

Design Development Report – Raft Foundation Option

101 Albert Street, Brisbane

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Report Amendment Register

Issue Ref	Amended Section(s)	Issue/Amendment Details	Author(s)	Reviewer	Date
T01	All	For Tender	Mark Avery	Nicholas Doyle	21 March 2025

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Appendices

Appendix A RBG Structural Raft Drawings

Appendix B Adjacent Existing Building Information and Temporary Shoring Strut RL's

Appendix C EDG Geotechnical Engineering Reports

- Appendix C.1 EDG Geotechnical Report B01493-1BC
- Appendix C.2 EDG Supplementary Report B01493-1BA_RevB
- Appendix C.3 EDG Supplementary Report Updated Shoring Pile Spring Stiffness

Appendix D RBG Proposed Building Loads

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Appendix F Heilig and Partners Vibration Assessment Reports

1. Introduction

1.1 Purpose of Report

This report sets out the structural design solution at 80% Design Development **(80%DD)** based on the alternative raft foundation option, carried out by Robert Bird Group (**RBG**) on the commercial development on Lot 2 Albert Street Brisbane (**101 Albert Street or Project**) for Queensland Investment Corporation **(QIC)**. The report also addresses issues relating to the adjoining Cross River Rail (**CRR**) assets and how the design addresses the imposed site constraints.

The report should be read in conjunction with the Project Movement and Tolerance Report ALB-RBG-REP-ST-00-000-03, Structural Design Brief – Raft Foundation Option ALB-RBG-REP-ST-00-000-04 and RBG Structural Drawings attached in **Appendix A**.

This document is a live document and will be updated throughout the life of the Project. Items highlighted in Red are live items that require close-out. Updates may be proposed by any member of the RBG engineering team. Updates will only be made with the authority of the Project Engineer. At the end of the Project, this document will form part of the RBG record of the structural design.

1.2 Site Details

The proposed 101 Albert Street Development and Project is located on Lot 2 of the Albert Street Station site for CRR. The site is located opposite the proposed Albert Street CRR Station. The site is noted as FOSD Lot 2 on the map below.

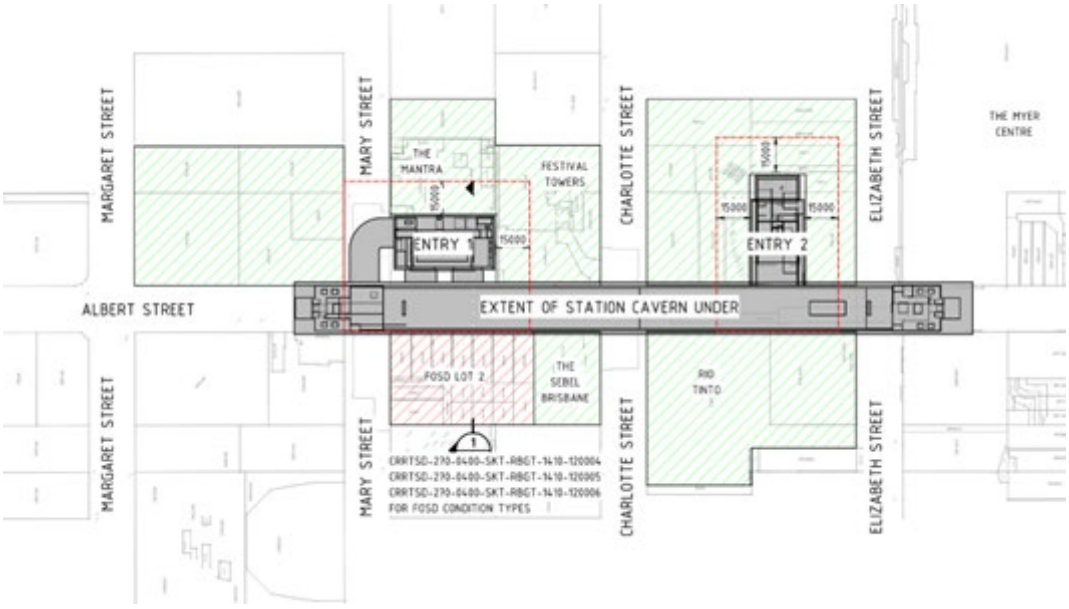


Figure 1 - Site Map

The site abuts the Station Cavern that runs under Albert Street and sits between Mary Street and the Brisbane Sebel **(The Sebel)** development. Two developments abut the Northern boundary, being 110 Mary Street and 119 Charlotte Street. The site 3D view is presented in Figure 2 is taken from the structural Revit model and shows the site during the basement construction stage where the temporary struts and walers are in position to brace the shoring and retention wall.

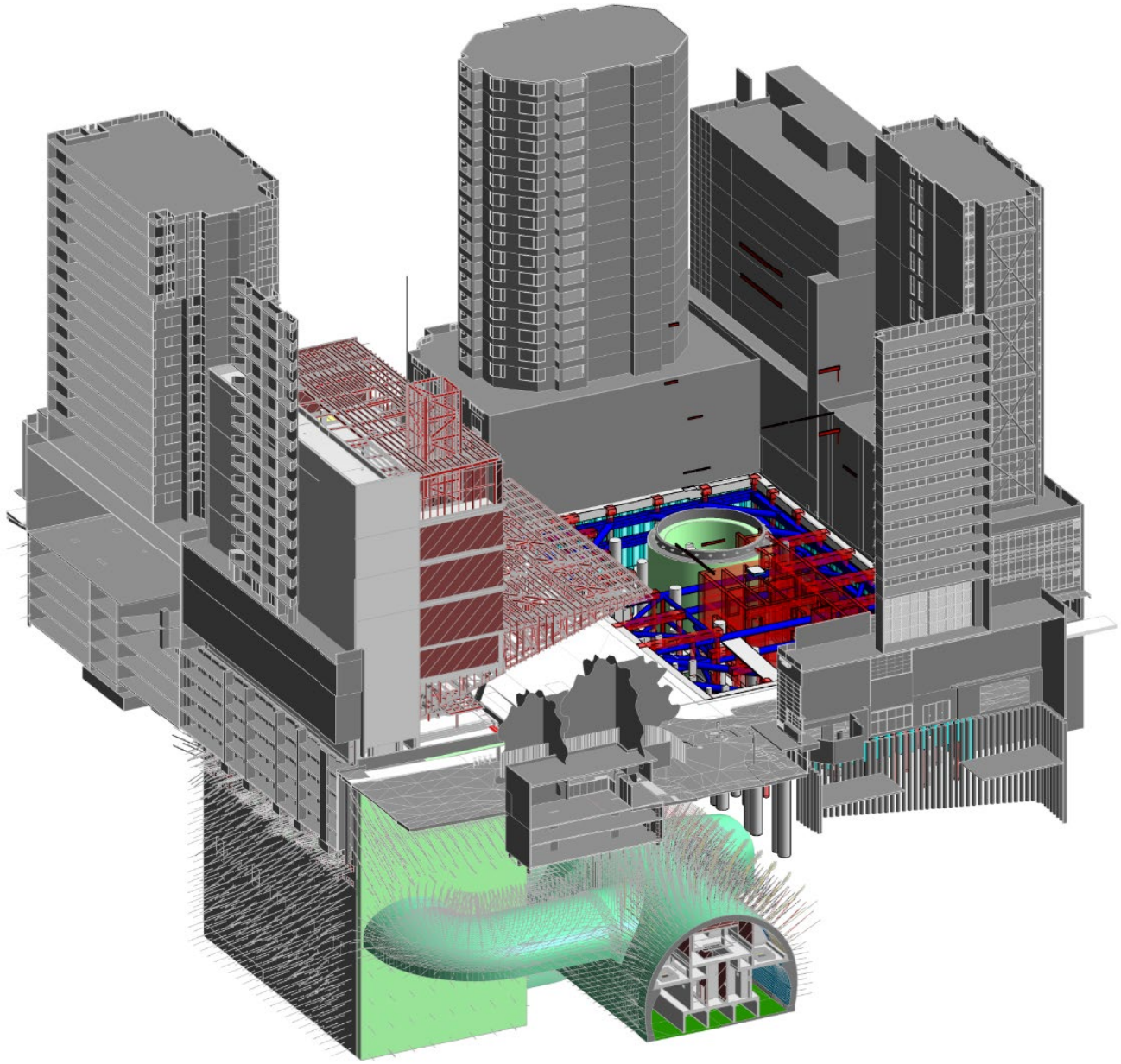


Figure 2 - 3D Site View from Model

Refer to the Structural Design Brief and **Appendix B** for further details on bounding structures and buildings, heritage structures, sensitive inground services and CRR assets.

1.3 Proposed Development

The proposed project development is to comprise of a predominantly commercial tower that will sit above Podium Retail, Amenities and Terraces, and Public Plaza with Basement parking below ground. The building will include three-level underground basement levels over the full site, with B1 containing the Loading Facilities with the balance of B1 and B2 being car parking. A part-size basement level between B1 and Ground will house the End of Trip **(EOT)** facilities. The finished floor level of B2 is currently proposed at RL-5.2m. Figure 3 shows the basic usage of the proposed development.

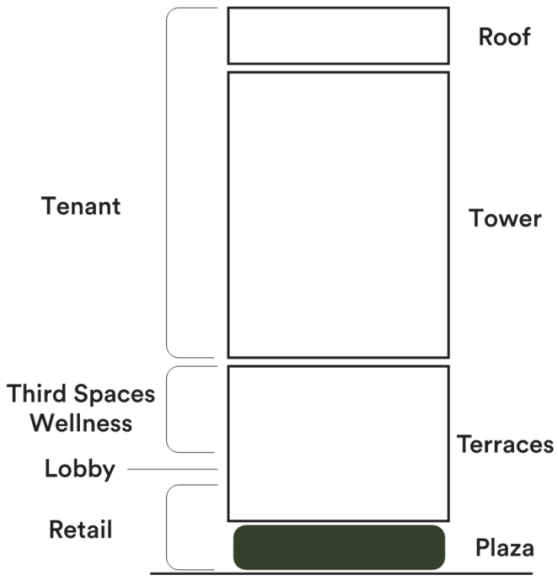
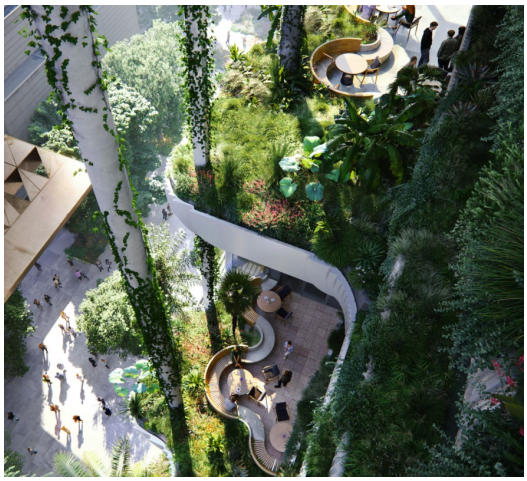


Figure 3 - Proposed Building Stack (By Henning Larsen/Architectus)

The Podium Retail, Amenities and Terraces consist of a mix of internal and external spaces with the external edges continually changing or eroding throughout the height of the terrace floors as illustrated by Figures 4 and 5 below.



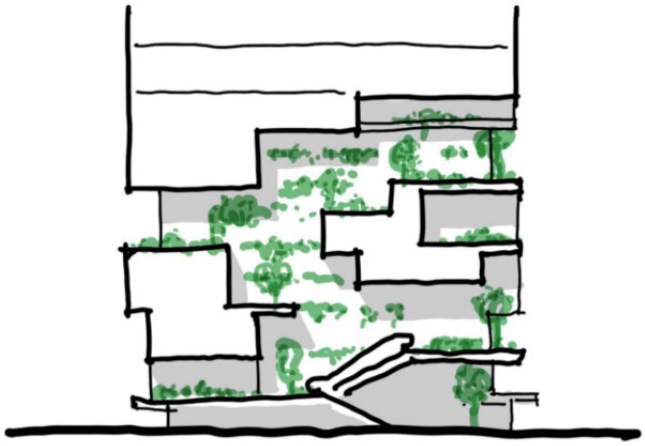


Figure 4 and Figure 5 - Proposed Terraces (By Henning Larsen/Architectus)

The commercial tower will be split into four rises, Low **(LR)**, Mid **(MR)**, High **(HR)** and Sky **(SR)**. Above the SR commercial stack at L38 will be a Destination Rooftop with an external terrace. Plant levels split the LR and MR stacks and the HR and SR Stacks.

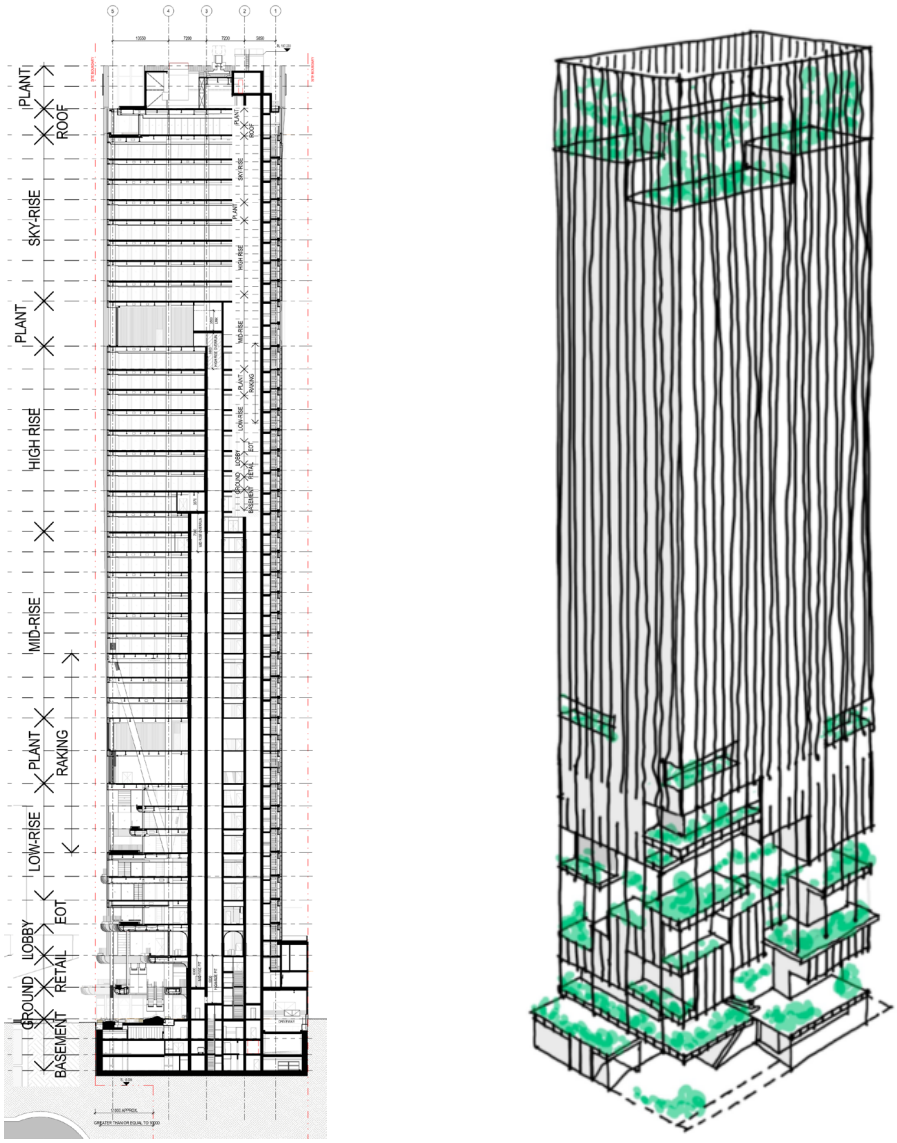


Figure 6 and Figure 7 - Proposed Section and Render (By Henning Larsen/Architectus)

1.4 Proximity to Cross River Rail Assets

As discussed in the Structural Design Brief, there are a number of existing temporary and permanent CRR Assets both within and adjacent to the development site. The below Proximity Diagrams show the approximate as-built locations of the CRR Assets that are to fully or partially remain post-completion of the station and hand over of the Project site to QIC, including the temporary acoustic shed piles, access shaft, adits and CRR cavern against the future development structure based on the current proposed structural solution. The access shaft is proposed to be backfilled with weak mix concrete of less than 10MPa compressive strength prior to hand over of the site. The Proximity Diagrams are based on the access shaft and adits being backfilled with concrete from the base of adits/access shaft to the underside of the proposed foundation and bulk excavation level **(BEL)** with the backfill transitioning to engineered fill or sand above the BEL up to natural ground level/top of the access shaft, to be developed with CRR. The rock bolts and/or anchors to the shaft and adits have not been shown for clarity.

These proximity diagrams have been produced for the proposed B2 finished floor level of RL-5.2m and maximum continuous excavation levels at RL-8m and RL-20m. CRR Assets and the proposed future structure have been shaded with different colours to illustrate their proximity to each other both in the plan and

section. The shaft and adit structure are shaded green; the acoustic shed structure is shaded red; CRR Cavern is shaded aqua, and the proposed development structure is shaded blue.

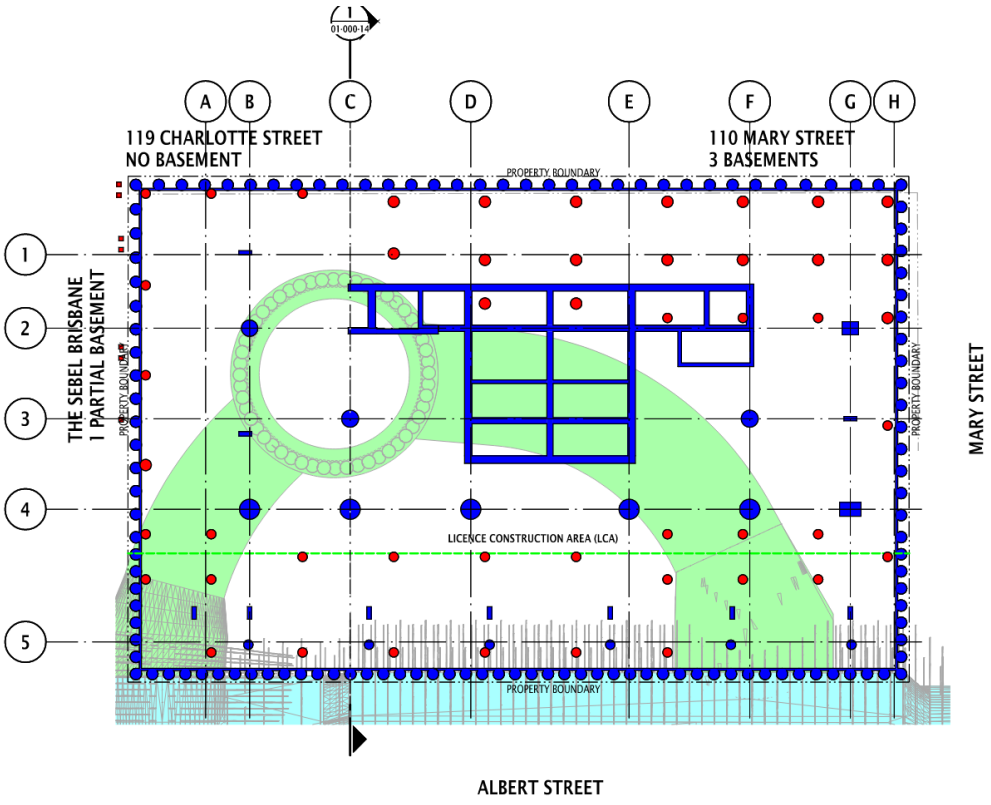


Figure 8 - CRR Asset and Proposed Development Structure Proximity Diagram – RL-5.2m

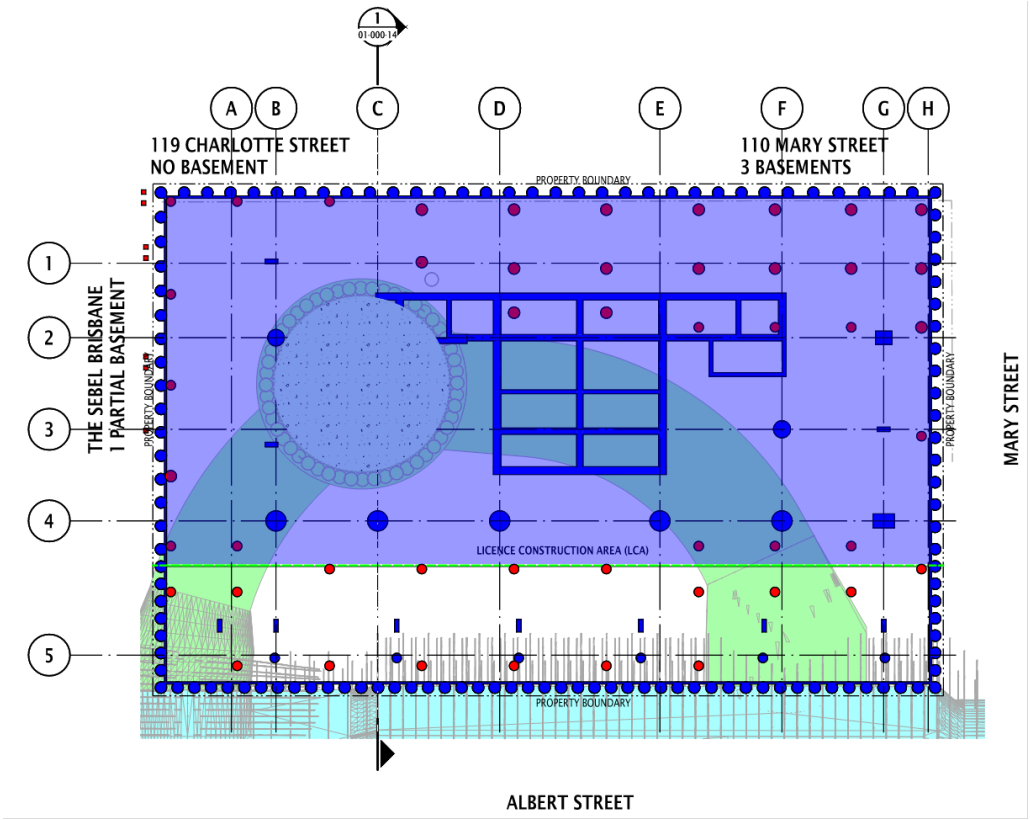


Figure 9 - CRR Asset and Proposed Development Structure Proximity Diagram – RL-8.0m

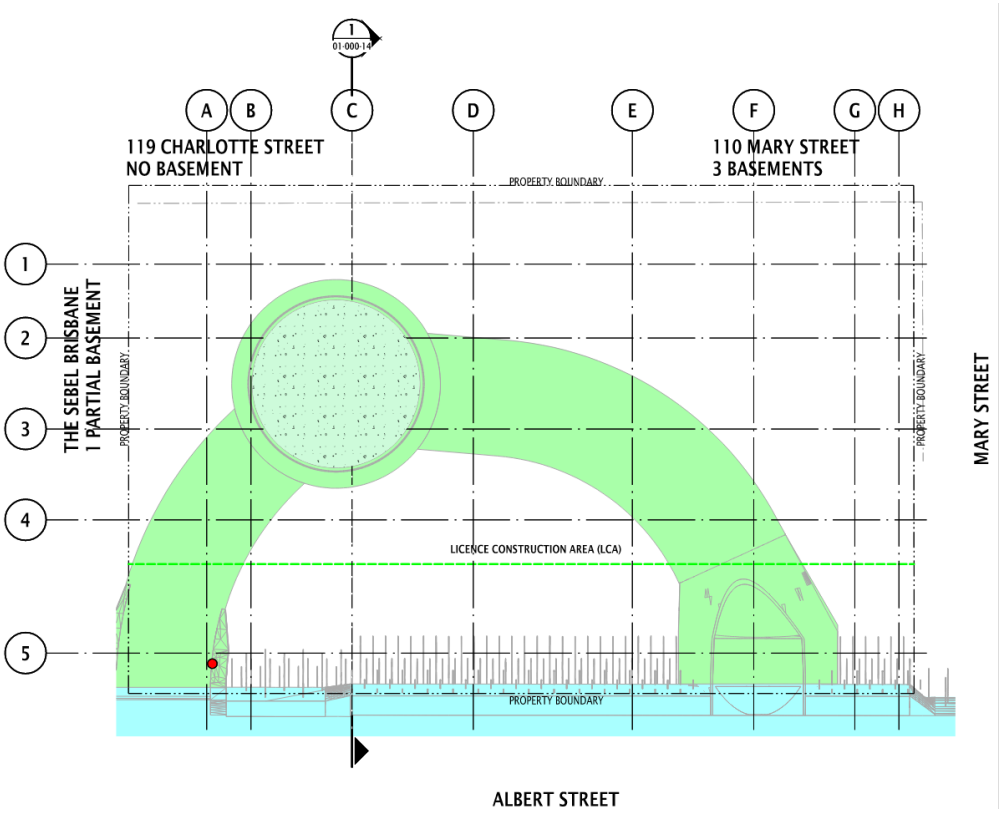


Figure 10 - CRR Asset and Proposed Development Structure Proximity Diagram – RL-20m

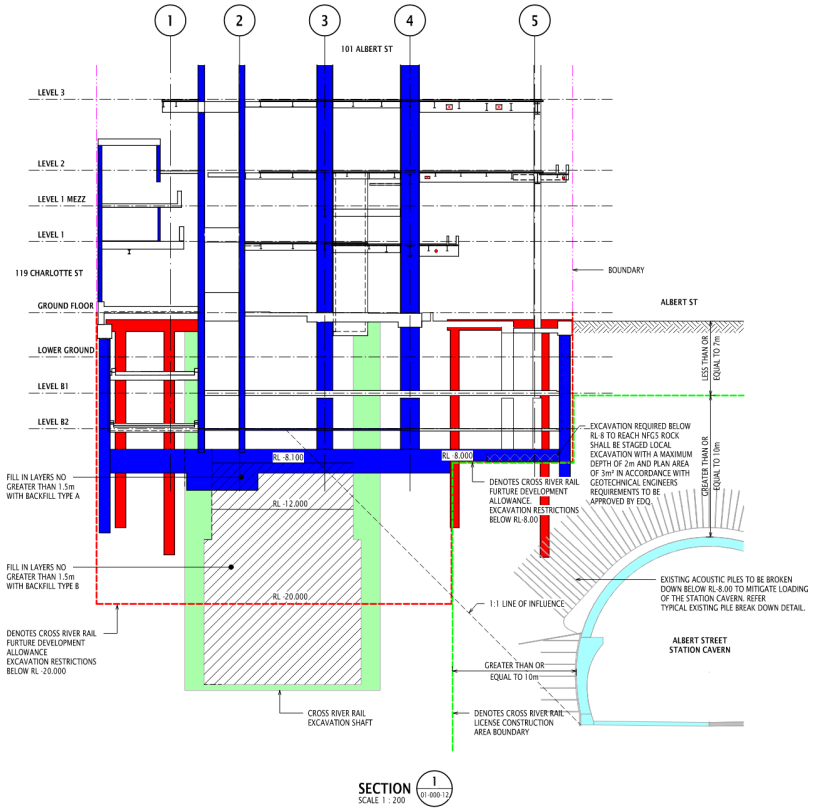


Figure 11 - CRR Asset and Proposed Development Structure Proximity Section

Figure 11 show that the majority of the proposed structure is clear of the CRR acoustic shed piles, provided the piles are demolished down to the bulk excavation levels. We would expect that these piles would be further broken down below the new structure and bulk excavation level to avoid accidental loading.

For the perimeter of the development's basement, there are some acoustic shed piles that clash with the proposed shoring and retention system structure. Further demolition of the acoustic shed piles or coordination of the proposed soldier piles will be required to resolve these clashes.

Given the alternative raft foundation terminates at the bulk excavation level there are no clashes with the adits and anchors, or access shaft provided the shaft is broken down below the bulk excavation level. The proposed shoring and retention system soldier piles to Albert Street terminate above and are clear of the cavern anchors.

2. Referenced Documents

2.1 Structural Design Brief

For reference documents including Standards, Codes, referenced CRR Reports refer to the Structural Design Brief – Raft Foundation Option ALB-RBG-REP-ST-00-000-04.

2.2 Geotechnical Report

EDG Consulting **(EDG)** are the Project Geotechnical Engineers. The Project site, as noted above, is currently fully covered by an acoustic shed as part of the CRR site works. There is also a crane and crane base on the site to facilitate lifting for CRR. There are adjoining buildings on two sides of the site, and the Station Cavern is under construction under the Albert Street frontage of the site. As such, at this stage, the geotechnical input is based on a desktop review of all available existing geotechnical studies in the site proximity. A physical site investigation for verification purposes is proposed when the site is handed over to the applicant.

Refer to **Appendix C** for the EDG Geotechnical Engineering Reports.

2.2.1 Summary of Anticipated Ground Conditions

Based on available geotechnical investigation data, as referenced within the EDG Geotechnical Engineering Report, the general geological stratigraphy below the site includes potential uncontrol or controlled surface fill material and/or soft to firm alluvium underlain by residual soils overlying various Neranleigh-Fernvale Group **(NFG)** weathered rock.

Based on the geotechnical cross sections developed by EDG, extremely weathered rock **(NFG5)** is expected at approximately RL-6.5 with potential localised areas of residual soil. Medium strength rock **(NFG3)** rock is expected between RL-15 and RL-10 and high strength rock **(NFG2/1)** below RL-15.

Two of the interpreted geotechnical sections from the EDG Report have been shown below for reference. The section in Figure 12 is cut along the site boundary, looking towards The Sebel. The top of the NFG5 looks to be highest on the development site closest to Albert Street and then gradually drops away moving from the Albert Street elevation towards the 110 Mary and 119 Charlotte boundaries.

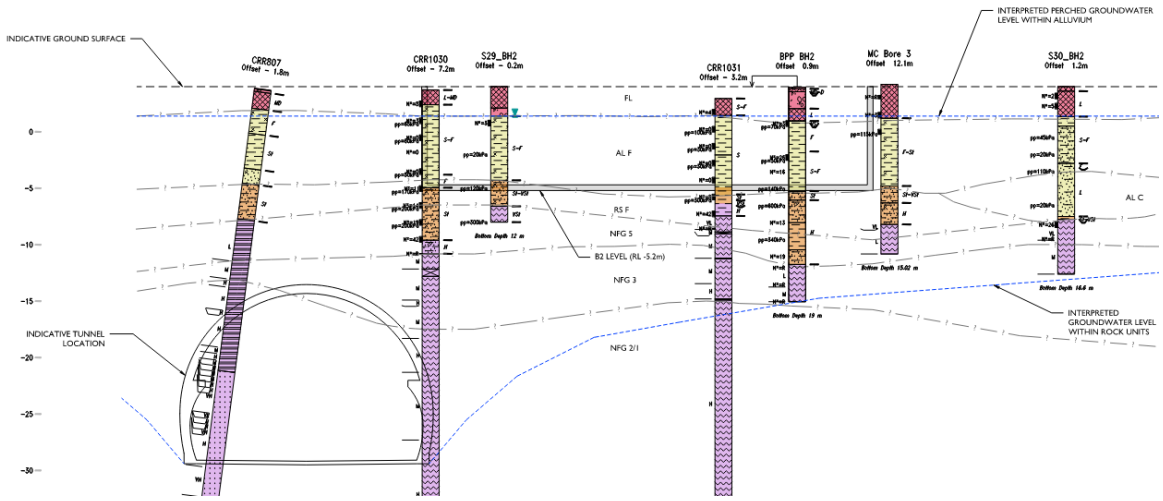


Figure 12 - EDG Interpreted Geotechnical Section B – Looking towards The Sebel

The section in Figure 13 is cut along the Albert Street boundary looking towards the CRR Cavern. This section indicates a localised soft spot were the top of NFG5 drops away to the north-west corner of the site adjacent Albert Street and The Sebel. Further boreholes to this area will be critical to determine if this is the actual rock profile.

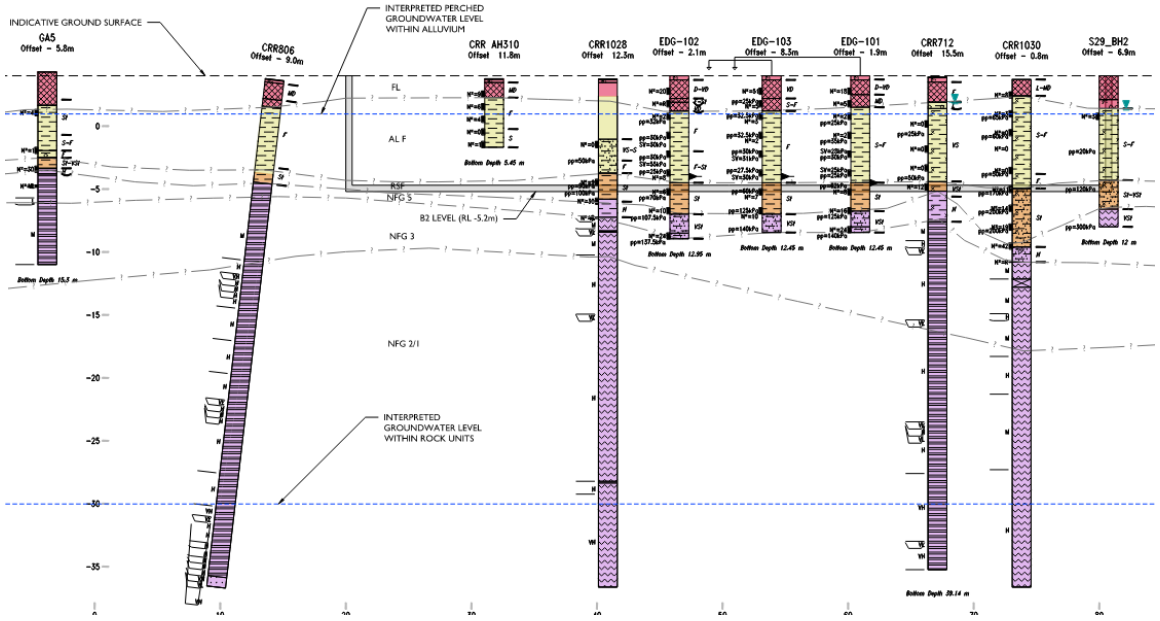


Figure 13 - EDG Interpreted Geotechnical Section D – Looking towards Albert Street

A verification stage geotechnical investigation is proposed once access to the site is obtained for drilling and testing.

2.2.2 Anticipated Groundwater Conditions

Groundwater levels taken from available geotechnical engineering boreholes indicate groundwater levels within the rock are quite variable across the site and are typically below the lowest proposed development Basement B2 level with anticipated levels between RL-5m to RL-10m.

Based on available CRR groundwater information and Albert Street cavern being permanently drained, EDG has advised that the typical long-term groundwater level within the rock units is expected to be drawn down

to approximately the cavern drainage level with the groundwater level increasing away from the cavern as indicatively shown in Figure 14 below.

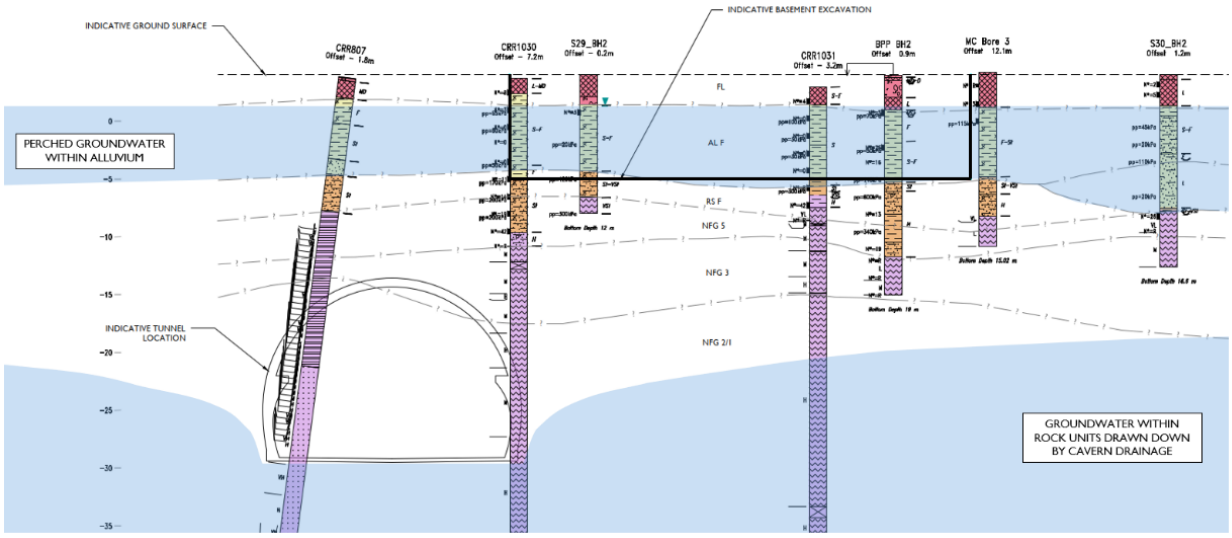


Figure 14 - EDG Conceptual Groundwater Conditions – Looking towards The Sebel

No groundwater information is currently available for the upper Fill and Alluvium layers however EDG have advised that it is likely there will be a perched groundwater as illustrated by Figure 14. A detailed groundwater assessment is required to confirm the current shoring system, basement waterproofing strategy and detailing, and basement slab drainage. Consideration is to be given to the basement design and whether it is to be a full or partial hydrostatic basement. For context, the basement treatment to adjacent 110 Mary, Festival Towers, and CRR station have drained basement systems. The adjacent Sebel building has a partial single-tanked basement.

Based on the above, a water-resistant shoring wall is proposed around the perimeter of the basement to control groundwater infiltration into the basement, combined with a drained raft foundation. Water below the raft is proposed to be collected via a subfloor drainage system. The subfloor drainage system will be designed by the Hydraulic Engineer based on inflow rates provided by the Geotechnical Engineer. EDG undertook preliminary analysis of three seepage scenarios to determine a range of potential approximate inflow rates with these ranging from 0.5ML/year to 1.5ML/year.

Further, advice from the Geotechnical Engineer is required on the extent of groundwater seepage along with additional investigations following the demolition of the existing basement slab/end of the bulk excavation, at which time pumps and sumps can be appropriately sized and located. The drainage system is to be designed with an effective means of access for inspection, cleaning, and maintenance.

A verification stage geotechnical investigation is proposed once access to the site is obtained for drilling and testing.

3. Structural Elements and Materials

The general structural elements and materials adopted during 80%DD are summarised below. The tower is framed from conventional reinforced concrete **(RC)** from foundation level to and including the Ground floor. At Ground floor, the columns transition to concrete-filled tubes **(CFT)**. The floor framing to levels above Ground are composite steel with RC slabs on metal formwork. The core is conventional reinforced concrete.

The detailed breakdown of elements and materials can be found in the Project Structural Drawings and Specifications.

Table 1 - Structural Elements and Materials

Element	Material	Details
Retention System	Holcim ECOPact 50MPa Concrete with Elastic Modulus E = 34,500MPa to 42,000MPa*	Retention piles are typically 900mm diameter soldier piles with concrete infill shotcrete panels to be confirmed by D&C once additional geotechnical investigations have been complete
Temporary Walers and Struts	Grade 400 Welded Beams and Grade 350LO Tubes	Twin 1200WB455 Walers and 914x19CHS Struts to be confirmed by D&C
Capping Beam	Holcim ECOPact 50MPa to 80MPa Concrete with Elastic Modulus E = 34,800	Mix of 1200mm to 1550mm deep capping beams to the top of the shoring and retention walls
Raft Foundation	Holcim ECOPact 80MPa Concrete with Elastic Modulus E = 37,400MPa to 47,000MPa*	Mix of 1000mm to 2000mm thickness. Temperature control measures will be required
RC Slabs and Beams	Holcim ECOPact 40MPa Concrete with Elastic Modulus E = 32,800MPa	Varying thicknesses
Composite Slabs	Holcim ECOPact 32MPa Concrete with Elastic Modulus E = 30,100MPa	Slabs reinforced with D500N deformed bars and mesh and poured on Condeck Metal Tray permanent formwork
Steel Floor Beams	Grade 300 Hot Rolled, Welded and Custom Welded Sections.	Varying sizes
CFT Columns	Grade 350 CFT Hollow Section and mix of Holcim ECOPact 50MPa to 100MPa Concrete with Elastic Modulus E = 34,800 to 42,200MPa	Mix 600mm to 1600mm diameter columns
RC Columns	Mix of Holcim ECOPact 50MPa to 100MPa Concrete with Elastic Modulus E = 34,800 to 42,200MPa	Varying rectangular and circular sizes
RC Core	Mix of Holcim ECOPact 40MPa to 100MPa Concrete with Elastic Modulus E = 32,800 to 42,200MPa. Walls with 50MPa high E = 42,000MPa*.	Varying thicknesses from 200mm to 600mm

Holcim green concrete mixes with cementitious replacement have been considered to meet the Environmental Sustainability Design **(ESD)** targets of the Project. Holcim supplies multiple mixes based on standard or premium aggregate and admixtures with the premium mixes able to achieve lower shrinkage and higher elastic modulus values. From Table 1, the Elastic Modulus value (denoted by *) indicates a premium mix offering.

Typically, where possible, structural steel from local suppliers such as Bluescope, Infrabuild and Liberty have been adopted during 80%DD. The extent and specification of fire rating and paint systems is discussed in the Structural Design Brief.

4. Proposed Structure

To respond to the CRR Cavern design criteria, the tower has been designed to minimise weight, locate and shift heavy loaded vertical elements, including tower columns and corebox, away from Albert Street, CRR Station Cavern, and outside of the RL-8m maximum continuous excavation zone where deeper bulk excavation is possible. Only light-loaded Podium and Basement columns have been located adjacent Albert Street. This vertical structure is illustrated in Figure 15 with the different structure shaded varying colours - tower columns (blue), corebox (red), podium columns (turquoise), basement columns (green), retention system (pink) and foundation (grey).

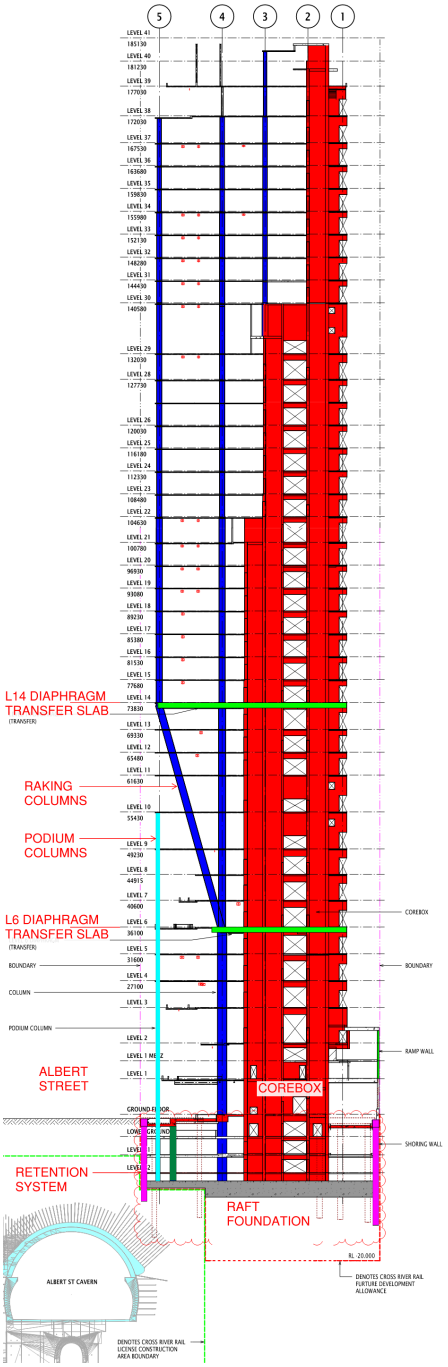


Figure 15: Typical Structural Stacking Diagram

4.1 Shoring and Retention System

The proposed basement is to be constructed with shoring and retention of the basement elevations in the temporary and permanent conditions. The shoring and retention system **(retention system)** shall be designed to limit lateral movements to all site boundaries in the temporary condition, provide stability to the required basement excavation and adjacent existing buildings, and control groundwater infiltration until the basement construction is completed. Groundwater is assumed to be drained and collected from behind the retention wall during construction. The retention system shall also be designed for the permanent condition to resist the boundary surcharges, groundwater and flood loads and basement and podium vertical and lateral loads. The proposed movement criteria for the retention system are summarised in the Structural Design Brief and Movement and Tolerance Report. The effect of vertical ground movement on finished levels will need to be assessed during the later stages.

The retention system shall be designed in accordance with the reference documents listed in the Structural Design Brief, together with other relevant Australian Standards. The flood condition is to be based on the full hydrostatic load during the permanent condition, once construction is complete, with the water level at the adopted Project design flood level of RL5.5m (RL5.2 AEP100 + 300mm freeboard).

The alternative raft foundation arrangement is to be connected into the retention system on all boundaries. The retention system loads provided to EDG are based on no interaction with the raft and soil and rock strata. Distribution of load between the raft and retention system is to be assessed with the structural and geotechnical raft models.

RBG has provided the proposed retention system and building loads for permanent and transient load cases to EDG for inclusion in the retention system assessment modelling. These included both vertical and in-plane lateral loads for the retention system and vertical loads for the columns. A summary of the proposed building loads has been attached in **Appendix D**. RBG requested that all loads are increased to include a contingency of 10% to allow for any unknowns or minor changes during the final design development stage.

The briefing to EDG on the details of bounding buildings and basement conditions is attached in **Appendix B**. This information was developed based on available existing building information and needs to be verified prior to the commencement of construction. Included with this information is the Project basement arrangement with key basement sections showing the proposed temporary and permanent structure, vertical spans between Ground and Basement slabs, double height through the loading dock, ramps etc.

The retention system is proposed to comprise bored cast-in-place reinforced concrete piles. Currently, 900mm diameter soldier piles have been investigated to the Albert Street, Mary Street and 119 Charlotte Street/110 Mary Street basement elevations at 1800mm centres with a reinforced concrete capping beam cast at Ground level to tie the tops of the piles together and to allow for transitioning between podium perimeter structure and the retention system. There is a provision for localised additional soldier piles to the north-west corner due to the potential presence of weaker material which is to be confirmed during additional geotechnical investigation works. Figure 16 illustrates a typical section taken perpendicular to Albert Street through the basement with the retention system wall shown turquoise (Albert Street) and purple (110 Mary Street/119 Charlotte Street existing building).

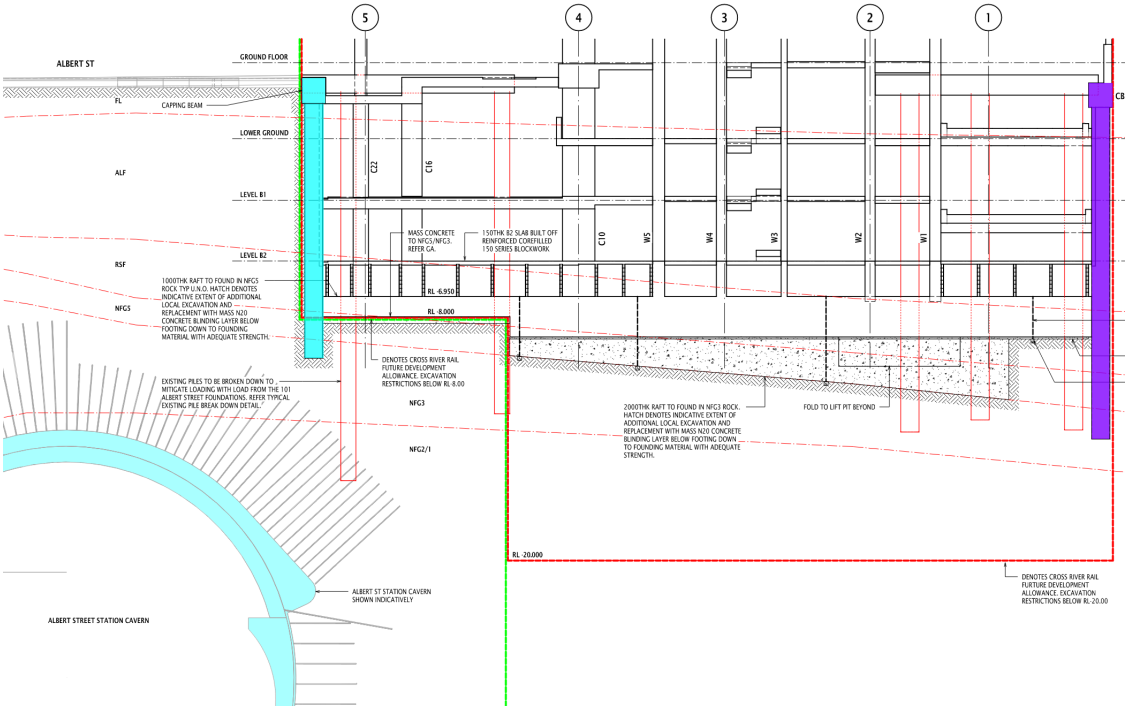


Figure 16 - Basement Section Perpendicular to Albert Street with Permanent Retention System highlighted

Final set out of piles is to be reviewed against existing inground structure and results of the additional geotechnical investigations. A permanent reinforced concrete infill shotcrete wall shall be constructed progressively between the soldier piles extending vertically from the soffit of the capping beam to the bulk excavation level or base of raft foundation. Geotechnical engineer to confirm maximum excavation lifts. Water pressure behind the retention wall is to be released during construction of the basement.

Primary and secondary waterproofing measures are proposed to the shoring wall joints to minimise water and moisture ingress as illustrated below in Figure 17. The specification of the concrete mix and reinforcement to the shoring system has been uplifted to mitigate risk of corrosion due to potential acid sulphate soil **(PASS)** that could be present in the alluvial layer to be confirmed by Environmental and Geotechnical Engineers.

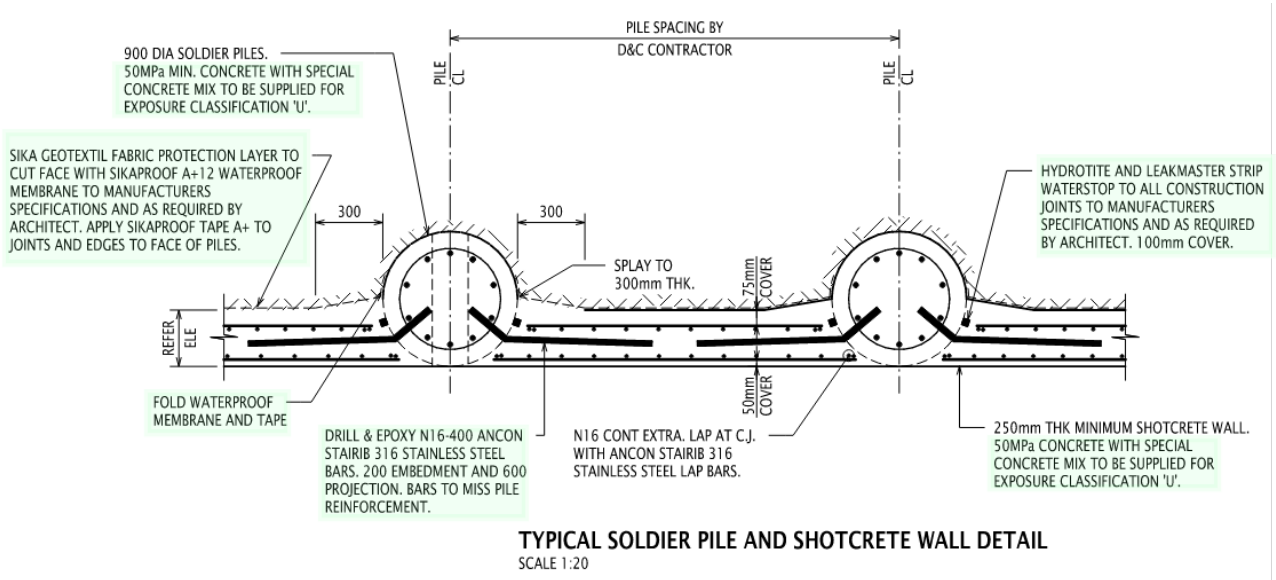


Figure 17 - Proposed Shoring Wall Typical Detail

The retention system is to be temporarily supported by internal struts and waler beams during construction. The potential strut elevation options that minimise clashes between permanent structure and the temporary walers and struts was produce based on the 80%DD basement levels, slab and beam thicknesses, and struts with a maximum diameter of 914mm. The strut elevation options are shown in turquoise below in Figure 18 and in **Appendix B**.

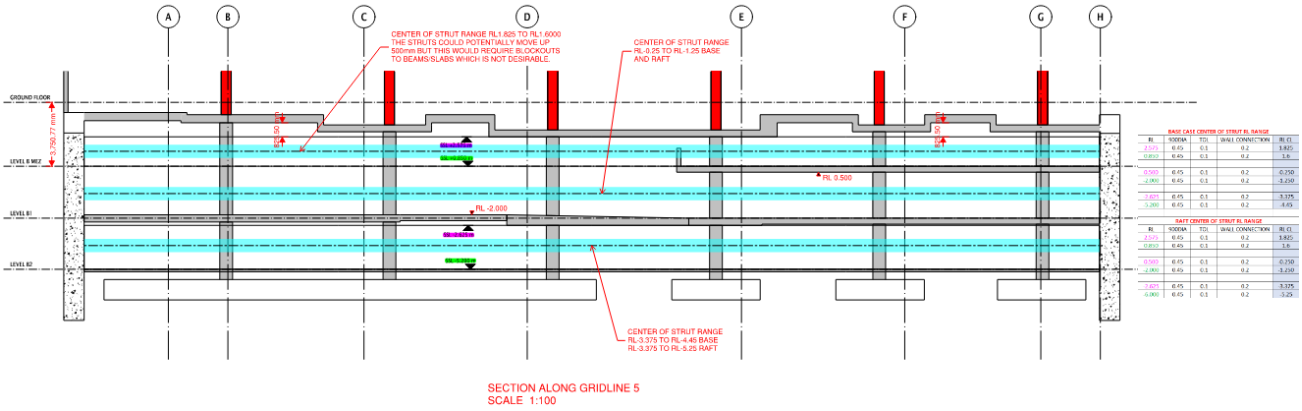


Figure 18 - Potential Temporary Strut Elevation Options

RBG have developed a concept for the temporary struts and walers as illustrated in Figure 19 consisting of the upper and lower strut elevation options. The waler beams consist of twin 1200WB455 welded beam 'I' sections orientated with the web laying horizontal in combination with the 914x19CHS struts. Some temporary vertical and horizontal bracing bays may be required to break down the spans of the longer struts and waler beams as illustrated below. To avoid locally increasing the waler beam horizontal bracing bays are proposed for 110 Mary Street and Albert Street elevations for the extent of the larger strut spacings adjacent to the corebox. The two longer struts located through the corebox are to have temporary plunge columns with two vertical bracing bays to reduce the strut's effective lengths. The plunge columns are proposed to be cast into the corebox bored piers.

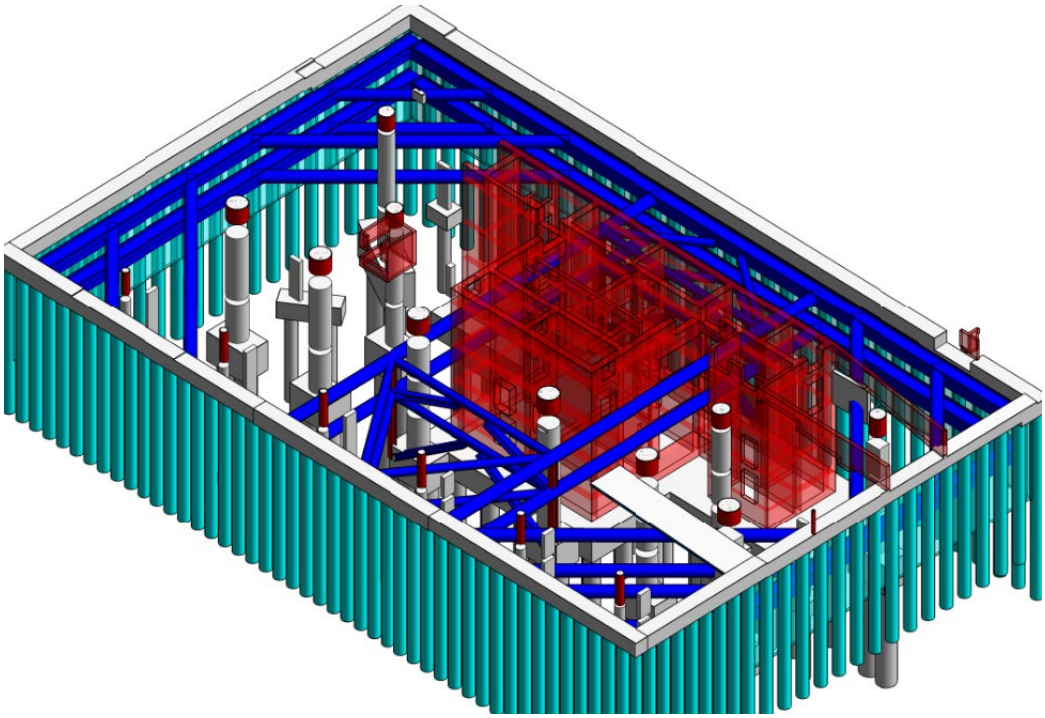


Figure 19 - Indicative Retention System 3D

The two longer struts located through the corebox have been set out in plan to approximately align with door openings/lintels that connect the main high-rise lift cell to the end goods lift and retail lift cells. This allows the corebox to be potentially split into three boxes through the basement levels to allow for the jumpform core construction to occur around the temporary struts. Other temporary strut and waler arrangements and basement construction methodologies such as top-down could be investigated by the Contractor during later design stages once the final shoring and retention designer has been engaged.

The geotechnical engineer and retention system designers are to advise the degree of pre-loading for the struts to achieve the design displacement. Steel struts to be externally insulated to reduce thermal effects.

The retention system, including the temporary struts and walers, is to be delivered by a Design and Construct **(D&C)** methodology with the main Contractor.

4.1.1 Retention System Modelling and Results

EDG have modelled and analysed six sections around the perimeter of the basement to capture the varying conditions, as illustrated in Figure 20 with sections marked S1 to S6. These sections were used to determine structural actions in the soldier piles under lateral and vertical loads, retention system deflections, number of horizontal strut layers, temporary prop and permanent slab axial loads, the soldier pile sizes/centres, toe depths and vertical springs.

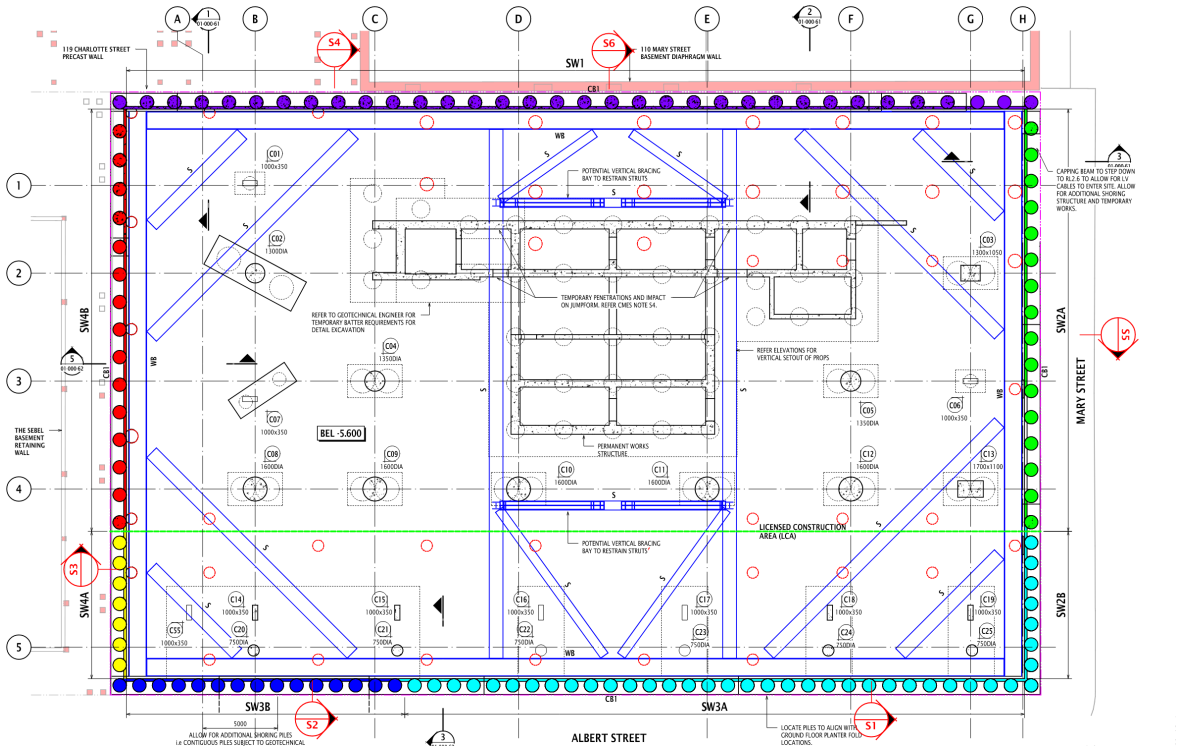


Figure 20 - Retention System General Arrangement Plan

This analysis is 2D and based on the available rock level information, RBG retention system and tower loads, briefing information on the adjacent buildings and basement conditions, temporary strut elevation options, RBG initial temporary strut and waler sizes, and the deflection criteria set out within the Structural Design Brief and Movement and Tolerance Report.

The soldier pile concrete material properties adopted in the analysis model are based on the Holcim standard 50MPa concrete mix with Elastic Modulus Ec = 34,500MPa. This mix can also be supplied as a premium mix with Elastic Modulus Ec = 42,000MPa. Based on this, we have up to 22% contingency if we need to make the soldier piles stiffer based on the current thicknesses and reinforcement. The piles have currently been

cracked to 70%EI for the ultimate limit state **(ULS)** condition. Moment rigidity between Ground/Basement slabs to soldier piles and the horizontal structure thickness has not been considered at this time.

The construction stages adopted for the retention system design and temporary strut levels are discussed in the EDG Report.

The summary of key results from the EDG analysis are as follows:

a. Adopted pile capacities and values of ultimate skin friction and ultimate end bearing have been taken from the EDG report and presented below.

Table 5 – Ultimate Pile Design Parameters

Material	Fs, Ultimate Skin Friction (kPa)	Fbu, Ultimate End Bearing (MPa)
Residual Soil	50	N/A
NFG 5	75	N/A
NFG 3	700	15
NFG 2/1	1300	25

Figure 21 - EDG Ultimate Pile Design Parameters

b. The analysis results indicate that the soldier piles need to be socketed into a mix of NFG5 and NFG3 rock as summarised in the retention system general arrangement plan shown in Figure 20.

   The following proposed pile toe depths and socket requirements (with reference to Figure 20): red denotes RL-12m to RL-13m with 1m embedment into NG3 (pile ultimate strength 7,627kN) purple denotes RL-14m with 1m embedment into NFG3 rock (pile ultimate strength 8,270kN) green denotes RL-10m to RL-11m with 1m embedment into NFG3/5 rock (pile ultimate strength 882kN to 7,627kN) turquoise and sage denotes RL-10m with 2m embedment into NFG3 rock (pile ultimate strength 8,776kN) navy blue denotes RL-10m with 1m embedment into NFG5 rock (pile ultimate strength 974kN) yellow denotes RL-10m with 2m embedment into NFG5 rock (pile ultimate strength 1,020kN).

   The turquoise, sage, navy blue and yellow extents (with reference to Figure 20) require a toe depth of RL-10 to facilitate the deeper bulk excavation level required for the raft foundation arrangement and to allow socketing into NFG5 to the north-west corner.

c. The piles and vertical spring stiffnesses for the retention system piles have been included in the raft foundation model and discussed in Section 4.3.

d. The long-term out-of-plane deflections of the retention wall for a non-flood condition are generally in accordance with the RBG deflection critieria except for the retention wall to Section 2 in the north-west corner where a maximum deflection of 19mm was measured against the RBG set limit of 15mm. The deflection exceeds the proposed critiera between RL-2m and RL-9m.

e. Based on piles at 1.8m centers the maximum unactored bending moment and shear force for the short-term scenario occur at Section 6 during the final excavation with perched water pressure at 725kNm/m (1,305kNm/pile) and 409KN/m (736kN/pile), respectively.

f. Based on piles at 1.8m centers the maximum unactored bending moment and shear force for the long-term scenario occur at Section 6 during the flood condition at 843kNm/m (1,517kNm/pile) and 481KN/m (865kN/pile), respectively.

g. The maximum unfactored working axial load in the temporary struts occurs in the lower strut at Section 5 at 4,356kN (load taken perpendicular to the wall). Based on the strut angle this load produces a resultant axial load of approximately 6,227kN through the strut. The strut has an axial capacity in the order of 10,000kN based on the strut's effective length.

h. The maximum unfactored working axial load imposed on the ground and basement slabs/raft based on the normal permanent condition occurs at Section 4 to Level B1 at 427kN/m. Based on a minimum 350mm thick slab this produces a compression force **(P/A)** of 1.22MPa.

i. The maximum unfactored working axial load imposed on the ground and basement slabs/raft based on the flood event condition occurs at Section 6 to Level B2 at 710kN/m. Based on a minimum 200mm thick slab this produces a P/A of 3.55MPa.

The results above generally indicate that the proposed retention system concept and design is viable.

As per Item d. the analysis does show an extent of retention wall exceeding the RBG proposed lateral deflection criteria limits. EDG note that this is due to the local zone of weaker material to the Albert Street north-west corner which will be better defined following completion of additional geotechnical investigation works. Further analysis to allow for detailed geotechncial information, 3D modelling to account for two-way action to retention wall corners, soldier pile to Ground/Basement slab connection rigidity, and final temporary strut and waler arrangement.

Serviceability and ultimate limit state cracked properties for the retention system are to be reviewed based on the final retention system solution. Further testing of the lower temporary strut elevation and potential additional struts to be undertaken in further design stages.

If required, there is also provision for additional piles to the north-west corner and increasing the concrete Elastic Modulus to increase the retention system stiffness.

Other construction methodologies and/or shoring and retention wall systems are to be investigated by the team once the Contractor has been engaged and geotechnical, groundwater, and the PASS investigation has been completed and can be used to inform the end design. Construction methodology and erection sequence loads are to be developed once the Contractor is engaged.

4.2 Basement Excavation

Post installation of the retention system, alternating staged demolition and excavation will be required across the site footprint to create the new BEL to accommodate the proposed basement and foundation system. Excavation will be undertaken using varying construction activities including excavators and hydraulic hammers. The demolition works will be required to break down the existing inground structure as discussed in Section 1.4. The size of machines used to demolish inground structure and excavate through residual soils and rock will need to be controlled to achieve vibration criteria for the adjacent buildings, heritage, S1 sewer and CRR infrastructure.

The proposed BEL as presented in Figure 22 has been determined by the foundation arrangement and blinding layer requirements and will be stepped with two benches at RL-8m and RL-8.95m, shown green and pink below, respectively. This approach ensures the bulk excavation complies with the RL-8m maximum continuous excavation level constraint.

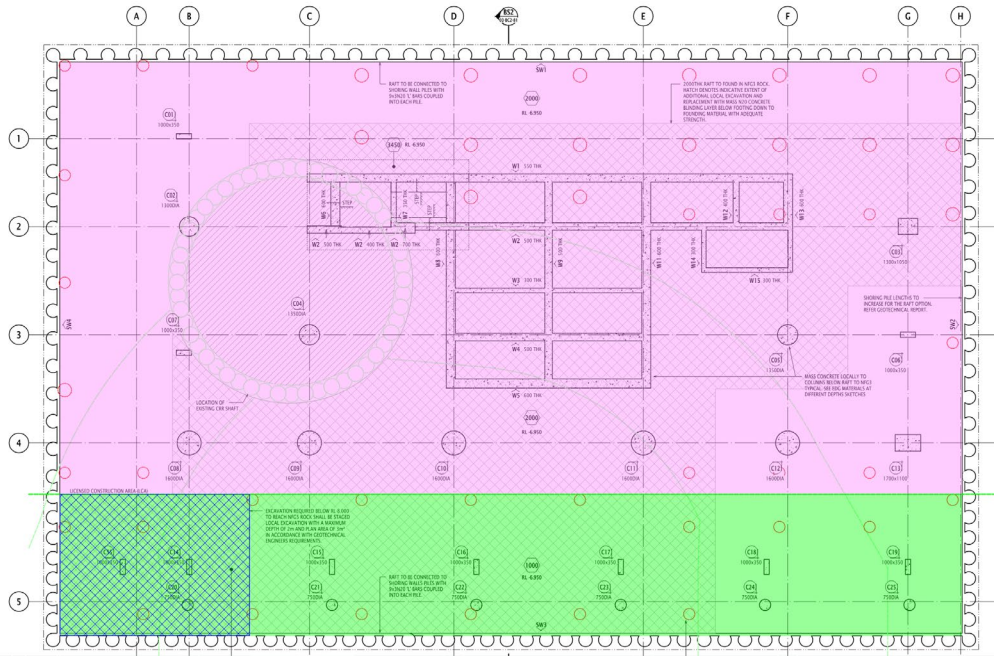


Figure 22 - Proposed Bulk Excavation Diagram

Detailed excavation will be required for the in-ground services, localised set down to the raft to accommodate the goods lift pit and potential trenches to house hydraulics. Other detailed excavation is expected to ensure the foundations are supported by suitable rock. This will involve controlled excavation of existing materials down to NFG5 and NFG3 rocks, as required by the Geotechnical Engineer and replacement with N20 mass concrete back up to the underside of the foundation.

Existing interpreted geotechnical borehole information indicates a local zone of weaker material to the Albert Street north-west corner illustrated by the hatched extent in Figure 22. Due to this, there may need to be ground improvement works to the base of the raft in this area consisting of controlled localised excavation, and replacement with N20 mass concrete. Where this work is required within the RL-8m maximum continuous excavation zone and below RL-8m, it is proposed to be undertaken in stages with a maximum excavation depth of 2m and plan area of 3m2 under Geotechnical Engineer's direction. This detailed excavation restriction is to mitigate unloading.

The extent of additional detailed excavation for the hydraulic drainage and encountering sufficient rock to support the foundation is to be confirmed by the Geotechnical and Hydraulic Engineers following geotechnical investigations.

Further to above, additional demolition and detailed excavation is proposed to the tops of the existing acoustic shed piles below the new foundation as illustrated in Figure 23. The removed pile and material will be replaced with an engineered backfill material to be confirmed by the Geotechnical Engineer. The removal of the tops of the piles is proposed to mitigate stiff points below the new foundation and accidental loading of the existing piles some of which terminate above and in close proximity to the CRR cavern.

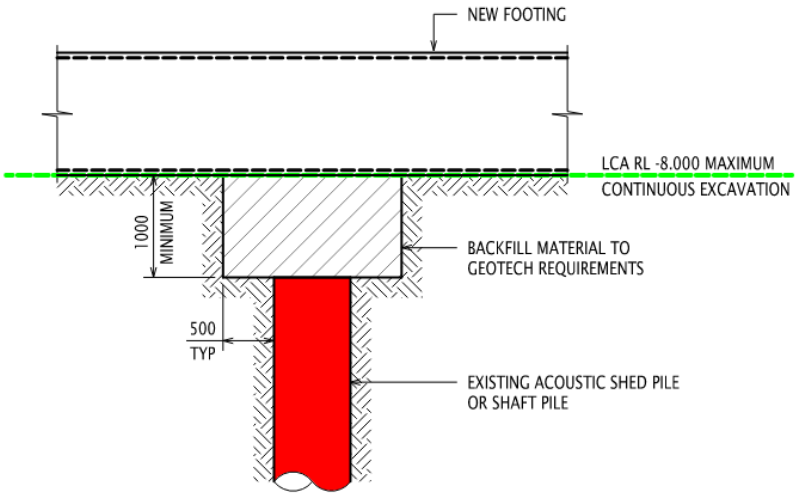


Figure 23 - Proposed Detail to Break Down Existing Piles

4.2.1 Vibration

Heilig and Partners are the Project Vibration Consultant. To investigate the approximate vibration levels and impacts due to the proposed Project construction activities and develop mitigation methodology, a site-specific construction phase vibration assessment has been undertaken by Heilig and Partners. The aim of this study was to confirm vibration and noise effects on the CRR cavern, neighbouring buildings, heritage buildings, inground services, and adjacent sensitive S1 Sewer, at varying elevations, are within acceptable limits. Critical construction activities considered are associated with bulk excavation, demolition of inground structure, installation of retention system piles through geological strata and concrete backfilled shaft and adits. Conservatively the shaft has been assumed to be backfilled with 20MPa concrete to ensure the vibration assessment is based on worst case scenario.

Based on this work three reports were produced including a Structural Monitoring and Vibration Report **(SMVR)** to ensure the condition of adjacent buildings, heritage buildings, and sensitive services are maintained; a Track and Structures Monitoring Report **(TSMR)**, which is similar to the SMVR but specific to the CRR infrastructure; and vibration effect from piling associated with the raft foundation report.

Refer to **Appendix F** for the Heilig and Partners Vibration Engineering Reports.

The key aspects and outcomes of the vibration assessment relevant to the raft foundation option are as follows:

a. The vibration modelling was based on bored and vibratory piling, and basement excavation with varying size hydraulic hammers ranging from 2tonne to 7tonne and a 35tonne excavator.

b. Vibration from the soldier piling works required for the raft foundation option are compliant with all adjacent building, S1 sewer and CRR Infrastructure vibration criteria.

c. Excavation with the 35tonne excavator produces smaller levels of vibration than the other considered construction activities with the 7tonne hydraulic hammer being critical.

d. Excavation with the 7tonne hammer looks to be feasible with low levels of vibration to adjacent buildings, heritage, and services including the S1 sewer. The maximum vibration at the closest heritage building is 3mm/s from the worst considered construction activity. The vibration at the S1 sewer is less than 10mm/s.

e. Locally reducing the size of the hydraulic hammer to key areas will assist in reducing vibration levels.

f. Excavation with the 7tonne hammer looks to be feasible with low levels of vibration to adjacent CRR infrastructure with the vibration at the CRR cavern lining and tunnels less than 10mm/s and 5mm/s, respectively.

g. Demolition activites could produce potential elevated levels of vibration to be assessed once Contractor input is available and confirmation of the demolishion methodology is confimred.

Further modelling will be required once the final construction methodology and activities are confirmed. The S1 sewer vibration criteria are to be confirmed with Queensland Urban Utilities **(QUU)**.

4.3 Foundation System

4.3.1 Raft

The key constraints the foundation needs to respond to include the excavation, vibration and loading limitations, variable founding materials and buried inground structure.

In response to the constraints, an alternative proposed foundation system was developed that consists of a reinforced concrete raft that extends across the basement between the internal faces of the retention system walls to support the columns, corebox and basement B2 loads. The raft edges will be connected to the retention system piles. The raft design has been developed as an alternative to piles to minimise construction activities through and around buried inground infrastructure, minimise differential settlements, and to spread foundation loads over a larger area.

The raft foundation thickness has been tailored to suit the tower load distribution and excavation constraints with a thickness of 1m across the RL-8m maximum continuous excavation level zone and a thickness of 2m outside of this zone as illustrated in Figure 24 (grey shaded extent). The plan position of the raft soffit step has been coordinated with the vertical LCA boundary line with the upper and lower bench excavation levels of RL-8m and RL-8.95, respectively.

The 1m and 2m thick raft extents are to be typically found in NFG3 and NFG5 rocks. A minimum 50mm concrete blinding layer and hydraulic drainage in the form of trenches is proposed below the raft. If the rock at the underside of the raft is not suitable then localised excavation and replacement with N20 concrete will be required down to the top of NFG3 and NFG5 rock.

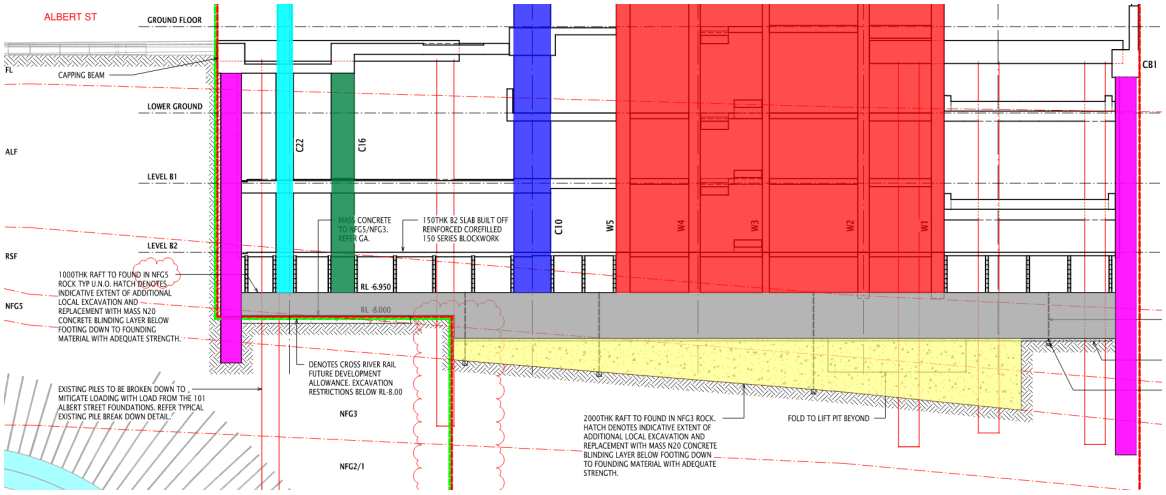


Figure 24 - Proposed Foundation Arrangement – Section through Albert St and Corebox

There will be existing CRR acoustic shed piles below the raft that will need to be cut down as discussed in Section 4.2 along with the existing CRR access shaft shoring piles and mass concrete filled shaft. The final details on the backfill material and filling methodology to the CRR shaft is to be confirmed. It is expected that the CRR shaft and backfill material will generate a stiff point below the raft. Conservatively the shaft has been assumed to be backfilled with 20MPa concrete for the calculation of the modulus of subgrade value to ensure the raft modelling is based on worst case scenario.

4.3.2 Raft Modelling and Results

Linear and nonlinear analysis of the raft was undertaken in the structural engineering concrete foundation design software RAM Concept based on the tower loads attached in **Appendix D**. The analysis undertaken is to achieve proof of concept that the raft foundation is a viable option to further develop with the Contractor during the final design development stage.

RBG requested that a 10% contingency be added to all gravity and lateral loads used in the geotechnical raft and cavern assessment models to allow for future proofing. For the structure raft model RBG allowed a 10% provision for all gravity loads in the columns and retention system.

The 3D view of the structural raft model from Ram Concept is shown in Figure 25 below. Loads from columns were applied as point loads to the centroid of each column. To simplify inputting the loads for the core walls, the loads were idealised into point loads at specified points along the centre lines of the core walls. Vertical gravity loads from the retention walls were applied as line loads along the centre lines of the retention walls. The lateral loads to the retention walls were not deemed to produce the critical load combination for the shoring wall design and have been ignored for the structural raft model for proof-of-concept analysis. Area loads were applied to cover the B2 slab loads. All vertical and lateral forces and bending moments have been applied to the top surface of the raft.

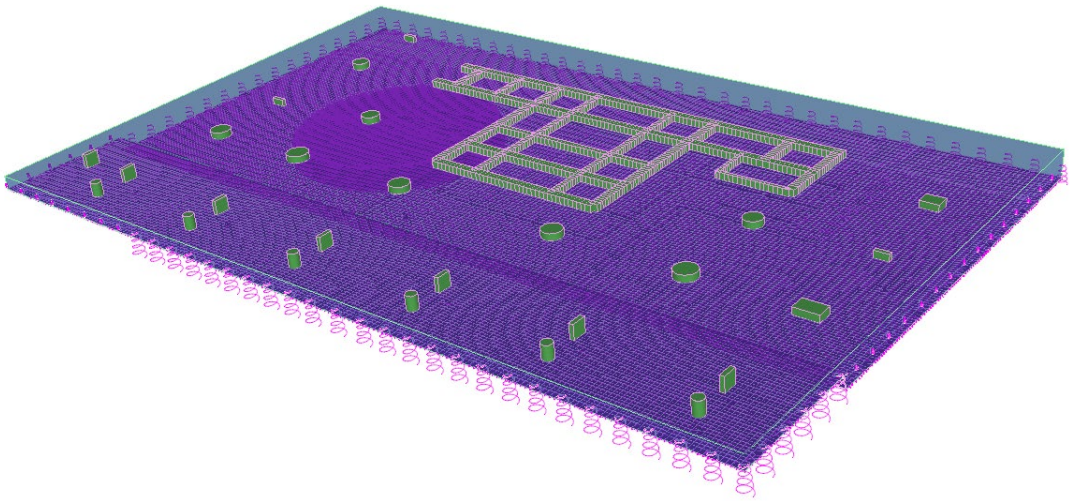
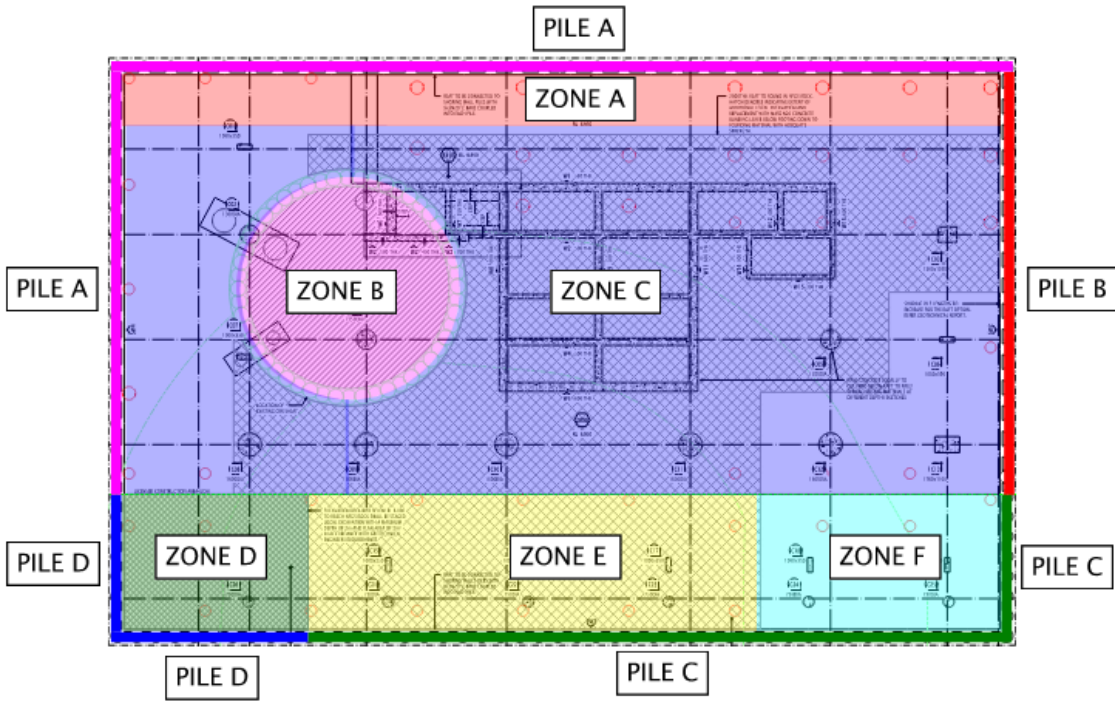


Figure 25 - Proposed Foundation Arrangement from RamConcept

The raft concrete material properties adopted in the structural raft model are based on the code define 65MPa concrete mix with Elastic Modulus Ec = 37,400MPa. The actual proposed concrete mix for the raft is an 80MPa mix from Holcim which can be supplied based on a standard or premium offering with Elastic Modulus of 41,500MPa and 47,000MPa, respectively. Based on this we have up to 25% contingency if we need to make the raft stiffer based on the current thicknesses and reinforcement.

The founding material stiffness including the modulus of subgrade reaction for the raft and spring stiffnesses for the retention system piles used in the structural raft model have been provided by EDG as discussed in the attached Geotechnical Reports. The initial stiffness values provided are attached in **Appendix C-1**. EDG followed up with a revised set of stiffness values which included higher values of modulus of subgrade reaction to reflect the rising NFG3 rock to the Mary Street/Albert Street corner and deeper excavation scenarios to the Albert Street/The Sebel corner. Additionally, to this EDG also provided revised pile spring stiffness values for contiguous piles to the Albert Street/The Sebel corner. The revised EDG advice is attached in **Appendices C-2 and C-3**.

The EDG recommended values shown in **Appendices C-2**-**Figure 1** and **C-3**–**Figure 2** have been adopted for the current structural raft model as presented in Figure 26 below. Several area and point springs were modelled based on extent of NFG3 and NFG5 rocks, the existing CRR shaft and infill material based on 20MPa mass concrete and the localised zone of expected weaker material to the Albert Street north-west corner. The purpose of the model is to investigate the raft vertical settlements and bearing stresses.



ZONE	SUBGRADE MODULUS [MPa/m]
A	20
B	3000
C	150
D	20
E	75
F	100

PILE	SPRING STIFFNESS [MN/m]
A	800
B	500
C	1000
D	200

Figure 26 - EDG Geotechnical Properties adopted for the Raft Model

The results from the initial structural raft model are based on linear analysis with the settlement and end bearing stress values compared to the EDG model to make sure that both structural and geotechnical models were sufficiently aligned. Some minor calibration was required to the models with the updated vertical settlement results for the ultimate limit state load combination 1.2G+1.5Q shown in Figure 27 and Figure 28 for both geotechnical model (left image) and structural model (right image).

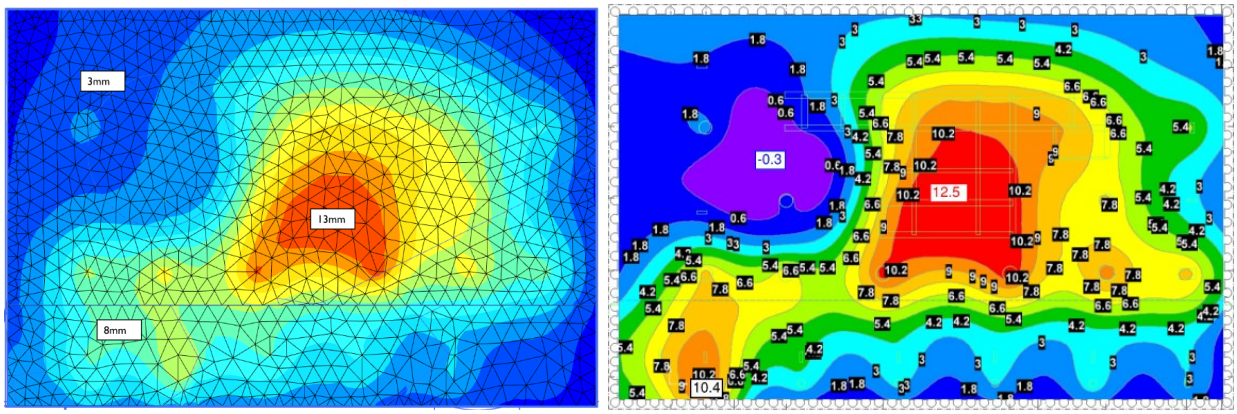


Figure 27 and Figure 28 - Geotechnical and Structural Raft Settlements for 1.2G+1.5Q load combination

The contour plots represent the direction and magnitude of vertical settlement with blue showing no downward (or uplift) movement and other colours showing varying magnitudes of downward movement with red as the maximum.

The maximum settlements occur beneath the core based on both structural and geotechnical models at approximately 13mm. Both models show very small settlement around the perimeter of the raft except to the north-west corner adjacent Albert Street where the local zone of weaker material has been modelled with both structural and geotechnical models indicating approximately 10mm of settlement. Again, both models show a localised area of no settlement or small uplift over the CRR shaft as the raft hangs up on the stiff inground structure.

The calibrated structural model was further developed to include a nonlinear time history case to account for long-term effects. The time history case was based on a simplified approximated construction methodology and erection sequence that consists of the completed raft achieving an 80-day age at which time 1/3 of the tower load is added, 80 days later another 1/3 of the tower load is added, and then 80 days later the final 1/3 tower load is added with the long-term settlements being measured at 30 years.

The summary of vertical settlements, end-bearing stresses, pile loads and pile-to-raft shear loads from the calibrated structural model are summarised in **Appendix E**. Based on the results the key findings are as follows:

a. Based on plots 2 and 3 the short-term and long-term vertical settlements below the corebox for the serviceability limit state load combination G+Q is approximately 10mm and 11.5mm. Therefore nonlinear or long-term effects increase the initial short-term settlements by approximately 15%.

b. The largest differential settlement for load combination G+Q occurs between the CRR shaft walls and centre of the corebox at circa 10mm over a distance of approximately 8600mm or span/860.

c. Plot 4 shows the short-term settlements for the critical ultimate limit state wind load combination 0.9G+RWDI_05 used to check uplift of the raft. This includes wind blowing towards Albert Street creating an overturning moment on the corebox in the same direction as gravity. The settlement along the raft edge to the back boundary (opposite to Albert Street) ranges from 0.7mm to 1.6mm in comparison to 0.9mm to 1.7mm from plot 2. This indicates that the raft has unloaded but has not gone into uplift which aligns with the mass distribution of the tower.

d. From plot 5 the peak bearing stress for load combination G+Q over NFG5 rock occurs to Zone E locally adjacent to the soffit step between the 2m and 1m raft at 0.69MPa. Moving away from the step line towards Albert Street the end bearing stress reduces to less than 0.36MPa where the NFG5 rock capity is 0.45MPa. The peak-end bearing stress to Zone D is 0.17MPa.

e. From plot 5 the peak-end bearing stress occurs in Zone B (over the CRR shaft) at 5.45MPa where the raft will be founding on mass concrete with 10-20MPa compressive strength and reinforced concrete shaft piles.

f. From plot 5 the peak end bearing stress over NFG3 rock occurs to Zone C below the corebox at 1.5MPa where the rock capacity is 2MPa.

g. The maximum and average vertical shear loads transferred through the connection between raft and retention system piles are shown in plot 6. The maximum shear loads are isolated to single piles at one location along each boundary wall with the shear loads being the largest to Albert Street and Mary Street boundary walls at 1700kN/pile and 2310kN/pile based on ultimate limit state load combination 1.2G+1.5Q. The shear loads reduce significantly moving along the wall away from the piles with the maximum shear loads as illustrated in plot 6 part plans. The average shear loads to connections range from 190kN to 890kN per pile.

h. The maximum pile loads to each retention wall extent comply with the ultimate retention system pile capacities provided by EDG except for several piles localised to the Albert Street frontage to the north-west corner.

The results above generally indicate that the raft settlements and end-bearing stresses are acceptable and in accordance with the geotechnical capacities provided.

As per Item d. the analysis shows a local extent of raft along the soffit step to the upper bench level that exceeds the NFG5 rock bearing capacity. If this cannot be resolved with more detailed modelling, we proposed to install a strip of compressible material RMAX GeoFoam X38 locally along the step to soften this area or locally remove NFG5 material and replace with mass concrete down to a stiffer material.

As per Item g. the connections between raft and piles are acceptable with two localised connections between raft and piles having higher shear loads. These higher loads generally occur where there is a large difference between the stiffness of the founding materials between raft and pile. The raft to these areas has been allocated a modulus of subgrade reaction based on NFG5 rock however based on the available geotechnical information there should be NFG3 rock present at RL-8. Therefore, investigations are to be undertaken on the rock stiffness to Zone E to see if the modulus of subgrade reaction values can be tapered along the Albert Street frontage from NFG5 rock to the north-west up to NFG3 rock adjacent Mary Street.

As per h. some of the soldier piles to the local zone of weaker material to the Albert Street north-west corner exceed the provided EDG ultimate pile capacities. The stiffness of the rock to the raft and piles are to be reviewed once additional geotechnical investigation works have been completed. If required, there is a provision for additional piles to this extent and/or local removal and replacement of weak material below the raft down to NFG5 rock. Based on adding the additional piles alone the pile reaction reduces to a maximum of 921kN which is within capacity.

Further detailed analysis and sensitivity assessment will be undertaken on the raft including the interaction with the retention wall piles once further geotechnical investigations have been completed, and the final backfill material to the CRR shaft is known. This will include a range of modulus of subgrade reaction values. The lateral loads from the retention system will be included.

A geotechnical assessment of the normal stress on the cavern lining and cavern vertical and horizontal distortion based on the proposed building vertical and lateral loads has been undertaken by EDG to demonstrate these are below that arising from the CRR PSTR FOSD load cases. Refer to **Appendix C**.

4.4 Lateral Stability System

The Lateral Stability System consists of a cantilevered concrete corebox extending the full height of the building. The corebox is built up from a series of concrete shear walls around the lifts and lobbies with interconnecting coupling beams. To achieve the key requirements of the development, the corebox has been offset to the side of the typical floor plate furthest from Albert Street and CRR cavern, as illustrated in Figure 29 and Figure 30, below.

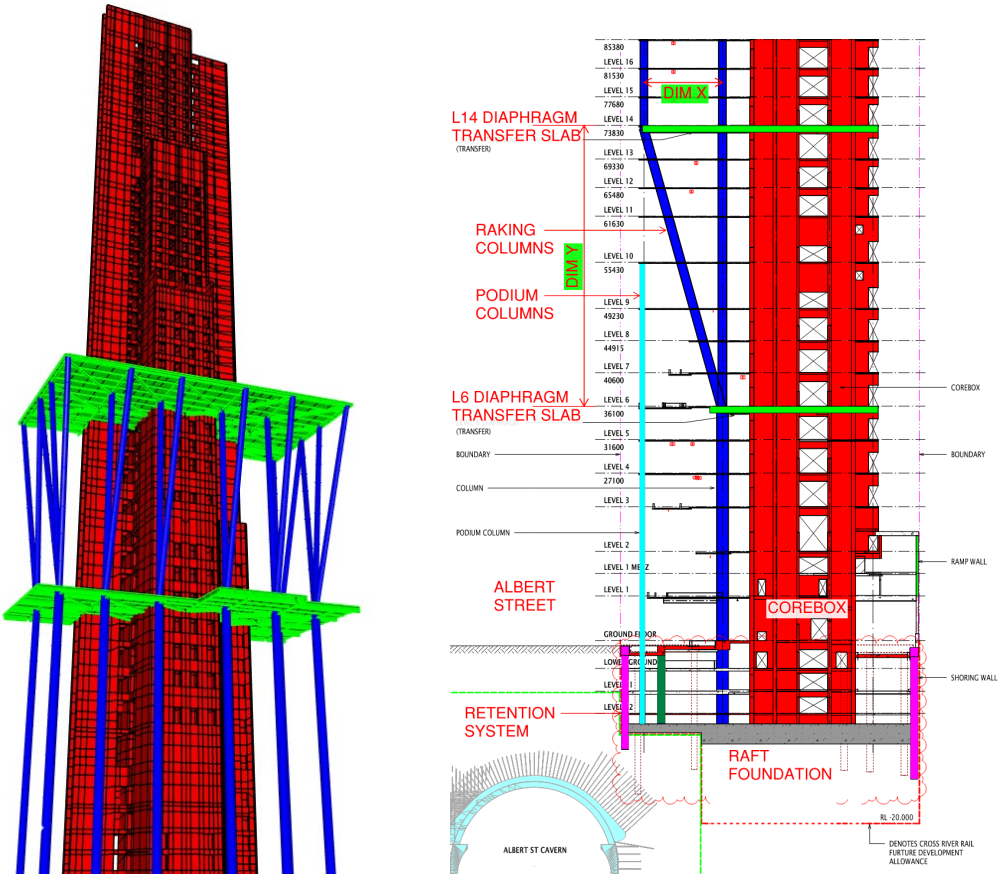
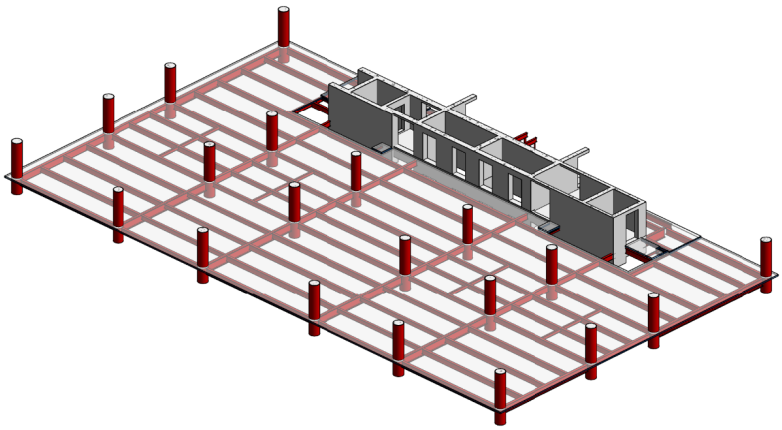


Figure 29 and Figure 30 - 3D View and Section of the Lateral Stability System

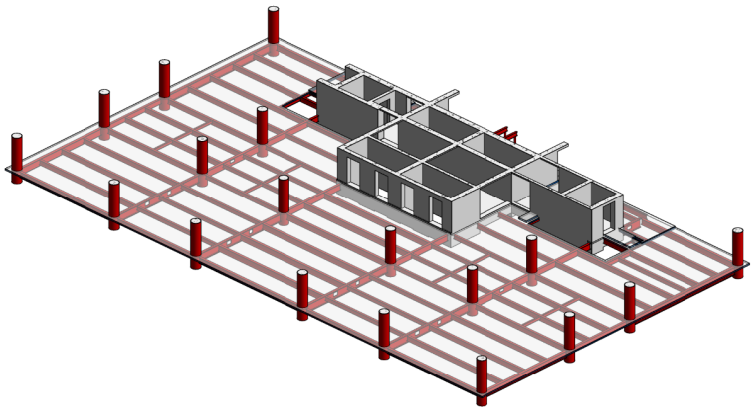
Due to the offset core, a larger area of the floor plate and, therefore, mass is applied to the internal core walls than that to the external core walls. This imbalance of loading on the core results in a horizontal gravity movement of the core towards Albert Street. The heavier the floor plate, the greater the horizontal gravity movement. This movement is, however, partially balanced by the stair box that cantilevering off the external rear side of the core.

The corebox at the base of the building is approximately 32m in length parallel to Albert Street **(Direction-X)** and 14.2m in width perpendicular to Albert Street **(Direction-Y)**. Due to the length-to-width ratio, the corebox has more stiffness in Direction-X and also less load than that in Direction-Y. Due to this, additional stiffness was required in Direction-Y to achieve the required horizontal movement limits to the top of the tower.

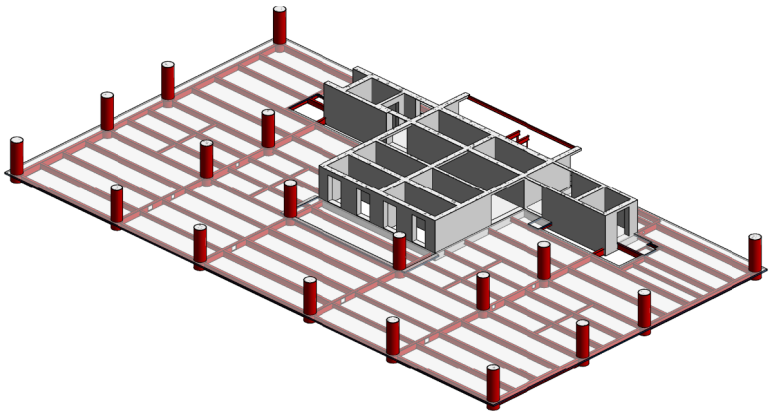
The LR, MR, HR and SR corebox arrangements, as shown in Figure 31, reduce in size with the termination of the LR lift shaft at Level 10 (the last floor served Level 8), MR lift shaft at Level 21/22 (the last floor served Level 19), HR lift shaft at Level 29 (the last floor served Level 28), and SR and goods lift **(GL)** lift shafts at Roof (the last floor served Level 38).



CONTEXT VIEW - TYPICAL SKY RISE LEVEL



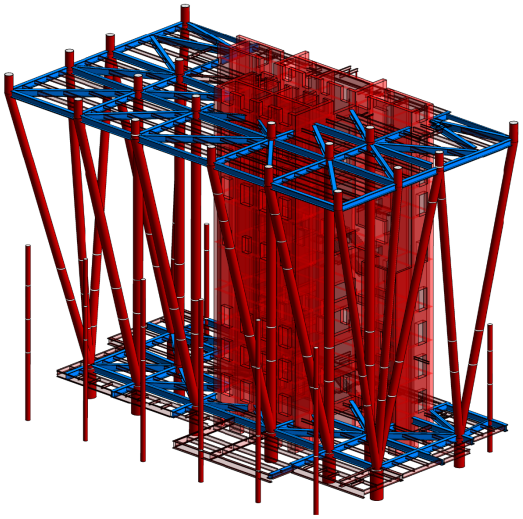
CONTEXT VIEW - TYPICAL HIGH RISE LEVEL



CONTEXT VIEW - TYPICAL MID RISE LEVEL

Figure 31 - Low, Mid, High and Sky-rise Corebox Arrangements

In order to respond to the site constraints and achieve the typical floor tower column positions in combination with all tower columns being located outside of the RL-8m maximum continuous excavation zone, a critical building transfer occurs to the base of the office floors in Direction-Y where the Albert Street tower column grid walks inboard via raking columns between Levels 14 and 6 as shown in Figure 32 and Figure 33 below.



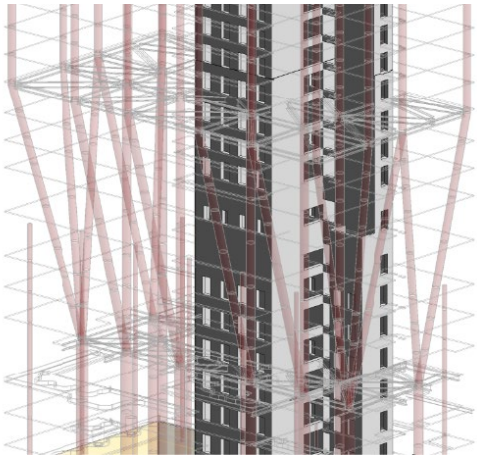


Figure 32 and Figure 33 - 3D View of the Bi-Directional Building Transfer

The building transfer has been adopted to shift the tower columns and tower load away from the CRR Cavern. The design is based on Dimensions X and Y from Figure 30, being a maximum of 10.55m and 37.75m, respectively.

Additionally, to the Direction-Y transfer, there is a secondary building transfer in Direction-X to achieve inboard columns to The Sebel and Mary Street elevations. This is also facilitated by raking The Sebel and Mary Street tower columns inwards from both edges at Level 14 to 3.5m inboard from both edges at Level 6. The magnitude of the tower column transfers to both The Sebel and Mary Street elevations was coordinated to be equal and opposite to minimise out of balance loads and the impact on the global lateral stability system. The direction-X transfer does have a local impact on the transfer diaphragm structures, as discussed further in Section 4.4.1.

The building transfers induce significant horizontal forces through the floor structure at Level 14, where the columns begin to rake and at Level 6, where the columns straighten, requiring a diaphragm transfer structure at both noted levels. The Direction-Y building transfer induces large shear forces and moments on the core, adding local and global stresses to the corebox and foundations. Due to the critical nature of the building transfer, the corebox and tower columns from Level 14 and below; Level 6 and 14 diaphragm floor framing and connections shall be designed to maintain elastic behaviour during a seismic event.

The corebox is supported off a raft foundation as discussed in Section 4.3.

The result of combining the building transfer and offset core is a lateral stability system with higher loads and horizontal movement than that of a conventional building which would only generally see wind or seismic loads. The horizontal movement limits for combined effects of dead load, live load, and serviceability wind load or single effect of serviceability wind are discussed within the Structural Design Brief and Movement and Tolerance Reports.

4.4.1 Levels 6 and 14 Transfer Diaphragm Structure

The critical building transfer that is facilitated via raking columns between Levels 6 and 14 in both Direction-X and Direction-Y requires a transfer diaphragm structure connecting the top and base of the raking columns to the corebox. The proposed transfer diaphragm structure has been shown below in Figures 34 and 35 for Levels 6 and 14.

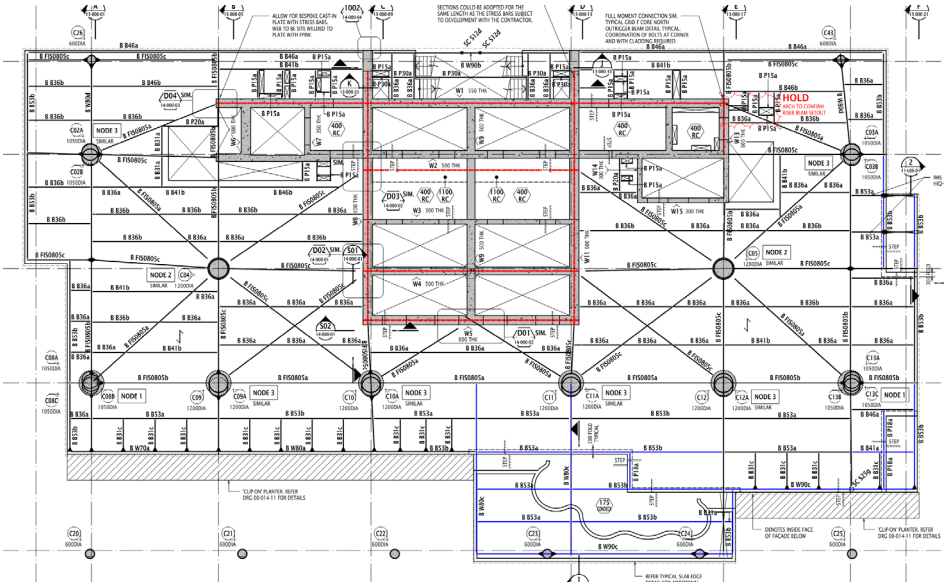


Figure 34: Plan View of the Level 6 Diaphragm Structure

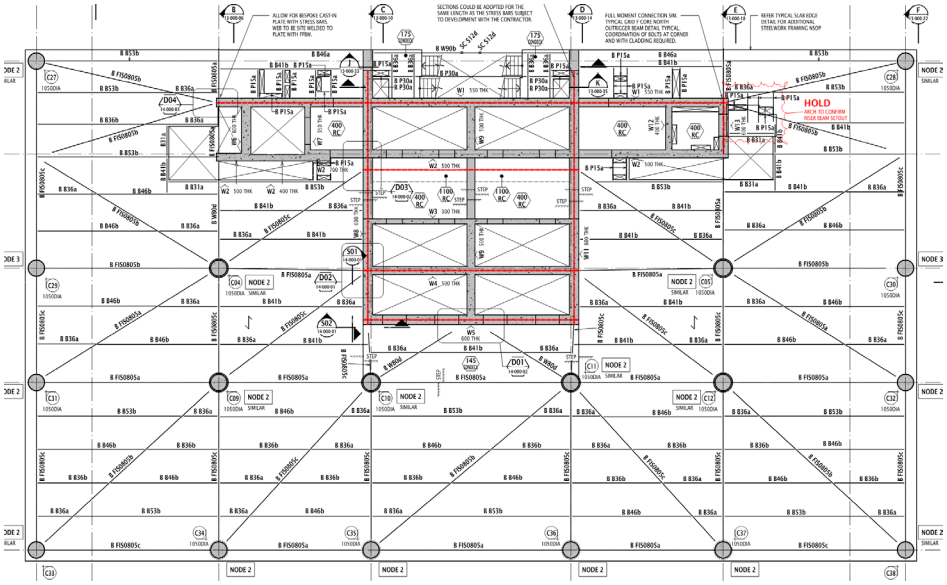


Figure 35 - Plan View of the Level 14 Diaphragm Structure

The current design proposes an integrated floor framing and transfer diaphragm structure consisting of fabricated structural steel I-section bracing members.

All service reticulation horizontally and vertically occurs below and around the transfer diaphragm structure, as penetrations through the bracing members are not acceptable. Further coordination with ADP is required to ensure the bracing members can node out with the walls, as shown above. No inter-tenancy voids are permitted through Levels 6 and 14 unless designed into the base design.

Under dead and live load actions, the building transfer imposes significant permanent horizontal forces through the transfer diaphragm structures, which in turn induces additional shear force and moment in the corebox. The dead and live horizontal loads for ultimate limit state combination 1.2G+1.5Q generated by the transfer and imposed on the transfer diaphragm structure and core in Direction-Y are illustrated in Figure 36 below. The total ultimate wind load based on wind tunnel testing by RWDI on the building has also been added to Figure 36 to illustrate the magnitude of the Direction-Y loads generated by the building transfer vs the total RWDI wind load on the building or 32.9MN vs 16.4MN.

The heavier the building, the larger the column loads, and horizontal loads imposed onto the diaphragms and core. The inclination of the raking columns also has a direct impact on the magnitude of the horizontal forces, and therefore it is critical that the Direction-X transfer is mirrored to both The Sebel and Mary Street elevations in order to minimise any global impacts on the lateral stability system. Pattern loading will be considered during the final Design Development stage to ensure the worst unbalanced case is considered.

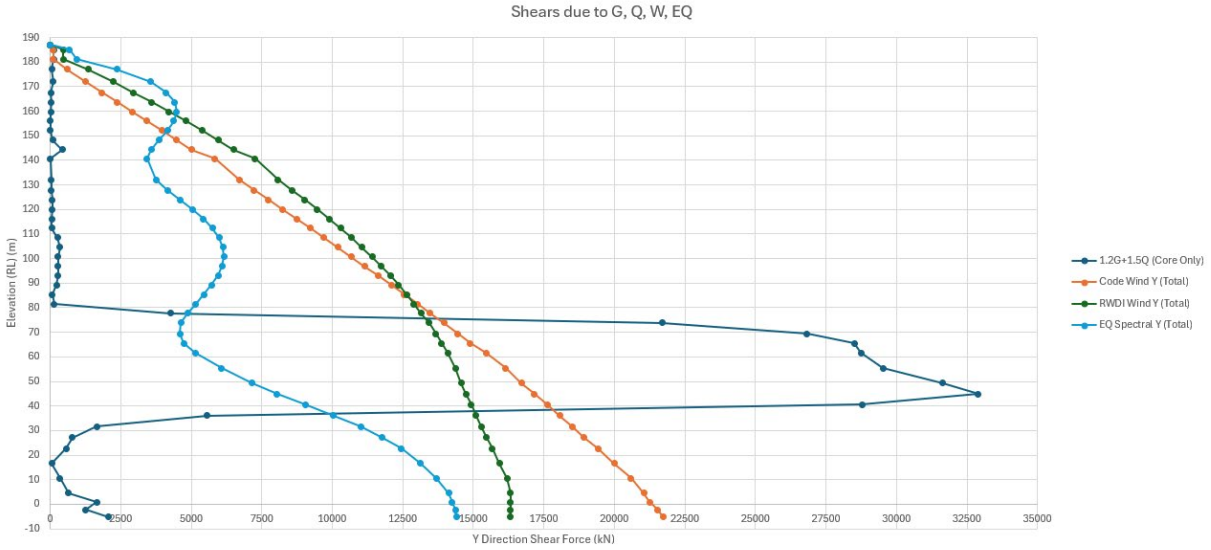


Figure 36 - Direction-Y Building Horizontal Load Summary

Note that a conventional building would only see and respond to robustness, wind and seismic loads. Due to the critical nature of the building transfer, the proposed transfer diaphragm steelwork framing allows for several alternative load paths to offer additional redundancy to avoid the risk of progressive collapse.

The diaphragm steelwork framing and web and flange plates are continued through column/raker/diaphragm nodes to ensure direct load path for the in-plane loads. The diaphragm steelwork framing is connected to the corebox with high tensile stress bars that are coupled through the length and width of the corebox. Figure 37 illustrates a typical diaphragm steelwork framing connection to the corebox and at a node location.

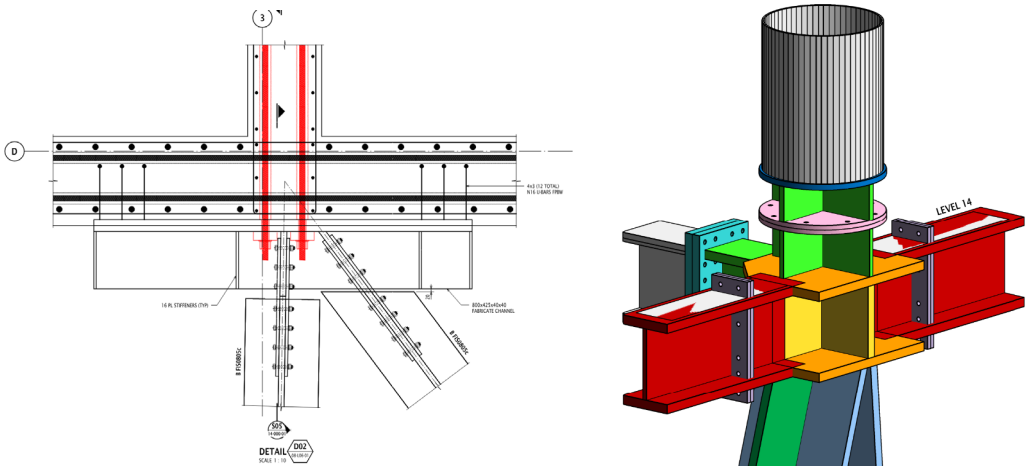


Figure 37 - Typical Diaphragm Connection and Node

4.4.2 Raking Column and Transfer Diaphragm Structure Set-out

The set-out of raking columns, vertical columns and transfer diaphragm steelwork framing beams at their intersecting points or nodes is critical to avoid any secondary actions being introduced into the structural systems. Typically, at node locations, all members have been set-out to intersect at their centre points, similar to that illustrated in Figure 38 below.

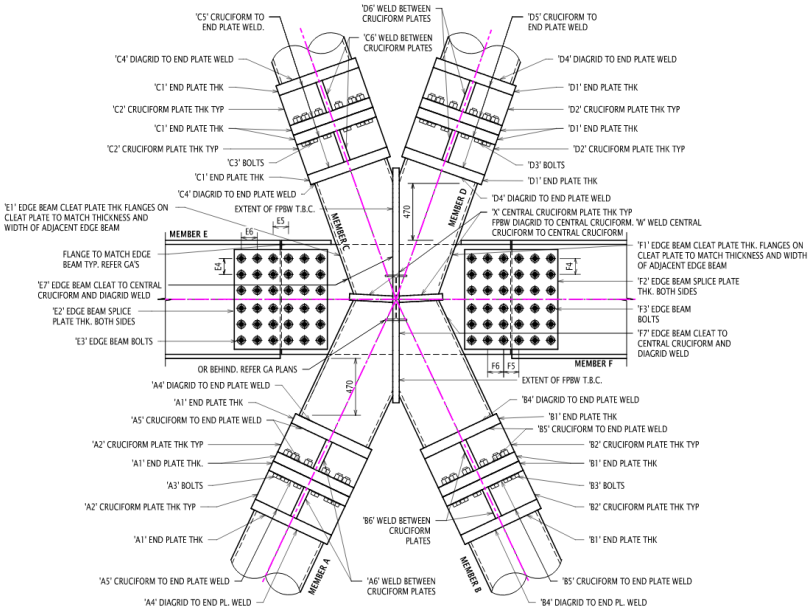


Figure 38 - Example of Set-out at a Raking Column Node Location

Therefore, in elevation, the set-out of the raking columns between diaphragm Levels 6 and 14 is based on intersection points between the centre lines of the raking columns, vertical columns and mid-depth of the diaphragm steelwork framing beams (-400mm from the top of steel).

In the plan, the diaphragm steelwork framing beams have been set-out with centres of beams nodding out at columns and typically with the centre of the wall similar to that shown in Figure 39 below.

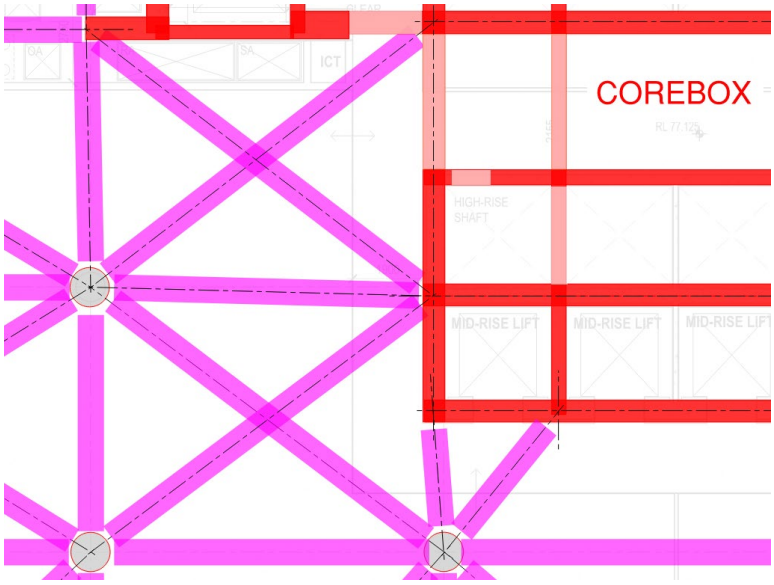


Figure 39 - Part Plan - Example of Set-out at a Corebox Node Location

4.4.3 Gravity Lean

Lateral movements under gravity have been considered in the tower lateral design due to the building height and location of the side core. Figure 40 shows the gravity lean for a wished-in structure **(Wished-in)**, staged floor by floor construction sequence with linear material properties **(Staged)**; and staged floor by floor construction sequence with linear but time dependent materials **(Staged+TD)**. The Wished-in place lateral movements do not consider the level correction that would occur during construction as each floor is constructed to the document RL.

The Staged+TD lateral movements would be closest to reality with the peak lateral movement occurring at approximately mid-height at 30-35mm. The gravity lateral movement at the top of the tower is approximately 10-15mm which is relatively small compared to the total allowable under a performance criterion of height/500 or 370mm (but inclusive of lateral loads and time-dependent effects). The critical Y-Direction lateral movement due to service limit state wind based on RWDI wind tunnel modelling is approximately 254mm. Cumulatively the wind and gravity movement produce a Y-Direction lateral movement of 269mm at roof level which is within acceptable limits.

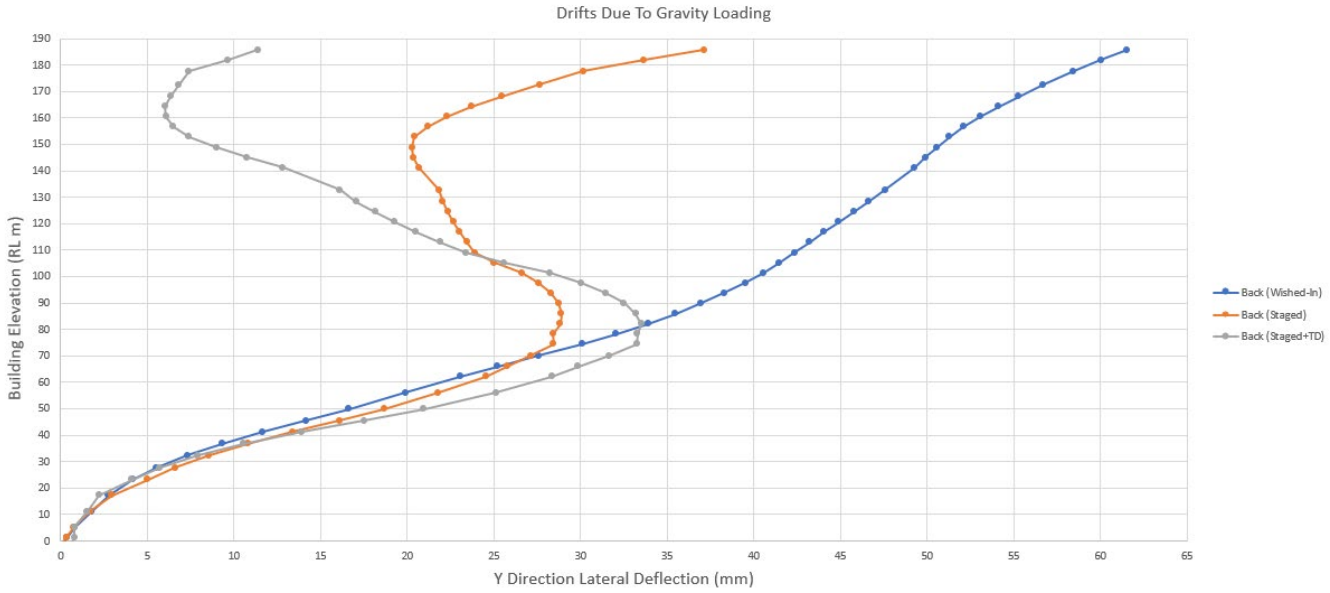


Figure 40 - Tower Gravity Lean (SW+SIDL, Staged, No f(t))

4.5 Gravity Load Resisting System

Gravity loads in the tower are resisted conventionally by columns and core walls. See Figure 41. The core walls are traditional reinforced concrete and will most likely be jump-formed. Core wall thickness decreases up the tower according to demand, with the thickest primary external walls being 600mm thick at the tower base and decreasing incrementally throughout the tower.

There are three distinct groups of columns throughout the development as summarized below:

Basement Columns - extend only up to the underside of ground level and are traditional reinforced concrete of primarily rectangular shape in the order of 1000x350mm.

Podium Columns - continue to as high as the underside of Levels 9 and 10. These are conventional reinforced concrete through the basements to ground level in the order of 750mm diameter, above which they convert to concrete-filled steel tubes in the order of 600mm diameter.

Tower Columns – continue from footing through the tower. These are conventional reinforced concrete through the basements to ground level in the order of 1100x1700mm, 1300x1050mm, 1300mm to 1600mm diameter, above which they convert to concrete-filled steel tubes ranging from 1300mm to1600mm diameter at ground level tapering back to 600mm diameter at the roof.

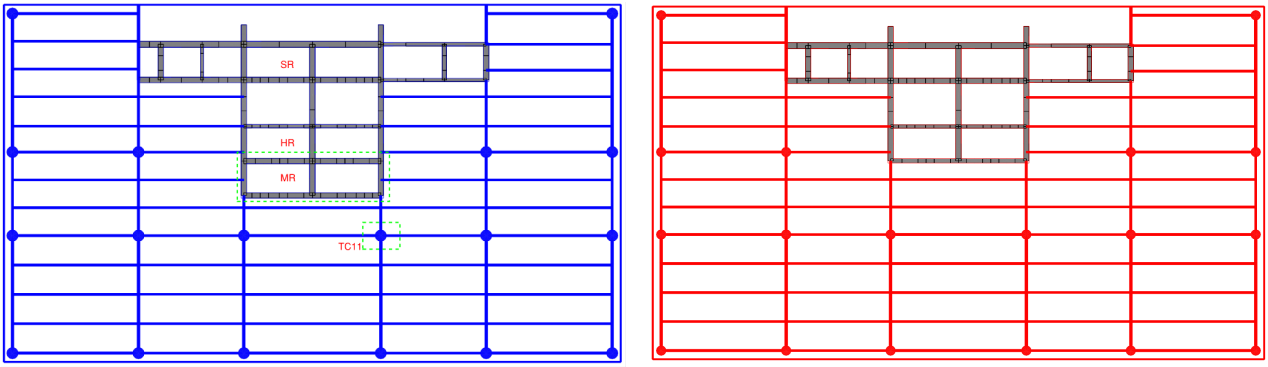


Figure 41 - Gravity Load Resisting System (Low-rise and High-rise)

4.5.1 Axial Shortening

Axial shortening is a relevant consideration for any structure. It often begins governing gravity system design for towers above 30-40 storeys or beyond 150m. At approximately 190m effective height, the development is of a height that axial shortening can influence vertical element design/geometry. Generally strategic set-out of verticals, vertical sizing and stress/strain balancing, correct concrete specification and coordination with the façade consultant is sufficient to overcome most issues in this intermediate height range. Nevertheless, an axial shortening analysis has been performed based on three varying analysis cases including linear **(Wished-in)**, staged floor by floor construction sequence with linear material properties **(Staged)**; and staged floor by floor construction sequence with linear but time dependent materials **(Staged+TD)**. The axial shortening analysis will need to be further developed once Contractor input is available and a detailed construction methodology and erections sequence can be confirmed.

Qualitatively, the composite floor system will generally be favourable for axial shortening as it is lightweight, and the pinned beam-column connections minimise secondary moments from the differential settlement. Similarly, the composite CFT columns help to reduce axial shortening by effectively preventing drying shrinkage, reducing creep and providing the equivalent of a very large steel percentages. The concrete specified to meet ESD targets is also beneficial for axial shortening as it typically entails large cement replacement and by association lower shrinkage.

At this stage two key aspects of the structure have been investigated as summarised below:

a. Gravity lean. With a side core, the tower will tend to lean away from the edge where the core is positioned, and this will be cumulative with lateral load displacements. This is discussed further in Section 4.4.3.

b. Columns in close proximity to the core. The left-hand side image in Figure 42 highlights the relevant core wall and columns and Figure 42 shows the axial shortening differential throughout the height of the tower. The columns have been modelled as concrete filled tubes. Based on the Staged+TD results the peak differential between the corebox and tower column TC11 occurs at L30 (last level with the high-rise lift box and 6.8m span to adjacent TC11) at approximately 13mm or span/523.

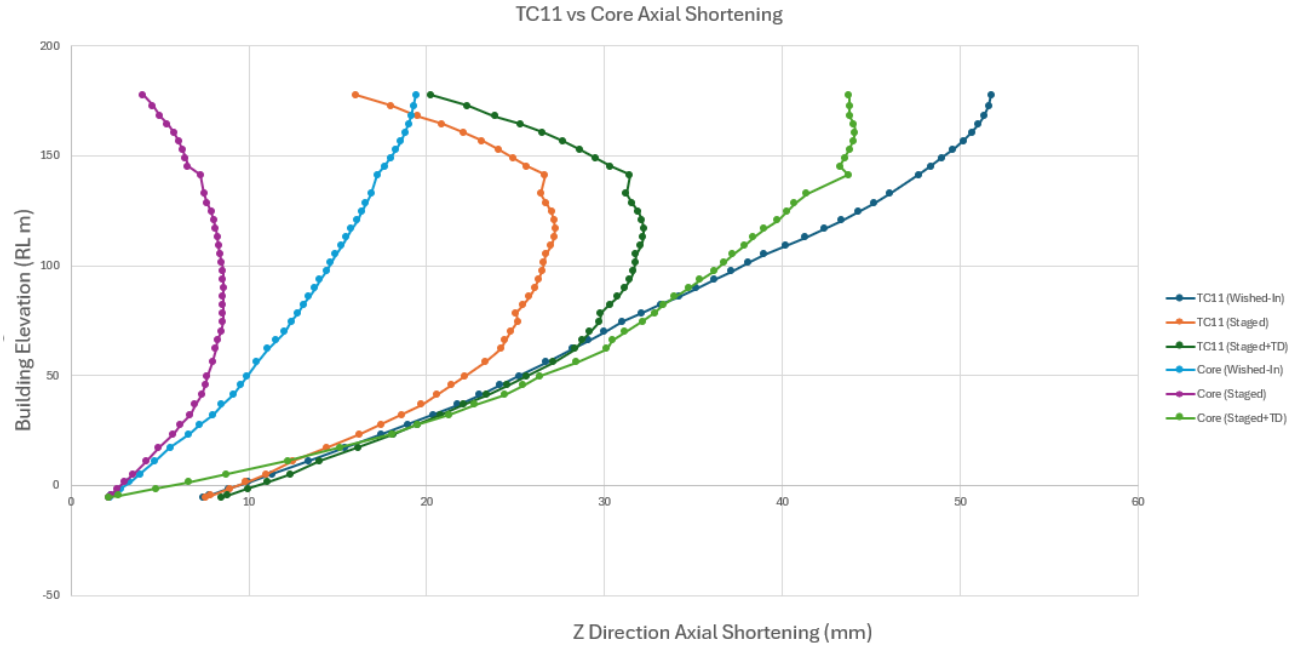


Figure 42 - TC11 and Core Differential Axial Shortening (SW+SIDL, Corrected, No f(t))

4.6 Floor Plate Systems

Typically, reinforced concrete is proposed for the floor plate system and columns for Basement B1 and Ground Level. Above the Ground floor, composite steel framing is proposed for the floors external to the corebox and columns.

4.6.1 Basements and EOT

Basement B2 is designed to be a suspended slab built off load-bearing blockwork walls that extend up off the raft foundation. The drainage system is proposed between the B2 slab and raft foundation with a vertical connection to the embedded strip drain system below the raft. The drain system is to be connected to sump pumps. The drainage system shall be designed for water inflows as directed by the Geotechnical engineer and be designed by the building hydraulics engineer. We recommend the sump pump system have access to backup generator power in case of a power outage to reduce the risk of water ingress to the basement.

Basement B1 is designed as a conventionally reinforced two-way flat slab to accommodate higher imposed live loads related to the loading dock area. The slab is a minimum of 350mm thick with 425mm to 550mm thick through the loading dock area and between the corebox and Albert Street shoring wall. The slab has been designed to allow for a shallow 50mm deep spoon drain to be cast into the surface of the slab for the perimeter of the basement. Service reticulation is to occur below the soffit of the slab.

The EOT is a partial level to the Mary Street side of the corebox extending between Albert Street and 110 Mary Street boundaries. It is designed as a conventionally reinforced two-way flat slab with a minimum of 300mm thick.

All basement slabs are to be designed to resist in-plane loads generated by the retention system.

4.6.2 Ground and Podium

Ground floor is located at street level with conventional reinforced two-way slabs and beams to accommodate higher imposed construction, live and flood loads. The Ground floor is a transition plane between basement RC columns and tower CFT columns.

The Podium levels are proposed to be framed with composite steel floor framing and columns. Additional podium columns are required to support the varying floorplate corners and edges where the Tower Columns have been transferred inboard. These podium columns typically extend up to the underside of Levels 9 and 10. The Albert Street podium column extends down to the foundation level. The podium columns to the Sebel/119 Charlotte Street and 110 Mary/Mary Street corners transfer at Level 2. In some areas where cantilevered edges are too large, hanging columns have been introduced.

The ground slabs are to be designed to resist in-plane loads generated by the retention system.

4.6.3 Typical Tower Floors

As the typical commercial office floors make up the bulk of the structure and load to the tower, it is critical to achieve an efficient column grid set out and structural floor framing solution to minimise the building transfer, materials, cost, and embodied carbon. The typical commercial office levels (external to the core box) are designed as composite steel consisting of steel beams and a 130mm thick condeck slab which produces a floor to the NLA with a self-weight mass of approximately 377kg/m^2. The slab in the corebox and stair box is conventionally reinforced and formed concrete slab.

The typical commercial floor-to-floor height is 3850mm. This floor-to-floor build-up comprises the following zones, as outlined in Table 2.

Table 2 - Typical Floor-to-Floor Height Provision

Floor-to-Floor Height Zones	Provision (mm)
Overall floor-to-floor height	3850
Clear floor-to-ceiling height	2700
Raised floor	150 to HR and SR
Ceiling and lighting zone	320 TBC
Tenant zoned	
Structure and service zone	830

Typically, the floor plates comprise primary steel beams aligned perpendicular to Albert Street, spanning between the tower columns and corebox. Secondary steel beams span between the primary beams and core box at circa maximum 2.8m centres and on each column grid.

Primary steel beams are typically 460mm/530mm/610mm/700mm deep, and secondary steel beams are typically 410mm/460mm deep, with the typical arrangement illustrated in Figure 43 below.

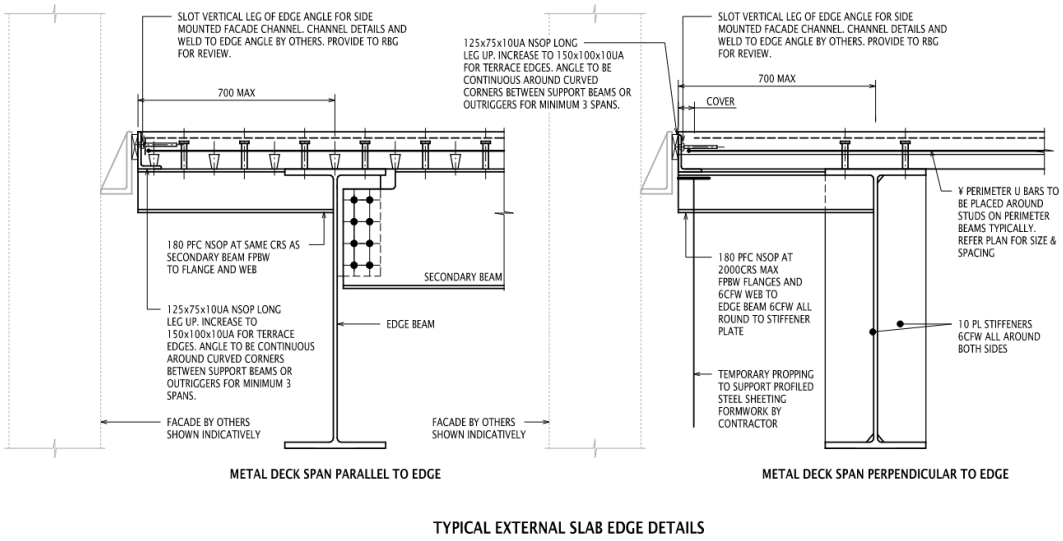


Figure 43 - Typical Composite Steel Edge Beam Details

Shear studs will be welded to the top flange to engage composite action with the condeck slab. Steel beams will be pre-cambered to suit the self-weight deflection.

The service and structural zone integration being targeted dictates that services run out of the risers below the secondary beams which typically run across and in front of the risers; these services then to traverse to each floor bay by passing below the shallower primary beams. The larger primary beams are to be detailed with service penetrations located at the mid-depth of the beam. The penetration sizes and locations are coordinated with services engineers to optimise beam design and services distribution. No penetrations are being considered for the smaller primary beams or any secondary beams at this time.

Fire protection is proposed for all beams at this time with the aim to refine this via Fire Engineering to primary beams and secondary beams on column grid lines only.

4.7 Construction Sequence

Based on conventional bottom-up construction methodology and erection sequence, the sequence of works of the primary structural elements will be as follows –

1. Retention pile and capping beam installation in accordance with D&C contractor.
2. Staged excavation and demolition of buried inground structure down to retention prop Level(s).
3. Install retention props and continue staged excavation and demolition to Basement 2.
4. Erect formwork, install reinforcement and place concrete raft foundation, columns, and basement slabs from the bottom up, removing temporary retention props sequentially.
5. Commence core jump system from the ground floor (Contractor can opt to do this within the excavation if coordinated with temporary retention system props), progressing ahead of the completed Levels by 10 storeys or as otherwise required for gravity lean correction, subject to detailed study. Core transitions at base of fire stair Level 2 and where the low, mid, high-rise lifts drop off.
6. Erect formwork, install reinforcement and place concrete ground floor. Install a temporary access deck over sunken planters for construction access.
7. Transition RC basement columns to CFT tower and podium columns, temporary bracing to columns if required.

8. Erect Level 1 steel beams with temporary bracing to the RC core, thus laterally restraining the steel columns and providing a temporary diaphragm.
9. Place steel decking, install reinforcement and place concrete to the column below and Level 1 steel deck.
10. Hang Level 3 terrace from Level 4 using local falsework over the ground floor, e.g. Temporary columns. Falsework is to be removed once Levels 2 to 4 achieve concrete transfer strength. Refer to Figure 44 below.



Figure 44 - Hanging Structure to Podium

11. Repeat steps 8 to 10 between Levels 2 and 6. Local transfer beam to Level 5 Grid G. Level corrections to columns may be required for the self-weight lean of the tower towards Albert St, pending a detailed study.
12. Install raking columns commencing at Level 6 and completing at Level 14, progressing two Levels ahead of constructed Levels, temporarily braced. Staging to allow for time to stress bars to core to connect diaphragm members.
13. Repeat steps 8 to 10 between Levels 7 and 14. Raking columns to be concrete filled with every steel deck.
14. Repeat steps 8 to 10 between Levels 14 and 41.
15. Install roof crown ring beam and crown fins.

5. Compliance with CRRDA Constraints

5.1 Proposed Excavation

The bulk excavation depth is RL-8m over the RL-8m maximum continuous excavation zone, and RL-8.95m over the RL-20m maximum continuous excavation zone. Local excavation is proposed below RL-8m to break down the existing acoustic shed piles to mitigate accidental loading of the existing piles which extend to within close proximity to the CRR Cavern. Additional controlled local excavation is proposed to remove and replace weak material with mass concrete.

The proposal complies with the continuous excavation restriction limit of RL-8m and unload rules over the CRR cavern rock pillar zone.

5.2 Tower Gravity and Lateral Load Paths and Methodology

The main site constraint of the CRR Cavern excavation and load limits has been a key driver for the currently proposed structural design solution. The below sections discuss how the gravity and lateral stability systems have been tailored to ensure compliance with the CRR Cavern design constraints.

RBG has provided the proposed building loads for permanent and transient load cases to EDG for inclusion in the cavern assessment modelling. These included both vertical and lateral loads for the corebox and retention system and vertical loads for the columns. RBG requested a 10% contingency be added to these loads for the cavern assessment.

A summary of the proposed building loads has been attached in **Appendix D**.

5.2.1 Tower Columns Loads and Compliance

The tower is supported by up to 20 tower columns on a varying orthogonal grid up to 13.05m spans, and an eccentric corebox that is positioned towards the 119 Charlotte Street/110 Mary Street boundary of the site furthest from the CRR cavern. This support grid is maintained from the top of the building to Level 14. At Level 14, a bi-directional building transfer occurs whereby the columns on Grid 5 (Albert Street elevation) rake inboard, moving up to 10.55m horizontally towards Grid 4, then straightening at Level 6. Columns on Grid H (Mary Street elevation) rake inboard, moving up to 3.5m horizontally towards Grid G between Levels 6 and 14 (mirrored column rake to Grid A-B (The Sebel elevation). Refer to Figure 45 below.

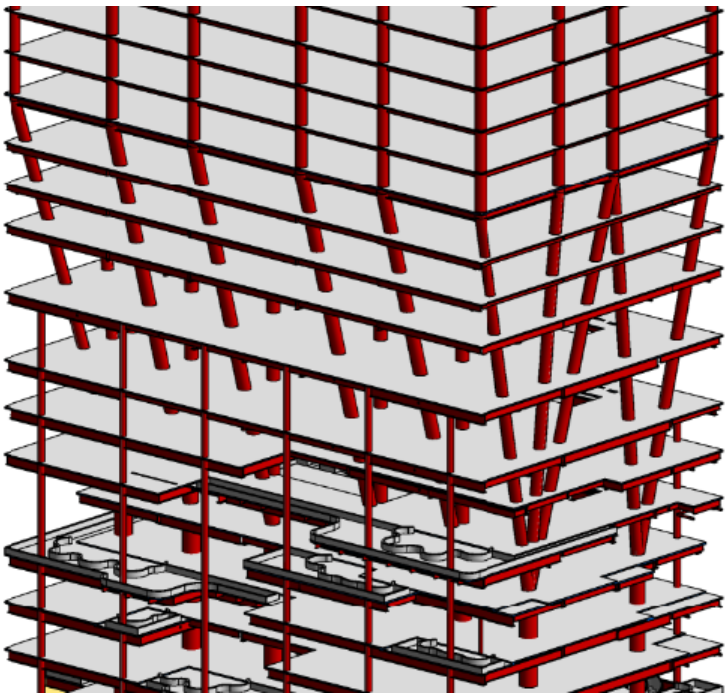


Figure 45 - Building Columns

The column rake perpendicular to Albert St is required to direct the tower loads away from the CRR Cavern and to locate the tower columns inboard of the RL-8m maximum continuous excavation zone, (within 10m of the CRR Cavern). With the load distribution of the building weighted to the back of the site away from Albert Street, the heavy loaded tower columns are then supported off a 2m deep raft which assists in distributing the tower column loads over a larger footprint to satisfy the load intent of the CRR Cavern design manual.

5.2.2 Podium Loads and Compliance

Where the tower columns rake inboard additional podium-only columns are introduced to provide sufficient support to some of the edges and corners to the podium floors up to Levels 9 and 10. The podium columns along the Albert Street frontage are spaced at 9.6m centres and extend down to the foundation level. Podium Levels 1 to 8 vary in extent on the Albert Street frontage with some of the podium columns clear spanning over several levels. Two hanging columns are required to support a section of Level 3; refer to Section 4.7 and Figure 46 below.

Additionally, to the podium columns, there are basement-only columns that break down the ground and basement slab spans. Both the podium and basement columns found above the RL-8m maximum continuous excavation zone, supported by a 1m thick raft which assists in distributing the podium and basement column loads over a larger footprint to satisfy the load intent of the CRR Cavern design manual.



Figure 46 - Albert Street and Mary Street Frontage

5.2.3 Corebox Loads and Compliance

The corebox has been positioned to the side of the development site furthest from the CRR cavern to minimize the lateral load imposed on the CRR Cavern. The corebox is located inboard of the RL-8m maximum continuous excavation zone, (within 10m of the CRR Cavern) with the corebox supported off a 2m deep raft which assists in distributing the corebox loads over a larger footprint to satisfy the load intent of the CRR Cavern design manual.

5.3 Current Geotechnical Modelling

In order to verify the proposed structural design solution described above complies with the CRR PSTR load and excavation cases geotechnical modelling has been undertaken by EDG which consists of the assessment of the normal stress on the CRR Cavern lining and cavern vertical and horizontal distortion based on the proposed building vertical and lateral loads. This analysis demonstrates that the stresses and distortions in the CRR Cavern lining are below those arising from the CRR PSTR FOSD load cases.

The results of this analysis have been presented within EDG Geotechnical Reports attached in **Appendix C**.

The outcome of the geotechnical assessment suggests that the predicted effects associated with the proposed building loads are within the effects associated with the PSTR design load cases with the results of the alternative raft foundation option similar to that of the piled foundation option and less than that determined during the DA Application stage.

5.4 Proposed Geotechnical Modelling

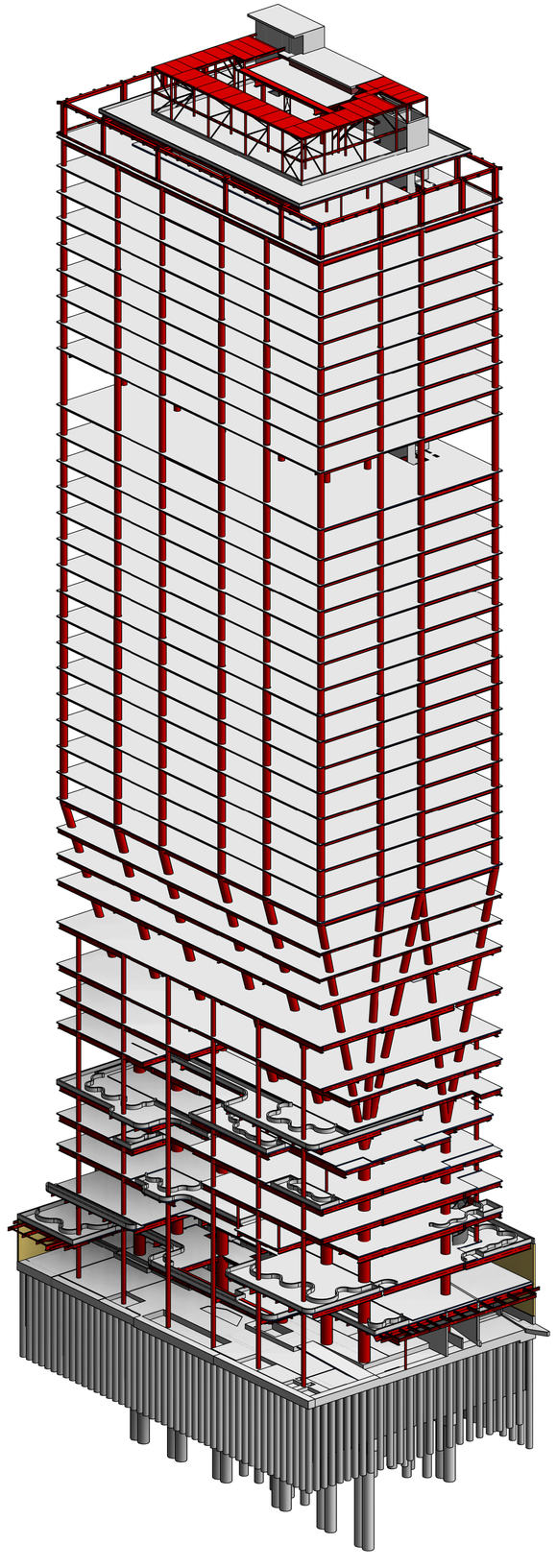
Further work will be required to the EDG cavern assessment modelling during the final design development and Construction stages including further development of the geotechnical model to suit additional geotechnical investigations and inclusion of the final structural arrangement.



Appendix A
RBG Structural Raft Drawings

Document Number: ALB-RBG-REP-ST-00-000-05
Revision: T01

PRINT DRAWINGS IN COLOUR



101 ALBERT STREET

BRISBANE

DRAWING LIST

SHEET NUMBER	SHEET NAME
ALB-RBG-DWG-ST-00-000-01	COVER SHEET
ALB-RBG-DWG-ST-00-000-11	GENERAL NOTES SHEET 1
ALB-RBG-DWG-ST-00-000-12	GENERAL NOTES SHEET 2
ALB-RBG-DWG-ST-00-000-13	GENERAL NOTES SHEET 3
ALB-RBG-DWG-ST-00-000-14	GENERAL NOTES SHEET 4
ALB-RBG-DWG-ST-00-000-15	GENERAL NOTES SHEET 5
ALB-RBG-DWG-ST-00-000-16	GENERAL NOTES SHEET 6
ALB-RBG-DWG-ST-00-000-21	REINFORCEMENT LAP SCHEDULES SHEET 1
ALB-RBG-DWG-ST-00-000-51	CONTEXT VIEWS SHEET 1
ALB-RBG-DWG-ST-00-000-52	CONTEXT VIEWS SHEET 2
ALB-RBG-DWG-ST-00-000-53	CONTEXT VIEWS SHEET 3
ALB-RBG-DWG-ST-00-000-54	CONTEXT VIEWS SHEET 4
ALB-RBG-DWG-ST-00-000-55	CONTEXT VIEWS SHEET 5
ALB-RBG-DWG-ST-00-000-56	CONTEXT VIEWS SHEET 6
ALB-RBG-DWG-ST-00-001-01	TYPICAL SHORING DETAILS SHEET 1
ALB-RBG-DWG-ST-00-001-02	TYPICAL SHORING DETAILS SHEET 2
ALB-RBG-DWG-ST-00-001-03	TYPICAL SHORING DETAILS SHEET 3
ALB-RBG-DWG-ST-00-003-01	TYPICAL FOOTING DETAILS SHEET 1
ALB-RBG-DWG-ST-00-003-02	TYPICAL FOOTING DETAILS SHEET 2
ALB-RBG-DWG-ST-00-004-01	TYPICAL COLUMN JUNCTION DETAILS SHEET 1
ALB-RBG-DWG-ST-00-004-02	TYPICAL COLUMN JUNCTION DETAILS SHEET 2
ALB-RBG-DWG-ST-00-004-03	TYPICAL COLUMN JUNCTION DETAILS SHEET 3
ALB-RBG-DWG-ST-00-004-04	TYPICAL COLUMN JUNCTION DETAILS SHEET 4
ALB-RBG-DWG-ST-00-004-05	TYPICAL COLUMN JUNCTION DETAILS SHEET 5
ALB-RBG-DWG-ST-00-004-06	TYPICAL TIE TYPE DETAILS SHEET 1
ALB-RBG-DWG-ST-00-006-01	TYPICAL INSITU WALLS DETAILS SHEET 1
ALB-RBG-DWG-ST-00-006-02	TYPICAL INSITU WALLS DETAILS SHEET 2
ALB-RBG-DWG-ST-00-006-06	TYPICAL LINTEL DETAILS SHEET 1
ALB-RBG-DWG-ST-00-006-11	TYPICAL BLOCKWORK DETAILS SHEET 1
ALB-RBG-DWG-ST-00-006-12	TYPICAL BLOCKWORK DETAILS SHEET 2
ALB-RBG-DWG-ST-00-006-21	TYPICAL PRECAST CONCRETE WALL DETAILS SHEET 1
ALB-RBG-DWG-ST-00-006-22	TYPICAL PRECAST CONCRETE WALL DETAILS SHEET 2
ALB-RBG-DWG-ST-00-007-01	TYPICAL CONCRETE STAIR DETAILS SHEET 1
ALB-RBG-DWG-ST-00-007-02	TYPICAL CONCRETE STAIR DETAILS SHEET 2
ALB-RBG-DWG-ST-00-007-11	TYPICAL STEELWORK STAIR DETAILS SHEET 1
ALB-RBG-DWG-ST-00-011-01	TYPICAL SLAB ON GROUND DETAILS SHEET 1
ALB-RBG-DWG-ST-00-011-02	TYPICAL SLAB ON GROUND DETAILS SHEET 2
ALB-RBG-DWG-ST-00-011-03	TYPICAL SLAB ON GROUND DETAILS SHEET 3
ALB-RBG-DWG-ST-00-011-06	TYPICAL COMPOSITE SLAB DETAILS SHEET 1
ALB-RBG-DWG-ST-00-011-07	TYPICAL COMPOSITE SLAB DETAILS SHEET 2
ALB-RBG-DWG-ST-00-011-08	TYPICAL COMPOSITE SLAB DETAILS SHEET 3
ALB-RBG-DWG-ST-00-011-09	TYPICAL COMPOSITE SLAB DETAILS SHEET 4
ALB-RBG-DWG-ST-00-011-11	TYPICAL SUSPENDED SLAB DETAILS SHEET 1
ALB-RBG-DWG-ST-00-011-12	TYPICAL SUSPENDED SLAB DETAILS SHEET 2
ALB-RBG-DWG-ST-00-011-21	TYPICAL PRECAST CAPPING SLAB DETAILS SHEET 1
ALB-RBG-DWG-ST-00-014-01	STEELWORK SCHEDULE SHEET 1
ALB-RBG-DWG-ST-00-014-02	STEELWORK SCHEDULE SHEET 2
ALB-RBG-DWG-ST-00-014-06	TYPICAL STEELWORK DETAILS SHEET 1
ALB-RBG-DWG-ST-00-014-07	TYPICAL STEELWORK DETAILS SHEET 2
ALB-RBG-DWG-ST-00-014-08	TYPICAL STEELWORK DETAILS SHEET 3
ALB-RBG-DWG-ST-00-014-09	TYPICAL STEELWORK DETAILS SHEET 4
ALB-RBG-DWG-ST-00-014-10	TYPICAL STEELWORK DETAILS SHEET 5
ALB-RBG-DWG-ST-00-014-11	TYPICAL STEELWORK DETAILS SHEET 6
ALB-RBG-DWG-ST-00-014-12	TYPICAL STEELWORK DETAILS SHEET 7
ALB-RBG-DWG-ST-00-014-51	TYPICAL SECONDARY STEELWORK DETAILS SHEET 1
ALB-RBG-DWG-ST-00-014-52	TYPICAL SECONDARY STEELWORK DETAILS SHEET 2
ALB-RBG-DWG-ST-01-000-01	SITE PLAN
ALB-RBG-DWG-ST-01-000-06	BUILDING SECTIONS SHEET 1
ALB-RBG-DWG-ST-01-000-11	CRR ASSET PROXIMITY PLANS SHEET 1
ALB-RBG-DWG-ST-01-000-12	CRR ASSET PROXIMITY PLANS SHEET 2
ALB-RBG-DWG-ST-01-000-21	TEMPORARY SHORING & RETENTION PLAN
ALB-RBG-DWG-ST-01-000-41	SHORING ELEVATIONS SHEET 1
ALB-RBG-DWG-ST-01-000-42	SHORING ELEVATIONS SHEET 2
ALB-RBG-DWG-ST-01-000-61	SHORING SECTIONS SHEET 1
ALB-RBG-DWG-ST-01-000-62	SHORING SECTIONS SHEET 2
ALB-RBG-DWG-ST-03-BC2-01	FOUNDATION PLAN
ALB-RBG-DWG-ST-03-BC2-31	BASEMENT SECTIONS SHEET 1
ALB-RBG-DWG-ST-03-BC2-51	FOOTING PLAN (RAFT OPTION)
ALB-RBG-DWG-ST-03-BC2-81	BASEMENT SECTIONS (RAFT OPTION) SHEET 1
ALB-RBG-DWG-ST-04-000-01	COLUMN SCHEDULES SHEET 1
ALB-RBG-DWG-ST-06-000-01	INSITU WALL ELEVATIONS SHEET 1
ALB-RBG-DWG-ST-06-000-02	INSITU WALL ELEVATIONS SHEET 2
ALB-RBG-DWG-ST-06-000-03	INSITU WALL ELEVATIONS SHEET 3
ALB-RBG-DWG-ST-06-000-04	INSITU WALL ELEVATIONS SHEET 4
ALB-RBG-DWG-ST-06-000-05	INSITU WALL ELEVATIONS SHEET 5
ALB-RBG-DWG-ST-06-000-06	INSITU WALL ELEVATIONS SHEET 6
ALB-RBG-DWG-ST-06-000-07	INSITU WALL ELEVATIONS SHEET 7
ALB-RBG-DWG-ST-06-000-10	INSITU WALL ELEVATIONS SHEET 10
ALB-RBG-DWG-ST-06-000-21	INSITU WALL ELEVATIONS SHEET 21
ALB-RBG-DWG-ST-06-000-22	INSITU WALL ELEVATIONS SHEET 22
ALB-RBG-DWG-ST-06-000-23	INSITU WALL ELEVATIONS SHEET 23
ALB-RBG-DWG-ST-06-000-24	INSITU WALL ELEVATIONS SHEET 24
ALB-RBG-DWG-ST-06-000-25	INSITU WALL ELEVATIONS SHEET 25

DRAWING LIST

SHEET NUMBER	SHEET NAME
ALB-RBG-DWG-ST-06-000-26	INSITU WALL ELEVATIONS SHEET 26
ALB-RBG-DWG-ST-06-000-27	INSITU WALL ELEVATIONS SHEET 27
ALB-RBG-DWG-ST-06-000-41	INSITU WALL ELEVATIONS SHEET 41
ALB-RBG-DWG-ST-06-000-42	INSITU WALL ELEVATIONS SHEET 42
ALB-RBG-DWG-ST-06-000-43	INSITU WALL ELEVATIONS SHEET 43
ALB-RBG-DWG-ST-06-000-44	INSITU WALL ELEVATIONS SHEET 44
ALB-RBG-DWG-ST-06-000-45	INSITU WALL ELEVATIONS SHEET 45
ALB-RBG-DWG-ST-06-000-46	INSITU WALL ELEVATIONS SHEET 46
ALB-RBG-DWG-ST-06-000-61	INSITU WALL ELEVATIONS SHEET 61
ALB-RBG-DWG-ST-06-000-62	INSITU WALL ELEVATIONS SHEET 62
ALB-RBG-DWG-ST-06-000-63	INSITU WALL ELEVATIONS SHEET 63
ALB-RBG-DWG-ST-06-000-64	INSITU WALL ELEVATIONS SHEET 64
ALB-RBG-DWG-ST-06-000-65	INSITU WALL ELEVATIONS SHEET 65
ALB-RBG-DWG-ST-06-000-66	INSITU WALL ELEVATIONS SHEET 66
ALB-RBG-DWG-ST-06-000-81	INSITU WALL ELEVATIONS SHEET 81
ALB-RBG-DWG-ST-06-000-82	INSITU WALL ELEVATIONS SHEET 82
ALB-RBG-DWG-ST-06-000-83	INSITU WALL ELEVATIONS SHEET 83
ALB-RBG-DWG-ST-06-000-84	INSITU WALL ELEVATIONS SHEET 84
ALB-RBG-DWG-ST-06-001-01	PRECAST WALL ELEVATIONS SHEET 1
ALB-RBG-DWG-ST-06-001-02	PRECAST WALL ELEVATIONS SHEET 2
ALB-RBG-DWG-ST-07-000-01	STAIR ELEVATIONS SHEET 1
ALB-RBG-DWG-ST-07-000-02	STAIR ELEVATIONS SHEET 2
ALB-RBG-DWG-ST-07-000-03	STAIR ELEVATIONS SHEET 3
ALB-RBG-DWG-ST-07-000-04	STAIR ELEVATIONS SHEET 4
ALB-RBG-DWG-ST-08-BC2-01	BASEMENT 2 GENERAL ARRANGEMENT PLAN
ALB-RBG-DWG-ST-08-BL1-01	BASEMENT 1 GENERAL ARRANGEMENT PLAN
ALB-RBG-DWG-ST-08-GL0-01	LOWER GROUND GENERAL ARRANGEMENT PLAN
ALB-RBG-DWG-ST-08-L00-01	GROUND LEVEL GENERAL ARRANGEMENT PLAN
ALB-RBG-DWG-ST-08-L01-01	LEVEL 1 GENERAL ARRANGEMENT PLAN
ALB-RBG-DWG-ST-08-L01-M1	LEVEL 1 MEZZANINE GENERAL ARRANGEMENT PLAN
ALB-RBG-DWG-ST-08-L02-01	LEVEL 2 GENERAL ARRANGEMENT PLAN
ALB-RBG-DWG-ST-08-L02-02	LEVEL 2 UPPER GENERAL ARRANGEMENT PLAN
ALB-RBG-DWG-ST-08-L03-01	LEVEL 3 GENERAL ARRANGEMENT PLAN
ALB-RBG-DWG-ST-08-L04-01	LEVEL 4 GENERAL ARRANGEMENT PLAN
ALB-RBG-DWG-ST-08-L05-01	LEVEL 5 GENERAL ARRANGEMENT PLAN
ALB-RBG-DWG-ST-08-L06-01	LEVEL 6 GENERAL ARRANGEMENT PLAN
ALB-RBG-DWG-ST-08-L07-01	LEVEL 7 GENERAL ARRANGEMENT PLAN
ALB-RBG-DWG-ST-08-L08-01	LEVEL 8 GENERAL ARRANGEMENT PLAN
ALB-RBG-DWG-ST-08-L09-01	LEVEL 9 GENERAL ARRANGEMENT PLAN
ALB-RBG-DWG-ST-08-L10-01	LEVEL 10 GENERAL ARRANGEMENT PLAN
ALB-RBG-DWG-ST-08-L11-01	LEVEL 11 GENERAL ARRANGEMENT PLAN
ALB-RBG-DWG-ST-08-L12-01	LEVEL 12 GENERAL ARRANGEMENT PLAN
ALB-RBG-DWG-ST-08-L13-01	LEVEL 13 GENERAL ARRANGEMENT PLAN
ALB-RBG-DWG-ST-08-L14-01	LEVEL 14 GENERAL ARRANGEMENT PLAN
ALB-RBG-DWG-ST-08-L15-01	LEVEL 15 GENERAL ARRANGEMENT PLAN
ALB-RBG-DWG-ST-08-L16-01	LEVEL 16 GENERAL ARRANGEMENT PLAN
ALB-RBG-DWG-ST-08-L18-01	LEVEL 18 GENERAL ARRANGEMENT PLAN
ALB-RBG-DWG-ST-08-L19-01	LEVEL 19 GENERAL ARRANGEMENT PLAN
ALB-RBG-DWG-ST-08-L20-01	LEVEL 20 GENERAL ARRANGEMENT PLAN
ALB-RBG-DWG-ST-08-L21-01	LEVEL 21 GENERAL ARRANGEMENT PLAN
ALB-RBG-DWG-ST-08-L22-01	LEVEL 22 GENERAL ARRANGEMENT PLAN
ALB-RBG-DWG-ST-08-L23-01	LEVEL 23 GENERAL ARRANGEMENT PLAN
ALB-RBG-DWG-ST-08-L27-01	LEVEL 27 GENERAL ARRANGEMENT PLAN
ALB-RBG-DWG-ST-08-L29-01	LEVEL 29 GENERAL ARRANGEMENT PLAN
ALB-RBG-DWG-ST-08-L30-01	LEVEL 30 GENERAL ARRANGEMENT PLAN
ALB-RBG-DWG-ST-08-L31-01	LEVEL 31 GENERAL ARRANGEMENT PLAN
ALB-RBG-DWG-ST-08-L34-01	LEVEL 34 GENERAL ARRANGEMENT PLAN
ALB-RBG-DWG-ST-08-L37-01	LEVEL 37 GENERAL ARRANGEMENT PLAN
ALB-RBG-DWG-ST-08-L38-01	LEVEL 38 GENERAL ARRANGEMENT PLAN
ALB-RBG-DWG-ST-08-L39-01	LEVEL 39 GENERAL ARRANGEMENT PLAN
ALB-RBG-DWG-ST-08-L40-01	LEVEL 40 GENERAL ARRANGEMENT PLAN
ALB-RBG-DWG-ST-08-L41-01	LEVEL 41 LOWER GENERAL ARRANGEMENT PLAN
ALB-RBG-DWG-ST-08-L41-02	LEVEL 41 UPPER GENERAL ARRANGEMENT PLAN
ALB-RBG-DWG-ST-09-BC2-01	BASEMENT 2 LOADING PLAN
ALB-RBG-DWG-ST-09-BL1-01	BASEMENT 1 LOADING PLAN
ALB-RBG-DWG-ST-09-GL0-01	BASEMENT 1 MEZZANINE LOADING PLAN
ALB-RBG-DWG-ST-09-L00-01	GROUND LEVEL LOADING PLAN
ALB-RBG-DWG-ST-09-L01-01	LEVEL 1 LOADING PLAN
ALB-RBG-DWG-ST-09-L01-M1	LEVEL 1 MEZZANINE LOADING PLAN
ALB-RBG-DWG-ST-09-L02-01	LEVEL 2 LOADING PLAN
ALB-RBG-DWG-ST-09-L03-01	LEVEL 3 LOADING PLAN
ALB-RBG-DWG-ST-09-L04-01	LEVEL 4 LOADING PLAN
ALB-RBG-DWG-ST-09-L05-01	LEVEL 5 LOADING PLAN
ALB-RBG-DWG-ST-09-L06-01	LEVEL 6 LOADING PLAN
ALB-RBG-DWG-ST-09-L07-01	LEVEL 7 LOADING PLAN
ALB-RBG-DWG-ST-09-L08-01	LEVEL 8 LOADING PLAN
ALB-RBG-DWG-ST-09-L09-01	LEVEL 9 LOADING PLAN
ALB-RBG-DWG-ST-09-L10-01	LEVEL 10 LOADING PLAN
ALB-RBG-DWG-ST-09-L11-01	LEVEL 11 LOADING PLAN
ALB-RBG-DWG-ST-09-L12-01	LEVEL 12 LOADING PLAN
ALB-RBG-DWG-ST-09-L13-01	LEVEL 13 LOADING PLAN
ALB-RBG-DWG-ST-09-L14-01	LEVEL 14 LOADING PLAN
ALB-RBG-DWG-ST-09-L15-01	LEVEL 15 LOADING PLAN

DRAWING LIST

SHEET NUMBER	SHEET NAME
ALB-RBG-DWG-ST-09-L18-01	LEVEL 18 LOADING PLAN
ALB-RBG-DWG-ST-09-L19-01	LEVEL 19 LOADING PLAN
ALB-RBG-DWG-ST-09-L20-01	LEVEL 20 LOADING PLAN
ALB-RBG-DWG-ST-09-L21-01	LEVEL 21 LOADING PLAN
ALB-RBG-DWG-ST-09-L22-01	LEVEL 22 LOADING PLAN
ALB-RBG-DWG-ST-09-L27-01	LEVEL 27 LOADING PLAN
ALB-RBG-DWG-ST-09-L28-01	LEVEL 28 LOADING PLAN
ALB-RBG-DWG-ST-09-L29-01	LEVEL 29 LOADING PLAN
ALB-RBG-DWG-ST-09-L30-01	LEVEL 30 LOADING PLAN
ALB-RBG-DWG-ST-09-L31-01	LEVEL 31 LOADING PLAN
ALB-RBG-DWG-ST-09-L37-01	LEVEL 37 LOADING PLAN
ALB-RBG-DWG-ST-09-L38-01	LEVEL 38 LOADING PLAN
ALB-RBG-DWG-ST-09-L39-01	LEVEL 39 LOADING PLAN
ALB-RBG-DWG-ST-09-L40-01	LEVEL 40 LOADING PLAN
ALB-RBG-DWG-ST-09-L41-01	LEVEL 41 LOADING PLAN
ALB-RBG-DWG-ST-11-L00-01	GROUND FLOOR SECTIONS & DETAILS SHEET 1
ALB-RBG-DWG-ST-11-L01-01	LEVEL 1 SECTIONS & DETAILS SHEET 1
ALB-RBG-DWG-ST-11-L01-02	LEVEL 1 SECTIONS & DETAILS SHEET 2
ALB-RBG-DWG-ST-11-L02-01	LEVEL 2 SECTIONS & DETAILS SHEET 1
ALB-RBG-DWG-ST-11-L03-01	LEVEL 3 SECTIONS & DETAILS SHEET 1
ALB-RBG-DWG-ST-11-L04-01	LEVEL 4 SECTIONS & DETAILS SHEET 1
ALB-RBG-DWG-ST-11-L05-01	LEVEL 5 SECTIONS & DETAILS SHEET 1
ALB-RBG-DWG-ST-11-L05-02	LEVEL 5 SECTIONS & DETAILS SHEET 2
ALB-RBG-DWG-ST-11-L06-01	LEVEL 6 SECTIONS & DETAILS SHEET 1
ALB-RBG-DWG-ST-11-L07-01	LEVEL 7 SECTIONS & DETAILS SHEET 1
ALB-RBG-DWG-ST-11-L08-01	LEVEL 8 SECTIONS & DETAILS SHEET 1
ALB-RBG-DWG-ST-11-L38-01	LEVEL 38 SECTIONS & DETAILS SHEET 1
ALB-RBG-DWG-ST-11-L41-01	LEVEL 41 LOWER SECTIONS & DETAILS SHEET 1
ALB-RBG-DWG-ST-13-000-01	STEELWORK ELEVATIONS SHEET 1
ALB-RBG-DWG-ST-13-000-02	STEELWORK ELEVATIONS SHEET 2
ALB-RBG-DWG-ST-13-000-03	STEELWORK ELEVATIONS SHEET 3
ALB-RBG-DWG-ST-13-000-04	STEELWORK ELEVATIONS SHEET 4
ALB-RBG-DWG-ST-13-000-05	STEELWORK ELEVATIONS SHEET 5
ALB-RBG-DWG-ST-13-000-06	STEELWORK ELEVATIONS SHEET 6
ALB-RBG-DWG-ST-13-000-07	STEELWORK ELEVATIONS SHEET 7
ALB-RBG-DWG-ST-13-000-08	STEELWORK ELEVATIONS SHEET 8
ALB-RBG-DWG-ST-13-000-09	STEELWORK ELEVATIONS SHEET 9
ALB-RBG-DWG-ST-13-000-10	STEELWORK ELEVATIONS SHEET 10
ALB-RBG-DWG-ST-13-000-11	STEELWORK ELEVATIONS SHEET 11
ALB-RBG-DWG-ST-13-000-12	STEELWORK ELEVATIONS SHEET 12
ALB-RBG-DWG-ST-13-000-13	STEELWORK ELEVATIONS SHEET 13
ALB-RBG-DWG-ST-13-000-14	STEELWORK ELEVATIONS SHEET 14
ALB-RBG-DWG-ST-13-000-15	STEELWORK ELEVATIONS SHEET 15
ALB-RBG-DWG-ST-13-000-16	STEELWORK ELEVATIONS SHEET 16
ALB-RBG-DWG-ST-13-000-17	STEELWORK ELEVATIONS SHEET 17
ALB-RBG-DWG-ST-13-000-18	STEELWORK ELEVATIONS SHEET 18
ALB-RBG-DWG-ST-13-000-19	STEELWORK ELEVATIONS SHEET 19
ALB-RBG-DWG-ST-13-000-20	STEELWORK ELEVATIONS SHEET 20
ALB-RBG-DWG-ST-13-000-21	STEELWORK ELEVATIONS SHEET 21
ALB-RBG-DWG-ST-13-000-22	STEELWORK ELEVATIONS SHEET 22
ALB-RBG-DWG-ST-13-000-23	STEELWORK ELEVATIONS SHEET 23
ALB-RBG-DWG-ST-13-000-24	STEELWORK ELEVATIONS SHEET 24
ALB-RBG-DWG-ST-13-000-25	STEELWORK ELEVATIONS SHEET 25
ALB-RBG-DWG-ST-13-000-26	STEELWORK ELEVATIONS SHEET 26
ALB-RBG-DWG-ST-13-000-27	STEELWORK ELEVATIONS SHEET 27
ALB-RBG-DWG-ST-13-000-28	STEELWORK ELEVATIONS SHEET 28
ALB-RBG-DWG-ST-13-000-29	STEELWORK ELEVATIONS SHEET 29
ALB-RBG-DWG-ST-13-000-30	STEELWORK ELEVATIONS SHEET 30
ALB-RBG-DWG-ST-13-000-31	STEELWORK ELEVATIONS SHEET 31
ALB-RBG-DWG-ST-13-000-32	STEELWORK ELEVATIONS SHEET 32
ALB-RBG-DWG-ST-13-000-33	STEELWORK ELEVATIONS SHEET 33
ALB-RBG-DWG-ST-13-000-34	STEELWORK ELEVATIONS SHEET 34
ALB-RBG-DWG-ST-13-000-35	STEELWORK ELEVATIONS SHEET 35
ALB-RBG-DWG-ST-13-000-36	STEELWORK ELEVATIONS SHEET 36
ALB-RBG-DWG-ST-14-000-01	STEELWORK DETAILS SHEET 1
ALB-RBG-DWG-ST-14-000-02	STEELWORK DETAILS SHEET 2
ALB-RBG-DWG-ST-14-000-03	STEELWORK DETAILS SHEET 3
ALB-RBG-DWG-ST-14-000-04	STEELWORK DETAILS SHEET 4
ALB-RBG-DWG-ST-14-000-05	STEELWORK DETAILS SHEET 5

Rev	Revision Description	By	App	Date
T02	ISSUED FOR TENDER	DS	MA	17.07.24
T01	ISSUED FOR TENDER	DS	MA	28.06.24
A02	80% DD DRAFT	DS	MA	07.06.24
A01	50% DD ISSUE	SV	MA	09.08.23
P01	DRAFT 50% DESIGN DEVELOPMENT	SV	MA	28.07.23

SCALE	1	2	3	4	5	6	7	8

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DO NOT SCALE DRAWINGS, USE FIGURED DIMENSIONS
REFER TO GENERAL NOTES UNLESS NOTED OTHERWISE

Structural, Civil & Construction
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Client
QIC

Project
101 ALBERT STREET, BRISBANE

Title
COVER SHEET

Date
Jun 2024
Scale at A1
1:400
Drawn
D.STUCKEY
Designer
N.DOYLE/T.KATUNAR
Design Checker
-
Approved
M.AVERY
Job Number
22131S

FOR TENDER - NOT FOR CONSTRUCTION

Drawing Number
ALB-RBG-DWG-ST-00-000-01
Revision
T02

PRINT DRAWINGS IN COLOUR

GENERAL NOTES

1. THESE ENGINEERING DRAWINGS ARE TO BE READ IN CONJUNCTION WITH PROJECT SPECIFICATIONS AND OTHER CONSULTANTS DRAWINGS ON THE PROJECT.

2. THESE ENGINEERING DRAWINGS HAVE BEEN PREPARED FROM INFORMATION AVAILABLE AT THE TIME OF ISSUE. AS THIS INFORMATION MAY BE THE SUBJECT OF CHANGE PRIOR TO OR DURING CONSTRUCTION THE CONTRACTOR IS TO ADVISE THE ENGINEER WHERE DISCREPANCIES OCCUR.

3. THE ORDER OF PRECEDENCE OF THE STRUCTURAL PROJECT DOCUMENTATION SHALL BE:
   1: THE PROJECT DRAWINGS
   2: DESIGN BRIEF; MOVEMENT AND TOLERANCE REPORT
   3: THE PROJECT SPECIFICATION.
   IF AN AMBIGUITY OR DISCREPANCY IN THE PROJECT DOCUMENTS IS DISCOVERED, THE CONTRACTOR IS TO NOTIFY RBG IN WRITING. RBG SHALL DIRECT THE CONTRACTOR IN WRITING AS TO THE INTERPRETATION TO BE FOLLOWED BY THE CONTRACTOR IN CARRYING OUT THE WORK. IN THE ABSENCE OF DIRECTION, THE MORE STRINGENT REQUIREMENTS SHALL APPLY.

4. THE STRUCTURE HAS BEEN DESIGNED FOR THE IN-SERVICE LOADS ACTING WHEN THE STRUCTURE IS COMPLETE ONLY. LOADS OR ACTIONS DUE TO CONSTRUCTION AND INSTALLATION METHODOLOGIES AND/OR EQUIPMENT HAVE NOT BEEN CONSIDERED UNLESS CLEARLY STATED OTHERWISE.

5. THESE DRAWINGS SHALL NOT BE USED FOR FINAL SETOUT OF THE PROJECT UNLESS SPECIFICALLY STATED.

6. WHERE STRUCTURAL CERTIFICATION IS REQUIRED, INSPECTIONS ARE TO BE PERFORMED BY A DULY APPOINTED INSPECTOR FROM 'ROBERT BIRD GROUP'. THESE INSPECTIONS ARE TO BE PERFORMED IN ACCORDANCE WITH THE INSPECTION & TEST PLANS PREPARED BY 'ROBERT BIRD GROUP.' THE INSPECTOR IS TO BE GIVEN A MINIMUM OF 48 HOURS NOTICE THAT AN INSPECTION IS REQUIRED.

7. PRIOR TO THE COMMENCEMENT OF WORKS THE CONTRACTOR IS TO IDENTIFY ALL EXISTING SERVICES. ANY SERVICES SHOWN ON 'ROBERT BIRD GROUP' DRAWINGS ARE INDICATIVE ONLY.

8. THE CONTRACTOR SHALL CHECK OR OBTAIN ALL DIMENSIONS RELEVANT TO SETTING OUT OF SITE WORKS, AND THE PROVISION OF ANY TEMPORARY BRACING, INCLUDING DESIGN, IN ACCORDANCE WITH THE SPECIFICATION.

9. DURING CONSTRUCTION THE CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTAINING THE STABILITY OF THE WORKS AND ENSURE NO PART IS OVERSTRESSED. THE DESIGN AND CERTIFICATION OF ALL FORMWORK AND BACKPROPPING IS TO BE THE RESPONSIBILITY OF THE CONTRACTOR. (REFER TO CONCRETE NOTES FOR STRIPPING PROCEDURES FOR IN-SITU CONCRETE).

10. THE CONTRACTOR IS TO OBTAIN DESIGN ADVICE FROM A SUITABLY QUALIFIED ENGINEER REGARDING DEMOLITION, RETROFITTING, TEMPORARY WORKS, HEALTH & SAFETY AND NUISANCE. THIS HAS BEEN REFERRED TO AS THE "CONTRACTORS ENGINEER" THROUGHOUT THE REMAINING NOTES.

11. WORKMANSHIP AND MATERIALS SHALL BE IN ACCORDANCE WITH THE CURRENT AUSTRALIAN STANDARDS AND NCC STATUTORY REQUIREMENTS, EXCEPT WHERE VARIED BY THE CONTRACT DOCUMENTS.

12. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ENSURING THAT SUFFICIENT TOLERANCES ARE PROVIDED AND INTEGRATED THROUGHOUT ALL ELEMENTS OF THE WORKS.

13. ALL NON-LOAD BEARING ELEMENTS SHALL BE KEPT CLEAR OF THE STRUCTURE SOFFIT BY AN ALLOWANCE DETERMINED FROM SPAN/250 OR CANTILEVER/125 BUT NOT LESS THAN 20mm, UNLESS NOTED OTHERWISE ON THE DRAWINGS.

14. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS STATED OTHERWISE.

15. SUPERIMPOSED DEAD LOADS AND LIVE LOADS HAVE BEEN DETERMINED IN ACCORDANCE WITH AS1170 AND ARE SHOWN ON THE GENERAL ARRANGEMENT DRAWINGS.

16. WIND LOADS HAVE BEEN DETERMINED BY RWDI WIND CONSULTANTS. REFER TO WIND REPORTS "RWDII-RPT-WE-0010 2" AND "RWDII-RPT-WE-0003 1" FOR DETAILS. SEISMIC LOADS HAVE BEEN DETERMINED IN ACCORDANCE WITH ASS1170 BASED ON THE FOLLOWING DESIGN CRITERIA :-

NCC STRUCTURAL IMPORTANCE LEVEL: 3

WIND LOADS:		EARTH QUAKE LOADS:	
ANNUAL PROBABILITY OF EXCEEDANCE	1:1000	ANNUAL PROBABILITY OF EXCEEDANCE	1:1000
REGION	RWDI	PROBABILITY FACTOR Kp	1.3
TERRAIN CATEGORY	RWDI	HAZARD FACTOR	0.08
REGIONAL WIND SPEED V_R (m/s)	RWDI	SITE SUB-SOIL CLASS	C
SHIELDING M_S	RWDI	STRUCTURAL DUCTILITY FACTOR u	1*
TOPOGRAPHIC Mt	RWDI	STRUCTURAL PERFORMANCE FACTOR Sp	0.77
		EARTHQUAKE DESIGN CATEGORY	III

17. SPECIALIST CONSULTANT REPORTS RELIED UPON FOR THE STRUCTURAL DESIGN INCLUDE BUT ARE NOT LIMITED TO, THE FOLLOWING.
THE GEOTECHINAL ENGINEERING INVESTIGATION HAS BEEN PERFORMED BY

EDG CONSULTING — REPORT NO : B01493-1BC — DATE : AUGUST 2024

THE VIBRATION ENGINEERING INVESTIGATION HAS BEEN PERFORMED BY

HEILIG AND PARTNERS — REPORT NO : IMP 101 ALBERT ST FINAL — DATE : JUNE 2024
REPORT NO : SMVR 101 ALBERT ST FINAL — DATE : JUNE 2024
REPORT NO : TSMR 101 ALBERT ST FINAL — DATE : JUNE 2024

THE STRUCTURAL FIRE ENGINEERING INVESTIGATION HAS BEEN PERFORMED BY

ADP AND UQ — REPORT NO : FIRE ENGINEERING BRIEF BNE0776 — DATE : JULY 2024

INSTRUMENTATION, VIBRATION AND MOVEMENT MONITORING NOTES

1. REFER TO THE CONSTRUCTION MONITORING MANAGEMENT PLAN AND VIBRATION ENGINEERING REPORTS SPECIFIED IN THE GENERAL NOTES.

2. THE CONTRACTOR IS TO INCORPORATE THE INSTRUMENTATION, MONITORING POINTS, MOVEMENT LIMITS AND SURVEY FREQUENCIES NOMINATED IN THE VIBRATION ENGINEERING REPORTS, CONSTRUCTION MONITORING MANAGEMENT PLAN AND THESE DRAWINGS.

3. THE CONTRACTOR IS TO INCORPORATE CONSTRUCTION ACTIVITY LIMITATIONS AS SPECIFIED IN THE CONSTRUCTION MONITORING MANAGEMENT PLAN AND VIBRATION REPORTS.

4. INSTRUMENTATION AND MONITORING SURVEY POINTS SHALL BE INCORPORATED INTO THE INITIAL RETENTION STRUCTURE BY THE CONTRACTOR. THE CAPPING BEAM MOVEMENTS SHALL BE MONITORED AT MID POINTS OF EACH BOUNDARY WALL AS A MINIMUM. SHORING WALL MOVEMENTS NOMINATED IN THE MOVEMENT AND TOLERANCE REPORT NOT TO BE EXCEEDED.

5. CONDITION SURVEYS TO BE UNDERTAKEN ON ADJACENT BUILDINGS, SERVICES, CRR ASSETS ETC IN ACCORDANCE WITH THE VIBRATION ENGINEERING REPORTS.

6. THE CONTRACTOR IS TO SUBMIT THE SURVEY AND INSTRUMENTATION MONITORING RESULTS MINIMUM ON A WEEKLY BASIS TO THE DESIGNER FOR REVIEW SHOWING VARIANCE FROM BASELINE VALUES.

7. INSTRUMENTATION SHALL BE MONITORED UNTIL THE COMPLETION OF THE PERMANENT PRIMARY STRUCTURE OR INSTRUMENTS ARE DECOMMISSIONED DUE TO CONSTRUCTION SEQUENCING.

8. MONITORING FREQUENCIES AND ZONES MAY BE MODIFIED BY THE DESIGNER DURING CONSTRUCTION BASED ON CONSTRUCTION ACTIVITIES AND OBSERVED MOVEMENTS REPORTED.

9. THE GEOTECHNICAL ASSESSOR IS TO NOTIFY THE DESIGNER IF ADVERSE GROUND CONDITIONS ARE ENCOUNTERED WHICH DIFFER SIGNIFICANTLY FROM STRATA INDICATED ON THE DRAWINGS, SUCH THAT ADDITIONAL MONITORING MAY BE REQUIRED BASED ON ACTUAL GROUND CONDITIONS ENCOUNTERED DURING EXCAVATION.

10. REFER TO EDQ NOTES FOR ADDITIONAL CERTIFICATION AND DA REQUIREMENTS.

HEALTH & SAFETY

1. THE CONTRACTOR SHALL DEVELOP, IMPLEMENT AND ADMINISTER A WORKPLACE HEALTH AND SAFETY PROGRAM THAT WILL ENSURE THAT ALL CONSTRUCTION ACTIVITIES ARE PERFORMED TO THE RELEVANT WORKPLACE HEALTH AND SAFETY REQUIREMENTS AND ANY OTHER RELEVANT STATUTORY REQUIREMENTS.

2. THE WORKPLACE HEALTH AND SAFETY PROGRAM MUST BE CO-ORDINATED WITH ADJOINING PROPERTY OWNERS AND ALL RELEVANT PARTIES AS NECESSARY TO ENSURE A SAFE BUILDING ENVIRONMENT AT ALL TIMES.

NUISANCE

1. THE CONTRACTOR SHALL DEVELOP, IMPLEMENT, AND ADMINISTER A PLAN THAT WILL ENSURE THE MANAGEMENT OF NOISE AND VIBRATION RESULTING FROM CONSTRUCTION WORKS. REFER TO SPECIFICATIONS FOR REQUIRED LIMITS, OTHERWISE, CONTACT ENGINEER FOR GUIDANCE.

2. THE CONTRACTOR WILL NEED TO ENSURE ALL ADJOINING PROPERTY REQUIREMENTS RELATING TO NOISE AND VIBRATION ARE MET.

3. IF IT IS ESTABLISHED THAT THERE ARE NO SITE SPECIFIC REQUIREMENTS, THEN THE CONTRACTOR SHALL REFER TO MINIMUM REQUIREMENTS FOR ABATEMENT OF NOISE AND VIBRATION NOMINATED BY RELEVANT STATUTORY REQUIREMENTS

4. THE CONTRACTOR WILL NEED TO PREPARE AND ADVISE ON MONITORING AND MANAGEMENT OF NOISE AND VIBRATION BASED ON PROFESSIONAL ADVICE FROM SUITABLY QUALIFIED PERSON OR PERSONS.

TEMPORARY WORKS

1. THE CONTRACTOR SHALL ALLOW FOR IN THEIR PRICE ALL COSTS ASSOCIATED WITH THE DESIGN, SUPPLY, INSTALLATION AND REMOVAL OF ALL TEMPORARY BACK PROPPING, SAFETY SCREENS, SCAFFOLDING AND OTHER REQUIREMENTS OF THE CONSTRUCTION PROCESS. THE CONTRACTOR SHALL ENGAGE SUITABLY QUALIFIED ENGINEER REFEREED TO AS "CONTRACTORS ENGINEER". TO DESIGN INSPECT AND CERTIFY ALL TEMPORARY WORKS, AND DEMOLITION WORKS.

2. THE CONTRACTOR IS TO PROVIDE ALL TEMPORARY WORKS CONTRACTOR ENGINEERING DRAWINGS TO THE STRUCTURAL ENGINEER FOR INFORMATION.

3. IT IS THE CONTRACTOR'S RESPONSIBILITY TO ENSURE THE OVERALL STABILITY OF THE STRUCTURE AND NO PART IS OVERSTRESSED DUE TO CONSTRUCTION & INSTALLATION METHODOLOGIES AND/OR EQUIPMENT DURING CONSTRUCTION. THE CONTRACTOR SHALL OBTAIN ADVICE FROM THE CONTRACTORS ENGINEER.

4. THE CONTRACTOR IS TO HAVE CONSTRUCTION METHODOLOGY STATEMENTS PREPARED AND SUBMITTED FOR GENERAL REVIEW TO ENSURE IT IS IN ACCORDANCE WITH THE DESIGN INTENT.

5. ALL VERTICAL DISPLACEMENTS AND MOVEMENTS ARE TO BE LIMITED TO ENSURE THE STRUCTURE IS NOT SUBJECTED TO LOADS OR MOVEMENTS CAUSING STRUCTURAL DISTRESS TO ANY ELEMENT WHILE THE STRUCTURE IS BEING TEMPORARILY SUPPORTED.

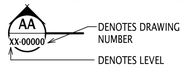
6. DEPENDING ON THE CONTRACTORS PREFERRED CONSTRUCTION SEQUENCE, PRE-LOADING OF STRUCTURAL ELEMENTS MAY BE REQUIRED TO LIMIT TOTAL VERTICAL DISPLACEMENTS.

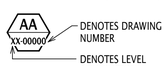
7. STRUCTURE TO BE ADEQUATELY BRACED TO PREVENT ANY HORIZONTAL MOVEMENT OR DEFLECTIONS.

LEGEND/ABBREVIATIONS

ABBREVIATION	DESCRIPTION
HORIZ	HORIZONTAL
VERT	VERTICAL
CENT	CENTRALLY PLACED
CRS	CENTRES
B or BTM	BOTTOM FACE
T	TOP FACE
T&B	TOP & BOTTOM
NF	NEAR FACE
FF	FAR FACE
EF	EACH FACE
EW	EACH WAY
EQ	EQUAL
NSOP	NOT SHOWN ON PLAN
NSOE	NOT SHOWN ON ELEVATION
UNO	UNLESS NOTED OTHERWISE
TYP	TYPICAL
CL	CENTRE LINE
PL	PLATE
CFW	CONTINUOUS FILLET WELD
FSBW	FULL STRENGTH BUTT WELD
FPBW	FULL PENETRATION BUTT WELD

ABBREVIATION	DESCRIPTION
N/S	NEAR SIDE
F/S	FAR SIDE
B/S	BOTH SIDES
U/S	UNDER SIDE
LG	LENGTH/LONG
w	WIDTH/WIDE
h	HEIGHT/HIGH
d	DEPTH/DEEP
NOM	NOMINAL
REQ'D	REQUIRED
REINF	REINFORCEMENT
OPP	OPPOSITE
SIM	SIMILAR
GA	GENERAL ARRANGEMENT
PT	POST TENSION
DWG	DRAWINGS
NTS	NOT TO SCALE
LL	LIVE LOAD
SIDL	SUPERIMPOSED DEAD LOAD
THRU	THROUGH
NLB	NON LOAD BEARING





ECONOMIC DEVELOPMENT QUEENSLAND (EDQ/QUU/BCC/AUTHORITY) NOTES

1. THE CONTRACTOR SHALL MAKE PROVISION FOR COST AND TIME ASSOCIATED WITH ANY CHANGES TO THE DOCUMENTED STRUCTURE THAT TRIGGER REDESIGN TO ACHIEVE COMPLIANCE WITH THE PDA DEVELOPMENT CONDITIONS (DA CONDITIONS) OUTLINED IN THE EDQ DECISION NOTICE TO APPLICANT LETTER DEV2023-1374 DATED 6 NOVEMBER 2023.

2. A GEOTECHNICAL CAVERN ASSEMENT HAS BEEN UNDERTAKEN BY EDG BASED ON THE DOCUMENTED STRUCTURAL ARRANGEMENT AT 80%DD. THE CONTRACTOR SHALL MAKE PROVISION FOR THE COST AND TIME ASSOCAITED WITH THIS ANALYSIS WORK BASED ON CONSTRUCTION DOCUMENTATION.

3. FOR ALL RELEVANT D&C ITEMS THE CONTRACTOR SHALL ALLOW FOR ALL COSTS ASSOCIATED WITH, BUT NOT LIMITED TO, THE FOLLOWING:
   A. ACHIEVING THE REQUIREMENTS OUTLINED WITHIN THE ECONOMIC DEVELOPMENT QUEENSLAND (EDQ) CERTIFICATION MANUAL (CPM). THE CPM PROCESS INCLUDES DEFINED DEED POLL AND CERTIFICATION PROCESS RELATED TO DESIGN, CONSTRUCTION AND DELIVERY OF STRUCTURE IN ACCORDANCE WITH THE PA CONDITIONS.
   B. THE D&C CONTRACTOR SHALL ALLOW FOR AN INDEPENDENT APPROVED RPEQ CERTIFIED ENGINEER TO ACT AS THE CERTIFIER FOR ALL DESIGN AND CONSTRUCTION STAGES TO EDQ.
   C. ALL COSTS ASSOCIATED WITH RE-DESIGN AND ANALYSIS WORK TO COMPLY WITH THE DA REQUIREMENTS.

4. D&C ITEMS IMPACTED BY THE DA REQUIREMENTS MAY INCLUDE THE FOLLOWING:
   A. SHORING SYSTEM INCLUDING TEMPORARY RESTRAINT SYSTEM OF INTERNAL STRUTS AND WALER BEAMS.
   B. CIVIL WORKS INCLUDING EXCAVATION, DEMOLITION OF IN GROUND STRUCTURE, FOUNDATIONS, CAST-IN SITU PILE SLEEVES ETC
   C. ALL TEMPORARY WORKS ITEMS NOT DOCUMENTED IN THE RBG STRUCTURAL DOCUMENTATION.
   D. STRUCTURAL AND GEOTECHNICAL ENGINEERING AND ANALYSIS ASSOCIATED WITH THE D&C ITEMS.

5. THE CONTRACTOR IS TO COMPLY WITH ALL STRUCTURAL AND SERVICES MONITORING AND VIBRATION LIMITS AS FOLLOWS:
   A. CIVIL CONSTRUCTION ACTIVITY LIMITATIONS AND RESTRICTIONS AS PER INSTRUMENTATION, VIBRATION AND MOVEMENT MONITORING NOTES.
   B. VIBRATION AND MONITORING AS PER INSTRUMENTATION, VIBRATION AND MOVEMENT MONITORING NOTES.
   C. CONDITION SURVEYS TO BE UNDERTAKEN ON ADJACENT BUILDINGS, SERVICES, CRR ASSETS ETC IN ACCORDANCE WITH THE VIBRATION ENGINEERING REPORTS.

6. THE CONTRACTOR TO ALLOW IN THEIR PROGRAMME AND PRICE A PROVISION FOR SUBMISSIONS, REVIEW AND APPROVAL PROCESS WITH AUTHORITIES.

7. THE CONTRACTOR TO ALLOW FOR MANAGING AND SUBMITTING A BUILD OVER INFRASTRUCTURE (BOI) APPLICATION TO OBTAIN APPROVAL FOR BUILDING OVER OR NEAR INFRASTRUCTURE INCLUDING PUBLIC WATER, STORMWATER, SEWERAGE, ENERGEX AND OTHER.

8. THESE ENGINEERING DRAWINGS ARE BASED ON CRRDA CONSTRAINTS RELIANCE INFORMATION.

CONSTRUCTION METHODOLOGY AND ERECTION SEQUENCE (CMES)

GENERAL

G1. THE FOLLOWING NOTES DENOTE MINIMUM PROJECT CMES REQUIREMENTS THAT NEED TO BE CONSIDERED BY THE CONTRACTOR AND PRICED INTO THEIR TENDER.

G2. ALL CONSTRUCTION ACTIVITIES NEED TO BE IN ACCORDANCE WITH THE CRR SITE DESIGN CONSTRAINTS, EDQ NOTES, AND IN ACCORDANCE WITH THE DA APPROVAL. THIS INCLUDES LIMITATION OF CONSTRUCTION ACTIVITIES TO ALBERT STREET, LIMITATIONS ON LOADING AND EXCAVATION, CLEARANCES TO THE CROSS RIVER RAIL **(CRR)** LICENCE CONSTRUCTION AREA **(LCA)**, CRR AWNING AND SENSITIVE SERVICES SUCH AS THE S1 SEWER.

G3. THE STRUCTURAL ELEMENT DESIGN AND DOCUMENTATION CONSIDERS THE PERMANENT CONDITION ONLY WITH NO ALLOWANCE MADE FOR TEMPORARY WORKS LOADS AND PENETRATIONS FOR BUT NOT LIMITED, PROTECTION AND EDGE SCREENS, PLATFORMS, RECOVER CRANES, HOISTS, STEEL AND FAÇADE INSTALLATION METHODOLOGY AND EQUIPMENT ETC. CONTRACTOR TO MAKE APPROPRIATE PROVISIONS.

G4. TEMPORARY WORKS DESIGN AND LOADS SHALL BE SUPPORTED OFF FLOOR BEAMS TO ENSURE IMPOSED LOADS ARE APPLIED THROUGH BEAM SHEAR CENTERS TO AVOID ECCENTRIC LOADING AND ADDITIONAL TORISONAL LOADS BEING IMPOSED ONTO THE PERMANENT STRUCTURE. ADDITIONAL TEMPORARY WORKS TO BE ALLOWED TO TRANSFER LATERAL LOADS BACK TO CENTER OF SLABS. THE CONTRACTOR TO MAKE APPROPRIATE PROVISIONS FOR ALL REVIEW AND REDESIGN OF PERMANENT STRUCTURE FOR TEMPORARY WORKS.

G5. PERMANENT OR TEMPORARY STRUCTURE LOADING AND EXCAVATION LIMITS WITHIN THE CRR LICENCE CONSTRUCTION AREA **(LCA)** OR BELOW RL-8.000 WITHIN THE EXCAVATION LIMIT AREA **(ELA)**.

G6. CONSTRUCTION AND EXCAVATION ACTIVITIES TO BE UNDERTAKEN WITH CARE TO PREVENT DAMAGE TO EXISTING NEIGHBOURING BUILDINGS AND INFRASTRUCTURE.

G7. ALL CONCRETE UPSTANDS, TRANSFER WALLS AND KICKER WALLS (MINIMUM STOREY HIGH) TO BE PROPPED, AS REQUIRED, UNTIL THE CONCRETE HAS ACHIEVED MINIMUM 28 DAY AGE.

G8. LOAD SHARE BETWEEN CONCRETE STRUCTURAL ELEMENTS AND SERVICEABILITY LIMIT STATE DESIGN TO CONSIDER BOTH COMPRESSIVE STRENGTH AND YOUNG MODULUS GAIN WITH AGE.

G9. CONTRACTOR TO MAKE PROVISION FOR REVIEW/DESIGN AND APPROVAL OF ADDITIONAL OR CHANGES TO THE CONSTRUCTION JOINTS AND STEELWORK SPLICES LOCATIONS AND TYPES SHOWN ON PLAN AND ELEVATION.

G10. READ THE STRUCTURAL DRAWINGS IN CONJUNCTION WITH THE FOLLOWING REPORTS:
   a. STRUCTURAL DESICN BRIEF ALB-RBG-REP-ST-00-000-01;
   b. MOVEMENT AND TOLERANCE REPORT ALB-RBG-REP-ST-00-000-03; AND
   c. STRUCTURAL SPECIFICATIONS.

G11. ALL CHANGES TO STRUCTURAL MATERIAL PROPERTIES TO ACHIEVE CONSTRUCTIONTIMEFRAME REDUCTIONS TO BE ISSUED TO RBG AND ESD CONSULTANT FOR REVIEW AND APPROVAL. I.E IF THE F'C OF SLABS IS INCREASED TO ALLOW EARLIER TRAFFICABILITY THIS CAN IMPACT ON THE EMBODIED CARBON RATES AND OVERAL PROJECT SAVINGS.

G12. REFER TO EDQ NOTES FOR ADDITIONAL DA REQUIREMENTS.

G13. THE CONTRACTOR IS TO INCORPORATE CONSTRUCTION ACTIVITY LIMITATIONS AS SPECIFIED IN THE CONSTRUCTION MONITORING MANAGEMENT PLAN AND VIBRATION REPORTS WHICH NOTE CONSTRUCTION ACTIVITY LIMITS. VIBRATION LIMITS FOR THE S1 SEWER TO BE CONFIRMED WITH QUU.

G14. THE PERMANENT WORKS DESIGN RELIES ON CONSRUCTION JOINTS BEING THOROUGHLY SCABBLED.

G15. THE CONTRACTOR NEEDS TO ALLOW FOR ADDITIONAL PROVISION FOR RBG TO UNDERTAKE ANY REDESIGN AND DOCUMENTATION TO ALLOW FOR TEMPORARY WORKS INCLUDING PRODUCING CMES DRAWINGS.

G16. READ IN CONJUNCTION WITH THE MCGREGOR 101 ALBERT STREET PRE TENDER INDICATIVE CONSTRUCTION MANAGEMENT PLAN.

SITE, SHORING, RETENTION AND EXCAVATION

S1. READ IN CONJUNCTION WITH THE CONTEXT VIEWS ON DRAWING SERIES ST-00-000-5#.

S2. THE CURRENT BASEMENT DESIGN IS BASED ON CONVENTIONAL SHORING AND BASEMENT CONSTRUCTION ADOPTING SOLDIER PILES AND SHOTCRETE WALLS, WITH 2 LAYERS OF STRUTS AND WALERS. CONTRACTOR TO ALLOW PROVISION FOR ADDITIONAL DESIGN AND DOCUMENTATION SHOULD THIS CONCEPT BE CHANGED. READ IN CONJUNCTION WITH EDQ NOTES AND

S3. CONSTRUCTION LOADING BEHIND SHORING AND RETENTION WALLS TO BE CONTROLLED IN ACCORDANCE WITH THE SITE PLAN ON DRAWING ST-01-000-01.

S4. CONTRACTORS PILING AND GEOTECHNICAL ENGINEERS TO CONFIRM DESIGN OF THE STRUTS AND WALERS TO HORIZONTALLY RESTRAIN THE SHORING WALL IN ACCORDANCE WITH THE STRUCTURAL DRAWINGS AND REPORTS.

S5. CONTRACTOR TO MAKE ALLOWANCE FOR ADDITIOANL TEMPORARY WORKS, DESIGN AND PROGRAMME REQUIRED FOR THE PROPOSED SHORING AND RETETNION WALL TEMPORARY SUPPORT SYSTEM OF INTERNAL STEELWORK STRUTS AND WALER BEAMS. THIS MIGHT INCLUDE BUT IS NOT LIMITED TO THE FOLLOWING:
   a. MODIFICATION OF THE JUMPFORM SYSTEM AND CORE TO ALLOW FOR TEMPORARY PENETRATIONS TO THE WALLS AND LINTELS FOR STEELWORK STRUTS.
   b. ADDITIONAL SPLICES TO ALLOW INSTALL AND REMOVAL OF STRUTS.
   c. STAGED CORE CONSTRUCTION THROUGH THE BASEMENTS LEVELS.
   d. REDESIGN OF THE SHORING AND RETENTION WALL AND FOUNDATION SYSTEMS FOR MODIFICATIONS TO THE STRUT AND WALER ARRANGEMENT INCLUDING STAGED STRUT INSTALL/MODIFICATION/REMOVAL SEQUENCING.
   e. TEMPORARY PENETRATION REQUIREMENTS TO GROUND AND BASEMENT SLABS TO REMOVE SHORING WALL TEMPORARY STRUTS AND WALERS.
   f. REDESIGN OF THE CORE AND LINTELS TO INCORPORATE THE STAGED CORE CONSTRUCTION METHODOLOGY.

S6. THE CONTRACTORS GEOTECHNICAL ENGINEER TO CONFIRM SAFE TEMPORARY BATTER ANGLE TO DETAILED EXCAVATION EXTENTS. IF SAFE TEMPORARY BATTER ANGLES ARE EXCEEDED ALLOW ADDITIONAL TEMPORARY SHORING AS REQUIRED TO CONSTRUCT THE FOUNDATIONS.

S7. THE FOUNDATION PILE DESIGN IS BASED ON PILING THROUGH IN-GROUND STRUCTURE AS ILLUSTRATED ON THE CRR ASSET PROXIMITY PLANS ON DRAWINGS ST-01-000-11 & 12. CONTRACTOR TO MAKE ADDITIONAL PROVISION WHICH MIGHT INCLUDE STOCK PILING REPLACEMENT PILING EQUIPMENT.

S8. BULK EXCAVATION LEVELS TO SLAB ON GROUND EXTENTS SUBJECT TO CONFIRMATION OF SLAB ON GROUND FOUNDING SUBGRADE AND DRAINAGE MATERIAL. ADDITIONAL EXCAVATION MAY BE REQUIRED TO ACHIEVE MINIMUM WORKING LOAD CAPACITY OR SUBGRADE CBR. GEOTECHNICAL ENGINEER TO CONFIRM ON SITE.

S9. THE SLAB ON GROUND DESIGN CONSIDERS PERMANENT CONDITION ONLY WITH NO ALLOWANCE CURRENTLY MADE FOR TEMPORARY WORKS LOADS. THE MATERIAL TO BASEMENT B2 TYPICALLY CONSISTS OF RESIDUAL SOIL. CONTRACTOR TO ALLOW PROVISION FOR ANY ADDITIONAL STRUCTURE AS REQUIRED TO ALLOW CONSTRUCTION OF THE BASEMENT 1, EOT AND GROUND SLABS.

S10. THE FOOTING DESIGN CONSIDERS THE PERMANENT CONDITION ONLY WITH NO ALLOWANCE CURRENTLY MADE FOR TEMPORARY WORKS LOADS AND TOP-DOWN CONSTRUCTION CMES. FOUNDATION PILES ASSUMED TO BE INSTALLED FROM THE BULK EXCAVATION LEVEL. ADDITIONAL PROVISION TO BE MADE BY CONTRACTOR TO ALLOW FOR REDESIGN AND DOCUMENTATION ETC.

S11. THE CONTRACTOR SHALL DEVELOP AND ADOPT APPROPRIATE CONSTRUCTION METHODOLOGIES SUCH THAT THE STABILITY OF THE WORKS IS MAINTAINED, NO PART IS OVERSTRESSED AND THERE IS NO DAMAGE TO THE ADJACENT STRUCTURES OR SERVICES.

S12. TEMPORARY STRUCTURES SUCH AS WORKING PLATFORMS, ACCESS STAIRS, CRANE AND THE LIKE REQUIRED FOR THE EXECUTION OF THE WORKS SHALL BE DESIGNED AND CERTIFIED BY OTHERS. TEMPORARY STRUCTURES SHALL NOT IMPACT TO THE TEMPORARY RETENTION WORKS.

WALLS

W1. READ IN CONJUNCTION WITH THE CONTEXT VIEWS ON DRAWING SERIES ST-00-000-5#.

W2. WALLS CONSTRUCTED OFF COLUMNS/SLABS OR SUSPENEDED ABOVE STRUCTURE NEED TO BE FULLY PROPPED UNTIL THE FIRST STOREY OF WALL AND SUPPORTED SLAB OVER HAVE ACHIEVED 28 DAY CONCRETE AGE. CONTRACTOR TO MAKE PROVISION FOR THIS REQUIREMENT IN THE CONSTRUCTION METHODOLOGY WHICH MAY INCLUDE TEMPORARY COLUMNS AND BEAMS ETC. SPECIAL WALL REINFORCEMENT TO BE ALLOWED FOR AS PER TYPICAL TRANSFER WALL DETAILS ON DRAWING ST-00-006-02.

W3. CONTRACTOR TO MAKE ALLOWANCE FOR ADDITIOANL TEMPORARY WORKS, DESIGN AND PROGRAMME REQUIRED TO KICK OFF THE FIRE STAIR CORE BOX TO THE REAR OF THE BUILDING. THIS MIGHT INCLUDE BUT IS NOT LIMITED TO THE FOLLOWING;
   a. TEMPORARY COLUMNS, FOOTINGS, TRANSFER BEAMS AND GRILLAGE TO SUPPORT THE STAIR CORE UNTILL WALLS W8 AND W11 HAVE BEEN CONSTRUCTED TO L4 AND CONCRETE AGE OF 28 DAYS HAS BEEN ACHIEVED.
   b. MODIFICATION OF THE JUMPFORM SYSTEM AND CORE TO ALLOW FOR THE ADDITIONAL CORE CELL.
   c. TEMPORARY PENETRATIONS TO THE WALLS AND LINTELS.
   d. JUMPFORM POCKETS.
   e. REDESIGN OF THE CORE AND LINTELS TO INCORPORATE THE STAGED CORE CONSTRUCTION METHODOLOGY.

W4. THE WALL DESIGN CONSIDERS THE PERMANENT CONDITION ONLY WITH NO ALLOWANCE FOR TEMPORARY WORKS LOADS, JUMPFORM LOADS, PENETRATIONS, POCKETS, STAGING ETC. ADDITIONAL PROVISION TO BE MADE BY CONTRACTOR TO ALLOW FOR REDESIGN AND DOCUMENTATION.

W5. PRECAST PANELS TO BE TEMPORARILY HORIZONTALLY PROPPED UNTIL CONNECTING SLABS HAVE BEEN CONSTRUCTED AND ACHIEVED 28 DAY AGE AND PERMANENT SUPPORTING STEELWORK HAS BEEN ERECTED.

W6. CONTRACTOR TO ALLOW FOR TEMPORARY WORKS REQUIRED TO INSTAL CAST-IN PLATES TO THE CORE WALLS AND LINTELS. CONSTRUCTION JOINTS TO BE COORDINATED TO SUIT CAST-IN PLATE AND ANCHORING BAR EXTENTS.

W7. CONTRACTOR TO ALLOW FOR TEMPORARY WORKS REQUIRED TO INSTAL STRESS BARS TO THE CORE WALLS AND LINTELS. STRESS BARS SHALL BE TRANSPORTED, STORED, PROTECTED, AND INSTALLED IN ACCORDANCE WITH MANUFACTURERES SPECIFICATIONS. REFER TO STRESS BAR DETAILS FOR STRESSING SEQUENCE.

W8. THE CORE WALLS AND LINTELS BETWEEN LEVEL 5 AND LEVEL 15, AT EACH LEVEL, TO BE FULLY CONSTRUCTED AND ACHIEVE 7 DAY AGE PRIOR TO CONNECTING ADJACENT STRUCTURAL STEELWORK.

W9. THE FIRE STAIR LINTELS TO GRIDS D AND E, AT EACH LEVEL, TO BE FULLY CONSTRUCTED AND ACHIEVE 7 DAY AGE PRIOR TO CONNECTING ADJACENT STRUCTURAL STEELWORK.

W10. CONTRACTOR TO ALLOW FOR REINFROCEMENT COUPLERS AND TIES AS REQUIRED FOR BOUNDARY REGIONS AS PER THE TYPICAL WALL DETAILS ON DRAWING ST-00-006-01.

W11. IF A POCKETED JUMPFORM SYSTEM IS PROPOSED, CONTRACTOR TO ALLOW PROVISION TO COORDINATE JUMPFORM POCKETS IN ACCEPTABLE LOCATIONS AND FOR THE STRUCTURAL ENGINEER TO REVIEW AND APPROVE JUMPFORM POCKET LOCATIONS.

FLOORS

F1. READ IN CONJUNCTION WITH THE CONTEXT VIEWS ON DRAWING SERIES ST-00-000-5#.

F2. TRANSFER STRUCTURE TO BE 100% PROPPED UNTIL 28 DAY CONCRETE AGE IS ACHIEVED.

F3. THE FLOOR DESIGN CONSIDERS THE PERMANENT CONDITION ONLY WITH NO ALLOWANCE FOR TEMPORARY WORKS LOADS U.N.O. PENETRATIONS, POCKETS, STAGING, MACHINERY U.N.O. ADDITIONAL PROVISION TO BE MADE BY CONTRACTOR TO ALLOW FOR REDESIGN AND DOCUMENTATION.

F4. THE DESIGN OF THE GROUND FLOOR STRUCTURE BETWEEN GRID 4 AND ALBERT STREET CONSIDERS CONSTRUCTION LOADING OF 15kPa. THIS IS BASED ON GROUND FLOOR AND BASEMENT FLOORS BEING 100% CONSTRUCTED AND AT MINIMUM 28 DAYS OF AGE.

F5. COMPOSITE SLABS AND SUPPORTING STEEL BEAMS HAVE BEEN DESIGNED FOR THE CONSTRUCTION STAGE L

PRINT DRAWINGS IN COLOUR

SHORING & RETENTION WALL NOTES

1. THE PILING CONTRACTOR SHALL BE RESPONSIBLE FOR THE GEOTECHNICAL AND STRUCTURAL DESIGN, INSTALLATION AND CERTIFICATION OF THE PILES, SHOTCRETE, UNDERPINNING, TEMPORARY STRUTS AND WALERS.

2. THE CONTRACTOR'S GEOTECHNICAL ENGINEER SHALL INSPECT AND CERTIFY ALL GEOTECHNICAL ASPECTS OF THE EXCAVATION, SHORING AND RETENTION WORK INCLUDING BUT NOT LIMITED TO:
   - ANCHOR & PASSIVE DOWEL LOCATIONS, SIZE, LENGTHS (FIXED & FREE) AND CAPACITIES
   - TEMPORARY STABILITY AND EXCAVATION STAGING
   - GEOTECHNICAL CAPACITY OF FOOTINGS AND UNDERPINNING
   - SHORING SEQUENCE AND DETAILS TO SUIT SITE CONDITIONS
   - TEMPORARY AND PERMANENT BATTER SLOPES AND STABILITY
   - DRAINAGE DETAILS
   - EXTENT OF REQUIRED SHOTCRETE FOR GEOTECHNICAL RESTRAINT OF CUT OR BATTERED FACES
   - PILING PLATFORM DESIGN

3. ROCK LEVELS WHICH HAVE BEEN PROVIDED ARE INDICATIVE AND EXTRAPOLATED FROM THE GEOTECHNICAL REPORT.

4. REFER TO THE GEOTECHNICAL REPORT FOR A DETAILED DESCRIPTION OF ANTICIPATED STRATA.

5. IT IS THE SUBCONTRACTORS RESPONSIBILITY TO ENSURE THAT ALL SHORING WALLS INSTALLED DO NOT DAMAGE ADJACENT STRUCTURES OR SERVICES.

6. A VIBRATION & MOVEMENT MONITORING PLAN IS REQUIRED IN ACCORDANCE WITH THE INSTRUMENTATION, VIBRATION AND MOVEMENT MONITORING NOTES. RESULTS ARE TO BE REPORTED REGULARLY TO THE HEAD CONTRACTOR. THIS SHALL COVER BOTH THE PROJECT STRUCTURE AND ADJACENT EXISTING BUILDINGS, CRR AND BCC, QUU ASSETTS AND SERVICES ETC.

7. WHERE MONITORING RESULTS ARE BEYOND ACCEPTABLE CRITERIA, AS OUTLINED WITHIN THE ENGINEERING DOCUMENTS, THE ENGINEER SHALL BE IDENTIFIED IMMEDIATELY.

8. NOTIFY THE ENGINEER IF ANY REINFORCED PILE IS DAMAGED IN ANY WAY.

9. REFER TO RELEVANT SERVICE CONSULTANTS DRAWINGS FOR SIZE AND POSITION OF ALL SERVICE PENETRATIONS. UNLESS DIRECTED BY THE HEAD CONTRACTOR.

10. THE PRESENCE OF UNCONTROLLED OR UNSUITABLE FILL MAY CONTAIN ELEMENTS WHICH WILL NEED TO BE REMOVED AND REPLACED BEFORE SHORING INSTALLATION CAN PROCEED. TEST PITS LOGGED BY THE GEOTECHNICAL ASSESSOR IN THE LOCATION OF THE PROPOSED INITIAL RETENTION WALL MAY IDENTIFY THE PRESENCE OF THIS UNCONTROLLED OF UNSUITABLE FILL.

11. THE SHORING CONTRACTOR SHALL PROVIDE AS-BUILT DRAWINGS OF THE SHORING WALLS FOR THE TEMPORARY STRUT AND WALER SUBCONTRACTOR'S USE IN PREPARING THE STRUT AND WALER SETOUT SHOP DRAWINGS. THE AS BUILT DRAWINGS ARE TO BE PROVIDED WITHIN 2 WEEKS OF COMPLETION OF SHORING AND ARE TO CONTAIN ALL INFORMATION AS DESCRIBED IN THE SPECIFICATION. ALL RECORDS ARE TO BE SUBMITTED BEFORE EXCAVATION PROCEEDS.

12. THE CONTRACTOR SHALL UNDERTAKE AN ENCROACHMENT SURVEY (IF REQUIRED) INCLUDING TEST PITS TO LOCATE EXISTING ADJOINING FOUNDATIONS PRIOR TO EXCAVATION OR BORING PILES.

13. THE SHORING CONTRACTOR IS TO CONFIRM CLEARANCE AND TOLERANCE REQUIREMENTS.

14. REFER GEOTECHNICAL REPORT FOR ACTUAL ROCK TYPES AND DESCRIPTION TO JUDGE EASE OF EXCAVATION.

15. IT IS THE SUBCONTRACTORS RESPONSIBILITY TO ENSURE THAT EXCAVATION STAGING ACROSS THE SITE DOES NOT OVERLOAD ANY STRUCTURAL MEMBER TO BOTH THE EXISTING SURROUNDING STRUCTURES AND THE NEW STRUCTURE BEING CONSTRUCTED.

16. REFER TO EDQ NOTES FOR ADDITIONAL CERTIFICATION AND DA REQUIREMENTS.

SHORING WORKS TEMPORARY STRUT AND WALER NOTES

1. THE PROPRIETARY PROP DESIGNER AND SUPPLIER IS TO ENSURE THE SUPPLIED PROP AND JACKING ARRANGEMENT IS SUITABLE FOR TWO LOAD CASES:
   LOAD CASE 1 = PRELOAD CASE
   LOAD CASE 2 = PRELOAD CASE COMBINED WITH +VE THERMAL STRESS CASE

2. THERMAL STRESSES BASED ON -20 DEGREE +30 DEGREE TEMPERATURE DIFFERENTIAL.

3. PROPS TO BE CHECKED FOR THE WORST LOADING CONDITION OF EITHER CASE ONE OR CASE TWO WITH THE APPROPRIATE ULTIMATE LOAD FACTORS.

4. MINIMUM REQUIRED STROKE LENGTH OF 100mm TO BE CONFIRMED BY PROPRIETARY PROP SUPPLIER.

5. PROPS TO BE PROVIDED WITH A LOAD MONITORING SYSTEM TO ENABLE REAL TIME MEASUREMENT OF THE FORCE IN ALL PROPS.

6. PROP MONITORING SCHEDULES AND TRIGGER VALUES TO BE DEVELOPED IN CONSULTATION BETWEEN CONTRACTOR, PROP DESIGNER AND PROPRIETARY PROP SUPPLIER.

7. THE DESIGN LIFE OF THE WALERS AND STRUTS TO BE TAKEN AS 10 YEARS.

BORED PIER NOTES

1. BORED PIERS SHALL BE IN ACCORDANCE WITH AS2159 AND WITH THE PROJECT SPECIFICATIONS.

2. REFER TO THE GEOTECHNICAL ENGINEERING REPORT SPECIFIED IN THE GENERAL NOTES FOR SITE SPECIFIC GEOTECHNICAL INFORMATION.

3. ALL BORED PIERS SHALL FOUND IN MATERIAL HAVING AN ULTIMATE BEARING CAPACITY OF [25] MPa AND ULTIMATE SHAFT FRICTION CAPACITY OF [1.3] MPa.

4. THE CONTRACTOR SHALL ENGAGE AND PAY FOR A GEOTECHNICAL ENGINEER TO VERIFY THE BEARING CAPACITY OF THE FOUNDING MATERIAL AND BORED PIER CAPACITY PRIOR TO THE PLACEMENT OF REINFORCEMENT OR POURING OF CONCRETE.

5. REFER TO THE FOOTING DRAWING FOR BORED PIER DIAMETERS AND DESIGN LOADS.

6. BORED PIERS SHALL BE DESIGNED TO CARRY THE DESIGN LOADS AT 75mm ECCENTRICITY TO MAKE ALLOWANCE FOR CONSTRUCTION TOLERANCE. ALL PIER CENTERLINES ARE TO BE CHECKED BEFORE ANY CONCRETE IS POURED. IF A VECTOR ECCENTRICITY GREATER THAN 75mm IS MEASURED 'ROBERT BIRD GROUP' ARE TO BE CONTACTED IMMEDIATELY.

7. UNLESS NOTED OTHERWISE THE CENTERLINE OF THE BORED PIER IS TO COINCIDE WITH CENTERLINE OF COLUMN ABOVE. REFER TO THE ARCHITECTURAL DRAWINGS FOR COLUMN SETOUT DETAILS.

8. BORED PIERS SHALL BE DRILLED USING A RIG CAPABLE OF BORING A HOLE WITH A VERTICAL TOLERANCE OF 1:100 INCLINATION.

9. NOTIFY 'ROBERT BIRD GROUP' IMMEDIATELY OF ANY OBSTRUCTIONS ENCOUNTERED DURING BORING, OTHER THAN THOSE INDICATED IN THE SITE INVESTIGATION.

10. THE BORED PIERS MAY HAVE TO BE LINED TO RETAIN LOOSE FILL.

11. REMOVE ALL LOOSE OR DISTURBED MATERIAL FROM THE SHAFT AND BASE OF THE BORED PIER.

12. BORED PIERS NOT CONCRETE FILLED BY THE END OF THE DAY WILL REQUIRED RE-DRILLING TO REMOVE ANY LOOSE MATERIAL.

13. PLACE CONCRETE TO ENSURE A SOUND MONOLITHIC COMPACTED CONCRETE SHAFT OF THE FULL DIAMETER REQUIRED TO CUT-OFF LEVEL. TAKE ADEQUATE MEASURES TO AVOID SEGREGATION, BLEEDING AND GROUT DEFICIENCY OF THE PIER.

14. EACH PIER SHALL BE TRIMMED TO ±25mm OF THE CUT-OFF LEVEL. ANY DAMAGE CAUSED TO THE BORED PIER DURING TRIMMING AND CAPPING IS TO BE REMOVED AND ADEQUATELY REPAIRED.

15. ISOLATION SLEEVES TO PILES MAY BE REQUIRED TO MINIMISE LOAD ON THE CRR STATION CAVERN. REFER GEOTECHNICAL ENGINEER FOR DETAILS.

16. REFER TO EDQ NOTES FOR ADDITIONAL DA REQUIREMENTS.

PILING NOTES

1.0 GENERAL

1.1 PILE DESIGN, INSTALLATION, TESTING AND CERTIFICATION TO BE TO AS 2159, THE PROJECT SPECIFICATION AND THE GEOTECHNICAL ENGINEERING REPORT SPECIFIED IN THE GENERAL NOTES

1.2 THE CONTRACTOR IS TO OBTAIN ALL NECESSARY APPROVALS FROM THE RELEVANT AUTHORITIES AND ADJACENT PROPERTY OWNERS PRIOR TO COMMENCEMENT OF WORK.

1.3 WHERE PILE DRIVING WORKS ARE TO BE CONDUCTED IN THE VICINITY OF EXISTING STRUCTURES, GEOTECHNICAL ADVICE MUST BE OBTAINED TO ENSURE THE PROPOSED WORKS DO NOT CAUSE DAMAGE TO THE EXISTING STRUCTURES

1.4 PRIOR TO COMMENCEMENT OF ANY PILING WORK THE BUILDER SHALL LOCATE ALL NEW AND EXISTING SERVICES RELATIVE TO THE PILE LOCATIONS. THE ROBERT BIRD GROUP IS TO BE NOTIFIED OF ANY POTENTIAL CLASHES.

1.5 PILING CONTRACTOR TO ENSURE THAT ALL PILES FOR THEIR FULL LENGTH ARE TO BE CONTAINED WITHIN THE PROPERTY BOUNDARY TITLE.

2.0 PRICING OF PILING WORKS

2.1 THE PILING CONTRACTOR SHALL BE RESPONSIBLE FOR THE GEOTECHNICAL AND STRUCTURAL DESIGN, INSTALLATION AND CERTIFICATION OF THE PILES.
THE PILES SHALL BE IN ACCORDANCE WITH AS 2159, THE SPECIFICATION, THE PILE DESIGN PARAMETERS SET OUT IN SECTION 3.1 AND THE INSTALLATION TOLERANCES SET OUT IN SECTION 4.4

2.2 THE DRAWINGS SHOWING THE PILE LAYOUT AND PILE CAP DETAILS ARE BASED ON THE CURRENT GEOTECHNICAL ADVICE AND ARCHITECTURAL LAYOUTS.

2.3 ANY CHANGES TO THE CURRENTLY SHOWN PILE LAYOUT AND PILE CAP DETAILS AS A RESULT OF THE PILING CONTRACTOR'S DESIGN WILL BE SUBJECT TO THE APPROVAL OF THE ROBERT BIRD GROUP AND MAY RESULT IN A RE-DESIGN OF THE AFFECTED PILE CAP.

2.4 THE CONTRACTOR SHALL ENGAGE AND PAY THE ROBERT BIRD GROUP TO DESIGN CHECK / CHANGE ANY STRUCTURAL MODIFICATIONS REQUIRED TO THE PILE LAYOUT AND PILE CAPS FOR ANY CHANGE OF LAYOUT OF PILES FROM THOSE SHOWN ON THE DRAWINGS OR DUE TO ANY PILE NOT CONFORMING TO THE REQUIRED TOLERANCES OR BEING DAMAGED OR OTHERWISE DEFECTIVE DURING THE INSTALLATION OF THE PILES.
THE PILING CONTRACTOR SHALL BE DEEMED TO HAVE MADE AN ALLOWANCE IN THEIR PRICING FOR ANY COSTS ASSOCIATED WITH THE RE-DESIGN OF THE PILE LAYOUTS OR PILE CAPS AS A RESULT OF ANY CHANGES DURING THE PILING CONTRACTOR DESIGN OF THE PILES AND DURING ANY NON-CONFORMANCES DURING THE INSTALLATION OF THE PILES.

2.5 THE PRICING OF THE PILING WORKS SHALL INCLUDE THE PROVISION OF A PILING PLATFORM FOR THE INSTALLATION OF THE PILES, BASED ON THE INFORMATION PROVIDED IN THE GEOTECHNICAL REPORT.

2.6 THE PRICING OF THE PILING WORKS SHALL INCLUDE FOR ALL WORKS ASSOCIATED WITH ANY SITE HAZARDS, SUCH AS CONTAMINATED SOILS, AS IDENTIFIED IN THE PROJECT SAFETY IN DESIGN REPORT.

2.7 THE PILING CONTRACTOR TO SUBMIT CALCULATIONS FOR GEOTECHNICAL AND STRUCTURAL DESIGN OF ALL PILES FOR REVEW PRIOR TO THE COMMENCEMENT OF PILING WORKS. CALCULATIONS TO INCLUDE CALCULATION OF $Ø_c$ (PHI G)
THE CALCULATIONS SHALL BE ACCOMPANIED BY DRAWINGS SHOWING PILE LAYOUT PLANS, REINFORCEMENT DETAILS, SPLICE DETAILS, PILE CAP CONNECTION DETAILS AND MATERIALS TO BE USED FOR THE PILES.
PRIOR TO THE COMMENCEMENT OF WORKS DETAILS OF THE PROPOSED PILE INSTALLATION METHODOLOGY AND CONSTRUCTION SEQUENCE SHALL BE PROVIDED FOR APPROVAL INDICATING HOW THE PILE INSTALLATION REQUIREMENTS SET OUT IN SECTION 4 WILL BE MET.

3.0 PILE DESIGN

3.1 PILE DESIGN PARAMETERS

TYPE OF PILE	**NON-DISPLACEMENT PILE** SHORING SOLDIER PILES AND FOUNDATION BORED PIERS/CFA PILES
DESIGN LOADS	REFER TO STRUCTURAL PILE LOAD SCHEDULE ON DRAWING: ALB-RBG-DWG-ST-00-003-01 REFER TO GEOTECHNICAL REPORT FOR NEGATIVE SKIN FRICTION (DOWNDRAG) LOADS, PRESENCE OF CAVERNS ETC.
LOAD COMBINATIONS FOR ULTIMATE STRENGTH & SERVICEABILITY	TO AS/NZS 1170.0 & AS 2159
GEOTECHNICAL PILE DESIGN FOR ULTIMATE STRENGTH	GEOTECHNICAL STRENGTH REDUCTION FACTOR $Ø_c$ = 0.5 AS PROVIDED IN THE GEOTECHNICAL REPORT VALUE TO BE CONFIRMED THROUGH PILE LOAD TESTING.
	FOUNDING MATERIAL TO HAVE: MINIMUM ULTIMATE END BEARING CAPACITY OF [2500] kPa MINIMUM ULTIMATE SHAFT ADHESION OF [1300] kPa
	UNLESS NOTED OTHERWISE ON THE DRAWINGS, ALL PILES SHALL BE SOCKETED MINIMUM 1.5m INTO ROCK DESIGNATED IN THE GEOTECHINCAL ENGINEERING REPORT AS NFG2/1 OR A HIGHER QUALITY ROCK.
STRUCTURAL PILE DESIGN FOR ULTIMATE STRENGTH	PILE DESIGN SHALL BE BASED ON ZERO FIXITY BETWEEN PILES AND SLABS/BEAMS AND ALLOW FOR MOMENTS DUE TO ECCENTRICITY OF ALL APPLIED LOADS. DESIGN ACTIONS ARE TO BE COMBINED IN ACCORDANCE WITH AS1170.0 TO PRODUCE THE MOST ADVERSE EFFECT.
	PILE REINFORCEMENT IS TO BE EXTENDED FOR THE FULL DEPTH OF THE CAPPING BEAM OR PILE CAP AND TERMINATED WITH A COG OR TERMINATOR U.N.O.
	CONNECTION OF PILE HEAD TO PILE CAP/FOOTING TO BE ADEQUATE TO RESIST THE LOADS LISTED IN THE PILE LOAD SCHEDULE ON DRAWING: ALB-RBG-DWG-ST-00-003-01 PILE FIXITY TO CORE PILE CAP CAN BE ASSUMED.
	THE POINT OF FIXITY OF THE PILES IS TO BE AS NOMINATED IN THE GEOTECHNICAL REPORT BUT SHALL BE NOT LESS THAN [5000] mm BELOW THE UNDERSIDE OF THE PILE CAP/FOOTING.
	SPLICES IN PILES SHALL BE DESIGNED TO WITHSTAND THE WORST-CASE LOAD COMBINATION OF THE LOADS SET OUT IN THE PILE LOAD SCHEDULE.
PILE DESIGN FOR SERVICEABILITY	REFER TO THE MOVEMENT AND TOLERANCE REPORT FOR PILE VERTICAL AND HORIZONTAL MOVEMENTS
DURABILITY	EXPOSURE CLASSIFICATION = FOUNDATION PILES - SEVERE SHORING PILES - VERY SEVERE (AS 2159 CLAUSE 6.4) FOR A DESIGN LIFE OF [50] YEARS

3.2 UNO THE LATERAL LOADS AND MOMENTS SHOWN IN THE TABLE OF STRUCTURAL PILE LOADS AS ACTING AT A COLUMN/ CORE OR WALL SHALL BE RESISTED ONLY BY THE PILES SHOWN UNDER THAT COLUMN/CORE OR WALL.
DISTRIBUTION OF LATERAL LOADS OR MOMENTS TO ANY OTHER PILES IS NOT PERMITTED WITHOUT THE PRIOR APPROVAL OF THE ROBERT BIRD GROUP.

PILING NOTES CONTINUED

4.0 PILE INSTALLATION

4.1 THE CONTRACTOR TO MINIMISE ANY NOISE AND VIBRATION DUE TO PILE INSTALLATION ADJACENT TO EXISTING BUILDINGS AND SERVICES. REFER PILING SPECIFICATION FOR REQUIREMENTS.

4.2 THE CONTRACTOR SHALL ENGAGE AND PAY FOR A GEOTECHNICAL ENGINEER TO VERIFY THAT ALL GEOTECHNICAL PILE DESIGN PARAMETERS AS SET OUT IN SECTION 3.1 HAVE BEEN SATISFIED PRIOR TO THE PLACEMENT OF REINFORCEMENT OR POURING OF CONCRETE IF IT IS A NON-DISPLACEMENT PILE OR PRIOR TO THE REMOVAL OF THE PILE INSTALLATION RIG FROM THE PILE IF IT IS A DISPLACEMENT PILE.

4.3 PILE INSTALLATION METHODOLOGY TO ENSURE THAT CONCRETE PILES ARE CRACK FREE. SECANT PILES TO HAVE REQUIRED OVERLAP.

4.4 REFER TO THE MOVEMENT AND TOLERANCE REPORT FOR PILE MAXIMUM PLAN AND VERTICAL CONSTRUCTION TOLERANCES.
- PLAN TOLERANCES ARE TO BE TAKEN AT THE CUT-OFF LEVEL AND APPLY IN ANY DIRECTION.
- PILE CENTRELINES ARE TO BE CHECKED PRIOR TO CONCRETE BEING POURED IN NON-DISPLACEMENT PILES.
- IF THESE TOLERANCES ARE EXCEEDED, THE ROBERT BIRD GROUP IS TO BE NOTIFIED IMMEDIATELY.
- ALLOW FOR GUIDE WALL TO CONTIGUOUS AND SECANT PILE WALLS TO ENSURE SPECIFIED TOLERANCES ARE MAINTAINED.

4.5 UNLESS NOTED OTHERWISE, CENTRELINE OF PILE IS TO COINCIDE WITH CENTRELINE OF COLUMN/WALL ABOVE. REFER ARCHITECTS DRAWINGS FOR COLUMN AND WALL SETOUT.

4.6 NOTIFY ROBERT BIRD GROUP IMMEDIATELY OF ANY OBSTRUCTIONS ENCOUNTERED DURING PILING, FAILURE OF THE PILE TO REACH THE REQUIRED DEPTH OR ANY OTHER IRREGULARITIES.

4.7 LINERS TO THE PILES MAY BE REQUIRED TO PROVIDE ADEQUATE PROTECTION FOR SOCKETING, CLEANING OUT, PROOF DRILLING, INSPECTION OF THE BASES AND CONCRETING AND TO PREVENT COLLAPSE OF SOIL INTO THE HOLE OR WATER INGRESS.

4.8 ISOLATION SLEEVES TO PILES MAY BE REQUIRED TO MINIMISE LOAD ON THE CRR STATION CAVERN. REFER GEOTECHNICAL ENGINEER FOR DETAILS.

4.9 FOR NON- DISPLACEMENT PILES:
- REMOVE ALL LOOSE OR DISTURBED MATERIAL FROM THE SHAFT AND BASE OF THE PILES PRIOR TO PLACING CONCRETE.
- THE SHAFT OF THE PILE SHALL BE KEPT FREE OF WATER, INCLUDING GROUND WATER OR SURFACE WATER, DURING CONCRETING.
- PILES NOT CONCRETE FILLED BY THE END OF THE DAY WILL REQUIRE RE-DRILLING TO REMOVE ANY LOOSE MATERIAL.
- PLACE CONCRETE TO ENSURE A SOUND MONOLITHIC COMPACTED CONCRETE SHAFT OF THE FULL DIAMETER REQUIRED TO CUT-OFF LEVEL. TAKE ADEQUATE MEASURES TO AVOID SEGREGATION, BLEEDING AND GROUT DEFICIENCY OF THE PILE.
- MICROPILE CASING AND REINFORCEMENT BAR NOT TO BE SPLICED UNLESS APPROVED BY THE ROBERT BIRD GROUP.
  GROUT SHALL BE INJECTED UNDER PRESSURE COMMENCING AT THE LOWEST POINT OF THE DRILL HOLE. USE PRESSURE GAUGES TO MONITOR GROUT PRESSURES DURING INJECTION OF THE GROUT.

4.10 TRIMMING OF PILES:
- PILES TO BE TRIMMED TO SOCKET INTO CAPPING BEAM OR PILE CAP 50mm WITH A VERTICAL TOLERANCE OF +/-25mm.
- PILES AT THE CUT OFF LEVEL SHALL HAVE THE FULL CROSS SECTION. ANY DAMAGE CAUSED TO THE PILE DURING TRIMMING IS TO BE REMOVED AND ADEQUATELY REPAIRED.
- THE PILE REINFORCEMENT SHALL EXTEND THE DISTANCE NOMINATED IN THE PILE DESIGN PARAMETERS INTO THE PILE CAP/ FOOTING/GROUND BEAM.

4.11 THE SEQUENCE OF WORK AND ORDER OF PILE INSTALLATION SHALL AVOID DAMAGE TO ADJACENT NEWLY INSTALLED PILES AND STRUCTURES DUE TO VERTICAL AND LATERAL HEAVE.

4.12 APPROPRIATE RECORDS IN ACCORDANCE WITH AS 2159 SHALL BE TAKEN FOR EACH PILE AND SUBMITTED TO ROBERT BIRD GROUP.

5.0 PILE TESTING

5.1 LOAD TESTING SHALL BE CARRIED OUT IN ACCORDANCE WITH AS2159 AND THE SPECIFICATION ON PILE LOCATIONS AS AGREED WITH ROBERT BIRD GROUP AND AS NOTED ON THE DRAWINGS.

5.2 REFER TO THE SCHEDULE OF LOAD TEST REQUIREMENTS IN THE PILING SPECIFICATION.

6.0 CERTIFICATION

6.1 PROVIDE AN "AS CONSTRUCTED" SURVEY OF THE PILE POSITIONS AND THEIR CUT OFF LEVELS.

6.2 CERTIFICATES FROM REGISTERED PROFESSIONAL ENGINEERS SHALL BE PROVIDED CERTIFYING THAT THE STRUCTURAL AND GEOTECHNICAL DESIGN AND INSTALLATON OF THE PILES COMPLIES FULLY WITH THE REQUIREMENTS OF THE DRAWINGS AND THE SPECIFICATIONS.

6.3 REFER TO EDQ NOTES FOR ADDITIONAL DA REQUIREMENTS.

EARTHWORKS NOTES

1. REFER TO THE GEOTECHNICAL ENGINEERING REPORT SPECIFIED IN THE GENERAL NOTES.

2. ONCE THE SITE HAS BEEN CLEARED OF EXISTING STRUCTURE STRIP SITE OF ALL TOPSOIL, VEGETATION AND DELETERIOUS MATTER TO A MINIMUM DEPTH OF 150mm.

3. PROOF ROLL SUBGRADE TO REVEAL SOFT SPOTS. SOFT SPOTS TO BE REMOVED AND BACKFILLED. ALL NATURAL SUBGRADE IS TO BE COMPACTED TO 98% STANDARD COMPACTION IN ACCORDANCE WITH AS1289 PRIOR TO PLACEMENT OF FILL MATERIAL.

4. MATERIAL WON FROM THE SITE TO BE INSPECTED BY THE GEOTECHNICAL ENGINEER FOR APPROVAL PRIOR TO USE AS FILL. ANY IMPORTED FILL TO HAVE A MINIMUM CBR VALUE OF 15%. ALL FILL TO BE COMPACTED TO 98% STANDARD COMPACTION IN 200mm MAXIMUM THICK LAYERS IN ACCORDANCE WITH AS1289.

5. TEST CERTIFICATES ON THE FILL MATERIAL SHALL BE SUPPLIED TO THE SUPERINTENDENT FOR APPROVAL PRIOR TO THE USE OF THE FILL MATERIAL.

6. IT IS POSSIBLE THAT CONTIMINATIONS AND/OR PASS WILL BE ENCOUNTED ON THIS SITE. ENVIROMENTAL ENGINEER TO UNDERTAKE INVESTIGATIONS TO CONFIRM. SUSPECT SOILS EXPOSED DURING EXCAVATION AND GROUND WORKS SHALL BE REPORTED TO THE SUPERINTENDENT.

7. REFER TO EDQ NOTES FOR ADDITIONAL DA REQUIREMENTS.

UNDERPINNING NOTES

1. UNDERPINNING INDICATIVE ONLY FOR PRELIMINARY COSTING PURPOSES. FINAL SIZE AND DEPTH OF UNDERPINNING TO BE CONFIRMED ON SITE ONCE EXCAVATION HAS COMMENCED AND GEOTECHNICAL ENGINEER HAS CONFIRMED LEVEL OF LOW STRENGTH ROCK IN EACH UNDERPINNING LOCATION AND THE EXISTING N55 FOUNDATION DETAILS AND LEVELS HAVE BEEN CONFIRMED.

2. UNDERPINNING TO BE UNDERTAKEN SEQUENTIALLY. EACH INDIVIDUAL UNDERPIN TO BE 1m LONG AND TO MATCH THE WIDTH OF THE EXISTING FOUNDATION OVER.

3. FOR DEEPER SECTIONS OF UNDERPINNING, UNDERPINS MAY NEED TO BE INSTALLED IN A NUMBER OF SEPARATE VERTICAL SECTIONS WITH NOMINAL DOWEL CONNECTIONS STITCHING THE VERTICAL SECTIONS TOGETHER.

4. ALL UNDERPINNING TO BE INSTALLED IN A HIT-MISS-MISS-MISS-HIT FASHION WITH NO ADJACENT UNDERPINS INSTALLED SIMULTANEOUSLY. A MINIMUM OF 3 DAYS REQUIRED BEFORE EXCAVATING ADJACENT TO A RECENTLY INSTALLED UNDERPIN. DETAILED SEQUENCE FOR INSTALLATION OF UNDERPINNING TO BE RESOLVED IN DISCUSSION WITH CONTRACTOR TO SUIT THE OVERALL CONSTRUCTION METHODOLOGY AND ERECTION SEQUENCE.

5. ALL UNDERPINNING TO BE FOUNDED IN LOW STRENGTH ROCK TO GEOTECHNICAL ENGINEERS DETAILS.

FOUNDATION NOTES

1. REFER TO THE GEOTECHNICAL ENGINEERING REPORT SPECIFIED IN THE GENERAL NOTES FOR SITE SPECIFIC GEOTECHNICAL INFORMATION.

2. FOOTINGS ARE TO BE FOUNDED ON MATERIAL HAVING AN ALLOWABLE BEARING CAPACITY AS NOTED IN THE FOOTING SCHEDULE. WHERE DIFFICULTY IN REACHING THE REQUIRED CAPACITY IS EXPERIENCED, 'ROBERT BIRD GROUP' IS TO BE CONTACTED TO REASSESS THE FOOTING DESIGN.

3. THE MAXIMUM BEARING PRESSURE UNDER THE STRUCTURE IS LIMITED TO 2000kPa DUE TO THE EXISTING TUNNEL UNDER THE SITE U.N.O

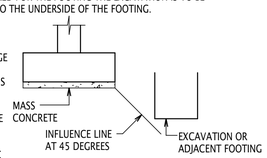
4. THE CONTRACTOR IS TO ENGAGE AND PAY A GEOTECHNICAL ENGINEER TO VERIFY THE BEARING CAPACITY OF THE FOUNDATIONS PRIOR TO PLACEMENT OF THE BLINDING LAYER.

5. ALL LOOSE MATERIAL AND WATER TO BE CLEANED OUT OF THE FOUNDATION. FORM WORK TO BE USED WHERE THE SIDES OF THE FOUNDATION ARE NOT STABLE.

   A 50mm MINIMUM BLINDING LAYER SHOULD BE APPLIED TO THE BASE OF ALL FOUNDATIONS IMMEDIATELY AFTER VERIFICATION OF THE BEARING CAPACITY BY THE GEOTECHNICAL ENGINEER. WHERE

6. THE FOUNDING MATERIAL IS DEEPER THAN REQUIRED FOR THE FOOTING THE EXCAVATION IS TO BE BACKFILLED WITH A WEAK MIX CONCRETE (N10) TO THE UNDERSIDE OF THE FOOTING.

7. WHERE AN EXCAVATION IS REQUIRED OR EXISTS BELOW THE BASE OF A FOOTING THE SIDE OF THE EXCAVATION SHALL BE LOCATED AWAY FROM EDGE OF FOOTING BY THE SAME DISTANCE THAT THE EXCAVATION IS BELOW FOOTING BASE. WHERE THIS CANNOT BE ACHIEVED, 'ROBERT BIRD GROUP' SHALL BE CONTACTED FOR FURTHER DIRECTION. MASS CONCRETE IS TO EXTEND TO THE INFLUENCE LINE AS REQUIRED.



8. ALL WALLS AND COLUMNS SHALL BE CONCENTRIC WITH THE SUPPORTING FOOTINGS UNLESS NOTED OTHERWISE ON THE DRAWINGS.

9. REFER TO EDQ NOTES FOR ADDITIONAL DA REQUIREMENTS.

SLAB ON GROUND NOTES

1. SLAB ON GROUND TO BE POURED ON A LAYER OF POLYETHYLENE SHEETING 200µm THICK ON TOP OF 50mm OF BEDDING SAND. JOINTS TO BE TAPED

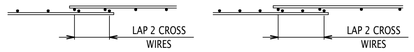
2. REFER ARCHITECT FOR WATERPROOFING DETAILS AND TERMITE PROTECTION.

3. ALL THICKNESSES SHOWN ARE MINIMUM STRUCTURAL REQUIREMENTS, NO REDUCTION IN THICKNESS DUE TO FALLS OR TOPPING IS PERMITTED. REFER ARCHITECT DRAWINGS FOR ALL SLAB FALLS AND CONFIRMATION OF SLAB STEPS.

4. REFER TO HYDRAULIC ENGINEER FOR UNDER SLAB DRAINAGE.

5. FABRIC TO BE PLACED ON CHAIRS AT 800 x 800 CENTRES AND CHAIRS TO BE PLACED ON STEEL PANS. ALL REINFORCEMENT BAR CHAIRS TO CONFORM TO THE REQUIREMENTS OF AS/NZS2425 AND TO BE STRENGTH GRADE 120 MINIMUM.

6. LAP FABRIC REINFORCEMENT THUS:



7. WHERE BEDDING SAND IS REQUIRED UNDER SLAB, THIS SHALL BE COMPACTED SUFFICIENTLY TO SUPPORT REINFORCEMENT PLUS 100kg/CHAIR WITHOUT VERTICAL DISPLACEMENT EXCEEDING 5mm.

Rev	Revision Description	By	App	Date
T03	ISSUED FOR TENDER	DS	MA	09.08.24
T02	ISSUED FOR TENDER	DS	MA	17.07.24
T01	ISSUED FOR TENDER	DS	MA	28.06.24
A02	80% DD DRAFT	DS	MA	07.06.24
A01	50% DD ISSUE	SV	MA	09.08.23
P01	DRAFT 50% DESIGN DEVELOPMENT	SV	MA	28.07.23

SCALE 1 2 3 4 5 6 7 8

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REFER TO GENERAL NOTES UNLESS NOTED OTHERWISE

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Title
GENERAL NOTES SHEET 2

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Approved
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FOR TENDER - NOT FOR CONSTRUCTION

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Revision
T03

PRINT DRAWINGS IN COLOUR

CONCRETE NOTES

GENERAL

1. CONCRETE WORK & MATERIALS SHALL BE IN ACCORDANCE WITH AS3600, AS3610 AND WITH THE PROJECT SPECIFICATIONS.

2. CONSTRUCTION JOINTS SHALL BE PROPERLY FORMED, SCABBLED, CLEANED AND USED ONLY WHERE SHOWN ON 'ROBERT BIRD GROUP' DRAWINGS OR SPECIFICALLY APPROVED BY 'ROBERT BIRD GROUP'.

3. ALL THICKNESSES SHOWN ARE MINIMUM STRUCTURAL REQUIREMENTS, NO REDUCTION IN THICKNESS DUE TO FALLS OR TOPPING IS PERMITTED. REFER ARCHITECT DRAWINGS FOR ALL SLAB FALLS AND CONFIRMATION OF SLAB STEPS.

4. UNLESS A GROOVE LINE ALLOWANCE HAS BEEN NOTED ON THE DRAWINGS, NO GROOVE LINES ARE PERMITTED, EXCEPT AT SLAB LINES. ALL GROOVE LINES ARE TO BE SUBMITTED TO 'ROBERT BIRD GROUP' FOR APPROVAL.

5. THE FACE OF ALL CONCRETE AGAINST WHICH NEW CONCRETE IS TO BE CAST IS TO BE THOROUGHLY ROUGHENED TO PROVIDE A SURFACE ROUGHNESS OF APPROXIMATELY 6mm FULLY EXPOSING THE AGGREGATE MIX. ALL LOOSE AGGREGATE PARTICLES AND LIAITANCE SHALL BE REMOVED.
   THE ROUGHENING OF THE SURFACE CAN BE ACHIEVED BY:
   5.a. SAND BLASTING
   5.b. WIRE BRUSHING, PNEUMATIC OR HAND HELD TOOLS
   5.c. GREEN CUTTING OF THE PARTIALLY HARDENED CONCRETE
   - SURFACE RETARDING AGENTS, IF USED, SHALL BE FOLLOWED BY ANY OF 5a. TO 5c. ABOVE
   - MEMBRANE CURING AGENTS SHALL NOT BE USED
   - PRIOR TO PLACING THE ADJOINING CONCRETE THE FACE OF THE CONSTRUCTION JOINT AND THE PROJECTING REINFORCEMENT SHALL BE CLEANED AND THE CONCRETE SURFACE SHALL BE DAMPENED WITH WATER.
   - ALL EXCESS WATER AND LOOSE MATERIAL SHALL BE REMOVED PRIOR TO PLACING THE ADJOINING CONCRETE.

6. NO PENETRATIONS GREATER THAN 150mm DIAMETER, OR EMBEDMENT OF PIPES GREATER THAN 40mm DIAMETER OTHER THAN THOSE SHOWN ON THE STRUCTURAL DRAWINGS SHALL BE MADE IN CONCRETE SLABS. FOR ALL OTHER CONCRETE MEMBERS NO PENETRATIONS, CHASES OR EMBEDMENTS SHALL BE MADE WITHOUT PRIOR APPROVAL BY 'ROBERT BIRD GROUP'.

7. CONDUITS GREATER THAN 25mm DIAMETER CAST INTO CONCRETE MEMBERS SHALL BE SPACED AT A MAXIMUM DISTANCE POSSIBLE AND UNDER NO CIRCUMSTANCES CLOSER THAN A CLEAR SPACING OF TWICE THE LARGER CONDUIT DIAMETER FROM PARALLEL REINFORCEMENT OR ANY OTHER CONDUIT. CONDUITS IN SLABS SHALL NOT BE STACKED ABOVE/BELOW EACH OTHER.

8. CONCRETE SURFACE FINISHES TO BE IN ACCORDANCE WITH THE ARCHITECTURAL OR OTHER PROJECT DRAWINGS OR SPECIFICATIONS

CONCRETE

1. THE CHARACTERISTIC COMPRESSIVE STRENGTH (f'c) AT 28 DAYS OF IN PLACE CONCRETE SHALL BE AS NOTED ON THE DRAWINGS. CONCRETE STRENGTHS SHOWN ARE TO ACHIEVE FULL STRENGTH AT 28 DAYS

2. REFER TO CONCRETE SPECIFICATION FOR MINIMUM MIX CHARACTERISTICS AND PERFORMANCE REQUIREMENTS.

3. ALL CONCRETE SHALL BE VIBRATED.

4. ALL CONCRETE SHALL BE CURED IN ACCORDANCE WITH THE SPECIFICATION

5. ALL CONCRETE SHALL BE SAMPLED AND TESTED IN ACCORDANCE WITH AS1012 AND THE PROJECT SPECIFICATION.

6. ALL FORM WORK SHALL COMPLY WITH SECTION 17.6 OF AS3600 AND AS3610

7. FORMWORK STRIPPING:
   UNLESS SPECIFIED OTHERWISE IN THE PROJECT DOCUMENTATION, MINIMUM STRIPPING TIMES FOR IN-SITU CONCRETE FORMWORK SHALL COMPLY WITH THE MORE STRINGENT REQUIREMENTS OF SECTION 17.6 OF AS3600 & SECTION 5.4.3 (TABLE 5.1.1) OF AS3610.

8. REMOVAL OF FORMWORK SUPPORTS FROM SLABS AND BEAMS NOT SUPPORTING STRUCTURES ABOVE:
   UNLESS SPECIFIED OTHERWISE IN THE PROJECT DOCUMENTATION AND FORMWORK DOCUMENTATION APPROVED BY 'ROBERT BIRD GROUP', THE REMOVAL OF FORMWORK SUPPORTS FOR SLABS AND BEAMS NOT SUPPORTING STRUCTURES ABOVE SHALL COMPLY WITH SECTION 17.6 OF AS 3600

9. MULTISTOREY FORMWORK:
   UNLESS SPECIFIED OTHERWISE IN THE PROJECT DOCUMENTATION AND FORMWORK DOCUMENTATION APPROVED BY 'ROBERT BIRD GROUP', THE MINIMUM NUMBER OF LEVELS OF SUPPORT TO BE IN PLACE DURING THE TIME OF EACH POUR ON A FLOOR SHALL BE IN ACCORDANCE WITH SECTION 5.4.4 (TABLE 5.4.3) OF AS3610.

CONCRETE NOTES CONTINUED

REINFORCEMENT

1. REINFORCEMENT IS TO BE MANUFACTURED IN ACCORDANCE WITH AS4671 AND SHALL BE FIXED AS SHOWN ON DRAWINGS.

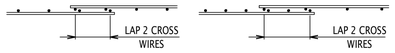
2. MATERIAL IS INDICATED BY THE FOLLOWING SYMBOLS:-
   Y DEFORMED BAR GRADE 400
   N DEFORMED BAR GRADE 500 (NORMAL DUCTILITY)
   R PLAIN ROUND BAR GRADE 250
   W PLAIN WIRE GRADE 450
   SL SQUARE FABRIC GRADE 500
   RL RECTANGULAR FABRIC GRADE 500

3. THE BAR SIZE IS INDICATED BY A NUMBER AFTER THE SYMBOL, WHICH INDICATES THE BAR DIAMETER IN MILLIMETRES.

4. REINFORCEMENT SPACING NOMINATED ON DRAWINGS IS TO ASSIST SCHEDULER AND STEEL FIXER TO ASSESS TOTAL NUMBER OF BARS REQUIRED. WHERE BARS PLACED IN ACCORDANCE WITH SPACING NOMINATED FOUL WITH OTHER STRUCTURAL REQUIREMENTS, PREFERENCE IS TO BE GIVEN TO RELOCATING BARS BY LOCALLY ADJUSTING SPACING TO ENABLE ASSEMBLY OF REINFORCEMENT TO BE COMPLETED. ENGINEER IS TO BE CONTACTED IN THE EVENT THAT REINFORCEMENT IS NEEDED TO BE CUT ON SITE PRIOR TO CONTINUING.

5. SPLICING OF REINFORCEMENT SHALL BE MADE ONLY WHERE SHOWN ON THE DRAWINGS OR OTHERWISE APPROVED BY THE ENGINEER. LAP LENGTHS AND DEVELOPMENT LENGTHS FOR REINFORCEMENT BARS TO BE AS NOTED ON THE RELEVANT DRAWINGS.

6. LAP FABRIC REINFORCEMENT THUS:



7. COVER SHALL BE AS NOTED ON THE RELEVANT DRAWINGS.

8. CONCRETE COVERS NOTED ARE MEASURED FROM THE FORM WORK OR GROUND FACE TO THE OUTERMOST REINFORCEMENT COMPONENT. i.e.. IN COLUMNS AND BEAMS TO THE OUTSIDE OF TIES OR LIGATURES.

9. COVER TO BE MAINTAINED DURING POURING BY THE USE OF PLASTIC CHAIRS OR PLASTIC TIPPED METAL CHAIRS WHICH ARE TO BE LOCATED AT 800mm MAX CRS BOTH WAYS. BARS TO BE TIED WITH TIE WIRE AT ALTERNATIVE INTERSECTIONS. ALL REINFORCEMENT BAR CHAIRS TO CONFORM TO THE REQUIREMENTS OF AS/NZS2425 AND TO BE STRENGTH GRADE 120 MINIMUM. NO TIE WIRE REINFORCEMENT TO PROTRUDE INTO THE CONCRETE COVER.

10. WHERE NO REINFORCEMENT IS SHOWN ON THE DRAWING AT RIGHT ANGLES TO THE MAIN REINFORCEMENT DISTRIBUTION REINFORCEMENT IS TO BE PROVIDED.

11. UNLESS NOTED OTHERWISE ON THE DRAWINGS, DISTRIBUTION REINFORCEMENT SHALL NOT BE LESS THAN:
   a) DISTRIBUTION REINFORCEMENT IN ONE LAYER FOR SLABS NOT EXCEEDING 150mm THICKNESS
   b) DISTRIBUTION REINFORCEMENT IN TOP & BOTTOM LAYER FOR SLABS LARGER THAN 150mm THICKNESS
   DISTRIBUTION REINFORCEMENT SHALL BE FULLY ANCHORED BY THE DEVELOPMENT LENGTH EXTENDING PAST THE POINT WHERE IT IS NO LONGER REQUIRED.
   WHERE DISTRIBUTION REINFORCEMENT IS TO BE LAPPED, THE LAP LENGTHS SHALL BE IN ACCORDANCE WITH THE LAP TABLES

12. BENDING & STRAIGHTENING
   COLD BENDING: BARS CANNOT BE COLD BENT WITHOUT PRIOR APPROVAL FROM THE PROJECT STRUCTURAL ENGINEER. CORRECT MINIMUM DIAMETER FORMERS ARE TO BE USED IN ACCORDANCE WITH AS3600.
   HOT BENDING: HOT BENDING MAY ONLY BE CONDUCTED WITH THE APPROVAL OF THE PROJECT STRUCTURAL ENGINEER. HOT BENDING CAN ONLY BE PERFORMED BY A CERTIFIED WELDER. TEST CERTIFICATE OF AFFECTED AREA TO BE OBTAINED.
   STRAIGHTENING: WHEN RE-STRAIGHTENING PARTIALLY EMBEDDED BARS, DO NOT BEND OVER FORMERS OF SMALLER DIAMETER THAN PERMITTED IN AS 3600. DO NOT SUBJECT REINFORCEMENT BARS TO IMPACT IN ORDER TO STRAIGHTEN.

13. NO WELDING OF REINFORCEMENT, INCLUDING TACK WELDING, ALLOWED UNLESS SPECIFICALLY SHOWN ON THE DRAWINGS OR APPROVED BY THE ENGINEER.

CONCRETE NOTES CONTINUED

WELDING OF REINFORCEMENT <u>WHERE APPROVED BY 'ROBERT BIRD GROUP' INSTRUCTION</u>:

1. ALL WELDING OF REINFORCEMENT, INCLUDING TACK WELDING, TO BE IN ACCORDANCE WITH AS/NZS 1554.3

2. HYDROGEN CONTROLLED ELECTRODES TO BE USED

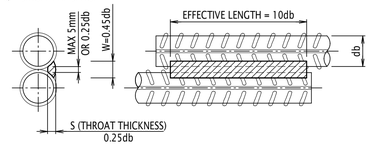
3. ALL WELDS TO BE CATEGORY SP

4. NO WELDS TO BE LOCATED WITHIN 2 BAR DIAMETERS FROM THE START OF A BEND OR ANY PART OF A BAR THAT HAS BEEN BENT AND SUBSEQUENTLY STRAIGHTENED

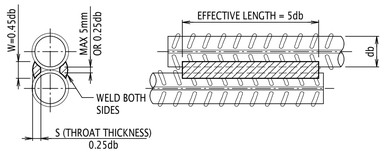
5. EARTHING OR LIGHTNING PROTECTION RODS SHALL NOT BE WELDED TO THE REINFORCEMENT UNLESS APPROVED BY THE ENGINEER

WELDED LAP SPLICES FOR GRADE D500N REINFORCING BARS:

a) SINGLE LAP SPLICE:

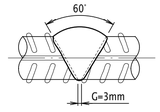


b) DOUBLE LAP SPLICE:

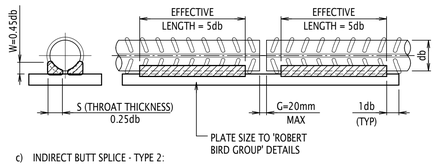


WELDED BUTT SPLICES FOR GRADE D500N REINFORCING BARS:

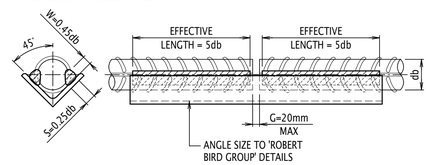
a) DIRECT BUTT SPLICE:



b) INDIRECT BUTT SPLICE - TYPE 1:



c) INDIRECT BUTT SPLICE - TYPE 2:



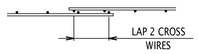
PRECAST CONCRETE NOTES

1. THE PRECAST CONTRACTOR SHALL:-
   - PREPARE AND SUBMIT SHOP DRAWINGS TO 'ROBERT BIRD GROUP' FOR APPROVAL PRIOR TO CASTING. SHOP DRAWINGS TO BE PREPARED IN ACCORDANCE WITH AS3850
   - BE RESPONSIBLE FOR THE ERECTION AND TEMPORARY PROPPING OF THE PANELS. ANY ADDITIONAL REINFORCEMENT CONSIDERED NECESSARY FOR THE LIFTING AND INSTALLATION OPERATION SHOULD BE ADDED BY THE CONTRACTOR AND SHOWN ON THE WORKSHOP DRAWINGS.
   - SUPPLY ALL CAST-IN LIFTING POINTS, FERRULES AND STRONGBACKS AS REQUIRED. ALL LIFTING POINTS SHALL BE INSTALLED STRICTLY IN ACCORDANCE WITH THE MANUFACTURERS SPECIFICATION AND SHOWN DIMENSIONED ON THE WORKSHOP DRAWINGS.
   - NOTIFY 'ROBERT BIRD GROUP' OF THE SURFACE TREATMENT FOR APPROVAL.

2. DIMENSIONS AND PROFILES SHALL BE OBTAINED FROM THE ARCHITECTURAL DRAWINGS.

3. FOR STANDARD REQUIREMENTS TO CONCRETE AND REINFORCING, REFER TO CONCRETE NOTES.

4. LAP FABRIC THUS:



5. ALL PRECAST TO HAVE A MINIMUM COMPRESSIVE STRENGTH OF 32 MPa AND A MINIMUM FLEXURAL TENSILE STRENGTH OF 3.4 MPa AT THE TIME OF LIFTING, UNLESS NOTED OTHERWISE.

6. ALL PRECAST FACES IN CONTACT WITH CAST-INSITU CONCRETE SHALL HAVE ROUGHENED SURFACES.

7. WHERE PANELS ARE TEMPORARILY SUPPORTED ON SHIMS THE GAP IS TO BE FULLY GROUTED WITH A WATER PROOF NON-SHRINK GROUT IN ACCORDANCE WITH THE MANUFACTURERS SPECIFICATION.

8. THE PRECAST REPRESENTED ON THE STRUCTURAL DRAWINGS HAS ONLY BEEN DESIGNED FOR IN-SERVICE LOADS ACTING WHEN THE PANEL IS IN ITS FINAL POSITION AND CONNECTED INTO THE COMPLETE STRUCTURE.

9. ANY PRECAST DAMAGED DURING CONSTRUCTION, TRANSPORTATION AND/OR ERECTION SHALL BE REJECTED, UNLESS INFORMED OTHERWISE BY 'ROBERT BIRD GROUP' SUBSEQUENT TO INSPECTION OF DAMAGED PANEL/S.

10. PRECAST RETAINING SOIL SHALL BE PROPPED DURING THE BACKFILLING OPERATION.

Rev	Revision Description	By	App	Date
T01	ISSUED FOR TENDER	DS	MA	28.06.24
A02	80% DD DRAFT	DS	MA	07.06.24
A01	50% DD ISSUE	SV	MA	09.08.23
P01	DRAFT 50% DESIGN DEVELOPMENT	SV	MA	28.07.23

SCALE 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8

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DO NOT SCALE DRAWINGS, USE FIGURED DIMENSIONS
REFER TO GENERAL NOTES UNLESS NOTED OTHERWISE

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Title
GENERAL NOTES SHEET 3

Date
Jun 2024
Scale at A1

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Approved
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Job Number
22131S

FOR TENDER - NOT FOR CONSTRUCTION

Drawing Number
ALB-RBG-DWG-ST-00-000-13

Revision
T01

PRINT DRAWINGS IN COLOUR

MASONRY NOTES

1.0 GENERAL

1.1 ALL MASONRY SHALL COMPLY WITH AS 3700, AS 4773.1, AS 4773.2 WHERE APPLICABLE AND THE SPECIFICATION.
1.2 ALL MASONRY TO HAVE A STRETCHER BOND PATTERN UNLESS NOTED OTHERWISE ON THE DRAWINGS.
1.3 MASONRY UNITS TO HAVE A SALT ATTACK RESISTANCE GRADE OF "GENERAL PURPOSE" AND GRADE "EXPOSURE" FOR RETAINING WALLS UNLESS NOTED OTHERWISE ON THE DRAWINGS
1.4 MASONRY TO BE BEDDED IN FRESHLY PREPARED MORTAR
1.5 HOLLOW BLOCK MASONRY UNITS SHALL HAVE FULL FACE SHELL AND CROSS WEB MORTAR BEDDING.
1.6 SOLID OR CORED MASONRY UNITS SHALL BE LAID ON A FULL BED OF MORTAR.
1.7 MORTAR JOINT THICKNESS NOT TO EXCEED 10mm FOR CONCRETE, CLAY AND CALCIUM SILICATE MASONRY AND NOT TO EXCEED 4mm FOR AAC MASONRY.
1.8 UNO CAVITY WIDTHS SHALL NOT BE LESS THAN 40mm AND SHALL NOT EXCEED 100mm
1.9 RAKING OF JOINTS IS NOT PERMITTED WITHOUT PRIOR APPROVAL FROM "ROBERT BIRD GROUP".
1.10 JOINT TOOLING IS PERMITTED PROVIDED IT DOES NOT EXCEED 3mm IN DEPTH.
1.11 UNLESS NOTED OR OTHERWISE SHOWN ON THE DRAWINGS, THERE ARE TO BE NO CHASES OR RECESSES PERMITTED IN MASONRY WALLS WITHOUT THE PRIOR APPROVAL OF "ROBERT BIRD GROUP"
1.12 ALL MASONRY WALL INTERSECTIONS SHALL BE FULLY BONDED OR TIED UNLESS NOTED OTHERWISE.

2.0 MATERIALS

2.1 MASONRY SHALL HAVE THE FOLLOWING MINIMUM REQUIRED CHARACTERISTIC UNCONFINED COMPRESSIVE STRENGTH (f'uc):
HOLLOW BLOCK CONCRETE MASONRY - 15 MPa
CORED OR SOLID CONCRETE MASONRY - 15 MPa
CLAY MASONRY - 5 MPa
CALCIUM SILICATE MASONRY - 5 MPa
AAC MASONRY - 3 MPa

2.2 MORTAR SHALL BE OF THE CLASS WITH THE PROPERTIES AS FOLLOWS:

MASONRY UNIT TYPE	MORTAR CLASS	MIX PROPORTION BY VOLUME			
		CEMENT	LIME	SAND	WATER THICKENER (CELLULOSE BASE)
CONCRETE	M3	1	1	6	-
FIRED CLAY	M3	1	1	6	-
CALCIUM SILICATE	M3	1	0	5	YES
AAC	M3	PROPRIETARY MORTAR PRODUCT			
CONCRETE/FIRED CLAY RETAINING WALLS	M4	1	0.25	3	-

"BRICKIES LOAM" SHALL NOT BE USED

2.3 GROUT SHALL HAVE THE FOLLOWING PROPERTIES:
a. MINIMUM CHARACTERISTIC COMPRESSIVE STRENGTH (f'c) OF 20 MPa AT 28 DAYS
b. MINIMUM CEMENT CONTENT OF 300 kg/CUBIC METRE
c. MAXIMUM AGGREGATE SIZE OF 10mm ROUNDED GRAVEL
d. 125mm SLUMP IN 150mm SLUMP CONE

2.4 REINFORCEMENT
a. UNLESS NOTED OTHERWISE DEFORMED BAR REINFORCEMENT SHALL BE D500N CONFORMING TO AS/NZS 4671
b. UNLESS NOTED OTHERWISE WELDED MESH SHALL BE D500N DEFORMED MESH CONFORMING TO AS/NZS 4671
c. BED JOINT REINFORCEMENT SHALL CONSIST OF MINIMUM 3 NO 1.25mm DIAMETER LONGITUDINAL WIRES WITH 0.65mm DIAMETER CROSS WIRES GALVANISED (470 g/m^2) FOR DURABILITY CLASSES R1 TO R3 AND STAINLESS STEEL WIRES FOR DURABILITY CLASS R4 AND SHALL CONFORM TO AS/NZS 2699.2

2.5 CAST-IN ITEMS
a. CONNECTORS AND ACCESSORIES SUCH AS MASONRY ANCHORS, FLEXIBLE TIES, WALL TIES, BED JOINT MESH, FIXINGS, SHELF ANGLES AND LINTELS SHALL HAVE A DURABILITY CLASS OF R?????
b. WALL TIES SHALL HAVE THE FOLLOWING PROPERTIES:

TYPE	DUTY RATING
TYPE A	-

c. SLIP JOINT MATERIAL TO BE ONE OF THE FOLLOWING:

TYPE	NON-EXPOSED LOCATION	EXPOSED LOCATION
BITUMEN -COATED ALUMINIUM	0.3mm MINIMUM BASE THICKNESS AND OVERALL MINIMUM THICKNESS OF 0.56mm AFTER COATING	0.55mm MINIMUM BASE THICKNESS AND OVERALL MINIMUM THICKNESS OF 0.81mm AFTER COATING
EMBOSSED POLYETHYLENE	AVERAGE 0.5mm MINIMUM THICKNESS PRIOR TO EMBOSSING AND 0.75mm AFTER EMBOSSING	NOT APPLICABLE
POLYETHYLENE AND BITUMEN COATED ALUMINIUM	MINIMUM 0.3mm BASE THICKNESS ENCLOSED WITH 0.1mm MINIMUM THICK POLYETHYLENE FILM WITH TOTAL OVERALL MINIMUM THICKNESS OF 0.5mm PRIOR TO COATING	NOT APPLICABLE

3.0 CONSTRUCTION

3.1 GENERAL
a. ALL WALLS TO BE KEPT STABLE AT ALL STAGES OF CONSTRUCTION AND NOT BE OVERSTRESSED AT ANY TIME
b. NO MASONRY WALLS TO BE ERECTED ON SLABS UNTIL THEY HAVE BEEN DE-PROPPED.

3.2 REINFORCED GROUTED CONCRETE MASONRY
a. EXTREME CARE TO BE TAKEN TO CORRECTLY POSITION STARTER BARS IN FOOTINGS IN ACCORDANCE WITH THE DETAILS SHOWN ON THE DRAWINGS
b. PROVIDE CLEAN-OUT OPENINGS TO ALL CORES FOR INSPECTION AND TYING OF REINFORCEMENT
c. ALL CORES TO BE CLEANED OF ALL MORTAR FINS AND DROPPINGS AFTER EACH DAYS LAYING AND BEFORE PLACING VERTICAL REINFORCEMENT
d. VERTICAL WALL REINFORCEMENT SHALL BE TIED TO STARTER BARS AND RESTRAINED AT THE TOP OF WALL IN ITS REQUIRED LOCATION IN ACCORDANCE WITH THE DETAILS SO AS NOT TO MOVE DURING GROUT FILLING OF THE WALL
e. CLEAN-OUT OPENINGS ARE NOT TO BE CLOSED PRIOR TO BEING INSPECTED BY "ROBERT BIRD GROUP"
f. WET ALL CORES PRIOR TO POURING GROUT
g. FULLY GROUT ALL CORES IN REINFORCED WALLS, UNLESS NOTED OTHERWISE
h. GROUT TO BE THOROUGHLY COMPACTED BY RODDING TO ENSURE THE COMPLETE FILLING OF ALL CORES
i. NO CORE TO BE GROUT FILLED TO A HEIGHT EXCEEDING 1200mm WITHOUT WALL HAVING BEEN SUITABLY SHORED.
j. FILL CORES TO A MAXIMUM OF 3000mm IN HEIGHT IN ANY ONE POUR
k. ALL GROUT POURS TO STOP 25mm BELOW THE TOP OF THE BLOCKS TO PROVIDE A KEY FOR THE FOLLOWING POUR.
l. UNLESS NOTED OTHERWISE, PROVIDE VERTICAL CONTROL JOINTS AT MAXIMUM OF 8000mm CENTRES OR TO MATCH CONTROL JOINTS IN THE SUPPORTED AND/OR SUPPORTING CONCRETE FLOOR SLABS.

3.3 UNREINFORCED UNGROUTED CONCRETE MASONRY
a. UNLESS NOTED OTHERWISE, ALL NON-LOAD BEARING WALLS TO HAVE A 20mm WIDE GAP BETWEEN TOP OF WALL AND SOFFIT OF SLAB OR BEAMS OVER. GAP TO BE FILLED WITH APPROVED COMPRESSIBLE MATERIAL. THE COMPRESSIBLE MATERIAL SHALL BE FIRE RATED IF SPECIFIED/REQ'D BY THE ARCHITECT.
b. TOPS OF ALL WALLS TO BE FIXED WITH FLEXIBLE TIES TO SOFFIT OF SLAB OR BEAMS OVER UNLESS NOTED OTHERWISE.
c. UNLESS NOTED OTHERWISE, PROVIDE VERTICAL CONTROL JOINTS AT MAXIMUM OF 5000mm CENTRES AND AT THE FOLLOWING LOCATIONS;
1. AT LOCATIONS SHOWN ON THE ARCHITECTS DRAWINGS
2. AT ABRUPT CHANGES OF WALL HEIGHTS
3. AT SIDES OF OPENINGS LARGER THAN 900mm x 900mm
4. AT CHANGES OF WALL THICKNESS OTHER THAN PIERS AND BUTTRESSES
5. AT CHASES IN WALLS
6. AT 4500mm MAXIMUM FROM CORNERS
7. AT CONTROL JOINTS IN THE SUPPORTING SLABS
d. UNREINFORCED UNGROUTED HOLLOW BLOCK WALLS SUPPORTING SLABS OR BEAMS OVER SHALL HAVE A GROUT FILLED BOND BEAM AT THE TOP COURSE OF THE WALL REINFORCED WITH A MINIMUM OF 1N16 UNLESS NOTED OTHERWISE.
BOND BEAM TO HAVE A LEVEL TOP SURFACE AND BE SEPARATED FROM SLAB OR BEAMS OVER WITH 2 LAYERS OF SLIP JOINT MATERIAL.
e. OPENINGS GREATER THAN 600 mm VERTICALLY OR HORIZONTALLY SHALL BE TRIMMED AT THE SIDES AND BOTTOM WITH GROUTED CORES WITH 1N16 EXTENDING MINIMUM OF 600mm PAST OPENING.
PROVIDE A REINFORCED LINTEL BEAM AT TOP OF OPENING.

3.4 SOLID OR CORED CLAY MASONRY
a. UNLESS NOTED OTHERWISE, ALL NON-LOAD BEARING WALLS TO HAVE A 20mm WIDE GAP BETWEEN TOP OF WALL AND SOFFIT OF SLAB OR BEAMS OVER. GAP TO BE FILLED WITH APPROVED COMPRESSIBLE MATERIAL. THE COMPRESSIBLE MATERIAL SHALL BE FIRE RATED IF SPECIFIED/REQ'D BY THE ARCHITECT.
b. TOPS OF ALL WALLS TO BE FIXED WITH FLEXIBLE TIES TO SOFFIT OF SLAB OR BEAMS OVER UNLESS NOTED OTHERWISE.
c. UNLESS NOTED OTHERWISE, PROVIDE VERTICAL CONTROL JOINTS AT MAXIMUM OF 8000mm CENTRES AND AT THE FOLLOWING LOCATIONS;
1. AT LOCATIONS SHOWN ON THE ARCHITECTS DRAWINGS
2. AT ABRUPT CHANGES OF WALL HEIGHTS
3. AT SIDES OF OPENINGS LARGER THAN 900mm x 900mm
4. AT CHANGES OF WALL THICKNESS OTHER THAN PIERS AND BUTTRESSES
5. AT CHASES IN WALLS
6. AT 4500mm MAXIMUM FROM CORNERS
7. AT CONTROL JOINTS IN THE SUPPORTING SLABS
d. UNLESS NOTED OTHERWISE, BED JOINT REINFORCEMENT SHALL BE PROVIDED AS FOLLOWS;
1. IN THE THREE BED JOINTS AT THE BOTTOM AND TOP OF THE WALLS.
2. IN THE THREE BED JOINTS ABOVE AND BELOW ALL OPENINGS IN THE WALLS WITH BED JOINT REINFORCEMENT EXTENDING 600mm MINIMUM PAST THE SIDES OF THE OPENING.
3. BED JOINT REINFORCEMENT TO BE LAPPED 450mm MINIMUM.
4. BED JOINT REINFORCEMENT TO BE FOLDED AND BENT AT WALL CORNERS TO ENSURE THAT THE LONGITUDINAL WIRES ARE CONTINUOUS.
5. PROVIDE 15mm MINIMUM COVER TO BED JOINT REINFORCEMENT.
e. CAVITY WALLS SHALL HAVE CAVITY TIES AT 600mm CENTRES VERTICALLY AND HORIZONTALLY AND 400mm MAXIMUM CENTRES AT SIDES OF OPENINGS.
TIES SHALL BE PLACED WITHIN 300 mm OF CONTROL JOINTS, ENDS AND TOPS OF WALLS, OPENINGS AND INTERSECTING WALLS AND ABOVE FLOOR LEVELS.
DOUBLE THE NUMBER OF TIES AT INTERSECTING WALLS.
EMBED TIES MINIMUM 50mm INTO EACH LEAF AND PROVIDE 15mm MINIMUM COVER TO EXPOSED FACE.

3.5 CALCIUM SILICATE SOLID MASONRY
a. UNLESS NOTED OTHERWISE, ALL NON-LOAD BEARING WALLS TO HAVE A 20mm WIDE GAP BETWEEN TOP OF WALL AND SOFFIT OF SLAB OR BEAMS OVER. GAP TO BE FILLED WITH APPROVED COMPRESSIBLE MATERIAL. THE COMPRESSIBLE MATERIAL SHALL BE FIRE RATED IF SPECIFIED/REQ'D BY THE ARCHITECT.
b. TOPS OF ALL WALLS TO BE FIXED WITH FLEXIBLE TIES TO SOFFIT OF SLAB OR BEAMS OVER UNLESS NOTED OTHERWISE.
c. UNLESS NOTED OTHERWISE, PROVIDE VERTICAL CONTROL JOINTS AT MAXIMUM OF 5000mm CENTRES AND AT THE FOLLOWING LOCATIONS;
1. AT LOCATIONS SHOWN ON THE ARCHITECTS DRAWINGS
2. AT ABRUPT CHANGES OF WALL HEIGHTS
3. AT SIDES OF OPENINGS LARGER THAN 900mm x 900mm
4. AT CHANGES OF WALL THICKNESS OTHER THAN PIERS AND BUTTRESSES
5. AT CHASES IN WALLS
6. AT 4500mm MAXIMUM FROM CORNERS
7. AT CONTROL JOINTS IN THE SUPPORTING SLABS
d. UNLESS NOTED OTHERWISE, BED JOINT REINFORCEMENT SHALL BE PROVIDED AS FOLLOWS;
1. IN THE THREE BED JOINTS AT THE BOTTOM AND TOP OF THE WALLS.
2. IN THE THREE BED JOINTS ABOVE AND BELOW ALL OPENINGS IN THE WALLS WITH BED JOINT REINFORCEMENT EXTENDING 600mm MINIMUM PAST THE SIDES OF THE OPENING.
3. BED JOINT REINFORCEMENT TO BE LAPPED 450mm MINIMUM.
4. BED JOINT REINFORCEMENT TO BE FOLDED AND BENT AT WALL CORNERS TO ENSURE THAT THE LONGITUDINAL WIRES ARE CONTINUOUS.
5. PROVIDE 15mm MINIMUM COVER TO BED JOINT REINFORCEMENT.

3.6 AAC SOLID MASONRY
a. UNLESS NOTED OTHERWISE, ALL NON-LOAD BEARING WALLS TO HAVE A 20mm WIDE GAP BETWEEN TOP OF WALL AND SOFFIT OF SLAB OR BEAMS OVER. GAP TO BE FILLED WITH APPROVED COMPRESSIBLE MATERIAL. THE COMPRESSIBLE MATERIAL SHALL BE FIRE RATED IF SPECIFIED/REQ'D BY THE ARCHITECT.
b. TOPS OF ALL WALLS TO BE FIXED WITH FLEXIBLE TIES TO SOFFIT OF SLAB OR BEAMS OVER UNLESS NOTED OTHERWISE.
c. UNLESS NOTED OTHERWISE, PROVIDE VERTICAL CONTROL JOINTS AT MAXIMUM OF 6000mm CENTRES AND AT THE FOLLOWING LOCATIONS;
1. AT LOCATIONS SHOWN ON THE ARCHITECTS DRAWINGS
2. AT ABRUPT CHANGES OF WALL HEIGHTS
3. AT SIDES OF OPENINGS LARGER THAN 900mm x 900mm
4. AT CHANGES OF WALL THICKNESS OTHER THAN PIERS AND BUTTRESSES
5. AT CHASES IN WALLS
6. AT 4500mm MAXIMUM FROM CORNERS
7. AT CONTROL JOINTS IN THE SUPPORTING SLABS

3.7 REINFORCED GROUTED CONCRETE AND SOLID CLAY MASONRY RETAINING WALLS
a. REFER TO NOTES IN SECTION 3.2 FOR REQUIREMENTS FOR REINFORCED GROUTED CONCRETE MASONRY
b. RETAINING WALLS NOT TO BE BACKFILLED UNTIL:
1. GROUT HAS OBTAINED ITS 28 DAY COMPRESSIVE STRENGTH
2. SLAB AT TOP OF WALL HAS OBTAINED ITS 28 DAY COMPRESSIVE STRENGTH
c. UNLESS NOTED OTHERWISE, PROVIDE VERTICAL CONSTRUCTION JOINTS AS SHOWN ON THE RETAINING WALL DETAILS.
d. BACKFILL MATERIAL TO CONSIST OF CLEAN GRAVEL FREE FROM ORGANIC MATERIAL, CLAY AND BUILDING RUBBLE.
e. PROVIDE SUB-SOIL DRAINAGE TO RETAINING WALL AS NOTED ON THE DRAWINGS.
AGRICULTURAL DRAIN PIPES TO BE WRAPPED IN GEOFABRIC AS PROTECTION AGAINST SILTATION.
AGRICULTURAL DRAIN PIPES TO HAVE ADEQUATE FALLS TO STORMWATER DRAINAGE SYSTEM.
WEEP HOLES TO BE PROVIDED AS NOTED ON THE DRAWINGS. PROVIDE WATERPROOF MEMBRANE WITH PROTECTIVE SHEETING AS NOTED ON THE ARCHITECTURAL DRAWINGS.
f. RETAINED SOIL BEHIND RETAINING WALL NOT TO BE SURCHARGED BY CONSTRUCTION EQUIPMENT UNLESS SPECIFICALLY APPROVED BY "ROBERT BIRD GROUP".
g. USE OF H BLOCKS PREFERRED FOR RETAINING WALL CONSTRUCTION.

COMPOSITE CONCRETE - STEEL SLABS & BEAMS NOTES

COMPOSITE CONCRETE STEEL SLABS & BEAMS

1. COMPOSITE STEEL SLABS & BEAMS ARE TO BE CONSTRUCTED IN ACCORDANCE WITH THE REQUIREMENTS OF
- AS/NZ 2327:2017, AS4100, & AS3600

PROFILED STEEL SHEET DECKING

1. THE PROFILED STEEL SHEET DECKING SHALL BE OF THE PROPRIETARY TYPE, PROFILE & BASE METAL THICKNESS SHOWN IN THE STRUCTURAL DRAWINGS. THE STEEL SHALL CONFORM TO AS/NZS 1365 (SERIES) & AS 1397 GRADE 550 AND HAVE A ZINC COATING OF AT LEAST Z350 STANDARD BUT NOT GREATER THAN Z450. UNLESS NOTED OTHERWISE STRAMIT CONDECK SHALL BE 1.08MT HP PLUS AND LYSAGHT BONDEK SHALL BE 1.08MT BONDEK PLUS.

2. UNLESS/UNTIL NOTED OTHERWISE ON PLANS, PROFILED STEEL SHEET FORMWORK SHALL BE TAKEN AS CONTINUOUS OVER MINIMUM OF TWO SPANS.

3. PROPS ARE TO BE PROVIDED AT MID-SPAN OF PROFILED STEEL SHEET FORMWORK WHERE CONTINUITY OF CONTINUOUS SPANS IS BROKEN LOCALLY DUE TO PENETRATING ELEMENTS SUCH AS COLUMNS OR FIXTURES TO BEAM TOP FLANGES.

4. PROVIDE CONTINUOUS LINES OF PROPPING, EQUALLY SPACED IN THE SPAN, AT LOCATIONS SHOWN ON THE STRUCTURAL DRAWINGS. PROP REMOVAL SHALL BE DESIGNED BY A RPEQ TEMPORARY WORKS ENGINEER AND BE IN ACCORDANCE WITH AS3610.

5. CONSTRUCTION LOADING SHALL MONITORED AND CONTROLLED IN ACCORDANCE WITH AS2327-2017 APPENDIX A WITH THE FOLLOWING CLARIFICATIONS:
- STAGE 2 LOADING (SLAB PREPARATION UP TO BUT BEFORE CONCRETE PLACEMENT)
- WEIGHT OF METAL DECK SHEETING
- WEIGHT OF REINFORCEMENT, MIN 10kg/m2
- UNIFORMLY DISTRIBUTED LIVE LOAD = 2.0kPa# (MATERIALS STACKING)
- OR 1kN LIVE LOAD AT EDGE OF PAN, 2kN OTHERWISE OVER 0.1x0.1m AREA.
- WIND LOADING (TO BE CONFIRMED BY TEMPORARY WORKS ENGINEER)
- STAGES 3&4 LOADING (POST CONCRETE PLACEMENT BUT PRIOR COMPOSITE ACTION)
- WEIGHT OF METAL DECK SHEETING
- WEIGHT OF REINFORCEMENT, MIN 10kg/m2
- UNIFORMLY DISTRIBUTED LOAD FROM WET WEIGHT OF CONCRETE ALLOWING 2,400kg/m3
- UNIFORMLY DISTRIBUTED LIVE LOAD = 1.0kPa (CONCRETE FINISHING OPERATION) OR 2.0kPa OVER AN ISOLATED 1.6x1.6m AREA FOR LOCALISED CONCRETE MOUNDING
- STAGE 5 (AFTER COMPOSITE ACTION DEVELOPED AT MIN. f'_{cj}=15MPa BUT BEFORE f'c(28) DEVELOPED)
- REDUCED DESIGN LOADS TO BE ASSESSED BY TEMPORARY WORKS ENGINEER
- STAGE 6
- DESIGN LOADS IN ACCORDANCE WITH RBG LOADING PLANS

AMENDMENTS TO THE DEFAULT CODE REQUIREMENTS ARE NOTED ABOVE BY #.
LIVE LOADING NOMINATED IS INCLUSIVE OF ALL PEOPLE, EQUIPMENT AND STACKING OF MATERIALS.

6. ALL CONSTRUCTION LOADING INCLUDING MATERIALS STACKING SHALL BE APPLIED TO THE PAN USING APPROPRIATE PACKING. RIBS SHALL NOT BE DIRECTLY LOADED.

7. SUPPORT SPACING SHOWN ON THE DOCUMENTS CONSIDERS MAXIMUM FORMWORK DISPLACEMENT OF L/130 UNLESS NOTED OTHERWISE. FOR AREAS DESIGNED BY OTHERS L/240 SHALL BE ADOPTED UNLESS CONFIRMED OTHERWISE.

8. PROFILED STEEL SHEET DECKING SHALL BE SECURELY FIXED OR HELD DOWN TO PREVENT DISPLACEMENT OR UPLIFT DURING CONSTRUCTION OR DUE TO WIND PRIOR TO POURING CONCRETE. REFER TO DECKING MANUFACTURER'S TECHNICAL LITERATURE FOR METHODS TO BE USED. FIXINGS SHALL BE LOCATED ADJACENT TO THE RIBS AT THE ENDS OF DECKING SHEETS AND AT EACH THIRD RIB (BUT NOT EXCEEDING 600 CRS) AT EACH INTERMEDIATE SLAB SUPPORT OVER WHICH THE DECKING SHEET IS CONTINUOUS.

9. THE PROFILED STEEL SHEET DECKING MAY FORM PART OF THE LATERAL STABILITY BRACING FOR THE PERMANENT STEEL SUPPORT BEAMS DURING CONSTRUCTION. THE FIXINGS OF THE PROFILED STEEL SHEET DECKING TO THESE BEAMS MUST SATISFY THE REQUIREMENTS OF THE TEMPORARY WORKS ENGINEER.

10. STEEL SUPPORTS FOR PROFILED STEEL SHEET DECKING THAT ARE TO HAVE SHEAR STUDS WELDED ON SITE ARE TO BE FREE OF ALL CONTAMINANTS, DEBRIS AND PAINT COATING(S) LIKELY TO INTERFERE WITH THE WELDING PROCESS.

11. MINIMUM BEARING LENGTH OF PROFILED STEEL SHEET DECKING PANELS ON SUPPORTING WALLS OR BEAMS SHALL BE 50mm AT DECKING ENDS AND 100mm AT INTERMEDIATE SUPPORTS OVER WHICH THE DECKING IS CONTINUOUS.

12. PROFILED STEEL SHEET DECKING SHALL HAVE ALL SIDE LAPS FASTENED TOGETHER TO MANUFACTURERS & TEMPORARY WORKS ENGINEERS REQUIREMENTS.

13. UNLESS NOTED OTHERWISE ON ROBERT BIRD GROUP DRAWINGS ALL PENETRATIONS ARE TO BE FORMED ABOVE THE PROFILED STEEL SHEET FORMWORK. PROFILED STEEL SHEETING SHALL NOT BE CUT PRIOR TO CONCRETE PLACEMENT. STEEL SHEETING CAN BE CUT ONCE SLAB ACHIEVES MINIMUM 20MPa.

14. ONLY PENETRATIONS SHOWN ON THE STRUCTURAL ENGINEERING DRAWINGS ARE PERMITTED. ADDITIONAL PENETRATIONS REQUIRE WRITTEN APPROVAL FROM THE PROJECT STRUCTURAL ENGINEER BEFORE CONSTRUCTION COMMENCES.

15. CAST-IN SERVICES ARE NOT PERMITTED UNLESS SHOWN ON THE ROBERT BIRD GROUP DRAWINGS. WHERE SHOWN ON THE DRAWINGS:
CAST-IN PARALLEL TO RIBS - PLACE BETWEEN RIBS, BELOW TOP FACE REINFORCING AND ABOVE PANS AND FLUTES OF DECKING.
CAST-IN PERPENDICULAR TO RIBS - PLACE BELOW TOP FACE REINFORCEMENT AND ABOVE TOP OF RIBS.

16. PROVIDE AND INSTALL ALL EDGE TRIMS, FLASHINGS, CLOSURE ITEMS AND SEALING MEMBRANES REQUIRED TO PREVENT CONCRETE AND CONCRETE SLURRY LOSS.

17. THE POURING SEQUENCE FOR CONCRETE SLABS FORMED BY PROFILED STEEL DECKING SHALL FOLLOW THE DECKING MANUFACTURERS INSTRUCTIONS. TYPICAL GUIDANCE IS AS FOLLOWS WHICH MUST BE CONFIRMED WITH THE MANUFACTURER:
a. COMMENCE POURING FROM SUPPORTS, SPREADING EVENLY OVER ADJACENT SPANS.
b. ENSURE CONCRETE IS THOROUGHLY COMPACTED, WORKED AND VIBRATED INTO RIBS, CORNERS AND EDGE FORMS.
c. CONCRETING IS TO BE COMPLETED IN BACKSPANS OF ANY CANTILEVERS FIRST PRIOR TO PROCEEDING TO PLACEMENT IN THE CANTILEVER. CANTILEVERS ONLY WHERE APPROVED BY THE STRUCTURAL ENGINEER AND DETAILED ON THE STRUCTURAL ENGINEERING DRAWINGS,
d. TIMING FOR REMOVAL OF ANY PROPS IS TO BE CONFIRMED BY THE TEMPORARY WORKS ENGINEER.

COMPOSITE CONCRETE - STEEL SLABS & BEAMS NOTES CONTINUED

SLAB REINFORCEMENT AND CONCRETE

1. ALL METAL DECK SLABS SHALL BE POURED BASED ON THE THICKNESS NOMINATED ON THE STRUCTURAL DRAWINGS IN ADDITION TO BE BEING CHECKED FOR LEVEL. THE THICKNESS OF THE CONCRETE SHALL BE VERIFIED BY DIP STICK DURING THE CONCRETE PLACEMENT OPERATION. SOME STEEL BEAMS WILL BE OVERCAMBERED AND POURING ONLY TO LEVEL WILL RESULT IN INADEQUATE SLAB THICKNESS.

2. SLAB REINFORCEMENT SIZE, SPACING AND DIMENSIONS ARE SHOWN ON THE STRUCTURAL DRAWINGS, TYPICAL SLAB SECTIONS AND SECTIONS.

3. ALL BOTTOM BARS ARE TO BE PLACED IN THE PROFILED STEEL SHEET DECKING TRAYS BEFORE FABRIC IS LAID AND TIED SECURELY TO SUPPORTING REINFORCEMENT.

4. ALL TOP BARS ARE TO BE PLACED ON TOP OF, AND TIED TO, THE FABRIC.

5. BEFORE PLACING CONCRETE REMOVE ANY DEBRIS, GREASE OR ANY OTHER SUBSTANCE WHICH COULD ADVERSELY AFFECT THE CONCRETE/STEEL BOND.

6. CONCRETE SHALL BE OF THE STRENGTH SHOWN ON THE STRUCTURAL DRAWINGS BUT WITH A f'c NOT LESS THAN 25 MPa. IT SHALL BE FREE OF ADMIXTURES UNLESS THEY COMPLY WITH AS 3600.

7. PROPPING UNDER THE SLAB SHALL BE REMOVED IN ACCORDANCE WITH AS 3610.

8. NO WALLS SHALL BE CONSTRUCTED ON PROPPED SLABS.

PROPPING OF BEAMS AND PROFILED STEEL SHEET DECKING

1. PROFILED STEEL SHEET DECKING SHALL BE PROPPED DURING CONSTRUCTION AS NOTED ON THE STRUCTURAL DRAWINGS AND TO THE MANUFACTURER'S REQUIREMENTS

2. THE PROPPING SYSTEM SHALL MEET THE REQUIREMENTS OF AS 3610 AND SHALL BE DESIGNED BY A TEMPORARY WORKS ENGINEER.

3. PROPPING SYSTEM SHALL BE ADEQUATE TO SUPPORT THE CONSTRUCTION LOADS AS WELL AS THE WEIGHT OF THE WET CONCRETE

4. BEARERS OVER PROPS SHALL EXTEND ACROSS THE FULL WIDTH OF THE PROFILED STEEL SHEET DECKING

5. THE PROPPING SYSTEM SHALL NOT DEFLECT OR SETTLE MORE THAN IS ALLOWED IN AS 3610

6. THE WIDTH OF THE BEARERS TO BE SUFFICIENT TO AVOID CREASING OF THE PROFILED STEEL SHEET DECKING

HEADED STUD SHEAR CONNECTORS

1. SHEAR CONNECTORS SHALL COMPLY WITH AS/NZS 1554.2:2003
UNO, SHEAR CONNECTORS SHALL HAVE A SHANK DIAMETER OF 19mm. THEY SHALL HAVE A LENGTH OF 100mm AFTER WELDING UNO.
THEY SHALL HAVE THE FOLLOWING MINIMUM MATERIAL PROPERTIES:
- MINIMUM YIELD STRENGTH (0.2% PROOF STRESS) - 345MPa
- MINIMUM TENSILE STRENGTH - 410 MPa

2. ALL STUD WELDING SHALL BE IN ACCORDANCE WITH AS 1554.2.
- STUDS SHALL NOT BE WELDED TO BEAMS MANUALLY THROUGH SLAB PROFILED STEEL SHEET DECKING.
- SUITABLE AUTOMATIC STUD WELDING GUNS SHOULD BE USED TO WELD STUDS DIRECTLY TO BEAMS OR THROUGH THE PROFILED STEEL SHEET DECKING TO THE BEAMS.

3. STUDS ARE TO BE TESTED IN ACCORDANCE WITH AS1554.2 SECTION 6 AND AS FOLLOWS:
- 1 IN 200 TESTED (MINIMUM 3 TESTED) - CLAUSE 6.1.1 FOR STATICALLY LOADED STRUCTURES & 1 IN 50 TESTED (MINIMUM 5 TESTED) - CLAUSE 6.1.1 FOR DYNAMICALLY LOADED STRUCTURES
- 1 IN 100 TESTED (MINIMUM 3 TESTED) - CLAUSE 6.1.2 FOR STATICALLY LOADED STRUCTURES & 1 IN 20 TESTED (MINIMUM 5 TESTED) - CLAUSE 6.1.2 FOR DYNAMICALLY LOADED STRUCTURES

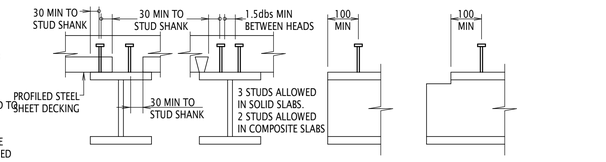
4. WHERE STUDS ARE TO BE ATTACHED THE SURFACES OF STEEL SUPPORTS FOR PROFILED STEEL SHEET DECKING AND THE PROFILED STEEL SHEET DECKING SHALL BE FREE OF ALL CONTAMINANTS, SCALE, RUST, MOISTURE, DEBRIS AND PAINT COATING(S) LIKELY TO INTERFERE WITH THE WELDING PROCESS.

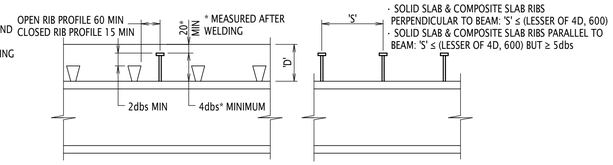
5. THE LOCATION OF STUDS RELATIVE TO BEAM FLANGE EDGES, ENDS, AND PROFILED STEEL SHEET DECKING ENDS, RIBS AND EMBOSSING SHALL BE AS SHOWN IN THE ACCOMPANYING TYPICAL DETAILS.
STUD NUMBERS PER BEAM AND LONGITUDINAL AND TRANSVERSE SPACINGS ARE ALSO SHOWN ON THE TYPICAL DETAILS AND THE PROJECT DETAILS AND SCHEDULES.

6. IN COMPOSITE SLABS STUDS SHALL BE PLACED IN DECKING VALLEYS WITH A MAXIMUM OF TWO STUDS PER VALLEY.
ALSO REFER TO THE PROFILED STEEL SHEET DECKING MANUFACTURER FOR RECOMMENDED STUD LOCATIONS.

7. STUD HEIGHT SHALL BE MEASURED AFTER WELDING.

8. ARRANGEMENT OF HEADED SHEAR CONNECTORS:





- SOLID SLAB & COMPOSITE SLAB RIBS PERPENDICULAR TO BEAM: 'S' ≤ (LESSER OF 4D, 600)
- SOLID SLAB & COMPOSITE SLAB RIBS PARALLEL TO BEAM: 'S' ≤ (LESSER OF 4D, 600) BUT ≥ 5dbs

- ALL HORIZONTAL DIMENSIONS ARE TO STUD CENTRELINE UNO
- dbs = STUD SHANK DIAMETER
- D = SLAB THICKNESS

Rev	Revision Description	By	App	Date
T01	ISSUED FOR TENDER	DS	MA	28.06.24
A02	80% DD DRAFT	DS	MA	07.06.24
A01	50% DD ISSUE	SV	MA	09.08.23
P01	DRAFT 50% DESIGN DEVELOPMENT	SV	MA	28.07.23

SCALE 1:1 | 2 | 3 | 4 | 5 | 6 | 7 | 8

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DO NOT SCALE DRAWINGS, USE FIGURED DIMENSIONS
REFER TO GENERAL NOTES UNLESS NOTED OTHERWISE

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GENERAL NOTES SHEET 4

Date
Jun 2024
Scale at A1

Drawn
D.STUCKEY
Designer

PRINT DRAWINGS IN COLOUR

STEELWORK NOTES

1.0 GENERAL

1.1 **CERTIFICATION**
ALL TENDERERS (FABRICATORS) MUST HAVE DOCUMENTED CURRENT EVIDENCE OF HAVING FULFILLED 'STAGE 1' OF THE SCA CERTIFICATION PROCESS, INCLUDING A GAP ANALYSIS OF THE NECESSARY ACTIONS TO MEET THE REQUIRED CONSTRUCTION CATEGORY. THE SUCCESSFUL FABRICATOR(S) MUST SUBMIT DOCUMENTARY EVIDENCE OF CURRENT FULL CERTIFICATION TO THE RELEVANT CONSTRUCTION CATEGORY BEFORE WORK COMMENCES ON THE PROJECT. THE CERTIFICATION MUST BE MAINTAINED FOR THE DURATION OF THE PROJECT

1.2 **CONSTRUCTION CATEGORY**
IN ACCORDANCE WITH THE REQUIREMENTS OF AS/NZS 5131 THE CONSTRUCTION CATEGORIES FOR THIS PROJECT ARE DEFINED IN THE TABLE BELOW:

ELEMENT	IMPORTANCE LEVEL	SERVICE CATEGORY	FABRICATION CATEGORY	CONSTRUCTION CATEGORY
ALL STRUCTURAL STEELWORK UNO	IL3	SC1	FC2	CC3

1.3 **TREATMENT GRADES**
UNLESS NOTED OTHERWISE IN THE PROJECT DRAWINGS, FOR THE ELEMENTS ON THIS PROJECT, THE TREATMENT GRADES ACCORDING TO AS/NZS 5131 SHALL BE:

ELEMENT	TREATMENT GRADE
ALL PAINTED STRUCTURAL STEELWORK UNO	P2
ALL ARCHITECTURALLY EXPOSED STRUCTURAL STEELWORK UNO	P3

1.4 **COATING QUALITY LEVEL**
THE COATING QUALITY LEVEL ASSESSED ACCORDING TO AS/NZS 5131 SHALL BE AS GIVEN IN THE TABLE BELOW.

ITEM	COATING QUALITY LEVEL (PC1, PC2)
EXTERNAL STEELWORK	PC2
INTERNAL STEELWORK	PC1

1.5 **SHOP DRAWINGS AND DIMENSIONS**
IF REVIEW OF SHOP DRAWINGS IS INCLUDED IN ENGINEER'S SCOPE OF WORK THEN BEFORE FABRICATION COMMENCES, THE CONTRACTOR SHALL SUBMIT TWO COPIES OF SHOP DRAWINGS TO THE ENGINEER FOR REVIEW OF ARRANGEMENT OF GENERAL STRUCTURAL ELEMENTS AND DESIGN INTENT.
ALL DIMENSIONS RELEVANT TO SETTING OUT AND SITE WORK ARE TO BE CHECKED ON SITE BY THE CONTRACTOR PRIOR TO WORK COMMENCING.
DO NOT SCALE DRAWINGS.

1.6 **STEELWORK QUANTITIES**
WHEN CALCULATING STEELWORK QUANTITIES FROM PRELIMINARY DRAWINGS, MULTIPLY PRELIMINARY STEELWORK BY 1.15 (I.E. 15% ALLOWANCE) FOR SPLICE PLATES, STIFFENERS, BOLTS ETC AND A FURTHER 1.15 (I.E. 15% ALLOWANCE) FOR MEMBERS SUCH AS TRIMMERS, MINOR BRACES, GUSSETS, STIFFENERS ETC THAT ARE DESIGNED DURING DETAILED DESIGN STAGE.

2.0 STRUCTURAL STEELWORK FABRICATION

2.1 **WORKMANSHIP AND QUALITY**
ALL STRUCTURAL STEELWORK SHALL BE FABRICATED IN ACCORDANCE WITH AS/NZS 5131.
ALL WORK ON THIS PROJECT SHALL BE UNDERTAKEN BY COMPETENT PERSONNEL. REQUIREMENTS AND EXAMPLES OF QUALIFICATIONS FOR COMPETENT PERSONNEL ARE CONTAINED IN AS/NZS 5131.
STEELWORK SHALL BE FABRICATED BY FABRICATORS CERTIFIED UNDER THE ASI 'NATIONAL STRUCTURAL STEELWORK COMPLIANCE SCHEME' (NSSCS) FOR THE CONSTRUCTION CATEGORY(S) DEFINED IN SECTION 1.2

2.2 **TOLERANCES**
FABRICATION TOLERANCES SHALL CONFORM TO THE REQUIREMENTS OF AS/NZS 5131.
UNLESS NOTED OTHERWISE, THE TOLERANCE CLASS FOR FUNCTIONAL TOLERANCE SHALL BE CLASS 1 FOR CONSTRUCTION CATEGORIES CC1 & CC2 & SHALL BE CLASS 2 FOR CONSTRUCTION CATEGORIES CC3 & CC4 NOMINATED IN SECTION 1.2.

2.3 **LEVEL OF TRACEABILITY**

CONSTRUCTION CATEGORY	TYPE OF TRACEABILITY (LOT, PIECE, PIECE-MARK AS DEFINED IN AS/NZS5131 CLAUSE 4.7)	EXTENT OF TRACEABILITY
CC1	NOT REQUIRED	THE GRADE OF STEEL SHALL REMAIN IDENTIFIABLE FOR ALL STEEL MATERIAL. INDIVIDUAL PLATE AND SECTION COMPONENTS SHALL BE MARKED OR OTHERWISE DESIGNATED TO ENSURE THE GRADE CAN BE CORRELATED DIRECTLY WITH THE FABRICATION DRAWING OR DATA
CC2	LOT	MAIN STRUCTURAL MEMBERS, CONNECTIONS BETWEEN MAIN STRUCTURAL MEMBERS & MAJOR PLATE COMPONENTS
CC3	LOT	LOT TRACEABILITY FOR ALL ITEMS (INCLUDING CLEATS, BRACKETS AND THE LIKE)
CC4	LOT	LOT TRACEABILITY FOR ALL ITEMS (INCLUDING CLEATS, BRACKETS AND THE LIKE)

2.4 **STEEL MATERIALS**

2.4.1 **GRADES**
ALL STRUCTURAL STEEL MATERIAL SHALL CONFORM TO THE FOLLOWING TABLE UNO:

COMPONENT	TO CONFORM WITH AUSTRALIAN STANDARD	MINIMUM GRADE
HOT ROLLED STEEL SECTIONS	AS/NZS 3679.1; TS102	300
PLATE	AS/NZS 3678; TS102	250
FLATS	AS/NZS 1594; TS102	300
HOLLOW SECTIONS: CIRCULAR (CHS) SQUARE (SHS) RECTANGULAR (RHS)	AS/NZS 1163; TS102	 C350L0 C450L0 C450L0
WELDED BEAMS & COLUMNS	AS/NZS 3679.2; TS102	300
SHEAR STUDS (COMPOSITE SLAB TO STEEL)	AS/NZS 1554.2	380
QUENCH & TEMPERED PLATE	AS3597	690
PURLINS & GIRTS	AS1397	450
CFT HOLLOW SECTION	AS/NZS 3678; TS102	350
CUSTOM WELDED BEAMS	AS/NZS 3678; TS102	300

MEMBER SIZES SHALL BE AS SHOWN ON THE STRUCTURAL DRAWINGS. NO SUBSTITUTION IS PERMITTED WITHOUT APPROVAL IN WRITING FROM THE ENGINEER.
DOCUMENTATION SUPPLIED WITH MATERIALS AND COMPONENTS SHALL CONFORM TO THE REQUIREMENTS OF AS/NZS 5131.

2.4.2 **LAMELLAR TEARING**
JOINT DETAILS WHICH ARE SUSCEPTIBLE TO LAMELLAR TEARING (LT) ARE INDICATED ON THE PROJECT DRAWINGS AS 'LT SUSCEPTIBLE', WITH THE SPECIFIC PLATE WITH HIGH THROUGH-THICKNESS STRESS NOTED.
THE SPECIFIC PLATE IN JOINTS THAT ARE INDICATED AS 'LT SUSCEPTIBLE' SHALL BE SUPPLIED ULTRASONICALLY TESTED TO AS 1710 CLASS 1.

STEELWORK NOTES CONTINUED

2.4.3 **Z-PLATE REQUIREMENT**
JOINTS THAT ARE DESIGNATED 'LT SUSCEPTIBLE' (SEE CLAUSE 2.4.2) AND FURTHER REQUIRE PLATE TO A NOMINATED Z-VALUE ARE INDICATED ON THE PROJECT DRAWINGS WITH A DESIGNATED Z-VALUE. THE PLATE USED FOR THESE JOINTS SHALL BE ORDERED TO THE DESIGNATED Z-VALUE.
UNLESS NOTED OTHERWISE WHERE THROUGH THICKNESS TENSILE FORCES ARE INDUCED IN MEMBERS OR CONNECTIONS IN THE FOLLOWING CASES, Z GRADE QUALITY STEEL GRADE Z35 TO AS/NZS 3678:2016 UNO IS REQUIRED:
- T (TEE) JOINTS: FILLET WELD THROAT THICKNESS > 35mm
- X (CRUCIFORM) JOINTS: ACROSS PLATE THICKNESS > 25mm
- L (CORNER) JOINTS: CROSS PLATE THICKNESS > 20mm

2.4.4 **SUPPLEMENTARY ULTRASONIC TESTING**
SUPPLEMENTARY ULTRASONIC TESTING TO AS 2207 AND AS/NZS 1554.1 IS REQUIRED FOR ALL PLATES 40mm THICKNESS AND OVER.

2.4.5 **STEEL QUALITY**
ALL STRUCTURAL STEEL SHALL BE SOURCED FROM MILLS WITH A RELEVANT JAS-ANZ ACCREDITED THIRD-PARTY CERTIFICATION SCHEME SUCH AS THE AUSTRALIAN CERTIFICATION FOR REINFORCING AND STRUCTURAL STEEL (ACRS) SCHEME. ALTERNATIVE SOURCING OF THIRD-PARTY CERTIFIED STRUCTURAL STEEL SHALL BE SUBMITTED FOR REVIEW AND MUST BE APPROVED PRIOR TO THE COMMENCEMENT OF PROCUREMENT.

2.4.6 **SPLICING OF STRUCTURAL MEMBERS**
ALL STRUCTURAL STEELWORK MEMBERS SHALL BE SUPPLIED IN A SINGLE LENGTH, EXCEPT WHERE OTHERWISE INDICATED WITH SPLICE LOCATIONS SHOWN ON THE STRUCTURAL DRAWINGS. SPLICES AT OTHER LOCATIONS SHALL BE APPROVED BY THE ENGINEER PRIOR TO FABRICATION COMMENCING.

2.5 **CUTTING, HOLING AND SHAPING**
ALL CUTTING, HOLING AND SHAPING OF STRUCTURAL STEEL SHALL CONFORM TO THE REQUIREMENTS OF AS/NZS 5131.
PENETRATIONS OR CUT-OUTS OTHER THAN THOSE SHOWN ON THE DRAWINGS SHALL NOT BE MADE WITHOUT PRIOR APPROVAL.

2.6 **BOLTING**
ALL BOLTS SHALL BE GRADE 8.8/S BOLTS FOR SERVICE CATEGORY SC1 ELEMENTS UNO
AND GRADE 8.8/TB BOLTS FOR SERVICE CATEGORY SC2 ELEMENTS UNO
MINIMUM SIZE OF BOLTS TO BE M20 UNO

2.6.1 **BOLT DESIGNATION**

BOLTING DESIGNATION	METHOD OF INSTALLATION
4.6/S	COMMERCIAL GRADE 4.6 BOLTS TO AS 1111, TIGHTENED TO A SNUG TIGHT CONDITION TO AS/NZS 5131
8.8/S	HIGH STRENGTH STRUCTURAL BOLTS OF GRADE 8.8 TO AS/NZS 1252.1, TIGHTENED TO A SNUG TIGHT CONDITION TO AS/NZS 5131
8.8/TB	HIGH STRENGTH STRUCTURAL BOLTS OF GRADE 8.8 TO AS/NZS 1252.1, FULLY TENSIONED TO AS/NZS 5131 AS A BEARING JOINT
8.8/TF	HIGH STRENGTH STRUCTURAL BOLTS OF GRADE 8.8 TO AS/NZS 1252.1, FULLY TENSIONED TO AS/NZS 5131 AS A FRICTION JOINT
10.9/TB	HIGH STRENGTH STRUCTURAL BOLTS OF GRADE 10.9 TO AS/NZS 1252.1, FULLY TENSIONED TO AS/NZS 5131 AS A BEARING JOINT
10.9/TF	HIGH STRENGTH STRUCTURAL BOLTS OF GRADE 10.9 TO AS/NZS 1252.1, FULLY TENSIONED TO AS/NZS 5131 AS A FRICTION JOINT

2.6.2 **BOLT QUALITY**
HIGH STRENGTH STRUCTURAL BOLTS SHALL BE VERIFIED TO AS/NZS 1252.2. THE DOCUMENTATION REQUIRED BY AS/NZS 5131, INCLUDING THE 'SUPPLIER DECLARATION OF CONFORMITY' (SDoC) SHALL BE PROVIDED.

2.6.3 **METHOD OF TENSIONING**
/TB AND /TF BOLTS SHALL BE INSTALLED AS AN APPROVED TENSION CONTROL BOLT INSTALLED TO MANUFACTURER'S INSTRUCTIONS. WHERE NOT POSSIBLE, LOAD INDICATING DEVICES SHALL BE USED. MINIMUM BOLT LENGTH FOR TENSIONED BOLTS TO BE FOUR BOLT DIAMETERS.

2.6.4 **CONTACT SURFACES IN TENSIONED CONNECTIONS**
FOR CONNECTIONS WHERE 8.8/TF OR 10.9/TF BOLTS ARE SPECIFIED, A FRICTION COEFFICIENT OF 0.35 HAS BEEN ASSUMED FOR THE DESIGN. THE CONTACT SURFACES SHALL BE PREPARED ACCORDING TO AS/NZS 5131 AND BE FREE FROM PAINT, LACQUER OR OTHER APPLIED FINISHES UNLESS THE APPLIED FINISH HAS BEEN TESTED IN ACCORDANCE WITH AS4100 APPENDIX J AND A FRICTION COEFFICIENT OF 0.35 OR HIGHER IS DETERMINED.

2.6.5 **BOLT FINISH**
ALL BOLTS, NUTS AND WASHERS SHALL BE HOT-DIP GALVANIZED TO AS/NZS 1214.

2.7 **WELDING**

2.7.1 **WELDING CONSUMABLES**
WELDING CONSUMABLES SHALL CONFORM TO THE REQUIREMENTS OF AS/NZS 1554, BASED ON THE YIELD STRENGTH OF THE STEEL TO BE WELDED, AS DEFINED IN THE TABLE BELOW:

NOMINAL YIELD STRENGTH OF STEEL TO BE WELDED	TO CONFORM WITH AUSTRALIAN STANDARD
≤ 500MPa	AS/NZS 1554.1
> 500MPa; ≤ 690MPa	AS/NZS 1554.4

2.7.2 **WELD CONSUMABLE STRENGTH**

NOMINAL YIELD STRENGTH OF STEEL TO BE WELDED	NOMINAL TENSILE STRENGTH OF WELD METAL, f_{uw} (MPa)
ALL STEEL WITH GRADE ≤ 300MPa	430
ALL STEEL WITH 300MPa < GRADE ≤ 450MPa	490
QUENCH & TEMPERED STEEL TO GRADE 690MPa	760

2.7.3 **WELD QUALITY**

ELEMENT	WELD CATEGORY
SHOP WELDS IN MEMBERS SUBJECT TO CYCLIC LOADING AND IN LIFTING DEVICES (e.g. LIFTING LUGS)	F.P. UNO
SHOP WELDS IN PERMANENT BUILDING WORKS ELEMENTS & IN SPECIAL STRUCTURES AND TEMPORARY FALSE WORKS	S.P. UNO
SITE WELDS IN PERMANENT BUILDING WORKS ELEMENTS & IN SPECIAL STRUCTURES AND TEMPORARY FALSE WORKS	S.P. UNO

STEELWORK NOTES CONTINUED

2.7.4 **NON-DESTRUCTIVE EXAMINATION**
THE EXTENT OF NON-DESTRUCTIVE EXAMINATION (NDE) SHALL BE AS DEFINED IN THE TABLES BELOW WHICH ARE BASED ON CLAUSE 13.6.2.2 OF AS/NZS 5131.

TYPE OF STRUCTURE	SERVICE CATEGORY	VISUAL	OTHER
STRUCTURAL MEMBERS SUBJECT TO CYCLIC LOADS AND IN LIFTING DEVICES (E.G. LIFTING LUGS)	SC2	100% VISUAL SCANNING 100% VISUAL EXAMINATION TO AS/NZS 1554	<u>WELD CATEGORY FP JOINTS FOR SC2</u> 100% ULTRASONIC EXAMINATION (UT) FOR BUTT WELDS TO AS/NZS 1554 PARTS 4 OR 5 AS APPROPRIATE 100% MAGNETIC PARTICLE EXAMINATION (MT) FOR FILLET WELDS TO AS/NZS 1554 PARTS 4 OR 5 AS APPROPRIATE
STRUCTURAL MEMBERS OR COMPONENTS WITH MEMBERS AND CONNECTIONS SUBJECT TO FATIGUE (CRANE SUPPORTING STRUCTURES, TEMPORARY WORKS, FALSEWORK)	SC2	100% VISUAL SCANNING 100% VISUAL EXAMINATION TO AS/NZS 1554	<u>WELD CATEGORY SP FOR SC2</u> 25% MAGNETIC PARTICLE EXAMINATION (MT) FOR SHOP AND FIELD FILLET WELDS (100% IF DEFECTS ARE FOUND) 100% RADIOGRAPHIC OR ULTRASONIC EXAMINATION (UT) FOR SHOP OR FIELD BUTT WELDS
STRUCTURAL MEMBERS OR COMPONENTS DESIGNED FOR PREDOMINANTLY QUASI-STATIC ACTIONS ONLY (BUILDINGS, WAREHOUSES, STORAGE FACILITIES)	SC1	100% VISUAL SCANNING 10% VISUAL EXAMINATION FOR GP WELDS TO AS/NZS 1554 25% VISUAL EXAMINATION FOR SP WELDS TO AS/NZS 1554	<u>WELD CATEGORY GP FOR SC1</u> 2% MAGNETIC PARTICLE EXAMINATION (MT) FOR SHOP FILLET WELDS 25% MAGNETIC PARTICLE EXAMINATION (MT) FOR FIELD FILLET WELDS (100% IF DEFECTS ARE FOUND) 2% RADIOGRAPHIC OR ULTRASONIC EXAMINATION (UT) FOR SHOP BUTT WELDS 100% RADIOGRAPHIC OR ULTRASONIC EXAMINATION (UT) FOR FIELD BUTT WELDS <u>WELD CATEGORY SP FOR SC1</u> 10% MAGNETIC PARTICLE EXAMINATION (MT) FOR SHOP FILLET WELDS 25% MAGNETIC PARTICLE EXAMINATION (MT) FOR FIELD FILLET WELDS (100% IF DEFECTS ARE FOUND) 10% RADIOGRAPHIC OR ULTRASONIC EXAMINATION (UT) FOR SHOP BUTT WELDS 100% RADIOGRAPHIC OR ULTRASONIC EXAMINATION (UT) FOR FIELD BUTT WELDS
WELDS CONNECTING WEB TO FLANGE PLATE IN WELDED SECTIONS	SC1 & SC2	100% VISUAL SCANNING 100% VISUAL EXAMINATION TO AS/NZS 1554	ALL FLANGE TO WEB WELDS TO BE TESTED IN ACCORDANCE WITH AS/NZS 3679.2 IN ADDITION TO DESTRUCTIVE TESTS IN ACCORDANCE WITH AS/NZS 3679.2, 10% OF THE LENGTH OF THE FLANGE TO WEB WELD IS TO BE ULTRASONICALLY TESTED. IF DEFECTS ARE FOUND IN THESE TESTS, THEN 100% OF THE WELD IS TO BE TESTED
FOR STRUCTURES DESIGNED TO EARTHQUAKE DESIGN CATEGORIES II & III · ALL WELDS TO BE GRADE SP · REFER TO TABLE 13.3.6.2 OF AS4100:2020 FOR NDE REQUIREMENTS			

- ALL DEFECTS TO BE REPAIRED IN ACCORDANCE WITH RELEVANT PARTS OF AS/NZS 1554
- ALL TESTS TO BE PERFORMED BY A NATA (OR SIMILAR APPROVED) TESTING COMPANY.
- WHERE THE EXTENT OF THE WELDING TO BE EXAMINED IS SPECIFIED TO BE LESS THAT 100%, THE NOMINATED PERCENTAGE OF WELD TYPE TO BE EXAMINED SHALL BE SELECTED TO ENSURE THAT A REPRESENTATIVE SAMPLE OF EACH WELD TYPE AND LOCATION IS EXAMINED.
- FOR CONNECTED PLATES WITH A THICKNESS GREATER THAN 20mm A PORTION OF EACH MULTI-PASS BUTT WELD SHOULD BE EXAMINED ULTRASONICALLY TO DETERMINE WHETHER THERE ARE ANY TRANSVERSE CRACKS IN THE WELD MATERIAL.
- IF DEFECTS ARE FOUND IN THE WELDS THEN 100% OF THE WELDS ARE TO BE TESTED.

2.8 **MINIMUM CONNECTION DETAILING GUIDELINES**
UNLESS SPECIFICALLY NOTED OTHERWISE ON THE DRAWINGS, CONNECTION DETAILS SHALL BE IN ACCORDANCE WITH THE FOLLOWING MINIMUM REQUIREMENTS:

a. CONNECTION CLEAT PLATES AND STIFFENER CLEAT PLATES ARE TO HAVE A THICKNESS TO BE EQUAL TO OR LARGER THAN THE WEB THICKNESS OF THE SUPPORTED MEMBER BUT NOT LESS THAN 10mm THICK.
b. ALL STEEL TO STEEL BOLTED CONNECTIONS SHALL BE MINIMUM TWO M20 GRADE 8.8/S BOLTS FOR SERVICE CATEGORY SC1 ELEMENTS UNO AND GRADE 8.8/TB BOLTS FOR SERVICE CATEGORY SC2 ELEMENTS UNO.
c. A MINIMUM OF TWO THREADS SHALL EXTEND PAST THE NUT.
d. ALL WELDS SHALL BE CONTINUOUS FILLET WELDS FOR SERVICE CATEGORY SC1 ELEMENTS UNO AND FULL STRENGTH FULL PENETRATION BUTT WELDS FOR SERVICE CATEGORY SC2 ELEMENTS UNO.
e. MINIMUM FILLET WELD SIZE WHERE SPECIFIED TO BE AS FOLLOWS UNO:

PLATE THICKNESS (mm) LESS THAN OR EQUAL TO	WELD SIZE (mm) SP GRADE & CONTINUOUS ALL ROUND
16	6
24	8
32	12

f. ALL MEMBERS' CENTROIDS AT JOINTS SHALL BE COINCIDENT UNO
g. ALL PURLIN CLEATS SHALL BE 8mm MINIMUM THICK.

ALL DETAILING WHERE NOT SPECIFICALLY SHOWN SHALL BE IN ACCORDANCE WITH THE AUSTRALIAN STEEL INSTITUTE (ASI) CURRENT EDITIONS OF THE 'DESIGN CAPACITY TABLES FOR STRUCTURAL STEEL' AND THE ASI STANDARDISED STRUCTURAL CONNECTION DETAILS CONTAINED THEREIN.
THE ENDS OF HOLLOW SECTION MEMBERS SHALL BE SEALED WITH NOMINAL THICKNESS PLATES AND CONTINUOUS SEAL WELDED UNLESS NOTED OTHERWISE.
IF HOLLOW SECTIONS ARE TO BE HOT-DIP GALVANIZED, VENT AND DRAINAGE HOLES SHALL BE PROVIDED CONFORMING TO THE REQUIREMENTS OF AS/NZS 5131 IN NON-VIEWABLE LOCATIONS.

STEELWORK NOTES CONTINUED

2.9 **SURFACE TREATMENT AND CORROSION PROTECTION**
UNLESS NOTED OTHERWISE IN THE CONTRACTUAL DOCUMENTATION, THE MINIMUM SURFACE TREATMENT OF BOTH INTERNAL AND EXTERNAL STEELWORK SHALL CONFORM TO THE REQUIREMENTS OF AS/NZS 5131.
STRUCTURAL STEELWORK TO BE GALVANIZED SHALL CONFORM TO THE REQUIREMENTS OF AS/NZS 5131.

DESIGN LIFE OF STRUCTURE = [50] YEARS

DURABILITY (COATING LIFE TO FIRST MAJOR MAINTENANCE) = [25] YEARS UNO

ATMOSPHERIC CORROSIVITY CATEGORY = INTERNAL AIR-CONDITIONED SPACE: C1
(INTERNAL SPACES MUST BE ENCLOSED, INTERNAL OTHERWISE: C2
AIR TIGHT & PROTECTED FROM EXTERNAL ENVIRONMENT) EXTERNAL PROTECTED WITHIN CEILING: C3
EXTERNAL EXPOSED: C3

BOLTS SHALL BE IN ACCORDANCE WITH SECTION 2.6.5

CAST IN FERRULES AND HOLDING DOWN BOLTS SHALL BE HOT DIP GALVANISED IN ACCORDANCE WITH AS/NZS 1214. U.N.O.

THE BUILDING OWNER SHALL UNDERTAKE ALL NECESSARY CLEANING, MAINTENANCE AND REPAIR OF APPLIED COATINGS TO ENSURE ALL COATINGS AND PROTECTED STEELWORK REACH THEIR STATED DESIGN LIFE.

UNLESS NOTED OTHERWISE IN THE CONTRACTUAL DOCUMENTATION, THE CORROSION PROTECTION WHEN SELECTING A PAINT SYSTEM SHALL BE AS SPECIFIED IN THE TABLE BELOW:

DESIGNATION	LOCATION	PROTECTIVE COATING SYSTEM	AS/NZS2312.1 REFERENCE
INT1	INTERNAL AIR-CONDITIONED SPACE NO COLOUR FINISH REQUIRED	ALKYD PRIMER SYSTEM	ALK6
INT2	INTERNAL AIR-CONDITIONED SPACE COLOUR FINISH REQUIRED	ALKYD PRIMER WITH ACRYLIC LATEX TOP COAT SYSTEM	ACL2
INT5*	INTERNAL OTHER SPACES NO COLOUR FINISH REQUIRED	ALKYD PRIMER SYSTEM	ALK6
INT6*	INTERNAL OTHER SPACES COLOUR FINISH REQUIRED	ALKYD PRIMER WITH ACRYLIC LATEX TOP COAT SYSTEM	ACL2
EXT1	EXTERNAL SPACE NO COLOUR FINISH REQUIRED	SINGLE COAT SOLVENT BORNE INORGANIC ZINC SILICATE SYSTEM	IZS3
EXT2	EXTERNAL SPACE COLOUR FINISH REQUIRED	HIGH BUILD POLYURETHANE SYSTEM	PUR5
EXT6*	EXTERNAL SPACE AGGRESSIVE ENVIRONMENT AND MIO FINISH ACCEPTABLE	MICACEOUS IRON OXIDE (MIO) SYSTEM	EHB6

* 15 YEARS LIFE TO FIRST MAJOR MAINTENANCE

2.10 **FIRE PROTECTION NOTE**
FIRE PROTECTION SHALL BE PROVIDED TO THE STEELWORK IN ACCORDANCE WITH THE PROJECT SPECIFICATION AND SHALL BE COMPATIBLE WITH THE CORROSION SYSTEM USED ON THE STEELWORK.

2.11 **ARCHITECTURALLY EXPOSED STRUCTURAL STEELWORK**
ARCHITECTURALLY EXPOSED STRUCTURAL STEEL (AESS) SHALL CONFORM TO THE REQUIREMENTS OF AS/NZS 5131.
AREAS TO BE TREATED AS AESS AND THE AESS CATEGORY ARE TO BE ADVISED BY THE ARCHITECT.
ARCHITECTURALLY SENSITIVE CONNECTION DETAILS ARE TO BE ADVISED BY THE ARCHITECT.
AESS COMPONENTS SHALL BE AESS 2 TYP. UNO.
EXPOSED COLUMNS AND CROWN STEELWORK TO BE AESS 3.
ALBERT STREET PODIUM COLUMN SPLICES TO BE AESS 4.

2.12 **LIGHT GAUGE STEEL MEMBERS**
LIGHT GAUGE STEEL MEMBERS, COMPRISING PURLINS, GIRTS AND STRUCTURAL DECKING, SHALL CONFORM TO THE REQUIREMENTS OF AS/NZS 5131.

PURLINS AND GIRTS
1. PURLINS AND GIRTS TO BE GALVANISED STEEL TO AS2312.2 Z350 ZINC COATING
2. ALL PURLIN AND GIRT DETAILS SHALL BE IN ACCORDANCE WITH THE MANUFACTURERS SPECIFICATION.
3. SERVICES SUPPORTED BY PURLINS MUST BE CONNECTED TO THE PURLIN WEB.
4. LAP ALL Z SECTION PURLINS AND GIRTS THE GREATER OF 15% OF THE SPAN OR 900mm.
5. BOLTING OF 100 TO 250 SERIES PURLINS AND GIRTS TO USE M12 GRADE 4.6 BOLTS. BOLTING OF SERIES 300 PURLINS AND GIRTS TO USE M16 GRADE 4.6 BOLTS. GRADE 8.8 BOLTS TO BE ADOPTED AS SPECIFICALLY NOTED ON PURLIN PLAN OR GIRT ELEVATIONS.
6. TO ENSURE A MAXIMUM SERVICE LIFE, PURLINS AND GIRTS SHOULD BE SUBJECT TO A REGULAR MAINTENANCE PROGRAMME INCLUDING INSPECTIONS, CLEANING OUT OF DUST AND DEBRIS AND WASHING DOWN WHERE POSSIBLE.

2.12.1 **ROOF, WALL AND EXTERNAL SOFFIT CLADDING**

2.12.1.1 **ROOF, WALL AND EXTERNAL SOFFIT CLADDING AS SHOWN ON THE PROJECT STRUCTURAL DRAWINGS**

1.1. ROOF, WALL AND EXTERNAL SOFFIT CLADDING INCLUDING THEIR FIXINGS SHALL BE AS SHOWN ON THE DRAWINGS AND THEIR MATERIAL AND INSTALLATION SHALL BE IN ACCORDANCE WITH THE MANUFACTURERS SPECIFICATIONS
1.2. THE ROOF, WALL OR EXTERNAL SOFFIT CLADDING TYPE OR PROFILE IS NOT TO BE CHANGED FROM THAT SHOWN ON THE DRAWINGS WITHOUT THE PRIOR APPROVAL OF THE ENGINEER.
CHANGE OF THE ROOF, WALL OR EXTERNAL SOFFIT CLADDING TYPE OR PROFILE MAY RESULT IN CHANGES TO THE SIZE AND SPACING OF THE PURLINS AND GIRTS.

2.12.1.2 **ROOF, WALL AND EXTERNAL SOFFIT CLADDING BY D&C CONTRACTOR**

2.1. ROOF, WALL & EXTERNAL SOFFIT CLADDING ARE BY D&C CONTRACTOR UNLESS NOTED OTHERWISE
2.2. THE D&C CONTRACTOR SHALL ENSURE THAT THE CLADDING AND THE CLADDING FIXINGS HAVE SUFFICIENT CAPACITY TO WITHSTAND ALL LOADS, INCLUDING WIND LOADS, FOR THE PURLIN AND GIRT SPACINGS AND SIZES, INCLUDING PURLIN AND GIRT CLEATS, SHOWN ON THE DRAWINGS.
2.3. PURLIN AND GIRT SPACINGS SHOWN ON THE DRAWINGS ARE MAXIMUM SPACINGS AND ARE TO BE AMENDED IF REQUIRED TO SUIT THE SELECTED CLADDING.
2.4. THE D&C CONTRACTOR SHALL PROVIDE A CERTIFICATE BY A REGISTERED PROFESSIONAL ENGINEER CERTIFYING THAT THE CLADDING, CLADDING FIXINGS AND PURLINS AND GIRTS ARE CAPABLE OF RESISTING THE DESIGN LOADS IN ACCORDANCE WITH THE RELEVANT AUSTRALIAN STANDARDS AND THAT THE CLADDING HAS BEEN INSTALLED IN ACCORDANCE WITH THE MANUFACTURER'S INSTRUCTIONS.

2.12.1.3. **MAINTENANCE OF ROOF, WALL AND EXTERNAL SOFFIT CLADDING**

3.1. THE ROOF, WALL AND EXTERNAL SOFFIT CLADDING TOGETHER WITH THE FIXINGS, FLASHINGS AND RAINWATER GOODS SHALL BE INSPECTED AND MAINTAINED IN ACCORDANCE WITH THE MANUFACTURER'S INSTRUCTIONS.

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STEELWORK NOTES CONTINUED

3.0 STRUCTURAL STEELWORK ERECTION

3.1 **GENERAL**
STRUCTURAL STEELWORK ERECTION SHALL CONFORM TO THE REQUIREMENTS OF AS/NZS 5131.

3.2 **CAMBER**
ALL MEMBERS HAVING A NATURAL CAMBER WITHIN THE STRAIGHTNESS TOLERANCE SHALL BE ERECTED WITH THE NATURAL CAMBER UP.

3.3 **TOLERANCES**
ERECTION TOLERANCES SHALL CONFORM TO THE REQUIREMENTS OF AS/NZS 5131.
THE TOLERANCE CLASS FOR FUNCTIONAL TOLERANCES SHALL BE CLASS 1 UNO.

3.4 **POST-INSTALLED ANCHORS**

3.4.1 THE INSTALLATION OF MECHANICAL AND CHEMICAL ANCHORS SHALL CONFORM TO THE REQUIREMENTS OF AS/NZS 5131.

3.4.2 ALL HOLES TO BE HAMMER DRILLED AND PREPARED IN ACCORDANCE WITH THE ANCHOR MANUFACTURERS REQUIREMENTS.

3.4.3 ALL EXTERNAL ANCHORS TO BE HOT DIP GALVANISED. ANCHORS WITHIN PLANTERS TO BE STAINLESS STEEL.

3.4.4 MINIMUM EDGE DISTANCE TO ANCHORS TO BE 150mm TYPICAL UNLESS NOTED OTHERWISE.

3.4.5 ALL CHEMICAL ANCHORS TO BE HILTI HIT-RE500-V4 UNO. ALL MECHANICAL ANCHORS TO BE HILTI HIT-HSL-3-B UNO.

3.4.6 SITE TESTING SHALL BE PERFORMED ON MECHANICAL AND CHEMICAL ANCHORS TO VALIDATE CORRECT INSTALLATION (PROOF TESTING). A MINIMUM TEST SAMPLE POPULATION SHALL BE THREE SPECIMENS OR 2.5% OF THE TOTAL RELEVANT ANCHOR POPULATION, WHICHEVER IS GREATER. IF A SINGLE FAILURE IS RECORDED, THE MINIMUM TEST SAMPLE POPULATION SHALL BE INCREASED TO SIX TEST SPECIMENS OR 5% OF THE TOTAL RELEVANT ANCHOR POPULATION, WHICHEVER IS GREATER. IF TWO OR MORE TEST SAMPLES FAIL, ALL ANCHORS IN THE RELEVANT ANCHOR POPULATION SHALL BE TESTED.
THE 'TEST SAMPLE POPULATION' IS DEFINED AS A GROUP OF ANCHORS REPRESENTATIVE OF THE RELEVANT ANCHOR POPULATION, HAVING THE SAME TYPE OF ANCHOR, THE SAME BASE MATERIAL (THAT HAS NOT EXPERIENCED DIFFERENT ENVIRONMENTAL EXPOSURE), SAME INSTALLATION METHOD AND TIME, AND SAME INSTALLATION PERSONNEL. WHERE ANY OF THESE VARIABLES CHANGE, THIS GROUP OF ANCHORS SHALL BE CONSIDERED A SEPARATE ANCHOR POPULATION.

3.4.7 100% OF POST INSTALLED ANCHORS THAT ARE IN PERMANENT TENSION, TENSION ANCHORS INDICATED ON THE DRAWINGS & ANCHORS FORMING PART OF FALL ARREST SYSTEMS, SHALL BE PROOF TESTED.

3.4.8 ALL SITE TESTING OF POST-INSTALLED ANCHORS SHALL BE UNDERTAKEN ACCORDING TO THE REQUIREMENTS OF AUSTRALIAN ENGINEERED FASTENERS AND ANCHORS COUNCIL (AEFAC) TECHNICAL NOTE – SITE TESTING GUIDELINES VOLUMES 1 TO 4.

3.4.9 THE TESTING OF POST INSTALLED ANCHORS SHALL BE PERFORMED BY A REGISTERED TESTING AUTHORITY (RTA) WHOSE TEST REPORTS SHALL BE SUBMITTED TO THE ENGINEER FOR APPROVAL.

3.5 **CONNECTION TO FOOTINGS**
FOOTING BOLTS SHALL MEET THE REQUIREMENTS OF AS/NZS 5131.
MATERIALS USED FOR GROUTING UNDER STEEL BASE PLATES AND BEARING PLATES SHALL MEET THE REQUIREMENTS DEFINED IN AS/NZS 5131.

3.6 **CAST-IN COMPONENTS**
ALL BOLTS, NUTS AND WASHERS, INCLUDING HOLD DOWN BOLTS, CAST-IN FERRULES AND MASONRY ANCHORS ARE TO BE HOT-DIP GALVANIZED UNLESS NOTED OTHERWISE. ALL GALVANIZED COMPONENTS TO BE CAST INTO CONCRETE MUST BE PASSIVATED.

3.7 **ERECTION SEQUENCE METHODOLOGY**
WHERE ASSESSED AS REQUIRED FROM THE RISK PLANNING WORKSHOPS, SUBMIT THE ERECTION SEQUENCE METHODOLOGY (ESM) FOR APPROVAL.
THE STRUCTURAL ENGINEER HAS DESIGNED THE WORKS TO BE STABLE ON COMPLETION OF ALL STRUCTURAL ELEMENTS OF THE WORKS, INCLUDING MEMBERS, CONNECTIONS, SUPPORTING STRUCTURAL ELEMENTS, BRACING ELEMENTS AND THE LIKE. THE CONTRACTOR AND/OR HIS SUBCONTRACTORS ARE RESPONSIBLE FOR ENGAGING A TEMPORARY WORKS ENGINEER TO ADVISE ON, AND CERTIFY THE TEMPORARY STABILITY AND SUPPORT (BOTH VERTICALLY AND LATERALLY) OF ALL STEELWORK DURING CONSTRUCTION/ERECTION/ TRANSPORTATION, INCLUDING DEVELOPING ERECTION METHODOLOGIES FOR SAME, UNTIL FULL ERECTION OF ALL STRUCTURAL ELEMENTS OF THE WORKS IS COMPLETED.THE TEMPORARY WORKS ENGINEER SHALL ENSURE THAT THE METHODOLOGY AND ERECTION SEQUENCE DOES NOT RESULT IN ADVERSE LOCKED IN STRESSES, OR THE TEMPORARY OVER-STRESSING OF ANY ELEMENTS.

3.8 **PROPRIETARY ITEMS**
PROPRIETARY ITEMS (E.G. PURLINS, ROOF/WALL SHEETING, FERRULES) SHALL BE INSTALLED IN ACCORDANCE WITH THE MANUFACTURER'S SPECIFICATIONS.

3.9 **GROUTING UNDER BASE PLATES**
DO NOT GROUT UNDER ANY BASE PLATE OR ADJACENT STEELWORK WHERE STEELWORK WELDING OR ALIGNMENT IS INCOMPLETE.

4.0 STRUCTURAL STEELWORK INSPECTION, TESTING AND CORRECTION
INSPECTION, TESTING AND CORRECTION SHALL CONFORM TO THE REQUIREMENTS OF AS/NZS 5131.
INSPECTION AND TEST PLANS (ITP) SHALL BE PREPARED, AS LISTED IN THE TABLE BELOW.

ITEM	ITP
MATERIALS & COMPONENTS	REQUIRED
PREPARATION & ASSEMBLY	REQUIRED
WELDING	REQUIRED
MECHANICAL FASTENING	REQUIRED
SURFACE TREATMENT	REQUIRED
PAINT COATINGS	REQUIRED
GALVANIZED COATINGS	REQUIRED
ERECTION	REQUIRED

5.0 PARTICULAR REQUIREMENTS
CONTRACTOR TO ALLOW PROVISION FOR BALUSTRADES WITHIN PLANTERS TO HAVE A PAINT SYSTEM WITH SUFFICIENT CORROSION PROTECTION TO ACHIEVE 25 YEARS COATING LIFE TO FIRST MAJOR MAINTENANCE. SOILS TO PLANTERS LIKELY TO CONTAIN FERTILISER OR SIMILAR. TO BE CONFIRMED BY PAINT SPECIALIST.

6.0 SECONDARY STEELWORK

6.1 THE STEELWORK SHOWN ON THE PROJECT STRUCTURAL STEELWORK DRAWINGS IS LIMITED TO THE MAIN STRUCTURAL FRAMING ELEMENTS OF THE BUILDING.
ALL STEELWORK THAT IS NOT REQUIRED TO SUPPORT, STABILISE OR TO ENSURE THE INTEGRITY OF THE MAIN STRUCTURAL FRAMING ELEMENTS OF THE BUILDING IS CONSIDERED TO BE SECONDARY STEEL AND UNLESS NOTED OTHERWISE IS NOT INCLUDED IN THE PROJECT STRUCTURAL DRAWINGS.

6.2 SECONDARY STEELWORK INFORMATION AND DETAILS ARE NOT INCLUDED IN THE PROJECT STRUCTURAL STEELWORK DRAWINGS AND SHOULD BE OBTAINED FROM OTHER CONSULTANTS.

6.3 SECONDARY STEELWORK INCLUDES BUT IS NOT LIMITED TO THE FOLLOWING;
- STEELWORK FOR CEILING AND WALL CLADDING SYSTEMS
- FAÇADE FRAMING SYSTEMS
- DOOR AND WINDOW FRAMING SYSTEMS
- PLANT AND EQUIPMENT SUPPORT
- NON- LOADBEARING PARTITIONS
- SIGNAGE SUPPORT STEELWORK
- HANDRAILS AND BARRIER SYSTEMS
- LIGHTING SYSTEMS
- FALL ARREST SYSTEMS
- ACCESS WALKWAYS
- INTERNAL FITOUT
- PROPRIETARY PRODUCTS

6.4 THE CONTRACTOR SHALL ALLOW FOR THE DESIGN, SUPPLY AND INSTALLATION OF ALL SECONDARY STEELWORK AS REQUIRED BY THE PROJECT SPECIFICATION, DRAWINGS AND PRODUCT MANUFACTURER'S REQUIREMENTS.

SERVICES, CEILINGS, GRC, AND FALL ARRESTS SUPPORT FRAMING NOTES

1. THE CONTRACTOR SHALL ENGAGE AND PAY FOR A QUALIFIED RPEQ ENGINEER TO COORDINATE AND DESIGN ALL SUPPORT FRAMING IN ACCORDANCE WITH THESE STRUCTURAL DRAWINGS.
2. THE STRUCTURAL ELEMENTS SHOWN ON THESE DRAWINGS DO NOT CONSIDER EARTHQUAKE AND WIND DESIGN ACTIONS IMPOSED BY THE SUPPORT FRAMING. CONTRACTOR TO MAKE APPROPRIATE PROVISION TO ENSURE SUPPORT FRAMING DOES NOT OVERLOAD ANY BASE BUILDING STRUCTURAL ELEMENTS. ADDITIONAL FRAMING MAY BE REQUIRED TO ENSURE SUPPORT FRAMING LOADS ARE TRANSFERRED BACK TO PRIMARY STRUCTURE, WHERE REQUIRED. CONTRACTOR TO ALLOW DESIGN CHECKS AND ENGINEERING APPROVAL BY QUALIFIED RPEQ ENGINEER.
3. SUPPORT FRAMING TO BE DESIGNED FOR BOTH GRAVITY, WIND AND EARTHQUAKE LOADS IN ACCORDANCE WITH AUSTRALIAN STANDARDS AND GENERAL NOTES.
4. SUPPORT FRAMING TO ALLOW FOR BUILDING MOVEMENTS AND TOLERANCES AS OUTLINED IN THE STRUCTURAL MOVEMENT AND TOLERANCE REPORT.
5. SUPPORT FRAMING IS TO BE DEVELOPED AND DESIGNED TO SUIT THE STRUCTURAL FRAMING LAYOUT AND DESIGN.
6. ALL SUPPORT FRAMING TO BE COORDINATED TO AVOID CLASHES AND IMPACTING THE STRUCTURAL ELEMENTS SHOWN ON THESE DRAWINGS, INCLUDING, BUT NOT LIMITED TO STRUCTURAL STEELWORK, PURLINS, GIRTS ETC. ENSURE SUPPORT FRAMING IS CONNECTED TO PRIMARY AND SECONDARY BEAMS WITH APPLIED VERTICAL AND LATERAL SHEAR LOADS ALIGNED THROUGH THE BEAM CENTROIDS I.E NO ECCENTRIC OR MOMENT CONNECTIONS HAVE BEEN ALLOWED FOR IN THE PRIMARY AND SECONDARY BEAM DESIGNS.
7. WELDED CLEATS OR OUTRIGGERS TO BE PROVIDED TO PRIMARY AND SECONDARY BEAMS TO ALLOW FOR CONNECTING SUPPORT FRAMING.
8. BOLTED CONNECTIONS TO PRIMARY AND SECONDARY BEAM FLANGES SHALL BE AVOIDED. CLAMP CONNECTIONS TO BE ADOPTED WHERE WELDED CLEATS ARE NOT ACHIEVABLE.
9. SUPPORT FRAMING TO PRIMARY AND SECONDARY BEAM CONNECTIONS AND FIRE PROTECTION SYSTEM AND EXTENT TO BE DEVELOPED WITH THE FIRE ENGINEER.
10. POST INSTALLED ANCHORS USED TO SECURE SUPPORT FRAMING TO BASE BUILDING STRUCTURE TO BE COORDINATED TO AVOID THE FOLLOWING: HITTING AND COMPROMISING SLAB METAL TRAY RIBS, ALL REINFORCEMENT, STEEL 'I' BEAM WEBS, HOLLOW SECTION WEBS ETC. ALL ANCHORS TO ACHIEVE MINIMUM ANCHOR EDGE DISTANCE REQUIREMENTS AND TO AVOID CUTTING EDGE REINFORCEMENT.
11. SUPPORT FRAMING TO BE DETAILED TO ENSURE DURABILITY OF BASE STRUCTURE IS MAINTAINED. THIS MAY REQUIRE SPECIFIC SUPPORT FRAMING MATERIALS, ISOLATION GASKETS, WASHERS ETC
12. WHERE SUPPORT FRAMING IS BEING HUNG FROM PROFILED STEEL SHEETING FORMWORK, CEILING HANGERS SHALL CONFORM TO THE DESIGN REQUIREMENTS AND LOAD LIMITS OUTLINED IN THE SUPPLIER DOCUMENTS.
13. UNLESS DOCUMENTED BY FACADE ENGINEER ALLOW FOR TERTIARY STEELWORK FOR SUPPORT OF RAPTOR RAILS OR EQUIVALENT SYSTEM, FALL ARREST ANCHORS AND OTHER FACADE MAINTENANCE ITEMS. REFER TO ACCESS AND MAINTENANCE REPORT ALB-EOC-RP-240612-iss01_FAM FOR DETAILS.

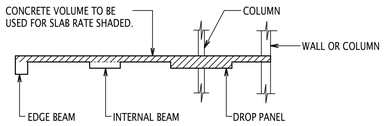
TENDER NOTES

1. THESE DRAWINGS ARE PRELIMINARY DRAWINGS ISSUED FOR TENDER AS AN INDICATION OF THE EXTENT OF WORKS ONLY. THEY ARE NOT A COMPLETE CONSTRUCTION SET OF DRAWINGS.
2. TO DETERMINE THE FULL EXTENT OF WORK, THESE DRAWINGS SHALL BE READ IN CONJUNCTION WITH THE ARCHITECTURAL DRAWINGS AND OTHER CONTRACT DOCUMENTS. ALLOW FOR ALL ITEMS SHOWN ON ARCHITECTURAL AND OTHER DRAWINGS AS NOT ALL ITEMS ARE SHOWN ON THE STRUCTURAL DRAWINGS.
3. SHOULD ANY AMBIGUITY, ERROR, OMISSIONS, DISCREPANCY, INCONSISTENCY OR OTHER FAULT EXIST OR SEEM TO EXIST IN THE DOCUMENTS, IMMEDIATELY NOTIFY THE SUPERINTENDENT IN WRITING.
4. RATES NOTED ON THE DRAWINGS ARE 'DESIGN RATES' NOT 'AS-CONSTRUCTED' RATES FOR THE STRUCTURE IN ITS PERMANENT CONDITION. REFER TO REINFORCEMENT QUANTITIES NOTES FOR FURTHER DETAIL ON ASPECTS WHICH ARE NOT INCLUDED IN THE NOTED RATES.

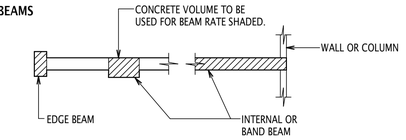
REINFORCEMENT QUANTITIES

1. WHERE PROVISIONAL REINFORCEMENT RATES ARE NOTED ON THE DRAWINGS THEY SHALL BE APPLIED IN CONJUNCTION WITH THE FOLLOWING CONCRETE VOLUMES.

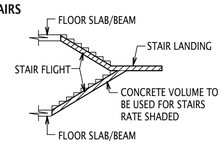
SLABS



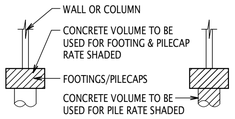
BEAMS



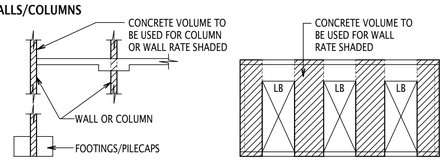
STAIRS



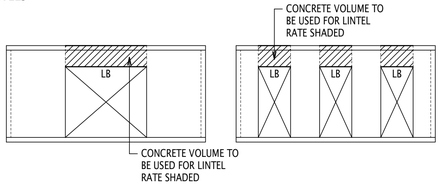
FOOTINGS/PILECAPS



WALLS/COLUMNS



LINTELS



2. THE REINFORCEMENT RATES NOTED ON THE DRAWINGS DO INCLUDE THE FOLLOWING:
- ALLOWANCE FOR THE PERMANENT LOADS SHOWN ON THE RBG LOADING PLANS
- TOP MAT, BOTTOM MAT, BEAM SHEAR AND BEAM TORSION REINFORCEMENT FOR BEAMS AND SLABS
- VERTICAL, HORIZONTAL AND WALL TIES FOR CONCRETE WALLS
- VERTICAL REINFORCEMENT AND TIES FOR COLUMNS
- LAPS
- ALLOWANCE FOR CONSTRUCTION JOINTS SHOWN ON PLAN AT THE TIME RATES ARE RELEASED INCLUDING POUR STRIPS. WHERE NO CONSTRUCTION JOINTS ARE SHOWN NO ALLOWANCE HAS BEEN INCLUDED.
- REINFORCEMENT REQUIRED THROUGH THE STEPS/FOLDS SHOWN ON PLAN AT THE TIME RATES ARE RELEASED. WHERE NO STEPS/FOLDS ARE SHOWN NO ALLOWANCE HAS BEEN INCLUDED.

3. THE REINFORCEMENT RATES NOTED ON THE DRAWINGS DO NOT INCLUDE THE FOLLOWING:
- ROLLING MARGIN
- WASTAGE
- OVERSUPPLY / OVERSCHEDULING
- LACER OR SPACER/SUPPORT BARS
- SUPPLEMENTARY MESH (SAFETY, CRACK CONTROL, CONTINUOUS TOP MAT FOR CONSTRUCTION PURPOSES)
- REINFORCEMENT FOR TEMPORARY LOADS SUCH AS LOADING PLATFORMS, HOISTS, CRANE TIES, FORMWORK/SAFETY SCREENS/TEMPORARY PENETRATIONS
- REINFORCEMENT FOR SLAB STRENGTHENING TO REDUCE BACKPROPPING.
- PROVISIONAL ALLOWANCE FOR PUNCHING SHEAR STUD RAILS
- TRIMMERS FOR MINOR (<150mm) PENETRATIONS
- ANTI-BURST (LOCAL AND GLOBAL) REINFORCEMENT FOR PRESTRESSING TENDONS
- PROVISIONAL ALLOWANCE FOR TEMPORARY OR PERMANENT MOVEMENT JOINTS.
- PROVISIONAL ALLOWANCE FOR SLAB CONNECTORS (THREADED INSERTS, PULLOUT BARS)
- PROVISIONAL ALLOWANCE FOR COUPLERS OR TERMINATORS
- ADDITIONAL REINFORCEMENT FOR EARLY FORMWORK STRIPPING
- TRIMMERS FOR FACADE AND JUMPFORM POCKETS
- ALLOWANCE FOR TEMPORARY PENETRATIONS AND INFILL SLABS. THESE CAN BE PROVIDED SEPARATELY AS REQUIRED.
- PROVISIONAL ALLOWANCE FOR SLAB ON GROUND PROPRIETARY JOINTS.
- PROVISIONAL ALLOWANCE FOR CONSTRUCTION OR DOWELED JOINTS NOT SHOWN ON PLAN.

4. ALL SLAB PENETRATIONS ARE TO BE COVERED WITH A CAST IN GALVANISED SAFETY MESH. THE RATES NOTED DO NOT INCLUDE ANY ALLOWANCE FOR THIS SAFETY MESH.
5. WALL & COLUMN REINFORCEMENT RATES ARE BASED ON CONVENTIONAL LAPPING OF VERTICAL BARS, WITH LAPS OCCURRING AT EACH FLOOR SLAB LEVEL ONLY.
6. SLAB, BEAM AND FOUNDATION RATES ARE BASED ON CONVENTIONAL LAPPING OF HORIZONTAL BARS WITH LAPS BASED ON A MAXIMUM BAR LENGTH OF 12m.
7. CONTRACTOR TO MAKE AN ALLOWANCE FOR INSTALLATION OF TIES TO WALL VERTICAL REINFORCEMENT WHERE NOMINATED ON WALL ELEVATIONS.

PRINT DRAWINGS IN COLOUR

Rev	Revision Description	By	App	Date
T01	ISSUED FOR TENDER	DS	MA	28.06.24
T02	ISSUED FOR TENDER	DS	MA	17.07.24

SCALE 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8

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ACN 010 580 248

Client
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Project
101 ALBERT STREET, BRISBANE

Title
GENERAL NOTES SHEET 6

Date
Jun 2024
Scale at A1

Drawn
D.STUCKEY
Designer
N.DOYLE/T.KATUNAR
Design Checker
-
Approved
M.AVERY

FOR TENDER - NOT FOR CONSTRUCTION

Drawing Number
ALB-RBG-DWG-ST-00-000-16

Revision
T02

PRINT DRAWINGS IN COLOUR

BEAM TENSION LAP CHART- FOR D500N REINF BARS

BAR SIZE	MIN CONCRETE STRENGTH (MPa)			
	32		40	
	BOTTOM	TOP	BOTTOM	TOP
N12	500	600	500	600
N16	650	850	650	800
N20	900	1150	800	1050
N24	1200	1500	1050	1350
N28	1450	1900	1300	1700
N32	1800	2300	1600	2100
N36	2150	2700	1900	2450
N40	2450	3150	2150	2800

- MINIMUM COVER TO LAPPED BAR = 35mm
- MINIMUM CLEAR DISTANCE BETWEEN BARS BEING LAPPED = 70mm
- LAP LENGTHS ARE IN ACCORDANCE WITH AS3600-2009 (A1+A2), AS3600-2018, AS5100-5:2017 (+A1)
- FOR STRAIGHT DEVELOPMENT LENGTH, DIVIDE ABOVE LAP LENGTHS BY 1.25
- MULTIPLY TABULATED VALUES BY:
  - 1.3 LIGHT WEIGHT CONCRETE
  - 1.3 FOR ELEMENTS BUILT WITH SLIP FORMS (REQUIRED FOR AS3600-2009 (A1+A2) & AS5100-5:2017 (A1))
  - 1.5 FOR EPOXY COATED BARS

FOOTING TENSION LAP CHART - FOR D500N REINF BARS

BAR SIZE	MIN CONCRETE STRENGTH (MPa)			
	32		40	
	BOTTOM	TOP	BOTTOM	TOP
N12	500	600	500	600
N16	650	800	650	800
N20	800	1000	800	950
N24	1050	1350	950	1200
N28	1350	1750	1200	1550
N32	1650	2150	1500	1950
N36	2000	2600	1800	2300
N40	2350	3050	2100	2700

- MINIMUM COVER TO LAPPED BAR = 50mm
- MINIMUM CLEAR DISTANCE BETWEEN BARS BEING LAPPED = 100mm
- LAP LENGTHS ARE IN ACCORDANCE WITH AS3600-2009 (A1+A2), AS3600-2018, AS5100-5:2017 (+A1)
- FOR STRAIGHT DEVELOPMENT LENGTH, DIVIDE ABOVE LAP LENGTHS BY 1.25
- MULTIPLY TABULATED VALUES BY:
  - 1.3 LIGHT WEIGHT CONCRETE
  - 1.5 FOR EPOXY COATED BARS

SLAB TENSION LAP CHART ≤ 300 THICK - FOR D500N REINF BARS

BAR SIZE	MIN CONCRETE STRENGTH (MPa)		
	32	40	50
N12	500	500	500
N16	700	650	650
N20	950	850	800
N24	1250	1150	1000
N28	1550	1400	1200
N32	1800	1600	1500
N36	2150	1900	1700
N40	2450	2150	2000

- MINIMUM COVER TO LAPPED BAR=30mm
- MINIMUM CLEAR DISTANCE BETWEEN BARS BEING LAPPED = 100mm
- LAP LENGTHS ARE IN ACCORDANCE WITH AS3600-2009 (A1+A2), AS3600-2018, AS5100-5:2017 (+A1)
- FOR STRAIGHT DEVELOPMENT LENGTH, DIVIDE ABOVE LAP LENGTHS BY 1.25
- MULTIPLY TABULATED VALUES BY:
  - 1.3 LIGHT WEIGHT CONCRETE
  - 1.3 FOR ELEMENTS BUILT WITH SLIP FORMS(REQURIED FOR AS3600-2009 (A1+A2) & AS5100-5:2017 (A1))
  - 1.5 FOR EPOXY COATED BARS

SLAB TENSION LAP CHART>300 THICK -FOR D500N REINF BARS

BAR SIZE	MIN CONCRETE STRENGTH (MPa)			
	32		40	
	BOTTOM	TOP	BOTTOM	TOP
N12	500	650	500	600
N16	700	900	650	800
N20	950	1250	850	1150
N24	1250	1600	1150	1450
N28	1550	1950	1400	1750
N32	1800	2350	1600	2100
N36	2150	2700	1900	2450
N40	2450	3150	2150	2800

- MINIMUM COVER TO LAPPED BAR = 30mm
- MINIMUM CLEAR DISTANCE BETWEEN BARS BEING LAPPED = 100mm
- LAP LENGTHS ARE IN ACCORDANCE WITH AS3600-2009 (A1+A2), AS3600-2018, AS5100-5:2017 (+A1)
- FOR STRAIGHT DEVELOPMENT LENGTH, DIVIDE ABOVE LAP LENGTHS BY 1.25
- MULTIPLY TABULATED VALUES BY:
  - 1.3 LIGHT WEIGHT CONCRETE
  - 1.3 FOR ELEMENTS BUILT WITH SLIP FORMS (REQUIRED FOR AS3600-2009 (A1+A2) & AS5100-5:2017 (A1))
  - 1.5 FOR EPOXY COATED BARS

WALL VERTICAL REINFORCEMENT TENSION/COMPRESSION LAP CHART (UNO) FOR D500N REINF BARS

BAR SIZE	MIN CONCRETE STRENGTH (MPa)				
	25	32	40	50	≥ 65
N12	500	500	500	500	500
N16	800	700	650	650	650
N20	1100	950	850	800	800
N24	1400	1200	1100	1000	1000
N28	1700	1500	1350	1200	1150
N32	2050	1800	1600	1450	1300
N36	2400	2100	1850	1700	1500
N40	2750	2450	2150	1950	1700

WALL HORIZONTAL REINF TENSION/COMPRESSION LAP CHART (UNO) FOR D500N REINF BARS

BAR SIZE	MIN CONCRETE STRENGTH (MPa)				
	25	32	40	50	≥ 65
N12	700	650	600	600	600
N16	1000	900	800	800	800
N20	1400	1250	1150	1000	1000
N24	1800	1600	1450	1250	1200
N28	2200	1950	1750	1600	1400
N32	2600	2350	2100	1850	1650
N36	3100	2700	2450	2200	1900
N40	3550	3150	2800	2500	2200

- MINIMUM COVER TO LAPPED BAR = 30mm
- MINIMUM CLEAR DISTANCE BETWEEN BARS BEING LAPPED = 100mm
- LAP LENGTHS ARE IN ACCORDANCE WITH AS3600-2009 (A1+A2), AS3600-2018, AS5100-5:2017 (+A1)
- FOR STRAIGHT DEVELOPMENT TENSION LENGTH, DIVIDE ABOVE LAP LENGTHS BY 1.25
- MULTIPLY TABULATED VALUES BY:
  - 1.3 LIGHT WEIGHT CONCRETE
  - 1.3 FOR ELEMENTS BUILT WITH SLIP FORMS (REQUIRED FOR AS3600-2009 (A1+A2) & AS5100-5:2017 (A1))
  - 1.5 FOR EPOXY COATED BARS

BLOCKWALL LAP CHART

BAR SIZE	VERTICAL REINFORCEMENT TENSION LAP LENGTH (UNO)	HORIZONTAL REINFORCEMENT LAP LENGTH (UNO)
N12	650	825
N16	950	1225
N20	1250	1625
N24	1575	2025

COLUMN REINFORCEMENT TENSION/COMPRESSION LAP CHART (UNO) - FOR D500N REINF BARS

BAR SIZE	MIN CONCRETE STRENGTH (MPa)				
	25	32	40	50	≥ 65
N12	500	500	500	500	500
N16	750	650	650	650	650
N20	1000	900	800	800	800
N24	1300	1150	1050	1000	1000
N28	1650	1450	1300	1150	1150
N32	2000	1750	1600	1400	1300
N36	2350	2100	1850	1700	1450
N40	2750	2450	2150	1950	1700

- MINIMUM COVER TO LAPPED BAR = 35mm
- MINIMUM CLEAR DISTANCE BETWEEN BARS BEING LAPPED = 70mm
- LAP LENGTHS ARE IN ACCORDANCE WITH AS3600-2009 (A1+A2), AS3600-2018, AS5100-5:2017 (+A1)
- FOR STRAIGHT DEVELOPMENT TENSION LENGTH, DIVIDE ABOVE LAP LENGTHS BY 1.25
- MULTIPLY TABULATED VALUES BY:
  - 1.3 LIGHT WEIGHT CONCRETE
  - 1.3 FOR ELEMENTS BUILT WITH SLIP FORMS (REQUIRED FOR AS3600-2009 (A1+A2) & AS5100-5:2017 (A1))
  - 1.5 FOR EPOXY COATED BARS

Rev	Revision Description	By	App	Date
T01	ISSUED FOR TENDER	DS	MA	28.06.24
A01	80% DD DRAFT	DS	MA	07.06.24

SCALE 1 2 3 4 5 6 7 8

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Client
QIC

Project
101 ALBERT STREET, BRISBANE

Title
REINFORCEMENT LAP SCHEDULES SHEET 1

Date
Jun 2024
Scale at A1

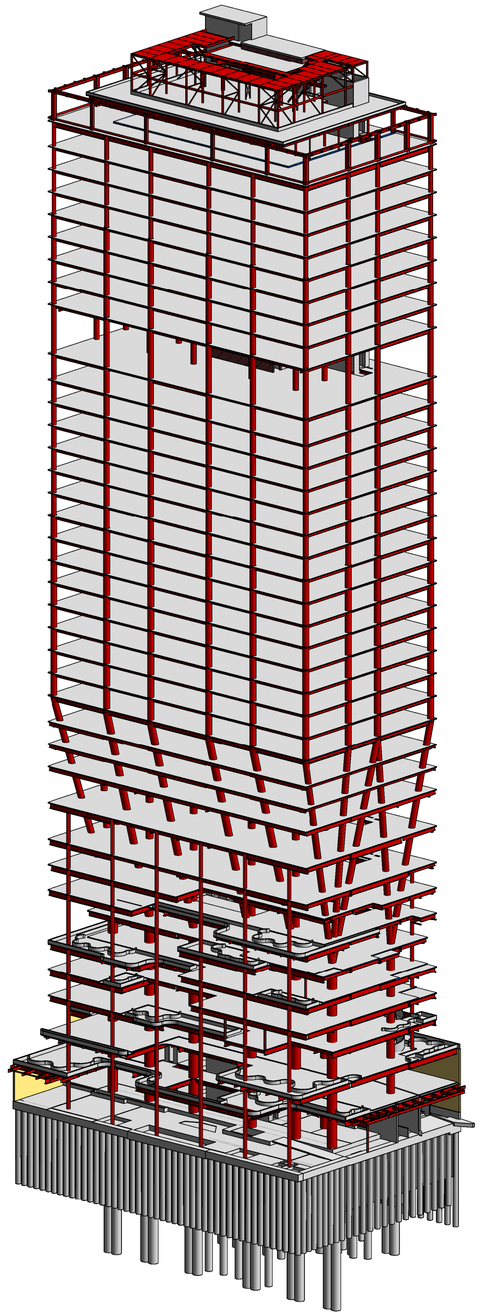
Drawn
D.STUCKEY
Designer
N.DOYLE/T.KATUNAR
Design Checker
-
Approved
M.AVERY

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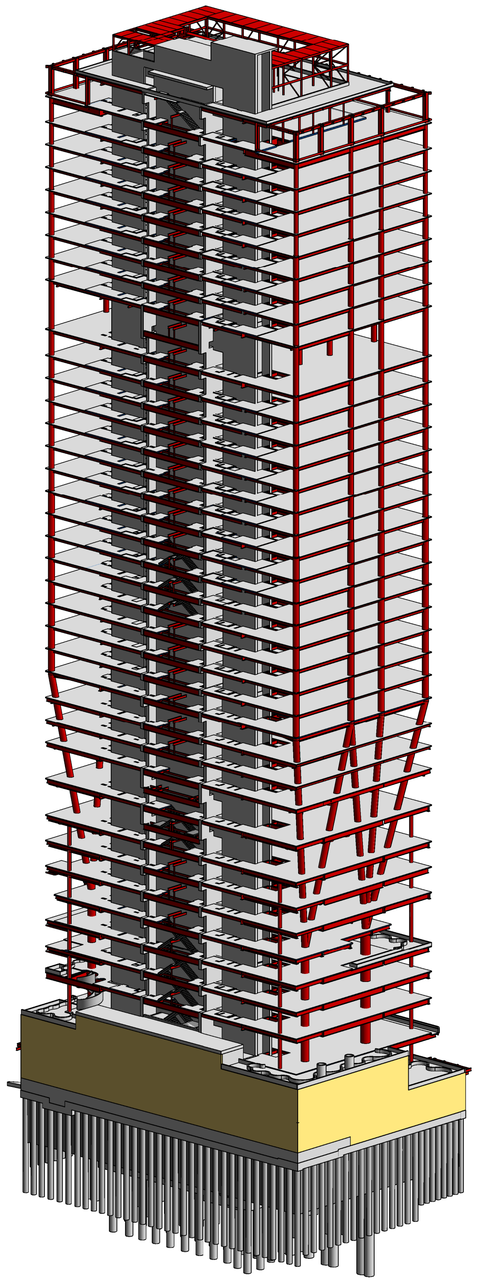
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Revision
T01

PRINT DRAWINGS IN COLOUR



CONTEXT VIEW - OVERALL



CONTEXT VIEW - OVERALL

Rev	Revision Description	By	App	Date
T02	ISSUED FOR TENDER	DS	MA	17.07.24
T01	ISSUED FOR TENDER	DS	MA	28.06.24

SCALE | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |

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Client
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Project
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Title
CONTEXT VIEWS
SHEET 1

Date
Jun 2024
Scale at A1
1:500

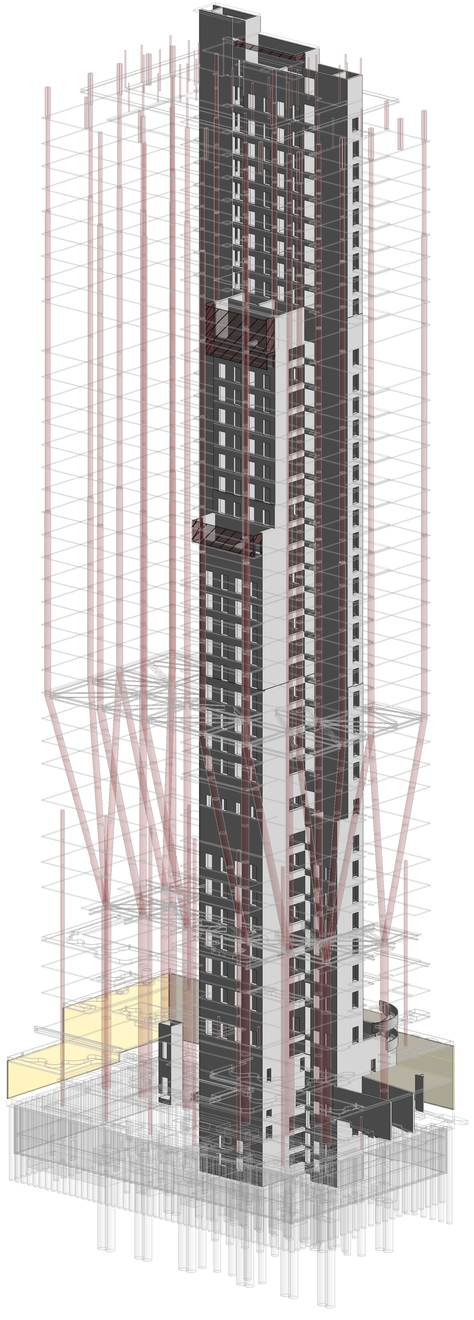
Drawn
D.STUCKEY
Designer
N.DOYLE/T.KATUNAR
Design Checker
-
Approved
M.AVERY

FOR TENDER - NOT FOR CONSTRUCTION

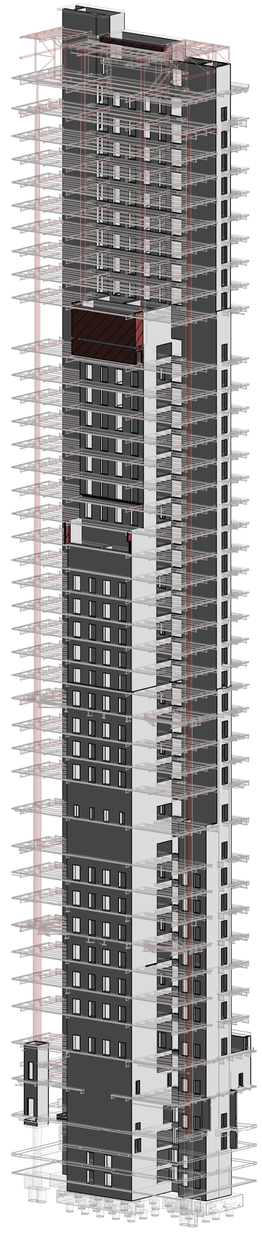
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ALB-RBG-DWG-ST-00-000-51

Revision
T02

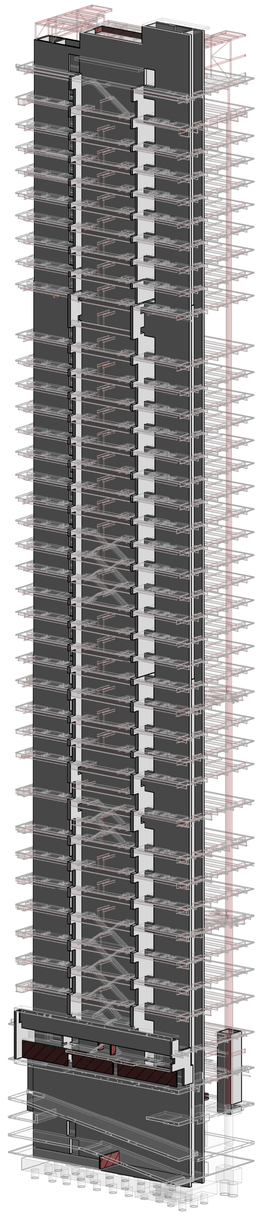
PRINT DRAWINGS IN COLOUR



CONTEXT VIEW - CORE WALLS



CONTEXT VIEW - CORE WALLS FROM SOUTHWEST



CONTEXT VIEW - CORE WALLS FROM NORTHEAST

Rev	Revision Description	By	App	Date
T02	ISSUED FOR TENDER	DS	MA	17.07.24
T01	ISSUED FOR TENDER	DS	MA	28.06.24

SCALE 1 2 3 4 5 6 7 8

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ACN 010 580 248

Client
QIC

Project
101 ALBERT STREET, BRISBANE

Title
CONTEXT VIEWS
SHEET 2

Date
Jun 2024
Scale at A1
1:500

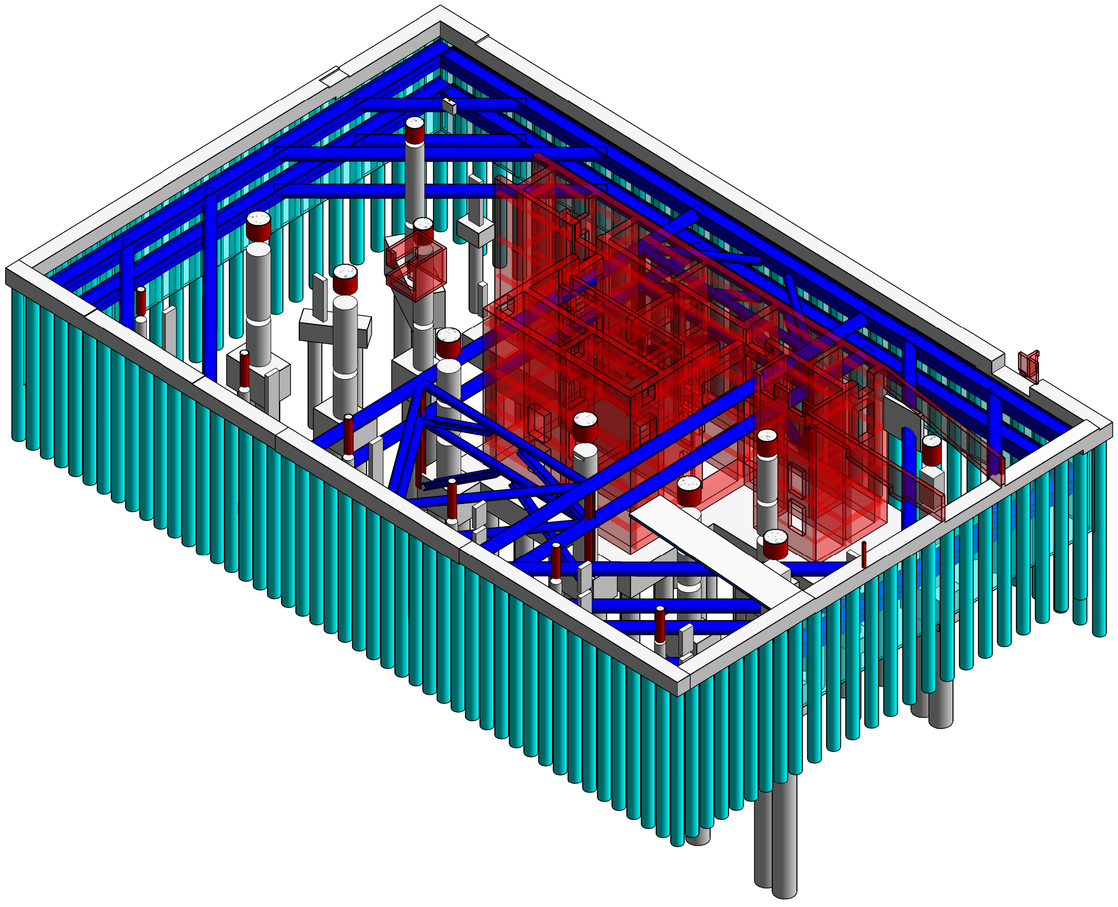
Drawn
D.STUCKEY
Designer
N.DOYLE/T.KATUNAR
Design Checker
-
Approved
M.AVERY

FOR TENDER - NOT FOR CONSTRUCTION

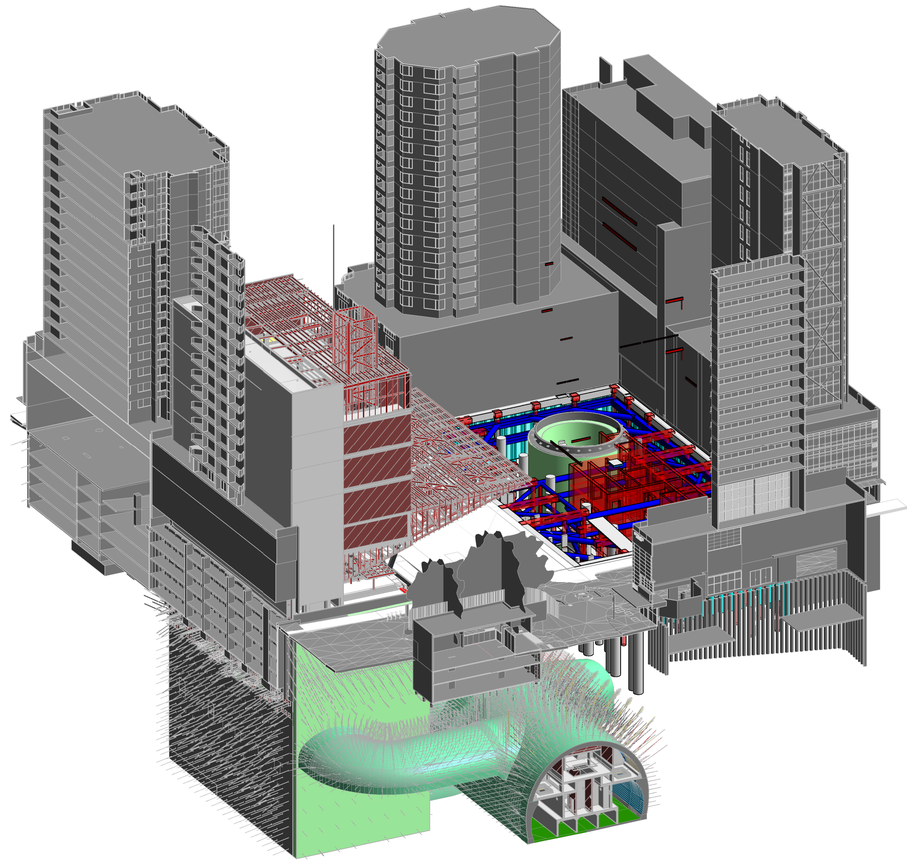
Drawing Number
ALB-RBG-DWG-ST-00-000-52

Revision
T02

PRINT DRAWINGS IN COLOUR



CONTEXT VIEW - SHORING AND FOUNDATIONS



CONTEXT VIEW - SHORING AND FOUNDATIONS

Rev	Revision Description	By	App	Date
T02	ISSUED FOR TENDER	DS	MA	17.07.24
T01	ISSUED FOR TENDER	DS	MA	28.06.24

SCALE 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8

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Client
QIC

Project
101 ALBERT STREET, BRISBANE

Title
CONTEXT VIEWS
SHEET 3

Date
Jun 2024
Scale at A1
1:200, 1:500

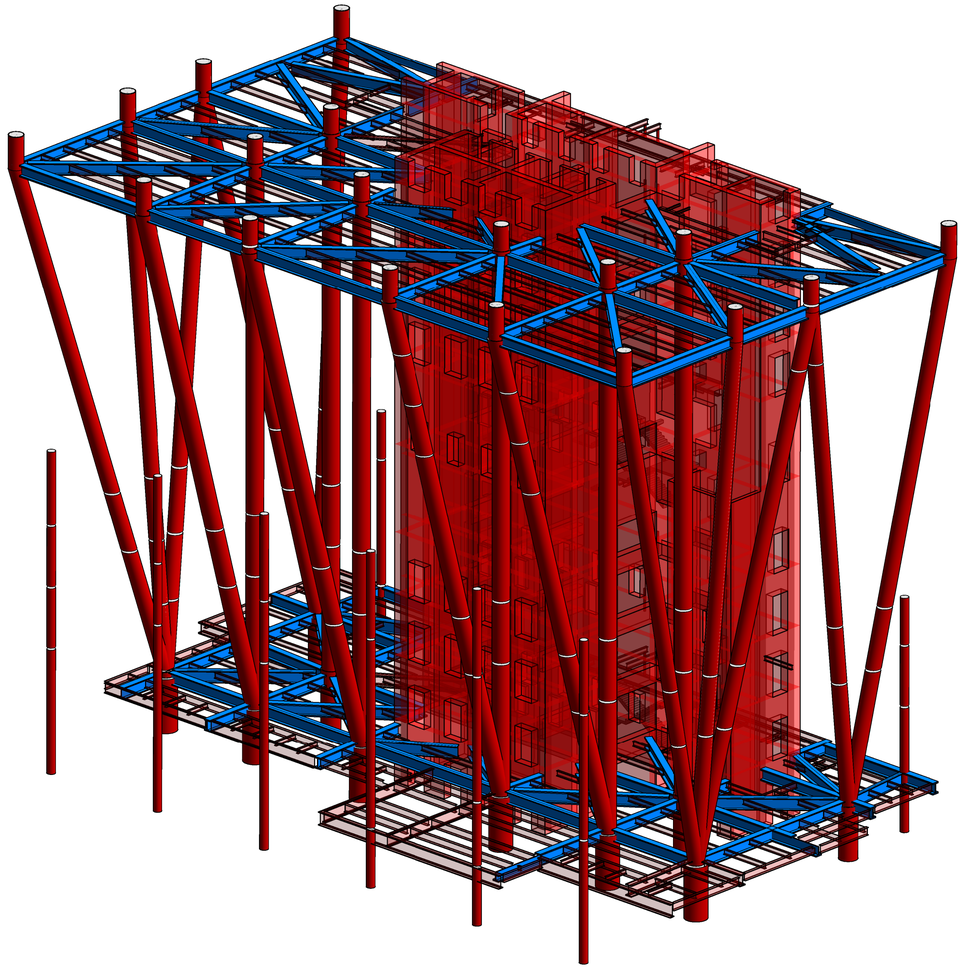
Drawn
D.STUCKEY
Designer
N.DOYLE/T.KATUNAR
Design Checker
-
Approved
M.AVERY

FOR TENDER - NOT FOR CONSTRUCTION

Drawing Number
ALB-RBG-DWG-ST-00-000-53

Revision
T02

PRINT DRAWINGS IN COLOUR



CONTEXT VIEW - RAKING COLUMNS AND TRANSFER DIAPHRAGM FLOORS L6 & L14
VIEWED FROM SOUTH-EAST CORNER

Rev	Revision Description	By	App	Date
T01	ISSUED FOR TENDER	DS	MA	28.06.24

SCALE | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8

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QIC

Project
101 ALBERT STREET, BRISBANE

Title
CONTEXT VIEWS
SHEET 4

Date
Jun 2024
Scale at A1
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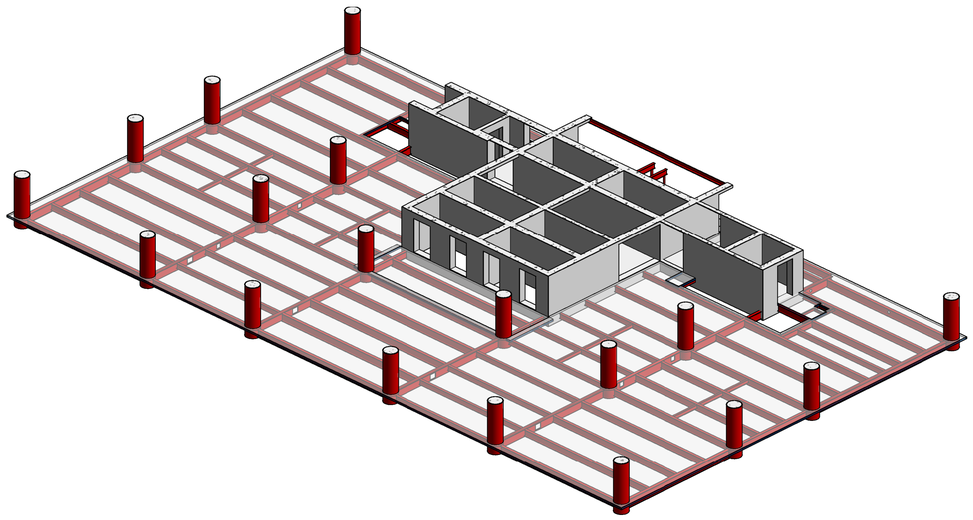
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D.STUCKEY
Designer
N.DOYLE/T.KATUNAR
Design Checker
-
Approved
M.AVERY

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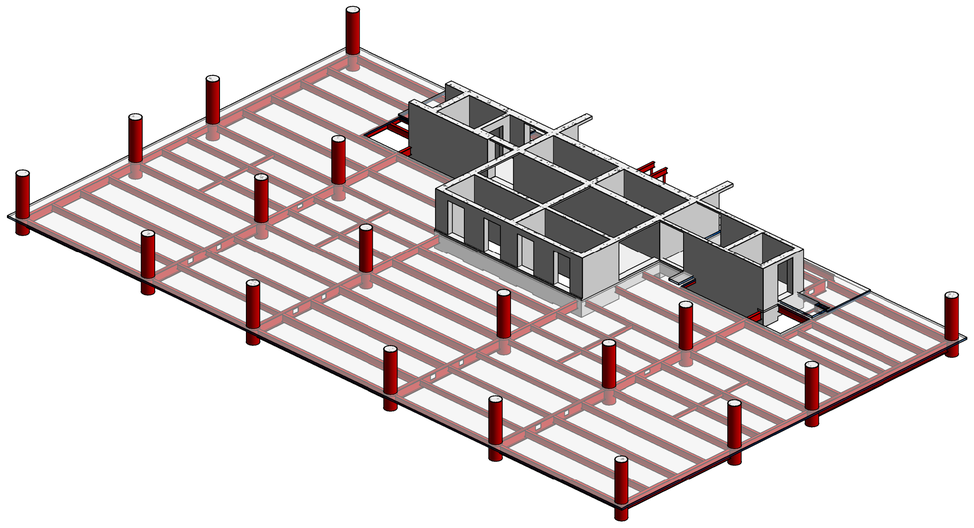
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Revision
T01

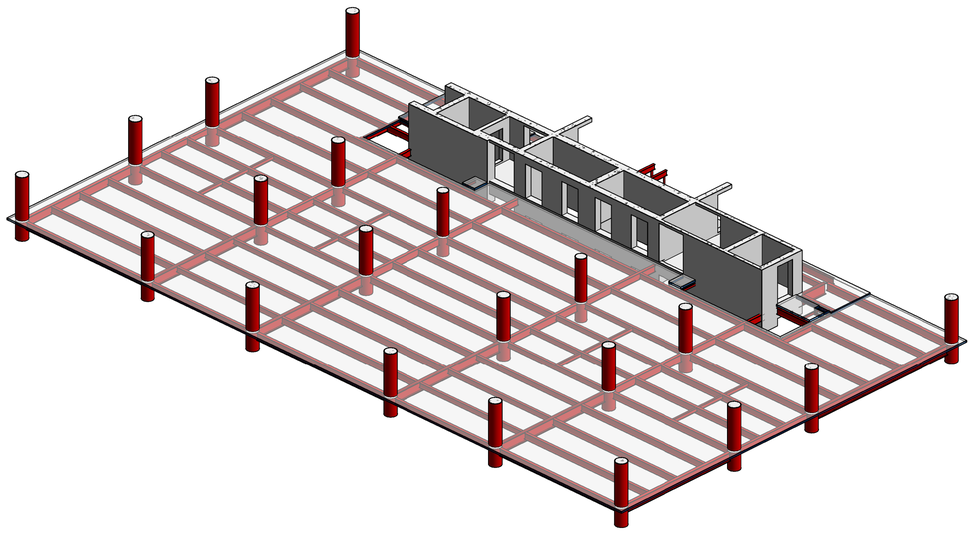
PRINT DRAWINGS IN COLOUR



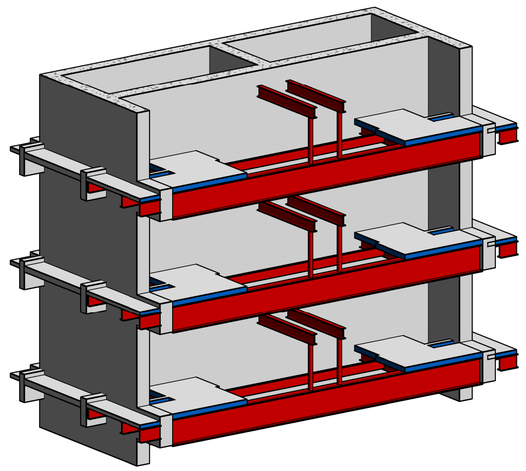
CONTEXT VIEW - TYPICAL MID RISE LEVEL



CONTEXT VIEW - TYPICAL HIGH RISE LEVEL



CONTEXT VIEW - TYPICAL SKY RISE LEVEL



CONTEXT VIEW - TYPICAL STAIR STEELWORK

Rev	Revision Description	By	App	Date
T01	ISSUED FOR TENDER	DS	MA	28.06.24

SCALE 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8

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101 ALBERT STREET, BRISBANE

Title
CONTEXT VIEWS
SHEET 5

Date
Jun 2024
Scale at A1
1:100, 1:200

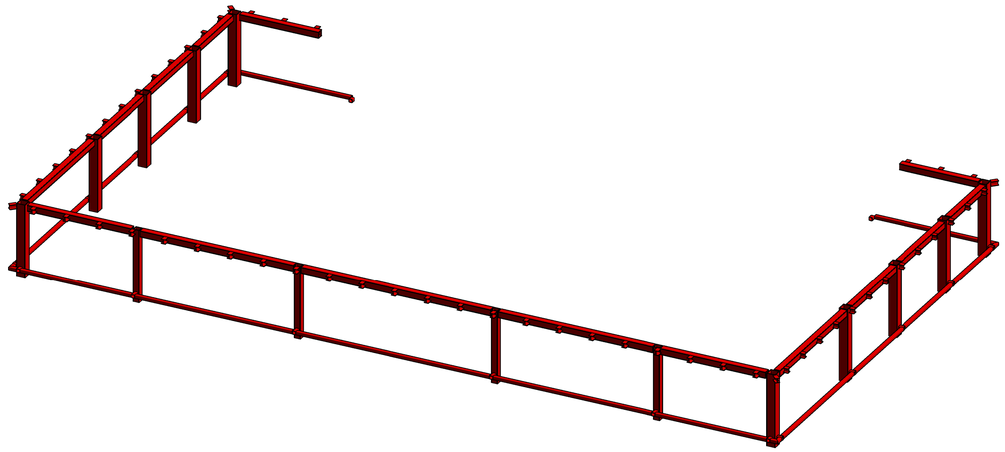
Drawn
D.STUCKEY
Designer
N.DOYLE/T.KATUNAR
Design Checker
-
Approved
M.AVERY

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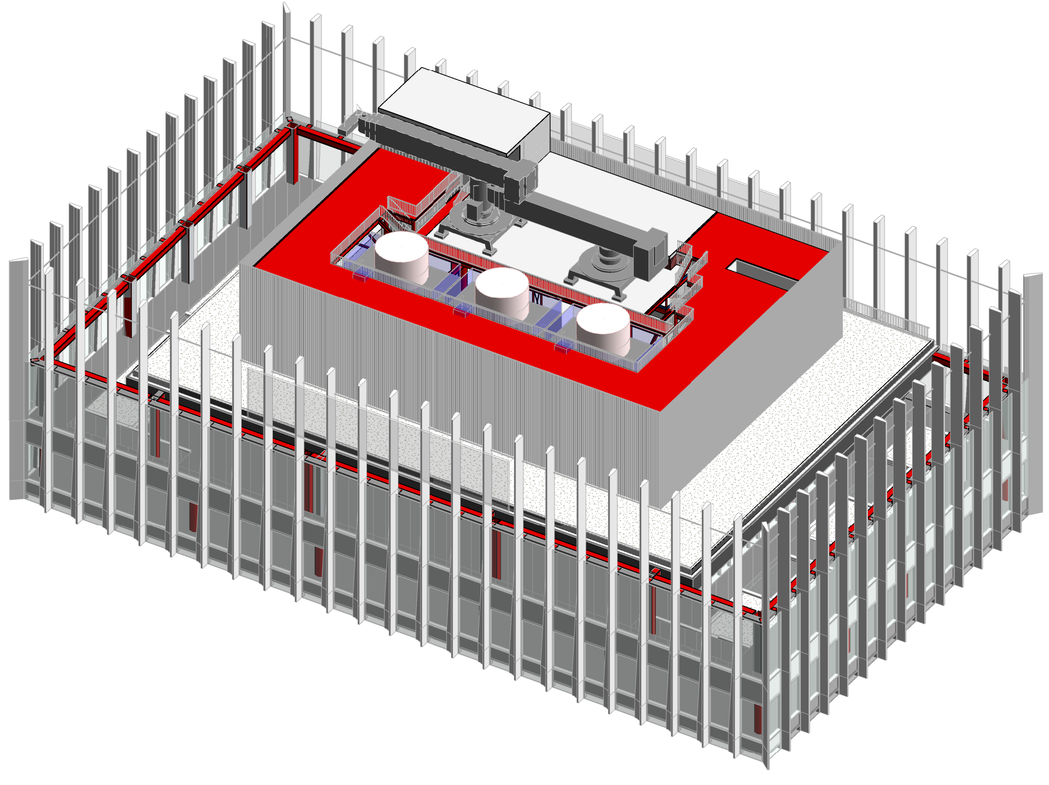
Drawing Number
ALB-RBG-DWG-ST-00-000-55

Revision
T01

PRINT DRAWINGS IN COLOUR



CONTEXT VIEW - CROWN FRAME



CONTEXT VIEW - CROWN FRAME WITH OVERLAY

Rev	Revision Description	By	App	Date
T02	ISSUED FOR TENDER	DS	MA	17.07.24
T01	ISSUED FOR TENDER	DS	MA	28.06.24

SCALE | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8

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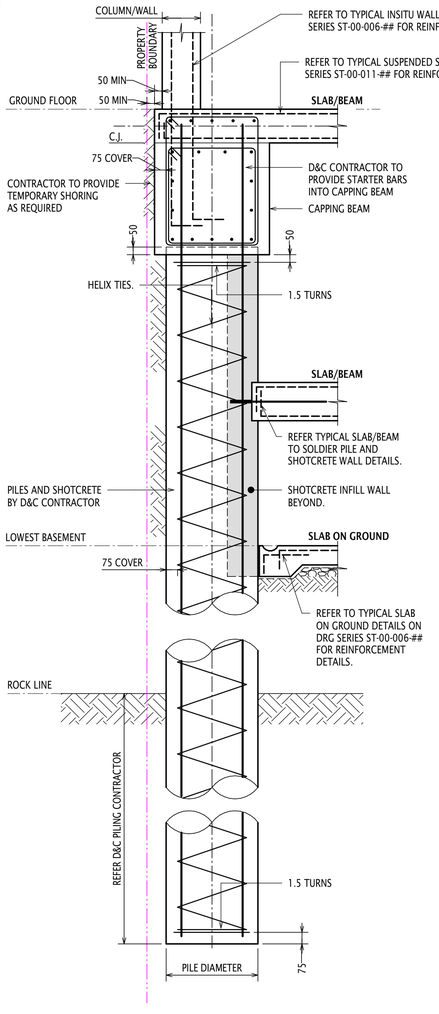
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CONTEXT VIEWS
SHEET 6

Date
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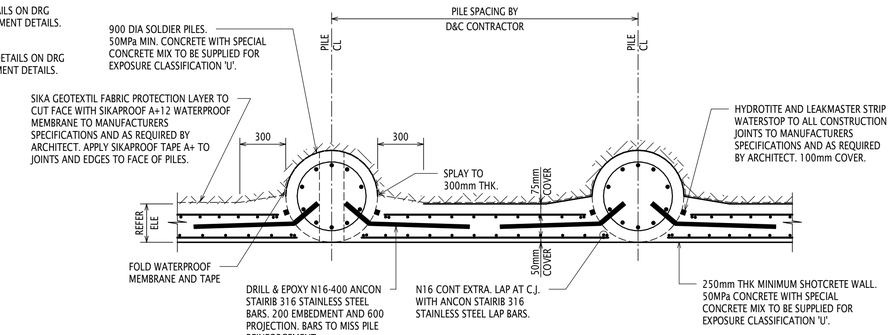
Drawn
D.STUCKEY
Designer
N.DOYLE/T.KATUNAR
Design Checker
-
Approved
M.AVERY

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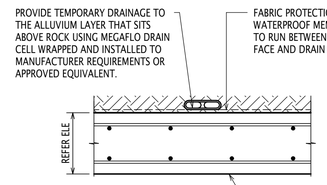
Drawing Number	Revision
ALB-RBG-DWG-ST-00-000-56	T02



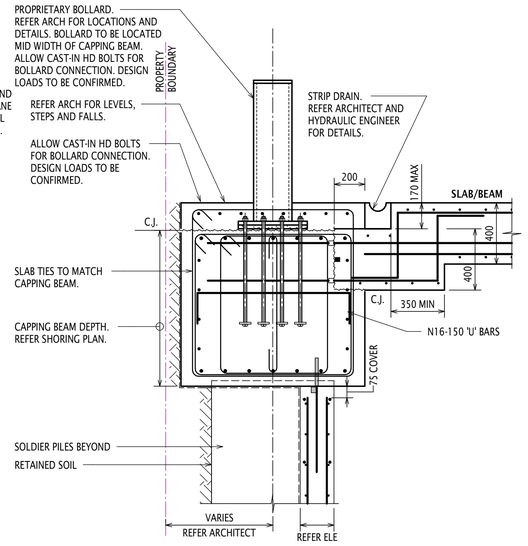
TYPICAL SHORING AND RETAINING WALL DETAIL
SCALE 1:20

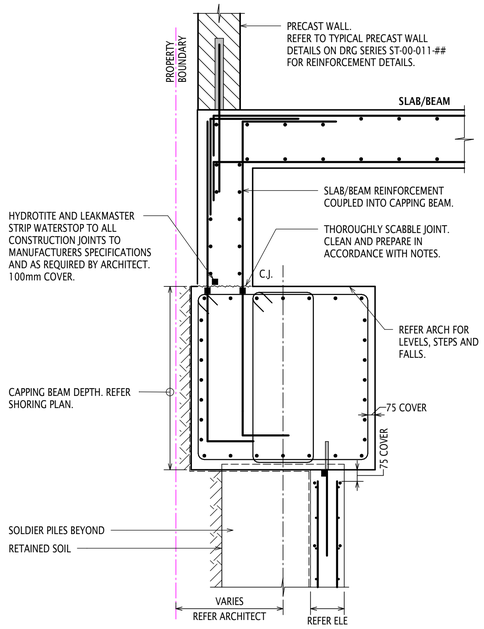


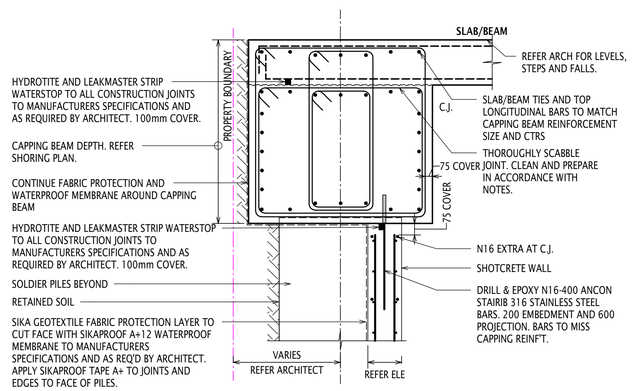
TYPICAL SOLDIER PILE AND SHOTCRETE WALL DETAIL
SCALE 1:20

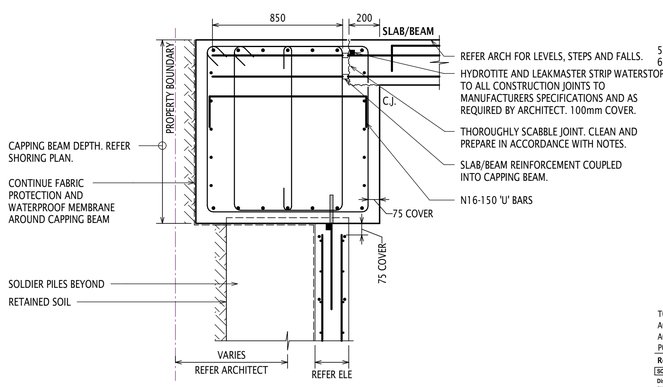


TYPICAL WALL DRAINAGE DETAIL
SCALE 1:10









PRINT DRAWINGS IN COLOUR

NOTES.

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL PROJECT DOCUMENTS INCLUDING BUT NOT LIMITED TO THE FOLLOWING.
   a. GENERAL NOTES ON DRG ST-00-000-11
   b. CONSTRUCTION METHODOLOGY AND ERECTION SEQUENCE (CMES) NOTES ON DRG ST-00-000-11
   c. SHORING & RETENTION WALL NOTES ON DRG ALB-RBG-DWG-ST-00-000-12
   d. FOUNDATION AND PILING NOTES ON DRG ST-00-000-12
   e. LAP SCHEDULES ON DRG ST-00-000-21
   f. TEMPORARY SHORING AND RETENTION GENERAL ARRANGEMENT PLAN ON DRG ST-01-000-21
   g. FOUNDATION PLAN ON DRG ST-03-BC2-01
   h. POST INSTALLED ANCHOR NOTES ON DRG ALB-RBG-DWG-ST-00-000-15
2. MINIMUM STRUCTURAL SET-OUT AND TOLERANCE AS PER MOVEMENT AND TOLERANCE REPORT.
3. SHOTCRETE WALL TO BE REINFORCED WITH MINIMUM RL1018 MESH ORIENTATED WITH LONG WIRES RUNNING VERTICALLY AND N16-400 HORIZ EXTRA EACH FACE TYP U.N.O. EXTRA BARS TO BE PLACED AGAINST PARALLEL WIRES.
4. CONSTRUCTION JOINTS TO SHORING WALLS INCLUDING SHOTCRETE, SHOTCRETE TO PILE OR CAPPING BEAM INTERFACES SHALL BE PREPARED AS FOLLOWS.
   a. ALL REINFORCEMENT BARS THROUGH CONSTRUCTION JOINTS TO BE ANCON STAIRIB 316 STAINLESS STEEL BARS. WHERE REQUIRED BARS ARE TO BE BENT TO SCHEDULE.
   b. THE SURFACE OF THE JOINT SHALL BE FINELY SCABBLED AND CLEANED IMMEDIATELY PRIOR TO CASTING CONCRETE AGAINST THE JOINT. THE SURFACE AND ANY PROJECTING STEEL SHALL THEN BE WASHED WITH CLEAN FRESH WATER TO REMOVE ANY SALT DEPOSITS OR OTHER CONTAMINANTS, AND EITHER BLOWN DRY WITH OIL-FREE AIR OR ALLOWED TO DRY WHILE PROTECTED FROM FURTHER CONTAMINATION.
   c. FOLLOWING CLEANING TAPE THE SIKAPROOF A+12 WATERPROOF MEMBRANE TO THE PILES AND AT JOINTS AS REQUIRED. THE JOINT SHALL THAN BE COATED WITH A WET-TO-DRY EPOXY RESIN, AS APPROVED BY THE SHORING WALL DESIGNER AND THEN INSTALLATION OF THE HYDROTITE AND LEAKMASTER STRIP WATERSTOP TO ALL JOINTS WITH IMMEDIATE PLACEMENT OF THE FRESH CONCRETE BEFORE THE EPOXY ON THE INTERFACE HAS HARDENED. ALTERNATIVELY THE CONSTRUCTION JOINT SHALL BE DAMPENED WITH WATER PRIOR TO PLACEMENT OF CONCRETE FOR A PERIOD OF FOUR HOURS BEFORE CONCRETE PLACEMENT.
5. COUPLERS TO 'L' OR 'Z' BARS TO BE ANCON TYPE C COUPLERS.
6. ALL PLATES TO BE GRADE 350.

Rev	Revision Description	By	App	Date
T01	ISSUED FOR TENDER	DS	MA	28.06.24
A02	80% DD DRAFT	DS	MA	07.06.24
A01	50% DD ISSUE	SV	MA	09.08.23
P01	DRAFT 50% DESIGN DEVELOPMENT	SV	MA	28.07.23

SCALE 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8

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ACN 010 580 248

Client
QIC

Project
101 ALBERT STREET, BRISBANE

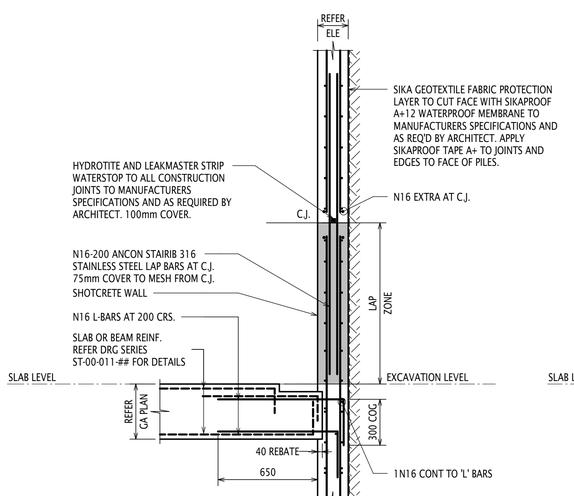
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TYPICAL SHORING DETAILS
SHEET 1

Date
Jun 2024
Scale at A1
1:10, 1:20
Job Number
22131S

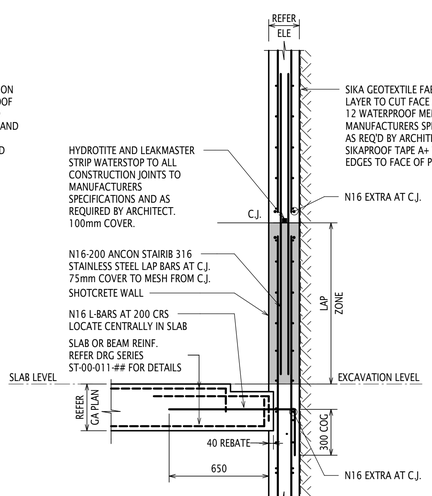
Drawn
D.STUCKEY
Designer
N.DOYLE/T.KATUNAR
Design Checker
-
Approved
M.AVERY

FOR TENDER - NOT FOR CONSTRUCTION

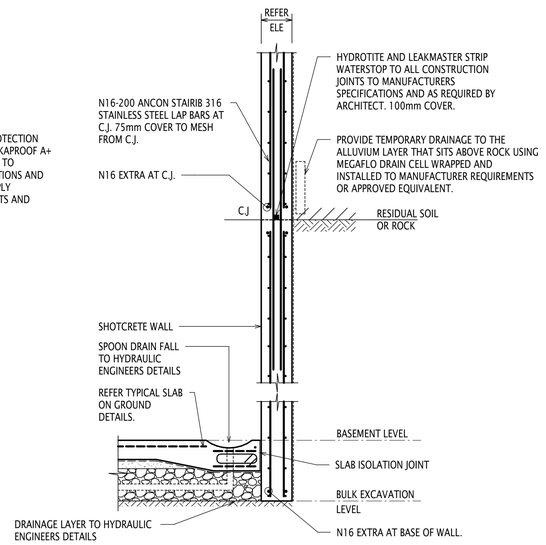
Drawing Number
ALB-RBG-DWG-ST-00-001-01
Revision
T01



TYPICAL SLAB/BEAM (THK>350mm) TO SHOTCRETE WALL DETAIL
SCALE 1:20



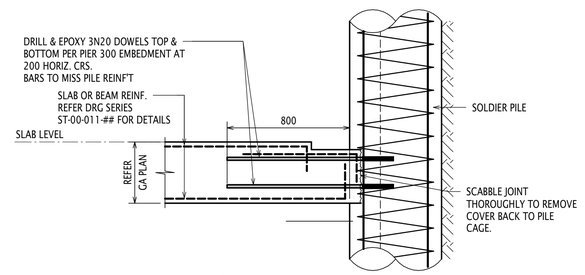
TYPICAL SLAB (THK≤350mm) TO SHOTCRETE WALL DETAIL
SCALE 1:20



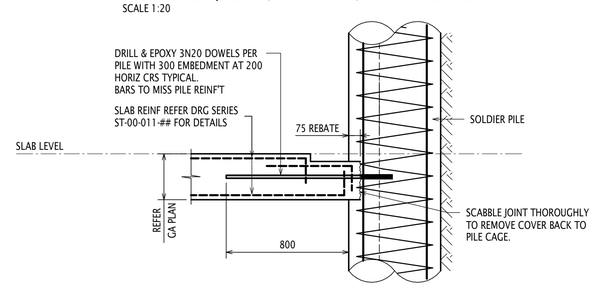
TYPICAL SHOTCRETE WALL BASE DETAIL
SCALE 1:20

NOTES SIMILAR FOR OTHER TYPICAL CAPPING BEAM TO SOLDIER PILE AND SHOTCRETE WALL DETAILS U.N.O.

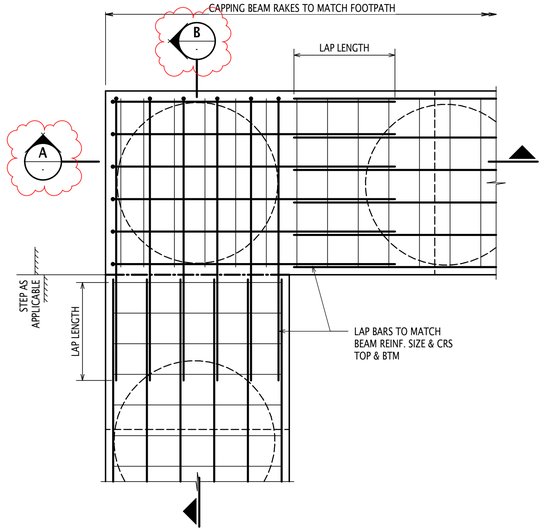
TYPICAL CAPPING BEAM TO SOLDIER PILE AND SHOTCRETE WALL DETAILS
SCALE 1:20



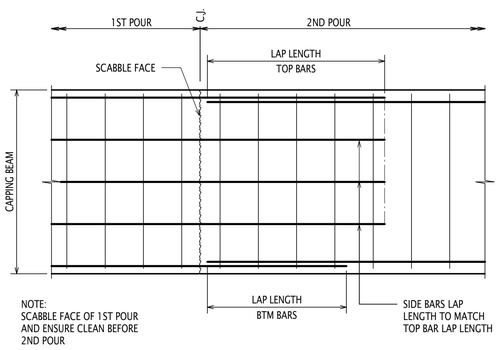
TYPICAL SLAB/BEAM (THK>350mm) TO SOLDIER PILE DETAIL
SCALE 1:20



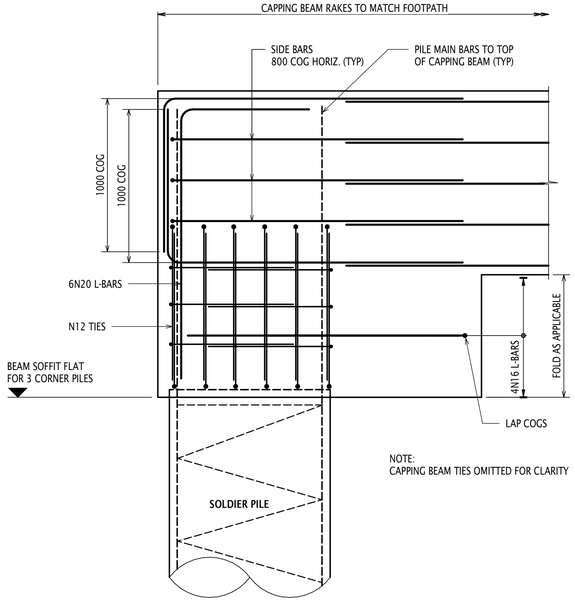
TYPICAL SLAB (THK≤350mm) TO SOLDIER PILE DETAIL
SCALE 1:20



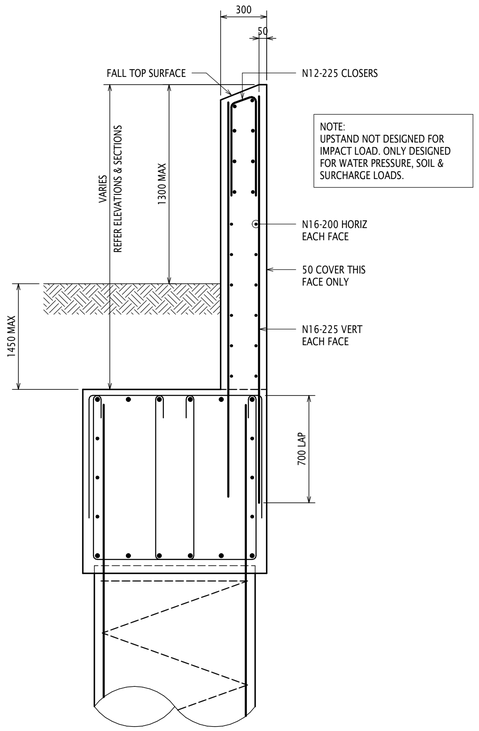
CAPPING BEAM PLAN AT CORNER DETAIL
SCALE 1:20



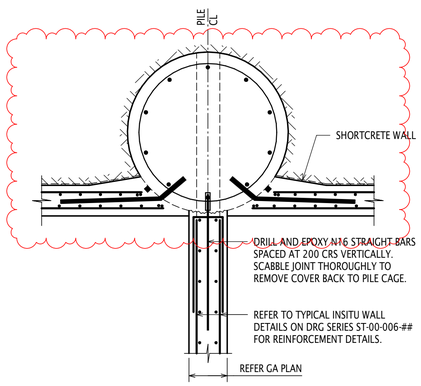
TYPICAL CAPPING BEAM CONSTRUCTION JOINT (C.J.)
SCALE 1:20



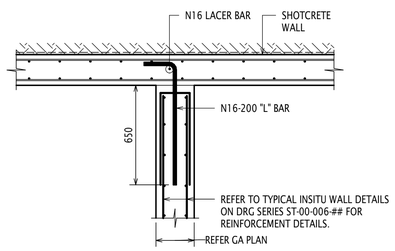
SECTION A
SCALE 1:20



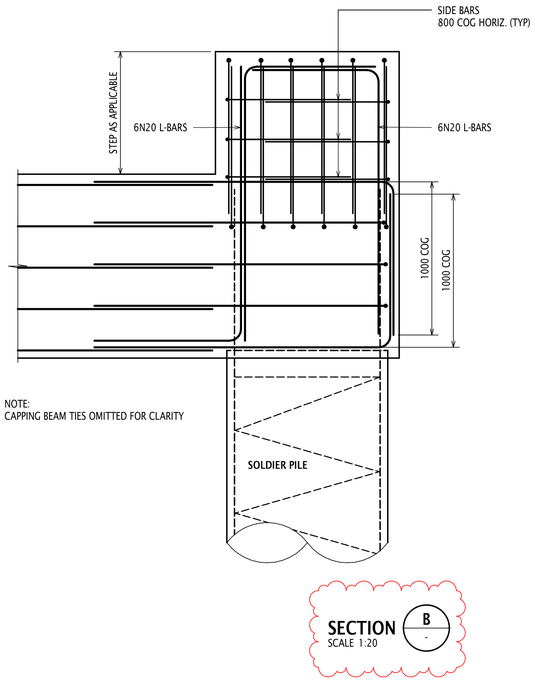
TYPICAL UPSTAND DETAIL
SCALE 1:20



TYPICAL INTERNAL WALL TO SOLDIER PIER WALL DETAIL (PLAN)
SCALE 1:20



TYPICAL INTERNAL WALL TO SHOTCRETE WALL DETAIL (PLAN)
SCALE 1:20



SECTION B
SCALE 1:20

PRINT DRAWINGS IN COLOUR

NOTES.

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5. COUPLERS TO 'L' OR 'Z' BARS TO BE ANCON TYPE C COUPLERS.
6. ALL PLATES TO BE GRADE 350.

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Rev	Revision Description	By	App	Date
T02	ISSUED FOR TENDER	DS	MA	17.07.24
T01	ISSUED FOR TENDER	DS	MA	28.06.24

SCALE 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8

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ACN 010 580 248

Client
QIC

Project
101 ALBERT STREET, BRISBANE

Title
TYPICAL SHORING DETAILS
SHEET 2

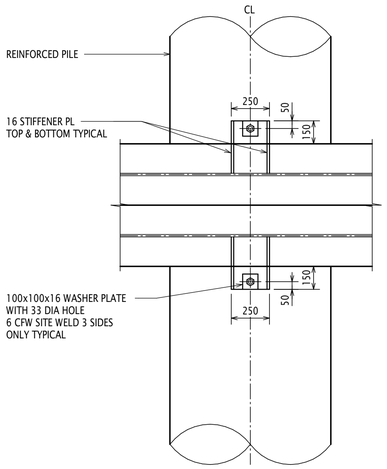
Date
Jun 2024
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Drawn
D.STUCKEY
Designer
N.DOYLE/T.KATUNAR
Design Checker
-
Approved
M.AVERY

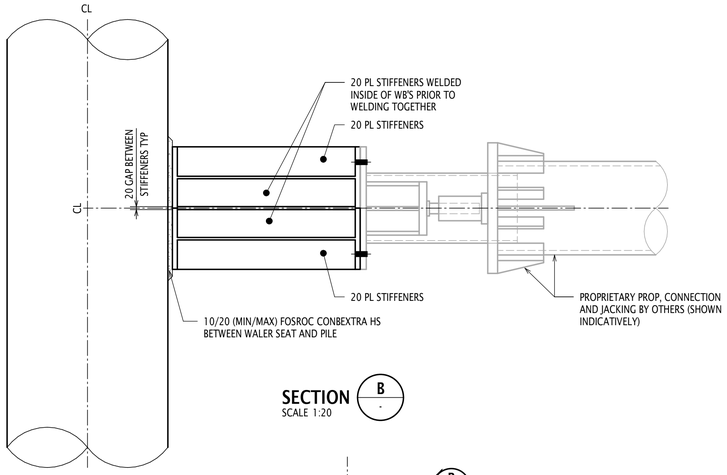
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Drawing Number
ALB-RBG-DWG-ST-00-001-02

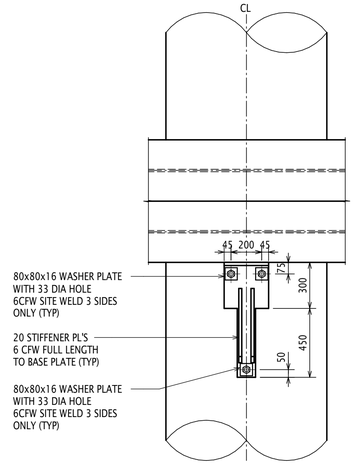
Revision
T02



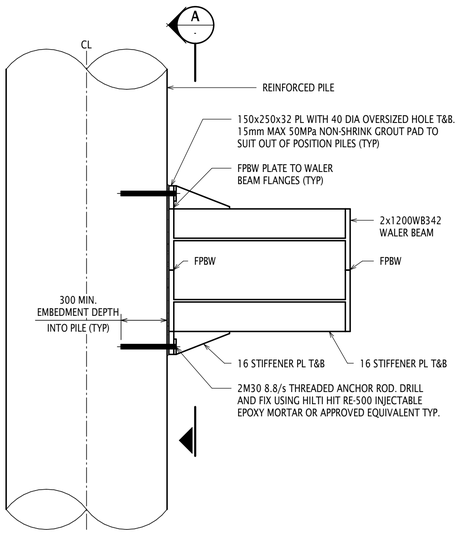
SECTION A
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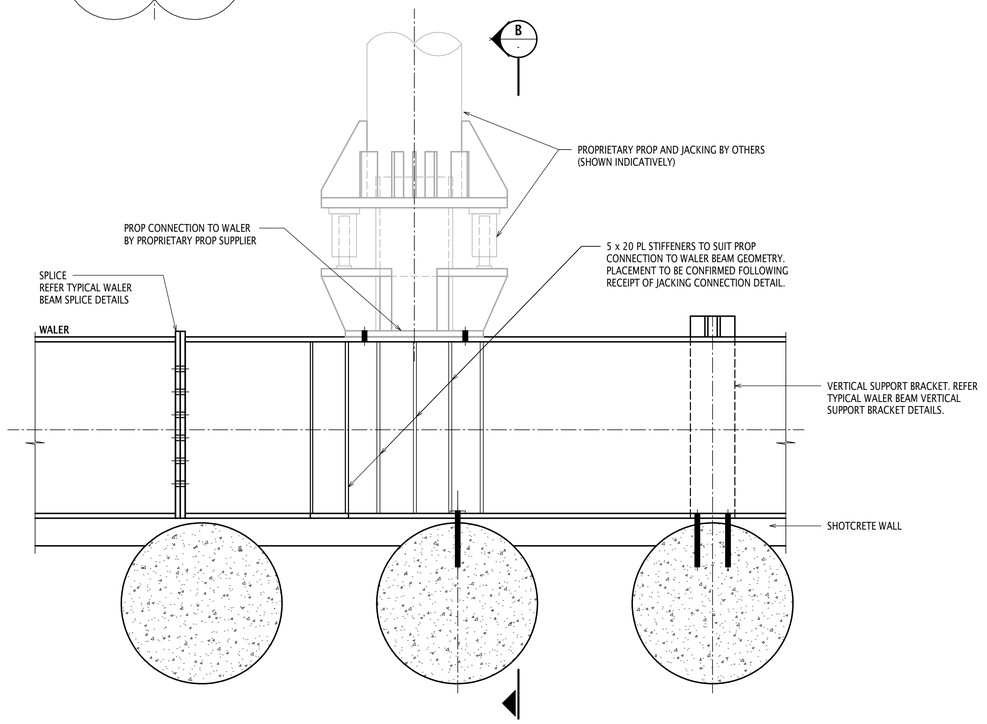
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SCALE 1:20



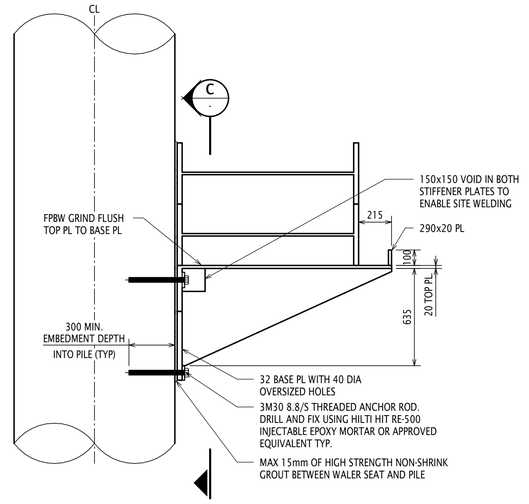
SECTION C
SCALE 1:20



INTERNALLY STRUTTED SHORING WALL
TYPICAL WALER AND CONNECTION DETAIL
SCALE 1:20

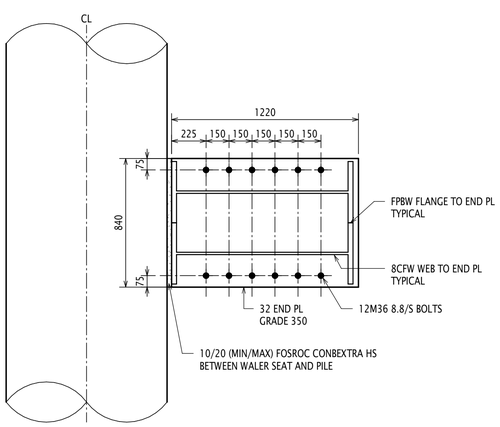


INTERNALLY STRUTTED SHORING WALL
TYPICAL PROP CONNECTION DETAIL
SCALE 1:20



INTERNALLY STRUTTED SHORING WALL
TYPICAL WALER BEAM VERTICAL SUPPORT BRACKET DETAIL
SCALE 1:20

NOTE:
WALER BEAM SUPPORT BRACKETS ARE DESIGNED FOR WALER BEAM SELF WEIGHT ONLY. ALL WALER BEAM FLANGE RESTRAINTS MUST BE INSTALLED AND WELDED PRIOR TO CONNECTING PROPS TO WALERS.



INTERNALLY STRUTTED SHORING WALL
TYPICAL WALER SPLICE DETAIL
SCALE 1:20

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SCALE 1 2 3 4 5 6 7 8

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Structural, Civil & Construction
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Member of the Surbana Jurong Group

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ACN 010 580 248

Client
QIC

Project
101 ALBERT STREET, BRISBANE

Title
TYPICAL SHORING DETAILS
SHEET 3

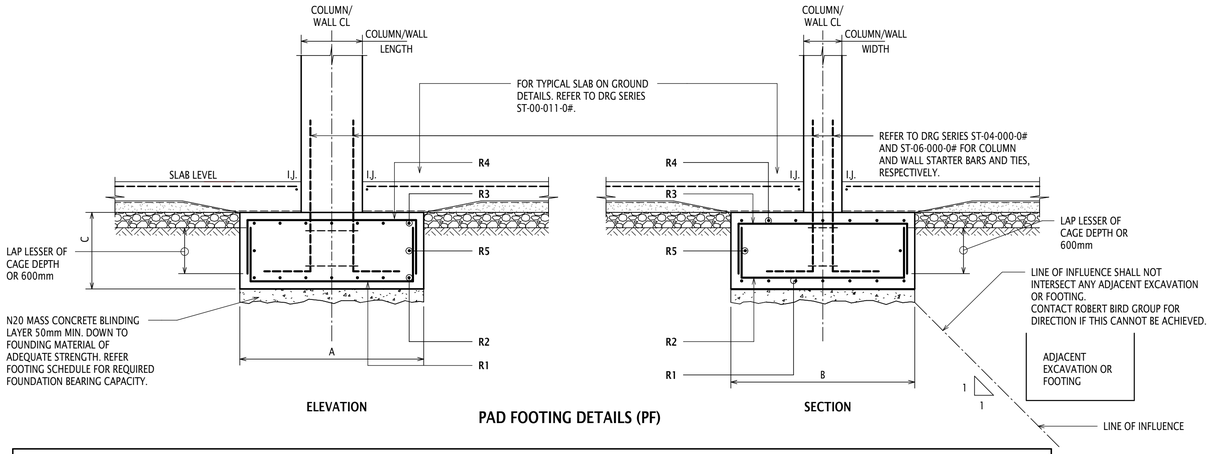
Date
Jun 2024
Scale at A1
1:20

Drawn
D.STUCKEY
Designer
N.DOYLE/T.KATUNAR
Design Checker
-
Approved
M.AVERY

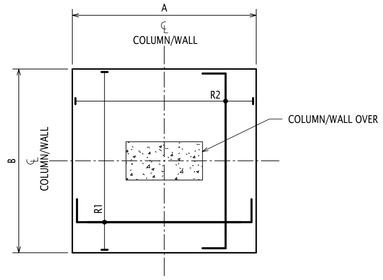
FOR TENDER - NOT FOR CONSTRUCTION

Drawing Number
ALB-RBG-DWG-ST-00-001-03

Revision
T02



PAD FOOTING DETAILS (PF)



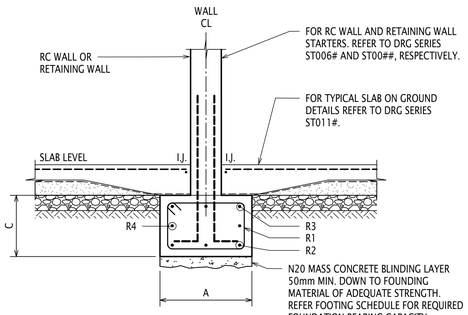
PAD FOOTING REINFORCEMENT PLAN

PAD FOOTING SCHEDULE - REINFORCEMENT

MARK	DIMENSIONS A	B	C	REINFORCEMENT R1	R2	R3	R4	R5	CONCRETE GRADE	FOUNDING MATERIAL	MINIMUM ALLOWABLE BEARING PRESSURE (kPa)	MAXIMUM WORKING PRESSURE (kPa)
PF1	6000	3100	1200						50	NFG3	2000	775
PF2	6155	16915	1500							NFG5	450	240

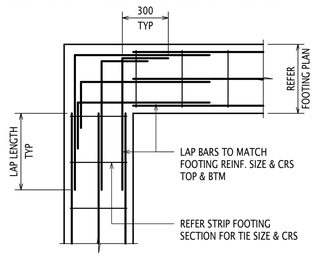
NOTES:

1. MINIMUM ALLOWABLE BEARING PRESSURE REPRESENTS THE QUALITY OF THE FOUNDING MATERIAL WHICH MUST BE VERIFIED BY A GEOTECHNICAL ENGINEER PRIOR TO PLACEMENT OF THE BLINDING LAYER. REFER TO FOUNDATION NOTES.
2. MAXIMUM WORKING PRESSURE TAKES INTO CONSIDERATION DIFFERENTIAL SETTLEMENT TO ADJACENT ELEMENTS. REFER TO MOVEMENT AND TOLERANCE REPORT AND GEOTECHNICAL ENGINEER FOR DETAILS.



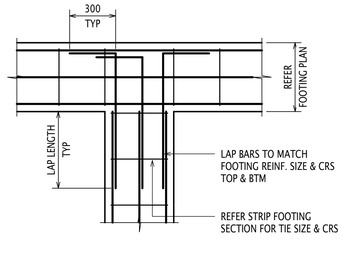
STRIP FOOTING DETAIL (SF)

SCALE 1:20



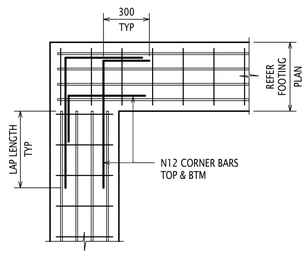
90 DEGREES STRIP FOOTING CORNER DETAIL

SCALE 1:20



STRIP FOOTING T-INTERSECTION DETAIL

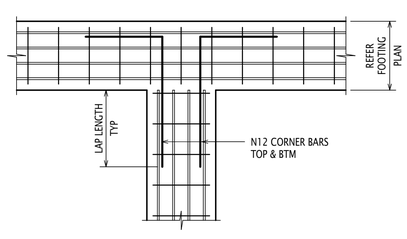
SCALE 1:20



90 DEGREES STRIP FOOTING CORNER DETAIL

SCALE 1:20

FOR TRENCH MESH REINFORCED FOOTINGS



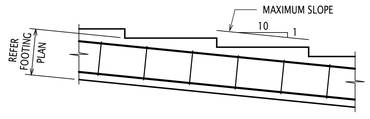
STRIP FOOTING T-INTERSECTION DETAIL

SCALE 1:20

FOR TRENCH MESH REINFORCED FOOTINGS

STRIP FOOTING SCHEDULE - REINFORCEMENT

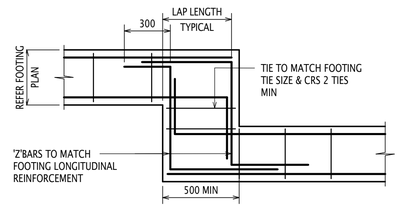
MARK	DIMENSIONS A	B	REINFORCEMENT R1	R2	R3	R4	REINF RATE (kg/m³)
SF1	1800	600					150



FOOTING STEP FOR GENTLE SLOPES

SCALE 1:20

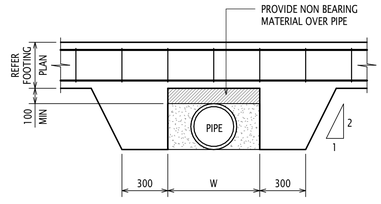
STEP FOOTING TO SUIT COURSING



TYPICAL FOOTING STEP DETAIL

SCALE 1:20

STEP FOOTING TO SUIT COURSING



STRIP FOOTING OVER PIPE DETAIL

NOTE:

1. FOR 'W' GREATER THAN 400 THE ENGINEER IS TO BE NOTIFIED FOR POSSIBLE FOOTINF RE-DESIGN.
2. WHERE FOUNDING MATERIAL IS ROCK REFER ENGINEER.

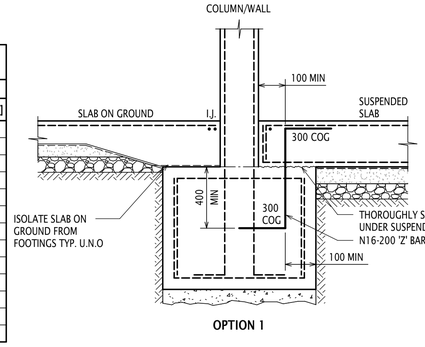
CORE PILE LOAD SCHEDULE

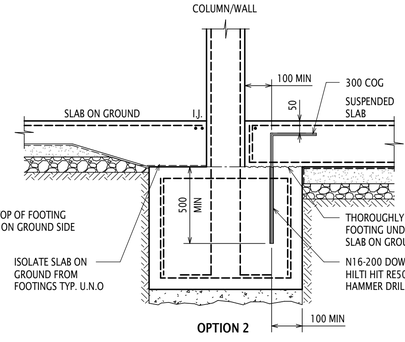
PILE MARK	G [kN] FX [kN]	FY [kN]	FZ [kN]	Q [kN] FX [kN]	FY [kN]	FZ [kN]	W [kN] FX [kN]	FY [kN]	FZ [kN]	EQX [kN] FX [kN]	FY [kN]	FZ [kN]	EQY [kN] FX [kN]	FY [kN]	FZ [kN]
P01	130	120	11920	30	40	2080	260	470	6570	850	660	4300	110	530	950
P02	80	70	13610	10	20	2010	240	480	11130	900	570	3600	140	520	2440
P03	70	20	15120	20	10	2350	230	470	10970	890	470	3100	130	500	2330
P04	60	30	14910	20	30	2230	220	470	11490	900	340	2330	130	470	2680
P05	50	40	14830	20	30	2180	200	440	11700	920	200	1310	140	410	2840
P06	40	50	15100	20	30	2240	200	430	11840	920	40	280	150	360	2980
P07	30	50	14770	30	30	2210	210	440	12300	930	130	1080	150	380	3120
P08	10	50	14710	30	30	2260	220	470	12850	930	280	2140	160	420	3240
P09	10	50	14230	30	30	2260	230	470	12860	920	430	2930	160	450	3130
P10	10	60	14270	30	20	2330	240	480	13170	930	570	3820	160	480	3080
P11	20	70	14110	30	20	2340	250	480	13380	920	770	5230	170	530	2970
P12	170	120	12910	40	40	2660	260	470	5410	800	660	5000	90	530	1180
P13	140	70	15840	40	20	3160	250	490	6200	790	570	4770	80	520	920
P14	90	10	14980	30	20	2910	220	470	5050	770	440	3110	80	500	610
P16	60	40	13680	30	30	2590	200	450	4830	770	200	1360	80	410	920
P17	40	50	13750	30	30	2610	200	430	4720	770	40	300	80	360	1000
P18	30	40	13160	20	30	2520	210	450	5040	760	130	980	80	380	1120
P19	20	50	12980	20	30	2540	220	470	5400	760	280	1870	90	430	1090
P20	20	50	12490	30	30	2510	220	470	5290	760	430	2460	90	460	810
P21	10	70	12520	30	20	2560	230	470	5460	760	570	3460	90	480	810
P22	10	80	12520	20	20	2590	230	480	6390	760	770	5010	90	530	840
P23	20	50	10740	20	30	2680	210	480	3130	620	440	2190	30	460	750
P24	30	60	10140	20	20	2580	210	470	3880	610	570	3050	30	480	1620
P25	20	90	9930	20	20	2550	210	470	5120	610	770	4540	30	530	2240
P26	70	20	14120	30	30	3590	220	470	4370	630	370	3200	40	490	870
P27	60	30	13290	30	30	3390	220	450	3680	630	200	1720	40	410	670
P28	40	30	13090	20	30	3350	220	430	3130	620	40	210	40	360	460
P29	30	30	12550	20	30	3240	220	450	3280	620	130	1300	40	380	650
P30	20	20	12000	20	20	3150	220	480	3730	620	300	2320	40	440	780
P31	70	40	14660	30	30	4410	280	480	11030	650	370	3730	100	490	2410
P32	50	30	14020	30	30	4270	280	450	10390	640	200	1980	100	410	2120
P33	40	20	14020	20	30	4310	270	420	10000	640	40	190	100	350	1870
P34	10	30	13390	10	30	4130	270	450	9890	640	130	1640	100	380	2100
P35	10	30	12850	10	20	4010	270	490	10220	650	300	3020	100	440	2370
P36	50	60	14300	30	40	4920	340	490	17650	680	370	3700	160	490	4510
P37	50	30	14060	30	30	4910	340	440	17400	690	200	1970	170	410	4290
P38	30	20	14390	20	30	5070	330	420	17430	690	40	220	170	350	4170
P39	10	20	13580	10	30	4800	330	450	16840	690	130	1800	170	380	4300
P40	10	40	12850	10	30	4590	330	500	16750	680	300	3250	160	440	4480
P41	80	120	8780	10	40	1090	250	480	9210	910	650	3110	160	530	2290

COLUMN LOAD SCHEDULE

COLUMN MARK	Pz [kN] G [kN]	Q [kN]	W (+/-) [kN]	EQ (+/-) [kN]	COLUMN MARK	Pz [kN] G [kN]	Q [kN]	W (+/-) [kN]	EQ (+/-) [kN]
C01	1600	900	-	-	C14	2000	1600	-	-
C02	36500	9400	7700	2500	C15	2200	2100	-	-
C03	34200	9300	8300	2600	C16	2600	2200	-	-
C04	27900	10700	500	400	C17	3100	1700	-	-
C05	26500	9900	1400	800	C18	2700	1500	-	-
C06	900	600	-	-	C19	2000	1300	-	-
C07	900	1100	-	-	C20	6900	2100	-	-
C08	45100	12300	5900	2500	C21	6600	1900	-	-
C09	48100	15000	1100	600	C22	5400	1600	-	-
C10	50200	14900	6400	1900	C23	4900	1500	-	-
C11	50800	14100	4900	1300	C24	7800	2400	-	-
C12	49100	15000	1000	600	C25	5300	2200	-	-
C13	45400	13500	5700	2600	C55	600	700	-	-

NOTES:
1. Pz DENOTES VERTICAL LOAD.
2. W DENOTES WIND LOADS.
3. EQ DENOTES EARTHQUAKE LOADS.





TYPICAL SLAB TO FOOTING CONNECTION DETAILS

SCALE 1:20

PRINT DRAWINGS IN COLOUR

NOTES:

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   c. FOUNDATION AND PILING NOTES ON DRG ST-00-000-12
   d. LAP SCHEDULES ON DRG ST-00-000-21
   e. FOUNDATION PLAN ON DRG ST-03-BC2-01
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3. REFER GEOTECHNICAL REPORT FOR EXCAVATION AND TEMPORARY BATTER ANGLES.

FOUNDATION COVER SCHEDULE UNO

LOCATION/ELEMENT	COVER (mm)
PC3	60
PILE CAPS	60
PAD FOOTINGS & RAFT	60
FOUNDATION PILES	75

FOUNDATION CONCRETE STRENGTH SCHEDULE UNO

LOCATION/ELEMENT	CONCRETE MIX
PC3	CM651
RAFT OPTION	CM801
PC1, PC4	CM801
PC2, PC5	CM651
PF1, PF2	CM502
FOUNDATION PILES	CM801

NOTES:
1. REFER TO CONCRETE SPECIFICATION FOR MIX TYPES

FOUNDATION RATES SCHEDULE UNO

LOCATION/ELEMENT	REINF'T RATE [kg/m3]
PC3	200
PC1	200
PC4	275
PC2, PC5	150
PF1, PF2	175
PILES	
- CORE FOUNDATIONS	250
- COLUMN FOUNDATIONS	180
RAFT OPTION	200

Rev	Revision Description	By	App	Date
T03	ISSUED FOR TENDER	DS	MA	09.08.24
T02	ISSUED FOR TENDER	DS	MA	02.08.24
T01	ISSUED FOR TENDER	DS	MA	28.06.24
A02	80% DD DRAFT	DS	MA	07.06.24
A01	50% DD ISSUE	SV	MA	09.08.23
P01	DRAFT 50% DESIGN DEVELOPMENT	SV	MA	28.07.23

SCALE 1 2 3 4 5 6 7 8

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Client
QIC

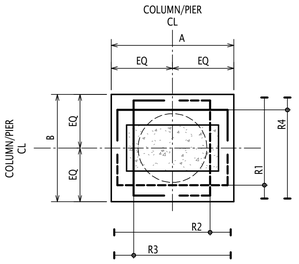
Project
101 ALBERT STREET, BRISBANE

Title
TYPICAL FOOTING DETAILS
SHEET 1

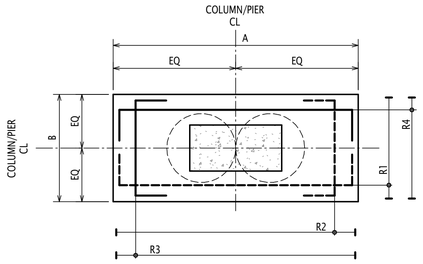
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Jun 2024
Scale at A1
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Drawn
D.STUCKEY
Designer
N.DOYLE/T.KATUNAR
Design Checker
-
Job Number
22131S
Approved
M.AVERY

FOR TENDER - NOT FOR CONSTRUCTION

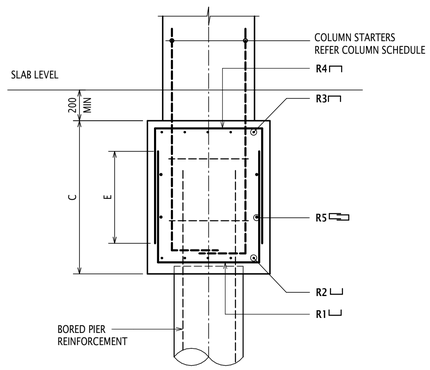
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ALB-RBG-DWG-ST-00-003-01
Revision
T03



PLAN
1 PIER CAP DETAIL



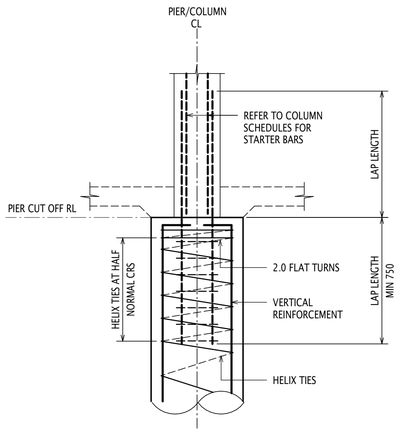
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2 PIER CAP DETAIL



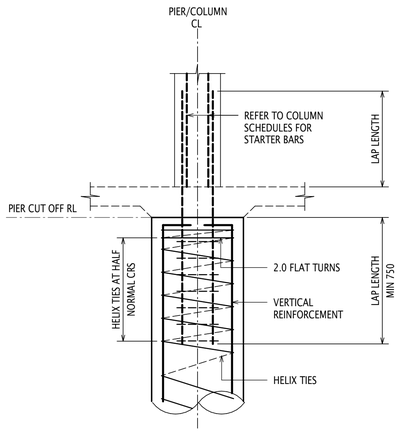
SECTION

PILE CAP SCHEDULE - REINFORCEMENT

MARK	DIMENSIONS A	B	C	REINFORCEMENT R1	R2	R3	R4	R5
PC1	3650	2200	2500					
PC2	2000	1500	1200					
PC4	6600	2200	3000					
PC5	4500	1500	1500					

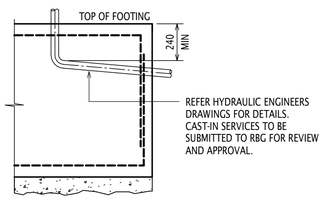


TYPICAL BORED PIER AT COLUMN (SOG)

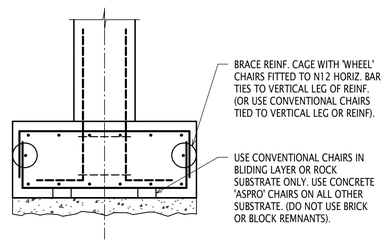


TYPICAL BORED PIER AT COLUMN (SUSPENDED)

TYPICAL UNCAPPED PIER DETAILS

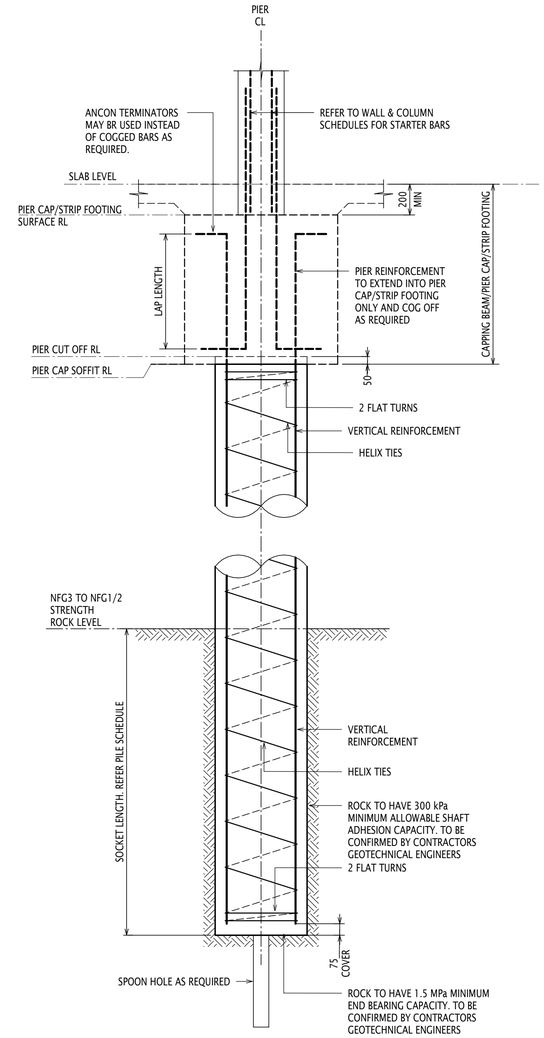


TYPICAL HYDRAULIC SERVICES CAST IN FOOTING DETAILS
SCALE 1:20

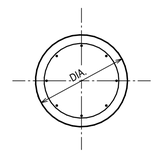


FOUNDATION REINFORCEMENT BRACING/COVER CONTROL
SCALE 1:20

NOTE: BAR STAKES INTO SIDE OF EXCAVATION ARE NOT TO BE USED AS CORROSION TO MAIN REINFORCEMENT WILL OCCUR

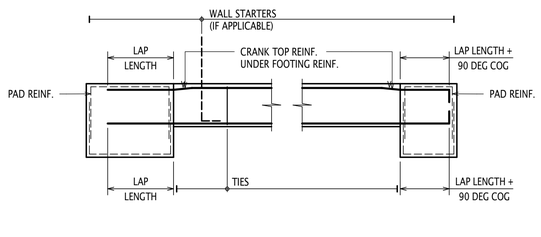


ELEVATION

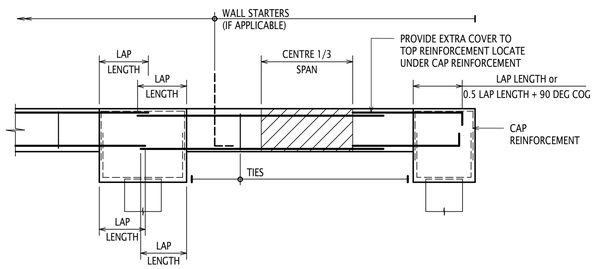


SECTION

TYPICAL BORED PIER DETAIL



TYPICAL STRIP FOOTING/TIE BEAM ELEVATION INTO PAD FOOTING
SCALE 1:50



TYPICAL STRIP FOOTING & GROUND BEAM ELEVATION INTO PILE CAPS
SCALE 1:50

PILE SCHEDULE

PILE MARK	PILE DIA (m)	SOCKET (m) 20MPa^	NFG3	NFG1/2	APPROX TOP OF SOCKET (RL)	APPROX PILE TOE (RL)	LINER SLEEVE LENGTH (m)	TOTAL PILE LENGTH (m)
P01(#), P12-P13(#)	1.2	7	-	-	-10	-17	N/A	7
P02-P04	1.2	-	3	5	-12	-20	N/A	10.1
P05-P11	1.2	-	3	5	-12	-20	N/A	11
P14-P18(*)	1.2	-	0	6.5	-27	-33.5	N/A	24.5
P19-P22	1.2	-	3	5	-11	-19	N/A	10
P23-P25	1.2	-	3.5	3	-10.5	-17	N/A	8
P26-P30(*)	1.2	-	0	5	-28	-33	N/A	24
P31-P35(*)	1.2	-	0	7.5	-28	-35.5	N/A	26.5
P36-P40(*)	1.2	-	0	11	-29	-40	N/A	31
P42	1.6	-	2	3	-11.3	-16.3	N/A	8.2
P42#	1.6	6	-	-	-8.6	-14.6	N/A	6
P43	1.6	-	2	2.5	-10.3	-14.8	N/A	6.7
P43#	1.6	6	-	-	-8.1	-14.1	N/A	6
P44	1.6	-	0	6.5	-16	-22.5	N/A	14.4
P45	0.9	-	1.5	0	-11.5	-13	N/A	6.2
P46#	0.9	4	-	-	-7.1	-11.1	N/A	4
P46*	0.9	-	1.5	0	-27	-28.5	N/A	21.4
P47*	1.6	-	0	6.5	-25	-31	N/A	22.9
P48*	1.6	-	0	6.5	-30	-36.5	N/A	28.4

PILE SCHEDULE NOTES:

1. WHERE NOTED BY '#' THE STATED SOCKET AND TOTAL PILE LENGTHS ASSUME SHAFT BACKFILL MATERIAL ACHIEVES EQUIVALENT CAPACITY TO NFG1/2 ROCK AND THAT NO VOIDS ARE PRESENT IN THE BACKFILL. LONGER LENGTHS ARE REQUIRED SHOULD BACKFILL MATERIAL BE FOUND TO BE UNSUITABLE. REFER TO GEOTECHNICAL REPORT FOR DETAILS.
2. WHERE NOTED BY '*' THE STATED SOCKET AND TOTAL PILE LENGTHS DO NOT CONSIDER THE ADIT BACKFILL AS SUITABLE OR EFFECTIVE FOUNDING MATERIAL. REFER TO GEOTECHNICAL REPORT FOR DETAILS.
3. SUBJECT TO GEOTECHNICAL INVESTIGATIONS. REFER GEOTECHNICAL REPORT.
4. CORE PILES P02-P04 & P13-P15 ARE SHORTER DUE TO LOCAL 2.9m PILE CAP THICKENING. COLUMN C02 PILES ARE SHORTER DUE TO 3m DEEP PILE CAP.
5. ^ DENOTES MINIMUM 20MPa CONCRETE BACKFILL.

PRINT DRAWINGS IN COLOUR

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FOUNDATION COVER SCHEDULE UNO

LOCATION/ELEMENT	COVER (mm)
PC3	60
PILE CAPS	60
PAD FOOTINGS & RAFT	60
FOUNDATION PILES	75

FOUNDATION CONCRETE STRENGTH SCHEDULE UNO

LOCATION/ELEMENT	CONCRETE MIX
PC3	CM651
RAFT OPTION	CM801
PC1, PC4	CM801
PC2, PC5	CM651
PF1, PF2	CM502
FOUNDATION PILES	CM801

NOTES:
1. REFER TO CONCRETE SPECIFICATION FOR MIX TYPES

FOUNDATION RATES SCHEDULE UNO

LOCATION/ELEMENT	REINF'T RATE [kg/m3]
PC3	200
PC1	200
PC4	275
PC2, PC5	150
PF1, PF2	175
PILES	
- CORE FOUNDATIONS	250
- COLUMN FOUNDATIONS	180
RAFT OPTION	200

Rev	Revision Description	By	App	Date
T05	ISSUED FOR TENDER	DS	MA	22.11.24
T04	ISSUED FOR TENDER	DS	MA	09.08.24
T03	ISSUED FOR TENDER	DS	MA	02.08.24
T02	ISSUED FOR TENDER	DS	MA	17.07.24
T01	ISSUED FOR TENDER	DS	MA	28.06.24
A01	80% DD DRAFT	DS	MA	07.06.24

SCALE 1 2 3 4 5 6 7 8

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ACN 010 580 248

Client
QIC

Project
101 ALBERT STREET, BRISBANE

Title
TYPICAL FOOTING DETAILS
SHEET 2

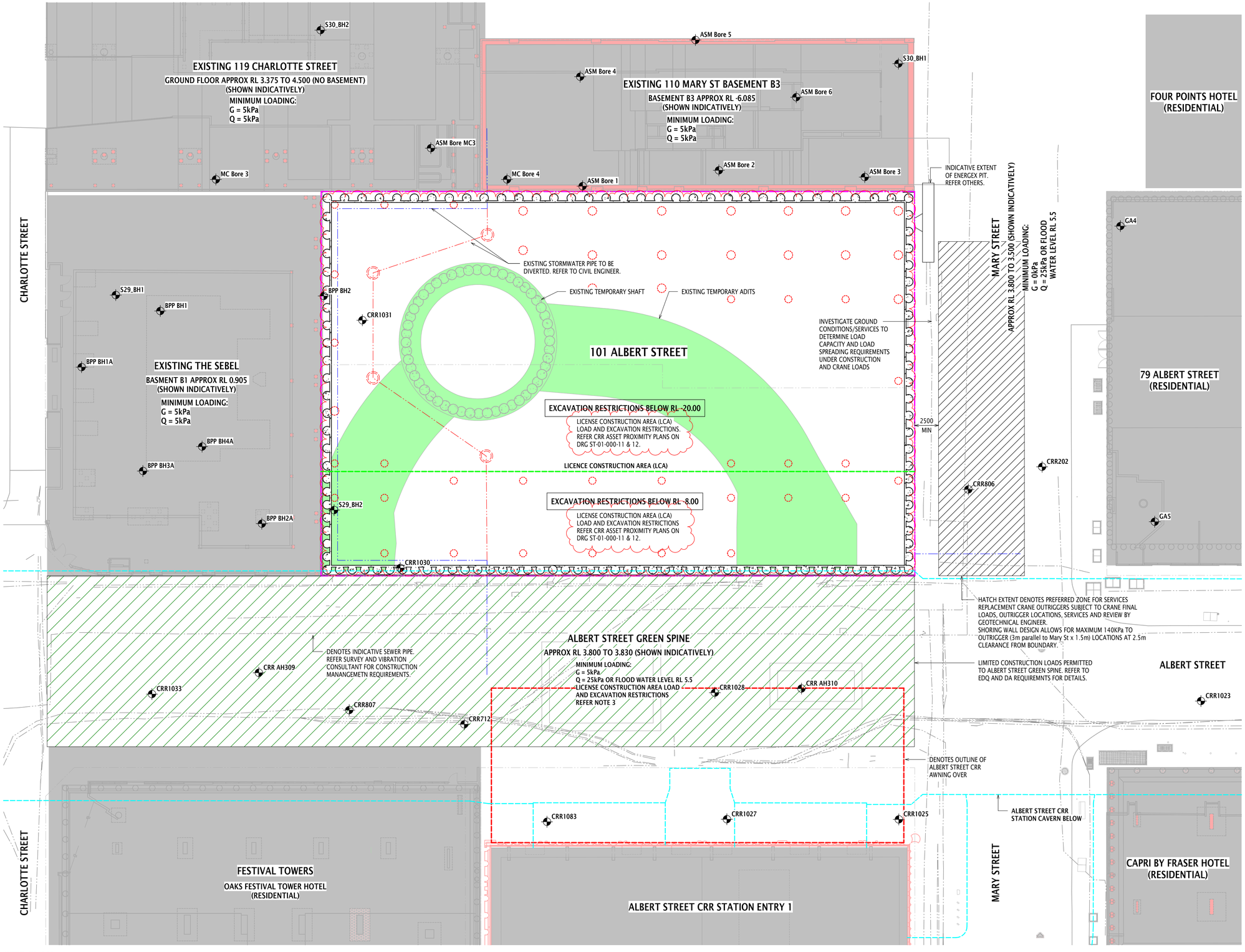
Date
Jun 2024
Scale at A1
1:20, 1:50

Drawn
D.STUCKEY
Designer
N.DOYLE/T.KATUNAR
Design Checker
-
Approved
M.AVERY

FOR TENDER - NOT FOR CONSTRUCTION

Drawing Number
ALB-RBG-DWG-ST-00-003-02

Revision
T05



SITE PLAN
SCALE 1 : 200

PRINT DRAWINGS IN COLOUR

LEGEND

- ??? GEOTECHNICAL INVESTIGATION POINTS. REFER TO EDG GEOTECHNICAL REPORT B01493-1AC DATED 16 NOVEMEBR 2022 FOR AVAILABLE GEOTECHNICAL INVESTIGATION DATA AND INTERPRETED GEOTECHNICAL PROFILES.
- DENOTES INDICATIVE NEIGHBORING BUILDING 110 MARY STREET EXISTING DIAPHRAGM WALL. REFER EXISTING BUILDING STRUCTURAL DRAWINGS FOR LOADS AND LEVELS.
- DENOTES INDICATIVE NEIGHBORING BUILDINGS THE SEBEL AND 119 CHARLOTTE STREET EXISTING PILES. ONLY PILES ADJACENT THE BOUNDARY SHOWN. REFER EXISTING BUILDING STRUCTURAL DRAWINGS FOR ALL PILES, LOADS AND LEVELS.
- DENOTES INDICATIVE TEMPORARY ACOUSTIC SHED PILES. REFER CRR MODELS FOR INFORMATION.
- DENOTES INDICATIVE TEMPORARY ACCESS SHAFT AND ADITS. REFER CRR MODELS FOR INFORMATION. TEMPORARY ROCK BOLTS AND ANCHORS NOT SHOWN.

NOTES

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL PROJECT DOCUMENTS INCLUDING BUT NOT LIMITED TO THE FOLLOWING:
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   b. GEOTECHNICAL REPORTS NOTED ON DRG ST-00-000-11.
   c. INSTRUMENTATION, VIBRATION AND MOVEMENT MONITORING REPORTS NOTED ON DRG ST-00-000-11.
   d. EDQ AND DA REQUIREMENTS NOTES ON DRG ST-00-000-11
   e. SHORING & RETENTION WALL NOTES ON DRG ST-00-000-12
   f. ROBERT BIRD GROUP CIVIL DRAWINGS.
2. RELIANCE INFORMATION SUCH AS, BUT NOT LIMITED TO, CROSS RIVER RAIL (CRR) DRAWINGS, MODELS, REPORTS AND DESIGN MANUALS, GEOTECHNICAL INFORMATION, GROUND WATER STUDIES, EXISTING SURVEY, EXISTING STRUCTURAL DRAWINGS ETC. IT IS THE CONTRACTOR'S RESPONSIBILITY TO VERIFY ALL RELIANCE INFORMATION ADOPTED IN THEIR CONTRUCTION METHODOLOGIES AND DESIGN OF D&C ELEMENTS.
3. ALL DESIGN LOAD, EXCAVATION, DISTORTION CRITERIA FOR THE CRR ALBERT STREET STATION CAVERN ARE TO BE STRICTLY FOLLOWED. THESE HAVE BEEN DISCUSSED IN THE RBG DESIGN CRITERIA REPORT ALB-RBG-REP-ST-00-000-01. THE CRITERIA INCLUDES SUCH ITEMS AS MAXIMUM EXCAVATION LEVELS, MAXIMUM DESIGN LOADS IN AND OUTSIDE OF THE PROJECT SITE, MINIMUM CLEARANCE DISTANCE FROM THE STATION CAVERN TO THE PROJECT EXCAVATION, MAXIMUM CHANGE IN STRESS 1m ABOVE THE STATION CROWN, MAXIMUM LOADS AT SURFACE LEVEL AND STATION CAVERN STRESS AND DISTORTION LIMITS ETC.
4. THE MINIMUM OF THE CRR ALBERT STREET STATION CAVERN LOAD CRITERIA AND GEOTECHNICAL CAPACITIES SHALL BE TAKEN FOR THE 101 ALBERT STREET DESIGN NOTING THAT IN SOME AREAS THE GEOTECHNICAL CAPACITY MAY GOVERN.
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11. REFER TO ROBERT BIRD GROUP CIVIL ENGINEER BUILK EARTHWORKS LAYOUT PLAN FOR DETAILS.
12. REFER TO THE ROBERT BIRD GROUP CIVIL ENGINEER FOR THE STORMWATER DIVERSION DETAILS.
13. REFER TO SERVICES CONSULTANT ADP FOR PLANT REMOVAL STRATEGY AND CRANE LOADS

Rev	Revision Description	By	App	Date
T02	ISSUED FOR TENDER	DS	MA	17.07.24
T01	ISSUED FOR TENDER	DS	MA	28.06.24
A02	80% DD DRAFT	DS	MA	07.06.24
A01	50% DD ISSUE	SV	MA	09.08.23
P01	DRAFT 50% DESIGN DEVELOPMENT	SV	MA	28.07.23

SCALE 1 2 3 4 5 6 7 8

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ACN 010 580 248

Client
QIC

Project
101 ALBERT STREET, BRISBANE

Title
SITE PLAN

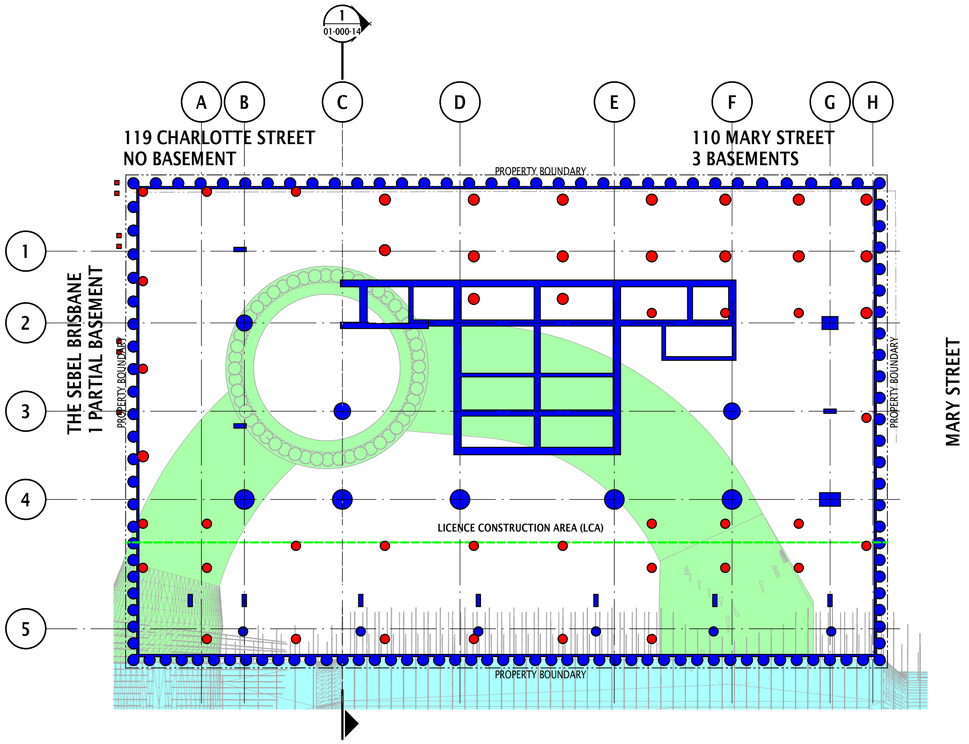
Date
Jun 2024
Scale at A1
1:200
Job Number
22131S

Drawn
D.STUCKEY
Designer
N.DOYLE/T.KATUNAR
Design Checker
-
Approved
M.AVERY

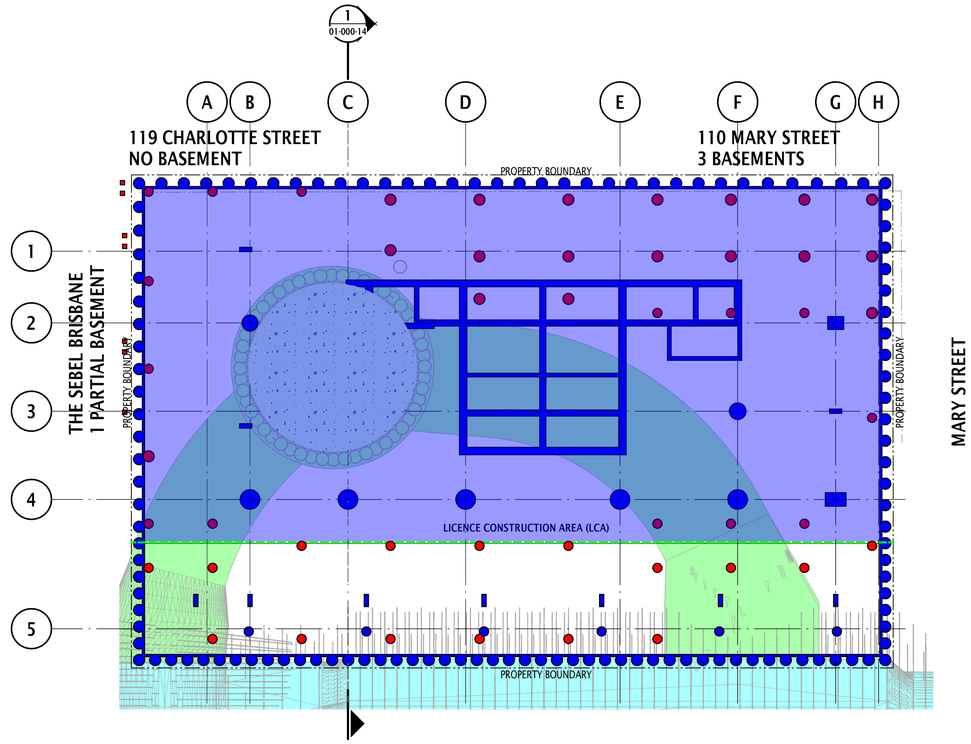
FOR TENDER - NOT FOR CONSTRUCTION

Drawing Number
ALB-RBG-DWG-ST-01-000-01

Revision
T02



CRR ASSET AND PROPOSED DEVELOPMENT
STRUCTURE PROXIMITY DIAGRAM - RL -5.2m
SCALE 1 : 250



CRR ASSET AND PROPOSED DEVELOPMENT
STRUCTURE PROXIMITY DIAGRAM - RL -8.0m
SCALE 1 : 250

PRINT DRAWINGS IN COLOUR

NOTES:

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   e. SHORING & RETENTION WALL NOTES ON DRG ST-00-000-12
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LEGEND:

- DENOTES CRR SHAFT AND ADIT STRUCTURE
- DENOTES CRR CAVERN STRUCTURE
- DENOTES CRR ACCOUSTIC SHED FOUNDATIONS
- DENOTES PROPOSED DEVELOPMENT STRUCTURE
- DENOTES BACKFILL TYPE A. REFER TO EDG GEOTECHNICAL REPORTS FOR BACKFILL DESCRIPTION.
- DENOTES BACKFILL TYPE B. REFER TO EDG GEOTECHNICAL REPORTS FOR BACKFILL DESCRIPTION.

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   b. DECOMMISSIONING, DEMOLITION AND REMOVAL OF THE FOLLOWING;
      - ALL ACOUSTIC SHED SUPERSTRUCTURE AND SUBSTRUCTURE INCLUDING PILE CAPS, PAD FOOTINGS, STRIP FOOTINGS, GROUND BEAMS AND SLABS.
      - THE TOP OF THE SHAFT INCLUDING THE TOP 1m OF SHAFT PILES;
      - THE TOP 1m OF ALL PILES ACROSS THE SITE;
      - ANY TEMPORARY INGROUND SERVICES SUCH AS SUMPS, TANKS, MANHOLES, ELECTRICAL, HYDRAULIC ETC;
      - DE-STRESSING OF ANY TEMPORARY ANCHORS; AND
      - QA AND ENGINEERING SIGN OFF COMPLETED.
   c. ENSURE NO CONTAMINATED MATERIAL DUE TO THE CRR WORKS REMAINS ONSITE INCLUDING CONTAMINATED SOIL BELOW THE ACOUSTIC SHED SLAB AND SERVICES STRUCTURE.
   d. THE DESIGN OF THE ALTERNATIVE RAFT FOUNDATION SYSTEM IS BASED ON THE TEMPORARY ACCESS SHAFT AND ADITS BEING BACKFILLED WITH 20MPa CONCRETE. THE ACTUAL BACKFILL MATERIAL WILL IMPACT ON THE FOUNDATION DESIGN AND NEEDS TO BE CONFIMED WITH CRR. THE PREFERRED BACKFILL MATERIAL AND METHODOLOGY WOULD INCLUDE THE FOLLOWING:
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Rev	Revision Description	By	App	Date
T01	ISSUED FOR TENDER	SV	MA	24.02.25

SCALE 1:1 | 2 | 3 | 4 | 5 | 6 | 7 | 8

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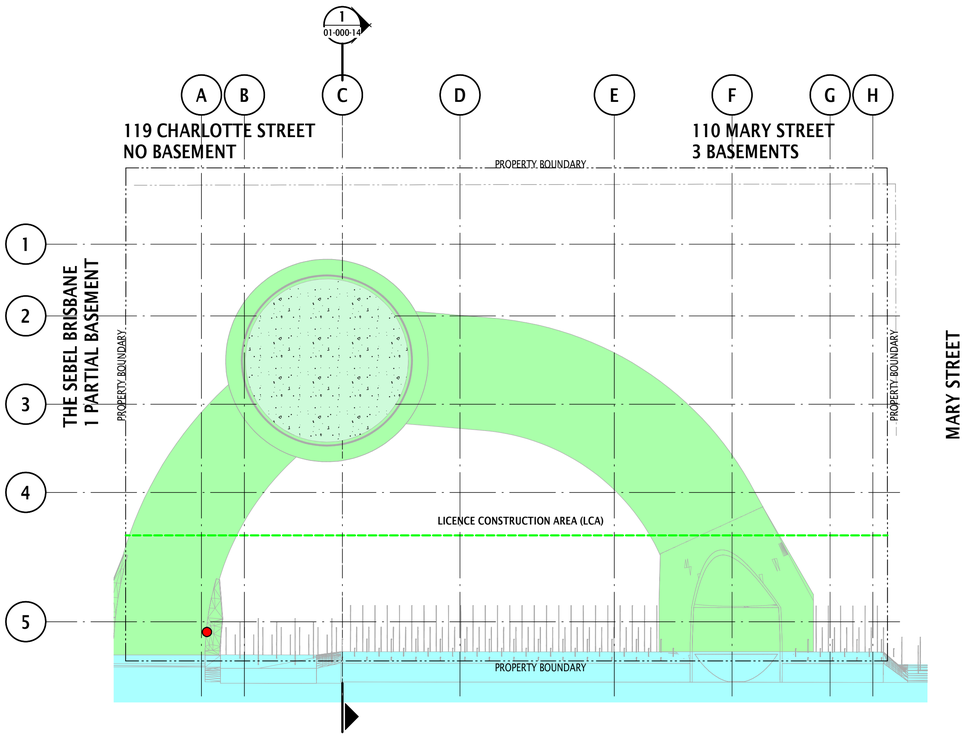
Title
CRR ASSET PROXIMITY PLANS
SHEET 3

Date	Drawn
Feb 2025	S.VINEY
Scale at A1	Designer
1:250	N.DOYLE/T.KATUNAR
	Design Checker
	-
	Approved
	M.AVERY

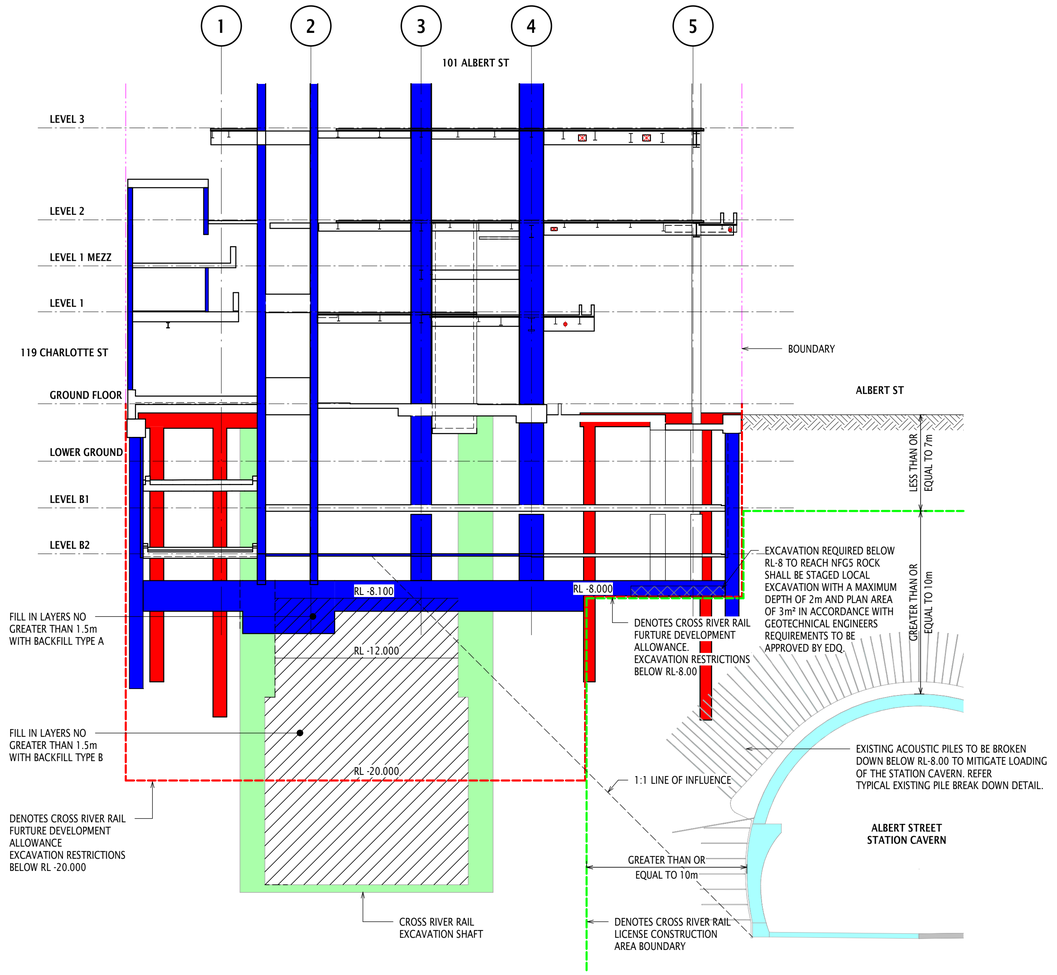
FOR TENDER - NOT FOR CONSTRUCTION

Drawing Number	Revision
ALB-RBG-DWG-ST-01-000-13	T01

PRINT DRAWINGS IN COLOUR



CRR ASSET AND PROPOSED DEVELOPMENT
STRUCTURE PROXIMITY DIAGRAM - RL -20.0m
SCALE 1 : 250



SECTION 1 (01-000-12)
SCALE 1 : 200

NOTES:

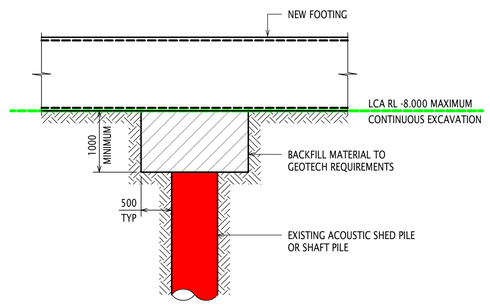
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Rev	Revision Description	By	App	Date
T01	ISSUED FOR TENDER	SV	MA	24.02.25

SCALE 1 2 3 4 5 6 7 8

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ACN 010 580 248

Client
QIC

Project
101 ALBERT STREET, BRISBANE

Title
CRR ASSET PROXIMITY PLANS
SHEET 4

Date
Feb 2025
Scale at A1
1:50, 1:200, 1:250

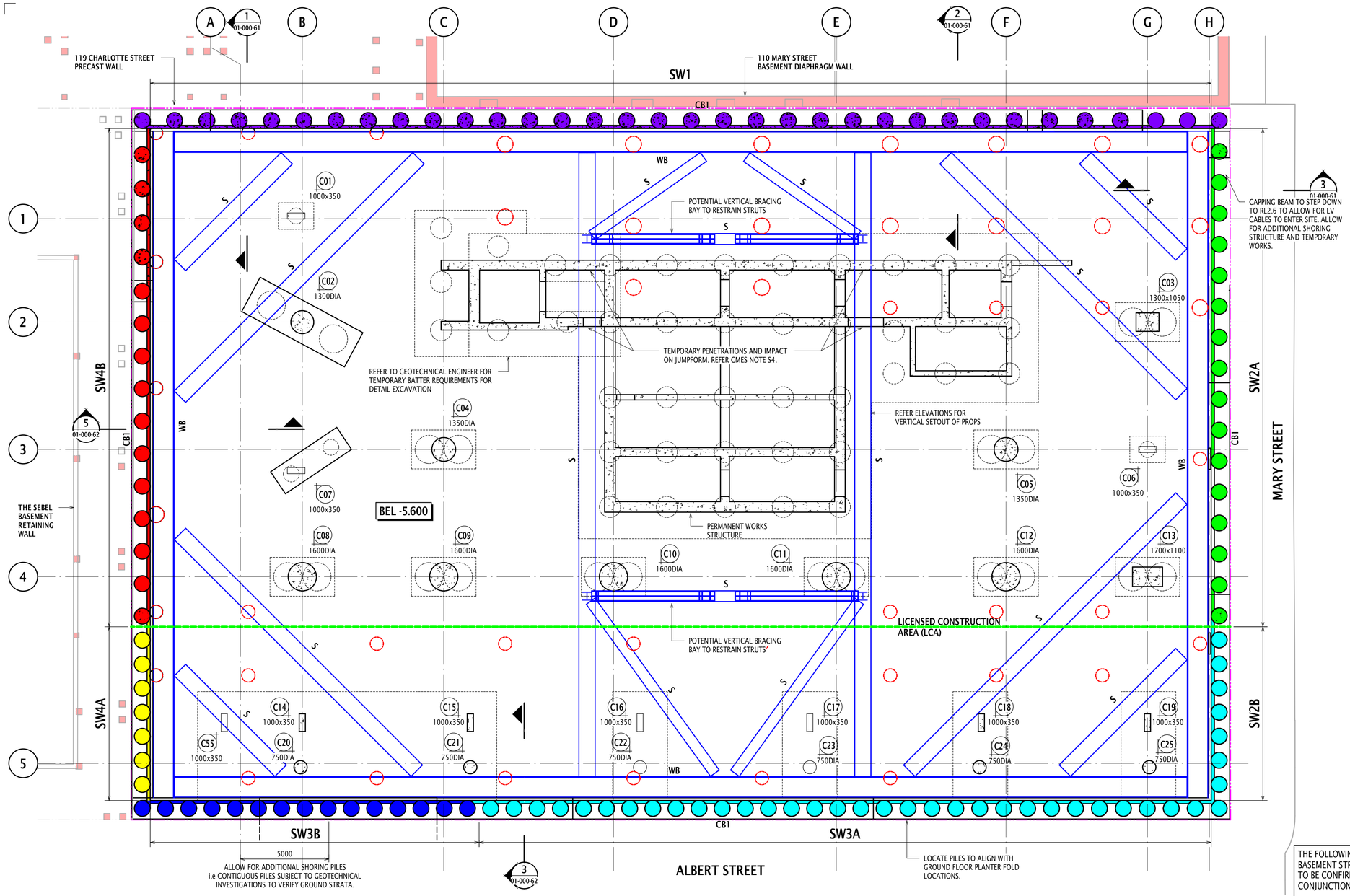
Drawn
S.VINEY
Designer
N.DOYLE/T.KATUNAR
Design Checker
-
Approved
M.AVERY

FOR TENDER - NOT FOR CONSTRUCTION

Drawing Number
ALB-RBG-DWG-ST-01-000-14

Revision
T01

PRINT DRAWINGS IN COLOUR



TEMPORARY SHORING AND RETENTION GENERAL ARRANGEMENT PLAN

SCALE 1 : 125

LEGEND:

BEL ?.???	DENOTES BULK EXCAVATION LEVEL
SW?	DENOTES SHORING WALL NUMBER AND DIRECTION ELEVATION IS VIEWED
BH?	DENOTES APPROX BOREHOLE LOCATION AND APPROXIMATE LEVEL OF LOW STRENGTH ROCK. REFER EDG CONSULTING GEOTECHNICAL REPORT B01493-1AC DATED 16 NOVEMBER 2022.
TAG / SIZE	DENOTES COLUMN NUMBER AND SIZE
S	DENOTES INDICATIVE STRUT. SIZE AND SET-OUT BY SHORING WALL D&C CONTRACTOR AND ENGINEER.
WB	DENOTES INDICATIVE WALER . SIZE AND SET-OUT BY SHORING WALL D&C CONTRACTOR AND ENGINEER.

SHORING & RETENTION SCHEDULE

TYPE	DESCRIPTION	COMMENTS
	REINFORCED 900Ø SOLDIER PILES AT 1800 CTRS + 250 SHOTCRETE	APPROXIMATE TOE LEVEL RL-14.000m OR 1m SOCKET INTO NFG3
	REINFORCED 900Ø SOLDIER PILES AT 1800 CTRS + 250THK SHOTCRETE	APPROXIMATE TOE LEVEL RL-10.500m OR 1m SOCKET INTO NFG3
	REINFORCED 900Ø SOLDIER PILES AT 1800 CTRS + 250THK SHOTCRETE	MAXIMUM TOE LEVEL RL-10.000m OR 2m SOCKET INTO NFG3
	REINFORCED 900Ø SOLDIER PILES AT 1800 CTRS + 250THK SHOTCRETE	MAXIMUM TOE LEVEL RL-10.000m OR 1m SOCKET INTO NFG3
	REINFORCED 900Ø SOLDIER PILES AT 1800 CTRS + 250THK SHOTCRETE	MAXIMUM TOE LEVEL RL-10.000m OR 2m SOCKET INTO NFG3
	REINFORCED 900Ø SOLDIER PILES AT 1800 CTRS + 250THK SHOTCRETE	APPROXIMATE TOE LEVEL RL-12.500m OR 1m SOCKET INTO NFG3

CAPPING BEAMS SCHEDULE

MARK	DEPTH	WIDTH	REINF RATE kg/m³
CB1	1200	1200	200
CB1	1250	1200	200
CB1	1300	1200	200
CB1	1325	1200	200
CB1	1350	1200	200
CB1	1550	1200	200

SHORING COVER SCHEDULE

LOCATION/ELEMENT	COVER (mm)
SOLDIER PILES	75
SHOTCRETE	
- RETAINING FACE	75
- INSIDE FACE	50
UNDERPINNING	75
CAPPING BEAM	
- RETAINING FACE	75
- OTHER FACES	75

SHORING CONCRETE STRENGTH SCHEDULE UNO

LOCATION/ELEMENT	CONCRETE MIX
SOLDIER PILES	CM503
SHOTCRETE	CM501
UNDERPINNING	CM502
CAPPING BEAM	CM502

NOTES:
1. REFER TO CONCRETE SPECIFICATION FOR MIX TYPES

SHORING TENDER RATES SCHEDULE UNO

LOCATION/ELEMENT	REINF'T RATE [kg/m3]
SOLDIER PILES	180
CAPPING BEAM	200
SHOTCRETE	150
UNDERPINNING	200

NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE FOLLOWING:
   a. SHORING & RETENTION WALL, TEMPORARY STRUT AND WALER, PILING NOTES ON DRG ST-00-000-12.
   b. SITE PLAN, LOADS AND NOTES ON DRG ST-01-000-01.
   c. CRR ASSET PROXIMITY PLANS ON DRG ST-01-000-11 & 12.
   d. GENERAL ARRANGEMENT PLANS ON DRG SERIES ST-08.
   e. REINFORCEMENT QUANTITY NOTES ON DRG ST-00-000-12.
   f. TYPICAL SHORING WALL DETAILS ON DRG ST-00-001-01.
2. THE SHORING AND RETENTION WALL IS PROPOSED TO BE TYPICALLY 900mm DIAMETER SOLDIER AND CONTIGUOUS PILES AND 250mm THICK SHOTCRETE INFILL PANELS. REFER SHORING & RETENTION SCHEDULE. TO BE CONFIRMED BY SHORING WALL D&C CONTRACTOR AND ENGINEER.
3. TEMPORARY SUPPORT TO THE SHORING AND RETENTION WALL IS PROPOSED VIA TWO LAYERS OF TEMPORARY INTERNAL STEELWORK STRUTS AND WALER BEAMS TO PROP THE SHORING WALL DUE TO THE SITE CONSTRAINTS AND ADJACENT EXISTING STRUCTURES AS DESCRIBED BELOW:
   - **110 MARY ST** -3 LEVELS OF BASEMENTS WITH DIAPHRAGM WALL BLOCK ALL ANCHORS
   - **THE SEBEL** - 1 BASEMENT SUPPORTED ON DRIVEN PILES. TEMPORARY ANCHORS WOULD NEED TO BE COORDINATED TO MISS THE SEBEL INGROUND STRUCTURE.
   - **ALBERT ST** - CRR LCA AND EXISTING SERVICES BELOW THE STREET LIMIT ZONES FOR TEMPORARY ANCHORS.
   - **MARY ST** - EXISTING SERVICES BELOW THE STREET LIMIT ZONES FOR TEMPORARY ANCHORS.

   THE 101 ALBERT STREET BASEMENT EXCAVATION SHALL NOT IMPACT ON THE NEIGHBORING BASEMENT DESIGN, CONDITION AND LOADING. INTRODUCTION OF OUT OF BALANCE LOADS TO THESE BASEMENTS IS TO BE AVOIDED.
4. THE SHORING AND RETENTION WALL, TEMPORARY STRUTS AND WALERS TO BE DESIGNED FOR THE CRITERIA SET OUT WITHIN THE RBG MOVEMENT AND TOLERANCE REPORT.
5. THE TEMPORARY STRUTS AND WALERS SHOWN ARE INDICATIVE ONLY AND REFLECT A POTENTIAL CONCEPT THAT HAS BEEN USED FOR THE DOCUMENTED SHORING WALL DESIGN. THE FINAL DESIGN AND SET-OUT TO BE CONFIRMED BY SHORING WALL D&C CONTRACTOR AND ENGINEER.
6. THE TEMPORARY STRUTS AND WALERS DESIGN TO CONSIDER THE FOLLOWING:
   - TEMPERATURE EFFECTS AND/OR EXTERNALLY INSULATED TO REDUCE THERMAL EFFECTS.
   - IMPACTS TO THE JUMPFORM AND FORMWORK, EXTENT/BUILD REQUIREMENTS INCLUDING WHETHER A TOP-DOWN METHODOLOGY IS ADOPTED NOTING STRUTS WILL NEED TO BE COORDINATED AROUND ANY BORED PIERS INSTALLED FROM EXISTING GROUND LEVEL, AND OTHER CONSTRUCTION RELATED ITEMS. CURRENTLY STRUTS ARE ONLY COORDINATED AROUND COLUMNS.
   - GROUNDWATER AND FLOOD LEVELS AS NOTED ON THE SITE PLAN. SENSITIVITY CASES SHALL BE CONSIDERED INCLUDING NO GROUND WATER, PARTIAL GROUNDWATER AND ASYMMETRIC GROUNDWATER.
   - THE GEOTECHNICAL ENGINEER IS TO ADVISE THE DEGREE OF PRE-LOADING FOR THE TEMPORARY STRUTS TO ACHIEVE THE DESIGN CRITERIA REQUIREMENTS.
7. ALL TEMPORARY STRUT AND WALER CONNECTIONS INCLUDING CONNECTIONS TO THE SHORING WALL TO BE DESIGNED BY THE SHORING WALL D&C CONTRACTOR AND ENGINEER.
8. ALL DEAD AND LIVE LOADS SHOWN ARE WORKING LOADS. ALL WIND AND EARTHQUAKE LOADS SHOWN ARE ULTIMATE LOADS. REFER LOAD LEGEND ON DRAWING ST-01-000-41.
9. ADDITIONAL TEMPORARY SHORING MAYBE REQUIRED TO CONSTRUCT THE LOWER CAPPING BEAM AT THE LV CABLE ENTRY POINT OFF MARY STREET. THIS MAY REQUIRED A THICKER SHORING ZONE FOR A LOCAL EXTENT OF THE SHORING WALL. TO BE CONFIMRED BY CONTRACTOR.
10. REFER TO ROBERT BIRD GROUP CIVIL ENGINEER BUILK EARTHWORKS LAYOUT PLAN FOR DETAILS.

Rev	Revision Description	By	App	Date
T03	ISSUED FOR TENDER	DS	MA	09.08.24
T02	ISSUED FOR TENDER	DS	MA	17.07.24
T01	ISSUED FOR TENDER	DS	MA	28.06.24
A02	80% DD DRAFT	DS	MA	07.06.24
A01	50% DD ISSUE	SV	MA	09.08.23
P01	DRAFT 50% DESIGN DEVELOPMENT	SV	MA	28.07.23

SCALE 1 2 3 4 5 6 7 8

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DO NOT SCALE DRAWINGS, USE FIGURED DIMENSIONS
REFER TO GENERAL NOTES UNLESS NOTED OTHERWISE

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ACN 010 580 248

Client
QIC

Project
101 ALBERT STREET, BRISBANE

Title
TEMPORARY SHORING AND RETENTION GENERAL ARRANGEMENT PLAN

Date
Jun 2024
Scale at A1
1:125
Job Number
22131S

Drawn
D.STUCKEY
Designer
N.DOYLE/T.KATUNAR
Design Checker
-
Approved
M.AVERY

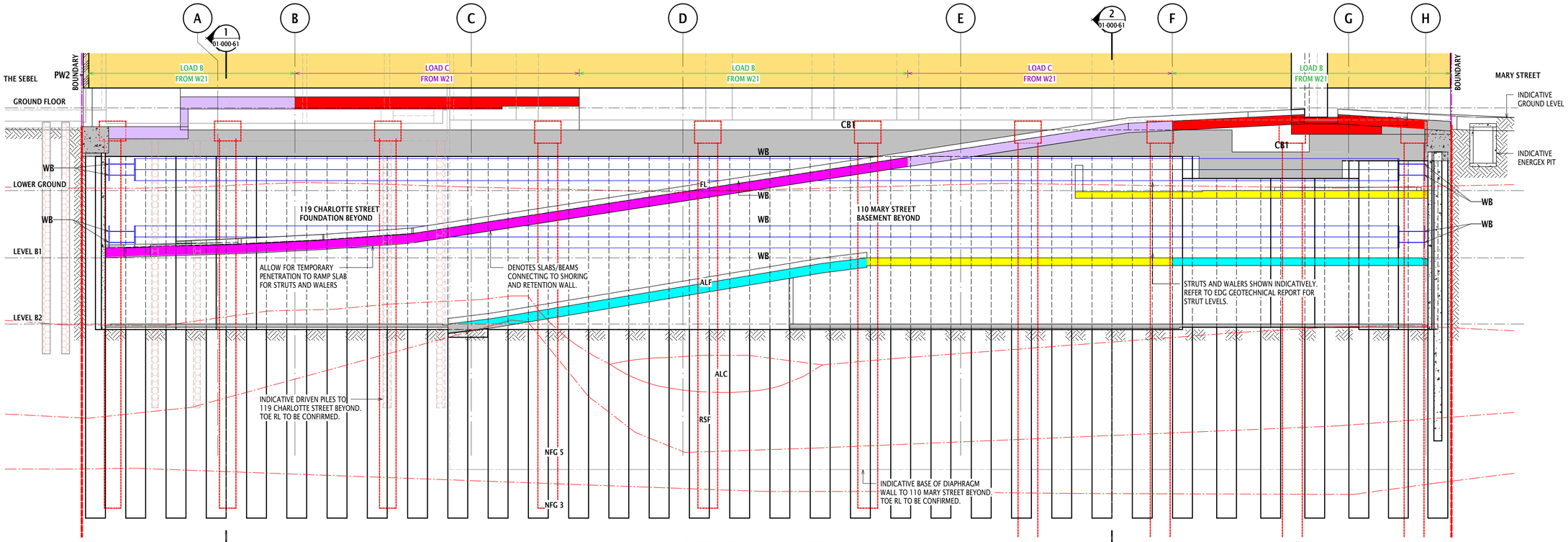
FOR TENDER - NOT FOR CONSTRUCTION

Drawing Number
ALB-RBG-DWG-ST-01-000-21

Revision
T03

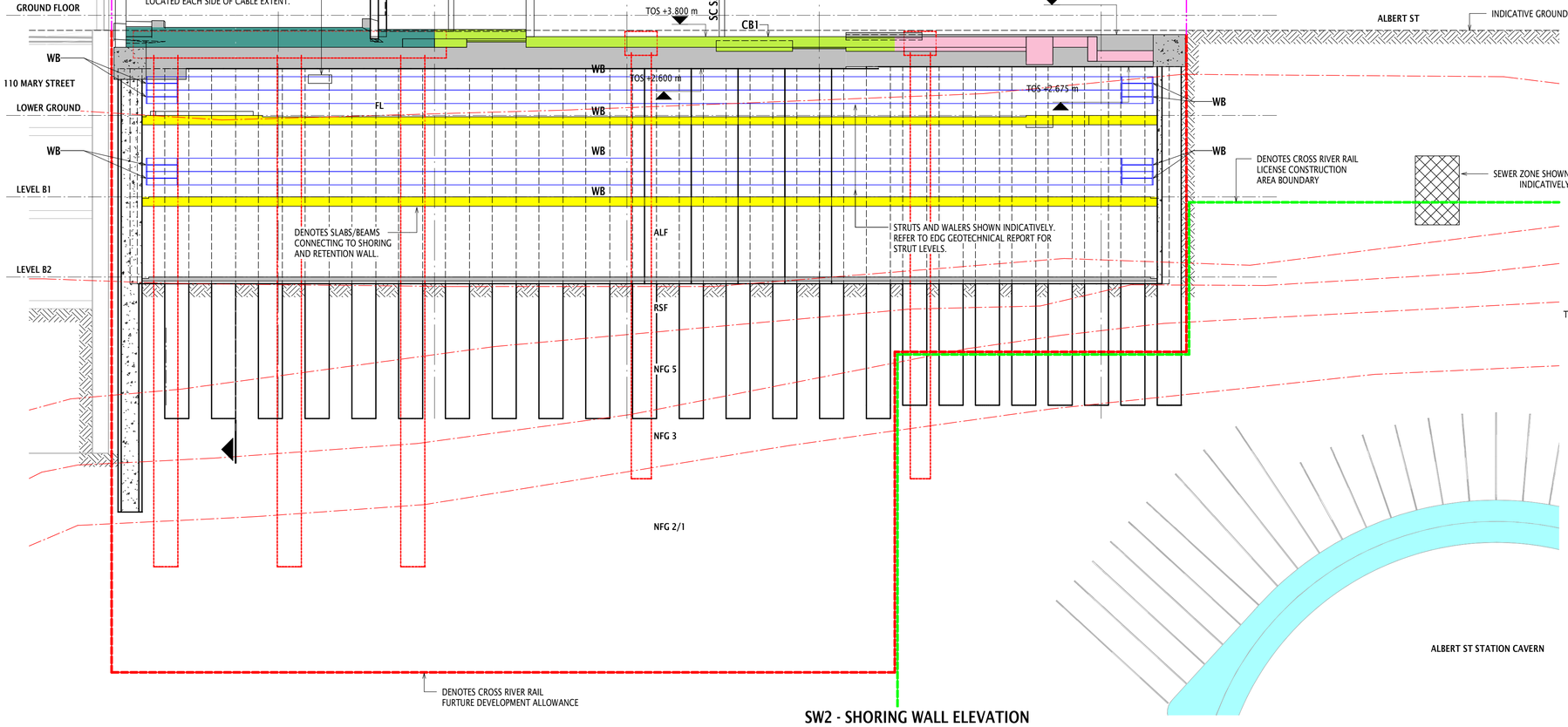
THE FOLLOWING INFORMATION IS BASED UPON A PARTIALLY HYDROSTATIC BASEMENT STRATEGY WITH HYDROSTATIC WALLS AND DRAINED BASEMENT B2 SLAB. TO BE CONFIRMED BY GEOTECHNICAL AND HYDRAULIC ENGINEERS. READ BELOW IN CONJUNCTION WITH THE CRR ASSET PROXIMITY PLANS ON DRG ST-01-000-11 & 12.

80%DD NOTE:
- THE SHORING WALL SYSTEM AND LEVEL OF WATER RESISTANCE TO BE REVIEWED AGAINST GROUNDWATER CONDITIONS ONCE CONFIRMED. ALTERNATIVE SYSTEMS MAY NEED TO BE INVESTIGATED.
- CURRENT SHORING WALL DESIGN ASSUMES THE WALL WILL BE TEMPORARILY DRAINED DURING CONSTRUCTION. TO BE CONFIRMED BY CONTRACTOR AND D&C PILING SUB-CONTRACTOR.
-THE SET-OUT OF SHORING WALL PILES AND CAPPING BEAM TO BE REVIEWED AGAINST NEIGHBORING BUILDING EXTENTS, ACCOUSTIC SHED PILES, OTHER INGROUND STRUCTURE AND PILING RIG CLEARANCES/ACCESS. PILE SIZES AND SET-OUT MAY NEED TO CHANGE TO SUIT. PILING RIG WITH CLOSE WALL APPLICATION CURRENTLY ASSUMED WITH 650mm CLEARANCE FROM BOUNDARY TO CENTER OF PILE.
-SHORING WALL TOE OF PILE LEVELS TO BE REVIEWED AGAINST BOREHOLE RESULTS ONCE COMPLETED.
- HYDRAULIC ENGINEER TO CONFIRM UNDER SLAB DRAINAGE REQUIREMENTS.
- CAPPING BEAM LEVELS SUBJECT TO CONFIRMATION OF GROUND LEVELS AND STRIP DRAIN AND DRAINAGE DESIGN.
- SHORING PILES HAVE BEEN SET-OUT WHERE POSSIBLE TO MINIMISE CLASHES WITH IN-GROUND CRR SUBSTRUCTURE INCLUDING THE TEMPORARY ACCESS SHAFT WALL, ADITS AND ACCOUSTIC SHED PILES.
- COORDINATION WORK IS BASED UPON AVAILABLE CRR INFORMATION AT THE TIME OF THIS DOCUMENT ISSUE. THE LOCATION AND SIZE OF CRR ASSETS ARE INDICATIVE ONLY AND TO BE CONFIRMED.
- NOT ALL EXISTING IN-GROUND STRUCTURE HAS BEEN SHOWN INCLUDING, BUT NOT LIMITED TO TEMPORARY ROCK BOLTS AND ANCHORS. SHORING PILES HAVE NOT BEEN POSITIONED TO MISS ROCK BOLTS AND ANCHORS AND THEREFORE THE CONTRACTOR IS TO MAKE ALLOWANCE FOR DRILLING THROUGH EXISTING IN-GROUND STRUCTURE.
- 914CHS STRUTS AND TWIN 1200WB WALERS HAVE BEEN ASSUMED IN THE CURRENT GEOTECHNICAL MODELS TO ACHIEVE THE MOVEMENT CRITERIA OUTLINED IN THE RBG MOVEMENT AND TOLERANCE REPORT. TO BE CONFIRMED BY D&C CONTRACTOR.



SW1 - SHORING WALL ELEVATION

SCALE 1 : 100



UPSTAND LOADS	
LOAD	P_Z
G	300kN
Q	150kN
E_2	0mm

UPSTAND LOADS	
LOAD	P_Z
G	150kN
Q	0kN
E_2	0mm

COLUMN LOADS	
LOAD	P_Z
G	850kN
Q	200kN
E_2	450mm

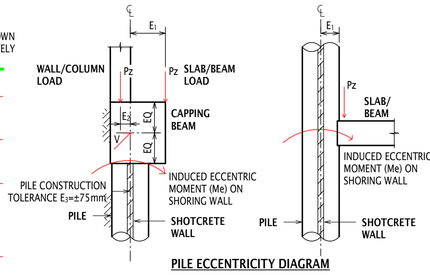
SW2 - SHORING WALL ELEVATION

SCALE 1 : 100

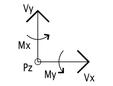
WALL/SLAB/BEAM Pz LOADS

	A	B	C	D	E	F	G
G (kN/m)	100	330	610	120	180	20	50
Q (kN/m)	60	70	170	30	40	20	20
E (mm)	400	-400	-400	-425	-425	450	450
	H	I	J	K	L	M	
G (kN/m)	100	70	80	90	160	100	
Q (kN/m)	60	10	20	40	60	20	
E (mm)	450	600	600	600	600	425	

SLAB/BEAM LOAD NOTES:
1. SLAB/BEAM LOAD INCLUDES SELF WEIGHT OF CAPPING BEAM AND SELF WEIGHT OF WALLS ABOVE GROUND FLOOR.
2. SLAB/BEAM LOAD EXCLUDES SELF WEIGHT OF SHORING WALL.
3. THE SELF WEIGHT OF THE SHORING WALL CAN BE TAKEN AS 15 kPa WITH RESPECT TO THE HEIGHT OF THE WALL. THIS IS BASED ON 900D PILES AT 1.8 M CENTRES WITH A 250THK SHOTCRETE INFILL.
4. FOR POSITIVE ECCENTRICITIES, LOADS SHALL BE APPLIED IN THE DIRECTION OF "E1".
5. FOR NEGATIVE ECCENTRICITIES, LOADS SHALL BE APPLIED IN THE DIRECTION OF "E2".



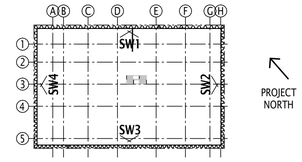
PILE ECCENTRICITY DIAGRAM



FORCE DIRECTION UNO

Pz DENOTES VERTICAL LOAD
Vx DENOTES HORIZONTAL LOAD APPLIED IN X DIRECTION
Vy DENOTES HORIZONTAL LOAD APPLIED IN Y DIRECTION
Mx DENOTES MOMENTS IN X DIRECTION
My DENOTES MOMENTS IN Y DIRECTION

FORCE DIRECTION ORIENTATED TO PROJECT NORTH



KEY PLAN (B1)
SCALE 1 : 1000

PRINT DRAWINGS IN COLOUR

NOTES:
1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE FOLLOWING:
   a. SITE PLAN, LOADS AND NOTES ON DRG ST-01-000-01.
   b. CRR ASSET PROXIMITY PLANS ON DRG ST-01-000-11 & 12.
   c. TEMPORARY SHORING AND RETENTION GENERAL ARRANGEMENT PLAN ON DRG ST-01-000-21.
2. PILE DESIGN SHALL BE BASED ON ZERO FIXITY BETWEEN PILES AND SLABS/BEAMS AND ALLOW FOR MOMENTS DUE TO ECCENTRICITY OF ALL APPLIED LOADS.
3. DESIGN ACTIONS ARE TO BE COMBINED IN ACCORDANCE WITH AS1170.0 TO PRODUCE THE MOST ADVERSE EFFECT.
4. DEAD, LIVE, WATER AND SOIL LOADS ARE PROVIDED UNFACTORED. SEISMIC AND WIND LOADS ARE PROVIDED AT ULTIMATE.
5. SEISMIC AND WIND LOADS ARE FULLY REVERSIBLE.
6. PILE DESIGN SHALL ALLOW FOR ECCENTRICITY OF APPLIED LOADS. ECCENTRICITIES SHALL BE COMBINED TO PRODUCE THE MOST ADVERSE EFFECT. ECCENTRICITIES TO BE CONFIRMED ONCE EXACT SHORING WALL SETOUT HAS BEEN CO-ORDINATED WITH ARCHITECT.
7. REFER TO ROBERT BIRD GROUP CIVIL ENGINEER BULK EARTHWORKS LAYOUT PLAN DRAWING CW8201 FOR DETAILS.
8. REFER ARCHITECTS FOR FINISHED GROUND LEVELS.

GEOTECHNICAL GROUND PROFILES NOTES:
1. GEOTECHNICAL PROFILES ARE TAKEN FROM EDG GEOTECHNICAL REPORTS NOTED ON DRG ST-00-000-11.
2. SOIL/ROCK PROFILES INDICATED ON THESE DRAWINGS ARE AN APPROXIMATION ONLY BASED ON INTERPOLATION BETWEEN BOREHOLE SOIL/ROCK LEVELS TAKEN AROUND THE SITE AS PER NOTE 1. ACTUAL ROCK LEVELS ON SITE ARE EXPECTED TO VARY.
3. SOIL/ROCK PROFILES MUST BE CONFIRMED PRIOR TO CONSTRUCTION WITH SITE SPECIFIC BOREHOLES WHICH ARE TO BE SUBMITTED TO THE DESIGNER AND BASE ENGINEER ROBERT BIRD GROUP FOR VERIFICATION OF DESIGN.
4. PILE TOE RL AND ROCK BOLT LENGTHS TO BE CONFIRMED ONCE GEOTECHNICAL ENGINEERS SUBMIT TO ROBERT BIRD GROUP ACTUAL SOIL/ROCK PROFILE RL'S WHEN GEOTECHNICAL MAPPING OCCURS AS CONSTRUCTION EXCAVATION PROCEEDS.

SHORING WALL IN-PLANE LATERAL LOAD SCHEDULE

SHORING WALL	V_CB [kN]		V_OT [kN]
	W	EQ	-
SW1	3,300	16,100	3,000
SW2	7,200	5,200	1,300
SW3	3,100	4,700	1,100
SW4	6,400	7,800	1,100

NOTES:
1. V_CB DENOTES IN PLANE SHEAR APPLIED AT CAPPING BEAM LEVEL.
2. V_OT DENOTES IN PLANE SHEAR TO APPLY AT OTHER LEVELS FOR THE PURPOSES OF DESIGNING SLAB CONNECTIONS ONLY. NOT INTENDED TO PRODUCE ANY DESIGN ACTIONS IN SHORING WALL AND SHOULD NOT BE ADDED TO V_CB.
3. LOADS PRESENTED ARE TOTAL LOADS ACROSS FULL LENGTH OF SHORING WALL.

Rev	Revision Description	By	App	Date
T04	ISSUED FOR TENDER	DS	MA	03.09.24
T03	ISSUED FOR TENDER	DS	MA	09.08.24
T02	ISSUED FOR TENDER	DS	MA	17.07.24
T01	ISSUED FOR TENDER	DS	MA	28.06.24
A02	80% DD DRAFT	DS	MA	07.06.24
A01	50% DD ISSUE	SV	MA	09.08.23
P01	DRAFT 50% DESIGN DEVELOPMENT	SV	MA	28.07.23

SCALE 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8

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Client
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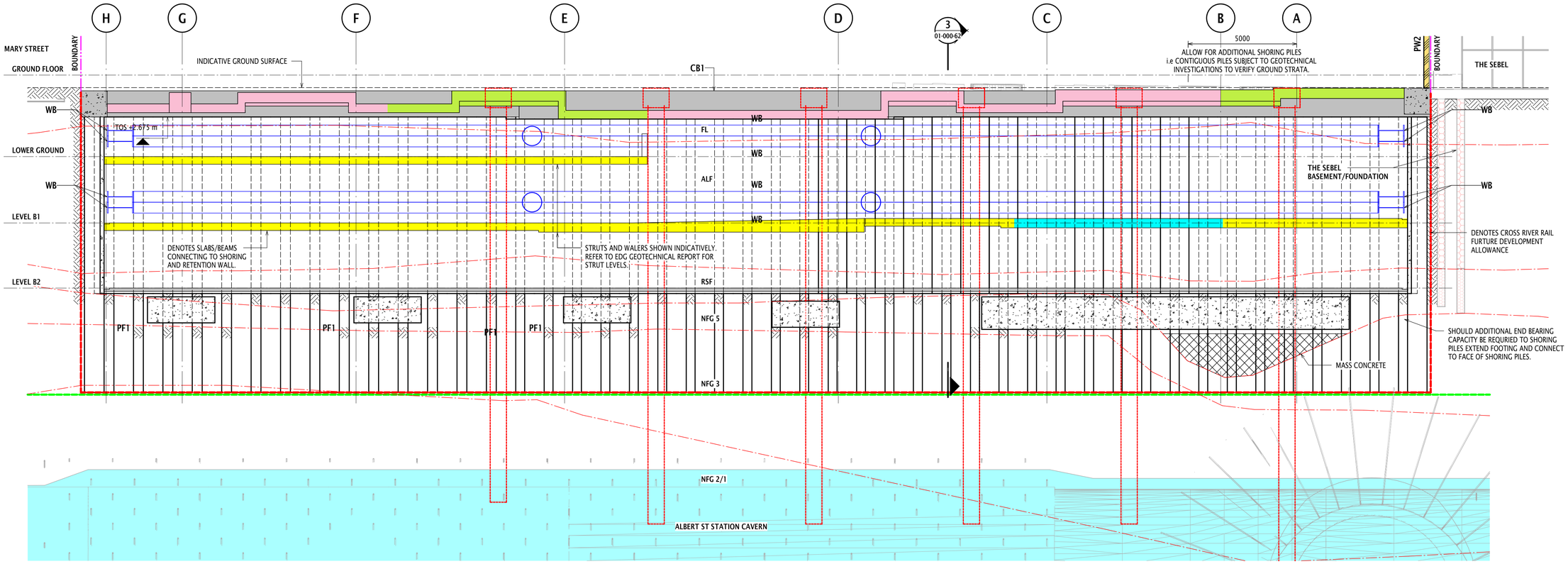
Project
101 ALBERT STREET, BRISBANE

Title
SHORING ELEVATIONS
SHEET 1

Date
Jun 2024
Scale at A1
1:100, 1:1000
Drawn
D.STUCKEY
Designer
N.DOYLE/T.KATUNAR
Design Checker
-
Job Number
22131S
Approved
M.AVERY

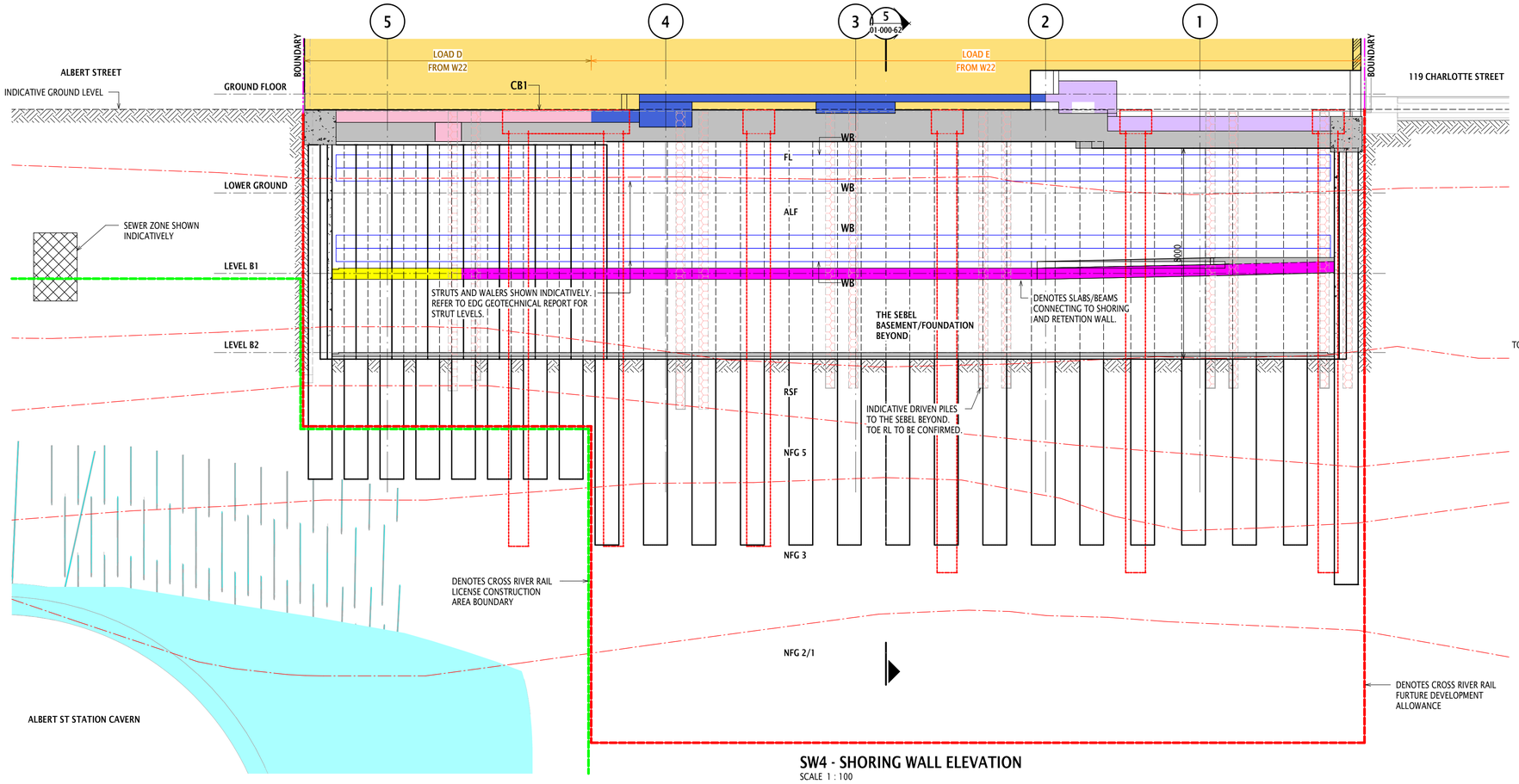
FOR TENDER - NOT FOR CONSTRUCTION

Drawing Number
ALB-RBG-DWG-ST-01-000-41
Revision
T04



SW3 - SHORING WALL ELEVATION

SCALE 1 : 100



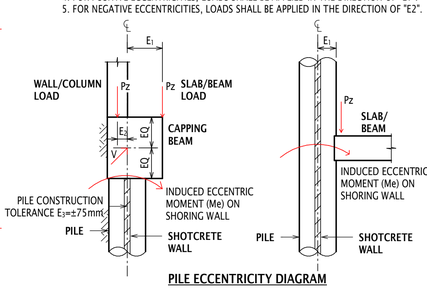
SW4 - SHORING WALL ELEVATION

SCALE 1 : 100

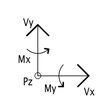
WALL/SLAB/BEAM Pz LOADS

	A	B	C	D	E	F	G
G (kN/m)	100	330	610	120	180	20	50
Q (kN/m)	60	70	170	30	40	20	20
E (mm)	400	-400	-400	-425	-425	450	450
	H	I	J	K	L	M	
G (kN/m)	100	70	80	90	160	100	
Q (kN/m)	60	10	20	40	60	20	
E (mm)	450	600	600	600	600	425	

SLAB/BEAM LOAD NOTES:
1. SLAB/BEAM LOAD INCLUDES SELF WEIGHT OF CAPPING BEAM AND SELF WEIGHT OF WALLS ABOVE GROUND FLOOR.
2. SLAB/BEAM LOAD EXCLUDES SELF WEIGHT OF SHORING WALL.
3. THE SELF WEIGHT OF THE SHORING WALL CAN BE TAKEN AS 15 kPa WITH RESPECT TO THE HEIGHT OF THE WALL. THIS IS BASED ON 900D PILES AT 1.8 M CENTRES WITH A 250THK SHOTCRETE INFILL.
4. FOR POSITIVE ECCENTRICITIES, LOADS SHALL BE APPLIED IN THE DIRECTION OF "E1".
5. FOR NEGATIVE ECCENTRICITIES, LOADS SHALL BE APPLIED IN THE DIRECTION OF "E2".



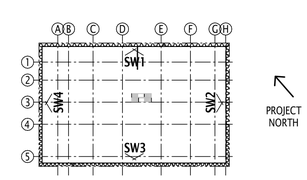
PILE ECCENTRICITY DIAGRAM



FORCE DIRECTION UNO

Pz DENOTES VERTICAL LOAD
Vx DENOTES HORIZONTAL LOAD APPLIED IN X DIRECTION
Vy DENOTES HORIZONTAL LOAD APPLIED IN Y DIRECTION
Mx DENOTES MOMENTS IN X DIRECTION
My DENOTES MOMENTS IN Y DIRECTION

FORCE DIRECTION ORIENTATED TO PROJECT NORTH



KEY PLAN (B1)
SCALE 1 : 1000

PRINT DRAWINGS IN COLOUR

NOTES:
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   a. SITE PLAN, LOADS AND NOTES ON DRG ST-01-000-01.
   b. CRR ASSET PROXIMITY PLANS ON DRG ST-01-000-11 & 12.
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4. DEAD, LIVE, WATER AND SOIL LOADS ARE PROVIDED UNFACTORED. SEISMIC AND WIND LOADS ARE PROVIDED AT ULTIMATE.
5. SEISMIC AND WIND LOADS ARE FULLY REVERSIBLE.
6. PILE DESIGN SHALL ALLOW FOR ECCENTRICITY OF APPLIED LOADS. ECCENTRICITIES SHALL BE COMBINED TO PRODUCE THE MOST ADVERSE EFFECT. ECCENTRICITIES TO BE CONFIRMED ONCE EXACT SHORING WALL SETOUT HAS BEEN CO-ORDINATED WITH ARCHITECT.
7. REFER TO ROBERT BIRD GROUP CIVIL ENGINEER BULK EARTHWORKS LAYOUT PLAN DRAWING CW8201 FOR DETAILS.
8. REFER ARCHITECTS FOR FINISHED GROUND LEVELS.

GEOTECHNICAL GROUND PROFILES NOTES:
1. GEOTECHNICAL PROFILES ARE TAKEN FROM EDG GEOTECHNICAL REPORTS NOTED ON DRG ST-00-000-11.
2. SOIL/ROCK PROFILES INDICATED ON THESE DRAWINGS ARE AN APPROXIMATION ONLY BASED ON INTERPOLATION BETWEEN BOREHOLE SOIL/ROCK LEVELS TAKEN AROUND THE SITE AS PER NOTE 1. ACTUAL ROCK LEVELS ON SITE ARE EXPECTED TO VARY.
3. SOIL/ROCK PROFILES MUST BE CONFIRMED PRIOR TO CONSTRUCTION WITH SITE SPECIFIC BOREHOLES WHICH ARE TO BE SUBMITTED TO THE DESIGNER AND BASE ENGINEER ROBERT BIRD GROUP FOR VERIFICATION OF DESIGN.
4. PILE TOE RL AND ROCK BOLT LENGTHS TO BE CONFIRMED ONCE GEOTECHNICAL ENGINEERS SUBMIT TO ROBERT BIRD GROUP ACTUAL SOIL/ROCK PROFILE RL'S WHEN GEOTECHNICAL MAPPING OCCURS AS CONSTRUCTION EXCAVATION PROCEEDS.

SHORING WALL IN-PLANE LATERAL LOAD SCHEDULE

SHORING WALL	V_CB [kN]		V_OT [kN]
	W	EQ	-
SW1	3,300	16,100	3,000
SW2	7,200	5,200	1,300
SW3	3,100	4,700	1,100
SW4	6,400	7,800	1,100

NOTES:
1. V_CB DENOTES IN PLANE SHEAR APPLIED AT CAPPING BEAM LEVEL.
2. V_OT DENOTES IN PLANE SHEAR TO APPLY AT OTHER LEVELS FOR THE PURPOSES OF DESIGNING SLAB CONNECTIONS ONLY. NOT INTENDED TO PRODUCE ANY DESIGN ACTIONS IN SHORING WALL AND SHOULD NOT BE ADDED TO V_CB.
3. LOADS PRESENTED ARE TOTAL LOADS ACROSS FULL LENGTH OF SHORING WALL.

Rev	Revision Description	By	App	Date
T04	ISSUED FOR TENDER	DS	MA	03.09.24
T03	ISSUED FOR TENDER	DS	MA	09.08.24
T02	ISSUED FOR TENDER	DS	MA	17.07.24
T01	ISSUED FOR TENDER	DS	MA	28.06.24
A02	80% DD DRAFT	DS	MA	07.06.24
A01	50% DD ISSUE	SV	MA	09.08.23
P01	DRAFT 50% DESIGN DEVELOPMENT	SV	MA	28.07.23

SCALE 1 : 1 : 2 : 3 : 4 : 5 : 6 : 7 : 8

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Client
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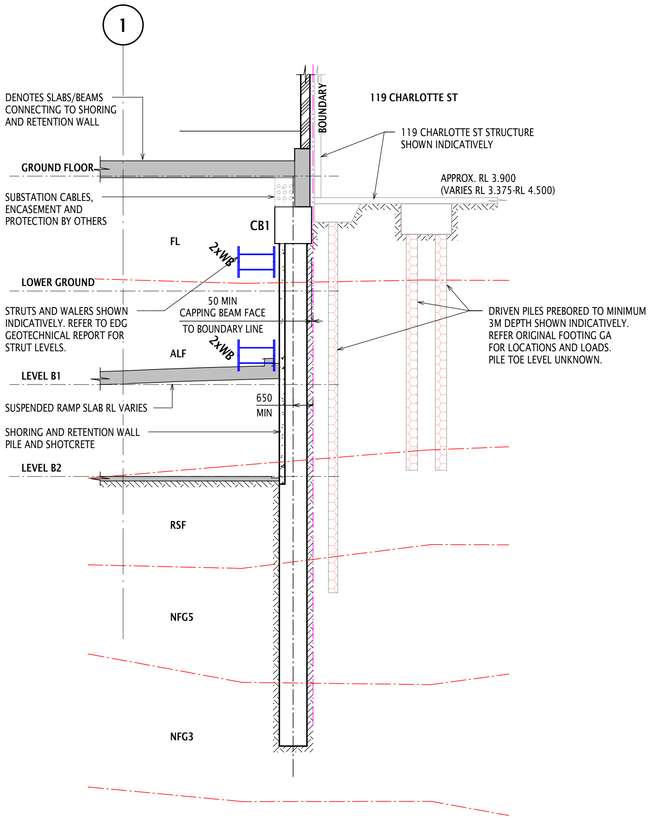
Project
101 ALBERT STREET, BRISBANE

Title
SHORING ELEVATIONS
SHEET 2

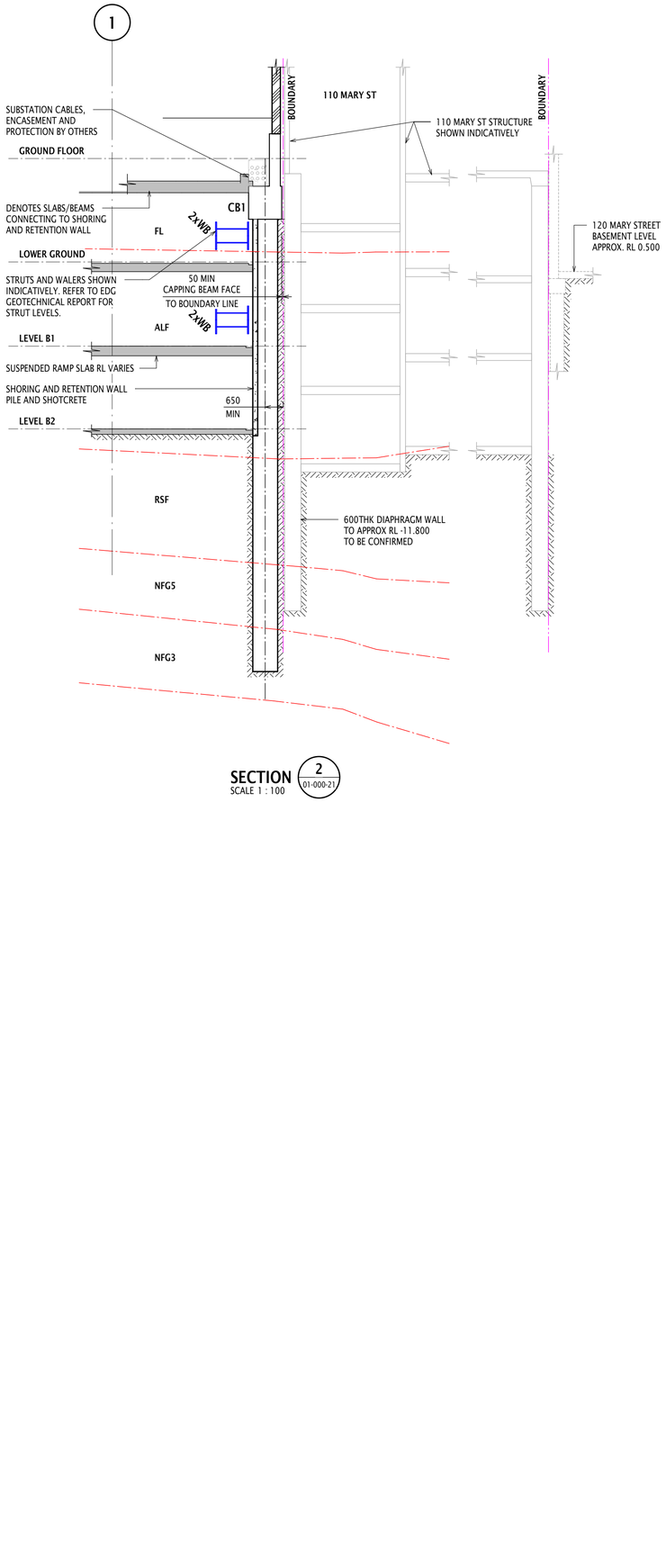
Date
Jun 2024
Scale at A1
1:100, 1:1000
Drawn
D.STUCKEY
Designer
N.DOYLE/T.KATUNAR
Design Checker
-
Job Number
22131S
Approved
M.AVERY

FOR TENDER - NOT FOR CONSTRUCTION

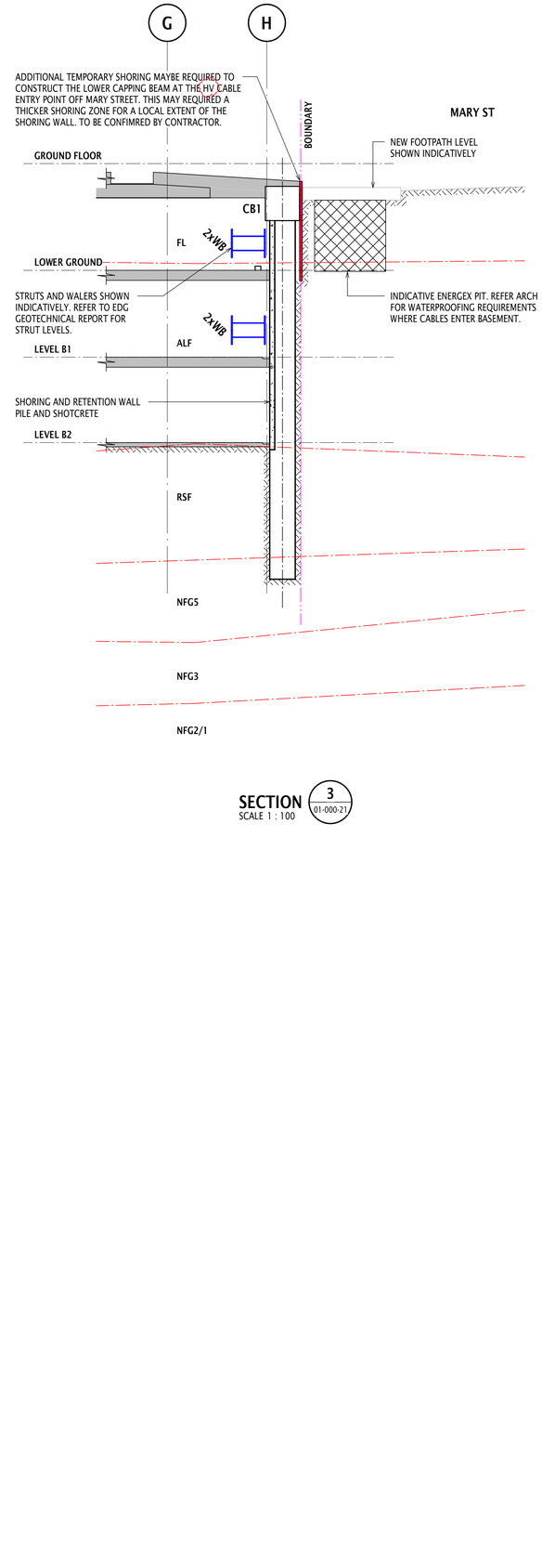
Drawing Number
ALB-RBG-DWG-ST-01-000-42
Revision
T04



SECTION 1 / 01-000-21
SCALE 1 : 100



SECTION 2 / 01-000-21
SCALE 1 : 100



SECTION 3 / 01-000-21
SCALE 1 : 100

PRINT DRAWINGS IN COLOUR

NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE FOLLOWING:
   a. SITE PLAN, LOADS AND NOTES ON DRG ST-01-000-01.
   b. CRR ASSET PROXIMITY PLANS ON DRG ST-01-000-11 & 12.
   c. TEMPORARY SHORING AND RETENTION GENERAL ARRANGEMENT PLAN ON DRG ST-01-000-21.
   d. SHORING ELEVATIONS ON DRG ST-01-000-41 & 42.
2. EXISTING BUILDING FOOTING RL'S ARE APPROXIMATE. TO BE CONFIRMED ON SITE.
3. EXISTING BUILDING LOADS, SETOUT AND GEOMETRY HAVE BEEN BASED ON THE AVAILABLE HISTORIC DRAWINGS AND ARE APPROXIMATE ONLY. RBG CANNOT CONFIRM THE ACCURACY OF THESE DRAWINGS, WHETHER THEY REFLECT THE AS-BUILT STRUCTURES OR WHETHER THE STRUCTURES HAVE BEEN UNKNOWINGLY MODIFIED LATER. DETAILED SURVEY REQUIRED TO VERIFY.
4. REFER TO EXISTING BUILDING STRUCTURAL DRAWINGS FOR NEIGHBORING BUILDING PILES LOADS AND LEVELS.
5. REFER TO ARCHITECTS FOR ALL FLOOR AND GROUND LEVELS.

80% DD NOTE:

- THE SHORING WALL SYSTEM AND LEVEL OF WATER RESISTANCE TO BE REVIEWED AGAINST GROUNDWATER CONDITIONS ONCE CONFIRMED. ALTERNATIVE SYSTEMS MAY NEED TO BE INVESTIGATED.
- GROUNDWATER LEVELS HAVE NOT BE SHOWN DUE TO INSUFFICIENT INFORMATION. TO BE CONFIRMED ONSITE.

Rev	Revision Description	By	App	Date
T02	ISSUED FOR TENDER	DS	MA	17.07.24
T01	ISSUED FOR TENDER	DS	MA	28.06.24
A01	80% DD DRAFT	DS	MA	07.06.24

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Project
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Title
SHORING SECTIONS
SHEET 1

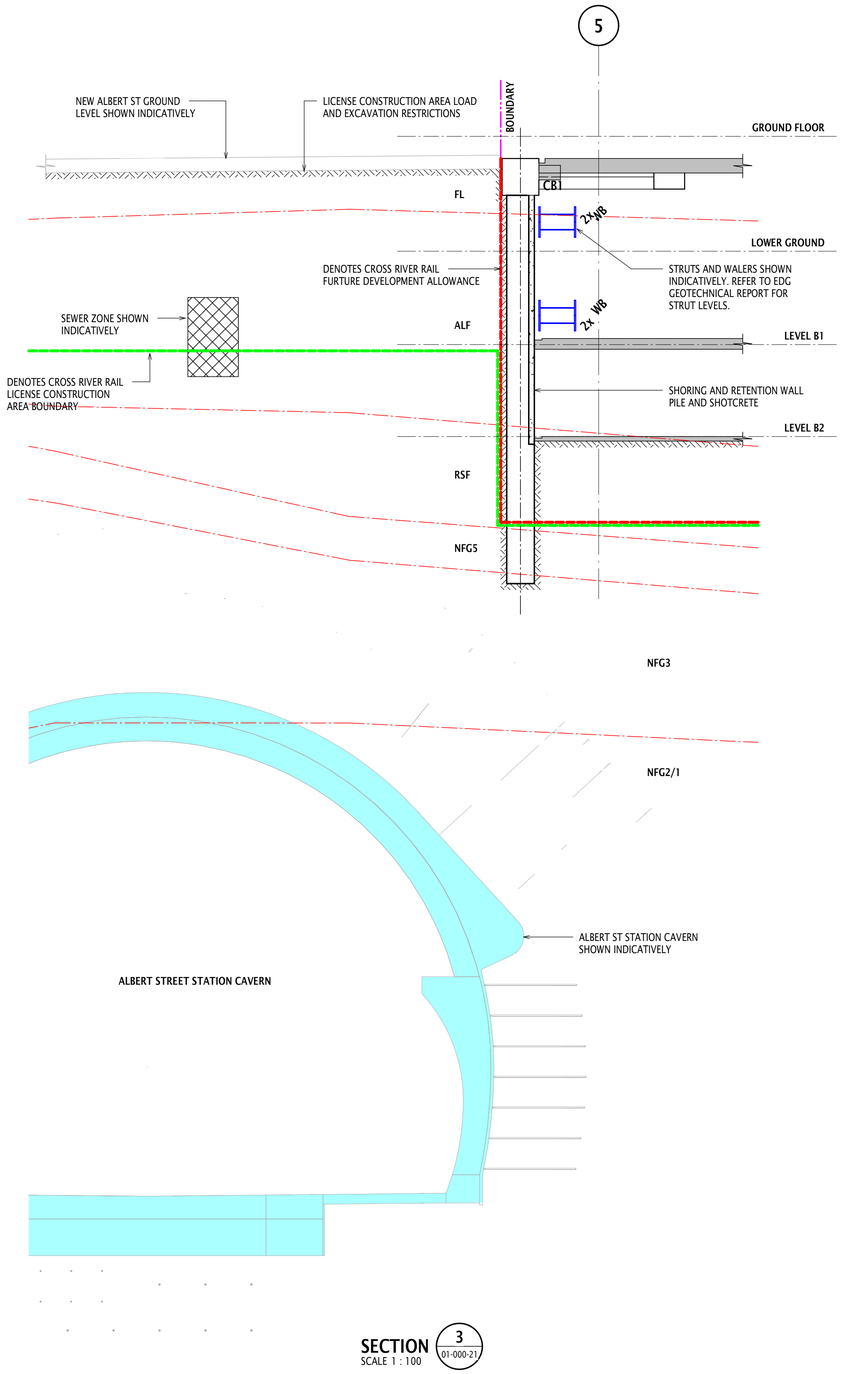
Date
Jun 2024
Scale at A1
1:100

Drawn
D.STUCKEY
Designer
N.DOYLE/T.KATUNAR
Design Checker
-
Approved
M.AVERY

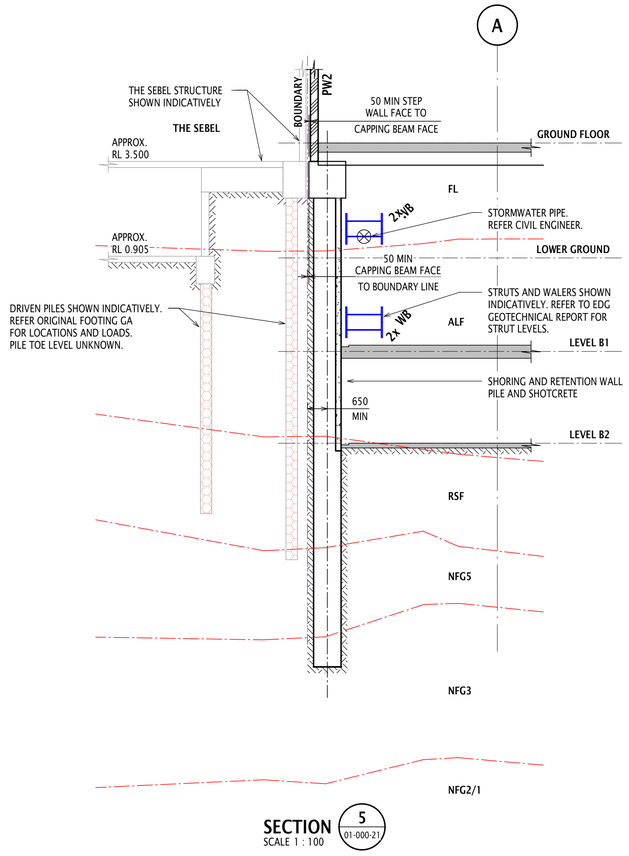
FOR TENDER - NOT FOR CONSTRUCTION

Drawing Number
ALB-RBG-DWG-ST-01-000-61

Revision
T02



SECTION 3 (01-000-21)
SCALE 1 : 100



SECTION 5 (01-000-21)
SCALE 1 : 100

PRINT DRAWINGS IN COLOUR

NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE FOLLOWING:
   a. SITE PLAN, LOADS AND NOTES ON DRG ST-01-000-01.
   b. CRR ASSET PROXIMITY PLANS ON DRG ST-01-000-11 & 12.
   c. TEMPORARY SHORING AND RETENTION GENERAL ARRANGEMENT PLAN ON DRG ST-01-000-21.
   d. SHORING ELEVATIONS ON DRG ST-01-000-41 & 42.
2. EXISTING BUILDING FOOTING RL'S ARE APPROXIMATE. TO BE CONFIRMED ON SITE.
3. EXISTING BUILDING LOADS, SETOUT AND GEOMETRY HAVE BEEN BASED ON THE AVAILABLE HISTORIC DRAWINGS AND ARE APPROXIMATE ONLY. RBG CANNOT CONFIRM THE ACCURACY OF THESE DRAWINGS, WHETHER THEY REFLECT THE AS-BUILT STRUCTURES OR WHETHER THE STRUCTURES HAVE BEEN UNKNOWINGLY MODIFIED LATER. DETAILED SURVEY REQUIRED TO VERIFY.
4. REFER TO EXISTING BUILDING STRUCTURAL DRAWINGS FOR NEIGHBORING BUILDING PILES LOADS AND LEVELS.
5. REFER TO ARCHITECTS FOR ALL FLOOR AND GROUND LEVELS.

80% DD NOTE:

- THE SHORING WALL SYSTEM AND LEVEL OF WATER RESISTANCE TO BE REVIEWED AGAINST GROUNDWATER CONDITIONS ONCE CONFIRMED. ALTERNATIVE SYSTEMS MAY NEED TO BE INVESTIGATED.
- GROUNDWATER LEVELS HAVE NOT BE SHOWN DUE TO INSUFFICIENT INFORMATION. TO BE CONFIRMED ONSITE.

Rev	Revision Description	By	App	Date
T02	ISSUED FOR TENDER	DS	MA	17.07.24
T01	ISSUED FOR TENDER	DS	MA	28.06.24
A01	80% DD DRAFT	DS	MA	07.06.24

SCALE | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8

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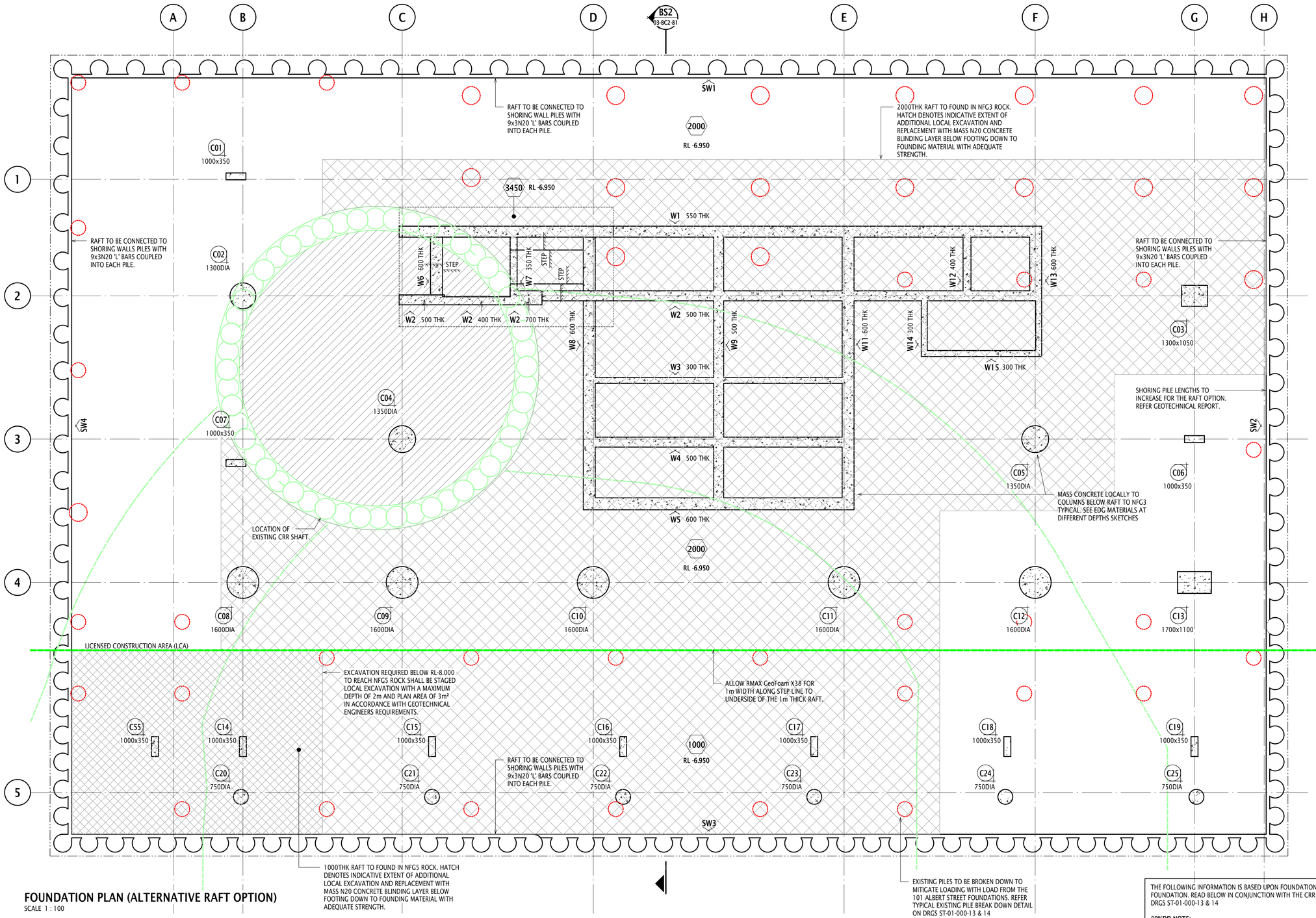
Title
SHORING SECITONS
SHEET 2

Date
Jun 2024
Scale at A1
1:100

Drawn
D.STUCKEY
Designer
N.DOYLE/T.KATUNAR
Design Checker
-
Approved
M.AVERY

FOR TENDER - NOT FOR CONSTRUCTION

Drawing Number	Revision
ALB-RBG-DWG-ST-01-000-62	T02



FOUNDATION PLAN (ALTERNATIVE RAFT OPTION)

SCALE 1 : 100

GENERAL ARRANGEMENT LEGEND:

- DENOTES INSITU CONCRETE ELEMENT OVER
- DENOTES LOAD BEARING ELEMENT UNDER
- DENOTES LOAD BEARING ELEMENT UNDER AND INSITU CONCRETE ELEMENT OVER
- STEP — DENOTES SLAB STEP
- THK — DENOTES SLAB THICKNESS
- TAG / SIZE — DENOTES COLUMN NUMBER AND SIZE
- W? — DENOTES WALL NUMBER & DIRECTION ELEVATION IS VIEWED
- SW# — DENOTES SHOWING WALL NUMBER & DIRECTION ELEVATION IS VIEWED
- HATCH DENOTES INDICATIVE EXTENT OF ADDITIONAL LOCAL EXCAVATION AND REPLACEMENT WITH MASS N20 CONCRETE BLINDING LAYER BELOW FOOTING DOWN TO FOUNDING MATERIAL WITH ADEQUATE STRENGTH.
- DENOTES CRR SHAFT BACKFILL MATERIAL EXTENT. REFER DRGS ST-01-000-13 & 14
- DENOTES CRR ACOUSTIC SHED STRUCTURE REFER DRGS ST-01-000-13 & 14
- DENOTES CRR SHAFT AND ADIT STRUCTURE REFER DRGS ST-01-000-13 & 14

FOUNDATION COVER SCHEDULE UNO

LOCATION/ELEMENT	COVER (mm)
PC3	60
PILE CAPS	60
PAD FOOTINGS & RAFT	60
FOUNDATION PILES	75

FOUNDATION CONCRETE STRENGTH SCHEDULE UNO

LOCATION/ELEMENT	CONCRETE MIX
PC3	CM651
RAFT OPTION	CM801
PC1, PC4	CM801
PC2, PC5	CM651
PF1, PF2	CM502
FOUNDATION PILES	CM801

NOTES:
1. REFER TO CONCRETE SPECIFICATION FOR MIX TYPES

FOUNDATION RATES SCHEDULE UNO

LOCATION/ELEMENT	REINF'T RATE [kg/m3]
PC3	200
PC1	200
PC4	275
PC2, PC5	150
PF1, PF2	175
PILES	
· CORE FOUNDATIONS	250
· COLUMN FOUNDATIONS	180
RAFT OPTION	200

THE FOLLOWING INFORMATION IS BASED UPON FOUNDATIONS CONSISTING OF A RAFT FOUNDATION. READ BELOW IN CONJUNCTION WITH THE CRR ASSET PROXIMITY PLANS ON DRGS ST-01-000-13 & 14

80%DD NOTE:
1. THE 1000THK AND 2000THK RAFT TO BE FOUND IN NFG3 ROCK TYP U.N.O. AS NOTED IN THE GEOTECHNICAL REPORT. THE RAFT DESIGN IS BASED ON THE FOLLOWING:
   - ADVISE PROVIDED IN THE GEOTECHNICAL REPORT IS BASED INTERPRETATION OF AVAILABLE GEOTECHNICAL INVESTIGATION INFORMATION AT THE TIME OF TENDER. ALL GEOTECHNICAL ADVISE NEEDS TO BE CONFIRMED VIA GEOTECHNICAL INVESTIGATIONS.
   - THE ELEVATION OF THE RAFT HAS BEEN ADOPTED TO MINIMISE REMOVAL OF RESIDUAL SOIL AND WEAKER ROCK AND REPLACEMENT WITH LOCALISED MASS CONCRETE. THE INDICATIVE EXTENT OF MASS CONCRETE NEEDS TO BE CONFIRMED VIA GEOTECHNICAL INVESTIGATIONS AND DURING EXCAVATION.
   - THE RAFT DESIGN IS BASED ON THE RECOMMENDED MODULUS OF SUBGRADE REACTION VALUES IN THE GEOTECHNICAL REPORT.
2. COORDINATION WORK IS BASED UPON AVAILABLE CRR INFORMATION AT THE TIME OF THIS DOCUMENT ISSUE. THE LOCATION AND SIZE OF CRR ASSETS ARE INDICATIVE ONLY AND TO BE CONFIRMED.
3. NOT ALL EXISTING IN-GROUND STRUCTURE HAS BEEN SHOWN INCLUDING, BUT NOT LIMITED TO TEMPORARY ROCK BOLTS AND ANCHORS. BORED PIERS HAVE NOT BEEN POSITIONED TO MISS ROCK BOLTS AND ANCHORS AND THEREFORE THE CONTRACTOR IS TO MAKE ALLOWANCE FOR DRILLING THROUGH EXISTING IN-GROUND STRUCTURE.
4. THE RAFT THICKNESSES ARE BASED ON THE TEMPORARY ACCESS SHAFT AND ADITS BEING BACKFILLED WITH 20MPa CONCRETE WITHOUT VOIDS. EXISTING SHAFT PILES & ACOUSTIC PILES BEING BROKEN DOWN. REFER CRR ASSETT PROXIMITY PLANS FOR DETAILS.

PRINT DRAWINGS IN COLOUR

NOTES:
1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE FOLLOWING:
   a. GENERAL AND CONSTRUCTION NOTES ON DRG ST-00-000-11
   b. SHORING & RETENTION WALL, PILING AND FOUNDATION NOTES ON DRG ST-00-000-12.
   c. GEOTECHNICAL REPORTS NOTED ON DRG ST-00-000-11.
   d. INSTRUMENTATION, VIBRATION AND MOVEMENT MONITORING REPORTS NOTED ON DRG ST-00-000-11.
   e. EDQ AND DA REQUIREMENTS NOTES ON DRG ST-00-000-11.
   f. SITE PLAN, LOADS AND NOTES ON DRG ST-01-000-01.
   g. CRR ASSET PROXIMITY PLANS ON DRG ST-01-000-11 & 12.
   h. TEMPORARY SHORING AND RETENTION GENERAL ARRANGEMENT PLAN ON DRG ST-01-000-21.
   i. LAP SCHEDULES ON DRG ST
   j. FOUNDATION TYPICAL DETAILS AND PILE LOADS ON DRG SERIES ST-00-003-##.
   k. ROBERT BIRD GROUP CIVIL DRAWINGS.
2. GEOTECHNICAL ENGINEER TO VERIFIY BEARING CAPACITY OF ALL FOOTINGS PRIOR TO POURING BLINDING LAYER.
3. CORE DRILLING OF FOOTING BASES TO CONFIRM THE QUALITY OF FOUNDING STRATA IN THE CRITICAL ZONE OF STRESS INFLUENCE IS TO BE CARRIED OUT AND ASSESSED BY QUALIFIED GEOTECHNICAL ENGINEER
4. REFER GEOTECHNICAL REPORTS FOR EXCAVATION AND TEMPORARY BATTER ANGLES.
5. DESIGN ACTIONS ARE TO BE COMBINED IN ACCORDANCE WITH AS1170.0 TO PRODUCE THE MOST ADVERSE EFFECT.
6. DEAD, LIVE AND SOIL LOADS ARE PROVIDED UNFACTORED. SEISMIC AND WIND LOADS ARE PROVIDED AT ULTIMATE.
7. SEISMIC AND WIND LOADS ARE FULLY REVERSIBLE.
8. ALLOW FOR THE COST ASSOCIATED WITH TEMPERATURE MONITORING AND CONTROL TO THE RAFT. THIS MIGHT INCLUDE THERMOCOUPLES, INSULATION, ICE, BESPOKE MIX DESIGN ETC.
9. HYDRAULIC ENGINEER TO CONFIRM UNDER SLAB DRAINAGE SYSTEM AND REQUIREMENTS. DRAINAGE TO BE COORDINATED AROUND FOUNDATIONS.

Rev	Revision Description	By	App	Date
T05	ISSUED FOR TENDER	SV	MA	24.02.25
T04	ISSUED FOR TENDER	DS	MA	09.08.24
T03	ISSUED FOR TENDER	DS	MA	02.08.24
T02	ISSUED FOR TENDER	DS	MA	17.07.24
T01	ISSUED FOR TENDER	DS	MA	28.06.24
A02	80% DD DRAFT	DS	MA	07.06.24
A01	50% DD ISSUE	SV	MA	09.08.23
P01	DRAFT 50% DESIGN DEVELOPMENT	SV	MA	28.07.23

SCALE 1 2 3 4 5 6 7 8

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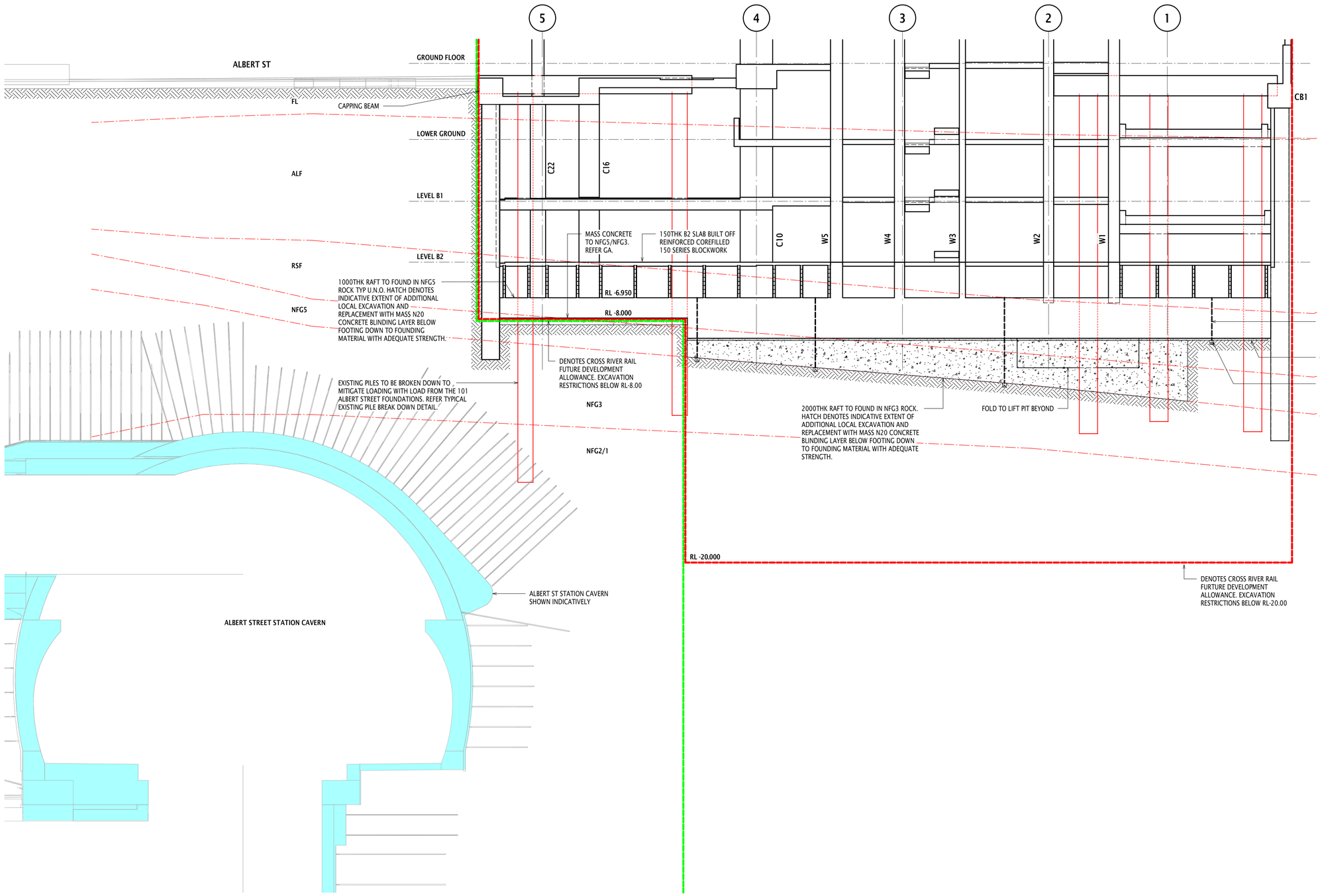
Title
FOOTING PLAN (RAFT OPTION)

Date: Jun 2024
Scale at A1: 1:100
Drawn: D.STUCKEY
Designer: N.DOYLE/T.KATUNAR
Design Checker: -
Job Number: 22131S
Approved: M.AVERY

FOR TENDER - NOT FOR CONSTRUCTION

Drawing Number: ALB-RBG-DWG-ST-03-BC2-51
Revision: T05

PRINT DRAWINGS IN COLOUR



SECTION
SCALE 1 : 100

BS2
03-BC2-51

Rev	Revision Description	By	App	Date
T04	ISSUED FOR TENDER	SV	MA	24.02.25
T03	ISSUED FOR TENDER	DS	MA	09.08.24
T02	ISSUED FOR TENDER	DS	MA	17.07.24
T01	ISSUED FOR TENDER	DS	MA	28.06.24
A02	80% DD DRAFT	DS	MA	07.06.24
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SCALE | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8

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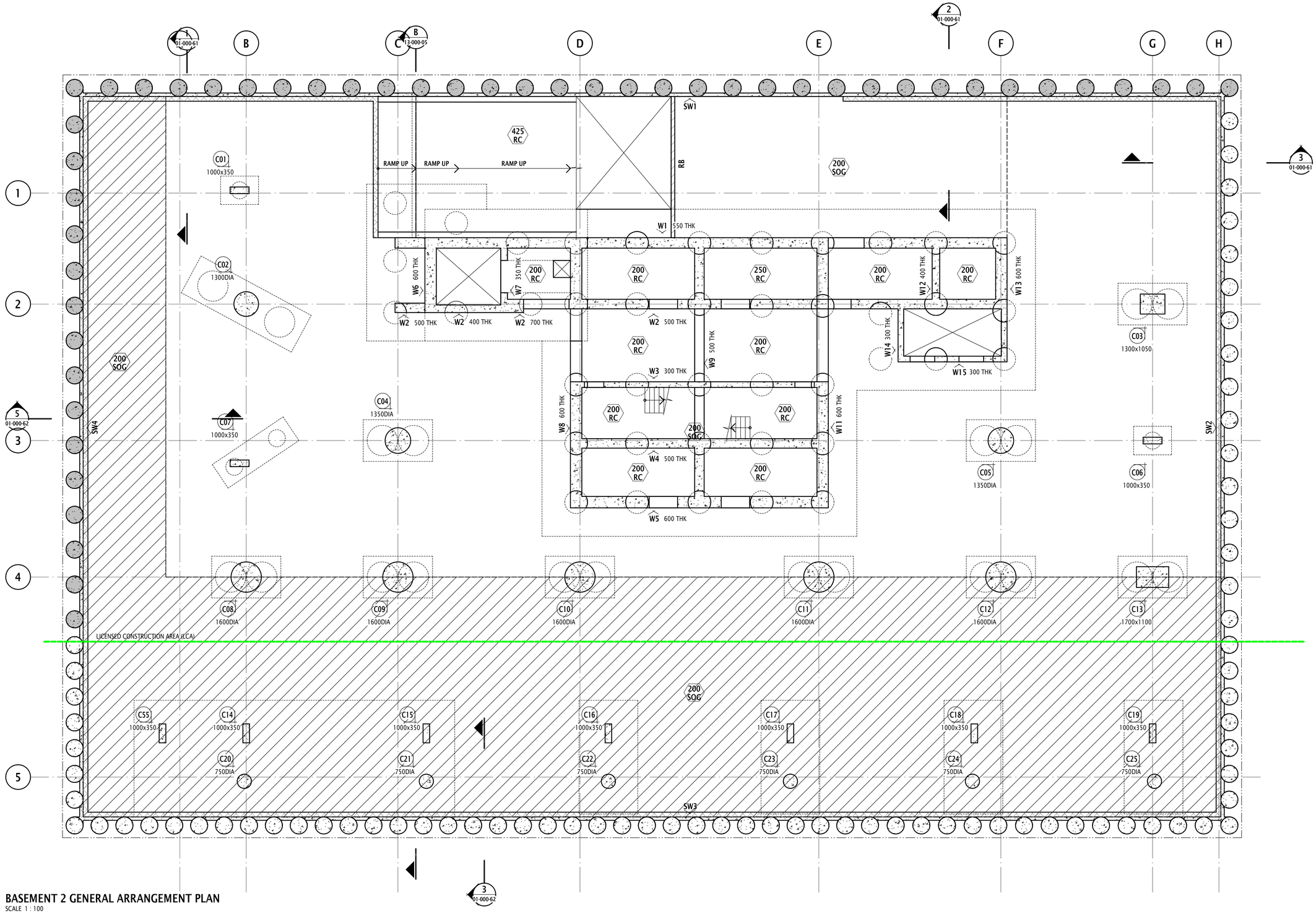
Project
101 ALBERT STREET, BRISBANE

Title
BASEMENT SECTIONS (RAFT OPTION)
SHEET 1

Date
Jun 2024
Scale at A1
1:100
Drawn
D.STUCKEY
Designer
N.DOYLE/T.KATUNAR
Design Checker
-
Job Number
22131S
Approved
M.AVERY

FOR TENDER - NOT FOR CONSTRUCTION

Drawing Number
ALB-RBG-DWG-ST-03-BC2-81
Revision
T04



BASEMENT 2 GENERAL ARRANGEMENT PLAN

SCALE 1 : 100

SLAB TO BE 150 SOG UNO

NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL PROJECT DOCUMENTS INCLUDING BUT NOT LIMITED TO THE FOLLOWING:
   a. GENERAL NOTES ON DRG ST-00-000-11
   b. CONSTRUCTION METHODOLOGY AND ERECTION SEQUENCE (CMES) NOTES ON DRG ST-00-000-11
   c. EARTHWORKS AND SLAB ON GROUND NOTES ON DRG ST-00-000-12
   d. CONCRETE NOTES ON DRG ST-00-000-13
   e. TYPICAL SLAB ON GROUND DETAILS ON DRG SERIES ST-00-011-##
   f. FOUNDATION, COLUMN AND WALL BASE DETAILS ON DRG SERIES ST-00-003-##, ST-00-0004-## AND ST-00-006-## RESPECTIVELY.
   g. TYPICAL BLOCKWORK DETAILS ON DRG ALB-RBG-DWG-ST-00-006-11
2. REFER TO ARCHITECT FOR ALL SETOUT, LEVELS, STEPS, FALLS, HOBS, REBATES, SURFACE FINISHES, WATERPROOFING AND TERMITE PROTECTION.
3. REFER TO ARCHITECT AND HYDRAULIC ENGINEER FOR DRAINAGE DETAILS SUCH AS DRAINAGE LAYER AND SPOON DRAINS.
4. ALL PENETRATIONS ARE TO BE INSTALLED AS PART OF THE INSITU POUR AND IN ACCORDANCE WITH PENETRATION SIZE AND LOCATION SHOWN ON THIS DRAWING. REFER ARCHITECT FOR DETAILED SETOUT.
5. ANY PENETRATIONS, REBATES AND POCKETS NOT SHOWN ON THESE DRAWINGS ARE NOT PERMITTED, UNLESS OTHERWISE APPROVED BY RBG. NO CORING OR DRILLING INTO SLABS, BEAMS, WALLS OR COLUMNS POST POUR IS PERMITTED UNLESS RBG HAVE REVIEWED AND APPROVED. THE CONTRACTOR IS TO CONTACT THE STRUCTURAL ENGINEER SHOULD ANY DISCREPANCIES OCCUR.
6. SLAB ON GROUND AND THICKENINGS TO BE POURED DOWN ONTO TOP OF PAD FOOTINGS AND PILE CAPS.
7. PROVIDE ISOLATION JOINTS TO SLAB ON GROUND AGAINST ALL WALLS AND COLUMNS TYP. UNO.
8. SLAB ON GROUND TO BE LOCALLY THICKENED TO 175THK OVER INGROUND SERVICES.
9. REFER TO ARCHITECT FOR NON-LOAD BEARING BLOCKWORK WALL EXTENTS. ALL BLOCKWORK ADJACENT CAR AISLES AND PARKS SUBJECT TO CAR IMPACTS TO BE FULLY REINFORCED AND COREFILLED 190 BLOCKWORK. PROVIDE SLAB THICKENINGS AS PER TYPICAL SLAB ON GROUND DETAILS.
10. ALLOW FOR LOCAL SLAB THICKENING TO DIESEL TANK AND STORE AREAS TO ACCOMODATE HIGHER SLAB LOADING. REFER TYPICAL SLAB ON GROUND DETAILS.
11. ALLOW FOR LOCAL SLAB THICKENING TO BOLLARDS. REFER ARCHITECT AND TRAFFIC FOR BOLLARD LOCATIONS.

80%DD NOTES:

1. THIS DRAWING IS BASED UPON A PARTIALLY HYDROSTATIC BASEMENT STRATEGY WITH HYDROSTATIC WALLS AND DRAINED BASEMENT B2 SLAB. TO BE CONFIRMED BY GEOTECHNICAL AND HYDRAULIC ENGINEERS.
2. SLAB TO BE LAID ON DAMP PROOF MEMBRANE, 50mm BEDDING SAND, CRUSHED ROCK DRAINAGE LAYER WITH GEOFABRIC, AG LINES AND PUMP OUT PITS TO HYDRAULIC ENGINEERS DETAILS. REFER TO TYPICAL SLAB ON GROUND BUILDUP ON DRG ST-00-011-02 FOR ADDITIONAL DETAIL.
3. A 250mm ZONE FOR THE ABOVE BUILDUP HAS BEEN ASSUMED FOR THE PURPOSES OF THIS DRAWING, HYDRAULIC ENGINEER TO CONFIRM DRAINAGE LAYER THICKNESS AND DESIGN AND CERTIFY THE SYSTEM.
4. ALLOW FOR GEOTECHNICAL ENGINEER TO PROVIDE INFILTRATION RATES TO SUPPORT DESIGN OF THE UNDER SLAB DRAINAGE SYSTEM BY THE HYDRAULIC ENGINEER. GEOTECHNICAL ENGINEER TO CERTIFY INFLOW RATES.
5. ALLOW FOR SLAB TO BE LOCALLY THICKENED AT SPOON DRAINS. SPOON DRAIN DETAILS AND LOCATIONS TO BE CONFIRMED BY HYDRAULIC ENGINEER.

SLAB ON GROUND COVER SCHEDULE UNO

LOCATION/ELEMENT	COVER (mm)
SLAB ON GROUND	
- BTM	50
- TOP (INTERNAL)	30
- TOP (EXTERNAL)	40

SLAB ON GROUND CONCRETE STRENGTH SCHEDULE UNO

LOCATION/ELEMENT	CONCRETE MIX
SLAB ON GROUND	CM321
RC SLABS	CM402

NOTES:
1. REFER TO CONCRETE SPECIFICATION FOR MIX TYPES

SLAB ON GROUND RATES SCHEDULE UNO

LOCATION/ELEMENT	REINFT RATE [kg/m3]
SLAB ON GROUND	SL92 MESH (SEE NOTE 1)
SLAB ON GROUND > 150THK	145
SLAB EDGE THICKENING	REFER NOTE 1

NOTES:
1. REFER TO TYPICAL SLAB ON GROUND DETAILS ON DRG SERIES ST-00-011-## FOR ADDITIONAL REINFORCEMENT ABOVE AND BEYOND BLANKET TOP MESH.
2. ALLOW SAWN JOINTS AT MAXIMUM 6m CENTRES, DOWEL JOINTS AT MAXIMUM 12m CENTRES AND MAXIMUM ASPECT RATIO OF 1.5 FOR BOTH SAWN AND DOWEL JOINT PANELS.
3. ALLOW ADDITIONAL 5kg/m AT STRIP DRAINS.

PRINT DRAWINGS IN COLOUR

GENERAL ARRANGEMENT LEGEND:

- DENOTES INSITU CONCRETE ELEMENT OVER
- DENOTES LOAD BEARING ELEMENT UNDER
- DENOTES LOAD BEARING ELEMENT UNDER AND INSITU CONCRETE ELEMENT OVER
- DENOTES PRECAST ELEMENT OVER
- RB? (LB) / RB? (NLB) — DENOTES BLOCKWORK AND TYPE REFER S??.?? SERIES DRAWINGS FOR SCHEDULE AND TYPICAL DETAILS
- DENOTES SPOON DRAIN
- DENOTES 150 CONDECK SLAB BUILT OFF COREFILLED REINFORCED 140 BLOCKWORK WALLS AT SLAB EDGES AND MAX 2000 CTRS.
- DENOTES STRIP DRAIN OR FLOOD BARRIER RECESS. SLAB DEPTH SUBJECT TO FINAL RECESS DIMENSIONS.
- DENOTES PENETRATION
- DENOTES EXTENT OF PROVISIONAL SERVICE PIPE PENETRATION ZONE INCLUDING FIRE COLLARS. PROVIDE TRIMMING REINFORCEMENT TO STANDARD DETAILS. SERVICES SHOP DRAWINGS TO BE SUBMITTED FOR RBG REVIEW
- DENOTES SUMP
- STEP — DENOTES SLAB STEP
- THK — DENOTES SLAB THICKNESS
- TAG / SIZE — DENOTES COLUMN NUMBER AND SIZE
- W? — DENOTES WALL NUMBER & DIRECTION ELEVATION IS VIEWED

Rev	Revision Description	By	App	Date
T03	ISSUED FOR TENDER	DS	MA	22.11.24
T02	ISSUED FOR TENDER	DS	MA	17.07.24
T01	ISSUED FOR TENDER	DS	MA	28.06.24
A02	80% DD DRAFT	DS	MA	07.06.24
A01	50% DD ISSUE	SV	MA	09.08.23
P01	DRAFT 50% DESIGN DEVELOPMENT	SV	MA	28.07.23

SCALE 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8

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REFER TO GENERAL NOTES UNLESS NOTED OTHERWISE

Structural, Civil & Construction Engineering Consultant

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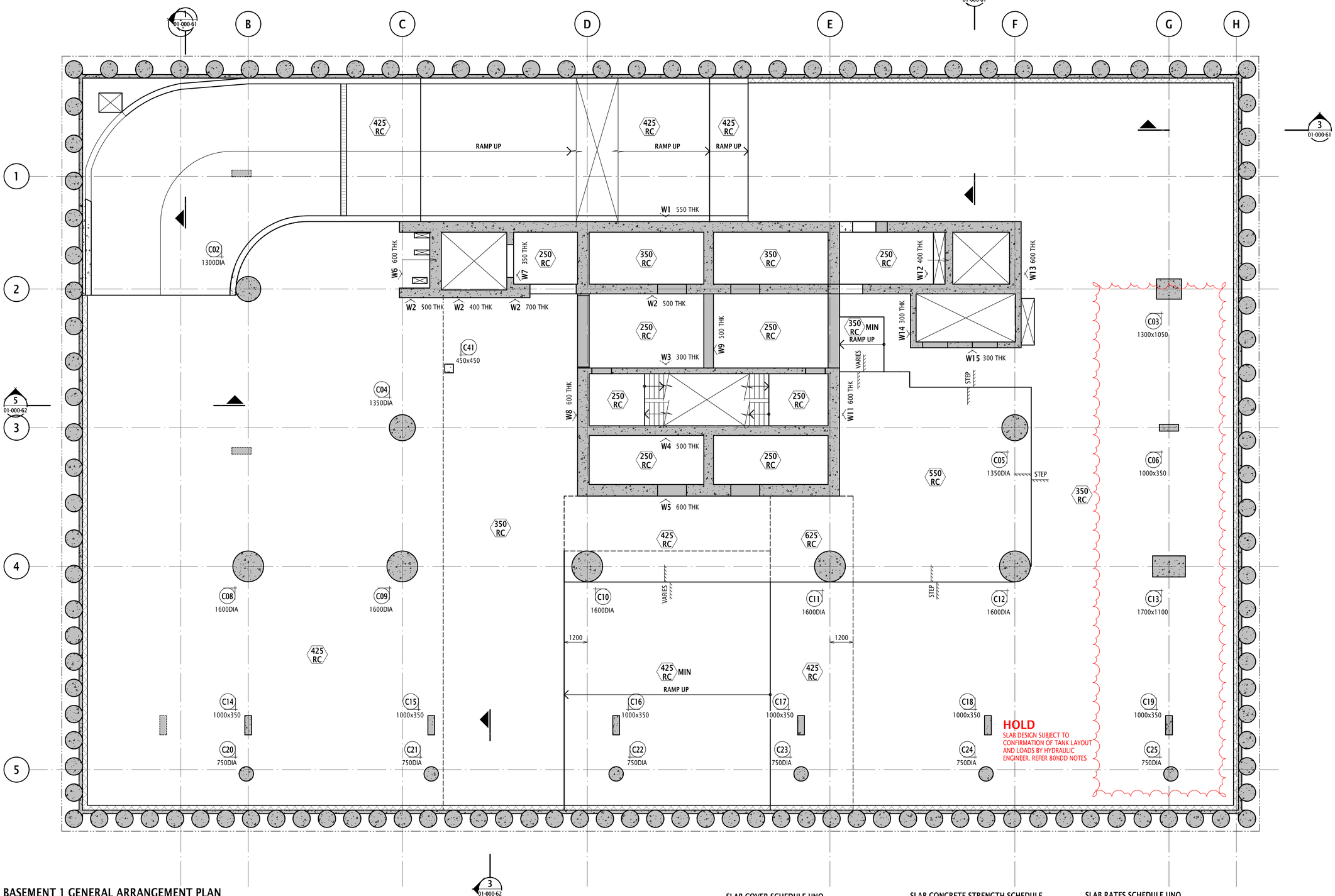
Project
101 ALBERT STREET, BRISBANE

Title
BASEMENT 2
GENERAL ARRANGEMENT PLAN

Date
Jun 2024
Scale at A1
1:100
Drawn
D.STUCKEY
Designer
N.DOYLE/T.KATUNAR
Design Checker
-
Approved
M.AVERY
Job Number
22131S

FOR TENDER - NOT FOR CONSTRUCTION

Drawing Number
ALB-RBG-DWG-ST-08-BC2-01
Revision
T03



BASEMENT 1 GENERAL ARRANGEMENT PLAN

SCALE 1 : 100

NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL PROJECT DOCUMENTS
   INCLUDING BUT NOT LIMITED TO THE FOLLOWING:
   a. GENERAL NOTES ON DRG ST-00-000-11.
   b. CONSTRUCTION METHODOLOGY AND ERECTION SEQUENCE (CMES) NOTES ON DRG ST-00-000-11.
   c. CONCRETE NOTES ON DRG ST-00-000-13.
   d. LAP SCHEDULES ON DRG ST-00-000-21.
   e. LOADING PLANS ON DRG SERIES ST-09-###-##.
   f. TYPICAL SUSPENDED SLAB DETAILS ON DRG ST-00-011-## BEGINNING AT -11.
   g. COLUMN AND WALL DETAILS ON DRG SERIES ST-00-004-## AND ST-00-006-## RESPECTIVELY.
   h. SECTIONS ON DRG SERIES ST-11-###-##.
2. REFER TO ARCHITECT FOR ALL SETOUT, LEVELS, STEPS, FALLS, HOBS, REBATES, SURFACE FINISHES, WATERPROOFING AND TERMITE PROTECTION.
3. REFER TO ARCHITECT AND HYDRAULIC ENGINEER FOR SPOON DRAINS.
4. ALL PENETRATIONS ARE TO BE INSTALLED AS PART OF THE INSITU POUR AND IN ACCORDANCE WITH PENETRATION SIZE AND LOCATION SHOWN ON THIS DRAWING. REFER ARCHITECT FOR DETAILED SETOUT.
5. ANY PENETRATIONS, REBATES AND POCKETS NOT SHOWN ON THESE DRAWINGS ARE NOT PERMITTED, UNLESS OTHERWISE APPROVED BY RBG. NO CORING OR DRILLING INTO SLABS, BEAMS, WALLS OR COLUMNS POST POUR IS PERMITTED UNLESS RBG HAVE REVIEWED AND APPROVED. THE CONTRACTOR IS TO CONTACT THE STRUCTURAL ENGINEER SHOULD ANY DISCREPANCIES OCCUR.

80%DD NOTES:

1. THIS DRAWING IS BASED UPON A PARTIALLY HYDROSTATIC BASEMENT STRATEGY WITH HYDROSTATIC WALLS AND DRAINED BASEMENT B2 SLAB. TO BE CONFIRMED BY GEOTECHNICAL AND HYDRAULIC ENGINEERS. REFER SCHEMATIC DESIGN REPORT 22131S-RBG-ZZ-XX-RP-ST-00002 AND STRUCTURAL DESIGN BRIEF ALB-RBG-REP-ST-00-000-01 FOR MORE DETAILS.
2. ALLOW FOR SLAB TO BE LOCALLY THICKENED AT SPOON DRAINS SUBJECT TO CONFIRMATION OF DETAILS. SPOON DRAIN DETAILS AND LOCATIONS TO BE CONFIRMED BY HYDRAULIC ENGINEER.
3. THE B1 SLAB HAS BEEN DESIGNED TO SUPPORT THE WEIGHT OF A RAINWATER TANK WHEN FULL OF WATER. NO ADDITIONAL PRESSURES DUE TO FLOOD CONDITION LOAD CASES HAS BEEN ADVISED BY THE HYDRAULIC ENGINEER AND THEREFORE HAS NOT BEEN ALLOWED FOR IN THE BASEMENT DESIGN.
4. ARCHITECT AND HYDRAULIC ENGINEER TO CONFIRM A RAINWATER TANK LAYOUT AND DESIGN THAT ACHIEVES THE FOLLOWING:
   a. THE TANK IS ONLY CONNECTED TO AND SUPPORTED OFF THE B1 SLAB.
   b. IT IS CRITICAL THAT THE TANK IS ISOLATED FROM ALL OTHER STRUCTURE ABOVE THE B1 SLAB TO AVOID CHANGING LOAD PATHS AND OVERLOADING THE BASEMENT STRUCTURE.
   c. THE ACCESS SHAFTS ARE ISOLATED FROM GROUND FLOOR SLAB.
   d. PENETRATIONS THROUGH LOWER GROUND AND GROUND FLOOR SHALL BE COORDINATED TO AVOID IMPACTING SLAB THICKNESSES.
5. RAINWATER TANK LOADS TO BE CONFIRMED.

SLAB COVER SCHEDULE UNO

LOCATION/ELEMENT	COVER (mm)
RC SLABS (B02-GROUND, LOBBIES)	
- B02 BTM	50
- INTERNAL BTM	30
- INTERNAL TOP	30
- EXTERNAL BTM	40
- EXTERNAL TOP	40
COMPOSITE SLABS	
- INTERNAL BTM	25
- INTERNAL TOP	25
- EXTERNAL BTM	30
- EXTERNAL TOP	30

NOTES:
1. EXTERNAL BONDEK SLABS TO BE 40MPa MINIMUM.
2. REFER DRG ST-00-011-07 FOR PLACEMENT OF REINFORCEMENT IN SLABS FORMED BY PROFILED STEEL SHEET FORMWORK.

SLAB CONCRETE STRENGTH SCHEDULE UNO

LOCATION/ELEMENT	CONCRETE MIX
B02, B01, LG, GROUND	CM403
LOBBY SLABS	CM402
COMPOSITE LEVELS	
- L01 - L14	CM402
- L15 - L28	CM321
- L29	CM402
- L30 - L37	CM321
- L38+	CM402
- L30 - U/S L39	CM503

NOTES:
1. REFER TO CONCRETE SPECIFICATION FOR MIX TYPES

SLAB RATES SCHEDULE UNO

LOCATION/ELEMENT	REINF'T RATE [kg/m3]
SUSPENDED RC SLABS	
- B02 - LG	150
- GROUND	200
- LOBBY SLABS	125
COMPOSITE SLABS	
- L01 - L14	
INTERNAL	110
EXTERNAL	135
- L15 - L37	90
- L38 - L39	135
- L39+	135

NOTES:
1. REFER TO DRG ST-08-BC2-01 AND DRG SERIES ST-00-011-01 TO -06 FOR SLAB ON GROUND REINFORCEMENT DETAILS.
2. ALLOW ADDITIONAL 6kg/m2 REINFORCEMENT FOR L06 & L14 COMPOSITE SLABS.
3. ALLOW ADDITIONAL 3kg/m2 REINFORCEMENT FOR L07-L13 COMPOSITE SLABS.
4. ALLOW ADDITIONAL 50kg/m3 FOR L06 AND L14 THICKENED LOBBY SLABS.

PRINT DRAWINGS IN COLOUR

GENERAL ARRANGEMENT LEGEND:

- DENOTES INSITU CONCRETE ELEMENT OVER
- DENOTES LOAD BEARING ELEMENT UNDER
- DENOTES LOAD BEARING ELEMENT UNDER AND INSITU CONCRETE ELEMENT OVER
- DENOTES PRECAST ELEMENT OVER
- RB? (LB) / RB? (NLB) — DENOTES BLOCKWORK AND TYPE REFER ST?.?? SERIES DRAWINGS FOR SCHEDULE AND TYPICAL DETAILS
- DENOTES SPOON DRAIN
- DENOTES 150 CONDECK SLAB BUILT OFF COREFILLED REINFORCED 140 BLOCKWORK WALLS AT SLAB EDGES AND MAX 2000 CTRS.
- DENOTES STRIP DRAIN OR FLOOD BARRIER RECESS. SLAB DEPTH SUBJECT TO FINAL RECESS DIMENSIONS.
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Rev	Revision Description	By	App	Date
T01	ISSUED FOR TENDER	DS	MA	28.06.24
A02	80% DD DRAFT	DS	MA	07.06.24
A01	50% DD ISSUE	SV	MA	09.08.23
P01	DRAFT 50% DESIGN DEVELOPMENT	SV	MA	28.07.23

SCALE 1 2 3 4 5 6 7 8

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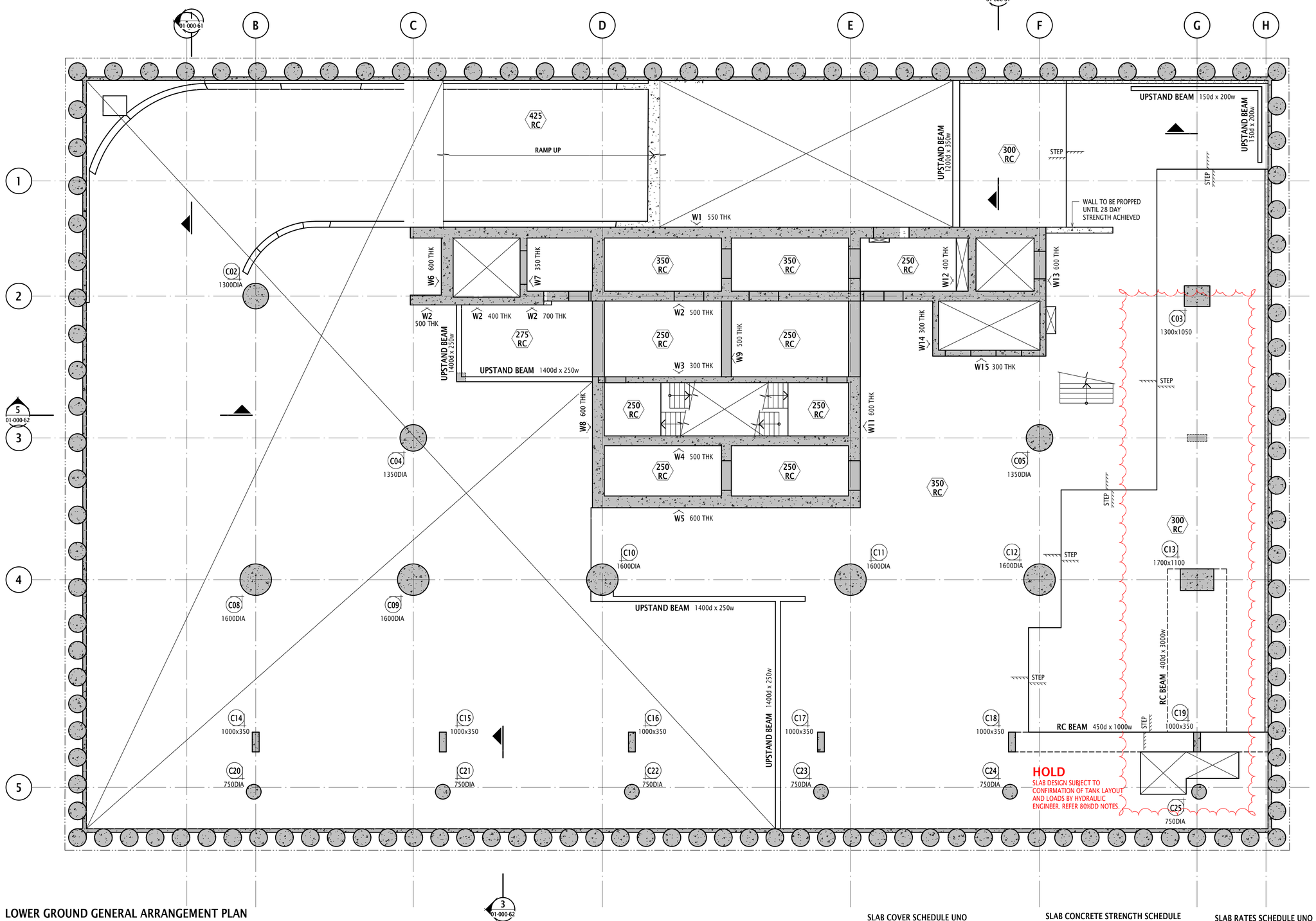
Project
101 ALBERT STREET, BRISBANE

Title
BASEMENT 1
GENERAL ARRANGEMENT PLAN

Date	Jun 2024
Scale at A1	1:100
Drawn	D.STUCKEY
Designer	N.DOYLE/T.KATUNAR
Design Checker	-
Job Number	22131S
Approved	M.AVERY

FOR TENDER - NOT FOR CONSTRUCTION

Drawing Number	Revision
ALB-RBG-DWG-ST-08-BL1-01	T01



LOWER GROUND GENERAL ARRANGEMENT PLAN

SCALE 1 : 100

NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL PROJECT DOCUMENTS
   INCLUDING BUT NOT LIMITED TO THE FOLLOWING:
   a. GENERAL NOTES ON DRG ST-00-000-11.
   b. CONSTRUCTION METHODOLOGY AND ERECTION SEQUENCE (CMES) NOTES ON DRG ST-00-000-11.
   c. CONCRETE NOTES ON DRG ST-00-000-13.
   d. LAP SCHEDULES ON DRG ST-00-000-21.
   e. LOADING PLANS ON DRG SERIES ST-09-###-##.
   f. TYPICAL SUSPENDED SLAB DETAILS ON DRG ST-00-011-## BEGINNING AT -11.
   g. COLUMN AND WALL DETAILS ON DRG SERIES ST-00-004-## AND ST-00-006-## RESPECTIVELY.
   h. SECTIONS ON DRG SERIES ST-11-###-##.
2. REFER TO ARCHITECT FOR ALL SETOUT, LEVELS, STEPS, FALLS, HOBS, REBATES, SURFACE FINISHES, WATERPROOFING AND TERMITE PROTECTION.
3. REFER TO ARCHITECT AND HYDRAULIC ENGINEER FOR SPOON DRAINS.
4. ALL PENETRATIONS ARE TO BE INSTALLED AS PART OF THE INSITU POUR AND IN ACCORDANCE WITH PENETRATION SIZE AND LOCATION SHOWN ON THIS DRAWING. REFER ARCHITECT FOR DETAILED SETOUT.
5. ANY PENETRATIONS, REBATES AND POCKETS NOT SHOWN ON THESE DRAWINGS ARE NOT PERMITTED, UNLESS OTHERWISE APPROVED BY RBG. NO CORING OR DRILLING INTO SLABS, BEAMS, WALLS OR COLUMNS POST POUR IS PERMITTED UNLESS RBG HAVE REVIEWED AND APPROVED. THE CONTRACTOR IS TO CONTACT THE STRUCTURAL ENGINEER SHOULD ANY DISCREPANCIES OCCUR.

80%DD NOTES:

1. THIS DRAWING IS BASED UPON A PARTIALLY HYDROSTATIC BASEMENT STRATEGY WITH HYDROSTATIC WALLS AND DRAINED BASEMENT B2 SLAB. TO BE CONFIRMED BY GEOTECHNICAL AND HYDRAULIC ENGINEERS. REFER SCHEMATIC DESIGN REPORT 221315-RBG-ZZ-XX-RP-ST-00002 AND STRUCTURAL DESIGN BRIEF ALB-RBG-REP-ST-00-000-01 FOR MORE DETAILS.
2. ALLOW FOR SLAB TO BE LOCALLY THICKENED AT SPOON DRAINS SUBJECT TO CONFIRMATION OF DETAILS. SPOON DRAIN DETAILS AND LOCATIONS TO BE CONFIRMED BY HYDRAULIC ENGINEER.
3. THE B1 SLAB HAS BEEN DESIGNED TO SUPPORT THE WEIGHT OF A RAINWATER TANK WHEN FULL OF WATER. NO ADDITIONAL PRESSURES DUE TO FLOOD CONDITION LOAD CASES HAS BEEN ADVISED BY THE HYDRAULIC ENGINEER AND THEREFORE HAS NOT BEEN ALLOWED FOR IN THE BASEMENT DESIGN.
4. ARCHITECT AND HYDRAULIC ENGINEER TO CONFIRM A RAINWATER TANK LAYOUT AND DESIGN THAT ACHIEVES THE FOLLOWING:
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   b. IT IS CRITICAL THAT THE TANK IS ISOLATED FROM ALL OTHER STRUCTURE ABOVE THE B1 SLAB TO AVOID CHANGING LOAD PATHS AND OVERLOADING THE BASEMENT STRUCTURE.
   c. THE ACCESS SHAFTS ARE ISOLATED FROM GROUND FLOOR SLAB.
   d. PENETRATIONS THROUGH LOWER GROUND AND GROUND FLOOR SHALL BE COORDINATED TO AVOID IMPACTING SLAB THICKNESSES.
5. RAINWATER TANK LOADS TO BE CONFIRMED.

SLAB COVER SCHEDULE UNO

LOCATION/ELEMENT	COVER (mm)
RC SLABS (B02-GROUND, LOBBIES)	
- B02 BTM	50
- INTERNAL BTM	30
- INTERNAL TOP	30
- EXTERNAL BTM	40
- EXTERNAL TOP	40
COMPOSITE SLABS	
- INTERNAL BTM	25
- INTERNAL TOP	25
- EXTERNAL BTM	30
- EXTERNAL TOP	30

NOTES:
1. EXTERNAL BONDEK SLABS TO BE 40MPa MINIMUM.
2. REFER DRG ST-00-011-07 FOR PLACEMENT OF REINFORCEMENT IN SLABS FORMED BY PROFILED STEEL SHEET FORMWORK.

SLAB CONCRETE STRENGTH SCHEDULE UNO

LOCATION/ELEMENT	CONCRETE MIX
B02, B01, LG, GROUND	CM403
LOBBY SLABS	CM402
COMPOSITE LEVELS	
- L01 - L14	CM402
- L15 - L28	CM321
- L29	CM402
- L30 - L37	CM321
- L38+	CM402
- L30 - U/S L39	CM503

NOTES:
1. REFER TO CONCRETE SPECIFICATION FOR MIX TYPES

SLAB RATES SCHEDULE UNO

LOCATION/ELEMENT	REINF'T RATE [kg/m3]
SUSPENDED RC SLABS	
- B02 - LG	150
- GROUND	200
- LOBBY SLABS	125
COMPOSITE SLABS	
- L01 - L14	
INTERNAL	110
EXTERNAL	135
- L15 - L37	90
- L38 - L39	135
- L39+	135

NOTES:
1. REFER TO DRG ST-08-BC2-01 AND DRG SERIES ST-00-011-01 TO -06 FOR SLAB ON GROUND REINFORCEMENT DETAILS.
2. ALLOW ADDITIONAL 6kg/m2 REINFORCEMENT FOR L06 & L14 COMPOSITE SLABS.
3. ALLOW ADDITIONAL 3kg/m2 REINFORCEMENT FOR L07-L13 COMPOSITE SLABS.
4. ALLOW ADDITIONAL 50kg/m3 FOR L06 AND L14 THICKENED LOBBY SLABS.

PRINT DRAWINGS IN COLOUR

GENERAL ARRANGEMENT LEGEND:

- DENOTES INSITU CONCRETE ELEMENT OVER
- DENOTES LOAD BEARING ELEMENT UNDER
- DENOTES LOAD BEARING ELEMENT UNDER AND INSITU CONCRETE ELEMENT OVER
- DENOTES PRECAST ELEMENT OVER
- RB? (LB) / RB? (NLB) — DENOTES BLOCKWORK AND TYPE REFER S??.?? SERIES DRAWINGS FOR SCHEDULE AND TYPICAL DETAILS
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- DENOTES PENETRATION
- DENOTES EXTENT OF PROVISIONAL SERVICE PIPE PENETRATION ZONE INCLUDING FIRE COLLARS. PROVIDE TRIMMING REINFORCEMENT TO STANDARD DETAILS. SERVICES SHOP DRAWINGS TO BE SUBMITTED FOR RBG REVIEW
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- TAG / SIZE — DENOTES COLUMN NUMBER AND SIZE
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A02	80% DD DRAFT	DS	MA	07.06.24
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P01	DRAFT 50% DESIGN DEVELOPMENT	SV	MA	28.07.23

SCALE 1 2 3 4 5 6 7 8

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ACN 010 580 248

Client
QIC

Project
101 ALBERT STREET, BRISBANE

Title
LOWER GROUND GENERAL ARRANGEMENT PLAN

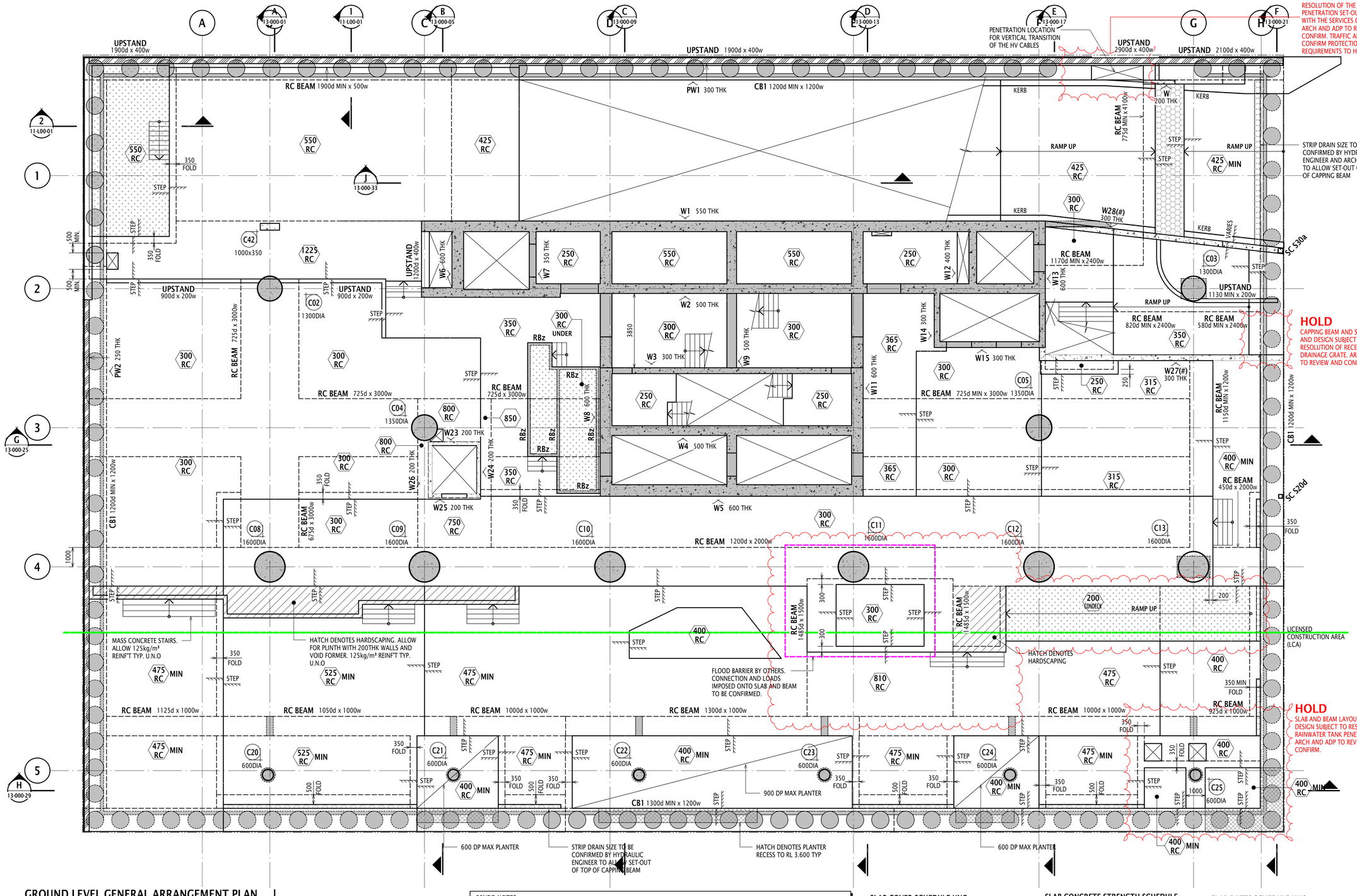
Date
Jun 2024
Scale at A1
1:100
Job Number
22131S

Drawn
D.STUCKEY
Designer
N.DOYLE/T.KATUNAR
Design Checker
-
Approved
M.AVERY

FOR TENDER - NOT FOR CONSTRUCTION

Drawing Number
ALB-RBG-DWG-ST-08-GL0-01

Revision
T01



GROUND LEVEL GENERAL ARRANGEMENT PLAN

SCALE 1 : 100

NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL PROJECT DOCUMENTS INCLUDING BUT NOT LIMITED TO THE FOLLOWING:
   a. GENERAL NOTES ON DRG ST-00-000-11.
   b. CONSTRUCTION METHODOLOGY AND ERECTION SEQUENCE (CMES) NOTES ON DRG ST-00-000-11.
   c. CONCRETE NOTES ON DRG ST-00-000-13.
   d. LAP SCHEDULES ON DRG ST-00-000-21.
   e. LOADING PLANS ON DRG SERIES ST-09-###-##.
   f. TYPICAL SUSPENDED SLAB DETAILS ON DRG ST-00-011-## BEGINNING AT -11.
   g. COLUMN AND WALL DETAILS ON DRG SERIES ST-00-004-## AND ST-00-006-## RESPECTIVELY.
   h. SECTIONS ON DRG SERIES ST-11-###-##.
2. REFER TO ARCHITECT FOR ALL SETOUT, LEVELS, STEPS, FALLS, HOBS, REBATES, SURFACE FINISHES, WATERPROOFING AND TERMITE PROTECTION.
3. REFER TO ARCHITECT AND HYDRAULIC ENGINEER FOR SPOON DRAINS.
4. ALL PENETRATIONS ARE TO BE INSTALLED AS PART OF THE INSITU POUR AND IN ACCORDANCE WITH PENETRATION SIZE AND LOCATION SHOWN ON THIS DRAWING. REFER ARCHITECT FOR DETAILED SETOUT.
5. ANY PENETRATIONS, REBATES AND POCKETS NOT SHOWN ON THESE DRAWINGS ARE NOT PERMITTED, UNLESS OTHERWISE APPROVED BY RBG. NO CORING OR DRILLING INTO SLABS, BEAMS, WALLS OR COLUMNS POST POUR IS PERMITTED UNLESS RBG HAVE REVIEWED AND APPROVED. THE CONTRACTOR IS TO CONTACT THE STRUCTURAL ENGINEER SHOULD ANY DISCREPANCIES OCCUR.

80%DD NOTES:

1. THIS DRAWING IS BASED UPON A PARTIALLY HYDROSTATIC BASEMENT STRATEGY WITH HYDROSTATIC WALLS AND DRAINED BASEMENT B2 SLAB. TO BE CONFIRMED BY GEOTECHNICAL AND HYDRAULIC ENGINEERS. REFER SCHEMATIC DESIGN REPORT 22131S-RBG-ZZ-XX-RP-ST-00002 AND STRUCTURAL DESIGN BRIEF ALB-RBG-REP-ST-00-000-01 FOR MORE DETAILS. ALLOW FOR SLAB TO BE LOCALLY THICKENED AT SPOON DRAINS SUBJECT TO CONFIRMATION OF DETAILS. SPOON DRAIN DETAILS AND
2. LOCATIONS TO BE CONFIRMED BY HYDRAULIC ENGINEER. ALL CONCRETE FILLED TUBE (CFT) COLUMNS TERMINATE AT GROUND FLOOR. REFER TO TYPICAL COLUMN JUNCTION DETAILS.
3. ALLOW FOR HYDROTITE HYDROPHILIC SEALS TO ALL GROUND LEVEL CONSTRUCTION JOINTS. ALLOW LEAKMASTER WATER-SWELLING SEALANT TO ALL PENETRATIONS CAST THROUGH OR INTO GROUND LEVEL.
4. THE B1 SLAB HAS BEEN DESIGNED TO SUPPORT THE WEIGHT OF A RAINWATER TANK WHEN FULL OF WATER. NO UPLIFT CASE HAS BEEN
5. ADVISED BY THE HYDRAULIC ENGINEER AND THEREFORE HAS NOT BEEN ALLOWED FOR IN THE BASEMENT DESIGN. ARCHITECT AND
6. HYDRAULIC ENGINEER TO CONFIRM A RAINWATER TANK LAYOUT AND DESIGN THAT ACHIEVES THE FOLLOWING:
   a. THE TANK IS ONLY CONNECTED TO AND SUPPORTED OFF THE B1 SLAB.
   b. IT IS CRITICAL THAT THE TANK IS ISOLATED FROM ALL OTHER STRUCTURE ABOVE THE B1 SLAB TO AVOID CHANGING LOAD PATHS AND OVERLOADING THE BASEMENT STRUCTURE.
   c. THE ACCESS SHAFTS ARE ISOLATED FROM GROUND FLOOR SLAB.
   d. PENETRATIONS THROUGH LOWER GROUND AND GROUND FLOOR SHALL BE COORDINATED TO AVOID IMPACTING SLAB THICKNESSES. THE FINAL TANK LAYOUT AND LOADS DO NEED TO BE CONFIRMED.
7. THE TOP OF CAPPING BEAM LEVELS AND CONNECTION BETWEEN SLABS/BEAMS AND CAPPING BEAM SUBJECT TO CONFIRMATION OF THE STRIP DRAIN SIZE, RECESS AND LOCATION. ARCH TO CONFIRM.
8. PIT SLAB THICKNESS TO LIFTS SUBJECT TO CONFIRMATION OF LIFT PIT LOADS BY VT SUB-CONTRACTOR.
9. CAST-IN ANCHORS TO BE PROVIDED FOR TEMPORARY FLOOD BARRIERS. REFER TO LOADING PLAN FOR FLOOD BARRIER EXTENTS.

SLAB COVER SCHEDULE UNO

LOCATION/ELEMENT	COVER (mm)
RC SLABS (B02-GROUND, LOBBIES)	
- B02 BTM	50
- INTERNAL BTM	30
- INTERNAL TOP	30
- EXTERNAL BTM	40
- EXTERNAL TOP	40
COMPOSITE SLABS	
- INTERNAL BTM	25
- INTERNAL TOP	25
- EXTERNAL BTM	30
- EXTERNAL TOP	30

NOTES:
1. EXTERNAL BONDEK SLABS TO BE 40MPa MINIMUM.
2. REFER DRG ST-00-011-07 FOR PLACEMENT OF REINFORCEMENT IN SLABS FORMED BY PROFILED STEEL SHEET FORMWORK.

SLAB CONCRETE STRENGTH SCHEDULE UNO

LOCATION/ELEMENT	CONCRETE MIX
B02, B01, LG, GROUND	CM403
LOBBY SLABS	CM402
COMPOSITE LEVELS	
- L01 - L14	CM402
- L15 - L28	CM321
- L29	CM402
- L30 - L37	CM321
- L38+	CM402
- L30 - U/S L39	CM503

NOTES:
1. REFER TO CONCRETE SPECIFICATION FOR MIX TYPES

SLAB RATES SCHEDULE UNO

LOCATION/ELEMENT	REINF'T RATE [kg/m3]
SUSPENDED RC SLABS	
- B02 - LG	150
- GROUND	200
- LOBBY SLABS	125
COMPOSITE SLABS	
- L01 - L14	
INTERNAL	110
EXTERNAL	135
- L15 - L37	90
- L38 - L39	135
- L39+	135

NOTES:
1. REFER TO DRG ST-08-BC2-01 AND DRG SERIES ST-00-011-01 TO -06 FOR SLAB ON GROUND REINFORCEMENT DETAILS.
2. ALLOW ADDITIONAL 6kg/m2 REINFORCEMENT FOR L06 & L14 COMPOSITE SLABS.
3. ALLOW ADDITIONAL 3kg/m2 REINFORCEMENT FOR L07-L13 COMPOSITE SLABS.
4. ALLOW ADDITIONAL 50kg/m3 FOR L06 AND L14 THICKENED LOBBY SLABS.

PRINT DRAWINGS IN COLOUR

GENERAL ARRANGEMENT LEGEND:

- DENOTES INSITU CONCRETE ELEMENT OVER
- DENOTES LOAD BEARING ELEMENT UNDER
- DENOTES LOAD BEARING ELEMENT UNDER AND INSITU CONCRETE ELEMENT OVER
- DENOTES PRECAST ELEMENT OVER
- RB? (LB) / RB? (NLB) — DENOTES BLOCKWORK AND TYPE REFER S??.?? SERIES DRAWINGS FOR SCHEDULE AND TYPICAL DETAILS
- DENOTES SPOON DRAIN
- DENOTES 150 CONDECK SLAB BUILT OFF COREFILLED REINFORCED 140 BLOCKWORK WALLS AT SLAB EDGES AND MAX 2000 CTRS.
- DENOTES STRIP DRAIN OR FLOOD BARRIER RECESS. SLAB DEPTH SUBJECT TO FINAL RECESS DIMENSIONS.
- DENOTES PENETRATION
- DENOTES EXTENT OF PROVISIONAL SERVICE PIPE PENETRATION ZONE INCLUDING FIRE COLLARS. PROVIDE TRIMMING REINFORCEMENT TO STANDARD DETAILS. SERVICES SHOP DRAWINGS TO BE SUBMITTED FOR RBG REVIEW
- DENOTES SUMP
- STEP — DENOTES SLAB STEP
- THK — DENOTES SLAB THICKNESS
- TAG / SIZE — DENOTES COLUMN NUMBER AND SIZE
- W? — DENOTES WALL NUMBER & DIRECTION ELEVATION IS VIEWED

Rev	Revision Description	By	App	Date
T02	ISSUED FOR TENDER	DS	MA	17.07.24
T01	ISSUED FOR TENDER	DS	MA	28.06.24
A02	80% DD DRAFT	DS	MA	07.06.24
A01	50% DD ISSUE	SV	MA	09.08.23
P01	DRAFT 50% DESIGN DEVELOPMENT	SV	MA	28.07.23

SCALE 1 2 3 4 5 6 7 8

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ACN 010 580 248

Client
QIC

Project
101 ALBERT STREET, BRISBANE

Title
GROUND LEVEL GENERAL ARRANGEMENT PLAN

Date
Jun 2024
Scale at A1
1:100
Drawn
D.STUCKEY
Designer
N.DOYLE/T.KATUNAR
Design Checker
-
Job Number
22131S
Approved
M.AVERY

FOR TENDER - NOT FOR CONSTRUCTION

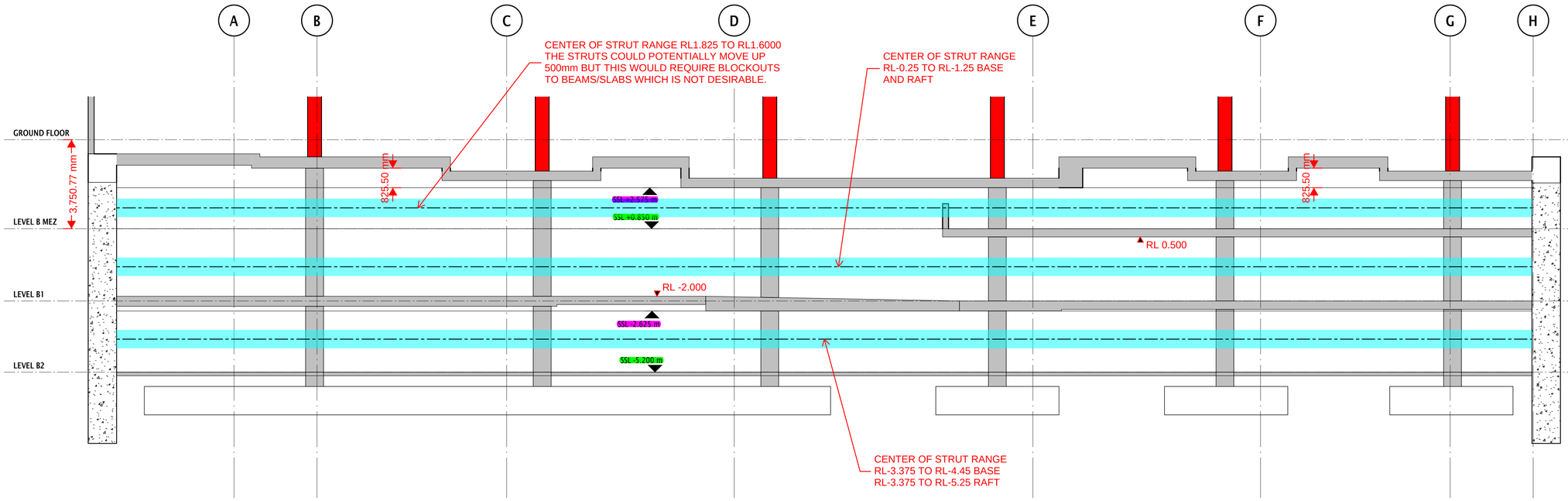
Drawing Number
ALB-RBG-DWG-ST-08-L00-01
Revision
T02



Appendix B
Adjacent Existing Building Information and Temporary Shoring Strut RL's

Document Number: ALB-RBG-REP-ST-00-000-05
Revision: T01

POTENTIAL TEMPORARY STRUT RL'S
S22131-RBG-ST-0016-02



BASE CASE CENTER OF STRUT RL RANGE

RL	900DIA	TOL	WALL CONNECTION	RL CL
2.575	0.45	0.1	0.2	1.825
0.850	0.45	0.1	0.2	1.6
0.500	0.45	0.1	0.2	-0.250
-2.000	0.45	0.1	0.2	-1.250
-2.625	0.45	0.1	0.2	-3.375
-5.200	0.45	0.1	0.2	-4.45

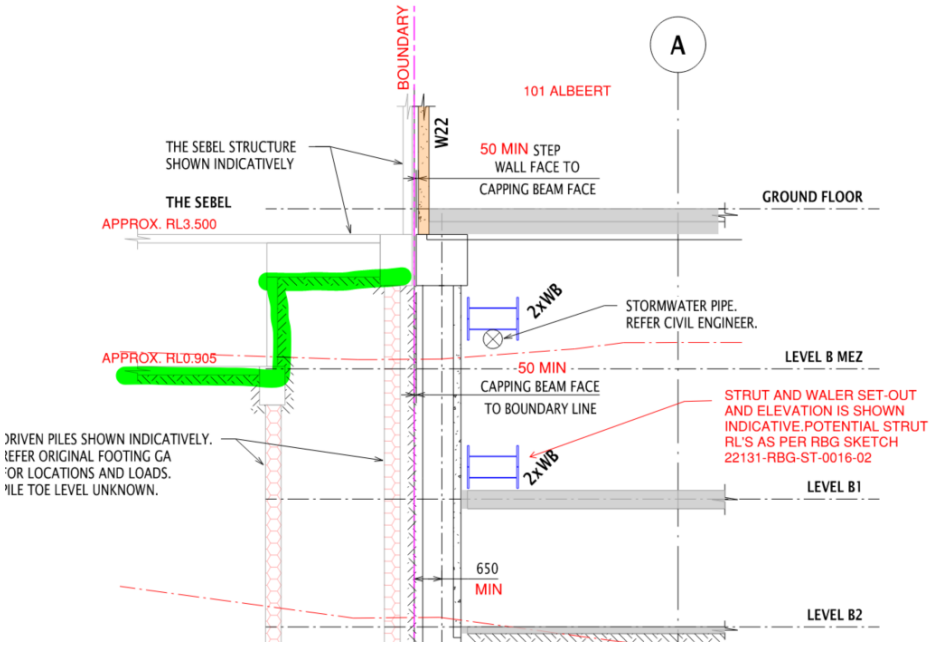
RAFT CENTER OF STRUT RL RANGE

RL	900DIA	TOL	WALL CONNECTION	RL CL
2.575	0.45	0.1	0.2	1.825
0.850	0.45	0.1	0.2	1.6
0.500	0.45	0.1	0.2	-0.250
-2.000	0.45	0.1	0.2	-1.250
-2.625	0.45	0.1	0.2	-3.375
-6.000	0.45	0.1	0.2	-5.25

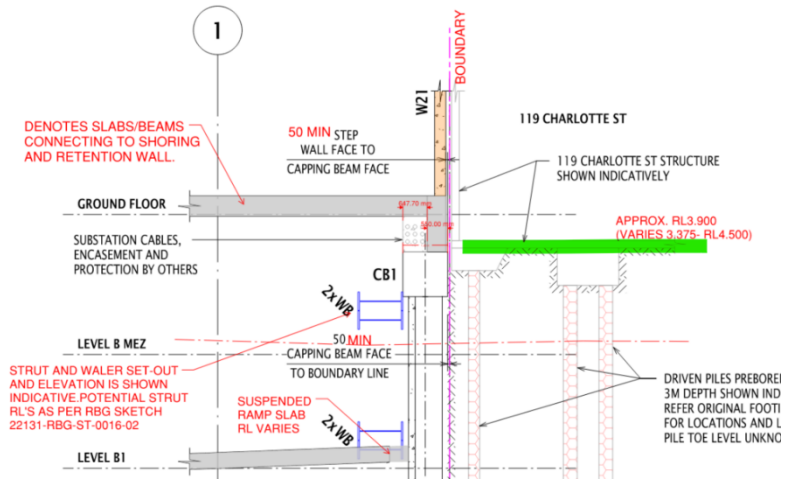
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Building Surcharge Markup and Levels (by RBG)

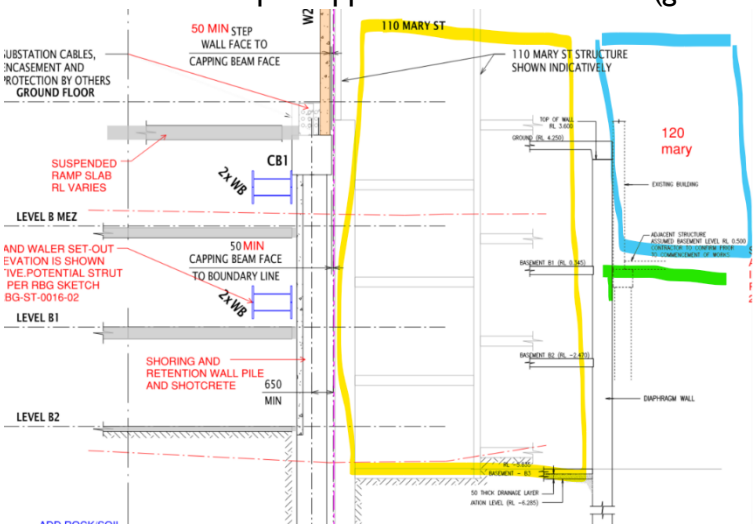
The Sebel: Design for Sebel pile loads if required. Design for soil load based on green height. G and Q loads from the site plan applied at basement level (green line).

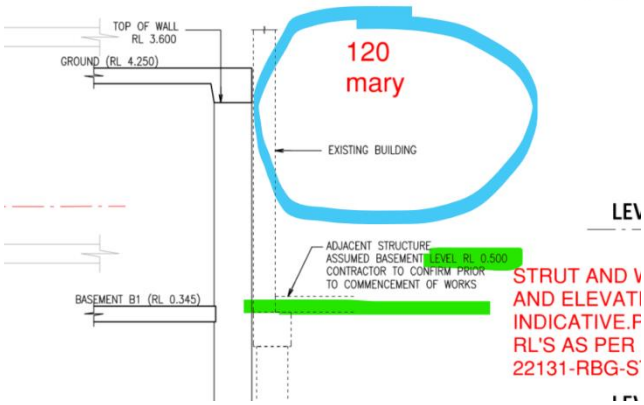


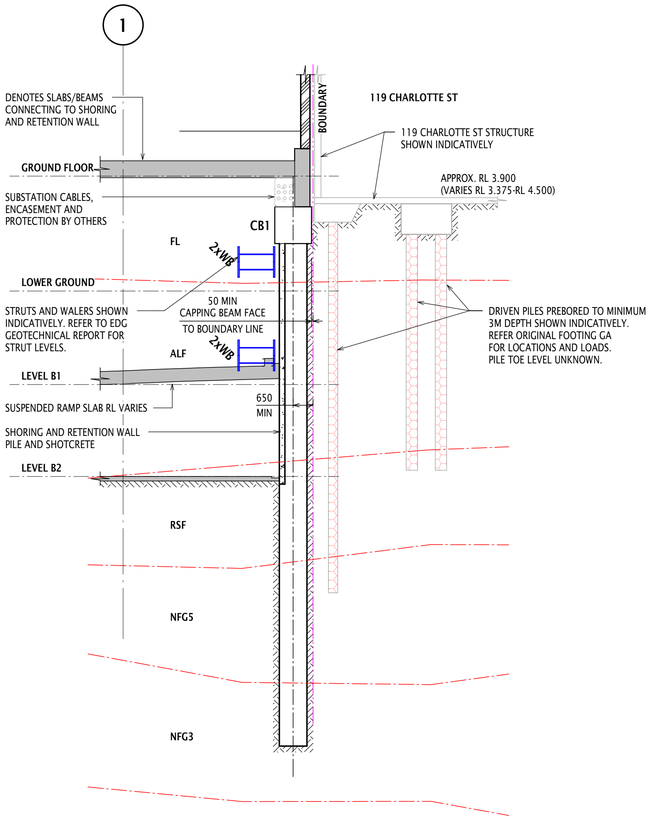
119 Charlotte: Design for 119 Charlotte pile loads if required. Design for soil load based on green height. G and Q loads from the site plan applied at basement level (green line).



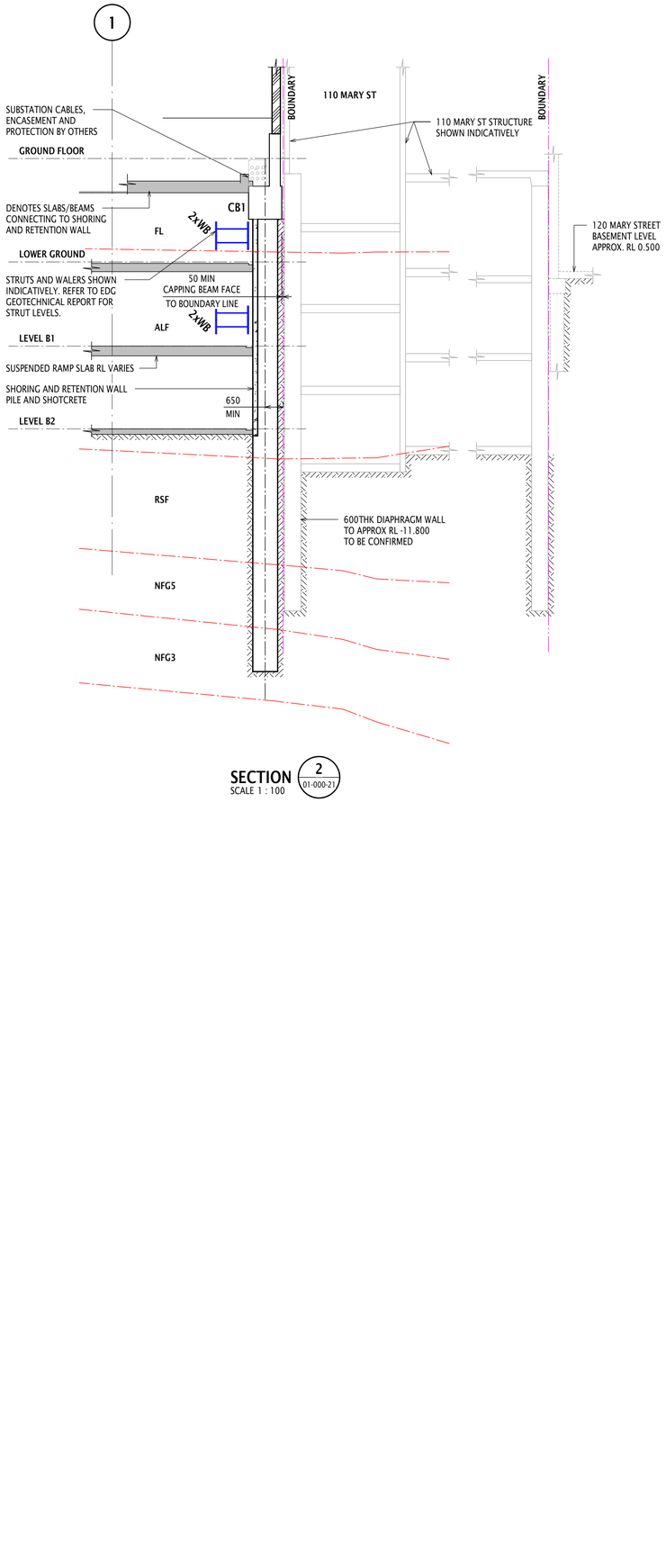
110 Mary: Design for soil load based on green height based on 120 Mary basement. G and Q loads from the site plan applied at basement level (green line).



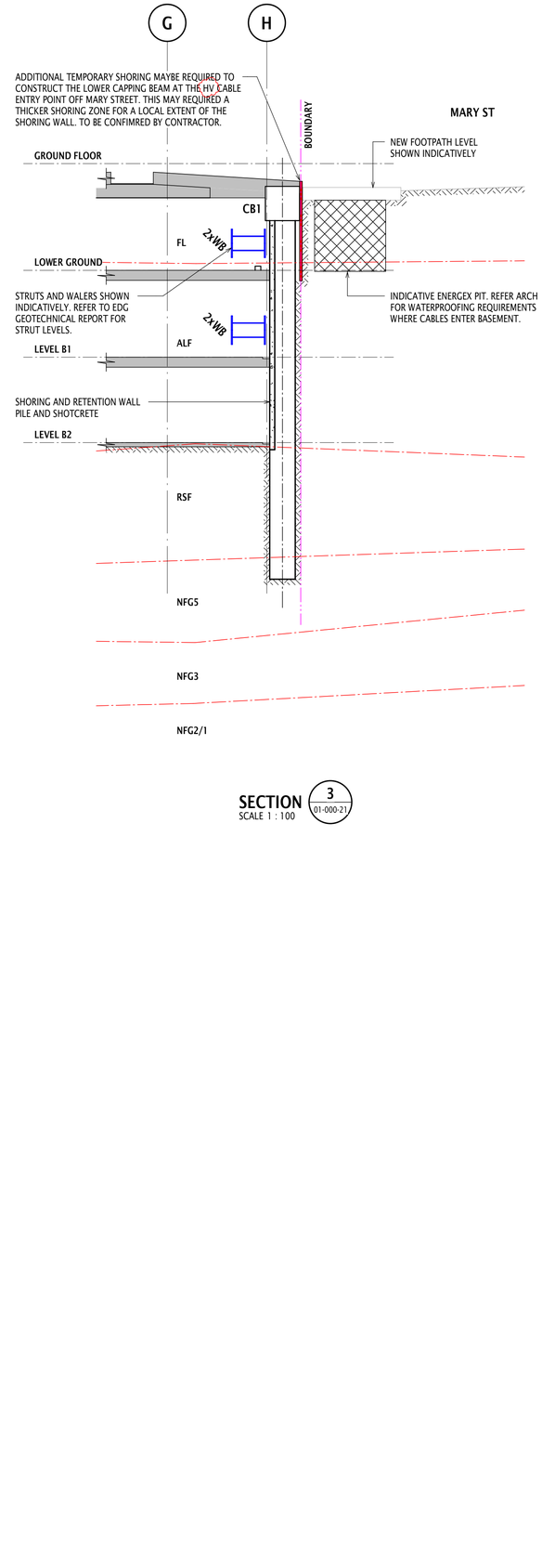




SECTION 1 / 01-000-21
SCALE 1 : 100



SECTION 2 / 01-000-21
SCALE 1 : 100



SECTION 3 / 01-000-21
SCALE 1 : 100

PRINT DRAWINGS IN COLOUR

NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE FOLLOWING:
   a. SITE PLAN, LOADS AND NOTES ON DRG ST-01-000-01.
   b. CRR ASSET PROXIMITY PLANS ON DRG ST-01-000-11 & 12.
   c. TEMPORARY SHORING AND RETENTION GENERAL ARRANGEMENT PLAN ON DRG ST-01-000-21.
   d. SHORING ELEVATIONS ON DRG ST-01-000-41 & 42.
2. EXISTING BUILDING FOOTING RL'S ARE APPROXIMATE. TO BE CONFIRMED ON SITE.
3. EXISTING BUILDING LOADS, SETOUT AND GEOMETRY HAVE BEEN BASED ON THE AVAILABLE HISTORIC DRAWINGS AND ARE APPROXIMATE ONLY. RBG CANNOT CONFIRM THE ACCURACY OF THESE DRAWINGS, WHETHER THEY REFLECT THE AS-BUILT STRUCTURES OR WHETHER THE STRUCTURES HAVE BEEN UNKNOWINGLY MODIFIED LATER. DETAILED SURVEY REQUIRED TO VERIFY.
4. REFER TO EXISTING BUILDING STRUCTURAL DRAWINGS FOR NEIGHBORING BUILDING PILES LOADS AND LEVELS.
5. REFER TO ARCHITECTS FOR ALL FLOOR AND GROUND LEVELS.

80% DD NOTE:

- THE SHORING WALL SYSTEM AND LEVEL OF WATER RESISTANCE TO BE REVIEWED AGAINST GROUNDWATER CONDITIONS ONCE CONFIRMED. ALTERNATIVE SYSTEMS MAY NEED TO BE INVESTIGATED.
- GROUNDWATER LEVELS HAVE NOT BE SHOWN DUE TO INSUFFICIENT INFORMATION. TO BE CONFIRMED ONSITE.

Rev	Revision Description	By	App	Date
T02	ISSUED FOR TENDER	DS	MA	17.07.24
T01	ISSUED FOR TENDER	DS	MA	28.06.24
A01	80% DD DRAFT	DS	MA	07.06.24

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ACN 010 580 248

Client
QIC

Project
101 ALBERT STREET, BRISBANE

Title
SHORING SECTIONS
SHEET 1

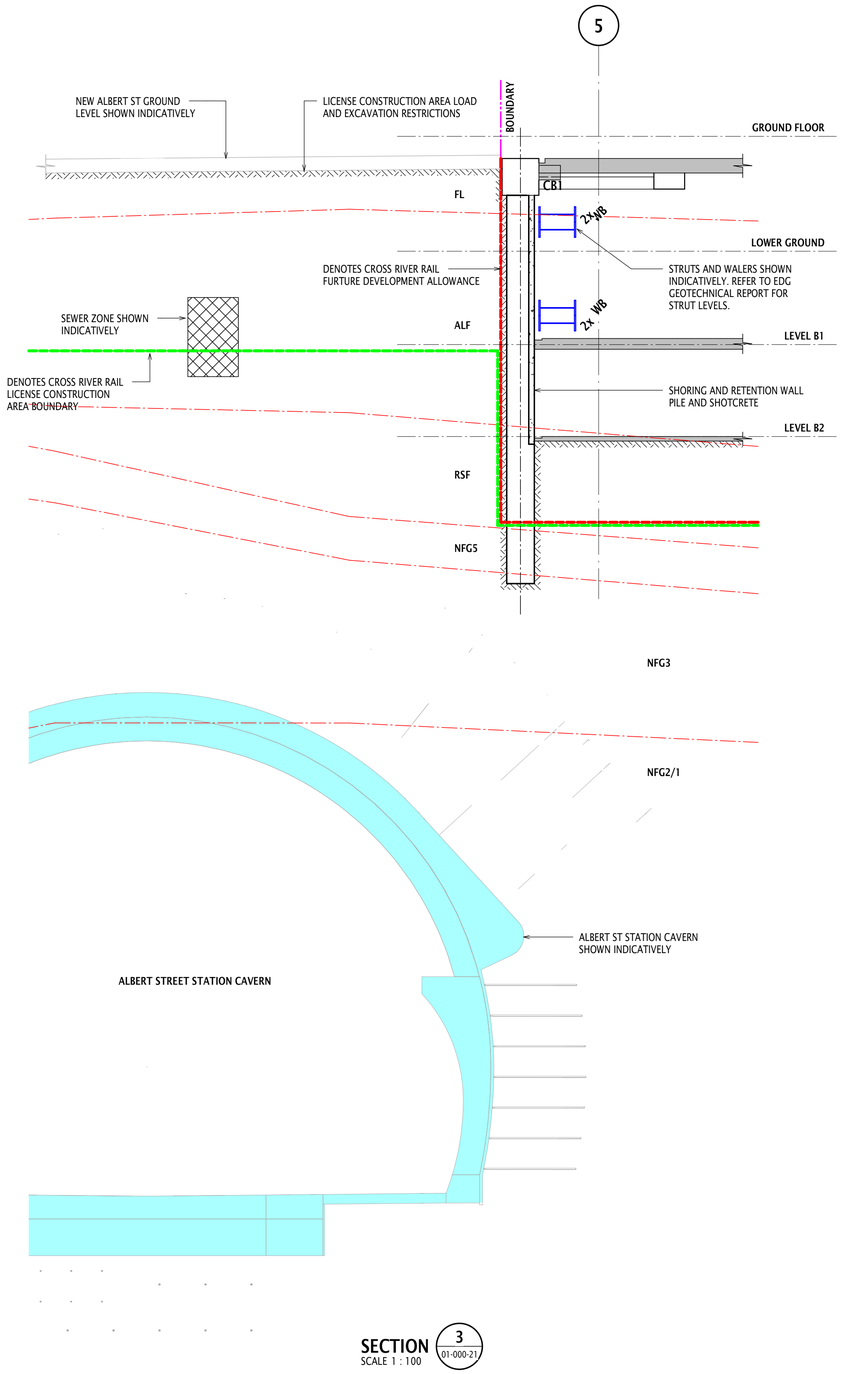
Date
Jun 2024
Scale at A1
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Drawn
D.STUCKEY
Designer
N.DOYLE/T.KATUNAR
Design Checker
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Approved
M.AVERY

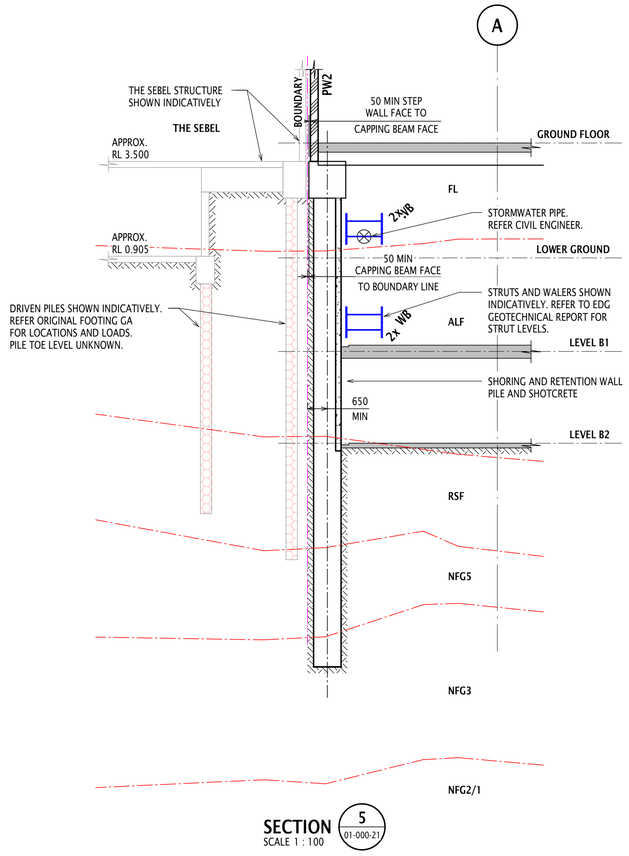
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Drawing Number
ALB-RBG-DWG-ST-01-000-61

Revision
T02



SECTION 3 (01-000-21)
SCALE 1 : 100



SECTION 5 (01-000-21)
SCALE 1 : 100

PRINT DRAWINGS IN COLOUR

NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE FOLLOWING:
   a. SITE PLAN, LOADS AND NOTES ON DRG ST-01-000-01.
   b. CRR ASSET PROXIMITY PLANS ON DRG ST-01-000-11 & 12.
   c. TEMPORARY SHORING AND RETENTION GENERAL ARRANGEMENT PLAN ON DRG ST-01-000-21.
   d. SHORING ELEVATIONS ON DRG ST-01-000-41 & 42.
2. EXISTING BUILDING FOOTING RL'S ARE APPROXIMATE. TO BE CONFIRMED ON SITE.
3. EXISTING BUILDING LOADS, SETOUT AND GEOMETRY HAVE BEEN BASED ON THE AVAILABLE HISTORIC DRAWINGS AND ARE APPROXIMATE ONLY. RBG CANNOT CONFIRM THE ACCURACY OF THESE DRAWINGS, WHETHER THEY REFLECT THE AS-BUILT STRUCTURES OR WHETHER THE STRUCTURES HAVE BEEN UNKNOWINGLY MODIFIED LATER. DETAILED SURVEY REQUIRED TO VERIFY.
4. REFER TO EXISTING BUILDING STRUCTURAL DRAWINGS FOR NEIGHBORING BUILDING PILES LOADS AND LEVELS.
5. REFER TO ARCHITECTS FOR ALL FLOOR AND GROUND LEVELS.

80% DD NOTE:

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- GROUNDWATER LEVELS HAVE NOT BE SHOWN DUE TO INSUFFICIENT INFORMATION. TO BE CONFIRMED ONSITE.

Rev	Revision Description	By	App	Date
T02	ISSUED FOR TENDER	DS	MA	17.07.24
T01	ISSUED FOR TENDER	DS	MA	28.06.24
A01	80% DD DRAFT	DS	MA	07.06.24

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Client
QIC

Project
101 ALBERT STREET, BRISBANE

Title
SHORING SECITONS
SHEET 2

Date
Jun 2024
Scale at A1
1:100

Drawn
D.STUCKEY
Designer
N.DOYLE/T.KATUNAR
Design Checker
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Approved
M.AVERY

FOR TENDER - NOT FOR CONSTRUCTION

Drawing Number	Revision
ALB-RBG-DWG-ST-01-000-62	T02



Appendix C
EDG Geotechnical Engineering Reports

Document Number: ALB-RBG-REP-ST-00-000-05
Revision: T01

C-1 EDG Geotechnical Report B01493-1BC

EDG consulting

Geotechnical Report
Albert Street - Issue for Tender
Brisbane, QLD



Prepared for:
Albert Street Trust

Document Reference:
B01493-1BC

Version:
11 August 2024

Document:

Geotechnical Report
Albert Street - Issue for Tender
Brisbane, QLD

Prepared for:

Albert Street Trust

Document Reference:

B01493-1BC

Version:

11 August 2024

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Notes:

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1 Project Background

The CRR Albert Street Pty Ltd (ACN 660 319 693) as trustee for CRR Albert Street Trust (Albert Street Trust) has been awarded the development rights for the Cross River Rail (CRR) precincts, including the proposed development at 101 Albert Street in Brisbane CBD. Development of the 101 Albert Street mixed used precinct will include a commercial tower in the order of 200m tall with approximately 45 floors above ground level, along with a multi-level basement,

The 101 Albert Street site is approximately 38m width and 60m length in plan dimensions and is located towards the southern portion of Brisbane CBD. It is bounded by Albert Street to the south west, the Sebel Brisbane Hotel to the north west, the buildings located at 110 Mary Street and 119 Charlotte Street to the north east and Mary Street to the south-east.

The site was referred to as 'Albert Street Lot 2' during the CRR project, and currently contains a temporary acoustic structure above ground and an access shaft and two mined adits below ground, that have provided temporary construction access for the CRR project.

The Albert Street Station cavern that runs parallel to Albert Street with the top of the cavern located approximately 17m below ground. The proposed building and its foundations must be designed to satisfy the requirements of the Cross River Rail Delivery Authority (CRRDA), which specifically must not exceed allowable loading and distortion criteria at the cavern location. The site location and nearby surrounds are shown on Diagram 1.



Diagram 1 – Site Layout

EDG Consulting Pty Ltd (EDG) has been engaged to provide geotechnical services for the project and have previously provided geotechnical interpretation and advice to inform the project Development Application (DA), which was presented in our previous correspondences, B01493-1AC (dated 21/12/2022) and B01493-1AE (dated 29/05/2023).

This report expands on the work carried out at DA stage and presents advice to inform the 80% design which will form part of the Issue For Tender (IFT) package. We understand that the subsequent design stage will include contractor involvement to finalise the design ahead of construction.

2 Ground Conditions

2.1 Overview of Geological History and General Stratigraphy

From the Devonian period to the Carboniferous period (about 360 million years ago), the sediments of the Neranleigh Fernvale Group were deposited off the edge of a broad continental shelf. Over tens of millions of years, these materials were lithified, then folded, faulted, recrystallised and uplifted to form much of the coastal land surface of south-east Queensland. Subsequently, a significant thickness of the deeply and variably weathered land surface was removed through erosion to form the irregular bedrock surface of the present.

Up to about 200 million years ago, various stress fields developed within the rocks underlying Brisbane through episodic volcanism and mild compression, leading to the formation of a foliation as the distinct fabric within the rock, and well developed sets of joints. Natural processes of weathering at surface level and along structures within the rock mass have resulted in residual soils near the old ground surface and a weathering profile with depth in the rock.

During the past 10,000 or so years Holocene aged alluvial materials have been deposited due to sea level rise, including within the broad west to east trending valley through Brisbane city, which according to published geological maps, is about 160m wide at the Albert Street site.

More recently, fill materials have been placed over the ground surface, and may be present to a depth of up to about 3m within the vicinity of the site. Table 1 provides a summary of the major geological units that relate to the project site.

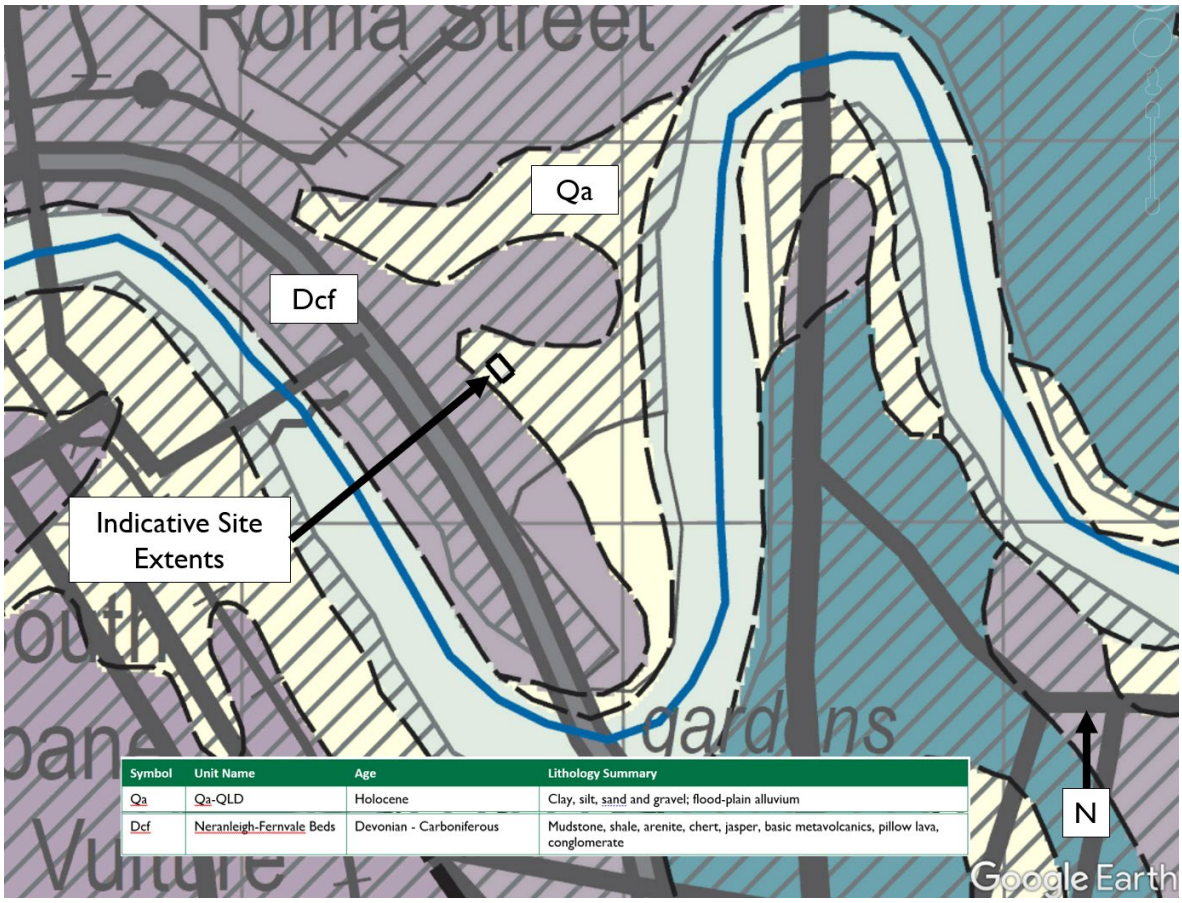
Table 1 – Summary of Geological Units

Age	Formation or Origin	Lithology or Soil Type and Fabric
Recent	Fill	Mixed fine and coarse grained soils, may be controlled or uncontrolled.
Holocene (Recent <10,000 years)	Alluvium	Fine and coarse grained soils.
Carboniferous to Devonian 330 to 360 MA	Neranleigh Fernvale Group	Argillite, greywacke, greenstone, phyllite. Undulating foliation dipping variably towards the north-east.

2.2 Published Information

Based on a review of the 1:100,000 series Brisbane geological map (2015), the site is underlain by Holocene Alluvium, which is underlain by weathered rock of the Devonian age, Neranleigh-Fernvale Beds.

Fill may be present from previous development of the site and general regrading associated with the alluvial areas predating the early development. The published geological information is reproduced in Diagram 2.



Symbol	Unit Name	Age	Lithology Summary
Qa	Qa-QLD	Holocene	Clay, silt, sand and gravel; flood-plain alluvium
Dcf	Neranleigh-Fernvale Beds	Devonian - Carboniferous	Mudstone, shale, arenite, chert, jasper, basic metavolcanics, pillow lava, conglomerate

Diagram 2 – Published Geological Information

2.3 Site Investigation Information

Several geotechnical ground investigations have been carried out at or near to the site, for the CRR project as well as the development of adjacent buildings. The available geotechnical investigation data mainly comprises boreholes, with a limited number of piezocones. The boreholes used in the assessment are summarised in Table A1 in Appendix A.

2.4 Stratigraphy

The available geotechnical investigation data has been interpreted to develop a series of geological cross sections which are shown on drawings B01493-01-B2 to B5 presented in Appendix B. The cross sections depict the interpreted distribution of the geotechnical units along each boundary of the site. Note that these cross sections represent an interpretation of stratigraphy between discrete data points and the actual ground stratigraphy may vary from what is shown on the cross sections. The general geological stratigraphy and engineering description relating to each of the geotechnical units is presented in Table 2.

Several defect sets are present within rock, with the dominant set being a well developed foliation, sub-parallel to bedding which in the project area dips variably to the north-east at angles between 30° and 60°.

Table 2 – Interpreted Geotechnical Units

Material Unit	General Description
Fill (FL)	Sand / Sandy Clay: medium plasticity, brown, fine to coarse sand and sub-rounded gravel, stiff / medium dense. Fill is uncontrolled and is variable in nature
Fine Grained Holocene Alluvium (AL F)	Clay: soft to firm, high plasticity, dark grey, with some sand
Fine Grained Holocene Alluvium (AL F)	Fine to medium sand with some clay
Residual Soil (RS F)	Clay: high plasticity, red-brown motley grey, some/trace sand and gravel, very stiff to hard
Extremely Weathered Material (NFG5)	Sandy Gravelly Clay: low to medium plasticity, brown and grey, fine to coarse angular gravel and sand, hard with visible rock structure
NFG3	Phyllite: fine grained, grey and pale brown, distinct laminations, dipping at 60° to 65°, medium strength, moderately weathered.
NFG1 / NFG2	Phyllite: fine grained, pale grey-blue, distinctly laminated, high strength, fresh.

3 Groundwater

The eastern extent of the project site is located approximately 325m from the riverbank of the Brisbane River. It is expected that groundwater is controlled by the Brisbane River level such that in the absence of activities due to human activity (such as basement dewatering), groundwater levels would be expected to be approximately equal to the level of Brisbane River at the riverbanks, and increase away from the riverbanks generally reflecting land surface topography.

Several deep basements and other buried infrastructure exist within the CBD which may have locally lowered groundwater levels due to dewatering. The closest buried structure is the CRR Albert Street cavern, which sits directly beneath the western edge of the site with its invert level at approximately 33m below ground level.

We understand that the Albert Street cavern is permanently drained, and therefore, groundwater heads within the vicinity of the cavern are expected to be locally lowered, impacting groundwater conditions within the 101 Albert Street site.

During the initial investigation stage of the CRR project, several groundwater monitoring instruments comprising standpipe piezometers and vibrating wire piezometers (VWPs) have been installed in boreholes located within proximity of the site. The available groundwater monitoring readings are summarised on the plan attached in Appendix C.

In addition to the groundwater monitoring readings shown on the plan attached in Appendix C, several more VWPs have been installed during the CRR project. Groundwater monitoring data from three VWPs located within proximity of the site location is summarised in Table 3.

Table 3 – Available Groundwater Monitoring Data Summary

Location	Available Monitoring Period		Groundwater RL (m AHD)
	From	To	
CRR1025	September 2020	February 2021	-22
CRR1026	October 2020	August 2021	-23
CRR1031	August 2020	May 2023	-21

Based on the monitoring data presented in Table 3 and the knowledge that the cavern is a drained structure, the groundwater level within the rock units is expected to be approximately equal to the cavern invert drainage level and increase in elevation away from the cavern as indicatively shown in Diagram 3.

No groundwater monitoring data has been made available to EDG for the shallow materials such as the Fill and Alluvium, perched groundwater is expected to exist within the alluvial soils, being continuously recharged by Brisbane River, and prevented from draining down into the rock units by the Residual Soil and Extremely Weathered materials.

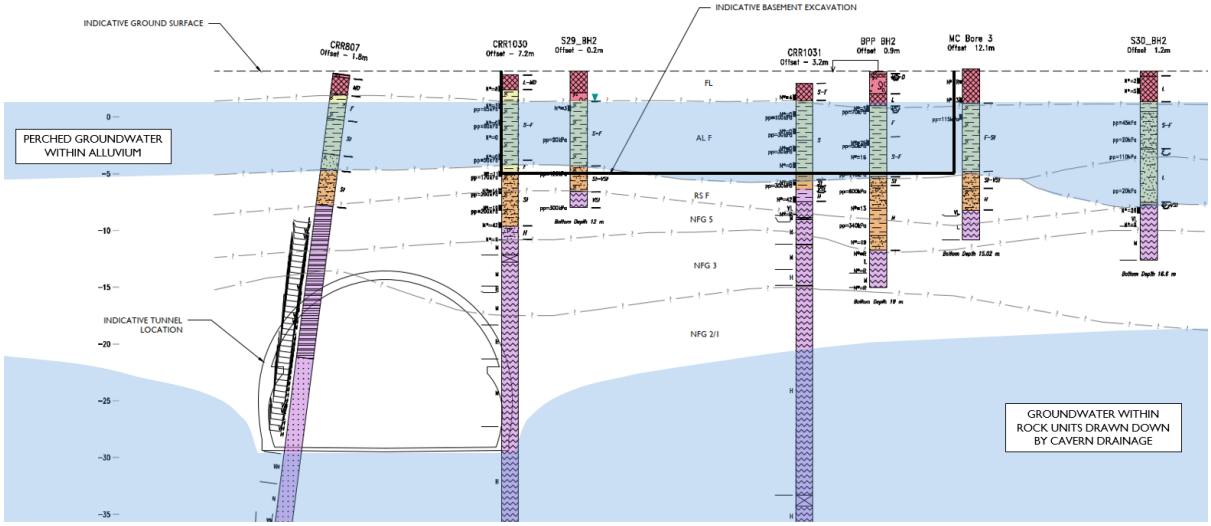


Diagram 3 – Conceptual Groundwater Conditions

4 Geotechnical Engineering Parameters

Geotechnical parameters have been developed on a 'moderately conservative' basis for the materials units present at the site based on the results of field and laboratory testing, supplemented with published data, correlations and previous experience. Note that a comparison of the derived parameters was carried out with the published rock mass parameters presented by Cammack (2023[1]) which indicated good agreement.

The basis of parameter selection is presented in Table 4. The adopted material parameters are summarised in Table D1 in Appendix D.

[1] Cammack, R., Bertuzzi, R., Smith, A., Brehaut, R., 2022. Rock Mass Parameters for the Brisbane CBD. Australian Geomechanics, Volume 57, No 4.

Table 4 – Basis of Geotechnical Parameter Interpretation

Parameter	Basis of Interpretation
Unit weight of soil	Previous experience with similar soils and rock, along with engineering judgement.
At rest earth pressure coefficient (K0)	Previous experience with similar soils and rock, along with engineering judgement.
Undrained shear strength parameters (Su)	Interpretation of results of in-situ testing including hand shear vane and pocket penetrometer testing.
Drained shear strength parameters (c´, ϕ')	Results of available triaxial shear strength testing along with previous experience with similar soils and rock, and engineering judgement. Assessment using RocLab based on rock mass characterisation to assess equivalent Mohr-Coulomb parameters.
Unconfined Compressive Strength of Rock Units	Interpretation of available point load and UCS test data.
Soil and Rock Elastic Modulus	Previous experience with similar soils and rock, along with engineering judgement.
Rock Mass Elastic Modulus	Assessment of the rock mass GSI and use of the Generalised Hoek and Diederichs equation (2006).
Poisson's Ratio	Previous experience with similar soils and rock, along with engineering judgement.
Soil and Rock Unit Permeabilities	Interpretation of available packer test data from CRR project, along with previous experience and engineering judgement.

5 Retention System

5.1 Proposed Arrangement

The proposed development comprises a three-level underground basement comprising LG, B1 and B2 levels. The basement will be constructed following a bottom-up methodology, therefore requiring a retention system to control groundwater infiltration, support the excavation and control wall deformations and until those lateral loads are transferred onto the permanent structure.

We expect that the final arrangement of the retention system would be finalised in the subsequent design stage, with involvement from the Contractor to incorporate its preferences and approach. At this stage RBG has nominated a retention system comprising an internally braced soldier pile retaining wall made up of 900mm diameter reinforced concrete bored piles. Reinforced shotcrete would be applied in between the soldier piles to prevent loss of material and control groundwater inflows.

Strip drains would be installed behind the shotcrete to control groundwater flows and pressure during the temporary excavation stages, with groundwater inflow controlled via a series of sumps. The strip drains would be subsequently blocked in the permanent case allowing hydrostatic water pressure to apply to the soldier piles and shotcrete.

Bulk Excavation Level (BEL) varies across the site: A BEL of RL -8m is adopted within the section along Albert St; RL -9m adopted within the core pile cap; and RL -5.6m adopted within the remaining areas. The base of pile caps for the podium piles are at RL -8m, requiring localised excavations to that level at those locations. The site BELs are shown in plan on Diagram 4 and in section on Diagram 5.

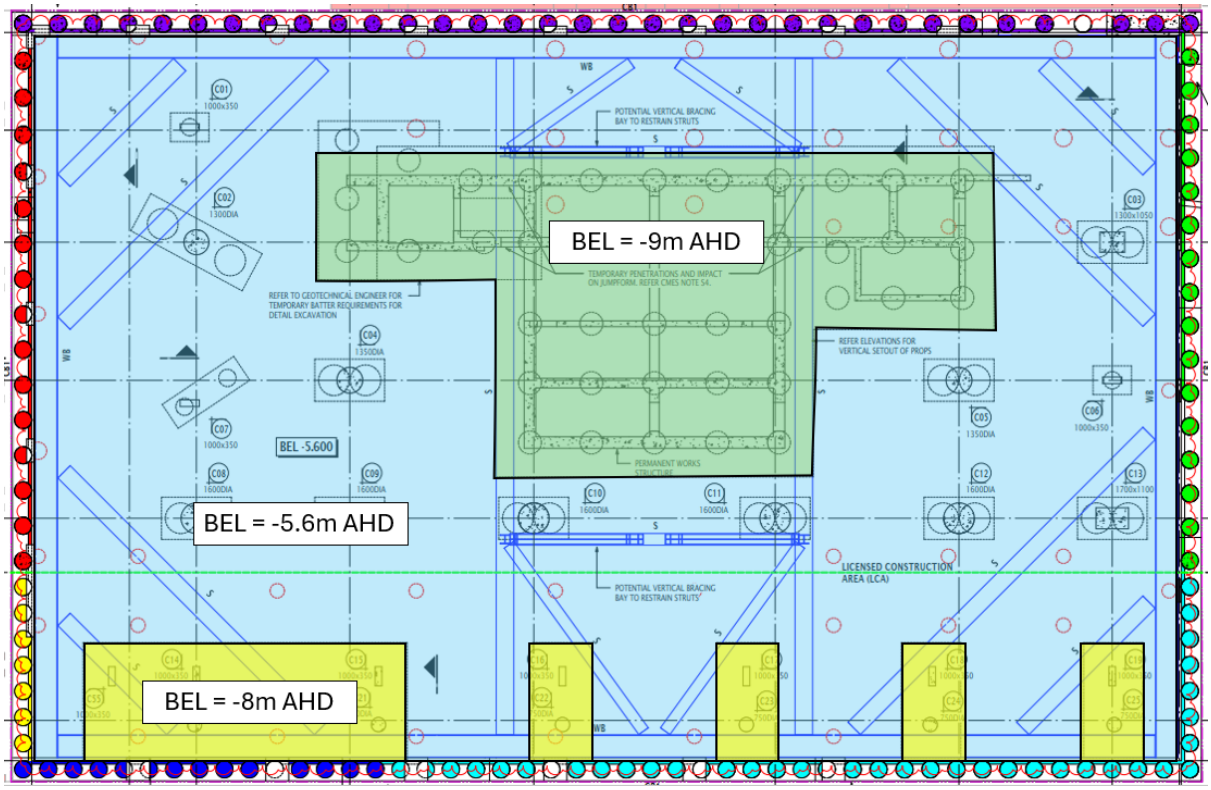


Diagram 4 – Bulk Excavation Levels

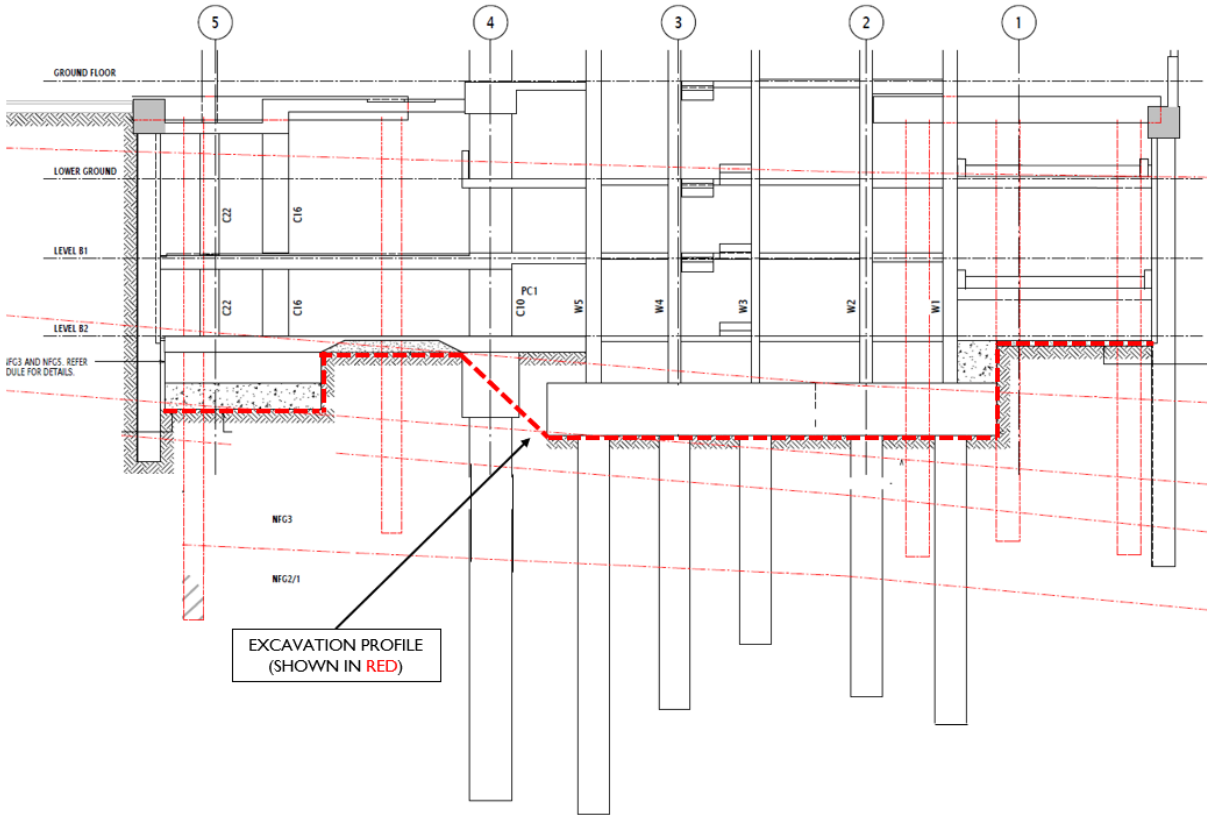


Diagram 5 – Excavation Profile

The retention piles would be connected at existing ground level by a reinforced concrete capping beam and would be laterally supported by a series of steel props and waler beams installed at two elevations, (i.e. an upper and lower row). In the permanent case, the soldier pile and shotcrete retaining wall will be supported by the permanent building slabs. The arrangement of the retention system is presented on the drawings in Appendix E.

Construction of the retention system is expected to be carried out in line with the following generalised sequence:

- Installation of bored piles and construction of capping beam.
- Excavation of first lift of material. Based on the variable nature of the fill and the relatively low strength of the alluvium and the potential for groundwater, it is expected that lift heights would be limited to approximately 1.5m. Note that removal of existing in ground structure, such as acoustic shed piles and pile caps would be carried out concurrently with bulk excavation.
- Application of shotcrete and reinforcement, along with strip drainage behind the shotcrete layer.
- Further excavation to below upper row of props, followed by installation of props and application of shotcrete and strip drainage.
- Pre-stress upper row of props.
- Further excavation to below lower row of props, followed by installation of props and application of shotcrete and strip drainage.
- Pre-stress lower row of props.
- Excavate to BEL.
- Removal of temporary props sequentially following installation of the permanent basement slabs.

5.2 Retention System Analysis – Vertical Capacity

5.2.1 Pile Requirements

As confirmed by RBG, the retention piles are required to accommodate permanent axial loads from the building as well as lateral loads from the retained materials. Assessment of the retention pile axial capacity has been carried out as described in the following sections.

5.2.2 Geotechnical Reduction Factor

A geotechnical strength reduction factor of ϕ_g = 0.5 is recommended at this stage in accordance with the process in AS2159:2009 Piling, based on the quality and quantity of information available.

The assessed geotechnical reduction factor is based on the quality and quantity of geotechnical site investigation information available. It may be possible to increase the geotechnical reduction factor following completion of the additional geotechnical investigation following site handover.

The geotechnical reduction factor considers that no pile load testing will be carried out during construction, however, increasing the geotechnical strength reduction factor would be expected should pile load testing be carried out during construction.

5.2.3 Pile Design Parameters

Design values of ultimate skin friction and ultimate end bearing have been assessed for all rock units. Ultimate skin friction and end bearing have been calculated based on the method proposed by Zhang

and Einstein (1998)[2]. Adopted values of ultimate skin friction and ultimate end bearing are summarised in Table 5.

Table 5 – Ultimate Pile Design Parameters

Material	Fs, Ultimate Skin Friction (kPa)	Fbu, Ultimate End Bearing (MPa)
Residual Soil	50	N/A
NFG 5	75	N/A
NFG 3	700	15
NFG 2/1	1300	25

5.2.4 Analysis Methodology

We have assessed the required pile socket lengths and associated pile toe levels in general accordance with AS2159-2009 Piling – Design and Installation and have followed the process shown on Figure 1 in Appendix F.

In addition to pile capacity calculations, vertical settlement of the retaining piles has been assessed using the commercially available software package Plaxis2D, considering the geotechnical parameters presented in Appendix D. Axisymmetric models were used to assess settlement under SLS loading conditions.

The assessment considered the following:

- The retaining wall will comprise reinforced concrete 900mm diameter piles spaced at a centre to centre (C2C) spacing of 1.8m.
- A young's modulus of 34.5GPa for the S50 concrete.
- Vertical loading from base slabs and capping beams as per the drawings provided by RBG in Appendix E were considered.
- Design Action Effect of 1.2G + 1.5Q for ultimate limit state (ULS). Note that no allowance for wind and earthquake loading has been considered, on the basis that wind and earthquake loads will be taken by the core as advised by RBG.
- Design Action Effect of G + Q for serviceability limit state (SLS). All estimated settlements and spring stiffness values are based on SLS loads.
- Pile toe levels on Albert Street side do not extend deeper than RL -10m.

5.2.5 Analysis Outcomes

In Appendix F, both the ultimate geotechnical capacity and design geotechnical capacity for the assessed pile toe levels have been provided, as well as estimated vertical settlements under working loads. Recommended values of vertical spring stiffness for structural modelling have also been included along with a range of lower and higher stiffness values which should be considered in a sensitivity assessment. Spring stiffness values have been extracted at bottom of pile cap level.

For Group 6 (as shown on the sketch in Appendix F), the retention piles are required to be socketed 1m into NFG5 material to satisfy the axial capacity requirements. Based on our interpretation of the

[2] Zhang, L. and Einstein, H. (1998). "End bearing capacity of drilled shafts in rock." ASCE Jnl. Geot. Eng., Vol. 124 (7), 574-584)

site conditions, the thickness of the NFG5 material would likely vary, and could be relatively thin in some areas. Its therefore possible that the retaining piles would actually found within the stiffer and stronger NFG3. Therefore, we recommend that RBG consider the set of spring stiffness values applicable to both NFG5 and NFG3 material in its structural model for Group 6, which is shown as Scenario 1 and Scenario 2 respectively, in Appendix F.

The required pile toe levels for the retention piles are summarised on Diagram 6.

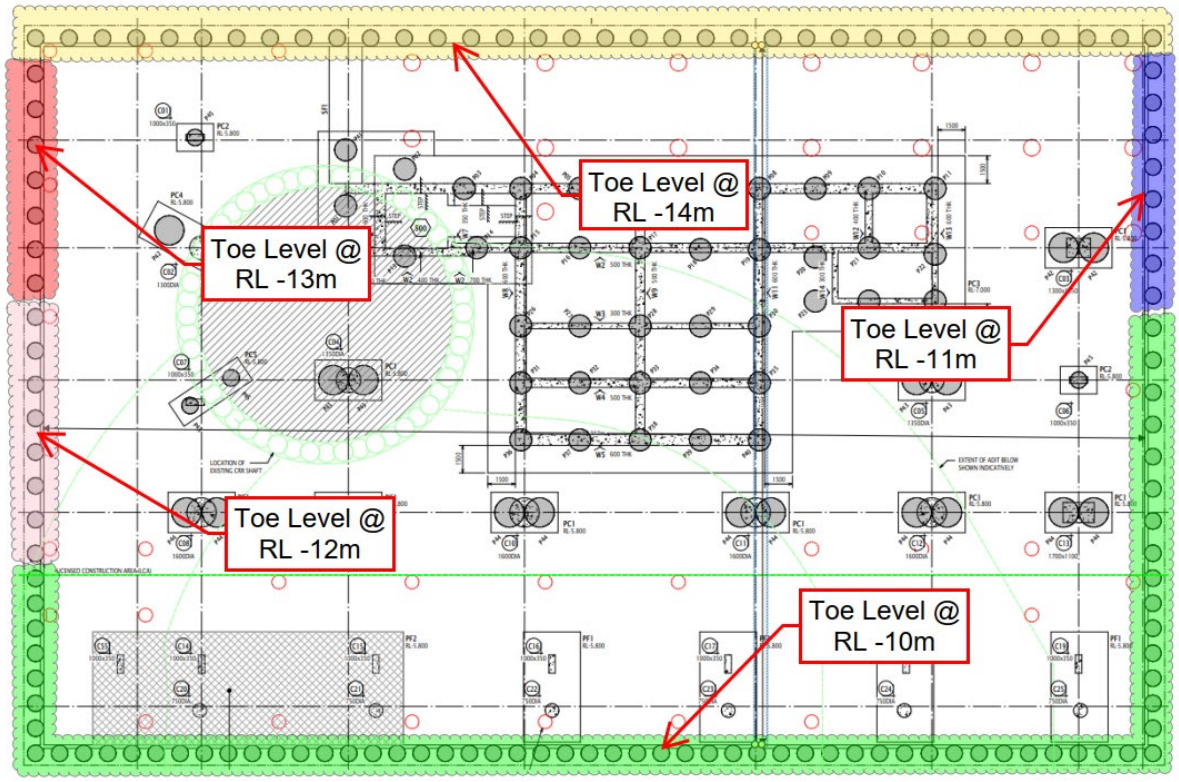


Diagram 6 – Retention Pile Toe Levels

5.3 Retention System Analysis – Lateral Performance

5.3.1 Analysis Methodology

Analysis of the lateral capacity and deflection of the retention system has been carried out using the commercially available software package WALLAP. The software carries out 2D analysis based on the plane-strain assumption and calculates wall structural actions and deflections. Several analysis sections have been selected to investigate the impacts of pile diameter, pile spacing, ground conditions, pile toe level and surface surcharge. The locations of the analysis sections are shown on Diagram 7.

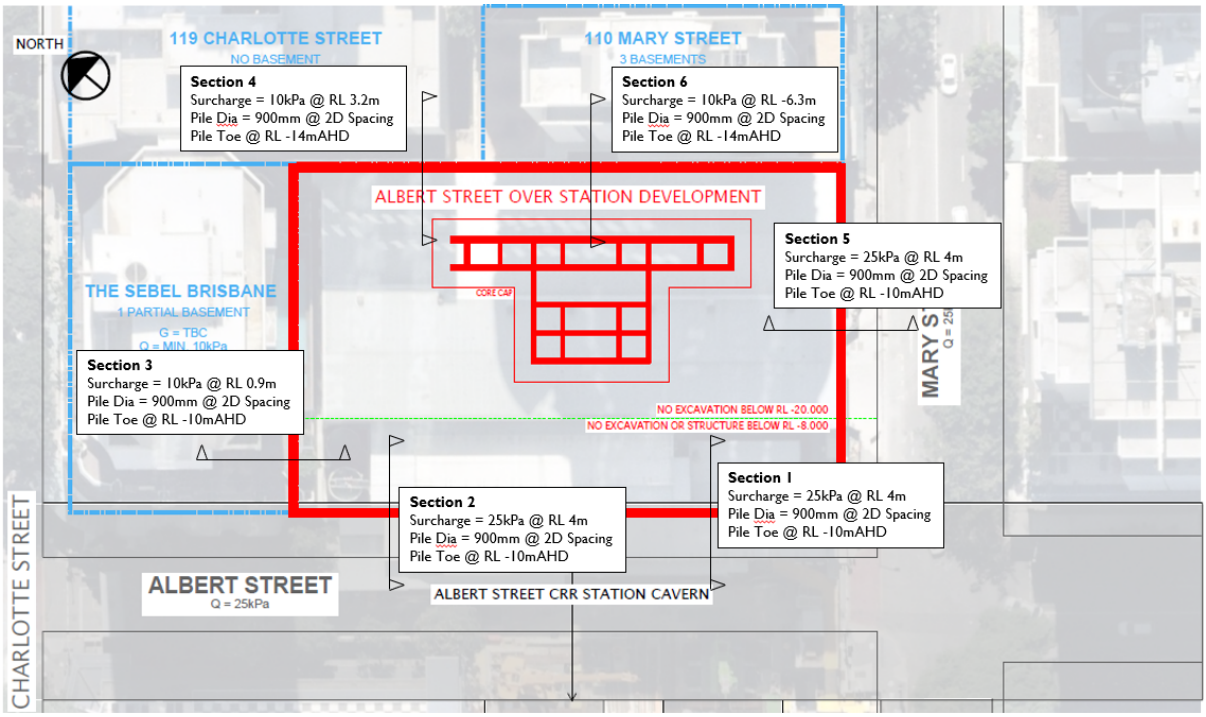


Diagram 7 – Retaining Wall Analysis Sections

Our assessment of the lateral performance of the retention system considers the following:

- The retaining wall will comprise reinforced concrete 900mm diameter piles spaced at a centre to centre (C2C) spacing of 1.8m.
- A young's modulus of 34.5GPa for the S50 concrete.
- As agreed with RBG, we have considered a full bending stiffness for the retention piles in the short term (during excavation) scenarios and a reduced bending stiffness of 70% in the long term (following installation of permanent slabs) and flood scenarios.
- Two rows of temporary props, we have considered an elevation of RL 1.8m and RL -3.4m for the upper and lower prop, respectively. A horizontal prop spacing of 7.5m has been considered.
- Surcharge and soil loads associated with the adjacent Sebel, 119 Charlotte Street and 110 Mary Street buildings have been updated and positioned at representative elevations based on the sketches provided by RBG, and attached in Appendix E.
- Incorporated additional bending moments due to eccentric structural loading as per the drawings provided by RBG in Appendix E.
- A flood level at RL 5.5m, which allows for a Q100 flood event plus additional freeboard has been considered in the long term permanent case.
- No flood case has been included in analysis of the construction stages.
- Pile toe levels on Albert Street side do not extend deeper than RL -10m.
- A pre-stress of 500kN per prop has been applied to limit wall deflections.

5.3.2 Construction Stages

The retaining wall analysis has considered the geotechnical parameters summarised in Table D1 in Appendix D and has followed the construction sequence summarised in Table 6.

Table 6 – Retaining Wall Analysis Construction Sequence

Stage	Action
1	Excavation on retained soil side to account for existing basements of adjacent buildings (where applicable).
2	Apply ground surcharge due to adjacent building/traffic load.
3	Reset all displacements.
4	Excavate to RL 1.8m AHD.
5	Install upper row of props at RL 1.8m AHD and apply 500kN pre-stress per prop.
6	Excavate to RL -3.4m AHD
7	Install lower row of props at RL -3.4m AHD and apply 500kN pre-stress per prop.
8	Excavate to Bulk Excavation Level (Either RL -5.6m or RL -8m AHD) depending on location
9	Apply water pressure from perched water table within alluvial materials (Due to blocking up of temporary strip drains).
10	Update material parameters in alluvial materials from undrained to drained behaviour.
11	Construct Basement B2 slab.
12	Construct Basement B1 slab.
13	Remove lower row of props (RL -3.4m AHD).
14	Construct Basement B Mez slab (where applicable).
15	Construct slab at ground level.
16	Remove upper row of props (RL 1.8m AHD).
17	Apply loading from bending moments of basement slabs and capping beams (i.e. permanent loads from building).
18	Reduce wall bending stiffness to 70% to account for long term effects.
19	Increase water pressures to RL 5.5m AHD, to allow for flood conditions.

5.3.3 Analysis Outcomes

Key analysis outcomes relating to retention pile deflections and structural actions at various construction stages are summarised in Table 7 to Table 11 along with output plots in Appendix F.

Note that the calculated deflection for analysis Section 2 exceeds its deflection criteria of 15mm in some cases. This is due to the interpreted locally weaker and softer ground conditions which will be better defined following completion of the site geotechnical investigation. Should the current interpreted ground conditions at Section 2 match the ground conditions observed during the geotechnical investigation, additional retention piles in a contiguous arrangement may be required to control wall movements to within the deflection criteria.

Table 7 – Short Term Scenario, Initial Excavation (Stage 1 to Stage 4), 100% EI

Section	Deflection Criteria (as nominated by RBG) (mm)	Assessed Max. Deflection (mm)	Max. Bending Moment (kNm/m)	Max. Shear Force (kN/m)
1	15	15	157	105
2	15	13	18	16
3	15	7	26	15
4	15	9	32	11
5	25	15	35	30
6	15	0	62	23

Table 8 – Short Term Scenario, Final Excavation without perched water pressure (Stage 5 to Stage 8), 100% EI

Section	Deflection Criteria (as nominated by RBG) (mm)	Assessed Max. Deflection (mm)	Max. Bending Moment (kNm/m)	Max. Shear Force (kN/m)
1	15	9	382	401
2	15	16	440	244
3	15	12	383	203
4	15	9	250	113
5	25	13	230	123
6	15	7	207	63

Table 9 – Short Term Scenario, Final Excavation with perched water pressure (Stage 9), 100% EI

Section	Deflection Criteria (as nominated by RBG) (mm)	Assessed Max. Deflection (mm)	Max. Bending Moment (kNm/m)	Max. Shear Force (kN/m)
1	15	11	429	406
2	15	19	433	339
3	15	13	375	246
4	15	11	339	186
5	25	15	343	195
6	15	11	369	259

Table 10 – Long Term Scenarios (Stage 11 to Stage 18), 70% EI

Section	Deflection Criteria (as nominated by RBG) (mm)	Assessed Max. Deflection (mm)	Max. Bending Moment (kNm/m)	Max. Shear Force (kN/m)
1	15	12	411	370
2	15	19	333	201
3	15	13	307	165
4	15	11	278	202
5	25	15	307	162
6	15	10	265	164

Table 11 – Long Term Scenarios under Flood Conditions (Stage 19), 70% EI

Section	Deflection Criteria (as nominated by RBG) (mm)	Assessed Max. Deflection (mm)	Max. Bending Moment (kNm/m)	Max. Shear Force (kN/m)
1	15	12	404	474
2	15	20	372	312
3	15	23	231	388
4	15	12	368	293
5	25	16	207	277
6	15	23	324	387

5.3.4 Analysis Outcomes – Temporary Props and Permanent Slabs

Maximum axial forces within the temporary props and permanent slabs are summarised in Table 12 to Table 14.

Table 12 – Maximum Temporary Prop Forces

Section	Max Temporary Prop Load (kN/prop)		Max Temporary Prop Load (kN/m)	
	Upper Prop (RL 1.80m)	Lower Prop (RL -3.4m)	Upper Prop (RL 1.80m)	Lower Prop (RL -3.4m)
1	1741	3013	232	401
2	1570	3959	209	528
3	1052	2960	140	394
4	1607	2403	214	320
5	1806	2471	240	329
6	977	2832	130	377

Table 13 – Maximum Basement Slab Axial Forces, normal conditions

Section	Max Permanent Axial Slab Load (kN/m)			
	Ground Level (RL 4m)	Level B Mez (RL 1m)	Level B1 (RL -2m)	Level B2 (RL -5m)
1	84	154	274	168
2	107	N/A	363	208
3	58	N/A	246	160
4	82	N/A	349	103
5	81	128	176	112
6	31	N/A	264	120

Table 14 – Maximum Basement Slab Axial Forces, flood conditions

Section	Max Permanent Axial Slab Load (kN/m)			
	Ground Level (RL 4m)	Level B Mez (RL 1m)	Level B1 (RL -2m)	Level B2 (RL -5m)
1	110	219	447	372
2	171	N/A	545	466
3	138	N/A	419	669
4	93	N/A	558	415
5	113	175	306	511
6	97	N/A	420	656

5.3.5 Discussion

All results presented in the sections above are unfactored working loads and therefore consideration of these analysis outcomes must adopt appropriate load factors. All prop forces are perpendicular to the wall and therefore should be converted to reflect the orientation of the prop relative to the wall.

The results presented herein relate to the construction sequence outlined in Table 6.

The shear forces and bending moments presented in the sections above are presented in terms of structural forces per unit length of wall. To convert these values to structural forces per pile, the values presented in the table should be multiplied by the pile centre to centre spacing (i.e. multiply all structural forces in Table 6 to Table 10 by a factor of 1.8).

6 Seepage Analysis

Steady state groundwater inflow into the proposed excavation level was assessed using 2D groundwater seepage analysis in the geotechnical software Slide2D by RocScience. Two cross sections were assessed comprising transverse and longitudinal sections as shown in Diagram 8. The models were based on our interpretation of the site geotechnical conditions, as per the interpreted geological sections presented in Appendix B.

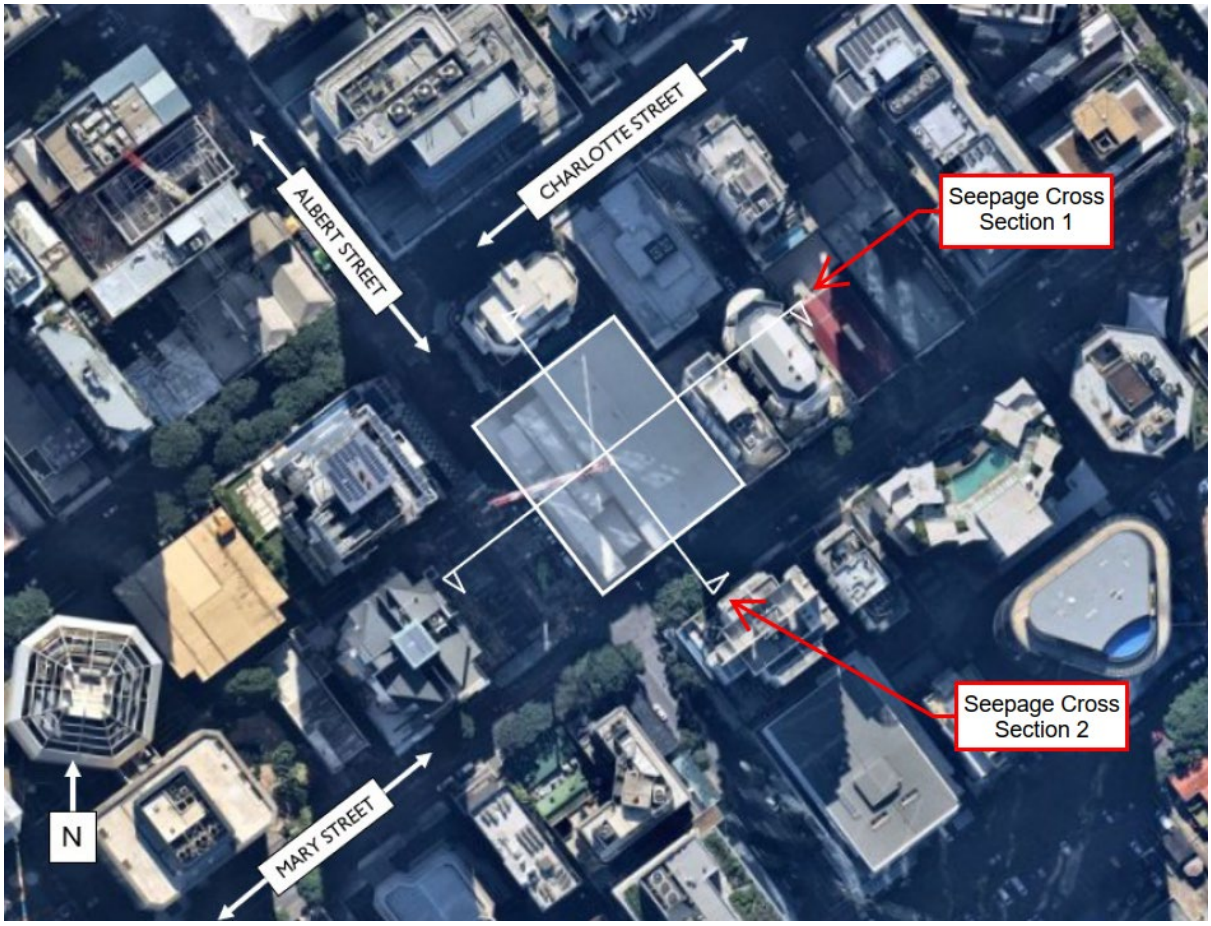


Diagram 8 – Seepage Analysis Sections

The hydraulic conductivity parameters adopted in the assessment are presented in Table 15, which are based on a review of available in-situ permeability (Packer) testing information from the CRR project along with our experience from nearby projects involving similar materials.

Table 15 – Summary of Material Parameters

Unit	Material Description	Coefficient of Permeability[1] k_v (m/s)
(F) – Fill	Various material including concrete, bricks and clay	1E-06
(AL F) – Fine Grained Holocene Alluvium	Mainly clay with occasional sand (soft to firm)	1E-07
(AL C) – Coarse Grained Holocene Alluvium	Fine to medium sand with some clay	1E-05
(RS) – Residual Soil	Clay (very stiff)	1E-09
(NFG-5) – Extremely Weathered Material	Silt and sand sized sedimentary rocks; slightly metamorphosed (typically called greywacke, phyllite, argillite)	1E-07
(NFG-3) – Medium Strength Rock		1E-07
(NFG-1/2) – High to Very High Strength Rock		1E-07

Notes: [1] The permeability values shown for the rock units do not consider the presence of fault and/or sheared zones.

6.1 Analysis Methodology

Our interpretation of the site groundwater conditions is described in Section 3 and comprises perched groundwater within the Alluvial layers and a deeper groundwater profile within the rock units due to local dewatering by the CRR Albert Street cavern. Assessment of groundwater inflows are therefore sensitive to ground stratigraphy, as only the Alluvial layers would contain groundwater pressure within proximity of the basement.

As the project geotechnical investigation has not yet been carried out and therefore ground stratigraphy within the project site remains relatively uncertain, we have based our seepage assessment on a simplified groundwater scenario adopting hydrostatic conditions from RL2m AHD (2m below ground level).

Groundwater seepage was modelled considering steady state flow conditions developed following the end of construction. All analyses were carried out on the following basis:

- The analyses assess groundwater flows occurring in two dimensions, within the plane of analysis, which are applied over a representative tributary area.
- The assessment only considers the effects of long-term steady-state seepage conditions developed following completion of construction.
- Each analysis section has considered that the retaining wall comprises soldier piles with reinforced shotcrete between the piles above the B2 slab level, and is therefore considered to be impermeable above the BEL. Sensitivity analyses have been carried out that vary the depth of shotcrete between the solider piles, as described further in Section 6.2.
- Construction phase temporary dewatering outside the excavation is not considered.
- Transient flow conditions, which may result in temporarily increased extraction demands, have not been analysed.
- The effect that surface infiltration has on extraction rates has not been assessed.

Several seepage analysis scenarios have been included in the assessment as detailed in Table 16.

Table 16 – Summary of Seepage Analysis Scenarios

Scenario	Description	Type
1	Phreatic surface set at RL2m AHD. Shotcrete extends down to BEL, which is at RL -8m AHD along the Albert St side and at RL -5.6m AHD in the other areas (see Diagram 4).	Base Case
2	As per Scenario 1, with the presence of a localised pocket of relatively higher permeability sand immediately below the base of the excavation.	Sensitivity
3	As above but with shotcrete extending deeper, at RL -8m AHD along the Albert St side and at RL -9m AHD in the other areas.	Sensitivity

6.2 Analysis Outcomes

Results from the seepage modelling are shown in Appendix G. The estimated steady state inflow quantities are shown in Table 17.

Table 17 – Summary of Seepage Analysis Outcomes

Scenario	Analysis Section	Inflow Rate (m^3/day/m)	Tributary Length (m)	Inflow Rate (ML/year)
1	1	0.027	60	0.6
	2	0.022	38	0.31
Total Steady State Inflow (Scenario 1)				0.9
Scenario	**Analysis Section**	**Inflow Rate (m^3/day/m)**	**Tributary Length (m)**	**Inflow Rate (ML/year)**
2	1	0.034	60	0.76
	2	0.032	38	0.44
Total Steady State Inflow (Scenario 2)				1.19
Scenario	**Analysis Section**	**Inflow Rate (m^3/day/m)**	**Tributary Length (m)**	**Inflow Rate (ML/year)**
3	1	0.020	60	0.44
	2	0.009	38	0.12
Total Steady State Inflow (Scenario 3)				0.57

6.3 Discussion

Based on the analysis scenarios described in Table 16, the long term estimated groundwater inflows range between approximately 0.5ML/year to approximately 1.5ML/year. The estimated inflow rates are expected to be within the capacity of groundwater underdrainage systems, typical for similar buildings. It is recommended that the capacity of the drainage system be reviewed for the estimated inflow rates and that the resilience of the system is assessed if extraction rates were three to five times the reported values.

The analysis suggests that should the reinforced shotcrete be extended into the Residual Soil at about RL -8m AHD or deeper around the full perimeter of the basement, the estimated inflow rates reduce.

In the additional geotechnical investigation, we recommend a series of Piezocones positioned around the perimeter of the basement to better define the ground stratigraphy and saturated layers.

We do not anticipate significant groundwater drawdown related settlement due to groundwater recharge from the nearby Brisbane River, which effectively maintains groundwater pressures and therefore limits drawdown related settlement.

The analyses consider that the retaining wall is impermeable above the BEL levels. Potential leakage rates through the soldier pile and reinforced shotcrete wall must be further assessed in collaboration with the contractor.

A review of the drainage conditions of existing basement structures in the vicinity of the development should be carried out to understand their influence on local groundwater conditions and to refine seepage analysis.

7 Foundation System

7.1 Foundation Arrangement

The proposed foundation is shown in plan on Diagram 9 and in section on Diagram 10. The proposed foundation system for the tower columns and core consists of pile caps and large diameter bored piles with twin 1600mm diameter bored piles for each tower column and approximately thirty-five 1200mm diameter bored piles for the core.

The line of podium columns along the Albert Street frontage (PC3 to PC8) and the first row of carpark only columns (BC1 located within the Albert Street side shown in green), are to be founded on high level pad and/or raft foundations above the cavern area (above RL-8.0m). If the bearing strata at that level is not suitable, either excavation of the existing materials and backfilling with mass concrete and/or replacement of the pad footings with a raft foundation to satisfy bearing requirements without extending below RL-8m AHD will be required.

The basement-only columns that are also located outside of the maximum RL -8.0m excavation zone will be supported on single 900mm diameter bored piles with pile caps.

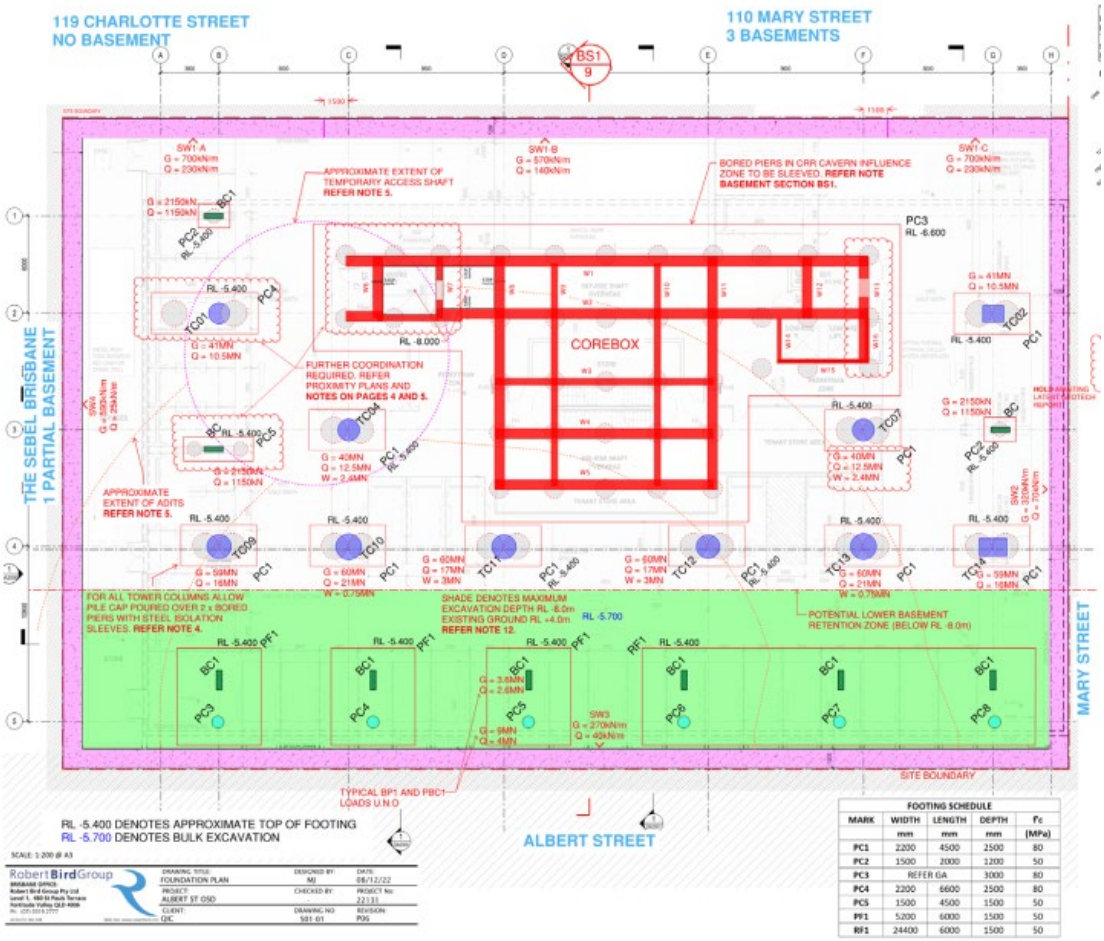


Diagram 9 – Foundation System Shown in Plan

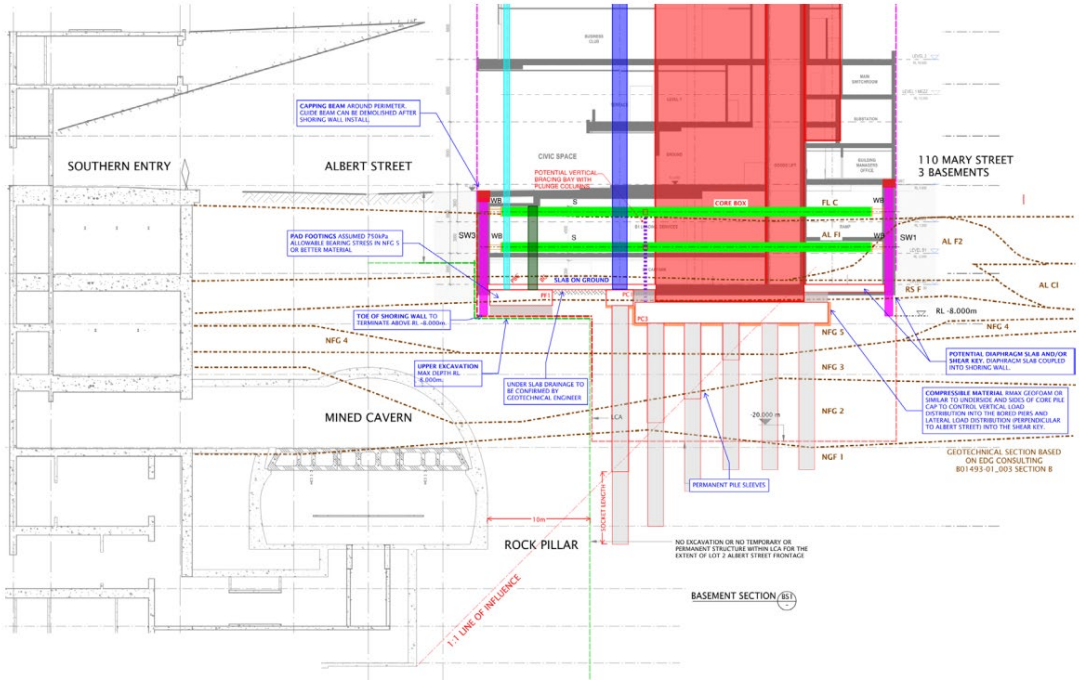


Diagram 10 – Foundation System Shown in Section

During the previous DA stage assessment, it was discussed that some of the foundation piles may be required to be sleeved to limit transfer of structural loading to the cavern lining. Assessment of the requirement to adopt sleeves for the foundation piles has been carried out and is discussed in further detail in Section 10.

7.2 Shallow Foundations

7.2.1 Bearing Capacity

Footings are proposed along the Albert Street side of the development to support loads from podium and basement columns. The elevation of the base of those footings will be confirmed in subsequent design stages, however, is expected to be approximately RL -7m AHD. Based on our interpretation of the geotechnical investigation information available at this stage, the material at the proposed foundation level is expected to be extremely weathered material (NFG5), however could also comprise localised areas of the relatively weaker and softer Residual Soil. Foundations comprising Residual Soil would be locally excavated and replaced with mass concrete to achieve the required bearing capacity. The exact local excavation limits are not yet confirmed, however are anticipated to no more than 2m deep and 3m^2 in plan.

Our assessment considers the following:

- The shallow footings along the Albert Street side of the development will support loads from podium and basement columns.
- Two types of shallow footings have been nominated by RBG on the drawings provided. Pad Footing 1 (PF1) has dimensions of 6m length by 5.2m width. Pad Footing 2 (PF2) has dimensions of 9.615m length by 6m width.
- In addition, RBG has also requested EDG to consider an alternative dimension of 6m length by 3.1m width for PF1.

- To satisfy bearing capacity requirements, the PF1 footings will be founded on NFG3 or better material (medium strength rock). Based on our existing ground model, this will require some localised areas of excavate and replace with mass concrete.
- To satisfy bearing capacity requirements, the PF2 footings will be founded on NFG5 or better material (extremely weathered rock). Based on our existing ground model, this will require some localised areas of excavate and replace with mass concrete.
- We have considered a load combination of 1.2G (dead load) + 1.5Q (live load) for ultimate limit state (ULS).
- We have considered a load combination of G +Q for serviceability limit state (SLS).

The results of our bearing capacity assessment are summarised in Table 18. Note that allowable bearing capacity has been calculated using a factor of safety of 3.0 applied to the ultimate bearing capacity.

Table 18 – Summary of Bearing Capacity Assessment

Footing ID	Founding Material	Ultimate Bearing Capacity (kPa)	Allowable Bearing Capacity (kPa)	Applied Structural Vertical Force (Working) (MN)	Applied Structural Vertical Force (Factored) (MN)	Factored Bearing Pressure (kPa)	Footing Dimensions (m)
PF1	NFG 3	6,000	2,000	14.4	18.45	591	6 x 5.2
						992	6 x 3.1
PF2	NFG 5	1,350	450	13.9	18	312	9.615 x 6

Estimates of settlement and the associated vertical modulus of subgrade reaction have been carried out using the software Settle 3D.

The outcomes of our assessment are summarised in Table 19 and are applicable to the footing sizes described above and shown in Table 19. We recommend that RBG consider the average values of modulus of subgrade reaction and carry out sensitivity analyses based on the recommended range.

Table 19 – Estimated Settlement and Modulus of Subgrade Reaction

Footing ID	Resultant Working Vertical Force (MN)	Footing Dimensions (m)	Working Bearing Pressure (kPa)	Estimated Settlement at Working Pressure (mm)	Modulus of Subgrade Reaction (MPa/m)		
					Lower	Recommended Value	Upper
PF1	14.4	6 x 5.2	460	1.5	150	300	450
		6 x 3.1	774	2.5	200	350	500
PF2	13.9	9.615 x 6	240	12	10	20	30

7.3 Piled Foundations

7.3.1 Buried Infrastructure

As described in Section 1, two temporary access adits and an access shaft currently exist beneath the site as shown in plan and elevation on Diagrams 11 and 12, respectively. We have been informed that upon completion of the CRR works at the site, the adits and shaft will be backfilled with a flowable concrete with a compressive strength of 20MPa. It may be possible to select other backfill materials that match the stiffness of the surrounding rock units and have further input into the backfilling methodology subject to further interaction with the CRRDA.

Diagram 11 shows that several of the foundation piles are situated above the adit or shaft. At this stage and considering that we have relatively limited input into selection of the backfill material and methodology of backfill placement, we recommend that all piles within proximity of the adits extend through the adit into the rock to mitigate the risk of additional pile settlements from potential voids at the top of the adits post backfilling. Piles situated above the shaft may found within the shaft backfill provided that the properties of the backfill, including its strength and stiffness do not change throughout the building design life.

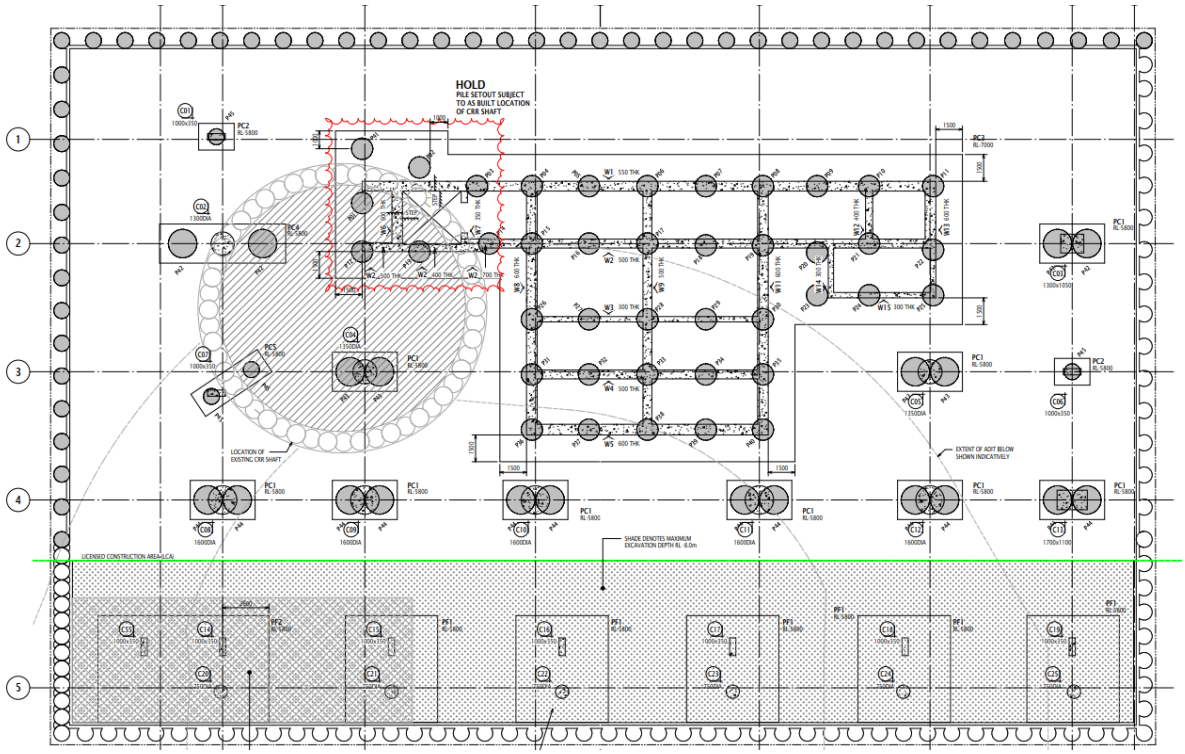


Diagram 11 – Foundation Arrangement, Adit and Shaft

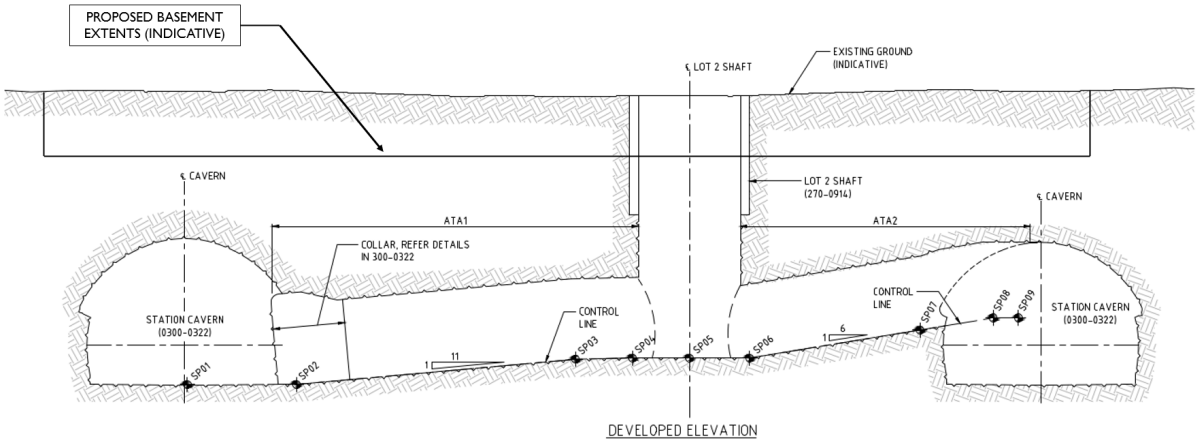


Diagram 12 – Elevation View: Cavern, Adit and Shaft

7.3.2 Geotechnical Reduction Factor

A geotechnical strength reduction factor of $ø_g$ = 0.5 is recommended at this stage in accordance with the process in AS2159:2009 Piling, based on the quality and quantity of information available.

The assessed geotechnical reduction factor is based on the quality and quantity of geotechnical site investigation information available. It may be possible to optimise the geotechnical reduction factor following completion of the additional geotechnical investigation following site handover.

The geotechnical reduction factor considers that no pile load testing will be carried out during construction, however, it would also be possible to optimise the geotechnical strength reduction factor should pile load testing be carried out during construction.

7.3.3 Pile Design Parameters

Design values of ultimate skin friction and ultimate end bearing have been assessed for all rock units. Ultimate skin friction and end bearing have been calculated based on the method proposed by Zhang and Einstein (1998)[3]. Recommended values of ultimate skin friction and ultimate end bearing are summarised in Table 20.

Table 20 – Ultimate Pile Design Parameters

Material	Fs, Ultimate Skin Friction (kPa)	Fbu, Ultimate End Bearing (MPa)
Residual Soil	50	N/A
NFG 5	75	N/A
NFG 3	700	15
NFG 2/1	1300	25

7.3.4 Assessment of Pile Lengths – Core Piles

A preliminary estimate of pile socket lengths for the 1200mm diameter core piles has been carried out based on the values of ultimate skin friction and end bearing, and the geotechnical reduction factor

[3] Zhang, L. and Einstein, H. (1998). "End bearing capacity of drilled shafts in rock." ASCE Jnl. Geot. Eng., Vol. 124 (7), 574-584)

described in the sections above. The pile loads considered in the assessment have been provided by RBG and include the load combinations as described below:

- The following ultimate limit state (ULS) load combinations have been considered:
  - 1.2G (dead load) + 1.5Q (live load).
  - 1.2G + 0.6Q + W (wind load).
  - 1G + 0.6Q + SpecY (earthquake load in y direction) + 0.3SpecX (earthquake load in x direction).
- We have considered the following serviceability limit state (SLS) load combinations:
  - G + Q.
  - G + 0.6Q + 0.54W.
  - G + 0.6Q + 0.35 SpecY.

The assessment has evaluated pile socket lengths based on satisfying the following criteria:

$$(1)\ R_{d,g} \geq E_d$$

Where:

E_d = Design Action Effect; and,

R_{dg} = shall be calculated as the design ultimate geotechnical strength ($R_{d,ug}$) multiplied by the geotechnical strength reduction factor (ϕ_g).

and;

$$(2)\ \frac{Ultimate\ Geotechnical\ Shaft\ Capacity}{SLS\ Compression\ Load} \geq 1.2$$

Criterion 1 satisfies the requirements of AS2159 for design geotechnical strength, whereas Criterion 2 assessed the ability of the skin friction alone to resist the SLS (working) loads. This additional criterion provides confidence at this preliminary stage that the piles do not rely heavily on end bearing and therefore pile settlements are expected to be within tolerable limits. A detailed soil-structure interaction analysis would be required for the detailed design of the piles, which is expected to comprise part of the subsequent design phase including contractor involvement.

Our recommended pile lengths and socket requirements for core piles is presented in the preliminary pile schedule in Appendix H. As described in Section 7.3.1, we recommend that all piles that are situated within proximity of the adits extend through the adit backfill into the rock below to mitigate the risk of additional pile settlements from voids remaining at the top of the adits post backfilling. Piles situated above the shaft may found within the shaft backfill provided that the properties of the backfill, including its strength and stiffness do not change throughout the building design life. Diagram 13 illustrates the required founding conditions for the core piles.

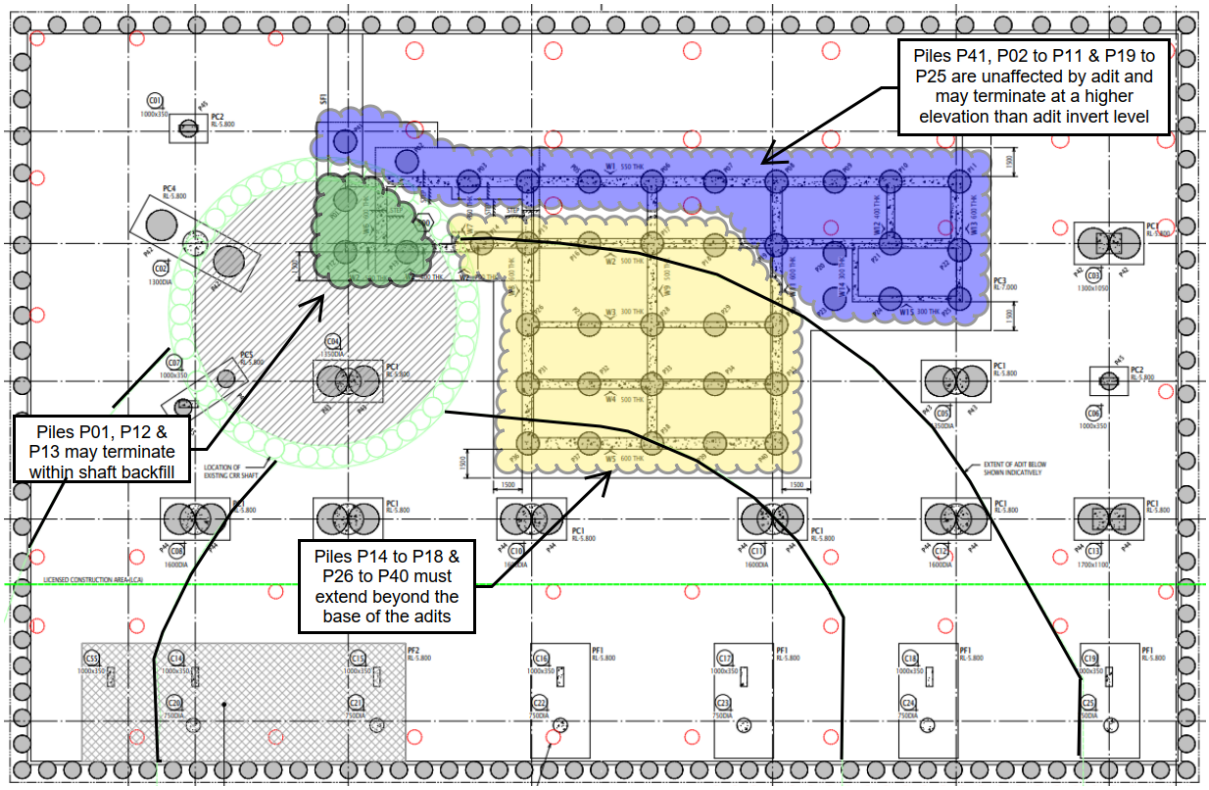


Diagram 13 – Core Pile Details

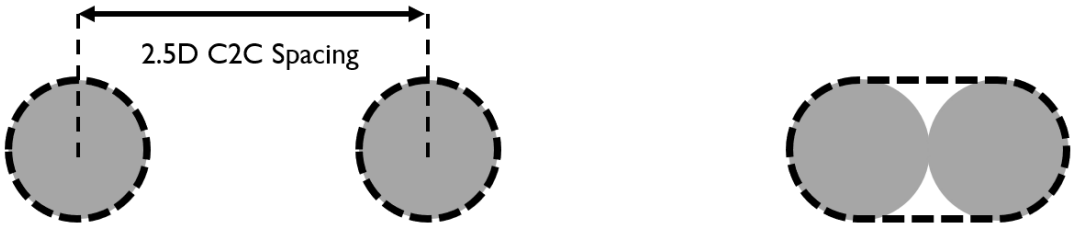
7.3.5 Estimated Settlement and Spring Stiffness Values Core Piles

Estimates of vertical settlement and the associated spring stiffness values for structural modelling have been carried out using the software Plaxis2D. All vertical settlement and spring stiffness values have been extracted at top of pile level (i.e. includes elastic shortening of pile).

The outcomes of our assessment are summarised in the preliminary pile schedule in Appendix H. We recommend that RBG consider the average values of spring stiffness values presented in Appendix H and carry out sensitivity analyses based on the recommended range.

7.3.6 Assessment of Pile Lengths – Podium Piles

To support the individual podium columns, bored piles of 1,800mm and 900mm diameter are adopted, either spaced horizontally at about 2.5D centre-to-centre (as per Pile arrangement A in Diagram 14), or at 1D centre-to-centre.



Pile Arrangement A

Distribution of pile load around full shaft perimeter

Pile Arrangement B

Distribution of pile load around effective combined shaft perimeter

Diagram 14 – Podium Piles

Based on our assessment of pile interaction, we consider that for pile sockets founded within the NFG1, NFG2 or NFG3 geotechnical units, piles spaced horizontally at 2.5D as per Pile Arrangement A will experience little interaction and therefore the axial pile capacity is unaffected by the adjacent pile. For more closely spaced piles such as Pile Arrangement B, the shaft is unable to distribute load around its full perimeter and therefore a reduced shaft capacity will be achieved. The reduction in shaft capacity is related to the reduced effective perimeter, which can be considered as a 20% reduction on the total shaft capacity.

The pile end bearing capacity will be unaffected even for closely space piles as recommended by the work of Meyerhof 1976[4].

Our assessment of pile lengths and socket requirements for the podium piles has followed a similar approach and adopted the same load cases to that described in Section 7.3.4 along with the following details:

- C01, C06 and C07 will be supported on 900mm piles.
- C02 to C05, and C08 to C13 will be supported on 1600mm piles.
- For columns which are supported on double piles, with the exception of C07, the load has been distributed equally between the two piles.
    - Due to the position of C07 and the underlying double piles, RBG has advised that the majority of the load will likely transfer to the pile directly underneath the column. In this assessment, pile lengths for C07 has been assessed on the basis that all loads transfer to a single pile.
- For pairs of pile which are horizontally spaced at one pile diameter centre to centre (i.e. no horizontal gap between piles), we have considered a 20% reduction on the total shaft capacity.

Our recommended pile lengths and socket requirements for podium piles is presented in the preliminary pile schedule in Appendix H. Diagram 15 illustrates the required founding conditions for the podium piles.

[4] Meyerhof, G.G. 1976. Bearing capacity and settlement of pile foundations. *Journal of Geotechnical Engineering Division, ASCE*, 102(GT3): 195–228.

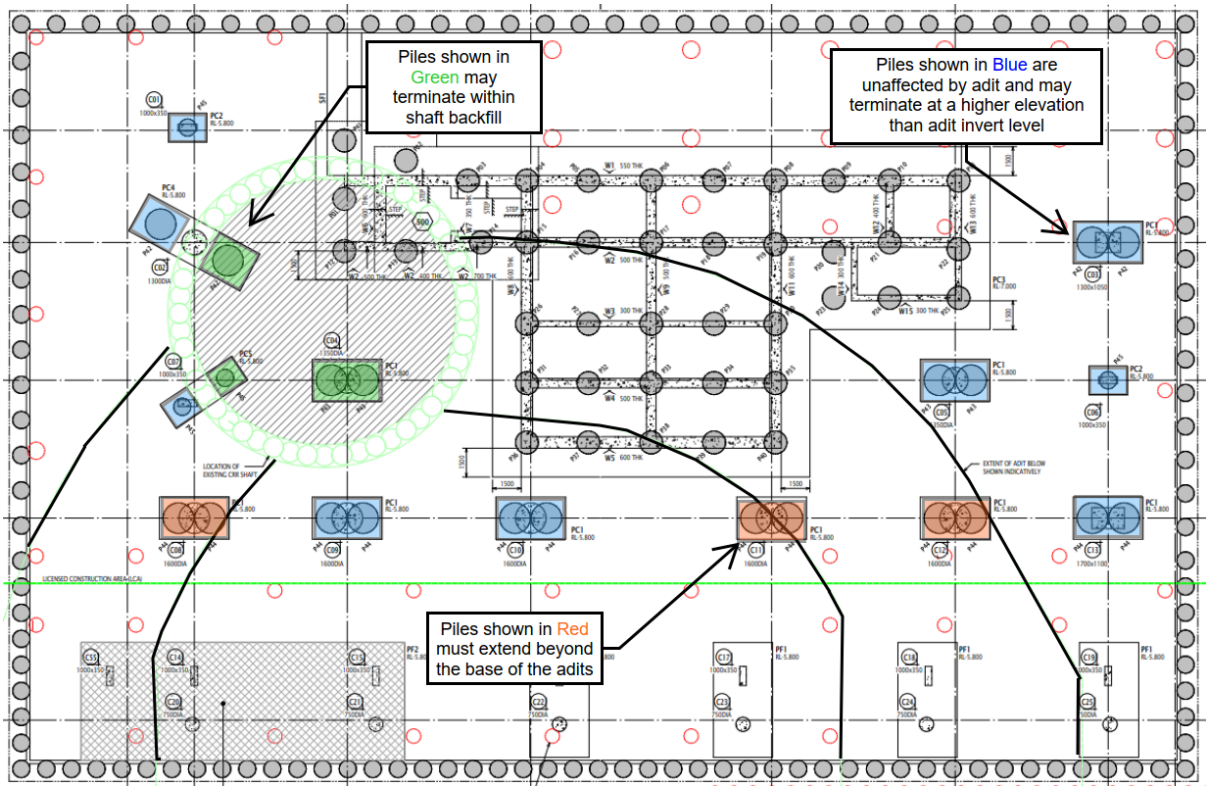


Diagram 15 – Core Pile Details

8 Alternative Foundation System

8.1 Foundation Arrangement

A raft foundation has been considered as an alternative to the piled foundation arrangement described in Section 7. The alternative raft foundation will extend over the full plan area of the building and will adopt a 1m thick reinforced concrete raft at the Albert Street side, founding at RL -8m, and away from the Albert street side, a 2m thick reinforced concrete raft will be adopted founding at RL -9m.

In the heavily loaded areas of the raft beneath the core, existing materials would need to be excavated until NFG3 (or better) rock is encountered and backfilled with mass concrete to the underside of raft level. The indicative arrangement of the alternative raft foundation is shown on Diagram 16.

The raft foundation will be structurally connected to the retention piles and therefore structural loads from the raft will be transferred to the retention piles. Our assessment of socket lengths for the retention piles allows for those additional loads transferred from the raft, however it may be required to include additional piles in the north west corner of the retention system (as shown on Diagram 17) due to the presence of locally weaker materials. The presence of weaker materials would be further investigated and verified during the additional geotechnical investigation.

As the BEL associated with raft foundation is deeper than the piled foundation, the pile toe levels required for the retention system increase in some areas. This is limited to the southern boundary where the pile toe depth is required to extend deeper by between 1m and 2m. The required retention pile toe levels for the raft foundation option are shown on Diagram 17.

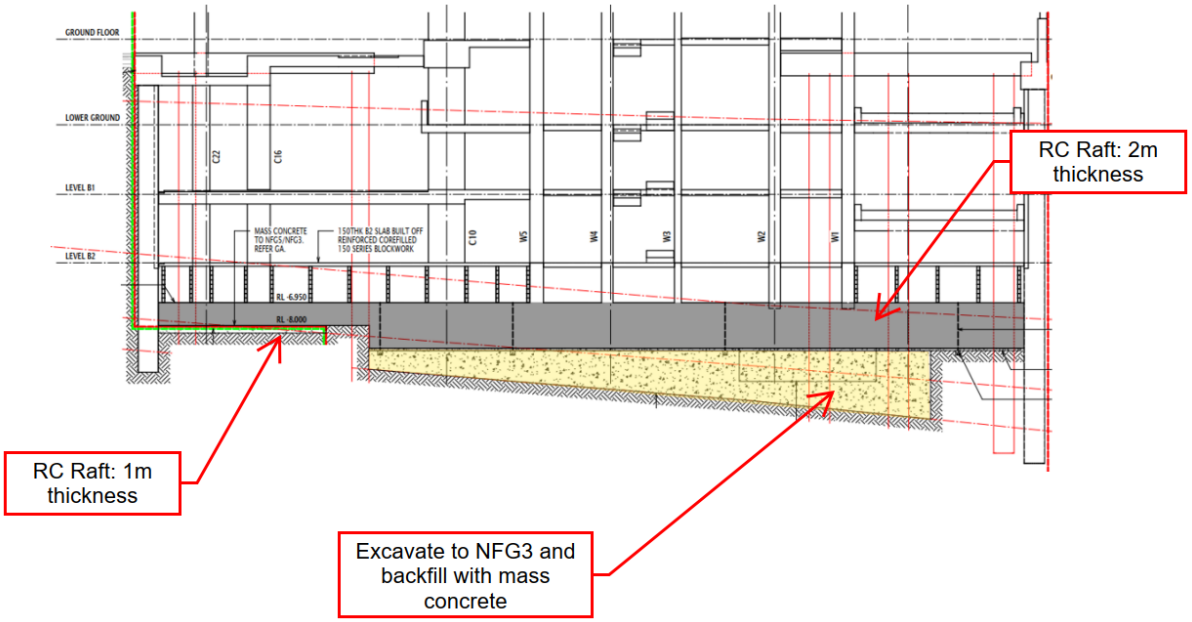


Diagram 16 – Raft Foundation Indicative Arrangement

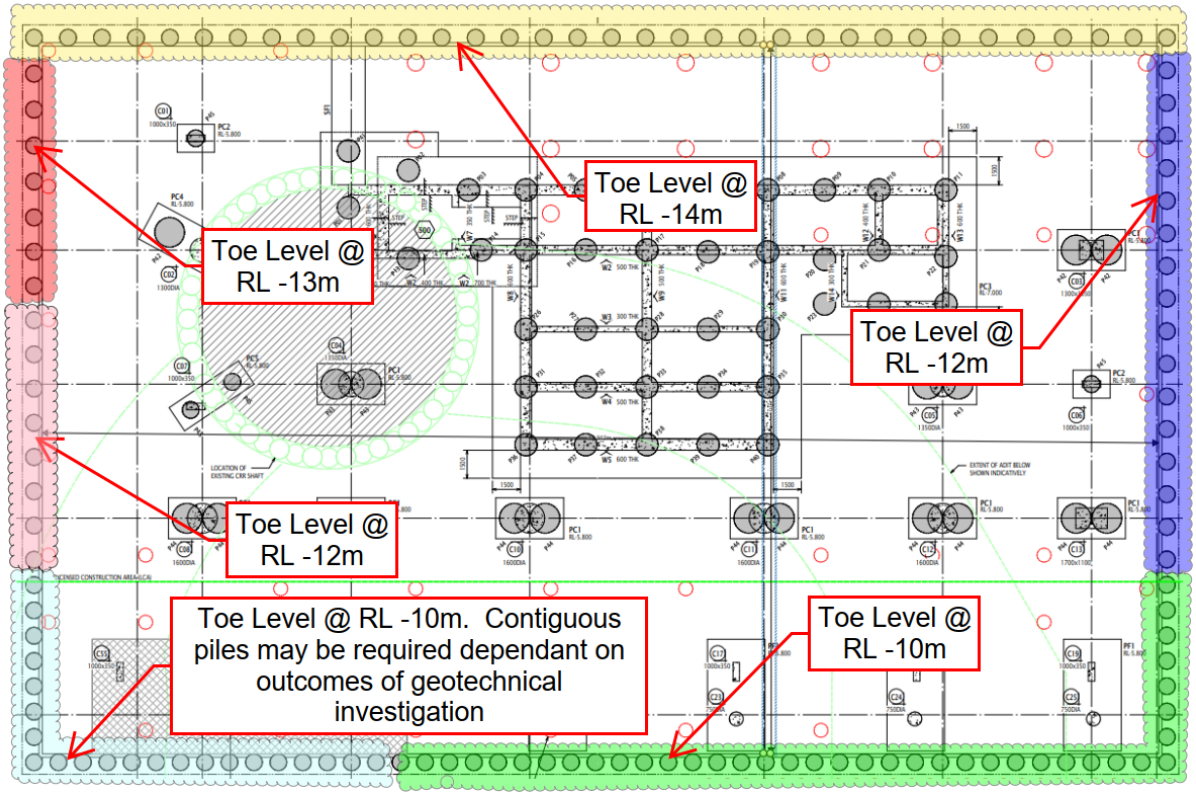


Diagram 17 – Retention Pile Toe Levels (Raft Foundation)

8.2 Retention System Analysis

8.2.1 Analysis Methodology

The retention system associated with the alternative raft foundation option has been assessed following a similar process as that described in Section 5, except that the BEL associated with the raft foundation option extends deeper, and therefore analysis Sections 4, 5 and 6 have considered a BEL of RL -9m AHD.

8.2.2 Analysis Outcomes – Retention Piles (Raft Option)

Key analysis outcomes relating to retention pile deflections and structural actions at various construction stages are summarised in Table 21 to Table 25 along with output plots in Appendix I.

Similar to the analysis outcomes discussed in Section 5.3.3, the calculated deflection for analysis Section 2 exceeds its deflection criteria of 15mm in some cases. This is due to the interpreted locally weaker and softer ground conditions which will be better defined following completion of the site geotechnical investigation. Should the current interpreted ground conditions at Section 2 match the ground conditions observed during the geotechnical investigation, additional retention piles in a contiguous arrangement may be required to control wall movements to within the deflection criteria.

Table 21 – Short Term Scenario, Initial Excavation (Stage 1 to Stage 4), 100% EI

Section	Deflection Criteria (as nominated by RBG) (mm)	Assessed Max. Deflection (mm)	Max. Bending Moment (kNm/m)	Max. Shear Force (kN/m)
1	15	15	157	105
2	15	13	18	16
3	15	7	26	15
4	15	9	86	43
5	25	15	46	17
6	15	0	74	45

Table 22 – Short Term Scenario, Final Excavation without perched water pressure (Stage 5 to Stage 8), 100% EI

Section	Deflection Criteria (as nominated by RBG) (mm)	Assessed Max. Deflection (mm)	Max. Bending Moment (kNm/m)	Max. Shear Force (kN/m)
1	15	9	382	401
2	15	16	440	244
3	15	12	383	203
4	15	13	669	390
5	25	19	650	261
6	15	10	531	238

Table 23 – Short Term Scenario, Final Excavation with perched water pressure (Stage 9), 100% EI

Section	Deflection Criteria (as nominated by RBG) (mm)	Assessed Max. Deflection (mm)	Max. Bending Moment (kNm/m)	Max. Shear Force (kN/m)
1	15	11	429	406
2	15	19	433	339
3	15	13	375	246
4	15	15	720	406
5	25	21	658	396
6	15	15	725	409

Table 24 – Long Term Scenarios (Stage 11 to Stage 18), 70% EI

Section	Deflection Criteria (as nominated by RBG) (mm)	Assessed Max. Deflection (mm)	Max. Bending Moment (kNm/m)	Max. Shear Force (kN/m)
1	15	12	411	370
2	15	19	333	201
3	15	13	307	165
4	15	15	624	345
5	25	21	545	229
6	15	15	570	307

Table 25 – Long Term Scenarios under Flood Conditions (Stage 19), 70% EI

Section	Deflection Criteria (as nominated by RBG) (mm)	Assessed Max. Deflection (mm)	Max. Bending Moment (kNm/m)	Max. Shear Force (kN/m)
1	15	12	404	474
2	15	20	372	312
3	15	23	231	388
4	15	18	765	543
5	25	23	639	390
6	15	20	843	481

8.2.3 Analysis Outcomes – Temporary Props and Permanent Slabs (Raft Option)

Maximum axial forces within the temporary props and permanent slabs are summarised in Table 26 to Table 28.

Table 26 – Maximum Temporary Prop Forces

Section	Max Temporary Prop Load (kN/prop)		Max Temporary Prop Load (kN/m)	
	Upper Prop (RL 1.80m)	Lower Prop (RL -3.4m)	Upper Prop (RL 1.80m)	Lower Prop (RL -3.4m)
1	1741	3013	232	401
2	1570	3959	209	528
3	1052	2960	140	394
4	1462	3816	195	508
5	1535	4356	204	580
6	828	4114	110	548

Table 27 – Maximum Basement Slab Axial Forces, normal conditions

Section	Max Permanent Axial Slab Load (kN/m)			
	Ground Level (RL 4m)	Level B Mez (RL 1m)	Level B1 (RL -2m)	Level B2 (RL -5m)
1	84	154	274	168
2	107	N/A	363	208
3	58	N/A	246	160
4	68	N/A	427	195
5	69	96	327	256
6	22	N/A	351	232

Table 28 – Maximum Basement Slab Axial Forces, flood conditions

Section	Max Permanent Axial Slab Load (kN/m)			
	Ground Level (RL 4m)	Level B Mez (RL 1m)	Level B1 (RL -2m)	Level B2 (RL -5m)
1	110	219	447	372
2	171	N/A	545	466
3	138	N/A	419	669
4	83	N/A	630	544
5	107	152	417	564
6	85	N/A	538	710

8.2.4 Discussion

All results presented in the sections above are unfactored working loads and therefore consideration of these analysis outcomes must adopt appropriate load factors. All prop forces are perpendicular to the wall and therefore should be converted to reflect the orientation of the prop relative to the wall.

The results presented herein relate to the construction sequence outlined in Table 6.

The shear forces and bending moments presented in the sections above are presented in terms of structural forces per unit length of wall. To convert these values to structural forces per pile, the values presented in the table should be multiplied by the pile centre to centre spacing (i.e. multiply all structural forces in Table 21 to Table 25 by a factor of 1.8).

8.3 Foundation Assessment

An assessment of the performance of the raft foundation when subject to the building structural loads has been carried out using the commercially available finite element software PLAXIS 3D v21. The assessment considered the interpreted ground conditions as shown on the geological cross sections in Appendix B, along with the geotechnical parameters presented in Appendix D.

The assessment considered a 1m thick raft at the Albert Street side and a 2m thick raft away from the Albert Street side, as well as the following details:

- The base of the Albert Street side of the foundation is at RL-8m AHD and founds directly on NFG5 rock (or better). Should materials of lower strength and stiffness be present at foundation level, those materials would be locally excavated and replaced with mass concrete.
- The base of the foundation away from Albert Street is at RL-9m AHD and founds directly on NFG3 rock (or better). Should materials of lower strength and stiffness be present at foundation level, those materials would be locally excavated and replaced with mass concrete.
- Part of the raft foundation will be founded on the proposed concrete backfill of the existing shaft structure, which will form a localised 'hard point' beneath the raft foundation. The exact details relating to the backfill material and method of placement are not yet confirmed, however in our assessment, we have considered a that the shaft backfill will comprise a Young's modulus of 24GPa consistent with a characteristic compressive strength of 20MPa.
- Several piles exist on the site associated with the CRR Albert Street Lot 2 acoustic shed. Our assessment considers that these piles will be broken back at least 1m below the underside of the raft foundation to reduce the potential for localised stress concentrations applying to the raft.

8.4 Assessment Outcomes

The outcomes of our assessment are shown in Appendix J. In Figure 1, recommended values of modulus of subgrade reaction have been assessed that should be considered by RBG in the structural design. A sensitivity range for the assessed values of modulus of subgrade reaction are also provided which should be considered in a sensitivity assessment.

Upon incorporation of the recommended modulus of subgrade reaction values into the structural model, it is recommended that a comparison of the settlement values is undertaken to ensure that the structural model and the geotechnical model has been calibrated appropriately.

Assessed vertical settlements at base of foundation level are shown on Figure 2 relating to ULS load combinations, and on Figure 3 for SLS load combinations. Note that the ULS case adopts a load combination of 1.2G + 1.5Q.

9 Cavern Assessment

9.1 Analysis Methodology

To provide a comparison between the cavern design load cases and the effects of the proposed building loads, we have developed a 3D finite element model to assess ground stresses and cavern liner distortions associated with the proposed building loads and the Future Over Station Development (FOSD) load cases. The assessment adopts the process shown in Diagram 18.

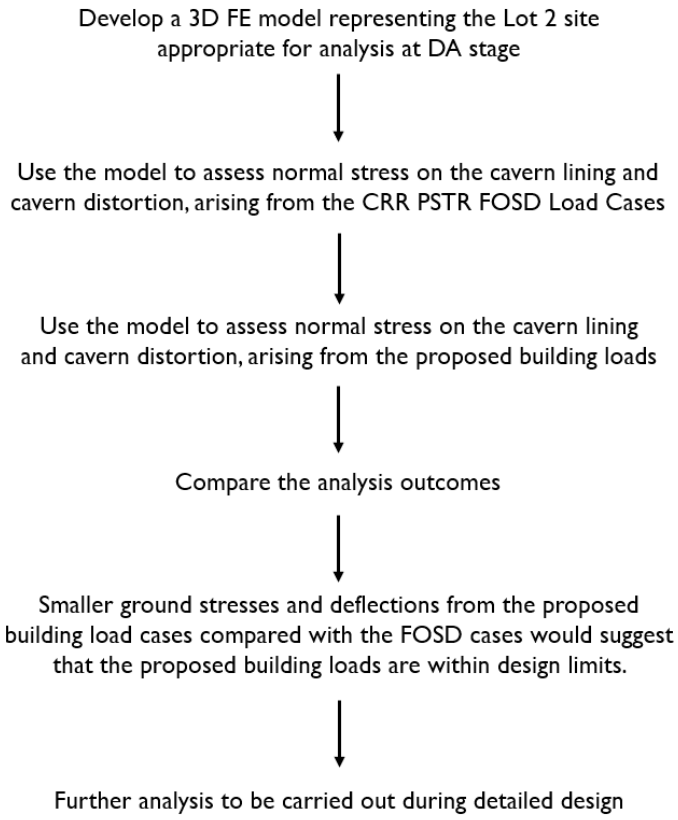


Diagram 18 – Analysis Process

9.2 Model Calibration

Ideally, the finite element model developed as part of this assessment would be calibrated with the finite element model used in the design of the cavern lining, by comparing the direct analysis outcomes that relate to specific load cases. We have reviewed the information presented in the Albert Street cavern detailed design report, aiming to extract key modelling outcomes that relate to the FOSD load cases. However, the cavern design modelling outcomes are presented in a summarised format and therefore the exact analysis outcomes that directly relate to each FOSD load case are not available.

We have therefore carried out the following comparisons to gain confidence that the cavern design modelling and the modelling for this assessment are similar:

- The ground stratigraphy adopted for this assessment was compared with the ground stratigraphy adopted for the cavern design analysis (as presented in the CRR Geotechnical Interpretative Report GIR Ref. CRRTSD-000-0351-RPT-PSMQ-1120-030021), and both were assessed to be sufficiently similar at the cavern location.
- The soil and rock material parameters adopted in the cavern assessment were all the same or similar to those adopted for the cavern design analysis, as presented in the CRR Geotechnical Interpretative Report (GIR).
- The cavern permanent lining details adopted in the cavern assessment, were based on the IFC drawings and were consistent with the details adopted in the cavern design. Note that the cavern geometry and lining thickness was based on the CRR drawing set: CRRTSD-300-0323-DRG-PSMQ-1330-190000s series.

9.3 Load Cases

The CRR PSTR nominates that design of the cavern lining must consider several FOSD load cases. Those load cases are defined in PSTR clauses OSD-31, OSD-46, OSD-47 and OSD-48. For ease of reference, those clauses are presented in Table 29, and are shown graphically on the attached sketches attached in Appendix K.

Table 29 – Assessment Load Cases

Load Case[1]	Additional Loading	Excavation or Distortion	PSTR Ref.
1	375kPa working load applied over part or the entire Albert Street Lot 2 site, applied at RL +4.0m		OSD-31
2	375kPa working load applied over part or the entire Albert Street Lot 2 site, applied at RL -8.0m	Excavation over the Albert Street Lot 2 site to RL-8.0m	OSD-31
3		Excavation over the Albert Street Lot 2 site to RL-8.0m	OSD-46
4		Excavation over the Albert Street Lot 2 site to RL-8.0m in the restricted zone and to RL -20m in other parts of the site	OSD-47
5	Vertical load of 50kPa acting on the ground 1m from the Tunnel crown, plus an additional 20kPa applied at ground surface		OSD-48
6		i) Up to 7m below natural surface to allow for future development ii) with a minimum of 10m residual ground cover above the Tunnel crown iii) with a minimum 10m pillar width between the side wall of the Tunnel and any adjacent building basement excavation.	OSD-48
7	Vertical load of 75kPa acting on the existing ground level, plus an additional 20kPa applied at ground surface	Permanent support to accommodate additional distortion of 15mm/span.	OSD-48

Notes: 1 – Load case numbers shown relate to this document only. Load cases may be referred to differently in other relevant documents.

We consider that interpretation of Load Cases 1 to 6 is relatively straightforward and is as illustrated on the sketches included in Appendix K.

Our interpretation of Load Case 7 is that the additional loading of 75kPa acting at existing ground surface and the additional 20kPa applied at ground surface are applied first and the associated cavern distortion calculated. The horizontal stiffness of the ground surrounding the tunnel is then reduced

to achieve a distortion of 7.5mm/radius, over and above that associated with application of the 75kPa and 20 kPa surcharges. The total cavern distortion assessed in the design from Load Case 7 is, therefore, the combination of the calculated distortion from the surcharge loads and the additional distortion allowance of 7.5mm/radius.

10 Finite Element Modelling

10.1 Material Parameters

Modelling of the proposed works was carried out using the commercially available finite element software package Plaxis 3D (v21). The assessment considered the interpreted ground conditions as shown on the geological cross sections in Appendix B, along with the interpreted groundwater conditions described in Section 3.

Soil and rock behaviour was represented by a linear-elastic perfectly plastic continuum constitutive model for all material units apart from the Alluvium, where the Hardening Soil constitutive model was used. Plasticity was controlled by a stress-dependent Mohr-Coulomb failure criterion for all soil types, based on the material parameters presented in Table D1, included in Appendix D. Drained shear strength parameters were used for all materials in all stages. Structural loads were defined by RBG and were applied as point loads at the pile heads or at the column location for the shallow footings. A loading plan showing that magnitude and location of structural loads is provided in Appendix E.

10.2 Structural Elements

Details of the structural elements used in the analysis are presented in Table 30.

Table 30 – Finite Element Model Structural Elements

Component	Plaxis Element Type	Details
Cavern Liner	Plate	The crown and sidewalls are modelled as a 700mm thick plate element. The base slab is modelled as a 300mm thick plate element. An elastic modulus value of 32.8GPa has been assigned to both plates.
Adit Liner	Plate	The adit crown, sidewalls and base slab are modelled as 300mm thick plate elements. An elastic modulus value of 32.8GPa has been assigned to both plates.
Retention Piles for existing shaft structure	Plate	The 1.05m diameter secant pile wall has been modelled as a circular plate element with equivalent smeared bending stiffness properties. An elastic modulus value of 32.8GPa has been assigned to the plate. During the excavation stage, the retention piles have been 'broken down' to 0.5m below excavation level.
Ring Beams for existing shaft structure	Beam	The 1m by 1m ring beam for the existing shaft structure has been modelled as a circular beam element. An elastic modulus value of 32.8GPa has been assigned to the beams.
Retention Piles	Beam	Retention piles are modelled as a 0.9m diameter circular beam with centre to centre spacing of 1.8m. An elastic modulus value of 32.8GPa has been assigned to the beams.
Shotcrete for retention wall	Plate	The shotcrete panels between the retention piles are modelled as 150mm thick plate elements. An elastic modulus value of 24GPa has been assigned to all plates.
Prop (914x19 CHS GR350LO)	Node to Node Anchor	All props are modelled as node to node anchors. A stiffness value (EA) of 10.7 GN has been assigned to all node to node anchors. A pre-stress of 500kN was assigned to all props.

Component	Plaxis Element Type	Details
Twin waler beam (1200WB455 GR400)	Beam	The twin waler beam has been modelled as a single beam element in our model, adopting material properties representative of the twin waler beam. An elastic modulus value of 200GPa has been assigned to all beams. Second moment of area values of $30.67 \times 10^9 mm^4$ and $8.91 \times 10^9 mm^4$ have been adopted in the two orthogonal bending directions.
Concrete Core Slab (PC3)	Plate	The concrete core slab has been modelled as a 2m thick plate element. An elastic modulus value of 39.6GPa has been assigned to the plate.
Core Piles	Embedded Beam	All core piles are modeled as 1.2m diameter embedded beams. An elastic modulus value of 34.8GPa has been assigned to all beams. Skin friction values as per Table 20 are adopted for the material units. A reduced skin friction of 50kPa has been allowed for piles within the steel sleeved zones.
Podium Pile Cap (PC1, PC2, PC4 and PC5)	Plate	Podium pile caps Type PC1 and PC4 are modelled as 2.5m thick plate elements. Podium pile caps Type PC2 are modelled as 1.2m thick plate elements. Podium pile caps Type PC5 are modelled as 1.5m thick plate elements. An elastic modulus value of 39.6GPa has been assigned to all plates.
Podium Piles	Embedded Beam	All podium piles are modelled as either 0.9m or 1.6m diameter embedded beams. An elastic modulus value of 34.8GPa has been assigned to all beams. Skin friction values as per Table 20 are adopted for the material units. A reduced skin friction of 50kPa has been allowed for piles within the steel sleeved zones.
Shallow Foundation Footing Type 1 and 2 (PF1 and PF2)	Plate	Shallow footings type 1 (PF1) and type 2 (PF2) are modelled as 1.2m thick plate elements. An elastic modulus value of 34.8GPa has been assigned to all plates.
Existing Acoustic Shed Piles	Embedded Beam	The existing acoustic shed piles are modelled as 0.75m and 0.9m diameter embedded beams as per the pile schedule. An elastic modulus value of 32.8GPa has been assigned to all beams. Skin friction values as per Table 20 are adopted for the material units. All acoustic piles have been 'broken down' to 0.5m below excavation level.

Key features of the finite element model for the piled foundation option are shown indicatively in Diagram 19 and Diagram 20.

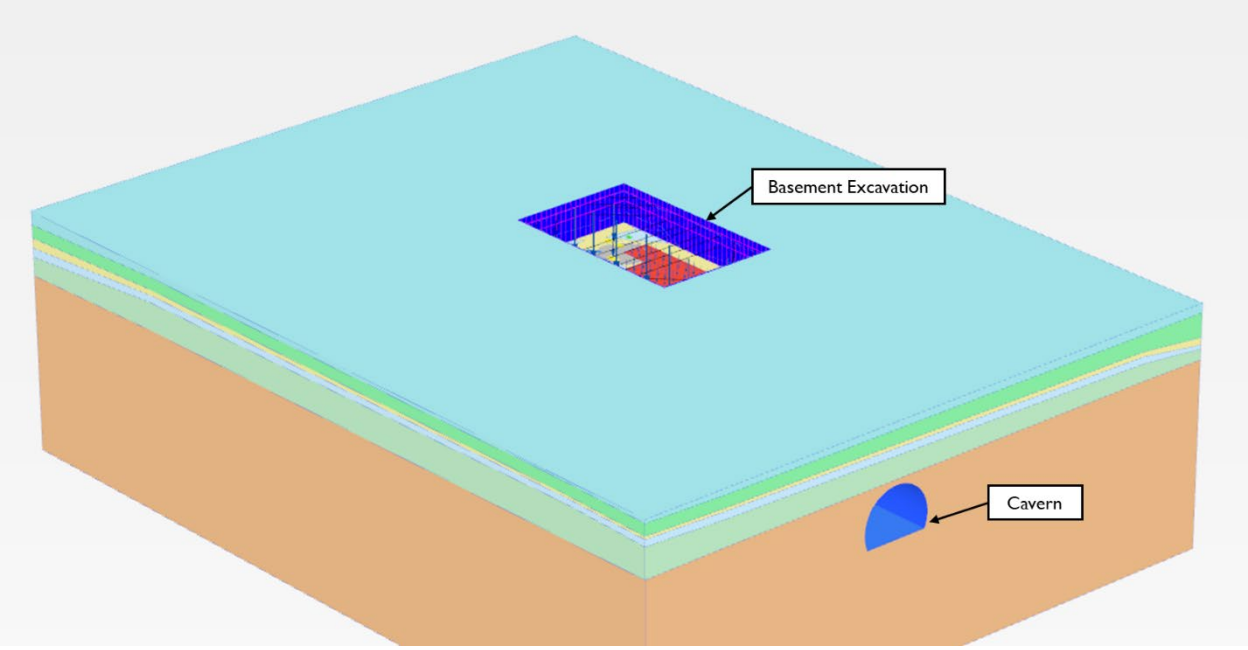


Diagram 19 – Finite Element Model Piled Foundation Markup 1

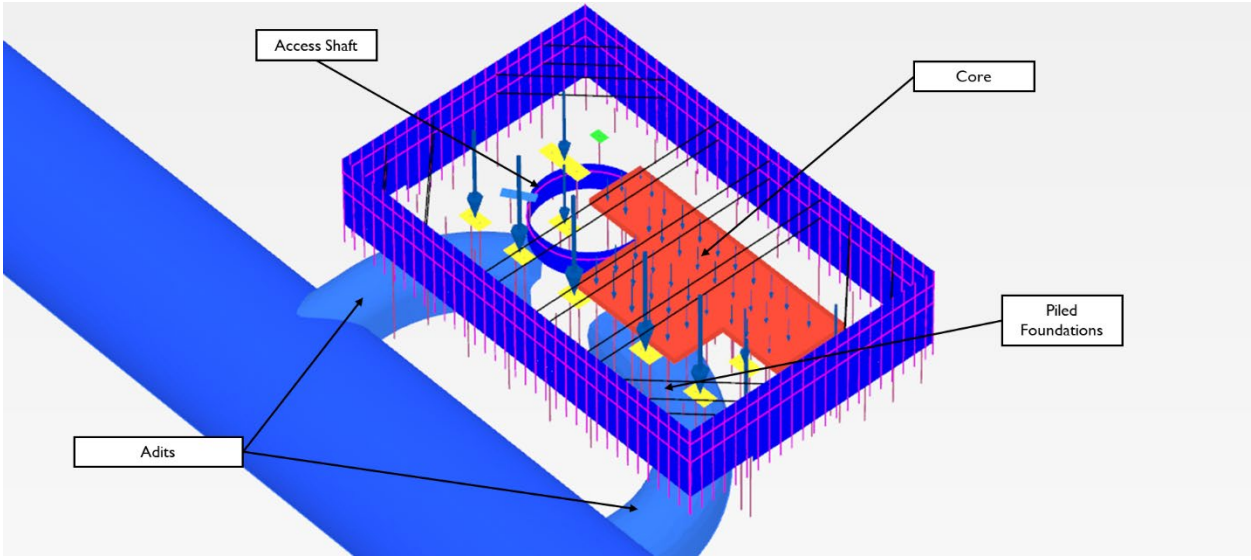


Diagram 20 – Finite Element Model Piled Foundation Markup 2

10.3 Construction Stages

The analysis adopted the construction stages as presented in Table 31.

Table 31 – Construction Sequence

Analysis Stage	Description	Details
1	Initial stage	Initial stresses are defined in the model using the K_0 procedure.
2	Install shaft piles	Retention piles around the perimeter of the circular shaft structure are activated. The retention piles are modelled as a circular plate element.
3	Shaft Excavation no.1	Shaft excavation is undertaken in four stages. Capping beam of the shaft structure is activated. The first stage of the excavation extends to the elevation of the first row of the ring beam.
4	Shaft Excavation no.2	Shaft excavation is undertaken in four stages. First row of ring beam is activated. The second stage of the excavation extends to the elevation of the second row of the ring beam.
5	Shaft Excavation no.3	Shaft excavation is undertaken in four stages. Second row of ring beam is activated. The third stage of the excavation extends to the elevation of the third row of the ring beam.
6	Shaft Excavation no.4	Shaft excavation is undertaken in four stages. Third row of ring beam is activated. The final stage of the excavation extends to the bottom of the circular shaft structure.
7	Adit excavation	The two adits are excavated across the model. Stress relaxation of the adits is represented using the ΣM_{Stage} factor.
8	Adit liner installation	The adit liner is activated after stress relaxation from the previous stage. The adit liner is modelled as plate elements.
9	Tunnel excavation	The tunnel is excavated across the model. Stress relaxation of the tunnel is represented using the ΣM_{Stage} factor.
10	Tunnel liner installation	The tunnel liner is activated after stress relaxation from the previous stage. The tunnel liner is modelled as plate elements.
11	Acoustic shed piles installation	Acoustic shed piles are activated. The acoustic shed piles are modelled as embedded beam elements.
12	Backfill shaft and adits	The temporary shaft and adits are backfilled with mass poured concrete. The concrete is modelled as material volume elements.
13	Retention piles installation	Retention piles around the perimeter of the site are activated. The retention piles are modelled as beam elements.
14	Bulk Excavation no.1	Bulk excavation is undertaken in three stages. The first stage of the excavation extends to the elevation of the upper row of strut and waler beams.
15	Upper prop and waler installation	The upper row of prop and waler beam is activated. The props are modelled as node to node anchors. The waler beams are modelled as beam elements.

Analysis Stage	Description	Details
16	Bulk Excavation no. 2	Bulk excavation is undertaken in three stages. The second stage of the excavation extends to the elevation of the lower row of strut and waler beams.
17	Lower prop and waler installation	The lower row of prop and waler beam is activated. The props are modelled as node to node anchors. The waler beams are modelled as beam elements.
18	Bulk Excavation no. 3	Bulk excavation is undertaken in three stages. The third stage of the excavation extends to the final excavation elevation.
19	Excavate and Replace	Material underlying shallow footing foundation type 1 (PF1) are excavated and replaced to NFG3 or better material. Material underlying shallow footing foundation type 2 (PF2) are excavated and replaced to NFG5 or better material.
20	Shallow footings, core slab, pile cap and pile installation	All shallow footings, core slab, pile caps and piles are installed in a single stage. The core slabs, shallow footings and pile caps are modelled as plate elements. The individual piles are modelled as embedded beam rows.
21	Apply loading	Axial and lateral loads for the piles, as provided by RBG, are applied at the head of each individual piles as point loads. The vertical loads along the retention system has been modelled as line loads acting at the bottom of the retaining piles.

10.4 Cavern and Adit Construction

We have made allowance for the progressive installation of primary lining by assessing the stress relaxation prior to support installation following the method by Hoek (2008[5]). This method assesses the proportion of convergence experienced at a point of interest back from the tunnel face. The method estimates the relative proportion of convergence due to tunnelling that would have occurred prior to installation of the primary lining. The proportion of total convergence at each analysis stage is considered in the Finite Element (FE) analysis via the PLAXIS "M_{Stage}" factor input.

The tunnel relaxation depends on a several factors associated with the method of construction including the plastic radius and the unsupported length prior to support installation. To assess an appropriate range of values that might apply a parametric study considering these variables has been carried out.

Assessment of the M_{Stage} factor was carried out in accordance with the following process:

1. The equivalent cavern and adit radii were adopted based on the tunnel and adit cross section dimensions.
2. The plastic zone radius was assessed by running an FE model to identify yield points around the tunnel. As the model showed no yield points around the tunnel, the plastic radius is assessed to be equal to the tunnel radius.

[5] Hoek, E., Carranza-Torres, C., Diederichs, M.S. and Corkum, B. 2008. Integration of geotechnical and structural design in tunnelling. Proceedings University of Minnesota 56th Annual Geotechnical Engineering Conference. Minneapolis, 29 February 2008, 1-53

For the purpose of this assessment, two scenarios of plastic zone radius have been adopted; 0m based on these FE results and a 1m and 2m plastic zone radius to allow for possible rock mass disturbance during adit and cavern excavation, respectively.

3. The assessment of the unsupported tunnel length was based on the details of the primary support design for the tunnel. Three primary support types are nominated for the cavern, as shown on the CRR drawing set: CRRTSD-300-0322-DRG-PSMQ-1330-180000s series, which are summarised in Table 32. Four primary support types are nominated for the adits, as shown on the CRR drawing set: CRRTSD-300-0909-DRG-PSMQ-1390-170000s series, which are summarised in Table 33.

Table 32 – Primary Support Types for Cavern

Support type	Max. Face Advance (m)	Max. Distance to Bolts (m)	Distance to ≥ 200mm Shotcrete (m)	Unsupported Cavern Length Based on		Bolt Spacing (m)
				Max. Distance to Completed Primary Shotcrete (m)	Max. Distance to any Shotcrete With 15MPa Strength (m)	
AC1-1	1.5	2.5	2.5	4	5.5	1.5
AC1-2	1.25	2.25	2.25	3.5	4.75	1.25
AC1-3	1.5	2.5	4	8.5	5.5	1.5

Table 33 – Primary Support Types for Adits

Support type	Max. Face Advance (m)	Max. Distance to Bolts (m)	Distance to ≥ 200mm Shotcrete (m)	Unsupported Cavern Length Based on		Bolt Spacing (m)
				Max. Distance to Completed Primary Shotcrete (m)	Max. Distance to any Shotcrete With 15MPa Strength (m)	
ATA1-1/ ATA2-1	1.5	2.5	2.5	4.0	5.5	1.5
ATA1-2/ ATA2-2	1.0	2.0	2.0	3.0	4.0	1.0
ATA1-3A/ ATA2-3A	1.0	N/A	3.0	4.0	4.0	N/A
ATA1-3B/ ATA2-3B	1.0	N/A	2.0	2.0	3.0	N/A

Based on the support types in Table 32 and Table 33, we have considered scenarios that cover the range of unsupported tunnels length to any shotcrete with minimum strength of 15MPa and completed primary shotcrete. All scenarios for the cavern have considered a Plastic Radius of both 0m and 2m, whereas all scenarios for the adit have considered a Plastic Radius of both 0m and 1m. The calculated M_{Stage} factors are summarised in Table 34 and Table 35 for the cavern and adit, respectively.

Table 34 – Summary of Calculated M_{Stage} Factors for Cavern

Cavern Primary Support Type	Distance Description	Distance Length (m)	Plastic Radius (m)	Calculated M_{Stage} Factor
AC1-1	Distance to any shotcrete with minimum strength of 15MPa	5.5	0	0.69
AC1-1	Distance to any shotcrete with minimum strength of 15MPa	5.5	2	0.64
AC1-1	Distance to completed primary shotcrete	4	0	0.61
AC1-1	Distance to completed primary shotcrete	4	2	0.56
AC1-2	Distance to any shotcrete with minimum strength of 15MPa	4.75	0	0.65
AC1-2	Distance to any shotcrete with minimum strength of 15MPa	4.75	2	0.60
AC1-2	Distance to completed primary shotcrete	3.5	0	0.58
AC1-2	Distance to completed primary shotcrete	3.5	2	0.53
AC1-3	Distance to any shotcrete with minimum strength of 15MPa	5.5	0	0.69
AC1-3	Distance to any shotcrete with minimum strength of 15MPa	5.5	2	0.64
AC1-3	Distance to completed primary shotcrete	8.5	0	0.80
AC1-3	Distance to completed primary shotcrete	8.5	2	0.75

Table 35 – Summary of Calculated M_{Stage} Factors for Adit

Cavern Primary Support Type	Distance Description	Distance Length (m)	Plastic Radius (m)	Calculated M_{Stage} Factor
ATA1-1/ ATA2-1	Distance to any shotcrete with minimum strength of 15MPa	5.5	0	0.89
ATA1-1/ ATA2-1	Distance to any shotcrete with minimum strength of 15MPa	5.5	1	0.84
ATA1-1/ ATA2-1	Distance to completed primary shotcrete	4	0	0.81
ATA1-1/ ATA2-1	Distance to completed primary shotcrete	4	1	0.76
ATA1-2/ ATA2-2	Distance to any shotcrete with minimum strength of 15MPa	4	0	0.81
ATA1-2/ ATA2-2	Distance to any shotcrete with minimum strength of 15MPa	4	1	0.76
ATA1-2/ ATA2-2	Distance to completed primary shotcrete	3	0	0.74
ATA1-2/ ATA2-2	Distance to completed primary shotcrete	3	1	0.68
ATA1-3A/ ATA2-3A	Distance to any shotcrete with minimum strength of 15MPa	4	0	0.81

Cavern Primary Support Type	Distance Description	Distance Length (m)	Plastic Radius (m)	Calculated M_{Stage} Factor
ATA1-3A/ ATA2-3A	Distance to any shotcrete with minimum strength of 15MPa	4	1	0.76
ATA1-3A/ ATA2-3A	Distance to completed primary shotcrete	4	0	0.81
ATA1-3A/ ATA2-3A	Distance to completed primary shotcrete	4	1	0.76
ATA1-3B/ ATA2-3B	Distance to any shotcrete with minimum strength of 15MPa	3	0	0.74
ATA1-3B/ ATA2-3B	Distance to any shotcrete with minimum strength of 15MPa	3	1	0.68
ATA1-3B/ ATA2-3B	Distance to completed primary shotcrete	2	0	0.63
ATA1-3B/ ATA2-3B	Distance to completed primary shotcrete	2	1	0.58

Our calculations indicate that based on the various scenarios considered, the calculated M_{Stage} factor typically varies between 0.6 and 0.8. To consider the potential variability in the degree of stress relaxation of the rock mass surrounding the tunnel, we have undertaken sensitivity assessments considering a convergence factor of 60% and 80% (i.e. in PLAXIS, setting M_{Stage} to 0.6 and 0.8). Outcomes of the sensitivity analysis are discussed in Section 10.6.

10.5 Analysis Cases

Several analysis cases have been carried out in this assessment which include the *main* analysis cases and a series of sensitivity analysis cases. All analysis cases have been grouped into one of four categories as described below. The analysis results from each analysis case group are discussed in the following sections.

- **Group 1** – Main analysis cases that provide a comparison between the CRR PSTR load cases and the proposed Albert Street FOSD building loads.
- **Group 2** – Sensitivity analysis cases investigating the relative impact of ground relaxation due to tunnel excavation, modelled as the M_{Stage} Factor.
- **Group 3** – Sensitivity analysis cases investigating the relative impact of rock stiffness surrounding the cavern.
- **Group 4** – Sensitivity analysis cases investigating the effects of pile steel liners.

10.6 Analysis Results

10.6.1 Analysis Group 1 – Main Cases

Analysis Group 1 comprises the main part of this assessment in which the CRR PSTR load cases and the proposed building load case are analysed and compared. The results relating to Analysis Group 1 are presented graphically on plots 1A to 1E in Appendix L and are discussed below.

Values of cavern liner displacement are presented in relative change (or delta) terms. The delta values present the total displacements following installation of liner and associated construction settlement (i.e. they do not include displacements due to tunnel excavation).

Plot 1A shows that the peak delta vertical displacement from the PSTR cases is approximately 6mm (Load Case 7) and approximately 2mm from the proposed building loads, indicating that the effects from the proposed building loads are within the effects from the PSTR cases.

The proposed building load case results in a slight increase in vertical displacement of approximately 2mm on the side of cavern closest to the proposed building. This indicates that the cavern is subject to a slight rotation of approximately 1 in 10,000 due to load transferred to the ground via the piles. This can be seen in Plot 1D, which illustrates the vertical and horizontal deformation on the cavern liner due to the PSTR cases and proposed building loads. The mechanism of movement is related to settlement of the surrounding rock mass and therefore the calculated liner distortion is not a representation of a change in cavern cross section, but rather a very small translation.

Plot 1B shows that the calculated delta horizontal displacements from the proposed building load case are generally within those calculated from the CRR PSTR load cases.

Plots 1C and 1E show that the calculated delta normal stresses from the proposed building load case are generally within those calculated from the CRR PSTR load cases.

10.6.2 Analysis Group 2 – Sensitivity Analysis of M_{Stage} Factor

Analysis Group 2 comprises sensitivity analysis cases, where the ground relaxation, or M_{Stage} factor is varied to investigate the relative impact of ground relaxation due to tunnel excavation. The results relating to Analysis Group 2 are presented graphically on plots 2A to 2E included in Appendix L.

Plots 2A to 2E show that there is negligible effect when looking at the change in (or delta) values of vertical, horizontal displacement and cavern normal stress, therefore indicating that the assessment results are not sensitive to the adopted M_{Stage} factor.

10.6.3 Analysis Group 3 – Sensitivity Analysis of Rock Stiffness

Analysis Group 3 comprises sensitivity analysis cases, where the stiffness of the rock surrounding the cavern is varied to investigate the relative impact of rock mass stiffness on cavern displacement. The results relating to Analysis Group 3 are presented graphically on plots 3A to 3E included in Appendix L and are discussed below.

The rock mass Young's Modulus adopted for the material that surrounds the cavern is 5GPa. We have considered a sensitivity range equal to 50% and 200% of the adopted value (2.5GPa to 10GPa).

Plot 3A shows that cavern vertical displacement increases due to a reduction in the rock mass stiffness. At the higher values of rock mass stiffness (5GPa and 10GPa), the vertical displacement from the proposed building load case in generally within that calculated from the plotted PSTR load case (Load Case 1). However, at the lower stiffness (2.5GPa) there is a small increase of approximately 4mm in cavern vertical settlement on the side of the cavern closest to the proposed building.

Plot 3B shows that the calculated delta horizontal displacements from the proposed building load case are generally within those calculated from the CRR PSTR load cases.

Plots 3C and 3E show that the calculated delta normal stresses from the proposed building load case are generally within those calculated from the CRR PSTR load cases.

10.6.4 Analysis Group 4 – Sensitivity Analysis of Pile Steel Liners

Analysis Group 4 comprises sensitivity analysis cases, where pile permanent steel liners have been included in the analysis and compared against analysis where no steel liners are included. The permanent steel liners are represented in the FE model by limiting distribution of axial force to the ground via skin friction along the length of the pile where the liner is present. The socket lengths are considered as the length of pile that extends below the 1:1 line of influence as illustrated in Diagram 21.

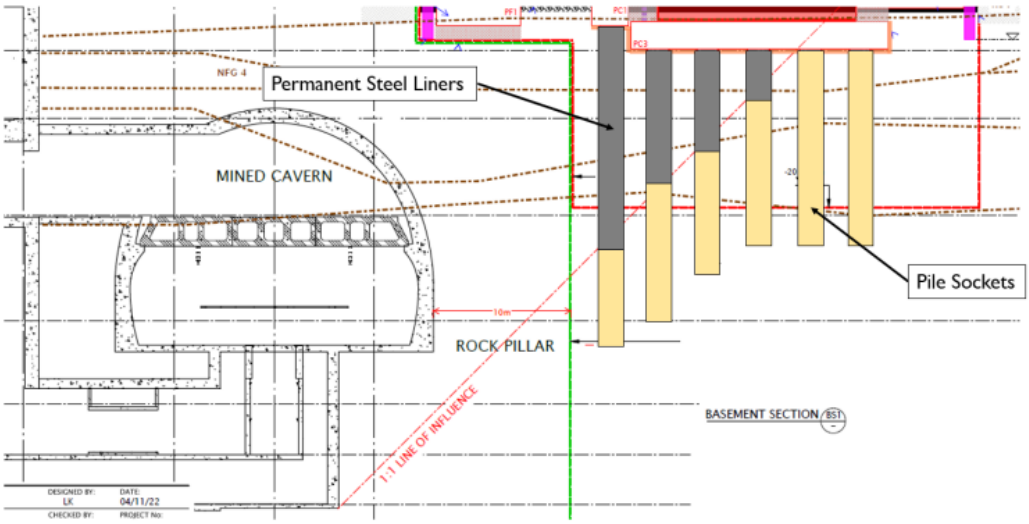


Diagram 21 – Pile Sockets

Plots 4A to 4E show that the presence of pile permanent steel liners has little effect on the cavern displacement and normal stress, which suggest that the inclusion of permanent steel liners provides little benefit in preventing load transfer to the cavern.

11 Alternative Raft Foundation Arrangement

11.1 Structural Elements

The structural elements used in the analysis for the raft foundations are generally the same as the structural elements used in the piled foundation analysis presented in Section 10. The differences in structural elements between the two finite element models are presented in Table 36.

Table 36 – Change in Finite Element Model Structural Elements for Raft Foundation Option

Component	Plaxis Element Type	Details
Concrete Core Slab (PC3)	Plate	Removed, not applicable for raft foundation.
Core Piles	Embedded Beam	Removed, not applicable for raft foundation.
Podium Pile Cap (PC1, PC2, PC4 and PC5)	Plate	Removed, not applicable for raft foundation.
Podium Piles	Embedded Beam	Removed, not applicable for raft foundation.
Shallow Foundation Footing Type 1 and 2 (PF1 and PF2)	Plate	Removed, not applicable for raft foundation.
Raft foundation – Albert Street side	Plate	The raft foundation on the Albert Street side of the site has been modelled as a 1m thick plate element. An elastic modulus value of 39.6GPa has been assigned to the plate.
Raft foundation – Core side	Plate	The raft foundation on the core side of the site has been modelled as a 2m thick plate element. An elastic modulus value of 39.6GPa has been assigned to the plate.

Key features of the finite element model for the raft foundation option are shown indicatively in Diagram 22 and Diagram 23.

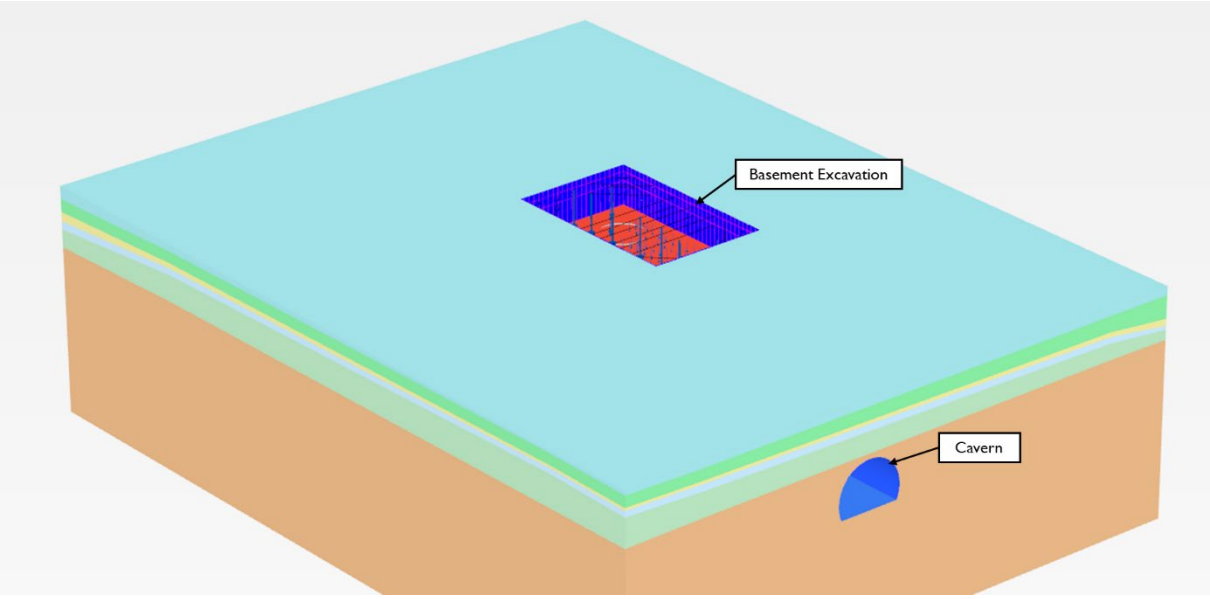


Diagram 22 – Finite Element Model Raft Foundation Markup 1

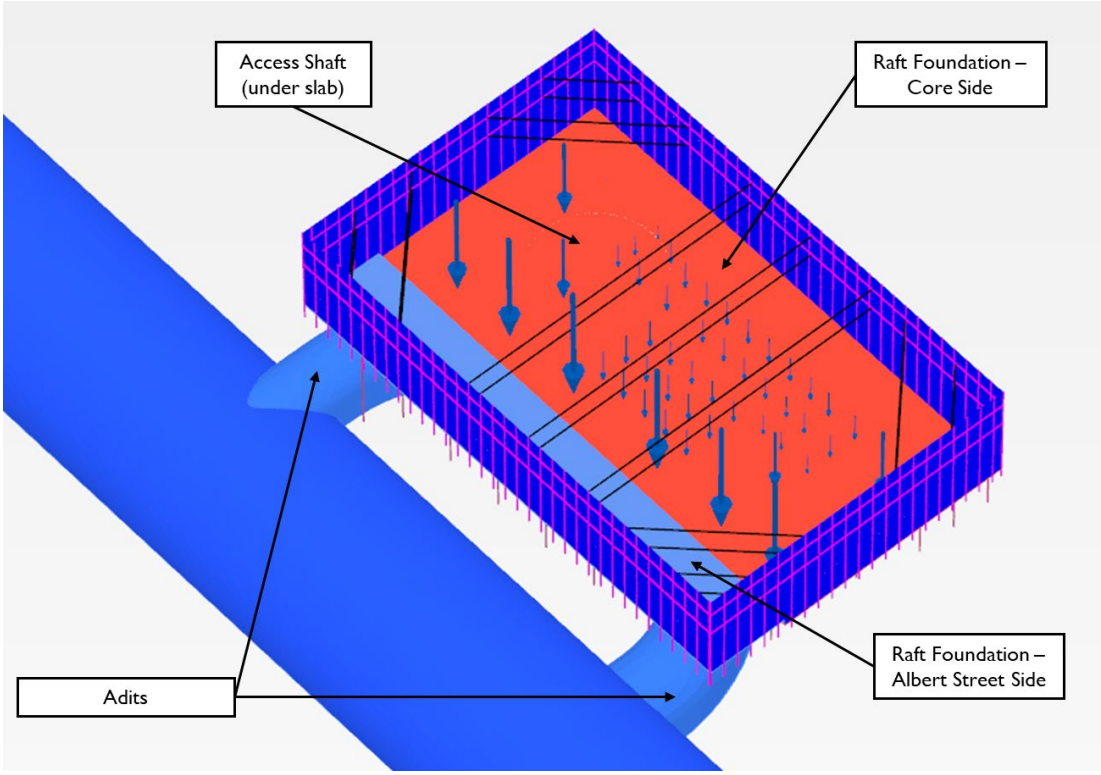


Diagram 23 – Finite Element Model Raft Foundation Markup 1

11.2 Construction Stages

The analysis for the raft foundation option generally adopts the same construction stages for the piled foundation option as presented previously in Table 31. The differences in construction stages between the two foundation options are summarised in Table 37.

Table 37 – Difference in Construction Sequence between Raft Foundation Option and Piled Foundation Option

Analysis Stage	Description	Details
19	Excavate and Replace	Material underlying the raft foundation on the core side are excavated and replaced to NFG3 or better material. Material underlying the raft foundation on the Albert Street side are excavated and replaced to NFG5 or better material.
20	Installation of raft foundations	Raft foundations are installed in a single stage. The raft foundation slabs are modelled as plate elements.

11.3 Analysis Cases

Several analysis cases have been carried out in this assessment which include the *main* analysis cases and a series of sensitivity analysis cases. All analysis cases have been grouped into one of two categories as described below. The analysis results from each analysis case group are discussed in the following sections.

- **Group 5** – Main analysis cases that provide a comparison between the CRR PSTR load cases and the proposed Albert Street FOSD building loads for the raft foundation option.
- **Group 6** – Sensitivity analysis cases investigating the relative impact of rock stiffness surrounding the cavern for the raft foundation option.

11.4 Analysis Results

11.4.1 Analysis Group 5 – Main Cases for Raft Foundations

Analysis Group 5 comprises the CRR PSTR load against the proposed building load case for the raft foundation option. The results relating to Analysis Group 5 are presented graphically on plots 5A to 5E in Appendix M.

Referring to Plots 1A to 1E and 5A to 5E, the displacement and normal stress on the cavern liner from the raft foundation option are generally comparable with the piled foundation option.

Values of cavern liner displacement are presented in relative change (or delta) terms. The delta values present the total displacements following installation of liner and associated construction settlement (i.e. they do not include displacements due to tunnel excavation).

Plot 5A shows that the peak delta vertical displacement from the PSTR cases is approximately 6mm (Load Case 7) and approximately 2mm from the proposed building loads, indicating that the effects from the proposed building loads are within the effects from the CRR PSTR load cases.

The proposed building load case results in a slight increase in vertical displacement of approximately 2mm on the side of cavern closest to the proposed building. This indicates that the cavern is subject to a slight rotation of approximately 1 in 10,000 due to load transferred to the ground via the piles. This can be seen in Plot 1D, which illustrates the vertical and horizontal deformation on the cavern liner due to the PSTR cases and proposed building loads. The mechanism of movement is related to elastic settlement of the surrounding rock mass and therefore the calculated liner distortion is not a representation of a change in cavern cross section, but rather a very small translation.

Plot 5B shows that the calculated delta horizontal displacements from the proposed building load case are generally within those calculated from the CRR PSTR load cases.

Plots 5C and 5E show that the calculated delta normal stresses from the proposed building load case are generally within those calculated from the CRR PSTR load cases.

11.4.2 Analysis Group 6 – Sensitivity Analysis of Rock Stiffness

Analysis Group 3 comprises sensitivity analysis cases, where the stiffness of the rock surrounding the cavern is varied to investigate the relative impact of rock mass stiffness on cavern displacement. The results relating to Analysis Group 6 are presented graphically on plots 6A to 6E included in Appendix M and are discussed below.

The rock mass Young's Modulus adopted for the material that surrounds the cavern is 5GPa. We have considered a sensitivity range equal to 50% and 200% of the adopted value (2.5GPa to 10GPa).

Plot 6A shows that cavern vertical displacement increases due to a reduction in the rock mass stiffness. At the higher values of rock mass stiffness (5GPa and 10GPa), the vertical displacement from the proposed building load case in generally within that calculated from the plotted PSTR load case (Load Case 1). However at the lower stiffness (2.5GPa) there is a small increase of approximately 4mm in cavern vertical settlement on the side of the cavern closest to the proposed building.

Plot 6B shows that the calculated delta horizontal displacements from the proposed building load case are generally within those calculated from the CRR PSTR load cases.

Plots 6C and 6E show that the calculated delta normal stresses from the proposed building load case are generally within those calculated from the CRR PSTR load cases.

Referring to Plots 3A to 3E and 6A to 6E, the displacement and normal stress on the cavern liner from the raft foundation option are generally comparable with the piled foundation option.

11.5 Discussion

The calculated vertical and horizontal distortions associated with the proposed building loads are generally within (or very close to) the calculated values from the CRR PSTR Load Cases 1 to 7 for both the piled foundation option and the raft foundation option.

The outcomes of the analysis for the piled foundation option and the raft foundation option are similar.

We consider that the analysis outcomes indicate that predicted effects associated with the proposed building loads are within the effects associated with the PSTR design load cases.

The sensitivity analysis cases indicate that the outcomes of the assessment are not sensitive to the parameters adopted in the analysis. These include the tunnel relaxation factor, rock mass stiffness and the presence of permanent steel pile liners.

12 Temporary Batter Slope Angles

During excavation of the basement, temporary batter slopes may need to be excavated within Fill and Alluvium. Temporary batter slopes are not expected to be required for durations longer than 1 week. We therefore recommend that all temporary batter slopes are excavated no steeper than 1V:1H with a vertical height less than 2m.

Once the contractor confirms the proposed excavation geometry, a slope stability assessment should be carried out by the geotechnical temporary works engineer. Should batter slopes be required for durations longer than 1 week, the slope should be reduced to 1V:2H.

13 Earthquake Subsoil Class

Based on our interpretation of the ground conditions, the site sub-soil class is classified as Class C – Shallow Soil Site in accordance with Section 4 of AS 1170.4-2007.

14 Excavatability and Trafficability

The materials present within the proposed basement are expected to comprise surface fill, soft to firm alluvium, and residual soils overlying weathered argillite. Excavation of these materials is expected to be achievable using mechanical excavators.

For excavation within low strength rock, hard digging with a large mechanical excavator and/or use of a hydraulic rock hammer may be required. Advice relating to vibrations associated with rock hammers should be sought from a specialist vibration consultant.

Most excavated materials will comprise alluvium, which is generally described as soft to firm in stiffness. It is therefore expected that poor trafficability conditions will be present, which would likely result in heavy rutting and/or heavy wheel mounted plant becoming bogged. Track mounted plant would be less affected, however further assessment of site trafficability conditions would be required following interpretation of additional geotechnical investigation data.

15 Ground Vibrations

Considering the proposed construction activities and methodologies as discussed with RBG, we anticipate that groundborne vibrations may arise from piling works and excavation within rock units, if there is rock strength material within the basement excavation and/or the lift core overrun pit. Advice relating to vibrations associated with the proposed construction activities should be sought from a specialist vibration consultant. Dilapidation surveys of sensitive structures should be carried out prior to construction. It is anticipated that limitations on vibratory equipment may be nominated based on the outcomes of specialist vibration advice.

16 Erosion and Sediment Control

16.1 Pre-Development Phase

Prior to construction commencing, the following erosion and sediment control measures will need to be installed around the subject site to minimise disturbance and ensure the quality of runoff discharging from the site is of an acceptable standard:

- Sediment barriers to be installed on all entrances to downstream stormwater infrastructure (i.e. gully pits).
- Install construction entry and exit shakedown areas.
- Sediment fences are to be installed on the downstream boundaries of the subject site and install dust control measures as required.
- All erosion and sediment control measures are to be designed and installed in accordance with IECA Guidelines. Further details regarding the proposed erosion and sediment control measures will be provided during the detailed design phase of the development.

16.2 Construction Phase

During the construction phase of the development, there is a risk of sedimentation transport due to large areas of disturbed land. The following erosion and sediment control measures will need to be installed in addition to the measures described in the section above:

- Construction of temporary diversion drains to divert water to sediment basins.
- Construction of temporary diversion drains to divert water to protect bioretention and treatment devices as required.
- Sediment barriers to be installed on all entrances to newly constructed stormwater infrastructure (i.e. gully pits).
- Sediment fences to be installed on the downstream side of any stockpiles and batters.

All erosion and sediment control measures are to be designed and installed in accordance with IECA Guidelines. Further details regarding the proposed erosion and sediment control measures will be provided during the detailed design phase of the development.

16.3 Maintenance

All erosion and sediment control devices are to be maintained through the entire phase of the development leading up to the operational phase. Erosion and sediment control devices will need to be monitored closely throughout the entire project to ensure they are operating correctly and efficiently. No erosion and sediment control devices are to be removed unless otherwise authorized by a suitably qualified engineer or the site superintendent.

17 Construction Comments

The geotechnical aspects of the works are expected to encounter several challenges during construction. A commentary on construction issues / requirements identified at this stage is provided in the following sections.

17.1 Piling

Piles associated with the retention system are expected to be drilled through fill, alluvium, residual soil and extremely weathered material. Considering the relatively low strength and stiffness of the fill and alluvium, it is likely that the pile holes may collapse unless supported by pile liners, which could be either temporary or sacrificial. As an alternative to bored piles, it may be feasible to install the retention piles using Continuous Flight Auger (CFA) methods, that would mitigate the risk of pile hole collapse due to the method of installation. Building foundation piles are expected to be bored piles and will require (either temporary or permanent) liners or support fluid to support the upper soil layers.

All piles must be logged during construction to verify that the encountered materials satisfy the design requirements, and particularly for the permanent foundation piles that the required pile axial capacity has been achieved. Pile logging must be carried out by a suitably qualified and experienced geotechnical professional. We expect that video cameras would be required to confirm socket materials and cleanliness.

We recommend that pile load testing (such as Osterberg cell and/or dynamic testing) is carried out during the works to confirm the axial capacity of the piles. Specialist advice from a pile testing contractor should be sought to confirm the requirements associated with carrying out pile testing on site.

We anticipate that piling would be carried out from either the existing ground level or from the base of excavation level. Should piling be carried out from existing ground level, it may be possible to use the existing acoustic shed slab to support the piling rig track pressures, subject to assessment and approval by the temporary works engineer. If piling is be carried out from the base of excavation level, an assessment of the subgrade must be carried out by the temporary works engineer and if required a temporary piling platform would need to be designed and constructed.

The project site contains several buried structures associated with CRR temporary works. These structures include a 14m diameter, approximately 30m deep circular access shaft, two temporary construction adits that provide access between the temporary shaft and the Albert St cavern, and several reinforced concrete piles that currently support the temporary acoustic shed.

It is likely that some proposed building foundation piles may clash with this existing buried infrastructure. Specialist advice from a piling contractor should be sought to assess the ability of typical piling equipment to penetrate through those obstructions, however, we highlight the following key points based on our understanding of the CRR construction details:

- The arrangement of building foundations should aim to (where possible) avoid buried infrastructure.
- Piling through unreinforced cementitious materials is expected to be achievable with conventional piling equipment, however the penetration rates may be reduced compared to drilling through natural rock units.
- Piling through concrete reinforced with steel of polypropylene fibres is expected to be as achievable with conventional piling equipment as for unreinforced concrete.
- Piling through concrete reinforced with steel bars or steel mesh is expected to be difficult and specialist advice from a piling contractor must be sought.

Diagram 24 shows the primary support details for the temporary adits. Two support classes are shown which comprise either, a relatively thin layer of shotcrete combined with steel rock bolts (Support Type 1&2), or a thicker layer of shotcrete without any rock bolts (Support Type 3A and 3B).

As mentioned above, piling through the shotcrete (as per Support Type 3A and 3B) is expected to be achievable, however it is expected that it will be difficult to achieve penetration should the piling rig clash with the steel rock bolts included in Support Type 1 and 2.

Nomination of tunnel face support types to be installed was based on the results of construction phase mapping of the tunnel face. We recommend that the construction mapping records are requested from CBGU so that we can confirm what support type was constructed along the length of the temporary adits. Specialist advice from a piling contractor must be sought to understand the ability of the piling equipment to penetrate a zone reinforced with steel rock bolts.

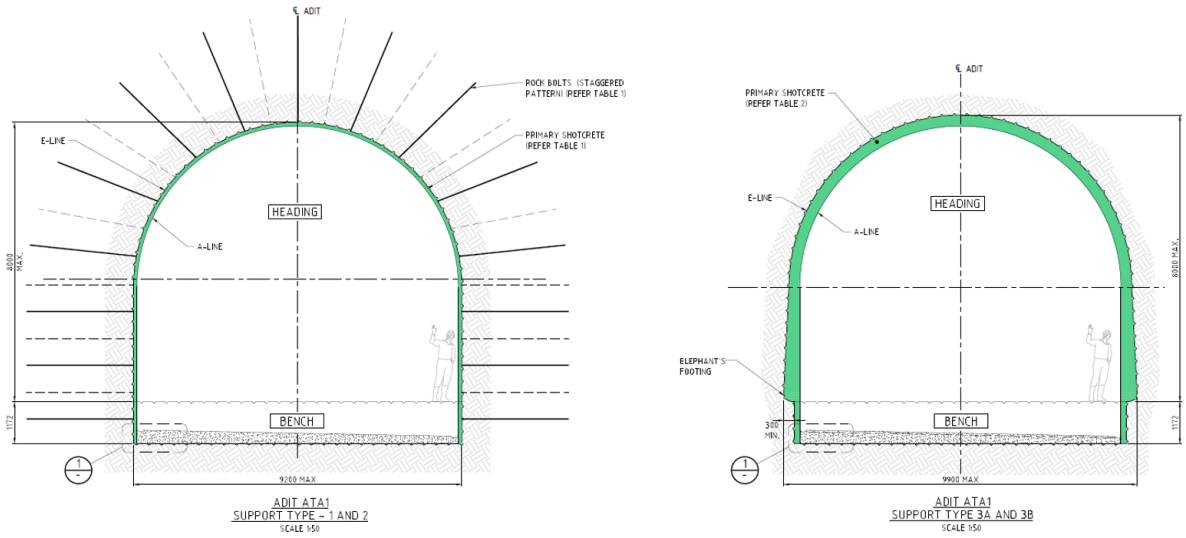


Diagram 24 – Adit Support Details

17.2 Shotcreting

Shotcrete is to be sprayed between the soldier piles that form the walls of the retention system. Excavation of the basement would be carried out in stages, such that each excavation stage is followed by application of shotcrete. The vertical height of each excavation stage must be limited such that materials in between the soldier piles do not become unstable. At this stage we anticipate that the excavation heights would be limited to approximately 1.5 metres. However, it may be possible to increase the excavation height, depending on the observed performance of the materials between the soldier piles during construction.

17.3 Shallow Footings

Several shallow footings (or a larger raft) are to be constructed to support the permanent building loads. Following excavation of the footings, geotechnical assessment must be carried out by an experienced geotechnical professional to verify that the design requirements have been achieved. The assessment process would likely comprise visual and tactile assessment along with in-situ testing.

17.4 Temporary Dewatering

The BELs range between RL -5.6m AHD and RL -9m AHD depending on which foundation option is selected. Should the groundwater level be above or close to the base of excavation level, local dewatering measures would likely be required. Further assessment of groundwater levels will be carried out following completion of the additional geotechnical investigation.

18 Geotechnical Investigations

The advice presented in this document has considered the available geotechnical investigation data which predominantly is located outside of the boundary of the proposed development site. Additional geotechnical investigations will therefore be required to verify the geotechnical conditions considered in the building design and will be carried out following completion of the CRR works and removal of the acoustic shed.

The actual scope of the additional geotechnical investigation will be further developed as the project progresses, however at this stage we recommend the scope of geotechnical investigation as described in Table 38. A preliminary site investigation location plan is provided in Appendix N.

Table 38 – Scope of Geotechnical Investigation

Investigation Type	Details
Cone Penetration Tests (Piezocones) CPTu	We recommend a series of Piezocones positioned around the perimeter of the site to help define ground stratigraphy and saturated layers.
Rotary Cored Boreholes	We recommend approximately eight rotary cored boreholes that will encounter the shaft and adit backfill materials, and extend beneath into the underlying rock, along with an additional eight boreholes positioned away from the shaft and adits. The boreholes will provide information confirming the parameters of the shaft and adit backfill, the soils and the rock units and will help define pile toe levels and founding levels for shallow foundations.
Pressuremeter	We recommend at least three pressuremeter tests performed in-situ in boreholes. The pressuremeter tests will provide a direct measurement of the rock mass stiffness.

Investigation Type	Details
Groundwater Monitoring Instrumentation	Approximately four standpipe piezometers installed in boreholes around the site, each comprising a screened zone within the upper Alluvial soils and the lower rock units.
Laboratory Testing	Classification and triaxial shear strength tests in the soils. Rock strength (UCS and Point Load Index) tests in the rock units.

19 Risks and Limitations

There are several key geotechnical risks that are identified at this stage and will be investigated further in the detailed design stage. A commentary on key geotechnical risks and limitations associated with this stage of geotechnical assessment is provided In Table 39.

Table 39 – Risks and Limitations

Issue	Discussion
Interpretation of ground conditions	The majority of the available geotechnical investigation data is from outside of the site extents and therefore we have assessed the ground conditions within the site based an interpretation of the nearby data. To help reduce uncertainty and risk associated with the interpretation of ground conditions, an additional geotechnical investigation will be carried out once the CRR works are complete and the site is handed over to Albert Street Trust. The exact scope of the additional geotechnical investigation will be further developed as the project progresses, however at this stage we recommend the scope of geotechnical investigation as described in Section 18.
Groundwater levels	At this stage, we have been provided with limited information relating to site groundwater levels. During subsequent design stages, it is required to gain a better understanding of the local groundwater conditions to develop the retention system design, B2 basement slab design and better understand temporary and permanent groundwater control measures. Definition of site groundwater levels via groundwater monitoring instrumentation would be a key requirement of the additional geotechnical investigation.
Surface settlements behind retention system	Note that the retaining wall analysis carried out at this stage is limited to calculation of wall movements only, and therefore ground surface settlements outside of the retention system have not been assessed at this stage. Ground surface settlements will be assessed during the detailed design stage for assessment of the performance of any sensitive buried infrastructure.
Shaft and Adit Backfilling	Backfilling of the adits and shaft must be carried out carefully to ensure there are no voids left at the top of the adits. Should foundation loads transfer to voids at the top of the adits, foundation settlements additional to those estimated in this report may occur.
Ground-borne vibrations affecting Cavern	We recommend that specialist advice is sought on ground-borne vibrations relating to the specific site details and proposed construction equipment be sought during the detailed design stage. Construction stage work may include monitoring of vibrations on-site associated with bored piling and rock excavation activities and re-calibrating the vibration levels for the observed measurements.
Piling obstructions	It is possible that there are steel buried rock bolts beneath the site associated with the primary support for the temporary adits. The presence of steel rock bolts in pile locations is expected to create difficulties associated with drilling to the nominated pile toe depths.

Issue	Discussion
	We recommend that Albert Street Trust seeks advice from a specialist piling contractor regarding piling through the buried CRR temporary infrastructure and also obtains construction records that confirm the type of primary support installed within the temporary adits.
Bearing capacity and stiffness of shallow footings	The available geotechnical investigation data suggests some variability in soil strength and stiffness at the proposed elevation of the base of the shallow footings along the Albert St side of the site. We will therefore further investigate parameters affecting the capacity and stiffness for shallow footings during the additional geotechnical investigation.
ASS in Alluvium	Interpretation of the available geotechnical investigation data suggests that the alluvium is PASS. We therefore recommend that Albert Street Trust obtains records of the construction phase environmental sampling and testing associated with excavation of the CRR Albert St Lot 2 temporary shaft.

For and on behalf of EDG Consulting Pty Ltd



David Cunliffe
Senior Principal

Ground conditions and the natural environment often present the highest potential risks to project construction and operation. Helping our clients manage their geotechnical risk is fundamental to the role of EDG. We have prepared these notes to assist our clients to understand the information we provide and to help them to manage their risk. Where there is uncertainty about the site, project or geotechnical conditions, contact EDG for assistance.

Scope of Services

The information provided in this document is based on the scope of services defined in the client's agreement with EDG Consulting Pty Ltd (EDG). In undertaking the work, EDG has relied on information provided by the client and other individuals and organisations. Unless stated in the document, EDG has not verified the accuracy of that information and does not accept responsibility for the conclusions, recommendations or designs developed based on that information should it be incorrect, misrepresented or withheld.

Unless specifically stated to the contrary, this document does not cover geo-environmental issues, which require significantly different equipment, techniques and personnel. A geo-environmental specialist should be engaged to provide such advice.

The document is based on specific project details

The information provided in this document is relevant to the subject site and project only. The document has been prepared based on the specific details and requirements of your project and may not be relevant if any changes to the project occur. Should changes occur, must review the report to identify if and how such changes will affect the conclusions, recommendations or designs provided. EDG accepts no responsibility if the client elects not to consult in the event of changes to the project.

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Should you choose to engage an alternative party for advice based on the information in the document, it must be understood that the alternative party will be less familiar with the site conditions and basis of information provided, and there is a potential for misinterpretation. EDG will not be held liable in any way from such misinterpretation.

EDG will not be liable to update or revise the document to take into account information any events or circumstances or facts occurring or becoming apparent after the date of the report.

All site conditions cannot be identified

The scope of work undertaken represents a professional assessment of the information cited to develop a basic geotechnical model of the site based on EDG's understanding of the client's risk profile. In some cases, increasing the frequency of investigations and/or sampling, or considering alternative investigation techniques may improve the interpretation, but may not identify all relevant subsurface conditions at the site.

The document presents an interpretation

Geotechnical information is an interpretation of conditions evident based on a limited number of facts established during a site investigation. Engineering logs are an interpretation of observations of samples and test results at discrete locations in the subsurface profile. A geotechnical model is an interpretation of site conditions, developed using information from discrete locations on the site and an understanding of geological processes. Interpreted conditions at and between investigation locations may be different to those inferred on the engineering logs and geotechnical model. The client must consider how variations in conditions could affect the project and seek advice to reduce risk if it is unacceptable to the client.

Conditions can change

The geotechnical information provided is based on the conditions observed at the time of the investigation. Such conditions may be time dependent and subject to external influences. Many things could influence the site conditions, including geological processes, variation in groundwater or surface water levels, other natural cycles and influence from human activities (on this site or nearby sites). Specific advice should be sought if conditions on site change from those observed at the time the report was prepared.

How to deal with different site conditions

The sub-surface conditions on the site may not be as inferred in this report. Geotechnical uncertainties can be managed throughout the project life cycle, but particularly during construction.

Knowledge of site conditions must be further developed as the ground is exposed during construction and/or operation. It is essential that the client implements the nominated design and construction requirements, including observation, interpretation and assessment of the exposed conditions during construction and operation using skilled staff familiar with the design assumptions and assumed geotechnical conditions, or engaging EDG to undertake this role on your behalf. EDG will not be held liable in any way from such misinterpretation.

Appendix A

Summary of Available Geotechnical Investigation Data

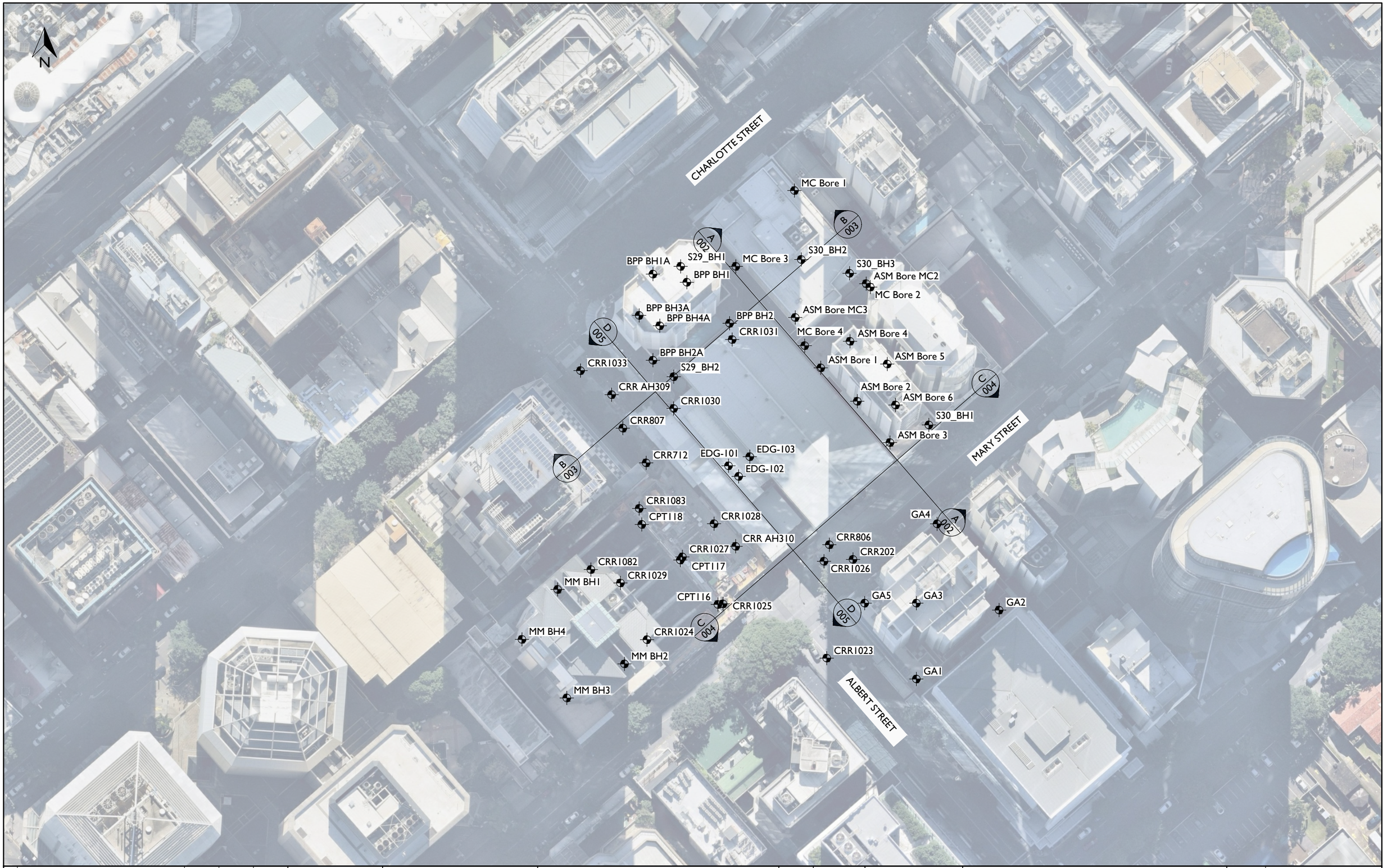
Table A1 – Summary of Borehole Logs

Borehole ID	Borehole Top RL (mAHD)	Total Depth (m)	Date Drilled
ASM Bore 1	4.4	22.7	November 2006
ASM Bore 2	4.4	3.5	November 2006
ASM Bore 3	4.2	22.6	November 2006
ASM Bore 4	4.2	12	November 2006
ASM Bore 5	4.2	3.5	November 2006
ASM Bore 6	4.2	12	November 2006
ASM Bore MC2	4.3	13	September 1999
ASM Bore MC3	4.3	15	September 1999
BPP BH1	3.76	18.25	January 1997
BPP BH1A	4	15	April 1986
BPP BH2	3.95	19	January 1997
BPP BH2A	4	12	April 1986
BPP BH3A	4	0.8	April 1986
BPP BH4A	4	4.5	April 1986
CRR AH309	3.742	5.45	September 2020
CRR AH310	3.766	5.45	May 2020
CRR1023	3.849	40.4	May 2020
CRR1024	5.045	60	February 2020
CRR1025	3.985	54	May 2020
CRR1027	3.891	88.1	April 2020
CRR1028	3.759	44.2	April 2020
CRR1029	2.62	59	April 2020
CRR1030	3.7	44	February 2020
CRR1031	2.95	44.4	January 2020
CRR1033	3.728	40.44	January 2020
CRR1082	5.264	55.45	March 2020
CRR1083	3.796	57.5	April 2020
CRR202	4	45.07	October 2010
CRR712	3.9	39.14	October 2017
CRR806	3.69	50.4	May 2018
CRR807	3.76	51.3	April 2018
GA1	4.5	15.07	January 2001
GA2	4.3	22.2	January 2001
GA3	4.1	16.03	February 2001

Borehole ID	Borehole Top RL (mAHD)	Total Depth (m)	Date Drilled
GA4	4	18.5	February 2001
GA5	4.3	15.3	February 2001
MC Bore 1	4.5	10.05	September 1999
MC Bore 2	4.3	13	September 1999
MC Bore 3	4.2	15.02	September 1999
MC Bore 4	4.2	13	September 1999
MM BH1	4.3	24.5	June 2004
MM BH2	4.7	17	July 2004
MM BH3	6.1	22.2	July 2004
MM BH4	3.6	15.6	June 2004
S29_BH1	4	15	Unknown
S29_BH2	4	12	Unknown
S30_BH1	4	19.5	Unknown
S30_BH2	4	16.6	Unknown
S30_BH3	4	17.3	Unknown

Appendix B

Interpreted Geological Sections



					SURVEY DATA
					Coordinate System:
					Height Datum:
					Base Plan
B	ADDITIONAL INVESTIGATIONS	DL	22/03/2023	DJC	
A	INITIAL ISSUE	DL	30/09/2022	SP	
	Revisions/Descriptions	Drawn	Date	Approved	

Dwg_Filename.dwg

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Dimensions shown in metres except where shown otherwise

ENGINEERING CERTIFICATION (RPEQ)

ENG. AREA	NAME	SIGNATURE	NO.	DATE

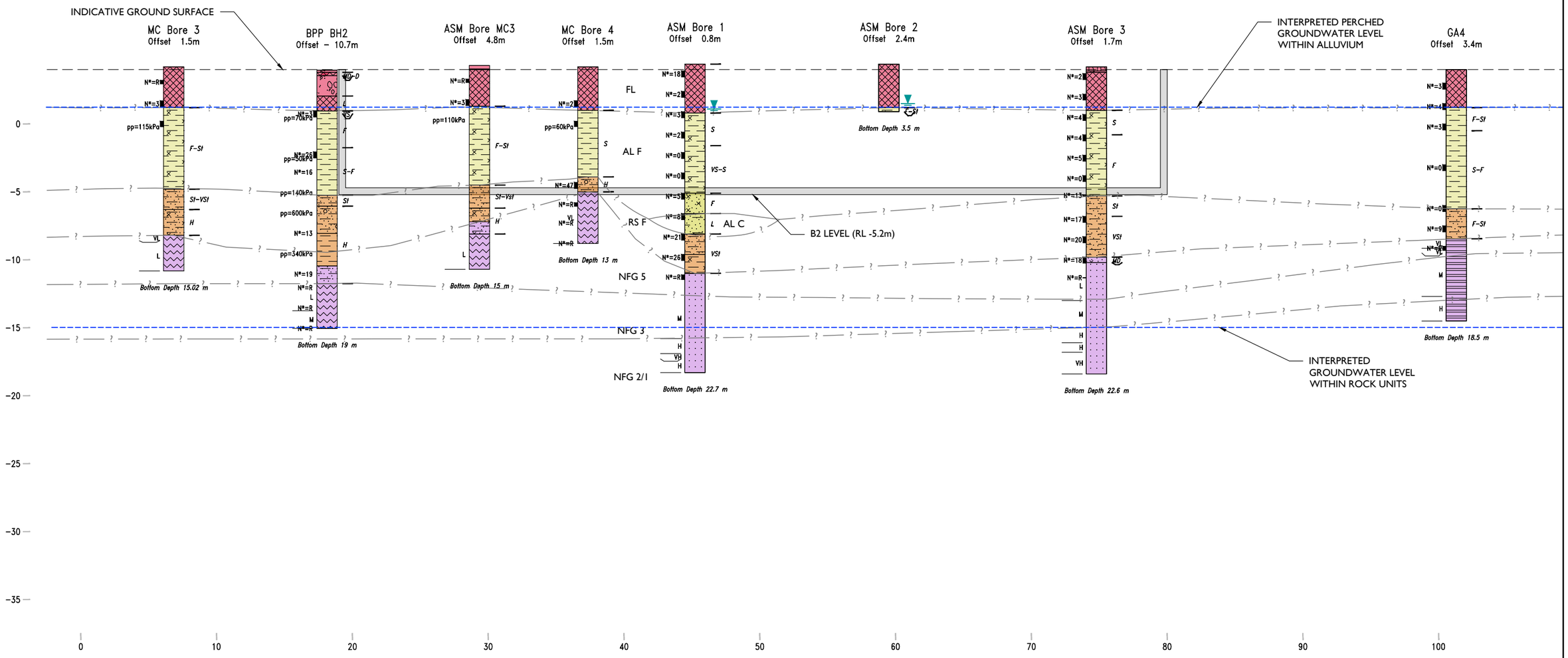
Drawn	DL
Checked	SP
Designed	DL
Verified	SP

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QUEENSLAND INVESTMENT CORPORATION
ALBERT STREET DEVELOPMENT
BRISBANE
PLAN

Job No.	B01493-01	
DRG No.	B01493-01_001	B
Client Ref.	Client Ref.	

File Location:
F:/Projects/B01017-1.....



LEGEND

- Water Level
- N*=17 Standard Penetration Test Results
- *IV* Rock Classification (Pells et al, 1998)
- XW Weathering (see Explanation Sheets)

FILL, SILTY CLAY, SANDY SILT, CLAYEY SAND, SANDY CLAY, GREYWACKE, TOPSOIL, CONCRETE, SILTY SAND, GRAVEL, CLAYEY GRAVEL, ASPHALT, CLAY, PHYLLITE, SILTY SANDY CLAY, SANDY GRAVELLY CLAY, CORE LOSS, GRAVELLY CLAY

FL, RS F, AL F/AL C, NFG

B	ADDITIONAL INVESTIGATIONS	DL	22/03/2023	DJC
A	INITIAL ISSUE	DL	30/09/2022	SP
	Revisions/Descriptions	Drawn	Date	Approved

Dwg_Filename.dwg

SURVEY DATA

Coordinate System

Height Datum

Base Plan

1:300 0 3.75 7.5m

Dimensions shown in metres except where shown otherwise

ENGINEERING CERTIFICATION (RPEQ)

ENG. AREA	NAME	SIGNATURE	NO.	DATE

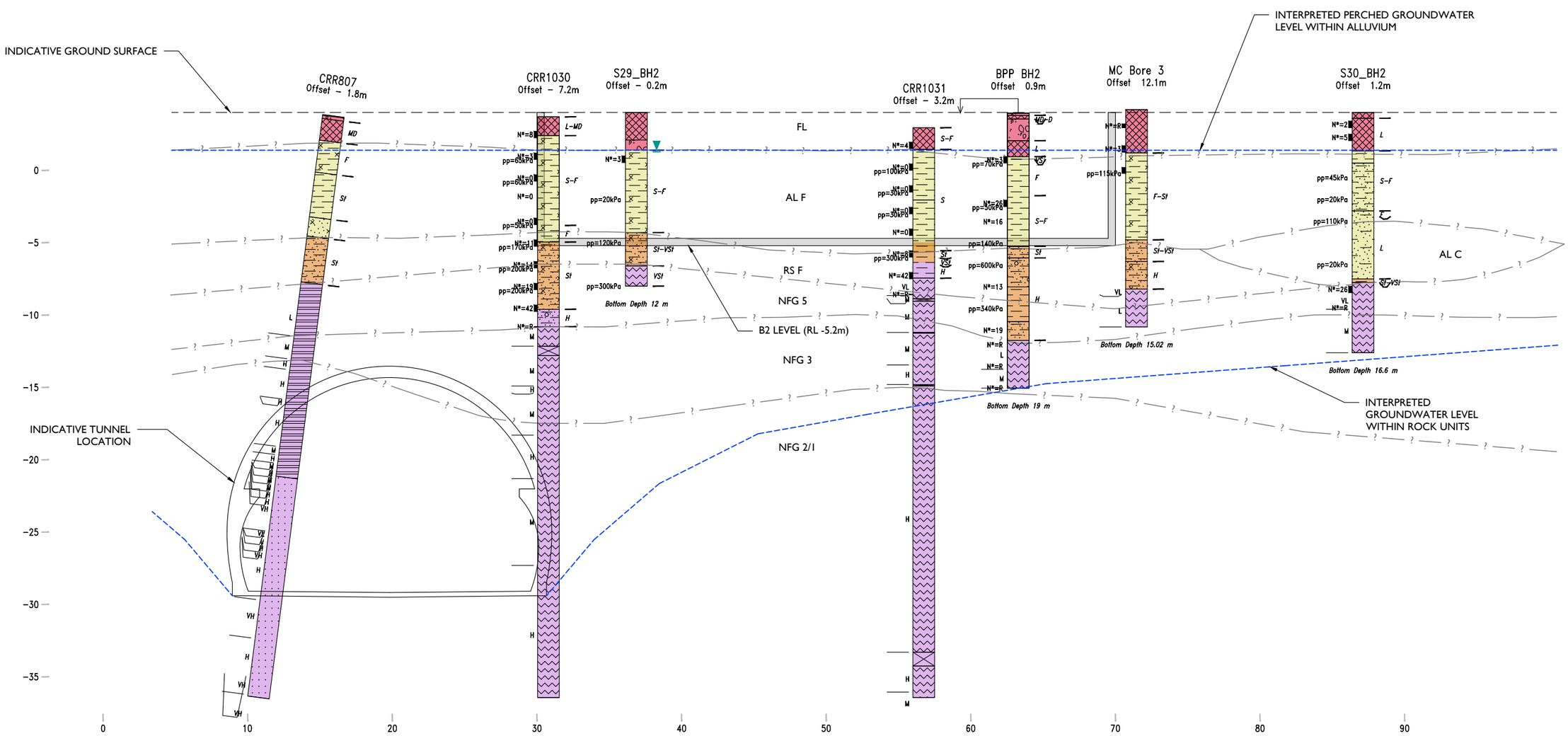
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Designed	DL
Verified	SP

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SECTION A - NORTH EAST

Job No.	B01493-01	
DRG No.	B01493-01_002	B
Client Ref.	Client Ref.	

File Location:
F:/Projects/B01017-1.....



LEGEND

- Water Level
- N*=17 Standard Penetration Test Results
- /V Rock Classification (Pells et al, 1998)
- XW Weathering (see Explanation Sheets)

FILL, SILTY CLAY, SANDY SILT, CLAYEY SAND, SANDY CLAY, GREYWACKE, TOPSOIL, CONCRETE, SILTY SAND, GRAVEL, CLAYEY GRAVEL, ASPHALT, CLAY, PHYLLITE, SILTY SANDY CLAY, SANDY GRAVELLY CLAY, CORE LOSS, GRAVELLY CLAY

FL, RS F, AL F/AL C, NFG

B	ADDITIONAL INVESTIGATIONS	DL	22/03/2023	DJC
A	INITIAL ISSUE	DL	30/09/2022	SP
	Revisions/Descriptions	Drawn	Date	Approved

Dwg_Filename.dwg

SURVEY DATA

Coordinate System

Height Datum

Base Plan

1:300 0 3.75 7.5m

Dimensions shown in metres except where shown otherwise

ENGINEERING CERTIFICATION (RPEQ)

ENG. AREA	NAME	SIGNATURE	NO.	DATE

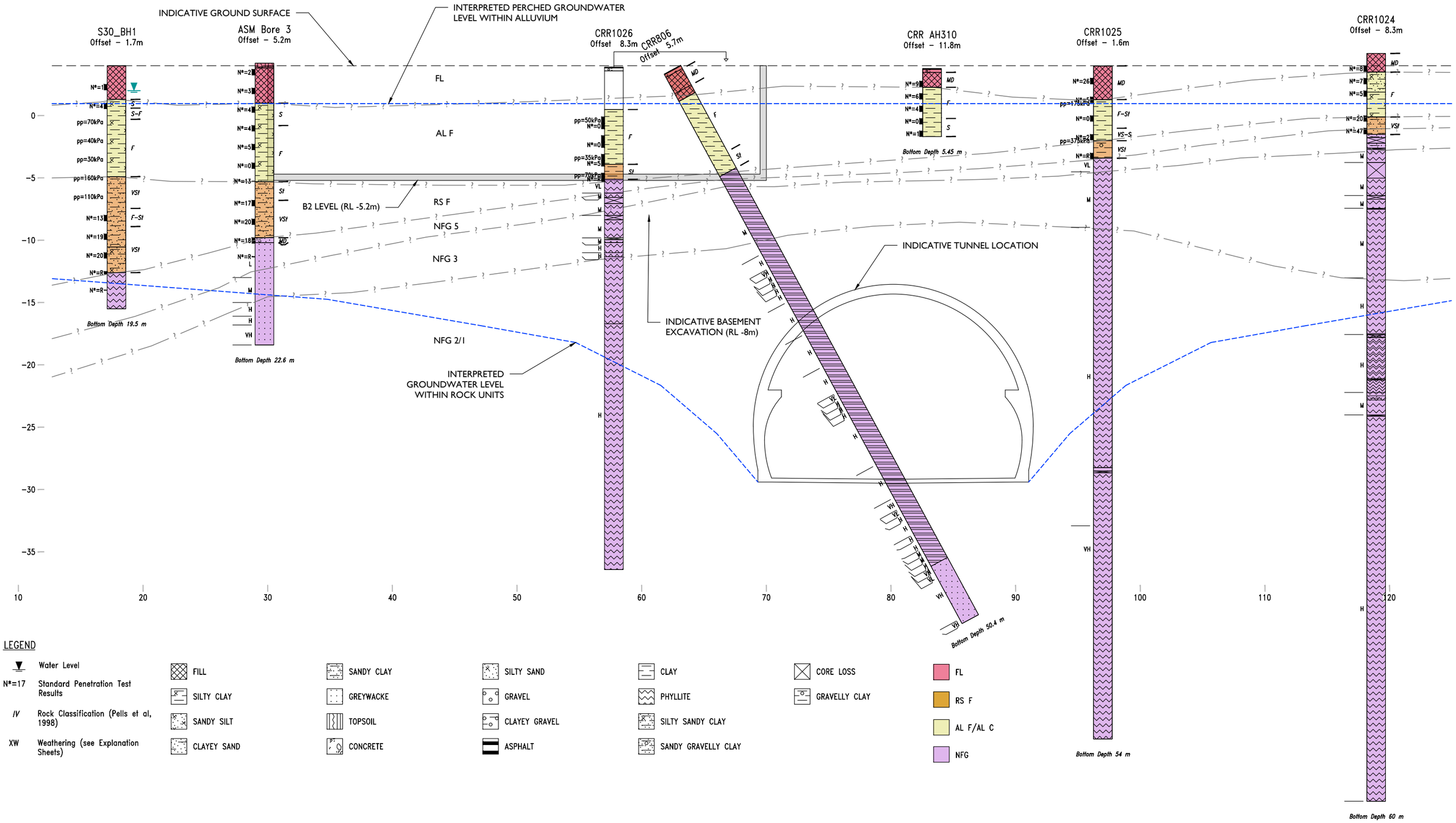
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Designed	DL
Verified	SP

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QUEENSLAND INVESTMENT CORPORATION
ALBERT STREET DEVELOPMENT
BRISBANE
SECTION B - NORTH WEST

Job No.	B01493-01	
DRG No.	B01493-01_003	B
Client Ref.	Client Ref.	

File Location:
F:/Projects/B01017-1.....



LEGEND

Water Level	FILL	SANDY CLAY	SILTY SAND	CLAY	CORE LOSS	FL
N*=17 Standard Penetration Test Results	SILTY CLAY	GREYWACKE	GRAVEL	PHYLLITE	GRAVELLY CLAY	RS F
IV Rock Classification (Pells et al, 1998)	SANDY SILT	TOPSOIL	CLAYEY GRAVEL	SILTY SANDY CLAY		AL F/AL C
XW Weathering (see Explanation Sheets)	CLAYEY SAND	CONCRETE	ASPHALT	SANDY GRAVELLY CLAY		NFG

	Revisions/Descriptions	Drawn	Date	Approved
B	ADDITIONAL INVESTIGATIONS	DL	22/03/2023	DJC
A	INITIAL ISSUE	DL	30/09/2022	SP

Dwg_Filename.dwg

SURVEY DATA

Coordinate System

Height Datum

Base Plan

1:300 0 3.75 7.5m

Dimensions shown in metres except where shown otherwise

ENGINEERING CERTIFICATION (RPEQ)

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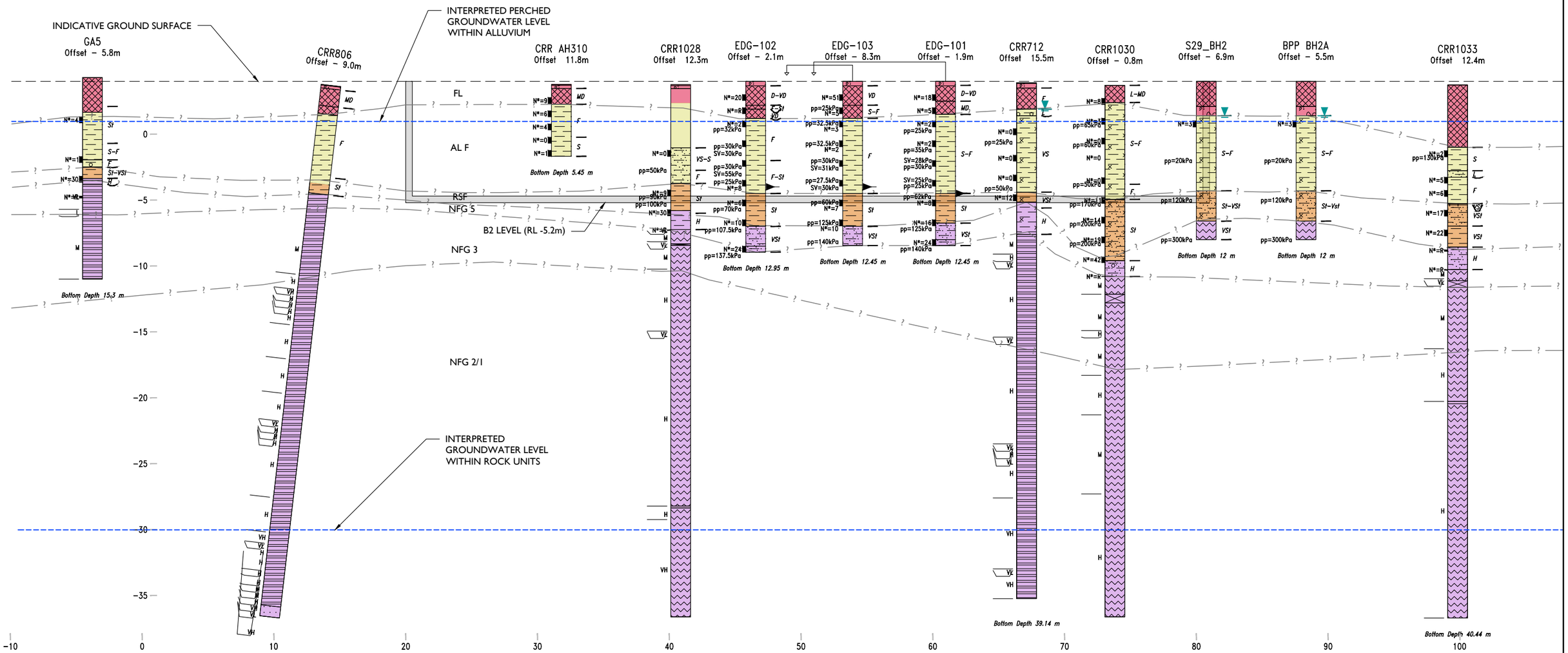
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Designed	DL
Verified	SP

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QUEENSLAND INVESTMENT CORPORATION
ALBERT STREET DEVELOPMENT
BRISBANE
SECTION C - SOUTH EAST

Job No.	B01493-01	
DRG No.	B01493-01_004	B
Client Ref.	Client Ref.	

File Location:
F:/Projects/B01017-1.....



LEGEND

- Water Level
- N*=17 Standard Penetration Test Results
- *IV* Rock Classification (Pells et al, 1998)
- XW Weathering (see Explanation Sheets)

- FILL
- SILTY CLAY
- SANDY SILT
- CLAYEY SAND
- SANDY CLAY
- GREYWACKE
- TOPSOIL
- CONCRETE
- SILTY SAND
- GRAVEL
- CLAYEY GRAVEL
- ASPHALT
- CLAY
- PHYLLITE
- SILTY SANDY CLAY
- SANDY GRAVELLY CLAY
- CORE LOSS
- GRAVELLY CLAY
- FL
- RS F
- AL F/AL C
- NFG

B	ADDITIONAL INVESTIGATIONS	DL	22/03/2023	DJC
A	INITIAL ISSUE	DL	30/09/2022	SP
	Revisions/Descriptions	Drawn	Date	Approved

Dwg_Filename.dwg

SURVEY DATA

Coordinate System

Height Datum

Base Plan

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Dimensions shown in metres except where shown otherwise

ENGINEERING CERTIFICATION (RPEQ)

ENG. AREA	NAME	SIGNATURE	NO.	DATE

Drawn	DL
Checked	SP
Designed	DL
Verified	SP

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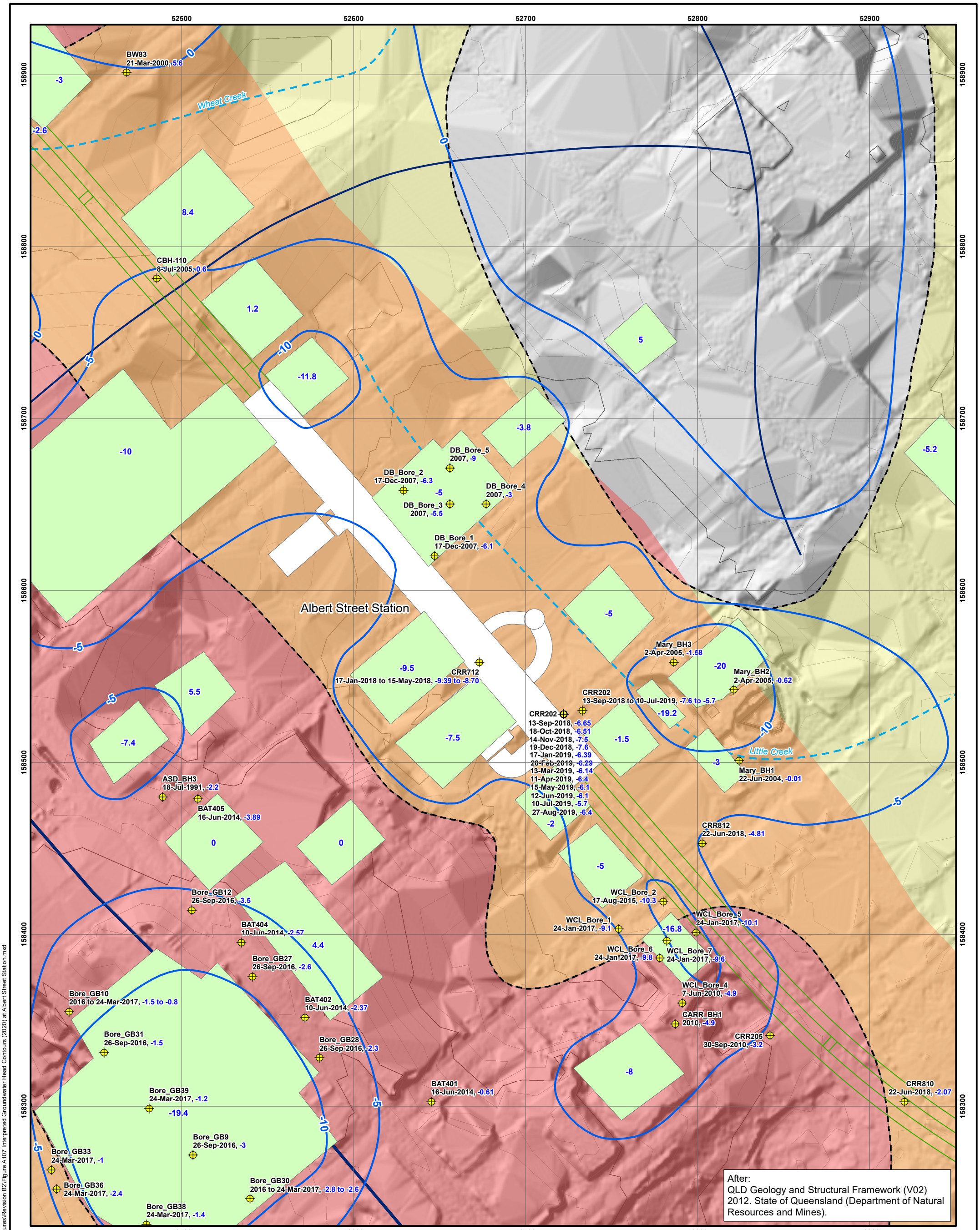
QUEENSLAND INVESTMENT CORPORATION
ALBERT STREET DEVELOPMENT
BRISBANE
SECTION D - SOUTH WEST

Job No.	B01493-01	
DRG No.	B01493-01_005	B
Client Ref.	Client Ref.	

File Location:
F:/Projects/B01017-1.....

Appendix C

Groundwater Monitoring Summary



Legend

- Borehole
- -2.4 Interpreted Groundwater Heads (m AHD)
- Interpreted Water Table Contours (m AHD)
- Project Alignment
- Cavern and Shaft Excavation
- Inferred Original Drainage
- Catchment Divide
- Sub-catchment Divide
- Topography Contours
- Alluvium
- Unconformity Zones
- Inferred Normanby Fault Zone - Outcrop in NFG
- -9.5 Basements and Bottom Elevations (m AHD)

N

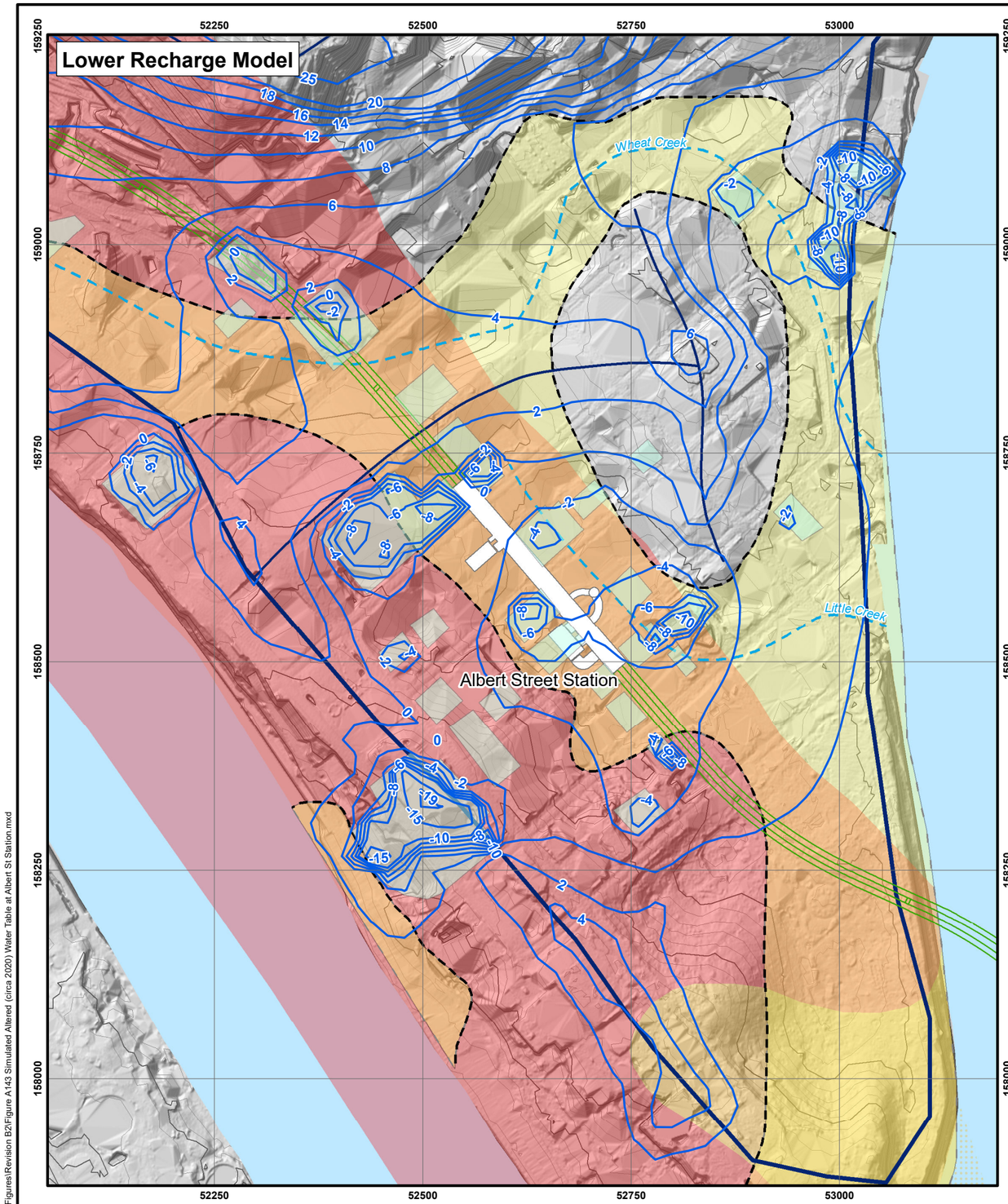
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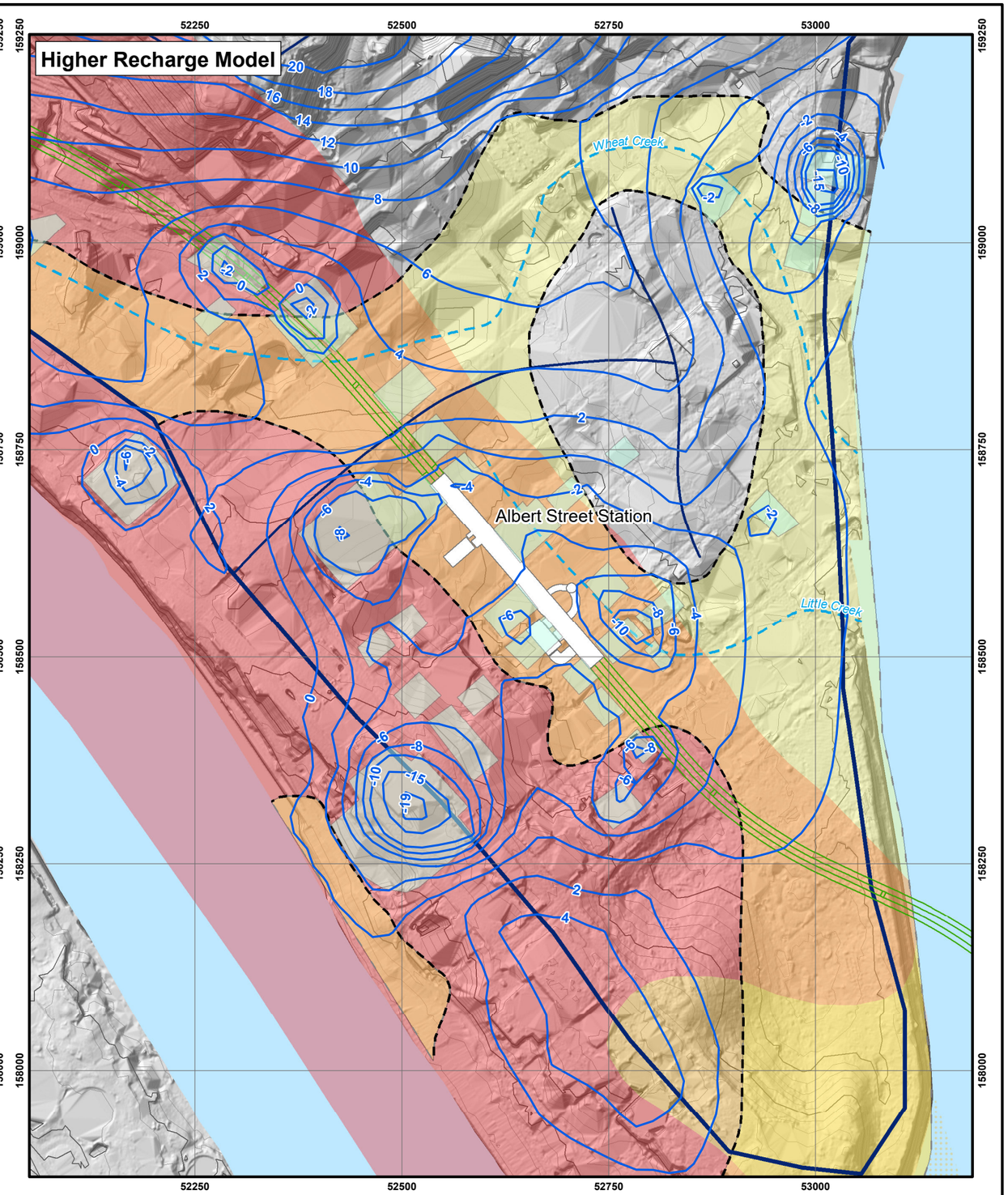
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Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 BCSG02

P S M	Created By: MB	Revision: B2	CPB Ghella Bam UGL Hydrogeological Interpretive Report Cross River Rail INTERPRETED GROUNDWATER HEAD CONTOURS (2020) AT ALBERT STREET STATION
	Date: 18 Mar 2020	Paper Size: A3	CRRTSD-000-0354-DPK-PSMQ-1120-000100 / Figure A107

X:\ArcGIS_Working\PSM3700 CRR03_Figures\HIR Figures\Revision B2\Figure A107 Interpreted Groundwater Head Contours (2020) at Albert Street Station.mxd





Legend

- Project Alignment
- Cavern and Shaft Excavation
- Inferred Original Drainage
- Catchment Divide
- Sub-catchment Divide
- Topography Contours
- Water Table (m AHD)
- Alluvium
- Unconformity Zones
- Inferred Normanby Fault Zone - Outcrop in NFG
- Southeast Projection of Normanby Fault Zone - Subcrop beneath Alluvium, Brisbane Tuff and Aspley Formation
- River Crossing - Subcrop beneath Aspley Formation
- Basements

After:
QLD Geology and Structural Framework (V02) 2012. State of Queensland (Department of Natural Resources and Mines).

N

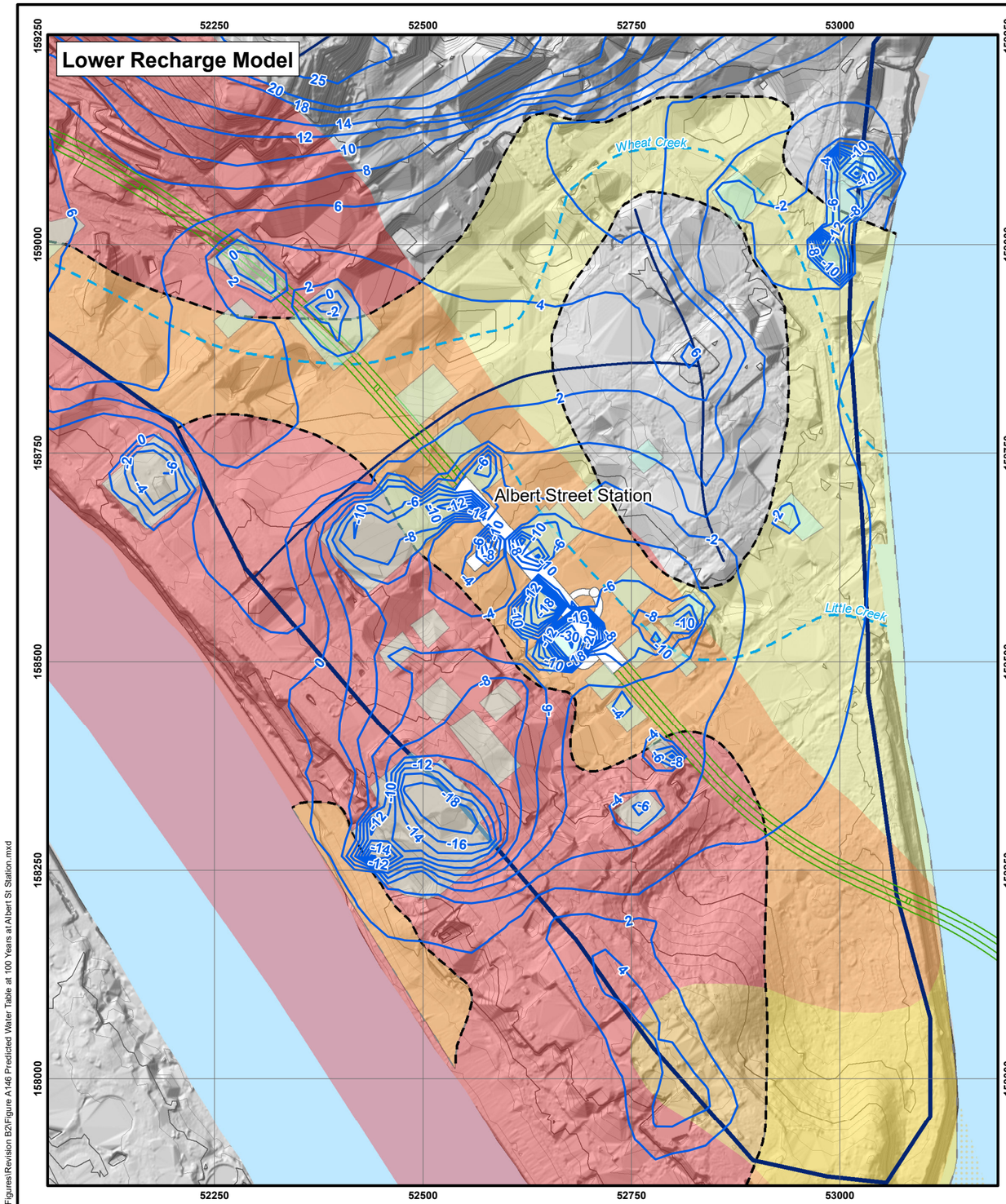
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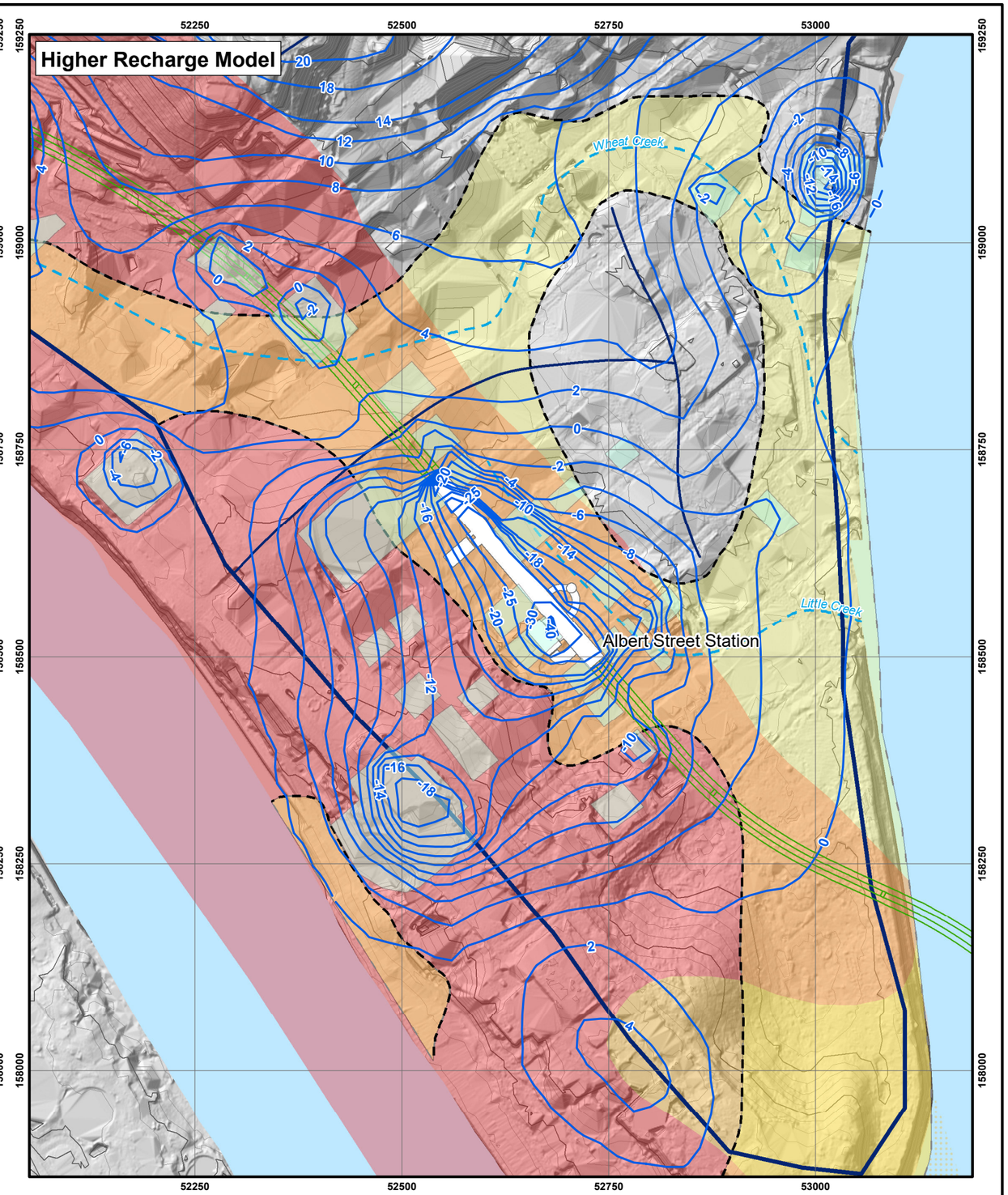
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Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 BCSG02

P S M	Created By: MB	Revision: B2	CPB Ghella Bam UGL Hydrogeological Interpretive Report Cross River Rail
	Date: 11 Mar 2020	Paper Size: A3	SIMULATED ALTERED (CIRCA 2020) WATER TABLE AT ALBERT ST STATION
			CRRTSD-000-0354-DPK-PSMQ-1120-000100 — Figure A143

X:\ArcGIS_Working\PSM3700 CRR\03_Figures\HIR Figures\Revision B2\Figure A143 Simulated Altered (circa 2020) Water Table at Albert St Station.mxd





Legend

- Project Alignment
- Cavern and Shaft Excavation
- Inferred Original Drainage
- Catchment Divide
- Sub-catchment Divide
- Topography Contours
- Water Table (m AHD)
- Alluvium
- Unconformity Zones
- Inferred Normanby Fault Zone - Outcrop in NFG
- Southeast Projection of Normanby Fault Zone - Subcrop beneath Alluvium, Brisbane Tuff and Aspley Formation
- River Crossing - Subcrop beneath Aspley Formation
- Basements

After:
QLD Geology and Structural Framework (V02)
2012. State of Queensland (Department of Natural Resources and Mines).

N

Scale 1:6,000

0 0.1 0.2 0.3 Km

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 BCSG02

P S M

Created By:	Revision:
MB	B2
Date:	Paper Size:
11 Mar 2020	A3

CPB Ghella Bam UGL
Hydrogeological Interpretive Report
Cross River Rail

PREDICTED WATER TABLE
AT 100 YEARS
AT ALBERT ST STATION

CRRTSD-000-0354-
DPK-PSMQ-1120-000100

Figure A146

X:\ArcGIS_Working\PSM3700 CRR\03_Figures\HIR Figures\Revision B2\Figure A146 Predicted Water Table at 100 Years at Albert St Station.mxd

Appendix D

Geotechnical Parameters

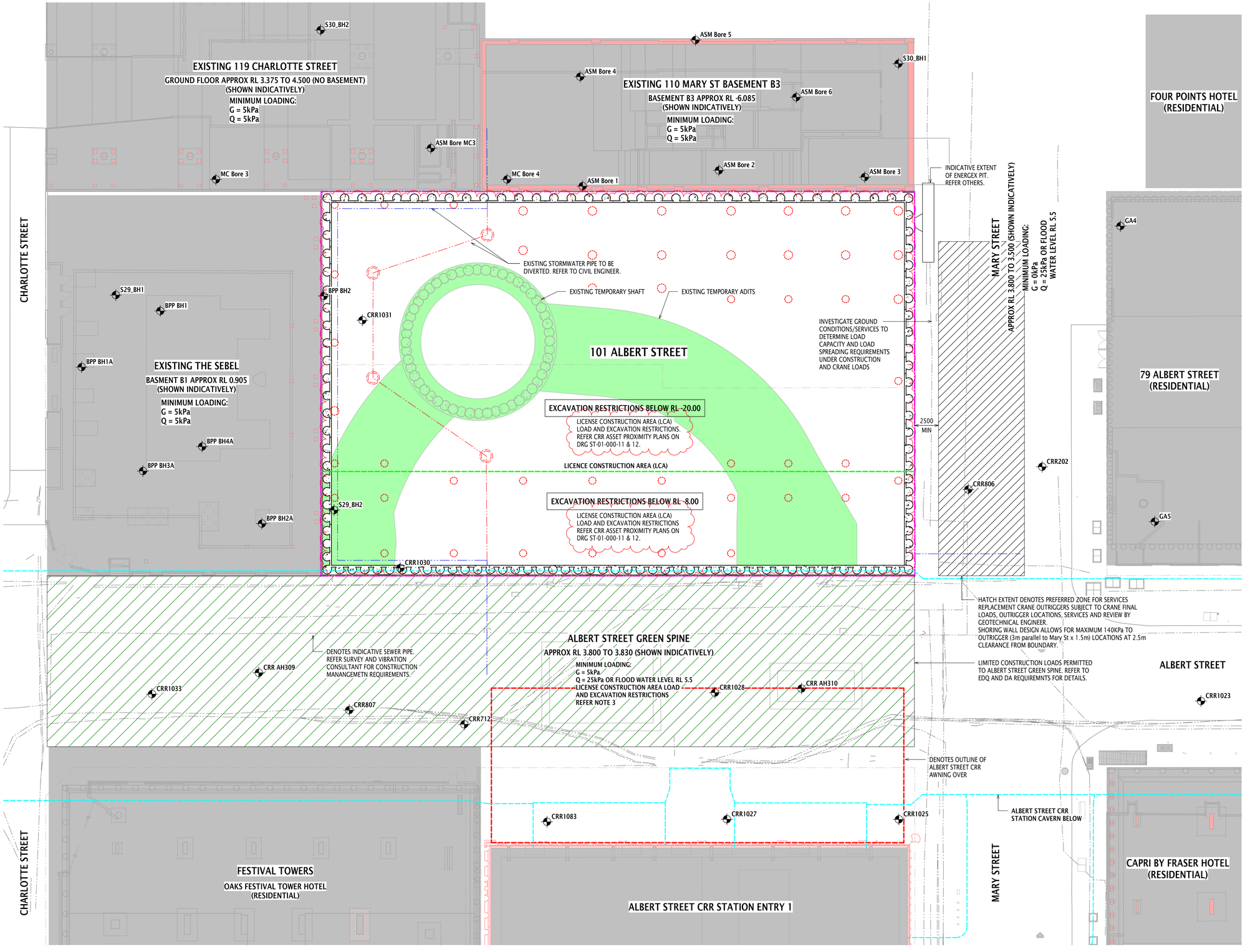
Table D1 – Summary of Material Parameters

Geological Age	Unit	Sub Unit	Materials	Unit Weight	Undrained Shear Strength	Drained Cohesion	Drained Friction Angle	Tensile Strength	Drained Young's Modulus	Drained Poisson's Ratio	Secant Stiffness in Standard Drained Triaxial Test [1]	Tangent Stiffness for Primary Oedometer Loading [1]	Unloading / Reloading Stiffness [1]	Over Consolidation Ratio	At Rest Earth Pressure Coefficient [2]	Vertical Coefficient of Permeability	Horizontal Coefficient of Permeability
				(kN/m^3)	s_u (kPa)	c' (kPa)	θ' (degrees)	σ_t (kPa)	E' (MPa)	ν'	E_{50}^{ref} (MPa)	E_{oed}^{ref} (MPa)	E_{ur}^{ref} (MPa)	OCR	K_0	k_v (m/s)	k_h (m/s)
Holocene	Fill	Fill (FL)	Various material including concrete, bricks, granular and fine grained fill	17	N/A	0	25	N/A	10	0.3	N/A	N/A	N/A	N/A	0.7	1E-06	1E-06
	Holocene Alluvium	Holocene Clay (AL F)	Mainly clay (soft to firm)	17	25 + 2z	4	26	N/A	5 + 0.4z	0.3	3.0	2.0	20	1.5	0.7	1E-07	1E-07
Devonian	Neranleigh Fernvale Beds	Residual Soil (RS F)	Mainly clay (stiff to hard)	20	100	10	30	N/A	25	0.3	N/A	N/A	N/A	3.0	1	1E-09	1E-09
		Extremely Weathered Material to Very Low Strength Rock (NFG 5)	Silt and sand sized sedimentary rocks; slightly metamorphosed (typically called greywacke, phyllite, argillite)	23	N/A	20	30	N/A	50	0.3	N/A	N/A	N/A	N/A	1	1E-07	1E-07
		Medium Strength Rock (NFG 3)		27	N/A	250	45	15	1,000	0.2	N/A	N/A	N/A	N/A	1	1E-07	1E-07
		High to Very High Strength Rock (NFG 2/1)		27	N/A	400	55	70	5,000	0.2	N/A	N/A	N/A	N/A	1	1E-07	1E-07

Notes:
[1] All stiffness parameters associated with the Hardening Soil Model are presented based on a reference pressure equal to 100 kPa.
[2] Based on $K_0 = (1-\sin(\phi))(OCR)^{\sin(\theta')}$. (Mayne P.W. and Kulhawy F.H., 1982)
[3] The permeability values shown for the rock units do not consider the presence of fault and/or sheared zones.

Appendix E

Retention System and Building Foundation Arrangement



SITE PLAN
SCALE 1 : 200

PRINT DRAWINGS IN COLOUR

LEGEND

- ??? GEOTECHNICAL INVESTIGATION POINTS. REFER TO EDG GEOTECHNICAL REPORT B01493-1AC DATED 16 NOVEMEBR 2022 FOR AVAILABLE GEOTECHNICAL INVESTIGATION DATA AND INTERPRETED GEOTECHNICAL PROFILES.
- DENOTES INDICATIVE NEIGHBORING BUILDING 110 MARY STREET EXISTING DIAPHRAGM WALL. REFER EXISTING BUILDING STRUCTURAL DRAWINGS FOR LOADS AND LEVELS.
- DENOTES INDICATIVE NEIGHBORING BUILDINGS THE SEBEL AND 119 CHARLOTTE STREET EXISTING PILES. ONLY PILES ADJACENT THE BOUNDARY SHOWN. REFER EXISTING BUILDING STRUCTURAL DRAWINGS FOR ALL PILES, LOADS AND LEVELS.
- DENOTES INDICATIVE TEMPORARY ACOUSTIC SHED PILES. REFER CRR MODELS FOR INFORMATION.
- DENOTES INDICATIVE TEMPORARY ACCESS SHAFT AND ADITS. REFER CRR MODELS FOR INFORMATION. TEMPORARY ROCK BOLTS AND ANCHORS NOT SHOWN.

NOTES

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL PROJECT DOCUMENTS INCLUDING BUT NOT LIMITED TO THE FOLLOWING:
   a. GENERAL AND CONSTRUCTION NOTES ON DRG ST-00-000-11
   b. GEOTECHNICAL REPORTS NOTED ON DRG ST-00-000-11.
   c. INSTRUMENTATION, VIBRATION AND MOVEMENT MONITORING REPORTS NOTED ON DRG ST-00-000-11.
   d. EDQ AND DA REQUIREMENTS NOTES ON DRG ST-00-000-11
   e. SHORING & RETENTION WALL NOTES ON DRG ST-00-000-12
   f. ROBERT BIRD GROUP CIVIL DRAWINGS.
2. RELIANCE INFORMATION SUCH AS, BUT NOT LIMITED TO, CROSS RIVER RAIL (CRR) DRAWINGS, MODELS, REPORTS AND DESIGN MANUALS, GEOTECHNICAL INFORMATION, GROUND WATER STUDIES, EXISTING SURVEY, EXISTING STRUCTURAL DRAWINGS ETC. IT IS THE CONTRACTOR'S RESPONSIBILITY TO VERIFY ALL RELIANCE INFORMATION ADOPTED IN THEIR CONTRUCTION METHODOLOGIES AND DESIGN OF D&C ELEMENTS.
3. ALL DESIGN LOAD, EXCAVATION, DISTORTION CRITERIA FOR THE CRR ALBERT STREET STATION CAVERN ARE TO BE STRICTLY FOLLOWED. THESE HAVE BEEN DISCUSSED IN THE RBG DESIGN CRITERIA REPORT ALB-RBG-REP-ST-00-000-01. THE CRITERIA INCLUDES SUCH ITEMS AS MAXIMUM EXCAVATION LEVELS, MAXIMUM DESIGN LOADS IN AND OUTSIDE OF THE PROJECT SITE, MINIMUM CLEARANCE DISTANCE FROM THE STATION CAVERN TO THE PROJECT EXCAVATION, MAXIMUM CHANGE IN STRESS 1m ABOVE THE STATION CROWN, MAXIMUM LOADS AT SURFACE LEVEL AND STATION CAVERN STRESS AND DISTORTION LIMITS ETC.
4. THE MINIMUM OF THE CRR ALBERT STREET STATION CAVERN LOAD CRITERIA AND GEOTECHNICAL CAPACITIES SHALL BE TAKEN FOR THE 101 ALBERT STREET DESIGN NOTING THAT IN SOME AREAS THE GEOTECHNICAL CAPACITY MAY GOVERN.
5. LOADS SHOWN ARE FOR THE DESIGN OF THE 101 ALBERT STREET BASEMENT AND SHORING AND RETENTION WALLS.
6. ALL LOADS ARE WORKING UNLESS STATED OTHERWISE.
7. EXISTING BUILDING FOOTING RL'S ARE APPROXIMATE. TO BE CONFIRMED ON SITE.
8. EXISTING BUILDING LOADS, SETOUT AND GEOMETRY HAVE BEEN BASED ON THE AVAILABLE HISTORIC DRAWINGS AND ARE APPROXIMATE ONLY. RBG CANNOT CONFIRM THE ACCURACY OF THESE DRAWINGS, WHETHER THEY REFLECT THE AS-BUILT STRUCTURES OR WHETHER THE STRUCTURES HAVE BEEN UNKNOWINGLY MODIFIED LATER. DETAILED SURVEY REQUIRED TO VERIFY.
9. EXISTING SERVICES TO BE SURVEYED AND LOAD SENSITIVE SERVICES CHECKED FOR LOADS PRIOR TO LOADS BEING APPLIED.
10. EDGE OF THE CRR STATION CAVERN TO BE SURVEYED AND CONFIRMED.
11. REFER TO ROBERT BIRD GROUP CIVIL ENGINEER BUILK EARTHWORKS LAYOUT PLAN FOR DETAILS.
12. REFER TO THE ROBERT BIRD GROUP CIVIL ENGINEER FOR THE STORMWATER DIVERSION DETAILS.
13. REFER TO SERVICES CONSULTANT ADP FOR PLANT REMOVAL STRATEGY AND CRANE LOADS

Rev	Revision Description	By	App	Date
T02	ISSUED FOR TENDER	DS	MA	17.07.24
T01	ISSUED FOR TENDER	DS	MA	28.06.24
A02	80% DD DRAFT	DS	MA	07.06.24
A01	50% DD ISSUE	SV	MA	09.08.23
P01	DRAFT 50% DESIGN DEVELOPMENT	SV	MA	28.07.23

SCALE 1 2 3 4 5 6 7 8

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Engineering Consultant

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Client
QIC

Project
101 ALBERT STREET, BRISBANE

Title
SITE PLAN

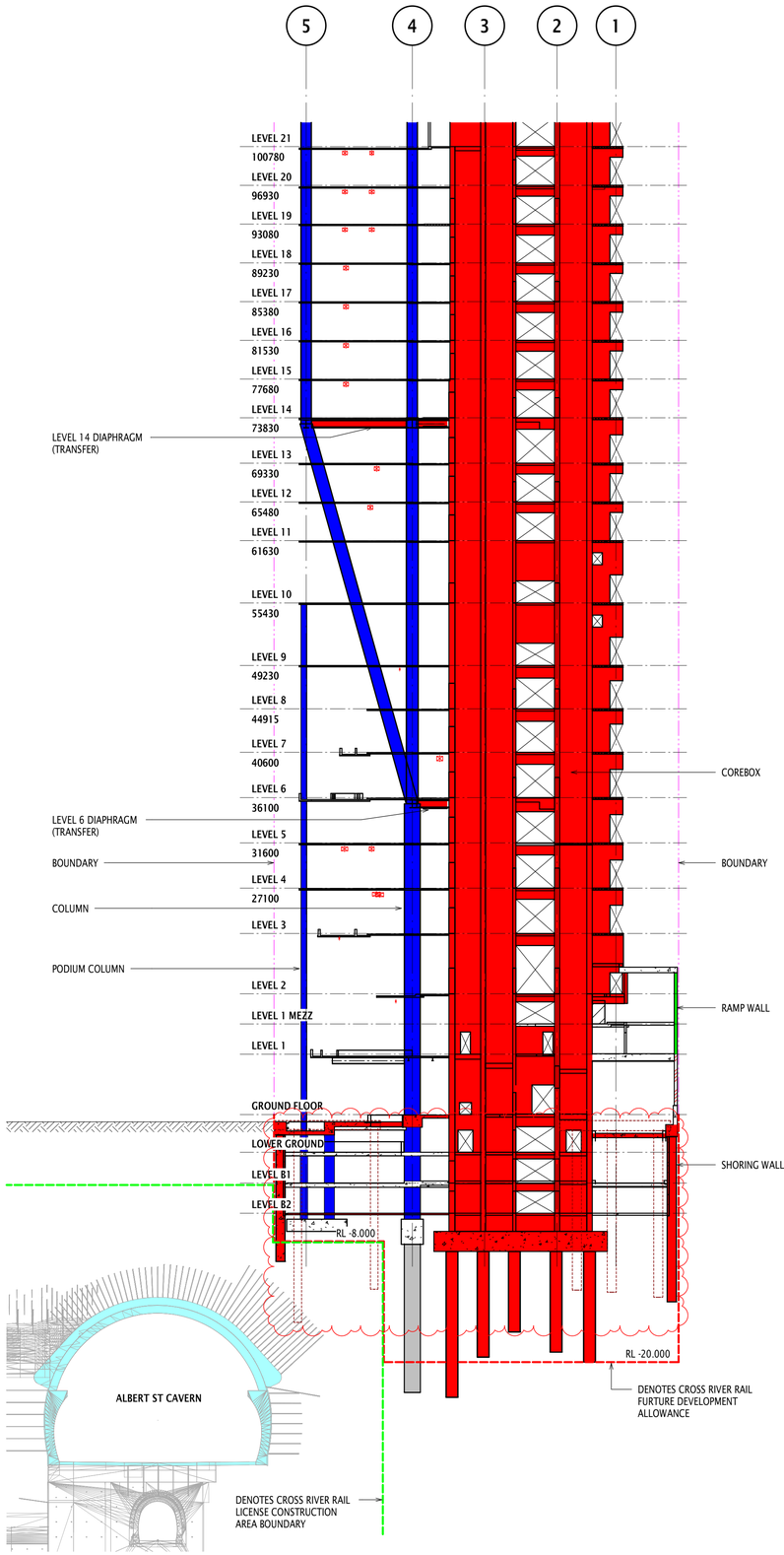
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Designer
N.DOYLE/T.KATUNAR
Design Checker
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Approved
M.AVERY

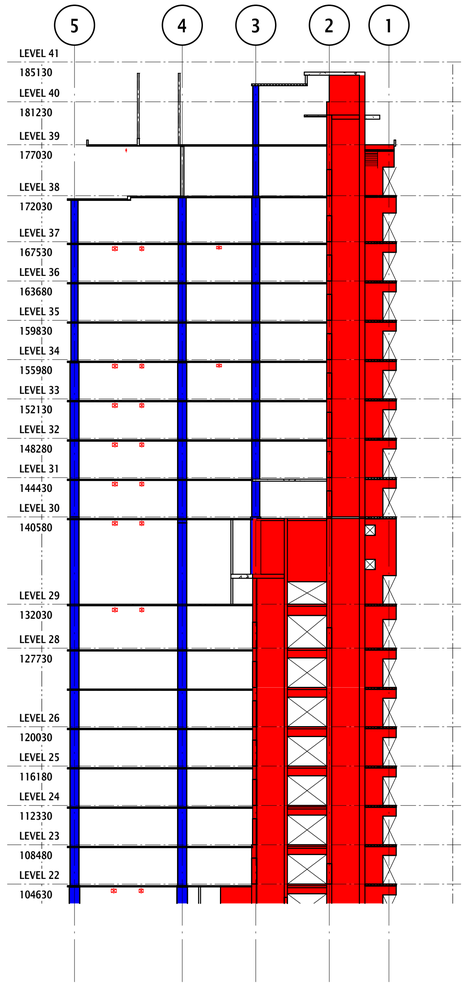
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Drawing Number
ALB-RBG-DWG-ST-01-000-01

Revision
T02



SECTION - GRID E



SECTION - GRID E CONTINUED

LEGEND:

DENOTES LATERAL STABILITY SYSTEM BASED ON THE SECTION CUT

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   c. INSTRUMENTATION, VIBRATION AND MOVEMENT MONITORING REPORTS NOTED ON DRG ST-00-000-11.
   d. EDQ AND DA REQUIREMENTS NOTES ON DRG ST-00-000-11
   e. SHORING & RETENTION WALL NOTES ON DRG ST-00-000-12
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13. REFER TO SERVICES CONSULTANT ADP FOR PLANT REMOVAL STRATEGY AND CRANE LOADS

80%DD NOTES:
THIS DRAWING IS PROVIDED TO ILLUSTRATE THE LATERAL STABILITY AND GRAVITY SYSTEMS. REFER SCHEMATIC REPORT 22131S-RBG-ZZ-XX-RP-ST-00003 AND STRUCTURAL DESIGN BRIEF ALB-RBG-REP-ST-00-000-01 FOR MORE DETAILS.

THE LATERAL STABILITY SYSTEM CONSISTS OF THE MAIN BUILDING LIFT AND STAIR CORE COMBINED WITH THE SHORING WALL. ALSO INCLUDED ARE IS THE PILE CAP AND PILES THAT SUPPORT THE CORE. CHANGING ANY PART OF THE LATERAL STABILITY SYSTEM WILL IMPACT ON THE MAGNITUDE OF LOADS AND THE DISTRIBUTION OF LOADS TO EACH LATERAL STABILITY ELEMENT AND BY DOING SO THE LOADS IMPOSED ONTO THE STATION CAVERN.

PRINT DRAWINGS IN COLOUR

Rev	Revision Description	By	App	Date
T02	ISSUED FOR TENDER	DS	MA	17.07.24
T01	ISSUED FOR TENDER	DS	MA	28.06.24
A02	80% DD DRAFT	DS	MA	07.06.24
A01	50% DD ISSUE	SV	MA	09.08.23
P01	DRAFT 50% DESIGN DEVELOPMENT	SV	MA	28.07.23

SCALE 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8

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Structural, Civil & Construction
Engineering Consultant

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Member of the Surbana Jurong Group

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ACN 010 580 248

Client
QIC

Project
101 ALBERT STREET, BRISBANE

Title
BUILDING SECTIONS
SHEET 1

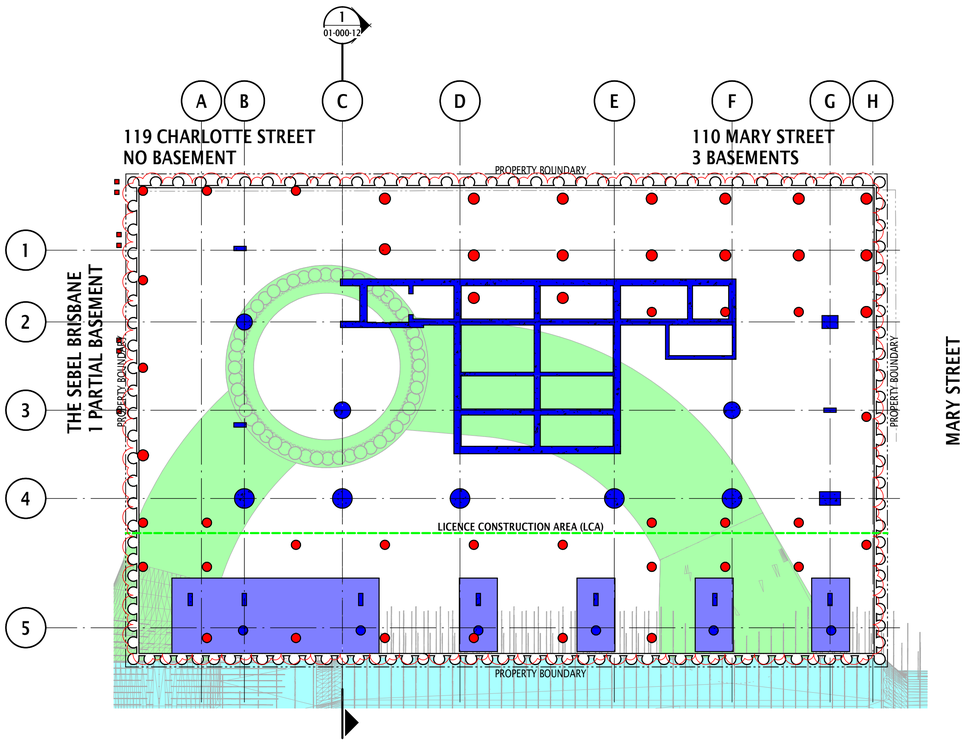
Date
Jun 2024
Scale at A1
1:300
Job Number
22131S

Drawn
D.STUCKEY
Designer
N.DOYLE/T.KATUNAR
Design Checker
-
Approved
M.AVERY

FOR TENDER - NOT FOR CONSTRUCTION

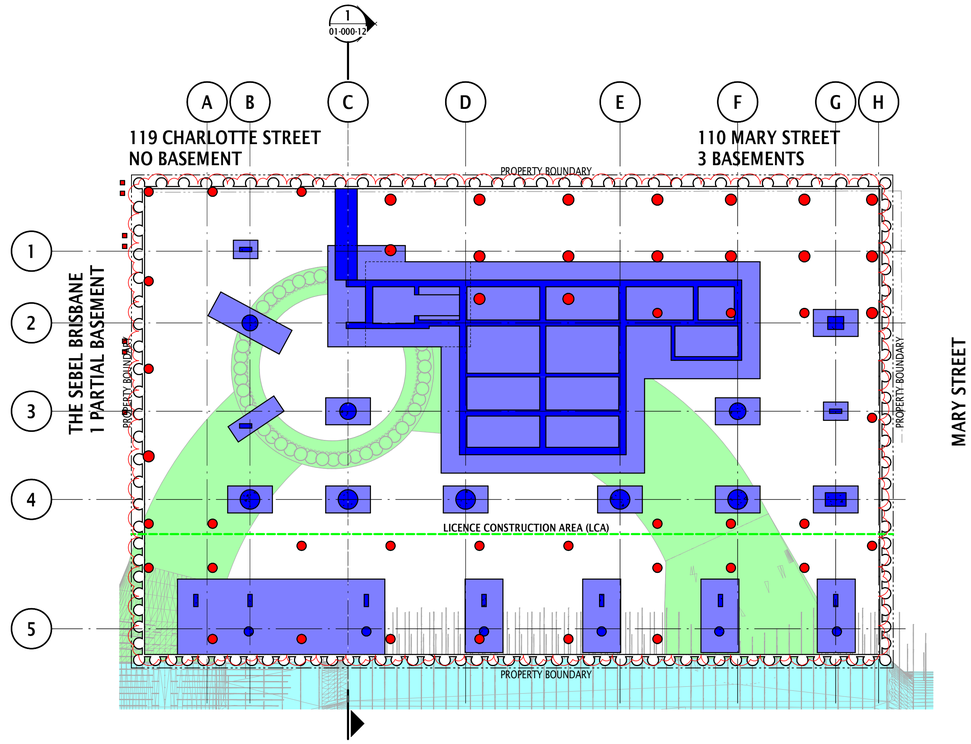
Drawing Number
ALB-RBG-DWG-ST-01-000-06

Revision
T02



CRR ASSET AND PROPOSED DEVELOPMENT
STRUCTURE PROXIMITY DIAGRAM - RL -5.0m

SCALE 1 : 250



CRR ASSET AND PROPOSED DEVELOPMENT
STRUCTURE PROXIMITY DIAGRAM - RL -8.0m

SCALE 1 : 250

NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL PROJECT DOCUMENTS INCLUDING BUT NOT LIMITED TO THE FOLLOWING;
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   b. GEOTECHNICAL REPORTS NOTED ON DRG ST-00-000-11.
   c. INSTRUMENTATION, VIBRATION AND MOVEMENT MONITORING REPORTS NOTED ON DRG ST-00-000-11.
   d. EDQ AND DA REQUIREMENTS NOTES ON DRG ST-00-000-11
   e. SHORING & RETENTION WALL NOTES ON DRG ST-00-000-12
   f. ROBERT BIRD GROUP CIVIL DRAWINGS.
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3. ALL DESIGN LOAD, EXCAVATION, DISTORTION CRITERIA FOR THE CRR ALBERT STREET STATION CAVERN ARE TO BE STRICTLY FOLLOWED. THESE HAVE BEEN DISCUSSED IN THE RBG STRUCTURAL DESIGN BRIEF ALB-RBG-REP-ST-00-000-01. THE CRITERIA INCLUDES SUCH ITEMS AS MAXIMUM EXCAVATION LEVELS, MAXIMUM DESIGN LOADS IN AND OUTSIDE OF THE PROJECT SITE, MINIMUM CLEARANCE DISTANCE FROM THE STATION CAVERN TO THE PROJECT EXCAVATION, MAXIMUM CHANGE IN STRESS 1M ABOVE THE STATION CROWN, MAXIMUM LOADS AT SURFACE LEVEL AND STATION CAVERN STRESS AND DISTORTION LIMITS ETC.
4. THE MINIMUM OF THE CRR ALBERT STREET STATION CAVERN LOAD CRITERIA AND GEOTECHNICAL CAPACITIES SHALL BE TAKEN FOR THE 101 ALBERT STREET DESIGN NOTING THAT IN SOME AREAS THE GEOTECHNICAL CAPACITY MAY GOVERN.
5. LOADS SHOWN ARE FOR THE DESIGN OF THE 101 ALBERT STREET BASEMENT AND SHORING AND RETENTION WALLS.
6. ALL LOADS ARE WORKING UNLESS STATED OTHERWISE.
7. EXISTING BUILDING FOOTING RL'S ARE APPROXIMATE. TO BE CONFIRMED ON SITE.
8. EXISTING BUILDING LOADS, SETOUT AND GEOMETRY HAVE BEEN BASED ON THE AVAILABLE HISTORIC DRAWINGS AND ARE APPROXIMATE ONLY. RBG CANNOT CONFIRM THE ACCURACY OF THESE DRAWINGS, WHETHER THEY REFLECT THE AS-BUILT STRUCTURES OR WHETHER THE STRUCTURES HAVE BEEN UNKNOWINGLY MODIFIED LATER. DETAILED SURVEY REQUIRED TO VERIFY.
9. EXISTING SERVICES TO BE SURVEYED AND LOAD SENSITIVE SERVICES CHECKED FOR LOADS PRIOR TO LOADS BEING APPLIED.
10. EDGE OF THE CRR STATION CAVERN TO BE SURVEYED AND CONFIRMED.
11. REFER TO ROBERT BIRD GROUP CIVIL ENGINEER BUILK EARTHWORKS LAYOUT PLAN FOR DETAILS.
12. REFER TO THE ROBERT BIRD GROUP CIVIL ENGINEER FOR THE STORMWATER DIVERSION DETAILS.
13. REFER TO SERVICES CONSULTANT ADP FOR PLANT REMOVAL STRATEGY AND CRANE LOADS
14. NOT ALL EXISTING IN-GROUND STRUCTURE HAS BEEN SHOWN. FURTHER COORDINATION REQUIRED TO RESOLVE CLASHES BETWEEN NEW AND EXISTING IN-GROUND STRUCTURE.
15. NOT ALL EXISTING SERVICES HAVE BEEN SHOWN.

LEGEND:

- DENOTES CRR SHAFT AND ADIT STRUCTURE
- DENOTES CRR CAVERN STRUCTURE
- DENOTES CRR ACCOUSTIC SHED FOUNDATIONS
- DENOTES PROPOSED DEVELOPMENT STRUCTURE
- DENOTES BACKFILL TYPE A. REFER TO EDG GEOTECHNICAL REPORTS FOR BACKFILL DESCRIPTION.
- DENOTES BACKFILL TYPE B. REFER TO EDG GEOTECHNICAL REPORTS FOR BACKFILL DESCRIPTION.

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   b. DECOMMISSIONING, DEMOLITION AND REMOVAL OF THE FOLLOWING:
      - ALL ACOUSTIC SHED SUPERSTRUCTURE AND SUBSTRUCTURE INCLUDING PILE CAPS, PAD FOOTINGS, STRIP FOOTINGS, GROUND BEAMS AND SLABS.
      - THE TOP OF THE SHAFT INCLUDING THE TOP 1m OF SHAFT PILES;
      - THE TOP 1m OF ALL PILES ACROSS THE SITE;
      - ANY TEMPORARY INGROUND SERVICES SUCH AS SUMPS, TANKS, MANHOLES, ELECTRICAL, HYDRAULIC ETC;
      - DE-STRESSING OF ANY TEMPORARY ANCHORS; AND
      - QA AND ENGINEERING SIGN OFF COMPLETED.
   c. ENSURE NO CONTAMINATED MATERIAL DUE TO THE CRR WORKS REMAINS ONSITE INCLUDING CONTAMINATED SOIL BELOW THE ACOUSTIC SHED SLAB AND SERVICES STRUCTURE.
   d. THE DESIGN OF THE PILE CAP AND BORED PIER FOUNDATION SYSTEM AND ALTERNATIVE RAFT FOUNDATION SYSTEM ARE BASED ON THE TEMPORARY ACCESS SHAFT AND ADITS BEING BACKFILLED WITH 20MPa CONCRETE. THE ACTUAL BACKFILL MATERIAL WILL IMPACT ON THE FOUNDATION DESIGN AND NEEDS TO BE CONFIMED WITH CRR. THE PREFERRED BACKFILL MATERIAL AND METHODOLOGY WOULD INCLUDE THE FOLLOWING:
      - THE TEMPORARY ADITS AND SHAFT SHOULD BE BACKFILLED PRIOR TO HANDOVER, WITH APPROPRIATE CARE TO ENSURE ALL VOIDS ARE FILLED. BACKFILLED AREAS TO ACHIEVE SIMILAR STIFFNESS TO SURROUNDING ROCK MASS TO ASSIST WITH RELATIVE UNIFORM DISTRIBUTION OF GROUND STRESSES. IN ADDITION, IT IS POSSIBLE THAT FOUNDATION PILES MAY BE DRILLED THROUGH THE BACKFILL.
      - CONTRACTOR TO ALLOW FOR TIME AND COST ASSOCIATED WITH REDESIGN OF THE FOUNDATION SYSTEM ONCE THE METHODOLOGY AND MATERIAL TO BE USED TO FILL ADITS AND ACCESS SHAFT HAS BEEN CONFIRMED.
   e. THE SITE GROUND SURFACE TO BE LEFT IN A LEVEL CONDITION AND THE SURFACE COMPACTED WITH A VIBRATORY ROLLER. THE GROUND SURFACE TO BE FREE DRAINING.
3. ALLOW FOR COST ASSOCIATED WITH REMOVAL OF ACOUSTIC SHED PILES DURING BULK EXCAVATION.
4. SHORING WALL PILES TO BE COORDINATED AROUND PERIMETER ACOUSTIC SHED PILES.
5. WHERE NEW DEVELOPMENT BORED PIERS CLASH WITH THE CRR SHAFT STRUCTURE ALLOW FOR RELOCATION OF THE PROPOSED BORED PIERS. ALLOW ADDITIONAL BORED PIERS AND/OR PROVISION FOR THE PILE CAP SIZE TO INCREASE FROM THAT SHOWN.
6. EXISTING ACOUSTIC PILES TO BE BROKEN DOWN BELOW RL-8.000 TO MITIGATE LOADING OF THE STATION CAVERN. REFER TYPICAL EXISTING PILE BREAK DOWN DETAIL. SIMILAR TO THE ACOUSTIC SHED PILES THE SHAFT PILES AND BACKFILL MATERIAL TO BE BROKEN DOWN MINIMUM 1m BELOW THE BASE OF NEW FOOTING LEVEL TO BE CONFIRMED BY THE GEOTECHNICAL ENGINEER.
7. PILING CONTRACTOR AND GEOTECHNICAL ENGINEER TO ADVISE ON FEASIBILITY OF DRILLING NEW DEVELOPMENT BORED PIERS THROUGH THE ADIT STRUCTURE, ADIT GROUND ANCHORS AND SHAFT GROUND ANCHORS, AND IMPACT TO PILING TIMEFRAME. THE BELOW GROUND ANCHORS ARE LIKELY TO BE ENCOUNTED SUBJECT TO CONFIRMATION BY CRR:
   - SHAFT - CT ROCK BOLTS IN ADDITION TO SOME LOCALISED GEWI ROCK BOLTS.
   - ADITS - SWELLEX EXPANDED ROCK BOLTS
8. BUILDING AND TEMPORARY WORKS LOADS FROM 101 ALBERT STREET SHALL NOT EXCEED THE ALBERT STREET STATION CAVERN MAXIMUM STRESS AND DEFORMATION LIMITS SET OUT IN THE CRR PSTR LOAD CASES.
9. LOCAL EXCAVATION REQUIRED BELOW RL-8.000 TO REACH NFG5 ROCK SHALL BE STAGED LOCAL EXCAVATION WITH A MAXIMUM DEPTH OF 2m AND PLAN AREA OF 3m² IN ACCORDANCE WITH GEOTECHNICAL ENGINEERS REQUIREMENTS. TO BE APPROVED BY EDQ.

PRINT DRAWINGS IN COLOUR

Rev	Revision Description	By	App	Date
T02	ISSUED FOR TENDER	DS	MA	17.07.24
T01	ISSUED FOR TENDER	DS	MA	28.06.24
A02	80% DD DRAFT	DS	MA	07.06.24
A01	50% DD ISSUE	SV	MA	09.08.23
P01	DRAFT 50% DESIGN DEVELOPMENT	SV	MA	28.07.23

SCALE 1 2 3 4 5 6 7 8

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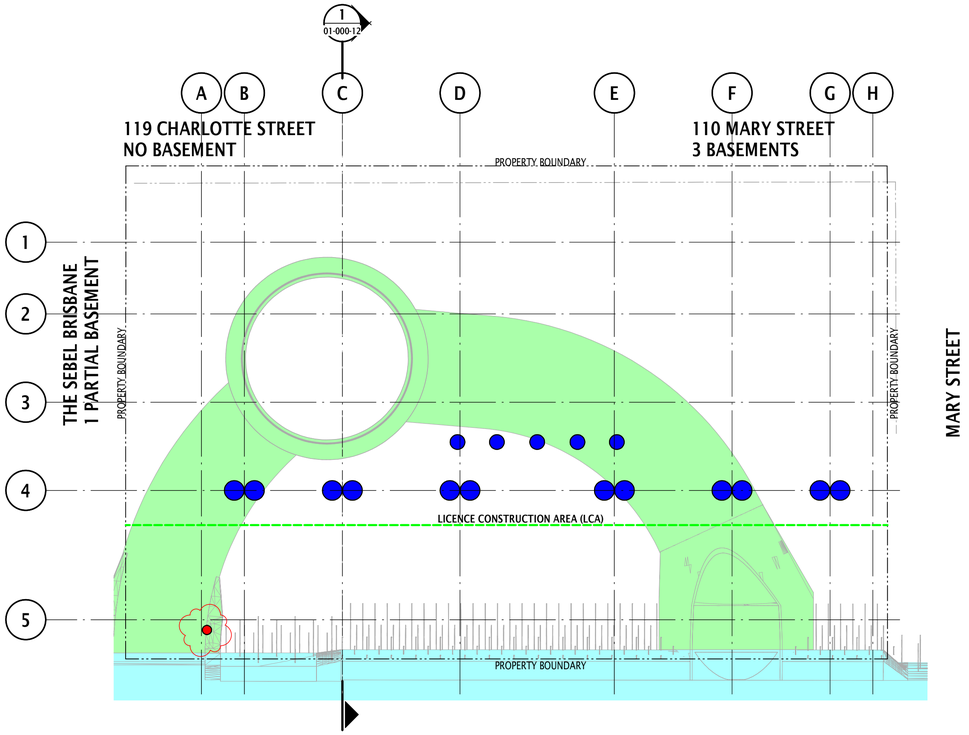
Title
CRR ASSET PROXIMITY PLANS
SHEET 1

Date Jun 2024	Drawn D.STUCKEY
Scale at A1 1:250	Designer N.DOYLE/T.KATUNAR
	Design Checker -
Job Number 22131S	Approved M.AVERY

FOR TENDER - NOT FOR CONSTRUCTION

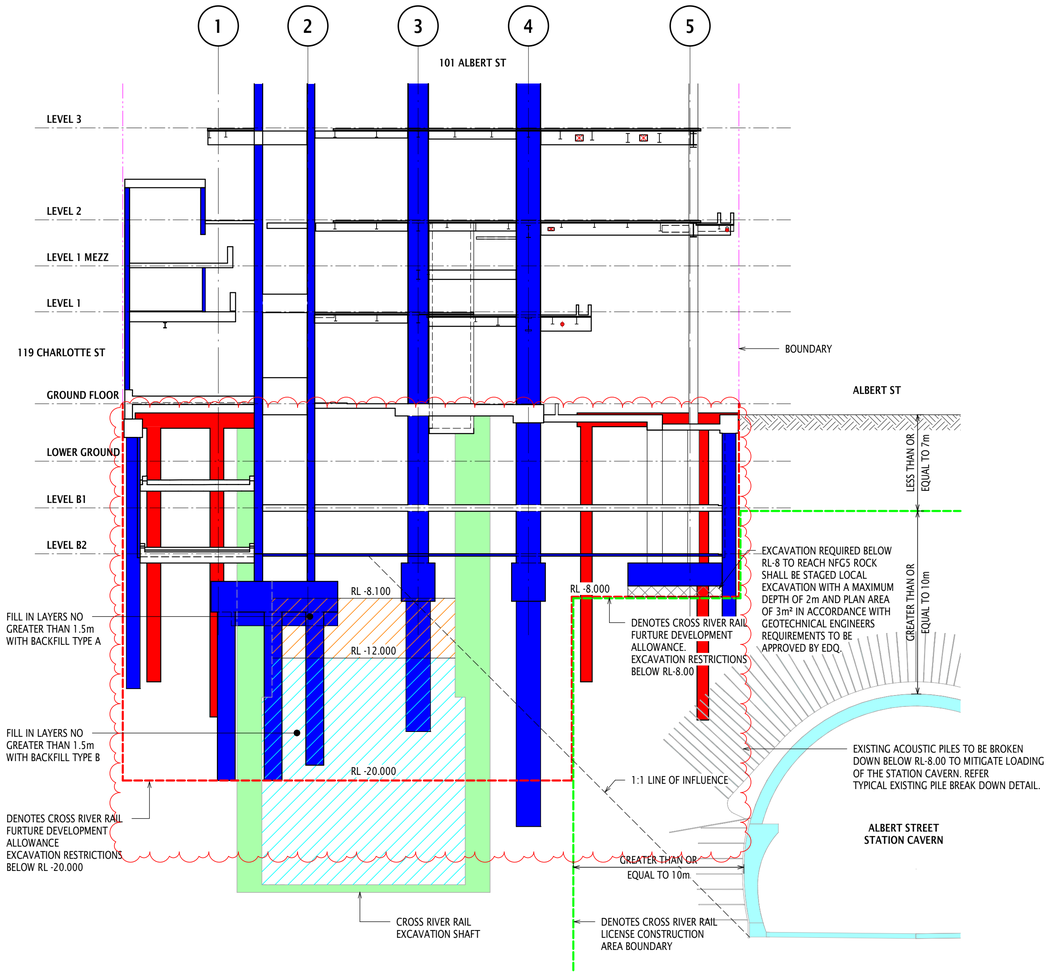
Drawing Number	Revision
ALB-RBG-DWG-ST-01-000-11	T02

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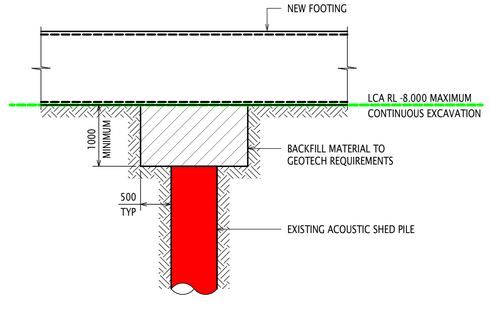
CRR ASSET AND PROPOSED DEVELOPMENT STRUCTURE PROXIMITY DIAGRAM - RL -20.0m

SCALE 1 : 250



SECTION 1 / 01-000-11

SCALE 1 : 200



TYPICAL EXISTING PILE BREAK DOWN DETAIL AT NEW FOOTING

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ACN 010 580 248

Client
QIC

Project
101 ALBERT STREET, BRISBANE

Title
CRR ASSET PROXIMITY PLANS
SHEET 2

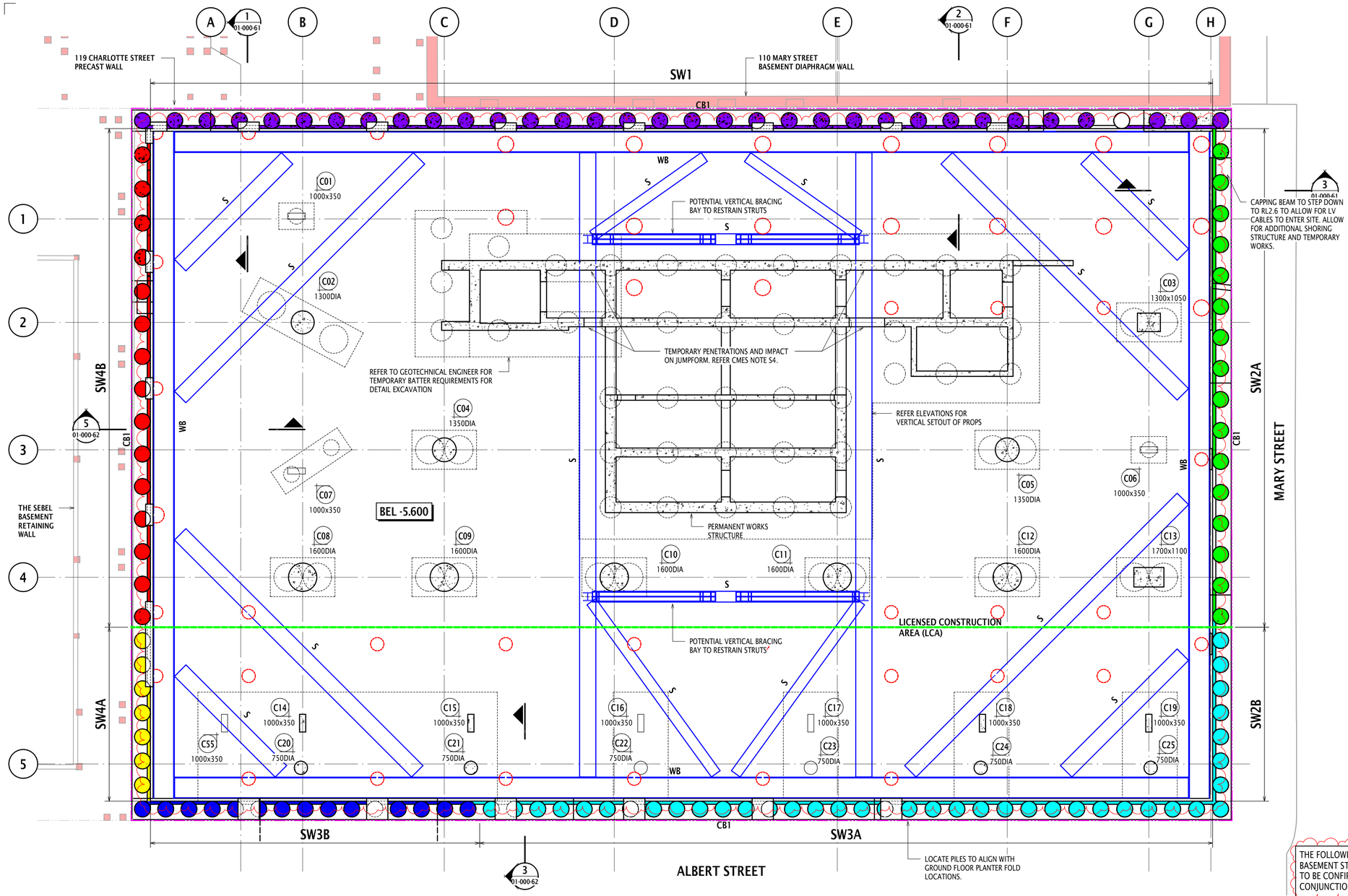
Date
Jun 2024
Scale at A1
1:50, 1:200, 1:250
Job Number
22131S

Drawn
D.STUCKEY
Designer
N.DOYLE/T.KATUNAR
Design Checker
-
Approved
M.AVERY

FOR TENDER - NOT FOR CONSTRUCTION

Drawing Number
ALB-RBG-DWG-ST-01-000-12

Revision
T02



TEMPORARY SHORING AND RETENTION GENERAL ARRANGEMENT PLAN

SCALE 1 : 125

LEGEND:

BEL ?.???	DENOTES BULK EXCAVATION LEVEL
SW?	DENOTES SHORING WALL NUMBER AND DIRECTION ELEVATION IS VIEWED
BH?	DENOTES APPROX BOREHOLE LOCATION AND APPROXIMATE LEVEL OF LOW STRENGTH ROCK. REFER EDG CONSULTING GEOTECHNICAL REPORT B01493-1AC DATED 16 NOVEMBER 2022.
TAG / SIZE	DENOTES COLUMN NUMBER AND SIZE
S	DENOTES INDICATIVE STRUT. SIZE AND SET-OUT BY SHORING WALL D&C CONTRACTOR AND ENGINEER.
WB	DENOTES INDICATIVE WALER . SIZE AND SET-OUT BY SHORING WALL D&C CONTRACTOR AND ENGINEER.

SHORING & RETENTION SCHEDULE

TYPE	DESCRIPTION	COMMENTS
	REINFORCED 900Ø SOLDIER PILES AT 1800 CTRS + 250 SHOTCRETE	APPROXIMATE TOE LEVEL RL-14.000m OR 1m SOCKET INTO NFG3
	REINFORCED 900Ø SOLDIER PILES AT 1800 CTRS + 250THK SHOTCRETE	APPROXIMATE TOE LEVEL RL-10.500m OR 1m SOCKET INTO NFG3
	REINFORCED 900Ø SOLDIER PILES AT 1800 CTRS + 250THK SHOTCRETE	MAXIMUM TOE LEVEL RL-10.000m OR 2m SOCKET INTO NFG3
	REINFORCED 900Ø SOLDIER PILES AT 1800 CTRS + 250THK SHOTCRETE	MAXIMUM TOE LEVEL RL-10.000m OR 1m SOCKET INTO NFG3
	REINFORCED 900Ø SOLDIER PILES AT 1800 CTRS + 250THK SHOTCRETE	MAXIMUM TOE LEVEL RL-10.000m OR 2m SOCKET INTO NFG3
	REINFORCED 900Ø SOLDIER PILES AT 1800 CTRS + 250THK SHOTCRETE	APPROXIMATE TOE LEVEL RL-12.500m OR 1m SOCKET INTO NFG3

CAPPING BEAMS SCHEDULE

MARK	DEPTH	WIDTH	REINF RATE kg/m³
CB1	1200	1200	200
CB1	1250	1200	200
CB1	1300	1200	200
CB1	1325	1200	200
CB1	1350	1200	200
CB1	1550	1200	200

SHORING COVER SCHEDULE

LOCATION/ELEMENT	COVER (mm)
SOLDIER PILES	75
SHOTCRETE	
- RETAINING FACE	75
- INSIDE FACE	50
UNDERPINNING	75
CAPPING BEAM	
- RETAINING FACE	75
- OTHER FACES	75

SHORING CONCRETE STRENGTH SCHEDULE UNO

LOCATION/ELEMENT	CONCRETE MIX
SOLDIER PILES	CM503
SHOTCRETE	CM501
UNDERPINNING	CM502
CAPPING BEAM	CM502

NOTES:
1. REFER TO CONCRETE SPECIFICATION FOR MIX TYPES

SHORING TENDER RATES SCHEDULE UNO

LOCATION/ELEMENT	REINF'T RATE [kg/m3]
SOLDIER PILES	180
CAPPING BEAM	200
SHOTCRETE	150
UNDERPINNING	200

PRINT DRAWINGS IN COLOUR

NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE FOLLOWING:
   a. SHORING & RETENTION WALL, TEMPORARY STRUT AND WALER, PILING NOTES ON DRG ST-00-000-12.
   b. SITE PLAN, LOADS AND NOTES ON DRG ST-01-000-01.
   c. CRR ASSET PROXIMITY PLANS ON DRG ST-01-000-11 & 12.
   d. GENERAL ARRANGEMENT PLANS ON DRG SERIES ST-08.
   e. REINFORCEMENT QUANTITY NOTES ON DRG ST-00-000-12.
   f. TYPICAL SHORING WALL DETAILS ON DRG ST-00-001-01.
2. THE SHORING AND RETENTION WALL IS PROPOSED TO BE TYPICALLY 900mm DIAMETER SOLDIER AND CONTIGUOUS PILES AND 250mm THICK SHOTCRETE INFILL PANELS. REFER SHORING & RETENTION SCHEDULE. TO BE CONFIRMED BY SHORING WALL D&C CONTRACTOR AND ENGINEER.
3. TEMPORARY SUPPORT TO THE SHORING AND RETENTION WALL IS PROPOSED VIA TWO LAYERS OF TEMPORARY INTERNAL STEELWORK STRUTS AND WALER BEAMS TO PROP THE SHORING WALL DUE TO THE SITE CONSTRAINTS AND ADJACENT EXISTING STRUCTURES AS DESCRIBED BELOW:
   - **110 MARY ST** -3 LEVELS OF BASEMENTS WITH DIAPHRAGM WALL BLOCK ALL ANCHORS
   - **THE SEBEL** - 1 BASEMENT SUPPORTED ON DRIVEN PILES. TEMPORARY ANCHORS WOULD NEED TO BE COORDINATED TO MISS THE SEBEL INGROUND STRUCTURE.
   - **ALBERT ST** - CRR LCA AND EXISTING SERVICES BELOW THE STREET LIMIT ZONES FOR TEMPORARY ANCHORS.
   - **MARY ST** - EXISTING SERVICES BELOW THE STREET LIMIT ZONES FOR TEMPORARY ANCHORS.

   THE 101 ALBERT STREET BASEMENT EXCAVATION SHALL NOT IMPACT ON THE NEIGHBORING BASEMENT DESIGN, CONDITION AND LOADING. INTRODUCTION OF OUT OF BALANCE LOADS TO THESE BASEMENTS IS TO BE AVOIDED.
4. THE SHORING AND RETENTION WALL, TEMPORARY STRUTS AND WALERS TO BE DESIGNED FOR THE CRITERIA SET OUT WITHIN THE RBG MOVEMENT AND TOLERANCE REPORT.
5. THE TEMPORARY STRUTS AND WALERS SHOWN ARE INDICATIVE ONLY AND REFLECT A POTENTIAL CONCEPT THAT HAS BEEN USED FOR THE DOCUMENTED SHORING WALL DESIGN. THE FINAL DESIGN AND SET-OUT TO BE CONFIRMED BY SHORING WALL D&C CONTRACTOR AND ENGINEER.
6. THE TEMPORARY STRUTS AND WALERS DESIGN TO CONSIDER THE FOLLOWING:
   - TEMPERATURE EFFECTS AND/OR EXTERNALLY INSULATED TO REDUCE THERMAL EFFECTS.
   - IMPACTS TO THE JUMPFORM AND FORMWORK, EXTENT/BUILD REQUIREMENTS INCLUDING WHETHER A TOP-DOWN METHODOLOGY IS ADOPTED NOTING STRUTS WILL NEED TO BE COORDINATED AROUND ANY BORED PIERS INSTALLED FROM EXISTING GROUND LEVEL, AND OTHER CONSTRUCTION RELATED ITEMS. CURRENTLY STRUTS ARE ONLY COORDINATED AROUND COLUMNS.
   - GROUNDWATER AND FLOOD LEVELS AS NOTED ON THE SITE PLAN. SENSITIVITY CASES SHALL BE CONSIDERED INCLUDING NO GROUND WATER, PARTIAL GROUNDWATER AND ASYMMETRIC GROUNDWATER.
   - THE GEOTECHNICAL ENGINEER IS TO ADVISE THE DEGREE OF PRE-LOADING FOR THE TEMPORARY STRUTS TO ACHIEVE THE DESIGN CRITERIA REQUIREMENTS.
7. ALL TEMPORARY STRUT AND WALER CONNECTIONS INCLUDING CONNECTIONS TO THE SHORING WALL TO BE DESIGNED BY THE SHORING WALL D&C CONTRACTOR AND ENGINEER.
8. ALL DEAD AND LIVE LOADS SHOWN ARE WORKING LOADS. ALL WIND AND EARTHQUAKE LOADS SHOWN ARE ULTIMATE LOADS. REFER LOAD LEGEND ON DRAWING ST-01-000-41.
9. ADDITIONAL TEMPORARY SHORING MAYBE REQUIRED TO CONSTRUCT THE LOWER CAPPING BEAM AT THE LV CABLE ENTRY POINT OFF MARY STREET. THIS MAY REQUIRED A THICKER SHORING ZONE FOR A LOCAL EXTENT OF THE SHORING WALL. TO BE CONFIMRED BY CONTRACTOR.
10. REFER TO ROBERT BIRD GROUP CIVIL ENGINEER BUILK EARTHWORKS LAYOUT PLAN FOR DETAILS.

Rev	Revision Description	By	App	Date
T02	ISSUED FOR TENDER	DS	MA	17.07.24
T01	ISSUED FOR TENDER	DS	MA	28.06.24
A02	80% DD DRAFT	DS	MA	07.06.24
A01	50% DD ISSUE	SV	MA	09.08.23
P01	DRAFT 50% DESIGN DEVELOPMENT	SV	MA	28.07.23

SCALE 1 2 3 4 5 6 7 8

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DO NOT SCALE DRAWINGS, USE FIGURED DIMENSIONS
REFER TO GENERAL NOTES UNLESS NOTED OTHERWISE

THE FOLLOWING INFORMATION IS BASED UPON A PARTIALLY HYDROSTATIC BASEMENT STRATEGY WITH HYDROSTATIC WALLS AND DRAINED BASEMENT B2 SLAB TO BE CONFIRMED BY GEOTECHNICAL AND HYDRAULIC ENGINEERS. READ BELOW IN CONJUNCTION WITH THE CRR ASSET PROXIMITY PLANS ON DRG ST-01-000-11 & 12.

80%DD NOTE:
- THE SHORING WALL SYSTEM AND LEVEL OF WATER RESISTANCE TO BE REVIEWED AGAINST GROUNDWATER CONDITIONS ONCE CONFIRMED. ALTERNATIVE SYSTEMS MAY NEED TO BE INVESTIGATED.
- CURRENT SHORING WALL DESIGN ASSUMES THE WALL WILL BE TEMPORARILY DRAINED DURING CONSTRUCTION. TO BE CONFIRMED BY CONTRACTOR AND D&C PILING SUB-CONTRACTOR.
-THE SET-OUT OF SHORING WALL PILES AND CAPPING BEAM TO BE REVIEWED AGAINST NEIGHBORING BUILDING EXTENTS, ACCOUSTIC SHED PILES, OTHER INGROUND STRUCTURE AND PILING RIG CLEARANCES/ACCESS. PILE SIZES AND SET-OUT MAY NEED TO CHANGE TO SUIT. PILING RIG WITH CLOSE WALL APPLICATION CURRENTLY ASSUMED WITH 650mm CLEARANCE FROM BOUNDARY TO CENTER OF PILE.
-SHORING WALL TOE OF PILE LEVELS TO BE REVIEWED AGAINST BOREHOLE RESULTS ONCE COMPLETED.
- HYDRAULIC ENGINEER TO CONFIRM UNDER SLAB DRAINAGE REQUIREMENTS.
- CAPPING BEAM LEVELS SUBJECT TO CONFIRMATION OF GROUND LEVELS AND STRIP DRAIN AND DRAINAGE DESIGN.
- SHORING PILES HAVE BEEN SET-OUT WHERE POSSIBLE TO MINIMISE CLASHES WITH IN-GROUND CRR SUBSTRUCTURE INCLUDING THE TEMPORARY ACCESS SHAFT WALL, ADITS AND ACCOUSTIC SHED PILES.
- COORDINATION WORK IS BASED UPON AVAILABLE CRR INFORMATION AT THE TIME OF THIS DOCUMENT ISSUE. THE LOCATION AND SIZE OF CRR ASSETS ARE INDICATIVE ONLY AND TO BE CONFIRMED.
- NOT ALL EXISTING IN-GROUND STRUCTURE HAS BEEN SHOWN INCLUDING, BUT NOT LIMITED TO TEMPORARY ROCK BOLTS AND ANCHORS. SHORING PILES HAVE NOT BEEN POSITIONED TO MISS ROCK BOLTS AND ANCHORS AND THEREFORE THE CONTRACTOR IS TO MAKE ALLOWANCE FOR DRILLING THROUGH EXISTING IN-GROUND STRUCTURE.
- 914CHS STRUTS AND TWIN 1200WB WALERS HAVE BEEN ASSUMED IN THE CURRENT GEOTECHNICAL MODELS TO ACHIEVE THE MOVEMENT CRITERIA OUTLINED IN THE RBG MOVEMENT AND TOLERANCE REPORT. TO BE CONFIRMED BY D&C CONTRACTOR.

Structural, Civil & Construction Engineering Consultant

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Client
QIC

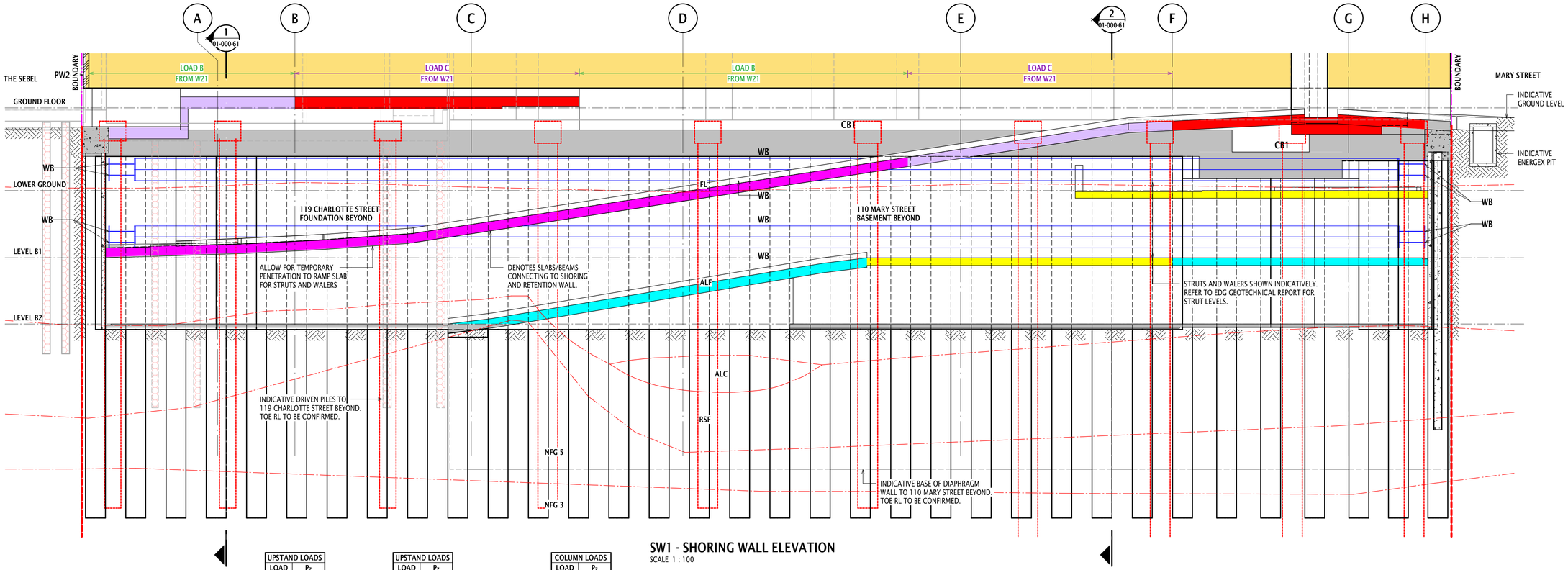
Project
101 ALBERT STREET, BRISBANE

Title
TEMPORARY SHORING AND RETENTION GENERAL ARRANGEMENT PLAN

Date
Jun 2024
Scale at A1
1:125
Drawn
D.STUCKEY
Designer
N.DOYLE/T.KATUNAR
Design Checker
-
Job Number
22131S
Approved
M.AVERY

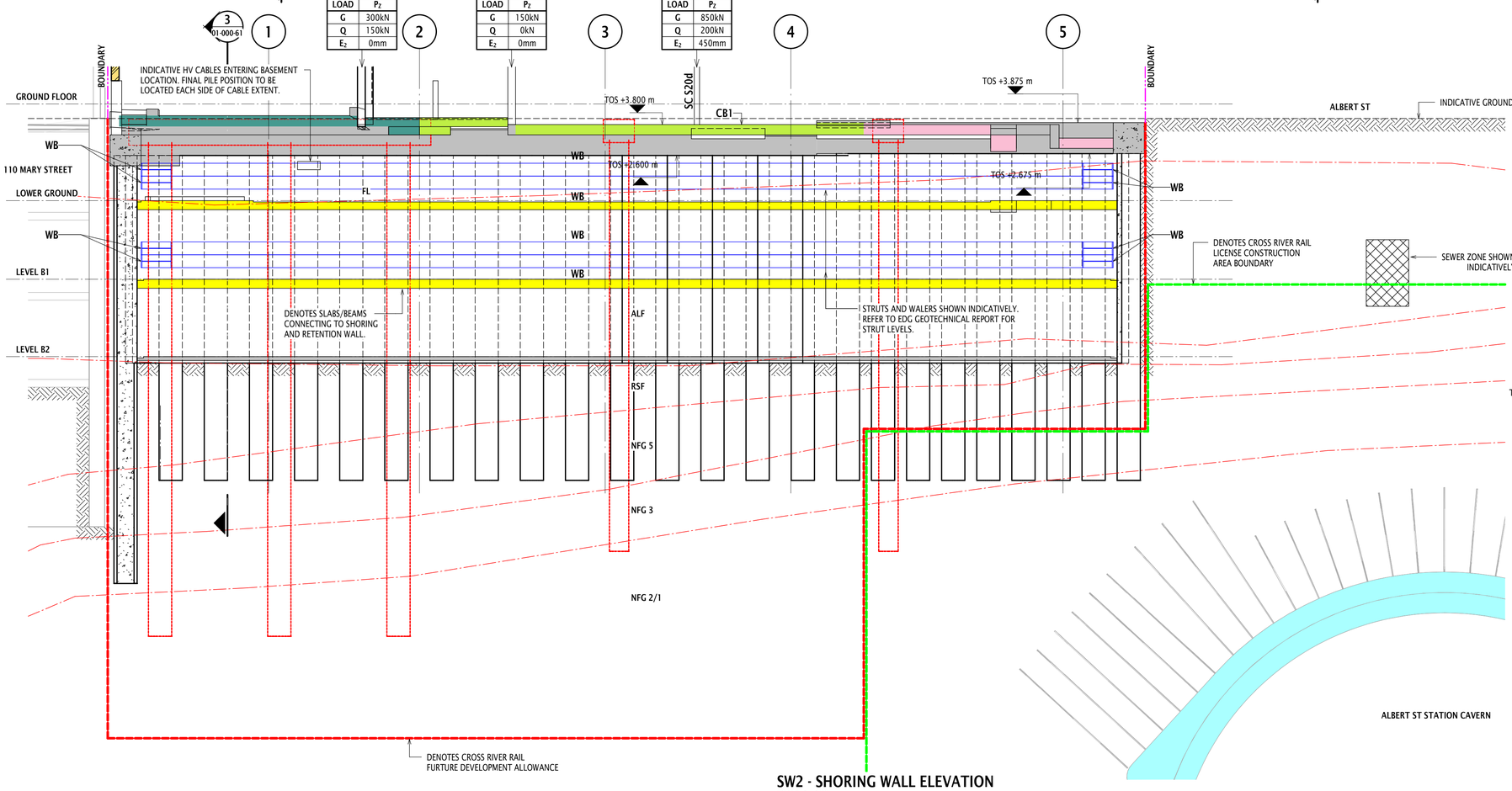
FOR TENDER - NOT FOR CONSTRUCTION

Drawing Number
ALB-RBG-DWG-ST-01-000-21
Revision
T02



SW1 - SHORING WALL ELEVATION

SCALE 1 : 100



UPSTAND LOADS	
LOAD	P_Z
G	300kN
Q	150kN
E_2	0mm

UPSTAND LOADS	
LOAD	P_Z
G	150kN
Q	0kN
E_2	0mm

COLUMN LOADS	
LOAD	P_Z
G	850kN
Q	200kN
E_2	450mm

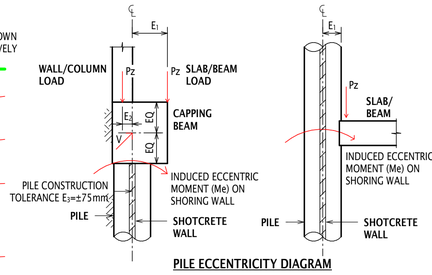
SW2 - SHORING WALL ELEVATION

SCALE 1 : 100

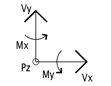
WALL/SLAB/BEAM Pz LOADS

	A	B	C	D	E	F	G
G (kN/m)	100	330	610	120	180	20	50
Q (kN/m)	60	70	170	30	40	20	20
E (mm)	400	-400	-400	-425	-425	450	450
	H	I	J	K	L	M	
G (kN/m)	100	70	80	90	160	100	
Q (kN/m)	60	10	20	40	60	20	
E (mm)	450	600	600	600	600	425	

SLAB/BEAM LOAD NOTES:
1. SLAB/BEAM LOAD INCLUDES SELF WEIGHT OF CAPPING BEAM AND SELF WEIGHT OF WALLS ABOVE GROUND FLOOR.
2. SLAB/BEAM LOAD EXCLUDES SELF WEIGHT OF SHORING WALL.
3. THE SELF WEIGHT OF THE SHORING WALL CAN BE TAKEN AS 15 kPa WITH RESPECT TO THE HEIGHT OF THE WALL. THIS IS BASED ON 900D PILES AT 1.8 M CENTRES WITH A 250THK SHOTCRETE INFILL.
4. FOR POSITIVE ECCENTRICITIES, LOADS SHALL BE APPLIED IN THE DIRECTION OF "E1".
5. FOR NEGATIVE ECCENTRICITIES, LOADS SHALL BE APPLIED IN THE DIRECTION OF "E2".



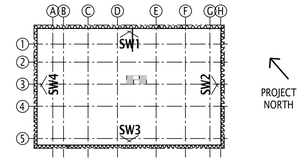
PILE ECCENTRICITY DIAGRAM



FORCE DIRECTION UNO

Pz DENOTES VERTICAL LOAD
Vx DENOTES HORIZONTAL LOAD APPLIED IN X DIRECTION
Vy DENOTES HORIZONTAL LOAD APPLIED IN Y DIRECTION
Mx DENOTES MOMENTS IN X DIRECTION
My DENOTES MOMENTS IN Y DIRECTION

FORCE DIRECTION ORIENTATED TO PROJECT NORTH



KEY PLAN (B1)
SCALE 1 : 1000

PRINT DRAWINGS IN COLOUR

NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE FOLLOWING:
   a. SITE PLAN, LOADS AND NOTES ON DRG ST-01-000-01.
   b. CRR ASSET PROXIMITY PLANS ON DRG ST-01-000-11 & 12.
   c. TEMPORARY SHORING AND RETENTION GENERAL ARRANGEMENT PLAN ON DRG ST-01-000-21.
2. PILE DESIGN SHALL BE BASED ON ZERO FIXITY BETWEEN PILES AND SLABS/BEAMS AND ALLOW FOR MOMENTS DUE TO ECCENTRICITY OF ALL APPLIED LOADS.
3. DESIGN ACTIONS ARE TO BE COMBINED IN ACCORDANCE WITH AS1170.0 TO PRODUCE THE MOST ADVERSE EFFECT.
4. DEAD, LIVE, WATER AND SOIL LOADS ARE PROVIDED UNFACTORED. SEISMIC AND WIND LOADS ARE PROVIDED AT ULTIMATE.
5. SEISMIC AND WIND LOADS ARE FULLY REVERSIBLE.
6. PILE DESIGN SHALL ALLOW FOR ECCENTRICITY OF APPLIED LOADS. ECCENTRICITIES SHALL BE COMBINED TO PRODUCE THE MOST ADVERSE EFFECT. ECCENTRICITIES TO BE CONFIRMED ONCE EXACT SHORING WALL SETOUT HAS BEEN CO-ORDINATED WITH ARCHITECT.
7. REFER TO ROBERT BIRD GROUP CIVIL ENGINEER BULK EARTHWORKS LAYOUT PLAN DRAWING CW8201 FOR DETAILS.
8. REFER ARCHITECTS FOR FINISHED GROUND LEVELS.

GEOTECHNICAL GROUND PROFILES NOTES:

1. GEOTECHNICAL PROFILES ARE TAKEN FROM EDG GEOTECHNICAL REPORTS NOTED ON DRG ST-00-000-11.
2. SOIL/ROCK PROFILES INDICATED ON THESE DRAWINGS ARE AN APPROXIMATION ONLY BASED ON INTERPOLATION BETWEEN BOREHOLE SOIL/ROCK LEVELS TAKEN AROUND THE SITE AS PER NOTE 1. ACTUAL ROCK LEVELS ON SITE ARE EXPECTED TO VARY.
3. SOIL/ROCK PROFILES MUST BE CONFIRMED PRIOR TO CONSTRUCTION WITH SITE SPECIFIC BOREHOLES WHICH ARE TO BE SUBMITTED TO THE DESIGNER AND BASE ENGINEER ROBERT BIRD GROUP FOR VERIFICATION OF DESIGN.
4. PILE TOE RL AND ROCK BOLT LENGTHS TO BE CONFIRMED ONCE GEOTECHNICAL ENGINEERS SUBMIT TO ROBERT BIRD GROUP ACTUAL SOIL/ROCK PROFILE RL'S WHEN GEOTECHNICAL MAPPING OCCURS AS CONSTRUCTION EXCAVATION PROCEEDS.

Rev	Revision Description	By	App	Date
T02	ISSUED FOR TENDER	DS	MA	17.07.24
T01	ISSUED FOR TENDER	DS	MA	28.06.24
A02	80% DD DRAFT	DS	MA	07.06.24
A01	50% DD ISSUE	SV	MA	09.08.23
P01	DRAFT 50% DESIGN DEVELOPMENT	SV	MA	28.07.23

SCALE | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8

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Project
101 ALBERT STREET, BRISBANE

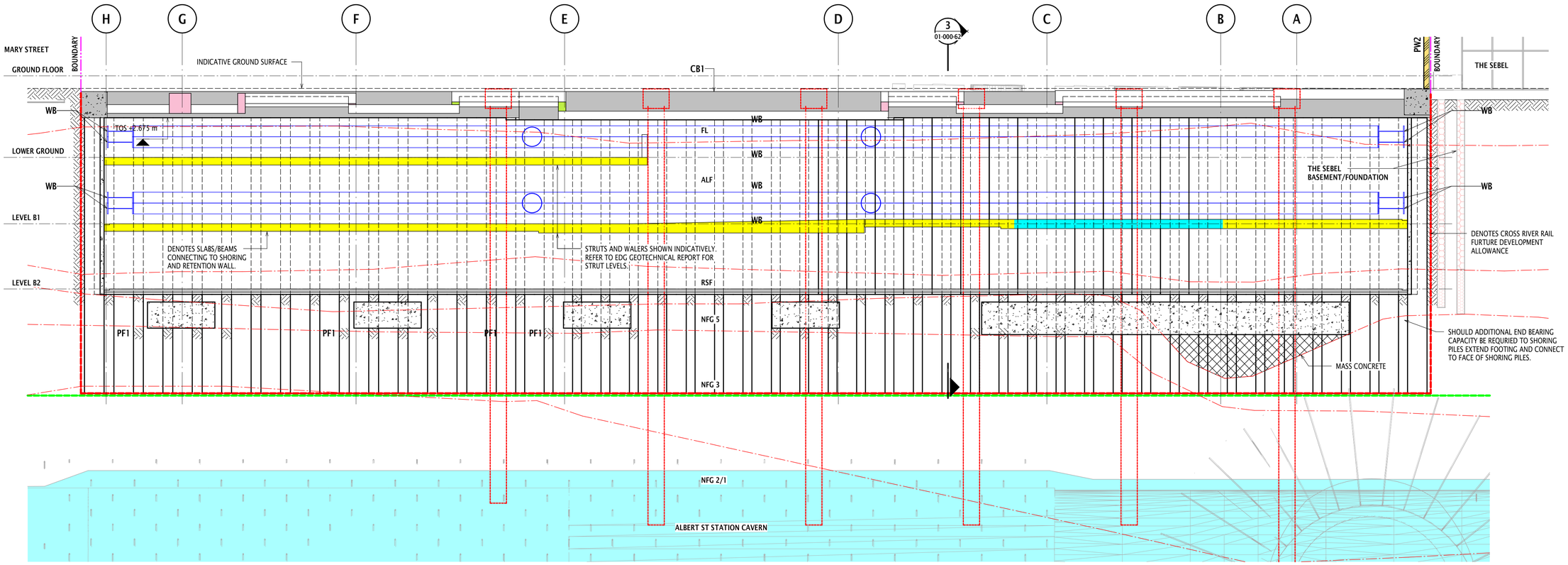
Title
SHORING ELEVATIONS
SHEET 1

Date
Jun 2024
Scale at A1
1:100, 1:1000
Job Number
22131S

Drawn
D.STUCKEY
Designer
N.DOYLE/T.KATUNAR
Design Checker
-
Approved
M.AVERY

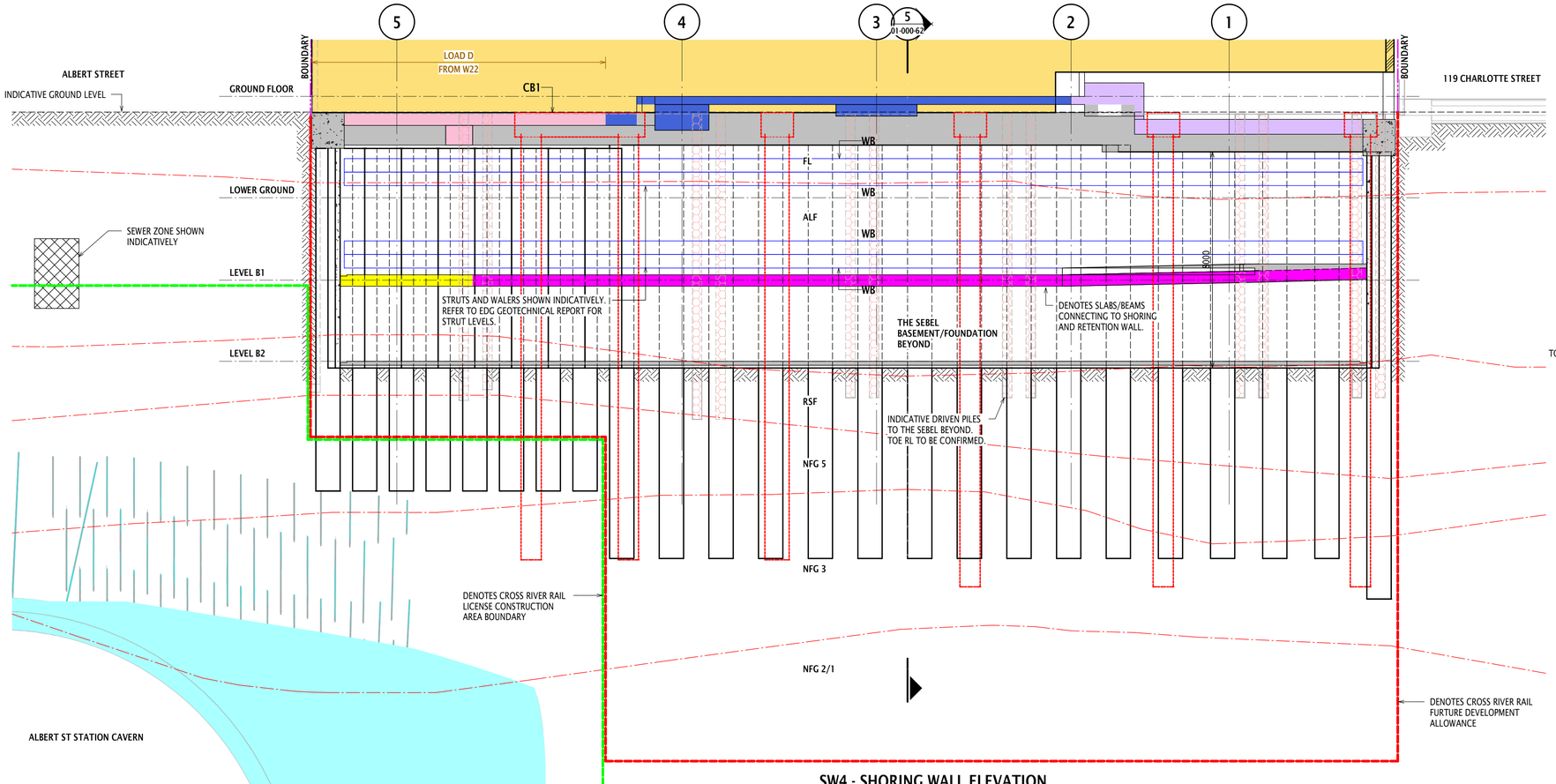
FOR TENDER - NOT FOR CONSTRUCTION

Drawing Number
ALB-RBG-DWG-ST-01-000-41
Revision
T02



SW3 - SHORING WALL ELEVATION

SCALE 1 : 100

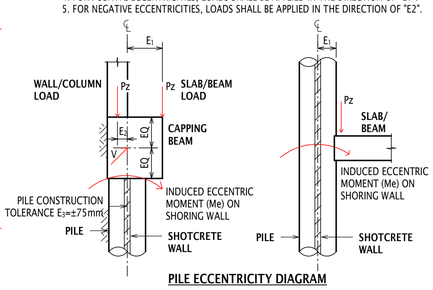


SW4 - SHORING WALL ELEVATION

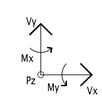
SCALE 1 : 100

WALL/SLAB/BEAM Pz LOADS							
	A	B	C	D	E	F	G
G (kN/m)	100	330	610	120	180	20	50
Q (kN/m)	60	70	170	30	40	20	20
E (mm)	400	-400	-400	-425	-425	450	450
	H	I	J	K	L	M	
G (kN/m)	100	70	80	90	160	100	
Q (kN/m)	60	10	20	40	60	20	
E (mm)	450	600	600	600	600	425	

SLAB/BEAM LOAD NOTES:
1. SLAB/BEAM LOAD INCLUDES SELF WEIGHT OF CAPPING BEAM AND SELF WEIGHT OF WALLS ABOVE GROUND FLOOR.
2. SLAB/BEAM LOAD EXCLUDES SELF WEIGHT OF SHORING WALL.
3. THE SELF WEIGHT OF THE SHORING WALL CAN BE TAKEN AS 15 kPa WITH RESPECT TO THE HEIGHT OF THE WALL. THIS IS BASED ON 900D PILES AT 1.8 M CENTRES WITH A 250THK SHOTCRETE INFILL.
4. FOR POSITIVE ECCENTRICITIES, LOADS SHALL BE APPLIED IN THE DIRECTION OF "E1".
5. FOR NEGATIVE ECCENTRICITIES, LOADS SHALL BE APPLIED IN THE DIRECTION OF "E2".



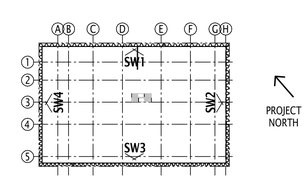
PILE ECCENTRICITY DIAGRAM



FORCE DIRECTION UNO

Pz DENOTES VERTICAL LOAD
Vx DENOTES HORIZONTAL LOAD APPLIED IN X DIRECTION
Vy DENOTES HORIZONTAL LOAD APPLIED IN Y DIRECTION
Mx DENOTES MOMENTS IN X DIRECTION
My DENOTES MOMENTS IN Y DIRECTION

FORCE DIRECTION ORIENTATED TO PROJECT NORTH



KEY PLAN (B1)
SCALE 1 : 1000

PRINT DRAWINGS IN COLOUR

NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE FOLLOWING:
   a. SITE PLAN, LOADS AND NOTES ON DRG ST-01-000-01.
   b. CRR ASSET PROXIMITY PLANS ON DRG ST-01-000-11 & 12.
   c. TEMPORARY SHORING AND RETENTION GENERAL ARRANGEMENT PLAN ON DRG ST-01-000-21.
2. PILE DESIGN SHALL BE BASED ON ZERO FIXITY BETWEEN PILES AND SLABS/BEAMS AND ALLOW FOR MOMENTS DUE TO ECCENTRICITY OF ALL APPLIED LOADS.
3. DESIGN ACTIONS ARE TO BE COMBINED IN ACCORDANCE WITH AS1170.0 TO PRODUCE THE MOST ADVERSE EFFECT.
4. DEAD, LIVE, WATER AND SOIL LOADS ARE PROVIDED UNFACTORED. SEISMIC AND WIND LOADS ARE PROVIDED AT ULTIMATE.
5. SEISMIC AND WIND LOADS ARE FULLY REVERSIBLE.
6. PILE DESIGN SHALL ALLOW FOR ECCENTRICITY OF APPLIED LOADS. ECCENTRICITIES SHALL BE COMBINED TO PRODUCE THE MOST ADVERSE EFFECT. ECCENTRICITIES TO BE CONFIRMED ONCE EXACT SHORING WALL SETOUT HAS BEEN CO-ORDINATED WITH ARCHITECT.
7. REFER TO ROBERT BIRD GROUP CIVIL ENGINEER BULK EARTHWORKS LAYOUT PLAN DRAWING CWB201 FOR DETAILS.
8. REFER ARCHITECTS FOR FINISHED GROUND LEVELS.

GEOTECHNICAL GROUND PROFILES NOTES:

1. GEOTECHNICAL PROFILES ARE TAKEN FROM EDG GEOTECHNICAL REPORTS NOTED ON DRG ST-00-000-11.
2. SOIL/ROCK PROFILES INDICATED ON THESE DRAWINGS ARE AN APPROXIMATION ONLY BASED ON INTERPOLATION BETWEEN BOREHOLE SOIL/ROCK LEVELS TAKEN AROUND THE SITE AS PER NOTE 1. ACTUAL ROCK LEVELS ON SITE ARE EXPECTED TO VARY.
3. SOIL/ROCK PROFILES MUST BE CONFIRMED PRIOR TO CONSTRUCTION WITH SITE SPECIFIC BOREHOLES WHICH ARE TO BE SUBMITTED TO THE DESIGNER AND BASE ENGINEER ROBERT BIRD GROUP FOR VERIFICATION OF DESIGN.
4. PILE TOE RL AND ROCK BOLT LENGTHS TO BE CONFIRMED ONCE GEOTECHNICAL ENGINEERS SUBMIT TO ROBERT BIRD GROUP ACTUAL SOIL/ROCK PROFILE RL'S WHEN GEOTECHNICAL MAPPING OCCURS AS CONSTRUCTION EXCAVATION PROCEEDS.

Rev	Revision Description	By	App	Date
T02	ISSUED FOR TENDER	DS	MA	17.07.24
T01	ISSUED FOR TENDER	DS	MA	28.06.24
A02	80% DD DRAFT	DS	MA	07.06.24
A01	50% DD ISSUE	SV	MA	09.08.23
P01	DRAFT 50% DESIGN DEVELOPMENT	SV	MA	28.07.23

SCALE 1 2 3 4 5 6 7 8

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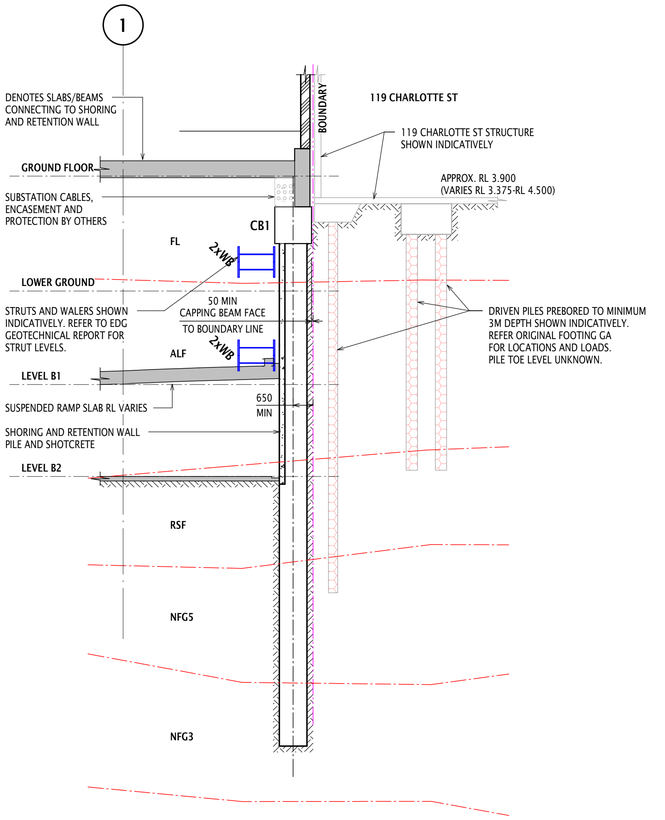
Project
101 ALBERT STREET, BRISBANE

Title
SHORING ELEVATIONS
SHEET 2

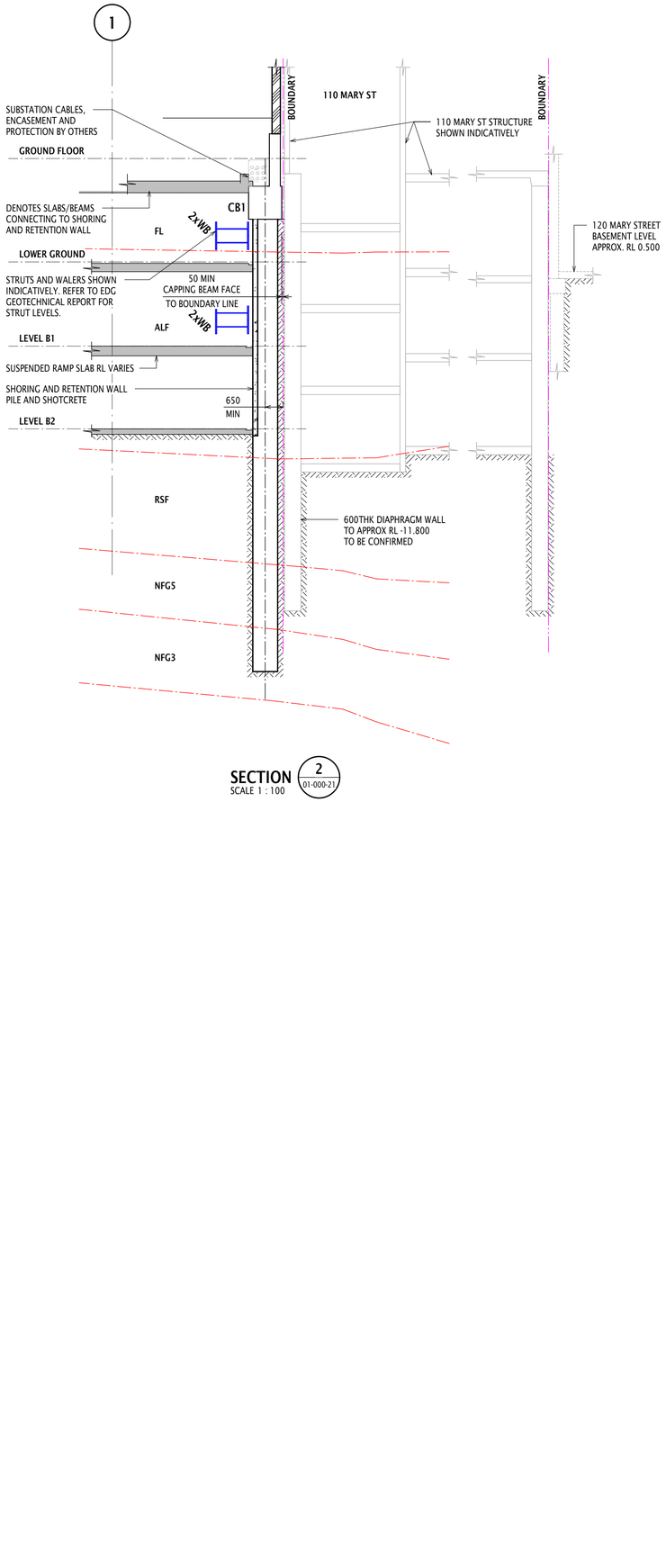
Date
Jun 2024
Scale at A1
1:100, 1:1000
Job Number
22131S
Drawn
D.STUCKEY
Designer
N.DOYLE/T.KATUNAR
Design Checker
-
Approved
M.AVERY

FOR TENDER - NOT FOR CONSTRUCTION

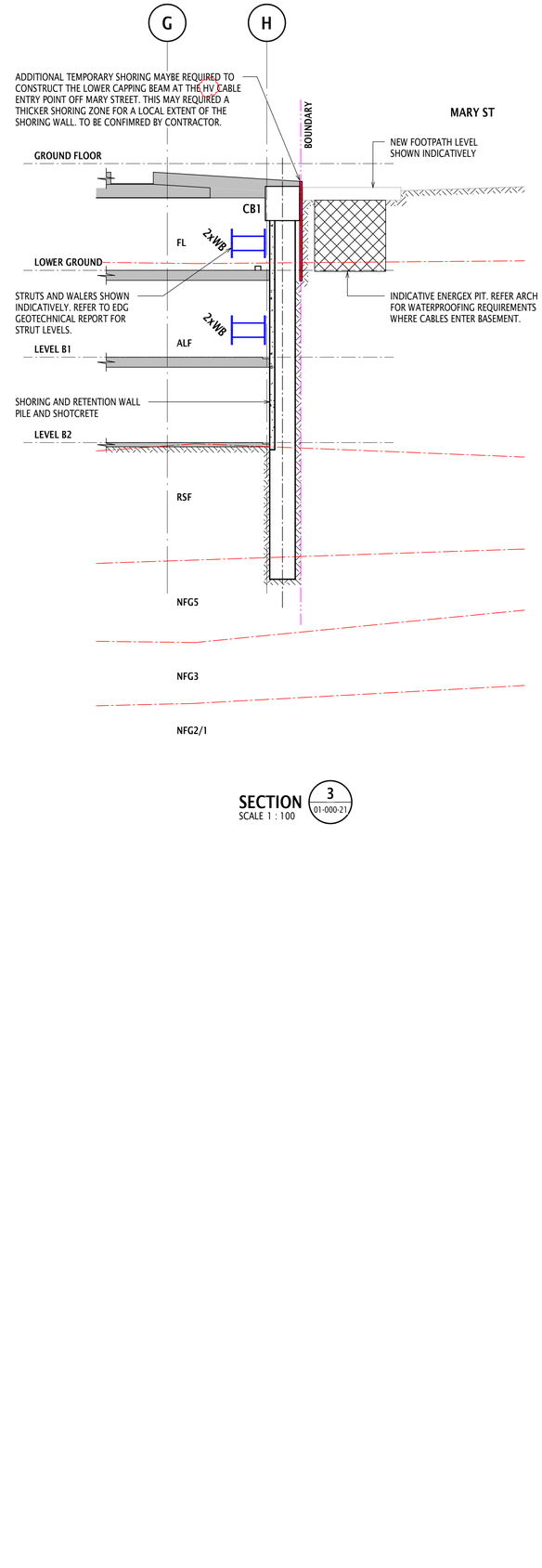
Drawing Number
ALB-RBG-DWG-ST-01-000-42
Revision
T02



SECTION 1 / 01-000-21
SCALE 1 : 100



SECTION 2 / 01-000-21
SCALE 1 : 100



SECTION 3 / 01-000-21
SCALE 1 : 100

PRINT DRAWINGS IN COLOUR

NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE FOLLOWING:
   a. SITE PLAN, LOADS AND NOTES ON DRG ST-01-000-01.
   b. CRR ASSET PROXIMITY PLANS ON DRG ST-01-000-11 & 12.
   c. TEMPORARY SHORING AND RETENTION GENERAL ARRANGEMENT PLAN ON DRG ST-01-000-21.
   d. SHORING ELEVATIONS ON DRG ST-01-000-41 & 42.
2. EXISTING BUILDING FOOTING RL'S ARE APPROXIMATE. TO BE CONFIRMED ON SITE.
3. EXISTING BUILDING LOADS, SETOUT AND GEOMETRY HAVE BEEN BASED ON THE AVAILABLE HISTORIC DRAWINGS AND ARE APPROXIMATE ONLY. RBG CANNOT CONFIRM THE ACCURACY OF THESE DRAWINGS, WHETHER THEY REFLECT THE AS-BUILT STRUCTURES OR WHETHER THE STRUCTURES HAVE BEEN UNKNOWINGLY MODIFIED LATER. DETAILED SURVEY REQUIRED TO VERIFY.
4. REFER TO EXISTING BUILDING STRUCTURAL DRAWINGS FOR NEIGHBORING BUILDING PILES LOADS AND LEVELS.
5. REFER TO ARCHITECTS FOR ALL FLOOR AND GROUND LEVELS.

80% DD NOTE:

- THE SHORING WALL SYSTEM AND LEVEL OF WATER RESISTANCE TO BE REVIEWED AGAINST GROUNDWATER CONDITIONS ONCE CONFIRMED. ALTERNATIVE SYSTEMS MAY NEED TO BE INVESTIGATED.
- GROUNDWATER LEVELS HAVE NOT BE SHOWN DUE TO INSUFFICIENT INFORMATION. TO BE CONFIRMED ONSITE.

Rev	Revision Description	By	App	Date
T02	ISSUED FOR TENDER	DS	MA	17.07.24
T01	ISSUED FOR TENDER	DS	MA	28.06.24
A01	80% DD DRAFT	DS	MA	07.06.24

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Project
101 ALBERT STREET, BRISBANE

Title
SHORING SECTIONS
SHEET 1

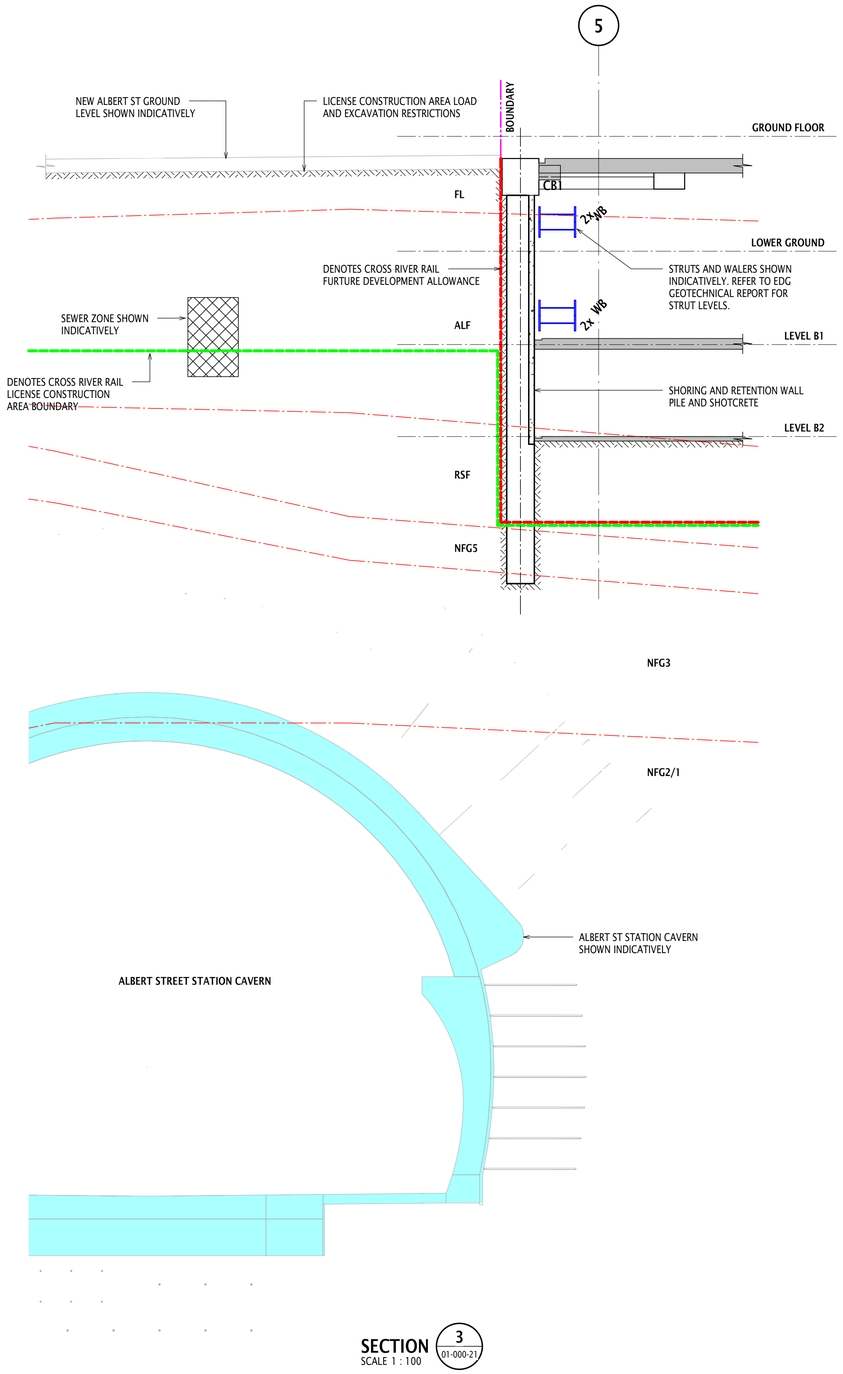
Date
Jun 2024
Scale at A1
1:100

Drawn
D.STUCKEY
Designer
N.DOYLE/T.KATUNAR
Design Checker
-
Approved
M.AVERY

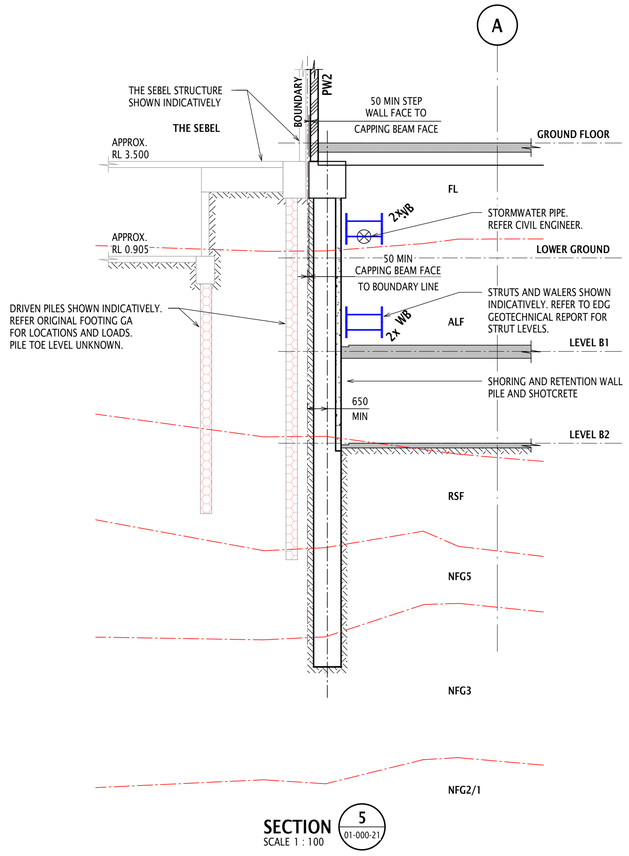
FOR TENDER - NOT FOR CONSTRUCTION

Drawing Number
ALB-RBG-DWG-ST-01-000-61

Revision
T02



SECTION 3 (01-000-21)
SCALE 1 : 100



SECTION 5 (01-000-21)
SCALE 1 : 100

PRINT DRAWINGS IN COLOUR

NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE FOLLOWING:
   a. SITE PLAN, LOADS AND NOTES ON DRG ST-01-000-01.
   b. CRR ASSET PROXIMITY PLANS ON DRG ST-01-000-11 & 12.
   c. TEMPORARY SHORING AND RETENTION GENERAL ARRANGEMENT PLAN ON DRG ST-01-000-21.
   d. SHORING ELEVATIONS ON DRG ST-01-000-41 & 42.
2. EXISTING BUILDING FOOTING RL'S ARE APPROXIMATE. TO BE CONFIRMED ON SITE.
3. EXISTING BUILDING LOADS, SETOUT AND GEOMETRY HAVE BEEN BASED ON THE AVAILABLE HISTORIC DRAWINGS AND ARE APPROXIMATE ONLY. RBG CANNOT CONFIRM THE ACCURACY OF THESE DRAWINGS, WHETHER THEY REFLECT THE AS-BUILT STRUCTURES OR WHETHER THE STRUCTURES HAVE BEEN UNKNOWINGLY MODIFIED LATER. DETAILED SURVEY REQUIRED TO VERIFY.
4. REFER TO EXISTING BUILDING STRUCTURAL DRAWINGS FOR NEIGHBORING BUILDING PILES LOADS AND LEVELS.
5. REFER TO ARCHITECTS FOR ALL FLOOR AND GROUND LEVELS.

80% DD NOTE:

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- GROUNDWATER LEVELS HAVE NOT BE SHOWN DUE TO INSUFFICIENT INFORMATION. TO BE CONFIRMED ONSITE.

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T01	ISSUED FOR TENDER	DS	MA	28.06.24
A01	80% DD DRAFT	DS	MA	07.06.24

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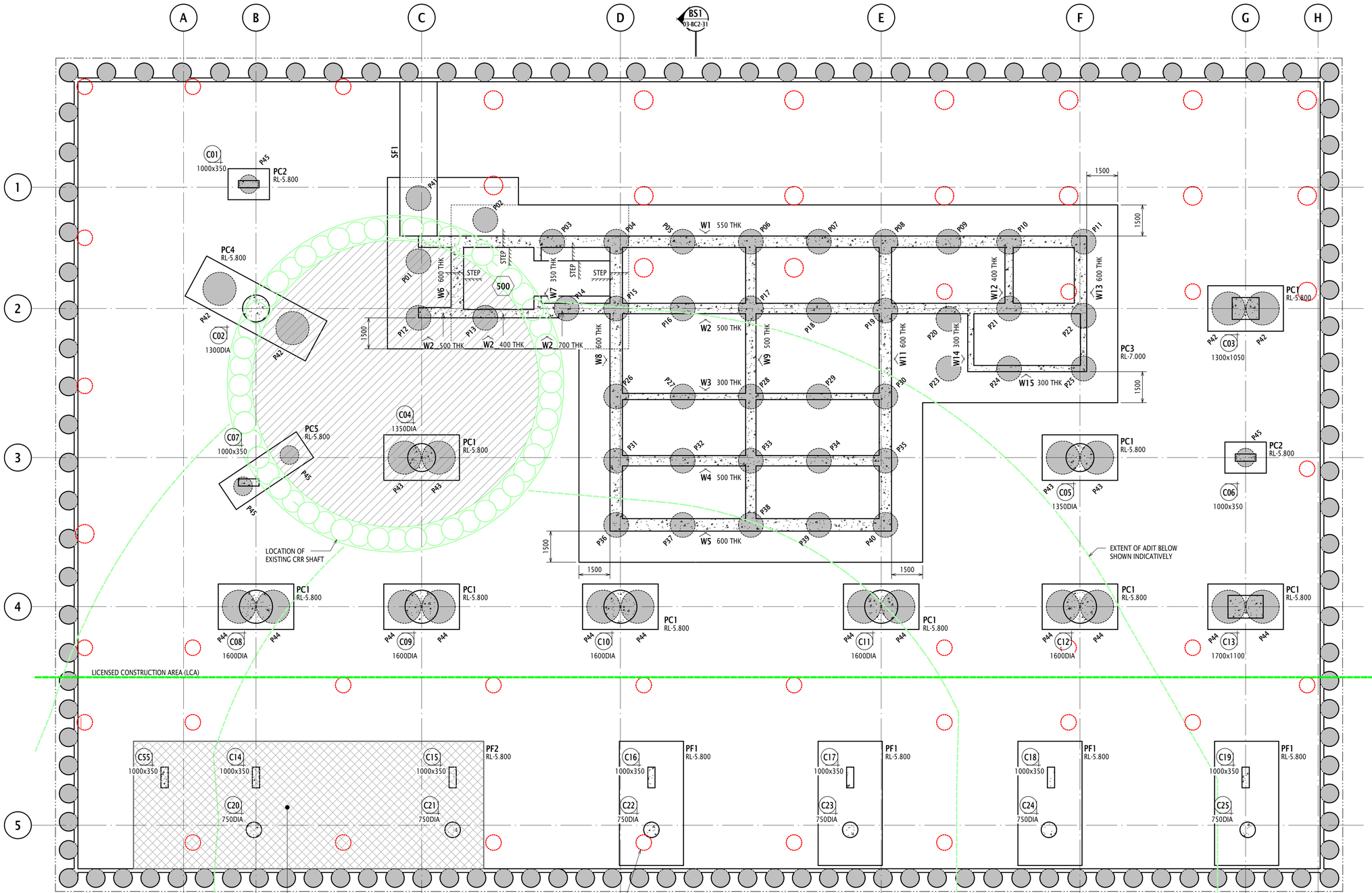
Title
SHORING SECITONS
SHEET 2

Date
Jun 2024
Scale at A1
1:100

Drawn
D.STUCKEY
Designer
N.DOYLE/T.KATUNAR
Design Checker
-
Approved
M.AVERY

FOR TENDER - NOT FOR CONSTRUCTION

Drawing Number	Revision
ALB-RBG-DWG-ST-01-000-62	T02



FOUNDATION PLAN

SCALE 1 : 100

GENERAL ARRANGEMENT LEGEND:

- DENOTES INSITU CONCRETE ELEMENT OVER
- DENOTES LOAD BEARING ELEMENT UNDER
- DENOTES LOAD BEARING ELEMENT UNDER AND INSITU CONCRETE ELEMENT OVER
- STEP — DENOTES SLAB STEP
- THK — DENOTES SLAB THICKNESS
- TAG / SIZE — DENOTES COLUMN NUMBER AND SIZE
- W? — DENOTES WALL NUMBER & DIRECTION ELEVATION IS VIEWED
- SW# — DENOTES SHOWING WALL NUMBER & DIRECTION ELEVATION IS VIEWED
- HATCH DENOTES INDICATIVE EXTENT OF ADDITIONAL LOCAL EXCAVATION AND REPLACEMENT WITH MASS N20 CONCRETE BUNDING LAYER BELOW FOOTING DOWN TO FOUNDING MATERIAL WITH ADEQUATE STRENGTH.
- DENOTES CRR SHAFT BACKFILL MATERIAL EXTENT. REFER DRGS ST-01-000-11 & 12
- DENOTES CRR ACOUSTIC SHED STRUCTURE REFER DRGS ST-01-000-11 & 12
- DENOTES CRR SHAFT AND ADIT STRUCTURE REFER DRGS ST-01-000-11 & 12

FOUNDATION COVER SCHEDULE UNO

LOCATION/ELEMENT	COVER (mm)
PC3	60
PC1	60
PC4	60
PC2, PC5	60
PAD FOOTINGS & RAFT	60
FOUNDATION PILES	75

FOUNDATION CONCRETE STRENGTH SCHEDULE UNO

LOCATION/ELEMENT	CONCRETE MIX
PC3	CM651
PC1, PC4	CM801
PC2, PC5	CM651
PF1, PF2	CM502
FOUNDATION PILES	CM801

NOTES:
1. REFER TO CONCRETE SPECIFICATION FOR MIX TYPES

FOUNDATION RATES SCHEDULE UNO

LOCATION/ELEMENT	REINF'T RATE [kg/m3]
PC3	200
PC1	200
PC4	275
PC2, PC5	150
PF1, PF2	175
PILES	
· CORE FOUNDATIONS	250
· COLUMN FOUNDATIONS	180
RAFT OPTION	200

PAD FOOTING SCHEDULE

PAD FOOTING MARK	LENGTH	WIDTH	DEPTH
PF1	6000	3100	1200
PF2	6155	16915	1500

PILE CAP SCHEDULE

PILE CAP MARK	LENGTH	WIDTH	DEPTH
PC1	3650	2200	2500
PC2	2000	1500	1200
PC3	REFER PLAN	REFER PLAN	2000
PC4	6600	2200	3000
PC5	4500	1500	1500

PILE SCHEDULE

PILE MARK	PILE DIA (m)	SOCKET[1] (m)		APPROX TOP OF SOCKET[2] (RL)	APPROX PILE TOE (RL)	LINER SLEEVE LENGTH (m)	TOTAL PILE LENGTH[1] (m)
		NFG3	NFG1/2				
P01-P11 & P41	1.2	3	5	-12	-20	N/A	11
P12-P22	1.2	3	5	-11	-19	N/A	10
P23-P30	1.2	3.5	3	-10.5	-17	N/A	8
P31-P35	1.2	3.5	5.5	-10.5	-19.5	N/A	10.5
P36-P40	1.2	1.5	10	-12	-23.5	3	14.5
P42	1.6	4.5	1.5	-10.3	-16.3	N/A	8
P43	1.6	5	1.5	-9.8	-16.3	N/A	8
P44	1.6	0	6.5	-16	-22.5	7.7	14.2
P45	0.9	1.5	0	-11.5	-13	N/A	6

1. PILE LENGTHS AND SOCKET REQUIREMENTS SUBJECT TO BACKFILL MATERIAL TO THE SHAFT AND ADITS ACHIEVING EQUIVALENT CAPACITY TO NFG1/2 ROCK. ADOPT THE ALTERNATIVE LENGTHS AND SOCKET REQUIREMENTS SHOULD BACKFILL MATERIAL BE UNSUITABLE. REFER TO GEOTECHNICAL REPORT.
2. SUBJECT TO GEOTECHNICAL INVESTIGATIONS. REFER GEOTECHNICAL REPORT.
3. CORE PILES P02-P04 & P13-P15 ARE SHORTER DUE TO LOCAL 2.9m PILE CAP THICKENING. COLUMN C02 PILES ARE SHORTER DUE TO 3m DEEP PILE CAP.

THE FOLLOWING INFORMATION IS BASED UPON FOUNDATIONS CONSISTING OF PILE CAPS AND LARGE DIAMETER BORED PIERS WITH POTENTIAL ISOLATION SLEEVES. READ BELOW IN CONJUNCTION WITH THE CRR ASSET PROXIMITY PLANS ON DRGS ST-01-000-11 & 12

80%DD NOTE:

1. THE FOUNDATION PILES TO BE SOCKETED INTO NFG3 AND NFG1/2 ROCK, RESPECTIVELY, AS NOTED IN THE GEOTECHNICAL REPORT. THE FOUNDATION PILE DESIGN IS BASED ON THE FOLLOWING:
   - ADVICE PROVIDED IN THE GEOTECHNICAL REPORT IS BASED INTERPRETATION OF AVAILABLE GEOTECHNICAL INVESTIGATION INFORMATION AT THE TIME OF TENDER. ALL GEOTECHNICAL ADVISE NEEDS TO BE CONFIRMED VIA GEOTECHNICAL INVESTIGATIONS.
   - THE PILE LENGTHS ASSUME BACKFILL MATERIAL TO SHAFT AND ADITS IS A SUITABLE ALTERNATIVE TO NFG1/2 ROCK .
   - THE PILE DESIGN IS BASED ON THE RECOMMENDED VERTICAL SPRINGS IN THE GEOTECHNICAL REPORT.
2. BORED PIERS HAVE BEEN SET-OUT WHERE POSSIBLE TO MINIMISE CLASHES WITH IN-GROUND CRR SUBSTRUCTURE INCLUDING THE TEMPORARY ACCESS SHAFT WALL, ADITS AND ACCOUSTIC SHED PILES.
3. COORDINATION WORK IS BASED UPON AVAILABLE CRR INFORMATION AT THE TIME OF THIS DOCUMENT ISSUE. THE LOCATION AND SIZE OF CRR ASSETS ARE INDICATIVE ONLY AND TO BE CONFIRMED.
4. NOT ALL EXISTING IN-GROUND STRUCTURE HAS BEEN SHOWN INCLUDING, BUT NOT LIMITED TO TEMPORARY ROCK BOLTS AND ANCHORS. BORED PIERS HAVE NOT BEEN POSITIONED TO MISS ROCK BOLTS AND ANCHORS AND THEREFORE THE CONTRACTOR IS TO MAKE ALLOWANCE FOR DRILLING THROUGH EXISTING IN-GROUND STRUCTURE.
5. BORED PIER SIZES ARE BASED ON THE TEMPORARY ACCESS SHAFT AND ADITS BEING BACKFILLED WITH 20MPa CONCRETE AND EXISTING SHAFT PILES & ACOUSTIC PILES BEING BROKEN DOWN. REFER CRR ASSETT PROXIMITY PLANS FOR DETAILS.

PRINT DRAWINGS IN COLOUR

NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE FOLLOWING:
   a. GENERAL AND CONSTRUCTION NOTES ON DRG ST-00-000-11
   b. SHORING & RETENTION WALL, PILING AND FOUNDATION NOTES ON DRG ST-00-000-12.
   c. GEOTECHNICAL REPORTS NOTED ON DRG ST-00-000-11.
   d. INSTRUMENTATION, VIBRATION AND MOVEMENT MONITORING REPORTS NOTED ON DRG ST-00-000-11.
   e. EDQ AND DA REQUIREMENTS NOTES ON DRG ST-00-000-11.
   f. SITE PLAN, LOADS AND NOTES ON DRG ST-01-000-01.
   g. CRR ASSET PROXIMITY PLANS ON DRG ST-01-000-11 & 12.
   h. TEMPORARY SHORING AND RETENTION GENERAL ARRANGEMENT PLAN ON DRG ST-01-000-21.
   i. LAP SCHEDULES ON DRG ST.
   j. FOUNDATION TYPICAL DETAILS AND PILE LOADS ON DRG SERIES ST-00-003-##.
   k. ROBERT BIRD GROUP CIVIL DRAWINGS.
2. GEOTECHNICAL ENGINEER TO VERIFIY BEARING CAPACITY OF ALL FOOTINGS PRIOR TO POURING BLINDING LAYER.
3. CORE DRILLING OF FOOTING BASES TO CONFIRM THE QUALITY OF FOUNDING STRATA IN THE CRITICAL ZONE OF STRESS INFLUENCE IS TO BE CARRIED OUT AND ASSESSED BY QUALIFIED GEOTECHNICAL ENGINEER
4. REFER GEOTECHNICAL REPORTS FOR EXCAVATION AND TEMPORARY BATTER ANGLES.
5. DESIGN ACTIONS ARE TO BE COMBINED IN ACCORDANCE WITH AS1170.0 TO PRODUCE THE MOST ADVERSE EFFECT.
6. DEAD, LIVE AND SOIL LOADS ARE PROVIDED UNFACTORED. SEISMIC AND WIND LOADS ARE PROVIDED AT ULTIMATE.
7. SEISMIC AND WIND LOADS ARE FULLY REVERSIBLE.
8. ALLOW FOR COST ASSOCIATED WITH TEMPERATURE MONITORING AND CONTROL TO PILE CAPS DEEPER THAN 1m. THIS MIGHT INCLUDE THERMOCOUPLES, INSULATION, ICE TO THE CONCRETE MIX ETC
9. HYDRAULIC ENGINEER TO CONFIRM UNDER SLAB DRAINAGE SYSTEM AND REQUIREMENTS. DRAIANGE TO BE COORDINATED AROUND FOUNDATIONS.

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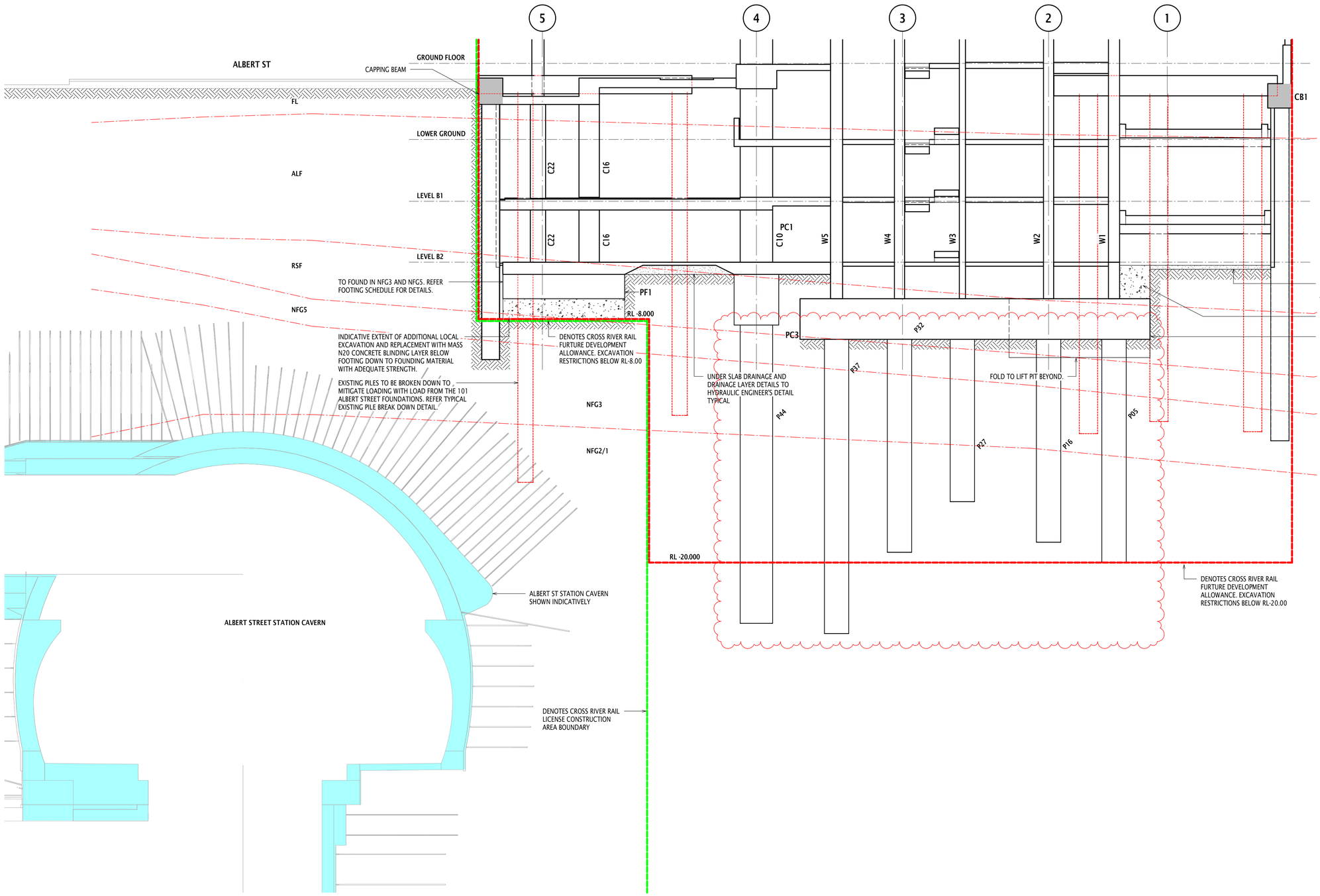
Title
FOUNDATION PLAN

Date
Jun 2024
Scale at A1
1:100
Drawn
D.STUCKEY
Designer
N.DOYLE/T.KATUNAR
Design Checker
-
Job Number
22131S
Approved
M.AVERY

FOR TENDER - NOT FOR CONSTRUCTION

Drawing Number
ALB-RBG-DWG-ST-03-BC2-01
Revision
T02

PRINT DRAWINGS IN COLOUR



SECTION BS1 (03-BC2-01)
SCALE 1 : 100

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T02	ISSUED FOR TENDER	DS	MA	17.07.24
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Project
101 ALBERT STREET, BRISBANE

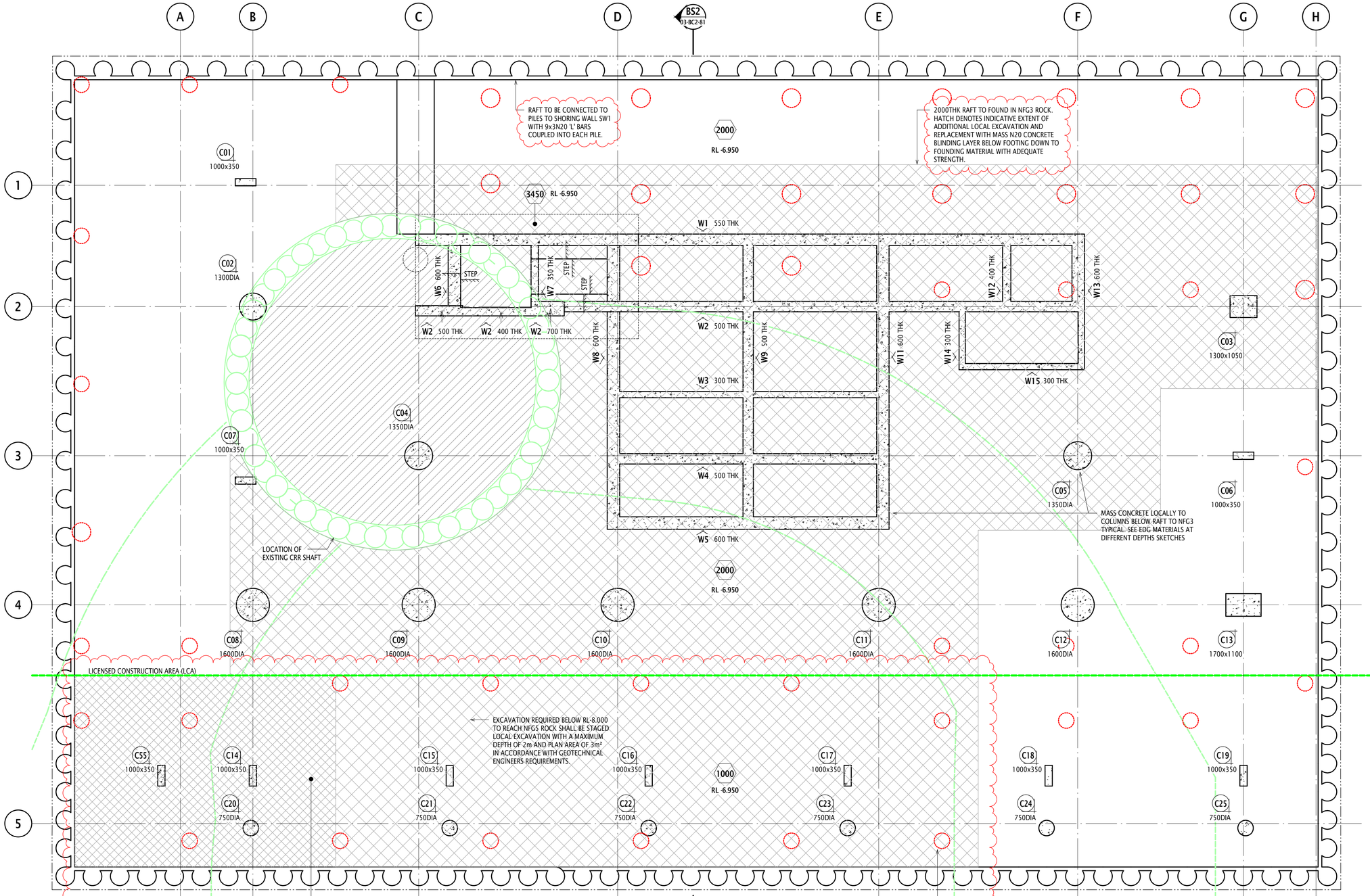
Title
BASEMENT SECTIONS
SHEET 1

Date
Jun 2024
Scale at A1
1:100
Drawn
D.STUCKEY
Designer
N.DOYLE/T.KATUNAR
Design Checker
-
Job Number
22131S
Approved
M.AVERY

FOR TENDER - NOT FOR CONSTRUCTION

Drawing Number
ALB-RBG-DWG-ST-03-BC2-31
Revision
T02

PRINT DRAWINGS IN COLOUR



FOUNDATION PLAN (ALTERNATIVE RAFT OPTION)

SCALE 1 : 100

GENERAL ARRANGEMENT LEGEND:

- DENOTES INSITU CONCRETE ELEMENT OVER
- DENOTES LOAD BEARING ELEMENT UNDER
- DENOTES LOAD BEARING ELEMENT UNDER AND INSITU CONCRETE ELEMENT OVER
- STEP — DENOTES SLAB STEP
- THK — DENOTES SLAB THICKNESS
- TAG SIZE — DENOTES COLUMN NUMBER AND SIZE
- W? — DENOTES WALL NUMBER & DIRECTION ELEVATION IS VIEWED
- SW# — DENOTES SHOWING WALL NUMBER & DIRECTION ELEVATION IS VIEWED
- HATCH DENOTES INDICATIVE EXTENT OF ADDITIONAL LOCAL EXCAVATION AND REPLACEMENT WITH MASS N20 CONCRETE BLINDING LAYER BELOW FOOTING DOWN TO FOUNDING MATERIAL WITH ADEQUATE STRENGTH.
- DENOTES CRR SHAFT BACKFILL MATERIAL EXTENT. REFER DRGS ST-01-000-11 & 12
- DENOTES CRR ACOUSTIC SHED STRUCTURE REFER DRGS ST-01-000-11 & 12
- DENOTES CRR SHAFT AND ADIT STRUCTURE REFER DRGS ST-01-000-11 & 12

FOUNDATION COVER SCHEDULE UNO

LOCATION/ELEMENT	COVER (mm)
PC3	60
PILE CAPS	60
PAD FOOTINGS & RAFT	60
FOUNDATION PILES	75

FOUNDATION CONCRETE STRENGTH SCHEDULE UNO

LOCATION/ELEMENT	CONCRETE MIX
PC3	CM651
PC1, PC4	CM801
PC2, PC5	CM651
PF1, PF2	CM502
FOUNDATION PILES	CM801

NOTES:
1. REFER TO CONCRETE SPECIFICATION FOR MIX TYPES

FOUNDATION RATES SCHEDULE UNO

LOCATION/ELEMENT	REINF'T RATE [kg/m3]
PC3	200
PC1	200
PC4	275
PC2, PC5	150
PF1, PF2	175
PILES	
· CORE FOUNDATIONS	250
· COLUMN FOUNDATIONS	180
RAFT OPTION	200

THE FOLLOWING INFORMATION IS BASED UPON FOUNDATIONS CONSISTING OF A RAFT FOUNDATION. READ BELOW IN CONJUNCTION WITH THE CRR ASSET PROXIMITY PLANS ON DRGS ST-01-000-11 & 12

80%DD NOTE:
1. THE 1000THK AND 2000THK RAFT TO BE FOUND IN NFG3 ROCK TYP U.N.O. AS NOTED IN THE GEOTECHNICAL REPORT. THE RAFT DESIGN IS BASED ON THE FOLLOWING:
   - ADVISE PROVIDED IN THE GEOTECHNICAL REPORT IS BASED INTERPRETATION OF AVAILABLE GEOTECHNICAL INVESTIGATION INFORMATION AT THE TIME OF TENDER. ALL GEOTECHNICAL ADVISE NEEDS TO BE CONFIRMED VIA GEOTECHNICAL INVESTIGATIONS.
   - THE ELEVATION OF THE RAFT HAS BEEN ADOPTED TO MINIMISE REMOVAL OF RESIDUAL SOIL AND WEAKER ROCK AND REPLACEMENT WITH LOCALISED MASS CONCRETE. THE INDICATIVE EXTENT OF MASS CONCRETE NEEDS TO BE CONFIRMED VIA GEOTECHNICAL INVESTIGATIONS AND DURING EXCAVATION.
   - THE RAFT DESIGN IS BASED ON THE RECOMMENDED MODULUS OF SUBGRADE REACTION VALUES IN THE GEOTECHNICAL REPORT.
2. COORDINATION WORK IS BASED UPON AVAILABLE CRR INFORMATION AT THE TIME OF THIS DOCUMENT ISSUE. THE LOCATION AND SIZE OF CRR ASSETS ARE INDICATIVE ONLY AND TO BE CONFIRMED.
3. NOT ALL EXISTING IN-GROUND STRUCTURE HAS BEEN SHOWN INCLUDING, BUT NOT LIMITED TO TEMPORARY ROCK BOLTS AND ANCHORS. BORED PIERS HAVE NOT BEEN POSITIONED TO MISS ROCK BOLTS AND ANCHORS AND THEREFORE THE CONTRACTOR IS TO MAKE ALLOWANCE FOR DRILLING THROUGH EXISTING IN-GROUND STRUCTURE.
4. THE RAFT THICKNESSES ARE BASED ON THE TEMPORARY ACCESS SHAFT AND ADITS BEING BACKFILLED WITH 20MPa CONCRETE AND EXISTING SHAFT PILES & ACOUSTIC PILES BEING BROKEN DOWN. REFER CRR ASSETT PROXIMITY PLANS FOR DETAILS.

NOTES:
1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE FOLLOWING:
   a. GENERAL AND CONSTRUCTION NOTES ON DRG ST-00-000-11
   b. SHORING & RETENTION WALL, PILING AND FOUNDATION NOTES ON DRG ST-00-000-12.
   c. GEOTECHNICAL REPORTS NOTED ON DRG ST-00-000-11.
   d. INSTRUMENTATION, VIBRATION AND MOVEMENT MONITORING REPORTS NOTED ON DRG ST-00-000-11.
   e. EDQ AND DA REQUIREMENTS NOTES ON DRG ST-00-000-11.
   f. SITE PLAN, LOADS AND NOTES ON DRG ST-01-000-01.
   g. CRR ASSET PROXIMITY PLANS ON DRG ST-01-000-11 & 12.
   h. TEMPORARY SHORING AND RETENTION GENERAL ARRANGEMENT PLAN ON DRG ST-01-000-21.
   i. LAP SCHEDULES ON DRG ST
   j. FOUNDATION TYPICAL DETAILS AND PILE LOADS ON DRG SERIES ST-00-003-##.
   k. ROBERT BIRD GROUP CIVIL DRAWINGS.
2. GEOTECHNICAL ENGINEER TO VERIFIY BEARING CAPACITY OF ALL FOOTINGS PRIOR TO POURING BLINDING LAYER.
3. CORE DRILLING OF FOOTING BASES TO CONFIRM THE QUALITY OF FOUNDING STRATA IN THE CRITICAL ZONE OF STRESS INFLUENCE IS TO BE CARRIED OUT AND ASSESSED BY QUALIFIED GEOTECHNICAL ENGINEER
4. REFER GEOTECHNICAL REPORTS FOR EXCAVATION AND TEMPORARY BATTER ANGLES.
5. DESIGN ACTIONS ARE TO BE COMBINED IN ACCORDANCE WITH AS1170.0 TO PRODUCE THE MOST ADVERSE EFFECT.
6. DEAD, LIVE AND SOIL LOADS ARE PROVIDED UNFACTORED. SEISMIC AND WIND LOADS ARE PROVIDED AT ULTIMATE.
7. SEISMIC AND WIND LOADS ARE FULLY REVERSIBLE.
8. ALLOW FOR THE COST ASSOCIATED WITH TEMPERATURE MONITORING AND CONTROL TO THE RAFT. THIS MIGHT INCLUDE THERMOCOUPLES, INSULATION, ICE, BESPOKE MIX DESIGN ETC.
9. HYDRAULIC ENGINEER TO CONFIRM UNDER SLAB DRAINAGE SYSTEM AND REQUIREMENTS. DRAINAGE TO BE COORDINATED AROUND FOUNDATIONS.

Rev	Revision Description	By	App	Date
T02	ISSUED FOR TENDER	DS	MA	17.07.24
T01	ISSUED FOR TENDER	DS	MA	28.06.24
A02	80% DD DRAFT	DS	MA	07.06.24
A01	50% DD ISSUE	SV	MA	09.08.23
P01	DRAFT 50% DESIGN DEVELOPMENT	SV	MA	28.07.23

SCALE 1 2 3 4 5 6 7 8

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QIC

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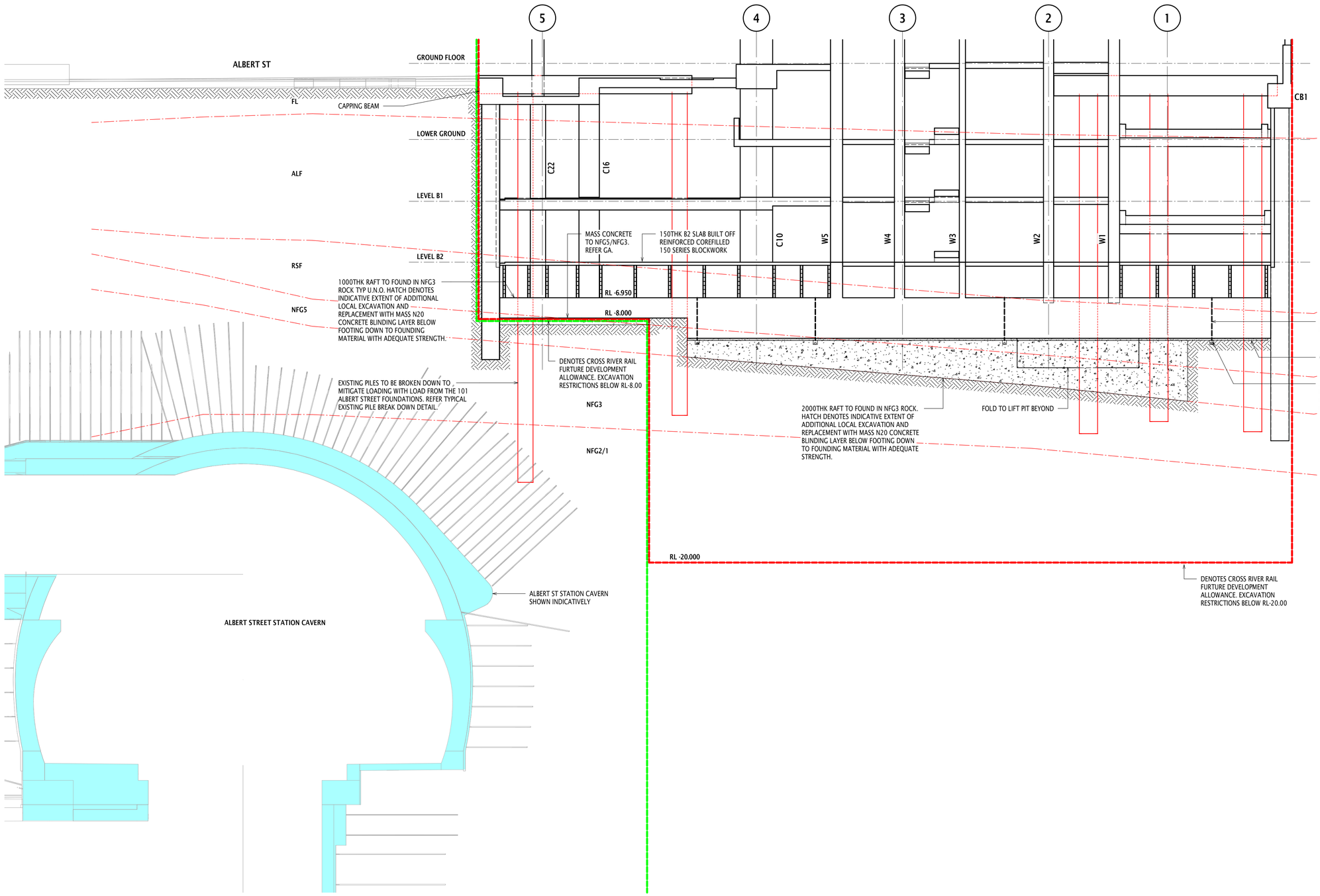
Title
FOOTING PLAN (RAFT OPTION)

Date	Drawn
Jun 2024	D.STUCKEY
Scale at A1	Designer
1:100	N.DOYLE/T.KATUNAR
	Design Checker
	-
Job Number	Approved
22131S	M.AVERY

FOR TENDER - NOT FOR CONSTRUCTION

Drawing Number: ALB-RBG-DWG-ST-03-BC2-51
Revision: T02

PRINT DRAWINGS IN COLOUR



SECTION
SCALE 1 : 100

BS2
03-BC2-51

Rev	Revision Description	By	App	Date
T02	ISSUED FOR TENDER	DS	MA	17.07.24
T01	ISSUED FOR TENDER	DS	MA	28.06.24
A02	80% DD DRAFT	DS	MA	07.06.24
A01	50% DD ISSUE	SV	MA	09.08.23
P01	DRAFT 50% DESIGN DEVELOPMENT	SV	MA	28.07.23

SCALE | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |

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Structural, Civil & Construction
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Client
QIC

Project
101 ALBERT STREET, BRISBANE

Title
BASEMENT SECTIONS (RAFT OPTION)
SHEET 1

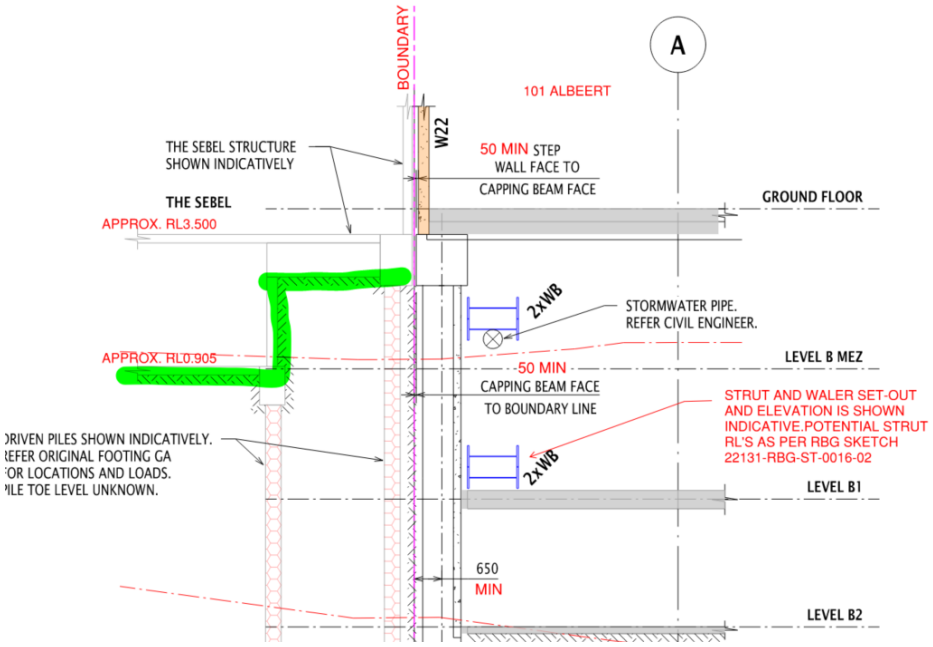
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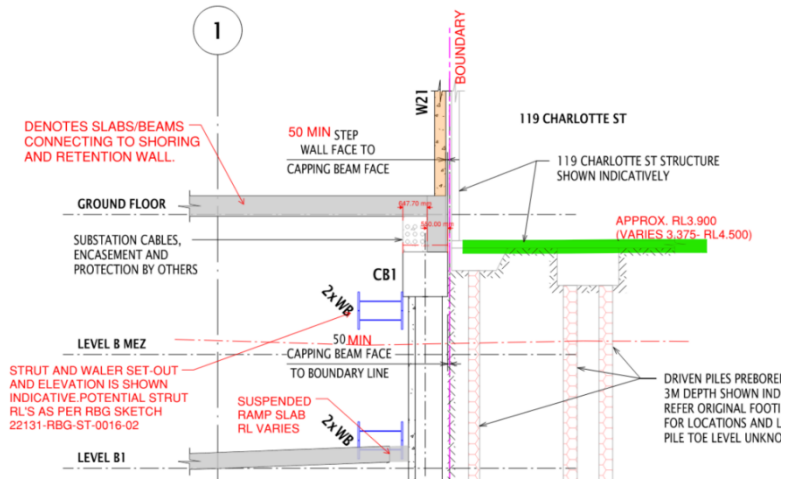
Drawing Number
ALB-RBG-DWG-ST-03-BC2-81
Revision
T02

Building Surcharge Markup and Levels (by RBG)

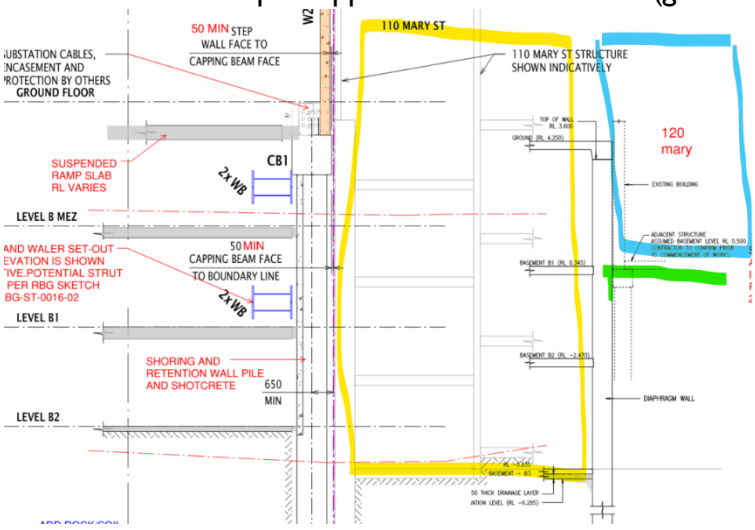
The Sebel: Design for Sebel pile loads if required. Design for soil load based on green height. G and Q loads from the site plan applied at basement level (green line).

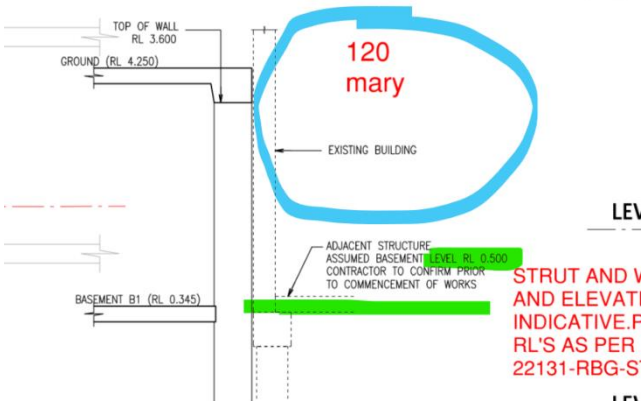


119 Charlotte: Design for 119 Charlotte pile loads if required. Design for soil load based on green height. G and Q loads from the site plan applied at basement level (green line).



110 Mary: Design for soil load based on green height based on 120 Mary basement. G and Q loads from the site plan applied at basement level (green line).





						Global RAM Force							
ETABS Load Case	**Joint**	**Element**	**x [m]**	**y [m]**	**z [m]**	**F_x [kN]**	**F_y [kN]**	**F_z [kN]**	**M_x [kNm]**	**M_y [kNm]**	**M_z [kNm]**	Wind?	Seismic?
EQSpecX	3267	CORE P04	21.3	28.4	-6	-898	-338	-2324	0	0	0	FALSE	TRUE
EQSpecY	3267	CORE P04	21.3	28.4	-6	-129	-463	-2676	0	0	0	FALSE	TRUE
Robustness X	3267	CORE P04	21.3	28.4	-6	401	-52	3262	0	0	0	FALSE	FALSE
Robustness Y	3267	CORE P04	21.3	28.4	-6	-15	471	-7353	0	0	0	FALSE	FALSE
0: Total Q	3267	CORE P04	21.3	28.4	-6	-13	-22	-2227	0	0	0	FALSE	FALSE
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0: RWDI_02	3267	CORE P04	21.3	28.4	-6	157	96	-909	0	0	0	TRUE	FALSE
0: RWDI_03	3267	CORE P04	21.3	28.4	-6	112	-221	5581	0	0	0	TRUE	FALSE
0: RWDI_04	3267	CORE P04	21.3	28.4	-6	179	-150	5527	0	0	0	TRUE	FALSE
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0: RWDI_06	3267	CORE P04	21.3	28.4	-6	-118	271	-6781	0	0	0	TRUE	FALSE
0: RWDI_07	3267	CORE P04	21.3	28.4	-6	-185	-115	803	0	0	0	TRUE	FALSE
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0: RWDI_15	3267	CORE P04	21.3	28.4	-6	-37	-424	10015	0	0	0	TRUE	FALSE
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0: RWDI_17	3267	CORE P04	21.3	28.4	-6	-70	41	-3476	0	0	0	TRUE	FALSE
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0: RWDI_19	3267	CORE P04	21.3	28.4	-6	-44	-246	4033	0	0	0	TRUE	FALSE
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0: RWDI_24	3267	CORE P04	21.3	28.4	-6	31	-16	2735	0	0	0	TRUE	FALSE
Total G (Wished-	3267	CORE P04	21.3	28.4	-6	-58	-23	-14900	0	0	0	FALSE	FALSE
EQSpecX	3274	CORE P06	27.6	28.4	-6	-919	-38	-274	0	0	0	FALSE	TRUE
EQSpecY	3274	CORE P06	27.6	28.4	-6	-143	-353	-2976	0	0	0	FALSE	TRUE
Robustness X	3274	CORE P06	27.6	28.4	-6	395	8	54	0	0	0	FALSE	FALSE
Robustness Y	3274	CORE P06	27.6	28.4	-6	20	467	-8134	0	0	0	FALSE	FALSE
0: Total Q	3274	CORE P06	27.6	28.4	-6	-19	-30	-2231	0	0	0	FALSE	FALSE
0: RWDI_01	3274	CORE P06	27.6	28.4	-6	95	122	-3519	0	0	0	TRUE	FALSE
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Total G (Wished-	3274	CORE P06	27.6	28.4	-6	-33	-42	-15095	0	0	0	FALSE	FALSE
EQSpecX	3293	CORE P08	33.9	28.4	-6	-924	-275	-2131	0	0	0	FALSE	TRUE
EQSpecY	3293	CORE P08	33.9	28.4	-6	-152	-417	-3236	0	0	0	FALSE	TRUE
Robustness X	3293	CORE P08	33.9	28.4	-6	408	59	-3216	0	0	0	FALSE	FALSE
Robustness Y	3293	CORE P08	33.9	28.4	-6	53	453	-8356	0	0	0	FALSE	FALSE
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0: RWDI_12	3293	CORE P08	33.9	28.4	-6	29	-426	11388	0	0	0	TRUE	FALSE
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0: RWDI_15	3293	CORE P08	33.9	28.4	-6	-133	-401	12722	0	0	0	TRUE	FALSE
0: RWDI_16	3293	CORE P08	33.9	28.4	-6	-58	-462	12841	0	0	0	TRUE	FALSE
0: RWDI_17	3293	CORE P08	33.9	28.4	-6	-35	264	-5707	0	0	0	TRUE	FALSE
0: RWDI_18	3293	CORE P08	33.9	28.4	-6	173	95	-5374	0	0	0	TRUE	FALSE
0: RWDI_19	3293	CORE P08	33.9	28.4	-6	-75	-22	2725	0	0	0	TRUE	FALSE
0: RWDI_20	3293	CORE P08	33.9	28.4	-6	127	-232	4263	0	0	0	TRUE	FALSE
0: RWDI_21	3293	CORE P08	33.9	28.4	-6	-173	207	-3407	0	0	0	TRUE	FALSE
0: RWDI_22	3293	CORE P08	33.9	28.4	-6	42	41	-3195	0	0	0	TRUE	FALSE
0: RWDI_23	3293	CORE P08	33.9	28.4	-6	-213	-80	5026	0	0	0	TRUE	FALSE
0: RWDI_24	3293	CORE P08	33.9	28.4	-6	-4	-287	6442	0	0	0	TRUE	FALSE
Total G (Wished-	3293	CORE P08	33.9	28.4	-6	-9	-44	-14703	0	0	0	FALSE	FALSE
EQSpecX	3266	CORE P14	19.0	25.1	-6	-769	-437	-3108	0	0	0	FALSE	TRUE
EQSpecY	3266	CORE P14	19.0	25.1	-6	-72	-491	-603	0	0	0	FALSE	TRUE
Robustness X	3266	CORE P14	19.0	25.1	-6	433	-72	4640	0	0	0	FALSE	FALSE
Robustness Y	3266	CORE P14	19.0	25.1	-6	-15	463	-2304	0	0	0	FALSE	FALSE
0: Total Q	3266	CORE P14	19.0	25.1	-6	-22	-13	-2909	0	0	0	FALSE	FALSE
0: RWDI_01	3266	CORE P14	19.0	25.1	-6	144	-11	2182	0	0	0	TRUE	FALSE
0: RWDI_02	3266	CORE P14	19.0	25.1	-6	178	81	2195	0	0	0	TRUE	FALSE
0: RWDI_03	3266	CORE P14	19.0	25.1	-6	162	-249	4471	0	0	0	TRUE	FALSE
0: RWDI_04	3266	CORE P14	19.0	25.1	-6	196	-157	4483	0	0	0	TRUE	FALSE
0: RWDI_05	3266	CORE P14	19.0	25.1	-6	-219	173	-5043	0	0	0	TRUE	FALSE
0: RWDI_06	3266	CORE P14	19.0	25.1	-6	-172	300	-5026	0	0	0	TRUE	FALSE
0: RWDI_07	3266	CORE P14	19.0	25.1	-6	-198	-105	-2374	0	0	0	TRUE	FALSE
0: RWDI_08	3266	CORE P14	19.0	25.1	-6	-150	22	-2357	0	0	0	TRUE	FALSE
0: RWDI_09	3266	CORE P14	19.0	25.1	-6	6	228	-2007	0	0	0	TRUE	FALSE
0: RWDI_10	3266	CORE P14	19.0	25.1	-6	48	341	-1992	0	0	0	TRUE	FALSE
0: RWDI_11	3266	CORE P14	19.0	25.1	-6	69	-464	4860	0	0	0	TRUE	FALSE
0: RWDI_12	3266	CORE P14	19.0	25.1	-6	106	-365	4873	0	0	0	TRUE	FALSE
0: RWDI_13	3266	CORE P14	19.0	25.1	-6	-147	300	-4989	0	0	0	TRUE	FALSE
0: RWDI_14	3266	CORE P14	19.0	25.1	-6	-105	413	-4974	0	0	0	TRUE	FALSE
0: RWDI_15	3266	CORE P14	19.0	25.1	-6	-40	-414	2755	0	0	0	TRUE	FALSE
0: RWDI_16	3266	CORE P14	19.0	25.1	-6	-3	-315	2768	0	0	0	TRUE	FALSE
0: RWDI_17	3266	CORE P14	19.0	25.1	-6	-8	-1	-491	0	0	0	TRUE	FALSE
0: RWDI_18	3266	CORE P14	19.0	25.1	-6	95	274	-454	0	0	0	TRUE	FALSE
0: RWDI_19	3266	CORE P14	19.0	25.1	-6	13	-279	2179	0	0	0	TRUE	FALSE
0: RWDI_20	3266	CORE P14	19.0	25.1	-6	119	-43	2597	0	0	0	TRUE	FALSE
0: RWDI_21	3266	CORE P14	19.0	25.1	-6	-180	79	-3824	0	0	0	TRUE	FALSE
0: RWDI_22	3266	CORE P14	19.0	25.1	-6	-68	351	-3612	0	0	0	TRUE	FALSE
0: RWDI_23	3266	CORE P14	19.0	25.1	-6	-158	-198	-1154	0	0	0	TRUE	FALSE
0: RWDI_24	3266	CORE P14	19.0	25.1	-6	-44	34	-561	0	0	0	TRUE	FALSE
Total G (Wished-	3266	CORE P14	19.0	25.1	-6	-84	-2	-14979	0	0	0	FALSE	FALSE
EQSpecX	3272	CORE P15	21.3	25.1	-6	-766	-348	-2426	0	0	0	FALSE	TRUE
EQSpecY	3272	CORE P15	21.3	25.1	-6	-74	-471	-780	0	0	0	FALSE	TRUE
Robustness X	3272	CORE P15	21.3	25.1	-6	428	-51	3499	0	0	0	FALSE	FALSE
Robustness Y	3272	CORE P15	21.3	25.1	-6	-5	472	-2641	0	0	0	FALSE	FALSE
0: Total Q	3272	CORE P15	21.3	25.1	-6	-23	-23	-2742	0	0	0	FALSE	FALSE
0: RWDI_01	3272	CORE P15	21.3	25.1	-6	144	23	1263	0	0	0	TRUE	FALSE
0: RWDI_02	3272	CORE P15	21.3	25.1	-6	178	96	1234	0	0	0	TRUE	FALSE
0: RWDI_03	3272	CORE P15	21.3	25.1	-6	155	-221	3749	0	0	0	TRUE	FALSE
0: RWDI_04	3272	CORE P15	21.3	25.1	-6	189	-148	3720	0	0	0	TRUE	FALSE
0: RWDI_05	3272	CORE P15	21.3	25.1	-6	-211	170	-4256	0	0	0	TRUE	FALSE
0: RWDI_06	3272	CORE P15	21.3	25.1	-6	-163	271	-4296	0	0	0	TRUE	FALSE
0: RWDI_07	3272	CORE P15	21.3	25.1	-6	-198	-116	-1356	0	0	0	TRUE	FALSE
0: RWDI_08	3272	CORE P15	21.3	25.1	-6	-150	-14	-1397	0	0	0	TRUE	FALSE
0: RWDI_09	3272	CORE P15	21.3	25.1	-6	15	256	-2507	0	0	0	TRUE	FALSE

0: RWDI_10	3272	CORE P15	21.3	25.1	-6	57	346	-2543	0	0	0	TRUE	FALSE
0: RWDI_11	3272	CORE P15	21.3	25.1	-6	55	-460	4942	0	0	0	TRUE	FALSE
0: RWDI_12	3272	CORE P15	21.3	25.1	-6	92	-381	4911	0	0	0	TRUE	FALSE
0: RWDI_13	3272	CORE P15	21.3	25.1	-6	-136	310	-4735	0	0	0	TRUE	FALSE
0: RWDI_14	3272	CORE P15	21.3	25.1	-6	-93	400	-4771	0	0	0	TRUE	FALSE
0: RWDI_15	3272	CORE P15	21.3	25.1	-6	-51	-422	3369	0	0	0	TRUE	FALSE
0: RWDI_16	3272	CORE P15	21.3	25.1	-6	-14	-343	3338	0	0	0	TRUE	FALSE
0: RWDI_17	3272	CORE P15	21.3	25.1	-6	-5	37	-828	0	0	0	TRUE	FALSE
0: RWDI_18	3272	CORE P15	21.3	25.1	-6	99	257	-915	0	0	0	TRUE	FALSE
0: RWDI_19	3272	CORE P15	21.3	25.1	-6	8	-248	2072	0	0	0	TRUE	FALSE
0: RWDI_20	3272	CORE P15	21.3	25.1	-6	114	-69	2399	0	0	0	TRUE	FALSE
0: RWDI_21	3272	CORE P15	21.3	25.1	-6	-173	97	-3318	0	0	0	TRUE	FALSE
0: RWDI_22	3272	CORE P15	21.3	25.1	-6	-60	313	-3275	0	0	0	TRUE	FALSE
0: RWDI_23	3272	CORE P15	21.3	25.1	-6	-160	-188	-419	0	0	0	TRUE	FALSE
0: RWDI_24	3272	CORE P15	21.3	25.1	-6	-46	-13	39	0	0	0	TRUE	FALSE
Total G (Wished-	3272	CORE P15	21.3	25.1	-6	-77	-28	-14319	0	0	0	FALSE	FALSE
EQSpecX	3311	CORE P19	33.9	25.1	-6	-758	-280	-1864	0	0	0	FALSE	TRUE
EQSpecY	3311	CORE P19	33.9	25.1	-6	-81	-424	-1081	0	0	0	FALSE	TRUE
Robustness X	3311	CORE P19	33.9	25.1	-6	422	61	-2754	0	0	0	FALSE	FALSE
Robustness Y	3311	CORE P19	33.9	25.1	-6	36	456	-3142	0	0	0	FALSE	FALSE
0: Total Q	3311	CORE P19	33.9	25.1	-6	-19	-24	-2531	0	0	0	FALSE	FALSE
0: RWDI_01	3311	CORE P19	33.9	25.1	-6	158	214	-3426	0	0	0	TRUE	FALSE
0: RWDI_02	3311	CORE P19	33.9	25.1	-6	191	156	-3356	0	0	0	TRUE	FALSE
0: RWDI_03	3311	CORE P19	33.9	25.1	-6	134	-33	-587	0	0	0	TRUE	FALSE
0: RWDI_04	3311	CORE P19	33.9	25.1	-6	168	-91	-517	0	0	0	TRUE	FALSE
0: RWDI_05	3311	CORE P19	33.9	25.1	-6	-182	147	126	0	0	0	TRUE	FALSE
0: RWDI_06	3311	CORE P19	33.9	25.1	-6	-137	67	222	0	0	0	TRUE	FALSE
0: RWDI_07	3311	CORE P19	33.9	25.1	-6	-210	-141	3438	0	0	0	TRUE	FALSE
0: RWDI_08	3311	CORE P19	33.9	25.1	-6	-164	-221	3535	0	0	0	TRUE	FALSE
0: RWDI_09	3311	CORE P19	33.9	25.1	-6	61	388	-4455	0	0	0	TRUE	FALSE
0: RWDI_10	3311	CORE P19	33.9	25.1	-6	101	317	-4370	0	0	0	TRUE	FALSE
0: RWDI_11	3311	CORE P19	33.9	25.1	-6	-3	-366	4078	0	0	0	TRUE	FALSE
0: RWDI_12	3311	CORE P19	33.9	25.1	-6	33	-428	4153	0	0	0	TRUE	FALSE
0: RWDI_13	3311	CORE P19	33.9	25.1	-6	-86	335	-2694	0	0	0	TRUE	FALSE
0: RWDI_14	3311	CORE P19	33.9	25.1	-6	-45	264	-2608	0	0	0	TRUE	FALSE
0: RWDI_15	3311	CORE P19	33.9	25.1	-6	-107	-403	5321	0	0	0	TRUE	FALSE
0: RWDI_16	3311	CORE P19	33.9	25.1	-6	-71	-466	5396	0	0	0	TRUE	FALSE
0: RWDI_17	3311	CORE P19	33.9	25.1	-6	19	268	-2616	0	0	0	TRUE	FALSE
0: RWDI_18	3311	CORE P19	33.9	25.1	-6	119	94	-2407	0	0	0	TRUE	FALSE
0: RWDI_19	3311	CORE P19	33.9	25.1	-6	-8	-20	696	0	0	0	TRUE	FALSE
0: RWDI_20	3311	CORE P19	33.9	25.1	-6	87	-235	1378	0	0	0	TRUE	FALSE
0: RWDI_21	3311	CORE P19	33.9	25.1	-6	-145	208	-647	0	0	0	TRUE	FALSE
0: RWDI_22	3311	CORE P19	33.9	25.1	-6	-37	38	-542	0	0	0	TRUE	FALSE
0: RWDI_23	3311	CORE P19	33.9	25.1	-6	-173	-80	2665	0	0	0	TRUE	FALSE
0: RWDI_24	3311	CORE P19	33.9	25.1	-6	-69	-291	3243	0	0	0	TRUE	FALSE
Total G (Wished-	3311	CORE P19	33.9	25.1	-6	-13	-41	-12978	0	0	0	FALSE	FALSE
EQSpecX	10345	CORE P17	27.6	25.1	-6	-760	-38	-294	0	0	0	FALSE	TRUE
EQSpecY	10345	CORE P17	27.6	25.1	-6	-77	-356	-991	0	0	0	FALSE	TRUE
Robustness X	10345	CORE P17	27.6	25.1	-6	419	8	236	0	0	0	FALSE	FALSE
Robustness Y	10345	CORE P17	27.6	25.1	-6	16	471	-3056	0	0	0	FALSE	FALSE
0: Total Q	10345	CORE P17	27.6	25.1	-6	-20	-30	-2601	0	0	0	FALSE	FALSE
0: RWDI_01	10345	CORE P17	27.6	25.1	-6	146	124	-1244	0	0	0	TRUE	FALSE
0: RWDI_02	10345	CORE P17	27.6	25.1	-6	181	131	-1217	0	0	0	TRUE	FALSE
0: RWDI_03	10345	CORE P17	27.6	25.1	-6	139	-129	1546	0	0	0	TRUE	FALSE
0: RWDI_04	10345	CORE P17	27.6	25.1	-6	173	-121	1573	0	0	0	TRUE	FALSE
0: RWDI_05	10345	CORE P17	27.6	25.1	-6	-191	161	-2054	0	0	0	TRUE	FALSE
0: RWDI_06	10345	CORE P17	27.6	25.1	-6	-143	171	-2017	0	0	0	TRUE	FALSE
0: RWDI_07	10345	CORE P17	27.6	25.1	-6	-200	-134	1200	0	0	0	TRUE	FALSE
0: RWDI_08	10345	CORE P17	27.6	25.1	-6	-152	-123	1237	0	0	0	TRUE	FALSE
0: RWDI_09	10345	CORE P17	27.6	25.1	-6	37	332	-3685	0	0	0	TRUE	FALSE
0: RWDI_10	10345	CORE P17	27.6	25.1	-6	80	341	-3653	0	0	0	TRUE	FALSE
0: RWDI_11	10345	CORE P17	27.6	25.1	-6	22	-424	4689	0	0	0	TRUE	FALSE
0: RWDI_12	10345	CORE P17	27.6	25.1	-6	59	-416	4718	0	0	0	TRUE	FALSE
0: RWDI_13	10345	CORE P17	27.6	25.1	-6	-107	330	-3834	0	0	0	TRUE	FALSE
0: RWDI_14	10345	CORE P17	27.6	25.1	-6	-64	340	-3801	0	0	0	TRUE	FALSE
0: RWDI_15	10345	CORE P17	27.6	25.1	-6	-80	-425	4584	0	0	0	TRUE	FALSE
0: RWDI_16	10345	CORE P17	27.6	25.1	-6	-43	-417	4613	0	0	0	TRUE	FALSE
0: RWDI_17	10345	CORE P17	27.6	25.1	-6	6	158	-1846	0	0	0	TRUE	FALSE
0: RWDI_18	10345	CORE P17	27.6	25.1	-6	109	181	-1766	0	0	0	TRUE	FALSE

0: RWDI_19	10345	CORE P17	27.6	25.1	-6	-3	-137	1408	0	0	0	TRUE	FALSE
0: RWDI_20	10345	CORE P17	27.6	25.1	-6	99	-156	1953	0	0	0	TRUE	FALSE
0: RWDI_21	10345	CORE P17	27.6	25.1	-6	-155	156	-2012	0	0	0	TRUE	FALSE
0: RWDI_22	10345	CORE P17	27.6	25.1	-6	-44	179	-1923	0	0	0	TRUE	FALSE
0: RWDI_23	10345	CORE P17	27.6	25.1	-6	-164	-139	1243	0	0	0	TRUE	FALSE
0: RWDI_24	10345	CORE P17	27.6	25.1	-6	-54	-157	1796	0	0	0	TRUE	FALSE
Total G (Wished-	10345	CORE P17	27.6	25.1	-6	-40	-43	-13745	0	0	0	FALSE	FALSE
EQSpecX	3275	CORE P26	21.3	20.8	-6	-622	-361	-3196	0	0	0	FALSE	TRUE
EQSpecY	3275	CORE P26	21.3	20.8	-6	-32	-486	-866	0	0	0	FALSE	TRUE
Robustness X	3275	CORE P26	21.3	20.8	-6	447	-55	4144	0	0	0	FALSE	FALSE
Robustness Y	3275	CORE P26	21.3	20.8	-6	12	482	1992	0	0	0	FALSE	FALSE
0: Total Q	3275	CORE P26	21.3	20.8	-6	-24	-21	-3583	0	0	0	FALSE	FALSE
0: RWDI_01	3275	CORE P26	21.3	20.8	-6	207	20	4064	0	0	0	TRUE	FALSE
0: RWDI_02	3275	CORE P26	21.3	20.8	-6	197	97	3796	0	0	0	TRUE	FALSE
0: RWDI_03	3275	CORE P26	21.3	20.8	-6	197	-228	2097	0	0	0	TRUE	FALSE
0: RWDI_04	3275	CORE P26	21.3	20.8	-6	187	-152	1829	0	0	0	TRUE	FALSE
0: RWDI_05	3275	CORE P26	21.3	20.8	-6	-193	173	-1574	0	0	0	TRUE	FALSE
0: RWDI_06	3275	CORE P26	21.3	20.8	-6	-207	279	-1944	0	0	0	TRUE	FALSE
0: RWDI_07	3275	CORE P26	21.3	20.8	-6	-205	-117	-3868	0	0	0	TRUE	FALSE
0: RWDI_08	3275	CORE P26	21.3	20.8	-6	-219	-11	-4239	0	0	0	TRUE	FALSE
0: RWDI_09	3275	CORE P26	21.3	20.8	-6	83	259	3735	0	0	0	TRUE	FALSE
0: RWDI_10	3275	CORE P26	21.3	20.8	-6	71	353	3406	0	0	0	TRUE	FALSE
0: RWDI_11	3275	CORE P26	21.3	20.8	-6	50	-470	-2227	0	0	0	TRUE	FALSE
0: RWDI_12	3275	CORE P26	21.3	20.8	-6	39	-387	-2515	0	0	0	TRUE	FALSE
0: RWDI_13	3275	CORE P26	21.3	20.8	-6	-93	315	1108	0	0	0	TRUE	FALSE
0: RWDI_14	3275	CORE P26	21.3	20.8	-6	-106	409	778	0	0	0	TRUE	FALSE
0: RWDI_15	3275	CORE P26	21.3	20.8	-6	-75	-430	-4082	0	0	0	TRUE	FALSE
0: RWDI_16	3275	CORE P26	21.3	20.8	-6	-85	-348	-4370	0	0	0	TRUE	FALSE
0: RWDI_17	3275	CORE P26	21.3	20.8	-6	84	34	2629	0	0	0	TRUE	FALSE
0: RWDI_18	3275	CORE P26	21.3	20.8	-6	54	264	1827	0	0	0	TRUE	FALSE
0: RWDI_19	3275	CORE P26	21.3	20.8	-6	72	-256	335	0	0	0	TRUE	FALSE
0: RWDI_20	3275	CORE P26	21.3	20.8	-6	40	-68	-796	0	0	0	TRUE	FALSE
0: RWDI_21	3275	CORE P26	21.3	20.8	-6	-113	97	-307	0	0	0	TRUE	FALSE
0: RWDI_22	3275	CORE P26	21.3	20.8	-6	-133	324	-955	0	0	0	TRUE	FALSE
0: RWDI_23	3275	CORE P26	21.3	20.8	-6	-125	-194	-2601	0	0	0	TRUE	FALSE
0: RWDI_24	3275	CORE P26	21.3	20.8	-6	-146	-8	-3577	0	0	0	TRUE	FALSE
Total G (Wished-	3275	CORE P26	21.3	20.8	-6	-62	-18	-14111	0	0	0	FALSE	FALSE
EQSpecX	3602	CORE P30	33.9	20.8	-6	-613	-293	-2310	0	0	0	FALSE	TRUE
EQSpecY	3602	CORE P30	33.9	20.8	-6	-34	-436	-774	0	0	0	FALSE	TRUE
Robustness X	3602	CORE P30	33.9	20.8	-6	441	70	-2893	0	0	0	FALSE	FALSE
Robustness Y	3602	CORE P30	33.9	20.8	-6	14	466	1847	0	0	0	FALSE	FALSE
0: Total Q	3602	CORE P30	33.9	20.8	-6	-14	-18	-3146	0	0	0	FALSE	FALSE
0: RWDI_01	3602	CORE P30	33.9	20.8	-6	205	225	-1278	0	0	0	TRUE	FALSE
0: RWDI_02	3602	CORE P30	33.9	20.8	-6	194	164	-1055	0	0	0	TRUE	FALSE
0: RWDI_03	3602	CORE P30	33.9	20.8	-6	195	-28	-3062	0	0	0	TRUE	FALSE
0: RWDI_04	3602	CORE P30	33.9	20.8	-6	184	-89	-2840	0	0	0	TRUE	FALSE
0: RWDI_05	3602	CORE P30	33.9	20.8	-6	-189	147	3177	0	0	0	TRUE	FALSE
0: RWDI_06	3602	CORE P30	33.9	20.8	-6	-204	62	3485	0	0	0	TRUE	FALSE
0: RWDI_07	3602	CORE P30	33.9	20.8	-6	-201	-148	1095	0	0	0	TRUE	FALSE
0: RWDI_08	3602	CORE P30	33.9	20.8	-6	-216	-233	1403	0	0	0	TRUE	FALSE
0: RWDI_09	3602	CORE P30	33.9	20.8	-6	82	400	1578	0	0	0	TRUE	FALSE
0: RWDI_10	3602	CORE P30	33.9	20.8	-6	69	325	1852	0	0	0	TRUE	FALSE
0: RWDI_11	3602	CORE P30	33.9	20.8	-6	49	-373	-3724	0	0	0	TRUE	FALSE
0: RWDI_12	3602	CORE P30	33.9	20.8	-6	38	-439	-3485	0	0	0	TRUE	FALSE
0: RWDI_13	3602	CORE P30	33.9	20.8	-6	-92	342	3413	0	0	0	TRUE	FALSE
0: RWDI_14	3602	CORE P30	33.9	20.8	-6	-105	266	3686	0	0	0	TRUE	FALSE
0: RWDI_15	3602	CORE P30	33.9	20.8	-6	-73	-414	-2430	0	0	0	TRUE	FALSE
0: RWDI_16	3602	CORE P30	33.9	20.8	-6	-84	-480	-2190	0	0	0	TRUE	FALSE
0: RWDI_17	3602	CORE P30	33.9	20.8	-6	83	279	217	0	0	0	TRUE	FALSE
0: RWDI_18	3602	CORE P30	33.9	20.8	-6	52	95	884	0	0	0	TRUE	FALSE
0: RWDI_19	3602	CORE P30	33.9	20.8	-6	72	-16	-1865	0	0	0	TRUE	FALSE
0: RWDI_20	3602	CORE P30	33.9	20.8	-6	38	-242	-1495	0	0	0	TRUE	FALSE
0: RWDI_21	3602	CORE P30	33.9	20.8	-6	-111	213	2268	0	0	0	TRUE	FALSE
0: RWDI_22	3602	CORE P30	33.9	20.8	-6	-132	33	2827	0	0	0	TRUE	FALSE
0: RWDI_23	3602	CORE P30	33.9	20.8	-6	-122	-82	186	0	0	0	TRUE	FALSE
0: RWDI_24	3602	CORE P30	33.9	20.8	-6	-145	-304	447	0	0	0	TRUE	FALSE
Total G (Wished-	3602	CORE P30	33.9	20.8	-6	-17	-15	-11994	0	0	0	FALSE	FALSE
EQSpecX	10519	CORE P28	27.6	20.8	-6	-619	-35	-209	0	0	0	FALSE	TRUE
EQSpecY	10519	CORE P28	27.6	20.8	-6	-33	-354	-454	0	0	0	FALSE	TRUE

Robustness X	10519	CORE P28	27.6	20.8	-6	444	7	298	0	0	0	FALSE	FALSE
Robustness Y	10519	CORE P28	27.6	20.8	-6	12	470	1822	0	0	0	FALSE	FALSE
0: Total Q	10519	CORE P28	27.6	20.8	-6	-19	-25	-3349	0	0	0	FALSE	FALSE
0: RWDI_01	10519	CORE P28	27.6	20.8	-6	205	124	1122	0	0	0	TRUE	FALSE
0: RWDI_02	10519	CORE P28	27.6	20.8	-6	195	131	1132	0	0	0	TRUE	FALSE
0: RWDI_03	10519	CORE P28	27.6	20.8	-6	195	-129	-708	0	0	0	TRUE	FALSE
0: RWDI_04	10519	CORE P28	27.6	20.8	-6	185	-122	-698	0	0	0	TRUE	FALSE
0: RWDI_05	10519	CORE P28	27.6	20.8	-6	-190	161	989	0	0	0	TRUE	FALSE
0: RWDI_06	10519	CORE P28	27.6	20.8	-6	-205	172	1002	0	0	0	TRUE	FALSE
0: RWDI_07	10519	CORE P28	27.6	20.8	-6	-202	-133	-1146	0	0	0	TRUE	FALSE
0: RWDI_08	10519	CORE P28	27.6	20.8	-6	-216	-123	-1132	0	0	0	TRUE	FALSE
0: RWDI_09	10519	CORE P28	27.6	20.8	-6	82	332	2500	0	0	0	TRUE	FALSE
0: RWDI_10	10519	CORE P28	27.6	20.8	-6	70	341	2512	0	0	0	TRUE	FALSE
0: RWDI_11	10519	CORE P28	27.6	20.8	-6	49	-424	-2987	0	0	0	TRUE	FALSE
0: RWDI_12	10519	CORE P28	27.6	20.8	-6	38	-416	-2976	0	0	0	TRUE	FALSE
0: RWDI_13	10519	CORE P28	27.6	20.8	-6	-92	331	2310	0	0	0	TRUE	FALSE
0: RWDI_14	10519	CORE P28	27.6	20.8	-6	-105	340	2322	0	0	0	TRUE	FALSE
0: RWDI_15	10519	CORE P28	27.6	20.8	-6	-74	-425	-3121	0	0	0	TRUE	FALSE
0: RWDI_16	10519	CORE P28	27.6	20.8	-6	-85	-417	-3110	0	0	0	TRUE	FALSE
0: RWDI_17	10519	CORE P28	27.6	20.8	-6	83	158	1272	0	0	0	TRUE	FALSE
0: RWDI_18	10519	CORE P28	27.6	20.8	-6	53	180	1302	0	0	0	TRUE	FALSE
0: RWDI_19	10519	CORE P28	27.6	20.8	-6	71	-137	-862	0	0	0	TRUE	FALSE
0: RWDI_20	10519	CORE P28	27.6	20.8	-6	39	-157	-1138	0	0	0	TRUE	FALSE
0: RWDI_21	10519	CORE P28	27.6	20.8	-6	-112	157	1060	0	0	0	TRUE	FALSE
0: RWDI_22	10519	CORE P28	27.6	20.8	-6	-132	179	1101	0	0	0	TRUE	FALSE
0: RWDI_23	10519	CORE P28	27.6	20.8	-6	-123	-138	-1074	0	0	0	TRUE	FALSE
0: RWDI_24	10519	CORE P28	27.6	20.8	-6	-146	-158	-1339	0	0	0	TRUE	FALSE
Total G (Wished-	10519	CORE P28	27.6	20.8	-6	-38	-27	-13088	0	0	0	FALSE	FALSE
EQSpecX	3283	CORE P31	21.3	17.6	-6	-640	-366	-3729	0	0	0	FALSE	TRUE
EQSpecY	3283	CORE P31	21.3	17.6	-6	-95	-484	-2408	0	0	0	FALSE	TRUE
Robustness X	3283	CORE P31	21.3	17.6	-6	472	-50	4620	0	0	0	FALSE	FALSE
Robustness Y	3283	CORE P31	21.3	17.6	-6	21	483	6376	0	0	0	FALSE	FALSE
0: Total Q	3283	CORE P31	21.3	17.6	-6	-25	-26	-4404	0	0	0	FALSE	FALSE
0: RWDI_01	3283	CORE P31	21.3	17.6	-6	263	25	6393	0	0	0	TRUE	FALSE
0: RWDI_02	3283	CORE P31	21.3	17.6	-6	216	102	6006	0	0	0	TRUE	FALSE
0: RWDI_03	3283	CORE P31	21.3	17.6	-6	238	-226	535	0	0	0	TRUE	FALSE
0: RWDI_04	3283	CORE P31	21.3	17.6	-6	191	-149	148	0	0	0	TRUE	FALSE
0: RWDI_05	3283	CORE P31	21.3	17.6	-6	-184	170	776	0	0	0	TRUE	FALSE
0: RWDI_06	3283	CORE P31	21.3	17.6	-6	-249	277	241	0	0	0	TRUE	FALSE
0: RWDI_07	3283	CORE P31	21.3	17.6	-6	-214	-123	-6058	0	0	0	TRUE	FALSE
0: RWDI_08	3283	CORE P31	21.3	17.6	-6	-278	-16	-6594	0	0	0	TRUE	FALSE
0: RWDI_09	3283	CORE P31	21.3	17.6	-6	137	263	9106	0	0	0	TRUE	FALSE
0: RWDI_10	3283	CORE P31	21.3	17.6	-6	80	358	8631	0	0	0	TRUE	FALSE
0: RWDI_11	3283	CORE P31	21.3	17.6	-6	50	-473	-8557	0	0	0	TRUE	FALSE
0: RWDI_12	3283	CORE P31	21.3	17.6	-6	0	-389	-8973	0	0	0	TRUE	FALSE
0: RWDI_13	3283	CORE P31	21.3	17.6	-6	-64	315	6194	0	0	0	TRUE	FALSE
0: RWDI_14	3283	CORE P31	21.3	17.6	-6	-122	410	5718	0	0	0	TRUE	FALSE
0: RWDI_15	3283	CORE P31	21.3	17.6	-6	-92	-436	-10613	0	0	0	TRUE	FALSE
0: RWDI_16	3283	CORE P31	21.3	17.6	-6	-142	-352	-11029	0	0	0	TRUE	FALSE
0: RWDI_17	3283	CORE P31	21.3	17.6	-6	156	36	5499	0	0	0	TRUE	FALSE
0: RWDI_18	3283	CORE P31	21.3	17.6	-6	16	268	4338	0	0	0	TRUE	FALSE
0: RWDI_19	3283	CORE P31	21.3	17.6	-6	127	-257	-1336	0	0	0	TRUE	FALSE
0: RWDI_20	3283	CORE P31	21.3	17.6	-6	-18	-67	-3472	0	0	0	TRUE	FALSE
0: RWDI_21	3283	CORE P31	21.3	17.6	-6	-69	94	2243	0	0	0	TRUE	FALSE
0: RWDI_22	3283	CORE P31	21.3	17.6	-6	-197	324	1254	0	0	0	TRUE	FALSE
0: RWDI_23	3283	CORE P31	21.3	17.6	-6	-98	-199	-4591	0	0	0	TRUE	FALSE
0: RWDI_24	3283	CORE P31	21.3	17.6	-6	-231	-11	-6556	0	0	0	TRUE	FALSE
Total G (Wished-	3283	CORE P31	21.3	17.6	-6	-60	-36	-14651	0	0	0	FALSE	FALSE
EQSpecX	3616	CORE P35	33.9	17.6	-6	-640	-298	-3017	0	0	0	FALSE	TRUE
EQSpecY	3616	CORE P35	33.9	17.6	-6	-94	-434	-2365	0	0	0	FALSE	TRUE
Robustness X	3616	CORE P35	33.9	17.6	-6	473	68	-3411	0	0	0	FALSE	FALSE
Robustness Y	3616	CORE P35	33.9	17.6	-6	-2	467	6147	0	0	0	FALSE	FALSE
0: Total Q	3616	CORE P35	33.9	17.6	-6	-6	-20	-4007	0	0	0	FALSE	FALSE
0: RWDI_01	3616	CORE P35	33.9	17.6	-6	252	226	203	0	0	0	TRUE	FALSE
0: RWDI_02	3616	CORE P35	33.9	17.6	-6	205	163	555	0	0	0	TRUE	FALSE
0: RWDI_03	3616	CORE P35	33.9	17.6	-6	252	-30	-5374	0	0	0	TRUE	FALSE
0: RWDI_04	3616	CORE P35	33.9	17.6	-6	205	-92	-5022	0	0	0	TRUE	FALSE
0: RWDI_05	3616	CORE P35	33.9	17.6	-6	-203	151	5969	0	0	0	TRUE	FALSE
0: RWDI_06	3616	CORE P35	33.9	17.6	-6	-268	65	6457	0	0	0	TRUE	FALSE

0: RWDI_07	3616	CORE P35	33.9	17.6	-6	-203	-148	-538	0	0	0	TRUE	FALSE
0: RWDI_08	3616	CORE P35	33.9	17.6	-6	-268	-234	-50	0	0	0	TRUE	FALSE
0: RWDI_09	3616	CORE P35	33.9	17.6	-6	104	404	6436	0	0	0	TRUE	FALSE
0: RWDI_10	3616	CORE P35	33.9	17.6	-6	46	328	6870	0	0	0	TRUE	FALSE
0: RWDI_11	3616	CORE P35	33.9	17.6	-6	93	-377	-10215	0	0	0	TRUE	FALSE
0: RWDI_12	3616	CORE P35	33.9	17.6	-6	43	-444	-9836	0	0	0	TRUE	FALSE
0: RWDI_13	3616	CORE P35	33.9	17.6	-6	-99	347	8580	0	0	0	TRUE	FALSE
0: RWDI_14	3616	CORE P35	33.9	17.6	-6	-157	270	9013	0	0	0	TRUE	FALSE
0: RWDI_15	3616	CORE P35	33.9	17.6	-6	-50	-418	-8702	0	0	0	TRUE	FALSE
0: RWDI_16	3616	CORE P35	33.9	17.6	-6	-100	-485	-8323	0	0	0	TRUE	FALSE
0: RWDI_17	3616	CORE P35	33.9	17.6	-6	140	282	2447	0	0	0	TRUE	FALSE
0: RWDI_18	3616	CORE P35	33.9	17.6	-6	-1	95	3503	0	0	0	TRUE	FALSE
0: RWDI_19	3616	CORE P35	33.9	17.6	-6	140	-17	-4060	0	0	0	TRUE	FALSE
0: RWDI_20	3616	CORE P35	33.9	17.6	-6	-1	-246	-3933	0	0	0	TRUE	FALSE
0: RWDI_21	3616	CORE P35	33.9	17.6	-6	-87	217	4843	0	0	0	TRUE	FALSE
0: RWDI_22	3616	CORE P35	33.9	17.6	-6	-216	34	5773	0	0	0	TRUE	FALSE
0: RWDI_23	3616	CORE P35	33.9	17.6	-6	-86	-81	-1664	0	0	0	TRUE	FALSE
0: RWDI_24	3616	CORE P35	33.9	17.6	-6	-215	-307	-1664	0	0	0	TRUE	FALSE
Total G (Wished-	3616	CORE P35	33.9	17.6	-6	3	-21	-12843	0	0	0	FALSE	FALSE
EQSpecX	3594	CORE P33	27.6	17.6	-6	-639	-34	-183	0	0	0	FALSE	TRUE
EQSpecY	3594	CORE P33	27.6	17.6	-6	-93	-348	-1869	0	0	0	FALSE	TRUE
Robustness X	3594	CORE P33	27.6	17.6	-6	469	7	358	0	0	0	FALSE	FALSE
Robustness Y	3594	CORE P33	27.6	17.6	-6	9	463	6448	0	0	0	FALSE	FALSE
0: Total Q	3594	CORE P33	27.6	17.6	-6	-16	-22	-4300	0	0	0	FALSE	FALSE
0: RWDI_01	3594	CORE P33	27.6	17.6	-6	254	122	3221	0	0	0	TRUE	FALSE
0: RWDI_02	3594	CORE P33	27.6	17.6	-6	208	129	3233	0	0	0	TRUE	FALSE
0: RWDI_03	3594	CORE P33	27.6	17.6	-6	242	-126	-2723	0	0	0	TRUE	FALSE
0: RWDI_04	3594	CORE P33	27.6	17.6	-6	196	-119	-2711	0	0	0	TRUE	FALSE
0: RWDI_05	3594	CORE P33	27.6	17.6	-6	-191	158	3685	0	0	0	TRUE	FALSE
0: RWDI_06	3594	CORE P33	27.6	17.6	-6	-255	168	3701	0	0	0	TRUE	FALSE
0: RWDI_07	3594	CORE P33	27.6	17.6	-6	-206	-131	-3250	0	0	0	TRUE	FALSE
0: RWDI_08	3594	CORE P33	27.6	17.6	-6	-269	-121	-3234	0	0	0	TRUE	FALSE
0: RWDI_09	3594	CORE P33	27.6	17.6	-6	119	326	7998	0	0	0	TRUE	FALSE
0: RWDI_10	3594	CORE P33	27.6	17.6	-6	62	335	8012	0	0	0	TRUE	FALSE
0: RWDI_11	3594	CORE P33	27.6	17.6	-6	72	-416	-9831	0	0	0	TRUE	FALSE
0: RWDI_12	3594	CORE P33	27.6	17.6	-6	22	-408	-9819	0	0	0	TRUE	FALSE
0: RWDI_13	3594	CORE P33	27.6	17.6	-6	-81	325	7769	0	0	0	TRUE	FALSE
0: RWDI_14	3594	CORE P33	27.6	17.6	-6	-138	334	7784	0	0	0	TRUE	FALSE
0: RWDI_15	3594	CORE P33	27.6	17.6	-6	-69	-417	-9993	0	0	0	TRUE	FALSE
0: RWDI_16	3594	CORE P33	27.6	17.6	-6	-119	-409	-9980	0	0	0	TRUE	FALSE
0: RWDI_17	3594	CORE P33	27.6	17.6	-6	146	155	4026	0	0	0	TRUE	FALSE
0: RWDI_18	3594	CORE P33	27.6	17.6	-6	8	177	4061	0	0	0	TRUE	FALSE
0: RWDI_19	3594	CORE P33	27.6	17.6	-6	132	-134	-2908	0	0	0	TRUE	FALSE
0: RWDI_20	3594	CORE P33	27.6	17.6	-6	-9	-154	-3864	0	0	0	TRUE	FALSE
0: RWDI_21	3594	CORE P33	27.6	17.6	-6	-77	154	3771	0	0	0	TRUE	FALSE
0: RWDI_22	3594	CORE P33	27.6	17.6	-6	-204	175	3819	0	0	0	TRUE	FALSE
0: RWDI_23	3594	CORE P33	27.6	17.6	-6	-91	-135	-3164	0	0	0	TRUE	FALSE
0: RWDI_24	3594	CORE P33	27.6	17.6	-6	-220	-155	-4106	0	0	0	TRUE	FALSE
Total G (Wished-	3594	CORE P33	27.6	17.6	-6	-30	-18	-14015	0	0	0	FALSE	FALSE
EQSpecX	3295	CORE P36	21.3	14.5	-6	-677	-365	-3698	0	0	0	FALSE	TRUE
EQSpecY	3295	CORE P36	21.3	14.5	-6	-160	-481	-4503	0	0	0	FALSE	TRUE
Robustness X	3295	CORE P36	21.3	14.5	-6	497	-43	4648	0	0	0	FALSE	FALSE
Robustness Y	3295	CORE P36	21.3	14.5	-6	18	488	11249	0	0	0	FALSE	FALSE
0: Total Q	3295	CORE P36	21.3	14.5	-6	-21	-32	-4912	0	0	0	FALSE	FALSE
0: RWDI_01	3295	CORE P36	21.3	14.5	-6	313	33	8373	0	0	0	TRUE	FALSE
0: RWDI_02	3295	CORE P36	21.3	14.5	-6	230	110	8002	0	0	0	TRUE	FALSE
0: RWDI_03	3295	CORE P36	21.3	14.5	-6	285	-224	-1458	0	0	0	TRUE	FALSE
0: RWDI_04	3295	CORE P36	21.3	14.5	-6	202	-148	-1829	0	0	0	TRUE	FALSE
0: RWDI_05	3295	CORE P36	21.3	14.5	-6	-185	170	3410	0	0	0	TRUE	FALSE
0: RWDI_06	3295	CORE P36	21.3	14.5	-6	-300	276	2896	0	0	0	TRUE	FALSE
0: RWDI_07	3295	CORE P36	21.3	14.5	-6	-218	-131	-8059	0	0	0	TRUE	FALSE
0: RWDI_08	3295	CORE P36	21.3	14.5	-6	-333	-25	-8573	0	0	0	TRUE	FALSE
0: RWDI_09	3295	CORE P36	21.3	14.5	-6	175	273	14394	0	0	0	TRUE	FALSE
0: RWDI_10	3295	CORE P36	21.3	14.5	-6	73	368	13937	0	0	0	TRUE	FALSE
0: RWDI_11	3295	CORE P36	21.3	14.5	-6	72	-482	-15185	0	0	0	TRUE	FALSE
0: RWDI_12	3295	CORE P36	21.3	14.5	-6	-18	-399	-15585	0	0	0	TRUE	FALSE
0: RWDI_13	3295	CORE P36	21.3	14.5	-6	-52	322	11479	0	0	0	TRUE	FALSE
0: RWDI_14	3295	CORE P36	21.3	14.5	-6	-155	416	11022	0	0	0	TRUE	FALSE
0: RWDI_15	3295	CORE P36	21.3	14.5	-6	-89	-448	-17243	0	0	0	TRUE	FALSE

0: RWDI_16	3295	CORE P36	21.3	14.5	-6	-178	-365	-17643	0	0	0	TRUE	FALSE
0: RWDI_17	3295	CORE P36	21.3	14.5	-6	221	43	8126	0	0	0	TRUE	FALSE
0: RWDI_18	3295	CORE P36	21.3	14.5	-6	-29	273	7011	0	0	0	TRUE	FALSE
0: RWDI_19	3295	CORE P36	21.3	14.5	-6	188	-258	-3344	0	0	0	TRUE	FALSE
0: RWDI_20	3295	CORE P36	21.3	14.5	-6	-67	-71	-6097	0	0	0	TRUE	FALSE
0: RWDI_21	3295	CORE P36	21.3	14.5	-6	-34	97	4868	0	0	0	TRUE	FALSE
0: RWDI_22	3295	CORE P36	21.3	14.5	-6	-270	324	3925	0	0	0	TRUE	FALSE
0: RWDI_23	3295	CORE P36	21.3	14.5	-6	-66	-204	-6602	0	0	0	TRUE	FALSE
0: RWDI_24	3295	CORE P36	21.3	14.5	-6	-307	-20	-9183	0	0	0	TRUE	FALSE
Total G (Wished-	3295	CORE P36	21.3	14.5	-6	-44	-53	-14291	0	0	0	FALSE	FALSE
EQSpecX	3635	CORE P40	33.9	14.5	-6	-678	-298	-3246	0	0	0	FALSE	TRUE
EQSpecY	3635	CORE P40	33.9	14.5	-6	-159	-430	-4471	0	0	0	FALSE	TRUE
Robustness X	3635	CORE P40	33.9	14.5	-6	500	61	-3477	0	0	0	FALSE	FALSE
Robustness Y	3635	CORE P40	33.9	14.5	-6	-9	471	10909	0	0	0	FALSE	FALSE
0: Total Q	3635	CORE P40	33.9	14.5	-6	-5	-25	-4584	0	0	0	FALSE	FALSE
0: RWDI_01	3635	CORE P40	33.9	14.5	-6	300	224	2109	0	0	0	TRUE	FALSE
0: RWDI_02	3635	CORE P40	33.9	14.5	-6	217	162	2491	0	0	0	TRUE	FALSE
0: RWDI_03	3635	CORE P40	33.9	14.5	-6	302	-38	-7373	0	0	0	TRUE	FALSE
0: RWDI_04	3635	CORE P40	33.9	14.5	-6	219	-99	-6990	0	0	0	TRUE	FALSE
0: RWDI_05	3635	CORE P40	33.9	14.5	-6	-207	158	8580	0	0	0	TRUE	FALSE
0: RWDI_06	3635	CORE P40	33.9	14.5	-6	-322	73	9110	0	0	0	TRUE	FALSE
0: RWDI_07	3635	CORE P40	33.9	14.5	-6	-205	-146	-2481	0	0	0	TRUE	FALSE
0: RWDI_08	3635	CORE P40	33.9	14.5	-6	-320	-232	-1951	0	0	0	TRUE	FALSE
0: RWDI_09	3635	CORE P40	33.9	14.5	-6	136	410	11611	0	0	0	TRUE	FALSE
0: RWDI_10	3635	CORE P40	33.9	14.5	-6	34	334	12082	0	0	0	TRUE	FALSE
0: RWDI_11	3635	CORE P40	33.9	14.5	-6	122	-388	-16745	0	0	0	TRUE	FALSE
0: RWDI_12	3635	CORE P40	33.9	14.5	-6	32	-455	-16333	0	0	0	TRUE	FALSE
0: RWDI_13	3635	CORE P40	33.9	14.5	-6	-93	356	13782	0	0	0	TRUE	FALSE
0: RWDI_14	3635	CORE P40	33.9	14.5	-6	-195	281	14252	0	0	0	TRUE	FALSE
0: RWDI_15	3635	CORE P40	33.9	14.5	-6	-40	-426	-15213	0	0	0	TRUE	FALSE
0: RWDI_16	3635	CORE P40	33.9	14.5	-6	-129	-492	-14801	0	0	0	TRUE	FALSE
0: RWDI_17	3635	CORE P40	33.9	14.5	-6	201	283	4996	0	0	0	TRUE	FALSE
0: RWDI_18	3635	CORE P40	33.9	14.5	-6	-48	99	6143	0	0	0	TRUE	FALSE
0: RWDI_19	3635	CORE P40	33.9	14.5	-6	203	-22	-6066	0	0	0	TRUE	FALSE
0: RWDI_20	3635	CORE P40	33.9	14.5	-6	-46	-250	-6499	0	0	0	TRUE	FALSE
0: RWDI_21	3635	CORE P40	33.9	14.5	-6	-55	223	7422	0	0	0	TRUE	FALSE
0: RWDI_22	3635	CORE P40	33.9	14.5	-6	-291	42	8442	0	0	0	TRUE	FALSE
0: RWDI_23	3635	CORE P40	33.9	14.5	-6	-53	-82	-3640	0	0	0	TRUE	FALSE
0: RWDI_24	3635	CORE P40	33.9	14.5	-6	-289	-307	-4200	0	0	0	TRUE	FALSE
Total G (Wished-	3635	CORE P40	33.9	14.5	-6	-1	-37	-12847	0	0	0	FALSE	FALSE
EQSpecX	10513	CORE P38	27.6	14.5	-6	-681	-34	-211	0	0	0	FALSE	TRUE
EQSpecY	10513	CORE P38	27.6	14.5	-6	-160	-347	-4167	0	0	0	FALSE	TRUE
Robustness X	10513	CORE P38	27.6	14.5	-6	500	8	432	0	0	0	FALSE	FALSE
Robustness Y	10513	CORE P38	27.6	14.5	-6	4	463	11831	0	0	0	FALSE	FALSE
0: Total Q	10513	CORE P38	27.6	14.5	-6	-14	-21	-5065	0	0	0	FALSE	FALSE
0: RWDI_01	10513	CORE P38	27.6	14.5	-6	307	122	5487	0	0	0	TRUE	FALSE
0: RWDI_02	10513	CORE P38	27.6	14.5	-6	223	129	5513	0	0	0	TRUE	FALSE
0: RWDI_03	10513	CORE P38	27.6	14.5	-6	294	-126	-4901	0	0	0	TRUE	FALSE
0: RWDI_04	10513	CORE P38	27.6	14.5	-6	210	-119	-4875	0	0	0	TRUE	FALSE
0: RWDI_05	10513	CORE P38	27.6	14.5	-6	-196	158	6583	0	0	0	TRUE	FALSE
0: RWDI_06	10513	CORE P38	27.6	14.5	-6	-312	168	6618	0	0	0	TRUE	FALSE
0: RWDI_07	10513	CORE P38	27.6	14.5	-6	-211	-132	-5537	0	0	0	TRUE	FALSE
0: RWDI_08	10513	CORE P38	27.6	14.5	-6	-327	-122	-5502	0	0	0	TRUE	FALSE
0: RWDI_09	10513	CORE P38	27.6	14.5	-6	156	327	13930	0	0	0	TRUE	FALSE
0: RWDI_10	10513	CORE P38	27.6	14.5	-6	53	336	13962	0	0	0	TRUE	FALSE
0: RWDI_11	10513	CORE P38	27.6	14.5	-6	98	-417	-17229	0	0	0	TRUE	FALSE
0: RWDI_12	10513	CORE P38	27.6	14.5	-6	8	-409	-17201	0	0	0	TRUE	FALSE
0: RWDI_13	10513	CORE P38	27.6	14.5	-6	-73	325	13656	0	0	0	TRUE	FALSE
0: RWDI_14	10513	CORE P38	27.6	14.5	-6	-176	334	13688	0	0	0	TRUE	FALSE
0: RWDI_15	10513	CORE P38	27.6	14.5	-6	-63	-418	-17423	0	0	0	TRUE	FALSE
0: RWDI_16	10513	CORE P38	27.6	14.5	-6	-154	-410	-17395	0	0	0	TRUE	FALSE
0: RWDI_17	10513	CORE P38	27.6	14.5	-6	212	156	6985	0	0	0	TRUE	FALSE
0: RWDI_18	10513	CORE P38	27.6	14.5	-6	-40	177	7063	0	0	0	TRUE	FALSE
0: RWDI_19	10513	CORE P38	27.6	14.5	-6	197	-134	-5135	0	0	0	TRUE	FALSE
0: RWDI_20	10513	CORE P38	27.6	14.5	-6	-57	-154	-6789	0	0	0	TRUE	FALSE
0: RWDI_21	10513	CORE P38	27.6	14.5	-6	-44	154	6678	0	0	0	TRUE	FALSE
0: RWDI_22	10513	CORE P38	27.6	14.5	-6	-282	175	6772	0	0	0	TRUE	FALSE
0: RWDI_23	10513	CORE P38	27.6	14.5	-6	-58	-136	-5442	0	0	0	TRUE	FALSE
0: RWDI_24	10513	CORE P38	27.6	14.5	-6	-299	-156	-7080	0	0	0	TRUE	FALSE

Total G (Wished-	10513	CORE P38	27.6	14.5	-6	-24	-19	-14387	0	0	0	FALSE	FALSE
EQSpecX	5152	CORE P10	39.7	28.4	-6	-923	-565	-3813	0	0	0	FALSE	TRUE
EQSpecY	5152	CORE P10	39.7	28.4	-6	-159	-479	-3077	0	0	0	FALSE	TRUE
Robustness X	5152	CORE P10	39.7	28.4	-6	422	78	-5871	0	0	0	FALSE	FALSE
Robustness Y	5152	CORE P10	39.7	28.4	-6	75	420	-8182	0	0	0	FALSE	FALSE
0: Total Q	5152	CORE P10	39.7	28.4	-6	-24	-19	-2320	0	0	0	FALSE	FALSE
0: RWDI_01	5152	CORE P10	39.7	28.4	-6	140	265	-7780	0	0	0	TRUE	FALSE
0: RWDI_02	5152	CORE P10	39.7	28.4	-6	207	154	-7696	0	0	0	TRUE	FALSE
0: RWDI_03	5152	CORE P10	39.7	28.4	-6	86	41	-708	0	0	0	TRUE	FALSE
0: RWDI_04	5152	CORE P10	39.7	28.4	-6	153	-71	-624	0	0	0	TRUE	FALSE
0: RWDI_05	5152	CORE P10	39.7	28.4	-6	-173	138	-359	0	0	0	TRUE	FALSE
0: RWDI_06	5152	CORE P10	39.7	28.4	-6	-80	-17	-243	0	0	0	TRUE	FALSE
0: RWDI_07	5152	CORE P10	39.7	28.4	-6	-235	-125	7891	0	0	0	TRUE	FALSE
0: RWDI_08	5152	CORE P10	39.7	28.4	-6	-142	-279	8007	0	0	0	TRUE	FALSE
0: RWDI_09	5152	CORE P10	39.7	28.4	-6	72	406	-10813	0	0	0	TRUE	FALSE
0: RWDI_10	5152	CORE P10	39.7	28.4	-6	154	269	-10709	0	0	0	TRUE	FALSE
0: RWDI_11	5152	CORE P10	39.7	28.4	-6	-73	-294	10421	0	0	0	TRUE	FALSE
0: RWDI_12	5152	CORE P10	39.7	28.4	-6	0	-414	10512	0	0	0	TRUE	FALSE
0: RWDI_13	5152	CORE P10	39.7	28.4	-6	-62	323	-7056	0	0	0	TRUE	FALSE
0: RWDI_14	5152	CORE P10	39.7	28.4	-6	21	186	-6952	0	0	0	TRUE	FALSE
0: RWDI_15	5152	CORE P10	39.7	28.4	-6	-167	-352	13073	0	0	0	TRUE	FALSE
0: RWDI_16	5152	CORE P10	39.7	28.4	-6	-95	-472	13164	0	0	0	TRUE	FALSE
0: RWDI_17	5152	CORE P10	39.7	28.4	-6	-15	342	-6163	0	0	0	TRUE	FALSE
0: RWDI_18	5152	CORE P10	39.7	28.4	-6	186	8	-5911	0	0	0	TRUE	FALSE
0: RWDI_19	5152	CORE P10	39.7	28.4	-6	-78	80	2087	0	0	0	TRUE	FALSE
0: RWDI_20	5152	CORE P10	39.7	28.4	-6	115	-292	3518	0	0	0	TRUE	FALSE
0: RWDI_21	5152	CORE P10	39.7	28.4	-6	-165	249	-1965	0	0	0	TRUE	FALSE
0: RWDI_22	5152	CORE P10	39.7	28.4	-6	45	-80	-1933	0	0	0	TRUE	FALSE
0: RWDI_23	5152	CORE P10	39.7	28.4	-6	-227	-13	6286	0	0	0	TRUE	FALSE
0: RWDI_24	5152	CORE P10	39.7	28.4	-6	-26	-380	7496	0	0	0	TRUE	FALSE
Total G (Wished-	5152	CORE P10	39.7	28.4	-6	10	-55	-14268	0	0	0	FALSE	FALSE
EQSpecX	5154	CORE P21	39.7	25.1	-6	-755	-566	-3455	0	0	0	FALSE	TRUE
EQSpecY	5154	CORE P21	39.7	25.1	-6	-86	-480	-802	0	0	0	FALSE	TRUE
Robustness X	5154	CORE P21	39.7	25.1	-6	430	74	-4910	0	0	0	FALSE	FALSE
Robustness Y	5154	CORE P21	39.7	25.1	-6	50	419	-2680	0	0	0	FALSE	FALSE
0: Total Q	5154	CORE P21	39.7	25.1	-6	-21	-20	-2560	0	0	0	FALSE	FALSE
0: RWDI_01	5154	CORE P21	39.7	25.1	-6	170	262	-4749	0	0	0	TRUE	FALSE
0: RWDI_02	5154	CORE P21	39.7	25.1	-6	202	151	-4851	0	0	0	TRUE	FALSE
0: RWDI_03	5154	CORE P21	39.7	25.1	-6	135	39	-2170	0	0	0	TRUE	FALSE
0: RWDI_04	5154	CORE P21	39.7	25.1	-6	167	-73	-2271	0	0	0	TRUE	FALSE
0: RWDI_05	5154	CORE P21	39.7	25.1	-6	-180	139	2057	0	0	0	TRUE	FALSE
0: RWDI_06	5154	CORE P21	39.7	25.1	-6	-136	-15	1917	0	0	0	TRUE	FALSE
0: RWDI_07	5154	CORE P21	39.7	25.1	-6	-221	-121	5067	0	0	0	TRUE	FALSE
0: RWDI_08	5154	CORE P21	39.7	25.1	-6	-177	-276	4927	0	0	0	TRUE	FALSE
0: RWDI_09	5154	CORE P21	39.7	25.1	-6	78	404	-4479	0	0	0	TRUE	FALSE
0: RWDI_10	5154	CORE P21	39.7	25.1	-6	117	267	-4604	0	0	0	TRUE	FALSE
0: RWDI_11	5154	CORE P21	39.7	25.1	-6	-19	-293	3236	0	0	0	TRUE	FALSE
0: RWDI_12	5154	CORE P21	39.7	25.1	-6	15	-413	3127	0	0	0	TRUE	FALSE
0: RWDI_13	5154	CORE P21	39.7	25.1	-6	-74	323	-1335	0	0	0	TRUE	FALSE
0: RWDI_14	5154	CORE P21	39.7	25.1	-6	-35	186	-1459	0	0	0	TRUE	FALSE
0: RWDI_15	5154	CORE P21	39.7	25.1	-6	-127	-350	5456	0	0	0	TRUE	FALSE
0: RWDI_16	5154	CORE P21	39.7	25.1	-6	-92	-470	5347	0	0	0	TRUE	FALSE
0: RWDI_17	5154	CORE P21	39.7	25.1	-6	31	340	-2682	0	0	0	TRUE	FALSE
0: RWDI_18	5154	CORE P21	39.7	25.1	-6	126	6	-2985	0	0	0	TRUE	FALSE
0: RWDI_19	5154	CORE P21	39.7	25.1	-6	-10	80	328	0	0	0	TRUE	FALSE
0: RWDI_20	5154	CORE P21	39.7	25.1	-6	79	-292	455	0	0	0	TRUE	FALSE
0: RWDI_21	5154	CORE P21	39.7	25.1	-6	-140	250	832	0	0	0	TRUE	FALSE
0: RWDI_22	5154	CORE P21	39.7	25.1	-6	-35	-80	344	0	0	0	TRUE	FALSE
0: RWDI_23	5154	CORE P21	39.7	25.1	-6	-180	-11	3842	0	0	0	TRUE	FALSE
0: RWDI_24	5154	CORE P21	39.7	25.1	-6	-82	-378	3784	0	0	0	TRUE	FALSE
Total G (Wished-	5154	CORE P21	39.7	25.1	-6	-5	-60	-12518	0	0	0	FALSE	FALSE
EQSpecX	5153	CORE P11	43.6	28.4	-6	-918	-767	-5226	0	0	0	FALSE	TRUE
EQSpecY	5153	CORE P11	43.6	28.4	-6	-161	-523	-2961	0	0	0	FALSE	TRUE
Robustness X	5153	CORE P11	43.6	28.4	-6	425	88	-7742	0	0	0	FALSE	FALSE
Robustness Y	5153	CORE P11	43.6	28.4	-6	82	397	-8049	0	0	0	FALSE	FALSE
0: Total Q	5153	CORE P11	43.6	28.4	-6	-23	-15	-2335	0	0	0	FALSE	FALSE
0: RWDI_01	5153	CORE P11	43.6	28.4	-6	147	301	-8986	0	0	0	TRUE	FALSE
0: RWDI_02	5153	CORE P11	43.6	28.4	-6	213	152	-8913	0	0	0	TRUE	FALSE
0: RWDI_03	5153	CORE P11	43.6	28.4	-6	88	92	-2026	0	0	0	TRUE	FALSE

0: RWDI_04	5153	CORE P11	43.6	28.4	-6	154	-57	-1952	0	0	0	TRUE	FALSE
0: RWDI_05	5153	CORE P11	43.6	28.4	-6	-172	132	1057	0	0	0	TRUE	FALSE
0: RWDI_06	5153	CORE P11	43.6	28.4	-6	-81	-75	1159	0	0	0	TRUE	FALSE
0: RWDI_07	5153	CORE P11	43.6	28.4	-6	-242	-112	9178	0	0	0	TRUE	FALSE
0: RWDI_08	5153	CORE P11	43.6	28.4	-6	-150	-319	9280	0	0	0	TRUE	FALSE
0: RWDI_09	5153	CORE P11	43.6	28.4	-6	81	418	-11058	0	0	0	TRUE	FALSE
0: RWDI_10	5153	CORE P11	43.6	28.4	-6	163	235	-10967	0	0	0	TRUE	FALSE
0: RWDI_11	5153	CORE P11	43.6	28.4	-6	-81	-242	9841	0	0	0	TRUE	FALSE
0: RWDI_12	5153	CORE P11	43.6	28.4	-6	-10	-403	9920	0	0	0	TRUE	FALSE
0: RWDI_13	5153	CORE P11	43.6	28.4	-6	-55	314	-6167	0	0	0	TRUE	FALSE
0: RWDI_14	5153	CORE P11	43.6	28.4	-6	26	131	-6076	0	0	0	TRUE	FALSE
0: RWDI_15	5153	CORE P11	43.6	28.4	-6	-178	-316	13293	0	0	0	TRUE	FALSE
0: RWDI_16	5153	CORE P11	43.6	28.4	-6	-106	-477	13372	0	0	0	TRUE	FALSE
0: RWDI_17	5153	CORE P11	43.6	28.4	-6	-9	394	-6474	0	0	0	TRUE	FALSE
0: RWDI_18	5153	CORE P11	43.6	28.4	-6	190	-53	-6253	0	0	0	TRUE	FALSE
0: RWDI_19	5153	CORE P11	43.6	28.4	-6	-78	150	1646	0	0	0	TRUE	FALSE
0: RWDI_20	5153	CORE P11	43.6	28.4	-6	111	-332	3027	0	0	0	TRUE	FALSE
0: RWDI_21	5153	CORE P11	43.6	28.4	-6	-162	278	-1008	0	0	0	TRUE	FALSE
0: RWDI_22	5153	CORE P11	43.6	28.4	-6	45	-164	-1075	0	0	0	TRUE	FALSE
0: RWDI_23	5153	CORE P11	43.6	28.4	-6	-231	34	7113	0	0	0	TRUE	FALSE
0: RWDI_24	5153	CORE P11	43.6	28.4	-6	-34	-442	8206	0	0	0	TRUE	FALSE
Total G (Wished-	5153	CORE P11	43.6	28.4	-6	19	-67	-14107	0	0	0	FALSE	FALSE
EQSpecX	5157	CORE P22	43.6	25.1	-6	-755	-770	-5010	0	0	0	FALSE	TRUE
EQSpecY	5157	CORE P22	43.6	25.1	-6	-86	-523	-835	0	0	0	FALSE	TRUE
Robustness X	5157	CORE P22	43.6	25.1	-6	432	80	-6755	0	0	0	FALSE	FALSE
Robustness Y	5157	CORE P22	43.6	25.1	-6	52	395	-2549	0	0	0	FALSE	FALSE
0: Total Q	5157	CORE P22	43.6	25.1	-6	-19	-16	-2587	0	0	0	FALSE	FALSE
0: RWDI_01	5157	CORE P22	43.6	25.1	-6	174	294	-5938	0	0	0	TRUE	FALSE
0: RWDI_02	5157	CORE P22	43.6	25.1	-6	206	145	-6085	0	0	0	TRUE	FALSE
0: RWDI_03	5157	CORE P22	43.6	25.1	-6	137	87	-3419	0	0	0	TRUE	FALSE
0: RWDI_04	5157	CORE P22	43.6	25.1	-6	169	-62	-3565	0	0	0	TRUE	FALSE
0: RWDI_05	5157	CORE P22	43.6	25.1	-6	-181	136	3441	0	0	0	TRUE	FALSE
0: RWDI_06	5157	CORE P22	43.6	25.1	-6	-137	-70	3238	0	0	0	TRUE	FALSE
0: RWDI_07	5157	CORE P22	43.6	25.1	-6	-225	-105	6380	0	0	0	TRUE	FALSE
0: RWDI_08	5157	CORE P22	43.6	25.1	-6	-180	-311	6177	0	0	0	TRUE	FALSE
0: RWDI_09	5157	CORE P22	43.6	25.1	-6	82	414	-4760	0	0	0	TRUE	FALSE
0: RWDI_10	5157	CORE P22	43.6	25.1	-6	121	230	-4940	0	0	0	TRUE	FALSE
0: RWDI_11	5157	CORE P22	43.6	25.1	-6	-22	-241	2764	0	0	0	TRUE	FALSE
0: RWDI_12	5157	CORE P22	43.6	25.1	-6	12	-401	2606	0	0	0	TRUE	FALSE
0: RWDI_13	5157	CORE P22	43.6	25.1	-6	-73	315	-503	0	0	0	TRUE	FALSE
0: RWDI_14	5157	CORE P22	43.6	25.1	-6	-33	131	-684	0	0	0	TRUE	FALSE
0: RWDI_15	5157	CORE P22	43.6	25.1	-6	-131	-311	5769	0	0	0	TRUE	FALSE
0: RWDI_16	5157	CORE P22	43.6	25.1	-6	-96	-471	5611	0	0	0	TRUE	FALSE
0: RWDI_17	5157	CORE P22	43.6	25.1	-6	32	390	-2967	0	0	0	TRUE	FALSE
0: RWDI_18	5157	CORE P22	43.6	25.1	-6	129	-57	-3408	0	0	0	TRUE	FALSE
0: RWDI_19	5157	CORE P22	43.6	25.1	-6	-11	149	-28	0	0	0	TRUE	FALSE
0: RWDI_20	5157	CORE P22	43.6	25.1	-6	79	-332	-49	0	0	0	TRUE	FALSE
0: RWDI_21	5157	CORE P22	43.6	25.1	-6	-140	280	1790	0	0	0	TRUE	FALSE
0: RWDI_22	5157	CORE P22	43.6	25.1	-6	-35	-161	1099	0	0	0	TRUE	FALSE
0: RWDI_23	5157	CORE P22	43.6	25.1	-6	-183	39	4729	0	0	0	TRUE	FALSE
0: RWDI_24	5157	CORE P22	43.6	25.1	-6	-84	-437	4458	0	0	0	TRUE	FALSE
Total G (Wished-	5157	CORE P22	43.6	25.1	-6	4	-77	-12512	0	0	0	FALSE	FALSE
EQSpecX	10905	CORE P25	43.6	22.0	-6	-604	-767	-4534	0	0	0	FALSE	TRUE
EQSpecY	10905	CORE P25	43.6	22.0	-6	-21	-521	-2236	0	0	0	FALSE	TRUE
Robustness X	10905	CORE P25	43.6	22.0	-6	426	75	-5285	0	0	0	FALSE	FALSE
Robustness Y	10905	CORE P25	43.6	22.0	-6	25	394	2282	0	0	0	FALSE	FALSE
0: Total Q	10905	CORE P25	43.6	22.0	-6	-18	-18	-2544	0	0	0	FALSE	FALSE
0: RWDI_01	10905	CORE P25	43.6	22.0	-6	191	289	-2805	0	0	0	TRUE	FALSE
0: RWDI_02	10905	CORE P25	43.6	22.0	-6	192	141	-3079	0	0	0	TRUE	FALSE
0: RWDI_03	10905	CORE P25	43.6	22.0	-6	173	84	-4312	0	0	0	TRUE	FALSE
0: RWDI_04	10905	CORE P25	43.6	22.0	-6	174	-65	-4586	0	0	0	TRUE	FALSE
0: RWDI_05	10905	CORE P25	43.6	22.0	-6	-181	139	5116	0	0	0	TRUE	FALSE
0: RWDI_06	10905	CORE P25	43.6	22.0	-6	-180	-66	4737	0	0	0	TRUE	FALSE
0: RWDI_07	10905	CORE P25	43.6	22.0	-6	-202	-101	3358	0	0	0	TRUE	FALSE
0: RWDI_08	10905	CORE P25	43.6	22.0	-6	-200	-306	2979	0	0	0	TRUE	FALSE
0: RWDI_09	10905	CORE P25	43.6	22.0	-6	80	410	1028	0	0	0	TRUE	FALSE
0: RWDI_10	10905	CORE P25	43.6	22.0	-6	82	228	691	0	0	0	TRUE	FALSE
0: RWDI_11	10905	CORE P25	43.6	22.0	-6	28	-240	-3555	0	0	0	TRUE	FALSE
0: RWDI_12	10905	CORE P25	43.6	22.0	-6	29	-400	-3850	0	0	0	TRUE	FALSE

0: RWDI_13	10905	CORE P25	43.6	22.0	-6	-83	315	4344	0	0	0	TRUE	FALSE
0: RWDI_14	10905	CORE P25	43.6	22.0	-6	-82	132	4007	0	0	0	TRUE	FALSE
0: RWDI_15	10905	CORE P25	43.6	22.0	-6	-88	-308	-1214	0	0	0	TRUE	FALSE
0: RWDI_16	10905	CORE P25	43.6	22.0	-6	-86	-467	-1509	0	0	0	TRUE	FALSE
0: RWDI_17	10905	CORE P25	43.6	22.0	-6	68	387	234	0	0	0	TRUE	FALSE
0: RWDI_18	10905	CORE P25	43.6	22.0	-6	71	-57	-587	0	0	0	TRUE	FALSE
0: RWDI_19	10905	CORE P25	43.6	22.0	-6	47	148	-1523	0	0	0	TRUE	FALSE
0: RWDI_20	10905	CORE P25	43.6	22.0	-6	48	-331	-2596	0	0	0	TRUE	FALSE
0: RWDI_21	10905	CORE P25	43.6	22.0	-6	-115	281	3940	0	0	0	TRUE	FALSE
0: RWDI_22	10905	CORE P25	43.6	22.0	-6	-102	-158	2924	0	0	0	TRUE	FALSE
0: RWDI_23	10905	CORE P25	43.6	22.0	-6	-136	41	2182	0	0	0	TRUE	FALSE
0: RWDI_24	10905	CORE P25	43.6	22.0	-6	-125	-432	915	0	0	0	TRUE	FALSE
Total G (Wished-	10905	CORE P25	43.6	22.0	-6	-19	-84	-9929	0	0	0	FALSE	FALSE
EQSpecX	3264	CORE P12	11.6	25.1	-6	-793	-655	-4995	0	0	0	FALSE	TRUE
EQSpecY	3264	CORE P12	11.6	25.1	-6	-81	-528	-1175	0	0	0	FALSE	TRUE
Robustness X	3264	CORE P12	11.6	25.1	-6	463	-151	6463	0	0	0	FALSE	FALSE
Robustness Y	3264	CORE P12	11.6	25.1	-6	-27	425	-306	0	0	0	FALSE	FALSE
0: Total Q	3264	CORE P12	11.6	25.1	-6	-36	33	-2658	0	0	0	FALSE	FALSE
0: RWDI_01	3264	CORE P12	11.6	25.1	-6	157	-118	4053	0	0	0	TRUE	FALSE
0: RWDI_02	3264	CORE P12	11.6	25.1	-6	194	21	4220	0	0	0	TRUE	FALSE
0: RWDI_03	3264	CORE P12	11.6	25.1	-6	191	-332	4823	0	0	0	TRUE	FALSE
0: RWDI_04	3264	CORE P12	11.6	25.1	-6	228	-193	4990	0	0	0	TRUE	FALSE
0: RWDI_05	3264	CORE P12	11.6	25.1	-6	-255	193	-5408	0	0	0	TRUE	FALSE
0: RWDI_06	3264	CORE P12	11.6	25.1	-6	-203	387	-5177	0	0	0	TRUE	FALSE
0: RWDI_07	3264	CORE P12	11.6	25.1	-6	-216	-56	-4510	0	0	0	TRUE	FALSE
0: RWDI_08	3264	CORE P12	11.6	25.1	-6	-164	137	-4279	0	0	0	TRUE	FALSE
0: RWDI_09	3264	CORE P12	11.6	25.1	-6	-10	141	288	0	0	0	TRUE	FALSE
0: RWDI_10	3264	CORE P12	11.6	25.1	-6	36	313	494	0	0	0	TRUE	FALSE
0: RWDI_11	3264	CORE P12	11.6	25.1	-6	100	-469	2635	0	0	0	TRUE	FALSE
0: RWDI_12	3264	CORE P12	11.6	25.1	-6	140	-318	2815	0	0	0	TRUE	FALSE
0: RWDI_13	3264	CORE P12	11.6	25.1	-6	-183	276	-3763	0	0	0	TRUE	FALSE
0: RWDI_14	3264	CORE P12	11.6	25.1	-6	-137	447	-3558	0	0	0	TRUE	FALSE
0: RWDI_15	3264	CORE P12	11.6	25.1	-6	-22	-374	-224	0	0	0	TRUE	FALSE
0: RWDI_16	3264	CORE P12	11.6	25.1	-6	18	-224	-44	0	0	0	TRUE	FALSE
0: RWDI_17	3264	CORE P12	11.6	25.1	-6	-16	-109	673	0	0	0	TRUE	FALSE
0: RWDI_18	3264	CORE P12	11.6	25.1	-6	96	310	1174	0	0	0	TRUE	FALSE
0: RWDI_19	3264	CORE P12	11.6	25.1	-6	23	-358	1570	0	0	0	TRUE	FALSE
0: RWDI_20	3264	CORE P12	11.6	25.1	-6	141	25	2200	0	0	0	TRUE	FALSE
0: RWDI_21	3264	CORE P12	11.6	25.1	-6	-210	42	-3856	0	0	0	TRUE	FALSE
0: RWDI_22	3264	CORE P12	11.6	25.1	-6	-87	452	-3116	0	0	0	TRUE	FALSE
0: RWDI_23	3264	CORE P12	11.6	25.1	-6	-170	-208	-2958	0	0	0	TRUE	FALSE
0: RWDI_24	3264	CORE P12	11.6	25.1	-6	-43	167	-2090	0	0	0	TRUE	FALSE
Total G (Wished-	3264	CORE P12	11.6	25.1	-6	-161	114	-12907	0	0	0	FALSE	FALSE
EQSpecX	11081	CORE P24	39.7	22.0	-6	-608	-563	-3046	0	0	0	FALSE	TRUE
EQSpecY	11081	CORE P24	39.7	22.0	-6	-21	-478	-1611	0	0	0	FALSE	TRUE
Robustness X	11081	CORE P24	39.7	22.0	-6	429	75	-3830	0	0	0	FALSE	FALSE
Robustness Y	11081	CORE P24	39.7	22.0	-6	25	418	1889	0	0	0	FALSE	FALSE
0: Total Q	11081	CORE P24	39.7	22.0	-6	-18	-19	-2574	0	0	0	FALSE	FALSE
0: RWDI_01	11081	CORE P24	39.7	22.0	-6	191	262	-1994	0	0	0	TRUE	FALSE
0: RWDI_02	11081	CORE P24	39.7	22.0	-6	192	151	-2153	0	0	0	TRUE	FALSE
0: RWDI_03	11081	CORE P24	39.7	22.0	-6	174	39	-3302	0	0	0	TRUE	FALSE
0: RWDI_04	11081	CORE P24	39.7	22.0	-6	175	-72	-3461	0	0	0	TRUE	FALSE
0: RWDI_05	11081	CORE P24	39.7	22.0	-6	-182	138	3872	0	0	0	TRUE	FALSE
0: RWDI_06	11081	CORE P24	39.7	22.0	-6	-181	-15	3652	0	0	0	TRUE	FALSE
0: RWDI_07	11081	CORE P24	39.7	22.0	-6	-202	-122	2346	0	0	0	TRUE	FALSE
0: RWDI_08	11081	CORE P24	39.7	22.0	-6	-201	-276	2126	0	0	0	TRUE	FALSE
0: RWDI_09	11081	CORE P24	39.7	22.0	-6	80	403	991	0	0	0	TRUE	FALSE
0: RWDI_10	11081	CORE P24	39.7	22.0	-6	82	267	795	0	0	0	TRUE	FALSE
0: RWDI_11	11081	CORE P24	39.7	22.0	-6	28	-292	-2970	0	0	0	TRUE	FALSE
0: RWDI_12	11081	CORE P24	39.7	22.0	-6	30	-412	-3141	0	0	0	TRUE	FALSE
0: RWDI_13	11081	CORE P24	39.7	22.0	-6	-84	322	3437	0	0	0	TRUE	FALSE
0: RWDI_14	11081	CORE P24	39.7	22.0	-6	-82	185	3241	0	0	0	TRUE	FALSE
0: RWDI_15	11081	CORE P24	39.7	22.0	-6	-87	-349	-1243	0	0	0	TRUE	FALSE
0: RWDI_16	11081	CORE P24	39.7	22.0	-6	-86	-469	-1414	0	0	0	TRUE	FALSE
0: RWDI_17	11081	CORE P24	39.7	22.0	-6	68	340	241	0	0	0	TRUE	FALSE
0: RWDI_18	11081	CORE P24	39.7	22.0	-6	71	7	-236	0	0	0	TRUE	FALSE
0: RWDI_19	11081	CORE P24	39.7	22.0	-6	48	79	-1285	0	0	0	TRUE	FALSE
0: RWDI_20	11081	CORE P24	39.7	22.0	-6	48	-291	-1980	0	0	0	TRUE	FALSE
0: RWDI_21	11081	CORE P24	39.7	22.0	-6	-115	249	2975	0	0	0	TRUE	FALSE

0: RWDI_22	11081	CORE P24	39.7	22.0	-6	-103	-80	2354	0	0	0	TRUE	FALSE
0: RWDI_23	11081	CORE P24	39.7	22.0	-6	-136	-12	1449	0	0	0	TRUE	FALSE
0: RWDI_24	11081	CORE P24	39.7	22.0	-6	-126	-377	610	0	0	0	TRUE	FALSE
Total G (Wished-	11081	CORE P24	39.7	22.0	-6	-21	-56	-10139	0	0	0	FALSE	FALSE
EQSpecX	11083	CORE P16	24.4	25.1	-6	-761	-193	-1358	0	0	0	FALSE	TRUE
EQSpecY	11083	CORE P16	24.4	25.1	-6	-75	-410	-917	0	0	0	FALSE	TRUE
Robustness X	11083	CORE P16	24.4	25.1	-6	420	-22	1853	0	0	0	FALSE	FALSE
Robustness Y	11083	CORE P16	24.4	25.1	-6	6	469	-2883	0	0	0	FALSE	FALSE
0: Total Q	11083	CORE P16	24.4	25.1	-6	-21	-26	-2586	0	0	0	FALSE	FALSE
0: RWDI_01	11083	CORE P16	24.4	25.1	-6	144	73	-4	0	0	0	TRUE	FALSE
0: RWDI_02	11083	CORE P16	24.4	25.1	-6	178	114	-23	0	0	0	TRUE	FALSE
0: RWDI_03	11083	CORE P16	24.4	25.1	-6	145	-175	2636	0	0	0	TRUE	FALSE
0: RWDI_04	11083	CORE P16	24.4	25.1	-6	179	-135	2617	0	0	0	TRUE	FALSE
0: RWDI_05	11083	CORE P16	24.4	25.1	-6	-199	165	-3120	0	0	0	TRUE	FALSE
0: RWDI_06	11083	CORE P16	24.4	25.1	-6	-151	221	-3146	0	0	0	TRUE	FALSE
0: RWDI_07	11083	CORE P16	24.4	25.1	-6	-197	-125	-40	0	0	0	TRUE	FALSE
0: RWDI_08	11083	CORE P16	24.4	25.1	-6	-150	-68	-66	0	0	0	TRUE	FALSE
0: RWDI_09	11083	CORE P16	24.4	25.1	-6	26	294	-3094	0	0	0	TRUE	FALSE
0: RWDI_10	11083	CORE P16	24.4	25.1	-6	68	344	-3118	0	0	0	TRUE	FALSE
0: RWDI_11	11083	CORE P16	24.4	25.1	-6	37	-442	4821	0	0	0	TRUE	FALSE
0: RWDI_12	11083	CORE P16	24.4	25.1	-6	74	-398	4800	0	0	0	TRUE	FALSE
0: RWDI_13	11083	CORE P16	24.4	25.1	-6	-120	320	-4263	0	0	0	TRUE	FALSE
0: RWDI_14	11083	CORE P16	24.4	25.1	-6	-77	370	-4286	0	0	0	TRUE	FALSE
0: RWDI_15	11083	CORE P16	24.4	25.1	-6	-65	-423	3996	0	0	0	TRUE	FALSE
0: RWDI_16	11083	CORE P16	24.4	25.1	-6	-28	-380	3976	0	0	0	TRUE	FALSE
0: RWDI_17	11083	CORE P16	24.4	25.1	-6	0	97	-1320	0	0	0	TRUE	FALSE
0: RWDI_18	11083	CORE P16	24.4	25.1	-6	104	219	-1377	0	0	0	TRUE	FALSE
0: RWDI_19	11083	CORE P16	24.4	25.1	-6	2	-193	1760	0	0	0	TRUE	FALSE
0: RWDI_20	11083	CORE P16	24.4	25.1	-6	105	-112	2143	0	0	0	TRUE	FALSE
0: RWDI_21	11083	CORE P16	24.4	25.1	-6	-162	126	-2626	0	0	0	TRUE	FALSE
0: RWDI_22	11083	CORE P16	24.4	25.1	-6	-51	247	-2614	0	0	0	TRUE	FALSE
0: RWDI_23	11083	CORE P16	24.4	25.1	-6	-161	-164	454	0	0	0	TRUE	FALSE
0: RWDI_24	11083	CORE P16	24.4	25.1	-6	-49	-85	906	0	0	0	TRUE	FALSE
Total G (Wished-	11083	CORE P16	24.4	25.1	-6	-56	-32	-13674	0	0	0	FALSE	FALSE
EQSpecX	11086	CORE P18	30.7	25.1	-6	-758	-123	-979	0	0	0	FALSE	TRUE
EQSpecY	11086	CORE P18	30.7	25.1	-6	-78	-373	-1115	0	0	0	FALSE	TRUE
Robustness X	11086	CORE P18	30.7	25.1	-6	418	36	-1352	0	0	0	FALSE	FALSE
Robustness Y	11086	CORE P18	30.7	25.1	-6	25	460	-3126	0	0	0	FALSE	FALSE
0: Total Q	11086	CORE P18	30.7	25.1	-6	-20	-26	-2511	0	0	0	FALSE	FALSE
0: RWDI_01	11086	CORE P18	30.7	25.1	-6	150	169	-2403	0	0	0	TRUE	FALSE
0: RWDI_02	11086	CORE P18	30.7	25.1	-6	184	144	-2331	0	0	0	TRUE	FALSE
0: RWDI_03	11086	CORE P18	30.7	25.1	-6	135	-80	413	0	0	0	TRUE	FALSE
0: RWDI_04	11086	CORE P18	30.7	25.1	-6	169	-105	484	0	0	0	TRUE	FALSE
0: RWDI_05	11086	CORE P18	30.7	25.1	-6	-185	153	-925	0	0	0	TRUE	FALSE
0: RWDI_06	11086	CORE P18	30.7	25.1	-6	-138	118	-826	0	0	0	TRUE	FALSE
0: RWDI_07	11086	CORE P18	30.7	25.1	-6	-203	-138	2360	0	0	0	TRUE	FALSE
0: RWDI_08	11086	CORE P18	30.7	25.1	-6	-156	-173	2459	0	0	0	TRUE	FALSE
0: RWDI_09	11086	CORE P18	30.7	25.1	-6	48	360	-4106	0	0	0	TRUE	FALSE
0: RWDI_10	11086	CORE P18	30.7	25.1	-6	90	329	-4018	0	0	0	TRUE	FALSE
0: RWDI_11	11086	CORE P18	30.7	25.1	-6	9	-394	4358	0	0	0	TRUE	FALSE
0: RWDI_12	11086	CORE P18	30.7	25.1	-6	46	-421	4435	0	0	0	TRUE	FALSE
0: RWDI_13	11086	CORE P18	30.7	25.1	-6	-96	332	-3250	0	0	0	TRUE	FALSE
0: RWDI_14	11086	CORE P18	30.7	25.1	-6	-54	301	-3162	0	0	0	TRUE	FALSE
0: RWDI_15	11086	CORE P18	30.7	25.1	-6	-93	-414	4962	0	0	0	TRUE	FALSE
0: RWDI_16	11086	CORE P18	30.7	25.1	-6	-56	-441	5039	0	0	0	TRUE	FALSE
0: RWDI_17	11086	CORE P18	30.7	25.1	-6	12	213	-2283	0	0	0	TRUE	FALSE
0: RWDI_18	11086	CORE P18	30.7	25.1	-6	114	137	-2070	0	0	0	TRUE	FALSE
0: RWDI_19	11086	CORE P18	30.7	25.1	-6	-7	-78	1002	0	0	0	TRUE	FALSE
0: RWDI_20	11086	CORE P18	30.7	25.1	-6	93	-195	1685	0	0	0	TRUE	FALSE
0: RWDI_21	11086	CORE P18	30.7	25.1	-6	-149	182	-1327	0	0	0	TRUE	FALSE
0: RWDI_22	11086	CORE P18	30.7	25.1	-6	-39	108	-1163	0	0	0	TRUE	FALSE
0: RWDI_23	11086	CORE P18	30.7	25.1	-6	-168	-109	1958	0	0	0	TRUE	FALSE
0: RWDI_24	11086	CORE P18	30.7	25.1	-6	-60	-225	2591	0	0	0	TRUE	FALSE
Total G (Wished-	11086	CORE P18	30.7	25.1	-6	-25	-36	-13153	0	0	0	FALSE	FALSE
EQSpecX	11087	CORE P05	24.4	28.4	-6	-910	-191	-1306	0	0	0	FALSE	TRUE
EQSpecY	11087	CORE P05	24.4	28.4	-6	-136	-407	-2832	0	0	0	FALSE	TRUE
Robustness X	11087	CORE P05	24.4	28.4	-6	396	-21	1688	0	0	0	FALSE	FALSE
Robustness Y	11087	CORE P05	24.4	28.4	-6	2	464	-7782	0	0	0	FALSE	FALSE
0: Total Q	11087	CORE P05	24.4	28.4	-6	-16	-28	-2178	0	0	0	FALSE	FALSE

0: RWDI_01	11087	CORE P05	24.4	28.4	-6	90	72	-2185	0	0	0	TRUE	FALSE
0: RWDI_02	11087	CORE P05	24.4	28.4	-6	160	113	-2208	0	0	0	TRUE	FALSE
0: RWDI_03	11087	CORE P05	24.4	28.4	-6	99	-173	4600	0	0	0	TRUE	FALSE
0: RWDI_04	11087	CORE P05	24.4	28.4	-6	169	-133	4577	0	0	0	TRUE	FALSE
0: RWDI_05	11087	CORE P05	24.4	28.4	-6	-199	163	-5764	0	0	0	TRUE	FALSE
0: RWDI_06	11087	CORE P05	24.4	28.4	-6	-102	218	-5796	0	0	0	TRUE	FALSE
0: RWDI_07	11087	CORE P05	24.4	28.4	-6	-189	-123	2152	0	0	0	TRUE	FALSE
0: RWDI_08	11087	CORE P05	24.4	28.4	-6	-92	-68	2121	0	0	0	TRUE	FALSE
0: RWDI_09	11087	CORE P05	24.4	28.4	-6	-18	290	-8654	0	0	0	TRUE	FALSE
0: RWDI_10	11087	CORE P05	24.4	28.4	-6	68	339	-8682	0	0	0	TRUE	FALSE
0: RWDI_11	11087	CORE P05	24.4	28.4	-6	24	-436	11697	0	0	0	TRUE	FALSE
0: RWDI_12	11087	CORE P05	24.4	28.4	-6	99	-393	11672	0	0	0	TRUE	FALSE
0: RWDI_13	11087	CORE P05	24.4	28.4	-6	-136	315	-9723	0	0	0	TRUE	FALSE
0: RWDI_14	11087	CORE P05	24.4	28.4	-6	-50	365	-9751	0	0	0	TRUE	FALSE
0: RWDI_15	11087	CORE P05	24.4	28.4	-6	-60	-418	10942	0	0	0	TRUE	FALSE
0: RWDI_16	11087	CORE P05	24.4	28.4	-6	15	-375	10917	0	0	0	TRUE	FALSE
0: RWDI_17	11087	CORE P05	24.4	28.4	-6	-66	96	-4113	0	0	0	TRUE	FALSE
0: RWDI_18	11087	CORE P05	24.4	28.4	-6	144	216	-4181	0	0	0	TRUE	FALSE
0: RWDI_19	11087	CORE P05	24.4	28.4	-6	-56	-190	3804	0	0	0	TRUE	FALSE
0: RWDI_20	11087	CORE P05	24.4	28.4	-6	155	-111	4866	0	0	0	TRUE	FALSE
0: RWDI_21	11087	CORE P05	24.4	28.4	-6	-198	124	-5308	0	0	0	TRUE	FALSE
0: RWDI_22	11087	CORE P05	24.4	28.4	-6	18	243	-5314	0	0	0	TRUE	FALSE
0: RWDI_23	11087	CORE P05	24.4	28.4	-6	-188	-162	2608	0	0	0	TRUE	FALSE
0: RWDI_24	11087	CORE P05	24.4	28.4	-6	30	-84	3734	0	0	0	TRUE	FALSE
Total G (Wished-	11087	CORE P05	24.4	28.4	-6	-48	-39	-14823	0	0	0	FALSE	FALSE
EQSpecX	11088	CORE P07	30.7	28.4	-6	-920	-120	-1078	0	0	0	FALSE	TRUE
EQSpecY	11088	CORE P07	30.7	28.4	-6	-147	-370	-3117	0	0	0	FALSE	TRUE
Robustness X	11088	CORE P07	30.7	28.4	-6	399	35	-1617	0	0	0	FALSE	FALSE
Robustness Y	11088	CORE P07	30.7	28.4	-6	36	456	-8214	0	0	0	FALSE	FALSE
0: Total Q	11088	CORE P07	30.7	28.4	-6	-21	-27	-2208	0	0	0	FALSE	FALSE
0: RWDI_01	11088	CORE P07	30.7	28.4	-6	105	167	-4758	0	0	0	TRUE	FALSE
0: RWDI_02	11088	CORE P07	30.7	28.4	-6	176	142	-4677	0	0	0	TRUE	FALSE
0: RWDI_03	11088	CORE P07	30.7	28.4	-6	84	-80	2372	0	0	0	TRUE	FALSE
0: RWDI_04	11088	CORE P07	30.7	28.4	-6	155	-104	2452	0	0	0	TRUE	FALSE
0: RWDI_05	11088	CORE P07	30.7	28.4	-6	-180	151	-3605	0	0	0	TRUE	FALSE
0: RWDI_06	11088	CORE P07	30.7	28.4	-6	-82	117	-3494	0	0	0	TRUE	FALSE
0: RWDI_07	11088	CORE P07	30.7	28.4	-6	-204	-136	4713	0	0	0	TRUE	FALSE
0: RWDI_08	11088	CORE P07	30.7	28.4	-6	-107	-170	4824	0	0	0	TRUE	FALSE
0: RWDI_09	11088	CORE P07	30.7	28.4	-6	21	355	-9925	0	0	0	TRUE	FALSE
0: RWDI_10	11088	CORE P07	30.7	28.4	-6	108	325	-9826	0	0	0	TRUE	FALSE
0: RWDI_11	11088	CORE P07	30.7	28.4	-6	-25	-390	11483	0	0	0	TRUE	FALSE
0: RWDI_12	11088	CORE P07	30.7	28.4	-6	51	-416	11569	0	0	0	TRUE	FALSE
0: RWDI_13	11088	CORE P07	30.7	28.4	-6	-98	328	-8896	0	0	0	TRUE	FALSE
0: RWDI_14	11088	CORE P07	30.7	28.4	-6	-11	298	-8798	0	0	0	TRUE	FALSE
0: RWDI_15	11088	CORE P07	30.7	28.4	-6	-109	-409	12209	0	0	0	TRUE	FALSE
0: RWDI_16	11088	CORE P07	30.7	28.4	-6	-33	-435	12295	0	0	0	TRUE	FALSE
0: RWDI_17	11088	CORE P07	30.7	28.4	-6	-47	210	-5233	0	0	0	TRUE	FALSE
0: RWDI_18	11088	CORE P07	30.7	28.4	-6	164	136	-4993	0	0	0	TRUE	FALSE
0: RWDI_19	11088	CORE P07	30.7	28.4	-6	-72	-78	3085	0	0	0	TRUE	FALSE
0: RWDI_20	11088	CORE P07	30.7	28.4	-6	137	-193	4513	0	0	0	TRUE	FALSE
0: RWDI_21	11088	CORE P07	30.7	28.4	-6	-180	179	-4084	0	0	0	TRUE	FALSE
0: RWDI_22	11088	CORE P07	30.7	28.4	-6	39	107	-3904	0	0	0	TRUE	FALSE
0: RWDI_23	11088	CORE P07	30.7	28.4	-6	-204	-108	4234	0	0	0	TRUE	FALSE
0: RWDI_24	11088	CORE P07	30.7	28.4	-6	11	-221	5602	0	0	0	TRUE	FALSE
Total G (Wished-	11088	CORE P07	30.7	28.4	-6	-20	-42	-14760	0	0	0	FALSE	FALSE
EQSpecX	11095	CORE P27	24.4	20.8	-6	-620	-192	-1719	0	0	0	FALSE	TRUE
EQSpecY	11095	CORE P27	24.4	20.8	-6	-33	-410	-660	0	0	0	FALSE	TRUE
Robustness X	11095	CORE P27	24.4	20.8	-6	445	-22	2182	0	0	0	FALSE	FALSE
Robustness Y	11095	CORE P27	24.4	20.8	-6	13	470	1856	0	0	0	FALSE	FALSE
0: Total Q	11095	CORE P27	24.4	20.8	-6	-23	-25	-3382	0	0	0	FALSE	FALSE
0: RWDI_01	11095	CORE P27	24.4	20.8	-6	207	74	2545	0	0	0	TRUE	FALSE
0: RWDI_02	11095	CORE P27	24.4	20.8	-6	197	114	2401	0	0	0	TRUE	FALSE
0: RWDI_03	11095	CORE P27	24.4	20.8	-6	196	-176	681	0	0	0	TRUE	FALSE
0: RWDI_04	11095	CORE P27	24.4	20.8	-6	186	-135	537	0	0	0	TRUE	FALSE
0: RWDI_05	11095	CORE P27	24.4	20.8	-6	-191	166	-263	0	0	0	TRUE	FALSE
0: RWDI_06	11095	CORE P27	24.4	20.8	-6	-205	222	-462	0	0	0	TRUE	FALSE
0: RWDI_07	11095	CORE P27	24.4	20.8	-6	-204	-125	-2438	0	0	0	TRUE	FALSE
0: RWDI_08	11095	CORE P27	24.4	20.8	-6	-218	-69	-2637	0	0	0	TRUE	FALSE
0: RWDI_09	11095	CORE P27	24.4	20.8	-6	83	295	3070	0	0	0	TRUE	FALSE

0: RWDI_10	11095	CORE P27	24.4	20.8	-6	71	346	2893	0	0	0	TRUE	FALSE
0: RWDI_11	11095	CORE P27	24.4	20.8	-6	48	-444	-2556	0	0	0	TRUE	FALSE
0: RWDI_12	11095	CORE P27	24.4	20.8	-6	38	-400	-2710	0	0	0	TRUE	FALSE
0: RWDI_13	11095	CORE P27	24.4	20.8	-6	-92	322	1696	0	0	0	TRUE	FALSE
0: RWDI_14	11095	CORE P27	24.4	20.8	-6	-104	372	1519	0	0	0	TRUE	FALSE
0: RWDI_15	11095	CORE P27	24.4	20.8	-6	-75	-426	-3525	0	0	0	TRUE	FALSE
0: RWDI_16	11095	CORE P27	24.4	20.8	-6	-86	-382	-3680	0	0	0	TRUE	FALSE
0: RWDI_17	11095	CORE P27	24.4	20.8	-6	84	98	1937	0	0	0	TRUE	FALSE
0: RWDI_18	11095	CORE P27	24.4	20.8	-6	54	220	1507	0	0	0	TRUE	FALSE
0: RWDI_19	11095	CORE P27	24.4	20.8	-6	71	-194	-237	0	0	0	TRUE	FALSE
0: RWDI_20	11095	CORE P27	24.4	20.8	-6	39	-113	-979	0	0	0	TRUE	FALSE
0: RWDI_21	11095	CORE P27	24.4	20.8	-6	-112	127	402	0	0	0	TRUE	FALSE
0: RWDI_22	11095	CORE P27	24.4	20.8	-6	-132	248	52	0	0	0	TRUE	FALSE
0: RWDI_23	11095	CORE P27	24.4	20.8	-6	-125	-164	-1773	0	0	0	TRUE	FALSE
0: RWDI_24	11095	CORE P27	24.4	20.8	-6	-146	-85	-2433	0	0	0	TRUE	FALSE
Total G (Wished-	11095	CORE P27	24.4	20.8	-6	-56	-27	-13281	0	0	0	FALSE	FALSE
EQSpecX	11108	CORE P29	30.7	20.8	-6	-617	-127	-1296	0	0	0	FALSE	TRUE
EQSpecY	11108	CORE P29	30.7	20.8	-6	-34	-374	-640	0	0	0	FALSE	TRUE
Robustness X	11108	CORE P29	30.7	20.8	-6	442	35	-1484	0	0	0	FALSE	FALSE
Robustness Y	11108	CORE P29	30.7	20.8	-6	12	462	1716	0	0	0	FALSE	FALSE
0: Total Q	11108	CORE P29	30.7	20.8	-6	-15	-24	-3234	0	0	0	FALSE	FALSE
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0: RWDI_02	11108	CORE P29	30.7	20.8	-6	194	145	-107	0	0	0	TRUE	FALSE
0: RWDI_03	11108	CORE P29	30.7	20.8	-6	195	-80	-1986	0	0	0	TRUE	FALSE
0: RWDI_04	11108	CORE P29	30.7	20.8	-6	185	-106	-1833	0	0	0	TRUE	FALSE
0: RWDI_05	11108	CORE P29	30.7	20.8	-6	-190	154	2128	0	0	0	TRUE	FALSE
0: RWDI_06	11108	CORE P29	30.7	20.8	-6	-205	118	2340	0	0	0	TRUE	FALSE
0: RWDI_07	11108	CORE P29	30.7	20.8	-6	-201	-138	114	0	0	0	TRUE	FALSE
0: RWDI_08	11108	CORE P29	30.7	20.8	-6	-216	-174	326	0	0	0	TRUE	FALSE
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0: RWDI_10	11108	CORE P29	30.7	20.8	-6	68	330	2055	0	0	0	TRUE	FALSE
0: RWDI_11	11108	CORE P29	30.7	20.8	-6	51	-396	-3276	0	0	0	TRUE	FALSE
0: RWDI_12	11108	CORE P29	30.7	20.8	-6	40	-424	-3111	0	0	0	TRUE	FALSE
0: RWDI_13	11108	CORE P29	30.7	20.8	-6	-93	335	2798	0	0	0	TRUE	FALSE
0: RWDI_14	11108	CORE P29	30.7	20.8	-6	-106	303	2986	0	0	0	TRUE	FALSE
0: RWDI_15	11108	CORE P29	30.7	20.8	-6	-72	-416	-2619	0	0	0	TRUE	FALSE
0: RWDI_16	11108	CORE P29	30.7	20.8	-6	-83	-444	-2454	0	0	0	TRUE	FALSE
0: RWDI_17	11108	CORE P29	30.7	20.8	-6	83	215	598	0	0	0	TRUE	FALSE
0: RWDI_18	11108	CORE P29	30.7	20.8	-6	51	137	1058	0	0	0	TRUE	FALSE
0: RWDI_19	11108	CORE P29	30.7	20.8	-6	72	-78	-1415	0	0	0	TRUE	FALSE
0: RWDI_20	11108	CORE P29	30.7	20.8	-6	39	-198	-1244	0	0	0	TRUE	FALSE
0: RWDI_21	11108	CORE P29	30.7	20.8	-6	-112	184	1639	0	0	0	TRUE	FALSE
0: RWDI_22	11108	CORE P29	30.7	20.8	-6	-133	107	2043	0	0	0	TRUE	FALSE
0: RWDI_23	11108	CORE P29	30.7	20.8	-6	-122	-109	-375	0	0	0	TRUE	FALSE
0: RWDI_24	11108	CORE P29	30.7	20.8	-6	-145	-227	-258	0	0	0	TRUE	FALSE
Total G (Wished-	11108	CORE P29	30.7	20.8	-6	-21	-28	-12547	0	0	0	FALSE	FALSE
EQSpecX	11121	CORE P37	24.4	14.5	-6	-680	-194	-1968	0	0	0	FALSE	TRUE
EQSpecY	11121	CORE P37	24.4	14.5	-6	-160	-408	-4285	0	0	0	FALSE	TRUE
Robustness X	11121	CORE P37	24.4	14.5	-6	500	-21	2552	0	0	0	FALSE	FALSE
Robustness Y	11121	CORE P37	24.4	14.5	-6	18	466	11426	0	0	0	FALSE	FALSE
0: Total Q	11121	CORE P37	24.4	14.5	-6	-21	-23	-4908	0	0	0	FALSE	FALSE
0: RWDI_01	11121	CORE P37	24.4	14.5	-6	314	73	6904	0	0	0	TRUE	FALSE
0: RWDI_02	11121	CORE P37	24.4	14.5	-6	230	114	6703	0	0	0	TRUE	FALSE
0: RWDI_03	11121	CORE P37	24.4	14.5	-6	287	-173	-3122	0	0	0	TRUE	FALSE
0: RWDI_04	11121	CORE P37	24.4	14.5	-6	203	-132	-3322	0	0	0	TRUE	FALSE
0: RWDI_05	11121	CORE P37	24.4	14.5	-6	-186	162	4961	0	0	0	TRUE	FALSE
0: RWDI_06	11121	CORE P37	24.4	14.5	-6	-302	219	4683	0	0	0	TRUE	FALSE
0: RWDI_07	11121	CORE P37	24.4	14.5	-6	-218	-126	-6735	0	0	0	TRUE	FALSE
0: RWDI_08	11121	CORE P37	24.4	14.5	-6	-334	-69	-7013	0	0	0	TRUE	FALSE
0: RWDI_09	11121	CORE P37	24.4	14.5	-6	175	292	14069	0	0	0	TRUE	FALSE
0: RWDI_10	11121	CORE P37	24.4	14.5	-6	72	342	13822	0	0	0	TRUE	FALSE
0: RWDI_11	11121	CORE P37	24.4	14.5	-6	74	-439	-16053	0	0	0	TRUE	FALSE
0: RWDI_12	11121	CORE P37	24.4	14.5	-6	-16	-395	-16269	0	0	0	TRUE	FALSE
0: RWDI_13	11121	CORE P37	24.4	14.5	-6	-54	316	12474	0	0	0	TRUE	FALSE
0: RWDI_14	11121	CORE P37	24.4	14.5	-6	-157	367	12227	0	0	0	TRUE	FALSE
0: RWDI_15	11121	CORE P37	24.4	14.5	-6	-87	-421	-17179	0	0	0	TRUE	FALSE
0: RWDI_16	11121	CORE P37	24.4	14.5	-6	-177	-377	-17395	0	0	0	TRUE	FALSE
0: RWDI_17	11121	CORE P37	24.4	14.5	-6	221	96	7540	0	0	0	TRUE	FALSE
0: RWDI_18	11121	CORE P37	24.4	14.5	-6	-30	219	6938	0	0	0	TRUE	FALSE

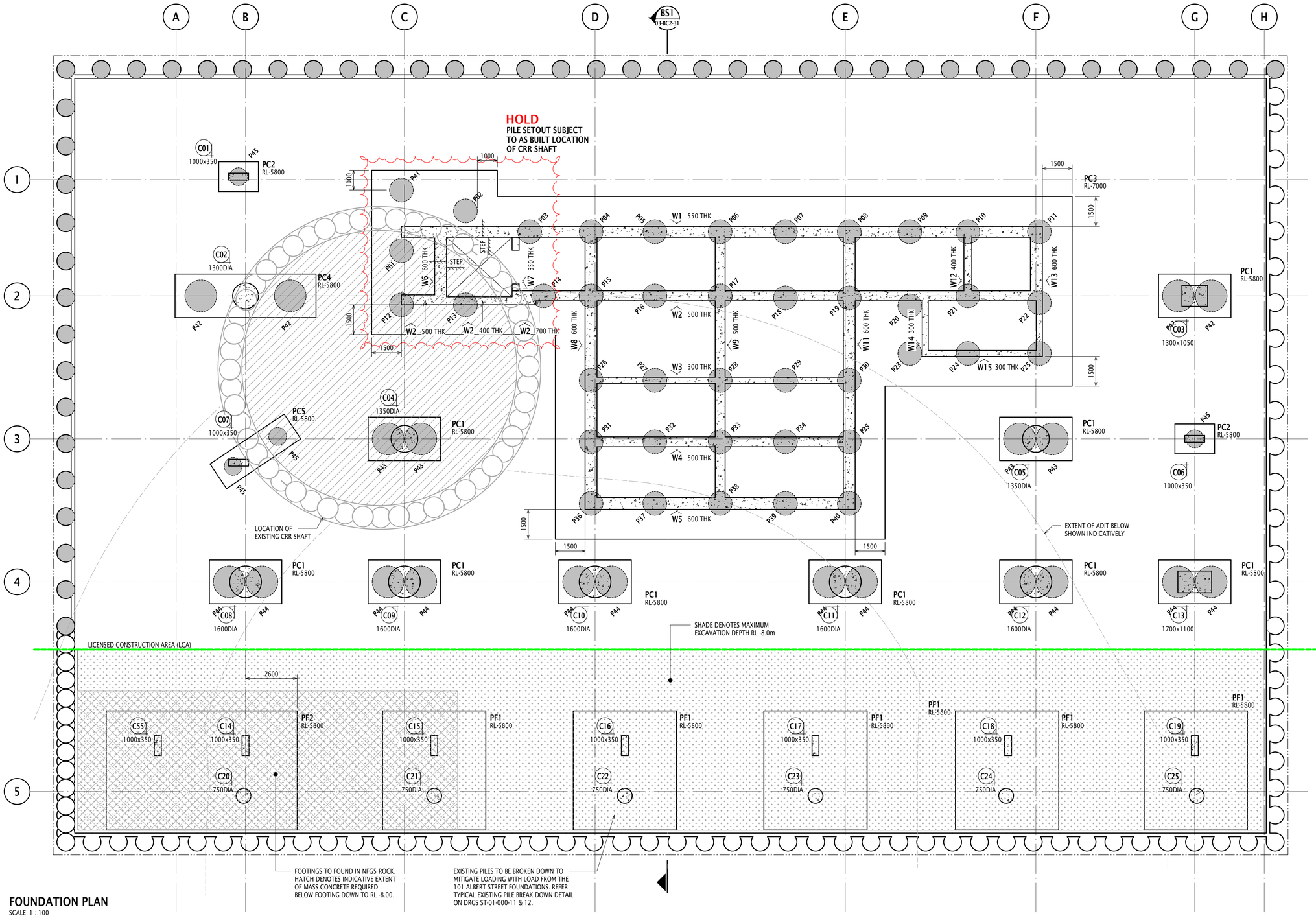
0: RWDI_19	11121	CORE P37	24.4	14.5	-6	189	-192	-4156	0	0	0	TRUE	FALSE
0: RWDI_20	11121	CORE P37	24.4	14.5	-6	-66	-110	-6429	0	0	0	TRUE	FALSE
0: RWDI_21	11121	CORE P37	24.4	14.5	-6	-34	123	5757	0	0	0	TRUE	FALSE
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0: RWDI_23	11121	CORE P37	24.4	14.5	-6	-66	-164	-5939	0	0	0	TRUE	FALSE
0: RWDI_24	11121	CORE P37	24.4	14.5	-6	-308	-84	-8118	0	0	0	TRUE	FALSE
Total G (Wished-	11121	CORE P37	24.4	14.5	-6	-42	-25	-14057	0	0	0	FALSE	FALSE
EQSpecX	11228	CORE P39	30.7	14.5	-6	-680	-130	-1792	0	0	0	FALSE	TRUE
EQSpecY	11228	CORE P39	30.7	14.5	-6	-160	-372	-4293	0	0	0	FALSE	TRUE
Robustness X	11228	CORE P39	30.7	14.5	-6	500	35	-1683	0	0	0	FALSE	FALSE
Robustness Y	11228	CORE P39	30.7	14.5	-6	-10	458	11207	0	0	0	FALSE	FALSE
0: Total Q	11228	CORE P39	30.7	14.5	-6	-7	-20	-4796	0	0	0	FALSE	FALSE
0: RWDI_01	11228	CORE P39	30.7	14.5	-6	300	170	3609	0	0	0	TRUE	FALSE
0: RWDI_02	11228	CORE P39	30.7	14.5	-6	217	143	3856	0	0	0	TRUE	FALSE
0: RWDI_03	11228	CORE P39	30.7	14.5	-6	302	-78	-6205	0	0	0	TRUE	FALSE
0: RWDI_04	11228	CORE P39	30.7	14.5	-6	218	-105	-5958	0	0	0	TRUE	FALSE
0: RWDI_05	11228	CORE P39	30.7	14.5	-6	-206	153	7579	0	0	0	TRUE	FALSE
0: RWDI_06	11228	CORE P39	30.7	14.5	-6	-322	116	7921	0	0	0	TRUE	FALSE
0: RWDI_07	11228	CORE P39	30.7	14.5	-6	-204	-137	-3871	0	0	0	TRUE	FALSE
0: RWDI_08	11228	CORE P39	30.7	14.5	-6	-320	-174	-3529	0	0	0	TRUE	FALSE
0: RWDI_09	11228	CORE P39	30.7	14.5	-6	137	360	12546	0	0	0	TRUE	FALSE
0: RWDI_10	11228	CORE P39	30.7	14.5	-6	34	327	12851	0	0	0	TRUE	FALSE
0: RWDI_11	11228	CORE P39	30.7	14.5	-6	121	-392	-16839	0	0	0	TRUE	FALSE
0: RWDI_12	11228	CORE P39	30.7	14.5	-6	31	-421	-16573	0	0	0	TRUE	FALSE
0: RWDI_13	11228	CORE P39	30.7	14.5	-6	-92	332	13589	0	0	0	TRUE	FALSE
0: RWDI_14	11228	CORE P39	30.7	14.5	-6	-195	299	13893	0	0	0	TRUE	FALSE
0: RWDI_15	11228	CORE P39	30.7	14.5	-6	-40	-412	-16103	0	0	0	TRUE	FALSE
0: RWDI_16	11228	CORE P39	30.7	14.5	-6	-130	-441	-15837	0	0	0	TRUE	FALSE
0: RWDI_17	11228	CORE P39	30.7	14.5	-6	202	215	5814	0	0	0	TRUE	FALSE
0: RWDI_18	11228	CORE P39	30.7	14.5	-6	-49	135	6555	0	0	0	TRUE	FALSE
0: RWDI_19	11228	CORE P39	30.7	14.5	-6	204	-75	-5636	0	0	0	TRUE	FALSE
0: RWDI_20	11228	CORE P39	30.7	14.5	-6	-47	-197	-6530	0	0	0	TRUE	FALSE
0: RWDI_21	11228	CORE P39	30.7	14.5	-6	-54	183	6978	0	0	0	TRUE	FALSE
0: RWDI_22	11228	CORE P39	30.7	14.5	-6	-291	105	7659	0	0	0	TRUE	FALSE
0: RWDI_23	11228	CORE P39	30.7	14.5	-6	-52	-107	-4471	0	0	0	TRUE	FALSE
0: RWDI_24	11228	CORE P39	30.7	14.5	-6	-290	-227	-5427	0	0	0	TRUE	FALSE
Total G (Wished-	11228	CORE P39	30.7	14.5	-6	-4	-19	-13577	0	0	0	FALSE	FALSE
EQSpecX	11229	CORE P32	24.4	17.6	-6	-639	-194	-1971	0	0	0	FALSE	TRUE
EQSpecY	11229	CORE P32	24.4	17.6	-6	-94	-408	-2114	0	0	0	FALSE	TRUE
Robustness X	11229	CORE P32	24.4	17.6	-6	470	-22	2464	0	0	0	FALSE	FALSE
Robustness Y	11229	CORE P32	24.4	17.6	-6	16	468	6319	0	0	0	FALSE	FALSE
0: Total Q	11229	CORE P32	24.4	17.6	-6	-22	-24	-4261	0	0	0	FALSE	FALSE
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0: RWDI_03	11229	CORE P32	24.4	17.6	-6	239	-175	-1071	0	0	0	TRUE	FALSE
0: RWDI_04	11229	CORE P32	24.4	17.6	-6	192	-134	-1276	0	0	0	TRUE	FALSE
0: RWDI_05	11229	CORE P32	24.4	17.6	-6	-187	164	2219	0	0	0	TRUE	FALSE
0: RWDI_06	11229	CORE P32	24.4	17.6	-6	-251	221	1935	0	0	0	TRUE	FALSE
0: RWDI_07	11229	CORE P32	24.4	17.6	-6	-210	-126	-4579	0	0	0	TRUE	FALSE
0: RWDI_08	11229	CORE P32	24.4	17.6	-6	-274	-69	-4863	0	0	0	TRUE	FALSE
0: RWDI_09	11229	CORE P32	24.4	17.6	-6	129	293	8458	0	0	0	TRUE	FALSE
0: RWDI_10	11229	CORE P32	24.4	17.6	-6	72	344	8206	0	0	0	TRUE	FALSE
0: RWDI_11	11229	CORE P32	24.4	17.6	-6	59	-441	-9070	0	0	0	TRUE	FALSE
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0: RWDI_13	11229	CORE P32	24.4	17.6	-6	-71	319	6908	0	0	0	TRUE	FALSE
0: RWDI_14	11229	CORE P32	24.4	17.6	-6	-128	369	6656	0	0	0	TRUE	FALSE
0: RWDI_15	11229	CORE P32	24.4	17.6	-6	-83	-423	-10164	0	0	0	TRUE	FALSE
0: RWDI_16	11229	CORE P32	24.4	17.6	-6	-132	-379	-10384	0	0	0	TRUE	FALSE
0: RWDI_17	11229	CORE P32	24.4	17.6	-6	152	96	4731	0	0	0	TRUE	FALSE
0: RWDI_18	11229	CORE P32	24.4	17.6	-6	13	220	4117	0	0	0	TRUE	FALSE
0: RWDI_19	11229	CORE P32	24.4	17.6	-6	128	-193	-2067	0	0	0	TRUE	FALSE
0: RWDI_20	11229	CORE P32	24.4	17.6	-6	-14	-111	-3653	0	0	0	TRUE	FALSE
0: RWDI_21	11229	CORE P32	24.4	17.6	-6	-72	125	2999	0	0	0	TRUE	FALSE
0: RWDI_22	11229	CORE P32	24.4	17.6	-6	-199	247	2476	0	0	0	TRUE	FALSE
0: RWDI_23	11229	CORE P32	24.4	17.6	-6	-95	-164	-3799	0	0	0	TRUE	FALSE
0: RWDI_24	11229	CORE P32	24.4	17.6	-6	-226	-84	-5293	0	0	0	TRUE	FALSE
Total G (Wished-	11229	CORE P32	24.4	17.6	-6	-50	-26	-14012	0	0	0	FALSE	FALSE
EQSpecX	11230	CORE P34	30.7	17.6	-6	-639	-129	-1631	0	0	0	FALSE	TRUE
EQSpecY	11230	CORE P34	30.7	17.6	-6	-94	-372	-2094	0	0	0	FALSE	TRUE

Robustness X	11230	CORE P34	30.7	17.6	-6	470	35	-1685	0	0	0	FALSE	FALSE
Robustness Y	11230	CORE P34	30.7	17.6	-6	2	460	6147	0	0	0	FALSE	FALSE
0: Total Q	11230	CORE P34	30.7	17.6	-6	-10	-22	-4123	0	0	0	FALSE	FALSE
0: RWDI_01	11230	CORE P34	30.7	17.6	-6	252	170	1529	0	0	0	TRUE	FALSE
0: RWDI_02	11230	CORE P34	30.7	17.6	-6	205	144	1748	0	0	0	TRUE	FALSE
0: RWDI_03	11230	CORE P34	30.7	17.6	-6	247	-79	-4118	0	0	0	TRUE	FALSE
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0: RWDI_07	11230	CORE P34	30.7	17.6	-6	-203	-137	-1753	0	0	0	TRUE	FALSE
0: RWDI_08	11230	CORE P34	30.7	17.6	-6	-267	-174	-1451	0	0	0	TRUE	FALSE
0: RWDI_09	11230	CORE P34	30.7	17.6	-6	109	361	7007	0	0	0	TRUE	FALSE
0: RWDI_10	11230	CORE P34	30.7	17.6	-6	52	329	7276	0	0	0	TRUE	FALSE
0: RWDI_11	11230	CORE P34	30.7	17.6	-6	85	-394	-9884	0	0	0	TRUE	FALSE
0: RWDI_12	11230	CORE P34	30.7	17.6	-6	35	-423	-9649	0	0	0	TRUE	FALSE
0: RWDI_13	11230	CORE P34	30.7	17.6	-6	-92	333	8060	0	0	0	TRUE	FALSE
0: RWDI_14	11230	CORE P34	30.7	17.6	-6	-149	301	8329	0	0	0	TRUE	FALSE
0: RWDI_15	11230	CORE P34	30.7	17.6	-6	-57	-414	-9141	0	0	0	TRUE	FALSE
0: RWDI_16	11230	CORE P34	30.7	17.6	-6	-107	-442	-8906	0	0	0	TRUE	FALSE
0: RWDI_17	11230	CORE P34	30.7	17.6	-6	142	215	3074	0	0	0	TRUE	FALSE
0: RWDI_18	11230	CORE P34	30.7	17.6	-6	2	136	3730	0	0	0	TRUE	FALSE
0: RWDI_19	11230	CORE P34	30.7	17.6	-6	137	-76	-3515	0	0	0	TRUE	FALSE
0: RWDI_20	11230	CORE P34	30.7	17.6	-6	-4	-197	-3800	0	0	0	TRUE	FALSE
0: RWDI_21	11230	CORE P34	30.7	17.6	-6	-83	184	4250	0	0	0	TRUE	FALSE
0: RWDI_22	11230	CORE P34	30.7	17.6	-6	-210	106	4844	0	0	0	TRUE	FALSE
0: RWDI_23	11230	CORE P34	30.7	17.6	-6	-88	-108	-2338	0	0	0	TRUE	FALSE
0: RWDI_24	11230	CORE P34	30.7	17.6	-6	-216	-227	-2686	0	0	0	TRUE	FALSE
Total G (Wished-	11230	CORE P34	30.7	17.6	-6	-10	-23	-13380	0	0	0	FALSE	FALSE
EQSpecX	11503	CORE P01	11.6	27.4	-6	-846	-655	-4294	0	0	0	FALSE	TRUE
EQSpecY	11503	CORE P01	11.6	27.4	-6	-109	-528	-947	0	0	0	FALSE	TRUE
Robustness X	11503	CORE P01	11.6	27.4	-6	438	-152	5955	0	0	0	FALSE	FALSE
Robustness Y	11503	CORE P01	11.6	27.4	-6	-50	426	-3250	0	0	0	FALSE	FALSE
0: Total Q	11503	CORE P01	11.6	27.4	-6	-21	33	-2079	0	0	0	FALSE	FALSE
0: RWDI_01	11503	CORE P01	11.6	27.4	-6	118	-119	2625	0	0	0	TRUE	FALSE
0: RWDI_02	11503	CORE P01	11.6	27.4	-6	171	21	2675	0	0	0	TRUE	FALSE
0: RWDI_03	11503	CORE P01	11.6	27.4	-6	168	-333	5703	0	0	0	TRUE	FALSE
0: RWDI_04	11503	CORE P01	11.6	27.4	-6	221	-194	5752	0	0	0	TRUE	FALSE
0: RWDI_05	11503	CORE P01	11.6	27.4	-6	-255	194	-6501	0	0	0	TRUE	FALSE
0: RWDI_06	11503	CORE P01	11.6	27.4	-6	-181	388	-6432	0	0	0	TRUE	FALSE
0: RWDI_07	11503	CORE P01	11.6	27.4	-6	-197	-56	-2911	0	0	0	TRUE	FALSE
0: RWDI_08	11503	CORE P01	11.6	27.4	-6	-123	137	-2842	0	0	0	TRUE	FALSE
0: RWDI_09	11503	CORE P01	11.6	27.4	-6	-49	142	-2814	0	0	0	TRUE	FALSE
0: RWDI_10	11503	CORE P01	11.6	27.4	-6	16	313	-2753	0	0	0	TRUE	FALSE
0: RWDI_11	11503	CORE P01	11.6	27.4	-6	113	-469	6429	0	0	0	TRUE	FALSE
0: RWDI_12	11503	CORE P01	11.6	27.4	-6	170	-319	6483	0	0	0	TRUE	FALSE
0: RWDI_13	11503	CORE P01	11.6	27.4	-6	-203	277	-6564	0	0	0	TRUE	FALSE
0: RWDI_14	11503	CORE P01	11.6	27.4	-6	-137	448	-6502	0	0	0	TRUE	FALSE
0: RWDI_15	11503	CORE P01	11.6	27.4	-6	4	-374	3782	0	0	0	TRUE	FALSE
0: RWDI_16	11503	CORE P01	11.6	27.4	-6	62	-224	3836	0	0	0	TRUE	FALSE
0: RWDI_17	11503	CORE P01	11.6	27.4	-6	-57	-109	-801	0	0	0	TRUE	FALSE
0: RWDI_18	11503	CORE P01	11.6	27.4	-6	103	310	-651	0	0	0	TRUE	FALSE
0: RWDI_19	11503	CORE P01	11.6	27.4	-6	1	-359	2789	0	0	0	TRUE	FALSE
0: RWDI_20	11503	CORE P01	11.6	27.4	-6	169	24	3452	0	0	0	TRUE	FALSE
0: RWDI_21	11503	CORE P01	11.6	27.4	-6	-228	42	-4992	0	0	0	TRUE	FALSE
0: RWDI_22	11503	CORE P01	11.6	27.4	-6	-60	453	-4622	0	0	0	TRUE	FALSE
0: RWDI_23	11503	CORE P01	11.6	27.4	-6	-170	-208	-1402	0	0	0	TRUE	FALSE
0: RWDI_24	11503	CORE P01	11.6	27.4	-6	7	167	-519	0	0	0	TRUE	FALSE
Total G (Wished-	11503	CORE P01	11.6	27.4	-6	-127	116	-11911	0	0	0	FALSE	FALSE
EQSpecX	11504	CORE P41	11.6	30.5	-6	-904	-649	-3108	0	0	0	FALSE	TRUE
EQSpecY	11504	CORE P41	11.6	30.5	-6	-153	-526	-2283	0	0	0	FALSE	TRUE
Robustness X	11504	CORE P41	11.6	30.5	-6	397	-154	4338	0	0	0	FALSE	FALSE
Robustness Y	11504	CORE P41	11.6	30.5	-6	-65	425	-5741	0	0	0	FALSE	FALSE
0: Total Q	11504	CORE P41	11.6	30.5	-6	-2	33	-1083	0	0	0	FALSE	FALSE
0: RWDI_01	11504	CORE P41	11.6	30.5	-6	69	-119	664	0	0	0	TRUE	FALSE
0: RWDI_02	11504	CORE P41	11.6	30.5	-6	142	20	575	0	0	0	TRUE	FALSE
0: RWDI_03	11504	CORE P41	11.6	30.5	-6	129	-334	5580	0	0	0	TRUE	FALSE
0: RWDI_04	11504	CORE P41	11.6	30.5	-6	202	-195	5490	0	0	0	TRUE	FALSE
0: RWDI_05	11504	CORE P41	11.6	30.5	-6	-241	196	-6444	0	0	0	TRUE	FALSE
0: RWDI_06	11504	CORE P41	11.6	30.5	-6	-141	388	-6568	0	0	0	TRUE	FALSE

0: RWDI_07	11504	CORE P41	11.6	30.5	-6	-172	-55	-709	0	0	0	TRUE	FALSE
0: RWDI_08	11504	CORE P41	11.6	30.5	-6	-71	137	-833	0	0	0	TRUE	FALSE
0: RWDI_09	11504	CORE P41	11.6	30.5	-6	-86	143	-5522	0	0	0	TRUE	FALSE
0: RWDI_10	11504	CORE P41	11.6	30.5	-6	3	313	-5632	0	0	0	TRUE	FALSE
0: RWDI_11	11504	CORE P41	11.6	30.5	-6	110	-470	9205	0	0	0	TRUE	FALSE
0: RWDI_12	11504	CORE P41	11.6	30.5	-6	188	-321	9109	0	0	0	TRUE	FALSE
0: RWDI_13	11504	CORE P41	11.6	30.5	-6	-210	279	-8272	0	0	0	TRUE	FALSE
0: RWDI_14	11504	CORE P41	11.6	30.5	-6	-121	449	-8383	0	0	0	TRUE	FALSE
0: RWDI_15	11504	CORE P41	11.6	30.5	-6	22	-374	7264	0	0	0	TRUE	FALSE
0: RWDI_16	11504	CORE P41	11.6	30.5	-6	101	-225	7167	0	0	0	TRUE	FALSE
0: RWDI_17	11504	CORE P41	11.6	30.5	-6	-102	-107	-2175	0	0	0	TRUE	FALSE
0: RWDI_18	11504	CORE P41	11.6	30.5	-6	116	309	-2445	0	0	0	TRUE	FALSE
0: RWDI_19	11504	CORE P41	11.6	30.5	-6	-33	-358	3560	0	0	0	TRUE	FALSE
0: RWDI_20	11504	CORE P41	11.6	30.5	-6	195	22	4110	0	0	0	TRUE	FALSE
0: RWDI_21	11504	CORE P41	11.6	30.5	-6	-241	45	-5249	0	0	0	TRUE	FALSE
0: RWDI_22	11504	CORE P41	11.6	30.5	-6	-15	452	-5357	0	0	0	TRUE	FALSE
0: RWDI_23	11504	CORE P41	11.6	30.5	-6	-171	-206	486	0	0	0	TRUE	FALSE
0: RWDI_24	11504	CORE P41	11.6	30.5	-6	64	166	1197	0	0	0	TRUE	FALSE
Total G (Wished-	11504	CORE P41	11.6	30.5	-6	-73	119	-8778	0	0	0	FALSE	FALSE
EQSpecX	11533	CORE P13	14.8	25.1	-6	-784	-567	-4760	0	0	0	FALSE	TRUE
EQSpecY	11533	CORE P13	14.8	25.1	-6	-77	-519	-916	0	0	0	FALSE	TRUE
Robustness X	11533	CORE P13	14.8	25.1	-6	452	-119	6529	0	0	0	FALSE	FALSE
Robustness Y	11533	CORE P13	14.8	25.1	-6	-25	451	-1477	0	0	0	FALSE	FALSE
0: Total Q	11533	CORE P13	14.8	25.1	-6	-31	13	-3159	0	0	0	FALSE	FALSE
0: RWDI_01	11533	CORE P13	14.8	25.1	-6	151	-71	3683	0	0	0	TRUE	FALSE
0: RWDI_02	11533	CORE P13	14.8	25.1	-6	187	49	3820	0	0	0	TRUE	FALSE
0: RWDI_03	11533	CORE P13	14.8	25.1	-6	181	-303	5468	0	0	0	TRUE	FALSE
0: RWDI_04	11533	CORE P13	14.8	25.1	-6	217	-183	5606	0	0	0	TRUE	FALSE
0: RWDI_05	11533	CORE P13	14.8	25.1	-6	-243	191	-6190	0	0	0	TRUE	FALSE
0: RWDI_06	11533	CORE P13	14.8	25.1	-6	-193	357	-6000	0	0	0	TRUE	FALSE
0: RWDI_07	11533	CORE P13	14.8	25.1	-6	-208	-79	-4107	0	0	0	TRUE	FALSE
0: RWDI_08	11533	CORE P13	14.8	25.1	-6	-158	87	-3917	0	0	0	TRUE	FALSE
0: RWDI_09	11533	CORE P13	14.8	25.1	-6	-6	187	-1007	0	0	0	TRUE	FALSE
0: RWDI_10	11533	CORE P13	14.8	25.1	-6	38	335	-838	0	0	0	TRUE	FALSE
0: RWDI_11	11533	CORE P13	14.8	25.1	-6	92	-480	4380	0	0	0	TRUE	FALSE
0: RWDI_12	11533	CORE P13	14.8	25.1	-6	131	-351	4528	0	0	0	TRUE	FALSE
0: RWDI_13	11533	CORE P13	14.8	25.1	-6	-172	297	-5167	0	0	0	TRUE	FALSE
0: RWDI_14	11533	CORE P13	14.8	25.1	-6	-128	444	-4998	0	0	0	TRUE	FALSE
0: RWDI_15	11533	CORE P13	14.8	25.1	-6	-25	-403	1444	0	0	0	TRUE	FALSE
0: RWDI_16	11533	CORE P13	14.8	25.1	-6	14	-273	1592	0	0	0	TRUE	FALSE
0: RWDI_17	11533	CORE P13	14.8	25.1	-6	-14	-60	77	0	0	0	TRUE	FALSE
0: RWDI_18	11533	CORE P13	14.8	25.1	-6	94	300	490	0	0	0	TRUE	FALSE
0: RWDI_19	11533	CORE P13	14.8	25.1	-6	21	-330	2160	0	0	0	TRUE	FALSE
0: RWDI_20	11533	CORE P13	14.8	25.1	-6	134	-8	2870	0	0	0	TRUE	FALSE
0: RWDI_21	11533	CORE P13	14.8	25.1	-6	-200	63	-4572	0	0	0	TRUE	FALSE
0: RWDI_22	11533	CORE P13	14.8	25.1	-6	-82	416	-3915	0	0	0	TRUE	FALSE
0: RWDI_23	11533	CORE P13	14.8	25.1	-6	-165	-207	-2489	0	0	0	TRUE	FALSE
0: RWDI_24	11533	CORE P13	14.8	25.1	-6	-42	108	-1535	0	0	0	TRUE	FALSE
Total G (Wished-	11533	CORE P13	14.8	25.1	-6	-133	69	-15839	0	0	0	FALSE	FALSE
EQSpecX	11568	CORE P02	14.8	29.4	-6	-893	-564	-3595	0	0	0	FALSE	TRUE
EQSpecY	11568	CORE P02	14.8	29.4	-6	-137	-515	-2438	0	0	0	FALSE	TRUE
Robustness X	11568	CORE P02	14.8	29.4	-6	407	-116	5339	0	0	0	FALSE	FALSE
Robustness Y	11568	CORE P02	14.8	29.4	-6	-51	446	-6754	0	0	0	FALSE	FALSE
0: Total Q	11568	CORE P02	14.8	29.4	-6	-7	12	-2001	0	0	0	FALSE	FALSE
0: RWDI_01	11568	CORE P02	14.8	29.4	-6	84	-70	920	0	0	0	TRUE	FALSE
0: RWDI_02	11568	CORE P02	14.8	29.4	-6	151	49	851	0	0	0	TRUE	FALSE
0: RWDI_03	11568	CORE P02	14.8	29.4	-6	133	-298	6846	0	0	0	TRUE	FALSE
0: RWDI_04	11568	CORE P02	14.8	29.4	-6	201	-179	6776	0	0	0	TRUE	FALSE
0: RWDI_05	11568	CORE P02	14.8	29.4	-6	-238	186	-7945	0	0	0	TRUE	FALSE
0: RWDI_06	11568	CORE P02	14.8	29.4	-6	-144	351	-8041	0	0	0	TRUE	FALSE
0: RWDI_07	11568	CORE P02	14.8	29.4	-6	-180	-80	-1032	0	0	0	TRUE	FALSE
0: RWDI_08	11568	CORE P02	14.8	29.4	-6	-86	86	-1128	0	0	0	TRUE	FALSE
0: RWDI_09	11568	CORE P02	14.8	29.4	-6	-67	183	-6638	0	0	0	TRUE	FALSE
0: RWDI_10	11568	CORE P02	14.8	29.4	-6	16	330	-6724	0	0	0	TRUE	FALSE
0: RWDI_11	11568	CORE P02	14.8	29.4	-6	97	-473	11122	0	0	0	TRUE	FALSE
0: RWDI_12	11568	CORE P02	14.8	29.4	-6	170	-344	11047	0	0	0	TRUE	FALSE
0: RWDI_13	11568	CORE P02	14.8	29.4	-6	-197	290	-10079	0	0	0	TRUE	FALSE
0: RWDI_14	11568	CORE P02	14.8	29.4	-6	-113	437	-10164	0	0	0	TRUE	FALSE
0: RWDI_15	11568	CORE P02	14.8	29.4	-6	5	-397	8693	0	0	0	TRUE	FALSE

0: RWDI_16	11568	CORE P02	14.8	29.4	-6	79	-268	8619	0	0	0	TRUE	FALSE
0: RWDI_17	11568	CORE P02	14.8	29.4	-6	-87	-61	-2634	0	0	0	TRUE	FALSE
0: RWDI_18	11568	CORE P02	14.8	29.4	-6	117	298	-2843	0	0	0	TRUE	FALSE
0: RWDI_19	11568	CORE P02	14.8	29.4	-6	-29	-326	4279	0	0	0	TRUE	FALSE
0: RWDI_20	11568	CORE P02	14.8	29.4	-6	183	-6	5058	0	0	0	TRUE	FALSE
0: RWDI_21	11568	CORE P02	14.8	29.4	-6	-231	59	-6480	0	0	0	TRUE	FALSE
0: RWDI_22	11568	CORE P02	14.8	29.4	-6	-20	411	-6486	0	0	0	TRUE	FALSE
0: RWDI_23	11568	CORE P02	14.8	29.4	-6	-174	-206	433	0	0	0	TRUE	FALSE
0: RWDI_24	11568	CORE P02	14.8	29.4	-6	46	108	1415	0	0	0	TRUE	FALSE
Total G (Wished-	11568	CORE P02	14.8	29.4	-6	-80	63	-13608	0	0	0	FALSE	FALSE
EQSpecX	11589	CORE P03	18.1	28.4	-6	-881	-461	-3092	0	0	0	FALSE	TRUE
EQSpecY	11589	CORE P03	18.1	28.4	-6	-123	-494	-2321	0	0	0	FALSE	TRUE
Robustness X	11589	CORE P03	18.1	28.4	-6	407	-81	4677	0	0	0	FALSE	FALSE
Robustness Y	11589	CORE P03	18.1	28.4	-6	-28	459	-6678	0	0	0	FALSE	FALSE
0: Total Q	11589	CORE P03	18.1	28.4	-6	-11	-8	-2343	0	0	0	FALSE	FALSE
0: RWDI_01	11589	CORE P03	18.1	28.4	-6	94	-23	463	0	0	0	TRUE	FALSE
0: RWDI_02	11589	CORE P03	18.1	28.4	-6	158	74	410	0	0	0	TRUE	FALSE
0: RWDI_03	11589	CORE P03	18.1	28.4	-6	126	-259	6382	0	0	0	TRUE	FALSE
0: RWDI_04	11589	CORE P03	18.1	28.4	-6	190	-162	6329	0	0	0	TRUE	FALSE
0: RWDI_05	11589	CORE P03	18.1	28.4	-6	-222	176	-7478	0	0	0	TRUE	FALSE
0: RWDI_06	11589	CORE P03	18.1	28.4	-6	-134	311	-7551	0	0	0	TRUE	FALSE
0: RWDI_07	11589	CORE P03	18.1	28.4	-6	-185	-99	-572	0	0	0	TRUE	FALSE
0: RWDI_08	11589	CORE P03	18.1	28.4	-6	-97	35	-645	0	0	0	TRUE	FALSE
0: RWDI_09	11589	CORE P03	18.1	28.4	-6	-41	220	-6784	0	0	0	TRUE	FALSE
0: RWDI_10	11589	CORE P03	18.1	28.4	-6	37	339	-6849	0	0	0	TRUE	FALSE
0: RWDI_11	11589	CORE P03	18.1	28.4	-6	70	-467	10961	0	0	0	TRUE	FALSE
0: RWDI_12	11589	CORE P03	18.1	28.4	-6	138	-362	10904	0	0	0	TRUE	FALSE
0: RWDI_13	11589	CORE P03	18.1	28.4	-6	-170	299	-9820	0	0	0	TRUE	FALSE
0: RWDI_14	11589	CORE P03	18.1	28.4	-6	-92	419	-9885	0	0	0	TRUE	FALSE
0: RWDI_15	11589	CORE P03	18.1	28.4	-6	-22	-411	8818	0	0	0	TRUE	FALSE
0: RWDI_16	11589	CORE P03	18.1	28.4	-6	47	-306	8761	0	0	0	TRUE	FALSE
0: RWDI_17	11589	CORE P03	18.1	28.4	-6	-69	-12	-2797	0	0	0	TRUE	FALSE
0: RWDI_18	11589	CORE P03	18.1	28.4	-6	122	279	-2956	0	0	0	TRUE	FALSE
0: RWDI_19	11589	CORE P03	18.1	28.4	-6	-31	-288	4109	0	0	0	TRUE	FALSE
0: RWDI_20	11589	CORE P03	18.1	28.4	-6	165	-36	4936	0	0	0	TRUE	FALSE
0: RWDI_21	11589	CORE P03	18.1	28.4	-6	-213	76	-6191	0	0	0	TRUE	FALSE
0: RWDI_22	11589	CORE P03	18.1	28.4	-6	-15	363	-6171	0	0	0	TRUE	FALSE
0: RWDI_23	11589	CORE P03	18.1	28.4	-6	-176	-199	715	0	0	0	TRUE	FALSE
0: RWDI_24	11589	CORE P03	18.1	28.4	-6	28	48	1721	0	0	0	TRUE	FALSE
Total G (Wished-	11589	CORE P03	18.1	28.4	-6	-67	12	-15118	0	0	0	FALSE	FALSE
EQSpecX	11629	CORE P20	37.0	25.1	-6	-753	-429	-2455	0	0	0	FALSE	TRUE
EQSpecY	11629	CORE P20	37.0	25.1	-6	-84	-451	-807	0	0	0	FALSE	TRUE
Robustness X	11629	CORE P20	37.0	25.1	-6	424	71	-3768	0	0	0	FALSE	FALSE
Robustness Y	11629	CORE P20	37.0	25.1	-6	44	435	-2844	0	0	0	FALSE	FALSE
0: Total Q	11629	CORE P20	37.0	25.1	-6	-21	-21	-2509	0	0	0	FALSE	FALSE
0: RWDI_01	11629	CORE P20	37.0	25.1	-6	164	241	-4027	0	0	0	TRUE	FALSE
0: RWDI_02	11629	CORE P20	37.0	25.1	-6	196	155	-4053	0	0	0	TRUE	FALSE
0: RWDI_03	11629	CORE P20	37.0	25.1	-6	134	7	-1379	0	0	0	TRUE	FALSE
0: RWDI_04	11629	CORE P20	37.0	25.1	-6	166	-80	-1405	0	0	0	TRUE	FALSE
0: RWDI_05	11629	CORE P20	37.0	25.1	-6	-179	141	1114	0	0	0	TRUE	FALSE
0: RWDI_06	11629	CORE P20	37.0	25.1	-6	-135	22	1078	0	0	0	TRUE	FALSE
0: RWDI_07	11629	CORE P20	37.0	25.1	-6	-214	-133	4204	0	0	0	TRUE	FALSE
0: RWDI_08	11629	CORE P20	37.0	25.1	-6	-170	-252	4168	0	0	0	TRUE	FALSE
0: RWDI_09	11629	CORE P20	37.0	25.1	-6	70	397	-4372	0	0	0	TRUE	FALSE
0: RWDI_10	11629	CORE P20	37.0	25.1	-6	110	291	-4403	0	0	0	TRUE	FALSE
0: RWDI_11	11629	CORE P20	37.0	25.1	-6	-12	-327	3568	0	0	0	TRUE	FALSE
0: RWDI_12	11629	CORE P20	37.0	25.1	-6	22	-420	3540	0	0	0	TRUE	FALSE
0: RWDI_13	11629	CORE P20	37.0	25.1	-6	-78	328	-1941	0	0	0	TRUE	FALSE
0: RWDI_14	11629	CORE P20	37.0	25.1	-6	-39	222	-1972	0	0	0	TRUE	FALSE
0: RWDI_15	11629	CORE P20	37.0	25.1	-6	-117	-376	5284	0	0	0	TRUE	FALSE
0: RWDI_16	11629	CORE P20	37.0	25.1	-6	-83	-469	5256	0	0	0	TRUE	FALSE
0: RWDI_17	11629	CORE P20	37.0	25.1	-6	25	307	-2586	0	0	0	TRUE	FALSE
0: RWDI_18	11629	CORE P20	37.0	25.1	-6	122	48	-2663	0	0	0	TRUE	FALSE
0: RWDI_19	11629	CORE P20	37.0	25.1	-6	-9	33	504	0	0	0	TRUE	FALSE
0: RWDI_20	11629	CORE P20	37.0	25.1	-6	82	-265	868	0	0	0	TRUE	FALSE
0: RWDI_21	11629	CORE P20	37.0	25.1	-6	-140	230	131	0	0	0	TRUE	FALSE
0: RWDI_22	11629	CORE P20	37.0	25.1	-6	-35	-25	-89	0	0	0	TRUE	FALSE
0: RWDI_23	11629	CORE P20	37.0	25.1	-6	-175	-44	3221	0	0	0	TRUE	FALSE
0: RWDI_24	11629	CORE P20	37.0	25.1	-6	-75	-338	3442	0	0	0	TRUE	FALSE

Total G (Wished-	11629	CORE P20	37.0	25.1	-6	-13	-44	-12483	0	0	0	FALSE	FALSE
EQSpecX	11635	CORE P23	37.0	22.0	-6	-611	-433	-2189	0	0	0	FALSE	TRUE
EQSpecY	11635	CORE P23	37.0	22.0	-6	-21	-455	-750	0	0	0	FALSE	TRUE
Robustness X	11635	CORE P23	37.0	22.0	-6	430	73	-3268	0	0	0	FALSE	FALSE
Robustness Y	11635	CORE P23	37.0	22.0	-6	23	437	1295	0	0	0	FALSE	FALSE
0: Total Q	11635	CORE P23	37.0	22.0	-6	-17	-20	-2677	0	0	0	FALSE	FALSE
0: RWDI_01	11635	CORE P23	37.0	22.0	-6	191	244	-1854	0	0	0	TRUE	FALSE
0: RWDI_02	11635	CORE P23	37.0	22.0	-6	192	157	-1850	0	0	0	TRUE	FALSE
0: RWDI_03	11635	CORE P23	37.0	22.0	-6	175	8	-2839	0	0	0	TRUE	FALSE
0: RWDI_04	11635	CORE P23	37.0	22.0	-6	176	-80	-2834	0	0	0	TRUE	FALSE
0: RWDI_05	11635	CORE P23	37.0	22.0	-6	-183	142	3120	0	0	0	TRUE	FALSE
0: RWDI_06	11635	CORE P23	37.0	22.0	-6	-182	21	3126	0	0	0	TRUE	FALSE
0: RWDI_07	11635	CORE P23	37.0	22.0	-6	-202	-134	1972	0	0	0	TRUE	FALSE
0: RWDI_08	11635	CORE P23	37.0	22.0	-6	-201	-255	1978	0	0	0	TRUE	FALSE
0: RWDI_09	11635	CORE P23	37.0	22.0	-6	79	400	570	0	0	0	TRUE	FALSE
0: RWDI_10	11635	CORE P23	37.0	22.0	-6	80	293	575	0	0	0	TRUE	FALSE
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0: RWDI_14	11635	CORE P23	37.0	22.0	-6	-84	222	2672	0	0	0	TRUE	FALSE
0: RWDI_15	11635	CORE P23	37.0	22.0	-6	-85	-378	-903	0	0	0	TRUE	FALSE
0: RWDI_16	11635	CORE P23	37.0	22.0	-6	-84	-473	-898	0	0	0	TRUE	FALSE
0: RWDI_17	11635	CORE P23	37.0	22.0	-6	67	310	-90	0	0	0	TRUE	FALSE
0: RWDI_18	11635	CORE P23	37.0	22.0	-6	70	48	-77	0	0	0	TRUE	FALSE
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0: RWDI_20	11635	CORE P23	37.0	22.0	-6	49	-267	-1390	0	0	0	TRUE	FALSE
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0: RWDI_22	11635	CORE P23	37.0	22.0	-6	-104	-27	2144	0	0	0	TRUE	FALSE
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0: RWDI_24	11635	CORE P23	37.0	22.0	-6	-125	-342	831	0	0	0	TRUE	FALSE
Total G (Wished-	11635	CORE P23	37.0	22.0	-6	-18	-41	-10732	0	0	0	FALSE	FALSE
EQSpecX	11638	CORE P09	37.0	28.4	-6	-919	-427	-2922	0	0	0	FALSE	TRUE
EQSpecY	11638	CORE P09	37.0	28.4	-6	-155	-447	-3123	0	0	0	FALSE	TRUE
Robustness X	11638	CORE P09	37.0	28.4	-6	415	69	-4536	0	0	0	FALSE	FALSE
Robustness Y	11638	CORE P09	37.0	28.4	-6	65	431	-8169	0	0	0	FALSE	FALSE
0: Total Q	11638	CORE P09	37.0	28.4	-6	-24	-21	-2257	0	0	0	FALSE	FALSE
0: RWDI_01	11638	CORE P09	37.0	28.4	-6	131	238	-6839	0	0	0	TRUE	FALSE
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0: RWDI_03	11638	CORE P09	37.0	28.4	-6	86	6	221	0	0	0	TRUE	FALSE
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0: RWDI_06	11638	CORE P09	37.0	28.4	-6	-81	22	-1218	0	0	0	TRUE	FALSE
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0: RWDI_09	11638	CORE P09	37.0	28.4	-6	59	393	-10509	0	0	0	TRUE	FALSE
0: RWDI_10	11638	CORE P09	37.0	28.4	-6	141	287	-10390	0	0	0	TRUE	FALSE
0: RWDI_11	11638	CORE P09	37.0	28.4	-6	-60	-323	10694	0	0	0	TRUE	FALSE
0: RWDI_12	11638	CORE P09	37.0	28.4	-6	12	-415	10797	0	0	0	TRUE	FALSE
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0: RWDI_19	11638	CORE P09	37.0	28.4	-6	-75	33	2361	0	0	0	TRUE	FALSE
0: RWDI_20	11638	CORE P09	37.0	28.4	-6	119	-262	3826	0	0	0	TRUE	FALSE
0: RWDI_21	11638	CORE P09	37.0	28.4	-6	-167	228	-2618	0	0	0	TRUE	FALSE
0: RWDI_22	11638	CORE P09	37.0	28.4	-6	42	-25	-2502	0	0	0	TRUE	FALSE
0: RWDI_23	11638	CORE P09	37.0	28.4	-6	-219	-43	5619	0	0	0	TRUE	FALSE
0: RWDI_24	11638	CORE P09	37.0	28.4	-6	-18	-334	6912	0	0	0	TRUE	FALSE
Total G (Wished-	11638	CORE P09	37.0	28.4	-6	1	-47	-14229	0	0	0	FALSE	FALSE



FOUNDATION PLAN

SCALE 1 : 100

GENERAL ARRANGEMENT LEGEND:

- DENOTES INSITU CONCRETE ELEMENT OVER
- DENOTES LOAD BEARING ELEMENT UNDER
- DENOTES LOAD BEARING ELEMENT UNDER AND INSITU CONCRETE ELEMENT OVER
- STEP DENOTES SLAB STEP
- THK DENOTES SLAB THICKNESS
- TAG SIZE DENOTES COLUMN NUMBER AND SIZE
- W? DENOTES WALL NUMBER & DIRECTION ELEVATION IS VIEWED
- SW# DENOTES SHOWING WALL NUMBER & DIRECTION ELEVATION IS VIEWED
- DENOTES MAXIMUM EXCAVATION DEPTH RL -8.0m
- DENOTES INDICATIVE EXTENT OF N10 MASS CONCRETE
- DENOTES CRR SHAFT BACKFILL MATERIAL EXTENT. REFER DRGS ST-01-000-11 & 12
- DENOTES CRR ACCOUSTIC SHED STRUCTURE REFER DRGS ST-01-000-11 & 12
- DENOTES CRR SHAFT AND ADIT STRUCTURE REFER DRGS ST-01-000-11 & 12

PAD FOOTING SCHEDULE

PAD FOOTING MARK	LENGTH	WIDTH	DEPTH
PF1	6000	5200	1200
PF2	6000	9615	1200

PILE CAP SCHEDULE

PILE CAP MARK	LENGTH	WIDTH	DEPTH
PC1	3650	2200	2500
PC2	2000	1500	1200
PC3	REFER PLAN	REFER PLAN	REFER PLAN
PC4	7100	2200	2500
PC5	4500	1500	1500

PILE SCHEDULE

PILE MARK	PILE DIA (mm)	SOCKET (m)		APPROX TOP OF SOCKET (RL)	APPROX PILE TOE (RL)	REINF RATE (kg/m³)
		NFG3	NFG1/2			
P01-P11 & P41	1200	6	10	-12	-28	
P12-P22	1200	6	6	-12	-24	
P23-P30	1200	2	4	-16^	-22	
P31-P40	1200	0	17	-19^	-36	
P42	1600	6	3	-12	-21	
P43	1600	2	3	-16^	-21	
P44	1600	0	8	-23^	-31	
P45	900	2	2	-16^	-20	

^ DENOTES TOP OF SOCKET LEVEL IMPACTED BY ISOLATION SLEEVE. GEOTECHNICAL ENGINEER TO CONFIRM ISOLATION SLEEVE REQUIREMENTS AND DETAILS.

CONCRETE NOTES :

-REFER NOTES ON COVER SHEET
-MIN CONC. STRENGTH AT 28 DAYS

LOCATION	f'c
PILE CAP PC1, PC3 & PC4	80MPa
PILE CAP PC2 & PC5	50MPa
PAD FOOTING PF1, PF2	50MPa

COLUMN LOAD SCHEDULE

COLUMN MARK	Pz [kN]				COLUMN MARK	Pz [kN]	
	G	Q	W	EQ		G	Q
C01	1600	900	-	-	C14	2000	1600
C02	36500	9400	7700	2500	C15	2200	2100
C03	34200	9300	8300	2600	C16	2600	2200
C04	27900	10700	500	400	C17	3100	1700
C05	26500	9900	1400	800	C18	2700	1500
C06	900	600	-	-	C19	2000	1300
C07	900	1100	-	-	C20	6900	2100
C08	45100	12300	5900	2500	C21	6600	1900
C09	48100	15000	1100	600	C22	5400	1600
C10	50200	14900	6400	1900	C23	4900	1500
C11	50800	14100	4900	1300	C24	7800	2400
C12	49100	15000	1000	600	C25	5300	2200
C13	45400	13500	5700	2600	C55	600	700

PRINT DRAWINGS IN COLOUR

NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE FOLLOWING:
   - GENERAL AND CONSTRUCTION NOTES ON DRG ST-00-000-11
   - SHORING & RETENTION WALL, PILING AND FOUNDATION NOTES ON DRG ST-00-000-12.
   - GEOTECHNICAL REPORTS NOTED ON DRG ST-00-000-11.
   - INSTRUMENTATION, VIBRATION AND MOVEMENT MONITORING REPORTS NOTED ON DRG ST-00-000-11.
   - EDQ AND DA REQUIREMENTS NOTES ON DRG ST-00-000-11.
   - SITE PLAN, LOADS AND NOTES ON DRG ST-01-000-01.
   - CRR ASSET PROXIMITY PLANS ON DRG ST-01-000-11 & 12.
   - TEMPORARY SHORING AND RETENTION GENERAL ARRANGEMENT PLAN ON DRG ST-01-000-21.
   - LAP SCHEDULES ON DRG ST
   - FOUNDATION TYPICAL DETAILS ON DRG SERIES ST
   - ROBERT BIRD GROUP CIVIL DRAWINGS.
2. GEOTECHNICAL ENGINEER TO VERIFIY BEARING CAPACITY OF ALL FOOTINGS PRIOR TO POURING BLINDING LAYER.
3. CORE DRILLING OF FOOTING BASES TO CONFIRM THE QUALITY OF FOUNDING STRATA IN THE CRITICAL ZONE OF STRESS INFLUENCE IS TO BE CARRIED OUT AND ASSESSED BY QUALIFIED GEOTECHNICAL ENGINEER
4. REFER GEOTECHNICAL REPORTS FOR EXCAVATION AND TEMPORARY BATTER ANGLES.
5. PILE DESIGN SHALL BE BASED ON ZERO FIXITY BETWEEN PILES AND SLABS/BEAMS AND ALLOW FOR MOMENTS DUE TO ECCENTRICITY OF ALL APPLIED LOADS.
6. DESIGN ACTIONS ARE TO BE COMBINED IN ACCORDANCE WITH AS1170.0 TO PRODUCE THE MOST ADVERSE EFFECT.
7. DEAD, LIVE AND SOIL LOADS ARE PROVIDED UNFACTORED. SEISMIC AND WIND LOADS ARE PROVIDED AT ULTIMATE.
8. SEISMIC AND WIND LOADS ARE FULLY REVERSIBLE.
9. PILE DESIGN SHALL ALLOW FOR ECCENTRICITY OF APPLIED LOADS. ECCENTRICITIES SHALL BE COMBINED TO PRODUCE THE MOST ADVERSE EFFECT.
10. PILE CAPS TO BE POURED ON COMPRESSIBLE MATERIAL RMAX GEOFOAM OR SIMILAR OUTSIDE OF THE BORED PIER EXTENTS TO CONTROL LOAD DISTRIBUTION INTO THE BORED PIERS.
11. ALLOW FOR COST ASSOCIATED WITH TEMPERATURE MONITORING AND CONTROL TO PILE CAPS DEEPER THAN 1m. THIS MIGHT INCLUDE THERMOCOUPLES, INSULATION, ICE TO THE CONCRETE MIX ETC
12. HYDRAULIC ENGINEER TO CONFIRM UNDER SLAB DRAINAGE SYSTEM AND REQUIREMENTS. DRAIANGE TO BE COORDINATED AROUND FOUNDATIONS.

THE FOLLOWING INFORMATION IS BASED UPON FOUNDATIONS CONSISTING OF PILE CAPS AND LARGE DIAMETER BORED PIERS WITH POTENTIAL ISOLATION SLEEVES. READ BELOW IN CONJUNCTION WITH THE CRR ASSET PROXIMITY PLANS ON DRGS ST-01-000-11 & 12

80%DD NOTE:

1. BORED PIERS HAVE BEEN SET-OUT WHERE POSSIBLE TO MINIMISE CLASHES WITH IN-GROUND CRR SUBSTRUCTURE INCLUDING THE TEMPORARY ACCESS SHAFT WALL, ADITS AND ACCOUSTIC SHED PILES.

2. COORDINATION WORK IS BASED UPON AVAILABLE CRR INFORMATION AT THE TIME OF THIS DOCUMENT ISSUE. THE LOCATION AND SIZE OF CRR ASSETS ARE INDICATIVE ONLY AND TO BE CONFIRMED.

3. NOT ALL EXISTING IN-GROUND STRUCTURE HAS BEEN SHOWN INCLUDING, BUT NOT LIMITED TO TEMPORARY ROCK BOLTS AND ANCHORS. BORED PIERS HAVE NOT BEEN POSITIONED TO MISS ROCK BOLTS AND ANCHORS AND THEREFORE THE CONTRACTOR IS TO MAKE ALLOWANCE FOR DRILLING THROUGH EXISTING IN-GROUND STRUCTURE.

4. BORED PIER SIZES ARE BASED ON THE TEMPORARY ACCESS SHAFT AND ADITS BEING BACKFILLED WITH SPECIFIC MATERIALS TO ASSIST WITH RELATIVE UNIFORM DISTRIBUTION OF GROUND STRESSES AND EXISTING ACOUSTIC PILES BEING BROKEN DOWN.

Rev	Revision Description	By	App	Date
A01	50% DD ISSUE	SV	MA	09.08.23
P01	DRAFT 50% DESIGN DEVELOPMENT	SV	MA	28.07.23

SCALE 1:1 2 3 4 5 6 7 8

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Client
QIC

Project
101 ALBERT STREET, BRISBANE

Title
FOOTING PLAN

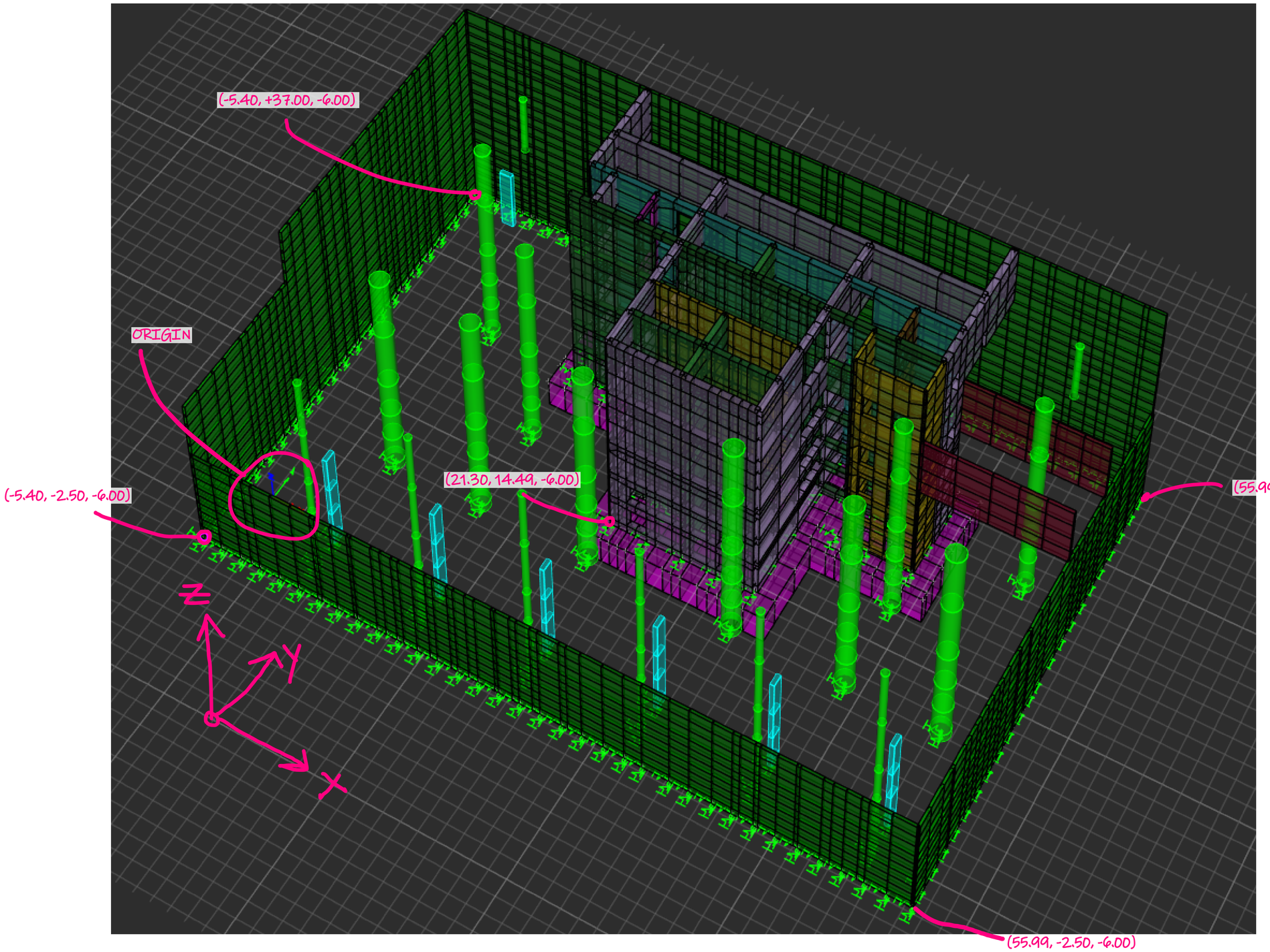
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Jul 2023
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Drawn
S.VINEY
Designer
M.AVERY
Design Checker
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Approved
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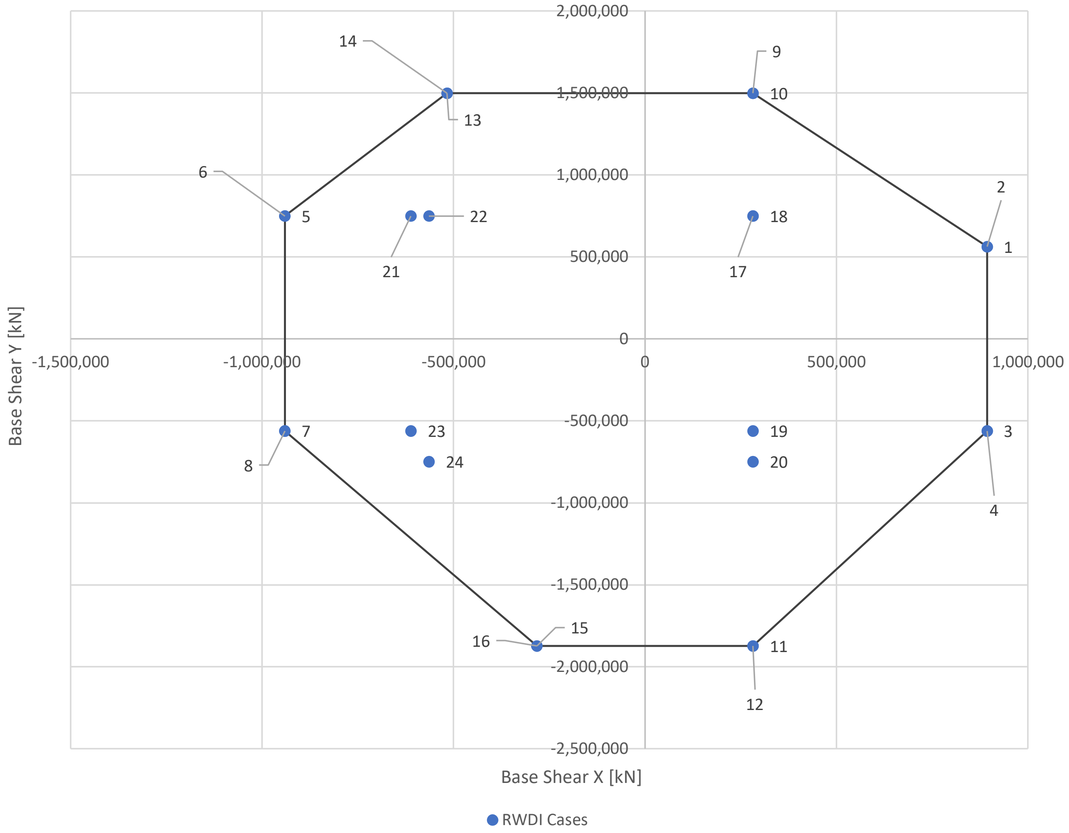
Drawing Number
ALB-RBG-DWG-ST-03-BC2-01

Revision
A01



MODEL CONTEXT VIEW & COORDINATE SYSTEM

RWDI WIND LOAD CASES
BASE SHEAR WIND ROSE



LOAD COMBINATIONS TO CONSIDER

ULTIMATE

1.2G+1.5Q
1.35G
1.2G+0.6Q+W
0.9G+W
G+0.6Q+SpecX+0.3SpecY
G+0.6Q-SpecX+0.3SpecY
G+0.6Q-SpecX-0.3SpecY
G+0.6Q-SpecX-0.3SpecY
G+0.6Q+SpecY+0.3SpecX
G+0.6Q-SpecY+0.3SpecX
G+0.6Q-SpecY-0.3SpecX
G+0.6Q-SpecY-0.3SpecX

SERVICE

G+Q
G+0.6Q+0.54W
0.9G+0.54W
G+0.6Q+0.35SpecX
G+0.6Q-0.35SpecX
G+0.6Q+0.35SpecY
G+0.6Q-0.35SpecY

- ROBUSTNESS COMBINATIONS NOT INCLUDED YET TO RATIONALISE. ROBUSTNESS COMBINATIONS ARE THE SAME AS SPECTRAL, I.E. G+0.6Q(+/-)Rx(+/-)0.3Ry WHEN YOU ARE READY TO CONSIDER THEM.
- W REPRESENTS ANY OF THE 24 RWDI WIND COMBINATIONS. I.E. THERE ARE 24 1.2G+0.6Q+W WIND COMBINATIONS.
- PLEASE INCLUDE 10% CONTINGENCY ON ALL SHORING LATERAL LOADS IN ADDITION TO THE LOAD FACTORS APPLIED ABOVE. G AND Q LOADS FOR THE SHORING WALLS ALREADY INCLUDE THIS 10% CONTINGENCY FACTOR SO DON'T APPLY TO G AND Q.
- PLEASE INCLUDE 10% CONTINGENCY ON ALL CORE PILE LOADS IN ADDITION TO THE LOAD FACTORS APPLIED ABOVE. FOR THE CORE PILES THIS APPLIES TO ALL LOADS INCLUDING G AND Q.
- COLUMN LOADS PROVIDED ALREADY HAVE THE 10% CONTINGENCY APPLIED IN THE LOADS WE HAVE PROVIDED TO YOU.

Appendix F

Retention System Calculation Outputs

Piling—Design and installation

3.2.1 General

The footing shall be durable, and of adequate strength, and the footing performance shall be compatible with the superstructure so that it remains serviceable and can perform its intended function.

The design shall take into account, as appropriate, the following:

(a) *Ultimate strength* The limit state at which static equilibrium is lost or at which there is a failure of the supporting ground or structural elements. To be of adequate ultimate strength, the probability of structural or geotechnical failure of the piles shall be acceptably low throughout the intended design life of the structure. The ultimate strength of piles shall be checked for both structural and geotechnical adequacy.

(b) *Serviceability* The limit state at which deformation of the piles will cause damage or loss of serviceability in the structure.

3.3.2 Load combinations for strength design

The load combinations for strength design shall be as follows:

(a) The design actions for ultimate strength design of piles shall be the combination of factored loads that produces the most adverse effect on the pile in accordance with AS/NZS 1170.0.

4.3.1 Design geotechnical strength

A pile shall be proportioned such that the design geotechnical strength ($R_{d,g}$) is not less than the design action effect ($E_{d)}$) as detailed in Clause 3.2.2, that is—

$$R_{d,g} \geq E_d \quad \ldots 4.3.1(1)$$

The design geotechnical strength ($R_{d,g}$) shall be calculated as the design ultimate geotechnical strength ($R_{d,ug}$) multiplied by a geotechnical strength reduction factor (ϕ_g), according to the following equation:

$$R_{d,g} = \phi_g R_{d,ug} \quad \ldots 4.3.1(2)$$

AS 1170

4.2.2 Strength

The basic combinations for the ultimate limit states used in checking strength (see Clause 7.2.2) shall be as follows, where the long-term and combination factors are given in Table 4.1:

(a)	$E_d = [1.35G]$	permanent action only (does not apply to prestressing forces)
(b)	$E_d = [1.2G, 1.5Q]$	permanent and imposed action
(c)	$E_d = [1.2G, 1.5\psi_l Q]$	permanent and long-term imposed action
(d)	$E_d = [1.2G, W_u, \psi_c Q]$	permanent, wind and imposed action
(e)	$E_d = [0.9G, W_u]$	permanent and wind action reversal
(f)	$E_d = [G, E_u, \psi_E Q]$	permanent, earthquake and imposed action
(g)	$E_d = [1.2G, S_u, \psi_c Q]$	permanent action, actions given in Clause 4.2.3 and imposed action

3.3.3 Load combinations for serviceability design

The design actions for serviceability design of piles shall be taken from the appropriate combinations of actions for short-term situations and long-term situations in accordance with this Clause with the actions as given in AS/NZS 1170.0 and including unfactored actions due to any of the ground movements referred to in Clause 3.3.1.2, as appropriate.

Unless otherwise specified, earthquake serviceability actions need not be taken into account.

4.5 GENERAL PRINCIPLES OF GEOTECHNICAL DESIGN FOR SERVICEABILITY

4.5.1 Design actions

The load combinations for serviceability design, as determined from Clause 3.3.3, shall be used for determining pile deflection (settlements, lateral deflections and rotations).

4.5.2 Design criteria

Both a single pile and a pile group shall be designed for serviceability by controlling or limiting pile movements so that deflections do not exceed the deflection limits.

4.5.3 Deflection limits

Limits for the total and differential settlement, lateral deflection and rotation of both a pile and a pile group, subject to axial compression, uplift, lateral, cyclic, dynamic, torsional or other actions, shall be appropriate to the structure and its intended use.

AS 1170

4.3 COMBINATIONS OF ACTIONS FOR SERVICEABILITY LIMIT STATES

Combinations of actions for the serviceability limit states shall be those appropriate for the serviceability condition being considered. Appropriate combinations may include one or a number of the following using the short-term and long-term values given in Table 4.1:

(a) G

(b) $\psi_s Q$

(c) $\psi_l Q$

(d) W_s

(e) E_s

(f) Serviceability values of other actions, as appropriate.

by:	DL	*client:*	QIC
date:	12/06/24	*project:*	Albert Street Development
approved:	DJC	*location:*	Brisbane, QLD
scale:	NTS	*title:*	*AS2159 Design Loads*
		job no:	B01493-1

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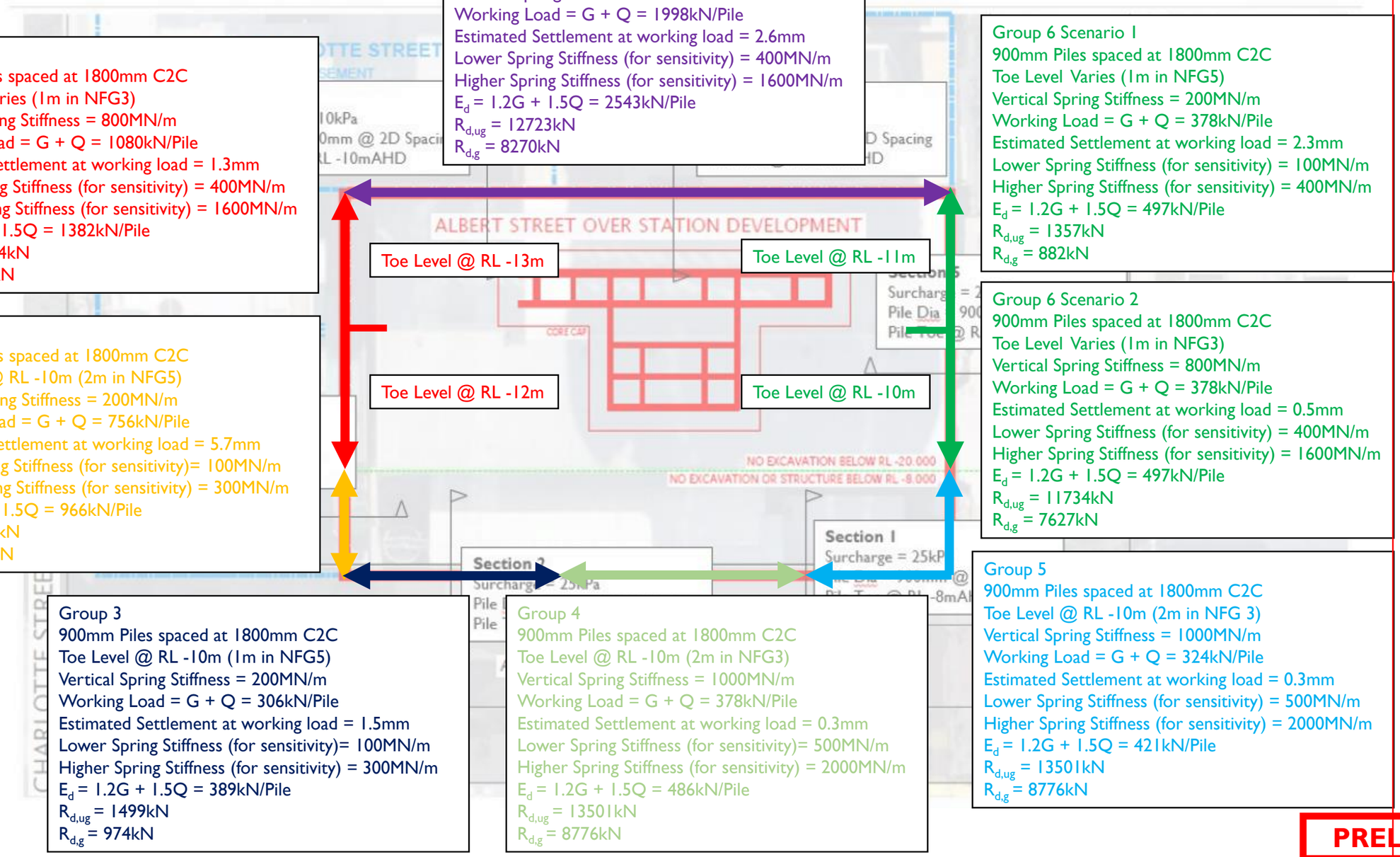
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Terminology	Description
$R_{d,ug}$	Design Ultimate Geotechnical Strength
$R_{d,g}$	Design Geotechnical Strength (= $\varphi_g R_{d,ug}$)
φ_g	Geotechnical Strength Reduction Factor
E_d	Design Action Effect

Group 7
900mm Piles spaced at 1800mm C2C
Toe Level @ RL -14m (1m in NFG3)
Vertical Spring Stiffness = 800MN/m
Working Load = G + Q = 1998kN/Pile
Estimated Settlement at working load = 2.6mm
Lower Spring Stiffness (for sensitivity) = 400MN/m
Higher Spring Stiffness (for sensitivity) = 1600MN/m
E_d = 1.2G + 1.5Q = 2543kN/Pile
$R_{d,ug}$ = 12723kN
$R_{d,g}$ = 8270kN

Group 1
900mm Piles spaced at 1800mm C2C
Toe Level Varies (1m in NFG3)
Vertical Spring Stiffness = 800MN/m
Working Load = G + Q = 1080kN/Pile
Estimated Settlement at working load = 1.3mm
Lower Spring Stiffness (for sensitivity) = 400MN/m
Higher Spring Stiffness (for sensitivity) = 1600MN/m
E_d = 1.2G + 1.5Q = 1382kN/Pile
$R_{d,ug}$ = 11734kN
$R_{d,g}$ = 7627kN

Group 6 Scenario 1
900mm Piles spaced at 1800mm C2C
Toe Level Varies (1m in NFG5)
Vertical Spring Stiffness = 200MN/m
Working Load = G + Q = 378kN/Pile
Estimated Settlement at working load = 2.3mm
Lower Spring Stiffness (for sensitivity) = 100MN/m
Higher Spring Stiffness (for sensitivity) = 400MN/m
E_d = 1.2G + 1.5Q = 497kN/Pile
$R_{d,ug}$ = 1357kN
$R_{d,g}$ = 882kN



Group 2
900mm Piles spaced at 1800mm C2C
Toe Level @ RL -10m (2m in NFG5)
Vertical Spring Stiffness = 200MN/m
Working Load = G + Q = 756kN/Pile
Estimated Settlement at working load = 5.7mm
Lower Spring Stiffness (for sensitivity)= 100MN/m
Higher Spring Stiffness (for sensitivity) = 300MN/m
E_d = 1.2G + 1.5Q = 966kN/Pile
$R_{d,ug}$ = 1569kN
$R_{d,g}$ = 1020kN

Group 6 Scenario 2
900mm Piles spaced at 1800mm C2C
Toe Level Varies (1m in NFG3)
Vertical Spring Stiffness = 800MN/m
Working Load = G + Q = 378kN/Pile
Estimated Settlement at working load = 0.5mm
Lower Spring Stiffness (for sensitivity) = 400MN/m
Higher Spring Stiffness (for sensitivity) = 1600MN/m
E_d = 1.2G + 1.5Q = 497kN/Pile
$R_{d,ug}$ = 11734kN
$R_{d,g}$ = 7627kN

Group 3
900mm Piles spaced at 1800mm C2C
Toe Level @ RL -10m (1m in NFG5)
Vertical Spring Stiffness = 200MN/m
Working Load = G + Q = 306kN/Pile
Estimated Settlement at working load = 1.5mm
Lower Spring Stiffness (for sensitivity)= 100MN/m
Higher Spring Stiffness (for sensitivity) = 300MN/m
E_d = 1.2G + 1.5Q = 389kN/Pile
$R_{d,ug}$ = 1499kN
$R_{d,g}$ = 974kN

Group 4
900mm Piles spaced at 1800mm C2C
Toe Level @ RL -10m (2m in NFG3)
Vertical Spring Stiffness = 1000MN/m
Working Load = G + Q = 378kN/Pile
Estimated Settlement at working load = 0.3mm
Lower Spring Stiffness (for sensitivity)= 500MN/m
Higher Spring Stiffness (for sensitivity) = 2000MN/m
E_d = 1.2G + 1.5Q = 486kN/Pile
$R_{d,ug}$ = 13501kN
$R_{d,g}$ = 8776kN

Group 5
900mm Piles spaced at 1800mm C2C
Toe Level @ RL -10m (2m in NFG 3)
Vertical Spring Stiffness = 1000MN/m
Working Load = G + Q = 324kN/Pile
Estimated Settlement at working load = 0.3mm
Lower Spring Stiffness (for sensitivity) = 500MN/m
Higher Spring Stiffness (for sensitivity) = 2000MN/m
E_d = 1.2G + 1.5Q = 421kN/Pile
$R_{d,ug}$ = 13501kN
$R_{d,g}$ = 8776kN

PRELIMINARY

Notes:
- Pile toe levels limited at Albert St side to RL -10m
- Design action effect (E_d) based on loads provided by RBG on 2024-06-05
- $R_{d,g} \geq E_d$
- Φ_g = 0.65

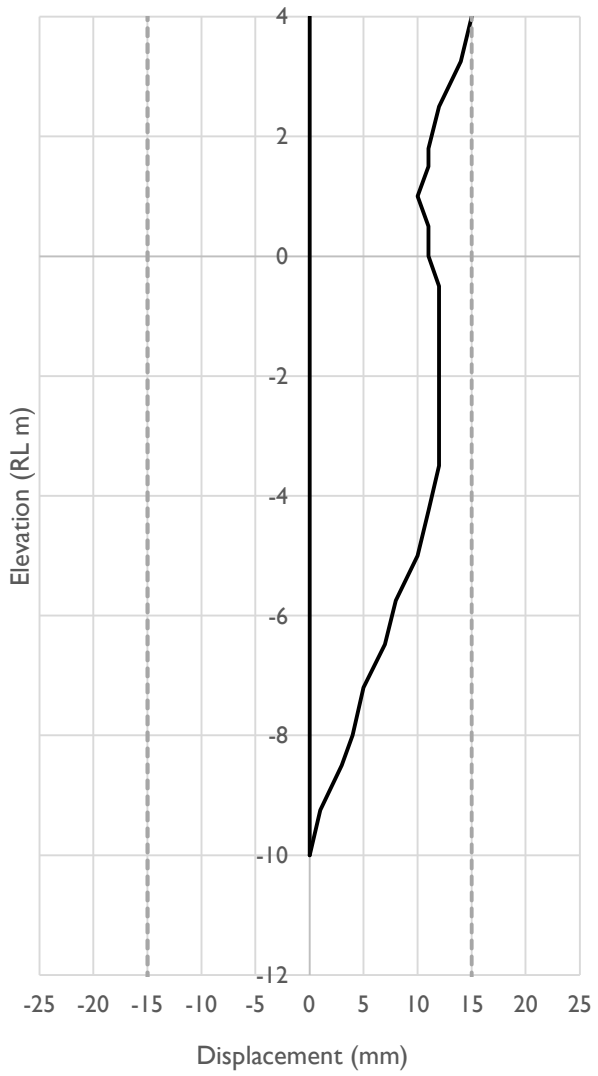
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approved:	DJC
scale:	NTS

client:	QIC
project:	Albert Street Development
location:	Brisbane, QLD
title:	*Retention Piles Axial Capacity*
job no:	B01493-1

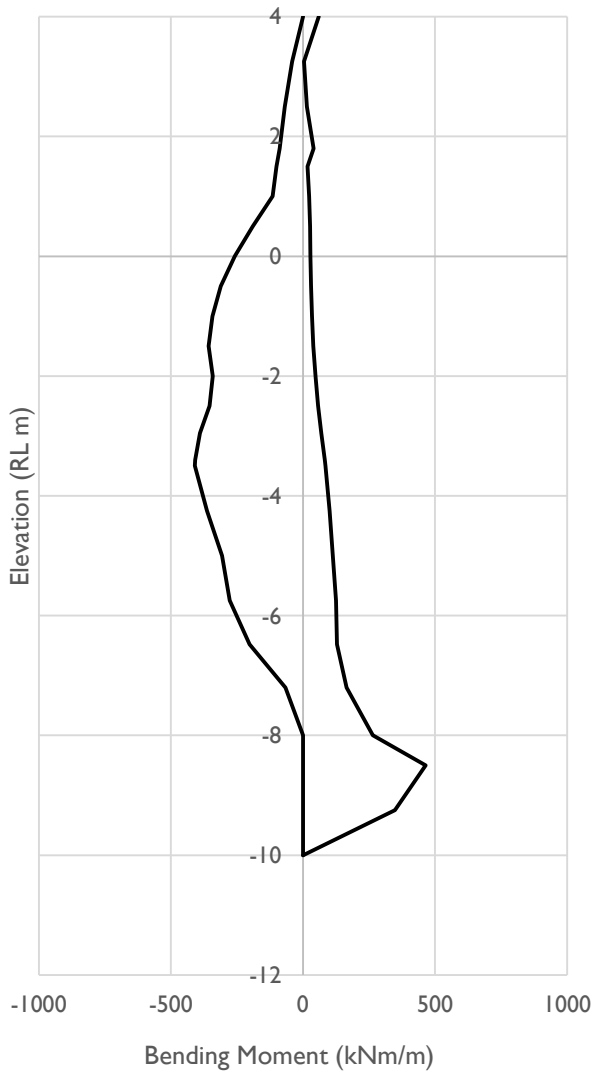
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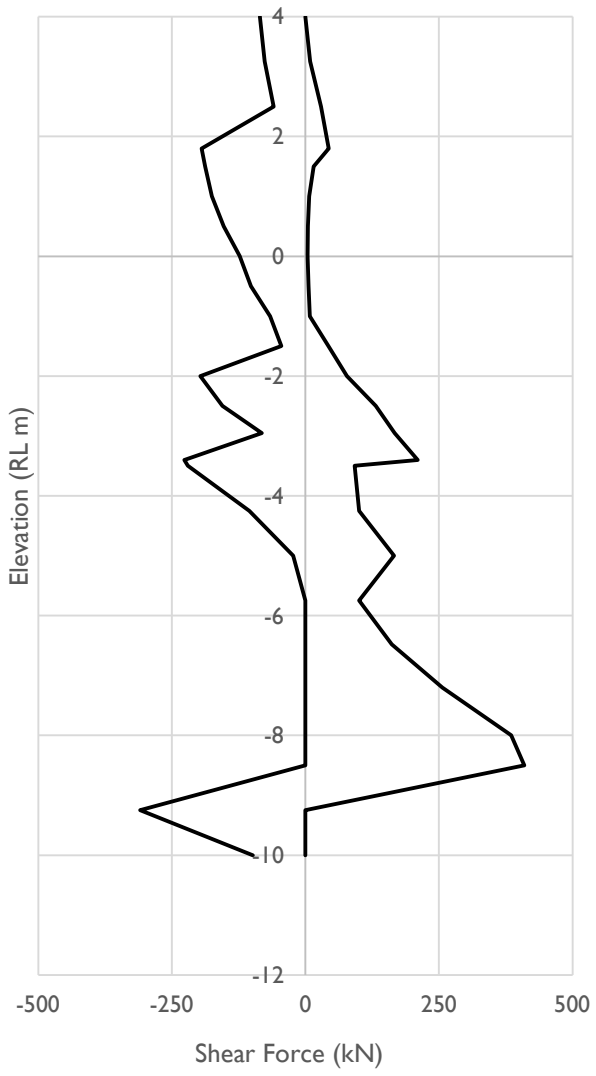
Displacement



Bending Moment



Shear Force



Notes:

- Displacement, bending moment and shear force envelopes
- Section 1
- Deflection limit of 15mm
- Non-flooding conditions

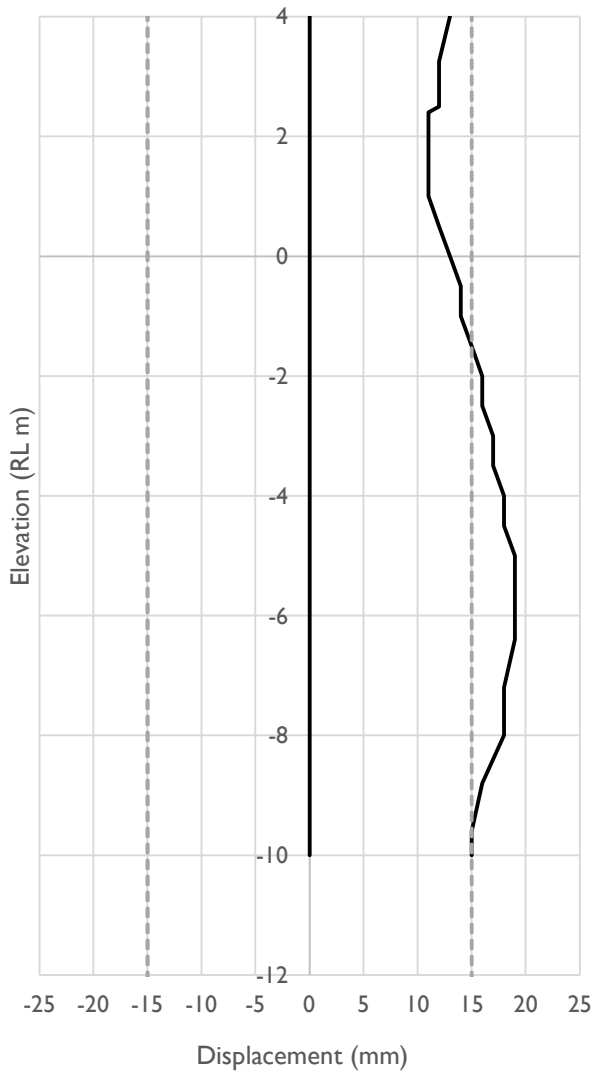
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approved:	DJC
scale:	

client:	QIC
project:	Albert Street Development
location:	Brisbane
title:	*Deflection, Bending Moment, Shear Force*
job no:	B01493-1

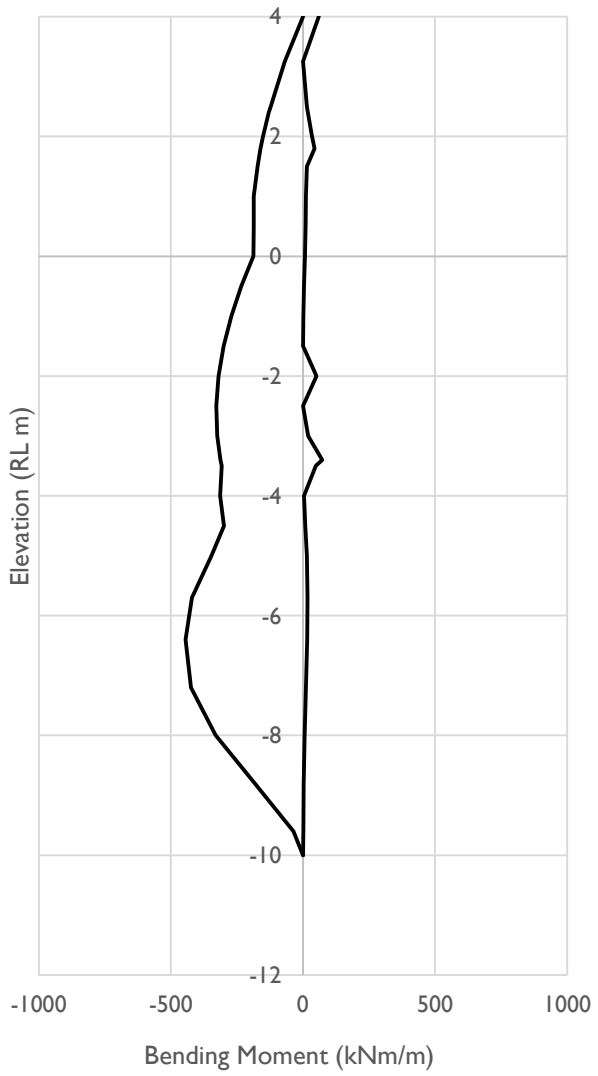
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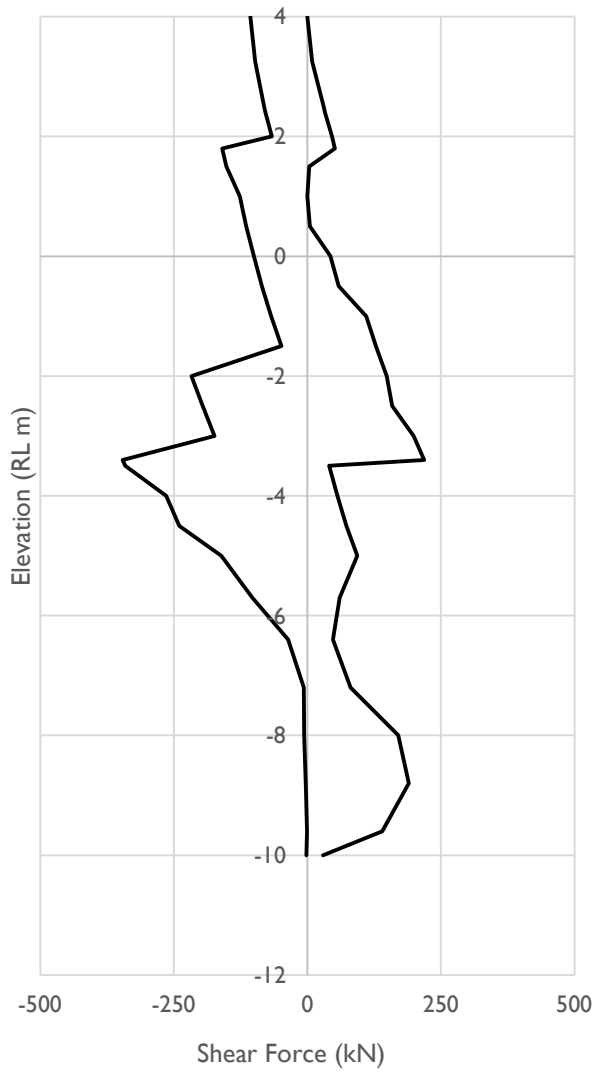
Displacement



Bending Moment



Shear Force



Notes:

- Displacement, bending moment and shear force envelopes
- Section 2
- Deflection limit of 15mm
- Non-flooding conditions

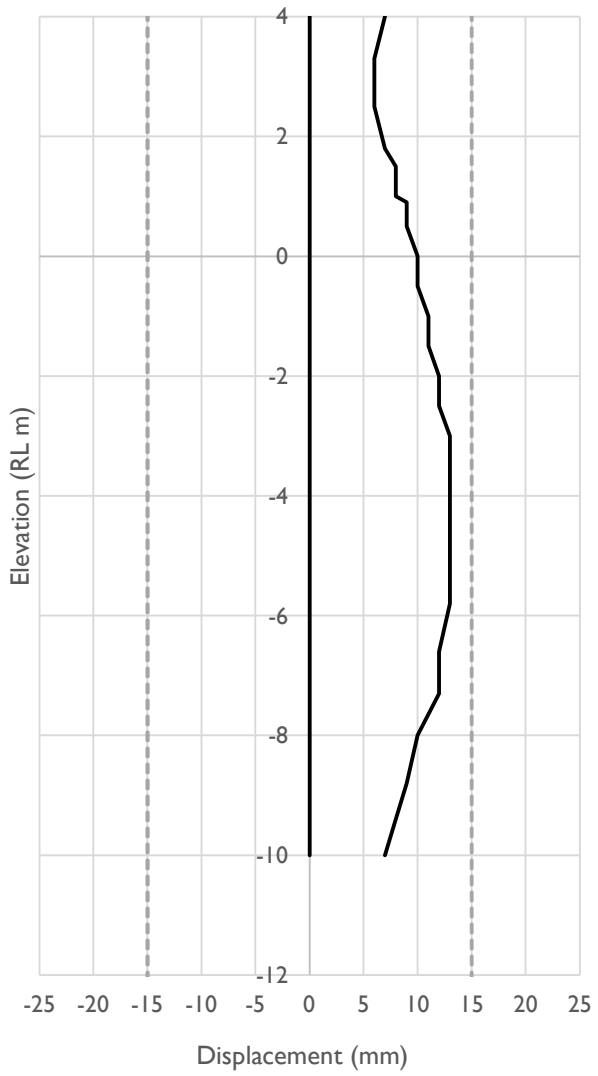
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location:	Brisbane
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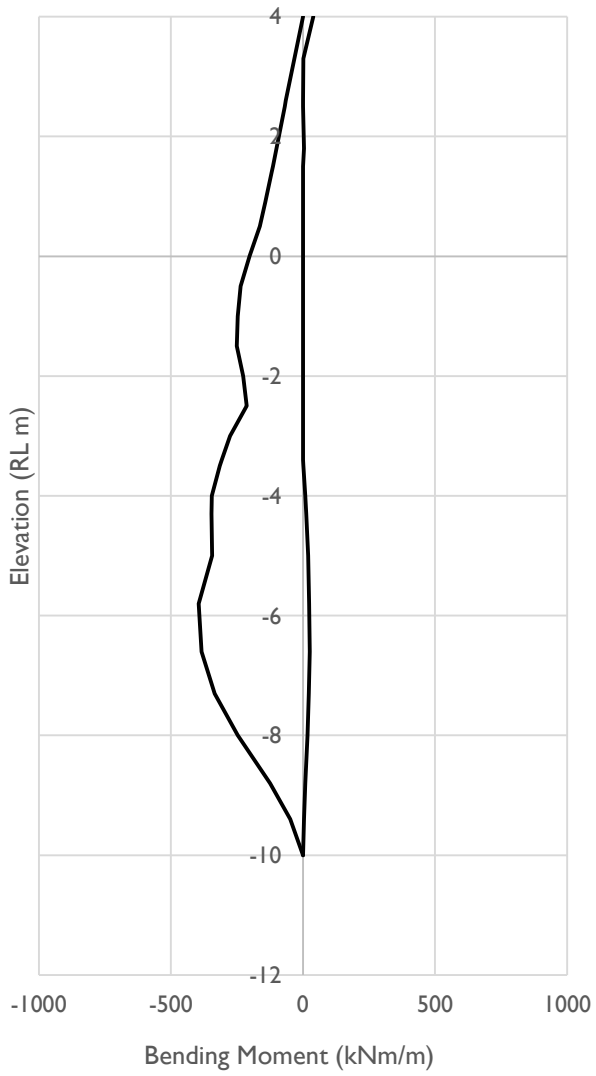
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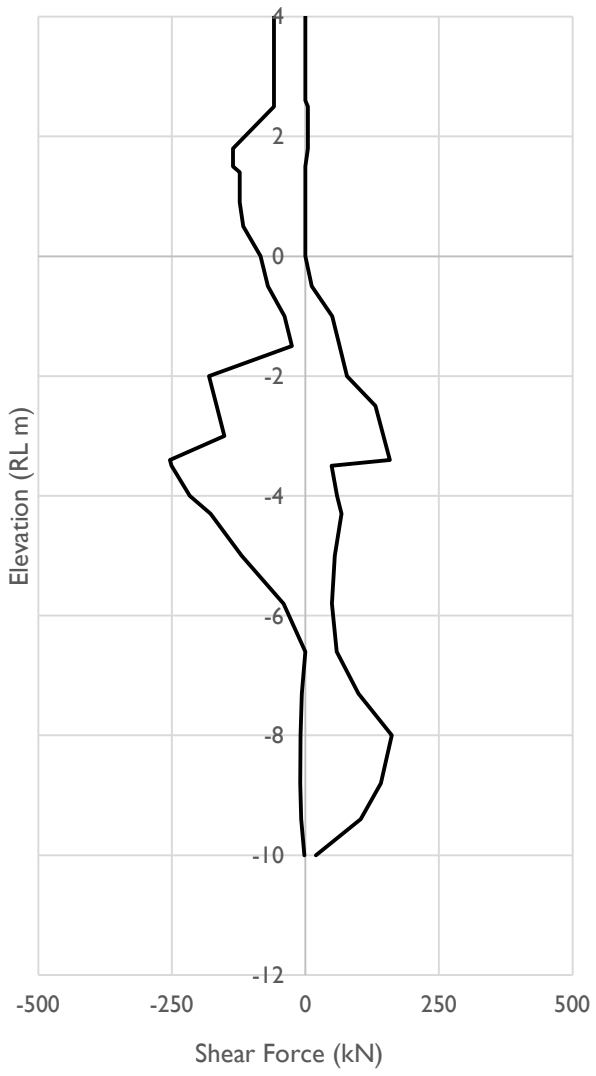
Displacement



Bending Moment



Shear Force



Notes:

- Displacement, bending moment and shear force envelopes
- Section 3
- Deflection limit of 15mm
- Non-flooding conditions

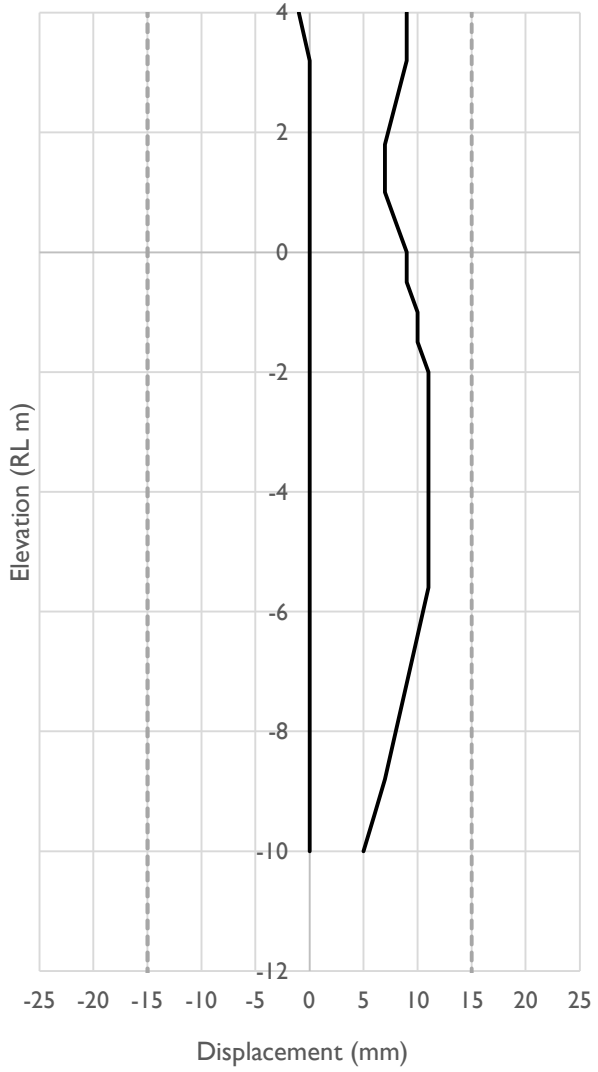
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location:	Brisbane
title:	*Deflection, Bending Moment, Shear Force*
job no:	B01493-1

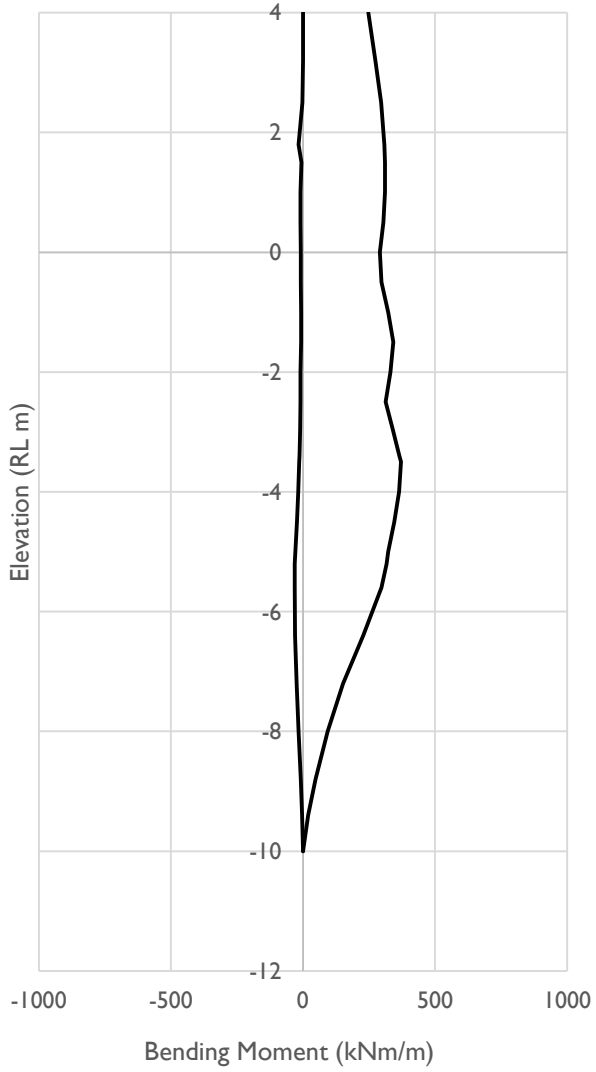
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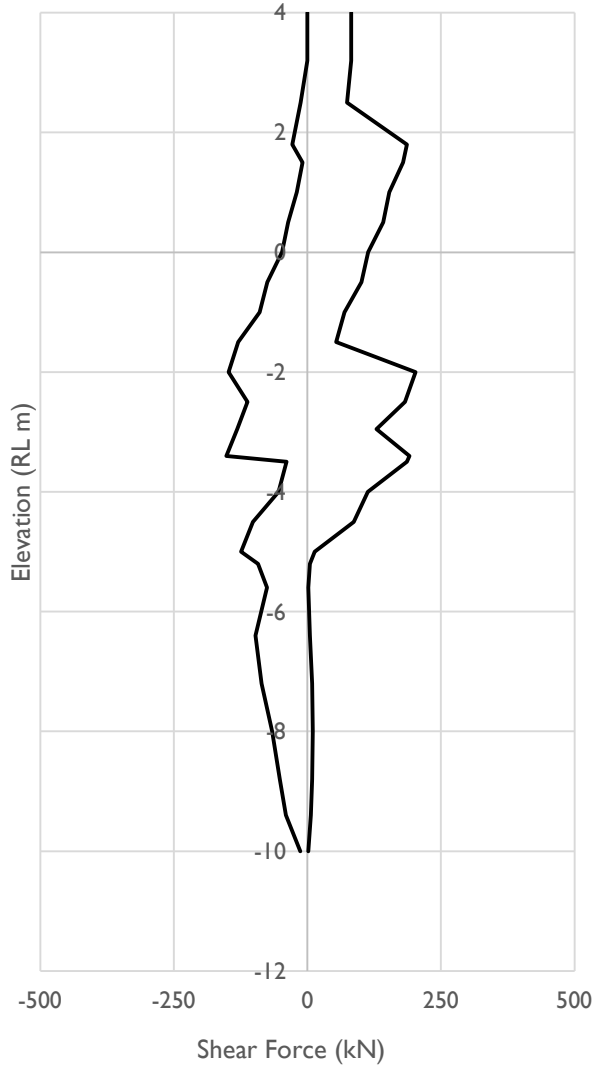
Displacement



Bending Moment



Shear Force



Notes:

- Displacement, bending moment and shear force envelopes
- Section 4
- Deflection limit of 15mm
- Non-flooding conditions

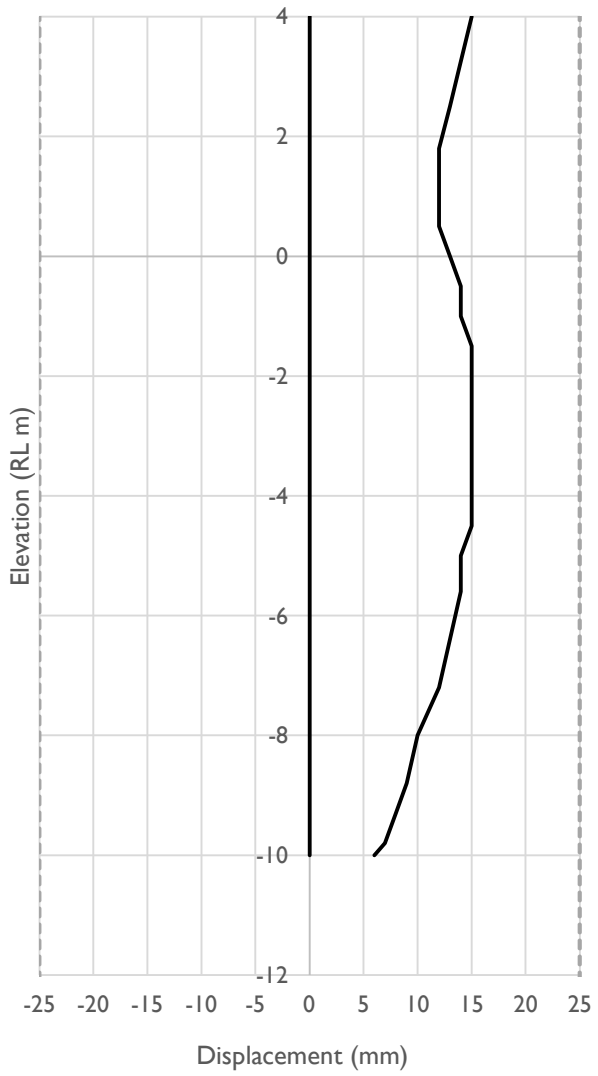
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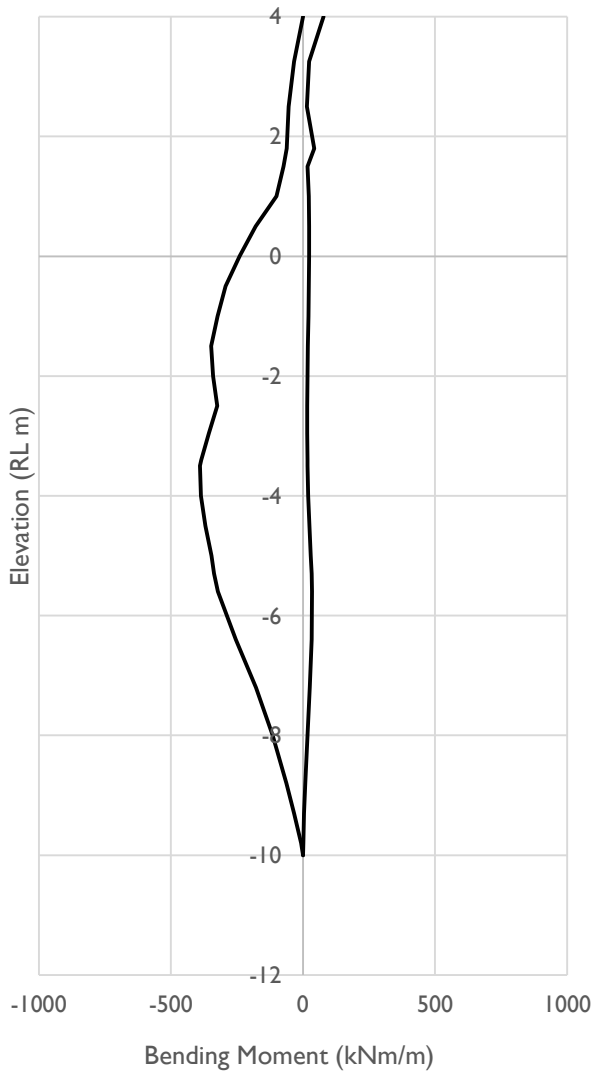
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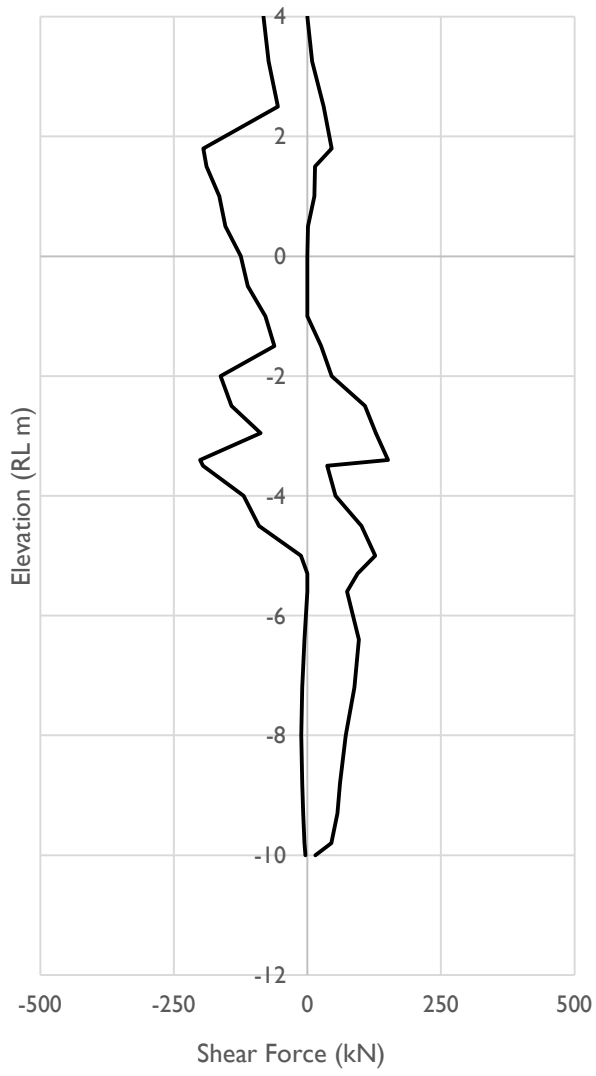
Displacement



Bending Moment



Shear Force



Notes:

- Displacement, bending moment and shear force envelopes
- Section 5
- Deflection limit of 25mm
- Non-flooding conditions

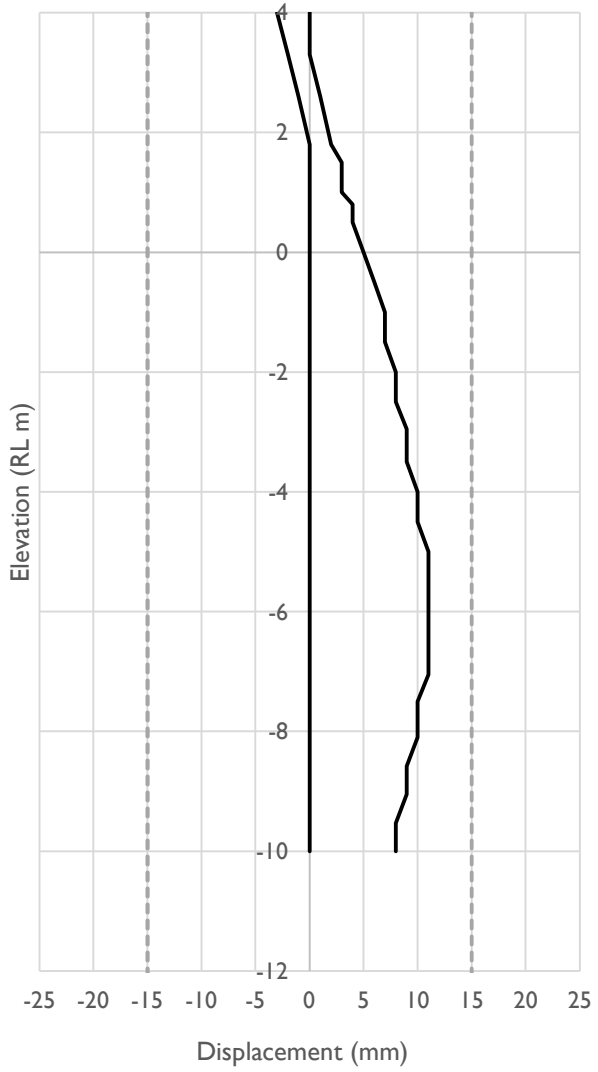
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job no:	B01493-1

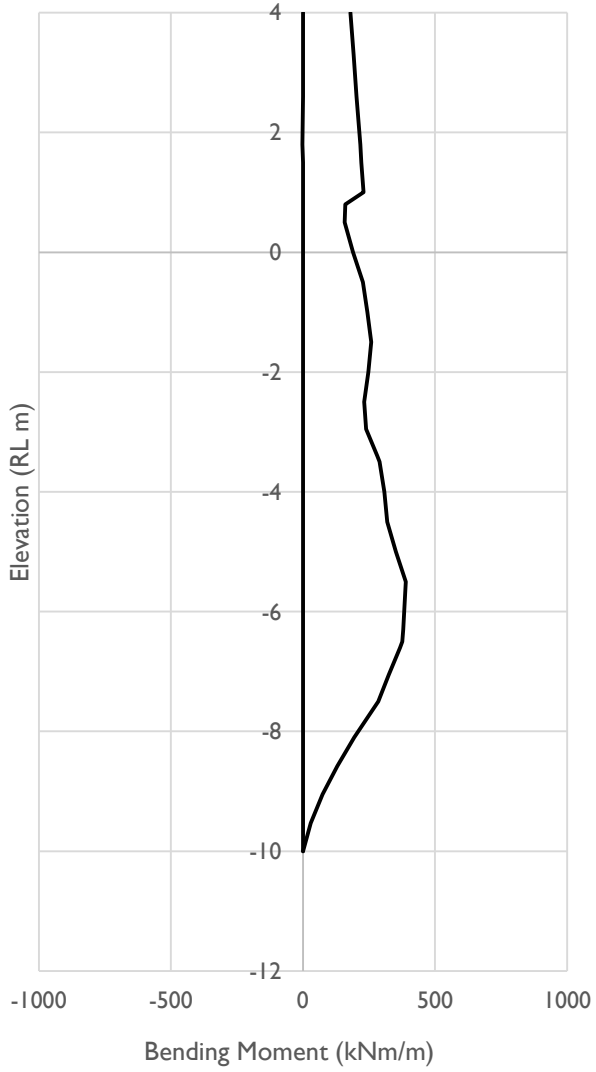
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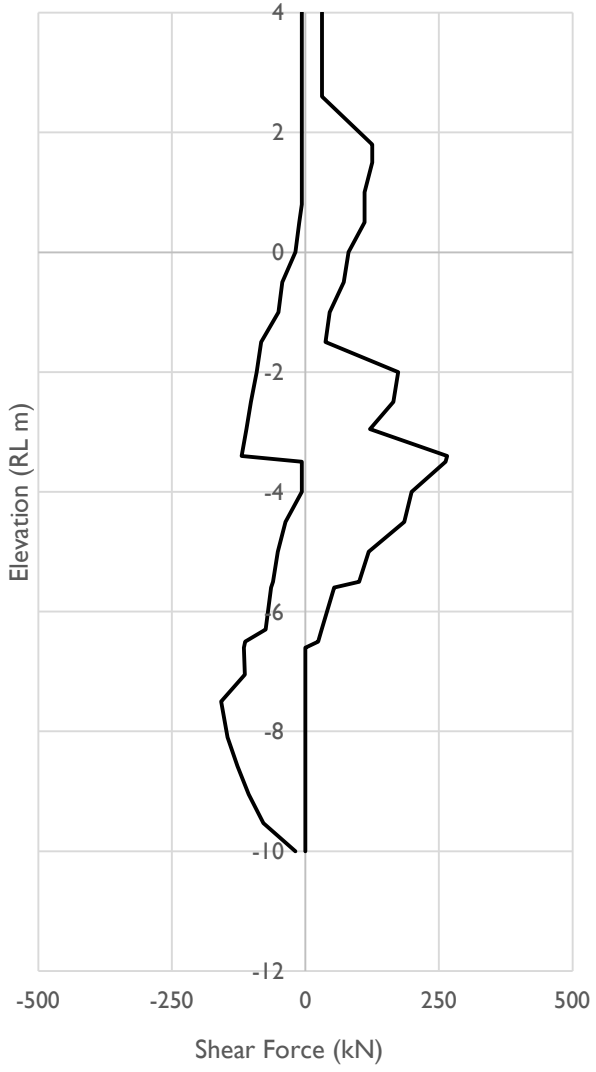
Displacement



Bending Moment



Shear Force



Notes:

- Displacement, bending moment and shear force envelopes
- Section 6
- Deflection limit of 15mm
- Non-flooding conditions

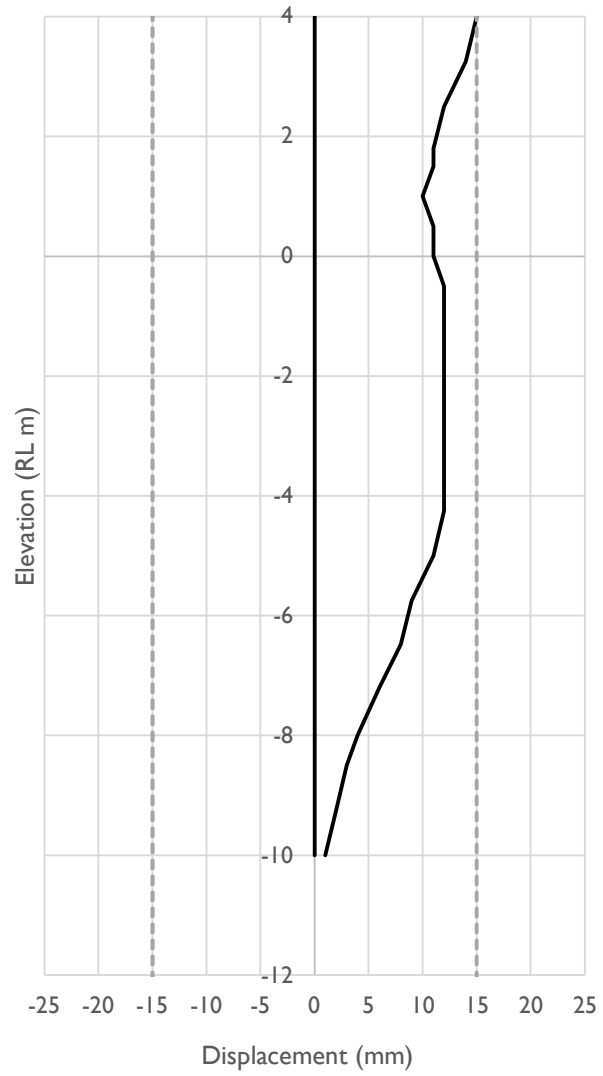
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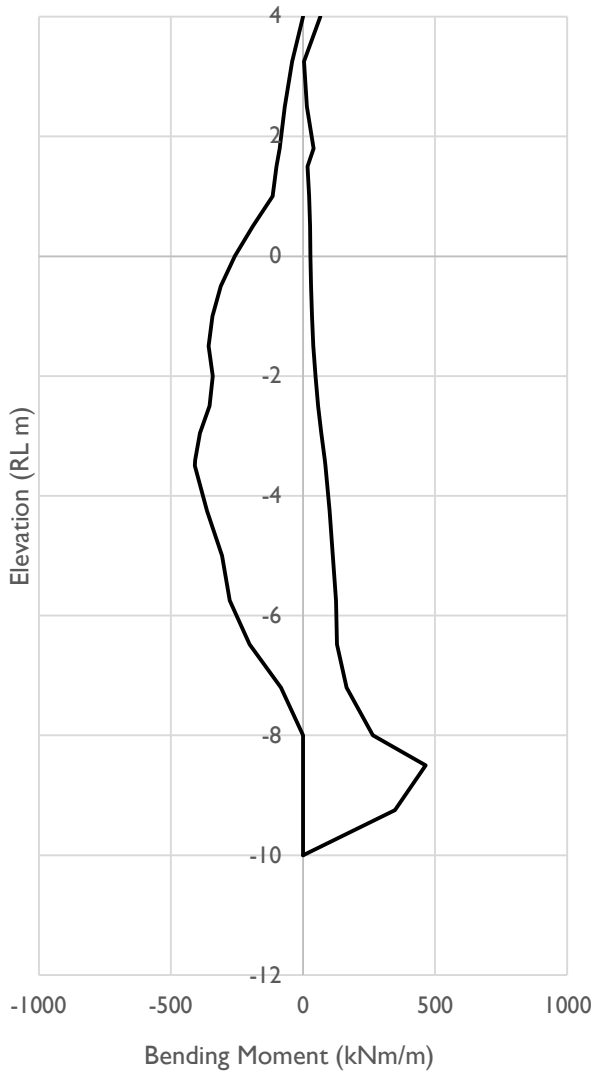
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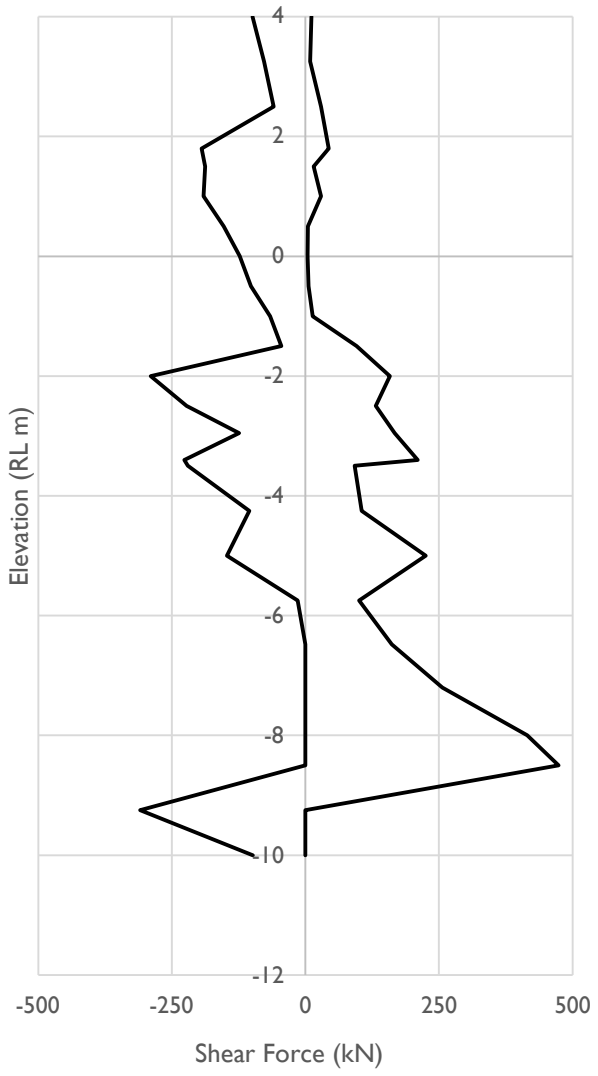
Displacement



Bending Moment



Shear Force



Notes:

- Displacement, bending moment and shear force envelopes
- Section 1
- Deflection limit of 15mm
- Flood conditions

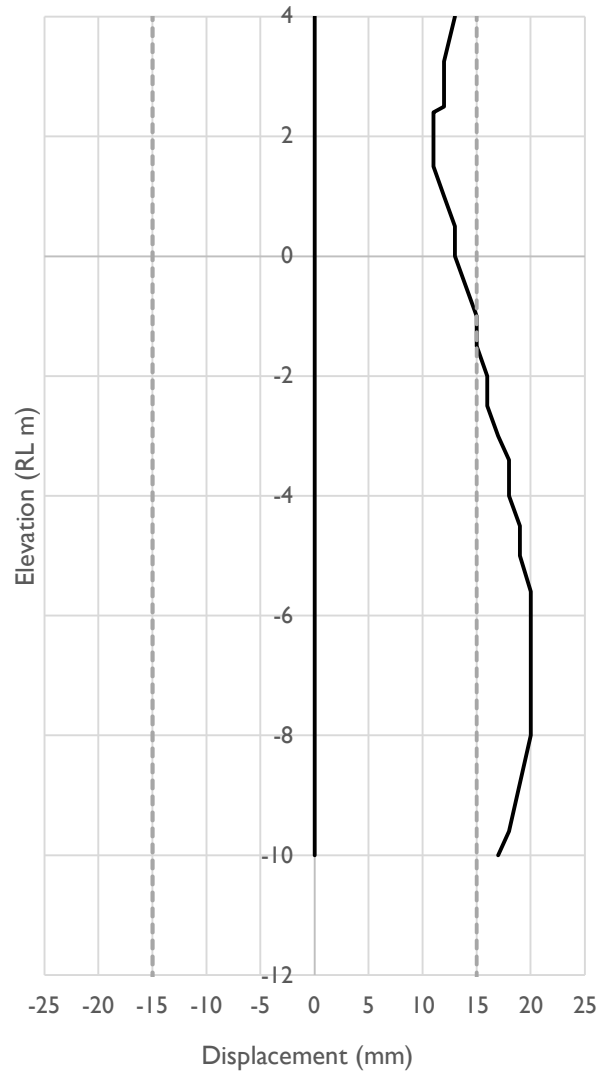
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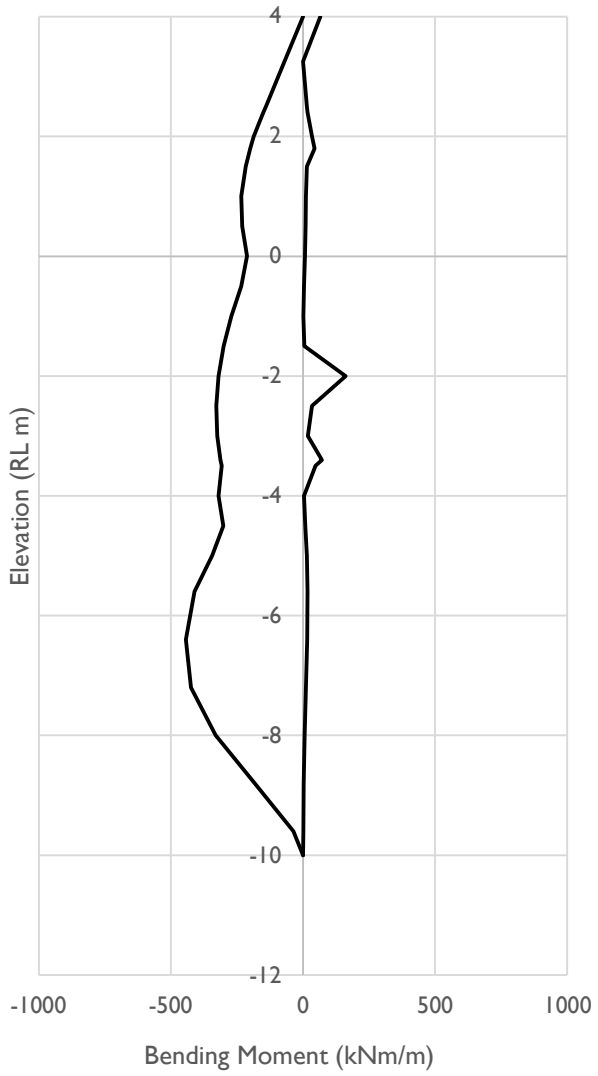
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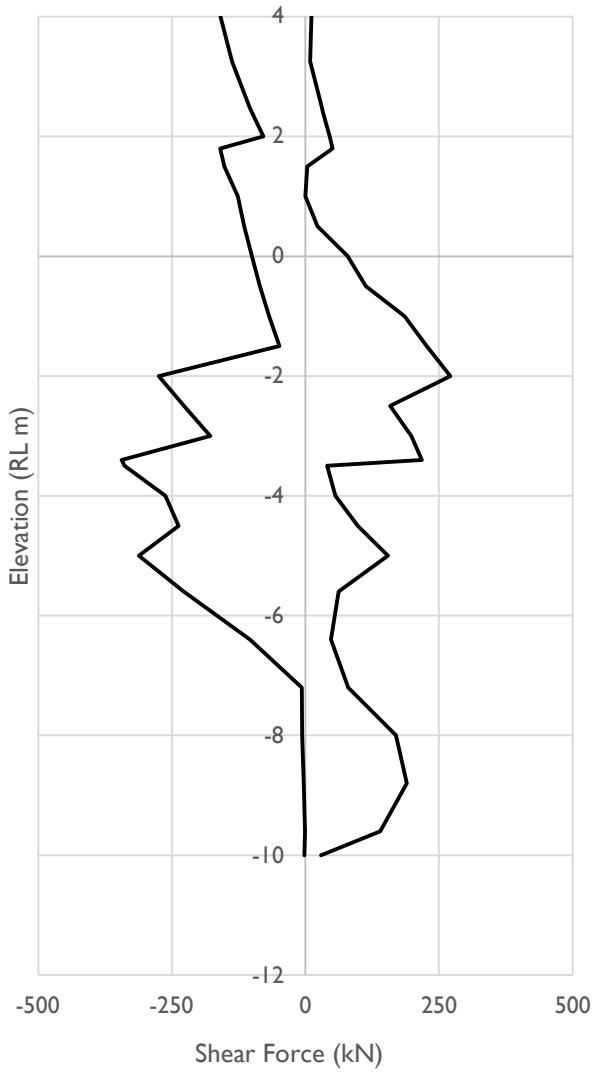
Displacement



Bending Moment



Shear Force



Notes:

- Displacement, bending moment and shear force envelopes
- Section 2
- Deflection limit of 15mm
- Flood conditions

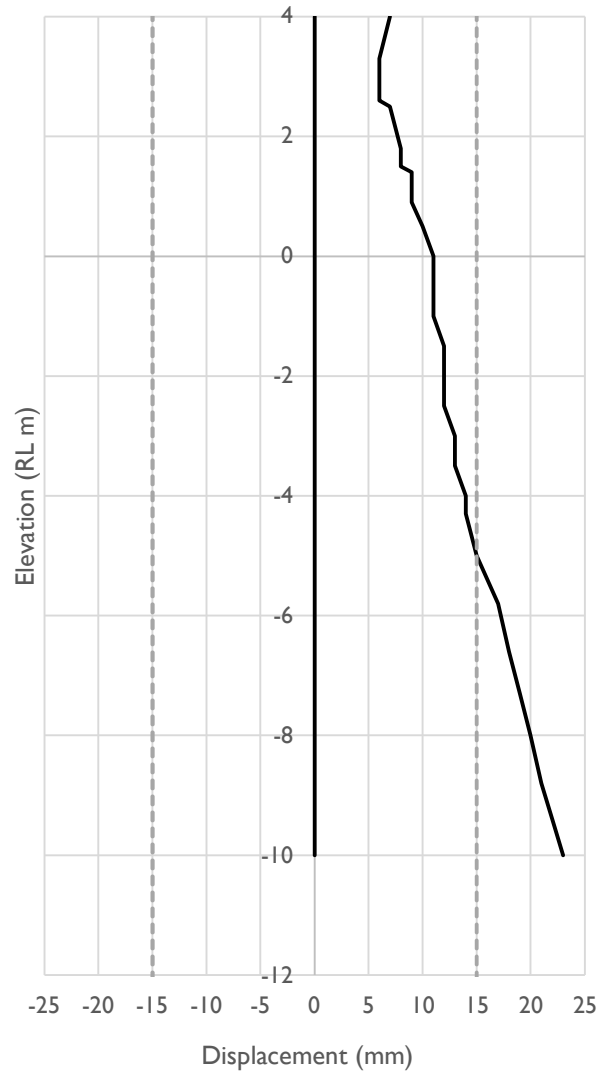
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job no:	B01493-1

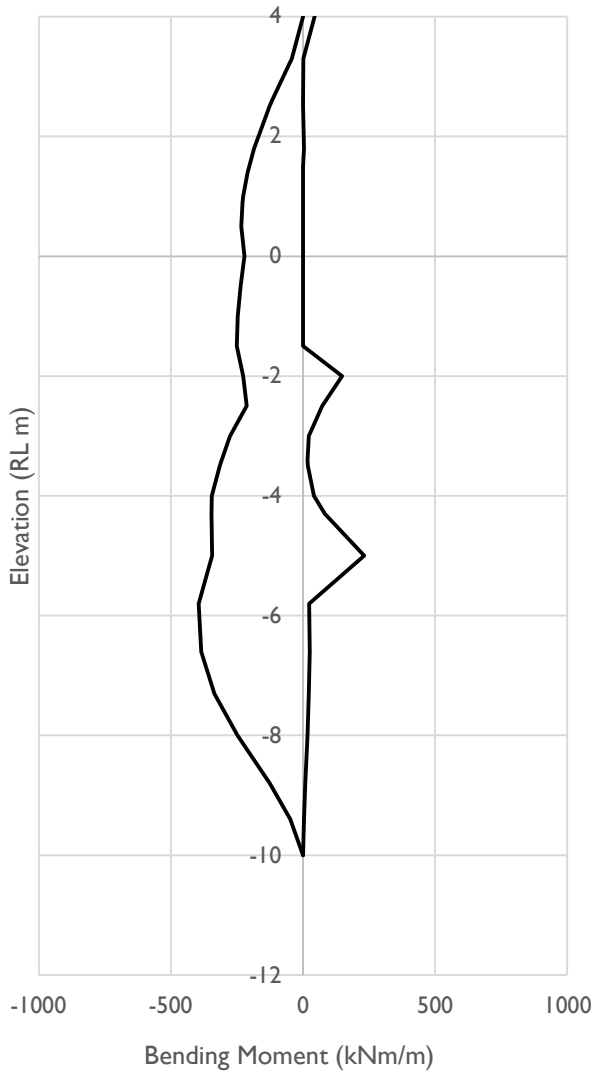
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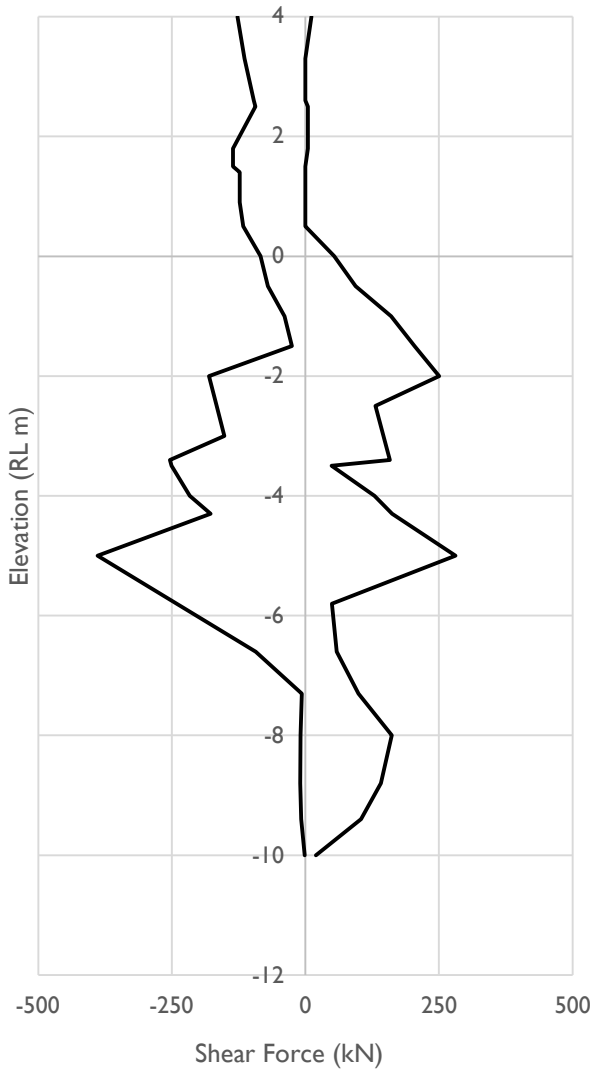
Displacement



Bending Moment



Shear Force



Notes:

- Displacement, bending moment and shear force envelopes
- Section 3
- Deflection limit of 15mm
- Flood conditions

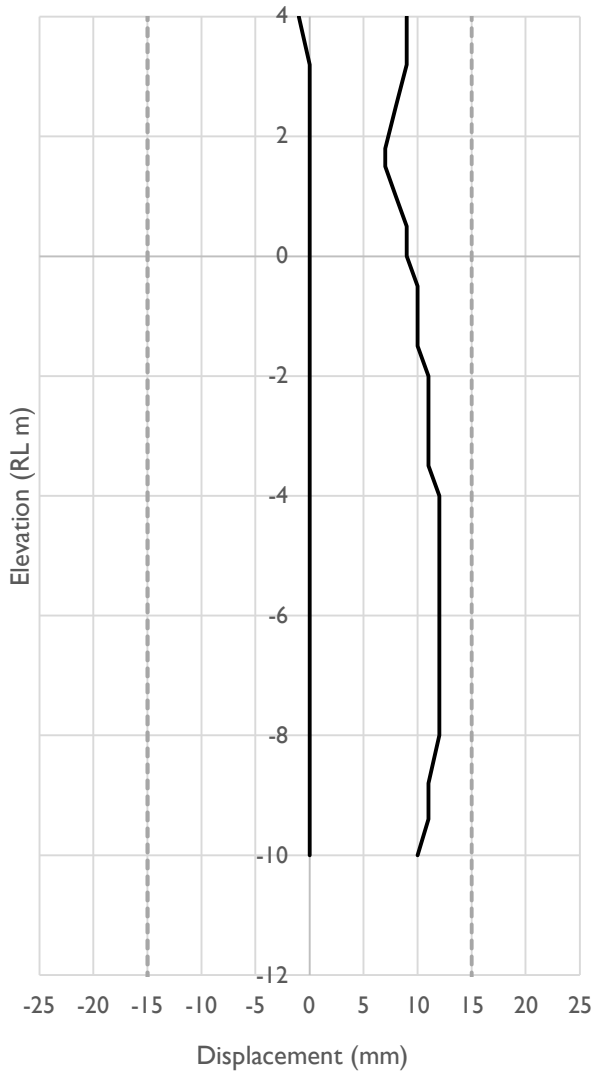
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job no:	B01493-1

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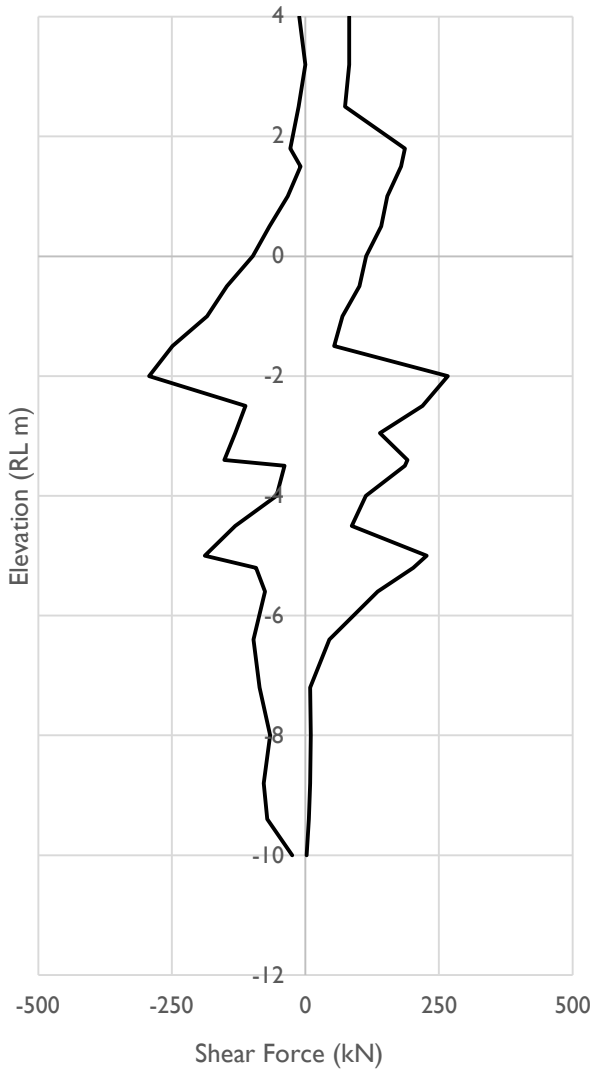
Displacement



Bending Moment



Shear Force



Notes:

- Displacement, bending moment and shear force envelopes
- Section 4
- Deflection limit of 15mm
- Flood conditions

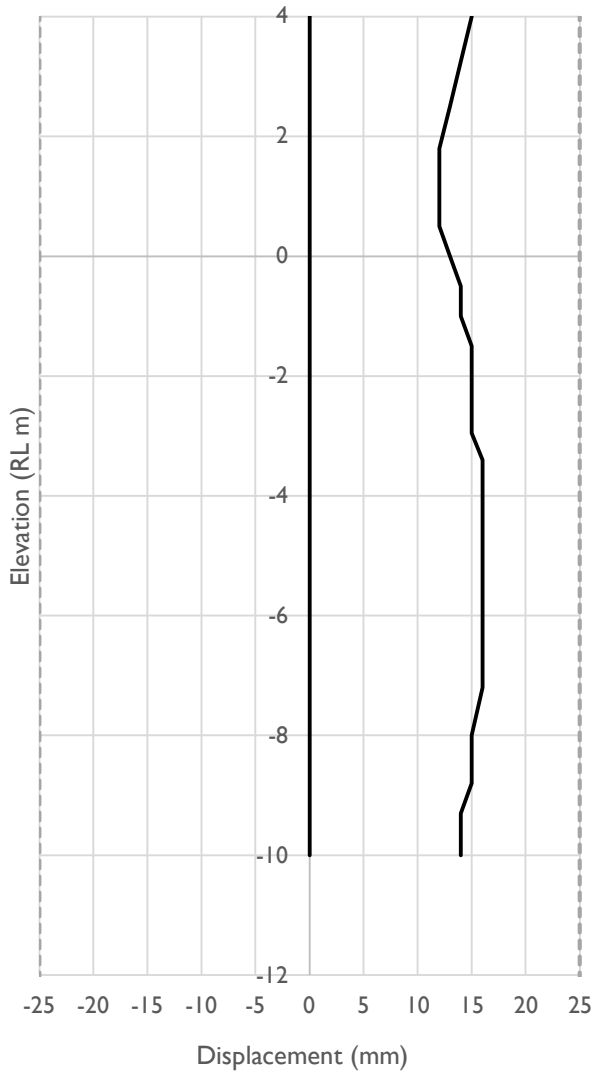
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job no:	B01493-1

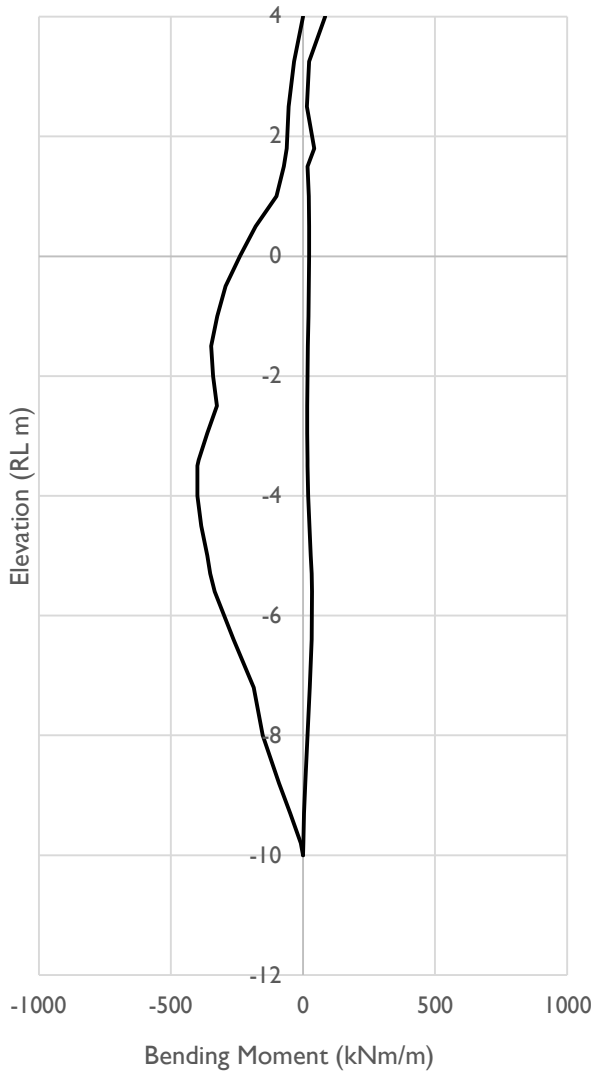
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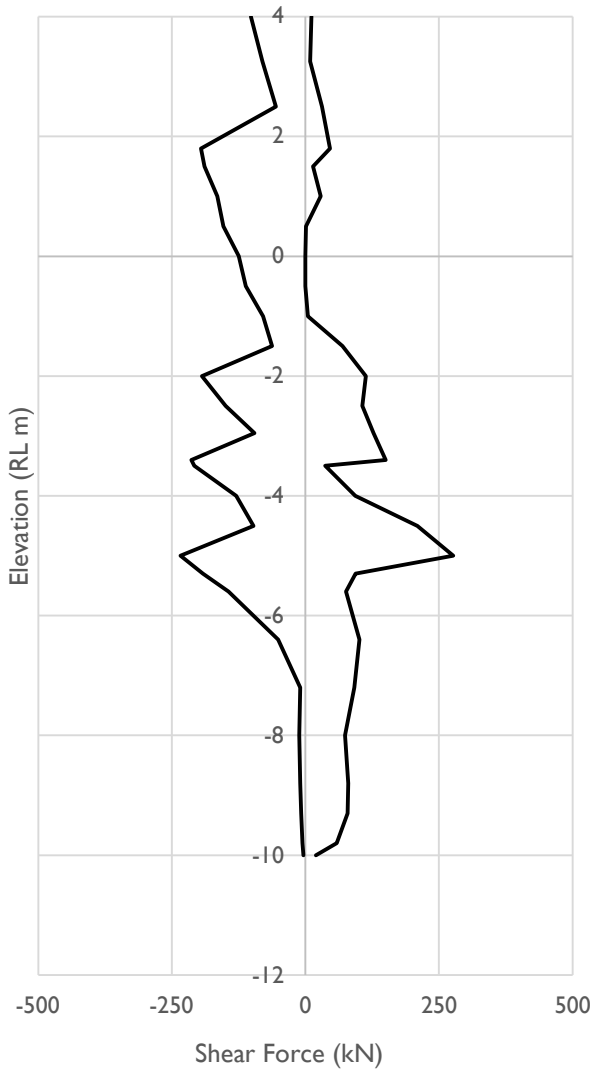
Displacement



Bending Moment



Shear Force



Notes:

- Displacement, bending moment and shear force envelopes
- Section 5
- Deflection limit of 25mm
- Flood conditions

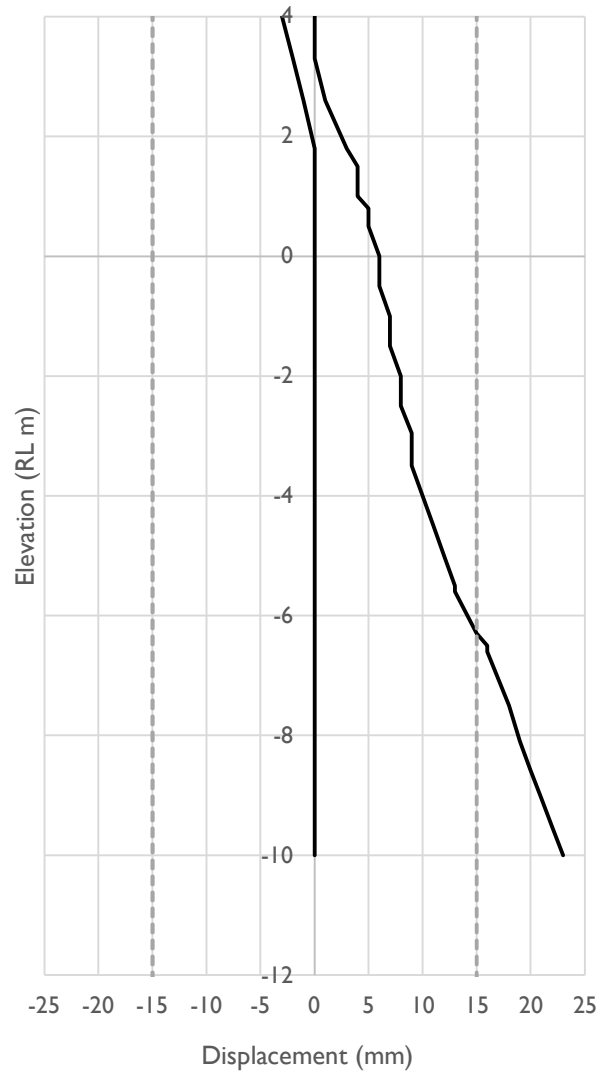
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approved:	DJC
scale:	

client:	QIC
project:	Albert Street Development
location:	Brisbane
title:	*Deflection, Bending Moment, Shear Force*
job no:	B01493-1

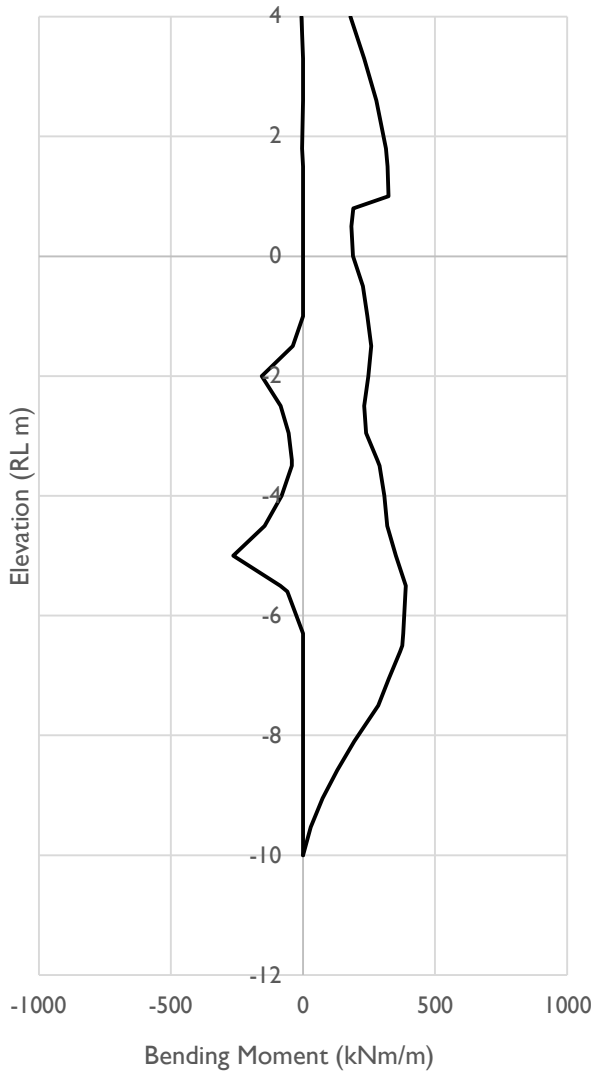
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figure: *F11*

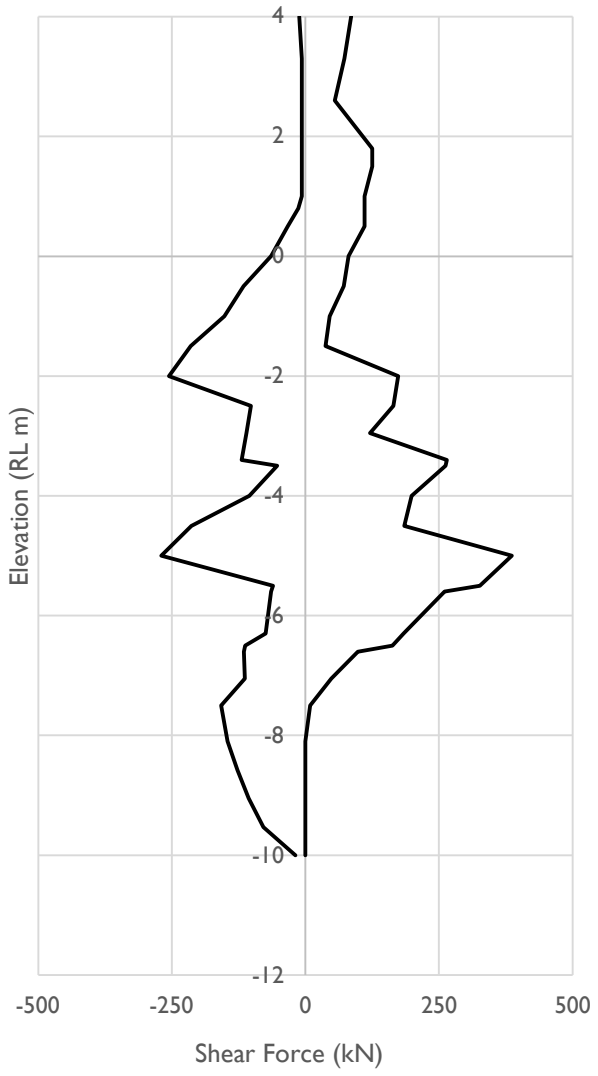
Displacement



Bending Moment



Shear Force



Notes:

- Displacement, bending moment and shear force envelopes
- Section 6
- Deflection limit of 15mm
- Flood conditions

by:	DL
date:	26/07/2024
approved:	DJC
scale:	

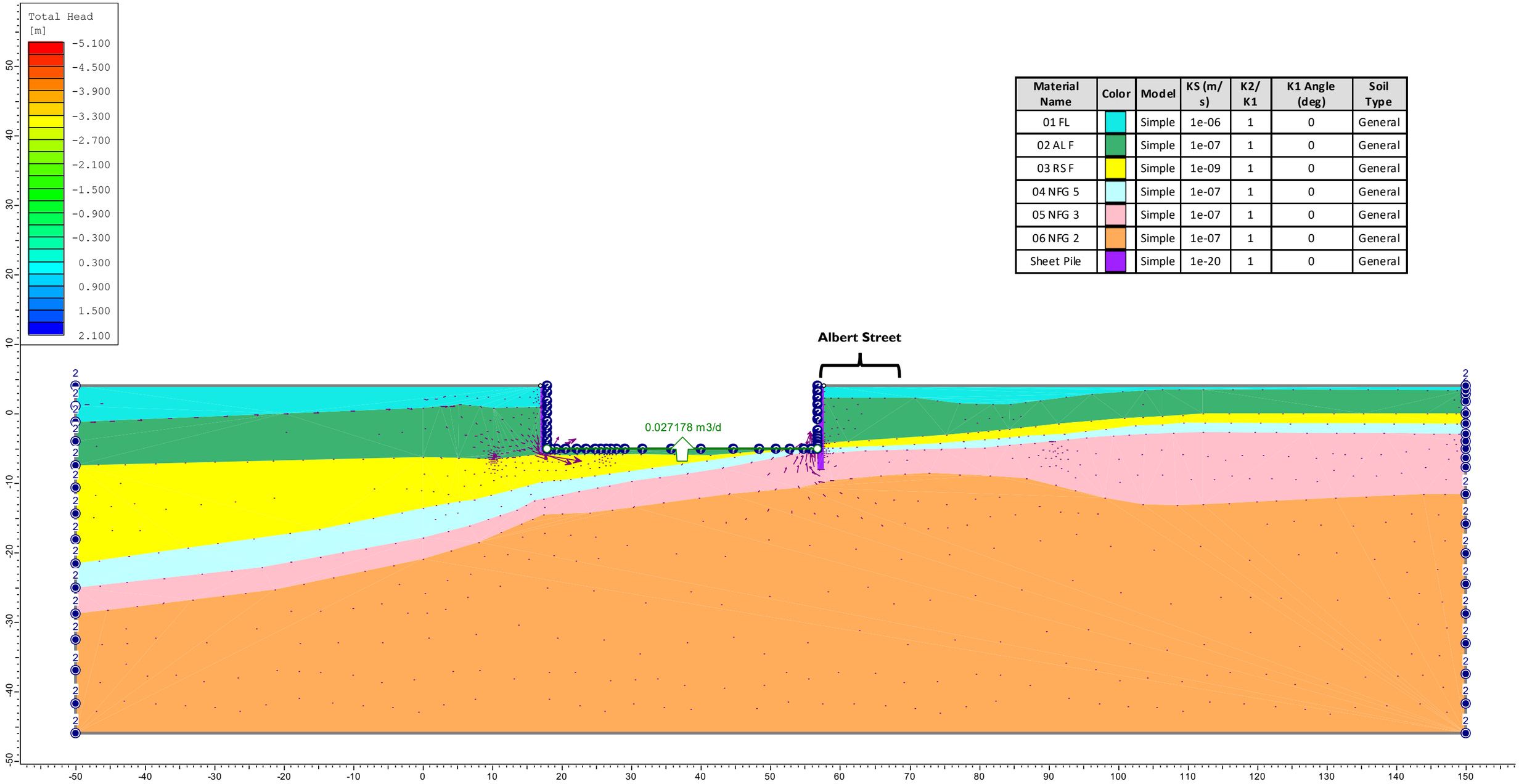
client:	QIC
project:	Albert Street Development
location:	Brisbane
title:	*Deflection, Bending Moment, Shear Force*
job no:	B01493-1

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figure: *F12*

Appendix G

Seepage Analysis Outputs



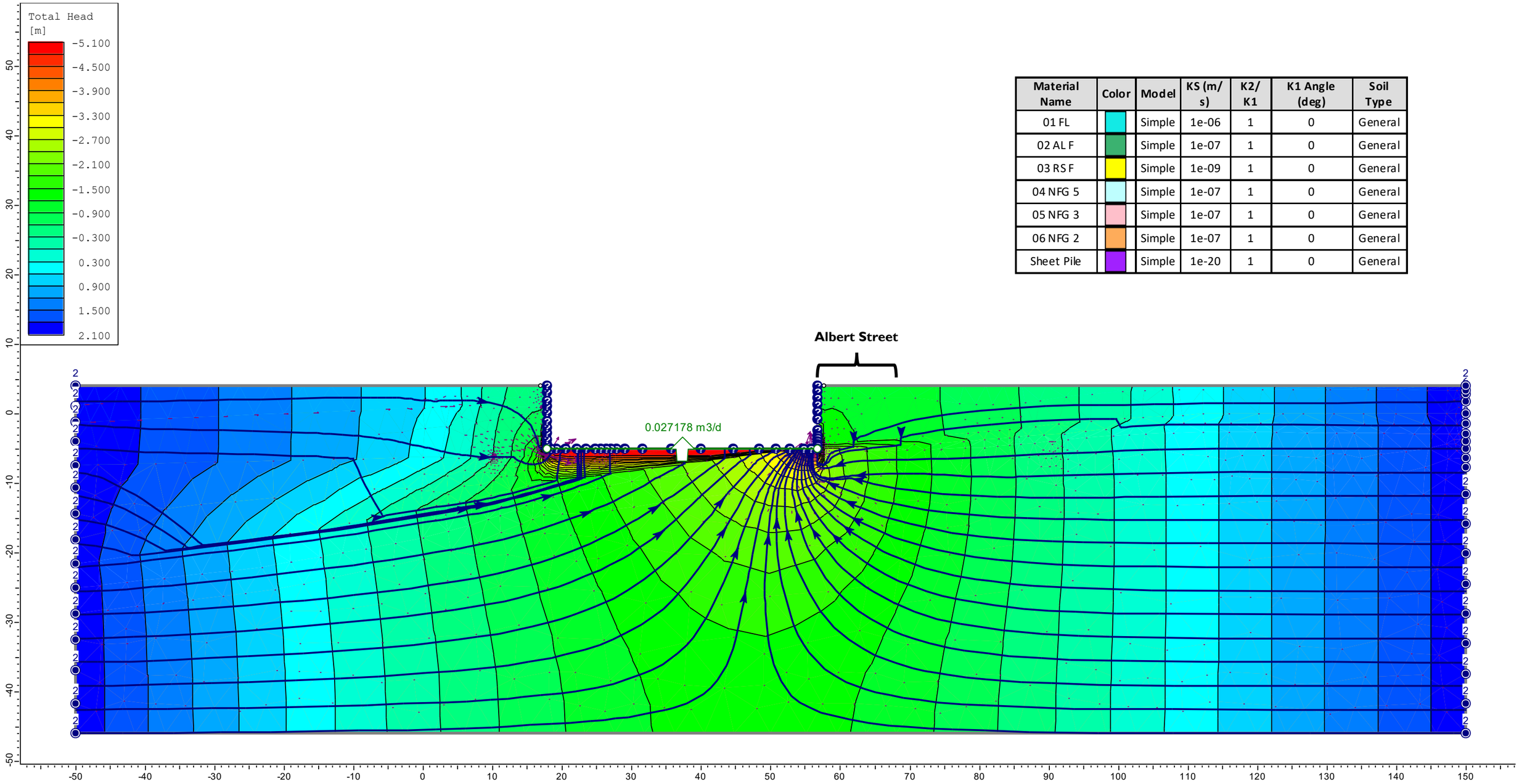
Material Name	Color	Model	KS (m/s)	K2/K1	K1 Angle (deg)	Soil Type
01 FL		Simple	1e-06	1	0	General
02 AL F		Simple	1e-07	1	0	General
03 RS F		Simple	1e-09	1	0	General
04 NFG 5		Simple	1e-07	1	0	General
05 NFG 3		Simple	1e-07	1	0	General
06 NFG 2		Simple	1e-07	1	0	General
Sheet Pile		Simple	1e-20	1	0	General

Note:
Shotcrete extends to B2 level (~RL -5.5m AHD)

by:	RG	*client:*	QIC
date:	02/08/24	*project:*	Albert Street Development
approved:	DJC	*location:*	Albert Street, Brisbane
scale:	NTS	*title:*	*Cross Section 1 – Scenario 1*
		job no:	B01493-1BC

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figure: G - 1



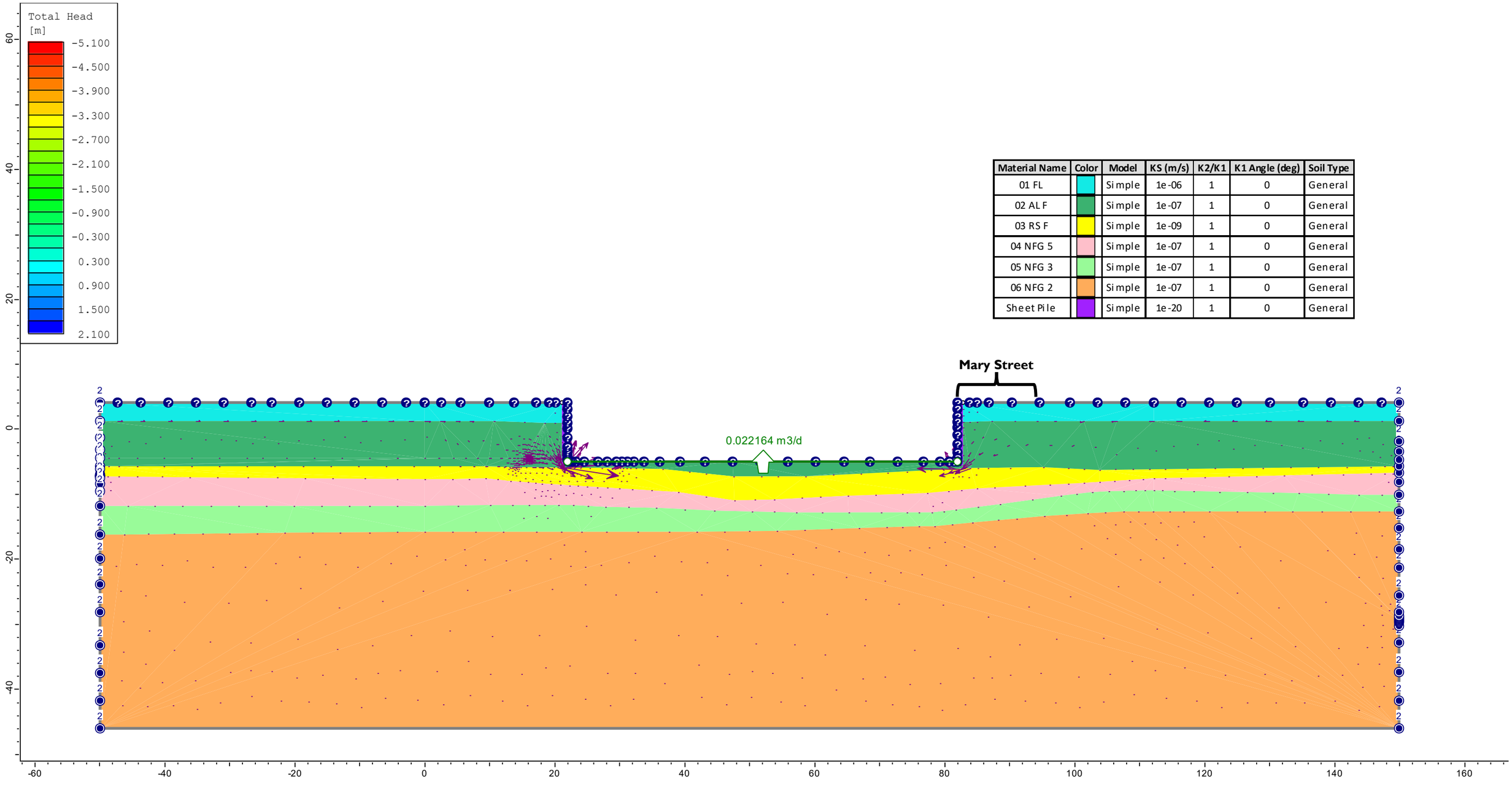
Material Name	Color	Model	KS (m/s)	K2/K1	K1 Angle (deg)	Soil Type
01 FL		Simple	1e-06	1	0	General
02 AL F		Simple	1e-07	1	0	General
03 RS F		Simple	1e-09	1	0	General
04 NFG 5		Simple	1e-07	1	0	General
05 NFG 3		Simple	1e-07	1	0	General
06 NFG 2		Simple	1e-07	1	0	General
Sheet Pile		Simple	1e-20	1	0	General

Note:
Shotcrete extends to B2 level (~RL -5.5m AHD)

by:	RG	*client:*	QIC
date:	02/08/24	*project:*	Albert Street Development
approved:	DJC	*location:*	Albert Street, Brisbane
scale:	NTS	*title:*	*Cross Section 1 – Scenario 1*
		job no:	B01493-1BC

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figure: G - 2



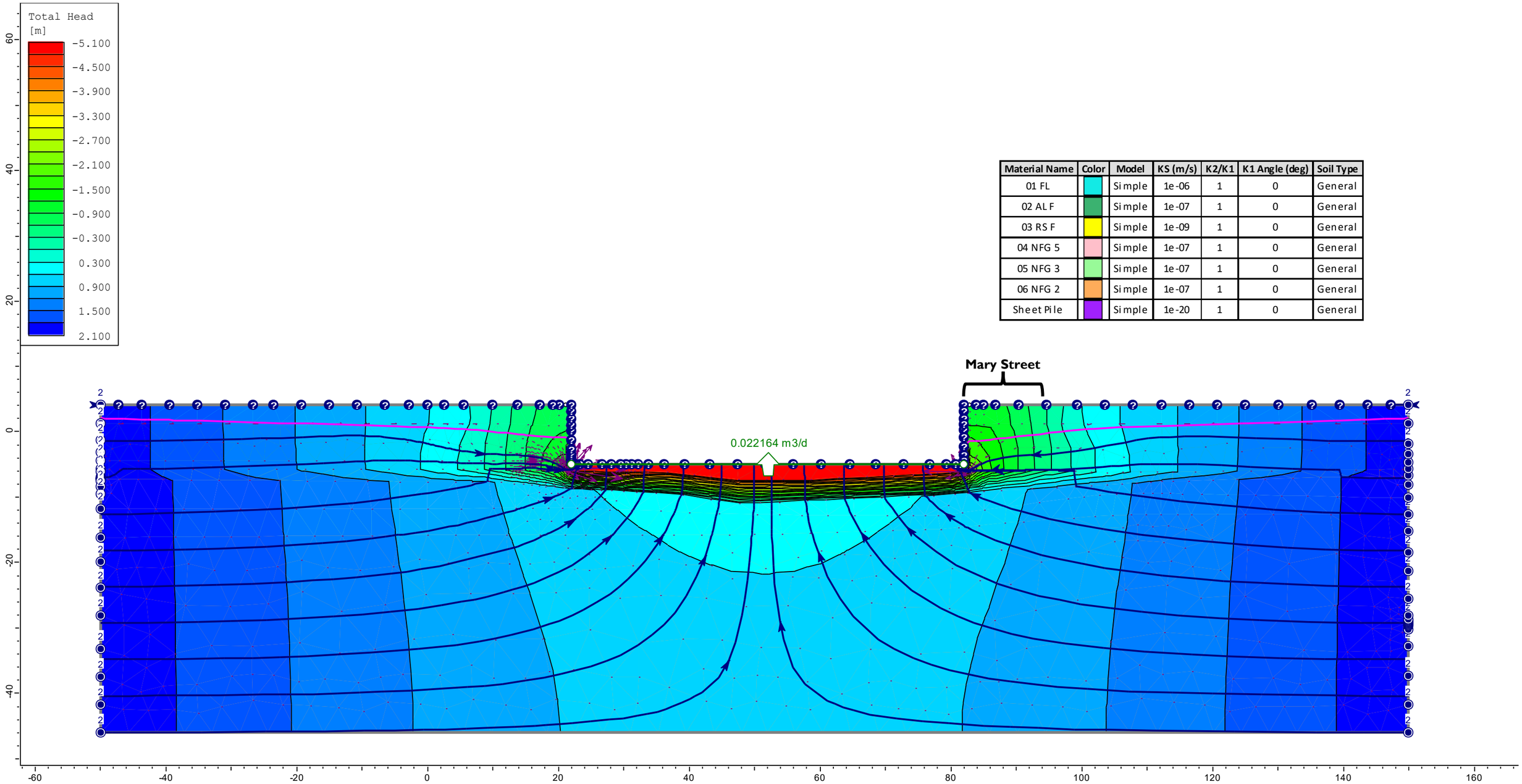
Material Name	Color	Model	KS (m/s)	K2/K1	K1 Angle (deg)	Soil Type
01 FL		Simple	1e-06	1	0	General
02 ALF		Simple	1e-07	1	0	General
03 RSF		Simple	1e-09	1	0	General
04 NFG 5		Simple	1e-07	1	0	General
05 NFG 3		Simple	1e-07	1	0	General
06 NFG 2		Simple	1e-07	1	0	General
Sheet Pile		Simple	1e-20	1	0	General

Note:
Shotcrete extends to B2 level (~RL -5.5m AHD)

by:	RG	*client:*	QIC
date:	02/08/24	*project:*	Albert Street Development
approved:	DJC	*location:*	Albert Street, Brisbane
scale:	NTS	*title:*	*Cross Section 2 – Scenario 1*
		job no:	B01493-1BC

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figure: *G - 3*



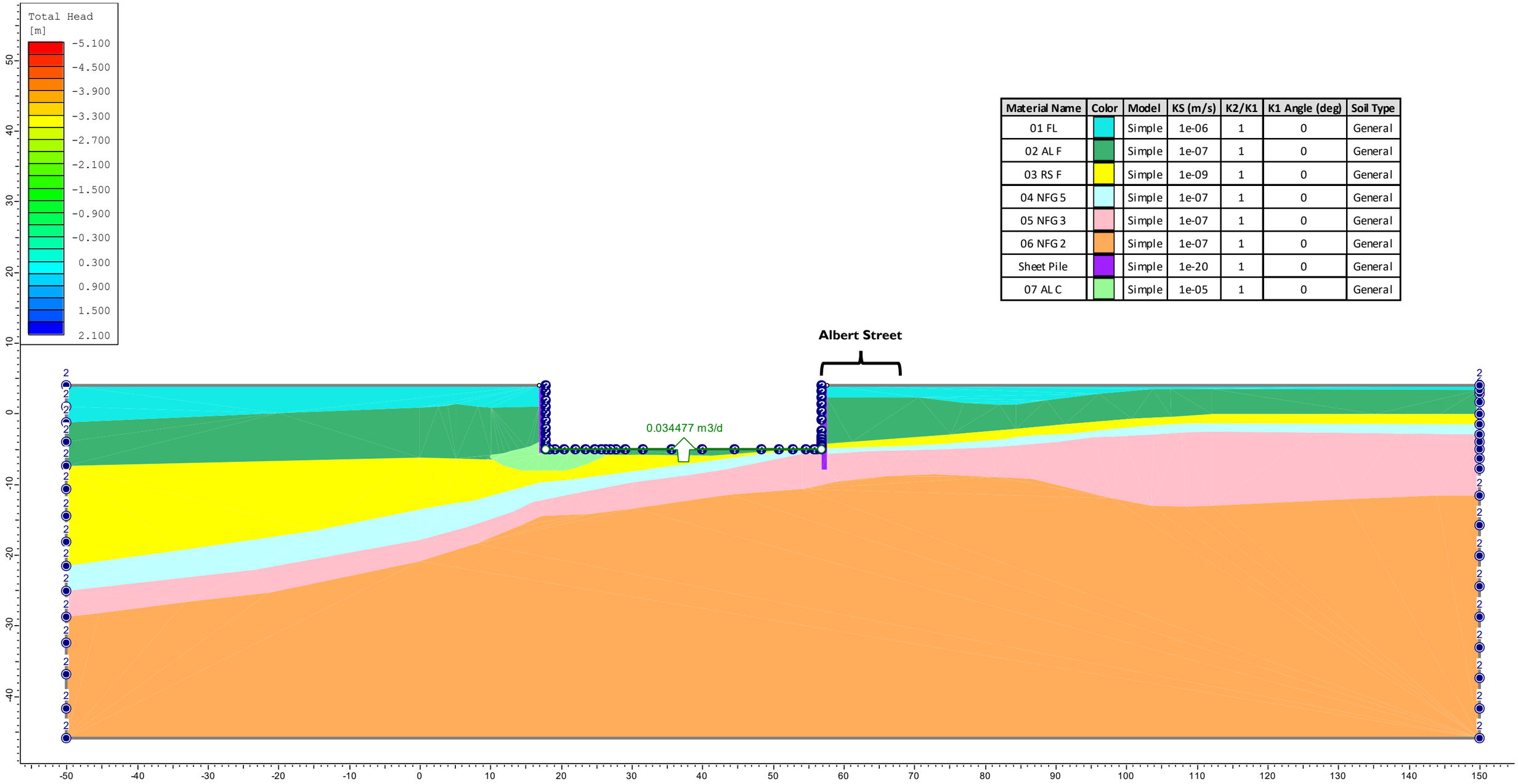
Material Name	Color	Model	KS (m/s)	K2/K1	K1 Angle (deg)	Soil Type
01 FL		Simple	1e-06	1	0	General
02 ALF		Simple	1e-07	1	0	General
03 RS F		Simple	1e-09	1	0	General
04 NFG 5		Simple	1e-07	1	0	General
05 NFG 3		Simple	1e-07	1	0	General
06 NFG 2		Simple	1e-07	1	0	General
Sheet Pile		Simple	1e-20	1	0	General

Note:
Shotcrete extends to B2 level (~RL -5.5m AHD)

by:	RG	*client:*	QIC
date:	02/08/24	*project:*	Albert Street Development
approved:	DJC	*location:*	Albert Street, Brisbane
scale:	NTS	*title:*	*Cross Section 2 – Scenario 1*
		job no:	B01493-1BC

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figure: G - 4



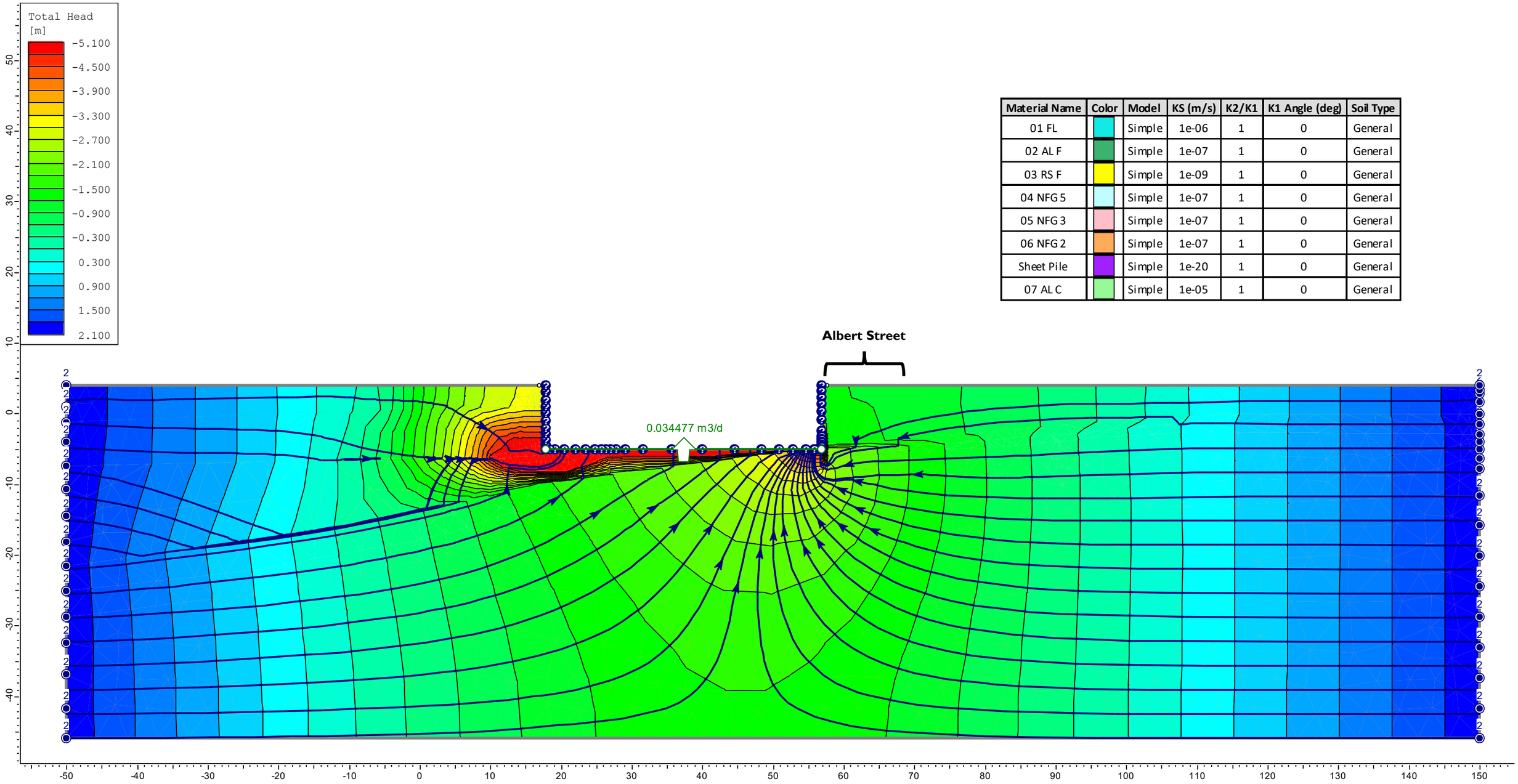
Material Name	Color	Model	KS (m/s)	K2/K1	K1 Angle (deg)	Soil Type
01 FL		Simple	1e-06	1	0	General
02 AL F		Simple	1e-07	1	0	General
03 RS F		Simple	1e-09	1	0	General
04 NFG 5		Simple	1e-07	1	0	General
05 NFG 3		Simple	1e-07	1	0	General
06 NFG 2		Simple	1e-07	1	0	General
Sheet Pile		Simple	1e-20	1	0	General
07 AL C		Simple	1e-05	1	0	General

Note:
Shotcrete extends to B2 level (~RL -5.5m AHD)

by:	RG	*client:*	QIC
date:	02/08/24	*project:*	Albert Street Development
approved:	DJC	*location:*	Albert Street, Brisbane
scale:	NTS	*title:*	*Cross Section 1 – Scenario 2*
		job no:	B01493-1BC

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figure: G - 5



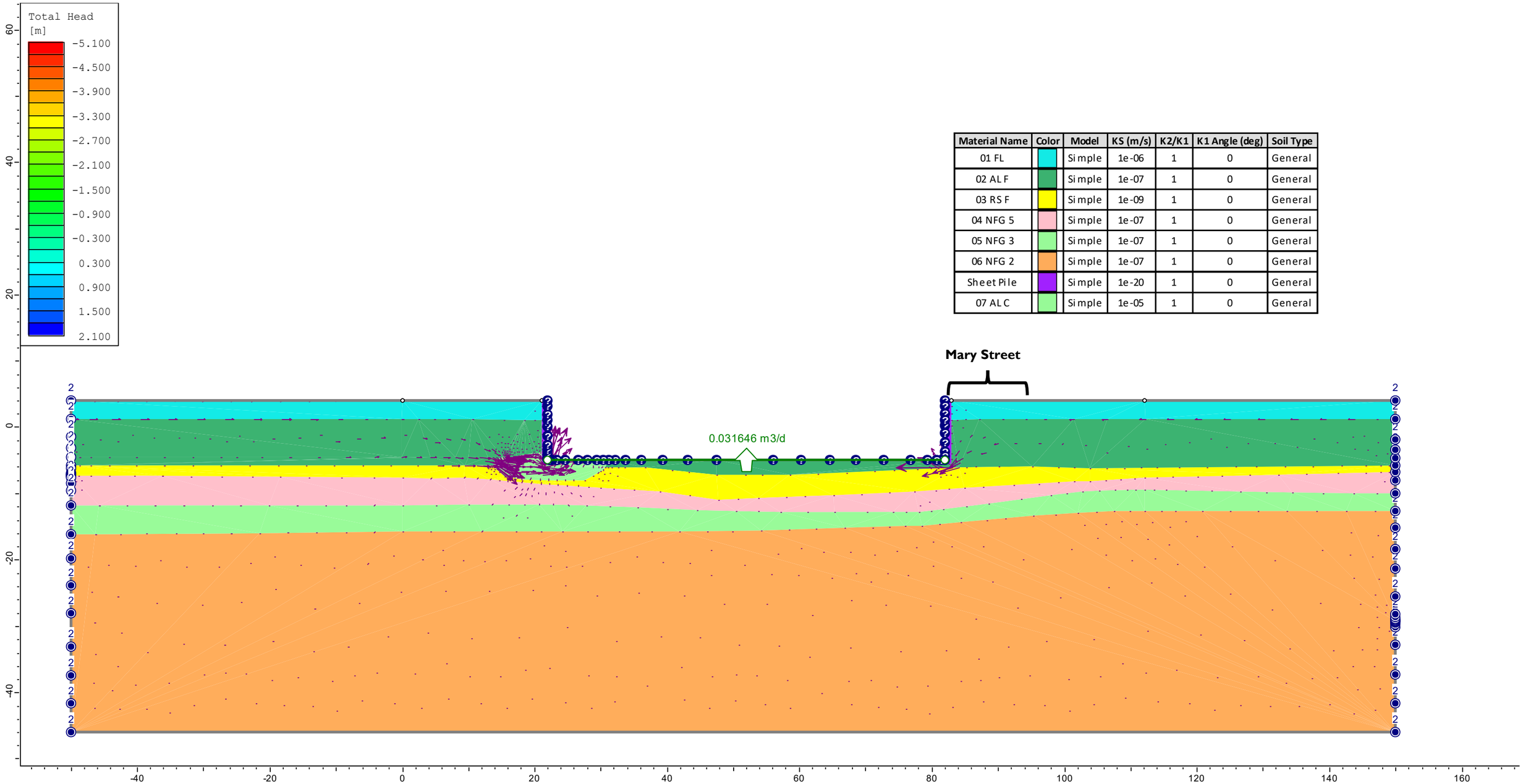
Material Name	Color	Model	KS (m/s)	K2/K1	K1 Angle (deg)	Soil Type
01 FL		Simple	1e-06	1	0	General
02 AL F		Simple	1e-07	1	0	General
03 RS F		Simple	1e-09	1	0	General
04 NFG 5		Simple	1e-07	1	0	General
05 NFG 3		Simple	1e-07	1	0	General
06 NFG 2		Simple	1e-07	1	0	General
Sheet Pile		Simple	1e-20	1	0	General
07 AL C		Simple	1e-05	1	0	General

Note:
Shotcrete extends to B2 level (~RL -5.5m AHD)

by:	RG	*client:*	QIC
date:	02/08/24	*project:*	Albert Street Development
approved:	DJC	*location:*	Albert Street, Brisbane
scale:	NTS	*title:*	*Cross Section 1 – Scenario 2*
		job no:	B01493-1BC

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figure: G - 6



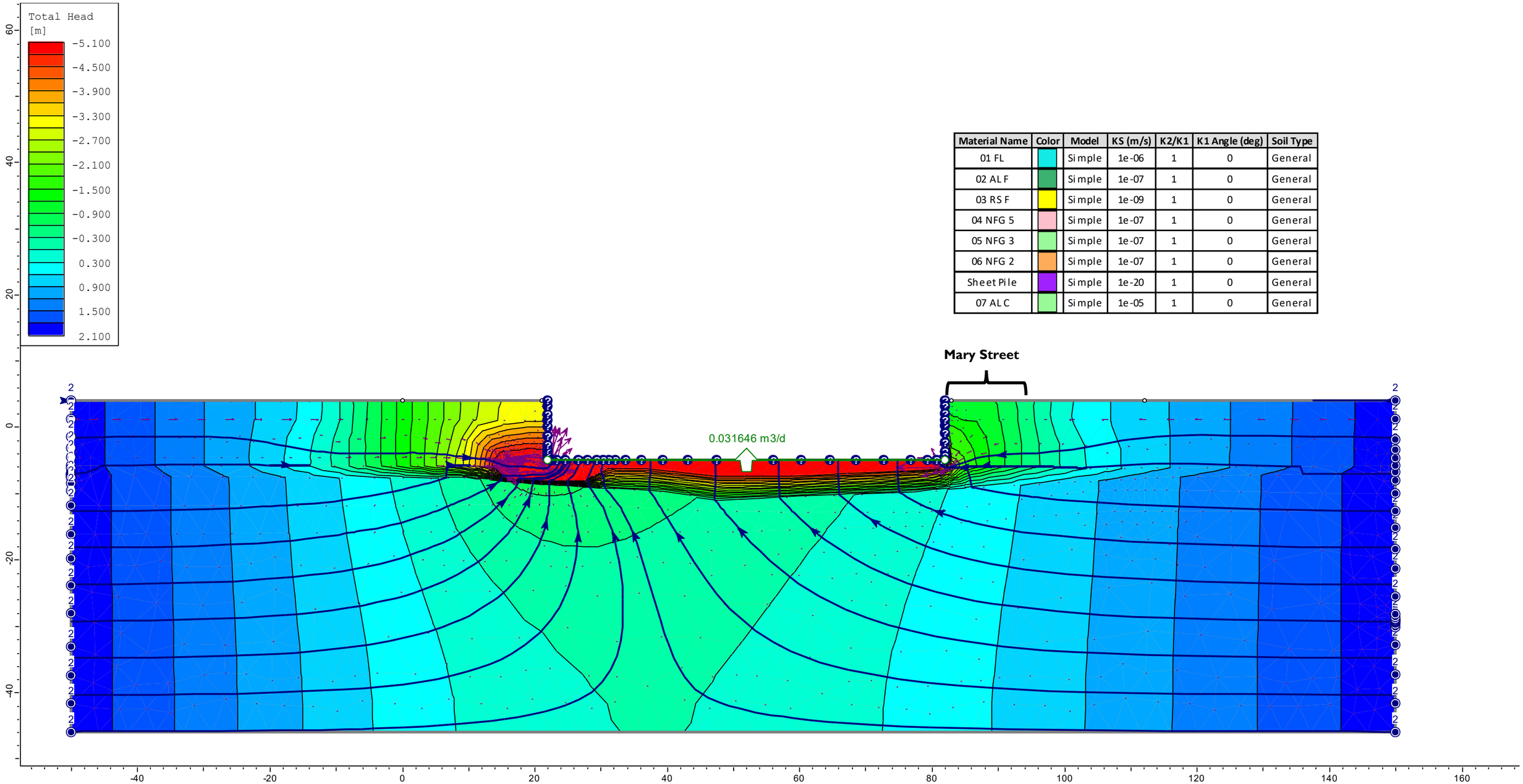
Material Name	Color	Model	KS (m/s)	K2/K1	K1 Angle (deg)	Soil Type
01 FL		Simple	1e-06	1	0	General
02 ALF		Simple	1e-07	1	0	General
03 RSF		Simple	1e-09	1	0	General
04 NFG 5		Simple	1e-07	1	0	General
05 NFG 3		Simple	1e-07	1	0	General
06 NFG 2		Simple	1e-07	1	0	General
Sheet Pile		Simple	1e-20	1	0	General
07 ALC		Simple	1e-05	1	0	General

Note:
Shotcrete extends to B2 level (~RL -5.5m AHD)

by:	RG	*client:*	QIC
date:	02/08/24	*project:*	Albert Street Development
approved:	DJC	*location:*	Albert Street, Brisbane
scale:	NTS	*title:*	*Cross Section 2 – Scenario 2*
		job no:	B01493-1BC

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figure: G - 7



Material Name	Color	Model	KS (m/s)	K2/K1	K1 Angle (deg)	Soil Type
01 FL		Simple	1e-06	1	0	General
02 ALF		Simple	1e-07	1	0	General
03 RSF		Simple	1e-09	1	0	General
04 NFG 5		Simple	1e-07	1	0	General
05 NFG 3		Simple	1e-07	1	0	General
06 NFG 2		Simple	1e-07	1	0	General
Sheet Pile		Simple	1e-20	1	0	General
07 ALC		Simple	1e-05	1	0	General

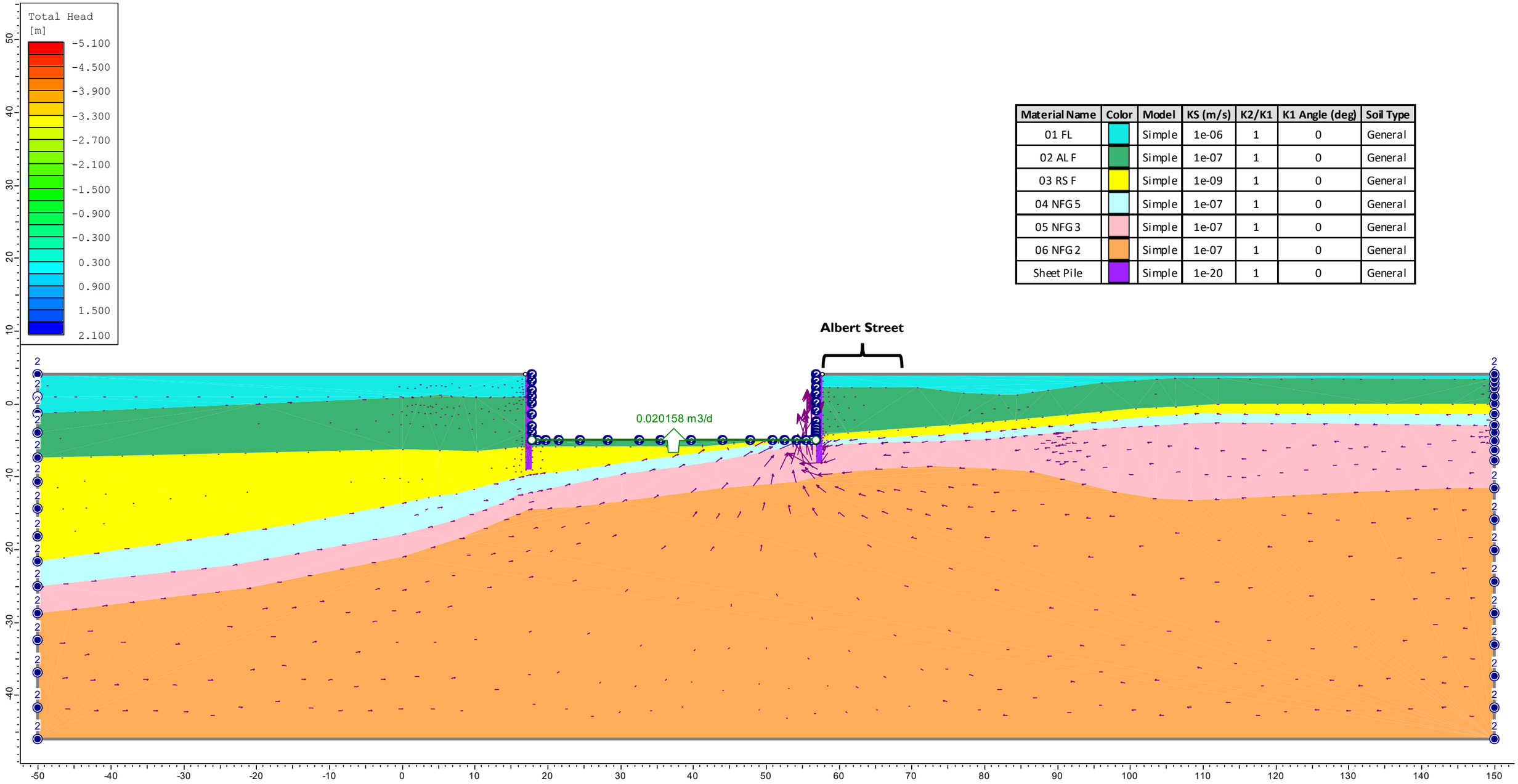
Note:
Shotcrete extends to B2 level (~RL -5.5m AHD)

by:	RG
date:	02/08/24
approved:	DJC
scale:	NTS

client:	QIC
project:	Albert Street Development
location:	Albert Street, Brisbane
title:	*Cross Section 2 – Scenario 2*
job no:	B01493-1BC

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figure: G - 8



Material Name	Color	Model	KS (m/s)	K2/K1	K1 Angle (deg)	Soil Type
01 FL		Simple	1e-06	1	0	General
02 AL F		Simple	1e-07	1	0	General
03 RS F		Simple	1e-09	1	0	General
04 NFG 5		Simple	1e-07	1	0	General
05 NFG 3		Simple	1e-07	1	0	General
06 NFG 2		Simple	1e-07	1	0	General
Sheet Pile		Simple	1e-20	1	0	General

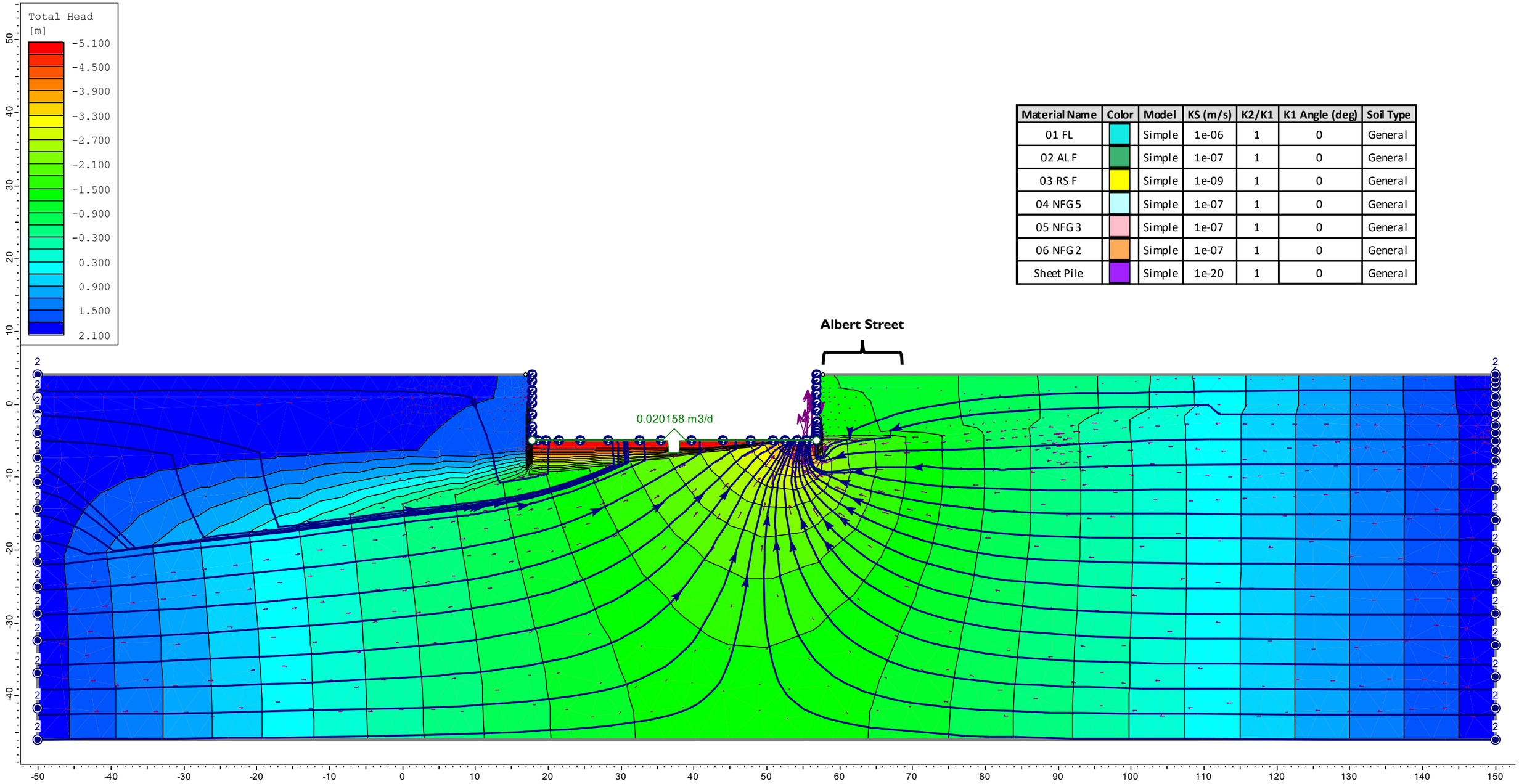
Note:
Shotcrete extends to ~RL -8m AHD

by:	RG
date:	02/08/24
approved:	DJC
scale:	NTS

client:	QIC
project:	Albert Street Development
location:	Albert Street, Brisbane
title:	*Cross Section 1 – Scenario 3*
job no:	B01493-1BC

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figure: G - 9



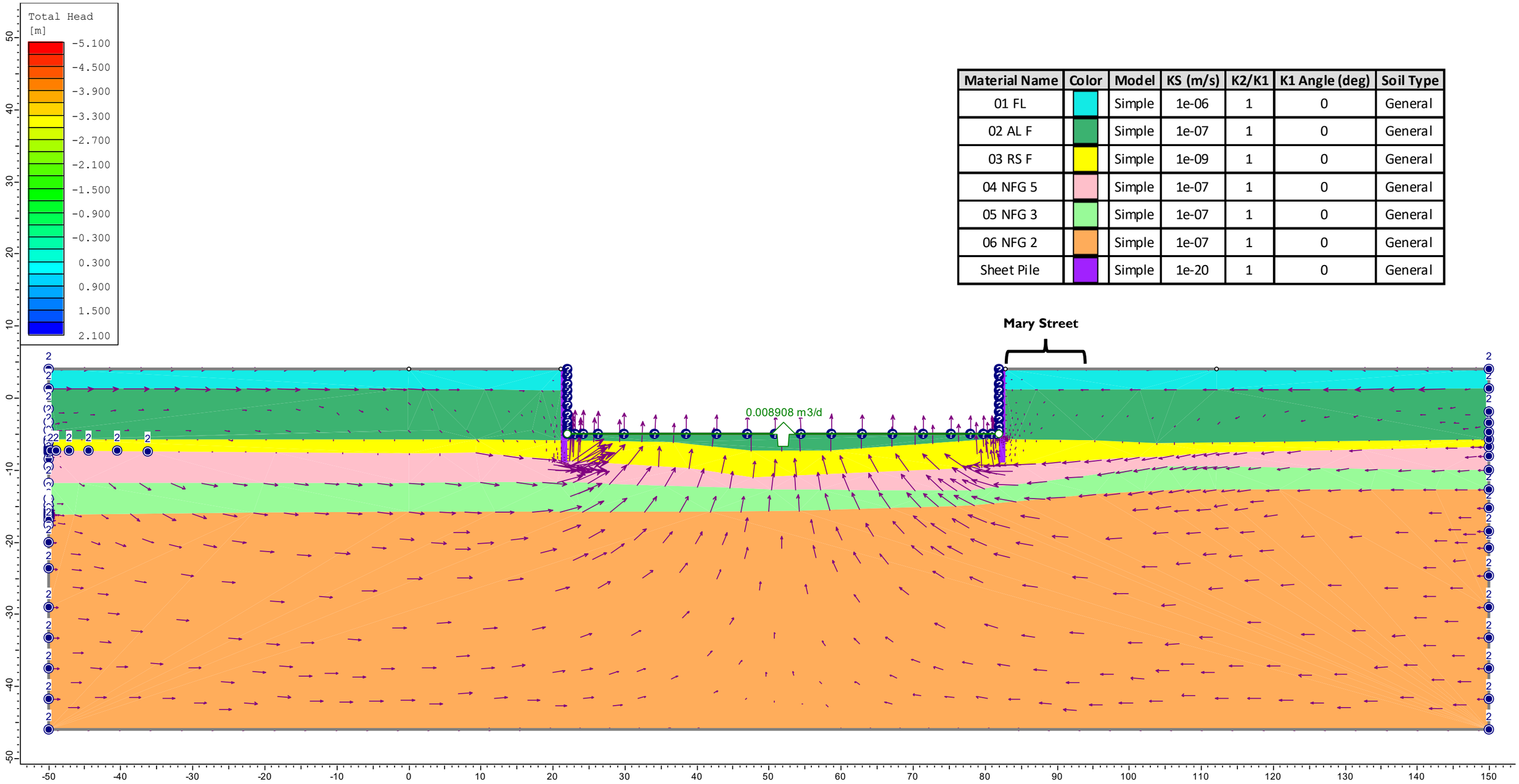
Material Name	Color	Model	KS (m/s)	K2/K1	K1 Angle (deg)	Soil Type
01 FL		Simple	1e-06	1	0	General
02 AL F		Simple	1e-07	1	0	General
03 RS F		Simple	1e-09	1	0	General
04 NFG 5		Simple	1e-07	1	0	General
05 NFG 3		Simple	1e-07	1	0	General
06 NFG 2		Simple	1e-07	1	0	General
Sheet Pile		Simple	1e-20	1	0	General

Note:
Shotcrete extends to ~RL -8m AHD

by:	RG	*client:*	QIC
date:	02/08/24	*project:*	Albert Street Development
approved:	DJC	*location:*	Albert Street, Brisbane
scale:	NTS	*title:*	*Cross Section 1 – Scenario 3*
		job no:	B01493-1BC

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figure: G - 10



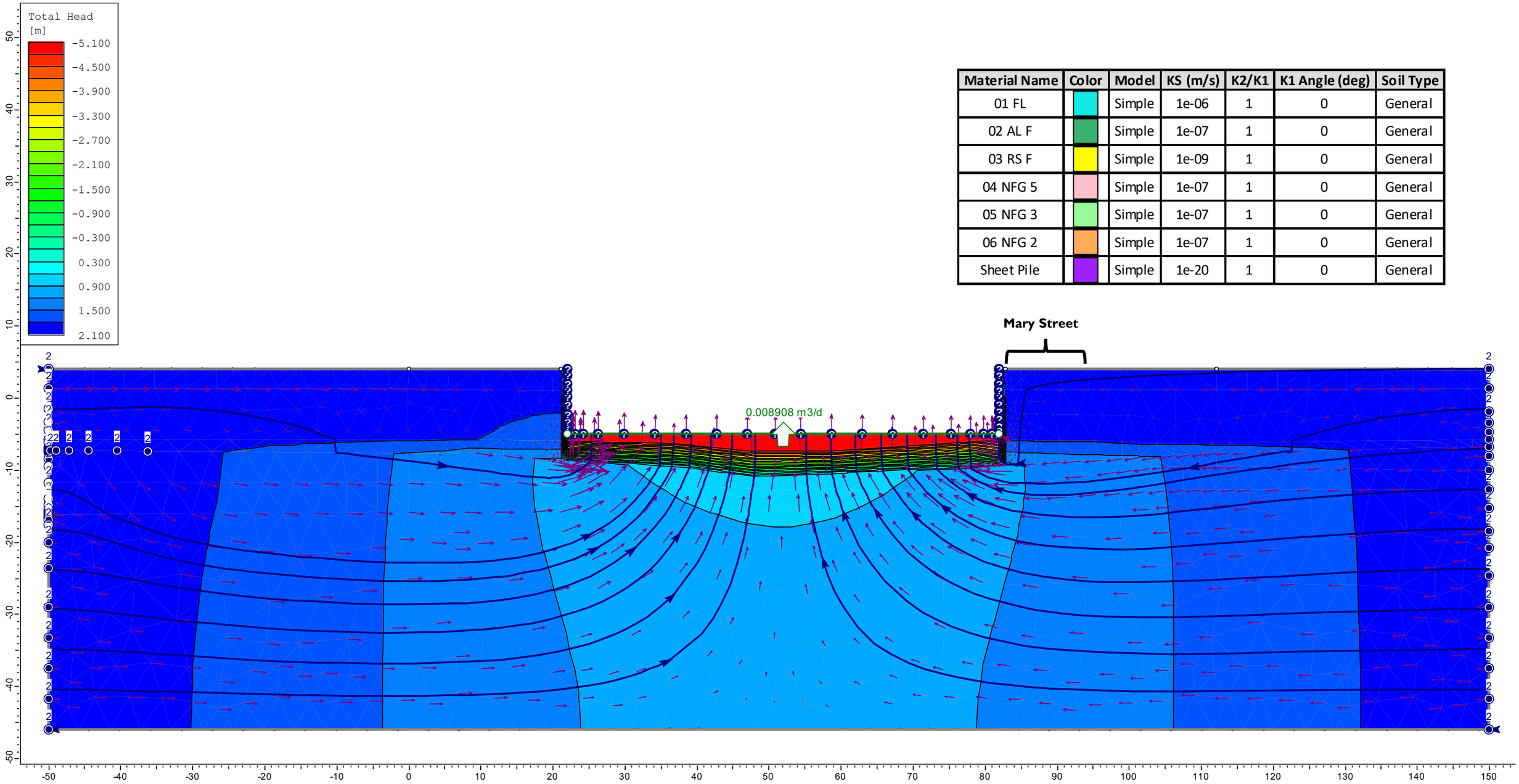
Material Name	Color	Model	KS (m/s)	K2/K1	K1 Angle (deg)	Soil Type
01 FL		Simple	1e-06	1	0	General
02 AL F		Simple	1e-07	1	0	General
03 RS F		Simple	1e-09	1	0	General
04 NFG 5		Simple	1e-07	1	0	General
05 NFG 3		Simple	1e-07	1	0	General
06 NFG 2		Simple	1e-07	1	0	General
Sheet Pile		Simple	1e-20	1	0	General

Note:
Shotcrete extends to ~RL -8m AHD

by:	RG	*client:*	QIC
date:	02/08/24	*project:*	Albert Street Development
approved:	DJC	*location:*	Albert Street, Brisbane
scale:	NTS	*title:*	*Cross Section 2 – Scenario 3*
		job no:	B01493-1BC

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figure: G - 11



Material Name	Color	Model	KS (m/s)	K2/K1	K1 Angle (deg)	Soil Type
01 FL		Simple	1e-06	1	0	General
02 AL F		Simple	1e-07	1	0	General
03 RS F		Simple	1e-09	1	0	General
04 NFG 5		Simple	1e-07	1	0	General
05 NFG 3		Simple	1e-07	1	0	General
06 NFG 2		Simple	1e-07	1	0	General
Sheet Pile		Simple	1e-20	1	0	General

Note:
Shotcrete extends to ~RL -8m AHD

by:	RG	*client:*	QIC
date:	02/08/24	*project:*	Albert Street Development
approved:	DJC	*location:*	Albert Street, Brisbane
scale:	NTS	*title:*	*Cross Section 2 – Scenario 3*
		job no:	B01493-1BC

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figure: G - 12

Appendix H

Pile Schedules

Appendix H – Preliminary Pile Schedule – Podium Piles

Column ID	Pile Diameter (m)	ULS load per pile (MN)	Pile Cut off level (mRL)	Approx Top of Socket (m RL)	Approx Pile Toe (m RL)	Socket Requirements (m)			Total Pile Length (m)	SLS load per pile (MN)	Estimated Settlement at SLS Load (mm)	Vertical Spring Stiffness (MN/m)		
						20MPa Concrete Backfill	NFG3	NFG1/2				Lower	Recommended Value	Upper
C01	0.9	3.27	-6.8	-11.5	-13	-	1.5	-	6.2	2.5	2	1200	1700	2200
C02	1.6	28.95	-8.6	-10.3	-16.3	-	4.5	1.5	7.7	22.95	3	6000	8500	11000
	1.6	28.95	-8.6	-8.6	-14.6	6	-	-	6	22.95	3	6000	8500	11000
C03	1.6	27.5	-8.1	-11.3	-16.3	-	2	3	8.2	21.75	3	6000	8500	11000
C04	1.6	24.8	-8.1	-8.6	-4.6	6	-	-	6	19.3	3	6000	8500	11000
C05	1.6	23.3	-8.1	-10.3	-14.8	-	2	2.5	6.7	18.2	2	6500	9500	12500
C06	0.9	1.98	-6.8	-10.5	-12	-	1.5	-	5.2	1.5	1	1500	2200	2900
C07	0.9	2.73 [Note 1]	-7.1	-9.8	-11.3	-	1.5	-	4.2	2 [Note 1]	1	1200	1800	2400
	0.9	2.73 [Note 1]	-7.1	-8.6	-12.6	4	-	-	4	2 [Note 1]	1	1200	1800	2400
C08	1.6	36.3	-8.1	-25	-31	-	-	6	22.9	28.7	5	4000	6000	8000
C09	1.6	40.1	-8.1	-16	-22.5	-	-	6.5	14.4	31.5	6	4000	6000	8000
C10	1.6	41.3	-8.1	-16	-22.5	-	-	6.5	14.4	32.5	6	4000	6000	8000
C11	1.6	41	-8.1	-30	-36.5	-	-	6.5	28.4	32.5	6	4000	6000	8000
C12	1.6	40.7	-8.1	-30	-36.5	-	-	6.5	28.4	32	6	4000	6000	8000
C13	1.6	37.4	-8.1	-16	-22	-	-	6	13.9	29.5	5	4000	6000	8000

Notes: [1] All loads transfer to one pile for the purpose of this assessment.

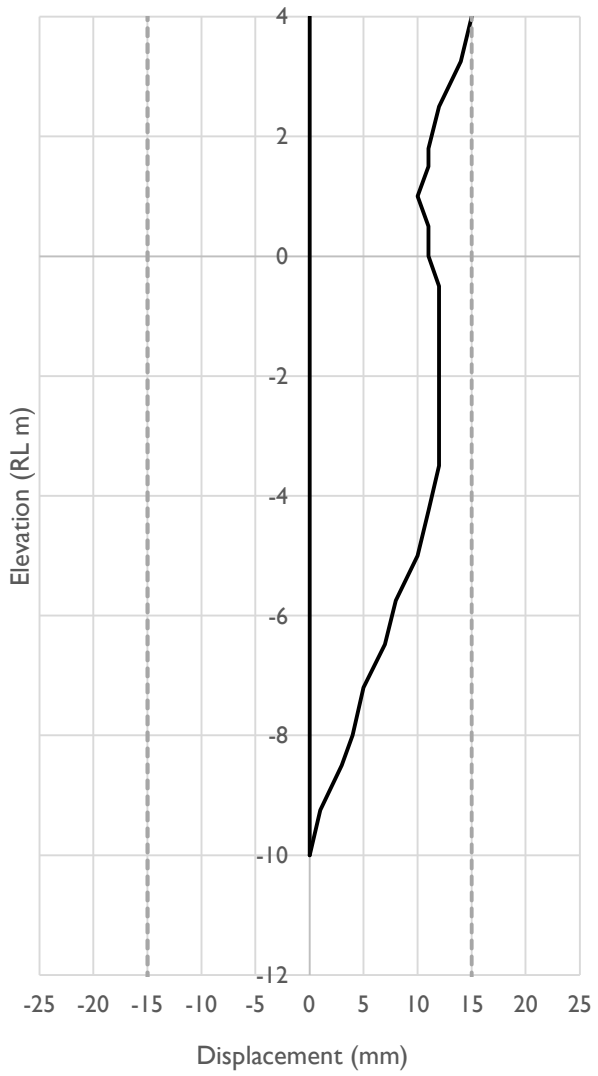
Appendix H – Preliminary Pile Schedule – Core Piles

Pile ID	Pile Diameter (m)	ULS load per pile (MN)	Pile Cut off level (mRL)	Approx Top of Socket (m RL)	Approx Pile Toe (m RL)	Socket Requirements (m)			Total Pile Length (m)	SLS load per pile (MN)	Estimated Settlement at SLS Load (mm)	Vertical Spring Stiffness (MN/m)		
						20MPa Concrete Backfill	NFG3	NFG1/2				Lower	Recommended Value	Upper
P01	1.2	30	-9	-10	-17	7	-	-	7	22	5	3500	5000	6500
P02	1.2	30	-9.9	-12	-20	-	3	5	10.1	22	5	3500	5000	6500
P03	1.2	30	-9.9	-12	-20	-	3	5	10.1	22	5	3500	5000	6500
P04	1.2	30	-9.9	-12	-20	-	3	5	10.1	22	5	3500	5000	6500
P05	1.2	30	-9	-12	-20	-	3	5	11	22	5	3500	5000	6500
P06	1.2	30	-9	-12	-20	-	3	5	11	22	5	3500	5000	6500
P07	1.2	30	-9	-12	-20	-	3	5	11	22	5	3500	5000	6500
P08	1.2	30	-9	-12	-20	-	3	5	11	22	5	3500	5000	6500
P09	1.2	30	-9	-12	-20	-	3	5	11	22	5	3500	5000	6500
P10	1.2	30	-9	-12	-20	-	3	5	11	22	5	3500	5000	6500
P11	1.2	30	-9	-12	-20	-	3	5	11	22	5	3500	5000	6500
P12	1.2	30	-9	-10	-17	7	-	-	7	22	4	4000	5500	7000
P13	1.2	30	-9.9	-10	-17	7	-	-	7	22	4	4000	5500	7000
P14	1.2	30	-9.9	-27	-33.5	-	-	6.5	23.6	22	4	4000	5500	7000
P15	1.2	30	-9.9	-27	-33.5	-	-	6.5	23.6	22	4	4000	5500	7000
P16	1.2	30	-9	-27	-33.5	-	-	6.5	24.5	22	4	4000	5500	7000
P17	1.2	30	-9	-27	-33.5	-	-	6.5	24.5	22	4	4000	5500	7000
P18	1.2	30	-9	-27	-33.5	-	-	6.5	24.5	22	4	4000	5500	7000
P19	1.2	30	-9	-11	-19	-	3	5	10	22	4	4000	5500	7000
P20	1.2	30	-9	-11	-19	-	3	5	10	22	4	4000	5500	7000
P21	1.2	30	-9	-11	-19	-	3	5	10	22	4	4000	5500	7000
P22	1.2	30	-9	-11	-19	-	3	5	10	22	4	4000	5500	7000
P23	1.2	25	-9	-10.5	-17	-	3.5	3	8	19	4	4500	6000	7500
P24	1.2	25	-9	-10.5	-17	-	3.5	3	8	19	4	4500	6000	7500
P25	1.2	25	-9	-10.5	-17	-	3.5	3	8	19	4	4500	6000	7500
P26	1.2	25	-9	-28	-33	-	-	5	24	19	4	4500	6000	7500
P27	1.2	25	-9	-28	-33	-	-	5	24	19	4	4500	6000	7500
P28	1.2	25	-9	-28	-33	-	-	5	24	19	4	4500	6000	7500
P29	1.2	25	-9	-28	-33	-	-	5	24	19	4	4500	6000	7500
P30	1.2	25	-9	-28	-33	-	-	5	24	19	4	4500	6000	7500
P31	1.2	31	-9	-28	-35.5	-	-	7.5	26.5	24	5	4000	5500	7000
P32	1.2	31	-9	-28	-35.5	-	-	7.5	26.5	24	5	4000	5500	7000
P33	1.2	31	-9	-28	-35.5	-	-	7.5	26.5	24	5	4000	5500	7000
P34	1.2	31	-9	-28	-35.5	-	-	7.5	26.5	24	5	4000	5500	7000
P35	1.2	31	-9	-28	-35.5	-	-	7.5	26.5	24	5	4000	5500	7000
P36	1.2	40	-9	-29	-40	-	-	11	31	27	6	3500	5000	6500
P37	1.2	40	-9	-29	-40	-	-	11	31	27	6	3500	5000	6500
P38	1.2	40	-9	-29	-40	-	-	11	31	27	6	3500	5000	6500
P39	1.2	40	-9	-29	-40	-	-	11	31	27	6	3500	5000	6500
P40	1.2	40	-9	-29	-40	-	-	11	31	27	6	3500	5000	6500
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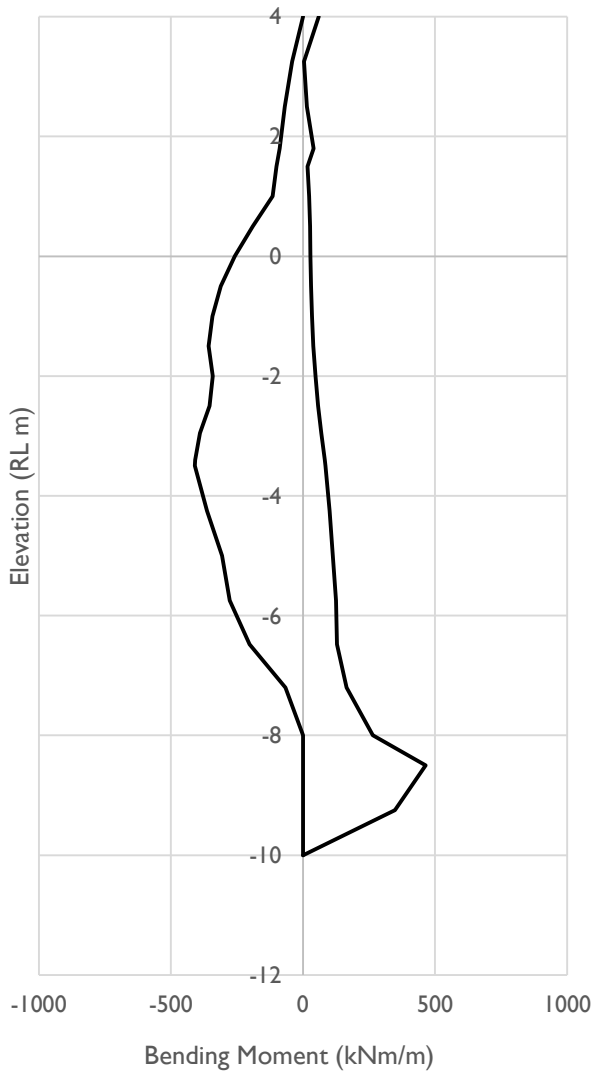
Appendix I

Retention System Calculation Outputs (Raft Option)

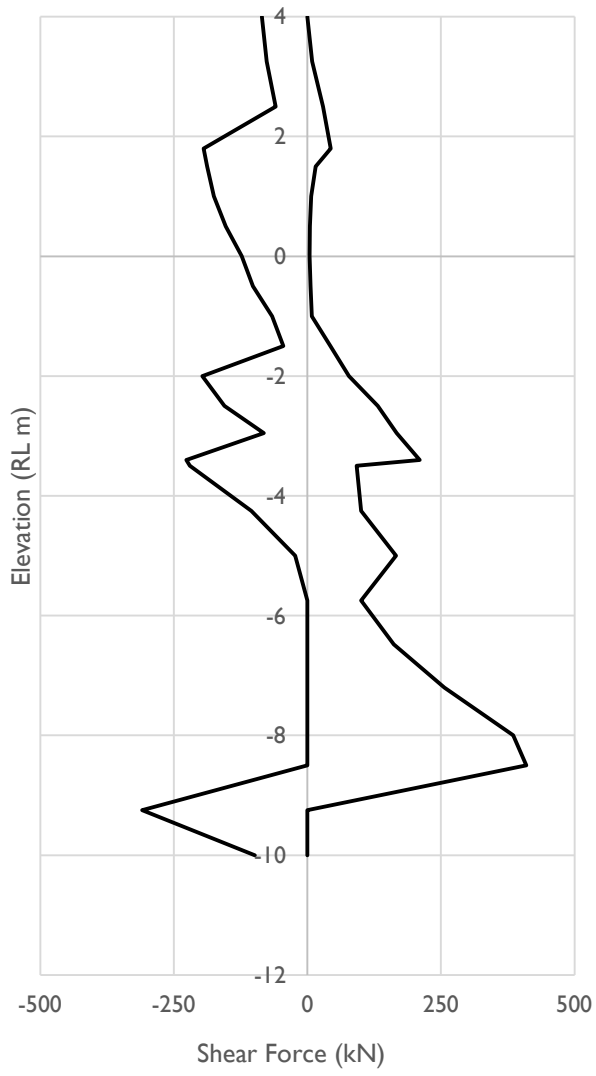
Displacement



Bending Moment



Shear Force



Notes:

- Displacement, bending moment and shear force envelopes
- Section 1
- Deflection limit of 15mm
- Non-flooding conditions

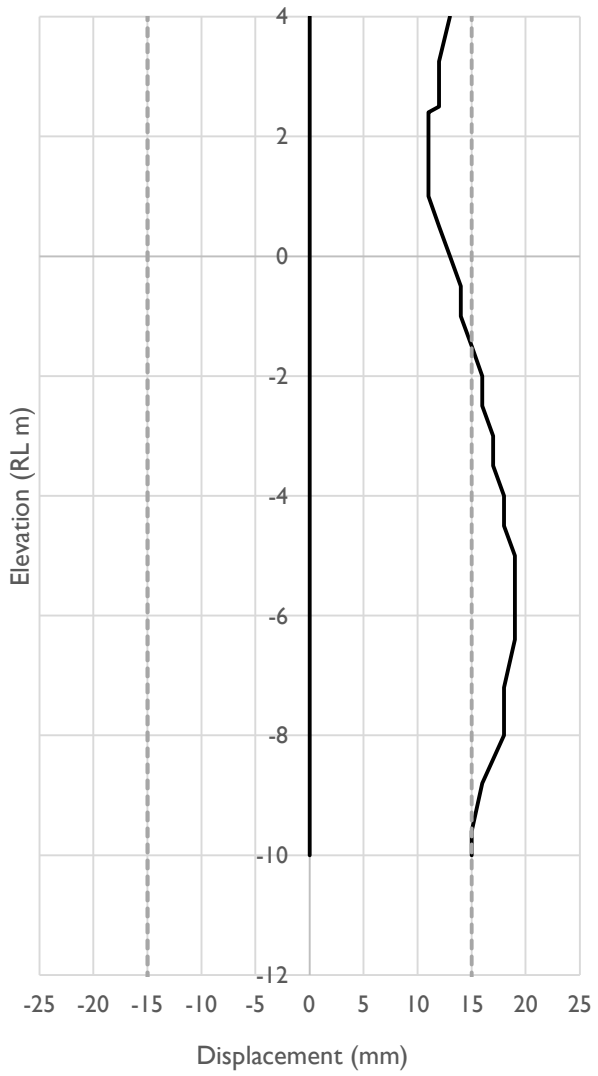
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approved:	DJC
scale:	

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project:	Albert Street Development
location:	Brisbane
title:	*Deflection, Bending Moment, Shear Force*
job no:	B01493-1

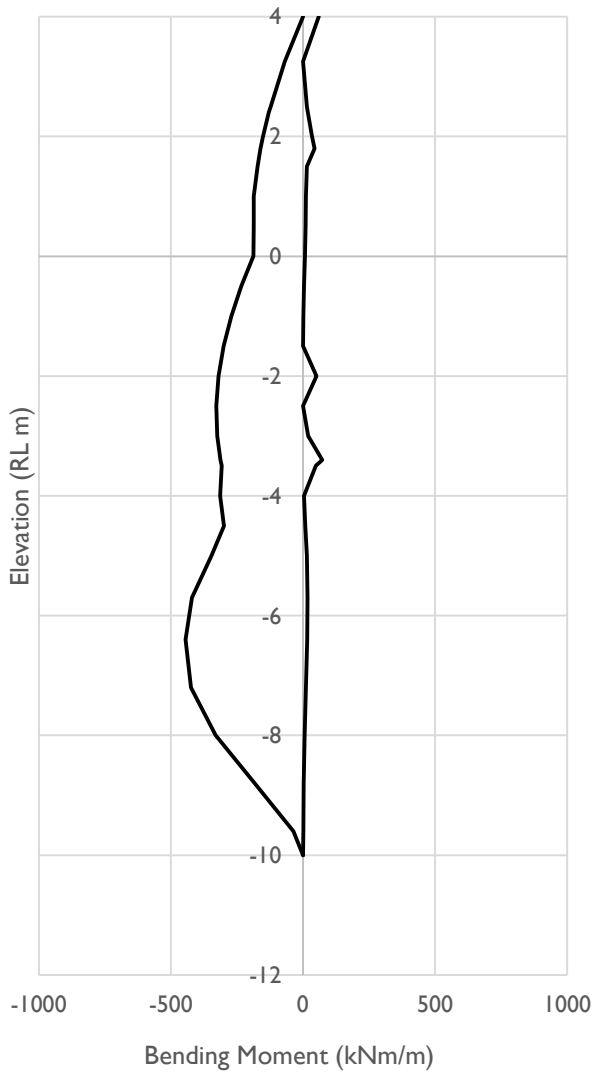
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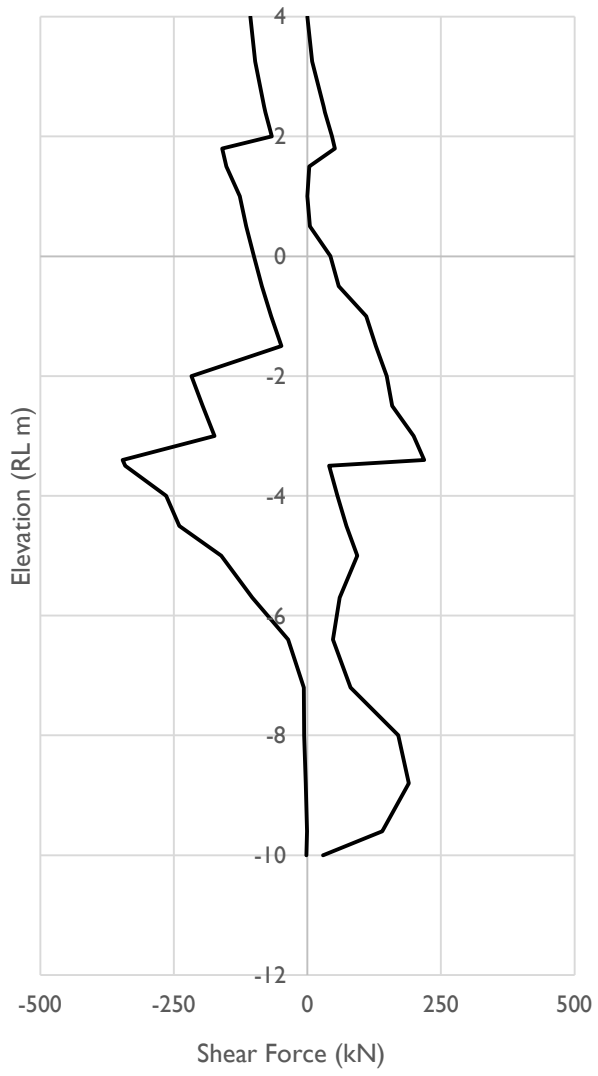
Displacement



Bending Moment



Shear Force



Notes:

- Displacement, bending moment and shear force envelopes
- Section 2
- Deflection limit of 15mm
- Non-flooding conditions

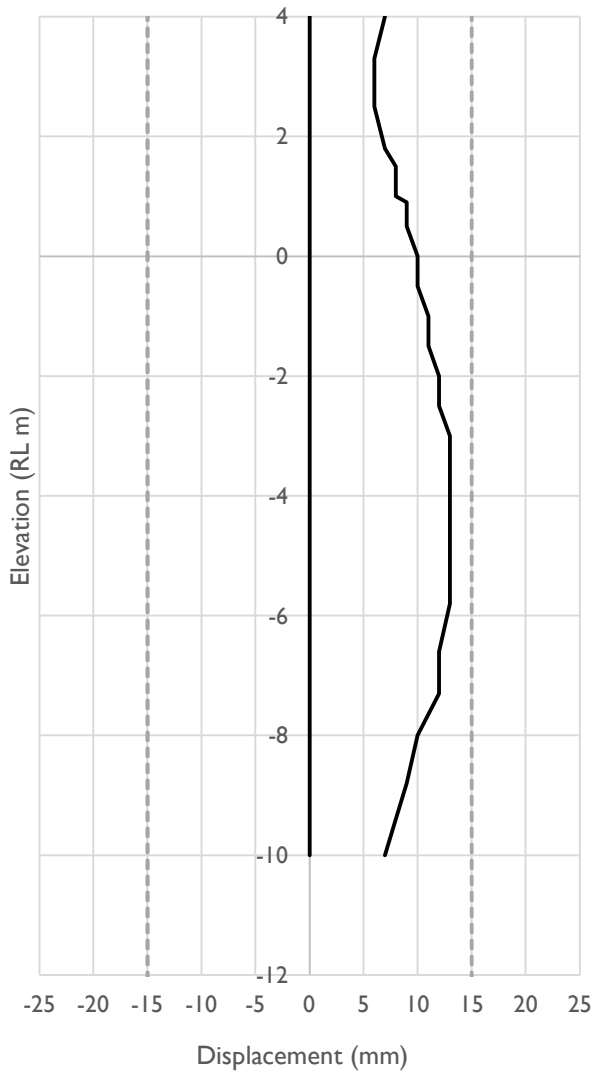
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approved:	DJC
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project:	Albert Street Development
location:	Brisbane
title:	*Deflection, Bending Moment, Shear Force*
job no:	B01493-1

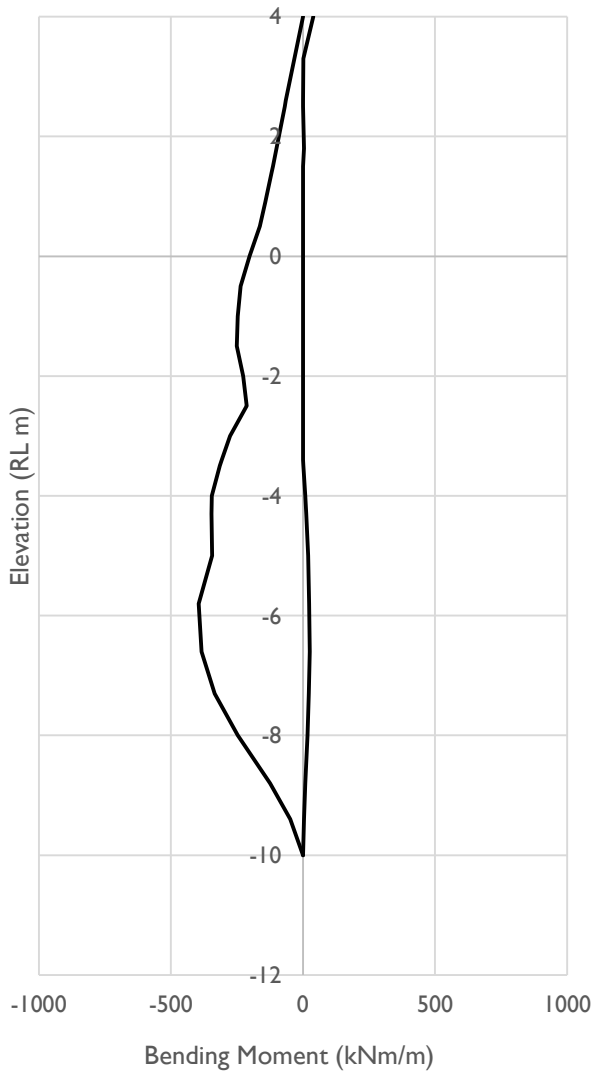
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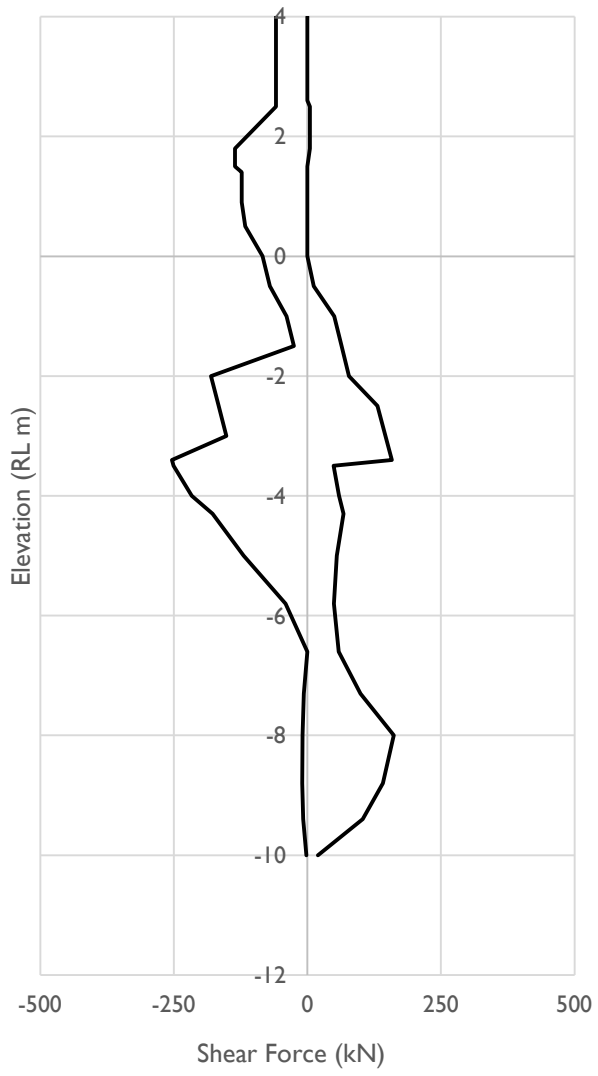
Displacement



Bending Moment



Shear Force



Notes:

- Displacement, bending moment and shear force envelopes
- Section 3
- Deflection limit of 15mm
- Non-flooding conditions

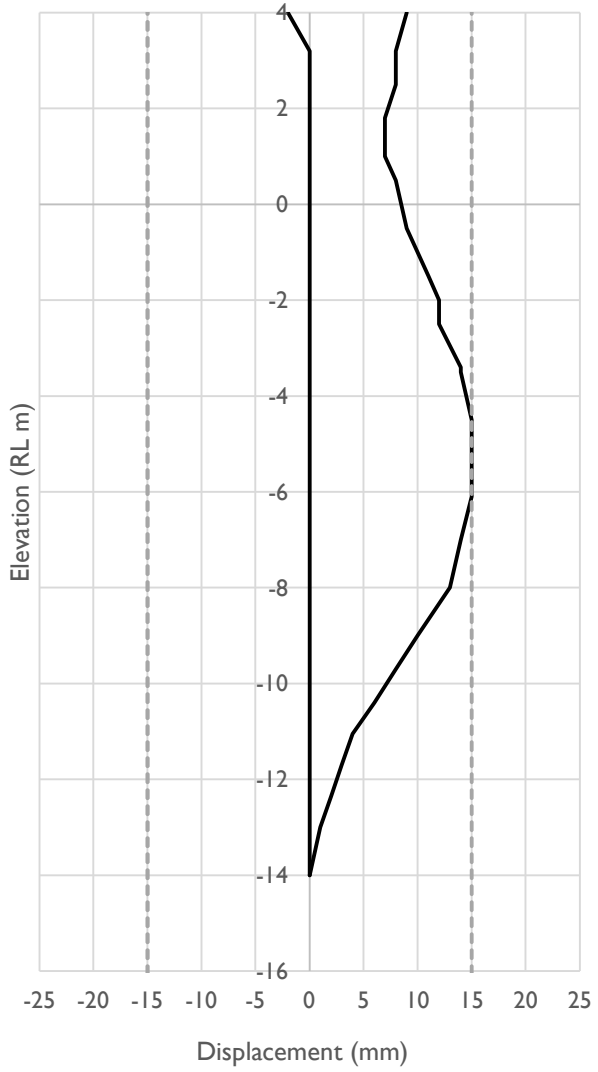
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project:	Albert Street Development
location:	Brisbane
title:	*Deflection, Bending Moment, Shear Force*
job no:	B01493-1

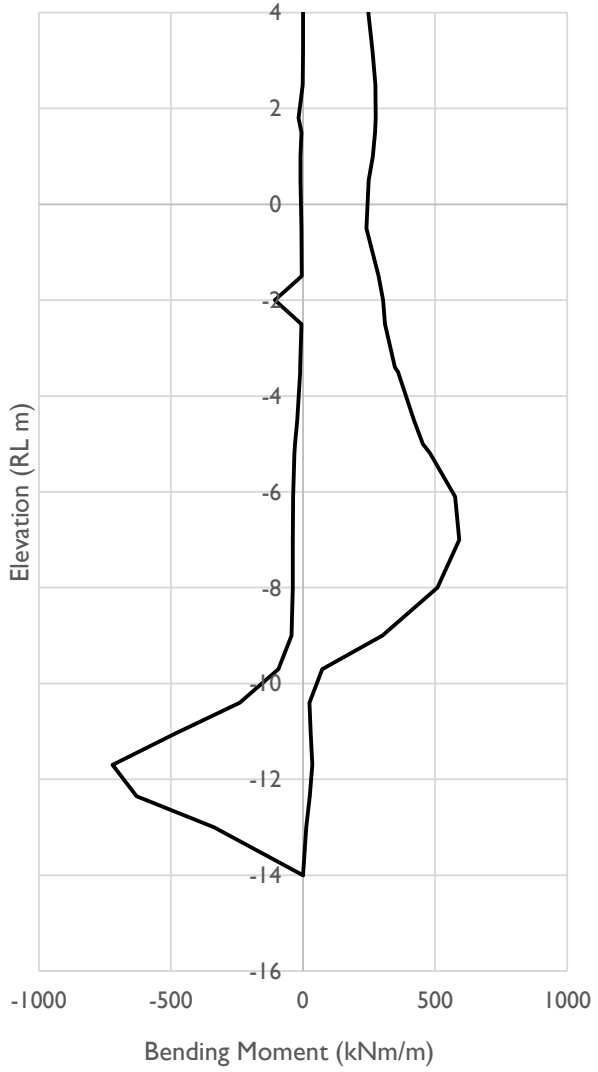
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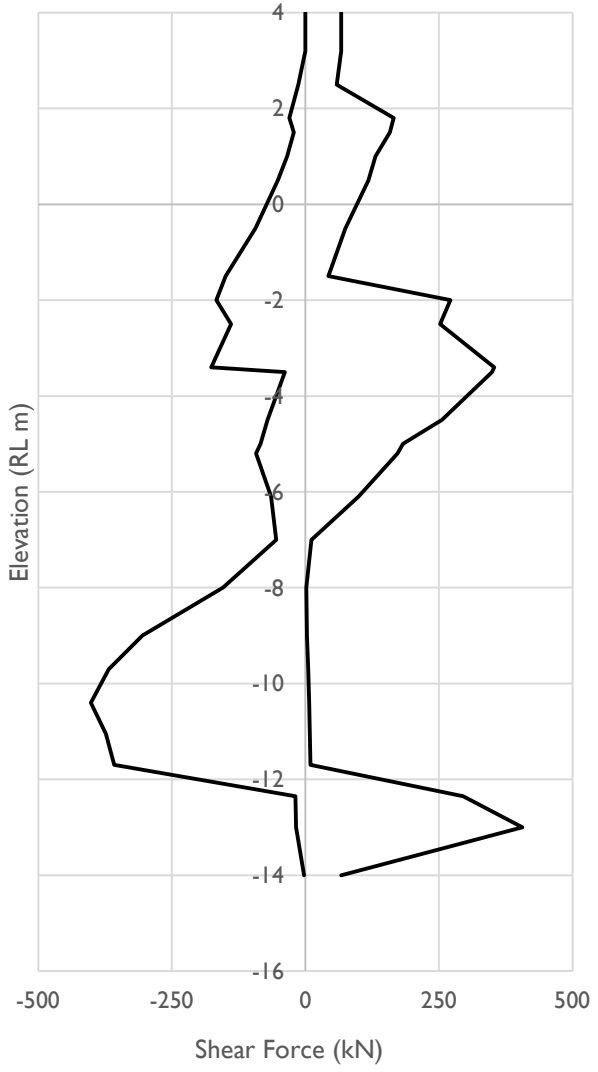
Displacement



Bending Moment



Shear Force



Notes:

- Displacement, bending moment and shear force envelopes
- Section 4
- Deflection limit of 15mm
- Non-flooding conditions

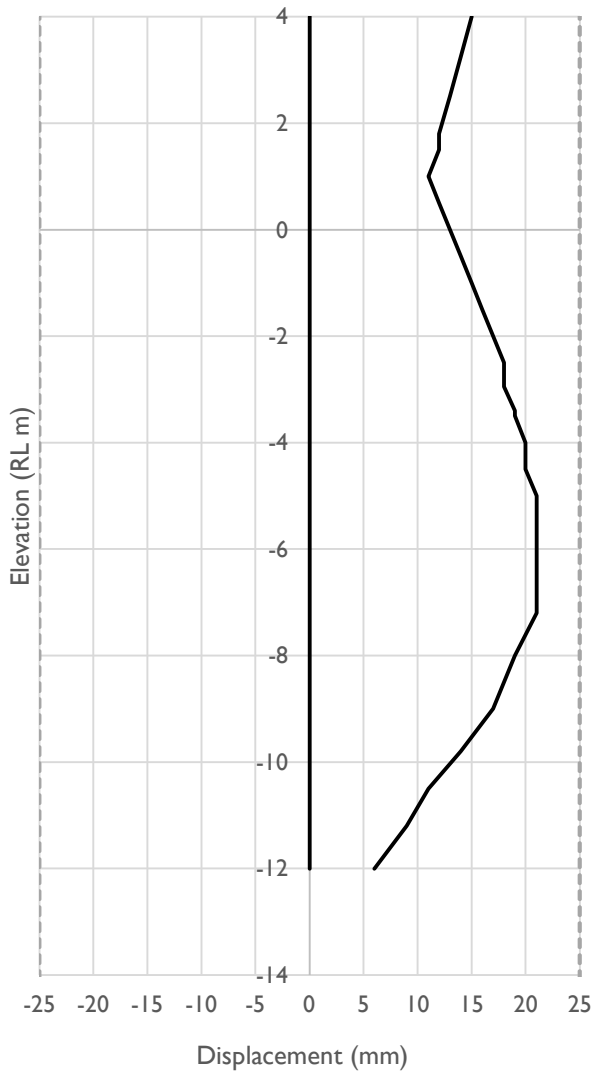
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location:	Brisbane
title:	*Deflection, Bending Moment, Shear Force*
job no:	B01493-1

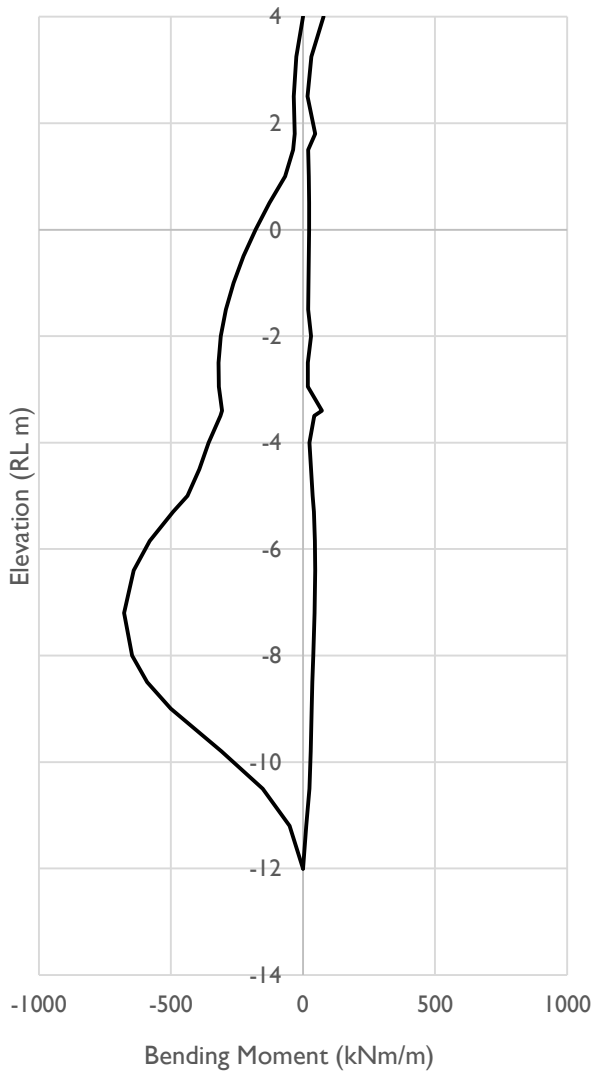
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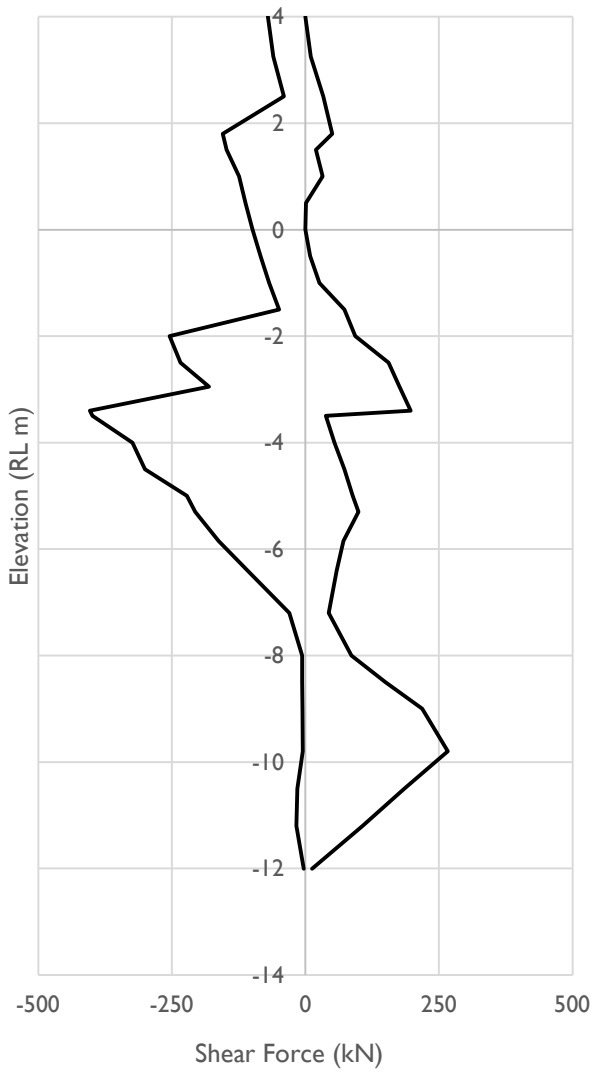
Displacement



Bending Moment



Shear Force



Notes:

- Displacement, bending moment and shear force envelopes
- Section 5
- Deflection limit of 25mm
- Non-flooding conditions

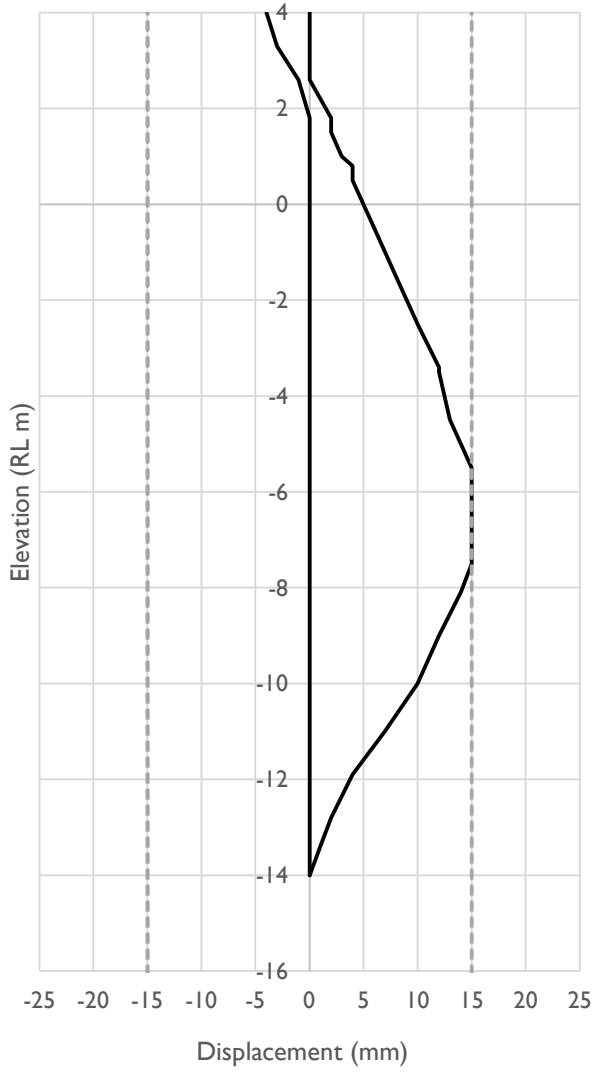
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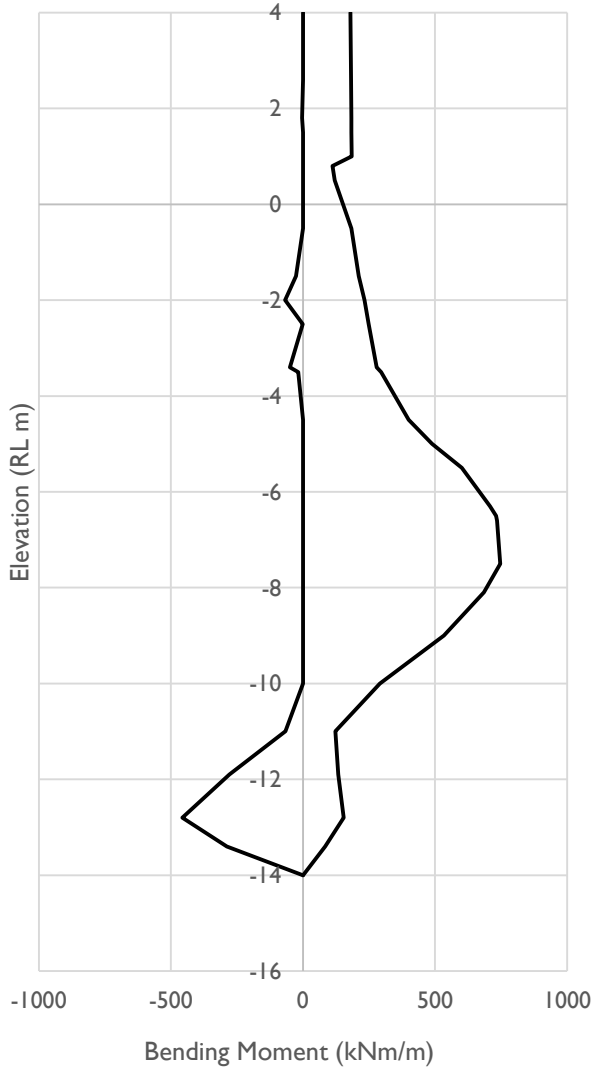
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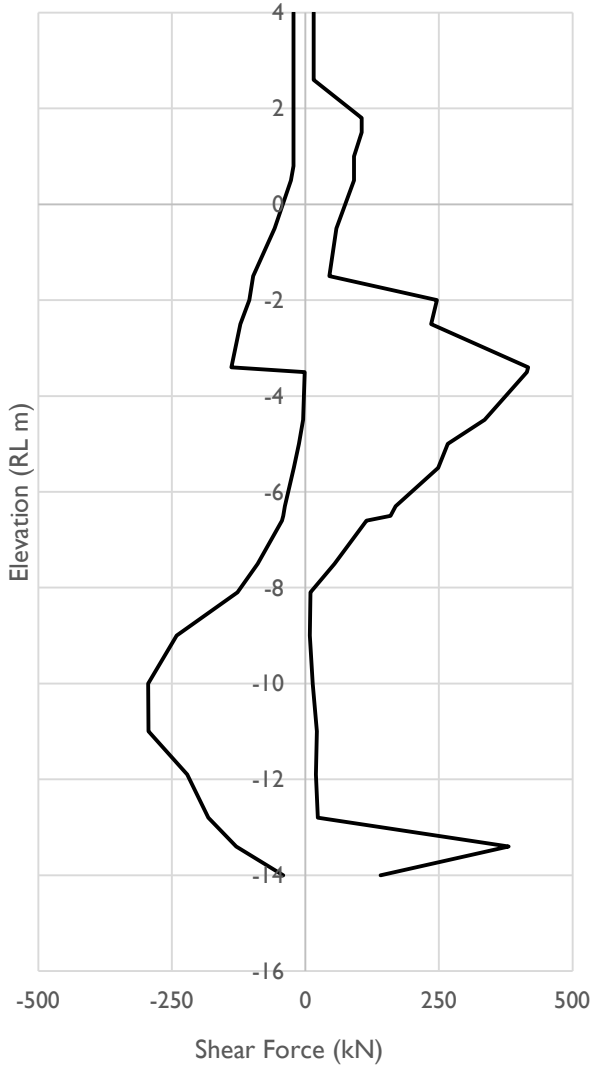
Displacement



Bending Moment



Shear Force



Notes:

- Displacement, bending moment and shear force envelopes
- Section 6
- Deflection limit of 15mm
- Non-flooding conditions

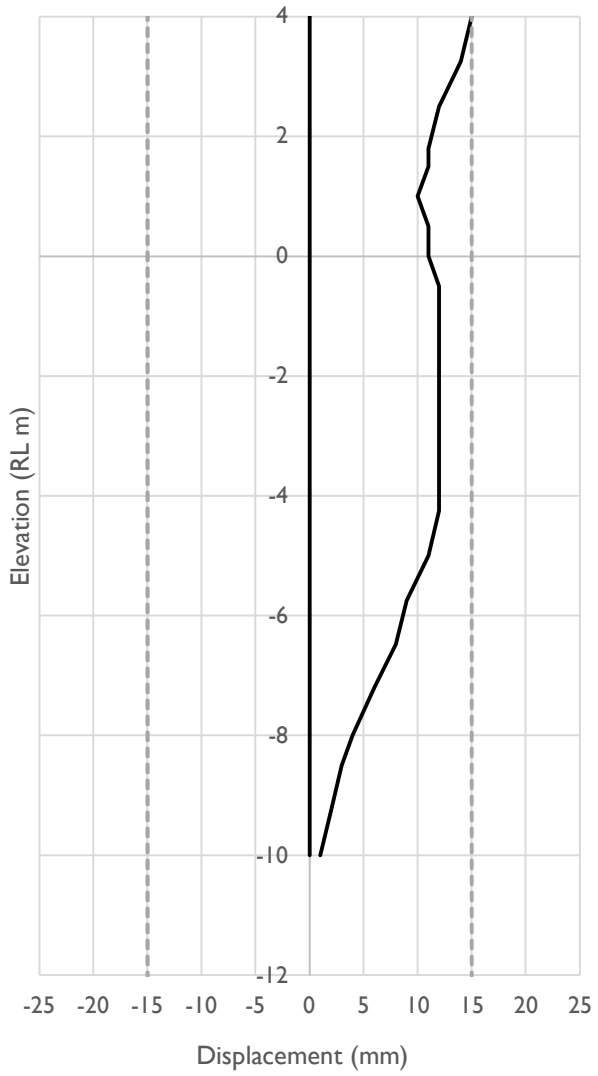
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location:	Brisbane
title:	*Deflection, Bending Moment, Shear Force*
job no:	B01493-1

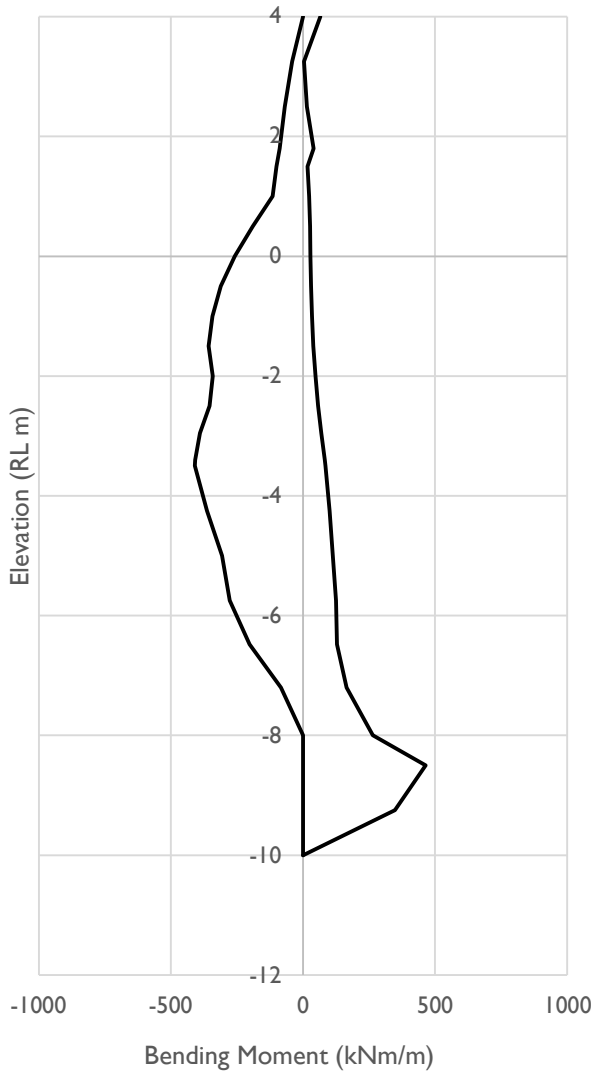
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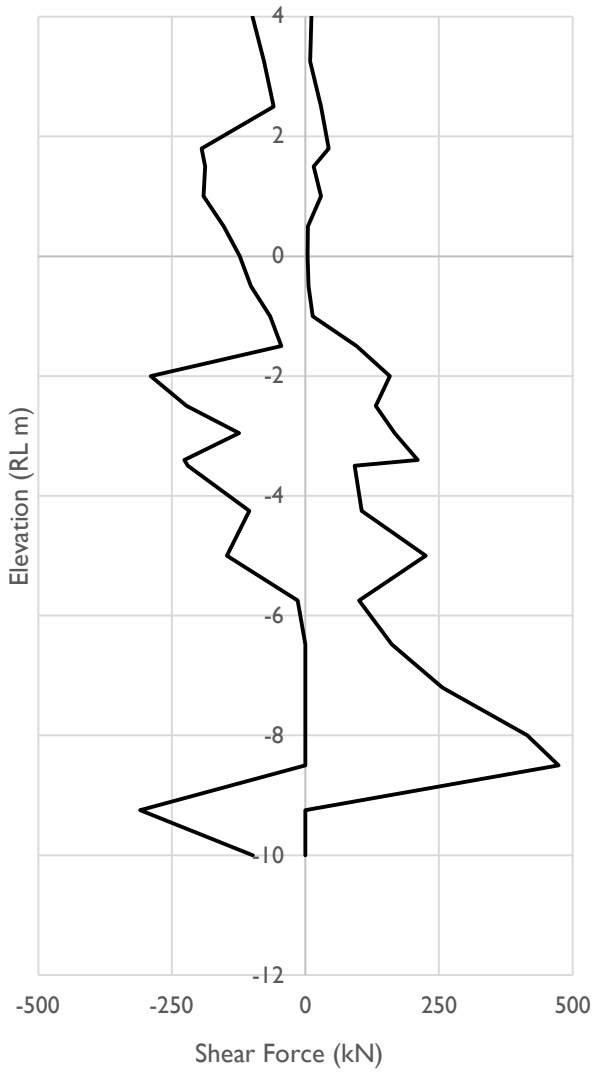
Displacement



Bending Moment



Shear Force



Notes:

- Displacement, bending moment and shear force envelopes
- Section 1
- Deflection limit of 15mm
- Flood conditions

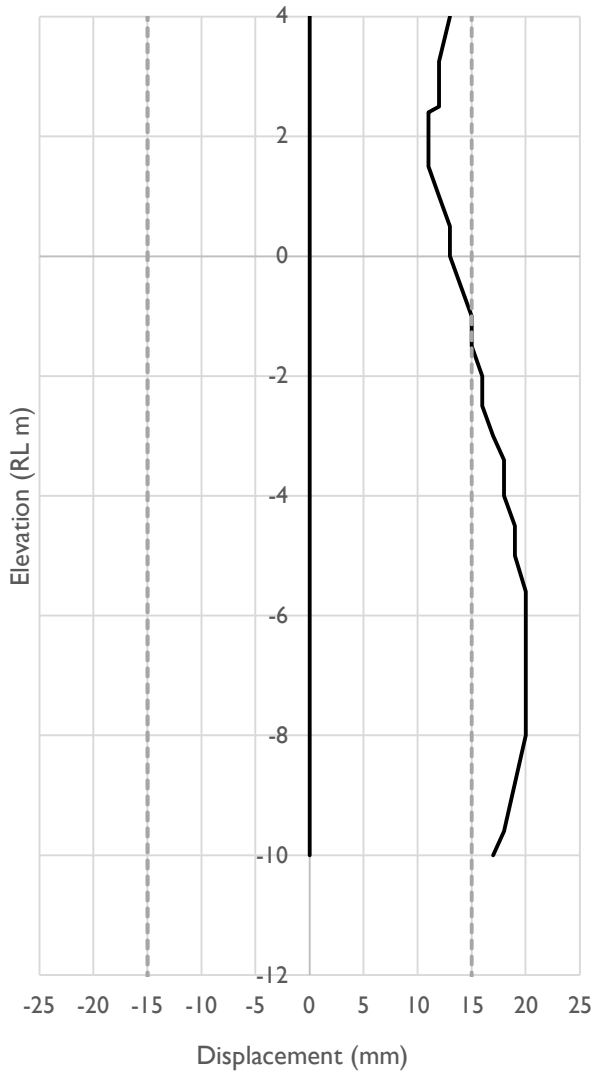
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project:	Albert Street Development
location:	Brisbane
title:	*Deflection, Bending Moment, Shear Force*
job no:	B01493-1

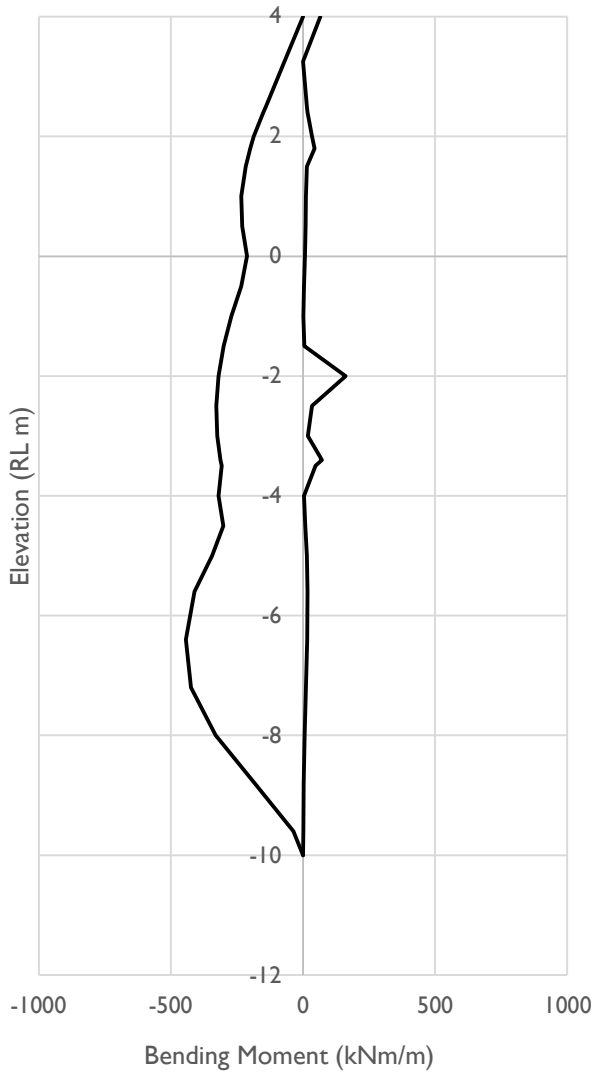
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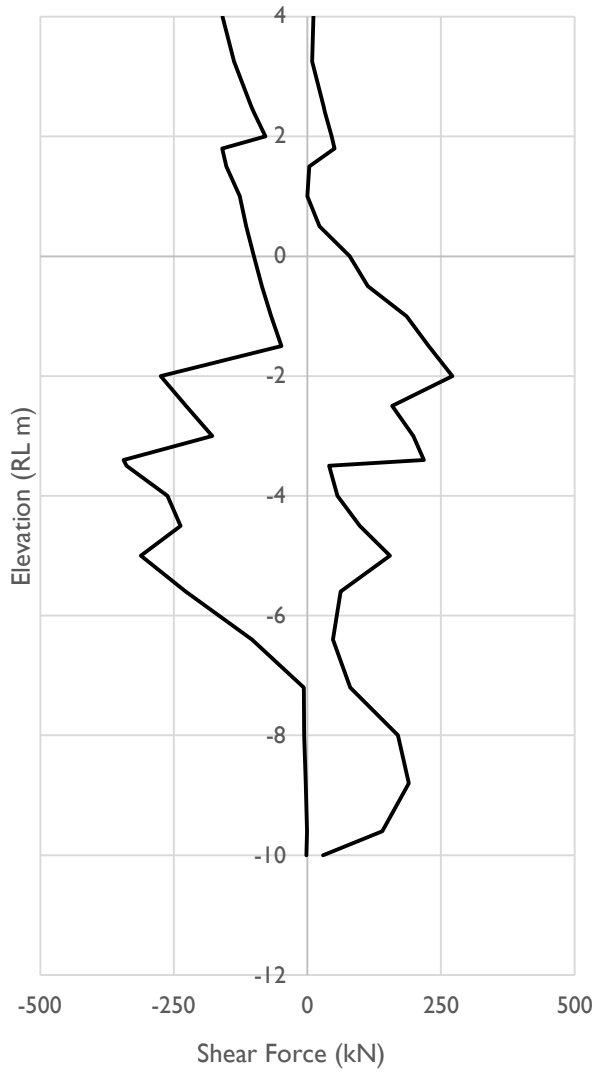
Displacement



Bending Moment



Shear Force



Notes:

- Displacement, bending moment and shear force envelopes
- Section 2
- Deflection limit of 15mm
- Flood conditions

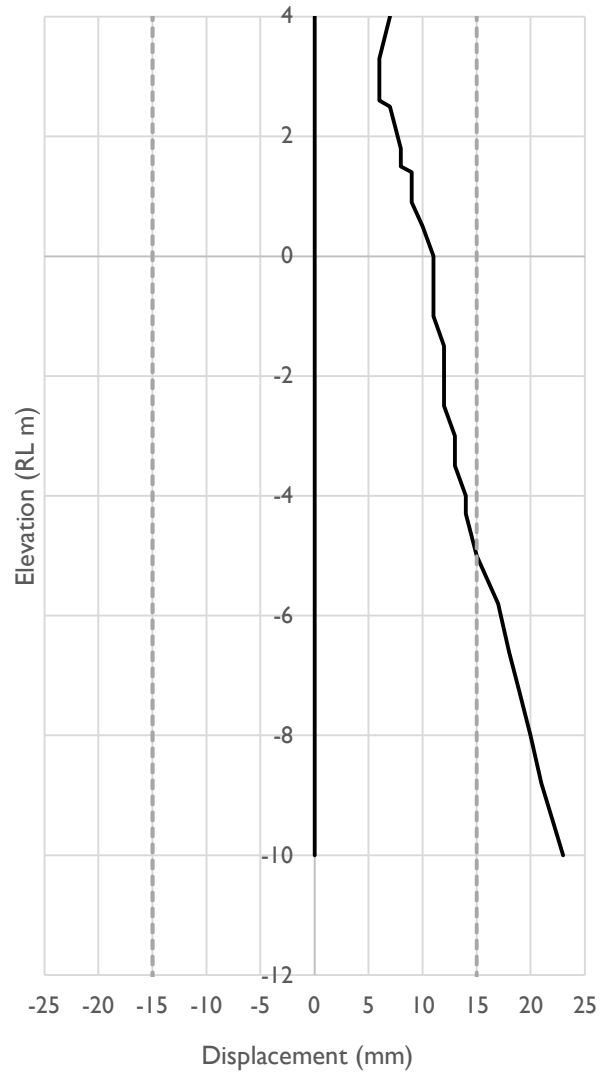
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project:	Albert Street Development
location:	Brisbane
title:	*Deflection, Bending Moment, Shear Force*
job no:	B01493-1

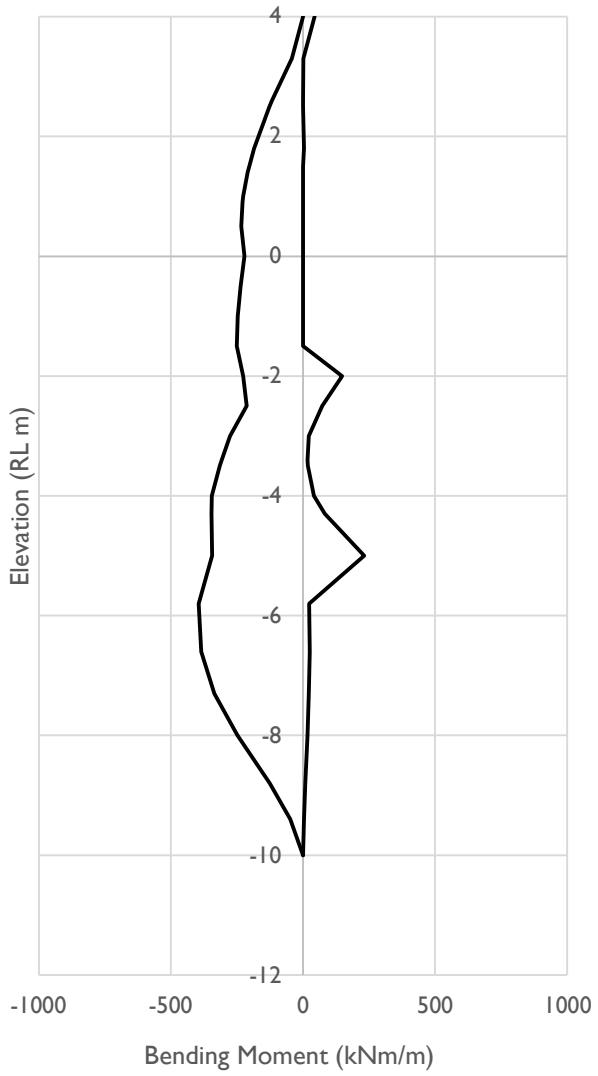
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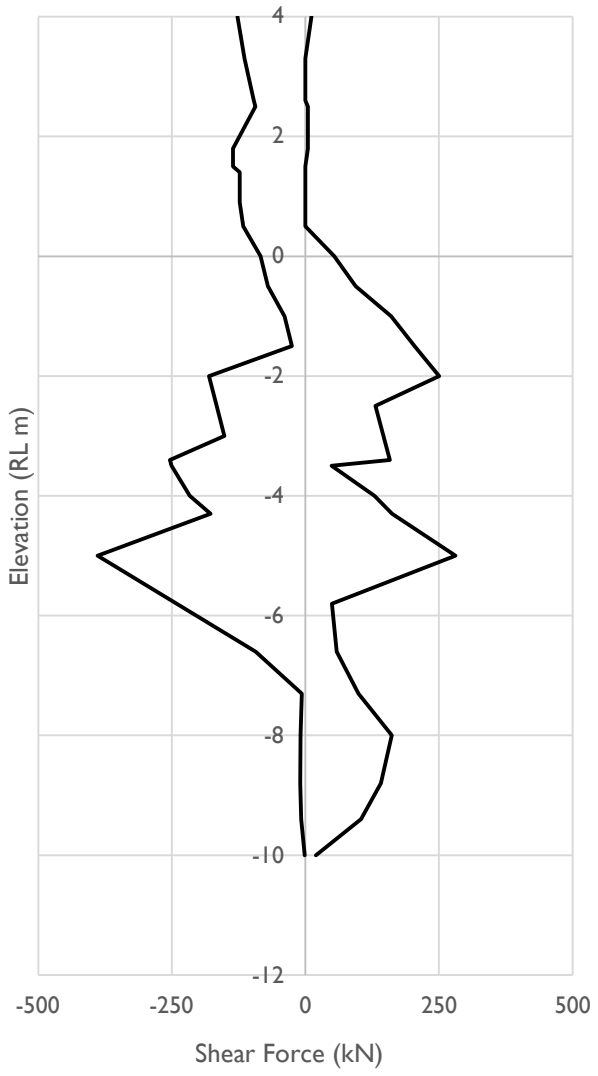
Displacement



Bending Moment



Shear Force



Notes:

- Displacement, bending moment and shear force envelopes
- Section 3
- Deflection limit of 15mm
- Flood conditions

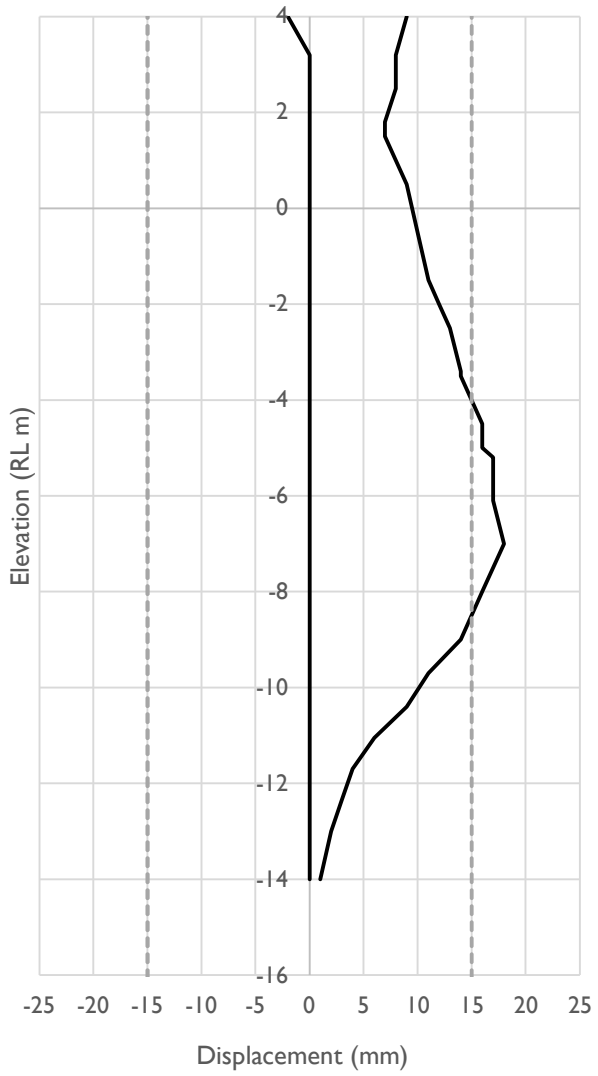
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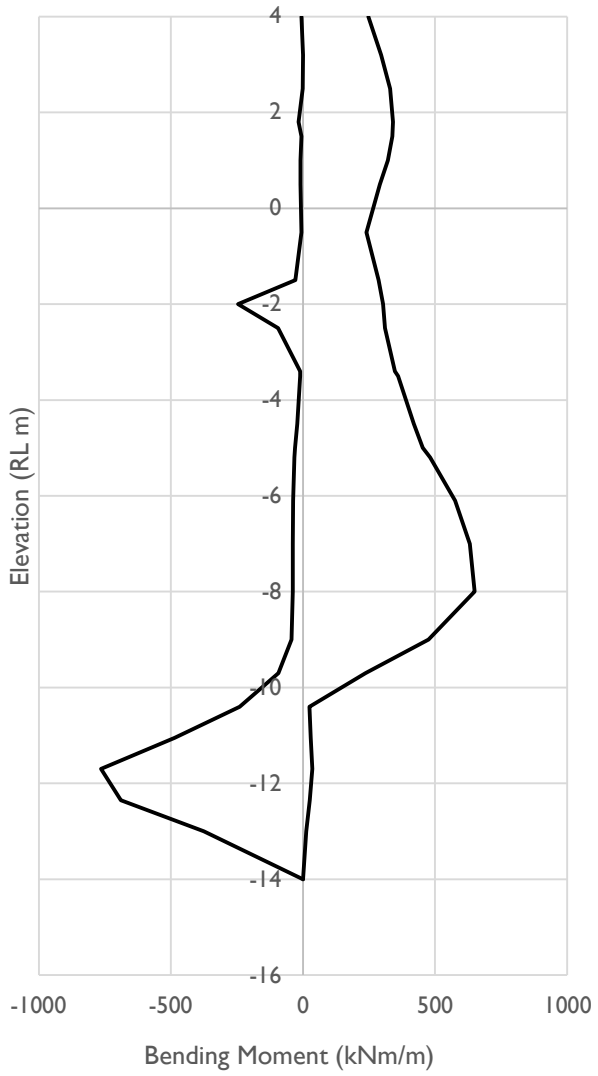
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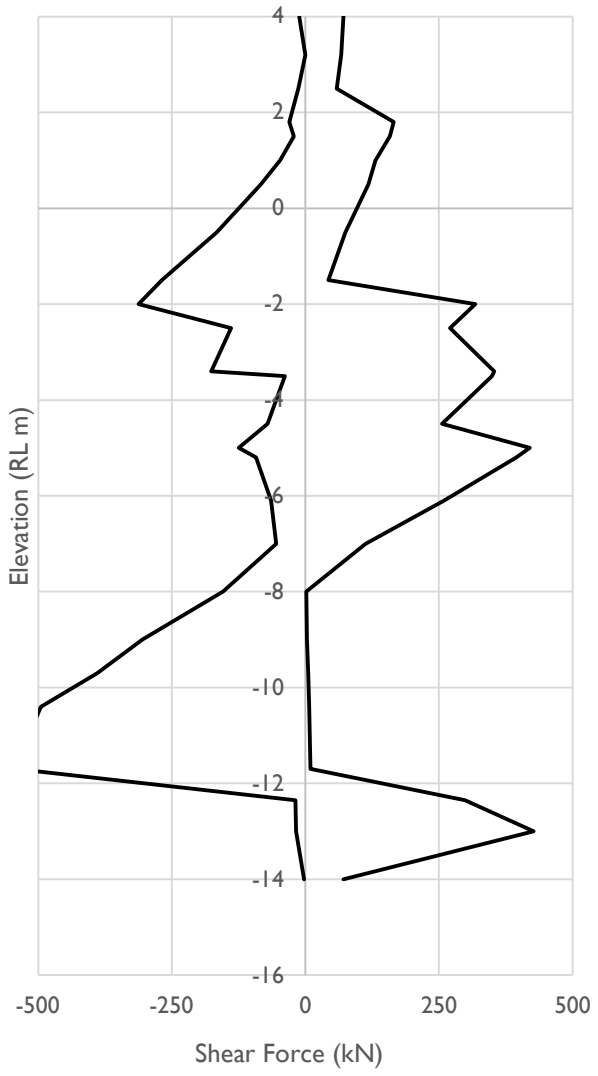
Displacement



Bending Moment



Shear Force



Notes:

- Displacement, bending moment and shear force envelopes
- Section 4
- Deflection limit of 15mm
- Flood conditions

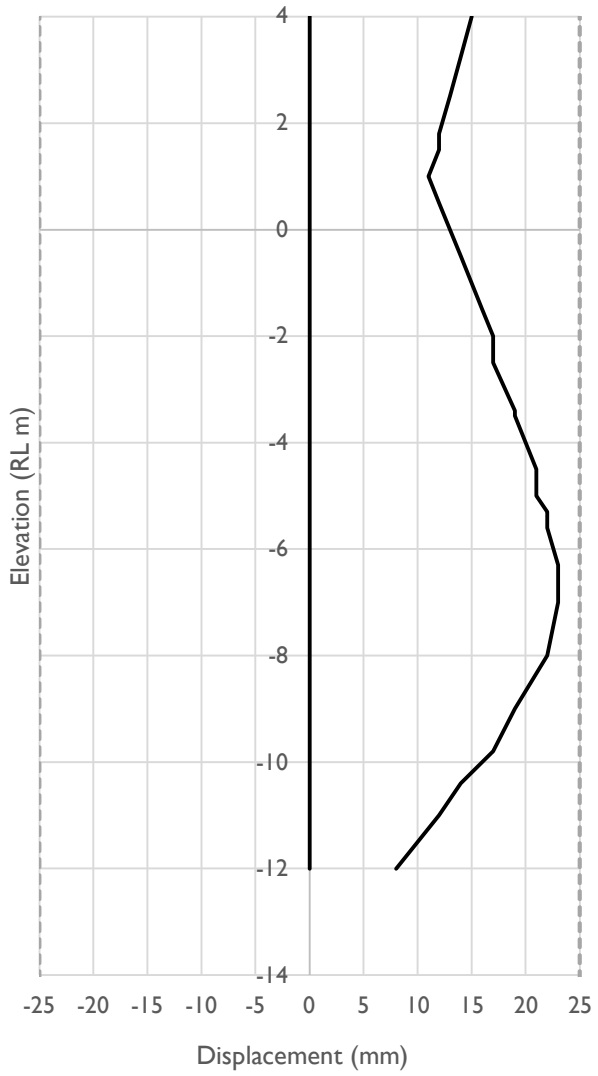
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job no:	B01493-1

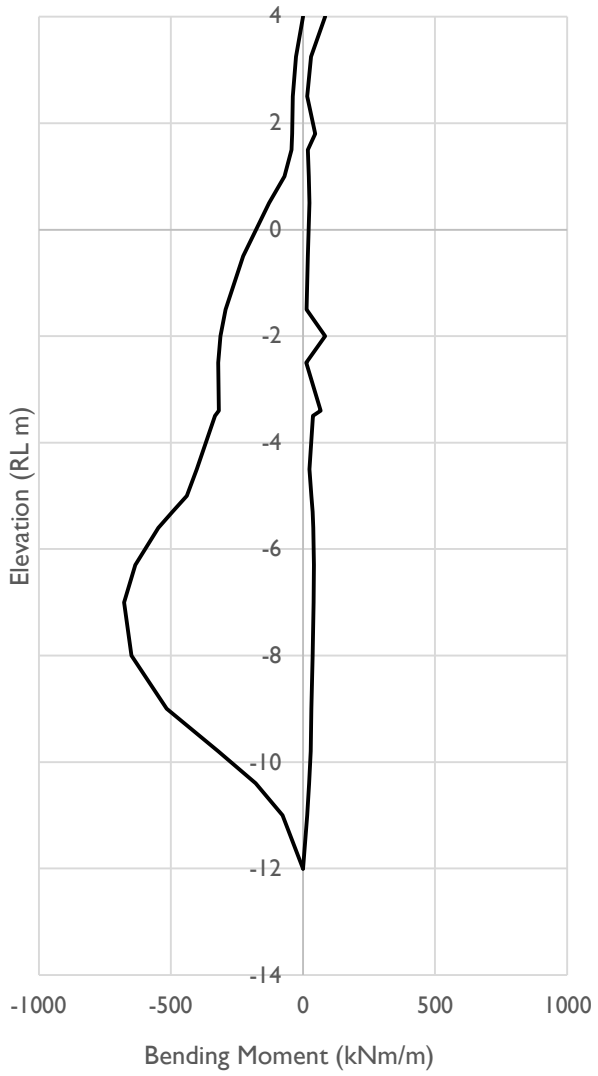
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figure: *110*

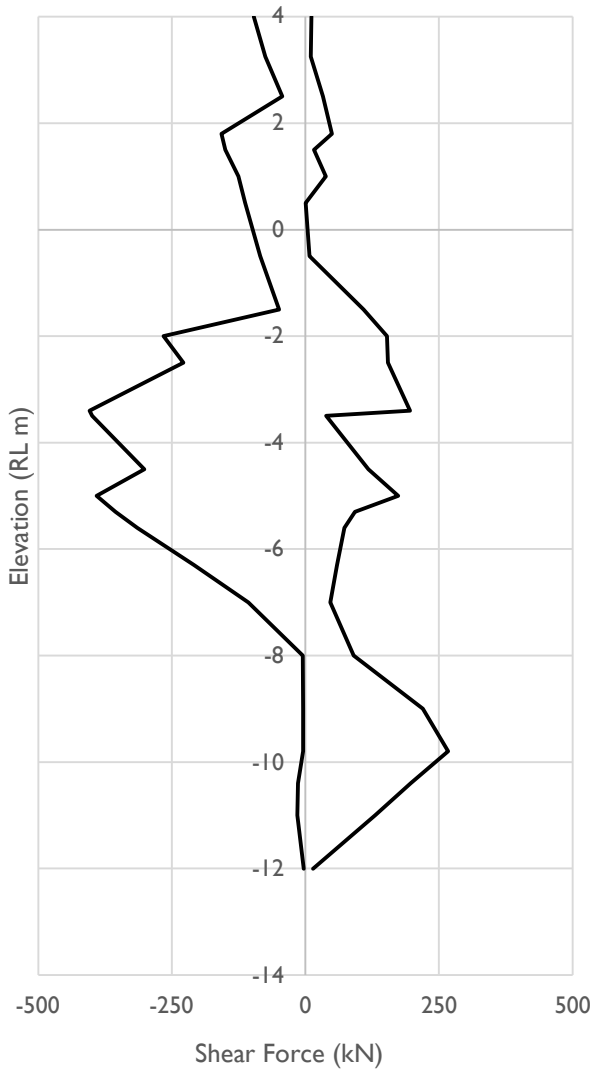
Displacement



Bending Moment



Shear Force



Notes:

- Displacement, bending moment and shear force envelopes
- Section 5
- Deflection limit of 25mm
- Flood conditions

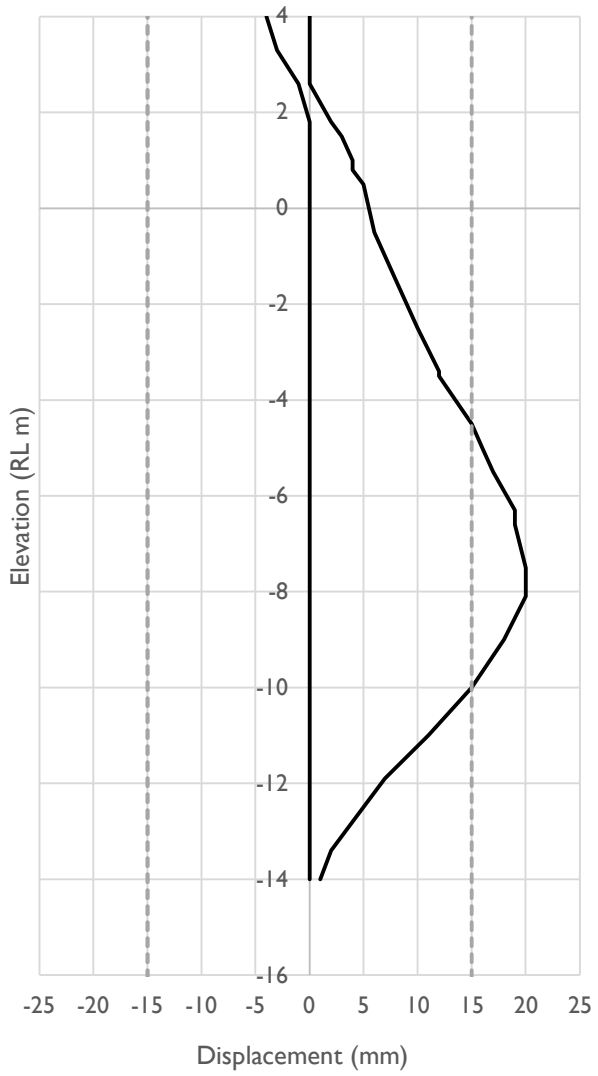
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client:	QIC
project:	Albert Street Development
location:	Brisbane
title:	*Deflection, Bending Moment, Shear Force*
job no:	B01493-1

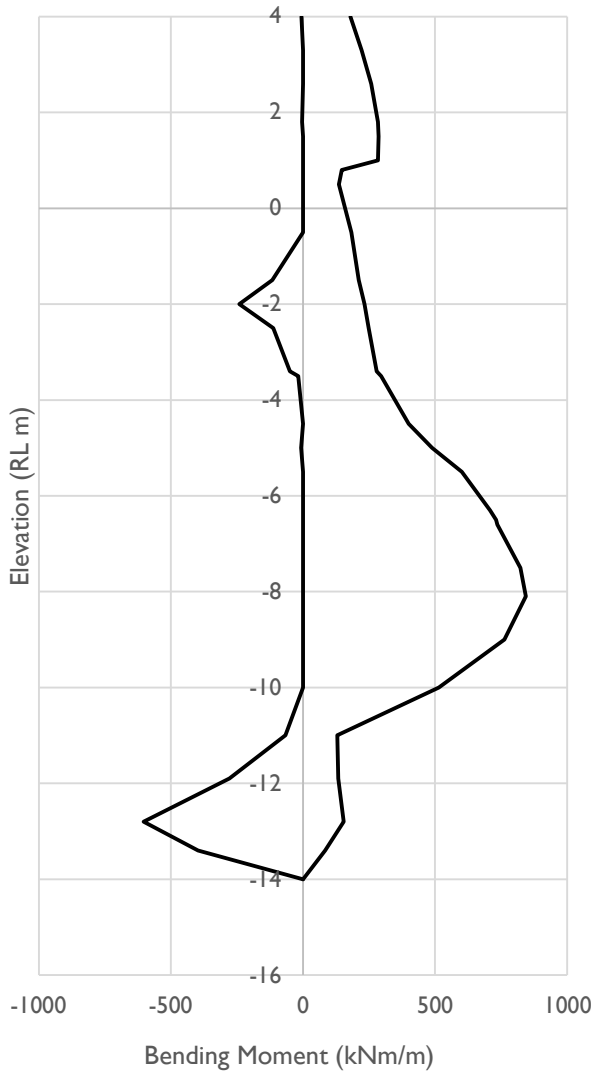
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figure: *111*

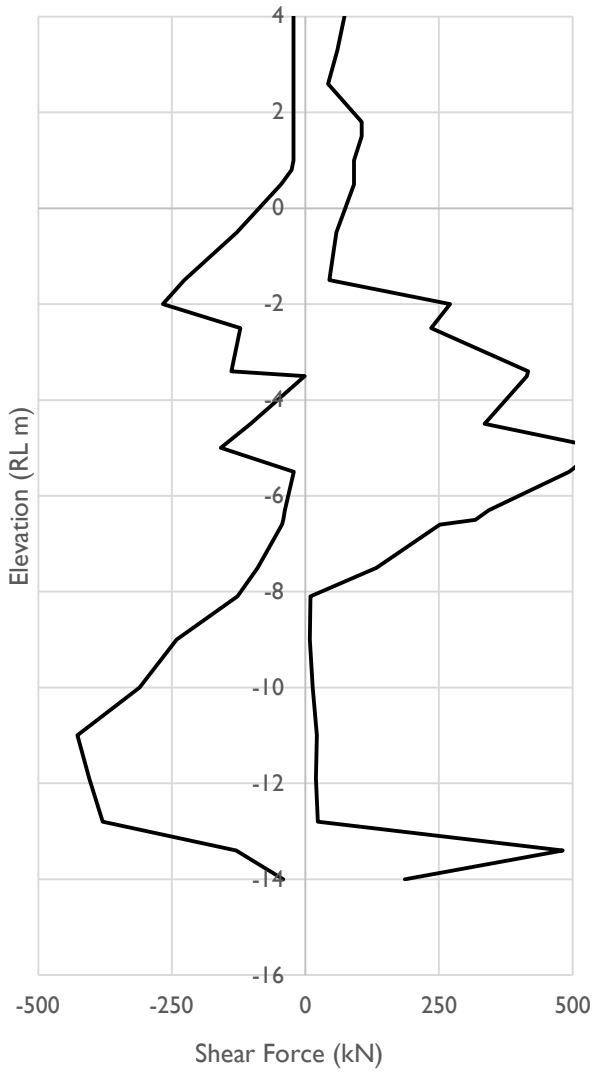
Displacement



Bending Moment



Shear Force



Notes:

- Displacement, bending moment and shear force envelopes
- Section 6
- Deflection limit of 15mm
- Flood conditions

by:	DL
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approved:	DJC
scale:	

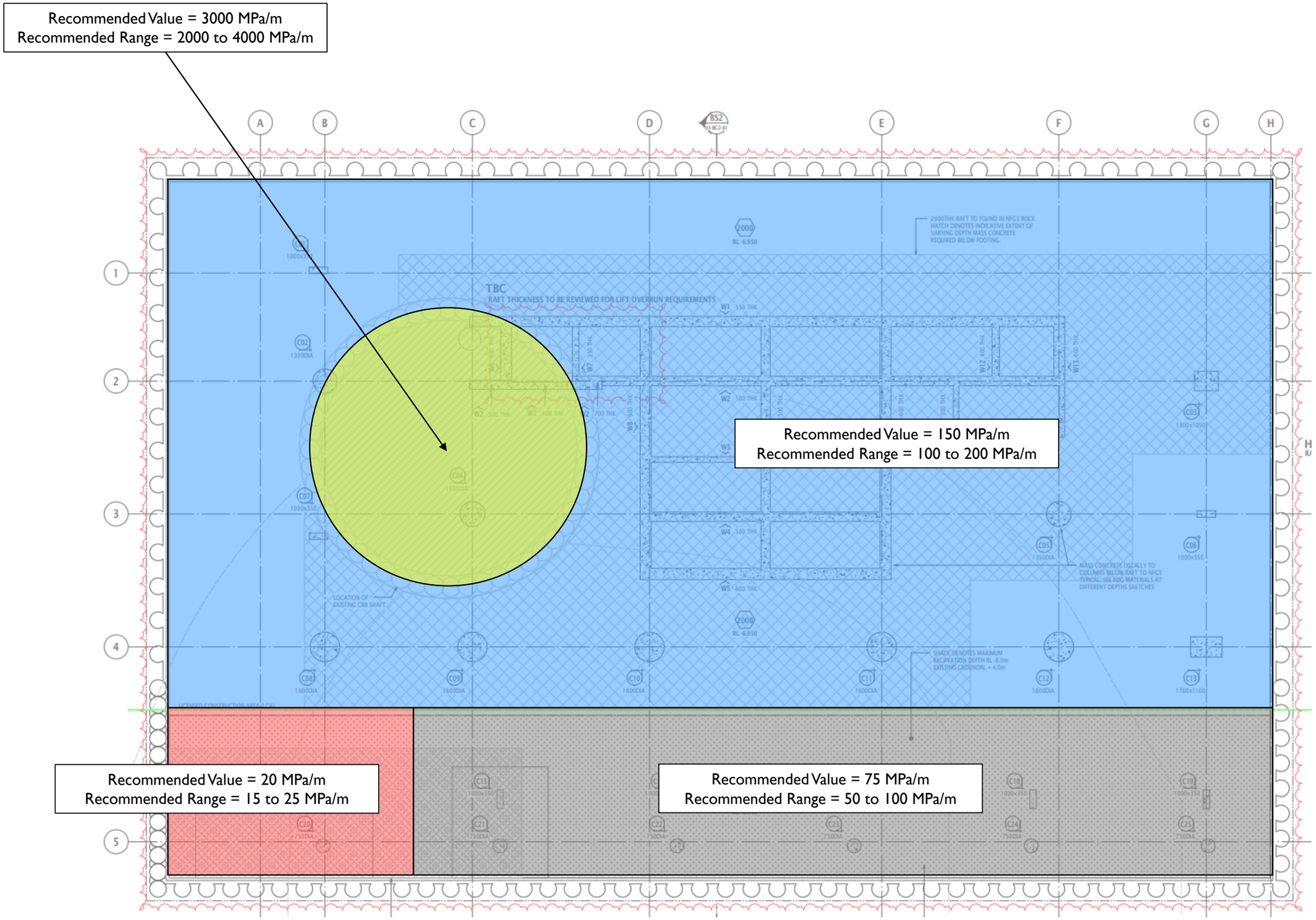
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project:	Albert Street Development
location:	Brisbane
title:	*Deflection, Bending Moment, Shear Force*
job no:	B01493-1

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figure: *112*

Appendix J

Alternate Foundation System Calculation Outputs



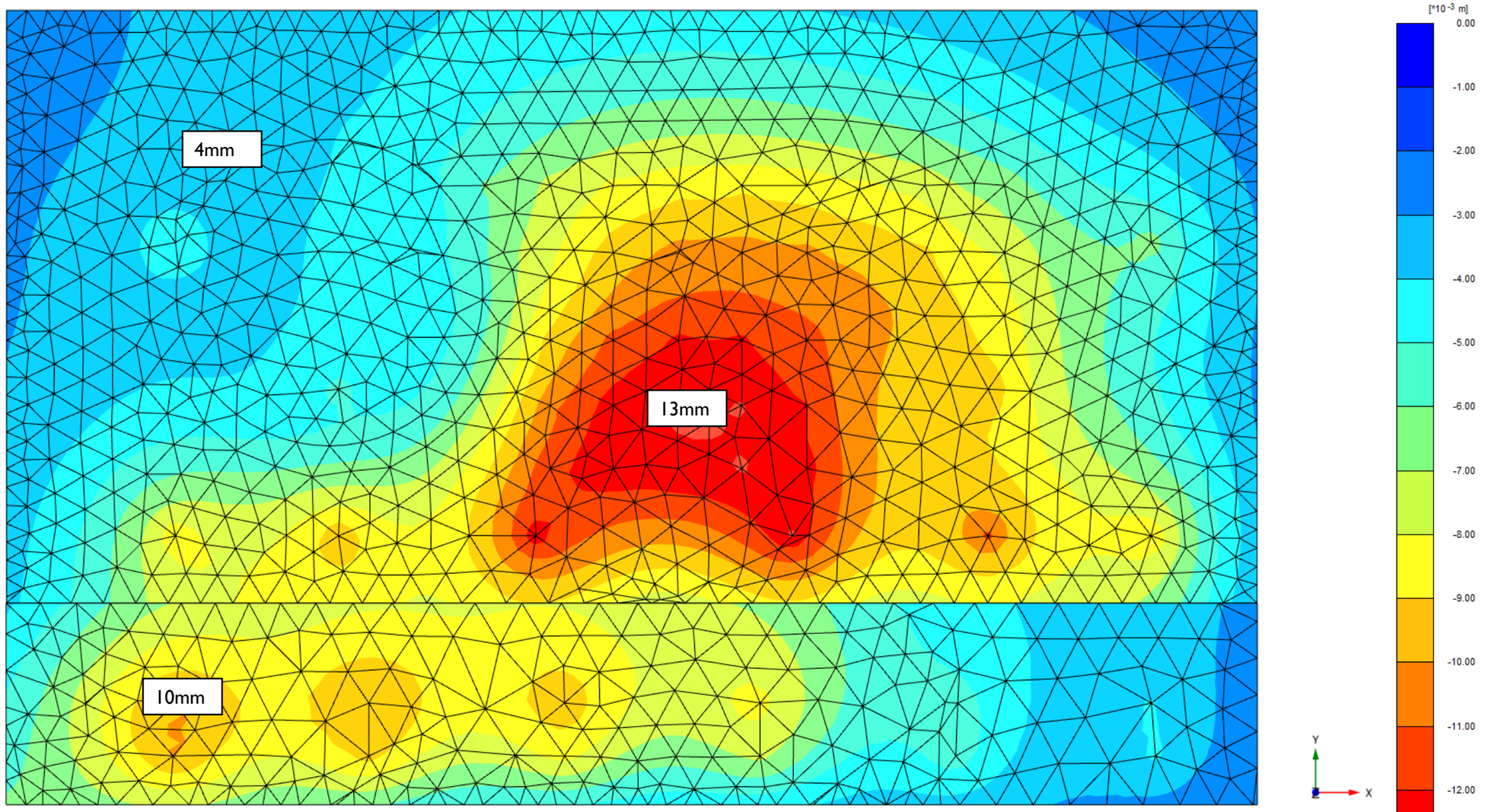
Notes:
- Excavate and replace to NFG5 under podium slab
- Excavate and replace to NFG3 under core slab

by:	DL	*client:*	QIC
date:	02/07/24	*project:*	Albert Street Development
approved:	DJC	*location:*	Albert Street, Brisbane
scale:	NTS	*title:*	*Modulus of Subgrade Reaction*
		job no:	B01493-1

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figure: 1

Output Version 21.1.0.479



Phase displacements Pu_z (scaled up 500 times)

Maximum value = $-2.193*10^{-3}$ m (Element 4341 at Node 1304)

Minimum value = -0.01323 m (Element 5287 at Node 4665)

PLAXIS® 3D CONNECT Edition

Project description		Date
		26/07/2024
Project filename: Raft 80% DD 007	Step: 264	Company: EDG Consulting Pty Ltd

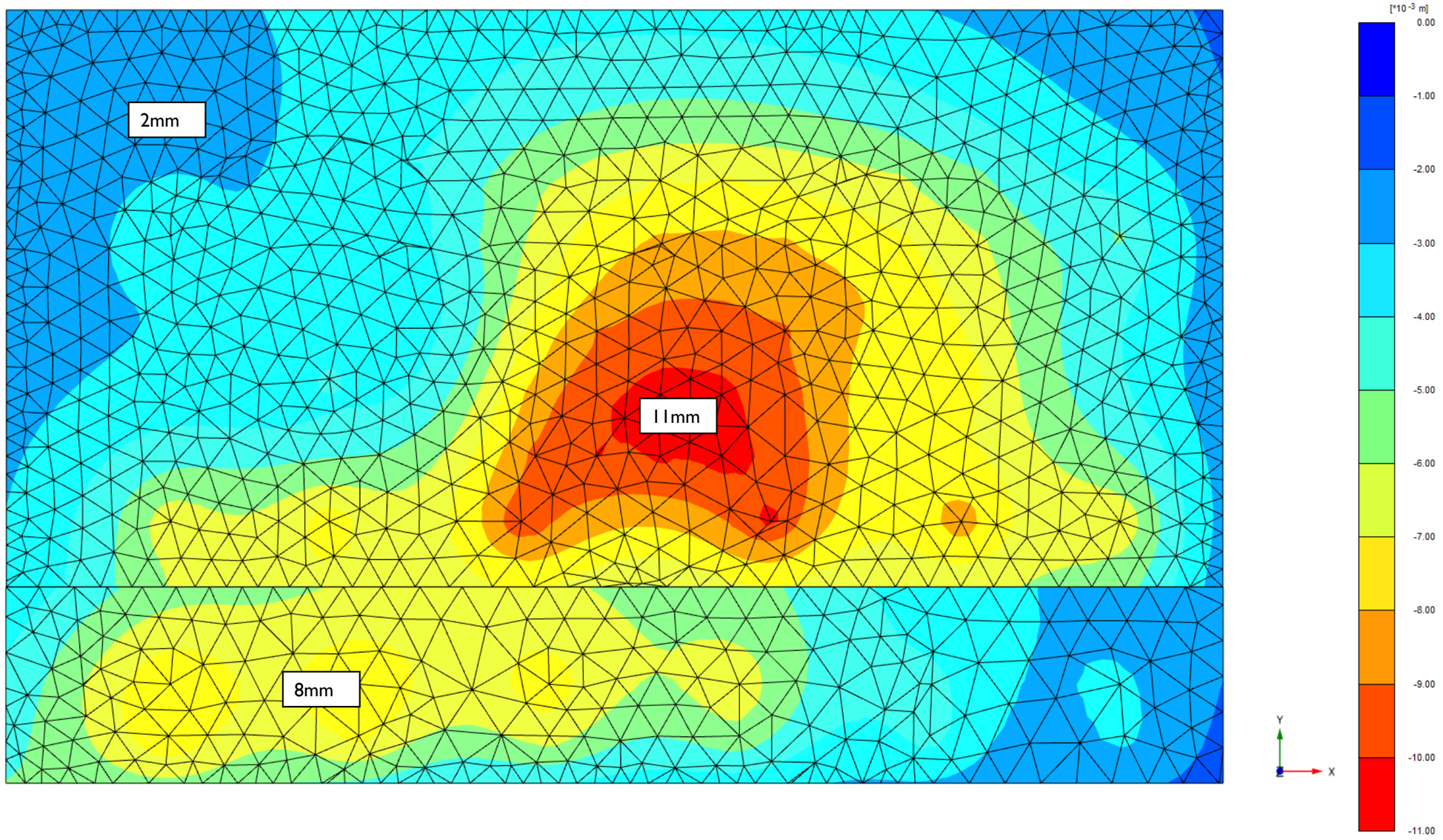
Notes:
- Settlement shown is under 1.2G + 1.5Q load case
- Settlement shown used the recommended values of modulus of subgrade reaction as per Figure 1
- Excavate and replace to NFG5 under podium slab
- Excavate and replace to NFG3 under core slab

by:	DL	client:	QIC
date:	02/07/24	project:	Albert Street Development
approved:	DJC	location:	Albert Street, Brisbane
scale:	NTS	title:	*Estimated Settlement*
		job no:	B01493-1

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figure: 2

Output Version 21.1.0.479



Phase displacements Pu_z (scaled up 500 times)

Maximum value = $-1.755*10^{-3}$ m (Element 4341 at Node 1304)

Minimum value = -0.01046 m (Element 5287 at Node 4665)

PLAXIS® 3D CONNECT Edition

Project description		Date
		26/07/2024
Project filename: Raft 80% DD 007	Step: 331	Company: EDG Consulting Pty Ltd

Notes:
- Settlement shown is under G + Q load case
- Settlement shown used the recommended values of modulus of subgrade reaction as per Figure 1
- Excavate and replace to NFG5 under podium slab
- Excavate and replace to NFG3 under core slab

by:	DL	client:	QIC
date:	02/07/24	project:	Albert Street Development
approved:	DJC	location:	Albert Street, Brisbane
scale:	NTS	title:	*Estimated Settlement*
		job no:	B01493-1

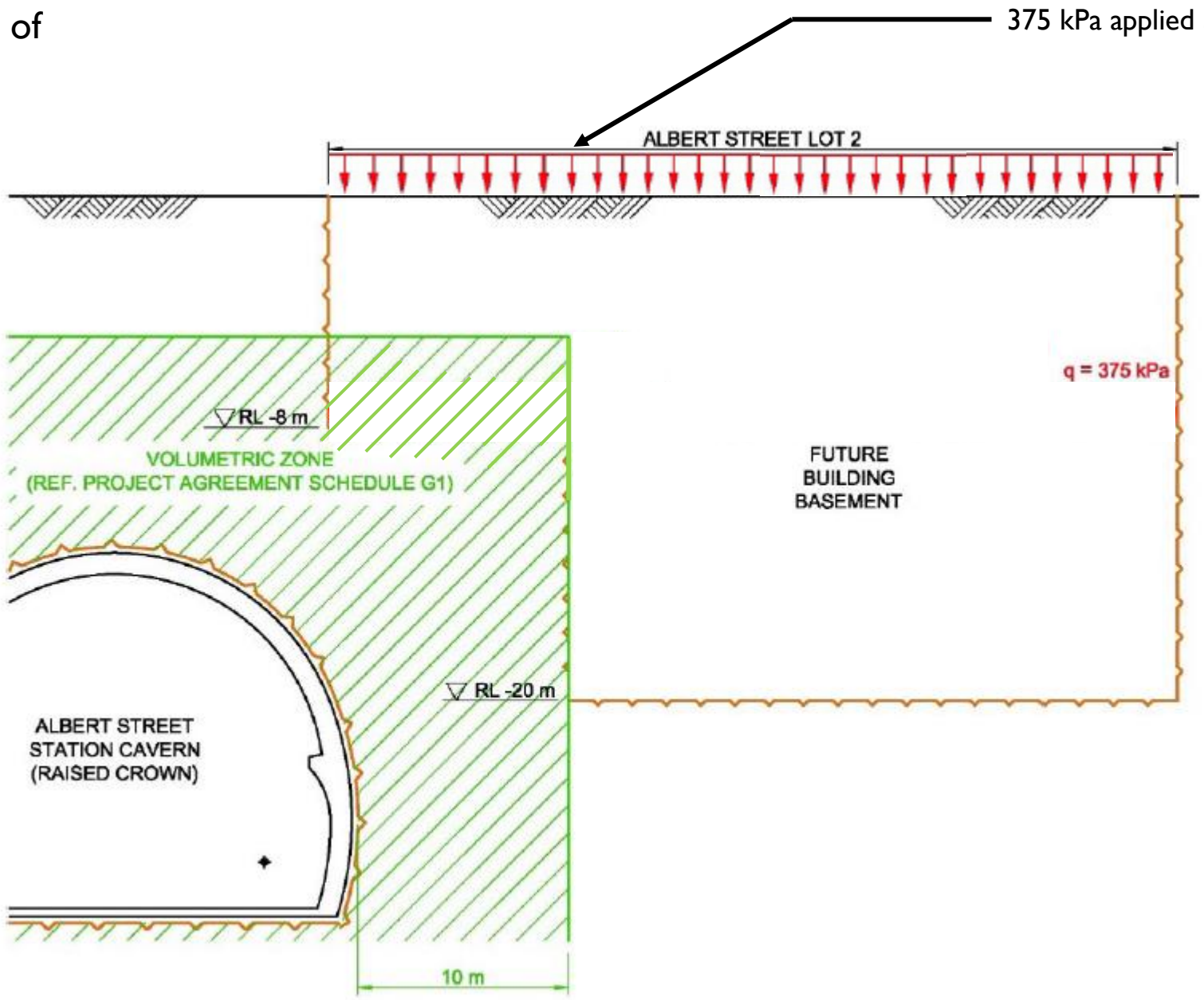
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figure: 3

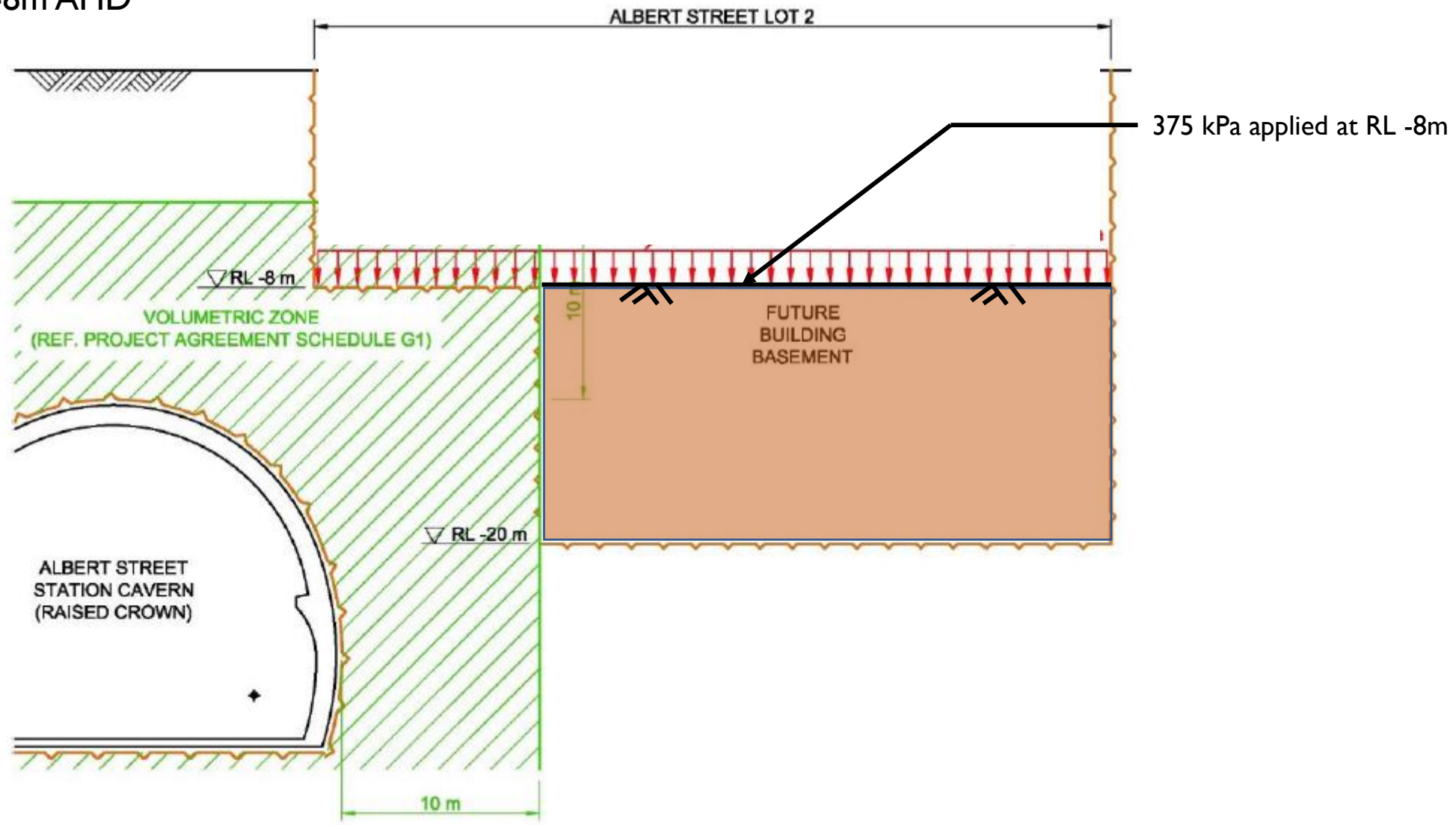
Appendix K

Cavern Assessment Load Cases

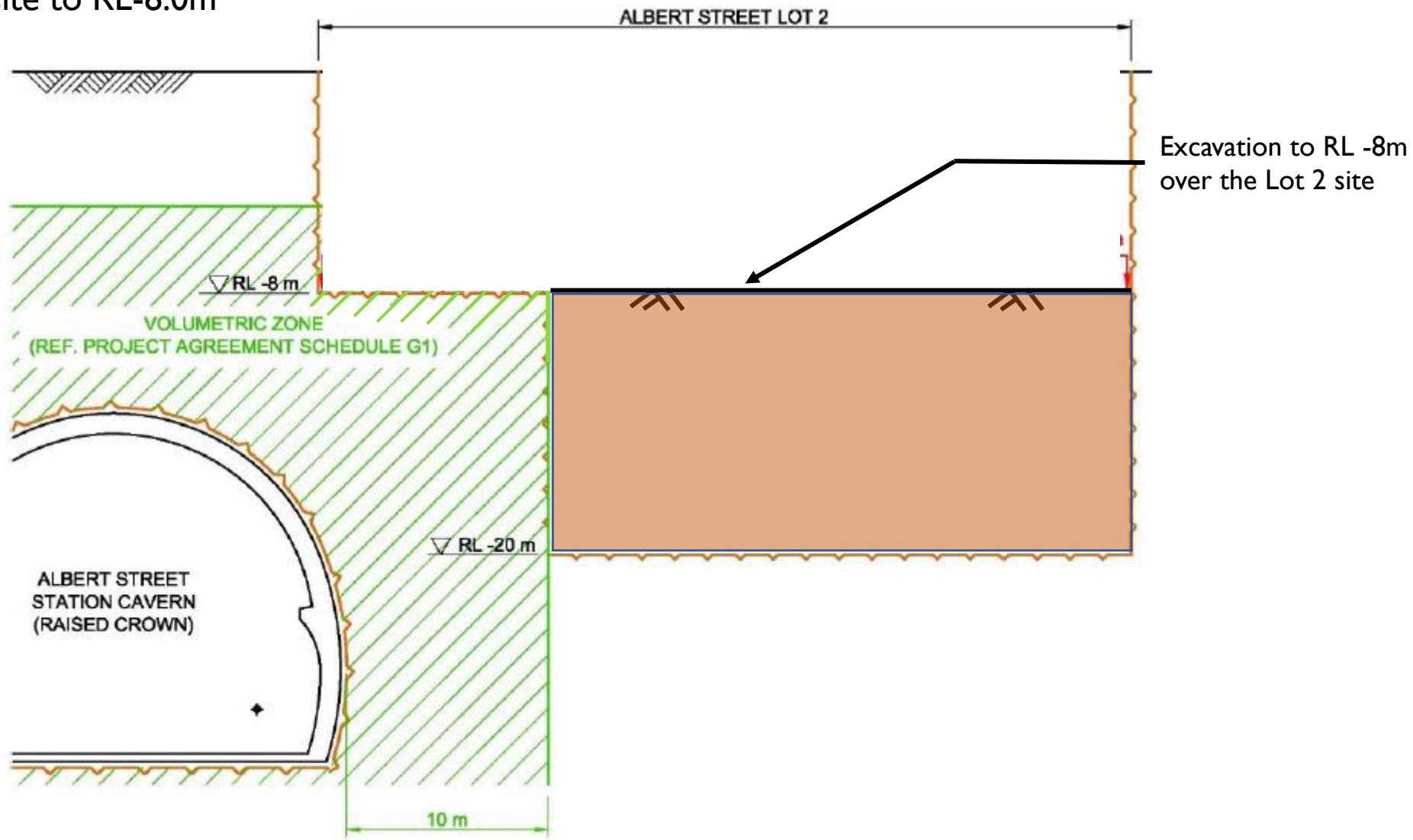
Case 1 – 375kPa over full area of Lot 2, applied at RL 4m AHD **(OSD-31)**



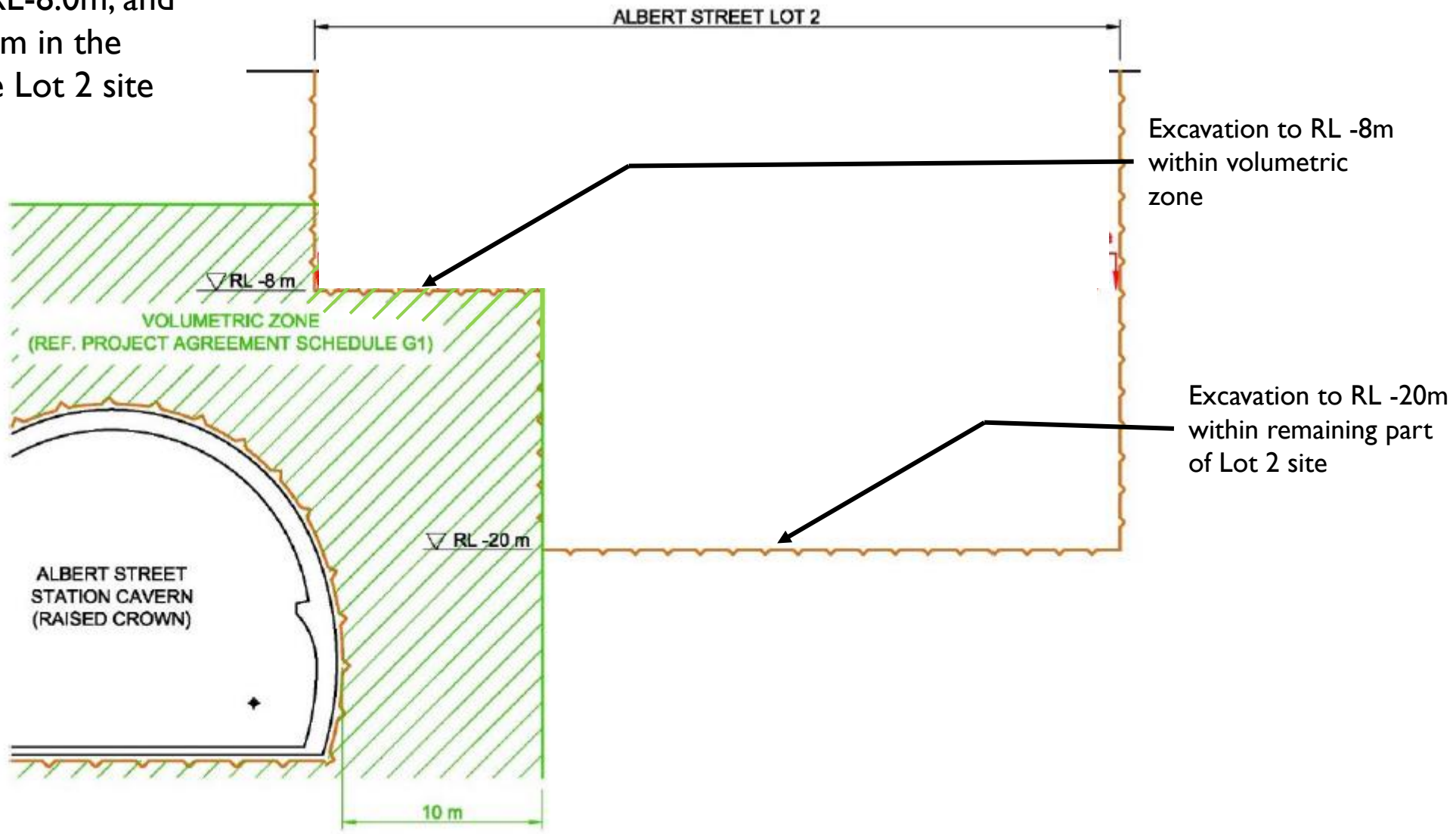
Case 2 – 375kPa over full area of Lot 2, applied at RL -8m AHD **(OSD-31)**



Case 3 – Excavation over the entire Albert Street Lot 2 site to RL-8.0m **(OSD-46)**



Case 4 – Excavation in the volumetric zone to RL-8.0m, and excavation to RL -20m in the remaining part of the Lot 2 site **(OSD-47)**



Case 5:

- 50kPa applied at 1m above cavern crown
- 20kPa applied at ground surface

(OSD-48)

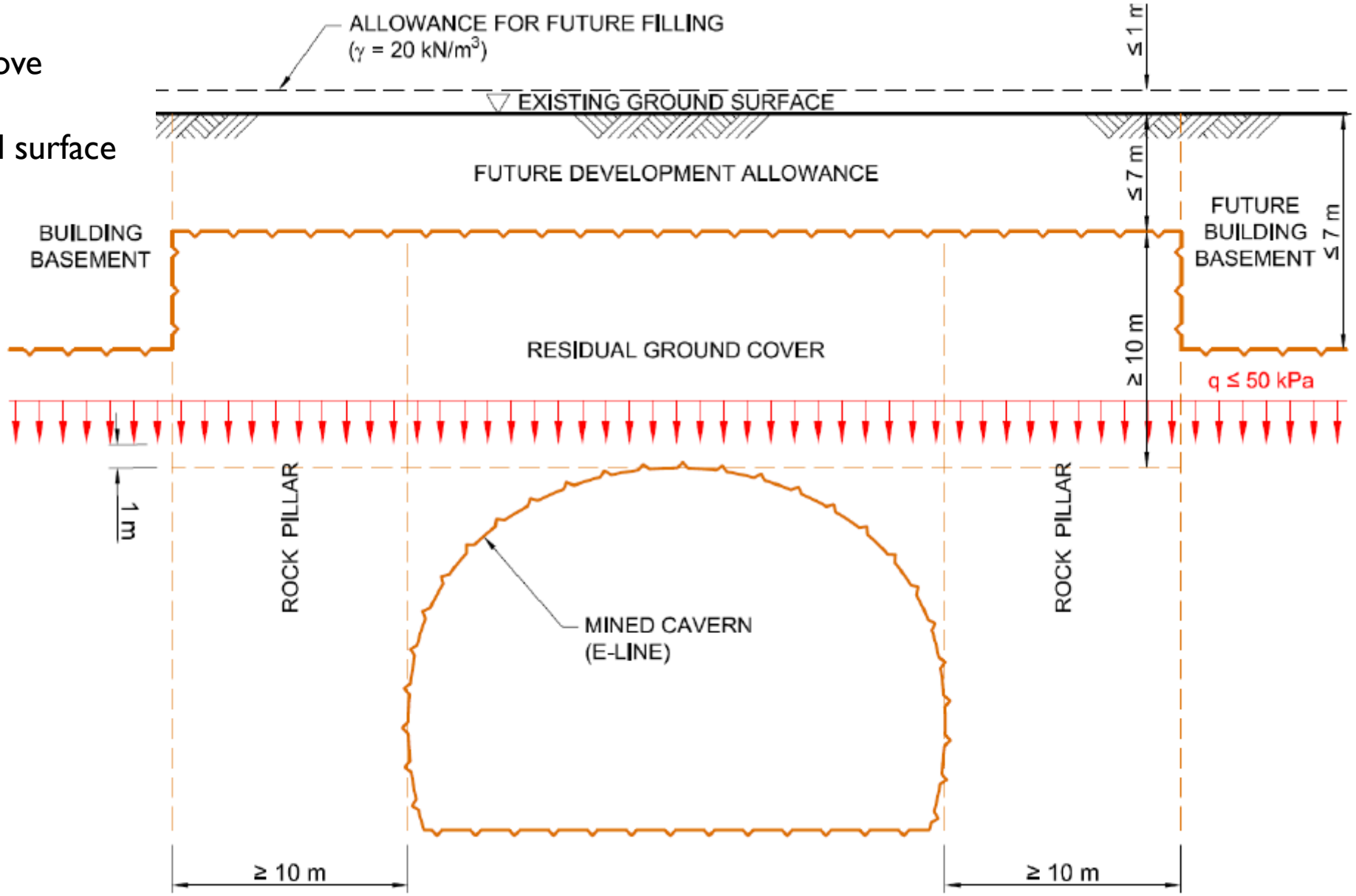


Figure 13 FOSD loading for caverns – Future development allowance Case 1 (Ref. Table B2-A, Annexure B, PSTR)

Case 6:

- 7m excavation over Lot 2 site to RL -3m

(OSD-48)

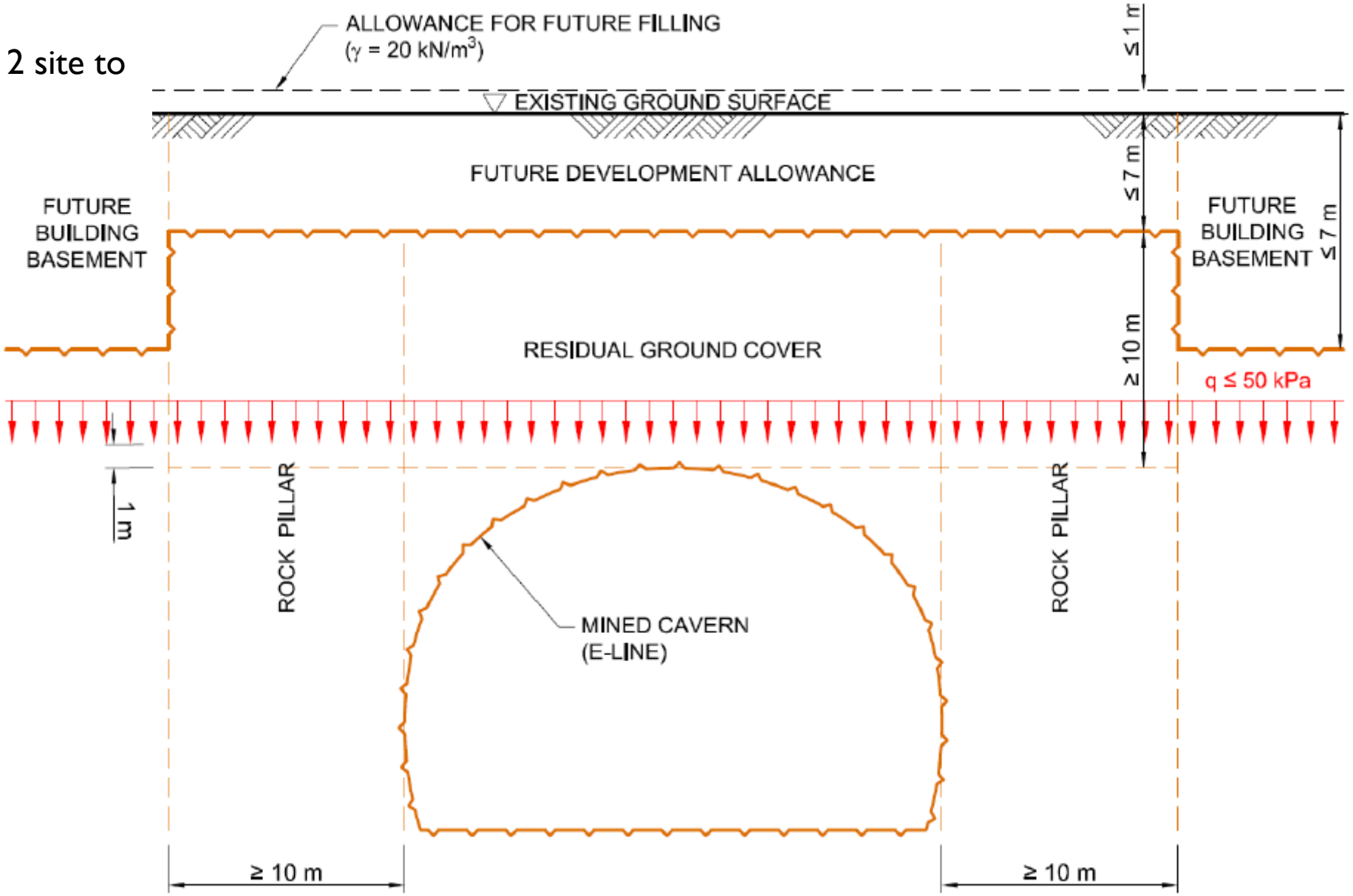


Figure 13 FOSD loading for caverns – Future development allowance Case 1 (Ref. Table B2-A, Annexure B, PSTR)

Case 7:

- 75kPa applied at ground surface
- 20kPa applied at ground surface
- Additional cavern distortion of ±15mm on diameter

(OSD-48)

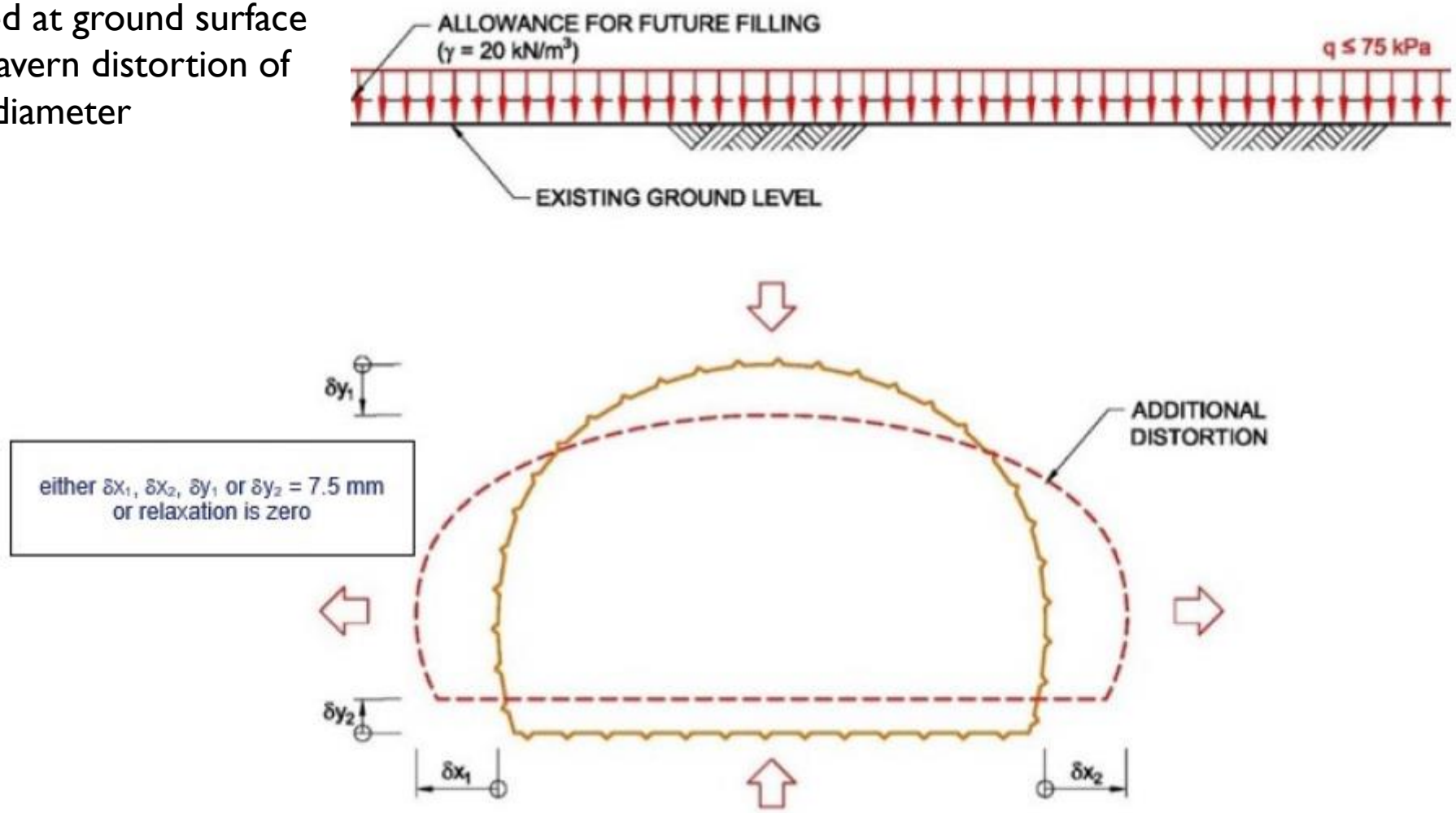
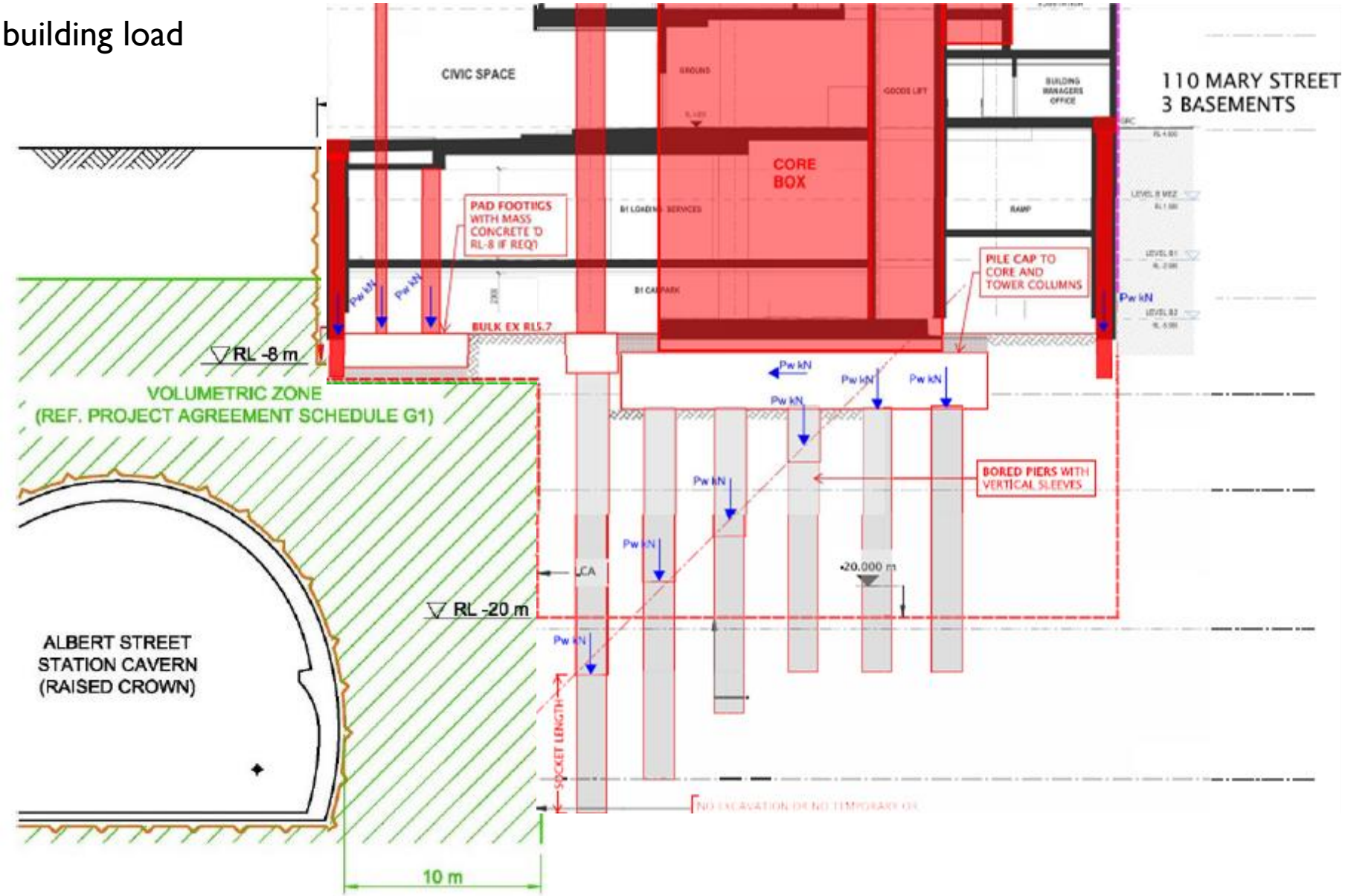


Figure 15 FOSD loading for caverns – Future development allowance Case 2 (Ref. Table B2-B, Annexure B, PSTR)

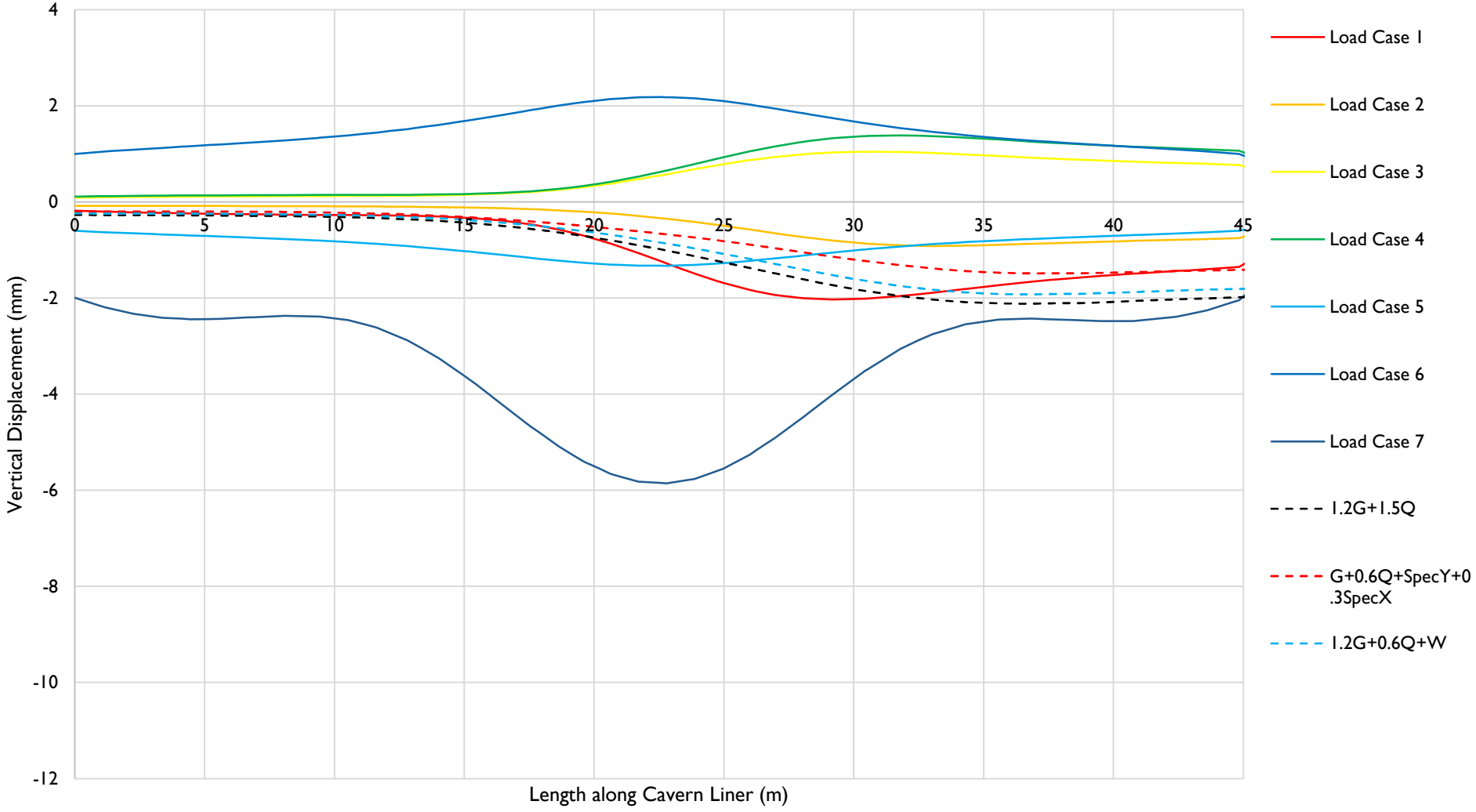
Case 8 – Proposed building load case



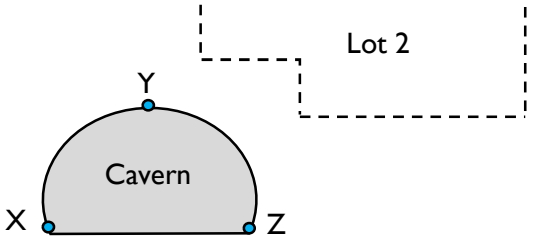
Appendix L

Cavern Assessment Outcomes (Piled Foundation)

Analysis Group 1 (1a) - Change in Vertical Displacement on Cavern Liner



Point X Point Y Point Z



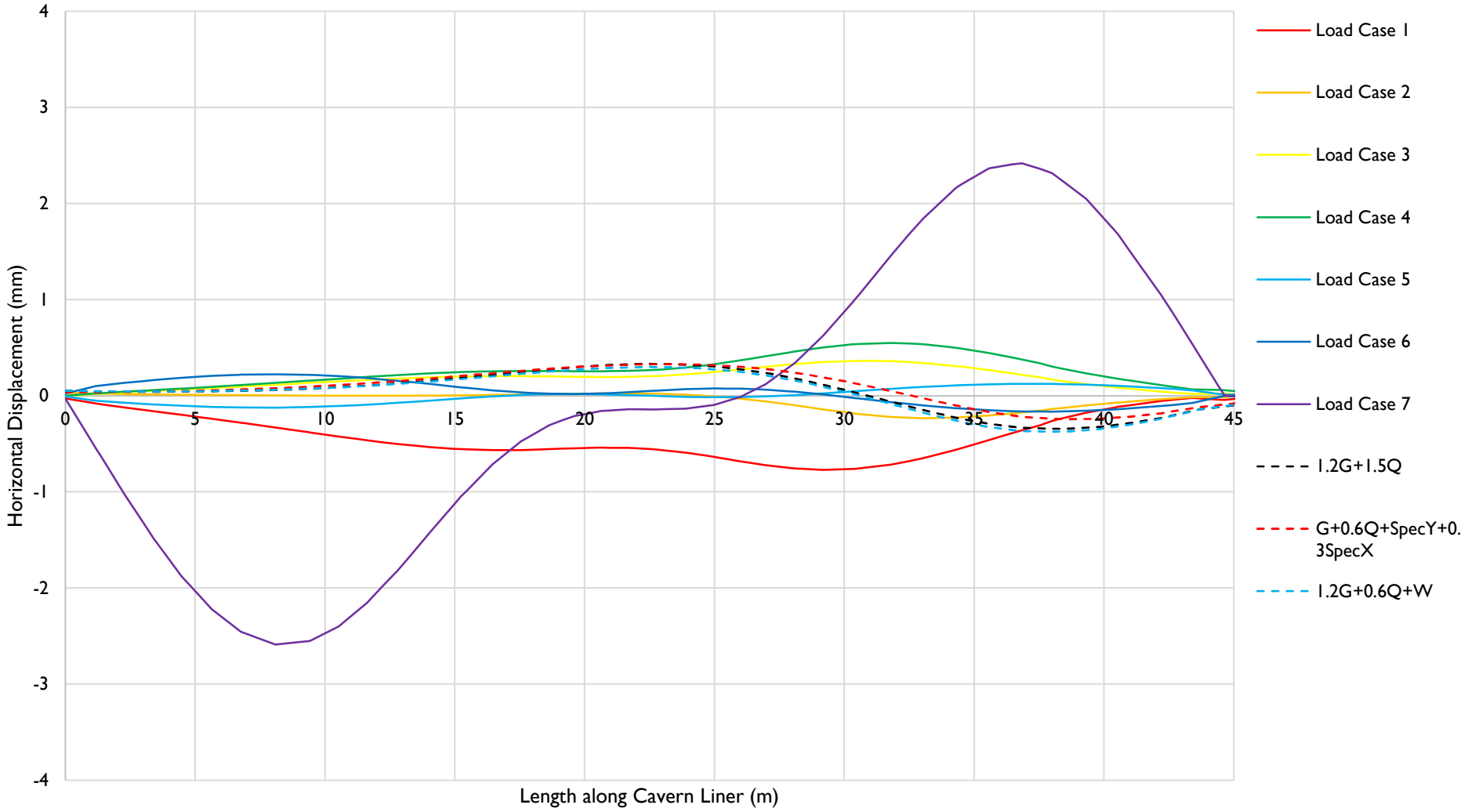
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date:	16/07/2024
approved:	DJC
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client:	RCP
project:	Albert Street Development
location:	Brisbane
title:	*Finite Element Outputs*
job no:	B01493-1

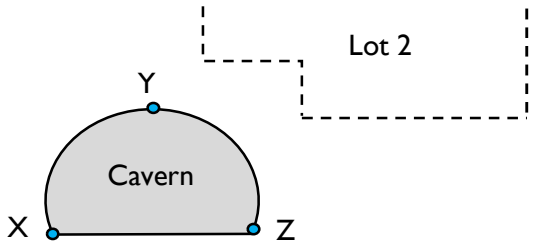
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figure: *1a*

Analysis Group 1 (1b) - Change in Horizontal Displacement on Cavern Liner



Point X Point Y Point Z



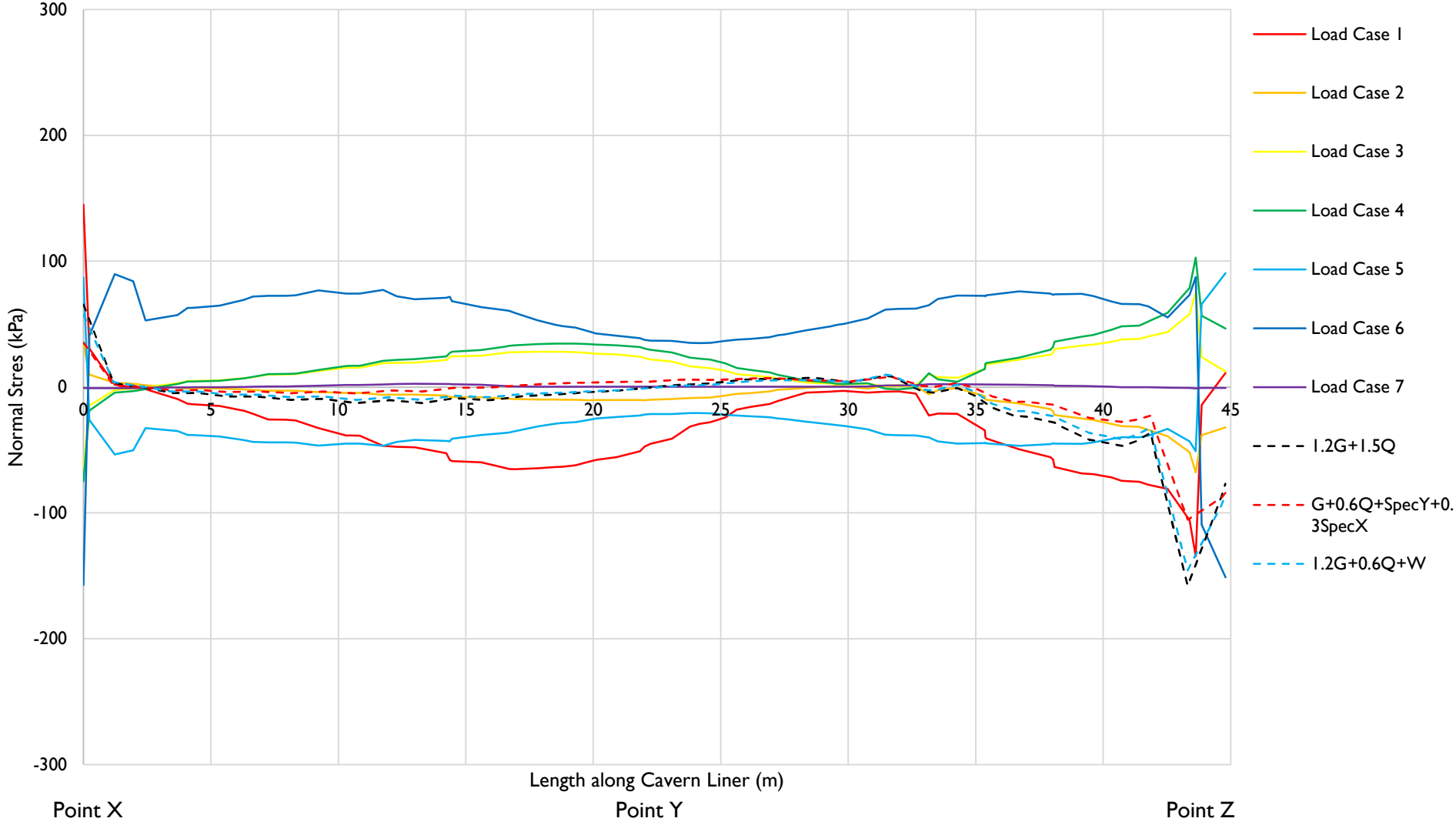
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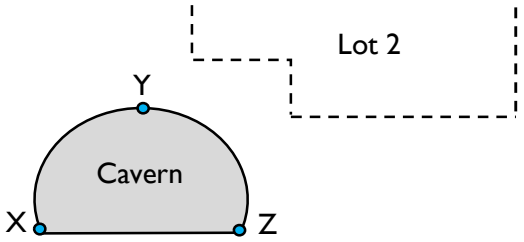
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location:	Brisbane
title:	*Finite Element Outputs*
job no:	B01493-1

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figure: *1b*

Analysis Group 1 (1c) - Change in Normal Stress on Cavern Liner





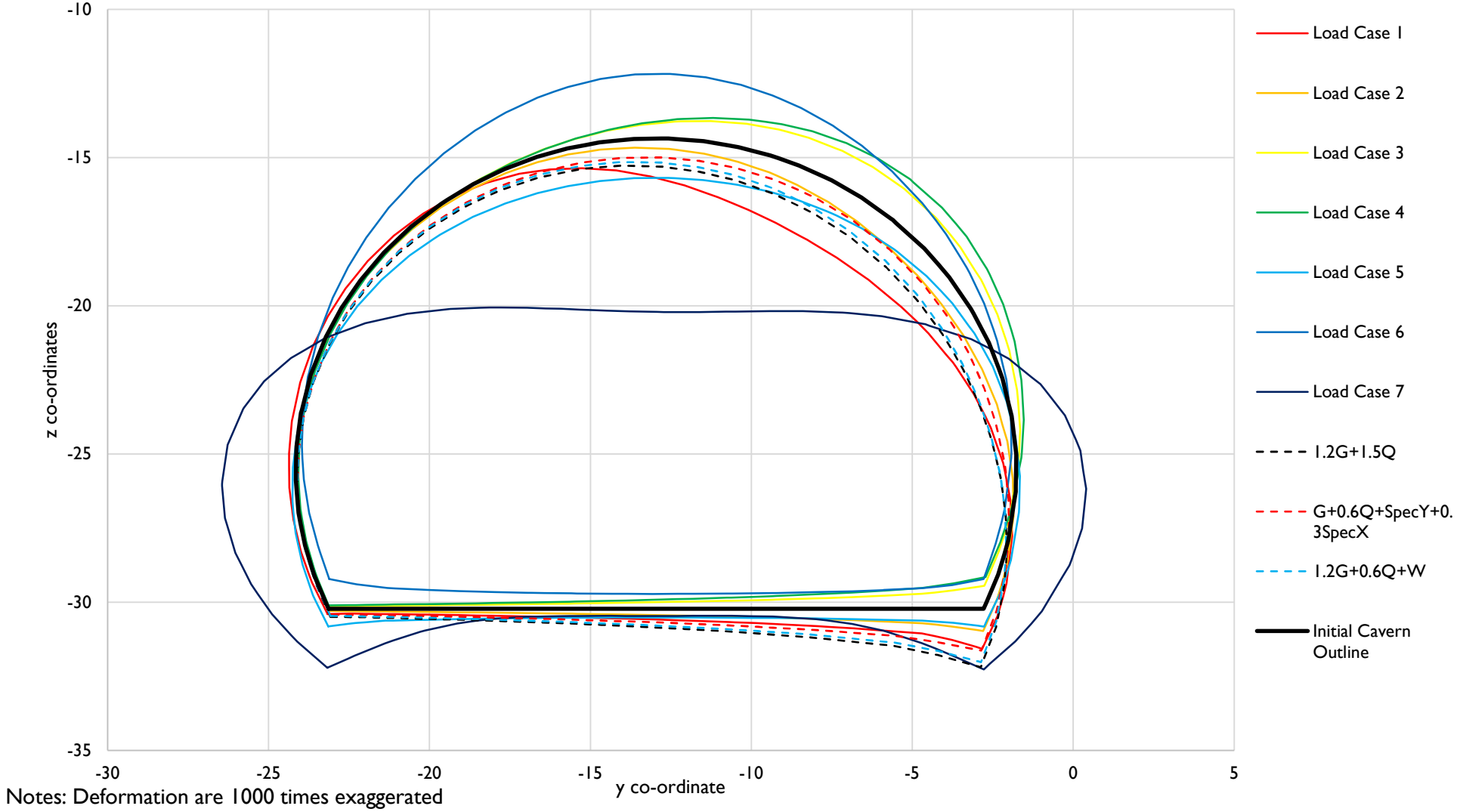
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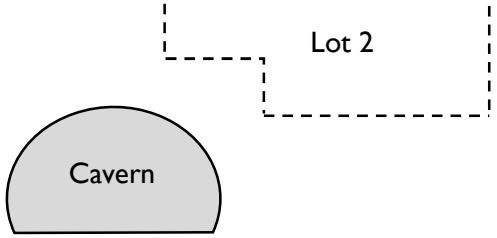
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figure: *1c*

Analysis Group 1 (1d) - Change in Displacement on Cavern Liner



Notes: Deformation are 1000 times exaggerated



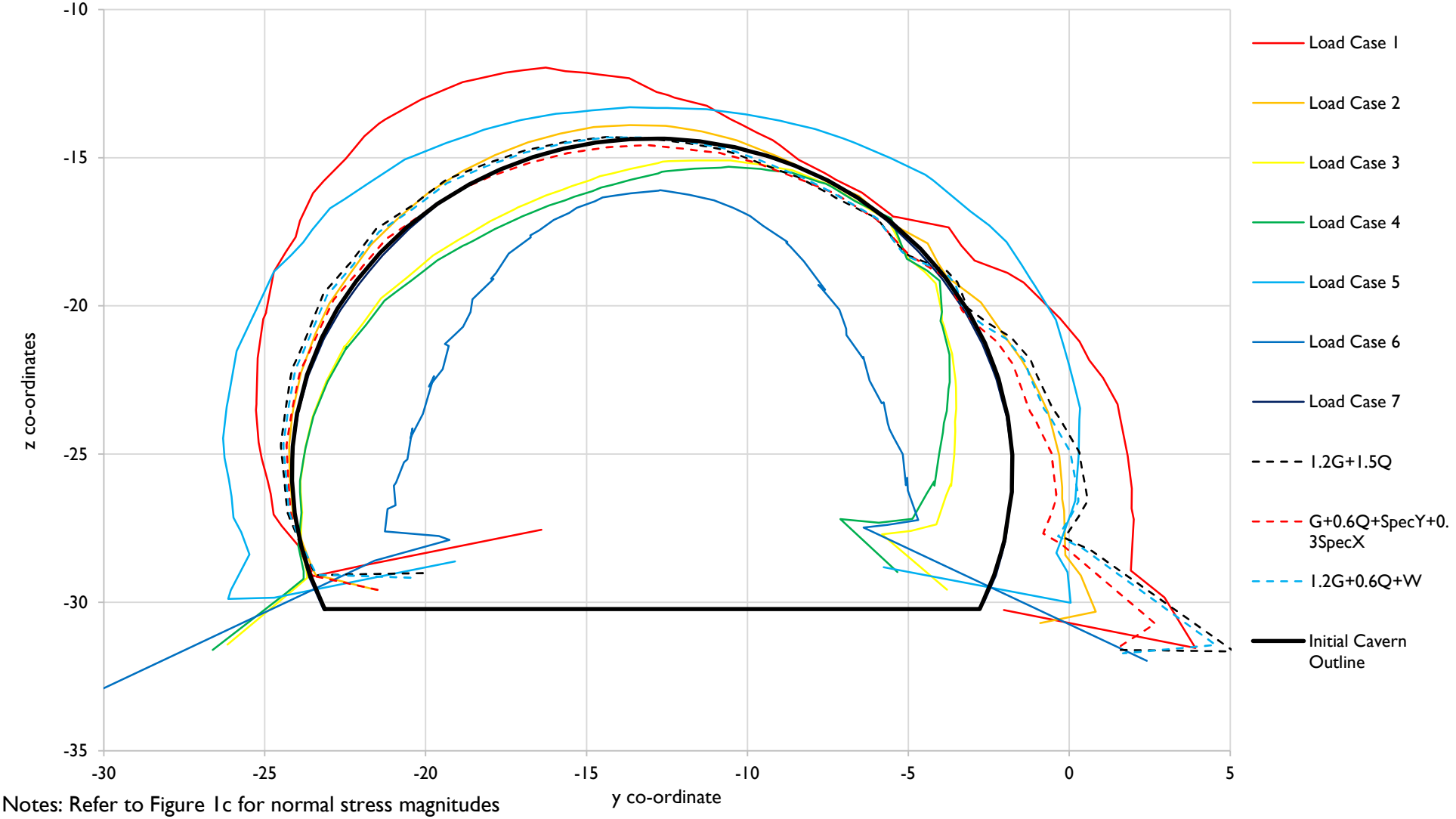
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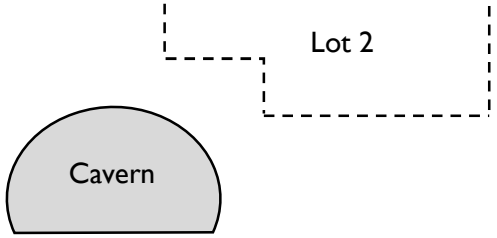
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figure: *1d*

Analysis Group 1 (1e) - Change in Normal Stress on Cavern Liner



Notes: Refer to Figure 1c for normal stress magnitudes

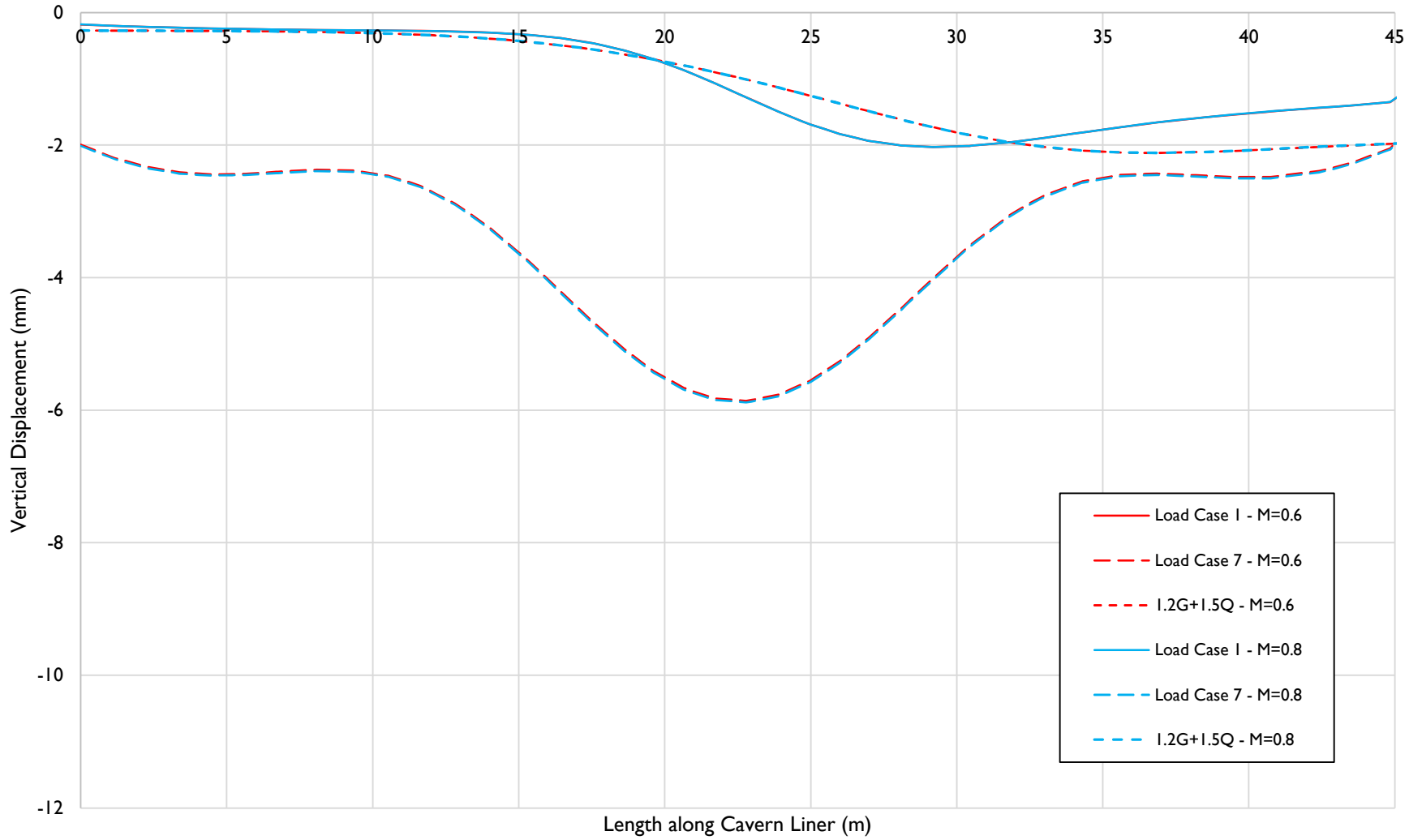


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		job no:	B01493-1

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figure: 1e

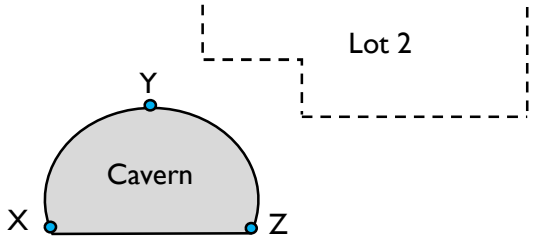
Analysis Group 2 (2a) - Change in Vertical Displacement on Cavern Liner



Point X

Point Y

Point Z



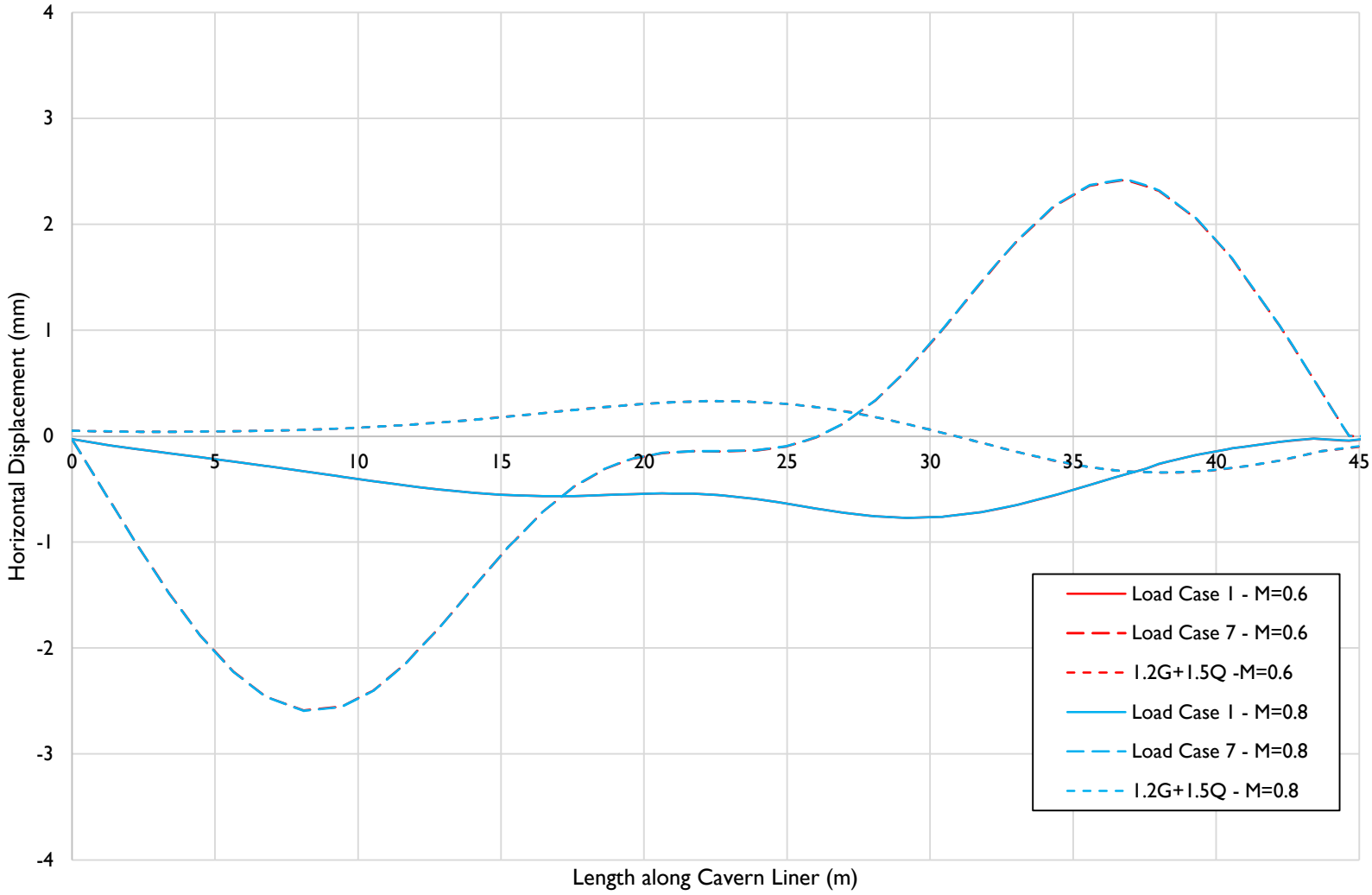
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location:	Brisbane
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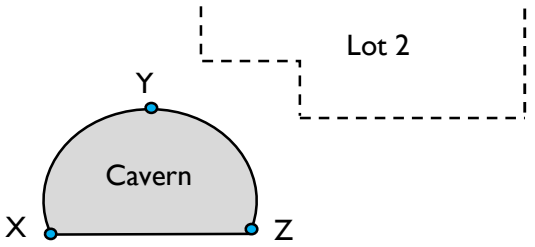
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figure: *2a*

Analysis Group 2 (2b) - Change in Horizontal Displacement on Cavern Liner



Point X Point Y Point Z



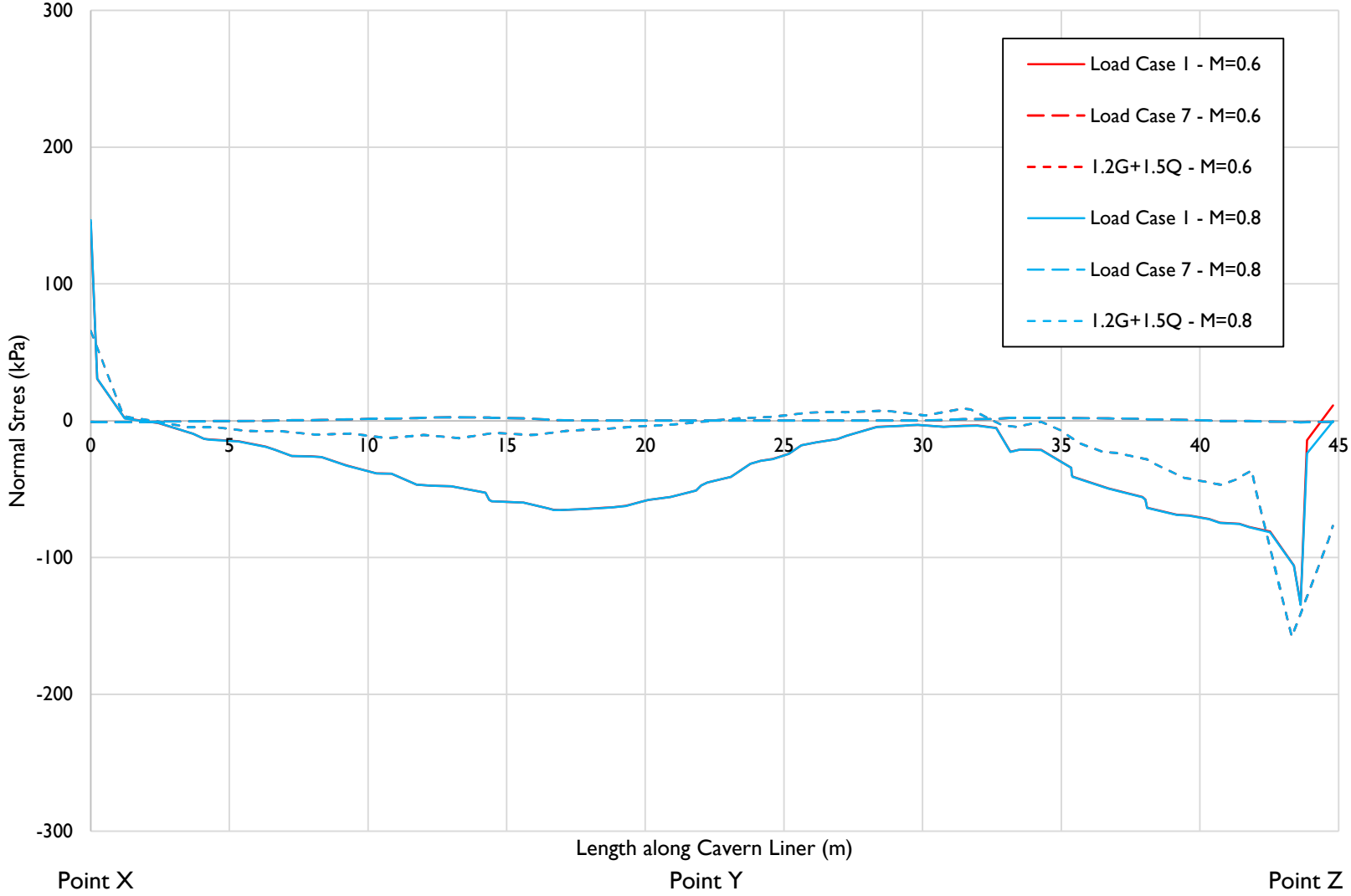
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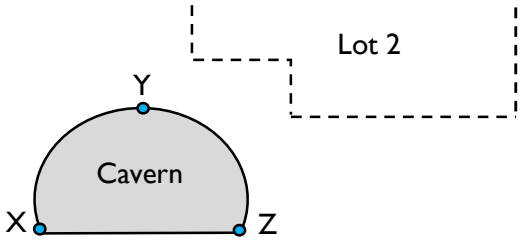
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figure: 2b

Analysis Group 2 (2c) - Change in Normal Stress on Cavern Liner





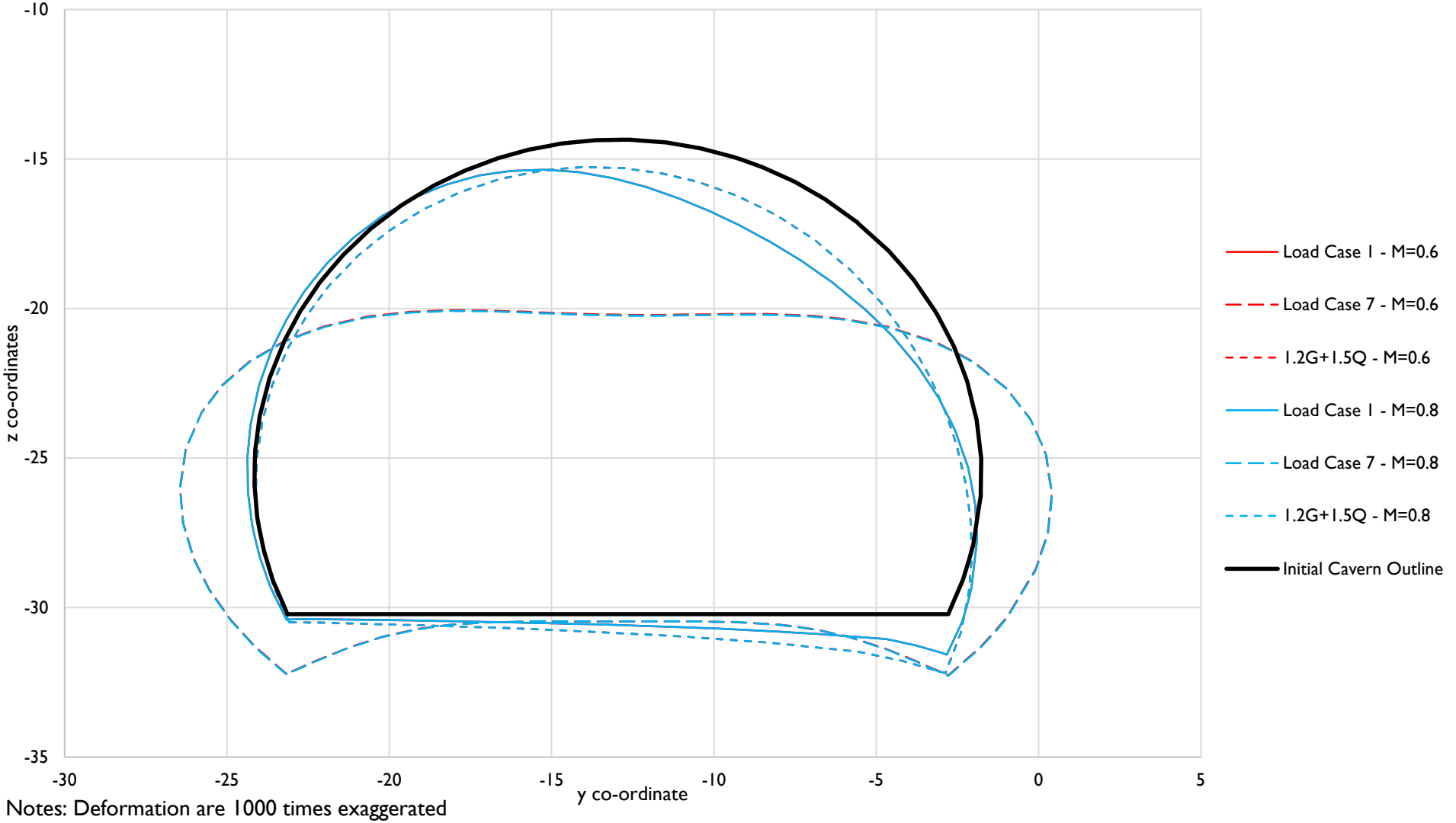
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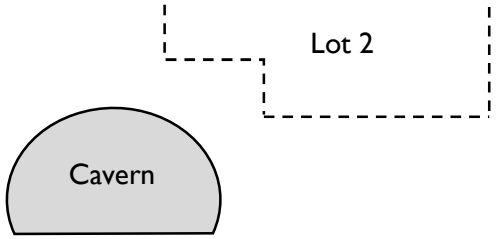
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figure: 2c

Analysis Group 2 (2d) - Change in Displacement on Cavern Liner



Notes: Deformation are 1000 times exaggerated



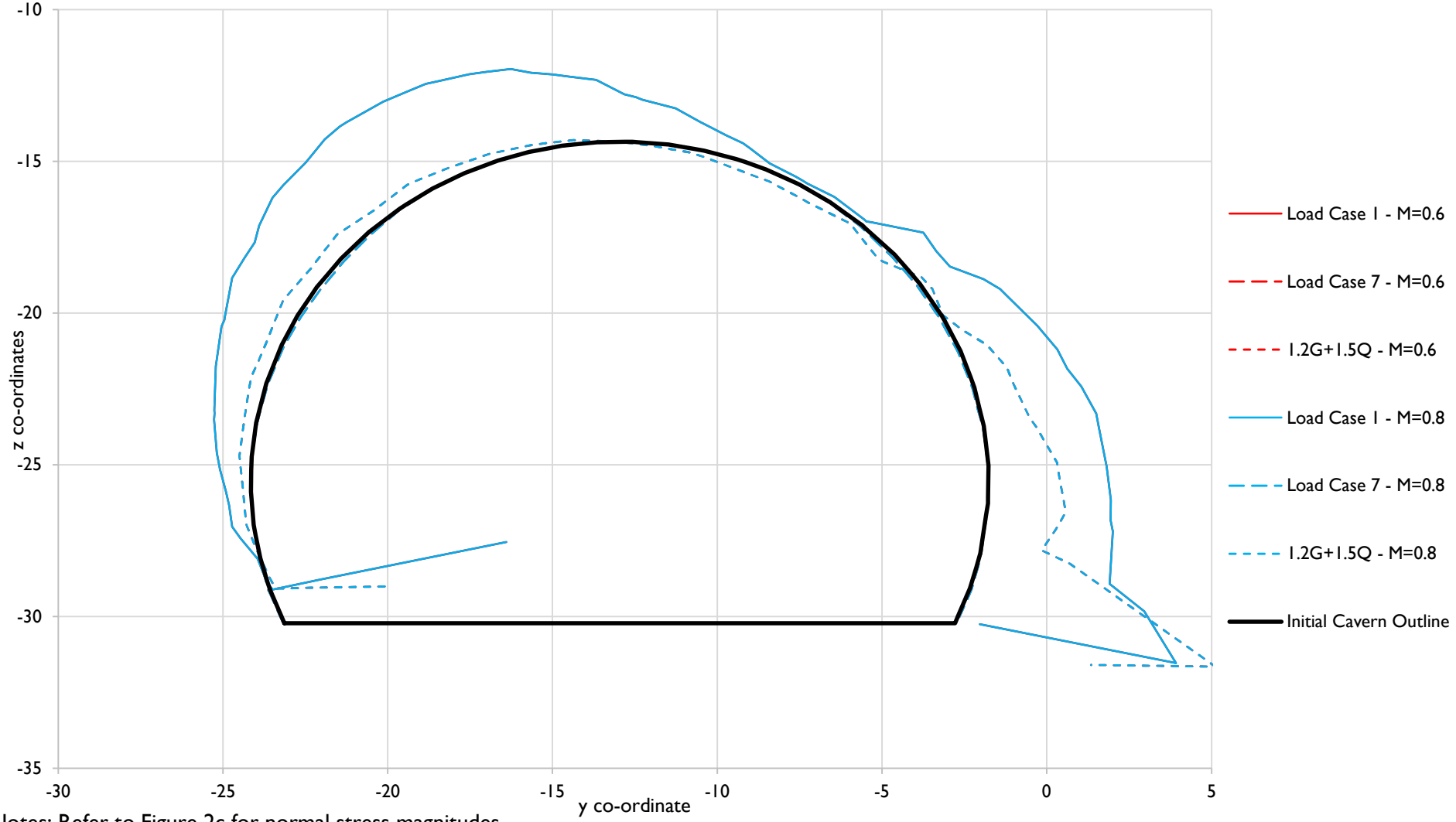
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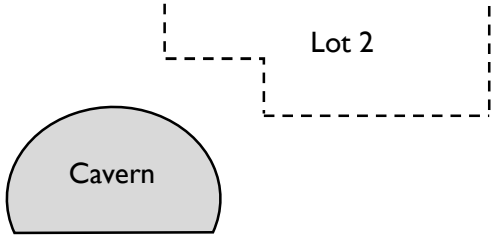
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figure: *2d*

Analysis Group 2 (2e) - Change in Normal Stress on Cavern Liner



Notes: Refer to Figure 2c for normal stress magnitudes



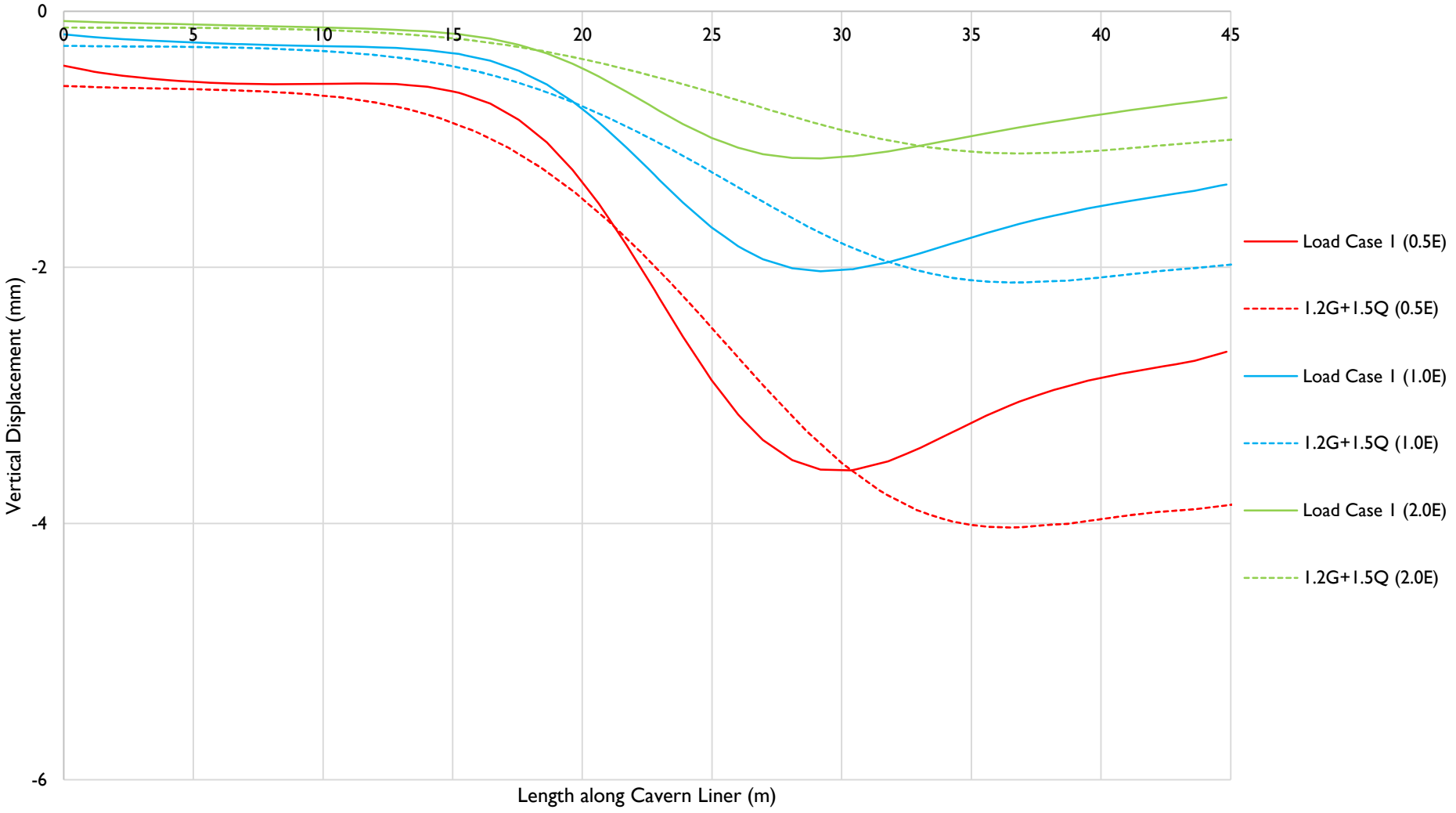
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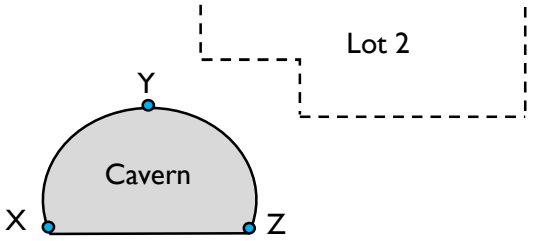
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figure: 2e

Analysis Group 3 (3a) - Change in Vertical Displacement on Cavern Liner



Point X Point Y Point Z



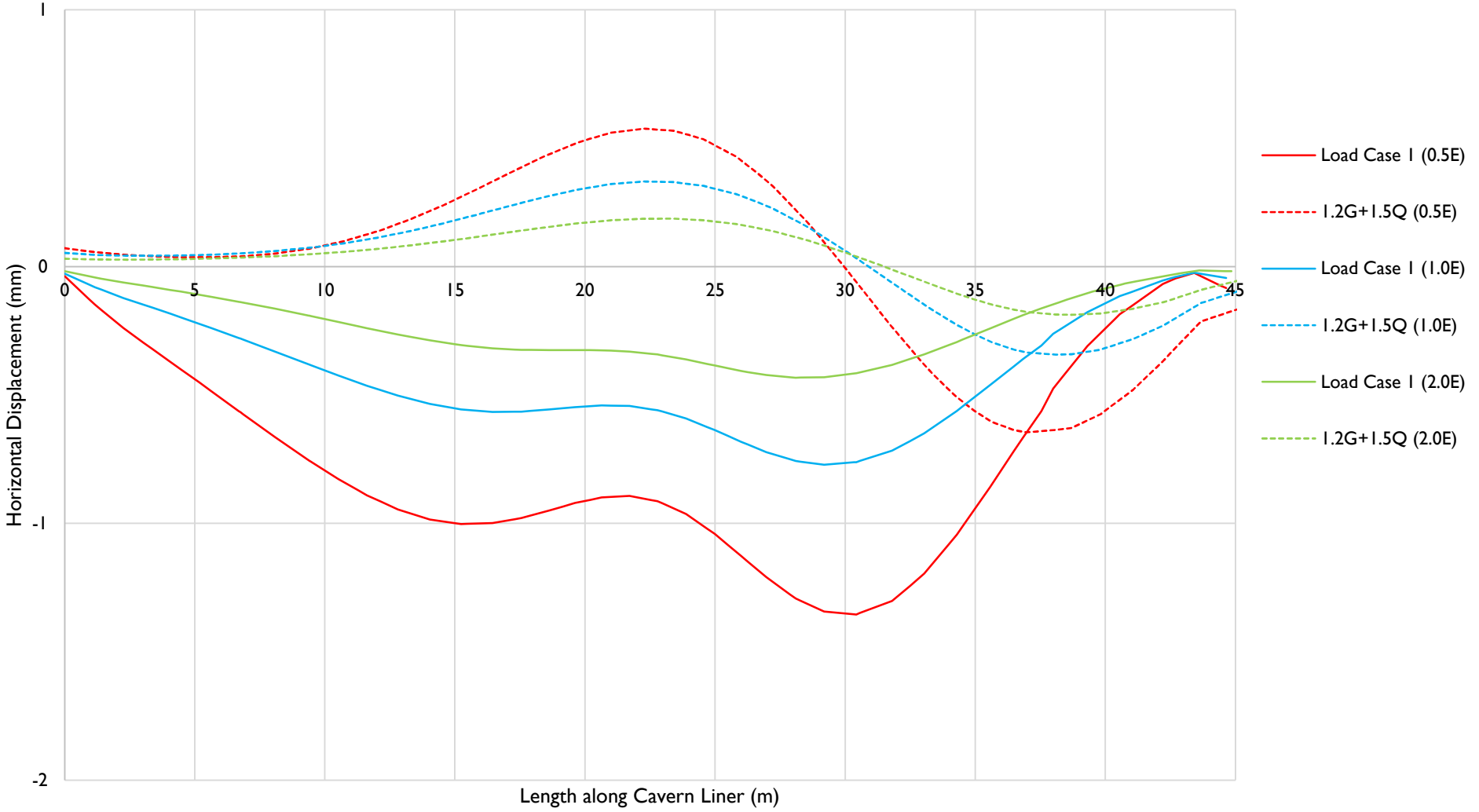
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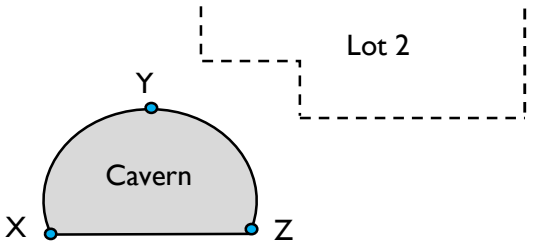
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figure: *3a*

Analysis Group 3 (3b) - Change in Horizontal Displacement on Cavern Liner



Point X Point Y Point Z



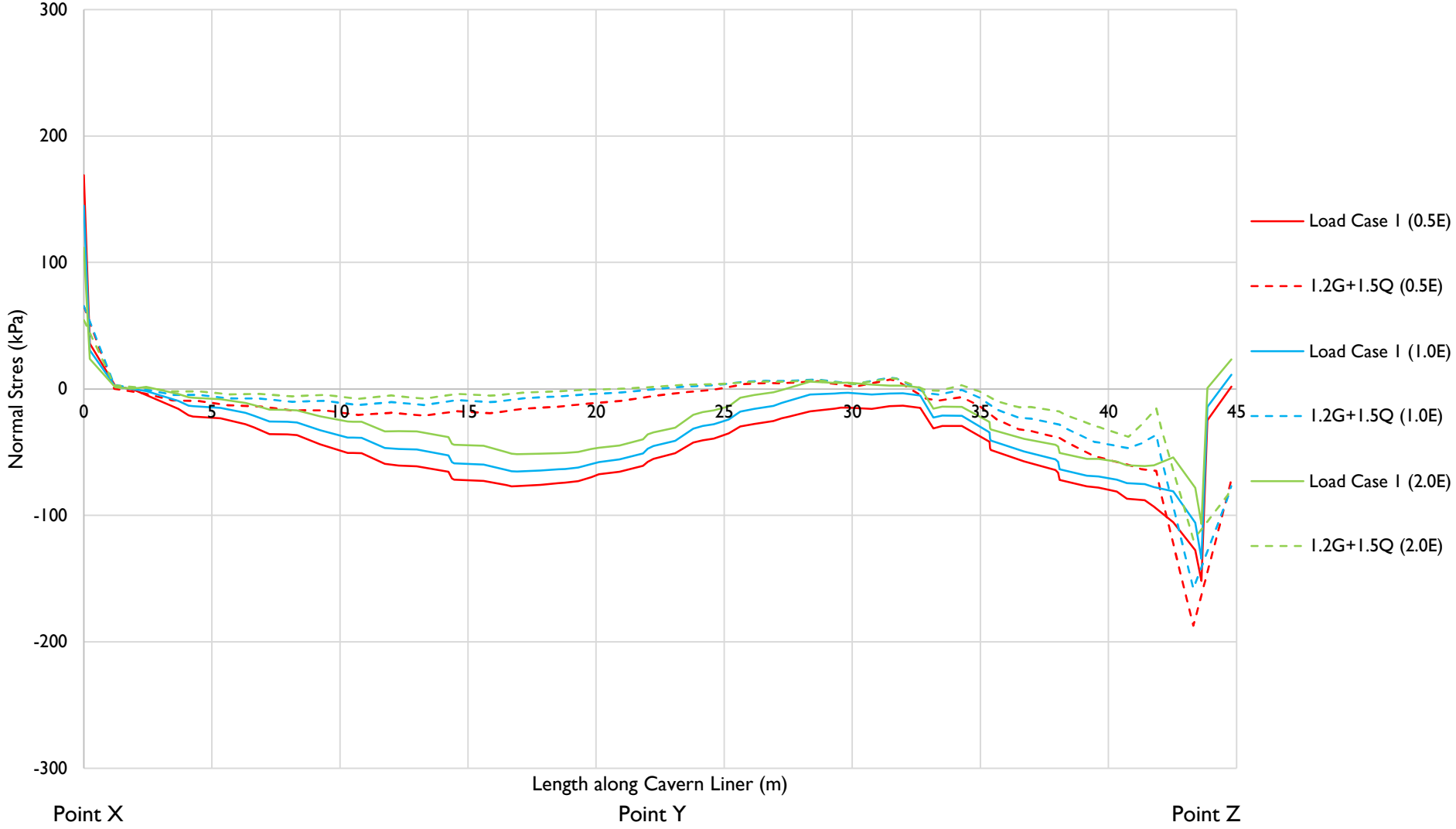
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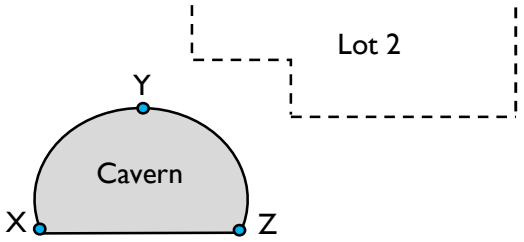
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location:	Brisbane
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job no:	B01493-1

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figure: *3b*

Analysis Group 3 (3c) - Change in Normal Stress on Cavern Liner





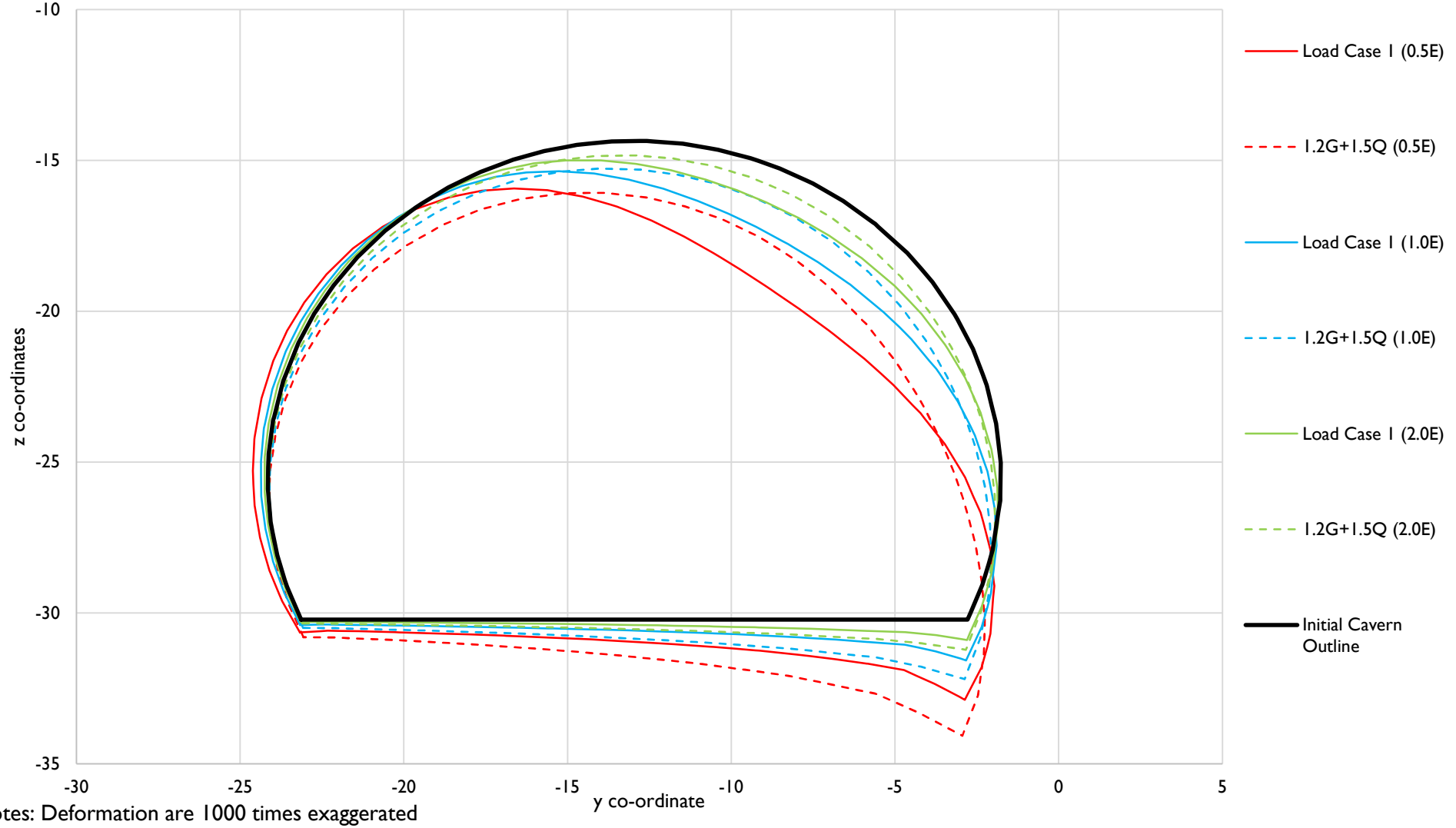
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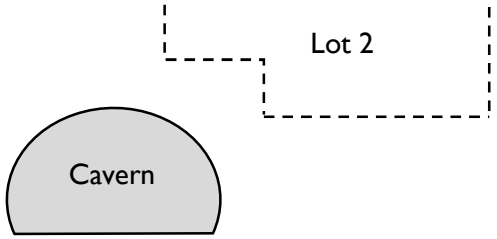
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figure: *3c*

Analysis Group 3 (3d) - Change in Displacement on Cavern Liner



Notes: Deformation are 1000 times exaggerated



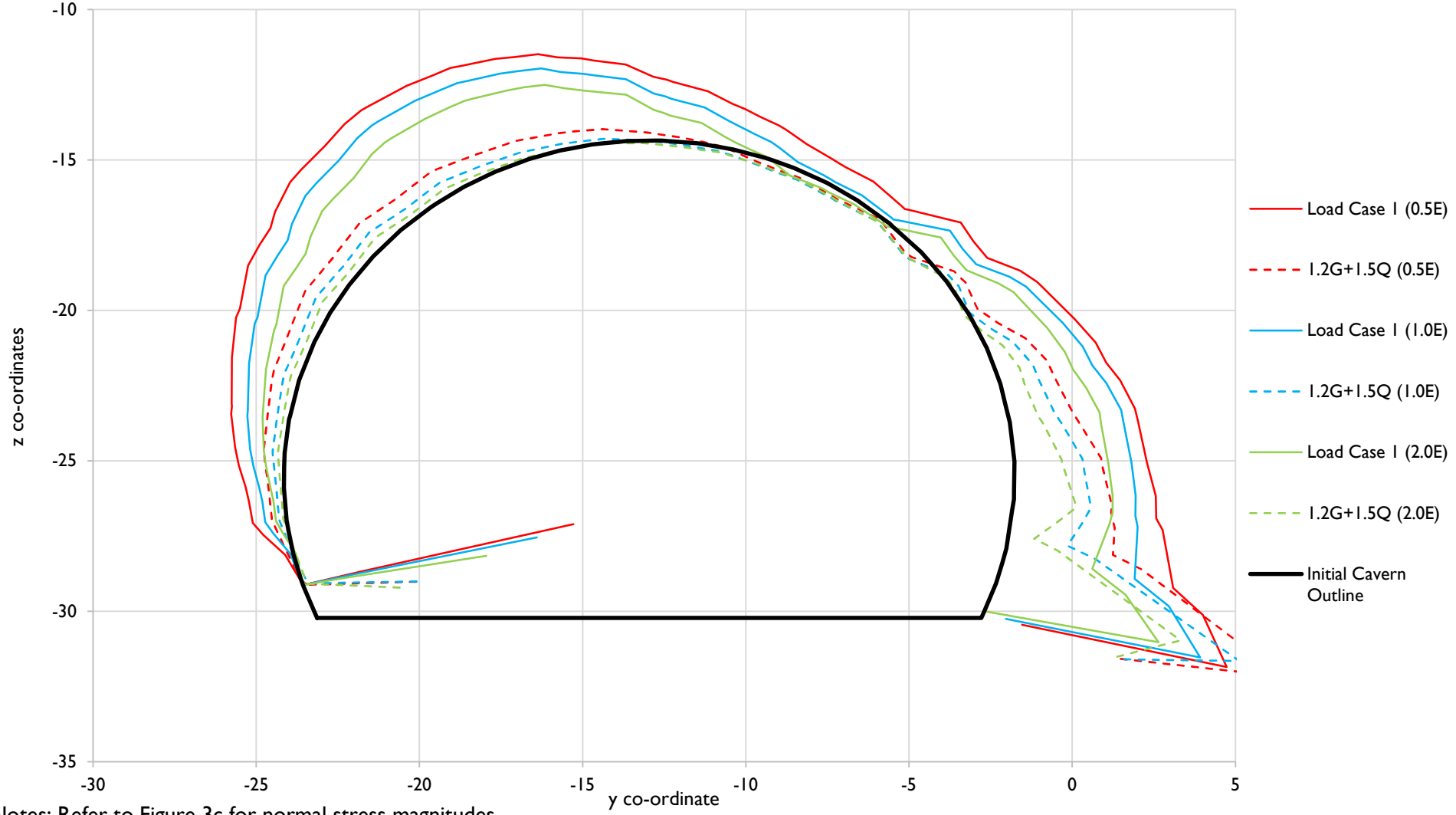
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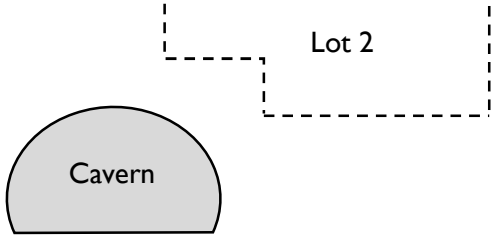
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figure: *3d*

Analysis Group 3 (3e) - Change in Normal Stress on Cavern Liner



Notes: Refer to Figure 3c for normal stress magnitudes



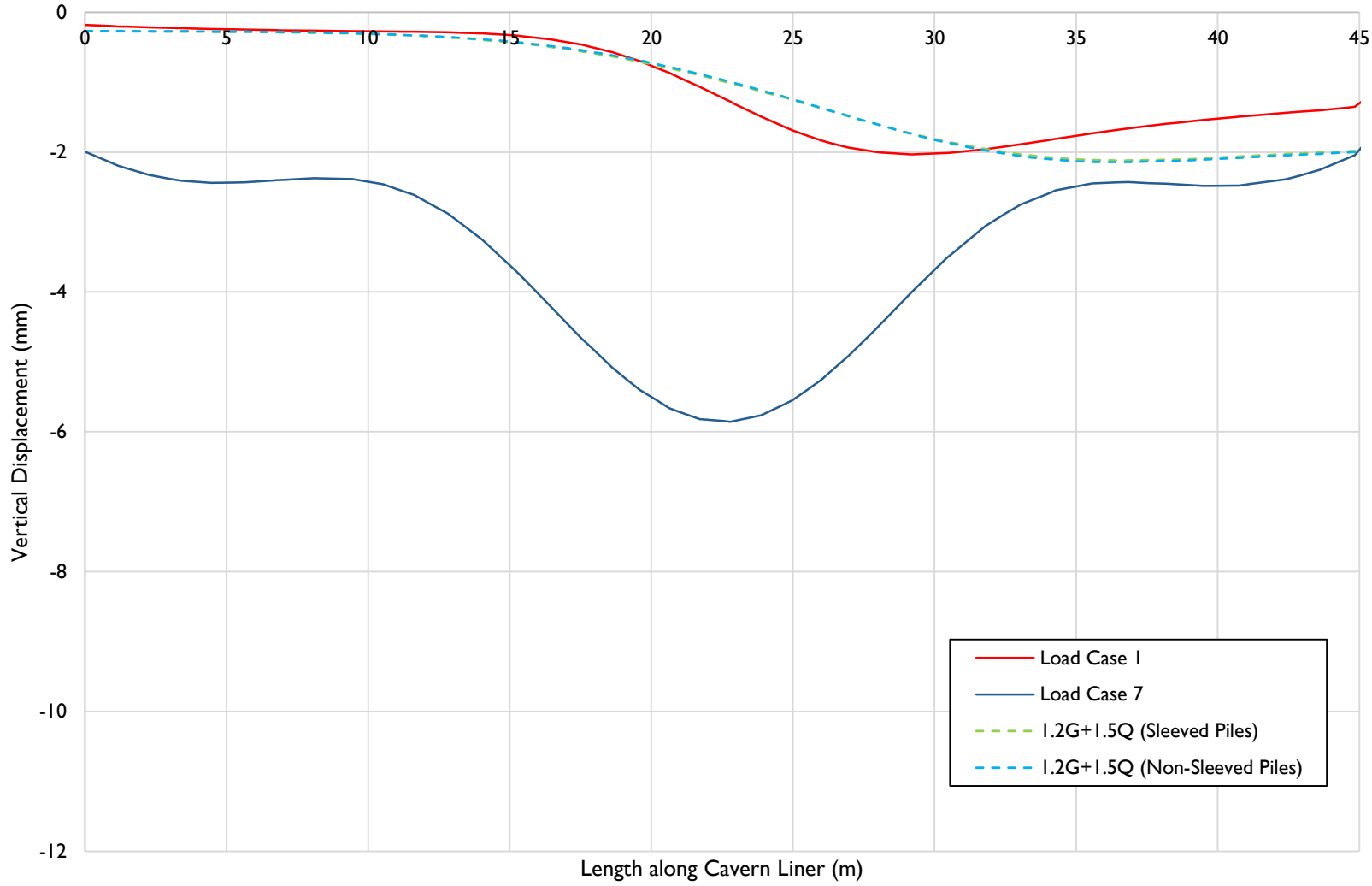
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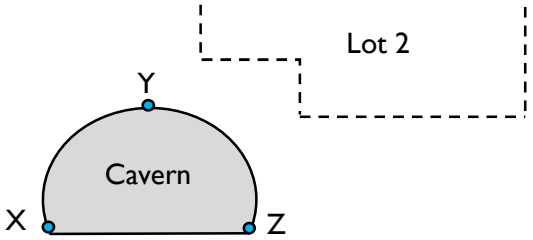
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figure: 3e

Analysis Group 4 (4a) - Change in Vertical Displacement on Cavern Liner



Point X Point Y Point Z



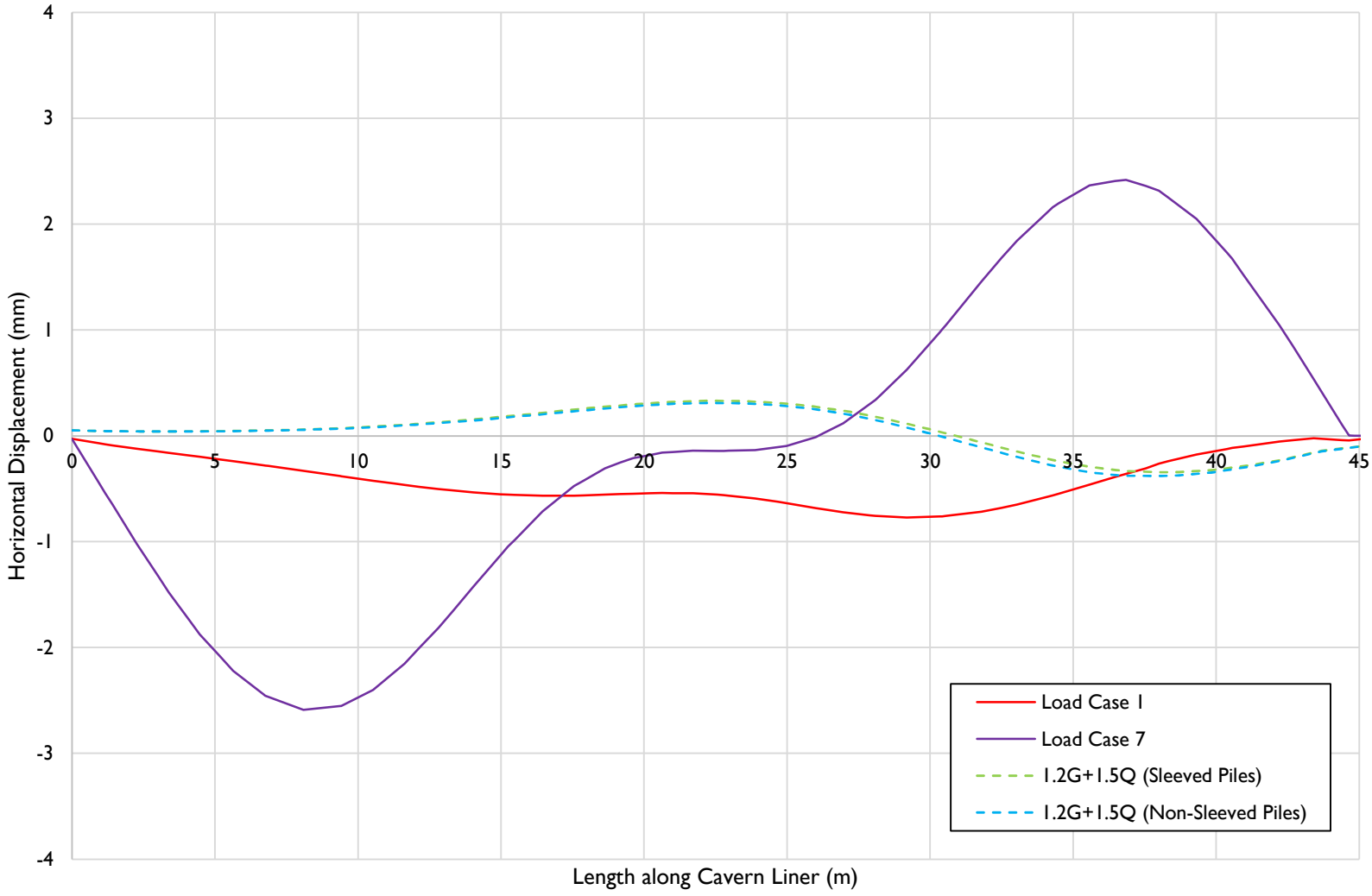
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approved:	DJC
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project:	Albert Street Development
location:	Brisbane
title:	*Finite Element Outputs*
job no:	B01493-1

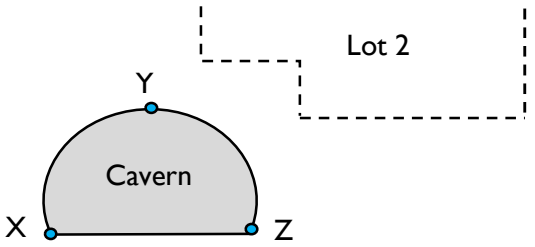
EDG consulting
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figure: *4a*

Analysis Group 4 (4b) - Change in Horizontal Displacement on Cavern Liner



Point X Point Y Point Z



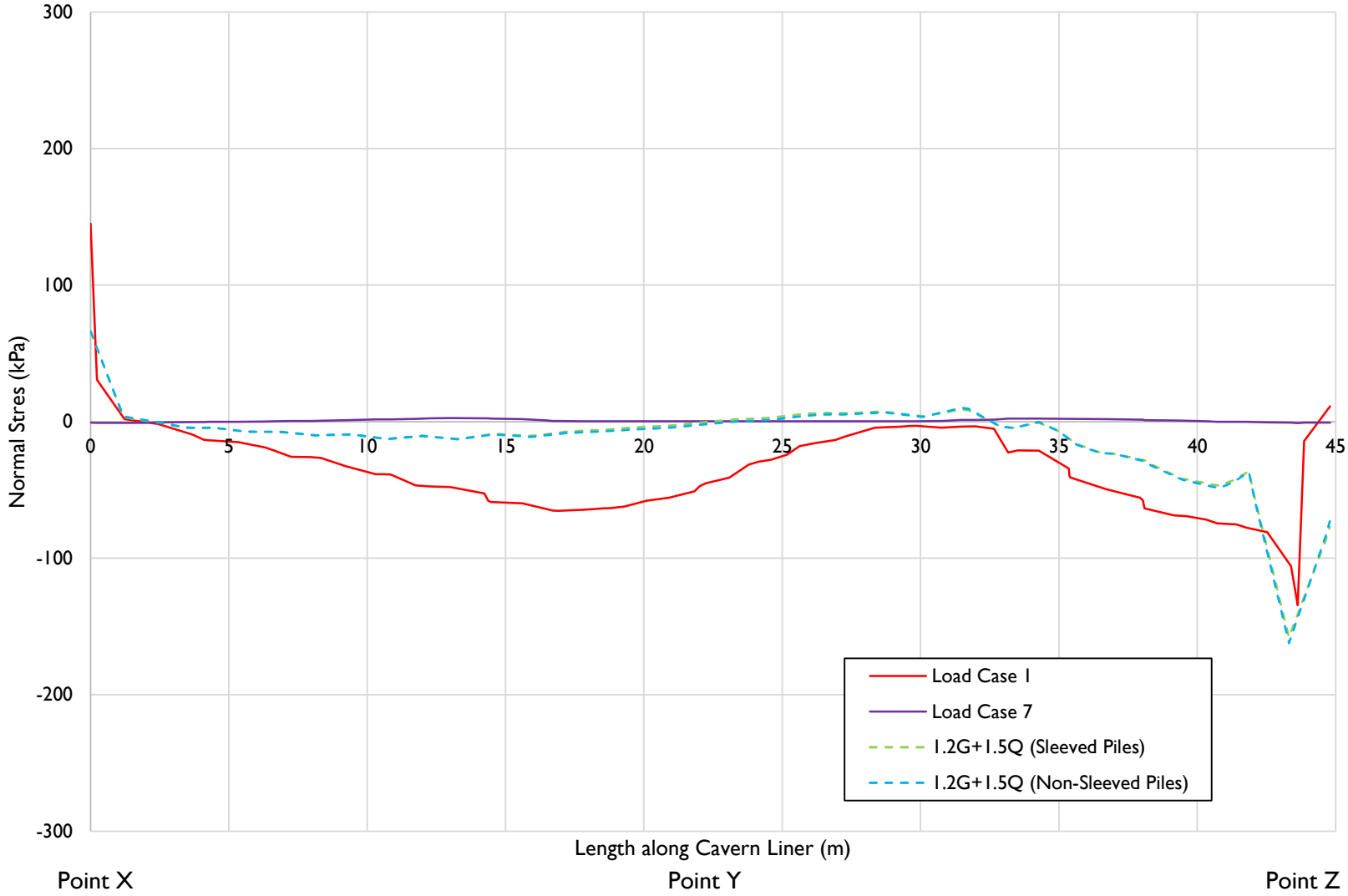
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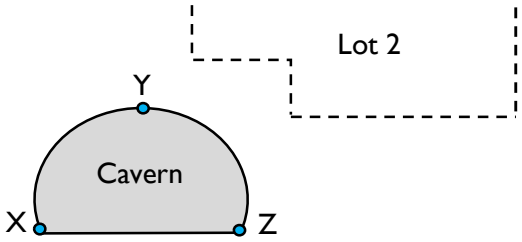
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location:	Brisbane
title:	*Finite Element Outputs*
job no:	B01493-1

EDG consulting
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figure: *4b*

Analysis Group 4 (4c) - Change in Normal Stress on Cavern Liner





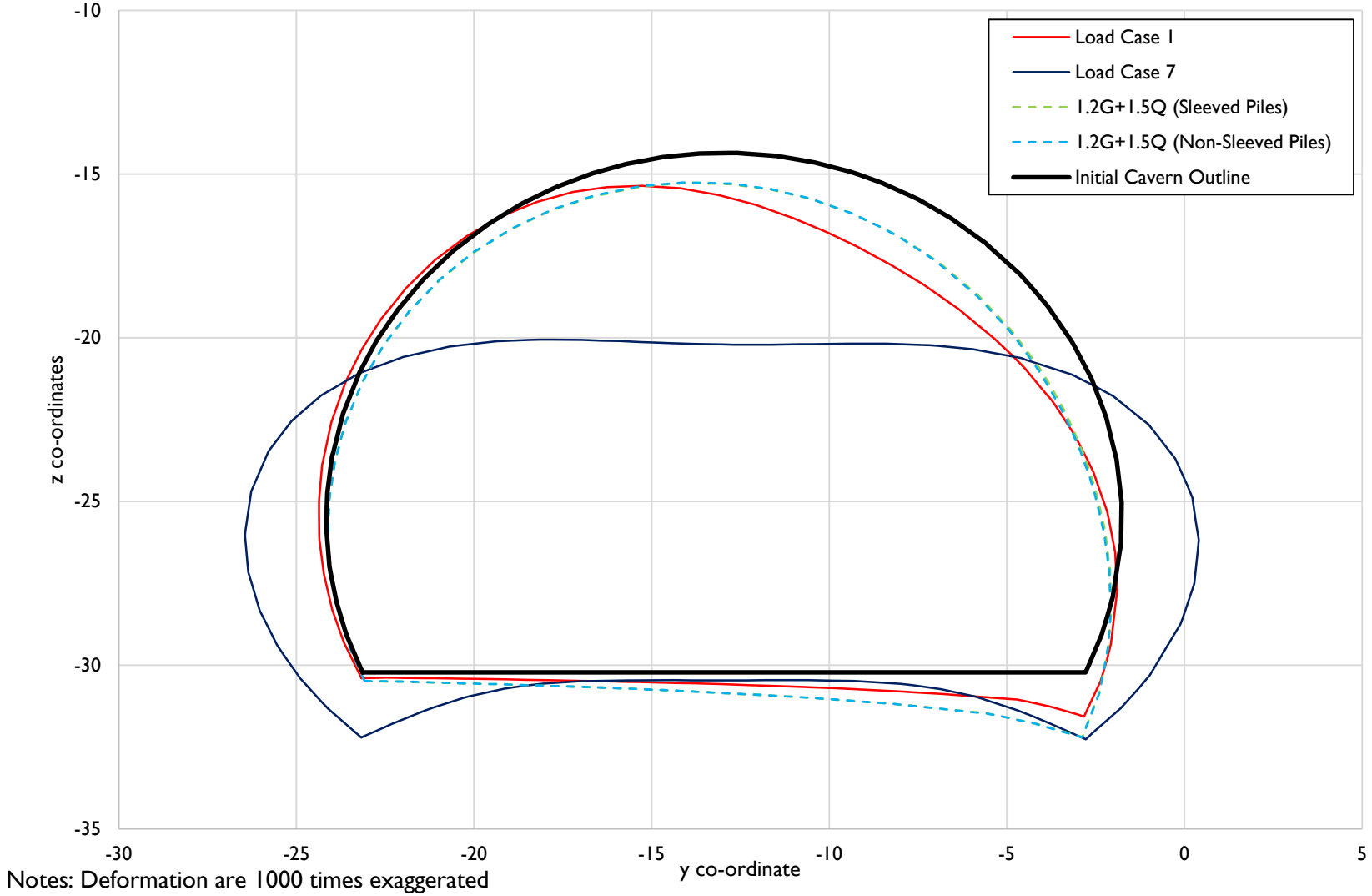
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location:	Brisbane
title:	*Finite Element Outputs*
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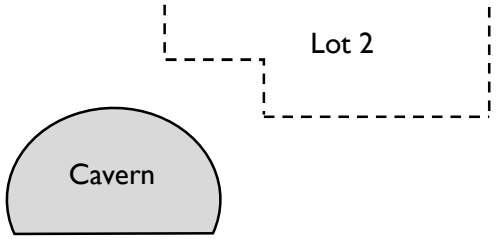
EDG consulting
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figure: *4c*

Analysis Group 4 (4d) - Change in Displacement on Cavern Liner



Notes: Deformation are 1000 times exaggerated



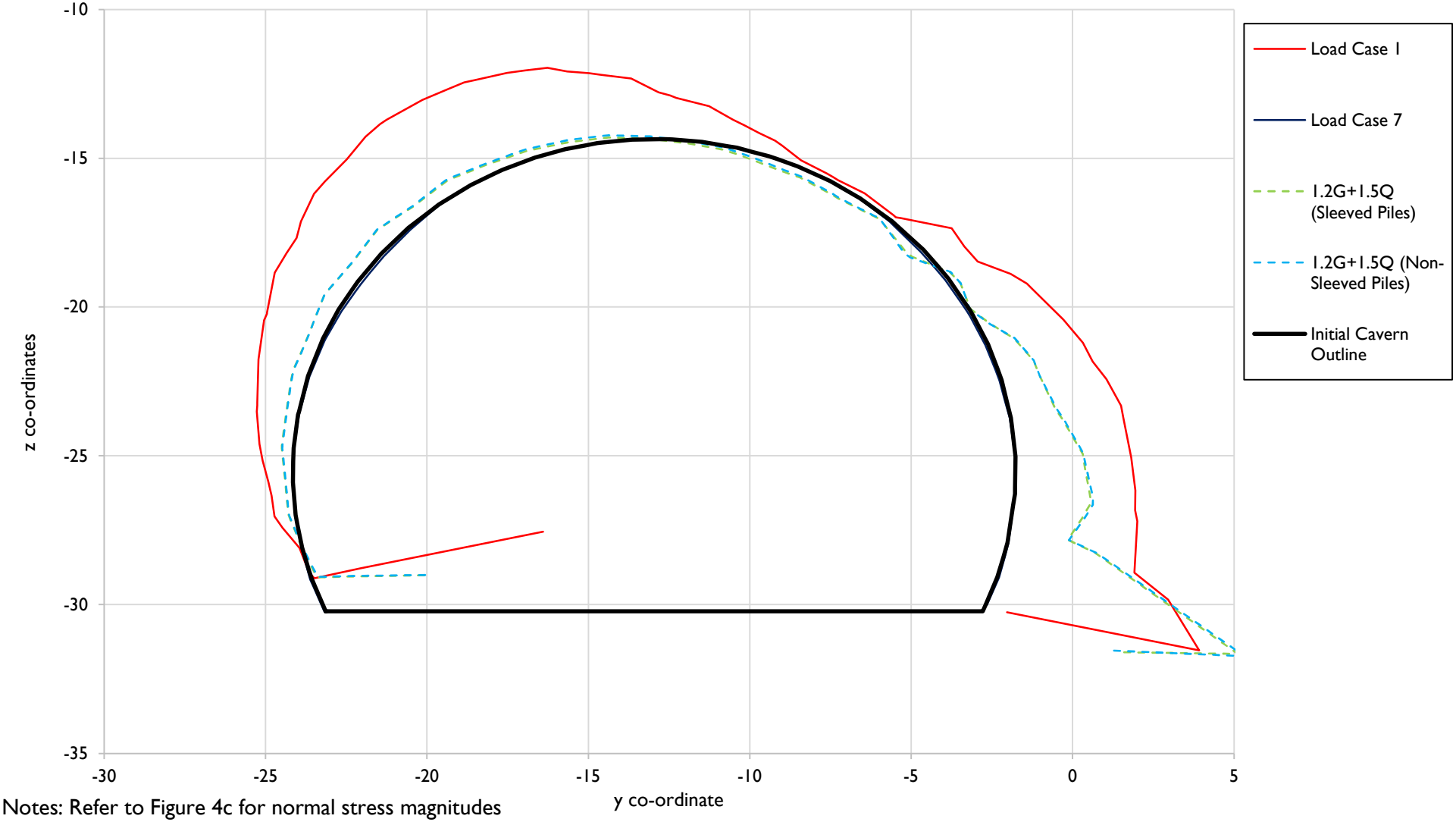
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location:	Brisbane
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job no:	B01493-1

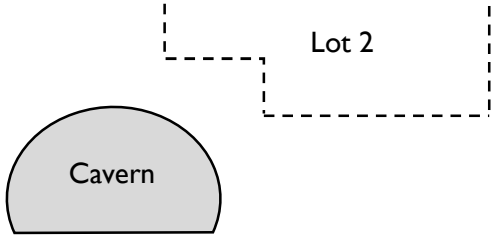
EDG consulting
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figure: *4d*

Analysis Group 4 (4e) - Change in Normal Stress on Cavern Liner



Notes: Refer to Figure 4c for normal stress magnitudes



by:	DL
date:	16/07/2024
approved:	DJC
scale:	NTS

client:	RCP
project:	Albert Street Development
location:	Brisbane
title:	*Finite Element Outputs*
job no:	B01493-1

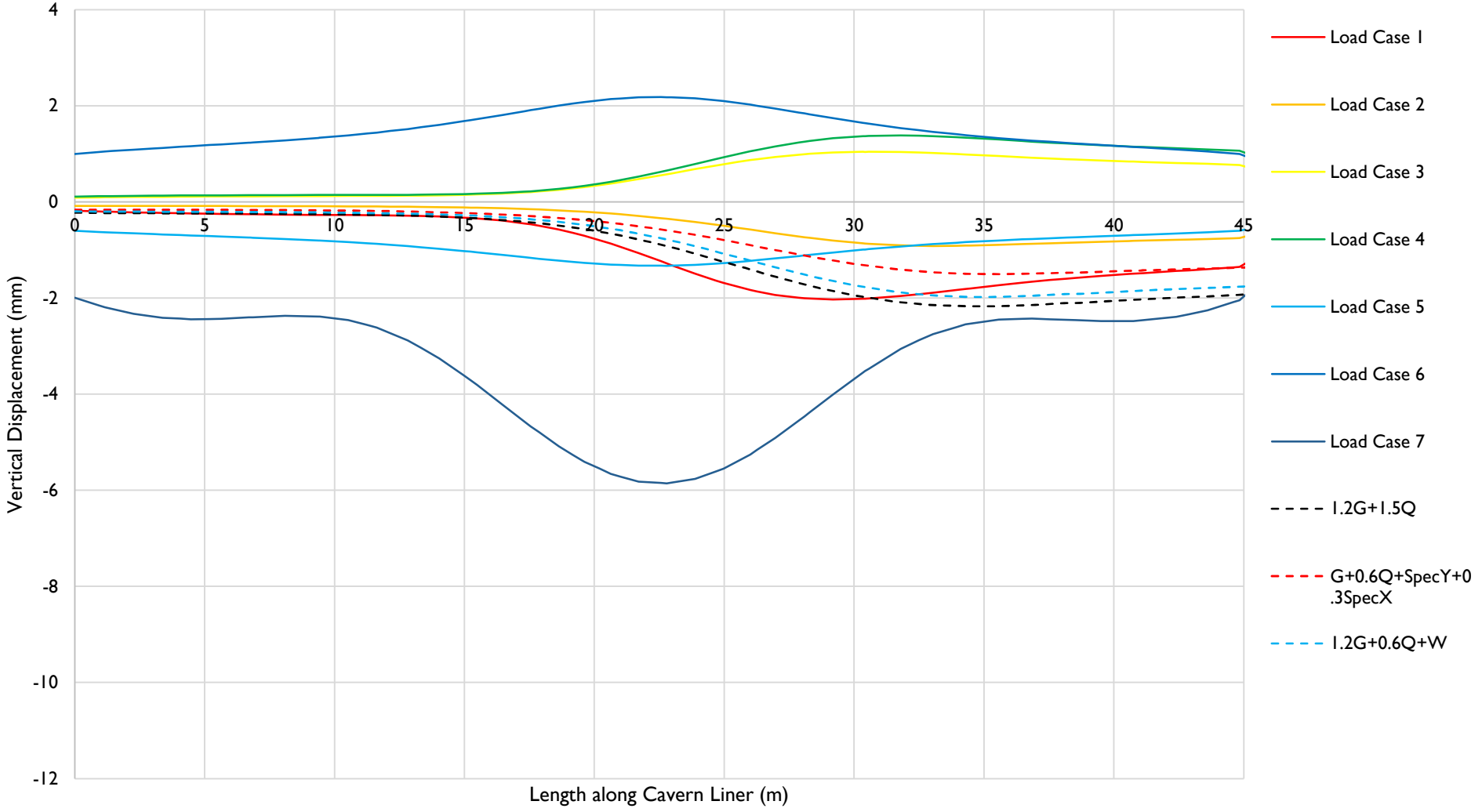
EDG consulting
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figure: 4e

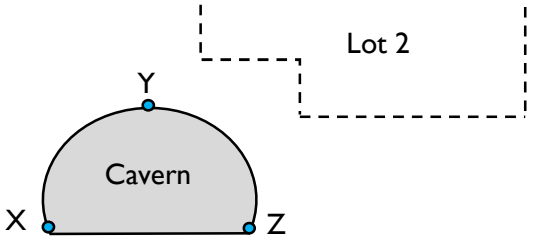
Appendix M

Cavern Assessment Outcomes (Piled Foundation)

Analysis Group 5 (5a) - Change in Vertical Displacement on Cavern Liner



Point X Point Y Point Z



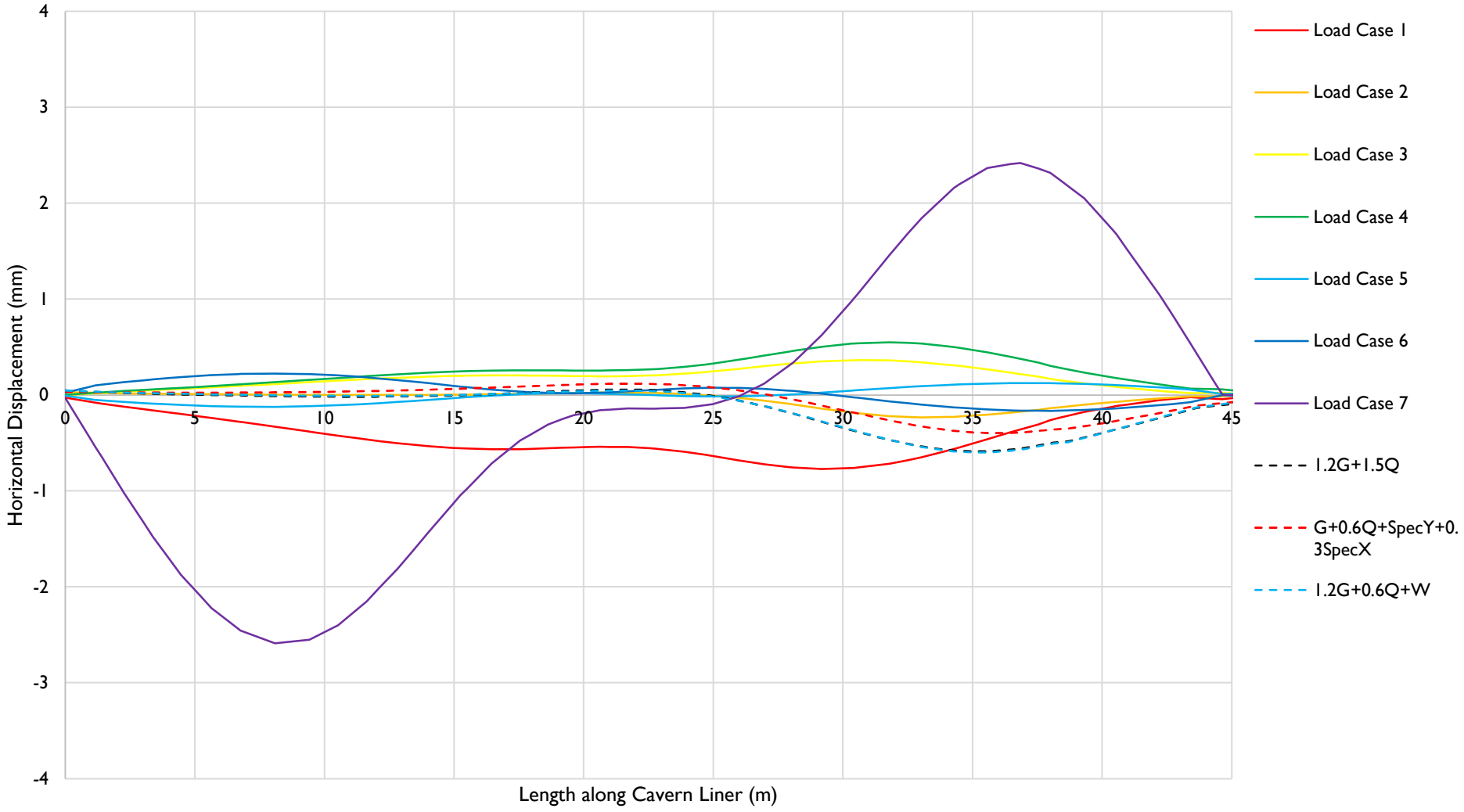
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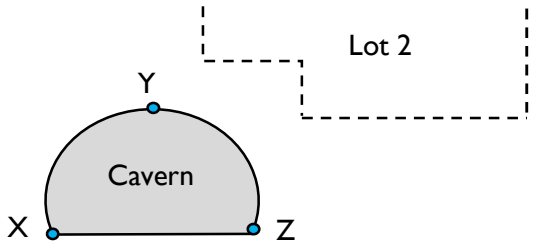
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figure: *5a*

Analysis Group 5 (5b) - Change in Horizontal Displacement on Cavern Liner



Point X Point Y Point Z



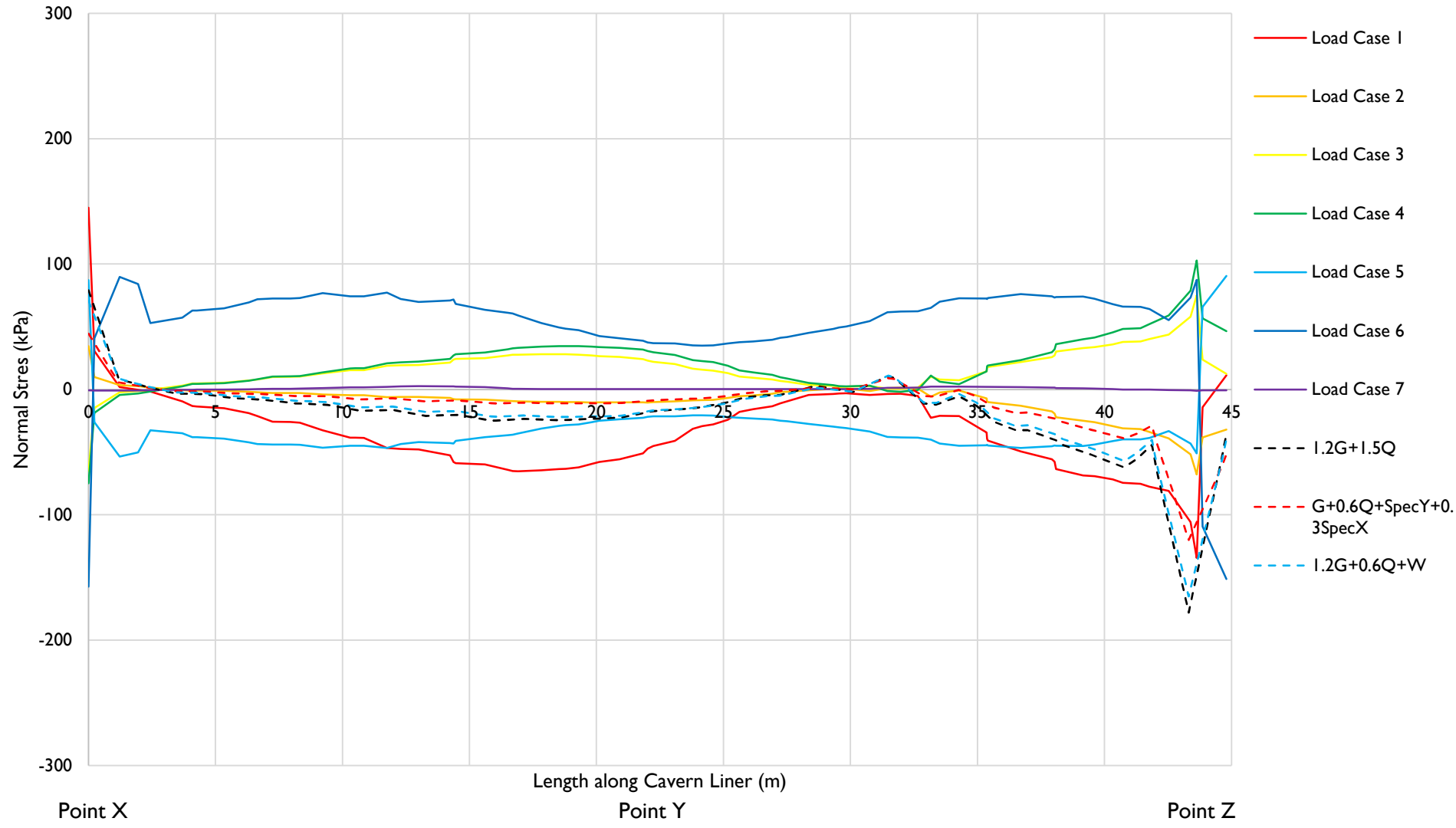
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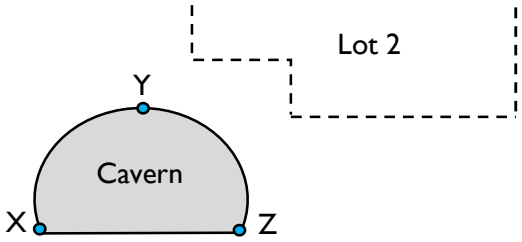
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project:	Albert Street Development
location:	Brisbane
title:	*Finite Element Outputs*
job no:	B01493-1

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figure: *5b*

Analysis Group 5 (5c) - Change in Normal Stress on Cavern Liner





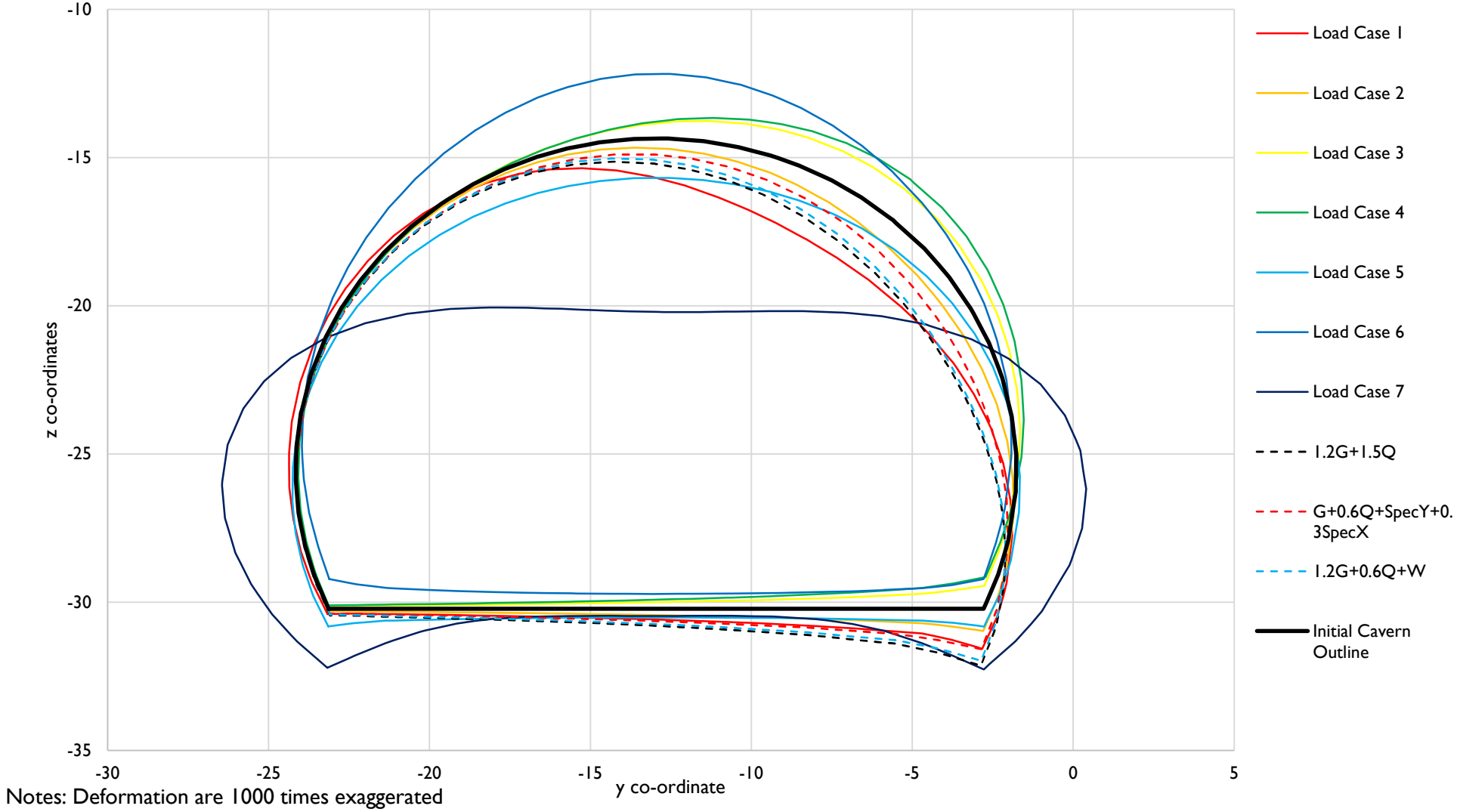
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location:	Brisbane
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job no:	B01493-1

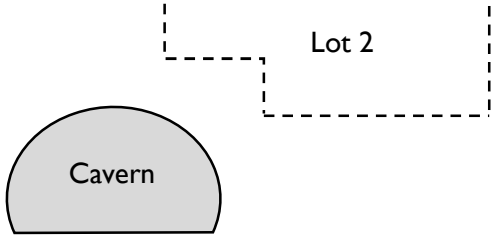
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figure: *5c*

Analysis Group 5 (5d) - Change in Displacement on Cavern Liner



Notes: Deformation are 1000 times exaggerated



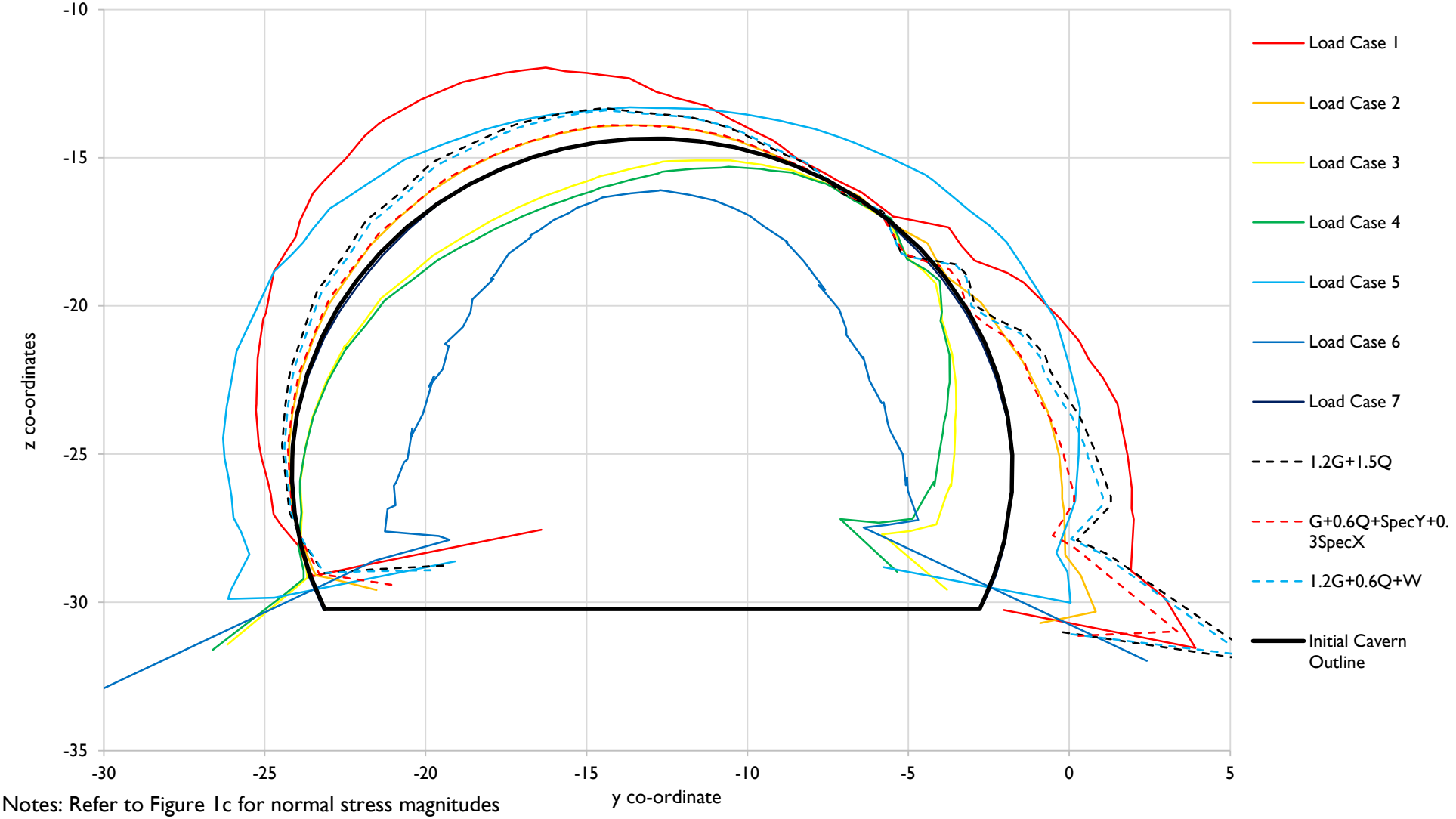
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title:	*Finite Element Outputs*
job no:	B01493-1

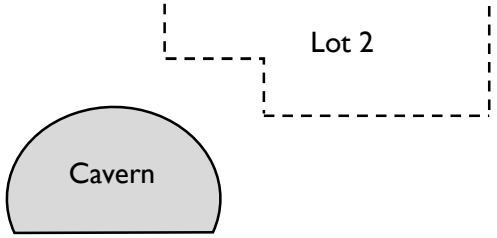
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figure: *5d*

Analysis Group 5 (5e) - Change in Normal Stress on Cavern Liner



Notes: Refer to Figure 1c for normal stress magnitudes

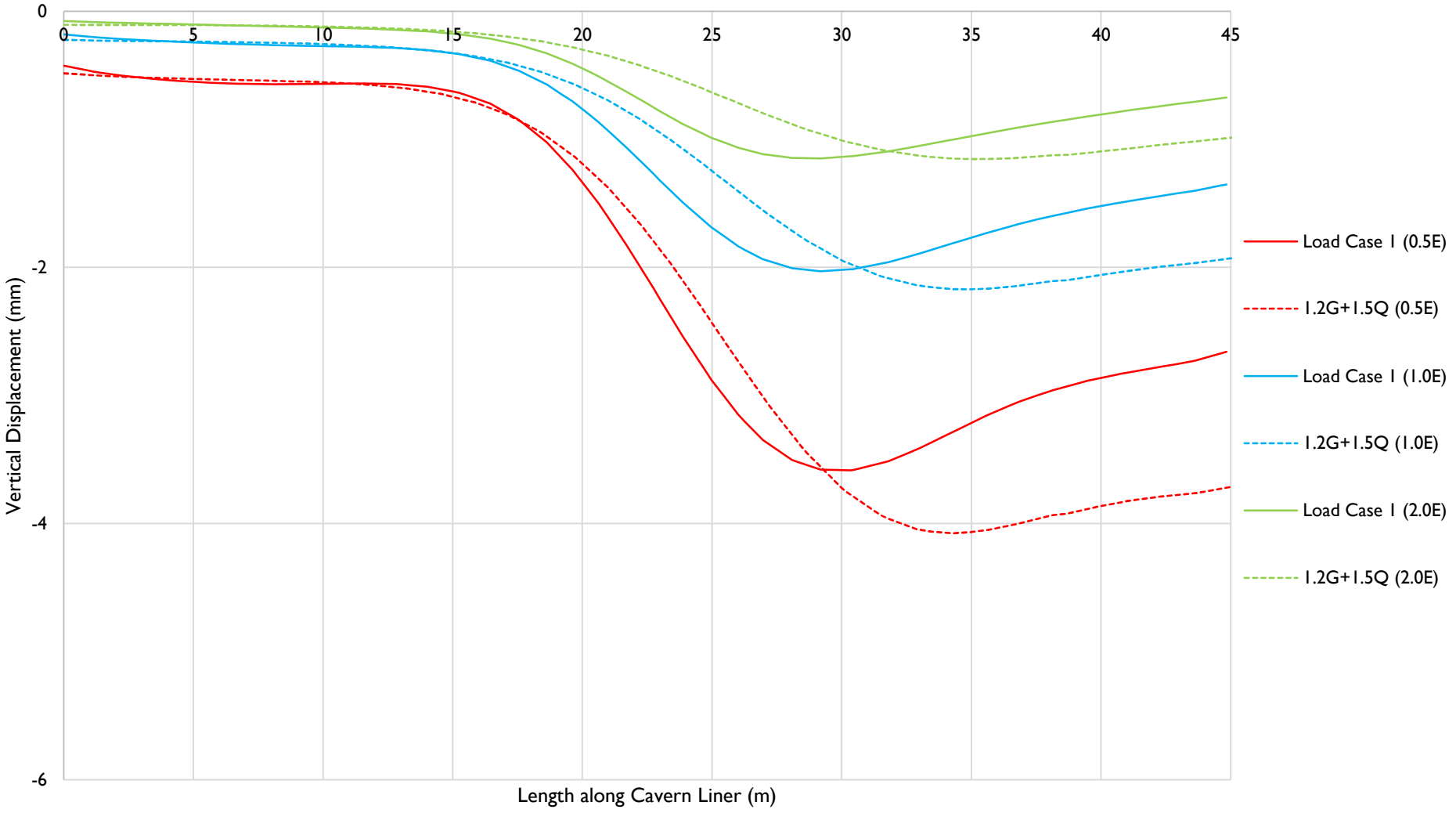


by:	DL	*client:*	RCP
date:	16/07/2024	*project:*	Albert Street Development
approved:	DJC	*location:*	Brisbane
scale:	NTS	*title:*	*Finite Element Outputs*
		job no:	B01493-1

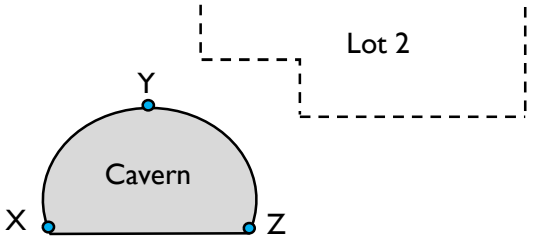
EDG consulting
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figure: 5e

Analysis Group 6 (6a) - Change in Vertical Displacement on Cavern Liner



Point X Point Y Point Z



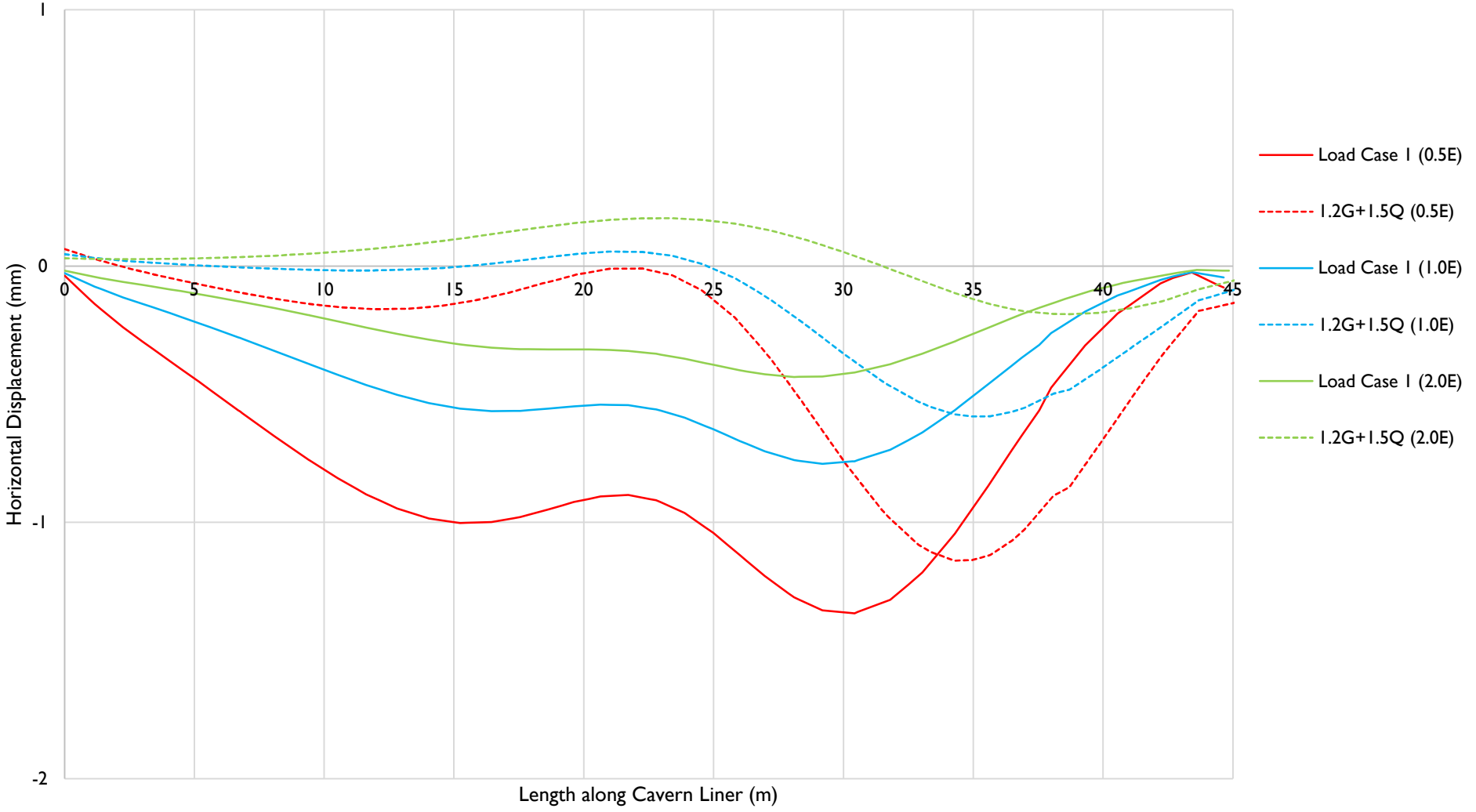
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client:	RCP
project:	Albert Street Development
location:	Brisbane
title:	*Finite Element Outputs*
job no:	B01493-1

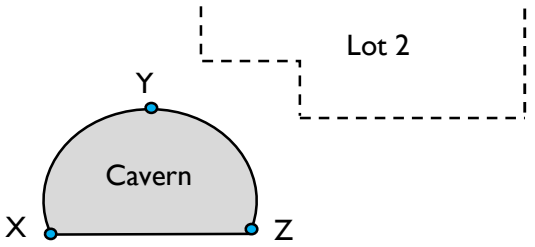
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figure: *6a*

Analysis Group 6 (6b) - Change in Horizontal Displacement on Cavern Liner



Point X Point Y Point Z



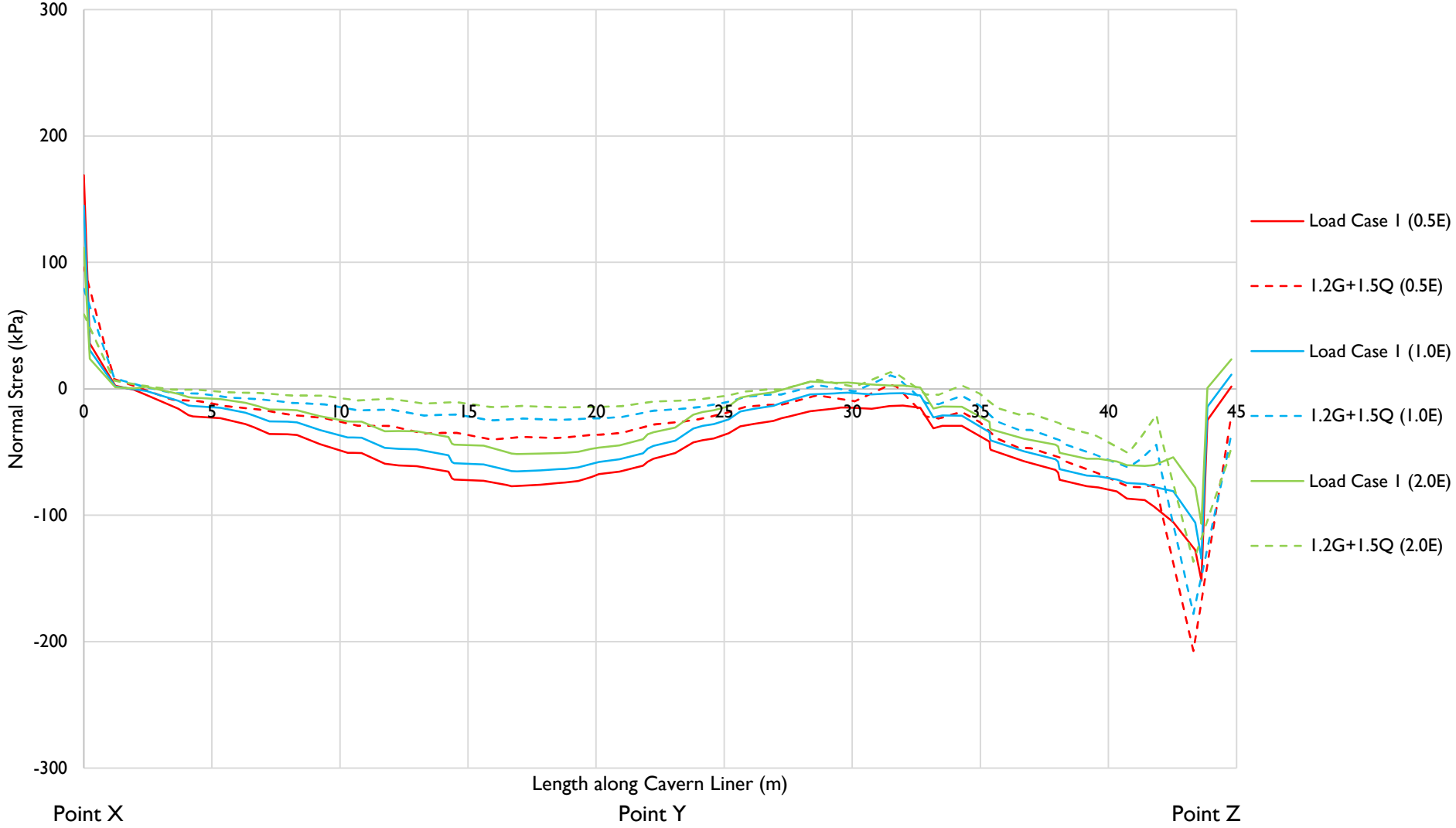
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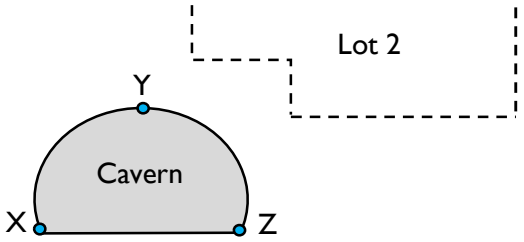
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location:	Brisbane
title:	*Finite Element Outputs*
job no:	B01493-1

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figure: *6b*

Analysis Group 6 (6c) - Change in Normal Stress on Cavern Liner





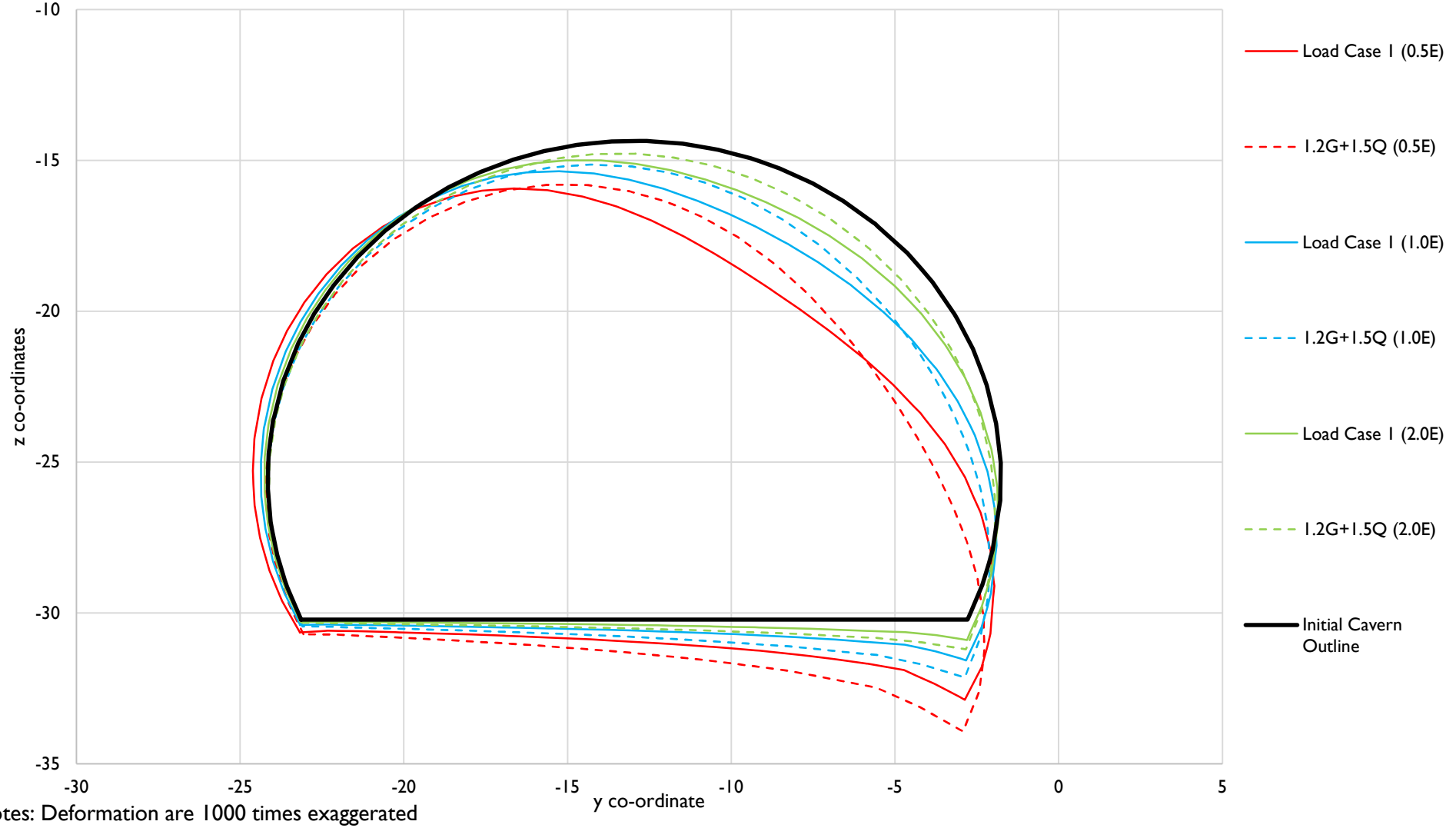
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date:	16/07/2024
approved:	DJC
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client:	RCP
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location:	Brisbane
title:	*Finite Element Outputs*
job no:	B01493-1

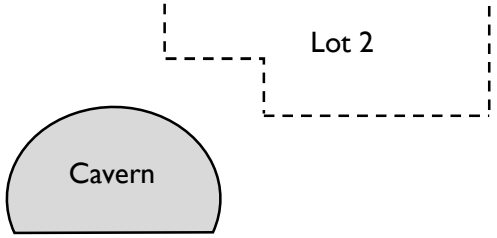
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figure: 6c

Analysis Group 6 (6d) - Change in Displacement on Cavern Liner



Notes: Deformation are 1000 times exaggerated



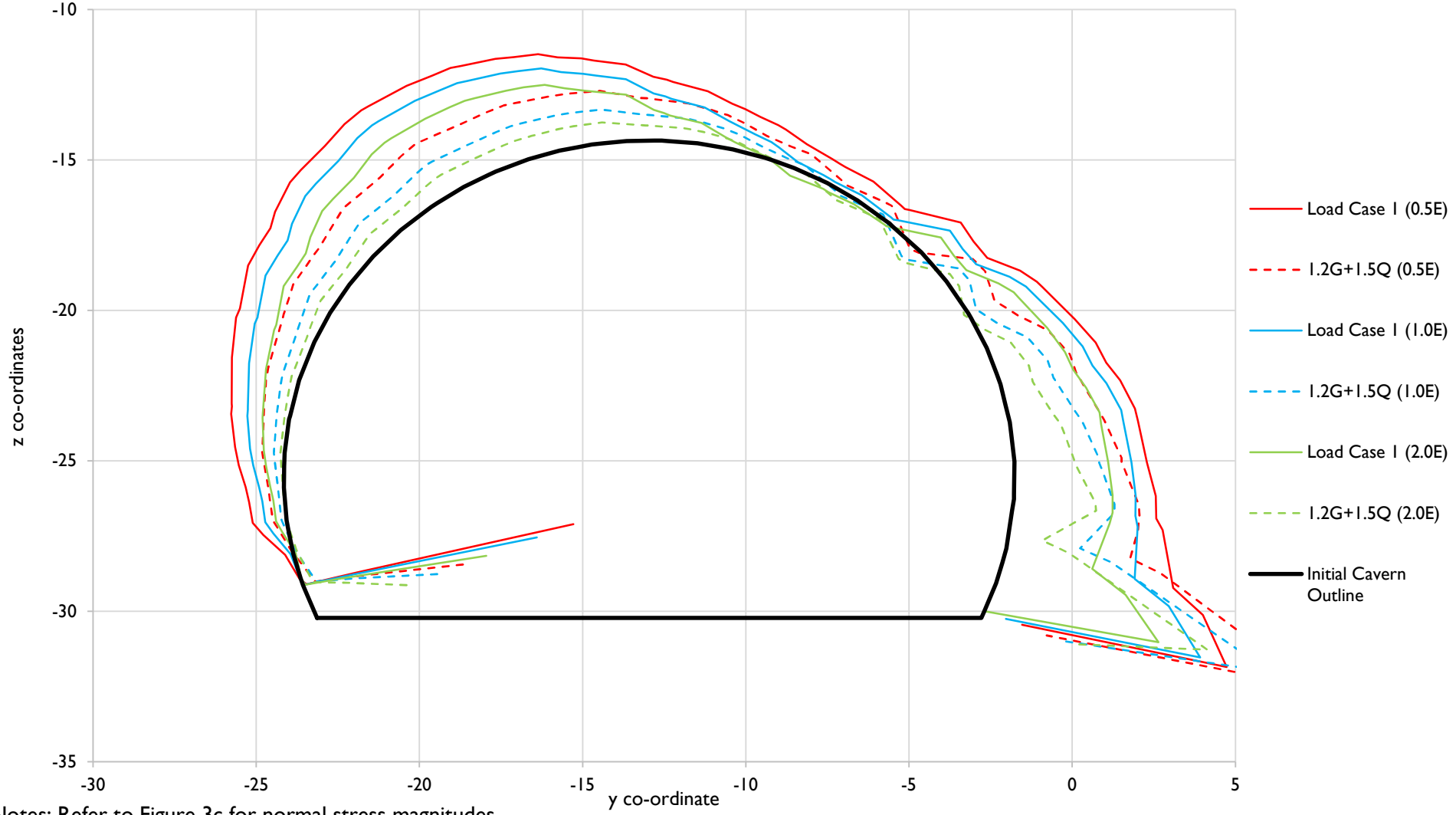
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client:	RCP
project:	Albert Street Development
location:	Brisbane
title:	*Finite Element Outputs*
job no:	B01493-1

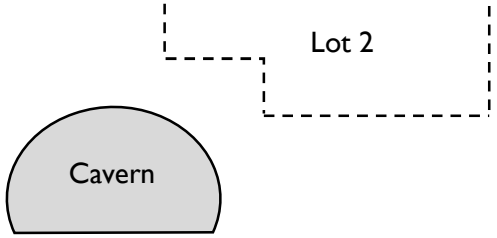
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figure: *6d*

Analysis Group 6 (6e) - Change in Normal Stress on Cavern Liner



Notes: Refer to Figure 3c for normal stress magnitudes



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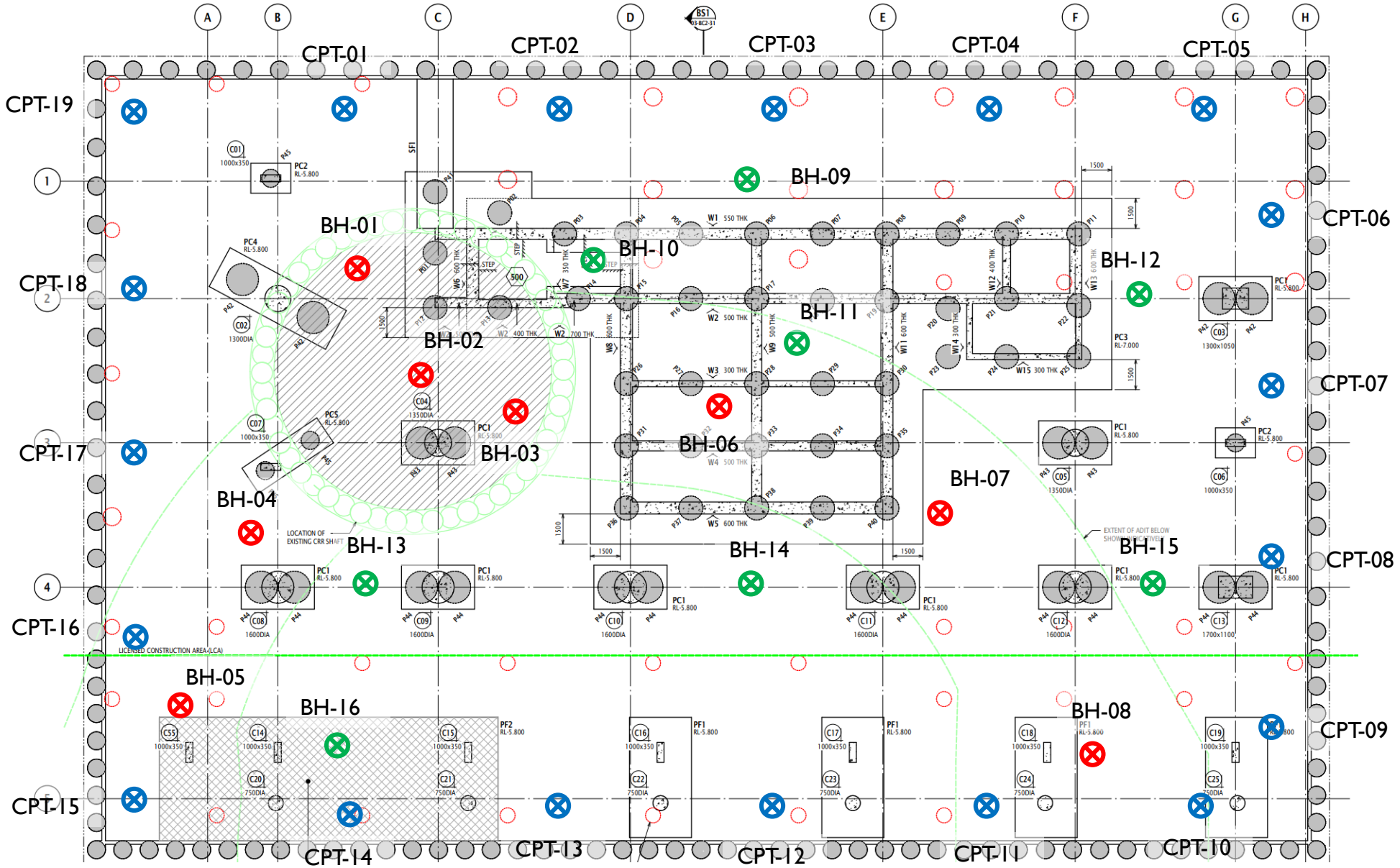
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job no:	B01493-1

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figure: 6e

Appendix N

Preliminary Site Investigation Location Plan



Legend:

- CPTs
- Boreholes for backfill material
- Boreholes for natural material

by:	DL
date:	6/08/2024
approved:	DJC
scale:	As Shown

client:	QIC
project:	Albert Street Development
location:	Brisbane
title:	*Proposed Investigations*
job no:	B01493-1

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TYPSA Group

figure: 1

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C-2 EDG Supplementary Report B01493-1BA_RevB

Albert Street Development - Modulus of Subgrade Reaction
QIC

Geotechnical Correspondence B01493-1BA

Package / Issue:	50% to 80% Design Stage – Modulus of Subgrade Reaction for Raft Options		**Doc Ref:**	B01493-1BA
			Version:	B
Location:	Brisbane, QLD		**Date:**	07 March 2025
Distribution:	Mark Avery, Nicholas Doyle			
Prepared:	Darron Lee	**Reviewed:**	David Cunliffe	
Attachments:	Appendix A – Modulus of Subgrade Reaction and Settlement Markup			
References:	Loads provided by RBG dated 24 June 2024			

1 Background

Robert Bird Group (RBG) has requested updated geotechnical advice relating to the Albert Street development as part of the 50% to 80% design stage. For the raft foundation option, updates associated with modulus of subgrade reaction values were requested. In our assessment, we have considered the arrangement and loads presented in the updated drawings provided by RBG dated 24 June 2024.

2 Basis of Assessment

Our assessment considers the following:

- The raft foundation at the Albert Street side is 1m thick and is founded at RL -8m. Excavate and replace to NFG5 or better material will be undertaken beneath the podium slab footprint.
- The raft foundation for the core side is 2m thick and is founded at RL -9m. Excavate and replace to NFG3 or better material will be undertaken beneath the core footprint.
- We note that part of the raft foundation will be founded on the proposed concrete backfill of the existing shaft structure, which will form a localised 'hard point' beneath the raft foundation. The exact details relating to the backfill material and method of placement are not yet confirmed. In our assessment, we have considered a young's modulus of 24GPa for the concrete backfill (i.e. characteristic compressive strength of 20MPa).

3 Assessment Outcomes

The outcomes of our assessment are shown in Appendix A. In Figure A1, recommended values of modulus of subgrade reaction have been included along with a range of lower and higher stiffness values which should be considered in a sensitivity assessment. In Figure A2 and A3, higher values of modulus of subgrade reaction are provided for cases considering deeper excavate and replace at the areas noted.

In Figure A4, assessed settlements underneath the raft foundations from our finite element assessment are shown. Please note that the settlements shown in Figure A4 considers a load combination of 1.2G + 1.5Q, and the recommended values of modulus of subgrade reaction previously shown in Figure A4. Upon incorporation of the recommended modulus of subgrade reaction values into the structural model, it is recommended that a comparison of the settlement values is undertaken to ensure that the structural model and the geotechnical model has been calibrated appropriately.

We note that the modulus of subgrade reaction values provided in this geotechnical correspondence is based on our current interpretation of the available geotechnical investigations and subject to update following additional geotechnical investigations in later stages of this project.

Please contact either David Cunliffe or the undersigned should you have any questions.

For and on behalf of EDG Consulting Pty Ltd

Darron Lee
Senior Engineer

Ground conditions and the natural environment often present the highest potential risks to project construction and operation. Helping our clients manage their geotechnical risk is fundamental to the role of EDG. We have prepared these notes to assist our clients to understand the information we provide and to help them to manage their risk. Where there is uncertainty about the site, project or geotechnical conditions, contact EDG for assistance.

Scope of Services

The information provided in this document is based on the scope of services defined in the client's agreement with EDG Consulting Pty Ltd (EDG). In undertaking the work, EDG has relied on information provided by the client and other individuals and organisations. Unless stated in the document, EDG has not verified the accuracy of that information and does not accept responsibility for the conclusions, recommendations or designs developed based on that information should it be incorrect, misrepresented or withheld.

Unless specifically stated to the contrary, this document does not cover geo-environmental issues, which require significantly different equipment, techniques and personnel. A geo-environmental specialist should be engaged to provide such advice.

The document is based on specific project details

The information provided in this document is relevant to the subject site and project only. The document has been prepared based on the specific details and requirements of your project and may not be relevant if any changes to the project occur. Should changes occur, must review the report to identify if and how such changes will affect the conclusions, recommendations or designs provided. EDG accepts no responsibility if the client elects not to consult in the event of changes to the project.

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The document is for our client only

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Should you choose to engage an alternative party for advice based on the information in the document, it must be understood that the alternative party will be less familiar with the site conditions and basis of information provided, and there is a potential for misinterpretation. EDG will not be held liable in any way from such misinterpretation.

EDG will not be liable to update or revise the document to take into account information any events or circumstances or facts occurring or becoming apparent after the date of the report.

All site conditions cannot be identified

The scope of work undertaken represents a professional assessment of the information cited to develop a basic geotechnical model of the site based on EDG's understanding of the client's risk profile. In some cases, increasing the frequency of investigations and/or sampling, or considering alternative investigation techniques may improve the interpretation, but may not identify all relevant subsurface conditions at the site.

The document presents an interpretation

Geotechnical information is an interpretation of conditions evident based on a limited number of facts established during a site investigation. Engineering logs are an interpretation of observations of samples and test results at discrete locations in the subsurface profile. A geotechnical model is an interpretation of site conditions, developed using information from discrete locations on the site and an understanding of geological processes. Interpreted conditions at and between investigation locations may be different to those inferred on the engineering logs and geotechnical model. The client must consider how variations in conditions could affect the project and seek advice to reduce risk if it is unacceptable to the client.

Conditions can change

The geotechnical information provided is based on the conditions observed at the time of the investigation. Such conditions may be time dependent and subject to external influences. Many things could influence the site conditions, including geological processes, variation in groundwater or surface water levels, other natural cycles and influence from human activities (on this site or nearby sites). Specific advice should be sought if conditions on site change from those observed at the time the report was prepared.

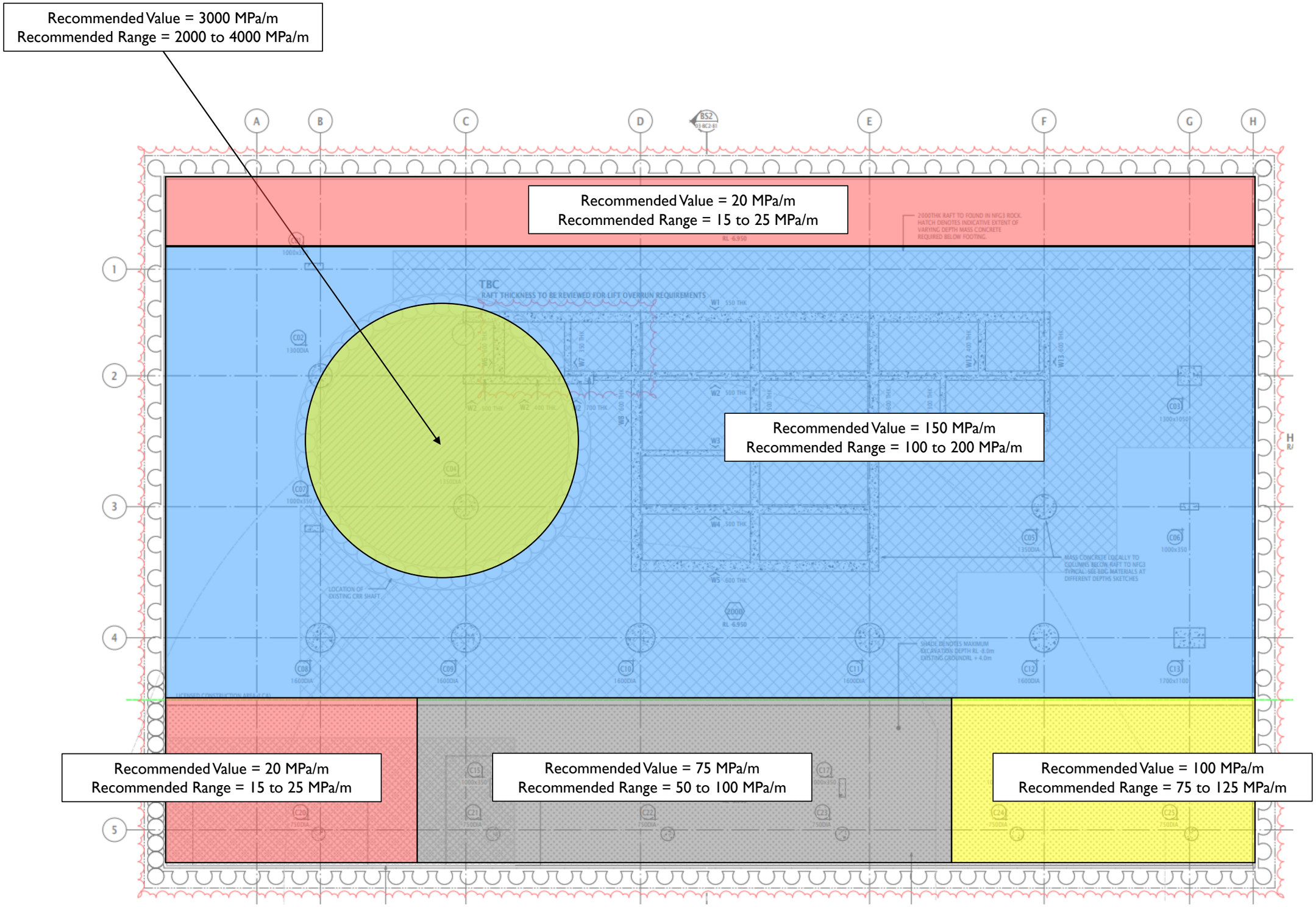
How to deal with different site conditions

The sub-surface conditions on the site may not be as inferred in this report. Geotechnical uncertainties can be managed throughout the project life cycle, but particularly during construction.

Knowledge of site conditions must be further developed as the ground is exposed during construction and/or operation. It is essential that the client implements the nominated design and construction requirements, including observation, interpretation and assessment of the exposed conditions during construction and operation using skilled staff familiar with the design assumptions and assumed geotechnical conditions, or engaging EDG to undertake this role on your behalf.

Appendix A

Modulus of Subgrade Reaction and Settlement Markup

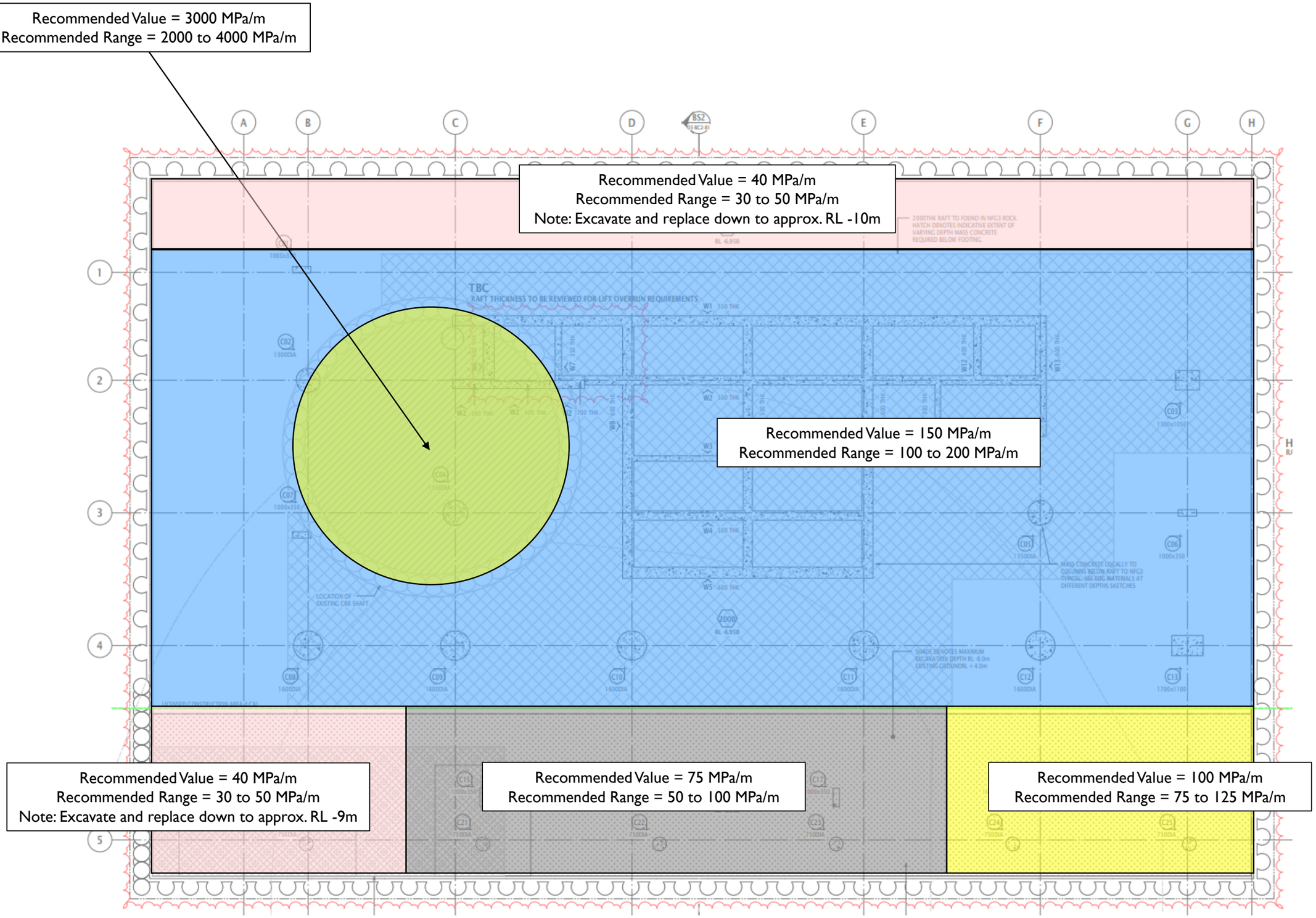


Notes:
- Excavate and replace to NFG5 under podium slab
- Excavate and replace to NFG3 under core slab

by:	DL	*client:*	QIC
date:	07/03/25	*project:*	Albert Street Development
approved:	DJC	*location:*	Albert Street, Brisbane
scale:	NTS	*title:*	*Modulus of Subgrade Reaction*
		job no:	B01493-1

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figure: 1



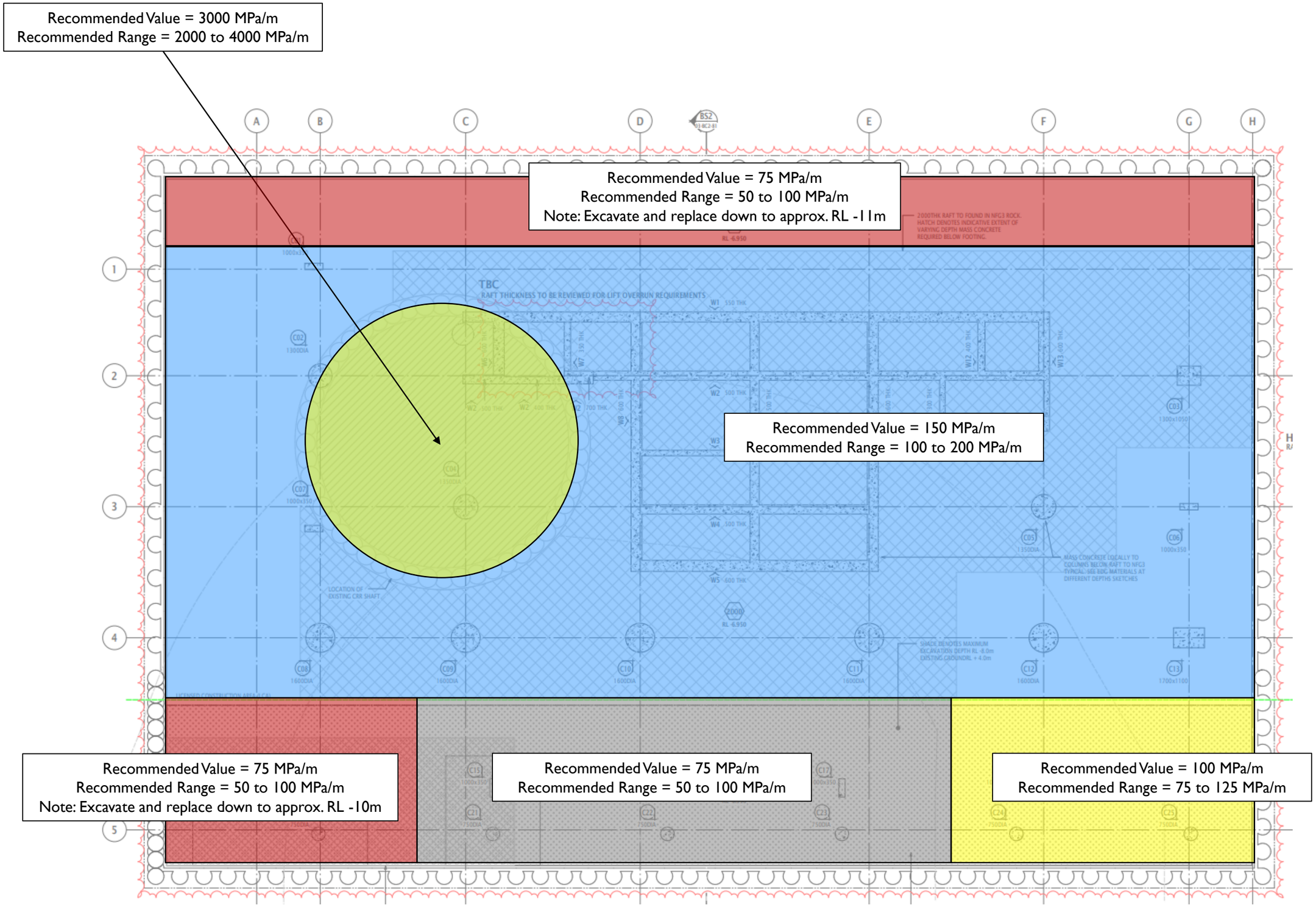
Notes:
- Excavate and replace to NFG5 under podium slab
- Excavate and replace to NFG3 under core slab

by:	DL
date:	07/03/25
approved:	DJC
scale:	NTS

client:	QIC
project:	Albert Street Development
location:	Albert Street, Brisbane
title:	*Modulus of Subgrade Reaction*
job no:	B01493-1

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figure: 2



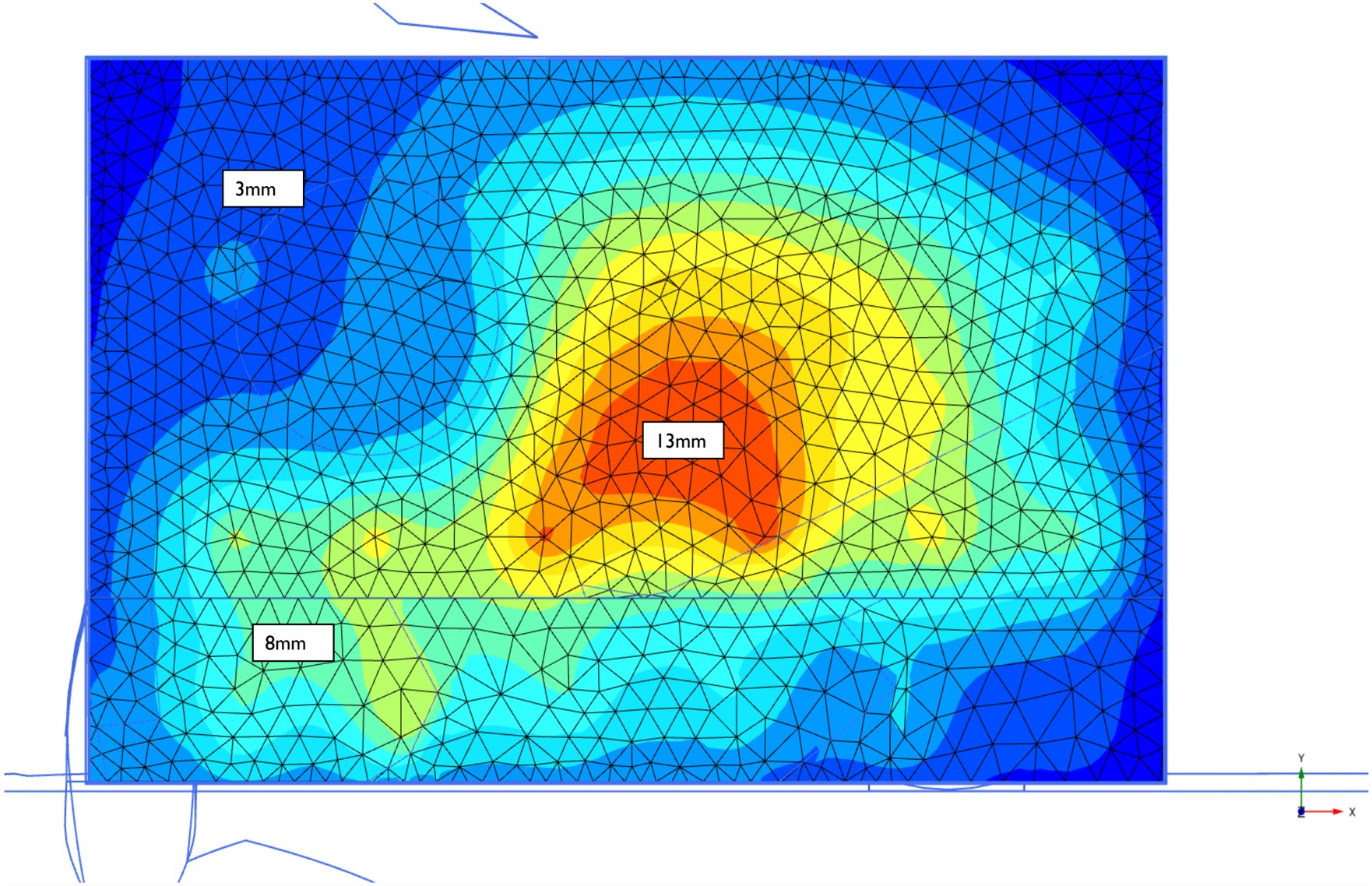
Notes:
- Excavate and replace to NFG5 under podium slab
- Excavate and replace to NFG3 under core slab

by:	DL	*client:*	QIC
date:	07/03/25	*project:*	Albert Street Development
approved:	DJC	*location:*	Albert Street, Brisbane
scale:	NTS	*title:*	*Modulus of Subgrade Reaction*
		job no:	B01493-1

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figure: 3

Output Version 21.1.0.479



Phase displacements Pu_z (scaled up 500 times)

Maximum value = $-2.200*10^{-3}$ m (Element 9972 at Node 1810)

Minimum value = -0.01302 m (Element 9024 at Node 4666)

PLAXIS® 3D CONNECT Edition

Project description		Date
		27/06/2024
Project filename: Raft 80% DD 001	Step: 190	Company: EDG Consulting Pty Ltd

Notes:
- Settlement shown is under 1.2G + 1.5Q load case
- Settlement shown used the recommended values of modulus of subgrade reaction as per Figure A1
- Excavate and replace to NFG5 under podium slab
- Excavate and replace to NFG3 under core slab

by:	DL	*client:*	QIC
date:	07/03/25	*project:*	Albert Street Development
approved:	DJC	*location:*	Albert Street, Brisbane
scale:	NTS	*title:*	*Estimated Settlement*
		job no:	B01493-1

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figure: 4

C-3 EDG Supplementary Report Updated Shoring Pile Spring Stiffness

Piling—Design and installation

3.2.1 General

The footing shall be durable, and of adequate strength, and the footing performance shall be compatible with the superstructure so that it remains serviceable and can perform its intended function.

The design shall take into account, as appropriate, the following:

(a) *Ultimate strength* The limit state at which static equilibrium is lost or at which there is a failure of the supporting ground or structural elements. To be of adequate ultimate strength, the probability of structural or geotechnical failure of the piles shall be acceptably low throughout the intended design life of the structure. The ultimate strength of piles shall be checked for both structural and geotechnical adequacy.

(b) *Serviceability* The limit state at which deformation of the piles will cause damage or loss of serviceability in the structure.

3.3.2 Load combinations for strength design

The load combinations for strength design shall be as follows:

(a) The design actions for ultimate strength design of piles shall be the combination of factored loads that produces the most adverse effect on the pile in accordance with AS/NZS 1170.0.

4.3.1 Design geotechnical strength

A pile shall be proportioned such that the design geotechnical strength ($R_{d,g}$) is not less than the design action effect ($E_{d)}$) as detailed in Clause 3.2.2, that is—

$$R_{d,g} \geq E_d \quad \ldots 4.3.1(1)$$

The design geotechnical strength ($R_{d,g}$) shall be calculated as the design ultimate geotechnical strength ($R_{d,ug}$) multiplied by a geotechnical strength reduction factor (ϕ_g), according to the following equation:

$$R_{d,g} = \phi_g R_{d,ug} \quad \ldots 4.3.1(2)$$

AS 1170

4.2.2 Strength

The basic combinations for the ultimate limit states used in checking strength (see Clause 7.2.2) shall be as follows, where the long-term and combination factors are given in Table 4.1:

(a)	$E_d = [1.35G]$	permanent action only (does not apply to prestressing forces)
(b)	$E_d = [1.2G, 1.5Q]$	permanent and imposed action
(c)	$E_d = [1.2G, 1.5\psi_l Q]$	permanent and long-term imposed action
(d)	$E_d = [1.2G, W_u, \psi_c Q]$	permanent, wind and imposed action
(e)	$E_d = [0.9G, W_u]$	permanent and wind action reversal
(f)	$E_d = [G, E_u, \psi_E Q]$	permanent, earthquake and imposed action
(g)	$E_d = [1.2G, S_u, \psi_c Q]$	permanent action, actions given in Clause 4.2.3 and imposed action

3.3.3 Load combinations for serviceability design

The design actions for serviceability design of piles shall be taken from the appropriate combinations of actions for short-term situations and long-term situations in accordance with this Clause with the actions as given in AS/NZS 1170.0 and including unfactored actions due to any of the ground movements referred to in Clause 3.3.1.2, as appropriate.

Unless otherwise specified, earthquake serviceability actions need not be taken into account.

4.5 GENERAL PRINCIPLES OF GEOTECHNICAL DESIGN FOR SERVICEABILITY

4.5.1 Design actions

The load combinations for serviceability design, as determined from Clause 3.3.3, shall be used for determining pile deflection (settlements, lateral deflections and rotations).

4.5.2 Design criteria

Both a single pile and a pile group shall be designed for serviceability by controlling or limiting pile movements so that deflections do not exceed the deflection limits.

4.5.3 Deflection limits

Limits for the total and differential settlement, lateral deflection and rotation of both a pile and a pile group, subject to axial compression, uplift, lateral, cyclic, dynamic, torsional or other actions, shall be appropriate to the structure and its intended use.

AS 1170

4.3 COMBINATIONS OF ACTIONS FOR SERVICEABILITY LIMIT STATES

Combinations of actions for the serviceability limit states shall be those appropriate for the serviceability condition being considered. Appropriate combinations may include one or a number of the following using the short-term and long-term values given in Table 4.1:

(a) G

(b) $\psi_s Q$

(c) $\psi_l Q$

(d) W_s

(e) E_s

(f) Serviceability values of other actions, as appropriate.

by:	DL	*client:*	QIC
date:	12/06/24	*project:*	Albert Street Development
approved:	DJC	*location:*	Brisbane, QLD
scale:	NTS	*title:*	*AS2159 Design Loads*
		job no:	B01493-1

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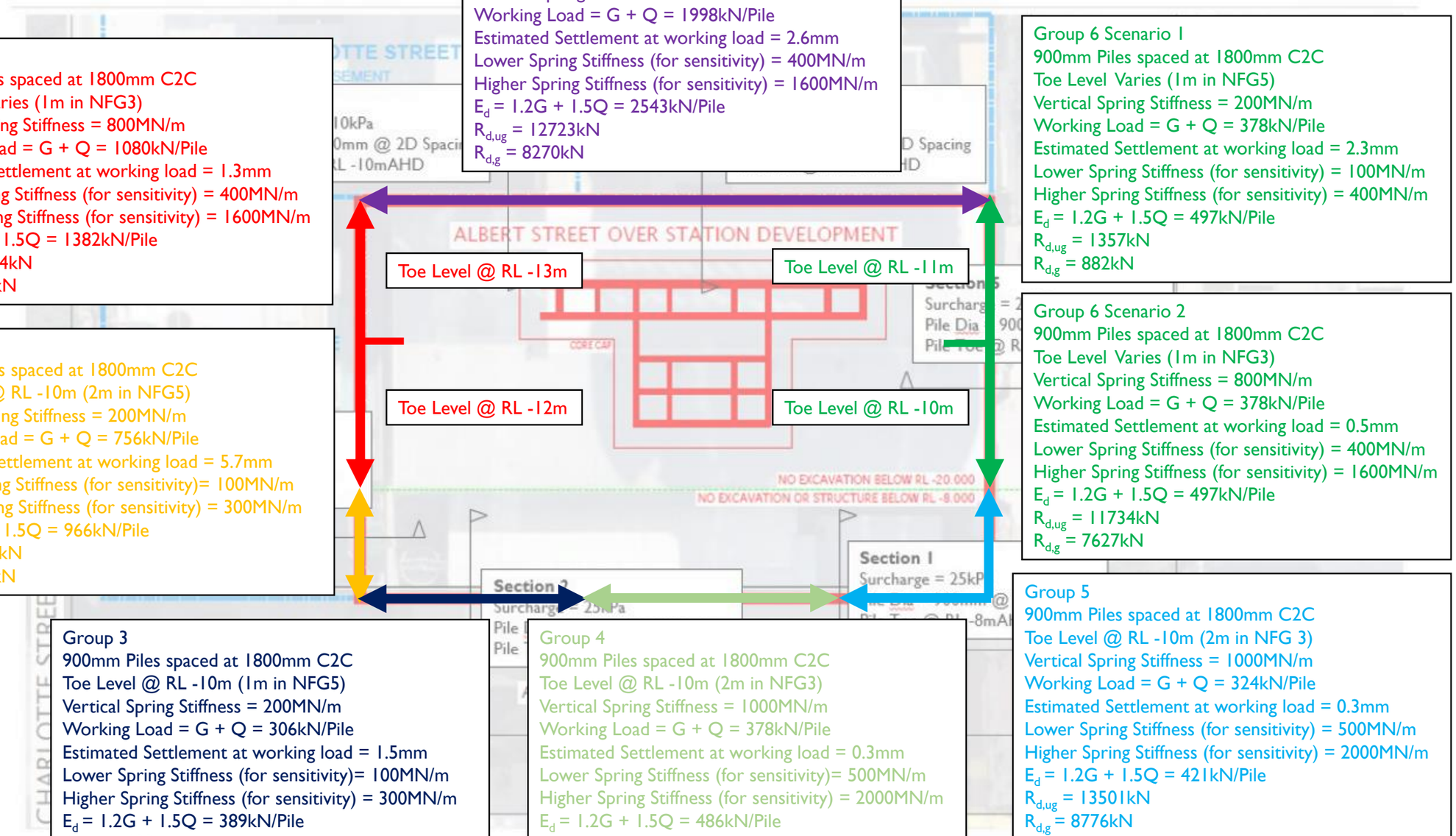
figure: 1

Terminology	Description
$R_{d,ug}$	Design Ultimate Geotechnical Strength
$R_{d,g}$	Design Geotechnical Strength (= $\varphi_g R_{d,ug}$)
φ_g	Geotechnical Strength Reduction Factor
E_d	Design Action Effect

Group 7
900mm Piles spaced at 1800mm C2C
Toe Level @ RL -14m (1m in NFG3)
Vertical Spring Stiffness = 800MN/m
Working Load = G + Q = 1998kN/Pile
Estimated Settlement at working load = 2.6mm
Lower Spring Stiffness (for sensitivity) = 400MN/m
Higher Spring Stiffness (for sensitivity) = 1600MN/m
E_d = 1.2G + 1.5Q = 2543kN/Pile
$R_{d,ug}$ = 12723kN
$R_{d,g}$ = 8270kN

Group 1
900mm Piles spaced at 1800mm C2C
Toe Level Varies (1m in NFG3)
Vertical Spring Stiffness = 800MN/m
Working Load = G + Q = 1080kN/Pile
Estimated Settlement at working load = 1.3mm
Lower Spring Stiffness (for sensitivity) = 400MN/m
Higher Spring Stiffness (for sensitivity) = 1600MN/m
E_d = 1.2G + 1.5Q = 1382kN/Pile
$R_{d,ug}$ = 11734kN
$R_{d,g}$ = 7627kN

Group 6 Scenario 1
900mm Piles spaced at 1800mm C2C
Toe Level Varies (1m in NFG5)
Vertical Spring Stiffness = 200MN/m
Working Load = G + Q = 378kN/Pile
Estimated Settlement at working load = 2.3mm
Lower Spring Stiffness (for sensitivity) = 100MN/m
Higher Spring Stiffness (for sensitivity) = 400MN/m
E_d = 1.2G + 1.5Q = 497kN/Pile
$R_{d,ug}$ = 1357kN
$R_{d,g}$ = 882kN



Group 2
900mm Piles spaced at 1800mm C2C
Toe Level @ RL -10m (2m in NFG5)
Vertical Spring Stiffness = 200MN/m
Working Load = G + Q = 756kN/Pile
Estimated Settlement at working load = 5.7mm
Lower Spring Stiffness (for sensitivity)= 100MN/m
Higher Spring Stiffness (for sensitivity) = 300MN/m
E_d = 1.2G + 1.5Q = 966kN/Pile
$R_{d,ug}$ = 1569kN
$R_{d,g}$ = 1020kN

Group 6 Scenario 2
900mm Piles spaced at 1800mm C2C
Toe Level Varies (1m in NFG3)
Vertical Spring Stiffness = 800MN/m
Working Load = G + Q = 378kN/Pile
Estimated Settlement at working load = 0.5mm
Lower Spring Stiffness (for sensitivity) = 400MN/m
Higher Spring Stiffness (for sensitivity) = 1600MN/m
E_d = 1.2G + 1.5Q = 497kN/Pile
$R_{d,ug}$ = 11734kN
$R_{d,g}$ = 7627kN

Group 3
900mm Piles spaced at 1800mm C2C
Toe Level @ RL -10m (1m in NFG5)
Vertical Spring Stiffness = 200MN/m
Working Load = G + Q = 306kN/Pile
Estimated Settlement at working load = 1.5mm
Lower Spring Stiffness (for sensitivity)= 100MN/m
Higher Spring Stiffness (for sensitivity) = 300MN/m
E_d = 1.2G + 1.5Q = 389kN/Pile
$R_{d,ug}$ = 1499kN
$R_{d,g}$ = 974kN

Group 4
900mm Piles spaced at 1800mm C2C
Toe Level @ RL -10m (2m in NFG3)
Vertical Spring Stiffness = 1000MN/m
Working Load = G + Q = 378kN/Pile
Estimated Settlement at working load = 0.3mm
Lower Spring Stiffness (for sensitivity)= 500MN/m
Higher Spring Stiffness (for sensitivity) = 2000MN/m
E_d = 1.2G + 1.5Q = 486kN/Pile
$R_{d,ug}$ = 13501kN
$R_{d,g}$ = 8776kN

Group 5
900mm Piles spaced at 1800mm C2C
Toe Level @ RL -10m (2m in NFG 3)
Vertical Spring Stiffness = 1000MN/m
Working Load = G + Q = 324kN/Pile
Estimated Settlement at working load = 0.3mm
Lower Spring Stiffness (for sensitivity) = 500MN/m
Higher Spring Stiffness (for sensitivity) = 2000MN/m
E_d = 1.2G + 1.5Q = 421kN/Pile
$R_{d,ug}$ = 13501kN
$R_{d,g}$ = 8776kN

PRELIMINARY

Notes:
- Pile toe levels limited at Albert St side to RL -10m
- Design action effect (E_d) based on loads provided by RBG on 2024-06-05
- $R_{d,g} \geq E_d$
- Φ_g = 0.65

by:	DL	*client:*	QIC
date:	12/06/24	*project:*	Albert Street Development
approved:	DJC	*location:*	Brisbane, QLD
scale:	NTS	*title:*	*Retention Piles Axial Capacity*
		job no:	B01493-1

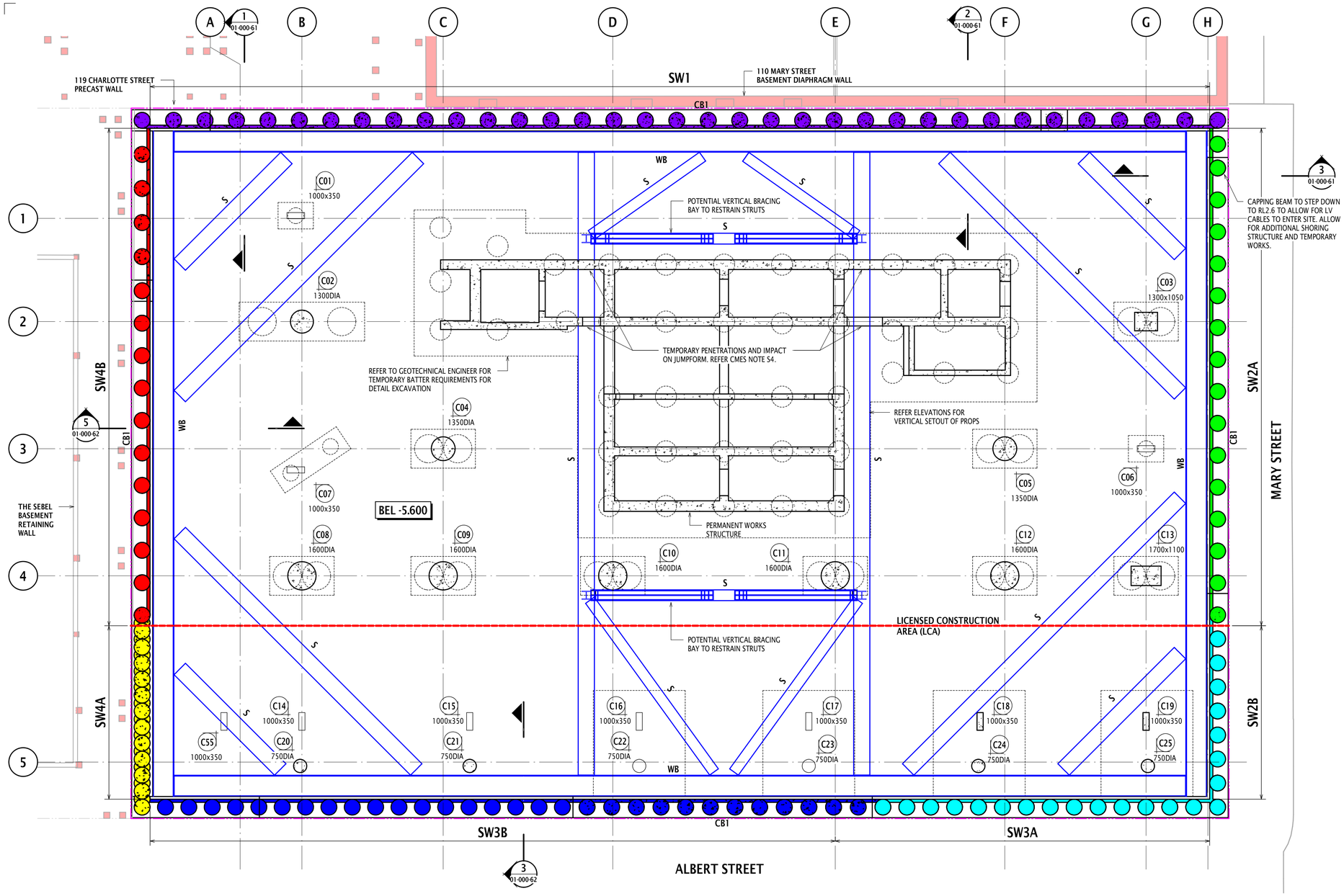
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figure: 2



Appendix D
RBG Proposed Building Loads

Document Number: ALB-RBG-REP-ST-00-000-05
Revision: T01



TEMPORARY SHORING AND RETENTION GENERAL ARRANGEMENT PLAN

SCALE 1 : 125

LEGEND:

BEL ?.???	DENOTES BULK EXCAVATION LEVEL
SW?	DENOTES SHORING WALL NUMBER AND DIRECTION ELEVATION IS VIEWED
BH?	DENOTES APPROX BOREHOLE LOCATION AND APPROXIMATE LEVEL OF LOW STRENGTH ROCK. REFER EDG CONSULTING GEOTECHNICAL REPORT B01493-1AC DATED 16 NOVEMBER 2022.
TAG / SIZE	DENOTES COLUMN NUMBER AND SIZE
S	DENOTES INDICATIVE STRUT. SIZE AND SET-OUT BY SHORING WALL D&C CONTRACTOR AND ENGINEER.
WB	DENOTES INDICATIVE WALER . SIZE AND SET-OUT BY SHORING WALL D&C CONTRACTOR AND ENGINEER.

SHORING & RETENTION SCHEDULE

TYPE	DESCRIPTION	COMMENTS
	REINFORCED 900Ø SOLDIER PILES AT 1800 CTRS + 250 SHOTCRETE	APPROXIMATE TOE LEVEL RL-14.000m OR 1m SOCKET INTO NFG3
	REINFORCED 900Ø SOLDIER PILES AT 1800 CTRS + 250THK SHOTCRETE	APPROXIMATE TOE LEVEL RL-10.000m OR 1m SOCKET INTO NFG3
	REINFORCED 900Ø SOLDIER PILES AT 1800 CTRS + 250THK SHOTCRETE	APPROXIMATE TOE LEVEL RL-8.000m
	REINFORCED 900Ø SOLDIER PILES AT 1350 CTRS + 250THK SHOTCRETE	APPROXIMATE TOE LEVEL RL-8.000m
	REINFORCED 900Ø CONTIGUOUS PILES	APPROXIMATE TOE LEVEL RL-8.000m
	REINFORCED 900Ø SOLDIER PILES AT 1800 CTRS + 250THK SHOTCRETE	APPROXIMATE TOE LEVEL RL-12.500m OR 1m SOCKET INTO NFG3

CAPPING BEAMS SCHEDULE

MARK	DEPTH	WIDTH	REINF RATE kg/m³
CB1	1200	1200	200
CB1	1300	1200	200
CB1	1325	1200	200
CB1	1350	1200	200
CB1	2500	1200	200

CONCRETE NOTES :
-REFER NOTES ON COVER SHEET
-MIN CONC. STRENGTH AT 28 DAYS

LOCATION	f'c
SOLDIER PILE	S50 REFER D&C
SHOTCRETE	S50 REFER D&C
UNDERPINNING	N40 REFER D&C
CAPPING BEAM	N40

-CONCRETE COVER

LOCATION	COVER (mm)
SOLDIER PILE	75
SHOTCRETE	50
UNDERPINNING	75
CAPPING BEAM	50

NOTES:
REFER TO CONCRETE SPECIFICATION FOR MIX TYPES

HOLD
UNDER REVIEW

THE FOLLOWING INFORMATION IS BASED UPON A PARTIALLY HYDROSTATIC BASEMENT STRATEGY WITH HYDROSTATIC WALLS AND DRAINED BASEMENT B2 SLAB. TO BE CONFIRMED BY GEOTECHNICAL AND HYDRAULIC ENGINEERS. REFER SCHEMATIC DESIGN REPORT 22131S-RBG-ZZ-XX-RP-ST-00002 FOR MORE DETAILS. READ BELOW IN CONJUNCTION WITH THE CRR ASSET PROXIMITY PLANS ON DRG ST-01-000-11 & 12

80%DD NOTE:
- THE SHORING WALL SYSTEM AND LEVEL OF WATER RESISTANCE TO BE REVIEWED AGAINST GROUNDWATER CONDITIONS ONCE CONFIRMED. ALTERNATIVE SYSTEMS MAY NEED TO BE INVESTIGATED.
-THE SET-OUT OF SHORING WALL PILES AND CAPPING BEAM TO BE REVIEWED AGAINST NEIGHBORING BUILDING EXTENTS, ACCOUSTIC SHED PILES, OTHER INGROUND STRUCTURE AND PILING RIG CLEARANCES/ACCESS. PILE SIZES AND SET-OUT MAY NEED TO CHANGE TO SUIT. PILING RIG WITH CLOSE WALL APPLICATION CURRENTLY ASSUMED WITH 650mm CLEARANCE FROM BOUNDARY TO CENTER OF PILE.
-SHORING WALL TOE OF PILE LEVELS TO BE REVIEWED AGAINST BOREHOLE RESULTS ONCE COMPLETED.
- HYDRAULIC ENGINEER TO CONFIRM UNDER SLAB DRAINAGE REQUIREMENTS.
- CAPPING BEAM LEVELS SUBJECT TO CONFIRMATION OF GROUND LEVELS AND STRIP DRAIN AND DRAINAGE DESIGN.
- SHORING PILES HAVE BEEN SET-OUT WHERE POSSIBLE TO MINIMISE CLASHES WITH IN-GROUND CRR SUBSTRUCTURE INCLUDING THE TEMPORARY ACCESS SHAFT WALL, ADITS AND ACCOUSTIC SHED PILES.
- COORDINATION WORK IS BASED UPON AVAILABLE CRR INFORMATION AT THE TIME OF THIS DOCUMENT ISSUE. THE LOCATION AND SIZE OF CRR ASSETS ARE INDICATIVE ONLY AND TO BE CONFIRMED.
- NOT ALL EXISTING IN-GROUND STRUCTURE HAS BEEN SHOWN INCLUDING, BUT NOT LIMITED TO TEMPORARY ROCK BOLTS AND ANCHORS. SHORING PILES HAVE NOT BEEN POSITIONED TO MISS ROCK BOLTS AND ANCHORS AND THEREFORE THE CONTRACTOR IS TO MAKE ALLOWANCE FOR DRILLING THROUGH EXISTING IN-GROUND STRUCTURE

PRINT DRAWINGS IN COLOUR

NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE FOLLOWING:
   a. SHORING & RETENTION WALL, TEMPORARY STRUT AND WALER, PILING NOTES ON DRG ST-00-000-12.
   b. SITE PLAN, LOADS AND NOTES ON DRG ST-01-000-01.
   c. CRR ASSET PROXIMITY PLANS ON DRG ST-01-000-11 & 12.
   d. GENERAL ARRANGEMENT PLANS ON DRG SERIES ST-08.
   e. REINFORCEMENT QUANTITY NOTES ON DRG ST-00-000-12.
   f. TYPICAL SHORING WALL DETAILS ON DRG ST-00-001-01.
2. THE SHORING AND RETENTION WALL IS PROPOSED TO BE TYPICALLY 900mm DIAMETER SOLDIER AND CONTIGUOUS PILES AND 250mm THICK SHOTCRETE INFILL PANELS. REFER SHORING & RETENTION SCHEDULE. TO BE CONFIRMED BY SHORING WALL D&C CONTRACTOR AND ENGINEER.
3. TEMPORARY SUPPORT TO THE SHORING AND RETETNION WALL IS PROPOSED VIA TWO LAYERS OF TEMPORARY INTERNAL STEELWORK STRUTS AND WALER BEAMS ARE PROPOSED TO PROP THE SHORING WALL DUE TO THE SITE CONSTRAINTS AND ADJACENT EXISTING STRUCTURES AS DESCRIBED BELOW:
   - **110 MARY ST** -3 LEVELS OF BASEMENTS WITH DIAPHRAGM WALL BLOCK ALL ANCHORS
   - **THE SEBEL** - 1 BASEMENT SUPPORTED ON DRIVEN PILES. TEMPORARY ANCHORS WOULD NEED TO BE COORDINATED TO MISS THE SEBEL INGROUND STRUCTURE.
   - **ALBERT ST** - CRR LCA AND EXISTING SERVICES BELOW THE STREET LIMIT ZONES FOR TEMPORARY ANCHORS.
   - **MARY ST** - EXISTING SERVICES BELOW THE STREET LIMIT ZONES FOR TEMPORARY ANCHORS.

   THE 101 ALBERT STREET BASEMENT EXCAVATION SHALL NOT IMAPCT ON THE NEIGHBORING BASEMENT DESIGN, CONDITION AND LOADING. INTRODUCTION OF OUT OF BALANCE LOADS TO THESE BASEMENTS IS TO BE AVOIDED.
4. THE SHORING AND RETENTION WALL, TEMPORARY STRUTS AND WALERS TO BE DESIGNED FOR THE CRITERIA SET OUT WITHIN THE RBG MOVEMENT AND TOLERANCE REPORT.
5. THE TEMPORARY STRUTS AND WALERS SHOWN ARE INDICATIVE ONLY AND REFLECT A POTENTIAL CONCEPT THAT HAS BEEN USED FOR THE DOCUMENTED SHORING WALL DESIGN. THE FINAL DESIGN AND SET-OUT TO BE CONFIRMED BY SHORING WALL D&C CONTRACTOR AND ENGINEER.
6. THE TEMPORARY STRUTS AND WALERS DESIGN TO CONSIDER THE FOLLOWING:
   - TEMPERATURE EFFECTS AND/OR EXTERNALLY INSULATED TO REDUCE THERMAL EFFECTS.
   - IMPACTS TO THE JUMPFORM AND FORMWORK, EXTENT/BUILD REQUIREMENTS INCLUDING WHETHER A TOP-DOWN METHODOLOGY IS ADOPTED NOTING STRUTS WILL NEED TO BE COORDINATED AROUND ANY BORED PIERS INSTALLED FROM EXISTING GROUND LEVEL, AND OTHER CONSTRUCTION RELATED ITEMS. CURRENTLY STRUTS ARE ONLY COORDINATED AROUND COLUMNS.
   - GROUNDWATER AND FLOOD LEVELS AS NOTED ON THE SITE PLAN. SENSITIVITY CASES SHALL BE CONSIDERED INCLUDING NO GROUND WATER, PARTIAL GROUNDWATER AND ASYMMETRIC GROUNDWATER.
   - THE GEOTECHNICAL ENGINEER IS TO ADVISE THE DEGREE OF PRE-LOADING FOR THE TEMPORARY STRUTS TO ACHIEVE THE DESIGN CRITERIA REQUIREMENTS.
7. ALL TEMPORARY STRUT AND WALER CONNECTIONS INCLUDING CONNECTIONS TO THE SHORING WALL TO BE DESIGNED BY THE SHORING WALL D&C CONTRACTOR AND ENGINEER.
8. ALL DEAD AND LIVE LOADS SHOWN ARE WORKING LOADS. ALL WIND AND EARTHQUAKE LOADS SHOWN ARE ULTIMATE LOADS. REFER LOAD LEGEND ON DRAWING ST-01-000-41.
9. ADDITIONAL TEMPORARY SHORING MAYBE REQUIRED TO CONSTRUCT THE LOWER CAPPING BEAM AT THE LV CABLE ENTRY POINT OFF MARY STREET. THIS MAY REQUIRED A THICKER SHORING ZONE FOR A LOCAL EXTENT OF THE SHORING WALL. TO BE CONFIMRED BY CONTRACTOR.
10. REFER TO ROBERT BIRD GROUP CIVIL ENGINEER BUILK EARTHWORKS LAYOUT PLAN FOR DETAILS.

Rev	Revision Description	By	App	Date
A01	50% DD ISSUE	SV	MA	09.08.23
P01	DRAFT 50% DESIGN DEVELOPMENT	SV	MA	28.07.23

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REFER TO GENERAL NOTES UNLESS NOTED OTHERWISE

Structural, Civil & Construction
Engineering Consultant

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ACN 010 580 248

Client
QIC

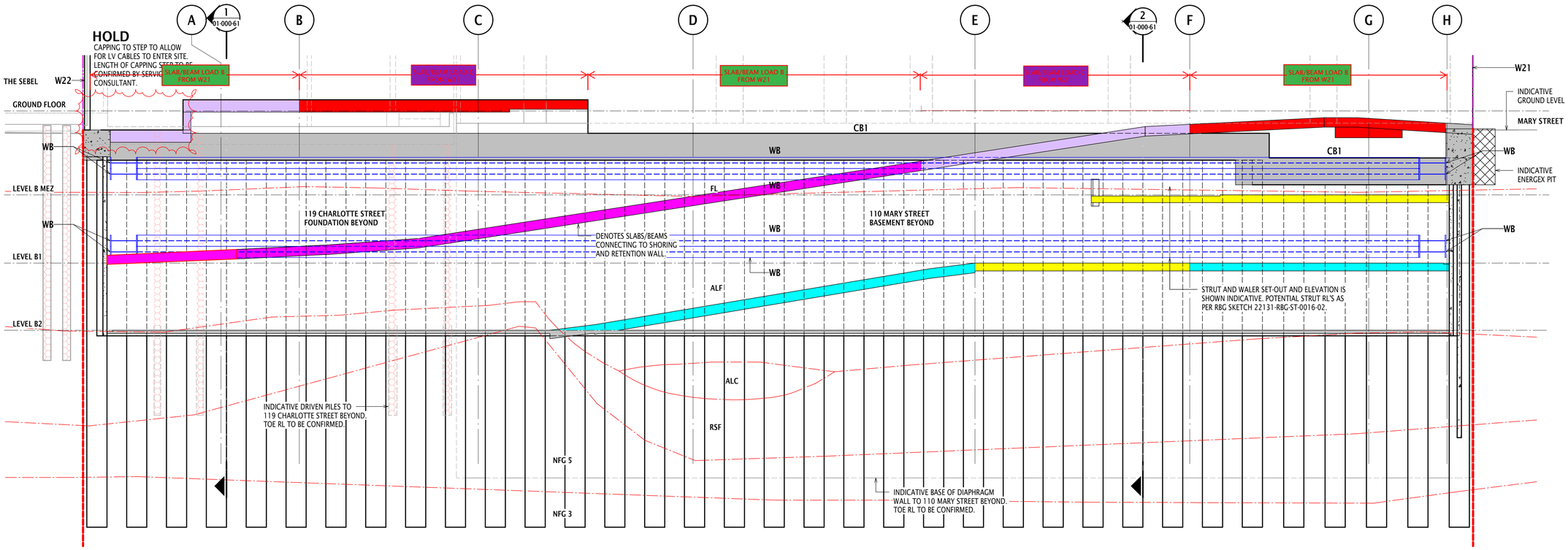
Project
101 ALBERT STREET, BRISBANE

Title
TEMPORARY SHORING AND RETENTION GENERAL ARRANGEMENT PLAN

Date	Drawn
Jul 2023	S.VINEY
Scale at A1	Designer
1:125	M.AVERY
	Design Checker
	-
Job Number	Approved
22131S	-

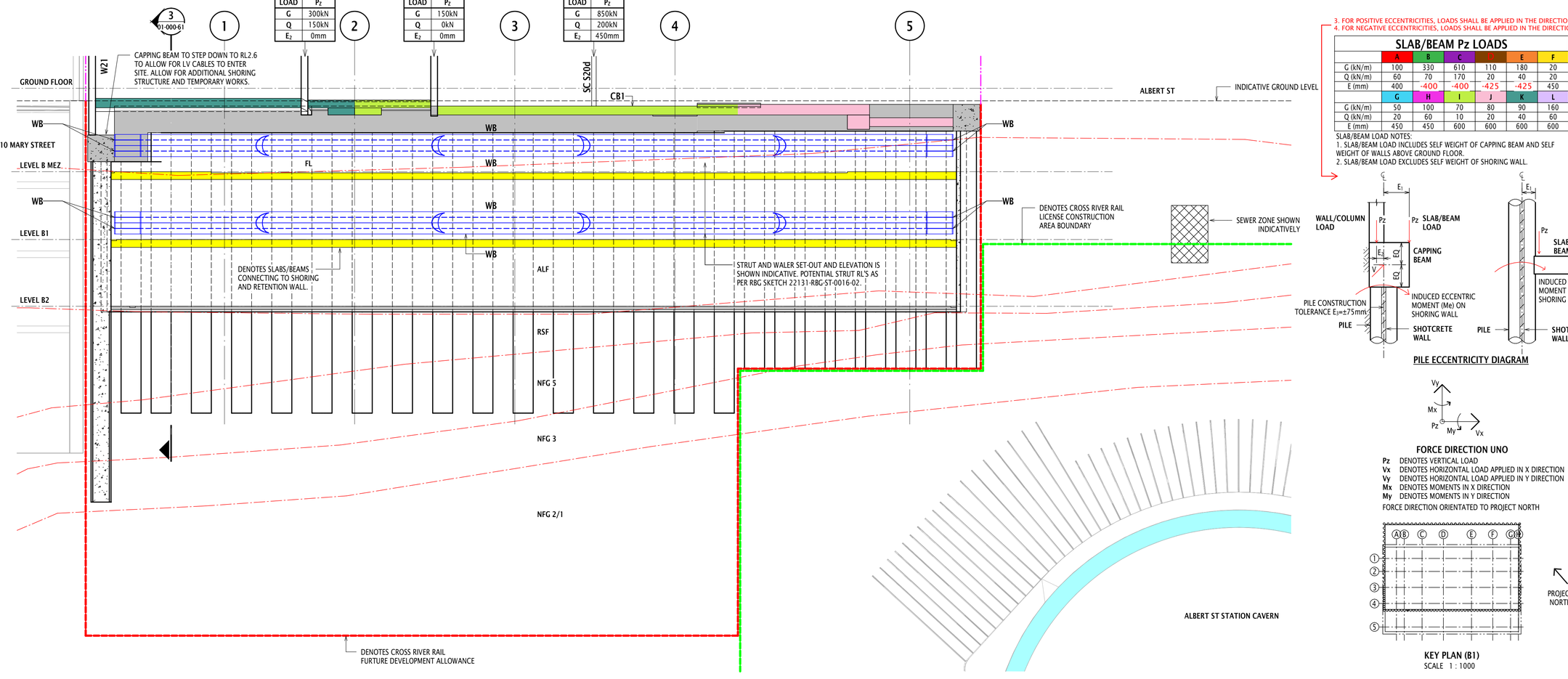
NOT FOR CONSTRUCTION

Drawing Number	Revision
ALB-RBG-DWG-ST-01-000-21	A01



SW1 - SHORING WALL ELEVATION

SCALE 1 : 100



SW2 - SHORING WALL ELEVATION

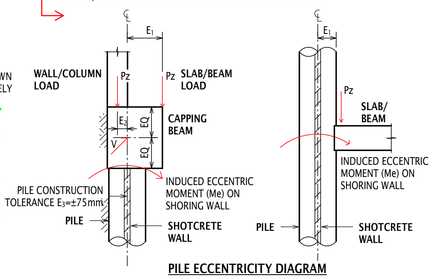
SCALE 1 : 100

3. FOR POSITIVE ECCENTRICITIES, LOADS SHALL BE APPLIED IN THE DIRECTION OF "E1".
4. FOR NEGATIVE ECCENTRICITIES, LOADS SHALL BE APPLIED IN THE DIRECTION OF "E2".

SLAB/BEAM Pz LOADS

	A	B	C	D	E	F
G (kN/m)	100	330	610	110	180	20
Q (kN/m)	60	70	170	20	40	20
E (mm)	400	-400	-400	-425	-425	450
	G	H	I	J	K	L
G (kN/m)	50	100	70	80	90	160
Q (kN/m)	20	60	10	20	40	60
E (mm)	450	450	600	600	600	600

SLAB/BEAM LOAD NOTES:
1. SLAB/BEAM LOAD INCLUDES SELF WEIGHT OF CAPPING BEAM AND SELF WEIGHT OF WALLS ABOVE GROUND FLOOR.
2. SLAB/BEAM LOAD EXCLUDES SELF WEIGHT OF SHORING WALL.



PILE ECCENTRICITY DIAGRAM

FORCE DIRECTION UNO

Pz DENOTES VERTICAL LOAD
Vx DENOTES HORIZONTAL LOAD APPLIED IN X DIRECTION
Vy DENOTES HORIZONTAL LOAD APPLIED IN Y DIRECTION
Mx DENOTES MOMENTS IN X DIRECTION
My DENOTES MOMENTS IN Y DIRECTION

FORCE DIRECTION ORIENTATED TO PROJECT NORTH

KEY PLAN (B1)
SCALE 1 : 1000

PRINT DRAWINGS IN COLOUR

NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE FOLLOWING:
- SITE PLAN, LOADS AND NOTES ON DRG ST-01-000-01.
- CRR ASSET PROXIMITY PLANS ON DRG ST-01-000-11 & 12.
- TEMPORARY SHORING AND RETENTION GENERAL ARRANGEMENT PLAN ON DRG ST-01-000-21.
2. PILE DESIGN SHALL BE BASED ON ZERO FIXITY BETWEEN PILES AND SLABS/BEAMS AND ALLOW FOR MOMENTS DUE TO ECCENTRICITY OF ALL APPLIED LOADS.
3. DESIGN ACTIONS ARE TO BE COMBINED IN ACCORDANCE WITH AS1170.0 TO PRODUCE THE MOST ADVERSE EFFECT.
4. DEAD, LIVE, WATER AND SOIL LOADS ARE PROVIDED UNFACTORED. SEISMIC AND WIND LOADS ARE PROVIDED AT ULTIMATE.
5. SEISMIC AND WIND LOADS ARE FULLY REVERSIBLE.
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7. REFER TO ROBERT BIRD GROUP CIVIL ENGINEER BULK EARTHWORKS LAYOUT PLAN DRAWING CW8201 FOR DETAILS.
8. REFER ARCHITECTS FOR FINISHED GROUND LEVELS.

GEOTECHNICAL GROUND PROFILES NOTES:

1. GEOTECHNICAL PROFILES ARE TAKEN FROM EDG GEOTECHNICAL REPORTS NOTED ON DRG ST-00-000-11.
2. SOIL/ROCK PROFILES INDICATED ON THESE DRAWINGS ARE AN APPROXIMATION ONLY BASED ON INTERPOLATION BETWEEN BOREHOLE SOIL/ROCK LEVELS TAKEN AROUND THE SITE AS PER NOTE 1. ACTUAL ROCK LEVELS ON SITE ARE EXPECTED TO VARY.
3. SOIL/ROCK PROFILES MUST BE CONFIRMED PRIOR TO CONSTRUCTION WITH SITE SPECIFIC BOREHOLES WHICH ARE TO BE SUBMITTED TO THE DESIGNER AND BASE ENGINEER ROBERT BIRD GROUP FOR VERIFICATION OF DESIGN.
4. PILE TOE RL AND ROCK BOLT LENGTHS TO BE CONFIRMED ONCE GEOTECHNICAL ENGINEERS SUBMIT TO ROBERT BIRD GROUP ACTUAL SOIL/ROCK PROFILE RL'S WHEN GEOTECHNICAL MAPPING OCCURS AS CONSTRUCTION EXCAVATION PROCEEDS.

Rev	Revision Description	By	App	Date
A01	50% DD ISSUE	SV	MA	09.08.23
P01	DRAFT 50% DESIGN DEVELOPMENT	SV	MA	28.07.23

SCALE 1 2 3 4 5 6 7 8

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REFER TO GENERAL NOTES UNLESS NOTED OTHERWISE

Structural, Civil & Construction Engineering Consultant

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Member of the Surbana Jurong Group

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Client
QIC

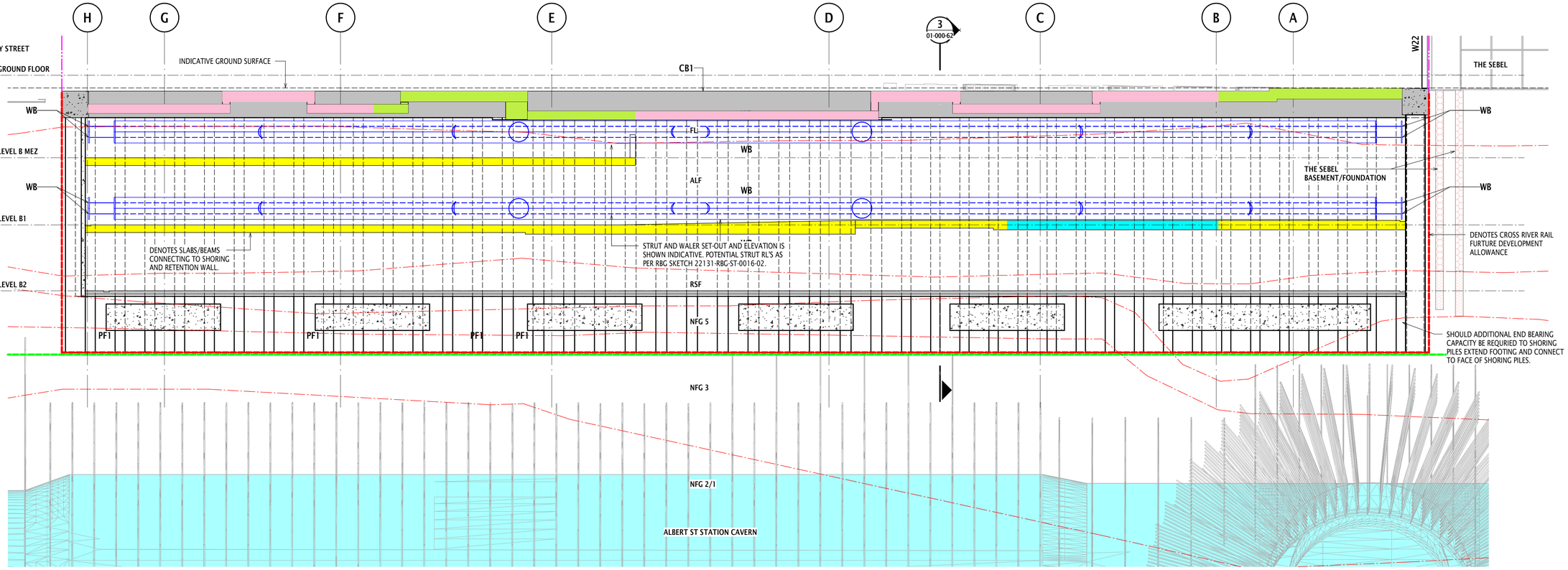
Project
101 ALBERT STREET, BRISBANE

Title
SHORING ELEVATIONS
SHEET 1

Date	Drawn
Jul 2023	S.VINEY
Scale at A1	Designer
1:100	M.AVERY
	Design Checker
	-
Job Number	Approved
22131S	-

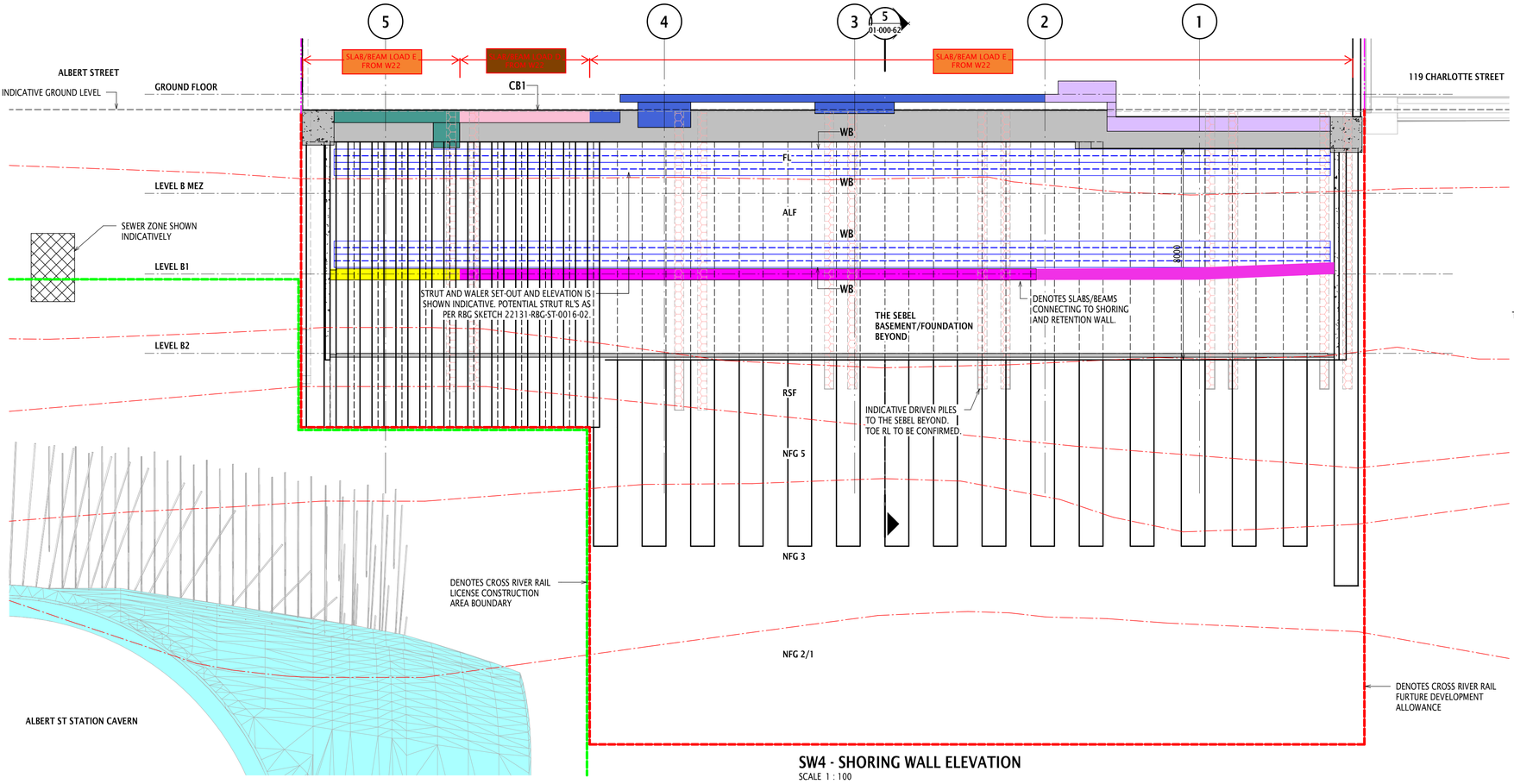
NOT FOR CONSTRUCTION

Drawing Number	Revision
ALB-RBG-DWG-ST-01-000-41	A01



SW3 - SHORING WALL ELEVATION

SCALE 1 : 100



SW4 - SHORING WALL ELEVATION

SCALE 1 : 100

PRINT DRAWINGS IN COLOUR

NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE FOLLOWING:
   - SITE PLAN, LOADS AND NOTES ON DRG ST-01-000-01.
   - CRR ASSET PROXIMITY PLANS ON DRG ST-01-000-11 & 12.
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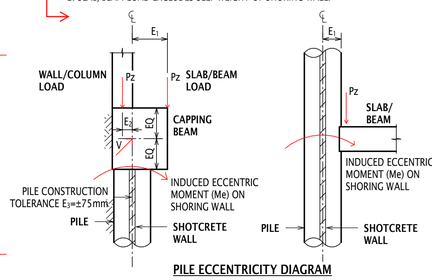
3. FOR POSITIVE ECCENTRICITIES, LOADS SHALL BE APPLIED IN THE DIRECTION OF "E1".
4. FOR NEGATIVE ECCENTRICITIES, LOADS SHALL BE APPLIED IN THE DIRECTION OF "E2".

SLAB/BEAM Pz LOADS

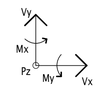
	A	B	C	D	E	F
G (kN/m)	100	330	610	110	180	20
Q (kN/m)	60	70	170	20	40	20
E (mm)	400	-400	-400	-425	-425	450

	G	H	I	J	K	L	M
G (kN/m)	50	100	70	80	90	160	110
Q (kN/m)	20	60	10	20	40	60	20
E (mm)	450	450	600	600	600	600	425

SLAB/BEAM LOAD NOTES:
1. SLAB/BEAM LOAD INCLUDES SELF WEIGHT OF CAPPING BEAM AND SELF WEIGHT OF WALLS ABOVE GROUND FLOOR.
2. SLAB/BEAM LOAD EXCLUDES SELF WEIGHT OF SHORING WALL.



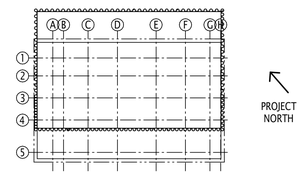
PILE ECCENTRICITY DIAGRAM



FORCE DIRECTION UNO

- **Pz** DENOTES VERTICAL LOAD
- **Vx** DENOTES HORIZONTAL LOAD APPLIED IN X DIRECTION
- **Vy** DENOTES HORIZONTAL LOAD APPLIED IN Y DIRECTION
- **Mx** DENOTES MOMENTS IN X DIRECTION
- **My** DENOTES MOMENTS IN Y DIRECTION

FORCE DIRECTION ORIENTATED TO PROJECT NORTH



KEY PLAN (B1)

SCALE 1 : 1000

Rev	Revision Description	By	App	Date
A01	50% DD ISSUE	SV	MA	09.08.23
P01	DRAFT 50% DESIGN DEVELOPMENT	SV	MA	28.07.23

SCALE 1 2 3 4 5 6 7 8

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Structural, Civil & Construction
Engineering Consultant

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ACN 010 580 248

Client
QIC

Project
101 ALBERT STREET, BRISBANE

Title
SHORING ELEVATIONS
SHEET 2

Date
Jul 2023
Scale at A1
1:100
Drawn
S.VINEY
Designer
M.AVERY
Design Checker
-
Job Number
22131S
Approved
-

NOT FOR CONSTRUCTION

Drawing Number
ALB-RBG-DWG-ST-01-000-42
Revision
A01

Thomas Katunar

From: Nicholas Doyle
Sent: Monday, June 24, 2024 9:22 PM
To: Darron Lee; Mark Avery
Cc: David Cunliffe; Thomas Katunar
Subject: RE: B01493-1AW and B01493-1AX
Attachments: 240624 Shoring Pile Lateral Loads.xlsm; 240624 Core Pile Loads.xlsm; 240624 Foundation Reference Plan.pdf

Darron,

Please find attached updated Shoring Pile and Core Pile loads based on the latest information provided in your reports. I wasn't sure what the best format to give you the information is, but I've given you the (x,y) coordinates of each pile in our model as well as a reference to what/where the pile is. Shoring wall piles are roughly at 1,800 crs but I had to shift them here or there a bit to suit the mesh of the walls in our ETABS model.

Column loads and shoring wall gravity loads (G and Q) have been provided previously/separately by Mark or Thomas and these are still in play. The attached just closes out the rest of the information required which is lateral case loads for the shoring walls, and all the loads for the core piles.

Now that we're into the detail it's definitely time to do away with the random combination we had previously and use something real. On the 3rd page of the pdf I've included all of the structural load combinations. You'll also notice we now have a lot of wind combinations as we've not got the information from the wind consultant in the ETABS model rather than relying on code wind. Hopefully to assist you in understanding what the different load cases from RWDI mean I've included a plot on the 3rd page of the pdf showing the base shear for each combination. There are some combinations you can probably ignore to cut down runtime of your model.

No doubt you'll have questions so give myself or Mark a call if needed.

Regards,
Nick

Nicholas Doyle
ASSOCIATE

Level 8, Jubilee Place
470 St Pauls Terrace, Fortitude Valley, Qld, 4006, Australia
Phone: 07 3319 2777
Website: www.robertbird.com

RobertBirdGroup
Member of the Surbana Jurong Group

In the spirit of reconciliation Robert Bird Group acknowledges the Traditional Custodians of Country throughout Australia and their connections to land, sea and community. We pay our respect to their Elders past and present and extend that respect to all Aboriginal and Torres Strait Islander peoples.

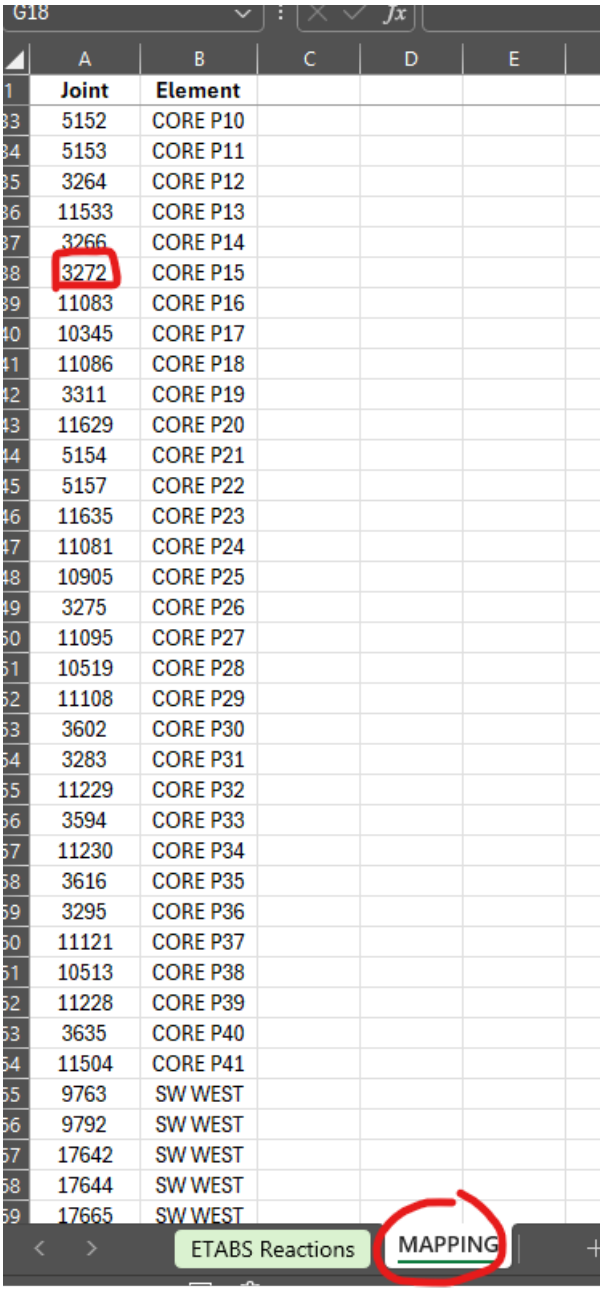
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Thomas Katunar

From: Nicholas Doyle
Sent: Wednesday, July 3, 2024 12:04 PM
To: Darron Lee
Cc: Mark Avery; David Cunliffe; Thomas Katunar
Subject: RE: B01493-1AW and B01493-1AX

Darron,

Ah that's my fault, I mistyped a number. If you unhide the "Mapping" tab, the correct joint number for Core P15 is 3272 as shown below. I think I had it as 3372. If you make that change that will add it into the table.



	A	B	C	D	E
1	**Joint**	**Element**			
33	5152	CORE P10			
34	5153	CORE P11			
35	3264	CORE P12			
36	11533	CORE P13			
37	3266	CORE P14			
38	3272	CORE P15			
39	11083	CORE P16			
40	10345	CORE P17			
41	11086	CORE P18			
42	3311	CORE P19			
43	11629	CORE P20			
44	5154	CORE P21			
45	5157	CORE P22			
46	11635	CORE P23			
47	11081	CORE P24			
48	10905	CORE P25			
49	3275	CORE P26			
50	11095	CORE P27			
51	10519	CORE P28			
52	11108	CORE P29			
53	3602	CORE P30			
54	3283	CORE P31			
55	11229	CORE P32			
56	3594	CORE P33			
57	11230	CORE P34			
58	3616	CORE P35			
59	3295	CORE P36			
60	11121	CORE P37			
61	10513	CORE P38			
62	11228	CORE P39			
63	3635	CORE P40			
64	11504	CORE P41			
65	9763	SW WEST			
66	9792	SW WEST			
67	17642	SW WEST			
68	17644	SW WEST			
69	17665	SW WEST			

ETABS Reactions | MAPPING

Regards,
Nick

Nicholas Doyle
ASSOCIATE

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470 St Pauls Terrace, Fortitude Valley, Qld, 4006, Australia
Phone: 07 3319 2777
Website: www.robertbird.com

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From: Darron Lee <Darron.Lee@edgconsult.com.au>
Sent: Wednesday, July 3, 2024 11:42 AM
To: Nicholas Doyle <Nicholas.Doyle@robertbird.com.au>
Cc: Mark Avery <Mark.Avery@robertbird.com.au>; David Cunliffe <David.Cunliffe@edgconsult.com.au>; Thomas Katunar <thomas.katunar@robertbird.com.au>
Subject: FW: B01493-1AW and B01493-1AX

This message Is From an External Sender

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Hi Nicholas,

Looks like the loads for Core Pile No. 15 is missing, can you take a look?

Cheers

Darron Lee Senior Engineer
EDG Consulting
TYPSA Group

m: +61 449 767 667
darron.lee@edgconsult.com.au

Level 1, 18 Wandoo Street
Fortitude Valley Qld 4006 Australia
http://edgconsult.com.au/

From: Nicholas Doyle <Nicholas.Doyle@robertbird.com.au>
Sent: Monday, June 24, 2024 9:22 PM
To: Darron Lee <Darron.Lee@edgconsult.com.au>; Mark Avery <Mark.Avery@robertbird.com.au>

Thomas Katunar

From: Darron Lee <Darron.Lee@edgconsult.com.au>
Sent: Tuesday, June 25, 2024 12:17 PM
To: Nicholas Doyle; Mark Avery
Cc: David Cunliffe; Thomas Katunar
Subject: RE: B01493-1AW and B01493-1AX

This message Is From an External Sender

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Hi Nicholas,

Thanks for the chat and clarifications earlier. Just notes from our meeting.

Regarding the core option:

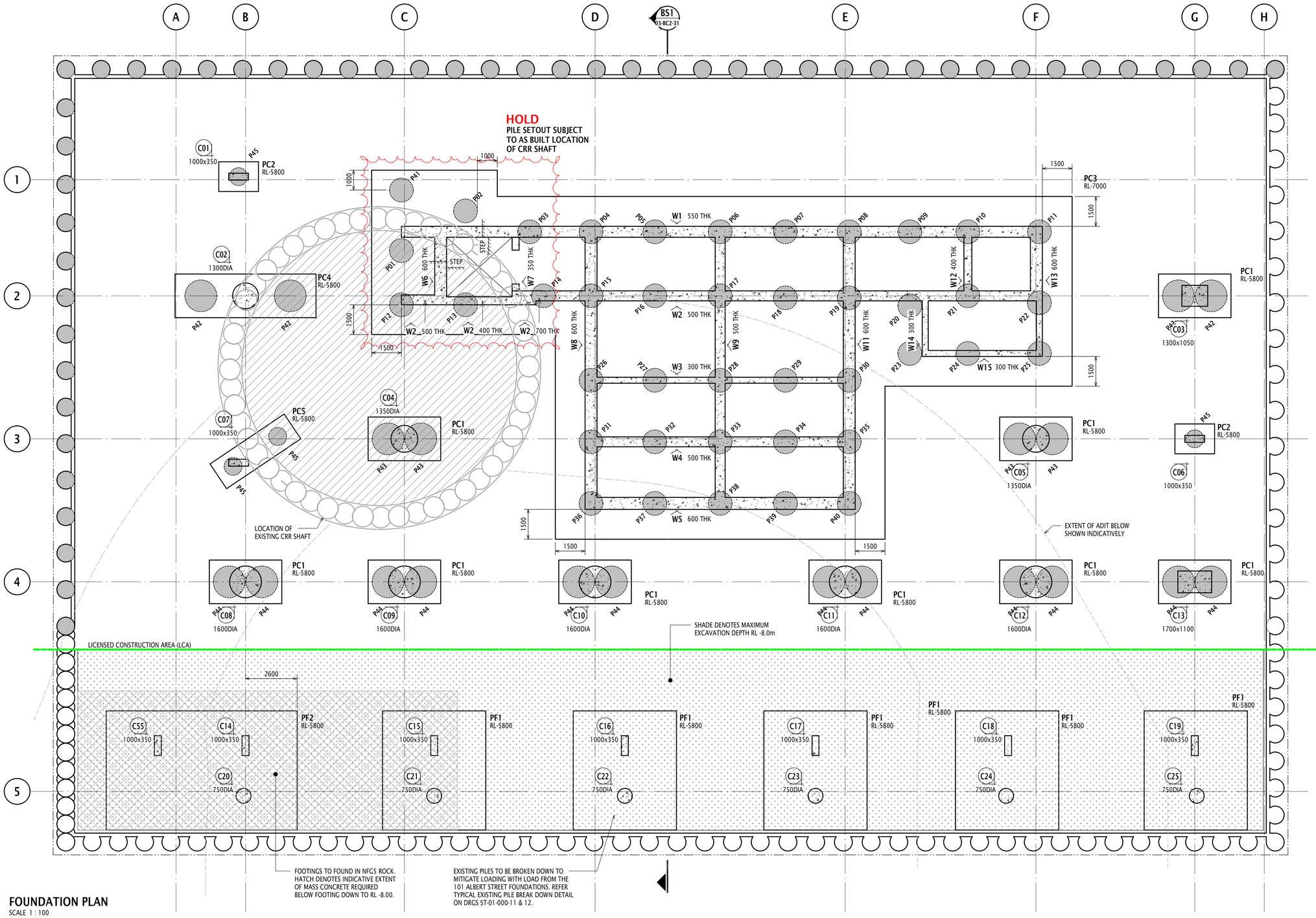
- No moments in core piles, columns or shallow footings
- 10% contingency has been included in the loads shown in the PDF drawings but not the excel. However, we manually corrected the excel during the meeting to include 10%. i.e. we will not include another 10% on top of any loads.
- Elevations shown in drawing are showing the top of footing levels.
- Core slab (in piled option) is 2400mm thick
- For cavern assessment, we will run the following cases as these will have the most significant impact on the cavern. Wind load combination 11 appears to be the worst and we will adopt this combination.

ULTIMATE
1.2G+1.5Q
1.35G
1.2G+0.6Q+W
0.9G+W
G+0.6Q+SpecX+0.3SpecY
G+0.6Q-SpecX+0.3SpecY
G+0.6Q-SpecX-0.3SpecY
G+0.6Q-SpecX-0.3SpecY
G+0.6Q+SpecY+0.3SpecX
G+0.6Q-SpecY+0.3SpecX
G+0.6Q-SpecY-0.3SpecX
G+0.6Q-SpecY-0.3SpecX

Regarding the raft option:

- Use the same load/combination as per the piled option for now
- Elevations shown in drawing are showing the top of raft slab level.

COLUMN LOADS



FOUNDATION PLAN

SCALE 1 : 100

GENERAL ARRANGEMENT LEGEND:

- DENOTES INSITU CONCRETE ELEMENT OVER
- DENOTES LOAD BEARING ELEMENT UNDER
- DENOTES LOAD BEARING ELEMENT UNDER AND INSITU CONCRETE ELEMENT OVER
- STEP — DENOTES SLAB STEP
- THK — DENOTES SLAB THICKNESS
- TAG / SIZE — DENOTES COLUMN NUMBER AND SIZE
- W? — DENOTES WALL NUMBER & DIRECTION ELEVATION IS VIEWED
- SW# — DENOTES SHOWING WALL NUMBER & DIRECTION ELEVATION IS VIEWED
- DENOTES MAXIMUM EXCAVATION DEPTH RL -8.0m
- DENOTES INDICATIVE EXTENT OF N10 MASS CONCRETE
- DENOTES CRR SHAFT BACKFILL MATERIAL EXTENT. REFER DRGS ST-01-000-11 & 12
- DENOTES CRR ACCOUSTIC SHED STRUCTURE REFER DRGS ST-01-000-11 & 12
- DENOTES CRR SHAFT AND ADIT STRUCTURE REFER DRGS ST-01-000-11 & 12

PAD FOOTING SCHEDULE

PAD FOOTING MARK	LENGTH	WIDTH	DEPTH
PF1	6000	5200	1200
PF2	6000	9615	1200

PILE CAP SCHEDULE

PILE CAP MARK	LENGTH	WIDTH	DEPTH
PC1	3650	2200	2500
PC2	2000	1500	1200
PC3	REFER PLAN	REFER PLAN	REFER PLAN
PC4	7100	2200	2500
PC5	4500	1500	1500

PILE SCHEDULE

PILE MARK	PILE DIA (mm)	SOCKET (m)		APPROX TOP OF SOCKET (RL)	APPROX PILE TOE (RL)	REINF RATE (kg/m³)
		NFG3	NFG1/2			
P01-P11 & P41	1200	6	10	-12	-28	
P12-P22	1200	6	6	-12	-24	
P23-P30	1200	2	4	-16^	-22	
P31-P40	1200	0	17	-19^	-36	
P42	1600	6	3	-12	-21	
P43	1600	2	3	-16^	-21	
P44	1600	0	8	-23^	-31	
P45	900	2	2	-16^	-20	

^ DENOTES TOP OF SOCKET LEVEL IMPACTED BY ISOLATION SLEEVE. GEOTECHNICAL ENGINEER TO CONFIRM ISOLATION SLEEVE REQUIREMENTS AND DETAILS.

CONCRETE NOTES :

-REFER NOTES ON COVER SHEET
-MIN CONC. STRENGTH AT 28 DAYS

LOCATION	f'c
PILE CAP PC1, PC3 & PC4	80MPa
PILE CAP PC2 & PC5	50MPa
PAD FOOTING PF1, PF2	50MPa

COLUMN LOAD SCHEDULE

COLUMN MARK	Pz [kN]				COLUMN MARK	Pz [kN]	
	G	Q	W	EQ		G	Q
C01	1600	900	-	-	C14	2000	1600
C02	36500	9400	7700	2500	C15	2200	2100
C03	34200	9300	8300	2600	C16	2600	2200
C04	27900	10700	500	400	C17	3100	1700
C05	26500	9900	1400	800	C18	2700	1500
C06	900	600	-	-	C19	2000	1300
C07	900	1100	-	-	C20	6900	2100
C08	45100	12300	5900	2500	C21	6600	1900
C09	48100	15000	1100	600	C22	5400	1600
C10	50200	14900	6400	1900	C23	4900	1500
C11	50800	14100	4900	1300	C24	7800	2400
C12	49100	15000	1000	600	C25	5300	2200
C13	45400	13500	5700	2600	C55	600	700

PRINT DRAWINGS IN COLOUR

NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE FOLLOWING:
   - GENERAL AND CONSTRUCTION NOTES ON DRG ST-00-000-11
   - SHORING & RETENTION WALL, PILING AND FOUNDATION NOTES ON DRG ST-00-000-12.
   - GEOTECHNICAL REPORTS NOTED ON DRG ST-00-000-11.
   - INSTRUMENTATION, VIBRATION AND MOVEMENT MONITORING REPORTS NOTED ON DRG ST-00-000-11.
   - EDQ AND DA REQUIREMENTS NOTES ON DRG ST-00-000-11.
   - SITE PLAN, LOADS AND NOTES ON DRG ST-01-000-01.
   - CRR ASSET PROXIMITY PLANS ON DRG ST-01-000-11 & 12.
   - TEMPORARY SHORING AND RETENTION GENERAL ARRANGEMENT PLAN ON DRG ST-01-000-21.
   - LAP SCHEDULES ON DRG ST
   - FOUNDATION TYPICAL DETAILS ON DRG SERIES ST
   - ROBERT BIRD GROUP CIVIL DRAWINGS.
2. GEOTECHNICAL ENGINEER TO VERIFIY BEARING CAPACITY OF ALL FOOTINGS PRIOR TO POURING BLINDING LAYER.
3. CORE DRILLING OF FOOTING BASES TO CONFIRM THE QUALITY OF FOUNDING STRATA IN THE CRITICAL ZONE OF STRESS INFLUENCE IS TO BE CARRIED OUT AND ASSESSED BY QUALIFIED GEOTECHNICAL ENGINEER
4. REFER GEOTECHNICAL REPORTS FOR EXCAVATION AND TEMPORARY BATTER ANGLES.
5. PILE DESIGN SHALL BE BASED ON ZERO FIXITY BETWEEN PILES AND SLABS/BEAMS AND ALLOW FOR MOMENTS DUE TO ECCENTRICITY OF ALL APPLIED LOADS.
6. DESIGN ACTIONS ARE TO BE COMBINED IN ACCORDANCE WITH AS1170.0 TO PRODUCE THE MOST ADVERSE EFFECT.
7. DEAD, LIVE AND SOIL LOADS ARE PROVIDED UNFACTORED. SEISMIC AND WIND LOADS ARE PROVIDED AT ULTIMATE.
8. SEISMIC AND WIND LOADS ARE FULLY REVERSIBLE.
9. PILE DESIGN SHALL ALLOW FOR ECCENTRICITY OF APPLIED LOADS. ECCENTRICITIES SHALL BE COMBINED TO PRODUCE THE MOST ADVERSE EFFECT.
10. PILE CAPS TO BE POURED ON COMPRESSIBLE MATERIAL RMAX GEOFOAM OR SIMILAR OUTSIDE OF THE BORED PIER EXTENTS TO CONTROL LOAD DISTRIBUTION INTO THE BORED PIERS.
11. ALLOW FOR COST ASSOCIATED WITH TEMPERATURE MONITORING AND CONTROL TO PILE CAPS DEEPER THAN 1m. THIS MIGHT INCLUDE THERMOCOUPLES, INSULATION, ICE TO THE CONCRETE MIX ETC
12. HYDRAULIC ENGINEER TO CONFIRM UNDER SLAB DRAINAGE SYSTEM AND REQUIREMENTS. DRAIANGE TO BE COORDINATED AROUND FOUNDATIONS.

THE FOLLOWING INFORMATION IS BASED UPON FOUNDATIONS CONSISTING OF PILE CAPS AND LARGE DIAMETER BORED PIERS WITH POTENTIAL ISOLATION SLEEVES. READ BELOW IN CONJUNCTION WITH THE CRR ASSET PROXIMITY PLANS ON DRGS ST-01-000-11 & 12

80%DD NOTE:

1. BORED PIERS HAVE BEEN SET-OUT WHERE POSSIBLE TO MINIMISE CLASHES WITH IN-GROUND CRR SUBSTRUCTURE INCLUDING THE TEMPORARY ACCESS SHAFT WALL, ADITS AND ACCOUSTIC SHED PILES.

2. COORDINATION WORK IS BASED UPON AVAILABLE CRR INFORMATION AT THE TIME OF THIS DOCUMENT ISSUE. THE LOCATION AND SIZE OF CRR ASSETS ARE INDICATIVE ONLY AND TO BE CONFIRMED.

3. NOT ALL EXISTING IN-GROUND STRUCTURE HAS BEEN SHOWN INCLUDING, BUT NOT LIMITED TO TEMPORARY ROCK BOLTS AND ANCHORS. BORED PIERS HAVE NOT BEEN POSITIONED TO MISS ROCK BOLTS AND ANCHORS AND THEREFORE THE CONTRACTOR IS TO MAKE ALLOWANCE FOR DRILLING THROUGH EXISTING IN-GROUND STRUCTURE.

4. BORED PIER SIZES ARE BASED ON THE TEMPORARY ACCESS SHAFT AND ADITS BEING BACKFILLED WITH SPECIFIC MATERIALS TO ASSIST WITH RELATIVE UNIFORM DISTRIBUTION OF GROUND STRESSES AND EXISTING ACOUSTIC PILES BEING BROKEN DOWN.

Rev	Revision Description	By	App	Date
A01	50% DD ISSUE	SV	MA	09.08.23
P01	DRAFT 50% DESIGN DEVELOPMENT	SV	MA	28.07.23

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DO NOT SCALE DRAWINGS, USE FIGURED DIMENSIONS
REFER TO GENERAL NOTES UNLESS NOTED OTHERWISE

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Client
QIC

Project
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Title
FOOTING PLAN

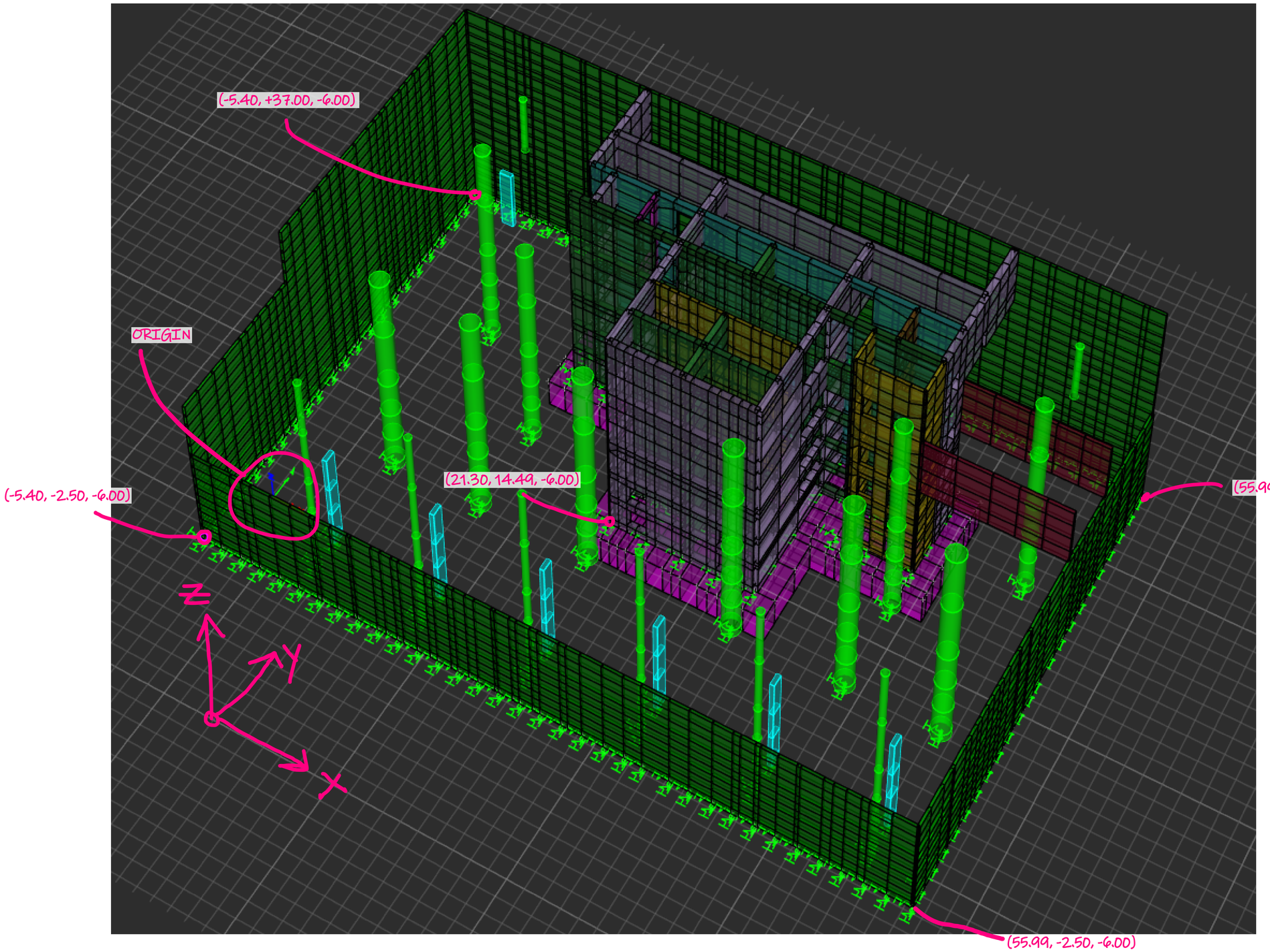
Date
Jul 2023
Scale at A1
1:100
Job Number
22131S

Drawn
S.VINEY
Designer
M.AVERY
Design Checker
-
Approved
-

NOT FOR CONSTRUCTION

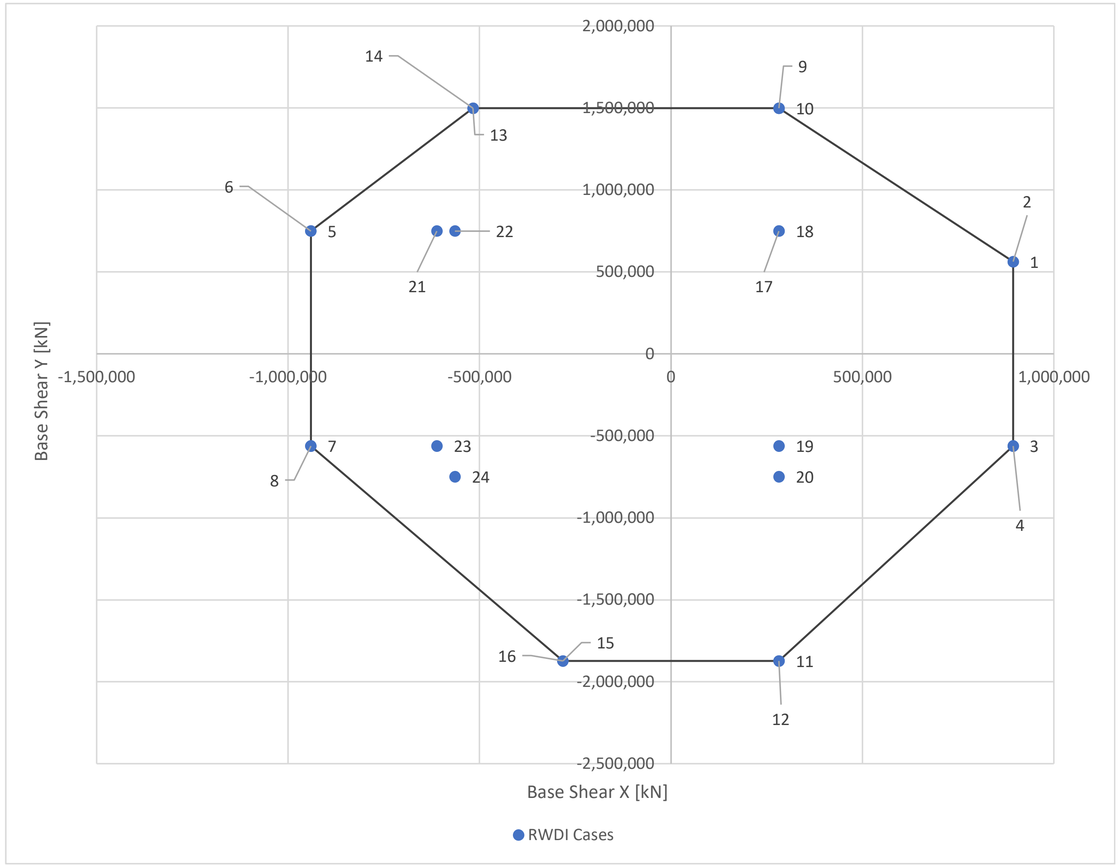
Drawing Number
ALB-RBG-DWG-ST-03-BC2-01

Revision
A01



MODEL CONTEXT VIEW & COORDINATE SYSTEM

RWDI WIND LOAD CASES
BASE SHEAR WIND ROSE



LOAD COMBINATIONS TO CONSIDER

ULTIMATE

1.2G+1.5Q
1.35G
1.2G+0.6Q+W
0.9G+W
G+0.6Q+SpecX+0.3SpecY
G+0.6Q-SpecX+0.3SpecY
G+0.6Q-SpecX-0.3SpecY
G+0.6Q-SpecX-0.3SpecY
G+0.6Q+SpecY+0.3SpecX
G+0.6Q-SpecY+0.3SpecX
G+0.6Q-SpecY-0.3SpecX
G+0.6Q-SpecY-0.3SpecX

SERVICE

G+Q
G+0.6Q+0.54W
0.9G+0.54W
G+0.6Q+0.35SpecX
G+0.6Q-0.35SpecX
G+0.6Q+0.35SpecY
G+0.6Q-0.35SpecY

- ROBUSTNESS COMBINATIONS NOT INCLUDED YET TO RATIONALISE. ROBUSTNESS COMBINATIONS ARE THE SAME AS SPECTRAL, I.E. G+0.6Q(+/-)Rx(+/-)0.3Ry WHEN YOU ARE READY TO CONSIDER THEM.
- W REPRESENTS ANY OF THE 24 RWDI WIND COMBINATIONS. I.E. THERE ARE 24 1.2G+0.6Q+W WIND COMBINATIONS.
- PLEASE INCLUDE 10% CONTINGENCY ON ALL SHORING LATERAL LOADS IN ADDITION TO THE LOAD FACTORS APPLIED ABOVE. G AND Q LOADS FOR THE SHORING WALLS ALREADY INCLUDE THIS 10% CONTINGENCY FACTOR SO DON'T APPLY TO G AND Q.
- PLEASE INCLUDE 10% CONTINGENCY ON ALL CORE PILE LOADS IN ADDITION TO THE LOAD FACTORS APPLIED ABOVE. FOR THE CORE PILES THIS APPLIES TO ALL LOADS INCLUDING G AND Q.
- COLUMN LOADS PROVIDED ALREADY HAVE THE 10% CONTINGENCY APPLIED IN THE LOADS WE HAVE PROVIDED TO YOU.

SHORING WALL PILE LOADS

FIRST PAGE OF LOADS PROVIDED AS AN EXAMPLE.
FULL LIST OF LOADS CAN BE PROVIDED UPON REQUEST.

						Global RAM Force					
ETABS Load Case	**Joint**	**Element**	**x [m]**	**y [m]**	**z [m]**	**F_x [kN]**	**F_y [kN]**	**F_z [kN]**	**M_x [kNm]**	**M_y [kNm]**	**M_z [kNm]**
EQSpecX	8361	SW EAST	56.0	-0.8	-6	-25	-57	-74	0	0	0
EQSpecY	8361	SW EAST	56.0	-0.8	-6	-8	-103	-131	0	0	0
Robustness X	8361	SW EAST	56.0	-0.8	-6	25	22	-63	0	0	0
Robustness Y	8361	SW EAST	56.0	-0.8	-6	-5	141	223	0	0	0
0: RWDI_01	8361	SW EAST	56.0	-0.8	-6	13	74	53	0	0	0
0: RWDI_02	8361	SW EAST	56.0	-0.8	-6	10	61	52	0	0	0
0: RWDI_03	8361	SW EAST	56.0	-0.8	-6	17	-25	-111	0	0	0
0: RWDI_04	8361	SW EAST	56.0	-0.8	-6	14	-38	-112	0	0	0
0: RWDI_05	8361	SW EAST	56.0	-0.8	-6	-14	57	142	0	0	0
0: RWDI_06	8361	SW EAST	56.0	-0.8	-6	-18	40	140	0	0	0
0: RWDI_07	8361	SW EAST	56.0	-0.8	-6	-10	-58	-50	0	0	0
0: RWDI_08	8361	SW EAST	56.0	-0.8	-6	-14	-76	-52	0	0	0
0: RWDI_09	8361	SW EAST	56.0	-0.8	-6	2	146	211	0	0	0
0: RWDI_10	8361	SW EAST	56.0	-0.8	-6	-2	131	209	0	0	0
0: RWDI_11	8361	SW EAST	56.0	-0.8	-6	11	-154	-283	0	0	0
0: RWDI_12	8361	SW EAST	56.0	-0.8	-6	8	-168	-284	0	0	0
0: RWDI_13	8361	SW EAST	56.0	-0.8	-6	-10	131	237	0	0	0
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0: RWDI_15	8361	SW EAST	56.0	-0.8	-6	2	-165	-264	0	0	0
0: RWDI_16	8361	SW EAST	56.0	-0.8	-6	-1	-179	-266	0	0	0
0: RWDI_17	8361	SW EAST	56.0	-0.8	-6	6	90	102	0	0	0
0: RWDI_18	8361	SW EAST	56.0	-0.8	-6	-2	52	98	0	0	0
0: RWDI_19	8361	SW EAST	56.0	-0.8	-6	10	-26	-90	0	0	0
0: RWDI_20	8361	SW EAST	56.0	-0.8	-6	2	-80	-121	0	0	0
0: RWDI_21	8361	SW EAST	56.0	-0.8	-6	-7	73	132	0	0	0
0: RWDI_22	8361	SW EAST	56.0	-0.8	-6	-15	36	126	0	0	0
0: RWDI_23	8361	SW EAST	56.0	-0.8	-6	-3	-43	-60	0	0	0
0: RWDI_24	8361	SW EAST	56.0	-0.8	-6	-11	-96	-93	0	0	0
EQSpecX	18201	SW NORTH	3.6	37.0	-6	-156	-9	-253	0	0	0
EQSpecY	18201	SW NORTH	3.6	37.0	-6	-37	-13	-238	0	0	0
Robustness X	18201	SW NORTH	3.6	37.0	-6	92	-2	296	0	0	0
Robustness Y	18201	SW NORTH	3.6	37.0	-6	-23	15	-449	0	0	0
0: RWDI_01	18201	SW NORTH	3.6	37.0	-6	28	1	21	0	0	0
0: RWDI_02	18201	SW NORTH	3.6	37.0	-6	42	4	16	0	0	0
0: RWDI_03	18201	SW NORTH	3.6	37.0	-6	51	-8	394	0	0	0
0: RWDI_04	18201	SW NORTH	3.6	37.0	-6	66	-6	389	0	0	0
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0: RWDI_09	18201	SW NORTH	3.6	37.0	-6	-26	10	-430	0	0	0
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0: RWDI_11	18201	SW NORTH	3.6	37.0	-6	47	-17	689	0	0	0
0: RWDI_12	18201	SW NORTH	3.6	37.0	-6	63	-14	684	0	0	0
0: RWDI_13	18201	SW NORTH	3.6	37.0	-6	-69	12	-613	0	0	0
0: RWDI_14	18201	SW NORTH	3.6	37.0	-6	-50	14	-619	0	0	0
0: RWDI_15	18201	SW NORTH	3.6	37.0	-6	17	-16	560	0	0	0

CORE PILE LOADS

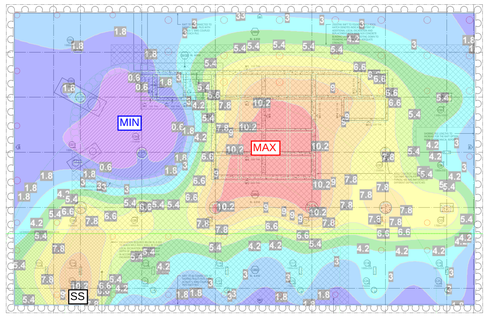
FIRST PAGE OF LOADS PROVIDED AS AN EXAMPLE.
FULL LIST OF LOADS CAN BE PROVIDED UPON REQUEST.

						Global RAM Force							
ETABS Load Case	**Joint**	**Element**	**x [m]**	**y [m]**	**z [m]**	**F_x [kN]**	**F_y [kN]**	**F_z [kN]**	**M_x [kNm]**	**M_y [kNm]**	**M_z [kNm]**	Wind?	Seismic?
EQSpecX	3267	CORE P04	21.3	28.4	-6	-817	-307	-2113	0	0	0	FALSE	TRUE
EQSpecY	3267	CORE P04	21.3	28.4	-6	-117	-421	-2432	0	0	0	FALSE	TRUE
Robustness X	3267	CORE P04	21.3	28.4	-6	364	-47	2965	0	0	0	FALSE	FALSE
Robustness Y	3267	CORE P04	21.3	28.4	-6	-14	429	-6684	0	0	0	FALSE	FALSE
0: Total Q	3267	CORE P04	21.3	28.4	-6	-12	-20	-2024	0	0	0	FALSE	FALSE
0: RWDI_01	3267	CORE P04	21.3	28.4	-6	82	22	-778	0	0	0	TRUE	FALSE
0: RWDI_02	3267	CORE P04	21.3	28.4	-6	143	87	-826	0	0	0	TRUE	FALSE
0: RWDI_03	3267	CORE P04	21.3	28.4	-6	102	-201	5073	0	0	0	TRUE	FALSE
0: RWDI_04	3267	CORE P04	21.3	28.4	-6	163	-137	5025	0	0	0	TRUE	FALSE
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0: RWDI_19	3267	CORE P04	21.3	28.4	-6	-40	-224	3667	0	0	0	TRUE	FALSE
0: RWDI_20	3267	CORE P04	21.3	28.4	-6	147	-67	4496	0	0	0	TRUE	FALSE
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0: RWDI_24	3267	CORE P04	21.3	28.4	-6	29	-15	2486	0	0	0	TRUE	FALSE
Total G (Wished-i	3267	CORE P04	21.3	28.4	-6	-53	-21	-13546	0	0	0	FALSE	FALSE
EQSpecX	3274	CORE P06	27.6	28.4	-6	-836	-35	-249	0	0	0	FALSE	TRUE
EQSpecY	3274	CORE P06	27.6	28.4	-6	-130	-321	-2705	0	0	0	FALSE	TRUE
Robustness X	3274	CORE P06	27.6	28.4	-6	359	7	49	0	0	0	FALSE	FALSE
Robustness Y	3274	CORE P06	27.6	28.4	-6	18	424	-7395	0	0	0	FALSE	FALSE
0: Total Q	3274	CORE P06	27.6	28.4	-6	-17	-27	-2029	0	0	0	FALSE	FALSE
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0: RWDI_17	3274	CORE P06	27.6	28.4	-6	-53	142	-4319	0	0	0	TRUE	FALSE
0: RWDI_18	3274	CORE P06	27.6	28.4	-6	141	163	-4246	0	0	0	TRUE	FALSE
0: RWDI_19	3274	CORE P06	27.6	28.4	-6	-61	-124	3196	0	0	0	TRUE	FALSE
0: RWDI_20	3274	CORE P06	27.6	28.4	-6	133	-140	4343	0	0	0	TRUE	FALSE
0: RWDI_21	3274	CORE P06	27.6	28.4	-6	-172	141	-4353	0	0	0	TRUE	FALSE



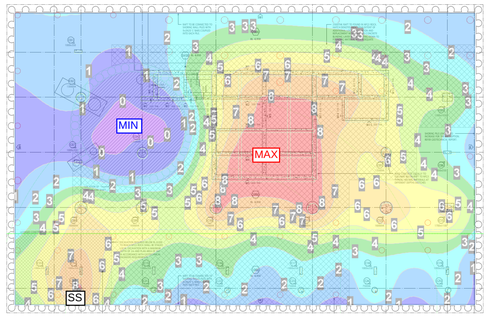
Appendix E
RBG Raft Analysis Summary

Document Number: ALB-RBG-REP-ST-00-000-05
Revision: T01



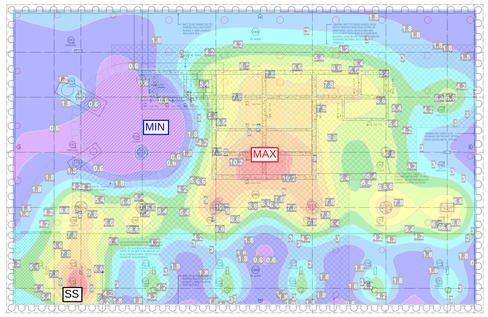
PLOT 1
1.2G+1.5Q SETTLEMENT (SHORT TERM)
SCALE 1:400

LOCATION	SETTLEMENT [mm]
MIN	-0.3
MAX	12.5
SOFTSPOT	10.4



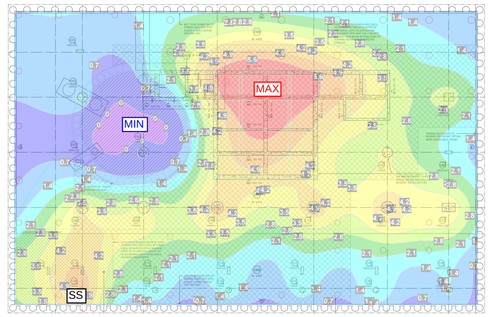
PLOT 2
G+Q SETTLEMENT (SHORT TERM)
SCALE 1:400

LOCATION	SETTLEMENT [mm]
MIN	-0.2
MAX	9.9
SOFTSPOT	8.2



PLOT 3
G+Q SETTLEMENT (30-YEAR)
SCALE 1:400

LOCATION	SETTLEMENT [mm]
MIN	-0.4
MAX	11.3
SOFTSPOT	12.2

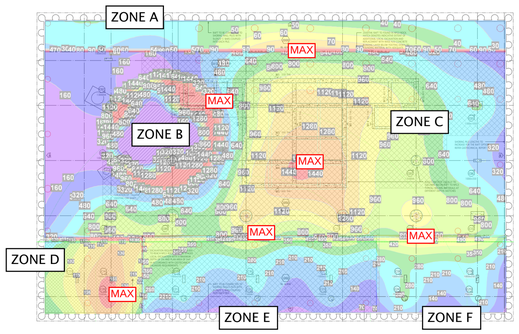


PLOT 4
0.9G+RWDI_05 WIND SETTLEMENT (SHORT TERM)
SCALE 1:400

LOCATION	SETTLEMENT [mm]
MIN	-0.2
MAX	6.8
SOFTSPOT	5.5

NOTES:

1. FOR PLOTS 1 TO 4, THE COLOURED TEXT BOXES MIN, MAX AND SS (SOFTSPOT) CORRESPOND TO LOCATIONS GIVEN IN THE TABLE BELOW THE PLOT.

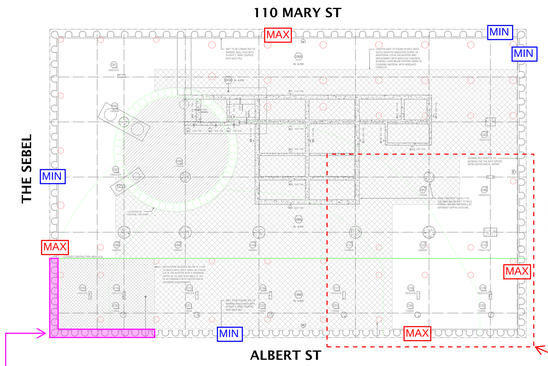


PLOT 5
G+Q BEARING PRESSURE PLOT
SCALE 1:400

ZONE	MAX BEARING PRESSURE [kPa]
A	100
B	5450
C	1500
D	200
E	700
F	700

NOTES:

1. "MAX" DENOTES LOCATION OF MAXIMUM BEARING PRESSURE WITHIN EACH ZONE.
2. DIFFERENT COLOR CONTOURS ARE USED WITHIN EACH ZONE, PROPORTIONED TO THEIR RESPECTIVE MAXIMUM BEARING PRESSURE.



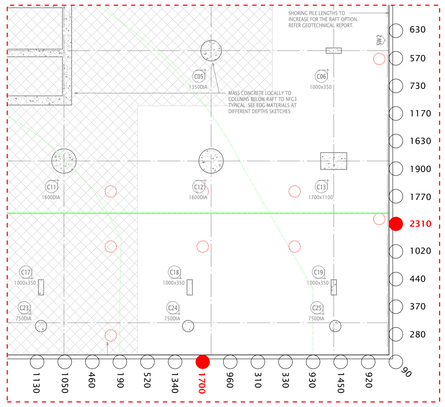
PLOT 6
CRITICALLY LOADED SHORING WALL PILE PLAN
SCALE 1:400

SOFTSPOT PILES IN PINK SHADED REGION

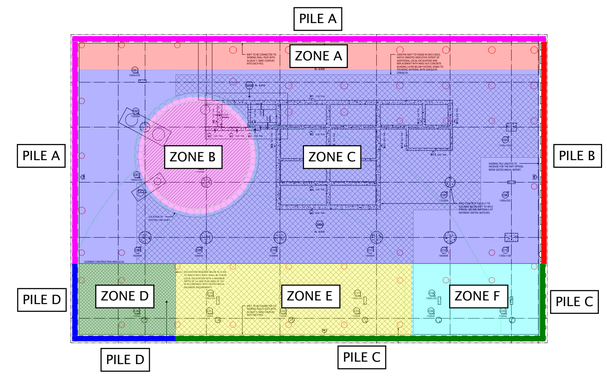
WALL	MAX PILE LOAD [kN]	LOAD CASE	MIN PILE LOAD [kN]	LOAD CASE	VERTICAL SHEAR FROM RAFT [kN] MAX	AVERAGE
110 MARY ST	2520	1.2G+0.6Q+RWDI_13	620	0.9G+RWDI_09	1010	470
MARY ST	2960	1.2G+1.5Q	370	0.9G+RWDI_01	2310	890
ALBERT ST	2220	1.2G+1.5Q	420	0.9G+RWDI_15	1700	840
THE SEBEL	1880	1.2G+1.5Q	340	0.9G+RWDI_11	600	190
SOFTSPOT	1780	1.2G+1.5Q	370	0.9G+RWDI_09	1400	550

NOTES:

1. "MAX" DENOTES THE APPROXIMATE LOCATION OF THE MAXIMALLY LOADED PILE ALONG EACH EDGE.
2. "MIN" DENOTES THE APPROXIMATE LOCATION OF THE MINIMALLY LOADED PILE ALONG EACH EDGE.
3. PILE LOCATION AND LOAD CASE FOR THE MAXIMUM VERTICAL SHEAR FROM RAFT IS THE SAME AS FOR THE MAXIMALLY LOADED PILE.
4. LOAD CASE FOR THE AVERAGE VERTICAL SHEAR FROM RAFT IS THE SAME AS FOR THE MAXIMALLY LOADED PILE.



PART PLAN OF VERTICAL SHEAR FROM RAFT [kN] FOR 1.2G+1.5Q LOAD CASE
SCALE 1:200



ZONE	SUBGRADE MODULUS [MPa/m]
A	20
B	3000
C	150
D	20
E	75
F	100

PILE	SPRING STIFFNESS [MN/m]
A	800
B	500
C	1000
D	200

GEOTECHNICAL PROPERTIES USED IN MODEL
SCALE 1:400

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Robert Bird Group
an SJ company
Website: www.robertbird.com

Rev:	Revision Description:	App:	Date:

Client: QIC
Designer:
Design Checker:
Status:
Project: 101 ALBERT ST OSD
Drawn: TK
Project Principal/Leader: MA
Job No: 22131
Sketch No:
Rev:
Title: APPENDIX E: RAFT FOUNDATION SUMMARY
Scale at A1:
Date: 7/03/2025



Appendix F
Heilig and Partners Vibration Assessment Reports

Document Number: ALB-RBG-REP-ST-00-000-05
Revision: T01

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- Tunnelling
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datatrap
vibration management software

Monday, August 12, 2024

Ref:jhh:Revised modelling results for Albert St raft piling

Ms. Christine Beeby
RCP Australia Pty Ltd
Level 15, 120 Edward Street
Brisbane, QLD 4000

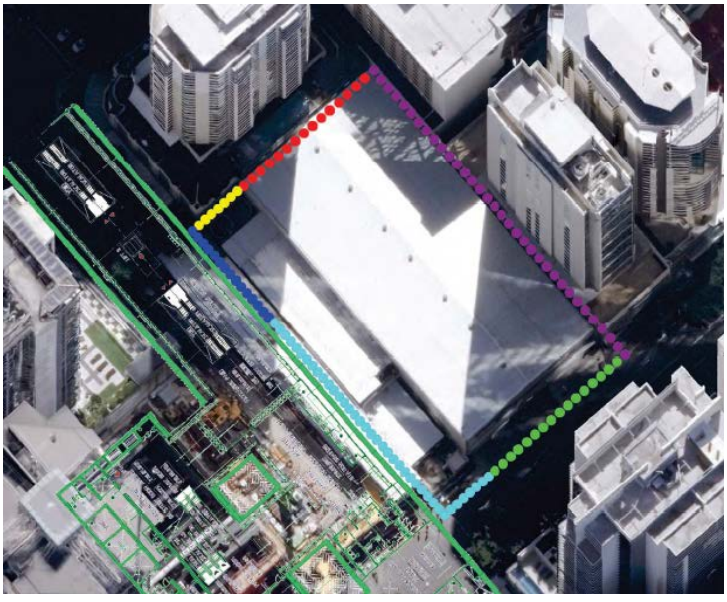
RE: Modelling of vibration from piling associated with raft slab design

Dear Christine,

Following on from our discussions, the vibration effects of the revised piling for the raft slab option assessment have been considered. The assessed piling schedule has 900mm diameter bored piles around the perimeter are of varying depth and described as follows:

Albert Street boundary (south-west face):		900mm to RL-10m with 1m (NFG5) and 2m socket
Rear boundary (north-east face)	:	900mm to RL-14m with 1m socket (NFG3)
Mary Street (south-east face)	:	900mm to RL-10m with 2m socket and to RL-10.5m with 1m socket
North-west boundary face	:	900mm to RL-12.5m with 1m socket (NFG3) and to RL-10m with 2m socket

The piling locations (and the Mezzanine level of the Cross River at RL-21.5) are as shown below.



Albert Street piles.

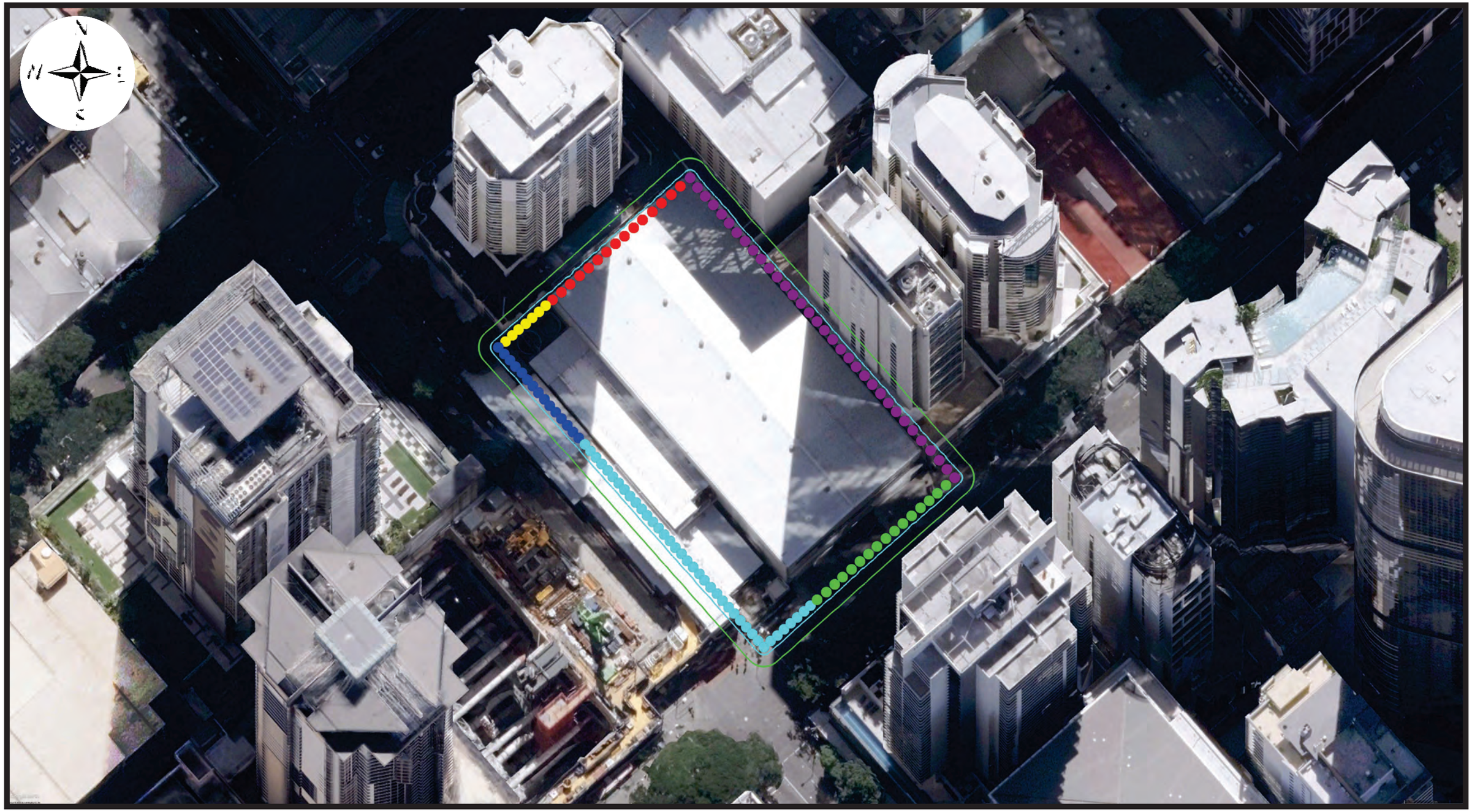
The modelling results confirm the vibration effects at all assessed locations are compliant with the permissible vibration criteria and the works will not require any further mitigation to reduce vibration levels to lower values. In particular:

- Vibration at the surface will be significantly low at the adjacent buildings and will not affect the integrity of the adjacent or amenity of persons inside.
- Vibration at RL3m representing the level of the majority of the key below ground services is low and compliant.
- Vibration at RL-5m which reflects the S1Sewer elevation are low and complaint with even stringent vibration criterion for this asset.
- The vibration level at both the Mezzanine level for the Cross River Rail (RL-21.5m) and the Albert Street Platform level (RL-28m) are less than 2mm/s because of the vertical separation by the shorter

The modelling results from the different scenarios are shown in the attached plates. The legend on each drawing describes the modelling horizon where the vibration contours are modelled. As always, let me know of any of the issues raised in this letter.

Yours truly,
John Heilig

Dr. John Heilig
Principal - Heilig & Partners Pty Ltd
RPEQ#6304



Created using TunnelTRAP Software

SCALE

0 5 10 15 20 25m

- Toe Level RL-14.000m
- Toe Level RL-10.500m
- Toe Level RL-10.000m
- Toe Level RL-10.000m
- Toe Level RL-10.000m
- Toe Level RL-12.500m

Vibration Levels

- 2 mm/s Vibration Contour
- 5 mm/s Vibration Contour
- 10 mm/s Vibration Contour
- 15 mm/s Vibration Contour
- 20 mm/s Vibration Contour
- 50 mm/s Vibration Contour

PROJECT DESCRIPTION Albert St 900mm Shoring Piers - Modelled vibration levels and associated vibration contours from piling activities involving 900mm bored piers. Vibration levels are shown at surface level and represent maximum expected values from piling.

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Plate No. A

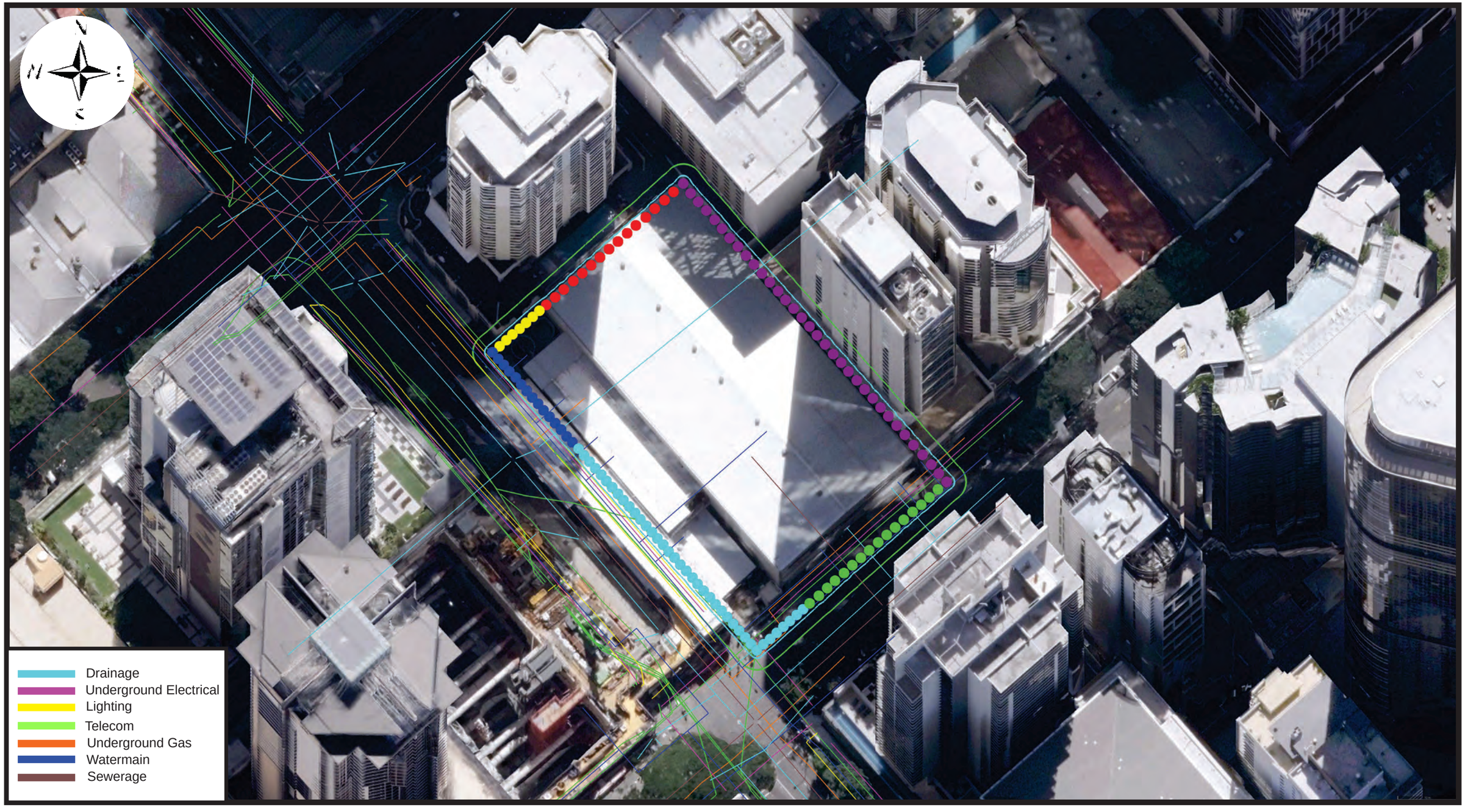
Revision History
R1: Original

Date Drawn: 8 August 2024

Ref No: Albert St 900mm Shoring Piers

Job No: HP2305-2

In preparing this drawing, HP have made certain assumptions. We have assumed that all information and documents provided to us by the Client or as a result of a specific request were complete, accurate and up to date. Where we have obtained information from a Government register or database, we have assumed that the information is accurate. Where a assumption has been made, we have not made any independent investigations with respect to the matters the subject of that assumption. We are not aware why any of the assumptions are incorrect.



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SCALE

0 5 10 15 20 25m

- Toe Level RL-14.000m
- Toe Level RL-10.500m
- Toe Level RL-10.000m
- Toe Level RL-10.000m
- Toe Level RL-10.000m
- Toe Level RL-12.500m

Vibration Levels

- 2 mm/s Vibration Contour
- 5 mm/s Vibration Contour
- 10 mm/s Vibration Contour
- 15 mm/s Vibration Contour
- 20 mm/s Vibration Contour
- 50 mm/s Vibration Contour

PROJECT DESCRIPTION Albert St 900mm Shoring Piers - Modelled vibration levels and associated vibration contours from piling activities involving 900mm bored piers. Vibration levels are shown at RL3 (Underground Utilities) and represent maximum expected values from piling.

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Plate No. B

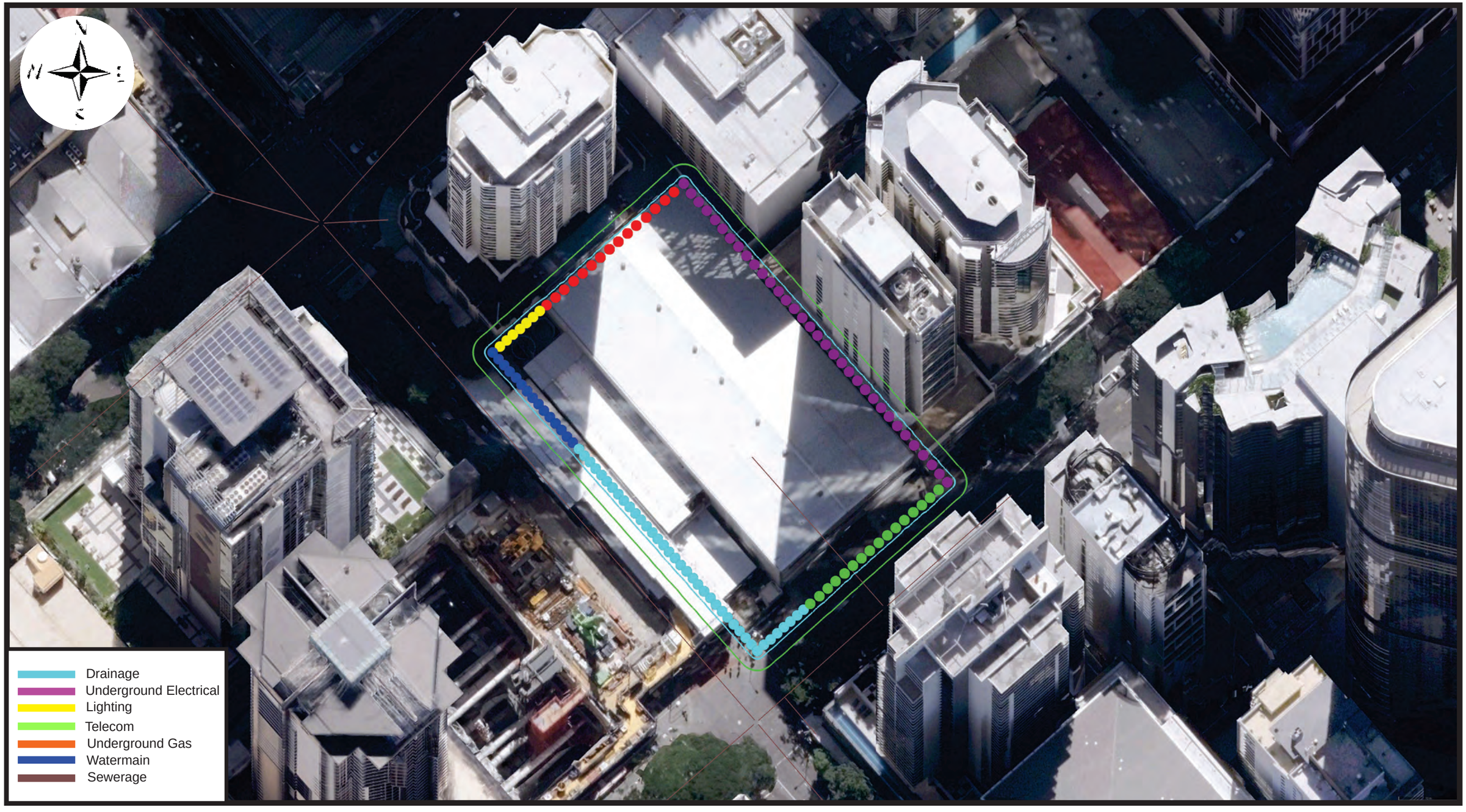
Revision History
R1: Original

Date Drawn: 8 August 2024

Ref No: Albert St 900mm Shoring Piers

Job No: HP2305-2

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Created using TunnelTRAP Software

SCALE

0 5 10 15 20 25m

- Toe Level RL-14.000m
- Toe Level RL-10.500m
- Toe Level RL-10.000m
- Toe Level RL-10.000m
- Toe Level RL-10.000m
- Toe Level RL-12.500m

Vibration Levels

- 2 mm/s Vibration Contour
- 5 mm/s Vibration Contour
- 10 mm/s Vibration Contour
- 15 mm/s Vibration Contour
- 20 mm/s Vibration Contour
- 50 mm/s Vibration Contour

PROJECT DESCRIPTION Albert St 900mm Shoring Piers - Modelled vibration levels and associated vibration contours from piling activities involving 900mm bored piers. Vibration levels are shown at RL-5 (Sewer) and represent maximum expected values from piling.

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Plate No. C

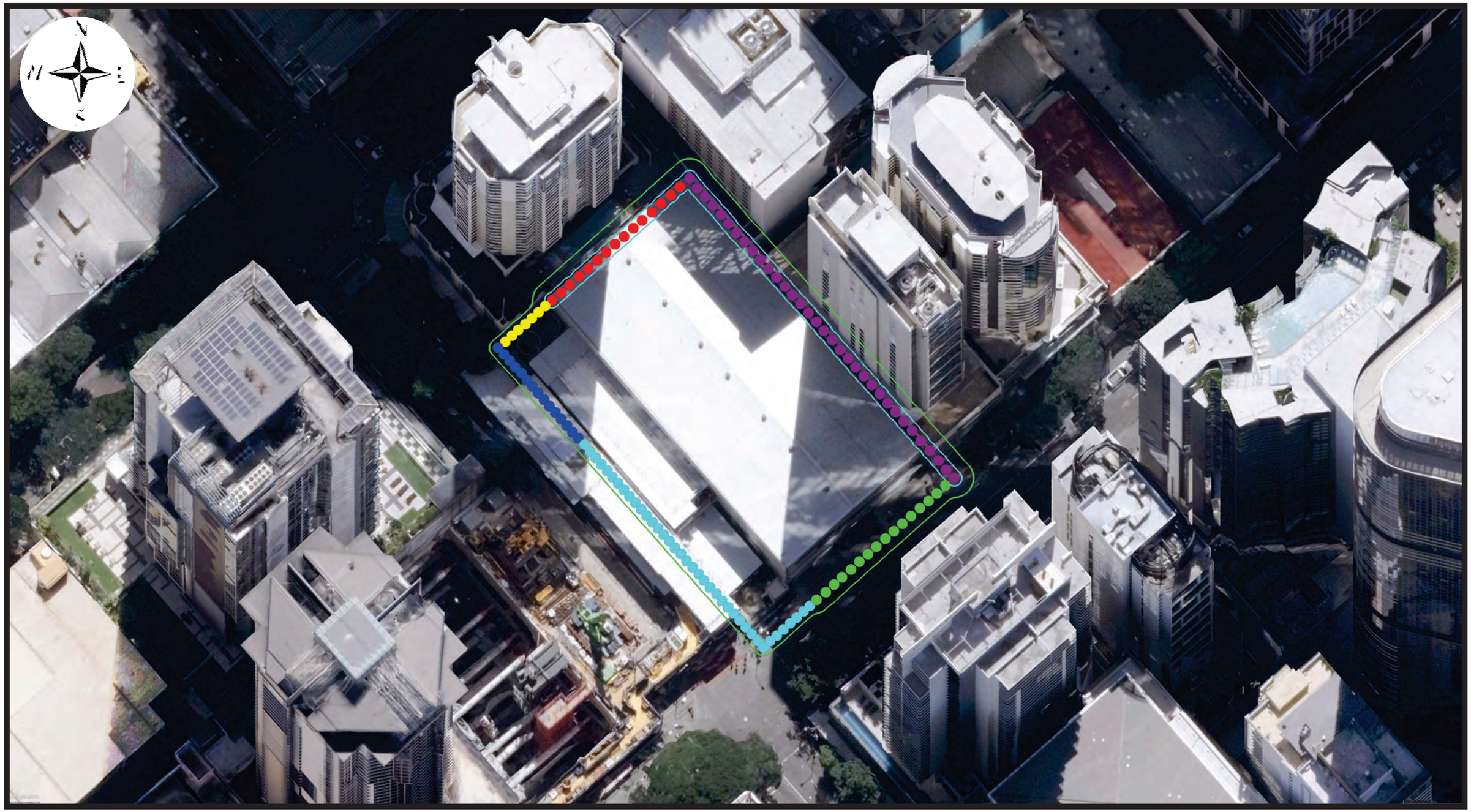
Revision History
R1: Original

Date Drawn: 8 August 2024

Ref No: Albert St 900mm Shoring Piers

Job No: HP2305-2

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SCALE

0 5 10 15 20 25m

- Toe Level RL-14.000m
- Toe Level RL-10.500m
- Toe Level RL-10.000m
- Toe Level RL-10.000m
- Toe Level RL-10.000m
- Toe Level RL-12.500m

Vibration Levels

- 2 mm/s Vibration Contour
- 5 mm/s Vibration Contour
- 10 mm/s Vibration Contour
- 15 mm/s Vibration Contour
- 20 mm/s Vibration Contour
- 50 mm/s Vibration Contour

PROJECT DESCRIPTION Albert St 900mm Shoring Piers - Modelled vibration levels and associated vibration contours from piling activities involving 900mm bored piers. Vibration levels are shown at RL-12.9 (Tunnel Crown) and represent maximum expected values from piling.

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Plate No. D

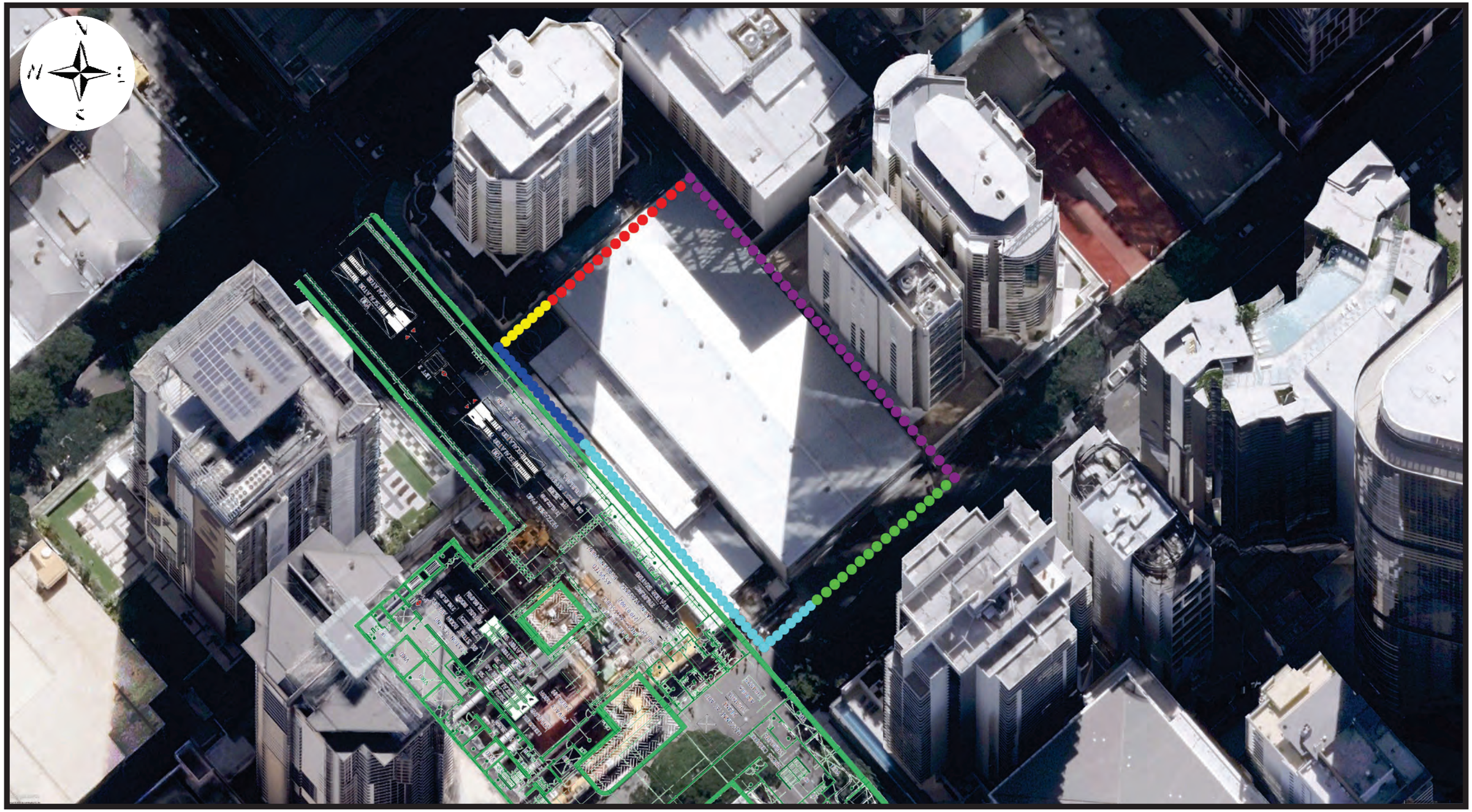
Revision History
R1: Original

Date Drawn: 8 August 2024

Ref No: Albert St 900mm Shoring Piers

Job No: HP2305-2

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Created using TunnelTRAP Software

SCALE

0 5 10 15 20 25m

- Toe Level RL-14.000m
- Toe Level RL-10.500m
- Toe Level RL-10.000m
- Toe Level RL-10.000m
- Toe Level RL-10.000m
- Toe Level RL-12.500m

Vibration Levels

- 2 mm/s Vibration Contour
- 5 mm/s Vibration Contour
- 10 mm/s Vibration Contour
- 15 mm/s Vibration Contour
- 20 mm/s Vibration Contour
- 50 mm/s Vibration Contour

PROJECT DESCRIPTION Albert St 900mm Shoring Piers - Modelled vibration levels and associated vibration contours from piling activities involving 900mm bored piers. Vibration levels are shown at RL-21.5 (Albert Street Station Mezzanine) and represent maximum expected values from piling.

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Plate No. E

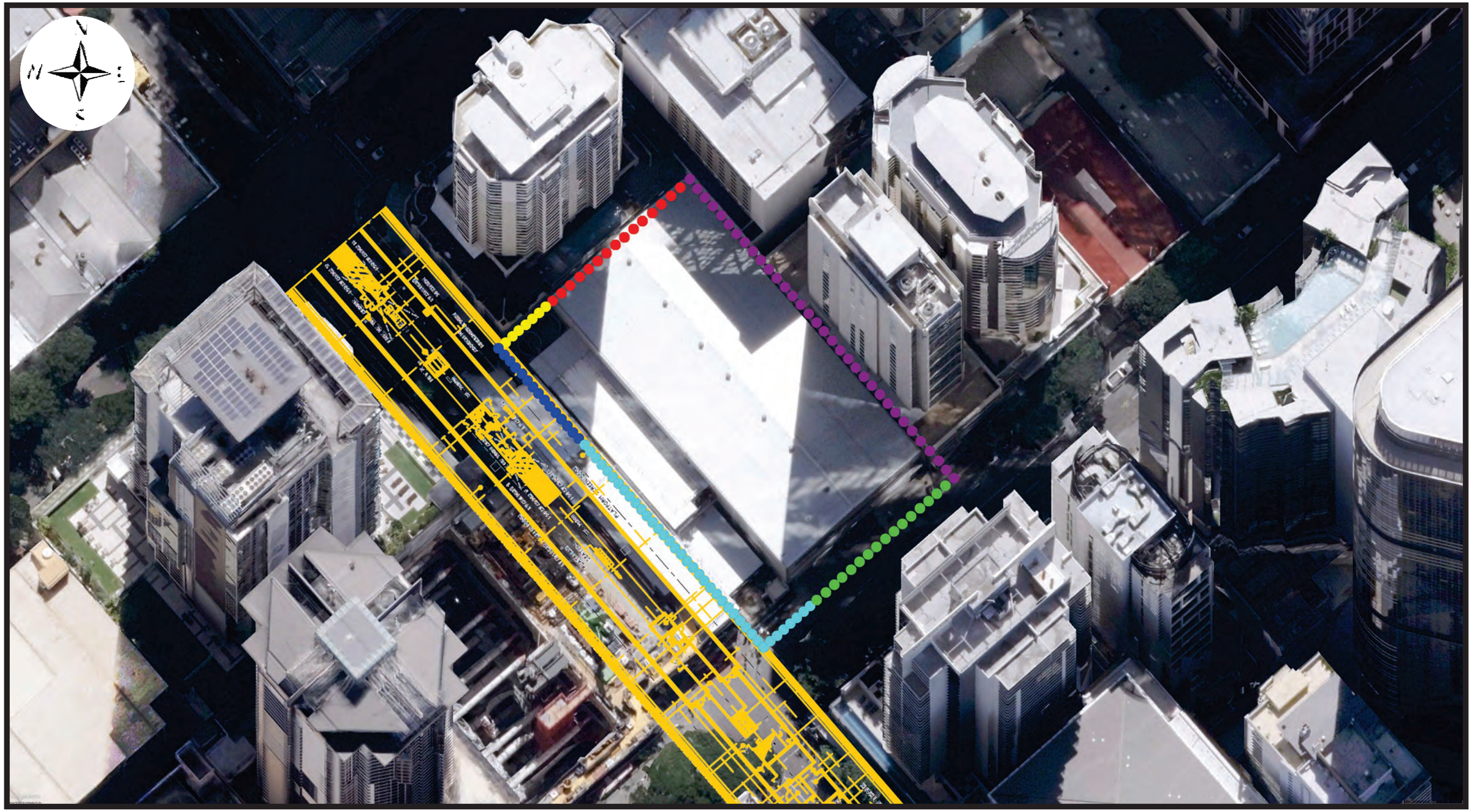
Revision History
R1: Original

Date Drawn: 8 August 2024

Ref No: Albert St 900mm Shoring Piers

Job No: HP2305-2

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SCALE

0 5 10 15 20 25m

- Toe Level RL-14.000m
- Toe Level RL-10.500m
- Toe Level RL-10.000m
- Toe Level RL-10.000m
- Toe Level RL-10.000m
- Toe Level RL-12.500m

Vibration Levels

- 2 mm/s Vibration Contour
- 5 mm/s Vibration Contour
- 10 mm/s Vibration Contour
- 15 mm/s Vibration Contour
- 20 mm/s Vibration Contour
- 50 mm/s Vibration Contour

PROJECT DESCRIPTION Albert St 900mm Shoring Piers - Modelled vibration levels and associated vibration contours from piling activities involving 900mm bored piers. Vibration levels are shown at RL-28 (Albert Street Station Platform) and represent maximum expected values from piling.

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Plate No. F

Revision History
R1: Original

Date Drawn: 8 August 2024

Ref No: Albert St 900mm Shoring Piers

Job No: HP2305-2

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Report for



Structural Monitoring and Vibration Report for 101 Albert Street, Brisbane

Prepared By:

Heilig & Partners Pty. Ltd.

June, 2024

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Project Number	:	HP2305-2
Date Completed	:	June 2024
File Name	:	SMVR 101 Albert Street Final
Date Saved	:	16/06/2024 8:25:00 AM

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This assessment and management report addresses the requirements for the SMVR (Structural Monitoring and Vibration Report) as the PDA MCU10 conditions. The report sets out the performance requirements and procedures to ensure that potential impacts associated with works at 101 Albert Street Brisbane site, including any demolition of existing structures, earthworks for the newly constructed building foundations and the resulting excavation are appropriately assessed and controlled at the adjacent buildings, including buildings on the Queensland Heritage Register, Cross River Rail infrastructure and the below ground utilities, such as the S1 Sewer. The instruction:

- *States the impacts which will be assessed and monitored.*
- *Describes the modelling and assessment procedures.*
- *Assesses the expected impacts from the different stages of the planned works.*
- *Describes acceptable vibration limits.*

and for the monitoring:

- *Describes the vibration monitoring system.*
- *Requirements for reporting of the monitored data.*
- *Specifies calibration of the monitoring units.*
- *Management measures and mitigation with respect to vibration*.

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1. DEFINITIONS AND ACRONYMS

Component particle velocity The instantaneous particle velocity of a particle at each orthogonal component axis (transverse, longitudinal and vertical)

Continuous vibration A vibration source that is continuous in nature during an assessment period (may be constant or variable). ISO10137 defines continuous vibration as having a duration of more than 30 minutes per 24-hour period

Frequency The rate per second of a vibration constituting a wave, either in the rock mass material (as in vibration) or in the air (as in sound waves), The number of cycles per unit of time, commonly per second, is called the frequency. The measurement is reported in Hertz (Hz).

Impulsive vibration A vibration source (continuous or intermittent) which has a rapid build up to a peak followed by a damped decay that may or may not involve several cycles of vibration (depending on frequency and damping).

Intermittent vibration Interrupted periods of continuous (e.g. a drill) or repeated periods of impulsive vibration (e.g. a pile driver), or continuous vibration that varies significantly in magnitude. ISO10137 define intermittent vibration as more than 10 excitations per 24-hour period

Peak Component Particle Velocity (PCPV) The maximum instantaneous velocity of a particle at any one of the three orthogonal component axis during a given time interval. Also represented by the notation in DIN 4150-3.

Peak Particle Velocity (Resultant PPV) The maximum instantaneous velocity of a particle at a point during a given time interval. The Resultant PPV is the vector sum of the three orthogonal component particle velocities (component PV)

RMS Particle Velocity The root mean square particle velocity, commonly used (with the RMS acceleration) to assess human response to vibration. Unless otherwise specified, RMS particle velocity (denoted V_{RMS}) refers to the overall vector sum RMS particle velocity rather than to any particular component of the RMS particle velocity.

Transient Vibration Vibration in which the oscillatory displacement of the ground or structure reaches a peak and then decays rapidly towards zero

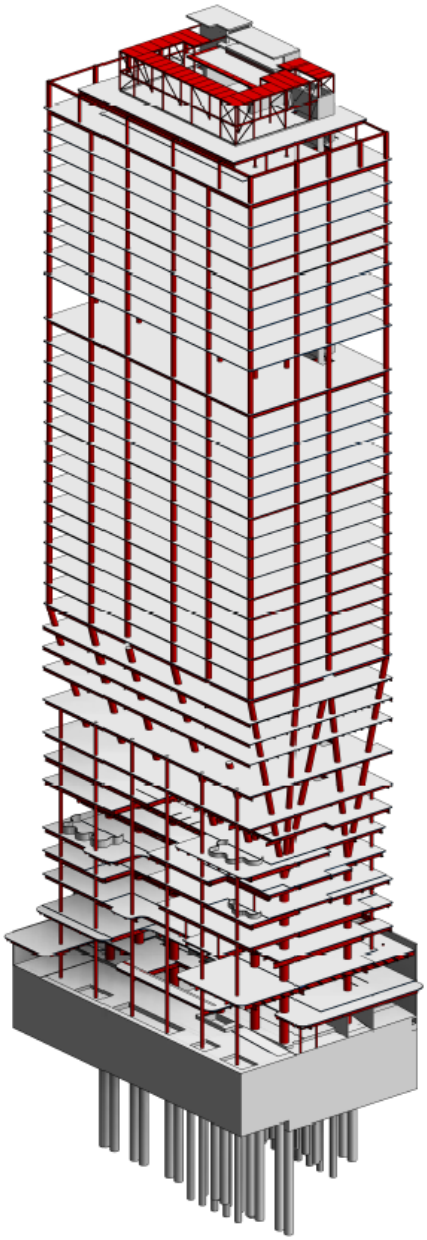
2. THE PROJECT

The CRR Albert Street Pty Ltd (ACN 660 319 693) as trustee for CRR Albert Street Trust (Albert Street Trust) has been awarded the development rights for the Cross River Rail (CRR) precincts, including the proposed development at Albert Street in the Brisbane CBD.

Development of the 101 Albert Street mixed use precinct will include a commercial tower in the order of 200 metre tall with approximately 45 floors above ground level. The building will include a multi-level basement, which will be designed to satisfy the requirements of the Cross River Rail Delivery Authority (CRRDA), due to the presence of CRR assets below.

The proposed development is anticipated to comprise a predominantly commercial tower above Podium retail and basement parking. Level 2 will be the main commercial lobby. The commercial tower will be split into four rises, Low, Mid, High and Sky Rise. Above the last commercial level (L37) will be a Destination Rooftop with an external terrace.

The building will include two and a half basement levels over the full site, with B01 containing the Loading Facilities with the balance of B1 and B2 being car parking. The half level will house the End of Trip facilities and will sit between B1 and the Ground floor. The finished floor level of Basement 2 is currently proposed at RL -5.2m.



RCP Australia Pty Ltd (RCP) has engaged multiple consultants to provide advice on behalf of Albert Street Trust:

- Geotechnical advice to help inform the Development Application (DA) and detailed design of the building by EDG Consulting
- Structural assessment to inform the design by Robert Bird Group

An assessment of ground stresses and cavern distortions associated with the proposed building loads has been completed and informed aspects of the ground support, piling, structural design and excavation works. A key element has been a comparison of ground stresses and deformations at the Albert Street cavern from the proposed building loads.

The proposed basement to the Over Station Development (OSD) requires an excavation circa 10 metres depth maximum at the boundary. The zone of influence for the retention system will not exceed twice the retained height (20 metres). Based on this, there are no listed buildings in the influence zone to the retention system.

3. PREAMBLE

The analysis of vibration impacts from the planned OSD is a necessary precursor to any demolition, excavation and construction activities for the project, given both the competency of the rock mass and the proximity of the CRR caverns and tunnels, adjacent commercial and heritage properties and the sensitive below ground utilities. Some demolition, excavation and construction activities will generate varying levels of vibration for varying durations, but generally short term semi-continuous ground vibration. The potential effects or concerns, amongst others, include damage to the rail caverns and tunnels, damage to adjacent buildings, damage to public utilities, impact on quality of life

and subsequent complaints from the tenants of adjacent buildings along Mary, Albert and Charlotte Street. Damage to the adjacent infrastructure will however be low risk when the vibration constraints imposed on the project are below that which will cause superficial damage to buildings.

4. SITE DETAILS

The proposed Albert Street OSD is located on Lot 2 of the Albert Street Station site for the CRR. The site is located opposite the proposed Albert Street Station. The site is noted as FOSD Lot 2 on the map below in Figure 1.



Figure 1 - Plan showing extent of the Lot 2 site north east of the Albert Street Station

The building will include a multi-level basement, which must be designed to satisfy the requirements of the Cross River Rail Delivery Authority, due to the presence of CRR assets below.

The development site is currently occupied by the temporary CRR acoustic shed. The acoustic shed has a typical slab on grade with a minimum 300mm thickness with a top surface level of RL +4.0m. The slab thickness is up to 600mm thick in some locations and is supported on ground beams up to 1200mm deep.

Within the shed is a 12 metre diameter temporary access shaft that extends down to nearly RL-30m. This access shaft links to two temporary adit shafts that curve and join the station cavern.

The acoustic shed, access shaft and connecting adits are all temporary structures. Upon completion of the station, the acoustic shed and its base slab will be removed with the founding piles to remain for their extent below the Proposed Lot 2 Basement. The adits and the access shaft will be concrete-filled.

The existing infrastructure showing the CRR tunnels, temporary access adits and shaft, adjacent building and the piling locations are shown in the following figure.

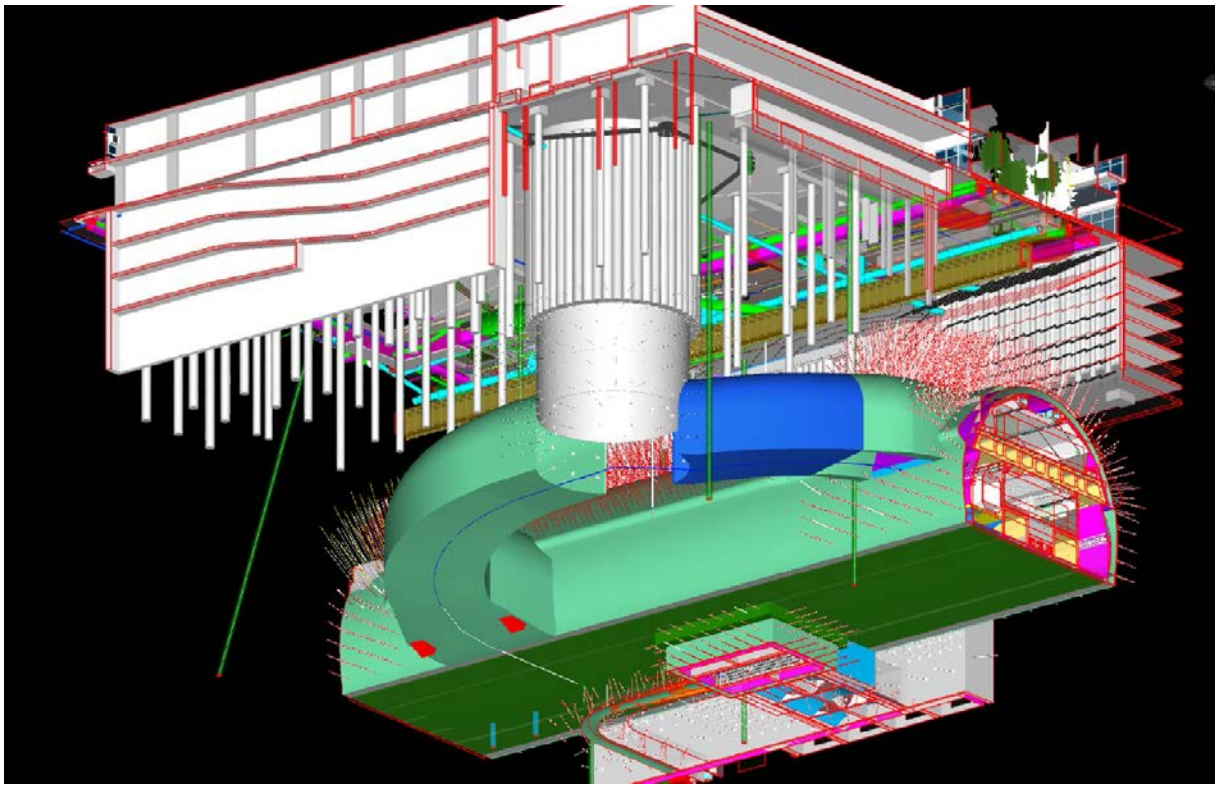


Figure 2 - Plan showing extent of the current works relative to Albert Street Station Cavern

5. GEOLOGY

Based on available geotechnical investigation data, as referenced within the EDG Geotechnical Engineering Report[1], the general geological stratigraphy described by EDG for the development site and proposed basement includes potential uncontrolled or controlled surface fill material and/or soft to firm alluvium underlain by residual soils overlying various Neranleigh-Fernvale Group (NFG) weathered rock.

Based on the geotechnical cross sections developed by EDG, extremely weathered rock (NFG5) is expected at approximately RL-6.5m with potential localised areas of residual soil. NFG3 rock is expected between RL-10m and RL-15m and NFG2/1 below RL-15m.

The interpreted geotechnical section from the EDG Report have been shown below for reference. The section in Figure 3 is cut along the site boundary, looking towards The Sebel Brisbane. The top of the extremely weathered rock (NFG5) is highest on the development site closest to Albert Street and then gradually drops away moving away from the Albert Street elevation towards the 110 Mary and 119 Charlotte boundaries.

[1] EDG Consulting, "Albert Street Cavern Assessment Report Albert Steet – Future Over Station Development, Brisbane, QLD", Prepared for Albert Street Trust, Document Reference B01493-1AE, Dated 29 May 2023

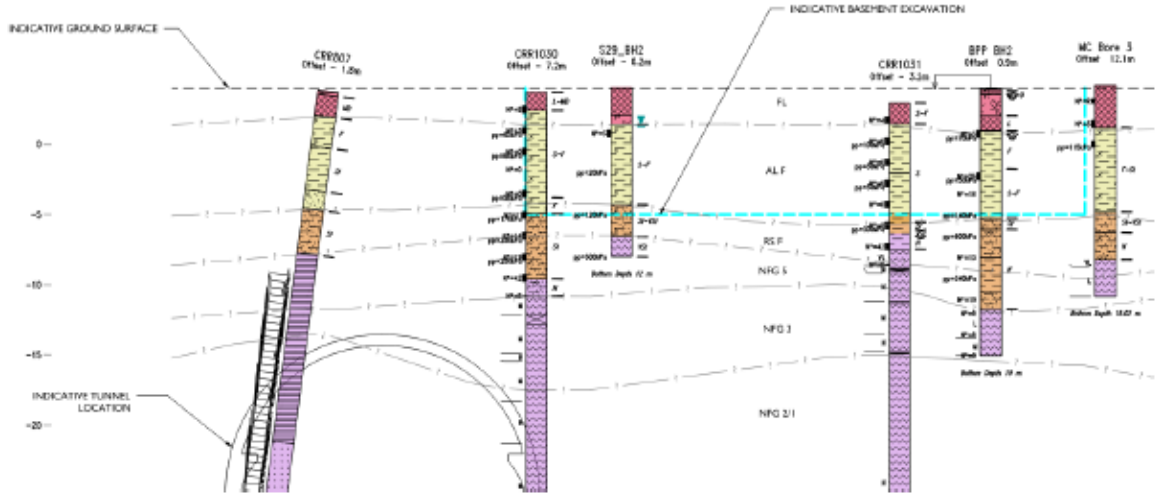


Figure 3 - EDG Interpreted Geotechnical Section B – Looking towards The Sebel

The existing static water table is below the level of the proposed basement excavation. Local perched areas of groundwater are likely to be encountered, however the static water table is below the proposed Basement 2 level. As such, the proposed Albert Street OSD is not anticipated to impact groundwater levels which could impact adjoining structures (particularly heritage structures).

6. PDA ACCOMPANYING DOCUMENTS

The Priority Development Area (PDA) DEV2023/1374 decision notice dated 6th November 2023 has granted the PDA development application in accordance with the decision notice that includes a number of conditions. Amongst other conditions, three plans that address MCU10, MCU11 and MCU12, two of which relate to the structural monitoring and railway monitoring respectively and MCU12 which relates to an instrumentation plan. In summary,

- MCU 10 requires a Structural Monitoring and Vibration Report (SMVR)
- MCU 11 requires a Track and Structures Monitoring Plan (TSMP)
- MCU 12 requires an Instrumentation and Monitoring plan (IMP)

MCU10, under SMVR requires a structural monitoring and vibration report that relates to the non-rail infrastructure. MCU11 addresses the impacts on rail infrastructure whilst MCU12 draws on the latter to produce a separate rail-based Instrumentation Monitoring Plan.

MCU12 requires an RPEQ certified instrumentation plan including but not limited to total station (prisms), inclinometer, piezometer and vibration monitoring that addresses any construction (including demolition and earthworks) impacts on the railway corridor, including rail transport infrastructure or other rail infrastructure.

Three technical reports will be prepared (SMVR, TSMP and IMP) to satisfy the MCU10, MCU11 and MCU12 conditions respectively. Elements will be common to the different plans and ultimately combine aspects based upon either the vibration requirements, structural or geotechnical assessments.

The relevant detailed responses applicable to this assessment, and where they are addressed in this document, are as follows:

Reference	*Condition*	*Timing*	*Where addressed in this document*
MCU10	**Structural monitoring and vibration report – Compliance Assessment**	Prior to commencing work	This report
	a) Submit to EDQ DA, for Compliance Assessment, a Structural Monitoring and Vibration Report (SMVR), certified by a suitably qualified RPEQ, addressing impacts to proximate Heritage Places and sensitive assets. The SMVR must include as a minimum:		The condensed SMVR report to be submitted
	i) the process for in-situ testing, based upon actual construction equipment, methods and onsite geotechnical conditions, to forecast expected vibration and ground movements during all works, detailing: 1. excavation of basement and shoring; 2. new excavation; 3. installation of new foundations (i.e. piling); 4. proposed methods to mitigate and control vibration and ground movement during construction		Section 18 Section 19 Modelling results presented in Appendix A, B and C Section 25
	ii) an instrumentation and monitoring plan, including drawings, frequency of monitoring, vibration and ground movement limits and actions to be taken should limits be exceeded. The monitoring must commence prior to excavation, continue during excavation and construction, and finish one month after the completion of permanent works;		Approach in Section 21 Commercial buildings in Section 23 Heritage buildings in Section 22 Utilities in Section 24
	iii) evidence that the vibrations and ground movement limits have been submitted to adjacent utility providers;		The condensed SMVR report to be submitted
	iv) proposed anchoring, including: 1. whether anchors are temporary or permanent; 2. anchors' lifespan; 3. consent from affected landowners, road managers and other asset custodians (e.g. utility services providers)		Refer to geotechnical report on detailed design by EDG Consulting
	v) pre-development dilapidation survey and assessment (determined by predictive modelling) of surrounding assets and ongoing monitoring of these assets, including: 1. proximate Heritage Places and other sensitive assets, including: a. details of existing assets including the nature and depth of the asset, footing information (i.e. footing construction, footing depth, footing width and founding soil type and consistency) and the condition of the asset; b. evidence to demonstrate that interim differential settlements (which may be much higher than final differential settlements) have been taken into account in the predictive analysis and that suitable controls / mitigations have been considered and put in place to protect Heritage Places and other sensitive assets; c. evidence that the effects of the high value of lateral retention wall movement arising from the Plaxis modelling has been considered; d. evidence that the construction methodology has considered the effects of vibrations and ground movements, arising from building demolition, retention, excavation and groundwater drawdown (both short and long term); e. determine limits for vibration, retention wall movements and groundwater movements for Heritage Places within the proximity of the site; f. points a. to e. above are to be considered in the design of the construction methodology proposed shoring, underpinning and stabilisation methods; and g. evidence to demonstrate that all Heritage Places within the zone of influence (geotechnical and vibrations) are categorised as high risk, and protected accordingly, regardless of their existing condition;		Section 20 Section 11.3 Section 11.4 Refer to geotechnical report on detailed design by EDG Consulting Refer to geotechnical report on detailed design by EDG Consulting Section 19 Section 13 Refer to geotechnical report on detailed design by EDG Consulting Section 12 and 22

	b) Carry out construction work in accordance with the certified SMVR endorsed under part a) of this condition.	At all times	As required
	c) Submit to the EDQ IS RPEQ certified post-development dilapidation surveys of proximate Heritage Places and other sensitive assets.	Within 20 days of completion or works	The condensed SMVR report to be submitted
	d) Where a comparison of the pre and post-development dilapidation surveys required in condition parts a) and c) identifies that rectification works are required, the applicant must: i) undertake all necessary rectification works at their expense; ii) submit RPEQ certification, including supporting documentation, to EDQ IS confirming that all necessary rectification works have been completed.	Within 40 business days, or an agreed period authorised by the relevant asset owner	As required

Table 1 – Responses to Condition MCU10 in the PDA Decision Notice

7. SMVR SCOPE

MCU10 requires a Structural Monitoring and Vibration Report (SMVR) that address the different stages of the works including the ground support (piling and shoring) and excavation works. The key requirements as per MCU10 include:

- An instrumentation and monitoring plan, including drawings, frequency of monitoring, vibration limits and actions to be taken should limits be exceeded.
- Separate reports detailing the condition surveys for the adjacent buildings. The list of requirements for these surveys is extensive and detailed in Section 6 of MCU12 and is consistent with the detailed work by the RBG and EDG as well as being informed by the vibration modelling and settlement assessments. A dedicated section of the SMVR report will confirm the extent of the condition surveys.
- Discussions with the utility providers and other authorities, such as TMR, are also required. Whilst there is a history of acceptable methods from previous projects, these tasks can be detailed and can necessitate extended consultation, particularly for Urban Utilities and the S1 Sewer.

The adjacent buildings are shown in the following figure.

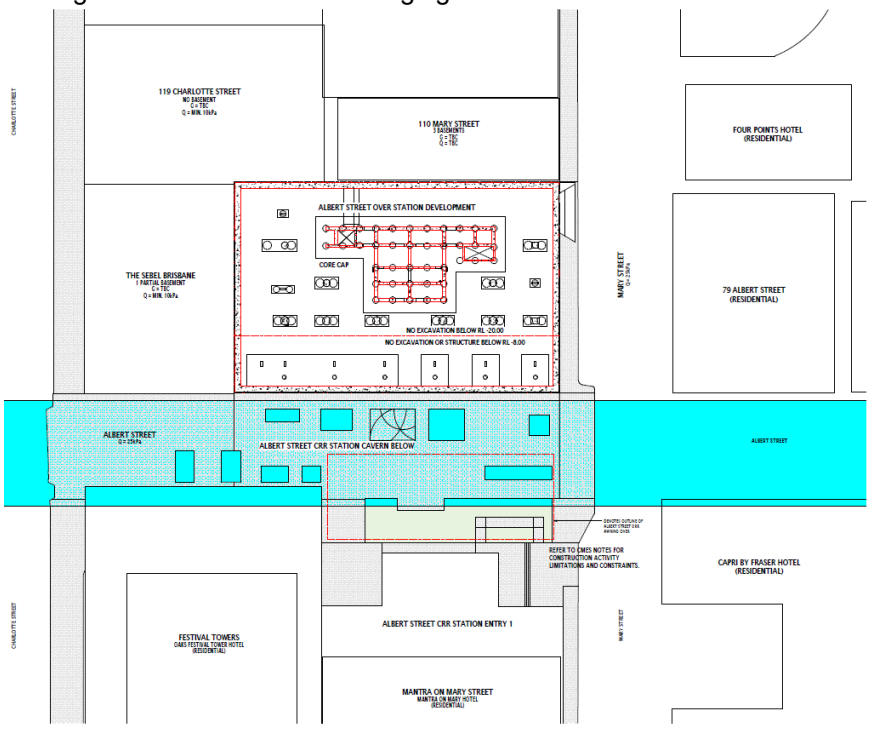


Figure 4 - Plan showing buildings adjacent to Albert Street Station OSD

The SMVR report is based upon the currently proposed structural design solution as at the Schematic Design Phase proposed for the Albert Street OSD and the approach to the building elements.

The assessment is based upon best practices for modelling the potential impacts of vibration. The modelling uses advanced data bases relevant to the equipment type together with the geology of the area in which the works will be undertaken. The assessments are based upon methods and data developed from more than 1000 other projects and therefore have an acceptable degree of accuracy in the predictions and effects.

The key requirements as per MCU10 include:

- An instrumentation and monitoring plan specific to the non-rail infrastructure, including drawings, frequency of monitoring, vibration limits and actions to be taken should limits be exceeded.

- Separate reports detailing the condition surveys for the adjacent buildings. The list of requirements for these surveys is extensive and detailed in MCU10 and are largely consistent with the detailed work by the RBG and EDG. In addition, these are informed by the vibration modelling and settlement assessments. A dedicated section of the SMVR report will include justifying the extent of the condition surveys.

- Discussions with the utility providers and other authorities, such as TMR, are also required. Whilst there is a history of acceptable methods from previous projects, these tasks can be onerous and can necessitate extended consultation, particularly for UU and the S1 Sewer.

8. TSMP SCOPE

In addition to the SMVR, MCU11 requires that Track and Structures Monitoring Plan (TSMP) is developed. The document is similar to the SMVR although specific to the CRR infrastructure, as opposed to the buildings and below ground utilities. The key aspects of the TSMP, as per MCU11, include:

- An RPEQ certified Track and Structures Monitoring Plan (TSMP) which addresses all construction, including demolition and earthworks, impacts on the railway corridor, including rail transport infrastructure, such as tunnel walls, tracks, retaining walls and Overhead Line Equipment (OHLE) and other rail infrastructure. The TSMP is to establish an alignment and vibration management and monitoring program which ensures that the safety and operational integrity of the railway corridor, including rail transport infrastructure and other rail infrastructure, is not adversely affected by the development. The TSMP must include mitigation measures to manage the identified risks.

- Establish an appropriate monitoring system utilising the relevant instrumentation, for the purpose of alignment and vibration monitoring, along the horizontal and vertical alignments of the nearest existing rail transport infrastructure such as tunnel walls, tracks, retaining walls and Overhead Line Equipment (OHLE) and other rail infrastructure.

- Monitoring at defined locations to determine the existing peak component particle vibration and alignment to establish a control baseline. Intervention limits must be determined to manage the safety and operational and structural integrity of the railway corridor affected by any construction works, including earthworks and demolition. The level of acceptable movement, trigger levels and monitoring accuracy must be addressed.

- The requirement for the applicant to engage a RPEQ to continuously monitor the instrumentation identified in this condition using an automated 24/7 system during the works and provide scheduled alignment and vibration monitoring reports to the Metropolitan District Compliance Unit.

The TSMP is presented as a separate report.

9. IMP SCOPE

In addition to the SMVR, MCU12 requires an Instrumentation and Monitoring Plan (IMP). The IMP extracts the assessment information from TSMP to produce a standalone rail-based Instrumentation Monitoring Plan. MCU12 requires an RPEQ certified instrumentation plan (including but not limited to total station (prisms), inclinometer, piezometer and vibration monitoring) which investigates any construction (including demolition and earthworks) impacts on the railway corridor, including rail transport infrastructure or other rail infrastructure. The relevant information within IMP will be contained within the TSMP. The key aspects as per MCU12 include:

- The locations, types and number of monitoring devices inside and adjacent to the rail transport infrastructure, other rail infrastructure and railway corridor.
- The requirement for the applicant to engage a RPEQ to establish the baseline structural (total station) and ground movement (inclinometer) and vibration readings.
- Confirmation of the frequency and the duration of monitoring supported by appropriate justifications and assumptions. During construction, the monitoring must be continued until the super structure has been completed.
- The requirement for the monitoring to be automated using a 24/7 system.
- Details of the approach when the movement and trigger levels are breached, including specific actions to be undertaken and who is responsible for each, the notification process, lines of communication, and stop work procedure.
- The requirement to provide the overall monitoring results to the Metropolitan District Compliance Unit.

The IMP is presented as a separate report.

10. CONSTRUCTION ACTIVITIES

The proposed bulk excavation level for the Albert Street OSD is RL-5.6m which complies with the Licence Construction Area and with RL-8.0m as the minimum excavation level constraint. Post installation of the shoring and retention system, alternating staged demolition and bulk excavation will be required across the basement footprint to create the new formation level to accommodate the proposed subfloor drainage system and Basement 2 slab-on-ground.

The extent of bulk excavation for the subfloor drainage is to be reviewed following the demolition of the existing acoustic shed slab. The extent of groundwater can be determined at this stage and any adjustments to the modelling outcomes undertaken should these be necessary. The extent of bulk excavation may therefore be refined following further geotechnical investigation.

Detailed excavation will be required for the building pad, raft and pile cap footings, in-ground services, and tanks. Secondary shoring, potentially in the form of sheet piles may be needed to enable detailed excavation to the deeper pile caps located above the rock in the residual soil layer. A survey of the existing footings and in-ground services will be required following the demolition of the existing acoustic shed slab. Existing footings clashing with proposed footings, in-ground services and tank locations will need to be removed and, where directed, backfilled with mass concrete (weak mix). Detailed excavation for new footings will then be saw-cut through low-strength rock/weak mix concrete.

The demolition and construction phases will utilise equipment that may be capable of producing

potentially elevated levels of vibration. The principal vibration inducing construction activities will be continuous, or semi-continuous.

The vibration from other sources of equipment that could also be used in some of the stages of the works, such as cranes, compressors, generators, demolitions saws, chainsaws, concrete booms, knuckle booms and so on have not been analysed. The vibration from these sources has not been assessed as it is considered insignificant compared to the vibration from the hydraulic hammer or vibratory piling. There is no precedent from other projects that this low vibration impact equipment could generate reasonable levels of vibration that justify further detailed levels of analyses. If there are concerns raised for any works associated with these other equipment types, vibration measurements will be undertaken, and the results analysed.

11. ADJACENT INFRASTRUCTURE

The project extends across two buildings at the rear of the 101 Albert Street site. The closest commercial building to the 101 Albert site is within several metres of the planned footprint at the closest point. The other properties on the eastern side of Albert Street are further than 25 metres from any of the planned works. The adjacent properties relative to the planned works are shown in the following drawing.

Buildings along Albert, Mary and Charlotte Streets necessitate detailed assessments to inform the design and monitoring procedures. The plan showing the extent of the works and the adjacent infrastructure is shown in the following Figure 5.

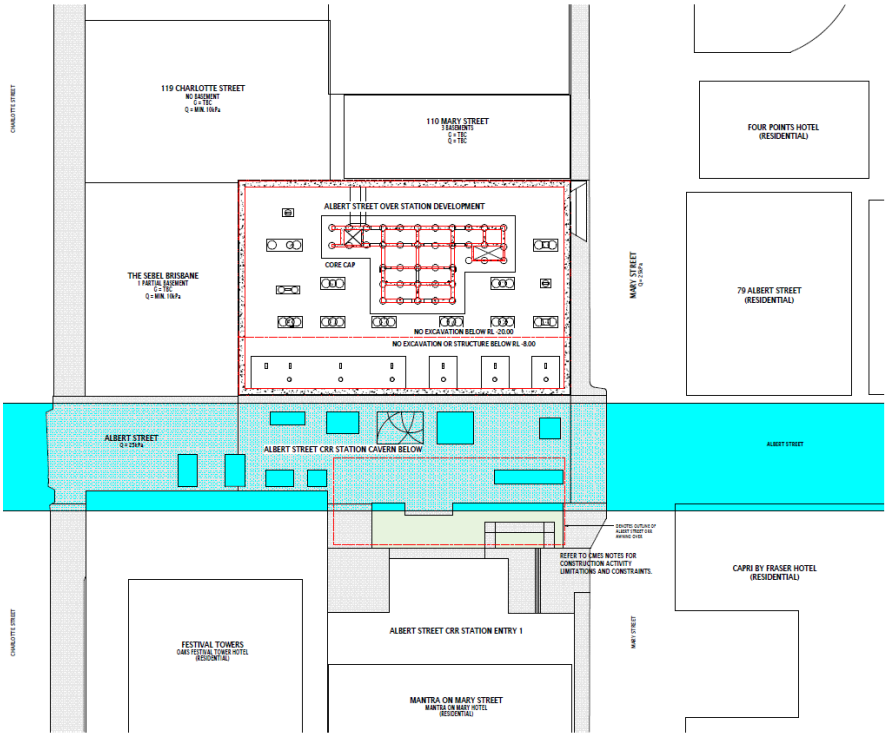


Figure 5 - Plan showing extent of works and adjacent buildings

Other significant below ground infrastructure, such as communications, water, sewer, electrical and gas run along Albert Street at depths varying between a few metres below the existing ground surface to around 8 metres for the deeper *S1 Sewer*.

11.1. Cross River Rail

The OSD site is adjacent to and partially over temporary and/or permanent CRR assets associated with the Albert Street Station. The major adjoining asset of most importance is the station Cavern that runs under Albert Street. This cavern sits just under the site boundary of Albert Street. The cavern is a mined arched structure with its base at circa RL-30m and its crown at circa RL-13m.

There are duct and escape passages below the cavern that link back to the primary station structure located on the opposite side of Albert Street.

The CRR Albert Street Station is presently under development but in terms of the key elements with respect to this assessment, includes both a Mezzanine level and platform level.

A plan showing extent of works relative to the overall length of the Albert Street Station Cavern is shown in the adjacent Figure 6. The length of the OSD footprint along Albert Street is approximately 65 metres and lies towards southern end of the Albert Street cavern.

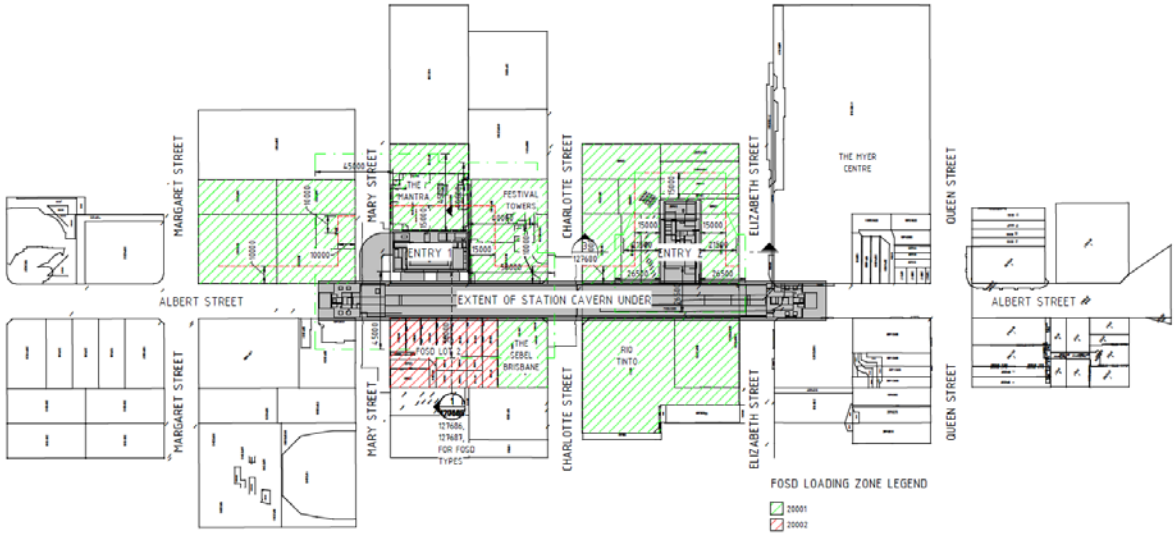


Figure 6 - Plan showing extent of works relative to Albert Street Station Cavern

The figure below includes a section through the development site and the adjacent cavern and station structure. The extent of the proposed basement on the development site is also highlighted. The section is looking southeast along Albert Street.

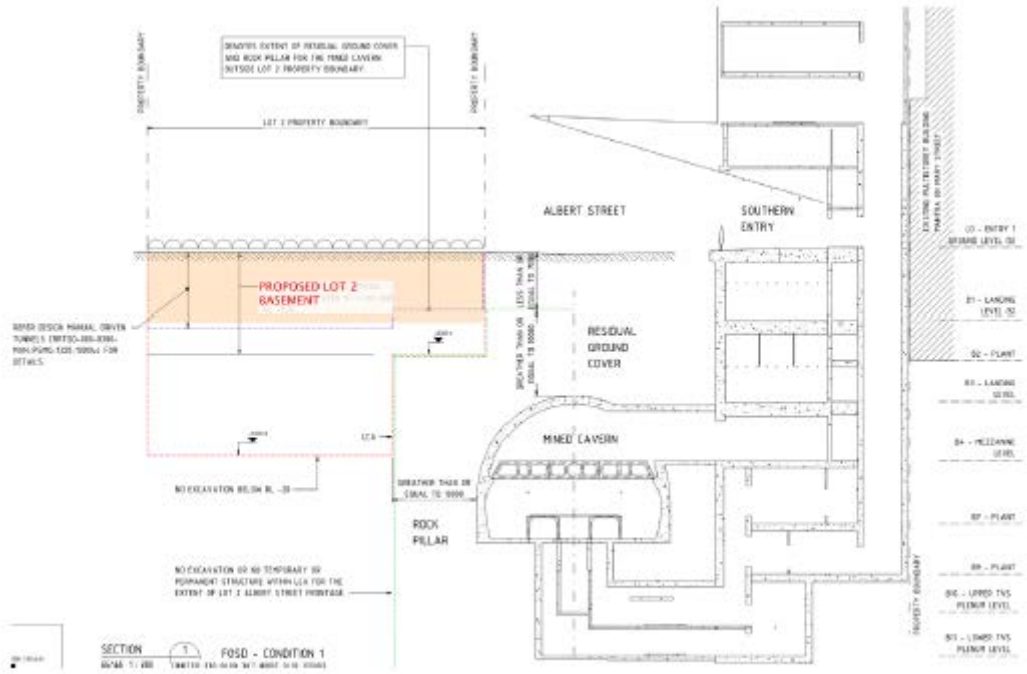


Figure 7 – Development site and the adjacent CRR assets (after RBG)

11.2. Commercial Buildings

The Albert Street OSD directly adjoins three properties on the northern and north-eastern boundaries of the site and include The Sebel Brisbane, Martin College Building and 110 Mary Street building. None of these structures are listed on the Queensland (State) or Local (BCC) Heritage structures register. All are multi-storey.

In addition to the adjoining buildings, other multistorey commercial towers are located along Mary, Albert and Charlotte Streets. The width of the road corridor necessarily increases the separation distance of these additional buildings to more than 20 metres.
The locations of these adjacent and other closest additional buildings are shown in the following Figure 8.

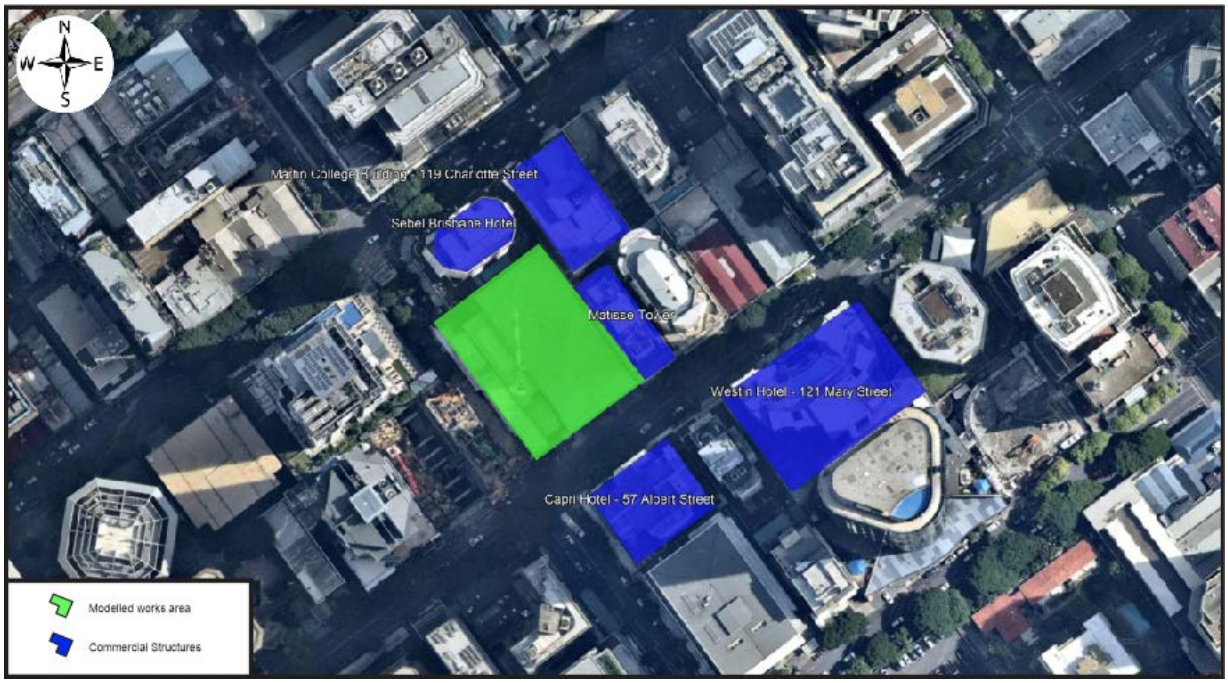


Figure 8 – Adjacent and nearby commercial buildings to the 101 Albert Street works site

Photographs of the buildings are shown in the following Figure 9



Sebel Brisbane Hotel – Albert and Charlotte Streets



Martin College Building – 119 Charlotte Street



Stonehouse - 110 Mary Street



Capri Hotel -57 Albert Street



Matise Tower - 110 Mary Street



Westin Hotel - 121 Mary Street

Figure 9 – Commercial buildings within 150 metres of the planned works

11.3. Queensland Heritage Register Listed Buildings

The nearest listed heritage structures identified on the Queensland Heritage Register are as follows:

- Mooneys Building 130-132 Mary Street that is approximately 40 metres to OSD at the closest point.
- 138 Mary Street that is 60 metres to OSD at the closest point.
- Perry House 167 Albert Street that is 115 metres to OSD at the closest point.

- Charlotte House 139-145 Charlotte Street that is 60 metres to OSD at the closest point.
- Brisbane Synagogue at 98 Margaret Street that is 150 metres to OSD at the closest point.

The locations of the heritage listed properties adjacent to the works are shown below in Figure 10.

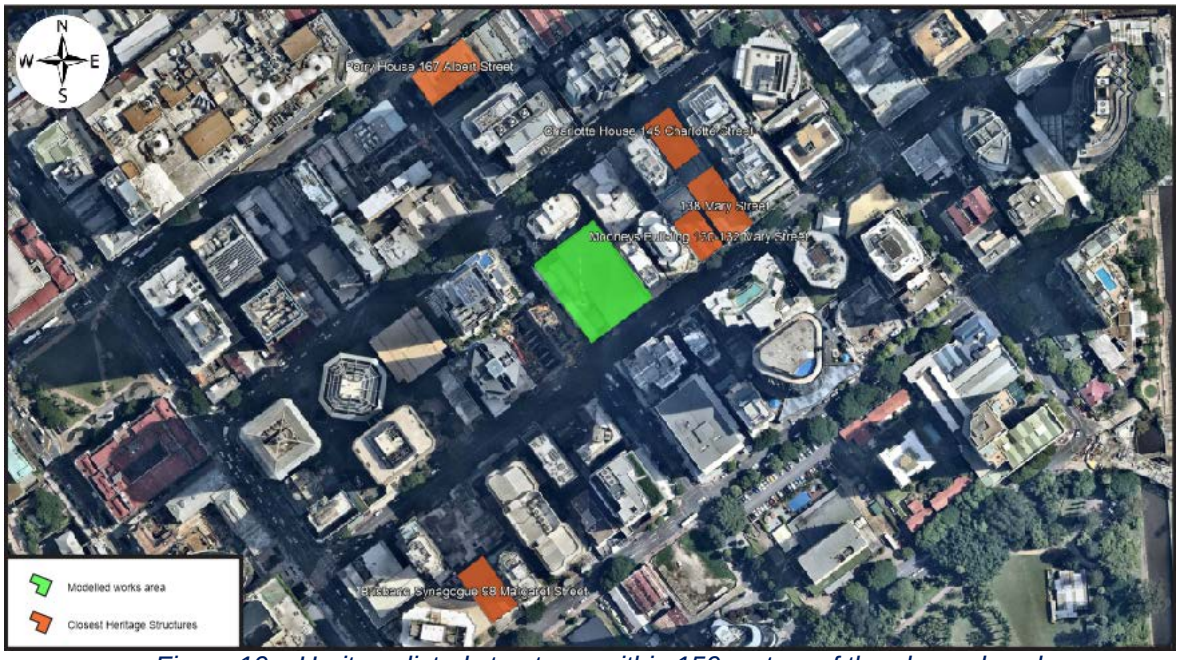


Figure 10 – Heritage listed structures within 150 metres of the planned works

Mooneys Building: Mooneys Building is a heritage-listed warehouse at 130–132 Mary Street. It was designed by Stanley and built in 1883. It was added to the Queensland Heritage Register on 22 June 1993. Mooney's Building, a two-story stone structure with a basement. It is adjacent to Perkins Stables and a laneway flanked by 138 Mary Street. Charlotte House and Harrolds Marine are positioned behind it, facing Charlotte Street.



The building features a symmetrical layout, mirroring the original land subdivision. Its façade, rendered with subtle Italianate detailing, predominantly exhibits horizontal banding. A string course divides the façade horizontally, while pilasters separate it vertically. Each section boasts three arched openings on both levels. Ornamentation includes architraves, pilasters, keystones, horizontal mouldings, rosettes, decorative urns, and centrally placed triangular pediments in the parapet.

Constructed from Brisbane Tuff with some sandstone, the side and rear walls have an opening leading to the laneway on both levels. At the rear, the gable roof forms of both sections. Although most upper-level openings have been altered, the original brick archways for these openings remain intact, except for one

Mooneys Building was listed on the Queensland Heritage Register on the 22nd June 1993 as being important in demonstrating the principal characteristics of an 1880 stone warehoiuse with its facde designed in Italianate style.

138 Mary Street: The building is a is a heritage-listed wine and spirits storehouse built around 1901 and remains an important remnant of a major industrial brewing complex. The building was added to

the Queensland Heritage Register on 21st October 1992.



The building is brick building with a stone basement, partially exposed at sidewalk level. The facade is split into two almost identical symmetrical parts, each featuring three major arched openings. The base treatment of the facade is rendered and coursed to mimic ashlar. A string course spans between the openings at the arches' springline level. The original entrance lies in the middle of the eastern section, with two additional entries added to match the original opening. Laneways flank both sides of the building, featuring square-headed openings to maximize natural light.

At the rear, a plain L-shaped brick building forms a courtyard with the rear of the main structure. This appears to be a later addition (before 1913), characterised by willow broad arched brick openings. The connecting narrow section of the building includes a loading bay at the first-floor level.

Internally, the front building displays some visible stonework in the basement, while the upper floors have been renovated. Much of the original floor structure of the rear building is observable from the basement level.

Perry House: The building is a heritage-listed office building at 167 Albert Street (corner of Elizabeth Street). It was constructed between 1911 and 1923 and added to the Queensland heritage Register on the 27th October 1994. The building is commonly referred to as the Royal Albert Apartments. The heritage status is noted to refer to an example of a very tall building in a timber framed construction method.



Originally designed as an eight-story timber frame brickwork structure in the Federation warehouse style, the building has a two-story podium finished with cement render. Plain brick piers are connected by recessed horizontal bands of cement render at each floor level. The current parapet, above the added storey, bears the name "Perry House". The piers include both arch and keystone elements. Bands of cement render on the turrets and upper floor enhance the banded effect seen on the main body of the building.

With minimal exterior alterations aside from the addition of the upper storey, minor adjustments to the ground floor facade, and the installation of a street awning featuring pressed metal ceilings, the building exterior appearance is consistent with the original works. Significant internal renovations on each floor have concealed the timber frame, with beams hidden above lowered ceilings and columns encased.

Charlotte House: The buiulding is heritage-listed warehouse at 139–145 Charlotte Street that was constructed bbetween 1888 and 1889. It was added to the Queensland Heritage Register on 21st October 1992. The heritage status is reported because the building is a rare and good example of late nineteenth century warehosue with an intact facde which incorporates Greek and Egyptian motifs.

The warehouse is made of a timber frames, brick, and cement render. It has four stories along with a basement. At the northeastern end, there's a distinctive bay marking a carriage entrance.

Six window openings and the carriage bay are separated by large pilasters with three of them being more ornate to highlight the ends of the building and the carriage entrance. The pilasters on the basement and ground floors have fluted designs, while those on the upper floors feature a Greek linear pattern.



The building is divided into three sections by two prominent string courses—one above the ground floor and another above the second floor. Above the minor pilasters on the upper floor, the words "Charlotte House" are painted, topped by a molded cornice. The roof is adorned with acroteria at the points of this pediment and each of the eight pilasters.

Adjacent to the building is a two-story brick store that was part of the original construction.

Although extensive internal changes were made in 1964, both the structure and the facade of the building remain unchanged.

Brisbane Synagogue: The Brisbane Synagogue is a heritage-listed building at 98 Margaret Street and constructed between 1885 and 1886. It was added to the Queensland Heritage Register on 21st October 1992. The heritage status reflects multiple elements specific to the construction, architects and presence of the community.



The building is made of brickwork covered in stucco, resting on a concrete foundation. On Margaret Street, the main highlight is a grand doorway crowned by a massive arch, above which sits a large circular window made of Oamaru stone. The window design incorporates circular patterns in its tracery and features leadlight panels. Flanking the front are minaret turrets, which transition into octagonal shapes towards the top and have narrow slit openings. Each turret is topped with an octagonal cupola. Above the entryway's gable, there's a central circular ventilator and a frieze with circular motifs. The recessed portions of the building on either side of the entry also feature circular tracery windows in arched openings on the upper level. Beneath these openings are pairs of Romanesque arched windows on each side.

The main arch of the entryway is supported by small Corinthian columns, with the section above the arch inscribed with "THE BRISBANE SYNAGOGUE." Above this inscription are decorative dentils and geometrical rosettes on either side. The back wall also boasts a large circular tracery window made of Oamaru stone. The side walls have large swinging windows to allow for cross ventilation.

Designed to accommodate 400 people, with 260 on the ground floor and the rest on the upper-level women's gallery, which extends over the entry and along both sides. Inside, the space is divided into a nave and side aisles by large octagonal columns with moulded caps and cement bases. Broad semi-circular arches span between these columns. The ceiling is made of timber boarding with circular fretwork ventilators evenly spaced down the centre. The gallery is supported by small trusses and accessed by two flights of stairs, one at the front and one at the rear. The seating on both levels is stepped and faces the centre, where there's a carved timber platform. An arched recess, approached

by stone steps, is in the end wall, flanked by marble plaques. Stained glass sits within the circular windows on the gallery level and the arched lower openings.

11.4. Adjacent Below Ground Utilities

Multiple below ground services are shown to be present to along Albert Street. The following figure shows the identified below ground services:

- Drainage
- Low voltage electrical
- Lighting
- Communications
- Gas
- Water
- Sewerage

The locations of the assets are shown in the following Figure 11.

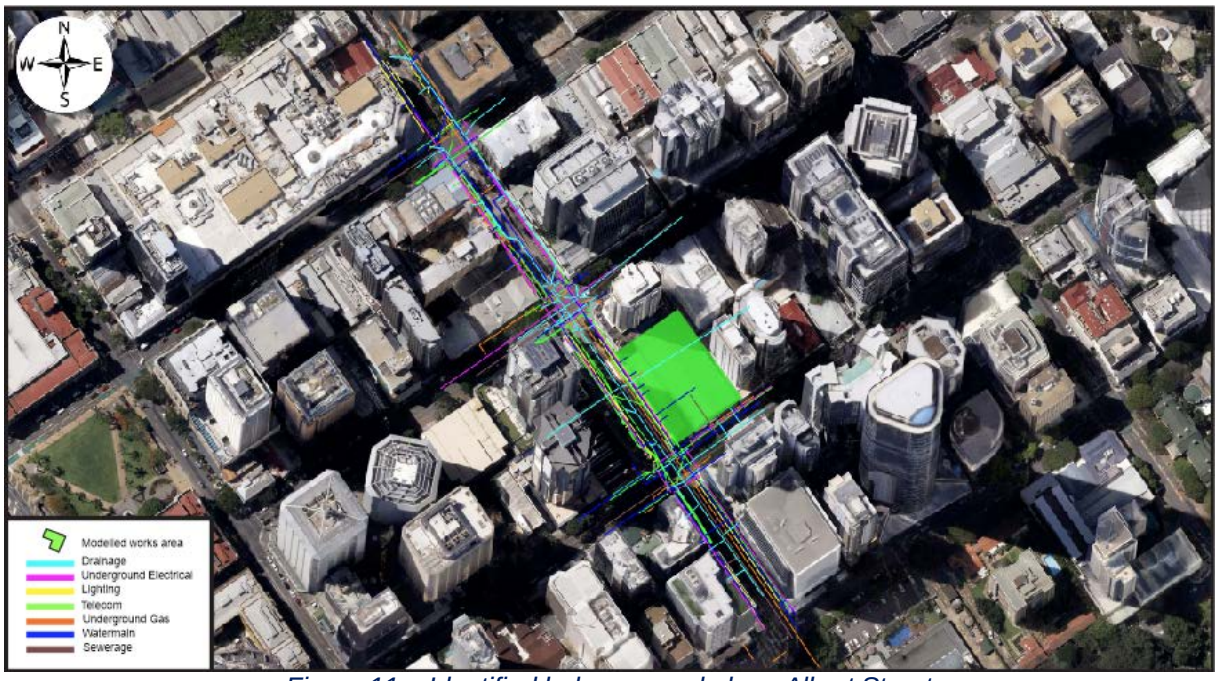


Figure 11 – Identified below ground along Albert Street

The RL for most of the services varies between RL2.0m and RL2.9m. The finished floor level for the lower basement B2 of the 101 Albert Street is RL-5.2m which confirms the services lie between the planned lower basement horizon and the existing ground surface. The S1 Serwer is the exception and lies at RL-3.0m.

11.5. S1 Sewer along Albert Street

Based upon the requirements and necessary assessments for other projects in the Brisbane CBD, the *S1 Sewer* is identified as the most critical utility in the general project areas and will necessitate an increased level of assessment and subsequent monitoring. Urban Utilities, as the agency responsible for the asset, have previously expressed concern given the unknow condition of the asset as well as its integral requirement as a key utility.

Other reports have indicated that the *S1 Sewer* is a 450mm diameter in-situ constructed pipeline that runs below Albert Street at an approximate depth of 8 metres. Figure 11 shows the location of the Albert Street sewer as the solid brown line. The sewer is approximately at RL-3m at Mary to Charlotte Streets, or around 8 metres below the surface ground level. The sewer has a fall of approximately

1.7%. The *S1 Sewer* is regarded as a piece of sensitive infrastructure and pre-dates the *Cross River Rail* station works that involved significant blasting and excavation in rock.

The exact details of the *S1 Sewer* are not well documented, including the condition and integrity of the surrounding mined tunnel into which the sewer was placed. The nominal *S1 Sewer* along Albert Street has a diameter of 450mm, of vitrified clay (concrete unreinforced) and laid through what is thought to be a slightly larger timber lined tunnel. It is not clear whether the original design arranged for fly ash to surround the sewer, however it is expected that much of the sewer will now have been covered with spoil or debris loosened from the crown or walls of the tunnel. Little is known as to whether it is in poor and/or deteriorating condition, in particular the crown of the sewer.

The following Figure 12 specifically shows the location of the Lot 1 station access area, the cavern and the 450mm diameter sewer in the timber lined tunnel, as identified by the brown utility closest to the tunnel crown.

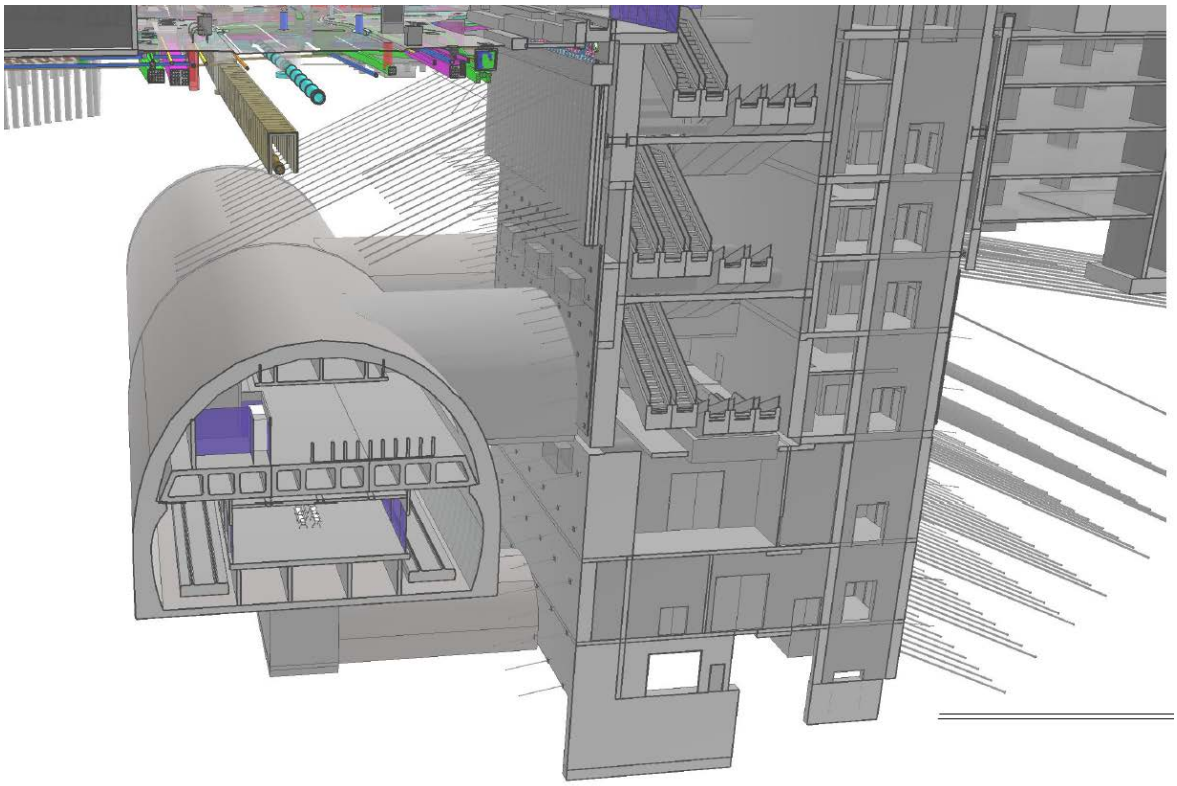


Figure 12 –Albert Street station with sewer shown above tunnel

The drawing indicates that the crown of the tunnel is at RL-12.9m with the centre of the sewer at RL-3.0m, or approximately 9.9 metres above the crown, but along the centre line of the tunnel.

Protecting of the *S1 Sewer* from vibration damage from the CRR activities at the Albert Street Station and other CBD works areas has been achieved by ensuring that the level of induced vibration complies with an appropriate vibration limit. Few reliable details are available on acceptable levels of vibration for aged pipelines of unknown construction type and methods. International literature and procedures indicate acceptable limits up to hundreds of mm/s for concrete pipelines, but an acceptable limit for the *S1 Sewer* will be less because of the greater sensitivity and consequences of failure. A review of the literature, vibration limits applied for other successfully completed projects in Australia, and theoretical calculations based on the material properties suggest limits around 25mm/s will ensure the sewer's integrity is maintained. However, based on the sensitivity of the *S1 Sewer* and some reticence towards exposing the sewer to any level of vibration, it is considered appropriate to restrict the level of vibration to below this limit.

12. HIGH RISK BUILDINGS

The Department of Transport and Main Roads (DTMR) have produced a Technical Specification (MRTS51 Environmental Management[2] which provides commentary around managing vibration impacts that are identified as high-risk elements. The term “high-risk” commonly apply to infrastructure that is either exposed to elevated impacts or has significant consequences if the integrity or the continued serviceability of the asset is affected. As per Condition MCU10 (g) and the MRTS51 definition is applied in this assessment, the five heritage listed structures are classed as high risk.

The following commentary relates oi the specific requirements under MTRS 51 for high risk structures.

In Section 8.6.1 of the MRTS51 document indicates that the contractor is responsible for managing Work under the Contract to avoid Environmental Harm to Sensitive Receptors, Infrastructure or Utilities. For the purposes of this assessment, the potential vibration impacts are to avoid structural damage to buildings and structures within and beyond the Site. This also includes to managing impacts on building contents and surrounding utilities and services.

MCU11 indicates that the identified heritage places ae all considered high risk and will therefore require compliance with the high-risk assessments and monitoring specified in the MRTS51 document.

The Contractor will document the reasonable and practicable Management Measures either in a Vibration Management Plan or the EMP(C). The Contractor will review the Vibration Management Plan and update and implement additional Management Measures are required.

The performance requirements of the Contract are dependent on the vibration risk level specified in Clause 5.1 of Annexure MRTS51.1.

As per Section 8.6.2.1 of the MTRS51, in managing vibration effects in nearby buildings and structures, the Contractor will comply with the following:

- *Vibration limits given within the Transport Noise Management Code of Practice: Volume 2 (for medium or high Vibration Risk Projects only).*

- *Ground vibration values in TN03 Measurement of Ground Vibrations and Airblast unless otherwise set by Vibration Assessment Report*

Where the vibration criteria cannot be achieved, the Contractor will notify the Administrator and advise the owner of the premise, building, service or structure affected of the predicted particle velocity and what reasonable and practicable Management Measures will be employed to minimise impacts.

For contracts identified high risk for vibration, Section 8.6.2.3 indicates:

- *Prepare and undertake a Vibration Assessment Report identifying Sensitive Receptors, Infrastructure and Utilities in accordance with the Transport Noise Management Code of Practice: Volume 2. The Vibration Assessment Report will identify Sensitive Receptors to be included within the Vibration Management Plan and will be carried out prior to the commencement of vibration-generating Works. The Vibration Assessment Report will be signed off by an RPEQ with relevant qualifications and experience.*
- *Where required by Vibration Assessment Report, a condition survey of buildings and structures as 'at risk' of damage. The survey will assess the current structural and architectural condition of buildings and structures and will record all existing cracks and other defect. Photographs will support the condition survey. A registered structural engineer (RPEQ) will carry out the condition survey. The survey is to be carried out with the consent and in the presence of the owner or owner’s representative.*

- *A Vibration Management Plan will be based on the information and outcomes of the RPEQ signed Vibration Assessment Report.*

[2] Queensland Government Transport and Main Roads Specification MRTS51 Environmental Management” June 2023

- *Undertake post-construction condition surveys at buildings and structures subsequent to completion of the works. Post-construction condition survey reports detailing the results of the inspections will be submitted to the Administrator following completion of the relevant activity.*
- *Undertake other investigations such as building contents investigations and infrastructure, services and utility investigations as determined in the Vibration Assessment Report.*

Section 8.6.3 requires that the contractor undertake assessment for vibration monitoring for structural impact during the works under the contract identified as having potential risk of impact.

13. VIBRATION CRITERIA FOR THE ABOVE GROUND INFRASTRUCTURE

The potential effect of vibration on structural integrity of buildings vary according to the building construction. The common broad building categories are heritage, residential and sensitive commercial with only the heritage and commercial building criteria relevant to this project.

The relevant vibration control requirements for the project, in particular the adjacent buildings, are drawn from conditions, associated guidelines and other standards that are referenced in the Australian Standard AS2436:10[3]. These also replicate other guidelines and criteria that have been applied on other projects as well as being consistent with the Queensland Department of Transport and Main Roads, Transport Noise Management Code of Practice: Volume 2 – Construction Noise and Vibration March 2016[4] and the German Standard DIN4150:3-2016[5]. The documents list appropriate vibration criteria for various sensitive land uses and, in this context, remains an applicable document.

The AS2436-2010 standard is particularly relevant because it specifically addresses vibration control from demolition and construction sites. The standard also references British Standard BS7385.2-1993 which is applicable for the protection of buildings from vibration related damage. The same British Standard is also referenced in other standards, such as the Australian Standard AS2187.2-2006[6] which addresses vibration.

The AS2436-2010 and the associated British Standard BS7385-2:1993 do not distinguish aged or very sensitive buildings from other structures. The Department of Main Roads document also promotes the same British Standard for protection of buildings although indicates that the German Standard DIN4150-3:2016 should be followed for this sensitive infrastructure.

The assessment therefore applies the DIN4150-3:2016 for the protection of buildings given the precedence of use for previous projects. The permissible values are also supported by the DTMR and BS7385-2:1993 documents.

Compliance with the proposed limits virtually ensures the effects of vibration from planned activities will not impact upon structural integrity or superficial elements of the buildings. Activities which induce levels of vibration that exceed the specifications also do not necessarily indicate that damage will follow. The limits are typically set at levels below which damage has not been observed rather than a level representing the onset of damage.

This Section 13 of the document presents criteria that are based around infrastructure protection rather personal amenity. Amenity matters are considered in Section 14.

13.1. Department of Transport and Main Roads (DTMR)

The Department of Transport and Main Roads (DTMR) have several documents that relate to the measurements control and mitigation of vibration levels from construction activities. These include:

[3] AS2436-2010, “Guide to noise and vibration control on construction, demolition and maintenance sites”, Australian Standards, SAI Global
[4] Queensland Government, Department of Transport and Main Roads, “ Transport Noise Management Code of Practice Volume 2 – Construction Noise and Vibration”
[5] DIN4150-3:2016, “Structural vibration Part 3: Effect of vibration on structures”, German Standards ICS91.120.25
[6] AS2187.2-2006, “Australian Standard Explosives Storage and Use of explosives”, Australian Standards, SAI Global

i. Design criteria for bridges and other structures [7]

ii. Transport Noise Management Code of Practice Volume 2 – Construction Nosie and Vibration

iii. Technical Note 03[8]

The Department of Transport and Main Roads have prepared a manual for the design criteria for bridges and other structures[9]. The document includes in Section 17.3.3, a table indicating assessment requirements. The table is qualitative and does provide vibration values that must be complied with.

The DTMR Technical Note 3 identifies limits for the protection of infrastructure from construction vibration. Whilst the suggested vibration values in the TN03 document are preliminary and have been provided by the department (rather than included in the main document), they largely replicate the values given in other standards and guidelines. The TN03 table is shown below:

Structures	*Max PCPV (mm/s)*
Bridges	25
Reinforced concrete industrial and heavy commercial buildings	15
Light framed structure, residential or light commercial type buildings	10
Un-reinforced concrete or masonry building	5
Heritage Listed Structure	2.5
Reinforced Culverts	10
Cut and Cover tunnel	10
Driven and Mined tunnel	10
Un-reinforced concrete tunnel	5

Table 2 – Recommended ground vibration limits for control for vibration at varying structure (reproduced from Department of Main Roads Technical Note 03 preliminary)

The DTMR Transport Noise Management Code of Practice Volume 2 – Construction Noise and Vibration also proposes vibration criteria for building and structure damage.

This DTMR Code of Practice indicates that vibration levels for potential damage contained in British Standard BS7385-2:1993 and Australian Standard AS2187.2:2006 are adopted as damage criteria from construction activities in this Code.

German Standard DIN 4150-3:2016 'Structural vibration – Effects of vibration on structures' provides building damage criteria for short-term or long-term vibration. DIN 4150-3 provides guidance on an additional type of structure that is of intrinsic value, which is a category not specifically covered within British Standard BS 7385-2:1993.

DTMR recommends both British Standard BS7385-2:1993 and German Standard DIN4150-3:2016 be used for construction projects to determine the likely building/structural damage impacts.

These standards are presented in the following Section 13.2 and 13.3.

13.2. Australian Standard AS2187.2:2006

The Australian Standard AS2187.2:2006 replicates the British Standard BS7385.2 and explicitly recognises vibration limits appropriate for protection of infrastructure as opposed to personal amenity. A summary of these criteria is reproduced as the following Table 3, noting that it refers to blast generated vibration which may lie at the upper end of acceptable values given the short-term nature of blasting and the higher vibration frequencies as opposed to the longer duration vibration from mechanical equipment.

[7] Queensland Government, Department of Transport and Main Roads, "Design criteria for bridges and other structures", February 2021
[8] Queensland Government, Department of Transport and Main Roads, Technical Note 03, "Measurement of Ground Vibrations and Airblast"
[9] Queensland Government, Department of Transport and Main Roads, "Design Criteria for Bridges and Other Structures", February 2024.

The Australian Standard AS2187.2:2006 recommends maximum peak particle velocities for different types of structures with respect to damage from vibration. Table J4.4.2.1 of the standard suggests levels for the prevention of minor or cosmetic damage occurring to structures from ground vibration generated by blasting. The table is reproduced in Table 3.

Type of Building	*Peak component particle velocity in frequency range of predominant pulse*	
	4Hz to 15Hz	*15Hz and above*
Reinforced or framed structures. Industrial and heavy industrial buildings	50mm/s at 4 Hz and above	
Un-reinforced or light framed structure. Residential or light industrial type buildings	15mm/s at 4 Hz increasing to 20mm/s at 15Hz	20mm/s at 15 Hz increasing to 50mm/s at 40 Hz and above

Table 3 – Transient vibration guide values for cosmetic damage (reproduced from AS2187.2-2006)

The expected frequency of vibration from construction activities measured within 30 metres will lie above 30Hz at these closer distances to the infrastructure.

The standard further defines *cosmetic* damage as the formation of hairline cracks on drywall surfaces, the growth of existing cracks in plaster or drywall surfaces or the formation of hairline cracks in the mortar joints of brick/concrete constructions. *Minor* damage is defined as the formation of cracks or loosening and falling of plaster or drywall surfaces, or cracks through brick/concrete blocks. The same standard proposes limits for ground vibration for control of other damage to structures, albeit related to blasting generated vibration.

Category	*Type of Blasting Operations*	*Peak component particle velocity (mm/s)*
Other structures or architectural elements that include masonry, plaster and plasterboard in their construction	All blasting	Frequency dependent damage limit criteria as in Table J4.4.2.1
Unoccupied structures of reinforced concrete or steel construction	All blasting	100mm/s maximum unless agreement is reached with the owner that a higher limit may apply
Service elements, such as pipelines, powerlines and cables	All blasting	Limit to be determined by structural design methodology

Table 4 – Recommended ground vibration limits for control of damage (reproduced from AS2187.2-2006)

For the commercial buildings like those adjacent to the 101 Albert Street site, the Australian Standard AS2187.2:2006 therefore suggests permissible limit of 50mm/s.

13.3. German Standard DIN4150.3:2016

The German Standard is also commonly applied in Australia for the protection of infrastructure. The standard recognises both the influence of frequency upon possible damage to structures, but oriented towards cosmetic or minor damage such as cracking of plaster, rather than damage to reinforced concrete structures.

The German Standard DIN4150.3:2016 specifies a method for measuring and evaluating the effects of vibration on structures. Notably, the standard gives guideline values, which when complied with, will not result in damage that will have an adverse effect on the structure's serviceability, and further if damage nevertheless occurs, it is to be assumed that other causes are responsible.

The standard lists acceptable values for both short- and long-term vibration with the distinction based as to whether there may be any fatigue related failure of the structure. It also recognises the

influence of frequency, recommending levels of 20 mm/s at a frequency of 10 Hz, increasing to 50 mm/s for a frequency of 100 Hz for commercial and industrial buildings. The standard is directed towards preventing cosmetic damage such as crack formation in plaster, rather than damage to reinforced concrete structures. The German Standard provides three curves for permissible vibration limits, according to the type of structure under consideration (commercial, residential, and heritage).

Type of Structure	*Guideline values for velocity (mm/s)*			
	Vibration at the foundation at a frequency of			*Vibration at horizontal plane of highest floor All frequencies*
	1 to 10 Hz	*10 to 50 Hz*	*50 to 100 Hz**	
Buildings used for commercial purposes, industrial buildings, and buildings of similar design	20	20 to 40	40 to 50	40
Dwellings and buildings of similar design and/or occupancy	5	5 to 15	15 to 20	15
Structures that, because of their particular sensitivity to vibration, cannot be classified under lines 1 and 2 and are of intrinsic value (eg. Heritage buildings)	3	3 to 8	8 to 10	8

*At frequencies > 100 Hz, the values given in this column may be used as a minimum

Table 5 - Guideline values for the vibration velocity to be used when evaluating the effects of short term vibration on structures

The German Standard also proposes levels for different structures based upon long term vibration where structural fatigue could occur. The proposed levels are shown in the following table:

Type of Structure	*Vibration Velocity, mm/s (Peak Component Particle Velocity) in horizontal plane at all frequencies*
Buildings used for commercial purposes, industrial buildings and similar design	10
Dwellings and buildings of similar design and/or occupancy	5
Structures that have a particular sensitivity to vibration eg heritage buildings	2.5

Table 6 - Guideline values for the vibration velocity to be used when evaluating the effects of long term vibration on structures

The following notes are referenced to the levels in the above table.

- Vibration levels marginally exceeding those in the table will not necessarily mean that damage will occur and further investigation is required will be required to determine if higher vibration levels can be accommodated without risk of damage.
- Long-term vibration means vibration events that may result in a resonant structural response which is not expected to occur.
- At frequencies above 100 Hz, the values given in this column may be used as minimum values.
- For civil engineering structures (e.g. with reinforced concrete constructions used as abutments or foundation pads) the values for Type 1 buildings may be increased by a factor of 2.
- Short-term vibration is defined as vibration which does not occur often enough to cause structural fatigue, and which does not produce resonance in the structure being evaluated.

For the reinforced concrete, the German Standard DIN4150 suggests a minimum permissible limit of 40mm/s with reference to 80mm/s for the engineered structures.

There is no indication that based upon the adjacent buildings that resonance will occur and therefore the values in first are appropriate for assessing against damage. Based upon the frequency of vibration, an applicable vibration limit will always lie above 15mm/s and generally nearer to 50mm/s.

The British Standard BS7385-2:1993 also indicates:

- important buildings which are difficult to repair may require special consideration on a case-by-case basis. A building of historical value should not (unless it is structurally unsound) be assumed to be more sensitive.

- structures below ground are known to sustain higher levels of vibration and are very resistant to damage unless in very poor condition.

14. AMENITY VIBRATION CRITERIA

Guideline documents have also been developed by various agencies to address amenity concerns from vibration generated by construction works. The British Standard BS6472-1:2008[10] proposes values however these are measured in the dosage metric and commonly difficult to monitor and administer. The same standard allows for the conversion to an equivalent peak vibration level and this approach could be adopted if an alternative vibration criterion for amenity is required.

The DTMR Volume 2 Construction Noise and Vibration code provides human comfort to minimise vibration due to ground borne construction vibration adopts vibration levels with lower and upper bounds. The lower limits are generally considered to be just perceptible. The upper limits are said to cause annoyance if exceeded, although experience at other projects suggests that these lie at the lower end of the relevant vibration values. The guideline values are given in the following table.

<table>
<tr><th rowspan="2">Building</th><th rowspan="2">Work Period</th><th colspan="2">Resultant PPV (mm/s)</th></tr>
<tr><th>Lower Limit</th><th>Upper Limit</th></tr>
<tr><td rowspan="3">Dwellings (including hotels and motels)</td><td>Standard Hours</td><td>1.0</td><td>2.0</td></tr>
<tr><td>Non-Standard Hours (Evening)</td><td rowspan="2">0.3</td><td rowspan="2">1.0</td></tr>
<tr><td>Non -Standard Hours (Night)</td></tr>
<tr><td>Medical/health buildings (wards, surgeries, operating theatres, consulting rooms)</td><td rowspan="4">All

Whilst in use</td><td rowspan="4">0.3</td><td rowspan="4">1.0</td></tr>
<tr><td>Educational facilities (rooms designated for teaching purposes)</td></tr>
<tr><td>Court of Law (Court rooms)</td></tr>
<tr><td>Court of Law (Court reporting and transcript areas, Judges' chambers)</td></tr>
<tr><td>Community buildings (libraries, places of worship)</td><td rowspan="2">Whilst in use</td><td rowspan="2">1.0</td><td rowspan="2">2.0</td></tr>
<tr><td>Commercial (offices) and retail areas</td></tr>
</table>

Table 7- Human comfort vibration limits to minimise annoyance (after Queensland Volume 2 – Construction Noise and Vibration Chapter 3)

Based upon the type of the buildings in the areas around the planned works (commercial buildings or residential apartments), an applicable vibration level to maintain amenity for persons occupying the buildings lies between 1 and 2mm/s for standard daytime works.

Given these adjacent buildings are typically muti-storey, the permissible vibration level at the ground level that corresponds to the DTMR vibration level within the living or sleeping areas of an apartment will be considerably higher. Vibration levels measured from other projects and presented in the international literature show that vibration levels decrease as the vibration propagates from floor to floor. As the vibration passes through the building structure from floor to floor, the vibration generally reduces. This accounts for the dispersion and attenuation of the vibration energy as it propagates

[10] BS6472-1:2008, "Guide to evaluation of human exposure to vibration in buildings Part 1: Vibration sources other than blasting", British Standard

through a building starting with the first suspended floor. The following data in Table 8 data shows the FTA Manual[11] calculations as to how vibration varies within a multi-storey building.

Floor to Floor	*Vibration Adjustment in dB*	*Vibration as % of floor level below*	*Floor above ground level*	*Vibration as % of internal ground level*
1 to 5 floors above ground level	-2dB per floor	80%	1	80%
			2	65%
			3	50%
			4	40%
			5	33%
5 to 10 floors above ground level	-1dB per floor	90%	6	29%
			7	26%
			8	24%
			9	21%
			10	19%

Table 8 – FTA reported vibration change as a result of floor to floor transmission

As an alternative to the values presented in the above table, discussions with the occupants of the potentially affected buildings may also be undertaken to identify alternative criteria, operating times or other appropriate mitigation measures to minimise amenity impacts.

15. VIBRATION CRITERIA FOR THE BELOW GROUND UTILITIES

Whilst overly restrictive vibration criteria will unnecessarily affect the excavation options that can be used, the proximity and type of equipment can be undertaken and provide no greater assurance against damage, appropriate constraints on the works are necessary to ensure the integrity of these assets is maintained. Vibration criteria like those given in the Australian Standards and nearly all other codes in use in Australia are based on protection of "*quality of life*" for residents adjacent to long term operations generating impulsive vibrations, such as blasting at quarries and mines, and therefore have very limited application for protection of engineered structures like below ground utilities.

Vibration limits imposed on construction operations conducted near to services, including fibre optic and copper cables, gas and water pipelines and other services are best determined based on the condition, type and sensitivity of the structure. This agrees with Section J3.2 of the Australian Standard AS2187.2:2006 document which indicates that a detailed assessment of the infrastructure enables the calculation of an appropriate vibration criterion.

The integrity and continued serviceability of the below ground infrastructure will be ensured through compliance with the vibration conditions that are specified in the Standards or other international standards, guidelines and or peer reviewed documents. Compliance with these limits virtually ensures the effects of vibration from equipment are unable to impact upon the below ground infrastructure. Activities which induce levels of vibration that exceed the vibration specifications also do not necessarily indicate damage will necessarily occur. The vibration limits are typically set at levels considerably below those at which damage has been observed, rather than a level representing the onset of damage.

Values for each utility or service are generally based on the asset owners' guidelines. Where asset specific vibration criteria do not exist, either the BS5228-2:2009[12] or the DIN4150-3:2016 values could be applied.

[11] Volpe, J.A., (2018), FTA Report Number 0123 Federal Transit Administration, "Transit Noise and Vibration Impact Assessment Manual", 2018, National Transportation Systems Centre

15.1. Gas Main

The location of the APA gas line is based upon the coordinates that have been provided for the CRR project. APA have previously indicated a requirement to comply with a conservative vibration criteria on their assets, varying between 5mm/s and 20mm/s depending upon the type and condition of the pipe asset. The APA maximum limits of vibration measured on the pipe (and not the ground) are as follows:

- 20mm/s measured at the carbon steel pipe.
- 20mm/s measured at the polyethylene pipe.
- 5mm/s for nylon gas mains

Whilst there are no Australian Standards that specifically propose permissible vibration levels for underground pipeline networks, the German Standard DIN4150.3:2016 has been applied in other areas of engineering vibration assessment, including the assessment of pipelines. This standard proposes a permissible vibration level of 100mm/s measured on a steel pipeline as being protective of the pipeline integrity, Compliance with a 20mm/s value is expected to include a factor of safety with respect to possible damage to the APA asset.

It is also known that small displacements from the vibration can impact upon the jointing between the pipeline segments, potentially leading to separation and failure of the service. The estimated displacement can be calculated from the following equation:

$$d = \frac{PPV}{2\pi f} \times 10^3$$

where d is the displacement measured in microns, PPV is the vibration level in mm/s and f is the dominant frequency of vibration.

At an estimated peak vibration level of 20mm/s and a corresponding estimated peak frequency of 30Hz, the dynamic displacement is calculated as approximately 100 microns, or 0.1mm.

In terms of the effect of vibration on the joints, a vibration of 20mm/s at the gas line equates to a momentary displacement of around 100 microns. As a comparison, lead has a thermal coefficient of expansion of approximately 50 microns per degree. Effectively this indicates that a 10°C change between winter and summer temperatures equates to around a 300 micron expansion differential, or about 3 times that expected from the equivalent 20mm/s vibration value.

The APA criterion is also specified in terms of the level of vibration measured on the pipe. The gas lines will likely be laid with an annulus of material around the gas line which necessarily reduces the transfer between the ground and the pipe because of the impedance mismatch (combination of the material density and compressional wave velocity of the different materials). This impedance mismatch results in some of the vibrational energy being reflected in much the same way as the sound is attenuated as the noise pulse is reflected as it travels through the different medium. This mismatch could result in the gas line vibration receiving around ¼ to ¾ of the ground vibration. The proposed limits for eh APA gas main is therefore conservative.

15.2. Fibre Optic Cables

Utility searches have confirmed fibre optic and other communications networks are within the Albert and Mary Streets and it is critical that continued service is maintained. Any interruption to service is not acceptable. The area contains multiple fibre optic and copper cables that are encased in conduits

[12] BS5228-2:2009 “Code of practice for noise and vibration control on construction and open sites Part2: Vibration”, British Standard

and are likely buried in sand in at least some sections which will further assist in dampening the vibrations from any construction activities.

Optus have previously accepted vibration limits up to 100mm/s for the protection of both copper and fibre optic cables, although more commonly a 50mm/s limit is applied given the sensitivity to service of the optical cable. Telstra have accepted a similar value on other projects.

Like all buried assets, caution will be exercised should any works outside of the main excavation box are required near the buried conduits to ensure that asset is not directly impacted by the equipment. The geometry of the ground support and excavation works however ensures direct impact will not occur. eliminating damage of this type.

15.3. Water

A specific vibration value for the water utilities is typically on either the BS5228-2:2009 or the DIN4150-3:2016 recommendation.

The British Standard BS5228-2:2009 provides some specific information for below ground services, however, because of the variability in use, condition and vibration characteristics, it concludes that they should be assessed on a case-by-case basis. Notwithstanding the above comment, however, it does provide guidance for some scenarios.

Underground services: BS5228-2:2009 proposes levels in the absence of asset owner guidelines:

- *A maximum PPV for intermittent or transient vibration of 30mm/s*
- *A maximum PPV for continuous vibration of 15mm/s.*

A PPV of 30mm/s gives rise to a dynamic stress that is equivalent to approximately five per cent of the allowable working stress in typical concrete and less in iron or steel.

BS5228-2:2009 further notes that in the event of aged or dilapidated brickwork around the asset, the base level should be reduced by 20 per cent to 50 per cent. For most metal and reinforced concrete pipes however, the values above are expected to be appropriate.

The German Standard DIN4150-3:2016 also provides guideline values for the effects of vibration on buried pipework. The proposed values in the DIN4150-3:2016 standard assume that the pipe has been laid using current technology and that there is no reduction for stress concentration because geometry are required. The values therefore exceed the suggested values in BS5228-2:2009. The guideline values provided in the DIN4150-3 for assessing short-term vibration on buried pipework are given in Table 9.

Pipe Material	*Guideline values for velocity measured on the pipe*
Steel (including welded pipes)	100mm/s
Clay, concrete, reinforced concrete, pre stressed concrete, metal (with or without flange)	80 mm/s
Masonry, plastic	50 mm/s
Note 1: When carrying measurements on pipework, sensors will be placed directly on the pipes whenever possible. As an alternative, the sensor may be placed on the ground surface directly above the pipe Note 2: The values presented are the maximum of the values recorded on three orthogonal sensor directions	

Table 9 –Guideline values for vibration velocity when evaluating the effects of short-term vibration in buried pipework

In the absence of a specific permissible vibration criterion for the below ground sensitive water assets, a screening value of 15mm/s is proposed. The value is the minimum level specified in the international standards, and less than the equivalent of what has been proposed on other projects with similar equipment. On other successfully completed projects of this scope, this vibration criterion has successfully protected the integrity of the below ground sensitive assets.

Although the water asset is operated by Urban Utilities, documents from other asset providers that reference vibration limits for water carrying pipelines, such as the SEQ Water guideline D-GDE-STD-001, indicate a limit of 50mm/s at their assets. As a guide, the SEQ Water indicate:

- The maximum vibration at the pipe will not exceed 50mm/s peak particle velocity.
- The applicant must provide sufficient evidence to SEQ water to demonstrate that the integrity and safe operation of the pipeline will be maintained during the operations. Seqwater reserves the right to withdraw its consent if, in its opinion, the process becomes hazardous or is likely to result in the integrity of the pipeline being compromised.
- Seqwater also requires vibration monitoring of its infrastructure, at the applicant's expense, to be undertaken as part of the protocols to ensure compliance and that damage has not been caused to its infrastructure.

The applicable vibration criterion for the Urban Utilities water assets is proposed as 15mm/s. This reflects the relevance to the British and German Standards and the reduction of 50% for continuous vibration.

15.4. Electrical

Energex have low and high voltage buried cable assets through the CBD along Albert and Mary Streets. The buried cables are within conduits an offer protection from vibration effects due to the air annulus between the conduit and the cable, similar to the fibre optic and communication cables. The transmission between the external ground vibration and the cable will be low with the coupling loss expected to be more than 80%, indicating that for a level of vibration in the adjacent rock of 100mm/s, the cable is exposed to a level of around 20mm/s.

16. S1 SEWER

The *S1 Sewer* is identified as the oldest and most sensitive below ground utility around the works. Of the below ground services along Albert Street, it requires the greatest level of assessment. The asset runs along Albert Street and is approximately 8 metres below the existing ground level at RL-3m in the section south-west of the 101 Albert Street site.

Several failure mechanisms for the *S1 Sewer* have been previously identified by Urban Utilities (UU) as potentially resulting from vibration produced by construction activities. These failure mechanisms formed part of the UU consultation process for the Kingsford Smith Drive assessment and were subsequently considered in the Cross River Rail project.

The likelihood of failure occurring depends upon the competency of the *S1 Sewer*, the mechanical properties of sewer (*i.e.* concrete strength *etc*), the nature and competency of the rock mass immediately around the sewer, as well as other controllable factors such the location of the excavation works, including the size and type of the mechanical equipment.

UU have previously identified possible failure mechanisms for the *S1 Sewer* include:

- A level of vibration that exceeds the tensile material properties of the concrete sewer line ultimately resulting in the creation of new defects or the extension/dilation of existing discontinuities with the concrete sewer (*i.e.* in simple terms, cracking of the concrete sewer).
- A level of vibration that impacts upon the rock mass in the tunnel crown above the *S1 Sewer*, creating new fracturing within the rock mass, possibly dislodging fragments of rock that impact upon the concrete sewer and result in failure.

Identifying an appropriate vibration criterion for the *S1 Sewer*, although difficult because of the absence of data on the sewer and any detailed knowledge about the mined tunnel stability, is best addressed through one or a combination of the following techniques:

- Review international literature where studies have been undertaken relating the susceptibility of pipelines to vibration related damage, including identifying vibration limits that have previously been successfully applied for construction activities undertaken near pipelines.

- Based upon the material properties of the sewer, calculate a minimum level of vibration that will lead to a stress in the sewer exceeding the material properties.

- Review international literate to establish the level of vibration which can impact upon the integrity of rock masses, potentially leading to the dislodgement of blocks of material within the crown.

16.1. Other Projects near Sensitive Aged Pipelines

Studies specifically aimed at determining a vibration level for aged concrete sewers are limited and are not well documented in the available literature. Of the projects presented in the literature, the pipelines are smaller in diameter and perhaps less critical with respect to the consequence of any damage. In these cases, the permissible level of vibration ranges upwards from a minimum value of 13mm/s, and more commonly a value of 25mm/s has been imposed.

It is however noted that of these referenced projects, none appear to be associated with the concrete sewer in a mined tunnel. Moreover, the pipelines are manufactured off site under presumably better controlled conditions rather than cast in-situ.

Based on a review of the technical information, it is reported in the literature that concrete pipelines can withstand high levels of vibration prior to damage occurring. It is however relevant to note that the vibration linked with these effects occurs from blasting activities where the source of the vibration is classed as impulsive/intermittent. For the more continuous and repeated nature of vibration that more closely resembles that generated by the hydraulic hammer or piling, the pipelines are generally not as old as the *S1 Sewer* and the consequences of failure of these pipelines are not as great as for the *S1 Sewer*. The projects do however show that permissible level of vibration exceeds 25mm/s. It should also be noted that this value represents a limit for the projects and not necessarily indicates the transition from "*safe practices*" to failure of the sewer.

During the Cross River Rail station construction, a vibration limit of 25mm/s was applied to the S1 Sewer and the blasting works were completed with no known impact. Other mechanical activities also complied with this criterion.

16.2. Theoretical Estimates of Allowable Vibration Level

Several groups have given formulae for calculating stresses and strains within a pipeline for plane wave vibrations propagating parallel to the axis, considered the worst case.

To allow a preliminary assessment of permissible vibration values for aged concrete, estimated material properties for the *S1 Sewer* are given in the following Table 10. These values have allowed for a 75% reduction in the concrete strength as a function of its age, although there is no present suggestion that the concrete strength has deteriorated over time. The approach is considered conservative.

Based upon a minimum "*typical*" concrete compressive strength of 20MPa and applying a conservative reduction of 75% of this value for age and deterioration, the compressive strength is estimated as 5MPa. The tensile strength is estimated to be around 10% of this value, or 0.5MPa. Also allowing for a similar conservative reduction in Youngs Modulus through ageing of 50% to 10GPA, the theoretically allowable strains are calculated on the data as follows.

Property	*ε (Poissons Ratio)*	*E (Youngs Modulus)*	*Compressive wave velocity*	*σ (Tensile Strength)*
Concrete Sewer	0.20	10GPa	3500m/s	0.5MPa

Table 10- Summary of material properties

(conservatively adjusted for the concrete age of the S1 Sewer)

Formulae for pipeline stress strain calculations that result from induced vibration show that for an assumed concrete tensile strength of 0.5 MPa, the critical levels of stress, strain and peak particle velocity are calculated as shown in the following table.

Property	*Critical Stress*	*Critical Strain*	*Critical PPV*
Concrete Sewer	0.5MPa	48μ	168 mm/s

Table 11- Critical vibration levels for S1 Sewer

The above tables indicate that a vibration level of at least 150mm/s is required to induce superficial cracking of the concrete, even at reduced compressive strength of 5MPa.

16.3. Fall of Rock from the Timber Lined Tunnel

The possibility of vibration dislodging weathered or loose rock fragments within the crown of the timber lined tunnel has been previously considered by UU as a potential failure mechanism that could affect the *S1 Sewer* pipeline integrity. Dislodged rock could impact upon any exposed sections of the sewer pipe and result in damage and loss of serviceability. There appears no information available to confirm whether the original void around the *S1 Sewer* remains open or is now filled with debris and/or previously dislodged rock from the crown or walls of the tunnel.

Based on a review of the literature, subjecting a rock mass to a vibration of around 300mm/s is considered sufficient to induce new fractures in the rock mass and could subsequently result in the dislodgement of rock from an unlined tunnel.

These data compare favourably with other published information on damage to rock masses. Other groups have also proposed that the on-set of damage in hard rock occurred at a vibration level in the range of 700 to 1000 mm/s. The data suggest maintaining a vibration level at the *S1 Sewer* of less than 250mm/s will limit the likelihood of fall of newly created blocks of rock created by introducing a fresh set of fracturing into the rock mass.

The level of vibration affecting the rock mass will be dependent upon the competency of the rock. It is however reasonable to conclude that for even very weak rocks, a level of vibration exceeding that which could be generated by mechanical equipment at a separation distance of 5 metres will be necessary to sufficiently fracture the rock mass to cause large blocks to become dislodged and damage the sewer.

16.4. Recommended Vibration Limits for the S1 Sewer

A review of the literature has indicated the difficulty in assessing a permissible level of vibration for an aged, sensitive sewer with unknown build properties and further complicated when the condition of the *S1 Sewer* is also unknown. Data valid for concrete pipelines where blasting has been undertaken has shown that vibration levels in the tens, or even hundreds, of mm/s are considered "*safe*" with respect to impacting upon the concrete integrity. Even accounting for the unknown sewer condition, it is impossible that damage to the concrete sewer could occur through tensile failure from the direct action of vibration, unless the separation distance is less than a few metres.

When compared to the required vibration level to affect tensile failure, the "*dislodgement*" mechanism of failure is more likely although where the rock mass is not sufficiently fractured, or where the blocks of rock in the crown are not essentially free to fall without further increasing the density of the fractures, the likelihood of damage of this type is also inconceivable.

The only likely mechanism for failure of the *S1 Sewer* is considered the "*dislodgement*" of any already loose and significantly large rock fragments within the tunnel crown. These could potentially impact the sewer if they were to fall. This necessarily requires that the original void around the sewer has been maintained and is free of debris to allow direct impact, and secondly, the size of the "*dislodged*" rock fragment is sufficiently large to have enough potential energy to fracture the concrete.

Given the sensitivity of the sewer, the consequences of any damage and the reticence towards initially permitting elevated vibration levels from any construction methods, it is considered appropriate to restrict, at least initially until vibration data have been recorded, the level of vibration. An initial limit of 10mm/s for semi-continuous vibration is identified as a conservative value that protects the integrity of the *S1 Sewer* and allows for a reasonable, cost-effective scale of excavation works to be undertaken.

17. SUMMARY OF VIBRATION CRITERIA FOR SENSITIVE RECEIVERS

The following vibration criteria for the 101 Albert Street project are proposed in Table 12 to protect the infrastructure from vibration occurring from the piling and/or excavation, including hydraulic hammers.

Asset	*Permissible Vibration Criterion*	*Proposed Screening Vibration Criterion*
Amenity	1 to 2mm/s	2 mm/s
Gas mains	20 mm/s	20 mm/s
Fibre optic cable	50 to 100 mm/s	50 mm/s
Water	15 to 30 mm/s	15 mm/s
Electrical	50 to 100 mm/s	50 mm/s
S1 Sewer	10 to 25 mm/s	10 mm/s
Commercial properties	20 to 40 mm/s	20 mm/s
Heritage Properties	3 to 8 mm/s	5 mm/s

Table 12- Proposed vibration criteria for semi continuous vibration for sensitive receivers

18. VIBRATION RELATIONSHIPS

To assess the impact of the project and its ability to comply with the presented vibration criteria, vibration data have been collected from different equipment types and sizes similar to those that may be used. This has involved measuring the level of vibration at a range of distances from the equipment source and analysing these data to develop relationships between the equipment type, distance and vibration level. Many of the equipment types were assessed from large scale projects in the Brisbane City, including the Clem 7, Airport Link, Northern Busways, Legacy Way, Brisbane Move and Cross River Rail tunnels, as well as the many basement excavations for the large-scale buildings.

These vibration relationships have been combined/compared against other vibration data collected from sites both within Australia and Internationally. These data have provided the basis for the equations that are used to determine the level of vibration as a function of distance from the equipment. Other vibration data collected from other projects have also been analysed to determine how the level of vibration decays with distance from the source.

The relationships determine:

- Whether the activity complies with the presented vibration guidelines for damage to the buildings or the below ground utilities.
- Whether the activity unnecessarily impacts upon the residences, tenants or other occupants within buildings living around the works who may perceive vibration.

The assessment also determines whether mitigation measures, such as the use of smaller or alternative equipment types are expected to be required for some sections of the project.

18.1. Vibration Relationships

Vibration relationships from these equipment types have been developed for other sites and have been used to estimate the level of vibration as a function of distance and the overall potential for damage to infrastructure.

Equations used to describe the loss in amplitude vary however a relationship used to represent the level of vibration for the site simplifies to:

$$PPV = \frac{K}{d} e^{-\alpha d}$$

where:

- PPV is the velocity of vibration measured in mm/s
- d is the distance between the source of vibration and the point of measurement measured in metres, and
- K and α are site specific constants which address the level of vibration very near to the source and the degree of attenuation respectively. A higher K value generally refers to a more energetic source. An increased α value normally refers to a ground mass where the level of vibration attenuates more rapidly as the vibration pulse travels from the source.

Although the level of vibration is affected by many factors and generally is best estimated through site-specific measurements, a screening assessment can be completed based upon these previously derived relationships. Given that the relationships that have been used have particular reference to the Brisbane geology and specifically the CBD area, the assessment is provided with an acceptable degree of confidence.

The distances determined from these relationships can be used as a screening guide to confirm whether any further assessment is required or consultation with the property owner is required regarding perceptible vibration.

18.2. Vibration Model

The impacts of the vibration from excavation with the different equipment types have been analysed through a purpose designed vibration model specifically tailored for the 101 Albert Street project. The results for the modelling are given as a series of vibration contours for each of the representative equipment types that will be used in the different demolition, ground support and constructions areas.

In the simplest terms of analysis, where a vibration contour of say 2mm/s is shown, all areas between the works site and the area marked by this contour are predicted to receive vibration from the works exceeding 2mm/s. The maximum level of the vibration contour intersects part of the building or below ground utilities indicates the maximum level of vibration that the asset will be subjected to from the different type of works. The modelling therefore identifies areas of the work where compliance with vibration criteria may necessitate a change in equipment operation, such as a smaller hammer size.

18.3. Initial Assessment of Vibration

The vibration predictions will be verified through initial on-site measurements. These trials will involve measuring the level of vibration from the equipment and at locations varying in distance from the works. The data will be regressed to confirm the vibration relationship and establish whether any re-modelling is required. When the hammering for the construction excavation occurs at the closer distances to the building, a significant amount of site-specific data will have been measured and analysed to verify the confidence in the predictions.

18.4. Vibration Model Verification

In addition to the initial assessment of the vibration level, the verification of the vibration modelling is based upon comparison of calculated distances between the cavern, building or below ground asset and the vibration source location within the 101 Albert Street works site with those values independently calculated from other spatial data bases. Based upon the distance, the predicted level of vibration is manually calculated by applying the vibration relationships for the type of mechanical equipment and compared against the modelled data. Verification is restricted to back calculation of the predicted level of vibration as a function of distance. The accuracy of vibration predictions is limited to the accuracy the relationships indicate for the attenuation of vibration with distance for the different equipment types.

19. ASSESSMENT OF VIBRATION

The integrity of the adjacent buildings, CRR infrastructure and below ground utilities will be ensured through compliance with the vibration conditions that have been proposed in Table 12. Compliance with these limits ensures the effects of vibration from activities will not impact upon structural integrity. The limits are also chosen such that activities which induce levels of vibration that exceed the specifications also do not necessarily indicate that damage will follow. The limits are therefore set at levels below which damage has not been observed rather than a level representing the onset of damage.

The project will utilise various equipment that could produce elevated and potentially measurable levels of vibration. The assessment has been based upon the construction activities described in Section 10 and includes:

- Excavator with and without hydraulic hammer attachment for demolition and excavation activities across the building footprint
- Bauer BG 28V/H (or equivalent) piling rig for installation of 900mm, 1200mm and 1600mm diameter bored concrete piles to a varying depth below ground level.
- Vibratory piling rig for installation of steel liners.
- Tracked excavators between 35 and 60 tonne for ground replacement works and moving of excess material over various stages of the project.

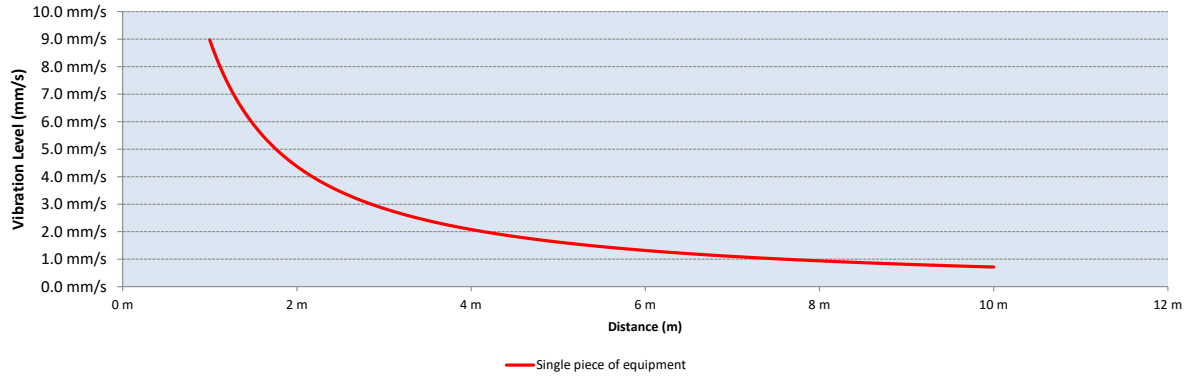
Other miscellaneous sources of vibration linked with the works construction may include:

- Trucks
- Cranes
- Concrete pumps
- Other "*heavy*" earthmoving equipment.

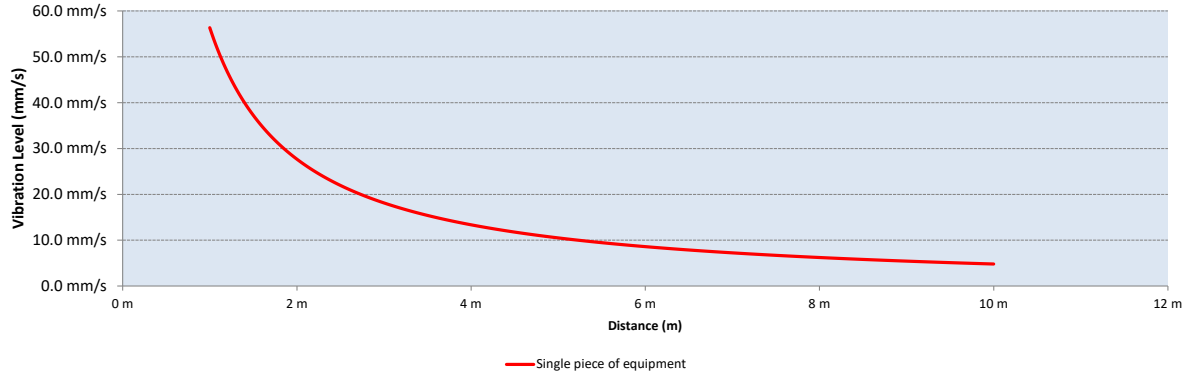
The vibration from these other miscellaneous sources is considered insignificant compared to the vibration from other equipment. The vibration from this equipment and other sources that could be used in some of the stages of the works, such as cranes, compressors, generators, demolitions saws, concrete booms, knuckle booms and so on have therefore not been analysed. There is no precedent from other projects that this low vibration impact equipment could generate elevated levels of vibration or other impacts that justify further detailed levels of analyses. If there are concerns raised for any works associated with these other equipment types, vibration measurements will be completed, and the results analysed.

The vibration data have been analysed to produce a series of vibration distance graphs for each of the equipment types that could be used. These relationships are shown in the following graphs:

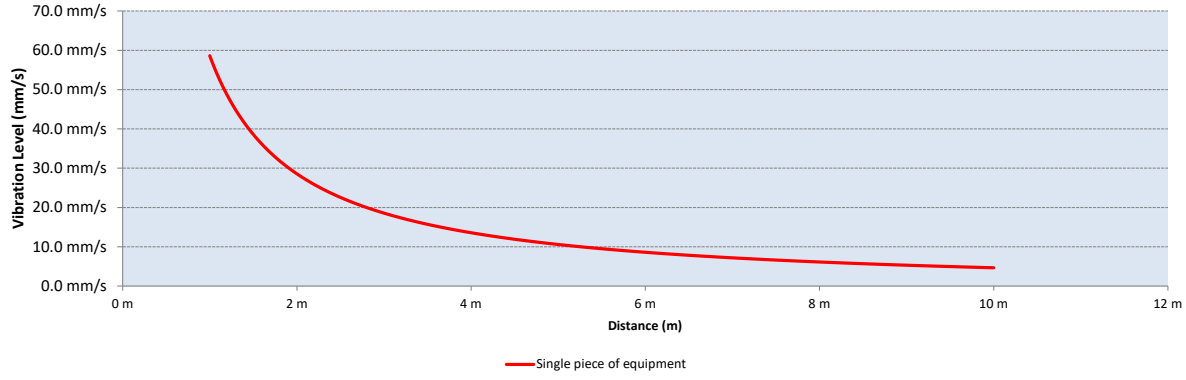
Bored piles



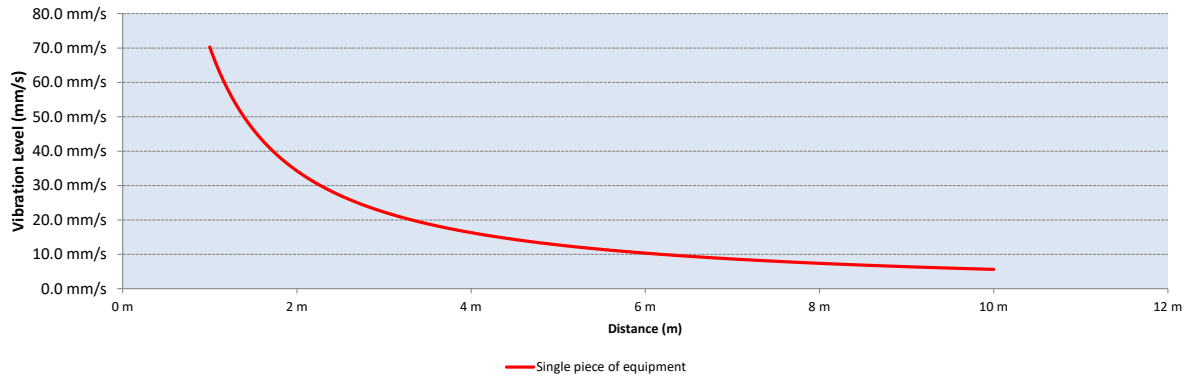
Piles installed with vibratory head (ICE416)



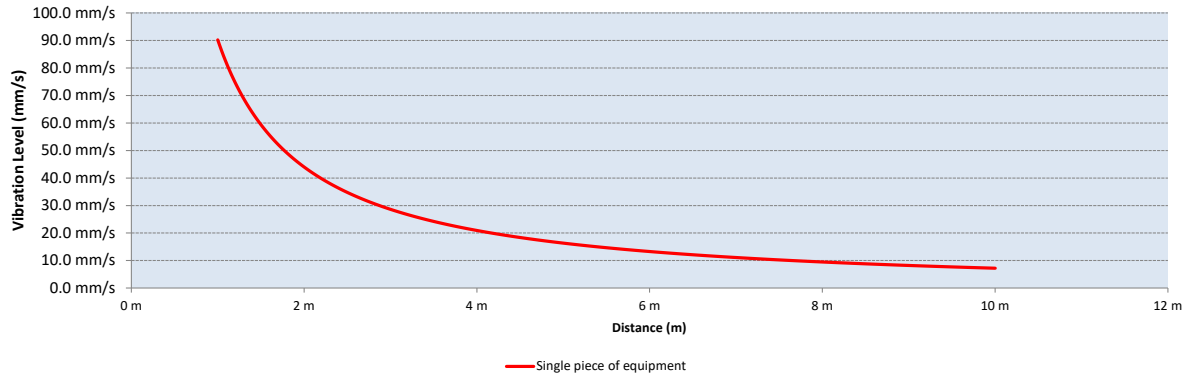
Hydraulic hammer 2000kg mounted to 30t excavator



Hydraulic hammer 3500kg mounted to 40t excavator



Hydraulic hammer 7000kg mounted to 60t excavator



Excavator 35 tonne

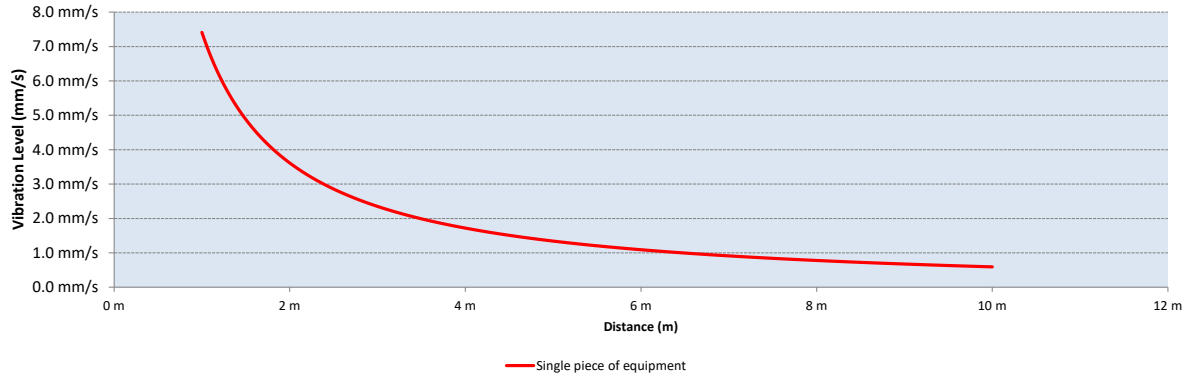


Figure 13 – Modelled vibration relationships for various equipment types for the excavation

For each piece of equipment, the required separation distance between the equipment and the sensitive receiver can be determined to comply with the Table 12 permissible vibration criteria. The following Table 13 shows the separation distances between the works and the asset for compliance with the buildings (commercial and heritage) or the below ground utilities criteria. The distance for compliance with the amenity criterion is also calculated.

Plant Equipment	*Assessment Basis*	*Type of receiver*	*Screening Vibration Level*	*Required Separation Distance*
Bored piers with BG28 or equivalent	DTMR	Amenity	2mm/s	4.5 m
	DIN4150.3	Heritage Buildings	5mm/s	2.0 m
	DTMR, AS2187.2 DIN4150.3 or BS7385	Commercial Buildings	20mm/s	0.5 m
	Engineered Assessment	S1 Sewer	10mm/s	1.0 m
	Previous projects	Fibre Optic	50mm/s	0.5 m

Plant Equipment	*Assessment Basis*	*Type of receiver*	*Screening Vibration Level*	*Required Separation Distance*
		Water	15mm/s	1.0 m
		Electrical	50mm/s	0.5 m
Vibratory pile with ICE416 head or equivalent	DTMR	Amenity	2mm/s	19.5 m
	DIN4150.3	Heritage Buildings	5mm/s	10.0 m
	DTMR, AS2187.2 DIN4150.3 or BS7385	Commercial Buildings	20mm/s	3.0 m
	Engineered Assessment	S1 Sewer	10mm/s	5.5 m
	Previous projects	Fibre Optic	50mm/s	1.5 m
		Water	15mm/s	4.0 m
		Electrical	50mm/s	1.5 m
Hydraulic Hammer 2000kg mounted to 30t excavator	DTMR	Amenity	2mm/s	19.0 m
	DIN4150.3	Heritage Buildings	5mm/s	10.0 m
	DTMR, AS2187.2 DIN4150.3 or BS7385	Commercial Buildings	20mm/s	3.0 m
	Engineered Assessment	S1 Sewer	10mm/s	5.5 m
	Previous projects	Fibre Optic	50mm/s	1.5 m
		Water	15mm/s	4.0 m
		Electrical	50mm/s	1.5 m
Hydraulic Hammer 3500kg mounted to 40t excavator	DTMR	Amenity	2mm/s	21.5 m
	DIN4150.3	Heritage Buildings	5mm/s	10.9 m
	DTMR, AS2187.2 DIN4150.3 or BS7385	Commercial Buildings	20mm/s	3.5 m
	Engineered Assessment	S1 Sewer	10mm/s	6.5 m
	Previous projects	Fibre Optic	50mm/s	1.5 m
		Water	15mm/s	4.5 m
		Electrical	50mm/s	1.5 m
Hydraulic Hammer 7000kg mounted to 60t excavator	DTMR	Amenity	2mm/s	25.0 m
	DIN4150.3	Heritage Buildings	5mm/s	13.4 m
	DTMR, AS2187.2 DIN4150.3 or BS7385	Commercial Buildings	20mm/s	4.5 m
	Engineered Assessment	S1 Sewer	10mm/s	8.0 m
	Previous projects	Fibre Optic	50mm/s	2.0 m
		Water	15mm/s	5.5 m
		Electrical	50mm/s	2.0 m
35 tonne excavator (without hydraulic hammer attachment)	DTMR	Amenity	2mm/s	3.5 m
	DIN4150.3	Heritage Buildings	5mm/s	1.5 m
	DTMR, AS2187.2 DIN4150.3 or BS7385	Commercial Buildings	20mm/s	0.5 m
	Engineered Assessment	S1 Sewer	10mm/s	1.0 m
	Previous projects	Fibre Optic	50mm/s	0.5 m
		Water	15mm/s	1.0 m
		Electrical	50mm/s	0.5 m

Table 13- Critical distance for compliance with vibration criterion for various equipment types

As an example, when excavating with the 2000-kilogram hydraulic hammer attached to the 30 tonne excavator, the 10mm/s vibration criterion specified for the S1 Sewer will be complied with at a distance of 5.5 metres.

The assessment considers that the excavation works could occur anywhere in the 101 Albert Street excavation footprint and is therefore a worst-case scenario. Should excavation not occur immediately adjacent to the boundary for a particular equipment type (i.e. excavation with the larger hydraulic hammer only in the middle of the excavation footprint), the vibration levels will reduce from those modelled values.

The modelled vibration contours are presented for the six different equipment types and different RL at

which they will operate. The vibration contours subsequently allow an assessment as to whether the use of the equipment at this specific RL will comply with the Table 12 criteria. The worst-case modelling results are based on equipment operating at the three RL's as indicated below:

- RL3m which is the approximate level for the below ground utilities along Albert Street. When the equipment is operating at the same RL3m, the separation distance will be a minimum and the vibration level greatest at these utilities. The vibration generated by equipment at this RL is also representative of the highest vibration that the adjacent buildings will be subjected to.

- RL-3m which is the approximate RL of the S1 Sewer. When equipment operates at the same RL-3m, the vibration level will be highest.

- RL-5m represents the lower Basement 2 level and therefore equipment operating at this horizon will be closest to the CRR tunnels and caverns.

The modelled results are presented in the plates that are attached to this document.

Scenario	*Modelling Plate*	*Equipment Type*	*Equipment Operating RL*	*Assessment RL*	*Outcome*
1	A	Bored piling	Approximate RL3m	Approximate RL3m @ services	Low levels of vibration at all below ground service along Albert Street. Maximum modelled vibration less than 0.5 mm/s Low but compliant vibration on services along Mary Street Vibration compliant with criteria for all services No impact No mitigation required
2	B		Approximate RL-3m	Approximate RL-3m @ S1 Sewer	Low levels of vibration at S1 Sewer. Maximum modelled vibration less than 0.5 mm/s Vibration compliant with criterion for S1 sewer No impact No mitigation required
3	C		Approximate RL-5m (Basement 2)	Approximate RL4m @ existing ground level	Low imperceptible levels of vibration at surface Maximum modelled vibration of less than 0.5 mm/s Vibration incapable of damaging adjacent buildings, including heritage. Vibration will be indistinguishable from existing background vibration No impact at any buildings No mitigation required
7	G	Vibratory piling	Approximate RL3m	Approximate RL3m @ services	Low levels of vibration at closest below ground service along Albert Street. Maximum modelled vibration of 3 mm/s for electrical and communications Maximum modelled vibration of 2 mm/s for gas and water Vibration compliant with criteria for services No impact No mitigation required
8	H		Approximate RL-3m	Approximate RL-3m @ S1 Sewer	Low levels of vibration at S1 Sewer. Maximum modelled vibration of less than 2 mm/s Vibration compliant with criterion for S1 sewer No impact No mitigation required
9	I		Approximate RL-5m (Basement 2)	Approximate RL4m @ existing ground level	Low imperceptible levels of vibration at surface further than 50 metres. Potentially perceptible at closest sections of three commercial buildings to the works Maximum modelled vibration of 3 mm/s at the Matisse Tower building All heritage buildings compliant Vibration incapable of damaging adjacent buildings, including heritage No impact No mitigation required

Scenario	Modelling Plate	Equipment Type	Equipment Operating RL	Assessment RL	Outcome
13	M	Excavation with 2000 kg hydraulic hammer	Approximate RL3m	Approximate RL3m @ services	Low levels of vibration at all below ground service along Albert Street. Maximum modelled vibration less than 3 mm/s Low but compliant vibration on services along Mary Street Vibration compliant with criteria for all services No impact No mitigation required
14	N		Approximate RL-3m	Approximate RL-3m @ S1 Sewer	Low levels of vibration at S1 Sewer. Maximum modelled vibration of less than 2 mm/s for section of works long Albert Street boundary. For other areas, For other works on the site, varying tp less than 0.5mm/s Vibration compliant with criterion for S1 sewer No impact No mitigation required
15	O		Approximate RL-5m (Basement 2)	Approximate RL4m @ existing ground level	Low imperceptible levels of vibration at surface with exception of the three closets commercial buildings where vibration may be felt for some of the works. Maximum modelled vibration of 2 mm/s at 130 Mary St heritage Vibration incapable of damaging adjacent buildings, including heritage No impact No mitigation required
19	S	Excavation with 3500 kg hydraulic hammer	Approximate RL3m	Approximate RL3m @ services	Low levels of vibration at closest below ground service along Albert Street. Maximum modelled vibration of 5 mm/s for electrical and communications when working at Albert Stret boundary of site Maximum modelled vibration of 3 mm/s for gas and water when working at Albert Stret boundary of site Vibration compliant with criteria for services No impact No mitigation required
20	T		Approximate RL-3m	Approximate RL-3m @ S1 Sewer	Low levels of vibration at S1 Sewer. Maximum modelled vibration of 2 mm/s from works nearest to Albert Street Vibration compliant with criterion for S1 sewer No impact No mitigation required
21	U		Approximate RL-5m (Basement 2)	Approximate RL4m @ existing ground level	Low imperceptible levels of vibration at surface with exception of the three closets commercial buildings where vibration may be felt for some of the works. Maximum modelled vibration of 2 mm/s at 130 Mary St heritage Vibration incapable of damaging adjacent buildings, including heritage No impact No mitigation required
25	Y	Excavation with 7000 kg hydraulic hammer	Approximate RL3m	Approximate RL3m @ services	Low levels of vibration at closest below ground service along Albert Street. Maximum modelled vibration of 6 mm/s for small section of works Vibration compliant with criteria for services No impact No mitigation required
26	Z		Approximate RL-3m	Approximate RL-3m @ S1 Sewer	Low levels of vibration at S1 Sewer. Maximum modelled vibration of 3 mm/s varying to less than 0.5 mm/s. Vibration compliant with criterion for S1 sewer No impact No mitigation required

Scenario	Modelling Plate	Equipment Type	Equipment Operating RL	Assessment RL	Outcome
27	AA		Approximate RL-5m (Basement 2)	Approximate RL4m @ existing ground level	Low perceptible levels of vibration at surface with the three closest commercial buildings most affected where vibration may be felt for some of the works. Capri Hotel and 130 Mary Street building tenants may perceive vibration. Maximum modelled vibration of 3 mm/s at 130 Mary St heritage Vibration incapable of damaging adjacent buildings, including heritage No impact No mitigation required
31	EE	Excavation with 35 tonne excavator no hydraulic hammer	Approximate RL3m	Approximate RL3m @ services	Low levels of vibration at closest below ground service along Albert Street. Maximum modelled vibration of 0.5 mm/s Vibration compliant with criteria for services No impact No mitigation required
32	FF		Approximate RL-3m	Approximate RL-3m @ S1 Sewer	Low levels of vibration at S1 Sewer. Maximum modelled vibration of 0.5 mm/s Vibration compliant with criterion for S1 sewer No impact No mitigation required
33	GG		Approximate RL-5m (Basement 2)	Approximate RL4m @ existing ground level	Low imperceptible levels of vibration at surface Maximum modelled vibration of less than 0.5 mm/s Vibration incapable of damaging adjacent buildings, including heritage. Vibration will be indistinguishable from existing background vibration No impact at any buildings No mitigation required

Table 14- Vibration assessment scenarios with modelled outcomes

The modelling results indicate:

- Confirms that whilst the works will generate elevated levels of vibration at the closest three commercial buildings, the vibration is compliant with the vibration level defined in Table 12 as preventing damage to the building structure.
- Depending upon the location of where the equipment operates at the site, as well as the RL, the vibration will be perceptible to some tenants with some areas of these buildings.
- The maximum vibration at the closest heritage building is 3mm/s form the larger hydraulic hammer operating near the surface in the worth-east section of the site.
- The below ground utilities, including the sensitive *S1 Sewer*, are all modelled to be subjected to vibration levels less than 10mm/s. The maximum vibration level at the S1 Sewer is 3mm/s from the larger 7000 kilogram hydraulic hammer operating along the south-west section of the site adjacent to Albert Street.

20. CONDITION SURVEYS

The PDA conditions for the project indicate that heritage properties are high risk, irrespective of their condition, and should therefore be offered a condition assessment to document the status prior to the commencement of any site activities that could generate elevated vibration levels. As per Section 11.3, the identified buildings on the Queensland heritage register vary between 40 and 150 metres from the 101 Albert Street site. Given that the modelling results presented in Table 13 and Table 14 indicate compliance with the heritage vibration criterion is modelled to occur providing the separation distance exceeds 14 metres for the 7 tonne hydraulic hammer (equipment modelled to generate the highest vibration), condition surveys will not be required for the heritage buildings unless the equipment list changes from that assessed in this document and/or the vibration measurements show significantly elevated levels of vibration.

The objective of a condition survey report is to provide an indicative representation of the condition of the infrastructure prior to the commencement of any construction activities and can help to ensure that the project adopt best practices that minimise the risk that of damage to adjacent infrastructure, buildings and/or services. The condition survey therefore protects against inappropriate construction activities, as well as protecting against misappropriate claims. The document will be prepared to meet these objectives.

The specific requirements for the condition surveys will include:

- A report of the property with photographs showing the existing defects that will be completed before commencement of any excavation or demolition. It is possible that some property owners/building managers may decline the offer, although this is less likely with commercial properties.
- Completion by a registered engineer with experience in condition surveys will undertake the inspection and preparation of the report.
- When completed, the condition report will be provided to building manager.
- Works will not commence until the condition survey report has been submitted.

The condition survey will be completed in accordance with the recommendations of the accepted standards. The description of crack widths will be in accordance with AS2870[13]. Classification of damage with reference to identified defects, evident cracking will be classified within the following categories.

Crack Category	*Definition*
0	Width less than 0.1mm Hairline cracks that do not need repair
1	Width less than 1mm Fine cracks which do not need repair
2	Width less than 5mm Noticeable cracks which can be readily filled
3	Width between 5mm and 15mm Cracks are repairable. Weather tightness may be impaired and repairs may require the replacement of small sections of the wall
4	Width greater than 15mm Extensive repairs required to walls and possibly adjacent window and door frames, lintels, beams and service pipes

Table 15- Classification of damage as per Australian Standard AS2870

Condition surveys will include inspection of all accessible spaces for each of the nominated buildings with a photographic record of all defects, including cracking, spalling, settlement, differential movement, separation at building joints, damaged finished, water leaks, mechanical damage. The photographs will be dated and time stamped to the relative buildings and location.

Wheer required, the condition surveys will be provided in electronic PDF format with separate reports for each building, utility, footpath, and CRR assets. The original high-definition photographs will be retained for the duration of the project and defects period. The condition survey will be undertaken by a person with RPEQ recognition.

For each survey, any significant defects that are identified and could potentially undergo further dilation or elongation as attributable to the construction works will be further monitored by the placement of crack gauges across the defect. The initial measurement of the crack gauge, and therefore a record of the defect aperture, will be recorded using a micrometer. An acceptable method of mounting the crack gauge that will; not lead to further damage to the surface will ultimately determine whether crack gauge monitoring is a viable assessment option.

[13] AS2870, "AS2870 – Residential slabs and footings – Construction, Appendix C1"

Whilst a condition survey will be completed for those buildings where elevated vibration may occur, vibration monitoring will also be undertaken. The vibration monitoring provides an additional layer of protection by quantifying the impacts from the construction works which can be compared with permissible vibration levels.

Whilst a condition survey provides comment on the visible condition of the infrastructure, no comment as to its engineering "*soundness*" is generally provided. Providing the Table 12 vibration criteria are applied, compliance with these vibration limits virtually ensure that the project will be safely completed without superficial or structural damage to adjacent infrastructure.

20.1. Extent of Condition Surveys

The modelled vibration data have shown minimal impact on the adjacent infrastructure from the construction activities. Notwithstanding the vibration impacts are compliant with the proposed vibration criteria that virtually eliminate any impact upon the integrity of the adjacent buildings (including the heritage buildings) or other infrastructure, condition surveys of the following buildings and infrastructure will be undertaken prior to the commencement of the works that could lead to potential impact:

The proposed extent of the condition surveys is as follows:

Adjacent Commercial Buildings:

- Martin College building at 119 Charlotte Street.
- The Sebel Brisbane at Albert and Charlotte Street
- Maltisse Tower at 110 Mary Street

For these multi-storey buildings, the survey is limited to the lower ground floor area.

Queensland Heritage Buildings

No surveys are proposed based upon the modelled vibration levels for the proposed equipment types.

Infrastructure

- Albert Street footpaths (both north-east and south-west footpaths) between Mary and Charlotte Streets for approximately 100 metres from the Albert and Mary Street intersection.
- Mary Street footpaths (both north-west and south-east footpaths) for approximately 100 metres from the Albert and Mary Street intersection.

The proposed locations for the condition surveys, excluding the three heritage buildings, are shown in the following figure.

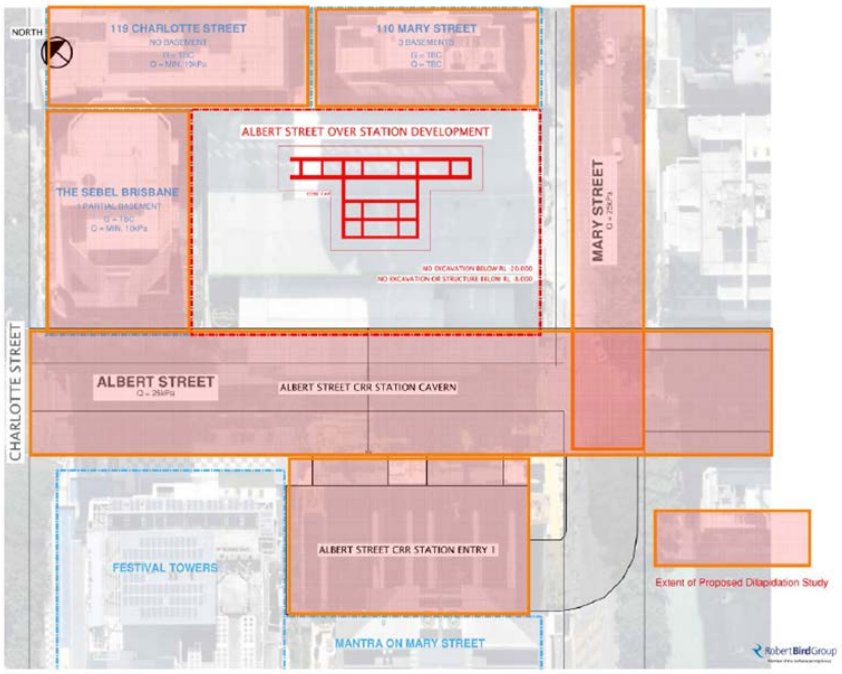


Figure 14 – Extent of sites recommended for condition surveys

20.2. Condition Survey Limitations

Whilst a condition survey report will be completed with due care and diligence, the condition survey will be subject to the following constraints:

- All information contained in this report will be limited by the level of site access on the day of the inspection.
- All observations will be used within the context of the scope of the report and should not be used outside the 101 Albert Street project.
- All documented defects will be identified solely from in-situ visual inspection only. No analysis of structural loading and expected design life of structural and/or non-structural members will be completed as part of the survey condition.
- The condition survey will not assess the electrical, plumbing, sewer, water, gas or air conditioning systems of the property.

20.3. Subsequent Use for a Condition Survey

Should a concern relating to damage to an adjacent building occur, a review of both the photographic and field notes will be undertaken to determine whether the defect existed prior to the commencement of the works. If the defect cannot be dismissed as existing prior to the works, the general condition of the infrastructure will be reviewed to determine whether similar defects existed prior to the works. Understandably, not all defects can be photographed often sections of the buildings are covered with other effects which prevent photographing. It is also common that defects occur because of environmental changes (temperature, humidity, water and ground displacement, *etc*.) and will occur even in the absence of any construction activities.

All appropriate information, including the data from the condition surveys of the building, the proximity to the works area and the level of vibration that the building has been subjected to should be reviewed to assess the legitimacy and likelihood of the damage.

Providing compliance with the vibration criteria in Table 12 is met, any superficial damage to the infrastructure is likely to be attributable to sources other than that from short term construction type

vibrations.

21. MONITORING APPROACH

The monitoring program will involve several groups with responsibilities to ensure the monitoring data are collected and analysed appropriately as well as ensuring that site personnel implement the necessary actions as a result of any elevated vibration values. The key persons are as follows:

Heilig & Partners: Responsible to installing, maintaining and reporting on vibration, tilt and displacement levels at rail, commercial buildings, heritage buildings and below ground utilities. Provide additional expertise in response to elevated vibration and the appropriate mitigation that may be necessary.

Contractor: Contractor responsible for any demolition and/or earthworks and will administer the plan ensuring that all operators, including any sub-contractors, are aware of the project requirements including the alerts procedures (email, SMS and other technical assessment) and the requirement to act when alerts are activities.

The monitoring of vibration is important to ensure adjacent infrastructure is not impacted. In addition to vibration monitoring, the project will also include additional assessment and monitoring approaches. These other monitoring options include tilt sensors for the verticality of the structure, or the displacement between the structural elements to determine any movement. Whilst a vibration criterion is imposed on these structures as way of protecting against other forms of damage, the rapid development of these alternative monitoring systems now allows them to be used on projects as a relevant and significantly advanced warning and assessment system.

Like the vibration monitoring systems, these alternative monitoring systems can be automated and allow for alerts to be forwarded to key persons if measured values approach threshold or intervention limits. Extensometers can be placed across defects and are capable of measuring changes of less than 10 microns, or around 10% of the thickness of a sheet of paper. Tilt sensors can be used to measure any changes in the verticality of a structural element, capable of detecting changes less than 0.0004 degrees, or less than 0.1mm over a 5 metre span. A laser sensor can measure changes in displacement between multiple points with an accuracy of less than 0.5mm over a 30 metre span. The CRR infrastructure are assessment locations where these advanced tilt, extensometer or distance sensors will be used to supplement the vibration monitoring.

As part of the sensor installation assessment, Heilig & Partners will complete a review of the infrastructure condition reports and identify and defects that may necessitate further monitoring or could be potentially affected by elevated vibration levels. Depending upon their location and the potential to be impacted, a simple crack gauge, or an extensometer connected to automated reporting system may be installed. These vibrating wire extensometers are particularly relevant when assessing impacts on key structures because they can detect changes in defects, discontinuities or expansion joints less than 10 microns and provide advanced warning if accelerated changes occur. These sensors could be anchored to a defect and continually measure the displacement. Should any changes be measured, alerts will be automatically forwarded to the key persons where they will be further investigated.

Heilig & Partners propose to consider the best available systems to ensure the construction works are completed without impact. The combination of the data that can be collectively analysed from these systems will ensures that works can be completed without impact on all adjacent infrastructure.

21.1. Vibration Monitoring Equipment

The vibration will be monitored continuously at multiple locations as per the conditions of approval via an arrangement of acquisition systems which will report the data daily, or more frequently if required, through to the Heilig & Partners servers.

Given that vibration will occur for some works, adjacent buildings or below ground utilities, a vibration monitoring system will be installed and consist of multiple monitors around the site. The vibration

monitors will have three recording channels with an external geophone (transducer) that monitors ground vibration in three directions (transverse, vertical and longitudinal particle velocities) and report the level in mm/s.

Vibration levels occurring from the works will be monitored continuously and the maximum value recorded for each sample period, generally taken to be 30 seconds, although smaller intervals may be appropriate where detailed analyses are required. During each 30 second period, the level of vibration will be sampled 30,000 times and the maximum level stored electronically. The levels, as a function of time, will be given in a graph of time versus vibration level. Statistics of vibration, including average, minimum, maximum and 90 percentile limits will also be calculated.

Recorded vibration data will be uploaded at set times during the day and the measured data analysed and compared against vibration criteria given in Table 12. Where levels are shown to approach the vibration criteria, emails or SMS alerts will be sent to key persons within the project.

As per the requirements for works around rail infrastructure, where vibration monitoring is identified as a risk mitigation strategy, the monitoring will:

- Utilise triaxial geophones (4.5 Hz) to capture vibration in the impacted existing Cross River Rail infrastructure.
- Install devices prior to commencement of any demolition, excavation, or construction work.
- Calibrate devices against a traceable event.
- Install devices as per the manufacturer's installation guidelines.

The Australian Standard AS2187.2:2006 specifies details the type of geophone (tri-axial with a low frequency capability of 4Hz) that should be used for the vibration monitoring.



Background monitoring and baseline readings of vibration will identify any external influences on monitoring results (i.e., people, rail and car traffic), which can lead to errors in reported data. The outputs of the monitors will also include waveforms for extreme events.

Monitoring will be consistent with previous developments in Brisbane where works as occurred in the immediate vicinity of the constructed building basements, road and rail tunnels. Tri-axial geophone assemblies will be installed adjacent to the planned works and at locations within the building site agreed to by the building managers. For the monitoring of the *S1 Sewer*, a triaxial geophone sonde will be grouted into a small diameter hole (102mm diameter) drilled to a safe depth and outside the *S1 Sewer* exclusion zone. The depth of the borehole and the sensor will also be confirmed by survey data.

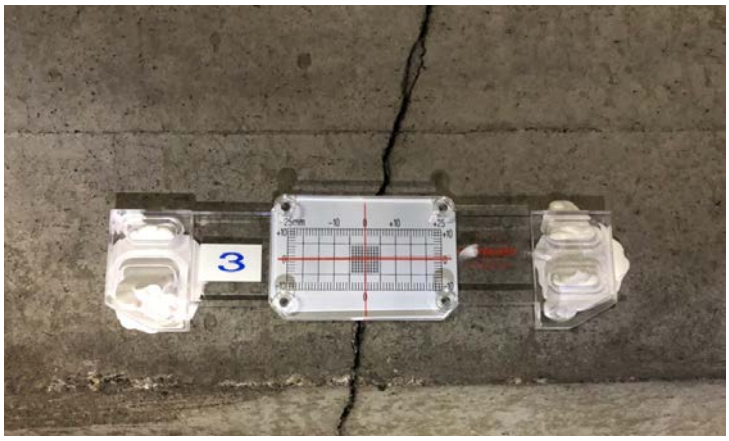
This pro-active approach ensures that vibration levels are kept below key threshold values. This approach has been undertaken for other projects and utilised on many of the large-scale projects completed in Brisbane and other project locations within Australia and internationally.

21.2. Crack Monitoring

Where the condition survey identifies significant defects and these cracks could subsequently be dilated or elongated as a consequence of the construction activities, crack monitoring using manual gauges as shown below is identified as a risk mitigation strategy. This will involve installing devices on

the defect/s in the surveyed infrastructure before the commencement of any demolition, excavation, or construction.

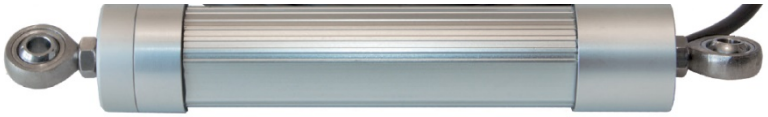
A typical manually read crack gauges is shown adjacent.



The location and the number of devices that may be installed for crack monitoring will be determined after the defects are identified from the condition survey. It is not anticipated that significant defects in buildings will be present.

The viability of using crack gauges will also depend upon the condition of the surface and whether bonding or mechanically anchoring a gauge like that shown above will detract from the wall condition after the gauge has been removed.

If there significant defects that could lead to structural damage to the infrastructure with significant consequences, advanced monitoring with vibrating wire gauge sensor will be installed. These systems use a vibrating wire extensometer which detects changes in length of the wire noting changes in the pinged frequency. When connected to an acquisition system, the data (distance between the anchor points) will be uploaded multiple times per day and a graph showing the displacement as a function of time and data prepared. The results will be emailed, as per the current arrangement with the vibration and tilt data. Where the displacement exceeds a pre-set value, an alert notification will be forwarded. These instruments have been successfully applied elsewhere in Brisbane for assessing impacts from the major construction projects. The results will be presented as a series of graphs showing the displacement as a function of time. The accuracy of the system is around 30 microns, or an ability to detect changes about the thickness of a human hair.



The installation involves drilling two holes either side of the defect to anchor the extensometer. Like the manual crack gauge, the feasibility of the extensometer system depends upon the unit being anchored without incurring further non repairable damage to the surface.

21.3. Monitor Operational Period

All monitoring for the project will be proactive, aside from any manually installed crack gauges, and operate 24/7 with regular uploads of the data through to the Heilig & Partners server where the data will be processed, and reports forwarded automatically to key persons. Daily, weekly and monthly reports will be presented. Alerts will be automatically forwarded via SMS and/or email where the levels approach the permissible intervention values. The alerts and data will be for vibration, tilt angle, and displacement.

21.4. Period of Monitoring

All monitoring systems will have baseline readings taken for at least 3 weeks prior to any demolition or earthworks commencing. The vibration monitoring will continue until the excavation works have been completed and the building established to the existing ground level. The monitoring with the other sensors (tilt, displacement, distance and/or crack gauges) will continue until the exterior of the building has been completed and no further load to the adjacent infrastructure anticipated. In all cases, monitoring will be terminated only with the acceptance of EDQ DA upon the project demonstrating to their satisfaction that the monitoring results confirm that the site conditions have stabilised.

During this period of monitoring, the monitoring system will continue to:

- Provide real-time monitoring and rapid data logging.
- Send alerts via SMS and email if any instrument exceeds the set alarm thresholds; and
- Provide adequate redundancy that allows uninterrupted function in the event of a component or system failure.

21.5. Records and Reporting

All monitoring requirements specified in the MCU's relating to sensors for assessing possible impacts on structures will be linked to an automated monitoring system, and include vibration, inclinometer, tilt, displacement (including temperature). The monitoring requirements are complex and for significant projects like 101 Albert Street, onerous in terms of the instrumentation required. There is significant value in having a single repository for the data and presentation of the information. This is consistent with the project conditions. Heilig & Partners have provided similar systems for the monitoring of other projects, including the Brisbane CBD projects, where a combination of vibration, inclinometer, tilt and piezometers formed part of the monitoring specification.

Vibration, tilt, displacement reports will be completed for each day of the works and contain the following information:

- Date and time of monitoring.
- Location of activities, or via a link to the site diary of activity
- Monitoring location, identified by a combination of address, photographs and coordinates.
- Peak vector sum level of vibration from each of the three orthogonally orientated geophones.
- Statistical levels showing vibration values for the 90, 95 and 99 percentile values.

The format of the daily vibration report is as per the example shown following. The graph will also display the vibration statistics associated for each day/week events. If required, other tilt and displacement graphs will be similarly presented as per Figure 16.

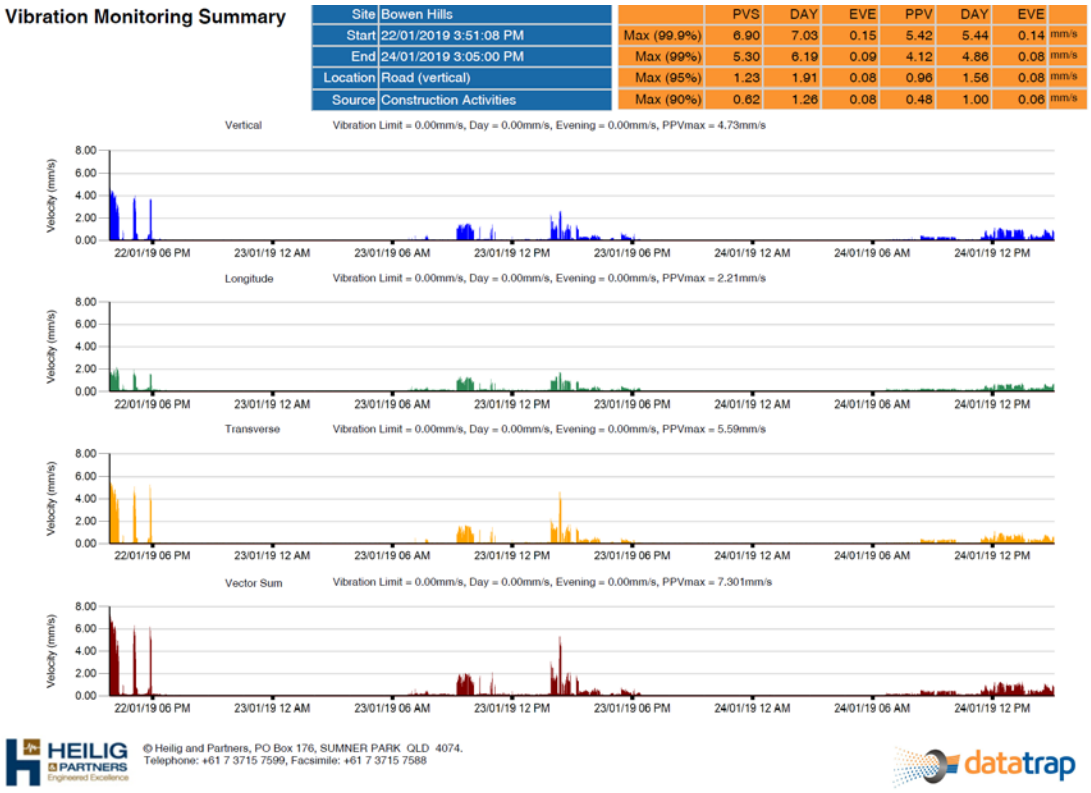


Figure 15 – Vibration report showing statistical calculations.

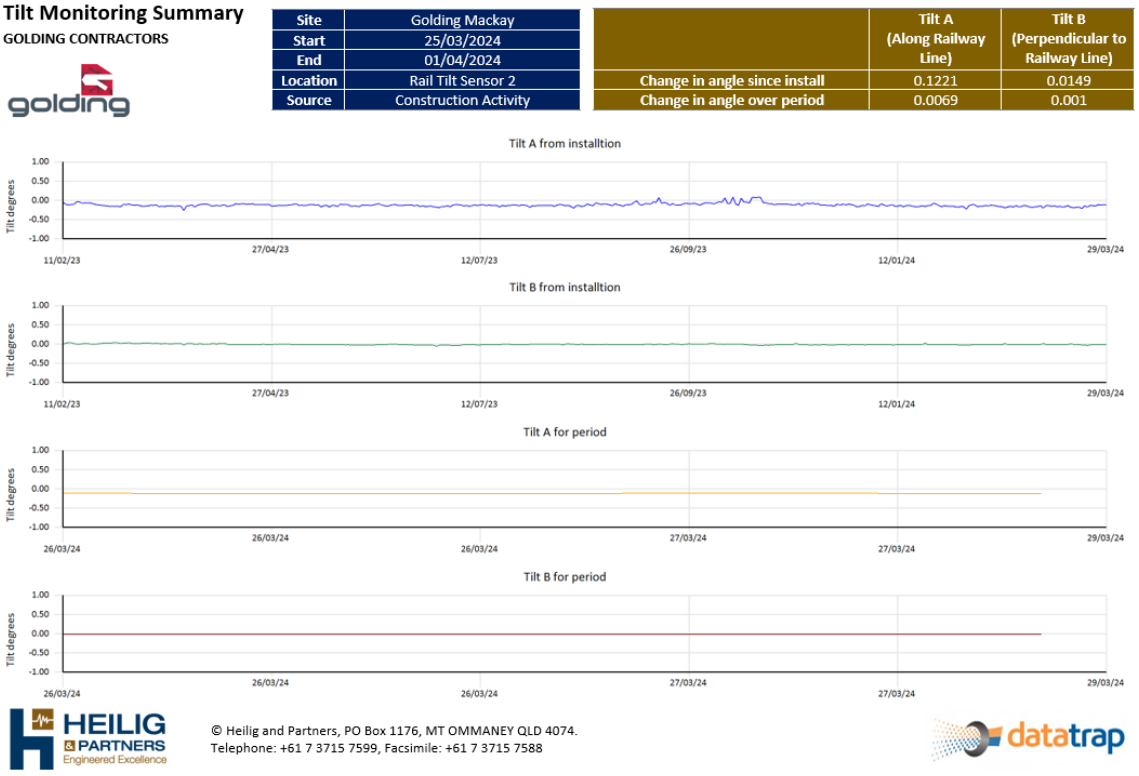


Figure 16 – Bi-axial tilt sensor report showing statistical calculations.

21.6. Equipment Calibration

The monitoring units deployed for the project will have undergone annual calibration by an independently certified group. Original calibrations certificates for each monitor will be kept in the

Heilig & Partners offices and contain the following information:

- Report number.
- Make and model of instrument.
- Monitor serial number.
- Geophone serial number.
- Calibration date.
- Test equipment references.
- Compliance with relevant standard.
- Signature of person performing calibration and date of service.

21.7. Training

Any site personnel involved with the monitoring equipment will be trained and demonstrate appropriate capabilities prior to undertaking and providing comment on the measured levels. The equipment will be configured, installed and maintained by Heilig & Partners.

In addition to the specific tasks that any persons associated with the monitoring equipment may be required to undertake, all site persons will be made aware of the proximity of the the adjacent buildings and the below ground utilities. The significance of vibration and other impacts, including the monitoring alert system, will be part of the on-site induction process.

22. HERITAGE BUILDING MONITORING REQUIREMENTS

The project will implement monitoring systems for the impact existing three closest heritage buildings, prior to and during the works, where:

- Monitoring is identified as a risk mitigation strategy, and
- Required by the EDQ DA / Queensland Heritage Council to ensure the integrity of the buildings is not affected by the planned construction activities.

Monitoring systems include:

- Condition surveys and assessments.
- Movement monitoring of existing significant cracks within the heritage buildings
- Vibration monitoring of the heritage buildings in accordance with the requirements of the German Standard DIN4150-3:2016 which proposes measurements at the foundation.

The project will submit a RPEQ certified monitoring plan to EDQ DA prior to commencement of works. The monitoring plan will include as a minimum:

- Details of the proposed monitoring systems (vibration and movement crack) including:
    - The type of monitoring equipment
    - Measurement locations for the various types of equipment
- Requirements for installation and maintenance of the monitoring systems equipment; and
- Monitoring frequency, and notification and intervention plan for exceedance of the threshold

parameters for each monitoring system (vibration and crack movement as required)

22.1. Vibration Monitoring

The project will ensure and demonstrate to the satisfaction of EDQ DA that vibration caused by the works onto the heritage buildings will not exceed a screening vibration level of 5mm/s. If required, the permissible level of vibration will be adjusted according to the frequency of the dominant pulse and the associated value shown in Line 3 of German Standard DIN4150.3 as given in Table 9.

The project has completed predictive analysis of the vibration caused by the methodology of the proposed works, including the prediction of the vibrations transmitted to these heritage buildings. This predictive analysis has not identified any instances that necessitate monitoring at any of the six adjacent heritage listed buildings.

22.2. Monitoring Locations

If the equipment list changes and/or vibration measurements indicate levels significantly exceeding the modelled levels, vibration sensors would be installed at one or more of the three closest heritage buildings. The vibration monitoring location/s will be identified after a site visit. If required, it is proposed that the monitoring unit will be placed at a single location for the period of the demolition/excavation works and for the period until the construction of the building to the existing ground level re-established. The possible monitoring locations are as follows:

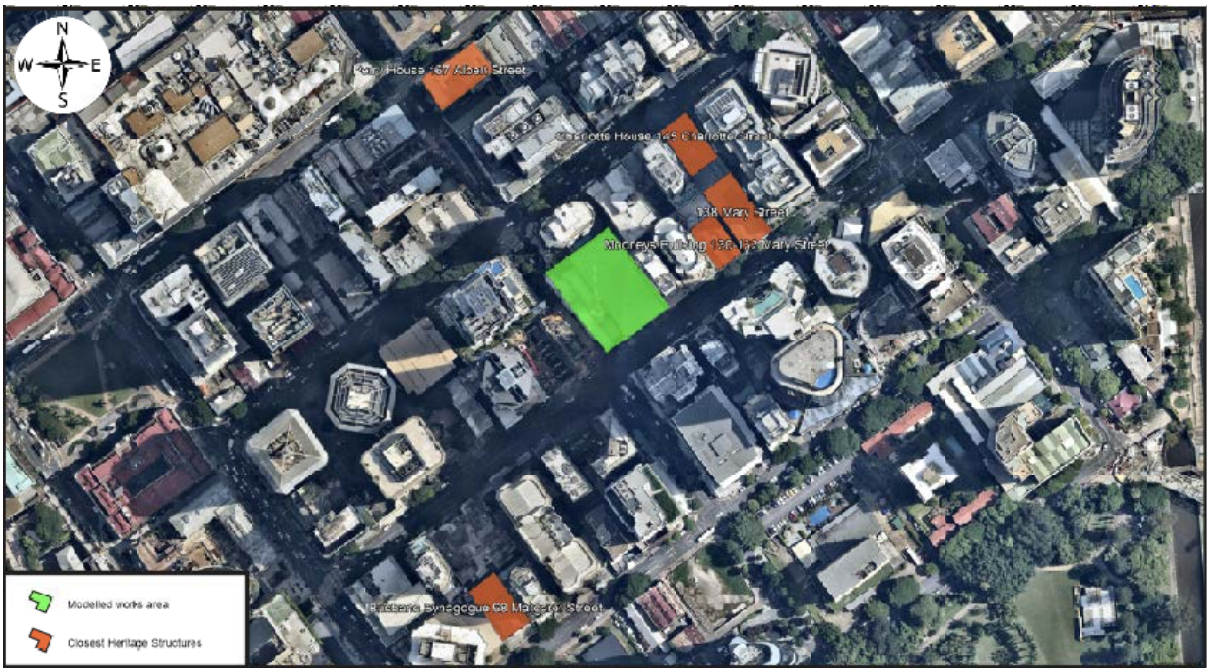


Figure 17 – Locations of the potential vibration sensors for heritage buildings

22.3. Intervention Vibration Levels

If required, the project will implement notification, intervention procedures and protocols for vibration for the heritage properties.

Notification and interventions will be based on the three alarm levels referring to acceptable, warning and mitigation stages. Prior to commencement of works, the project will configure the threshold intervention limits as per the following table. The project will:

- Provide EDQ DA access to the data when an exceedance of the mitigation stage is recorded.
- Issue weekly and monthly monitoring reports to EDQ DA detailing the measured results for each heritage building. These will highlight any vibration exceedances.

Where required, alarm levels for each of the vibration monitoring systems will as per the following table. The SMS alerts will be as follows and contain information relating the monitoring location, measured vibration level, trigger value and the time of the alert. Email alerts will contain similar information.

SMS ALERT:
PVS Limit Exceeded Limit Of 8.00mm/s with reading of 8.01mm/s on Monitor Tunnel 5 North Wall Chainage 437 for Project HP2010-5 with monitor VIBe0380 - PVS Limit > 8 mm/s

Figure 18 – Typical SMS alert for exceedance of intervention limit for vibration

The pro-active monitoring approach ensures that the vibration is kept below key performance value of identifying in advance any works that are likely to exceed the performance limits.

The key trigger vibration limits are as follows:

Trigger Level	*Heritage Vibration Monitoring*	*Responses*
Green	μ_{PPV} < 4mm/s	Proceed with works. Contractor to provide via email to EDQ DA a weekly report. pdadevelopmentassessment@dsdilgp.qld.gov.au
Orange	4mm/s < μ_{PPV} < 5mm/s	Contractor to discuss changes to site procedure to control vibration levels. Notify EDQ DA via email on: pdadevelopmentassessment@dsdilgp.qld.gov.au
Red	μ_{PPV} > 5 mm/s	Works to cease immediately onsite. Contractor to organise a meeting with EDG DA with all stakeholders present to agree how methods can be altered & work restarted. EDQ DA may require site representation, this will be agreed upon in the meeting. If required this representative will have authority to permit or prohibit excavations and/or the equipment used. Notify EDQ DA via email on: pdadevelopmentassessment@dsdilgp.qld.gov.au

Table 16- Intervention vibration levels for heritage buildings

Where the vibration level triggers the orange warning alert (4mm/s to 5mm/s), the works will be reviewed and a meeting with the construction team arranged to determine the most appropriate demolition/excavation process that will ensure compliance with the 5mm/s limit, or the adjusted vibration value that reflects the permissible level given in Table 9 for the dominant frequency. Where an exceedance of the red mitigation stage is recorded, the outcome will be presented in a technical letter prepared by Heilig & Partners and made available to EDQ DA for comments.

23. COMMERCIAL BUILDING MONITORING REQUIREMENTS

The project will implement monitoring systems for the impact existing three closest commercial buildings, prior to and during the works, where:

- Monitoring is identified as a risk mitigation strategy, and
- Required by the EDQ DA to ensure the integrity of the buildings is not affected by the planned construction activities.

Monitoring systems include:

- Condition surveys and assessments.
- Movement monitoring of existing significant cracks within the heritage buildings
- Vibration monitoring of the heritage buildings in accordance with the requirements of eh German Standard Din4150-3:2016 which proposes measurements at the foundation.

The project will submit a RPEQ certified Monitoring Plan to EDQ DA prior to commencement of works. The Monitoring Plan will include as a minimum:

- Details of the proposed monitoring systems (vibration and movement crack) including:
    - the type of monitoring equipment
    - measurement locations for the various types of equipment
- Requirements for installation and maintenance of the monitoring systems equipment; and
- Monitoring frequency, and notification and intervention plan for exceedance of the threshold parameters for each monitoring system (vibration and crack monitoring where required).

23.1. Vibration Monitoring

The project will ensure and demonstrate to the satisfaction of EDQ DA that vibration caused by the works onto the commercial buildings will not exceed a screening vibration level of 20mm/s. If required, the permissible level of vibration will be adjusted according to the frequency of the dominant pulse and the associated value shown in Line 1 of German Standard DIN4150.3 as given in Table 9.

The project has completed a predictive analysis of the expected vibration caused by the methodology of the proposed works, including the prediction of the vibrations transmitted to these commercial buildings. This predictive analysis has not identified the requirements for any additional monitoring.

23.2. Monitoring Locations

At each of the three closest commercial buildings, a vibration monitoring location will be determined after the site visit. It is proposed that a monitoring unit will be placed at a single location in each of the three commercial buildings for the period of the demolition/excavation works and for the period until the construction of the building to the existing ground level re-established. The proposed monitoring locations are as follows:

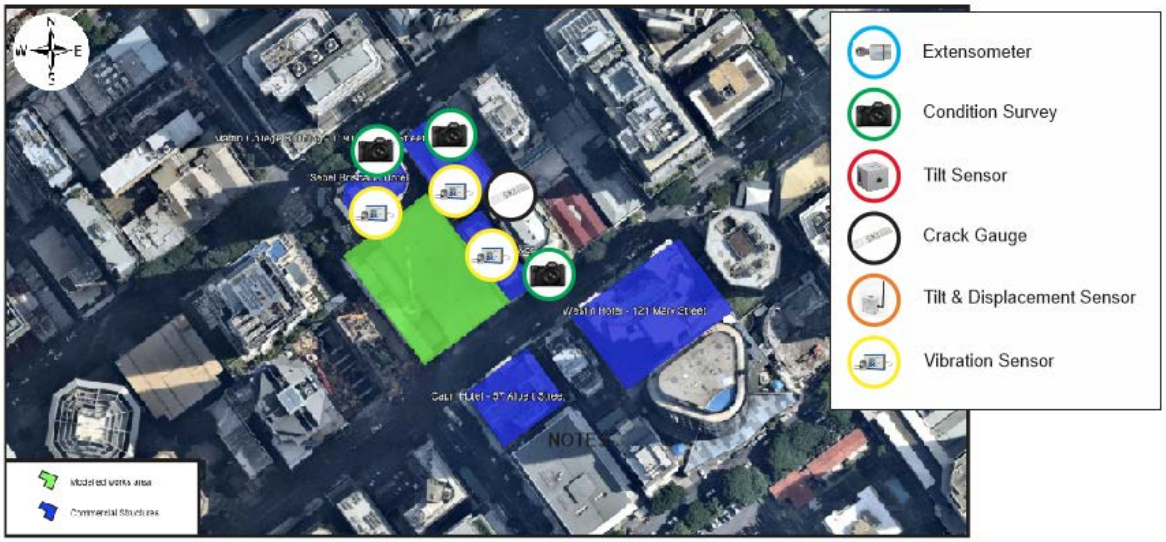


Figure 19 – Locations of vibration sensors for adjacent commercial buildings

23.3. Intervention Vibration Levels

The project will implement notification, intervention procedures and protocols for vibration at the commercial buildings.

Notification and interventions will be based on the three alarm levels referring to acceptable, warning and mitigation stages. Prior to commencement of works, the project will configure the threshold intervention limits as per the following table. The project will:

- Provide EDQ DA access to the data when an exceedance of the mitigation stage is recorded.
- Issue weekly and monthly monitoring reports to EDQ DA detailing the measured results for each commercial buildings. These will highlight any vibration exceedances.

Alarm levels for each of the vibration monitoring systems will as per the following table. The SMS alerts will be as follows and contain information relating the monitoring location, measured vibration level, trigger value and the time of the alert. Email alerts will contain similar information.

SMS ALERT:
PVS Limit Exceeded Limit Of 8.00mm/s with reading of 8.01mm/s on Monitor Tunnel 5 North Wall Chainage 437 for Project HP2010-5 with monitor VIBe0380 - PVS Limit > 8 mm/s

Figure 20 – Typical SMS alert for exceedance of intervention limit for vibration

The pro-active monitoring approach ensures that the vibration is kept below key performance value of identifying in advance any works that are likely to exceed the performance limits.

The key trigger vibration limits are as follows:

Trigger Level	*Building Vibration*	*Responses*

Green	μ_{PPV} < 15mm/s	Proceed with works. Contractor to provide via email to EDQ DA a weekly report. pdadevelopmentassessment@dsdilgp.qld.gov.au
Orange	15mm/s < μ_{PPV} < 20mm/s	Contractor to discuss changes to site procedure to control vibration levels. Notify EDQ DA via email on: pdadevelopmentassessment@dsdilgp.qld.gov.au
Red	μ_{PPV} > 20 mm/s	Works to cease immediately onsite. Contractor to organise a meeting with EDQ DA with all stakeholders present to agree how methods can be altered & work restarted. EDQ DA may require site representation, this will be agreed upon in the meeting. If required this representative will have authority to permit or prohibit excavations and/or the equipment used. Notify EDQ DA via email on: pdadevelopmentassessment@dsdilgp.qld.gov.au

Table 17- Intervention vibration levels for commercial buildings

Where the vibration level triggers the orange alert (15mm/s to 20mm/s), the works will temporarily cease and a meeting arrangement with the relevant parties arranged to determine the most appropriate demolition/excavation process that will ensure compliance with the 20mm/s limit. The outcome will be presented in a technical letter prepared by Heilig & Partners and made available to EDQ DA for comments.

24. BELOW GROUND UTILITIES MONITORING REQUIREMENTS

The project will implement monitoring systems for the impact of the vibration from the works on the adjacent services that run along Albert Street. The depths of the utilities vary between less than 2 metres to approximately 8 metres below the existing ground level. The *S1 Sewer* is identified in Table 12 as the most sensitive utility with respect to vibration. It is proposed that compliance with 10mm/s vibration criterion at the *S1 Sewer* will necessarily lead to compliance at the other utilities as these have higher permissible limits of vibration and that the separation distance from the works is not significantly different to that for the *S1 Sewer*.

The two monitoring systems include:

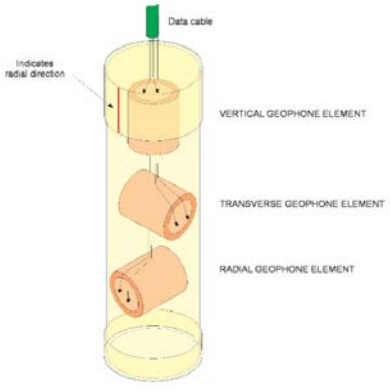
- Condition survey and assessments via CCTV.
- Vibration monitoring of the external ground mass around the buried asset by placement of a borehole vibration sonde at a depth of approximately 8 metres below surface.

The project will submit a RPEQ certified Monitoring Plan to Urban Utilities and other asset owners prior to commencement of works. The Monitoring Plan will include as a minimum:

- details of the proposed automated vibration monitoring systems including:
    - type of monitoring equipment
    - location of equipment
- requirements for installation and maintenance of the monitoring systems equipment; and
- monitoring frequency, and notification and intervention plan for exceedance of the threshold parameters for the vibration monitoring system.

24.1. Vibration Monitoring

The project will ensure and demonstrate to the satisfaction of Urban Utilities, APA and Energex that vibration caused by the works will not exceed a vibration level that could impact upon the integrity of the pipe or cable network or lead to a reduction in the



continued service supply. A vibration sensor will be installed into a borehole drilled from the surface to a depth of approximately 8 metres which approximated the level of the sewer. The sensor is shown adjacent and requires a102mm diameter borehole. This approach is consistent with that adopted for the CRR works.

The project has completed a predictive analysis of the expected vibration caused by the methodology of the proposed works, including the prediction of these vibrations transmitted through the ground surrounding they services infrastructure. This predictive analysis has not indicated any further monitoring of the services other than the proposed vibration monitoring is required.

24.2. Monitoring Locations

A single vibration monitoring location at approximately 8 metres below the existing ground level will be determined after a site visit. It is proposed that monitoring units will be placed at the other locations for assessing the Cross River Rail tunnels and caverns for the period of the demolition/construction works, or until it can be shown that the effect is not detrimental to the S1 Sewer integrity. The proposed monitoring location for the S1 Sewer is as follows:



Figure 21 – Locations of vibration sensors for Albert Street S1 Sewer

24.3. Intervention Vibration Levels

The project will establish notification, intervention procedures and protocols for vibration at the below ground utilities.

Notification and interventions will be based on the three alarm levels referring to acceptable, warning and mitigation stages. Prior to commencement of works, the project will configure the threshold intervention limits as per the following table. The project will:

- Provide EDQ DA access to the data when an exceedance of the mitigation stage is recorded.
- Issue weekly and monthly monitoring reports to EDQ DA detailing the measured results for each commercial buildings. These will highlight any vibration exceedances.

Alarm levels for each of the vibration monitoring systems will as per the following table. The SMS alerts will be as follows and contain information relating the monitoring location, measured vibration

level, trigger value and the time of the alert. Email alerts will contain similar information.

SMS ALERT:
PVS Limit Exceeded Limit Of 8.00mm/s with reading of 8.01mm/s on Monitor Tunnel 5 North Wall Chainage 437 for Project HP2010-5 with monitor VIBe0380 - PVS Limit > 8 mm/s

Figure 22 – Typical SMS alert for exceedance of intervention limit for vibration

The pro-active monitoring approach ensures that the vibration is kept below key performance value of identifying in advance any works that are likely to exceed the performance limits.

The key trigger vibration limits are as follows:

Trigger Level	*S1 Sewer Vibration*	*Responses*
Green	μ_{PPV} < 8mm/s	Proceed with works. Contractor to provide via email to UU a weekly report.
Orange	8mm/s < μ_{PPV} < 10mm/s	Contractor to discuss changes to site procedure to control vibration levels. Notify UU via email on:
Red	μ_{PPV} > 10 mm/s	Works to cease immediately onsite. Contractor to organise a meeting with UU with all stakeholders present to agree how methods can be altered & work restarted. UU may require site representation, this will be agreed upon in the meeting. If required this representative will have authority to permit or prohibit excavations and/or the equipment used. Notify UU via email on:

Table 18- Intervention vibration levels for S1 Sewer

Where the vibration level triggers the orange alert (8mm/s to 10mm/s), the works will be reviewed, and a meeting arranged with the relevant parties to determine the most appropriate demolition/excavation process that will ensure compliance with the 10mm/s limit. The outcome will be presented in a technical letter prepared by Heilig & Partners and made available to Urban Utilities, APA Gas and Energex as required for comments.

25. VIBRATION MITIGATION

The analyses have reasonably guaranteed that the works will comply with the vibration criteria for the types and locations of equipment that have been specified in Table 12. No impact on the integrity of surrounding infrastructure is expected from the scale of works due to their distance from the planned activities and the general low level of impact by the equipment. Some elevated vibration may occur at the adjacent commercial properties should the larger hydraulic hammering or vibratory piling equipment operate at the extents of the assessed areas and at minimum separation distance to these three closest properties. However, should the measured levels of vibration differ from the modelled values, mitigation measures may be necessary. Where necessary, these management and control measures could be incorporated to minimise the effect of any construction vibration on the adjacent infrastructure. Mitigationl measures could include the following:

- Management controls
- Source controls (adjustments to the equipment generating the elevated levels of vibration)
- Path controls (adjustments to the vibration path between the source and the receiver)

25.1. Management Measures

The level of vibration will be managed throughout the project by the construction contractors. The possible management measures will include:

- Adjusting the size of the hammering equipment (vibration energy) to control the level of

vibration at the commercial or heritage properties or the below ground utilities.

- Real time monitoring of the level of vibration to assess in advance whether the activity complies with the vibration conditions. (i.e. minute by minute data available through iPhone app)

- Comparison of the measured level with the predicted value to determine whether there should be any reassessment of future impacts and proposed mitigation measures.

- Consultation with the DTMR, EDQ DA or utility providers.

25.2. Source and Path Control Measures

The source and path control mitigation measures are as follows:

Action Required	*Applies*	*Details*
Equipment characteristics	Vibration	Adjustments to the equipment operation may be used to reduce the level of induced vibration. This will however be at the expense of productivity which may ultimately prove counter-productive in terms of improving or lessening impact.
Simultaneous operation of vibration intensive equipment	Vibration	Simultaneous operation of equipment within a small distance of each other is to be avoided where the activity is close to the buildings. Where possible, the offset distance between the equipment and the specific location of the adjacent sensitive receivers is to be maximised. Weekly data assessment will be undertaken to ensure the equipment is not inducing excess vibration.

Table 19- Potential measures that may be implemented to control vibration at the equipment source

Where required, the vibration path control outlined in Table 20 could be implemented to reduce the vibration at the adjacent buildings. Adjustments to the vibration path as a control measure are only considered as a final measure after other mitigation options have been exhausted.

Action Required	*Applies*	*Details*
Introduction of open discontinuity between the source and the sensitive receiver.	Vibration	In extreme circumstances, open discontinuities that are positioned close to the sensitive receiver can be used to attenuate the level of vibration. The effectiveness of the discontinuity (cut) is related to the depth versus the proximity of the works or the receiver but may be of no benefit where the equipment is at significant depth or lies beneath the building. Where the works are undertaken at a distance more than twice the depth of the trench, the benefit is limited. The discontinuity must remain open and not filled with water

Table 20- Potential measures that may be implemented to control vibration path

26. REFERENCE DOCUMENTS

AS2187.2-2006, “Australian Standard Explosives Storage and Use of explosives”, Australian Standards, SAI Global

AS2436-2010, “Guide to noise and vibration control on construction, demolition and maintenance sites”, Australian Standards, SAI Global

BS7385-2: 1993, “British Standard Evaluation and measurement for vibration in buildings Part 2: Guide to damage levels from ground borne vibration”

DECC 2006 Department of Environment and Conservation for New South Wales (NSW). “Assessing vibration: A technical guideline”

DIN4150-3:2016, “Structural vibration Part 3: Effect of vibration on structures”, German Standards ICS91.120.25

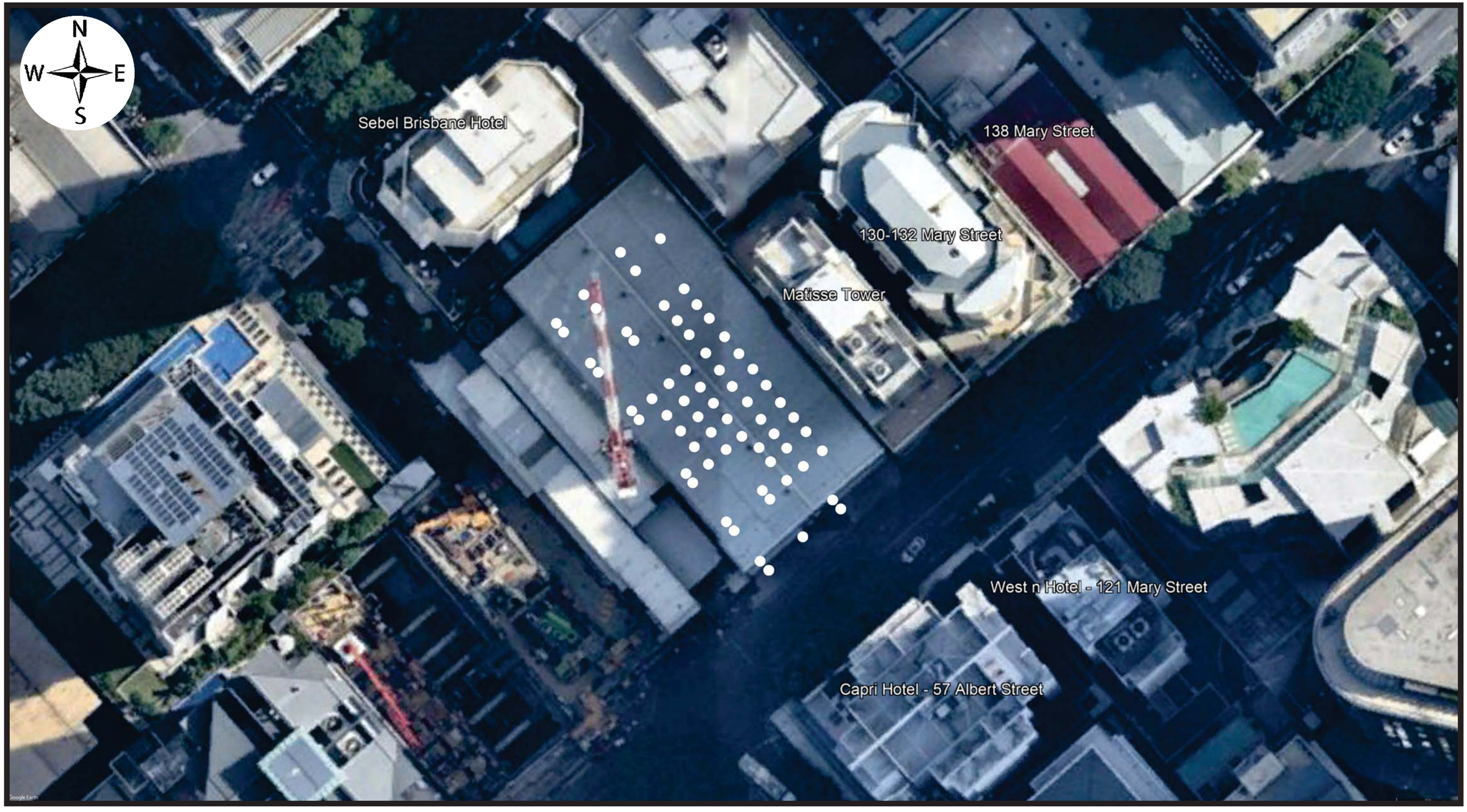
27. COMPLETED

The above assessment has been prepared by John Heilig (RPEQ 6304) of Heilig & Partners consulting engineers. In preparing this assessment, HP have made certain assumptions. We have assumed that all information and documents provided to us by RPC or as a result of a specific request were complete, accurate and up to date. Where we have obtained information from a Government register or database, we have assumed that the information is accurate. Where an assumption has been made, we have not made any independent investigations with respect to the matters the subject of that assumption. We are not aware why any of the assumptions are incorrect.

Dr. John Heilig (RPEQ6304)



28. APPENDIX A – MODELLING ASSESSMENT FOR ABOVE GROUND BUILDINGS



Created using TunnelTRAP Software

SCALE

0 5 10 15 20 25m

Surface Vibration Levels

- 2 mm/s Vibration Contour
- 5 mm/s Vibration Contour
- 10 mm/s Vibration Contour
- 15 mm/s Vibration Contour
- 20 mm/s Vibration Contour
- 50 mm/s Vibration Contour

PROJECT DESCRIPTION Albert St Works - Modelled vibration levels and associated vibration contours from piling activities at RL-5. Vibration contours are shown at RL4 and represent maximum expected values at the surface.

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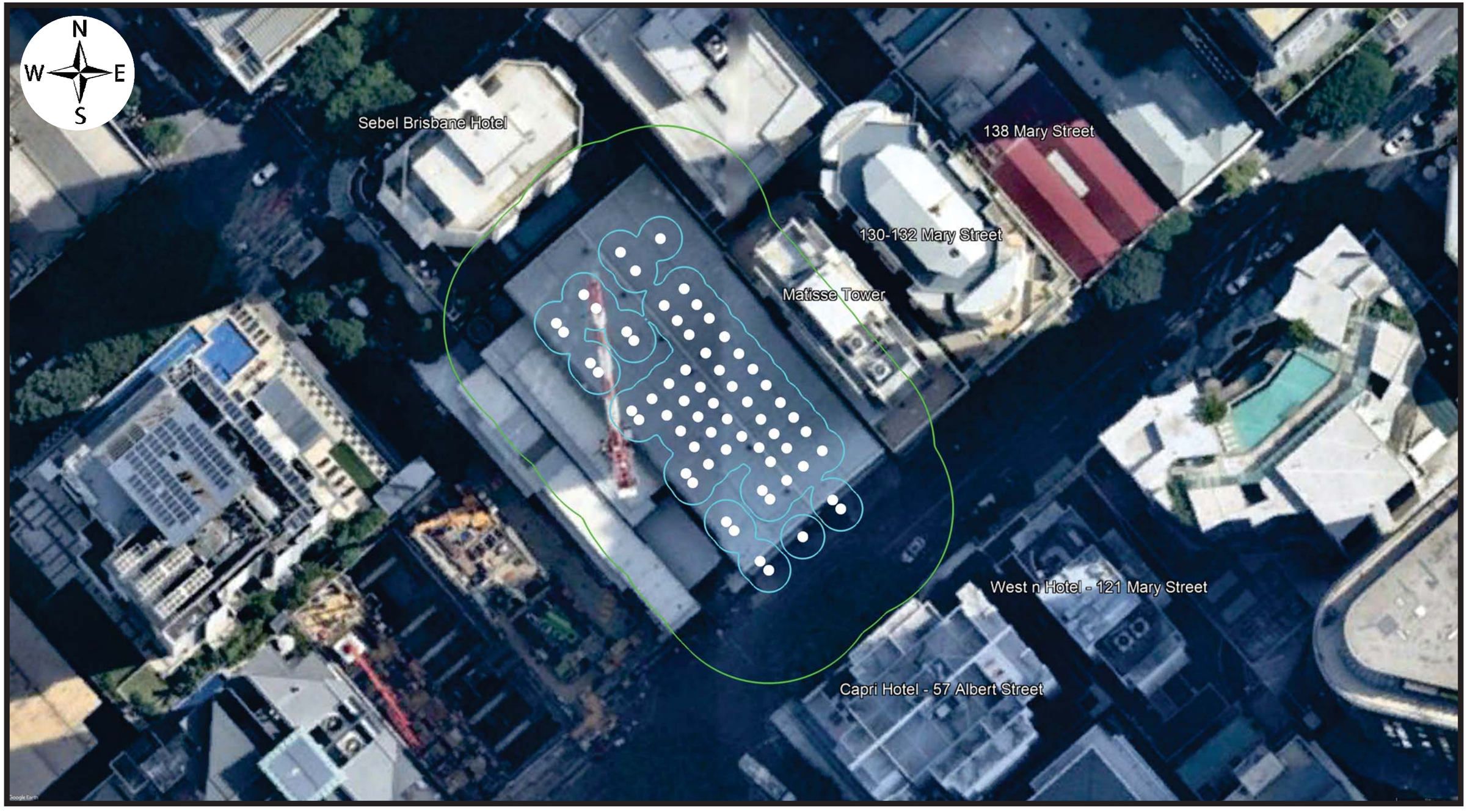
Revision History
R1: Original

Date Drawn: 2 April 2024

Ref No: Albert St Works

Job No: HP2305-2

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SCALE

0 5 10 15 20 25m

RL 4 Vibration Levels

- 2 mm/s Vibration Contour
- 5 mm/s Vibration Contour
- 10 mm/s Vibration Contour
- 15 mm/s Vibration Contour
- 20 mm/s Vibration Contour
- 50 mm/s Vibration Contour

PROJECT DESCRIPTION Albert St Works - Modelled vibration levels and associated vibration contours from vibratory piling activities at RL-5. Vibration contours are shown at RL4 and represent maximum expected values at the surface.

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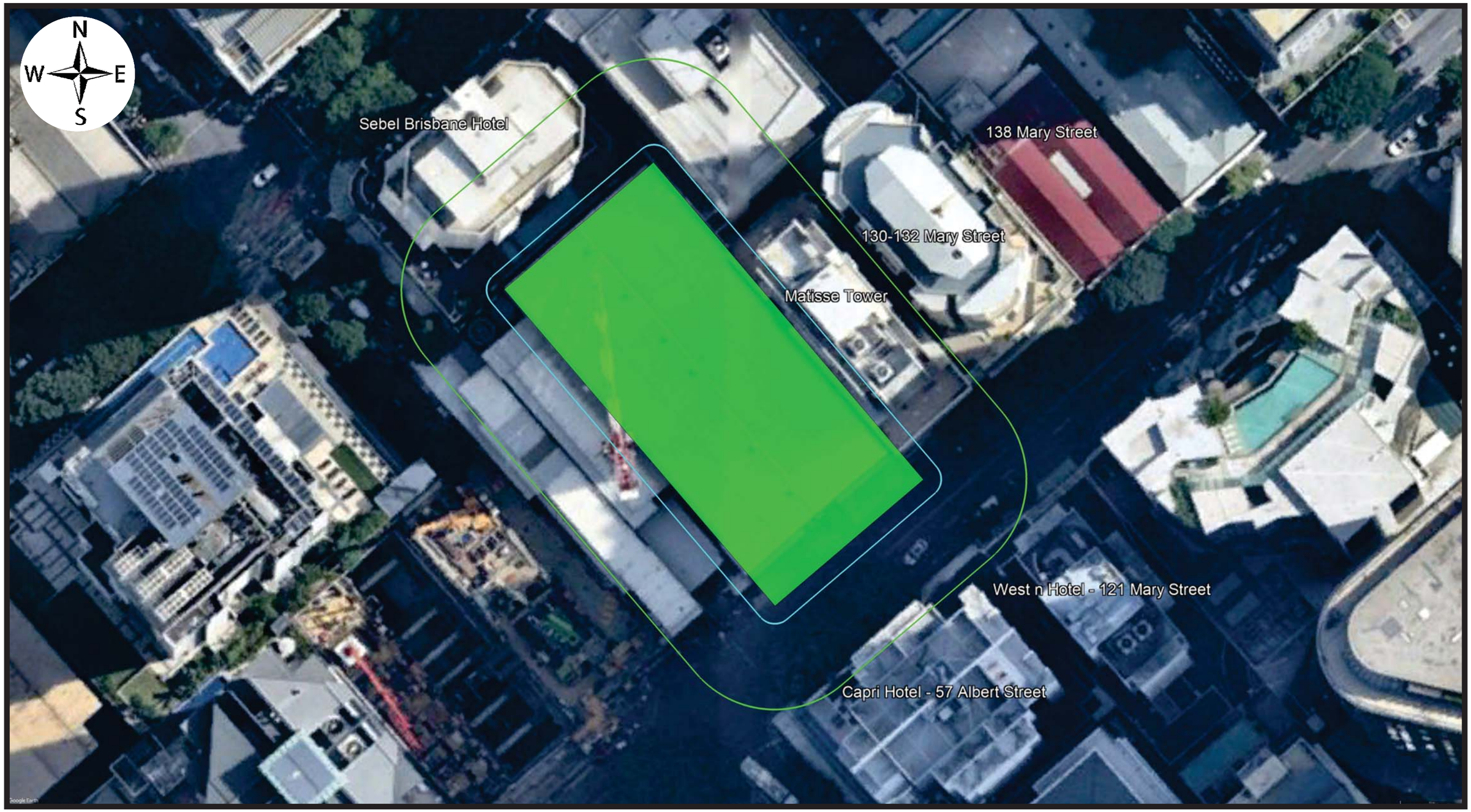
Revision History
R1: Original

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Created using TunnelTRAP Software

Modelled works area

SCALE

0 5 10 15 20 25m

RL 4 Vibration Levels

- 2 mm/s Vibration Contour
- 5 mm/s Vibration Contour
- 10 mm/s Vibration Contour
- 15 mm/s Vibration Contour
- 20 mm/s Vibration Contour
- 50 mm/s Vibration Contour

PROJECT DESCRIPTION Albert St Works - Modelled vibration levels and associated vibration contours from basement excavation with a 2000kg hydraulic hammer at RL-5. Vibration contours are shown at RL4 and represent maximum expected values at the surface.

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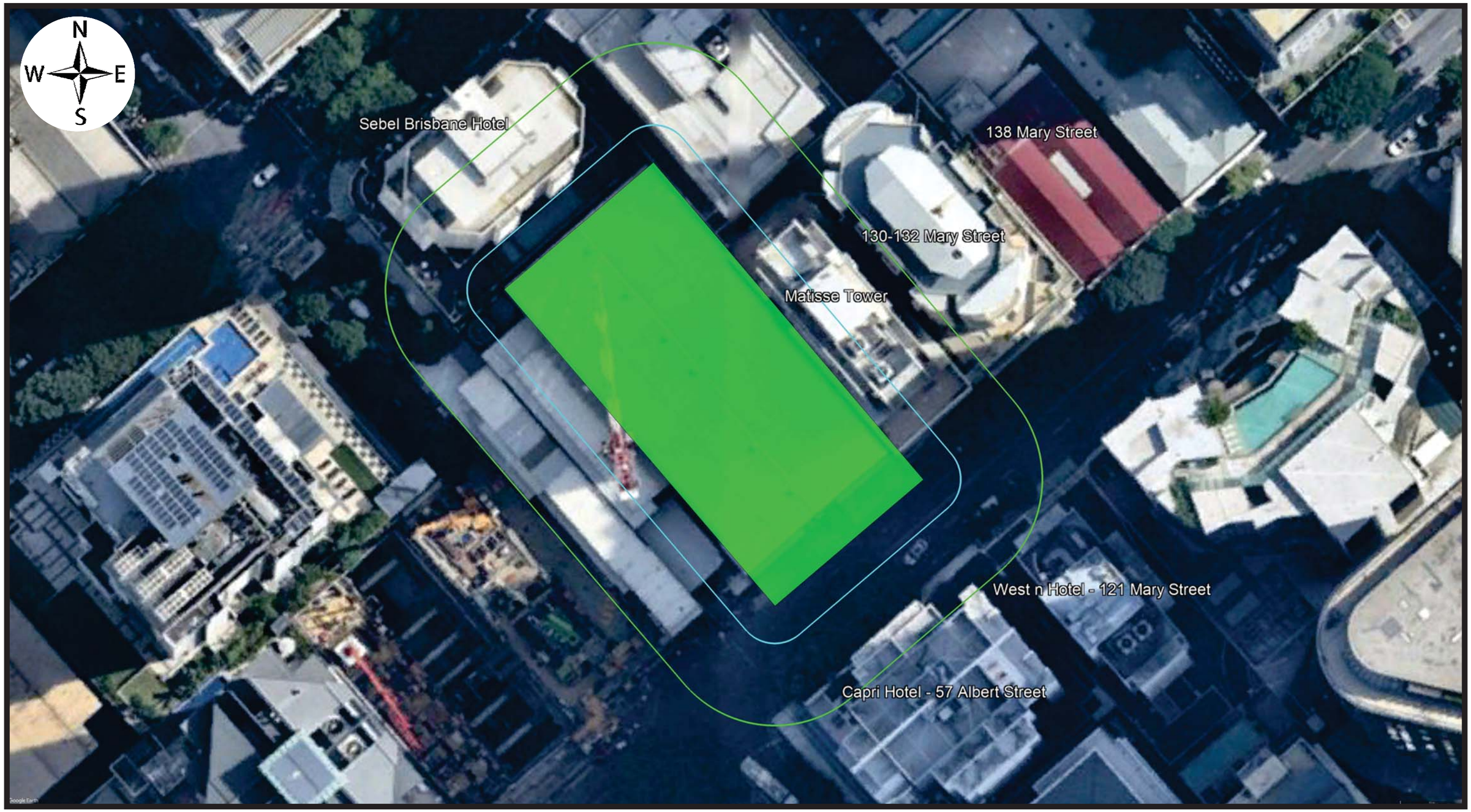
Revision History
R1: Original

Date Drawn: 2 April 2024

Ref No: Albert St Works

Job No: HP2305-2

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Modelled works area

SCALE

0 5 10 15 20 25m

RL 4 Vibration Levels

- 2 mm/s Vibration Contour
- 5 mm/s Vibration Contour
- 10 mm/s Vibration Contour
- 15 mm/s Vibration Contour
- 20 mm/s Vibration Contour
- 50 mm/s Vibration Contour

PROJECT DESCRIPTION Albert St Works - Modelled vibration levels and associated vibration contours from basement excavation with a 3500kg hydraulic hammer at RL-5. Vibration contours are shown at RL4 and represent maximum expected values at the surface.

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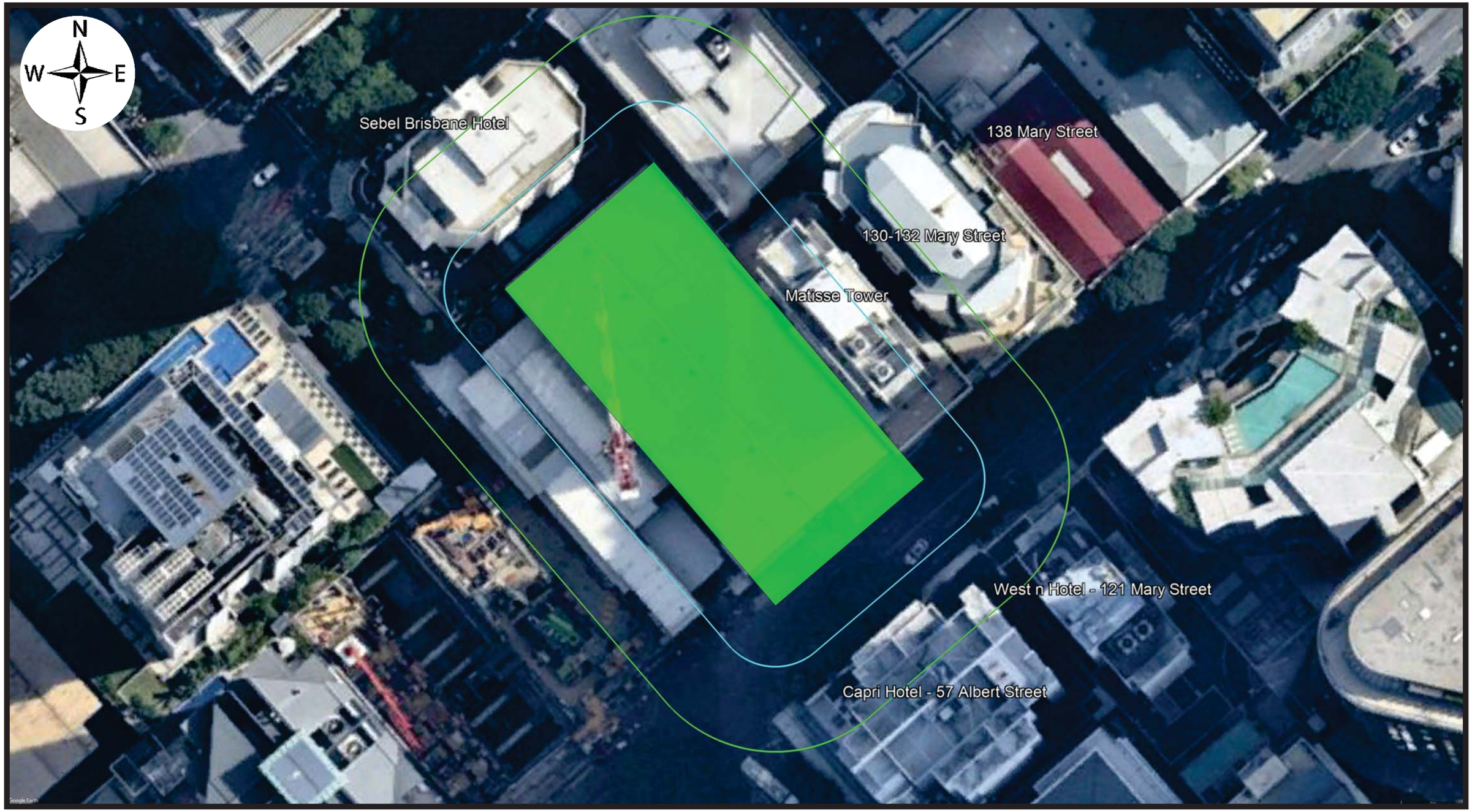
Revision History
R1: Original

Date Drawn: 2 April 2024

Ref No: Albert St Works

Job No: HP2305-2

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Created using TunnelTRAP Software

Modelled works area

SCALE

0 5 10 15 20 25m

RL 4 Vibration Levels

- 2 mm/s Vibration Contour
- 5 mm/s Vibration Contour
- 10 mm/s Vibration Contour
- 15 mm/s Vibration Contour
- 20 mm/s Vibration Contour
- 50 mm/s Vibration Contour

PROJECT DESCRIPTION Albert St Works - Modelled vibration levels and associated vibration contours from basement excavation with a 7000kg hydraulic hammer at RL-5. Vibration contours are shown at RL4 and represent maximum expected values at the surface.

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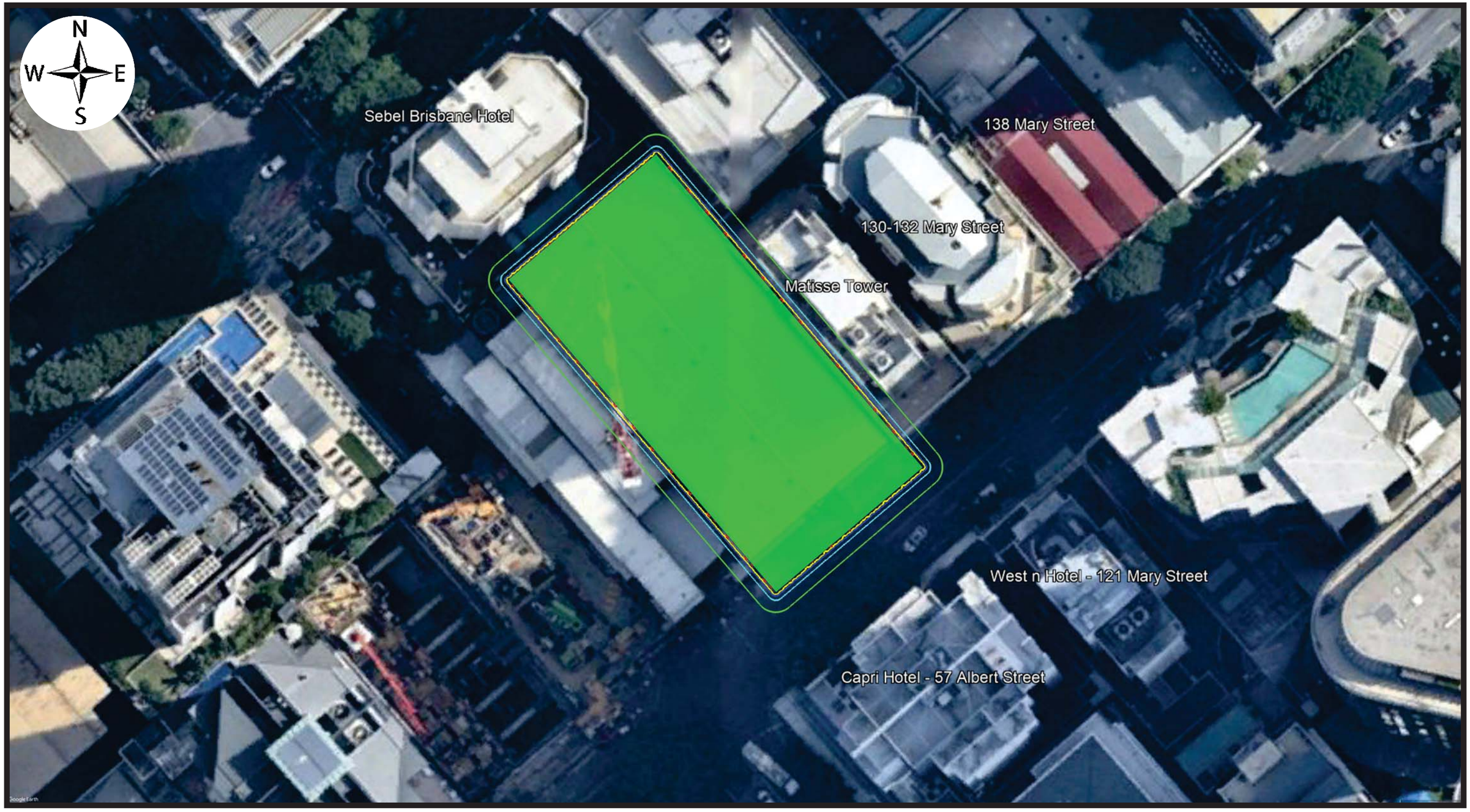
Revision History
R1: Original

Date Drawn: 2 April 2024

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Created using TunnelTRAP Software

Modelled works area

SCALE

0 5 10 15 20 25m

Surface Vibration Levels

- 2 mm/s Vibration Contour
- 5 mm/s Vibration Contour
- 10 mm/s Vibration Contour
- 15 mm/s Vibration Contour
- 20 mm/s Vibration Contour
- 50 mm/s Vibration Contour

PROJECT DESCRIPTION Albert St Works - Modelled vibration levels and associated vibration contours from basement excavation with a 35t excavator at RL-5. Vibration contours are shown at RL4 and represent maximum expected values at the surface.

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Revision History
R1: Original

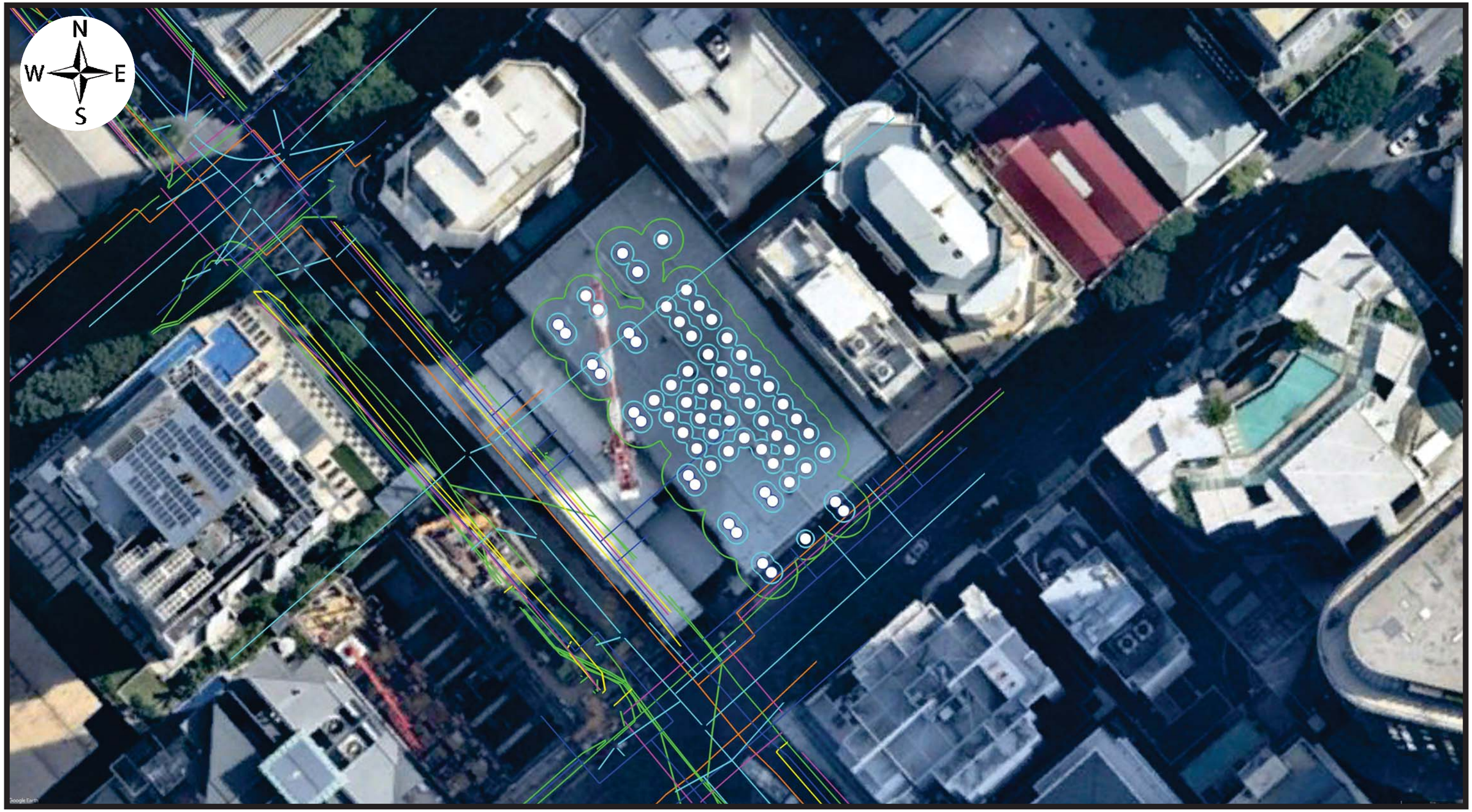
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Job No: HP2305-2

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29. APPENDIX B – MODELLING ASSESSMENT FOR BELOW GROUND UTILITIES



Created using TunnelTRAP Software

SCALE

0 5 10 15 20 25m

Services Legend

- Drainage
- Underground Electrical
- Lighting
- Telecom
- Underground Gas
- Watermain
- Sewerage

RL 3 Vibration Levels

- 2 mm/s Vibration Contour
- 5 mm/s Vibration Contour
- 10 mm/s Vibration Contour
- 15 mm/s Vibration Contour
- 20 mm/s Vibration Contour
- 50 mm/s Vibration Contour

PROJECT DESCRIPTION Albert St Works - Modelled vibration levels and associated vibration contours from piling activities at RL3. Vibration contours are shown at RL3 and represent maximum expected values at the underground services.

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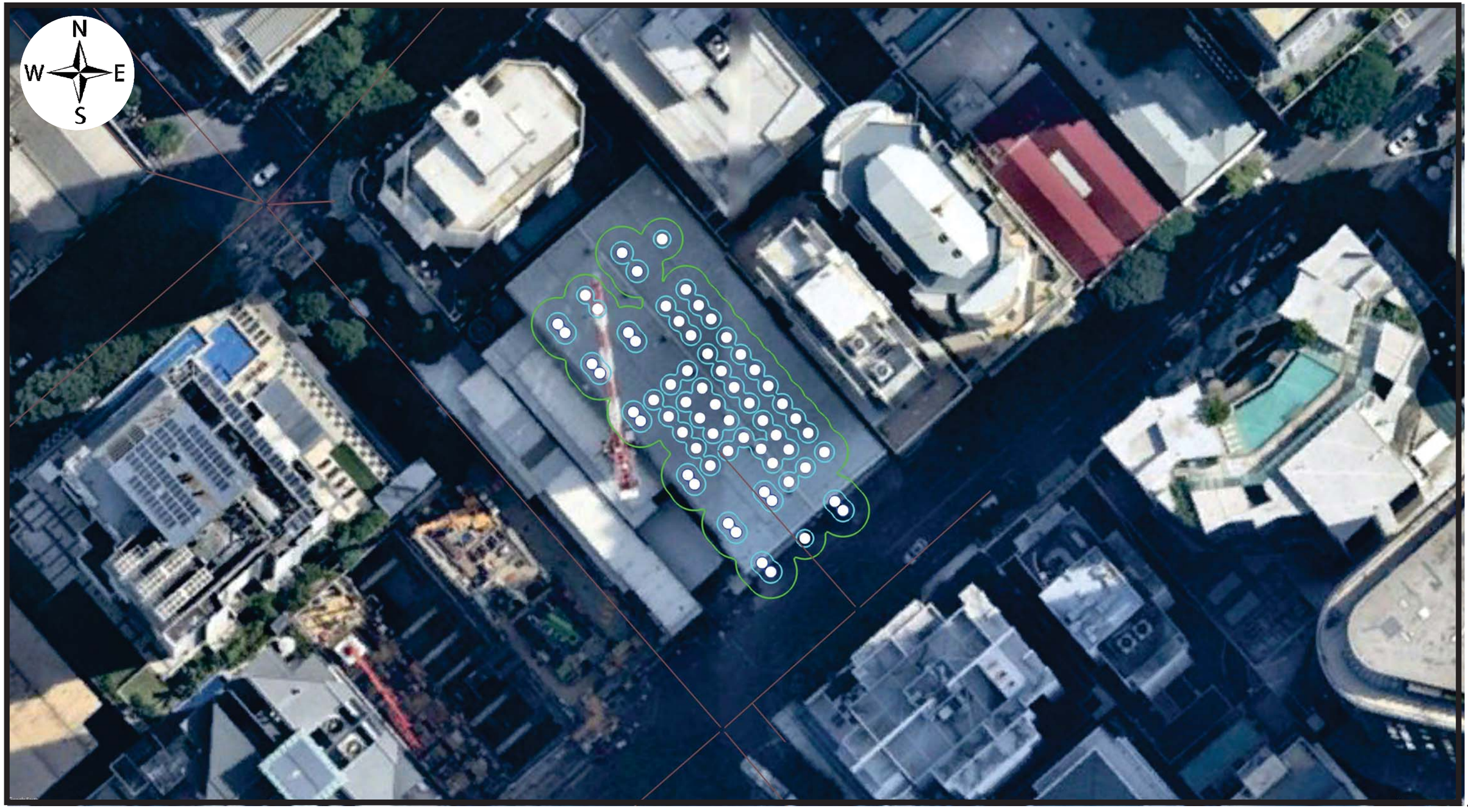
Revision History
R1: Original

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SCALE

0 5 10 15 20 25m

Services Legend

Sewerage

RL -5 Vibration Levels

- 2 mm/s Vibration Contour
- 5 mm/s Vibration Contour
- 10 mm/s Vibration Contour
- 15 mm/s Vibration Contour
- 20 mm/s Vibration Contour
- 50 mm/s Vibration Contour

PROJECT DESCRIPTION Albert St Works - Modelled vibration levels and associated vibration contours from piling activities at RL-3. Vibration contours are shown at RL-3 and represent maximum expected values at the underground sewer.

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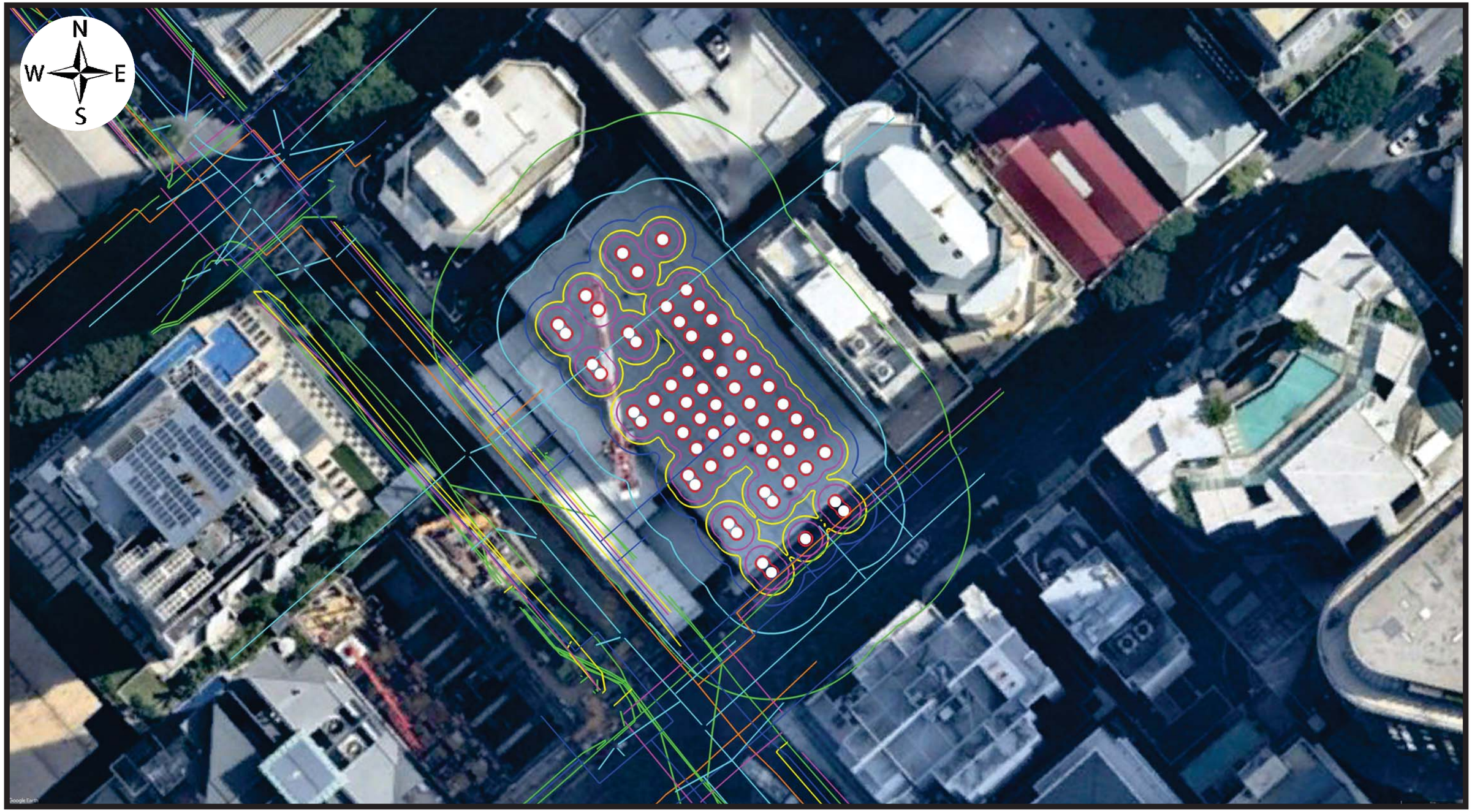
Revision History
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Job No: HP2305-2

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SCALE

0 5 10 15 20 25m

Services Legend

- Drainage
- Underground Electrical
- Lighting
- Telecom
- Underground Gas
- Watermain
- Sewerage

RL 3 Vibration Levels

- 2 mm/s Vibration Contour
- 5 mm/s Vibration Contour
- 10 mm/s Vibration Contour
- 15 mm/s Vibration Contour
- 20 mm/s Vibration Contour
- 50 mm/s Vibration Contour

PROJECT DESCRIPTION Albert St Works - Modelled vibration levels and associated vibration contours from vibratory piling activities at RL3. Vibration contours are shown at RL3 and represent maximum expected values at the underground services.

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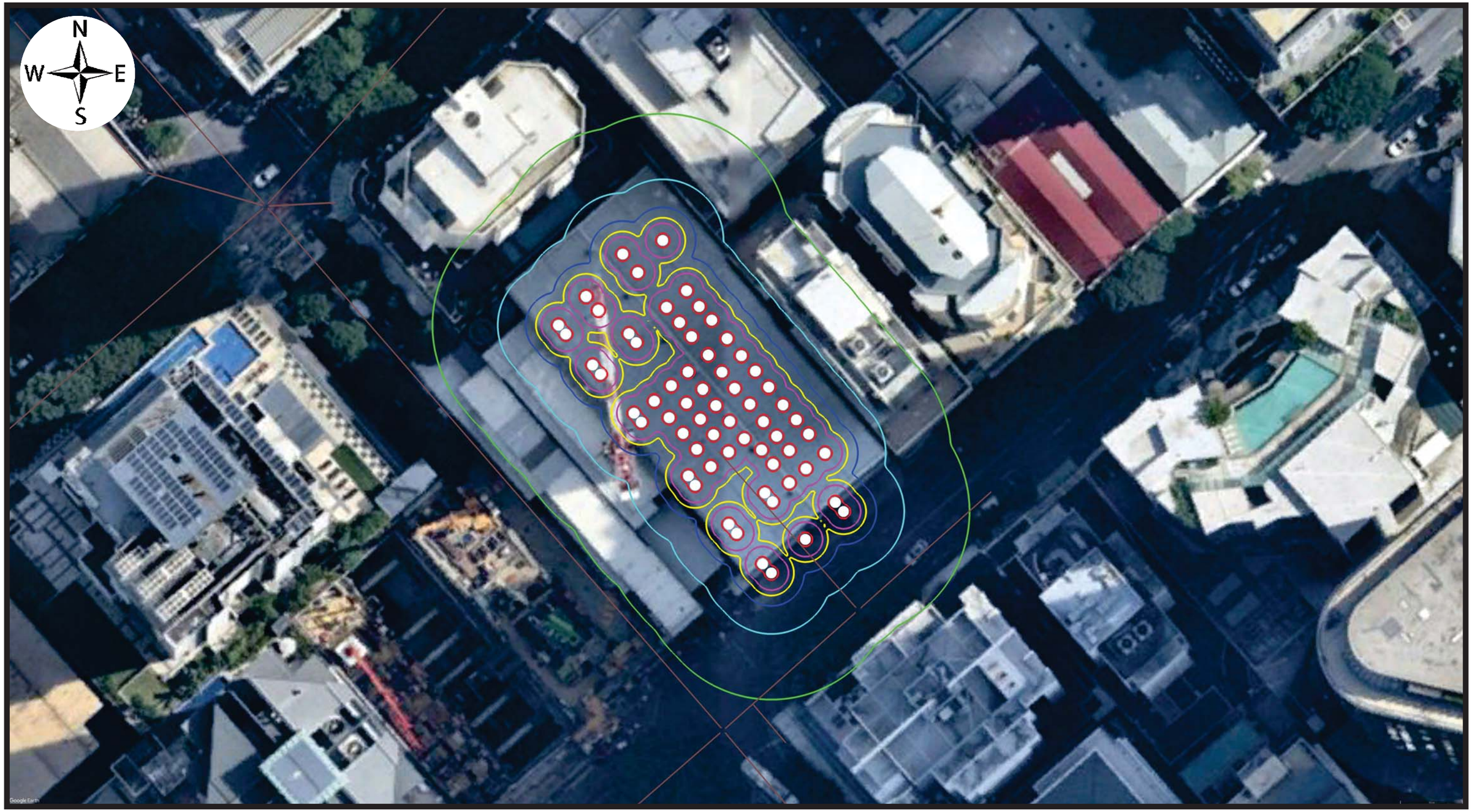
Revision History
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SCALE

0 5 10 15 20 25m

Services Legend

Sewerage

RL -5 Vibration Levels

- 2 mm/s Vibration Contour
- 5 mm/s Vibration Contour
- 10 mm/s Vibration Contour
- 15 mm/s Vibration Contour
- 20 mm/s Vibration Contour
- 50 mm/s Vibration Contour

PROJECT DESCRIPTION Albert St Works - Modelled vibration levels and associated vibration contours from vibratory piling activities at RL-3. Vibration contours are shown at RL-3 and represent maximum expected values at the underground sewer.

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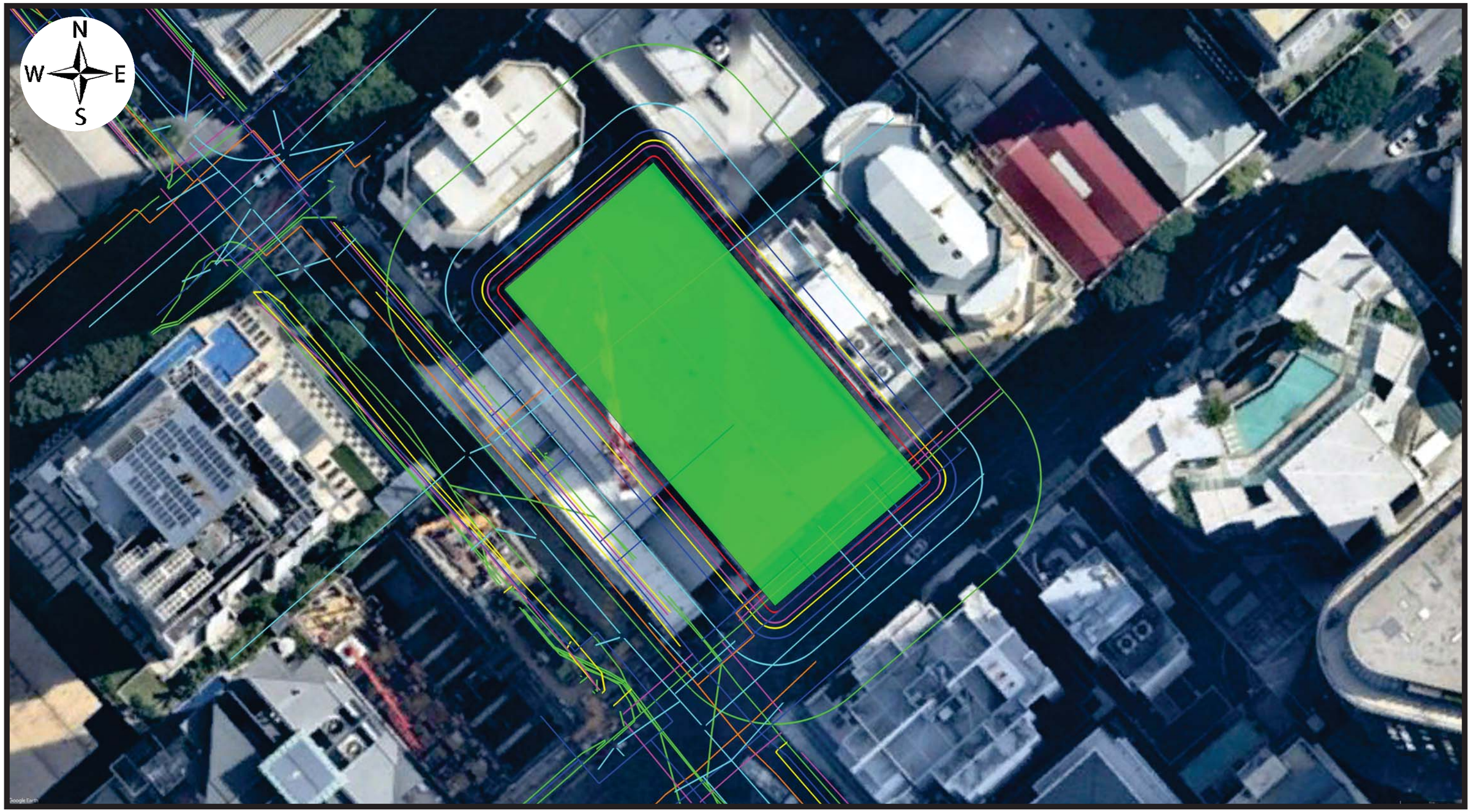
Revision History
R1: Original

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Modelled works area

Services Legend

- Drainage
- Underground Electrical
- Lighting
- Telecom
- Underground Gas
- Watermain
- Sewerage

SCALE

0 5 10 15 20 25m

RL 3 Vibration Levels

- 2 mm/s Vibration Contour
- 5 mm/s Vibration Contour
- 10 mm/s Vibration Contour
- 15 mm/s Vibration Contour
- 20 mm/s Vibration Contour
- 50 mm/s Vibration Contour

PROJECT DESCRIPTION Albert St Works - Modelled vibration levels and associated vibration contours from basement excavation with a 2000kg hydraulic hammer at RL3. Vibration contours are shown at RL3 and represent maximum expected values at the underground services.

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QIC

Plate No. M

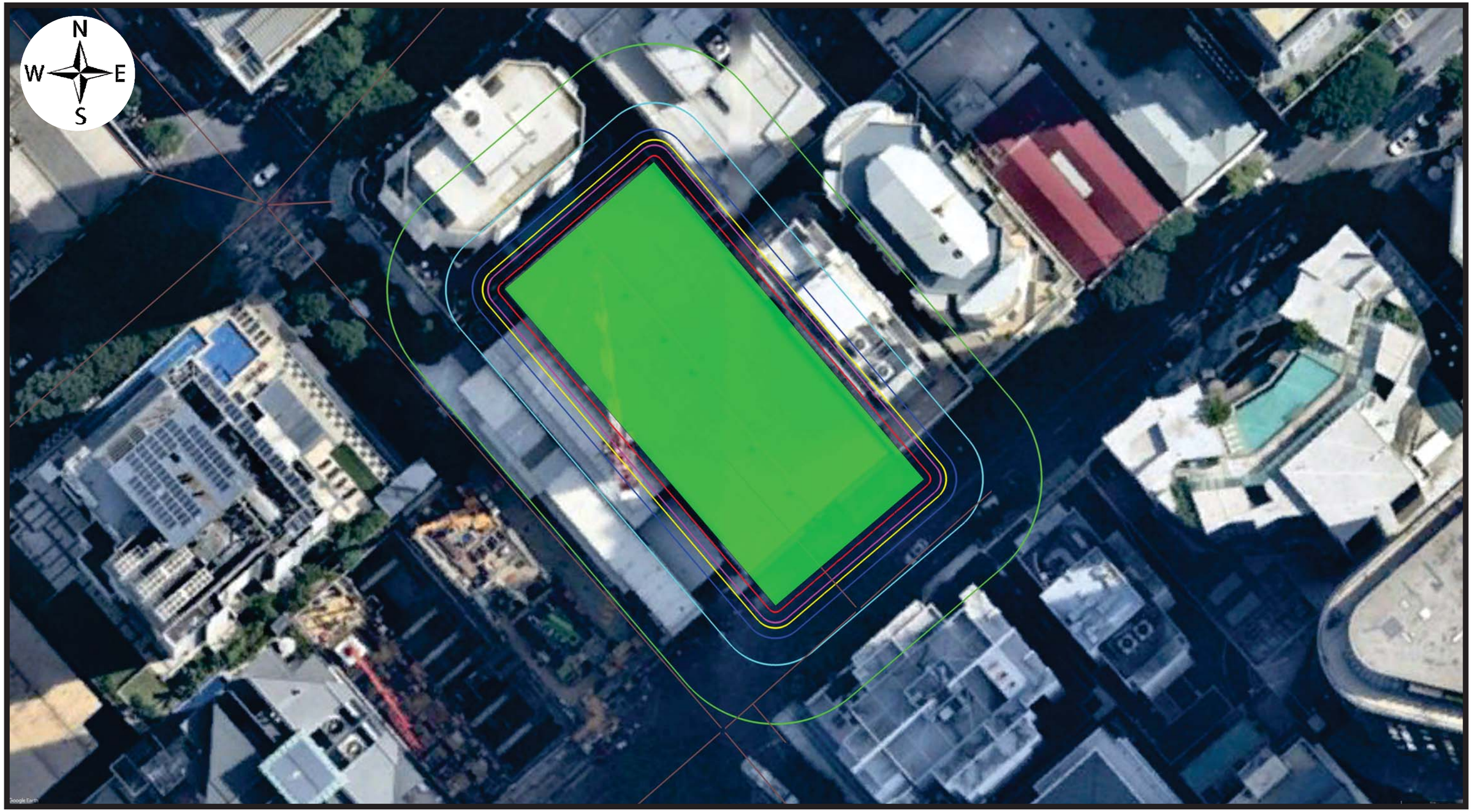
Revision History
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Ref No: Albert St Works

Job No: HP2305-2

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Created using TunnelTRAP Software

Modelled works area

Services Legend

Sewerage

SCALE

0 5 10 15 20 25m

RL -5 Vibration Levels

- 2 mm/s Vibration Contour
- 5 mm/s Vibration Contour
- 10 mm/s Vibration Contour
- 15 mm/s Vibration Contour
- 20 mm/s Vibration Contour
- 50 mm/s Vibration Contour

PROJECT DESCRIPTION Albert St Works - Modelled vibration levels and associated vibration contours from basement excavation with a 2000kg hydraulic hammer at RL-3. Vibration contours are shown at RL-3 and represent maximum expected values at the underground sewer.

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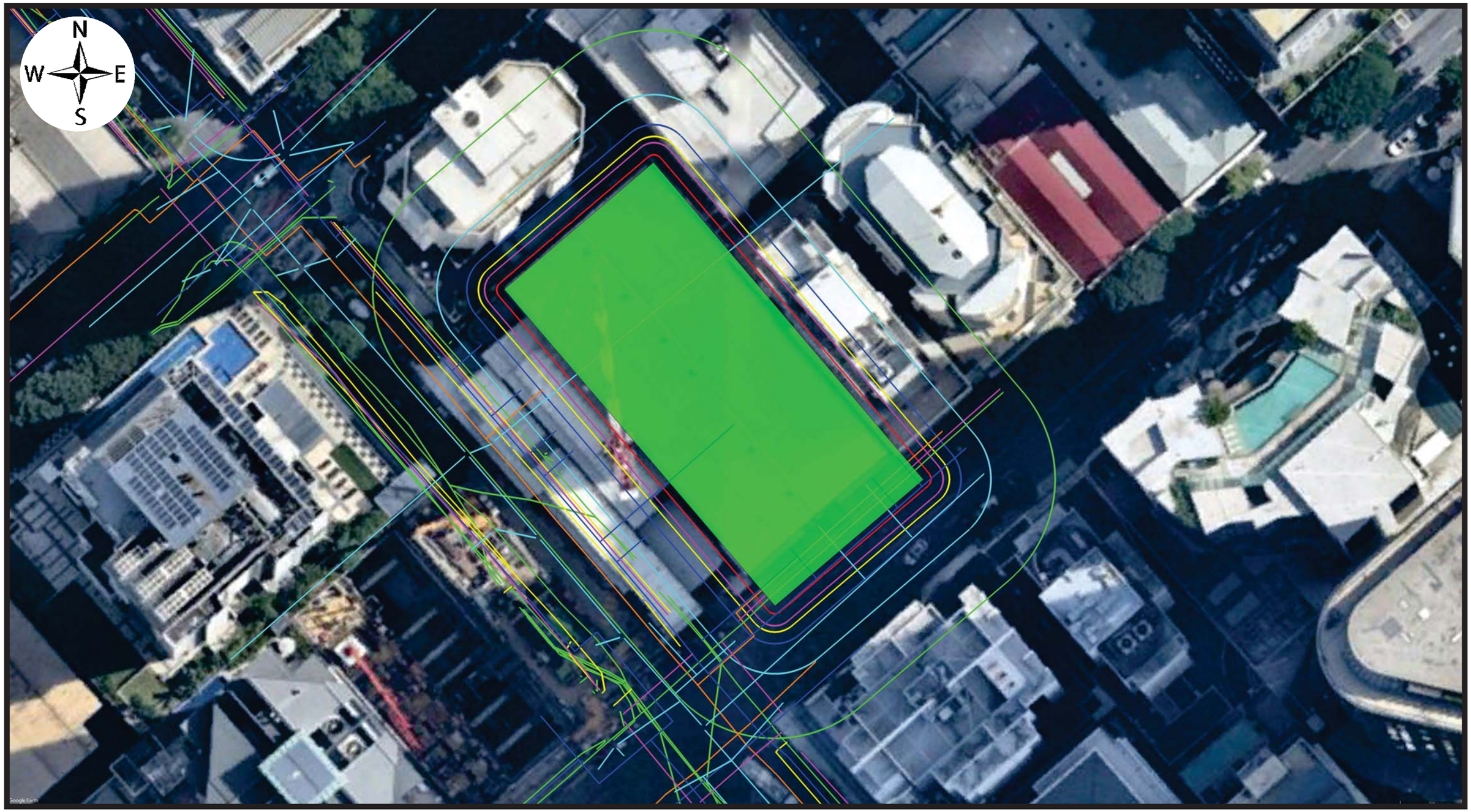
Revision History
R1: Original

Date Drawn: 2 April 2024

Ref No: Albert St Works

Job No: HP2305-2

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Modelled works area

Services Legend

- Drainage
- Underground Electrical
- Lighting
- Telecom
- Underground Gas
- Watermain
- Sewerage

SCALE

0 5 10 15 20 25m

RL 3 Vibration Levels

- 2 mm/s Vibration Contour
- 5 mm/s Vibration Contour
- 10 mm/s Vibration Contour
- 15 mm/s Vibration Contour
- 20 mm/s Vibration Contour
- 50 mm/s Vibration Contour

PROJECT DESCRIPTION Albert St Works - Modelled vibration levels and associated vibration contours from basement excavation with a 3500kg hydraulic hammer at RL3. Vibration contours are shown at RL3 and represent maximum expected values at the underground services.

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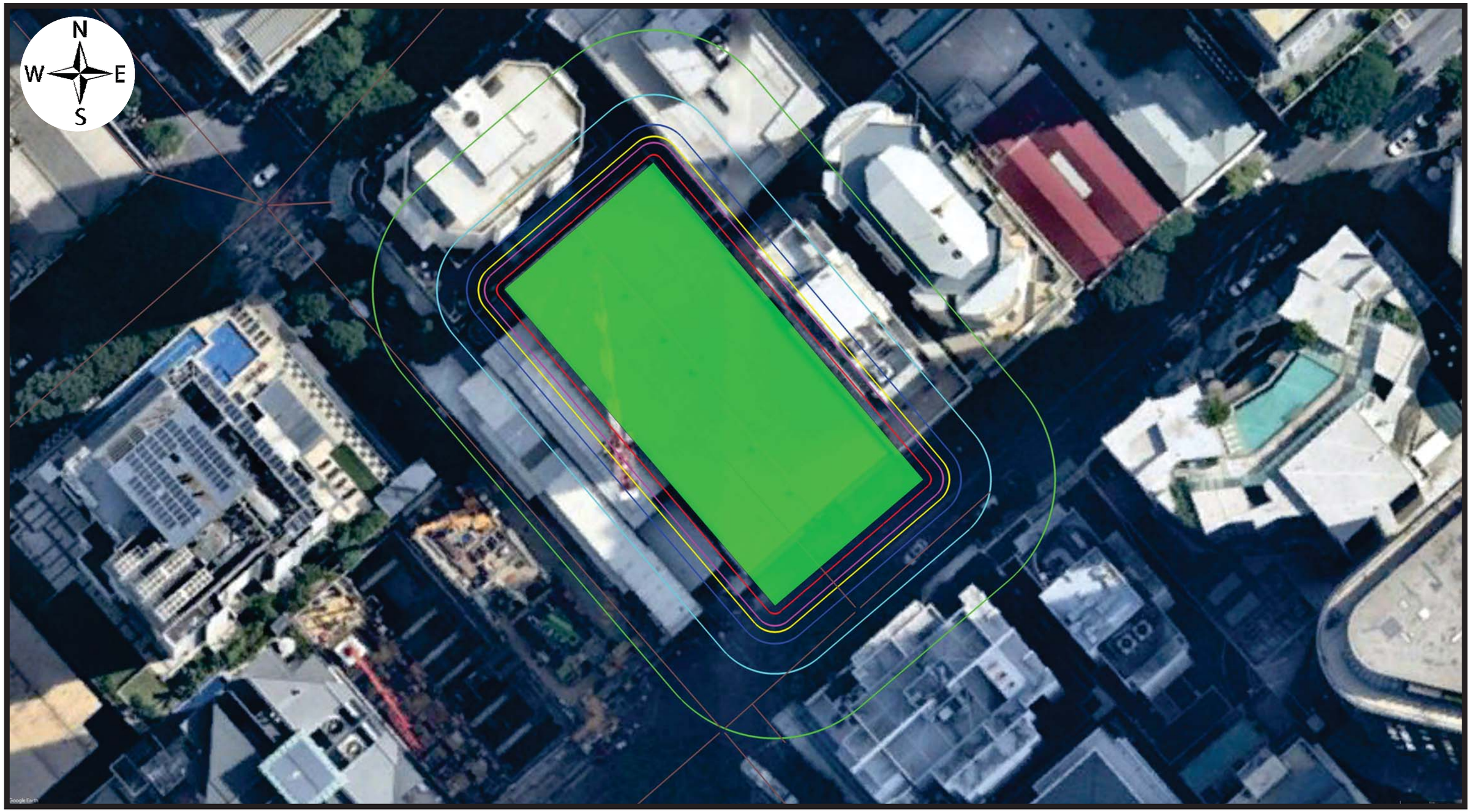
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Modelled works area

Services Legend

Sewerage

SCALE

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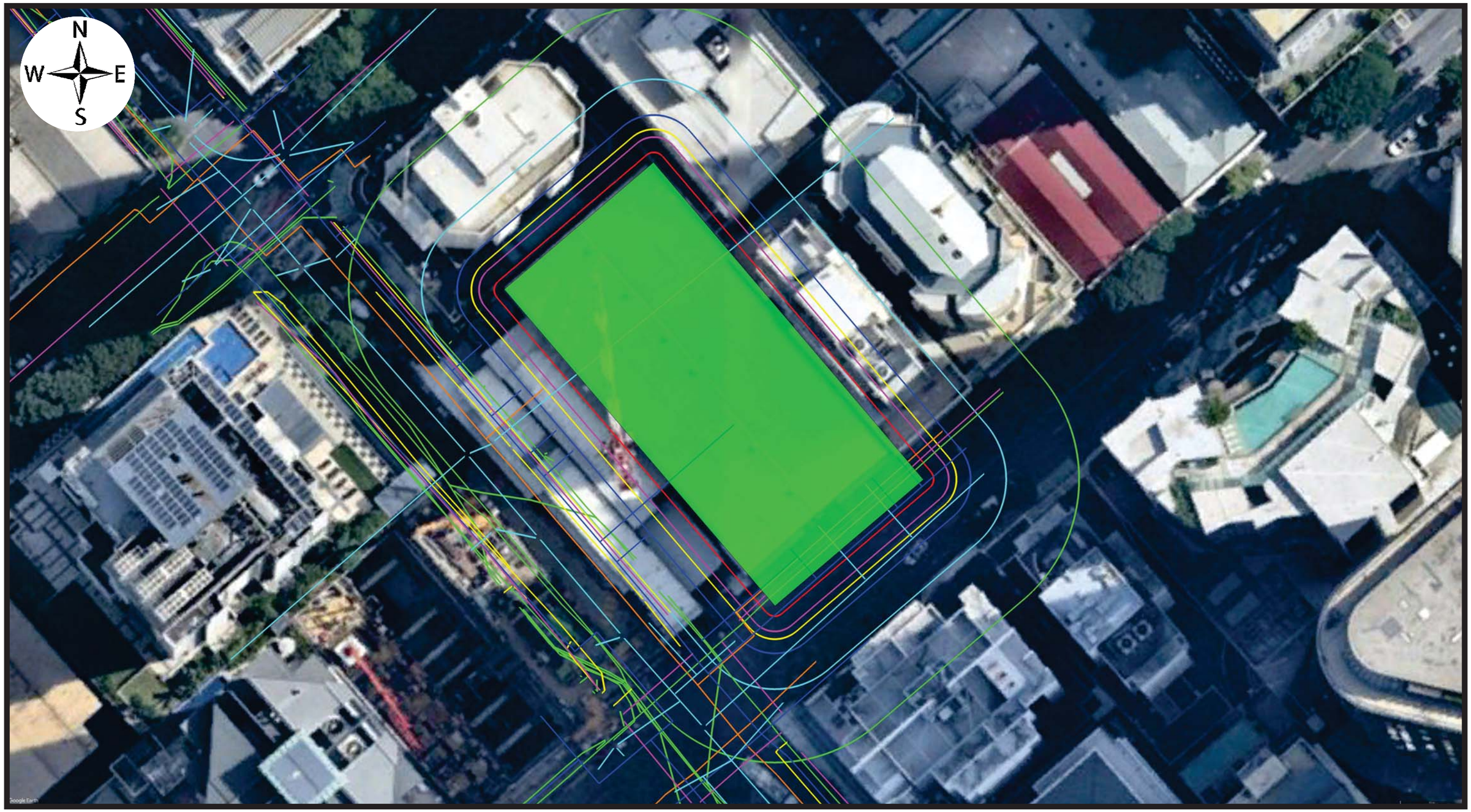
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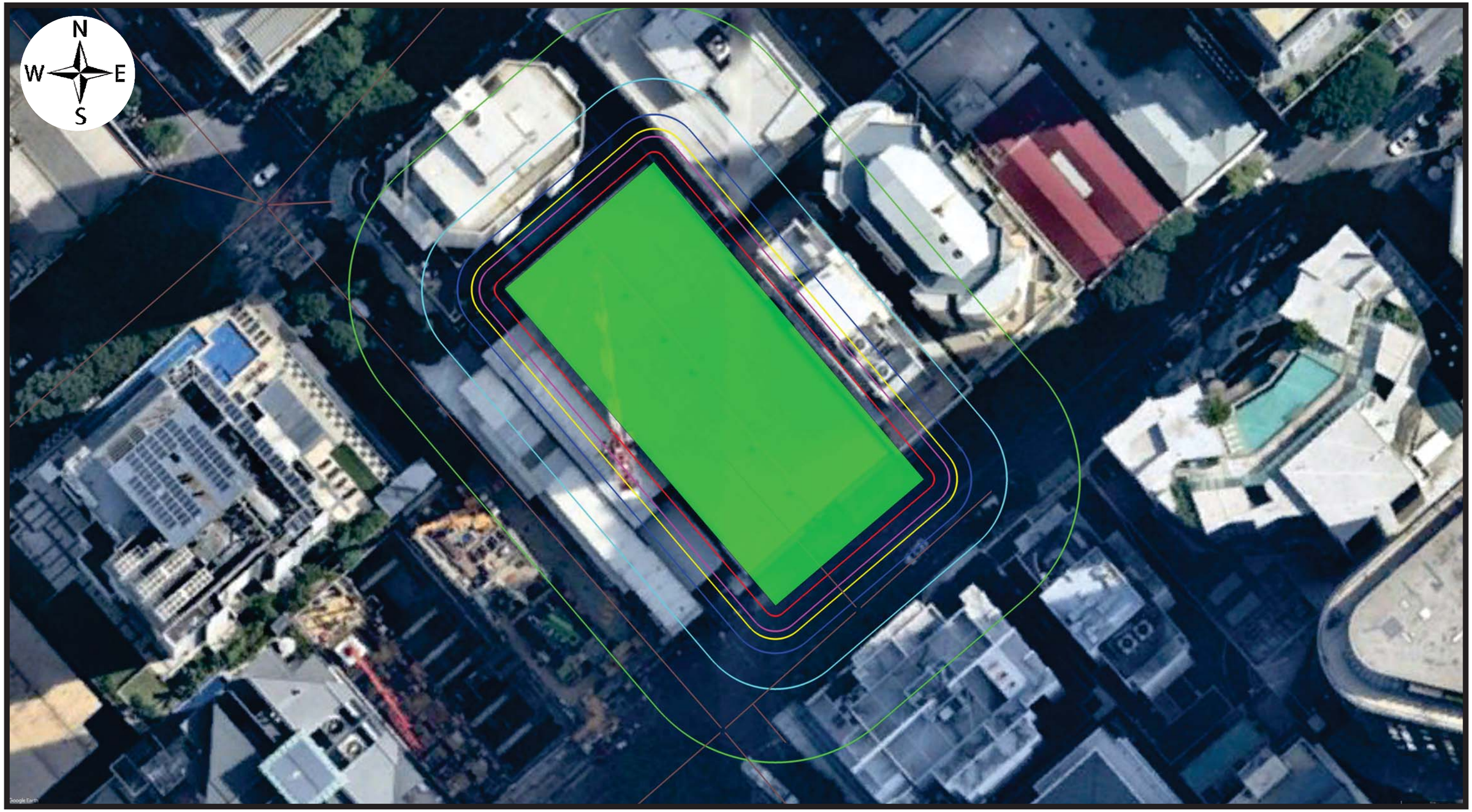
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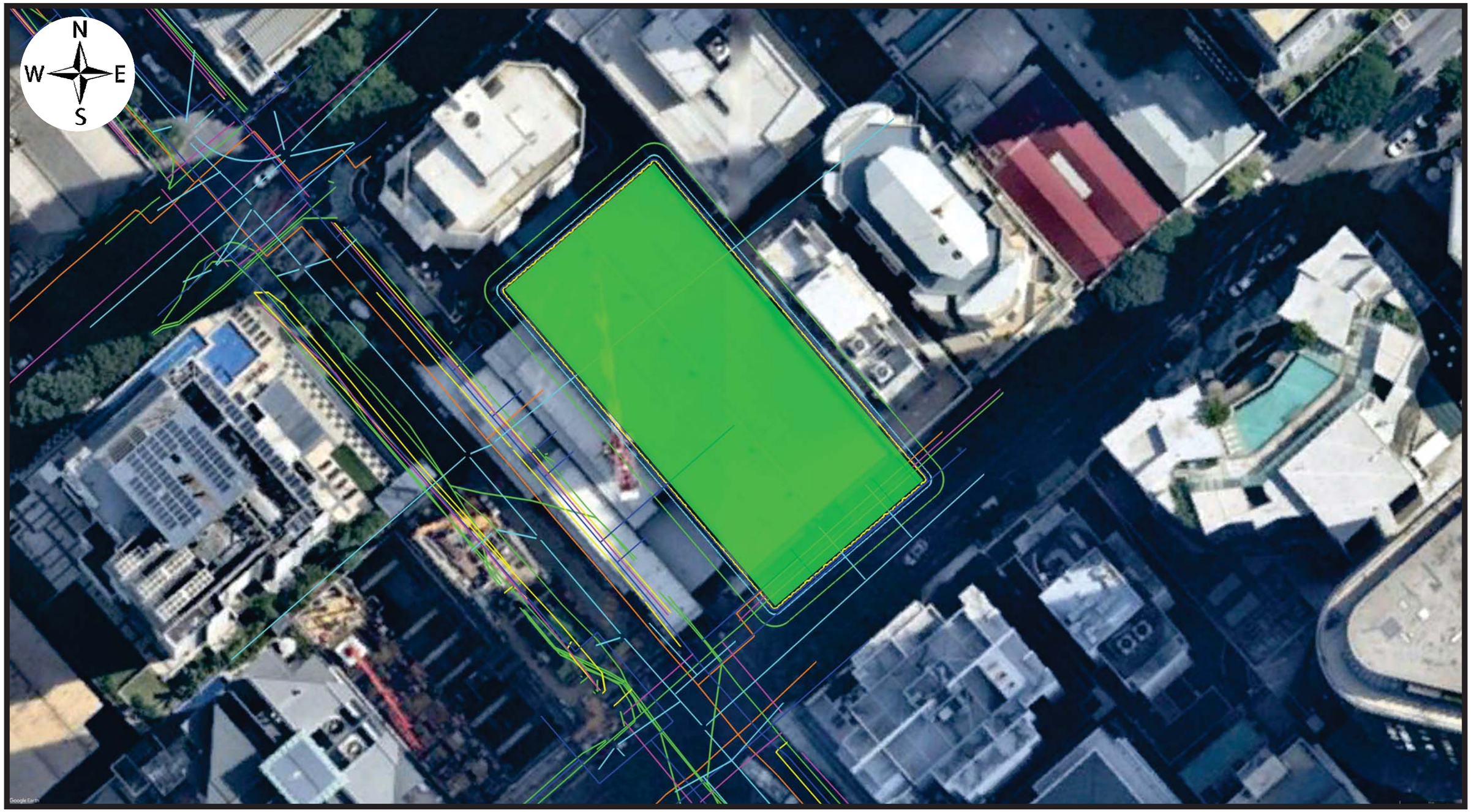
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PROJECT DESCRIPTION Albert St Works - Modelled vibration levels and associated vibration contours from basement excavation with a 35t excavator at RL3. Vibration contours are shown at RL3 and represent maximum expected values at the underground services.

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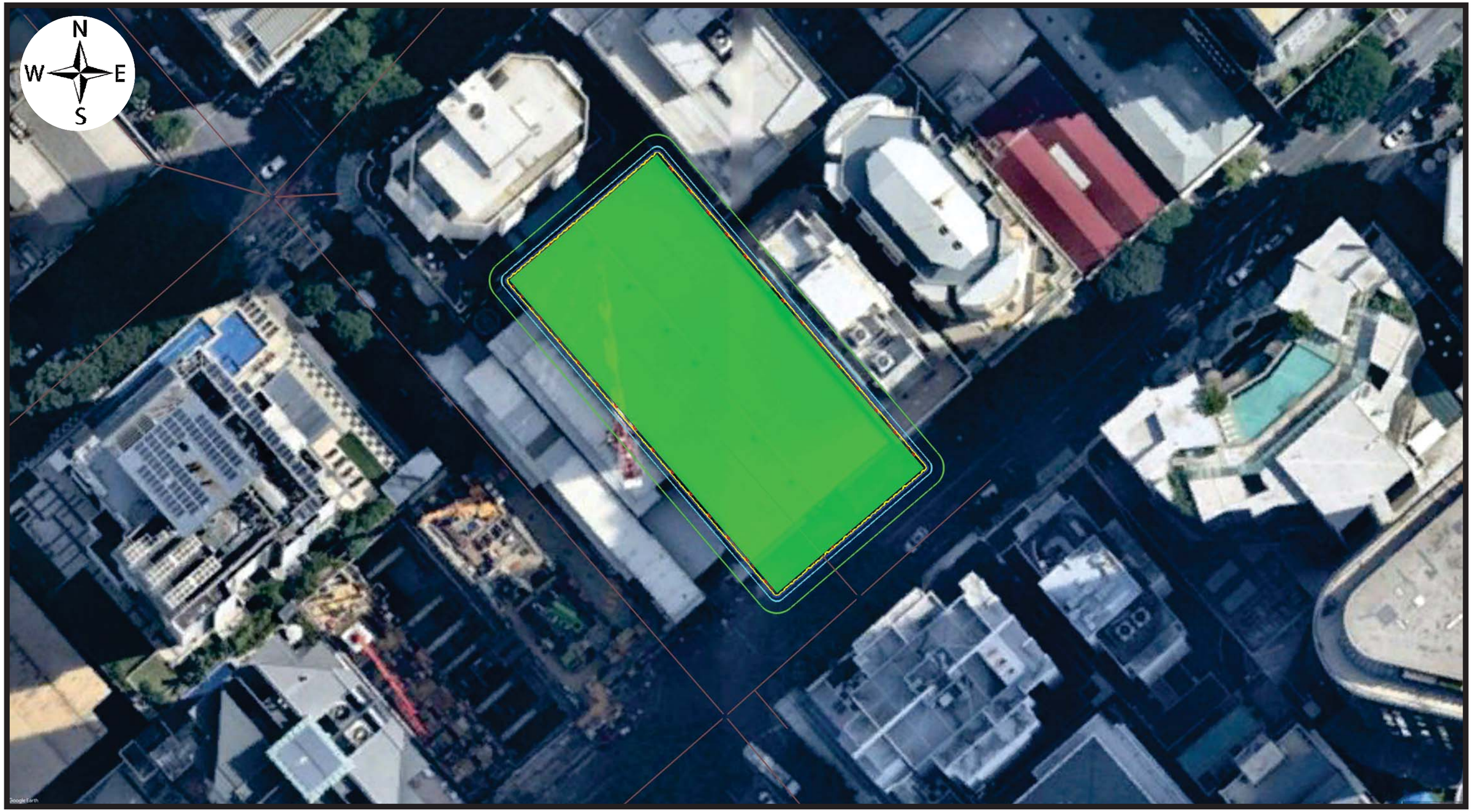
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Report for



Track and Structures Monitoring Plan
For
101 Albert Street, Brisbane

Prepared By:

Heilig & Partners Pty. Ltd.

June, 2024

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This assessment and management report encompasses the requirements for the TSMP (Track and Structures Monitoring Plan) as the PDA MCU11 condition. The report sets out the performance requirements and procedures to ensure that potential impacts associated with works at 101 Albert Street Brisbane site, including any demolition of existing structures, earthworks for the newly constructed building foundations and the resulting excavation are appropriately assessed and controlled at the adjacent buildings, including buildings on the Queensland Heritage Register, Cross River Rail infrastructure and the below ground utilities, such as the S1 Sewer. The instruction:

- *States the impacts which will be assessed and monitored.*
- *Describes the modelling and assessment procedures.*
- *Assesses the expected impacts from the different stages of the planned works.*
- *Describes acceptable vibration limits.*

and for the monitoring:

- *Describes the vibration monitoring system.*
- *Requirements for reporting of the monitored data.*
- *Specifies calibration of the monitoring units.*
- *Management measures and mitigation with respect to vibration*.

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1. DEFINITIONS AND ACRONYMS

Component particle velocity The instantaneous particle velocity of a particle at each orthogonal component axis (transverse, longitudinal and vertical)

Continuous vibration A vibration source that is continuous in nature during an assessment period (may be constant or variable). ISO10137 defines continuous vibration as having a duration of more than 30 minutes per 24-hour period

Frequency The rate per second of a vibration constituting a wave, either in the rock mass material (as in vibration) or in the air (as in sound waves), The number of cycles per unit of time, commonly per second, is called the frequency. The measurement is reported in Hertz (Hz).

Impulsive vibration A vibration source (continuous or intermittent) which has a rapid build up to a peak followed by a damped decay that may or may not involve several cycles of vibration (depending on frequency and damping).

Intermittent vibration Interrupted periods of continuous (e.g. a drill) or repeated periods of impulsive vibration (e.g. a pile driver), or continuous vibration that varies significantly in magnitude. ISO10137 define intermittent vibration as more than 10 excitations per 24-hour period

Peak Component Particle Velocity (PCPV) The maximum instantaneous velocity of a particle at any one of the three orthogonal component axis during a given time interval. Also represented by the notation in DIN 4150-3.

Peak Particle Velocity (Resultant PPV) The maximum instantaneous velocity of a particle at a point during a given time interval. The Resultant PPV is the vector sum of the three orthogonal component particle velocities (component PV)

RMS Particle Velocity The root mean square particle velocity, commonly used (with the RMS acceleration) to assess human response to vibration. Unless otherwise specified, RMS particle velocity (denoted V_{RMS}) refers to the overall vector sum RMS particle velocity rather than to any particular component of the RMS particle velocity.

Transient Vibration Vibration in which the oscillatory displacement of the ground or structure reaches a peak and then decays rapidly towards zero

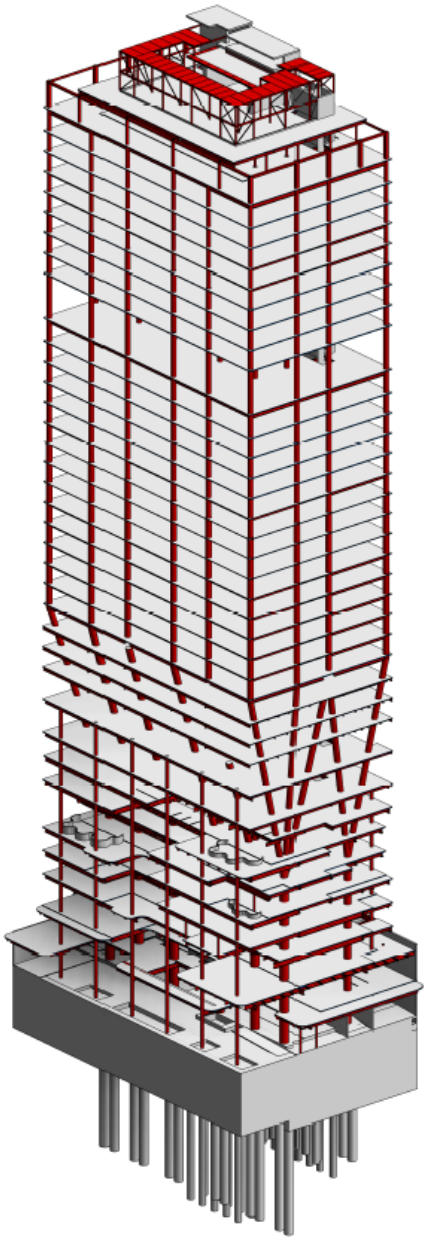
2. THE PROJECT

The CRR Albert Street Pty Ltd (ACN 660 319 693) as trustee for CRR Albert Street Trust (Albert Street Trust) has been awarded the development rights for the Cross River Rail (CRR) precincts, including the proposed development at Albert Street in the Brisbane CBD.

Development of the 101 Albert Street mixed use precinct will include a commercial tower in the order of 200 metre tall with approximately 45 floors above ground level. The building will include a multi-level basement, which will be designed to satisfy the requirements of the Cross River Rail Delivery Authority (CRRDA), due to the presence of CRR assets below.

The proposed development is anticipated to comprise a predominantly commercial tower above Podium retail and basement parking. Level 2 will be the main commercial lobby. The commercial tower will be split into four rises, Low, Mid, High and Sky Rise. Above the last commercial level (L37) will be a Destination Rooftop with an external terrace.

The building will include two and a half basement levels over the full site, with B01 containing the Loading Facilities with the balance of B1 and B2 being car parking. The half level will house the End of Trip facilities and will sit between B1 and the Ground floor. The finished floor level of Basement 2 is currently proposed at RL -5.2m.



RCP Australia Pty Ltd (RCP) has engaged multiple consultants to provide advice on behalf of Albert Street Trust:

- Geotechnical advice to help inform the Development Application (DA) and detailed design of the building by EDG Consulting
- Structural assessment to inform the design by Robert Bird Group

An assessment of ground stresses and cavern distortions associated with the proposed building loads has been completed and informed aspects of the ground support, piling, structural design and excavation works. A key element has been a comparison of ground stresses and deformations at the Albert Street cavern from the proposed building loads.

The proposed basement to the Over Station Development (OSD) requires an excavation circa 10 metres depth maximum at the boundary. The zone of influence for the retention system will not exceed twice the retained height (20 metres). Based on this, there are no listed buildings in the influence zone to the retention system.

3. PREAMBLE

The analysis of vibration impacts from the planned OSD is a necessary precursor to any demolition, excavation and construction activities for the project, given both the competency of the rock mass and the proximity of the CRR caverns and tunnels, adjacent commercial and heritage properties and the sensitive below ground utilities. Some demolition, excavation and construction activities will generate varying levels of vibration for varying durations, but generally short term semi-continuous ground vibration. The potential effects or concerns, amongst others, include damage to the rail caverns and tunnels, damage to adjacent buildings, damage to public utilities, impact on quality of life and subsequent

complaints from the tenants of adjacent buildings along Mary, Albert and Charlotte Street. Damage to the adjacent infrastructure will however be low risk when the vibration constraints imposed on the project are below that which will cause superficial damage to buildings.

4. SITE DETAILS

The proposed Albert Street OSD is located on Lot 2 of the Albert Street Station site for the CRR. The site is located opposite the proposed Albert Street Station. The site is noted as FOSD Lot 2 on the map below in Figure 1.



Figure 1 - Plan showing extent of the Lot 2 site north east of the Albert Street Station

The building will include a multi-level basement, which must be designed to satisfy the requirements of the Cross River Rail Delivery Authority, due to the presence of CRR assets below.

The development site is currently occupied by the temporary CRR acoustic shed. The acoustic shed has a typical slab on grade with a minimum 300mm thickness with a top surface level of RL +4.0m. The slab thickness is up to 600mm thick in some locations and is supported on ground beams up to 1200mm deep.

Within the shed is a 12 metre diameter temporary access shaft that extends down to nearly RL-30m. This access shaft links to two temporary adit shafts that curve and join the station cavern.

The acoustic shed, access shaft and connecting adits are all temporary structures. Upon completion of the station, the acoustic shed and its base slab will be removed with the founding piles to remain for their extent below the Proposed Lot 2 Basement. The adits and the access shaft will be concrete-filled.

The existing infrastructure showing the CRR tunnels, temporary access adits and shaft, adjacent building and the piling locations are shown in the following figure.

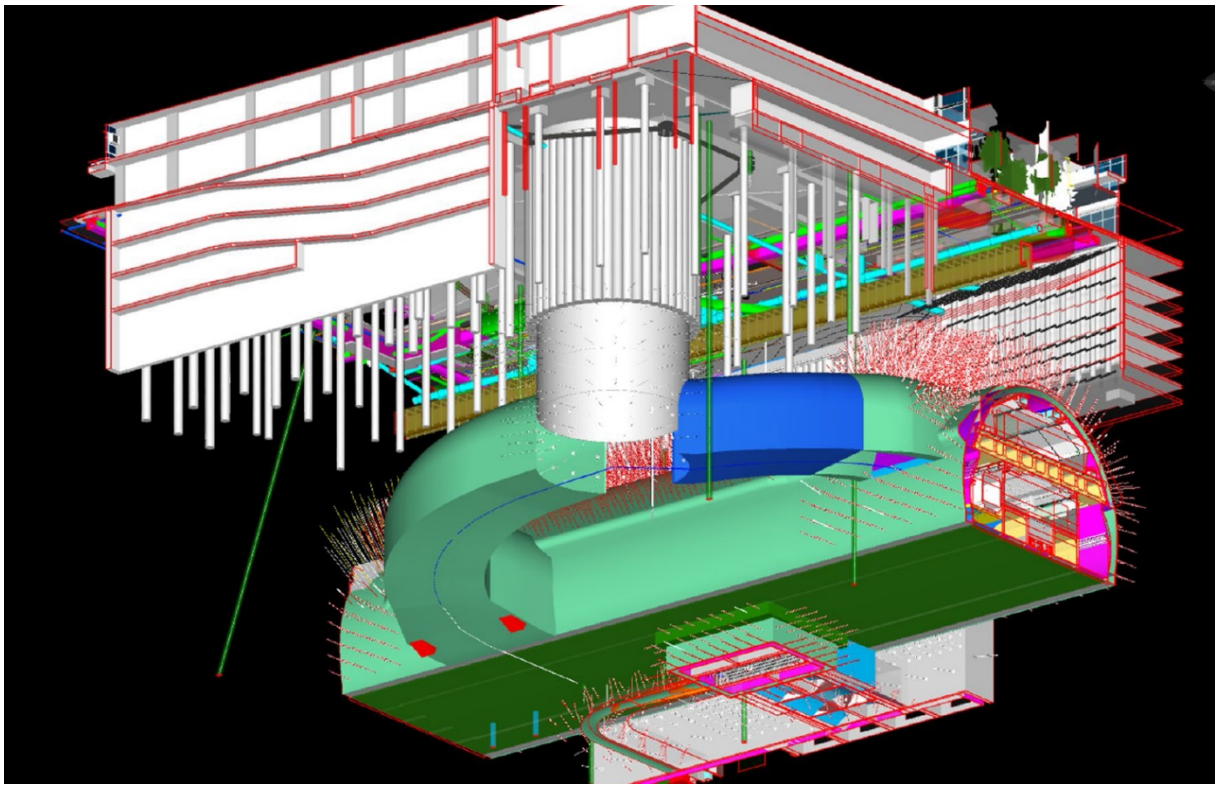


Figure 2 - Plan showing extent of the current works relative to Albert Street Station Cavern

5. GEOLOGY

Based on available geotechnical investigation data, as referenced within the EDG Geotechnical Engineering Report[1], the general geological stratigraphy described by EDG for the development site and proposed basement includes potential uncontrolled or controlled surface fill material and/or soft to firm alluvium underlain by residual soils overlying various Neranleigh-Fernvale Group (NFG) weathered rock.

Based on the geotechnical cross sections developed by EDG, extremely weathered rock (NFG5) is expected at approximately RL-6.5m with potential localised areas of residual soil. NFG3 rock is expected between RL-10m and RL-15m and NFG2/1 below RL-15m.

The interpreted geotechnical section from the EDG Report have been shown below for reference. The section in Figure 3 is cut along the site boundary, looking towards The Sebel Brisbane. The top of the extremely weathered rock (NFG5) is highest on the development site closest to Albert Street and then gradually drops away moving away from the Albert Street elevation towards the 110 Mary and 119 Charlotte boundaries.

[1] EDG Consulting, "Albert Street Cavern Assessment Report Albert Steet – Future Over Station Development, Brisbane, QLD", Prepared for Albert Street Trust, Document Reference B01493-1AE, Dated 29 May 2023

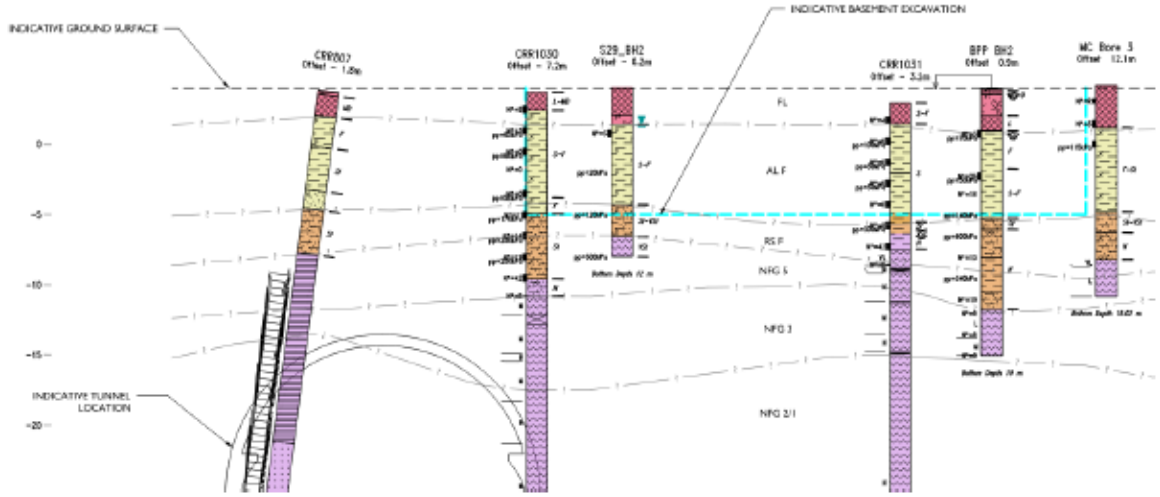


Figure 3 - EDG Interpreted Geotechnical Section B – Looking towards The Sebel

The existing static water table is below the level of the proposed basement excavation. Local perched areas of groundwater are likely to be encountered, however the static water table is below the proposed Basement 2 level. As such, the proposed Albert Street OSD is not anticipated to impact groundwater levels which could impact adjoining structures (particularly heritage structures).

6. PDA ACCOMPANYING DOCUMENTS

The Priority Development Area (PDA) DEV2023/1374 decision notice dated 6th November 2023 has granted the PDA development application in accordance with the decision notice that includes a number of conditions. Amongst other conditions, three plans that address MCU10, MCU11 and MCU12, two of which relate to the structural monitoring and railway monitoring respectively and MCU12 which relates to an instrumentation plan. In summary,

- MCU 10 requires a Structural Monitoring and Vibration Report (SMVR)
- MCU 11 requires a Track and Structures Monitoring Plan (TSMP)
- MCU 12 requires an Instrumentation and Monitoring plan (IMP)

MCU10, under SMVR requires a structural monitoring and vibration report that relates to the non-rail infrastructure. MCU11 addresses the impacts on rail infrastructure whilst MCU12 draws on the latter to produce a separate rail-based Instrumentation Monitoring Plan.

MCU12 requires an RPEQ certified instrumentation plan including but not limited to total station (prisms), inclinometer, piezometer and vibration monitoring that addresses any construction (including demolition and earthworks) impacts on the railway corridor, including rail transport infrastructure or other rail infrastructure.

Three technical reports will be prepared (SMVR, TSMP and IMP) to satisfy the MCU10, MCU11 and MCU12 conditions respectively. Elements will be common to the different plans and ultimately combine aspects based upon either the vibration requirements, structural or geotechnical assessments.

The relevant detailed responses applicable to this assessment, and where they are addressed in this document, are as follows:

Reference	*Condition*	*Timing*	*Where addressed in this document*
MCU11	**Railway Vibration Monitoring – Compliance Assessment**	Prior to the commencement of work	
	a) Submit to EDQ DA, for Compliance Assessment, an RPEQ certified Track and Structures Monitoring Plan (TSMP) which investigates any construction (including demolition and earthworks) impacts on the railway corridor, including rail transport infrastructure, such as tunnel walls, tracks, retaining walls and Overhead Line Equipment (OHLE) and other rail infrastructure. The TSMP must establish an alignment and vibration management and monitoring program which ensures that the safety and operational integrity of the railway corridor, including rail transport infrastructure and other rail infrastructure, is not adversely affected by the development. The TSMP must include evidence of consultation with the Railway Manager, mitigation measures to manage identified risks and include the following:		The condensed TSMP report to be submitted
	i) The requirement to engage a licensed surveyor and RPEQ to establish an appropriate monitoring system utilising the relevant instrumentation, for the purpose of alignment and vibration monitoring, along the horizontal and vertical alignments of the nearest existing rail transport infrastructure such as tunnel walls, tracks, retaining walls and Overhead Line Equipment (OHLE) and other rail infrastructure. Any monitoring instrumentation must: 1. be placed to record track condition, including settlement, horizontal and vertical alignments, rail twist and vibration; 2. be located on but not limited to the nearest track, tunnel walls, retaining walls/structures and foundations of the masts supporting the OHLE at intervals; and . 3. be shown on a survey plan prepared by a registered surveyor in conjunction with a RPEQ and be RPEQ certified and provided to EDQ DA		Section 20 as per person with qualifications set out in Section 23 Section 20.3 Section 20.1 and 20.4 Section 20.4
	i) The requirement to engage an RPEQ to conduct control monitoring at all locations established in part (i) of this condition to determine the existing peak component particle vibration and alignment and establish a control baseline. Intervention limits must be determined to manage the safety and operational and structural integrity of the railway corridor affected by any construction works, including earthworks and demolition. The level of acceptable movement, trigger levels and monitoring accuracy must be addressed;		As per person with qualifications set out in Section 23 Section 20.5 and 20.6
	iii) The requirement to provide the findings from control monitoring to the Metropolitan District Compliance Unit (Metropolitan.IDAS@tmr.qld.gov.au) within TMR;		As required
	iv) The requirement that horizontal and vertical displacement and vibration caused from any construction works, including earthworks and demolition, must not exceed the intervention limits determined in part (ii) of this condition;		Section 20.1
	v) Details of the protocols to be complied with when the movement and trigger levels (intervention limits) are breached, including specific actions to be undertaken and who is responsible for each, the notification process, lines of communication, and stop work procedures		Section 20.5 and 20.6
	vi) The requirement for mitigation measures to be employed during the works to manage vibration impacts;		Section 21
	vii) The requirement to engage an RPEQ to continuously monitor the instrumentation identified in part (i) of this condition using an automated 24/7 system during the works and provide scheduled alignment and vibration monitoring reports to the Metropolitan District Compliance Unit (Metropolitan.IDAS@tmr.qld.gov.au) within the TMR. The alignment and vibration monitoring reports must include: 1. alignment and vibration monitoring using relevant instrumentation; 2. continuous monitoring of displacement and vibrations at all locations determined in part (i) of this condition from construction, including any demolition and earthworks;		Section 20.1, 20.5 and 20.6 Section 19.1, 19.3, and 19.2 Section 19.5

	3. the requirement to provide written notification of any alignment displacement and/or vibration which exceeds the limits determined in part (ii) of this condition or other alignment displacement and/or vibration issues, to the Metropolitan District Compliance Unit (Metropolitan.IDAS@tmr.qld.gov.au) within TMR within 1 business day		Section 19.7, 20.5 and 20.6
	b) Construct the approved development generally in accordance with TSMP endorsed under part a) of this condition.	At all times during construction	As required
	c) Submit to EDQ IS RPEQ certification, with supporting documentation, confirming that the development has been designed and constructed in accordance with parts (a) of this condition and that no change and/or worsening of the safety, and structural and operational integrity of the railway corridor, including rail transport infrastructure and/or other rail infrastructure has resulted from the development.	Prior to the commencement to use	As required

Table 1 – Responses to Conditions MCU11 in the PDA Decision Notice

7. TSMP SCOPE

MCU11 requires that Track and Structures Monitoring Plan (TSMP) is developed. The document is similar to the SMVR although specific to the CRR infrastructure, as opposed to the buildings and below ground utilities. The key aspects of the TSMP, as per MCU11, include:

- An RPEQ certified Track and Structures Monitoring Plan (TSMP) which addresses all construction, including demolition and earthworks, impacts on the railway corridor, including rail transport infrastructure, such as tunnel walls, tracks, retaining walls and Overhead Line Equipment (OHLE) and other rail infrastructure. The TSMP is to establish an alignment and vibration management and monitoring program which ensures that the safety and operational integrity of the railway corridor, including rail transport infrastructure and other rail infrastructure, is not adversely affected by the development. The TSMP must include mitigation measures to manage the identified risks.

- Establish an appropriate monitoring system utilising the relevant instrumentation, for the purpose of alignment and vibration monitoring, along the horizontal and vertical alignments of the nearest existing rail transport infrastructure such as tunnel walls, tracks, retaining walls and Overhead Line Equipment (OHLE) and other rail infrastructure.

- Monitoring at defined locations to determine the existing peak component particle vibration and alignment to establish a control baseline. Intervention limits must be determined to manage the safety and operational and structural integrity of the railway corridor affected by any construction works, including earthworks and demolition. The level of acceptable movement, trigger levels and monitoring accuracy must be addressed.

- The requirement for the applicant to engage a RPEQ to continuously monitor the instrumentation identified in this condition using an automated 24/7 system during the works and provide scheduled alignment and vibration monitoring reports to the Metropolitan District Compliance Unit.

8. IMP SCOPE

In addition to the TSMP, MCU12 requires an Instrumentation and Monitoring Plan (IMP). The IMP extracts the assessment information from TSMP to produce a standalone rail-based Instrumentation Monitoring Plan. MCU12 requires an RPEQ certified instrumentation plan (including but not limited to total station (prisms), inclinometer, piezometer and vibration monitoring) which investigates any construction (including demolition and earthworks) impacts on the railway corridor, including rail transport infrastructure or other rail infrastructure. The relevant information within IMP will be contained within the TSMP. The key aspects as per MCU12 include:

- The locations, types and number of monitoring devices inside and adjacent to the rail transport infrastructure, other rail infrastructure and railway corridor.

- The requirement for the applicant to engage a RPEQ to establish the baseline structural (total station) and ground movement (inclinometer) and vibration readings.

- Confirmation of the frequency and the duration of monitoring supported by appropriate justifications and assumptions. During construction, the monitoring must be continued until the super structure has been completed.

- The requirement for the monitoring to be automated using a 24/7 system.

- Details of the approach when the movement and trigger levels are breached, including specific actions to be undertaken and who is responsible for each, the notification process, lines of communication, and stop work procedure.

- The requirement to provide the overall monitoring results to the Metropolitan District Compliance Unit.

The IMP is presented as a separate report.

9. SMVR SCOPE

In addition to the TSMP, MCU10 requires a Structural Monitoring and Vibration Report (SMVR) that address the different stages of the works including the ground support (piling and shoring) and excavation works. The key requirements as per MCU10 include:

- An instrumentation and monitoring plan, including drawings, frequency of monitoring, vibration limits and actions to be taken should limits be exceeded.

- Separate reports detailing the condition surveys for the adjacent buildings. The list of requirements for these surveys is extensive and detailed in Section 6 of MCU12 and is consistent with the detailed work by the RBG and EDG as well as being informed by the vibration modelling and settlement assessments. A dedicated section of the SMVR report will confirm the extent of the condition surveys.

- Discussions with the utility providers and other authorities, such as TMR, are also required. Whilst there is a history of acceptable methods from previous projects, these tasks can be detailed and can necessitate extended consultation, particularly for Urban Utilities and the S1 Sewer.

The adjacent buildings are shown in the following figure.

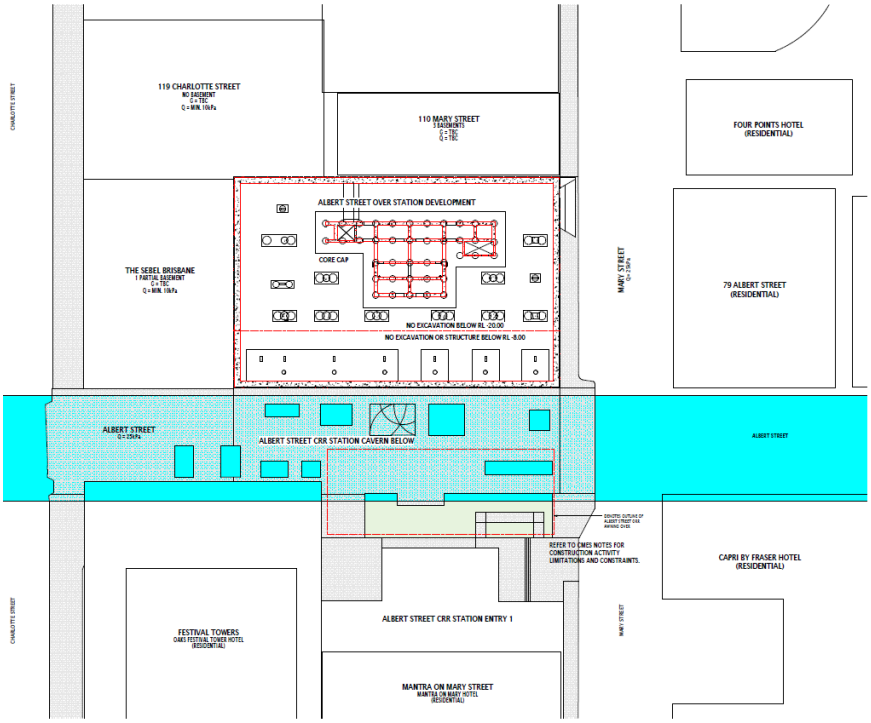


Figure 4 - Plan showing buildings adjacent to Albert Street Station OSD

The SMVR report is based upon the currently proposed structural design solution as at the Schematic Design Phase proposed for the Albert Street OSD and the approach to the building elements.

The assessment is based upon best practices for modelling the potential impacts of vibration. The modelling uses advanced data bases relevant to the equipment type together with the geology of the area in which the works will be undertaken. The assessments are based upon methods and data developed from more than 1000 other projects and therefore have an acceptable degree of accuracy in the predictions and effects.

The key requirements as per MCU10 include:

- An instrumentation and monitoring plan specific to the non-rail infrastructure, including drawings, frequency of monitoring, vibration limits and actions to be taken should limits be exceeded.

- Separate reports detailing the condition surveys for the adjacent buildings. The list of requirements for these surveys is extensive and detailed in MCU10 and are largely consistent with the detailed work by the RBG and EDG. In addition, these are informed by the vibration modelling and settlement assessments. A dedicated section of the SMVR report will include justifying the extent of the condition surveys.

- Discussions with the utility providers and other authorities, such as TMR, are also required. Whilst there is a history of acceptable methods from previous projects, these tasks can be onerous and can necessitate extended consultation, particularly for UU and the S1 Sewer.

The SMVR is presented as a separate report.

10. CONSTRUCTION ACTIVITIES

The proposed bulk excavation level for the Albert Street OSD is RL-5.6m which complies with the Licence Construction Area and with RL-8.0m as the minimum excavation level constraint. Post installation of the shoring and retention system, alternating staged demolition and bulk excavation will

be required across the basement footprint to create the new formation level to accommodate the proposed subfloor drainage system and Basement 2 slab-on-ground.

The extent of bulk excavation for the subfloor drainage is to be reviewed following the demolition of the existing acoustic shed slab. The extent of groundwater can be determined at this stage and any adjustments to the modelling outcomes undertaken should these be necessary. The extent of bulk excavation may therefore be refined following further geotechnical investigation.

Detailed excavation will be required for the building pad, raft and pile cap footings, in-ground services, and tanks. Secondary shoring, potentially in the form of sheet piles may be needed to enable detailed excavation to the deeper pile caps located above the rock in the residual soil layer. A survey of the existing footings and in-ground services will be required following the demolition of the existing acoustic shed slab. Existing footings clashing with proposed footings, in-ground services and tank locations will need to be removed and, where directed, backfilled with mass concrete (weak mix). Detailed excavation for new footings will then be saw-cut through low-strength rock/weak mix concrete.

The demolition and construction phases will utilise equipment that may be capable of producing potentially elevated levels of vibration. The principal vibration inducing construction activities will be continuous, or semi-continuous.

The vibration from other sources of equipment that could also be used in some of the stages of the works, such as cranes, compressors, generators, demolitions saws, chainsaws, concrete booms, knuckle booms and so on have not been analysed. The vibration from these sources has not been assessed as it is considered insignificant compared to the vibration from the hydraulic hammer or vibratory piling. There is no precedent from other projects that this low vibration impact equipment could generate reasonable levels of vibration that justify further detailed levels of analyses. If there are concerns raised for any works associated with these other equipment types, vibration measurements will be undertaken, and the results analysed.

11. ADJACENT INFRASTRUCTURE

The project extends across two buildings at the rear of the 101 Albert Street site. The closest commercial building to the 101 Albert site is within several metres of the planned footprint at the closest point. The other properties on the eastern side of Albert Street are further than 25 metres from any of the planned works. The adjacent properties relative to the planned works are shown in the following drawing.

The CRR caverns and tunnels are the most significant infrastructure to the works and necessitate detailed assessments to inform the design and monitoring procedures.

11.1. Cross River Rail

The OSD site is adjacent to and partially over temporary and/or permanent CRR assets associated with the Albert Street Station. The major adjoining asset of most importance is the station Cavern that runs under Albert Street. This cavern sits just under the site boundary of Albert Street. The cavern is a mined arched structure with its base at circa RL-30m and its crown at circa RL-13m. There are duct and escape passages below the cavern that link back to the primary station structure located on the opposite side of Albert Street.

The CRR Albert Street Station is presently under development but in terms of the key elements with respect to this assessment, includes both a Mezzanine level and platform level.

A plan showing extent of works relative to the overall length of the Albert Street Station Cavern is shown in the adjacent Figure 5. The length of the OSD footprint along Albert Street is approximately 65 metres and lies towards southern end of the Albert Street cavern.

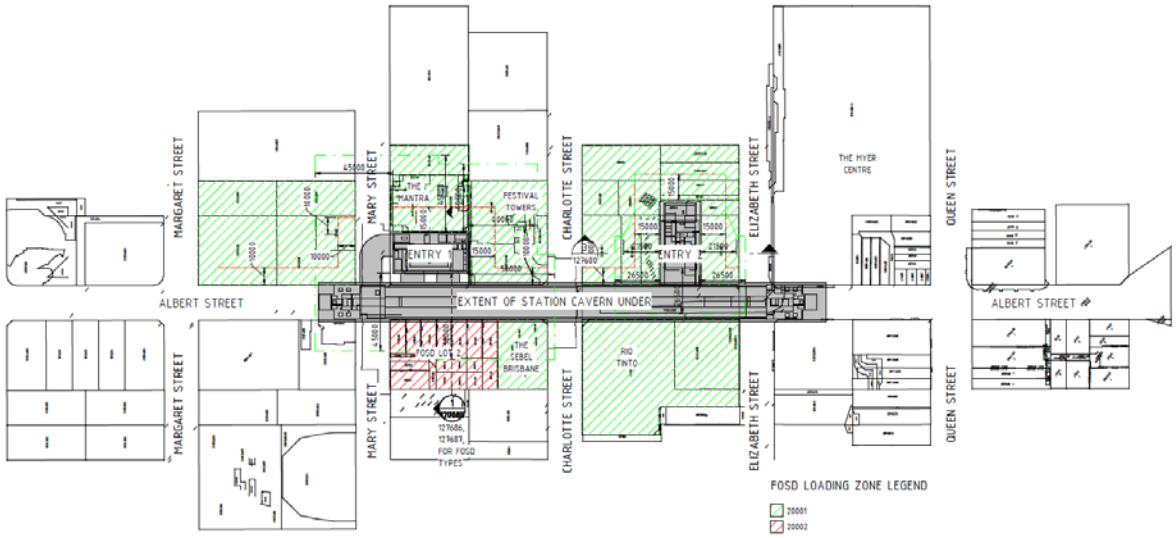


Figure 5 - Plan showing extent of works relative to Albert Street Station Cavern

The figure below includes a section through the development site and the adjacent cavern and station structure. The extent of the proposed basement on the development site is also highlighted. The section is looking southeast along Albert Street.

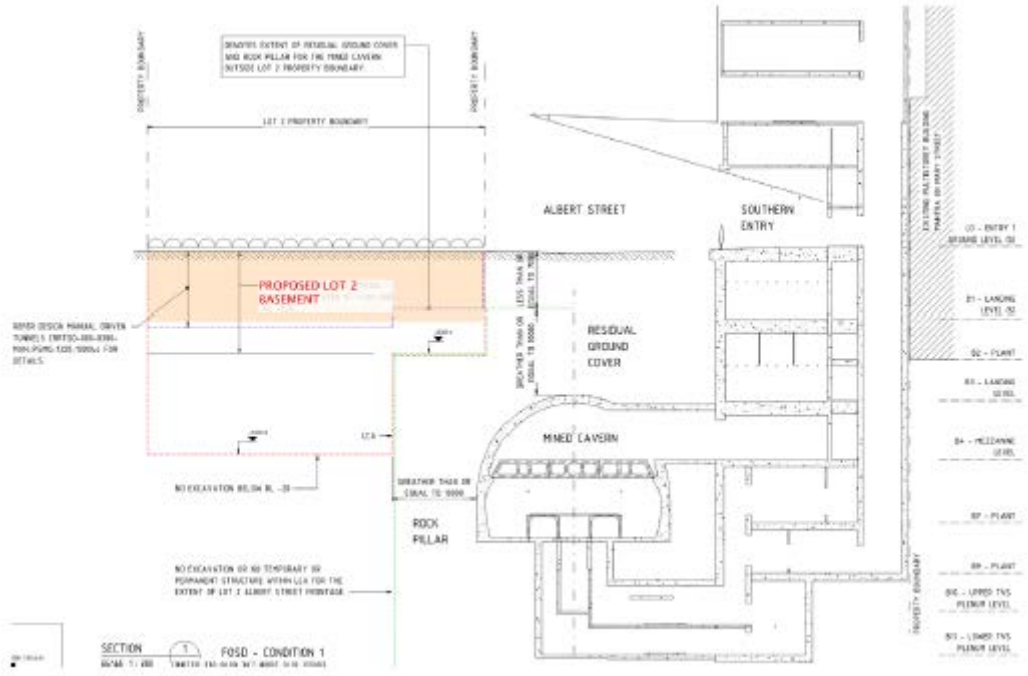


Figure 6 – Development site and the adjacent CRR assets (after RBG)

12. CRR VIBRATION CRITERIA

The relevant vibration control requirements for the CRR infrastructure have based upon information relevant to other rail projects. This includes other associated guidelines and standards for the protection of rail-based infrastructure.

Several components of CRR infrastructure may be considered potentially vibration sensitive. Although no specific equipment list has been sought from CRR DA, the tunnels, platforms and caverns at Albert Street Station may potentially contain sensitive infrastructure that could include:

- *Insulators*: Insulators for high voltage transmission lines, transformers, substations or overhead power lines are typically constructed of an epoxy material and are capable of withstanding high

levels of vibration without any deterioration. A review of porcelain insulators on transformers has shown that a peak particle velocity of 200mm/s has no effect on the condition of the insulator (verified by ultrasonic testing).

- *Circuit Breakers:* The British Standard BS142 identifies minimum specifications for circuit breakers and indicates that these devices should be capable of operation when subjected to 0.5g in the frequency range 10 to 300Hz. At a vibration frequency of 15Hz, this equates to approximately 50mm/s.
- *Relays*: A manufacturer of relays (Q-Relays) has indicated that they can withstand a level of vibration equal in magnitude to that if the relay was dropped onto a concrete floor from a height of 25mm. Like tests produced an acceleration of up to 80m/s^2 which equates to a peak particle velocity of more than 300mm/s at a frequency of 30Hz.
- *Signal Equipment*: Sensitive signalling and telecommunications equipment has been shown by the overseas authorities to operate effectively when subjected to a vibration level of 20mm/s. This limit was recognised by the group as a conservative value since occasionally vibration levels up to 40mm/s occurred with no loss of equipment functionality. An upper vibration limit at which failure occurred was never reached.
- *Rail tracks:* Vibration from construction activities is virtually incapable of damaging or producing any misalignment of rail tracks, unless undertaken within metres of the tracks. Vibration from construction scale is expected to produce momentary displacements of less than 0.5mm. Other vibration measurements undertaken for QR projects have shown that train movements regularly induce vibration of 100mm/s and greater on the sleepers and immediately adjacent infrastructure.
- *Overhead Power Cables*: High voltage power cables and return conductors run above the tracks. These are unaffected by vibration.

Based upon the rail infrastructure that could potentially exist in the CRR corridor, complying with a vibration level of 50mm/s ensures the vibration from the construction works will have no effect on the continued operation of the rail network.

Queensland Rail (QR) have identified permissible vibration criteria to ensure the integrity of their tunnels is unaffected by the demolition and construction activities. The limits are presented in the Queensland Rail SEMS Report for building over operational railway.

The SEMS report indicates that for a build over is to demonstrate that the vibration caused by the construction (and/or operation) of the building onto the permanent lining of the existing CRR infrastructure will not exceed a vibration peak vector sum of 10mm/s.

The SEMS document requires that project undertake predictive analysis of the expected vibration caused by the proposed construction methodology of the proposed development, including the prediction of these vibrations transmitted down into the permanent liming of the existing CRR tunnels and caverns infrastructure and associated ancillary infrastructure.

13. VIBRATION CRITERIA FOR THE ABOVE GROUND BUILDINGS

The potential effect of vibration on structural integrity of buildings vary according to the building construction. The common broad building categories are heritage, residential and sensitive commercial with only the heritage and commercial building criteria relevant to this project.

The relevant vibration control requirements for the project, in particular the adjacent buildings, are drawn from conditions, associated guidelines and other standards that are referenced in the Australian Standard AS2436:10[2]. These also replicate other guidelines and criteria that have been applied on other projects as well as being consistent with the Queensland Department of Transport and Main Roads, Transport Noise Management Code of Practice: Volume 2 – Construction Noise and Vibration March

[2] AS2436-2010, "Guide to noise and vibration control on construction, demolition and maintenance sites", Australian Standards, SAI Global

2016[3] and the German Standard DIN4150:3-2016[4]. The documents list appropriate vibration criteria for various sensitive land uses and, in this context, remains an applicable document.

The AS2436-2010 standard is particularly relevant because it specifically addresses vibration control from demolition and construction sites. The standard also references British Standard BS7385.2-1993 which is applicable for the protection of buildings from vibration related damage. The same British Standard is also referenced in other standards, such as the Australian Standard AS2187.2-2006[5] which addresses vibration.

The AS2436-2010 and the associated British Standard BS7385-2:1993 do not distinguish aged or very sensitive buildings from other structures. The Department of Main Roads document also promotes the same British Standard for protection of buildings although indicates that the German Standard DIN4150-3:2016 should be followed for this sensitive infrastructure.

The assessment therefore applies the DIN4150-3:2016 for the protection of buildings given the precedence of use for previous projects. The permissible values are also supported by the DTMR and BS7385-2:1993 documents.

Compliance with the proposed limits virtually ensures the effects of vibration from planned activities will not impact upon structural integrity or superficial elements of the buildings. Activities which induce levels of vibration that exceed the specifications also do not necessarily indicate that damage will follow. The limits are typically set at levels below which damage has not been observed rather than a level representing the onset of damage.

This Section 13 of the document presents criteria that are based around infrastructure protection rather personal amenity. Amenity matters are considered in Section 14.

13.1. Department of Transport and Main Roads (DTMR)

The Department of Transport and Main Roads (DTMR) have several documents that relate to the measurements control and mitigation of vibration levels from construction activities. These include:

i. Design criteria for bridges and other structures [6]

ii. Transport Noise Management Code of Practice Volume 2 – Construction Nosie and Vibration

iii. Technical Note 03[7]

The Department of Transport and Main Roads have prepared a manual for the design criteria for bridges and other structures[8]. The document includes in Section 17.3.3, a table indicating assessment requirements. The table is qualitative and does provide vibration values that must be complied with.

The DTMR Technical Note 3 identifies limits for the protection of infrastructure from construction vibration. Whilst the suggested vibration values in the TN03 document are preliminary and have been provided by the department (rather than included in the main document), they largely replicate the values given in other standards and guidelines. The TN03 table is shown below:

[3] Queensland Government, Department of Transport and Main Roads, " Transport Noise Management Code of Practice Volume 2 – Construction Noise and Vibration"
[4] DIN4150-3:2016, "Structural vibration Part 3: Effect of vibration on structures", German Standards ICS91.120.25
[5] AS2187.2-2006, "Australian Standard Explosives Storage and Use of explosives", Australian Standards, SAI Global
[6] Queensland Government, Department of Transport and Main Roads, "Design criteria for bridges and other structures", February 2021
[7] Queensland Government, Department of Transport and Main Roads, Technical Note 03, "Measurement of Ground Vibrations and Airblast"
[8] Queensland Government, Department of Transport and Main Roads, "Design Criteria for Bridges and Other Structures", February 2024.

Structures	*Max PCPV (mm/s)*
Bridges	25
Reinforced concrete industrial and heavy commercial buildings	15
Light framed structure, residential or light commercial type buildings	10
Un-reinforced concrete or masonry building	5
Heritage Listed Structure	2.5
Reinforced Culverts	10
Cut and Cover tunnel	10
Driven and Mined tunnel	10
Un-reinforced concrete tunnel	5

Table 2 – Recommended ground vibration limits for control for vibration at varying structure (reproduced from Department of Main Roads Technical Note 03 preliminary)

The DTMR Transport Noise Management Code of Practice Volume 2 – Construction Noise and Vibration also proposes vibration criteria for building and structure damage.

This DTMR Code of Practice indicates that vibration levels for potential damage contained in British Standard BS7385-2:1993 and Australian Standard AS2187.2:2006 are adopted as damage criteria from construction activities in this Code.

German Standard DIN 4150-3:2016 'Structural vibration – Effects of vibration on structures' provides building damage criteria for short-term or long-term vibration. DIN 4150-3 provides guidance on an additional type of structure that is of intrinsic value, which is a category not specifically covered within British Standard BS 7385-2:1993.

DTMR recommends both British Standard BS7385-2:1993 and German Standard DIN4150-3:2016 be used for construction projects to determine the likely building/structural damage impacts.

These standards are presented in the following Section 13.2 and 13.3.

13.2. Australian Standard AS2187.2:2006

The Australian Standard AS2187.2:2006 replicates the British Standard BS7385.2 and explicitly recognises vibration limits appropriate for protection of infrastructure as opposed to personal amenity. A summary of these criteria is reproduced as the following Table 3, noting that it refers to blast generated vibration which may lie at the upper end of acceptable values given the short-term nature of blasting and the higher vibration frequencies as opposed to the longer duration vibration from mechanical equipment.

The Australian Standard AS2187.2:2006 recommends maximum peak particle velocities for different types of structures with respect to damage from vibration. Table J4.4.2.1 of the standard suggests levels for the prevention of minor or cosmetic damage occurring to structures from ground vibration generated by blasting. The table is reproduced in Table 3.

Type of Building	*Peak component particle velocity in frequency range of predominant pulse*	
	4Hz to 15Hz	*15Hz and above*
Reinforced or framed structures. Industrial and heavy industrial buildings	50mm/s at 4 Hz and above	
Un-reinforced or light framed structure. Residential or light industrial type buildings	15mm/s at 4 Hz increasing to 20mm/s at 15Hz	20mm/s at 15 Hz increasing to 50mm/s at 40 Hz and above

Table 3 – Transient vibration guide values for cosmetic damage (reproduced from AS2187.2-2006)

The expected frequency of vibration from construction activities measured within 30 metres will lie above 30Hz at these closer distances to the infrastructure.

The standard further defines *cosmetic* damage as the formation of hairline cracks on drywall surfaces, the growth of existing cracks in plaster or drywall surfaces or the formation of hairline cracks in the

mortar joints of brick/concrete constructions. *Minor* damage is defined as the formation of cracks or loosening and falling of plaster or drywall surfaces, or cracks through brick/concrete blocks. The same standard proposes limits for ground vibration for control of other damage to structures, albeit related to blasting generated vibration.

Category	*Type of Blasting Operations*	*Peak component particle velocity (mm/s)*
Other structures or architectural elements that include masonry, plaster and plasterboard in their construction	All blasting	Frequency dependent damage limit criteria as in Table J4.4.2.1
Unoccupied structures of reinforced concrete or steel construction	All blasting	100mm/s maximum unless agreement is reached with the owner that a higher limit may apply
Service elements, such as pipelines, powerlines and cables	All blasting	Limit to be determined by structural design methodology

Table 4 – Recommended ground vibration limits for control of damage (reproduced from AS2187.2-2006)

For the commercial buildings like those adjacent to the 101 Albert Street site, the Australian Standard AS2187.2:2006 therefore suggests permissible limit of 50mm/s.

13.3. German Standard DIN4150.3:2016

The German Standard is also commonly applied in Australia for the protection of infrastructure. The standard recognises both the influence of frequency upon possible damage to structures, but oriented towards cosmetic or minor damage such as cracking of plaster, rather than damage to reinforced concrete structures.

The German Standard DIN4150.3:2016 specifies a method for measuring and evaluating the effects of vibration on structures. Notably, the standard gives guideline values, which when complied with, will not result in damage that will have an adverse effect on the structure's serviceability, and further if damage nevertheless occurs, it is to be assumed that other causes are responsible.

The standard lists acceptable values for both short- and long-term vibration with the distinction based as to whether there may be any fatigue related failure of the structure. It also recognises the influence of frequency, recommending levels of 20 mm/s at a frequency of 10 Hz, increasing to 50 mm/s for a frequency of 100 Hz for commercial and industrial buildings. The standard is directed towards preventing cosmetic damage such as crack formation in plaster, rather than damage to reinforced concrete structures. The German Standard provides three curves for permissible vibration limits, according to the type of structure under consideration (commercial, residential, and heritage).

Type of Structure	*Guideline values for velocity (mm/s)*			
	Vibration at the foundation at a frequency of			*Vibration at horizontal plane of highest floor All frequencies*
	1 to 10 Hz	*10 to 50 Hz*	*50 to 100 Hz**	
Buildings used for commercial purposes, industrial buildings, and buildings of similar design	20	20 to 40	40 to 50	40
Dwellings and buildings of similar design and/or occupancy	5	5 to 15	15 to 20	15
Structures that, because of their particular sensitivity to vibration, cannot be classified under lines 1 and 2 and are of intrinsic value (eg. Heritage buildings)	3	3 to 8	8 to 10	8

*At frequencies > 100 Hz, the values given in this column may be used as a minimum

Table 5 - Guideline values for the vibration velocity to be used when evaluating the effects of short term vibration on structures

The German Standard also proposes levels for different structures based upon long term vibration

where structural fatigue could occur. The proposed levels are shown in the following table:

Type of Structure	*Vibration Velocity, mm/s (Peak Component Particle Velocity) in horizontal plane at all frequencies*
Buildings used for commercial purposes, industrial buildings and similar design	10
Dwellings and buildings of similar design and/or occupancy	5
Structures that have a particular sensitivity to vibration eg heritage buildings	2.5

Table 6 - Guideline values for the vibration velocity to be used when evaluating the effects of long term vibration on structures

The following notes are referenced to the levels in the above table.

- Vibration levels marginally exceeding those in the table will not necessarily mean that damage will occur and further investigation is required will be required to determine if higher vibration levels can be accommodated without risk of damage.
- Long-term vibration means vibration events that may result in a resonant structural response which is not expected to occur.
- At frequencies above 100 Hz, the values given in this column may be used as minimum values.
- For civil engineering structures (e.g. with reinforced concrete constructions used as abutments or foundation pads) the values for Type 1 buildings may be increased by a factor of 2.
- Short-term vibration is defined as vibration which does not occur often enough to cause structural fatigue, and which does not produce resonance in the structure being evaluated.

For the reinforced concrete, the German Standard DIN4150 suggests a minimum permissible limit of 40mm/s with reference to 80mm/s for the engineered structures.

There is no indication that based upon the adjacent buildings that resonance will occur and therefore the values in first are appropriate for assessing against damage. Based upon the frequency of vibration, an applicable vibration limit will always lie above 15mm/s and generally nearer to 50mm/s.

The British Standard BS7385-2:1993 also indicates:

- important buildings which are difficult to repair may require special consideration on a case-by-case basis. A building of historical value should not (unless it is structurally unsound) be assumed to be more sensitive.
- structures below ground are known to sustain higher levels of vibration and are very resistant to damage unless in very poor condition.

14. AMENITY VIBRATION CRITERIA

Guideline documents have also been developed by various agencies to address amenity concerns from vibration generated by construction works. The British Standard BS6472-1:2008[9] proposes values however these are measured in the dosage metric and commonly difficult to monitor and administer. The same standard allows for the conversion to an equivalent peak vibration level and this approach could be adopted if an alternative vibration criterion for amenity is required.

The DTMR Volume 2 Construction Noise and Vibration code provides human comfort to minimise vibration due to ground borne construction vibration adopts vibration levels with lower and upper bounds. The lower limits are generally considered to be just perceptible. The upper limits are said to cause

[9] BS6472-1:2008, “Guide to evaluation of human exposure to vibration in buildings Part 1: Vibration sources other than blasting”, British Standard

annoyance if exceeded, although experience at other projects suggests that these lie at the lower end of the relevant vibration values. The guideline values are given in the following table.

Building	*Work Period*	*Resultant PPV (mm/s)*	
		Lower Limit	*Upper Limit*
Dwellings (including hotels and motels)	Standard Hours	1.0	2.0
	Non-Standard Hours (Evening)	0.3	1.0
	Non -Standard Hours (Night)		
Medical/health buildings (wards, surgeries, operating theatres, consulting rooms)	All Whilst in use	0.3	1.0
Educational facilities (rooms designated for teaching purposes)			
Court of Law (Court rooms)			
Court of Law (Court reporting and transcript areas, Judges' chambers)			
Community buildings (libraries, places of worship)	Whilst in use	1.0	2.0
Commercial (offices) and retail areas			

Table 7- Human comfort vibration limits to minimise annoyance (after Queensland Volume 2 – Construction Noise and Vibration Chapter 3)

Based upon the type of the buildings in the areas around the planned works (commercial buildings or residential apartments), an applicable vibration level to maintain amenity for persons occupying the buildings lies between 1 and 2mm/s for standard daytime works.

Given these adjacent buildings are typically muti-storey, the permissible vibration level at the ground level that corresponds to the DTMR vibration level within the living or sleeping areas of an apartment will be considerably higher. Vibration levels measured from other projects and presented in the international literature show that vibration levels decrease as the vibration propagates from floor to floor. As the vibration passes through the building structure from floor to floor, the vibration generally reduces. This accounts for the dispersion and attenuation of the vibration energy as it propagates through a building starting with the first suspended floor. The following data in Table 8 data shows the FTA Manual[10] calculations as to how vibration varies within a multi-storey building.

Floor to Floor	*Vibration Adjustment in dB*	*Vibration as % of floor level below*	*Floor above ground level*	*Vibration as % of internal ground level*
1 to 5 floors above ground level	-2dB per floor	80%	1	80%
			2	65%
			3	50%
			4	40%
			5	33%
5 to 10 floors above ground level	-1dB per floor	90%	6	29%
			7	26%
			8	24%
			9	21%
			10	19%

Table 8 – FTA reported vibration change as a result of floor to floor transmission

As an alternative to the values presented in the above table, discussions with the occupants of the potentially affected buildings may also be undertaken to identify alternative criteria, operating times or other appropriate mitigation measures to minimise amenity impacts.

15. SUMMARY OF VIBRATION CRITERIA FOR SENSITIVE RECEIVERS

The following vibration criteria for the 101 Albert Street project are proposed in Table 9 to protect the infrastructure from vibration occurring from the piling and/or excavation, including hydraulic hammers.

[10] Volpe, J.A., (2018), FTA Report Number 0123 Federal Transit Administration, "Transit Noise and Vibration Impact Assessment Manual", 2018, National Transportation Systems Centre

Asset	*Permissible Vibration Criterion*	*Proposed Screening Vibration Criterion*
Amenity	1 to 2mm/s	2 mm/s
Commercial properties	20 to 40 mm/s	20 mm/s
Cross River Rail Assets	50 to 200 mm/s	50 mm/s
Tunnels and caverns	10 mm/s	10 mm/s

Table 9- Proposed vibration criteria for semi continuous vibration for sensitive receivers

16. VIBRATION RELATIONSHIPS

To assess the impact of the project and its ability to comply with the presented vibration criteria, vibration data have been collected from different equipment types and sizes similar to those that may be used. This has involved measuring the level of vibration at a range of distances from the equipment source and analysing these data to develop relationships between the equipment type, distance and vibration level. Many of the equipment types were assessed from large scale projects in the Brisbane City, including the Clem 7, Airport Link, Northern Busways, Legacy Way, Brisbane Move and Cross River Rail tunnels, as well as the many basement excavations for the large-scale buildings.

These vibration relationships have been combined/compared against other vibration data collected from sites both within Australia and Internationally. These data have provided the basis for the equations that are used to determine the level of vibration as a function of distance from the equipment. Other vibration data collected from other projects have also been analysed to determine how the level of vibration decays with distance from the source.

The relationships determine:

- Whether the activity complies with the presented vibration guidelines for damage to the buildings, Cross River Rail tunnels or the below ground utilities.
- Whether the activity unnecessarily impacts upon the residences, tenants or other occupants within buildings living around the works who may perceive vibration.

The assessment also determines whether mitigation measures, such as the use of smaller or alternative equipment types are expected top be required for some sections of the project.

16.1. Vibration Relationships

Vibration relationships from these equipment types have been developed for other sites and have been used to estimate the level of vibration as a function of distance and the overall potential for damage to infrastructure.

Equations used to describe the loss in amplitude vary however a relationship used to represent the level of vibration for the site simplifies to:

$$PPV = \frac{K}{d} e^{-\alpha d}$$

where:

- PPV is the velocity of vibration measured in mm/s
- d is the distance between the source of vibration and the point of measurement measured in metres, and
- K and α are site specific constants which address the level of vibration very near to the source and the degree of attenuation respectively. A higher K value generally refers to a more energetic source. An increased α value normally refers to a ground mass where the level of vibration attenuates more rapidly as the vibration pulse travels from the source.

Although the level of vibration is affected by many factors and generally is best estimated through site-specific measurements, a screening assessment can be completed based upon these previously

derived relationships. Given that the relationships that have been used have particular reference to the Brisbane geology and specifically the CBD area, the assessment is provided with an acceptable degree of confidence.

The distances determined from these relationships can be used as a screening guide to confirm whether any further assessment is required or consultation with the property owner is required regarding perceptible vibration.

16.2. Vibration Model

The impacts of the vibration from excavation with the different equipment types have been analysed through a purpose designed vibration model specifically tailored for the 101 Albert Street project. The results for the modelling are given as a series of vibration contours for each of the representative equipment types that will be used in the different demolition, ground support and constructions areas.

In the simplest terms of analysis, where a vibration contour of say 2mm/s is shown, all areas between the works site and the area marked by this contour are predicted to receive vibration from the works exceeding 2mm/s. The maximum level of the vibration contour intersects part of the building, the CRR caverns or tunnels, or below ground utilities indicates the maximum level of vibration that the asset will be subjected to from the different type of works. The modelling therefore identifies areas of the work where compliance with vibration criteria may necessitate a change in equipment operation, such as a smaller hammer size.

16.3. Initial Assessment of Vibration

The vibration predictions will be verified through initial on-site measurements. These trials will involve measuring the level of vibration from the equipment and at locations further from the tunnel. The data will be regressed to confirm the vibration relationship and establish whether any re-modelling is required. The trial vibration measurements will necessarily be further from the tunnel because of the upper level of excavation. When the hammering for the construction excavation occurs at the closer distances to the tunnel, a significant amount of site-specific data will have been measured and analysed to verify the confidence in the predictions.

16.4. Vibration Model Verification

In addition to the initial assessment of the vibration level, the verification of the vibration modelling is based upon comparison of calculated distances between the cavern, building or below ground asset and the vibration source location within the 101 Albert Street works site with those values independently calculated from other spatial data bases. Based upon the distance, the predicted level of vibration is manually calculated by applying the vibration relationships for the type of mechanical equipment and compared against the modelled data. Verification is restricted to back calculation of the predicted level of vibration as a function of distance. The accuracy of vibration predictions is limited to the accuracy the relationships indicate for the attenuation of vibration with distance for the different equipment types.

17. ASSESSMENT OF VIBRATION

The integrity of the adjacent buildings and CRR infrastructure will be ensured through compliance with the vibration conditions that have been proposed in Table 9. Compliance with these limits ensures the effects of vibration from activities will not impact upon structural integrity. The limits are also chosen such that activities which induce levels of vibration that exceed the specifications also do not necessarily indicate that damage will follow. The limits are therefore set at levels below which damage has not been observed rather than a level representing the onset of damage.

The project will utilise various equipment that could produce elevated and potentially measurable levels of vibration. The assessment has been based upon the construction activities described in Section 10 and includes:

- Excavator with and without hydraulic hammer attachment for demolition and excavation activities across the building footprint

- Bauer BG 28V/H (or equivalent) piling rig for installation of 900mm, 1200mm and 1600mm diameter bored concrete piles to a varying depth below ground level.
- Vibratory piling rig for installation of steel liners.
- Tracked excavators between 35 and 60 tonne for ground replacement works and moving of excess material over various stages of the project.

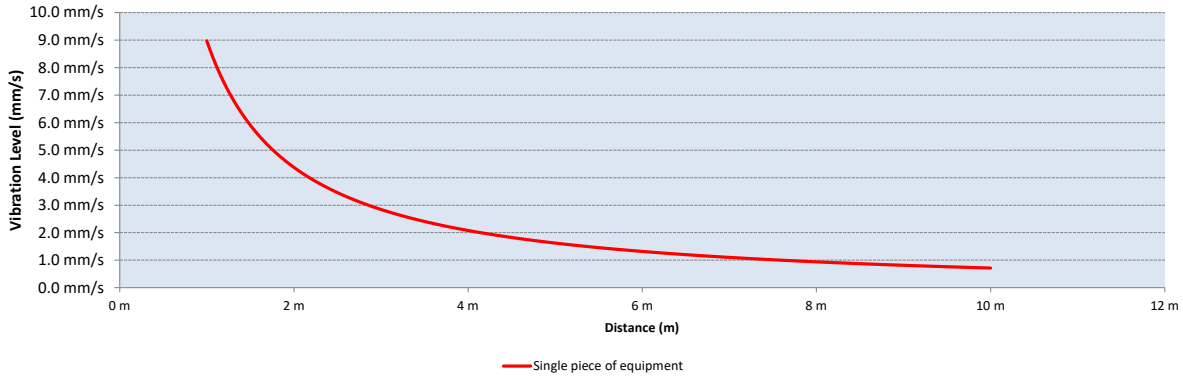
Other miscellaneous sources of vibration linked with the works construction may include:

- Trucks
- Cranes
- Concrete pumps
- Other "*heavy*" earthmoving equipment.

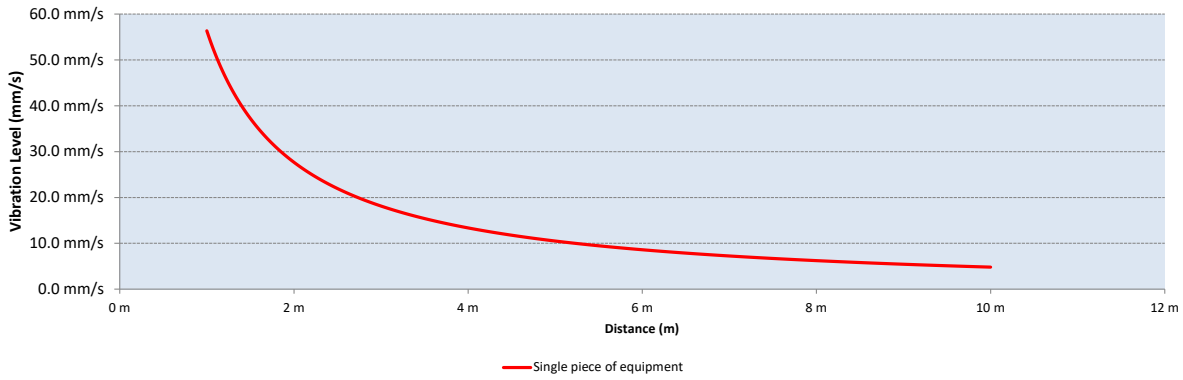
The vibration from these other miscellaneous sources is considered insignificant compared to the vibration from other equipment. The vibration from this equipment and other sources that could be used in some of the stages of the works, such as cranes, compressors, generators, demolitions saws, concrete booms, knuckle booms and so on have therefore not been analysed. There is no precedent from other projects that this low vibration impact equipment could generate elevated levels of vibration or other impacts that justify further detailed levels of analyses. If there are concerns raised for any works associated with these other equipment types, vibration measurements will be completed, and the results analysed.

The vibration data have been analysed to produce a series of vibration distance graphs for each of the equipment types that could be used. These relationships are shown in the following graphs:

Bored piles



Piles installed with vibratory head (ICE416)



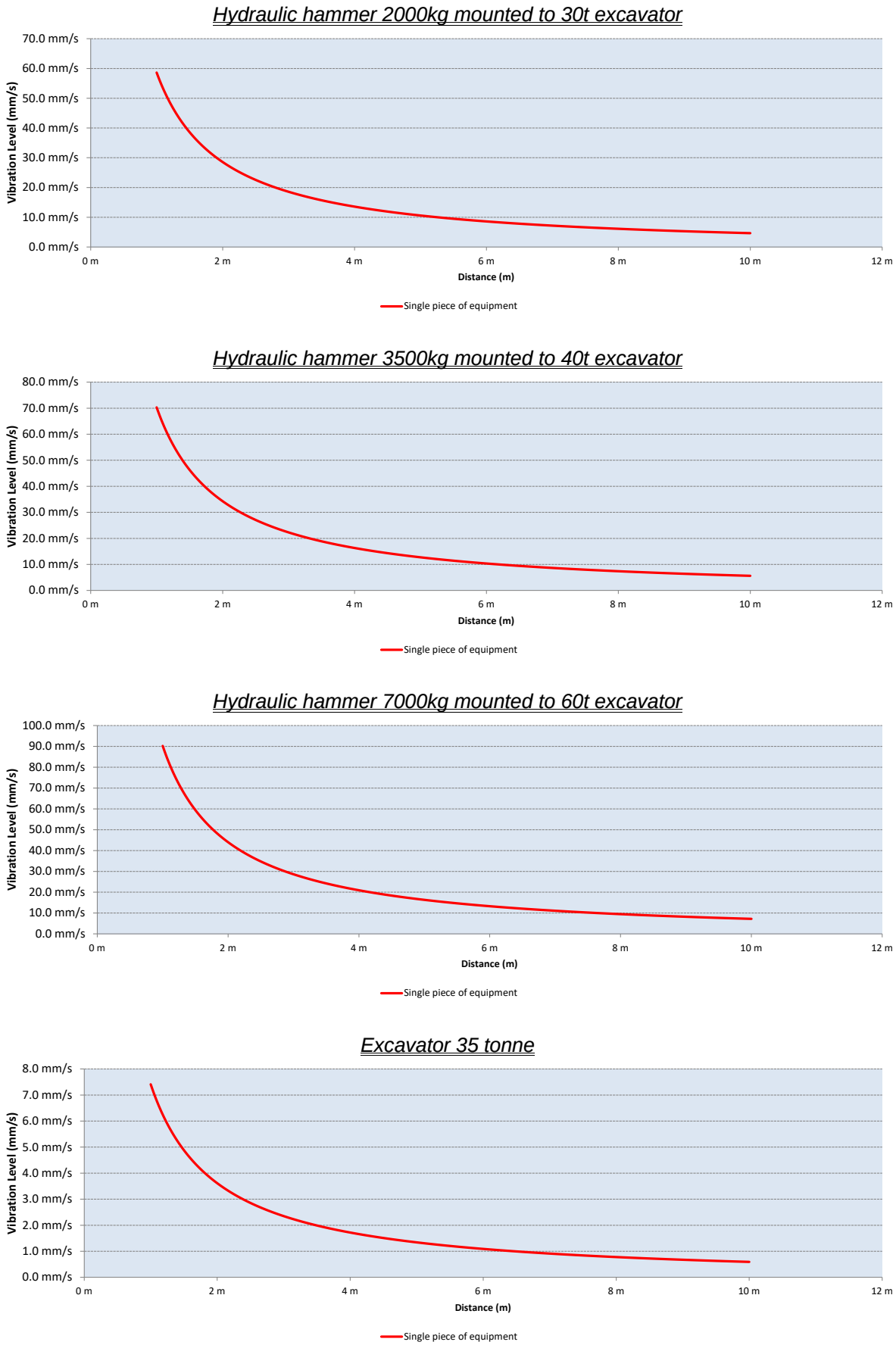


Figure 7 – Modelled vibration relationships for various equipment types for the excavation

For each piece of equipment, the required separation distance between the equipment and the sensitive receiver can be determined to comply with the Table 9 permissible vibration criteria. The following Table 10 shows the separation distances between the works and the asset for compliance with the buildings (commercial) and the CRR cavern and tunnel criteria. The distance for compliance with the amenity criterion is also calculated.

Plant Equipment	*Assessment Basis*	*Type of receiver*	*Screening Vibration Level*	*Required Separation Distance*
Bored piers with BG28 or equivalent	DTMR	Amenity	2mm/s	4.5 m
	DTMR	Tunnel liner	10mm/s	1.0 m
	Engineered Assessment	Cross River Rail Assets	50mm/s	0.5 m
	DTMR, AS2187.2 DIN4150.3 or BS7385	Commercial Buildings	20mm/s	0.5 m
Vibratory pile with ICE416 head or equivalent	DTMR	Amenity	2mm/s	19.5 m
	DTMR	Tunnel liner	10mm/s	5.5 m
	Engineered Assessment	Cross River Rail Assets	50mm/s	1.5 m
	DTMR, AS2187.2 DIN4150.3 or BS7385	Commercial Buildings	20mm/s	3.0 m
Hydraulic Hammer 2000kg mounted to 30t excavator	DTMR	Amenity	2mm/s	19.0 m
	DTMR	Tunnel liner	10mm/s	5.5 m
	Engineered Assessment	Cross River Rail Assets	50mm/s	1.5 m
	DTMR, AS2187.2 DIN4150.3 or BS7385	Commercial Buildings	20mm/s	3.0 m
Hydraulic Hammer 3500kg mounted to 40t excavator	DTMR	Amenity	2mm/s	21.5 m
	DTMR	Tunnel liner	10mm/s	6.5 m
	Engineered Assessment	Cross River Rail Assets	50mm/s	1.5 m
	DTMR, AS2187.2 DIN4150.3 or BS7385	Commercial Buildings	20mm/s	3.5 m
Hydraulic Hammer 7000kg mounted to 60t excavator	DTMR	Amenity	2mm/s	25.0 m
	DTMR	Tunnel liner	10mm/s	8.0 m
	Engineered Assessment	Cross River Rail Assets	50mm/s	2.0 m
	DTMR, AS2187.2 DIN4150.3 or BS7385	Commercial Buildings	20mm/s	4.5 m
35 tonne excavator (without hydraulic hammer attachment)	DTMR	Amenity	2mm/s	3.5 m
	DTMR	Tunnel liner	10mm/s	1.0 m
	Engineered Assessment	Cross River Rail Assets	50mm/s	0.5 m
	DTMR, AS2187.2 DIN4150.3 or BS7385	Commercial Buildings	20mm/s	0.5 m

Table 10- Critical distance for compliance with vibration criterion for various equipment types

As an example, when excavating with the 2000-kilogram hydraulic hammer attached to the 30 tonne excavator, the 10mm/s vibration criterion specified for the CRR tunnels and caverns will be complied with at a distance of 5.5 metres.

The assessment considers that the excavation works could occur anywhere in the 101 Albert Street excavation footprint and is therefore a worst-case scenario. Should excavation not occur immediately adjacent to the boundary for a particular equipment type (i.e. excavation with the larger hydraulic hammer only in the middle of the excavation footprint), the vibration levels will reduce from those modelled values.

The modelled vibration contours are presented for the six different equipment types and different RL at which they will operate. The vibration contours subsequently allow an assessment as to whether the use of the equipment at this specific RL will comply with the Table 9 criteria. The worst-case modelling

results are based on equipment operating at RL-5m as this represents the lower Basement 2 level and therefore equipment operating at this horizon will be closest to the CRR tunnels and caverns.

For the CRR infrastructure, the modelling contours are presented at three RLs and represent:

- RL-12.9m which is the approximate crown of the CRR cavern.
- RL-21.5m which is the Mezzanine level.
- RL-28mwhich is the lower track level.

The modelled results are presented in the plates that are attached to this document.

Scenario	*Modelling Plate*	*Equipment Type*	*Equipment Operating RL*	*Assessment RL*	*Outcome*
3	C		Approximate RL-5m (Basement 2)	Approximate RL4m @ existing ground level	Low imperceptible levels of vibration at surface Maximum modelled vibration of less than 0.5 mm/s Vibration incapable of damaging adjacent buildings. Vibration will be indistinguishable from existing background vibration No impact at any buildings No mitigation required
4	D		Approximate RL-5m (Basement 2)	Approximate RL-12.9m @ tunnel crown	Low levels of vibration at tunnel crown Maximum modelled vibration of 0.5 mm/s Vibration compliant with criterion for mined tunnels No impact No mitigation required
5	E		Approximate RL-5m (Basement 2)	Approximate RL-21.5m @ Albert St Station Mezzanine	Low imperceptible levels of vibration at station mezzanine level Maximum modelled vibration of 0.5 mm/s Vibration incapable of damaging tunnel or station equipment No impact No mitigation required
6	F		Approximate RL-5m (Basement 2)	Approximate RL-28m @ Albert St Station Platform	Low imperceptible levels of vibration at station rail/platform level Vibration incapable of damaging tunnel or station equipment No impact No mitigation required
9	I		Approximate RL-5m (Basement 2)	Approximate RL4m @ existing ground level	Low imperceptible levels of vibration at surface further than 50 metres. Potentially perceptible at closest sections of three commercial buildings to the works Maximum modelled vibration of 3 mm/s at the Matisse Tower building All heritage buildings compliant Vibration incapable of damaging adjacent buildings, including heritage No impact No mitigation required
10	J		Approximate RL-5m (Basement 2)	Approximate RL-12.9m @ tunnel crown	Low levels of vibration at tunnel crown Maximum modelled vibration of approximately 1 mm/s Vibration compliant with criterion for mined tunnels No impact No mitigation required
11	K		Approximate RL-5m (Basement 2)	Approximate RL-21.5m @ Albert St Station Mezzanine	Low imperceptible levels of vibration at station mezzanine level Maximum modelled vibration of 1 mm/s hen working at the south-west section of site Vibration incapable of damaging tunnel or station equipment No impact No mitigation required
12	L		Approximate RL-5m	Approximate RL-28m @	Low imperceptible levels of vibration at station rail/platform level

Scenario	Modelling Plate	Equipment Type	Equipment Operating RL	Assessment RL	Outcome
			(Basement 2)	Albert St Station Platform	Maximum modelled vibration less than 1 mm/s when working at the south-west section of site Vibration incapable of damaging tunnel or station equipment No impact No mitigation required
15	O		Approximate RL-5m (Basement 2)	Approximate RL4m @ existing ground level	Low imperceptible levels of vibration at surface with exception of the three closets commercial buildings where vibration may be felt for some of the works. Maximum modelled vibration of 2 mm/s at 130 Mary St heritage Vibration incapable of damaging adjacent buildings, including heritage No impact No mitigation required
16	P		Approximate RL-5m (Basement 2)	Approximate RL-12.9m @ tunnel crown	Low levels of vibration at tunnel crown Maximum modelled vibration of less than 2 mm/s Vibration compliant with criterion for mined tunnels No impact No mitigation required
17	Q		Approximate RL-5m (Basement 2)	Approximate RL-21.5m @ Albert St Station Mezzanine	Low imperceptible levels of vibration at station mezzanine level Maximum modelled vibration of less than 2 mm/s Vibration incapable of damaging tunnel or station equipment No impact No mitigation required
18	R		Approximate RL-5m (Basement 2)	Approximate RL-28m @ Albert St Station Platform	Low imperceptible levels of vibration at station rail/platform level Maximum modelled vibration of less than 1 mm/s Vibration incapable of damaging tunnel or station equipment No impact No mitigation required
21	U		Approximate RL-5m (Basement 2)	Approximate RL4m @ existing ground level	Low imperceptible levels of vibration at surface with exception of the three closets commercial buildings where vibration may be felt for some of the works. Maximum modelled vibration of 2 mm/s at 130 Mary St heritage Vibration incapable of damaging adjacent buildings, including heritage No impact No mitigation required
22	V		Approximate RL-5m (Basement 2)	Approximate RL-12.9m @ tunnel crown	Low levels of vibration at tunnel crown Maximum modelled vibration of approximately 2mm/s Vibration compliant with criterion for mined tunnels No impact No mitigation required
23	W		Approximate RL-5m (Basement 2)	Approximate RL-21.5m @ Albert St Station Mezzanine	Low imperceptible levels of vibration at station mezzanine level Maximum modelled vibration of 2 mm/s when working at the south-west section of site Vibration incapable of damaging tunnel or station equipment No impact No mitigation required
24	X		Approximate RL-5m (Basement 2)	Approximate RL-28m @ Albert St Station Platform	Low imperceptible levels of vibration at station rail/platform level Maximum modelled vibration of less than 1 mm/s Vibration incapable of damaging tunnel or station equipment No impact No mitigation required
27	AA		Approximate RL-5m (Basement 2)	Approximate RL4m @ existing ground level	Low perceptible levels of vibration at surface with the three closest commercial buildings most affected where vibration may be felt for some of

Scenario	Modelling Plate	Equipment Type	Equipment Operating RL	Assessment RL	Outcome
					the works. Capri Hotel and 130 Mary Street building tenants may perceive vibration. Maximum modelled vibration of 3 mm/s at 130 Mary St heritage Vibration incapable of damaging adjacent buildings, including heritage No impact No mitigation required
28	BB		Approximate RL-5m (Basement 2)	Approximate RL-12.9m @ tunnel crown	Low levels of vibration at tunnel crown Maximum modelled vibration of approximately 2 mm/s Vibration compliant with criterion for mined tunnels No impact No mitigation required
29	CC		Approximate RL-5m (Basement 2)	Approximate RL-21.5m @ Albert St Station Mezzanine	Low imperceptible levels of vibration at station mezzanine level Maximum modelled vibration of 3 mm/s when working at the south-west section of site Vibration incapable of damaging tunnel or station equipment No impact No mitigation required
30	DD		Approximate RL-5m (Basement 2)	Approximate RL-28m @ Albert St Station Platform	Low imperceptible levels of vibration at station rail/platform level Maximum modelled vibration of 2 mm/s when working at the south-west section of site Vibration incapable of damaging tunnel or station equipment No impact No mitigation required
33	GG		Approximate RL-5m (Basement 2)	Approximate RL4m @ existing ground level	Low imperceptible levels of vibration at surface Maximum modelled vibration of less than 0.5 mm/s Vibration incapable of damaging adjacent buildings, including heritage. Vibration will be indistinguishable from existing background vibration No impact at any buildings No mitigation required
34	HH		Approximate RL-5m (Basement 2)	Approximate RL-12.9m @ tunnel crown	Low levels of vibration at tunnel crown Maximum modelled vibration less than 0.5 mm/s Vibration compliant with criterion for mined tunnels No impact No mitigation required
35	II		Approximate RL-5m (Basement 2)	Approximate RL-21.5m @ Albert St Station Mezzanine	Low imperceptible levels of vibration at station mezzanine level Maximum modelled vibration less than 0.5 mm/s Vibration incapable of damaging tunnel or station equipment No impact No mitigation required
36	JJ		Approximate RL-5m (Basement 2)	Approximate RL-28m @ Albert St Station Platform	Low imperceptible levels of vibration at station rail/platform level Maximum modelled vibration less than 0.5 mm/s Vibration incapable of damaging tunnel or station equipment No impact No mitigation required

Table 11- Vibration assessment scenarios with modelled outcomes

The modelling results indicate:

- Confirms that the level of vibration at the closest section of the cavern lining of the CRR to the 101 Albert Street works is compliant with the 10mm/s vibration limit for modelled hammer sizes up to 7000 kilograms. The maximum level of vibration at the CRR tunnels and caverns is 3mm/s.

- Confirms that whilst the works will generate elevated levels of vibration at the closest three commercial buildings, the vibration is compliant with the vibration level defined in Table 9 as preventing damage to the building structure.

- Depending upon the location of where the equipment operates at the site, as well as the RL, the vibration will be perceptible to some tenants with some areas of these buildings.

- The maximum vibration at the closest heritage building is 3mm/s form the larger hydraulic hammer operating near the surface in the worth-east section of the site.

- The below ground utilities, including the sensitive *S1 Sewer*, are all modelled to be subjected to vibration levels less than 10mm/s. The maximum vibration level at the S1 Sewer is 3mm/s from the larger 7000 kilogram hydraulic hammer operating along the south-west section of the site adjacent to Albert Street.

18. CONDITION SURVEYS

The objective of a condition survey report is to provide an indicative representation of the condition of the infrastructure prior to the commencement of any construction activities and can help to ensure that the project adopt best practices that minimise the risk that of damage to adjacent infrastructure, buildings and/or services. The condition survey therefore protects against inappropriate construction activities, as well as protecting against misappropriate claims. The document will be prepared to meet these objectives.

The specific requirements for the condition surveys will include:

- A report of the property with photographs showing the existing defects that will be completed before commencement of any excavation or demolition. It is possible that some property owners/building managers may decline the offer, although this is less likely with commercial properties.

- Completion by a registered engineer with experience in condition surveys will undertake the inspection and preparation of the report.

- When completed, the condition report will be provided to building manager.

- Works will not commence until the condition survey report has been submitted.

The condition survey will be completed in accordance with the recommendations of the accepted standards. The description of crack widths will be in accordance with AS2870[11]. Classification of damage with reference to identified defects, evident cracking will be classified within the following categories.

Crack Category	*Definition*
0	Width less than 0.1mm Hairline cracks that do not need repair
1	Width less than 1mm Fine cracks which do not need repair
2	Width less than 5mm Noticeable cracks which can be readily filled
3	Width between 5mm and 15mm Cracks are repairable. Weather tightness may be impaired and repairs may require the replacement of small sections of the wall
4	Width greater than 15mm Extensive repairs required to walls and possibly adjacent window and door frames, lintels, beams and service pipes

Table 12- Classification of damage as per Australian Standard AS2870

[11] AS2870, "AS2870 – Residential slabs and footings – Construction, Appendix C1"

Condition surveys will include inspection of all accessible spaces for each of the nominated buildings with a photographic record of all defects, including cracking, spalling, settlement, differential movement, separation at building joints, damaged finished, water leaks, mechanical damage. The photographs will be dated and time stamped to the relative buildings and location.

Wheer required, the condition surveys will be provided in electronic PDF format with separate reports for each building, utility, footpath, and CRR assets. The original high-definition photographs will be retained for the duration of the project and defects period. The condition survey will be undertaken by a person with RPEQ recognition.

For each survey, any significant defects that are identified and could potentially undergo further dilation or elongation as attributable to the construction works will be further monitored by the placement of crack gauges across the defect. The initial measurement of the crack gauge, and therefore a record of the defect aperture, will be recorded using a micrometer. An acceptable method of mounting the crack gauge that will; not lead to further damage to the surface will ultimately determine whether crack gauge monitoring is a viable assessment option.

Whilst a condition survey will be completed for those buildings where elevated vibration may occur, vibration monitoring will also be undertaken. The vibration monitoring provides an additional layer of protection by quantifying the impacts from the construction works which can be compared with permissible vibration levels.

Whilst a condition survey provides comment on the visible condition of the infrastructure, no comment as to its engineering "*soundness*" is generally provided. Providing the Table 9 vibration criteria are applied, compliance with these vibration limits virtually ensure that the project will be safely completed without superficial or structural damage to adjacent infrastructure.

18.1. Extent of Condition Surveys

The modelled vibration data have shown minimal impact on the adjacent infrastructure from the construction activities. Notwithstanding the vibration impacts are compliant with the proposed vibration criteria that virtually eliminate any impact upon the integrity of the adjacent buildings (including the heritage buildings) or other infrastructure, condition surveys of the following buildings and infrastructure will be undertaken prior to the commencement of the works that could lead to potential impact:

The proposed extent of the condition surveys for the rail infrastructure is as follows:

- Albert Street Station, including the platform and mezzanine levels, for the section of the cavern extending 25 metres either side of the 101 Albert Street building footprint. The extent of the station that will be surveyed is approximately 1110 metres

- Albert Street Station emergency adits from the platform to mezzanine levels that lie within 25 metres of the 101 Albert Street building footprint.

The proposed locations for the condition surveys are also shown in the following figure.

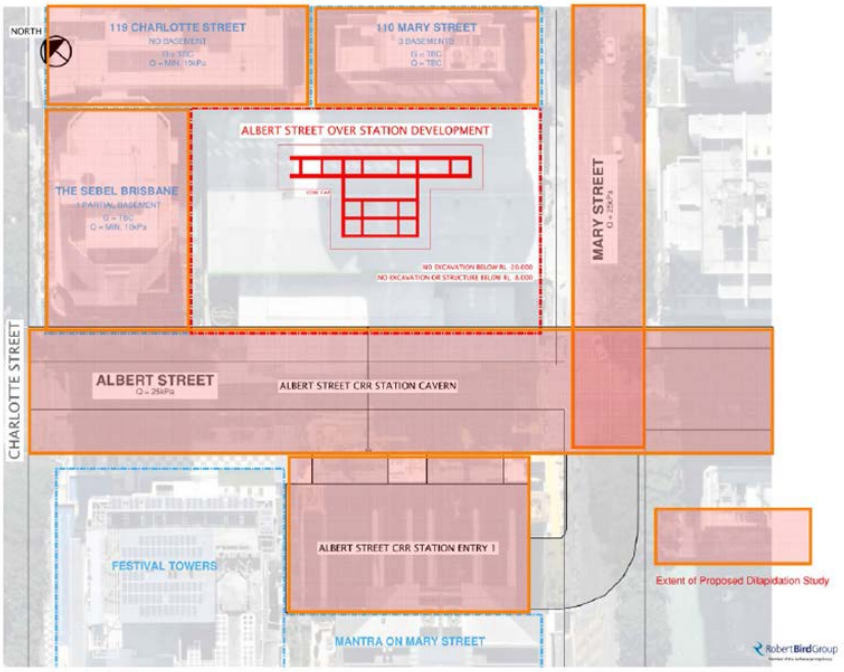


Figure 8 – Extent of sites recommended for condition surveys

18.2. Condition Survey Limitations

Whilst a condition survey report will be completed with due care and diligence, the condition survey will be subject to the following constraints:

- All information contained in this report will be limited by the level of site access on the day of the inspection.
- All observations will be used within the context of the scope of the report and should not be used outside the 101 Albert Street project.
- All documented defects will be identified solely from in-situ visual inspection only. No analysis of structural loading and expected design life of structural and/or non-structural members will be completed as part of the survey condition.
- The condition survey will not assess the electrical, plumbing, sewer, water, gas or air conditioning systems of the property.

18.3. Subsequent Use for a Condition Survey

Should a concern relating to damage to an adjacent building occur, a review of both the photographic and field notes will be undertaken to determine whether the defect existed prior to the commencement of the works. If the defect cannot be dismissed as existing prior to the works, the general condition of the infrastructure will be reviewed to determine whether similar defects existed prior to the works. Understandably, not all defects can be photographed often sections of the buildings are covered with other effects which prevent photographing. It is also common that defects occur because of environmental changes (temperature, humidity, water and ground displacement, *etc*.) and will occur even in the absence of any construction activities.

All appropriate information, including the data from the condition surveys of the building, the proximity to the works area and the level of vibration that the building has been subjected to should be reviewed to assess the legitimacy and likelihood of the damage.

Providing compliance with the vibration criteria in Table 9 is met, any superficial damage to the infrastructure is likely to be attributable to sources other than that from short term construction type vibrations.

19. MONITORING APPROACH

The monitoring program will involve several groups with responsibilities to ensure the monitoring data are collected and analysed appropriately as well as ensuring that site personnel implement the necessary actions as a result of any elevated vibration values. The key persons are as follows:

Heilig & Partners: Responsible to installing, maintaining and reporting on vibration, tilt and displacement levels at rail, commercial buildings, heritage buildings and below ground utilities. Provide additional expertise in response to elevated vibration and the appropriate mitigation that may be necessary.

Contractor: Contractor responsible for any demolition and/or earthworks and will administer the plan ensuring that all operators, including any sub-contractors, are aware of the project requirements including the alerts procedures (email, SMS and other technical assessment) and the requirement to act when alerts are activities.

The monitoring of vibration is important to ensure adjacent infrastructure is not impacted. In addition to vibration monitoring, the project will also include additional assessment and monitoring approaches. These other monitoring options include tilt sensors for the verticality of the structure, or the displacement between the structural elements to determine any movement. Whilst a vibration criterion is imposed on these structures as way of protecting against other forms of damage, the rapid development of these alternative monitoring systems now allows them to be used on projects as a relevant and significantly advanced warning and assessment system.

Like the vibration monitoring systems, these alternative monitoring systems can be automated and allow for alerts to be forwarded to key persons if measured values approach threshold or intervention limits. Extensometers can be placed across defects and are capable of measuring changes of less than 10 microns, or around 10% of the thickness of a sheet of paper. Tilt sensors can be used to measure any changes in the verticality of a structural element, capable of detecting changes less than 0.0004 degrees, or less than 0.1mm over a 5 metre span. A laser sensor can measure changes in displacement between multiple points with an accuracy of less than 0.5mm over a 30 metre span. The CRR infrastructure are assessment locations where these advanced tilt, extensometer or distance sensors will be used to supplement the vibration monitoring.

As part of the sensor installation assessment, Heilig & Partners will complete a review of the infrastructure condition reports and identify and defects that may necessitate further monitoring or could be potentially affected by elevated vibration levels. Depending upon their location and the potential to be impacted, a simple crack gauge, or an extensometer connected to automated reporting system may be installed. These vibrating wire extensometers are particularly relevant when assessing impacts on key structures because they can detect changes in defects, discontinuities or expansion joints less than 10 microns and provide advanced warning if accelerated changes occur. These sensors could be anchored to a defect on the tunnel structure and continually measure the displacement. Should any changes be measured, alerts will be automatically forwarded to the key persons where they will be further investigated.

Heilig & Partners propose to consider the best available systems to ensure the construction works are completed without impact. The combination of the data that can be collectively analysed from these systems will ensures that works can be completed without impact on all adjacent infrastructure.

19.1. Track Monitoring Equipment

Track monitoring is identified as a risk mitigation strategy in the project conditions. The monitoring approach is proposed to include multiple high resolution biaxial tilt sensors, as opposed to the often-used total survey stations.



For real time track monitoring, the proposed approach is to install sensitive bi-axial tilt sensors on the FTS (Floating Track Slab) supports along the length of the track. These sensors will have back to base capabilities and provide for a proactive system with early warning capabilities. The sensors are typically installed at small intervals, around 10 to 20 metres, with the tilt head unit positioned between the tracks and mechanically onto a sleeper or Floating Slab Track (FST) support. The tilt sensor will regularly, every 5 minutes, detect any variation in the angle of the rail along the track, or across the track, that might occur as result of the works. the adjacent image shows a tilt sensor monitoring potential deviation on a convention timber rail sleeper. The tilt sensors will be mechanically anchored to ensure there is no interference to the train movement. The units extend approximately 100 mm from the sleeper.

The proposed tilt sensor units have a resolution of less than 0.01º which equates to detecting a variation in the rotation of the sleeper/track of less than 0.2mm. Each tilt sensor will transmit data remotely to a gateway positioned away from the track corridor. These data will subsequently be transferred by modem communications to the Heilig & Partners server where the data will be processed and daily reports forwarded to key persons. If the measured tilt angles vary by more than intervention value, an email alert will be immediately forwarded to site persons to notify the project team of the tilt alert.

The tilt sensors approach to track monitoring ensures the system the proactive and allows for intervention should movement be detected.

19.2. Cavern Wall Monitoring



Any deflection of the CRR caverns or tunnel wall that occurs as a result of vibration effects, changing ground conditions or shifted stress levels will be assessed by the placement of bi-axial tilt sensors with an incorporated distance sensor. These sensors will be positioned along cavern wall of the lower platform level, approximately 750mm above the rial level, and detect any variation in the angle of the cavern or tunnel wall on which they are anchored. In addition, the sensor will be orientated to measure the distance between the cavern wall and the platform to determine any differential displacement. Every 5 minutes, the sensor unit will record the current pitch and roll angles of the tilt sensor parallel to and perpendicular to the cavern or tunnel wall. The angles will be compared to a minimum threshold value and any exceedance of this value will result in a notification to key persons. The data will be transferred via GSM modem to the Heilig & Partners server, analysed and a daily report prepared and emailed. The data will show the angle, or tilt, at five-minute intervals. The tilt sensor arrangement has been accepted at other projects as an alternative to total survey monitoring stations as a proactive system that has continuous recording and alert capabilities. The adjacent photograph shows the placement of the tilt sensors in the Roma Street to Central Station tunnels.



The accuracy of the tilt sensor is consistent with the unit that will be used for the track monitoring.

The tilt sensors that will be used for the cavern and tunnel wall monitoring differ from the track monitoring tilt sensors as the former have incorporated distance measurement capability that the track monitoring tilt sensors do not have.

19.3. Vibration Monitoring Equipment

The vibration will be monitored continuously at multiple locations as per the conditions of approval via an arrangement of acquisition systems which will report the data daily, or more frequently if required, through to the Heilig & Partners servers.

Given that vibration will occur for some works at the CRR tunnels, adjacent buildings or below ground utilities, a vibration monitoring system will be installed and consist of multiple monitors around the tunnels and further monitors at other locations around the site. The vibration monitors will have three recording channels with an external geophone (transducer) that monitors ground vibration in three directions (transverse, vertical and longitudinal particle velocities) and report the level in mm/s.

Vibration levels occurring from the works will be monitored continuously and the maximum value recorded for each sample period, generally taken to be 30 seconds, although smaller intervals may be appropriate where detailed analyses are required. During each 30 second period, the level of vibration will be sampled 30,000 times and the maximum level stored electronically. The levels, as a function of time, will be given in a graph of time versus vibration level. Statistics of vibration, including average, minimum, maximum and 90 percentile limits will also be calculated.

Recorded vibration data will be uploaded at set times during the day and the measured data analysed and compared against vibration criteria given in Table 9. Where levels are shown to approach the vibration criteria, emails or SMS alerts will be sent to key persons within the project.

As per the requirements for works around rail infrastructure, where vibration monitoring is identified as a risk mitigation strategy, the monitoring will:

- Utilise triaxial geophones (4.5 Hz) to capture vibration in the impacted existing Cross River Rail infrastructure.
- Install devices prior to commencement of any demolition, excavation, or construction work.
- Calibrate devices against a traceable event.
- Install devices as per the manufacturer's installation guidelines.



The Australian Standard AS2187.2:2006 specifies details the type of geophone (tri-axial with a low frequency capability of 4Hz) that should be used for the vibration monitoring.

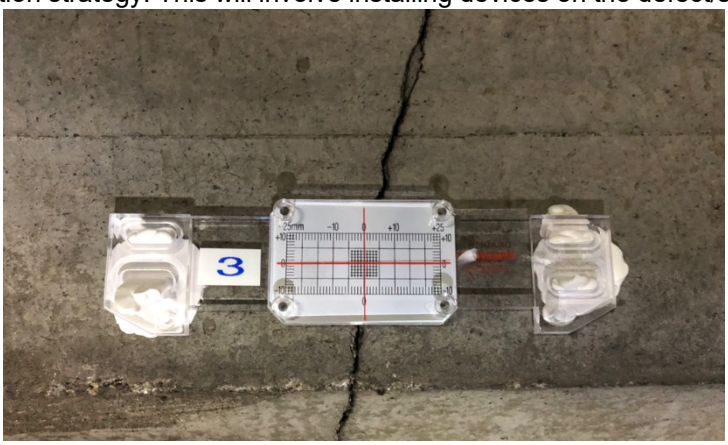
Background monitoring and baseline readings of vibration will identify any external influences on monitoring results (i.e., people, rail and car traffic), which can lead to errors in reported data. The outputs of the monitors will also include waveforms for extreme events.

Monitoring will be consistent with previous developments in Brisbane where works as occurred in the immediate vicinity of the constructed road and rail tunnels. Tri-axial geophone assemblies will be installed adjacent to the planned works and at locations within the tunnel agreed to by DTMR and the building managers. For the monitoring of the *S1 Sewer*, a triaxial geophone sonde will be grouted into a small diameter hole (102mm diameter) drilled to a safe depth and outside the *S1 Sewer* exclusion zone. The depth of the borehole and the sensor will also be confirmed by survey data.

This pro-active approach ensures that vibration levels are kept below key threshold values. This approach has been undertaken for other projects and utilised on many of the large-scale projects completed in Brisbane and other project locations within Australia and internationally.

19.4. Crack Monitoring

Where the condition survey identifies significant defects and these cracks could subsequently be dilated or elongated as a consequence of the construction activities, crack monitoring using manual gauges as shown below is identified as a risk mitigation strategy. This will involve installing devices on the defect/s in the surveyed infrastructure before the commencement of any demolition, excavation, or construction.

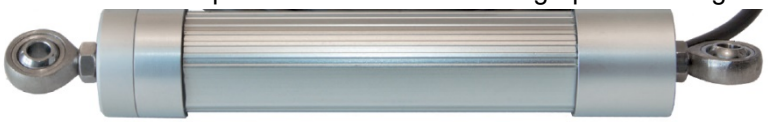


A typical manually read crack gauges is shown adjacent.

The location and the number of devices that may be installed for crack monitoring will be determined after the defects are identified from the condition survey. Given the CRR will have only be just completed, it is not anticipated that significant defects in caverns or tunnels will be present.

The viability of using crack gauges will also depend upon the condition of the surface and whether bonding or mechanically anchoring a gauge like that shown above will detract from the wall condition after the gauge has been removed.

If there significant defects that could lead to structural damage to the infrastructure with significant consequences, advanced monitoring with vibrating wire gauge sensor will be installed. These systems use a vibrating wire extensometer which detects changes in length of the wire noting changes in the pinged frequency. When connected to an acquisition system, the data (distance between the anchor points) will be uploaded multiple times per day and a graph showing the displacement as a function of time and data prepared. The results will be emailed, as per the current arrangement with the vibration and tilt data. Where the displacement exceeds a pre-set value, an alert notification will be forwarded. These instruments have been successfully applied elsewhere in Brisbane for assessing impacts from the major construction projects. The results will be presented as a series of graphs showing the displacement as a function of time. The accuracy of the system is around 30 microns, or an ability to detect changes about the thickness of a human hair.



The installation involves drilling two holes either side of the defect to anchor the extensometer. Like the manual crack gauge, the feasibility of the extensometer system depends upon the unit being anchored without incurring further non repairable damage to the surface.

19.5. Monitor Operational Period

All monitoring for the project will be proactive, aside from any manually installed crack gauges, and operate 24/7 with regular uploads of the data through to the Heilig & Partners server where the data will be processed, and reports forwarded automatically to key persons. Daily, weekly and monthly reports will be presented. Alerts will be automatically forwarded via SMS and/or email where the levels approach the permissible intervention values. The alerts and data will be for vibration, tilt angle, and displacement.

19.6. Period of Monitoring

All monitoring systems will have baseline readings taken for at least 3 weeks prior to any demolition or earthworks commencing. The vibration monitoring will continue until the excavation works have been completed and the building established to the existing ground level. The monitoring with the other sensors (tilt, displacement, distance and/or crack gauges) will continue until the exterior of the building has been completed and no further load to the adjacent infrastructure anticipated. In all cases, monitoring will be terminated only with the acceptance of EDQ DA upon the project demonstrating to their satisfaction that the monitoring results confirm that the site conditions have stabilised.

During this period of monitoring, the monitoring system will continue to:

- Provide real-time monitoring and rapid data logging.
- Send alerts via SMS and email if any instrument exceeds the set alarm thresholds; and
- Provide adequate redundancy that allows uninterrupted function in the event of a component or system failure.

19.7. Records and Reporting

All monitoring requirements specified in the MCU's relating to sensors for assessing possible impacts on structures will be linked to an automated monitoring system, and include vibration, inclinometer, tilt, displacement (including temperature). The monitoring requirements are complex and for significant projects like 101 Albert Street, onerous in terms of the instrumentation required. There is significant value in having a single repository for the data and presentation of the information. This is consistent with the project conditions. Heilig & Partners have provided similar systems for the monitoring of other projects, including the Brisbane CBD projects, where a combination of vibration, inclinometer, tilt and piezometers formed part of the monitoring specification.

Vibration, tilt, displacement reports will be completed for each day of the works and contain the following information:

- Date and time of monitoring.
- Location of activities, or via a link to the site diary of activity
- Monitoring location, identified by a combination of address, photographs and coordinates.
- Peak vector sum level of vibration from each of the three orthogonally orientated geophones.
- Statistical levels showing vibration values for the 90, 95 and 99 percentile values.

The format of the daily vibration report is as per the example shown following. The graph will also display the vibration statistics associated for each day/week events. Other tilt and displacement graphs will be similarly presented as per Figure 10.

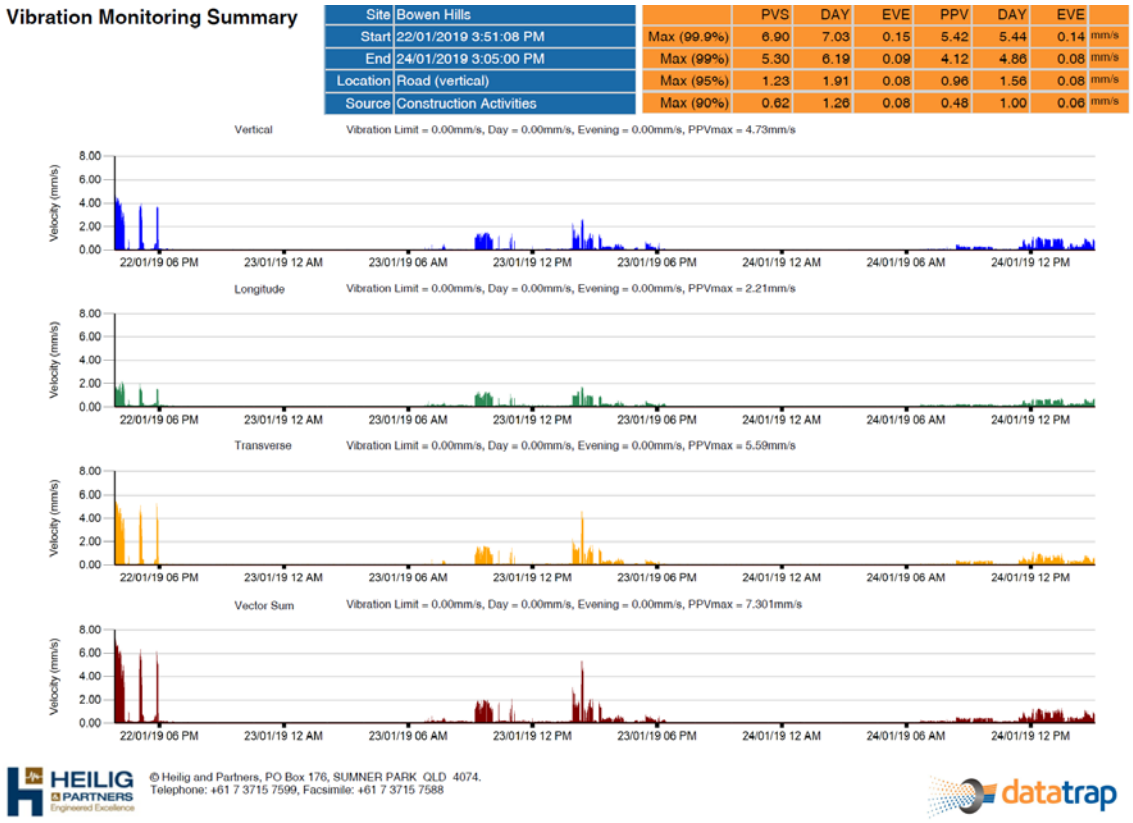


Figure 9 – Vibration report showing statistical calculations.

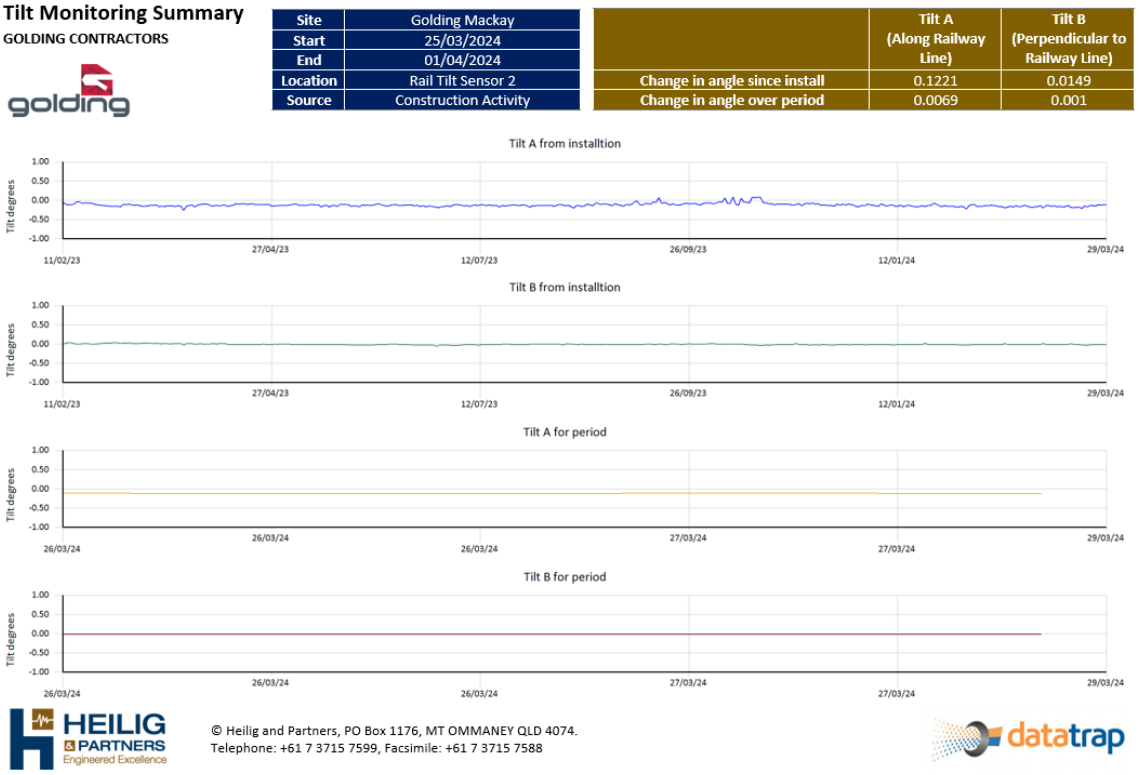


Figure 10 – Bi-axial tilt sensor report showing statistical calculations.

19.8. Equipment Calibration

The monitoring units deployed for the project will have undergone annual calibration by an independently certified group. Original calibrations certificates for each monitor will be kept in the Heilig & Partners offices and contain the following information:

- Report number.
- Make and model of instrument.
- Monitor serial number.
- Geophone serial number.
- Calibration date.
- Test equipment references.
- Compliance with relevant standard.
- Signature of person performing calibration and date of service.

19.9. Training

Any site personnel involved with the monitoring equipment will be trained and demonstrate appropriate capabilities prior to undertaking and providing comment on the measured levels. The equipment will be configured, installed and maintained by Heilig & Partners.

In addition to the specific tasks that any persons associated with the monitoring equipment may be required to undertake, all site persons will be made aware of the proximity of the CRR caverns and tunnels, the adjacent buildings and the below ground utilities. The significance of vibration and other impacts, including the monitoring alert system, will be part of the on-site induction process.

20. CROSS RIVER RAIL MONITORING REQUIREMENTS

As per the IMP requirements specified in MCU12, a rail monitoring system will be implemented and include multiple sensors, such as:

- Geophones positioned on the walls of the tunnels to determine the level of vibration and assess any dynamic effects of the tunnels and caverns.
- Tilt and displacement sensors to determine any movement of the walls of the tunnels or caverns.
- Tilt sensors to assess and movement or twisting of the rail track.
- Crack gauges to measure any change in the aperture of the existing defects (i.e. cracks in the concrete liner of the tunnel or cavern)

The Queensland Rail Specification MD-20-14 for "*Civil, Work over Operational Rail Tunnels*"[12] specifies the minimum requirements that will be met by the project for any work over or near an existing railway tunnel. It applies to the planning, design, construction, and operation stages of the works. The Specifications will be followed where work occurs on land above or within the greater of:

- The easement boundary of an existing railway tunnel

[12] Queensland Rail Safety Policy MD-20-14, "Civil – Work over operational rail tunnels", Version 2.0 September 2021

- 15 metres laterally from the outer most excavated face of an existing railway tunnel in the South East Queensland Suburban Network, or

- 25 metres laterally from the outer most excavated face of an existing railway tunnel elsewhere.

This MD-20-14 Specification is to be read in conjunction with the following document Queensland Government, Department of Transport and Main Roads (DTMR) “Guide for development in a transport environment: Rail”.

As a general comment, the project is required to demonstrate to the satisfaction of DTMR that the proposed works do not:

- cause movement of permanent lining within the existing Cross River Rail infrastructure

- impose any additional loading (e.g. due to building foundation loads) on existing Cross River Rail infrastructure.

The project Is required to submit a RPEQ certified Monitoring Plan, referred to as the IMP, to EDQ DA prior to commencement of works. The monitoring plan will include as a minimum:

- details of the proposed monitoring systems (track, vibration, movement crack etc) including:
  - monitoring equipment
  - measurement tolerances of equipment

- requirements for installation and maintenance of the monitoring systems equipment; and

- monitoring frequency, and notification and intervention plan for exceedance of the threshold parameters for each monitoring system (track, vibration, movement crack etc)

20.1. Monitoring Approach

The project will implement monitoring systems to quantify any impact on the existing rail infrastructure, prior to and during the works, where:

- Monitoring is identified as a risk mitigation strategy, and

- Required by the Queensland Rail Safety Policies to ensure safe operation of the railway.

Monitoring systems include:

- Condition surveys and assessments.

- Movement monitoring of the tracks within the adjacent Albert Street Station existing rail infrastructure, including monitoring of settlement, heave, and rotation (twist).

- Movement monitoring of the existing permanent tunnel and cavern lining within the Albert Street Station platform and Mezzanine levels, as well as the initial section of the down track rail tunnel to Woolloongabba.

- Vibration monitoring of the existing permanent lining of the cavern and tunnel within the existing rail infrastructure

20.2. Vibration Monitoring

The project will monitor to demonstrate that vibration resulting from the construction works onto the permanent lining of the existing rail tunnels at the platform (RL-28m) and Mezzanine (RL-21.5m) levels do not exceed a vibration level of 10mm/s as per the Table 9 specified criteria.

Prior to the commencement of the works, predictive analyses of the expected vibration caused by the different construction methodologies that may induce elevated vibration will be undertaken, including the prediction of these vibrations at the various RL's including the cavern crown, Mezzanine and platform levels. The track and cavern assessment locations include those shown in the following image:

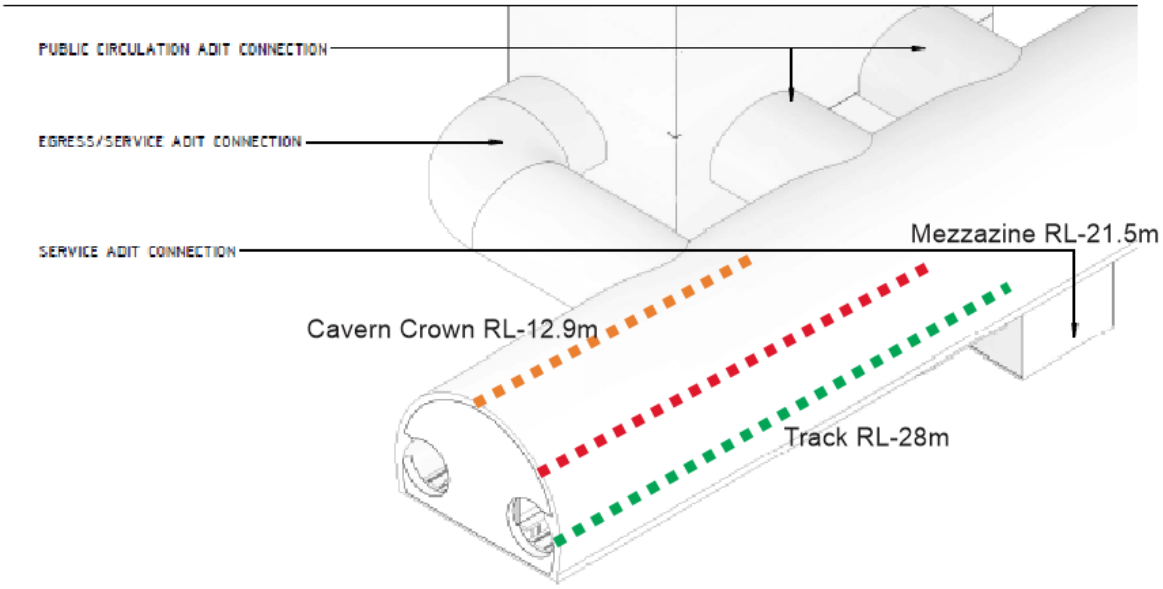


Figure 11 – Locations of vibration assessment levels

This assessment and the results presented in Table 11 and the relevant appendices have not highlighted any specific locations within the CRR that require a more detailed level of monitoring over that which has been generally proposed.

20.3. Track Monitoring

The project will demonstrate to the satisfaction of EDQ DA that the design, excavation and construction method for 101 Albert Street will not cause movement of the track within the Albert Street Station rail infrastructure that exceeds the Track Geometry Parameter Limits as given in Table 9.3, Table 9.4 and Table 9.6 of Queensland Rail Standard MD-10-575[13]. In particular, Section 9.3 of this standard indicates that for a ballasted track in tunnels or in the vicinity of platforms, the critical limit is +/-15mm. For a track in fixed position, the critical limit reduces to +/- 5mm.

The standard further indicates that the vertical and horizontal position of the overhead wiring associated with electrification has been designed in relation to the track level and track centreline and only very small variations are allowable in the track parameters. Table 9.4 which details the location tolerances for track with overhead wires indicates that the critical limit for Ballasted open track adjacent to Feeder Stations and Track Sectioning Cabins, turnouts and crossovers and any other Neutral Sections and Section Insulators not at these specific locations, is +/- 10mm.

At regular locations along the rail infrastructure, tilt sensors will be installed to capture precise movements, but also act as a pro-active monitoring system that will provide alerts should elevated displacements occur. These sensors will be installed approximately every 20 metres along the rail FST supports to which the rail is fastened. These will be installed prior to commencement of demolition, earthworks or construction of the proposed development. This ensures enhanced accuracy is already in place and precise readings available to monitor locations should reading approach thresholds for alarm levels. The variability in the background levels and accuracy of the monitoring system will be determined during this initial phase of monitoring. The monitoring in the Albert Street Station cavern will

[13] Queensland Rail Safety Policy MD-10-575, "Civil Engineering Track Standard (CETS)", Version 5.5, Updated March 2020

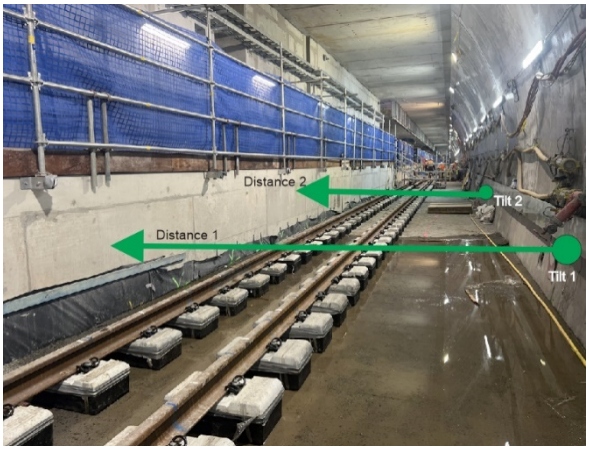
extend approximately 20 metres either side of the Lot 2 building envelope, or approximately 105 metres in total.

20.4. Monitoring Locations

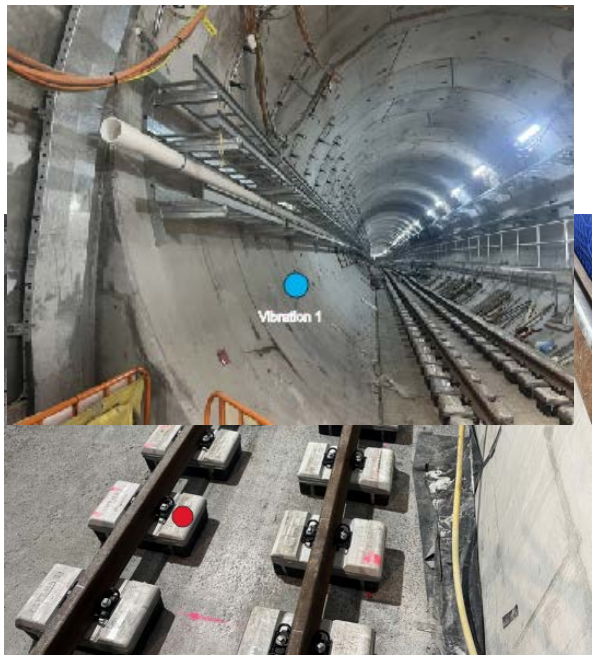
At multiple locations along the CRR infrastructure, multiple sensors, including tilt meters, displacement gauges, laser distance measurements and vibration sensors will be installed to record possible effects. These sensors will be installed at locations within the existing rail infrastructure prior to commencement of construction of the proposed development.

Sensor locations for each monitoring type have been determined following a site visit on the 24th March 2024 to the partially completed Albert Street Station and cavern. Some minor adjustments may be necessary after the final works to the CRR infrastructure has been completed.

It is proposed that monitoring units will be installed on the platform level, approximately RL-28m, as follows:



Five bi-axial *Tilt & Displacement* sensors will be attached to the cavern wall. The distance element of the sensor will measure the distance to the platform. Five sensors placed at approximately 20 metre spacings between north-west limit (opposite The Sebel Brisbane to south-east limit past Mary Street). Sensors will be anchored to north-east wall at approximately 750mm above rail level. The sensors will monitor any variation in the orientation/alignment of the cavern wall closest to the 101 Albert Street works (down track) as well as confirming any variation in the distance between the cavern wall and the platform base as shown in the adjacent image.



One triaxial vibration sensor will be placed approximately 5 metres inside down track driven tunnel on north-east wall at 1 metre from rail level. This section of the tunnel is approximately 50 metres from the closest area of works at 101 Albert Street

Five bi-axial tilt sensors attached to Floating Slab Track (FST) support at approximately 20 metre spacings between north-west limit (opposite Sebel) to south-east limit past Mary Street. The tilt sensors will be mechanically anchored to the inside of the concrete sleeper using a small anchor bolt. The top of the tilt sensor will not extend above the top of the rail. Representative sensor locations are identified by the red circles.

Condition survey of tunnel and platform infrastructure will extend from north-west limit (opposite The Sebel Brisbane) to south-east limit past Mary Street. Approximate assessment distance of 110 metres.

If required, manual crack gauges will be placed across any significant defects identified during condition survey. These manual gauges will be installed for the period of the demolition/construction works.
The proposed monitoring locations for the Platform level of the CRR are as follows:

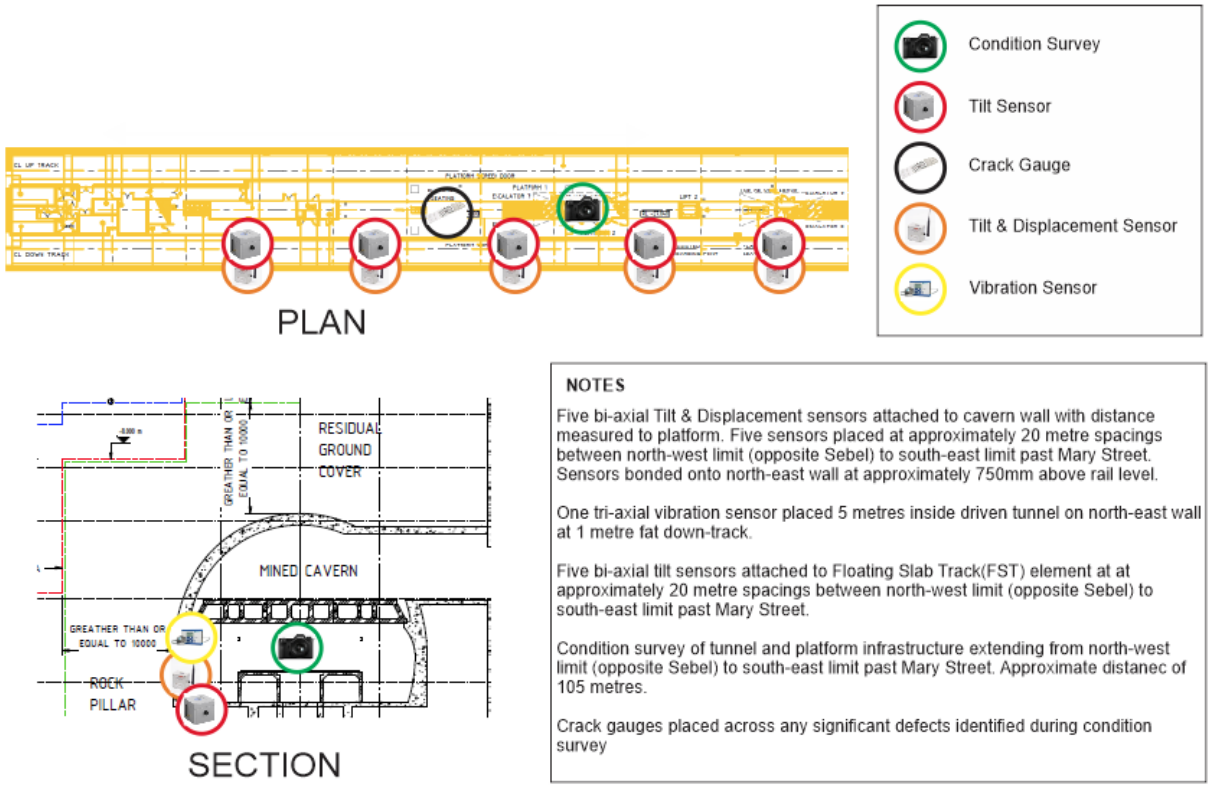
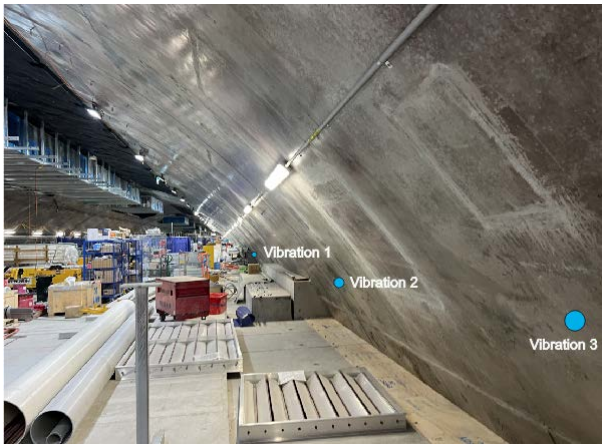


Figure 12 – Locations of vibration sensors within Albert Street Platform level

Additional monitoring units will be installed on the Mezzanine level, approximate RL-21.5m, as follows:

Five bi-axial tilt sensors attached to cavern wall with distance measured to platform. Six sensors placed at approximately 20 metre spacings between north-west limit (opposite the Sebel Brisbane) to south-east limit past Mary Street. Sensors bonded onto north-east wall at approximately 750mm above Mezzanine floor level. The representative locations for the tilt sensors are shown in the adjacent photograph as the yellow circles.





Five tri-axial vibration sensors will be placed at approximately 20 metre spacings between north-west limit (opposite the Sebel Brisbane) to south-east limit past Mary Street. Sensors bonded onto north-east wall at approximately 750mm above Mezzanine floor level. Representative locations for the vibration sensors are shown by the blue circles in the adjacent image.

Condition survey of Mezzanine cavern wall and infrastructure extending from north-west limit (opposite Sebel) to south-east limit past Mary Street. Approximate distance of 110 metres.

Crack gauges placed across any significant defects identified during condition survey. The proposed monitoring locations for the Mezzanine level of the CRR are as follows:

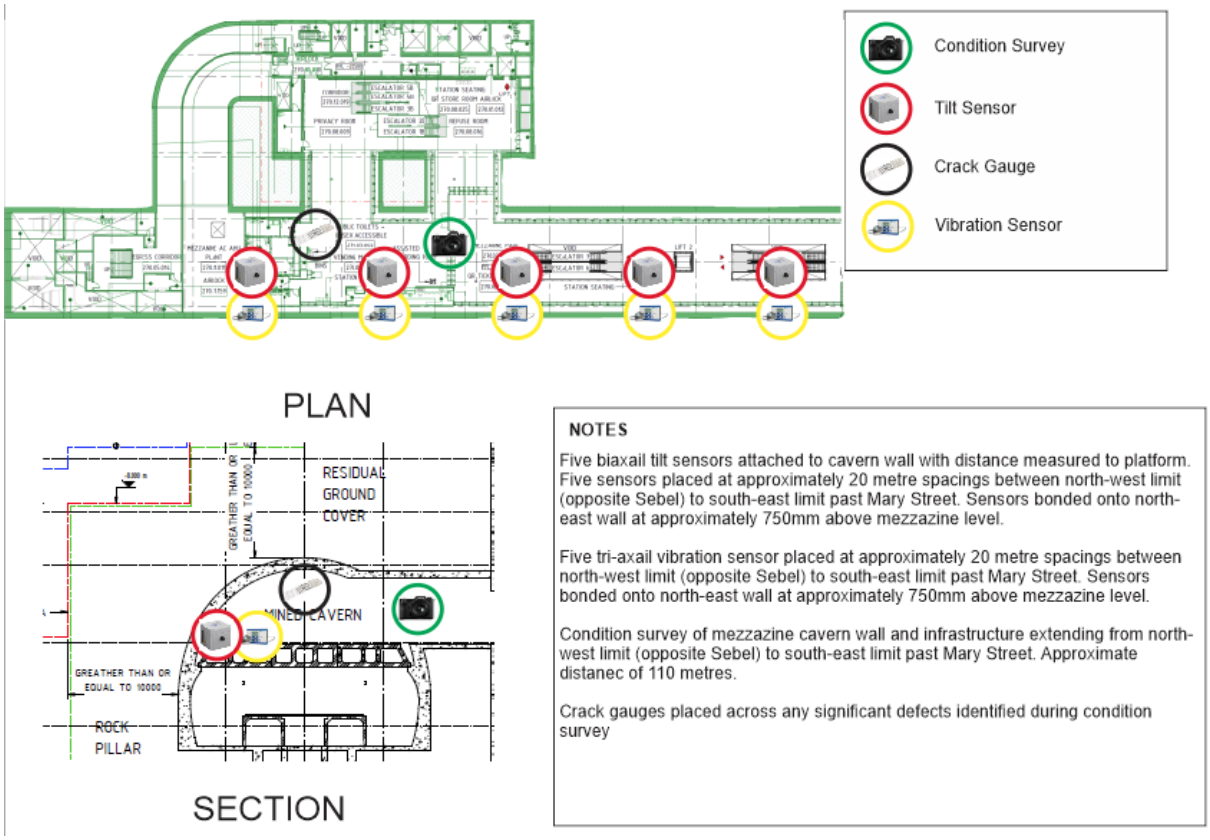


Figure 13 – Locations of vibration sensors within Albert Street Mezzanine level

20.5. Intervention Vibration Levels

The project will implement notification, intervention procedures and protocols for vibration at the CRR infrastructure.

Notification and interventions will be based on the three alarm levels referring to acceptable, warning and mitigation stages. Prior to commencement of works, the monitoring equipment will be configured with the threshold intervention limits as per the following table. For the vibration monitoring system, the project will:

- Provide EDQ DA access to the data when an exceedance of the mitigation stage is recorded.
- Issue weekly and monthly monitoring reports to EDQ DA detailing the measured results from each of the sensors. These will highlight any vibration exceedances.

Alarm levels for the vibration monitoring systems will be as per the following Table 13. The SMS alerts will be as follows and contain information relating the monitoring location, measured vibration level, trigger value and the time of the alert. Email alerts will contain similar information.

SMS ALERT: PVS Limit Exceeded Limit Of 8.00mm/s with reading of 8.01mm/s on Monitor Tunnel 5 North Wall Chainage 437 for Project HP2010-5 with monitor VIBe0380 - PVS Limit > 8 mm/s

Figure 14 – Typical SMS alert for exceedance of intervention limit for vibration

The pro-active monitoring approach ensures that vibration levels are kept below key performance values by identifying areas of the site or equipment types that generate elevated values. These are identified in advance of reaching or exceeding the performance limits.
The key trigger vibration limits are as follows:

Trigger Level	*Cavern or Tunnel Lining Vibration Monitoring*	*Responses*
Green	μ_{PPV} < 8mm/s	Proceed with works. Contractor to provide via email to TMR a weekly report. Metropolitan.IDAS@tmr.qld.gov.au
Orange	8mm/s < μ_{PPV} < 10mm/s	Contractor to discuss changes to site procedure to control vibration levels. Notify TMR via email on: Metropolitan.IDAS@tmr.qld.gov.au
Red	μ_{PPV} >10mm/s	Works to cease immediately onsite. Contractor to organise a meeting with Cross River Rail with all stakeholders present to agree how methods can be altered & work restarted. DTMR may require site representation, this will be agreed upon in the meeting. If required this representative will have authority to permit or prohibit excavations and/or the equipment used. Notify TMR via email on: Metropolitan.IDAS@tmr.qld.gov.au

Table 13- Intervention vibration levels for Cross River Rail Infrastructure

Where the vibration level triggers the orange warning alert (8mm/s to 10mm/s), the works will be reviewed and a meeting arranged with the construction team to determine the most appropriate demolition/excavation process that will ensure compliance with the 10mm/s limit. Where an exceedance of the red mitigation stage is recorded, the outcome will be presented in a technical letter prepared by Heilig & Partners and made available to DTMR for comments.

20.6. Intervention Track Displacement Levels

The intervention limits for the track monitoring are based upon the measured pitch and roll angles across a separation distance between the cavern wall and the edge of the platform resulting in unacceptable horizontal and vertical displacements. The intervention limits are shown in Table 14. An angle variation of 0.1° is equivalent to a 2mm variation in the track alignment over the standard gauge width of 1.07 metres.

Trigger Level	*Cavern or Tunnel Lining Displacement*	*Tilt (Pitch or Roll)*	*Responses*
Green	δ < 2mm	$\varphi_{Pitch/Roll}$<0.1°	Proceed with works. Contractor to provide via email to TMR a weekly report. Metropolitan.IDAS@tmr.qld.gov.au
Orange	2mm < δ < 4mm	0.1< $\varphi_{Pitch/Roll}$<0.2°	Contractor to discuss changes to site procedure to control vibration levels. Notify TMR via email on: Metropolitan.IDAS@tmr.qld.gov.au
Red	δ > 4mm	$\varphi_{Pitch/Roll}$ >0.2°	Works to cease immediately onsite. Contractor to organise a meeting with Cross River Rail with all stakeholders present to agree how methods can be altered & work restarted. DTMR may require site representation, this will be agreed upon in the meeting. If required, this representative will have authority to permit or prohibit excavations and/or the equipment used. Notify TMR via email on: Metropolitan.IDAS@tmr.qld.gov.au

Table 14- Intervention track pitch and roll levels for Cross River Rail Infrastructure

21. VIBRATION MITIGATION

The analyses have reasonably guaranteed that the works will comply with the vibration criteria for the types and locations of equipment that have been specified in Table 9. No impact on the integrity of surrounding infrastructure is expected from the scale of works due to their distance from the planned activities and the general low level of impact by the equipment. Some elevated vibration may occur at the adjacent commercial properties should the larger hydraulic hammering or vibratory piling equipment operate at the extents of the assessed areas and at minimum separation distance to these three closest properties. However, should the measured levels of vibration differ from the modelled values, mitigation measures may be necessary. Where necessary, these management and control measures could be incorporated to minimise the effect of any construction vibration on the adjacent infrastructure. Mitigationl measures could include the following:

- Management controls
- Source controls (adjustments to the equipment generating the elevated levels of vibration)
- Path controls (adjustments to the vibration path between the source and the receiver)

21.1. Management Measures

The level of vibration will be managed throughout the project by the construction contractors. The possible management measures will include:

- Adjusting the size of the hammering equipment (vibration energy) to control the level of vibration at the CRR tunnels and caverns, commercial or heritage or properties or the below ground utilities.
- Real time monitoring of the level of vibration to assess in advance whether the activity complies with the vibration conditions. (i.e. minute by minute data available through iPhone app)
- Comparison of the measured level with the predicted value to determine whether there should be any reassessment of future impacts and proposed mitigation measures.
- Consultation with the DTMR, EDQ DA or utility providers.

21.2. Source and Path Control Measures

The source and path control mitigation measures are as follows:

Action Required	*Applies*	*Details*
Equipment characteristics	Vibration	Adjustments to the equipment operation may be used to reduce the level of induced vibration. This will however be at the expense of productivity which may ultimately prove counter-productive in terms of improving or lessening impact.
Simultaneous operation of vibration intensive equipment	Vibration	Simultaneous operation of equipment within a small distance of each other is to be avoided where the activity is close to the buildings. Where possible, the offset distance between the equipment and the specific location of the adjacent sensitive receivers is to be maximised. Weekly data assessment will be undertaken to ensure the equipment is not inducing excess vibration.

Table 15- Potential measures that may be implemented to control vibration at the equipment source

Where required, the vibration path control outlined in Table 16 could be implemented to reduce the vibration at the adjacent buildings. Adjustments to the vibration path as a control measure are only considered as a final measure after other mitigation options have been exhausted.

Action Required	*Applies*	*Details*
Introduction of open discontinuity between the source and the sensitive receiver.	Vibration	In extreme circumstances, open discontinuities that are positioned close to the sensitive receiver can be used to attenuate the level of vibration. The effectiveness of the discontinuity (cut) is related to the depth versus the proximity of the works or the receiver but may be of no benefit where the equipment is at significant depth or lies beneath the building. Where the works are undertaken at a distance more than twice the depth of the trench, the benefit is limited. The discontinuity must remain open and not filled with water

Table 16- Potential measures that may be implemented to control vibration path

22. REFERENCE DOCUMENTS

AS2187.2-2006, “Australian Standard Explosives Storage and Use of explosives”, Australian Standards, SAI Global

AS2436-2010, “Guide to noise and vibration control on construction, demolition and maintenance sites”, Australian Standards, SAI Global

BS7385-2: 1993, “British Standard Evaluation and measurement for vibration in buildings Part 2: Guide to damage levels from ground borne vibration”

DECC 2006 Department of Environment and Conservation for New South Wales (NSW). “Assessing vibration: A technical guideline”

DIN4150-3:2016, “Structural vibration Part 3: Effect of vibration on structures”, German Standards ICS91.120.25

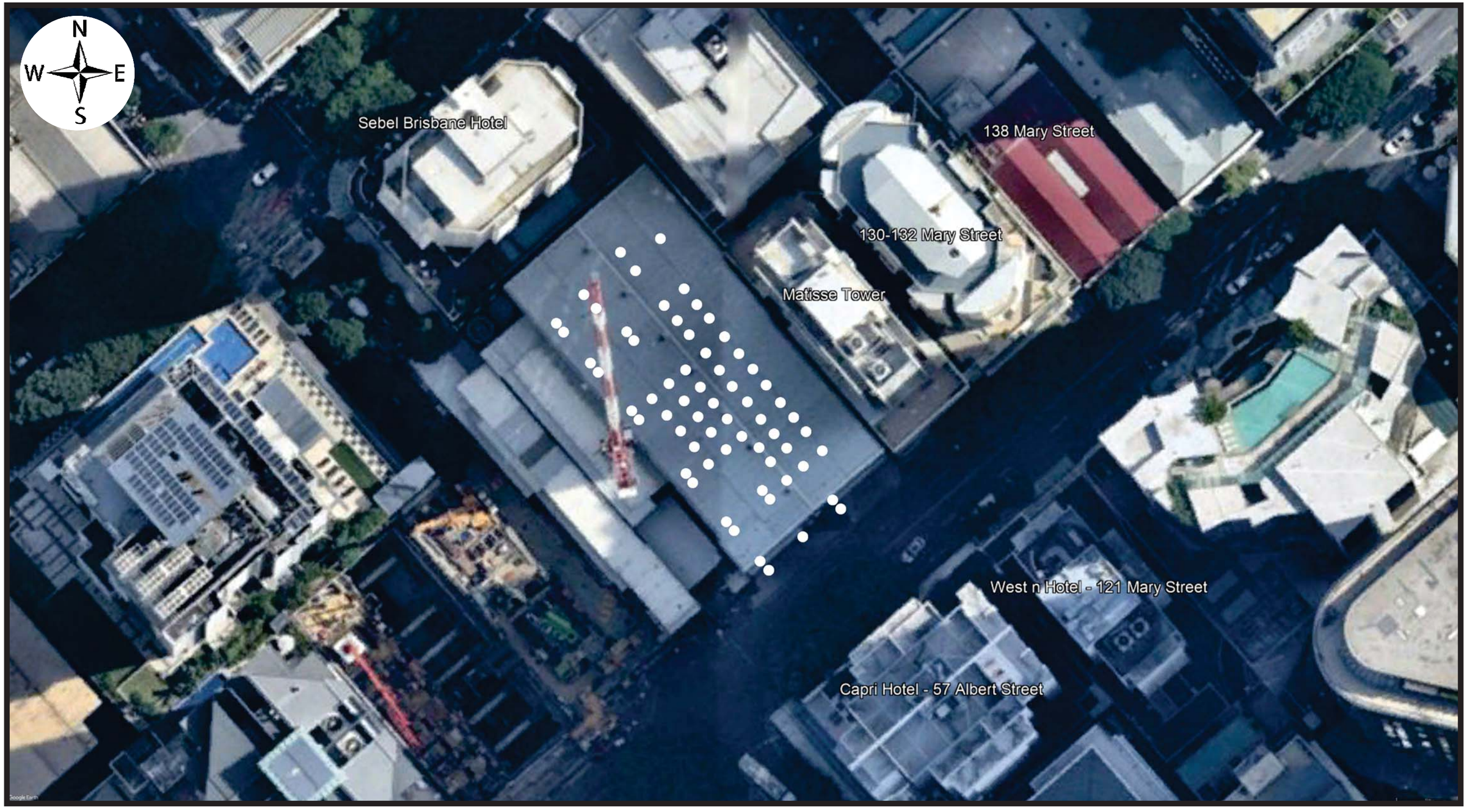
23. COMPLETED

The above assessment has been prepared by John Heilig (RPEQ 6304) of Heilig & Partners consulting engineers. In preparing this assessment, HP have made certain assumptions. We have assumed that all information and documents provided to us by RPC or as a result of a specific request were complete, accurate and up to date. Where we have obtained information from a Government register or database, we have assumed that the information is accurate. Where an assumption has been made, we have not made any independent investigations with respect to the matters the subject of that assumption. We are not aware why any of the assumptions are incorrect.

Dr. John Heilig (RPEQ6304)



24. APPENDIX A – MODELLING ASSESSMENT FOR ABOVE GROUND BUILDINGS



Created using TunnelTRAP Software

SCALE

0 5 10 15 20 25m

Surface Vibration Levels

- 2 mm/s Vibration Contour
- 5 mm/s Vibration Contour
- 10 mm/s Vibration Contour
- 15 mm/s Vibration Contour
- 20 mm/s Vibration Contour
- 50 mm/s Vibration Contour

PROJECT DESCRIPTION Albert St Works - Modelled vibration levels and associated vibration contours from piling activities at RL-5. Vibration contours are shown at RL4 and represent maximum expected values at the surface.

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QIC

Plate No. C

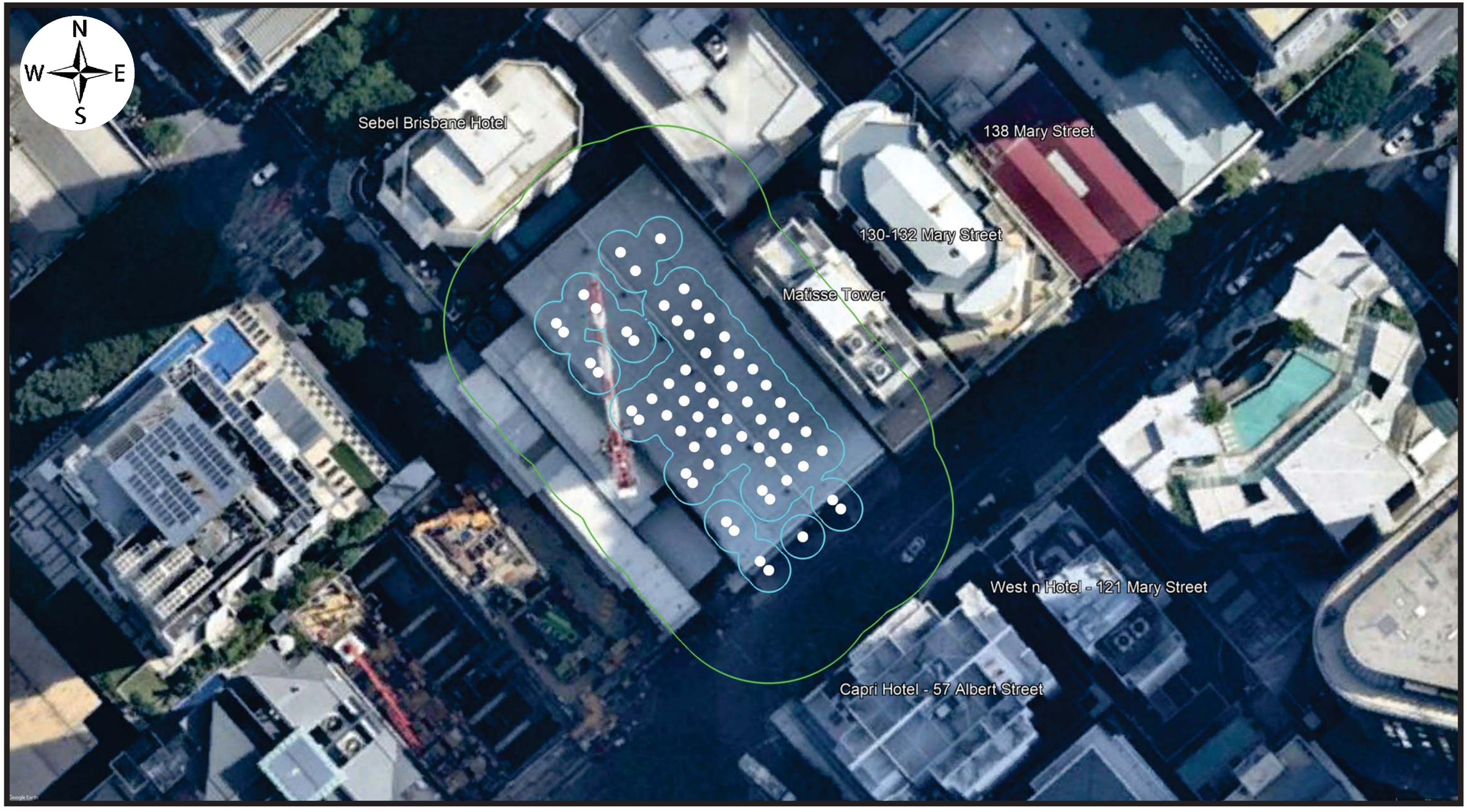
Revision History
R1: Original

Date Drawn: 2 April 2024

Ref No: Albert St Works

Job No: HP2305-2

In preparing this drawing, HP have made certain assumptions. We have assumed that all information and documents provided to us by the Client or as a result of a specific request were complete, accurate and up to date. Where we have obtained information from a Government register or database, we have assumed that the information is accurate. Where an assumption has been made, we have not made any independent investigations with respect to the matters the subject of that assumption. We are not aware why any of the assumptions are incorrect.



Created using TunnelTRAP Software

SCALE

0 5 10 15 20 25m

RL 4 Vibration Levels

- 2 mm/s Vibration Contour
- 5 mm/s Vibration Contour
- 10 mm/s Vibration Contour
- 15 mm/s Vibration Contour
- 20 mm/s Vibration Contour
- 50 mm/s Vibration Contour

PROJECT DESCRIPTION Albert St Works - Modelled vibration levels and associated vibration contours from vibratory piling activities at RL-5. Vibration contours are shown at RL4 and represent maximum expected values at the surface.

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Plate No. I

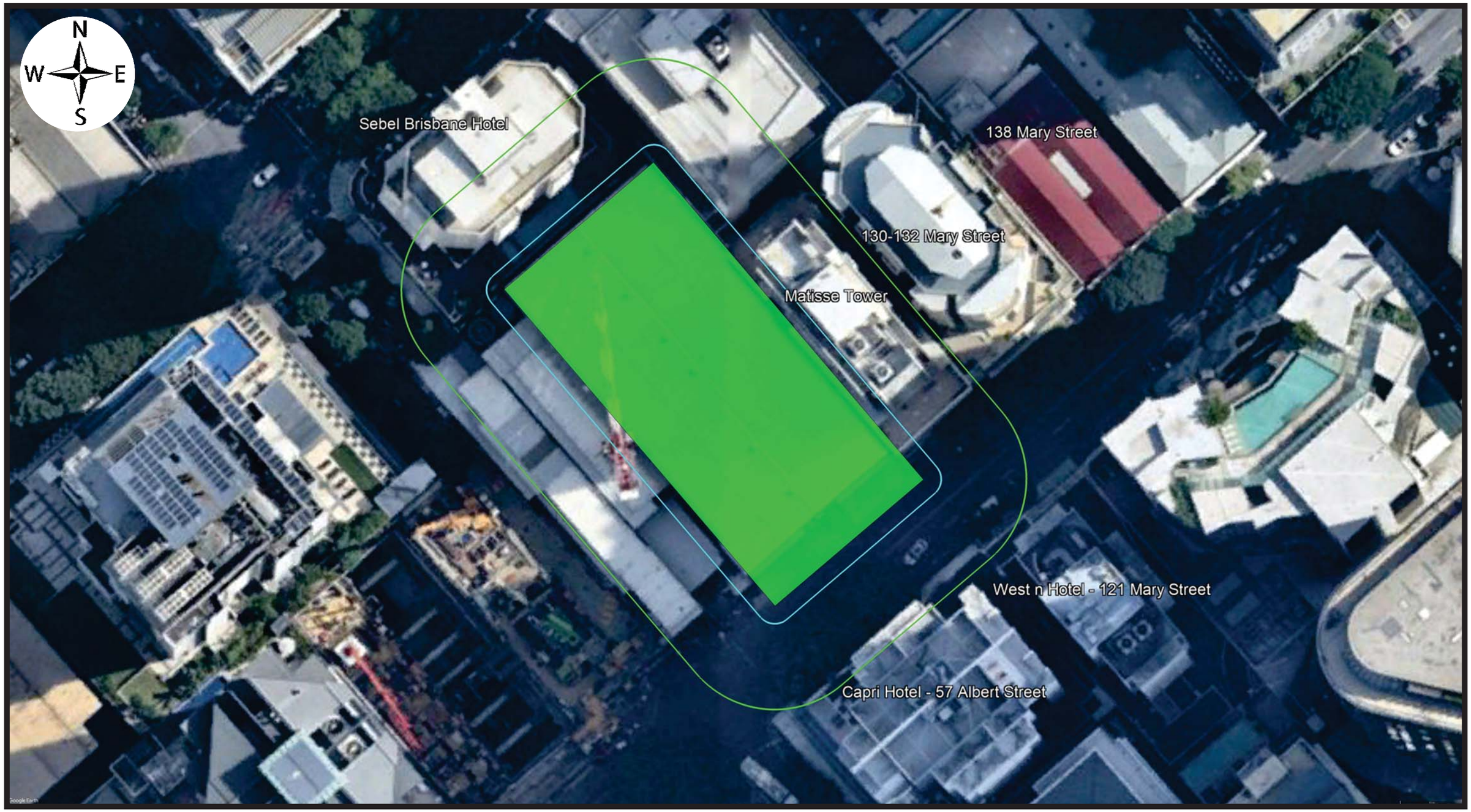
Revision History
R1: Original

Date Drawn: 2 April 2024

Ref No: Albert St Works

Job No: HP2305-2

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Created using TunnelTRAP Software

Modelled works area

SCALE

0 5 10 15 20 25m

RL 4 Vibration Levels

- 2 mm/s Vibration Contour
- 5 mm/s Vibration Contour
- 10 mm/s Vibration Contour
- 15 mm/s Vibration Contour
- 20 mm/s Vibration Contour
- 50 mm/s Vibration Contour

PROJECT DESCRIPTION Albert St Works - Modelled vibration levels and associated vibration contours from basement excavation with a 2000kg hydraulic hammer at RL-5. Vibration contours are shown at RL4 and represent maximum expected values at the surface.

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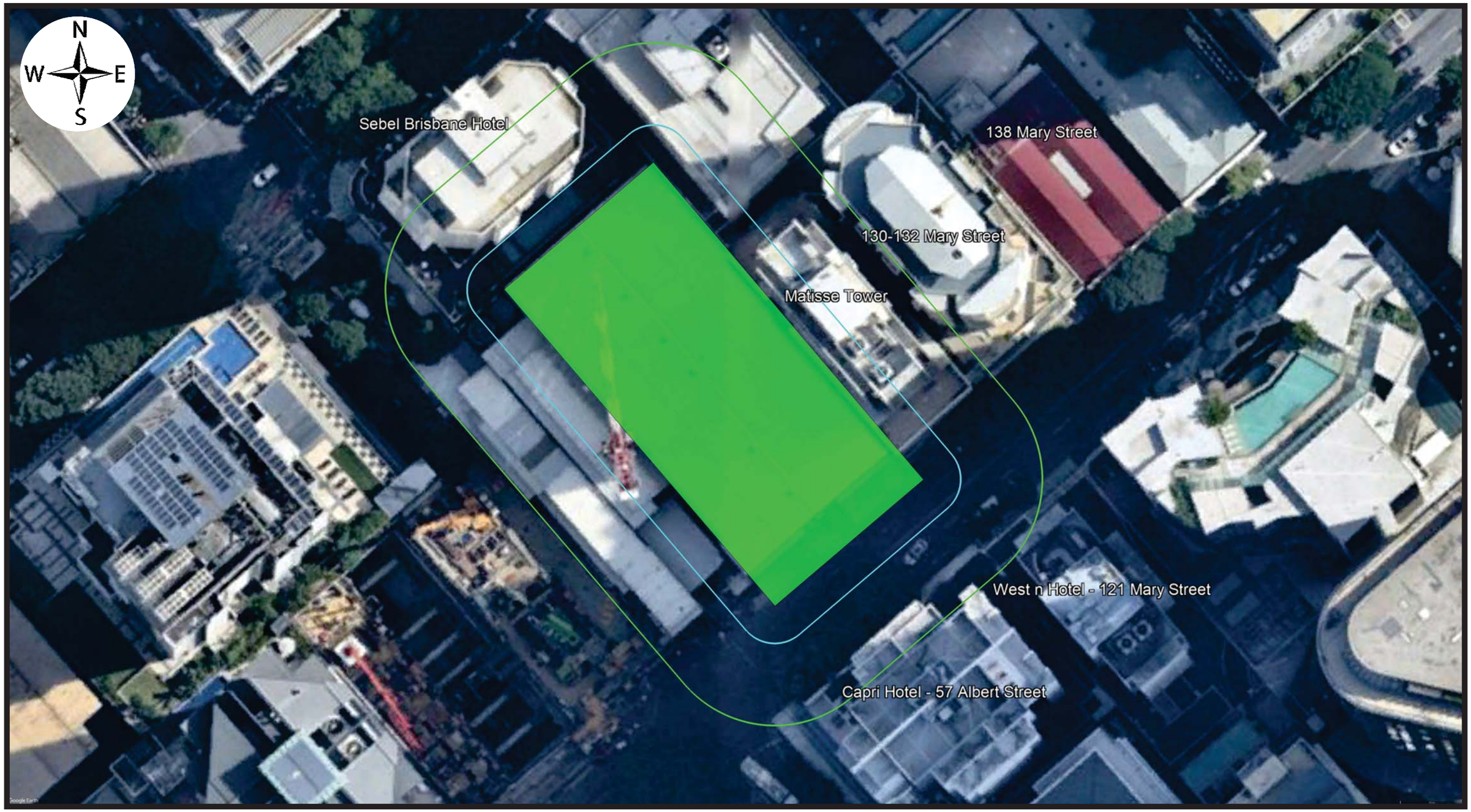
Revision History
R1: Original

Date Drawn: 2 April 2024

Ref No: Albert St Works

Job No: HP2305-2

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Modelled works area

SCALE

0 5 10 15 20 25m

RL 4 Vibration Levels

- 2 mm/s Vibration Contour
- 5 mm/s Vibration Contour
- 10 mm/s Vibration Contour
- 15 mm/s Vibration Contour
- 20 mm/s Vibration Contour
- 50 mm/s Vibration Contour

PROJECT DESCRIPTION Albert St Works - Modelled vibration levels and associated vibration contours from basement excavation with a 3500kg hydraulic hammer at RL-5. Vibration contours are shown at RL4 and represent maximum expected values at the surface.

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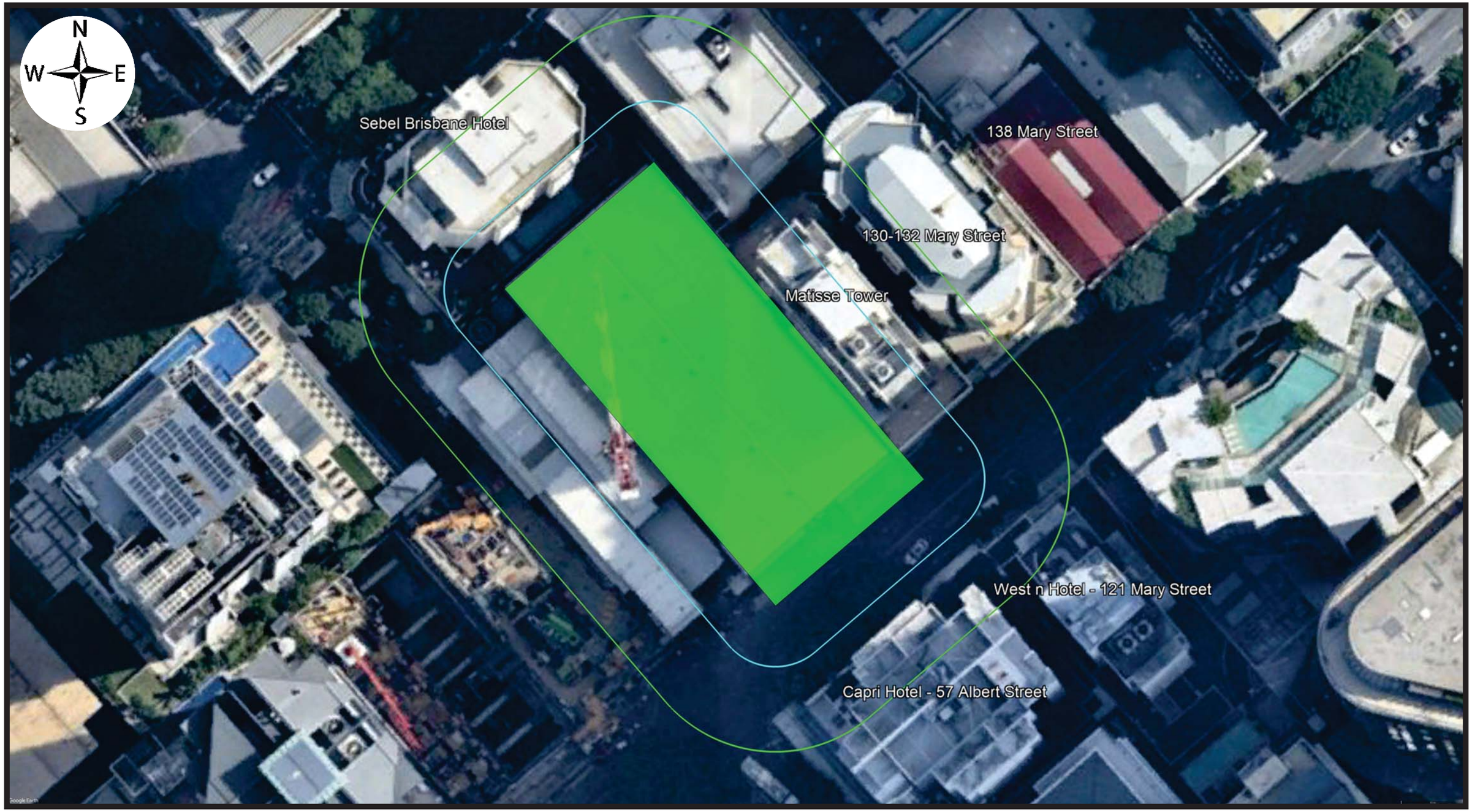
Revision History
R1: Original

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Job No: HP2305-2

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Modelled works area

SCALE

0 5 10 15 20 25m

RL 4 Vibration Levels

- 2 mm/s Vibration Contour
- 5 mm/s Vibration Contour
- 10 mm/s Vibration Contour
- 15 mm/s Vibration Contour
- 20 mm/s Vibration Contour
- 50 mm/s Vibration Contour

PROJECT DESCRIPTION Albert St Works - Modelled vibration levels and associated vibration contours from basement excavation with a 7000kg hydraulic hammer at RL-5. Vibration contours are shown at RL4 and represent maximum expected values at the surface.

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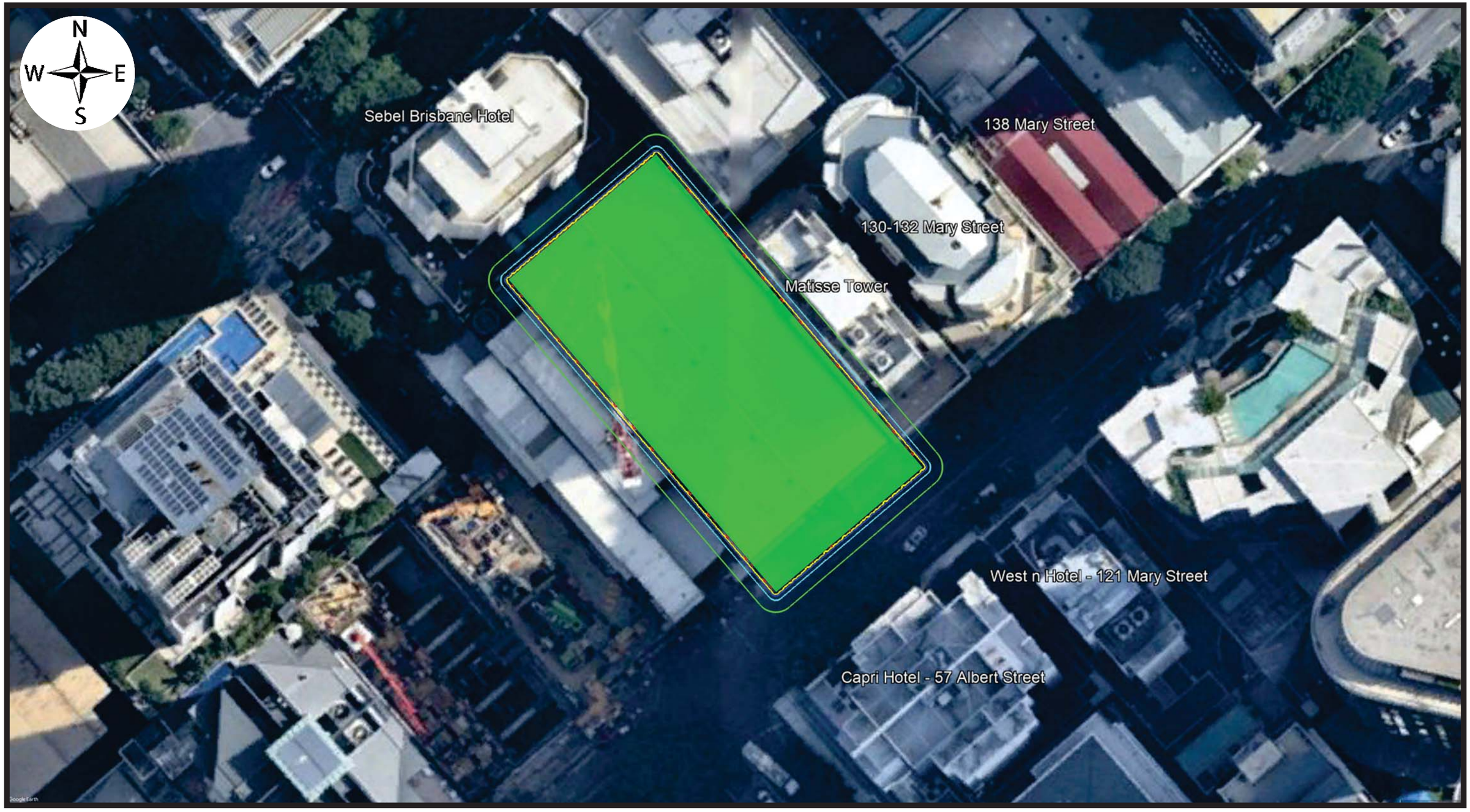
Revision History
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Job No: HP2305-2

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Modelled works area

SCALE

0 5 10 15 20 25m

Surface Vibration Levels

- 2 mm/s Vibration Contour
- 5 mm/s Vibration Contour
- 10 mm/s Vibration Contour
- 15 mm/s Vibration Contour
- 20 mm/s Vibration Contour
- 50 mm/s Vibration Contour

PROJECT DESCRIPTION Albert St Works - Modelled vibration levels and associated vibration contours from basement excavation with a 35t excavator at RL-5. Vibration contours are shown at RL4 and represent maximum expected values at the surface.

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Revision History
R1: Original

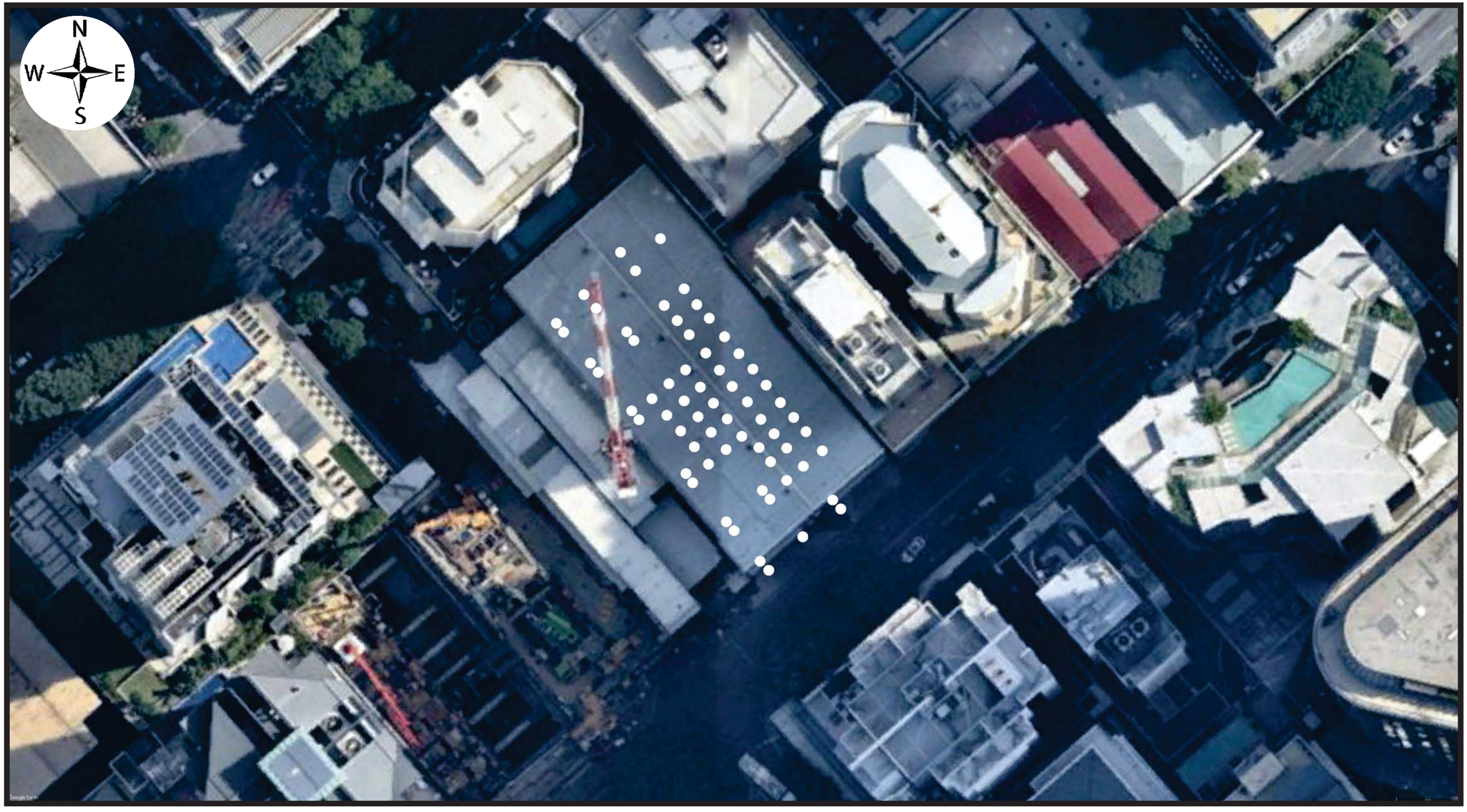
Date Drawn: 2 April 2024

Ref No: Albert St Works

Job No: HP2305-2

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25. APPENDIX B – MODELLING ASSESSMENT FOR CROSS RIVER RAIL ASSETS



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SCALE

0 5 10 15 20 25m

RL-12.9 Vibration Levels

- 2 mm/s Vibration Contour
- 5 mm/s Vibration Contour
- 10 mm/s Vibration Contour
- 15 mm/s Vibration Contour
- 20 mm/s Vibration Contour
- 50 mm/s Vibration Contour

PROJECT DESCRIPTION Albert St Works - Modelled vibration levels and associated vibration contours from piling activities at RL-5. Vibration contours are shown at RL-12.9 and represent maximum expected values at the tunnel crown.

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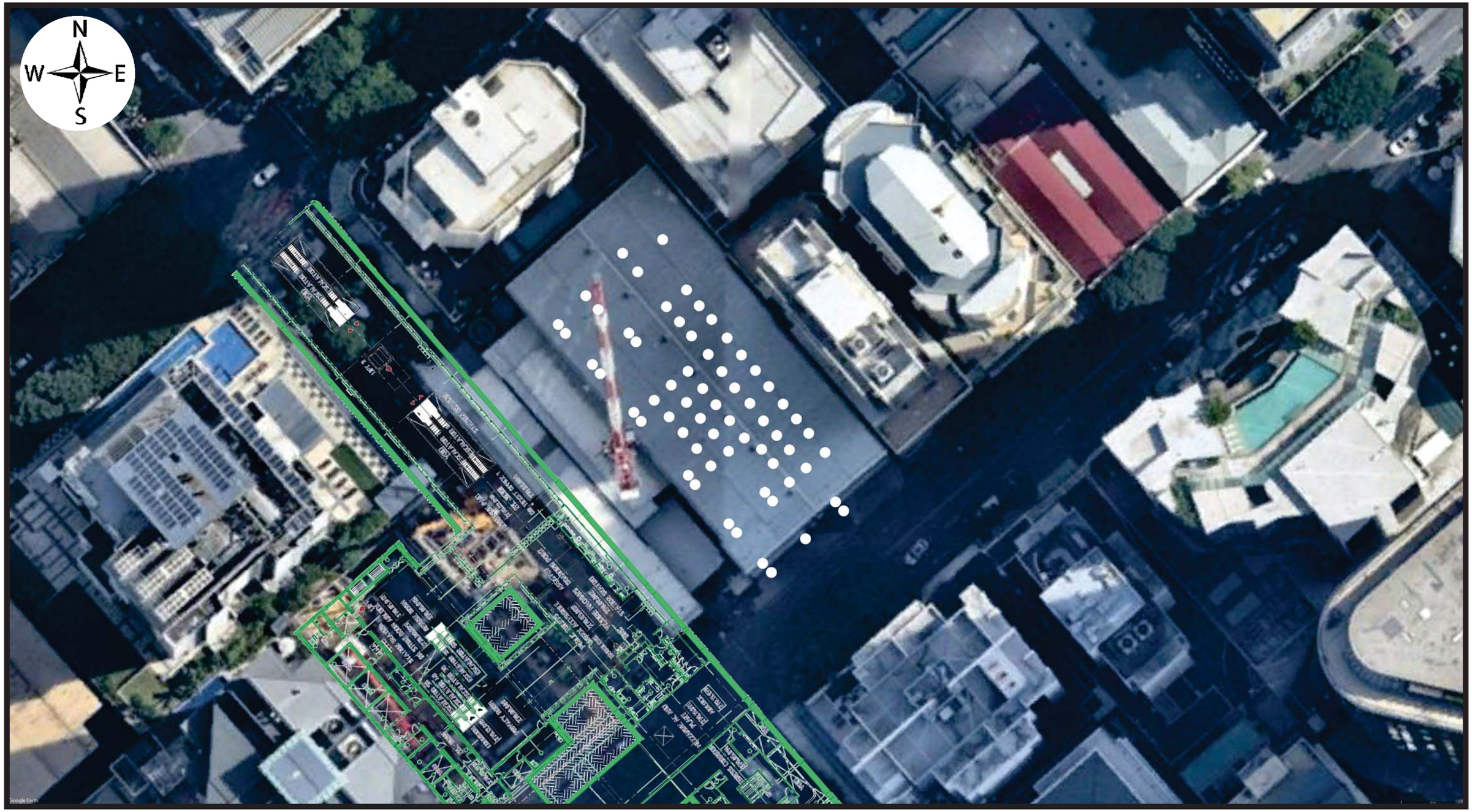
Revision History
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SCALE

0 5 10 15 20 25m

RL-21.5 Vibration Levels

- 2 mm/s Vibration Contour
- 5 mm/s Vibration Contour
- 10 mm/s Vibration Contour
- 15 mm/s Vibration Contour
- 20 mm/s Vibration Contour
- 50 mm/s Vibration Contour

PROJECT DESCRIPTION Albert St Works - Modelled vibration levels and associated vibration contours from piling activities at RL-5. Vibration contours are shown at RL-21.5 and represent maximum expected values at the Albert Street Station Mezzanine.

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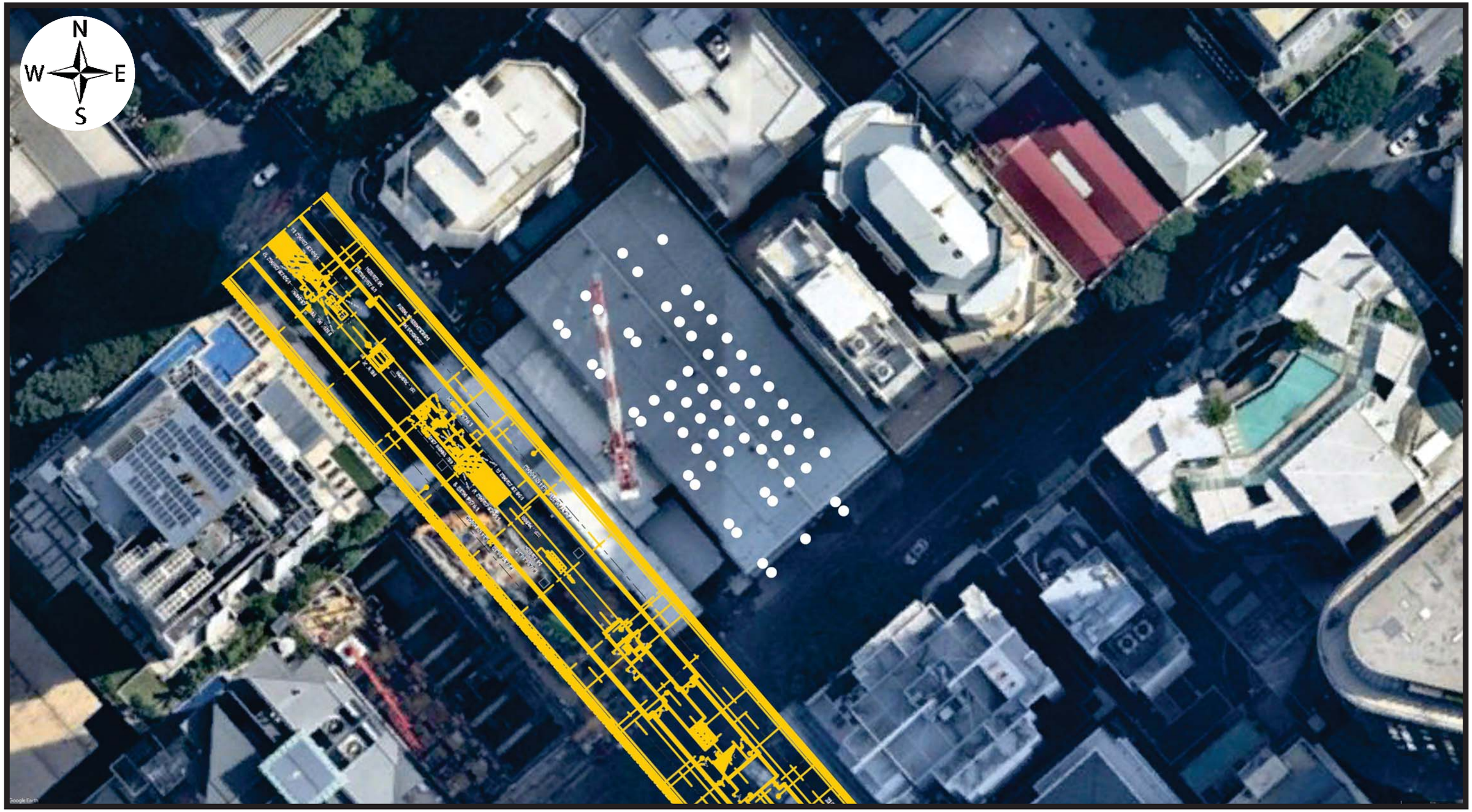
Revision History
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SCALE

0 5 10 15 20 25m

RL-28 Vibration Levels

- 2 mm/s Vibration Contour
- 5 mm/s Vibration Contour
- 10 mm/s Vibration Contour
- 15 mm/s Vibration Contour
- 20 mm/s Vibration Contour
- 50 mm/s Vibration Contour

PROJECT DESCRIPTION Albert St Works - Modelled vibration levels and associated vibration contours from piling activities at RL-5. Vibration contours are shown at RL-28 and represent maximum expected values at the Albert Street Station Platform.

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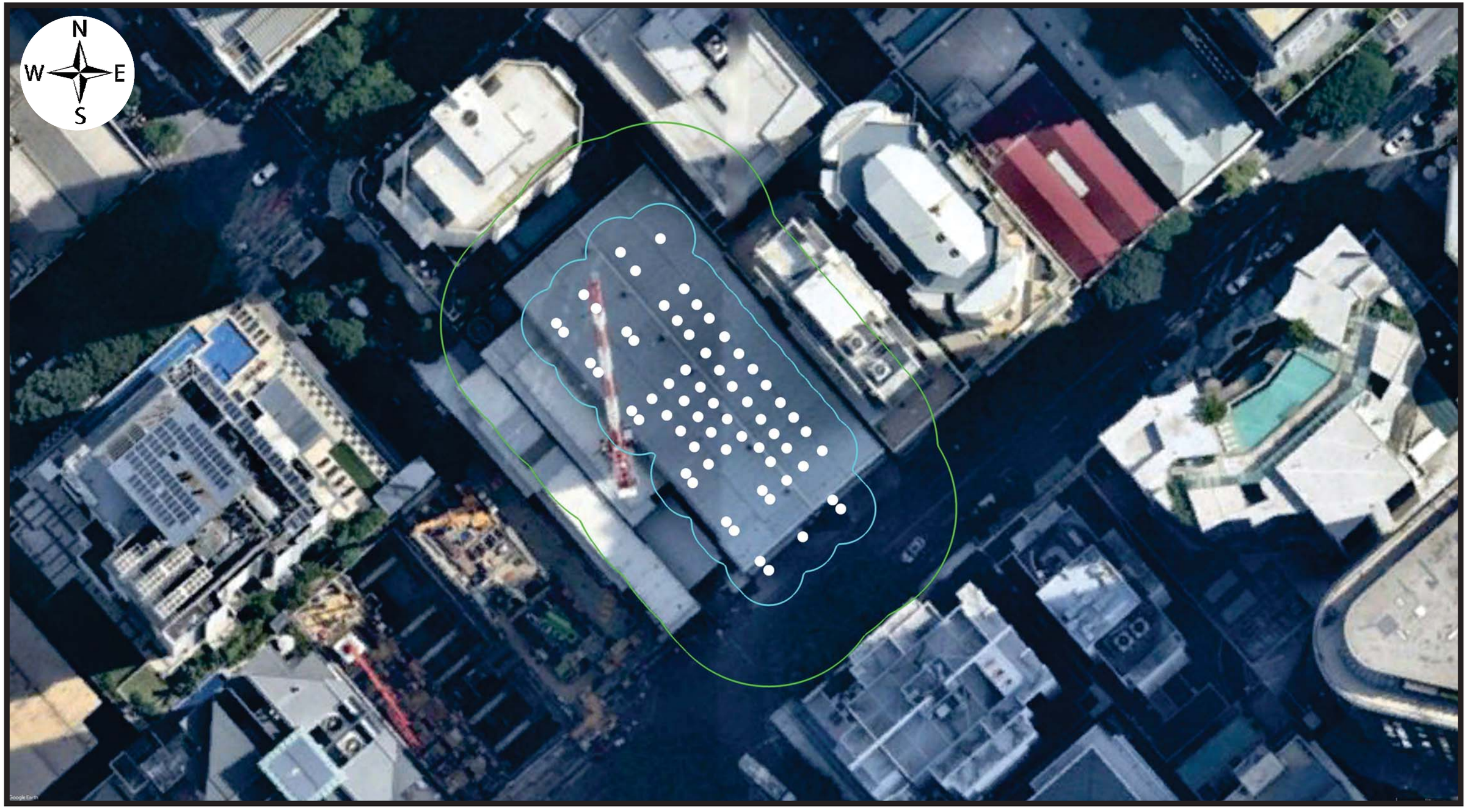
Revision History
R1: Original

Date Drawn: 2 April 2024

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Job No: HP2305-2

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SCALE

0 5 10 15 20 25m

RL -12.9 Vibration Levels

- 2 mm/s Vibration Contour
- 5 mm/s Vibration Contour
- 10 mm/s Vibration Contour
- 15 mm/s Vibration Contour
- 20 mm/s Vibration Contour
- 50 mm/s Vibration Contour

PROJECT DESCRIPTION Albert St Works - Modelled vibration levels and associated vibration contours from vibratory piling activities at RL-5. Vibration contours are shown at RL-12.9 and represent maximum expected values at the tunnel crown.

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Plate No. J

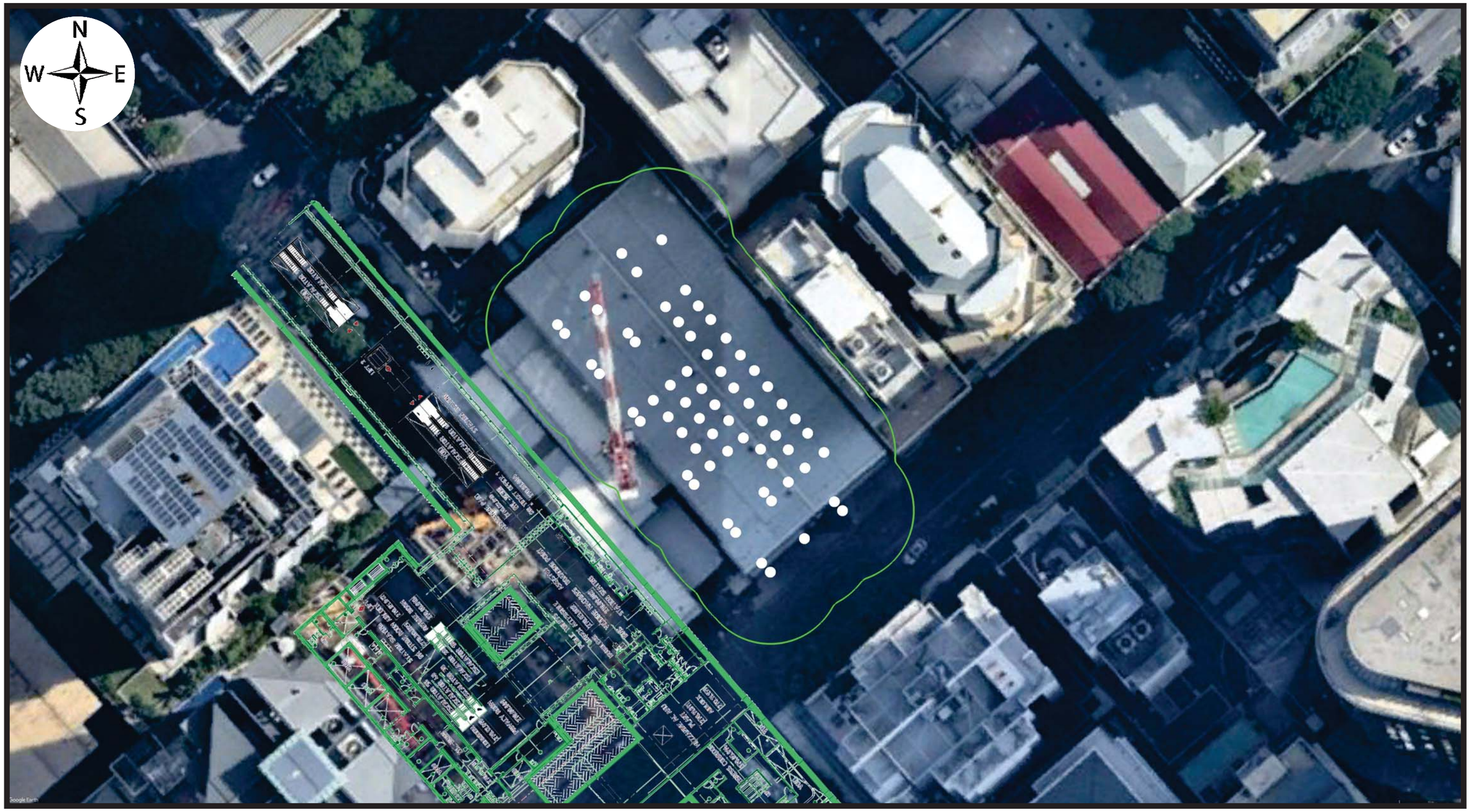
Revision History
R1: Original

Date Drawn: 2 April 2024

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Job No: HP2305-2

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SCALE

0 5 10 15 20 25m

RL -21.5 Vibration Levels

- 2 mm/s Vibration Contour
- 5 mm/s Vibration Contour
- 10 mm/s Vibration Contour
- 15 mm/s Vibration Contour
- 20 mm/s Vibration Contour
- 50 mm/s Vibration Contour

PROJECT DESCRIPTION Albert St Works - Modelled vibration levels and associated vibration contours from vibratory piling activities at RL-5. Vibration contours are shown at RL-21.5 and represent maximum expected values at the Albert Street Station Mezzanine.

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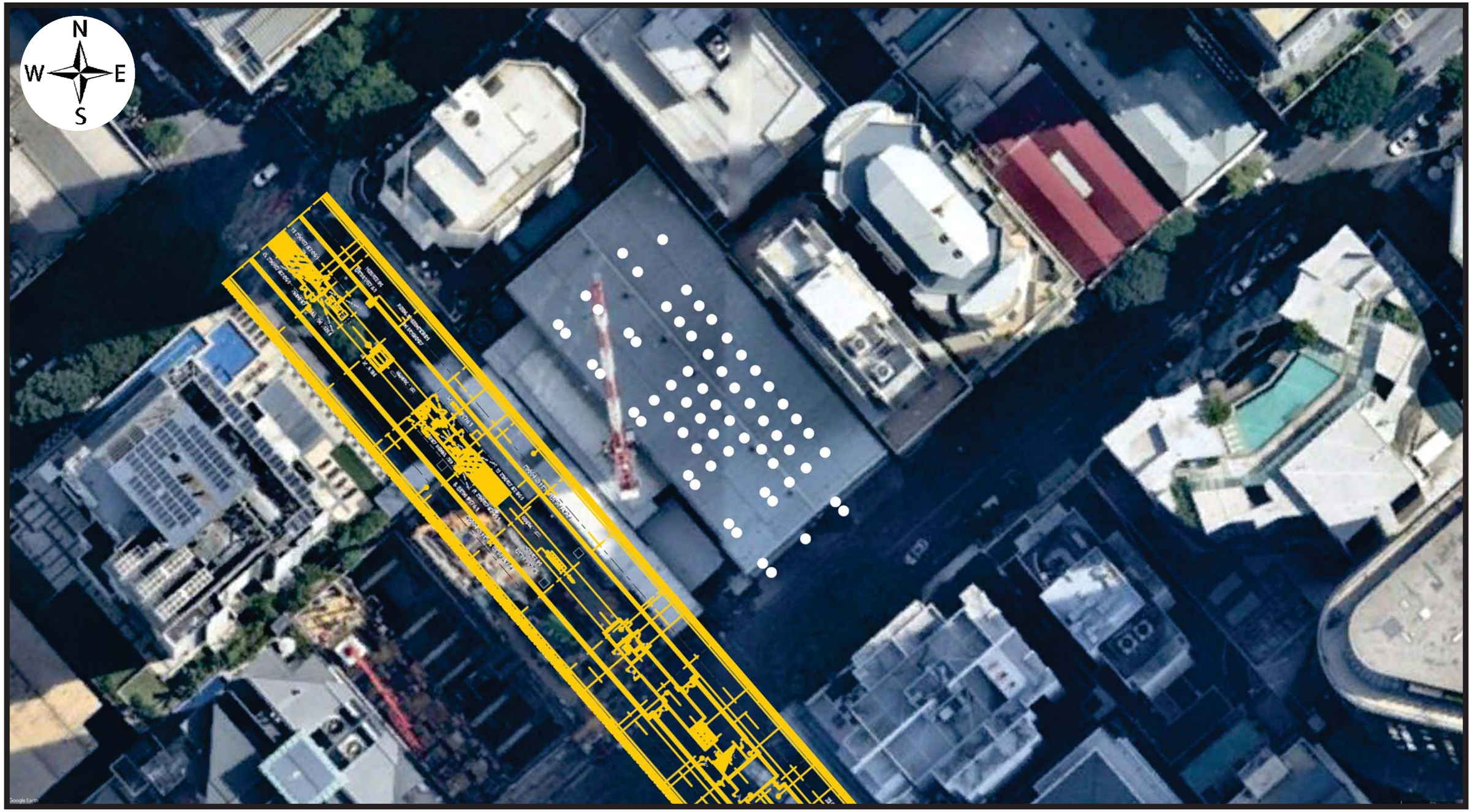
Revision History
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Job No: HP2305-2

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SCALE

0 5 10 15 20 25m

RL -28 Vibration Levels

- 2 mm/s Vibration Contour
- 5 mm/s Vibration Contour
- 10 mm/s Vibration Contour
- 15 mm/s Vibration Contour
- 20 mm/s Vibration Contour
- 50 mm/s Vibration Contour

PROJECT DESCRIPTION Albert St Works - Modelled vibration levels and associated vibration contours from vibratory piling activities at RL-5. Vibration contours are shown at RL-28 and represent maximum expected values at the Albert Street Station Platform.

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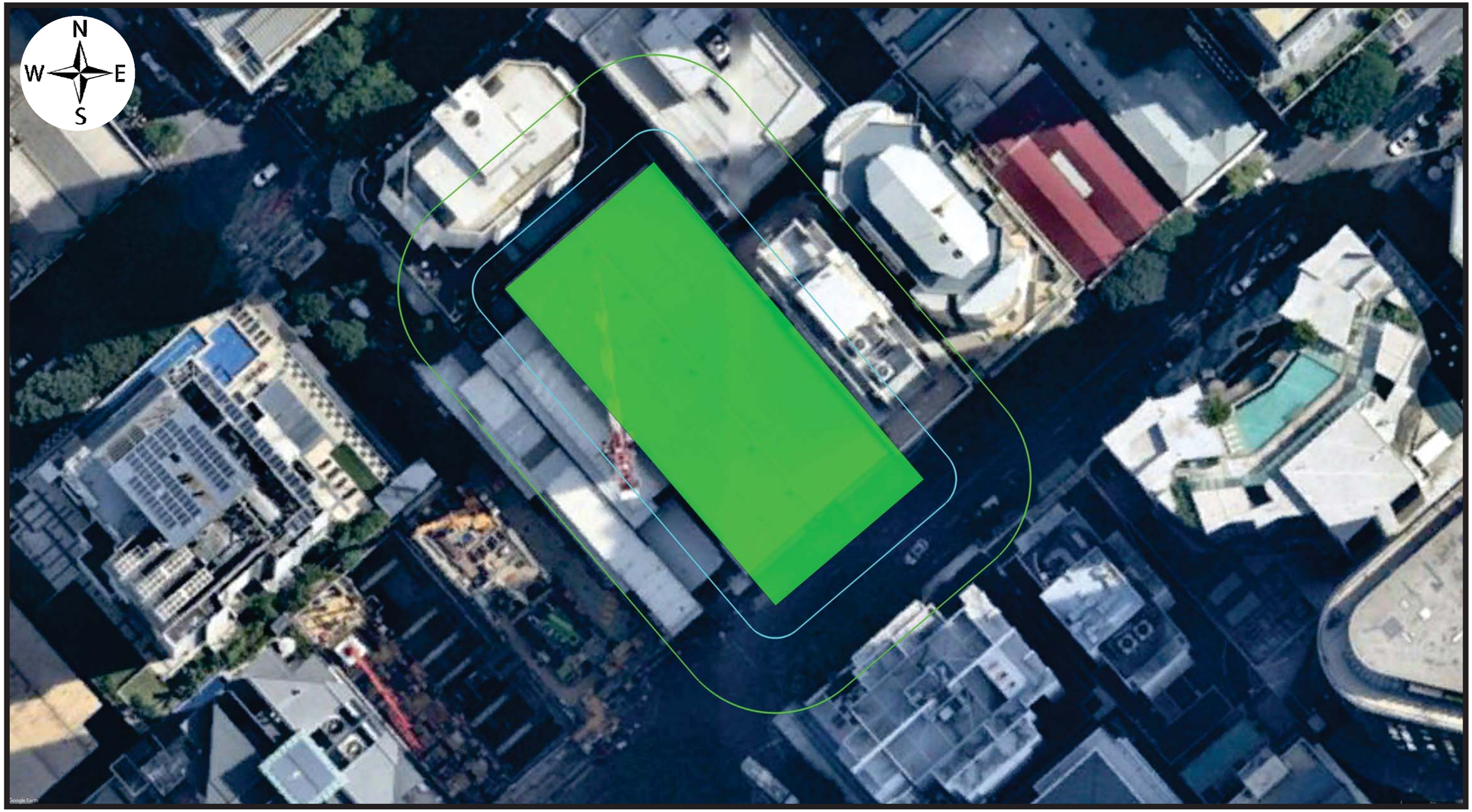
Revision History
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Modelled works area

SCALE

0 5 10 15 20 25m

RL -12.9 Vibration Levels

- 2 mm/s Vibration Contour
- 5 mm/s Vibration Contour
- 10 mm/s Vibration Contour
- 15 mm/s Vibration Contour
- 20 mm/s Vibration Contour
- 50 mm/s Vibration Contour

PROJECT DESCRIPTION Albert St Works - Modelled vibration levels and associated vibration contours from basement excavation with a 2000kg hydraulic hammer at RL-5. Vibration contours are shown at RL-12.9 and represent maximum expected values at the tunnel crown.

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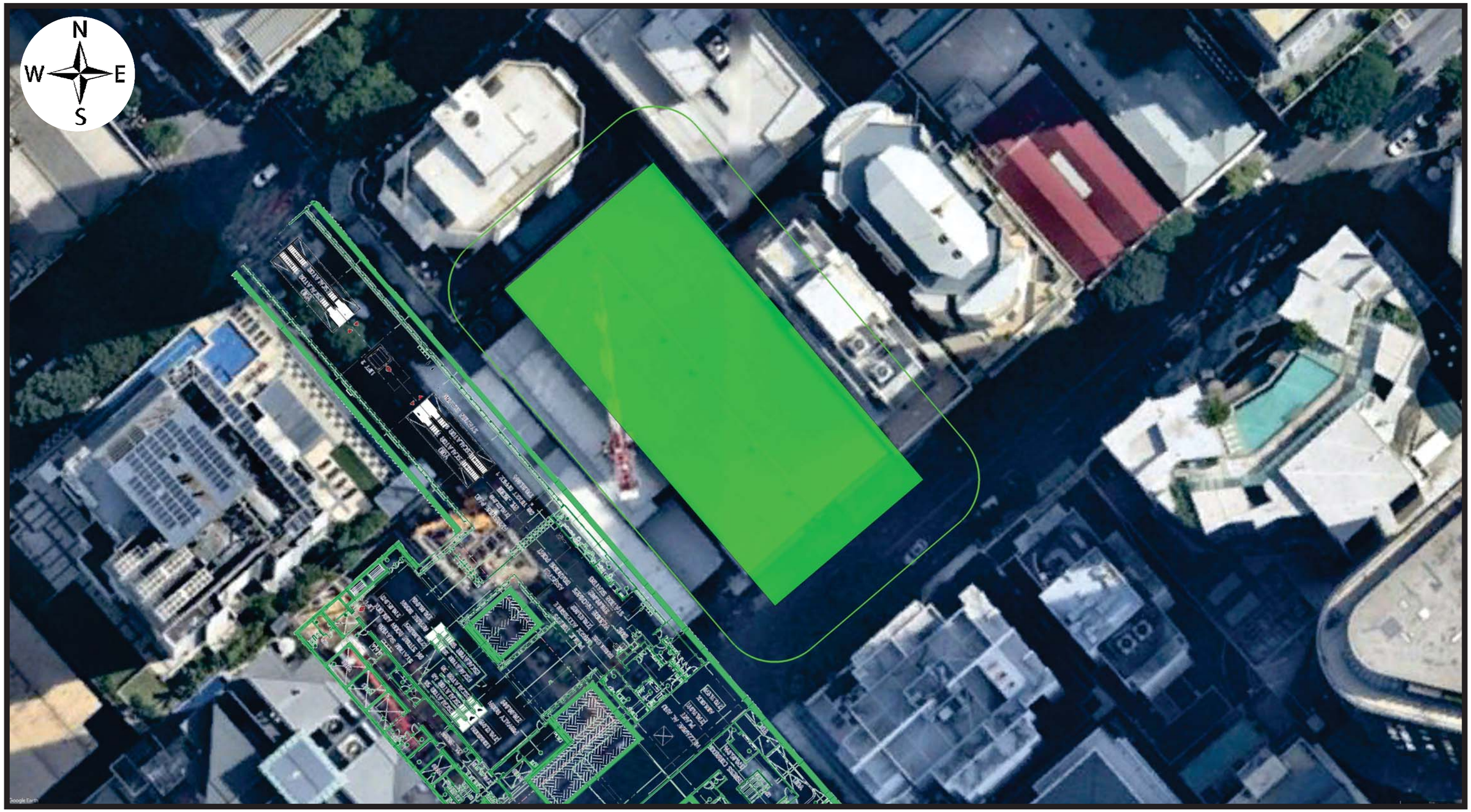
Revision History
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Modelled works area

SCALE

0 5 10 15 20 25m

RL -21.5 Vibration Levels

- 2 mm/s Vibration Contour
- 5 mm/s Vibration Contour
- 10 mm/s Vibration Contour
- 15 mm/s Vibration Contour
- 20 mm/s Vibration Contour
- 50 mm/s Vibration Contour

PROJECT DESCRIPTION Albert St Works - Modelled vibration levels and associated vibration contours from basement excavation with a 2000kg hydraulic hammer at RL-5. Vibration contours are shown at RL-21.5 and represent maximum expected values at the Albert Street Station Mezzanine.

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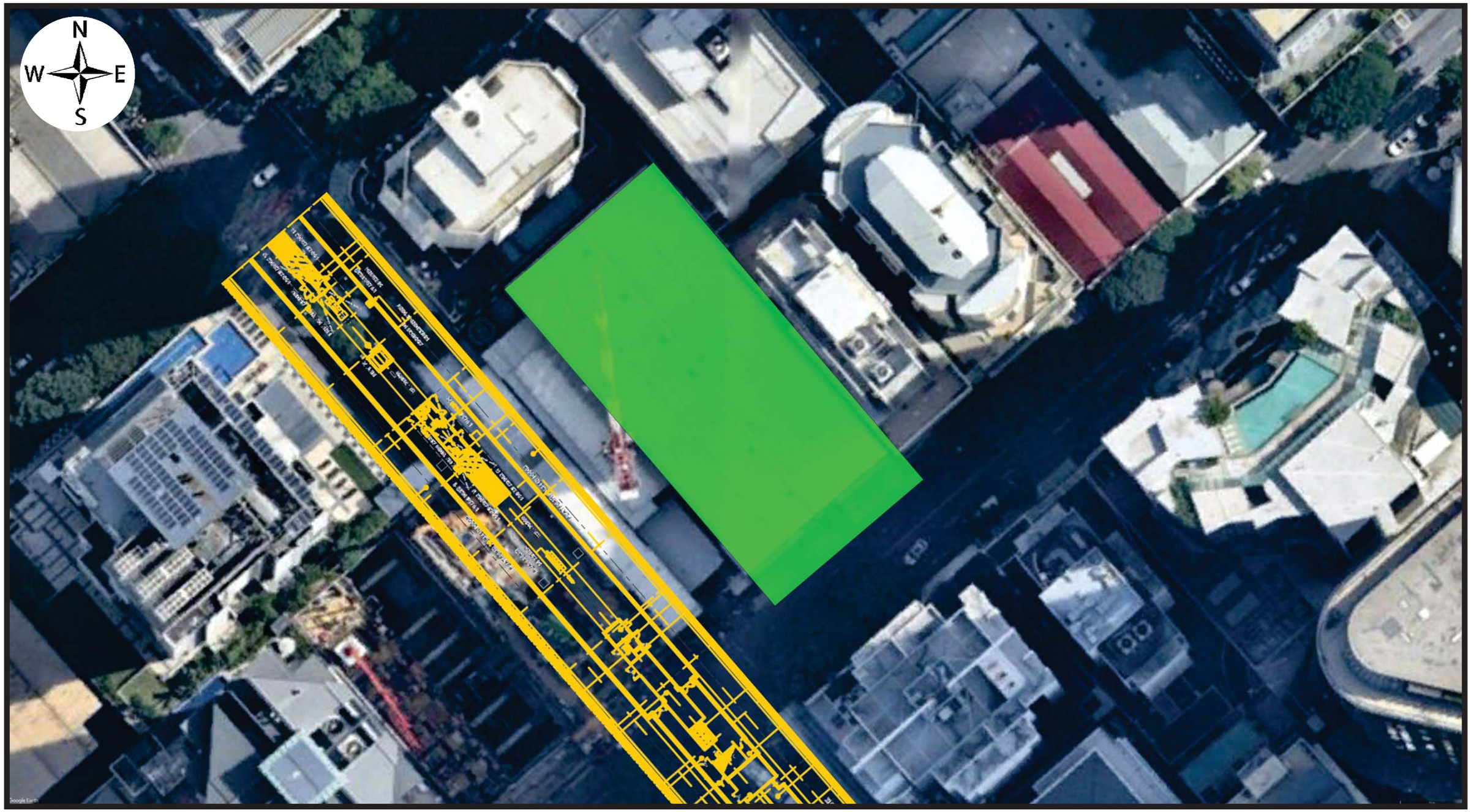
Date Drawn: 2 April 2024

Revision History
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Modelled works area

SCALE

0 5 10 15 20 25m

RL -28 Vibration Levels

- 2 mm/s Vibration Contour
- 5 mm/s Vibration Contour
- 10 mm/s Vibration Contour
- 15 mm/s Vibration Contour
- 20 mm/s Vibration Contour
- 50 mm/s Vibration Contour

PROJECT DESCRIPTION Albert St Works - Modelled vibration levels and associated vibration contours from basement excavation with a 2000kg hydraulic hammer at RL-5. Vibration contours are shown at RL-28 and represent maximum expected values at the Albert Street Station Platform.

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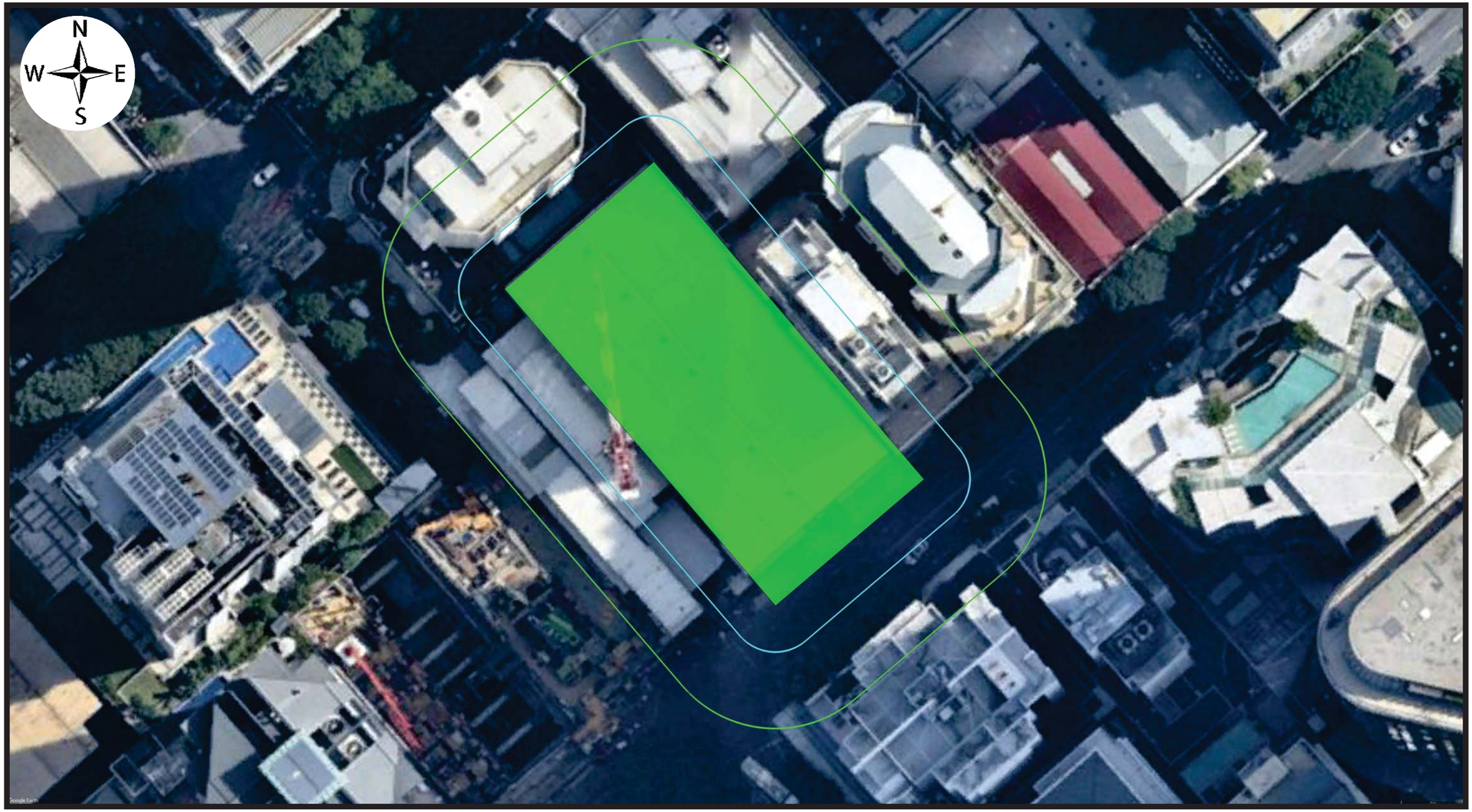
Revision History
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Modelled works area

SCALE

0 5 10 15 20 25m

RL -12.9 Vibration Levels

- 2 mm/s Vibration Contour
- 5 mm/s Vibration Contour
- 10 mm/s Vibration Contour
- 15 mm/s Vibration Contour
- 20 mm/s Vibration Contour
- 50 mm/s Vibration Contour

PROJECT DESCRIPTION Albert St Works - Modelled vibration levels and associated vibration contours from basement excavation with a 3500kg hydraulic hammer at RL-5. Vibration contours are shown at RL-12.9 and represent maximum expected values at the tunnel crown.

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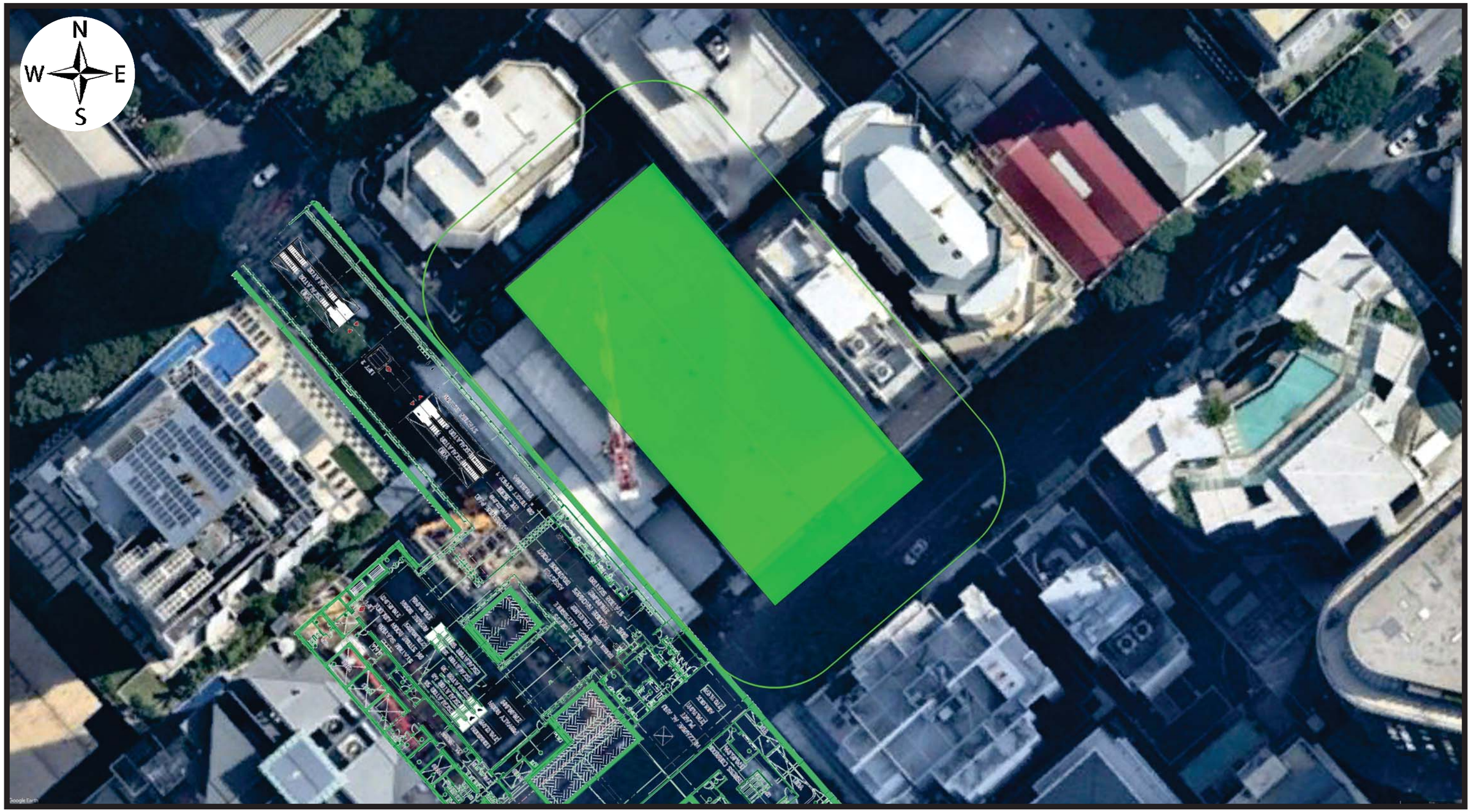
Revision History
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Modelled works area

SCALE

0 5 10 15 20 25m

RL -21.5 Vibration Levels

- 2 mm/s Vibration Contour
- 5 mm/s Vibration Contour
- 10 mm/s Vibration Contour
- 15 mm/s Vibration Contour
- 20 mm/s Vibration Contour
- 50 mm/s Vibration Contour

PROJECT DESCRIPTION Albert St Works - Modelled vibration levels and associated vibration contours from basement excavation with a 3500kg hydraulic hammer at RL-5. Vibration contours are shown at RL-21.5 and represent maximum expected values at the Albert Street Mezannine.

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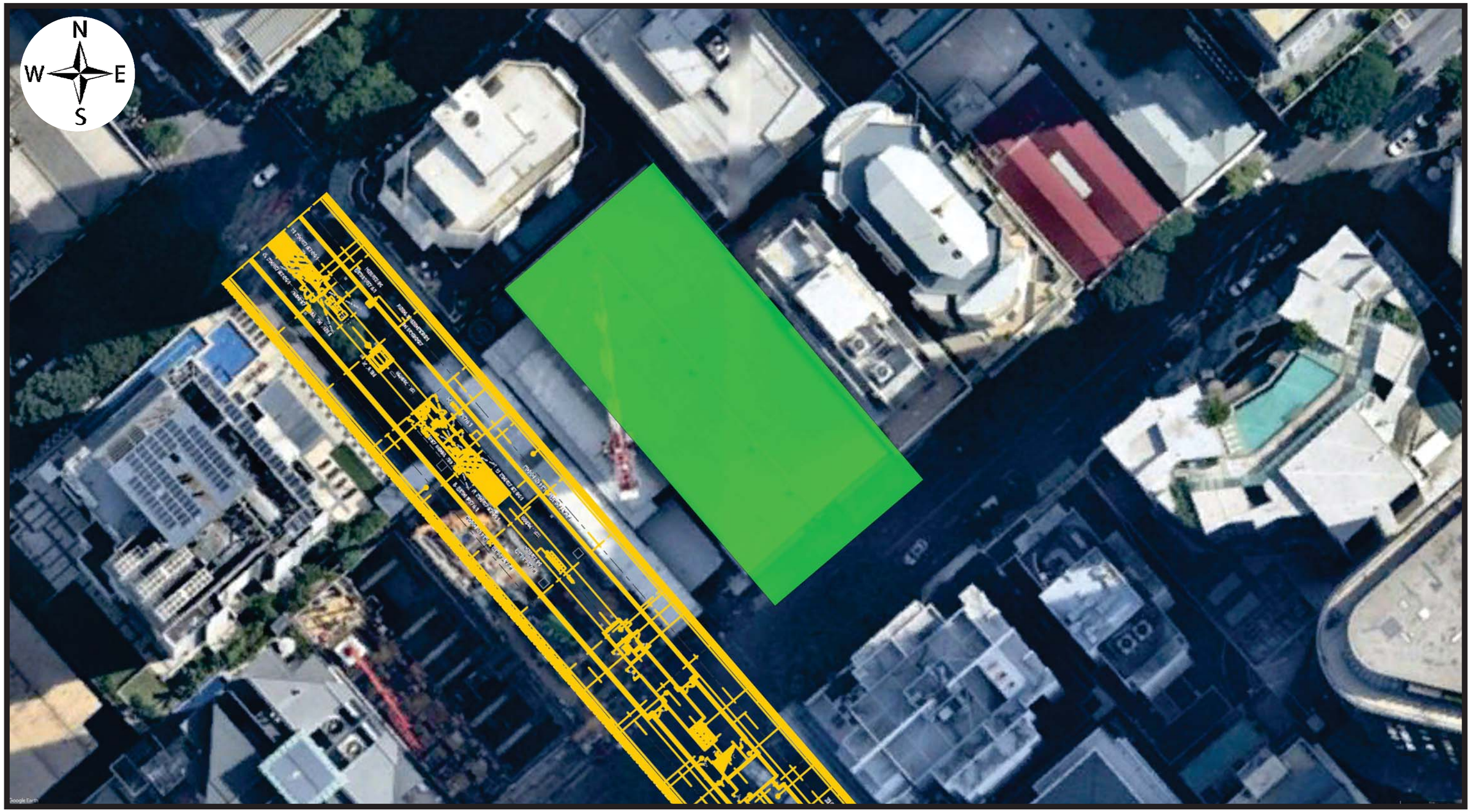
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Ref No: Albert St Works

Job No: HP2305-2

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Created using TunnelTRAP Software

Modelled works area

SCALE

0 5 10 15 20 25m

RL -28 Vibration Levels

- 2 mm/s Vibration Contour
- 5 mm/s Vibration Contour
- 10 mm/s Vibration Contour
- 15 mm/s Vibration Contour
- 20 mm/s Vibration Contour
- 50 mm/s Vibration Contour

PROJECT DESCRIPTION Albert St Works - Modelled vibration levels and associated vibration contours from basement excavation with a 3500kg hydraulic hammer at RL-5. Vibration contours are shown at RL-28 and represent maximum expected values at the Albert Street Station Platform.

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QIC

Plate No. X

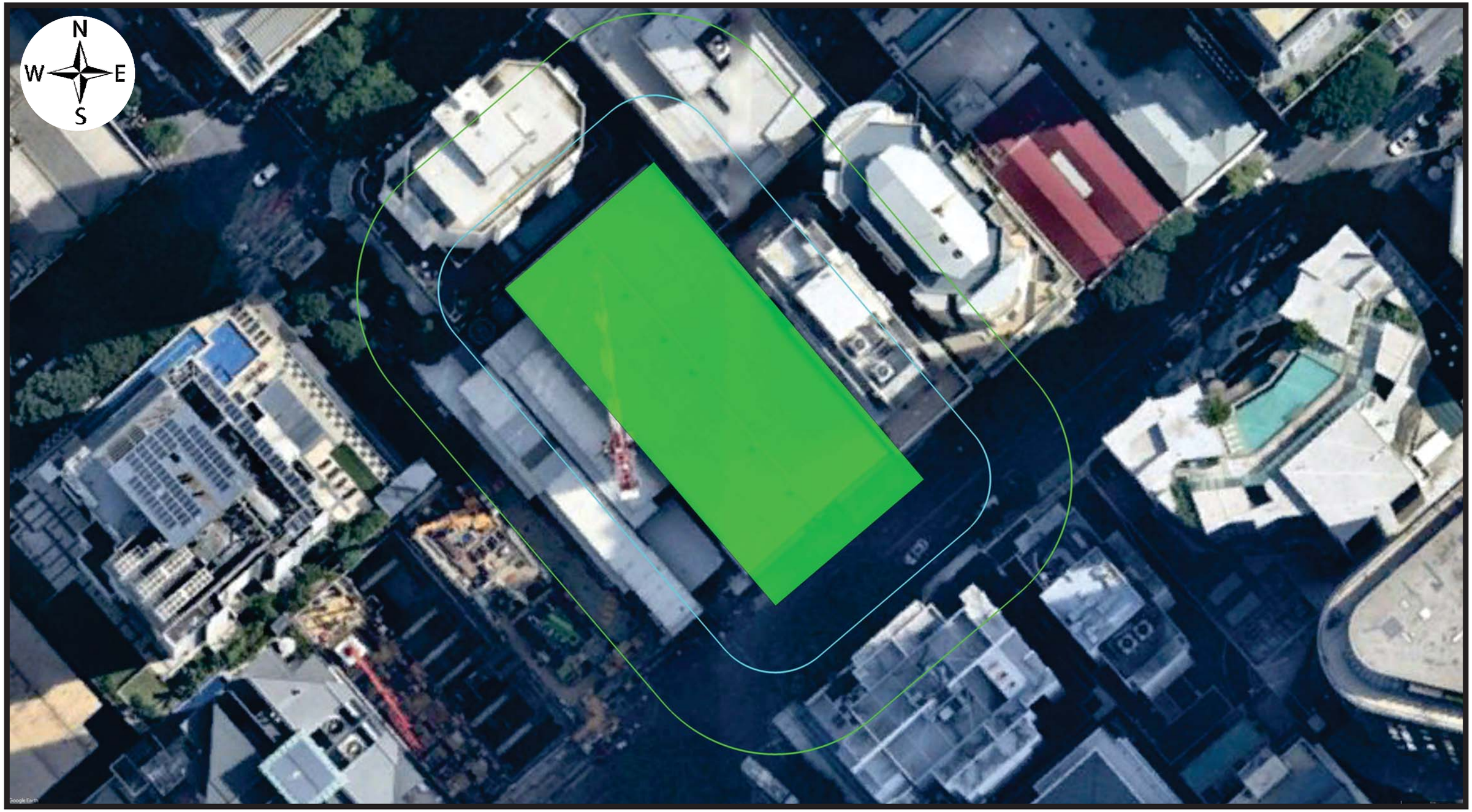
Revision History
R1: Original

Date Drawn: 2 April 2024

Ref No: Albert St Works

Job No: HP2305-2

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Created using TunnelTRAP Software

Modelled works area

SCALE

0 5 10 15 20 25m

RL -12.9 Vibration Levels

- 2 mm/s Vibration Contour
- 5 mm/s Vibration Contour
- 10 mm/s Vibration Contour
- 15 mm/s Vibration Contour
- 20 mm/s Vibration Contour
- 50 mm/s Vibration Contour

PROJECT DESCRIPTION Albert St Works - Modelled vibration levels and associated vibration contours from basement excavation with a 7000kg hydraulic hammer at RL-5. Vibration contours are shown at RL-12.9 and represent maximum expected values at the tunnel crown.

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Plate No. BB

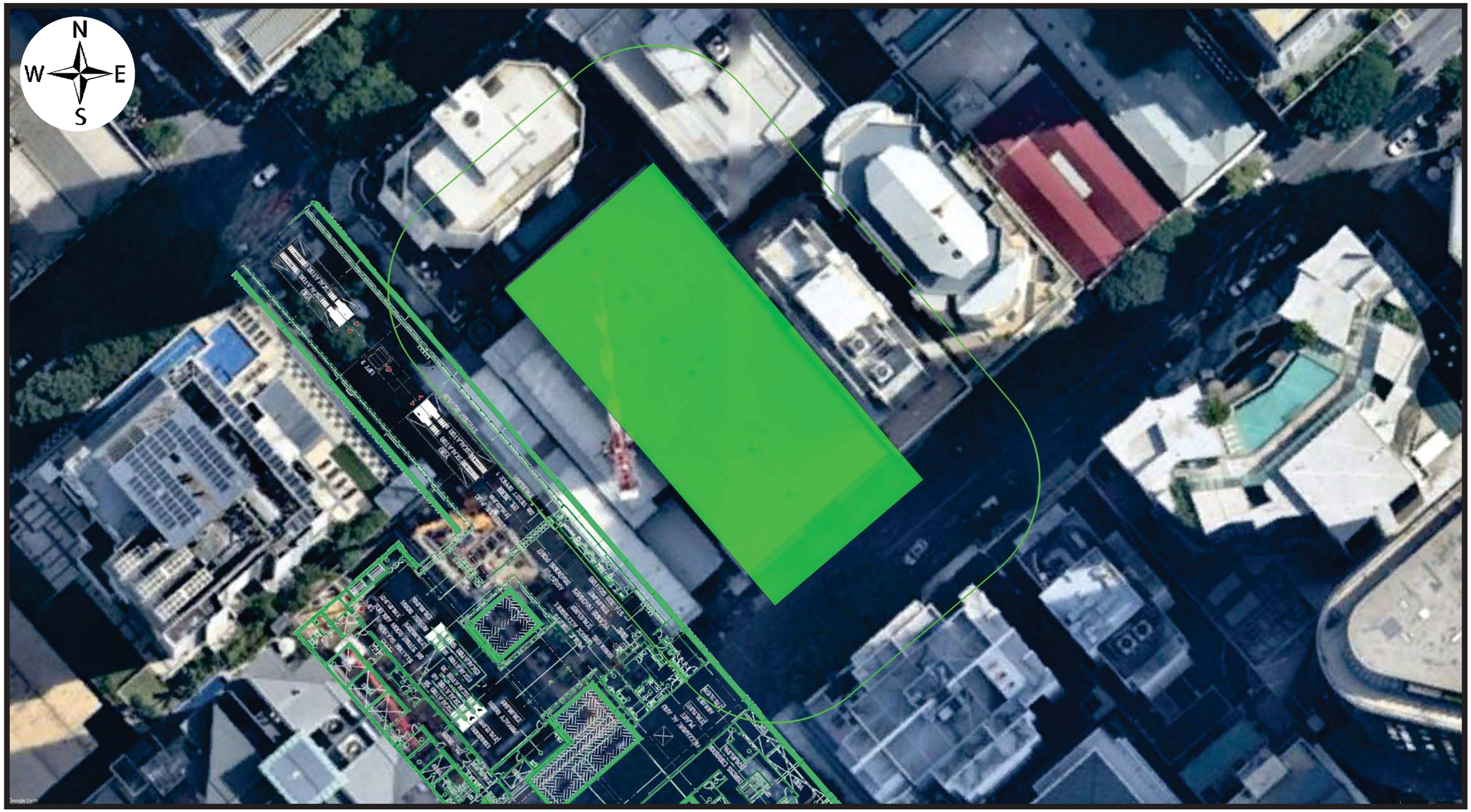
Revision History
R1: Original

Date Drawn: 2 April 2024

Ref No: Albert St Works

Job No: HP2305-2

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Created using TunnelTRAP Software

Modelled works area

SCALE

0 5 10 15 20 25m

RL -21.5 Vibration Levels

- 2 mm/s Vibration Contour
- 5 mm/s Vibration Contour
- 10 mm/s Vibration Contour
- 15 mm/s Vibration Contour
- 20 mm/s Vibration Contour
- 50 mm/s Vibration Contour

PROJECT DESCRIPTION Albert St Works - Modelled vibration levels and associated vibration contours from basement excavation with a 7000kg hydraulic hammer at RL-5. Vibration contours are shown at RL-21.5 and represent maximum expected values at the Albert Street Station Mezzanine.

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Plate No. CC

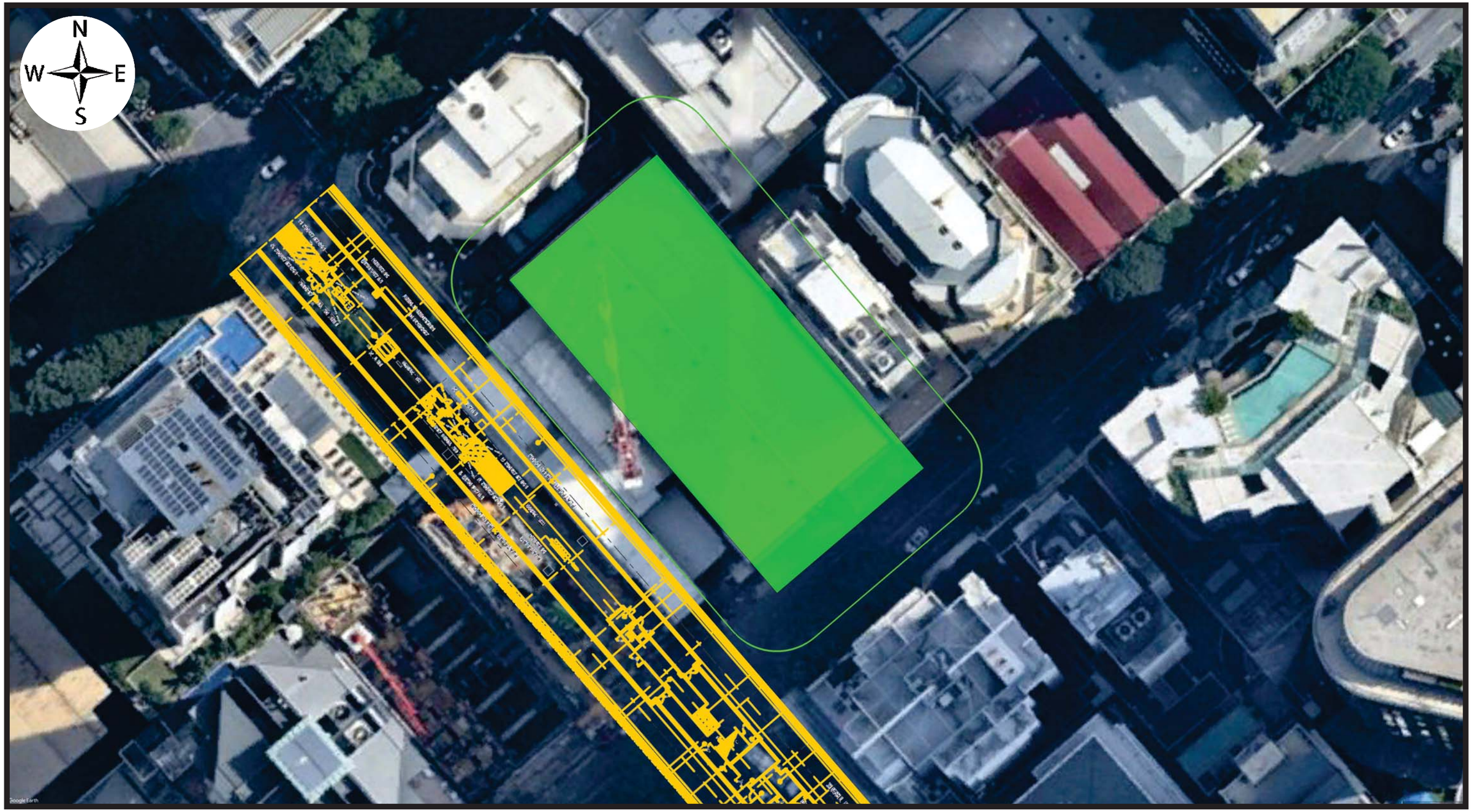
Date Drawn: 2 April 2024

Revision History
R1: Original

Ref No: Albert St Works

Job No: HP2305-2

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Created using TunnelTRAP Software

Modelled works area

SCALE

0 5 10 15 20 25m

RL -28 Vibration Levels

- 2 mm/s Vibration Contour
- 5 mm/s Vibration Contour
- 10 mm/s Vibration Contour
- 15 mm/s Vibration Contour
- 20 mm/s Vibration Contour
- 50 mm/s Vibration Contour

PROJECT DESCRIPTION Albert St Works - Modelled vibration levels and associated vibration contours from basement excavation with a 7000kg hydraulic hammer at RL-5. Vibration contours are shown at RL-28 and represent maximum expected values at the Albert Street Station Platform.

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Plate No. DD

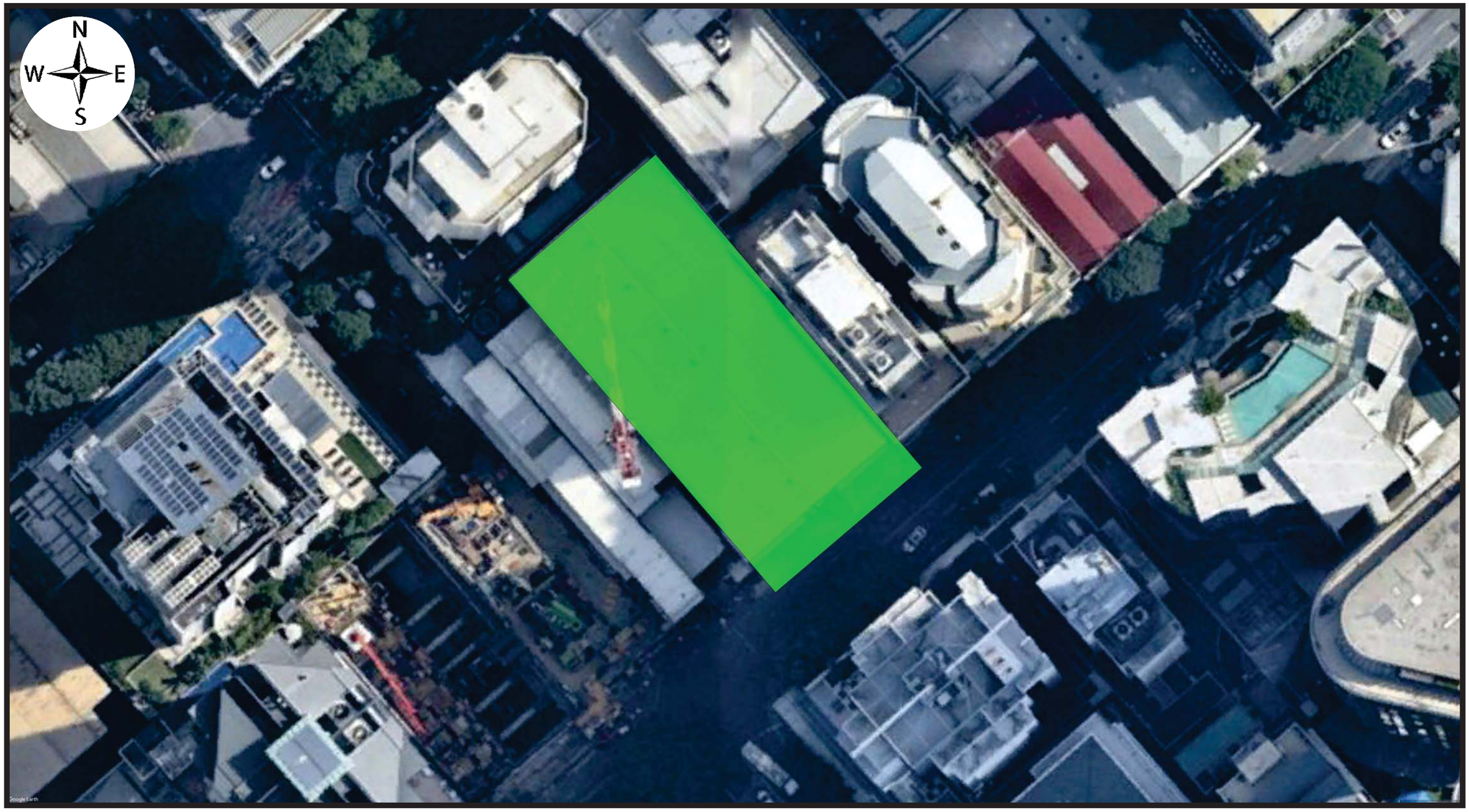
Revision History
R1: Original

Date Drawn: 2 April 2024

Ref No: Albert St Works

Job No: HP2305-2

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Created using TunnelTRAP Software

Modelled works area

SCALE

0 5 10 15 20 25m

RL -12.9 Vibration Levels

- 2 mm/s Vibration Contour
- 5 mm/s Vibration Contour
- 10 mm/s Vibration Contour
- 15 mm/s Vibration Contour
- 20 mm/s Vibration Contour
- 50 mm/s Vibration Contour

PROJECT DESCRIPTION Albert St Works - Modelled vibration levels and associated vibration contours from basement excavation with a 35t excavator at RL-5. Vibration contours are shown at RL-12.9 and represent maximum expected values at the tunnel crown.

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Plate No. HH

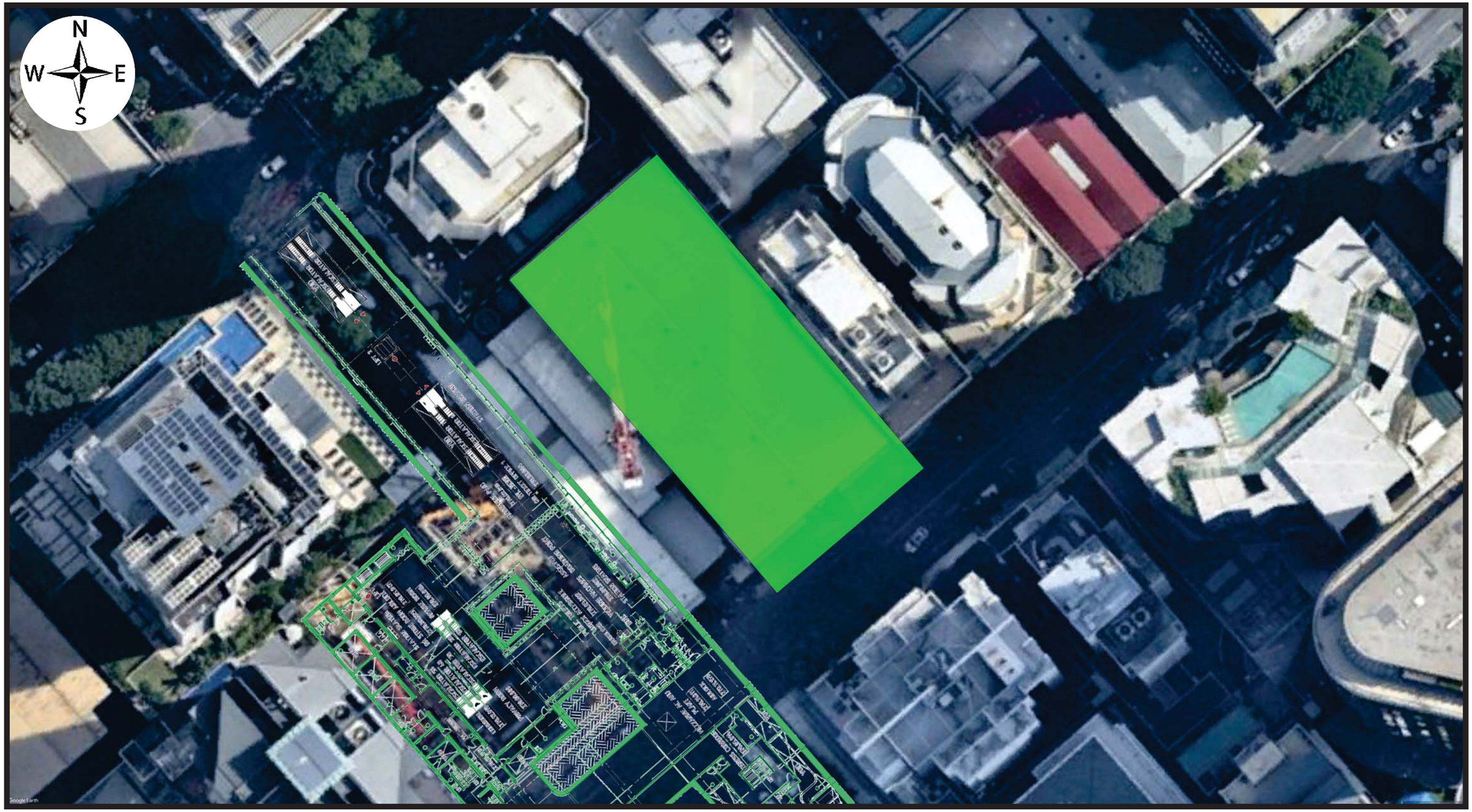
Revision History
R1: Original

Date Drawn: 2 April 2024

Ref No: Albert St Works

Job No: HP2305-2

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Created using TunnelTRAP Software

Modelled works area

SCALE

0 5 10 15 20 25m

RL -21.5 Vibration Levels

- 2 mm/s Vibration Contour
- 5 mm/s Vibration Contour
- 10 mm/s Vibration Contour
- 15 mm/s Vibration Contour
- 20 mm/s Vibration Contour
- 50 mm/s Vibration Contour

PROJECT DESCRIPTION Albert St Works - Modelled vibration levels and associated vibration contours from basement excavation with a 35t excavator at RL-5. Vibration contours are shown at RL-21.5 and represent maximum expected values at the Albert Street Station Mezzanine.

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Plate No. II

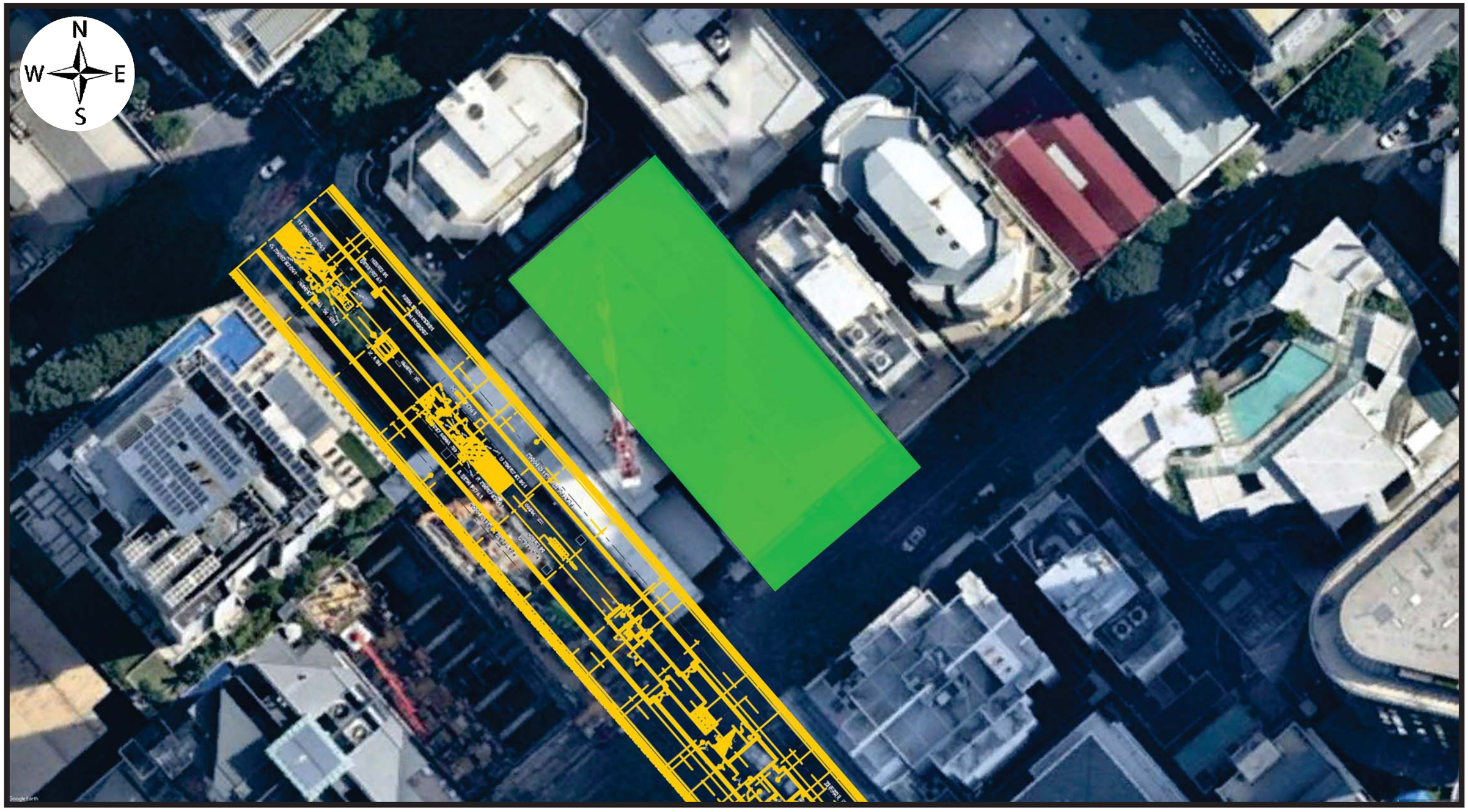
Date Drawn: 2 April 2024

Revision History
R1: Original

Ref No: Albert St Works

Job No: HP2305-2

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Created using TunnelTRAP Software

Modelled works area

SCALE

0 5 10 15 20 25m

RL -28 Vibration Levels

- 2 mm/s Vibration Contour
- 5 mm/s Vibration Contour
- 10 mm/s Vibration Contour
- 15 mm/s Vibration Contour
- 20 mm/s Vibration Contour
- 50 mm/s Vibration Contour

PROJECT DESCRIPTION Albert St Works - Modelled vibration levels and associated vibration contours from basement excavation with a 35t excavator at RL-5. Vibration contours are shown at RL-28 and represent maximum expected values at the Albert Street Station Platform.

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Plate No. JJ

Date Drawn: 2 April 2024

Revision History
R1: Original

Ref No: Albert St Works

Job No: HP2305-2

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