix). Gravel: rounded to well rounded; weathered; quartz.		22.5
										4.0		3.40m, streaked orange 3.70m, trace silt, light brownish orange speckled grey		22.0
		83 %	SPT					4 6 7 6 9 9 N=31		4.5		4.20m, dark reddish brown from 4.50m, dense		21.5

DATE STARTED: 27/6/18 — DRILLED BY: McNeill Drilling

DATE FINISHED: 27/6/18 — EQUIPMENT: Sonic

LOGGED BY: DD — DRILL METHOD: Sonic/SPT/VE

SHEAR VANE No: — DRILL FLUID: Water

DIAMETER/INCLINATION: -/ 90°

COMMENTS:
Coordinates were determined using a hand held GPS. Elevations were obtained from Google Earth. Borehole terminated at target depth. Groundwater encountered at 2.2m below ground level. SPT hammer efficiency = 87.8%.

FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS SEE KEY SHEET

A4 Scale 1:25

BECA LIB 1.07.4.GLB Log BECA MACHINE BOREHOLE 5320381 - ILT - DEE ST HOTEL.GPJ <<DrawingFile>> 30/07/2018 09:55 8.30.004 Datgel Lab and In Situ Tool - DGD | Lib: Beca 1.07.4 2016-01-15 Prj: Beca 1.07 2014-12-16

Beca

BOREHOLE No: BH03

MACHINE BOREHOLE LOG

SHEET 2 of 5

PROJECT: Dee Street Hotel — JOB NUMBER: 5320381

SITE LOCATION: Refer Site Plan (Dee St - Don St) — CLIENT: The Invercargill Licensing Trust

CIRCUIT: NZTM — BOREHOLE LOCATION:

COORDINATES: N 4,849,745 m — R L: 26 m — COORDINATE ORIGIN: hhGPS

E 1,242,507 m — DATUM: MSL — ACCURACY: ±5m

DRILLING: FLUID LOSS	DRILLING: DAILY WATER LEVEL	DRILLING: CORE RECOVERY	DRILLING: METHOD	DRILLING: CASING	DRILLING: RQD	IN-SITU TESTS: SV	IN-SITU TESTS: τ (kPa)	IN-SITU TESTS: SPT 'N'	SAMPLES	DEPTH (m)	GRAPHIC LOG	SOIL / ROCK DESCRIPTION	GEOLOGICAL UNIT	R L (m)
		100 %	Sonic							5.5		Dense, fine to coarse sandy fine to coarse GRAVEL, trace silt; dark reddish brown; moist; non-plastic (matrix). Gravel: rounded to well rounded; weathered; quartz. Oxidisation.		
												Dense, fine to coarse sandy fine to coarse GRAVEL, some silt; light brownish orange; moist; non-plastic (matrix). Gravel: rounded to well rounded; weathered; quartz. Oxidisation.		20.5
		93 %	SPT					6 7 7 12 13 12 N=44		6.0		6.00m, light greyish brown		20.0
		100 %	Sonic							6.5				19.5
										7.0				19.0
		76 %	SPT					2 6 8 14 8 12 N=44		7.5		Dense, fine to coarse gravelly fine to coarse SAND, minor silt; light greyish brown; moist; non-plastic. Gravel: rounded to well rounded; weathered; quartz. Oxidisation.	Quaternary Alluvium	18.5
												Dense, silty fine to coarse sandy fine to coarse GRAVEL; light brownish orange; moist; non-plastic (matrix). Gravel: rounded to well rounded; weathered; quartz.		
		100 %	Sonic							8.0				18.0
												8.30m, light greyish orange		
										8.5				17.5
		93 %	SPT					5 6 11 13 12 14 N=50+ for 295mm		9.0		from 9.00m, very dense, light brownish orange		17.0
		100 %	Sonic							9.5		9.50m, light greyish brown		16.5

DATE STARTED: 27/6/18 — DRILLED BY: McNeill Drilling

DATE FINISHED: 27/6/18 — EQUIPMENT: Sonic

LOGGED BY: DD — DRILL METHOD: Sonic/SPT/VE

SHEAR VANE No: — DRILL FLUID: Water

DIAMETER/INCLINATION: -/ 90°

COMMENTS:
Coordinates were determined using a hand held GPS. Elevations were obtained from Google Earth. Borehole terminated at target depth. Groundwater encountered at 2.2m below ground level. SPT hammer efficiency = 87.8%.

FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS SEE KEY SHEET

A4 Scale 1:25

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Beca

BOREHOLE No: BH03

MACHINE BOREHOLE LOG

SHEET 3 of 5

PROJECT: Dee Street Hotel — JOB NUMBER: 5320381

SITE LOCATION: Refer Site Plan (Dee St - Don St) — CLIENT: The Invercargill Licensing Trust

CIRCUIT: NZTM — BOREHOLE LOCATION:

COORDINATES: N 4,849,745 m — R L: 26 m — COORDINATE ORIGIN: hhGPS

E 1,242,507 m — DATUM: MSL — ACCURACY: ±5m

DRILLING: FLUID LOSS	DAILY WATER LEVEL	CORE RECOVERY	METHOD	CASING	RQD	IN-SITU TESTS: SV	τ (kPa)	SPT 'N'	SAMPLES	DEPTH (m)	GRAPHIC LOG	SOIL / ROCK DESCRIPTION	GEOLOGICAL UNIT	R L (m)
		100 %	Sonic					7 9 16		10.5		Very dense, silty fine to coarse sandy fine to coarse GRAVEL; light greyish brown; moist; non-plastic (matrix). Gravel: rounded to well rounded; weathered; quartz.		15.5
		76 %	SPT					14 16 10 N=50+ for 280mm		11.0				15.0
		100 %	Sonic							11.20m, clay seam (30mm); light grey; moist; high plasticity Very dense, silty fine to coarse sandy fine to coarse GRAVEL, some clay; light brownish orange; moist; non-plastic (matrix). Gravel: rounded to well rounded; weathered; quartz. 11.40m, no clay		14.5
		84 %	SPT					5 6 6 10 10 11 N=37		12.0		Dense, fine to coarse SAND, minor silt; light greyish orange; moist; non-plastic.		14.0
		100 %	Sonic							12.5		Dense, fine to coarse sandy fine to coarse GRAVEL, minor silt; light brownish orange; moist; non-plastic (matrix). Gravel: rounded to well rounded; weathered; quartz. Oxidisation. 12.75m, dark brownish orange	Quaternary Alluvium	13.5
										13.0		13.20m, light brownish orange		13.0
		98 %	SPT					4 8 12 19 19 N=50+ for 215mm		13.5		from 13.50m, very dense		12.5
		100 %	Sonic							14.0		14.15m, dark brown speckled orange 14.35m, light greyish brown, oxidisation		12.0
										14.5				11.5
								10						

DATE STARTED: 27/6/18 — DRILLED BY: McNeill Drilling

DATE FINISHED: 27/6/18 — EQUIPMENT: Sonic

LOGGED BY: DD — DRILL METHOD: Sonic/SPT/VE

SHEAR VANE No: — DRILL FLUID: Water

DIAMETER/INCLINATION: -/ 90°

COMMENTS:
Coordinates were determined using a hand held GPS. Elevations were obtained from Google Earth. Borehole terminated at target depth. Groundwater encountered at 2.2m below ground level. SPT hammer efficiency = 87.8%.

FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS SEE KEY SHEET

A4 Scale 1:25

BECA LIB 1.07.4.GLB Log BECA MACHINE BOREHOLE 5320381 - ILT - DEE ST HOTEL.GPJ <<DrawingFile>> 30/07/2018 09:55 8.30.004 Datgel Lab and In Situ Tool - DGD | Lib: Beca 1.07.4 2016-01-15 Prj: Beca 1.07 2014-12-16

Beca

BOREHOLE No: BH03

MACHINE BOREHOLE LOG

SHEET 4 of 5

PROJECT: Dee Street Hotel — JOB NUMBER: 5320381

SITE LOCATION: Refer Site Plan (Dee St - Don St) — CLIENT: The Invercargill Licensing Trust

CIRCUIT: NZTM — BOREHOLE LOCATION:

COORDINATES: N 4,849,745 m — R L: 26 m — COORDINATE ORIGIN: hhGPS

E 1,242,507 m — DATUM: MSL — ACCURACY: ±5m

DRILLING: FLUID LOSS	DRILLING: DAILY WATER LEVEL	DRILLING: CORE RECOVERY	DRILLING: METHOD	DRILLING: CASING	DRILLING: RQD	IN-SITU TESTS: SV	IN-SITU TESTS: τ (kPa)	IN-SITU TESTS: SPT 'N'	SAMPLES	DEPTH (m)	GRAPHIC LOG	SOIL / ROCK DESCRIPTION	GEOLOGICAL UNIT	R L (m)
		76 %	SPT					12 17 18 15 N=50+ for 180mm		15.5		Very dense, fine to coarse sandy fine to coarse GRAVEL, minor silt; light greyish brown; moist; non-plastic (matrix). Gravel: rounded to well rounded; weathered; quartz. Oxidisation.	Quaternary Alluvium	10.5
		100 %	Sonic						DBH3-16.4	16.0		Very stiff, LIGNITE, some clay; black; moist; non-plastic.	Gore Lignite Measures	10.0
		0 %	SPT					3 4 5 6 7 10 N=28		16.5		Medium dense, fine to coarse SAND, trace clay; dark brownish black; moist; non-plastic.		9.5
		100 %	Sonic						DBH3-17.5	17.0				9.0
										17.5		Stiff, silty fine sandy CLAY; dark greyish black; moist; high plasticity.		8.5
												Very stiff, LIGNITE, some clay; black; moist; low plasticity.		
		56 %	SPT					3 7 9 8 8 8 N=33		18.0		Hard, silty fine sandy CLAY; dark greyish black; moist; high plasticity.		8.0
												Dense, fine to coarse SAND, trace clay; light grey speckled white; moist; non-plastic.		
		100 %	Sonic						DBH3-19.0	18.5				7.5
												Dense, fine to coarse SAND, minor clay, minor silt; light grey speckled white; moist; non-plastic.		
										19.0		19.15m, trace fine to coarse gravel. Gravel: rounded to well rounded; weathered; quartz.		7.0
		27 %	SPT					4 11 21 20 Bounce for 95mm		19.5		Very dense, fine to coarse sandy fine to coarse GRAVEL; light grey; moist; non-plastic (matrix). Gravel: rounded to well rounded; weathered; quartz.		6.5

DATE STARTED: 27/6/18 — DRILLED BY: McNeill Drilling

DATE FINISHED: 27/6/18 — EQUIPMENT: Sonic

LOGGED BY: DD — DRILL METHOD: Sonic/SPT/VE

SHEAR VANE No: — DRILL FLUID: Water

DIAMETER/INCLINATION: -/ 90°

COMMENTS:
Coordinates were determined using a hand held GPS. Elevations were obtained from Google Earth. Borehole terminated at target depth. Groundwater encountered at 2.2m below ground level. SPT hammer efficiency = 87.8%.

FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS SEE KEY SHEET

A4 Scale 1:25

BECA LIB 1.07.4.GLB Log BECA MACHINE BOREHOLE 5320381 - ILT - DEE ST HOTEL.GPJ <<DrawingFile>> 30/07/2018 09:55 8.30.004 Datgel Lab and In Situ Tool - DGD | Lib: Beca 1.07.4 2016-01-15 Prj: Beca 1.07 2014-12-16

Beca

BOREHOLE No: BH03

MACHINE BOREHOLE LOG

SHEET 5 of 5

PROJECT: Dee Street Hotel — JOB NUMBER: 5320381

SITE LOCATION: Refer Site Plan (Dee St - Don St) — CLIENT: The Invercargill Licensing Trust

CIRCUIT: NZTM — BOREHOLE LOCATION:

COORDINATES: N 4,849,745 m — R L: 26 m — COORDINATE ORIGIN: hhGPS

E 1,242,507 m — DATUM: MSL — ACCURACY: ±5m

DRILLING						IN-SITU TESTS								
FLUID LOSS	DAILY WATER LEVEL	CORE RECOVERY	METHOD	CASING	RQD	SV	τ (kPa)	SPT 'N'	SAMPLES	DEPTH (m)	GRAPHIC LOG	SOIL / ROCK DESCRIPTION	GEOLOGICAL UNIT	R L (m)
		100 %	Sonic							20.5		Very dense, fine to coarse sandy fine to coarse GRAVEL; light grey; moist; non-plastic (matrix). Gravel: rounded to well rounded; weathered; quartz.	Gore Lignite Measures	5.5
		60 %	SPT					20 19 23 10 Bounce for 75mm		21.0				5.0
		100 %	Sonic							21.5				4.5
		0 %	SPT					20 Bounce for 50mm		22.0				4.0
		100 %	Sonic							22.5				3.5
		0 %	SPT					21 26 Bounce for 100mm		23.0				3.0
										23.5				2.5
										24.0				2.0
										24.5		END OF LOG @ 24.45 m		1.5

DATE STARTED: 27/6/18 — DRILLED BY: McNeill Drilling

DATE FINISHED: 27/6/18 — EQUIPMENT: Sonic

LOGGED BY: DD — DRILL METHOD: Sonic/SPT/VE

SHEAR VANE No: — DRILL FLUID: Water

DIAMETER/INCLINATION: -/ 90°

COMMENTS:
Coordinates were determined using a hand held GPS. Elevations were obtained from Google Earth. Borehole terminated at target depth. Groundwater encountered at 2.2m below ground level. SPT hammer efficiency = 87.8%.

FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS SEE KEY SHEET

A4 Scale 1:25

BECA LIB 1.07.4.GLB Log BECA MACHINE BOREHOLE 5320381 - ILT - DEE ST HOTEL.GPJ <<DrawingFile>> 30/07/2018 09:55 8.30.004 Datgel Lab and In Situ Tool - DGD | Lib: Beca 1.07.4 2016-01-15 Prj: Beca 1.07 2014-12-16

Beca

BOREHOLE No: BH04

SHEET 1 of 5

MACHINE BOREHOLE LOG

PROJECT: Dee Street Hotel — JOB NUMBER: 5320381

SITE LOCATION: Refer Site Plan (Dee St - Don St) — CLIENT: The Invercargill Licensing Trust

CIRCUIT: NZTM — BOREHOLE LOCATION:

COORDINATES: N 4,849,755 m — R L: 27 m — COORDINATE ORIGIN: hhGPS

E 1,242,444 m — DATUM: MSL — ACCURACY: ±5m

DRILLING: FLUID LOSS	DRILLING: DAILY WATER LEVEL	DRILLING: CORE RECOVERY	DRILLING: METHOD	DRILLING: CASING	DRILLING: RQD	IN-SITU TESTS: SV	IN-SITU TESTS: τ (kPa)	IN-SITU TESTS: SPT 'N'	SAMPLES	DEPTH (m)	GRAPHIC LOG	SOIL / ROCK DESCRIPTION	GEOLOGICAL UNIT	R L (m)
	26/06/2018 4:30:00 p.m.	0 %	VE						DBH4-0.7	0.5		Asphalt.		26.5
												"Loose" fine to coarse sandy fine to coarse GRAVEL, minor silt, minor clay; dark brownish grey; moist; non-plastic. Gravel; angular to sub-rounded; unweathered; basalt chips, brick fragments.		
										1.0		0.90m, dark brown	Fill	26.0
										1.5				25.5
										2.0				25.0
		100 %	Sonic									"Loose" silty fine to coarse sandy fine to coarse GRAVEL, minor clay; light brownish orange; moist; low plasticity. Gravel: angular to sub-rounded; unweathered; basalt chips and rounded to well rounded; weathered; quartz.		
		78 %	SPT					0 1 6 5 5 5 N=21		2.5		"Loose" Fine to coarse sandy fine to coarse GRAVEL, minor silt; light brownish grey mottled orange; moist; non-plastic (matrix). Gravel: rounded to well rounded; weathered; quartz.		24.5
										3.0		from 3.00m, medium dense		24.0
		100 %	Sonic							3.5		Medium dense, fine to coarse sandy fine to coarse GRAVEL; light grey; moist; non-plastic (matrix). Gravel: rounded to well rounded; weathered; quartz.	Quaternary Alluvium	23.5
										4.0				23.0
									DBH4-4.4			Stiff, silty clay; light grey; moist; low plasticity.		
		82 %	SPT					6 8 8 8 8 7 N=31		4.5		Dense, fine to coarse sandy fine to coarse GRAVEL; light grey; moist; non-plastic (matrix). Gravel: rounded to well rounded; weathered; quartz.		22.5

DATE STARTED: 26/6/18 — DRILLED BY: McNeill Drilling

DATE FINISHED: 26/6/18 — EQUIPMENT: Sonic

LOGGED BY: DD — DRILL METHOD: Sonic/SPT/VE

SHEAR VANE No: — DRILL FLUID: Water

DIAMETER/INCLINATION: -/ 90°

COMMENTS:
Coordinates were determined using a hand held GPS. Elevations were obtained from Google Earth maps. Borehole terminated at target depth. Groundwater encountered at ~2.0m below ground level (level uncertain due to inability to provide adequate settlement time - borehole reinstatement required). SPT hammer efficiency = 87.8%.

FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS SEE KEY SHEET

A4 Scale 1:25

BECA LIB 1.07.4.GLB Log BECA MACHINE BOREHOLE 5320381 - ILT - DEE ST HOTEL.GPJ <<DrawingFile>> 30/07/2018 09:55 8.30.004 Datgel Lab and In Situ Tool - DGD | Lib: Beca 1.07.4 2016-01-15 Prj: Beca 1.07 2014-12-16

Beca

BOREHOLE No: BH04

MACHINE BOREHOLE LOG

SHEET 2 of 5

PROJECT: Dee Street Hotel — JOB NUMBER: 5320381

SITE LOCATION: Refer Site Plan (Dee St - Don St) — CLIENT: The Invercargill Licensing Trust

CIRCUIT: NZTM — BOREHOLE LOCATION:

COORDINATES: N 4,849,755 m, E 1,242,444 m — R L: 27 m, DATUM: MSL — COORDINATE ORIGIN: hhGPS, ACCURACY: ±5m

DRILLING: FLUID LOSS	DRILLING: DAILY WATER LEVEL	DRILLING: CORE RECOVERY	DRILLING: METHOD	DRILLING: CASING	DRILLING: RQD	IN-SITU TESTS: SV	IN-SITU TESTS: τ (kPa)	IN-SITU TESTS: SPT 'N'	SAMPLES	DEPTH (m)	GRAPHIC LOG	SOIL / ROCK DESCRIPTION	GEOLOGICAL UNIT	R L (m)
		100 %	Sonic							5.5		Dense, fine to coarse sandy fine to coarse GRAVEL; light grey; moist; non-plastic (matrix). Gravel: rounded to well rounded; weathered; quartz. 5.10m, mottled orange		21.5
												5.60m, light orange mottled grey		
		93 %	SPT					6 8 8 8 8 10 N=34		6.0				21.0
		100 %	Sonic							6.5				20.5
												Dense, fine to coarse gravelly fine to coarse SAND, some silt; light orange mottled grey; moist; non-plastic. Gravel: rounded to well rounded; weathered; quartz.		
										7.0				20.0
		76 %	SPT					5 8 11 16 19 4 N=50+ for 230mm		7.5		Very dense, fine to coarse sandy fine to coarse GRAVEL, some silt; light brownish orange; moist; non-plastic (matrix). Gravel: rounded to well rounded; weathered; quartz.	Quaternary Alluvium	19.5
		100 %	Sonic							8.0				19.0
										8.5				18.5
		93 %	SPT					4 8 12 14 18 6 N=50+ for 230mm		9.0				18.0
		100 %	Sonic							9.5				17.5

DATE STARTED: 26/6/18 — DRILLED BY: McNeill Drilling

DATE FINISHED: 26/6/18 — EQUIPMENT: Sonic

LOGGED BY: DD — DRILL METHOD: Sonic/SPT/VE

SHEAR VANE No: — DRILL FLUID: Water

DIAMETER/INCLINATION: -/ 90°

COMMENTS:
Coordinates were determined using a hand held GPS. Elevations were obtained from Google Earth maps. Borehole terminated at target depth. Groundwater encountered at ~2.0m below ground level (level uncertain due to inability to provide adequate settlement time - borehole reinstatement required). SPT hammer efficiency = 87.8%.

FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS SEE KEY SHEET

A4 Scale 1:25

BECA LIB 1.07.4.GLB Log BECA MACHINE BOREHOLE 5320381 - ILT - DEE ST HOTEL.GPJ <<DrawingFile>> 30/07/2018 09:55 8.30.004 Datgel Lab and In Situ Tool - DGD | Lib: Beca 1.07.4 2016-01-15 Prj: Beca 1.07 2014-12-16

Beca

BOREHOLE No: BH04

MACHINE BOREHOLE LOG

SHEET 3 of 5

PROJECT: Dee Street Hotel — JOB NUMBER: 5320381

SITE LOCATION: Refer Site Plan (Dee St - Don St) — CLIENT: The Invercargill Licensing Trust

CIRCUIT: NZTM — BOREHOLE LOCATION:

COORDINATES: N 4,849,755 m, E 1,242,444 m — R L: 27 m, DATUM: MSL — COORDINATE ORIGIN: hhGPS, ACCURACY: ±5m

DRILLING: FLUID LOSS	DAILY WATER LEVEL	CORE RECOVERY	METHOD	CASING	RQD	IN-SITU TESTS: SV	τ (kPa)	SPT 'N'	SAMPLES	DEPTH (m)	GRAPHIC LOG	SOIL / ROCK DESCRIPTION	GEOLOGICAL UNIT	R L (m)
		100 %	Sonic							10.5		Very dense, fine to coarse sandy fine to coarse GRAVEL, some silt; light brownish orange; moist; non-plastic (matrix). Gravel: rounded to well rounded; weathered; quartz.		16.5
		76 %	SPT					10 10 10 12 18 10 N=50+ for 225mm		11.0				16.0
		100 %	Sonic							11.5				15.5
		84 %	SPT					3 3 5 6 6 7 N=24		12.0				15.0
		100 %	Sonic							12.5		Medium dense fine to coarse SAND, minor gravel, some silt; light orange speckled grey; moist; non-plastic. Gravel: rounded to well rounded; weathered; quartz.		14.5
										13.0		Medium dense, fine to coarse sandy fine to coarse GRAVEL, some silt; light orange speckled grey; moist; non-plastic (matrix). Gravel: rounded to well rounded; weathered; quartz. Oxidisation.	Quaternary Alluvium	14.0
												13.30m, light grey mottled orange		
		98 %	SPT					3 7 14 16 20 N=50+ for 225mm		13.5		from 13.50m, very dense		13.5
		100 %	Sonic							14.0		Very dense fine to coarse SAND, some gravel, some silt; light grey mottled orange; moist; non-plastic. Gravel: rounded to well rounded; weathered; quartz.		13.0
										14.5		Very dense, fine to coarse sandy fine to coarse GRAVEL, trace silt; light brownish orange; moist; non-plastic (matrix). Gravel: rounded to well rounded; weathered; quartz. Oxidisation.		12.5

DATE STARTED: 26/6/18 — DRILLED BY: McNeill Drilling

DATE FINISHED: 26/6/18 — EQUIPMENT: Sonic

LOGGED BY: DD — DRILL METHOD: Sonic/SPT/VE

SHEAR VANE No: — DRILL FLUID: Water

DIAMETER/INCLINATION: -/ 90°

COMMENTS:
Coordinates were determined using a hand held GPS. Elevations were obtained from Google Earth maps. Borehole terminated at target depth. Groundwater encountered at ~2.0m below ground level (level uncertain due to inability to provide adequate settlement time - borehole reinstatement required). SPT hammer efficiency = 87.8%.

FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS SEE KEY SHEET

A4 Scale 1:25

BECA LIB 1.07.4.GLB Log BECA MACHINE BOREHOLE 5320381 - ILT - DEE ST HOTEL.GPJ <<DrawingFile>> 30/07/2018 09:55 8.30.004 Datgel Lab and In Situ Tool - DGD | Lib: Beca 1.07.4 2016-01-15 Prj: Beca 1.07 2014-12-16

Beca

BOREHOLE No: BH04

MACHINE BOREHOLE LOG

SHEET 4 of 5

PROJECT: Dee Street Hotel — JOB NUMBER: 5320381

SITE LOCATION: Refer Site Plan (Dee St - Don St) — CLIENT: The Invercargill Licensing Trust

CIRCUIT: NZTM — BOREHOLE LOCATION:

COORDINATES: N 4,849,755 m, E 1,242,444 m — R L: 27 m, DATUM: MSL — COORDINATE ORIGIN: hhGPS, ACCURACY: ±5m

DRILLING: FLUID LOSS	DRILLING: DAILY WATER LEVEL	DRILLING: CORE RECOVERY	DRILLING: METHOD	DRILLING: CASING	DRILLING: RQD	IN-SITU TESTS: SV	IN-SITU TESTS: τ (kPa)	IN-SITU TESTS: SPT 'N'	SAMPLES	DEPTH (m)	GRAPHIC LOG	SOIL / ROCK DESCRIPTION	GEOLOGICAL UNIT	R L (m)
		84 %	SPT					14 14 14 14 8 N=50+ for 290mm	DBH4-16.3	15.5		Very dense, fine to coarse sandy fine to coarse GRAVEL, trace silt; light brownish orange; moist; non-plastic (matrix). Gravel: rounded to well rounded; weathered; quartz. Oxidisation.	Quaternary Alluvium	11.5
		100 %	Sonic							16.0				11.0
												16.30m, clay seam (30mm); light grey; moist; high plasticity		
		0 %	SPT					20 Bounce for 75mm		16.5		Very dense, fine to coarse sandy fine to coarse GRAVEL, trace silt; light brownish orange; moist; non-plastic (matrix). Gravel: rounded to well rounded; weathered; quartz. Oxidisation. 16.50m, light grey 16.70m, light orange, oxidisation		10.5
		100 %	Sonic							17.0		17.05m, dark orange streaked black		10.0
										17.5		Very stiff, LIGNITE; black; moist; non-plastic.		9.5
		56 %	SPT					1 3 8 14 15 13 N=50+ for 290mm	DBH4-18.1	18.0		Dense, fine to coarse SAND, some silt; dark greyish brown speckled black; moist; non-plastic. from 18.00m, very dense	Gore Lignite Measures	9.0
		100 %	Sonic							18.5				8.5
										19.0		Very stiff LIGNITE, some clay; black; moist; low plasticity.		8.0
		27 %	SPT					7 20 Bounce for 150mm		19.5		Very dense fine to coarse SAND, minor clay, trace fine gravel; light greyish black; moist; low plasticity. Gravel: rounded to well rounded; weathered; quartz. 19.70m, trace clay, no gravel, light greenish grey 19.90m, no clay		7.5

DATE STARTED: 26/6/18 — DRILLED BY: McNeill Drilling

DATE FINISHED: 26/6/18 — EQUIPMENT: Sonic

LOGGED BY: DD — DRILL METHOD: Sonic/SPT/VE

SHEAR VANE No: — DRILL FLUID: Water

DIAMETER/INCLINATION: -/ 90°

COMMENTS:
Coordinates were determined using a hand held GPS. Elevations were obtained from Google Earth maps. Borehole terminated at target depth. Groundwater encountered at ~2.0m below ground level (level uncertain due to inability to provide adequate settlement time - borehole reinstatement required). SPT hammer efficiency = 87.8%.

FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS SEE KEY SHEET

A4 Scale 1:25

BECA LIB 1.07.4.GLB Log BECA MACHINE BOREHOLE 5320381 - ILT - DEE ST HOTEL.GPJ <<DrawingFile>> 30/07/2018 09:55 8.30.004 Datgel Lab and In Situ Tool - DGD | Lib: Beca 1.07.4 2016-01-15 Prj: Beca 1.07 2014-12-16

Beca

BOREHOLE No: BH04

MACHINE BOREHOLE LOG

SHEET 5 of 5

PROJECT: Dee Street Hotel — JOB NUMBER: 5320381

SITE LOCATION: Refer Site Plan (Dee St - Don St) — CLIENT: The Invercargill Licensing Trust

CIRCUIT: NZTM — BOREHOLE LOCATION:

COORDINATES: N 4,849,755 m — R L: 27 m — COORDINATE ORIGIN: hhGPS

E 1,242,444 m — DATUM: MSL — ACCURACY: ±5m

DRILLING: FLUID LOSS	DRILLING: DAILY WATER LEVEL	DRILLING: CORE RECOVERY	DRILLING: METHOD	DRILLING: CASING	DRILLING: RQD	IN-SITU TESTS: SV	IN-SITU TESTS: τ (kPa)	IN-SITU TESTS: SPT 'N'	SAMPLES	DEPTH (m)	GRAPHIC LOG	SOIL / ROCK DESCRIPTION	GEOLOGICAL UNIT	R L (m)
		100 %	Sonic							20.5		Very dense, fine to coarse SAND, minor clay, trace fine gravel; light grey; moist; low plasticity. Gravel: rounded to well rounded; weathered; quartz.		6.5
		51 %	SPT					11 25 50 N=50+ for 75mm		21.0		Very dense, fine to coarse sandy fine to coarse GRAVEL; light grey; moist; non-plastic (matrix). Gravel: rounded to well rounded; weathered; quartz.		6.0
		100 %	Sonic							21.5				5.5
										22.0				5.0
		0 %	SPT					7 32 25 Bounce for 30mm		22.5			Gore Lignite Measures	4.5
		100 %	Sonic							23.0				4.0
										23.5				3.5
		25 %	SPT					17 25 Bounce for 150mm		24.0				3.0
										24.5		END OF LOG @ 24.45 m		2.5

DATE STARTED: 26/6/18 — DRILLED BY: McNeill Drilling

DATE FINISHED: 26/6/18 — EQUIPMENT: Sonic

LOGGED BY: DD — DRILL METHOD: Sonic/SPT/VE

SHEAR VANE No: — DRILL FLUID: Water

DIAMETER/INCLINATION: -/ 90°

COMMENTS:
Coordinates were determined using a hand held GPS. Elevations were obtained from Google Earth maps. Borehole terminated at target depth. Groundwater encountered at ~2.0m below ground level (level uncertain due to inability to provide adequate settlement time - borehole reinstatement required). SPT hammer efficiency = 87.8%.

FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS SEE KEY SHEET

A4 Scale 1:25

BECA LIB 1.07.4.GLB Log BECA MACHINE BOREHOLE 5320381 - ILT - DEE ST HOTEL.GPJ <<DrawingFile>> 30/07/2018 09:55 8.30.004 Datgel Lab and In Situ Tool - DGD | Lib: Beca 1.07.4 2016-01-15 Prj: Beca 1.07 2014-12-16

NZGD ID: HA_136763

KEY ⌖ HAND AUGER / DCP TEST LOCATION △1 CPT LOCATION / I.D

0m 100m

No.	Revision	By	Chk	Appd	Date

Drawing Originator: Beca

Original Scale (A1) | Reduced Scale (A3)

Design | Drawn | Dsg Verifier | Dwg Check

* Refer to Revision 1 for Original Signature

Client: Invercargill City Council

Project: Invercargill Water Tower

Title: Geotechnical Investigation Site Plan

Discipline: Geotechnical

Drawing No.: 000-GA-001

Rev.: 1

DO NOT SCALE

IF IN DOUBT ASK

BLUEBEAM

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NZGD ID: HA_136763

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Log Key Sheet

WATER

Water level on date shown

METHOD *(shows drilling method)*

OB	open barrel
Wash	wash boring
TT	triple tube
UT	thin walled undisturbed tube
SPT	standard penetration test – open nose sampler
Nc	standard penetration test – solid nose sampler
MA	machine auger
PS	piston sample
PCT	percussion – top drive
PCB	percussion – bottom drive
Conc	concentrics
Sonic	sonic
HA	hand auger
VE	vacuum excavation

SAMPLES

Dx	Disturbed sample, number x
Bx	Bulk sample, number x
Ux(d)	Undisturbed sample, number x, tube diameter d in mm
Wx	Water sample, number x

MOISTURE

Dry, looks and feels dry
Moist, no free water on hand when remoulding
Wet, free water on hand when remoulding
Saturated, soil below water table

SOIL AND ROCK DESCRIPTIONS

Soil and Rock Descriptions are generally as described in the NZ Geotechnical Society "Field Description of Soil and Rock – Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes", dated December 2005.
Vane Shear Strength measurements in accordance with the NZ Geotechnical Society "Guideline for hand held shear vane test" dated August 2001.

IN SITU TESTS

SV	= 40/10	In situ shear strength and remoulded shear strength respectively, as measured by Geotechnics/ Pilcon Shear Vane
τ	= 50/12	Vane shear strength and remoulded vane shear strength respectively, corrected to BS1377
UTP	=	Unable To Penetrate with Shear Vane
N	= 15	SPT uncorrected blow count for 300mm penetration
N_c	= 50+	SPT uncorrected blow count for 300 mm penetration using solid nose sampler

★	**Laboratory Test(s) carried out:**
AL	Atterberg limits
UU	Unconsolidated undrained triaxial
PSD	Particle size
CU	Consolidated undrained triaxial
CONS	Consolidation
COMP	Compaction
UCS	Unconfined compression

WEATHERING

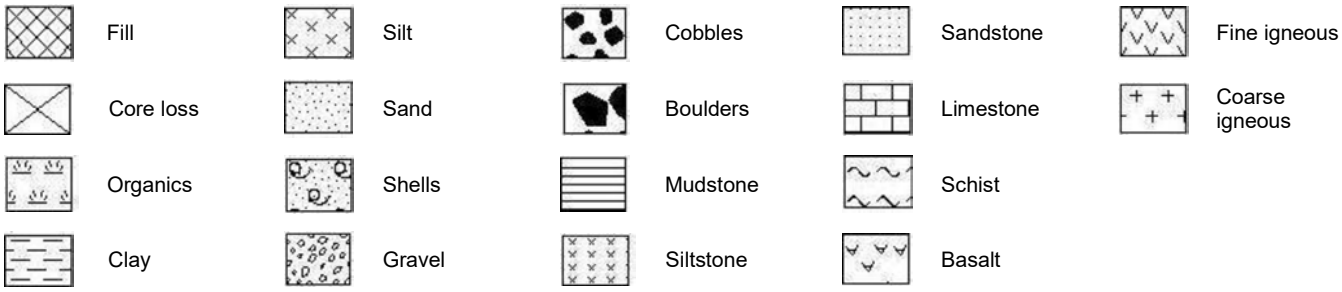
CW	Completely weathered
HW	Highly weathered
MW	Moderately weathered
SW	Slightly weathered
UW	Unweathered

CONSISTENCY

Cohesive Soils	Undrained Shear Strength (kPa)
Very soft	<12
Soft	12 to 25
Firm	25 to 50
Stiff	50 to 100
Very stiff	100 to 200
Hard	>200

Non-cohesive Soils	SPT – Uncorrected
Very loose	0 to 4
Loose	4 to 10
Medium dense	10 to 30
Dense	30 to 50
Very dense	>50

GRAPHIC LOG (1 or a combination of the following)



ORGANIC SOILS

Von Post Degree of Humification

H1	Completely unconverted and mud-free peat, when pressed gives clear water and plant structure is visible.
H2	Practically unconverted and mud-free peat, when pressed gives almost clear water and plant structure is visible.
H3	Very slightly decomposed or very slightly muddy peat, when pressed gives marked muddy water, no peat substance passes through the fingers and plant structure is less visible.
H4	Slightly decomposed or slightly muddy peat, when pressed gives marked muddy water and plant structure is less visible.
H5	Moderately decomposed or very muddy peat with growth structure evident but slightly obliterated.
H6	Moderately decomposed or very muddy peat with indistinct growth structure.
H7	Fairly well decomposed or very muddy peat but the growth structure can just be seen.
H8	Well decomposed or very muddy peat with very indistinct growth structure.
H9	Practically decomposed or mud-like peat in which almost no growth structure is evident.
H10	Completely decomposed or mud peat where no growth structure can be seen, entire substance passes through the fingers when pressed.

Beca

HAND AUGER No: HA01

HAND AUGER LOG

SHEET 1 of 1

PROJECT:	ICC Water Tower & Control Building	JOB NUMBER:	4682750
SITE LOCATION:	101 Doon St, Invercargill	CLIENT:	Invercargill City Council

CIRCUIT:	NZTM	AUGER LOCATION:	North Water Tower (refer site plan)		
COORDINATES:	N 4,850,218 m	R L:	16 m	COORDINATE ORIGIN:	hhGPS
	E 1,243,443 m	DATUM:	NZVD2016	ACCURACY:	±5m

DEPTH (m)	SAMPLES	GRAPHIC LOG	SOIL / ROCK DESCRIPTION	GEOLOGICAL UNIT	Scala (Blows/100mm)	SV	τ (kPa)	WATER LEVEL	R L (m)
0			Loose silty fine SAND, some organics; brown; moist; non-plastic. Organics: grass, rootlets. [Topsoil]		1 2				
			Very loose to loose silty fine to coarse SAND, trace fine gravel; brown mottled orange; moist; non-plastic. Gravel: angular, moderately weathered, black to orange, quartz to brick fragments.	FILL	1 1 1				
0.5			From 0.60m: some fine to medium gravel.		2 2 3				15.5
			From 0.85m: speckled white.		4 3				
1.0			END OF LOG @ 1 m						15.0
1.5									14.5
2.0									14.0
2.5									13.5
3.0									13.0
3.5									12.5
4.0									12.0
4.5									11.5

DATE AUGERED:	17/6/19	DIAMETER:	50 mm	COMMENTS:
LOGGED BY:	DD	METHOD:	HA	Co-ordinates by hand held GPS to an accuracy of +/-3m. Elevation by topographic maps to an accurcay of +/-5m. Hand auger terminated due to refusal. Scala refusal at 1.0m, 8 consectutive blows with less than 20mm advance. No groundwater encountered.
SHEAR VANE No:	N/A			

FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS SEE KEY SHEET

A4 Scale 1:25

SOUTHDRILL
WATER EXPLORATION

STANDARD TEST

SITE Southland Museum **JOB No**
BORE No 1 **DATE 30/9/2010** **EQUIP No T555 Schramm**
CO-ORDS **DATUM** **SURFACE R.L**
PLANT & TECHNIQUE
ROD mm **CASING 150mm** **G.W.L. 1.6m**
TECHNICIAN Evan Pascoe **CHECKED Maurice Pascoe**
TEST SPECIFICATION NZS 4402 Test 6.5.1:1988

Penetration (blows)		Depth .... 1.5m Soil Description	Penetration (blows)		Depth ..... Soil Description
2	75 mm				
2	150	Clay			
2	225				
2	300				
2	375	N = 10			N=
4	450	N = blows/300mm			N= blows/300mm

Penetration (blows)		Depth .... 3.0m Soil Description	Penetration (blows)		Depth ..... Soil Description
3	75 mm			75 mm	
3	150	Grey Sand		150	
4	225			225	
4	300			300	
8	375	N = 25		375	N=
9	450	N = blows/300mm		450	N= blows/300mm

Penetration (blows)		Depth .... 4.5m Soil Description	Penetration (blows)		Depth ..... Soil Description
3	75 mm			75 mm	
2	150	Silt onto gravels		150	
4	225			225	
4	300			300	
7	375	N = 30		375	N=
15	450	N = blows/300mm		450	N= blows/300mm

Penetration (blows)		Depth .... 6.0m Soil Description	Penetration (blows)		Depth.... Soil Description
5	75 mm			75 mm	
11	150			150	
14	225	Gravels		225	
30	300			300	
	375	N = 60 blows for 300m		375	N=
	450	N = blows/300mm		450	N= blows/300mm

0 - 0.4 GRAVEL FILL
0.4 - 2.8 YELLOW CLAY
2.8 - 4.45 GREY SAND
4.45 - 4.5 BLUE SILT
4.5 - 6.0 QUARTZ GRAVELS & SAND

SOUTHDRILL
WATER EXPLORATION

STANDARD TEST
SITE ...Southland Museum..... JOB No .....
BORE No BH2..... DATE 30-09-2010 EQUIP No T555 Schramm.
CO-ORDS ..... DATUM .....m SURFACE R.L. .....
PLANT & TECHNIQUE .....
ROD .....mm CASING ...150mm G.W.L. ...1.650m
TECHNICIAN ..... Evan Pascoe CHECKED..... Maurice Pascoe
TEST SPECIFICATION NZS 4402 Test 6.5.1:1988

Penetration (blows)		Depth .... 1.5m Soil Description	Penetration (blows)		Depth ..... Soil Description
1	75 mm			75 mm	
2	150	Clay		150	
1	225			225	
2	300			300	
1	375	N =		375	N=
2	450	N = blows/300mm		450	N= blows/300mm

Penetration (blows)		Depth .... 3.m Soil Description	Penetration (blows)		Depth ..... Soil Description
3	75 mm			75 mm	
4	150			150	
5	225	Gray sand		225	
6	300			300	
7	375	N =		375	N=
8	450	N = blows/300mm		450	N= blows/300mm

Penetration (blows)		Depth .... 4.5m Soil Description	Penetration (blows)		Depth ..... Soil Description
2	75 mm			75 mm	
2	150	Gray sand into gravel		150	
13	225			225	
15	300			300	
20	375	N =		375	N=
25	450	N = blows/300mm		450	N= blows/300mm

Penetration (blows)		Depth .....6m..... Soil Description	Penetration (blows)		Depth.... Soil Description
6	75 mm			75 mm	
7	150			150	
14	225	Gravels		225	
16	300			300	
17	375	N =		375	N=
18	450	N = blows/300mm		450	N= blows/300mm

0 - .3m	Gravel fill
.3 - 2.7m	Yellow clay
2.7 - 4.6m	Grey sand
4.6 - 6.0m	Quartz gravels & sand

APPENDIX 3:

Test Pit Logs

Geotechnical Soil Logging Key

ENGEO borehole and test pit logs are written in general accordance with the New Zealand Geotechnical Society field classification guidelines (2005).
Please refer to this document for the methods of field classification and description for engineering purposes.

Grain Size (mm)

0.06	0.2	0.6	2	6	20	60	200

SILT and CLAY	SAND			GRAVEL			COBBLE	BOULDER
	Fine	Medium	Coarse	Fine	Medium	Coarse		

Additional Info

▼	Standing water level
UTP	Unable to Penetrate
NA	Not Assessed

Graphic Logs

The graphic log shows soil types and their corresponding UCS classification

Granular Soil (>65% of soil >0.06 mm)			Cohesive Soil (>35% of soil <0.06 mm)		
GW	Well graded GRAVEL		MH	High plasticity SILT	
GP	Poorly graded GRAVEL		ML	Low plasticity SILT	
GM	Silty GRAVEL		CH	High plasticity CLAY	
GC	Clayey GRAVEL		CL	Low plasticity CLAY	
SW	Well graded SAND			**Organic Soil**	
SP	Poorly graded SAND		OH	High Plasticity organic SILT or CLAY	
SM	Silty SAND		OL	Low plasticity organic SILT or CLAY	
SC	Clayey SAND		PT	Peat	
Other Soils					
TS/BTS	Topsoil/ Buried Topsoil		F	Fill	

G = Gravel W = Well Graded P = Poorly Graded C = Clay S = Sand M = Silt H = High Plasticity L = Low Plasticity O = Organic

Cohesive Soils - Consistency Index

		Undrained shear strength (kPa)	Field Diagnostic Features
VS	Very Soft	<12	Easily exudes between fingers when squeezed
S	Soft	12 – 25	Easily indented by fingers
F	Firm	25 – 50	Indented by strong finger pressure and can be indented by thumb pressure
St	Stiff	50 – 100	Cannot be indented by thumb pressure
VSt	Very Stiff	100 – 200	Can be indented by thumb nail
H	Hard	200+	Difficult to indent by thumb nail

Moisture Content

D	Dry	Looks and feels dry
M	Moist	Feels cool and darkened in colour and granular soils tend to be cohere
W	Wet	Feels cool and darkened in colour. Granular soils tend to cohere and free water forms when remoulding cohesive soils
S	Saturated	Feels cool, darkened in colour and free water present on the sample

Granular Soils - Density Index

		SPT 'N' Value (blows /300mm)	Scala Penetrometer (blows/100 mm)
VL	Very loose	<4	0 - 2
L	Loose	4 – 10	1 – 3
MD	Medium Dense	10 - 30	3 - 7
D	Dense	30 - 50	7 – 17
VD	Very Dense	<50	>17

Proportional Terms Definition

Fraction	Term	% of Soil	Example
Major	(UPPERCASE)	>50	GRAVEL
Subordinate	(lowercase)y	20 - 50	Sandy
Minor	With some....	12 - 20	With some sand
	With minor....	5 - 12	With minor sand
	With trace....	<5	With trace sand

Soil Structure

Zoning		Cementing	
Layers	Continuous across exposure or sample	Weakly Cemented	Easily broken up by hand in air or water
Lenses	Discontinuous layers of lenticular shape	Moderately cemented	Effort is required to break up the soil by hand in air or water
Pockets	Irregular inclusions of different material		

LOG OF TEST PIT SM-ENG20-TP01

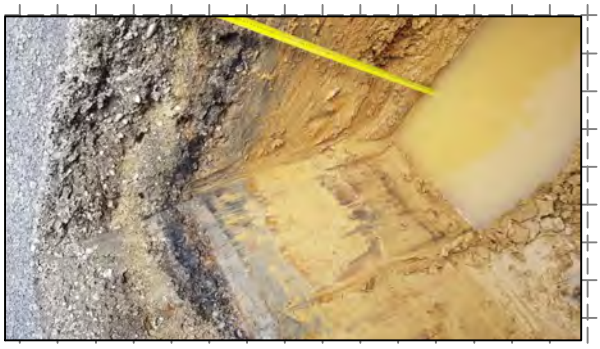
Southland Museum and Art Gallery

108 Gala Street, Queens Park
Invercargill
17651

Client : ICC
Date : 06/09/2020
Max Test Pit Depth : 2 m
Digger Type/Size : Bucket Excavator
Bucket Type/Size : Soil/Rock Bucket

Shear Vane No : 2534
Logged By : BRCO
Reviewed By : SSM
Latitude : -46.40537
Longitude : 168.3533

Depth (m BGL)	Material	Excavatability (Relative Scale) Easier–Harder	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Peak/Remolded (kPa)	Scala Penetrometer Blows per 100mm
0	FILL		GW	Sandy fine to coarse GRAVEL, dark grey. Tightly packed, dry, well graded. Gravel, fine to coarse, subangular to subrounded. [FILL]. Grades to yellow brown.				D	TP		
			GW	ASHPALT and medium to coarse GRAVEL, black. Tightly packed, dry, well graded. Gravel, subrounded to subangular. [FILL].				D	TP	92/21	
0.5			CH	Silty CLAY with trace organics, grey. Stiff, moist, high plasticity. Organics, amorphous. [ALLUVIUM]. Laboratory data @ 0.5 m : Fines with minor sand; LL-55, PL-32, PI-23.				M	F	140/38	
1.0	ALLUVIUM		ML	SILT with trace clay, yellow brown. Stiff to very stiff, moist, low plasticity. [ALLUVIUM]. 0.9 m : seepage from base / side of excavation. Laboratory data @ 0.5 m : Fines with minor sand; LL-43, PL-28, PI-15.		15		M	St - VSt	92/27	
1.5											
2.0				Depth of Excavation: 2 m Termination Condition: Target depth		14					
2.5											



Test pit met target depth at 2 m.
Scala Penetrometer met target depth at 2 m.

LL - Liquid Limit; PL - Platic Limit; PI - Placticity Index

GEOTECH TEST PIT LOG - PHOTOS 17651 - SMAG TEST PITS.GPJ NZ MASTER DATA TEMPLATE.GDT 19/11/20

LOG OF TEST PIT SM-ENG20-TP02

Southland Museum and Art Gallery

108 Gala Street, Queens Park
Invercargill
17651

Client : ICC
Date : 06/09/2020
Max Test Pit Depth : 2 m
Digger Type/Size : Bucket Excavator
Bucket Type/Size : Rock Bucket

Shear Vane No : 2534
Logged By : BRCO
Reviewed By : SSM
Latitude : -46.40503
Longitude : 168.35377

Depth (m BGL)	Material	Excavatability (Relative Scale) Easier–Harder	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Peak/Remolded (kPa)
0.0	TOPSOIL		OL	Organic SILT, dark brown. Firm, moist, low plasticity. [TOPSOIL].				M	F	
	FILL		OL	Organic SILT with minor to some gravel. Firm, moist, non-plastic. Gravel, medium to coarse, subrounded. [FILL].				M	F	
0.5	FILL		SW	Silty fine to coarse SAND with some charcoal and trace to minor gravel, black. Loose, moist, well graded. Gravel, fine to coarse, subrounded to subangular, schist. [FILL].				M	L	
1.0	FILL		OL	Organic SILT with minor organics, dark brown. Firm, moist, non-plastic. Organics, roots up to 5 cm diameter. [FILL].		15		M	F	
	ALLUVIUM		ML	SILT with trace organics, grey with some orange/brown mottling. Stiff to very stiff, moist, low plasticity. Organics, amorphous and fibrous. [ALLUVIUM]. 1.4 m : Minor seepage from side of excavation Laboratory data @ 1.5 m : Fines with minor sand; LL-28, PL-21, PI-7. Laboratory data @ 0.5 m : Fines with minor sand; LL-32, PL-22, PI-10.				M	St - VSt	142/28 115/24
2.0						14				
2.5				Depth of Excavation: 2 m Termination Condition: Target depth						

Scala Penetrometer — Blows per 100mm (2 4 6 8 10 12)

Test pit met target depth at 2 m.
Scala Penetrometer met target depth at 2 m.

LL - Liquid Limit; PL - Platic Limit; PI - Placticity Index

GEOTECH TEST PIT LOG - PHOTOS 17651 - SMAG TEST PITS.GPJ NZ MASTER DATA TEMPLATE.GDT 19/11/20

APPENDIX 4:

Laboratory Testing Results

Central Testing Services
18 Ngapara St, P.O. Box 397, Alexandra 9340, Central Otago, New Zealand
P: 03 4487644, W: www.centraltesting.co.nz, E: info@centraltesting.co.nz

Reference No: 20/2587

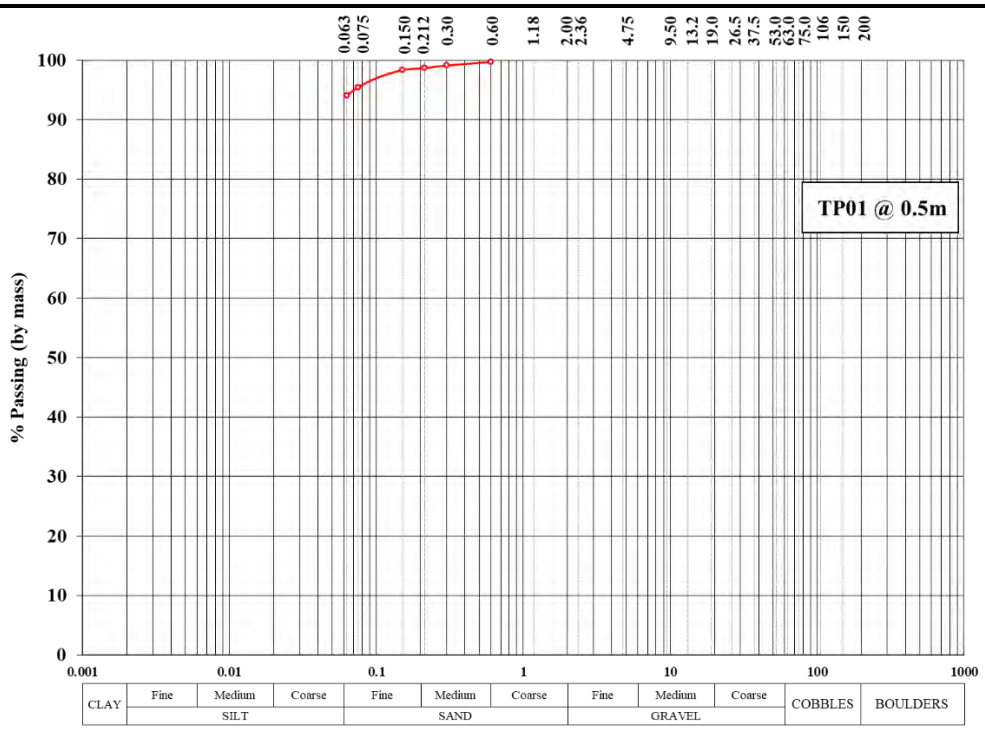
Date: 5 November 2020

TEST REPORT – SOUTHLAND MUSEUM INVESTIGATIONS

Client Details:	**ENGEO, 25 Glenda Drive, Frankton, Queenstown**	**Attention:**	**S. Murray**
Job Description:	**Southland Museum Investigations**		
Sample Description:	**SILT with minor sand**	**Client Reference No:**	**17651**
Sample Source:	**TP01 @ 0.5m**	**Sample Label No:**	**N/A**
Date & Time Sampled:	**Unknown**	**Sampled By:**	**Unknown**
Sample Method:	**Test Pit ***	**Date Received:**	**28-Oct-20**

PARTICLE SIZE ANALYSIS (NZS 4402:1986, Test 2.8.1)

Test Sieve (mm)	% Passing (by mass)
37.5	
26.5	
19.0	
13.2	
9.50	
4.75	
2.36	
2.00	
1.18	
0.60	100
0.30	99
0.212	99
0.150	98
0.075	95
0.063	94



The sample was received in a natural state. The percentage passing the 63µm test sieve was obtained by difference.

WATER CONTENT, PLASTICITY INDEX & SOLID DENSITY RESULTS (NZS 4402:1986, Test 2.1, 2.2, 2.3, 2.4 & 2.7.2)

Water Content: ("All In" As Received)	**38.0 %**
Liquid Limit: (LL)	**55**
Plastic Limit: (PL)	**32**
Plasticity Index: (PI)	**23**
Solid Density "All In" (vacuum method):	**2.69 t/m^3**
Note: The sample was received in a natural state. The plasticity index material tested was the fraction passing the 425 µm test sieve.	

Notes:

- ***Information contained in this report which is Not IANZ Accredited relates to the sample descriptions based on NZ Geotechnical Society Guidelines 2005, the sample method * and sampling.***
- ***This report may not be reproduced except in full.***

Tested By: **L.T. Smith** **Date:** **29-Oct-20 to 2-Nov-20**

Checked By:

ACCREDITED IANZ TESTING LABORATORY
№ 434

Test results indicated as not accredited are outside the scope of the laboratory's accreditation

Central Testing Services
18 Ngapara St, P.O. Box 397, Alexandra 9340, Central Otago, New Zealand
P: 03 4487644, W: www.centraltesting.co.nz, E: info@centraltesting.co.nz

Reference No: 20/2587

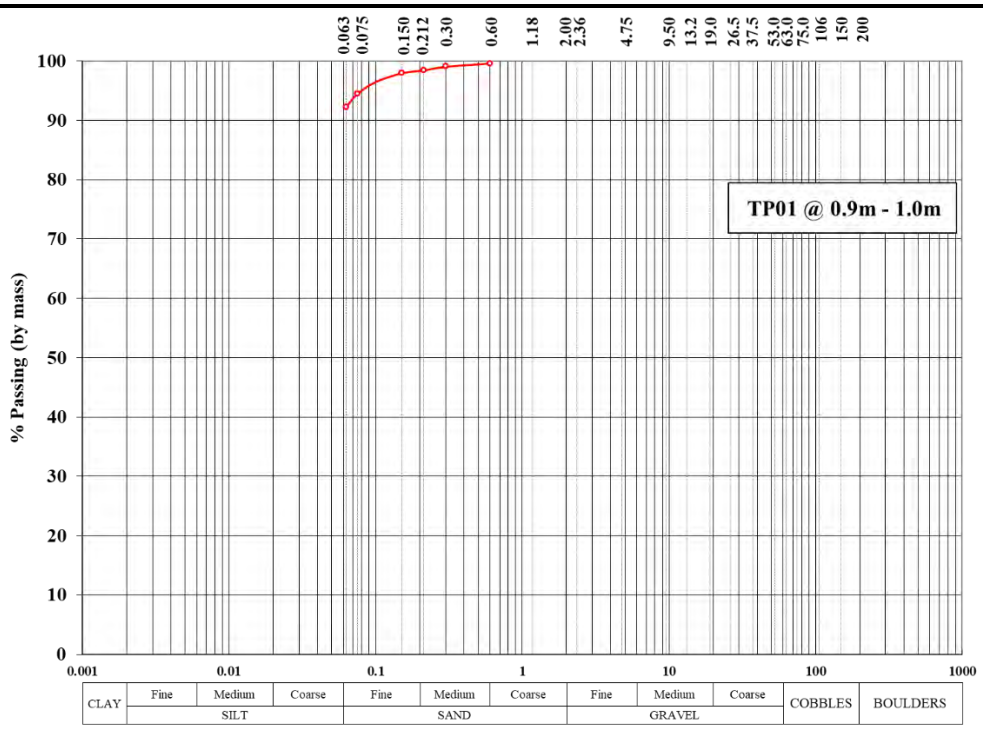
Date: 5 November 2020

TEST REPORT – SOUTHLAND MUSEUM INVESTIGATIONS

Client Details:	**ENGEO, 25 Glenda Drive, Frankton, Queenstown**	**Attention:**	**S. Murray**
Job Description:	**Southland Museum Investigations**		
Sample Description:	**SILT with minor sand**	**Client Reference No:**	**17651**
Sample Source:	**TP01 @ 0.9m - 1.0m**	**Sample Label No:**	**N/A**
Date & Time Sampled:	**Unknown**	**Sampled By:**	**Unknown**
Sample Method:	**Test Pit ***	**Date Received:**	**28-Oct-20**

PARTICLE SIZE ANALYSIS (NZS 4402:1986, Test 2.8.1)

Test Sieve (mm)	% Passing (by mass)
37.5	
26.5	
19.0	
13.2	
9.50	
4.75	
2.36	
2.00	
1.18	
0.60	100
0.30	99
0.212	98
0.150	98
0.075	94
0.063	92



The sample was received in a natural state. The percentage passing the 63µm test sieve was obtained by difference.

WATER CONTENT & PLASTICITY INDEX RESULTS - NZS 4402:1986, Test 2.1, 2.2, 2.3 & 2.4	
Water Content: ("All In" As Received)	**36.5 %**
Liquid Limit: (LL)	**43**
Plastic Limit: (PL)	**28**
Plasticity Index: (PI)	**15**
Note: The sample was received in a natural state. The plasticity index material tested was the fraction passing the 425 µm test sieve.	

Notes:

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- ***This report may not be reproduced except in full.***

Tested By: **L.T. Smith** **Date:** **29-Oct-20 to 2-Nov-20**

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Reference No: 20/2587

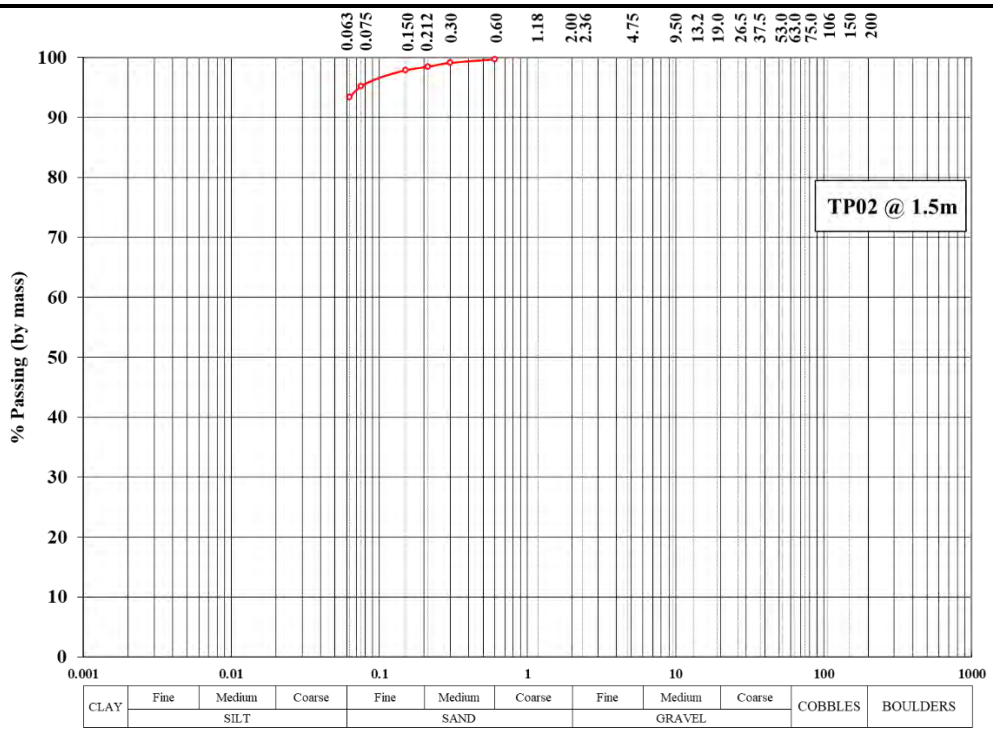
Date: 5 November 2020

TEST REPORT – SOUTHLAND MUSEUM INVESTIGATIONS

Client Details:	**ENGEO, 25 Glenda Drive, Frankton, Queenstown**	**Attention:**	**S. Murray**
Job Description:	**Southland Museum Investigations**		
Sample Description:	**SILT with minor sand**	**Client Reference No:**	**17651**
Sample Source:	**TP02 @ 1.5m**	**Sample Label No:**	**N/A**
Date & Time Sampled:	**Unknown**	**Sampled By:**	**Unknown**
Sample Method:	**Test Pit ***	**Date Received:**	**28-Oct-20**

PARTICLE SIZE ANALYSIS (NZS 4402:1986, Test 2.8.1)

Test Sieve (mm)	% Passing (by mass)
37.5	
26.5	
19.0	
13.2	
9.50	
4.75	
2.36	
2.00	
1.18	
0.60	100
0.30	99
0.212	98
0.150	98
0.075	95
0.063	93



The sample was received in a natural state. The percentage passing the 63µm test sieve was obtained by difference.

WATER CONTENT, PLASTICITY INDEX & SOLID DENSITY RESULTS (NZS 4402:1986, Test 2.1, 2.2, 2.3, 2.4 & 2.7.2)

Water Content: ("All In" As Received)	**23.1 %**
Liquid Limit: (LL)	**28**
Plastic Limit: (PL)	**21**
Plasticity Index: (PI)	**7**
Solid Density "All In" (vacuum method):	**2.74 t/m^3**
Note: The sample was received in a natural state. The plasticity index material tested was the fraction passing the 425 µm test sieve.	

Notes:

- ***Information contained in this report which is Not IANZ Accredited relates to the sample descriptions based on NZ Geotechnical Society Guidelines 2005, the sample method * and sampling.***
- ***This report may not be reproduced except in full.***

Tested By: **L.T. Smith** **Date:** **29-Oct-20 to 2-Nov-20**

Checked By:

ACCREDITED IANZ TESTING LABORATORY № 434

Test results indicated as not accredited are outside the scope of the laboratory's accreditation

Central Testing Services
18 Ngapara St, P.O. Box 397, Alexandra 9340, Central Otago, New Zealand
P: 03 4487644, W: www.centraltesting.co.nz, E: info@centraltesting.co.nz

Reference No: 20/2587

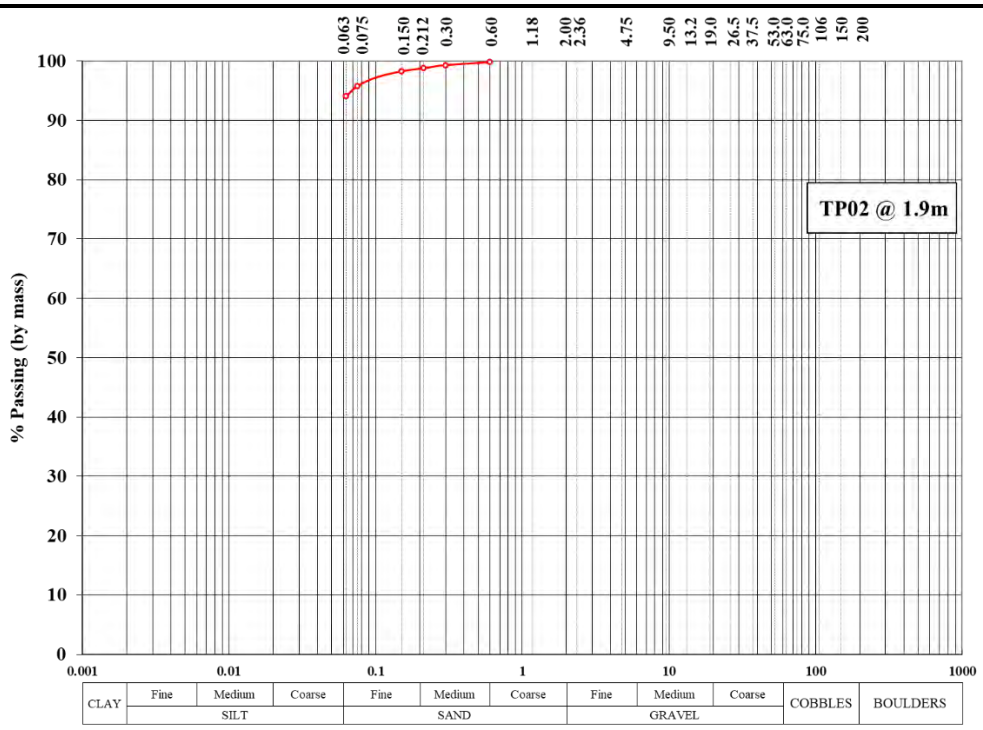
Date: 5 November 2020

TEST REPORT – SOUTHLAND MUSEUM INVESTIGATIONS

Client Details:	**ENGEO, 25 Glenda Drive, Frankton, Queenstown**	**Attention:**	**S. Murray**
Job Description:	**Southland Museum Investigations**		
Sample Description:	**SILT with minor sand**	**Client Reference No:**	**17651**
Sample Source:	**TP02 @ 1.9m**	**Sample Label No:**	**N/A**
Date & Time Sampled:	**Unknown**	**Sampled By:**	**Unknown**
Sample Method:	**Test Pit ***	**Date Received:**	**28-Oct-20**

PARTICLE SIZE ANALYSIS (NZS 4402:1986, Test 2.8.1)

Test Sieve (mm)	% Passing (by mass)
37.5	
26.5	
19.0	
13.2	
9.50	
4.75	
2.36	
2.00	
1.18	
0.60	100
0.30	99
0.212	99
0.150	98
0.075	96
0.063	94



The sample was received in a natural state. The percentage passing the 63µm test sieve was obtained by difference.

WATER CONTENT & PLASTICITY INDEX RESULTS - NZS 4402:1986, Test 2.1, 2.2, 2.3 & 2.4	
Water Content: ("All In" As Received)	**24.7 %**
Liquid Limit: (LL)	**32**
Plastic Limit: (PL)	**22**
Plasticity Index: (PI)	**10**
Note: The sample was received in a natural state. The plasticity index material tested was the fraction passing the 425 µm test sieve.	

Notes:

- ***Information contained in this report which is Not IANZ Accredited relates to the sample descriptions based on NZ Geotechnical Society Guidelines 2005, the sample method * and sampling.***
- ***This report may not be reproduced except in full.***

Tested By: **L.T. Smith** **Date:** **29-Oct-20 to 2-Nov-20**

Checked By:

Approved Signatory

A.P. Julius
Laboratory Manager

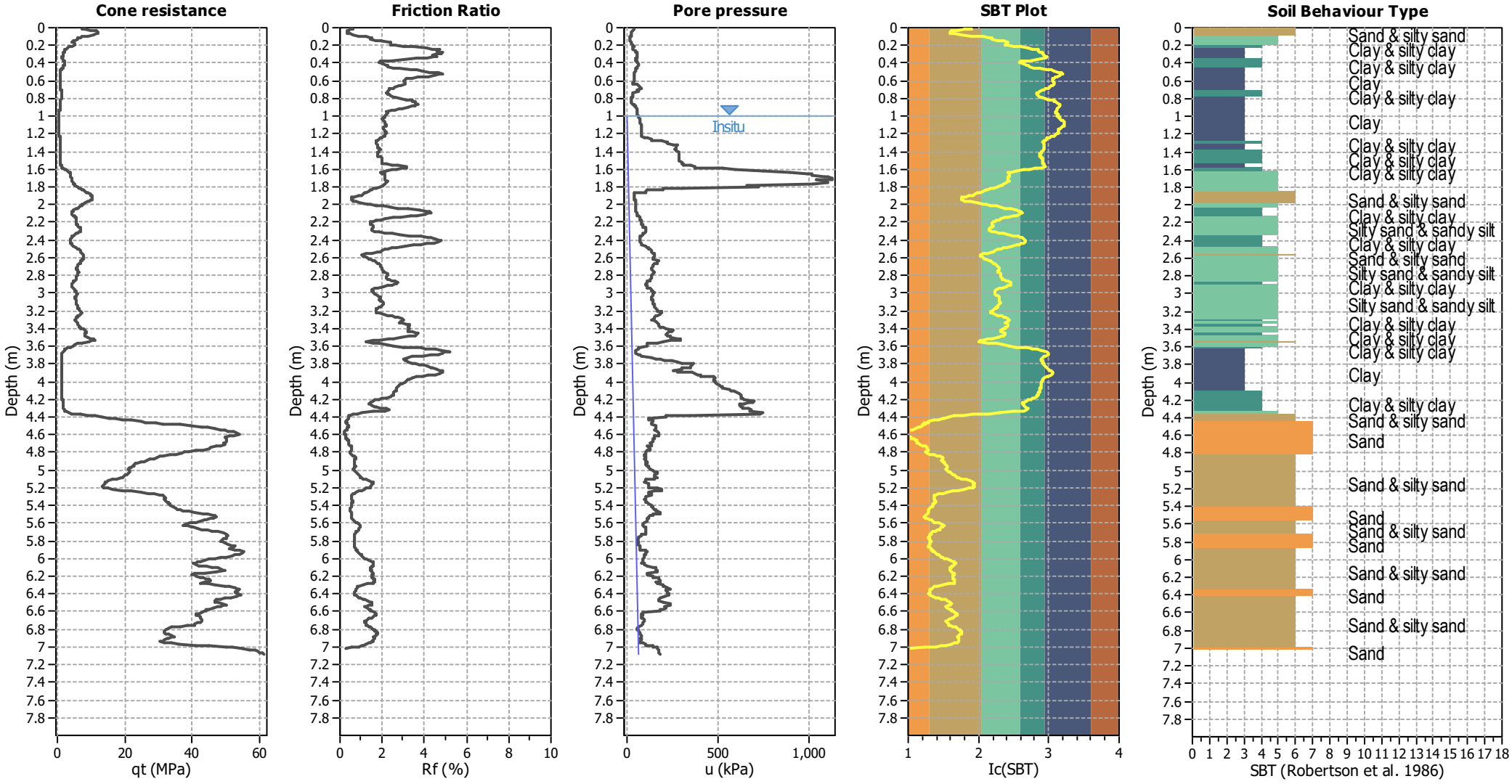
ACCREDITED IANZ TESTING LABORATORY
№ 434

Test results indicated as not accredited are outside the scope of the laboratory's accreditation

APPENDIX 5:

Liquefaction Assessment Results

CPT basic interpretation plots



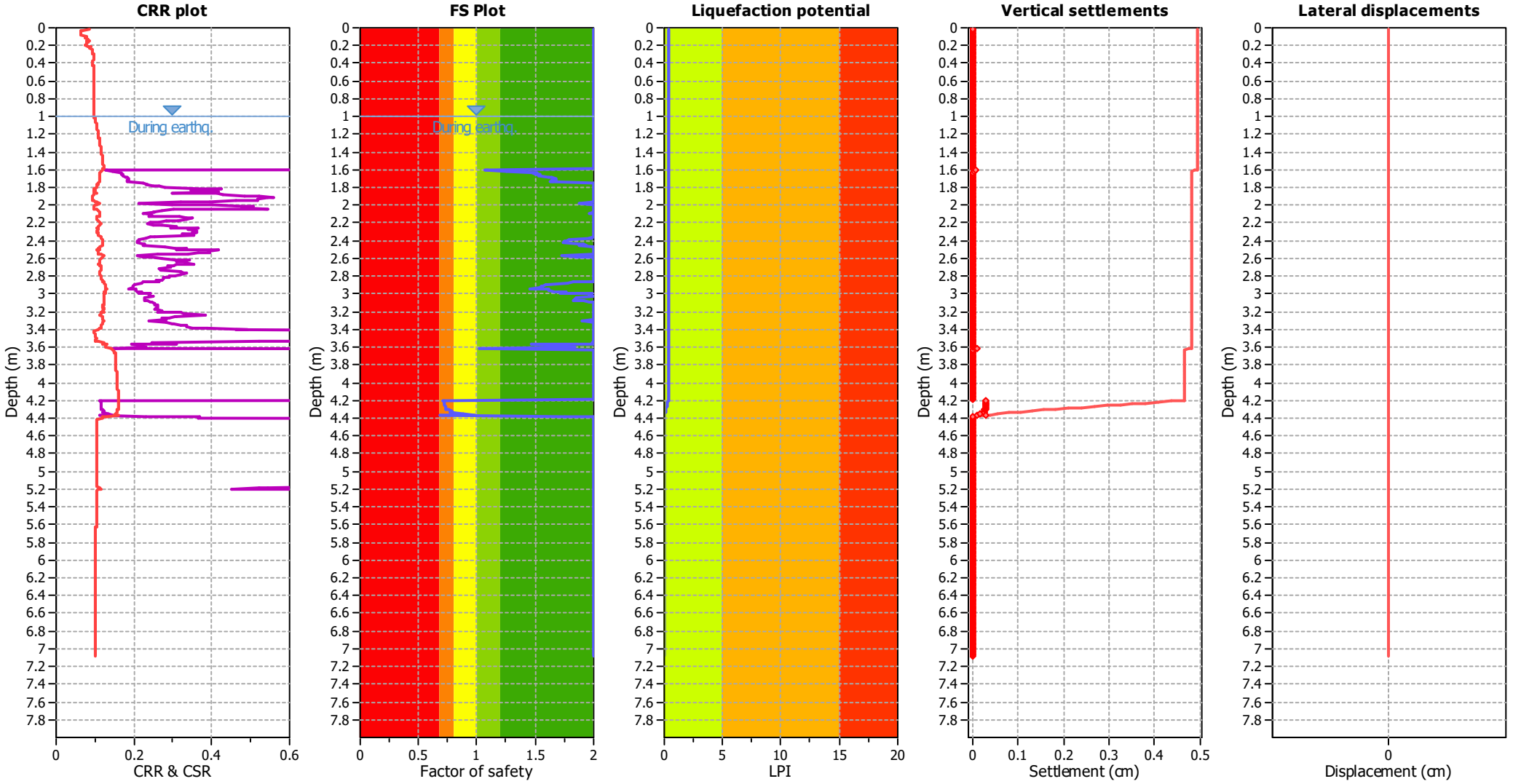
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.00 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_σ applied:	Yes
Earthquake magnitude M_w:	6.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.18	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
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.00 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_σ applied:	Yes
Earthquake magnitude M_w:	6.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
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Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

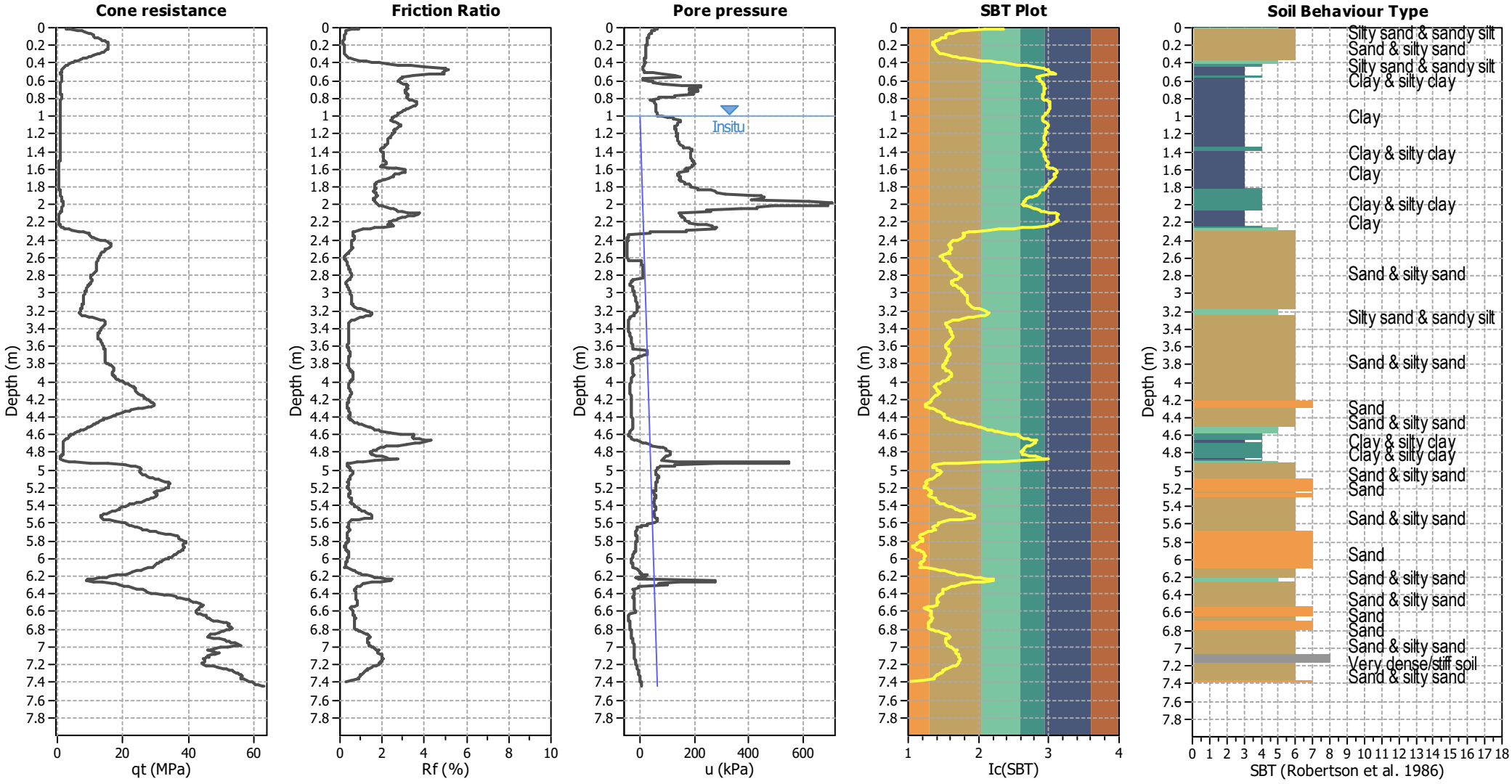
F.S. color scheme

- 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

CPT basic interpretation plots



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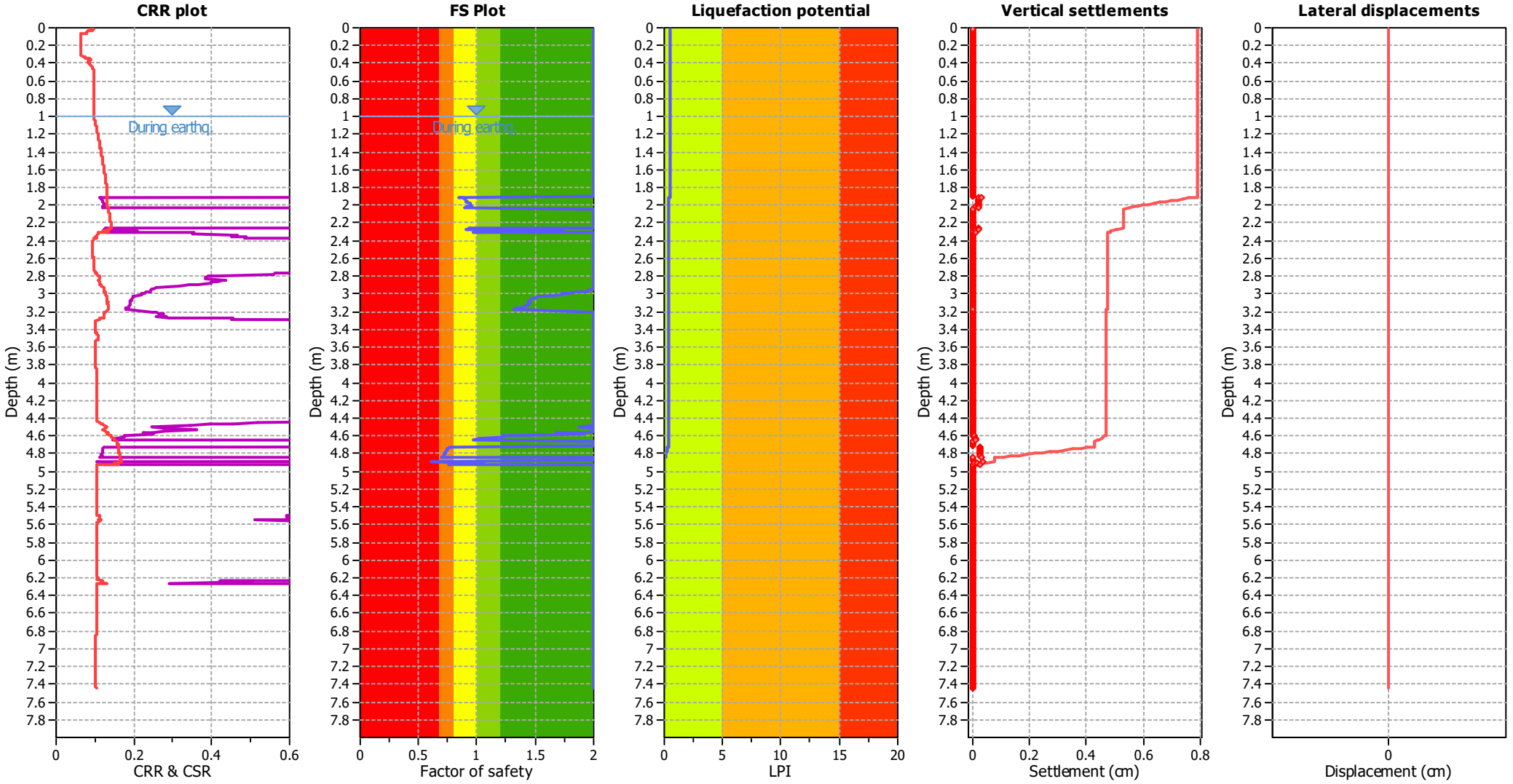
Earthquake magnitude M_w:	6.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.18	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

SBT legend

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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
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Peak ground acceleration:	0.18	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

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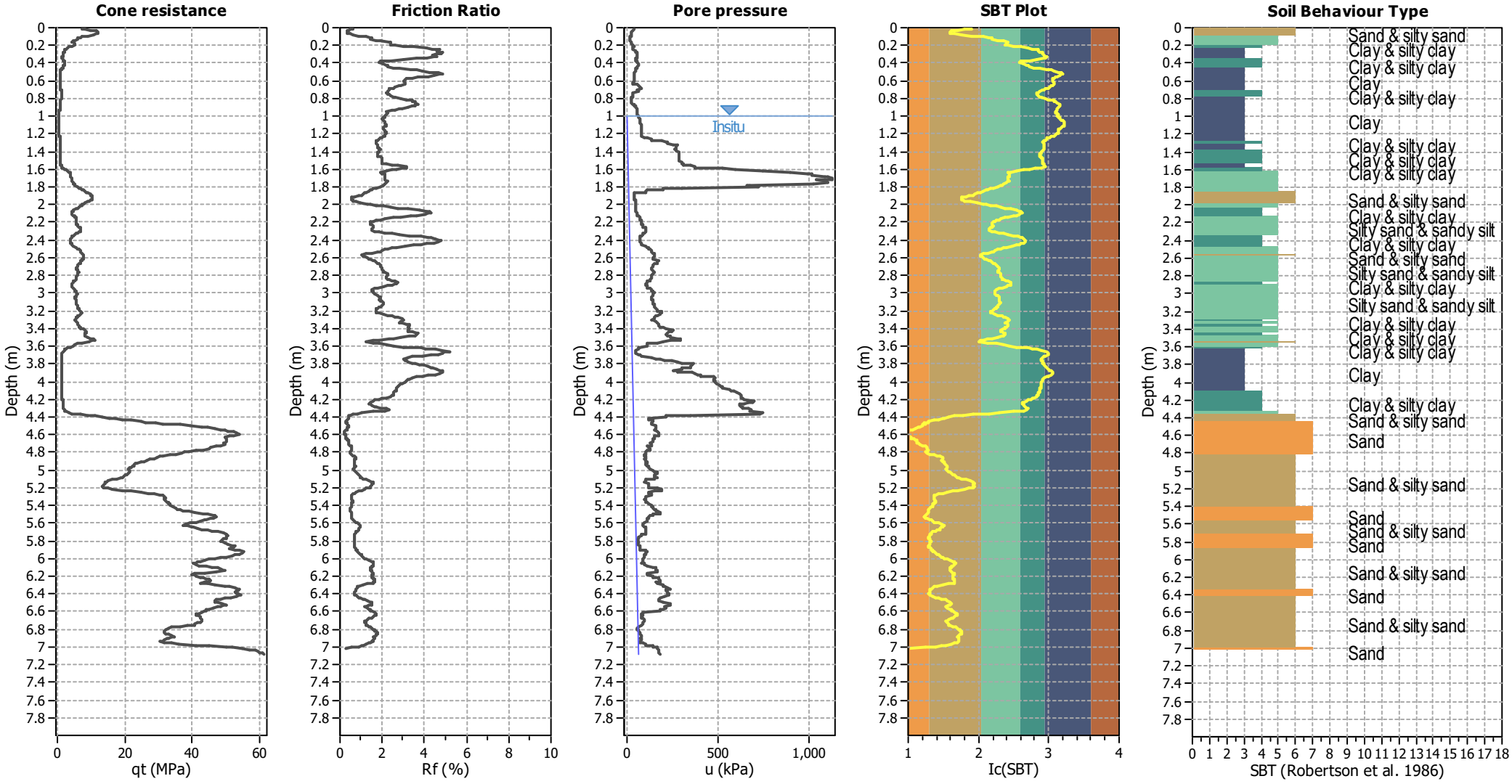
LPI color scheme

- Very high risk
- High risk
- Low risk

CPT basic interpretation plots



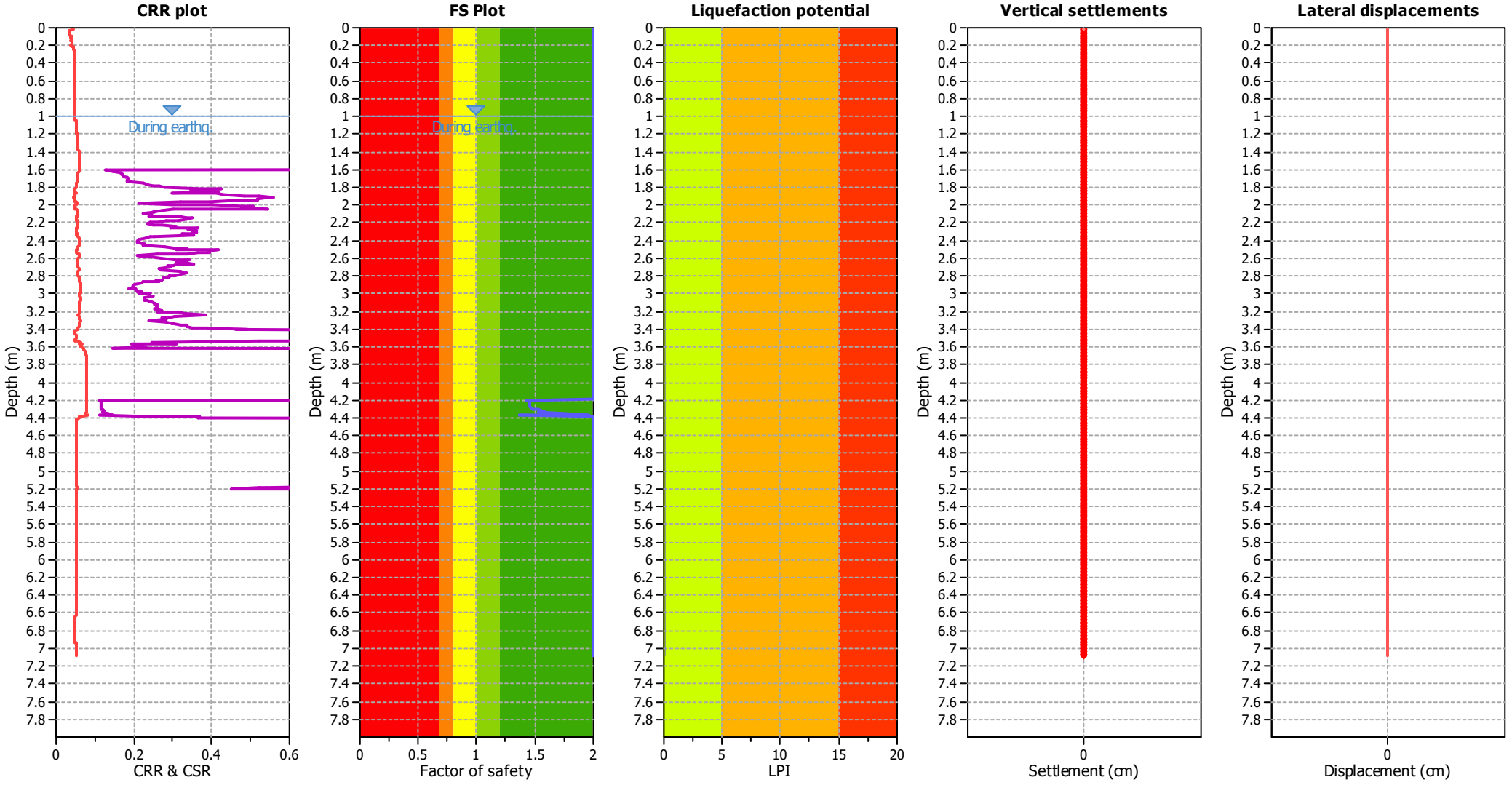
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.00 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_σ applied:	Yes
Earthquake magnitude M_w:	6.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.09	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
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

Liquefaction analysis overall plots



Input parameters and analysis data

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Peak ground acceleration:	0.09	Use fill:	No	Limit depth applied:	No
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F.S. color scheme

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LPI color scheme

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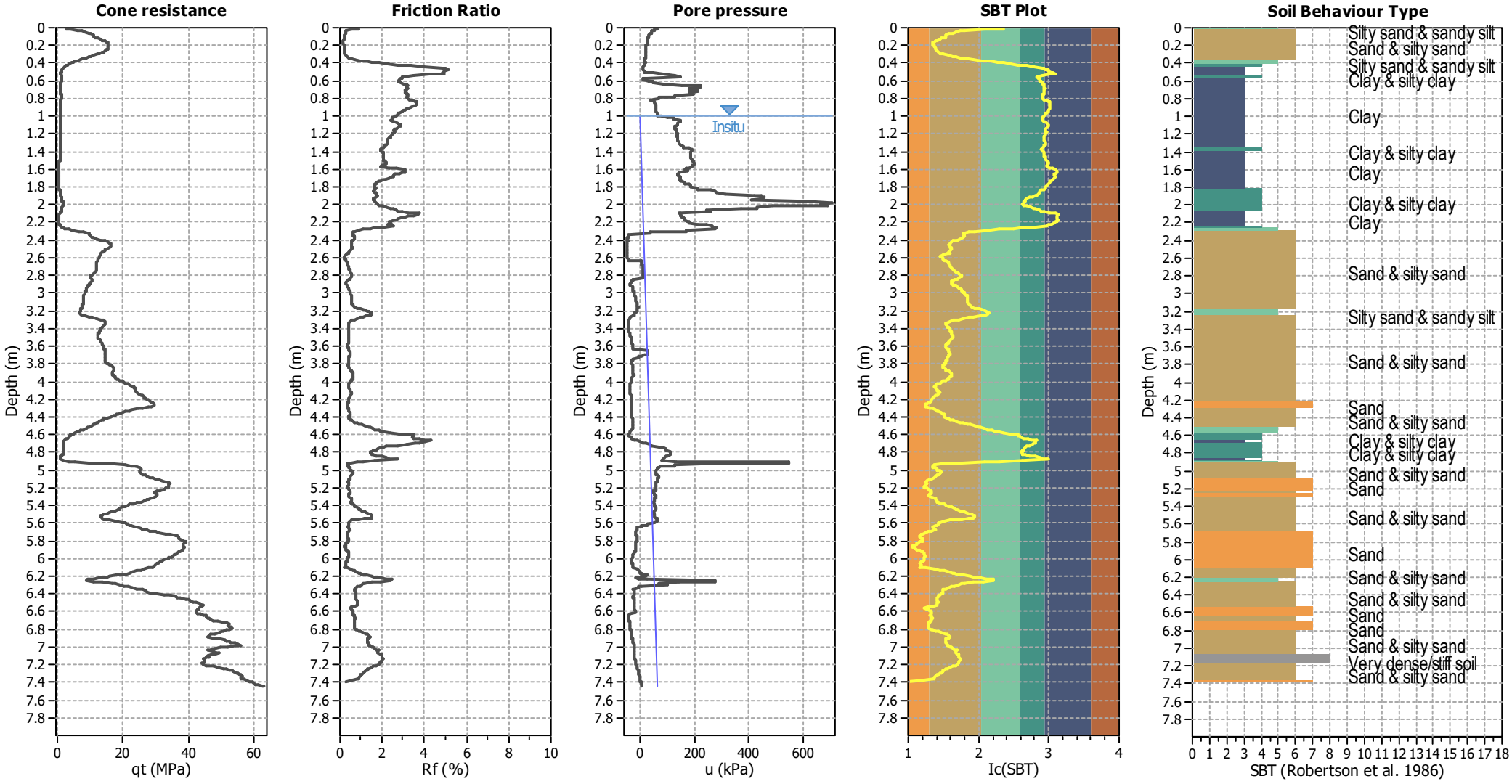
CPT basic interpretation plots



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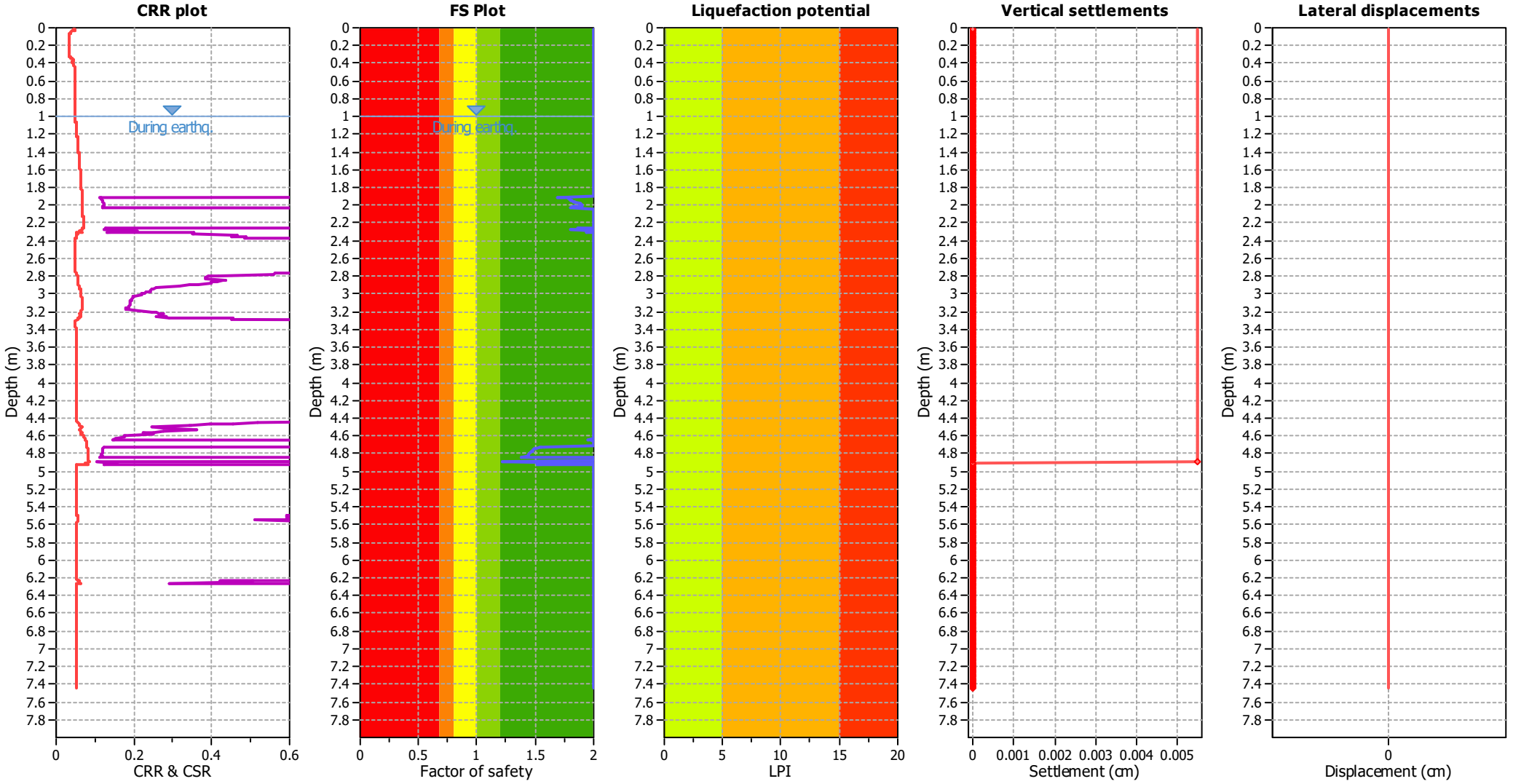
Peak ground acceleration:	0.09	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

SBT legend

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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
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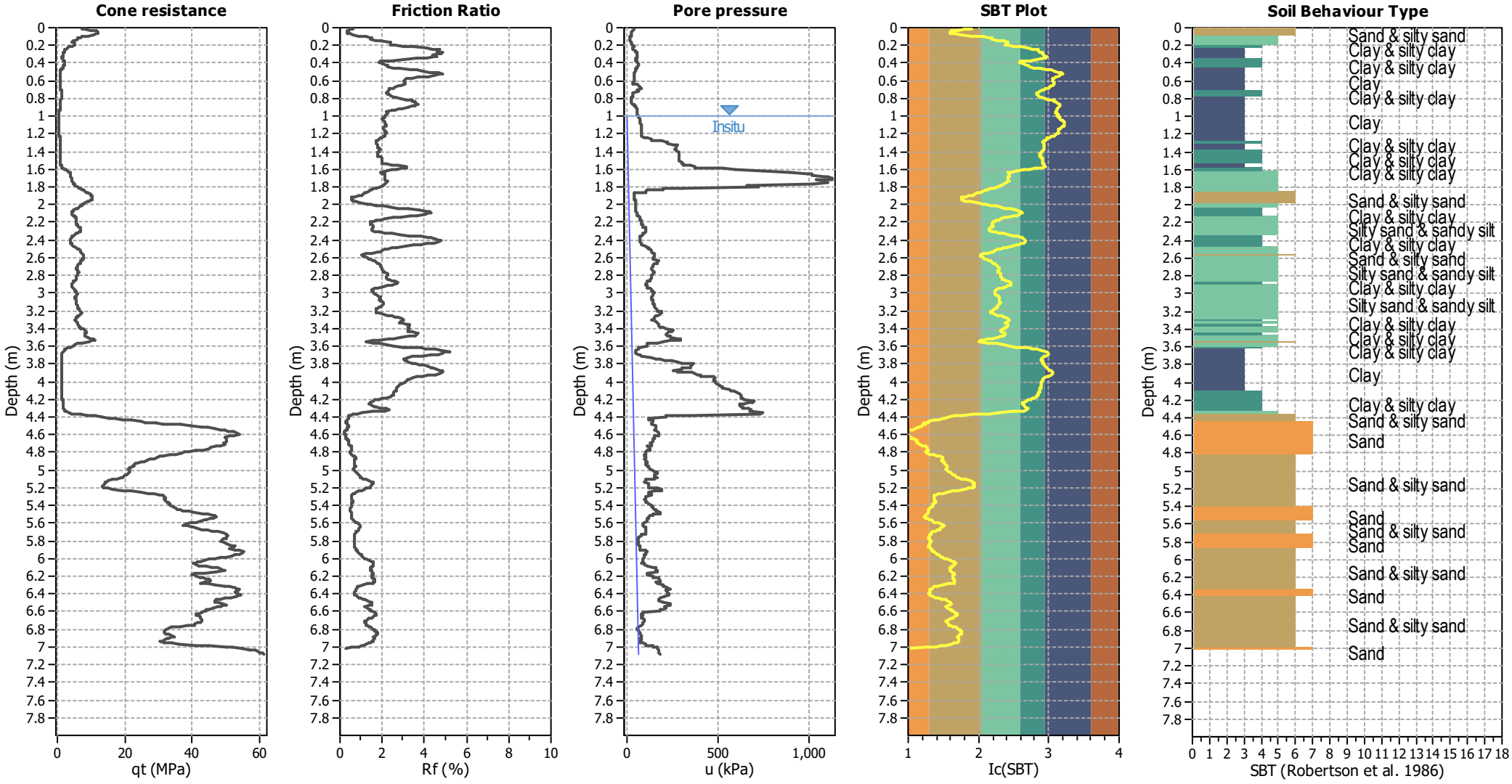

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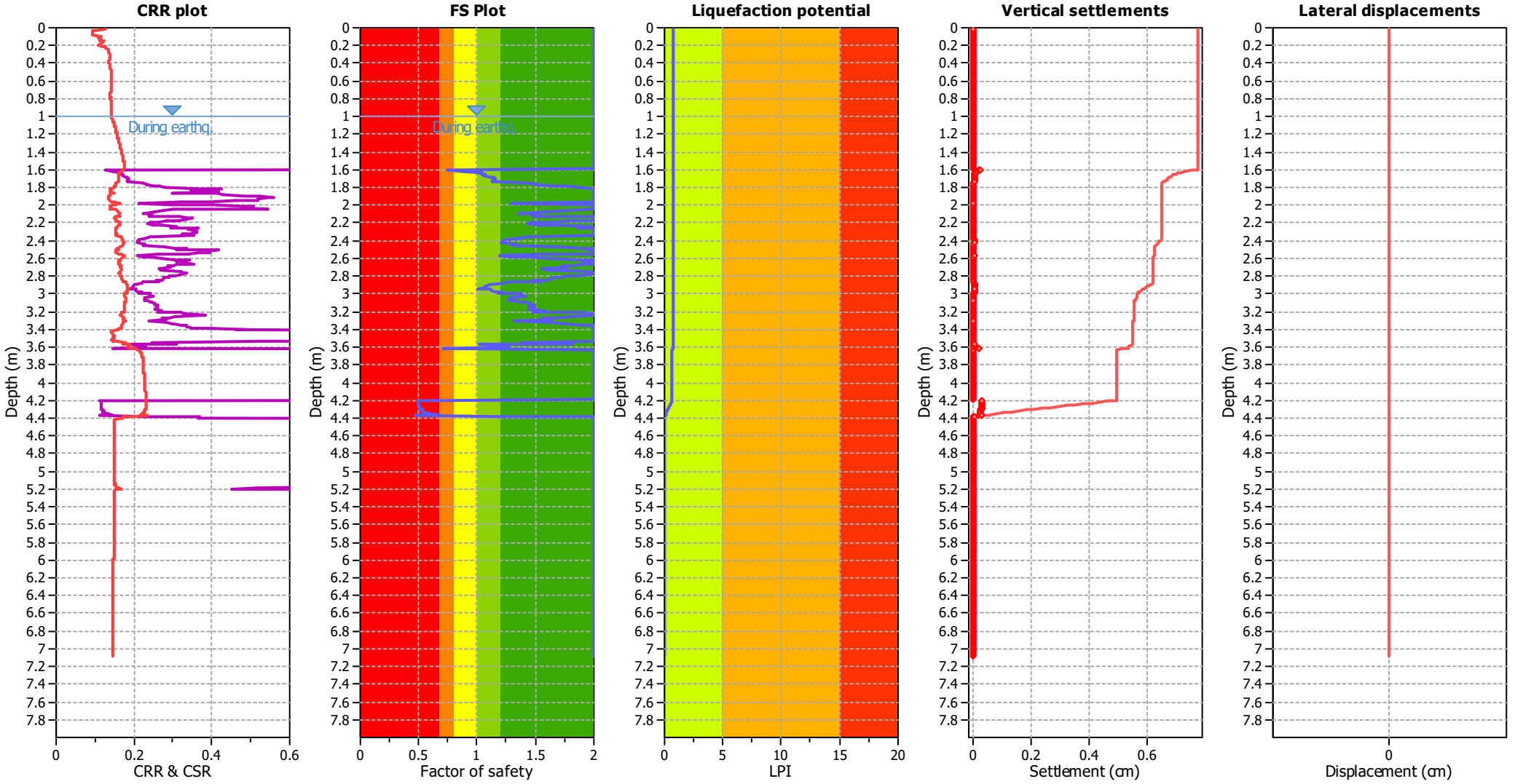
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.26	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
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

Liquefaction analysis overall plots



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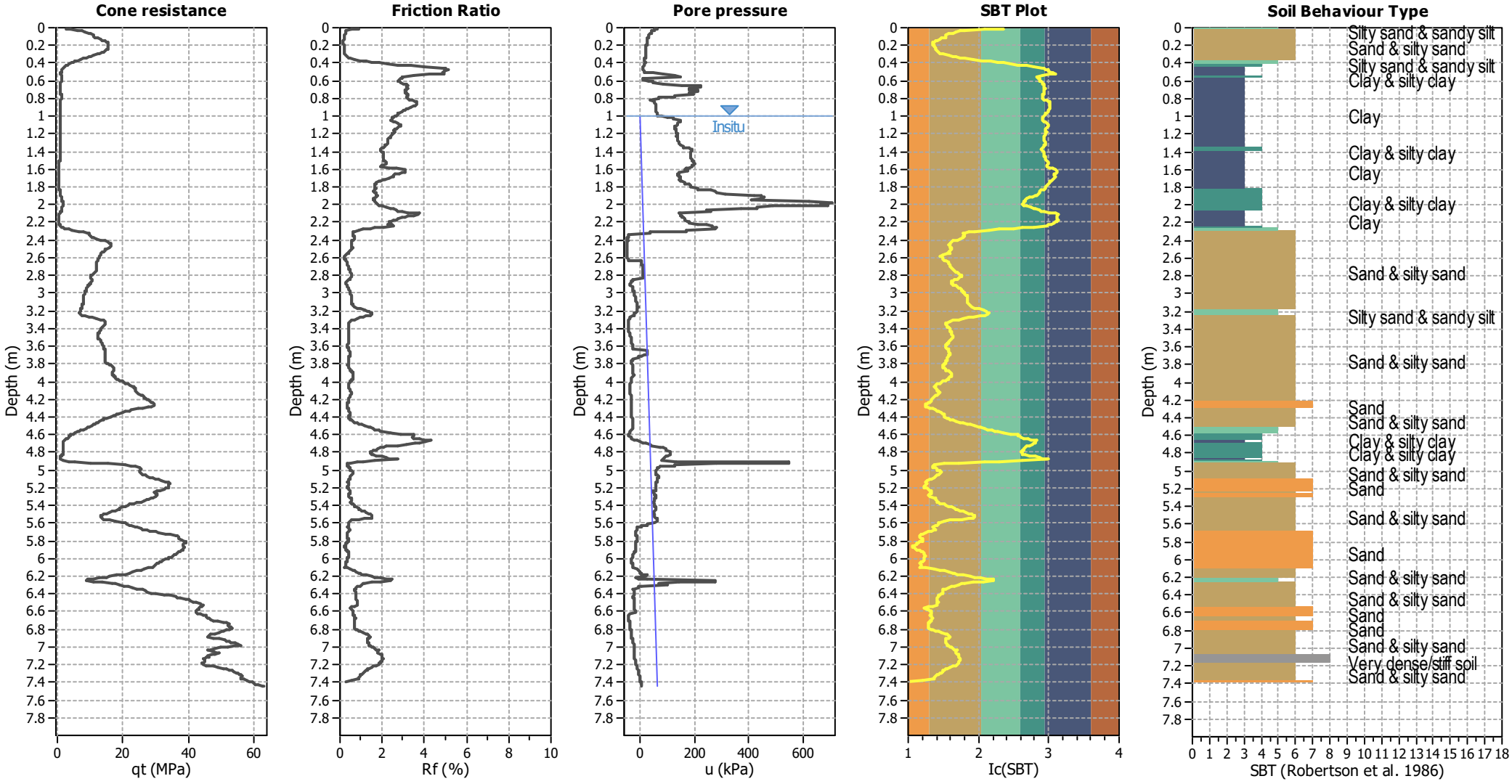

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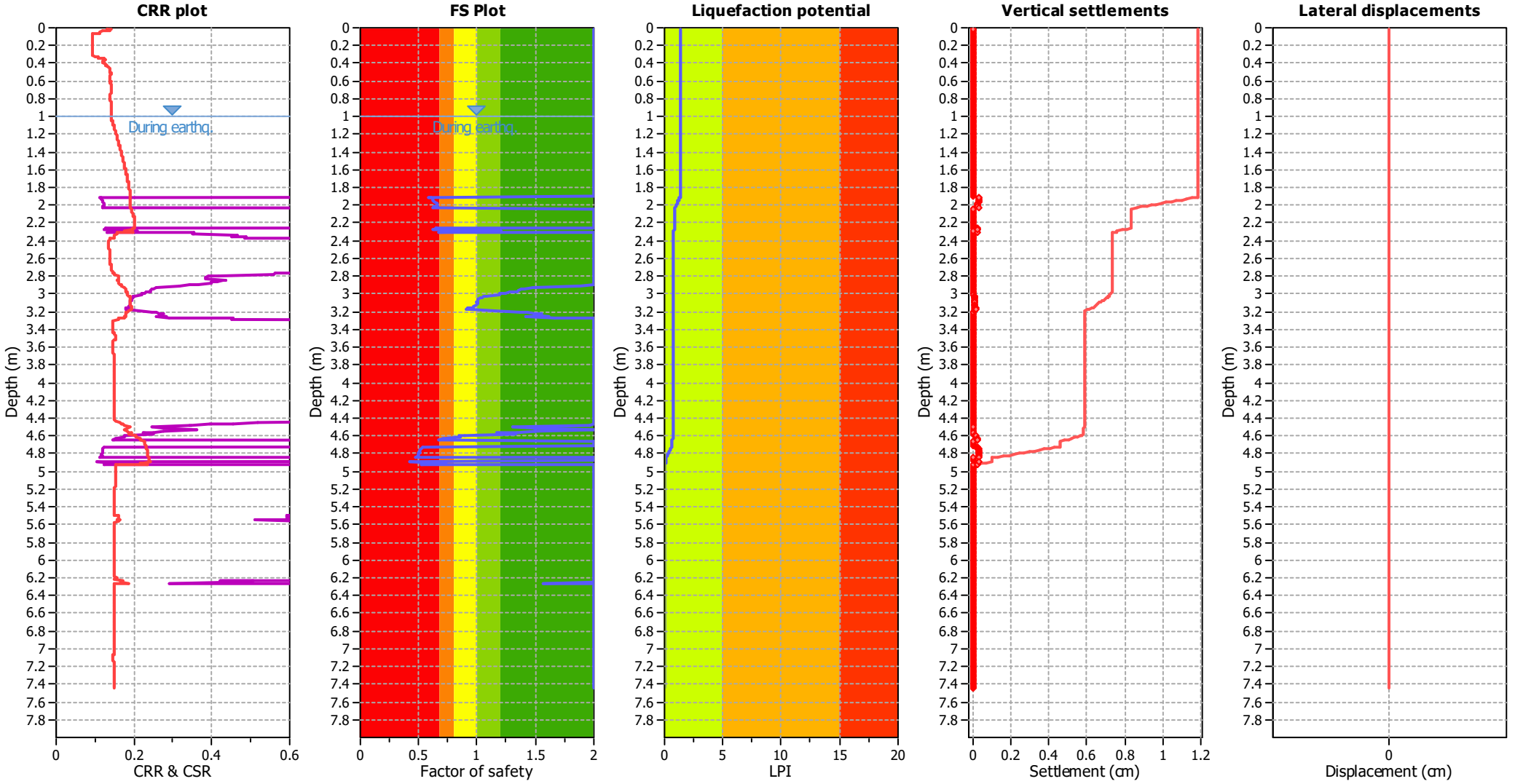
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

Liquefaction analysis overall plots



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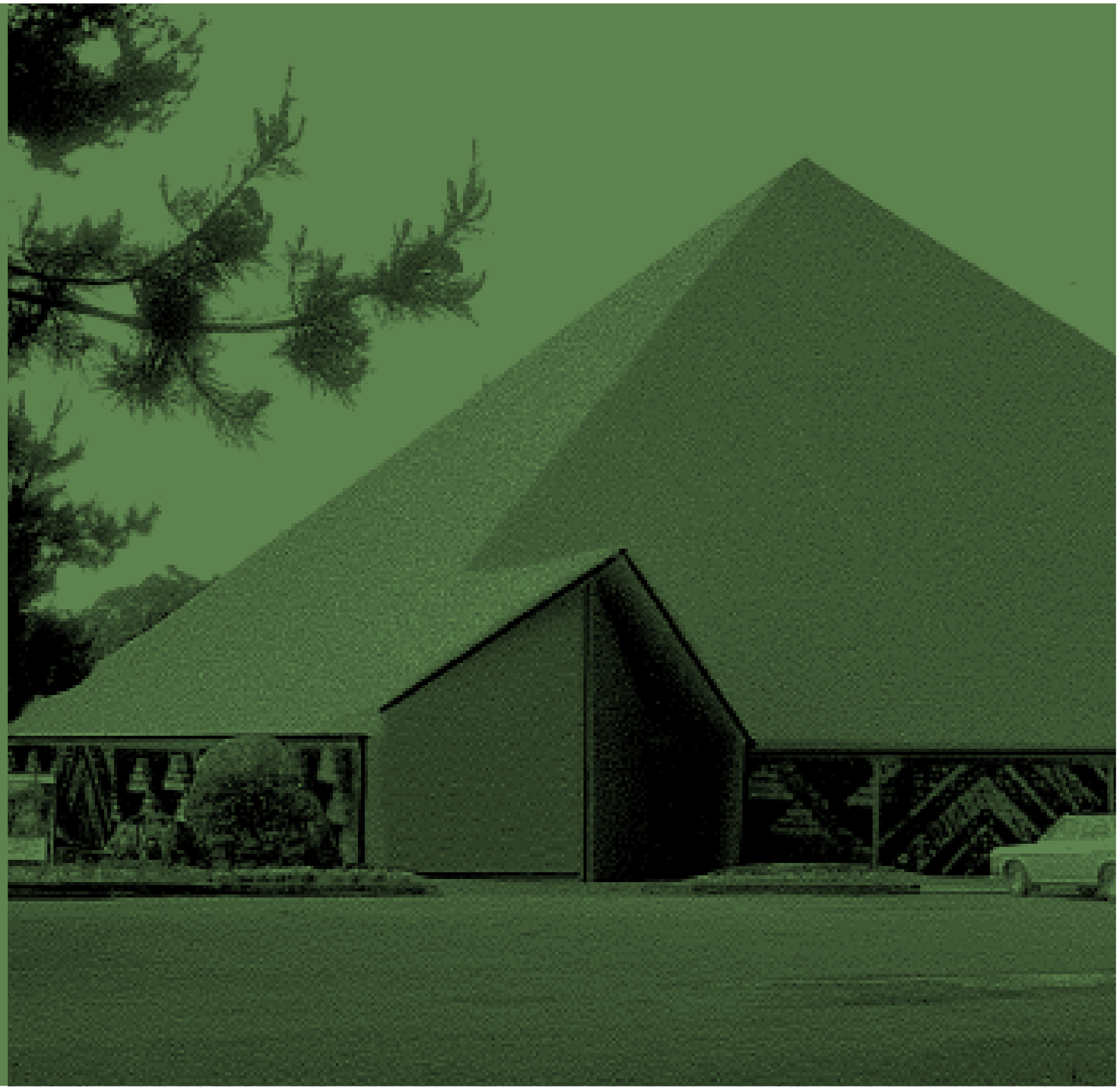
Structural Upgrade Works

Architectural Report



WARREN AND MAHONEY®

Southland Museum & Art Gallery

For: Invercargill City Council

13/11/ 2020 / REV A

Prepared For

Invercargill City Council

Document Revision Status

Revision A : 13.11.2020

Document Control

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Contents

Introduction

THE BUILDING:

The Southland Museum and Art Gallery, located at 108 Gala Street, Invercargill, consists of three independent structures and the remains of a fourth. These are the original building, which was constructed in 1940; the addition constructed in 1960 to the north-west of the original building, and another addition built in 1988 to the east of the 1960 building. This final addition included the construction of a pyramid that enclosed all of the buildings.

PURPOSE:

The purpose of this report is an initial assessment of the scope of architectural & interior refurbishment that would be required for NBS 34% and 67% structural seismic upgrade of the Southland Museum & Art Gallery (SMAG) building and the upgrades required to meet, as far as is reasonable practicable, the requirements for accessibility and facilities under NZ Building Code and compliance with the Fire Engineers report. This report forms part of building options report prepared by The Building Information Group and should be read in conjuction with the Structural, Fire, Mechanical, Electrical and geotechnical reports provided.

This report is based on an initial site walk through-out the building carried out on Monday 10th August 2020 along with review of the Matterport 3D scan of the existing building provided by Invercargioll City Council. The scope of this report is limited to the facilities viewed and observations made. A further detailed full building delapidation survey would be required to confirm whether the building meets all the requirements of the Building Code.

BUILDING CODE COMPLIANCE:

This report has been prepared based on the requirements of clause D1/AS1, part F4/AS1, G1/AS1, and NZS 4121:2001 - this latter document being the reference standard in section 119 of the Building Act 2004 as the means of determining compliance for access and facilities for persons with disabilities.

It is intended that any new work will comply with NZS 4121 with respect to accessible routes, corridors, doorways, doors, and toilet facilities. For the existing building, facilities compliance has been assessed with regard to requirements and being reasonably practicable.

ASSUMPTIONS:

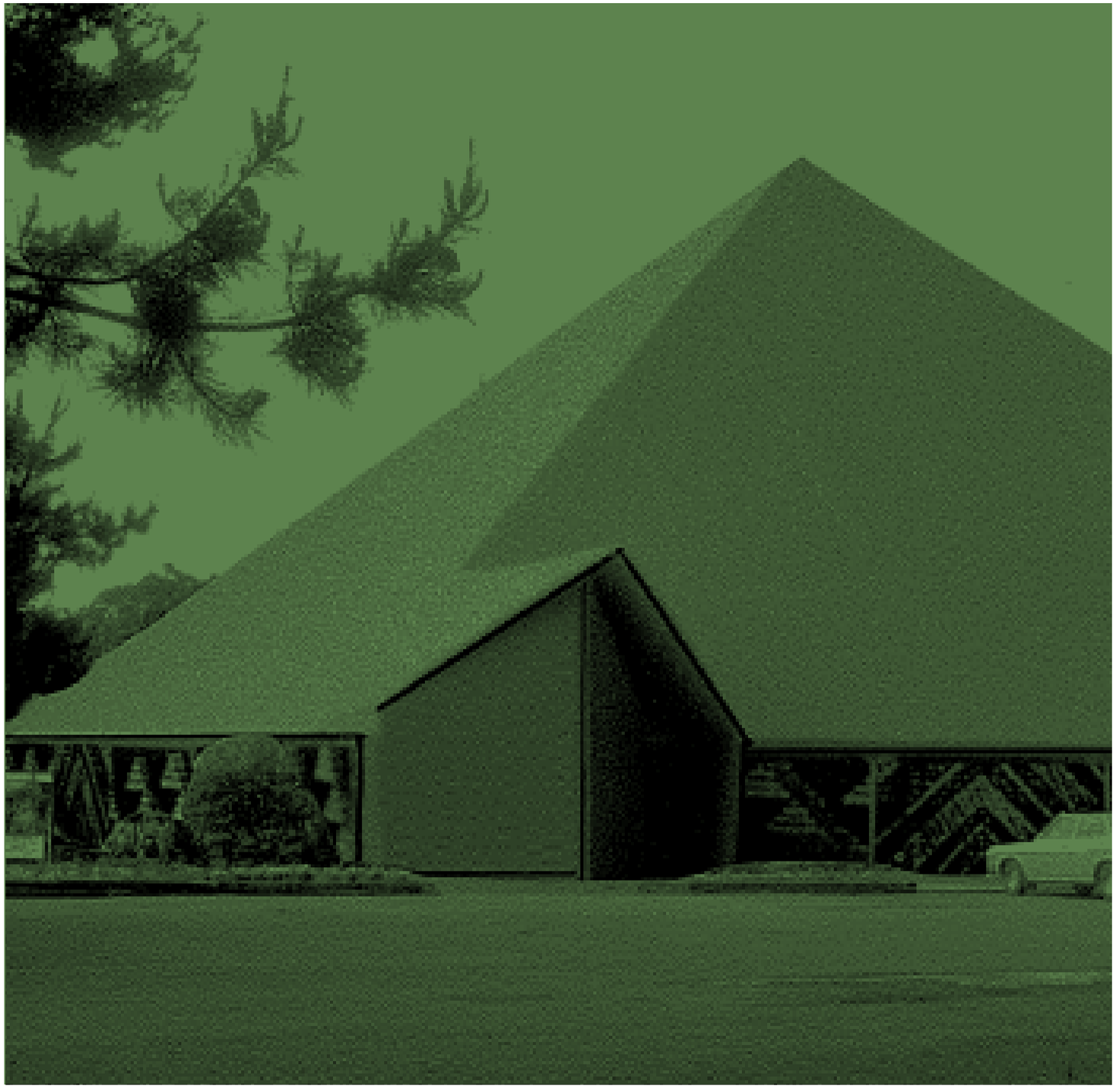
- Minimum Works only - Scope only includes areas that have been directly affected by the required Structural & Fire compliance upgrade works. This is not a refurbishment of spaces, rather a reinstatement.
- Those areas that have been identified as Non-compliant with respect to accessibilty, but are not directly affected by the required Structural & Fire upgrade works have been assumed to comply on an ‘As near as reasonably pratical’ (ANARP) basis - ie. Existing Accessible WC’s.
- Maximum design occupancy has been assumed as 825p in accordance with the Fire Engineers Design Advice. These occupancies need to be checked and confirmed by the Museum management to be appropriate. Note: these occupancies are significantly more than what is currently stated on the BWOF (500). Current WC provision needs further analysis.
- 34% vs 67% NBS - Works associated with increased structural compliance do not materially affect the architectural scope as the change between 34-67% structurally involves more steel reinforcing in walls, footing & beams in the same locations and extent as per the 34% scheme.
- Architectural scope assumes that current museum layout is to remain and that museum displays and BOH layouts are not changed.
- Due to the structural works and fire compliance the pyramid roof and secondary structure assumed to be replaced.
- Vertical circulation (Lift) - while non-compliant, is assumed to remain on ANARP approach.

Southland Museum & Art Gallery

Architectural Report

Option 1/2:

- Building Compliant to 34% / 67% NBS
- Minimum Refurbishment

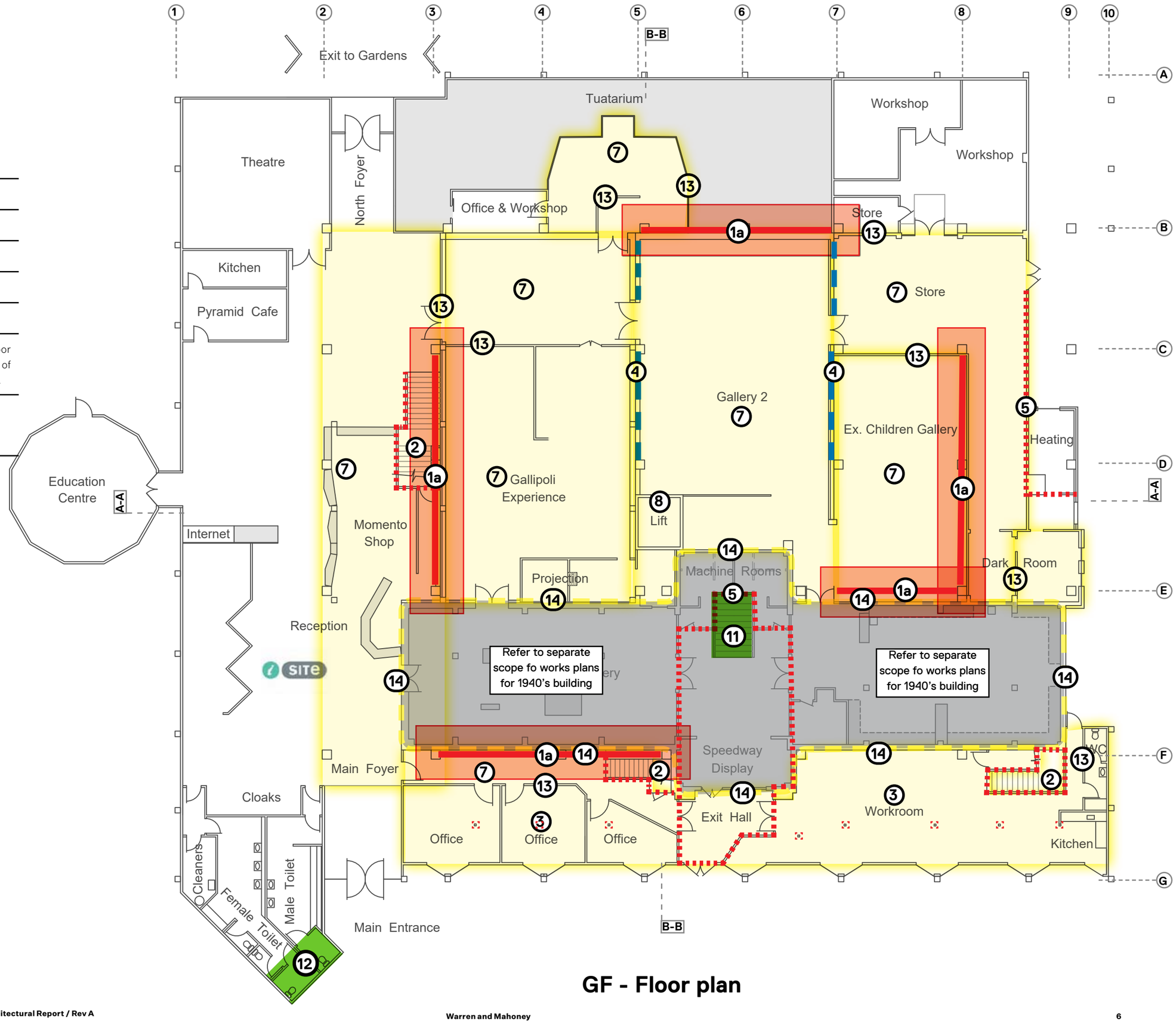


Option 1/2:
34/67% NBS

(Minimum Refurbishment)

LEGEND

	Existing Retained (Black Lines)
	Wall to be removed
	Scope of works Area
	New Structural wall
	New Fire Rated walls & doors
	Floor Finishes to be repaired/replaced - Note: All floor finishes to meet a minimum critical radinat heat flux of 1.2 kW/m2 in accordance with Fire Engineers advice.
	Ceiling Finishes upgraded to meet code - Note: All ceiling finishes to be Group 2 surface finish in accordance with Fire Engineers advice.



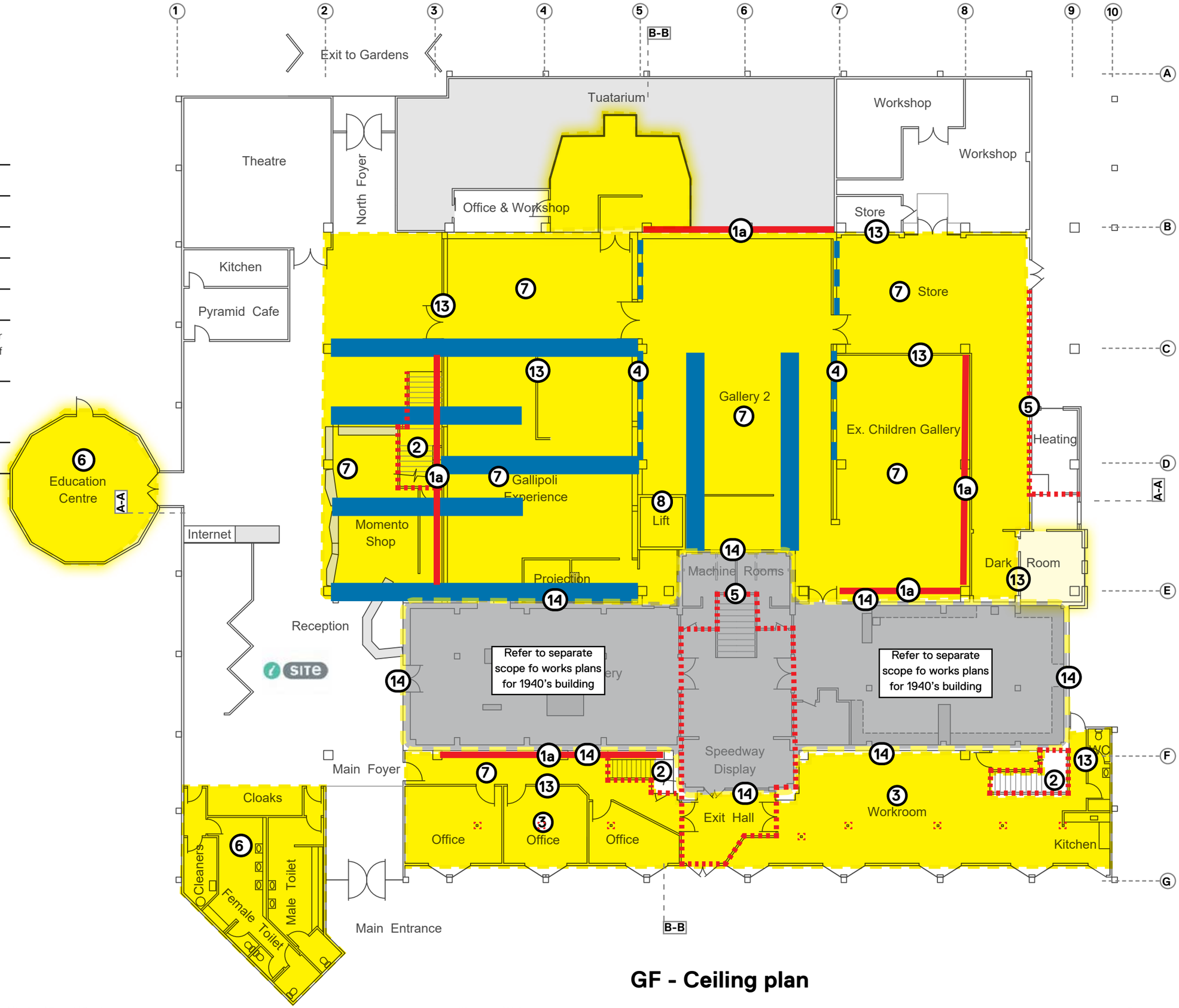
GF - Floor plan

Option 1/2:
34/67% NBS

(Minimum Refurbishment)

LEGEND

- Existing Retained (Black Lines)
- Wall to be removed
- Scope of works Area
- New Structural wall
- New Fire Rated walls & doors
- Floor Finishes to be repaired/replaced - Note: All floor finishes to meet a minimum critical radinat heat flux of 1.2 kW/m2 in accordance with Fire Engineers advice.
- Ceiling Finishes upgraded to meet code - Note: All ceiling finishes to be Group 2 surface finish in accordance with Fire Engineers advice.
- New Structural beam



GF - Ceiling plan

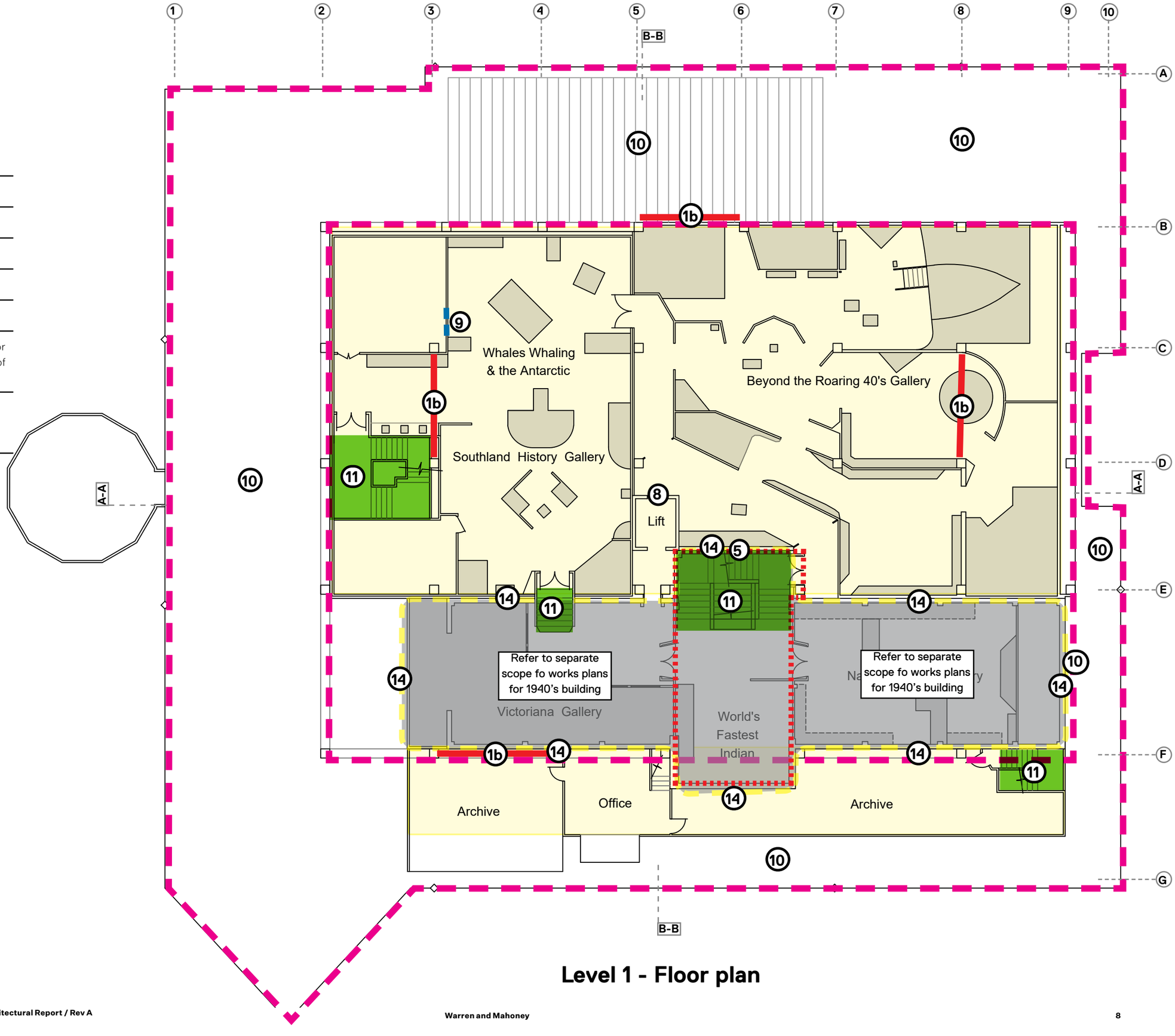
Option 1/2:

34/67% NBS

(Minimum Refurbishment)

LEGEND

	Existing Retained (Black Lines)
	Wall to be removed
	Scope of works Area
	New Structural wall
	New Fire Rated walls & doors
	Floor Finishes to be repaired/replaced - Note: All floor finishes to meet a minimum critical radinat heat flux of 1.2 kW/m2 in accordance with Fire Engineers advice.
	Ceiling Finishes upgraded to meet code - Note: All ceiling finishes to be Group 2 surface finish in accordance with Fire Engineers advice.



Level 1 - Floor plan

Option 1/2:

34/67% NBS

(Minimum Refurbishment)

LEGEND

- Existing Retained (Black Lines)
- Wall to be removed
- Scope of works Area
- New Structural wall
- New Fire Rated walls & doors
- Floor Finishes to be repaired/replaced - Note: All floor finishes to meet a minimum critical radinat heat flux of 1.2 kW/m2 in accordance with Fire Engineers advice.
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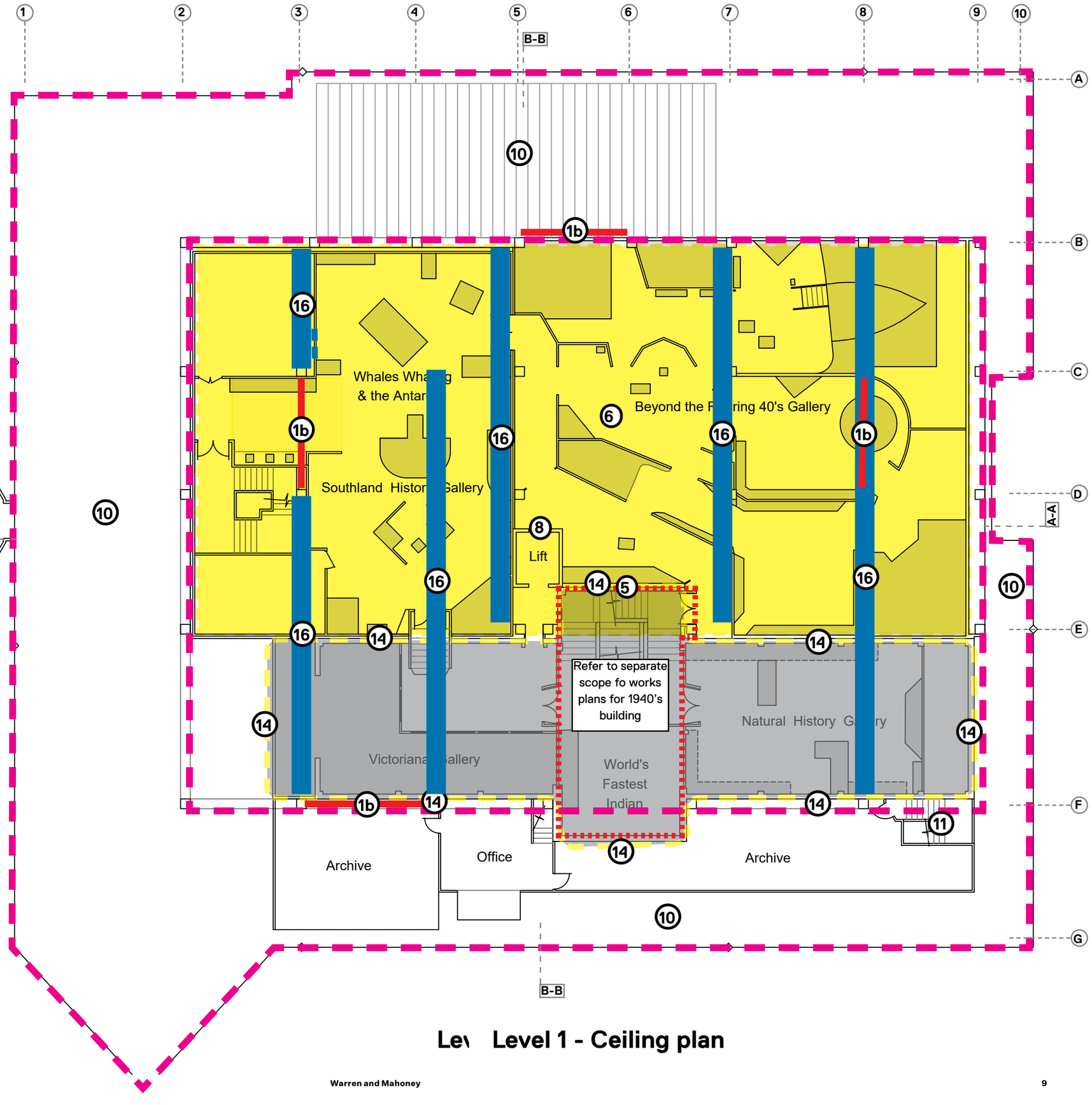
- New Structural beam



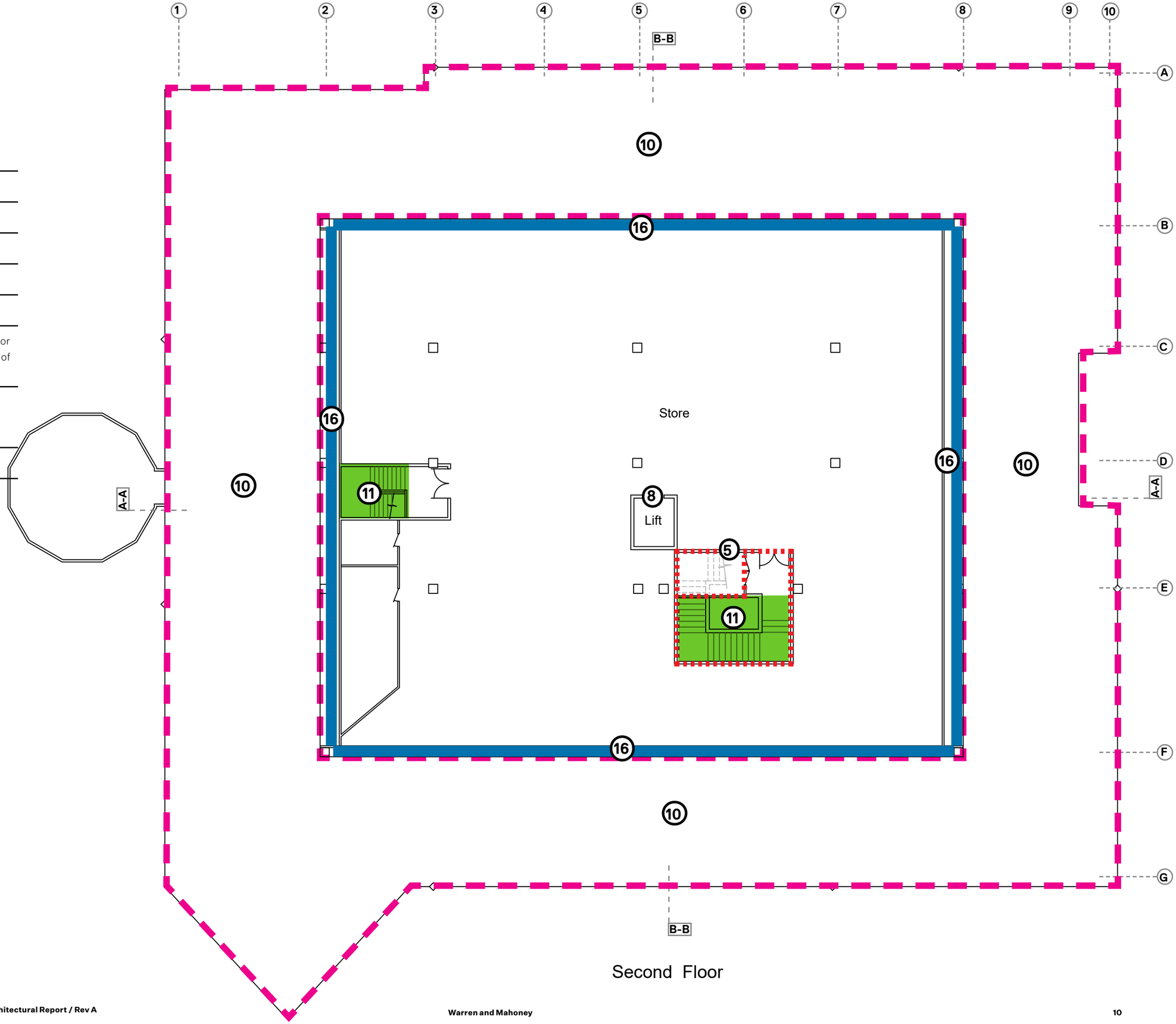
Le Level 1 - Ceiling plan

Option 1/2:
34/67% NBS

(Minimum Refurbishment)

LEGEND

	Existing Retained (Black Lines)
	Wall to be removed
	Scope of works Area
	New Structural wall
	New Fire Rated walls & doors
	Floor Finishes to be repaired/replaced - Note: All floor finishes to meet a minimum critical radinat heat flux of 1.2 kW/m2 in accordance with Fire Engineers advice.
	Ceiling Finishes upgraded to meet code - Note: All ceiling finishes to be Group 2 surface finish in accordance with Fire Engineers advice.
	New Structural beam



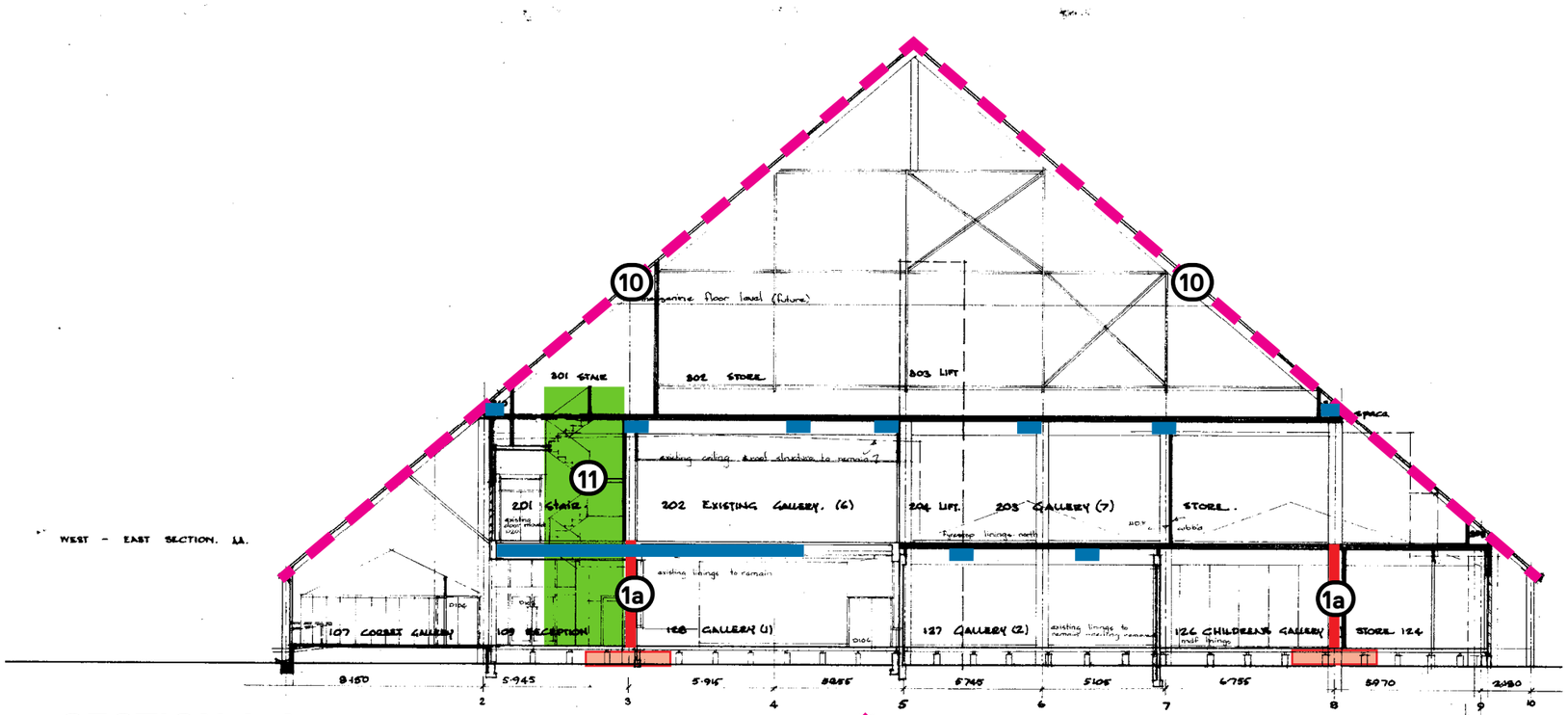
Second Floor

Option 1/2:

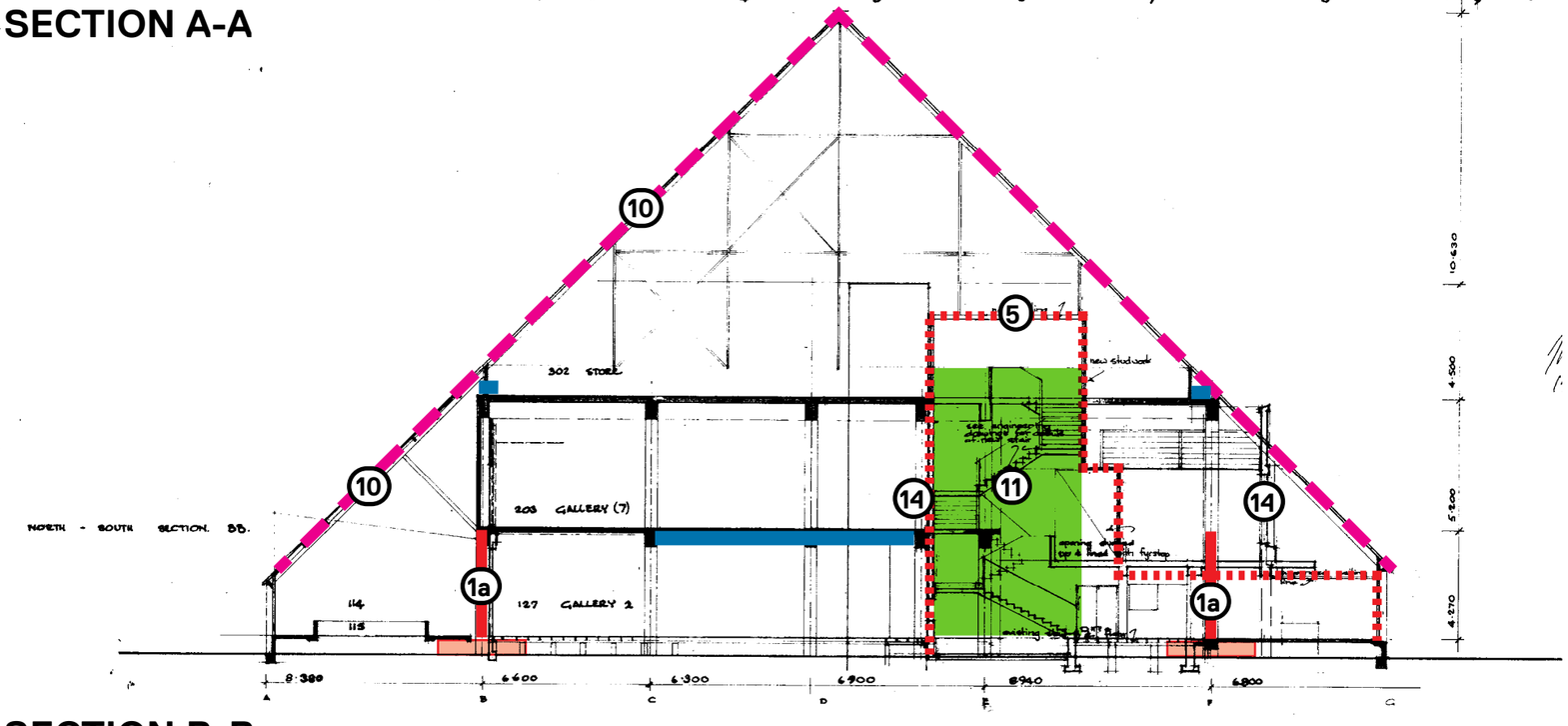
34/67% NBS

(Minimum Refurbishment)

LEGEND	
	Existing Retained (Black Lines)
	Wall to be removed
	Scope of works Area
	New Structural wall
	New Fire Rated walls & doors
	Floor Finishes to be repaired/replaced - Note: All floor finishes to meet a minimum critical radinat heat flux of 1.2 kW/m2 in accordance with Fire Engineers advice.
	Ceiling Finishes upgraded to meet code - Note: All ceiling finishes to be Group 2 surface finish in accordance with Fire Engineers advice.
	New Structural beam



SECTION A-A



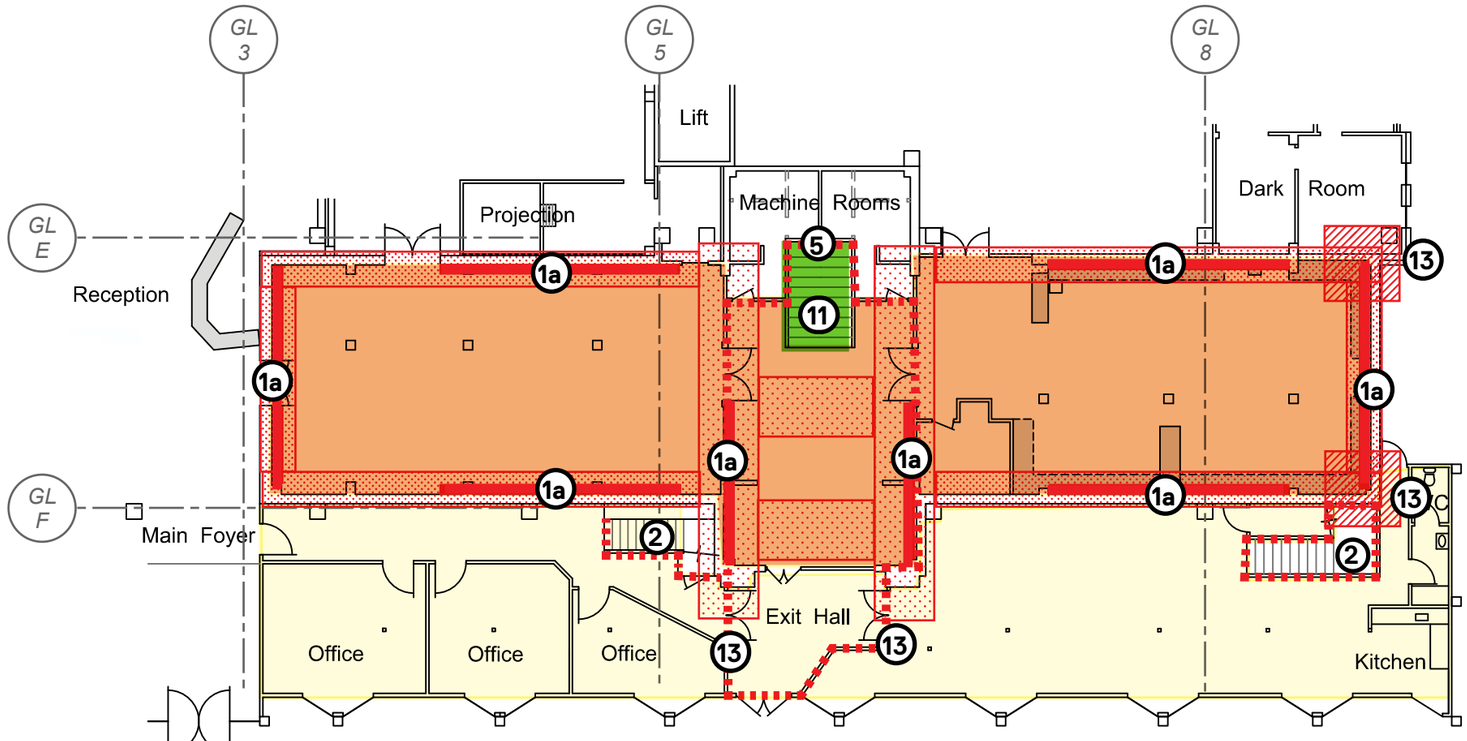
SECTION B-B

Option 1/2: 1940's Building

34/67% NBS

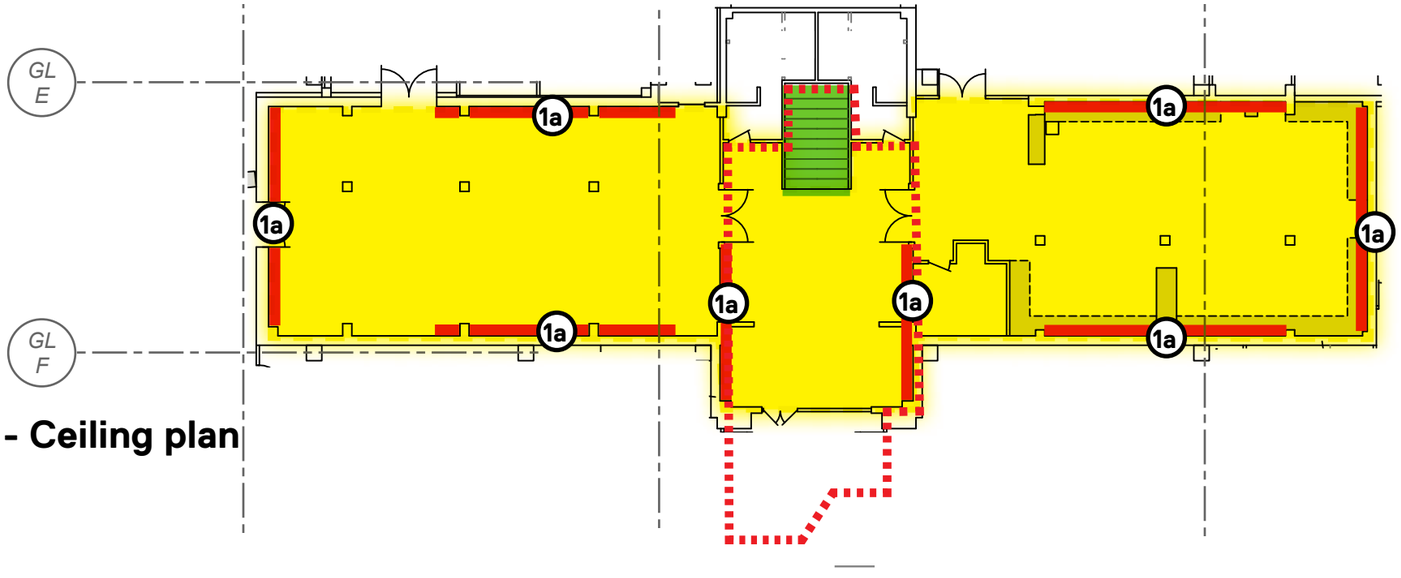
(Minimum Refurbishment)

LEGEND	
	Existing Retained (Black Lines)
	Wall to be removed
	Scope of works Area
	New Structural wall
	New Fire Rated walls & doors
	Floor Finishes to be repaired/replaced - Note: All floor finishes to meet a minimum critical radinat heat flux of 1.2 kW/m2 in accordance with Fire Engineers advice.
	Ceiling Finishes upgraded to meet code - Note: All ceiling finishes to be Group 2 surface finish in accordance with Fire Engineers advice.
	Replace existing timber framed floor where removed to provide access for new foundation beams - allow to replace carpet tile floor finish.



Foundation Plan

GF - Floor plan



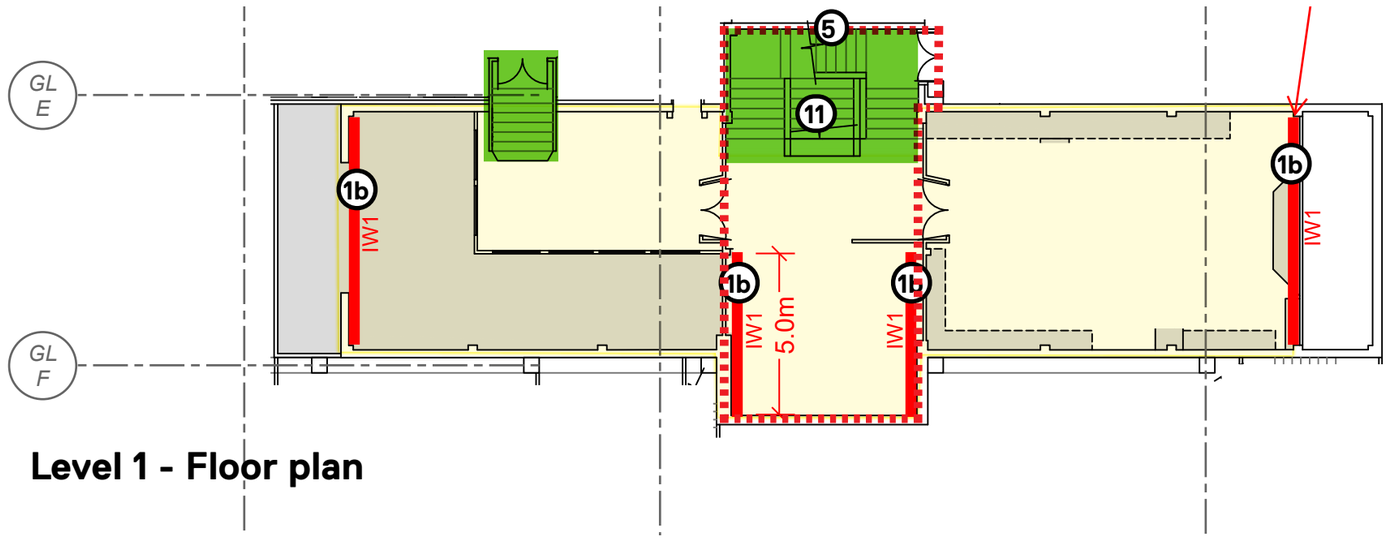
GF - Ceiling plan

Option 1/2: 1940's Building

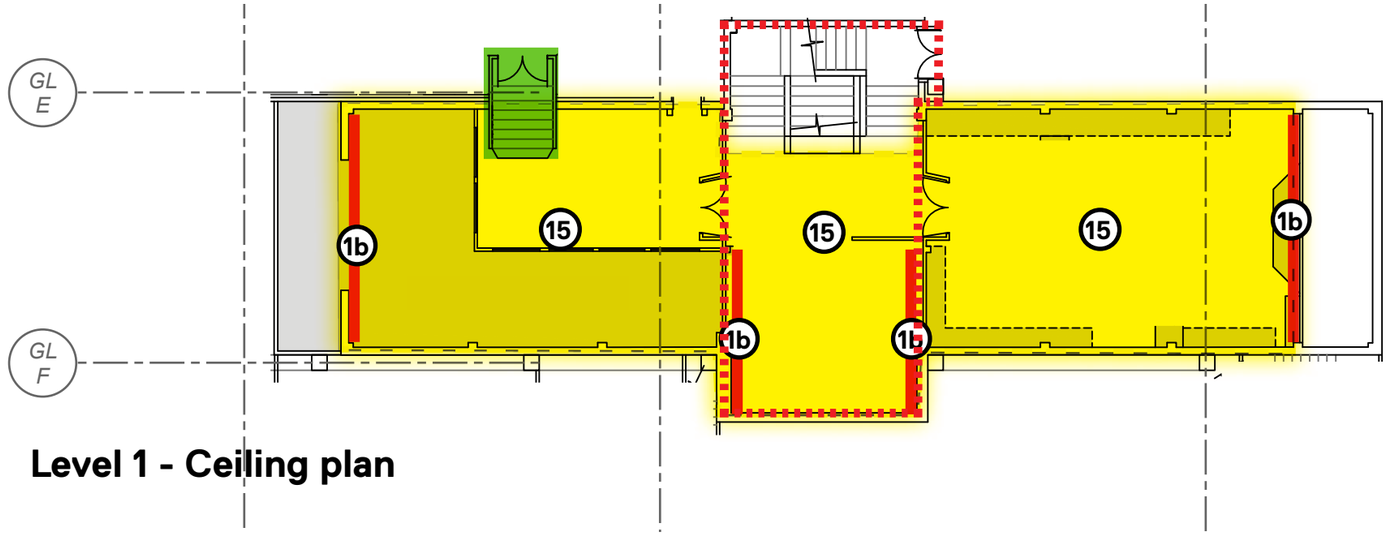
34/67% NBS

(Minimum Refurbishment)

LEGEND	
	Existing Retained (Black Lines)
	Wall to be removed
	Scope of works Area
	New Structural wall
	New Fire Rated walls & doors
	Floor Finishes to be replaced - Note: All floor finishes to meet a minimum critical radinat heat flux of 1.2 kW/m2 in accordance with Fire Engineers advice.
	Ceiling Finishes replaced to meet code - Note: All ceiling finishes to be Group 2 surface finish in accordance with Fire Engineers advice.
	Replace existing timber framed floor where removed to provide access for new foundation beams - allow to replace carpet tile floor finish.



Level 1 - Floor plan



Level 1 - Ceiling plan

Option 1/2:
34/67% NBS

(Minimum Refurbishment)

SCOPE OF WORKS

1a **New Structural wall & Foundation beam**
New in-situ reinforced concrete wall and foundation beam - Refer to structural engineers details and specification - Existing floor to be removed to allow for new concrete foundation and floor to be reinstated.

1b **New Structural wall**
New in-situ reinforced concrete wall. Refer to structural engineers details and specification.

2 **New Stair**
Replace/upgrade existing stair w/ new Accessible compliant stair (Rise: MIn150mm/ Max 180mm x 310mm min tread, Handrail @ 900-1000mm) and 16mm Fyreline to U/S of stair and support in accordance with Fire Engineers advice.

3 **Southern Mezzanine Floor**
Reline the underside of the floor with 16mm Fyreline. Ensure any structural steel support beams are concealed above this fyreline layer. The existing RHS posts supporting the steel beams shall be lined all around with 16mm fyreline on timber blocking.

4 **Remove Wall - Structurally Weak**
Demolish existing full height wall. Patch existing floor covering where wall removed or flooring damaged during demolition. Make good and paint soffit and columns.

5 **Fire rated walls and doors**
Upgrade existing wall linings, doors to form new fire separation / enclosure in accordance with Fire Engineers advice.

6 **Replace/upgrade existing ceiling**
Replace existing ceilings were removed to facilitate structural works. All new ceiling finishes to meet Group 2 surface finish in accordance with Fire Engineers advice and NZBC.

7 **Replace floor finishes**
Remove and salvage existing carpet tiles for reinstatment or replace with new to match where removed to enable structural or fire upgrades.

8 **Accessible Lift**
Existing non-compliant lift to remain - ANARP applied fo consenting purposes.

9 **New 850min egress door/opening**
Create new egress route door opening to provide access around new structural wall to existing means of escape stair.

10 **Replace existing roofing system**
Removal of existing roof required to allow for structural connections to be stregthened. Replace existing Bondor panels with Kingspan Architectural wall panels on new steel purlins.

11 **Upgrade Accessible Stairs**
Upgrade existing stair as near as reasonably practical (ANARP) to Building Code compliant stair (Rise: MIn150mm/ Max 180mm x 310mm min tread, Handrail @ 900-1000mm).

12 **Accessible WC upgrade**
Upgrade existing Accessible WC's as near as reasonably practical (ANARP) to meet Building code requirements.

13 **Existing walls & partitions**
Reinstate / replace existing wall where partially demolished to allow for structural upgrade.

14 **Remove existing brick veneer**
All existing brick veneer cladding to 1940's building to be removed - make good / strap & line existing walls.

15 **Structural ceiling diaphragm**
New structural plywood ceiling diaphragm to uderside of the exisying roof. Refer to structural engineers details and specification.

16 **New Concrete Beams**
New in-situ reinforced concrete beams cast between ribs of existing TT floor units - Refer to structural engineers details & specification.

NOTES:

Architectural report to be read in conjunction with Structural, Fire, Building Services and Geotechnical reports.

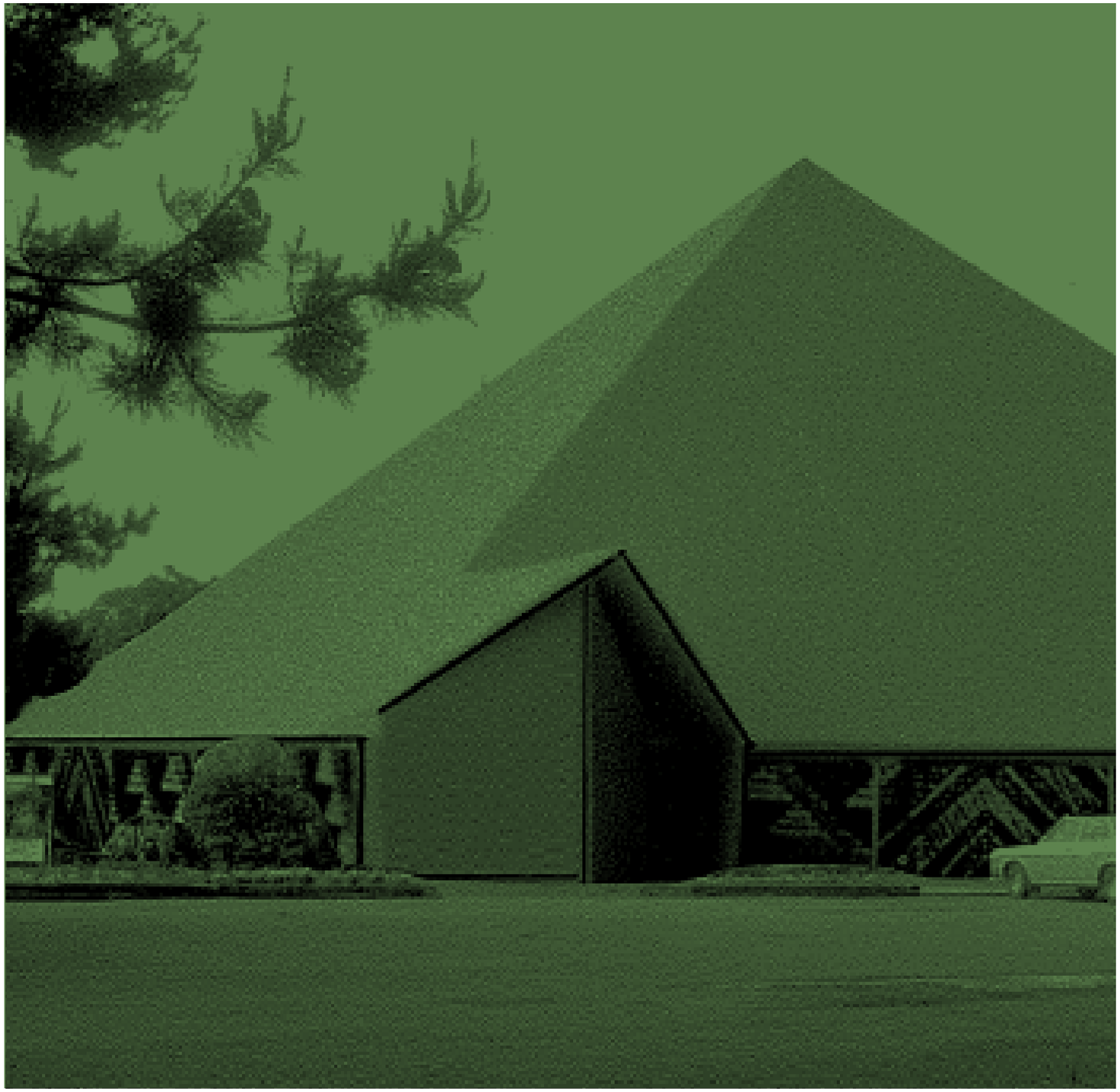
Southland Museum & Art Gallery

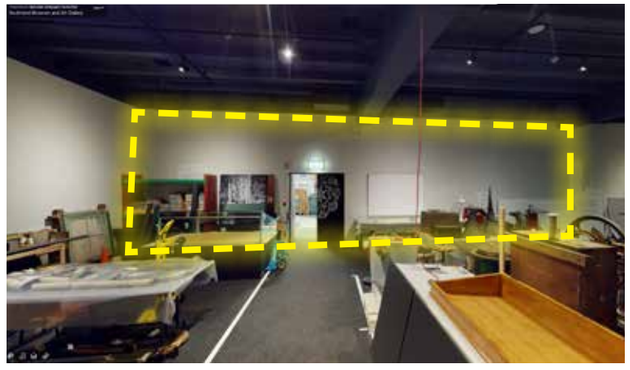
Architectural Report

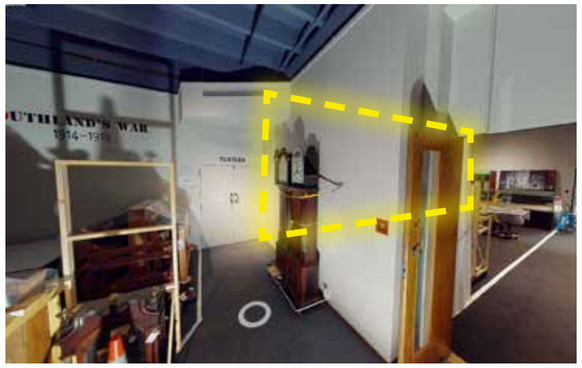
Appendix 1.

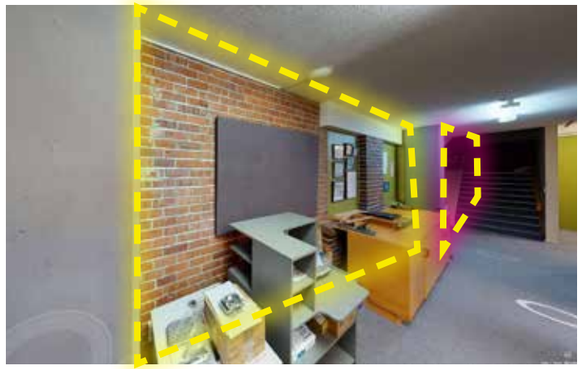
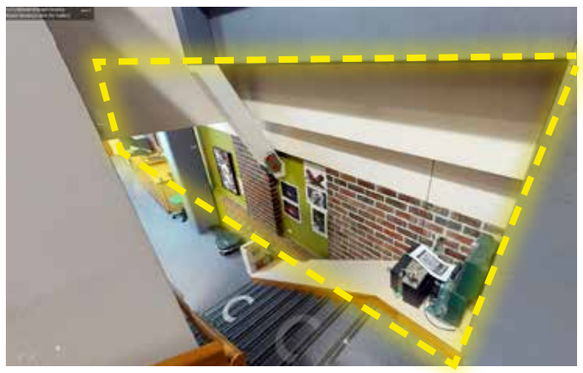
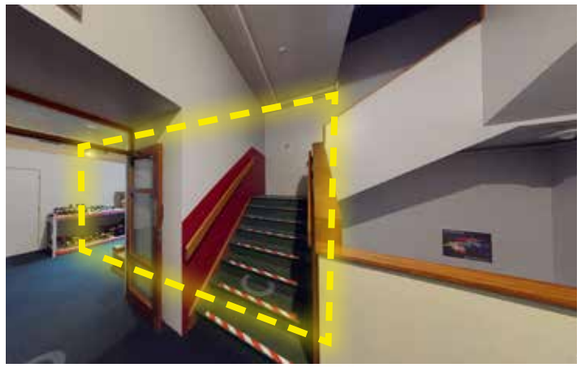
Outline Scope of works

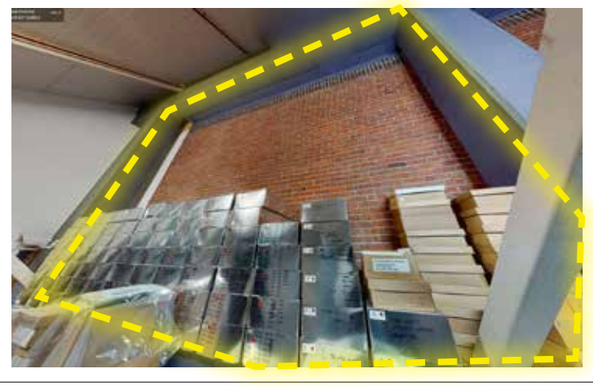
- Strutural wall insertions



Location	Scope of work	Description	Notes
GF- Structure / Fire / Accessibility GRID 3 / C-E	RECEPTION STAIR  	New structural wall & foundation beam required. **Demolition:** - Remove existing stair. - Cut out existing floor for new structural footing. **New Works:** - Form new structural flooring and wall to Structural engineers specification. - Form new accessible compliant stair and balustrade with Fire rated lining to underside to fire engineers specification. - reinstate floor coverings to new section of floor and new stair. - Strap & line structural wall and paint.	Head room issuse to be resolved at later design stage.
GF - Structure GRID 5 / B-D	GALLERY 2 WALL REMOVAL 	Remove existing wall due to structural weakness & safety hazard. **Demolition:** - Demolish existing full height wall on Grid 5 between grids B-D. **New Works:** - Patch existing floor covering where wall removed or flooring damaged during demolition - Make good and paint soffit and columns.	
GF - Structure GRID 7 / B-D	EX CHILDREN GALLERY  GALLERY 2 	Remove existing wall due to structural weakness & safety hazard. **Demolition:** - Demolish existing full height wall on Grid 7 between grids B-D. **New Works:** - Replace wall with new full height PB lined timber partition w/ new double door to storage area. Patch existing floor covering where wall removed or flooring damaged during demolition - Make good and paint soffit and columns. - Paint new wall both sides	
	Store room - structural wall removal & replacement 		Review services connections - elctrical, HVAC & Plumbing interface with exitsinmg wall removal. Make good where necessary.

Location	Scope of work	Description	Notes
GF- Structure GRID 8 / C-E NEW STRUCTURAL WALL AND FOOTING	RECEPTION STAIR 	New structural wall & foundation beam required. **Demolition:** - Cut out existing floor for new structural footing. - Cut back existing partition **New Works:** - Form new structural flooring and wall to Structural engineers specification. - Reinstate floor coverings to new section of floor - Strap & line structural wall and paint. - Re-instate	Retention of existing partition to be reviewed
GF - Structure GRID B / 5-7	GALLERY 2  	New structural wall & foundation beam required. **Demolition:** - Cut out existing floor for new structural footing. - Cut back existing wall/ partition **New Works:** - Form new structural flooring and wall to Structural engineers specification. - Reinstate floor coverings to new section of floor - Strap & line structural wall and paint. - Re-instate	
	TUATARIUM 		
GF - Structure GRID E / 7-8	EX. CHILDREN GALLERY 	New structural wall & foundation beam required. **Demolition:** - Cut out existing floor for new structural footing. - Cut back existing wall/ partition **New Works:** - Form new structural flooring and wall to Structural engineers specification. - Reinstate floor coverings to new section of floor - Strap & line structural wall and paint. - Re-instate	

Location	Scope of work	Description	Notes
GF - Structure GRID F / 3-5 NEW STRUCTURAL WALL AND FOOTING	OFFICE CORRIDOR  OFFICE CORRIDOR 	New structural wall & foundation beam required. **Demolition:** - Cut out existing floor for new structural footing. - Remove existing stair to mezzaine to allow access. - Remove existing brick cladding. - Removal of existing ceililng to allw for connection of new structural wall to beam above CL. **New Works:** - Form new structural flooring and wall to Structural engineers specification. - Reinstate floor coverings to new section of floor - Strap & line structural wall and paint. - New Fire rated lining to u/s of mezzanine floor. - New painted PB suspended ceiling. - Replace lighting.	
	MEZZ STAIR 		
LEVEL 1 - Structure GRID 3 / C-D NEW STRUCTURAL WALL AND FOOTING	STAIR CORE / WHALING GALLERY  	New structural wall & foundation beam required. **Demolition:** - Remove ceiling to provide access to beam over. - - Cut back existing wall/ partition around stair. - **New Works:** - Form new structural wall to Structural engineers specification. - Reinstate floor coverings /replace where damged or removed. - Strap & line structural wall and paint. - Repair/ reinstate stair and handrail REplace/ repair ceiling grid localised to works.	
	STAIR CORE / WHALING GALLERY 		

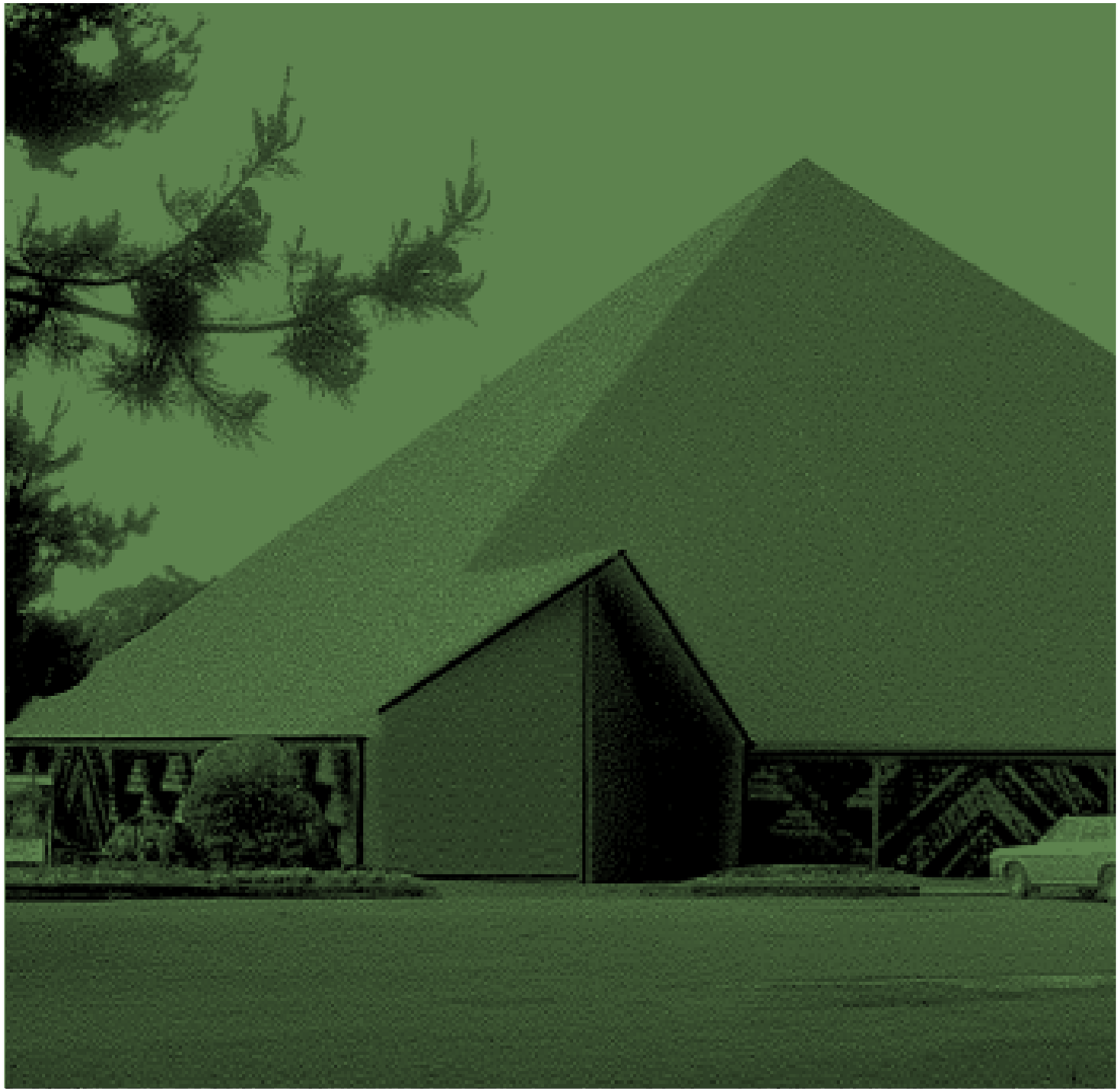
Location	Scope of work	Description	Notes
LEVEL 1 - Structure GRID F / 3-5 NEW STRUCTURAL WALL	OFFICE CORRIDOR  OFFICE CORRIDOR 	New structural wall & foundation beam required. **Demolition:** - Cut out existing floor for new structural footing. - Remove existing stair to mezzaine to allow access. - Remove existing brick cladding. - Removal of existing ceililng to allw for connection of new structural wall to beam above CL. **New Works:** - Form new structural fooring and wall to Structural engineers specification. - Reinstate floor coverings to new section of floor - Strap & line structural wall and paint. - New Fire rated lining to u/s of mezzanine floor. - New painted PB suspended ceiling. - Replace lighting.	
LEVEL 1 - Structure GRID F / 3-5 NEW STRUCTURAL WALL	ARCHIVE  		

Southland Museum & Art Gallery

Architectural Report

Appendix 2.

Accessibility Report



Appendix 2.

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RPT0001_SMAG_ACCESSIBLITY GAP ANALYSIS_AUGUST 2020

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REPORT

Project	9344 Southland Museum and Art Gallery
Subject	Accessibility GAP analysis – Initial findings
Date / time	17 August 2020
Prepared	*on behalf of* Warren and Mahoney Architects New Zealand Ltd
Distribution	Tess Browne – TBIG Nick Hamlin – Maxxis Projects

1. PURPOSE:

The purpose of this report is an initial assessment of the work that would be required for the various levels of development of the Southland Museum & Art Gallery (SMAG) building and to establish if it generally meets, as far as is reasonable practicable, the requirements for access and facilities for the disabled. This report forms part of building options report prepared by The Building Information Group.

This report is based on an initial site walk through-out the building carried out on Monday 10th August and the scope of the report is limited to the facilities viewed and observations made. A further full detailed building survey would be required to confirm whether the building meets all the requirements of the Building Code with respect to accessibility.

2. THE BUILDING:

The Southland Museum and Art Gallery, located on Gala Street at Invercargill, consists of three independent structures and the remains of a fourth. These are the original building, which was constructed in 1940; the addition constructed in 1960 to the northwest of the original building, and another addition built in 1988 to the east of the 1960 building. This final addition included the construction of a pyramid that enclosed all of the buildings.

3. BUILDING CODE COMPLIANCE:

This report has been prepared based on the requirements of clause D1/AS1, part F4/AS1, G1/AS1, and NZS 4121:2001 - this latter document being the reference standard in section 119 of the Building Act 2004 as the means of determining compliance for access and facilities for persons with disabilities.

It is intended that any new work will comply with NZS 4121 with respect to accessible routes, corridors, doorways, doors, and toilet facilities. For the existing building, facilities compliance has been assessed with regard to requirements and being reasonably practicable as set out in the tables below.

4. CODE REQUIREMENTS - EXISTING CONDITIONS:

4.1 ACCESSIBLE ROUTES - GENERALLY:

It is required that people with disabilities shall be able to:

- Park in accessible car parks
- Approach the accessible main entrance (or entrances) by footpath on an accessible route
- Enter the building or facility at an entrance, which has a level threshold, or which is approached via an incline or ramp of appropriate gradient

- Move freely inside and to use the facilities within the building or facility, except as provided for in this part of the standard
- Operate electronic access mechanisms and systems.

These criteria are generally met throughout by the existing building, with critical exceptions with regards to the provision of accessible stairs and ramps on MOE routes, as noted in the following table.

5. ACCESSIBILTY GAP ANALYSIS:

REQUIRED FEATURE	CURRENT SITUATION (Existing Building)	Upgrade Action proposed under Sections 112 or 115 of the Building Act. (Existing Buildings Only)
CAR PARKS (NZBC D1.3.5 & D1.3.6, D1/AS1/10, NZS 4121 SECTIONS 5 & F3)		
Provide at the ratio of 1 for up to 20, 2 for up to 50, plus 1 more for every additional 50 parks (or part thereof) (NZS 4121). Although this differs from our Proposed City Plan, our Planners will accept this Standard.	Complies	
Identified by the symbol of access (on ground or post).	Complies	
Location of accessible car park is either visible from a vehicle at the entrance to the car park area, or is sign posted from the entrance to the parking area.	Complies	
Min. 3500mm width (NZS 4121). Min. 3200mm width (AS2890.1 Fig. 2.2) but 3500mm if beside an obstruction (D1/AS1/10.1.1 Comment)	Appears to comply	
Located on an accessible route, as close as possible to the building accessible entry.	Complies – located directly adjacent to the accessible entrance.	
Located on a surface with a max. 1:50 slope.	Complies	
Located to avoid conflict between vehicles and people, and provided with direct access to an accessible route without having to pass behind parked cars.	Complies	
RAMPS AND FOOTPATHS (NZBC D1, D1/AS1/2.3, 3.0 & 6.0, NZS 4121 SECTION 6)	N/A (Outside of scope of review – Building only reviewed)	
STEP RAMPS (NZS 4121 SECTION 6)		
Ramps have a max. Gradient of 1:12(preferably 1:14)	Non-Compliant	
Ramps have landings top and bottom, extending 1200mm beyond any doorway or door swing. Landings may have a maximum gradient, in the direction of travel, of 1:50	Non-compliant	
All ramps have any upstand or low rail to prevent wheel-chair wheel from running off the edge.	N/A	
Ramps steeper than 1:20 have handrails both sides, continuing for 300mm beyond head and foot of ramp, plus an intermediate safety rail where not against a wall or barrier (NZS 4121 Fig. 12)	Non-Compliant	
Height of handrails is between 840mm and 1000mm vertically above “plane” surface of ramp	Non-compliant	

Appendix 2.

Handrail diameter is between 32mm and 50mm (or to Fig. 26(b) D1/AS1)	TBC	
Handrails have projecting ends (NZS 4121 Fig. 13)	Non-compliant	
Ramp landings (and rest areas) allow 1200mm space clear of door swings	Non-compliant	
Max. rise between landings is 750mm	Complies	
MAIN ENTRANCE AND ALL ACCESSIBLE ROUTES, INCLUDING CORRIDORS, DOORWAYS AND DOORS (NZBC D1.3.4(f), D1 AS1/7.0, FIG 27, NZS 4121 SECTION 7)		
The main entrance is on the accessible route.	Complies	
If the main entrance is not accessible, it has signage indicating location of accessible entrance.	Complies	
Preferably there are no thresholds in doorway. If they cannot be avoided, they are max. 20mm high, or 56mm high is a 1:8 max. ramp is provided both sides (NZS 4121 Fig. 17).	Complies	
There are accessible routes extending from the accessible entry to all spaces that are required to be accessible, 1200mm min. width.	Non-compliant – lift lobby entrance L1	
If existing corridors are less than 1200mm wide, doorways off it are made wider to compensate.	N/A	
Doorways have 760mm min. clear opening (unless from narrow corridors where wider clear openings are required).	Appears to comply – not all doors checked as part of initial review.	
Double doors have at least one leaf which provides 760mm min. clear opening.	Appears to comply – not all doors checked as part of initial review.	
Doors are colour-contrasted with their surroundings.	Complies	
Doors are dual swing and have visibility glazing panels.	N/A	
Doors with full height glazing have manifestation markings 7001000mm above floor.	N/A	
Clear space between successive doors is 1200mm min. (Fig. 27 D1/AS1).	Non-compliant – Male WC lobby	

Where doors open towards wheelchair, an unobstructed wall space not less than 300mm wide is required at side of door adjacent to door handle.	Appears to comply – not all doors checked as part of initial review.	
Forces required to open non-fire doors are within limits.	Not tested	
PUBLIC FACILITIES (NZBC G5.3.4, NZS 4121 SECTION 11)		
Where public counters or desks are provided in reception areas, bars, shops & supermarkets, at least one is accessible for both the public and for the staff using it.	Non-Compliant	

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Accessible portion of counter has top of work surface 775mm max. above floor, with 675mm min. height clearance under for a depth of 540mm.	Non-Compliant	
Public telephones comply with NZS 4121 Section 11.2.	N/A	
LIFTS (NZBC D1.3.4 (c), D2.3.5, D2/AS1/71, NZS 4121 SECTION 9)		
Lifts are required as follows:		
□ in all buildings with four or more floors	N/A	
□ in a three floor building when the total gross floor area of the two upper floors is 500m^2 or more and the design occupancy exceeds 50 persons	N/A	
□ in a two floor building when the gross floor area of the upper floor is 400m^2 or more and the design occupancy exceeds 40 persons	Complies	
□ notwithstanding any of the above, a lift is required if an upper floor is used for: a place of assembly for 250 or more persons, public reception area for a bank, central and local government offices and facilities (including libraries), medical and dental rooms, health care centres	N/A	
At least one lift is on the accessible route.	Complies	
Lobbies have 1800mm min. unobstructed depth in front of lift doors.	Complies	
Car floor has 1400mm x 1400mm min. internal dimensions.	Complies (TBC)	
Doors have 900mm min. clear opening.	Complies	
Doors are readily distinguishable from their surroundings.	Complies	
Doors remain open for at least 5 seconds before starting to close.	Not tested	
Car has handrails on walls to NZBC D1/6.0 or NZS 4121 Fig 26.	Non-compliant (TBC)	
All controls are located between 900mm and 1350mm above the floor.	Appears to comply	
All controls have tactile features.	Not reviewed	
Lift indicators are provided as NZS 4121:2001 cl. 9.2.5.	Not reviewed	
STAIRS (NZBC D1.3.4 (g)(h)(i), D1/AS1/4.0, 4.2, 4.4, 4.5, NZS 4121 SECTION 8)		

All multi-storeyed buildings that are required to be accessible have at least one accessible stair.	Non-compliant	
Stair treads 310mm min.; Risers 180mm max. (of uniform height over each flight).	Non-compliant	
Stair has 900mm min. width between handrails.	Complies	
Landings have 900mm min. depth (1200mm recommended)	Appears to comply	
Max. total rise of 2500mm between landings.	Not reviewed	

Appendix 2.

No open risers, no winders, no spiral stairs.	Complies	
Nosing's are rounded and colour contrasted with rest of tread.	Complies	
Colour-contrasted change of floor surface texture are provided at head and foot of stair.	Non-compliant	
STAIR HANDRAILS (NZBC D1.3.4 (i), D1/AS1/6.1, NZS 4121 SECTION 8.6)		
Are provided on both sides of the stair.	Complies	
Have no obstruction to the passage of the hand along the rail.	Complies (TBC)	
Are continuous around landings (except at doorways).	Non-compliant	
Extend 610mm min. beyond the foot of the stair and 300mm min. beyond the head of the stair.	Non-compliant	
At the same slope as the pitch line.	Complies	
Between 900mm and 1000mm above pitch line.	Non-compliant	
Profiles are to D1/AS1 Fig. 26(b)	Complies (TBC)	
Have no projecting ends, and have domed buttons 150mm from the ends (NZS 4121 Fig. 23).	Non-compliant	
TOILET FACILITIES (NZBC D1.3.2(c) & G1.1 & 1.3.4 G1/AS1, NZS 4121 SECTION 10)		
Accessible toilets are on the accessible route.	Complies	
Route to accessible toilets does not traverse different tenancies.	Complies	
Minimum dimensions of space are 1900mm x 1600mm and the layout of fittings is correct.	Non-compliant	
In certain large buildings having more than 300 occupants, accessible toilets are evenly distributed.	N/A	
If doors are hinged, they swing outwards unless the space is sufficiently large (sliding doors are also acceptable).	Complies	
Door has 760mm min. clear opening (with 1200mm clear space in any lobby between door swing arcs).	Non-compliant	
If hinged, the door has a grab rail on inner face.	Non-compliant	
Indicator bolt is of sufficient size so as to be usable by person with limited hand movement.	Non-compliant	
Horizontal leg of grab rail beside WC pan is fixed 700mm above floor.	Appears compliant (to be confirmed)	
Vertical leg of grab rail is fixed between 150mm and 250mm from front of WC pan.	Appears compliant (to be confirmed)	
Top of WC pan seat is 460mm above floor level.	Non-compliant	
Front edge of WC pan is 700-750mm from wall behind it.	Non-compliant	

Toilet paper holder is located in the correct zone.	Compliant	

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Wash basin has 675mm min. underside clearance from floor, and is located 300mm min. from the front of the WC pan.	Non-compliant	
Taps on wash basins have capstan or lever handles (hot tap to left of cold tap).	Non-compliant	
Any nappy changing tables do not intrude into the wheelchair manoeuvring space.	N/A	
DOOR & WINDOW CONTROLS AND LIGHT SWITCHES (NZBC D1.3.4 (f), G9/AS1, NZS 4121 SECTIONS 4, 7 & C5)		
Doors can be opened with one hand.	Appears Complaint – not all doors tested	
Door handles are fixed between 900mm and 1200mm (1000 optimum) above floor.	Appears Complaint – not all doors tested	
Door handles are level action, with end returned towards door (knob handles are not permitted).	N/A	
Door closers have min. tension required to bring door to closed position.	Appears Complaint – not all doors tested	
Electronic access units are located as NZS 4121 clause 4.11.5.	Not reviewed	
Window locking & opening controls are located between 900mm & 1200mm above the floor.	Not reviewed	
Light switches throughout building are horizontally aligned with door handles.	Not reviewed	
Socket outlets are located 500-1200mm above the floor.	Not reviewed	
VISIBILITY FACTORS (NZBC F2, G7 AND G8, NZS 4121 215, D1/AS1/1.5.4 & 1.8)		
All signs, information boards and all elements of accessible routes are well illuminated.	Non-compliant / not reviewed	
SIGNS (BUILDING ACT CL. 47A(5), NZBC G5.3, 5.3.6 & F8.3.4, F8/AS1/5.0, NZS SECTIONS 3.6 & 4.8)		
Signs are positioned on walls, doors, etc between 1400mm and 1700mm above the floor.	TBC	
International symbol of access is displayed outside the building or so as to be visible from outside it.	Complies	
Access symbol on main information board(s) identifies location of lift, accessible routes, toilets, rooms with listening aids, etc.	Non-Compliant	
Accessible toilets / showers are identified with an access symbol on entrance door.	TBC	
All symbols have correct proportional layout, lettering and colour contrast with background.	TBC	
Identify facilities:		
□ accessible car park spaces	Complies	
□ accessible entrance	Complies	
□ services available in building	Non-Compliant	

Appendix 2.

Handrail diameter is between 32mm and 50mm (or to Fig. 26(b) D1/AS1)	TBC	
Handrails have projecting ends (NZS 4121 Fig. 13)	Non-compliant	
Ramp landings (and rest areas) allow 1200mm space clear of door swings	Non-compliant	
Max. rise between landings is 750mm	Complies	
MAIN ENTRANCE AND ALL ACCESSIBLE ROUTES, INCLUDING CORRIDORS, DOORWAYS AND DOORS (NZBC D1.3.4(f), D1 AS1/7.0, FIG 27, NZS 4121 SECTION 7)		
The main entrance is on the accessible route.	Complies	
If the main entrance is not accessible, it has signage indicating location of accessible entrance.	Complies	
Preferably there are no thresholds in doorway. If they cannot be avoided, they are max. 20mm high, or 56mm high is a 1:8 max. ramp is provided both sides (NZS 4121 Fig. 17).	Complies	
There are accessible routes extending from the accessible entry to all spaces that are required to be accessible, 1200mm min. width.	Non-compliant – lift lobby entrance L1	
If existing corridors are less than 1200mm wide, doorways off it are made wider to compensate.	N/A	
Doorways have 760mm min. clear opening (unless from narrow corridors where wider clear openings are required).	Appears to comply – not all doors checked as part of initial review.	
Double doors have at least one leaf which provides 760mm min. clear opening.	Appears to comply – not all doors checked as part of initial review.	
Doors are colour-contrasted with their surroundings.	Complies	
Doors are dual swing and have visibility glazing panels.	N/A	
Doors with full height glazing have manifestation markings 7001000mm above floor.	N/A	
Clear space between successive doors is 1200mm min. (Fig. 27 D1/AS1).	Non-compliant – Male WC lobby	

Where doors open towards wheelchair, an unobstructed wall space not less than 300mm wide is required at side of door adjacent to door handle.	Appears to comply – not all doors checked as part of initial review.	
Forces required to open non-fire doors are within limits.	Not tested	
PUBLIC FACILITIES (NZBC G5.3.4, NZS 4121 SECTION 11)		
Where public counters or desks are provided in reception areas, bars, shops & supermarkets, at least one is accessible for both the public and for the staff using it.	Non-Compliant	

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RPT0001_SMAG_ACCESSIBLITY GAP ANALYSIS_AUGUST 2020

Accessible portion of counter has top of work surface 775mm max. above floor, with 675mm min. height clearance under for a depth of 540mm.	Non-Compliant	
Public telephones comply with NZS 4121 Section 11.2.	N/A	
LIFTS (NZBC D1.3.4 (c), D2.3.5, D2/AS1/71, NZS 4121 SECTION 9)		
Lifts are required as follows:		
□ in all buildings with four or more floors	N/A	
□ in a three floor building when the total gross floor area of the two upper floors is 500m^2 or more and the design occupancy exceeds 50 persons	N/A	
□ in a two floor building when the gross floor area of the upper floor is 400m^2 or more and the design occupancy exceeds 40 persons	Complies	
□ notwithstanding any of the above, a lift is required if an upper floor is used for: a place of assembly for 250 or more persons, public reception area for a bank, central and local government offices and facilities (including libraries), medical and dental rooms, health care centres	N/A	
At least one lift is on the accessible route.	Complies	
Lobbies have 1800mm min. unobstructed depth in front of lift doors.	Complies	
Car floor has 1400mm x 1400mm min. internal dimensions.	Complies (TBC)	
Doors have 900mm min. clear opening.	Complies	
Doors are readily distinguishable from their surroundings.	Complies	
Doors remain open for at least 5 seconds before starting to close.	Not tested	
Car has handrails on walls to NZBC D1/6.0 or NZS 4121 Fig 26.	Non-compliant (TBC)	
All controls are located between 900mm and 1350mm above the floor.	Appears to comply	
All controls have tactile features.	Not reviewed	
Lift indicators are provided as NZS 4121:2001 cl. 9.2.5.	Not reviewed	
STAIRS (NZBC D1.3.4 (g)(h)(i), D1/AS1/4.0, 4.2, 4.4, 4.5, NZS 4121 SECTION 8)		

All multi-storeyed buildings that are required to be accessible have at least one accessible stair.	Non-compliant	
Stair treads 310mm min.; Risers 180mm max. (of uniform height over each flight).	Non-compliant	
Stair has 900mm min. width between handrails.	Complies	
Landings have 900mm min. depth (1200mm recommended)	Appears to comply	
Max. total rise of 2500mm between landings.	Not reviewed	

Appendix 3.

Architectural Report

Appendix 3.

WC Calculations

BUILDING PERFORMANCE

Calculator for toilet pans, basins and urinals

Building use	Museum
Is the number of people for the building known?	Yes
Number of occupants	825
Population of the building use	825

Results as of 21 October 2020 at 04:29:00 p.m.

Option 1 - Unisex	**Number**
Facilities	4
Accessible facilities	2
Option 2 - Single Sex pans only	
Female	
Pans	3
Accessible facilities	1
Basins	2
Male	
Pans	2
Accessible facilities	1
Basins	2
Option 3 - Single sex with pans and urinal for males	
Female	
Pans	3
Accessible facilities	1
Basins	2
Male	
Pans	2
Accessible facilities	1
Urinals	1
Basins	2
Option 4 - Single sex pans only, plus accessible unisex	
Female	
Pans	3
Basins	1
Male	
Pans	2
Basins	1
Unisex	
Accessible facilities	2
Option 5 - Single sex with pans and urinals for males, plus accessible unisex	
Female	
Pans	3
Basins	1
Male	
Pans	3
Urinals	1
Basins	1
Unisex	
Accessible facilities	2

The calculator is intended as a guide only and is issued as a guidance material under s175 of the Building Act 2004. While theDepartment has taken care in producing this calculator, this calculator is not a substitute for professional advice, and advice should besought on establishing compliance with the relevant building code clauses.

http://www.building.govt.nz

DESIGN ADVICE MEMO

FIRE

Powell Fenwick

P 03 366 1777
W www.pfc.co.nz
383 Colombo St, Sydenham, Christchurch
PO Box 7110, Sydenham 8240 Christchurch

Memo No	**F01**
Job Name	**Southland Museum & Art Gallery**
Job No	**200848/F**
Date	**14 August 2020**
To	**TBIG**
Email	**t.browne@tbig.co.nz, nick@maxisprojects.co.nz**
Attention	**Tess Browne, Nick Hamlin**
Copies to	Client QS Architect

Signature **David James**

Fire Safety & Egress

1. Introduction

This purpose of this Design Memo is to identify the **Fire Safety & Egress** upgrade work that would be required for the various levels of development of the SMAG building. Refer also to Fire drawings F1-F3 attached.

2. Strengthen to 34% NBS

A building consent is required even if the building were to be strengthened to only 34% NBS. As required by Section 112 of the Building Act, a consent can only be granted if the Council is satisfied that the building will comply as near as is reasonably practicable (ANARP) with the Means of Escape provisions of the Building Code.

Because of the geometry of the building, an analysis using the Building Code's Verification Method would be required.

The following is the Fire Safety upgrade work that would be expected to be required for the building to comply ANARP with the Fire Code using a C/VM2 approach. This requires a computer analysis of the building, and negotiation with the Council, peer reviewer and FENZ, none of which has been carried out at this stage.

Building Use & Design Occupancies:
The use and design occupancies of the various floors are as follows:
2nd floor: storage - occupancy 10
1st floor: museum - occupancy 250
Ground: museum, exhibition, classroom, workshops, offices - occupancy 565
These occupancies need to be checked and confirmed by the Museum management to be appropriate. Note these occupancies are significantly more than what is currently stated on the BWOF (500).
It is critical that the total building occupancy is less than **1000**.

Fire Cells:
Because of the difficulty in ensuring the edges of the two upper floors are tight and fire stopped where they meet the Bondor roof, the entire building is considered to be in one single firecell (excluding the stairs and Boiler Room). This allows separating walls, gaps in walls and floors, service penetrations, mechanical ducting etc to remain unrated.

Sprinkler System:
The building is fully sprinkler protected. The museum areas are protected to ELH and the storage areas are protected to OH3.
The control valves and Fire Service Inlet are in the SVR on the east side of the building.
The water supply is from the 150mm diameter townsmain in Gala St. The water supply includes a diesel booster pump in the valveroom.
A monitored backflow preventer is required at the street boundary, including concrete slab and cage.
Any defect items on the latest biennial survey must be attended to.
The sprinkler pipework and heads will require modifying to allow for the structural strengthening.
Seismic restraint of the system will also need to be included.

Fire Alarm System:
A manual fire alarm system presently exists throughout, including manual call points and a fire alarm panel at the SW main entrance. Some very old smoke and heat detectors exist.
A new Type 4 analogue addressable smoke detection system shall be installed throughout the building, including a new analogue addressable fire alarm panel and new analogue addressable call points and detectors. Remove the existing fire alarm equipment including the old smoke & heat detectors and alarm panel.

Internal Fire Hydrant System:
An internal fire hydrant is required in the main central stair, with hydrant outlets on each of the 3 floors.
The Fire Service Inlet for this system shall be located under the existing sprinkler FSI.
Include a vertical test pipe alongside the vertical riser in the stair, with outlet at the FSI.

Air Handling Systems:
Connect the air handling systems to the fire alarm system so that, on fire alarm activation, the air handling systems shut down.

Fire Hose Reels & Fire Extinguishers:
All existing fire hose reels may be removed entirely.
Add new fire extinguishers in:

- all plant rooms
- workshops
- adjacent to switchboards
- kitchens

Smoke Extract:
There is some existing smoke extract system activated by the fire alarm. This needs investigating.
A smoke extract system may be required above the western Reception/Exhibition area. The system is needed to ensure the smoke layer on Ground floor is sufficiently high to allow people to egress down the western stair. A make-up air supply via the auto entry door is required.

Upper Floors:
The 2 upper floors are concrete supported on concrete beams and concrete columns.
Fire stopping is not required to service penetrations through these floors.

Southern Mezzanine Floor:
This floor is presently lined on its underside with plasterboard. Reline the underside of the floor with 16mm fyreline. Ensure any structural steel support beams are concealed above this fyreline layer.
The existing RHS posts supporting the steel beams shall be lined all around with 16mm fyreline on timber blocking.

Central Stair:
The central stair is 1530mm wide and must be fire separated on all 3 floors to achieve a 60/60/- FRR.
Some walls are concrete. The timber framed walls shall be relined on both sides with 13mm fyreline, and shall extend up to the underside of the floor above. Create a fire rated lid on top of the stair, lined on its topside and underside with 16mm fyreline.
Doors into the stair on all 3 floors shall be replaced with new -/60/-sm firedoors with magnetic hold open devices, door closers, roller ball latching etc. No locking is permitted.
All displays and combustible items shall be removed from this stair on all floors including the exit route on Ground floor. This also includes the display cupboard and glass door at the midlanding between 1st and 2nd floors.

The walls shall be extended in the subfloor space to the ground with timber framing lined both sides with Hardiflex.
Service penetrations through these walls must be fire stopped including fire dampers to mechanical ducts.

Western Stair:
The western stair is 1060mm wide from 2nd to 1st floor, and 1730mm wide from 1st to Ground floor.
This stair need not be fire or smoke rated on any floor. Existing walls and doors surrounding the stair on 1st and 2nd floors may remain as is. The stair is completely open on Ground floor and shall remain as is.
Line the underside of the stair soffit between ground and 1st floors with 16mm fyreline. Line the underside of the support walls with 16mm fyreline both sides.

Observatory Stair:
Replace this stair altogether with a new galvanised steel stair, 1m wide, if this space is to continue to be accessed.

Southern Mezzanine floor stairs:
Line the underside of the these two stairs with 16mm fyreline.
Line the underside of the support walls with 16mm fyreline both sides.

External Walls:
External walls need not be fire rated to protect neighbouring property, as the neighbouring property is Public Open space.

Exit Signs:
Maintained illuminated Exit signs are required as shown on the Fire plans. These may be green writing on black background.
Remove all existing Exit signs.

Emergency Lighting:
New emergency lighting is required to all:

- public spaces
- stairs, including the observatory stair
- egress routes from the base of all stairs to outside
- internal and external ramps and steps

Lift:
The liftshaft need not be fire or smoke rated. This may remain as is.

Egress Doors:
Refer to the Fire plans. The hardware to some doors shall be upgraded to include:
NL = no latch
CR = crash bar
Otherwise egress doors shall include keyless hardware on the inside.
If electronic access control is provided to exit doors, these must also include EMREX breakglass on the inside. If crash bars are also required, the crash bars must deactivate the mag lock.

Surface Finishes:
All internal ceilings shall include a Group 2 surface finish. Remove existing pinex ceilings, including in the Education Centre.
All internal walls shall include a Group 3 surface finish.
Flooring shall include a critical radiant heat flux of at least 1.2 kW/m2.

Roof:
The Bondor roof is acceptable from a Fire Code point of view. However, the building's insurers need to comment that it is acceptable to them. FENZ also shall comment. Replacement of the roof with Kingspan may be required.

Boiler Room:
The walls surrounding the boiler room shall be fire rated to 90/90/90 FRR. Walls shall be lined both sides with 16mm fyreline. The door shall be replaced with a -/90/-sm firedoor. Services penetrations through the fire rated walls shall be fire stopped.

3. Upgrade to Building Code Standard

The same work as in Section 2 above is required.

4. Upgrade to TENNZ Guidelines and/or Fit for Purpose

The Guidelines prepared by Touring Exhibitions Network of New Zealand require that the building be sprinkler protected and include a smoke detection system. This is already included in Section 2 above.

DESIGN ADVICE MEMO

MULTIDISCIPLINE

Memo No	**MEHA 01**
Job Name	**Southland Museum & Art Gallery (SMAG)**
Job No	**200848/MEHA**
Date	**17 August 2020**
To	**TBIG**
Email	**t.browne@tbig.co.nz, nick@maxisprojects.co.nz**
Attention	**Tess Browne, Nick Hamlin**
Copies to	Client QS Architect
Signature	**Tim White**

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Building Services - Mechanical, Electrical, Hydraulics and Acoustics

1. Introduction

This purpose of this Design Memo is to identify the **Mechanical, Electrical, Hydraulics and Acoustics** upgrade work that would be required for the various levels of development of the SMAG building.
Descriptions are provided as a high level summary only; further design work is required on the relevant items once the scope of works has been defined in further detail.

2. Strengthen to 34% NBS (only)

A building consent is required even if the building were to be strengthened to only 34% NBS. As required by Section 112 of the Building Act, a consent can only be granted if the Council is satisfied that the building will comply as near as is reasonably practicable (ANARP) with the Means of Escape and Accessibility provisions of the Building Code.

Emergency Lighting:
As noted in the Fire Engineering Design Memo F01, new emergency lighting would be required to provide coverage to various areas of the building, as well as illuminated exit signage as per the fire engineering drawings F1-F3.
Some existing emergency lighting is present but is outdated technology requiring regular maintenance to maintain compliance, and would not provide adequate coverage to most areas as required by current standards.
For a facility of this size we would also strongly recommend that an automated emergency lighting testing system is deployed to ensure and simplify on-going compliance.

Accessibility - Stairs:
Building Code clause D1 requires stairs to be illuminated to a minimum of 150 lux (average). From an initial visual inspection, several of the existing stairways appear to not meet this requirement and therefore additional/new general lighting would be required specifically over stairs.

Other Services:
No other services works would be required to achieve this minimum standard only, but there are significant compromises and limitations within the current building with regards to being fit for purpose as a modern museum space and these would of course remain if no further upgrades are pursued.
It is noted that other services such as electrical RCD protection, hydraulic services and ventilation do not comply with the current building code but are not technically required to be upgraded under this level of consent.

3. Upgrade to Building Code Standard - All services

In addition to the works described within Section 2 above, the following would be required to achieve compliance with the building code for all services.

Lighting:
The only mandatory building code requirement for general lighting is that all occupied spaces achieve a minimum illuminance level of 20 lux. From an initial visual inspection, this should be achieved by existing lighting.

RCD protection:
For the safety of occupants, RCD (residual current device) protection is required to all general power circuits within wet areas (such as kitchens, toilets etc.) and to all areas primarily used by children. RCD protection can be added to local socket outlets or at the respective distribution board.

Seismic Restraint:
There appears to be essentially no seismic restraint to existing services. A full investigation, design and installation of seismic restraint in compliance with NZS4219 for all services such as mechanical plant and ducts, suspended lighting, suspended pipework etc. would be required in order to comply with current standards.

Ventilation:
Following a site inspection and a review of the existing mechanical services drawings it is unlikely that the existing systems meet building code requirements for ventilation. The drawings provided don't specifically state the outdoor air supplied by the main air handling unit, but an assessment of the duct sizing suggests a maximum of approximately 2500l/s of fresh air will enter the building. The BWOF on site stated a maximum of 500 people within the building. NZS 4303 requires 8l/s/person of outdoor air which would require 4000l/s of fresh air required for this number of people. If the building was to meet building code fresh air requirements, the ventilation system would require upgrading. This would require new fresh air handling systems and likely require an upgrade in central plant capacity to allow for cooling and heating of the additional fresh air.
We note that the fundamental issues within the mechanical system would not be solved by this upgrade. Temperature and humidity control issues would remain which will not meet best practice for museum environment control (TENNZ guidelines).

Incoming Water Supply:
A compliant boundary backflow prevention device is required on the incoming water supply. This device is subject to annual testing as part of the building WOF.

Domestic Hot Water:
Hot water temperature at personal hygiene fixtures, i.e. wash hand basins is required to be no more than 55°C by code.

Café Kitchen Drainage:
Comment was made during the initial site inspecting that there are issues with the drainage from the existing café kitchen. We are unsure exactly what the issues are or works which may be required to resolve them, but this should be investigated further.

Toilet Facilities Alterations:
It is understood that changes to the existing toilet facilities have already been discussed and even if these are not required for accessibility compliance, changes are strongly desired by staff and members of the public.
Further investigation of existing and design for new mechanical ventilation/extract, hydraulics services and possibly also electrical services (e.g. hand driers) would be required as part of these alterations.

4. Upgrade to TENNZ Guidelines and/or Fit for Purpose

The Guidelines prepared by Touring Exhibitions Network of New Zealand provide advice regarding a number of services and are considered a benchmark for best practice within a museum facility.
Meeting these guidelines not only provides a more comfortable, more engaging and more functional facility but also enables SMAG greater ability to attract high value or popular items/collections which otherwise may not be offered.

Other ‘fit for purpose’ items are also outlined below which may not be specifically mentioned in the TENNZ guidelines but would be strongly recommended to be incorporated within a new (or ‘as new’) museum/art gallery facility.
These items are in addition to, or an extension of, the works described within Section 2 and 3 above.

Power Supply:
If heating plant was to be upgraded and/or was to transition more towards electrically supplied plant, such as heat pumps, then the incoming power supply rating would require further investigation.

Electrical Reticulation:
The existing Main Switchboard appears to be circa 1990s and generally in good order. Egress from the room housing the switchboard does not comply with current electrical standards, which requires two means of escape with door swings in the direction of egress.
One distribution board was noted as being relatively new but the majority of existing switchboards appear to be circa 1960s and contain obsolete circuit protection. One was located at the top of a stair which would be considered a safety hazard.
It is be recommended that all existing 1960s era distribution boards are replaced, including some being relocated.

Lighting:
TENNZ notes 100 lux to be provided to photographic prints. Other standards/design guidelines also recommend 50 lux to paintings, in combination with lower background illuminance. TENNZ and other guidelines also discuss the minimisation of exposure to UV spectrum light which can be achieved using specific, modern LED luminaires.

The existing lighting creates significant glare in many areas which detracts from viewing of exhibitions and collections, as the human eye has to constantly adjust and re-adjust. This can also cause significant discomfort or headaches to photo-sensitive people.
Staff also made comment that many of the existing lighting tracks are generally not in optimal locations.
Some LED lighting appears to have been installed but the much of the general lighting is older technology which is less energy efficient and has a higher maintenance cost than modern LED fixtures.

Lighting Control:
Existing lighting controls are manual ON/OFF switching only. A lighting control system with the ability to control and dim lighting to various areas would significantly enhance the functionality and flexibility of the facility.

Flexible Power:
Very few general power outlets were observed from the initial visual inspection. Modern facilities typically require/expect general power to be readily available for use within exhibitions/displays/artworks which have a powered or internally lit component, and this was verified with SMAG staff as highly desirable in order to deliver a modern museum/art gallery experience once the building is able to be re-opened.

Data/Communications:
The existing communications system was not inspected in detail, but consideration should be given to the potential to upgrade incoming communications infrastructure, connectivity and wireless network coverage throughout the facility.

Security/CCTV:
TENNZ guidelines require CCTV coverage of exhibitions at all times and restricted access to works during packing/unpacking. CCTV is also required in storage areas, which is not currently provided.
An existing electronic access control system exists but expansion of this system should be considered to provide greater control/flexibility to secure different areas of the building.
There is an existing coax based CCTV system, but coverage is not extensive and the system is not of the type which would be expected for a modern facility.

AV/PA System:
The clarity and reliability of the existing PA system is not fit for purpose, based on feedback from staff. The system also appears to be outdated.
No specific AV system is present to accommodate interactive/technology displays etc.

Mechanical Services:

To meet the requirements of the TENNZ guidelines, the entire mechanical system would need to be replaced with new. The current chiller/heatpump is a 4-pipe system which provides simultaneous heating and cooling. Based on discussions with the asset manager of the site, this system cannot produce chilled water at temperatures cold enough to provide adequate dehumidification.

The general requirements of the TEENZ for environment control are as follows:

- Temperature: 20-22ºC +/- 3ºC
- Humidity: 52% +/- 7% with no more than 5% within a 24 hour period

Note that the above standard is required to be met for various important artefacts, archives and collections to be displayed at SMAG. Other facilities will require these standards to be met. Without adherence to this, the Southland Museum and Art Gallery will not be allowed to accommodate and display collections that they may wish to.

A new mechanical system to meet the above standards will include the following; a separate heat pump for heating water and a chiller for chilled water, new humidifiers, dehumidifiers, air handling units, fan coil units and associated ancillaries such as pipework, ductwork, buffer tanks etc.

It also needs to be noted that the stringent environmental control requirements of the TENNZ will only be met if the architectural design of the facility is also improved. For example, the current leaking roof will allow too much moisture into the space to accurately control humidity. Additional design elements such as ante rooms and well-sealed air tight spaces are also required for accurate temperature and humidity control.

Acoustic Performance:

We consider that there is potential to inadvertently make the acoustics worse through the structural strengthening/minimum code improvements to other services. The following high level considerations are based on a bare minimum of achieving compliance in a *"no worse than existing"* scenario, examples of which are raised below:

- Where surface finishes are removed/replaced, acoustic consideration will be required to ensure the overall functionality of space is not worsened. One example would be the removal of carpet for other flooring surfaces, carpet is useful acoustic absorber as well as providing a degree of resiliency for footfall noise on suspended floors.

- Pinex ceilings (as identified as an issue in the Fire Engineering Design Memo F01) will provide some acoustic benefit over a plasterboard ceiling; therefore a like for like replacement might include direct fixed acoustic panel absorbers.

- Where linings are removed/replaced, these should be replaced like for like or with a material with a greater density to preserve/improve the sound insulation performance.

- Acoustical performance of high rated partitioning systems (floors/walls) can be dependent on structural isolation of elements. Where elements are tied together for structural/seismic strengthening purposes these will require significant consideration to avoid introducing additional problematic areas.

- If/where mechanical plant is replaced and/or rehoused; consideration will be required for compliance with boundary noise criteria in adjacent sites. We note that the Mechanical Services Engineer may look to provide a greater amount of free area for airflow reasons, this can reduce acoustic screening and result in increased noise levels for neighbouring properties but also on the building it serves.

Other options for further improvement to acoustic performance could be considered in coordination with architectural/other services alterations to the building should this be desired.

Invercargill City Council (ICC)

Southland Museum and Art Gallery (SMAG) - Options Summary

i) The following cost table summarises RLB's recent costings for SMAG. All estimates shown below are 'order of costs' only, as such we recommend that cost sensitivities are applied to any overarching cost model/ report.

ii) Costs have been formed on a number of assumptions and clarifications. Please refer to each separate estimate for this detail.

Ref	Cost Centre	Existing Building Cost Options			New Build Cost Options						RLB Comments
					Demolish Existing Pyramid & New Build Museum (Location TBC)			Demolish Existing Pyramid & New Build Museum (Location TBC)			
		34% Option (Minimal Works)	67% Option (Minimal Works)	67% Option (Full Refurbishment)	Low 4,575m2 (Inc Storage)	Medium 4,575m2 (Inc Storage)	High 4,575m2 (Inc Storage)	Low 5,300m2 + Storage	Medium 5,300m2 + Storage	High 5,300m2 + Storage	
1	**De-Cant of Artefacts and Exhibition Fit Out**	Excluded	Excluded	Excluded	Excluded	Excluded	Excluded	Excluded	Excluded	Excluded	We assume that the de-canting of artifacts and exhibition space will be carried out by ICC direct and this cost isn't capitalised against the project? Parties to discuss with ICC.
2	**De-Cant of Existing Temporary Buildings (Adjacent SMAG) & Make Good**	Excluded	Excluded	Excluded	Excluded	Excluded	Excluded	Excluded	Excluded	Excluded	
3	**Tuatara Relocation Costs and Temporary Facilities**	Excluded	Excluded	Excluded	Excluded	Excluded	Excluded	Excluded	Excluded	Excluded	Discuss with ICC. Reasonable level of cost variability depending on requirements.
	Construction Works:-										
4	Construction Works to Existing Museum	$13,310,000	$14,190,000	$25,200,000	N/A	N/A	N/A	N/A	N/A	N/A	
5	Demolition of Existing Pyramid & Site Make Good	N/A	N/A	N/A	$1,490,000	$1,490,000	$1,490,000	$1,490,000	$1,490,000	$1,490,000	
6	Infrastructure for New Museum	N/A	N/A	N/A	$670,000	$820,000	$970,000	$670,000	$820,000	$970,000	
7	New Build Museum	N/A	N/A	N/A	$28,600,000	$33,170,000	$40,040,000	$33,130,000	$38,430,000	$46,380,000	
8	External Works	Excluded	Excluded	$700,000	$400,000	$900,000	$1,400,000	$500,000	$1,000,000	$1,500,000	
9	Compliance Risk Scope	Excluded	Excluded	$790,000	N/A	N/A	N/A	N/A	N/A	N/A	
10	General Betterment Works	Excluded	Excluded	Included	N/A	N/A	N/A	N/A	N/A	N/A	
	Specialist Fit Out Works:-										
11	New Exhibition Fit Out	Excluded	Excluded	$6,800,000	$3,780,000	$6,800,000	$9,820,000	$4,380,000	$7,880,000	$11,370,000	Assumed 33% of the building floor area is to have exhibition space.
12	Furniture, Furniture and Equipment (FF&E)	Excluded	Excluded	$900,000	$400,000	$900,000	$1,400,000	$500,000	$1,000,000	$1,500,000	Cost put forward in the 'low' category assume the re-use of some existing FF&E. Medium and high categories assume new.
13	IT Equipment	Excluded	Excluded	$200,000	$200,000	$200,000	$200,000	$250,000	$250,000	$250,000	Budget allowance.
	Storage Facilities for Artifacts:-										
14	Temporary Storage	$4,500,000	$4,500,000	$4,500,000	$4,500,000	$4,500,000	$4,500,000	N/A	N/A	N/A	Budget allowance.
15	Separate Permanent Storage - Assumed New 1,000m2 Building	N/A	N/A	N/A	N/A	N/A	N/A	$4,500,000	$4,500,000	$4,500,000	Includes provision for infrastructure and some external work requirements.
16	**Reinstatement of Artefacts**	Excluded	Excluded	Excluded	Excluded	Excluded	Excluded	Excluded	Excluded	Excluded	We assume that the reinstatement of artifacts and exhibition space will be carried out by ICC direct and this cost isn't capitalised against the project? Parties to discuss with ICC.
	Sub-Total Construction Cost Only (GST Exclusive)	**$17,810,000**	**$18,690,000**	**$39,090,000**	**$40,040,000**	**$48,780,000**	**$59,820,000**	**$45,420,000**	**$55,370,000**	**$67,960,000**	
17	**Market Escalation to Q4 2024 Only**	$1,350,000	$1,430,000	$2,450,000	**$4,400,000**	**$5,370,000**	**$6,580,000**	**$5,000,000**	**$6,090,000**	**$7,480,000**	
	Sub-Total Construction Cost Only (GST Exclusive)	**$19,160,000**	**$20,120,000**	**$41,540,000**	**$44,440,000**	**$54,150,000**	**$66,400,000**	**$50,420,000**	**$61,460,000**	**$75,440,000**	
	Design and Management Fees:-										
18	Historical Fee Spend to Q3 2020	Excluded	Excluded	Excluded	Excluded	Excluded	Excluded	Excluded	Excluded	Excluded	
19	Consultant Fees From Q3 2020 Onwards - New Building & Storage	$2,750,000	$2,900,000	$4,600,000	$5,970,000	$7,300,000	$9,170,000	$6,750,000	$8,260,000	$10,400,000	
20	Consultant Fees From Q3 2020 Onwards - Exhibition Fit Out & FF&E	N/A	N/A	N/A	$400,000	$500,000	$600,000	$400,000	$500,000	$600,000	
	Other Body Costs:-										
21	ICC Internal Costs	Excluded	Excluded	Excluded	Excluded	Excluded	Excluded	Excluded	Excluded	Excluded	
22	Southland Museum & Gallery Trust Costs	Excluded	Excluded	Excluded	Excluded	Excluded	Excluded	Excluded	Excluded	Excluded	
23	Iwi Costs	Excluded	Excluded	Excluded	Excluded	Excluded	Excluded	Excluded	Excluded	Excluded	
24	**Local Authority Fees/Charges/Insurances**	$450,000	$450,000	$620,000	$780,000	$950,000	$1,160,000	$880,000	$1,080,000	$1,320,000	Includes Resource Consent, Demolition Consent, Building Consent(s) and Development Contributions.
25	**Contingency**	$3,000,000	$3,200,000	$5,760,000	$10,320,000	$12,580,000	$15,470,000	$11,690,000	$14,260,000	$17,550,000	
	Total Project Cost (GST Exclusive)	**$25,360,000**	**$26,670,000**	**$52,520,000**	**$61,910,000**	**$75,480,000**	**$92,800,000**	**$70,140,000**	**$85,560,000**	**$105,310,000**	

RLB Key Clarifications / Assumptions

Procurement:-

a) We have assumed that the works will be procured in a 'traditional' form whereby ICC maintain design control.

b) We have assumed that any construction works will be competitively tendered.

Programme:-

c) Costs assume that the new Museum and Art Gallery will be complete and open by no later than Q4 2024.

Covid:-

d) We advise that at the time of preparing this cost table the impacts of COVID 19 remain fluid. Even though New Zealand is currently operating under Alert 1, we note that the full effects of COVID 19 on the construction industry are yet to fully materialise. The ongoing consequences of this pandemic are likely to influence CAPEX. Some key issues include but are not limited to:-

i) General market economy changes.
ii) Border closures affecting supply of labour in particular.
iii) Exchange rate fluctuations.
iv) Off shore manufacturing capacity and timing of delivery.
v) Local and national logistics including delivery of materials and supplies etc.

RLB Exclusions

1) **GST.**
2) **Land purchase costs.**
3) **Finance / funding costs.**
4) **ICC internal costs.**
5) **Legal fees.**
6) **Stakeholder engagement and consequential effects.**
7) **Market escalation costs beyond Q4 2024.**
8) **Assumed all new build options are designed to IL3**
9) **Exclusions listed in above table.**