REPORT

Downtown Carpark Site Development - Geotechnical and Groundwater Assessment Report

1016043.2000-RPT-GT-001

Prepared for
Precinct Properties New Zealand Limited
Prepared by
Tonkin & Taylor Ltd
Date
November 2025
Job Number
1016043.2000 v3.1

Together we create and sustain a better world
www.tonkintaylor.com

Document control

Title: Downtown Carpark Site Development - Geotechnical and Groundwater Assessment Report					
Date	**Version**	**Description**	**Prepared by:**	**Reviewed by:**	**Authorised by:**
April 25	1.0	50% Preliminary Design	R. Wilkinson	P. Millar	P. Millar
Sept 25	2.0	Draft for FTAA	R. Wilkinson	P. Millar	P. Millar
Oct 25	3.0	100% FTAA	R. Wilkinson	P. Millar	P. Millar
Nov 25	3.1	100% FTAA	R. Wilkinson	P. Millar	P. Millar

Distribution:

Precinct Properties New Zealand Limited	PDF copy
Holmes Consulting Limited	PDF copy
RCP Limited	PDF copy
Tonkin & Taylor Ltd (FILE)	electronic copy

Table of contents

Executive summary

Precinct Properties New Zealand Limited ("**Precinct**") has engaged Tonkin and Taylor Limited ("**T+T**") to provide geotechnical, environmental engineering, civil and infrastructure consultancy services for the proposed development of the Downtown Carpark Site into an integrated mixed-use precinct ("**Project**"), located at 2 Lower Hobson Street in the Auckland City Centre ("**Site**").

The key findings and conclusions of our assessment are summarised in the table below. Sections within the main body of the report contains further information and discussion, which puts into context the findings that are encapsulated within this summary. The findings and conclusions presented in this preliminary design report will be further developed as the next stages of developed and detailed design proceed for building consent.

Key Consideration	Key findings and conclusions
Ground and groundwater model	The ground conditions beneath the existing Site generally consists of Reclamation Fill, marine sediments and Tauranga Group sediments overlying East Coast Bays Formation ("**ECBF**") rock. The elevation of the rock typically varies between RL -2 m on the south-east corner to RL -7 m over the north-west portion of the Site. A 4-level basement is estimated to be at least 4 m below the deepest rock level. The basement extends across the Site footprint with the finished floor level for the 4th level at RL -10.32 m and the base of the excavation assumed to be at RL -12.32 m to accommodate the basement slab and over excavation for the foundation works. Additional local excavations below B4 level are proposed to accommodate the lift pits and water tanks, with the excavation level for these works extending up to RL -17.02 m. Groundwater levels for preliminary design are based on groundwater monitoring installations installed in July 2025, supplemented by groundwater data from the Quay Street Seawall strengthening project to the north, Commercial Bay and CRL tunnel projects to the east. The groundwater regime for the Site is governed by the presence of the Waitemata Harbour 50 to 150 m north of the Site, and in particular tidal recharge through service conduits. The Site may also be impacted by the infilling of the graving dock and the conduit it may provide to the Waitemata Harbour. For preliminary design, a design static groundwater level has been adopted at **RL 1.4 m**. An elevated groundwater level has been adopted at **RL 2.5 m**. Further information on the ground and groundwater model is provided in **Section 3.** This includes results of additional deep borehole investigations and testing to update design parameters.
Retaining wall type for basement excavation	Sheet pile walls and diaphragm walls have been considered to retain the proposed basement excavation for preliminary design. Key requirements for the basement retention design include: • Top-down construction at the northern end of the Site utilising two-levels of permanent floor slab. The permanent floor slabs used to prop the northern side will extend part way along the north-eastern and north-western boundaries to transfer the loads acting on the floor slab from the northern wall. • Bottom-up construction for the remaining portion of the Site, providing access to the excavation from the south. • Anchored sheet piles along the southern and south-eastern sides of the Site where rock is shallow (typically between RL -2 to -4 m). To achieve groundwater cut-off, the sheet piles are proposed to be embedded a minimum 1.5 m into the ECBF rock. The exposed rock face will be spot bolted and meshed as required.

Key Consideration	Key findings and conclusions
	• 800 mm wide diaphragm wall that is either tied back using anchors or internally propped for the remaining excavation sides where rock is deeper. The diaphragm wall is proposed to be full depth and taken a minimum 4 m below the base of the excavation (i.e. at least to RL -16.0 m). Further discussion and details for the proposed retention solution are provided in **Section 4.5**. Note there remains an option to use diaphragm wall or secant piles instead of the proposed sheet piles or consider other retention options (such as secant pile walls), as the design for the overall development develops. Pressed sheetpiles may also be considered to limit noise and vibrations, as well as extend the sheet pile sections for the east and west walls. The retaining wall options will be developed further in subsequent design phases.
Assessment of deformation and settlement effects	The potential for surface deformation of the surrounding ground due to the development has been assessed, with the key findings as follows. • The estimated ground settlement below neighbouring structures is estimated to be less than 12 mm, with differential gradients generally less than 1V:500H. This corresponds to a Risk Category 1 in accordance with CIRIA PR30, with negligible damage to surrounding buildings expected due to the proposed development, and no significant cumulative effects from other works in the area. • Total settlement less than 20 mm is estimated for surrounding pavements and underground services. The differential gradients, from settlements where services are oriented perpendicular to the excavation, are likely to be less than 1V:1,000H and are within the allowable tolerance for the various types of underground services surrounding the Site
Earthworks and construction considerations	The soil and rock materials are excavatable using conventional equipment and plant. Due to the complex historical land-use of the Site, in-ground obstructions can be present in the form of cobbles, boulders and construction waste in the reclamation fill, remnants of the graving dock, old seawalls and associated structures, reinforced concrete piles for the existing Downtown Carpark building, and remnant foundations of historical commercial and workshop buildings that occupied the north-western and south-eastern portions of the Site. Where the walls encounter existing piles, overcoring may be required, and options to optimise alignment of the wall to minimise these are being considered. Noise and vibration, due to driving of sheet pile walls, will also need to be considered as part of the construction noise and vibration monitoring plan.

1 Introduction

Precinct has engaged T+T to provide geotechnical, environmental engineering, civil and infrastructure consultancy services for the Project in support of a Fast-track Approvals Act 2024 ("**FTAA**") application for consent.

This report should be read in conjunction with the civil infrastructure and flooding design reports and the preliminary contaminated land Site management report.

1.1 Scope of work

This geotechnical report is based on Site-specific geotechnical investigations and a desk study of existing geotechnical and groundwater information available at and near the Site, together with our historical knowledge of the Site and surrounding areas.

The scope of work that has been undertaken for the preliminary design is as follows:

1. Development of preliminary ground and groundwater models using existing geotechnical information. This includes recent investigations undertaken on the Site between 2020 – 2024.
2. Undertake 2 No. machine boreholes in July 2025 to a depth of 30 m below ground level to confirm the depth to and competency of the ECBF rock, collect rock samples for subsequent laboratory testing, and undertake in-situ pressuremeter testing.
3. Development of preliminary soil and rock parameters based on the recent investigations and laboratory testing, in addition to our historical knowledgebase.
4. Development of conceptual retaining wall types for the basement excavation, and a discussion of benefits and limitations of each retaining wall type for the Site-specific constraints.
5. Development of conceptual foundation types and foundation capacities for preliminary geotechnical and structural design.
6. Preliminary assessment of effects due to the basement excavation on surrounding structures including impact of groundwater drawdown.
7. Discussion of construction methodologies and construction considerations.
8. Recommendations for further work required during subsequent design stages.

A draft groundwater and settlement monitoring and contingency plan has also been prepared for the Site and is provided in **Appendix B**.

The current understanding of the proposed Project is provided in Section 1.3 below. The geotechnical design for the redevelopment will be developed in parallel to the architectural, structural, civil and infrastructure design of the Project.

1.2 Site description

The Site is located at 2 Lower Hobson Street, at the corner of Lower Hobson Street and Customs Street West in the Auckland City Centre (legal description Lot 9 DP 60151). The proposed Site to be developed is approximately 6,442 m^2 in area, with the Site on land reclaimed in stages between 1850 and 1920 by the Auckland Harbour Board.

The Site is relatively level, with the ground surrounding the Site varying from RL 4 m to RL 5 m. A 9-storey (1 below ground level and 8 suspended floors) public carpark building known as the Downtown Carpark currently occupies the Site. The carpark building was designed in 1968 and the concrete superstructure is supported on belled reinforced concrete piles with precast flooring. The building is approximately 70 m wide (parallel to Customs Street West) and 88 m long (parallel to Lower Hobson Street). The building is surrounded by M Social Hotel immediately to the north, HSBC and Aon Towers to the east, Custom Street West and Lower Hobson Street to the south and west respectively. Figure 1.1 shows the location of the Site. The historical Tepid Baths are located across Lower Hobson Street to the west.

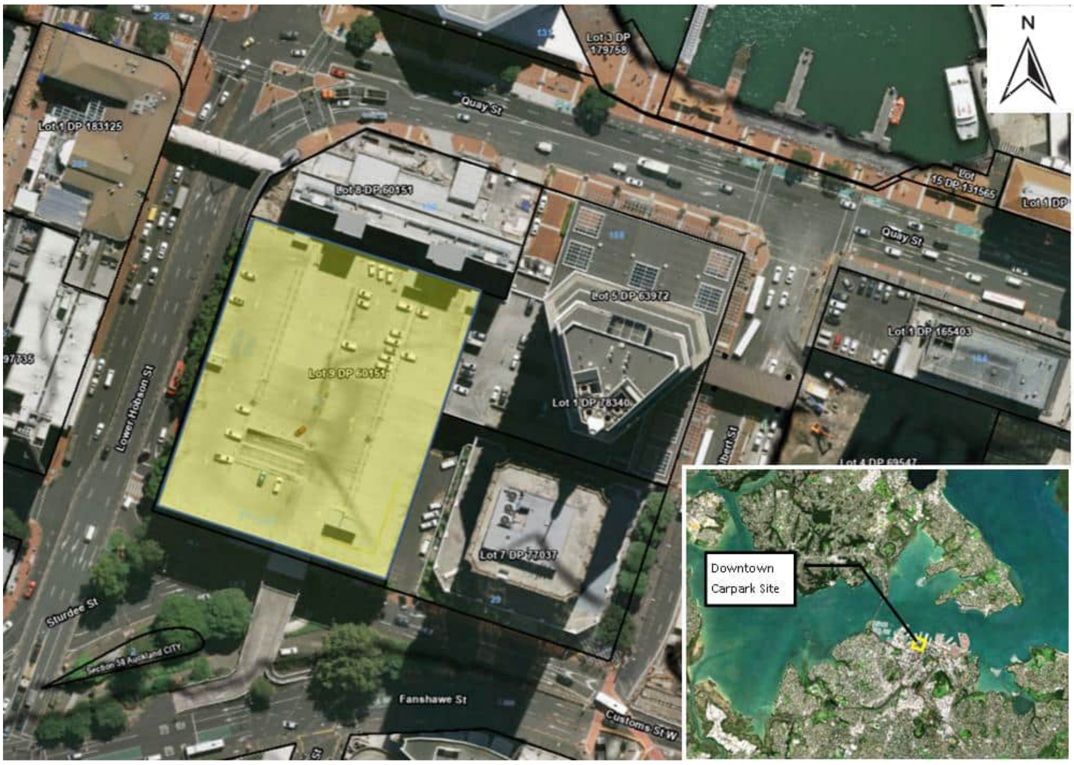


Figure 1.1: Site.

1.3 Proposed development

The proposed Project includes the demolition of the existing downtown carpark building (together with the Lower Hobson Street pedestrian bridge and Customs Street West vehicle ramp located within part of the road reserve) and redevelopment of the Site to provide for a mixed-use precinct providing for commercial, residential, hotel, retail, food and beverage, and civic uses. The redevelopment involves three podium buildings, two towers, and four levels of shared basement, including new public spaces and a new laneway network to provide connectivity within the city centre. In addition, the proposed development involves modifications to the podia of existing adjacent buildings (HSBC and AON) to facilitate the new laneway network.

The basement floor levels, and footprint are based on the current Architectural Drawings for Preliminary Design provided by the Architect, Warren and Mahoney and dated 3/10/2025. The following design floor levels have been adopted for this assessment:

B4 Basement Level:	FFL -10.32 m RL
B3 Basement Level:	FFL -7.32 m RL
B2 Basement Level:	FFL -4.32 m RL
B1 Basement Level:	FFL -1.32 m RL
GF Level:	FFL +4.18 m RL

An excavation level to -12.32 m RL has been adopted to allow for the basement slab and any over excavation for the retention analyses presented in Section 4.5. Groundwater drawdown analyses presented in Section 4.4 conservatively considers a deeper excavation level of -16.3 m RL from the previous development plans (now superseded). Effects of this change are small.

An additional excavation below B4 level locally accommodates lift pits and water tanks, with the finished floor level for the lift pits and water tanks extending up from FFL -15.02 m. This excavation is located away from the perimeter of the Site. It has been assumed that the excavation may need to extend up to -17.02 m RL to accommodate these works.

2 Site history

Historical information relating to the Site has been collected from a variety of sources including the Auckland Council property file, Site contamination enquiry, historical aerial photographs, archaeological assessments, and T+T project archives. This history focuses on on-Site activities, except for the aerial photograph review where comments are also provided on readily observable surrounding land use. The information reviewed is summarised in the following sections.

2.1 Archaeological information

Reclamation to provide additional land, in addition to deeper harbours, was a central part of the early vision for Auckland. Figure 2.1 shows the original coastline relative to the subject Site.

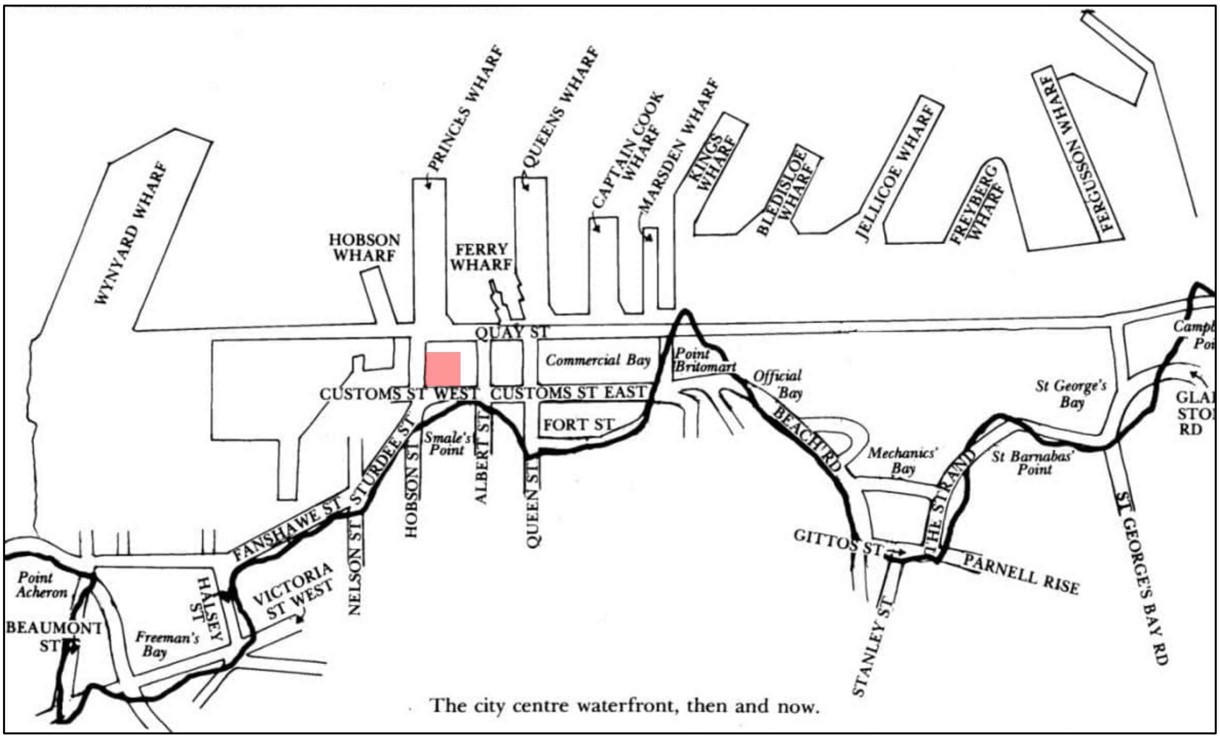


Figure 2.1: Reclamation and historical features in project area (from Barnett, 1981[1]).

The archaeological assessment completed by Clough & Associates for the Project[2] provides detailed accounts of the history of Auckland CBD, including the process of reclamation. The key findings are summarised below:

- Reclamation has been carried out in stages since the 1850s, with the first major reclamation to infill the area between Fort Street and Custom Street East starting in 1859. The process of construction involved creation of a seawall along what is now Customs Street East, with the use of material from Smales Point (the western headland) to provide fill.
- Throughout the 1870s, and early 1880s, a basalt sea wall along present-day Quay Street was constructed. Point Britomart was demolished, with manual labour (including horse drawn carts) used to move the excess materials to points of ongoing reclamation. Dredging waste and construction debris were also noted to be used as infill.

---

[1] Barnett, S. 1981. A Picture Book of Old Auckland. Auckland: Benton Ross Ltd.

[2] Clough & Associates Ltd (September 2025). Downtown Carpark Redevelopment, Auckland: Fast Track Archaeological Assessment.

- Throughout the 1870s – 1900 existing wharves were removed and drains constructed throughout the reclamations. Commercial / industrial buildings were constructed once the infill had stabilised, and the reclamation was complete. The Site extends over an old graving dock which was backfilled, and the area above developed in the early 1900's (see Figure 2.2).

2.2 Historical aerial photographs

Historical aerial photographs from the T+T library and other sources (as shown in Table 2.1) have been reviewed. Relevant features of the Site and surrounding land are summarised from each aerial photograph in Table 2.1.

Table 2.1: Summary of aerial photograph review

Date, run number and source	Key Site features	Surrounding land features
1940 Auckland Council GeoMaps	Sturdee Street divides the Site in a south-west to north-east alignment. The larger northern section of the Site is vacant and appears to be either grass or gravel covered. Parts of it is being used for materials lay down / parking purposes. The smaller, triangular shaped southern section of the Site is occupied by a single commercial building.	General port activities occupy the surrounds to the north. Commercial buildings occupy the immediate surrounds to the west, east and south.
1950 T+T Library (Run 1917 Photo 29)	A large commercial building has been established on the northern part of Site.	No significant changes are evident.
1959 Auckland Council GeoMaps	No significant changes are evident.	No significant changes are evident.
1961 T+T Library (Run 3234 Photo 38)	No significant changes are evident.	No significant changes are evident.
1972 T+T Library (Run 4600 photo 11)	Sturdee Street no longer divides the Site. The buildings that formerly occupied the northern and southern sections of the Site have been removed and replaced by a single structure built over the entire Site footprint including the former Sturdee Street Road reserve.	A high rise building has been constructed immediately to the north between the Site and Quay Street. Further development and construction of buildings has occurred in areas east of the Site.
1980 T+T Library (Run SN5783/M14)	No significant changes are evident.	A large high-rise has been constructed immediately east of the Site, replacing the smaller buildings that were established sometime between 1940 and 1950.
1987 T+T Library (Run SN8772/K4)	For the first time vehicles are visible parked on the roof of the building but no significant changes are evident.	Some redevelopment of buildings to the north and west, but no other significant changes are evident.

Date, run number and source	Key Site features	Surrounding land features
1996 Auckland Council GeoMaps	No significant changes are evident.	Some redevelopments of buildings to the west, but no other significant changes are evident.
2001 Auckland Council GeoMaps	No significant changes are evident.	PWC tower, adjoining the Sites north-eastern corner, is under construction.
2003 to 2016 Auckland Council GeoMaps	No significant changes are evident.	No significant changes are evident.
2017 Auckland Council GeoMaps	No significant changes are evident.	Former Downtown Shopping Centre has been removed and redevelopment of the Site, located to the east, is underway.

2.3 Council property file review

The following information was identified during review of the property file:

- An undated plan hand annotated with dates from 1911 and 1912 show a “dock” covers most of the Site. This is consistent with Ports of Auckland records and early photographs of Auckland City T+T has obtained for other projects which indicate that a boat graving dock (dry dock) was originally constructed at the Site in the 1870s. The graving dock was subsequently infilled, prior to the reclamation of Quay Street (between Princess Wharf and the Site) in 1923. Figure 2.2 below provides the timeline for the construction and reclamation of the graving dock.
- Plans dated from 1911 through 1947 show that a three level “warehousing” building occupied the south-eastern corner of the Site, to the south of the graving dock and Sturdee Street. The Harbour Board workshops were also constructed in the north-western corner in the early 1940s.
- Plans dated 1968 show the proposed development of a “Car Parking Station” for Auckland City Council. The building includes 8 levels of parking, including the basement and roof levels, with a “service station” shown to occupy the south-western corner of the ground floor.
- Plans dated 1970 prepared for Shell Oil New Zealand Limited show the general layout of the “Downtown Service Station” within the “Downtown Parking Building”.
- Correspondence dated 1973 and 1975 refer to the transfer of the service station operations from “Dock Site Service Centre Ltd.” To “Paine Services Ltd.” With the addition of a rental vehicle operation, including “a limited amount of servicing of rental vehicles”.
- A dangerous goods license dated 1996 refers to the removal of two underground tanks, of 13,000 and 18,000 litre capacities, from a Site occupied by “Downtown Auto Services”. The Site is noted as being used as “Service station” with the future use proposed to be a “Garage”.
- Subsequent records relate to:
    - Alterations to the former service station/garage area for occupation by various restaurants and bars;
    - A barbers shop is noted as occupying a tenancy within the wider Site; and
    - Various alterations and improvements, including the addition of two floors, to the car parking facilities.

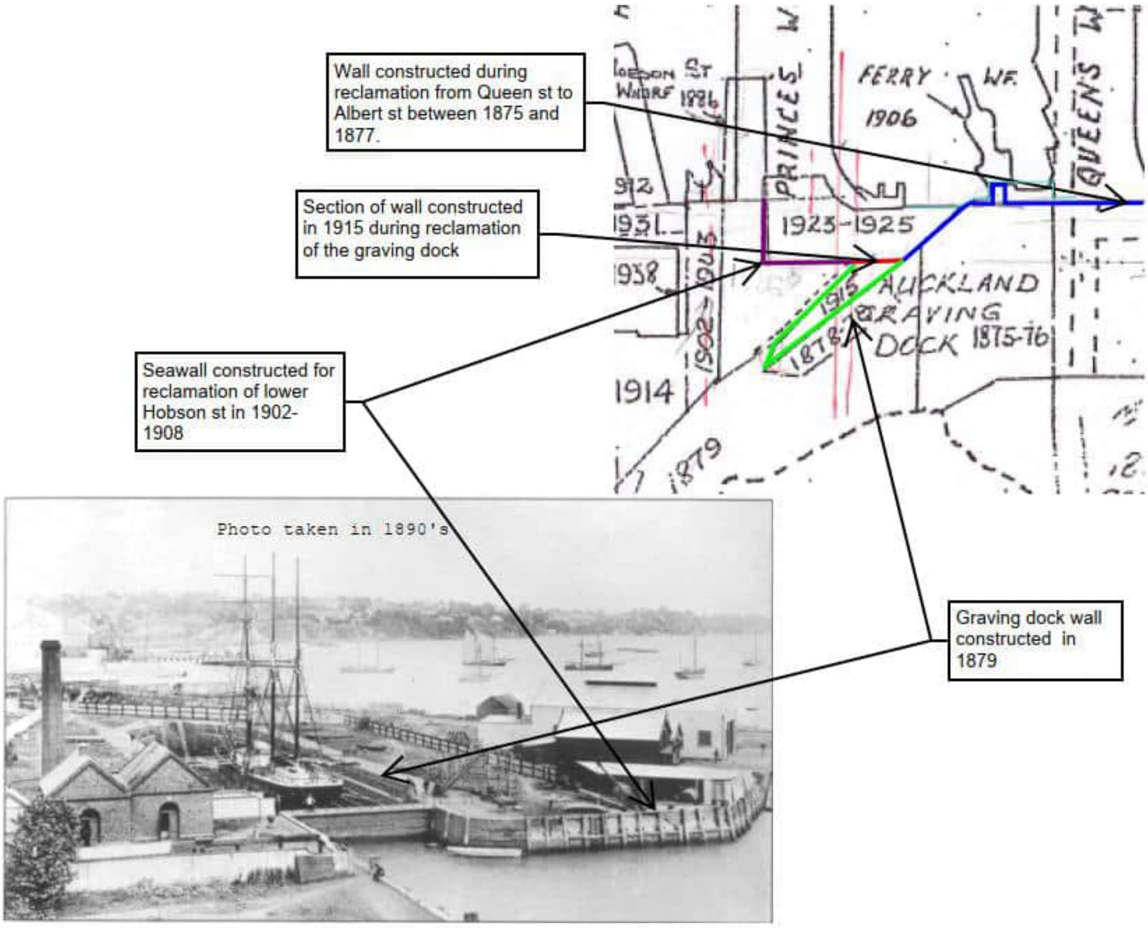


Figure 2.2: Construction and reclamation of the graving dock at the Site.

2.4 Existing structure and remnant foundations

The existing carpark was designed in 1968 and comprises a concrete super structure with precast flooring and is founded on belled reinforced concrete piles. The ground floor of the structure is staggered where the north half is at a lower elevation than the south half. Building records indicate that the ground floor of the structure is a concrete slab on-grade, with some Fill likely beneath the floor slab.

The original 1968 design drawings show the length of piles are between 5.6 to 13.9 m, the shaft diameters are between 0.9 to 1.4 m and the bell diameters are between 1.5 to 2.3 m. These design drawings indicate that the pile lengths were to be adjusted during construction based on actual depth of rock. Based on geotechnical investigations in the area and the inferred elevation of the ECBF rock surface, and assuming a typical pile embedment of 3 m in the ECBF rock, the total pile lengths are estimated to vary between 6 m to 11 m. Pile lengths typically increase towards the north and west with the longest piles located in the northwest corner of the building where the depth to rock is deepest.

Design drawings for the existing Downtown Carpark structure showing the foundation layout are provided in **Appendix C**.

Prior to development of the Downtown Carpark structure, it is understood two multi-level structures occupied the Site in south-east and north-west corners with the Site split diagonally through the centre by Sturdee St. It is possible remnant foundations from these structures will still be present below the Site. Available records for the south-eastern structure (**Appendix C**) indicate the structure was built on shallow pad foundations. No records are available for the north-western structure, but it is likely to have been founded on driven timber pile foundations.

The majority of the piles will be exposed during the basement excavations but, where they conflict with the perimeter retaining walls or building piles installed from existing ground level, the piles may need to be removed to enable the new works.

3 Geotechnical model

3.1 Historical Site investigations

Existing geotechnical and groundwater investigations at and near the Site have been used to develop a preliminary ground model for design, including:

- 8 No. machine drilled boreholes that were undertaken within the Site footprint prior to construction of the existing carpark building in 1968.
- 2 No. machine drilled boreholes undertaken within the Site footprint for the seismic assessment of the existing carpark building in 2020.
- Investigations at adjacent sites including investigations for the Millennium and Copthorne Hotels (now the M Social Hotel) to the north, investigations for the Quay Street Seawall strengthening, and investigations for the development of the HSBC, AON, Commercial Bay developments, Watermark (85 Custom Street West) and Tepid Baths.

A plan showing existing site investigations in the vicinity of the Site is provided in Figure 3.1 below and included in **Appendix A**.

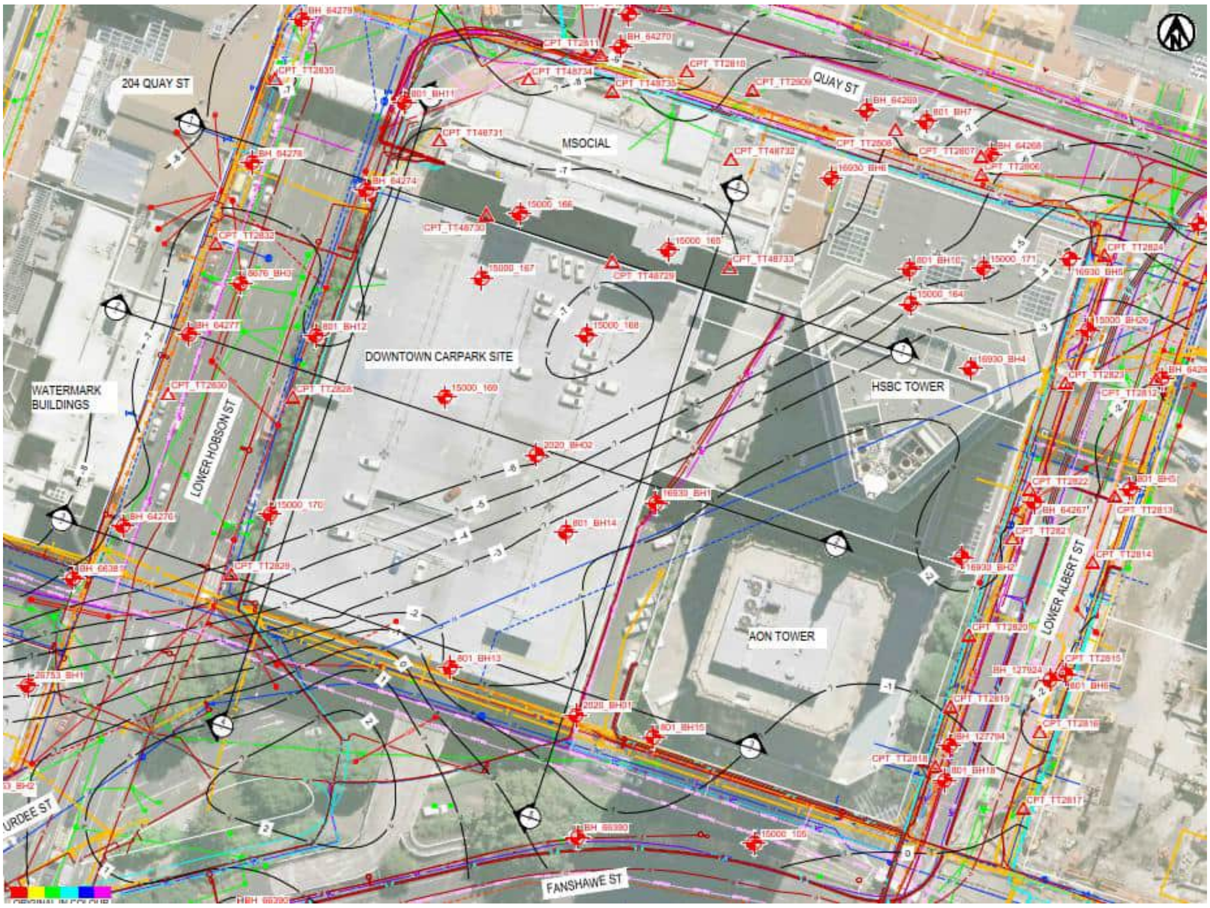


Figure 3.1: Existing investigation data in the vicinity of the Site.

Existing groundwater monitoring information includes groundwater levels measured using standpipe piezometers and vibrating wire piezometers over a period varying from three months to three years. The groundwater monitoring from the Quay Street seawall strengthening, Commercial Bay development and the CRL cut-and-cover tunnel excavation works has been used for the preliminary design.

The ground and groundwater model for this preliminary design report was also supported by our historical knowledge of the area based on geotechnical and ground contamination assessment we have carried out in the vicinity between 1999 to 2022. An outline of these relevant works in the area are summarised in Table 3.1 below.

Table 3.1: Previous T+T investigations in the vicinity of the Site.

Site	T+T Job Reference	Information sources
PwC Tower	16930	AMP Waterfront Tower Project – Geotechnical Report. Report prepared for AMP Asset Management Ltd, dated 1999.
Quay Street	28557.002	Quay Street Seawall Geotechnical and Ground Contamination Assessment. Report prepared for Auckland Transport ("**AT**"), dated September 2012.
Copthorne Hotel	29493.1000vA	Ground Contamination Assessment, 196 Quay St, Auckland. Report prepared for Millennium & Copthorne Hotels NZ Ltd, dated November 2014. T+T reference no. 29493.1000; and Site Management Plan for Ground Contamination, 196 Quay St, Auckland. Report prepared for Millennium & Copthorne Hotels NZ Ltd, dated December 2014.
Tepid Baths	26753.001	Tepid Baths Redevelopment Geotechnical Report. Report prepared for Auckland City Council, dated September 2010.
West Plaza Centre, Albert Street	24700	3-15 Albert Street, Auckland Central, Geotechnical and Ground Contamination Desk Study Report. Report prepared for West Plaza Centre Limited, dated August 2007.
Precinct Downtown Shopping Centre	30108.3000v3	Downtown Development, Auckland, Preliminary Ground Contamination Assessment. Report prepared for Precinct, dated January 2015.
Downtown Carpark	1012134	Downtown Carpark, Rock Level Investigation. Report prepared for AT, dated September 2020.

3.2 Site-specific investigations

T+T completed additional Site-specific geotechnical investigations for the proposed development between 9 June and 11 June 2025. This consisted of the following:

- 2 No. machine boreholes ranging to depths of approximately 30 m bgl;
- 1 No. machine borehole within the basement footprint to collect contaminated land samples to a depth of 8.0 m bgl;
- In-situ pressuremeter testing within the ECBF rock at 3 No. depths;
- Laboratory Unconfined Compressive Strength ("**UCS**") testing on 12 No. select rock samples; and
- Installation of groundwater monitoring standpipes for subsequent groundwater monitoring and sampling.

The boreholes were drilled by McMillan Drilling Ltd under the supervision of a geotechnical engineer from T+T. Locations of the machine boreholes are presented in **Appendix A** with borehole logs and photographs of the recovered core presented in **Appendix D**.

Table 3.2: Summary of T+T Site-specific geotechnical investigations

BH ID	Location (NZTM)		Ground Surface elevation RL (m) (1)	Termination depth (m bgl)	Reason for termination
	Northing	Easting			
BH01	5921111	1757308	3.0	30.5	Target Depth
BH02	5921083	1757380	3.3	30	Target Depth

(1) Ground elevation estimated based on ground surface contours available on Auckland Council Geomaps

In-situ pressuremeter testing was undertaken by Rori Green Consulting Ltd downhole during borehole investigations within an NQ diameter shaft. Full reporting of the testing undertaken and results is provided in **Appendix D**, and summarised below:

Table 3.3: Summary of pressuremeter testing results

BH ID	Test Zone (m bgl)	Yield Stress (MPa)	Modulus Estimates (MPa)				
			E1 (Initial)	E2 (Unloading)	E3 (Reloading)	E4 (Post-yield	E5 (Unloading)
BH02	13.5 to 14.0	2.0	200	510	400	180	940
	22.4 to 22.9	4.5	740	1310	1080	630	1290
	28.2 to 28.7	5.0	670	1190	1030	500	1180

Geotechnical laboratory testing was undertaken by Geotechnics Ltd on rock core samples selected by T+T. The testing report is presented in **Appendix D**, with results summarised below:

Table 3.4: Summary of UCS testing results

BH ID	Sample depth (m bgl)	Core size	Bulk density (t/m³)	Dry density (t/m³)	UCS result (kPa)	Core description
BH01	12.72	PQ	1.99	1.60	1165	Siltstone
	16.75		2.09	1.72	1013	Siltstone
	20.14		2.04	1.67	1781	Sandstone
	21.75		2.09	1.75	3914	Sandstone
	23.54		2.12	1.79	2137	Siltstone
	28.18		2.14	1.80	1592	Siltstone
BH02	17.77		2.07	1.72	3678	Sandstone
	18.87		2.06	1.67	5049	Siltstone
	19.79	NQ	2.07	1.72	5415	Sandstone
	22.3		2.05	1.73	1373	Siltstone
	22.51		2.01	1.73	3075	Sandstone
	27.17		2.09	1.76	253	Siltstone

It should be noted that UCS tests tend to provide lower-bound strengths due to the effects of drilling disturbance and relaxation of samples. This is noticeable from the lower strength results for the smaller NQ samples and the lower stiffnesses measured than the pressuremeter tests.

3.3 Geological setting

The ground conditions beneath the Downtown West generally consists of Reclamation Fill, marine sediments and Tauranga Group sediments overlying ECBF rock. The nature of these units is discussed in more detail in Section 3.4.

The geological boundary for the ECBF near the surface is located south of the Site and is broadly consistent with the original "coastline" or cliff" that was shown in Figure 2.1. In addition, the geological map for Auckland shows Late Pliocene to mid-Pleistocene pumiceous river deposits belonging to the Tauranga Group immediately to the south of the Site and Auckland Volcanic Field deposits consists of basalt and ash south east of the Site.

Figure 3.2 presents an extract from the 1:250,000 geological map for the Auckland area is provided below showing the high-level geological setting in the vicinity of the Site.

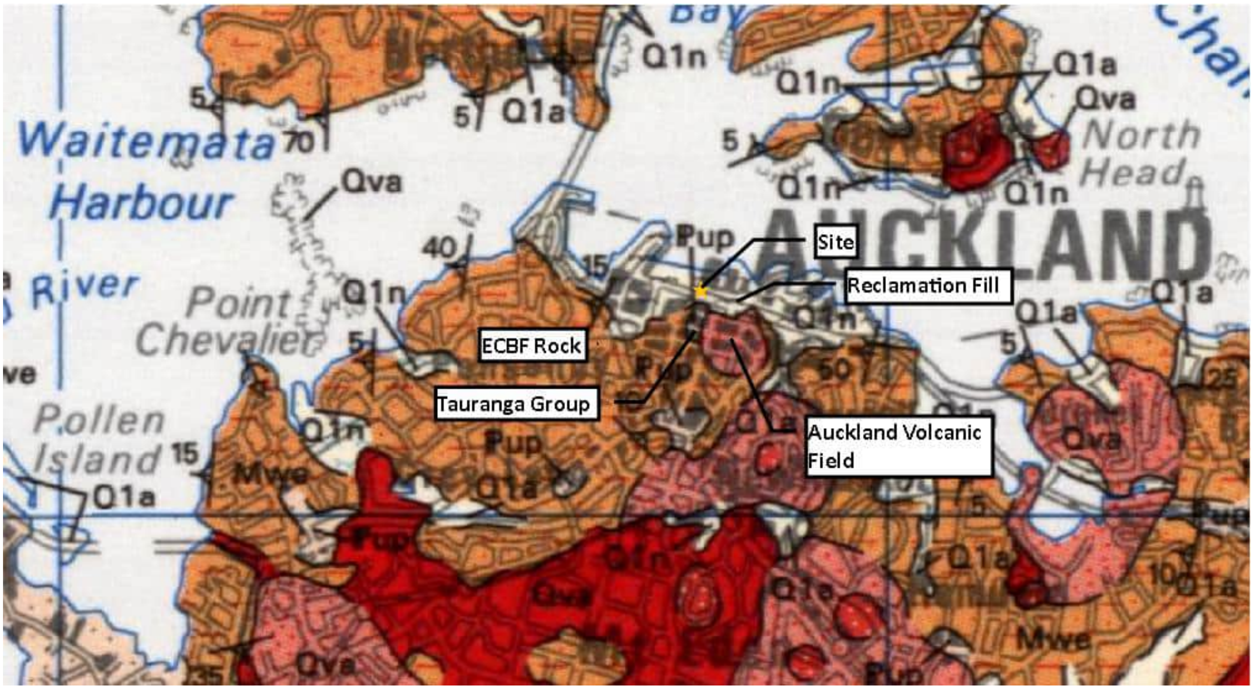


Figure 3.2: 1:250,000 Geological map of the Auckland area (Edbrooke, 2001).

3.4 Ground model

Based on historical investigations and recent Site-specific investigations available at and near the Site, the underlying ground conditions broadly consist of:

- Reclamation Fill; overlying
- Recent marine sediments and Alluvium from the Tauranga Group; overlying
- East Coast Bays Formation from the Waitemata group

A discussion of each of the above units is provided below. Preliminary geotechnical cross-sections showing the variability in ground conditions are provided **Appendix A**. Note that the nature and continuity of the subsoils away from investigation locations is inferred, and it must be appreciated that actual conditions could vary from the assumed model.

Geotechnical parameters that have been adopted for the preliminary analysis and design are provided in Section 4.

3.4.1 Reclamation fill

Reclamation fill materials are present below ground level across the Site. The thickness of the reclamation fill varies between 4 and 9 m and is generally comprised of both locally sourced and imported fill materials, dredged materials and Reclamation fill together with debris from earlier construction of seawalls and structures. The available records from boreholes within the Site indicate that variable gravels, sands and soft to very stiff silts and clays will be encountered within the fill layers, with occasional basalt boulders, organics, timber, brick, porcelain, and other rubble.

As noted previously, the graving dock that was located across the Site was infilled in 1923. The fill within the old graving dock was excavated from local sources of regional basement rock, typically comprising fine-grained cohesive soils (silts and clays). The old seawalls are reported to have been constructed using timber and masonry breast works constructed on rock rubble. Auckland Harbour Board drawings indicate that the graving dock walls may have later been replaced with mass concrete wall. It is unknown whether all or part of the walls were removed and to what extent any remnants of these walls were encountered during construction of the existing structure. As such, remnants of these walls may still be present at the Site and encountered during the excavation of the basement for the Project, see also further discussion in Section 4.7.5.

3.4.2 Recent Marine Sediments and Alluvium (Takaanini Formation)

Tauranga Group sediments include recent marine “muds” typically comprising soft to stiff sandy silts and clays with significant organic content; and underlying Pleistocene-era alluvial sediments typically comprising soft to stiff pumiceous clays, silts and sands with some organic layers. Based on available geotechnical investigations this layer typically varies between 1 and 4 m in thickness.

3.4.3 East Coast Bays Formation rock

ECBF rock underlies the Auckland CBD, and typically comprises interbedded very weak to weak siltstone and sandstone. This unit often shows a well-developed weathering profile consisting of sands, silts and clays depending on the original parent lithology.

In the recent investigations the ECBF rock was encountered as interbedded siltstone and sandstone beds typical of the ECBF rock. No moderately strong Parnell grit lenses or calcite cemented beds were discovered at the investigation locations, nor were open jointed or high permeability beds present.

Laboratory testing on the ECBF rock confirmed the rock strengths are typically very weak to weak, with a weathered horizon at the top of the unit approximately 3 to 4 m thick where lower strengths were observed, becoming stronger and more intact with depth.

Historical records indicate the former sea cliffs prior to land reclamation were present to the south of the Site (see Figure 2.1). The weathering profile in the top of the rock at the Site has been affected by the historical coastal erosion processes in this area. The pre-European shoreline at the Site is more or less along the boundary with Customs Street, and as a result the rock surface profile in this area is highly variable, because of the presence of wave cut platforms, and possible caves and small cliffs or other steep rock interfaces. Natural Tauranga Group sediments and manmade fill were subsequently depoSited over this rock surface.

3.5 Groundwater model

The groundwater model for the preliminary design is based on historical ground monitoring available from the Quay Street seawall, Commercial Bay development and CRL cut and cover tunnel works, in addition to recent groundwater monitoring within Site-specific boreholes. Groundwater monitoring is currently ongoing at the Site, with monitoring data to date summarised in Table 3.5 below. Historical monitoring datasets are discussed further below.

Table 3.5: Groundwater standpipe installation detail and monitoring data

Piezometer ID		Collar RL (m)	Piezometer Screen Installation (m bgl) [RL m]	Groundwater level (m bgl) [RL m]	Geological unit over screened depth
BH01	Shallow	3.0	2.0 to 5.0 [RL 1.0 to RL -2.0]	2.0 to 2.2 [0.8 to 1.0]	Reclamation Fill / Marine Sediments
	Deep		12.5 to 15.5 [RL -9.5 to -12.5]	2.7 to 2.95 [0.05 to 0.3]	ECBF Rock
BH02	Shallow	3.3	2.0 to 5.0 [RL 1.3 to RL -1.7]	2.7 to 3.0 [0.3 to 0.6]	Reclamation Fill / Marine Sediments
	Deep		12.5 to 15.5 [RL -9.2 to -12.2]	2.95 to 3.3 [0.0 to 0.35]	ECBF Rock

Broadly the groundwater regime for the Site is governed by the presence of the Waitemata Harbour 50 to 150 m north of the Site, and in particular tidal recharge through service conduits. The Site may also be impacted by the infilling of the graving dock and the conduit it may provide to the Waitemata Harbour. The site-specific groundwater levels are also considered to be impacted by the drained basements at the HSBC tower (formerly the PWC tower) to the east and West Plaza to the south-south east that extend below historical regional groundwater levels.

For preliminary design, groundwater levels have been adopted based on recent and historical groundwater monitoring available in the vicinity of the Site, as presented in Table 3.5 and **Appendix F**. The monitoring results available from these positions, which include a number multi-level vibrating wire piezometer (VWP) installations (plotted on Figure 3.3 below), provide a long-term semi-continuous record of groundwater levels. The following conclusions can be drawn from the data:

- Static groundwater levels across the Site up to RL 1.4 m have been observed. Groundwater pressures observed with depth across the dual-screen standpipes and multi-level VWP installations indicate full-hydrostatic pressures are not developed. Plotting groundwater pressure with VWP elevation (Figure 3.3) indicates the pressures are at approximately 85% of hydrostatic pressure.
- The groundwater levels are influenced by tides, however, negligible fluctuations are observed (100 – 200 mm) within the VWP monitoring records available.
- Due to the close proximity to the harbour, it is considered that rainfall events have a negligible effect on the groundwater level, but flows within fill material and stormwater pipes may locally affect groundwater levels. There is also potential for high connectivity with the harbour through open joints / faults which may be present within the ECBF rock.
- Groundwater monitoring adjacent to HSBC Tower (BH02) recorded groundwater levels typically 0.5 m below BH01, which may be a result of influence of the permanently drained basement founded at approximately RL -4 m.

For preliminary design, a design static groundwater level has been adopted at **RL 1.4 m**. An elevated groundwater level has been adopted at RL 2.5 m.

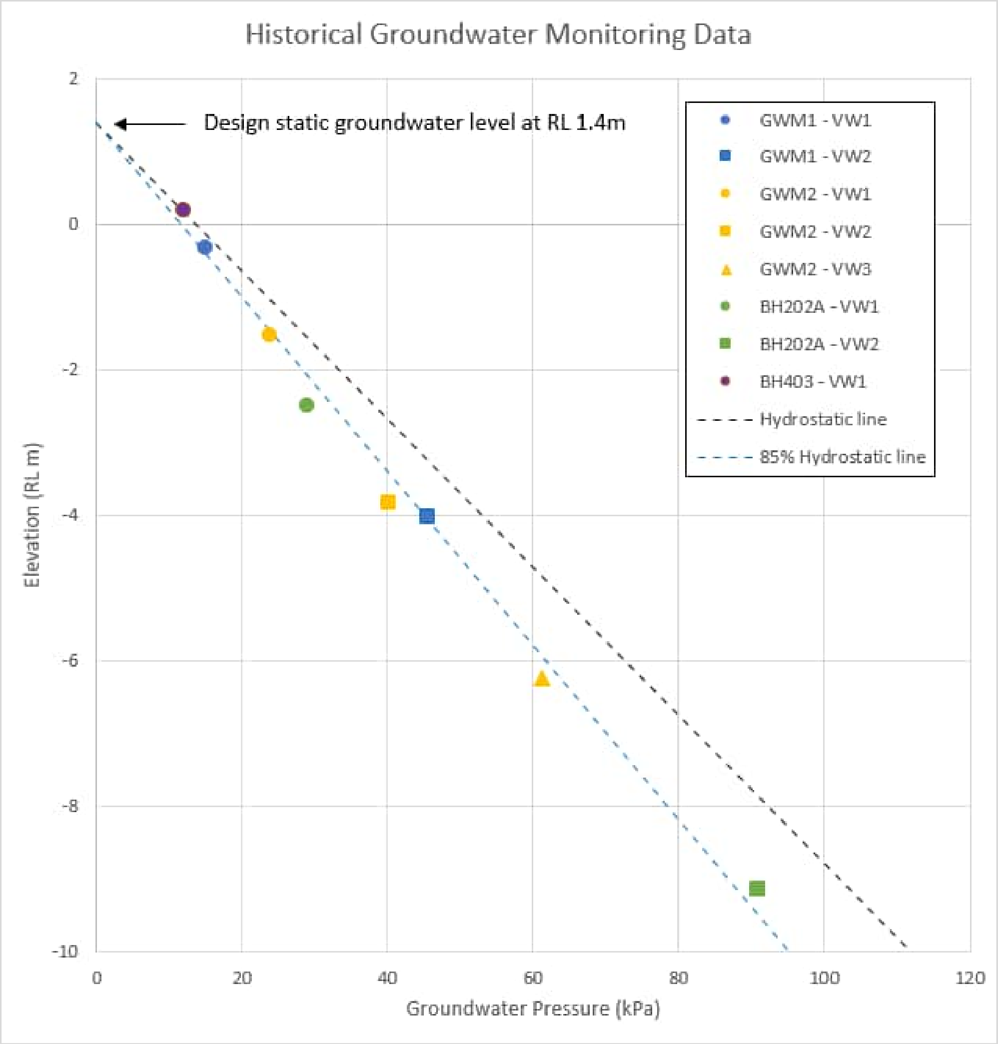


Figure 3.3: Historical groundwater monitoring records in the Site vicinity.

4 Geotechnical implications for preliminary design

The assessment presented in this report is for the redevelopment of the Site with a new structure consisting of up to five levels of basement (including lift pits and tanks), a podium structure over the Site footprint and two towers.

For this assessment, the B4 basement, which extends over the Site footprint, FFL has been assumed at RL -10.32 m. The bulk excavation level has been assumed at RL -12.32 m (allowing 1 m for basement slab and subbase for a tanked basement option, and 1 m for over-excavation). The over excavation allows for site concrete, waterproofing, temporary sumps / underdrains and potential adjustments of excavation level as the design develops. This does not include local excavations for ground beams, water tanks and/or lift pits which are remote from the perimeter but may extend below this level. The bulk excavation level is likely to be at RL -11.32 m (approximately 1 m shallower) should a permanent drained basement be adopted.

Groundwater drawdown effects have been considered adopting a deeper basement extent from previous iterations of design, allowing for bulk excavation up to -16.3 m RL. Because the basement excavation extends into rock, the additional drawdown effects of this deeper excavation are expected to be minimal. The sensitivity to localised excavation for water tanks and/ or lift pits has been accounted for in the groundwater drawdown assessment, with a localised excavation level of -21.0 m RL adopted. As the localised excavations are away from the perimeter walls, they are not expected to impact the retaining wall design.

For the assumptions noted above, a discussion of suitable foundation options, temporary and permanent groundwater considerations, retention options, seismic considerations and construction considerations are presented in subsequent sections.

4.1 Seismic considerations

4.1.1 Seismic shaking hazard

Seismic accelerations to be resisted by a structure are dependent upon the stiffness of the underlying soil/rock. Soft soils have the potential to amplify ground accelerations, requiring the structures built upon them to be designed to resist a higher seismic coefficient.

The ECBF rock level is expected to vary between approximate RL of -2 m to -7 m over the Site footprint, and it is anticipated that the entire basement footprint would be founded upon ECBF rock (or at least <3 m weathered ECBF soil). Therefore, the Site is considered to be classified as subsoil **Class B – Rock** in accordance with NZS 1170.5:2004 for the **design of building foundations**.

For the **design of retention structures** and to assess lateral actions on the basement walls, a subsoil **Class C – Shallow soil Site** is considered appropriate to allow for the amplification of seismic accelerations within the retained Reclamation fill / marine sediments behind the wall.

The PGA for geotechnical design has been calculated in accordance with MBIE/ NZGS Module 1[3] and are summarised in Table 4.1 below. We have assumed a structure design life of 50 years and the new structure will be classified as Importance Level (IL) 3 to calculate the peak ground accelerations (PGA) for geotechnical design. The structure design life and IL should be confirmed with the structural engineer and architect as the design of the development progresses.

---

[3] MBIE/ NZGS Module 1. (2021). Overview of the guidelines

Table 4.1: Design peak ground accelerations for geotechnical design

Design Element	Site Subsoil Class	Annual exceedance probability		PGA	Magnitude
Building Foundations	B – Rock	SLS	1 in 25	0.05	5.9
		ULS	1 in 1000	0.20 (0.19)	5.9 (6.5)
Retaining Walls	C – Shallow soil Site	SLS	1 in 25	0.05	5.9
		ULS	1 in 1000	0.20 (0.19)	5.9 (6.5)

The lower bound PGA and Magnitude as per Module 1 (2021) is provided as bracketed values.

4.1.2 Liquefaction assessment

Liquefaction describes a process where significant excess pore water pressures are generated in typically loose, saturated, generally cohesionless soil during earthquake shaking, causing the soil to undergo a partial to near complete loss in strength and stiffness. The occurrence of liquefaction is dependent on several factors, including the intensity and duration of ground shaking, soil density, particle size distribution and the elevation of groundwater.

Based on our experience at the Site and surrounding area, we expect thin layers within the Reclamation Fill and marine sediments may liquefy under ULS levels of earthquake shaking. Liquefaction is not expected to occur under SLS levels of earthquake shaking. Under ULS levels of earthquake shaking, typically only pockets of material are likely to liquefy and continuous liquefiable layers are unlikely to occur.

Liquefaction may occur within the soil retained by the perimeter retaining walls. Site specific investigations and more detailed analyses will be undertaken during detailed design to consider any increased lateral pressure loading on the basement walls if the surrounding material was to liquefy.

4.2 Foundation design considerations

The development superstructure will comprise two towers and three podium structures extending between approximately 30 m and 226 m above existing ground level, comprising up to 54 floor levels (excluding the podium). Structures of this size will impose significant foundation loading, including large uplift loads from wind / seismic loading and groundwater uplift (where tanked basements are implemented).

The B4 basement level (and additional lift pit excavations) are likely to be founded entirely below ECBF rock level across the Site. This allows for consideration of either (or a combination of) the following foundation options:

- Shallow strip, pad or raft foundations bearing directly upon ECBF rock. Where required, ground anchors and/or tension piles may be required to resist high uplift loads.
- Piled foundations – comprising either driven steel piles or bored cast insitu concrete piles.

Further details on each option are provided in subsequent sections.

4.2.1 Shallow foundations at B4 level

The subgrade across the assumed B4 basement level is anticipated to comprise slightly to unweathered ECBF rock. Shallow foundations comprising of strip, pad or raft foundations bearing upon this stratum are considered suitable to support anticipated design loads.

A geotechnical ultimate bearing capacity of 4 MPa, with a strength reduction factor of $\phi_g = 0.5$ may be used for preliminary design where the shallow foundations are directly bearing on ECBF rock.

Foundations settlements are anticipated to be within typical building tolerances where the above values are adopted.

Where shallow foundations are considered, ground anchors or tension piles may be required to resist uplift loads. For the preliminary design of ground anchors that have a fixed length within ECBF rock, a geotechnical ultimate shear strength capacity of 1000 kPa, with a strength reduction factor of ϕ_g = 0.5 may be used. When assessing pile uplift capacity, a further reduction factor of 0.67 should be applied to this capacity. The minimum free length, maximum fixed length, borehole and strand diameters and the corrosion protection details for the ground anchors should be confirmed as part of detailed design.

4.2.2 Driven UC Piles

Driven steel UC piles embedded in ECBF rock are considered to be an appropriate founding method, although noise and vibration issues will need to be addressed as discussed further in Section 4.7 and options for use of variable moment hammers and pressed sheetpiles are being considered.

Preliminary geotechnical design capacities for various UC pile sizes are presented in Table 4.2 below. The UCs should be driven to refusal with an appropriately sized hammer.

In accordance with AS2159[4], a strength reduction factor of ϕ_g = 0.5 should be applied to the geotechnical ultimate capacity, although the strength reduction factor could be increased to ϕ_g = 0.7 if 10% of the piles undergo Pile Dynamic Analysis ("**PDA**") testing.

Table 4.2: Design parameters for Driven UC Piles into ECBF Rock

Pile Type	Geotechnical ultimate capacity (kN)	Maximum ULS load if PDA testing not undertaken (ϕ_g = 0.5) (kN)	Maximum ULS load if 10% of piles subjected to PDA testing (ϕ_g = 0.7) (kN)
310UC97	2,330	1,165	1,630
310UC137	3,390	1,645	2,370
310UC158	3,800	1,900	2,660
310UC198	4,750	2,375	3,325
305x305x240	5,760	2,880	4,030
356x406x287	6,890	3,445	4,820
356x406x393	9,430	4,715	6,600
Note: Larger steel sections may be used but are not available ex stock in NZ. Equipment is presently available to drive sections up to a maximum of 202 kg/m			

4.2.3 Bored reinforced concrete pile foundations

Bored reinforced concrete piles embedded in the underlying ECBF rock are expected to be the preferred foundation option. These will generally be founded in the deeper, higher quality ECBF rock.

The vertical capacity for piles founded in ECBF rock has been assessed following the method outlined in Sinclair & Every (2006)[5]. Geotechnical ultimate capacities assessed using this method are presented in Table 4.3, based on average representative input parameters derived from Site-specific laboratory and in-situ pressuremeter testing, alongside historical data available in the vicinity of the Site. In addition, vertical pile springs have been provided for structural design, derived using

---

[4] AS2159 – 2009. *Australian Standard: Piling - Design and Installation*. SANZ

[5] Sinclair, T.J.E. & Every, C.P. (2006). *Designing for Rock Socket Piles.*

representative lower and upper-bound input parameters to capture the expected range of stiffness response. These are presented in **Appendix J** for typical pile diameters and lengths proposed.

Table 4.3: Preliminary bored pile design parameters

Geological unit	Anticipated level of unit (RL m)	Geotechnical ultimate capacity (kPa)		Ultimate Limit State (ULS) capacity ϕg = 0.5 (kPa)	
		Skin friction(2)	End Bearing(1,3)	Skin friction(2)	End Bearing(1,3)
ECBF rock	-2 to -7	500 (smooth) 800 (grooved)	10,000	250 (smooth) 400 (grooved)	5,000
Notes	(1)	Requires an embedment of at least 3 pile diameters into geological unit to mobilise end bearing capacity, otherwise reduce end bearing to ⅔ of recommended values			
	(2)	When assessing pile uplift capacity, a further reduction factor of 0.67 should be applied to the presented skin friction values.			
	(3)	Pile group effects have not been allowed for in the above values. This will need to be considered for closely spaced pile foundations.			

Where piles are installed from current Site levels, temporary support (i.e. casing / fluid support) will be required to support the Reclamation Fill, Marine sediments and Pleistocene Alluvium. Excavations with ECBF rock are expected to remain open during pile construction.

The basement retention presented in Section 4.5 has not been designed to support building loadings. Where this is proposed to be adopted also as a building foundation, the Structural engineer should review the vertical capacity and embedment accordingly.

Elastic shortening of the pile should be considered by the structural engineer. Based on preliminary load information, it is anticipated that elastic pile shortening will have a similar magnitude as the anticipated pile settlement / displacement.

Lateral pile springs were developed using the geotechnical pile analysis software LPile for piles founded within ECBF rock. These were developed for both pinned-head and fixed-head connections for pile diameters of 2.4 m (P1), 1.8 m (P2), and 1.2 m (P3). Summary plots of the springs are presented in **Appendix K**. For closely spaced piles (less than 8 x pile diameter), appropriate group effects should be applied to the provided springs.

4.3 Basement wall springs

The basement walls will provide lateral resistance to the structure through passive earth pressures under loads perpendicular to the wall axis, and through sliding resistance under loads parallel to the wall axis.

Passive soil springs were generated to represent the force-displacement relationship (backbone curves) to mobilise these passive pressures based on the methodology proposed by Tehrani et al. (2016)[6]. For the retained soil overlying ECBF rock, undrained shear strengths of 20 to 50 kPa were adopted for lower and upper bound spring stiffnesses for the development of these springs, which are conservatively based on the strength of the reclamation fill / marine sediments, which predominantly overlies the ECBF rock.

Passive lateral springs for the basement walls below ECBF rock were assessed using LPile software, due to the limitations of modelling weak rock using the Tehrani method.

---

[6] Khalili-Tehrani, P., Shamsabadi, A., Stewart, J. P., & Taciroglu, E. (2016). Backbone curves with physical parameters for passive lateral response of homogeneous abutment backfills. Bulletin of Earthquake Engineering, 14(11), 3003-3023.

Preliminary lateral springs for structural design are presented in **Appendix K**. These should be reviewed during detailed design following confirmation of the basement / foundation depth, size, and layout.

4.4 Groundwater drawdown

4.4.1 General

The proposed four-level basement excavation will extend below the groundwater and require temporary dewatering.

Dewatering of the Site (and beyond) has the potential to cause settlement of the surrounding ground due to the additional pressure applied to the soil skeleton as groundwater is removed. The reclamation fill and underlying marine deposits are considered highly compressible, and control of groundwater drawdown within these units is a key settlement risk. Groundwater drawdown within the ECBF bedrock underlying these deposits has been observed to result in negligible settlements in nearby projects such as Commercial Bay and City Rail Link ("**CRL**").

A partially drained Site is expected to be used for construction with an impermeable perimeter wall installed prior to earthworks to provide groundwater cut-off to the excavation. For concept design, the perimeter cut-off walls are to be founded within embedment into the ECBF rock to minimise potential drawdown of the overlying compressible soils. For the permanent structure, both a drained and tanked basement has been considered at this stage.

For preliminary design, a maximum temporary excavation level has been adopted at **RL -16.3 m**, to allow for over dig, Site concrete, waterproofing, temporary sumps / underdrains and potential adjustments of excavation level. This is deeper than currently proposed and is therefore a conservative assessment of effects. Localised excavation to accommodate lift pits, water tanks etc. has also been considered for groundwater drawdown assessment (where appropriate, with a maximum excavation level of RL -21.0 m considered).

4.4.2 Methodology

Numerical analysis was undertaken using GeoStudio the finite element software package[7]. SEEP/w was used to assess the effects of the basement excavation on the surrounding groundwater regime and change in effective stress, which was then modelled in SIGMA/w to estimate ground settlement. A total of 4 No. analysis sections of groundwater drawdown and settlement have been undertaken as summarised below, and presented on Figure 4.1:

- <u>Section 1a (West)</u> – located at the south-west corner of the basement excavation. Modelled to assess the impact on underground services within Lower Hobson Street and Tepid Baths / Watermark Buildings. Diaphragm cut-off wall modelled.
- <u>Section 1b (East)</u> – located at the south-east corner of the basement excavation. Modelled to assess the impact on the neighbouring AON tower. Sheet pile cut-off wall modelled.
- <u>Section 2a (West)</u> – located at the north-west corner of the basement excavation. Modelled to assess the impact of excavation on underground services within Lower Hobson Street, 204 Quay Street and the M Social Building to the north. Diaphragm cut-off wall modelled.
- <u>Section 2b (East)</u> – located in the north-east corner of the basement excavation. Modelled to assess the impact on the neighbouring HSBC and AON tower. Diaphragm cut-off wall modelled.

---

[7] GeoStudio 2021.3 SEEP/W & SIGMA/W module; version 11.2.2.23310.

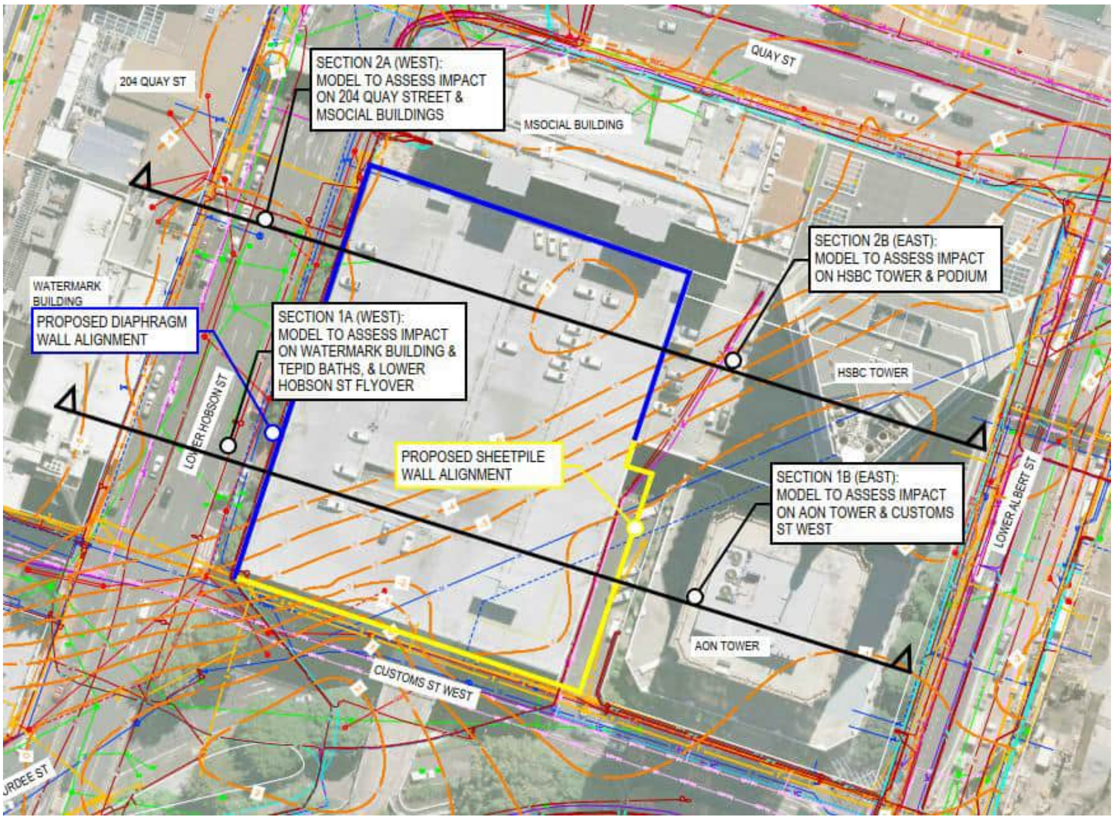


Figure 4.1: Indicative alignments of the groundwater drawdown analysis sections.

The following design cases were considered:

- Transient analysis for a 12-month drained construction period.
- Steady-state analysis for options of both a permanent drained and tanked basement.

4.4.3 Hydrogeological design parameters

Hydrogeological design parameters are presented in Table 4.4 below. These have been adopted based on the parameters derived and adopted from CRL and Commercial Bay developments in proximity to the Site.

For concept design, settlements were assessed in SIGMA/W adopting ‘isotropic elastic’ soil models to model the stiffness of the soil / rock. Elastic modulus values were derived based on available in-situ testing from borehole and CPTs undertaken in proximity to the Site, alongside our experience with similar geological units.

Table 4.4: Design parameters for groundwater and settlement assessment

Geological unit	Horizontal Permeability, k_h (m/s)	Vertical Permeability, k_v (m/s)	Equivalent Stiffness (MPa)
Reclamation Fill / Marine Sediments	3×10^{-5}	1×10^{-6}	6
Pleistocene Alluvium	2×10^{-7}	4×10^{-9}	20
Weathered ECBF	2×10^{-7}	4×10^{-9}	40
ECBF Rock	5×10^{-7}	5×10^{-8}	200

4.4.4 Initial groundwater conditions & historical drawdown

The initial groundwater conditions were defined in the SEEP/w model by applying the adopted groundwater pressures with depth at the model boundaries. The resulting modelled pre-construction groundwater levels have then been checked against available groundwater level monitoring records in the area.

When estimating potential settlements due to dewatering, it is important to allow for historical human and natural influences, otherwise settlements will likely be greatly overestimated. The historical changes in effective stresses mean that the soil has been effectively preconsolidated to some extent, and significant consolidation settlements due to groundwater drawdown are only expected to occur once groundwater decreases below previous low groundwater levels. Historical excavations at or near the Site would have caused groundwater drawdown and settlement in the area of the Site previously. Drawdown within this historical variation range is likely to result in negligible to minor settlements, as most consolidation settlements associated with this groundwater change have already occurred.

Given the high-density of development in the area surrounding the Site, including the neighbouring two-level basement at 188 Quay Street (HSBC Tower) and CRL tunnel excavation less than 100 m east of the Site, it is anticipated significant historical drawdown / settlement has occurred.

4.4.5 Retaining wall permeability design parameters

Two wall types have been modelled for concept design:

Diaphragm Wall

An 800 mm wide diaphragm wall has been modelled. The wall has been extended a minimum of 4 m below temporary excavation level to RL -20.3 m (allowing for deeper excavation level). **The design embedment of the wall will be confirmed during detailed design.**

The permeability of the walls has been modelled assuming some leakage during construction by assuming a permeability significantly greater than that of concrete. The following permeability values have been adopted:

- Construction phase: 1×10^{-10} m/s
- Permanent (i.e. where waterproofed above excavation level): 1×10^{-12} m/s (effectively impermeable)

Sheet pile walls

Sheet pile walls have been modelled in the south-east and south basement perimeter where ECBF rock is inferred to be encountered at shallower depths. The design has allowed for a minimum embedment into the ECBF rock of 1.5 m, which is anticipated to be achievable for a sheet pile for the section size modelled (Arcelor AU25).

For sheet piles along the south and south-east boundaries of the Site there is a potential opportunity to remove the 1 m wide rock shelf. To realise this opportunity:

- The tie-back at the toe of the sheet pile will need to be installed with a shallower decline (approximately 15°). As rock level is inferred to rise to the south and south-east, it is likely to be feasible to install the tie-back at the toe of the wall at a shallower incline.
- The tie-back at the toe of the sheet pile will be pre-stressed to provide sufficient normal force against the rock to resist vertical actions due to the tie-back rows installed at higher elevations for the sheet pile wall.
- There is a risk that sheet pile elements with the tie-back may be dragged down relative to the adjacent elements. This may require strengthening by welding between panels/ waler beams to tie the panels together.
- There is a risk of leakage at the toe of the sheet pile wall without the rock shelf. This may require additional grouting of the toe to minimise groundwater flow.

This opportunity will be further developed during the developed and detailed design stages.

For this assessment we have assumed a permeability of $k_s = 8 \times 10^{-9}$ m/s over a thickness of 0.25 m for the sheet piles. In practice, the permeability of the sheet piles will depend on the water tightness of the interlock between sheets. Leakage could occur at joints unless adequate sealants are applied to reduce flow.

4.4.6 Analysis results

Analysis results are summarised in Table 4.5 below.

Table 4.5: Summary of SEEP/W & SIGMA/W analyses

Design case		Maximum pressure head reduction (m)		Maximum Drawdown Settlement (mm)
		Surficial Deposits	ECBF Rock	
Section 1a (West)	Construction (12 months)	0.7	11.5	5
	Permanent Drained	0.7	11.4	
	Permanent Tanked	0.0	0.0	
Section 1b (East)	Construction (12 months)	0.4	18.2	2
	Permanent Drained	0.2	16.0	
	Permanent Tanked	0.0	0.0	
Section 2a (West)	Construction (12 months)	0.6	11.0	2
	Permanent Drained	0.6	11.0	
	Permanent Tanked	0.0	0.0	
Section 2b (East)	Construction (12 months)	0.3	10.7	2
	Permanent Drained	0.3	10.7	
	Permanent Tanked	0.0	0.0	

4.4.7 Hydrostatic uplift of basement slab

Where a permanent tanked basement is adopted, the basement slab will also require assessment for hydrostatic uplift pressures. These uplifts pressures should consider potential long-term groundwater levels which may be expected over the life of the structure (i.e. sea level rise etc.).

These uplift pressures can be resisted using bored piles (refer to Table 4.3 for preliminary capacities) or through the use of tension anchors (refer Section 4.2.1).

4.4.8 Groundwater inflows

Inflow estimates are provided in Table 4.6 below.

Table 4.6: Construction stage and permanent groundwater inflows

Wall Type	Design inflow (assuming 90 m x 70 m floor area) (m^3/day)
Sheet Pile + ECBF open-cut	30 to 60
Diaphragm wall (full-length)	20 to 40

The upper range for construction allows for typically higher rates of inflow observed shortly after excavation has occurred while the lower rate is more typical summer conditions. Inflow rates exclude surface water and rainfall, which should be assessed separately. Groundwater stored within the soil material will also drain as the material is excavated and an allowance should be made to capture this as the excavation proceeds.

It is noted that these estimates are determined using conservative parameters and may be compared qualitatively with measured flows in other buildings with permanently drained basements. Recorded groundwater flows on nearby drained basements at Downtown (prior to Commercial Bay) and ANZ Building on Albert St, indicate flows of between 1 m^3/day and 3 m^3/day, respectively. This scales to approximately 5 to 10 m^3/day for the proposed basement project, which is significantly less than those estimated above.

While significant inflows through walls during construction can be sealed (grouted) as the excavation progresses, groundwater inflows into the excavation could be significantly affected by the quality of the diaphragm and sheet pile wall construction. This risk can be mitigated by adopting good construction practices (such as sufficient overlap between the joint between the diaphragm and sheet pile wall) to ensure effective groundwater cut-off is achieved.

Significant local inflows may occur due to presence of persistent faulting / open joints within the basement excavation which provide connectivity to the Waitemata Harbour, as was encountered during the Britomart Station excavation. If encountered, grouting of these features would be required to limit the flow, which may add significant cost / time delay to the project.

Where a fully drained basement is considered, an underdrainage system should be installed discharging via gravity or pumping to a reticulated stormwater system suitable to discharge groundwater flows estimated in Table 4.6 above. This drainage system should be designed by a suitably qualified engineer, and may typically comprise of (refer Figure 4.2):

- Minimum 200 mm thick permeable hardfill layer across the basement slab.
- 200 mm deep by 200 mm wide subsoil drains with perforated drain pipes (110 mm dia drainage coil) installed at regular intervals both north-south and west-east beneath the basement slab, interconnected for redundancy.
- Inspection points should be available at the ends of each subsoil pipe for clearing where required.
- Relief valves to operate in the event of extended pump or power failure

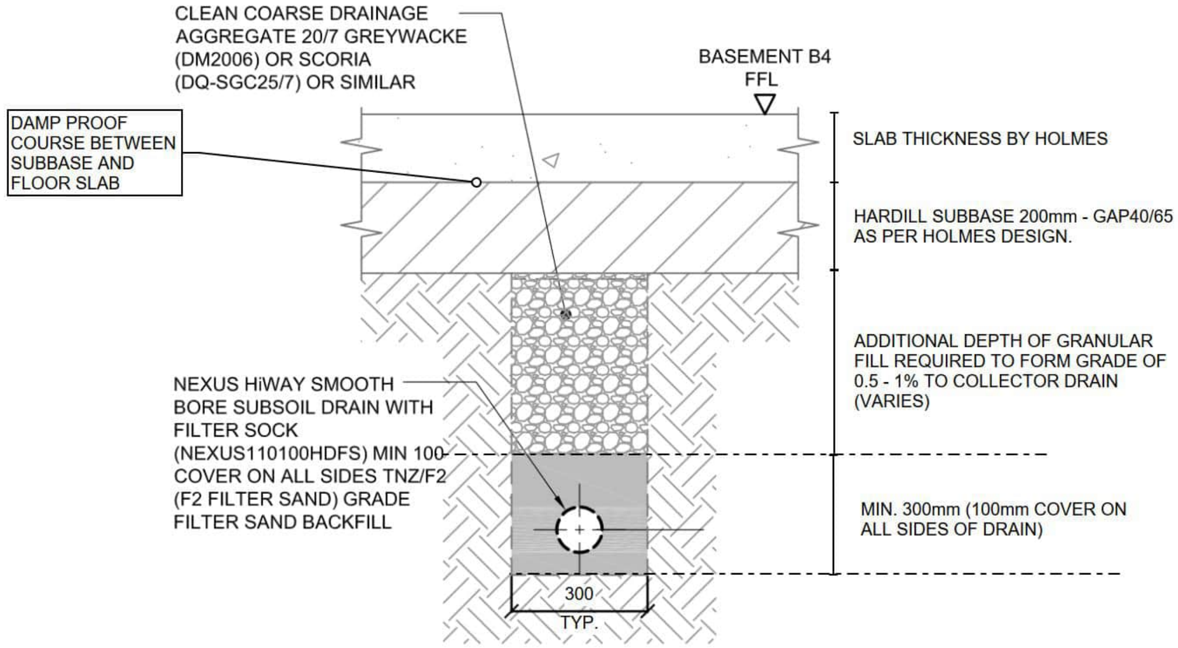


Figure 4.2: Typical subsoil drainage cross-section.

A subsoil collector drain should be installed inside the perimeter of the basement retaining wall to collect groundwater flow and re-direct to a sump/discharge point. As outlined above, our assessment has estimated 20 – 40 m^3/day using conservative assumptions. This is consistent with published standards, e.g. French Standard NF DTU 14.1, which recommends limiting inflows to less than 0.5l/m^2/day. Pumps within the basement should be adequately sized to manage these groundwater flows, however, it is noted that significantly lower flow rates have been observed in several drained basements in the Auckland CBD (Downtown Centre and ANZ Building) which suggests these values will be conservative.

4.4.9 Potential for groundwater mounding

Lateral groundwater flow towards the harbour may be impeded by the installation of diaphragm and sheet pile walls for the basement excavation. However, the potential for groundwater mounding is considered to be low given the reasonably high horizontal permeability of the reclamation fill and marine sediments, and as groundwater flow to the harbour are not impeded along Lower Hobson Street, along the eastern boundary of the Site, and Lower Albert Street. The development is on the western shoulder of the spur ridge of ECBF rock and hence will not be affected by any effects of deep basement structures to the east.

The potential for groundwater mounding will be considered further during detailed design, and if required mitigation measures such as installation of highly permeable trenches around the wall perimeter to redivert groundwater flows will be considered.

4.4.10 Potential for cumulative effects of a drained basement

As outlined above, the HSBC Tower operates a two-level drained basement located approximately 10 m from the edge of the proposed basement. Groundwater monitoring undertaken approximately 5m from the HSBC basement edge (BH02) indicates this has had only minor effect on the shallow groundwater regime to date, with groundwater levels recorded generally 0.5 m shallower than other parts of the Site.

Given the limited groundwater drawdown anticipated from the proposed basement due to the presence of the diaphragm wall cut-off, no significant cumulative lowering of the groundwater table is expected between the two basements. Although the proposed basement will ultimately operate as a drained structure, the internal drainage system will act only to intercept minor seepage inflows that bypass the diaphragm wall or enter through the founding rock. The rate of long-term groundwater take within the basement is therefore expected to be low, and the associated zone of influence will remain confined to the immediate wall perimeter.

In addition, the Site is located in close proximity to the harbour, where shallow groundwater is subject to frequent recharge, which provides a rapid mechanism for groundwater level recovery and further limits the potential for any long-term or cumulative drawdown effects.

Accordingly, the combined operation of both drained basements is not expected to result in any measurable cumulative effects on near-surface groundwater levels or on the wider hydrogeological regime.

4.5 Retaining wall design considerations

4.5.1 General

To support the proposed basement excavation, the following retention options have been modelled:

- Diaphragm wall – to support the entire western and northern extents, and the northern section of the eastern perimeter wall.
- Steel sheet pile walls – to support the entire southern extent, and the southern section of the eastern perimeter wall.

Groundwater cut-off will be required to be maintained where the two wall types join. This may be done during construction by casting a steel sheet into the outside edge of the diaphragm wall. Should noise and vibration concerns not permit the use of the steel sheet piles (as discussed in Section 4.7), a diaphragm wall and/or secant pile walls may also be considered in these areas.

Geotechnical analyses of the retaining walls have been undertaken using pseudo non-linear finite element software WALLAP[8]. The design of the retaining walls has been undertaken to achieve an adequate factor of safety during construction and the long-term / permanent case, and to minimise wall deflections and potential ground settlement.

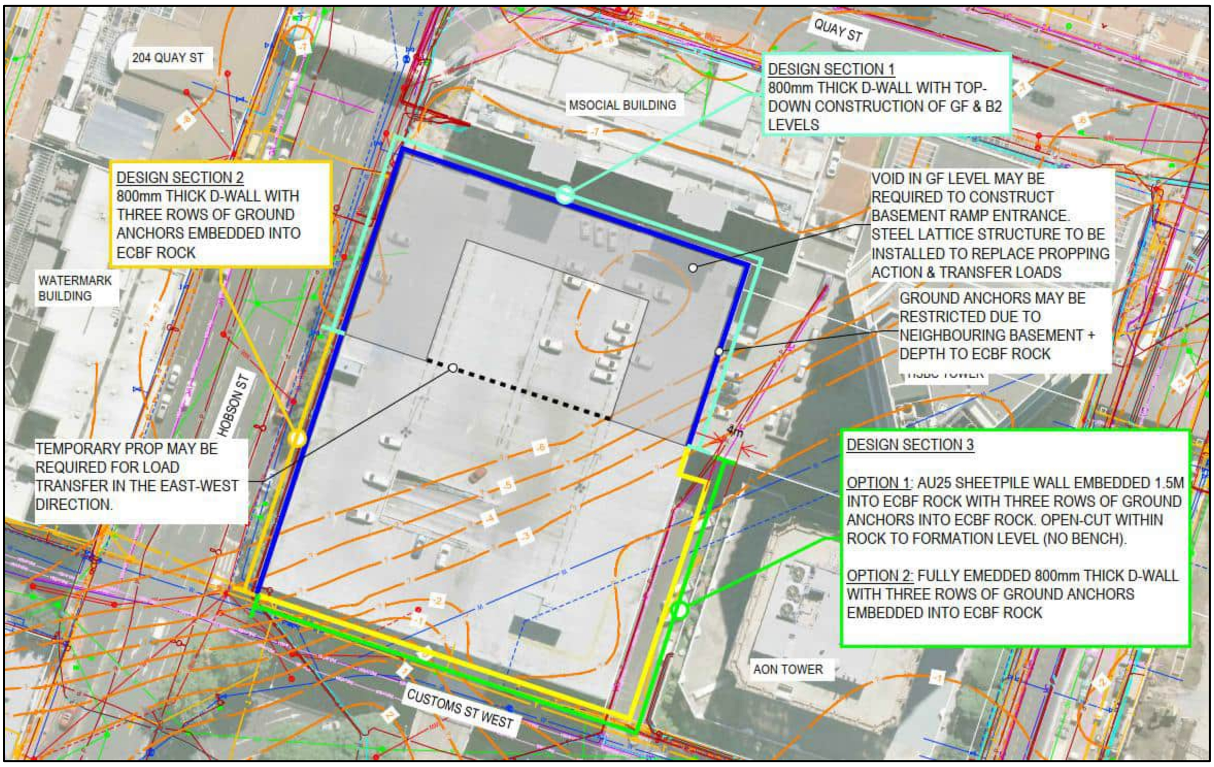
Retaining wall analyses for 3 No. design sections has been completed for the proposed basement excavation. The following summarises these design sections:

- Section 1 – north-west corner of the basement. This section represents the top-down construction methodology adopting an 800 mm thick Diaphragm wall and two-levels of permanent floor slab supports across the northern section of the basement perimeter and the northeast and northwest extents, as shown in Figure 4.3.
- Section 2 – western basement perimeter. This section represents bottom-up construction methodology adopting an 800 mm thick Diaphragm wall and multi-level ground anchors to provide lateral restraint.
- Section 3 – eastern and southern basement perimeter. This section represents bottom-up construction methodology adopting a sheet pile wall and multi-level ground anchors to provide lateral restraint.

The location of the above sections is shown on Figure 4.3 below. The following sections provide details of the analysis undertaken.

---

[8] Geosolve (2013). *WALLAP. Anchored and Cantilevered Retaining Wall Analysis Program.* Version 6.05.



DESIGN SECTION 1
800mm THICK D-WALL WITH TOP-DOWN CONSTRUCTION OF GF & B2 LEVELS

DESIGN SECTION 2
800mm THICK D-WALL WITH THREE ROWS OF GROUND ANCHORS EMBEDDED INTO ECBF ROCK

VOID IN GF LEVEL MAY BE REQUIRED TO CONSTRUCT BASEMENT RAMP ENTRANCE. STEEL LATTICE STRUCTURE TO BE INSTALLED TO REPLACE PROPPING ACTION & TRANSFER LOADS

GROUND ANCHORS MAY BE RESTRICTED DUE TO NEIGHBOURING BASEMENT + DEPTH TO ECBF ROCK

TEMPORARY PROP MAY BE REQUIRED FOR LOAD TRANSFER IN THE EAST-WEST DIRECTION.

DESIGN SECTION 3

OPTION 1: AU25 SHEETPILE WALL EMBEDDED 1.5M INTO ECBF ROCK WITH THREE ROWS OF GROUND ANCHORS INTO ECBF ROCK. OPEN-CUT WITHIN ROCK TO FORMATION LEVEL (NO BENCH).

OPTION 2: FULLY EMEDDED 800mm THICK D-WALL WITH THREE ROWS OF GROUND ANCHORS EMBEDDED INTO ECBF ROCK

Figure 4.3: Retaining wall modelling design section alignment.

4.5.2 Geotechnical parameters

The parameters presented in Table 4.7 have been adopted for this assessment, which are based on the available geotechnical investigations in the Site area and our experience with similar geological units.

Table 4.7: Retention geotechnical design parameters

Design parameter		Units	Reclamation Fill / Marine Sediments	Pleistocene Sediments	Weathered ECBF	ECBF rock
Unit weight	γ	kN/m^3	16.5	17.5	19	21
Effective friction angle	ϕ	deg	28	30	32	40
Effective cohesion	c’	kPa	3	5	7	100
Poisson’s ratio	v’	-	0.3	0.3	0.3	0.25
Equivalent linear modulus of elasticity (1)	E’	MPa	6	20	40	400

To calculate the active and passive pressure coefficient, the following wall friction coefficients have been assumed for the wall types modelled:

- Concrete: assumed to be 2/3 of the soil friction angle on the active side, and ½ of the soil friction angle on the passive side of the wall.
- Steel: assumed to be ½ of the soil friction angle on the active side, and 1/3 of the soil friction angle on the passive side of the wall.

4.5.3 Wall structural parameters

Two wall types have been modelled for preliminary design:

An 800 mm wide diaphragm wall has been modelled. The stiffness of the fully embedded retaining wall has been calculated adopting the following cracked section moduli for each stage in accordance with CIRIA guidance[9]:

- Construction stage – 75% of gross value
- Long-term / elevated groundwater case – 50% of gross value
- Seismic case – 25% of gross value

Arcelor AU25 sheet piles have been modelled for preliminary design of the sheet pile wall.

The wall section properties adopted in the analysis are summarised in Table 4.8 below.

Table 4.8: Wall structural properties

Wall type	Modulus of Elasticity (GPa)	Second moment of inertia, I_{gross} (m^4 / m run)	Wall Flexural Stiffness (kNm^2 / m run)
800 mm thick D-wall	27.4	4.27×10^{-2}	1,170,000
Arcelor AU25 Sheet piles	210	5.62×10^{-4}	118,100

4.5.4 Temporary lateral support properties

Adopted temporary prop / anchor support parameters are given in Table 4.9 below.

Table 4.9: Temporary prop properties

Prop Type	Section area (m^2)	Elastic modulus, E (GPa)
GF and B2 Partial floor support constructed top-down	0.4 x 1.0	27.4
5 x 15.2 mm VSL strand anchors	7.17×10^{-4}	210
7 x 15.2 mm VSL strand anchors	1.003×10^{-3}	210
12 x 15.2 mm VSL strand anchors	1.720×10^{-3}	210

It is assumed that internal props or anchors installed at or near the ground level will be supported at the perimeter capping beam. Where lateral supports are installed at lower elevations, walers may be required to be incorporated as part of the design to distribute the loading between piles.

In the top-down case, partially constructed floors are modelled conservatively as continuous 0.4 m thick slabs of reinforced concrete. It is anticipated that the floors may be constructed in a 'U-shape' around the perimeter of the excavation to maintain an open pit near the centre of the excavation. However, to transfer shear load from the west and east walls, temporary propping may be required spanning across the southern extent of the floor slabs.

In WALLAP, the temporary floors are applied at the mid-slab elevation, modelled with a span equal to the total basement width for each section.

---

[9] CIRIA (2017). *CIRIA C760. Guidance on embedded retaining wall design.*

4.5.5 Permanent lateral supports

The permanent floors are modelled as continuous slabs of reinforced concrete. The B1 and B3 levels, which were not were not utilised as top-down supports, were modelled as 0.2 m thick slabs. The B4 floor has been modelled as a 0.8 m thick raft foundation. In WALLAP, the permanent floors are applied at the mid-slab elevation and the prop free length was adopted as a span equal to half of the basement width for each section (or maximum 30 m).

The following summarises the floor levels assumed for preliminary design:

• B4 Basement Level:	FFL -10.32 m RL
• B3 Basement Level:	FFL -7.32 m RL
• B2 Basement Level:	FFL -4.32 m RL
• B1 Basement Level:	FFL -1.32 m RL
• GF Level:	FFL +4.18 m RL

4.5.6 Construction methodology

The following construction methodologies have been assumed in the Preliminary Design. The bulk excavation level provides an allowance for up to 1.0 m excavation below the B4 basement formation level for the base slab and sub-slab build up, drainage and contingency for disturbance / over-dig.

At the northern end of the Site construction will be top-down with installation of the perimeter wall. Top-down support will be provided by GF and B2 floor slabs. A void in a section of the GF slab may be required in the north-eastern corner to form the basement ramp entrance. A cut-out or temporary steel lattice structure will be required in this area to replace the propping action of the slab and transfer loads to the diaphragm wall. Access for excavation will be from the south.

At the western end of the Site, the basement excavation will be retained by a diaphragm wall with three-rows of ground anchors founded within the ECBF rock and/or internal props. Part of this wall may be constructed using pressed piles or secant piles between the existing carpark belled piles.

The southern and south-eastern perimeter, a sheet pile wall is proposed with three-rows of ground anchors founded within the ECBF rock. Once excavation proceeds to ECBF rock, an open-cut excavation would be undertaken vertically within the ECBF below the toe of the sheetpiles. Temporary support with rock bolts with mesh facing and/or shotcrete may be required to stabilise the rock cut as excavation proceeds. Horizontal drains may also be required in the rock cut to temporarily relieve groundwater pressures near the cut face. Alternatively, a diaphragm wall with three-rows of ground anchors and/or internal props may be considered.

The concept design basement retention layout is presented in **Appendix H**, and design sketches for the respective WALLAP sections are also provided.

The following summarises the construction methodology assumed for the WALLAP analysis:

Section 1 – Top-down Diaphragm wall

1. Install guide wall and 800 mm thick diaphragm wall with a toe level at RL -16.32 m.
2. Install 400 mm thick GF level slab.
3. Excavate to no deeper than RL -5.0 m and install 400 mm thick B2 level floor slab.
4. Excavate to no deeper than RL -12.32 m and install B4 level slab.
5. Install B3 and B1 level slabs.
6. Apply elevated groundwater design scenario.
7. Apply seismic design scenario.

Section 2 – Anchored Diaphragm wall

1 Install guide wall and 800 mm thick diaphragm wall with a toe level at RL -16.32 m.

2 Excavate no deeper than RL 2.0 m and install 7 x 15.2 mm VSL strand ground anchors at 2.5 m c/c spacing and inclination of 30°, at RL 2.5 m. Pre-stress anchor to 150 kN.

3 Continue excavation to no deeper than RL -2.4 m and install 7 x 15.2 mm VSL strand ground anchors at 2.5 m c/c spacing and inclination of 30°, at RL -1.9 m. Pre-stress anchor to 200 kN.

4 Excavate no deeper than RL -6.5 m and install 12 x 15.2 mm VSL strand ground anchors at 2.0 m c/c spacing and inclination of 20°, at RL -6.0 m. Pre-stress anchor to 400 kN.

5 Excavate to no deeper than RL -12.32 m and install B4 slab.

6 Install B3 and B2 slabs, and remove low-level ground anchors at RL -6.0 m.

7 Install B1 and GF slab and remove ground anchors at RL -1.9 m and RL 2.5 m.

8 Apply elevated groundwater design scenario.

9 Apply seismic design scenario.

Section 3 – Anchored Sheet pile wall

1 Install Arcelor AU25 sheet piles with a minimum toe embedment of 1.5 m into ECBF rock.

2 Excavate no deeper than RL 2.0 m and install 5 x 15.2 mm VSL strand ground anchor at 3.0 m c/c spacing and inclination of 45°, at RL 2.5 m. Pre-stress anchor to 200 kN.

3 Continue excavation to no deeper than RL -1.0 m and install 5 x 15.2 mm VSL strand ground anchor at 3.0 m c/c spacing and inclination of 35°, at RL -0.5 m. Pre-stress anchor to 200 kN.

4 Continue excavation to no deeper than RL -5.0 m and install 5 x 15.2 mm VSL strand ground anchor (or 40 mm Macalloy rock anchor) at 3.0 m c/c spacing and inclination of 15°, at RL -4.8 m. Pre-stress anchor to 100 kN.

5 Excavate vertical rock-cut below the sheet pile wall (with temporary support with rock bolts and mesh / shotcrete as required) to no deeper than RL -12.32 m.

6 Install permanent basement wall and internal floor slabs. Backfill between sheet piles and permanent wall.

The section analysed above represents the ‘critical’ section adopting the highest depth to rock based on the current ground profile. The elevation of the rock shelf and anchor supports will be adjusted as the depth to rock and ground level behind the excavation changes (generally rising to the south / east). This will be considered during detailed design.

4.5.7 Surcharge loading

The analyses have been undertaken adopting a design construction traffic surcharge of 12 kPa. The neighbouring structures in close proximity to the development are all anticipated to be on piled foundations, and therefore will impose negligible surcharges at the ground surface.

4.5.8 Groundwater Levels

Design static groundwater levels have been adopted at RL 1.4 m, which is consistent with typical winter groundwater levels recorded surrounding the proposed basement, as presented in **Appendix F**. This is above groundwater levels recorded in the recent standpipe installations during Winter 2025.

Long-term high groundwater levels have been adopted at RL 2.5 m (approximately 1 m below ground level).

4.5.9 Seismic loading

For the design of piled retaining walls permanently propped by the internal basement structure recommendations for ‘stiff’ walls (i.e. deflection<0.4%H) have been adopted as recommended by NZGS Module 6: Earthquake Resistant Retaining Wall Design. This seismic load component is calculated by the following formula and applied midway up the retained height (i.e. modelled as uniform distribution):

$$\Delta P_E = 0.6.K_h.\gamma.H^2$$

Where: K_h is the earthquake acceleration design coefficient determined from MBIE module 6 eq.5-1
γ = bulk unit weight of retained soil (adopt typical 17.5 kN/m^3)
H = Permanent retained height

4.5.10 Analysis results

Analysis results are summarised in Table 4.10 below.

Table 4.10: WALLAP analysis results

	Section			**Design Section 1**	**Design Section 2**	**Design Section 3**
	Location			**Northern section**	**Western perimeter**	**South and south-east perimeter**
Wall	Retained ground level		mRL	4.0	4.0	4.0
	Design pile toe		mRL	-16.32	-16.32	-6.0
	Wall Type			800 mm D-Wall	800 mm D-Wall	AU25 Sheet pile
Description of props	Prop / anchor 1	Prop Type	-	0.4 m thick floor slab (GF)	7 x 15.2 mm VSL ground anchor	5 x 15.2 mm VSL ground anchor
		Level	mRL	4.0	2.5	2.5
		Spacing	m	-	2.5	3.0
		Inclination	deg.	0	30	45
		Pre-stress	kN	-	150	200
	Prop / anchor 2	Prop Type	-	0.4 m thick floor slab (B2)	7 x 15.2 mm VSL ground anchor	5 x 15.2 mm VSL ground anchor
		Level	mRL	-4.5	-1.9	-0.5
		Spacing	m	-	2.5	3.0
		Inclination	deg.	0	30	35
		Pre-stress	kN	-	200	200
	Prop / anchor 3	Prop Type	-	-	12 x 15.2 mm VSL ground anchor	5 x 15.2 mm VSL ground anchor
		Level	mRL	-	-6.0	-4.8
		Spacing	m	-	2.5	3.0
		Inclination	deg.	-	20	15
		Pre-stress	kN	-	400	100
Design actions	Deflection (ground level)		mm	2	24	16
	Deflection (maximum)		mm	18	24	18
	Max. Deflection Level		mRL	-6.9	4.0	-1.4

	Section			Design Section 1	Design Section 2	Design Section 3
	Location			Northern section	Western perimeter	South and south-east perimeter
	Bending moment (max)		kNm/m	670	475	170
	Shear force (maximum)		kN/m	430	425	185
	Max. force at support **(horizontal loads(1))**	Prop / anchor 1	kN/m	180	115	210
		Prop / anchor 2	kN/m	730	110	300
		Prop / anchor 3	kN/m	-	780	575
Actions – static/seismic	Bending moment (max)		kNm/m	465	230	-
	Shear force (maximum)		kN/m	420	250	-
	Static force applied to the prop	GF	kN/m	165	130	-
		B1	kN/m	245	320	-
		B2	kN/m	735	435	-
		B3	kN/m	235	445	-
		B4	kN/m	480	355	-

(1) Prop / anchor forces are presented as horizontal forces at the wall face only in per m length of wall. Where supports are installed at an inclination, the actual force within the support will need to be calculated. For anchors spaced at intervals along the wall, loads should be scaled for anchor spacing to determine the load per anchor.

4.5.11 Further retaining wall design considerations

The retaining wall design presented meets the minimum requirements to achieve acceptable deflections for both groundwater and mechanical settlements, for the purposes of an application under the FTAA.

During developed design, detailed analysis using finite element software will be undertaken to consider the following:

1. The wall design currently allows for a minimum 4 m toe embedment for the diaphragm wall sections, and minimum 1.5 m toe embedment for the sheet pile wall sections. Detailed design will test sensitivity for a fault zone / joint at the base of the excavation. This may require a contingency for an extension of the pile embedment, or installation of low-level anchors / props to stabilise the base of the wall. Further analysis should be undertaken to confirm suitable design options as part of detailed design.
2. There is potential for high hydrostatic water pressures within the ECBF rock to cause the diaphragm wall panels to 'lift' off the rock face (i.e. wall deflection in excess of relaxation in the rock). This could result in a gap to form between the wall and the rock face affecting shear transfer and affecting leakage flows. This may require consideration of pre-stressing of the lower floor levels (B4) and/or installation of low-level ground anchors and will be considered as part of detailed design.
3. The south-east portion of the Site is located at the former land cliff-edge prior to the reclamation of the Downtown area, and at the top of a rock-cut platform. It is anticipated the rock surface will be highly variable, with local erosional features at the top of the rock forming an undulating rock surface and localised 'hard' areas of higher strength rock that were more resistant to erosion. This may result in an increase in retained height or a reduced pile

embedment into ECBF rock, respectively, and may require contingency to install additional low-level anchors to control deflections and/or prevent failure at the toe of the piles.

4.6 Assessment of deformations and settlement effects

4.6.1 Mechanisms of settlement effects

The potential for surface deformation of the surrounding ground due to the Project has been assessed as detailed in the following sections. The main contributing factors potentially causing ground settlements near the Site that could impact on the immediately adjacent buildings, services or infrastructure include:

1. Excavation will extend below groundwater levels and so will result in local groundwater drawdown. Consolidation of the ground due to groundwater drawdown may occur due to the reduction in porewater pressures and increase in effective stress in the soil as groundwater seeps into the excavation and will be dependent on time.
2. As the excavation proceeds and the perimeter walls take load from the retained soil, lateral deflections will result. Mechanical settlement of the ground is associated with the deformation of the retaining walls. The associated ground settlements will occur relatively quickly and are expected to rapidly diminish with distance from the excavation.

4.6.2 Deformation criteria for buildings

Ground deformation can affect adjacent buildings and infrastructure (buried services and road pavements) through changes in grade and elongation / horizontal strain. A risk level of Aesthetic Damage of ‘negligible’ to ‘slight damage’ as defined in CIRIA PR30[10] is considered appropriate for neighbouring buildings. The limiting criteria of less than 1(V):500(H) differential settlement and less than 10 mm total settlement (negligible effects) have been adopted for this preliminary assessment.

Table 4.11: Typical values of maximum settlements for building damage risk assessment

Risk cat.	Maximum Differential Settlement	Maximum Settlement of Building (mm)	Description of Risk
1	Less than 1 in 500	Less than 10	Negligible: superficial damage unlikely
2	1 in 500 to 1 in 200	10 to 50	Slight: possible superficial damage which is unlikely to have structural significance
3	1 in 200 to 1 in 50	50 to 75	Moderate: expected superficial damage and possible structural damage to building, possible damage to relatively rigid pipelines.
4	Greater than 1 in 50	Greater than 75	High: expected structural damage to buildings and rigid pipelines or possible damage to other pipelines.

Where ‘slight damage’ risk (category 2) may occur, further assessment, as per Burland (2012)[11] will be required to considered to assess likely effects on potentially affected structures.

---

[10] CIRIA (1996). *Project Report 30: Prediction and effects of ground movements caused by tunnelling in soft ground beneath urban areas*. March 1996

[11] Burland, J.B. (2012). *Chapter 26 Building Response to Ground Movements* in ICE Manual of Geotechnical Engineering. Institution of Civil Engineers.

4.6.3 Deformation criteria for underground services

While many types of utilities can accommodate high levels of differential settlement, certain types can be susceptible to damage. In general, a utility's tolerance to settlement depends upon the construction type/material, existing condition, and whether the utility runs parallel or perpendicular to the excavation. Utilities running perpendicular to the excavation works are considered to be at the highest risk of damage. Utilities which run parallel and are near the excavation works may experience horizontal displacement associated with ground loss at the excavation face; however, they will experience a much gentler differential settlement.

The methodology to assess the effects on utilities is based on the method on O'Rourke and Trautman (1982)[12] – which provides guidance on allowable differential settlement for various utility construction types.

Table 4.12: Allowable differential settlement based on utility type

Utility type	Maximum allowable differential settlement (V:H)
Brick unlined	1:245
Welded steel pipe	1:122
Cast in-situ concrete	1:173
PVC & HDPE	1:67
Reinforced concrete pipe	1:229
Ductile iron pipe	1:229
Vitrified clay pipe	1:299
Cast iron pipe	1:150 – 1:500 (varies based on diameter)

Estimations of potential damage to a utility have been based off the calculated ground surface settlement profiles perpendicular to the excavation. This is likely to over-estimate the actual differential settlement experienced by the utility as:

- Where a utility crosses oblique to the alignment, the estimated differential settlement is expected to be lower than if the utility was crossing perpendicular to the alignment.
- It has been assumed that the differential settlement affecting each recorded utility is equal to the differential settlement at the ground surface. In reality the differential settlements at depth are likely to be less than at the ground surface, and consequently the settlement estimates are conservative.

4.6.4 Cumulative settlement and effects on neighbouring buildings and structures

Table 4.13 below presents a summary of the estimated total and differential settlements resulting from the combined effects of wall deformations and groundwater induced settlements on the neighbouring structures surrounding the development. Settlement profiles with distance perpendicular to the excavation are presented in **Appendix I**.

This assessment indicates the potential effects due to the proposed basement excavation are generally within Risk Category 1 – Negligible in accordance with CIRIA PR30, and negligible damage is expected to occur as a result.

---

[12] O'Rourke, T D, and C H Trautmann. 1982. Buried pipeline response to tunnel ground movements. In Europipe 82 Conf., Basel, Switzerland, paper 1.

Table 4.13: Estimated settlements below neighbouring buildings and structures

Building and Structures	Basement + Foundation Types	Date of Construction	Estimated ground settlement below structure (mm)		Assessed Risk of Building Damage due to Ground Settlement[1]
			Total	Differential	
M Social Building	Main Tower – piled foundations to rock Front of house – shallow foundations	1970s (upgraded in 2017, including external re-cladding)	<10	<1(v):2,000(h)	Very low – modern building on piled foundations socketed into rock. Front of house building is over 15 m from the excavation and groundwater is controlled/ recharged by the harbour. No cumulative effects from HSBC drained basement.
HSBC Tower	Main Tower – 2-Level basement + piled foundations to rock Podium – piled foundations	2002	<10 <10	<1(v):1,000(h) <1(v):2,000(h)	Very low – modern building on piled foundations socketed into rock. Existing permanently drained basement to RL-4m. Groundwater is controlled/ recharged by the harbour.
AON Tower	Double level basement + pad foundations bearing on rock	1970s	<10	<1(v):600(h)	Very low – modern building with two level basement, bearing on rock. Basement floor slab higher tolerance to deformations. Groundwater is controlled/ recharged by the HSBC drained basement.
204 Quay Street	Unknown	1940s	<5	<1(v):5,000(h)	Very low – 30 m+ distant from excavation and very low total and differential ground settlement assessed. Groundwater is controlled/ recharged by the harbour.
Tepid Baths	CompoSite shallow + driven piled foundations	1914 (upgraded in 2010, including upgrades to piled foundations)	<7	<1(v):5,000(h)	Very low – 40 m+ distant from excavation and Low total and differential ground settlement assessed. Main structure is supported on piled foundations socketed into rock. Limited existing historic fabric generally supported by the new structure.

Building and Structures	Basement + Foundation Types	Date of Construction	Estimated ground settlement below structure (mm)		Assessed Risk of Building Damage due to Ground Settlement[1]
			Total	Differential	
Watermark Building (85 Customs St West)	Partial level basement + piled foundations	2000	<5	<1(v):5,000(h)	Very low – modern building, 30 m+ distant, piled foundations socketed into rock. Low total and differential ground settlement assessed. ground water control/ recharge by harbour
Hobson St Flyover	Piled foundations	Late 1980s / early 1990s	<10	<1(v):1,000(h)	Very low – piled foundations and low differential movements assessed.

[1] Considering maximum total and different ground settlement, foundation type and age of structure. Assessed risk of building damage is a joint assessment by Geotechnical and Structural Engineer.

4.6.5 Settlement effects on underground services and pavements

Table 4.14 below presents a summary of the estimated total and differential settlements beneath services surround the development. Settlement profiles with distance perpendicular to the excavation are presented in **Appendix I**.

Table 4.14: Estimated settlement below services within pavement

Street	Services within pavement	Service orientation to excavation	Estimated ground settlement below structure (mm)	
			Total	Differential*
Customs St West	Wastewater – 150VC / CONC & 225AC	Parallel	9	-
	Stormwater – 225 Ceramic	Parallel	4	-
	Water – 250/600 CLS & 175CI	Parallel	1	-
	Telecommunications – Chorus + Vodafone	Parallel + Perpendicular	8 – 10	-
	Vector – Gas	Parallel	9	
Lower Hobson St	Wastewater – 225VC / AC	Parallel + Perpendicular	13 – 17	<1(v):1,000(h)
	Stormwater – 300 to 1050 CONC	Parallel + Perpendicular	13 – 17	<1(v):1,000(h)
	Water – 200CLS	Parallel	13 – 17	-
	Power & Telecommunications (Chorus + Vodafone)	Parallel + Perpendicular	13 – 17	-
Private Accessway between HSBC Tower / AON Tower	Power & Telecommunications (Vector + Vodafone)	Parallel	10 – 12	-

* Differential settlements estimated for services which are orientated perpendicular to the excavation only. Where the services run parallel to the excavation face, negligible differential settlements are expected to occur.

4.7 Other construction considerations

4.7.1 Earthworks and excavating through rock

The underlying ground conditions at the Site are likely to be excavatable using conventional equipment and plant, such as a 20-tonne digger with a toothed bucket. The ECBF rock generally has an unconfined compressive strength of 1 to 5 MPa, with possible seams of cemented rock of up to 20 MPa strength.

Sections of the basement excavation are proposed to be supported by sheet piles as shown in Figure 4.3 above. An open excavation through rock is proposed in these areas. The use of vertical open cuts with spot bolting as required has been adopted for a number of basement projects in the Auckland CBD. Allowances should be made for mapping of the vertical rock face, installation of rock bolts and grouting as the excavation proceeds, to support the rock and reduce groundwater seepage respectively.

4.7.2 Saline intrusion

The proposed design includes a groundwater cutoff wall on the northern side and extending on the east and west sides. This is intended to ensure that the groundwater effects in the upper zones of the soil profile are effectively isolated and the Site is not affected by tidal effects or saline intrusion from the harbour to the north.

However, the effectiveness of the barrier is dependent on both the integrity of the wall and its interface with the underlying ECBF rock. Imperfections in the wall, construction joints, or natural discontinuities within the rock mass could provide pathways for seawater ingress. If present, these could result in elevated groundwater inflows during construction or long-term operation, as well as increased demands on waterproofing and durability provisions for the basement structure.

No open joints or highly permeable beds have been encountered in the geotechnical investigations to date. However, if present during construction, this may require localised grouting to seal joints if high levels of leakage are observed and can be dealt with effectively.

4.7.3 Earthworks volumes

Approximate volumes for the bulk excavation are provided below for the purpose of construction planning. These approximate volumes are based on the current understanding of basement footprint, current basement levels and existing geotechnical investigations at the Site. We recommend that an appropriate contingency is applied to these volumes, including bulking factors for storage of material or transport away from the Site.

- Total estimated bulk excavation – 100,000 m^3
- Estimated volume for plunge columns and DWalls - 4500 m^3

Split based on geological unit:

- Fill/ Reclamation Fill/ Marine Sediments – 50,000 m^3
- East Coast Bays Formation soil – 3,500 m^3
- East Coast Bays Formation rock – 51,000 m^3

4.7.4 Noise & vibrations

Anchored sheet piles have been considered as a potential retention solution along the southern and south-eastern perimeter of the Site. The sheet piles are proposed to be driven through the reclamation fill and marine sediments with an embedment of at least 1 m into the ECBF rock. The noise and vibration that will be generated during the driving of the sheet piles, particularly into the ECBF rock, will need to be considered as part of the construction noise and vibration monitoring plan.

Pertinent structures that are likely to be impacted by noise and vibration due to sheet piling include:

- The AON building which is located within 10 m of the proposed sheet piles and is supported on pile foundations that are embedded into ECBF rock.
- The HSBC building, Tepid Baths, and the Watermark buildings (85 Custom Street West), which are located between 30 and 50 m from the proposed sheet piles. All of the buildings are expected to be supported on pile foundation embedded into ECBF rock.

M-Social and other neighbouring structures are located greater than 50 m from the proposed sheet piling and the impact on these structures are expected to be minimal.

4.7.5 In-ground obstructions

Due to the extensive historical land-use across the Site, consideration of in-ground obstructions will be required for design and construction, including; foundation layout, basement excavation, and pile / perimeter wall construction. The following historical land-uses should be considered:

Reclamation Fill & Graving Dock

The reclamation fill is likely to be highly variable and is inferred to consist of fine-grained soils through to cobbles, boulders and construction waste material. The graving dock which extended across majority of the Site was infilled in 1923. The material used to infill this is not known and remnants of the graving dock and associated structure may still be present at the Site. Therefore, potential construction issues may arise due to obstruction from large boulders within the reclamation fill, old graving dock structure, relict wharfs and old seawalls. In particular this may impact the driveability of sheet piles and/or excavation of bored piles. Further investigations and assessment are proposed in subsequent design phases to assess this.

Existing Downtown Car Park foundations

The existing belled reinforced concrete pile foundations will also need to be removed as the excavation proceeds. The existing piles may need to be cut down or overcored where they conflict with construction of the foundations for the proposed development and to reduce the potential for hard points beneath the B5 floor level. Optimising the location of the basement walls may reduce the number of piles encountered. **Appendix C** provides the historical pile layout for the existing carpark building.

The presence of these existing foundations should be considered as part of the foundation / superstructure design and set-out to avoid pile clashes where possible, particularly if piled foundations are adopted for the development with installation undertaken at existing ground levels.

Historical (pre-carpark) foundations

Remnants of the old seawalls and graving dock walls may still be present at the Site and can be encountered during the excavation of the basement for the Project.

In addition, prior to construction of the existing carpark building, commercial/ workshop buildings were noted to occupy the northwestern and southeastern portions of the Site. It is not known if the foundations of these structures were fully removed during the construction of the existing Downtown Carpark structure and may still be present and encountered during the excavation of the basement for the Project.

4.7.6 Potential contamination

There may be contaminants within the basement excavation spoil that limits disposal to a clean landfill Site. A detailed Site investigation (DSI) study and a preliminary contamination Site management plan (CSMP) have been undertaken for the Site and are provided separately.

5 Auckland Unitary Plan – Operative in Part

We have reviewed the Auckland Unitary Plan (AUP) rules regarding the take, use, damming and diversion of groundwater that are relevant to the proposed basement excavation. The AUP provides for the take, using damming and diversion of groundwater and drilling in association with excavation. The AUP includes several requirements that must be met for developments to be considered as a permitted activities with regard to groundwater, which are listed in Activity Table E7.4.1 and Permitted Activity Standards E7.6.1.10 and E7.6.1.6.

The assessment of compliance with these rules is summarised below and identifies a number of non-compliances. On the basis of our assessment the project is likely to be considered as a restricted discretionary activity in accordance with AUP, Table E7.4.1 (A20) and (A28).

Table 5.1: AUP E7 engineering assessment

E7 Taking, using, damming and diversion of water and drilling - E7.6.1 PERMITTED ACTIVITY STANDARDS		
E7.6.1.6 Dewatering or groundwater level control associated with a groundwater diversion permitted under Standard E7.6.1.10, all of the following must be met.		
(A27) Permitted Activity Standards: Exemptions	**Geotechnical Interpretation of Compliance**	**Permitted activity compliance**
(1) The water take must not be geothermal water;	Geothermal water not expected at the Site.	Yes
(2) The water take must not be for a period of more than 10 days where it occurs in peat soils, or 30 days in other types of soil or rock; and	Groundwater diversion/ take will be for a period greater than 30 days.	No
(3) The water take must only occur during construction.	Groundwater take may extend beyond construction if drained basement is adopted	No
E7 Taking, using, damming and diversion of water and drilling - E7.6.1 PERMITTED ACTIVITY STANDARDS		
E7.6.1.10. Diversion of Groundwater Caused by any Excavation (including trench), or tunnel		
(A27) Permitted Activity Standards: Exemptions	**Geotechnical Interpretation of Compliance**	**Permitted activity compliance**
(1) All of the following activities are exempt from the Standards E7.6.1.10(2) – (6):		
(a) pipes cables or tunnels including associated structures which are drilled or thrust and are less than 1.2 m in external diameter;	There are not expected to be any pipes cables or tunnels ≥1.2 m.	Yes
(b) pipes including associated structures up to 1.5 m in external diameter where a closed face or earth pressure balanced machine is used;	N/A due to compliance with 1(a) above.	Yes
(c) piles up to 1.5 m in external diameter are exempt from these standards;	All piles are expected to be <1.5 m diameter.	Yes
(d) diversions for no longer than 10 days; or	Groundwater diversion due to construction of the basement will be longer than 10 days.	No

E7 Taking, using, damming and diversion of water and drilling - E7.6.1 PERMITTED ACTIVITY STANDARDS		
E7.6.1.6 Dewatering or groundwater level control associated with a groundwater diversion permitted under Standard E7.6.1.10, all of the following must be met.		
(A27) Permitted Activity Standards: Exemptions	**Geotechnical Interpretation of Compliance**	**Permitted activity compliance**
(e) diversions for network utilities and road network linear trenching activities that are progressively opened, closed and stabilised where the part of the trench that is open at any given time is no longer than 10 days.	The groundwater diversion is for purposes other than network utilities and road network linear trenching activities.	No
(2) Any excavation that extends below natural groundwater level, must not exceed:		
(a) 1 ha in total area: and	(a) The development area does not exceed 1 ha in total area	Yes
(b) 6 m depth below the natural ground level	(b) The maximum excavation depths will be greater than 6 m below existing ground levels	No
(3) The natural groundwater level must not be reduced by more than 2 m on the boundary of any adjoining Site.	(3) The natural groundwater level in the surficial soils is not expected to be reduced by more than 2 m at the Site boundary.	Yes
(4) Any structure, excluding sheet piling that remains in place for no more than 30 days, that physically impedes the flow of groundwater through the Site must not:		
(a) impede the flow of groundwater over a length of more than 20 m; and	(a) The development will impede the flow of groundwater over a length of more than 20 m (Site measures approximately 88 m by 70 m)	No
(b) extend more than 2 m below the natural groundwater level.	(b) The structure will extend more than 2 m below natural groundwater levels	No
(5) The distance to any existing building or structure (excluding timber fences and small structures on the boundary) on an adjoining Site from the edge of any:		
(a) trench or open excavation that extends below natural groundwater level must be at least equal to the depth of the excavation;	(a) Several neighbouring structures will be inside the specified envelope.	No
(b) tunnel or pipe with an external diameter of 0.2 - 1.5 m that extends below natural groundwater level must be offset 2 m or greater; or	(b) Any Site connections are likely to be greater than 2 m from neighbouring structures.	Yes
(c) a tunnel or pipe with an external diameter of up to 0.2 m that extends below natural groundwater level has no separation requirement.	(c) No comment required	Yes
(6) The distance from the edge of any excavation that extends below natural groundwater level, must not be less than:		
(a) 50 m from the Wetland Management Areas Overlay;	The proposed excavation that extends below natural groundwater level is located more than 50 m from Wetland Management Areas Overlay	Yes

E7 Taking, using, damming and diversion of water and drilling - E7.6.1 PERMITTED ACTIVITY STANDARDS		
E7.6.1.6 Dewatering or groundwater level control associated with a groundwater diversion permitted under Standard E7.6.1.10, all of the following must be met.		
(A27) Permitted Activity Standards: Exemptions	**Geotechnical Interpretation of Compliance**	**Permitted activity compliance**
(b) 10 m from a scheduled Historic Heritage Overlay; or	The proposed excavation that extends below natural groundwater level is approximately 30 m from the closest scheduled Historic Heritage overlay	Yes
(c) 10 m from a lawful groundwater take	(c) A specific search of groundwater takes adjacent to the Site has not been undertaken. However, we expect a groundwater take consent may have been required for the current HSBC building present immediately to the north-west (188 Quay Street) and West Plaza development to the south-west (3-15 Albert Street). Groundwater take consent also existing for the Commercial Bay precinct development further to the east.	No

6 Recommendations for Site investigations and monitoring work

6.1 Recommendations for Site investigations

Further geotechnical Site investigations of the carpark may be required during the detailed design stage. These would be used to provide further detail on the rock profile, assess nature of soils for disposal and refine the geotechnical and groundwater model that has been adopted for this preliminary design.

6.2 Construction survey and monitoring

A draft GSMCP is provided in **Appendix B**. The GSMCP provides draft proposed monitoring of the basement excavation works and surrounding areas to assess if the ground and groundwater conditions are consistent with the design analyses and the response of structures are within design tolerances.

7 Risk & opportunities register

Presented below are identified geotechnical risks and opportunities for the proposed Project. The presented risks are those identified at this time and may not be a complete list. Risks (including safety in design considerations) should be regularly reviewed by the project team as the design and construction progresses.

Table 7.1: Geotechnical opportunity register

ID	Opportunity	Description
1	Optimise the location of the walls to avoid existing carpark piles	The existing Downtown carpark is founded upon belled piles founding within the ECBF rock that are located along the Site boundaries. The current basement layout has been moved to avoid clash with these piles, and minimise cost and delays to construction programme to remove the existing piles. Along the western boundary, the basement has been shifted eastward to avoid conflict with the piles, which has slightly reduced the overall basement footprint. However, based on the current pile locations relative to the boundary, there appears to be sufficient offset to install new boundary retention to the west of the existing piles and thereby maximise the basement extent. This retention system is likely to comprise secant piles constructed between the existing belled piles, with temporary sheet pile walls installed directly behind the belled piles to provide groundwater cut-off. Below the level of the belled piles, a reinforced concrete stitching panel may be incorporated. Further assessment of this arrangement can be undertaken during the developed and detailed design stages.
2	Further contaminated land investigations	Further investigations within the basement footprint for contaminated land sampling and testing may be undertaken during detailed design to manage contamination risk within the reclamation fill. Early identification and management of this risk will enable appropriate handling and disposal of impacted materials, reduce potential health and environmental risks during excavation, and minimise the likelihood of construction delays or unanticipated costs.
3	Monitoring of groundwater flows during construction	As outlined above, groundwater flows during construction have been assessed conservatively and are consistent with published standards. However our experience for similar basement structures in Auckland CBD indicates actual flows may be lower than predicted. Inflows into the basement are expected to peak during the early stages of excavation, and monitoring of pumping volumes will allow actual peak flows to be compared with our assessment. Should inflows prove lower than estimated, this may provide an opportunity to use smaller pumps, potentially reducing both construction and operational costs over the life of the structure.

Table 7.2: Geotechnical risk register

ID	Risk	Further assessment proposed	Residual risk	Likelihood of residual risk
1	The depth to unweathered ECBF rock varies from that assumed for basement retention design and pile embedment	Further Site-specific investigations proposed in detailed design. Detailed design will consider contingencies to extend diaphragm wall, sheet pile and foundation piles should rock be deeper than expected. Consider proof drilling at pile locations during construction, particularly where sheet pile retention is proposed (i.e. south and south-east perimeter). Sheet pile retention design to consider contingency options where sheet piles extend deeper than ground model allows. This may include additional low-level ground anchor supports.	Depth to rock varies over short distances (i.e. erosional channels in rock)	Low to medium
2	Obstructions during excavation works from the existing carpark pile foundations, historical foundations (pre-carpark), remnants of old seawalls and boulders and waste material that may be present in the reclamation fill	Detailed design of the proposed foundations for the development to consider current carpark foundation layout, particularly for any piles that are to be formed from ground surface. Existing reinforced concrete piles to be cut down below the B4 floor levels Design to consider contingency if obstructions impact the driveability of sheet piles or interference during diaphragm wall / secant pile installation.	Unknown location, magnitude and size of obstructions	Medium to high
3	Collapse of pile shaft and anchor bores within the reclamation fill and marine sediments	Temporary support of pile shafts required through reclamation fill and marine sediments. Options include using temporary casing or drilling with a slurry (bentonite or polymer)	Collapsing of pile or anchor holes	Medium
4	Storage of excavated soil on Site, such as stockpiling of soil above the proposed retaining walls may cause excessing wall deformation	Maintain a designated area behind the back of the retaining walls where storage of soil or plant and machinery is not permitted	Due to limited space available at the Site, designated areas to stockpile fill may be difficult	Low
5	Clash between proposed temporary ground anchors and the pile foundation of neighbouring building	Pile layouts for neighbouring buildings are known. Design to consider anchor inclination and length so that they generally do not extend into the neighbouring building footprint. If this is not feasible design shall consider the	Unexpected differences between actual foundation locations and	Low

ID	Risk	Further assessment proposed	Residual risk	Likelihood of residual risk
		layout of ground anchors to avoid clashes with the existing pile foundations beneath neighbouring structures	available as-built plans	
6	High groundwater inflows during construction due to open joints / fault zone through ECBF rock providing hydraulic connection to harbour	Frequent geotechnical observations during basement excavation to identify risk areas. Contingency option to grout joint / fault zones to provide seal and reduce groundwater inflows.	Construction difficulties installing grout seal. Grout volumes required to provide seal.	Low
7	Strong Calcite cemented bed making drilling, excavation and driven pile installation difficult	Further geotechnical investigations proposed to assess competency of ECBF rock within basement excavation. Detailed design of sheet pile retention to consider contingency options should minimum 1 m embedment into ECBF rock not be achieved. This may include additional low-level anchors and/or pre-augering of the sheet-piles.	Isolated beds of strong cemented material not identified during investigation	Low
8	Water pressures in ECBF rock causing the diaphragm wall to 'lift' off the rock face. Impacts on shear transfer between wall and rock interface and affecting leakage flows	Detailed design to consider impacts and contingency options, including pre-stressing of lower floor levels and/or installation of low-level ground anchors.	Gaps between the ECBF rock and diaphragm results in increased likelihood of leakage.	Low
9	Pump failure during construction or for drained basement operation	If a drained basement is adopted the underdrainage system beneath the basement floor needs to provide redundancy as well as flushing points for maintenance to address siltation. Proposed 200mm drainage layer beneath the floor slab will provide capacity for 5-20 days of seepage flow before uplift pressures develop. Relief valves need to be provided in the event of extended power failure (including generators), when partial flooding of the basement floor will occur to balance pressures and protect the floor slab	Extended hydrostatic pressure from partial flooding could create localized uplift or stress on the floor slab or slab–wall connections if relief is insufficient or slow.	Low

8 Applicability

This report presents the preliminary geotechnical design and groundwater assessment for the Project as per our proposal dated 24 October 2024. This report has been prepared for the exclusive use of our client Precinct, with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

We understand and agree that our client will submit this report as part of an application under the FTAA and that an Expert Panel as the consenting authority will use this report for the purpose of assessing that application. We understand and agree that this report will be used by the Expert Panel in undertaking its regulatory functions.

Compliance with the Environment Court Practice Note 2023

I confirm that, in my capacity as author of this report, I have read and abided by the Environment Court of New Zealand's Code of Conduct for Expert Witnesses contained in the Practice Note 2023.

I am a Senior Geotechnical Engineer and Business Development Manager at T+T, where I specialise in geotechnical engineering. I have worked at T+T since 1987. Prior to joining T+T, I was employed by the Ministry of Works and Development for 17 years.

I have 52 years' post-graduate experience in geotechnical engineering. I am a Distinguished Fellow of the Institution of Professional Engineers New Zealand, a member of the New Zealand Geotechnical Society Inc and New Zealand Society for Earthquake Engineering Inc. I was the joint recipient of the first NZ Geotechnical Society Award and have received a Fulton Downer Gold Medal – President's Award and the Turner Award from IPENZ. I hold the degree of Masters of Engineering 1st Class from the University of Auckland.

I have been responsible for the design of foundations of many of the major building developments in the Auckland CBD. I have also held senior technical roles in and been a Board member of the Waterview Connection Alliance, the Northern Gateway Alliance (Albany to Puhoi Motorway and the replacement of the Newmarket Viaduct). I was a Board member for the Link alliance (Central Rail Link) and am currently on the board of the Mt Messenger Alliance.

Of particular relevance to this Project, I was the Project Director for Civil and geotechnical design for the 38 storey Commercial Bay Development; was the Geotechnical Investigations and foundation design engineer for the 53 storey Seascape Residential Development; was the project coordinator for geotechnical investigations and foundation design for the Vero Centre, the majority of multistorey buildings recently constructed on Wynyard Quarter the Quay Park Development.

Tonkin & Taylor Ltd
Environmental and Engineering Consultants

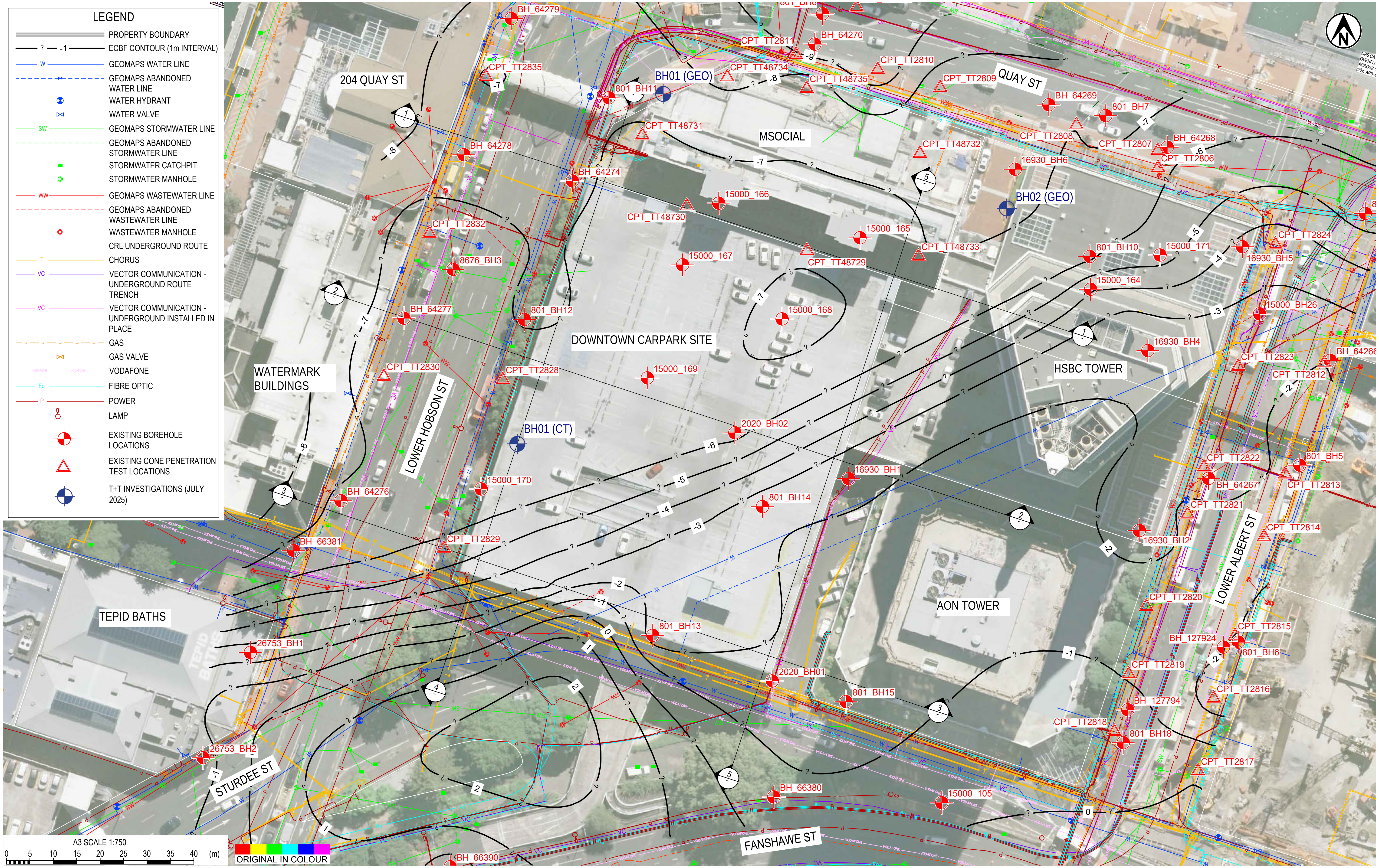
Authorised for Tonkin & Taylor Ltd by:

[redacted]......................

Peter Millar
Project Director

7-Nov-25 \\ttgroup.local\corporate\auckland\projects\1016043\1016043.2000\issueddocuments\20251024 rpt-gt-001 v3\1016043.2000-rpt-gt-001_v3.docx

Appendix A Site Plan and Geological Cross-sections



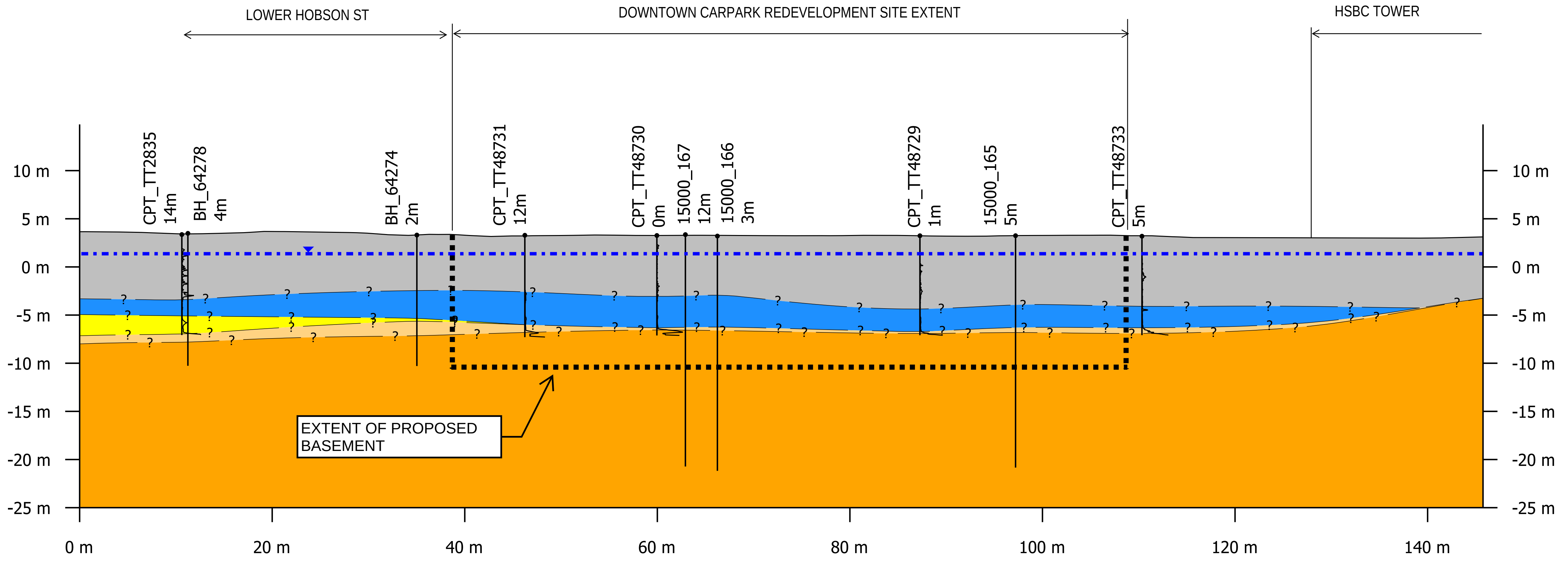
NOTES:
1. AERIAL PHOTO, STORMWATER LINE, WASTEWATER LINE AND WATER LINE SOURCED FROM AUCKLAND COUNCIL GEOMAPS, LICENSED FOR RE-USE UNDER THE CREATIVE COMMONS ATTRIBUTION 4.0 NEW ZEALAND LICENCE (CC BY 4.0). CAPTURE DATE 24/05/2023.
2. VODAFONE AND CRL INFORMATION SUPPLIED BY BEFORE U DIG. REF 11197173 - Vodafone Plan.pdf AND "11197172 - CityLink Plan (002).pdf".
3. CHORUS INFORMATION SUPPLIED BY CHORUS, REF "CHORUS.pdf".
4. VECTOR POWER, COMMUNICATION AND GAS SUPPLIED BY VECTOR, REF "VECTOR ELECTRICITY.pdf" , "VECTOR COMMUNICATION.pdf" AND "VECTOR GAS.pdf".

Tonkin+Taylor
Exceptional thinking together   www.tonkintaylor.co.nz

PROJECT No.	1016043.1000	
DESIGNED	KASC	May.23
DRAWN	JC	May.23
CHECKED		
APPROVED	DATE	

CLIENT **PRECINCT PROPERTIES NEW ZEALAND LIMITED**
PROJECT **DOWNTOWN CARPARK SITE DEVELOPMENT**
TITLE GEOTECHNICAL LAYOUT PLAN

SCALE (A3) 1:750   FIG No. FIGURE 1   REV 1



Section 1

Legend
- ▨ Fill
- 🟦 Marine Sediments
- 🟨 Tauranga Group
- ▨ Weathered ECBF
- 🟧 ECBF N>50

Scale: 1:500
Vertical exaggeration: 1x
0m 40m

Tonkin+Taylor
Exceptional thinking together www.tonkintaylor.co.nz

NOTES

REV	DESCRIPTION	CAD	CHK	DATE	APPROVED	DATE

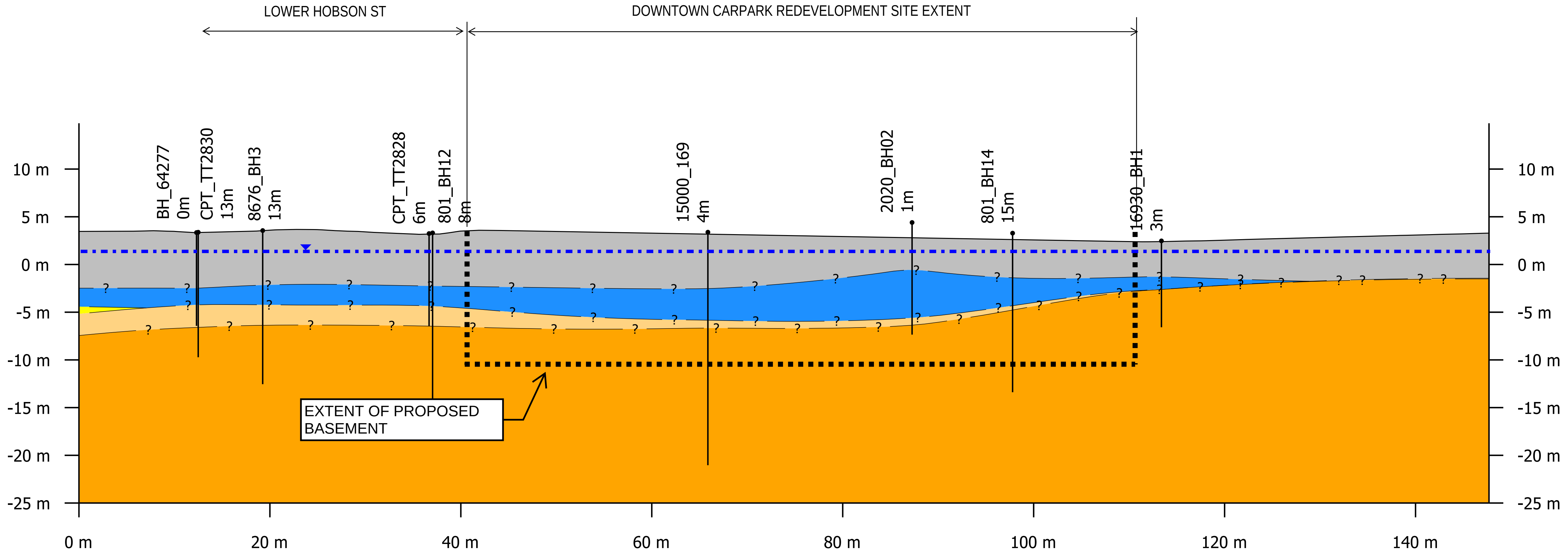
DESIGNED	JOWI	8.6.23
DRAWN	JOWI	8.6.23
DESIGN CHECKED	ABL	Xxx. XX
DRAWING CHECKED	ABL	Xxx. XX

DRAWING STATUS
FOR INFORMATION
PROJECT PHASE
CONCEPT

NOT FOR CONSTRUCTION

THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION PURPOSES UNLESS SIGNED AS APPROVED

CLIENT **PRECINCT PROPERTIES NEW ZEALAND LIMITED**
PROJECT **DOWNTOWN CARPARK SITE DEVELOPMENT**
TITLE GEOLOGICAL SECTION
SECTION 1
SCALE (A3) 1:500 REV A



Section 2

Legend

- ▨ Fill
- 🟦 Marine Sediments
- 🟨 Tauranga Group
- ▨ Weathered ECBF
- 🟧 ECBF N>50

Scale: 1:500

Vertical exaggeration: 1x

0m 40m

Tonkin+Taylor

Exceptional thinking together

www.tonkintaylor.co.nz

NOTES

REV	DESCRIPTION	CAD	CHK	DATE	APPROVED	DATE

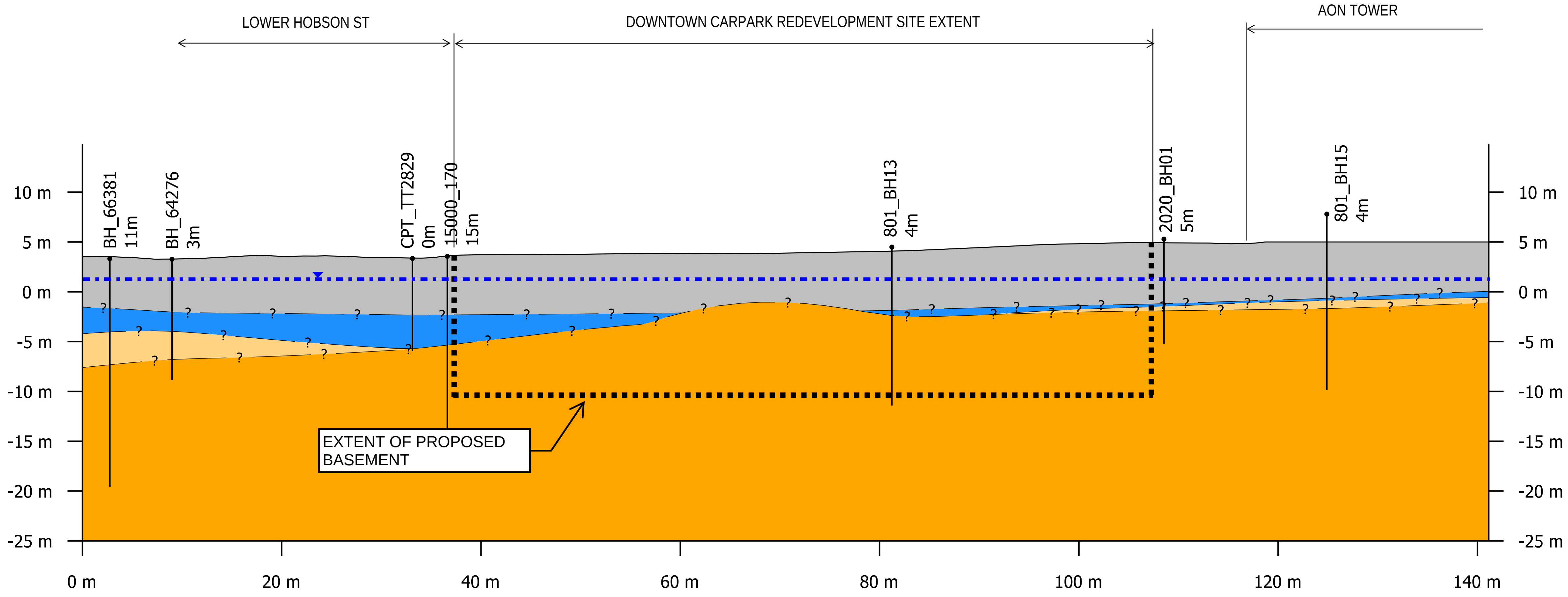
DESIGNED	JOWI	8.6.23
DRAWN	JOWI	8.6.23
DESIGN CHECKED	ABL	Xxx. XX
DRAWING CHECKED	ABL	Xxx. XX

DRAWING STATUS
FOR INFORMATION
PROJECT PHASE
CONCEPT

NOT FOR CONSTRUCTION

THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION PURPOSES UNLESS SIGNED AS APPROVED

CLIENT **PRECINCT PROPERTIES NEW ZEALAND LIMITED**
PROJECT **DOWNTOWN CARPARK SITE DEVELOPMENT**
TITLE GEOLOGICAL SECTION
SECTION 2
SCALE (A3) 1:500
REV A



Section 3

Legend

▨ Fill
🟦 Marine Sediments
🟨 Tauranga Group
▨ Weathered ECBF
🟧 ECBF N>50

Scale: 1:500
Vertical exaggeration: 1x

0m 40m

Tonkin+Taylor
Exceptional thinking together www.tonkintaylor.co.nz

REV	DESCRIPTION	CAD	CHK	DATE

NOTES

DESIGNED	JOWI	8.6.23
DRAWN	JOWI	8.6.23
DESIGN CHECKED	ABL	Xxx. XX
DRAWING CHECKED	ABL	Xxx. XX

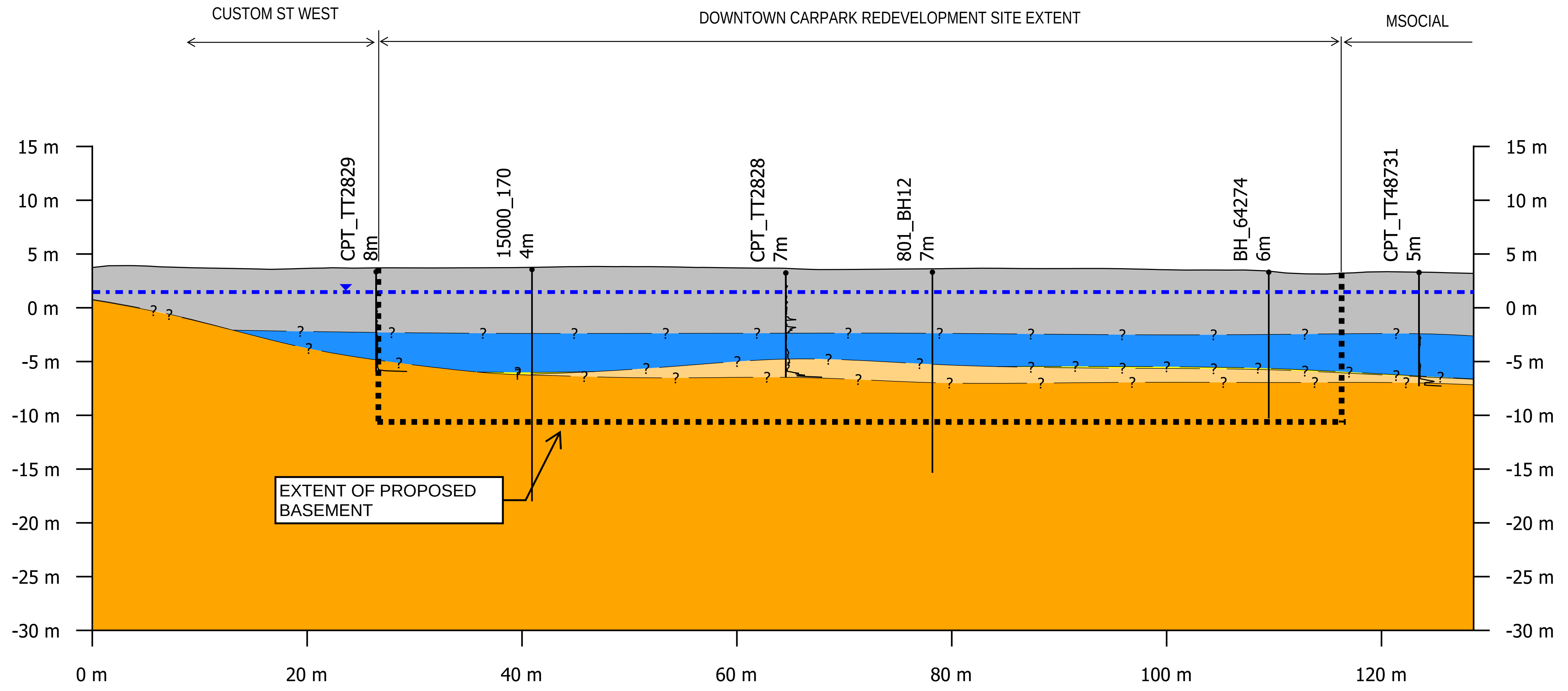
DRAWING STATUS
FOR INFORMATION
PROJECT PHASE
CONCEPT

NOT FOR CONSTRUCTION

THIS DRAWING IS NOT TO BE USED
FOR CONSTRUCTION PURPOSES
UNLESS SIGNED AS APPROVED

APPROVED DATE

CLIENT **PRECINCT PROPERTIES NEW ZEALAND LIMITED**
PROJECT **DOWNTOWN CARPARK SITE DEVELOPMENT**
TITLE GEOLOGICAL SECTION
SECTION 3
SCALE (A3) 1:500
REV A



Section 4

Legend

- ▨ Fill
- 🟦 Marine Sediments
- 🟨 Tauranga Group
- ▨ Weathered ECBF
- 🟧 ECBF N>50

Scale: 1:500
Vertical exaggeration: 1x
0m 40m

Tonkin+Taylor
Exceptional thinking together
www.tonkintaylor.co.nz

NOTES

REV	DESCRIPTION	CAD	CHK	DATE

DESIGNED	JOWI	8.6.23
DRAWN	JOWI	8.6.23
DESIGN CHECKED	ABL	Xxx. XX
DRAWING CHECKED	ABL	Xxx. XX

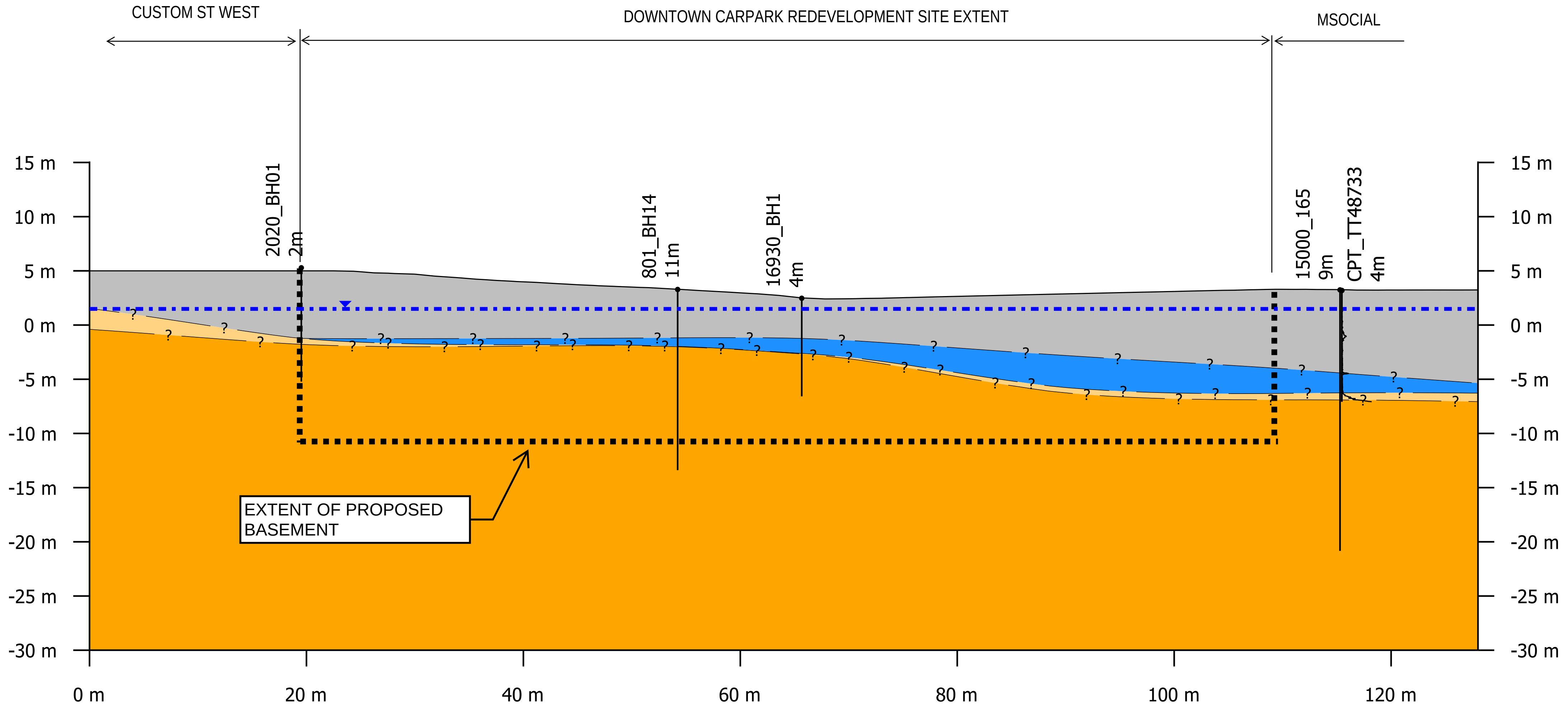
DRAWING STATUS
FOR INFORMATION
PROJECT PHASE
CONCEPT

NOT FOR CONSTRUCTION

THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION PURPOSES UNLESS SIGNED AS APPROVED

APPROVED DATE

CLIENT **PRECINCT PROPERTIES NEW ZEALAND LIMITED**
PROJECT **DOWNTOWN CARPARK SITE DEVELOPMENT**
TITLE GEOLOGICAL SECTION
SECTION 4
SCALE (A3) 1:500
REV A



Section 5

Legend

▨ Fill
🟦 Marine Sediments
🟨 Tauranga Group
🟧 Weathered ECBF
🟧 ECBF N>50

Scale: 1:500
Vertical exaggeration: 1x
0m 40m

Tonkin+Taylor
Exceptional thinking together www.tonkintaylor.co.nz

REV	DESCRIPTION	CAD	CHK	DATE

NOTES

DESIGNED JOWI 8.6.23
DRAWN JOWI 8.6.23
DESIGN CHECKED ABL Xxx. XX
DRAWING CHECKED ABL Xxx. XX
NOT FOR CONSTRUCTION
APPROVED DATE

DRAWING STATUS FOR INFORMATION
PROJECT PHASE CONCEPT
THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION PURPOSES UNLESS SIGNED AS APPROVED

CLIENT **PRECINCT PROPERTIES NEW ZEALAND LIMITED**
PROJECT **DOWNTOWN CARPARK SITE DEVELOPMENT**
TITLE GEOLOGICAL SECTION
SECTION 5
SCALE (A3) 1:500
REV A

Appendix B Draft groundwater and settlement monitoring and contingency plan

REPORT

Tonkin+Taylor

Downtown Carpark Site Development

Groundwater and Settlement Monitoring and Contingency Plan

Prepared for
Precinct Properties New Zealand Limited
Prepared by
Tonkin & Taylor Ltd
Date
November 2025
Job Number
1016043.2000 v5.1

Together we create and sustain a better world
www.tonkintaylor.com

Document control

Title: **Downtown Carpark Site Development**					
Date	**Version**	**Description**	**Prepared by:**	**Reviewed by:**	**Authorised by:**
June 2023	0	50% Draft for Client Review	ABL	PJM	PJM
September 2023	1	100% Draft for Client Review	ABL	PJM	PJM
June 2024	2	Updated 100% Draft for Client Review	ABL	PJM	PJM
July 2024	3	Final issue	ABL	PJM	PJM
December 2024	4	Updated final issue following s92 comments	ABL	PJM	PJM
October 2025	5	100% FTAA Application	RXSW	PJM	PJM
November 2025	5.1	100% FTAA Application	RXSW	PJM	PJM

Distribution:

Precinct Properties New Zealand Limited	PDF copy
RCP Limited	PDF copy
Tonkin & Taylor Ltd (FILE)	electronic copy

Table of contents

Appendix C Piezometer construction records

Appendix D Groundwater monitoring records

1 Introduction

Precinct Properties New Zealand Limited ("**Precinct**") has engaged Tonkin and Taylor Limited ("**T+T**") to prepare a Groundwater and Settlement Monitoring Contingency Plan ("**GSMCP**") for the proposed basement construction at the Downtown Carpark Site ("**Project**").

This draft GSMCP is applicable for up to four levels of basement construction and assumes a basement excavation generally to RL -10.32 m, though with localised excavation of up to RL -17.02 m to accommodate water tanks and lift pits. This draft GSMCP has been prepared to supplement a Fast-track Approvals Act ("**FTAA**") application for the Project and will be updated as the design for the Project develops. This draft GSMCP should be read in conjunction with the Geotechnical and Groundwater Assessment Report for the Project.

1.1 Project description

The proposed Project Site is located at 2 Lower Hobson Street, at the corner of Lower Hobson Street and Customs Street West within the Auckland City Centre ("**Site**") (legal description Lot 9 DP 60151). The Site to be developed is approximately 6,442 m^2 in area, with the Site on land reclaimed in stages between 1850 and 1920 by the Auckland Harbour Board.

The Site is relatively level, with the ground surrounding the Site varying from RL 4 m to RL 5 m. A 9-storey (1 below ground level and 8 suspended floors) public carpark building known as the Downtown Carpark currently occupies the Site. The building is surrounded by M Social Hotel immediately to the north, HSBC and Aon Towers to the east, Custom Street West and Lower Hobson Street to the south and west respectively. Figure 1.1 shows the location of the Site. The historical Tepid Baths are located across Lower Hobson Street to the west.

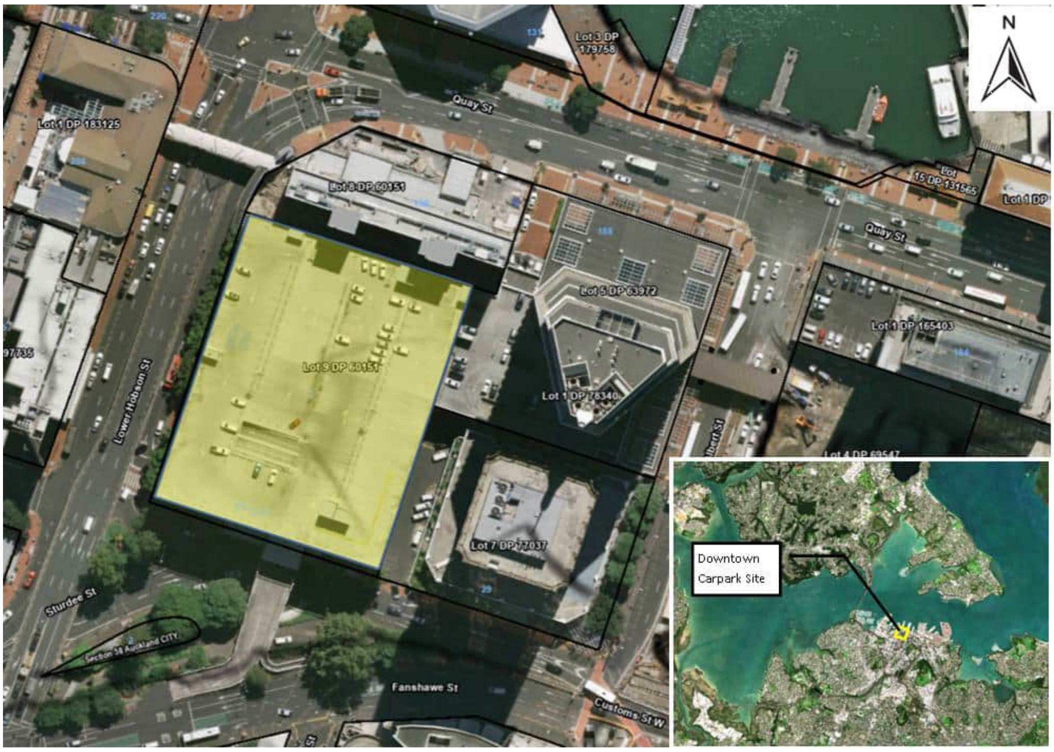


Figure 1.1: Downtown Carpark Development Site.

The proposed Project consists of two multi-storey towers, three podium structures and up to four level basement that extends across the full footprint of the Site.

1.2 Definitions

AC	The Auckland Council.
Commencement of dewatering	Excavation below the groundwater table and/or commencing taking any groundwater from the basement excavation excluding the installation of the pile walls.
Completion of excavation	When all bulk excavation below groundwater level has been completed. The permanent retaining walls have been propped with the building floors and all foundation/footing excavations within 10 m of the retaining wall have been completed.
Completion of temporary dewatering	When all the external base slab and basement walls are essentially completed, with permanent drainage systems in place, and the structures internal support mechanisms, including basement floors have been completed.
Completion of construction	When the Certificate of Completion is issued by AC.
Significant damage	When damage is considered to affect serviceability or structural integrity.
Serviceability damage	The degree of damage is minor i.e. when doors and windows start sticking.
Damage	Includes aesthetic, serviceability and significant damage.
Alert Level	Monitoring reaches a level close to, or equal to the design value, which is above the level where potential damage could occur, and requires a review to assess the future trend.
Alarm Level	Monitoring reaches the design value, and/or level close to which damage could occur, and requires immediate action including the cessation of ground dewatering and other construction activities that may have an effect on ground deformation.
The Council	Auckland Council (Team Leader, Water Allocation, NRSI) or nominated AC staff acting on The Team Leader’s behalf.
NRSI	Natural Resources and Specialist Input, Auckland Council.
RL	Reduced Level.
Services	Includes for example fibre optic cables, sanitary drainage, gas and water mains, power and telephone, road infrastructure assets such as footpaths, kerbs, catch-pits, pavements and street furniture.

2 Monitoring

2.1 Summary

Monitoring of the excavation works and surroundings shall be undertaken to check that the ground deformations and groundwater conditions are consistent with the design analyses and that the response of neighbouring structures is within adopted design tolerances.

The monitoring requirements include location of monitoring points, frequency of monitoring, action trigger levels, response procedures and reporting requirements are detailed in the following sections. Survey monitoring locations are shown in the Construction Monitoring Instrumentation Plan Figure 1, **Appendix A**.

The proposed construction phase monitoring to assess the effects on ground surrounding the Site and of the services and structures identified above shall include:

- Pre and post-basement construction condition surveys of the potentially affected building and services.
- Regular visual external survey of the surrounding ground, pavement, associated street infrastructure and structures during construction to identify any deterioration of pre-construction baseline conditions.
- Precise levelling survey of markers/pins on the buildings and maintained existing retention structures surrounding the excavation. The marks shall be set as low as practicable on structures on elements in direct connection with the foundation level (i.e. columns or perimeter footings).
- Precise levelling survey of pavement line levels surrounding the Site at ground deformation marks.
- Survey of the retaining wall capping beam at approximately 15 m spacing. The number and spacing of locations may be altered depending on the layout including lateral support spacing and basement access points.
- Retaining wall deformation profile measurement via inclinometers installed within the walls at critical locations, allowing for Site access constraints that limit where measurements may be safely undertaken.
- Groundwater monitoring of piezometer installations to assess any relationship between groundwater drawdown and ground deformation.

Monitoring results will be collated by the project Geotechnical Engineer and compared with the specified trigger levels. These records will be held by the project Geotechnical Engineer and will be available for inspection as required.

2.2 Reporting of monitoring records

2.2.1 General

Survey points will be monitored by the Contractor and results will be provided to a qualified Geotechnical Engineer for their review at the frequency set out in the Consent conditions and the following sections. Survey results should be submitted to the project Geotechnical Engineer within three working days of taking the readings.

Monitoring results will be collated by the project Geotechnical Engineer and compared with the specified trigger levels. These records will be held by the project Geotechnical Engineer and will be available for inspection as required. If results exceed the trigger levels mitigation measures will be implemented and results will be reported to the Consents Manager as described in Section 7 to 8.

2.2.2 Pre-dewatering baseline readings

Building dilapidation and pre-condition surveys will be required prior to commencement of construction.

Baseline readings for ground and building deformation and retaining wall deformation shall be established prior to commencement of excavation.

Baseline readings for groundwater shall be established with weekly readings for at least one month prior to the commencement of dewatering. These baseline readings shall be submitted to the Council for approval prior to the commencement of excavation.

2.2.3 Reporting intervals and requirements

During excavation, all monitoring records as detailed in this report shall be compiled and submitted to the Council at **three monthly intervals** from the commencement of excavation until **six months** after the completion of basement construction, when the basement is sealed (or at such time following the completion of basement construction that stable measurements are demonstrated and written approval is granted from the Council).

Each report shall include the following:

1. Monitoring records presented in a tabulated format as well as on a timeline plot;
2. Comparison of monitoring data with trigger levels and the assumed design models;
3. Previous results set out with an explanation of any trends;
4. A construction progress summary; and
5. Any other information relevant to the reporting period (i.e. exceedance of trigger levels and contingency measures being undertaken).

3 Groundwater monitoring

3.1 Monitoring piezometer details and proposed drawdown trigger levels

Groundwater levels shall be monitored at four locations, as set out in Table 3.1. Two of the proposed monitoring bores (MW01 and MW04) have been installed as part of recent investigations during preliminary design, with the remaining bores (MW02 and MW03) to be installed subject to accessibility to the locations and more detailed underground service location check.

Measurements shall be accurate to ±100 mm for all readings.

Table 3.1: Groundwater drawdown planned locations and drawdown trigger levels

ID	**Location**	**Screen Depth (mRL)**[2]	**Trigger limits below lowest baseline level**[1] **(m)**	
			Alert Trigger Level 1	**Alert Trigger Level 2**
MW01	Northeast corner of the Site targeting infilled graving dock	-2 to 1	0.7	1.0
MW02	Southeast corner of the Site	-1 to 3	0.7	1.0
MW03	Southwest corner of the Site	-4 to 3	0.7	1.0
MW04	Northwestern corner – to be confirmed based on access	-2 to 1	0.7	1.0

Note:

1 Baseline readings shall be agreed upon in writing with the Council prior to dewatering.

2 The screen for the monitoring wells are proposed within the reclamation fill and marine sediments. The screen depths will be confirmed following drilling of the boreholes.

See Figure 1 in **Appendix A** for the monitoring well planned locations.

Should any of the monitoring bores be damaged and become inoperable during the basement construction monitoring period, then the Council is to be informed and a new monitoring bore is to be drilled at a nearby location in consultation with the Team Leader.

3.2 Groundwater monitoring intervals

The groundwater level in the piezometers shall be measured at the following intervals:

Prior to dewatering	Weekly in the month prior to commencement of dewatering.
During temporary dewatering	Weekly, until the completion of temporary dewatering, or at such time following the completion of excavation that stable measurements are demonstrated and written approval is granted from The Team Leader (AC) to reduce monitoring frequency.
After completion of dewatering for construction	Monthly for minimum six (6) months or until a consistent pattern of groundwater records are obtained in which no evidence of adverse effects is apparent and groundwater levels are above alert trigger levels.

The monitoring frequency may be changed if approved by the Team Leader Central Monitoring. Any change shall be specified in the GSMCP. In addition, the monitoring period post Completion of Temporary Dewatering may be extended, by the Team Leader, Central Monitoring, Resource Consenting and Compliance, if measured groundwater levels are not consistent with inferred seasonal trends or predicted groundwater movement.

The project Geotechnical Engineer will review the results of this monitoring and compare with the trigger levels detailed in the Consent Conditions. If the alert or alarm levels in Table 4.1 are reached, the actions outlined in Section 7 shall be carried out.

4 Retaining wall deflection monitoring

4.1 General

The retention system shall be monitored via survey monitoring points installed along the perimeter capping beam at approximately 15 m spacing, and deformation down the retaining wall will be measured via inclinometers installed within the walls at critical locations. The number and spacing of locations may be altered depending on the layout including lateral support spacing and basement access points.

Proposed locations of the survey monitoring points are shown in Figure 1 in **Appendix A**.

Survey measurements shall be accurate to ±2 mm. A record of the survey results should be submitted to the Geotechnical Engineer within one working day.

4.2 Retaining wall monitoring intervals

Surveys shall be carried out at the following intervals:

Prior to dewatering	At least two baseline surveys to establish baseline readings
During dewatering, until one month after completion of excavation	Weekly (minimum) and at each 2 metres depth of excavation or when changes to the propping system are being carried out
From one month after completion of excavation, until completion of temporary dewatering	Fortnightly until completion of temporary dewatering.

Monitoring frequency may be reduced if stable measurements are demonstrated and written approval is granted from the Council.

4.3 Retaining wall deflection trigger levels

The results of this monitoring are to be compared with the design assumptions and baseline readings. Trigger levels at which actions are required to be undertaken are summarised in Table 4.1. If the Trigger Levels are reached, the actions outlined in Section 7 shall be carried out.

Table 4.1: Trigger levels for retaining wall deflections

Monitoring ID	Location	Alert trigger level	Alarm trigger level
Survey peg on retaining wall	Top of wall along northern boundary	15 mm	20 mm
	Top of wall along western and eastern boundary	20 mm	25 mm
	Top of wall along southern boundary	15 mm	20 mm
Inclinometers (01 to 03)	Inclinometer in the retaining walls	20 mm	25 mm

Note: Inclinometers are proposed to be installed within the Diaphragm wall. Inclinometers are currently not allowed for along the southern and southeastern perimeter where anchored sheet piles are proposed. However, inclinometer over this section will be considered as required.

5 Ground and building deformation monitoring

5.1 General

Ground and building deformation monitoring marks shall be established on the pavements and buildings surrounding the excavation area at the locations shown on Figure 1 in **Appendix A**, subject to permission from neighbouring properties.

Survey measurements shall be accurate to ±2 mm. A record of the survey results should be maintained on Site and forwarded to the project Geotechnical Engineer within one working day.

5.2 Settlement monitoring intervals

Surveys shall be carried out at the following intervals:

Prior to dewatering	At least two baseline surveys to establish baseline readings
During temporary dewatering	Weekly
Post temporary dewatering	Monthly for six months or until such a time following the completion of temporary dewatering that stable measurements are demonstrated and written approval is granted from the Council

Monitoring frequency may be reduced following the completion of excavation if stable measurements are demonstrated and written approval is granted from the Council.

5.3 Settlement trigger levels

Monitoring data are to be compared with the design assumptions and baseline readings. Alert and Alarm Levels at which actions are required to be undertaken are summarised in Table 5.1. If the alert or alarm levels in Table 4.1 are reached, the actions outlined in Section 7 shall be carried out.

Table 5.1: Ground and building deformation mark trigger levels

Settlement survey mark ID	Location	Total settlement (mm)		Differential settlement	
		Alert level	Alarm level	Alert level	Alarm level
Ground survey pins	Custom Street West	14	20	1V:500H[1]	1V:250H[1]
	Lower Hobson Street	17	25		
	Private accessway between Site and AON/ HSBC tower	14	20		
Building survey pins	M Social	7	10	1:1000 between any two Building deformation marks	1:500 between any two Building deformation marks
	HSBC Tower	7	10		
	AON Tower	7	10		
	Hobson St Flyover	7	10		
	204 Quay Street	7	10		
	Tepid Baths	7	10		
	Watermark Building (85 Custom St West)	7	10		

6 Condition surveys

6.1 Underground service condition surveys

6.1.1 General

The condition surveys should comprise pressure testing or leak detection (acoustic) surveys carried out on the water main and pressure testing or CCTV inspection of the stormwater and wastewater pipes within 20 m of the Site.

6.1.2 Condition survey intervals

A condition survey of the public services immediately adjacent to the Site shall be carried out before the commencement of dewatering. The survey shall be repeated no earlier than six months after the completion of basement construction.

Following the post-construction survey, a report shall be submitted to the Council within 15 working days demonstrating that the services surveyed have not been damaged.

If the survey indicates damage to the services since the pre-construction survey, a determination of the cause of damage identified shall be reported by a Chartered Professional Engineer, together with a methodology for repair of any damage caused wholly or in part by the construction works.

6.2 Building condition surveys

6.2.1 Accessibility

If a structural condition survey requires access to a building or property, then in the event that access is declined by the owner or subject to unreasonable terms, the Council shall be notified as soon as is practicable. A report from a Chartered Professional Engineer shall be provided identifying whether any alternate risk monitoring options are available that do not involve access to the third party property. The report shall clearly state whether the identified alternative monitoring options will be sufficient to monitor any settlement risk to the property/s to which the monitoring relates and whether they will provide sufficient early detection warning to enable contingency measures to be implemented. Written approval from the Council must be obtained before any alternative monitoring option is implemented.

6.2.2 Recommended building condition survey locations

A visual inspection of the surrounding ground and buildings within 20 m of the project boundary. Survey shall be carried out for the structures in the immediate vicinity of the development, as set out in the following table. For the internal building survey, the survey shall cover the basement levels and the ground floor.

Table 6.1: List of buildings requiring condition surveys

Address	Legal Title	External survey	Internal Survey	Settlement Pins (Yes/No)
M Social (196 Quay St)	Lot 8 DP 60151	✓	✓	Yes
HSBC Tower (188 Quay St)	Lot 5 DP 63972 and Lot 1 DP 7834	✓	✓	Yes
AON Tower (21/29 Custom St West)	Lot 7 DP 77037	✓	✓	Yes
Tepid Baths (100 Custom St West)	Lot 2 DP 184176	✓	✓	Yes
Watermark (85 Custom St West/ 1 Lower Hobson St)	Lot 2 DP 197735	✓	✗	Yes
204 Quay Street	Lot 1 DP 183125	✓	✗	No
Lower Hobson Street flyover	N/A	✓	✗	Yes

6.2.3 Pre and post-construction condition survey

A pre-construction condition survey of the specified buildings shall be carried out prior to the commencement of dewatering.

The survey report shall confirm the existing condition of the building and enable the sensitivity of the buildings to potential damage caused by groundwater and ground settlement changes to be accurately determined. Major features of the building and Site developments shall be recorded including location, type of construction, age and present conditions including defects.

The survey shall include, but not be limited to, the following:

1 A description of the type of foundations.

2 A description of existing levels of damage considered to be of an aesthetic or superficial nature.

3 A description of existing levels of damage considered affecting the serviceability of the building where visually apparent without recourse to intrusive or destructive investigation.

4 An assessment as to whether existing damage may or may not be associated with actual structural damage and an assessment of the susceptibility of the buildings/structures to further movement and damage, to the extent predicted.

5 Photographic evidence of existing observable damage.

6 Confirmation of the installation of deformation pins as required by this specification.

7 A review of proposed Alarm and Alert Levels to confirm they are appropriately set and confirmation that any ground settlement less than the Alarm Level will not cause damage.

8 An assessment of whether the monitoring frequency is appropriate.

9 An assessment of whether the location and density of existing deformation pins is adequate and appropriate for the effective detection of change to building and structure condition.

Within six months of completion of construction, a post-construction survey covering the matters detailed above shall be completed the building. The survey report shall include a determination of the cause of damage identified (if any) since the pre-construction or previous survey and steps to repair it.

A copy of the pre and post-construction reports shall be forwarded to the Council within 15 working days of completing the reports along with a certificate from the Chartered Surveyor or Chartered Professional Engineer who has certified that the survey has been completed in a professional manner and is an accurate assessment of the condition of the building concerned.

6.2.4 Construction phase inspections

A visual inspection undertaken by the Principal Contractor at regular intervals shall monitor any deterioration or further cracking of any pre-existing cracks on the following:

- The ground within 10 m of the excavation.
- External facades of the buildings identified for structural condition surveys.

A photographic record of the surveys is to be maintained including the time, date and any observations for each inspection. This record is to be maintained on Site and forwarded to T+T typically monthly but within one day if any deterioration or cracking is observed.

6.2.5 Condition survey intervals

A visual inspection of the surrounding ground and specified buildings shall be carried out at the following intervals:

Prior to dewatering	Pre-construction survey as detailed in Section 6.2.3
From Commencement of Dewatering to Completion of Dewatering	Weekly visual inspections as detailed in Section 6.2.4.
After completion of basement construction	Post-construction survey within six months of completion of construction as detailed in Section 6.2.3

6.3 Underground service condition surveys

6.3.1 General

The condition surveys should comprise pressure testing or leak detection (acoustic) surveys carried out on the water main and pressure testing or CCTV inspection of the stormwater and wastewater pipes within 20 m of the Site.

6.3.2 Condition survey intervals

A condition survey of the public services immediately adjacent to the Site shall be carried out before the commencement of dewatering. The survey shall be repeated no earlier than six months after the completion of basement construction.

Following the post-construction survey, a report shall be submitted to the Council within 15 working days demonstrating that the services surveyed have not been damaged.

If the survey indicates damage to the services since the pre-construction survey, a determination of the cause of damage identified shall be reported by a Chartered Professional Engineer, together with a methodology for repair of any damage caused wholly or in part by the construction works.

7 Alert and alarm trigger level response procedures

7.1 Response procedure if the alert trigger levels are exceeded

If any of the monitoring alert settlement trigger levels are reached then one or more of the contingency options described in Section 8 of this plan should be carried out together with:

1. Notify the Project Manager;
2. Notify the Council, in writing within one working day of the trigger level being exceeded, with details of any actions being undertaken;
3. Survey all monitoring marks within a 50 m radius of the monitoring point, and compare them to settlement trigger levels;
4. Review the monitoring data, as-built details and geology and compare against the assumptions made in the design analyses;
5. Submit a report by a Chartered Professional Engineer to the Council for approval, within one week of trigger level exceedance, which provides analyses of all monitoring data, including wall deflection monitoring, relating to the exceedance of any of the trigger levels and any recommendations for remedial actions and time frames for implementing these actions. If no remedial actions are considered necessary, then justification for this viewpoint is required; and
6. All monitoring pins and groundwater levels within 50 m shall be surveyed at two day intervals until such time the written report in (5) has been approved by the Council.

If considered necessary:

1. Increase monitoring frequency; or
2. Develop a detailed contingency plan and submit to the Council.

7.2 Response procedure if the alarm trigger levels are exceeded

If any of the monitoring alarm settlement trigger levels are reached then the following shall be carried out in addition to the actions outlined in the previous section:

1. Cease further lowering of the water table or any other activity which has the potential to cause further deformations;
2. Submit a written report by a Chartered Professional Engineer to the Council for approval, within one week of alarm trigger Level exceedance, which provides analyses of all monitoring data and any recommendations for remedial action; and
3. Once approved by the Council the recommendations shall be implemented.

Dewatering and/or construction may be resumed once the Council provides written notice to the Consent Holder that the Council is satisfied that damage to buildings, structures and services is unlikely with or without any approved additional mitigation measures to be undertaken or that the Council is satisfied that owners of potentially affected buildings, structures and services have given written approval for dewatering and/or construction to continue.

8 Contingency options

8.1 General

If any of the monitoring trigger levels are exceeded the general response will be as detailed in Section 7. Specific actions will be selected depending on the exact nature of the problem. Possible contingency actions are detailed in the following sections.

8.2 Retaining wall deflection contingency measures

In the event of retaining wall deflections exceeding the monitoring trigger levels, a review of the retaining design model shall be carried out to assess the potential increased load in the wall, anchors and existing props, and potential increase in mechanical ground deformations.

If required, the following actions may be taken:

1. Reduce load on the wall by allowing water to drain from behind the wall. This would be temporary while one of the other mitigation measures is undertaken;
2. Place a temporary berm of soil in front of the wall; and
3. Install additional props and/ or anchors.

8.3 Groundwater drawdown contingency measures

8.3.1 Groundwater recharge during construction

One option to lessen the effect of groundwater dewatering during the excavation in a local area is to inject further water into the ground through shallow injection wells or a trench.

The shallow well injection system will likely consist of the following:

1. 2 m to 6 m deep, 150 mm diameter wells spaced at approximately 10 m centres (depending on degree of drawdown); and
2. A water supply manifold connected to a header tank with float valve and flow meter.

The location of the wells will be dependent on where the groundwater has been drawn down. Following the implementation of the injection wells the groundwater levels will be monitored closely.

8.3.2 Options to reduce temporary and permanent drawdown

In the event of groundwater drawdown exceeding the monitoring trigger levels, one or more of the following actions may be taken:

1. Grout anchor points, wall connections or other areas of excessive seepage;
2. Shallow reinjection wells to inject potable water into the ground to mitigate the change in groundwater level (groundwater recharge);
3. Construct a grout curtain to reduce inflow;
4. Install an impermeable wall inside the diaphragm/ sheet pile wall, designed to resist hydraulic pressure;
5. Locally tank floor to extend the drainage path; and
6. Convert to a tanked basement.

8.4 Ground and building deformation contingency measures

In the event of ground or building deformation exceeding the monitoring trigger levels, one or more of the following actions shall be taken:

1 Check public safety is maintained;
2 Review the potential causes for ground of building deformations;
3 Discuss the situation with the property/service owner that may be affected;
4 Monitor the rate of settlement (assuming that other steps have been undertaken to address the cause);
5 Undertake remedial works including foundation strengthening; and
6 Accept and reinstate resultant damage.

9 Applicability

This report has been prepared for the exclusive use of our client Precinct Properties New Zealand Limited, with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

We understand and agree that our client will submit this report as part of an FTAA application, and that the consenting authority will use this report for the purpose of assessing that application.

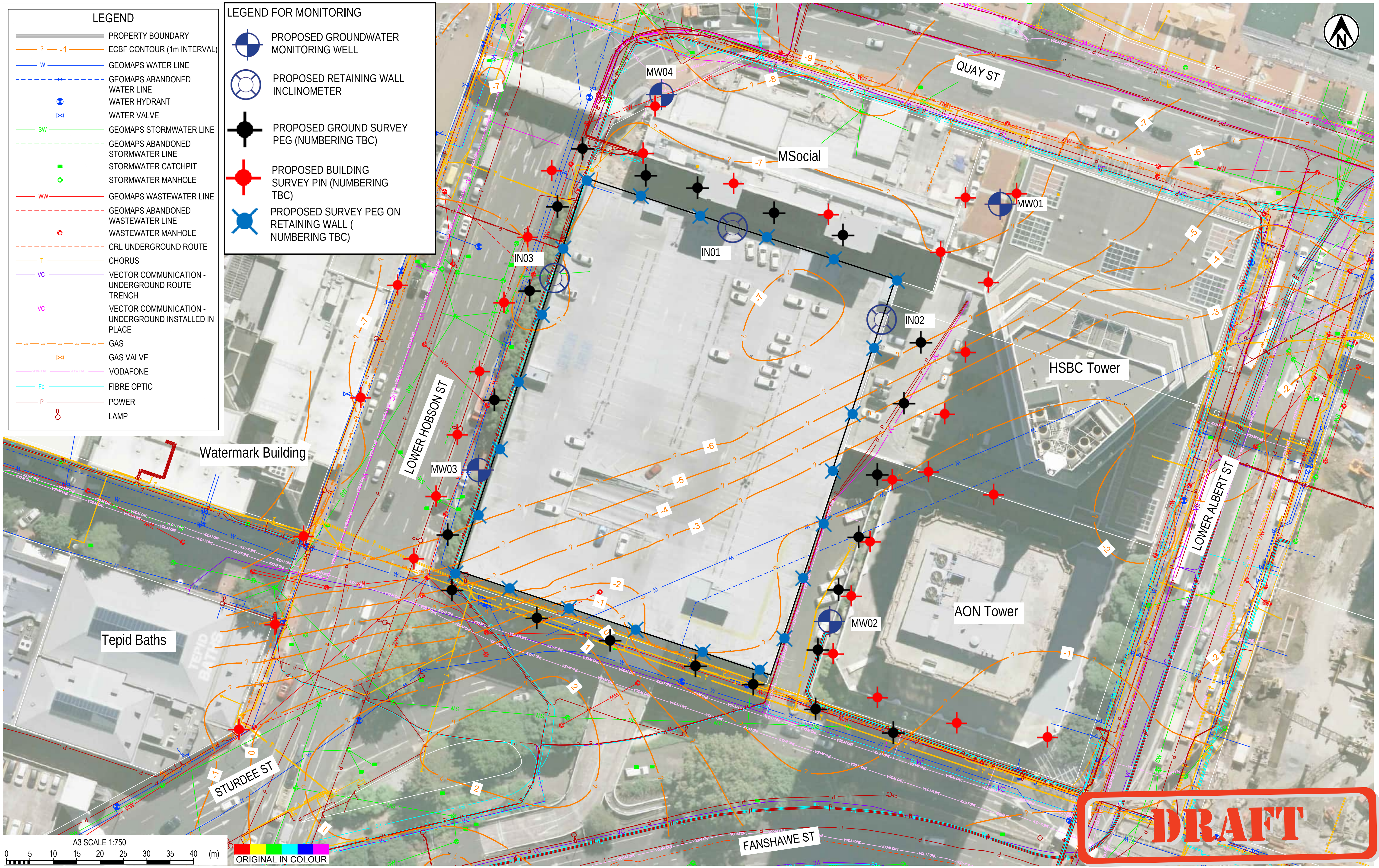
Recommendations and opinions in this report are based on data from discrete investigation locations. The nature and continuity of subsoil away from these locations are inferred but it must be appreciated that actual conditions could vary from the assumed model.

Tonkin & Taylor Ltd
Environmental and Engineering Consultants

Report prepared by:	Authorised for Tonkin & Taylor Ltd by:
[redacted].....	[redacted]..................
Ric Wilkinson Senior Geotechnical Engineer	Peter Millar Project Director

7-Nov-25
\\ttgroup.local\corporate\auckland\projects\1016043\1016043.2000\issueddocuments\20251107 gsmcp\gsmcp-dtw-november 2025 - rev5.1.docx

Appendix A Construction Monitoring and Instrumentation plan



LEGEND

	PROPERTY BOUNDARY
? — -1	ECBF CONTOUR (1m INTERVAL)
W	GEOMAPS WATER LINE
	GEOMAPS ABANDONED WATER LINE
	WATER HYDRANT
⋈	WATER VALVE
SW	GEOMAPS STORMWATER LINE
	GEOMAPS ABANDONED STORMWATER LINE
■	STORMWATER CATCHPIT
◎	STORMWATER MANHOLE
WW	GEOMAPS WASTEWATER LINE
	GEOMAPS ABANDONED WASTEWATER LINE
◎	WASTEWATER MANHOLE
	CRL UNDERGROUND ROUTE
T	CHORUS
VC	VECTOR COMMUNICATION - UNDERGROUND ROUTE TRENCH
VC	VECTOR COMMUNICATION - UNDERGROUND INSTALLED IN PLACE
GAS	GAS
⋈	GAS VALVE
VODAFONE	VODAFONE
FO	FIBRE OPTIC
P	POWER
	LAMP

LEGEND FOR MONITORING

	PROPOSED GROUNDWATER MONITORING WELL
	PROPOSED RETAINING WALL INCLINOMETER
	PROPOSED GROUND SURVEY PEG (NUMBERING TBC)
	PROPOSED BUILDING SURVEY PIN (NUMBERING TBC)
	PROPOSED SURVEY PEG ON RETAINING WALL (NUMBERING TBC)

Tonkin+Taylor

Exceptional thinking together www.tonkintaylor.co.nz

NOTES:
1. AERIAL PHOTO, STORMWATER LINE, WASTEWATER LINE AND WATER LINE SOURCED FROM AUCKLAND COUNCIL GEOMAPS, LICENSED FOR RE-USE UNDER THE CREATIVE COMMONS ATTRIBUTION 4.0 NEW ZEALAND LICENCE (CC BY 4.0). CAPTURE DATE 24/05/2023.
2. VODAFONE AND CRL INFORMATION SUPPLIED BY BEFORE U DIG. REF 11197173 - Vodafone Plan.pdf AND "11197172 - CityLink Plan (002).pdf".
3. CHORUS INFORMATION SUPPLIED BY CHORUS, REF "CHORUS.pdf".
4. VECTOR POWER, COMMUNICATION AND GAS SUPPLIED BY VECTOR, REF "VECTOR ELECTRICITY.pdf" , "VECTOR COMMUNICATION.pdf" AND "VECTOR GAS.pdf".

PROJECT No.	1016043.1000	
DESIGNED	ABL	May.23
DRAWN	JC	May.23
CHECKED		
APPROVED	DATE	

CLIENT PRECINCT PROPERTIES NEW ZEALAND LIMITED
PROJECT DOWNTOWN CARPARK SITE DEVELOPMENT
TITLE CONSTRUCTION MONITORING AND INSTRUMENTATION PLAN
SCALE (A3) 1:750 **FIG No.** FIGURE 1 **REV** 1

Appendix B Summary of monitoring requirements

[Placeholder]

Appendix C Piezometer construction records

[Placeholder]

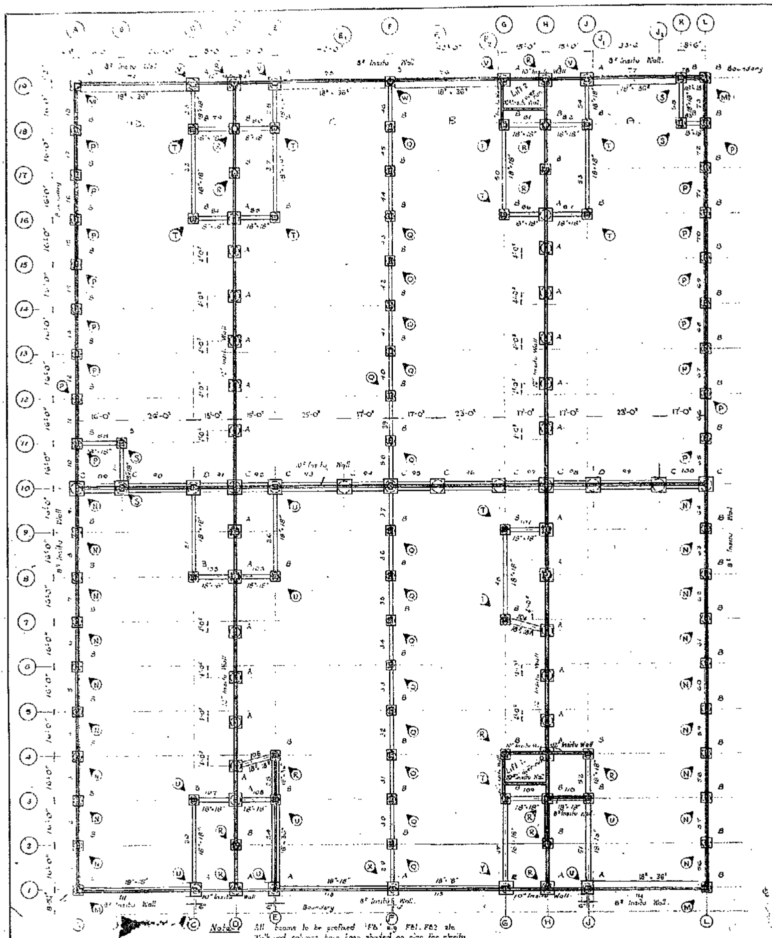
Appendix D Groundwater monitoring records

[Placeholder]

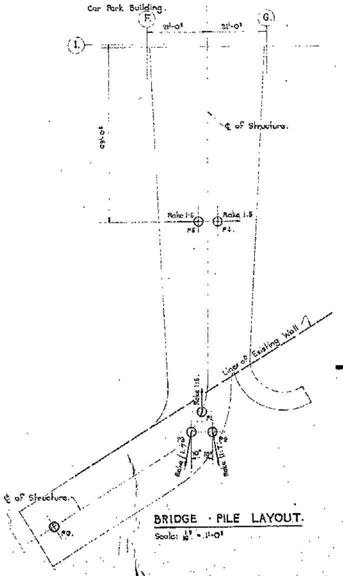
www.tonkintaylor.com

Appendix C Foundation plans for the existing carpark

Zone A
Zone B
Zone C



Note: All beams to be prefixed 'FB' e.g. FB1, FB2 etc.
Walls and columns have been shaded on plan for clarity
Refer to Beam Schedule for tie beam sizes.
Piles & Pilecaps C1, E1, F1, & J1 offset 6" from Grid Line



BRIDGE · PILE LAYOUT.
Scale: 1/8" = 1'-0"

TOP OF PILE CAPS & PILE CUT OFF LEVELS

GRID		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
A	Top of Pile Cap Level	7·0	7·00	7·00	7·00	7·00	7·00	7·00	7·00	7·00	4·75	4·75	4·75	4·75	4·75	4·75	4·75	4·75	[illegible]	[illegible]
	Pile Cut Off Level	4·75	4·75	4·75	4·75	4·75	4·75	4·75	4·75	4·75	1·00	2·50	2·50	2·50	2·50	2·50	2·50	2·50		[illegible]
B	Top of Pile Cap Level										4·75	4·75								
	Pile Cut Off Level										1·00	2·50								
C	Top of Pile Cap Level	7·00		8·00					8·00		2·75						4·75		[illegible]	[illegible]
	Pile Cut Off Level	3·25		5·75					5·75		4·75						2·50		[illegible]	[illegible]
D	Top of Pile Cap Level	8·00	8·00	8·00	8·00	8·00	8·00	8·00	8·00	8·00	0·00	0·00	0·00	0·00	0·00	0·00	0·00	0·00	0·00	0·00
	Pile Cut Off Level	4·25	5·75	4·25	4·25	4·25	4·25	4·25	4·25	4·25	-3·75	-3·75	-3·75	-3·75	-3·75	-3·75	-3·75	[illegible]	[illegible]	[illegible]
E	Top of Pile Cap Level	8·00		8·00	8·00				8·00		0·00						0·00		[illegible]	[illegible]
	Pile Cut Off Level	4·25		5·75	5·75				5·75		-3·75						-2·25			[illegible]
E1	Top of Pile Cap Level										0·00									
	Pile Cut Off Level										-3·75									
F	Top of Pile Cap Level	9·50	10·50	11·00	11·00	11·00	11·00	11·00	11·00	11·00	0·00	1·25	1·25	1·25	1·25	1·25	1·25	1·25	[illegible]	[illegible]
	Pile Cut Off Level	5·75	8·25	8·75	8·75	8·75	8·75	8·75	8·75	8·75	-3·75	-1·00	-1·00	-1·00	-1·00	-1·00	-1·00	-1·00		-1·00
F1	Top of Pile Cap Level										0·00									
	Pile Cut Off Level										-3·75									
G	Top of Pile Cap Level	9·50		9·50	2·00			10·25		10·25							0·00		0·00	2·00
	Pile Cut Off Level	5·75		7·25	-0·25			8·00		8·00							-2·25		[illegible]	[illegible]
H	Top of Pile Cap Level	11·00	9·50	9·50	2·00	10·25	10·25	10·25	10·25	10·25	0·00	0·00	0·00	0·00	0·00	0·00	0·00	0·00	0·00	[illegible]
	Pile Cut Off Level	7·25	7·25	7·25	-1·75	6·50	6·50	6·50	6·50	6·50	-3·75	-3·75	-3·75	-2·75	-3·75	-3·75	-3·75	[illegible]	[illegible]	[illegible]
J	Top of Pile Cap Level	11·00		9·50	15·00												4·75		[illegible]	[illegible]
	Pile Cut Off Level	7·25		7·25	11·75												2·50		[illegible]	[illegible]
J1	Top of Pile Cap Level										2·75									
	Pile Cut Off Level										-1·75									
K	Top of Pile Cap Level																		[illegible]	[illegible]
	Pile Cut Off Level																		[illegible]	[illegible]
L	Top of Pile Cap Level	11·00	11·00	11·00	6·00	6·00	6·00	6·00	6·00	6·00	4·75	4·75	4·75	4·75	4·75	4·75	4·75	4·75	[illegible]	[illegible]
	Pile Cut Off Level	8·75	8·75	8·75	3·75	3·75	3·75	3·75	3·75	3·75	1·00	2·50	2·50	2·50	2·50	2·50	2·50	2·50	[illegible]	[illegible]
F2	Top of Pile Cap Level										0·00									
	Pile Cut Off Level										-3·75									
J2	Top of Pile Cap Level										4·75									
	Pile Cut Off Level										1·00									

BEAM	SIZE
1-18	18"·14"
19-33, 26-55	18"·18"
56-73	18"·14"
24,25, 74-77	15"·36"
78-88	18"·18"
89-100	24"·36"
101-113	18"·18"
114	18"·36"

Beams FB49 & FB109 omitted

TIE BEAM SCHEDULE

PILE CAP TYPES

A	4'-0"·4'-0"·4'-0" DEEP
B	3'-6"·3'-6"·2'-6" DEEP
C	4'-6"·4'-6"·4'-0" DEEP
D	4'-6"·4'-6"·4'-9" DEEP.
E	5'-6"·4'-0"·4'-0 DEEP

PEDESTAL TYPES INDICATED THUS Ⓟ

For all Pedestal types see drg Nº45

No.	AMENDMENTS		
D.	Boundary dimensions amended	[illegible]	[illegible]
C.	Tie Beam Schedule amended	[illegible]	[illegible]
B.	Bridge Pile Layout added	E.G.	[illegible]
A.	Pedestal types added · Beams 24 & 25 altered	[illegible]	[illegible]

CONTRACTOR TO VERIFY ALL DIMENSIONS ON SITE.
FIGURED DIMENSIONS TO BE TAKEN IN PREFERENCE TO SCALE

AUCKLAND DOWNTO
REDEVELOPMENT
STAGE 1

CAR PARKING STATION
FOR
AUCKLAND CITY COUNCIL

DRAWING TITLE
LAYOUT OF BORED PILES

P

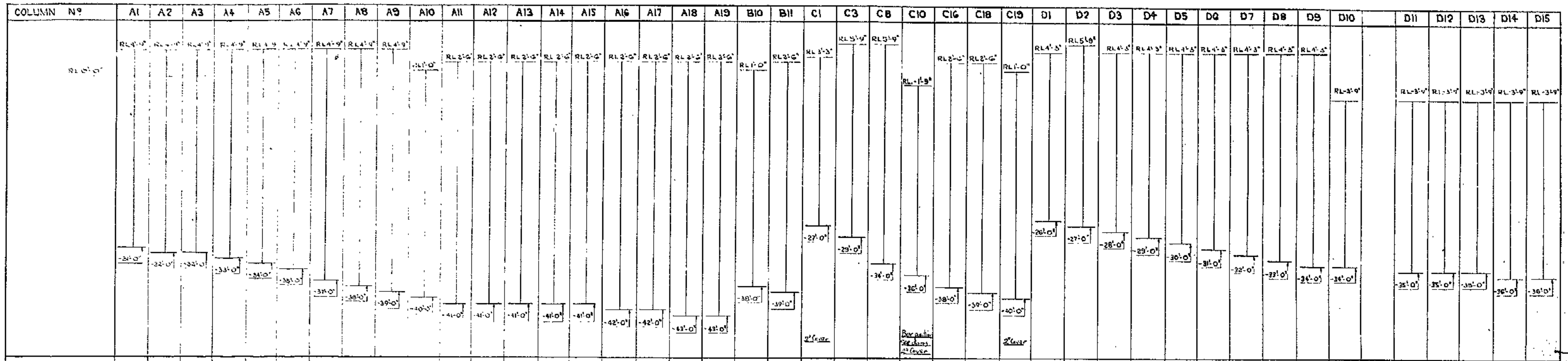
DRAWN M.S.
DATE JULY 1968
DESIGN R.N.?
SCALES 1/16", 1/8" = 1'-0"
CHECKED 15-1-68
APPROVED
JOB No. CS 0373

CONSULTING ENGINEERS
RANKINE & HILL
[illegible] STREET,
NORTH SYDNEY, N.S.W.
TEL [illegible]

BRICKELL, MOSS, RANKINE & [illegible]

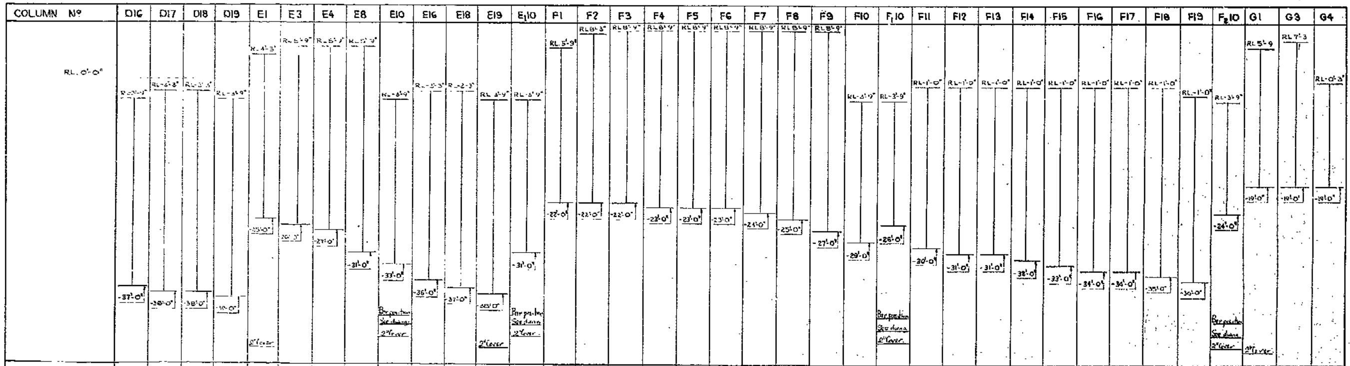
(A0)
73-81 Customs Street West
P. no 956

84 of 90



COLUMN Nº	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A17	A18	A19	B10	B11
LENGTH OF PILE (TOTAL)	35'-9"	36'-9"	34'-9"	37'-9"	36'-9	39'-9"	41'-9"	43'-9"	45'-9"	41'-0"	42'-6"	43'-6"	43'-6"	43'-6"	43'-6"	44'-6"	44'-6"	45'-6"	45'-6"	39'-0"	41'-6"
DIAMETER OF PILE	3'-0"	3'-0"	3'-0"	3'-0"	3'-0"	3'-0"	3'-0"	3'-0"	3'-0"	4'-0"	3'-0"	3'-0"	3'-0"	3'-0"	3'-0"	3'-0"	3'-0"	3'-0"	3'-0"	4'-0"	3'-0"
DIAMETER OF BELL	5'-0"	5'-0"	5'-0"	5'-0"	5'-0"	5'-0"	5'-0"	5'-0"	5'-0"	7'-6"	5'-0"	5'-0"	5'-0"	5'-0"	5'-0"	5'-0"	5'-0"	5'-0"	5'-0"	7'-6"	4'-0"
REINFORCEMENT.	10-#10H	10-#10H	10-#10H	10-#10H	10-#10H	10-#10H	10-#10H	10-#10H	10-#10H	25-#10H	10-#10H	10-#10H	10-#10H	10-#10H	10-#10H	10-#10H	10-#10H	10-#10H	10-#10H	25-#10H	10-#10H
COLUMN Nº	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A17	A18	A19	B10	B11

COLUMN Nº	C1	C3	C8	C10	C16	C18	C19	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10		D11	D12	D13	D14	D15
LENGTH OF PILE (TOTAL)	30'-3"	34'-9"	39'-9"	34'-3"	40'-6"	41'-6"	41'-0"	30'-3"	32'-9"	32'-3"	33'-3"	34'-3"	35'-3"	36'-3"	37'-3"	38'-3"	30'-3"		31'-3"	31'-3"	31'-3"	32'-3"	32'-3"
DIAMETER OF PILE	3'-6"	3'-0"	3'-0"	4'-0"	3'-0"	3'-0"	3'-6"	3'-6"	3'-0"	3'-6"	3'-6"	3'-6"	3'-6"	3'-6"	3'-6"	3'-6"	4'-0"		3'-6"	3'-6"	3'-6"	3'-6"	3'-6"
DIAMETER OF BELL	6'-6"	6'-0"	3'-0"	7'-6"	6'-0"	6'-0"	6'-6"	5'-0"	4'-0"	6'-6"	6'-6"	6'-6"	6'-0"	6'-0"	6'-0"	6'-0"	6'-6"		6'-0	6'-0	6'-0	6'-0"	6'-6"
REINFORCEMENT.	~~20-#10H~~ 32-#10H	10-#10H	10-#10H	27-#10H	10-#10H	10-#10H	~~20-#10H~~ 22-#10H	32-#10H	10-#10H	13-#10H	13-#10H	13-#10H	13-#10H	13-#10H	13-#10H	13-#10H	25-#10H		13-#10H	13-#10H	13-#10H	13-#10H	13-#10H
COLUMN Nº	C1	C3	C8	C10	C16	C18	C19	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10		D11	D12	D13	D14	D15



COLUMN Nº	D16	D17	D18	D19	E1	E3	E4	E8	E10	E16	E18	E19	$E_1$10	F1	F2	F3	F4	F5	F6
LENGTH OF PILE (TOTAL)	33'-3"	35'-9"	35'-9"	35'-3"	29'-3"	31'-9"	32'-9"	36'-9"	29'-3"	33'-9"	34'-9"	34'-3"	27'-3"	27'-9"	30'-3"	30'-9"	31'-9"	31'-9"	31'-9"
DIAMETER OF PILE	3'-6"	3'-0"	3'-0"	3'-6"	3'-6"	3'-0"	3'-0"	3'-0"	4'-0"	3'-0"	3'-0	3'-6"	4'-0"	3'-6"	3'-0	3'-0"	3'-0"	3'-0"	3'-0"
DIAMETER OF BELL	4'-6"	4'-0"	4'-0"	5'-0"	6'-6"	6'-0"	4'-0"	3'-0"	7'-6"	6'-0"	6'-0"	6'-6"	7'-6"	6'-6"	6'-0"	6'-0"	6'-0"	6'-0"	6'-0"
REINFORCEMENT	13-#10H	10-#10H	10-#10H	22-#10H	~~20-#10H~~ 22-#10H	10-#10H	10-#10H	10-#10H	27-#10H	10-#10H	10-#10H	~~20-#10H~~ 22-#10H	27-#10H	10-#10H	~~10-#10H~~ 9-#10H	~~10-#10H~~ 9-#10H	~~10-#10H~~ 9-#10H	~~10-#10H~~ 9-#10H	~~10-#10H~~ 9-#10H
COLUMN Nº	D16	D17	D18	D19	E1	E3	E4	E8	E10	E16	E18	E19	$E_1$10	F1	F2	F3	F4	F5	F6

COLUMN Nº	F7	F8	F9	F10	$F_1$10	F11	F12	F13	F14	F15	F16	F17	F18	F19	$F_2$10	G1	G3	G4
LENGTH OF PILE (TOTAL)	32'-9"	33'-9"	35'-9"	25'-3"	22'-9"	29'-0"	30'-0"	30'-0"	31'-0"	32'-0"	33'-0"	33'-0"	34'-0"	35'-0"	20'-9"	24'-9"	36'-3"	18'-9"
DIAMETER OF PILE	3'-0"	3'-0"	3'-0"	4'-0"	4'-0"	3'-0"	3'-0"	3'-0"	3'-0"	3'-0"	3'-0"	3'-0"	3'-0"	3'-0"	4'-0"	3'-6"	3'-0"	3'-0"
DIAMETER OF BELL	6'-0"	6'-0"	6'-0"	6'-6"	7'-6"	6'-0"	6'-0	6'-0"	6'-0"	6'-0"	6'-0"	6'-0"	6'-0"	6'-0"	7'-6"	6'-6"	6'-0"	4'-0"
REINFORCEMENT	~~10-#10H~~ 9-#10H	~~10-#10H~~ 9-#10H	~~10-#10H~~ 9-#10H	25-#10H	27-#10H	~~10-#10H~~ 9-#10H	~~10-#10H~~ 9-#10H	~~10-#10H~~ 9-#10H	~~10-#10H~~ 9-#10H	~~10-#10H~~ 9-#10H	~~10-#10H~~ 9-#10H	~~10-#10H~~ 9-#10H	~~10-#10H~~ 9-#10H	10-#10H	27-#10H	~~20-#10H~~ 22-#10H	10-#10H	10-#10H
COLUMN Nº	F7	F8	F9	F10	$F_1$10	F11	F12	F13	F14	F15	F16	F17	F18	F19	$F_2$10	G1	G3	G4

(A0)
73-81 Customs Street
West
P.no 956

No.	AMENDMENTS	BY	DATE	CH'ECK
A	Piles revised throughout		4.10.68	

CONTRACTOR TO VERIFY ALL DIMENSIONS ON SITE
FIGURED DIMENSIONS TO BE TAKEN IN PREFERENCE TO SCALE

AUCKLAND DOWNTOWN REDEVELOPMENT
STAGE 1

CAR PARKING STATION
FOR
AUCKLAND CITY COUNCIL

DRAWING TITLE
BORED PILES
PART SCHEDULE

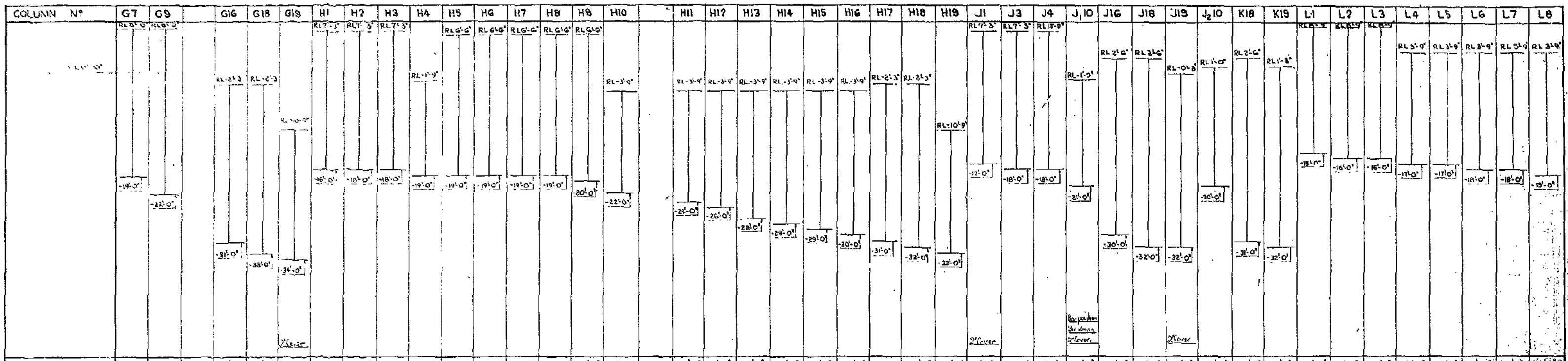
DRAWN IGH
DATE 31-5-68
JOB No. CS 0023
DESIGN R.H.T.
SCALES N.T.S.
CHECKED 15-9-68
APPROVED
DWG. No. 2A

CONSULTING ENGINEERS
RANKINE & HILL
40 MILLER STREET,
NORTH SYDNEY, N.S.W.
TEL.: 29-0085

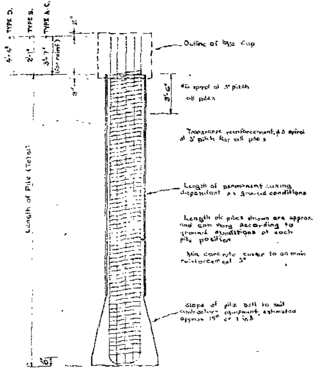
BRICKELL, MOSS,
RANKINE & HILL
A.N.Z. HOUSE,
203 QUEEN STREET,
AUCKLAND, N.Z.
TEL.: 49 888

85 of 90

PEDDLE THORP & WALKER
RESIDENT PARTNER • CHARLES ANDERSON • ARCHITECT
27 QUEEN STREET, AUCKLAND



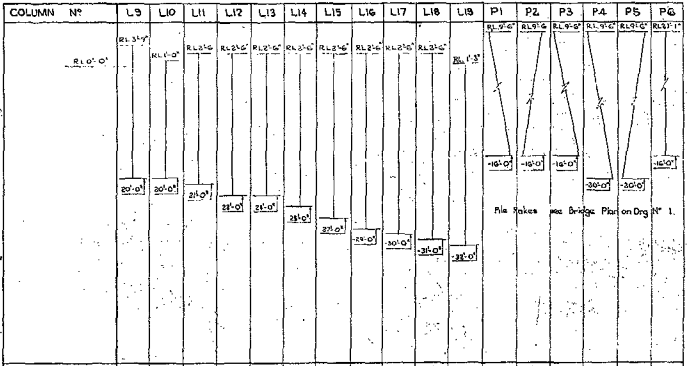
COLUMN N°	G7	G9		G16	G18	G19	H1	H2	H3	H4	H5	H6	H7	H8	H9	H10		H11	H12	H13	H14	H15	H16	H17	H18	H19	J1	J3	J4	J$_1$10	J16	J18	J19	J$_2$10	K18	K19	L1	L2	L3	L4	L5	L6	L7	L8
LENGTH OF PILE (TOTAL)	27'-0"	30'-0"		28'-9"	30'-9"	23'-3"	25'-3"	25'-3"	25'-3"	17'-3"	25'-3"	25'-6"	25'-6"	25'-6"	26'-6"	18'-3"		20'-3"	22'-3"	24'-3"	25'-3"	25'-3"	26'-3"	28'-9"	29'-9"	19'-3"	24'-3"	25'-3"	30'-9"	19'-3"	32'-6"	34'-6"	31'-9"	21'-0"	33'-6"	33'-3"	23'-9"	24'-0"	24'-9"	20'-9"	20'-9"	21'-9"	21'-9"	[illegible]
DIAMETER OF PILE.	3'-0"	3'-0"		3'-0"	3'-0"	3'-6"	3'-6"	3'-0"	3'-0"	3'-6"	3'-6"	3'-6"	3'-6"	3'-6"	3'-6"	4'-0"		3'-6"	3'-6"	3'-6"	3'-6"	3'-6"	3'-6"	3'-0"	3'-0"	3'-6"	3'-6"	3'-0"	3'-0"	4'-0"	3'-0"	3'-0"	3'-6"	4'-0"	3'-0"	3'-0"	3'-0"	3'-0"	3'-0"	3'-0"	3'-0"	3'-0"	3'-0"	3'-0"
DIAMETER OF BELL.	3'-0	3'-0"		6'-0"	6'-0"	6'-6"	5'-0"	4'-0"	4'-0"	6'-6"	6'-6"	6'-0"	6'-0"	6'-0"	6'-0"	6'-6"		6'-0"	6'-0"	6'-0"	6'-0"	6'-6	6'-6"	4'-0"	4'-0"	5'-0"	6'-6"	6'-0"	4'-0"	7'-6"	6'-0"	6'-0"	6'-6"	7'-6"	4'-0"	4'-0"	5'-0"	5'-0"	5'-0"	5'-0"	5'-0"	5'-0"	5'-0"	5'-0"
REINFORCEMENT.	10-#10H	10-#10H		10-#10H	10-#10H	[illegible]	13-#10H	10-#10H	10-#10H	13-#10H	13-#10H	13-#10H	13-#10H	13-#10H	13-#10H	25-#10H		13-#10H	13-#10H	13-#10H	13-#10H	13-#10H	13-#10H	10-#10H	10-#10H	22-#10H	~~30-#10H~~ 22-#10H	10-#10H	10-#10H	27-#10H	10-#10H	10-#10H	~~30-#10H~~ 22-#10H	25-#10H	10-#10H	10-#10H	10-#10H	10-#10H	10-#10H	10-#10H	10-#10H	10-#10H	10-#10H	10-#10H
COLUMN N°	G7	G9		G16	G18	G19	H1	H2	H3	H4	H5	H6	H7	H8	H9	H10		H11	H12	H13	H14	H15	H16	H17	H18	H19	J1	J3	J4	J$_1$10	J16	J18	J19	J$_2$10	K18	K19	L1	L2	L3	L4	L5	L6	L7	L8



Absolutely no welding permitted on pile reinf.

NOTES:

1. All concrete in piles to be 4000 p.s.i. crushing strength in accordance with NZSS 1900 Chapter 9.3-21 "Concrete placing under water", whereby max. water-cement ratio by weight: 0.60 and min. cement content 675 lb/cu.yd. of conc. for High Grade Concrete.
2. Main (vert.) reinforcement to be 60,000 p.s.i. yield strength steel (marked "H") (NZSS 187 & 1693), secondary reinf. (spirals) to be structural grade mild steel.
3. Laps for main reinforcement to be 36 dia of bar where unavoidable, but use continuous bars if possible.
4. Casing shown for full length of pile as permanent, but contractor may withdraw casing if approved by the Engineer. Contractor should also refer to Quantity Surveyors schedule.
5. Length of pile is the measurement between founding level & levels shown at top of pile. (See typical pile.)
6. All levels are to ACC datum (See "Foundation Investigation" - Stage I - Auckland Harbour Board Central Area Properties Redevelopment - Auckland NZ."
7. Founding levels of piles shown in schedule are based on information given in the above "Foundation Investigation...." but it may vary according to ground conditions at each pile.
8. Design bearing pressures: DL + LL + Seismic = 24 T/sq.ft.; DL + LL = 20T/sq.ft.



COLUMN N°	L9	L10	L11	L12	L13	L14	L15	L16	L17	L18	L19	P1	P2	P3	P4	P5	P6
LENGTH OF PILE (TOTAL)	23'-9"	21'-0"	23'-6"	25'-6"	26'-6"	27'-6"	29'-6"	31'-6"	32'-6"	33'-6"	33'-3"	26'-4"	25'-11"	25'-11"	30'-1"	30'-1"	37'-1"
DIAMETER OF PILE	3'-0"	4'-0"	3'-0"	3'-0"	3'-0"	3'-0"	3'-0"	3'-0"	3'-0"	3'-0"	3'-0"	3'-0"	3'-0"	3'-0"	3'-0"	3'-0"	3'-6"
DIAMETER OF BELL	5'-0"	7'-6"	5'-0"	5'-0"	5'-0"	5'-0"	5'-0"	5'-0"	5'-0"	5'-0"	5'-0"	5'-0"	5'-0"	5'-0"	5'-0"	5'-0"	6'-6"
REINFORCEMENT.	10-#10H	23-#10H	10-#10H	10-#10H	10-#10H	10-#10H	10-#10H	10-#10H	10-#10H	10-#10H	10-#10H	16-#9	16-#9	16-#9	16-#9	16-#9	42-#10
COLUMN N°	L9	L10	L11	L12	L13	L14	L15	L16	L17	L18	L19	P1	P2	P3	P4	P5	P6

(A0)

73-81 Customs Street West

P.no 956

No.	AMENDMENTS	BY	DATE	CHECK
A	Piles revised throughout. Bridge Piles added	LH	8/10	[illegible]

CONTRACTOR TO VERIFY ALL DIMENSIONS ON SITE
FIGURED DIMENSIONS TO BE TAKEN IN PREFERENCE TO SCALE

AUCKLAND DOWNTOWN REDEVELOPMENT
STAGE 1

CAR PARKING STATION
FOR
AUCKLAND CITY COUNCIL

DRAWING TITLE
BORED PILES
PART SCHEDULE

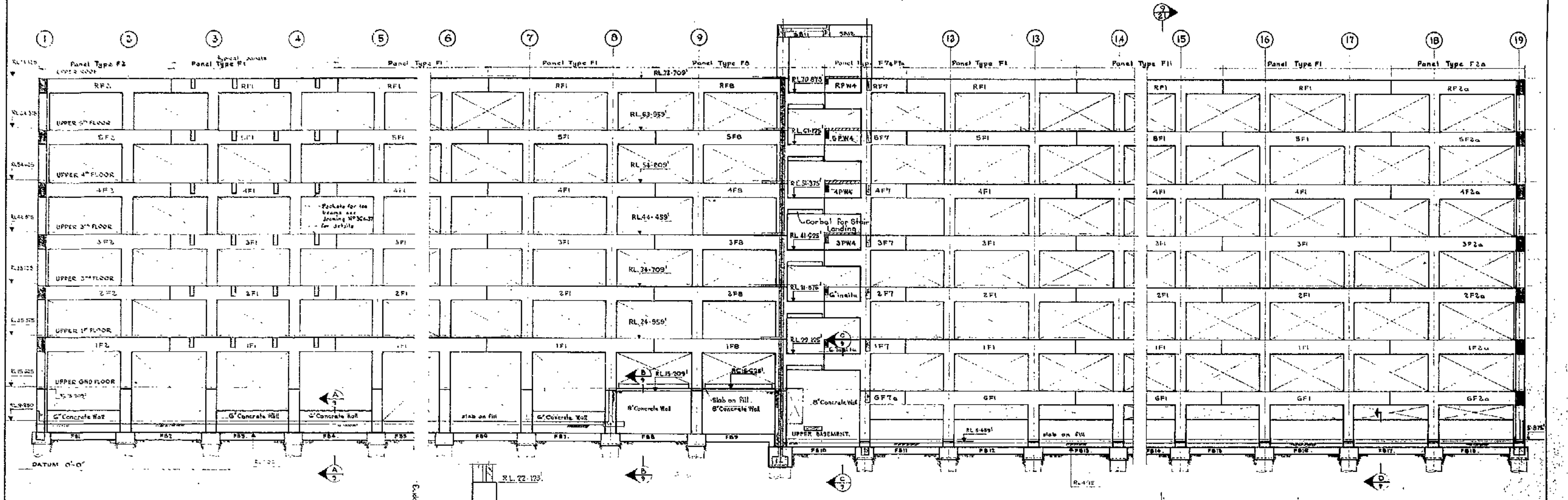
DRAWN I.G.H.
DATE 31-5-68
JOB No. CS 0023
DESIGN R.N.T.
SCALES N.T.S.
CHECKED 15-9-68
APPROVED
DWG. No. 3A

CONSULTING ENGINEERS
RANKINE & HILL
45 MILLER STREET,
NORTH SYDNEY, N.S.W.
TEL.: 92-0606

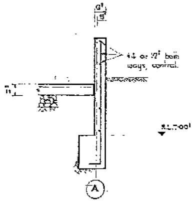
BRICKELL, MOSS, RANKINE & HILL
A.M.P. HOUSE,
203 QUEEN STREET,
AUCKLAND, N.Z.
TEL.: 48-605

86 of 90

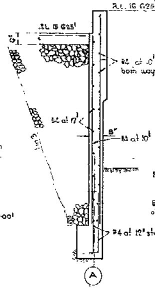
PEDDLE THORP & WALKER
RESIDENT PARTNER • CHARLES ANDERSON • ARCHITECT
37 QUEEN STREET, AUCKLAND



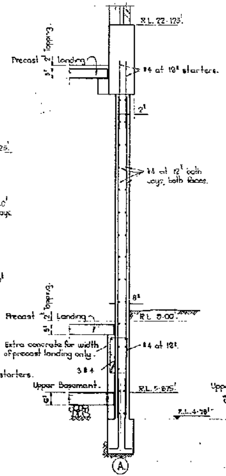
ELEVATION GRID A



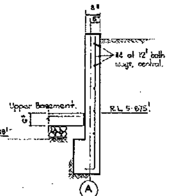
SECTION $\frac{A}{9}$



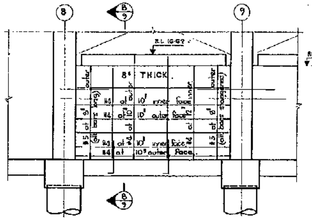
SECTION $\frac{B}{9}$



SECTION $\frac{C}{9}$



SECTION $\frac{D}{9}$



TYPICAL WALL BETWEEN GRIDS 8 & 10

NOTE:
All Retaining walls have been designed assuming granular back fill.
All walls over 5'-0" high & walls on Grids D & H to be back filled with approved granular material. see foundation report.

(AD)

73-81 Customs Street West

P·no 956

For General Notes see Drawing Nº CS0023-0.
All block walls are omitted for clarity.
For reinforcing steel in typical perimeter kerbs refer to drg Nº27
For reinforcement of precast panels see drg Nº 36 & 37.

No.	AMENDMENTS	BY	DATE	CHECK
A	Sections B&C amended	LH	11/68	

CONTRACTOR TO VERIFY ALL DIMENSIONS ON SITE
FIGURED DIMENSIONS TO BE TAKEN IN PREFERENCE TO SCALE

AUCKLAND DOWNTOWN
REDEVELOPMENT
STAGE 1

CAR PARKING STATION
FOR
AUCKLAND CITY COUNCIL

DRAWING TITLE
ELEVATION - GRID A.

P

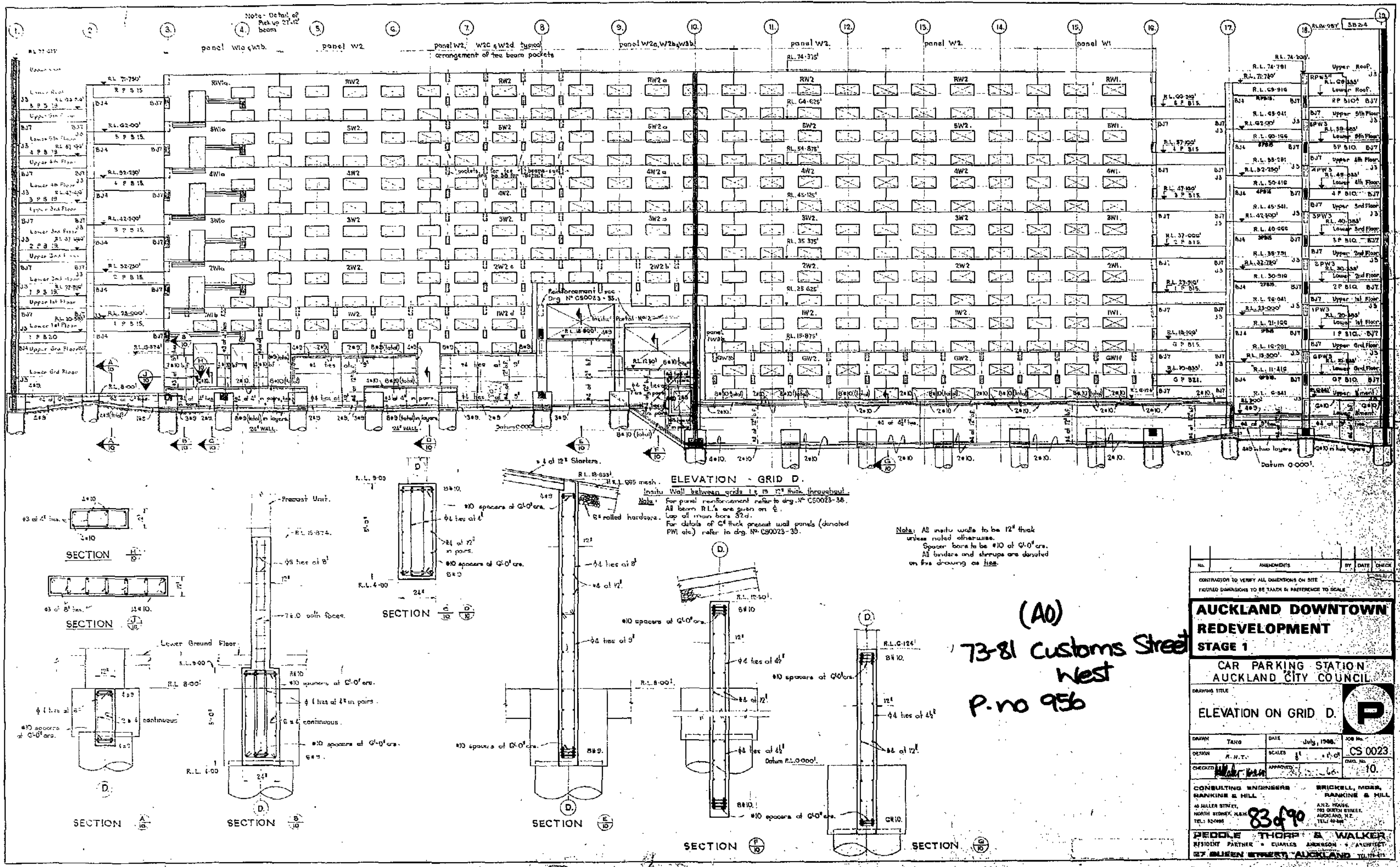
DRAWN T.G.H.	DATE JULY 1968	JOB No. CS 0023
DESIGN R.N.T.	SCALES 1/8" = 1'-0"	DWG. No. 9.A
CHECKED 4·9·68	APPROVED	

CONSULTING ENGINEERS
RANKINE & HILL
40 MILLER STREET,
NORTH SYDNEY, N.S.W.
TEL.: 92-0605

BRICKELL, MOSS, RANKINE & HILL
A.N.Z. HOUSE,
200 QUEEN STREET,
AUCKLAND, N.Z.
TEL.: 49-546

82 of 90

PEDDLE THORP & WALKER
RESIDENT PARTNER - CHARLES ANDERSON - ARCHITECT
27 QUEEN STREET, AUCKLAND



ELEVATION - GRID D.

Insitu Wall between grids 1 & 15 12" thick throughout.

Note: For panel reinforcement refer to drg. Nº CS0023-38.
All beam R.L.'s are given on ℄.
Lap all main bars 32d.
For details of 6" thick precast wall panels (denoted PW1 etc.) refer to drg. Nº CS0023-39.

Note: All insitu walls to be 12" thick unless noted otherwise.
Spacer bars to be #10 at 6'-0" crs.
All binders and stirrups are denoted on this drawing as ties.

(A0)

73-81 Customs Street West

P. no 956

No.	AMENDMENTS	BY	DATE	CHECK

CONTRACTOR TO VERIFY ALL DIMENSIONS ON SITE
FIGURED DIMENSIONS TO BE TAKEN IN PREFERENCE TO SCALE

AUCKLAND DOWNTOWN REDEVELOPMENT
STAGE 1

CAR PARKING STATION
for
AUCKLAND CITY COUNCIL

DRAWING TITLE
ELEVATION ON GRID D.

P

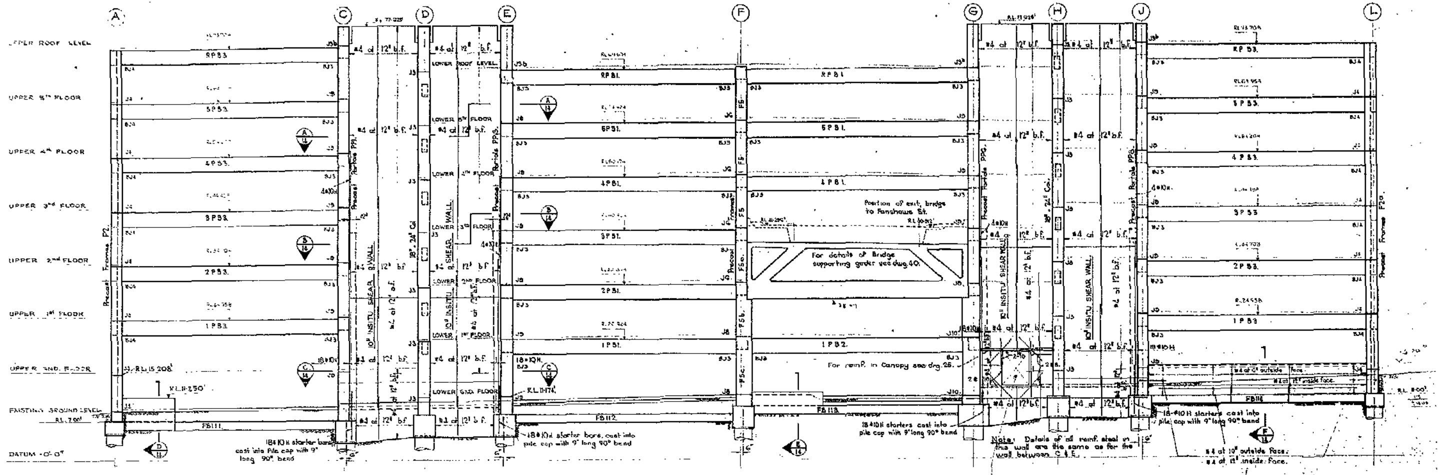
DRAWN Tang
DATE July, 1966.
JOB No. CS 0023
DESIGN R.H.T.
SCALES 1/8" = 1'-0"
DWG. No. 10.
CHECKED
APPROVED

CONSULTING ENGINEERS
RANKINE & HILL
40 MILLER STREET,
NORTH SYDNEY, N.S.W.
TEL.: 92-0495

BRICKELL, MOSS, RANKINE & HILL
A.N.Z. HOUSE,
203 QUEEN STREET,
AUCKLAND, N.Z.
TEL.: 40-649

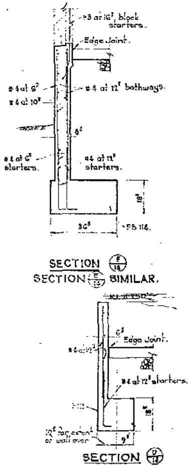
83 of 90

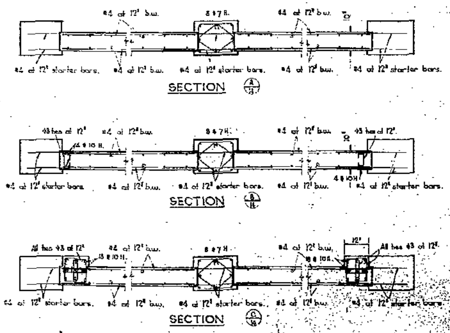
PEDDLE THORP & WALKER
RESIDENT PARTNER • CHARLES ANDERSON • ARCHITECT
27 QUEEN STREET, AUCKLAND TEL. 775-675



ELEVATION GRID 1.

For details of precast beams, refer drg. 39.
Beam Joints denoted by 'BJ', e.g. BJ3.
Column Joints denoted by 'J', e.g. J6.
All connections between precast columns & 10" insitu shear walls must have a keyed surface cast into the precast columns, through the height of the shear wall.
For details of precast column splice, J3 & J3b refer drg. 16.
For reinforcement in Perimeter Kerbs see drg No 27.





(A0)
73-81 Customs Street West
P. no 956

No. | AMENDMENTS | BY | DATE | CHECK

CONTRACTOR TO VERIFY ALL DIMENSIONS ON SITE
FIGURED DIMENSIONS TO BE TAKEN IN PREFERENCE TO SCALE

AUCKLAND DOWNTOWN REDEVELOPMENT
STAGE 1

CAR PARKING STATION
AUCKLAND CITY COUNCIL

DRAWING TITLE
ELEVATION - GRID 1

DRAWN I.G.H.
DATE JULY 1968
JOB No. CS.0023
DESIGN R.N.T.
SCALES 1/8" = 1'-0"
DWG. No. 14
CHECKED 1-10-68
APPROVED

CONSULTING ENGINEERS
RANKINE & HILL
48 MILLER STREET,
NORTH SYDNEY, N.S.W.
TEL.: 92-0000

BRICKELL, MOSS, RANKINE & HILL
A.N.Z. HOUSE,
203 QUEEN STREET,
AUCKLAND, N.Z.
TEL.: 48-000

78 of 90

PEDDLE THORP & WALKER
RESIDENT PARTNER - CHARLES ANDERSON - ARCHITECT
97 QUEEN STREET, AUCKLAND

Appendix D Site-specific investigation results

- **BH01 and BH02 logs and core photography**
- **In-situ pressuremeter test report**
- **UCS laboratory test results**

Tonkin+Taylor

BOREHOLE LOG

BOREHOLE No.:
BH01
SHEET: 1 OF 4

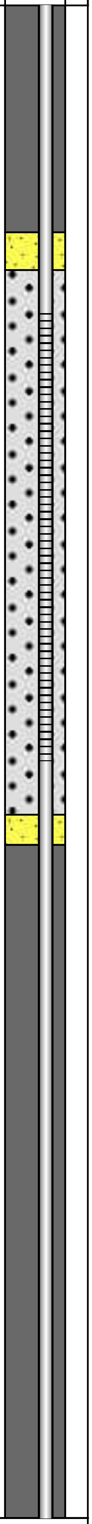
DRILLED BY: Akash,steve
LOGGED BY: ANDS
CHECKED: CWM
START DATE: 23/07/2025
FINISH DATE: 25/07/2025
CONTRACTOR: McMillan Drilling

PROJECT: Downtown Carpark Site Development
JOB No.: 1016043.2000.01
LOCATION: Downtown carpark

CO-ORDINATES: 5921111 mN
(NZTM2000) 1757308 mE
DIRECTION:
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 3m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: GIS\Web map viewer

GEOLOGICAL UNIT	MATERIAL DESCRIPTION SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation	Rock Weathering UW SW MW HW CW RS	Rock Strength VS+ S MS W VW EW	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	Defect Log	Fracture Spacing (mm) 2000 600 200 60 20	RQD (%)	Description & Additional Observations	Water Level / Fluid Loss (%) 25 50 75	Casing	Installation	Core Box No
	0.00 - 10.50m: NO RECOVERY. Hydro Excavated to 3 m and wash drilled to 10.5 m. Nearby historical BH data indicates that the first 10.5 m of soil comprises fine to medium Gravel underlain by interbedded fine Sand and Silty Clay layers of Tauranga Group Formation. .			HVAC	0		2	1						24/07/2025			
							1	2						23/07/2025 24/07/2025			
				W	0		0	3									
							-1	4									
							-2	5									
							-3	6									
							-4	7									
							-5	8									
							-6	9									



COMMENTS: The historical BH logs referenced between 0.0 m - 10.5 m refer to T+T BH66604 and T+T BH210.

Hole Depth
30.5m

Scale 1:50

Rev.: A

BOREHOLE LOG

BOREHOLE No.:
BH01
SHEET: 2 OF 4

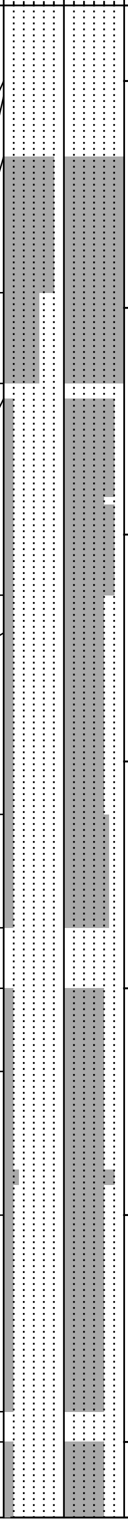
DRILLED BY: Akash,steve
LOGGED BY: ANDS
CHECKED: CWM
START DATE: 23/07/2025
FINISH DATE: 25/07/2025
CONTRACTOR: McMillan Drilling

PROJECT: Downtown Carpark Site Development
JOB No.: 1016043.2000.01
LOCATION: Downtown carpark

CO-ORDINATES: (NZTM2000) 5921111 mN 1757308 mE
DIRECTION:
ANGLE FROM HORIZ.: -90°

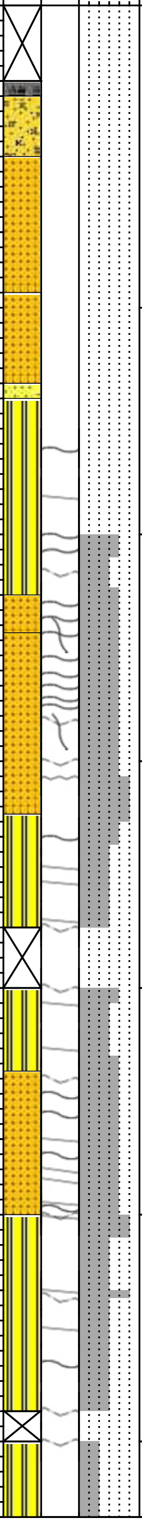
R.L. GROUND: 3m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: GIS\Web map viewer

GEOLOGICAL UNIT	MATERIAL DESCRIPTION SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation
Taug	[CONT] *0.00 - 10.50m:* NO RECOVERY. Hydro Excavated to 3 m and wash drilled to 10.5 m. Nearby historical BH data indicates that the first 10.5 m of soil comprises fine to medium Gravel underlain by interbedded fine Sand and Silty Clay layers of Tauranga Group Formation. .
	10.50m: Silty PEAT (FIBROUS); black . Soft to firm, wet, non-plastic. Organics, branches (partially decomposed).
	10.60m: Sandy SILT, trace clay; light grey. Stiff, moist, low plasticity.
East Coast Bays Formation	*11.00m:* Completely weathered, grey, SANDSTONE. Extremely weak.
	11.90m: Moderately to highly weathered, light grey, SANDSTONE. Extremely weak.
	12.50m: Fine to medium SAND; light grey. Loosely packed, moist, uniformly graded.
	12.60m: Unweathered, light grey, bedded, SILTSTONE. Very weak, fine grained. Bedding.
	13.90m: Unweathered, light grey, massive, SANDSTONE. Weak, coarse grained.
	14.15m: Unweathered, light grey, massive, SANDSTONE. Weak.
	15.35m: Unweathered, dark grey, distinctly bedded, SILTSTONE. Very weak to weak. Bedding. Interbedded with: Unweathered, light grey, SANDSTONE. Very weak to weak, fine to medium grained.
	16.10m: CORE LOSS.
	16.50m: Unweathered, light grey, massive, SILTSTONE. Weak.
	17.05m: Unweathered, grey, massive, SANDSTONE. Weak, coarse grained.
	18.00m: Unweathered, light grey, massive, SILTSTONE. Weak.
	19.30m: CORE LOSS.
	19.50m: Unweathered, light grey, massive, SILTSTONE. Weak.



Sampling Method	Core Recovery (%)	Testing
W	0	
PQTT	100	
PQTT	87	UCS @ 12.70m
PQTT	100	
PQTT	73	
PQTT	100	UCS @ 16.60m
PQTT	87	
PQTT	100	

RL (m)	Depth (m)
-8	11
-9	12
-10	13
-11	14
-12	15
-13	16
-14	17
-15	18
-16	19

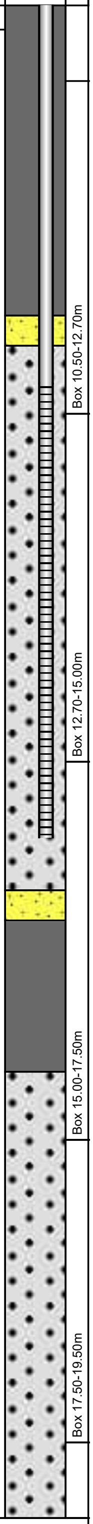


ROCK MASS DISCONTINUITIES

RQD (%)	Description & Additional Observations
70	*12.93m:* J, 5°, PL, R, N, Cn *13.25m:* B, 5°, PL, R, N, Cn
47	*13.50m:* J, 5°, ST, R, N *13.60m:* J, IR, R, N *13.75m:* DD, 5°, CU, R, N *13.95m:* J, 5°, IR, R, VN *14.05m:* J, 5°, IR, R, VN *14.15m:* J, 5°, PL, R, VN *14.16-14.30m:* J (x2), VCS-ECS, 70°, IR, R-SM, VN, Cn *14.31m:* J, 5°, IR, R, VN, CG *14.42m:* J, 5°, PL, R, VN *14.50m:* J, 5°, PL, R, T *14.58m:* J, 5°, PL, SM, VN
40	*14.63m:* J, 5°, PL, R, VN *14.73m:* DD, 5°, CU, SM, VN *14.80-14.90m:* J, ECS, 70°, CU, R-SM, VN *15.00m:* DD, IR, R, N *15.10-15.35m:* BZ (x8), IR, R, N, Cn *15.50m:* J, 5°, PL, R, VN, Cn *15.70m:* B, 5°, IR, R, N, Cn *15.80m:* B, 5°, UN, R, N, Cn *16.05m:* B, 5°, PL, R, VN, Cn *16.10m:* DD, 5°, IR, R, Cn
74	*16.50m:* DD, 5°, UN, R, Cn *16.60m:* B, 5°, PL, R, VN, Cn *16.90m:* B, 5°, UN, R, VN, Cn *17.10m:* DD, 5°, UN, Cn *17.20m:* J, 10°, UN, R, VN, Cn *17.33m:* J, 10°, IR, R, T, Cn *17.50m:* B, 5°, IR, R, N, Cn *17.60m:* J, 10°, PL, R, N, Cn *17.70m:* B, 8°, PL, R, VN, Cn *17.77m:* B, 8°, PL, R, VN, Cn
73	*17.92m:* B, 5°, PL, R, N, Cn *17.95m:* J, 10°, UN, R, VN, Cn *18.00m:* DD, IR, R, Cn *18.01-18.15m:* B (x3), VCS-ECS, 5°, PL, R, VN, CV *18.50m:* B, 5°, UN, R, VN, Cn *18.55m:* DD, 10°, UN, R, Cn *18.75m:* B, 5°, PL, R, VN, Cn *18.98m:* J, 10°, IR, R, N, Cn *19.30m:* DD, 5°, PL, R, Cn
63	*19.50m:* DD

Water Level / Fluid Loss (%) 25 50 75

Casing: PQ



Core Box No
Box 10.50-12.70m
Box 12.70-15.00m
Box 15.00-17.50m
Box 17.50-19.50m

COMMENTS: The historical BH logs referenced between 0.0 m - 10.5 m refer to T+T BH66604 and T+T BH210.

Hole Depth
30.5m

Scale 1:50

Rev.: A

BOREHOLE LOG

BOREHOLE No.:
BH01
SHEET: 3 OF 4

DRILLED BY: Akash,steve
LOGGED BY: ANDS
CHECKED: CWM
START DATE: 23/07/2025
FINISH DATE: 25/07/2025
CONTRACTOR: McMillan Drilling

PROJECT: Downtown Carpark Site Development
JOB No.: 1016043.2000.01
LOCATION: Downtown carpark

CO-ORDINATES: (NZTM2000) 5921111 mN 1757308 mE
DIRECTION:
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 3m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: GIS\Web map viewer

GEOLOGICAL UNIT | MATERIAL DESCRIPTION | Rock Weathering (UW SW MW HW CW RS) | Rock Strength (VS+ S MS W VW EW) | Sampling Method | Core Recovery (%) | Testing | RL (m) | Depth (m) | Graphic Log | Defect Log | Fracture Spacing (mm) (2000 600 200 60 20) | RQD (%) | ROCK MASS DISCONTINUITIES: Description & Additional Observations | Water Level / Fluid Loss (%) (25 50 75) | Casing | Installation | Core Box No

SOIL: Classification, colour, consistency / density, moisture, plasticity
ROCK: Weathering, colour, fabric, name, strength, cementation

GEOLOGICAL UNIT: East Coast Bays Formation

[CONT] *19.50m:* Unweathered, light grey, massive, SILTSTONE. Weak.

20.10m: Unweathered, light grey, massive, SANDSTONE. Weak, fine to medium grained.

22.00m: Unweathered, light grey, massive, SILTSTONE. Weak. Interbedded with: Unweathered, grey, SANDSTONE. Weak.

22.20m: Unweathered, grey, massive, SANDSTONE. Weak.

22.35m: Unweathered, grey, massive, SILTSTONE. Weak.

24.00m: Unweathered, grey, massive, SANDSTONE. Weak, moderately cemented, medium to coarse grained.

25.50m: Unweathered, grey, SILTSTONE. Weak. Interbedded with: Unweathered, grey, SANDSTONE. Weak.

26.65m: Unweathered, grey, SANDSTONE. Weak, well cemented, medium to coarse grained.

27.10m: Unweathered, grey, SILTSTONE. Weak. Interbedded with: Unweathered, grey, SANDSTONE. Weak, well cemented, medium to coarse grained.

27.75m: Unweathered, grey, massive, SILTSTONE. Weak.

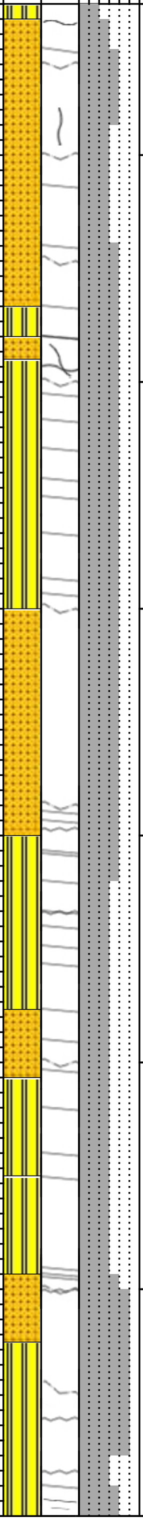
28.40m: Unweathered, grey, SANDSTONE. Very weak, poorly cemented to moderately cemented.

28.85m: Unweathered, grey, SILTSTONE. Weak.

Sampling Method	Core Recovery (%)	RQD (%)
PQTT	100	63
PQTT	100	93
PQTT	100	93
PQTT	13	13
PQTT	100	93
PQTT	100	85
PQTT	75	35

Testing:
UCS @ 20.10m
UCS @ 21.70m
UCS @ 28.10m

RL (m)	Depth (m)
-18	21
-19	22
-20	23
-21	24
-22	25
-23	26
-24	27
-25	28
-26	29



20.10m: J, 5°, PL, R, Cn
20.30m: B, 8°, UN, R, VN, Cn
20.40-20.80m: DD (x4), CS-VCS, UN, R, Cn
20.81m: J, 90°, PL, R, Cn
21.00m: DD, PL, R
21.20m: B, 5°, PL, R, VN, Cn
21.60m: B, 5°, PL, R, N, Cn
21.70m: DD, 8°, UN, R, Cn
22.00m: B, 5°, PL, R, N, Cn
22.20m: BF, 5°, PL, R, N, Cn
22.35m: J, 60°, IR, R, T, Cn
22.40m: J, 8°, IR, R, N, Cn
22.50m: DD, 5°, IR, R, Cn
22.58m: B, 5°, IR, R, N, Cn
22.75m: B, 5°, IR, R, N, Cn
22.94m: B, 5°, IR, R, N, Cn
23.14m: B, 5°, IR, R, N, Cn
23.26m: B, 5°, IR, R, N, Cn
23.50m: B, 5°, IR, R, N, Cn
23.80m: B, 5°, IR, R, N, Cn
23.90m: B, 5°, IR, R, N, Cn
24.00m: DD, 8°, IR, R
25.30m: DD, 5°
25.34m: B, 5°, IR, R, N, Cn
25.40m: B, 5°, IR, R, N, Cn
25.45-25.50m: BZ
25.60m: B, 5°, IR, R, N, Cn
25.62m: B, 5°, IR, R, N, Cn
25.80m: B, 5°, IR, R, N, Cn
26.00-26.05m: BZ
26.00m: B, 5°, IR, R, N, Cn
26.10m: B, 5°, IR, R, N, Cn
26.23m: B, 5°, IR, R, N, Cn
26.35m: B, 5°, IR, R, N, Cn
26.65m: B, 5°, IR, R, N, Cn
26.85m: B, 5°, IR, R, N, Cn
27.00m: DD, 5°, IR
27.05m: B, 5°, IR, R, N, Cn
27.30m: B, 5°, IR, R, N, Cn
27.60m: B, 5°, IR, R, N, Cn
27.76m: B, 5°, IR, R, N, Cn
28.36m: B, 5°, IR, R, N, Cn
28.40m: B, 5°, IR, R, N, Cn
28.42m: B, 5°, IR, R, N, Cn
28.50-28.95m: BZ
28.50m: DD, 5°, IR
29.16m: DD, 20°, IR
29.35-29.40m: BZ
29.70-29.77m: BZ
29.80m: B, 5°, IR, R, N, Cn

Core Box No:
Box 19.50-21.70m
Box 21.70-23.50m
Box 23.50-26.85m
Box 26.85-28.70m

COMMENTS: The historical BH logs referenced between 0.0 m - 10.5 m refer to T+T BH66604 and T+T BH210.

Hole Depth
30.5m

Scale 1:50

Rev.: A

TTNZ_20240902 - GeneralLog - 5/09/2025 2:33:04 pm - Produced with Core-GS by GeRoc

BOREHOLE LOG

BOREHOLE No.:
BH01
SHEET: 4 OF 4

DRILLED BY: Akash,steve
LOGGED BY: ANDS
CHECKED: CWM
START DATE: 23/07/2025
FINISH DATE: 25/07/2025
CONTRACTOR: McMillan Drilling

PROJECT: Downtown Carpark Site Development
JOB No.: 1016043.2000.01
LOCATION: Downtown carpark

CO-ORDINATES: 5921111 mN 1757308 mE
(NZTM2000)
DIRECTION:
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 3m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: GIS\Web map viewer

GEOLOGICAL UNIT	MATERIAL DESCRIPTION SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation	Rock Weathering UW SW MW HW CW RS	Rock Strength VS+ S MS W VW EW	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	Defect Log	Fracture Spacing (mm) 2000 600 200 60 20	RQD (%)	ROCK MASS DISCONTINUITIES Description & Additional Observations	Water Level / Fluid Loss (%) 25 50 75	Casing	Installation	Core Box No
East Coast Bays Formation	[CONT] *28.85m:* Unweathered, grey, SILTSTONE. Weak.	UW	W	PQTT	75							35	*29.90m:* B, 5°, IR, R, N, Cn *30.00m:* B, 5°, IR, R, N, Cn *30.10m:* B, 5°, IR, R, N, Cn *30.25m:* B, 5°, IR, R, N, Cn *30.45m:* B, 5°, IR, R, N, Cn				Box 28.70-30.50m
	30.5m: EOBH. Target depth																
							-28	31									
							-29	32									
							-30	33									
							-31	34									
							-32	35									
							-33	36									
							-34	37									
							-35	38									
							-36	39									

COMMENTS: The historical BH logs referenced between 0.0 m - 10.5 m refer to T+T BH66604 and T+T BH210.

Hole Depth
30. 5m

Scale 1:50

Rev.: A

TTNZ_20240902 - GeneralLog - 5/09/2025 2:33:04 pm - Produced with Core-GS by GeRoc
V4.0.01

CORE PHOTOS

BOREHOLE No.: **BH01**

Hole Location: Downtown carpark

SHEET: 1 OF 5

PROJECT: Downtown Carpark Site Development	LOCATION: 31 Customs Street West, Auckland Ce	JOB No.: 1016043.2000.01
CO-ORDINATES: (NZTM2000) 5921111 mN 1757308 mE R.L.: 3m DATUM: NZVD2016	DRILL TYPE: N118 METHOD: Rotary cored	HOLE STARTED: 23/07/2025 HOLE FINISHED: 25/07/2025 DRILLED BY: McMillan Drilling LOGGED BY: ANDS CHECKED: CWM

10.50-12.70m

12.70-15.00m

CORE PHOTOS

BOREHOLE No.: **BH01**

Hole Location: Downtown carpark

SHEET: 2 OF 5

PROJECT: Downtown Carpark Site Development

LOCATION: 31 Customs Street West, Auckland Ce

JOB No.: 1016043.2000.01

CO-ORDINATES: (NZTM2000) 5921111 mN 1757308 mE

R.L.: 3m

DATUM: NZVD2016

DRILL TYPE: N118

METHOD: Rotary cored

HOLE STARTED: 23/07/2025

HOLE FINISHED: 25/07/2025

DRILLED BY: McMillan Drilling

LOGGED BY: ANDS

CHECKED: CWM

15.00-17.50m

17.50-19.50m

Tonkin+Taylor

CORE PHOTOS

BOREHOLE No.: **BH01**

Hole Location: Downtown carpark

SHEET: 3 OF 5

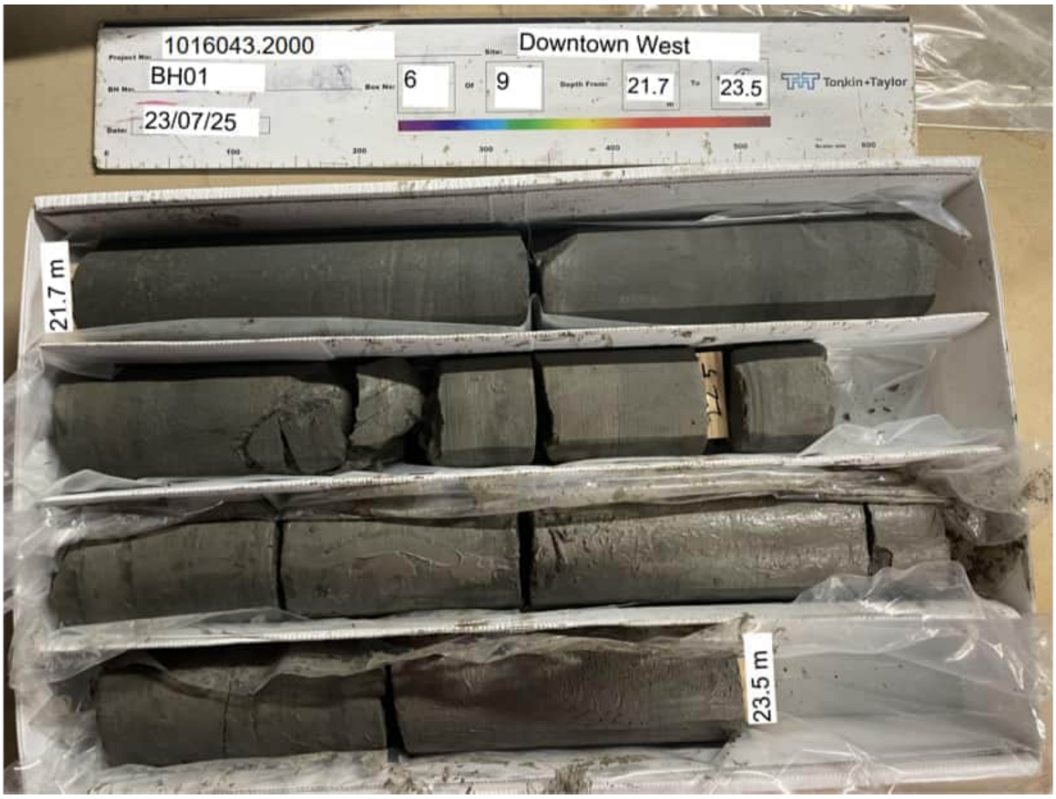
PROJECT: Downtown Carpark Site Development
LOCATION: 31 Customs Street West, Auckland Ce
JOB No.: 1016043.2000.01

CO-ORDINATES: (NZTM2000) 5921111 mN 1757308 mE
R.L.: 3m
DATUM: NZVD2016

DRILL TYPE: N118
METHOD: Rotary cored

HOLE STARTED: 23/07/2025
HOLE FINISHED: 25/07/2025
DRILLED BY: McMillan Drilling
LOGGED BY: ANDS
CHECKED: CWM

19.50-21.70m



21.70-23.50m

CORE PHOTOS

BOREHOLE No.: **BH01**

Hole Location: Downtown carpark

SHEET: 4 OF 5

PROJECT: Downtown Carpark Site Development
LOCATION: 31 Customs Street West, Auckland Ce
JOB No.: 1016043.2000.01

CO-ORDINATES: (NZTM2000) 5921111 mN 1757308 mE
R.L.: 3m
DATUM: NZVD2016

DRILL TYPE: N118
METHOD: Rotary cored

HOLE STARTED: 23/07/2025
HOLE FINISHED: 25/07/2025
DRILLED BY: McMillan Drilling
LOGGED BY: ANDS
CHECKED: CWM

23.50-26.85m

26.85-28.70m

CORE PHOTOS

BOREHOLE No.: **BH01**

Hole Location: Downtown carpark

SHEET: 5 OF 5

PROJECT: Downtown Carpark Site Development

LOCATION: 31 Customs Street West, Auckland Ce

JOB No.: 1016043.2000.01

CO-ORDINATES: 5921111 mN
(NZTM2000) 1757308 mE

R.L.: 3m

DATUM: NZVD2016

DRILL TYPE: N118

METHOD: Rotary cored

HOLE STARTED: 23/07/2025

HOLE FINISHED: 25/07/2025

DRILLED BY: McMillan Drilling

LOGGED BY: ANDS

CHECKED: CWM

28.70-30.50m

BOREHOLE LOG

BOREHOLE No.:
BH02
SHEET: 1 OF 3

PROJECT:	Downtown Carpark Site Development
JOB No.:	1016043.2000.01
LOCATION:	Downtown carpark
CO-ORDINATES: (NZTM2000)	5921083 mN 1757380 mE
DIRECTION:	
ANGLE FROM HORIZ.:	-90°
R.L. GROUND:	3m
R.L. COLLAR:	
DATUM:	NZVD2016
SURVEY:	GIS\Web map viewer
DRILLED BY:	Akash
LOGGED BY:	ANDS
CHECKED:	CWM
START DATE:	28/07/2025
FINISH DATE:	04/08/2025
CONTRACTOR:	McMillan Drilling

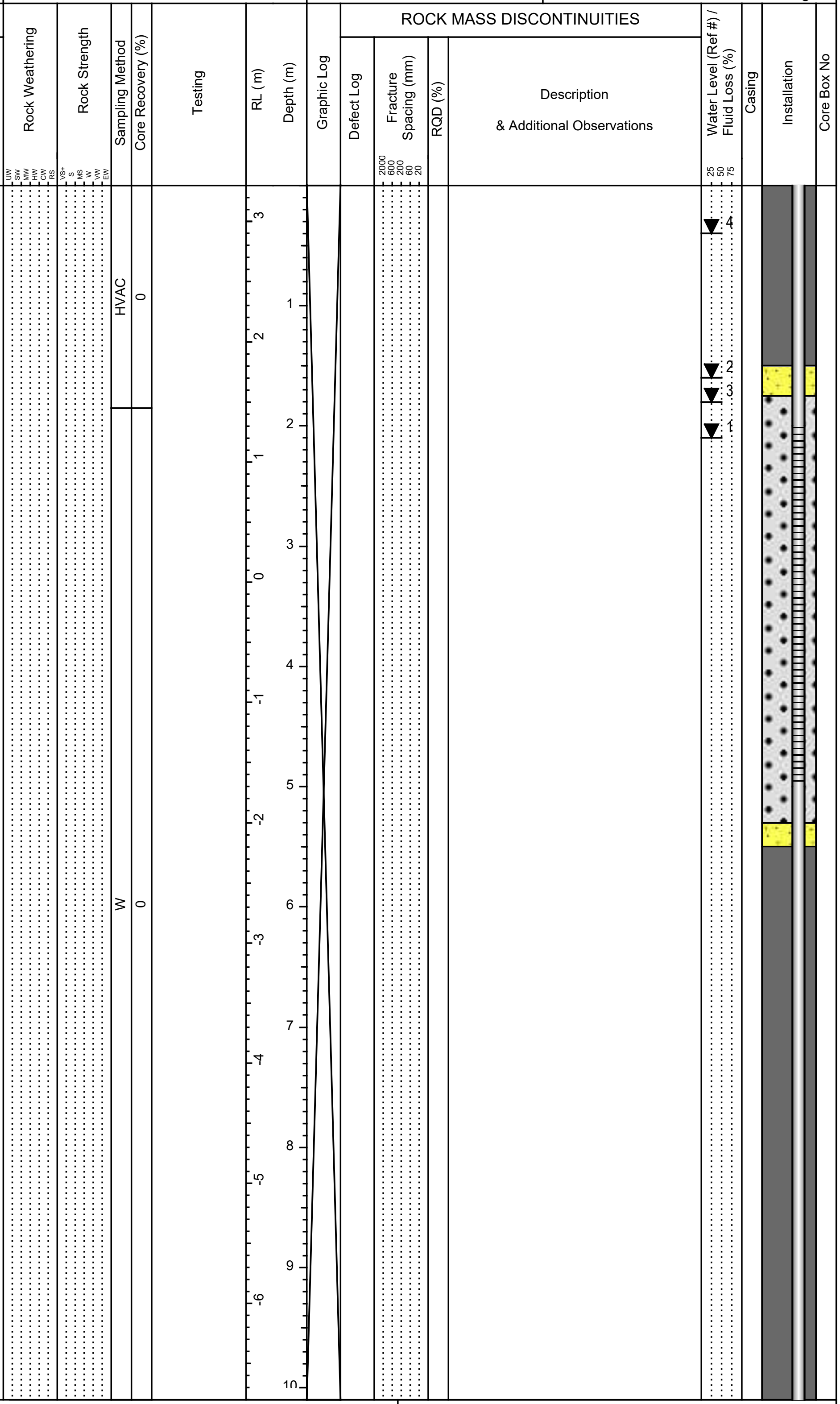
GEOLOGICAL UNIT

MATERIAL DESCRIPTION

SOIL: Classification, colour, consistency / density, moisture, plasticity

ROCK: Weathering, colour, fabric, name, strength, cementation

0.00m: NO RECOVERY. Hydro Excavated to 3 m and wash drilled to 10.5 m. Nearby historical BH data indicates that the first 10.5 m of soil comprises Sandy Silt underlain by interbedded Silt and clayey Silt layers of marine sediments/ hydraulic fill. .



COMMENTS:
Water loss was experienced during drilling of BH02. The historical BH log referenced between 0.0 m - 10.5 m refers to T+T BH16930.

Scale 1:56

Tonkin+Taylor

BOREHOLE LOG

BOREHOLE No.:
BH02
SHEET: 2 OF 3

DRILLED BY: Akash
LOGGED BY: ANDS
CHECKED: CWM
START DATE: 28/07/2025
FINISH DATE: 04/08/2025
CONTRACTOR: McMillan Drilling

PROJECT: Downtown Carpark Site Development
JOB No.: 1016043.2000.01
LOCATION: Downtown carpark

CO-ORDINATES: (NZTM2000) 5921083 mN 1757380 mE
DIRECTION:
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 3m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: GIS\Web map viewer

MATERIAL DESCRIPTION

SOIL: Classification, colour, consistency / density, moisture, plasticity
ROCK: Weathering, colour, fabric, name, strength, cementation

[CONT] *0.00m:* NO RECOVERY. Hydro Excavated to 3 m and wash drilled to 10.5 m. Nearby historical BH data indicates that the first 10.5 m of soil comprises Sandy Silt underlain by interbedded Silt and clayey Silt layers of marine sediments/ hydraulic fill. .

10.50m: Unweathered, light grey, massive, SANDSTONE. Very weak, poorly cemented to moderately cemented, coarse grained.

12.00m: Unweathered, light grey, massive, SILTSTONE. Very weak.

13.00m: Unweathered, light grey, massive, SILTSTONE. Very weak.

14.00m: Completely weathered, grey, SANDSTONE. Extremely weak, uncemented.

14.80m: Unweathered, light grey, massive, SILTSTONE. Very weak.

15.00m: Unweathered, light grey, massive, SILTSTONE. Weak. Interbedded with: Unweathered, grey, SANDSTONE. Weak, well cemented, fine to medium grained.

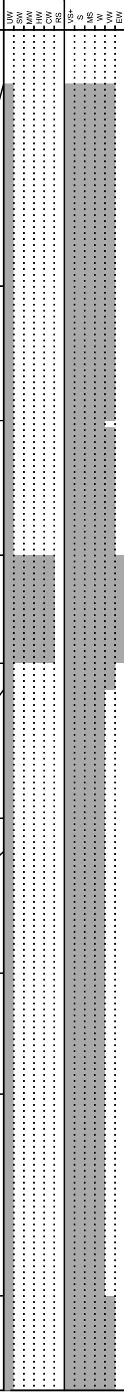
15.95m: Unweathered, light grey, massive, SANDSTONE. Weak, moderately cemented, coarse grained.

16.20m: Unweathered, light grey, SILTSTONE. Weak.

17.10m: Unweathered, light grey, SANDSTONE. Weak.

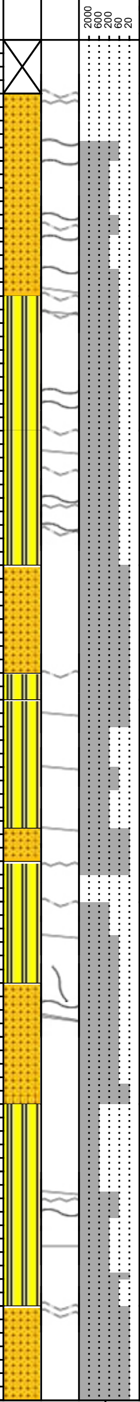
18.00m: Unweathered, light grey, bedded, SILTSTONE. Weak. Bedding. Interbedded with: Unweathered, light grey, SANDSTONE. Weak, well cemented, fine to medium grained.

19.50m: Unweathered, light grey, SANDSTONE. Very weak, poorly cemented, fine to medium grained.



Sampling Method	Core Recovery (%)	Testing	RQD (%)
W	0		
PQTT	100		74
NQTT	100		90
NQTT	100		80
NQTT	100		30
PQTT	87		49
PQTT	100	UCS @ 17.76m	52
PQTT	100	UCS @ 18.80m	81
NQTT	100	UCS @ 19.77m	40

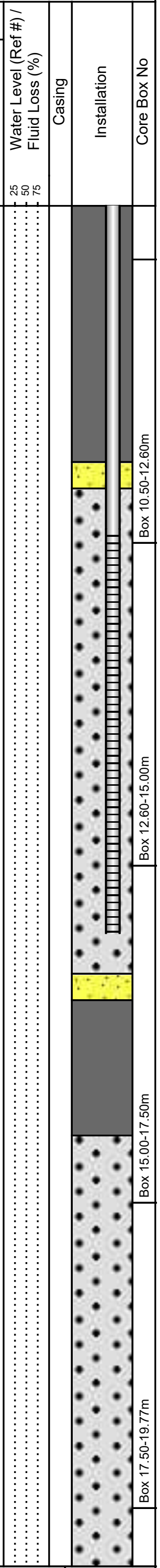
RL (m)	Depth (m)
-7	
-8	11
-9	12
-10	13
-11	14
-12	15
-13	16
-14	17
-15	18
-16	19
	20



ROCK MASS DISCONTINUITIES

Description & Additional Observations

10.50m: DD, 5°, UN, R, Cn
10.55-10.85m: BZ
10.85m: J, 8°, ST, R, Cn
11.00m: J, 5°, IR, R, N, Cn
11.40m: J, 10°, UN, R, N, Cn
11.48m: DD, 5°, PL, R, Cn
11.56m: J, 5°, PL, R, N, Cn
11.80m: J, 10°, IR, R, N, Cn
11.95m: B, 8°, UN, R, N, Cn
12.00m: DD, 5°, PL, R, Cn
12.12m: B, 5°, PL, R, N, Cn
12.13-12.70m: DD (x4), VCS, 5°, PL, R, Cn
12.70m: J, 5°, PL, R, Cn
12.80m: J, 10°, IR, R, VN, Cn
13.00m: DD, 5°, PL, R, VN, Cn
13.15-13.25m: B (x7), ECS, 5°, PL-UN, VN, Cn
13.30-13.45m: DD (x2), 5°, PL, R, Cn
13.50m: J, 10°, PL, R, VN, Cn
13.55-13.70m: BZ
13.71m: J, 12°, IR, R, VN, Cn
13.75-14.00m: DD (x4), 5-10°, PL, R, Cn
14.80-15.00m: DD (x5), IR, R
15.10-15.20m: B (x4), VCS-ECS, 5°, PL, R, VN, Cn
15.50-15.95m: B (x3), CS-VCS, 5°, PL, R, VN, Cn
15.95-16.20m: B (x7), ECS, 5°, PL, R, VN, Cn
16.21-16.30m: BZ
16.50m: DD, 5°, PL, R
16.75-17.05m: B (x4), VCS-ECS, 5°, PL, R, VN, CV
17.10m: J, 70°, IR, R, Cn
17.25m: J, 10°, UN, R, N, Cn
17.35m: B, 10°, IR, R, VN, Cn
17.36-18.00m: B (x7), VCS-ECS, 5-10°, IR, R, VN, Cn
18.65m: B, 5°, PL, R, VN, Cn
18.70-18.77m: BZ, CV
18.80m: J, 10°, PL, R, N, Cn
19.05-19.40m: B (x4), VCS, PL, R, N, Cn
19.50m: DD, 5°, PL, R, Cn
19.55-20.50m: DD (x11), VCS-ECS, 5°, PL, R, N



COMMENTS:
Water loss was experienced during drilling of BH02. The historical BH log referenced between 0.0 m - 10.5 m refers to T+T BH16930.

REF	DATE / TIME	HOLE (m)	CASING (m)	GWL (m)
1	2025-07-29 16:12	15.00m	-	2.10m
2	2025-07-30 09:12	15.00m	-	1.60m

Scale 1:56

Tonkin+Taylor

BOREHOLE LOG

BOREHOLE No.:
BH02
SHEET: 3 OF 3

PROJECT: Downtown Carpark Site Development	CO-ORDINATES: (NZTM2000) 5921083 mN 1757380 mE
JOB No.: 1016043.2000.01	DIRECTION:
LOCATION: Downtown carpark	ANGLE FROM HORIZ.: -90°
R.L. GROUND: 3m	DRILLED BY: Akash
R.L. COLLAR:	LOGGED BY: ANDS
DATUM: NZVD2016	CHECKED: CWM
SURVEY: GIS\Web map viewer	START DATE: 28/07/2025
	FINISH DATE: 04/08/2025
	CONTRACTOR: McMillan Drilling

MATERIAL DESCRIPTION
SOIL: Classification, colour, consistency / density, moisture, plasticity
ROCK: Weathering, colour, fabric, name, strength, cementation

Depth (m)	MATERIAL DESCRIPTION	Testing
19.50	[CONT] *19.50m:* Unweathered, light grey, SANDSTONE. Very weak, poorly cemented, fine to medium grained.	
21.50	*21.50m:* Unweathered, light grey, SILTSTONE. Very weak. Interbedded with: Unweathered, light grey, SANDSTONE. Weak, moderately cemented, fine to medium grained.	UCS @ 22.27m UCS @ 22.50m
23.50	*23.50m:* Unweathered, light grey, SANDSTONE. Weak, well cemented, medium to coarse grained.	
24.50	*24.50m:* Unweathered, light grey, SILTSTONE. Very weak.	
24.65	*24.65m:* CORE LOSS.	
25.50	*25.50m:* Unweathered, light grey, SILTSTONE. Very weak.	
25.60	*25.60m:* CORE LOSS.	
26.50	*26.50m:* Unweathered, light grey, SILTSTONE. Weak.	
27.00	*27.00m:* Unweathered, light grey, SILTSTONE. Extremely weak.	UCS @ 27.15m
27.50	*27.50m:* Unweathered, light grey, bedded, SILTSTONE. Very weak. Bedding. Interbedded with: Unweathered, light grey, SANDSTONE. Very weak, coarse grained. 50mm thick.	
29.00	*29.00m:* Unweathered, grey, SILTSTONE. Very weak.	
29.70	*29.70m:* CORE LOSS.	

30m: EOBH. Target depth

Sampling Method	Core Recovery (%)	RQD (%)
NQTT	100	40
NQTT	100	50
NQTT	100	70
NQTT	80	80
NQTT	15	15
NQTT	10	0
NQTT	100	100
NQTT	100	40
NQTT	100	100
NQTT	100	100
NQTT	70	

ROCK MASS DISCONTINUITIES – Description & Additional Observations

Cn

20.00m: Below 20.0 m, the small core size has resulted in drilling induced fractures that have obscured natural jointing

23.90m: J, 0°, PL, SM, N

26.50 - 27.00m: NQ

29.50m: B, 0°, PL, SM, N

Core Box No: Box 19.77-22.00m; Box 22.00-24.50m; Box 24.50-28.50m; Box 28.50-30.00m

COMMENTS:
Water loss was experienced during drilling of BH02. The historical BH log referenced between 0.0 m - 10.5 m refers to T+T BH16930.

REF	DATE / TIME	HOLE (m)	CASING (m)	GWL (m)
3	2025-07-31 11:22	23.50m	-	1.80m
4	2025-07-31 15:00	30.00m	-	0.40m

Scale 1:56

CORE PHOTOS

BOREHOLE No.: **BH02**

Hole Location: Downtown carpark

SHEET: 1 OF 4

PROJECT: Downtown Carpark Site Development	LOCATION: 31 Customs Street West, Auckland Ce	JOB No.: 1016043.2000.01
CO-ORDINATES: (NZTM2000) 5921083 mN 1757380 mE R.L.: 3m DATUM: NZVD2016	DRILL TYPE: N118 METHOD: Rotary cored	HOLE STARTED: 28/07/2025 HOLE FINISHED: 04/08/2025 DRILLED BY: McMillan Drilling LOGGED BY: ANDS CHECKED: CWM

10.50-12.60m

12.60-15.00m

CORE PHOTOS

BOREHOLE No.: **BH02**

Hole Location: Downtown carpark

SHEET: 2 OF 4

PROJECT: Downtown Carpark Site Development

LOCATION: 31 Customs Street West, Auckland Ce

JOB No.: 1016043.2000.01

CO-ORDINATES: (NZTM2000)	5921083 mN 1757380 mE	DRILL TYPE: N118	HOLE STARTED: 28/07/2025
		METHOD: Rotary cored	HOLE FINISHED: 04/08/2025
R.L.:	3m		DRILLED BY: McMillan Drilling
DATUM:	NZVD2016		LOGGED BY: ANDS CHECKED: CWM

15.00-17.50m

17.50-19.77m

CORE PHOTOS

BOREHOLE No.: **BH02**

Hole Location: Downtown carpark

SHEET: 3 OF 4

PROJECT: Downtown Carpark Site Development	LOCATION: 31 Customs Street West, Auckland Ce	JOB No.: 1016043.2000.01
CO-ORDINATES: (NZTM2000) 5921083 mN 1757380 mE	DRILL TYPE: N118	HOLE STARTED: 28/07/2025
	METHOD: Rotary cored	HOLE FINISHED: 04/08/2025
R.L.: 3m		DRILLED BY: McMillan Drilling
DATUM: NZVD2016		LOGGED BY: ANDS CHECKED: CWM

19.77-22.00m

22.00-24.50m

CORE PHOTOS

BOREHOLE No.: **BH02**

Hole Location: Downtown carpark

SHEET: 4 OF 4

PROJECT: Downtown Carpark Site Development

LOCATION: 31 Customs Street West, Auckland Ce

JOB No.: 1016043.2000.01

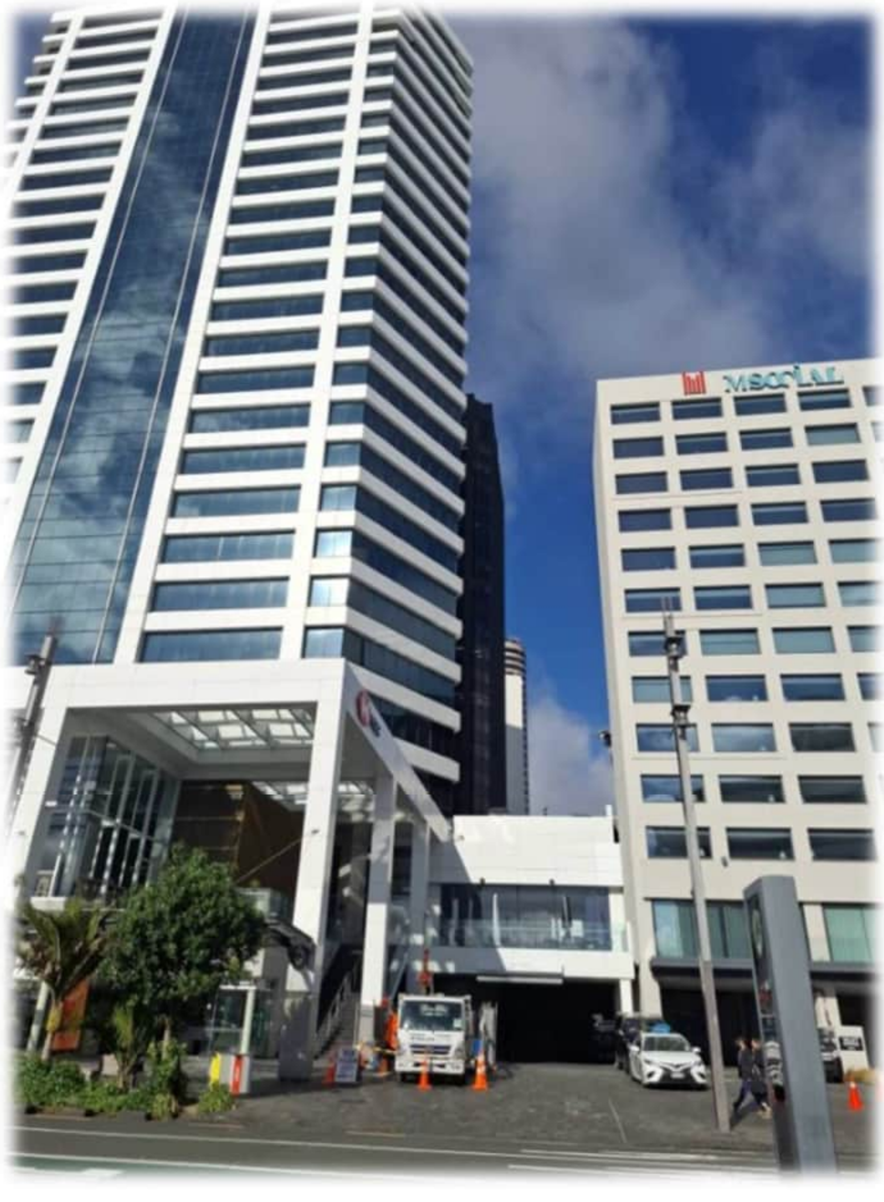
CO-ORDINATES: (NZTM2000)	5921083 mN 1757380 mE	DRILL TYPE: N118	HOLE STARTED: 28/07/2025
		METHOD: Rotary cored	HOLE FINISHED: 04/08/2025
R.L.:	3m		DRILLED BY: McMillan Drilling
DATUM:	NZVD2016		LOGGED BY: ANDS CHECKED: CWM

24.50-28.50m

28.50-30.00m

RG Consulting Ltd
GEOTECHNICAL SERVICES & GEOHAZARD MANAGEMENT

Downtown West Dilatometer Testing



22 August 2025

Prepared For: Tonkin & Taylor

Final Issue V1

Rori Green Consulting Limited

Project: Downtown West Dilatometer Testing, Auckland

Date: 22 August 2025

Status: Final Issue – V1

Testing, data reduction and reporting was completed by Rori Green and Flo Buech of Rori Green Consulting Limited between July 29 and August 22, 2025.

[redacted] _______

Rori Green

Geological Engineer
Director – Rori Green Consulting Limited

This report has been prepared for Tonkin & Taylor and is not to be provided to third parties without prior written consent of Rori Green Consulting Limited. Rori Green Consulting Limited accepts no liability for unauthorised use of the contents of this report.

Table of Contents

Tables

Figures

Appendices

Introduction

Rori Green Consulting Ltd (RGC) was contracted by Tonkin & Taylor (T & T) to conduct dilatometer testing at one borehole site for the proposed Downtown West project in Auckland. The testing is part of a wider programme of geotechnical investigations being conducted by T & T.

This report presents the results of the dilatometer testing programme carried out between July 29 and July 31, 2025. The purpose of the testing was to investigate the deformability properties of the East Coast Bays formation bedrock at the proposed Downtown West development site.

McMillan Drilling conducted the diamond core borehole drilling and assisted with lowering and raising of the testing tool.

Testing Programme

Dilatometer testing was carried out by Rori Green and Florian Buech of RGC. A total of 3 tests were completed in one borehole, BH02, on land below ground level (mbgl). The testing summary is provided in Table 1.

Table 1: Summary of Dilatometer Testing

Borehole ID	Test #	Test Zone [mbgl]	Test Date	Test Coordinates		Test Location
				mN	mE	
BH02	1	13.54 – 14.00	29 Jul 2025	5921083	1757380	188 Quay St, Auckland Central, Auckland 1010
	2	22.40 – 22.86	30 Jul 2025			
	3	28.20 – 28.66	31 Jul 2025			

The test hole was wash drilled through fill material then cored at PQ diameter while NQ diameter coring was performed over the dilatometer testing zone using an NQ triple tube system.

The recovered core was logged on site by a representative of T & T and material descriptions provided to RGC. Test depths were selected by T & T to investigate the variation in rock mass modulus of the rock mass over the total depth of the borehole. The test depths were selected based on an inspection of the recovered core, preliminary geological logging, and discussion between T & T geotechnical team and RGC.

Test Results

A summary of the test results is presented in Table 2. Plots of the corrected test curves are presented on Figure 1.

The individual test results and photographs of the core recovered from the test zones are presented in Appendix A. The test results provide raw and corrected data, plots of the corrected test curves, estimates of modulus values, and the pressure at which plastic deformation began. An estimate of Poisson's ratio is needed for making the modulus estimates; T & T advised RGC to use a Poisson's ratio value of 0.25.

Table 2: Summary of Dilatometer Testing Results

Borehole	Test ID	Midpoint (mbgl)	Test Depth From (mbgl)	Test Depth To (mbgl)	Yield Stress (MPa)	Modulus Estimates E1 (MPa)	E2 (MPa)	E3 (MPa)	E4 (MPa)	E5 (MPa)
BH02	1	13.77	13.54	14.00	2	200	510	400	180	940
	2	22.63	22.40	22.86	4.5	740	1310	1080	630	1290
	3	28.43	28.20	28.66	5	670	1190	1030	500	1180

The modulus and stress estimates provided in this report have been made by RGC; these offer one possible estimate. The client should review the test data and make their own interpretation of the results for use in design.

Comments on Tests

All tests were completed successfully, with no notable issues regarding the tests.

With regard to drilling, return circulation of drill fluid to the surface was lost prior to Test 2. A 1 to 2mm-thick layer of drill cuttings was present on the NQ core collected from Tests 2 and 3 -- presumably this may have also been present on the borehole walls; the cuttings were silt and clay. The layer of drill cuttings was thicker and contained a higher proportion of clay for Test 3. There was about 1m of core lost while drilling the NQ test pocket for Test 3.

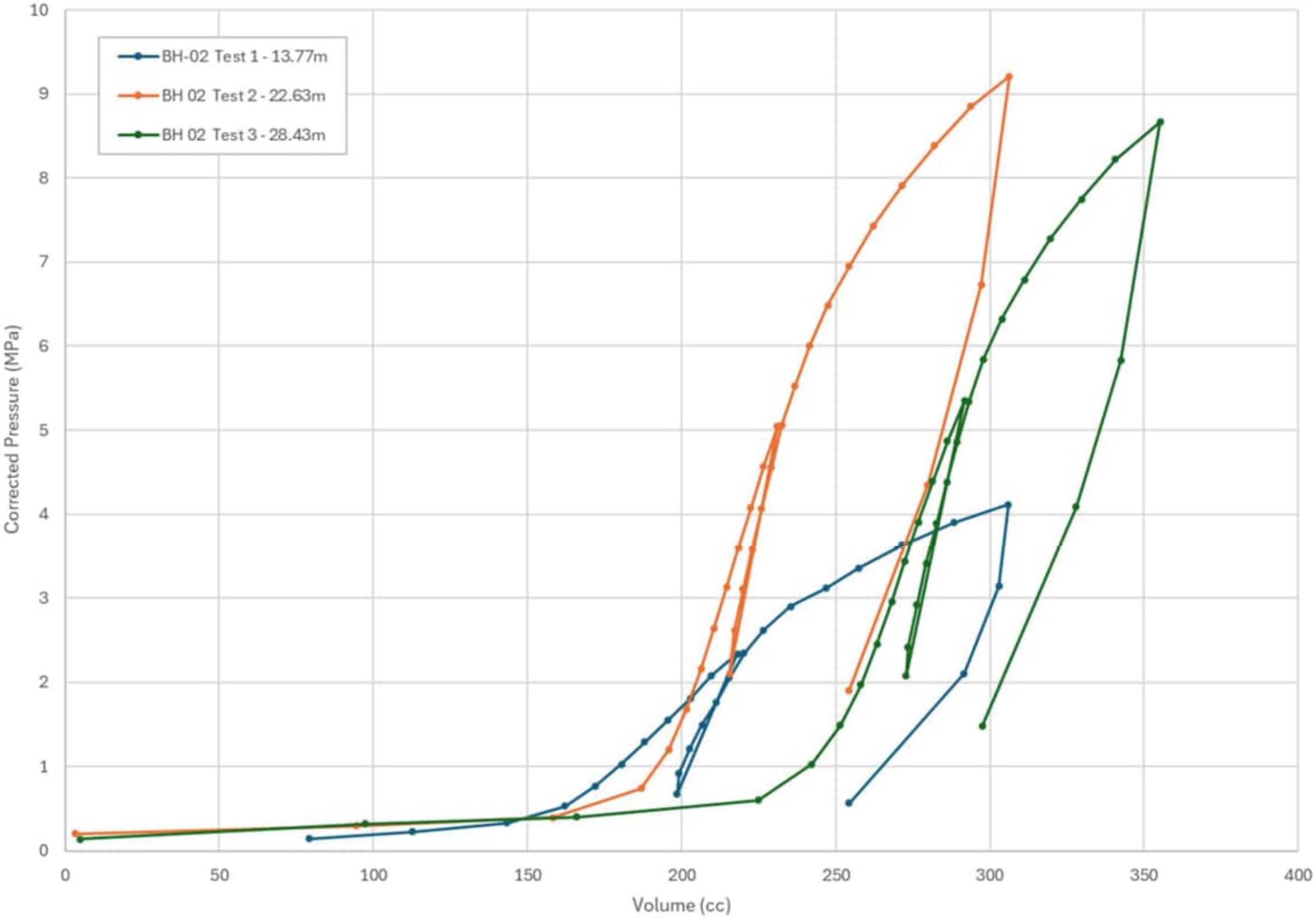


Figure 1: Plot of Corrected Test Curves – BH02

Test Methodology

This section provides a summary of equipment and methodology used to perform the tests. The methodology is based on procedures contained in the manufacturer's manual (Roctest, 2024) and in ASTM D8359-21, *Standard Test Method for Determining the In Situ Rock Deformation Modulus and Other Associated Rock Properties Using a Flexible Volumetric Dilatometer* (ASTM, 2021)

Testing Tool

A PROBEX rock dilatometer (pressuremeter) was used to perform the testing; the tool is manufactured by Roctest in Montreal, Canada. The 2.6m-long steel cylindrical probe has a 73.7 mm diameter and is designed to operate in NQ-sized boreholes drilled into rock. It has a maximum working pressure of 30 MPa.

The dilatometer works via inflation of a 460 mm-long flexible membrane against the borehole wall. Both the inflation pressure and expansion of the membrane are recorded during the test. The membrane is inflated by water that is stored in a 676 cm^3 (cc) reservoir located in the probe body; the water is pushed into the membrane by a hydraulically-operated piston that that is connected via hydraulic cables to a manual hydraulic pump at the surface.

The inflation of the membrane is measured via a linear transducer that measures the displacement of the piston; this gives with the volume of water (in cc) that is pushed into the membrane, which correlates with the diameter of the membrane (and deformation of the borehole wall). The membrane is assumed to undergo uniform radial expansion against the borehole wall.

Pressure is measured at the surface via a transducer connected to the hydraulic pump.

Test data is recorded via a read-out box connected to both transducers. The test can be viewed in real-time on a tablet that is connected to the readout box via Bluetooth.

Calibrations

Two types of calibrations are performed to account for the effects of the membrane on the test:

- *Pressure calibration.* The membrane is inflated to its full volume (676 cm^3) in equal volume steps in open air. This calibration is used to correct for the pressure needed to inflate the membrane with no external resistance.
- *Volume calibration.* A steel cylinder is placed around the membrane and it is inflated to its full working pressure (30 MPa). This calibration is used to correct for the compression of the membrane during testing.

At least one pressure calibration is performed for each test site. At least two volume calibrations are performed each day testing is to be performed. The membrane is fully expanded twice at the start of the day to "knead" it prior to performing the calibrations.

Test Procedure

Once the probe is lowered to the chosen test depth, the test is undertaken by inflating the membrane against the borehole wall in equal pressure steps; usually this is 0.5 to 1.0 MPa, depending on the anticipated strength of the rock from inspection of core samples. At each pressure step, the pressure is held for one minute to allow the reading to stabilise. The test is continued until either the maximum working pressure (30 MPa) or the maximum recommended volume[1] (300 to 550 cm^3) is reached; the test may be ended earlier if sufficient data is collected.

If plastic behaviour is observed during the test, an unload-reload cycle is performed. The pressure is reduced by 50% and the test is continued as above. Plastic behaviour indicates that the rock is beginning to fail (yield); it is determined by an increase in the rate of deformation (volume change) between pressure steps.

On reaching the maximum test pressure, the system is unloaded by reducing the pressure over about 3 to 4 steps of approximately equal pressure reductions.

Data Processing and Results

Raw test data is processed using equations provided by Roctest (Roctest, 2024) to correct for the effects of the membrane as measured from the pressure and volume calibrations. The test data is presented in tabular format and is plotted as a pressure-deformation curve.

Figure 2 shows a typical pressure-deformation curve from a test, with annotations describing the various stages of the test.

RGC provides estimates of several modulus values from the test; these are measures of the slope of the test curve over selected ranges, as outlined in Table 3   A value for Poisson's ratio is needed for these estimates; this is provided by the Client.

RGC also provides an estimate of the yield pressure; this is the pressure at which the onset of plastic behaviour is observed, rounded to the nearest pressure step. Note that yield may not during a test, especially when testing high strength rocks.

Table 3: List of moduli values estimated from test curve

E1	Initial loading modulus	Slope of initial curve over pseudo-elastic range
E2	First unload modulus	Slope of unload curve (from pressure at onset of plastic deformation to 50% of that pressure)
E3	Reload modulus	Slope of reload curve over pseudo-elastic range
E4	Post-yield modulus	Slope of curve following reload (plastic behaviour confirmed if E4<E1)
E5	Second unload modulus	Slope of final unload curve (from max pressure to about 50% of max pressure)

---

[1] the maximum recommended volume depends on the borehole wall condition, as inferred from the recovered core; the membrane can be expanded to a greater volume where there is high confidence in good borehole wall condition (relatively small borehole diameter, full core recovery and minimal fractures present).

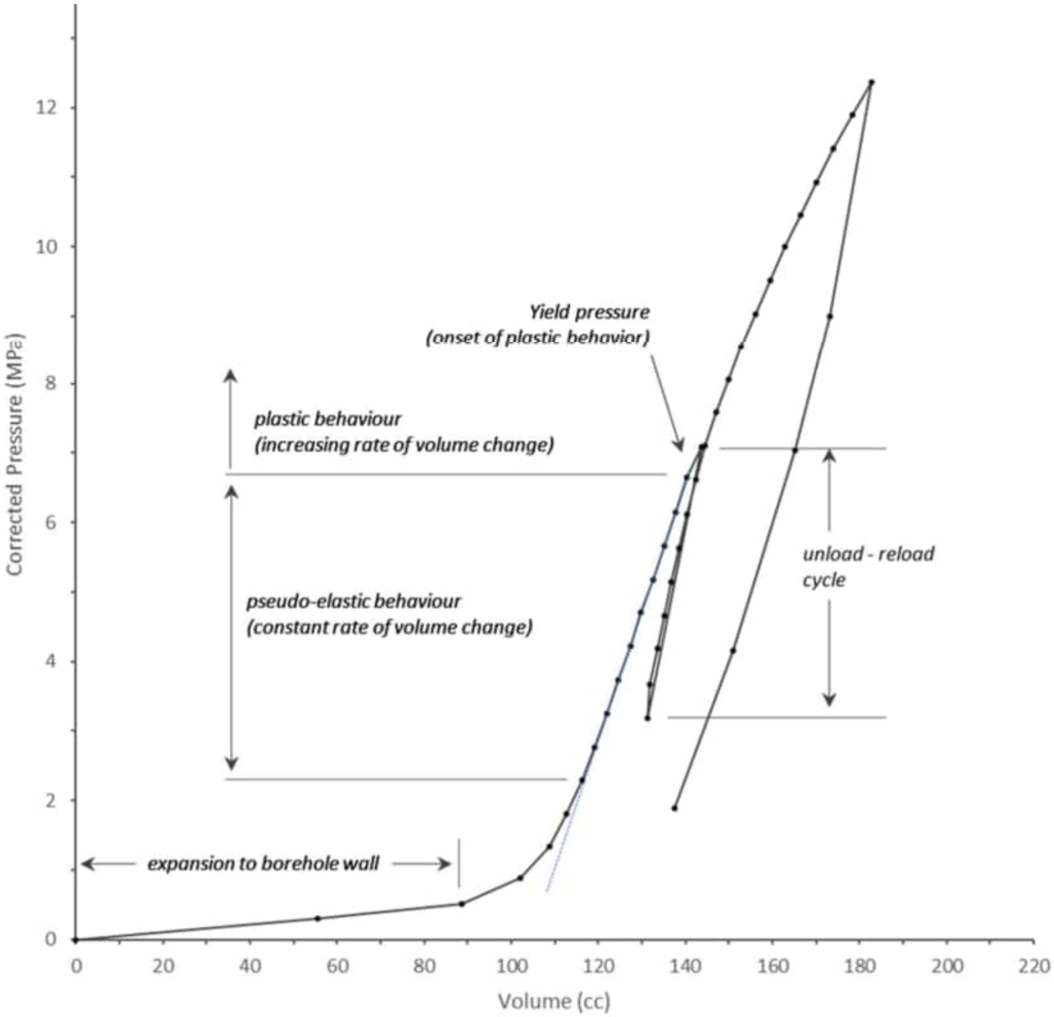


Figure 2: Typical dilatometer test curve

References

ASTM, 2021. *Standard Test Method for Determining the In Situ Rock Deformation Modulus and Other Associated Rock Properties Using a Flexible Volumetric Dilatometer.* ASTM D8359-21, approved 15 Aug 2021. ASTM International. Pennsylvania, USA. DOI:10.1520/D8359-21.

ROCTEST Limited 2024. Instruction Manual, Borehole Dilatometer (Rock Pressuremeter), Model PROBEX. (https://roctest.com/wp-content/uploads/2024/03/E10037-26032024.pdf)

Limitations

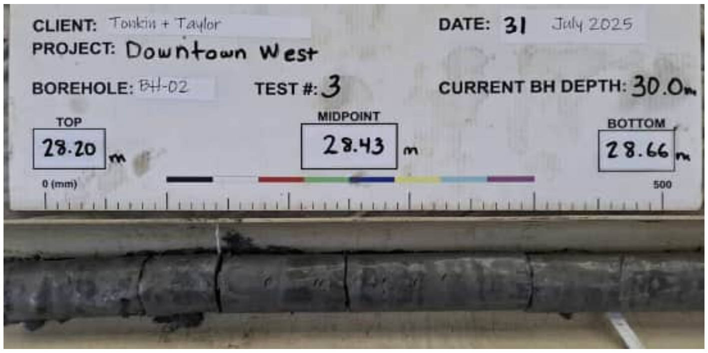
This report was prepared in August 2025 exclusively for Tonkin & Taylor Limited in accordance with the requirements and purpose as set out in contract dated 31 July 2025. RGC accepts no liability whatsoever for any use of the Deliverables, in whole or in part, for any purpose whatsoever other than that stated in the Contract; or for use by any party other than the client.

Any disclosure, use or reliance on the Deliverables by any third party is at that party's sole risk, without recourse to RGC.

This report contains information obtained by testing as part of a geotechnical drilling investigation. This information is directly relevant only to the points in the ground where testing was conducted.

Appendix A – BH02 Dilatometer Test Results

DILATOMETER TEST ZONE PHOTOS - BH02

Photo	Geological Description *(From T&T Geologic Log)*
	Unweathered, light grey, massive, SILTSTONE. Very weak.
	Unweathered, light grey, SILTSTONE. Very weak. Interbedded with: Unweathered, light grey, SANDSTONE. Weak, moderately cemented, fine to medium grained.
	Unweathered, light grey, bedded, SILTSTONE. Very weak. Interbedded with: Unweathered, light grey, SANDSTONE. Very weak, coarse grained.

DILATOMETER TEST RESULTS

CALIBRATION REPORT - PLOTS

RG Consulting Ltd

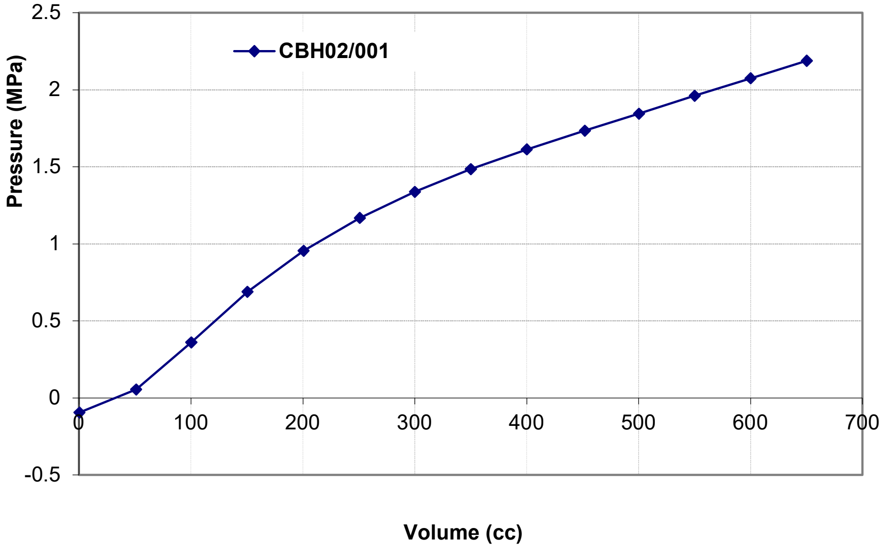
CLIENT Tonkin & Taylor
PROJECT Downtown West

TEST 1

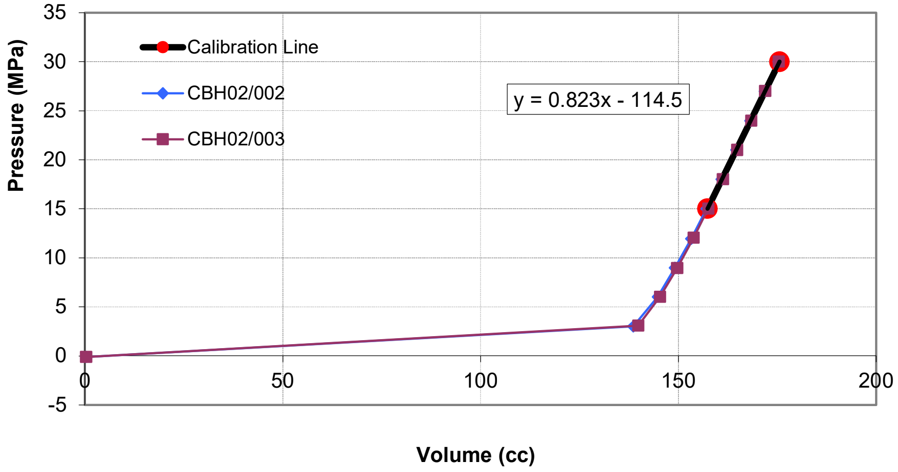
BOREHOLE BH02
LOCATION 1757380 E
5921083 N
3 m RL
ORIENTATION 0
INCLINATION 90

Volume Calibration ΔX (a) = 1.21500
Calibration Tube Correction Factor (b) = 0.08457 cc/Mpa
Volume Correction Factor (c) = 1.13043
Rock Poisson's Ratio (ν_R) = 0.25
At-Rest Volume of Probe (v_0) = 1950 cc

Pressure Calibration



Volume Calibration



DILATOMETER TEST RESULTS

CALIBRATION REPORT - DATA

CLIENT Tonkin & Taylor

PROJECT Downtown West

BOREHOLE BH02

Pressure Calibration

Pressure	Volume
-0.094	0.440
0.056	51.150
0.361	100.300
0.689	150.620
0.956	200.680
1.169	250.920
1.338	300.130
1.485	350.060
1.613	400.070
1.736	451.970
1.846	500.470
1.962	550.070
2.076	600.050
2.188	650.160

Volume Calibration

V1		V2		V3		V4		V5	
CBH02/002		CBH02/003							
Pressure	Volume	Pressure	Volume	Pressure	Volume	Pressure	Volume	Pressure	Volume
-0.121	0.320	-0.121	0.320						
3.012	138.580	3.080	139.850						
6.023	144.730	6.018	145.350						
8.992	149.110	8.962	149.660						
11.944	153.180	12.066	153.840						
15.019	157.110	15.039	157.510						
18.005	160.860	18.022	161.260						
21.008	164.580	21.002	164.850						
23.966	168.160	24.009	168.400						
26.980	171.810	27.033	171.920						
30.014	175.290	30.034	175.390						

DILATOMETER TEST RESULTS

TEST DATA

RG Consulting Ltd

CLIENT Tonkin & Taylor
PROJECT Downtown West

TEST NUMBER 1
FILE NAME TBH02/001
TEST DEPTH, FROM 13.54 m
TEST DEPTH, TO 14.00 m

BOREHOLE BH02
LOCATION 1757380 E
5921083 N
3 m RL
ORIENTATION 0
INCLINATION 90

TESTED BY R Green
DATE 29/07/2025 2:50:53 pm

MATERIAL DESCRIPTION Unweathered, light grey, massive, SILTSTONE. Very weak.

Volume Calibration ∆X (a)= 1.21500
Calibration Tube Correction Factor (b)= 0.08457 **cc/MPa**
Volume Correction Factor (c)= 1.13043

COMMENTS

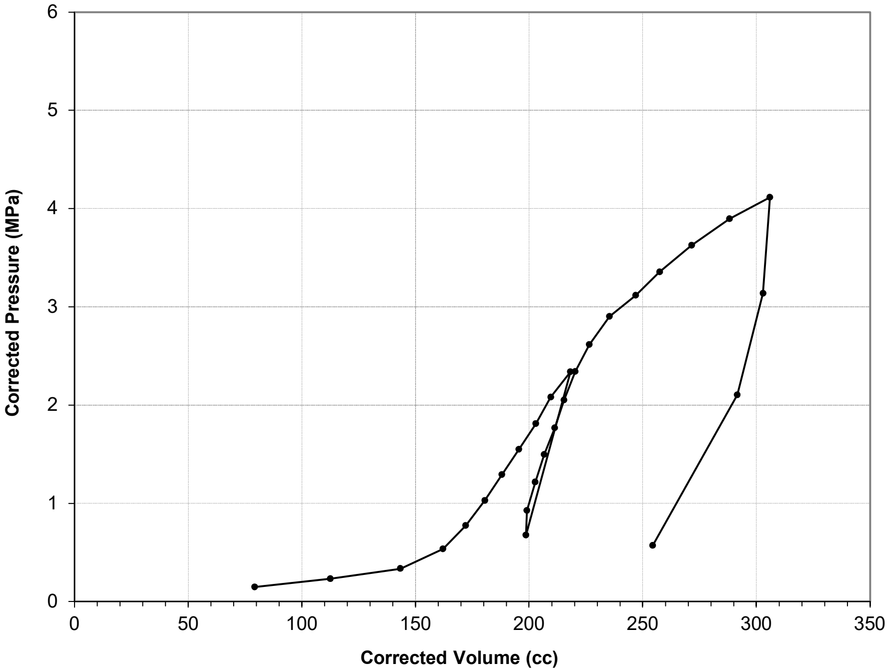
				Probe	Probe	Probe	Probe	Probe
Raw Data		Corrected Data		Total	Volumetric	Radius	Delta	Radial
Pressure	Volume	Pressure	Volume	Volume	Strain		radius	Strain
(MPa)	(cc)	(MPa)	(cc)	(cc)	(%)	(mm)	(mm)	(%)
0.299	79.200	0.148	79.200	2029.2	3.90	37.59	0.74	1.98
0.592	112.630	0.229	112.630	2062.6	5.46	37.90	1.05	2.78
0.898	143.350	0.335	143.350	2093.4	6.85	38.18	1.33	3.50
1.208	162.120	0.536	162.120	2112.1	7.68	38.36	1.51	3.92
1.498	172.110	0.773	172.110	2122.1	8.11	38.45	1.60	4.15
1.798	180.550	1.028	180.550	2130.6	8.47	38.52	1.67	4.34
2.102	188.060	1.292	188.060	2138.1	8.80	38.59	1.74	4.51
2.399	195.540	1.549	195.540	2145.5	9.11	38.66	1.81	4.68
2.699	202.960	1.812	202.960	2153.0	9.43	38.72	1.87	4.84
2.993	209.500	2.078	209.500	2159.5	9.70	38.78	1.93	4.98
3.291	218.190	2.339	218.190	2168.2	10.06	38.86	2.01	5.18
1.543	198.570	0.677	198.570	2148.6	9.24	38.68	1.83	4.74
1.796	199.100	0.927	199.100	2149.1	9.26	38.69	1.84	4.75
2.100	202.670	1.214	202.670	2152.7	9.41	38.72	1.87	4.83
2.398	206.690	1.495	206.690	2156.7	9.58	38.76	1.91	4.92
2.688	211.260	1.766	211.260	2161.3	9.77	38.80	1.95	5.02
2.990	215.360	2.050	215.360	2165.4	9.95	38.84	1.99	5.11
3.302	220.230	2.342	220.230	2170.2	10.15	38.88	2.03	5.22
3.603	226.500	2.616	226.500	2176.5	10.41	38.94	2.09	5.36
3.926	235.400	2.902	235.400	2185.4	10.77	39.02	2.17	5.55
4.189	246.880	3.116	246.880	2196.9	11.24	39.12	2.27	5.80
4.466	257.410	3.353	257.410	2207.4	11.66	39.21	2.36	6.02
4.788	271.470	3.627	271.470	2221.5	12.22	39.34	2.49	6.32
5.114	288.190	3.896	288.190	2238.2	12.88	39.48	2.63	6.67
5.391	305.910	4.115	305.910	2255.9	13.56	39.64	2.79	7.04
4.404	302.950	3.136	302.950	2253.0	13.45	39.61	2.76	6.98
3.334	291.610	2.104	291.610	2241.6	13.01	39.51	2.66	6.74
1.672	254.340	0.570	254.340	2204.3	11.54	39.18	2.33	5.96

DILATOMETER TEST RESULTS

PLOT OF CORRECTED TEST DATA

CLIENT	Tonkin & Taylor	**BOREHOLE**	BH02
PROJECT	Downtown West	**LOCATION**	1757380 E 5921083 N 3 m RL
TEST NUMBER	1	**ORIENTATION**	0
FILE NAME	TBH02/001	**INCLINATION**	90
DEPTH, FROM	13.54 m		
DEPTH, TO	14.00 m	**TESTED BY**	R Green
		DATE	29/07/2025 2:50:53 pm

MATERIAL DESCRIPTION Unweathered, light grey, massive, SILTSTONE. Very weak.

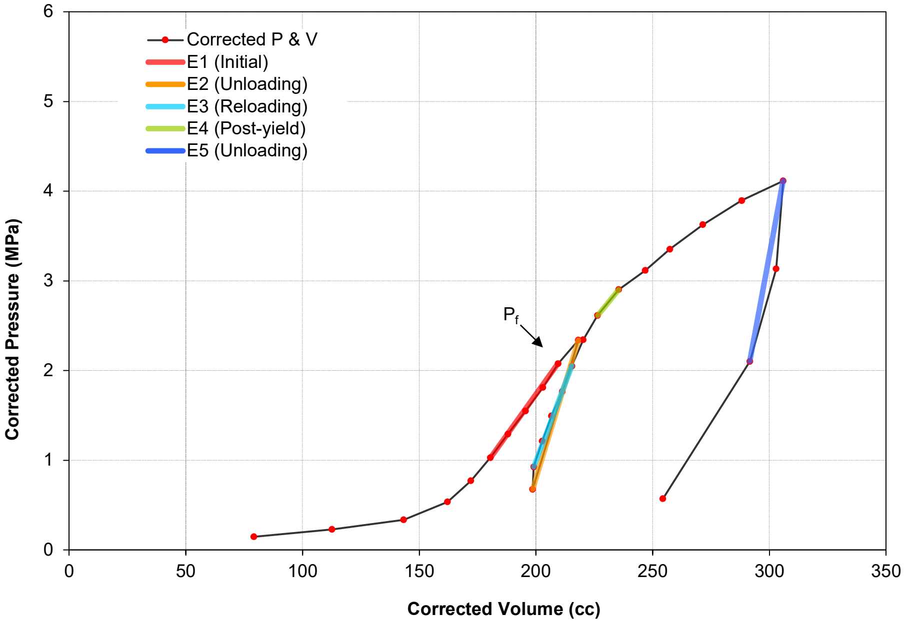


DILATOMETER TEST RESULTS

MODULUS ESTIMATES

CLIENT	Tonkin & Taylor	**BOREHOLE**	BH02
PROJECT	Downtown West	**LOCATION**	1757380 E 5921083 N 3 m RL
TEST NUMBER	1	**ORIENTATION**	0
FILE NAME	TBH02/001	**INCLINATION**	90
DEPTH, FROM	13.54 m		
DEPTH, TO	14.00 m	**TESTED BY**	R Green
		DATE	29/07/2025 2:50:53 pm

MATERIAL DESCRIPTION Unweathered, light grey, massive, SILTSTONE. Very weak.



MODULUS ESTIMATES

STAGE	MODULUS TYPE	MODULUS (MPa)
E1	Initial	203
E2	Unloading	506
E3	Reloading	404
E4	Post-yield	181
E5	Unloading	940

Poisson's Ratio = 0.25

ONSET OF PLASTIC BEHAVIOUR

P_f = 2 MPa

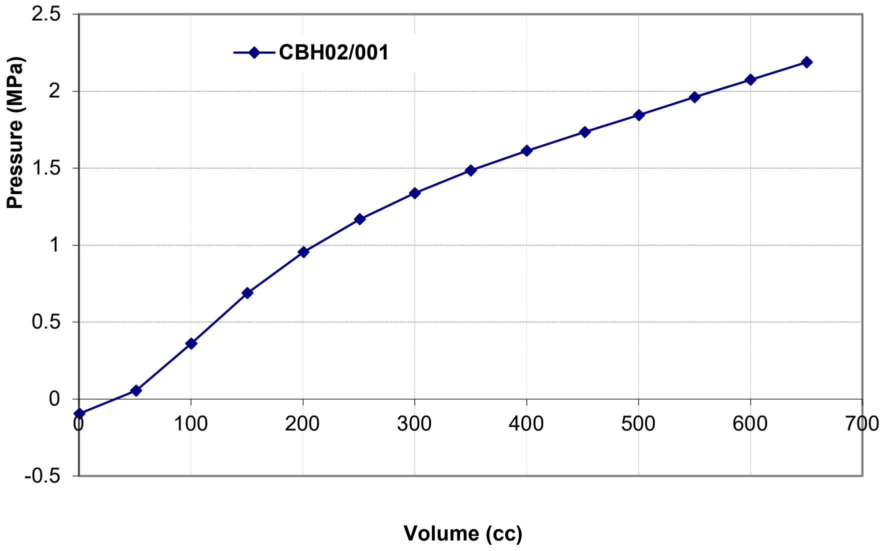
DILATOMETER TEST RESULTS

CALIBRATION REPORT - PLOTS

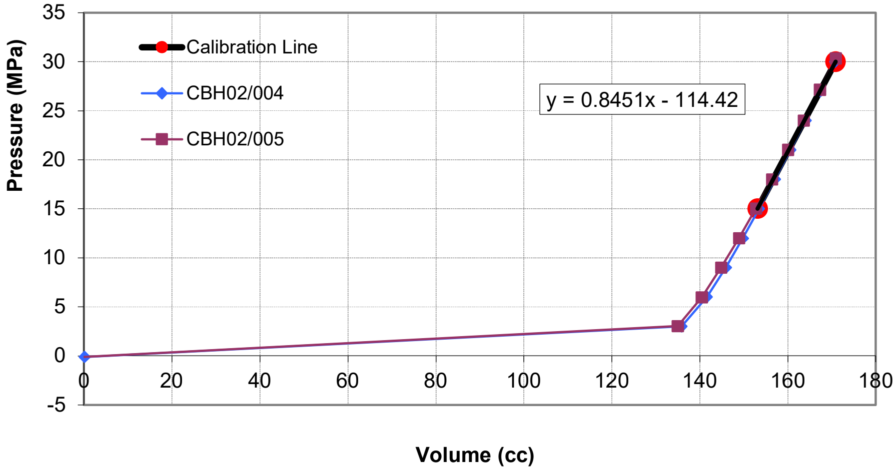
CLIENT	Tonkin & Taylor	**BOREHOLE**	BH02
PROJECT	Downtown West	**LOCATION**	1757380 E 5921083 N 3 m RL
TEST	2		
		ORIENTATION	0
		INCLINATION	90

Volume Calibration ΔX (a) =	1.18335	
Calibration Tube Correction Factor (b) =	0.08457	cc/Mpa
Volume Correction Factor (c) =	1.09878	
Rock Poisson's Ratio (ν_R) =	0.25	
At-Rest Volume of Probe (v_0) =	1950	cc

Pressure Calibration



Volume Calibration



DILATOMETER TEST RESULTS

CALIBRATION REPORT - DATA

CLIENT Tonkin & Taylor **BOREHOLE** BH02
PROJECT Downtown West

Pressure Calibration

Pressure	Volume
-0.094	0.440
0.056	51.150
0.361	100.300
0.689	150.620
0.956	200.680
1.169	250.920
1.338	300.130
1.485	350.060
1.613	400.070
1.736	451.970
1.846	500.470
1.962	550.070
2.076	600.050
2.188	650.160

Volume Calibration

V1		V2		V3		V4		V5	
CBH02/004		CBH02/005							
Pressure	Volume	Pressure	Volume	Pressure	Volume	Pressure	Volume	Pressure	Volume
-0.112	0.150	-0.131	-0.490						
3.018	135.870	3.034	135.000						
6.013	141.620	5.974	140.480						
9.009	145.910	9.005	144.850						
12.004	149.760	11.990	148.920						
15.016	153.470	15.028	152.780						
18.023	157.060	18.010	156.440						
21.007	160.560	21.002	160.050						
24.006	164.050	24.007	163.650						
27.018	167.390	27.149	167.300						
30.006	170.780	30.353	170.910						

DILATOMETER TEST RESULTS

TEST DATA

RG Consulting Ltd

CLIENT	Tonkin & Taylor	**BOREHOLE**	BH02
PROJECT	Downtown West	**LOCATION**	1757380 E 5921083 N 3 m RL
TEST NUMBER	2	**ORIENTATION**	0
FILE NAME	TBH02/002	**INCLINATION**	90
TEST DEPTH, FROM	22.40 m		
TEST DEPTH, TO	22.86 m	**TESTED BY**	R Green
		DATE	30/07/2025 2:42:01 pm

MATERIAL DESCRIPTION Unweathered, light grey, SILTSTONE. Very weak. Interbedded with: Unweathered, light grey, SANDSTONE. Weak, moderately cemented, fine to medium grained.

Volume Calibration ΔX (a)=	1.18335	
Calibration Tube Correction Factor (b)=	0.08457	**cc/MPa**
Volume Correction Factor (c)=	1.09878	

COMMENTS

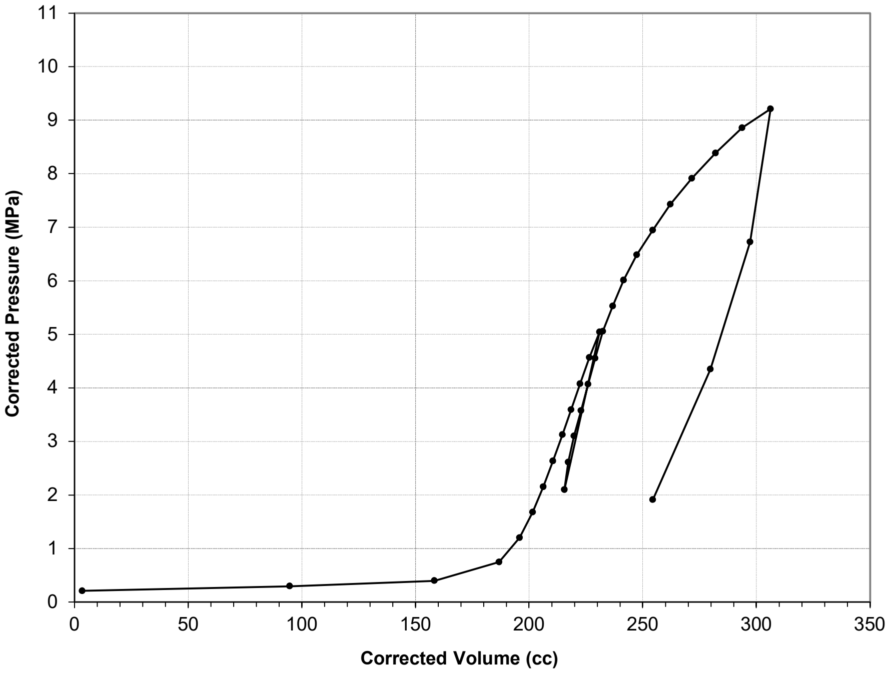
				Probe	Probe	Probe	Probe	Probe
Raw Data		Corrected Data		Total	Volumetric	Radius	Delta	Radial
Pressure	Volume	Pressure	Volume	Volume	Strain		radius	Strain
(MPa)	(cc)	(MPa)	(cc)	(cc)	(%)	(mm)	(mm)	(%)
-0.010	3.360	0.207	3.360	1953.4	0.17	36.89	0.04	0.10
0.491	94.640	0.297	94.640	2044.6	4.63	37.74	0.89	2.35
0.995	158.290	0.397	158.290	2108.3	7.51	38.32	1.47	3.84
1.497	186.860	0.747	186.860	2136.9	8.74	38.58	1.73	4.48
2.000	195.870	1.202	195.870	2145.9	9.13	38.66	1.81	4.68
2.505	201.580	1.677	201.580	2151.6	9.37	38.71	1.86	4.81
3.003	206.290	2.155	206.290	2156.3	9.57	38.75	1.90	4.91
3.501	210.490	2.635	210.490	2160.5	9.74	38.79	1.94	5.01
4.009	214.570	3.126	214.570	2164.6	9.91	38.83	1.98	5.10
4.493	218.430	3.594	218.430	2168.4	10.07	38.86	2.01	5.18
4.992	222.340	4.076	222.340	2172.3	10.24	38.90	2.05	5.27
5.501	226.530	4.567	226.530	2176.5	10.41	38.94	2.09	5.36
5.997	230.990	5.044	230.990	2181.0	10.59	38.98	2.13	5.45
2.987	215.530	2.100	215.530	2165.5	9.95	38.84	1.99	5.12
3.508	217.150	2.614	217.150	2167.2	10.02	38.85	2.00	5.15
4.007	219.820	3.102	219.820	2169.8	10.13	38.88	2.03	5.21
4.496	222.860	3.578	222.860	2172.9	10.26	38.90	2.05	5.28
5.000	225.910	4.069	225.910	2175.9	10.38	38.93	2.08	5.34
5.495	229.040	4.551	229.040	2179.0	10.51	38.96	2.11	5.41
6.016	232.430	5.057	232.430	2182.4	10.65	38.99	2.14	5.49
6.503	236.800	5.526	236.800	2186.8	10.83	39.03	2.18	5.58
7.006	241.530	6.009	241.530	2191.5	11.02	39.07	2.22	5.68
7.506	247.380	6.484	247.380	2197.4	11.26	39.12	2.27	5.81
7.994	254.350	6.945	254.350	2204.4	11.54	39.18	2.33	5.96
8.503	262.110	7.427	262.110	2212.1	11.85	39.25	2.40	6.12
9.019	271.570	7.911	271.570	2221.6	12.22	39.34	2.49	6.32
9.527	282.080	8.383	282.080	2232.1	12.64	39.43	2.58	6.54
10.038	293.760	8.854	293.760	2243.8	13.09	39.53	2.68	6.79
10.432	306.240	9.208	306.240	2256.2	13.57	39.64	2.79	7.04
7.923	297.210	6.727	297.210	2247.2	13.23	39.56	2.71	6.86
5.483	279.770	4.347	279.770	2229.8	12.55	39.41	2.56	6.49
2.958	254.330	1.909	254.330	2204.3	11.54	39.18	2.33	5.96

DILATOMETER TEST RESULTS

PLOT OF CORRECTED TEST DATA

CLIENT	Tonkin & Taylor	**BOREHOLE**	BH02
PROJECT	Downtown West	**LOCATION**	1757380 E 5921083 N 3 m RL
TEST NUMBER	2	**ORIENTATION**	0
FILE NAME	TBH02/002	**INCLINATION**	90
DEPTH, FROM	22.40 m		
DEPTH, TO	22.86 m	**TESTED BY**	R Green
		DATE	30/07/2025 2:42:01 pm

MATERIAL DESCRIPTION Unweathered, light grey, SILTSTONE. Very weak. Interbedded with: Unweathered, light grey, SANDSTONE. Weak, moderately cemented, fine to medium grained.

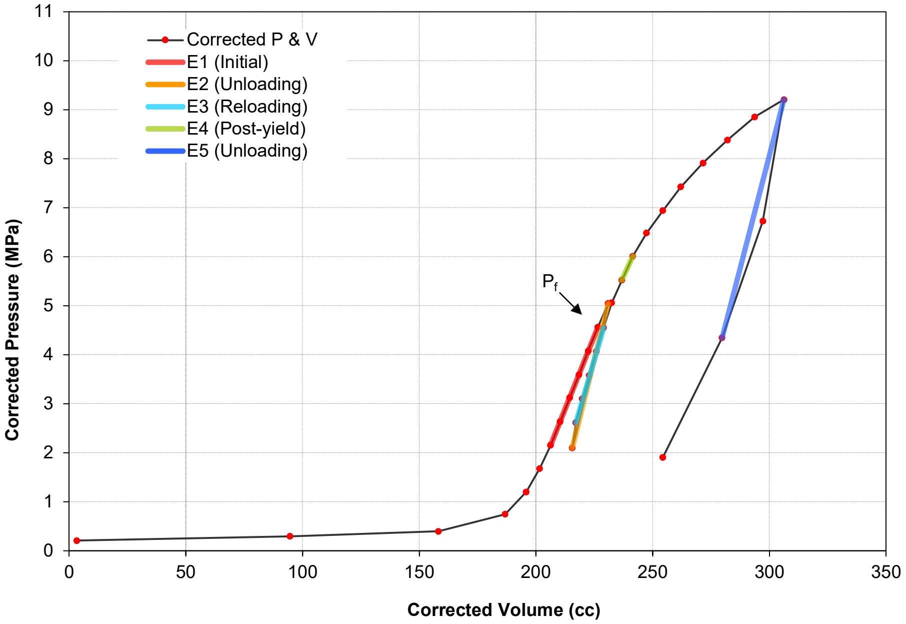


DILATOMETER TEST RESULTS

MODULUS ESTIMATES

CLIENT	Tonkin & Taylor	**BOREHOLE**	BH02
PROJECT	Downtown West	**LOCATION**	1757380 E 5921083 N 3 m RL
TEST NUMBER	2	**ORIENTATION**	0
FILE NAME	TBH02/002	**INCLINATION**	90
DEPTH, FROM	22.40 m		
DEPTH, TO	22.86 m	**TESTED BY**	R Green
		DATE	30/07/2025 2:42:01 pm

MATERIAL DESCRIPTION Unweathered, light grey, SILTSTONE. Very weak. Interbedded with: Unweathered, light grey, SANDSTONE. Weak, moderately cemented, fine to medium grained.



MODULUS ESTIMATES

STAGE	MODULUS TYPE	MODULUS (MPa)
E1	Initial	743
E2	Unloading	1309
E3	Reloading	1078
E4	Post-yield	629
E5	Unloading	1290

Poisson's Ratio = 0.25

ONSET OF PLASTIC BEHAVIOUR

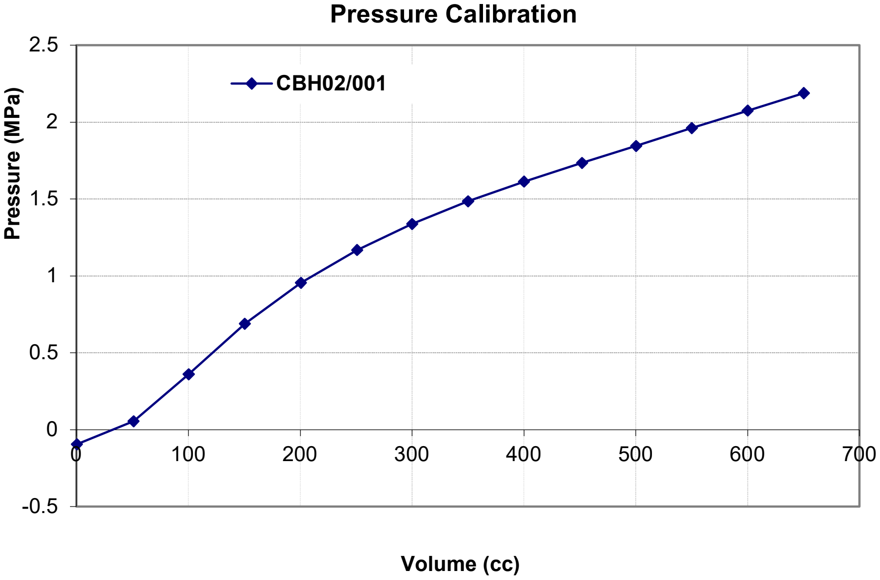
P_f = 4.5 MPa

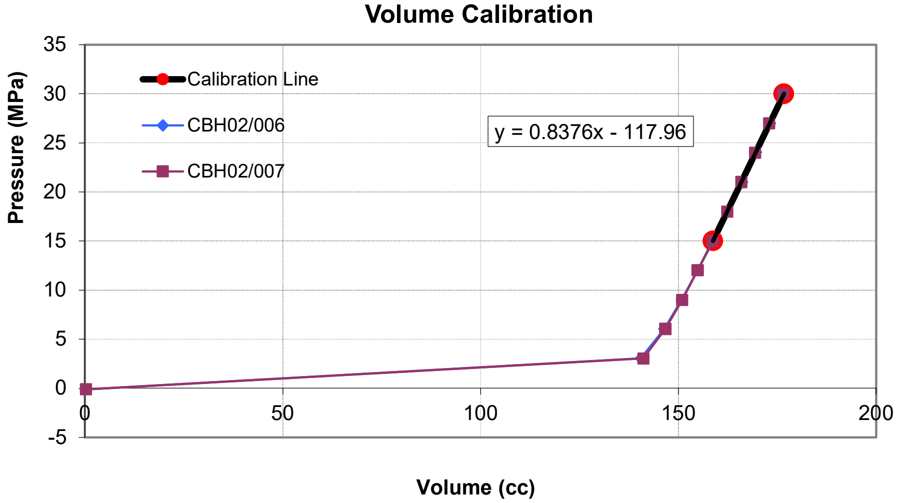
DILATOMETER TEST RESULTS

CALIBRATION REPORT - PLOTS

CLIENT	Tonkin & Taylor	**BOREHOLE**	BH02
PROJECT	Downtown West	**LOCATION**	1757380 E 5921083 N 3 m RL
TEST	3		
		ORIENTATION	0
		INCLINATION	90

Volume Calibration ΔX (a) =	1.19383	
Calibration Tube Correction Factor (b) =	0.08457	cc/Mpa
Volume Correction Factor (c) =	1.10926	
Rock Poisson's Ratio (ν_R) =	0.25	
At-Rest Volume of Probe (v_0) =	1950	cc





DILATOMETER TEST RESULTS

CALIBRATION REPORT - DATA

CLIENT Tonkin & Taylor
PROJECT Downtown West

BOREHOLE BH02

Pressure Calibration	
Pressure	**Volume**
-0.094	0.440
0.056	51.150
0.361	100.300
0.689	150.620
0.956	200.680
1.169	250.920
1.338	300.130
1.485	350.060
1.613	400.070
1.736	451.970
1.846	500.470
1.962	550.070
2.076	600.050
2.188	650.160

Volume Calibration

V1		V2		V3		V4		V5	
CBH02/006		CBH02/007							
Pressure	**Volume**	**Pressure**	**Volume**	**Pressure**	**Volume**	**Pressure**	**Volume**	**Pressure**	**Volume**
-0.114	0.200	-0.107	0.260						
3.019	140.490	3.038	141.110						
6.036	146.430	6.051	146.690						
9.017	150.860	9.021	150.980						
12.080	154.890	12.032	154.880						
14.952	158.670	15.036	158.630						
18.006	162.420	17.998	162.300						
21.002	166.120	21.003	165.900						
24.062	169.630	23.998	169.370						
26.994	173.100	27.002	172.910						
30.061	176.580	30.043	176.360						

DILATOMETER TEST RESULTS

TEST DATA

RG Consulting Ltd

CLIENT Tonkin & Taylor
PROJECT Downtown West

BOREHOLE BH02
LOCATION 1757380 E
5921083 N
3 m RL

TEST NUMBER 3
FILE NAME TBH02/003
TEST DEPTH, FROM 28.20 m
TEST DEPTH, TO 28.66 m

ORIENTATION 0
INCLINATION 90

TESTED BY R Green
DATE 31/07/2025 4:14:49 pm

MATERIAL DESCRIPTION Unweathered, light grey, bedded, SILTSTONE. Very weak. Interbedded with: Unweathered, light grey, SANDSTONE. Very weak, coarse grained.

Volume Calibration ΔX (a)= 1.19383
Calibration Tube Correction Factor (b)= 0.08457 **cc/MPa**
Volume Correction Factor (c)= 1.10926

COMMENTS Observed higher than usual displacements at low pressure before reaching elastic behaviour. This is possibly due to drill cuttings on the borehole wall; water circulation was lost in borelole and up to 1m of core loss occurred above test interval.

				Probe	Probe	Probe	Probe	Probe
Raw Data		Corrected Data		Total	Volumetric	Radius	Delta	Radial
Pressure	Volume	Pressure	Volume	Volume	Strain		radius	Strain
(MPa)	(cc)	(MPa)	(cc)	(cc)	(%)	(mm)	(mm)	(%)
-0.107	4.860	0.141	4.860	1954.9	0.25	36.90	0.05	0.14
0.501	97.270	0.325	97.270	2047.3	4.75	37.76	0.91	2.42
1.010	165.970	0.406	165.970	2116.0	7.84	38.39	1.54	4.01
1.497	224.770	0.606	224.770	2174.8	10.34	38.92	2.07	5.32
1.996	242.140	1.031	242.140	2192.1	11.05	39.08	2.23	5.69
2.496	251.440	1.492	251.440	2201.4	11.42	39.16	2.31	5.89
2.997	258.110	1.970	258.110	2208.1	11.69	39.22	2.37	6.04
3.498	263.460	2.453	263.460	2213.5	11.90	39.26	2.41	6.15
4.013	268.220	2.951	268.220	2218.2	12.09	39.31	2.46	6.25
4.505	272.330	3.429	272.330	2222.3	12.25	39.34	2.49	6.34
4.998	276.810	3.907	276.810	2226.8	12.43	39.38	2.53	6.43
5.499	281.420	4.392	281.420	2231.4	12.61	39.42	2.57	6.53
5.993	286.150	4.870	286.150	2236.2	12.80	39.47	2.62	6.63
6.492	291.700	5.350	291.700	2241.7	13.01	39.51	2.66	6.74
3.161	272.770	2.084	272.770	2222.8	12.27	39.35	2.50	6.35
3.500	273.440	2.420	273.440	2223.4	12.30	39.35	2.50	6.36
4.005	276.250	2.916	276.250	2226.3	12.41	39.38	2.53	6.42
4.514	279.320	3.414	279.320	2229.3	12.53	39.41	2.56	6.48
5.001	282.690	3.890	282.690	2232.7	12.66	39.43	2.58	6.55
5.498	285.970	4.375	285.970	2236.0	12.79	39.46	2.61	6.62
5.989	289.380	4.855	289.380	2239.4	12.92	39.49	2.64	6.69
6.490	293.190	5.343	293.190	2243.2	13.07	39.53	2.68	6.77
6.999	297.770	5.836	297.770	2247.8	13.25	39.57	2.72	6.87
7.505	303.830	6.323	303.830	2253.8	13.48	39.62	2.77	6.99
7.996	311.130	6.792	311.130	2261.1	13.76	39.69	2.84	7.14
8.504	319.490	7.276	319.490	2269.5	14.08	39.76	2.91	7.32
9.006	329.730	7.748	329.730	2279.7	14.46	39.85	3.00	7.52
9.514	340.770	8.223	340.770	2290.8	14.88	39.94	3.09	7.75
9.996	355.220	8.664	355.220	2305.2	15.41	40.07	3.22	8.04
7.121	342.440	5.825	342.440	2292.4	14.94	39.96	3.11	7.78
5.336	327.950	4.083	327.950	2278.0	14.40	39.83	2.98	7.49
2.643	297.470	1.481	297.470	2247.5	13.24	39.57	2.72	6.86

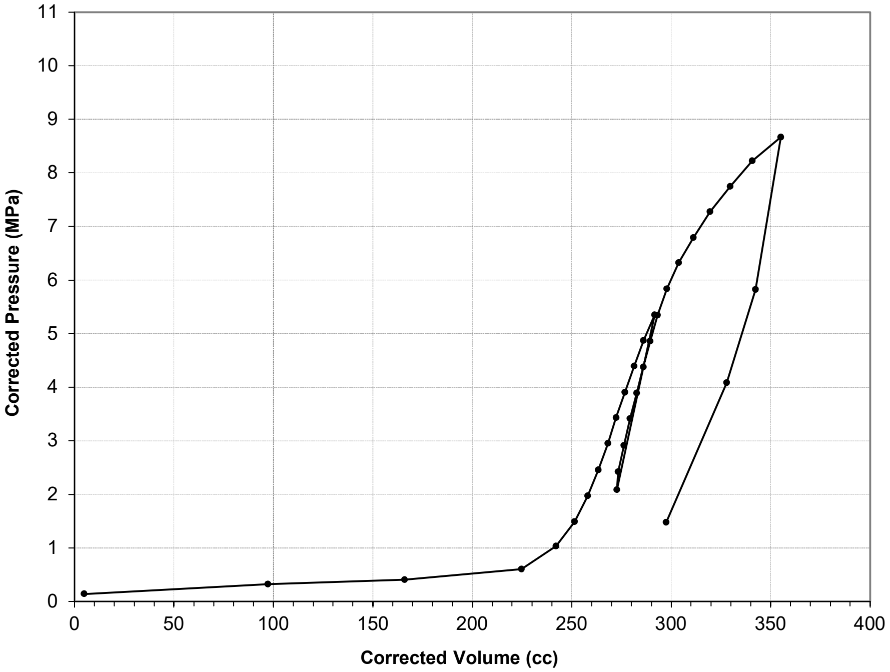
DILATOMETER TEST RESULTS

PLOT OF CORRECTED TEST DATA

RG Consulting Ltd

CLIENT	Tonkin & Taylor	**BOREHOLE**	BH02
PROJECT	Downtown West	**LOCATION**	1757380 E 5921083 N 3 m RL
TEST NUMBER	3	**ORIENTATION**	0
FILE NAME	TBH02/003	**INCLINATION**	90
DEPTH, FROM	28.20 m		
DEPTH, TO	28.66 m	**TESTED BY**	R Green
		DATE	31/07/2025 4:14:49 pm

MATERIAL DESCRIPTION Unweathered, light grey, bedded, SILTSTONE. Very weak. Interbedded with: Unweathered, light grey, SANDSTONE. Very weak, coarse grained.

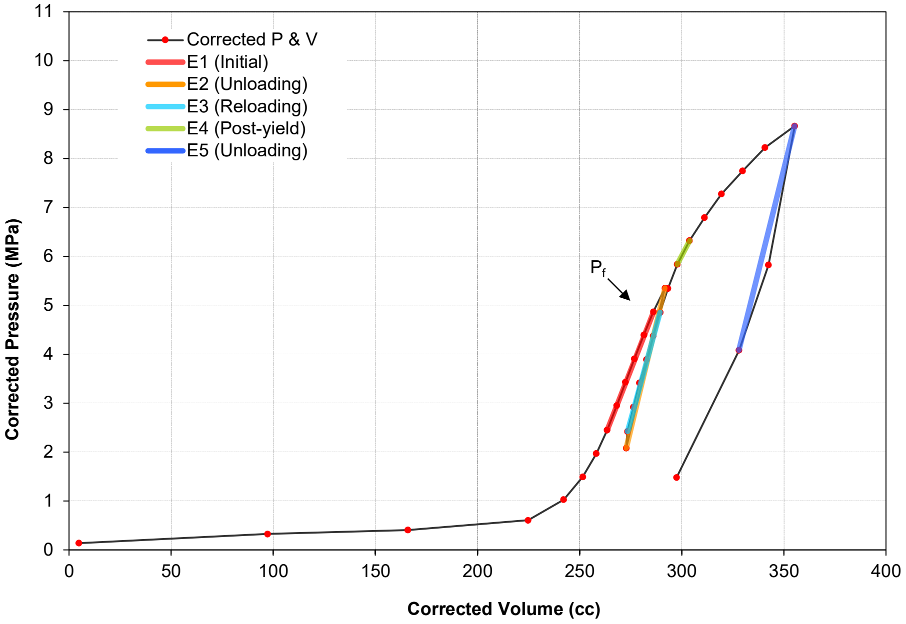


DILATOMETER TEST RESULTS

MODULUS ESTIMATES

CLIENT	Tonkin & Taylor	**BOREHOLE**	BH02
PROJECT	Downtown West	**LOCATION**	1757380 E 5921083 N 3 m RL
TEST NUMBER	3	**ORIENTATION**	0
FILE NAME	TBH02/003	**INCLINATION**	90
DEPTH, FROM	28.20 m		
DEPTH, TO	28.66 m	**TESTED BY**	R Green
		DATE	31/07/2025 4:14:49 pm

MATERIAL DESCRIPTION Unweathered, light grey, bedded, SILTSTONE. Very weak. Interbedded with: Unweathered, light grey, SANDSTONE. Very weak, coarse grained.



MODULUS ESTIMATES

STAGE	MODULUS TYPE	MODULUS (MPa)
E1	Initial	672
E2	Unloading	1191
E3	Reloading	1026
E4	Post-yield	496
E5	Unloading	1183

Poisson's Ratio = 0.25

ONSET OF PLASTIC BEHAVIOUR

P_f = 5 MPa

GEOTECHNICS

18 August 2025
Our Ref: 1099777.0000.0.0/Rep1
Customer Ref: 1016043.2000

Tonkin & Taylor Limited
PO BOX 5271
AUCKLAND 1141

Attention: Conor Morrison

Dear Conor

Downtown West

Laboratory Test Report

Samples from the above-mentioned site have been tested as received according to your instructions and the results are included in this report. Results apply only to the sample(s) tested.

Descriptions are enclosed for your information but are not covered under the IANZ endorsement of this report.

This report has been prepared for the benefit of Tonkin & Taylor Limited, with respect to the particular brief given to us and it cannot be relied upon in other contexts or for any other purpose without our prior review and agreement.

This report may be reproduced only in full.

Samples not destroyed during testing will be retained for one month from the date of this report before being discarded. If we can be of any further assistance, feel free to get in touch. Contact details are provided at the bottom of this page.

GEOTECHNICS LTD

Report approved by:	Authorised for Geotechnics by:
..... [redacted]	....
Kelsey Sanderson	Steven Anderson
Senior Laboratory Technician	Project Director
Key Technical Person	

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

18-Aug-25

T:\GeotechnicsGroup\Projects\1099777\IssuedDocuments - Report 1

Customer Ref: 1016043.2000

GEOTECHNICS

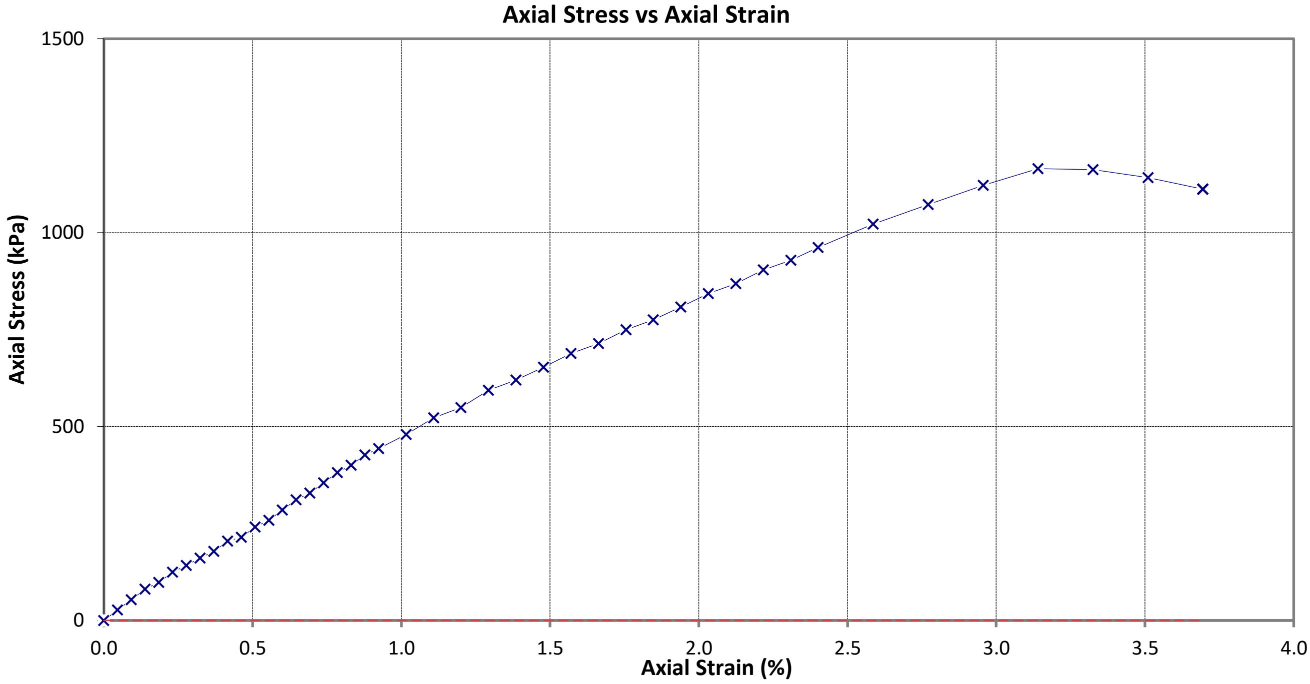
1 Hill Street
Onehunga
Auckland
New Zealand
p. +64 9 356 3510

Geotechnics Project ID: **1099777.0000.0.0**
Customer Project ID: **1016043.2**

Site:	Downtown West	Location ID:	BH1
Sample Ref.:	AKL1280.1	Depth:	12.72-12.86 m (m)

Test method used: NZS 4402:1986 Test 6.3.1 Determination of the Unconfined Compressive Strength of Cohesive Soil
NZS 4402:1986 Test 2.1 Determination of Water Content

UNCONFINED COMPRESSION STRENGTH TEST



Initial Sample Parameters:

Sample Length (mm)	108.26	Bulk Density (t/m³)	1.99
Sample Diameter (mm)	81.41	Dry Density (t/m³)	1.60
Test Length (mm)	108.26	Water Content (%)	24.2
Test Height / Diameter Ratio	1.33		

Failure Value:

Axial Strain ε (%)	Unconfined Compressive Strength q_u (kPa)	Rate of Compression (mm/min)
3.14	1165	0.11

Mode of Failure: Axial

Sample History: Undisturbed core trimmed at natural water content.

Sample Description: Unweathered, grey; SILTSTONE, very weak.

Test Remarks: Unconfined Compressive Strength reported to the nearest 1 kPa.
This test result is not IANZ accredited as it fails to meet the height to diameter ratio requirements of 2:1.

Failure Photo:

Tested by:	KAPO	Date:	14/08/2025	Approved by:	KESA	Date:	18/08/2025

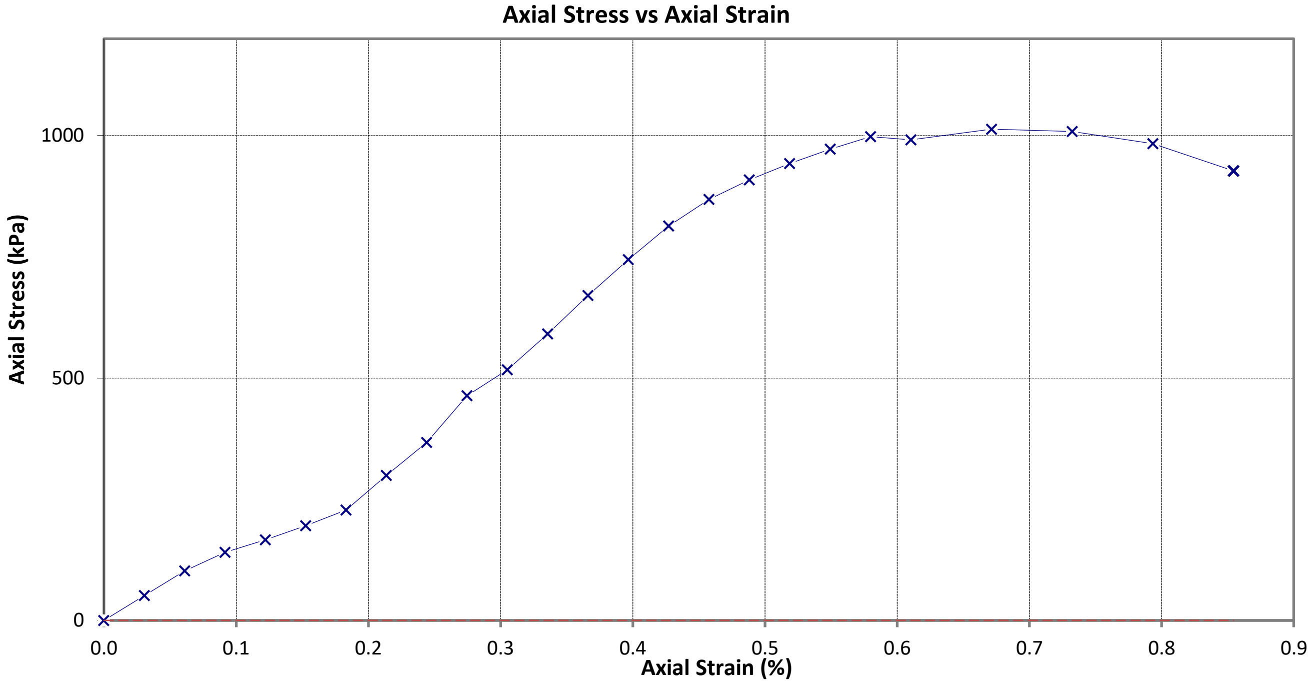
1 Hill Street
Onehunga
Auckland
New Zealand
p. +64 9 356 3510

Geotechnics Project ID: **1099777.0000.0.0**
Customer Project ID: **1016043.2**

Site:	Downtown West	Location ID:	BH1	
Sample Ref.:	AKL1280.2	Depth:	16.75-16.91	(m)

Test method used: NZS 4402:1986 Test 6.3.1 Determination of the Unconfined Compressive Strength of Cohesive Soil
NZS 4402:1986 Test 2.1 Determination of Water Content

UNCONFINED COMPRESSION STRENGTH TEST



Initial Sample Parameters:

Sample Length (mm)	163.83	Bulk Density (t/m³)	2.09
Sample Diameter (mm)	82.50	Dry Density (t/m³)	1.72
Test Length (mm)	163.83	Water Content (%)	21.1
Test Height / Diameter Ratio	1.99		

Failure Value:

Axial Strain ε (%)	Unconfined Compressive Strength q_u (kPa)	Rate of Compression (mm/min)
0.67	1013	0.24

Mode of Failure: Axial

Sample History: Undisturbed core trimmed at natural water content.

Sample Description: Unweathered, grey; SILTSTONE, very weak.

Test Remarks: Unconfined Compressive Strength reported to the nearest 1 kPa.

Failure Photo:

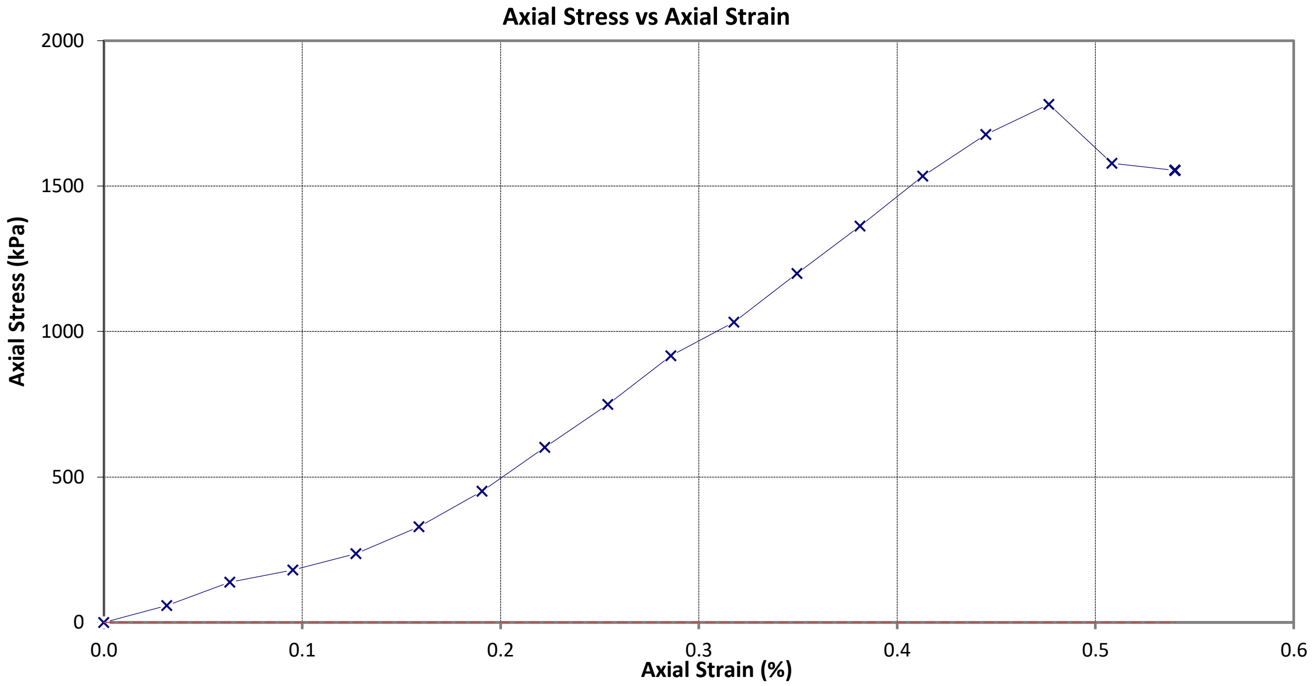
Tested by:	KAPO	Date:	14/08/2025	Approved by KTP:	KESA	Date:	18/08/2025

Our Ref: 1099777.0000.0.0/Rep1

Site:	Downtown West	Location ID:	BH1	
Sample Ref.:	AKL1280.3	Depth:	20.14-20.29	(m)

Test method used: NZS 4402:1986 Test 6.3.1 Determination of the Unconfined Compressive Strength of Cohesive Soil
NZS 4402:1986 Test 2.1 Determination of Water Content

UNCONFINED COMPRESSION STRENGTH TEST



Initial Sample Parameters:

Sample Length (mm)	157.38	Bulk Density (t/m³)	2.04
Sample Diameter (mm)	82.53	Dry Density (t/m³)	1.67
Test Length (mm)	157.38	Water Content (%)	22.2
Test Height / Diameter Ratio	1.91		

Failure Value:

Axial Strain ε (%)	Unconfined Compressive Strength q_u (kPa)	Rate of Compression (mm/min)
0.48	1781	0.17

Mode of Failure: Shear

Sample History: Undisturbed core trimmed at natural water content.

Sample Description: Unweathered, grey; SANDSTONE, very weak.

Test Remarks: Unconfined Compressive Strength reported to the nearest 1 kPa.

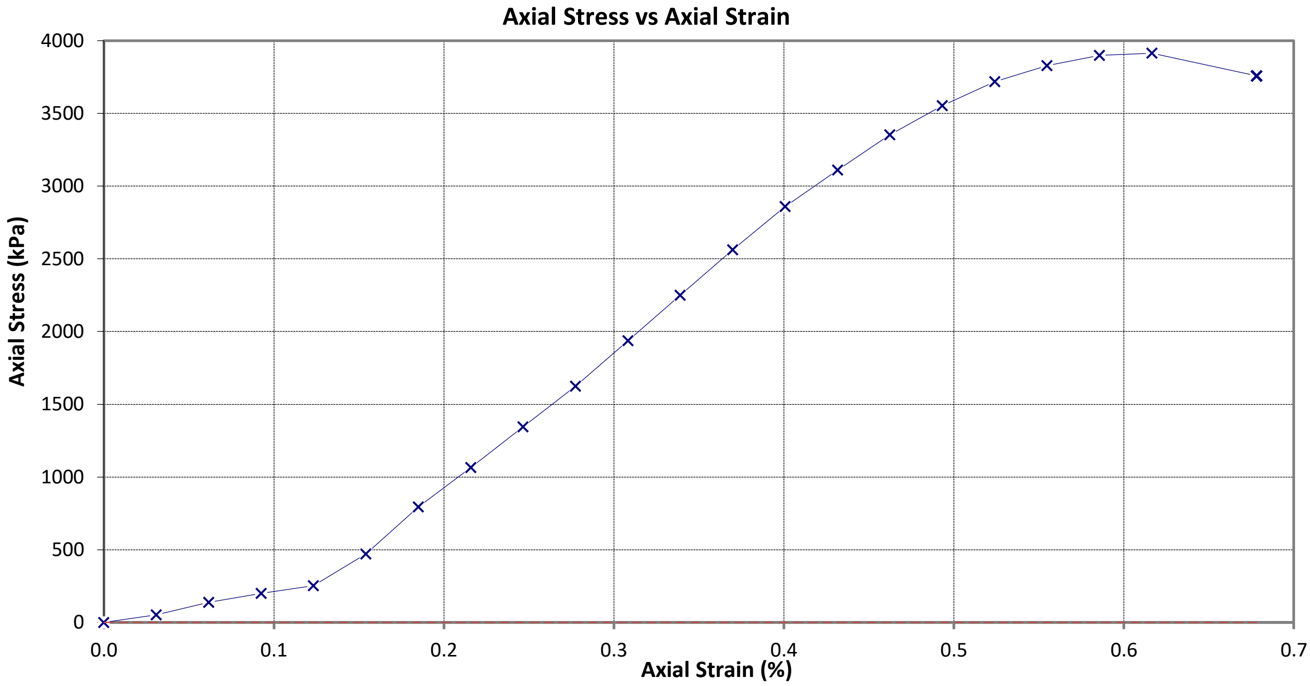
Failure Photo:

Tested by:	KAPO	Date:	14/08/2025	Approved by KTP:	KESA	Date:	18/08/2025

Site:	Downtown West	Location ID:	BH1	
Sample Ref.:	AKL1280.4	Depth:	21.75-21.91	(m)

Test method used: NZS 4402:1986 Test 6.3.1 Determination of the Unconfined Compressive Strength of Cohesive Soil
NZS 4402:1986 Test 2.1 Determination of Water Content

UNCONFINED COMPRESSION STRENGTH TEST



Initial Sample Parameters:

Sample Length (mm)	162.18	Bulk Density (t/m³)	2.09
Sample Diameter (mm)	82.44	Dry Density (t/m³)	1.75
Test Length (mm)	162.18	Water Content (%)	19.6
Test Height / Diameter Ratio	1.97		

Failure Value:

Axial Strain ε (%)	Unconfined Compressive Strength q_u (kPa)	Rate of Compression (mm/min)
0.62	3914	0.12

Mode of Failure:

Sample History: Undisturbed core trimmed at natural water content.

Sample Description: Unweathered, grey; SILTSTONE, very weak.

Test Remarks: Unconfined Compressive Strength reported to the nearest 1 kPa.

Failure Photo:

Tested by:	KAPO	Date:	14/08/2025	Approved by KTP:	KESA	Date:	18/08/2025

GEOTECHNICS

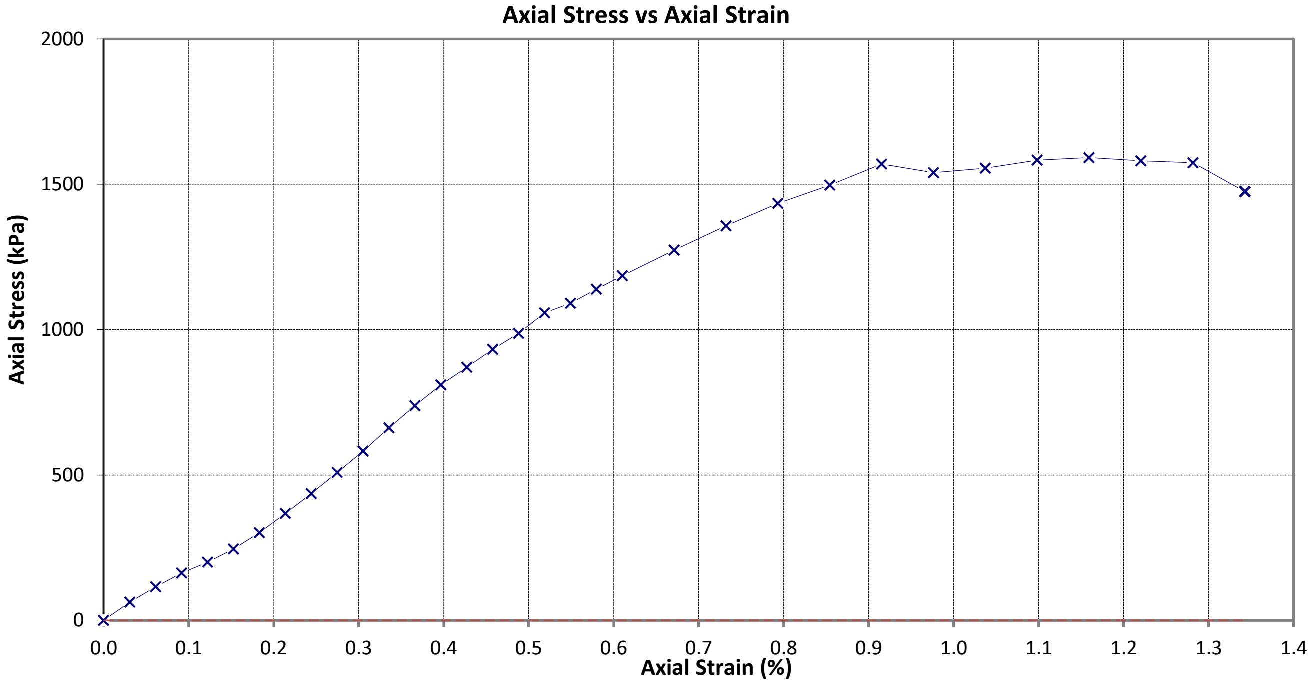
1 Hill Street
Onehunga
Auckland
New Zealand
p. +64 9 356 3510

Geotechnics Project ID: **1099777.0000.0.0**
Customer Project ID: **1016043.2**

Site:	Downtown West	Location ID:	BH1	
Sample Ref.:	AKL1280.5	Depth:	28.18-28.35	(m)

Test method used: NZS 4402:1986 Test 6.3.1 Determination of the Unconfined Compressive Strength of Cohesive Soil
NZS 4402:1986 Test 2.1 Determination of Water Content

UNCONFINED COMPRESSION STRENGTH TEST



Initial Sample Parameters:

Sample Length (mm)	163.85	Bulk Density (t/m³)	2.14
Sample Diameter (mm)	82.54	Dry Density (t/m³)	1.80
Test Length (mm)	163.85	Water Content (%)	18.9
Test Height / Diameter Ratio	1.99		

Failure Value:

Axial Strain ε (%)	Unconfined Compressive Strength q_u (kPa)	Rate of Compression (mm/min)
1.16	1592	0.23

Mode of Failure: Axial

Sample History: Undisturbed core trimmed at natural water content.

Sample Description: Unweathered, grey; SILTSTONE, very weak.

Test Remarks: Unconfined Compressive Strength reported to the nearest 1 kPa.

Failure Photo:

Tested by:	KAPO	Date:	14/08/2025	Approved by KTP:	KESA	Date:	18/08/2025

Our Ref: 1099777.0000.0.0/Rep1

GEOTECHNICS

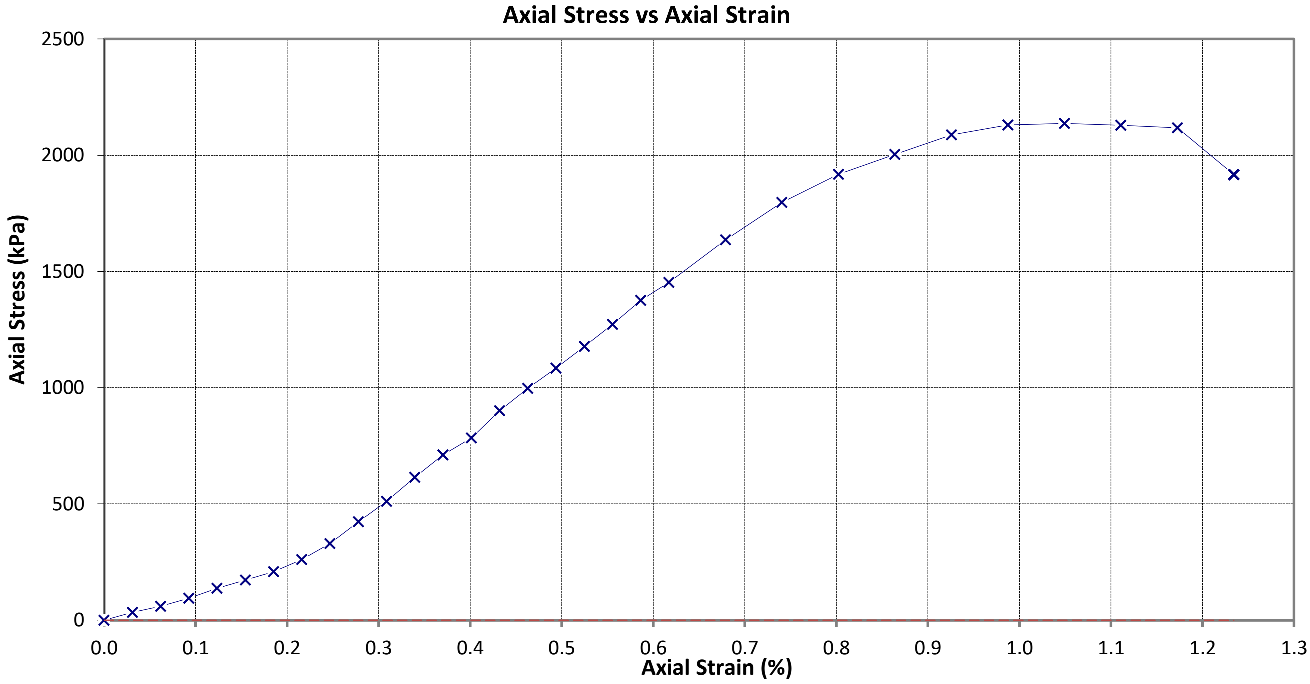
1 Hill Street
Onehunga
Auckland
New Zealand
p. +64 9 356 3510

Geotechnics Project ID: **1099777.0000.0.0**
Customer Project ID: **1016043.2**

Site:	Downtown West	Location ID:	BH1	
Sample Ref.:	AKL1280.6	Depth:	23.54-23.71	(m)

Test method used:
NZS 4402:1986 Test 6.3.1 Determination of the Unconfined Compressive Strength of Cohesive Soil
NZS 4402:1986 Test 2.1 Determination of Water Content

UNCONFINED COMPRESSION STRENGTH TEST



Initial Sample Parameters:

Sample Length (mm)	162.03	Bulk Density (t/m³)	2.12
Sample Diameter (mm)	82.63	Dry Density (t/m³)	1.79
Test Length (mm)	162.03	Water Content (%)	18.9
Test Height / Diameter Ratio	1.96		

Failure Value:

Axial Strain ε (%)	Unconfined Compressive Strength q_u (kPa)	Rate of Compression (mm/min)
1.05	2137	0.17

Mode of Failure: Axial

Sample History: Undisturbed core trimmed at natural water content.

Sample Description: Slightly weathered, grey; SILTSTONE, very weak.

Test Remarks: Unconfined Compressive Strength reported to the nearest 1 kPa.
This test result is not IANZ accredited due to not failing in the required timeframe of 5-10 minutes.

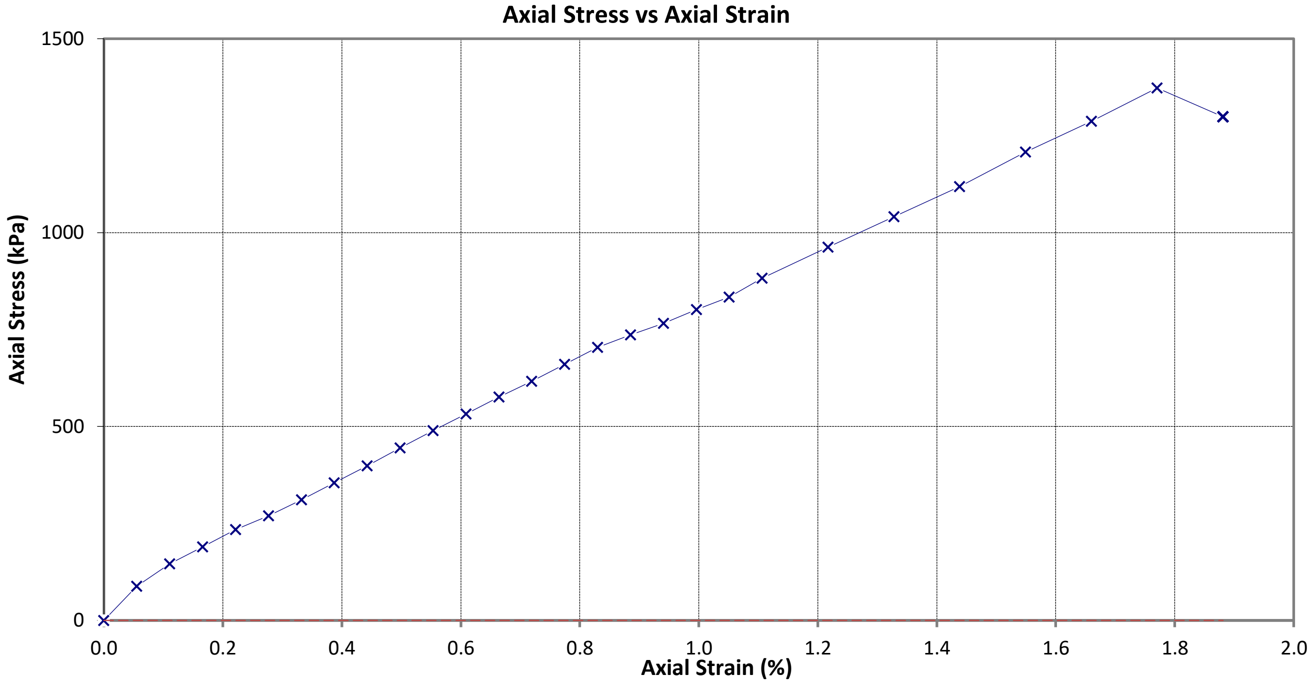
Failure Photo:

Tested by:	KAPO	Date:	14/08/2025	Approved by:	KESA	Date:	18/08/2025

Site:	Downtown West	Location ID:	BH2	
Sample Ref.:	AKL1280.7	Depth:	22.30-22.39	(m)

Test method used: NZS 4402:1986 Test 6.3.1 Determination of the Unconfined Compressive Strength of Cohesive Soil
NZS 4402:1986 Test 2.1 Determination of Water Content

UNCONFINED COMPRESSION STRENGTH TEST



Initial Sample Parameters:

Sample Length (mm)	90.37	Bulk Density (t/m³)	2.05
Sample Diameter (mm)	45.31	Dry Density (t/m³)	1.73
Test Length (mm)	90.37	Water Content (%)	18.3
Test Height / Diameter Ratio	1.99		

Failure Value:

Axial Strain ε (%)	Unconfined Compressive Strength q_u (kPa)	Rate of Compression (mm/min)
1.77	1373	0.15

Mode of Failure: Axial

Sample History: Undisturbed core trimmed at natural water content.

Sample Description: Unweathered, grey; SILSTONE, very weak.

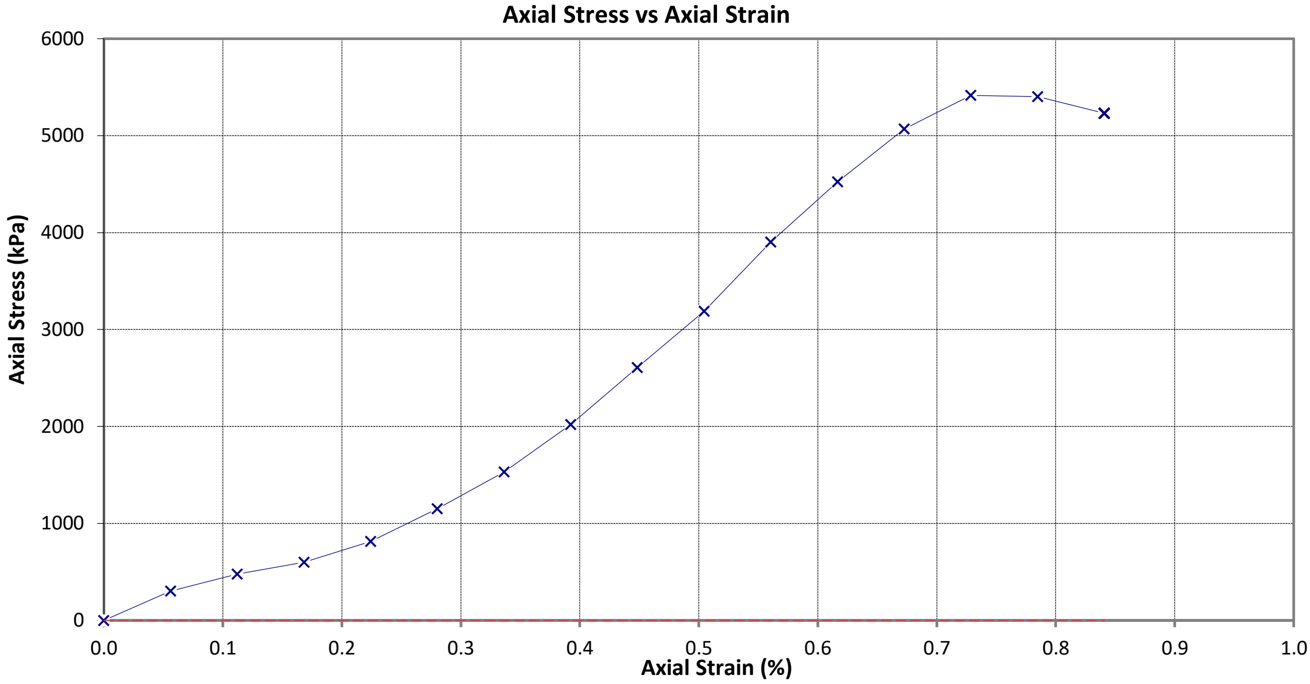
Test Remarks: Unconfined Compressive Strength reported to the nearest 1 kPa.
This test result is not IANZ accredited due to not failing in the required timeframe of 5-10 minutes.

Failure Photo:

Tested by:	KAPO	Date:	13/08/2025	Approved by:	KESA	Date:	18/08/2025

Site: Downtown West
Location ID: BH2
Sample Ref.: AKL1280.8
Depth: 19.79-19.88 (m)
Test method used: NZS 4402:1986 Test 6.3.1 Determination of the Unconfined Compressive Strength of Cohesive Soil
NZS 4402:1986 Test 2.1 Determination of Water Content

UNCONFINED COMPRESSION STRENGTH TEST



Initial Sample Parameters:

Sample Length (mm)	89.20	Bulk Density (t/m³)	2.07
Sample Diameter (mm)	44.61	Dry Density (t/m³)	1.72
Test Length (mm)	89.20	Water Content (%)	20.1
Test Height / Diameter Ratio	2.00		

Failure Value:

Axial Strain ε (%)	Unconfined Compressive Strength q_u (kPa)	Rate of Compression (mm/min)
0.73	5415	0.10

Mode of Failure: Axial

Sample History: Undisturbed core trimmed at natural water content.

Sample Description: Slightly weathered, grey; SILSTONE, weak.

Test Remarks: Unconfined Compressive Strength reported to the nearest 1 kPa.

Failure Photo:

Tested by: KAPO Date: 13/08/2025 Approved by KTP: KESA Date: 18/08/2025

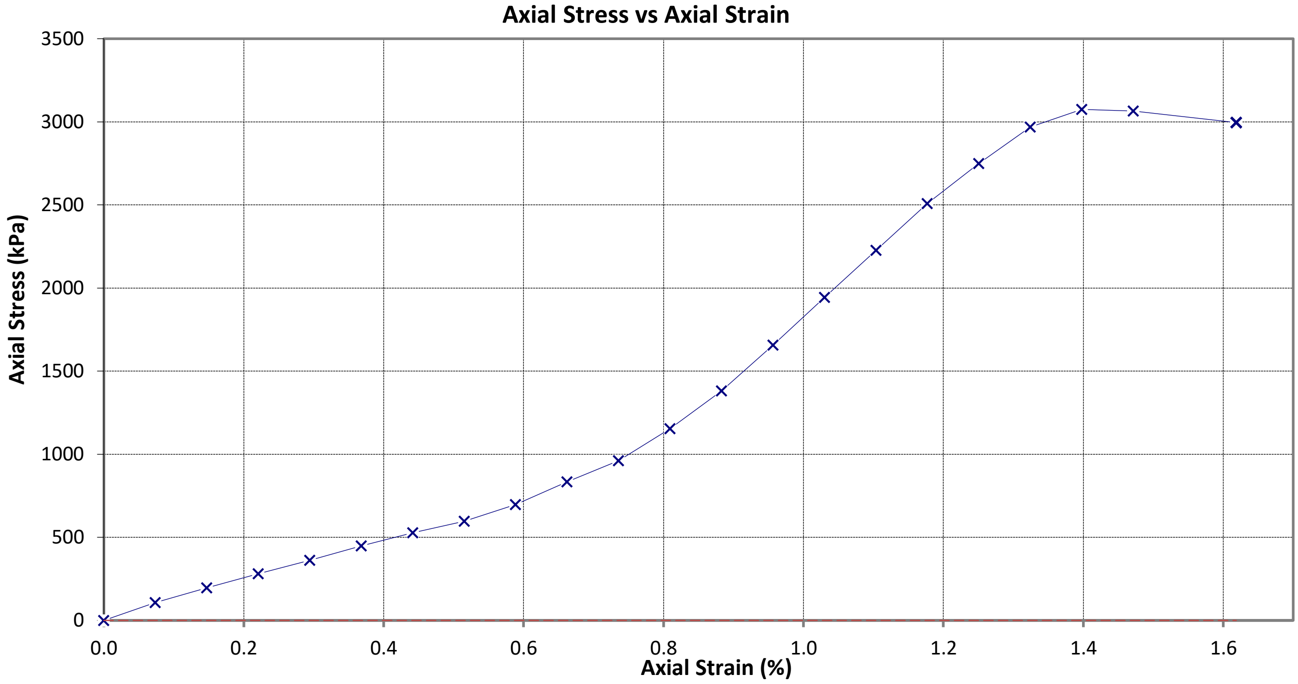
GEOTECHNICS
1 Hill Street
Onehunga
Auckland
New Zealand
p. +64 9 356 3510

Geotechnics Project ID: **1099777.0000.0.0**
Customer Project ID: **1016043.2**

Site:	Downtown West	Location ID:	BH2	
Sample Ref.:	AKL1280.9	Depth:	22.51 - 22.59	(m)

Test method used: NZS 4402:1986 Test 6.3.1 Determination of the Unconfined Compressive Strength of Cohesive Soil
NZS 4402:1986 Test 2.1 Determination of Water Content

UNCONFINED COMPRESSION STRENGTH TEST



Initial Sample Parameters:

Sample Length (mm)	67.96	Bulk Density (t/m³)	2.01
Sample Diameter (mm)	44.88	Dry Density (t/m³)	1.73
Test Length (mm)	67.96	Water Content (%)	16.2
Test Height / Diameter Ratio	1.51		

Failure Value:

Axial Strain ε (%)	Unconfined Compressive Strength q_u (kPa)	Rate of Compression (mm/min)
1.40	3075	0.14

Mode of Failure: Axial

Sample History: Undisturbed core trimmed at natural water content.

Sample Description: Unweathered, grey; SILTSTONE, very weak.

Test Remarks: Unconfined Compressive Strength reported to the nearest 1 kPa.
This test result is not IANZ accredited due to failing to meet the 2:1 height to diameter ratio requirement.

Failure Photo:

Tested by:	KAPO	Date:	14/08/2025	Approved by:	KESA	Date:	18/08/2025

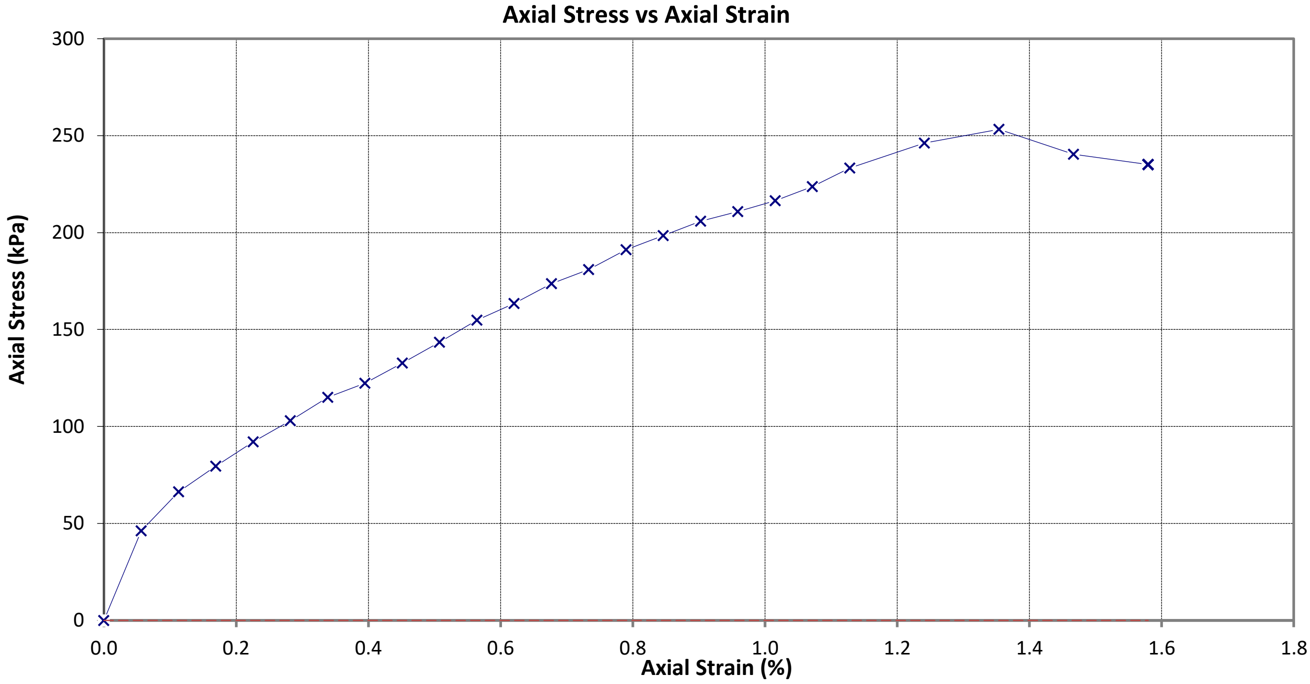
GEOTECHNICS
1 Hill Street
Onehunga
Auckland
New Zealand
p. +64 9 356 3510

Geotechnics Project ID: **1099777.0000.0.0**
Customer Project ID: **1016043.2**

Site:	Downtown West	Location ID:	BH2	
Sample Ref.:	AKL1280.10	Depth:	27.17 - 27.26	(m)

Test method used: NZS 4402:1986 Test 6.3.1 Determination of the Unconfined Compressive Strength of Cohesive Soil
NZS 4402:1986 Test 2.1 Determination of Water Content

UNCONFINED COMPRESSION STRENGTH TEST



Initial Sample Parameters:

Sample Length (mm)	88.62	Bulk Density (t/m³)	2.09
Sample Diameter (mm)	46.98	Dry Density (t/m³)	1.76
Test Length (mm)	88.62	Water Content (%)	18.9
Test Height / Diameter Ratio	1.89		

Failure Value:

Axial Strain ε (%)	Unconfined Compressive Strength q_u (kPa)	Rate of Compression (mm/min)
1.35	253	0.20

Mode of Failure: Brittle

Sample History: Undisturbed core trimmed at natural water content.

Sample Description: Clayey SILT; grey. Hard, moist, low plasticity.

Test Remarks: Unconfined Compressive Strength reported to the nearest 1 kPa.

Failure Photo:

Tested by:	KAPO	Date:	13/08/2025	Approved by KTP:	KESA	Date:	18/08/2025

Our Ref: 1099777.0000.0.0/Rep1

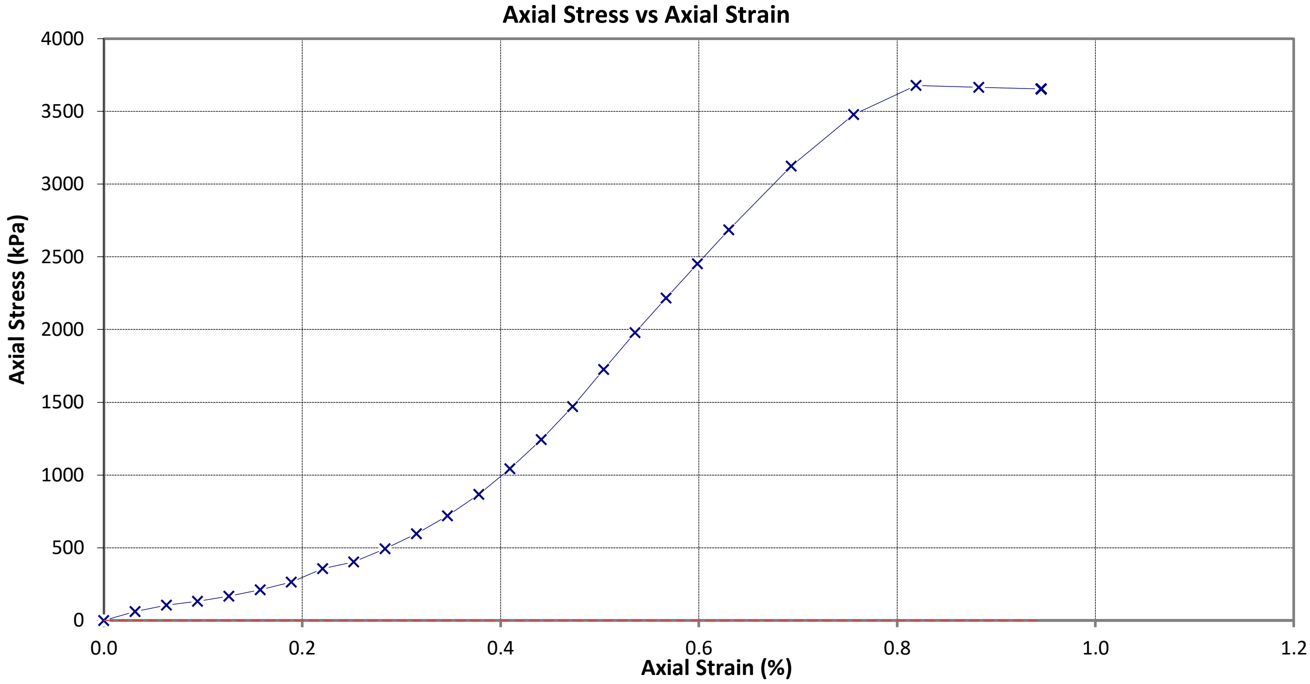
1 Hill Street
Onehunga
Auckland
New Zealand
p. +64 9 356 3510

Geotechnics Project ID: **1099777.0000.0.0**
Customer Project ID: **1016043.2**

Site:	Downtown West	Location ID:	BH2	
Sample Ref.:	AKL1280.11	Depth:	17.77-17.93	(m)

Test method used: NZS 4402:1986 Test 6.3.1 Determination of the Unconfined Compressive Strength of Cohesive Soil
NZS 4402:1986 Test 2.1 Determination of Water Content

UNCONFINED COMPRESSION STRENGTH TEST



Initial Sample Parameters:

Sample Length (mm)	158.69	Bulk Density (t/m³)	2.07
Sample Diameter (mm)	82.18	Dry Density (t/m³)	1.72
Test Length (mm)	158.69	Water Content (%)	20.3
Test Height / Diameter Ratio	1.93		

Failure Value:

Axial Strain ε (%)	Unconfined Compressive Strength q_u (kPa)	Rate of Compression (mm/min)
0.82	3678	0.15

Mode of Failure: Axial

Sample History: Undisturbed core trimmed at natural water content.

Sample Description: Unweathered, grey; SILTSTONE, very weak.

Test Remarks: Unconfined Compressive Strength reported to the nearest 1 kPa.
Small cracks in sample present prior to testing.

Failure Photo:

Tested by:	KAPO	Date:	14/08/2025	Approved by KTP:	KESA	Date:	18/08/2025

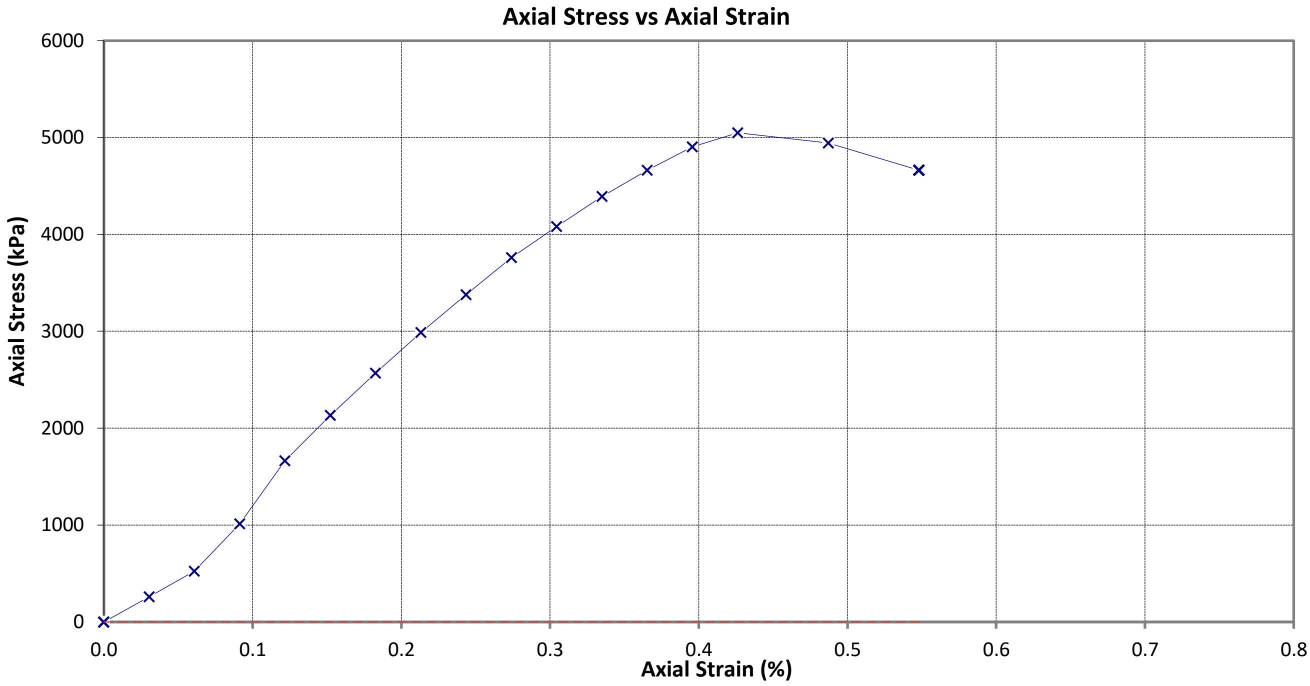
GEOTECHNICS
1 Hill Street
Onehunga
Auckland
New Zealand
p. +64 9 356 3510

Geotechnics Project ID: **1099777.0000.0.0**
Customer Project ID: **1016043.2**

Site:	Downtown West	Location ID:	BH2	
Sample Ref.:	AKL1280.12	Depth:	18.87-19.03	(m)

Test method used: NZS 4402:1986 Test 6.3.1 Determination of the Unconfined Compressive Strength of Cohesive Soil
NZS 4402:1986 Test 2.1 Determination of Water Content

UNCONFINED COMPRESSION STRENGTH TEST



Initial Sample Parameters:

Sample Length (mm)	164.24	Bulk Density (t/m³)	2.06
Sample Diameter (mm)	82.55	Dry Density (t/m³)	1.67
Test Length (mm)	164.24	Water Content (%)	23.0
Test Height / Diameter Ratio	1.99		

Failure Value:

Axial Strain ε (%)	Unconfined Compressive Strength q_u (kPa)	Rate of Compression (mm/min)
0.43	5049	0.09

Mode of Failure: Axial

Sample History: Undisturbed core trimmed at natural water content.

Sample Description: Unweathered, grey; SILTSTONE, very weak.

Test Remarks: Unconfined Compressive Strength reported to the nearest 1 kPa.

Failure Photo:

Tested by:	KAPO	Date:	14/08/2025	Approved by KTP:	KESA	Date:	18/08/2025

Appendix E Previous ground investigation results

801_BH11

BH_TT66664

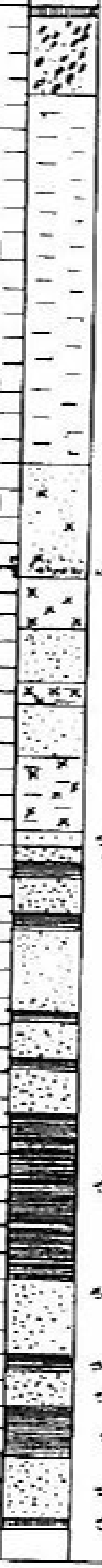
BH_64334

DEP	SYMBOL	BORE 11 63	SAMP	CONFINE STRESS SD	NATURAL MOISTURE CONTENT	BULK DENSITY DD	REDUCED LEVEL	
		bitumen footpath.					▼0.0 3.63m ×o L.L.S	
		scoria gravel fill. traces clay & bricks. ø & basalt. boulder.						
5		clay soft yellow brown fill						
		sandy clay soft fill	▯	C=2.4				
10								
		clay fill soft medium ▼G.W.L. grey yellow brown. wood & crockery inclusions					FILL	
15		sandstone fill some fine scoria						
20	LOST	soft.					▼-14.0	5ly
25		sand silty soft greenish grey. shell inclusions						
30		clay. silty soft-med grey. sand. silty compact grey. clay. silty firm lt. grey.	▯	9.0	31			
			▯	16.0	35			
35		clay sandy firm. lt grey. sand cemented dk grey silt, well cemented. silt clayey firm dk grey	▯	60.0	28		WAITEMATA SERIES SOIL	
40	LOST.							
		sand - slightly cemented dk grey. - breaks in horizontal discs.	▯	41.0	31			
45		silt, well cemented. sand slightly cemented. breaks on horizontal plane.						
		silt. well cemented	▯	77.0	26			
50		sand, slightly cemented. siltstone hard. carbon traces.	▯	470.0	20		▼-41.0	
		sand slightly. cemented. dk grey breaks in horizontal planes. siltstone.					WAITEMATA SERIES ROCK	
55	LOST							
		siltstone. carbon traces.	▯	695.0	18			
60		sand silty. cemented. dk grey	▯	33.0	24			
		END OF BORE					▼-53.0	

BH_TT66665

801_BH12

BORE 12 64



DEPTH	SYMBOL	BORE 12 64	SAMPLE	COMPRESSIVE STRENGTH P.S.I.	NATURAL MOISTURE CONTENT %	BULK DENSITY P.C.F.	REDUCED LEVEL
		bitumen paving.					▼8.0
		gravel scor a. 2"φ					
		some clay fill.					
5							
		clay fill soft medium yellow brown grey.					
10							
		siltstone inclusions					FILL
		wood inclusions					
15							
							▼-10.0
20		sand silty compact dk grey shell inclusions					
		. . greenish tinge					
25		silt clayey soft dk grey	[]	7.0	36		
		sand silty compact grey					
		silt clayey firm grey					
		sand silty compact. grey intact	[]	14.0	28	83	WAITEMATA SERIES SOIL
30							
		silt clayey stiff more cemented with depth					
		sandstone					
35		sand cemented breaks on horizontal planes					
		. . . .	[]	24.0	24		
			[]	85.0	—		
		. . . .					
40		silt well cemented carbon traces					
		sand cemented breaks on horiz planes					
		. . . .					
							▼-36.0
45							
		siltstone grey	[]	513.0	19	128	WAITEMATA SERIES ROCK
50							
		sand cemented dk grey breaks on horizontal planes	[]	626.0	21		
		siltstone					
55		sand silty compact dk grey					
		siltstone	[]	410.0	19	126	
		sand cemented, dk grey carbon traces					
60		siltstone					
		END OF BORE					▼-53.0

BH_64335

BH_TT66657

BH_64327

TONKIN & TAYLOR LTD.

D/Base N° 88

BOREHOLE LOG

BOREHOLE NO 3
SHEET 1 OF 2

PROJECT: Lower Hobson St. Bridge
LOCATION: Lower Hobson St.
JOB NO: 8676
CO-ORDINATES: See Dwg 8676-1
DRILL TYPE: Mayhew 250
DRILL METHOD: Open-barrel HMLC
DRILL FLUID: Water
RL: 3.90m
DATUM: L & S
HOLE STARTED: 16/7/88
HOLE FINISHED: 16/7/88
DRILLED BY: Drillwell Ltd
LOGGED BY MH
CHECKED BY: CJF

Core recovery	Method/casing	Samples, tests	Depth (m)	Engineering description (soil name, plasticity or particle size characteristics, colour, secondary and minor components)	Shear strength or relative density	Estimated shear strength, kPa	Geological (origin type, mineral composition, defects, structure)	Unit
0	WASH		0–1.0	NO CORE : Cuttings are GRAVELS (Basecourse?) 1.0m ? ——— ? ———				
100 100 100		• 96kPa *LV • 121kPa	1.0–3.0	CLAY, silty, yellow-brown and grey mottles, some pockets of SILT - some pieces of mudstone & sandstone h.w. ≯ 50mm	St - Vst		FILL fine texture	FILL
100 100 100 100	OPEN BARREL	• Too Hard • Too Hard • Too Hard • Too Hard	3.0–5.2	Matrix of ROCK (80%) and SOIL (20%) Rock is sandstone and mudstone, HW, weakly cemented. Soil is SILT and CLAY yellow-brown mottles	Extremely Low (Rock)	N/A	FILL Rock and Silt	FILL
100 0 100 100 100		N=5 N=5	5.2–8.3	SAND (fine), dark grey, some sea shells - grades silty, some bands of SAND, clayey, silty - grades clayey	VL-L	N/A	Marine Sediments	KAIHU GROUP
30			8.3–10.0	CLAY, plastic, lt grey-brown, some dk brown mottles minor silt	S - F?			KAIHU GROUP
			10.0	Rock and soil (PTO)				

BH_TT66657

D/Base N° 88

TONKIN & TAYLOR LTD.

BOREHOLE LOG

BOREHOLE NO 3

SHEET 2 OF 2

PROJECT: Lower Hobson St Bridge
LOCATION: Lower Hobson St
JOB NO: 8676
CO-ORDINATES: See Dwg 8676-1
DRILL TYPE: Mayhew 250
DRILL METHOD: Open-barrel HMLC
HOLE STARTED: 16/7/88
HOLE FINISHED: 16/7/88
RL: 3.90m
DATUM: L & S
DRILL FLUID: Water
DRILLED BY: Drillwell Ltd
LOGGED BY MH
CHECKED BY: CJF

DRILLING AND TESTS							ENGINEERING DESCRIPTION					GEOLOGICAL	
FLUID LOSS	WATER	CORE RECOVERY	METHOD/CASING	SAMPLES, TESTS	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION	SHEAR STRENGTH OR RELATIVE DENSITY	ESTIMATED SHEAR STRENGTH, kPa	ORIGIN TYPE, MINERAL COMPOSITION, DEFECTS, STRUCTURE	UNIT
		100		N=70+					NO CORE : SOIL?					
		66		* UC		11.0			ROCK and SOIL : Rock is interbedded SANDSTONE and MUDSTONE, SW., weakly to moderately cemented, dk grey Soil is SAND (fine) dk grey, silty.		Ext. Low - Very Low Strength (ROCK)	N/A	ROCK and SOIL	Waitemata Group Formation
		0		N=100+		12.0								
		100				13.0								
		100		N=100+		14.0								
		100				15.0								
		100		N=100+		16.0								
									End of Borehole @ 16.1m					

BH_64327

BH_66381 ARTP76

NEW ZEALAND GEOLOGICAL SURVEY

LOG OF DRILL HOLE

HOLE No. ART 43

PROJECT Auckland Rapid Transit FEATURE tunnel alignment LOCATION Customs St West

GRID REF. M.O.W. CO-ORD 703810.6N 299896.4E DATUM L & S RL GROUND 3.73m

ANGLE FROM HORIZONTAL 90° DIRECTION PHOTO FILE No. COLLAR

DESCRIPTION OF CORE: FORMATION NAME, ROCK TYPE, DESCRIPTION OF CORE | SW MW HW CW weathering | VH H MH M S VS hardness | R.L. M DEPTH | GRAPHIC LOG | LIFT & CORE LOSS % 5 10 50 | STRUCTURES: JOINTS; VEINS; SEAMS; SHATTER; SHEAR & CRUSH ZONES; FOLIATION; SCHISTOSITY; LINEATIONS. | FRACTURE LOG 1 10 20 10^2 | R.Q.D. | POINT LOAD TEST (kPa) | WATER LEVEL DATE | DRILL WATER LOSS % 0-100 | WATER PRESSURE TESTS LUGEONS 20 40 60 80

FILL

concrete pavement

fill, stiff clays and weathered Waitemata Gp sands

basalt sand layer

Fe stained sands and silts, occ corestones of sandst and siltst

well cem sst frags

Fe stained

MARINE SANDS

grey/green marine sands with numerous shell frag

sands loose

WAITEMATA GROUP

stiff grey clays

interb uncem sands

f sands grad to med sst poorly cemented

interb w siltst

f sst gr to med sst rel uncemented

siltst with concr layer

rel well cem f sst interb siltst

f sst gr to med sst with interb siltst

med and f sst well cem siltst

f sst grad to med sst

siltst with thin layers of f sst

f sst with siltst lenses

siltstone

fine sandstone grading to coarse sst mod cem

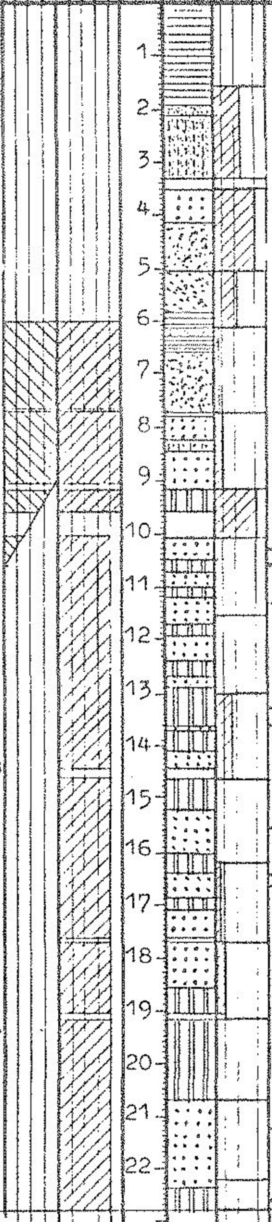
siltst with interb cem f sst

med sst gr to c sst, mod cem

siltstone in thick layer

fine sandstone

grad to c sandstone



STRUCTURES

tube sample

soft material washed by drilling

fractures at 70° in clay

2 jts partly cem dip 60° and 70°

bedding horizontal

fracture in sandstone dips 70° v rough surface

bedding dips 20°

bedding dips 30°

R.Q.D.

79

91

87

54

70

82

100

77

27

WEATHERING
UW Unweathered
SW Slightly Weathered
MW Moderately Weathered
HW Highly Weathered
CW Completely Weathered

HARDNESS
VH Very Hard
H Hard
MH Moderately Hard
M Medium
S Soft
VS Very Soft

1 10 20 10^2 10^3 – nat fractures/m of core

COMMENTS

←— grinding of core

ENGINEERING GEOLOGY SECTION

LOGGED I. R. Brown
DATE 28/5/74
TRACED B. R.
CHECKED
LENGTH 22.86m.

DRILLED G. Hadfiel
DATE 16-17/5/7
DRILL Acker
CORE BOXES

Tonkin+Taylor

BOREHOLE LOG

BOREHOLE No.: BH01

SHEET: 1 OF 3

DRILLED BY: Lei
LOGGED BY: JELE
CHECKED: CRB
START DATE: 05/09/2020
FINISH DATE: 05/09/2020
CONTRACTOR: McMillan Drilling

PROJECT: Downtown Car Park
JOB No.: 1012134.1000
LOCATION: 31 Customs Street West, Auckland

CO-ORDINATES: (NZTM2000) 5920984.16 mN 1757327.82 mE
DIRECTION:
ANGLE FROM HORIZ.: -90°

R.L. GROUND:
R.L. COLLAR:
DATUM:
SURVEY: GIS\Web map viewer

GEOLOGICAL UNIT	DESCRIPTION OF CORE SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation	Sampling Method	Core Recovery (%)	Depth (m)	RL (m)
Fill	CONCRETE: 0.00 - 0.15m	HVAC	0	0.0 - 0.15	5
	HYDRO-EXCAVATION (NO RECOVERY): 0.15 - 2.00 m Sandy GRAVEL [INFERRED].			0.5, 1.0, 1.5	4
	2.00 - 2.10 m: Clayey SILT with minor gravel; brown. Firm, moist, low plasticity. Gravel: angular, medium.	HQTT	100	2.0	3
	2.20 - 3.30 m: Silty CLAY with minor gravel; brown. Firm, moist, medium to high plasticity. Gravel: fine to medium.			2.5, 3.0	2
	3.30 - 3.60 m: Silty fine SAND; grey. Moist, well graded.			3.5	
	3.60 - 4.00 m: Silty CLAY; brownish grey. Soft to firm, moist, medium to high plasticity.	HQTT	66	4.0	1
	4.00 - 4.50 m: Core loss.			4.5	

Column headings: Rock Weathering (UW SW MW HW CW); Rock Strength (ES VS S MS W VW EW); Sampling Method; Core Recovery (%); Testing; RL (m); Depth (m); Graphic Log; ROCK DEFECTS: Defect Log; Fracture Spacing (mm) (2000 600 200 60 20); RQD (%); Description & Additional Observations; Fluid Loss (%) (25 50 75); Water Level; Casing; Installation; Core Box No

Water Level: ▼ 05/09/2020

COMMENTS: Water level inferred at 2.65m b.g.l. by driller.

Hole Depth
10.5m

2020_BH01

Tonkin+Taylor

BOREHOLE LOG

BOREHOLE No.: BH01

SHEET: 2 OF 3

PROJECT: Downtown Car Park
JOB No.: 1012134.1000
LOCATION: 31 Customs Street West, Auckland

CO-ORDINATES: (NZTM2000) 5920984.16 mN 1757327.82 mE
DIRECTION:
ANGLE FROM HORIZ.: -90°

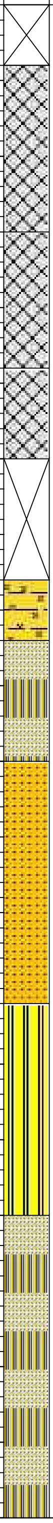
R.L. GROUND:
R.L. COLLAR:
DATUM:
SURVEY: GIS\Web map viewer

DRILLED BY: Lei
LOGGED BY: JELE
CHECKED: CRB
START DATE: 05/09/2020
FINISH DATE: 05/09/2020
CONTRACTOR: McMillan Drilling

DESCRIPTION OF CORE
SOIL: Classification, colour, consistency / density, moisture, plasticity
ROCK: Weathering, colour, fabric, name, strength, cementation

GEOLOGICAL UNIT	DESCRIPTION OF CORE	Sampling Method	Core Recovery (%)	Core Box No
Fill	5.20 - 5.75 m: Silty CLAY with minor sand; grey. Soft to firm, moist, medium to high plasticity. Sand: fine.	HQTT	86	Box 1, 0.0-6.1m
	5.75 - 6.00 m: Silty CLAY, light grey. Stiff, moist, medium plasticity. *6.00m:* Grades to soft to firm.			
	6.20 - 6.50 m: Silty CLAY with minor sand; brown. Firm, moist, low to medium plasticity. Sand: fine. *6.50m:* Trace of decomposed wood.			
East Coast Bays Formation	6.50 - 6.90 m: Core loss.	HQTT	73	Box 2, 6.1-8.8m
	6.90 - 7.10 m: Clayey SILT; grey. Very stiff, moist, low plasticity. (Moderately to highly weathered SILTSTONE)			
	7.10 - 7.50 m: Slightly to moderately weathered, grey, interbedded SILTSTONE and SANDSTONE. Extremely weak to very weak, weakly cemented, sub-horizontal.			
	7.50 - 8.30 m: Slightly to moderately weathered, grey, SANDSTONE. Very weak, weakly cemented, sub-horizontal.	HQTT	100	
	8.30 - 9.00 m: Unweathered to slightly weathered, grey, SILTSTONE. Very weak, weakly cemented, sub-horizontal.			
	9.00 - 10.50 m: Unweathered to slightly weathered, grey, interbedded SILTSTONE and SANDSTONE. Extremely weak to very weak, weakly cemented, sub-horizontal.			

Rock Weathering: UW SW MW HW CW
Rock Strength: ES VS S MS W VW EW
Testing
RL (m): 0, -1, -2, -3, -4
Depth (m): 5.5, 6.0, 6.5, 7.0, 7.5, 8.0, 8.5, 9.0, 9.5



ROCK DEFECTS
Defect Log
Fracture Spacing (mm): 2000 600 200 60 20
RQD (%)
Description & Additional Observations
Fluid Loss (%): 25 50 75
Water Level
Casing
Installation

COMMENTS: Water level inferred at 2.65m b.g.l. by driller.

Hole Depth 10.5m

SOURCE: NZGD

2020_BH01

Tonkin+Taylor

BOREHOLE LOG

BOREHOLE No.:

BH01

SHEET: 3 OF 3

DRILLED BY: Lei
LOGGED BY: JELE
CHECKED: CRB
START DATE: 05/09/2020
FINISH DATE: 05/09/2020
CONTRACTOR: McMillan Drilling

PROJECT: Downtown Car Park
JOB No.: 1012134.1000
LOCATION: 31 Customs Street West, Auckland

CO-ORDINATES: 5920984.16 mN
(NZTM2000) 1757327.82 mE
DIRECTION:
ANGLE FROM HORIZ.: -90°

R.L. GROUND:
R.L. COLLAR:
DATUM:
SURVEY: GIS\Web map viewer

GEOLOGICAL UNIT	DESCRIPTION OF CORE SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation	Rock Weathering UW SW MW HW CW	Rock Strength ES VS S MS W VW EW	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS Defect Log	Fracture Spacing (mm) 2000 600 200 60 20	RQD (%)	Description & Additional Observations	Fluid Loss (%) 25 50 75	Water Level	Casing	Installation	Core Box No
East Coast Bays Formation	9.00 - 10.50 m: Unweathered to slightly weathered, grey, interbedded SILTSTONE and SANDSTONE. Extremely weak to very weak, weakly cemented, sub-horizontal.			HQTT	100		-5											Box 3, 8.8-10.5m
	10.5m: END OF BOREHOLE					12/38 for 75mm **N>=50** Solid	-6 -7 -8 -9	10.5 11.0 11.5 12.0 12.5 13.0 13.5 14.0 14.5										

COMMENTS: Water level inferred at 2.65m b.g.l. by driller.

Hole Depth
10.5m

Tonkin+Taylor

CORE PHOTOS

BOREHOLE No.: **BH01**

SHEET: 1 OF 2

PROJECT: Downtown Car Park	LOCATION: 31 Customs Street West, Auckland	JOB No.: 1012134.1000
CO-ORDINATES: (NZTM2000) 5920984.16 mN 1757327.82 mE	DRILL TYPE:	HOLE STARTED: 05/09/2020 HOLE FINISHED: 05/09/2020 DRILLED BY: McMillan Drilling
R.L.:	DRILL METHOD: RC	
DATUM:		LOGGED BY: JELE CHECKED: CRB

0.00-6.10m

6.10-8.80m

Tonkin+Taylor

CORE PHOTOS

BOREHOLE No.: **BH01**

SHEET: 2 OF 2

PROJECT: Downtown Car Park
LOCATION: 31 Customs Street West, Auckland
JOB No.: 1012134.1000

CO-ORDINATES: (NZTM2000) 5920984.16 mN 1757327.82 mE
R.L.:
DATUM:

DRILL TYPE:
DRILL METHOD: RC

HOLE STARTED: 05/09/2020
HOLE FINISHED: 05/09/2020
DRILLED BY: McMillan Drilling
LOGGED BY: JELE
CHECKED: CRB


BORE NO: BH01
BOX NO: 3 OF 3
FROM 8.8 METRES TO 10.5 METRES

8.80-10.50m

SOURCE: NZGD

2020_BH02

Tonkin+Taylor

BOREHOLE LOG

BOREHOLE No.:
BH02
SHEET: 1 OF 3

DRILLED BY: Andrew. K
LOGGED BY: VELA
CHECKED: CRB
START DATE: 28/08/2020
FINISH DATE: 31/08/2020
CONTRACTOR: McMillan Drilling

PROJECT: Downtown Car Park
JOB No.: 1012134.1000
LOCATION: 31 Customs Street West, Auckland

CO-ORDINATES: (NZTM2000) 5921037.30 mN 1757320.80 mE
DIRECTION:
ANGLE FROM HORIZ.: -90°

R.L. GROUND:
R.L. COLLAR:
DATUM:
SURVEY: GIS\Web map viewer

GEOLOGICAL UNIT	DESCRIPTION OF CORE SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation	Rock Weathering UW SW MW HW CW	Rock Strength ES VS S MS W VW EW	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS: Defect Log	Fracture Spacing (mm) 2000 600 200 60 20	RQD (%)	Description & Additional Observations	Fluid Loss (%) 25 50 75	Water Level	Casing	Installation	Core Box No
Fill	CONCRETE: GL - 0.15m																	
	HYDRO-EXCAVATION (NO RECOVERY): 0.15 - 0.75m 0.15 - 0.22m: Dark brownish-black, fine to coarse, asphalt and greywacke GRAVEL with minor greywacke cobbles. 0.20 - 0.40m: Brown SAND with some silt. Moist. Sand is medium. 0.40 - 0.50m: Light brownish-grey CLAY 0.50 - 0.75m: Brown, fine to medium, SAND with sandstone fragments and basalt cobbles (sand is locally weakly cemented)			HVAC	0		4	0.5										
	SAND, some gravel; brown. Moist, poorly graded; sand, fine to medium; gravel, coarse, subangular, Brick, ceramic and concrete.			HA	100			1.0										
	Silty CLAY, minor gravel; brown. Soft to firm, moist, high plasticity; gravel, fine, subangular.																	
	GRAVEL, some silt, minor clay and sand; brown. Moist, well graded; gravel, fine to coarse, subangular to angular, Brick, concrete and scoria; sand, fine.			HQTT	17		3	1.5										
	CORE LOSS: 1.71 - 2.70m (Brick fragment caught in core barrel)							2.0 2.5										
	GRAVEL; grey and reddish brown. Poorly graded; gravel, medium to coarse, subangular to angular, Concrete, basalt and scoria.			HQTT	50		2									120mm PQ		
	Gravelly CLAY, some silt; dark grey. Soft, moist, high plasticity; gravel, fine to medium, subangular to angular, Brick, basalt and mudstone; Slight organic odour.					● 32/13 kPa		3.0										
	CORE LOSS: 3.20 - 3.70m (Concrete caught in core barrel driven into soft clay below)							3.5										
	GRAVEL & COBBLES; dark greyish-black. Poorly graded; gravel, coarse, subangular to angular, Basalt, cobbles, Basalt.			HQTT	30		1											
	CORE LOSS: 3.85 - 4.20m (Basalt cobble caught in core barrel)							4.0										
	GRAVEL & COBBLES, minor silt; dark greyish black. Poorly graded; gravel, coarse, subangular to angular, Basalt, cobbles, Basalt.			HQTT	54								*4.20 - 4.70m:* Slow drilling progress due to basalt					
	CORE LOSS: 4.47 - 4.70m							4.5										
Marine Sediments	SILT, minor sand and clay; light greenish-grey. Very soft to soft, moist, low plasticity; sand, fine; Inclusions of shell fragments.						0											

COMMENTS: Hydro-excavation undertaken to 0.75m depth. Crew switched to hand auger to between 0.75m and 1.5m depth.Fill encountered between 8.5 - 9.05 m may be buttress fill placed at the time of the old seawall construction.

Hole Depth
11.75m

Scale 1:25

Tonkin+Taylor

BOREHOLE LOG

BOREHOLE No.: BH02

SHEET: 2 OF 3

DRILLED BY: Andrew. K
LOGGED BY: VELA
CHECKED: CRB
START DATE: 28/08/2020
FINISH DATE: 31/08/2020
CONTRACTOR: McMillan Drilling

PROJECT: Downtown Car Park
JOB No.: 1012134.1000
LOCATION: 31 Customs Street West, Auckland

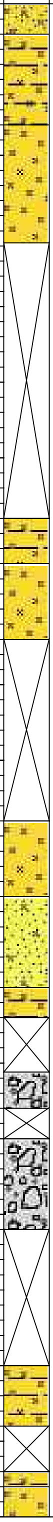
CO-ORDINATES: (NZTM2000) 5921037.30 mN 1757320.80 mE
DIRECTION:
ANGLE FROM HORIZ.: -90°

R.L. GROUND:
R.L. COLLAR:
DATUM:
SURVEY: GIS\Web map viewer

GEOLOGICAL UNIT	DESCRIPTION OF CORE SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation
Marine Sediments	Sandy SILT, trace clay; grey. Very soft to soft, moist, dilatant; sand, fine; Abundant inclusions of shell fragments.
	Clayey SILT; grey. Soft, moist, medium plasticity.
	SILT, minor sand, trace clay; grey. Very soft to soft, moist, dilatant; sand, fine; Inclusions of shell fragments.
	CORE LOSS: 5.79 - 6.70m
	Clayey SILT; greyish-brown. Soft, moist, low plasticity.
	SILT, minor sand, trace clay; grey. Very soft to soft, wet, dilatant; sand, fine; Inclusions of shell fragments.
	CORE LOSS: 7.10 - 7.70m
	SILT, some clay, minor sand; grey. Very soft to soft, wet; sand, fine; Inclusions of shell fragments.
	Silty SAND, trace clay; grey. Moist, dilatant. sand, fine; Inclusions of shell fragments.
	Clayey SILT; grey. Soft, moist, low plasticity.
	CORE LOSS: 8.35 - 8.53m
Fill	Gravelly COBBLES; dark grey and red. Loose, moist, poorly graded; cobbles, highly weathered to moderately weathered, basalt; gravel, medium to coarse, subangular, highly weathered to moderately weathered, basalt.
	CORE LOSS: 8.65 - 8.75
	Gravelly COBBLES (as above)
Marine Sediments	CORE LOSS: 9.05 - 9.50
	Clayey SILT, minor sand; grey. Very soft, wet, non-plastic; sand, fine to coarse, shell and volcanic.
	CORE LOSS: 9.70 - 9.85
East Coast Bays For...	Clayey SILT, minor sand (as above)

Sampling Method	Core Recovery (%)	Testing
HQTT	100	● 8/2 kPa
HQTT	9	
HQTT	40	● 0/0 kPa Sample turning in core barrel
HQTT	80	
HQTT	58	
HQTT	35	

Rock Weathering: UW SW MW HW CW
Rock Strength: ES VS S MS W VW EW
RL (m): -1, -2, -3, -4, -5
Depth (m): 5.5, 6.0, 6.5, 7.0, 7.5, 8.0, 8.5, 9.0, 9.5



ROCK DEFECTS: Defect Log | Fracture Spacing (mm) 2000 600 200 60 20 | RQD (%) | Description & Additional Observations
Fluid Loss (%) 25 50 75 | Water Level | Casing | Installation | Core Box No

Core Box No: Box 1, 0.0-7.7m

COMMENTS: Hydro-excavation undertaken to 0.75m depth. Crew switched to hand auger to between 0.75m and 1.5m depth.Fill encountered between 8.5 - 9.05 m may be buttress fill placed at the time of the old seawall construction.

Hole Depth
11.75m

2020_BH02

BOREHOLE LOG

BOREHOLE No.: BH02

SHEET: 3 OF 3

PROJECT:	Downtown Car Park
JOB No.:	1012134.1000
LOCATION:	31 Customs Street West, Auckland
CO-ORDINATES (NZTM2000):	5921037.30 mN 1757320.80 mE
DIRECTION:	
ANGLE FROM HORIZ.:	-90°
R.L. GROUND:	
R.L. COLLAR:	
DATUM:	
SURVEY:	GIS\Web map viewer
DRILLED BY:	Andrew. K
LOGGED BY:	VELA
CHECKED:	CRB
START DATE:	28/08/2020
FINISH DATE:	31/08/2020
CONTRACTOR:	McMillan Drilling

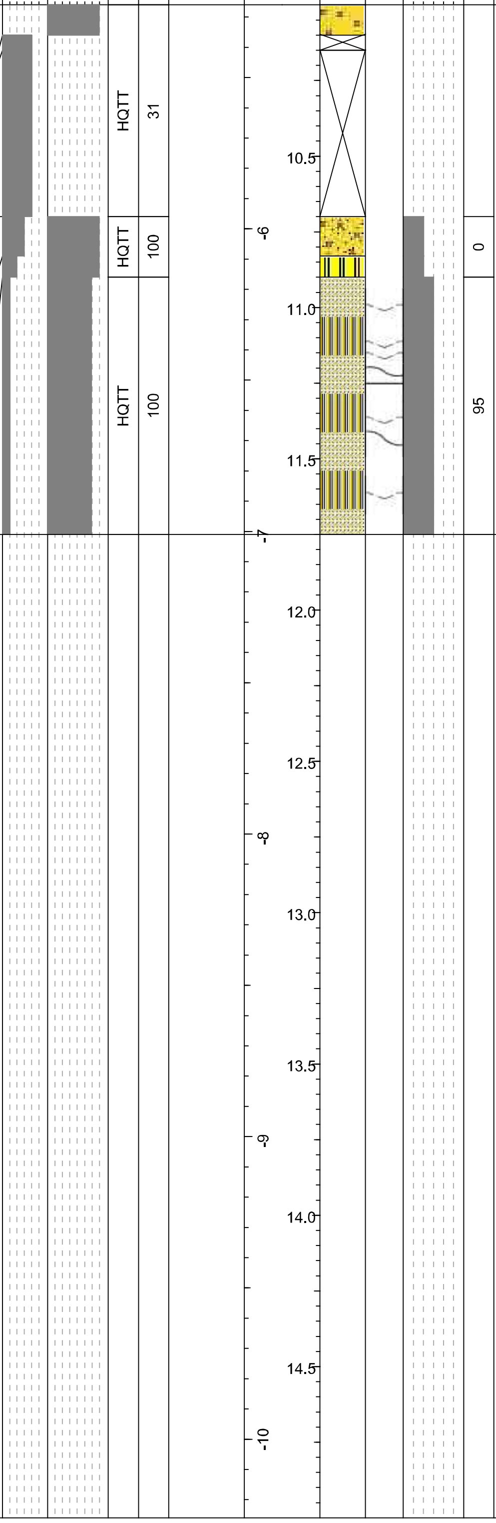
DESCRIPTION OF CORE

SOIL: Classification, colour, consistency / density, moisture, plasticity

ROCK: Weathering, colour, fabric, name, strength, cementation

GEOLOGICAL UNIT	DESCRIPTION OF CORE	Sampling Method	Core Recovery (%)	RQD (%)	ROCK DEFECTS Description & Additional Observations	Core Box No
East Coast Bays Formation	Highly weathered, grey, SILTSTONE. Extremely Weak, Recovered as (SILT with minor clay and trace sand, grey. Stiff to very stiff, wet to moist, low plasticity. Sand; fine.). CORE LOSS: 10.15 - 10.70 (Due to basalt cobble being caught in barrel.	HQTT	31			Box 2, 7.7-11.8m
	Moderately weathered, grey, SILTSTONE. Extremely Weak, Recovered as (SILT with some sand and minor clay, grey. Very stiff, moist, non plastic. Sand; fine.).	HQTT	100	0		
	Slightly weathered, grey speckled white, SANDSTONE. Extremely Weak, sub-horizontal, moderately cemented, Recovered as (SAND, with minor silt and clay, grey speckled white. Dense, moist, poorly graded.). Unweathered, grey, SANDSTONE. Very Weak, sub-horizontal. - INTERBEDDED WITH - Unweathered, grey, SILTSTONE. Very Weak, sub-horizontal, moderately thick.	HQTT	100	95	11.00m: DD 11.12m: DD 11.16m: DD 11.21m: J, 15° dip, PL, SM, VN 11.25m: BF, 0° dip, PL, SM 11.37m: DD 11.43m: J, 25° dip, PL, R, VN, VE(Silt) 11.62m: DD	

11.75m: END OF BOREHOLE



COMMENTS: Hydro-excavation undertaken to 0.75m depth. Crew switched to hand auger to between 0.75m and 1.5m depth. Fill encountered between 8.5 - 9.05 m may be buttress fill placed at the time of the old seawall construction.

Hole Depth
11.75m

CORE PHOTOS

BOREHOLE No.: **BH02**

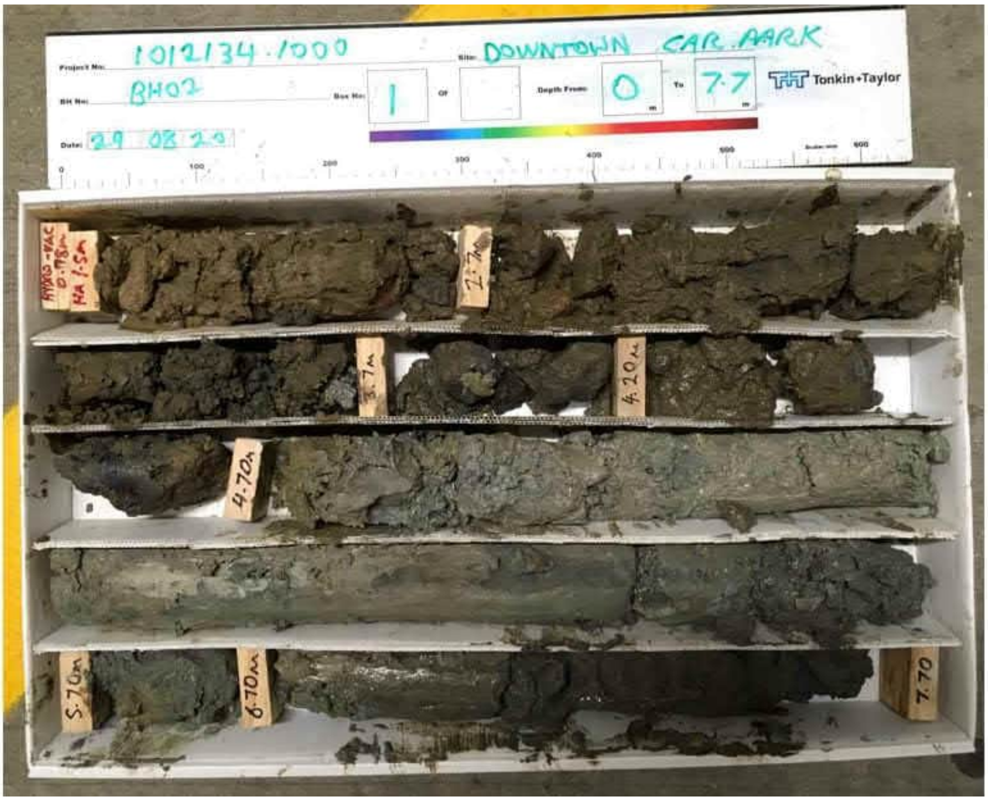
SHEET: 1 OF 1

PROJECT: Downtown Car Park
LOCATION: 31 Customs Street West, Auckland
JOB No.: 1012134.1000

CO-ORDINATES: (NZTM2000) 5921037.30 mN 1757320.80 mE
R.L.:
DATUM:

DRILL TYPE: Portable
DRILL METHOD: RC

HOLE STARTED: 28/08/2020
HOLE FINISHED: 31/08/2020
DRILLED BY: McMillan Drilling
LOGGED BY: VELA
CHECKED: CRB



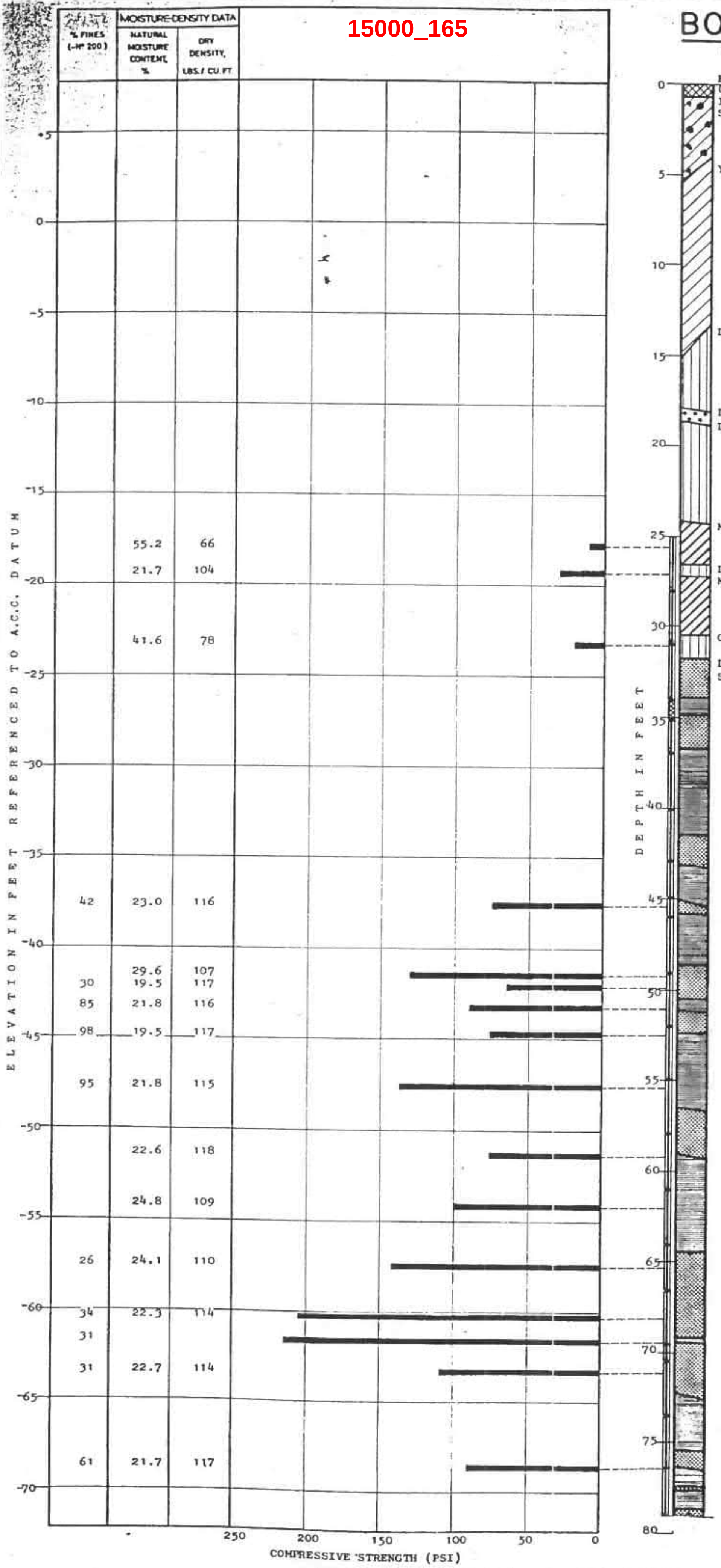
0.00-7.70m

7.70-11.75m

General Log - 4/11/2020 9:21:24 AM - Produced with Core-GS by GeRoc

15000_165

BORING 22



% FINES (-Nº 200)	MOISTURE-DENSITY DATA	
	NATURAL MOISTURE CONTENT, %	DRY DENSITY, LBS./ CU.FT
	55.2	66
	21.7	104
	41.6	78
42	23.0	116
	29.6	107
30	19.5	117
85	21.8	116
98	19.5	117
95	21.8	115
	22.6	118
	24.8	109
26	24.1	110
34	22.3	114
31		
31	22.7	114
61	21.7	117

Elevation +7.8 feet

Concrete Slab

Intermixed fill - CLAY, gravel-size SCORIA with random broken brick & concrete

Yellowish-brown SANDY CLAY (CL)
(moderately firm)

Dark grey SANDY SILT (ML)
(soft to moderately firm)

Dark grey fine SAND (SP) (loose, 30% shell)

FILL

Dark grey SANDY SILT (ML)
(moderately firm, up to 25% shell)
(random traces of angular, gravel-size BASALT)

Mottled dark brown & grey CLAY (CH)
(soft, compressible)

Dark grey SILT (ML) (firm)

Mottled yellow & grey SILTY CLAY (CH)
(soft)
(grades light grey)

Greenish-grey SANDY SILT (ML)
(firm)

DARK GREY, VARIABLY CEMENTED, ALTERNATING SILTSTONES & SANDSTONES - WEAK ROCK

(18-inch lens - strongly fractured)

WAITEMATA SERIES

(20-inch lens - fractured, poorly cemented)

(6-inch lens - very strongly cemented)

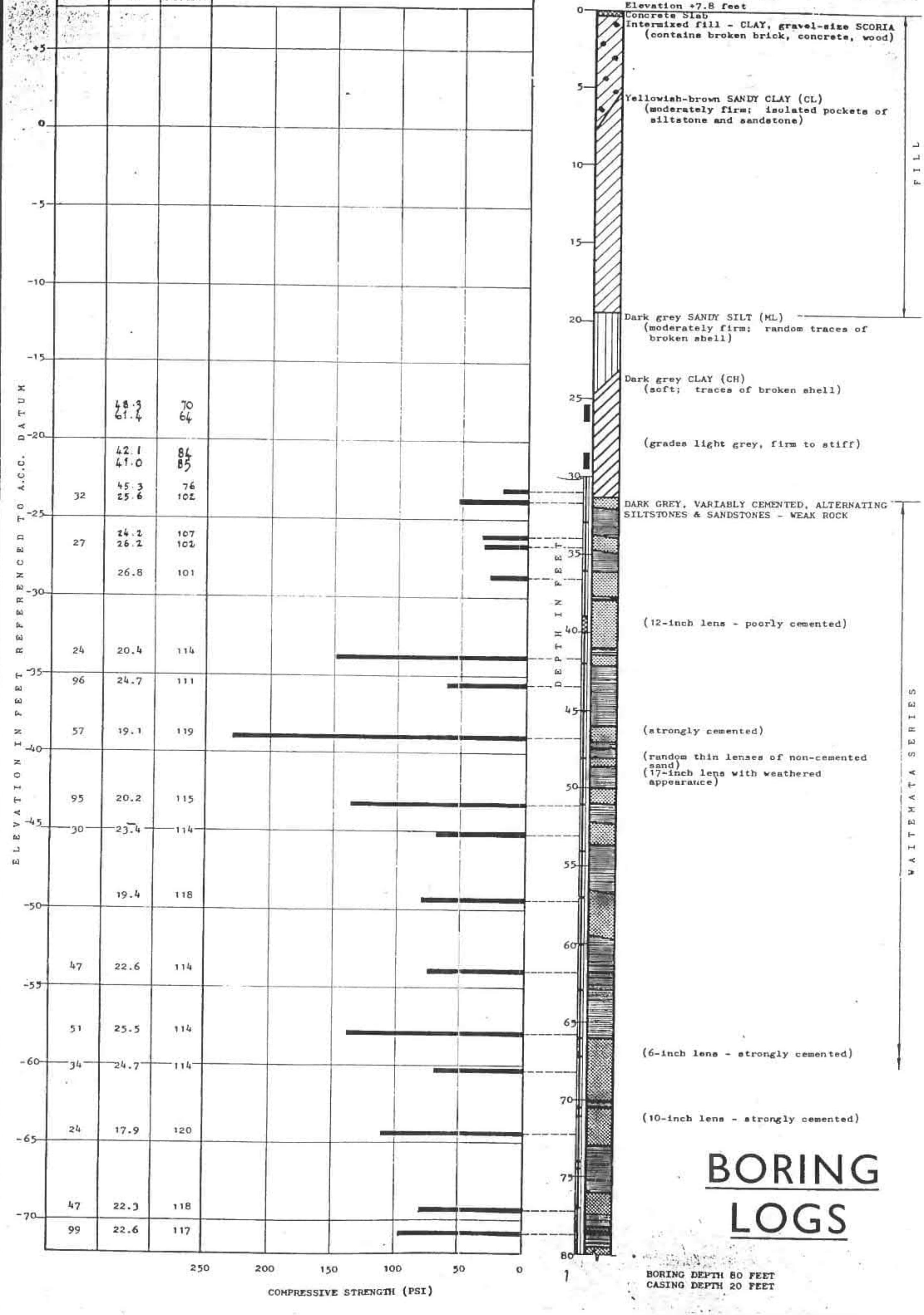
(3-foot stratum - fractured)

BORING DEPTH 79 FEET
CASING DEPTH 40 FEET

BORING LOGS

BRICKELL, MOSS, RANKINE & HILL

BORING 23



% FINES (-Nº 200)	MOISTURE-DENSITY DATA	
	NATURAL MOISTURE CONTENT, %	DRY DENSITY, LBS./CU.FT
	48.3	70
	61.4	64
	42.1	84
	41.0	85
	45.3	76
32	25.6	102
27	24.2	107
	26.2	102
	26.8	101
24	20.4	114
96	24.7	111
57	19.1	119
95	20.2	115
30	23.4	114
	19.4	118
47	22.6	114
51	25.5	114
34	24.7	114
24	17.9	120
47	22.3	118
99	22.6	117

Elevation +7.8 feet

Concrete Slab

Intermixed fill - CLAY, gravel-size SCORIA
(contains broken brick, concrete, wood)

Yellowish-brown SANDY CLAY (CL)
(moderately firm; isolated pockets of siltstone and sandstone)

Dark grey SANDY SILT (ML)
(moderately firm; random traces of broken shell)

Dark grey CLAY (CH)
(soft; traces of broken shell)

(grades light grey, firm to stiff)

DARK GREY, VARIABLY CEMENTED, ALTERNATING SILTSTONES & SANDSTONES - WEAK ROCK

(12-inch lens - poorly cemented)

(strongly cemented)

(random thin lenses of non-cemented sand)
(17-inch lens with weathered appearance)

(6-inch lens - strongly cemented)

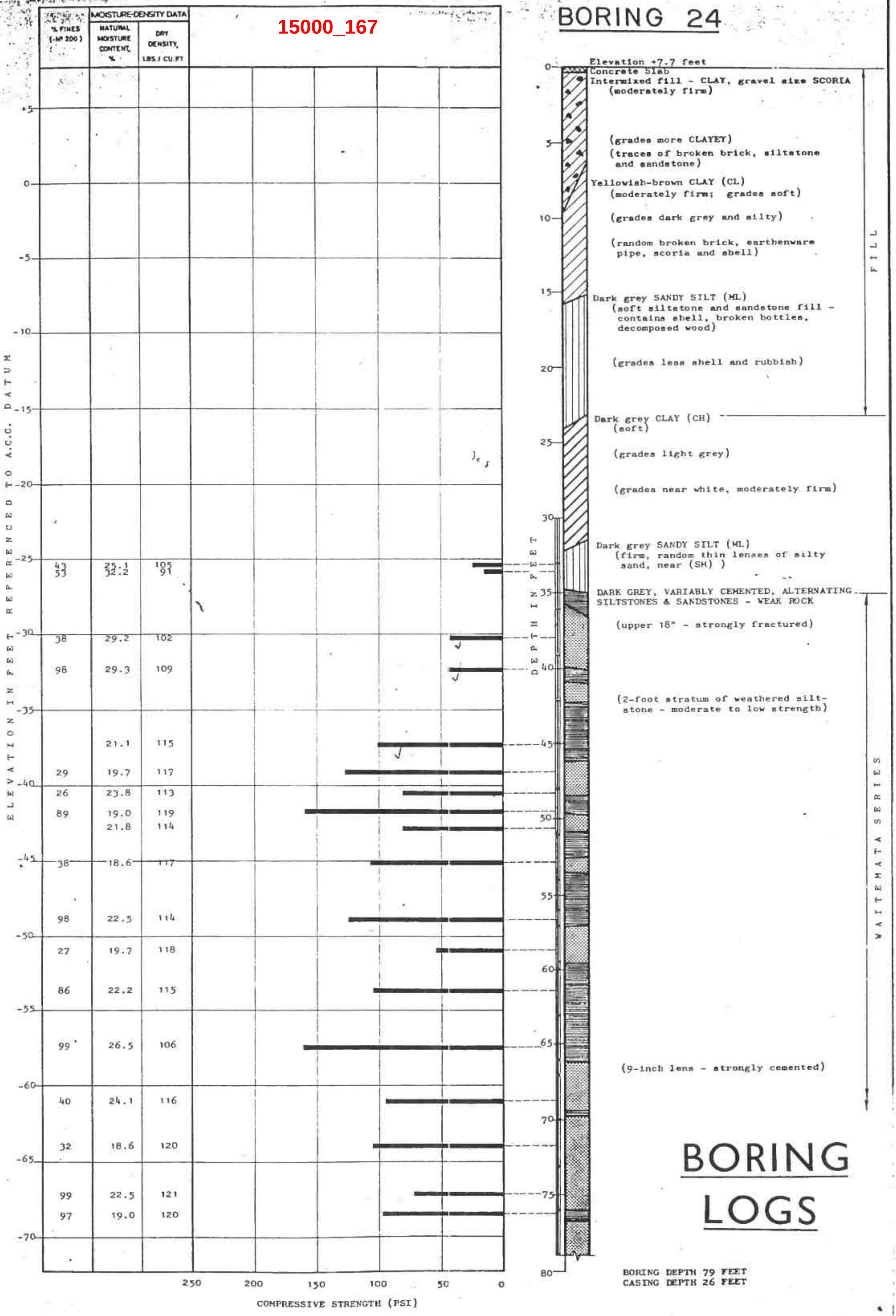
(10-inch lens - strongly cemented)

BORING LOGS

BORING DEPTH 80 FEET
CASING DEPTH 20 FEET

BRICKELL, MOSS, RANKINE & HILL

BORING 24



% FINES (-Nº 200)	MOISTURE-DENSITY DATA	
	NATURAL MOISTURE CONTENT, %	DRY DENSITY, LBS / CU.FT
43	25.1	105
53	32.2	91
38	29.2	102
98	29.3	109
	21.1	115
29	19.7	117
26	23.8	113
89	19.0	119
	21.8	114
38	18.6	117
98	22.5	114
27	19.7	118
86	22.2	115
99	26.5	106
40	24.1	116
32	18.6	120
99	22.5	121
97	19.0	120

Elevation +7.7 feet

Concrete Slab

Intermixed fill - CLAY, gravel size SCORIA
(moderately firm)

(grades more CLAYEY)

(traces of broken brick, siltstone and sandstone)

Yellowish-brown CLAY (CL)
(moderately firm; grades soft)

(grades dark grey and silty)

(random broken brick, earthenware pipe, scoria and shell)

Dark grey SANDY SILT (ML)
(soft siltstone and sandstone fill - contains shell, broken bottles, decomposed wood)

(grades less shell and rubbish)

Dark grey CLAY (CH)
(soft)

(grades light grey)

(grades near white, moderately firm)

Dark grey SANDY SILT (ML)
(firm, random thin lenses of silty sand, near (SM))

DARK GREY, VARIABLY CEMENTED, ALTERNATING SILTSTONES & SANDSTONES - WEAK ROCK

(upper 18" - strongly fractured)

(2-foot stratum of weathered siltstone - moderate to low strength)

(9-inch lens - strongly cemented)

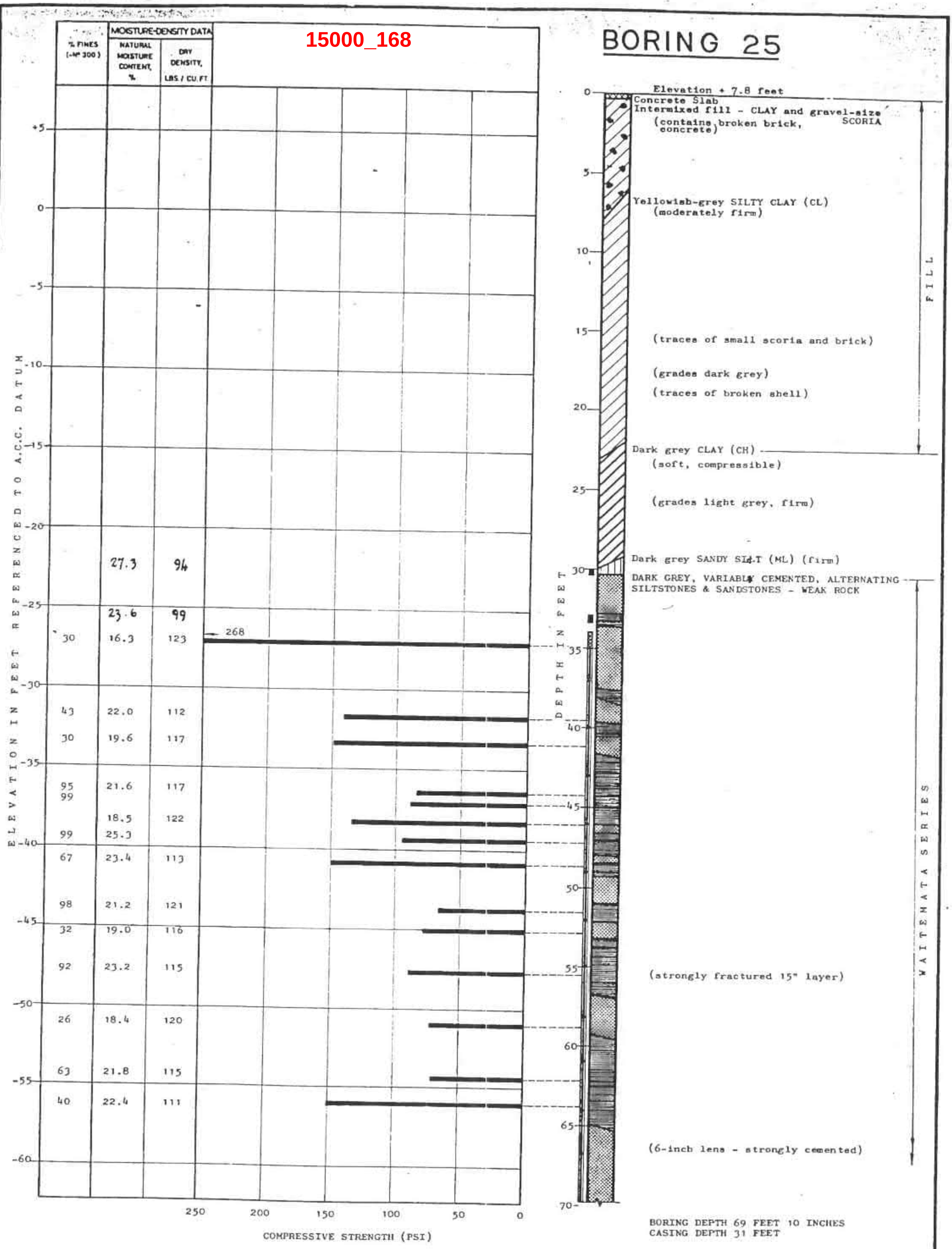
BORING LOGS

BORING DEPTH 79 FEET
CASING DEPTH 26 FEET

BRICKELL, MOSS, RANKINE & HILL

15000_168

BORING 25



% FINES (-Nº 300)	MOISTURE-DENSITY DATA NATURAL MOISTURE CONTENT, %	MOISTURE-DENSITY DATA DRY DENSITY, LBS / CU. FT
	27.3	94
	23.6	99
30	16.3	123
43	22.0	112
30	19.6	117
95 99	21.6	117
	18.5	122
99	25.3	
67	23.4	113
98	21.2	121
32	19.0	116
92	23.2	115
26	18.4	120
63	21.8	115
40	22.4	111

Elevation + 7.8 feet

Concrete Slab

Intermixed fill - CLAY and gravel-size SCORIA (contains broken brick, concrete)

Yellowish-grey SILTY CLAY (CL) (moderately firm)

(traces of small scoria and brick)

(grades dark grey)

(traces of broken shell)

Dark grey CLAY (CH) (soft, compressible)

(grades light grey, firm)

Dark grey SANDY SILT (ML) (firm)

DARK GREY, VARIABLY CEMENTED, ALTERNATING SILTSTONES & SANDSTONES - WEAK ROCK

(strongly fractured 15" layer)

(6-inch lens - strongly cemented)

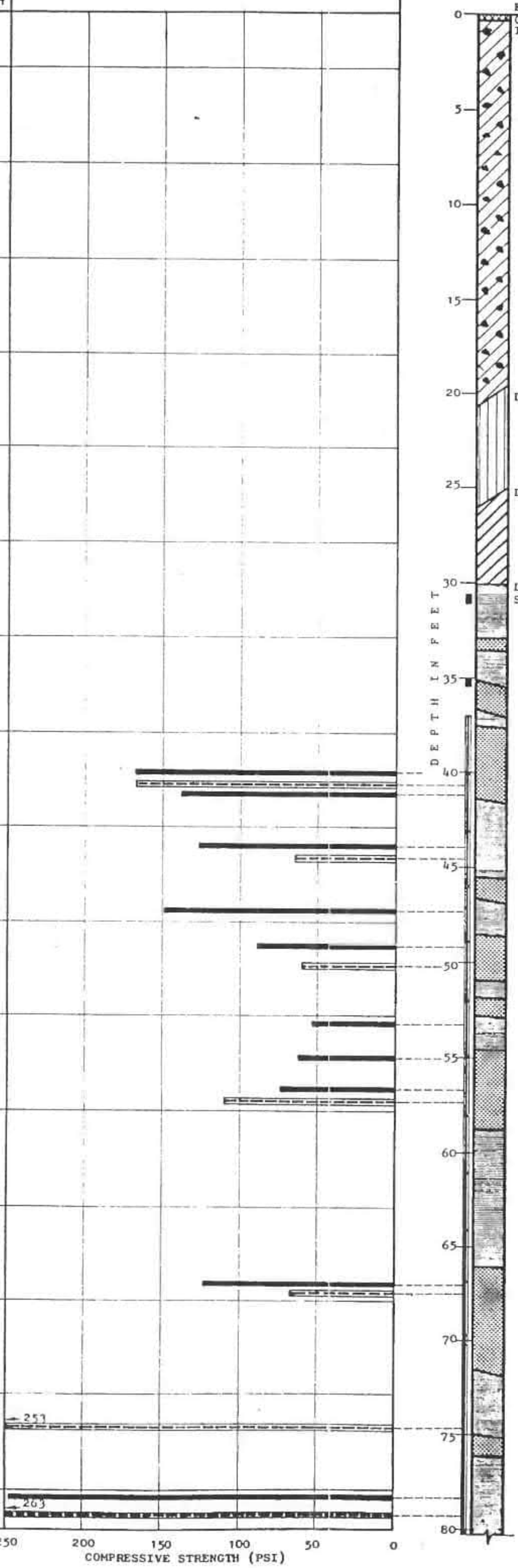
BORING DEPTH 69 FEET 10 INCHES
CASING DEPTH 31 FEET

BORING LOGS

15000_169

BORING 26

% FINES (-Nº 200)	MOISTURE-DENSITY DATA NATURAL MOISTURE CONTENT, %	DRY DENSITY, LBS / CU FT
	28 5	96
	23 2	101
35	21.7	114
33	18.2	118
83	20.0	120
56	17.1	125
33	19.5	116
99	20.2	118
25	19.0	117
28	19.2	118
36	22.0	112



Elevation +7.9 feet

Concrete Slab

Intermixed fill - CLAY and gravel-size SCORIA

(traces of decomposed timber)

(random pockets of reddish-brown SILT (ML)

FILL

Dark-grey SANDY SILT (ML) - (moderately firm - traces of broken shell, grades CLAYEY)

Dark grey CLAY (CH) (soft, compressible)

(grades light grey, firm)

(grades SANDY, near (CL))

DARK GREY, VARIABLY CEMENTED, ALTERNATING SILTSTONES & SANDSTONES - WEAK ROCK

(6-inch lens - strongly cemented)

(12-inch lens - strongly cemented)

WAITEMATA SERIES

BORING DEPTH 80 FEET 2 INCHES
CASING DEPTH 34 FEET

BORING LOGS

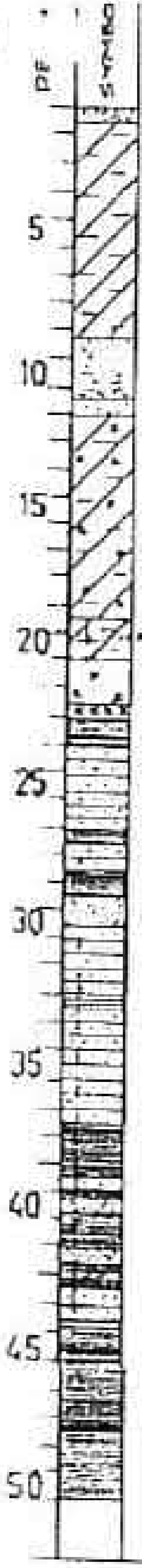
BRICKELL, MOSS, RANKINE & HILL

801_BH13

BH_TT66666

BH_64336

13 ·5



	SAM	COMP STRE P.S.I.	NATURAL MOISTURE CONTENT	BULK DENS P.C.F.	REDUCED LEVELS
concrete					11·5
clay fill medium grey greenish tinge					
" med firm yellow brown					
" grey softer with depth					
" greenish grey soft					
sand cemented fill greenish grey					
clay sand and silt fill grey					
sandstone lumps & siltstone grey					
clay sand & cemented silt grey some yellow brown mottled					FILL
clay, fill, soft pale grey					-9·5'
sand silty soft dk grey some broken shell					
silt clayey firm carbon traces					-11·5
siltstone					
sandstone hard grey	▯	4540	20	121	
siltstone					
sandstone					
siltstone hard	▯	5770	22	122	
sand silty cemented dk grey					
sandstone					WAITEMATA SERIES ROCK
coarser thin layers					
siltstone					
sandstone dk grey	▯	4000	17	122	
horizontal discs					
coarser					
siltstone	▯	4750	15	130	
sandstone					
sand cemented dk grey					
siltstone					
sand cemented dk-grey	▯	4720	10	120	
siltstone					
sandstone soft horiz discs					
siltstone					
	▯	6700	18	130	
END OF BORE					-40·5

801_BH14

BH_TT66667

BH_64337

DEPTH	BORE 14 66	SAMPLE	COMPRESSIVE STRENGTH P.S.I.	NATURAL MOISTURE CONTENT (%)	BULK DENSITY P.C.F.	REDUCED LEVELS
	concrete					▼ 0.5
	scoria & gravel up to 2"φ					
5	clay fill. med firm yellow brown ditto. grey to dk grey.					
	sand silty fill grey soft dk grey.					
10	clay silty fill yellow brown & grey med. firm					FILL
	occasional cemented silt inclusions.					
15	silt cemented clay fill yellow brown, soft					▼-7.5
	sand silty compact dk grey broken shell inclusions					
20	sandstone siltstone sandstone carbon traces					▼-10.0
	LOST					
25	siltstone sandstone sand silty compact dk grey					
	sandstone	⌷	280·0	23		
30	sand silty compact dk grey. sandstone	⌷	3790	20	121	
	siltstone sandstone, carbon traces.	⌷	647·0	14		
35	siltstone sandstone dk grey	⌷	564·0	23		
	siltstone sand silty cemented broken in horz, discs sandstone siltstone sandstone					WAITEMATA SERIES
40	siltstone carbon traces	⌷	820·0	19		
45	sand silty. cemented. dk. grey breaks in horizontal discs.					
	siltstone	⌷	482·0	21		
	sand silty cemented dk grey breaks on horizontal discs					
50	sandstone siltstone carbon traces. sandstone siltstone					
	sand silty. cemented. grey breaks on horizontal discs.	⌷	11·0	24		
55	END OF BORE					▼-46.5

RL to 445 Datum

3.75

801_BH15

BH_TT66668

BH_64338

DEPTH	BORE 15 67	SAMPLE	[illegible]	[illegible]	[illegible]	▼ 16.5	[illegible] LEVELS
	concrete road						
	scoria gravel up to 2"ф						
	clay & gravel fill, up to 1½"ф, firm brown						
5	clay fill firm greenish grey						
	grey gravel inclusions						
	greenish grey firm						
	clay fill med firm yellow brown						
10	sand fill with cemented silt lumps yellow brown with grey denser inclusions						
	clay fill, firm, pale grey						FILL
15	cemented silt fill sandy lenses						
	sand silty fill compact grey-brown						
20	silt cemented fill dense sandy lenses						
	silt sandy med grey					I -4.0	
	siltstone hard dark grey sandstone					I -5.0	
25	sandstone hard	⎕	249.0	19			
	siltstone						
	sandstone dk grey	⎕	626.0	18			
30	siltstone sandstone siltstone						
	sand silty cemented dk grey breaks easily on horizontal planes	⎕	48.0	19	112		
35	LOST sandstone dk grey, hard	⎕	531.0	18			
	sand silty cemented horizontal discs sandstone siltstone [illegible] sand sandstone [illegible]						
40	sand silty cemented dk grey breaks on horizontal planes 1/2" thick siltstone sandstone siltstone	⎕	460.0	17			
	sand silty cemented breaks on horiz planes siltstone						WAITEMATA
45		⎕	552.0	20	127		
	sand silty, cemented dk grey breaks on horiz planes sandstone	⎕	413.0	—	—		
	siltstone sand cemented dk grey broken siltstone						
50	sand silty compact dk grey siltstone						
	END OF BORE					I -34.0	

BH_64274

BH_TT66604

BH_64274

RECORD OF BOREHOLE 211

SHEET 1 OF 3

BH211

JOB NAME : Quay Street West Underpass
CLIENT : Auckland City Council
JOB NO. : 2409275

LOCATION : Lower Hobson Street
COORDS : 6482788.40N, 2667722.90E
ELEV.: 3.59 DATUM: LANDS & SURVEY

DEPTH (m)	STRATA DESCRIPTION	ELEVATN (meters)	SAMPLE DEPTH (m)	SAMPLE TYPE	FIELD TESTS SPT	FIELD TESTS VANE	FIELD TESTS OTHER
0.00	Asphaltic Concrete	3.59	0.00				OB
0.15	Medium dense grey GRAVEL;moderately weathered,moderately strong,subangular Basalt [FILL]	3.44					
0.60	Loose reddish brown sandy fine to medium GRAVEL,moderately weathered,moderately strong vesicular Basalt [FILL]	2.79					
1.50	— becoming brown	2.09					
2.50	Firm orange brown mottled grey/black/white SILT-CLAY,some fine sand,trace shells,moist,highly plastic, intermixed with fine to medium gravel sized silt clasts and grey SAND,some silt,wet,non plastic [FILL]	1.09	2.50	↕			
3.00	— becoming grey	0.59	3.00	●	1 6 4 10	C = 44 CR= 10	
			3.50	↕			
4.00	— with clasts of coarse gravel sized SILTSTONE and SANDSTONE	-0.41	4.00	↕			
			4.50	●	1 1 1 2	C = 30 CR= 8	

OBSERVATIONS:

SAMPLES
- ● Small disturbed sample
- ↕ Large disturbed sample
- ▮ Undisturbed tube sample
- ▯ Undisturbed core sample
- ↓ SPT Split spoon sample

FIELD TESTS
SPT = Standard Penetration Test (blows/150mm,N=blows/300mm)
C = Cohesion as measured direct with shear vane (kPa)
CR = Remoulded C
CC = Corrected Reading (kPa)

PILCON VANE DIAL NO.: DR3969

DATE STARTED : 5-Apr-98
DATE FINISHED: 5-Apr-98
CORE DIA.: 90 mm
LOGGED BY: M.Watson
RIG : Trailer
CONTRACTOR: Prodrill

BECA CARTER HOLLINGS AND FERNER LTD. Ph: (09) 3773 410

BH_64274

BH_TT66604

RECORD OF BOREHOLE 211

SHEET 2 OF 3

BH211

JOB NAME : Quay Street West Underpass
CLIENT : Auckland City Council
JOB NO. : 2409275

LOCATION : Lower Hobson Street
COORDS : 6482788.40N, 2667722.90E
ELEV.: 3.59 DATUM: LANDS & SURVEY

DEPTH(m)	STRATA DESCRIPTION	ELEVATN (meters)	SAMPLE DEPTH(m)	SAMPLE TYPE	SPT	VANE	OTHER
			–				
			5 50	↕		C = 40 CR= 18	
5 60	with trace wood	-2 01					
5 80	Very loose dark grey SAND,minor fine gravel sized shell fragments;saturated,non plastic, intermixed with orange brown mottled white SILT-CLAY trace fine sand;moist,highly plastic [TAURANGA GROUP SEDIMENTS(Upper)]	-2 21					
6 00	No recovery	-2 41	6.00		1 1 1 2	C = 16	VB
6 50	No recovery, washings indicate grey silty SAND	-2 91					
7.50	Soft grey SILT-CLAY,some fine sand,moist,highly plastic [TAURANGA GROUP SEDIMENTS(Upper)]	-3.91	7.50	●	0 0 0 0		OB
8 00	Loose grey greenish brown SAND,trace fine gravel sized shells;moist,non plastic [TAURANGA GROUP SEDIMENTS(Upper)]	-4 41	8 00	↕			
8 50	Firm light grey mottled green and dark grey speckled white SILT,minor fine sand,minor clay,trace rootlets;moist, moderately plastic [TAURANGA GROUP SEDIMENTS(Lower)]	-4 91	8 50	↕		C = 26	
8 80	Dense light grey mottled orange and speckled white faintly bedded silty SAND minor clay;moist,non plastic [WAITEMATA GROUP]	-5 21					
9 00	very stiff	-5 41	9.00	●	1 3 4 7	C = 100+	
9 60	becoming dark grey	-6 01					
			9 80	↕			
9 95	bedding disturbed,grey layer of 10mm moderately weathered,extremely weak SILTSTONE	-6 36					

OBSERVATIONS:

SAMPLES
- ● Small disturbed sample
- ↕ Large disturbed sample
- ▮ Undisturbed tube sample
- ▯ Undisturbed core sample
- ↓ SPT Split spoon sample

FIELD TESTS
SPT = Standard Penetration Test (blows/150mm,N=blows/300mm)
C = Cohesion as measured direct with shear vane (kPa)
CR = Remoulded C
CC = Corrected Reading (kPa)

PILCON VANE DIAL NO.: DR3969

DATE STARTED : 5-Apr-98 CORE DIA.: 90 mm RIG : Trailer
DATE FINISHED: 5-Apr-98 LOGGED BY: M.Watson CONTRACTOR: Prodrill

BECA CARTER HOLLINGS AND FERNER LTD. Ph: (09) 3773 410

BH_64274

BH_64274

BH_TT66604

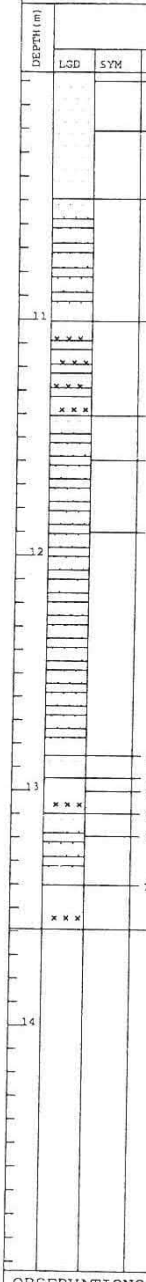
RECORD OF BOREHOLE 211

SHEET 3 OF 3

BH211

JOB NAME : Quay Street West Underpass
CLIENT : Auckland City Council
JOB NO. : 2409275

LOCATION : Lower Hobson Street
COORDS : 6482788.40N, 2667722.90E
ELEV.: 3.59 DATUM: LANDS & SURVEY



STRATA DEPTH	DESCRIPTION	ELEVATN (meters)	SAMPLE DEPTH (m)	SAMPLE TYPE	FIELD TESTS SPT	VANE	OTHER	
10.00	wavy orange SILT-CLAY seam 3mm, soft sediment deformation?	-6.41						
10.20	with 10mm seam, subhorizontal light grey mottled orange SILT-CLAY; moist, highly plastic	-6.61						
			10.10		25		TT	SPT=25/80mm
					26			
10.50	Grey moderately weathered, extremely weak SANDSTONE [WAITEMATA GROUP]	-6.91			25 51+			
11.00	Grey moderately weathered, extremely weak SILTSTONE [WAITEMATA GROUP]	-7.41	11.00	▯				
11.40	Grey moderately weathered, extremely weak SANDSTONE [WAITEMATA GROUP]	-7.81	11.50	▯				
11.60	becoming slightly weathered, very weak	-8.01						
11.90	with subhorizontal laminated layers of brown carbonaceous material	-8.31						
			12.00		50 50+			SPT=50/150
			12.50	▯				
12.85	Grey slightly weathered, very weak SANDSTONE [WAITEMATA GROUP]	-9.26						
12.95		-9.36						
13.00		-9.41	13.00	▯				
13.10	Grey slightly weathered, very weak SILTSTONE [WAITEMATA GROUP]	-9.51						
13.20	becoming extremely weak	-9.61						
13.40	Grey slightly weathered, very weak SANDSTONE	-9.81						
	becoming weak		13.50		50 50+			SPT=50/90mm
	Grey slightly weathered, very weak SILTSTONE [WAITEMATA GROUP]							

END OF BOREHOLE 211 , 13.59m BELOW GROUND SURFACE

OBSERVATIONS:

SAMPLES
- ● Small disturbed sample
- ⇕ Large disturbed sample
- ▮ Undisturbed tube sample
- ▯ Undisturbed core sample
- ↓ SPT Split spoon sample

FIELD TESTS
SPT = Standard Penetration Test (blows/150mm, N=blows/300mm)
C = Cohesion as measured direct with shear vane (kPa)
CR = Remoulded C
CC = Corrected Reading (kPa)

PILCON VANE DIAL NO.: DR3969

DATE STARTED : 5-Apr-98	CORE DIA.: 90 mm	RIG	: Trailer
DATE FINISHED: 5-Apr-98	LOGGED BY: M.Watson	CONTRACTOR:	Prodrill

BECA CARTER HOLLINGS AND FERNER LTD. Ph: (09) 3773 410

BH_64276

BH_TT66606

RECORD OF BOREHOLE 213

SHEET 1 OF 3

BH213

JOB NAME : Quay Street West Underpass
CLIENT : Auckland City Council
JOB NO. : 2409275

LOCATION : Lower Hobson St
COORDS : 6482721.30N, 2667672.10E
ELEV.: 3.54 DATUM: LANDS & SURVEY

STRATA

DEPTH (m)	DESCRIPTION	ELEVATN (meters)
0.00	Asphaltic Concrete	3.54
0.10	Brown GRAVEL,some sand,minor silt,trace clay,moist,non plastic. Gravel,brown grey moderately weathered,moderately strong subangular Basalt.	3.44
0.80	with red brown scoriaceous Basalt	2.74
0.95	with some reddish brown silty SAND	2.59
1.00	Loose brown silty sandy GRAVEL,minor clay;moist,moderately plastic.	2.54
1.10	Firm orange brown SAND,some silt,minor clay,minor fine to medium gravel,moist,non plastic. Gravel,grey,moderately weathered,very weak to extremely weak SILTSTONE.	2.44
1.35	Soft orange mottled white,red/orange and grey SILT-CLAY,minor fine sand,moist,highly plastic	2.19
1.45	with some orange brown fine sand,wet [FILL]	2.09
2.35	with a moderately thick layer of reddish brown highly weathered, extremely weak SANDSTONE	1.19
2.55	with some coarse GRAVEL;grey mottled orange and orange brown moderately to highly weathered,very weak to extremely weak SILTSTONE, with carbonaceous flecks [FILL]	0.99
2.85	Loose bluish grey mottled black and greenish brown/grey silty fine SAND,minor clay,moist,moderately plastic. [FILL]	0.69
3.45	bottom of tube contains grey fine SAND,moist,non plastic, intermixed with reddish brown highly weathered extremely weak SANDSTONE and stiff greenish brownish grey SILT-CLAY,moist,highly plastic.	0.09
3.50	Firm greenish brownish grey highly weathered,very weak SANDSTONE and reddish brown highly weathered,extremely weak SANDSTONE [FILL]	0.04
4.00	with a thin layer of soft grey mottled white and orange brown SILT-CLAY,some gravel,moist,highly plastic. Gravel;coarse,grey,moderately weathered,very weak SILTSTONE	-0.46
4.40	Firm grey mottled reddish orange and brown moderately weathered extremely weak SANDSTONE [FILL]	-0.86

SAMPLE / FIELD TESTS

SAMPLE DEPTH (m)	TYPE	SPT	VANE	OTHER
1.00	↕			GB
1.50	▮		C = 36 CR= 24	
2.00	↓	0 1 1 2		
2.50	↕			
3.00	▮		C = 70 CR= 14	
3.50	↓	3 3 4 7		
4.00	↕			
4.50	↓	1 2 2 4		THP

OBSERVATIONS:
THP=Too Hard to Penetrate with shear vane

SAMPLES
- ● Small disturbed sample
- ↕ Large disturbed sample
- ▮ Undisturbed tube sample
- ▯ Undisturbed core sample
- ↓ SPT Split spoon sample

FIELD TESTS
SPT = Standard Penetration Test (blows/150mm.N=blows/300mm)
C = Cohesion as measured direct with shear vane (kPa)
CR = Remoulded C
CC = Corrected Reading (kPa)

PILCON VANE
DIAL NO.: DR2122

DATE STARTED : 21-Jan-98
DATE FINISHED: 21-Jan-98
CORE DIA.: 90 mm
LOGGED BY: M.Watson
RIG : Trailer Mounted
CONTRACTOR: Prodrill

BECA CARTER HOLLINGS AND FERNER LTD.
Ph: (09) 3773 410

BH_64276

BH_64276

BH_TT66606

RECORD OF BOREHOLE 213

SHEET 2 OF 3

BH213

JOB NAME : Quay Street West Underpass
CLIENT : Auckland City Council
JOB NO. : 2409275

LOCATION : Lower Hobson St
COORDS : 6482721.30N, 2667672.10E
ELEV.: 3.54 DATUM: LANDS & SURVEY

DEPTH (m)	STRATA DESCRIPTION	ELEVATN (meters)	SAMPLE DEPTH (m)	SAMPLE TYPE	FIELD TESTS SPT	FIELD TESTS VANE	FIELD TESTS OTHER
			5.00	↕			
5.45		-1.91					
5.50	Grey coarse GRAVEL,moderately weathered weak SILTSTONE	-1.96	5.50	↕			
	Loose grey speckled white fine SAND,some silt,minor clay,minor fine gravel,moist,non plastic. Gravel,shells. [TAURANGA GROUP SEDIMENTS(Upper)]						
6			6.00	▮		C = 38 CR= 14	
6.50	bottom of tube contains stiff grey SILT-CLAY,moist,highly plastic	-2.96	6.50	↓	3 4 6 10		
6.65	Medium dense grey fine SAND,wet,non plastic,intermixed with grey SILT-CLAY,wet,highly plastic [TAURANGA GROUP SEDIMENTS(Upper)]	-3.11					
7.00	Medium dense grey fine to medium SAND,wet,non plastic. [TAURANGA GROUP SEDIMENTS(Upper)]	-3.46	7.00	↕			
7.35	Hard grey SILT-CLAY,wet,highly plastic. [WAITEMATA GROUP]	-3.61					
7.50	Medium dense grey silty fine SAND,minor clay,wet,moderately plastic, intermixed with grey SILT-CLAY,wet,highly plastic. [WAITEMATA GROUP]	-3.96	7.50	↓	6 8 12 20		THP
7.95	with some fine gravel sized wood fragments	-4.41					
8.00	Dense grey fine SAND,some silt,trace clay;wet,non plastic [WAITEMATA GROUP]	-4.46	8.00	↕			
			8.50	↕			
9.00	Intermixed dense grey fine SAND,some silt,trace clay,wet,non plastic with very stiff grey SILT-CLAY,wet,highly plastic [WAITEMATA GROUP]	-5.46	9.00	↕	5 15 43 55		
			9.50				TT

OBSERVATIONS:
THP=Too Hard to Penetrate with shear vane

SAMPLES
- ● Small disturbed sample
- ↕ Large disturbed sample
- ▮ Undisturbed tube sample
- ▯ Undisturbed core sample
- ↓ SPT Split spoon sample

FIELD TESTS
SPT = Standard Penetration Test (blows/150mm,N=blows/300mm)
C = Cohesion as measured direct with shear vane (kPa)
CR = Remoulded C
CC = Corrected Reading (kPa)

PILCON VANE DIAL NO.: DR2122

DATE STARTED : 21-Jan-98
DATE FINISHED: 21-Jan-98
CORE DIA.: 90 mm
LOGGED BY: M.Watson
RIG : Trailer Mounted
CONTRACTOR: Prodrill

BH_64276

BH_TT66606

RECORD OF BOREHOLE 213

SHEET 3 OF 3

BH213

JOB NAME : Quay Street West Underpass
CLIENT : Auckland City Council
JOB NO. : 2409275

LOCATION : Lower Hobson St
COORDS : 6482721.30N, 2667672.10E
ELEV.: 3.54 DATUM: LANDS & SURVEY

DEPTH (m)	STRATA			ELEVATN (metres)	SAMPLE		FIELD TESTS			
	LGD	SYM	DESCRIPTION		DEPTH (m)	TYPE	SPT	VANE	OTHER	
	x x x		10.00 — Moderately thickly interbedded with grey slightly weathered very weak SILTSTONE and grey moderately weathered, extremely weak SANDSTONE [WAITEMATA GROUP]	-6.46	10.00	▯				
	x x x				10.50		28			SPT=22 95mm
	x x x						22 50+			
11	x x x				11.00	▯				
	x x x				11.50	▯				
	x x x		11.70 — laminated with carbonaceous material	-8.16						
12	x x x				12.00		50 50+			SPT=50/125mm
			END OF BOREHOLE 213 . 12.13m BELOW GROUND SURFACE							
13										
14										

OBSERVATIONS:
THP=Too Hard to Penetrate with shear vane

SAMPLES
- ● Small disturbed sample
- ⇕ Large disturbed sample
- ▮ Undisturbed tube sample
- ▯ Undisturbed core sample
- ↓ SPT Split spoon sample

FIELD TESTS
SPT = Standard Penetration Test (blows/150mm, N=blows/300mm)
C = Cohesion as measured direct with shear vane (kPa)
CR = Remoulded C
CC = Corrected Reading (kPa)

PILCON VANE
DIAL NO.: DR2122

DATE STARTED : 21-Jan-98
DATE FINISHED: 21-Jan-98
CORE DIA.: 90 mm
LOGGED BY: M.Watson
RIG : Trailer Mounted
CONTRACTOR: Prodrill

BECA CARTER HOLLINGS AND FERNER LTD.
Ph: (09) 3773 410

BH_64277

BH_TT66607

RECORD OF BOREHOLE 214

SHEET 1 OF 3

BH214

JOB NAME : Quay Street West Underpass

CLIENT : Auckland City Council

JOB NO. : 2409275

LOCATION : Lower Hobson St

COORDS : 6482760.10N, 2667686.50E

ELEV.: 3.59 DATUM: LANDS & SURVEY

DEPTH (m)	STRATA DESCRIPTION	ELEVATN (meters)	SAMPLE DEPTH (m)	SAMPLE TYPE	FIELD TESTS SPT	FIELD TESTS VANE	FIELD TESTS OTHER
0.00	Asphaltic Concrete	3.59					
0.15	Grey fine to coarse GRAVEL; moderately weathered, moderately strong, sub angular Basalt.	3.44	–				
			0.50	↕			
0.70	Dark grey gravelly SILT-CLAY, minor sand; wet, highly plastic, organic odour present. Gravel, grey, moderately weathered, moderately strong, sub angular Basalt.	2.89	0.70				OB
0.80		2.79	0.80			C = 70 CR= 40	
1.00	Orange brown sandy GRAVEL, some silt, minor clay; wet, non plastic. Gravel, reddish brown highly weathered weak basalt. [FILL]	2.59	1.00	↕			
	Soft to very stiff orange brown mottled grey and orange fine sandy SILT-CLAY intermixed with grey moderately weathered extremely weak SILTSTONE and orange grey highly weathered extremely weak SANDSTONE. [FILL]						
1.50	with mottles of white	2.09	1.50	↓	0 0 1 1	C = 100+	
2.40	Soft to firm orange brown mottled white, grey and brown SILT-CLAY with clasts of fine gravel sized moderately weathered, very weak SILTSTONE [FILL]	1.19	2.40	↕			
			2.50			C = 40 CR= 8	
2.85	Very stiff to hard grey mottled brown grey and orange highly weathered, extremely weak SILTSTONE [FILL]	0.74					
3.00 3.02	with a thin layer of brown sandy fine GRAVEL, wet, non plastic	0.59 0.57	3.00	↓	1 1 1 2		THP
3.10	with a thin layer of black silty SAND, minor clay, wet, moderately plastic. with a thin layer of medium gravel sized red brick	0.49					
	Soft grey mottled orange brown SILT-CLAY, some fine sand, some fine to medium gravel, wet, highly plastic Gravel, orange brownish grey, moderately weathered, very weak SANDSTONE and grey moderately weathered weak SILTSTONE						
4.00	with a thin layer of soft dark grey silty SAND, minor clay; wet, moderately plastic, and with a lense of stiff brown SILT-CLAY, trace fibrous material, moist, highly plastic	-0.41	4.00	↕			
4.15		-0.56					
	Stiff grey mottled orange brownish grey intermixed grey moderately weathered very weak SILTSTONE and brownish grey mottled orange highly weathered, very weak SANDSTONE [FILL]		4.50	↓	3 4 5 9		THP

OBSERVATIONS:
THP=Too Hard to Penetrate with shear vane

SAMPLES
- ● Small disturbed sample
- ↕ Large disturbed sample
- ▮ Undisturbed tube sample
- ▯ Undisturbed core sample
- ↓ SPT Split spoon sample

FIELD TESTS
SPT = Standard Penetration Test (blows/150mm, N=blows/300mm)
C = Cohesion as measured direct with shear vane (kPa)
CR = Remoulded C
CC = Corrected Reading (kPa)

PILCON VANE

DIAL NO.: DR2122

DATE STARTED : 20-Jan-98

DATE FINISHED: 20-Jan-98

CORE DIA.: 90 mm

LOGGED BY: M.Watson

RIG : Trailer Mounted

CONTRACTOR: Prodrill

BECA CARTER HOLLINGS AND FERNER LTD.

Ph: (09) 3773 410

BH_64277

BH_TT66607

RECORD OF BOREHOLE 214	SHEET 2 OF 3	BH214

JOB NAME : Quay Street West Underpass
CLIENT : Auckland City Council
JOB NO. : 2409275

LOCATION : Lower Hobson St
COORDS : 6482760.10N, 2667686.50E
ELEV.: 3.59 DATUM: LANDS & SURVEY

DEPTH (m)	STRATA DESCRIPTION	ELEVATN (meters)	SAMPLE DEPTH (m)	SAMPLE TYPE	FIELD TESTS SPT	FIELD TESTS VANE	FIELD TESTS OTHER
5.50	No recovery	-1.91	5.50	↕			
5.65	Hard grey moderately weathered, very weak SANDSTONE with a thin layer of brownish orange highly weathered extremely weak SANDSTONE [FILL]	-2.06					
5.75		-2.16					
5.80		-2.21					
5.90	with a thin layer of brownish orange SANDSTONE	-2.31					
6.00	Hard grey moderately weathered very weak SILTSTONE	-2.41	6.00	↓	0 1 1 2		
	Medium dense dark grey SAND, some silt ,minor clay, minor fine gravel; wet, non plastic. Gravel; shell fragments [FILL]						
6.50	Loose grey SAND, minor fine to medium gravel; wet, non plastic intermixed with soft grey SILT-CLAY, trace fine sand, wet, highly plastic. Gravel: shell fragments and wood [FILL]	-2.91	6.50	▮			
	No recovery in tube						
7.00	Loose grey SAND, minor fine to medium gravel; moist, non plastic, intermixed with soft grey SILT-CLAY, trace fine sand, moist, highly plastic. Gravel, shell fragments. [TAURANGA GROUP SEDIMENTS (Upper)]	-3.41	7.00	↕		C = 12 CR= 6	
7.35	with a thin layer of very stiff orange brown SILT-CLAY, trace fine sand, moist, highly plastic	-3.76					
7.40		-3.81					
7.55	with a thin layer of firm bluish grey SILT-CLAY, minor fine sand; wet, highly plastic, speckled dark brown with organics	-3.96	7.50	↓	2 3 4 7	C = 66 CR= 10	
	Loose grey silty fine SAND, trace clay, wet, non plastic. [WAITEMATA GROUP]						
7.90	becoming medium dense	-4.31					
			8.00	↕			
8.15	becoming dense	-4.56					
			8.50	↕			
			9.00	↓	4 6 9 15		
9.55	intermixed with grey slightly weathered, very weak SILTSTONE and slightly weathered very weak SANDSTONE	-5.96					
			9.90		40 10 50+		SPT=50/152mm

OBSERVATIONS:
THP=Too Hard to Penetrate with shear vane

SAMPLES
- ● Small disturbed sample
- ↕ Large disturbed sample
- ▮ Undisturbed tube sample
- 0 Undisturbed core sample
- ↓ SPT Split spoon sample

FIELD TESTS
SPT = Standard Penetration Test (blows/150mm, N=blows/300mm)
C = Cohesion as measured direct with shear vane (kPa)
CR = Remoulded C
CC = Corrected Reading (kPa)

PILCON VANE DIAL NO.: DR2122

DATE STARTED : 20-Jan-98
DATE FINISHED: 20-Jan-98
CORE DIA.: 90 mm
LOGGED BY: M.Watson
RIG : Trailer Mounted
CONTRACTOR: Prodrill

BECA CARTER HOLLINGS AND FERNER LTD. Ph: (09) 3773 410

BH_64277

BH_TT66607

RECORD OF BOREHOLE 214	SHEET 3 OF 3	BH214

JOB NAME : Quay Street West Underpass
CLIENT : Auckland City Council
JOB NO. : 2409275

LOCATION : Lower Hobson St
COORDS : 6482760.10N, 2667686.50E
ELEV.: 3.59 DATUM: LANDS & SURVEY

DEPTH (m)	STRATA LGD	STRATA SYM	STRATA DESCRIPTION	ELEVATN (meters)	SAMPLE DEPTH (m)	SAMPLE TYPE	FIELD TESTS SPT	FIELD TESTS VANE	FIELD TESTS OTHER	
			10.00 Moderately thickly interbedded with grey slightly weathered very weak SANDSTONE and grey slightly weathered, very weak SILTSTONE	-6.41	10.00				TT	
					10.40	▯				
11					11.00	▯				
					11.50	▯				
			11.65 — laminated with carbonaceous material	-8.06						
12					12.00		28 22 50+			SPT=22/25mm
					12.40	▯				
13					13.00		50 50+			SPT=50,95mm
			END OF BOREHOLE 214 , 13.10m BELOW GROUND SURFACE							
14										

OBSERVATIONS:
THP=Too Hard to Penetrate with shear vane

SAMPLES
- ● Small disturbed sample
- ↕ Large disturbed sample
- ▮ Undisturbed tube sample
- ▯ Undisturbed core sample
- ↓ SPT Split spoon sample

FIELD TESTS
SPT = Standard Penetration Test (blows/150mm,N=blows/300mm)
C = Cohesion as measured direct with shear vane (kPa)
CR = Remoulded C
CC = Corrected Reading (kPa)

PILCON VANE DIAL NO.: DR2122

DATE STARTED : 20-Jan-98 CORE DIA.: 90 mm RIG : Trailer Mounted
DATE FINISHED: 20-Jan-98 LOGGED BY: M.Watson CONTRACTOR: Prodrill

BECA CARTER HOLLINGS AND FERNER LTD. Ph: (09) 3773 410

BH_64277

BH_64278

BH_TT66608

BH_64278

RECORD OF BOREHOLE 215

SHEET 1 OF 3

BH215

JOB NAME : Quay Street West Underpass
CLIENT : Auckland City Council
JOB NO. : 2409275

LOCATION : Lower Hobson St
COORDS : 6482794.50N, 2667699.80E
ELEV.: 3.69 DATUM: LANDS & SURVEY

DEPTH (m)	STRATA DESCRIPTION	ELEVATN (meters)	SAMPLE DEPTH (m)	SAMPLE TYPE	SPT	VANE	OTHER
0.00	Asphaltic Concrete	3.69					
0.15	Dense brownish grey GRAVEL, fine to coarse, moderately weathered, moderately strong, vesicular, subangular Basalt	3.54	-				
0.70	Loose orange mottled light brown silty clayey SAND, wet, moderately plastic [FILL]	2.99	0.70	↕			DB
0.90	mottled with black SILT-CLAY, wet, highly plastic	2.79					
0.95	becoming hard greenish brown SILT-CLAY	2.74					
1.00	Very stiff brown mottled reddish orange and grey SILT-CLAY, some sand, trace gravel, moist, highly plastic. Gravel, reddish orange, highly weathered, weak Basalt.	2.69	1.00	↕			
1.50	Soft, brownish grey and orange extremely weathered, extremely weak SILTSTONE [FILL]	2.19	1.50	↓	1 1 1 2		THP
2.50	Brownish greenish grey highly weathered, extremely weak SANDSTONE, intermixed with soft grey SILT-CLAY, moist, highly plastic and loose brownish grey SAND, some silt, minor clay, moist, non plastic [FILL]	1.19	2.50	↕			
			3.00	↓	1 1 2 3		THP
4.00	Soft to very stiff brownish grey mottled orange and grey SILT-CLAY trace fine sand, moist, highly plastic with pockets of grey, moderately weathered very weak SILTSTONE. [FILL]	-0.31	4.00	↕			
4.15	with a moderately thin layer of grey, moderately weathered to highly weathered, very weak SANDSTONE, stained orange along defects	-0.46					
4.50	Stiff grey brown SILT-CLAY, trace fine sand, moist, highly plastic	-0.81	4.50	↓	1 4 4 8		THP
4.60	Grey moderately weathered, extremely weak SILTSTONE	-0.91					

OBSERVATIONS:
THP=Too Hard to Penetrate with shear vane

SAMPLES
- ● Small disturbed sample
- ↕ Large disturbed sample
- ▮ Undisturbed tube sample
- ▯ Undisturbed core sample
- ↓ SPT Split spoon sample

FIELD TESTS
SPT = Standard Penetration Test (blows/150mm, N=blows/300mm)
C = Cohesion as measured direct with shear vane (kPa)
CR = Remoulded C
CC = Corrected Reading (kPa)

PILCON VANE
DIAL NO.: DR2122

DATE STARTED : 19-Jan-98
DATE FINISHED: 20-Jan-98
CORE DIA.: 90 mm
LOGGED BY: M.Watson
RIG : Trailer Mounted
CONTRACTOR: Prodrill

BECA CARTER HOLLINGS AND FERNER LTD.
Ph: (09) 3773 410

BH_64278

BH_TT66608

RECORD OF BOREHOLE 215	SHEET 2 OF 3	BH215

JOB NAME : Quay Street West Underpass
CLIENT : Auckland City Council
JOB NO. : 2409275

LOCATION : Lower Hobson St
COORDS : 6482794.50N, 2667699.80E
ELEV.: 3.69 DATUM: LANDS & SURVEY

DEPTH (m)	STRATA DESCRIPTION	ELEVATN (meters)	SAMPLE DEPTH (m)	SAMPLE TYPE	FIELD TESTS SPT	FIELD TESTS VANE	FIELD TESTS OTHER
			-				
5.50	Medium dense grey mottled orange SAND, wet, non plastic, intermixed with very stiff to hard grey SILT-CLAY, trace fine sand, wet, highly plastic [FILL]	-1.81	5.50	↕			
6			6.00	↓	0 0 1 1		THP
			6.50	▮			
7.00	Loose grey SAND, minor silt, minor fine gravel sized shells, trace clay; wet, non plastic. [TAURANGA GROUP SEDIMENTS (Upper)]	-3.31	7.00	↕			
			7.50	▮		C = 30 CR= 10	
8.00	Soft grey sandy SILT-CLAY, trace fine gravel sized shells, wet, highly plastic [TAURANGA GROUP SEDIMENTS (Upper)]	-4.31	8.00	↓	1 2 1 3		
8.50	Stiff light grey mottled brownish orange speckled white SILT-CLAY, some fine sand, moist, highly plastic [TAURANGA GROUP SEDIMENTS (Lower)]	-4.61	8.50	↕			
9			9.00	↓	5 7 10 17	C = 150+	
			9.50	↕			
9.70	— with trace fine sand	-6.01					

OBSERVATIONS:
THP=Too Hard to Penetrate with shear vane

SAMPLES
- ● Small disturbed sample
- ↕ Large disturbed sample
- ▮ Undisturbed tube sample
- ▯ Undisturbed core sample
- ↓ SPT Split spoon sample

FIELD TESTS
SPT = Standard Penetration Test (blows/150mm, N=blows/300mm)
C = Cohesion as measured direct with shear vane (kPa)
CR = Remoulded C
CC = Corrected Reading (kPa)

PILCON VANE DIAL NO.: DR2122

DATE STARTED : 19-Jan-98	CORE DIA.: 90 mm	RIG : Trailer Mounted
DATE FINISHED: 20-Jan-98	LOGGED BY: M.Watson	CONTRACTOR: Prodrill

BH_64278

BH_64278

BH_TT66608

RECORD OF BOREHOLE 215

SHEET 3 OF 3

BH215

JOB NAME : Quay Street West Underpass
CLIENT : Auckland City Council
JOB NO. : 2409275

LOCATION : Lower Hobson St
COORDS : 6482794.50N, 2667699.80E
ELEV.: 3.69 DATUM: LANDS & SURVEY

DEPTH (m)	STRATA DESCRIPTION	ELEVATN (meters)	SAMPLE DEPTH (m)	SAMPLE TYPE	FIELD TESTS SPT	FIELD TESTS VANE	FIELD TESTS OTHER	
10.00	Brownish pinkish grey mottled orange SILT-CLAY, minor fine sand, trace gravel sized wood, moist, highly plastic	-6.31	10.00	↕		C = 56 CR= 28		
10.20	Medium dense grey silty clayey SAND; wet, moderately plastic	-6.51						
10.30	Very stiff grey SILT-CLAY, trace fine sand, moist, highly plastic.	-6.61		–				
10.35	Dense grey SAND; wet, non plastic. (WAITEMATA GROUP)	-6.66						
			10.50	↓	31 21 52		THP	
11			11.00				TT	
11.50	Moderately thickly interbedded with grey slightly weathered, very weak SILTSTONE and SANDSTONE	-7.81						
12			12.00		50 50+			SPT=50/115mm
12.55	thinly laminated with carbonaceous material	-8.86	12.50	▯				
13			13.00	▯				
			13.50		32 20 52+			SPT=20/35mm
	END OF BOREHOLE 215, 13.70m BELOW GROUND SURFACE							
14								

OBSERVATIONS:
THP=Too Hard to Penetrate with shear vane

SAMPLES
● Small disturbed sample
↕ Large disturbed sample
▮ Undisturbed tube sample
▯ Undisturbed core sample
↓ SPT Split spoon sample

FIELD TESTS
SPT = Standard Penetration Test (blows.150mm.N=blows/300mm)
C = Cohesion as measured direct with shear vane (kPa)
CR = Remoulded C
CC = Corrected Reading (kPa)

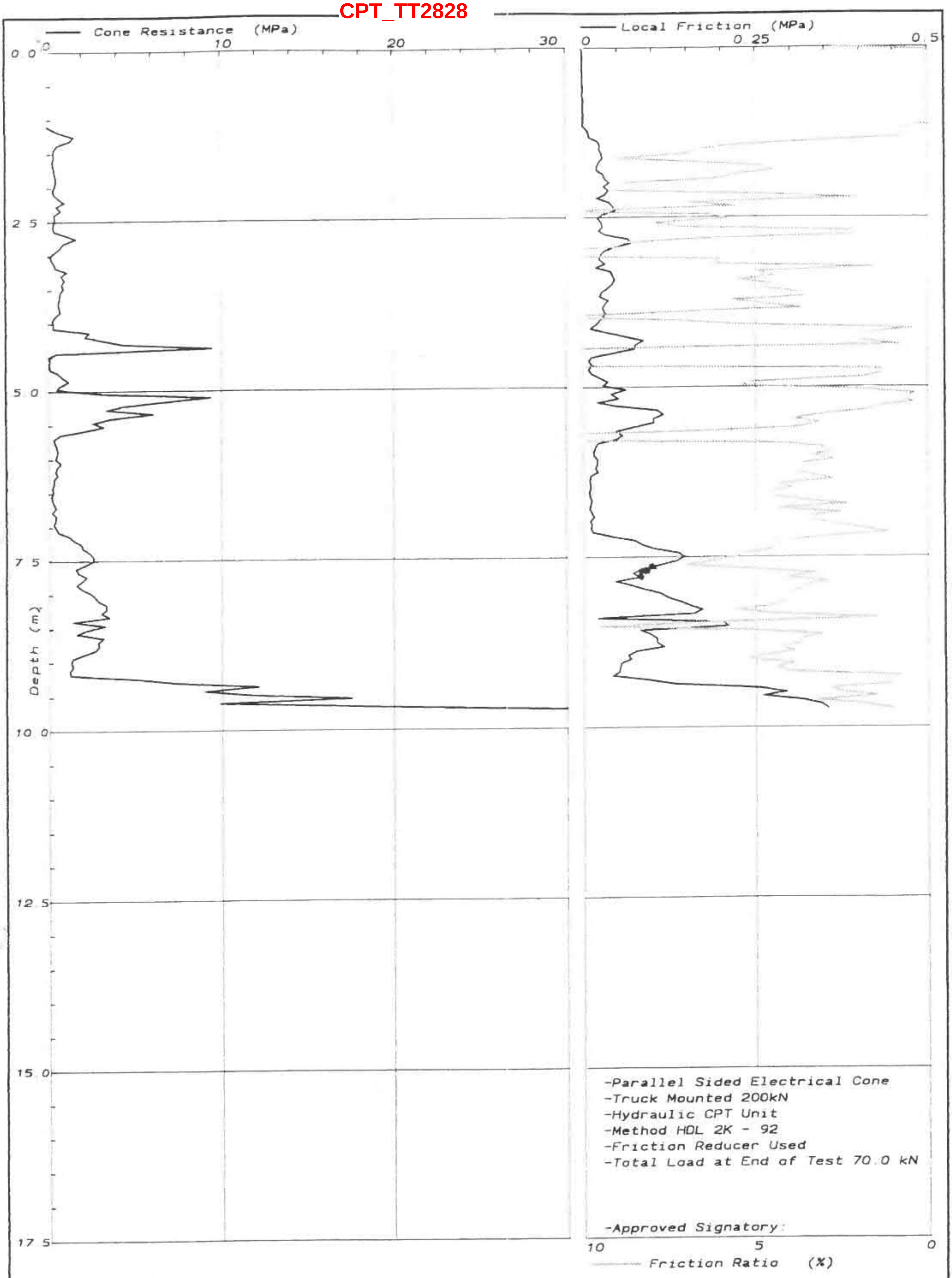
PILCON VANE DIAL NO.: DR2122

DATE STARTED : 19-Jan-98
DATE FINISHED: 20-Jan-98
CORE DIA.: 90 mm
LOGGED BY: M.Watson
RIG : Trailer Mounted
CONTRACTOR: Prodrill

BECA CARTER HOLLINGS AND FERNER LTD.
Ph: (09) 3773 410

BH_64278

CPT_TT2828

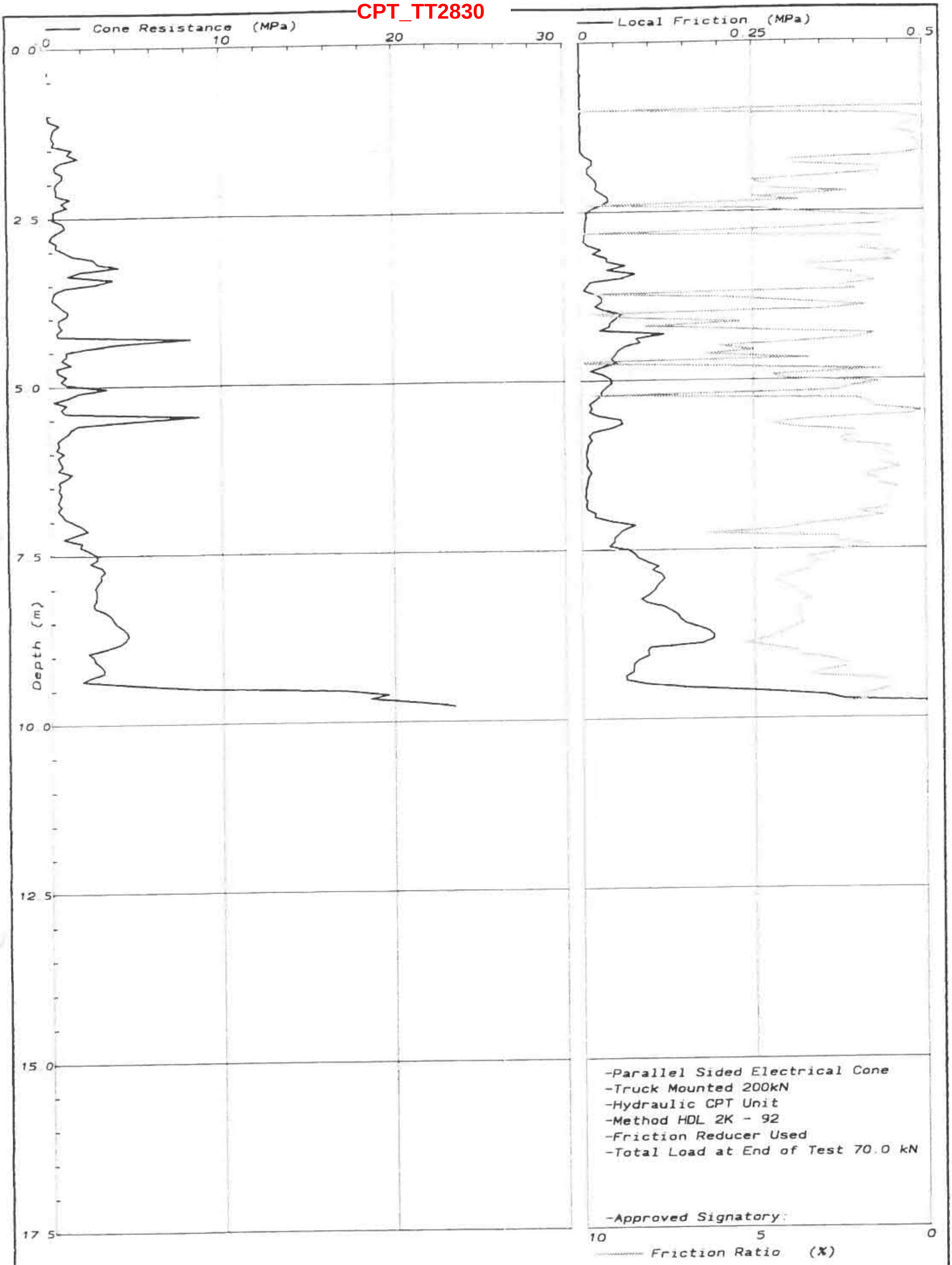


-Parallel Sided Electrical Cone
-Truck Mounted 200kN
-Hydraulic CPT Unit
-Method HDL 2K - 92
-Friction Reducer Used
-Total Load at End of Test 70.0 kN

-Approved Signatory:

BECA CARTER QUAY STREET WEST GEOTECH INVESTIGATION	2-68210.82	LR98/210/002
	6/4/1998	G E BAIRD
	Sheet of	CPT 229

CPT_TT2830



-Parallel Sided Electrical Cone
-Truck Mounted 200kN
-Hydraulic CPT Unit
-Method HDL 2K - 92
-Friction Reducer Used
-Total Load at End of Test 70.0 kN

-Approved Signatory:

BECA CARTER QUAY STREET WEST GEOTECH INVESTIGATION	2-68210.82	LR98/210/002
	6/4/1998	G E BAIRD
	Sheet of	CPT 231

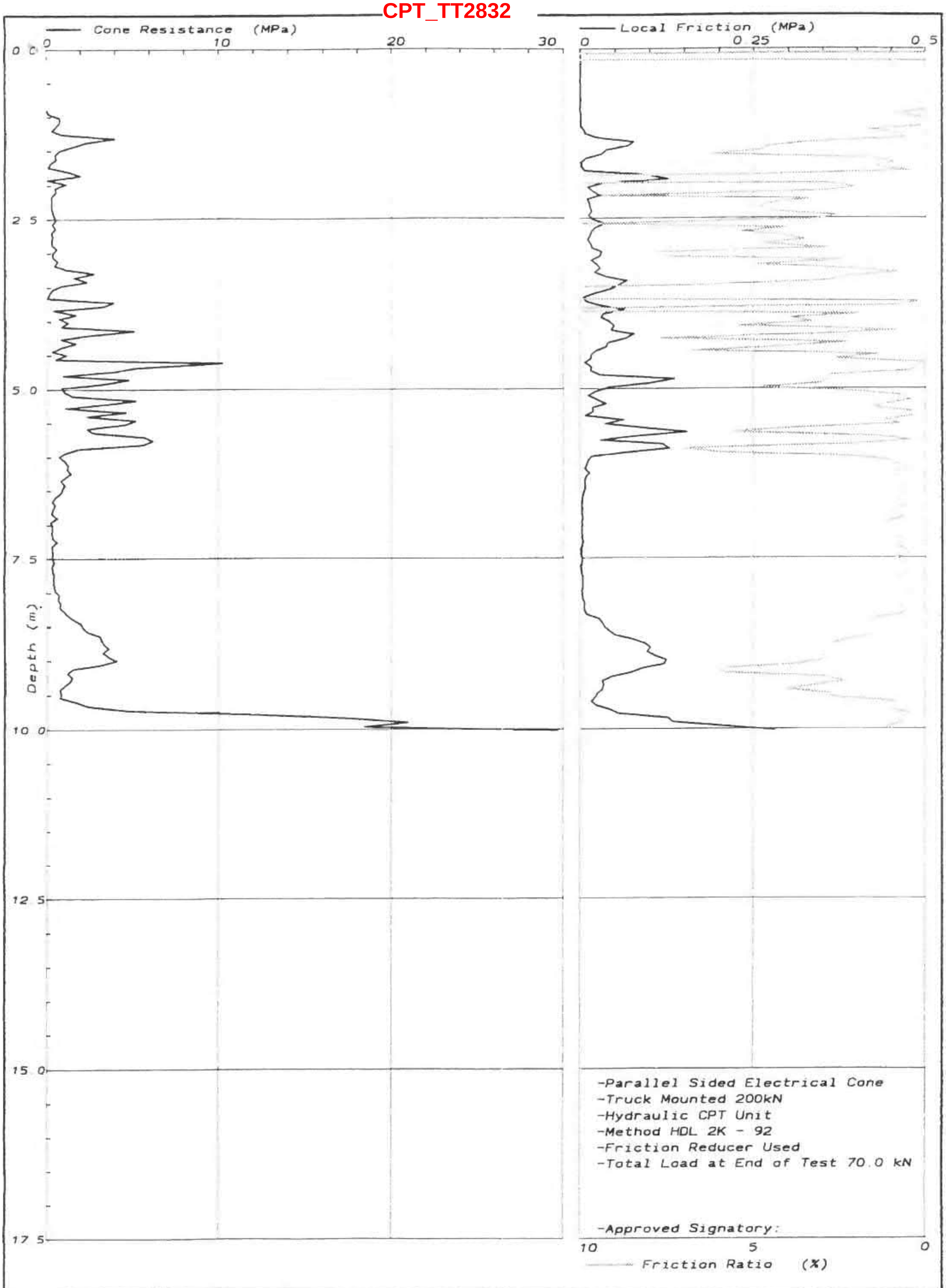
Opus International Consultants Limited
Hamilton Laboratory
Quality Management Systems Certified to ISO 9001

Fox Street
Private Bag 3057
Hamilton, New Zealand

Telephone: +64 7 856 2870
Facsimile: +64 7 856 2873
Web site: www.opus.co.nz

Formerly Works
Consultancy
Services Limited

CPT_TT2832

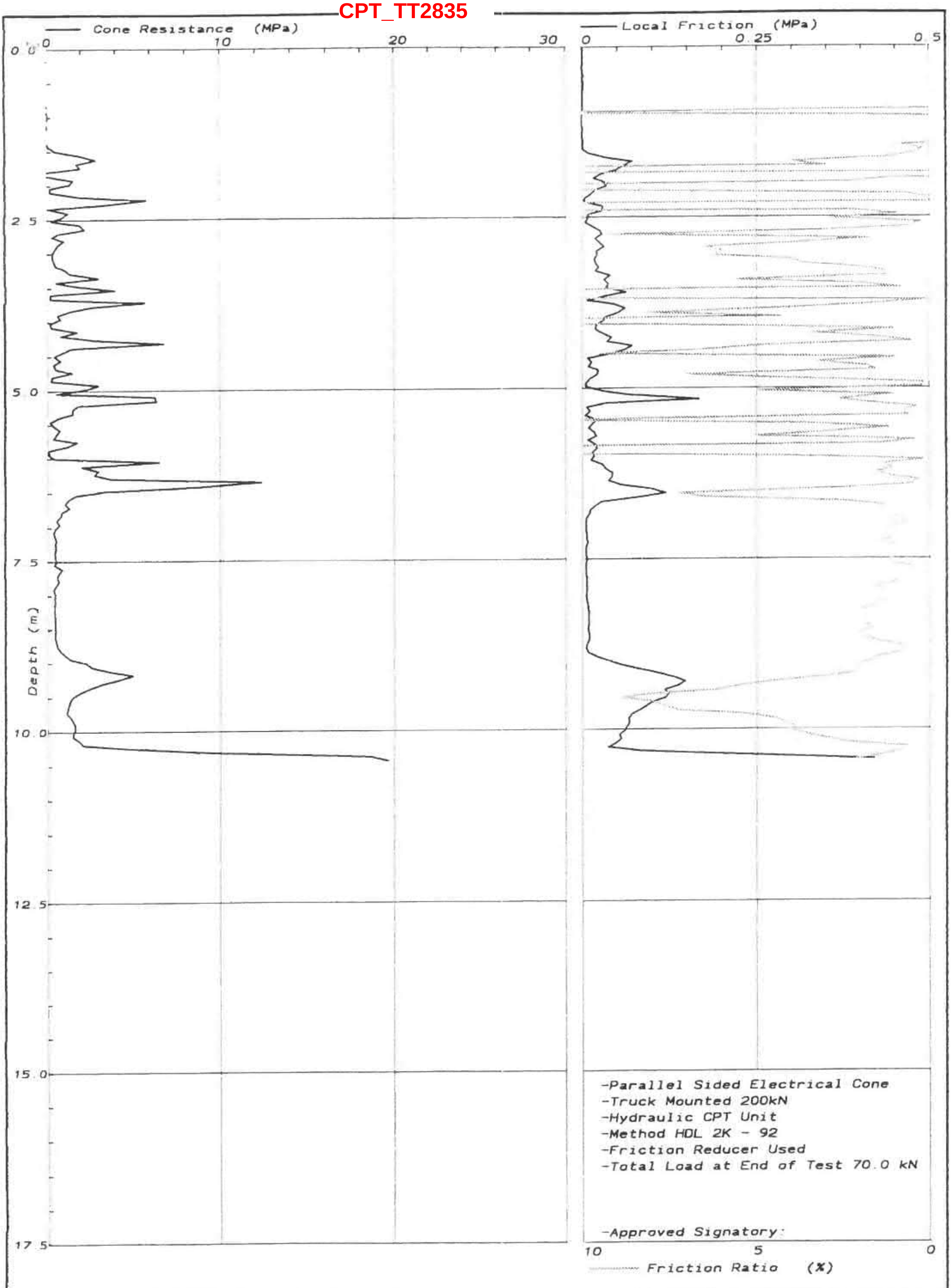


-Parallel Sided Electrical Cone
-Truck Mounted 200kN
-Hydraulic CPT Unit
-Method HDL 2K - 92
-Friction Reducer Used
-Total Load at End of Test 70.0 kN

-Approved Signatory:

OPUS			
	BECA CARTER	2-68210.82	LR98/210/002
	QUAY STREET WEST	6/4/1998	G E BAIRD
	GEOTECH INVESTIGATION	Sheet of	CPT 232

CPT_TT2835



-Parallel Sided Electrical Cone
-Truck Mounted 200kN
-Hydraulic CPT Unit
-Method HDL 2K - 92
-Friction Reducer Used
-Total Load at End of Test 70.0 kN

-Approved Signatory:

OPUS	BECA CARTER QUAY STREET WEST GEOTECH INVESTIGATION	2-68210.82	LR98/210/002
		6/4/1998	G E BAIRD
		Sheet of	CPT 233

Opus International Consultants Limited
Hamilton Laboratory
Quality Management Systems Certified to ISO 9001

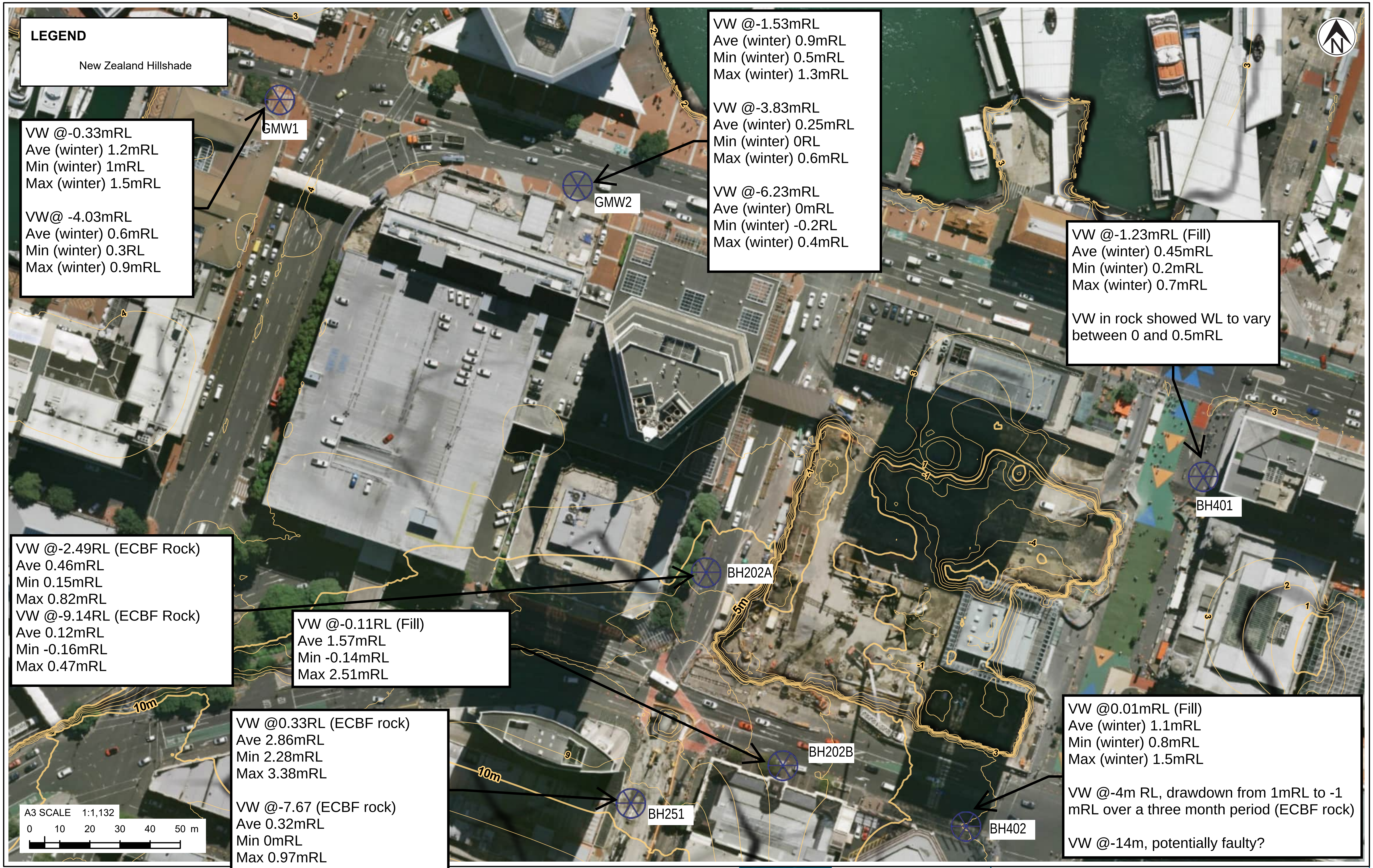
Fox Street
Private Bag 3057
Hamilton, New Zealand

Telephone: +64 7 856 2870
Facsimile: +64 7 856 2873
Web site: www.opus.co.nz

Formerly Works
Consultancy
Services Limited

Appendix F Historical Groundwater Monitoring

COPYRIGHT ON THIS FIGURE IS RESERVED   DO NOT SCALE FROM THIS FIGURE.   Source: Tonkin + Taylor Map Viewer (NZ)   Date: 19/04/2023 5:33 PM



VW @-0.33mRL
Ave (winter) 1.2mRL
Min (winter) 1mRL
Max (winter) 1.5mRL

VW@ -4.03mRL
Ave (winter) 0.6mRL
Min (winter) 0.3RL
Max (winter) 0.9mRL

VW @-1.53mRL
Ave (winter) 0.9mRL
Min (winter) 0.5mRL
Max (winter) 1.3mRL

VW @-3.83mRL
Ave (winter) 0.25mRL
Min (winter) 0RL
Max (winter) 0.6mRL

VW @-6.23mRL
Ave (winter) 0mRL
Min (winter) -0.2RL
Max (winter) 0.4mRL

VW @-1.23mRL (Fill)
Ave (winter) 0.45mRL
Min (winter) 0.2mRL
Max (winter) 0.7mRL

VW in rock showed WL to vary between 0 and 0.5mRL

VW @-2.49RL (ECBF Rock)
Ave 0.46mRL
Min 0.15mRL
Max 0.82mRL
VW @-9.14RL (ECBF Rock)
Ave 0.12mRL
Min -0.16mRL
Max 0.47mRL

VW @-0.11RL (Fill)
Ave 1.57mRL
Min -0.14mRL
Max 2.51mRL

VW @0.33RL (ECBF rock)
Ave 2.86mRL
Min 2.28mRL
Max 3.38mRL

VW @-7.67 (ECBF rock)
Ave 0.32mRL
Min 0mRL
Max 0.97mRL

VW @0.01mRL (Fill)
Ave (winter) 1.1mRL
Min (winter) 0.8mRL
Max (winter) 1.5mRL

VW @-4m RL, drawdown from 1mRL to -1 mRL over a three month period (ECBF rock)

VW @-14m, potentially faulty?

Tonkin+Taylor
Exceptional thinking together   www.tonkintaylor.co.nz

NOTES:

CRS: NZGD 2000 New Zealand Transverse Mercator   Credits: Eagle Technology, Land Information New Zealand, Earthstar Geographics, Eagle Technology, Land Information New Zealand, GEBCO, Community maps contributors

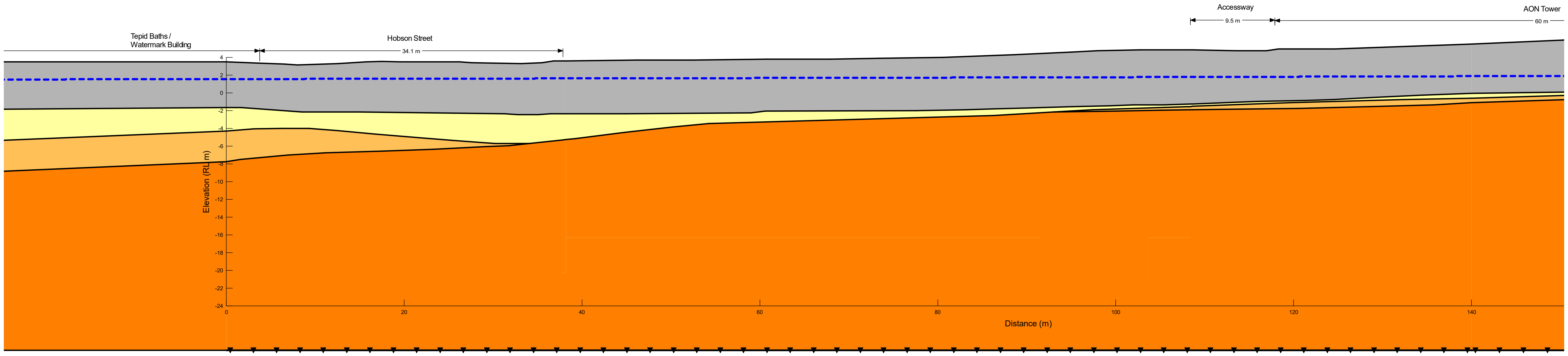

LOCATION PLAN

PROJECT No.	1016043.1000	
DESIGNED	ABL	APR.23
DRAWN	-WEB-	APR.23
CHECKED		
APPROVED	**DATE**	

CLIENT **PRECINCT**
PROJECT **DOWNTOWN CARPARK DEVELOPMENT**
TITLE GROUNDWATER MONITORING INFO
SCALE (A3) 1:1,132   **FIG No.** FIGURE 1.   **REV** 0

Appendix G Groundwater Seepage Analysis

Color	Name	Vol. WC. Function	Ky'/Kx' Ratio
🟧	ECBF rock	ECBF rock	0.1
⬜	Hydraulic Fill	Hydraulic Fill	0.0333
🟨	Marine Sediments	Marine Sediments	0.0333
🟧	Weathered ECBF	Weathered ECBF	0.02



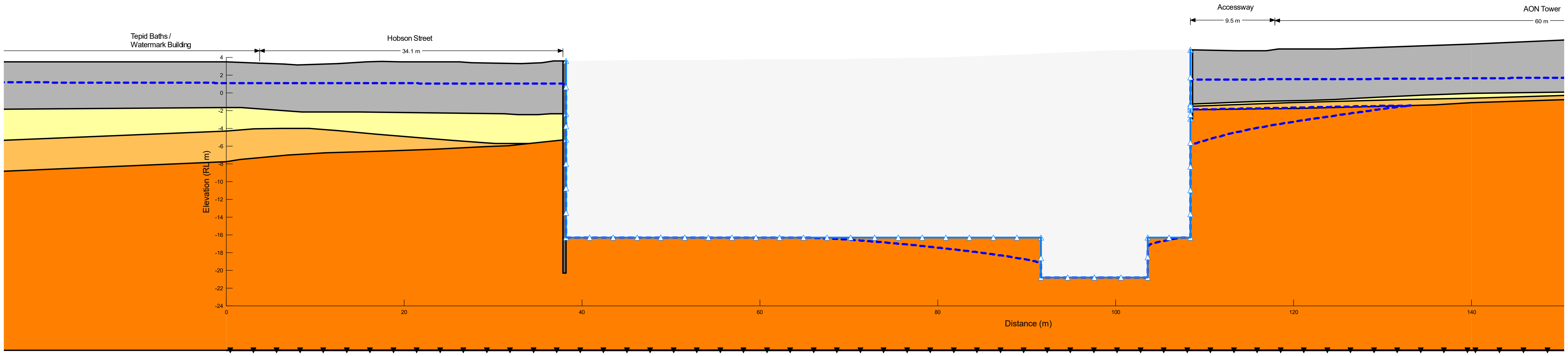
Tonkin+Taylor	Project: 1. Section 1 - South (West to East).gsz	
	Project Number: 1016043.1000	
	A3 Scale: 1:500	Vertical Exaggeration: 1
	Analysed by: Ric Wilkinson	Checked By: Ananth Balachandra

Analysis Details:
1. Analysis Scenario: 1a. Existing Condition
2. Method: Steady-State
3. Elapsed Time: 0 d

Analysis Description:

Directory: C:\Users\rxsw\OneDrive - Tonkin + Taylor Group Ltd\Desktop\Downtown Carpark - SEEPW\Rev3 - July24\

Color	Name	Sat Kx (m/sec)	Vol. WC. Function	Ky'/Kx' Ratio
🟧	ECBF rock		ECBF rock	0.1
⬜	Hydraulic Fill		Hydraulic Fill	0.0333
🟨	Marine Sediments		Marine Sediments	0.0333
⬛	Secant (construction)	1e-10		1
🟪	Sheetpiles	8.4e-09		1
🟧	Weathered ECBF		Weathered ECBF	0.02



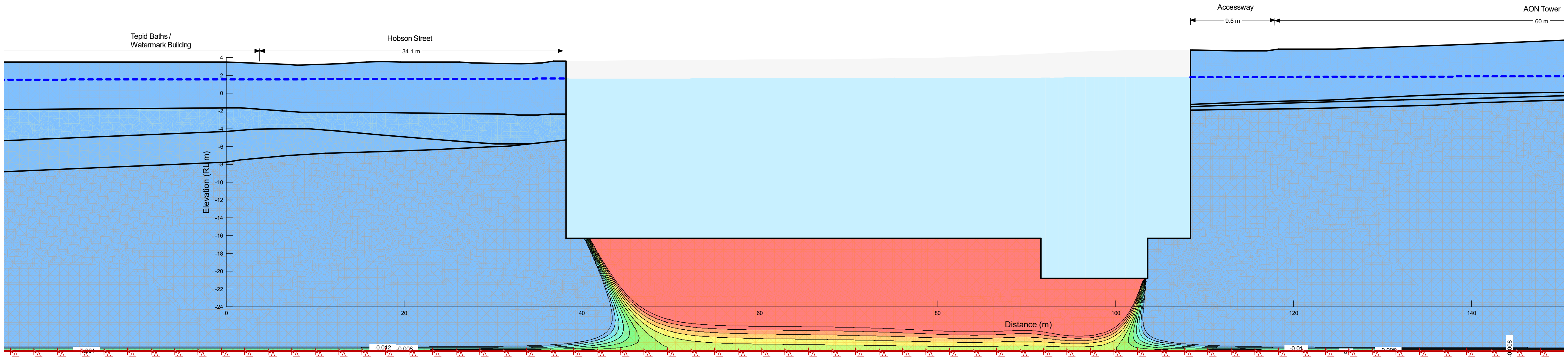
Tonkin+Taylor	Project: 1. Section 1 - South (West to East).gsz	
	Project Number: 1016043.1000	
	A3 Scale: 1:500	Vertical Exaggeration: 1
	Analysed by: Ric Wilkinson	Checked By: Ananth Balachandra

Analysis Details:
1. Analysis Scenario: 1b. Temporary Excavation
2. Method: Transient
3. Elapsed Time: 365 d

Analysis Description:

Directory: C:\Users\rxsw\OneDrive - Tonkin + Taylor Group Ltd\Desktop\Downtown Carpark - SEEPW\Rev3 - July24\

Color	Name	Stress Material Model	Unit Weight (kN/m³)	Effective Elastic Modulus (kPa)	Effective Poisson's Ratio	K0	Vol. WC. Function	Ky'/Kx' Ratio
🟧	ECBF rock	Isotropic Elastic	21	200,000	0.3	1	ECBF rock	0.1
⬜	Hydraulic Fill	Isotropic Elastic	16	6,000	0.35	1	Hydraulic Fill	0.0333
🟨	Marine Sediments	Isotropic Elastic	16	6,000	0.35	1	Marine Sediments	0.0333
🟧	Weathered ECBF	Isotropic Elastic	19	40,000	0.3	1	Weathered ECBF	0.02



Project: 1. Section 1 - South (West to East).gsz

Project Number: 1016043.1000

A3 Scale: 1:500

Vertical Exaggeration: 1

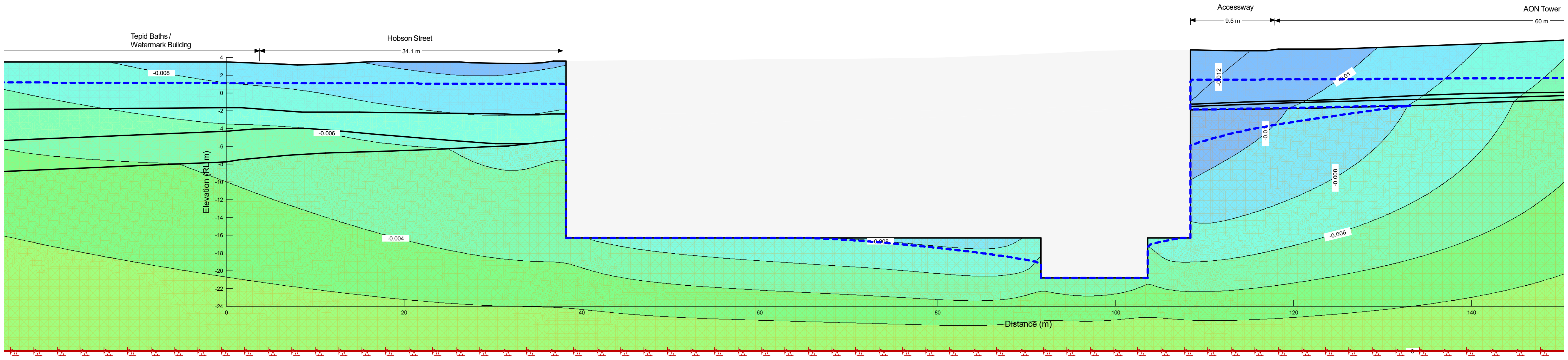
Analysed by: Ric Wilkinson

Checked By: Ananth Balachandra

Analysis Description:

Directory: C:\Users\rxsw\OneDrive - Tonkin + Taylor Group Ltd\Desktop\Downtown Carpark - SEEPW\Rev3 - July24\

Color	Name	Stress Material Model	Unit Weight (kN/m³)	Effective Elastic Modulus (kPa)	Effective Poisson's Ratio	K0	Vol. WC. Function	Ky'/Kx' Ratio
🟧	ECBF rock	Isotropic Elastic	21	200,000	0.3	1	ECBF rock	0.1
⬜	Hydraulic Fill	Isotropic Elastic	16	6,000	0.35	1	Hydraulic Fill	0.0333
🟨	Marine Sediments	Isotropic Elastic	16	6,000	0.35	1	Marine Sediments	0.0333
🟧	Weathered ECBF	Isotropic Elastic	19	40,000	0.3	1	Weathered ECBF	0.02

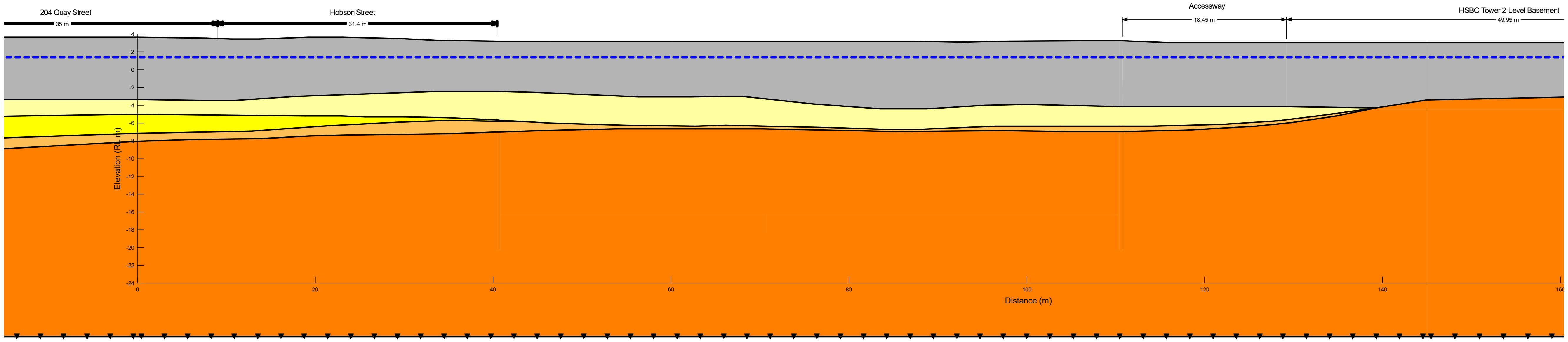


Project: 1. Section 1 - South (West to East).gsz	
Project Number: 1016043.1000	
A3 Scale: 1:500	Vertical Exaggeration: 1
Analysed by: Ric Wilkinson	Checked By: Ananth Balachandra

Analysis Description: Ground settlement profile due to groundwater drawdown

Directory: C:\Users\rxsw\OneDrive - Tonkin + Taylor Group Ltd\Desktop\Downtown Carpark - SEEPW\Rev3 - July24\

Color	Name	Vol. WC. Function	Ky'/Kx' Ratio
🟧	ECBF rock	ECBF rock	0.1
⬜	Hydraulic Fill	Hydraulic Fill	0.0333
🟨	Marine Sediments	Marine Sediments	0.0333
🟨	Pleistocene Alluvium	Pleistocene Alluvium	0.02
🟧	Weathered ECBF	Weathered ECBF	0.02



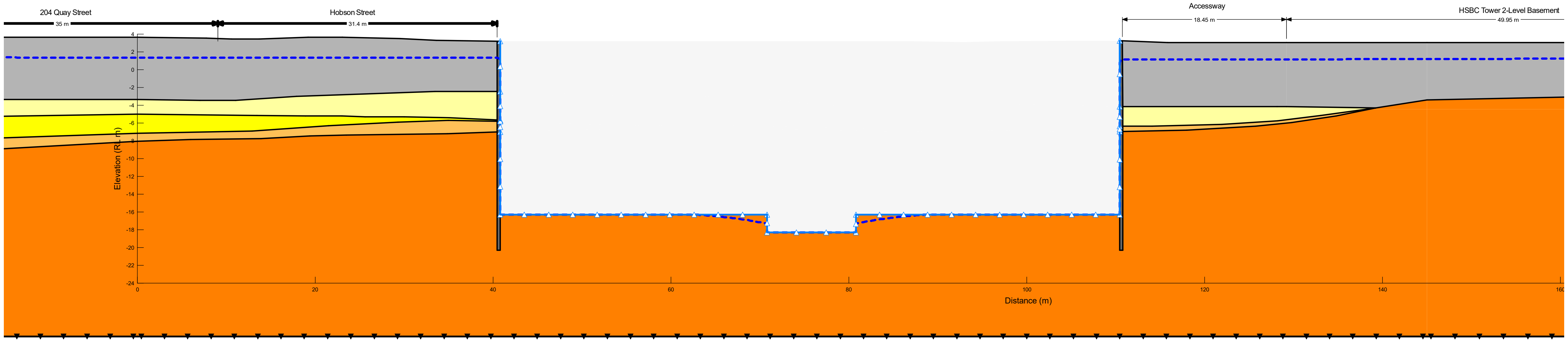
Project: 2. Section 2 - North (West to East).gsz	
Project Number: 1016043.1000	
A3 Scale: 1:500	Vertical Exaggeration: 1
Analysed by: Ric Wilkinson	Checked By: Ananth Balachandra

Analysis Details:
1. Analysis Scenario: 1a. Existing Condition
2. Method: Steady-State
3. Elapsed Time: 0 d

Analysis Description:

Directory: C:\Users\rxsw\OneDrive - Tonkin + Taylor Group Ltd\Desktop\Downtown Carpark - SEEPW\Rev4 - S92\

Color	Name	Sat Kx (m/sec)	Vol. WC. Function	Ky'/Kx' Ratio
🟧	ECBF rock		ECBF rock	0.1
⬜	Hydraulic Fill		Hydraulic Fill	0.0333
🟨	Marine Sediments		Marine Sediments	0.0333
🟨	Pleistocene Alluvium		Pleistocene Alluvium	0.02
⬛	Secant (construction)	1e-10		1
🟧	Weathered ECBF		Weathered ECBF	0.02



Tonkin+Taylor

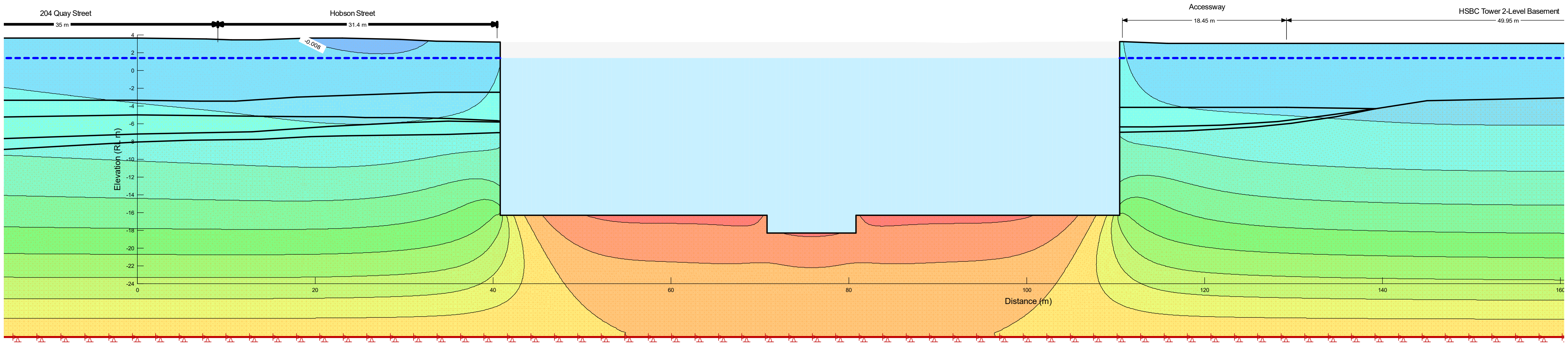
Project: 2. Section 2 - North (West to East).gsz	
Project Number: 1016043.1000	
A3 Scale: 1:500	Vertical Exaggeration: 1
Analysed by: Ric Wilkinson	Checked By: Ananth Balachandra

Analysis Details:
1. Analysis Scenario: 1b. Temporary Excavation
2. Method: Transient
3. Elapsed Time: 365 d

Analysis Description:

Directory: C:\Users\rxsw\OneDrive - Tonkin + Taylor Group Ltd\Desktop\Downtown Carpark - SEEPW\Rev4 - S92\

Color	Name	Stress Material Model	Unit Weight (kN/m³)	Effective Elastic Modulus (kPa)	Effective Poisson's Ratio	K0	Vol. WC. Function	Ky'/Kx' Ratio
🟧	ECBF rock	Isotropic Elastic	21	200,000	0.3	1	ECBF rock	0.1
▨	Hydraulic Fill	Isotropic Elastic	16	6,000	0.35	1	Hydraulic Fill	0.0333
🟨	Marine Sediments	Isotropic Elastic	16	6,000	0.35	1	Marine Sediments	0.0333
🟨	Pleistocene Alluvium	Isotropic Elastic	17.5	20,000	0.35	1	Pleistocene Alluvium	0.02
🟧	Weathered ECBF	Isotropic Elastic	19	40,000	0.3	1	Weathered ECBF	0.02

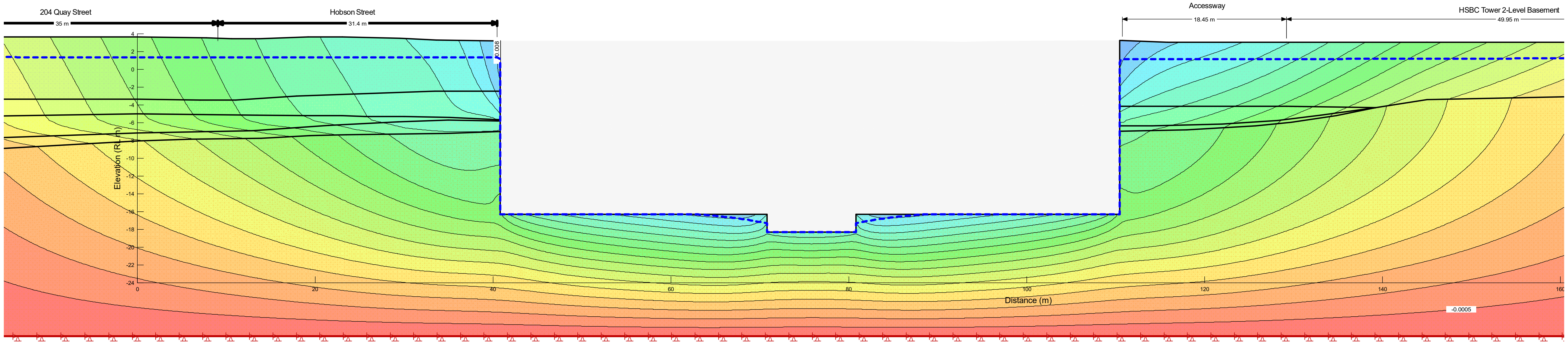


Project: 2. Section 2 - North (West to East).gsz
Project Number: 1016043.1000
A3 Scale: 1:500
Vertical Exaggeration: 1
Analysed by: Ric Wilkinson
Checked By: Ananth Balachandra

Analysis Description:

Directory: C:\Users\rxsw\OneDrive - Tonkin + Taylor Group Ltd\Desktop\Downtown Carpark - SEEPW\Rev4 - S92\

Color	Name	Stress Material Model	Unit Weight (kN/m³)	Effective Elastic Modulus (kPa)	Effective Poisson's Ratio	K0	Vol. WC. Function	Ky'/Kx' Ratio
🟧	ECBF rock	Isotropic Elastic	21	200,000	0.3	1	ECBF rock	0.1
▨	Hydraulic Fill	Isotropic Elastic	16	6,000	0.35	1	Hydraulic Fill	0.0333
🟨	Marine Sediments	Isotropic Elastic	16	6,000	0.35	1	Marine Sediments	0.0333
🟨	Pleistocene Alluvium	Isotropic Elastic	17.5	20,000	0.35	1	Pleistocene Alluvium	0.02
🟧	Weathered ECBF	Isotropic Elastic	19	40,000	0.3	1	Weathered ECBF	0.02



Tonkin+Taylor

Project: 2. Section 2 - North (West to East).gsz	
Project Number: 1016043.1000	
A3 Scale: 1:500	Vertical Exaggeration: 1
Analysed by: Ric Wilkinson	Checked By: Ananth Balachandra

Analysis Details:
1. Analysis Scenario: Load/Deformation
2. Method: Load/Deformation
3. Elapsed Time: 1 d
4. Initial Stress and PWP Conditions from Parent Analysis: In Situ [(last)]
5. Final PWP Conditions from Other GeoStudio Analysis: 1b. Temporary Excavation [(last)]

Analysis Description:

Directory: C:\Users\rxsw\OneDrive - Tonkin + Taylor Group Ltd\Desktop\Downtown Carpark - SEEPW\Rev4 - S92\

Appendix H Basement Retention Analysis

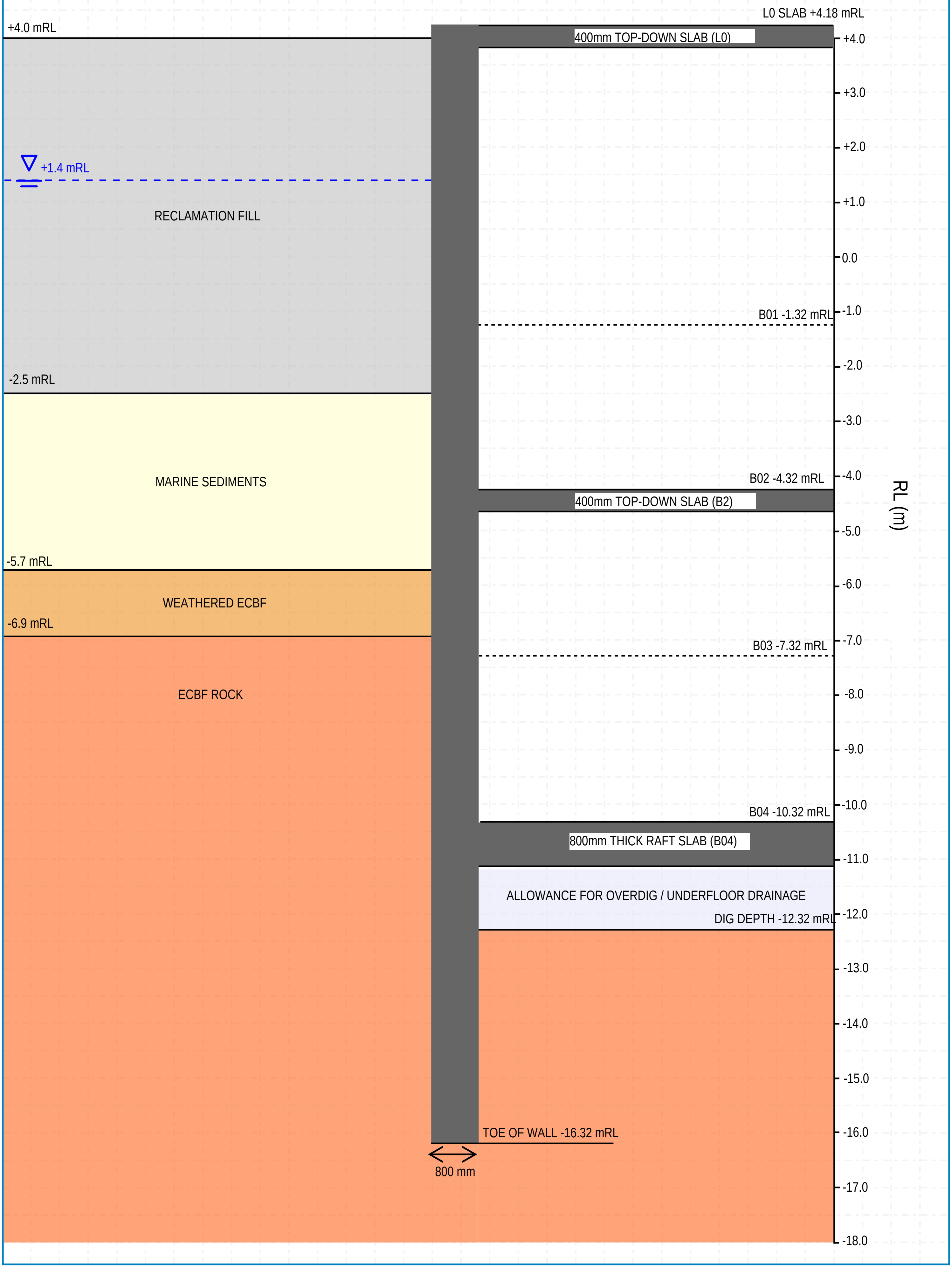
ADDRESS: DOWNTOWN CARPARK

TITLE

T+T JOB No. 1016043.1000

DESCRIPTION: SECTION 1 - TOP-DOWN CONSTRUCTION

SHEET 1 **of** 1



```
TONKIN + TAYLOR LTD                                         | Sheet No.
Program: WALLAP  Version 6.09  Revision A60.B77.R61         | Job No. 1016043
                             Licensed from GEOSOLVE         | Made by :  rxsw
Data filename/Run ID: 1-1_North_800DWall_topdown_B4         |
Downtown Carpark Redevelopment                              | Date:23-10-2025
800mm D-Wall - Top Down Only (B4)                           | Checked :
-----------------------------------------------------------------------------
                                                       Units: kN,m
INPUT DATA

SOIL PROFILE
Stratum   Elevation of    ------------------ Soil types -------------------
  no.    top of stratum    Left side                 Right side
   1          4.00       1  Fill                   1  Fill
   2         -2.50       2  Marine Sediment        2  Marine Sediment
   3         -5.70       5  Weathered ECBF         3  Pleistocene Alluvium
   4         -6.90       4  ECBF                   4  ECBF

SOIL PROPERTIES
                       Bulk    Young's   At rest  Consol  Active  Passive
-- Soil type --      density  Modulus    coeff.  state.   limit    limit   Cohesion
No. Description       kN/m3  Eh,kN/m2     Ko     NC/OC    Ka       Kp      kN/m2
  (Datum elev.)              (dEh/dy ) (dKo/dy) (  Nu ) ( Kac ) (  Kpc ) ( dc/dy )
 1  Fill              16.50      6000    0.530     OC    0.309    3.868     3.000d
                                                (0.300) (1.300) ( 5.395)
 2  Marine            16.50      6000    0.530     OC    0.309    4.369     3.000d
    Sediment                                    (0.300) (1.300) ( 5.836)
 3  Pleistocene        17.50     20000    0.500     OC    0.283    4.369     5.000d
    Alluvium                                    (0.300) (1.241) ( 5.836)
 4  ECBF              21.00    400000    0.357     OC    0.180    8.892     100.0d
                                                (0.250) (0.978) ( 9.405)
 5  Weathered         19.00     40000    0.470     OC    0.259    4.964     7.000d
    ECBF                                        (0.300) (1.185) ( 6.343)
 6  Engineered        19.00     40000    0.384     OC    0.197    7.588       0.0d
    Fill                                        (0.300) (1.027) ( 8.432)

Additional soil parameters associated with Ka and Kp
                              --- parameters for Ka ---  --- parameters for Kp ---
                                Soil      Wall    Back-    Soil      Wall    Back-
------- Soil type ------- friction  adhesion  fill   friction  adhesion  fill
No. Description             angle     coeff.   angle    angle     coeff.   angle
 1  Fill                    28.00     0.670    0.00     28.00     0.500    0.00
 2  Marine Sediment         28.00     0.670    0.00     30.00     0.500    0.00
 3  Pleistocene Alluvium    30.00     0.670    0.00     30.00     0.500    0.00
 4  ECBF                    40.00     0.670    0.00     40.00     0.500    0.00
 5  Weathered ECBF          32.00     0.670    0.00     32.00     0.500    0.00
 6  Engineered Fill         38.00     0.670    0.00     38.00     0.500    0.00

GROUND WATER CONDITIONS
 Density of water = 10.00 kN/m3
                                   Left side     Right side
 Initial water table elevation       1.40           1.40

 Automatic water pressure balancing at toe of wall :  No

 Water             Left side                     Right side
 press. ------------------------------  ------------------------------
profile Point   Elev.    Piezo   Water   Point   Elev.     Piezo   Water
  no.    no.             elev.   press.   no.              elev.   press.
                  m        m     kN/m2              m        m     kN/m2
   1      1      1.40     1.40     0.0     1     -5.00    -5.00     0.0

   2      1      1.40     1.40     0.0     1    -12.32   -12.32     0.0
```

```
          2    -5.90     1.40    73.0
          3   -20.30   -11.30    90.0

   3      1      2.50     2.50     0.0     1    -11.12   -11.12     0.0

   4      1      1.40     1.40     0.0     1    -11.12   -11.12     0.0
===========================================================================
WALL PROPERTIES
                          Type of structure = Fully Embedded Wall
                   Elevation of toe of wall = -16.32
              Maximum finite element length =   1.20 m
                   Youngs modulus of wall E = 2.7400E+07 kN/m2
                 Moment of inertia of wall I = 0.042700 m4/m run
                                        E.I = 1.1700E+06 kN.m2/m run
                       Yield Moment of wall = Not defined

STRUTS and ANCHORS
                       Cross-                    Inclin    Pre-  Strut  Allow
Prop         Prop     section   Youngs    Free   -ation  stress   or   tension
 no.  Elev. spacing     area    modulus  length  (degs)   /prop Anchor    ?   L/R
                m       sq.m     kN/m2      m              kN
 1     4.00    1.00  0.400000  2.740E+07  30.00    0.00     0    Strut    No   R
 2    -1.40    1.00  0.200000  2.740E+07  30.00    0.00     0    Strut    No   R
 3    -4.50    1.00  0.400000  2.740E+07  30.00    0.00     0    Strut    No   R
 4    -7.40    1.00  0.200000  2.740E+07  30.00    0.00     0    Strut    No   R
 5   -10.70    1.00  0.800000  2.740E+07  30.00    0.00     0    Strut    No   R

HORIZONTAL and MOMENT LOADS/RESTRAINTS
 Load            Horizontal    Moment      Moment     Partial
  no.  Elevation    load        load      restraint   factor
                  kN/m run  kN.m/m run  kN.m/m/rad  (Category)
   1     -9.60       51.10      0           0         n/a
   2     -8.20       51.10      0           0         n/a
   3     -6.70       51.10      0           0         n/a
   4     -5.30       51.10      0           0         n/a
   5     -3.90       51.10      0           0         n/a
   6     -2.40       51.10      0           0         n/a
   7     -1.00       51.10      0           0         n/a
   8      0.40       51.10      0           0         n/a
   9      1.90       51.10      0           0         n/a
  10      3.30       51.10      0           0         n/a

SURCHARGE LOADS
             Distance  Length    Width   Surcharge(kN/m2) Surcharge  Part  Short Q
  Surcharge    from   parallel  perpend.   Near    Far        Soil  fact.  reduc.
 no.   Elev.   wall   to wall   to wall    edge    edge   Cat. type         fact.
  1    4.00  2.00(L)  100.00    20.00     12.00     =      --   --    --     --

    Note: L = Left side,  R = Right side
===========================================================================
CONSTRUCTION STAGES
Construction   Stage description
  stage no.    -----------------------------------------------------
      1        Change EI of wall to 877500 kN.m2/m run
               Reset wall displacements to zero at this stage
      2        Apply surcharge no.1 at elevation 4.00
      3        Install strut or anchor no.1 at elevation 4.00
      4        Apply water pressure profile no.1
               No analysis at this stage
      5        Excavate to elevation -5.00 on RIGHT side
      6        Install strut or anchor no.3 at elevation -4.50
      7        Apply water pressure profile no.2
               No analysis at this stage
```

```
      8        Excavate to elevation -12.32 on RIGHT side
      9        Fill to elevation -11.12 on RIGHT side with soil type 2
     10        Install strut or anchor no.5 at elevation -10.70
     11        Install strut or anchor no.4 at elevation -7.40
     12        Install strut or anchor no.2 at elevation -1.40
     13        Change EI of wall to 585000 kN.m2/m run
               Allow wall to relax with new modulus value
     14        Apply water pressure profile no.3
     15        Apply water pressure profile no.4
     16        Change EI of wall to 292500 kN.m2/m run
               Allow wall to relax with new modulus value
     17        Apply load no.1 at elevation -9.60
     18        Apply load no.2 at elevation -8.20
     19        Apply load no.3 at elevation -6.70
     20        Apply load no.4 at elevation -5.30
     21        Apply load no.5 at elevation -3.90
     22        Apply load no.6 at elevation -2.40
     23        Apply load no.7 at elevation -1.00
     24        Apply load no.8 at elevation 0.40
     25        Apply load no.9 at elevation 1.90
     26        Apply load no.10 at elevation 3.30
```

FACTORS OF SAFETY and ANALYSIS OPTIONS

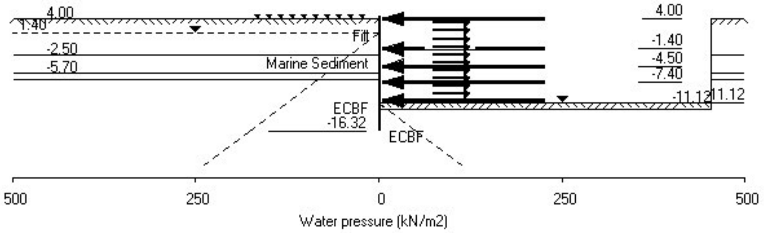
```
 Stability analysis:
  Method of analysis  -  Strength Factor method
  Factor on soil strength for calculating wall depth = 1.00

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

 Bending moment and displacement calculation:
  Method  -  2-D finite element model
  Open Tension Crack analysis? - No
  Active limit arching modelled?  -  Yes
  Non-linear Modulus Parameter (L) = 20.00 m

 Boundary conditions:
  Length of wall (normal to plane of analysis) = 1000.00 m

  Width of excavation/fill on Left  side of wall  = 60.00 m
  Width of excavation/fill on Right side of wall  = 60.00 m

  Distance to rigid boundary on Left side  = 60.00 m
  Distance to rigid boundary on Right side = 60.00 m
  Elevation of rigid lower boundary = -44.50

  Lower rigid boundary at elevation -44.50 - Rough
  Rigid boundary on Left side           - Rough
  Rigid boundary on Right side          - Smooth
  Soil-wall interface                   - Smooth

===========================================================================
```

OUTPUT OPTIONS

```
 Stage ------ Stage description ----------- ------- Output options -------
  no.                                       Displacement   Active,  Graph.
                                            Bending mom.   Passive  output
                                            Shear force   pressures
   1 Change EI of wall to 877500kN.m2/m run      No           No      No
   2 Apply surcharge no.1 at elev. 4.00          No           No      No
   3 Install prop no.1 at elev. 4.00             No          Yes      No
   4 Apply water pressure profile no.1           No           No      No
   5 Excav. to elev. -5.00 on RIGHT side        Yes           No      No
   6 Install prop no.3 at elev. -4.50            No           No      No
   7 Apply water pressure profile no.2           No           No      No
   8 Excav. to elev. -12.32 on RIGHT side       Yes          Yes     Yes
   9 Fill to elev. -11.12 on RIGHT side          No           No      No
  10 Install prop no.5 at elev. -10.70          Yes          Yes     Yes
  11 Install prop no.4 at elev. -7.40           Yes          Yes     Yes
  12 Install prop no.2 at elev. -1.40            No          Yes      No
  13 Change EI of wall to 585000kN.m2/m run      No           No      No
  14 Apply water pressure profile no.3           No           No      No
  15 Apply water pressure profile no.4           No           No      No
  16 Change EI of wall to 292500kN.m2/m run      No           No      No
  17 Apply load no.1 at elev. -9.60              No           No      No
  18 Apply load no.2 at elev. -8.20              No           No      No
  19 Apply load no.3 at elev. -6.70              No           No      No
  20 Apply load no.4 at elev. -5.30              No           No      No
  21 Apply load no.5 at elev. -3.90              No           No      No
  22 Apply load no.6 at elev. -2.40              No           No      No
  23 Apply load no.7 at elev. -1.00              No           No      No
  24 Apply load no.8 at elev. 0.40              Yes           No      No
  25 Apply load no.9 at elev. 1.90               No           No      No
  26 Apply load no.10 at elev. 3.30              No           No      No
   * Summary output                             Yes           -      Yes
```

```
Program WALLAP - Copyright (C) 2024 by DL Borin,  distributed by GEOSOLVE
         150 St. Alphonsus Road, London SW4 7BW, UK
www.geosolve.co.uk==================================================================
=====TONKIN + TAYLOR LTD                                          | Sheet No.
Program: WALLAP  Version 6.09  Revision A60.B77.R61         | Job No. 1016043
                             Licensed from GEOSOLVE         | Made by :  rxsw
Data filename/Run ID: 1-1_North_800DWall_topdown_B4         |
Downtown Carpark Redevelopment                              | Date:23-10-2025
800mm D-Wall - Top Down Only (B4)                           | Checked :
------------------------------------------------------------------------------
                                                       Units: kN,m
```

Stage No.26   Apply load no.10 at elev. 3.30



```
===========================================================================TONKIN +
TAYLOR LTD                                          | Sheet No.
Program: WALLAP  Version 6.09  Revision A60.B77.R61          | Job No. 1016043
                             Licensed from GEOSOLVE          | Made by :  rxsw
Data filename/Run ID: 1-1_North_800DWall_topdown_B4          |
Downtown Carpark Redevelopment                               | Date:23-10-2025
800mm D-Wall - Top Down Only (B4)                            | Checked :
-----------------------------------------------------------------------------
                                                        Units: kN,m
Stage No. 1   Change EI of wall to 877500 kN.m2/m run
              Reset wall displacements to zero at this stage

STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method
 Factor of safety on soil strength

                             FoS for toe         Toe elev. for
                            elev. =  -16.32       FoS = 1.000
 Stage  Ground level    Prop   Factor  Moment      Toe    Wall     Direction
```

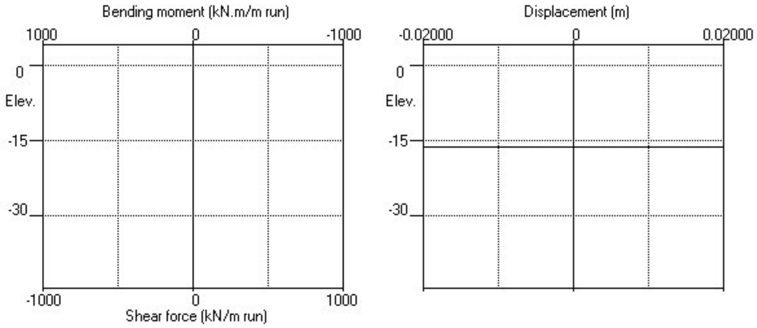
```
  No.   Act.   Pass.    Elev.   of     equilib.   elev.  Penetr        of
                               Safety  at elev.          -ation      failure
   1    4.00    4.00    Cant.  Conditions not suitable for FoS calc.


BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall
  Analysis options
  2-D finite element model.    Active limit arching modelled.
  Soil deformations are elastic until the active or passive limit is reached
  Open Tension Crack analysis - No

  Length of wall perpendicular to section = 1000.00m
  Rigid boundaries:     Left side 60.00m from wall                Rough
                       Right side 60.00m from wall               Smooth
               Lower boundary at elevation -44.50m                Rough
                               Soil-wall interface                Smooth

    *** Wall displacements reset to zero at stage 1

 Node   Y      Nett        Wall     Wall       Shear   Bending    Prop      EI of
 no.  coord  pressure      disp.  rotation     force   moment    forces      wall
               kN/m2         m       rad.       kN/m    kN.m/m    kN/m    kN.m2/m
  1    4.00     0.01     -0.000  -5.57E-07      0.0      -0.0               877500
  2    3.30     0.02     -0.000  -5.58E-07      0.0       0.0               877500
  3    2.50     0.02     -0.000  -5.67E-07      0.0       0.0               877500
  4    1.90     0.02     -0.000  -5.84E-07      0.0       0.0               877500
  5    1.40     0.02     -0.000  -6.11E-07      0.1       0.1               877500
  6    0.40     0.03     -0.000  -7.13E-07      0.1       0.1               877500
  7   -0.30     0.03     -0.000  -8.34E-07      0.1       0.2               877500
  8   -1.00     0.03     -0.000  -1.00E-06      0.1       0.3               877500
  9   -1.40     0.03     -0.000  -1.13E-06      0.1       0.3               877500
 10   -2.40     0.03     -0.000  -1.56E-06      0.2       0.4               877500
 11   -2.50     0.03     -0.000  -1.61E-06      0.2       0.5               877500
 12   -3.20     0.04     -0.000  -2.04E-06      0.2       0.6               877500
 13   -3.90     0.04     -0.000  -2.56E-06      0.2       0.7               877500
 14   -4.50     0.04     -0.000  -3.11E-06      0.2       0.9               877500
 15   -5.00     0.04     -0.000  -3.63E-06      0.3       1.0               877500
 16   -5.30     0.04     -0.000  -3.99E-06      0.3       1.1               877500
 17   -5.70     0.04     -0.000  -4.50E-06      0.3       1.2               877500
               -2.45     -0.000  -4.50E-06      0.3       1.2
 18   -6.70    -2.00     -0.000  -5.35E-06     -1.9       0.3               877500
 19   -6.90    -1.92      0.000  -5.38E-06     -2.3      -0.1               877500
                2.95      0.000  -5.38E-06     -2.3      -0.1
 20   -7.40     1.71      0.000  -5.09E-06     -1.2      -0.9               877500
 21   -8.20     0.83      0.000  -4.09E-06     -0.2      -1.3               877500
 22   -8.90     0.28      0.000  -3.10E-06      0.2      -1.2               877500
 23   -9.60     0.01      0.000  -2.25E-06      0.3      -1.0               877500
 24  -10.70    -0.08      0.000  -1.28E-06      0.3      -0.6               877500
 25  -11.12    -0.10      0.000  -1.03E-06      0.3      -0.5               877500
 26  -12.32    -0.08      0.000  -5.48E-07      0.1      -0.2               877500
 27  -13.36    -0.04      0.000  -3.33E-07      0.1      -0.1               877500
=========================================================================
Run ID. 1-1_North_800DWall_topdown_B4                        | Sheet No.
Downtown Carpark Redevelopment                               | Date:23-10-2025
800mm D-Wall - Top Down Only (B4)                            | Checked :
-----------------------------------------------------------------------------
                                                              (continued)
Stage No.1   Change EI of wall to 877500 kN.m2/m run
              Reset wall displacements to zero at this stage

 Node   Y      Nett        Wall     Wall       Shear   Bending    Prop      EI of
 no.  coord  pressure      disp.  rotation     force   moment    forces      wall
               kN/m2         m       rad.       kN/m    kN.m/m    kN/m    kN.m2/m
```

```
 28  -14.40     -0.02     0.000  -2.19E-07       0.0      -0.1              877500
 29  -15.36     -0.01     0.000  -1.68E-07       0.0      -0.0              877500
 30  -16.32     -0.05     0.000  -1.53E-07       0.0       0.0                   0
 31  -16.47      0.00     0.000          0      -0.0       0.0                   0
 32  -16.77      0.00     0.000          0      -0.0       0.0                   0
 33  -20.39     -0.00     0.000          0      -0.0       0.0                   0
 34  -24.00     -0.00     0.000          0      -0.0       0.0                   0
 35  -28.80     -0.00     0.000          0      -0.0       0.0                   0
 36  -33.60     -0.00     0.000          0      -0.0       0.0                   0
 37  -38.40      0.00     0.000          0      -0.0       0.0                   0
 38  -41.45      0.00     0.000          0      -0.0       0.0                   0
 39  -44.50     -0.00     0.000          0      -0.0       0.0                 ---

                                        LEFT side
                     ____________________________________________________________
                              Effective stresses                Total  Adjusted
Node    Y    Water   Vertic  Active  Passive  Earth             earth    soil
no.   coord  press.   -al    limit    limit   press.            press.  modulus
              kN/m2   kN/m2   kN/m2    kN/m2   kN/m2             kN/m2    kN/m2
  1    4.00    0.00    0.00    0.00    16.18    0.01              0.01     5999
  2    3.30    0.00   11.55    0.00    60.86    6.13              6.13     5999
  3    2.50    0.00   24.75    3.75   111.92   13.13             13.13     5999
  4    1.90    0.00   34.65    6.81   150.22   18.38             18.38     5999
  5    1.40    0.00   42.90    9.36   182.14   22.75             22.75     5999
  6    0.40   10.00   49.40   11.37   207.28   26.20             36.20     5999
  7   -0.30   17.00   53.95   12.77   224.88   28.61             45.61     5999
  8   -1.00   24.00   58.50   14.18   242.48   31.02             55.02     5999
  9   -1.40   28.00   61.10   14.98   252.54   32.40             60.40     5999
 10   -2.40   38.00   67.60   16.99   277.68   35.84             73.84     5999
 11   -2.50   39.00   68.25   17.19   280.20   36.19             75.19     5999
              39.00   68.25   17.19   315.72   36.19             75.19     5999
 12   -3.20   46.00   72.80   18.60   335.60   38.60             84.60     5999
 13   -3.90   53.00   77.35   20.00   355.48   41.01             94.01     5999
 14   -4.50   59.00   81.25   21.21   372.52   43.08            102.08     5999
 15   -5.00   64.00   84.50   22.21   386.72   44.81            108.81     5999
 16   -5.30   67.00   86.45   22.82   395.24   45.84            112.84     5999
 17   -5.70   71.00   89.05   23.62   406.60   47.22            118.22     5999
              71.00   89.05   14.81   486.41   42.00            113.00    39994
 18   -6.70   81.00   98.05   17.15   531.08   46.21            127.21    39994
 19   -6.90   83.00   99.85   17.61   540.02   47.04            130.04    39994
              83.00   99.85    0.00  1828.29   36.76            119.76   399941
 20   -7.40   88.00  105.35    0.00  1877.20   38.13            126.13   399941
 21   -8.20   96.00  114.15    0.00  1955.44   40.83            136.83   399941
 22   -8.90  103.00  121.85    0.00  2023.91   43.31            146.31   399941
 23   -9.60  110.00  129.55    0.00  2092.37   45.93            155.93   399941
 24  -10.70  121.00  141.65    0.00  2199.96   50.20            171.20   399941
 25  -11.12  125.20  146.27    0.00  2241.04   51.84            177.04   399941
 26  -12.32  137.20  159.47    0.00  2358.40   56.57            193.77   399941
 27  -13.36  147.60  170.91    0.00  2460.12   60.67            208.27   399941
 28  -14.40  158.00  182.35    0.00  2561.84   64.77            222.77   399941
 29  -15.36  167.60  192.91    0.00  2655.74   68.54            236.14   399941
 30  -16.32  177.20  203.47    0.00  2749.63   72.29            249.49   399941
 31  -16.47  178.70  205.12    0.00  2764.30   72.91            251.61   399941
 32  -16.77  181.70  208.42    0.00  2793.64   74.08            255.78   399941
 33  -20.39  217.85  248.18    0.00  3147.21   88.28            306.13   399941
 34  -24.00  254.00  287.95    0.00  3500.79  102.48            356.48   399941
 35  -28.80  302.00  340.75    0.00  3970.26  121.33            423.33   399941
```

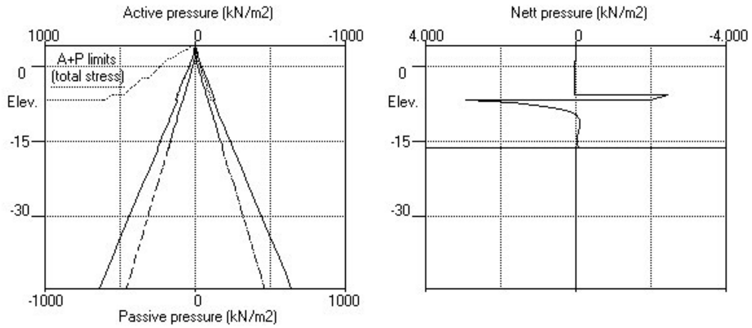
```
Stage No.1   Change EI of wall to 877500 kN.m2/m run
              Reset wall displacements to zero at this stage

                                         LEFT side
             ____________________________________________________________
                         Effective stresses                Total  Adjusted
Node    Y    Water   Vertic  Active  Passive  Earth        earth    soil
no.   coord  press.   -al    limit    limit   press.       press.  modulus
              kN/m2   kN/m2   kN/m2    kN/m2   kN/m2        kN/m2    kN/m2
 36  -33.60  350.00  393.55    0.00  4439.73  140.18       490.18   399941
 37  -38.40  398.00  446.35    0.00  4909.20  159.03       557.03   399941
 38  -41.45  428.50  479.90    0.00  5207.51  171.00       599.50   399941
 39  -44.50  459.00  513.45    0.00  5505.82  182.98       641.98   399941


                                        RIGHT side
             ____________________________________________________________
                         Effective stresses                Total  Adjusted
Node    Y    Water   Vertic  Active  Passive  Earth        earth    soil
no.   coord  press.   -al    limit    limit   press.       press.  modulus
              kN/m2   kN/m2   kN/m2    kN/m2   kN/m2        kN/m2    kN/m2
  1    4.00    0.00    0.00    0.00    16.18    0.00         0.00a    5999
  2    3.30    0.00   11.55    0.00    60.86    6.11         6.11     5999
  3    2.50    0.00   24.75    3.75   111.92   13.11        13.11     5999
  4    1.90    0.00   34.65    6.81   150.22   18.35        18.35     5999
  5    1.40    0.00   42.90    9.36   182.14   22.72        22.72     5999
  6    0.40   10.00   49.40   11.37   207.28   26.17        36.17     5999
  7   -0.30   17.00   53.95   12.77   224.88   28.58        45.58     5999
  8   -1.00   24.00   58.50   14.18   242.48   30.99        54.99     5999
  9   -1.40   28.00   61.10   14.98   252.54   32.37        60.37     5999
 10   -2.40   38.00   67.60   16.99   277.68   35.81        73.81     5999
 11   -2.50   39.00   68.25   17.19   280.20   36.16        75.16     5999
              39.00   68.25   17.19   315.72   36.16        75.16     5999
 12   -3.20   46.00   72.80   18.60   335.60   38.57        84.57     5999
 13   -3.90   53.00   77.35   20.00   355.48   40.98        93.98     5999
 14   -4.50   59.00   81.25   21.21   372.52   43.04       102.04     5999
 15   -5.00   64.00   84.50   22.21   386.72   44.76       108.76     5999
 16   -5.30   67.00   86.45   22.82   395.24   45.80       112.80     5999
 17   -5.70   71.00   89.05   23.62   406.60   47.17       118.17     5999
              71.00   89.05   19.03   418.27   44.45       115.45    19997
 18   -6.70   81.00   96.55   21.15   451.04   48.21       129.21    19997
 19   -6.90   83.00   98.05   21.58   457.60   48.97       131.97    19997
              83.00   98.05    0.00  1812.29   33.82       116.82   399941
 20   -7.40   88.00  103.55    0.00  1861.19   36.42       124.42   399941
 21   -8.20   96.00  112.35    0.00  1939.44   40.01       136.01   399941
 22   -8.90  103.00  120.05    0.00  2007.90   43.03       146.03   399941
 23   -9.60  110.00  127.75    0.00  2076.37   45.92       155.92   399941
 24  -10.70  121.00  139.85    0.00  2183.95   50.29       171.29   399941
 25  -11.12  125.20  144.47    0.00  2225.03   51.95       177.15   399941
 26  -12.32  137.20  157.67    0.00  2342.40   56.65       193.85   399941
 27  -13.36  147.60  169.11    0.00  2444.12   60.71       208.31   399941
 28  -14.40  158.00  180.55    0.00  2545.84   64.79       222.79   399941
 29  -15.36  167.60  191.11    0.00  2639.73   68.55       236.15   399941
 30  -16.32  177.20  201.67    0.00  2733.63   72.34       249.54   399941
 31  -16.47  178.70  203.32    0.00  2748.30   72.91       251.61   399941
 32  -16.77  181.70  206.62    0.00  2777.64   74.08       255.78   399941
 33  -20.39  217.85  246.38    0.00  3131.21   88.28       306.13   399941
 34  -24.00  254.00  286.15    0.00  3484.78  102.48       356.48   399941
 35  -28.80  302.00  338.95    0.00  3954.25  121.33       423.33   399941
 36  -33.60  350.00  391.75    0.00  4423.73  140.18       490.18   399941
 37  -38.40  398.00  444.55    0.00  4893.20  159.03       557.03   399941
 38  -41.45  428.50  478.10    0.00  5191.51  171.00       599.50   399941
 39  -44.50  459.00  511.65    0.00  5489.82  182.98       641.98   399941

===========================================================================
```

```
Run ID. 1-1_North_800DWall_topdown_B4                       | Sheet No.
Downtown Carpark Redevelopment                              | Date:23-10-2025
800mm D-Wall - Top Down Only (B4)                           | Checked :
-----------------------------------------------------------------------------
                                                              (continued)
Stage No.1   Change EI of wall to 877500 kN.m2/m run
              Reset wall displacements to zero at this stage
Note:      0.00 a  Soil pressure at active limit
         123.45 p  Soil pressure at passive limit
 =========================================================================TONKIN +
TAYLOR LTD                                         | Sheet No.
Program: WALLAP  Version 6.09  Revision A60.B77.R61         | Job No. 1016043
                             Licensed from GEOSOLVE         | Made by :  rxsw
Data filename/Run ID: 1-1_North_800DWall_topdown_B4         |
Downtown Carpark Redevelopment                              | Date:23-10-2025
800mm D-Wall - Top Down Only (B4)                           | Checked :
-----------------------------------------------------------------------------
                                                       Units: kN,m
```

Stage No.1 Change EI of wall to 877500kN.m2/m run



Stage No.1 Change EI of wall to 877500kN.m2/m run



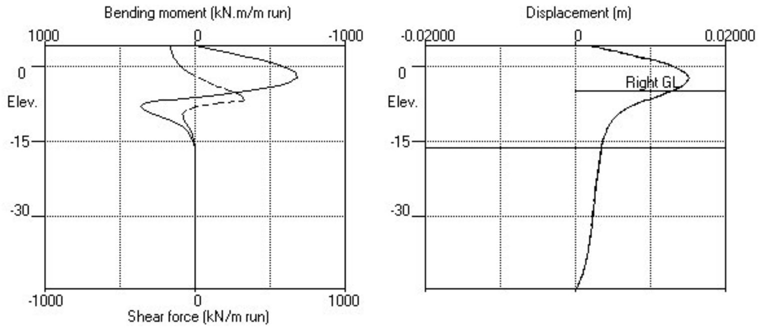
```
=========================================================================TONKIN +
TAYLOR LTD                                         | Sheet No.
Program: WALLAP  Version 6.09  Revision A60.B77.R61         | Job No. 1016043
                             Licensed from GEOSOLVE         | Made by :  rxsw
Data filename/Run ID: 1-1_North_800DWall_topdown_B4         |
Downtown Carpark Redevelopment                              | Date:23-10-2025
800mm D-Wall - Top Down Only (B4)                           | Checked :
-----------------------------------------------------------------------------
                                                       Units: kN,m
Stage No. 5   Excavate to elevation -5.00 on RIGHT side

STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method
 Factor of safety on soil strength

                                FoS for toe       Toe elev. for
                               elev. =  -16.32     FoS = 1.000
 Stage  Ground level    Prop   Factor  Moment      Toe     Wall     Direction
  No.   Act.   Pass.    Elev.    of    equilib.   elev.   Penetr       of
                               Safety  at elev.           -ation     failure
   5    4.00   -5.00     4.00   4.796     n/a     -7.14     2.14      L to R


BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall
  Analysis options
  2-D finite element model.    Active limit arching modelled.
  Soil deformations are elastic until the active or passive limit is reached
  Open Tension Crack analysis - No

  Length of wall perpendicular to section = 1000.00m
  Rigid boundaries:      Left side 60.00m from wall                 Rough
                        Right side 60.00m from wall                Smooth
                Lower boundary at elevation -44.50m                 Rough
                                Soil-wall interface                 Smooth

    *** Wall displacements reset to zero at stage 1

 Node   Y      Nett       Wall      Wall      Shear   Bending   Prop      EI of
```

```
 no.  coord  pressure     disp.   rotation    force   moment    forces     wall
                kN/m2       m        rad.      kN/m    kN.m/m     kN/m  kN.m2/m
  1    4.00     12.47     0.002  -3.20E-03   -177.9       0.0   -177.9   877500
  2    3.30     13.14     0.004  -3.15E-03   -168.9    -121.0            877500
  3    2.50     16.23     0.007  -2.98E-03   -157.2    -251.1            877500
  4    1.90     18.77     0.009  -2.78E-03   -146.7    -342.2            877500
  5    1.40     20.69     0.010  -2.57E-03   -136.8    -413.0            877500
  6    0.40     32.27     0.012  -2.02E-03   -110.3    -537.1            877500
  7   -0.30     39.86     0.013  -1.57E-03    -85.1    -605.6            877500
  8   -1.00     48.31     0.014  -1.07E-03    -54.2    -654.7            877500
  9   -1.40     52.84     0.015  -7.68E-04    -34.0    -672.3            877500
 10   -2.40     66.06     0.015   7.28E-07     25.4    -677.6            877500
 11   -2.50     67.11     0.015   7.77E-05     32.1    -674.8            877500
 12   -3.20     76.62     0.015   6.00E-04     82.4    -635.1            877500
 13   -3.90     86.28     0.014   1.07E-03    139.4    -557.8            877500
 14   -4.50     94.64     0.014   1.42E-03    193.7    -458.1            877500
 15   -5.00    101.49     0.013   1.65E-03    242.7    -349.2            877500
                83.99     0.013   1.65E-03    242.7    -349.2
 16   -5.30     81.45     0.012   1.75E-03    267.6    -272.6            877500
 17   -5.70     84.04     0.012   1.85E-03    300.7    -159.0            877500
                22.36     0.012   1.85E-03    300.7    -159.0
 18   -6.70     24.35     0.010   1.86E-03    324.0     152.9            877500
 19   -6.90     28.78     0.009   1.81E-03    329.3     218.2            877500
              -448.13     0.009   1.81E-03    329.3     218.2
 20   -7.40   -254.21     0.008   1.66E-03    153.7     326.8            877500
 21   -8.20   -129.05     0.007   1.34E-03      0.4     368.5            877500
 22   -8.90    -51.64     0.006   1.06E-03    -62.8     337.2            877500
 23   -9.60    -11.48     0.006   8.19E-04    -84.9     280.5            877500
 24  -10.70     15.88     0.005   5.30E-04    -82.5     180.2            877500
 25  -11.12     26.70     0.005   4.52E-04    -73.5     147.0            877500
 26  -12.32     21.93     0.004   2.98E-04    -44.4      77.9            877500
 27  -13.36     12.80     0.004   2.26E-04    -26.3      43.6            877500
===========================================================================
Run ID. 1-1_North_800DWall_topdown_B4                        | Sheet No.
Downtown Carpark Redevelopment                               | Date:23-10-2025
800mm D-Wall - Top Down Only (B4)                            | Checked :
-----------------------------------------------------------------------------
                                                              (continued)
Stage No.5   Excavate to elevation -5.00 on RIGHT side

 Node   Y      Nett       Wall      Wall      Shear   Bending   Prop      EI of
 no.  coord  pressure     disp.   rotation    force   moment    forces     wall
                kN/m2       m        rad.      kN/m    kN.m/m     kN/m  kN.m2/m
 28  -14.40      5.83     0.004   1.86E-04    -16.6      23.2            877500
 29  -15.36      3.63     0.004   1.68E-04    -12.1       9.9            877500
 30  -16.32     18.62     0.003   1.63E-04     -1.4       0.0                 0
 31  -16.47      0.00     0.003          0      0.0       0.0                 0
 32  -16.77      0.10     0.003          0      0.0       0.0                 0
 33  -20.39      0.02     0.003          0      0.2       0.0                 0
 34  -24.00      0.08     0.003          0      0.4       0.0                 0
 35  -28.80      0.03     0.002          0      0.7       0.0                 0
 36  -33.60      0.02     0.002          0      0.8       0.0                 0
 37  -38.40     -0.12     0.001          0      0.5       0.0                 0
 38  -41.45      0.01     0.001          0      0.4       0.0                 0
 39  -44.50     -0.25     0.000          0      0.0       0.0               ---
 At elev.    4.00                Prop force =    177.9 kN/m run

                                          LEFT side
                           Effective stresses          Total  Adjusted
 Node   Y    Water   Vertic  Active  Passive  Earth    earth     soil
 no.  coord  press.    -al   limit   limit   press.   press.  modulus
              kN/m2   kN/m2   kN/m2    kN/m2   kN/m2    kN/m2    kN/m2
  1    4.00    0.00    0.00    0.00   16.18   12.47   12.47     5999
```

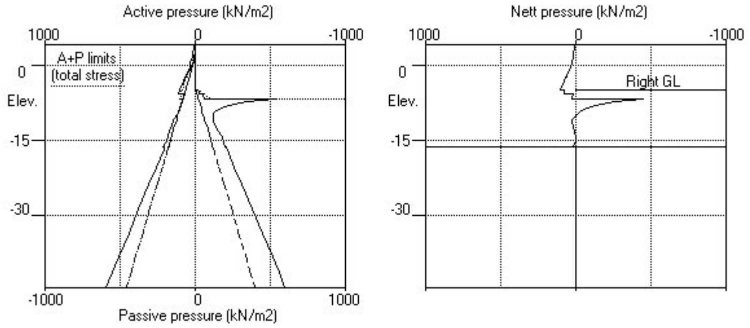
```
  2    3.30    0.00   11.74    0.00   61.60   13.14   13.14     5999
  3    2.50    0.00   26.00    4.14  116.75   16.23   16.23     5999
  4    1.90    0.00   37.02    7.54  159.38   18.77   18.77     5999
  5    1.40    0.00   46.19   10.38  194.86   20.69   20.69     5999
  6    0.40   10.00   54.26   12.87  226.08   22.27   32.27     5999
  7   -0.30   17.00   59.67   14.54  246.99   22.86   39.86     5999
  8   -1.00   24.00   64.90   16.16  267.24   24.31   48.31     5999
  9   -1.40   28.00   67.83   17.06  278.57   24.84   52.84     5999
 10   -2.40   38.00   74.99   19.28  306.28   28.06   66.06     5999
 11   -2.50   39.00   75.70   19.49  309.01   28.11   67.11     5999
              39.00   75.70   19.49  348.27   28.11   67.11     5999
 12   -3.20   46.00   80.60   21.01  369.66   30.62   76.62     5999
 13   -3.90   53.00   85.43   22.50  390.77   33.28   86.28     5999
 14   -4.50   59.00   89.52   23.77  408.67   35.64   94.64     5999
 15   -5.00   64.00   92.91   24.81  423.47   37.49  101.49     5999
 16   -5.30   67.00   94.93   25.44  432.31   38.42  105.42     5999
 17   -5.70   71.00   97.62   26.27  444.04   41.02  112.02     5999
              71.00   97.62   17.04  528.95    0.00   71.00A   39994
 18   -6.70   81.00  106.79   19.41  574.45    0.00   81.00A   39994
 19   -6.90   83.00  108.61   19.89  583.51    2.85   85.85A   39994
              83.00  108.61    0.00 1906.20    0.00   83.00a  399941
 20   -7.40   88.00  114.17    0.00 1955.61    0.00   88.00a  399941
 21   -8.20   96.00  123.03    0.00 2034.43    0.00   96.00a  399941
 22   -8.90  103.00  130.77    0.00 2103.20    0.00  103.00a  399941
 23   -9.60  110.00  138.48    0.00 2171.81    0.00  110.00a  399941
 24  -10.70  121.00  150.58    0.00 2279.35   15.20  136.20   399941
 25  -11.12  125.20  155.19    0.00 2320.34   21.85  147.05   399941
 26  -12.32  137.20  168.33    0.00 2437.23   23.91  161.11   399941
 27  -13.36  147.60  179.70    0.00 2538.32   23.19  170.79   399941
 28  -14.40  158.00  191.06    0.00 2639.26   23.64  181.64   399941
 29  -15.36  167.60  201.52    0.00 2732.32   26.20  193.80   399941
 30  -16.32  177.20  211.98    0.00 2825.28   37.40  214.60   399941
 31  -16.47  178.70  213.61    0.00 2839.80   28.64  207.34   399941
 32  -16.77  181.70  216.88    0.00 2868.83   29.79  211.49   399941
 33  -20.39  217.85  256.17    0.00 3218.25   43.86  261.71   399941
 34  -24.00  254.00  295.43    0.00 3567.27   58.05  312.05   399941
 35  -28.80  302.00  347.54    0.00 4030.63   76.97  378.97   399941

===========================================================================
Run ID. 1-1_North_800DWall_topdown_B4                        | Sheet No.
Downtown Carpark Redevelopment                               | Date:23-10-2025
800mm D-Wall - Top Down Only (B4)                            | Checked :
-----------------------------------------------------------------------------
                                                              (continued)
Stage No.5   Excavate to elevation -5.00 on RIGHT side

                                          LEFT side
                           Effective stresses          Total  Adjusted
 Node   Y    Water   Vertic  Active  Passive  Earth    earth     soil
 no.  coord  press.    -al   limit   limit   press.   press.  modulus
              kN/m2   kN/m2   kN/m2    kN/m2   kN/m2    kN/m2    kN/m2
 36  -33.60  350.00  399.69    0.00 4494.29   96.03  446.03   399941
 37  -38.40  398.00  451.89    0.00 4958.42  115.14  513.14   399941
 38  -41.45  428.50  485.08    0.00 5253.60  127.44  555.94   399941
 39  -44.50  459.00  518.31    0.00 5549.00  139.57  598.57   399941


                                          RIGHT side
                           Effective stresses          Total  Adjusted
 Node   Y    Water   Vertic  Active  Passive  Earth    earth     soil
 no.  coord  press.    -al   limit   limit   press.   press.  modulus
              kN/m2   kN/m2   kN/m2    kN/m2   kN/m2    kN/m2    kN/m2
  1    4.00    0.00    0.00    0.00    0.00    0.00    0.00      0.0
```

```
  2    3.30    0.00    0.00    0.00     0.00    0.00     0.00      0.0
  3    2.50    0.00    0.00    0.00     0.00    0.00     0.00      0.0
  4    1.90    0.00    0.00    0.00     0.00    0.00     0.00      0.0
  5    1.40    0.00    0.00    0.00     0.00    0.00     0.00      0.0
  6    0.40    0.00    0.00    0.00     0.00    0.00     0.00      0.0
  7   -0.30    0.00    0.00    0.00     0.00    0.00     0.00      0.0
  8   -1.00    0.00    0.00    0.00     0.00    0.00     0.00      0.0
  9   -1.40    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 10   -2.40    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 11   -2.50    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 12   -3.20    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 13   -3.90    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 14   -4.50    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 15   -5.00    0.00    0.00    0.00     0.00    0.00     0.00      0.0
               0.00    0.00    0.00    17.51   17.51    17.51p    5999
 16   -5.30    3.00    1.95    0.00    26.03   20.97    23.97     5999
 17   -5.70    7.00    4.55    0.00    37.39   20.98    27.98     5999
               7.00    4.55    0.00    49.06   41.64    48.64    19998
 18   -6.70   17.00   12.05    0.00    81.84   39.65    56.65    19998
 19   -6.90   19.00   13.55    0.00    88.39   38.08    57.08    19998
              19.00   13.55    0.00  1060.97  512.13   531.13   399955
 20   -7.40   24.00   19.05    0.00  1109.89  318.21   342.21   399955
 21   -8.20   32.00   27.86    0.00  1188.19  193.05   225.05   399955
 22   -8.90   39.00   35.57    0.00  1256.72  115.64   154.64   399955
 23   -9.60   46.00   43.28    0.00  1325.28   75.48   121.48   399955
 24  -10.70   57.00   55.40    0.00  1433.09   63.33   120.33   399955
 25  -11.12   61.20   60.04    0.00  1474.29   59.15   120.35   399955
 26  -12.32   73.20   73.28    0.00  1592.07   65.98   139.18   399955
 27  -13.36   83.60   84.78    0.00  1694.27   74.39   157.99   399955
 28  -14.40   94.00   96.29    0.00  1796.60   81.81   175.81   399955
 29  -15.36  103.60  106.92    0.00  1891.18   86.56   190.16   399955
 30  -16.32  113.20  117.58    0.00  1985.90   82.78   195.98   399955
 31  -16.47  114.70  119.24    0.00  2000.71   92.64   207.34   399955
 32  -16.77  117.70  122.57    0.00  2030.35   93.69   211.39   399955
 33  -20.39  153.85  162.87    0.00  2388.63  107.84   261.69   399955
 34  -24.00  190.00  203.43    0.00  2749.31  121.97   311.97   399955
 35  -28.80  238.00  257.75    0.00  3232.25  140.94   378.94   399955
 36  -33.60  286.00  312.58    0.00  3719.79  160.01   446.01   399955
 37  -38.40  334.00  367.89    0.00  4211.61  179.26   513.26   399955
 38  -41.45  364.50  403.26    0.00  4526.06  191.43   555.93   399955
 39  -44.50  395.00  438.77    0.00  4841.82  203.83   598.83   399955

===========================================================================
Run ID. 1-1_North_800DWall_topdown_B4                          | Sheet No.
Downtown Carpark Redevelopment                                 | Date:23-10-2025
800mm D-Wall - Top Down Only (B4)                              | Checked :
-----------------------------------------------------------------------------
                                                                (continued)
Stage No.5   Excavate to elevation -5.00 on RIGHT side
Note:    110.00 a  Soil pressure at active limit
          17.51 p  Soil pressure at passive limit
          85.85 A  Arching - soil pressure below active limit
 ==========================================================================TONKIN +
TAYLOR LTD                                                | Sheet No.
Program: WALLAP  Version 6.09  Revision A60.B77.R61        | Job No. 1016043
                             Licensed from GEOSOLVE        | Made by :  rxsw
Data filename/Run ID: 1-1_North_800DWall_topdown_B4        |
Downtown Carpark Redevelopment                             | Date:23-10-2025
800mm D-Wall - Top Down Only (B4)                          | Checked :
-----------------------------------------------------------------------------
                                                       Units: kN,m
```

Stage No.5 Excav. to elev. -5.00 on RIGHT side



Stage No.5 Excav. to elev. -5.00 on RIGHT side



```
==========================================================================TONKIN +
TAYLOR LTD                                                | Sheet No.
Program: WALLAP  Version 6.09  Revision A60.B77.R61        | Job No. 1016043
                             Licensed from GEOSOLVE        | Made by :  rxsw
Data filename/Run ID: 1-1_North_800DWall_topdown_B4        |
Downtown Carpark Redevelopment                             | Date:23-10-2025
800mm D-Wall - Top Down Only (B4)                          | Checked :
-----------------------------------------------------------------------------
                                                       Units: kN,m
Stage No. 8   Excavate to elevation -12.32 on RIGHT side
```

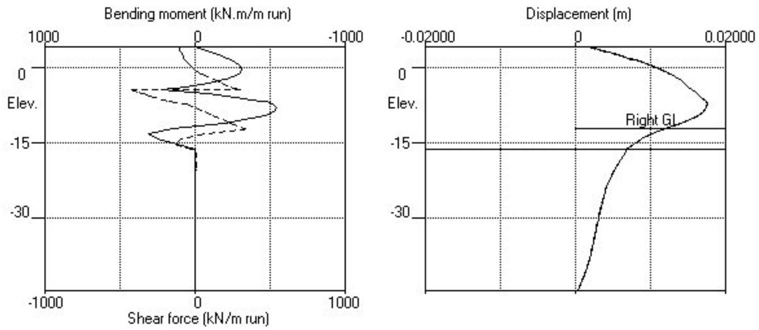
```
STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method
 Factor of safety on soil strength

                                FoS for toe       Toe elev. for
                               elev. =  -16.32     FoS = 1.000
 Stage  Ground level    Prop   Factor  Moment      Toe    Wall    Direction
 No.    Act.   Pass.    Elev.    of    equilib.   elev.  Penetr       of
                               Safety  at elev.          -ation     failure
   8    4.00  -12.32           More than one prop. No FoS calc.


BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall
  Analysis options
  2-D finite element model.    Active limit arching modelled.
  Soil deformations are elastic until the active or passive limit is reached
  Open Tension Crack analysis - No

  Length of wall perpendicular to section = 1000.00m
  Rigid boundaries:     Left side 60.00m from wall                Rough
                       Right side 60.00m from wall               Smooth
               Lower boundary at elevation -44.50m                Rough
                               Soil-wall interface                Smooth

    *** Wall displacements reset to zero at stage 1

 Node   Y      Nett       Wall      Wall      Shear  Bending   Prop      EI of
 no.  coord  pressure     disp.   rotation    force  moment    forces     wall
                kN/m2       m       rad.        kN/m   kN.m/m    kN/m   kN.m2/m
  1    4.00     11.51     0.002  -2.51E-03    -113.3      0.0   -113.3   877500
  2    3.30     13.86     0.004  -2.48E-03    -104.4    -76.0            877500
  3    2.50     18.42     0.006  -2.37E-03     -91.5   -154.3            877500
  4    1.90     22.03     0.007  -2.25E-03     -79.4   -205.6            877500
  5    1.40     24.92     0.008  -2.12E-03     -67.7   -242.3            877500
  6    0.40     37.42     0.010  -1.81E-03     -36.5   -295.2            877500
  7   -0.30     45.86     0.011  -1.57E-03      -7.3   -310.8            877500
  8   -1.00     54.87     0.012  -1.33E-03      27.9   -303.9            877500
  9   -1.40     59.89     0.013  -1.19E-03      50.9   -288.2            877500
 10   -2.40     73.53     0.014  -9.16E-04     117.6   -205.1            877500
 11   -2.50     74.77     0.014  -8.93E-04     125.0   -193.0            877500
 12   -3.20     84.50     0.014  -7.82E-04     180.7    -86.4            877500
 13   -3.90     94.27     0.015  -7.72E-04     243.3     61.6            877500
 14   -4.50    102.53     0.016  -8.70E-04     302.4    225.1   -729.3   877500
               102.53     0.016  -8.70E-04    -426.9    225.1
 15   -5.00    109.09     0.016  -9.41E-04    -374.0     24.7            877500
 16   -5.30    112.86     0.016  -9.31E-04    -340.7    -82.5            877500
 17   -5.70    120.70     0.017  -8.64E-04    -294.0   -209.6            877500
               128.86     0.017  -8.64E-04    -294.0   -209.6
 18   -6.70    108.12     0.017  -4.95E-04    -175.5   -438.4            877500
 19   -6.90    107.51     0.017  -3.92E-04    -153.9   -471.4            877500
               344.10     0.017  -3.92E-04    -153.9   -471.4
 20   -7.40     74.77     0.018  -1.11E-04     -49.2   -513.3            877500
 21   -8.20     75.72     0.017   3.69E-04      11.0   -541.8            877500
 22   -8.90     76.54     0.017   7.93E-04      64.3   -521.6            877500
 23   -9.60     77.37     0.016   1.18E-03     118.1   -460.9            877500
 24  -10.70     78.67     0.015   1.65E-03     203.9   -285.7            877500
 25  -11.12     79.16     0.014   1.76E-03     237.1   -193.2            877500
 26  -12.32     80.58     0.012   1.79E-03     332.9    151.1            877500
              -345.96     0.012   1.79E-03     332.9    151.1
===========================================================================
```

```
-----------------------------------------------------------------------------
                                                              (continued)
Stage No.8   Excavate to elevation -12.32 on RIGHT side

 Node   Y      Nett       Wall      Wall      Shear  Bending   Prop      EI of
 no.  coord  pressure     disp.   rotation    force  moment    forces     wall
                kN/m2       m       rad.        kN/m   kN.m/m    kN/m   kN.m2/m
 27  -13.36   -202.64     0.010   1.52E-03      47.7    309.2            877500
 28  -14.40    -74.35     0.009   1.19E-03     -96.4    248.0            877500
 29  -15.36      7.90     0.008   9.92E-04    -128.3    120.4            877500
 30  -16.32    224.34     0.007   9.26E-04     -16.8      0.0                 0
 31  -16.47      0.30     0.007          0       0.0      0.0                 0
 32  -16.77      6.42     0.007          0       1.1      0.0                 0
 33  -20.39     -3.44     0.005          0       6.4      0.0                 0
 34  -24.00      0.09     0.004          0       0.4      0.0                 0
 35  -28.80      0.05     0.003          0       0.7      0.0                 0
 36  -33.60      0.05     0.003          0       1.0      0.0                 0
 37  -38.40     -0.14     0.002          0       0.7      0.0                 0
 38  -41.45      0.02     0.001          0       0.6      0.0                 0
 39  -44.50     -0.38     0.000          0       0.0      0.0               ---
 At elev.   4.00                 Prop force =    113.3 kN/m run
 At elev.  -4.50                 Prop force =    729.3 kN/m run

                                          LEFT side
                           Effective stresses          Total  Adjusted
 Node   Y    Water   Vertic  Active  Passive  Earth    earth     soil
 no.  coord  press.    -al    limit   limit   press.   press.   modulus
              kN/m2   kN/m2   kN/m2     kN/m2   kN/m2    kN/m2    kN/m2
  1    4.00    0.00    0.00    0.00     16.18   11.51    11.51     5999
  2    3.30    0.00   11.74    0.00     61.60   13.86    13.86     5999
  3    2.50    0.00   26.00    4.14    116.75   18.42    18.42     5999
  4    1.90    0.00   37.02    7.54    159.38   22.03    22.03     5999
  5    1.40    0.00   46.19   10.38    194.86   24.92    24.92     5999
  6    0.40   10.00   54.26   12.87    226.08   27.42    37.42     5999
  7   -0.30   17.00   59.67   14.54    246.99   28.86    45.86     5999
  8   -1.00   24.00   64.90   16.16    267.24   30.87    54.87     5999
  9   -1.40   28.00   67.83   17.06    278.57   31.89    59.89     5999
 10   -2.40   38.00   74.99   19.28    306.28   35.53    73.53     5999
 11   -2.50   39.00   75.70   19.49    309.01   35.77    74.77     5999
              39.00   75.70   19.49    348.27   35.77    74.77     5999
 12   -3.20   46.00   80.60   21.01    369.66   38.50    84.50     5999
 13   -3.90   53.00   85.43   22.50    390.77   41.27    94.27     5999
 14   -4.50   59.00   89.52   23.77    408.67   43.53   102.53     5999
 15   -5.00   64.00   92.91   24.81    423.47   45.09   109.09     5999
 16   -5.30   67.00   94.93   25.44    432.31   45.86   112.86     5999
 17   -5.70   71.00   97.62   26.27    444.04   49.70   120.70     5999
              71.00   97.62   17.04    528.95   57.86   128.86    39994
 18   -6.70   73.94  113.84   21.25    609.47   34.18   108.12    39994
 19   -6.90   74.18  117.43   22.18    627.29   33.33   107.51    39994
              74.18  117.43    0.00   1984.62  269.92   344.10   399941
 20   -7.40   74.77  127.40    0.00   2073.24    0.00    74.77a  399941
 21   -8.20   75.72  143.32    0.00   2214.79    0.00    75.72a  399941
 22   -8.90   76.54  157.23    0.00   2338.46    0.00    76.54a  399941
 23   -9.60   77.37  171.12    0.00   2461.96    0.00    77.37a  399941
 24  -10.70   78.67  192.91    0.00   2655.76    0.00    78.67a  399941
 25  -11.12   79.16  201.23    0.00   2729.68    0.00    79.16a  399941
 26  -12.32   80.58  224.96    0.00   2940.67    0.00    80.58a  399941
 27  -13.36   81.81  245.50    0.00   3123.32    0.00    81.81a  399941
 28  -14.40   83.03  266.02    0.00   3305.81   34.92   117.96   399941
 29  -15.36   84.17  284.95    0.00   3474.15   71.66   155.83   399941
 30  -16.32   85.30  303.88    0.00   3642.40  182.43   267.73   399941
 31  -16.47   85.48  306.83    0.00   3668.68   68.35   153.83   399941
 32  -16.77   85.83  312.74    0.00   3721.24   68.65   154.48   399941
```

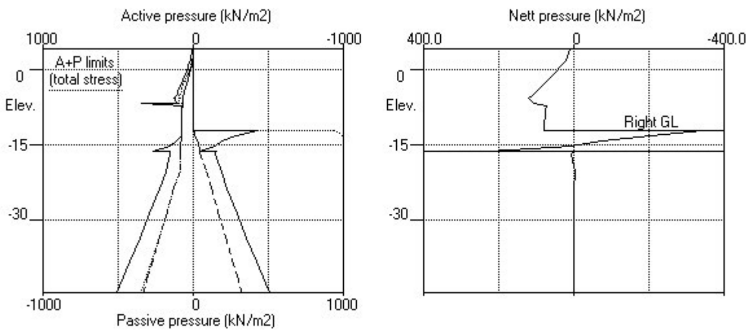
```
 33  -20.39   90.85  383.17    0.00  4347.48   90.29   181.14   399941

==========================================================================
Run ID. 1-1_North_800DWall_topdown_B4                         | Sheet No.
Downtown Carpark Redevelopment                                | Date:23-10-2025
800mm D-Wall - Top Down Only (B4)                             | Checked :
-----------------------------------------------------------------------------
                                                              (continued)
Stage No.8   Excavate to elevation -12.32 on RIGHT side

                               LEFT side
            --------------------------------------------------------
                    Effective stresses              Total   Adjusted
 Node    Y     Water   Vertic  Active  Passive  Earth     earth     soil
 no.   coord   press.   -al    limit    limit   press.    press.  modulus
                kN/m2   kN/m2   kN/m2    kN/m2   kN/m2     kN/m2    kN/m2
 34  -24.00  127.00  422.43    0.00  4696.49   99.83   226.83   399941
 35  -28.80  175.00  474.54    0.00  5159.86  115.83   290.83   399941
 36  -33.60  223.00  526.69    0.00  5623.52  133.61   356.61   399941
 37  -38.40  271.00  578.89    6.16  6087.64  152.53   423.53   399941
 38  -41.45  301.50  612.08   12.12  6382.83  165.20   466.70   399941
 39  -44.50  332.00  645.31   18.09  6678.22  177.77   509.77   399941


                              RIGHT side
            --------------------------------------------------------
                    Effective stresses              Total   Adjusted
 Node    Y     Water   Vertic  Active  Passive  Earth     earth     soil
 no.   coord   press.   -al    limit    limit   press.    press.  modulus
                kN/m2   kN/m2   kN/m2    kN/m2   kN/m2     kN/m2    kN/m2
  1    4.00    0.00    0.00    0.00     0.00    0.00     0.00      0.0
  2    3.30    0.00    0.00    0.00     0.00    0.00     0.00      0.0
  3    2.50    0.00    0.00    0.00     0.00    0.00     0.00      0.0
  4    1.90    0.00    0.00    0.00     0.00    0.00     0.00      0.0
  5    1.40    0.00    0.00    0.00     0.00    0.00     0.00      0.0
  6    0.40    0.00    0.00    0.00     0.00    0.00     0.00      0.0
  7   -0.30    0.00    0.00    0.00     0.00    0.00     0.00      0.0
  8   -1.00    0.00    0.00    0.00     0.00    0.00     0.00      0.0
  9   -1.40    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 10   -2.40    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 11   -2.50    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 12   -3.20    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 13   -3.90    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 14   -4.50    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 15   -5.00    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 16   -5.30    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 17   -5.70    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 18   -6.70    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 19   -6.90    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 20   -7.40    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 21   -8.20    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 22   -8.90    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 23   -9.60    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 24  -10.70    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 25  -11.12    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 26  -12.32    0.00    0.00    0.00     0.00    0.00     0.00      0.0
               0.00    0.00    0.00   940.47  426.54   426.54   399973
 27  -13.36   10.40   11.44    0.00  1042.20  274.05   284.45   399973
 28  -14.40   20.80   22.89    0.00  1143.96  171.51   192.31   399973
 29  -15.36   30.40   33.46    0.00  1237.95  117.53   147.93   399973
 30  -16.32   40.00   44.04    0.00  1332.03    3.38    43.38   399973
 31  -16.47   41.50   45.69    0.00  1346.74  112.03   153.53   399973
 32  -16.77   44.50   49.00    0.00  1376.16  103.57   148.07   399973
 33  -20.39   80.65   89.01    0.00  1731.93  103.93   184.58   399973
 34  -24.00  116.80  129.36    0.00  2090.71  109.95   226.75   399973
```

```
 35  -28.80  164.80  183.66    0.00  2573.45  125.98   290.78   399973
 36  -33.60  212.80  238.92    0.00  3064.84  143.75   356.55   399973
 37  -38.40  260.80  295.22    0.00  3565.44  162.88   423.68   399973
 38  -41.45  291.30  331.52    0.00  3888.21  175.38   466.68   399973
 39  -44.50  321.80  368.20    0.00  4214.36  188.35   510.15   399973

==========================================================================
Run ID. 1-1_North_800DWall_topdown_B4                         | Sheet No.
Downtown Carpark Redevelopment                                | Date:23-10-2025
800mm D-Wall - Top Down Only (B4)                             | Checked :
-----------------------------------------------------------------------------
                                                              (continued)
Stage No.8   Excavate to elevation -12.32 on RIGHT side
Note:     81.81 a  Soil pressure at active limit
         123.45 p  Soil pressure at passive limit
 ========================================================================TONKIN +
TAYLOR LTD                                               | Sheet No.
Program: WALLAP  Version 6.09  Revision A60.B77.R61           | Job No. 1016043
                            Licensed from GEOSOLVE            | Made by :  rxsw
Data filename/Run ID: 1-1_North_800DWall_topdown_B4           |
Downtown Carpark Redevelopment                                | Date:23-10-2025
800mm D-Wall - Top Down Only (B4)                             | Checked :
-----------------------------------------------------------------------------
                                                        Units: kN,m
```

Stage No.8 Excav. to elev. -12.32 on RIGHT side



Stage No.8 Excav. to elev. -12.32 on RIGHT side



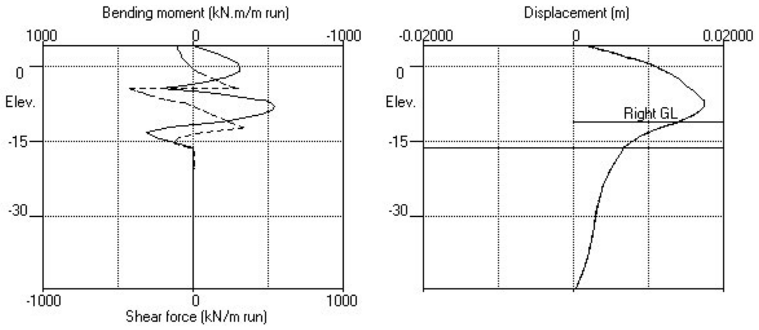
```
==========================================================================TONKIN +
TAYLOR LTD                                             | Sheet No.
Program: WALLAP  Version 6.09  Revision A60.B77.R61         | Job No. 1016043
                             Licensed from GEOSOLVE         | Made by :  rxsw
Data filename/Run ID: 1-1_North_800DWall_topdown_B4         |
Downtown Carpark Redevelopment                              | Date:23-10-2025
800mm D-Wall - Top Down Only (B4)                           | Checked :
------------------------------------------------------------------------------
                                                       Units: kN,m
Stage No. 9   Fill to elevation -11.12 on RIGHT side with soil type 2

STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method
 Factor of safety on soil strength

                             FoS for toe       Toe elev. for
                            elev. =  -16.32     FoS = 1.000
 Stage  Ground level    Prop  Factor  Moment      Toe    Wall   Direction
  No.   Act.    Pass.   Elev.   of    equilib.   elev.  Penetr      of
                              Safety  at elev.                -ation   failure
   9    4.00  -11.12          More than one prop. No FoS calc.


BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall
  Analysis options
  2-D finite element model.    Active limit arching modelled.
  Soil deformations are elastic until the active or passive limit is reached
  Open Tension Crack analysis - No

  Length of wall perpendicular to section = 1000.00m
  Rigid boundaries:     Left side 60.00m from wall                Rough
                       Right side 60.00m from wall               Smooth
               Lower boundary at elevation -44.50m                Rough
                               Soil-wall interface               Smooth

    *** Wall displacements reset to zero at stage 1

 Node   Y      Nett       Wall      Wall      Shear   Bending   Prop      EI of
```

```
 no.  coord  pressure      disp.   rotation      force   moment     forces      wall
               kN/m2         m       rad.         kN/m   kN.m/m      kN/m    kN.m2/m
  1    4.00     11.51      0.002  -2.51E-03    -113.7       0.0    -113.7    877500
  2    3.30     13.85      0.004  -2.48E-03    -104.8     -76.2              877500
  3    2.50     18.40      0.006  -2.38E-03     -91.9    -154.9              877500
  4    1.90     22.00      0.007  -2.25E-03     -79.8    -206.3              877500
  5    1.40     24.88      0.008  -2.12E-03     -68.1    -243.3              877500
  6    0.40     37.37      0.010  -1.82E-03     -36.9    -296.6              877500
  7   -0.30     45.81      0.011  -1.57E-03      -7.8    -312.5              877500
  8   -1.00     54.81      0.012  -1.33E-03      27.4    -305.9              877500
  9   -1.40     59.82      0.013  -1.19E-03      50.3    -290.4              877500
 10   -2.40     73.46      0.014  -9.11E-04     117.0    -207.9              877500
 11   -2.50     74.70      0.014  -8.88E-04     124.4    -195.9              877500
 12   -3.20     84.42      0.014  -7.74E-04     180.1     -89.7              877500
 13   -3.90     94.20      0.015  -7.61E-04     242.6      57.8              877500
 14   -4.50    102.45      0.016  -8.56E-04     301.6     220.8    -726.6    877500
               102.45      0.016  -8.56E-04    -425.0     220.8
 15   -5.00    109.01      0.016  -9.25E-04    -372.2      21.4              877500
 16   -5.30    112.78      0.016  -9.15E-04    -338.9     -85.3              877500
 17   -5.70    120.62      0.017  -8.47E-04    -292.2    -211.7              877500
               128.36      0.017  -8.47E-04    -292.2    -211.7
 18   -6.70    107.68      0.017  -4.76E-04    -174.2    -439.0              877500
 19   -6.90    107.13      0.017  -3.72E-04    -152.7    -471.7              877500
               340.29      0.017  -3.72E-04    -152.7    -471.7
 20   -7.40     74.77      0.017  -9.21E-05     -48.9    -513.5              877500
 21   -8.20     75.72      0.017   3.88E-04      11.2    -541.7              877500
 22   -8.90     76.54      0.017   8.12E-04      64.5    -521.4              877500
 23   -9.60     77.82      0.016   1.20E-03     118.6    -460.5              877500
 24  -10.70     80.10      0.015   1.67E-03     205.4    -284.5              877500
 25  -11.12     81.77      0.014   1.78E-03     239.4    -191.3              877500
 26  -12.32     75.67      0.012   1.80E-03     333.8     155.6              877500
              -349.11      0.012   1.80E-03     333.8     155.6
===========================================================================
Run ID. 1-1_North_800DWall_topdown_B4                       | Sheet No.
Downtown Carpark Redevelopment                              | Date:23-10-2025
800mm D-Wall - Top Down Only (B4)                           | Checked :
------------------------------------------------------------------------------
                                                              (continued)
Stage No.9   Fill to elevation -11.12 on RIGHT side with soil type 2

 Node   Y      Nett       Wall      Wall      Shear   Bending   Prop      EI of
 no.  coord  pressure     disp.   rotation    force   moment   forces     wall
               kN/m2        m       rad.       kN/m   kN.m/m    kN/m    kN.m2/m
 27  -13.36   -203.38     0.010   1.53E-03     46.5    312.9             877500
 28  -14.40    -74.21     0.009   1.19E-03    -97.8    250.3             877500
 29  -15.36      8.31     0.007   9.95E-04   -129.4    121.3             877500
 30  -16.32    226.06     0.007   9.28E-04    -16.9      0.0                  0
 31  -16.47      0.30     0.007          0      0.0      0.0                  0
 32  -16.77      6.42     0.006          0      1.1      0.0                  0
 33  -20.39     -3.44     0.005          0      6.4      0.0                  0
 34  -24.00      0.09     0.004          0      0.4      0.0                  0
 35  -28.80      0.05     0.003          0      0.7      0.0                  0
 36  -33.60      0.05     0.002          0      1.0      0.0                  0
 37  -38.40     -0.14     0.002          0      0.7      0.0                  0
 38  -41.45      0.02     0.001          0      0.5      0.0                  0
 39  -44.50     -0.37     0.000          0      0.0      0.0                ---
 At elev.   4.00                    Prop force =    113.7 kN/m run
 At elev.  -4.50                    Prop force =    726.6 kN/m run

                                         LEFT side
              ____________________________________________________________
                          Effective stresses           Total   Adjusted
 Node   Y     Water   Vertic  Active  Passive  Earth    earth     soil
 no.  coord   press.   -al    limit    limit   press.   press.   modulus
```

```
               kN/m2   kN/m2   kN/m2    kN/m2   kN/m2    kN/m2    kN/m2
  1    4.00    0.00    0.00    0.00    16.18   11.51    11.51     5999
  2    3.30    0.00   11.74    0.00    61.60   13.85    13.85     5999
  3    2.50    0.00   26.00    4.14   116.75   18.40    18.40     5999
  4    1.90    0.00   37.02    7.54   159.38   22.00    22.00     5999
  5    1.40    0.00   46.19   10.38   194.86   24.88    24.88     5999
  6    0.40   10.00   54.26   12.87   226.08   27.37    37.37     5999
  7   -0.30   17.00   59.67   14.54   246.99   28.81    45.81     5999
  8   -1.00   24.00   64.90   16.16   267.24   30.81    54.81     5999
  9   -1.40   28.00   67.83   17.06   278.57   31.82    59.82     5999
 10   -2.40   38.00   74.99   19.28   306.28   35.46    73.46     5999
 11   -2.50   39.00   75.70   19.49   309.01   35.70    74.70     5999
              39.00   75.70   19.49   348.27   35.70    74.70     5999
 12   -3.20   46.00   80.60   21.01   369.66   38.42    84.42     5999
 13   -3.90   53.00   85.43   22.50   390.77   41.20    94.20     5999
 14   -4.50   59.00   89.52   23.77   408.67   43.45   102.45     5999
 15   -5.00   64.00   92.91   24.81   423.47   45.01   109.01     5999
 16   -5.30   67.00   94.93   25.44   432.31   45.78   112.78     5999
 17   -5.70   71.00   97.62   26.27   444.04   49.62   120.62     5999
              71.00   97.62   17.04   528.95   57.36   128.36    39994
 18   -6.70   73.94  113.84   21.25   609.47   33.73   107.68    39994
 19   -6.90   74.18  117.43   22.18   627.29   32.95   107.13    39994
              74.18  117.43    0.00  1984.62  266.11   340.29   399941
 20   -7.40   74.77  127.40    0.00  2073.24    0.00    74.77a  399941
 21   -8.20   75.72  143.32    0.00  2214.79    0.00    75.72a  399941
 22   -8.90   76.54  157.23    0.00  2338.46    0.00    76.54a  399941
 23   -9.60   77.37  171.12    0.00  2461.96    0.45    77.82   399941
 24  -10.70   78.67  192.91    0.00  2655.76    1.43    80.10   399941
 25  -11.12   79.16  201.23    0.00  2729.68    2.61    81.77   399941
 26  -12.32   80.58  224.96    0.00  2940.67    3.57    84.15   399941
 27  -13.36   81.81  245.50    0.00  3123.32    4.11    85.92   399941
 28  -14.40   83.03  266.02    0.00  3305.81   39.04   122.07   399941
 29  -15.36   84.17  284.95    0.00  3474.15   75.69   159.86   399941
 30  -16.32   85.30  303.88    0.00  3642.40  187.02   272.32   399941
 31  -16.47   85.48  306.83    0.00  3668.68   72.02   157.50   399941
 32  -16.77   85.83  312.74    0.00  3721.24   72.23   158.06   399941
 33  -20.39   90.85  383.17    0.00  4347.48   93.76   184.61   399941

===========================================================================
Run ID. 1-1_North_800DWall_topdown_B4                        | Sheet No.
Downtown Carpark Redevelopment                               | Date:23-10-2025
800mm D-Wall - Top Down Only (B4)                            | Checked :
-----------------------------------------------------------------------------
                                                             (continued)
Stage No.9   Fill to elevation -11.12 on RIGHT side with soil type 2

                                         LEFT side
             --------------------------------------------------------------
                                Effective stresses             Total  Adjusted
 Node    Y    Water   Vertic  Active  Passive   Earth     earth     soil
 no.   coord  press.    -al   limit    limit   press.    press.  modulus
              kN/m2   kN/m2   kN/m2    kN/m2   kN/m2    kN/m2    kN/m2
 34  -24.00  127.00  422.43    0.00  4696.49  103.22   230.22   399941
 35  -28.80  175.00  474.54    0.00  5159.86  119.20   294.20   399941
 36  -33.60  223.00  526.69    0.00  5623.52  136.96   359.96   399941
 37  -38.40  271.00  578.89    6.16  6087.64  155.88   426.88   399941
 38  -41.45  301.50  612.08   12.12  6382.83  168.55   470.05   399941
 39  -44.50  332.00  645.31   18.09  6678.22  181.11   513.11   399941


                                        RIGHT side
             --------------------------------------------------------------
                                Effective stresses             Total  Adjusted
 Node    Y    Water   Vertic  Active  Passive   Earth     earth     soil
 no.   coord  press.    -al   limit    limit   press.    press.  modulus
```

```
               kN/m2   kN/m2   kN/m2    kN/m2   kN/m2    kN/m2    kN/m2
  1    4.00    0.00    0.00    0.00     0.00    0.00     0.00      0.0
  2    3.30    0.00    0.00    0.00     0.00    0.00     0.00      0.0
  3    2.50    0.00    0.00    0.00     0.00    0.00     0.00      0.0
  4    1.90    0.00    0.00    0.00     0.00    0.00     0.00      0.0
  5    1.40    0.00    0.00    0.00     0.00    0.00     0.00      0.0
  6    0.40    0.00    0.00    0.00     0.00    0.00     0.00      0.0
  7   -0.30    0.00    0.00    0.00     0.00    0.00     0.00      0.0
  8   -1.00    0.00    0.00    0.00     0.00    0.00     0.00      0.0
  9   -1.40    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 10   -2.40    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 11   -2.50    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 12   -3.20    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 13   -3.90    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 14   -4.50    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 15   -5.00    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 16   -5.30    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 17   -5.70    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 18   -6.70    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 19   -6.90    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 20   -7.40    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 21   -8.20    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 22   -8.90    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 23   -9.60    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 24  -10.70    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 25  -11.12    0.00    0.00    0.00     0.00    0.00     0.00      0.0
               0.00    0.00    0.00    17.51    0.05     0.05     6000
 26  -12.32    0.00   19.80    2.22   104.03    8.49     8.49     6000
               0.00   19.80    0.00  1116.53  433.27   433.27   399970
 27  -13.36   10.40   31.25    0.00  1218.30  278.90   289.30   399970
 28  -14.40   20.80   42.70    0.00  1320.13  175.48   196.28   399970
 29  -15.36   30.40   53.28    0.00  1414.22  121.15   151.55   399970
 30  -16.32   40.00   63.87    0.00  1508.41    6.26    46.26   399970
 31  -16.47   41.50   65.53    0.00  1523.14  115.71   157.21   399970
 32  -16.77   44.50   68.84    0.00  1552.61  107.14   151.64   399970
 33  -20.39   80.65  108.92    0.00  1908.98  107.40   188.05   399970
 34  -24.00  116.80  149.35    0.00  2268.44  113.34   230.14   399970
 35  -28.80  164.80  203.73    0.00  2751.94  129.35   294.15   399970
 36  -33.60  212.80  259.02    0.00  3243.54  147.11   359.91   399970
 37  -38.40  260.80  315.26    0.00  3743.57  166.23   427.03   399970
 38  -41.45  291.30  351.46    0.00  4065.49  178.73   470.03   399970
 39  -44.50  321.80  388.00    0.00  4390.41  191.68   513.48   399970

===========================================================================
Run ID. 1-1_North_800DWall_topdown_B4                        | Sheet No.
Downtown Carpark Redevelopment                               | Date:23-10-2025
800mm D-Wall - Top Down Only (B4)                            | Checked :
-----------------------------------------------------------------------------
                                                             (continued)
Stage No.9   Fill to elevation -11.12 on RIGHT side with soil type 2
Note:     76.54 a  Soil pressure at active limit
         123.45 p  Soil pressure at passive limit
 ========================================================================TONKIN +
TAYLOR LTD                                              | Sheet No.
Program: WALLAP  Version 6.09  Revision A60.B77.R61          | Job No. 1016043
                             Licensed from GEOSOLVE          | Made by :  rxsw
Data filename/Run ID: 1-1_North_800DWall_topdown_B4          |
Downtown Carpark Redevelopment                               | Date:23-10-2025
800mm D-Wall - Top Down Only (B4)                            | Checked :
-----------------------------------------------------------------------------
                                                      Units: kN,m
```

Stage No.9 Fill to elev. -11.12 on RIGHT side



```
==========================================================================TONKIN +
TAYLOR LTD                                             | Sheet No.
Program: WALLAP  Version 6.09  Revision A60.B77.R61         | Job No. 1016043
                             Licensed from GEOSOLVE         | Made by :  rxsw
Data filename/Run ID: 1-1_North_800DWall_topdown_B4         |
Downtown Carpark Redevelopment                              | Date:23-10-2025
800mm D-Wall - Top Down Only (B4)                           | Checked :
-----------------------------------------------------------------------------
                                                   Units: kN,m
Stage No. 13   Change EI of wall to 585000 kN.m2/m run
```

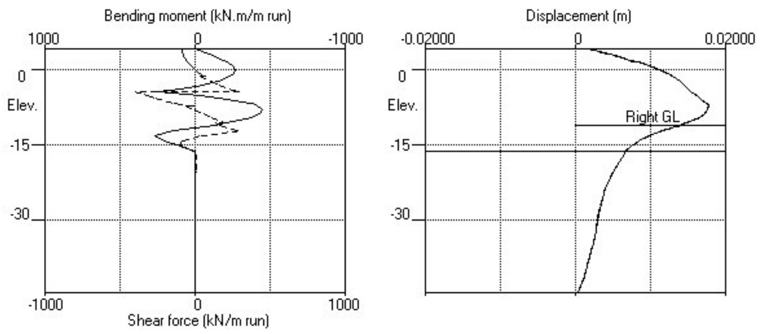
```
              Allow wall to relax with new modulus value

STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method
 Factor of safety on soil strength

                                        FoS for toe       Toe elev. for
                                       elev. =  -16.32     FoS = 1.000
 Stage  Ground level     Prop   Factor  Moment       Toe    Wall     Direction
  No.   Act.    Pass.   Elev.    of    equilib.    elev.  Penetr        of
                                Safety  at elev.          -ation     failure
  13    4.00   -11.12           More than one prop. No FoS calc.

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall
  Analysis options
  2-D finite element model.    Active limit arching modelled.
  Soil deformations are elastic until the active or passive limit is reached
  Open Tension Crack analysis - No

  Length of wall perpendicular to section = 1000.00m
  Rigid boundaries:     Left side 60.00m from wall                 Rough
                       Right side 60.00m from wall                Smooth
               Lower boundary at elevation -44.50m                 Rough
                           Soil-wall interface                    Smooth

    *** Wall displacements reset to zero at stage 1

 Node   Y     Nett       Wall     Wall      Shear   Bending   Prop      EI of
 no.  coord  pressure    disp.   rotation   force    moment   forces     wall
              kN/m2        m       rad.      kN/m    kN.m/m    kN/m    kN.m2/m
  1    4.00    12.05     0.002  -2.67E-03   -98.1       0.0    -98.1   585000
  2    3.30    14.04     0.004  -2.63E-03   -88.9     -68.0            585000
  3    2.50    18.32     0.006  -2.49E-03   -76.0    -137.0            585000
  4    1.90    21.75     0.007  -2.34E-03   -64.0    -181.4            585000
  5    1.40    24.53     0.008  -2.18E-03   -52.4    -212.4            585000
  6    0.40    36.99     0.010  -1.80E-03   -21.6    -254.1            585000
  7   -0.30    45.48     0.012  -1.51E-03     7.2    -262.0            585000
  8   -1.00    54.58     0.012  -1.23E-03    42.2    -247.7            585000
  9   -1.40    59.75     0.013  -1.08E-03    65.1    -227.7    -29.0   585000
               59.75     0.013  -1.08E-03    36.1    -227.7
 10   -2.40    73.51     0.014  -7.87E-04   102.7    -155.9            585000
 11   -2.50    74.93     0.014  -7.64E-04   110.1    -144.9            585000
 12   -3.20    84.82     0.014  -6.68E-04   166.1     -46.2            585000
 13   -3.90    94.83     0.015  -7.13E-04   228.9      94.0            585000
 14   -4.50   103.21     0.015  -9.01E-04   288.3     251.0   -684.0   585000
              103.21     0.015  -9.01E-04  -395.7     251.0
 15   -5.00   109.73     0.016  -1.04E-03  -342.5      62.6            585000
 16   -5.30   113.43     0.016  -1.05E-03  -309.0     -37.3            585000
 17   -5.70   121.18     0.017  -1.00E-03  -262.1    -154.7            585000
              132.05     0.017  -1.00E-03  -262.1    -154.7
 18   -6.70   109.32     0.017  -6.07E-04  -141.4    -358.0            585000
 19   -6.90   108.46     0.018  -4.89E-04  -119.6    -385.8            585000
              353.56     0.018  -4.89E-04  -119.6    -385.8
 20   -7.40    74.77     0.018  -1.74E-04   -12.5    -413.9    -46.2   585000
               74.77     0.018  -1.74E-04   -58.7    -413.9
 21   -8.20    75.72     0.018   3.71E-04     1.5    -448.0            585000
 22   -8.90    76.54     0.017   8.61E-04    54.7    -432.8            585000
 23   -9.60    77.37     0.016   1.31E-03   108.6    -377.1            585000
 24  -10.70    78.67     0.015   1.81E-03   194.4    -209.5    -60.4   585000
               78.67     0.015   1.81E-03   134.1    -209.5
===========================================================================
Run ID. 1-1_North_800DWall_topdown_B4                        | Sheet No.
Downtown Carpark Redevelopment                               | Date:23-10-2025
```

```
800mm D-Wall - Top Down Only (B4)                           | Checked :
-----------------------------------------------------------------------------
                                                              (continued)
Stage No.13  Change EI of wall to 585000 kN.m2/m run
              Allow wall to relax with new modulus value

 Node    Y      Nett        Wall      Wall       Shear   Bending   Prop       EI of
 no.   coord  pressure     disp.    rotation     force   moment    forces      wall
                 kN/m2        m        rad.       kN/m    kN.m/m    kN/m    kN.m2/m
 25   -11.12     89.49     0.014   1.92E-03     169.4    -138.8              585000
                 88.94     0.014   1.92E-03     169.4    -138.8
 26   -12.32     96.03     0.012   1.89E-03     280.4     148.9              585000
               -332.08     0.012   1.89E-03     280.4     148.9
 27   -13.36   -163.37     0.010   1.53E-03      22.7     271.4              585000
 28   -14.40    -43.10     0.008   1.13E-03     -84.6     206.4              585000
 29   -15.36     13.28     0.007   9.07E-04     -99.0      97.6              585000
 30   -16.32    166.85     0.007   8.34E-04     -12.5       0.0                   0
 31   -16.47      0.30     0.007          0       0.0       0.0                   0
 32   -16.77      6.42     0.006          0       1.1       0.0                   0
 33   -20.39     -3.44     0.005          0       6.4       0.0                   0
 34   -24.00      0.09     0.004          0       0.4       0.0                   0
 35   -28.80      0.05     0.003          0       0.7       0.0                   0
 36   -33.60      0.05     0.002          0       1.0       0.0                   0
 37   -38.40     -0.14     0.002          0       0.7       0.0                   0
 38   -41.45      0.02     0.001          0       0.5       0.0                   0
 39   -44.50     -0.37     0.000          0       0.0       0.0                 ---
 At elev.   4.00                 Prop force =      98.1 kN/m run
 At elev.  -1.40                 Prop force =      29.0 kN/m run
 At elev.  -4.50                 Prop force =     684.0 kN/m run
 At elev.  -7.40                 Prop force =      46.2 kN/m run
 At elev. -10.70                 Prop force =      60.4 kN/m run

                                            LEFT side
              ----------------------------------------------------------------
                        Effective stresses                   Total  Adjusted
 Node    Y     Water   Vertic  Active  Passive    Earth      earth      soil
 no.   coord   press.    -al    limit    limit    press.     press.  modulus
               kN/m2   kN/m2   kN/m2     kN/m2    kN/m2      kN/m2     kN/m2
  1     4.00    0.00    0.00    0.00     16.18    12.05      12.05      5999
  2     3.30    0.00   11.74    0.00     61.60    14.04      14.04      5999
  3     2.50    0.00   26.00    4.14    116.75    18.32      18.32      5999
  4     1.90    0.00   37.02    7.54    159.38    21.75      21.75      5999
  5     1.40    0.00   46.19   10.38    194.86    24.53      24.53      5999
  6     0.40   10.00   54.26   12.87    226.08    26.99      36.99      5999
  7    -0.30   17.00   59.67   14.54    246.99    28.48      45.48      5999
  8    -1.00   24.00   64.90   16.16    267.24    30.58      54.58      5999
  9    -1.40   28.00   67.83   17.06    278.57    31.75      59.75      5999
 10    -2.40   38.00   74.99   19.28    306.28    35.51      73.51      5999
 11    -2.50   39.00   75.70   19.49    309.01    35.93      74.93      5999
               39.00   75.70   19.49    348.27    35.93      74.93      5999
 12    -3.20   46.00   80.60   21.01    369.66    38.82      84.82      5999
 13    -3.90   53.00   85.43   22.50    390.77    41.83      94.83      5999
 14    -4.50   59.00   89.52   23.77    408.67    44.21     103.21      5999
 15    -5.00   64.00   92.91   24.81    423.47    45.73     109.73      5999
 16    -5.30   67.00   94.93   25.44    432.31    46.43     113.43      5999
 17    -5.70   71.00   97.62   26.27    444.04    50.18     121.18      5999
               71.00   97.62   17.04    528.95    61.05     132.05     39994
 18    -6.70   73.94  113.84   21.25    609.47    35.38     109.32     39994
 19    -6.90   74.18  117.43   22.18    627.29    34.28     108.46     39994
               74.18  117.43    0.00   1984.62   279.38     353.56    399941
 20    -7.40   74.77  127.40    0.00   2073.24     0.00      74.77a   399941
 21    -8.20   75.72  143.32    0.00   2214.79     0.00      75.72a   399941
 22    -8.90   76.54  157.23    0.00   2338.46     0.00      76.54a   399941
 23    -9.60   77.37  171.12    0.00   2461.96     0.00      77.37a   399941
```

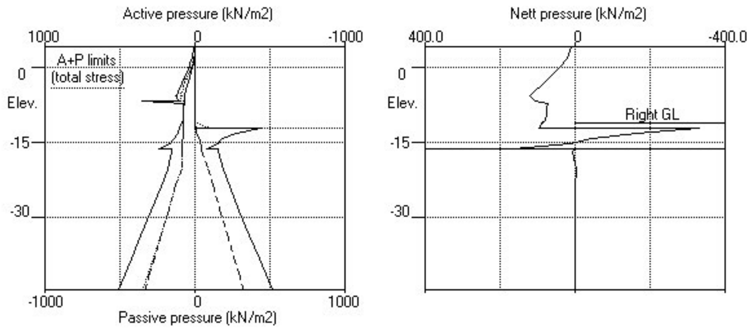
```
 24  -10.70   78.67  192.91    0.00  2655.76    0.00    78.67a  399941
 25  -11.12   79.16  201.23    0.00  2729.68   10.33    89.49   399941

===========================================================================
Run ID. 1-1_North_800DWall_topdown_B4                         | Sheet No.
Downtown Carpark Redevelopment                                | Date:23-10-2025
800mm D-Wall - Top Down Only (B4)                             | Checked :
-----------------------------------------------------------------------------
                                                              (continued)
Stage No.13  Change EI of wall to 585000 kN.m2/m run
              Allow wall to relax with new modulus value

                                            LEFT side
              ----------------------------------------------------------------
                        Effective stresses                   Total  Adjusted
 Node    Y     Water   Vertic  Active  Passive    Earth      earth      soil
 no.   coord   press.    -al    limit    limit    press.     press.  modulus
               kN/m2   kN/m2   kN/m2     kN/m2    kN/m2      kN/m2     kN/m2
 26  -12.32   80.58  224.96    0.00  3940.67   23.99   104.57   399941
 27  -13.36   81.81  245.50    0.00  3123.32   29.45   111.26   399941
 28  -14.40   83.03  266.02    0.00  3305.81   56.87   139.90   399941
 29  -15.36   84.17  284.95    0.00  3474.15   79.48   163.65   399941
 30  -16.32   85.30  303.88    0.00  3642.40  158.38   243.68   399941
 31  -16.47   85.48  306.83    0.00  3668.68   72.80   158.28   399941
 32  -16.77   85.83  312.74    0.00  3721.24   72.67   158.51   399941
 33  -20.39   90.85  383.17    0.00  4347.48   93.95   184.80   399941
 34  -24.00  127.00  422.43    0.00  4696.49  103.25   230.25   399941
 35  -28.80  175.00  474.54    0.00  5159.86  119.19   294.19   399941
 36  -33.60  223.00  526.69    0.00  5623.52  136.96   359.96   399941
 37  -38.40  271.00  578.89    6.16  6087.64  155.90   426.90   399941
 38  -41.45  301.50  612.08   12.12  6382.83  168.60   470.10   399941
 39  -44.50  332.00  645.31   18.09  6678.22  181.19   513.19   399941

                                            RIGHT side
              ----------------------------------------------------------------
                        Effective stresses                   Total  Adjusted
 Node    Y     Water   Vertic  Active  Passive    Earth      earth      soil
 no.   coord   press.    -al    limit    limit    press.     press.  modulus
               kN/m2   kN/m2   kN/m2     kN/m2    kN/m2      kN/m2     kN/m2
  1    4.00    0.00    0.00    0.00     0.00    0.00     0.00      0.0
  2    3.30    0.00    0.00    0.00     0.00    0.00     0.00      0.0
  3    2.50    0.00    0.00    0.00     0.00    0.00     0.00      0.0
  4    1.90    0.00    0.00    0.00     0.00    0.00     0.00      0.0
  5    1.40    0.00    0.00    0.00     0.00    0.00     0.00      0.0
  6    0.40    0.00    0.00    0.00     0.00    0.00     0.00      0.0
  7   -0.30    0.00    0.00    0.00     0.00    0.00     0.00      0.0
  8   -1.00    0.00    0.00    0.00     0.00    0.00     0.00      0.0
  9   -1.40    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 10   -2.40    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 11   -2.50    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 12   -3.20    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 13   -3.90    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 14   -4.50    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 15   -5.00    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 16   -5.30    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 17   -5.70    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 18   -6.70    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 19   -6.90    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 20   -7.40    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 21   -8.20    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 22   -8.90    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 23   -9.60    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 24  -10.70    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 25  -11.12    0.00    0.00    0.00     0.00    0.00     0.00      0.0
```

```
                0.00    0.00    0.00    17.51    0.55     0.55     6000
 26   -12.32    0.00   19.80    2.22   104.03    8.54     8.54     6000
                0.00   19.80    0.00  1116.53  436.65   436.65   399970
 27   -13.36   10.40   31.25    0.00  1218.30  264.22   274.62   399970
 28   -14.40   20.80   42.70    0.00  1320.13  162.20   183.00   399970
 29   -15.36   30.40   53.28    0.00  1414.22  119.97   150.37   399970
 30   -16.32   40.00   63.87    0.00  1508.41   36.83    76.83   399970
 31   -16.47   41.50   65.53    0.00  1523.14  116.49   157.99   399970

===========================================================================
Run ID. 1-1_North_800DWall_topdown_B4                          | Sheet No.
Downtown Carpark Redevelopment                                 | Date:23-10-2025
800mm D-Wall - Top Down Only (B4)                              | Checked :
-----------------------------------------------------------------------------
                                                                     (continued)
Stage No.13  Change EI of wall to 585000 kN.m2/m run
              Allow wall to relax with new modulus value

                                              RIGHT side
                            Effective stresses               Total   Adjusted
 Node    Y     Water    Vertic  Active  Passive   Earth      earth     soil
 no.   coord   press.    -al    limit    limit    press.     press.   modulus
                kN/m2   kN/m2   kN/m2    kN/m2    kN/m2      kN/m2     kN/m2
 32   -16.77   44.50   68.84    0.00  1552.61  107.58   152.08   399970
 33   -20.39   80.65  108.92    0.00  1908.98  107.59   188.24   399970
 34   -24.00  116.80  149.35    0.00  2268.44  113.36   230.16   399970
 35   -28.80  164.80  203.73    0.00  2751.94  129.34   294.14   399970
 36   -33.60  212.80  259.02    0.00  3243.54  147.11   359.91   399970
 37   -38.40  260.80  315.26    0.00  3743.57  166.24   427.04   399970
 38   -41.45  291.30  351.46    0.00  4065.49  178.78   470.08   399970
 39   -44.50  321.80  388.00    0.00  4390.41  191.76   513.56   399970

Note:     78.67 a  Soil pressure at active limit
         123.45 p  Soil pressure at passive limit
 ==========================================================================TONKIN +
TAYLOR LTD                                                 | Sheet No.
Program: WALLAP  Version 6.09  Revision A60.B77.R61         | Job No. 1016043
                             Licensed from GEOSOLVE         | Made by :  rxsw
Data filename/Run ID: 1-1_North_800DWall_topdown_B4         |
Downtown Carpark Redevelopment                              | Date:23-10-2025
800mm D-Wall - Top Down Only (B4)                           | Checked :
-----------------------------------------------------------------------------
                                                       Units: kN,m
```

Stage No.13 Change EI of wall to 585000kN.m2/m run



Stage No.13 Change EI of wall to 585000kN.m2/m run



```
==========================================================================TONKIN +
TAYLOR LTD                                                 | Sheet No.
Program: WALLAP  Version 6.09  Revision A60.B77.R61         | Job No. 1016043
                             Licensed from GEOSOLVE         | Made by :  rxsw
Data filename/Run ID: 1-1_North_800DWall_topdown_B4         |
Downtown Carpark Redevelopment                              | Date:23-10-2025
800mm D-Wall - Top Down Only (B4)                           | Checked :
-----------------------------------------------------------------------------
                                                       Units: kN,m
Stage No. 16   Change EI of wall to 292500 kN.m2/m run
```

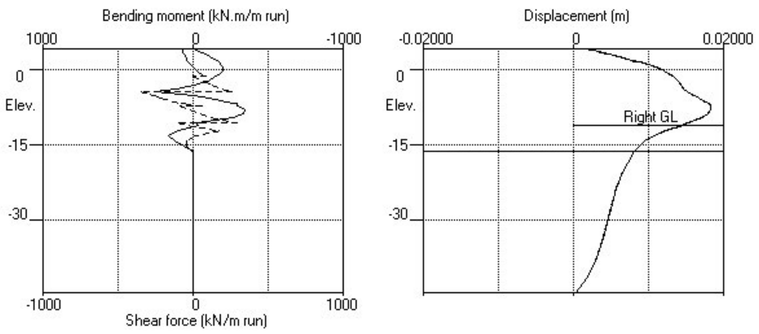
```
              Allow wall to relax with new modulus value

STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method
 Factor of safety on soil strength

                                FoS for toe       Toe elev. for
                               elev. =  -16.32     FoS = 1.000
 Stage  Ground level     Prop  Factor  Moment      Toe    Wall     Direction
  No.   Act.    Pass.    Elev.   of    equilib.  elev.   Penetr       of
                               Safety  at elev.          -ation     failure
  16    4.00  -11.12           More than one prop. No FoS calc.


BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall
  Analysis options
  2-D finite element model.    Active limit arching modelled.
  Soil deformations are elastic until the active or passive limit is reached
  Open Tension Crack analysis - No

  Length of wall perpendicular to section = 1000.00m
  Rigid boundaries:     Left side 60.00m from wall                Rough
                       Right side 60.00m from wall               Smooth
              Lower boundary at elevation -44.50m                Rough
                              Soil-wall interface                Smooth

    *** Wall displacements reset to zero at stage 1

 Node    Y      Nett        Wall      Wall       Shear   Bending   Prop       EI of
 no.   coord  pressure     disp.    rotation     force   moment    forces      wall
                 kN/m2        m        rad.        kN/m    kN.m/m    kN/m    kN.m2/m
  1     4.00     13.25     0.002  -3.02E-03    -78.4       0.0    -78.4    292500
  2     3.30     14.46     0.004  -2.95E-03    -68.7     -57.6             292500
  3     2.50     18.15     0.006  -2.75E-03    -55.6    -114.7             292500
  4     1.90     21.23     0.008  -2.51E-03    -43.8    -150.1             292500
  5     1.40     23.84     0.009  -2.27E-03    -32.6    -173.8             292500
  6     0.40     36.30     0.011  -1.73E-03     -2.5    -201.0             292500
  7    -0.30     44.99     0.012  -1.34E-03     26.0    -199.1             292500
  8    -1.00     54.38     0.013  -9.94E-04     60.7    -175.1             292500
  9    -1.40     59.93     0.013  -8.36E-04     83.6    -149.6    -82.9    292500
                 59.93     0.013  -8.36E-04      0.7    -149.6
 10    -2.40     73.92     0.014  -5.47E-04     67.7    -101.2             292500
 11    -2.50     75.66     0.014  -5.25E-04     75.1     -92.5             292500
 12    -3.20     85.89     0.014  -4.65E-04    131.7      -9.8             292500
 13    -3.90     96.39     0.015  -6.28E-04    195.5     114.8             292500
 14    -4.50    105.05     0.015  -1.02E-03    255.9     258.8   -599.7    292500
                105.05     0.015  -1.02E-03   -343.8     258.8
 15    -5.00    111.41     0.016  -1.33E-03   -289.6      87.7             292500
 16    -5.30    114.90     0.016  -1.39E-03   -255.7      -1.8             292500
 17    -5.70    122.30     0.017  -1.35E-03   -208.3    -105.1             292500
                139.53     0.017  -1.35E-03   -208.3    -105.1
 18    -6.70    116.96     0.018  -8.74E-04    -80.0    -269.2             292500
 19    -6.90    116.43     0.018  -7.26E-04    -56.7    -288.4             292500
                388.78     0.018  -7.26E-04    -56.7    -288.4
 20    -7.40     88.00     0.018  -3.54E-04     62.5    -290.6   -152.9    292500
                 88.00     0.018  -3.54E-04    -90.4    -290.6
 21    -8.20     96.00     0.018   2.99E-04    -16.8    -344.2             292500
 22    -8.90    103.00     0.018   9.32E-04     52.9    -332.8             292500
 23    -9.60    118.79     0.017   1.48E-03    130.5    -264.6             292500
 24   -10.70    170.61     0.015   1.83E-03    289.7     -27.4   -386.5    292500
                170.61     0.015   1.83E-03    -96.8     -27.4
===========================================================================
```

```
-----------------------------------------------------------------------------
                                                              (continued)
Stage No.16  Change EI of wall to 292500 kN.m2/m run
              Allow wall to relax with new modulus value

 Node    Y      Nett        Wall      Wall       Shear   Bending   Prop       EI of
 no.   coord  pressure     disp.    rotation     force   moment    forces      wall
                 kN/m2        m        rad.        kN/m    kN.m/m    kN/m    kN.m2/m
 25   -11.12    172.43     0.014   1.83E-03    -24.8     -36.7             292500
                171.87     0.014   1.83E-03    -24.8     -36.7
 26   -12.32    152.68     0.012   1.69E-03    170.0      96.0             292500
               -238.30     0.012   1.69E-03    170.0      96.0
 27   -13.36    -80.99     0.011   1.31E-03      3.9     164.7             292500
 28   -14.40    -10.47     0.009   9.30E-04    -43.6     123.0             292500
 29   -15.36      4.32     0.009   7.13E-04    -46.6      60.1             292500
 30   -16.32     80.19     0.008   6.43E-04     -6.0       0.0                  0
 31   -16.47      0.00     0.008          0      0.0       0.0                  0
 32   -16.77      0.08     0.008          0      0.0       0.0                  0
 33   -20.39      0.02     0.007          0      0.2       0.0                  0
 34   -24.00      0.09     0.006          0      0.4       0.0                  0
 35   -28.80      0.05     0.005          0      0.7       0.0                  0
 36   -33.60      0.05     0.004          0      1.0       0.0                  0
 37   -38.40     -0.14     0.003          0      0.7       0.0                  0
 38   -41.45      0.02     0.002          0      0.5       0.0                  0
 39   -44.50     -0.37     0.000          0      0.0       0.0                ---
 At elev.   4.00                    Prop force =      78.4 kN/m run
 At elev.  -1.40                    Prop force =      82.9 kN/m run
 At elev.  -4.50                    Prop force =     599.7 kN/m run
 At elev.  -7.40                    Prop force =     152.9 kN/m run
 At elev. -10.70                    Prop force =     386.5 kN/m run

                                     LEFT side
               ---------------------------------------------------------
                       Effective stresses                Total  Adjusted
 Node    Y     Water   Vertic  Active  Passive  Earth    earth    soil
 no.   coord   press.   -al    limit    limit   press.   press.  modulus
                kN/m2   kN/m2   kN/m2    kN/m2   kN/m2    kN/m2    kN/m2
  1     4.00    0.00    0.00    0.00    16.18   13.25    13.25     5999
  2     3.30    0.00   11.74    0.00    61.60   14.46    14.46     5999
  3     2.50    0.00   26.00    4.14   116.75   18.15    18.15     5999
  4     1.90    0.00   37.02    7.54   159.38   21.23    21.23     5999
  5     1.40    0.00   46.19   10.38   194.86   23.84    23.84     5999
  6     0.40   10.00   54.26   12.87   226.08   26.30    36.30     5999
  7    -0.30   17.00   59.67   14.54   246.99   27.99    44.99     5999
  8    -1.00   24.00   64.90   16.16   267.24   30.38    54.38     5999
  9    -1.40   28.00   67.83   17.06   278.57   31.93    59.93     5999
 10    -2.40   38.00   74.99   19.28   306.28   35.92    73.92     5999
 11    -2.50   39.00   75.70   19.49   309.01   36.66    75.66     5999
               39.00   75.70   19.49   348.27   36.66    75.66     5999
 12    -3.20   46.00   80.60   21.01   369.66   39.89    85.89     5999
 13    -3.90   53.00   85.43   22.50   390.77   43.39    96.39     5999
 14    -4.50   59.00   89.52   23.77   408.67   46.05   105.05     5999
 15    -5.00   64.00   92.91   24.81   423.47   47.41   111.41     5999
 16    -5.30   67.00   94.93   25.44   432.31   47.90   114.90     5999
 17    -5.70   71.00   97.62   26.27   444.04   51.30   122.30     5999
               71.00   97.62   17.04   528.95   68.53   139.53    39994
 18    -6.70   81.00  106.79   19.41   574.45   35.96   116.96    39994
 19    -6.90   83.00  108.61   19.89   583.51   33.43   116.43    39994
               83.00  108.61    0.00  1906.20  305.78   388.78   399941
 20    -7.40   88.00  114.17    0.00  1955.61    0.00    88.00a  399941
 21    -8.20   96.00  123.03    0.00  2034.43    0.00    96.00a  399941
 22    -8.90  103.00  130.77    0.00  2103.20    0.00   103.00a  399941
 23    -9.60  110.00  138.48    0.00  2171.81    8.79   118.79   399941
```

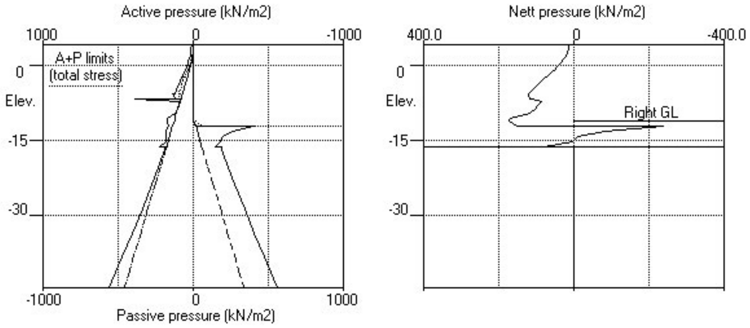
```
 24  -10.70  121.00  150.58    0.00  2279.35   49.61   170.61   399941
 25  -11.12  125.20  155.19    0.00  2320.34   47.23   172.43   399941

===========================================================================
Run ID. 1-1_North_800DWall_topdown_B4                       | Sheet No.
Downtown Carpark Redevelopment                              | Date:23-10-2025
800mm D-Wall - Top Down Only (B4)                           | Checked :
-----------------------------------------------------------------------------
                                                                  (continued)
Stage No.16  Change EI of wall to 292500 kN.m2/m run
              Allow wall to relax with new modulus value

                                      LEFT side
                         Effective stresses              Total  Adjusted
Node    Y     Water   Vertic  Active  Passive  Earth     earth     soil
no.   coord   press.   -al    limit    limit   press.   press.   modulus
               kN/m2   kN/m2   kN/m2    kN/m2   kN/m2    kN/m2     kN/m2
 26  -12.32  137.20  168.33    0.00  2437.23   30.29   167.49   399941
 27  -13.36  147.60  179.70    0.00  2538.32   34.24   181.84   399941
 28  -14.40  158.00  191.06    0.00  2639.26   25.00   183.00   399941
 29  -15.36  167.60  201.52    0.00  2732.32   16.81   184.41   399941
 30  -16.32  177.20  211.98    0.00  2825.28   52.30   229.50   399941
 31  -16.47  178.70  213.61    0.00  2839.80    9.61   188.31   399941
 32  -16.77  181.70  216.88    0.00  2868.83    8.19   189.89   399941
 33  -20.39  217.85  256.17    0.00  3218.25   12.58   230.43   399941
 34  -24.00  254.00  295.43    0.00  3567.27   21.38   275.38   399941
 35  -28.80  302.00  347.54    0.00  4030.63   37.92   339.92   399941
 36  -33.60  350.00  399.69    0.00  4494.29   55.96   405.96   399941
 37  -38.40  398.00  451.89    0.00  4958.42   74.96   472.96   399941
 38  -41.45  428.50  485.08    0.00  5253.60   87.61   516.11   399941
 39  -44.50  459.00  518.31    0.00  5549.00  100.15   559.15   399941


                                     RIGHT side
                         Effective stresses              Total  Adjusted
Node    Y     Water   Vertic  Active  Passive  Earth     earth     soil
no.   coord   press.   -al    limit    limit   press.   press.   modulus
               kN/m2   kN/m2   kN/m2    kN/m2   kN/m2    kN/m2     kN/m2
  1    4.00    0.00    0.00    0.00     0.00    0.00     0.00      0.0
  2    3.30    0.00    0.00    0.00     0.00    0.00     0.00      0.0
  3    2.50    0.00    0.00    0.00     0.00    0.00     0.00      0.0
  4    1.90    0.00    0.00    0.00     0.00    0.00     0.00      0.0
  5    1.40    0.00    0.00    0.00     0.00    0.00     0.00      0.0
  6    0.40    0.00    0.00    0.00     0.00    0.00     0.00      0.0
  7   -0.30    0.00    0.00    0.00     0.00    0.00     0.00      0.0
  8   -1.00    0.00    0.00    0.00     0.00    0.00     0.00      0.0
  9   -1.40    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 10   -2.40    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 11   -2.50    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 12   -3.20    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 13   -3.90    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 14   -4.50    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 15   -5.00    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 16   -5.30    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 17   -5.70    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 18   -6.70    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 19   -6.90    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 20   -7.40    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 21   -8.20    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 22   -8.90    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 23   -9.60    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 24  -10.70    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 25  -11.12    0.00    0.00    0.00     0.00    0.00     0.00      0.0
```

```
                0.00    0.00    0.00    17.51    0.56     0.56     6000
 26  -12.32   12.00    7.80    0.00    51.59    2.81    14.81     6000
               12.00    7.80    0.00  1009.84  393.79   405.79   399970
 27  -13.36   22.40   19.25    0.00  1111.60  240.44   262.84   399970
 28  -14.40   32.80   30.70    0.00  1213.43  160.67   193.47   399970
 29  -15.36   42.40   41.28    0.00  1307.52  137.69   180.09   399970
 30  -16.32   52.00   51.87    0.00  1401.71   97.32   149.32   399970
 31  -16.47   53.50   53.53    0.00  1416.44  134.81   188.31   399970

===========================================================================
Run ID. 1-1_North_800DWall_topdown_B4                       | Sheet No.
Downtown Carpark Redevelopment                              | Date:23-10-2025
800mm D-Wall - Top Down Only (B4)                           | Checked :
-----------------------------------------------------------------------------
                                                                  (continued)
Stage No.16  Change EI of wall to 292500 kN.m2/m run
              Allow wall to relax with new modulus value

                                     RIGHT side
                         Effective stresses              Total  Adjusted
Node    Y     Water   Vertic  Active  Passive  Earth     earth     soil
no.   coord   press.   -al    limit    limit   press.   press.   modulus
               kN/m2   kN/m2   kN/m2    kN/m2   kN/m2    kN/m2     kN/m2
 32  -16.77   56.50   56.84    0.00  1445.91  133.31   189.81   399970
 33  -20.39   92.65   96.92    0.00  1802.28  137.76   230.41   399970
 34  -24.00  128.80  137.35    0.00  2161.75  146.50   275.30   399970
 35  -28.80  176.80  191.73    0.00  2645.24  163.07   339.87   399970
 36  -33.60  224.80  247.02    0.00  3136.84  181.11   405.91   399970
 37  -38.40  272.80  303.26    0.00  3636.87  200.31   473.11   399970
 38  -41.45  303.30  339.46    0.00  3958.80  212.80   516.10   399970
 39  -44.50  333.80  376.00    0.00  4283.72  225.72   559.52   399970

Note:    103.00 a  Soil pressure at active limit
         123.45 p  Soil pressure at passive limit
 ========================================================================TONKIN +
TAYLOR LTD                                              | Sheet No.
Program: WALLAP  Version 6.09  Revision A60.B77.R61         | Job No. 1016043
                             Licensed from GEOSOLVE         | Made by :  rxsw
Data filename/Run ID: 1-1_North_800DWall_topdown_B4         |
Downtown Carpark Redevelopment                              | Date:23-10-2025
800mm D-Wall - Top Down Only (B4)                           | Checked :
-----------------------------------------------------------------------------
                                                       Units: kN,m
```

Stage No.16 Change EI of wall to 292500kN.m2/m run



Stage No.16 Change EI of wall to 292500kN.m2/m run



```
==========================================================================TONKIN +
TAYLOR LTD                                                | Sheet No.
Program: WALLAP  Version 6.09  Revision A60.B77.R61         | Job No. 1016043
                              Licensed from GEOSOLVE         | Made by :  rxsw
Data filename/Run ID: 1-1_North_800DWall_topdown_B4         |
Downtown Carpark Redevelopment                              | Date:23-10-2025
800mm D-Wall - Top Down Only (B4)                           | Checked :
-------------------------------------------------------------------------------
                                                         Units: kN,m
Summary of results
```

```
STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method
 Factor of safety on soil strength

                                        FoS for toe       Toe elev. for
                                       elev. =  -16.32      FoS = 1.000
 Stage  Ground level     Prop  Factor  Moment       Toe     Wall      Direction
  No.   Act.    Pass.    Elev.    of   equilib.   elev.   Penetr        of
                               Safety  at elev.            -ation      failure
   1    4.00    4.00     Cant.  Conditions not suitable for FoS calc.
   2    4.00    4.00     Cant.  Conditions not suitable for FoS calc.
   3    4.00    4.00            No analysis at this stage
   4    4.00    4.00            No analysis at this stage
   5    4.00   -5.00      4.00   4.796     n/a      -7.14    2.14      L to R
   6    4.00   -5.00            No analysis at this stage
   All remaining stages have more than one prop - FoS calculation n/a

============================================================================
TONKIN + TAYLOR LTD                                          | Sheet No.
Program: WALLAP  Version 6.09  Revision A60.B77.R61           | Job No. 1016043
                             Licensed from GEOSOLVE           | Made by :  rxsw
Data filename/Run ID: 1-1_North_800DWall_topdown_B4           |
Downtown Carpark Redevelopment                                | Date:23-10-2025
800mm D-Wall - Top Down Only (B4)                             | Checked :
-------------------------------------------------------------------------------
                                                         Units: kN,m
Summary of results

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall
  Analysis options
  2-D finite element model.    Active limit arching modelled.
  Soil deformations are elastic until the active or passive limit is reached
  Open Tension Crack analysis - No

  Length of wall perpendicular to section = 1000.00m
  Rigid boundaries:     Left side 60.00m from wall                Rough
                       Right side 60.00m from wall               Smooth
               Lower boundary at elevation -44.50m                Rough
                               Soil-wall interface                Smooth

Bending moment, shear force and displacement envelopes
 Node    Y       Displacement          Bending moment         Shear force
 no.   coord   maximum   minimum     maximum   minimum     maximum   minimum
                  m         m        kN.m/m    kN.m/m       kN/m      kN/m
  1     4.00    0.002    -0.000         0.0      -0.0         0.0    -177.9
  2     3.30    0.005    -0.000         0.0    -121.0         0.0    -168.9
  3     2.50    0.007    -0.000         0.0    -251.1         0.0    -157.2
  4     1.90    0.009    -0.000         0.0    -342.2         0.0    -146.7
  5     1.40    0.010    -0.000         0.1    -413.0         0.1    -136.8
  6     0.40    0.012    -0.000         0.1    -537.1        63.6    -110.3
  7    -0.30    0.013    -0.000         0.2    -605.6        91.1     -85.1
  8    -1.00    0.014    -0.000         0.3    -654.7       176.4     -54.2
  9    -1.40    0.015    -0.000         0.3    -672.3       199.1     -43.6
 10    -2.40    0.015    -0.000         0.4    -677.6       117.6       0.0
 11    -2.50    0.015    -0.000         0.5    -674.8       125.0       0.0
 12    -3.20    0.015    -0.000         8.2    -635.1       180.7       0.0
 13    -3.90    0.015    -0.000       137.6    -557.8       265.8       0.0
 14    -4.50    0.016    -0.000       316.6    -458.1       326.2    -426.9
 15    -5.00    0.016    -0.000       111.7    -349.2       242.7    -374.0
 16    -5.30    0.017    -0.000        12.8    -272.6       267.6    -340.7
 17    -5.70    0.017    -0.000        17.2    -211.7       300.7    -294.0
 18    -6.70    0.018    -0.000       152.9    -439.0       324.0    -175.5
 19    -6.90    0.019     0.000       218.2    -471.7       329.3    -153.9
```

```
 20   -7.40     0.019     0.000      326.8    -513.5      153.7    -137.2
 21   -8.20     0.019     0.000      368.5    -541.8       11.2     -61.9
 22   -8.90     0.018     0.000      337.2    -521.6       80.8     -62.8
 23   -9.60     0.017     0.000      280.5    -460.9      189.3     -84.9
 24  -10.70     0.015     0.000      180.2    -285.7      361.7    -129.0
 25  -11.12     0.014     0.000      147.0    -193.2      239.4     -73.5
 26  -12.32     0.012     0.000      155.6      -0.2      333.8     -44.4
 27  -13.36     0.011     0.000      312.9      -0.1       47.7     -26.3
 28  -14.40     0.010     0.000      250.3      -0.1        0.0     -97.8
 29  -15.36     0.009     0.000      121.3      -0.0        0.0    -129.4
 30  -16.32     0.008     0.000        0.0       0.0        0.0     -16.9
 31  -16.47     0.008     0.000        0.0       0.0        0.0      -0.0
 32  -16.77     0.008     0.000        0.0       0.0        1.1      -0.0
 33  -20.39     0.007     0.000        0.0       0.0        6.4      -0.0
 34  -24.00     0.006     0.000        0.0       0.0        0.4      -0.0
 35  -28.80     0.005     0.000        0.0       0.0        0.7      -0.0
 36  -33.60     0.004     0.000        0.0       0.0        1.0      -0.0
 37  -38.40     0.003     0.000        0.0       0.0        0.7      -0.0
 38  -41.45     0.002     0.000        0.0       0.0        0.6      -0.0
 39  -44.50     0.000     0.000        0.0       0.0        0.0      -0.0
===========================================================================
Run ID. 1-1_North_800DWall_topdown_B4                      | Sheet No.
Downtown Carpark Redevelopment                             | Date:23-10-2025
800mm D-Wall - Top Down Only (B4)                          | Checked :
-----------------------------------------------------------------------------
```

Summary of results   (continued)

Maximum and minimum bending moment and shear force at each stage

```
Stage  --------- Bending moment --------   ---------- Shear force ----------
 no.   maximum   elev.   minimum   elev.   maximum   elev.   minimum   elev.
        kN.m/m            kN.m/m            kN/m              kN/m
  1        1.2   -5.70      -1.3   -8.20       0.3   -9.60      -2.3   -6.90
  2       29.4   -7.40      -7.1   -1.00      11.5   -5.70      -8.8   -8.90
  3    No calculation at this stage
  4    No calculation at this stage
  5      368.5   -8.20    -677.6   -2.40     329.3   -6.90    -177.9    4.00
  6    No calculation at this stage
  7    No calculation at this stage
  8      309.2  -13.36    -541.8   -8.20     332.9  -12.32    -426.9   -4.50
  9      312.9  -13.36    -541.7   -8.20     333.8  -12.32    -425.0   -4.50
 10    No calculation at this stage
 11    No calculation at this stage
 12    No calculation at this stage
 13      271.4  -13.36    -448.0   -8.20     288.3   -4.50    -395.7   -4.50
 14      277.0   -4.50    -469.7   -8.20     361.7  -10.70    -417.3   -4.50
 15      266.1   -4.50    -466.5   -8.20     339.6  -10.70    -404.6   -4.50
 16      258.8   -4.50    -344.2   -8.20     289.7  -10.70    -343.8   -4.50
 17      261.7   -4.50    -350.1   -8.20     321.1  -10.70    -344.4   -4.50
 18      269.0   -4.50    -379.6   -8.20     341.9  -10.70    -349.0   -4.50
 19      279.1   -4.50    -381.1   -8.20     348.0  -10.70    -365.6   -4.50
 20      282.9   -4.50    -377.0   -8.20     349.0  -10.70    -400.8   -4.50
 21      285.0   -4.50    -374.7   -8.20     348.5  -10.70    -399.6   -4.50
 22      297.2   -4.50    -374.2   -8.20     348.1  -10.70    -403.3   -4.50
 23      306.4   -4.50    -374.5   -8.20     347.9  -10.70    -406.7   -4.50
 24      312.3   -4.50    -375.1   -8.20     348.0  -10.70    -409.2   -4.50
 25      315.6   -4.50    -375.6   -8.20     348.1  -10.70    -410.8   -4.50
 26      316.6   -4.50    -375.9   -8.20     348.2  -10.70    -411.4   -4.50
===========================================================================
Run ID. 1-1_North_800DWall_topdown_B4                      | Sheet No.
Downtown Carpark Redevelopment                             | Date:23-10-2025
800mm D-Wall - Top Down Only (B4)                          | Checked :
-----------------------------------------------------------------------------
```

Summary of results   (continued)

Maximum and minimum displacement at each stage

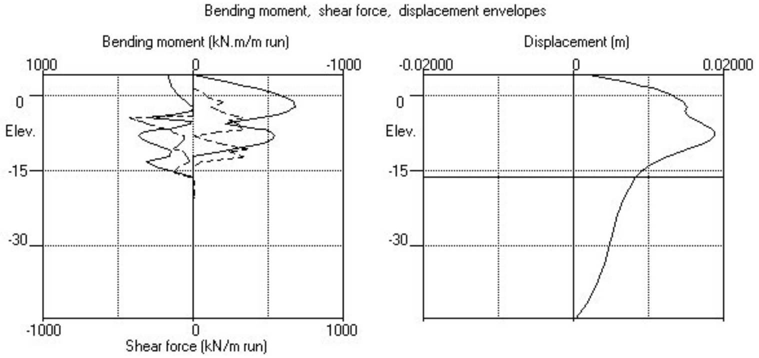
```
Stage -------- Displacement ---------
 no.  maximum  elev.   minimum  elev.   Stage description                    _
         m                m
  1    0.000  -16.77   -0.000    4.00   Change EI of wall to 877500kN.m2/m run
  2    0.002    4.00    0.000    4.00   Apply surcharge no.1 at elev. 4.00
  3    No calculation at this stage     Install prop no.1 at elev. 4.00
  4    No calculation at this stage     Apply water pressure profile no.1
  5    0.015   -2.40    0.000    4.00   Excav. to elev. -5.00 on RIGHT side
  6    No calculation at this stage     Install prop no.3 at elev. -4.50
  7    No calculation at this stage     Apply water pressure profile no.2
  8    0.018   -7.40    0.000    4.00   Excav. to elev. -12.32 on RIGHT side
  9    0.017   -7.40    0.000    4.00   Fill to elev. -11.12 on RIGHT side
 10    No calculation at this stage     Install prop no.5 at elev. -10.70
 11    No calculation at this stage     Install prop no.4 at elev. -7.40
 12    No calculation at this stage     Install prop no.2 at elev. -1.40
 13    0.018   -7.40    0.000    4.00   Change EI of wall to 585000kN.m2/m run
 14    0.018   -7.40    0.000    4.00   Apply water pressure profile no.3
 15    0.018   -7.40    0.000    4.00   Apply water pressure profile no.4
 16    0.018   -8.20    0.000    4.00   Change EI of wall to 292500kN.m2/m run
 17    0.018   -8.20    0.000    4.00   Apply load no.1 at elev. -9.60
 18    0.019   -8.20    0.000    4.00   Apply load no.2 at elev. -8.20
 19    0.019   -8.20    0.000    4.00   Apply load no.3 at elev. -6.70
 20    0.019   -8.20    0.000    4.00   Apply load no.4 at elev. -5.30
 21    0.019   -8.20    0.000    4.00   Apply load no.5 at elev. -3.90
 22    0.019   -8.20    0.000    4.00   Apply load no.6 at elev. -2.40
 23    0.019   -8.20    0.000    4.00   Apply load no.7 at elev. -1.00
 24    0.019   -8.20    0.000    4.00   Apply load no.8 at elev. 0.40
 25    0.019   -8.20    0.000    4.00   Apply load no.9 at elev. 1.90
 26    0.019   -8.20    0.000    4.00   Apply load no.10 at elev. 3.30
===========================================================================
Run ID. 1-1_North_800DWall_topdown_B4                      | Sheet No.
Downtown Carpark Redevelopment                             | Date:23-10-2025
800mm D-Wall - Top Down Only (B4)                          | Checked :
-----------------------------------------------------------------------------
```

Summary of results   (continued)

Prop forces at each stage (horizontal components)

```
Stage   --- Strut no. 1 ---   --- Strut no. 2 ---   --- Strut no. 3 ---
 no.       at elev. 4.00         at elev.-1.40         at elev.-4.50
        kN/m run  kN/prop     kN/m run  kN/prop     kN/m run  kN/prop
  5      177.90    177.90        ---       ---         ---       ---
  8      113.32    113.32        ---       ---       729.25    729.25
  9      113.67    113.67        ---       ---       726.60    726.60
 13       98.08     98.08      29.01     29.01     684.03    684.03
 14      104.01    104.01      48.18     48.18     722.71    722.71
 15       98.04     98.04      26.09     26.09     697.76    697.76
 16       78.39     78.39      82.86     82.86     599.67    599.67
 17       78.44     78.44      82.05     82.05     601.39    601.39
 18       78.50     78.50      79.99     79.99     608.59    608.59
 19       78.42     78.42      77.42     77.42     628.34    628.34
 20       78.01     78.01      77.65     77.65     663.90    663.90
 21       77.15     77.15      89.34     89.34     702.55    702.55
 22       76.94     76.94     120.17    120.17     725.88    725.88
 23       80.96     80.96     162.60    162.60     732.88    732.88
 24       94.01     94.01     203.45    203.45     731.41    731.41
 25      120.90    120.90     231.83    231.83     727.73    727.73
 26      163.24    163.24     242.69    242.69     725.68    725.68

===========================================================================
Run ID. 1-1_North_800DWall_topdown_B4                      | Sheet No.
```

```
Downtown Carpark Redevelopment                                | Date:23-10-2025
800mm D-Wall - Top Down Only (B4)                             | Checked :
-----------------------------------------------------------------------------

Stage   --- Strut no. 4 ---   --- Strut no. 5 ---
 no.       at elev.-7.40         at elev.-10.70
         kN/m run  kN/prop     kN/m run  kN/prop
 13       46.24     46.24       60.37     60.37
 14       98.96     98.96      397.14    397.14
 15       86.33     86.33      352.58    352.58
 16      152.88    152.88      386.49    386.49
 17      166.81    166.81      426.57    426.57
 18      197.23    197.23      461.17    461.17
 19      224.71    224.71      474.55    474.55
 20      237.66    237.66      477.92    477.92
 21      239.43    239.43      477.51    477.51
 22      237.76    237.76      476.60    476.60
 23      235.96    235.96      476.12    476.12
 24      234.54    234.54      475.99    475.99
 25      233.68    233.68      476.05    476.05
 26      233.39    233.39      476.11    476.11
 =========================================================================TONKIN +
TAYLOR LTD                                            | Sheet No.
Program: WALLAP  Version 6.09  Revision A60.B77.R61         | Job No. 1016043
                             Licensed from GEOSOLVE         | Made by :  rxsw
Data filename/Run ID: 1-1_North_800DWall_topdown_B4         |
Downtown Carpark Redevelopment                              | Date:23-10-2025
800mm D-Wall - Top Down Only (B4)                           | Checked :
-----------------------------------------------------------------------------
                                                       Units: kN,m
```



ADDRESS: DOWNTOWN CARPARK

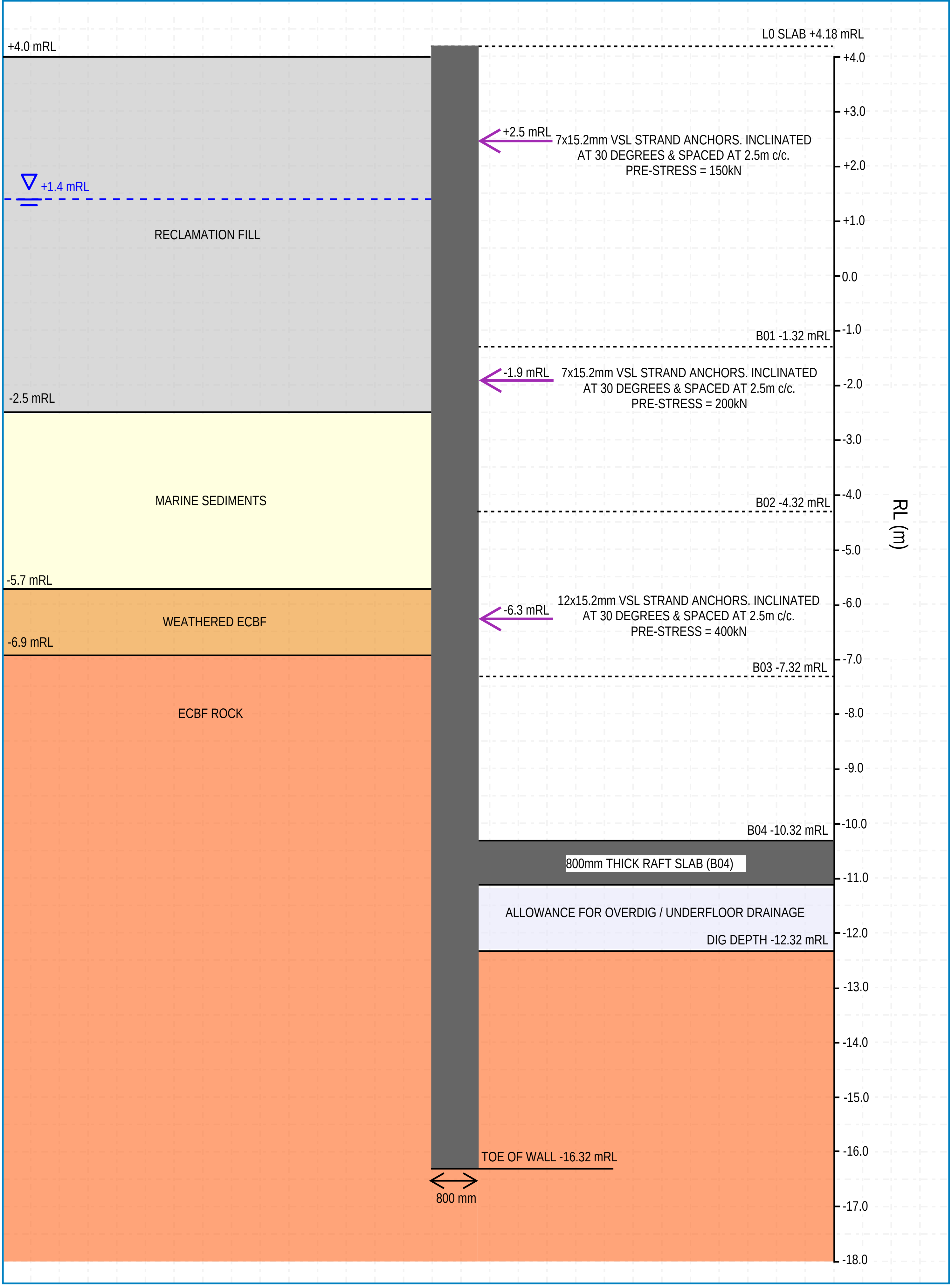
TITLE

T+T JOB No. 1016043.1000

DESCRIPTION: SECTION 2 - GROUND ANCHORS

SHEET 1 **of** 1

Tonkin+Taylor
Exceptional thinking together www.tonkintaylor.co.nz



```
TONKIN + TAYLOR LTD                                         | Sheet No.
Program: WALLAP  Version 6.09  Revision A60.B77.R61         | Job No. 1016043
                             Licensed from GEOSOLVE         | Made by :  rxsw
Data filename/Run ID: 2_West_800DWall_anchored              |
Downtown Carpark Redevelopment                              | Date:23-10-2025
800mm D-Wall - Anchored                                     | Checked :
-----------------------------------------------------------------------------
                                                     Units: kN,m
```

INPUT DATA

SOIL PROFILE

```
Stratum   Elevation of    ------------------ Soil types -------------------
  no.    top of stratum    Left side                Right side
   1          4.00       1  Fill                   1  Fill
   2         -2.50       2  Marine Sediment        2  Marine Sediment
   3         -5.70       5  Weathered ECBF         3  Tauranga Group
   4         -6.90       4  ECBF                   4  ECBF
```

SOIL PROPERTIES

```
                      Bulk    Young's   At rest  Consol  Active  Passive
-- Soil type --     density  Modulus    coeff.  state.  limit    limit   Cohesion
No. Description      kN/m3  Eh,kN/m2     Ko     NC/OC    Ka       Kp       kN/m2
  (Datum elev.)             (dEh/dy ) (dKo/dy) (  Nu ) ( Kac ) (  Kpc ) ( dc/dy )
 1  Fill             16.50      6000    0.530     OC    0.309    3.868     3.000d
                                               (0.300) (1.300) ( 5.395)
 2  Marine           16.50      6000    0.530     OC    0.309    4.369     3.000d
    Sediment                                   (0.300) (1.300) ( 5.836)
 3  Tauranga         17.50     20000    0.500     OC    0.283    4.369     5.000d
    Group                                      (0.300) (1.241) ( 5.836)
 4  ECBF             21.00    400000    0.357     OC    0.180    8.892     100.0d
                                               (0.250) (0.978) ( 9.405)
 5  Weathered        19.00     40000    0.470     OC    0.259    4.964     7.000d
    ECBF                                       (0.300) (1.185) ( 6.343)
 6  Engineered       19.00     40000    0.840     OC    0.197    7.588       0.0d
    Fill                                       (0.300) (1.027) ( 8.432)
```

Additional soil parameters associated with Ka and Kp

```
                          --- parameters for Ka ---  --- parameters for Kp ---
                            Soil      Wall    Back-    Soil      Wall    Back-
------- Soil type ------- friction  adhesion  fill   friction  adhesion  fill
No. Description             angle    coeff.   angle    angle    coeff.   angle
 1  Fill                    28.00    0.670    0.00     28.00    0.500    0.00
 2  Marine Sediment         28.00    0.670    0.00     30.00    0.500    0.00
 3  Tauranga Group          30.00    0.670    0.00     30.00    0.500    0.00
 4  ECBF                    40.00    0.670    0.00     40.00    0.500    0.00
 5  Weathered ECBF          32.00    0.670    0.00     32.00    0.500    0.00
 6  Engineered Fill         38.00    0.670    0.00     38.00    0.500    0.00
```

GROUND WATER CONDITIONS

```
 Density of water = 10.00 kN/m3
                                     Left side     Right side
 Initial water table elevation         1.40            1.40

 Automatic water pressure balancing at toe of wall :  No

 Water             Left side                      Right side
 press. ------------------------------  ------------------------------
profile Point   Elev.    Piezo   Water  Point   Elev.     Piezo   Water
  no.    no.             elev.   press.  no.              elev.   press.
                  m        m     kN/m2             m        m     kN/m2
   1      1     1.40     1.40     0.0     1     -2.40    -2.40     0.0

   2      1     1.40     1.40     0.0     1     -6.80    -6.80     0.0

   3      1     1.40     1.40     0.0     1    -12.32   -12.32     0.0

   4    Not defined
   5      1     2.50     2.50     0.0     1    -11.12   -11.12     0.0

   6      1     1.40     1.40     0.0     1    -11.12   -11.12     0.0
===========================================================================
```

WALL PROPERTIES

```
                         Type of structure = Fully Embedded Wall
                  Elevation of toe of wall = -16.32
             Maximum finite element length =   1.20 m
                  Youngs modulus of wall E = 2.7400E+07 kN/m2
                Moment of inertia of wall I = 0.042700 m4/m run
                                       E.I = 1.1700E+06 kN.m2/m run
                     Yield Moment of wall = Not defined
```

STRUTS and ANCHORS

```
                       Cross-                     Inclin    Pre-  Strut  Allow
Prop         Prop     section   Youngs     Free   -ation  stress   or   tension
 no.  Elev. spacing    area    modulus   length   (degs)   /prop Anchor    ?   L/R
                m      sq.m     kN/m2       m                kN
 1     2.50    2.50  0.001003  2.100E+08  18.00    30.00   150.0 Anchor   n/a   R
 2    -1.90    2.50  0.001003  2.100E+08  11.00    30.00   200.0 Anchor   n/a   R
 3    -6.30    2.00  0.001720  2.100E+08   2.00    20.00   400.0 Anchor   n/a   R
 4   -10.70    1.00  0.800000  2.740E+07  30.00     0.00     0    Strut    No   R
 5    -7.40    1.00  0.200000  2.740E+07  30.00     0.00     0    Strut    No   R
 6    -4.40    1.00  0.200000  2.740E+07  30.00     0.00     0    Strut    No   R
 7    -1.40    1.00  0.200000  2.740E+07  30.00     0.00     0    Strut    No   R
 8     4.00    1.00  0.200000  2.740E+07  30.00     0.00     0    Strut    No   R
```

HORIZONTAL and MOMENT LOADS/RESTRAINTS

```
 Load            Horizontal    Moment      Moment     Partial
  no.  Elevation    load        load      restraint   factor
                 kN/m run   kN.m/m run  kN.m/m/rad  (Category)
   1      -9.60      51.10      0            0         n/a
   2      -8.20      51.10      0            0         n/a
   3      -6.70      51.10      0            0         n/a
   4      -5.30      51.10      0            0         n/a
   5      -3.90      51.10      0            0         n/a
   6      -2.40      51.10      0            0         n/a
   7      -1.00      51.10      0            0         n/a
   8       0.40      51.10      0            0         n/a
   9       1.90      51.10      0            0         n/a
  10       3.30      51.10      0            0         n/a
```

SURCHARGE LOADS

```
             Distance  Length    Width   Surcharge(kN/m2) Surcharge  Part  Short Q
 Surcharge     from   parallel  perpend.   Near     Far         Soil  fact.  reduc.
 no.   Elev.   wall   to wall   to wall    edge     edge   Cat. type         fact.
  1    4.00  2.00(L)  100.00    20.00    12.00      =      --   --    --     --

    Note: L = Left side,  R = Right side
===========================================================================
```

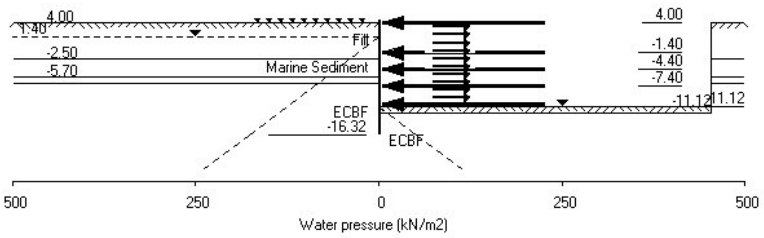
CONSTRUCTION STAGES

```
Construction   Stage description
  stage no.    -------------------------------------------------------
      1        Change EI of wall to 877500 kN.m2/m run
               Reset wall displacements to zero at this stage
      2        Apply surcharge no.1 at elevation 4.00
      3        Excavate to elevation 2.00 on RIGHT side
      4        Install strut or anchor no.1 at elevation 2.50
      5        Apply water pressure profile no.1
```

```
              No analysis at this stage
     6        Excavate to elevation -2.40 on RIGHT side
     7        Install strut or anchor no.2 at elevation -1.90
     8        Apply water pressure profile no.2
              No analysis at this stage
     9        Excavate to elevation -6.80 on RIGHT side
    10        Install strut or anchor no.3 at elevation -6.30
    11        Apply water pressure profile no.3
              No analysis at this stage
    12        Excavate to elevation -12.32 on RIGHT side
    13        Fill to elevation -11.12 on RIGHT side with soil type 6
    14        Install strut or anchor no.4 at elevation -10.70
    15        Install strut or anchor no.5 at elevation -7.40
    16        Install strut or anchor no.6 at elevation -4.40
    17        Remove strut or anchor no.3 at elevation -6.30
    18        Install strut or anchor no.7 at elevation -1.40
    19        Install strut or anchor no.8 at elevation 4.00
    20        Remove strut or anchor no.2 at elevation -1.90
    21        Remove strut or anchor no.1 at elevation 2.50
    22        Change EI of wall to 585000 kN.m2/m run
              Allow wall to relax with new modulus value
    23        Apply water pressure profile no.5
    24        Apply water pressure profile no.6
    25        Change EI of wall to 292500 kN.m2/m run
              Allow wall to relax with new modulus value
    26        Apply load no.1 at elevation -9.60
    27        Apply load no.2 at elevation -8.20
    28        Apply load no.3 at elevation -6.70
    29        Apply load no.4 at elevation -5.30
    30        Apply load no.5 at elevation -3.90
    31        Apply load no.6 at elevation -2.40
    32        Apply load no.7 at elevation -1.00
    33        Apply load no.8 at elevation 0.40
    34        Apply load no.9 at elevation 1.90
    35        Apply load no.10 at elevation 3.30


FACTORS OF SAFETY and ANALYSIS OPTIONS
 Stability analysis:
  Method of analysis  -  Strength Factor method
  Factor on soil strength for calculating wall depth = 1.00

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

 Bending moment and displacement calculation:
  Method  -  2-D finite element model
  Open Tension Crack analysis? - No
  Active limit arching modelled?  -  Yes
  Non-linear Modulus Parameter (L) = 20.00 m

 Boundary conditions:
  Length of wall (normal to plane of analysis) = 1000.00 m

  Width of excavation/fill on Left  side of wall  = 60.00 m
  Width of excavation/fill on Right side of wall  = 60.00 m

  Distance to rigid boundary on Left side  = 60.00 m
  Distance to rigid boundary on Right side = 60.00 m
  Elevation of rigid lower boundary = -45.25
```

```
  Lower rigid boundary at elevation -45.25 - Rough
  Rigid boundary on Left side           - Rough
  Rigid boundary on Right side          - Smooth
  Soil-wall interface                   - Smooth

===========================================================================
OUTPUT OPTIONS

 Stage ------ Stage description ----------- ------- Output options -------
  no.                                       Displacement   Active,  Graph.
                                            Bending mom.   Passive  output
                                            Shear force   pressures
    1 Change EI of wall to 877500kN.m2/m run      No          No      No
    2 Apply surcharge no.1 at elev. 4.00          No          No      No
    3 Excav. to elev. 2.00 on RIGHT side         Yes         Yes     Yes
    4 Install prop no.1 at elev. 2.50             No          No      No
    5 Apply water pressure profile no.1           No          No      No
    6 Excav. to elev. -2.40 on RIGHT side        Yes         Yes     Yes
    7 Install prop no.2 at elev. -1.90            No          No      No
    8 Apply water pressure profile no.2           No          No      No
    9 Excav. to elev. -6.80 on RIGHT side        Yes         Yes     Yes
   10 Install prop no.3 at elev. -6.30            No          No      No
   11 Apply water pressure profile no.3           No          No      No
   12 Excav. to elev. -12.32 on RIGHT side       Yes          No      No
   13 Fill to elev. -11.12 on RIGHT side          No          No      No
   14 Install prop no.4 at elev. -10.70           No          No      No
   15 Install prop no.5 at elev. -7.40            No          No      No
   16 Install prop no.6 at elev. -4.40            No          No      No
   17 Remove prop no.3 at elev. -6.30             No          No      No
   18 Install prop no.7 at elev. -1.40            No          No      No
   19 Install prop no.8 at elev. 4.00             No          No      No
   20 Remove prop no.2 at elev. -1.90             No         Yes      No
   21 Remove prop no.1 at elev. 2.50              No          No      No
   22 Change EI of wall to 585000kN.m2/m run      No          No      No
   23 Apply water pressure profile no.5           No          No      No
   24 Apply water pressure profile no.6           No          No      No
   25 Change EI of wall to 292500kN.m2/m run      No          No      No
   26 Apply load no.1 at elev. -9.60              No          No      No
   27 Apply load no.2 at elev. -8.20              No          No      No
   28 Apply load no.3 at elev. -6.70              No          No      No
   29 Apply load no.4 at elev. -5.30              No          No      No
   30 Apply load no.5 at elev. -3.90              No          No      No
   31 Apply load no.6 at elev. -2.40              No          No      No
   32 Apply load no.7 at elev. -1.00              No          No      No
   33 Apply load no.8 at elev. 0.40              Yes          No      No
   34 Apply load no.9 at elev. 1.90               No          No      No
   35 Apply load no.10 at elev. 3.30              No          No      No
    * Summary output                             Yes          -      Yes


Program WALLAP - Copyright (C) 2024 by DL Borin,  distributed by GEOSOLVE
       150 St. Alphonsus Road, London SW4 7BW, UK
www.geosolve.co.uk=================================================================
=====TONKIN + TAYLOR LTD                                    | Sheet No.
Program: WALLAP  Version 6.09  Revision A60.B77.R61         | Job No. 1016043
                             Licensed from GEOSOLVE         | Made by :  rxsw
Data filename/Run ID: 2_West_800DWall_anchored              |
Downtown Carpark Redevelopment                              | Date:23-10-2025
800mm D-Wall - Anchored                                     | Checked :
---------------------------------------------------------------------------
                                                       Units: kN,m
```

Stage No.35   Apply load no.10 at elev. 3.30



```
==========================================================================TONKIN +
TAYLOR LTD                                         | Sheet No.
Program: WALLAP  Version 6.09  Revision A60.B77.R61         | Job No. 1016043
                             Licensed from GEOSOLVE         | Made by :  rxsw
Data filename/Run ID: 2_West_800DWall_anchored              |
Downtown Carpark Redevelopment                              | Date:23-10-2025
800mm D-Wall - Anchored                                     | Checked :
-----------------------------------------------------------------------------
                                                       Units: kN,m
Stage No. 1   Change EI of wall to 877500 kN.m2/m run
              Reset wall displacements to zero at this stage

STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method
 Factor of safety on soil strength

                                FoS for toe       Toe elev. for
                               elev. =  -16.32     FoS = 1.000
 Stage  Ground level    Prop   Factor  Moment     Toe    Wall    Direction
```

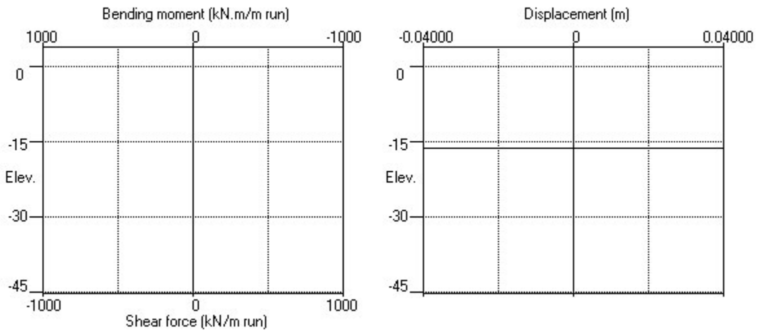
```
  No.   Act.   Pass.    Elev.    of    equilib.   elev.  Penetr       of
                               Safety  at elev.          -ation      failure
   1    4.00    4.00     Cant.  Conditions not suitable for FoS calc.


BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall
  Analysis options
  2-D finite element model.    Active limit arching modelled.
  Soil deformations are elastic until the active or passive limit is reached
  Open Tension Crack analysis - No

  Length of wall perpendicular to section = 1000.00m
  Rigid boundaries:     Left side 60.00m from wall                Rough
                       Right side 60.00m from wall               Smooth
               Lower boundary at elevation -45.25m                Rough
                               Soil-wall interface                Smooth

    *** Wall displacements reset to zero at stage 1

 Node  Y      Nett       Wall      Wall       Shear   Bending   Prop     EI of
 no.  coord  pressure     disp.   rotation    force   moment    forces     wall
                kN/m2       m       rad.      kN/m    kN.m/m    kN/m  kN.m2/m
  1    4.00      0.01    -0.000  -5.34E-07      0.0      -0.0            877500
  2    3.30      0.02    -0.000  -5.34E-07      0.0       0.0            877500
  3    2.50      0.02    -0.000  -5.42E-07      0.0       0.0            877500
  4    2.00      0.02    -0.000  -5.56E-07      0.0       0.0            877500
  5    1.90      0.02    -0.000  -5.59E-07      0.0       0.0            877500
  6    1.40      0.02    -0.000  -5.86E-07      0.1       0.1            877500
  7    0.40      0.03    -0.000  -6.86E-07      0.1       0.1            877500
  8   -0.30      0.03    -0.000  -8.05E-07      0.1       0.2            877500
  9   -1.00      0.03    -0.000  -9.77E-07      0.1       0.3            877500
 10   -1.40      0.03    -0.000  -1.10E-06      0.1       0.3            877500
 11   -1.90      0.03    -0.000  -1.29E-06      0.1       0.4            877500
 12   -2.40      0.03    -0.000  -1.52E-06      0.2       0.4            877500
 13   -2.50      0.03    -0.000  -1.57E-06      0.2       0.5            877500
 14   -3.20      0.04    -0.000  -1.98E-06      0.2       0.6            877500
 15   -3.90      0.04    -0.000  -2.50E-06      0.2       0.7            877500
 16   -4.40      0.04    -0.000  -2.94E-06      0.2       0.8            877500
 17   -5.30      0.04    -0.000  -3.91E-06      0.3       1.1            877500
 18   -5.70      0.05    -0.000  -4.41E-06      0.3       1.2            877500
                -2.44    -0.000  -4.41E-06      0.3       1.2
 19   -6.30     -2.18    -0.000  -5.12E-06     -1.1       0.9            877500
 20   -6.70     -2.01    -0.000  -5.40E-06     -1.9       0.3            877500
 21   -6.80     -1.98     0.000  -5.42E-06     -2.1       0.1            877500
 22   -6.90     -1.92     0.000  -5.42E-06     -2.3      -0.1            877500
                 2.97     0.000  -5.42E-06     -2.3      -0.1
 23   -7.40      1.72     0.000  -5.13E-06     -1.2      -0.9            877500
 24   -8.20      0.83     0.000  -4.11E-06     -0.1      -1.3            877500
 25   -8.90      0.28     0.000  -3.12E-06      0.2      -1.2            877500
 26   -9.60      0.01     0.000  -2.25E-06      0.3      -1.0            877500
 27  -10.70     -0.08     0.000  -1.28E-06      0.3      -0.6            877500
===========================================================================
Run ID. 2_West_800DWall_anchored                            | Sheet No.
Downtown Carpark Redevelopment                              | Date:23-10-2025
800mm D-Wall - Anchored                                     | Checked :
-----------------------------------------------------------------------------
                                                              (continued)
Stage No.1   Change EI of wall to 877500 kN.m2/m run
              Reset wall displacements to zero at this stage

 Node  Y      Nett       Wall      Wall       Shear   Bending   Prop     EI of
 no.  coord  pressure     disp.   rotation    force   moment    forces     wall
                kN/m2       m       rad.      kN/m    kN.m/m    kN/m  kN.m2/m
```

```
 28  -11.12     -0.11     0.000  -1.03E-06      0.3      -0.5            877500
 29  -12.32     -0.08     0.000  -5.51E-07      0.1      -0.2            877500
 30  -13.36     -0.04     0.000  -3.36E-07      0.1      -0.1            877500
 31  -14.40     -0.02     0.000  -2.23E-07      0.0      -0.1            877500
 32  -15.36     -0.01     0.000  -1.72E-07      0.0      -0.0            877500
 33  -16.32     -0.05     0.000  -1.57E-07      0.0       0.0                 0
 34  -16.47     -0.00     0.000          0      0.0       0.0                 0
 35  -16.77      0.00     0.000          0      0.0       0.0                 0
 36  -20.39      0.00     0.000          0      0.0       0.0                 0
 37  -24.00     -0.00     0.000          0      0.0       0.0                 0
 38  -28.80     -0.00     0.000          0      0.0       0.0                 0
 39  -33.60      0.00     0.000          0      0.0       0.0                 0
 40  -38.40      0.00     0.000          0      0.0       0.0                 0
 41  -41.83     -0.00     0.000          0      0.0       0.0                 0
 42  -45.25      0.00     0.000          0      0.0       0.0               ---

                                          LEFT side
                           Effective stresses        Total  Adjusted
 Node   Y    Water   Vertic  Active  Passive  Earth    earth     soil
 no.  coord  press.    -al   limit    limit   press.   press.  modulus
              kN/m2   kN/m2   kN/m2    kN/m2   kN/m2    kN/m2    kN/m2
  1    4.00    0.00    0.00    0.00    16.18    0.01     0.01     5999
  2    3.30    0.00   11.55    0.00    60.86    6.13     6.13     5999
  3    2.50    0.00   24.75    3.75   111.92   13.13    13.13     5999
  4    2.00    0.00   33.00    6.30   143.84   17.50    17.50     5999
  5    1.90    0.00   34.65    6.81   150.22   18.38    18.38     5999
  6    1.40    0.00   42.90    9.36   182.14   22.75    22.75     5999
  7    0.40   10.00   49.40   11.37   207.28   26.20    36.20     5999
  8   -0.30   17.00   53.95   12.77   224.88   28.61    45.61     5999
  9   -1.00   24.00   58.50   14.18   242.48   31.02    55.02     5999
 10   -1.40   28.00   61.10   14.98   252.54   32.40    60.40     5999
 11   -1.90   33.00   64.35   15.99   265.11   34.12    67.12     5999
 12   -2.40   38.00   67.60   16.99   277.68   35.84    73.84     5999
 13   -2.50   39.00   68.25   17.19   280.20   36.19    75.19     5999
              39.00   68.25   17.19   315.72   36.19    75.19     5999
 14   -3.20   46.00   72.80   18.60   335.60   38.60    84.60     5999
 15   -3.90   53.00   77.35   20.00   355.48   41.01    94.01     5999
 16   -4.40   58.00   80.60   21.01   369.68   42.74   100.74     5999
 17   -5.30   67.00   86.45   22.82   395.24   45.84   112.84     5999
 18   -5.70   71.00   89.05   23.62   406.60   47.22   118.22     5999
              71.00   89.05   14.81   486.41   42.01   113.01    39994
 19   -6.30   77.00   94.45   16.21   513.21   44.53   121.53    39994
 20   -6.70   81.00   98.05   17.15   531.08   46.20   127.20    39994
 21   -6.80   82.00   98.95   17.38   535.55   46.62   128.62    39994
 22   -6.90   83.00   99.85   17.61   540.02   47.04   130.04    39994
              83.00   99.85    0.00  1828.29   36.77   119.77   399941
 23   -7.40   88.00  105.35    0.00  1877.20   38.13   126.13   399941
 24   -8.20   96.00  114.15    0.00  1955.44   40.83   136.83   399941
 25   -8.90  103.00  121.85    0.00  2023.91   43.31   146.31   399941
 26   -9.60  110.00  129.55    0.00  2092.37   45.93   155.93   399941
 27  -10.70  121.00  141.65    0.00  2199.96   50.20   171.20   399941
 28  -11.12  125.20  146.27    0.00  2241.04   51.84   177.04   399941
 29  -12.32  137.20  159.47    0.00  2358.40   56.57   193.77   399941
 30  -13.36  147.60  170.91    0.00  2460.12   60.67   208.27   399941
 31  -14.40  158.00  182.35    0.00  2561.84   64.77   222.77   399941
 32  -15.36  167.60  192.91    0.00  2655.74   68.54   236.14   399941
```

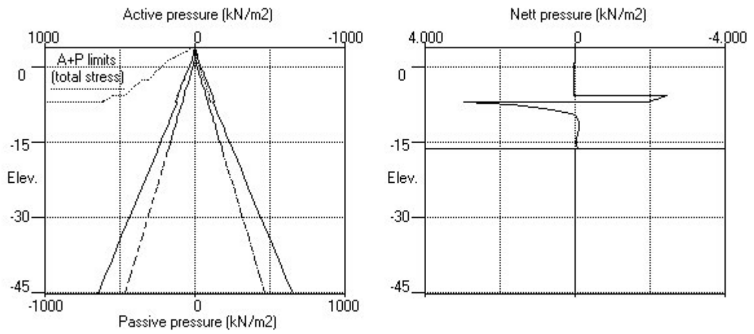
```
Stage No.1   Change EI of wall to 877500 kN.m2/m run
              Reset wall displacements to zero at this stage

                                          LEFT side
                           Effective stresses        Total  Adjusted
 Node   Y    Water   Vertic  Active  Passive  Earth    earth     soil
 no.  coord  press.    -al   limit    limit   press.   press.  modulus
              kN/m2   kN/m2   kN/m2    kN/m2   kN/m2    kN/m2    kN/m2
 33  -16.32  177.20  203.47    0.00  2749.63   72.29   249.49   399941
 34  -16.47  178.70  205.12    0.00  2764.30   72.91   251.61   399941
 35  -16.77  181.70  208.42    0.00  2793.64   74.08   255.78   399941
 36  -20.39  217.85  248.18    0.00  3147.21   88.28   306.13   399941
 37  -24.00  254.00  287.95    0.00  3500.79  102.48   356.48   399941
 38  -28.80  302.00  340.75    0.00  3970.26  121.33   423.33   399941
 39  -33.60  350.00  393.55    0.00  4439.73  140.18   490.18   399941
 40  -38.40  398.00  446.35    0.00  4909.20  159.03   557.03   399941
 41  -41.83  432.25  484.02    0.00  5244.19  172.48   604.73   399941
 42  -45.25  466.50  521.70    0.00  5579.18  185.93   652.43   399941


                                         RIGHT side
                           Effective stresses        Total  Adjusted
 Node   Y    Water   Vertic  Active  Passive  Earth    earth     soil
 no.  coord  press.    -al   limit    limit   press.   press.  modulus
              kN/m2   kN/m2   kN/m2    kN/m2   kN/m2    kN/m2    kN/m2
  1    4.00    0.00    0.00    0.00    16.18    0.00     0.00a    5999
  2    3.30    0.00   11.55    0.00    60.86    6.11     6.11     5999
  3    2.50    0.00   24.75    3.75   111.92   13.11    13.11     5999
  4    2.00    0.00   33.00    6.30   143.84   17.48    17.48     5999
  5    1.90    0.00   34.65    6.81   150.22   18.35    18.35     5999
  6    1.40    0.00   42.90    9.36   182.14   22.72    22.72     5999
  7    0.40   10.00   49.40   11.37   207.28   26.17    36.17     5999
  8   -0.30   17.00   53.95   12.77   224.88   28.58    45.58     5999
  9   -1.00   24.00   58.50   14.18   242.48   30.99    54.99     5999
 10   -1.40   28.00   61.10   14.98   252.54   32.37    60.37     5999
 11   -1.90   33.00   64.35   15.99   265.11   34.09    67.09     5999
 12   -2.40   38.00   67.60   16.99   277.68   35.81    73.81     5999
 13   -2.50   39.00   68.25   17.19   280.20   36.16    75.16     5999
              39.00   68.25   17.19   315.72   36.16    75.16     5999
 14   -3.20   46.00   72.80   18.60   335.60   38.57    84.57     5999
 15   -3.90   53.00   77.35   20.00   355.48   40.98    93.98     5999
 16   -4.40   58.00   80.60   21.01   369.68   42.70   100.70     5999
 17   -5.30   67.00   86.45   22.82   395.24   45.80   112.80     5999
 18   -5.70   71.00   89.05   23.62   406.60   47.17   118.17     5999
              71.00   89.05   19.03   418.27   44.45   115.45    19997
 19   -6.30   77.00   93.55   20.30   437.94   46.71   123.71    19997
 20   -6.70   81.00   96.55   21.15   451.04   48.22   129.22    19997
 21   -6.80   82.00   97.30   21.36   454.32   48.59   130.59    19997
 22   -6.90   83.00   98.05   21.58   457.60   48.97   131.97    19997
              83.00   98.05    0.00  1812.29   33.81   116.81   399941
 23   -7.40   88.00  103.55    0.00  1861.19   36.41   124.41   399941
 24   -8.20   96.00  112.35    0.00  1939.44   40.01   136.01   399941
 25   -8.90  103.00  120.05    0.00  2007.90   43.03   146.03   399941
 26   -9.60  110.00  127.75    0.00  2076.37   45.92   155.92   399941
 27  -10.70  121.00  139.85    0.00  2183.95   50.29   171.29   399941
 28  -11.12  125.20  144.47    0.00  2225.03   51.95   177.15   399941
 29  -12.32  137.20  157.67    0.00  2342.40   56.65   193.85   399941
 30  -13.36  147.60  169.11    0.00  2444.12   60.71   208.31   399941
 31  -14.40  158.00  180.55    0.00  2545.84   64.79   222.79   399941
 32  -15.36  167.60  191.11    0.00  2639.73   68.55   236.15   399941
 33  -16.32  177.20  201.67    0.00  2733.63   72.34   249.54   399941
 34  -16.47  178.70  203.32    0.00  2748.30   72.91   251.61   399941
```

```
===========================================================================
Run ID. 2_West_800DWall_anchored                            | Sheet No.
Downtown Carpark Redevelopment                              | Date:23-10-2025
800mm D-Wall - Anchored                                     | Checked :
-----------------------------------------------------------------------------
                                                               (continued)
Stage No.1   Change EI of wall to 877500 kN.m2/m run
              Reset wall displacements to zero at this stage

                                          RIGHT side
                        ______________________________________________________
                                 Effective stresses          Total  Adjusted
 Node    Y     Water    Vertic  Active  Passive  Earth      earth    soil
 no.   coord   press.    -al    limit    limit   press.     press.  modulus
                kN/m2    kN/m2   kN/m2    kN/m2   kN/m2      kN/m2    kN/m2
 35   -16.77  181.70   206.62    0.00  2777.64   74.08     255.78   399941
 36   -20.39  217.85   246.38    0.00  3131.21   88.28     306.13   399941
 37   -24.00  254.00   286.15    0.00  3484.78  102.48     356.48   399941
 38   -28.80  302.00   338.95    0.00  3954.25  121.33     423.33   399941
 39   -33.60  350.00   391.75    0.00  4423.73  140.18     490.18   399941
 40   -38.40  398.00   444.55    0.00  4893.20  159.03     557.03   399941
 41   -41.83  432.25   482.23    0.00  5228.19  172.48     604.73   399941
 42   -45.25  466.50   519.90    0.00  5563.17  185.93     652.43   399941

Note:      0.00 a  Soil pressure at active limit
         123.45 p  Soil pressure at passive limit
 ========================================================================TONKIN +
TAYLOR LTD                                         | Sheet No.
Program: WALLAP  Version 6.09  Revision A60.B77.R61         | Job No. 1016043
                             Licensed from GEOSOLVE         | Made by :  rxsw
Data filename/Run ID: 2_West_800DWall_anchored              |
Downtown Carpark Redevelopment                              | Date:23-10-2025
800mm D-Wall - Anchored                                     | Checked :
-----------------------------------------------------------------------------
                                                       Units: kN,m
```

Stage No.1 Change EI of wall to 877500kN.m2/m run



Stage No.1 Change EI of wall to 877500kN.m2/m run



```
========================================================================TONKIN +
TAYLOR LTD                                         | Sheet No.
Program: WALLAP  Version 6.09  Revision A60.B77.R61         | Job No. 1016043
                             Licensed from GEOSOLVE         | Made by :  rxsw
Data filename/Run ID: 2_West_800DWall_anchored              |
Downtown Carpark Redevelopment                              | Date:23-10-2025
800mm D-Wall - Anchored                                     | Checked :
-----------------------------------------------------------------------------
                                                       Units: kN,m
Stage No. 3   Excavate to elevation 2.00 on RIGHT side

STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method
 Factor of safety on soil strength

                                  FoS for toe       Toe elev. for
                                 elev. =  -16.32     FoS = 1.000
 Stage  Ground level     Prop   Factor  Moment      Toe    Wall     Direction
  No.   Act.    Pass.    Elev.    of    equilib.   elev.  Penetr       of
                                Safety  at elev.           -ation    failure
   3    4.00    2.00     Cant.   6.930   -13.93     1.32    0.68      L to R


BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall
  Analysis options
  2-D finite element model.    Active limit arching modelled.
  Soil deformations are elastic until the active or passive limit is reached
  Open Tension Crack analysis - No

  Length of wall perpendicular to section = 1000.00m
  Rigid boundaries:     Left side 60.00m from wall                Rough
                       Right side 60.00m from wall               Smooth
                Lower boundary at elevation -45.25m               Rough
                                Soil-wall interface               Smooth

    *** Wall displacements reset to zero at stage 1

 Node   Y      Nett       Wall      Wall      Shear   Bending   Prop      EI of
```

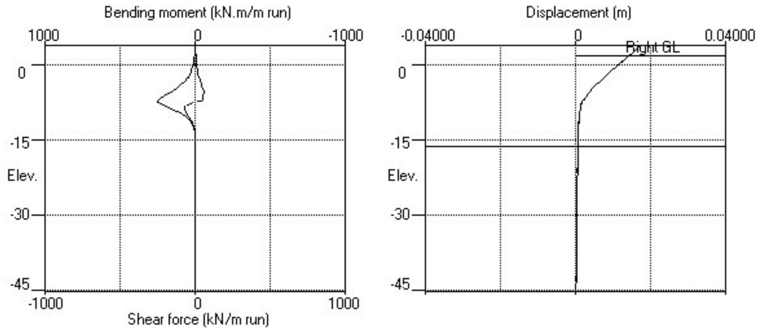
```
 no.  coord  pressure     disp.   rotation    force   moment    forces     wall
                kN/m2       m     rad.       kN/m  kN.m/m      kN/m   kN.m2/m
  1    4.00      0.00     0.017   1.55E-03      0.0      -0.0            877500
  2    3.30      0.00     0.016   1.55E-03      0.0       0.5            877500
  3    2.50      5.05     0.015   1.55E-03      2.0       1.3            877500
  4    2.00     10.38     0.014   1.54E-03      5.9       3.1            877500
                -3.90     0.014   1.54E-03      5.9       3.1
  5    1.90     -2.06     0.014   1.54E-03      5.6       3.7            877500
  6    1.40     -0.19     0.013   1.54E-03      5.0       6.2            877500
  7    0.40      2.37     0.012   1.53E-03      6.1      11.3            877500
  8   -0.30      4.54     0.011   1.52E-03      8.5      16.2            877500
  9   -1.00      6.07     0.010   1.50E-03     12.2      23.3            877500
 10   -1.40      7.26     0.009   1.49E-03     14.9      28.7            877500
 11   -1.90      8.26     0.008   1.47E-03     18.8      37.0            877500
 12   -2.40      9.02     0.008   1.45E-03     23.1      47.5            877500
 13   -2.50      9.83     0.007   1.44E-03     24.1      49.8            877500
 14   -3.20     10.73     0.006   1.40E-03     31.2      69.1            877500
 15   -3.90     11.74     0.005   1.33E-03     39.1      93.6            877500
 16   -4.40     12.71     0.005   1.27E-03     45.2     114.6            877500
 17   -5.30     13.26     0.004   1.13E-03     56.9     160.5            877500
 18   -5.70     10.68     0.003   1.05E-03     61.7     184.3            877500
               -21.63     0.003   1.05E-03     61.7     184.3
 19   -6.30     -9.93     0.003   9.21E-04     52.2     217.4            877500
 20   -6.70     -3.27     0.002   8.17E-04     49.6     237.6            877500
 21   -6.80     -0.77     0.002   7.90E-04     49.4     242.5            877500
 22   -6.90     -8.03     0.002   7.62E-04     48.9     247.4            877500
              -192.13     0.002   7.62E-04     48.9     247.4
 23   -7.40    -94.56     0.002   6.21E-04    -22.7     247.9            877500
 24   -8.20    -24.97     0.001   4.17E-04    -70.5     199.5            877500
 25   -8.90     15.15     0.001   2.80E-04    -74.0     144.0            877500
 26   -9.60     24.81     0.001   1.84E-04    -60.0      95.9            877500
 27  -10.70     22.07     0.001   9.62E-05    -34.2      44.9            877500
===========================================================================
Run ID. 2_West_800DWall_anchored                            | Sheet No.
Downtown Carpark Redevelopment                              | Date:23-10-2025
800mm D-Wall - Anchored                                     | Checked :
-----------------------------------------------------------------------------
                                                              (continued)
Stage No.3   Excavate to elevation 2.00 on RIGHT side

 Node   Y     Nett        Wall      Wall     Shear   Bending   Prop      EI of
 no.  coord  pressure     disp.   rotation    force   moment    forces     wall
                kN/m2       m     rad.       kN/m  kN.m/m      kN/m   kN.m2/m
 28  -11.12     15.49     0.001   7.77E-05    -26.3      32.5            877500
 29  -12.32      9.26     0.001   4.72E-05    -11.5      12.1            877500
 30  -13.36      3.84     0.001   3.70E-05     -4.7       5.2            877500
 31  -14.40      1.26     0.001   3.25E-05     -2.0       2.4            877500
 32  -15.36      0.34     0.001   3.07E-05     -1.2       1.0            877500
 33  -16.32      1.92     0.001   3.01E-05     -0.1      -0.0                 0
 34  -16.47      0.00     0.001          0      0.0       0.0                 0
 35  -16.77      0.07     0.001          0      0.0       0.0                 0
 36  -20.39      0.01     0.000          0      0.2       0.0                 0
 37  -24.00      0.04     0.000          0      0.2       0.0                 0
 38  -28.80      0.00     0.000          0      0.3       0.0                 0
 39  -33.60      0.00     0.000          0      0.3       0.0                 0
 40  -38.40     -0.04     0.000          0      0.2       0.0                 0
 41  -41.83     -0.00     0.000          0      0.2       0.0                 0
 42  -45.25     -0.10     0.000          0      0.0       0.0               ---

                                          LEFT side
                           Effective stresses          Total  Adjusted
 Node   Y    Water   Vertic  Active  Passive  Earth    earth     soil
 no.  coord  press.    -al    limit    limit   press.   press.  modulus
```

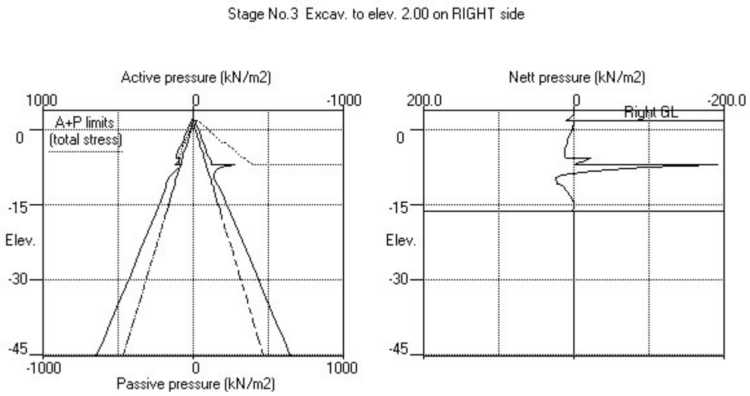
```
              kN/m2   kN/m2   kN/m2    kN/m2   kN/m2    kN/m2     kN/m2
  1    4.00    0.00    0.00    0.00    16.18    0.00    0.00a     5999
  2    3.30    0.00   11.74    0.00    61.60    0.00    0.00a     5999
  3    2.50    0.00   26.00    4.14   116.75    5.05    5.05      5999
  4    2.00    0.00   35.18    6.97   152.26   10.38   10.38      5999
  5    1.90    0.00   37.02    7.54   159.38   11.74   11.74      5999
  6    1.40    0.00   46.19   10.38   194.86   17.08   17.08      5999
  7    0.40   10.00   54.26   12.87   226.08   21.95   31.95      5999
  8   -0.30   17.00   59.67   14.54   246.99   25.49   42.49      5999
  9   -1.00   24.00   64.90   16.16   267.24   28.72   52.72      5999
 10   -1.40   28.00   67.83   17.06   278.57   30.70   58.70      5999
 11   -1.90   33.00   71.44   18.18   292.52   32.96   65.96      5999
 12   -2.40   38.00   74.99   19.28   306.28   35.09   73.09      5999
 13   -2.50   39.00   75.70   19.49   309.01   35.82   74.82      5999
              39.00   75.70   19.49   348.27   35.82   74.82      5999
 14   -3.20   46.00   80.60   21.01   369.66   38.72   84.72      5999
 15   -3.90   53.00   85.43   22.50   390.77   41.65   94.65      5999
 16   -4.40   58.00   88.84   23.56   405.70   43.85  101.85      5999
 17   -5.30   67.00   94.93   25.44   432.31   47.24  114.24      5999
 18   -5.70   71.00   97.62   26.27   444.04   46.96  117.96      5999
              71.00   97.62   17.04   528.95   19.49   90.49     39994
 19   -6.30   77.00  103.13   18.47   556.28   30.47  107.47     39994
 20   -6.70   81.00  106.79   19.41   574.45   36.75  117.75     39994
 21   -6.80   82.00  107.70   19.65   578.98   38.89  120.89     39994
 22   -6.90   83.00  108.61   19.89   583.51   35.28  118.28     39994
              83.00  108.61    0.00  1906.20    0.00   83.00a   399941
 23   -7.40   88.00  114.17    0.00  1955.61    0.00   88.00a   399941
 24   -8.20   96.00  123.03    0.00  2034.43   25.52  121.52    399941
 25   -8.90  103.00  130.77    0.00  2103.20   47.70  150.70    399941
 26   -9.60  110.00  138.48    0.00  2171.81   54.97  164.97    399941
 27  -10.70  121.00  150.58    0.00  2279.35   57.76  178.76    399941
 28  -11.12  125.20  155.19    0.00  2320.34   55.98  181.18    399941
 29  -12.32  137.20  168.33    0.00  2437.23   57.50  194.70    399941
 30  -13.36  147.60  179.70    0.00  2538.32   58.80  206.40    399941
 31  -14.40  158.00  191.06    0.00  2639.26   61.55  219.55    399941
 32  -15.36  167.60  201.52    0.00  2732.32   64.82  232.42    399941
 33  -16.32  177.20  211.98    0.00  2825.28   69.36  246.56    399941

===========================================================================
Run ID. 2_West_800DWall_anchored                            | Sheet No.
Downtown Carpark Redevelopment                              | Date:23-10-2025
800mm D-Wall - Anchored                                     | Checked :
-----------------------------------------------------------------------------
                                                              (continued)
Stage No.3   Excavate to elevation 2.00 on RIGHT side

                                          LEFT side
                           Effective stresses          Total  Adjusted
 Node   Y    Water   Vertic  Active  Passive  Earth    earth     soil
 no.  coord  press.    -al    limit    limit   press.   press.  modulus
              kN/m2   kN/m2   kN/m2    kN/m2   kN/m2    kN/m2     kN/m2
 34  -16.47  178.70  213.61    0.00  2839.80   68.97  247.67    399941
 35  -16.77  181.70  216.88    0.00  2868.83   70.16  251.86    399941
 36  -20.39  217.85  256.17    0.00  3218.25   84.26  302.11    399941
 37  -24.00  254.00  295.43    0.00  3567.27   98.41  352.41    399941
 38  -28.80  302.00  347.54    0.00  4030.63  117.20  419.20    399941
 39  -33.60  350.00  399.69    0.00  4494.29  136.04  486.04    399941
 40  -38.40  398.00  451.89    0.00  4958.42  154.89  552.89    399941
 41  -41.83  432.25  489.17    0.00  5289.91  168.40  600.65    399941
 42  -45.25  466.50  526.48    0.00  5621.67  181.84  648.34    399941


                                         RIGHT side
```

```
                           Effective stresses           Total  Adjusted
 Node   Y    Water   Vertic  Active  Passive  Earth    earth     soil
 no.  coord  press.    -al   limit    limit   press.   press.  modulus
              kN/m2   kN/m2   kN/m2    kN/m2   kN/m2    kN/m2    kN/m2
  1    4.00    0.00    0.00    0.00     0.00    0.00     0.00      0.0
  2    3.30    0.00    0.00    0.00     0.00    0.00     0.00      0.0
  3    2.50    0.00    0.00    0.00     0.00    0.00     0.00      0.0
  4    2.00    0.00    0.00    0.00     0.00    0.00     0.00      0.0
               0.00    0.00    0.00    16.18   14.28    14.28     5999
  5    1.90    0.00    1.65    0.00    22.57   13.80    13.80     5999
  6    1.40    0.00    9.90    0.00    54.48   17.27    17.27     5999
  7    0.40   10.00   16.40    1.17    79.63   19.58    29.58     5999
  8   -0.30   17.00   20.95    2.58    97.23   20.95    37.95     5999
  9   -1.00   24.00   25.50    3.98   114.83   22.65    46.65     5999
 10   -1.40   28.00   28.10    4.79   124.89   23.44    51.44     5999
 11   -1.90   33.00   31.35    5.79   137.47   24.69    57.69     5999
 12   -2.40   38.00   34.61    6.80   150.05   26.07    64.07     5999
 13   -2.50   39.00   35.26    7.00   152.57   25.99    64.99     5999
              39.00   35.26    7.00   171.55   25.99    64.99     5999
 14   -3.20   46.00   39.81    8.40   191.45   27.99    73.99     5999
 15   -3.90   53.00   44.36    9.81   211.35   29.91    82.91     5999
 16   -4.40   58.00   47.62   10.82   225.56   31.14    89.14     5999
 17   -5.30   67.00   53.47   12.63   251.16   33.98   100.98     5999
 18   -5.70   71.00   56.08   13.43   262.54   36.28   107.28     5999
              71.00   56.08    9.68   274.21   41.11   112.11    19997
 19   -6.30   77.00   60.59   10.96   293.90   40.40   117.40    19997
 20   -6.70   81.00   63.59   11.81   307.04   40.03   121.03    19997
 21   -6.80   82.00   64.34   12.02   310.32   39.66   121.66    19997
 22   -6.90   83.00   65.09   12.24   313.60   43.31   126.31    19997
              83.00   65.09    0.00  1519.26  192.13   275.13   399942
 23   -7.40   88.00   70.60    0.00  1568.24   94.56   182.56   399942
 24   -8.20   96.00   79.42    0.00  1646.61   50.48   146.48   399942
 25   -8.90  103.00   87.13    0.00  1715.20   32.56   135.56   399942
 26   -9.60  110.00   94.85    0.00  1783.81   30.16   140.16   399942
 27  -10.70  121.00  106.98    0.00  1891.65   35.69   156.69   399942
 28  -11.12  125.20  111.61    0.00  1932.84   40.49   165.69   399942
 29  -12.32  137.20  124.85    0.00  2050.56   48.24   185.44   399942
 30  -13.36  147.60  136.33    0.00  2152.63   54.96   202.56   399942
 31  -14.40  158.00  147.81    0.00  2254.75   60.28   218.28   399942
 32  -15.36  167.60  158.42    0.00  2349.05   64.48   232.08   399942
 33  -16.32  177.20  169.03    0.00  2443.39   67.43   244.63   399942
 34  -16.47  178.70  170.69    0.00  2458.13   68.97   247.67   399942
 35  -16.77  181.70  174.00    0.00  2487.63   70.08   251.78   399942

===========================================================================
Run ID. 2_West_800DWall_anchored                            | Sheet No.
Downtown Carpark Redevelopment                              | Date:23-10-2025
800mm D-Wall - Anchored                                     | Checked :
-----------------------------------------------------------------------------
                                                              (continued)
Stage No.3   Excavate to elevation 2.00 on RIGHT side

                                         RIGHT side
                           Effective stresses           Total  Adjusted
 Node   Y    Water   Vertic  Active  Passive  Earth    earth     soil
 no.  coord  press.    -al   limit    limit   press.   press.  modulus
              kN/m2   kN/m2   kN/m2    kN/m2   kN/m2    kN/m2    kN/m2
 36  -20.39  217.85  214.01    0.00  2843.32   84.25   302.10   399942
 37  -24.00  254.00  254.08    0.00  3199.60   98.37   352.37   399942
 38  -28.80  302.00  307.38    0.00  3673.53  117.20   419.20   399942
 39  -33.60  350.00  360.78    0.00  4148.36  136.04   486.04   399942
 40  -38.40  398.00  414.27    0.00  4623.93  154.93   552.93   399942
 41  -41.83  432.25  452.47    0.00  4963.63  168.40   600.65   399942
```

```
 42  -45.25  466.50  490.70    0.00  5303.56  181.94   648.44   399942

Note:     88.00 a  Soil pressure at active limit
         123.45 p  Soil pressure at passive limit
 ========================================================================TONKIN +
TAYLOR LTD                                                  | Sheet No.
Program: WALLAP  Version 6.09  Revision A60.B77.R61          | Job No. 1016043
                             Licensed from GEOSOLVE          | Made by :  rxsw
Data filename/Run ID: 2_West_800DWall_anchored               |
Downtown Carpark Redevelopment                               | Date:23-10-2025
800mm D-Wall - Anchored                                      | Checked :
-----------------------------------------------------------------------------
                                                       Units: kN,m
```

Stage No.3 Excav. to elev. 2.00 on RIGHT side





```
=========================================================================TONKIN +
TAYLOR LTD                                         | Sheet No.
Program: WALLAP  Version 6.09  Revision A60.B77.R61         | Job No. 1016043
                             Licensed from GEOSOLVE         | Made by :  rxsw
Data filename/Run ID: 2_West_800DWall_anchored              |
Downtown Carpark Redevelopment                              | Date:23-10-2025
800mm D-Wall - Anchored                                     | Checked :
-----------------------------------------------------------------------------
                                                       Units: kN,m
Stage No. 6   Excavate to elevation -2.40 on RIGHT side

STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method
 Factor of safety on soil strength

                                FoS for toe       Toe elev. for
                               elev. =  -16.32     FoS = 1.000
 Stage  Ground level    Prop   Factor  Moment      Toe    Wall    Direction
  No.   Act.   Pass.    Elev.    of    equilib.   elev.  Penetr       of
                               Safety  at elev.          -ation     failure
   6    4.00   -2.40     2.50   6.883     n/a     -6.15    3.75     L to R


BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall
  Analysis options
  2-D finite element model.    Active limit arching modelled.
  Soil deformations are elastic until the active or passive limit is reached
  Open Tension Crack analysis - No

  Length of wall perpendicular to section = 1000.00m
  Rigid boundaries:     Left side 60.00m from wall                Rough
                       Right side 60.00m from wall               Smooth
               Lower boundary at elevation -45.25m                Rough
                               Soil-wall interface                Smooth

    *** Wall displacements reset to zero at stage 1

 Node  Y      Nett       Wall      Wall      Shear   Bending   Prop      EI of
```

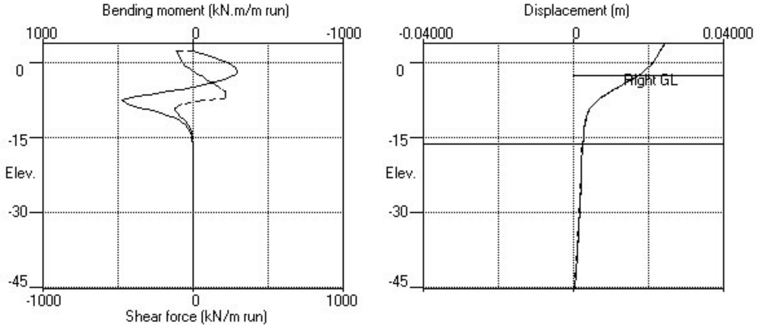
```
 no.  coord  pressure     disp.   rotation    force   moment    forces     wall
                kN/m2       m       rad.       kN/m   kN.m/m     kN/m   kN.m2/m
  1    4.00      1.18     0.024   8.09E-04      0.0      -0.0            877500
  2    3.30      0.00     0.024   8.09E-04      0.4       0.8            877500
  3    2.50      3.60     0.023   8.08E-04      1.8       1.9   -111.6   877500
                 3.60     0.023   8.08E-04   -109.7       1.9
  4    2.00      8.11     0.023   8.22E-04   -106.8     -52.3            877500
  5    1.90      8.86     0.023   8.29E-04   -105.9     -62.9            877500
  6    1.40     13.38     0.022   8.79E-04   -100.4    -114.6            877500
  7    0.40     27.23     0.021   1.06E-03    -80.1    -205.9            877500
  8   -0.30     36.87     0.021   1.24E-03    -57.6    -254.5            877500
  9   -1.00     46.62     0.020   1.46E-03    -28.4    -285.0            877500
 10   -1.40     52.30     0.019   1.59E-03     -8.6    -292.5            877500
 11   -1.90     59.40     0.018   1.75E-03     19.3    -290.0            877500
 12   -2.40     66.46     0.017   1.91E-03     50.8    -272.6            877500
                50.28     0.017   1.91E-03     50.8    -272.6
 13   -2.50     48.54     0.017   1.94E-03     55.7    -267.3            877500
                46.90     0.017   1.94E-03     55.7    -267.3
 14   -3.20     48.31     0.016   2.14E-03     89.0    -216.8            877500
 15   -3.90     50.19     0.014   2.28E-03    123.5    -142.6            877500
 16   -4.40     52.21     0.013   2.34E-03    149.1     -74.6            877500
 17   -5.30     53.30     0.011   2.34E-03    196.6      80.7            877500
 18   -5.70     50.96     0.010   2.28E-03    217.4     163.6            877500
                -9.16     0.010   2.28E-03    217.4     163.6
 19   -6.30     -4.67     0.009   2.13E-03    213.3     292.5            877500
 20   -6.70      5.75     0.008   1.98E-03    213.5     377.4            877500
 21   -6.80     11.05     0.007   1.93E-03    214.3     398.8            877500
 22   -6.90      1.36     0.007   1.88E-03    215.0     420.3            877500
              -444.54     0.007   1.88E-03    215.0     420.3
 23   -7.40   -220.58     0.006   1.63E-03     48.7     472.2            877500
 24   -8.20    -97.37     0.005   1.21E-03    -78.5     440.5            877500
 25   -8.90    -28.58     0.005   8.99E-04   -122.6     361.7            877500
===========================================================================
Run ID. 2_West_800DWall_anchored                            | Sheet No.
Downtown Carpark Redevelopment                              | Date:23-10-2025
800mm D-Wall - Anchored                                     | Checked :
-----------------------------------------------------------------------------
                                                              (continued)
Stage No.6   Excavate to elevation -2.40 on RIGHT side

 Node  Y      Nett       Wall      Wall      Shear   Bending   Prop      EI of
 no.  coord  pressure     disp.   rotation    force   moment    forces     wall
                kN/m2       m       rad.       kN/m   kN.m/m     kN/m   kN.m2/m
 26   -9.60     26.58     0.004   6.47E-04   -123.3     268.9            877500
 27  -10.70     38.41     0.003   3.85E-04    -87.5     149.4            877500
 28  -11.12     34.54     0.003   3.22E-04    -72.2     116.0            877500
 29  -12.32     23.53     0.003   2.05E-04    -37.4      54.2            877500
 30  -13.36     11.56     0.003   1.56E-04    -19.1      28.0            877500
 31  -14.40      4.59     0.003   1.31E-04    -10.7      14.4            877500
 32  -15.36      2.23     0.003   1.20E-04     -7.5       6.1            877500
 33  -16.32     11.52     0.002   1.17E-04     -0.9       0.0                 0
 34  -16.47      0.00     0.002          0      0.0       0.0                 0
 35  -16.77      0.10     0.002          0      0.0       0.0                 0
 36  -20.39      0.01     0.002          0      0.2       0.0                 0
 37  -24.00      0.07     0.002          0      0.4       0.0                 0
 38  -28.80      0.02     0.002          0      0.6       0.0                 0
 39  -33.60      0.01     0.001          0      0.6       0.0                 0
 40  -38.40     -0.08     0.001          0      0.5       0.0                 0
 41  -41.83      0.00     0.001          0      0.4       0.0                 0
 42  -45.25     -0.23     0.000          0      0.0       0.0               ---
 At elev.   2.50                 Prop force =    111.6 kN/m run (horiz.)
                                            =    128.8 kN/m run (inclined)
```

```
                                          LEFT side
                           Effective stresses          Total  Adjusted
 Node   Y    Water   Vertic  Active  Passive  Earth    earth     soil
 no.  coord  press.    -al   limit    limit   press.   press.  modulus
              kN/m2   kN/m2   kN/m2    kN/m2   kN/m2    kN/m2    kN/m2
  1    4.00    0.00    0.00    0.00    16.18    1.18     1.18     5999
  2    3.30    0.00   11.74    0.00    61.60    0.00     0.00a    5999
  3    2.50    0.00   26.00    4.14   116.75    3.60     3.60A    5999
  4    2.00    0.00   35.18    6.97   152.26    8.11     8.11     5999
  5    1.90    0.00   37.02    7.54   159.38    8.86     8.86     5999
  6    1.40    0.00   46.19   10.38   194.86   13.38    13.38     5999
  7    0.40   10.00   54.26   12.87   226.08   17.23    27.23     5999
  8   -0.30   17.00   59.67   14.54   246.99   19.87    36.87     5999
  9   -1.00   24.00   64.90   16.16   267.24   22.62    46.62     5999
 10   -1.40   28.00   67.83   17.06   278.57   24.30    52.30     5999
 11   -1.90   33.00   71.44   18.18   292.52   26.40    59.40     5999
 12   -2.40   38.00   74.99   19.28   306.28   28.46    66.46     5999
 13   -2.50   39.00   75.70   19.49   309.01   29.24    68.24     5999
              39.00   75.70   19.49   348.27   29.24    68.24     5999
 14   -3.20   46.00   80.60   21.01   369.66   32.22    78.22     5999
 15   -3.90   53.00   85.43   22.50   390.77   35.34    88.34     5999
 16   -4.40   58.00   88.84   23.56   405.70   37.80    95.80     5999
 17   -5.30   67.00   94.93   25.44   432.31   41.19   108.19     5999
 18   -5.70   71.00   97.62   26.27   444.04   40.67   111.67     5999
              71.00   97.62   17.04   528.95    0.00    71.00A   39994
 19   -6.30   77.00  103.13   18.47   556.28    0.00    77.00A   39994
 20   -6.70   81.00  106.79   19.41   574.45    7.98    88.98A   39994
 21   -6.80   82.00  107.70   19.65   578.98   12.07    94.07A   39994
 22   -6.90   83.00  108.61   19.89   583.51    6.93    89.93A   39994
              83.00  108.61    0.00  1906.20    0.00    83.00a  399941
 23   -7.40   88.00  114.17    0.00  1955.61    0.00    88.00a  399941
 24   -8.20   96.00  123.03    0.00  2034.43    0.00    96.00a  399941
 25   -8.90  103.00  130.77    0.00  2103.20    3.23   106.23   399941
 26   -9.60  110.00  138.48    0.00  2171.81   32.65   142.65   399941
 27  -10.70  121.00  150.58    0.00  2279.35   42.38   163.38   399941
 28  -11.12  125.20  155.19    0.00  2320.34   41.67   166.87   399941
 29  -12.32  137.20  168.33    0.00  2437.23   40.61   177.81   399941

===========================================================================
Run ID. 2_West_800DWall_anchored                            | Sheet No.
Downtown Carpark Redevelopment                              | Date:23-10-2025
800mm D-Wall - Anchored                                     | Checked :
-----------------------------------------------------------------------------
                                                              (continued)
Stage No.6   Excavate to elevation -2.40 on RIGHT side

                                          LEFT side
                           Effective stresses          Total  Adjusted
 Node   Y    Water   Vertic  Active  Passive  Earth    earth     soil
 no.  coord  press.    -al   limit    limit   press.   press.  modulus
              kN/m2   kN/m2   kN/m2    kN/m2   kN/m2    kN/m2    kN/m2
 30  -13.36  147.60  179.70    0.00  2538.32   38.47   186.07   399941
 31  -14.40  158.00  191.06    0.00  2639.26   38.91   196.91   399941
 32  -15.36  167.60  201.52    0.00  2732.32   41.37   208.97   399941
 33  -16.32  177.20  211.98    0.00  2825.28   49.73   226.93   399941
 34  -16.47  178.70  213.61    0.00  2839.80   44.52   223.22   399941
 35  -16.77  181.70  216.88    0.00  2868.83   45.65   227.35   399941
 36  -20.39  217.85  256.17    0.00  3218.25   59.70   277.55   399941
 37  -24.00  254.00  295.43    0.00  3567.27   73.86   327.86   399941
 38  -28.80  302.00  347.54    0.00  4030.63   92.74   394.74   399941
 39  -33.60  350.00  399.69    0.00  4494.29  111.74   461.74   399941
 40  -38.40  398.00  451.89    0.00  4958.42  130.79   528.79   399941
 41  -41.83  432.25  489.17    0.00  5289.91  144.51   576.76   399941
```

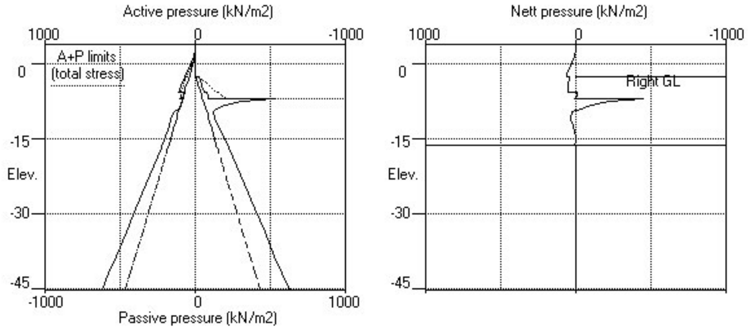
```
 42  -45.25  466.50  526.48    0.00  5621.67  158.09   624.59   399941


                                         RIGHT side
                           Effective stresses          Total  Adjusted
 Node   Y    Water   Vertic  Active  Passive  Earth    earth     soil
 no.  coord  press.    -al   limit    limit   press.   press.  modulus
              kN/m2   kN/m2   kN/m2    kN/m2   kN/m2    kN/m2    kN/m2
  1    4.00    0.00    0.00    0.00     0.00    0.00     0.00      0.0
  2    3.30    0.00    0.00    0.00     0.00    0.00     0.00      0.0
  3    2.50    0.00    0.00    0.00     0.00    0.00     0.00      0.0
  4    2.00    0.00    0.00    0.00     0.00    0.00     0.00      0.0
  5    1.90    0.00    0.00    0.00     0.00    0.00     0.00      0.0
  6    1.40    0.00    0.00    0.00     0.00    0.00     0.00      0.0
  7    0.40    0.00    0.00    0.00     0.00    0.00     0.00      0.0
  8   -0.30    0.00    0.00    0.00     0.00    0.00     0.00      0.0
  9   -1.00    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 10   -1.40    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 11   -1.90    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 12   -2.40    0.00    0.00    0.00     0.00    0.00     0.00      0.0
               0.00    0.00    0.00    16.18   16.18    16.18p    5999
 13   -2.50    1.00    0.65    0.00    18.70   18.70    19.70p    5999
               1.00    0.65    0.00    20.35   20.34    21.34     5999
 14   -3.20    8.00    5.20    0.00    40.23   21.92    29.92     5999
 15   -3.90   15.00    9.75    0.00    60.11   23.15    38.15     5999
 16   -4.40   20.00   13.00    0.12    74.32   23.60    43.60     5999
 17   -5.30   29.00   18.86    1.93    99.89   25.90    54.90     5999
 18   -5.70   33.00   21.46    2.73   111.26   27.71    60.71     5999
              33.00   21.46    0.00   122.94   47.16    80.16    19998
 19   -6.30   39.00   25.96    1.15   142.62   42.67    81.67    19998
 20   -6.70   43.00   28.97    2.00   155.75   40.23    83.23    19998
 21   -6.80   44.00   29.72    2.21   159.03   39.02    83.02    19998
 22   -6.90   45.00   30.47    2.43   162.31   43.56    88.56    19998
              45.00   30.47    0.00  1211.39  482.54   527.54   399953
 23   -7.40   50.00   35.98    0.00  1260.35  258.58   308.58   399953
 24   -8.20   58.00   44.79    0.00  1338.73  135.37   193.37   399953
 25   -8.90   65.00   52.51    0.00  1407.33   69.81   134.81   399953
 26   -9.60   72.00   60.23    0.00  1475.98   44.07   116.07   399953
 27  -10.70   83.00   72.37    0.00  1583.92   41.98   124.98   399953
 28  -11.12   87.20   77.00    0.00  1625.16   45.13   132.33   399953
 29  -12.32   99.20   90.27    0.00  1743.08   55.08   154.28   399953
 30  -13.36  109.60  101.77    0.00  1845.39   64.90   174.50   399953
 31  -14.40  120.00  113.29    0.00  1947.81   72.31   192.31   399953

===========================================================================
Run ID. 2_West_800DWall_anchored                            | Sheet No.
Downtown Carpark Redevelopment                              | Date:23-10-2025
800mm D-Wall - Anchored                                     | Checked :
-----------------------------------------------------------------------------
                                                              (continued)
Stage No.6   Excavate to elevation -2.40 on RIGHT side

                                         RIGHT side
                           Effective stresses          Total  Adjusted
 Node   Y    Water   Vertic  Active  Passive  Earth    earth     soil
 no.  coord  press.    -al   limit    limit   press.   press.  modulus
              kN/m2   kN/m2   kN/m2    kN/m2   kN/m2    kN/m2    kN/m2
 32  -15.36  129.60  123.94    0.00  2042.47   77.15   206.75   399953
 33  -16.32  139.20  134.60    0.00  2137.23   76.21   215.41   399953
 34  -16.47  140.70  136.26    0.00  2152.05   82.51   223.21   399953
 35  -16.77  143.70  139.60    0.00  2181.69   83.55   227.25   399953
 36  -20.39  179.85  179.87    0.00  2539.82   97.69   277.54   399953
 37  -24.00  216.00  220.36    0.00  2899.77  111.79   327.79   399953
```

```
 38  -28.80  264.00  274.43    0.00  3380.61  130.72   394.72   399953
 39  -33.60  312.00  328.87    0.00  3864.62  149.73   461.73   399953
 40  -38.40  360.00  383.62    0.00  4351.45  168.87   528.87   399953
 41  -41.83  394.25  422.85    0.00  4700.29  182.51   576.76   399953
 42  -45.25  428.50  462.20    0.00  5050.11  196.32   624.82   399953

Note:     96.00 a  Soil pressure at active limit
          19.70 p  Soil pressure at passive limit
          89.93 A  Arching - soil pressure below active limit
 ========================================================================TONKIN +
TAYLOR LTD                                          | Sheet No.
Program: WALLAP  Version 6.09  Revision A60.B77.R61          | Job No. 1016043
                             Licensed from GEOSOLVE          | Made by :  rxsw
Data filename/Run ID: 2_West_800DWall_anchored               |
Downtown Carpark Redevelopment                               | Date:23-10-2025
800mm D-Wall - Anchored                                      | Checked :
-----------------------------------------------------------------------------
                                                       Units: kN,m
```

Stage No.6 Excav. to elev. -2.40 on RIGHT side



Stage No.6 Excav. to elev. -2.40 on RIGHT side



```
========================================================================TONKIN +
TAYLOR LTD                                          | Sheet No.
Program: WALLAP  Version 6.09  Revision A60.B77.R61          | Job No. 1016043
                             Licensed from GEOSOLVE          | Made by :  rxsw
Data filename/Run ID: 2_West_800DWall_anchored               |
Downtown Carpark Redevelopment                               | Date:23-10-2025
800mm D-Wall - Anchored                                      | Checked :
-----------------------------------------------------------------------------
                                                       Units: kN,m
Stage No. 9   Excavate to elevation -6.80 on RIGHT side

STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method
 Factor of safety on soil strength

                                    FoS for toe       Toe elev. for
                                   elev. =  -16.32     FoS = 1.000
 Stage  Ground level      Prop    Factor  Moment      Toe     Wall    Direction
  No.   Act.    Pass.     Elev.    of    equilib.    elev.   Penetr       of
                                 Safety  at elev.             -ation    failure
   9    4.00    -6.80            More than one prop. No FoS calc.


BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall
  Analysis options
  2-D finite element model.    Active limit arching modelled.
  Soil deformations are elastic until the active or passive limit is reached
  Open Tension Crack analysis - No

  Length of wall perpendicular to section = 1000.00m
  Rigid boundaries:     Left side 60.00m from wall                 Rough
                       Right side 60.00m from wall                Smooth
               Lower boundary at elevation -45.25m                 Rough
                           Soil-wall interface                     Smooth

    *** Wall displacements reset to zero at stage 1

 Node   Y      Nett       Wall      Wall      Shear    Bending    Prop      EI of
```

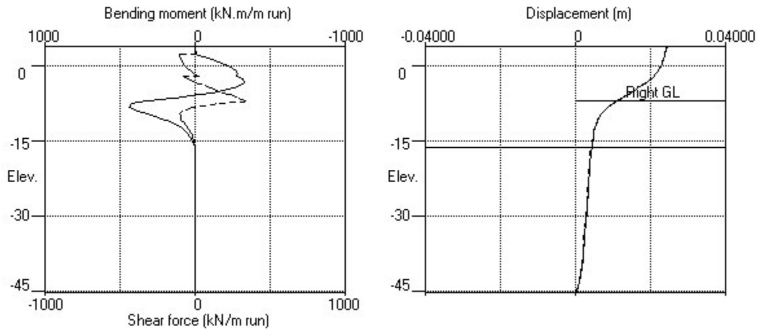
```
 no.  coord  pressure     disp.   rotation    force    moment    forces      wall
                kN/m2        m      rad.       kN/m   kN.m/m     kN/m   kN.m2/m
  1    4.00      3.38     0.024   3.42E-04       0.0      -0.0            877500
  2    3.30      1.82     0.024   3.41E-04       1.8       1.3            877500
  3    2.50      5.01     0.024   3.39E-04       4.6       4.2   -113.7   877500
                 5.01     0.024   3.39E-04    -109.1       4.2
  4    2.00      9.27     0.024   3.52E-04    -105.6     -49.6            877500
  5    1.90      9.84     0.024   3.58E-04    -104.6     -60.1            877500
  6    1.40     14.11     0.023   4.07E-04     -98.6    -110.9            877500
  7    0.40     27.63     0.023   5.84E-04     -77.7    -200.1            877500
  8   -0.30     36.92     0.022   7.62E-04     -55.1    -247.0            877500
  9   -1.00     46.41     0.022   9.71E-04     -26.0    -275.7            877500
 10   -1.40     51.83     0.021   1.09E-03      -6.3    -282.3            877500
 11   -1.90     58.68     0.021   1.25E-03      21.3    -278.7    -99.7   877500
                58.68     0.021   1.25E-03     -78.4    -278.7
 12   -2.40     65.51     0.020   1.42E-03     -47.3    -310.3            877500
 13   -2.50     66.97     0.020   1.46E-03     -40.7    -314.7            877500
 14   -3.20     76.62     0.019   1.71E-03       9.5    -326.0            877500
 15   -3.90     86.37     0.018   1.96E-03      66.6    -299.8            877500
 16   -4.40     93.51     0.017   2.12E-03     111.6    -255.5            877500
 17   -5.30    105.70     0.015   2.31E-03     201.2    -115.7            877500
 18   -5.70    109.92     0.014   2.34E-03     244.3     -26.6            877500
                71.00     0.014   2.34E-03     244.3     -26.6
 19   -6.30     77.00     0.012   2.31E-03     288.7     133.0            877500
 20   -6.70     81.00     0.011   2.22E-03     320.3     254.7            877500
 21   -6.80     82.00     0.011   2.19E-03     328.5     287.2            877500
                52.82     0.011   2.19E-03     328.5     287.2
 22   -6.90     49.54     0.011   2.15E-03     333.6     320.3            877500
              -511.91     0.011   2.15E-03     333.6     320.3
 23   -7.40   -277.08     0.010   1.94E-03     136.4     423.1            877500
 24   -8.20   -131.84     0.009   1.55E-03     -27.2     443.5            877500
 25   -8.90    -44.58     0.008   1.21E-03     -89.0     392.2            877500
============================================================================
Run ID. 2_West_800DWall_anchored                             | Sheet No.
Downtown Carpark Redevelopment                               | Date:23-10-2025
800mm D-Wall - Anchored                                      | Checked :
------------------------------------------------------------------------------
                                                               (continued)
Stage No.9   Excavate to elevation -6.80 on RIGHT side

 Node    Y      Nett       Wall      Wall     Shear   Bending     Prop     EI of
 no.  coord  pressure     disp.   rotation    force    moment    forces      wall
                kN/m2        m      rad.       kN/m   kN.m/m     kN/m   kN.m2/m
 26   -9.60     -0.32     0.007   9.33E-04    -104.7     319.0            877500
 27  -10.70     19.72     0.006   6.06E-04     -94.0     203.6            877500
 28  -11.12     30.76     0.006   5.17E-04     -83.4     165.9            877500
 29  -12.32     24.93     0.005   3.44E-04     -50.0      87.9            877500
 30  -13.36     14.35     0.005   2.62E-04     -29.6      49.4            877500
 31  -14.40      6.43     0.005   2.17E-04     -18.8      26.4            877500
 32  -15.36      4.01     0.004   1.97E-04     -13.7      11.4            877500
 33  -16.32     21.30     0.004   1.90E-04      -1.6       0.0                 0
 34  -16.47      0.00     0.004          0       0.0       0.0                 0
 35  -16.77      0.10     0.004          0       0.0       0.0                 0
 36  -20.39      0.02     0.004          0       0.2       0.0                 0
 37  -24.00      0.08     0.003          0       0.4       0.0                 0
 38  -28.80      0.03     0.003          0       0.7       0.0                 0
 39  -33.60      0.03     0.002          0       0.8       0.0                 0
 40  -38.40     -0.10     0.002          0       0.7       0.0                 0
 41  -41.83      0.01     0.001          0       0.5       0.0                 0
 42  -45.25     -0.33     0.000          0       0.0       0.0               ---
 At elev.   2.50                 Prop force =     113.7 kN/m run (horiz.)
                                            =     131.3 kN/m run (inclined)
 At elev.  -1.90                 Prop force =      99.7 kN/m run (horiz.)
```

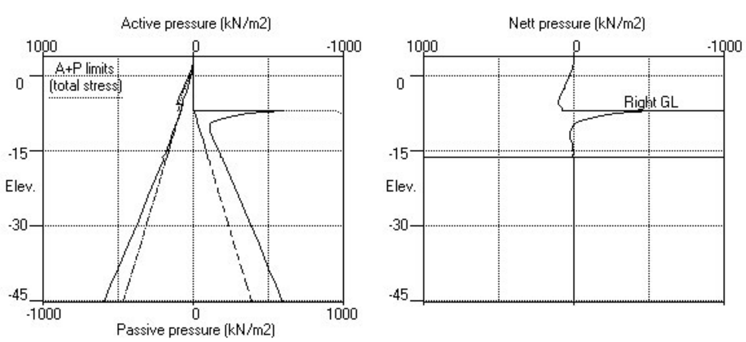
```
                                            =     115.1 kN/m run (inclined)

                                          LEFT side
                           Effective stresses          Total  Adjusted
 Node   Y    Water   Vertic  Active  Passive  Earth     earth     soil
 no.  coord  press.    -al   limit    limit   press.   press.  modulus
               kN/m2   kN/m2   kN/m2    kN/m2   kN/m2    kN/m2    kN/m2
  1    4.00    0.00    0.00    0.00    16.18    3.38     3.38     5999
  2    3.30    0.00   11.74    0.00    61.60    1.82     1.82     5999
  3    2.50    0.00   26.00    4.14   116.75    5.01     5.01     5999
  4    2.00    0.00   35.18    6.97   152.26    9.27     9.27     5999
  5    1.90    0.00   37.02    7.54   159.38    9.84     9.84     5999
  6    1.40    0.00   46.19   10.38   194.86   14.11    14.11     5999
  7    0.40   10.00   54.26   12.87   226.08   17.63    27.63     5999
  8   -0.30   17.00   59.67   14.54   246.99   19.92    36.92     5999
  9   -1.00   24.00   64.90   16.16   267.24   22.41    46.41     5999
 10   -1.40   28.00   67.83   17.06   278.57   23.83    51.83     5999
 11   -1.90   33.00   71.44   18.18   292.52   25.68    58.68     5999
 12   -2.40   38.00   74.99   19.28   306.28   27.51    65.51     5999
 13   -2.50   39.00   75.70   19.49   309.01   27.97    66.97     5999
              39.00   75.70   19.49   348.27   27.97    66.97     5999
 14   -3.20   46.00   80.60   21.01   369.66   30.62    76.62     5999
 15   -3.90   53.00   85.43   22.50   390.77   33.37    86.37     5999
 16   -4.40   58.00   88.84   23.56   405.70   35.51    93.51     5999
 17   -5.30   67.00   94.93   25.44   432.31   38.70   105.70     5999
 18   -5.70   71.00   97.62   26.27   444.04   38.92   109.92     5999
              71.00   97.62   17.04   528.95    0.00    71.00A   39994
 19   -6.30   77.00  103.13   18.47   556.28    0.00    77.00A   39994
 20   -6.70   81.00  106.79   19.41   574.45    0.00    81.00A   39994
 21   -6.80   82.00  107.70   19.65   578.98    0.00    82.00A   39994
 22   -6.90   83.00  108.61   19.89   583.51    0.00    83.00A   39994
              83.00  108.61    0.00  1906.20    0.00    83.00a  399941
 23   -7.40   88.00  114.17    0.00  1955.61    0.00    88.00a  399941
 24   -8.20   96.00  123.03    0.00  2034.43    0.00    96.00a  399941
 25   -8.90  103.00  130.77    0.00  2103.20    0.00   103.00a  399941
 26   -9.60  110.00  138.48    0.00  2171.81    0.00   110.00a  399941
 27  -10.70  121.00  150.58    0.00  2279.35    6.53   127.53   399941

============================================================================
Run ID. 2_West_800DWall_anchored                             | Sheet No.
Downtown Carpark Redevelopment                               | Date:23-10-2025
800mm D-Wall - Anchored                                      | Checked :
------------------------------------------------------------------------------
                                                               (continued)
Stage No.9   Excavate to elevation -6.80 on RIGHT side

                                          LEFT side
                           Effective stresses          Total  Adjusted
 Node   Y    Water   Vertic  Active  Passive  Earth     earth     soil
 no.  coord  press.    -al   limit    limit   press.   press.  modulus
               kN/m2   kN/m2   kN/m2    kN/m2   kN/m2    kN/m2    kN/m2
 28  -11.12  125.20  155.19    0.00  2320.34   13.13   138.33   399941
 29  -12.32  137.20  168.33    0.00  2437.23   14.58   151.78   399941
 30  -13.36  147.60  179.70    0.00  2538.32   13.06   160.66   399941
 31  -14.40  158.00  191.06    0.00  2639.26   12.97   170.97   399941
 32  -15.36  167.60  201.52    0.00  2732.32   15.38   182.98   399941
 33  -16.32  177.20  211.98    0.00  2825.28   27.71   204.91   399941
 34  -16.47  178.70  213.61    0.00  2839.80   17.60   196.30   399941
 35  -16.77  181.70  216.88    0.00  2868.83   18.71   200.41   399941
 36  -20.39  217.85  256.17    0.00  3218.25   32.75   250.60   399941
 37  -24.00  254.00  295.43    0.00  3567.27   46.90   300.90   399941
 38  -28.80  302.00  347.54    0.00  4030.63   65.82   367.82   399941
 39  -33.60  350.00  399.69    0.00  4494.29   84.92   434.92   399941
```

```
  40  -38.40  398.00  451.89    0.00  4958.42  104.10    502.10    399941
  41  -41.83  432.25  489.17    0.00  5289.91  117.96    550.21    399941
  42  -45.25  466.50  526.48    0.00  5621.67  131.65    598.15    399941


                                        RIGHT side
                         Effective stresses          Total  Adjusted
 Node    Y    Water   Vertic  Active  Passive  Earth    earth     soil
 no.   coord  press.   -al    limit    limit   press.   press.  modulus
               kN/m2   kN/m2   kN/m2    kN/m2   kN/m2    kN/m2    kN/m2
   1    4.00    0.00    0.00    0.00     0.00    0.00     0.00      0.0
   2    3.30    0.00    0.00    0.00     0.00    0.00     0.00      0.0
   3    2.50    0.00    0.00    0.00     0.00    0.00     0.00      0.0
   4    2.00    0.00    0.00    0.00     0.00    0.00     0.00      0.0
   5    1.90    0.00    0.00    0.00     0.00    0.00     0.00      0.0
   6    1.40    0.00    0.00    0.00     0.00    0.00     0.00      0.0
   7    0.40    0.00    0.00    0.00     0.00    0.00     0.00      0.0
   8   -0.30    0.00    0.00    0.00     0.00    0.00     0.00      0.0
   9   -1.00    0.00    0.00    0.00     0.00    0.00     0.00      0.0
  10   -1.40    0.00    0.00    0.00     0.00    0.00     0.00      0.0
  11   -1.90    0.00    0.00    0.00     0.00    0.00     0.00      0.0
  12   -2.40    0.00    0.00    0.00     0.00    0.00     0.00      0.0
  13   -2.50    0.00    0.00    0.00     0.00    0.00     0.00      0.0
  14   -3.20    0.00    0.00    0.00     0.00    0.00     0.00      0.0
  15   -3.90    0.00    0.00    0.00     0.00    0.00     0.00      0.0
  16   -4.40    0.00    0.00    0.00     0.00    0.00     0.00      0.0
  17   -5.30    0.00    0.00    0.00     0.00    0.00     0.00      0.0
  18   -5.70    0.00    0.00    0.00     0.00    0.00     0.00      0.0
  19   -6.30    0.00    0.00    0.00     0.00    0.00     0.00      0.0
  20   -6.70    0.00    0.00    0.00     0.00    0.00     0.00      0.0
  21   -6.80    0.00    0.00    0.00     0.00    0.00     0.00      0.0
                0.00    0.00    0.00    29.18   29.18    29.18p   19998
  22   -6.90    1.00    0.75    0.00    32.46   32.46    33.46p   19998
                1.00    0.75    0.00   947.14  593.91   594.91    399960
  23   -7.40    6.00    6.25    0.00   996.05  359.08   365.08    399960
  24   -8.20   14.00   15.05    0.00  1074.30  213.84   227.84    399960
  25   -8.90   21.00   22.75    0.00  1142.79  126.58   147.58    399960
  26   -9.60   28.00   30.46    0.00  1211.29   82.32   110.32    399960
  27  -10.70   39.00   42.57    0.00  1318.99   68.81   107.81    399960
  28  -11.12   43.20   47.20    0.00  1360.14   64.38   107.58    399960
  29  -12.32   55.20   60.43    0.00  1477.78   71.65   126.85    399960
  30  -13.36   65.60   71.91    0.00  1579.85   80.70   146.30    399960
  31  -14.40   76.00   83.40    0.00  1682.04   88.54   164.54    399960

===========================================================================
Run ID. 2_West_800DWall_anchored                           | Sheet No.
Downtown Carpark Redevelopment                             | Date:23-10-2025
800mm D-Wall - Anchored                                    | Checked :
-----------------------------------------------------------------------------
                                                            (continued)
Stage No.9   Excavate to elevation -6.80 on RIGHT side

                                        RIGHT side
                         Effective stresses          Total  Adjusted
 Node    Y    Water   Vertic  Active  Passive  Earth    earth     soil
 no.   coord  press.   -al    limit    limit   press.   press.  modulus
               kN/m2   kN/m2   kN/m2    kN/m2   kN/m2    kN/m2    kN/m2
  32  -15.36   85.60   94.03    0.00  1776.51   93.37   178.97    399960
  33  -16.32   95.20  104.67    0.00  1871.10   88.41   183.61    399960
  34  -16.47   96.70  106.33    0.00  1885.90   99.60   196.30    399960
  35  -16.77   99.70  109.66    0.00  1915.50  100.61   200.31    399960
  36  -20.39  135.85  149.92    0.00  2273.46  114.73   250.58    399960
  37  -24.00  172.00  190.48    0.00  2634.13  128.81   300.81    399960
```

```
  38  -28.80  220.00  244.87    0.00  3117.76  147.79    367.79    399960
  39  -33.60  268.00  299.90    0.00  3607.00  166.89    434.89    399960
  40  -38.40  316.00  355.52    0.00  4101.58  186.19    502.19    399960
  41  -41.83  350.25  395.54    0.00  4457.43  199.95    550.20    399960
  42  -45.25  384.50  435.80    0.00  4815.38  213.97    598.47    399960

Note:    110.00 a  Soil pressure at active limit
          33.46 p  Soil pressure at passive limit
          83.00 A  Arching - soil pressure below active limit
 ======================================================================TONKIN +
TAYLOR LTD                                            | Sheet No.
Program: WALLAP  Version 6.09  Revision A60.B77.R61         | Job No. 1016043
                             Licensed from GEOSOLVE         | Made by :  rxsw
Data filename/Run ID: 2_West_800DWall_anchored              |
Downtown Carpark Redevelopment                              | Date:23-10-2025
800mm D-Wall - Anchored                                     | Checked :
---------------------------------------------------------------------------
                                                       Units: kN,m
```

Stage No.9 Excav. to elev. -6.80 on RIGHT side





Stage No.9 Excav. to elev. -6.80 on RIGHT side

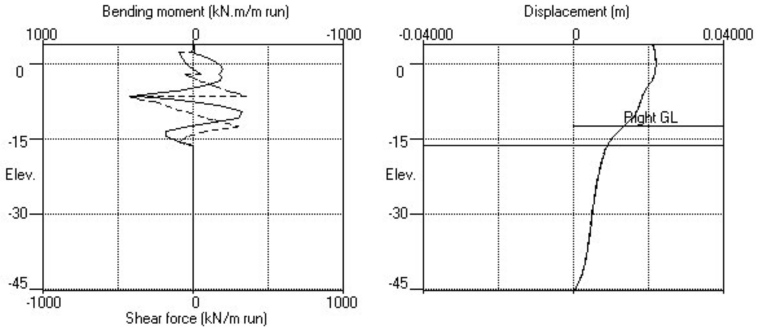
```
========================================================================TONKIN +
TAYLOR LTD                                         | Sheet No.
Program: WALLAP  Version 6.09  Revision A60.B77.R61         | Job No. 1016043
                             Licensed from GEOSOLVE         | Made by :  rxsw
Data filename/Run ID: 2_West_800DWall_anchored              |
Downtown Carpark Redevelopment                              | Date:23-10-2025
800mm D-Wall - Anchored                                     | Checked :
----------------------------------------------------------------------------
                                                  Units: kN,m
Stage No. 12   Excavate to elevation -12.32 on RIGHT side

STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method
 Factor of safety on soil strength

                                 FoS for toe       Toe elev. for
                                elev. =  -16.32     FoS = 1.000
 Stage  Ground level    Prop    Factor  Moment      Toe    Wall    Direction
  No.   Act.    Pass.   Elev.     of    equilib.   elev.  Penetr      of
                                Safety  at elev.                -ation     failure
  12    4.00  -12.32          More than one prop. No FoS calc.


BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall
  Analysis options
  2-D finite element model.    Active limit arching modelled.
  Soil deformations are elastic until the active or passive limit is reached
  Open Tension Crack analysis - No

  Length of wall perpendicular to section = 1000.00m
  Rigid boundaries:     Left side 60.00m from wall                Rough
                       Right side 60.00m from wall               Smooth
              Lower boundary at elevation -45.25m                Rough
                          Soil-wall interface                    Smooth

    *** Wall displacements reset to zero at stage 1

 Node    Y      Nett       Wall       Wall      Shear   Bending    Prop      EI of
 no.   coord  pressure     disp.    rotation    force    moment   forces      wall
              kN/m2          m        rad.       kN/m    kN.m/m    kN/m    kN.m2/m
  1     4.00      7.66     0.021  -2.52E-04       0.0      -0.0              877500
  2     3.30      6.02     0.021  -2.53E-04       4.8       2.4              877500
  3     2.50      9.09     0.022  -2.58E-04      10.8       8.9   -105.5     877500
                  9.09     0.022  -2.58E-04     -94.7       8.9
  4     2.00     13.26     0.022  -2.50E-04     -89.1     -37.1              877500
  5     1.90     13.78     0.022  -2.46E-04     -87.8     -45.9              877500
  6     1.40     17.97     0.022  -2.07E-04     -79.8     -87.9              877500
  7     0.40     31.40     0.022  -6.87E-05     -55.1    -156.4              877500
  8    -0.30     40.64     0.022   6.79E-05     -29.9    -186.5              877500
  9    -1.00     50.10     0.022   2.20E-04       1.8    -196.7              877500
 10    -1.40     55.52     0.022   3.09E-04      23.0    -191.8              877500
 11    -1.90     62.39     0.022   4.13E-04      52.4    -173.1   -103.5     877500
                 62.39     0.022   4.13E-04     -51.1    -173.1
 12    -2.40     69.25     0.021   5.16E-04     -18.2    -190.6              877500
 13    -2.50     70.69     0.021   5.38E-04     -11.2    -192.1              877500
 14    -3.20     80.43     0.021   6.87E-04      41.7    -181.8              877500
 15    -3.90     90.33     0.020   8.13E-04     101.4    -132.2              877500
 16    -4.40     97.68     0.020   8.70E-04     148.4     -70.0              877500
 17    -5.30    110.46     0.019   8.52E-04     242.1     104.7              877500
 18    -5.70    116.65     0.019   7.81E-04     287.5     210.6              877500
                115.88     0.019   7.81E-04     287.5     210.6
 19    -6.30    111.42     0.018   5.70E-04     355.7     404.2   -782.1     877500
                111.42     0.018   5.70E-04    -426.4     404.2
 20    -6.70    106.68     0.018   4.23E-04    -382.8     242.6              877500
 21    -6.80    103.41     0.018   3.97E-04    -372.3     204.8              877500
 22    -6.90    109.34     0.018   3.76E-04    -361.6     168.1              877500
                346.38     0.018   3.76E-04    -361.6     168.1
 23    -7.40     88.00     0.018   3.22E-04    -253.0      22.5              877500
 24    -8.20     96.00     0.018   3.86E-04    -179.4    -163.6              877500
 25    -8.90    103.00     0.017   5.60E-04    -109.8    -270.8              877500
========================================================================
Run ID. 2_West_800DWall_anchored                              | Sheet No.
Downtown Carpark Redevelopment                                | Date:23-10-2025
800mm D-Wall - Anchored                                       | Checked :
-----------------------------------------------------------------------------
                                                               (continued)
Stage No.12  Excavate to elevation -12.32 on RIGHT side

 Node    Y      Nett       Wall       Wall      Shear   Bending    Prop      EI of
 no.   coord  pressure     disp.    rotation    force    moment   forces      wall
              kN/m2          m        rad.       kN/m    kN.m/m    kN/m    kN.m2/m
 26    -9.60    110.00     0.017   7.97E-04     -35.2    -324.7              877500
 27   -10.70    121.00     0.016   1.18E-03      91.8    -296.7              877500
 28   -11.12    125.20     0.015   1.31E-03     143.5    -247.5              877500
 29   -12.32    137.20     0.013   1.47E-03     300.9      19.4              877500
               -268.54     0.013   1.47E-03     300.9      19.4
 30   -13.36   -162.84     0.012   1.35E-03      76.6     187.1              877500
 31   -14.40    -75.40     0.011   1.13E-03     -47.3     178.7              877500
 32   -15.36    -20.06     0.010   9.82E-04     -93.1      98.6              877500
 33   -16.32    185.07     0.009   9.28E-04     -13.9      -0.0                   0
 34   -16.47      0.00     0.009          0       0.0       0.0                   0
 35   -16.77      0.07     0.009          0       0.0       0.0                   0
 36   -20.39      0.02     0.007          0       0.2       0.0                   0
 37   -24.00      0.09     0.006          0       0.4       0.0                   0
 38   -28.80      0.05     0.005          0       0.7       0.0                   0
 39   -33.60      0.05     0.004          0       1.0       0.0                   0
 40   -38.40     -0.10     0.003          0       0.9       0.0                   0
 41   -41.83      0.02     0.002          0       0.7       0.0                   0
 42   -45.25     -0.44     0.000          0       0.0       0.0                 ---
 At elev.   2.50                 Prop force =    105.5 kN/m run (horiz.)
                                            =    121.9 kN/m run (inclined)
```

```
At elev.  -1.90               Prop force =    103.5 kN/m run (horiz.)
                                         =    119.6 kN/m run (inclined)
At elev.  -6.30               Prop force =    782.1 kN/m run (horiz.)
                                         =    832.3 kN/m run (inclined)

                                        LEFT side
            ------------------------------------------------------
                       Effective stresses              Total  Adjusted
Node    Y    Water   Vertic  Active  Passive  Earth    earth     soil
no.   coord  press.    -al    limit   limit   press.   press.  modulus
              kN/m2   kN/m2   kN/m2    kN/m2   kN/m2    kN/m2    kN/m2
 1     4.00   0.00    0.00    0.00    16.18    7.66     7.66     5999
 2     3.30   0.00   11.74    0.00    61.60    6.02     6.02     5999
 3     2.50   0.00   26.00    4.14   116.75    9.09     9.09     5999
 4     2.00   0.00   35.18    6.97   152.26   13.26    13.26     5999
 5     1.90   0.00   37.02    7.54   159.38   13.78    13.78     5999
 6     1.40   0.00   46.19   10.38   194.86   17.97    17.97     5999
 7     0.40  10.00   54.26   12.87   226.08   21.40    31.40     5999
 8    -0.30  17.00   59.67   14.54   246.99   23.64    40.64     5999
 9    -1.00  24.00   64.90   16.16   267.24   26.10    50.10     5999
10    -1.40  28.00   67.83   17.06   278.57   27.52    55.52     5999
11    -1.90  33.00   71.44   18.18   292.52   29.39    62.39     5999
12    -2.40  38.00   74.99   19.28   306.28   31.25    69.25     5999
13    -2.50  39.00   75.70   19.49   309.01   31.69    70.69     5999
             39.00   75.70   19.49   348.27   31.69    70.69     5999
14    -3.20  46.00   80.60   21.01   369.66   34.43    80.43     5999
15    -3.90  53.00   85.43   22.50   390.77   37.33    90.33     5999
16    -4.40  58.00   88.84   23.56   405.70   39.68    97.68     5999
17    -5.30  67.00   94.93   25.44   432.31   43.46   110.46     5999
18    -5.70  71.00   97.62   26.27   444.04   45.65   116.65     5999
             71.00   97.62   17.04   528.95   44.88   115.88    39994
19    -6.30  77.00  103.13   18.47   556.28   34.42   111.42    39994
20    -6.70  81.00  106.79   19.41   574.45   25.68   106.68    39994
21    -6.80  82.00  107.70   19.65   578.98   21.41   103.41    39994
22    -6.90  83.00  108.61   19.89   583.51   26.34   109.34    39994
             83.00  108.61    0.00  1906.20  263.38   346.38   399941
23    -7.40  88.00  114.17    0.00  1955.61    0.00    88.00a  399941
24    -8.20  96.00  123.03    0.00  2034.43    0.00    96.00a  399941

===========================================================================
Run ID. 2_West_800DWall_anchored                           | Sheet No.
Downtown Carpark Redevelopment                             | Date:23-10-2025
800mm D-Wall - Anchored                                    | Checked :
-----------------------------------------------------------------------------
                                                               (continued)
Stage No.12  Excavate to elevation -12.32 on RIGHT side

                                        LEFT side
            ------------------------------------------------------
                       Effective stresses              Total  Adjusted
Node    Y    Water   Vertic  Active  Passive  Earth    earth     soil
no.   coord  press.    -al    limit   limit   press.   press.  modulus
              kN/m2   kN/m2   kN/m2    kN/m2   kN/m2    kN/m2    kN/m2
25    -8.90 103.00  130.77    0.00  2103.20    0.00   103.00a  399941
26    -9.60 110.00  138.48    0.00  2171.81    0.00   110.00a  399941
27   -10.70 121.00  150.58    0.00  2279.35    0.00   121.00a  399941
28   -11.12 125.20  155.19    0.00  2320.34    0.00   125.20a  399941
29   -12.32 137.20  168.33    0.00  2437.23    0.00   137.20a  399941
30   -13.36 147.60  179.70    0.00  2538.32    0.00   147.60a  399941
31   -14.40 158.00  191.06    0.00  2639.26    0.00   158.00a  399941
32   -15.36 167.60  201.52    0.00  2732.32    0.00   167.60a  399941
33   -16.32 177.20  211.98    0.00  2825.28   94.29   271.49   399941
34   -16.47 178.70  213.61    0.00  2839.80    0.00   178.70a  399941
35   -16.77 181.70  216.88    0.00  2868.83    0.00   181.70a  399941
36   -20.39 217.85  256.17    0.00  3218.25    4.79   222.64   399941
```

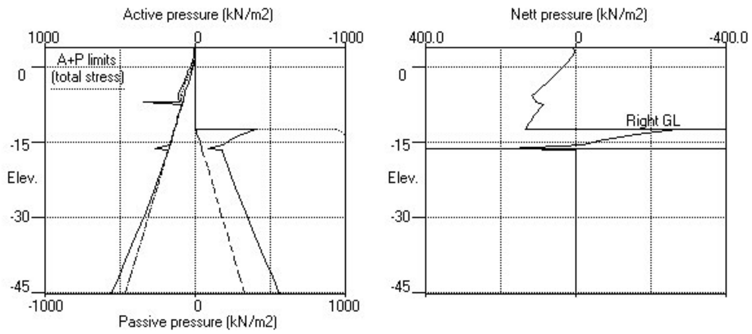
```
37   -24.00 254.00  295.43    0.00  3567.27   14.08   268.08   399941
38   -28.80 302.00  347.54    0.00  4030.63   30.67   332.67   399941
39   -33.60 350.00  399.69    0.00  4494.29   48.66   398.66   399941
40   -38.40 398.00  451.89    0.00  4958.42   67.57   465.57   399941
41   -41.83 432.25  489.17    0.00  5289.91   81.63   513.88   399941
42   -45.25 466.50  526.48    0.00  5621.67   95.60   562.10   399941


                                        RIGHT side
            ------------------------------------------------------
                       Effective stresses              Total  Adjusted
Node    Y    Water   Vertic  Active  Passive  Earth    earth     soil
no.   coord  press.    -al    limit   limit   press.   press.  modulus
              kN/m2   kN/m2   kN/m2    kN/m2   kN/m2    kN/m2    kN/m2
 1     4.00   0.00    0.00    0.00     0.00    0.00     0.00      0.0
 2     3.30   0.00    0.00    0.00     0.00    0.00     0.00      0.0
 3     2.50   0.00    0.00    0.00     0.00    0.00     0.00      0.0
 4     2.00   0.00    0.00    0.00     0.00    0.00     0.00      0.0
 5     1.90   0.00    0.00    0.00     0.00    0.00     0.00      0.0
 6     1.40   0.00    0.00    0.00     0.00    0.00     0.00      0.0
 7     0.40   0.00    0.00    0.00     0.00    0.00     0.00      0.0
 8    -0.30   0.00    0.00    0.00     0.00    0.00     0.00      0.0
 9    -1.00   0.00    0.00    0.00     0.00    0.00     0.00      0.0
10    -1.40   0.00    0.00    0.00     0.00    0.00     0.00      0.0
11    -1.90   0.00    0.00    0.00     0.00    0.00     0.00      0.0
12    -2.40   0.00    0.00    0.00     0.00    0.00     0.00      0.0
13    -2.50   0.00    0.00    0.00     0.00    0.00     0.00      0.0
14    -3.20   0.00    0.00    0.00     0.00    0.00     0.00      0.0
15    -3.90   0.00    0.00    0.00     0.00    0.00     0.00      0.0
16    -4.40   0.00    0.00    0.00     0.00    0.00     0.00      0.0
17    -5.30   0.00    0.00    0.00     0.00    0.00     0.00      0.0
18    -5.70   0.00    0.00    0.00     0.00    0.00     0.00      0.0
19    -6.30   0.00    0.00    0.00     0.00    0.00     0.00      0.0
20    -6.70   0.00    0.00    0.00     0.00    0.00     0.00      0.0
21    -6.80   0.00    0.00    0.00     0.00    0.00     0.00      0.0
22    -6.90   0.00    0.00    0.00     0.00    0.00     0.00      0.0
23    -7.40   0.00    0.00    0.00     0.00    0.00     0.00      0.0
24    -8.20   0.00    0.00    0.00     0.00    0.00     0.00      0.0
25    -8.90   0.00    0.00    0.00     0.00    0.00     0.00      0.0
26    -9.60   0.00    0.00    0.00     0.00    0.00     0.00      0.0
27   -10.70   0.00    0.00    0.00     0.00    0.00     0.00      0.0
28   -11.12   0.00    0.00    0.00     0.00    0.00     0.00      0.0
29   -12.32   0.00    0.00    0.00     0.00    0.00     0.00      0.0
              0.00    0.00    0.00   940.47  405.74   405.74   399973

===========================================================================
Run ID. 2_West_800DWall_anchored                           | Sheet No.
Downtown Carpark Redevelopment                             | Date:23-10-2025
800mm D-Wall - Anchored                                    | Checked :
-----------------------------------------------------------------------------
                                                               (continued)
Stage No.12  Excavate to elevation -12.32 on RIGHT side

                                        RIGHT side
            ------------------------------------------------------
                       Effective stresses              Total  Adjusted
Node    Y    Water   Vertic  Active  Passive  Earth    earth     soil
no.   coord  press.    -al    limit   limit   press.   press.  modulus
              kN/m2   kN/m2   kN/m2    kN/m2   kN/m2    kN/m2    kN/m2
30   -13.36  10.40   11.44    0.00  1042.20  300.04   310.44   399973
31   -14.40  20.80   22.89    0.00  1143.96  212.60   233.40   399973
32   -15.36  30.40   33.46    0.00  1237.95  157.26   187.66   399973
33   -16.32  40.00   44.04    0.00  1332.03   46.42    86.42   399973
34   -16.47  41.50   45.69    0.00  1346.74  137.20   178.70   399973
35   -16.77  44.50   49.00    0.00  1376.16  137.13   181.63   399973
```

```
 36  -20.39   80.65   89.01    0.00  1731.93  141.97   222.62   399973
 37  -24.00  116.80  129.36    0.00  2090.71  151.20   268.00   399973
 38  -28.80  164.80  183.66    0.00  2573.45  167.81   332.61   399973
 39  -33.60  212.80  238.92    0.00  3064.84  185.80   398.60   399973
 40  -38.40  260.80  295.22    0.00  3565.44  204.87   465.67   399973
 41  -41.83  295.05  336.01    0.00  3928.13  218.80   513.85   399973
 42  -45.25  329.30  377.28    0.00  4295.05  233.24   562.54   399973

Note:    181.70 a  Soil pressure at active limit
         123.45 p  Soil pressure at passive limit
 ===========================================================================TONKIN +
TAYLOR LTD                                                 | Sheet No.
Program: WALLAP  Version 6.09  Revision A60.B77.R61         | Job No. 1016043
                             Licensed from GEOSOLVE         | Made by :  rxsw
Data filename/Run ID: 2_West_800DWall_anchored              |
Downtown Carpark Redevelopment                              | Date:23-10-2025
800mm D-Wall - Anchored                                     | Checked :
-----------------------------------------------------------------------------
                                                       Units: kN,m
```

Stage No.12 Excav. to elev. -12.32 on RIGHT side



Stage No.12 Excav. to elev. -12.32 on RIGHT side



```
 ===========================================================================TONKIN +
TAYLOR LTD                                                 | Sheet No.
Program: WALLAP  Version 6.09  Revision A60.B77.R61         | Job No. 1016043
                             Licensed from GEOSOLVE         | Made by :  rxsw
Data filename/Run ID: 2_West_800DWall_anchored              |
Downtown Carpark Redevelopment                              | Date:23-10-2025
800mm D-Wall - Anchored                                     | Checked :
-----------------------------------------------------------------------------
                                                       Units: kN,m
Stage No. 13   Fill to elevation -11.12 on RIGHT side with soil type 6

STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method
 Factor of safety on soil strength

                               FoS for toe       Toe elev. for
                              elev. =  -16.32     FoS = 1.000
 Stage  Ground level    Prop   Factor  Moment     Toe     Wall    Direction
  No.   Act.    Pass.   Elev.    of    equilib.  elev.   Penetr      of
                               Safety  at elev.          -ation    failure
  13    4.00  -11.12           More than one prop. No FoS calc.


BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall
  Analysis options
  2-D finite element model.    Active limit arching modelled.
  Soil deformations are elastic until the active or passive limit is reached
  Open Tension Crack analysis - No

  Length of wall perpendicular to section = 1000.00m
  Rigid boundaries:     Left side 60.00m from wall                 Rough
                       Right side 60.00m from wall                Smooth
               Lower boundary at elevation -45.25m                 Rough
                          Soil-wall interface                     Smooth

    *** Wall displacements reset to zero at stage 1

 Node   Y      Nett       Wall      Wall      Shear    Bending   Prop      EI of
```

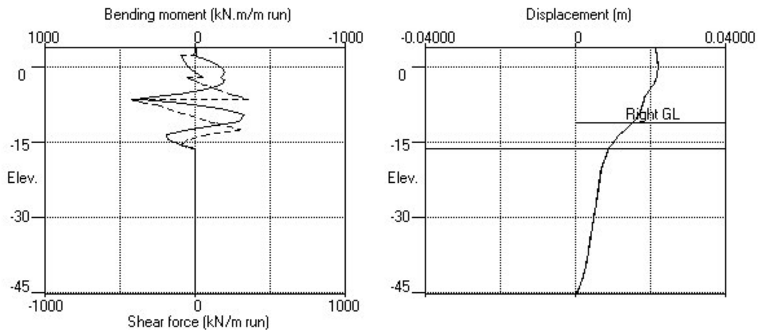
```
 no.  coord  pressure     disp.   rotation    force   moment    forces     wall
                kN/m2       m       rad.       kN/m    kN.m/m    kN/m   kN.m2/m
  1    4.00      7.62     0.021  -2.49E-04      0.0      -0.0            877500
  2    3.30      5.99     0.021  -2.50E-04      4.8       2.4            877500
  3    2.50      9.05     0.022  -2.55E-04     10.8       8.9   -105.6   877500
                 9.05     0.022  -2.55E-04    -94.9       8.9
  4    2.00     13.22     0.022  -2.47E-04    -89.3     -37.2            877500
  5    1.90     13.73     0.022  -2.42E-04    -87.9     -46.1            877500
  6    1.40     17.92     0.022  -2.04E-04    -80.0     -88.1            877500
  7    0.40     31.35     0.022  -6.48E-05    -55.4    -156.8            877500
  8   -0.30     40.59     0.022   7.23E-05    -30.2    -187.1            877500
  9   -1.00     50.05     0.022   2.25E-04      1.5    -197.5            877500
 10   -1.40     55.46     0.022   3.14E-04     22.6    -192.8            877500
 11   -1.90     62.33     0.022   4.19E-04     52.1    -174.2   -103.6   877500
                62.33     0.022   4.19E-04    -51.5    -174.2
 12   -2.40     69.19     0.021   5.23E-04    -18.6    -191.9            877500
 13   -2.50     70.63     0.021   5.45E-04    -11.7    -193.4            877500
 14   -3.20     80.37     0.021   6.95E-04     41.2    -183.6            877500
 15   -3.90     90.26     0.020   8.22E-04    100.9    -134.3            877500
 16   -4.40     97.61     0.020   8.81E-04    147.9     -72.3            877500
 17   -5.30    110.39     0.019   8.66E-04    241.5     101.9            877500
 18   -5.70    116.58     0.019   7.95E-04    286.9     207.4            877500
               115.41     0.019   7.95E-04    286.9     207.4
 19   -6.30    110.93     0.018   5.88E-04    354.8     400.5   -778.9   877500
               110.93     0.018   5.88E-04   -424.2     400.5
 20   -6.70    106.21     0.018   4.42E-04   -380.7     239.8            877500
 21   -6.80    102.96     0.018   4.17E-04   -370.3     202.2            877500
 22   -6.90    108.93     0.018   3.96E-04   -359.7     165.7            877500
               342.31     0.018   3.96E-04   -359.7     165.7
 23   -7.40     88.00     0.018   3.42E-04   -252.1      20.5            877500
 24   -8.20     96.00     0.018   4.08E-04   -178.5    -164.7            877500
 25   -8.90    103.00     0.017   5.82E-04   -108.9    -271.3            877500
===========================================================================
Run ID. 2_West_800DWall_anchored                            | Sheet No.
Downtown Carpark Redevelopment                              | Date:23-10-2025
800mm D-Wall - Anchored                                     | Checked :
-----------------------------------------------------------------------------
                                                              (continued)
Stage No.13  Fill to elevation -11.12 on RIGHT side with soil type 6

 Node   Y      Nett       Wall      Wall       Shear   Bending   Prop      EI of
 no.  coord  pressure     disp.   rotation    force   moment    forces     wall
                kN/m2       m       rad.       kN/m    kN.m/m    kN/m   kN.m2/m
 26   -9.60    110.20     0.017   8.20E-04    -34.2    -324.6            877500
 27  -10.70    122.42     0.016   1.20E-03     93.7    -295.4            877500
 28  -11.12    128.07     0.015   1.33E-03    146.3    -245.2            877500
 29  -12.32    131.45     0.013   1.48E-03    302.0      24.7            877500
              -272.22     0.013   1.48E-03    302.0      24.7
 30  -13.36   -163.71     0.012   1.36E-03     75.3     191.6            877500
 31  -14.40    -75.26     0.011   1.13E-03    -48.9     181.4            877500
 32  -15.36    -19.59     0.010   9.86E-04    -94.5      99.7            877500
 33  -16.32    187.15     0.009   9.31E-04    -14.0      -0.0                 0
 34  -16.47      0.00     0.009          0      0.0       0.0                 0
 35  -16.77      0.08     0.008          0      0.0       0.0                 0
 36  -20.39      0.02     0.007          0      0.2       0.0                 0
 37  -24.00      0.09     0.006          0      0.4       0.0                 0
 38  -28.80      0.05     0.005          0      0.7       0.0                 0
 39  -33.60      0.05     0.004          0      1.0       0.0                 0
 40  -38.40     -0.10     0.003          0      0.8       0.0                 0
 41  -41.83      0.02     0.002          0      0.7       0.0                 0
 42  -45.25     -0.42     0.000          0      0.0       0.0               ---
 At elev.   2.50                 Prop force =    105.6 kN/m run (horiz.)
                                            =    122.0 kN/m run (inclined)
```

```
 At elev.  -1.90                 Prop force =    103.6 kN/m run (horiz.)
                                            =    119.6 kN/m run (inclined)
 At elev.  -6.30                 Prop force =    778.9 kN/m run (horiz.)
                                            =    828.9 kN/m run (inclined)

                                          LEFT side
                           Effective stresses          Total  Adjusted
 Node   Y    Water   Vertic  Active  Passive  Earth    earth     soil
 no.  coord  press.    -al   limit    limit   press.   press.  modulus
              kN/m2   kN/m2   kN/m2    kN/m2   kN/m2    kN/m2    kN/m2
  1    4.00    0.00    0.00    0.00    16.18    7.62     7.62     5999
  2    3.30    0.00   11.74    0.00    61.60    5.99     5.99     5999
  3    2.50    0.00   26.00    4.14   116.75    9.05     9.05     5999
  4    2.00    0.00   35.18    6.97   152.26   13.22    13.22     5999
  5    1.90    0.00   37.02    7.54   159.38   13.73    13.73     5999
  6    1.40    0.00   46.19   10.38   194.86   17.92    17.92     5999
  7    0.40   10.00   54.26   12.87   226.08   21.35    31.35     5999
  8   -0.30   17.00   59.67   14.54   246.99   23.59    40.59     5999
  9   -1.00   24.00   64.90   16.16   267.24   26.05    50.05     5999
 10   -1.40   28.00   67.83   17.06   278.57   27.46    55.46     5999
 11   -1.90   33.00   71.44   18.18   292.52   29.33    62.33     5999
 12   -2.40   38.00   74.99   19.28   306.28   31.19    69.19     5999
 13   -2.50   39.00   75.70   19.49   309.01   31.63    70.63     5999
              39.00   75.70   19.49   348.27   31.63    70.63     5999
 14   -3.20   46.00   80.60   21.01   369.66   34.37    80.37     5999
 15   -3.90   53.00   85.43   22.50   390.77   37.26    90.26     5999
 16   -4.40   58.00   88.84   23.56   405.70   39.61    97.61     5999
 17   -5.30   67.00   94.93   25.44   432.31   43.39   110.39     5999
 18   -5.70   71.00   97.62   26.27   444.04   45.58   116.58     5999
              71.00   97.62   17.04   528.95   44.41   115.41    39994
 19   -6.30   77.00  103.13   18.47   556.28   33.93   110.93    39994
 20   -6.70   81.00  106.79   19.41   574.45   25.21   106.21    39994
 21   -6.80   82.00  107.70   19.65   578.98   20.96   102.96    39994
 22   -6.90   83.00  108.61   19.89   583.51   25.93   108.93    39994
              83.00  108.61    0.00  1906.20  259.31   342.31   399941
 23   -7.40   88.00  114.17    0.00  1955.61    0.00    88.00a  399941
 24   -8.20   96.00  123.03    0.00  2034.43    0.00    96.00a  399941

===========================================================================
Run ID. 2_West_800DWall_anchored                            | Sheet No.
Downtown Carpark Redevelopment                              | Date:23-10-2025
800mm D-Wall - Anchored                                     | Checked :
-----------------------------------------------------------------------------
                                                              (continued)
Stage No.13  Fill to elevation -11.12 on RIGHT side with soil type 6

                                          LEFT side
                           Effective stresses          Total  Adjusted
 Node   Y    Water   Vertic  Active  Passive  Earth    earth     soil
 no.  coord  press.    -al   limit    limit   press.   press.  modulus
              kN/m2   kN/m2   kN/m2    kN/m2   kN/m2    kN/m2    kN/m2
 25   -8.90  103.00  130.77    0.00  2103.20    0.00   103.00a  399941
 26   -9.60  110.00  138.48    0.00  2171.81    0.20   110.20   399941
 27  -10.70  121.00  150.58    0.00  2279.35    1.42   122.42   399941
 28  -11.12  125.20  155.19    0.00  2320.34    2.87   128.07   399941
 29  -12.32  137.20  168.33    0.00  2437.23    4.04   141.24   399941
 30  -13.36  147.60  179.70    0.00  2538.32    4.70   152.30   399941
 31  -14.40  158.00  191.06    0.00  2639.26    4.73   162.73   399941
 32  -15.36  167.60  201.52    0.00  2732.32    4.66   172.26   399941
 33  -16.32  177.20  211.98    0.00  2825.28   99.64   276.84   399941
 34  -16.47  178.70  213.61    0.00  2839.80    4.24   182.94   399941
 35  -16.77  181.70  216.88    0.00  2868.83    4.13   185.83   399941
 36  -20.39  217.85  256.17    0.00  3218.25    8.79   226.64   399941
```

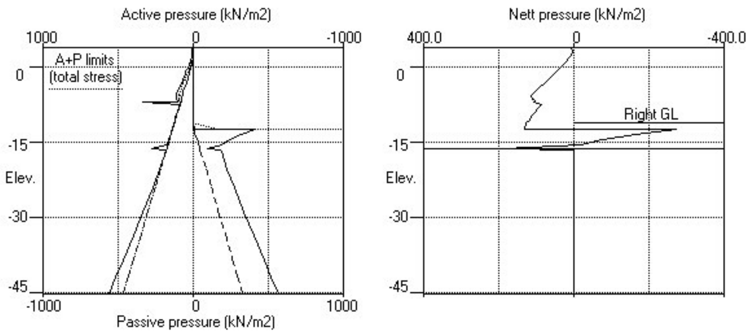
```
 37  -24.00  254.00  295.43    0.00  3567.27   17.99   271.99   399941
 38  -28.80  302.00  347.54    0.00  4030.63   34.54   336.54   399941
 39  -33.60  350.00  399.69    0.00  4494.29   52.52   402.52   399941
 40  -38.40  398.00  451.89    0.00  4958.42   71.43   469.43   399941
 41  -41.83  432.25  489.17    0.00  5289.91   85.47   517.72   399941
 42  -45.25  466.50  526.48    0.00  5621.67   99.44   565.94   399941


                                           RIGHT side
                ___________________________________________________________
                          Effective stresses             Total  Adjusted
                         _____________________________
 Node    Y      Water   Vertic  Active  Passive  Earth    earth     soil
 no.   coord    press.    -al   limit    limit   press.   press.  modulus
                 kN/m2   kN/m2   kN/m2    kN/m2    kN/m2    kN/m2    kN/m2
  1     4.00    0.00    0.00    0.00     0.00     0.00     0.00      0.0
  2     3.30    0.00    0.00    0.00     0.00     0.00     0.00      0.0
  3     2.50    0.00    0.00    0.00     0.00     0.00     0.00      0.0
  4     2.00    0.00    0.00    0.00     0.00     0.00     0.00      0.0
  5     1.90    0.00    0.00    0.00     0.00     0.00     0.00      0.0
  6     1.40    0.00    0.00    0.00     0.00     0.00     0.00      0.0
  7     0.40    0.00    0.00    0.00     0.00     0.00     0.00      0.0
  8    -0.30    0.00    0.00    0.00     0.00     0.00     0.00      0.0
  9    -1.00    0.00    0.00    0.00     0.00     0.00     0.00      0.0
 10    -1.40    0.00    0.00    0.00     0.00     0.00     0.00      0.0
 11    -1.90    0.00    0.00    0.00     0.00     0.00     0.00      0.0
 12    -2.40    0.00    0.00    0.00     0.00     0.00     0.00      0.0
 13    -2.50    0.00    0.00    0.00     0.00     0.00     0.00      0.0
 14    -3.20    0.00    0.00    0.00     0.00     0.00     0.00      0.0
 15    -3.90    0.00    0.00    0.00     0.00     0.00     0.00      0.0
 16    -4.40    0.00    0.00    0.00     0.00     0.00     0.00      0.0
 17    -5.30    0.00    0.00    0.00     0.00     0.00     0.00      0.0
 18    -5.70    0.00    0.00    0.00     0.00     0.00     0.00      0.0
 19    -6.30    0.00    0.00    0.00     0.00     0.00     0.00      0.0
 20    -6.70    0.00    0.00    0.00     0.00     0.00     0.00      0.0
 21    -6.80    0.00    0.00    0.00     0.00     0.00     0.00      0.0
 22    -6.90    0.00    0.00    0.00     0.00     0.00     0.00      0.0
 23    -7.40    0.00    0.00    0.00     0.00     0.00     0.00      0.0
 24    -8.20    0.00    0.00    0.00     0.00     0.00     0.00      0.0
 25    -8.90    0.00    0.00    0.00     0.00     0.00     0.00      0.0
 26    -9.60    0.00    0.00    0.00     0.00     0.00     0.00      0.0
 27   -10.70    0.00    0.00    0.00     0.00     0.00     0.00      0.0
 28   -11.12    0.00    0.00    0.00     0.00     0.00     0.00      0.0
                0.00    0.00    0.00     0.00     0.00     0.00    39997
 29   -12.32    0.00   22.80    4.50   173.01     9.78     9.78    39997
                0.00   22.80    0.00  1143.21   413.45   413.45   399970

===========================================================================
Run ID. 2_West_800DWall_anchored                           | Sheet No.
Downtown Carpark Redevelopment                             | Date:23-10-2025
800mm D-Wall - Anchored                                    | Checked :
---------------------------------------------------------------------------
                                                             (continued)
Stage No.13  Fill to elevation -11.12 on RIGHT side with soil type 6

                                           RIGHT side
                ___________________________________________________________
                          Effective stresses             Total  Adjusted
                         _____________________________
 Node    Y      Water   Vertic  Active  Passive  Earth    earth     soil
 no.   coord    press.    -al   limit    limit   press.   press.  modulus
                 kN/m2   kN/m2   kN/m2    kN/m2    kN/m2    kN/m2    kN/m2
 30   -13.36   10.40   34.25    0.00  1244.97  305.61   316.01   399970
 31   -14.40   20.80   45.70    0.00  1346.80  217.19   237.99   399970
 32   -15.36   30.40   56.28    0.00  1440.89  161.44   191.84   399970
 33   -16.32   40.00   66.87    0.00  1535.08   49.69    89.69   399970
 34   -16.47   41.50   68.53    0.00  1549.81  141.44   182.94   399970
```

```
 35  -16.77   44.50   71.84    0.00  1579.28  141.25   185.75   399970
 36  -20.39   80.65  111.92    0.00  1935.65  145.97   226.62   399970
 37  -24.00  116.80  152.35    0.00  2295.12  155.10   271.90   399970
 38  -28.80  164.80  206.73    0.00  2778.61  171.69   336.49   399970
 39  -33.60  212.80  262.02    0.00  3270.22  189.67   402.47   399970
 40  -38.40  260.80  318.26    0.00  3770.24  208.73   469.53   399970
 41  -41.83  295.05  358.94    0.00  4131.96  222.65   517.70   399970
 42  -45.25  329.30  400.04    0.00  4497.41  237.06   566.36   399970

Note:    103.00 a  Soil pressure at active limit
         123.45 p  Soil pressure at passive limit
 =======================================================================TONKIN +
TAYLOR LTD                                              | Sheet No.
Program: WALLAP  Version 6.09  Revision A60.B77.R61         | Job No. 1016043
                            Licensed from GEOSOLVE          | Made by :  rxsw
Data filename/Run ID: 2_West_800DWall_anchored              |
Downtown Carpark Redevelopment                              | Date:23-10-2025
800mm D-Wall - Anchored                                     | Checked :
----------------------------------------------------------------------------
                                                     Units: kN,m
```

Stage No.13 Fill to elev. -11.12 on RIGHT side



Stage No.13 Fill to elev. -11.12 on RIGHT side



```
========================================================================TONKIN +
TAYLOR LTD                                          | Sheet No.
Program: WALLAP  Version 6.09  Revision A60.B77.R61         | Job No. 1016043
                            Licensed from GEOSOLVE          | Made by :  rxsw
Data filename/Run ID: 2_West_800DWall_anchored              |
Downtown Carpark Redevelopment                              | Date:23-10-2025
800mm D-Wall - Anchored                                     | Checked :
----------------------------------------------------------------------------
                                                   Units: kN,m
Stage No. 22   Change EI of wall to 585000 kN.m2/m run
              Allow wall to relax with new modulus value

STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method
 Factor of safety on soil strength

                               FoS for toe       Toe elev. for
                              elev. =  -16.32      FoS = 1.000
 Stage  Ground level    Prop  Factor  Moment      Toe    Wall    Direction
  No.   Act.   Pass.   Elev.    of    equilib.   elev.  Penetr      of
                              Safety  at elev.           -ation    failure
  22    4.00  -11.12          More than one prop. No FoS calc.


BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall
  Analysis options
  2-D finite element model.    Active limit arching modelled.
  Soil deformations are elastic until the active or passive limit is reached
  Open Tension Crack analysis - No

  Length of wall perpendicular to section = 1000.00m
  Rigid boundaries:     Left side 60.00m from wall                Rough
                       Right side 60.00m from wall               Smooth
               Lower boundary at elevation -45.25m                Rough
                               Soil-wall interface                Smooth

    *** Wall displacements reset to zero at stage 1
```

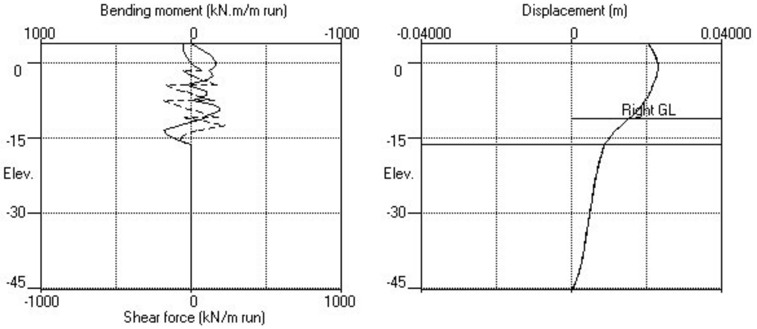
```
 Node    Y      Nett         Wall      Wall       Shear   Bending    Prop       EI of
 no.   coord  pressure      disp.    rotation     force   moment    forces       wall
                 kN/m2         m        rad.        kN/m    kN.m/m     kN/m    kN.m2/m
  1     4.00     10.13      0.020  -8.54E-04     -62.1      -0.0     -62.1    585000
  2     3.30      7.47      0.021  -8.29E-04     -55.9     -42.4              585000
  3     2.50      9.73      0.022  -7.46E-04     -49.0     -86.3              585000
  4     2.00     13.51      0.022  -6.66E-04     -43.2    -110.8              585000
  5     1.90     13.83      0.022  -6.47E-04     -41.8    -115.3              585000
  6     1.40     17.83      0.022  -5.46E-04     -33.9    -135.7              585000
  7     0.40     31.11      0.023  -3.07E-04      -9.4    -161.2              585000
  8    -0.30     40.28      0.023  -1.28E-04      15.5    -161.3              585000
  9    -1.00     49.74      0.023   3.74E-05      47.0    -141.7              585000
 10    -1.40     55.11      0.023   1.16E-04      68.0    -119.8    -122.7    585000
                 55.11      0.023   1.16E-04     -54.7    -119.8
 11    -1.90     61.88      0.023   2.14E-04     -25.4    -139.2              585000
 12    -2.40     68.69      0.023   3.23E-04       7.2    -143.1              585000
 13    -2.50     70.07      0.023   3.45E-04      14.1    -141.8              585000
 14    -3.20     79.78      0.022   4.82E-04      66.6    -112.9              585000
 15    -3.90     89.58      0.022   5.63E-04     125.9     -44.8              585000
 16    -4.40     96.54      0.022   5.60E-04     172.4      30.3    -339.6    585000
                 96.54      0.022   5.60E-04    -167.2      30.3
 17    -5.30    108.65      0.021   5.82E-04     -74.9     -79.3              585000
 18    -5.70    115.21      0.021   6.37E-04     -30.1    -100.3              585000
                106.26      0.021   6.37E-04     -30.1    -100.3
 19    -6.30     94.24      0.021   7.29E-04      30.0     -99.0              585000
 20    -6.70     88.33      0.020   7.83E-04      66.6     -79.4              585000
 21    -6.80     85.58      0.020   7.94E-04      75.3     -72.3              585000
 22    -6.90     94.77      0.020   8.04E-04      84.3     -64.3              585000
                200.71      0.020   8.04E-04      84.3     -64.3
 23    -7.40     93.86      0.020   8.25E-04     157.9      -5.4    -339.2    585000
                 93.86      0.020   8.25E-04    -181.3      -5.4
 24    -8.20     96.00      0.019   9.06E-04    -105.3    -132.6              585000
========================================================================
Run ID. 2_West_800DWall_anchored                              | Sheet No.
Downtown Carpark Redevelopment                                | Date:23-10-2025
800mm D-Wall - Anchored                                       | Checked :
--------------------------------------------------------------------------
                                                            (continued)
Stage No.22  Change EI of wall to 585000 kN.m2/m run
              Allow wall to relax with new modulus value

 Node    Y      Nett         Wall      Wall       Shear   Bending    Prop       EI of
 no.   coord  pressure      disp.    rotation     force   moment    forces       wall
                 kN/m2         m        rad.        kN/m    kN.m/m     kN/m    kN.m2/m
 25    -8.90    103.00      0.018   1.08E-03     -35.7    -188.0              585000
 26    -9.60    110.00      0.017   1.29E-03      38.9    -189.8              585000
 27   -10.70    147.87      0.016   1.53E-03     180.7     -78.8    -226.9    585000
                147.87      0.016   1.53E-03     -46.2     -78.8
 28   -11.12    166.94      0.015   1.58E-03      19.9     -81.9              585000
 29   -12.32    169.11      0.013   1.59E-03     221.6      73.7              585000
               -238.66      0.013   1.59E-03     221.6      73.7
 30   -13.36   -119.55      0.012   1.37E-03      35.3     181.3              585000
 31   -14.40    -42.69      0.010   1.09E-03     -49.1     153.6              585000
 32   -15.36    -10.51      0.010   9.18E-04     -74.6      82.1              585000
 33   -16.32    143.55      0.009   8.55E-04     -10.8      -0.0                   0
 34   -16.47      0.00      0.009          0       0.0       0.0                   0
 35   -16.77      0.08      0.009          0       0.0       0.0                   0
 36   -20.39      0.02      0.007          0       0.2       0.0                   0
 37   -24.00      0.09      0.006          0       0.4       0.0                   0
 38   -28.80      0.05      0.005          0       0.7       0.0                   0
 39   -33.60      0.05      0.004          0       1.0       0.0                   0
 40   -38.40     -0.10      0.003          0       0.8       0.0                   0
 41   -41.83      0.02      0.002          0       0.7       0.0                   0
```

```
 42  -45.25     -0.42     0.000          0      0.0       0.0                ---
At elev.   4.00                Prop force =     62.1 kN/m run
At elev.  -1.40                Prop force =    122.7 kN/m run
At elev.  -4.40                Prop force =    339.6 kN/m run
At elev.  -7.40                Prop force =    339.2 kN/m run
At elev. -10.70                Prop force =    226.9 kN/m run

                                      LEFT side
                    Effective stresses             Total  Adjusted
Node    Y    Water   Vertic  Active  Passive  Earth    earth    soil
no.   coord  press.    -al   limit    limit   press.   press.  modulus
              kN/m2   kN/m2   kN/m2    kN/m2   kN/m2    kN/m2    kN/m2
  1    4.00    0.00    0.00    0.00    16.18   10.13    10.13     5999
  2    3.30    0.00   11.74    0.00    61.60    7.47     7.47     5999
  3    2.50    0.00   26.00    4.14   116.75    9.73     9.73     5999
  4    2.00    0.00   35.18    6.97   152.26   13.51    13.51     5999
  5    1.90    0.00   37.02    7.54   159.38   13.83    13.83     5999
  6    1.40    0.00   46.19   10.38   194.86   17.83    17.83     5999
  7    0.40   10.00   54.26   12.87   226.08   21.11    31.11     5999
  8   -0.30   17.00   59.67   14.54   246.99   23.28    40.28     5999
  9   -1.00   24.00   64.90   16.16   267.24   25.74    49.74     5999
 10   -1.40   28.00   67.83   17.06   278.57   27.11    55.11     5999
 11   -1.90   33.00   71.44   18.18   292.52   28.88    61.88     5999
 12   -2.40   38.00   74.99   19.28   306.28   30.69    68.69     5999
 13   -2.50   39.00   75.70   19.49   309.01   31.07    70.07     5999
              39.00   75.70   19.49   348.27   31.07    70.07     5999
 14   -3.20   46.00   80.60   21.01   369.66   33.78    79.78     5999
 15   -3.90   53.00   85.43   22.50   390.77   36.58    89.58     5999
 16   -4.40   58.00   88.84   23.56   405.70   38.54    96.54     5999
 17   -5.30   67.00   94.93   25.44   432.31   41.65   108.65     5999
 18   -5.70   71.00   97.62   26.27   444.04   44.21   115.21     5999
              71.00   97.62   17.04   528.95   35.26   106.26    39994
 19   -6.30   77.00  103.13   18.47   556.28   17.24    94.24A   39994
 20   -6.70   81.00  106.79   19.41   574.45    7.33    88.33A   39994
 21   -6.80   82.00  107.70   19.65   578.98    3.58    85.58A   39994
 22   -6.90   83.00  108.61   19.89   583.51   11.77    94.77A   39994
              83.00  108.61    0.00  1906.20  117.71   200.71   399941

===========================================================================
Run ID. 2_West_800DWall_anchored                              | Sheet No.
Downtown Carpark Redevelopment                                | Date:23-10-2025
800mm D-Wall - Anchored                                       | Checked :
-----------------------------------------------------------------------------
                                                                    (continued)
Stage No.22  Change EI of wall to 585000 kN.m2/m run
              Allow wall to relax with new modulus value

                                      LEFT side
                    Effective stresses             Total  Adjusted
Node    Y    Water   Vertic  Active  Passive  Earth    earth    soil
no.   coord  press.    -al   limit    limit   press.   press.  modulus
              kN/m2   kN/m2   kN/m2    kN/m2   kN/m2    kN/m2    kN/m2
 23   -7.40   88.00  114.17    0.00  1955.61    5.86    93.86   399941
 24   -8.20   96.00  123.03    0.00  2034.43    0.00    96.00a  399941
 25   -8.90  103.00  130.77    0.00  2103.20    0.00   103.00a  399941
 26   -9.60  110.00  138.48    0.00  2171.81    0.00   110.00a  399941
 27  -10.70  121.00  150.58    0.00  2279.35   26.87   147.87   399941
 28  -11.12  125.20  155.19    0.00  2320.34   41.74   166.94   399941
 29  -12.32  137.20  168.33    0.00  2437.23   42.15   179.35   399941
 30  -13.36  147.60  179.70    0.00  2538.32   37.28   184.88   399941
 31  -14.40  158.00  191.06    0.00  2639.26   26.85   184.85   399941
 32  -15.36  167.60  201.52    0.00  2732.32   13.04   180.64   399941
 33  -16.32  177.20  211.98    0.00  2825.28   80.92   258.12   399941
```

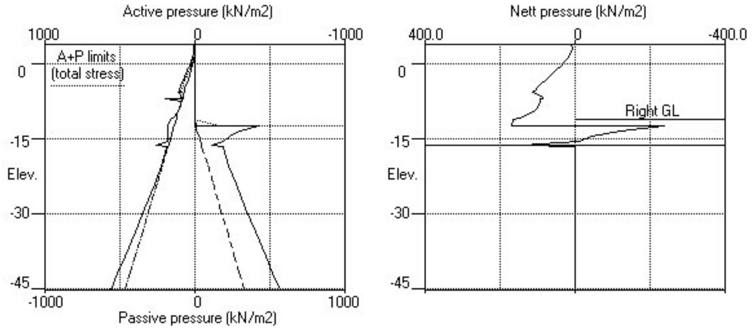
```
 34  -16.47  178.70  213.61    0.00  2839.80    6.51   185.21   399941
 35  -16.77  181.70  216.88    0.00  2868.83    5.56   187.26   399941
 36  -20.39  217.85  256.17    0.00  3218.25    9.53   227.38   399941
 37  -24.00  254.00  295.43    0.00  3567.27   18.21   272.21   399941
 38  -28.80  302.00  347.54    0.00  4030.63   34.60   336.60   399941
 39  -33.60  350.00  399.69    0.00  4494.29   52.54   402.54   399941
 40  -38.40  398.00  451.89    0.00  4958.42   71.50   469.50   399941
 41  -41.83  432.25  489.17    0.00  5289.91   85.65   517.90   399941
 42  -45.25  466.50  526.48    0.00  5621.67   99.72   566.22   399941


                                      RIGHT side
                    Effective stresses             Total  Adjusted
Node    Y    Water   Vertic  Active  Passive  Earth    earth    soil
no.   coord  press.    -al   limit    limit   press.   press.  modulus
              kN/m2   kN/m2   kN/m2    kN/m2   kN/m2    kN/m2    kN/m2
  1    4.00    0.00    0.00    0.00     0.00    0.00     0.00      0.0
  2    3.30    0.00    0.00    0.00     0.00    0.00     0.00      0.0
  3    2.50    0.00    0.00    0.00     0.00    0.00     0.00      0.0
  4    2.00    0.00    0.00    0.00     0.00    0.00     0.00      0.0
  5    1.90    0.00    0.00    0.00     0.00    0.00     0.00      0.0
  6    1.40    0.00    0.00    0.00     0.00    0.00     0.00      0.0
  7    0.40    0.00    0.00    0.00     0.00    0.00     0.00      0.0
  8   -0.30    0.00    0.00    0.00     0.00    0.00     0.00      0.0
  9   -1.00    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 10   -1.40    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 11   -1.90    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 12   -2.40    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 13   -2.50    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 14   -3.20    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 15   -3.90    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 16   -4.40    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 17   -5.30    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 18   -5.70    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 19   -6.30    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 20   -6.70    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 21   -6.80    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 22   -6.90    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 23   -7.40    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 24   -8.20    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 25   -8.90    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 26   -9.60    0.00    0.00    0.00     0.00    0.00     0.00      0.0
 27  -10.70    0.00    0.00    0.00     0.00    0.00     0.00      0.0

===========================================================================
Run ID. 2_West_800DWall_anchored                              | Sheet No.
Downtown Carpark Redevelopment                                | Date:23-10-2025
800mm D-Wall - Anchored                                       | Checked :
-----------------------------------------------------------------------------
                                                                    (continued)
Stage No.22  Change EI of wall to 585000 kN.m2/m run
              Allow wall to relax with new modulus value

                                      RIGHT side
                    Effective stresses             Total  Adjusted
Node    Y    Water   Vertic  Active  Passive  Earth    earth    soil
no.   coord  press.    -al   limit    limit   press.   press.  modulus
              kN/m2   kN/m2   kN/m2    kN/m2   kN/m2    kN/m2    kN/m2
 28  -11.12    0.00    0.00    0.00     0.00    0.00     0.00      0.0
               0.00    0.00    0.00     0.00    0.00     0.00    39997
 29  -12.32    0.00   22.80    4.50   173.01   10.24    10.24    39997
               0.00   22.80    0.00  1143.21  418.01   418.01   399970
 30  -13.36   10.40   34.25    0.00  1244.97  294.03   304.43   399970
```

```
 31  -14.40   20.80   45.70    0.00  1346.80  206.73   227.53   399970
 32  -15.36   30.40   56.28    0.00  1440.89  160.75   191.15   399970
 33  -16.32   40.00   66.87    0.00  1535.08   74.57   114.57   399970
 34  -16.47   41.50   68.53    0.00  1549.81  143.71   185.21   399970
 35  -16.77   44.50   71.84    0.00  1579.28  142.68   187.18   399970
 36  -20.39   80.65  111.92    0.00  1935.65  146.71   227.36   399970
 37  -24.00  116.80  152.35    0.00  2295.12  155.32   272.12   399970
 38  -28.80  164.80  206.73    0.00  2778.61  171.75   336.55   399970
 39  -33.60  212.80  262.02    0.00  3270.22  189.69   402.49   399970
 40  -38.40  260.80  318.26    0.00  3770.24  208.80   469.60   399970
 41  -41.83  295.05  358.94    0.00  4131.96  222.83   517.88   399970
 42  -45.25  329.30  400.04    0.00  4497.41  237.34   566.64   399970

Note:    110.00 a  Soil pressure at active limit
         123.45 p  Soil pressure at passive limit
          94.77 A  Arching - soil pressure below active limit
 =========================================================================TONKIN +
TAYLOR LTD                                                 | Sheet No.
Program: WALLAP  Version 6.09  Revision A60.B77.R61         | Job No. 1016043
                             Licensed from GEOSOLVE         | Made by :  rxsw
Data filename/Run ID: 2_West_800DWall_anchored              |
Downtown Carpark Redevelopment                              | Date:23-10-2025
800mm D-Wall - Anchored                                     | Checked :
-----------------------------------------------------------------------------
                                                       Units: kN,m
```

Stage No.22 Change EI of wall to 585000kN.m2/m run



Stage No.22 Change EI of wall to 585000kN.m2/m run



```
=========================================================================TONKIN +
TAYLOR LTD                                                 | Sheet No.
Program: WALLAP  Version 6.09  Revision A60.B77.R61         | Job No. 1016043
                             Licensed from GEOSOLVE         | Made by :  rxsw
Data filename/Run ID: 2_West_800DWall_anchored              |
Downtown Carpark Redevelopment                              | Date:23-10-2025
800mm D-Wall - Anchored                                     | Checked :
-----------------------------------------------------------------------------
                                                       Units: kN,m
Stage No. 25   Change EI of wall to 292500 kN.m2/m run
             Allow wall to relax with new modulus value

STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method
 Factor of safety on soil strength

                               FoS for toe       Toe elev. for
                              elev. =  -16.32     FoS = 1.000
 Stage  Ground level    Prop  Factor  Moment       Toe     Wall     Direction
  No.   Act.   Pass.   Elev.    of    equilib.    elev.   Penetr       of
                              Safety  at elev.            -ation     failure
  25    4.00  -11.12          More than one prop. No FoS calc.


BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall
  Analysis options
  2-D finite element model.    Active limit arching modelled.
  Soil deformations are elastic until the active or passive limit is reached
  Open Tension Crack analysis - No

  Length of wall perpendicular to section = 1000.00m
  Rigid boundaries:     Left side 60.00m from wall                 Rough
                       Right side 60.00m from wall                Smooth
                    Lower boundary at elevation -45.25m            Rough
                               Soil-wall interface                 Smooth

    *** Wall displacements reset to zero at stage 1
```

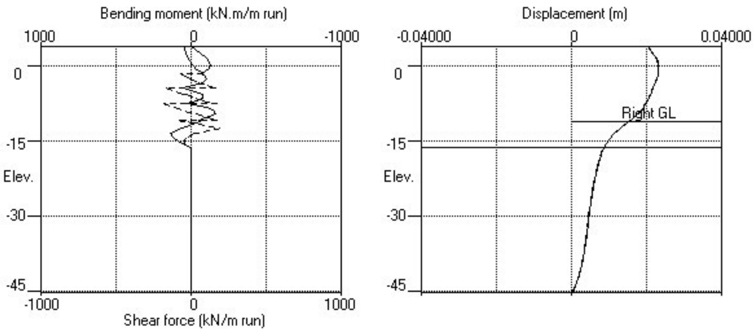
```
 Node   Y      Nett       Wall      Wall      Shear   Bending   Prop      EI of
 no.  coord  pressure     disp.   rotation    force   moment    forces     wall
                kN/m2        m      rad.       kN/m    kN.m/m    kN/m   kN.m2/m
  1    4.00     10.80     0.020  -1.05E-03    -48.5      -0.0    -48.5   292500
  2    3.30      7.68     0.021  -1.01E-03    -42.0     -35.3            292500
  3    2.50      9.59     0.022  -8.89E-04    -35.1     -70.9            292500
  4    2.00     13.20     0.022  -7.71E-04    -29.4     -90.3            292500
  5    1.90     13.43     0.022  -7.44E-04    -28.1     -93.8            292500
  6    1.40     17.37     0.023  -5.96E-04    -20.4    -109.2            292500
  7    0.40     30.65     0.023  -2.65E-04      3.6    -124.8            292500
  8   -0.30     39.95     0.023  -3.49E-05     28.3    -118.3            292500
  9   -1.00     49.59     0.023   1.45E-04     59.7     -92.1            292500
 10   -1.40     55.10     0.023   2.09E-04     80.6     -66.5   -149.0   292500
                55.10     0.023   2.09E-04    -68.4     -66.5
 11   -1.90     61.88     0.023   2.87E-04    -39.2     -90.6            292500
 12   -2.40     68.68     0.023   3.99E-04     -6.5     -99.3            292500
 13   -2.50     70.11     0.023   4.23E-04      0.4     -99.0            292500
 14   -3.20     79.92     0.022   5.72E-04     52.9     -76.8            292500
 15   -3.90     89.92     0.022   6.31E-04    112.4     -15.4            292500
 16   -4.40     97.00     0.022   5.66E-04    159.1      55.0   -325.2   292500
                97.00     0.022   5.66E-04   -166.1      55.0
 17   -5.30    108.98     0.021   5.11E-04    -73.4     -54.2            292500
 18   -5.70    115.44     0.021   5.76E-04    -28.6     -75.0            292500
               107.85     0.021   5.76E-04    -28.6     -75.0
 19   -6.30     95.30     0.021   6.91E-04     32.4     -73.1            292500
 20   -6.70     89.45     0.020   7.52E-04     69.3     -52.9            292500
 21   -6.80     88.39     0.020   7.62E-04     78.2     -45.7            292500
 22   -6.90     96.09     0.020   7.70E-04     87.4     -37.6            292500
               213.91     0.020   7.70E-04     87.4     -37.6
 23   -7.40    105.80     0.020   7.48E-04    167.4      23.4   -351.0   292500
               105.80     0.020   7.48E-04   -183.6      23.4
 24   -8.20     96.00     0.019   7.98E-04   -102.9    -103.4            292500
===========================================================================
Run ID. 2_West_800DWall_anchored                            | Sheet No.
Downtown Carpark Redevelopment                              | Date:23-10-2025
800mm D-Wall - Anchored                                     | Checked :
-----------------------------------------------------------------------------
                                                              (continued)
Stage No.25  Change EI of wall to 292500 kN.m2/m run
              Allow wall to relax with new modulus value

 Node   Y      Nett       Wall      Wall      Shear   Bending   Prop      EI of
 no.  coord  pressure     disp.   rotation    force   moment    forces     wall
                kN/m2        m      rad.       kN/m    kN.m/m    kN/m   kN.m2/m
 25   -8.90    103.00     0.019   1.05E-03    -33.2    -158.2            292500
 26   -9.60    110.00     0.018   1.37E-03     41.3    -159.1            292500
 27  -10.70    134.14     0.016   1.67E-03    175.6     -47.6   -259.0   292500
               134.14     0.016   1.67E-03    -83.4     -47.6
 28  -11.12    167.28     0.015   1.72E-03    -20.1     -61.4            292500
 29  -12.32    177.04     0.013   1.71E-03    186.5      61.5            292500
              -239.02     0.013   1.71E-03    186.5      61.5
 30  -13.36    -86.84     0.011   1.41E-03     17.0     142.9            292500
 31  -14.40    -13.90     0.010   1.06E-03    -35.4     113.4            292500
 32  -15.36     -5.56     0.009   8.46E-04    -44.7      60.2            292500
 33  -16.32     85.40     0.009   7.72E-04     -6.4      -0.0                 0
 34  -16.47      0.00     0.008          0      0.0       0.0                 0
 35  -16.77      0.08     0.008          0      0.0       0.0                 0
 36  -20.39      0.02     0.007          0      0.2       0.0                 0
 37  -24.00      0.09     0.006          0      0.4       0.0                 0
 38  -28.80      0.05     0.005          0      0.7       0.0                 0
 39  -33.60      0.05     0.004          0      1.0       0.0                 0
 40  -38.40     -0.10     0.003          0      0.8       0.0                 0
 41  -41.83      0.02     0.002          0      0.7       0.0                 0
```

```
 42  -45.25     -0.42     0.000          0      0.0       0.0                   ---
 At elev.   4.00                Prop force =     48.5 kN/m run
 At elev.  -1.40                Prop force =    149.0 kN/m run
 At elev.  -4.40                Prop force =    325.2 kN/m run
 At elev.  -7.40                Prop force =    351.0 kN/m run
 At elev. -10.70                Prop force =    259.0 kN/m run

                                          LEFT side
                           Effective stresses          Total  Adjusted
 Node   Y    Water   Vertic  Active  Passive  Earth    earth     soil
 no.  coord  press.    -al   limit    limit   press.   press.  modulus
              kN/m2   kN/m2   kN/m2    kN/m2   kN/m2    kN/m2    kN/m2
  1    4.00    0.00    0.00    0.00    16.18   10.80    10.80     5999
  2    3.30    0.00   11.74    0.00    61.60    7.68     7.68     5999
  3    2.50    0.00   26.00    4.14   116.75    9.59     9.59     5999
  4    2.00    0.00   35.18    6.97   152.26   13.20    13.20     5999
  5    1.90    0.00   37.02    7.54   159.38   13.43    13.43     5999
  6    1.40    0.00   46.19   10.38   194.86   17.37    17.37     5999
  7    0.40   10.00   54.26   12.87   226.08   20.65    30.65     5999
  8   -0.30   17.00   59.67   14.54   246.99   22.95    39.95     5999
  9   -1.00   24.00   64.90   16.16   267.24   25.59    49.59     5999
 10   -1.40   28.00   67.83   17.06   278.57   27.10    55.10     5999
 11   -1.90   33.00   71.44   18.18   292.52   28.88    61.88     5999
 12   -2.40   38.00   74.99   19.28   306.28   30.68    68.68     5999
 13   -2.50   39.00   75.70   19.49   309.01   31.11    70.11     5999
              39.00   75.70   19.49   348.27   31.11    70.11     5999
 14   -3.20   46.00   80.60   21.01   369.66   33.92    79.92     5999
 15   -3.90   53.00   85.43   22.50   390.77   36.92    89.92     5999
 16   -4.40   58.00   88.84   23.56   405.70   39.00    97.00     5999
 17   -5.30   67.00   94.93   25.44   432.31   41.98   108.98     5999
 18   -5.70   71.00   97.62   26.27   444.04   44.44   115.44     5999
              71.00   97.62   17.04   528.95   36.85   107.85    39994
 19   -6.30   77.00  103.13   18.47   556.28   18.30    95.30A   39994
 20   -6.70   81.00  106.79   19.41   574.45    8.45    89.45A   39994
 21   -6.80   82.00  107.70   19.65   578.98    6.39    88.39A   39994
 22   -6.90   83.00  108.61   19.89   583.51   13.09    96.09A   39994
              83.00  108.61    0.00  1906.20  130.91   213.91   399941

===========================================================================
Run ID. 2_West_800DWall_anchored                            | Sheet No.
Downtown Carpark Redevelopment                              | Date:23-10-2025
800mm D-Wall - Anchored                                     | Checked :
-----------------------------------------------------------------------------
                                                              (continued)
Stage No.25  Change EI of wall to 292500 kN.m2/m run
              Allow wall to relax with new modulus value

                                          LEFT side
                           Effective stresses          Total  Adjusted
 Node   Y    Water   Vertic  Active  Passive  Earth    earth     soil
 no.  coord  press.    -al   limit    limit   press.   press.  modulus
              kN/m2   kN/m2   kN/m2    kN/m2   kN/m2    kN/m2    kN/m2
 23   -7.40   88.00  114.17    0.00  1955.61   17.80   105.80   399941
 24   -8.20   96.00  123.03    0.00  2034.43    0.00    96.00a  399941
 25   -8.90  103.00  130.77    0.00  2103.20    0.00   103.00a  399941
 26   -9.60  110.00  138.48    0.00  2171.81    0.00   110.00a  399941
 27  -10.70  121.00  150.58    0.00  2279.35   13.14   134.14   399941
 28  -11.12  125.20  155.19    0.00  2320.34   42.08   167.28   399941
 29  -12.32  137.20  168.33    0.00  2437.23   57.74   194.94   399941
 30  -13.36  147.60  179.70    0.00  2538.32   63.94   211.54   399941
 31  -14.40  158.00  191.06    0.00  2639.26   48.42   206.42   399941
 32  -15.36  167.60  201.52    0.00  2732.32   21.54   189.14   399941
 33  -16.32  177.20  211.98    0.00  2825.28   57.41   234.61   399941
```

```
 34  -16.47  178.70  213.61    0.00  2839.80   11.82   190.52   399941
 35  -16.77  181.70  216.88    0.00  2868.83   10.46   192.16   399941
 36  -20.39  217.85  256.17    0.00  3218.25   14.00   231.85   399941
 37  -24.00  254.00  295.43    0.00  3567.27   22.37   276.37   399941
 38  -28.80  302.00  347.54    0.00  4030.63   38.67   340.67   399941
 39  -33.60  350.00  399.69    0.00  4494.29   56.57   406.57   399941
 40  -38.40  398.00  451.89    0.00  4958.42   75.54   473.54   399941
 41  -41.83  432.25  489.17    0.00  5289.91   89.72   521.97   399941
 42  -45.25  466.50  526.48    0.00  5621.67  103.83   570.33   399941


                                            RIGHT side
                ----------------------------------------------------------
                            Effective stresses             Total  Adjusted
                        -------------------------------
 Node    Y     Water   Vertic  Active  Passive   Earth     earth     soil
 no.   coord  press.     -al   limit    limit   press.    press.  modulus
                kN/m2   kN/m2   kN/m2    kN/m2   kN/m2     kN/m2    kN/m2
  1     4.00    0.00    0.00    0.00     0.00    0.00      0.00      0.0
  2     3.30    0.00    0.00    0.00     0.00    0.00      0.00      0.0
  3     2.50    0.00    0.00    0.00     0.00    0.00      0.00      0.0
  4     2.00    0.00    0.00    0.00     0.00    0.00      0.00      0.0
  5     1.90    0.00    0.00    0.00     0.00    0.00      0.00      0.0
  6     1.40    0.00    0.00    0.00     0.00    0.00      0.00      0.0
  7     0.40    0.00    0.00    0.00     0.00    0.00      0.00      0.0
  8    -0.30    0.00    0.00    0.00     0.00    0.00      0.00      0.0
  9    -1.00    0.00    0.00    0.00     0.00    0.00      0.00      0.0
 10    -1.40    0.00    0.00    0.00     0.00    0.00      0.00      0.0
 11    -1.90    0.00    0.00    0.00     0.00    0.00      0.00      0.0
 12    -2.40    0.00    0.00    0.00     0.00    0.00      0.00      0.0
 13    -2.50    0.00    0.00    0.00     0.00    0.00      0.00      0.0
 14    -3.20    0.00    0.00    0.00     0.00    0.00      0.00      0.0
 15    -3.90    0.00    0.00    0.00     0.00    0.00      0.00      0.0
 16    -4.40    0.00    0.00    0.00     0.00    0.00      0.00      0.0
 17    -5.30    0.00    0.00    0.00     0.00    0.00      0.00      0.0
 18    -5.70    0.00    0.00    0.00     0.00    0.00      0.00      0.0
 19    -6.30    0.00    0.00    0.00     0.00    0.00      0.00      0.0
 20    -6.70    0.00    0.00    0.00     0.00    0.00      0.00      0.0
 21    -6.80    0.00    0.00    0.00     0.00    0.00      0.00      0.0
 22    -6.90    0.00    0.00    0.00     0.00    0.00      0.00      0.0
 23    -7.40    0.00    0.00    0.00     0.00    0.00      0.00      0.0
 24    -8.20    0.00    0.00    0.00     0.00    0.00      0.00      0.0
 25    -8.90    0.00    0.00    0.00     0.00    0.00      0.00      0.0
 26    -9.60    0.00    0.00    0.00     0.00    0.00      0.00      0.0
 27   -10.70    0.00    0.00    0.00     0.00    0.00      0.00      0.0

===========================================================================
Run ID. 2_West_800DWall_anchored                             | Sheet No.
Downtown Carpark Redevelopment                               | Date:23-10-2025
800mm D-Wall - Anchored                                      | Checked :
-----------------------------------------------------------------------------
                                                              (continued)
Stage No.25  Change EI of wall to 292500 kN.m2/m run
              Allow wall to relax with new modulus value

                                            RIGHT side
                ----------------------------------------------------------
                            Effective stresses             Total  Adjusted
                        -------------------------------
 Node    Y     Water   Vertic  Active  Passive   Earth     earth     soil
 no.   coord  press.     -al   limit    limit   press.    press.  modulus
                kN/m2   kN/m2   kN/m2    kN/m2   kN/m2     kN/m2    kN/m2
 28   -11.12    0.00    0.00    0.00     0.00    0.00      0.00      0.0
                0.00    0.00    0.00     0.00    0.00      0.00    39997
 29   -12.32   12.00   10.80    2.13    81.95    5.89     17.89    39997
               12.00   10.80    0.00  1036.51  421.96    433.96   399970
 30   -13.36   22.40   22.25    0.00  1138.27  275.98    298.38   399970
```

```
 31  -14.40   32.80   33.70    0.00  1240.11  187.52   220.32   399970
 32  -15.36   42.40   44.28    0.00  1334.19  152.30   194.70   399970
 33  -16.32   52.00   54.87    0.00  1428.39   97.20   149.20   399970
 34  -16.47   53.50   56.53    0.00  1443.11  137.02   190.52   399970
 35  -16.77   56.50   59.84    0.00  1472.58  135.58   192.08   399970
 36  -20.39   92.65   99.92    0.00  1828.96  139.18   231.83   399970
 37  -24.00  128.80  140.35    0.00  2188.42  147.49   276.29   399970
 38  -28.80  176.80  194.73    0.00  2671.91  163.82   340.62   399970
 39  -33.60  224.80  250.02    0.00  3163.52  181.72   406.52   399970
 40  -38.40  272.80  306.26    0.00  3663.55  200.84   473.64   399970
 41  -41.83  307.05  346.94    0.00  4025.26  214.90   521.95   399970
 42  -45.25  341.30  388.04    0.00  4390.71  229.45   570.75   399970

Note:    110.00 a  Soil pressure at active limit
         123.45 p  Soil pressure at passive limit
          96.09 A  Arching - soil pressure below active limit
 ======================================================================TONKIN +
TAYLOR LTD                                                 | Sheet No.
Program: WALLAP  Version 6.09  Revision A60.B77.R61         | Job No. 1016043
                             Licensed from GEOSOLVE         | Made by :  rxsw
Data filename/Run ID: 2_West_800DWall_anchored              |
Downtown Carpark Redevelopment                              | Date:23-10-2025
800mm D-Wall - Anchored                                     | Checked :
-----------------------------------------------------------------------------
                                                      Units: kN,m
```

Stage No.25 Change EI of wall to 292500kN.m2/m run



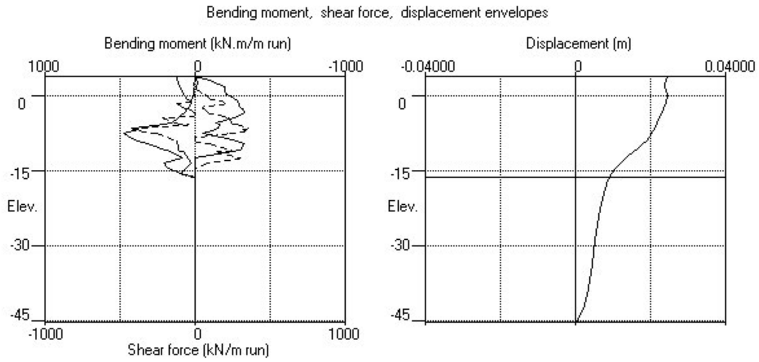
```
=========================================================================TONKIN +
TAYLOR LTD                                         | Sheet No.
Program: WALLAP  Version 6.09  Revision A60.B77.R61         | Job No. 1016043
                             Licensed from GEOSOLVE         | Made by :  rxsw
Data filename/Run ID: 2_West_800DWall_anchored              |
Downtown Carpark Redevelopment                              | Date:23-10-2025
800mm D-Wall - Anchored                                     | Checked :
------------------------------------------------------------------------
                                                    Units: kN,m
Summary of results

STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method
 Factor of safety on soil strength

                               FoS for toe       Toe elev. for
                              elev. =  -16.32     FoS = 1.000
 Stage  Ground level    Prop  Factor  Moment     Toe    Wall     Direction
  No.   Act.    Pass.   Elev.   of    equilib.  elev.  Penetr       of
                              Safety  at elev.         -ation     failure
   1    4.00    4.00    Cant. Conditions not suitable for FoS calc.
   2    4.00    4.00    Cant. Conditions not suitable for FoS calc.
   3    4.00    2.00    Cant.  6.930   -13.93    1.32    0.68     L to R
   4    4.00    2.00     2.50 19.969     n/a     1.95    0.05     L to R
   5    4.00    2.00          No analysis at this stage
   6    4.00   -2.40     2.50  6.883     n/a    -6.15    3.75     L to R
   7    4.00   -2.40          More than one prop. No FoS calc.
   All remaining stages have more than one prop - FoS calculation n/a

Minimum required Anchor Free Lengths
 This additional information would be given here if the
 Wedge Analysis option had been selected.

=======================================================================
TONKIN + TAYLOR LTD                                         | Sheet No.
Program: WALLAP  Version 6.09  Revision A60.B77.R61         | Job No. 1016043
                             Licensed from GEOSOLVE         | Made by :  rxsw
Data filename/Run ID: 2_West_800DWall_anchored              |
```

```
Downtown Carpark Redevelopment                              | Date:23-10-2025
800mm D-Wall - Anchored                                     | Checked :
------------------------------------------------------------------------
                                                    Units: kN,m
Summary of results

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall
  Analysis options
  2-D finite element model.    Active limit arching modelled.
  Soil deformations are elastic until the active or passive limit is reached
  Open Tension Crack analysis - No

  Length of wall perpendicular to section = 1000.00m
  Rigid boundaries:     Left side 60.00m from wall               Rough
                       Right side 60.00m from wall              Smooth
               Lower boundary at elevation -45.25m               Rough
                              Soil-wall interface                Smooth

Bending moment, shear force and displacement envelopes
 Node   Y      Displacement        Bending moment       Shear force
 no.  coord   maximum   minimum   maximum  minimum    maximum  minimum
                   m         m    kN.m/m   kN.m/m       kN/m      kN/m
  1    4.00    0.024    -0.000       0.0     -0.0        0.0    -131.1
  2    3.30    0.024    -0.000       2.8    -92.7        5.8    -123.9
  3    2.50    0.024    -0.000      10.6   -152.8       12.8    -109.7
  4    2.00    0.024    -0.000       3.1   -187.8        5.9    -106.8
  5    1.90    0.024    -0.000       3.7   -194.4        5.6    -105.9
  6    1.40    0.024    -0.000       6.2   -200.3        5.0    -100.4
  7    0.40    0.025    -0.000      11.3   -205.9       71.7     -80.1
  8   -0.30    0.024    -0.000      16.2   -254.5       95.5     -57.6
  9   -1.00    0.024    -0.000      23.3   -285.0      177.5     -28.4
 10   -1.40    0.024    -0.000      28.7   -292.5      198.3    -121.7
 11   -1.90    0.024    -0.000      37.0   -290.0       59.0     -92.4
 12   -2.40    0.024    -0.000      47.5   -310.3       50.8     -59.8
 13   -2.50    0.023    -0.000      49.8   -314.7       55.7     -40.7
 14   -3.20    0.023    -0.000      69.1   -326.0       89.0       0.0
 15   -3.90    0.023    -0.000      93.6   -299.8      174.0       0.0
 16   -4.40    0.022    -0.000     114.6   -255.5      220.5    -217.7
 17   -5.30    0.022    -0.000     160.5   -140.6      242.1    -125.0
 18   -5.70    0.022    -0.000     210.6   -159.0      287.5     -44.9
 19   -6.30    0.021    -0.000     404.2   -153.7      355.7    -426.4
 20   -6.70    0.021    -0.000     377.4   -131.3      320.3    -382.8
 21   -6.80    0.021     0.000     398.8   -123.6      328.5    -372.3
 22   -6.90    0.021     0.000     420.3   -115.0      333.6    -361.6
 23   -7.40    0.020     0.000     472.2    -52.8      214.6    -253.0
 24   -8.20    0.020     0.000     443.5   -174.8        0.0    -179.4
 25   -8.90    0.019     0.000     392.2   -271.3        0.2    -122.6
 26   -9.60    0.018     0.000     319.0   -324.7       98.7    -123.3
 27  -10.70    0.016     0.000     203.6   -296.7      237.8    -116.4
 28  -11.12    0.015     0.000     165.9   -247.5      146.3     -83.4
 29  -12.32    0.013     0.000      87.9     -0.2      302.0     -50.0
 30  -13.36    0.012     0.000     211.8     -0.1       76.6     -29.6
 31  -14.40    0.011     0.000     184.6     -0.1        0.0     -58.9
 32  -15.36    0.010     0.000      99.7     -0.0        0.0     -96.1
 33  -16.32    0.009     0.000       0.0     -0.0        0.0     -14.0
 34  -16.47    0.009     0.000       0.0      0.0        0.0       0.0
 35  -16.77    0.009     0.000       0.0      0.0        0.0       0.0
 36  -20.39    0.007     0.000       0.0      0.0        0.2       0.0
 37  -24.00    0.006     0.000       0.0      0.0        0.4       0.0
 38  -28.80    0.005     0.000       0.0      0.0        0.7       0.0
 39  -33.60    0.004     0.000       0.0      0.0        1.0       0.0
 40  -38.40    0.003     0.000       0.0      0.0        0.9       0.0
 41  -41.83    0.002     0.000       0.0      0.0        0.7       0.0
```

```
 42  -45.25     0.000     0.000        0.0       0.0        0.0      -0.0
===========================================================================
Run ID. 2_West_800DWall_anchored                              | Sheet No.
Downtown Carpark Redevelopment                                | Date:23-10-2025
800mm D-Wall - Anchored                                       | Checked :
-----------------------------------------------------------------------------
Summary of results   (continued)

Maximum and minimum bending moment and shear force at each stage
Stage  --------- Bending moment --------   ---------- Shear force ----------
 no.   maximum   elev.   minimum   elev.   maximum   elev.   minimum   elev.
        kN.m/m            kN.m/m             kN/m              kN/m
  1        1.2   -5.70      -1.3   -8.20       0.3   -9.60      -2.3   -6.90
  2       29.4   -7.40      -7.1   -1.00      11.5   -5.70      -8.8   -8.90
  3      247.9   -7.40      -0.0  -16.32      61.7   -5.70     -74.0   -8.90
  4      132.9   -7.40     -65.7   -1.40      56.4   -5.70     -40.1    2.50
  5    No calculation at this stage
  6      472.2   -7.40    -292.5   -1.40     217.4   -5.70    -123.3   -9.60
  7      374.2   -7.40    -219.2   -1.00     191.6   -6.90     -99.9   -9.60
  8    No calculation at this stage
  9      443.5   -8.20    -326.0   -3.20     333.6   -6.90    -109.1    2.50
 10      385.7   -7.40    -280.4   -2.50     316.7   -6.30    -104.6    2.50
 11    No calculation at this stage
 12      404.2   -6.30    -324.7   -9.60     355.7   -6.30    -426.4   -6.30
 13      400.5   -6.30    -324.6   -9.60     354.8   -6.30    -424.2   -6.30
 14    No calculation at this stage
 15    No calculation at this stage
 16    No calculation at this stage
 17      211.8  -13.36    -226.0   -8.90     248.0  -12.32    -173.0   -7.40
 18    No calculation at this stage
 19    No calculation at this stage
 20      211.5  -13.36    -220.0   -9.60     247.9  -12.32    -179.2   -7.40
 21      211.3  -13.36    -220.9   -9.60     248.3  -12.32    -181.3   -7.40
 22      181.3  -13.36    -189.8   -9.60     221.6  -12.32    -181.3   -7.40
 23      182.9  -13.36    -197.2   -8.90     220.9  -12.32    -194.2   -7.40
 24      188.3  -13.36    -198.1   -9.60     228.2  -12.32    -186.8   -7.40
 25      142.9  -13.36    -159.1   -9.60     186.5  -12.32    -183.6   -7.40
 26      143.5  -13.36    -184.8   -9.60     212.7  -10.70    -197.5   -7.40
 27      143.5  -13.36    -190.3   -8.90     232.6  -10.70    -228.3   -7.40
 28      143.3  -13.36    -188.2   -8.90     237.2  -10.70    -222.8   -7.40
 29      143.2  -13.36    -183.9   -8.90     237.8  -10.70    -224.9   -7.40
 30      143.1  -13.36    -181.5   -8.90     237.4  -10.70    -228.2   -7.40
 31      143.1  -13.36    -180.8   -9.60     236.9  -10.70    -230.4   -7.40
 32      143.1  -13.36    -181.0   -9.60     236.7  -10.70    -231.3   -7.40
 33      143.1  -13.36    -181.4   -8.90     236.8  -10.70    -231.4   -7.40
 34      143.1  -13.36    -194.4    0.40     236.9  -10.70    -231.2   -7.40
 35      143.1  -13.36    -200.3    1.40     237.0  -10.70    -231.1   -7.40
===========================================================================
Run ID. 2_West_800DWall_anchored                              | Sheet No.
Downtown Carpark Redevelopment                                | Date:23-10-2025
800mm D-Wall - Anchored                                       | Checked :
-----------------------------------------------------------------------------
Summary of results   (continued)

Maximum and minimum displacement at each stage
Stage -------- Displacement ---------
 no.  maximum  elev.    minimum  elev.    Stage description
          m                m
  1    0.000  -20.39   -0.000    4.00    Change EI of wall to 877500kN.m2/m run
  2    0.002    4.00    0.000    4.00    Apply surcharge no.1 at elev. 4.00
  3    0.017    4.00    0.000    4.00    Excav. to elev. 2.00 on RIGHT side
  4    0.007    4.00    0.000    4.00    Install prop no.1 at elev. 2.50
  5    No calculation at this stage      Apply water pressure profile no.1
```

```
  6    0.024    4.00    0.000    4.00    Excav. to elev. -2.40 on RIGHT side
  7    0.021    4.00    0.000    4.00    Install prop no.2 at elev. -1.90
  8    No calculation at this stage      Apply water pressure profile no.2
  9    0.024    4.00    0.000    4.00    Excav. to elev. -6.80 on RIGHT side
 10    0.023    4.00    0.000    4.00    Install prop no.3 at elev. -6.30
 11    No calculation at this stage      Apply water pressure profile no.3
 12    0.022   -0.30    0.000    4.00    Excav. to elev. -12.32 on RIGHT side
 13    0.022    0.40    0.000    4.00    Fill to elev. -11.12 on RIGHT side
 14    No calculation at this stage      Install prop no.4 at elev. -10.70
 15    No calculation at this stage      Install prop no.5 at elev. -7.40
 16    No calculation at this stage      Install prop no.6 at elev. -4.40
 17    0.022   -1.40    0.000    4.00    Remove prop no.3 at elev. -6.30
 18    No calculation at this stage      Install prop no.7 at elev. -1.40
 19    No calculation at this stage      Install prop no.8 at elev. 4.00
 20    0.023   -1.40    0.000    4.00    Remove prop no.2 at elev. -1.90
 21    0.023   -1.00    0.000    4.00    Remove prop no.1 at elev. 2.50
 22    0.023   -1.00    0.000    4.00    Change EI of wall to 585000kN.m2/m run
 23    0.023   -1.00    0.000    4.00    Apply water pressure profile no.5
 24    0.023   -1.00    0.000    4.00    Apply water pressure profile no.6
 25    0.023   -0.30    0.000    4.00    Change EI of wall to 292500kN.m2/m run
 26    0.023   -0.30    0.000    4.00    Apply load no.1 at elev. -9.60
 27    0.023   -0.30    0.000    4.00    Apply load no.2 at elev. -8.20
 28    0.023   -0.30    0.000    4.00    Apply load no.3 at elev. -6.70
 29    0.023   -0.30    0.000    4.00    Apply load no.4 at elev. -5.30
 30    0.023   -1.00    0.000    4.00    Apply load no.5 at elev. -3.90
 31    0.023   -1.00    0.000    4.00    Apply load no.6 at elev. -2.40
 32    0.024   -1.00    0.000    4.00    Apply load no.7 at elev. -1.00
 33    0.024   -0.30    0.000    4.00    Apply load no.8 at elev. 0.40
 34    0.024    0.40    0.000    4.00    Apply load no.9 at elev. 1.90
 35    0.025    0.40    0.000    4.00    Apply load no.10 at elev. 3.30
===========================================================================
Run ID. 2_West_800DWall_anchored                              | Sheet No.
Downtown Carpark Redevelopment                                | Date:23-10-2025
800mm D-Wall - Anchored                                       | Checked :
-----------------------------------------------------------------------------
Summary of results   (continued)

Prop forces at each stage  (horizontal components)

Stage   -- Anchor no. 1 ---   -- Anchor no. 2 ---   -- Anchor no. 3 ---
 no.      at elev. 2.50         at elev.-1.90         at elev.-6.30
        kN/m run  kN/prop     kN/m run  kN/prop     kN/m run  kN/prop
  4       51.96    129.90        ---       ---         ---       ---
  6      111.55    278.88        ---       ---         ---       ---
  7       99.04    247.59      69.28    173.21         ---       ---
  9      113.67    284.19      99.68    249.20         ---       ---
 10      109.14    272.85      89.91    224.78      187.94    375.88
 12      105.54    263.86     103.55    258.86      782.13   1564.27
 13      105.63    264.08     103.58    258.96      778.95   1557.90
 17      103.24    258.10     107.55    268.87         ---       ---
 20      103.80    259.50        ---       ---         ---       ---

===========================================================================
Run ID. 2_West_800DWall_anchored                              | Sheet No.
Downtown Carpark Redevelopment                                | Date:23-10-2025
800mm D-Wall - Anchored                                       | Checked :
-----------------------------------------------------------------------------

Stage   --- Strut no. 4 ---   --- Strut no. 5 ---   --- Strut no. 6 ---
 no.      at elev.-10.70        at elev.-7.40         at elev.-4.40
        kN/m run  kN/prop     kN/m run  kN/prop     kN/m run  kN/prop
 17      210.37    210.37     335.47    335.47      310.15    310.15
 20      208.00    208.00     339.07    339.07      343.65    343.65
```

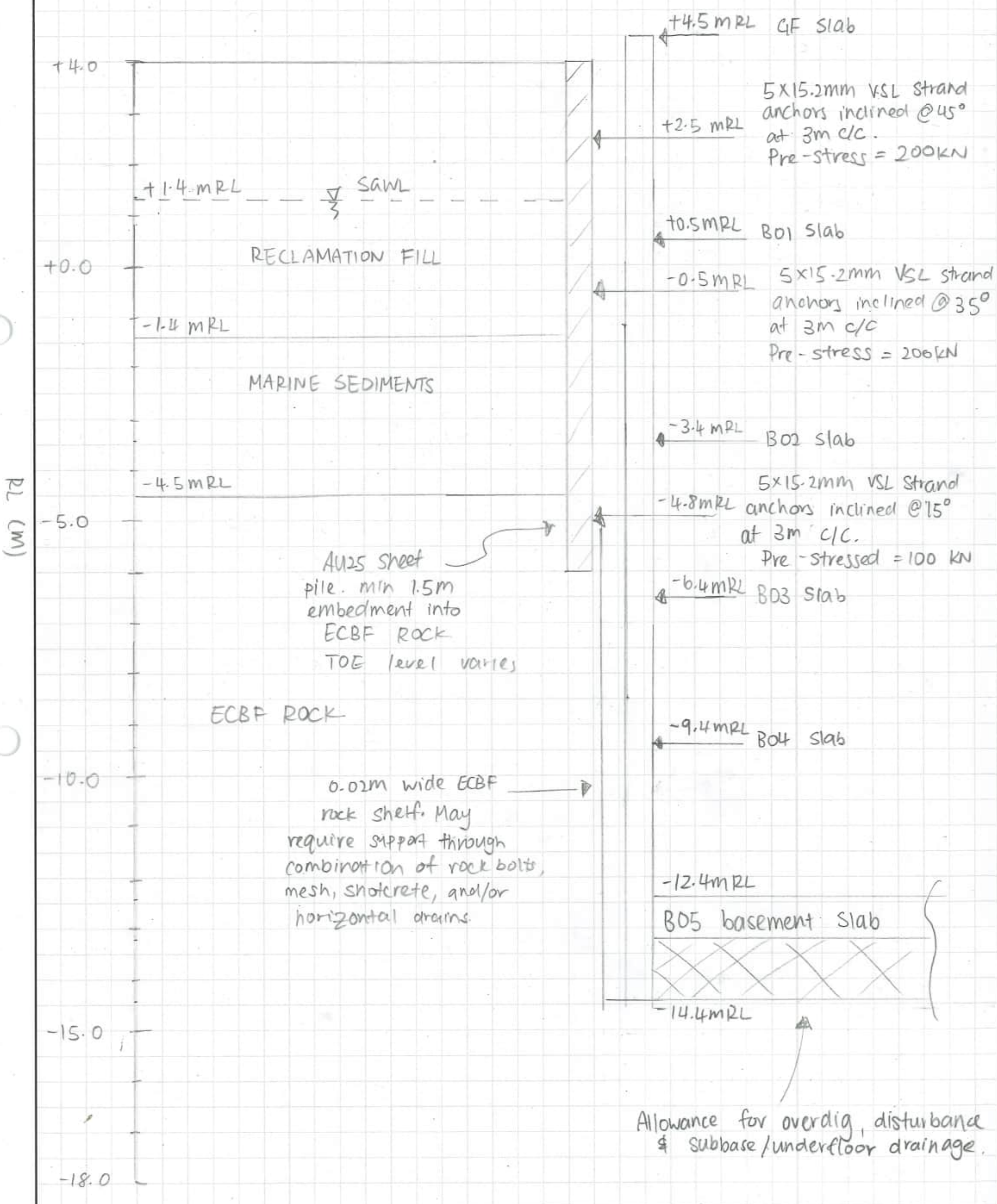
```
 21      206.49    206.49      336.37    336.37      345.22    345.22
 22      226.87    226.87      339.20    339.20      339.60    339.60
 23      256.45    256.45      358.79    358.79      360.18    360.18
 24      211.54    211.54      343.63    343.63      340.96    340.96
 25      259.04    259.04      350.97    350.97      325.23    325.23
 26      306.54    306.54      367.65    367.65      326.79    326.79
 27      339.64    339.64      396.52    396.52      331.76    331.76
 28      350.47    350.47      421.87    421.87      346.27    346.27
 29      353.65    353.65      437.33    437.33      374.76    374.76
 30      353.76    353.76      442.83    442.83      406.79    406.79
 31      353.05    353.05      443.09    443.09      426.32    426.32
 32      352.62    352.62      441.81    441.81      432.27    432.27
 33      352.48    352.48      440.19    440.19      431.07    431.07
 34      352.52    352.52      438.94    438.94      427.82    427.82
 35      352.59    352.59      438.40    438.40      425.70    425.70

===========================================================================
Run ID. 2_West_800DWall_anchored                            | Sheet No.
Downtown Carpark Redevelopment                              | Date:23-10-2025
800mm D-Wall - Anchored                                     | Checked :
-----------------------------------------------------------------------------

Stage   --- Strut no. 7 ---   --- Strut no. 8 ---
 no.       at elev.-1.40         at elev. 4.00
        kN/m run  kN/prop     kN/m run  kN/prop
 20       67.22     67.22        4.89      4.89
 21      105.30    105.30       73.32     73.32
 22      122.71    122.71       62.06     62.06
 23      147.28    147.28       67.51     67.51
 24      122.49    122.49       61.97     61.97
 25      149.03    149.03       48.48     48.48
 26      148.27    148.27       48.51     48.51
 27      146.95    146.95       48.50     48.50
 28      146.19    146.19       48.21     48.21
 29      149.23    149.23       47.44     47.44
 30      163.55    163.55       46.22     46.22
 31      195.85    195.85       45.80     45.80
 32      238.74    238.74       49.72     49.72
 33      279.71    279.71       62.65     62.65
 34      308.37    308.37       89.27     89.27
 35      319.98    319.98      131.15    131.15
 =========================================================================TONKIN +
TAYLOR LTD                                          | Sheet No.
Program: WALLAP  Version 6.09  Revision A60.B77.R61         | Job No. 1016043
                             Licensed from GEOSOLVE         | Made by :  rxsw
Data filename/Run ID: 2_West_800DWall_anchored              |
Downtown Carpark Redevelopment                              | Date:23-10-2025
800mm D-Wall - Anchored                                     | Checked :
-----------------------------------------------------------------------------
                                                       Units: kN,m
```



Tonkin+Taylor

Project: Downtown Carpark
Computed: kewu 16/04/2025
Checked: 20
Revised: 20
Checked: 20
Office: AKl
Job No: 1016043.2
File:
Sheet No.
Description:

SECTION 3 - AU25 SHEETPILE ANCHORED



SCALE 1:100

```
TONKIN + TAYLOR LTD                                         | Sheet No.
Program: WALLAP  Version 6.07  Revision A55.B74.R58         | Job No. 1016043
                             Licensed from GEOSOLVE         | Made by :  rxsw
Data filename/Run ID: 3_AU25_Sheetpiles_Anchored_no_bench_v2|
Downtown Carpark Redevelopment                              | Date:16-04-2025
AU25_Sheetpiles_Anchored (no bench)                         | Checked :
-----------------------------------------------------------------------------
                                                       Units: kN,m
INPUT DATA

SOIL PROFILE
Stratum   Elevation of    ------------------ Soil types -------------------
  no.    top of stratum    Left side                 Right side
   1          4.00        1  Fill                    1  Fill
   2         -1.40        2  Marine Sediment         2  Marine Sediment
   3         -4.50        4  ECBF                    4  ECBF

SOIL PROPERTIES
                   Bulk    Young's   At rest  Consol  Active  Passive
-- Soil type --  density  Modulus    coeff.  state.  limit    limit    Cohesion
No. Description   kN/m3  Eh,kN/m2     Ko     NC/OC    Ka       Kp       kN/m2
  (Datum elev.)          (dEh/dy ) (dKo/dy) (  Nu ) ( Kac ) (  Kpc ) ( dc/dy )
 1  Fill          16.50      6000    0.530     OC    0.318    3.543     3.000d
                                             (0.300) (1.282) ( 4.783)
 2  Marine        16.50      6000    0.530     OC    0.318    3.960     3.000d
    Sediment                                 (0.300) (1.282) ( 5.127)
 3  Tauranga      17.50     20000    0.500     OC    0.292    3.960     5.000d
    Group                                    (0.300) (1.226) ( 5.127)
 4  ECBF          21.00    400000    0.357     OC    0.186    7.532     100.0d
                                             (0.250) (0.970) ( 7.784)
 5  Weathered     19.00     40000    0.470     OC    0.268    4.448     7.000d
    ECBF                                     (0.300) (1.171) ( 5.518)

Additional soil parameters associated with Ka and Kp
                          --- parameters for Ka ---  --- parameters for Kp ---
                            Soil     Wall    Back-    Soil     Wall     Back-
------- Soil type ------- friction adhesion  fill   friction adhesion  fill
No. Description             angle    coeff.  angle    angle    coeff.   angle
 1  Fill                    28.00    0.500   0.00     28.00    0.333    0.00
 2  Marine Sediment         28.00    0.500   0.00     30.00    0.333    0.00
 3  Tauranga Group          30.00    0.500   0.00     30.00    0.333    0.00
 4  ECBF                    40.00    0.500   0.00     40.00    0.333    0.00
 5  Weathered ECBF          32.00    0.500   0.00     32.00    0.333    0.00

GROUND WATER CONDITIONS
 Density of water = 10.00 kN/m3
                                  Left side     Right side
 Initial water table elevation       1.40          1.40

 Automatic water pressure balancing at toe of wall : Yes

 Water             Left side                      Right side
 press. ------------------------------  ------------------------------
profile Point   Elev.    Piezo   Water  Point   Elev.    Piezo   Water
  no.    no.             elev.   press.  no.             elev.   press.
                  m        m     kN/m2             m       m     kN/m2
   1      1      1.40     1.40     0.0    1     -1.00    -1.00     0.0

   2      1      1.40     1.40     0.0    1     -5.00    -5.00     0.0

   3      1      1.40     1.40     0.0    1     -6.00    -6.00     0.0

WALL PROPERTIES
                         Type of structure = Fully Embedded Wall
                  Elevation of toe of wall = -6.00
             Maximum finite element length =  0.60 m
                  Youngs modulus of wall E = 2.1000E+08 kN/m2
               Moment of inertia of wall I = 5.6240E-04 m4/m run
                        (Arcelor AU25) E.I = 118104 kN.m2/m run
                      Yield Moment of wall = Not defined
```

```
STRUTS and ANCHORS
                          Cross-                      Inclin    Pre-  Strut  Allow
Prop          Prop       section    Youngs     Free   -ation  stress   or   tension
 no.  Elev. spacing       area     modulus   length   (degs)   /prop Anchor    ?   L/R
               m          sq.m      kN/m2      m                kN
 1     2.50    3.00   0.000717  2.100E+08    9.90    45.00    200.0 Anchor   n/a   R
 2    -0.50    3.00   0.000717  2.100E+08    6.40    35.00    200.0 Anchor   n/a   R
 3    -4.80    3.00   0.000717  2.100E+08    1.50    15.00    100.0 Anchor   n/a   R

SURCHARGE LOADS
Surch          Distance   Length    Width        Surcharge       Equiv. Partial
-arge            from    parallel  perpend. -----  kN/m2  -----  soil  factor/
 no.    Elev.    wall    to wall   to wall  Near edge  Far edge  type  Category
  1     4.00    2.00(L)  100.00     20.00     12.00       =       N/A     N/A

    Note: L = Left side,  R = Right side

CONSTRUCTION STAGES
Construction   Stage description
  stage no.    -------------------------------------------------------
      1        Apply surcharge no.1 at elevation 4.00
      2        Excavate to elevation 2.00 on RIGHT side
      3        Install strut or anchor no.1 at elevation 2.50
      4        Apply water pressure profile no.1
               No analysis at this stage
      5        Excavate to elevation -1.00 on RIGHT side
      6        Install strut or anchor no.2 at elevation -0.50
      7        Apply water pressure profile no.2
               No analysis at this stage
      8        Excavate to elevation -5.00 on RIGHT side
      9        Install strut or anchor no.3 at elevation -4.80
     10        Apply water pressure profile no.3
     11        Excavate to elevation -5.00 on RIGHT side
               Toe of berm at elevation -6.00
               Width of top of berm = 0.01
               Width of toe of berm = 0.02

FACTORS OF SAFETY and ANALYSIS OPTIONS

 Stability analysis:
  Method of analysis  -  Strength Factor method
  Factor on soil strength for calculating wall depth = 1.00

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

 Bending moment and displacement calculation:
  Method  -  2-D finite element model
  Open Tension Crack analysis? - No
  Active limit arching modelled?  -  Yes
  Non-linear Modulus Parameter (L) = 9.500 m

 Boundary conditions:
  Length of wall (normal to plane of analysis) = 1000.00 m

  Width of excavation on Left  side of wall  = 60.00 m
  Width of excavation on Right side of wall  = 60.00 m

  Distance to rigid boundary on Left side  = 60.00 m
  Distance to rigid boundary on Right side = 60.00 m
  Elevation of rigid lower boundary = -15.00

  Lower rigid boundary at elevation -15.00 - Rough
  Rigid boundary on Left side           - Rough
  Rigid boundary on Right side          - Rough
  Wall / soil interface                   - Smooth
```

```
OUTPUT OPTIONS

 Stage ------ Stage description ----------- ------- Output options -------
  no.                                        Displacement   Active,  Graph.
                                             Bending mom.   Passive  output
                                             Shear force   pressures
   1 Apply surcharge no.1 at elev. 4.00           No           No      No
   2 Excav. to elev. 2.00 on RIGHT side           No           No      No
   3 Install prop no.1 at elev. 2.50              No           No      No
   4 Apply water pressure profile no.1            No           No      No
   5 Excav. to elev. -1.00 on RIGHT side         Yes           No      No
   6 Install prop no.2 at elev. -0.50             No           No      No
   7 Apply water pressure profile no.2            No           No      No
   8 Excav. to elev. -5.00 on RIGHT side         Yes          Yes     Yes
   9 Install prop no.3 at elev. -4.80             No           No      No
  10 Apply water pressure profile no.3            No           No      No
  11 Excav. to elev. -5.00 on RIGHT side          No          Yes      No
   * Summary output                              Yes            -     Yes


Program WALLAP - Copyright (C) 2020 by DL Borin,  distributed by GEOSOLVE
         150 St. Alphonsus Road, London SW4 7BW, UK    www.geosolve.co.uk
```

```
Stage No. 1   Apply surcharge no.1 at elevation 4.00

STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method
 Factor of safety on soil strength

                                FoS for toe       Toe elev. for
                               elev. =    -6.00      FoS = 1.000
 Stage  Ground level    Prop   Factor  Moment      Toe    Wall    Direction
  No.   Act.    Pass.   Elev.    of    equilib.   elev.  Penetr      of
                               Safety  at elev.          -ation    failure
   1    4.00    4.00    Cant.  Conditions not suitable for FoS calc.


BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall
  Analysis options
  Length of wall perpendicular to section = 1000.00m
  2-D finite element model.    Active limit arching modelled.
  Soil deformations are elastic until the active or passive limit is reached
  Open Tension Crack analysis - No

  Rigid boundaries:     Left side 60.00 from wall        Rough boundary
                       Right side 60.00 from wall        Rough boundary
  Lower rigid boundary at elevation -15.00              Rough boundary

 Node   Y      Nett       Wall     Wall        Shear   Bending    Prop
 no.  coord   pressure    disp.   rotation     force   moment    forces
                kN/m2       m       rad.        kN/m    kN.m/m    kN/m
  1    4.00     -0.40     0.001   1.01E-05      0.0       0.0
  2    3.63     -0.91     0.001   1.02E-05     -0.2      -0.0
  3    3.25     -0.93     0.001   1.05E-05     -0.6      -0.2
  4    2.88     -0.83     0.001   1.15E-05     -0.9      -0.5
  5    2.50     -0.66     0.001   1.36E-05     -1.2      -0.9
  6    2.00     -0.34     0.001   1.87E-05     -1.4      -1.5
  7    1.40      0.06     0.001   2.87E-05     -1.5      -2.4
  8    1.00      0.30     0.001   3.80E-05     -1.5      -3.0
  9    0.60      0.53     0.001   4.92E-05     -1.3      -3.6
 10    0.05      0.83     0.001   6.73E-05     -0.9      -4.2
 11   -0.50      1.12     0.001   8.78E-05     -0.4      -4.6
 12   -1.00      1.38     0.001   1.07E-04      0.2      -4.6
 13   -1.40      1.61     0.001   1.22E-04      0.8      -4.4
 14   -1.90      1.88     0.001   1.39E-04      1.7      -3.8
 15   -2.40      2.19     0.000   1.53E-04      2.7      -2.7
 16   -3.00      2.54     0.000   1.61E-04      4.2      -0.6
 17   -3.60      2.86     0.000   1.57E-04      5.8       2.3
 18   -4.05      3.10     0.000   1.43E-04      7.1       5.2
 19   -4.50      2.75     0.000   1.16E-04      8.4       8.7
               -50.47     0.000   1.16E-04      8.4       8.7
 20   -4.80    -24.58     0.000   9.42E-05     -2.8       9.0
 21   -5.00     -8.62     0.000   7.99E-05     -6.2       7.9
 22   -5.50      1.51     0.000   5.51E-05     -7.9       3.8
 23   -6.00     23.23     0.000   4.71E-05     -1.7      -0.0
 24   -6.15     -0.02     0.000          0     -0.0       0.0
 25   -7.88      0.01     0.000          0     -0.0       0.0
 26   -9.60      0.01     0.000          0     -0.0       0.0
 27  -12.00      0.00     0.000          0      0.0       0.0
 28  -13.50      0.00     0.000          0      0.0       0.0
 29  -15.00     -0.01     0.000          0      0.0       0.0
```

```
                                                              (continued)
Stage No.1   Apply surcharge no.1 at elevation 4.00

                                         LEFT side
                             Effective stresses          Total    Adjusted
 Node   Y    Water   Vertic  Active   Passive    Earth     earth       soil
 no.  coord  press.    -al   limit     limit   pressure   pressure   modulus
              kN/m2   kN/m2   kN/m2     kN/m2    kN/m2      kN/m2     kN/m2
  1    4.00    0.00    0.00    0.00     14.35     0.00       0.00a     6000
  2    3.63    0.00    6.22    0.00     36.39     2.83       2.83      6000
  3    3.25    0.00   12.60    0.17     59.00     6.14       6.14      6000
  4    2.88    0.00   19.21    2.27     82.42     9.56       9.56      6000
  5    2.50    0.00   26.00    4.43    106.46    13.06      13.06      6000
  6    2.00    0.00   35.18    7.35    138.98    17.78      17.78      6000
  7    1.40    0.00   46.19   10.86    178.00    23.47      23.47      6000
  8    1.00    4.00   49.47   11.90    189.62    25.12      29.12      6000
  9    0.60    8.00   52.68   12.92    201.00    26.74      34.74      6000
 10    0.05   13.50   56.99   14.29    216.25    28.94      42.44      6000
 11   -0.50   19.00   61.18   15.63    231.10    31.11      50.11      6000
 12   -1.00   24.00   64.90   16.81    244.29    33.07      57.07      6000
 13   -1.40   28.00   67.83   17.74    254.67    34.63      62.63      6000
              28.00   67.83   17.74    284.01    34.63      62.63      6000
 14   -1.90   33.00   71.44   18.89    298.29    36.57      69.57      6000
 15   -2.40   38.00   74.99   20.02    312.38    38.51      76.51      6000
 16   -3.00   44.00   79.20   21.36    329.06    40.82      84.82      6000
 17   -3.60   50.00   83.36   22.69    345.53    43.10      93.10      6000
 18   -4.05   54.50   86.45   23.67    357.77    44.80      99.30      6000
 19   -4.50   59.00   89.52   24.65    369.92    46.21     105.21      6000
              59.00   89.52    0.00   1452.74     5.15      64.15    399995
 20   -4.80   62.00   92.91    0.00   1478.23    19.29      81.29    399995
 21   -5.00   64.00   95.16    0.00   1495.20    28.06      92.06    399995
 22   -5.50   69.00  100.78    0.00   1537.50    35.11     104.11    399995
 23   -6.00   74.00  106.38    0.00   1579.67    47.95     121.95    399995
 24   -6.15   75.50  108.05    0.00   1592.30    36.92     112.42    399995
 25   -7.88   92.75  127.24    0.00   1736.79    43.74     136.49    399995
 26   -9.60  110.00  146.28    0.00   1880.26    50.53     160.53    399995
 27  -12.00  134.00  172.63    0.00   2078.71    59.94     193.94    399995
 28  -13.50  149.00  189.03    0.00   2202.25    65.81     214.81    399995
 29  -15.00  164.00  205.40    0.00   2325.51    71.67     235.67    399995


                                        RIGHT side
                             Effective stresses          Total    Adjusted
 Node   Y    Water   Vertic  Active   Passive    Earth     earth       soil
 no.  coord  press.    -al   limit     limit   pressure   pressure   modulus
              kN/m2   kN/m2   kN/m2     kN/m2    kN/m2      kN/m2     kN/m2
  1    4.00    0.00    0.00    0.00     14.35     0.40       0.40      6000
  2    3.63    0.00    6.19    0.00     36.27     3.74       3.74      6000
  3    3.25    0.00   12.38    0.09     58.19     7.07       7.07      6000
  4    2.88    0.00   18.56    2.06     80.12    10.39      10.39      6000
  5    2.50    0.00   24.75    4.03    102.04    13.71      13.71      6000
  6    2.00    0.00   33.00    6.66    131.27    18.13      18.13      6000
  7    1.40    0.00   42.90    9.81    166.35    23.41      23.41      6000
  8    1.00    4.00   45.50   10.64    175.56    24.82      28.82      6000
  9    0.60    8.00   48.10   11.46    184.77    26.21      34.21      6000
 10    0.05   13.50   51.67   12.60    197.44    28.11      41.61      6000
 11   -0.50   19.00   55.25   13.74    210.10    29.99      48.99      6000
 12   -1.00   24.00   58.50   14.77    221.62    31.69      55.69      6000
 13   -1.40   28.00   61.10   15.60    230.83    33.02      61.02      6000
              28.00   61.10   15.60    257.36    33.02      61.02      6000
 14   -1.90   33.00   64.35   16.64    270.23    34.68      67.68      6000
 15   -2.40   38.00   67.60   17.67    283.10    36.32      74.32      6000
 16   -3.00   44.00   71.50   18.91    298.54    38.28      82.28      6000
```

```
                                                              (continued)
Stage No.1   Apply surcharge no.1 at elevation 4.00

                                        RIGHT side
                             Effective stresses          Total    Adjusted
 Node   Y    Water   Vertic  Active   Passive    Earth     earth       soil
 no.  coord  press.    -al   limit     limit   pressure   pressure   modulus
              kN/m2   kN/m2   kN/m2     kN/m2    kN/m2      kN/m2     kN/m2
 17   -3.60   50.00   75.40   20.15    313.99    40.24      90.24      6000
 18   -4.05   54.50   78.32   21.08    325.57    41.71      96.21      6000
 19   -4.50   59.00   81.25   22.01    337.16    43.46     102.46      6000
              59.00   81.25    0.00   1390.42    55.62     114.62    399995
 20   -4.80   62.00   84.55    0.00   1415.28    43.87     105.87    399995
 21   -5.00   64.00   86.75    0.00   1431.85    36.68     100.68    399995
 22   -5.50   69.00   92.25    0.00   1473.27    33.60     102.60    399995
 23   -6.00   74.00   97.75    0.00   1514.70    24.72      98.72    399995
 24   -6.15   75.50   99.40    0.00   1527.13    36.94     112.44    399995
 25   -7.88   92.75  118.38    0.00   1670.05    43.73     136.48    399995
 26   -9.60  110.00  137.35    0.00   1812.97    50.52     160.52    399995
 27  -12.00  134.00  163.75    0.00   2011.81    59.94     193.94    399995
 28  -13.50  149.00  180.25    0.00   2136.09    65.81     214.81    399995
 29  -15.00  164.00  196.75    0.00   2260.36    71.69     235.69    399995

Note:      0.00 a  Soil pressure at active limit
         123.45 p  Soil pressure at passive limit
```

```
TONKIN + TAYLOR LTD                                         | Sheet No.
Program: WALLAP  Version 6.07  Revision A55.B74.R58         | Job No. 1016043
                             Licensed from GEOSOLVE         | Made by :  rxsw
Data filename/Run ID: 3_AU25_Sheetpiles_Anchored_no_bench_v2|
Downtown Carpark Redevelopment                              | Date:16-04-2025
AU25_Sheetpiles_Anchored (no bench)                         | Checked :
-----------------------------------------------------------------------------
                                                       Units: kN,m
Stage No. 2   Excavate to elevation 2.00 on RIGHT side

STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method
 Factor of safety on soil strength

                                FoS for toe       Toe elev. for
                               elev. =   -6.00     FoS = 1.000
 Stage  Ground level    Prop   Factor  Moment      Toe    Wall    Direction
  No.   Act.    Pass.   Elev.    of    equilib.   elev.  Penetr       of
                               Safety  at elev.          -ation     failure
   2    4.00    2.00    Cant.   2.668    -5.32     1.23    0.77     L to R


BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall
  Analysis options
  Length of wall perpendicular to section = 1000.00m
  2-D finite element model.    Active limit arching modelled.
  Soil deformations are elastic until the active or passive limit is reached
  Open Tension Crack analysis - No

  Rigid boundaries:     Left side 60.00 from wall        Rough boundary
                       Right side 60.00 from wall        Rough boundary
  Lower rigid boundary at elevation -15.00               Rough boundary

 Node   Y      Nett       Wall      Wall      Shear   Bending   Prop
 no.  coord  pressure     disp.   rotation    force   moment    forces
                kN/m2       m       rad.       kN/m   kN.m/m     kN/m
   1   4.00      0.00     0.016   1.91E-03      0.0       0.0
   2   3.63      0.00     0.016   1.91E-03      0.0       0.1
   3   3.25      0.17     0.015   1.91E-03      0.0       0.2
   4   2.88      2.27     0.014   1.91E-03      0.5       0.3
   5   2.50      4.43     0.014   1.91E-03      1.7       0.7
   6   2.00      8.24     0.013   1.90E-03      4.9       2.3
                -6.11     0.013   1.90E-03      4.9       2.3
   7   1.40     -5.43     0.011   1.89E-03      1.4       4.2
   8   1.00     -3.09     0.011   1.87E-03     -0.3       4.3
   9   0.60     -1.02     0.010   1.86E-03     -1.1       4.0
  10   0.05      1.16     0.009   1.84E-03     -1.0       3.3
  11  -0.50      3.31     0.008   1.83E-03      0.2       2.9
  12  -1.00      5.15     0.007   1.81E-03      2.3       3.4
  13  -1.40      6.87     0.006   1.80E-03      4.7       4.7
  14  -1.90      8.58     0.005   1.77E-03      8.6       8.0
  15  -2.40     10.51     0.004   1.73E-03     13.3      13.3
  16  -3.00     12.51     0.003   1.63E-03     20.2      23.2
  17  -3.60     14.29     0.003   1.48E-03     28.3      37.6
  18  -4.05     15.72     0.002   1.31E-03     35.0      51.8
  19  -4.50     10.26     0.001   1.08E-03     40.9      69.2
              -266.11     0.001   1.08E-03     40.9      69.2
  20  -4.80   -155.39     0.001   9.08E-04    -22.3      69.5
  21  -5.00    -79.14     0.001   7.96E-04    -45.8      61.9
  22  -5.50     14.76     0.001   6.04E-04    -61.9      29.1
  23  -6.00    179.07     0.000   5.42E-04    -13.4       0.0
  24  -6.15     -0.02     0.000          0     -0.0       0.0
  25  -7.88      0.01     0.000          0     -0.0       0.0
  26  -9.60      0.01     0.000          0      0.0       0.0
  27 -12.00     -0.00     0.000          0      0.0       0.0
  28 -13.50      0.00     0.000          0      0.0       0.0
  29 -15.00     -0.02     0.000          0     -0.0       0.0
```

```
Run ID. 3_AU25_Sheetpiles_Anchored_no_bench_v2              | Sheet No.
Downtown Carpark Redevelopment                              | Date:16-04-2025
AU25_Sheetpiles_Anchored (no bench)                         | Checked :
-----------------------------------------------------------------------------
                                                              (continued)
Stage No.2   Excavate to elevation 2.00 on RIGHT side

                                         LEFT side
                             Effective stresses            Total    Adjusted
 Node   Y    Water   Vertic  Active   Passive    Earth     earth       soil
 no.  coord  press.    -al   limit     limit   pressure   pressure   modulus
              kN/m2   kN/m2   kN/m2     kN/m2    kN/m2      kN/m2     kN/m2
   1   4.00    0.00    0.00    0.00     14.35    0.00        0.00a     6000
   2   3.63    0.00    6.22    0.00     36.39    0.00        0.00a     6000
   3   3.25    0.00   12.60    0.17     59.00    0.17        0.17a     6000
   4   2.88    0.00   19.21    2.27     82.42    2.27        2.27a     6000
   5   2.50    0.00   26.00    4.43    106.46    4.43        4.43a     6000
   6   2.00    0.00   35.18    7.35    138.98    8.24        8.24      6000
   7   1.40    0.00   46.19   10.86    178.00   14.90       14.90      6000
   8   1.00    4.00   49.47   11.90    189.62   17.38       21.38      6000
   9   0.60    8.00   52.68   12.92    201.00   19.75       27.75      6000
  10   0.05   13.50   56.99   14.29    216.25   22.75       36.25      6000
  11  -0.50   19.00   61.18   15.63    231.10   25.72       44.72      6000
  12  -1.00   24.00   64.90   16.81    244.29   28.37       52.37      6000
  13  -1.40   28.00   67.83   17.74    254.67   30.61       58.61      6000
              28.00   67.83   17.74    284.01   30.61       58.61      6000
  14  -1.90   33.00   71.44   18.89    298.29   33.21       66.21      6000
  15  -2.40   38.00   74.99   20.02    312.38   35.91       73.91      6000
  16  -3.00   44.00   79.20   21.36    329.06   39.00       83.00      6000
  17  -3.60   50.00   83.36   22.69    345.53   41.99       91.99      6000
  18  -4.05   54.50   86.45   23.67    357.77   44.28       98.78      6000
  19  -4.50   59.00   89.52   24.65    369.92   42.91      101.91      6000
              59.00   89.52    0.00   1452.74    0.00       59.00a   399995
  20  -4.80   62.00   92.91    0.00   1478.23    0.00       62.00a   399995
  21  -5.00   64.00   95.16    0.00   1495.20    0.00       64.00a   399995
  22  -5.50   69.00  100.78    0.00   1537.50   36.63      105.63    399995
  23  -6.00   74.00  106.38    0.00   1579.67  179.07      253.07    399995
  24  -6.15   75.50  108.05    0.00   1592.30   31.71      107.21    399995
  25  -7.88   92.75  127.24    0.00   1736.79   38.46      131.21    399995
  26  -9.60  110.00  146.28    0.00   1880.26   45.18      155.18    399995
  27 -12.00  134.00  172.63    0.00   2078.71   54.57      188.57    399995
  28 -13.50  149.00  189.03    0.00   2202.25   60.45      209.45    399995
  29 -15.00  164.00  205.40    0.00   2325.51   66.33      230.33    399995


                                        RIGHT side
                             Effective stresses            Total    Adjusted
 Node   Y    Water   Vertic  Active   Passive    Earth     earth       soil
 no.  coord  press.    -al   limit     limit   pressure   pressure   modulus
              kN/m2   kN/m2   kN/m2     kN/m2    kN/m2      kN/m2     kN/m2
   1   4.00    0.00    0.00    0.00      0.00    0.00        0.00       0.0
   2   3.63    0.00    0.00    0.00      0.00    0.00        0.00       0.0
   3   3.25    0.00    0.00    0.00      0.00    0.00        0.00       0.0
   4   2.88    0.00    0.00    0.00      0.00    0.00        0.00       0.0
   5   2.50    0.00    0.00    0.00      0.00    0.00        0.00       0.0
   6   2.00    0.00    0.00    0.00      0.00    0.00        0.00       0.0
               0.00    0.00    0.00     14.35   14.35       14.35p     6000
   7   1.40    0.00    9.90    0.00     49.42   20.33       20.33      6000
   8   1.00    4.00   12.50    0.13     58.64   20.47       24.47      6000
   9   0.60    8.00   15.10    0.96     67.85   20.78       28.78      6000
  10   0.05   13.50   18.68    2.10     80.52   21.59       35.09      6000
  11  -0.50   19.00   22.25    3.24     93.18   22.41       41.41      6000
  12  -1.00   24.00   25.50    4.27    104.70   23.22       47.22      6000
  13  -1.40   28.00   28.10    5.10    113.92   23.74       51.74      6000
              28.00   28.10    5.10    126.68   23.74       51.74      6000
  14  -1.90   33.00   31.35    6.13    139.55   24.63       57.63      6000
  15  -2.40   38.00   34.61    7.17    152.43   25.40       63.40      6000
```

```
                                                              (continued)
Stage No.2   Excavate to elevation 2.00 on RIGHT side

                                        RIGHT side
                             Effective stresses            Total    Adjusted
 Node   Y    Water   Vertic  Active   Passive    Earth     earth       soil
 no.  coord  press.    -al   limit     limit   pressure   pressure  modulus
              kN/m2   kN/m2   kN/m2     kN/m2    kN/m2      kN/m2     kN/m2
 16   -3.00   44.00   38.51    8.41    167.89    26.49      70.49      6000
 17   -3.60   50.00   42.41    9.65    183.34    27.70      77.70      6000
 18   -4.05   54.50   45.34   10.58    194.94    28.55      83.05      6000
 19   -4.50   59.00   48.27   11.52    206.54    32.65      91.65      6000
              59.00   48.27    0.00   1142.00   266.11     325.11    400002
 20   -4.80   62.00   51.57    0.00   1166.87   155.39     217.39    400002
 21   -5.00   64.00   53.77    0.00   1183.46    79.14     143.14    400002
 22   -5.50   69.00   59.28    0.00   1224.92    21.86      90.86    400002
 23   -6.00   74.00   64.78    0.00   1266.39     0.00      74.00a   400002
 24   -6.15   75.50   66.43    0.00   1278.83    31.72     107.22    400002
 25   -7.88   92.75   85.44    0.00   1421.95    38.45     131.20    400002
 26   -9.60  110.00  104.45    0.00   1565.14    45.17     155.17    400002
 27  -12.00  134.00  130.92    0.00   1764.51    54.57     188.57    400002
 28  -13.50  149.00  147.47    0.00   1889.21    60.45     209.45    400002
 29  -15.00  164.00  164.04    0.00   2014.00    66.35     230.35    400002

Note:     74.00 a  Soil pressure at active limit
          14.35 p  Soil pressure at passive limit
```

```
                                                       Units: kN,m
Stage No. 3   Install strut or anchor no.1 at elevation 2.50

STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method
 Factor of safety on soil strength

                                FoS for toe       Toe elev. for
                               elev. =   -6.00     FoS = 1.000
 Stage  Ground level    Prop   Factor  Moment      Toe    Wall   Direction
  No.   Act.   Pass.    Elev.    of    equilib.   elev.  Penetr      of
                               Safety  at elev.          -ation    failure
   3    4.00    2.00     2.50   8.578     n/a      1.98    0.02     L to R


BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall
  Analysis options
  Length of wall perpendicular to section = 1000.00m
  2-D finite element model.    Active limit arching modelled.
  Soil deformations are elastic until the active or passive limit is reached
  Open Tension Crack analysis - No

  Rigid boundaries:     Left side 60.00 from wall        Rough boundary
                       Right side 60.00 from wall        Rough boundary
  Lower rigid boundary at elevation -15.00               Rough boundary

 Node   Y      Nett       Wall      Wall      Shear   Bending    Prop
 no.  coord  pressure     disp.   rotation    force   moment     forces
                kN/m2       m       rad.       kN/m   kN.m/m     kN/m
  1    4.00     11.82     0.005   7.24E-05     0.0       0.0
  2    3.63     11.08     0.005   7.10E-05     4.3       0.9
  3    3.25     10.30     0.005   6.42E-05     8.3       3.4
  4    2.88     11.49     0.005   4.72E-05    12.4       7.3
  5    2.50     12.62     0.005   1.53E-05    16.9      12.8     -47.1
                12.62     0.005   1.53E-05   -30.2      12.8
  6    2.00     15.12     0.005  -1.08E-05   -23.3      -0.5
                11.08     0.005  -1.08E-05   -23.3      -0.5
  7    1.40      8.60     0.005   2.20E-05   -17.4     -12.5
  8    1.00      8.02     0.005   7.48E-05   -14.1     -18.7
  9    0.60      7.73     0.005   1.46E-04   -10.9     -23.7
 10    0.05      7.68     0.004   2.68E-04    -6.7     -28.5
 11   -0.50      7.84     0.004   4.06E-04    -2.4     -31.0
 12   -1.00      8.20     0.004   5.38E-04     1.6     -31.2
 13   -1.40      8.74     0.004   6.42E-04     5.0     -29.9
 14   -1.90      9.50     0.003   7.61E-04     9.5     -26.3
 15   -2.40     10.55     0.003   8.60E-04    14.6     -20.4
 16   -3.00     11.81     0.003   9.36E-04    21.3      -9.7
 17   -3.60     13.03     0.002   9.48E-04    28.7       5.2
 18   -4.05     13.92     0.002   9.01E-04    34.8      19.4
 19   -4.50     11.85     0.001   7.95E-04    40.6      36.5
              -160.27     0.001   7.95E-04    40.6      36.5
 20   -4.80   -116.02     0.001   6.96E-04    -0.9      41.4
 21   -5.00    -75.70     0.001   6.28E-04   -20.0      38.9
 22   -5.50      0.14     0.000   5.04E-04   -38.9      19.4
 23   -6.00    119.67     0.000   4.63E-04    -9.0       0.0
 24   -6.15     -0.02     0.000          0    -0.0       0.0
 25   -7.88      0.01     0.000          0    -0.0       0.0
 26   -9.60      0.01     0.000          0     0.0       0.0
 27  -12.00     -0.00     0.000          0     0.0       0.0
 28  -13.50      0.00     0.000          0     0.0       0.0
 29  -15.00     -0.02     0.000          0    -0.0       0.0
 At elev.   2.50                 Prop force =     47.1 kN/m run (horiz.)
                                            =     66.7 kN/m run (inclined)
```

```
                                                              (continued)
Stage No.3   Install strut or anchor no.1 at elevation 2.50

                                         LEFT side
                             Effective stresses           Total    Adjusted
 Node   Y    Water   Vertic  Active   Passive    Earth     earth        soil
 no.  coord  press.    -al   limit     limit   pressure   pressure   modulus
              kN/m2   kN/m2   kN/m2     kN/m2    kN/m2      kN/m2     kN/m2
  1    4.00    0.00    0.00    0.00     14.35    11.82      11.82      6000
  2    3.63    0.00    6.22    0.00     36.39    11.08      11.08      6000
  3    3.25    0.00   12.60    0.17     59.00    10.30      10.30      6000
  4    2.88    0.00   19.21    2.27     82.42    11.49      11.49      6000
  5    2.50    0.00   26.00    4.43    106.46    12.62      12.62      6000
  6    2.00    0.00   35.18    7.35    138.98    15.12      15.12      6000
  7    1.40    0.00   46.19   10.86    178.00    20.47      20.47      6000
  8    1.00    4.00   49.47   11.90    189.62    21.83      25.83      6000
  9    0.60    8.00   52.68   12.92    201.00    23.25      31.25      6000
 10    0.05   13.50   56.99   14.29    216.25    25.32      38.82      6000
 11   -0.50   19.00   61.18   15.63    231.10    27.44      46.44      6000
 12   -1.00   24.00   64.90   16.81    244.29    29.46      53.46      6000
 13   -1.40   28.00   67.83   17.74    254.67    31.18      59.18      6000
              28.00   67.83   17.74    284.01    31.18      59.18      6000
 14   -1.90   33.00   71.44   18.89    298.29    33.35      66.35      6000
 15   -2.40   38.00   74.99   20.02    312.38    35.66      73.66      6000
 16   -3.00   44.00   79.20   21.36    329.06    38.42      82.42      6000
 17   -3.60   50.00   83.36   22.69    345.53    41.14      91.14      6000
 18   -4.05   54.50   86.45   23.67    357.77    43.16      97.66      6000
 19   -4.50   59.00   89.52   24.65    369.92    43.69     102.69      6000
              59.00   89.52    0.00   1452.74    52.15     111.15    399995
 20   -4.80   62.00   92.91    0.00   1478.23    19.28      81.28    399995
 21   -5.00   64.00   95.16    0.00   1495.20     1.36      65.36    399995
 22   -5.50   69.00  100.78    0.00   1537.50    29.00      98.00    399995
 23   -6.00   74.00  106.38    0.00   1579.67   149.10     223.10    399995
 24   -6.15   75.50  108.05    0.00   1592.30    31.48     106.98    399995
 25   -7.88   92.75  127.24    0.00   1736.79    38.30     131.05    399995
 26   -9.60  110.00  146.28    0.00   1880.26    45.08     155.08    399995
 27  -12.00  134.00  172.63    0.00   2078.71    54.49     188.49    399995
 28  -13.50  149.00  189.03    0.00   2202.25    60.37     209.37    399995
 29  -15.00  164.00  205.40    0.00   2325.51    66.23     230.23    399995


                                        RIGHT side
                             Effective stresses           Total    Adjusted
 Node   Y    Water   Vertic  Active   Passive    Earth     earth        soil
 no.  coord  press.    -al   limit     limit   pressure   pressure   modulus
              kN/m2   kN/m2   kN/m2     kN/m2    kN/m2      kN/m2     kN/m2
  1    4.00    0.00    0.00    0.00      0.00     0.00       0.00       0.0
  2    3.63    0.00    0.00    0.00      0.00     0.00       0.00       0.0
  3    3.25    0.00    0.00    0.00      0.00     0.00       0.00       0.0
  4    2.88    0.00    0.00    0.00      0.00     0.00       0.00       0.0
  5    2.50    0.00    0.00    0.00      0.00     0.00       0.00       0.0
  6    2.00    0.00    0.00    0.00      0.00     0.00       0.00       0.0
               0.00    0.00    0.00     14.35     4.05       4.05      6000
  7    1.40    0.00    9.90    0.00     49.42    11.87      11.87      6000
  8    1.00    4.00   12.50    0.13     58.64    13.81      17.81      6000
  9    0.60    8.00   15.10    0.96     67.85    15.53      23.53      6000
 10    0.05   13.50   18.68    2.10     80.52    17.64      31.14      6000
 11   -0.50   19.00   22.25    3.24     93.18    19.60      38.60      6000
 12   -1.00   24.00   25.50    4.27    104.70    21.25      45.25      6000
 13   -1.40   28.00   28.10    5.10    113.92    22.43      50.43      6000
              28.00   28.10    5.10    126.68    22.43      50.43      6000
 14   -1.90   33.00   31.35    6.13    139.55    23.85      56.85      6000
 15   -2.40   38.00   34.61    7.17    152.43    25.11      63.11      6000
```

```
                                                              (continued)
Stage No.3   Install strut or anchor no.1 at elevation 2.50

                                        RIGHT side
                             Effective stresses           Total    Adjusted
 Node   Y    Water   Vertic  Active   Passive    Earth     earth        soil
 no.  coord  press.    -al   limit     limit   pressure   pressure   modulus
              kN/m2   kN/m2   kN/m2     kN/m2    kN/m2      kN/m2     kN/m2
 16   -3.00   44.00   38.51    8.41    167.89    26.60      70.60      6000
 17   -3.60   50.00   42.41    9.65    183.34    28.11      78.11      6000
 18   -4.05   54.50   45.34   10.58    194.94    29.23      83.73      6000
 19   -4.50   59.00   48.27   11.52    206.54    31.84      90.84      6000
              59.00   48.27    0.00   1142.00   212.42     271.42    400002
 20   -4.80   62.00   51.57    0.00   1166.87   135.29     197.29    400002
 21   -5.00   64.00   53.77    0.00   1183.46    77.06     141.06    400002
 22   -5.50   69.00   59.28    0.00   1224.92    28.86      97.86    400002
 23   -6.00   74.00   64.78    0.00   1266.39    29.42     103.42    400002
 24   -6.15   75.50   66.43    0.00   1278.83    31.50     107.00    400002
 25   -7.88   92.75   85.44    0.00   1421.95    38.29     131.04    400002
 26   -9.60  110.00  104.45    0.00   1565.14    45.07     155.07    400002
 27  -12.00  134.00  130.92    0.00   1764.51    54.49     188.49    400002
 28  -13.50  149.00  147.47    0.00   1889.21    60.37     209.37    400002
 29  -15.00  164.00  164.04    0.00   2014.00    66.25     230.25    400002
```

```
                                                        Units: kN,m
Stage No. 5   Excavate to elevation -1.00 on RIGHT side

STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method
 Factor of safety on soil strength

                                FoS for toe       Toe elev. for
                               elev. =    -6.00    FoS = 1.000
 Stage  Ground level     Prop  Factor  Moment     Toe    Wall     Direction
  No.   Act.   Pass.    Elev.    of   equilib.   elev.  Penetr       of
                               Safety  at elev.          -ation    failure
   5    4.00   -1.00     2.50  3.488     n/a     -4.07    3.07      L to R


BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall
  Analysis options
  Length of wall perpendicular to section = 1000.00m
  2-D finite element model.    Active limit arching modelled.
  Soil deformations are elastic until the active or passive limit is reached
  Open Tension Crack analysis - No

  Rigid boundaries:      Left side 60.00 from wall        Rough boundary
                        Right side 60.00 from wall        Rough boundary
  Lower rigid boundary at elevation -15.00                Rough boundary

 Node    Y      Nett        Wall      Wall        Shear   Bending    Prop
 no.   coord  pressure      disp.   rotation      force    moment   forces
                 kN/m2        m       rad.         kN/m    kN.m/m    kN/m
  1     4.00      9.52      0.013  -2.54E-04       0.0       0.0
  2     3.63      7.89      0.013  -2.56E-04       3.3       0.7
  3     3.25      6.21      0.013  -2.61E-04       5.9       2.6
  4     2.88      6.62      0.013  -2.74E-04       8.3       5.3
  5     2.50      6.96      0.013  -2.96E-04      10.9       9.0     -69.0
                  6.96      0.013  -2.96E-04     -58.1       9.0
  6     2.00      8.55      0.013  -2.75E-04     -54.3     -19.0
  7     1.40     13.02      0.014  -1.01E-04     -47.8     -49.5
  8     1.00     17.26      0.014   9.64E-05     -41.7     -67.4
  9     0.60     21.76      0.013   3.50E-04     -33.9     -82.6
 10     0.05     28.42      0.013   7.70E-04     -20.1     -97.6
 11    -0.50     35.43      0.013   1.23E-03      -2.6    -104.0
 12    -1.00     42.19      0.012   1.67E-03      16.8    -100.6
                 27.84      0.012   1.67E-03      16.8    -100.6
 13    -1.40     22.44      0.011   1.99E-03      26.9     -91.7
                 21.89      0.011   1.99E-03      26.9     -91.7
 14    -1.90     23.12      0.010   2.35E-03      38.1     -75.6
 15    -2.40     25.50      0.009   2.62E-03      50.3     -53.6
 16    -3.00     28.25      0.007   2.81E-03      66.4     -18.9
 17    -3.60     30.72      0.005   2.79E-03      84.1      25.9
 18    -4.05     32.52      0.004   2.61E-03      98.3      66.8
 19    -4.50     25.74      0.003   2.27E-03     111.4     114.4
               -552.20      0.003   2.27E-03     111.4     114.4
 20    -4.80   -328.69      0.002   1.96E-03     -20.7     122.9
 21    -5.00   -163.80      0.002   1.77E-03     -69.9     112.2
 22    -5.50     -4.87      0.001   1.41E-03    -112.1      56.7
 23    -6.00    348.69      0.001   1.29E-03     -26.2       0.0
 24    -6.15     -0.02      0.001          0      -0.0       0.0
 25    -7.88      0.01      0.001          0      -0.0       0.0
 26    -9.60      0.01      0.000          0       0.0       0.0
 27   -12.00     -0.00      0.000          0       0.0       0.0
 28   -13.50      0.00      0.000          0       0.0       0.0
 29   -15.00     -0.03      0.000          0       0.0       0.0
 At elev.   2.50                 Prop force =      69.0 kN/m run (horiz.)
                                            =      97.6 kN/m run (inclined)
```

```
                                                             (continued)
Stage No.5   Excavate to elevation -1.00 on RIGHT side

                                 LEFT side
              --------------------------------------------------------------
                      Effective stresses                  Total     Adjusted
                -------------------------------------
 Node    Y    Water   Vertic  Active   Passive    Earth      earth      soil
 no.   coord  press.   -al    limit     limit   pressure   pressure   modulus
               kN/m2   kN/m2   kN/m2     kN/m2     kN/m2      kN/m2     kN/m2
  1     4.00    0.00    0.00    0.00     14.35      9.52       9.52      6000
  2     3.63    0.00    6.22    0.00     36.39      7.89       7.89      6000
  3     3.25    0.00   12.60    0.17     59.00      6.21       6.21      6000
  4     2.88    0.00   19.21    2.27     82.42      6.62       6.62      6000
  5     2.50    0.00   26.00    4.43    106.46      6.96       6.96      6000
  6     2.00    0.00   35.18    7.35    138.98      8.55       8.55      6000
  7     1.40    0.00   46.19   10.86    178.00     13.02      13.02      6000
  8     1.00    3.23   50.24   12.15    192.36     14.04      17.26      6000
  9     0.60    6.45   54.23   13.41    206.48     15.31      21.76      6000
 10     0.05   10.89   59.60   15.12    225.51     17.53      28.42      6000
 11    -0.50   15.32   64.85   16.80    244.13     20.11      35.43      6000
 12    -1.00   19.35   69.55   18.29    260.75     22.83      42.19      6000
 13    -1.40   22.58   73.25   19.47    273.87     25.45      48.03      6000
               22.58   73.25   19.47    305.47     25.45      48.03      6000
 14    -1.90   26.61   77.82   20.92    323.59     28.79      55.40      6000
 15    -2.40   30.65   82.35   22.36    341.51     32.56      63.21      6000
 16    -3.00   35.48   87.72   24.07    362.78     37.03      72.52      6000
 17    -3.60   40.32   93.04   25.77    383.85     41.35      81.68      6000
 18    -4.05   43.95   97.00   27.03    399.54     44.53      88.48      6000
 19    -4.50   47.58  100.94   28.28    415.15     43.29      90.87      6000
               47.58  100.94    0.00   1538.75      0.00      47.58a   399995
 20    -4.80   50.00  104.91    0.00   1568.62      0.00      50.00a   399995
 21    -5.00   51.61  107.55    0.00   1588.50      0.00      51.61a   399995
 22    -5.50   55.65  114.13    0.00   1638.09     22.96      78.61    399995
 23    -6.00   59.68  120.70    0.00   1687.55    348.69     408.37    399995
 24    -6.15   61.18  122.37    0.00   1700.17     28.69      89.86    399995
 25    -7.88   78.43  141.56    0.00   1844.66     35.32     113.75    399995
 26    -9.60   95.68  160.61    0.00   1988.14     41.92     137.60    399995
 27   -12.00  119.68  186.95    0.00   2186.59     51.25     170.92    399995
 28   -13.50  134.68  203.36    0.00   2310.12     57.09     191.77    399995
 29   -15.00  149.68  219.72    0.00   2433.39     62.95     212.63    399995


                                 RIGHT side
              --------------------------------------------------------------
                      Effective stresses                  Total     Adjusted
                -------------------------------------
 Node    Y    Water   Vertic  Active   Passive    Earth      earth      soil
 no.   coord  press.   -al    limit     limit   pressure   pressure   modulus
               kN/m2   kN/m2   kN/m2     kN/m2     kN/m2      kN/m2     kN/m2
  1     4.00    0.00    0.00    0.00      0.00      0.00       0.00       0.0
  2     3.63    0.00    0.00    0.00      0.00      0.00       0.00       0.0
  3     3.25    0.00    0.00    0.00      0.00      0.00       0.00       0.0
  4     2.88    0.00    0.00    0.00      0.00      0.00       0.00       0.0
  5     2.50    0.00    0.00    0.00      0.00      0.00       0.00       0.0
  6     2.00    0.00    0.00    0.00      0.00      0.00       0.00       0.0
  7     1.40    0.00    0.00    0.00      0.00      0.00       0.00       0.0
  8     1.00    0.00    0.00    0.00      0.00      0.00       0.00       0.0
  9     0.60    0.00    0.00    0.00      0.00      0.00       0.00       0.0
 10     0.05    0.00    0.00    0.00      0.00      0.00       0.00       0.0
 11    -0.50    0.00    0.00    0.00      0.00      0.00       0.00       0.0
 12    -1.00    0.00    0.00    0.00      0.00      0.00       0.00       0.0
                0.00    0.00    0.00     14.35     14.35      14.35p     6000
 13    -1.40    4.77    1.83    0.00     20.82     20.82      25.59p     6000
                4.77    1.83    0.00     22.61     21.36      26.13      6000
 14    -1.90   10.74    4.11    0.00     31.65     21.54      32.28      6000
 15    -2.40   16.71    6.39    0.00     40.69     21.00      37.71      6000
```

```
                                                              (continued)
Stage No.5   Excavate to elevation -1.00 on RIGHT side

                                        RIGHT side
                             Effective stresses            Total    Adjusted
 Node   Y    Water   Vertic  Active   Passive    Earth     earth       soil
 no.  coord  press.    -al   limit     limit   pressure   pressure   modulus
              kN/m2   kN/m2   kN/m2     kN/m2    kN/m2      kN/m2     kN/m2
 16   -3.00   23.87    9.13    0.00     51.54    20.39      44.26      6000
 17   -3.60   31.03   11.87    0.00     62.39    19.92      50.95      6000
 18   -4.05   36.40   13.93    0.59     70.53    19.56      55.96      6000
 19   -4.50   41.77   15.98    1.24     78.68    23.35      65.13      6000
              41.77   15.98    0.00    898.83   558.01     599.78    399997
 20   -4.80   45.35   18.70    0.00    919.33   333.33     378.69    399997
 21   -5.00   47.74   20.52    0.00    932.99   167.68     215.42    399997
 22   -5.50   53.71   25.05    0.00    967.16    29.77      83.48    399997
 23   -6.00   59.68   29.59    0.00   1001.34     0.00      59.68a   399997
 24   -6.15   61.18   31.24    0.00   1013.78    28.70      89.88    399997
 25   -7.88   78.43   50.25    0.00   1156.93    35.31     113.74    399997
 26   -9.60   95.68   69.27    0.00   1300.21    41.91     137.59    399997
 27  -12.00  119.68   95.78    0.00   1499.86    51.25     170.93    399997
 28  -13.50  134.68  112.37    0.00   1624.84    57.09     191.77    399997
 29  -15.00  149.68  128.99    0.00   1750.00    62.98     212.66    399997

Note:     59.68 a  Soil pressure at active limit
          25.59 p  Soil pressure at passive limit
```

```
                                                       Units: kN,m
Stage No. 6   Install strut or anchor no.2 at elevation -0.50

STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method
 Factor of safety on soil strength

                                FoS for toe       Toe elev. for
                               elev. =    -6.00    FoS = 1.000
 Stage  Ground level    Prop   Factor  Moment      Toe    Wall    Direction
  No.   Act.   Pass.    Elev.    of    equilib.   elev.  Penetr       of
                               Safety  at elev.          -ation    failure
   6    4.00   -1.00           More than one prop. No FoS calc.


BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall
  Analysis options
  Length of wall perpendicular to section = 1000.00m
  2-D finite element model.    Active limit arching modelled.
  Soil deformations are elastic until the active or passive limit is reached
  Open Tension Crack analysis - No

  Rigid boundaries:     Left side 60.00 from wall        Rough boundary
                       Right side 60.00 from wall        Rough boundary
  Lower rigid boundary at elevation -15.00               Rough boundary

 Node   Y      Nett       Wall      Wall      Shear   Bending   Prop
 no.  coord  pressure     disp.   rotation    force   moment    forces
                kN/m2       m       rad.       kN/m    kN.m/m    kN/m
  1    4.00     10.56     0.010  -1.35E-04      0.0       0.0
  2    3.63      9.31     0.010  -1.36E-04      3.7       0.8
  3    3.25      8.00     0.010  -1.42E-04      7.0       3.0
  4    2.88      8.74     0.010  -1.57E-04     10.1       6.2
  5    2.50      9.41     0.010  -1.84E-04     13.5      10.7    -60.1
                 9.41     0.010  -1.84E-04    -46.6      10.7
  6    2.00     11.37     0.010  -1.83E-04    -41.4     -11.2
  7    1.40     16.22     0.010  -6.94E-05    -33.1     -33.5
  8    1.00     20.77     0.010   6.40E-05    -25.7     -45.3
  9    0.60     25.51     0.010   2.31E-04    -16.5     -53.8
 10    0.05     32.32     0.010   4.93E-04     -0.6     -58.6
 11   -0.50     39.29     0.009   7.54E-04     19.1     -53.7    -54.6
                39.29     0.009   7.54E-04    -35.5     -53.7
 12   -1.00     45.69     0.009   1.00E-03    -14.2     -66.2
                36.00     0.009   1.00E-03    -14.2     -66.2
 13   -1.40     29.76     0.008   1.23E-03     -1.1     -69.1
                29.22     0.008   1.23E-03     -1.1     -69.1
 14   -1.90     29.07     0.008   1.52E-03     13.5     -66.0
 15   -2.40     29.86     0.007   1.78E-03     28.2     -55.6
 16   -3.00     31.10     0.006   2.00E-03     46.5     -33.4
 17   -3.60     32.38     0.005   2.09E-03     65.6       0.0
 18   -4.05     33.37     0.004   2.02E-03     80.4      32.8
 19   -4.50     28.48     0.003   1.82E-03     94.3      72.3
              -369.71     0.003   1.82E-03     94.3      72.3
 20   -4.80   -250.34     0.002   1.63E-03      1.3      83.9
 21   -5.00   -144.34     0.002   1.49E-03    -38.2      79.2
 22   -5.50    -19.07     0.001   1.23E-03    -79.1      42.0
 23   -6.00    257.93     0.001   1.14E-03    -19.3       0.0
 24   -6.15     -0.02     0.001          0     -0.0       0.0
 25   -7.88      0.01     0.001          0     -0.0       0.0
 26   -9.60      0.01     0.000          0      0.0       0.0
 27  -12.00     -0.00     0.000          0      0.0       0.0
 28  -13.50      0.00     0.000          0      0.0       0.0
```

```
------------------------------------------------------------------------------
                                                                (continued)
Stage No.6   Install strut or anchor no.2 at elevation -0.50

 Node   Y      Nett       Wall     Wall       Shear   Bending   Prop
 no.  coord  pressure    disp.   rotation     force   moment   forces
                kN/m2      m       rad.        kN/m    kN.m/m    kN/m
 29  -15.00     -0.03    0.000          0       0.0       0.0
 At elev.   2.50                Prop force =     60.1 kN/m run (horiz.)
                                           =     85.0 kN/m run (inclined)

 At elev.  -0.50                Prop force =     54.6 kN/m run (horiz.)
                                           =     66.7 kN/m run (inclined)

                               LEFT side
                     Effective stresses                 Total    Adjusted
 Node   Y     Water   Vertic  Active  Passive   Earth      earth       soil
 no.  coord  press.    -al    limit    limit   pressure  pressure   modulus
              kN/m2   kN/m2   kN/m2    kN/m2    kN/m2      kN/m2      kN/m2
  1    4.00    0.00    0.00    0.00    14.35    10.56      10.56       6000
  2    3.63    0.00    6.22    0.00    36.39     9.31       9.31       6000
  3    3.25    0.00   12.60    0.17    59.00     8.00       8.00       6000
  4    2.88    0.00   19.21    2.27    82.42     8.74       8.74       6000
  5    2.50    0.00   26.00    4.43   106.46     9.41       9.41       6000
  6    2.00    0.00   35.18    7.35   138.98    11.37      11.37       6000
  7    1.40    0.00   46.19   10.86   178.00    16.22      16.22       6000
  8    1.00    3.23   50.24   12.15   192.36    17.54      20.77       6000
  9    0.60    6.45   54.23   13.41   206.48    19.05      25.51       6000
 10    0.05   10.89   59.60   15.12   225.51    21.43      32.32       6000
 11   -0.50   15.32   64.85   16.80   244.13    23.97      39.29       6000
 12   -1.00   19.35   69.55   18.29   260.75    26.33      45.69       6000
 13   -1.40   22.58   73.25   19.47   273.87    28.42      51.00       6000
              22.58   73.25   19.47   305.47    28.42      51.00       6000
 14   -1.90   26.61   77.82   20.92   323.59    31.18      57.80       6000
 15   -2.40   30.65   82.35   22.36   341.51    34.29      64.94       6000
 16   -3.00   35.48   87.72   24.07   362.78    38.11      73.60       6000
 17   -3.60   40.32   93.04   25.77   383.85    41.93      82.25       6000
 18   -4.05   43.95   97.00   27.03   399.54    44.78      88.73       6000
 19   -4.50   47.58  100.94   28.28   415.15    44.64      92.22       6000
              47.58  100.94    0.00  1538.75    90.50     138.08     399995
 20   -4.80   50.00  104.91    0.00  1568.62    38.64      88.64     399995
 21   -5.00   51.61  107.55    0.00  1588.50     9.25      60.86     399995
 22   -5.50   55.65  114.13    0.00  1638.09    15.44      71.09     399995
 23   -6.00   59.68  120.70    0.00  1687.55   302.94     362.62     399995
 24   -6.15   61.18  122.37    0.00  1700.17    28.39      89.57     399995
 25   -7.88   78.43  141.56    0.00  1844.66    35.11     113.54     399995
 26   -9.60   95.68  160.61    0.00  1988.14    41.80     137.48     399995
 27  -12.00  119.68  186.95    0.00  2186.59    51.16     170.84     399995
 28  -13.50  134.68  203.36    0.00  2310.12    57.02     191.69     399995
 29  -15.00  149.68  219.72    0.00  2433.39    62.87     212.55     399995


                               RIGHT side
                     Effective stresses                 Total    Adjusted
 Node   Y     Water   Vertic  Active  Passive   Earth      earth       soil
 no.  coord  press.    -al    limit    limit   pressure  pressure   modulus
              kN/m2   kN/m2   kN/m2    kN/m2    kN/m2      kN/m2      kN/m2
  1    4.00    0.00    0.00    0.00     0.00     0.00       0.00        0.0
  2    3.63    0.00    0.00    0.00     0.00     0.00       0.00        0.0
  3    3.25    0.00    0.00    0.00     0.00     0.00       0.00        0.0
  4    2.88    0.00    0.00    0.00     0.00     0.00       0.00        0.0
  5    2.50    0.00    0.00    0.00     0.00     0.00       0.00        0.0
  6    2.00    0.00    0.00    0.00     0.00     0.00       0.00        0.0
  7    1.40    0.00    0.00    0.00     0.00     0.00       0.00        0.0
  8    1.00    0.00    0.00    0.00     0.00     0.00       0.00        0.0
```

```
------------------------------------------------------------------------------
                                                                (continued)
Stage No.6   Install strut or anchor no.2 at elevation -0.50

                               RIGHT side
                     Effective stresses                 Total    Adjusted
 Node   Y     Water   Vertic  Active  Passive   Earth      earth       soil
 no.  coord  press.    -al    limit    limit   pressure  pressure   modulus
              kN/m2   kN/m2   kN/m2    kN/m2    kN/m2      kN/m2      kN/m2
  9    0.60    0.00    0.00    0.00     0.00     0.00       0.00        0.0
 10    0.05    0.00    0.00    0.00     0.00     0.00       0.00        0.0
 11   -0.50    0.00    0.00    0.00     0.00     0.00       0.00        0.0
 12   -1.00    0.00    0.00    0.00     0.00     0.00       0.00        0.0
               0.00    0.00    0.00    14.35     9.68       9.68       6000
 13   -1.40    4.77    1.83    0.00    20.82    16.46      21.24       6000
               4.77    1.83    0.00    22.61    17.01      21.78       6000
 14   -1.90   10.74    4.11    0.00    31.65    17.98      28.73       6000
 15   -2.40   16.71    6.39    0.00    40.69    18.37      35.08       6000
 16   -3.00   23.87    9.13    0.00    51.54    18.63      42.50       6000
 17   -3.60   31.03   11.87    0.00    62.39    18.84      49.87       6000
 18   -4.05   36.40   13.93    0.59    70.53    18.95      55.35       6000
 19   -4.50   41.77   15.98    1.24    78.68    21.97      63.75       6000
              41.77   15.98    0.00   898.83   466.01     507.79     399997
 20   -4.80   45.35   18.70    0.00   919.33   293.63     338.98     399997
 21   -5.00   47.74   20.52    0.00   932.99   157.47     205.21     399997
 22   -5.50   53.71   25.05    0.00   967.16    36.45      90.16     399997
 23   -6.00   59.68   29.59    0.00  1001.34    45.01     104.69     399997
 24   -6.15   61.18   31.24    0.00  1013.78    28.41      89.59     399997
 25   -7.88   78.43   50.25    0.00  1156.93    35.10     113.53     399997
 26   -9.60   95.68   69.27    0.00  1300.21    41.79     137.46     399997
 27  -12.00  119.68   95.78    0.00  1499.86    51.16     170.84     399997
 28  -13.50  134.68  112.37    0.00  1624.84    57.01     191.69     399997
 29  -15.00  149.68  128.99    0.00  1750.00    62.90     212.58     399997
```

```
TONKIN + TAYLOR LTD                                          | Sheet No.
Program: WALLAP  Version 6.07  Revision A55.B74.R58          | Job No. 1016043
                             Licensed from GEOSOLVE          | Made by :  rxsw
Data filename/Run ID: 3_AU25_Sheetpiles_Anchored_no_bench_v2|
Downtown Carpark Redevelopment                               | Date:16-04-2025
AU25_Sheetpiles_Anchored (no bench)                          | Checked :
----------------------------------------------------------------------------
                                                     Units: kN,m
Stage No. 8   Excavate to elevation -5.00 on RIGHT side

STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method
 Factor of safety on soil strength

                                FoS for toe       Toe elev. for
                               elev. =    -6.00    FoS = 1.000
 Stage  Ground level    Prop   Factor  Moment      Toe    Wall     Direction
  No.   Act.    Pass.   Elev.    of    equilib.   elev.  Penetr       of
                               Safety  at elev.           -ation     failure
   8    4.00    -5.00          More than one prop. No FoS calc.


BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall
  Analysis options
  Length of wall perpendicular to section = 1000.00m
  2-D finite element model.    Active limit arching modelled.
  Soil deformations are elastic until the active or passive limit is reached
  Open Tension Crack analysis - No

  Rigid boundaries:     Left side 60.00 from wall         Rough boundary
                       Right side 60.00 from wall         Rough boundary
  Lower rigid boundary at elevation -15.00                Rough boundary

 Node    Y      Nett        Wall      Wall       Shear   Bending   Prop
 no.   coord  pressure      disp.   rotation     force   moment    forces
                 kN/m2        m        rad.       kN/m    kN.m/m    kN/m
  1     4.00     13.49      0.010  -8.91E-04      0.0       0.0
  2     3.63     11.72      0.010  -8.93E-04      4.7       1.0
  3     3.25      9.80      0.011  -9.00E-04      8.8       3.7
  4     2.88      9.97      0.011  -9.19E-04     12.5       7.8
  5     2.50     10.05      0.011  -9.52E-04     16.2      13.2     -63.9
                 10.05      0.011  -9.52E-04    -47.7      13.2
  6     2.00     11.35      0.012  -9.60E-04    -42.4      -9.2
  7     1.40     15.55      0.012  -8.56E-04    -34.3     -32.1
  8     1.00     18.19      0.013  -7.26E-04    -27.6     -44.4
  9     0.60     21.03      0.013  -5.60E-04    -19.7     -53.9
 10     0.05     25.36      0.013  -2.92E-04     -7.0     -61.3
 11    -0.50     29.71      0.013  -7.36E-06      8.2     -61.0     -75.0
                 29.71      0.013  -7.36E-06    -66.8     -61.0
 12    -1.00     33.63      0.013   3.13E-04    -50.9     -90.5
 13    -1.40     36.80      0.013   6.49E-04    -36.9    -107.9
 14    -1.90     41.21      0.012   1.13E-03    -17.3    -121.5
 15    -2.40     46.02      0.012   1.65E-03      4.5    -124.9
 16    -3.00     52.23      0.011   2.26E-03     33.9    -113.7
 17    -3.60     58.66      0.009   2.76E-03     67.2     -83.7
 18    -4.05     63.46      0.008   3.01E-03     94.7     -47.4
 19    -4.50     66.64      0.006   3.10E-03    123.9       1.8
                 14.05      0.006   3.10E-03    123.9       1.8
 20    -4.80     14.76      0.005   3.05E-03    128.3      37.1
 21    -5.00     15.24      0.005   2.96E-03    131.3      62.1
                -531.93     0.005   2.96E-03    131.3      62.1
 22    -5.50   -240.00      0.003   2.70E-03    -61.7      61.1
 23    -6.00    374.52      0.002   2.57E-03    -28.1       0.0
 24    -6.15     -0.02      0.002          0     -0.0       0.0
 25    -7.88      0.01      0.001          0     -0.0       0.0
 26    -9.60      0.01      0.001          0      0.0       0.0
 27   -12.00     -0.00      0.001          0      0.0       0.0
 28   -13.50      0.00      0.000          0      0.0       0.0
 29   -15.00     -0.03      0.000          0      0.0       0.0
 At elev.   2.50                Prop force =      63.9 kN/m run (horiz.)
                                           =      90.4 kN/m run (inclined)

 At elev.  -0.50                Prop force =      75.0 kN/m run (horiz.)
                                           =      91.5 kN/m run (inclined)
```

```
Run ID. 3_AU25_Sheetpiles_Anchored_no_bench_v2             | Sheet No.
Downtown Carpark Redevelopment                             | Date:16-04-2025
AU25_Sheetpiles_Anchored (no bench)                        | Checked :
----------------------------------------------------------------------------
                                                              (continued)
Stage No.8   Excavate to elevation -5.00 on RIGHT side

                                  LEFT side
                           Effective stresses                Total    Adjusted
 Node   Y    Water   Vertic  Active   Passive    Earth       earth      soil
 no.  coord  press.   -al    limit     limit    pressure   pressure   modulus
              kN/m2   kN/m2   kN/m2     kN/m2     kN/m2      kN/m2      kN/m2
  1    4.00   0.00    0.00    0.00     14.35     13.49      13.49       6000
  2    3.63   0.00    6.22    0.00     36.39     11.72      11.72       6000
  3    3.25   0.00   12.60    0.17     59.00      9.80       9.80       6000
  4    2.88   0.00   19.21    2.27     82.42      9.97       9.97       6000
  5    2.50   0.00   26.00    4.43    106.46     10.05      10.05       6000
  6    2.00   0.00   35.18    7.35    138.98     11.35      11.35       6000
  7    1.40   0.00   46.19   10.86    178.00     15.55      15.55       6000
  8    1.00   0.95   52.52   12.87    200.42     17.24      18.19       6000
  9    0.60   1.90   58.78   14.86    222.59     19.13      21.03       6000
 10    0.05   3.21   67.27   17.57    252.70     22.15      25.36       6000
 11   -0.50   4.52   75.65   20.23    282.39     25.19      29.71       6000
 12   -1.00   5.71   83.19   22.63    309.08     27.92      33.63       6000
 13   -1.40   6.67   89.16   24.53    330.26     30.14      36.80       6000
              6.67   89.16   24.53    368.49     30.14      36.80       6000
 14   -1.90   7.86   96.58   26.89    397.87     33.35      41.21       6000
 15   -2.40   9.05  103.95   29.24    427.04     36.97      46.02       6000
 16   -3.00  10.48  112.73   32.03    461.82     41.75      52.23       6000
 17   -3.60  11.90  121.46   34.81    496.40     46.76      58.66       6000
 18   -4.05  12.98  127.98   36.89    522.21     50.48      63.46       6000
 19   -4.50  14.05  134.48   38.96    547.95     52.59      66.64       6000
             14.05  134.48    0.00   1791.32      0.00      14.05a    399995
 20   -4.80  14.76  140.15    0.00   1834.03      0.00      14.76a    399995
 21   -5.00  15.24  143.92    0.00   1862.47      0.00      15.24a    399995
 22   -5.50  16.43  153.35    0.00   1933.47      0.00      16.43a    399995
 23   -6.00  17.62  162.76    0.00   2004.33    386.72     404.34     399995
 24   -6.15  19.12  164.43    0.00   2016.96     43.50      62.62     399995
 25   -7.88  36.37  183.62    0.00   2161.45     43.19      79.56     399995
 26   -9.60  53.62  202.67    0.00   2304.92     46.24      99.86     399995
 27  -12.00  77.62  229.01    0.00   2503.37     54.71     132.33     399995
 28  -13.50  92.62  245.41    0.00   2626.91     60.41     153.03     399995
 29  -15.00 107.62  261.78    0.00   2750.17     66.48     174.10     399995


                                 RIGHT side
                           Effective stresses                Total    Adjusted
 Node   Y    Water   Vertic  Active   Passive    Earth       earth      soil
 no.  coord  press.   -al    limit     limit    pressure   pressure   modulus
              kN/m2   kN/m2   kN/m2     kN/m2     kN/m2      kN/m2      kN/m2
  1    4.00   0.00    0.00    0.00      0.00      0.00       0.00        0.0
  2    3.63   0.00    0.00    0.00      0.00      0.00       0.00        0.0
  3    3.25   0.00    0.00    0.00      0.00      0.00       0.00        0.0
  4    2.88   0.00    0.00    0.00      0.00      0.00       0.00        0.0
  5    2.50   0.00    0.00    0.00      0.00      0.00       0.00        0.0
  6    2.00   0.00    0.00    0.00      0.00      0.00       0.00        0.0
  7    1.40   0.00    0.00    0.00      0.00      0.00       0.00        0.0
  8    1.00   0.00    0.00    0.00      0.00      0.00       0.00        0.0
  9    0.60   0.00    0.00    0.00      0.00      0.00       0.00        0.0
 10    0.05   0.00    0.00    0.00      0.00      0.00       0.00        0.0
 11   -0.50   0.00    0.00    0.00      0.00      0.00       0.00        0.0
 12   -1.00   0.00    0.00    0.00      0.00      0.00       0.00        0.0
 13   -1.40   0.00    0.00    0.00      0.00      0.00       0.00        0.0
 14   -1.90   0.00    0.00    0.00      0.00      0.00       0.00        0.0
 15   -2.40   0.00    0.00    0.00      0.00      0.00       0.00        0.0
 16   -3.00   0.00    0.00    0.00      0.00      0.00       0.00        0.0
 17   -3.60   0.00    0.00    0.00      0.00      0.00       0.00        0.0
```

```
-----------------------------------------------------------------------------
                                                              (continued)
Stage No.8   Excavate to elevation -5.00 on RIGHT side

             ----------------RIGHT side-------------------------------------
                             Effective stresses                Total    Adjusted
 Node   Y    Water   Vertic  Active   Passive    Earth      earth      soil
 no.  coord  press.   -al    limit    limit   pressure   pressure   modulus
              kN/m2   kN/m2   kN/m2    kN/m2    kN/m2      kN/m2     kN/m2
 18   -4.05    0.00    0.00    0.00      0.00     0.00       0.00       0.0
 19   -4.50    0.00    0.00    0.00      0.00     0.00       0.00       0.0
 20   -4.80    0.00    0.00    0.00      0.00     0.00       0.00       0.0
 21   -5.00    0.00    0.00    0.00      0.00     0.00       0.00       0.0
               0.00    0.00    0.00    778.45   547.17     547.17    400000
 22   -5.50    8.81    1.69    0.00    791.18   247.62     256.43    400000
 23   -6.00   17.62    3.38    0.00    803.92    12.20      29.82    400000
 24   -6.15   19.12    5.03    0.00    816.35    43.52      62.64    400000
 25   -7.88   36.37   24.01    0.00    959.31    43.18      79.55    400000
 26   -9.60   53.62   43.01    0.00   1102.40    46.23      99.85    400000
 27  -12.00   77.62   69.48    0.00   1301.78    54.71     132.33    400000
 28  -13.50   92.62   86.06    0.00   1426.64    60.40     153.02    400000
 29  -15.00  107.62  102.67    0.00   1551.74    66.51     174.13    400000

Note:     16.43 a  Soil pressure at active limit
         123.45 p  Soil pressure at passive limit
```

```
-----------------------------------------------------------------------------
                                                       Units: kN,m
Stage No. 9   Install strut or anchor no.3 at elevation -4.80

STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method
 Factor of safety on soil strength

                              FoS for toe       Toe elev. for
                             elev. =    -6.00    FoS = 1.000
 Stage  Ground level    Prop   Factor  Moment     Toe    Wall     Direction
  No.   Act.    Pass.   Elev.    of    equilib.  elev.  Penetr       of
                               Safety  at elev.         -ation    failure
   9    4.00    -5.00          More than one prop. No FoS calc.


BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall
  Analysis options
  Length of wall perpendicular to section = 1000.00m
  2-D finite element model.    Active limit arching modelled.
  Soil deformations are elastic until the active or passive limit is reached
  Open Tension Crack analysis - No

  Rigid boundaries:     Left side 60.00 from wall        Rough boundary
                       Right side 60.00 from wall        Rough boundary
  Lower rigid boundary at elevation -15.00               Rough boundary

 Node   Y       Nett       Wall      Wall       Shear   Bending    Prop
 no.  coord   pressure     disp.   rotation     force   moment    forces
                kN/m2        m        rad.       kN/m    kN.m/m     kN/m
  1    4.00     13.35      0.010  -8.57E-04       0.0       0.0
  2    3.63     11.60      0.010  -8.58E-04       4.7       1.0
  3    3.25      9.71      0.011  -8.66E-04       8.7       3.7
  4    2.88      9.90      0.011  -8.84E-04      12.4       7.7
  5    2.50     10.01      0.011  -9.17E-04      16.1      13.1      -63.8
                10.01      0.011  -9.17E-04     -47.7      13.1
  6    2.00     11.35      0.012  -9.25E-04     -42.4      -9.3
  7    1.40     15.57      0.012  -8.20E-04     -34.3     -32.2
  8    1.00     18.24      0.012  -6.90E-04     -27.5     -44.5
  9    0.60     21.10      0.013  -5.23E-04     -19.7     -54.0
 10    0.05     25.46      0.013  -2.55E-04      -6.9     -61.3
 11   -0.50     29.85      0.013   2.96E-05       8.4     -61.0      -74.1
                29.85      0.013   2.96E-05     -65.7     -61.0
 12   -1.00     33.80      0.013   3.48E-04     -49.8     -89.9
 13   -1.40     37.01      0.013   6.82E-04     -35.6    -106.8
 14   -1.90     41.46      0.012   1.16E-03     -16.0    -119.8
 15   -2.40     46.31      0.012   1.67E-03       5.9    -122.5
 16   -3.00     52.56      0.010   2.26E-03      35.6    -110.4
 17   -3.60     59.04      0.009   2.74E-03      69.1     -79.3
 18   -4.05     63.87      0.008   2.97E-03      96.7     -42.1
 19   -4.50     66.97      0.006   3.04E-03     126.2       8.1
                36.11      0.006   3.04E-03     126.2       8.1
 20   -4.80     37.31      0.005   2.97E-03     137.2      45.0      -32.2
                37.31      0.005   2.97E-03     105.0      45.0
 21   -5.00     32.26      0.005   2.88E-03     111.9      65.8
              -491.43      0.005   2.88E-03     111.9      65.8
 22   -5.50   -218.00      0.003   2.61E-03     -65.4      60.2
 23   -6.00    368.98      0.002   2.48E-03     -27.7       0.0
 24   -6.15     -0.02      0.002          0      -0.0       0.0
 25   -7.88      0.01      0.001          0      -0.0       0.0
 26   -9.60      0.01      0.001          0       0.0       0.0
 27  -12.00     -0.00      0.001          0       0.0       0.0
 28  -13.50      0.00      0.000          0       0.0       0.0
```

```
                                                              (continued)
Stage No.9   Install strut or anchor no.3 at elevation -4.80

 Node   Y      Nett       Wall      Wall      Shear   Bending   Prop
 no.  coord  pressure     disp.   rotation    force   moment    forces
                kN/m2       m       rad.       kN/m    kN.m/m     kN/m
 29  -15.00     -0.03     0.000          0      0.0       0.0
 At elev.   2.50                  Prop force =      63.8 kN/m run (horiz.)
                                             =      90.2 kN/m run (inclined)
 At elev.  -0.50                  Prop force =      74.1 kN/m run (horiz.)
                                             =      90.4 kN/m run (inclined)
 At elev.  -4.80                  Prop force =      32.2 kN/m run (horiz.)
                                             =      33.3 kN/m run (inclined)

                                         LEFT side
                             Effective stresses            Total    Adjusted
 Node   Y    Water   Vertic  Active   Passive    Earth     earth       soil
 no.  coord  press.    -al   limit     limit   pressure   pressure   modulus
               kN/m2   kN/m2   kN/m2     kN/m2    kN/m2      kN/m2    kN/m2
  1    4.00     0.00    0.00    0.00     14.35    13.35      13.35     6000
  2    3.63     0.00    6.22    0.00     36.39    11.60      11.60     6000
  3    3.25     0.00   12.60    0.17     59.00     9.71       9.71     6000
  4    2.88     0.00   19.21    2.27     82.42     9.90       9.90     6000
  5    2.50     0.00   26.00    4.43    106.46    10.01      10.01     6000
  6    2.00     0.00   35.18    7.35    138.98    11.35      11.35     6000
  7    1.40     0.00   46.19   10.86    178.00    15.57      15.57     6000
  8    1.00     0.95   52.52   12.87    200.42    17.29      18.24     6000
  9    0.60     1.90   58.78   14.86    222.59    19.20      21.10     6000
 10    0.05     3.21   67.27   17.57    252.70    22.25      25.46     6000
 11   -0.50     4.52   75.65   20.23    282.39    25.32      29.85     6000
 12   -1.00     5.71   83.19   22.63    309.08    28.09      33.80     6000
 13   -1.40     6.67   89.16   24.53    330.26    30.35      37.01     6000
                6.67   89.16   24.53    368.49    30.35      37.01     6000
 14   -1.90     7.86   96.58   26.89    397.87    33.60      41.46     6000
 15   -2.40     9.05  103.95   29.24    427.04    37.26      46.31     6000
 16   -3.00    10.48  112.73   32.03    461.82    42.09      52.56     6000
 17   -3.60    11.90  121.46   34.81    496.40    47.13      59.04     6000
 18   -4.05    12.98  127.98   36.89    522.21    50.89      63.87     6000
 19   -4.50    14.05  134.48   38.96    547.95    52.92      66.97     6000
               14.05  134.48    0.00   1791.32    22.07      36.11   399995
 20   -4.80    14.76  140.15    0.00   1834.03    22.55      37.31   399995
 21   -5.00    15.24  143.92    0.00   1862.47    17.02      32.26   399995
 22   -5.50    16.43  153.35    0.00   1933.47     8.74      25.17   399995
 23   -6.00    17.62  162.76    0.00   2004.33   382.60     400.22   399995
 24   -6.15    19.12  164.43    0.00   2016.96    42.98      62.09   399995
 25   -7.88    36.37  183.62    0.00   2161.45    42.96      79.33   399995
 26   -9.60    53.62  202.67    0.00   2304.92    46.17      99.79   399995
 27  -12.00    77.62  229.01    0.00   2503.37    54.67     132.29   399995
 28  -13.50    92.62  245.41    0.00   2626.91    60.38     153.00   399995
 29  -15.00   107.62  261.78    0.00   2750.17    66.44     174.06   399995

                                        RIGHT side
                             Effective stresses            Total    Adjusted
 Node   Y    Water   Vertic  Active   Passive    Earth     earth       soil
 no.  coord  press.    -al   limit     limit   pressure   pressure   modulus
               kN/m2   kN/m2   kN/m2     kN/m2    kN/m2      kN/m2    kN/m2
  1    4.00     0.00    0.00    0.00      0.00     0.00       0.00      0.0
  2    3.63     0.00    0.00    0.00      0.00     0.00       0.00      0.0
  3    3.25     0.00    0.00    0.00      0.00     0.00       0.00      0.0
  4    2.88     0.00    0.00    0.00      0.00     0.00       0.00      0.0
  5    2.50     0.00    0.00    0.00      0.00     0.00       0.00      0.0
  6    2.00     0.00    0.00    0.00      0.00     0.00       0.00      0.0
```

```
                                                              (continued)
Stage No.9   Install strut or anchor no.3 at elevation -4.80

                                        RIGHT side
                             Effective stresses            Total    Adjusted
 Node   Y    Water   Vertic  Active   Passive    Earth     earth       soil
 no.  coord  press.    -al   limit     limit   pressure   pressure   modulus
               kN/m2   kN/m2   kN/m2     kN/m2    kN/m2      kN/m2    kN/m2
  7    1.40     0.00    0.00    0.00      0.00     0.00       0.00      0.0
  8    1.00     0.00    0.00    0.00      0.00     0.00       0.00      0.0
  9    0.60     0.00    0.00    0.00      0.00     0.00       0.00      0.0
 10    0.05     0.00    0.00    0.00      0.00     0.00       0.00      0.0
 11   -0.50     0.00    0.00    0.00      0.00     0.00       0.00      0.0
 12   -1.00     0.00    0.00    0.00      0.00     0.00       0.00      0.0
 13   -1.40     0.00    0.00    0.00      0.00     0.00       0.00      0.0
 14   -1.90     0.00    0.00    0.00      0.00     0.00       0.00      0.0
 15   -2.40     0.00    0.00    0.00      0.00     0.00       0.00      0.0
 16   -3.00     0.00    0.00    0.00      0.00     0.00       0.00      0.0
 17   -3.60     0.00    0.00    0.00      0.00     0.00       0.00      0.0
 18   -4.05     0.00    0.00    0.00      0.00     0.00       0.00      0.0
 19   -4.50     0.00    0.00    0.00      0.00     0.00       0.00      0.0
 20   -4.80     0.00    0.00    0.00      0.00     0.00       0.00      0.0
 21   -5.00     0.00    0.00    0.00      0.00     0.00       0.00      0.0
                0.00    0.00    0.00    778.45   523.68     523.68   400000
 22   -5.50     8.81    1.69    0.00    791.18   234.37     243.18   400000
 23   -6.00    17.62    3.38    0.00    803.92    13.62      31.24   400000
 24   -6.15    19.12    5.03    0.00    816.35    43.00      62.11   400000
 25   -7.88    36.37   24.01    0.00    959.31    42.95      79.32   400000
 26   -9.60    53.62   43.01    0.00   1102.40    46.16      99.78   400000
 27  -12.00    77.62   69.48    0.00   1301.78    54.67     132.29   400000
 28  -13.50    92.62   86.06    0.00   1426.64    60.37     152.99   400000
 29  -15.00   107.62  102.67    0.00   1551.74    66.47     174.09   400000
```

```
                                                       Units: kN,m
Stage No. 10   Apply water pressure profile no.3

STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method
 Factor of safety on soil strength

                                 FoS for toe       Toe elev. for
                               elev. =    -6.00      FoS = 1.000
 Stage  Ground level    Prop   Factor  Moment      Toe    Wall     Direction
  No.   Act.    Pass.   Elev.    of    equilib.   elev.  Penetr        of
                               Safety  at elev.          -ation     failure
  10    4.00    -5.00          More than one prop. No FoS calc.


BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall
  Analysis options
  Length of wall perpendicular to section = 1000.00m
  2-D finite element model.    Active limit arching modelled.
  Soil deformations are elastic until the active or passive limit is reached
  Open Tension Crack analysis - No

  Rigid boundaries:     Left side 60.00 from wall        Rough boundary
                       Right side 60.00 from wall        Rough boundary
  Lower rigid boundary at elevation -15.00               Rough boundary

 Node    Y      Nett      Wall      Wall      Shear   Bending    Prop
 no.   coord  pressure    disp.   rotation    force   moment    forces
                 kN/m2        m       rad.     kN/m    kN.m/m     kN/m
   1    4.00     14.07     0.011  -1.18E-03      0.0      -0.0
   2    3.63     12.00     0.012  -1.18E-03      4.9       1.1
   3    3.25      9.74     0.012  -1.19E-03      9.0       3.8
   4    2.88      9.60     0.013  -1.21E-03     12.6       8.0
   5    2.50      9.38     0.013  -1.25E-03     16.1      13.4    -68.7
                  9.38     0.013  -1.25E-03    -52.5      13.4
   6    2.00     10.32     0.014  -1.25E-03    -47.6     -11.4
   7    1.40     14.17     0.014  -1.12E-03    -40.2     -37.6
   8    1.00     18.24     0.015  -9.77E-04    -33.8     -52.4
   9    0.60     22.55     0.015  -7.79E-04    -25.6     -64.3
  10    0.05     29.00     0.016  -4.56E-04    -11.4     -74.6
  11   -0.50     35.48     0.016  -1.05E-04      6.3     -76.1    -88.4
                 35.48     0.016  -1.05E-04    -82.1     -76.1
  12   -1.00     41.36     0.016   2.93E-04    -62.9    -112.4
  13   -1.40     46.12     0.016   7.10E-04    -45.4    -133.9
  14   -1.90     52.63     0.015   1.31E-03    -20.7    -150.6
  15   -2.40     59.66     0.014   1.95E-03      7.4    -154.1
  16   -3.00     68.67     0.013   2.70E-03     45.9    -138.5
  17   -3.60     78.00     0.011   3.30E-03     89.9     -98.2
  18   -4.05     84.98     0.009   3.58E-03    126.6     -49.7
  19   -4.50     90.00     0.008   3.64E-03    165.9      16.1
                 59.00     0.008   3.64E-03    165.9      16.1
  20   -4.80     62.00     0.007   3.54E-03    184.1      66.0    -75.8
                 62.00     0.007   3.54E-03    108.2      66.0
  21   -5.00     64.00     0.006   3.41E-03    120.8      88.0
               -596.55     0.006   3.41E-03    120.8      88.0
  22   -5.50   -239.99     0.004   3.06E-03    -88.3      74.4
  23   -6.00    456.31     0.003   2.91E-03    -34.2       0.0
  24   -6.15     -0.02     0.003          0     -0.0       0.0
  25   -7.88      0.01     0.002          0     -0.0       0.0
  26   -9.60      0.01     0.001          0      0.0       0.0
  27  -12.00     -0.00     0.001          0      0.0       0.0
  28  -13.50      0.00     0.001          0      0.0       0.0
```

```
                                                                (continued)
Stage No.10  Apply water pressure profile no.3

 Node    Y      Nett      Wall      Wall      Shear   Bending    Prop
 no.   coord  pressure    disp.   rotation    force   moment    forces
                 kN/m2        m       rad.     kN/m    kN.m/m     kN/m
  29  -15.00     -0.03     0.000          0      0.0       0.0
 At elev.   2.50                Prop force =     68.7 kN/m run (horiz.)
                                           =     97.1 kN/m run (inclined)
 At elev.  -0.50                Prop force =     88.4 kN/m run (horiz.)
                                           =    107.9 kN/m run (inclined)
 At elev.  -4.80                Prop force =     75.8 kN/m run (horiz.)
                                           =     78.5 kN/m run (inclined)


                                    LEFT side
                          Effective stresses                Total     Adjusted
 Node    Y     Water  Vertic  Active   Passive    Earth     earth       soil
 no.   coord  press.    -al   limit     limit   pressure  pressure    modulus
               kN/m2   kN/m2   kN/m2     kN/m2    kN/m2     kN/m2      kN/m2
   1    4.00    0.00    0.00    0.00     14.35    14.07      14.07      6000
   2    3.63    0.00    6.22    0.00     36.39    12.00      12.00      6000
   3    3.25    0.00   12.60    0.17     59.00     9.74       9.74      6000
   4    2.88    0.00   19.21    2.27     82.42     9.60       9.60      6000
   5    2.50    0.00   26.00    4.43    106.46     9.38       9.38      6000
   6    2.00    0.00   35.18    7.35    138.98    10.32      10.32      6000
   7    1.40    0.00   46.19   10.86    178.00    14.17      14.17      6000
   8    1.00    4.00   49.47   11.90    189.62    14.24      18.24      6000
   9    0.60    8.00   52.68   12.92    201.00    14.55      22.55      6000
  10    0.05   13.50   56.99   14.29    216.25    15.50      29.00      6000
  11   -0.50   19.00   61.18   15.63    231.10    16.48      35.48      6000
  12   -1.00   24.00   64.90   16.81    244.29    17.36      41.36      6000
  13   -1.40   28.00   67.83   17.74    254.67    18.12      46.12      6000
               28.00   67.83   17.74    284.01    18.12      46.12      6000
  14   -1.90   33.00   71.44   18.89    298.29    19.63      52.63      6000
  15   -2.40   38.00   74.99   20.02    312.38    21.66      59.66      6000
  16   -3.00   44.00   79.20   21.36    329.06    24.67      68.67      6000
  17   -3.60   50.00   83.36   22.69    345.53    28.00      78.00      6000
  18   -4.05   54.50   86.45   23.67    357.77    30.48      84.98      6000
  19   -4.50   59.00   89.52   24.65    369.92    31.00      90.00      6000
               59.00   89.52    0.00   1452.74     0.00      59.00a   399995
  20   -4.80   62.00   92.91    0.00   1478.23     0.00      62.00a   399995
  21   -5.00   64.00   95.16    0.00   1495.20     0.00      64.00a   399995
  22   -5.50   69.00  100.78    0.00   1537.50     0.00      69.00a   399995
  23   -6.00   74.00  106.38    0.00   1579.67   390.17     464.17    399995
  24   -6.15   75.50  108.05    0.00   1592.30     3.46      78.96    399995
  25   -7.88   92.75  127.24    0.00   1736.79     1.24      93.99    399995
  26   -9.60  110.00  146.28    0.00   1880.26     3.34     113.34    399995
  27  -12.00  134.00  172.63    0.00   2078.71    11.57     145.57    399995
  28  -13.50  149.00  189.03    0.00   2202.25    17.22     166.22    399995
  29  -15.00  164.00  205.40    0.00   2325.51    23.35     187.35    399995


                                    RIGHT side
                          Effective stresses                Total     Adjusted
 Node    Y     Water  Vertic  Active   Passive    Earth     earth       soil
 no.   coord  press.    -al   limit     limit   pressure  pressure    modulus
               kN/m2   kN/m2   kN/m2     kN/m2    kN/m2     kN/m2      kN/m2
   1    4.00    0.00    0.00    0.00      0.00     0.00       0.00       0.0
   2    3.63    0.00    0.00    0.00      0.00     0.00       0.00       0.0
   3    3.25    0.00    0.00    0.00      0.00     0.00       0.00       0.0
   4    2.88    0.00    0.00    0.00      0.00     0.00       0.00       0.0
   5    2.50    0.00    0.00    0.00      0.00     0.00       0.00       0.0
   6    2.00    0.00    0.00    0.00      0.00     0.00       0.00       0.0
```

```
Run ID. 3_AU25_Sheetpiles_Anchored_no_bench_v2              | Sheet No.
Downtown Carpark Redevelopment                              | Date:16-04-2025
AU25_Sheetpiles_Anchored (no bench)                         | Checked :
-----------------------------------------------------------------------------
                                                                (continued)
Stage No.10  Apply water pressure profile no.3

                                  RIGHT side
             -------------------------------------------------------------
                        Effective stresses
                     ------------------------------------
Node    Y     Water   Vertic  Active   Passive    Earth      Total   Adjusted
no.   coord   press.    -al   limit     limit    pressure   earth      soil
                                                           pressure  modulus
              kN/m2   kN/m2   kN/m2     kN/m2    kN/m2      kN/m2     kN/m2
  7    1.40    0.00    0.00    0.00      0.00     0.00       0.00       0.0
  8    1.00    0.00    0.00    0.00      0.00     0.00       0.00       0.0
  9    0.60    0.00    0.00    0.00      0.00     0.00       0.00       0.0
 10    0.05    0.00    0.00    0.00      0.00     0.00       0.00       0.0
 11   -0.50    0.00    0.00    0.00      0.00     0.00       0.00       0.0
 12   -1.00    0.00    0.00    0.00      0.00     0.00       0.00       0.0
 13   -1.40    0.00    0.00    0.00      0.00     0.00       0.00       0.0
 14   -1.90    0.00    0.00    0.00      0.00     0.00       0.00       0.0
 15   -2.40    0.00    0.00    0.00      0.00     0.00       0.00       0.0
 16   -3.00    0.00    0.00    0.00      0.00     0.00       0.00       0.0
 17   -3.60    0.00    0.00    0.00      0.00     0.00       0.00       0.0
 18   -4.05    0.00    0.00    0.00      0.00     0.00       0.00       0.0
 19   -4.50    0.00    0.00    0.00      0.00     0.00       0.00       0.0
 20   -4.80    0.00    0.00    0.00      0.00     0.00       0.00       0.0
 21   -5.00    0.00    0.00    0.00      0.00     0.00       0.00       0.0
               0.00    0.00    0.00    778.45   660.55     660.55    400000
 22   -5.50    0.00   10.50    0.00    857.54   308.99     308.99    400000
 23   -6.00    0.00   21.00    0.00    936.62     7.86       7.86    400000
 24   -6.15    1.50   22.65    0.00    949.05    77.48      78.98    400000
 25   -7.88   18.75   41.63    0.00   1092.02    75.23      93.98    400000
 26   -9.60   36.00   60.63    0.00   1235.10    77.33     113.33    400000
 27  -12.00   60.00   87.10    0.00   1434.48    85.57     145.57    400000
 28  -13.50   75.00  103.68    0.00   1559.35    91.21     166.21    400000
 29  -15.00   90.00  120.29    0.00   1684.44    97.37     187.37    400000

Note:     69.00 a  Soil pressure at active limit
         123.45 p  Soil pressure at passive limit
```

```
TONKIN + TAYLOR LTD                                              | Sheet No.
Program: WALLAP  Version 6.07  Revision A55.B74.R58              | Job No. 1016043
                             Licensed from GEOSOLVE              | Made by :  rxsw
Data filename/Run ID: 3_AU25_Sheetpiles_Anchored_no_bench_v2|
Downtown Carpark Redevelopment                                   | Date:16-04-2025
AU25_Sheetpiles_Anchored (no bench)                              | Checked :
--------------------------------------------------------------------------------
                                                          Units: kN,m
Stage No. 11   Excavate to elevation -5.00 on RIGHT side
              Toe of berm at elevation -6.00
              Width of top of berm = 0.01
              Width of toe of berm = 0.02

STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method
 Factor of safety on soil strength

                                  FoS for toe       Toe elev. for
                                 elev. =   -6.00     FoS = 1.000
 Stage  Ground level     Prop   Factor  Moment      Toe     Wall      Direction
  No.   Act.   Pass.    Elev.     of    equilib.   elev.   Penetr        of
                                Safety  at elev.           -ation      failure
  11    4.00   -5.00            More than one prop. No FoS calc.


BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall
  Analysis options
  Length of wall perpendicular to section = 1000.00m
  2-D finite element model.    Active limit arching modelled.
  Soil deformations are elastic until the active or passive limit is reached
  Open Tension Crack analysis - No

  Rigid boundaries:      Left side 60.00 from wall         Rough boundary
                        Right side 60.00 from wall         Rough boundary
  Lower rigid boundary at elevation -15.00                 Rough boundary

 Node    Y      Nett       Wall      Wall       Shear   Bending   Prop
 no.   coord  pressure     disp.   rotation     force   moment   forces
                kN/m2        m       rad.        kN/m    kN.m/m    kN/m
  1    4.00     14.35     0.011  -1.64E-03      0.0      -0.0
  2    3.63     13.93     0.012  -1.65E-03      5.3       1.1
  3    3.25     11.37     0.012  -1.65E-03     10.0       4.1
  4    2.88     10.95     0.013  -1.67E-03     14.2       8.8
  5    2.50     10.43     0.014  -1.71E-03     18.2      15.0     -69.8
                10.43     0.014  -1.71E-03    -51.6      15.0
  6    2.00     11.05     0.014  -1.72E-03    -46.2      -9.3
  7    1.40     14.58     0.015  -1.61E-03    -38.5     -34.5
  8    1.00     18.37     0.016  -1.47E-03    -31.9     -48.6
  9    0.60     22.41     0.017  -1.29E-03    -23.8     -59.7
 10    0.05     28.54     0.017  -9.94E-04     -9.7     -69.0
 11   -0.50     34.64     0.018  -6.71E-04      7.6     -69.7     -98.8
                34.64     0.018  -6.71E-04    -91.2     -69.7
 12   -1.00     40.10     0.018  -2.89E-04    -72.5    -110.6
 13   -1.40     44.42     0.018   1.28E-04    -55.6    -136.1
 14   -1.90     50.49     0.018   7.51E-04    -31.8    -158.1
 15   -2.40     57.00     0.017   1.44E-03     -5.0    -167.4
 16   -3.00     65.48     0.016   2.27E-03     31.8    -159.8
 17   -3.60     74.33     0.015   3.00E-03     73.7    -128.5
 18   -4.05     80.91     0.013   3.41E-03    108.6     -87.6
 19   -4.50     88.03     0.011   3.63E-03    146.7     -30.3
                59.01     0.011   3.63E-03    146.7     -30.3
 20   -4.80     62.01     0.010   3.66E-03    164.8      13.8    -191.1
                62.01     0.010   3.66E-03    -26.3      13.8
 21   -5.00     64.00     0.010   3.64E-03    -13.7       8.9
                60.95     0.010   3.64E-03    -13.7       8.9
 22   -5.50     66.69     0.008   3.63E-03     18.2      -4.4
 23   -6.00   -106.99     0.006   3.64E-03      8.1       0.0
 24   -6.15     -0.02     0.006          0      0.1       0.0
 25   -7.88      0.01     0.003          0      0.1       0.0
```

```
-----------------------------------------------------------------------------
                                                              (continued)
Stage No.11  Excavate to elevation -5.00 on RIGHT side
              Toe of berm at elevation -6.00
              Width of top of berm = 0.01
              Width of toe of berm = 0.02

 Node   Y      Nett       Wall      Wall      Shear   Bending   Prop
 no.  coord  pressure     disp.   rotation    force   moment    forces
                kN/m2       m       rad.       kN/m    kN.m/m    kN/m
 26    -9.60     0.01      0.002         0       0.1       0.0
 27   -12.00    -0.00      0.001         0       0.1       0.0
 28   -13.50     0.00      0.001         0       0.1       0.0
 29   -15.00    -0.03      0.000         0       0.1       0.0
 At elev.   2.50                 Prop force =     69.8 kN/m run (horiz.)
                                            =     98.7 kN/m run (inclined)
 At elev.  -0.50                 Prop force =     98.8 kN/m run (horiz.)
                                            =    120.6 kN/m run (inclined)
 At elev.  -4.80                 Prop force =    191.1 kN/m run (horiz.)
                                            =    197.9 kN/m run (inclined)

                                         LEFT side
                             Effective stresses            Total    Adjusted
 Node   Y    Water   Vertic  Active   Passive    Earth     earth       soil
 no.  coord  press.    -al   limit    limit    pressure   pressure   modulus
              kN/m2   kN/m2   kN/m2     kN/m2    kN/m2      kN/m2     kN/m2
  1     4.00   0.00    0.00    0.00     14.35    14.35      14.35p     6000
  2     3.63   0.00    6.22    0.00     36.39    13.93      13.93      6000
  3     3.25   0.00   12.60    0.17     59.00    11.37      11.37      6000
  4     2.88   0.00   19.21    2.27     82.42    10.95      10.95      6000
  5     2.50   0.00   26.00    4.43    106.46    10.43      10.43      6000
  6     2.00   0.00   35.18    7.35    138.98    11.05      11.05      6000
  7     1.40   0.00   46.19   10.86    178.00    14.58      14.58      6000
  8     1.00   4.00   49.47   11.90    189.62    14.37      18.37      6000
  9     0.60   8.00   52.68   12.92    201.00    14.41      22.41      6000
 10     0.05  13.50   56.99   14.29    216.25    15.04      28.54      6000
 11    -0.50  19.00   61.18   15.63    231.10    15.64      34.64      6000
 12    -1.00  24.00   64.90   16.81    244.29    16.10      40.10A     6000
 13    -1.40  28.00   67.83   17.74    254.67    16.42      44.42A     6000
              28.00   67.83   17.74    284.01    16.42      44.42A     6000
 14    -1.90  33.00   71.44   18.89    298.29    17.49      50.49A     6000
 15    -2.40  38.00   74.99   20.02    312.38    19.00      57.00A     6000
 16    -3.00  44.00   79.20   21.36    329.06    21.48      65.48      6000
 17    -3.60  50.00   83.36   22.69    345.53    24.33      74.33      6000
 18    -4.05  54.50   86.45   23.67    357.77    26.41      80.91      6000
 19    -4.50  59.00   89.52   24.65    369.92    29.03      88.03      6000
              59.00   89.52    0.00   1452.74     0.01      59.01    399995
 20    -4.80  62.00   92.91    0.00   1478.23     0.01      62.01    399995
 21    -5.00  64.00   95.16    0.00   1495.20     0.00      64.00a   399995
 22    -5.50  69.00  100.78    0.00   1537.50     0.00      69.00a   399995
 23    -6.00  74.00  106.38    0.00   1579.67     0.00      74.00a   399995
 24    -6.15  75.50  108.05    0.00   1592.30    16.34      91.84    399995
 25    -7.88  92.75  127.24    0.00   1736.79     9.57     102.32    399995
 26    -9.60 110.00  146.28    0.00   1880.26     7.36     117.36    399995
 27   -12.00 134.00  172.63    0.00   2078.71    13.69     147.69    399995
 28   -13.50 149.00  189.03    0.00   2202.25    18.57     167.57    399995
 29   -15.00 164.00  205.40    0.00   2325.51    24.55     188.55    399995
```

```
-----------------------------------------------------------------------------
                                                              (continued)
Stage No.11  Excavate to elevation -5.00 on RIGHT side
              Toe of berm at elevation -6.00
              Width of top of berm = 0.01
              Width of toe of berm = 0.02

                                        RIGHT side
                             Effective stresses            Total    Adjusted
 Node   Y    Water   Vertic  Active   Passive    Earth     earth       soil
 no.  coord  press.    -al   limit    limit    pressure   pressure   modulus
              kN/m2   kN/m2   kN/m2     kN/m2    kN/m2      kN/m2     kN/m2
  1     4.00   0.00    0.00    0.00      0.00     0.00       0.00       0.0
  2     3.63   0.00    0.00    0.00      0.00     0.00       0.00       0.0
  3     3.25   0.00    0.00    0.00      0.00     0.00       0.00       0.0
  4     2.88   0.00    0.00    0.00      0.00     0.00       0.00       0.0
  5     2.50   0.00    0.00    0.00      0.00     0.00       0.00       0.0
  6     2.00   0.00    0.00    0.00      0.00     0.00       0.00       0.0
  7     1.40   0.00    0.00    0.00      0.00     0.00       0.00       0.0
  8     1.00   0.00    0.00    0.00      0.00     0.00       0.00       0.0
  9     0.60   0.00    0.00    0.00      0.00     0.00       0.00       0.0
 10     0.05   0.00    0.00    0.00      0.00     0.00       0.00       0.0
 11    -0.50   0.00    0.00    0.00      0.00     0.00       0.00       0.0
 12    -1.00   0.00    0.00    0.00      0.00     0.00       0.00       0.0
 13    -1.40   0.00    0.00    0.00      0.00     0.00       0.00       0.0
 14    -1.90   0.00    0.00    0.00      0.00     0.00       0.00       0.0
 15    -2.40   0.00    0.00    0.00      0.00     0.00       0.00       0.0
 16    -3.00   0.00    0.00    0.00      0.00     0.00       0.00       0.0
 17    -3.60   0.00    0.00    0.00      0.00     0.00       0.00       0.0
 18    -4.05   0.00    0.00    0.00      0.00     0.00       0.00       0.0
 19    -4.50   0.00    0.00    0.00      0.00     0.00       0.00       0.0
 20    -4.80   0.00    0.00    0.00      0.00     0.00       0.00       0.0
 21    -5.00   0.00    0.00    0.00      0.00     0.00       0.00       0.0
               0.00    0.00    0.00      3.06b    3.05       3.05     400000
 22    -5.50   0.00   10.50    0.00      2.31b    2.31       2.31p   400000
 23    -6.00   0.00   21.00    0.00    180.99b  180.99     180.99p   400000
 24    -6.15   1.50   22.65    0.00    801.20b   90.36      91.86    400000
 25    -7.88  18.75   41.63    0.00    933.40b   83.56     102.31    400000
 26    -9.60  36.00   60.63    0.00   1079.96b   81.35     117.35    400000
 27   -12.00  60.00   87.10    0.00   1271.81b   87.69     147.69    400000
 28   -13.50  75.00  103.68    0.00   1401.15b   92.56     167.56    400000
 29   -15.00  90.00  120.29    0.00   1520.41b   98.58     188.58    400000

Note:     74.00 a  Soil pressure at active limit
         180.99 p  Soil pressure at passive limit
        1520.41 b  Passive limit reduced because of berm
          57.00A  Arching - soil pressure below active limit
```

Summary of results

STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method

```
 Factor of safety on soil strength

                                FoS for toe       Toe elev. for
                               elev. =   -6.00     FoS = 1.000
 Stage  Ground level    Prop   Factor  Moment      Toe    Wall     Direction
  No.   Act.   Pass.    Elev.    of    equilib.   elev.  Penetr       of
                               Safety  at elev.          -ation     failure
   1    4.00    4.00    Cant.  Conditions not suitable for FoS calc.
   2    4.00    2.00    Cant.   2.668    -5.32      1.23    0.77     L to R
   3    4.00    2.00     2.50   8.578      n/a      1.98    0.02     L to R
   4    4.00    2.00           No analysis at this stage
   5    4.00   -1.00     2.50   3.488      n/a     -4.07    3.07     L to R
   6    4.00   -1.00           More than one prop. No FoS calc.
   All remaining stages have more than one prop - FoS calculation n/a
```

Summary of results

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall

Analysis options

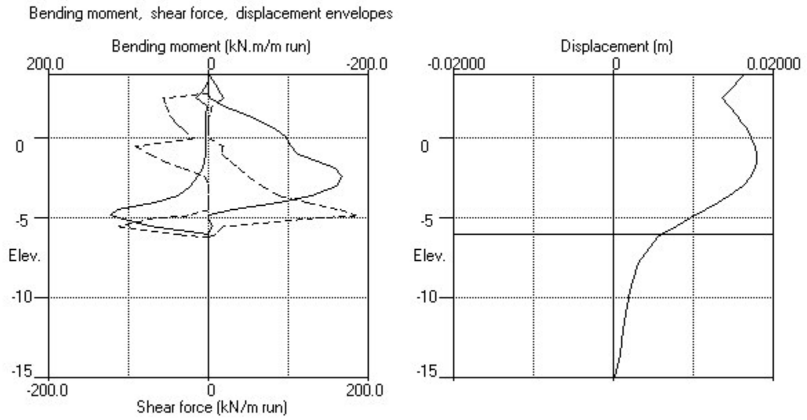
```
  Length of wall perpendicular to section = 1000.00m
  2-D finite element model.    Active limit arching modelled.
  Soil deformations are elastic until the active or passive limit is reached
  Open Tension Crack analysis - No

  Rigid boundaries:     Left side 60.00 from wall        Rough boundary
                       Right side 60.00 from wall        Rough boundary
  Lower rigid boundary at elevation -15.00               Rough boundary
```

Bending moment, shear force and displacement envelopes

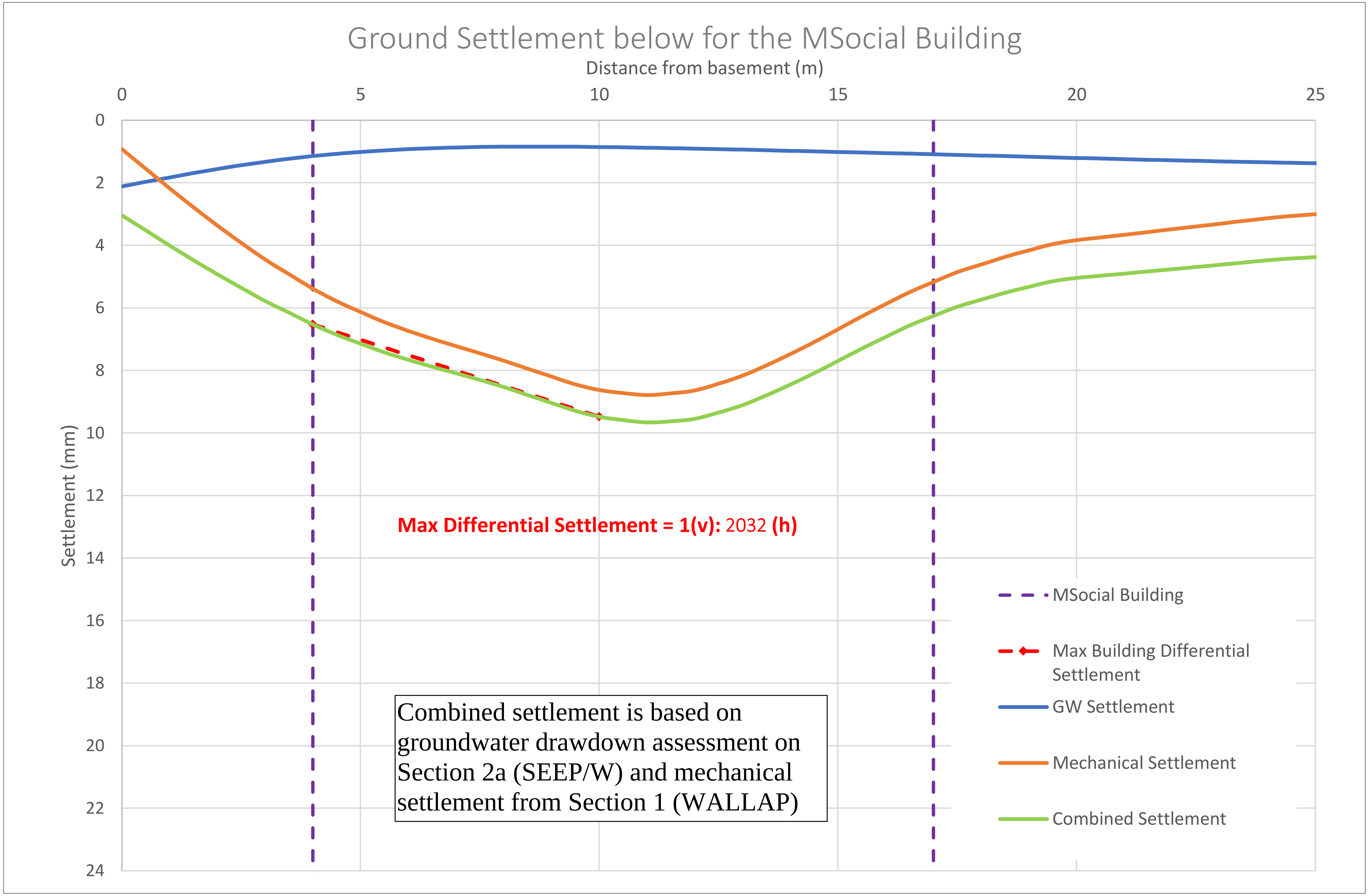
```
 Node   Y       Displacement         Bending moment       Shear force
 no.  coord   maximum   minimum    maximum   minimum    maximum   minimum
                  m         m       kN.m/m    kN.m/m      kN/m      kN/m
  1    4.00     0.016     0.000        0.0      -0.0        0.0       0.0
  2    3.63     0.016     0.000        1.1      -0.0        5.3      -0.2
  3    3.25     0.015     0.000        4.1      -0.2       10.0      -0.6
  4    2.88     0.014     0.000        8.8      -0.5       14.2      -0.9
  5    2.50     0.014     0.000       15.0      -0.9       18.2     -58.1
  6    2.00     0.014     0.000        2.3     -19.0        4.9     -54.3
  7    1.40     0.015     0.000        4.2     -49.5        1.4     -47.8
  8    1.00     0.016     0.000        4.3     -67.4        0.0     -41.7
  9    0.60     0.017     0.000        4.0     -82.6        0.0     -33.9
 10    0.05     0.017     0.000        3.3     -97.6        0.0     -20.1
 11   -0.50     0.018     0.000        2.9    -104.0       19.1     -91.2
 12   -1.00     0.018     0.000        3.4    -112.4       16.8     -72.5
 13   -1.40     0.018     0.000        4.7    -136.1       26.9     -55.6
 14   -1.90     0.018     0.000        8.0    -158.1       38.1     -31.8
 15   -2.40     0.017     0.000       13.3    -167.4       50.3      -5.0
 16   -3.00     0.016     0.000       23.2    -159.8       66.4       0.0
 17   -3.60     0.015     0.000       37.6    -128.5       89.9       0.0
 18   -4.05     0.013     0.000       66.8     -87.6      126.6       0.0
 19   -4.50     0.011     0.000      114.4     -30.3      165.9       0.0
 20   -4.80     0.010     0.000      122.9       0.0      184.1     -26.3
 21   -5.00     0.010     0.000      112.2       0.0      131.3     -69.9
 22   -5.50     0.008     0.000       74.4      -4.4       18.2    -112.1
 23   -6.00     0.006     0.000        0.0      -0.0        8.1     -34.2
 24   -6.15     0.006     0.000        0.0       0.0        0.1      -0.0
 25   -7.88     0.003     0.000        0.0       0.0        0.1      -0.0
 26   -9.60     0.002     0.000        0.0       0.0        0.1      -0.0
 27  -12.00     0.001     0.000        0.0       0.0        0.1       0.0
 28  -13.50     0.001     0.000        0.0       0.0        0.1       0.0
 29  -15.00     0.000     0.000        0.0       0.0        0.1      -0.0
```

```
Summary of results   (continued)

Maximum and minimum bending moment and shear force at each stage
Stage  --------- Bending moment --------    ---------- Shear force ----------
 no.   maximum   elev.   minimum   elev.    maximum   elev.   minimum   elev.
        kN.m/m            kN.m/m              kN/m              kN/m
  1        9.0   -4.80      -4.6   -1.00        8.4   -4.50      -7.9   -5.50
  2       69.5   -4.80       0.0    4.00       40.9   -4.50     -61.9   -5.50
  3       41.4   -4.80     -31.2   -1.00       40.6   -4.50     -38.9   -5.50
  4    No calculation at this stage
  5      122.9   -4.80    -104.0   -0.50      111.4   -4.50    -112.1   -5.50
  6       83.9   -4.80     -69.1   -1.40       94.3   -4.50     -79.1   -5.50
  7    No calculation at this stage
  8       62.1   -5.00    -124.9   -2.40      131.3   -5.00     -66.8   -0.50
  9       65.8   -5.00    -122.5   -2.40      137.2   -4.80     -65.7   -0.50
 10       88.0   -5.00    -154.1   -2.40      184.1   -4.80     -88.3   -5.50
 11       15.0    2.50    -167.4   -2.40      164.8   -4.80     -91.2   -0.50

Maximum and minimum displacement at each stage
Stage -------- Displacement ---------
 no.  maximum  elev.    minimum  elev.    Stage description
         m                 m

  1    0.001    4.00    0.000    4.00    Apply surcharge no.1 at elev. 4.00
  2    0.016    4.00    0.000    4.00    Excav. to elev. 2.00 on RIGHT side
  3    0.005    4.00    0.000    4.00    Install prop no.1 at elev. 2.50
  4    No calculation at this stage      Apply water pressure profile no.1
  5    0.014    1.00    0.000    4.00    Excav. to elev. -1.00 on RIGHT side
  6    0.010    1.00    0.000    4.00    Install prop no.2 at elev. -0.50
  7    No calculation at this stage      Apply water pressure profile no.2
  8    0.013   -0.50    0.000    4.00    Excav. to elev. -5.00 on RIGHT side
  9    0.013   -0.50    0.000    4.00    Install prop no.3 at elev. -4.80
 10    0.016   -0.50    0.000    4.00    Apply water pressure profile no.3
 11    0.018   -1.40    0.000    4.00    Excav. to elev. -5.00 on RIGHT side

Prop forces at each stage  (horizontal components)
Stage    -- Anchor no. 1 ---    -- Anchor no. 2 ---    -- Anchor no. 3 ---
 no.        at elev. 2.50          at elev.-0.50          at elev.-4.80
         kN/m run   kN/prop     kN/m run   kN/prop     kN/m run   kN/prop
  3        47.14    141.42         ---       ---          ---       ---
  5        69.01    207.03         ---       ---          ---       ---
  6        60.10    180.30       54.61    163.83          ---       ---
  8        63.95    191.85       74.96    224.89          ---       ---
  9        63.79    191.36       74.06    222.17        32.20     96.59
 10        68.65    205.95       88.39    265.18        75.85    227.54
 11        69.81    209.43       98.78    296.35       191.12    573.36
```

```
                                                     Units: kN,m
```

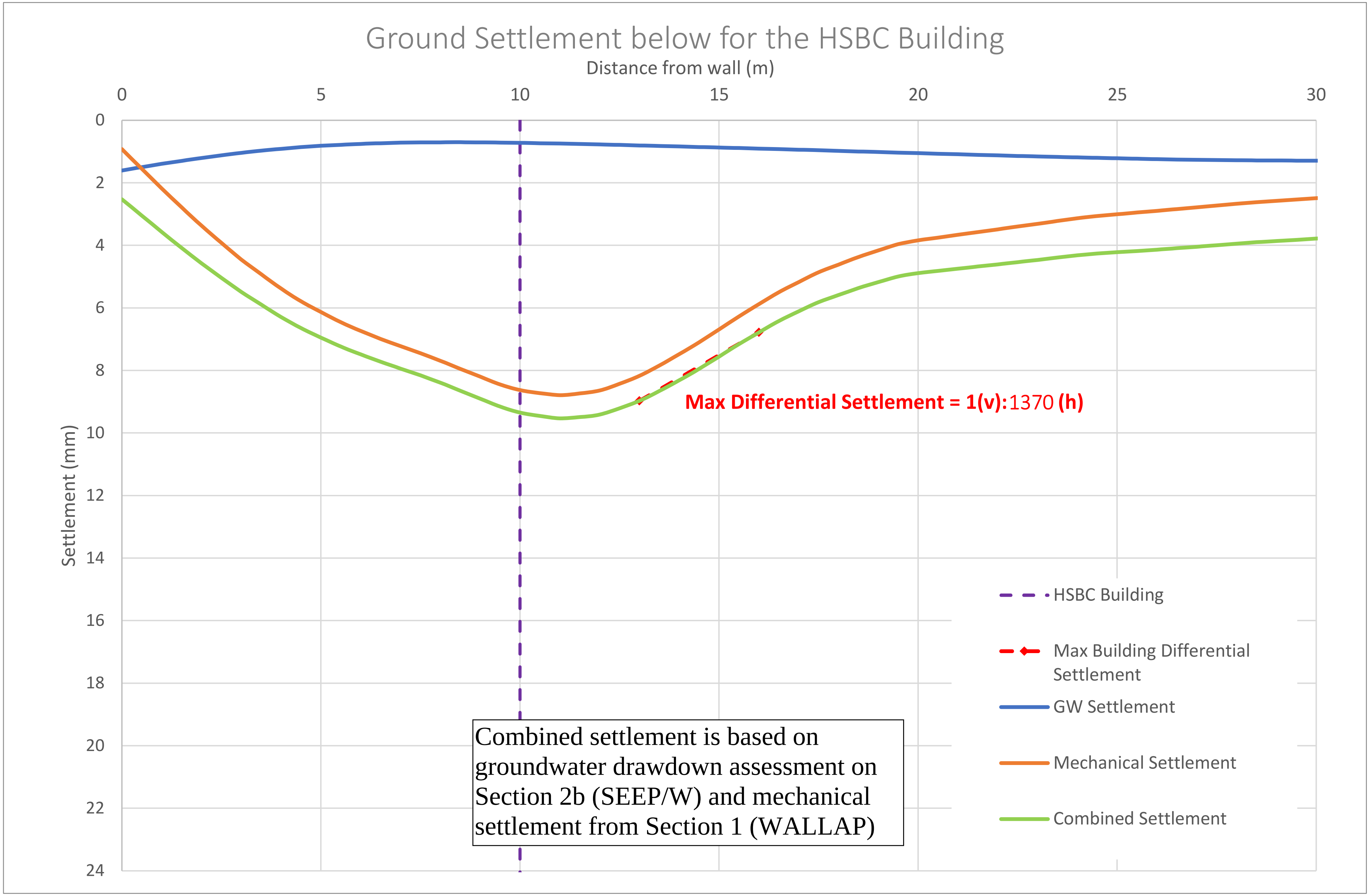


Appendix I Combined Settlement Profiles



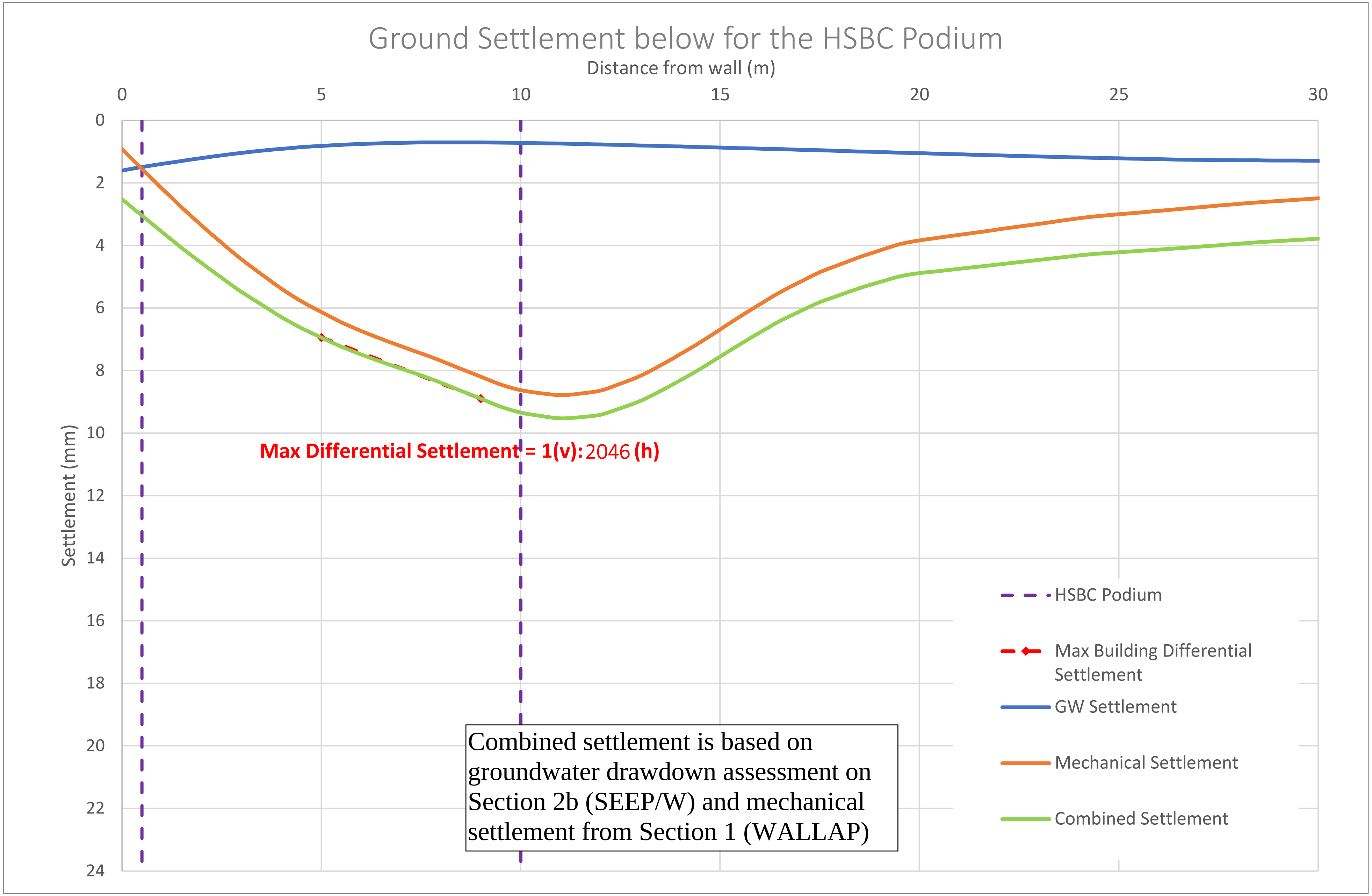
Ground Settlement below for the MSocial Building

Combined settlement is based on groundwater drawdown assessment on Section 2a (SEEP/W) and mechanical settlement from Section 1 (WALLAP)



Max Differential Settlement = 1(v):1370 **(h)**

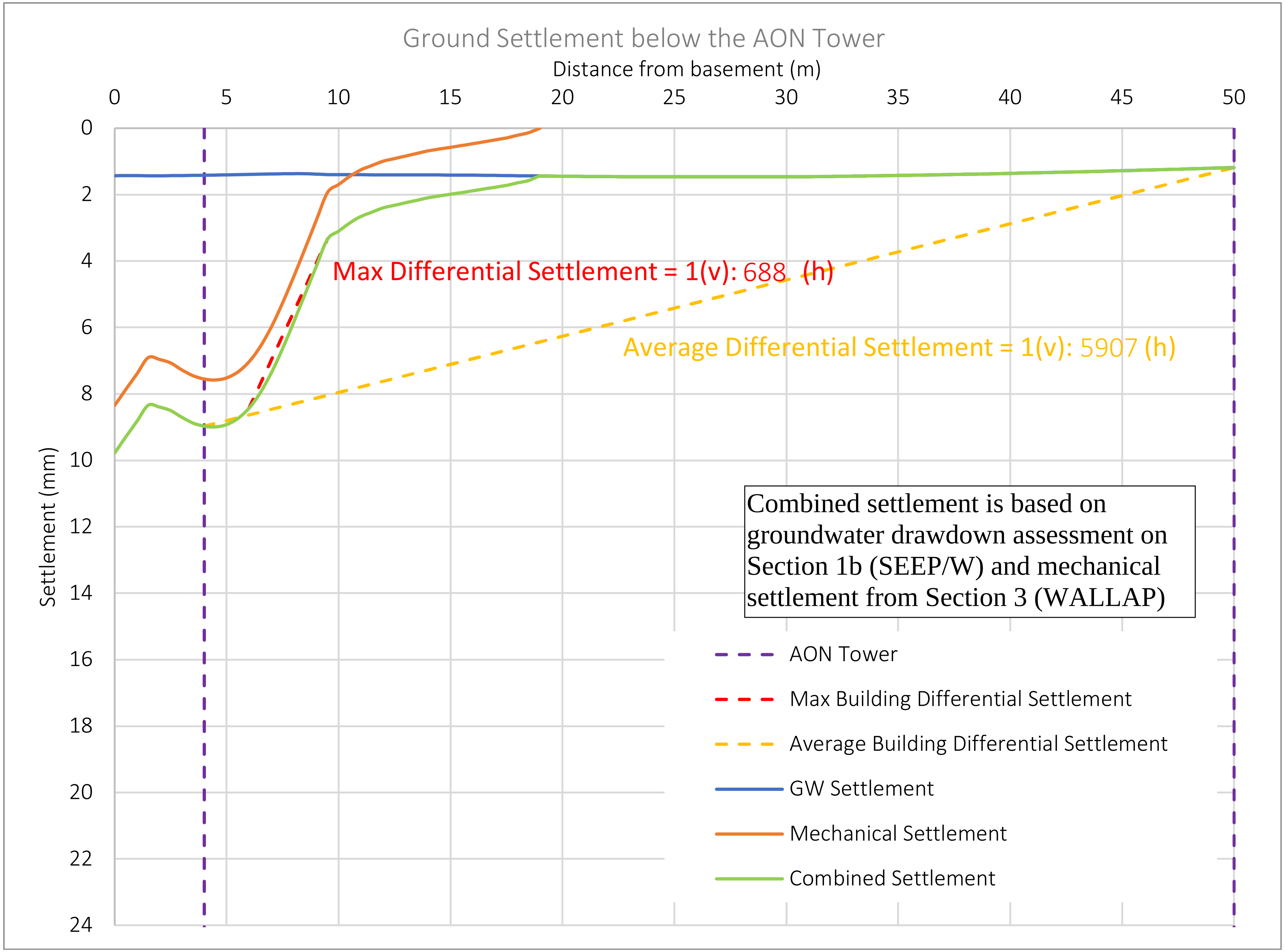
Combined settlement is based on groundwater drawdown assessment on Section 2b (SEEP/W) and mechanical settlement from Section 1 (WALLAP)

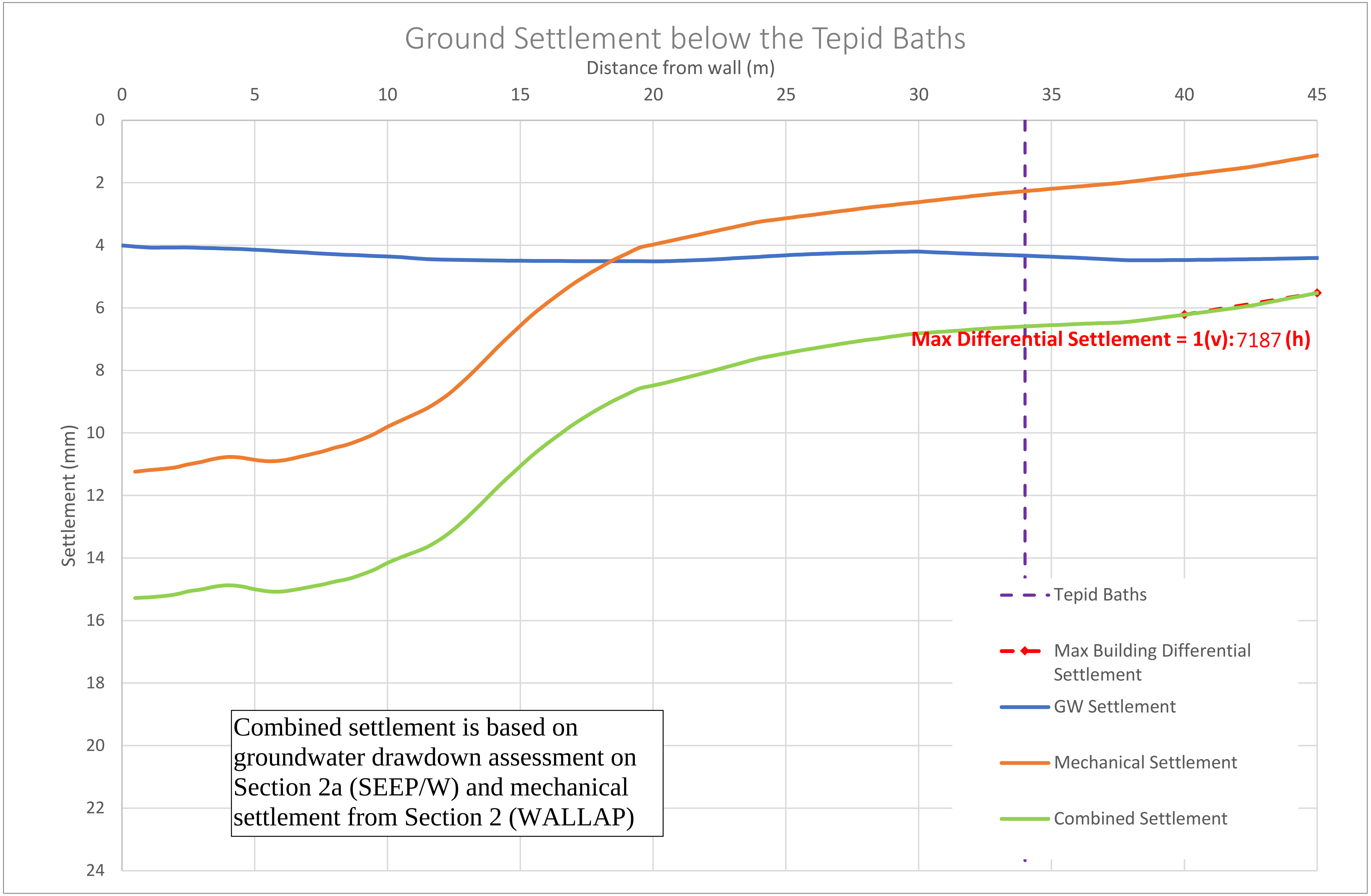


Ground Settlement below for the HSBC Podium

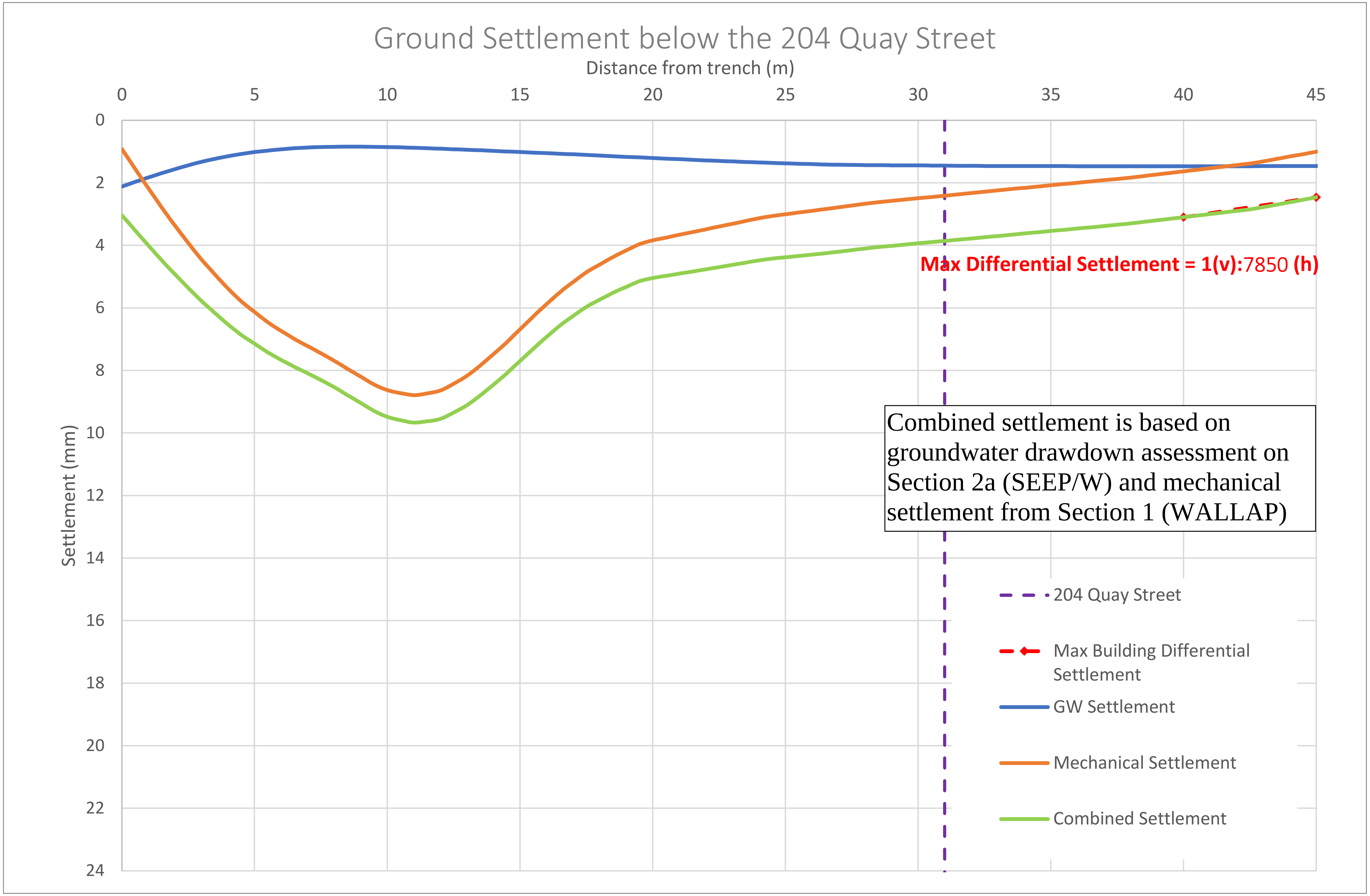
Max Differential Settlement = 1(v):2046 **(h)**

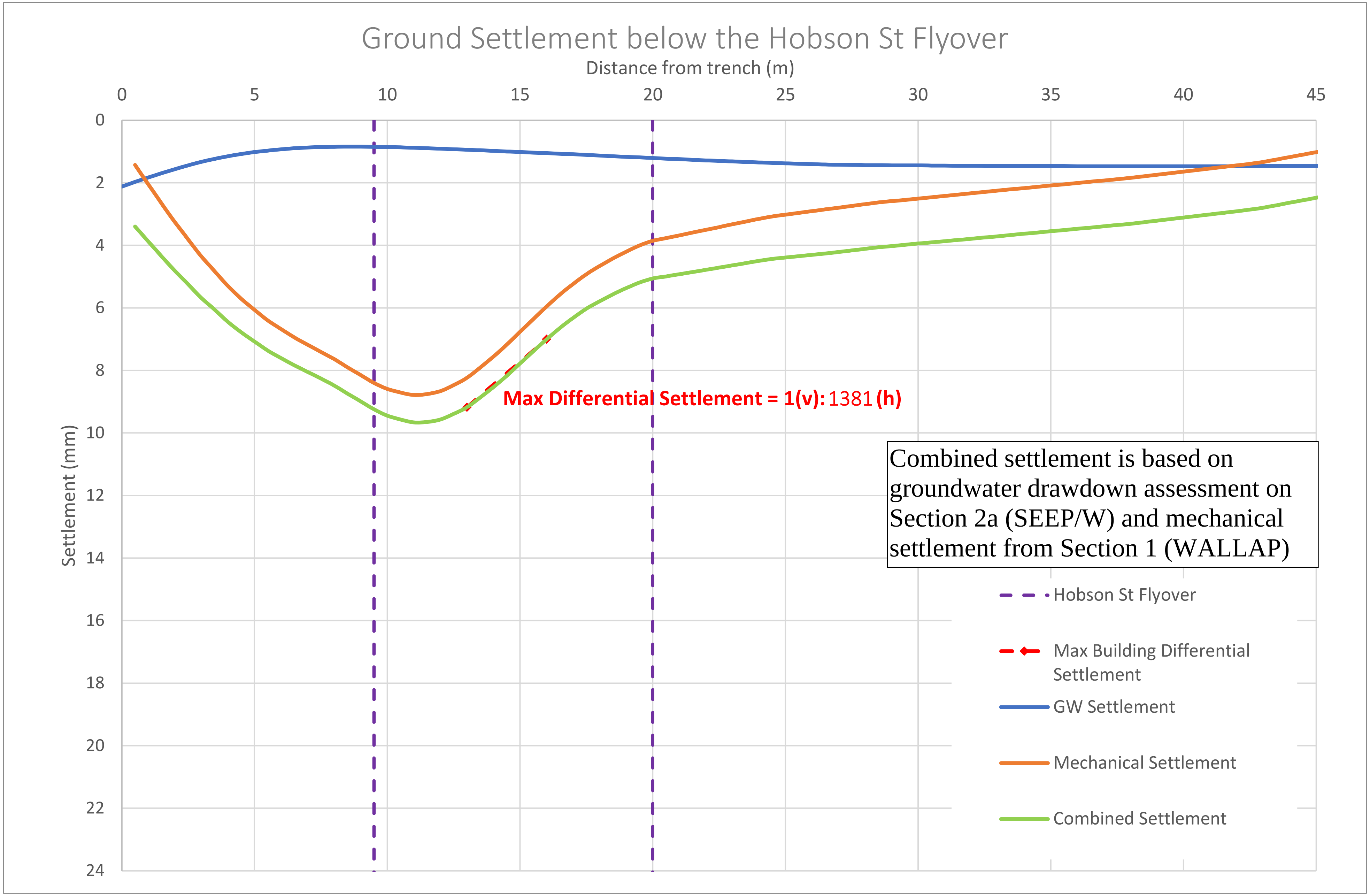
Combined settlement is based on groundwater drawdown assessment on Section 2b (SEEP/W) and mechanical settlement from Section 1 (WALLAP)


Ground Settlement below the AON Tower
Distance from basement (m)
0
5
10
15
20
25
30
35
40
45
50
Settlement (mm)
0
2
4
6
8
10
12
14
16
18
20
22
24
Max Differential Settlement = 1(v): 688 (h)
Average Differential Settlement = 1(v): 5907 (h)
Combined settlement is based on groundwater drawdown assessment on Section 1b (SEEP/W) and mechanical settlement from Section 3 (WALLAP)
AON Tower
Max Building Differential Settlement
Average Building Differential Settlement
GW Settlement
Mechanical Settlement
Combined Settlement



Combined settlement is based on groundwater drawdown assessment on Section 2a (SEEP/W) and mechanical settlement from Section 2 (WALLAP)

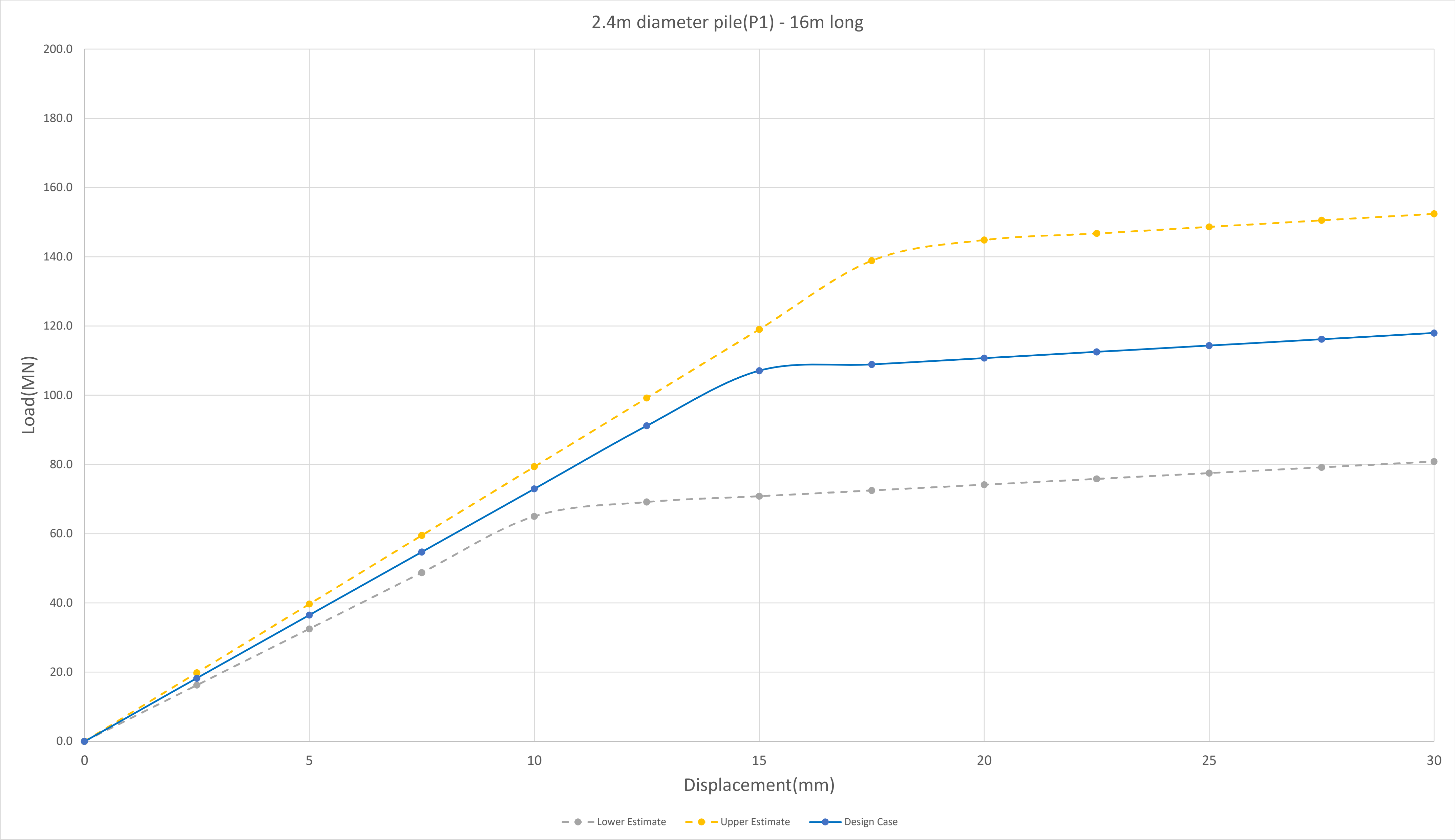

Ground Settlement below the 204 Quay Street
Distance from trench (m)
0
5
10
15
20
25
30
35
40
45
Settlement (mm)
0
2
4
6
8
10
12
14
16
18
20
22
24
Max Differential Settlement = 1(v):7850 (h)
Combined settlement is based on groundwater drawdown assessment on Section 2a (SEEP/W) and mechanical settlement from Section 1 (WALLAP)
204 Quay Street
Max Building Differential Settlement
GW Settlement
Mechanical Settlement
Combined Settlement



Combined settlement is based on groundwater drawdown assessment on Section 2a (SEEP/W) and mechanical settlement from Section 1 (WALLAP)

Appendix J Vertical spring stiffness values

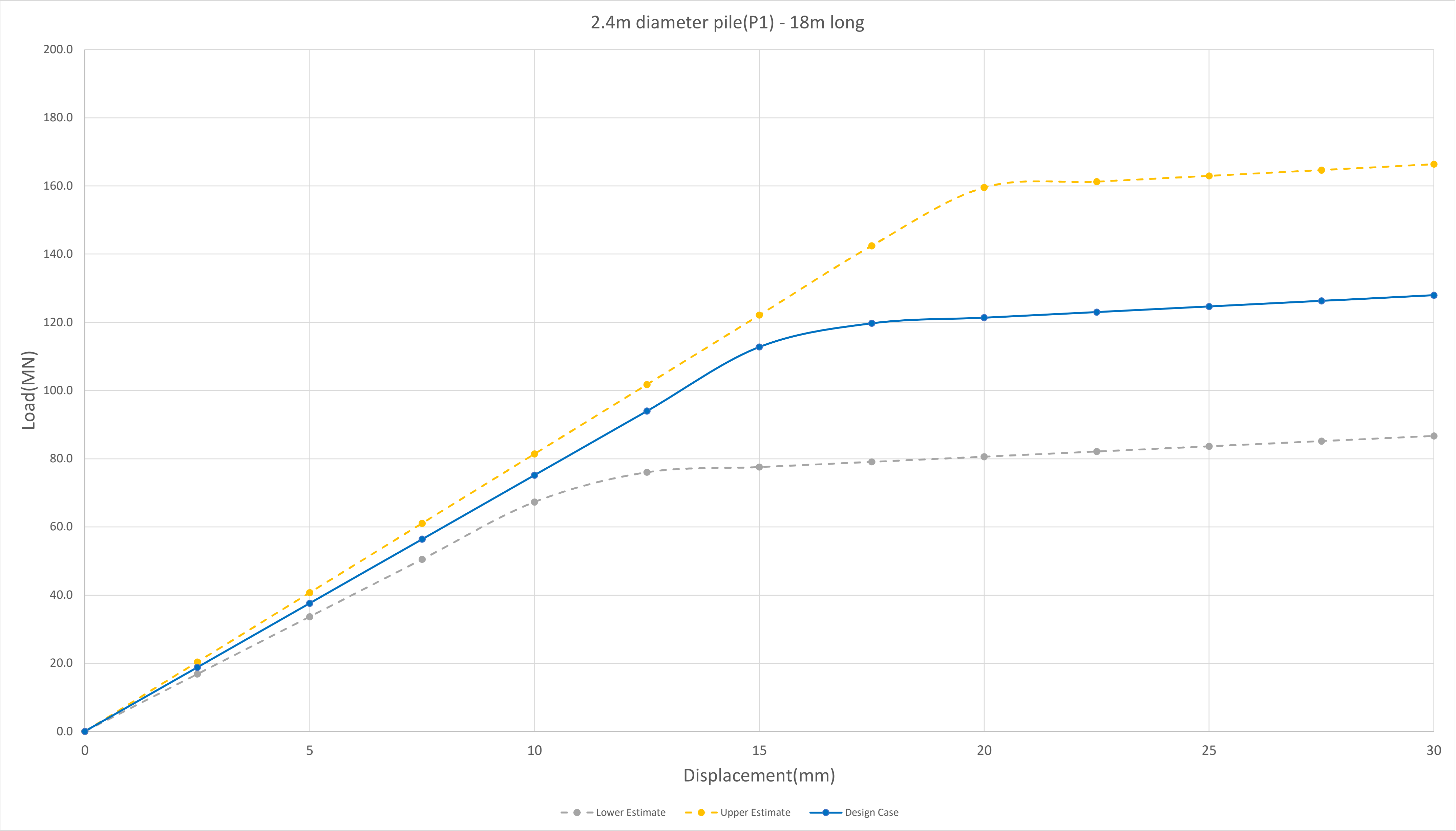
Downtown West - Axial Pile Springs



Date: 1/09/2025

T+T Ref: 1016043.2000

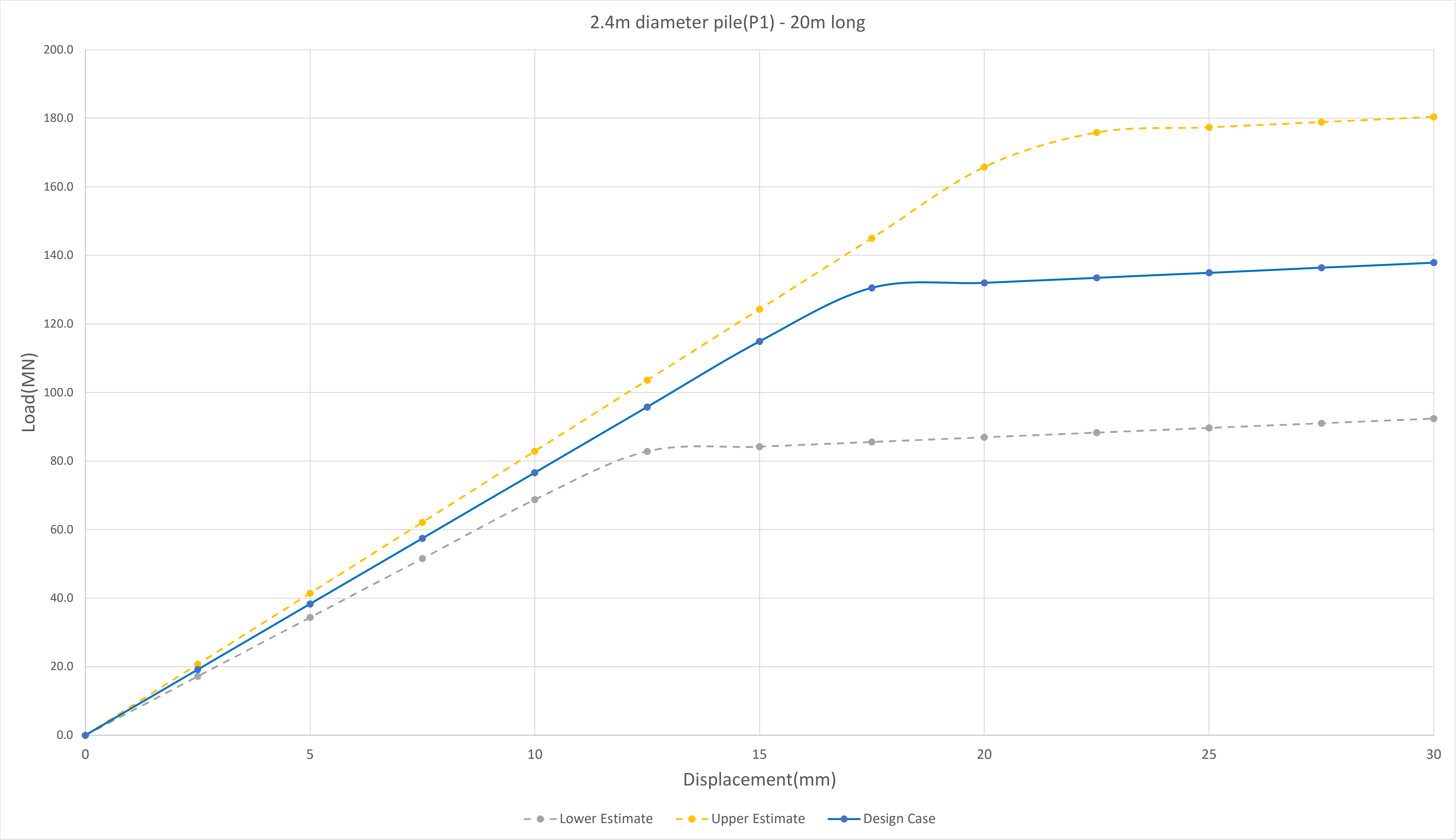
Downtown West - Axial Pile Springs



Date: 1/09/2025

T+T Ref: 1016043.2000

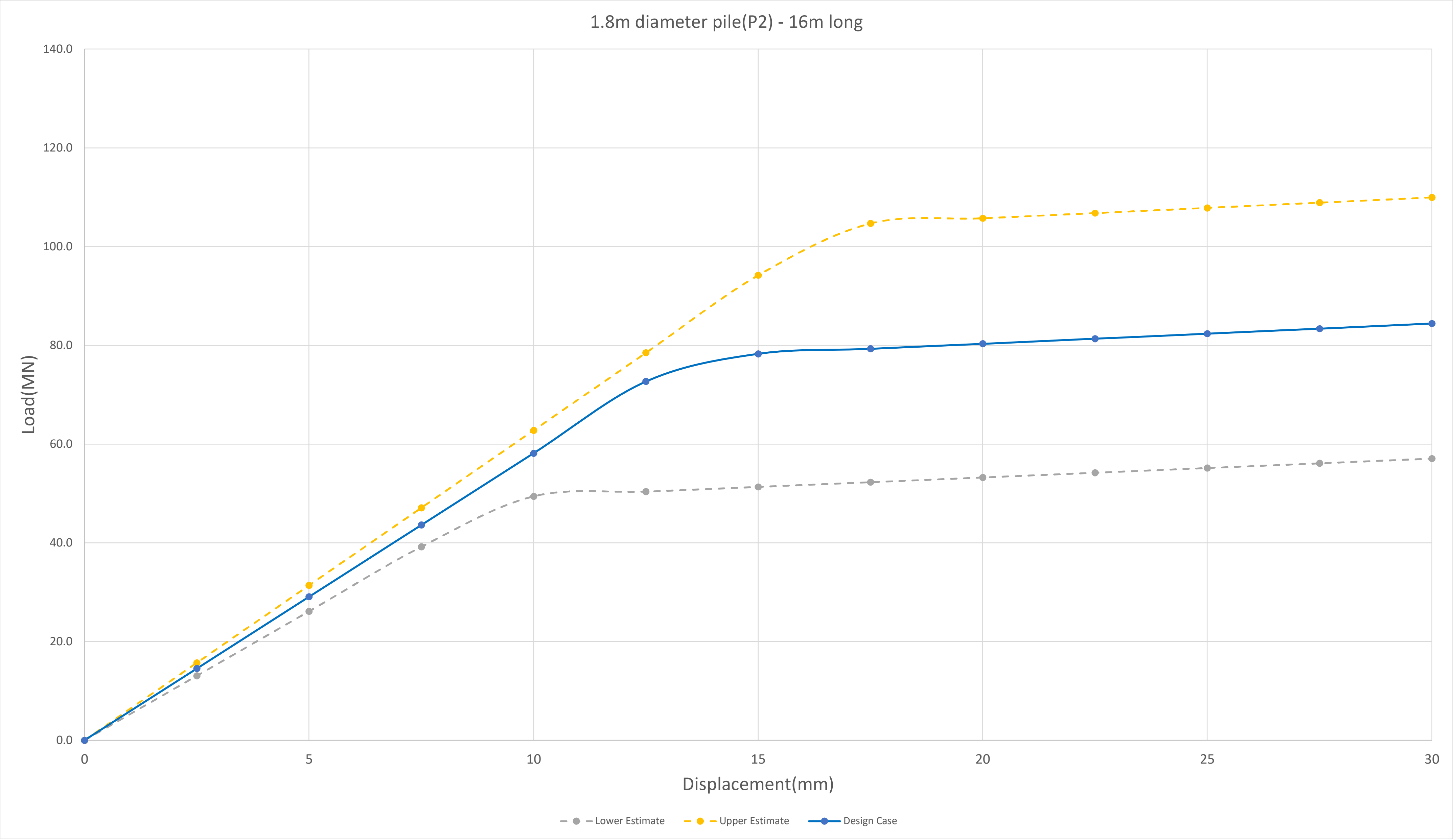
Downtown West - Axial Pile Springs



Date: 1/09/2025

T+T Ref: 1016043.2000

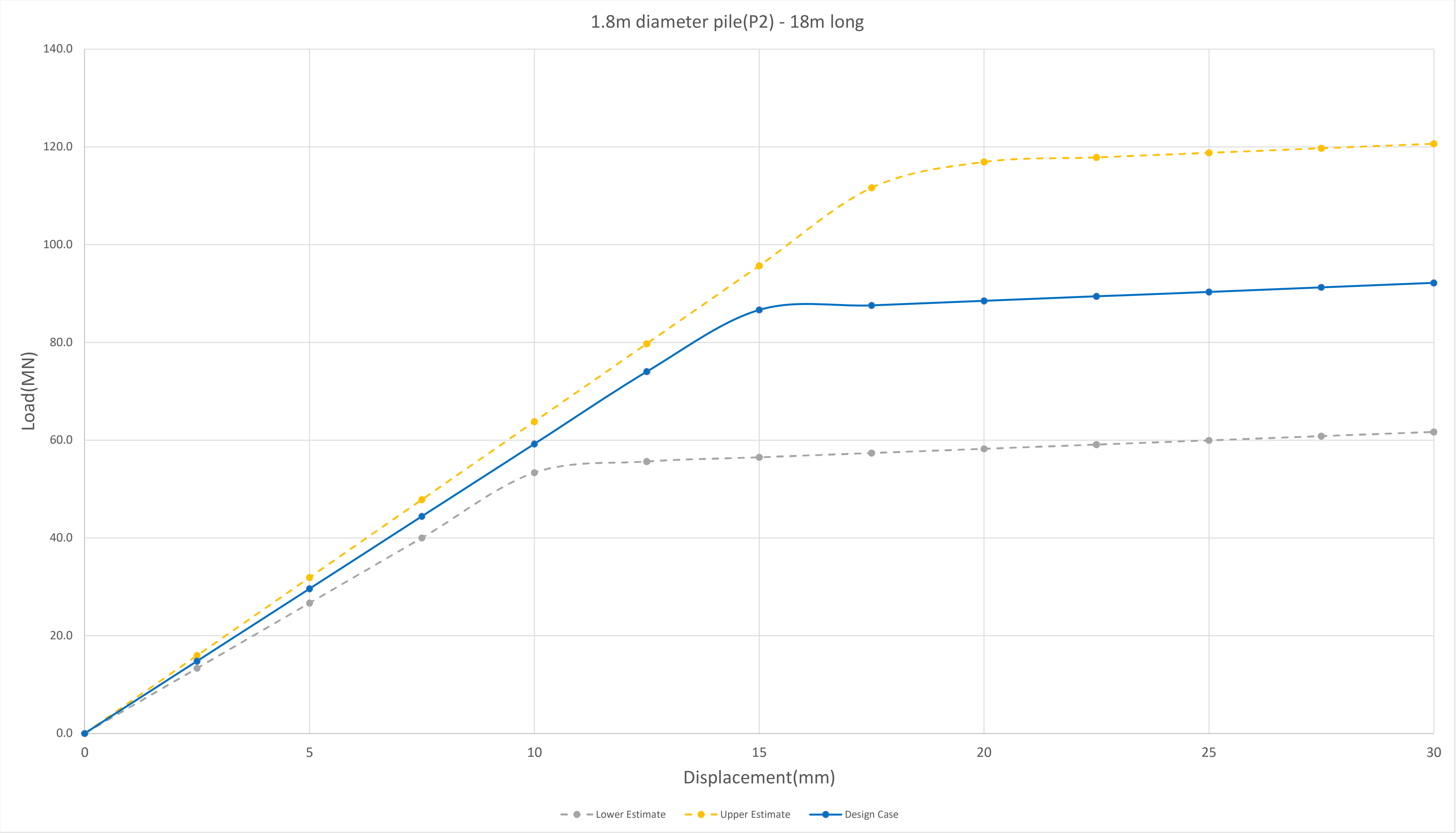
Downtown West - Axial Pile Springs



Date: 1/09/2025

T+T Ref: 1016043.2000

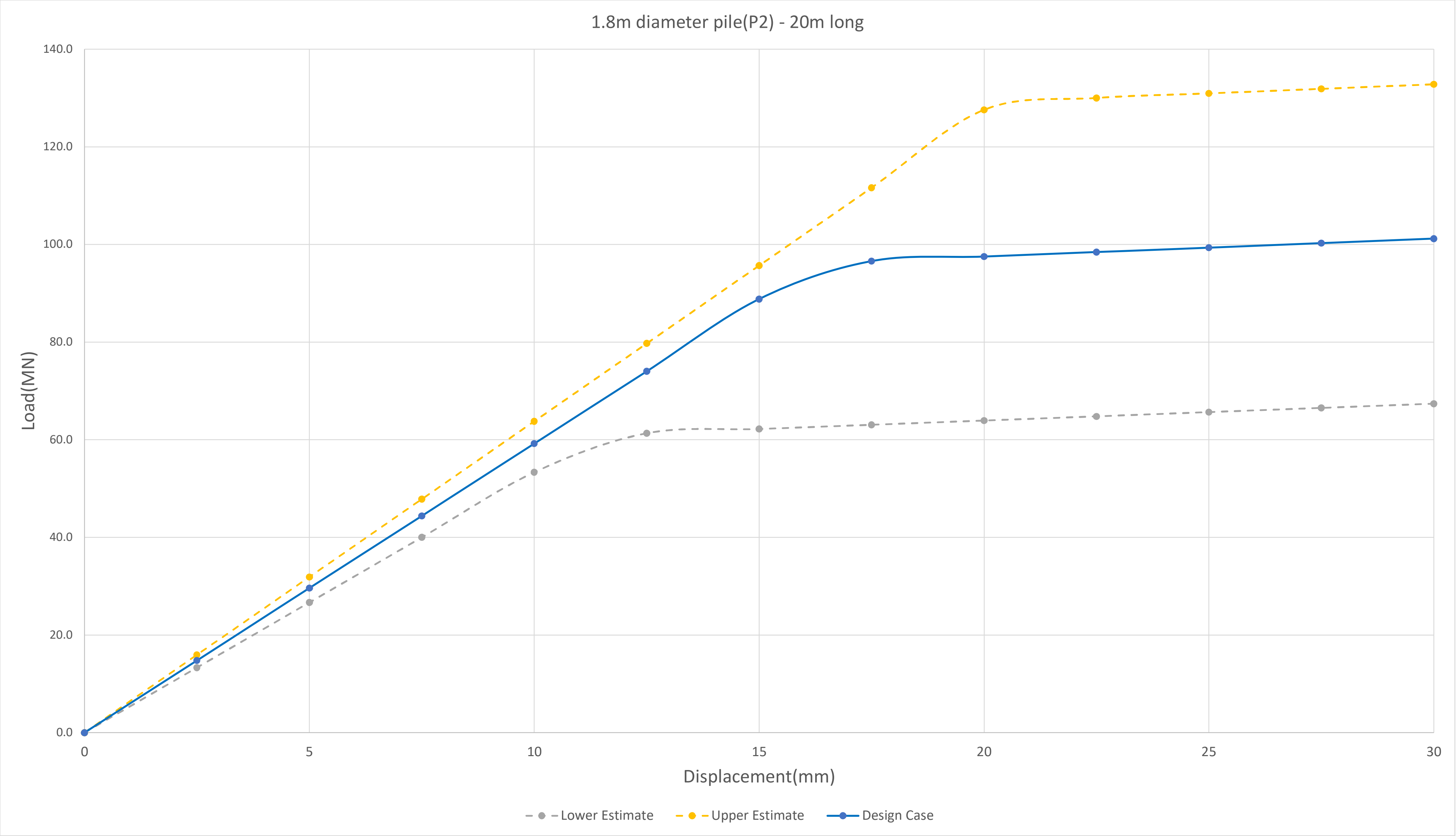
Downtown West - Axial Pile Springs



Date: 1/09/2025

T+T Ref: 1016043.2000

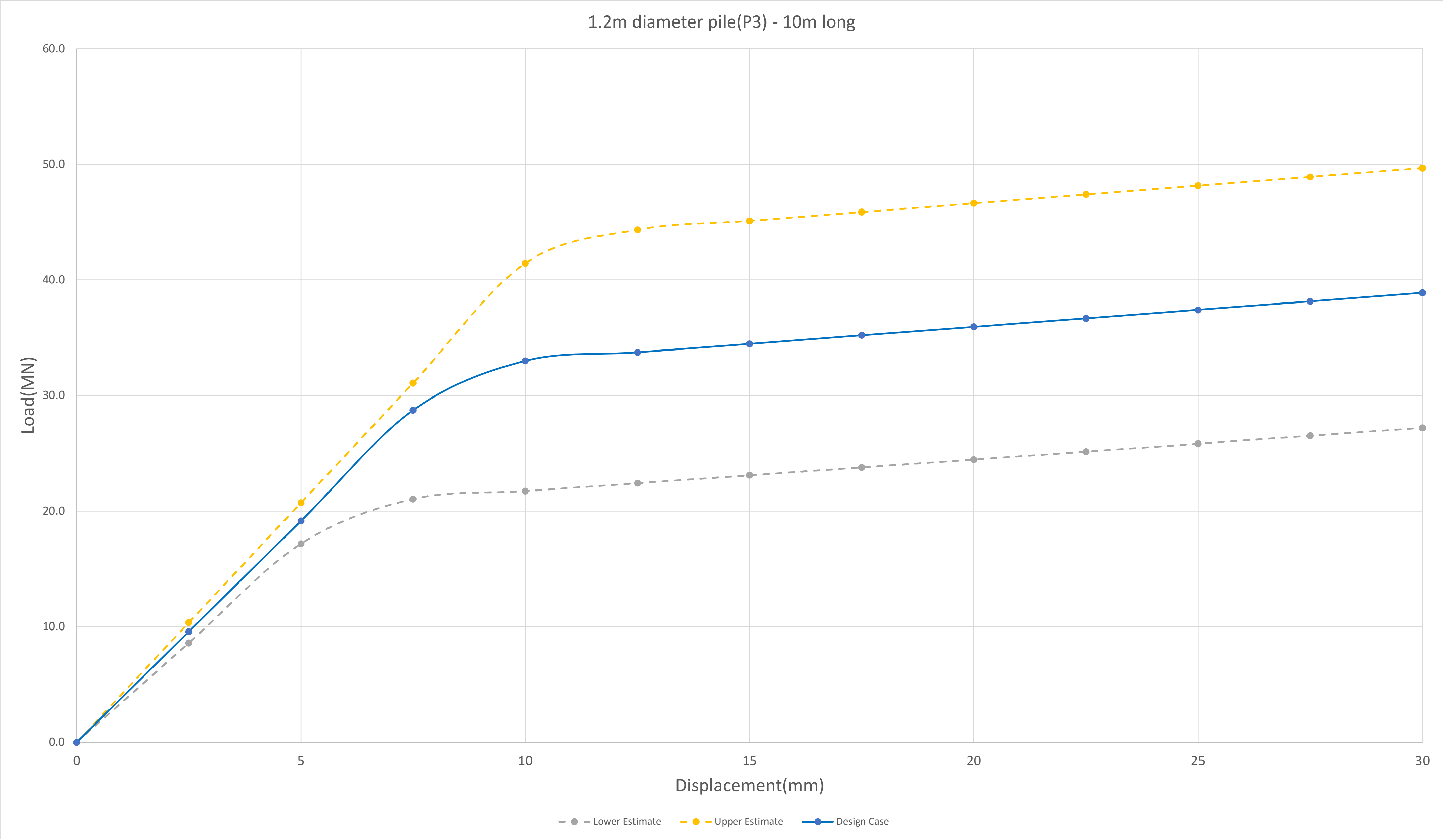
Downtown West - Axial Pile Springs



Date: 1/09/2025

T+T Ref: 1016043.2000

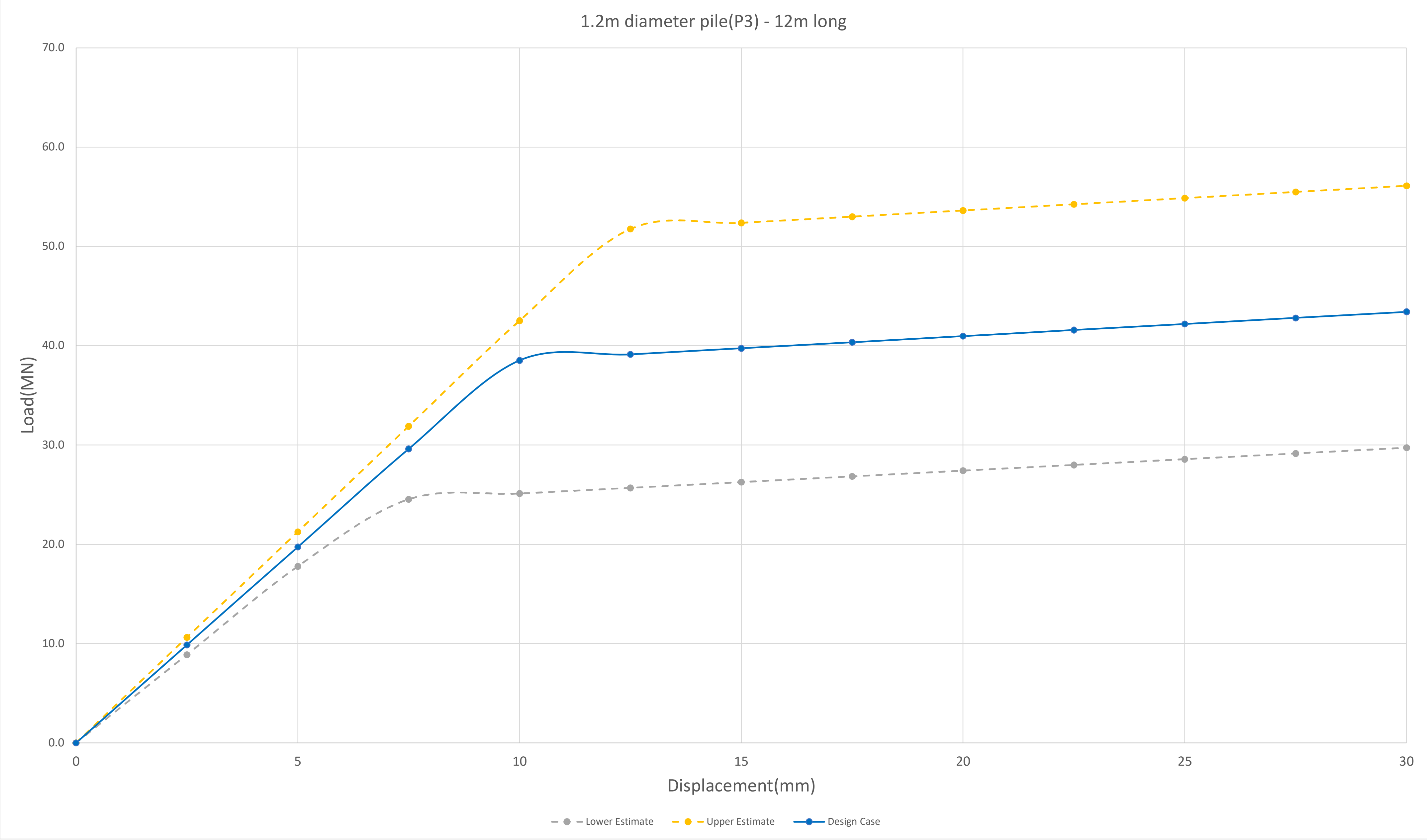
Downtown West - Axial Pile Springs



Date: 1/09/2025

T+T Ref: 1016043.2000

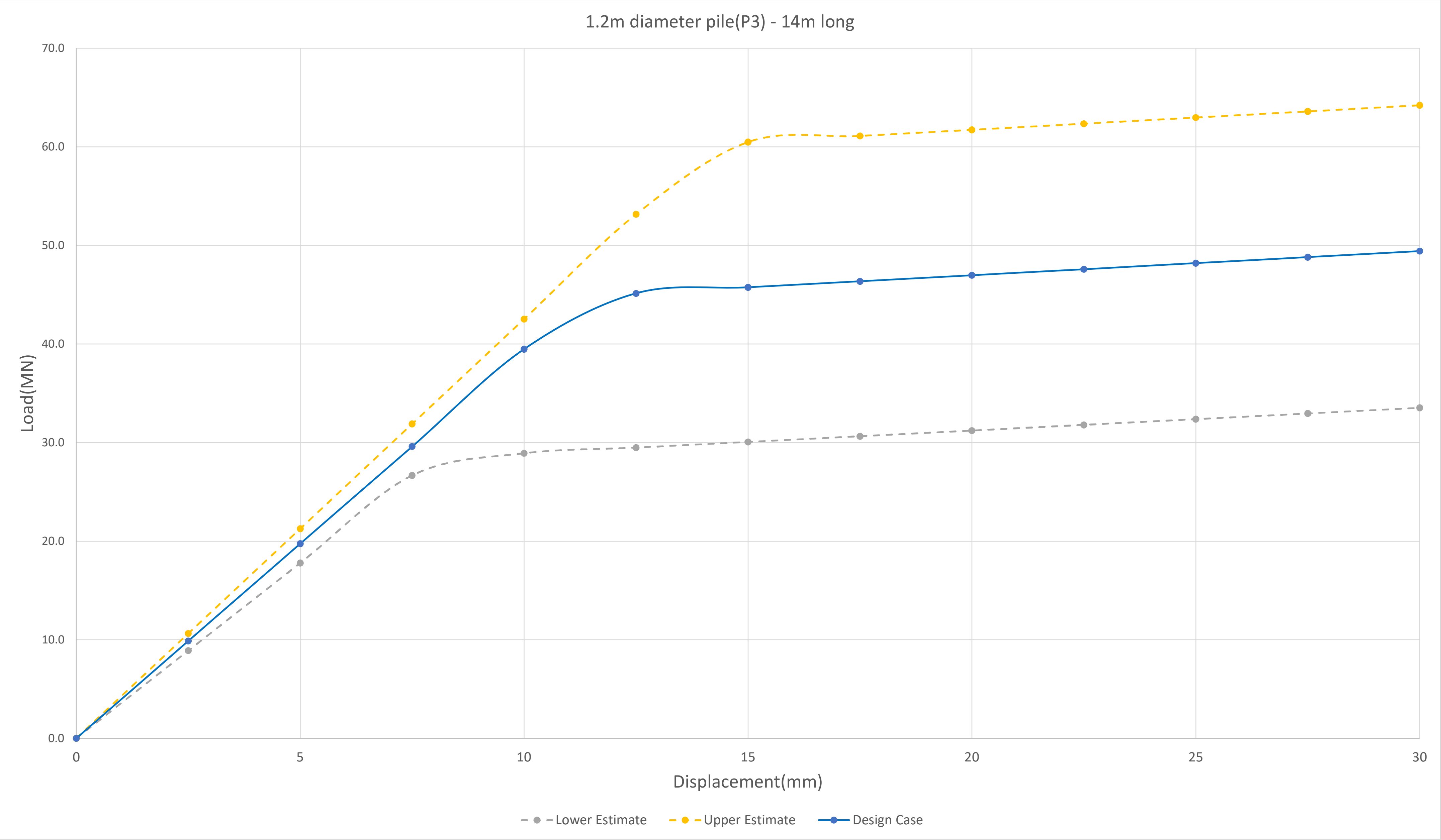
Downtown West - Axial Pile Springs



Date: 1/09/2025

T+T Ref: 1016043.2000

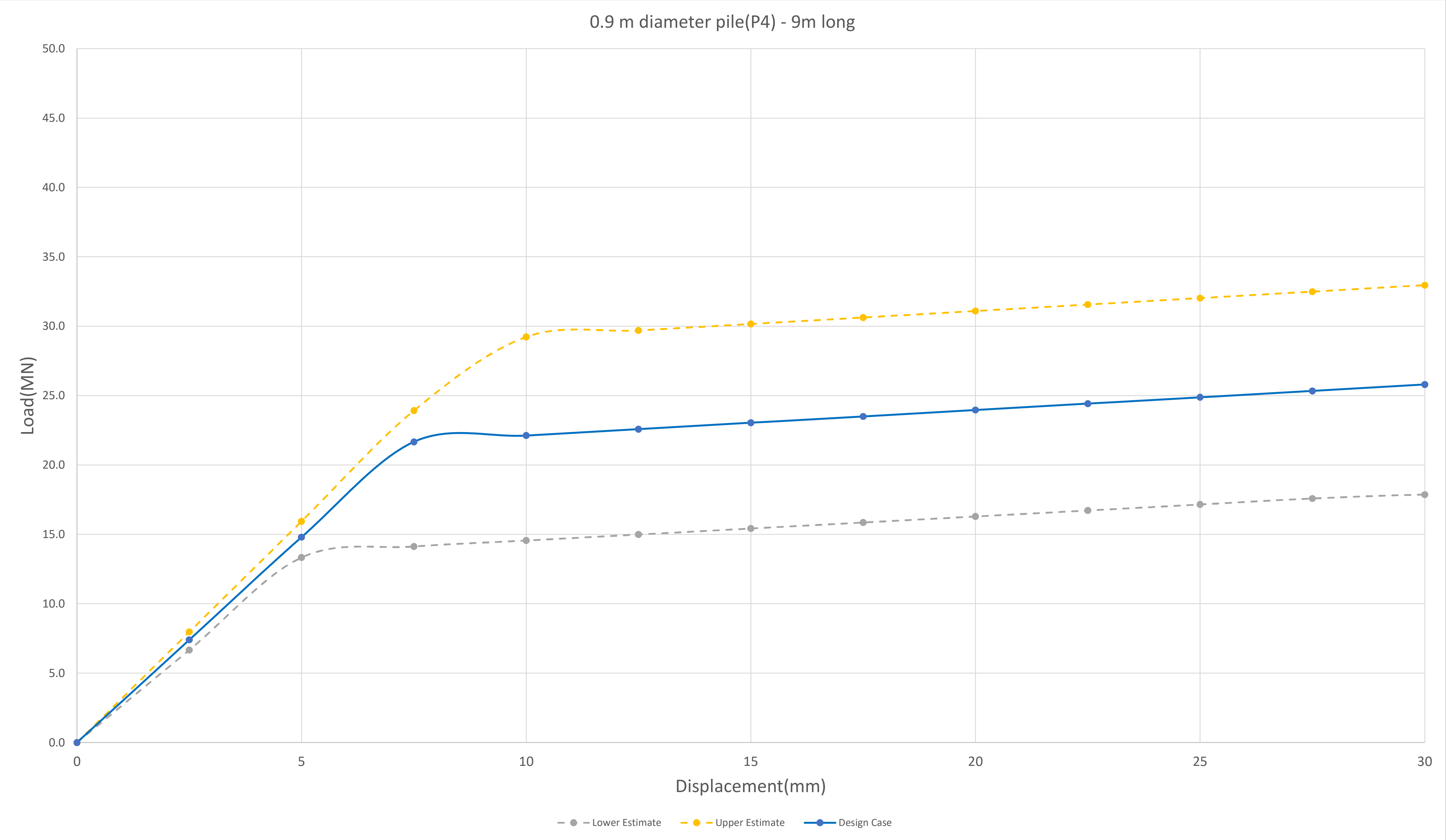
Downtown West - Axial Pile Springs



Date: 1/09/2025

T+T Ref: 1016043.2000

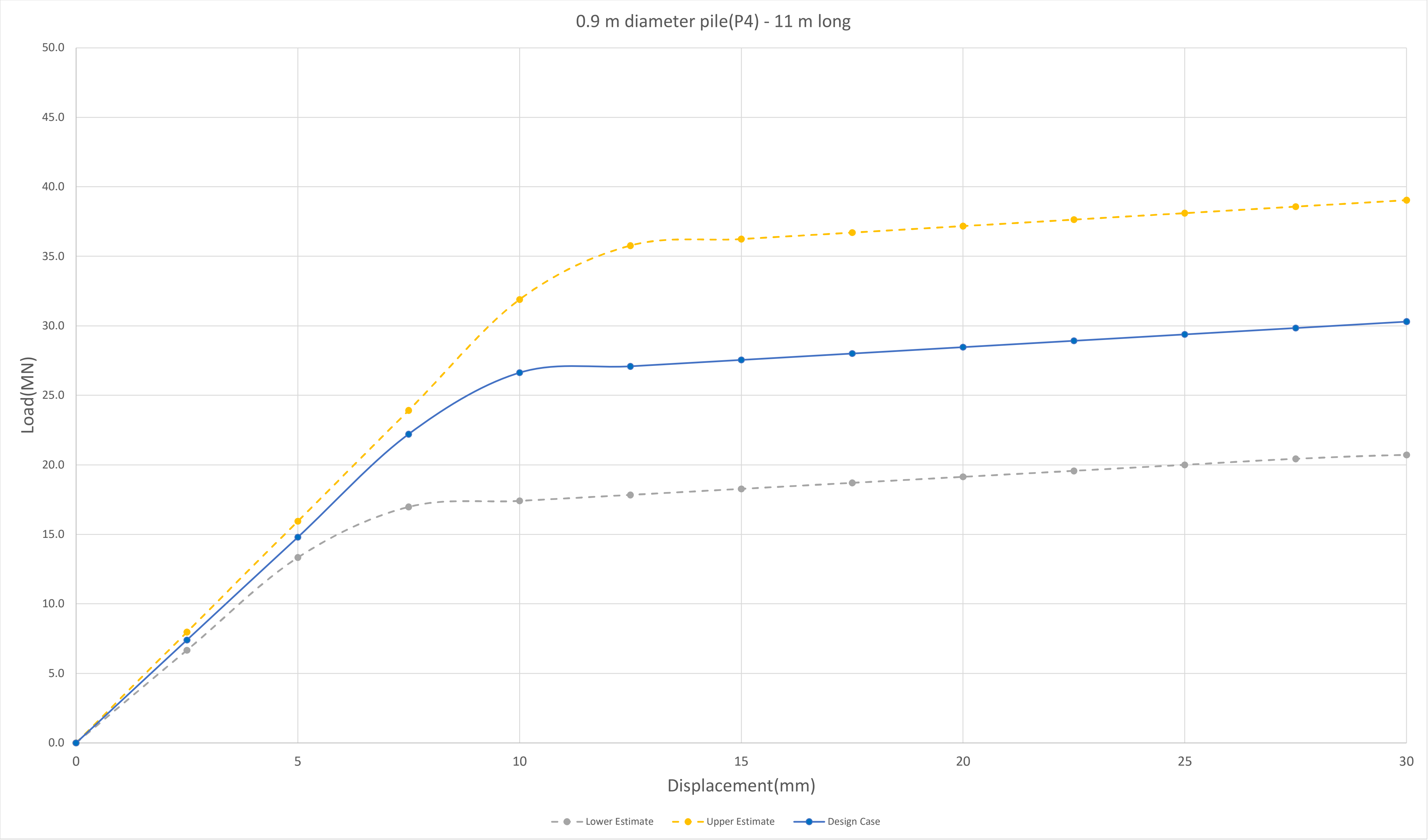
Downtown West - Axial Pile Springs



Date: 1/09/2025

T+T Ref: 1016043.2000

Downtown West - Axial Pile Springs

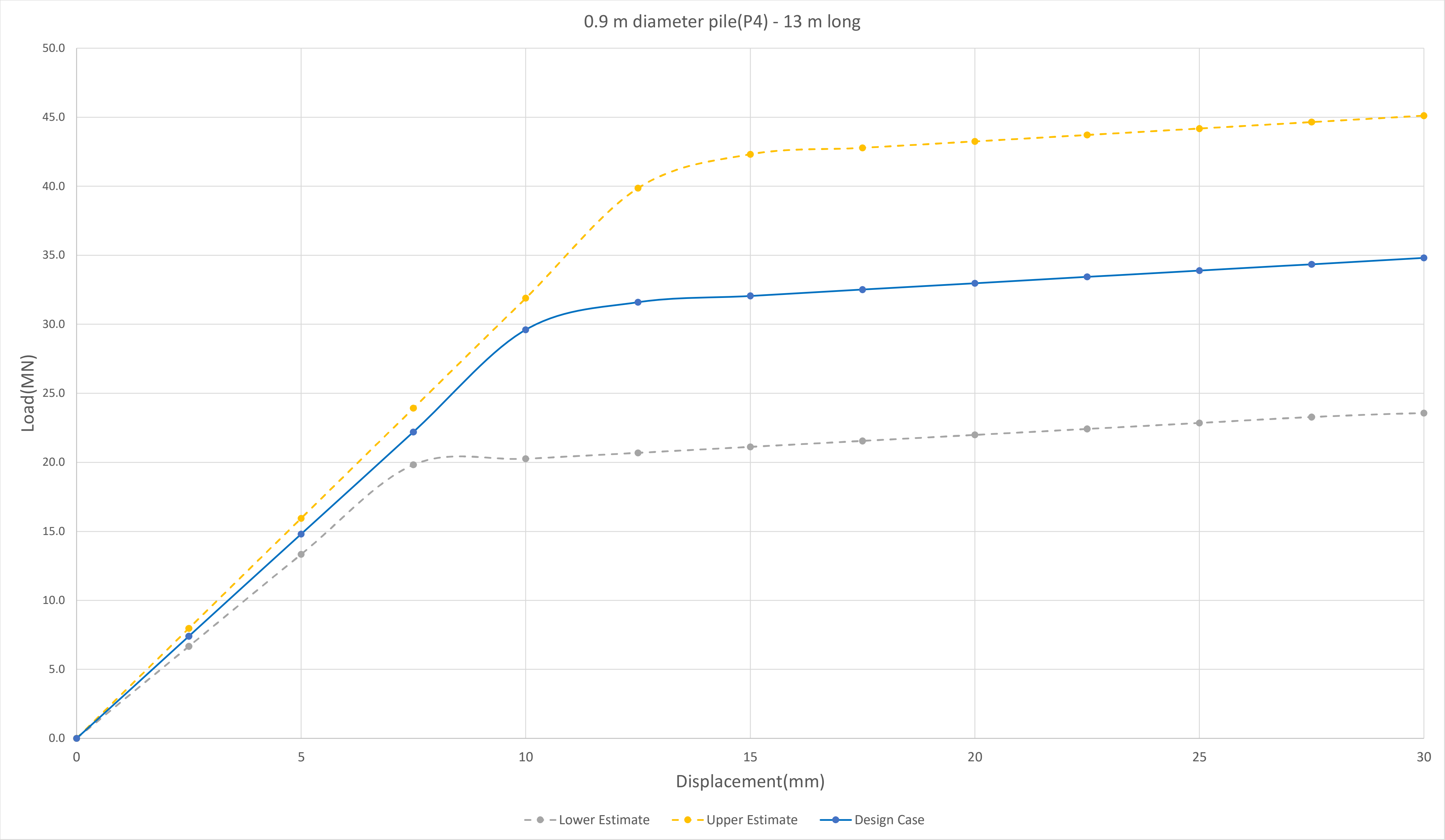


Date: 1/09/2025

T+T Ref: 1016043.2000

Downtown West - Axial Pile Springs

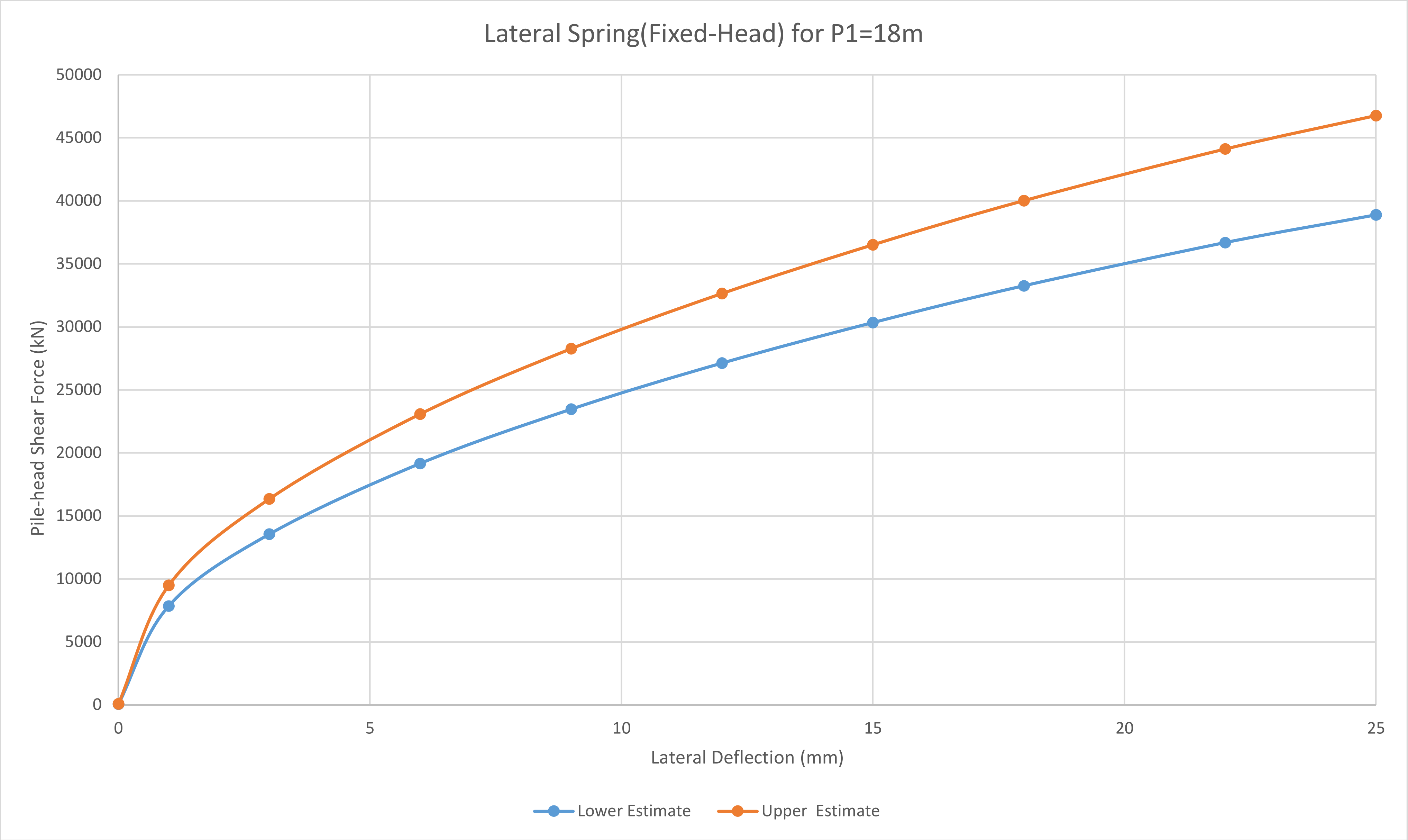
Tonkin+Taylor

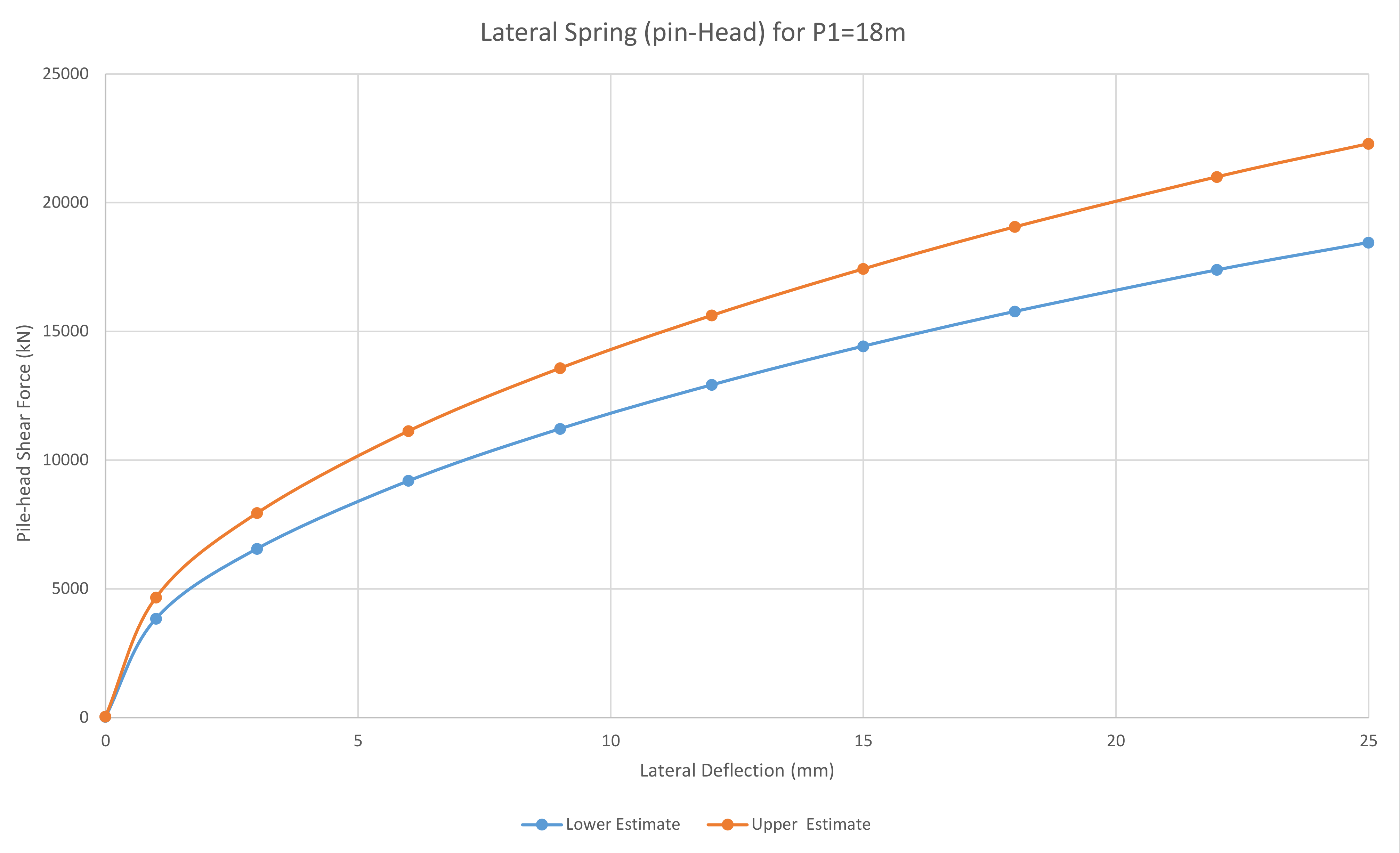


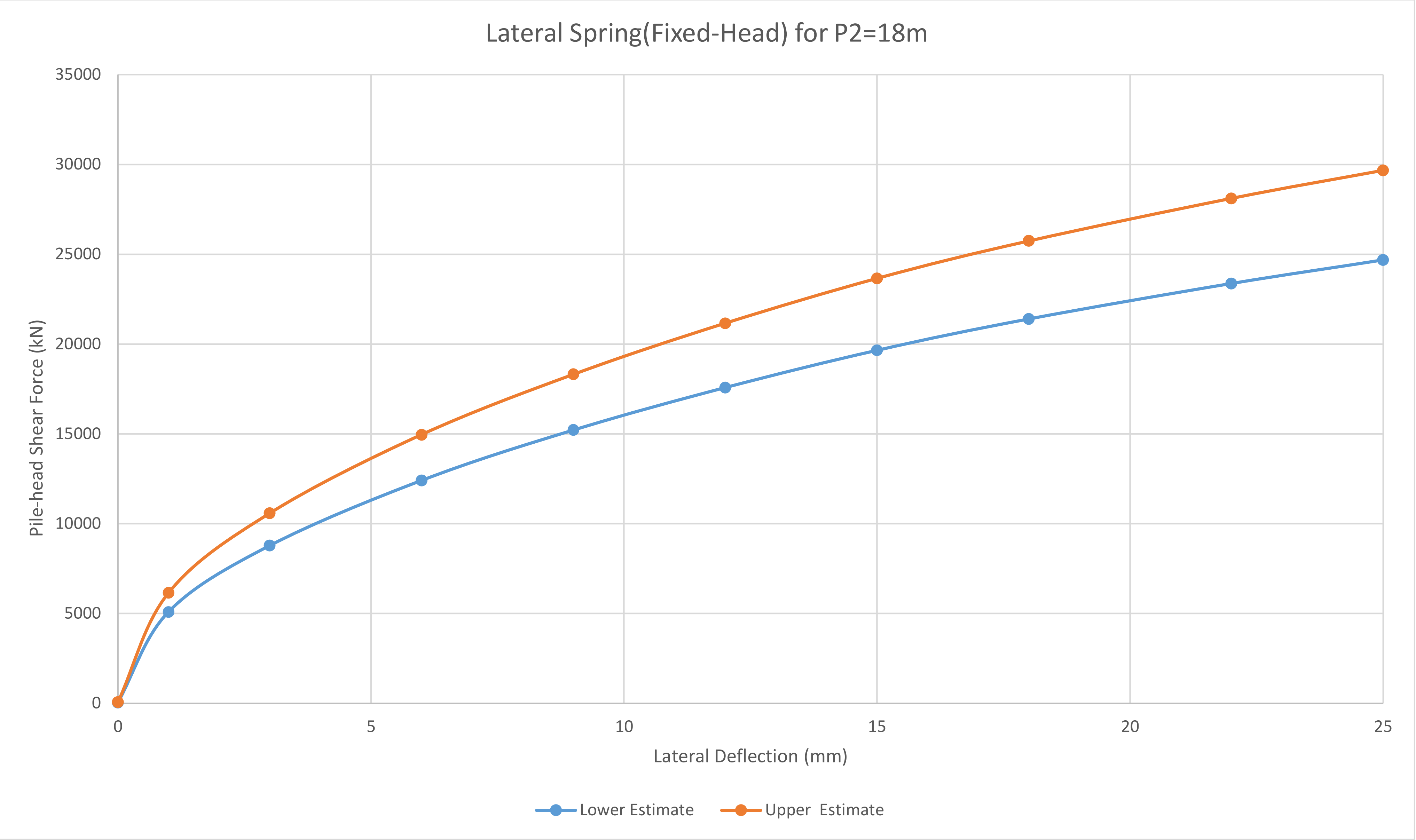
Date: 1/09/2025

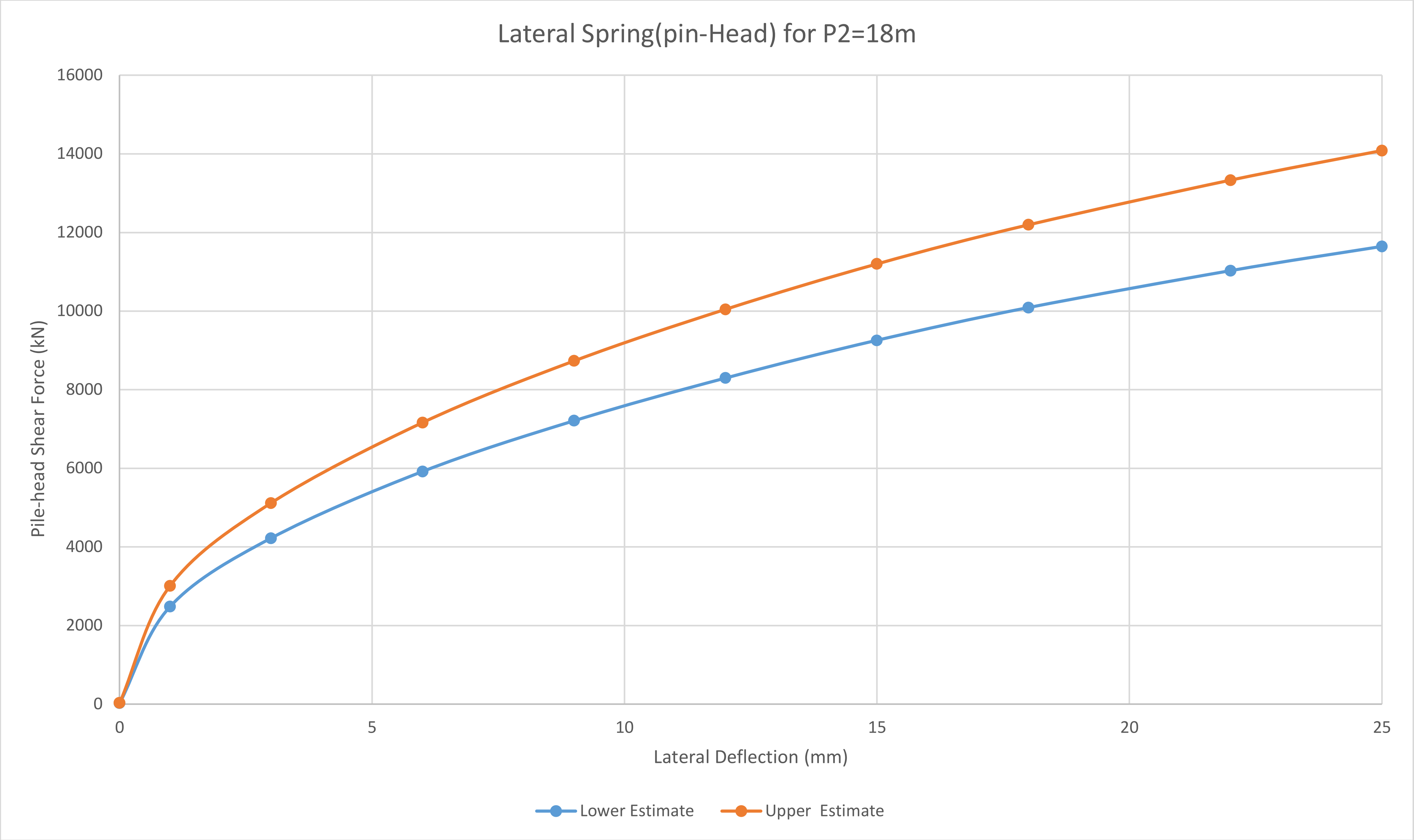
T+T Ref: 1016043.2000

Appendix K Lateral spring stiffness values

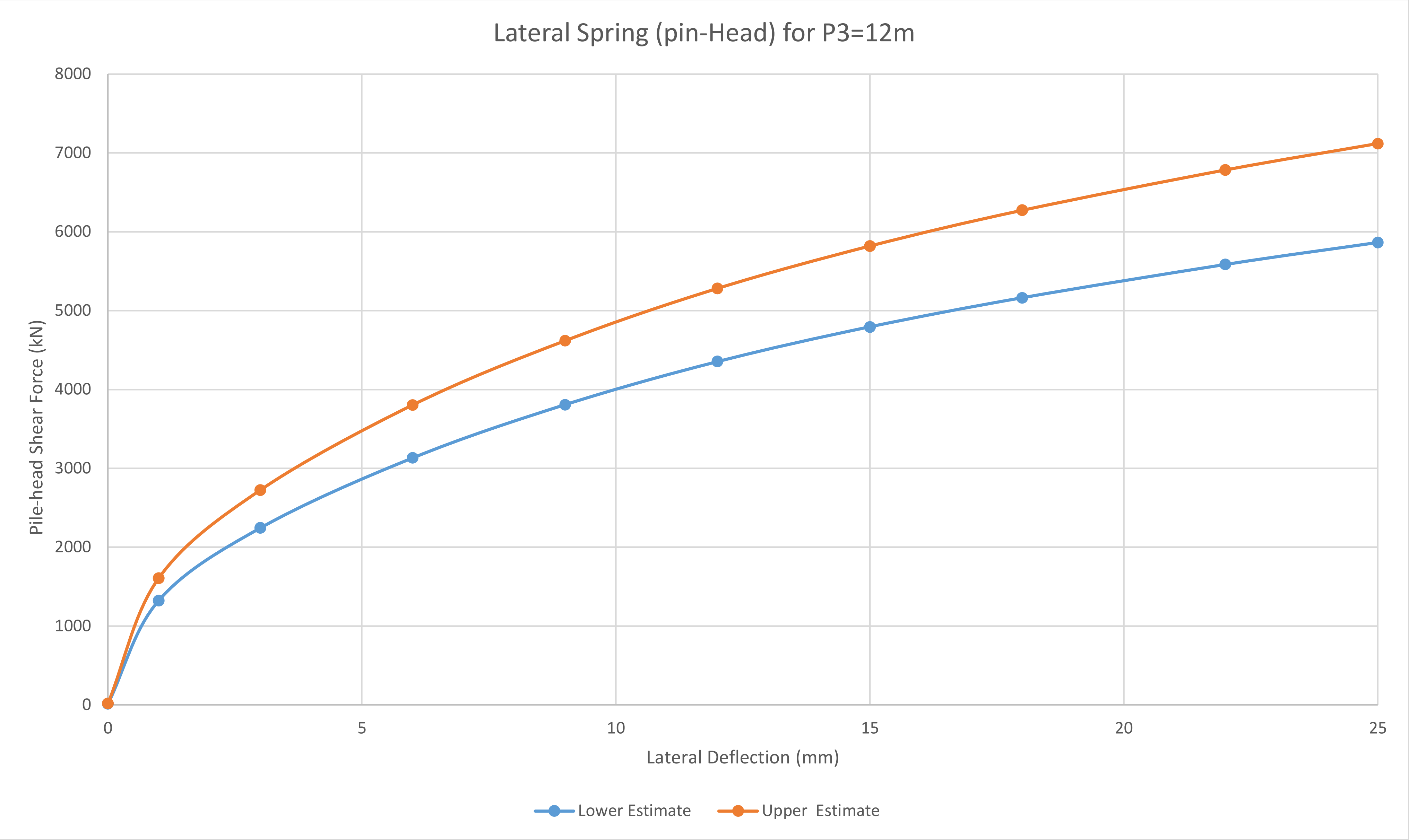

Lateral Spring(Fixed-Head) for P1=18m
50000
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
Pile-head Shear Force (kN)
0
5
10
15
20
25
Lateral Deflection (mm)
Lower Estimate
Upper Estimate


Lateral Spring (pin-Head) for P1=18m
Pile-head Shear Force (kN)
25000
20000
15000
10000
5000
0
0
5
10
15
20
25
Lateral Deflection (mm)
Lower Estimate
Upper Estimate

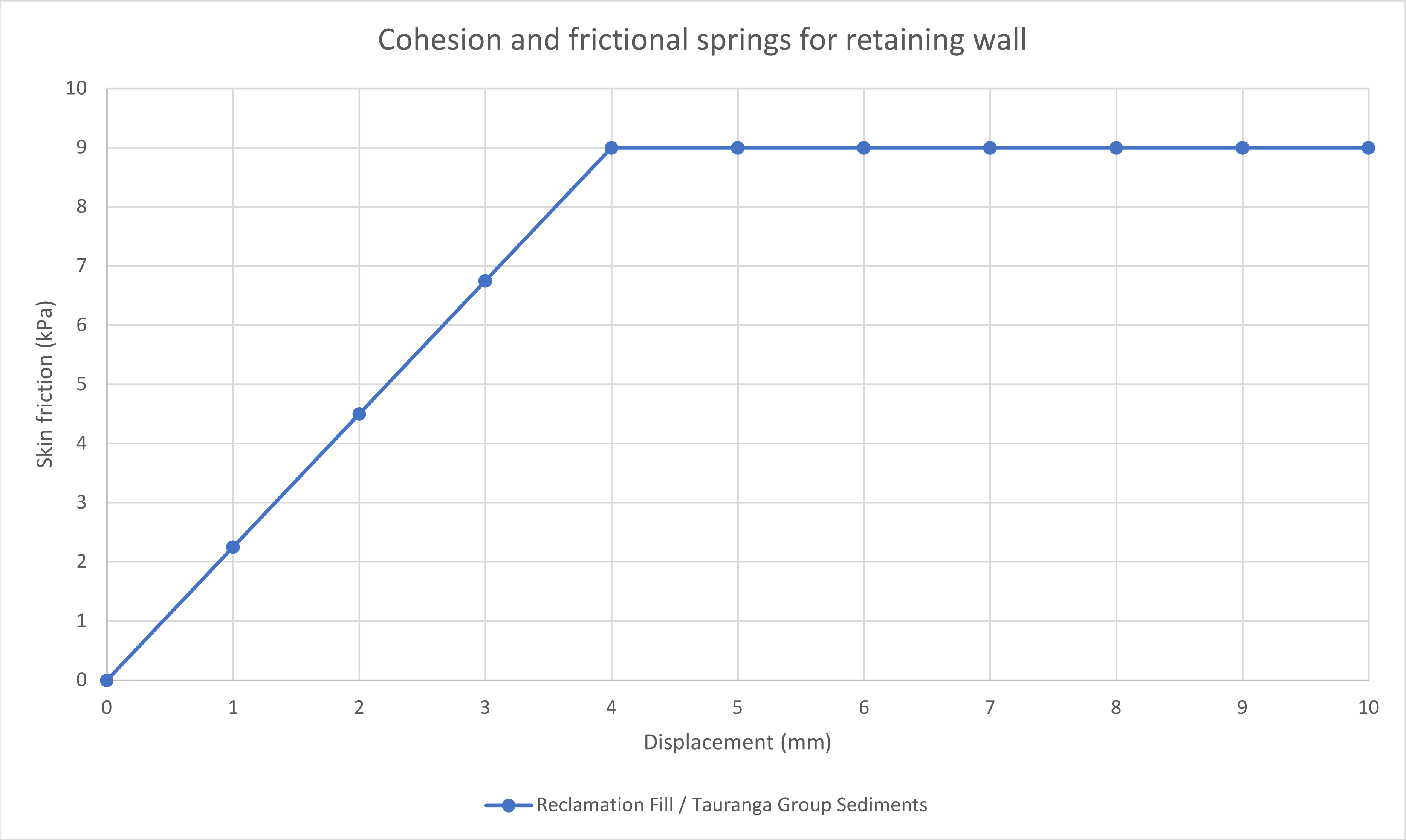

Lateral Spring(Fixed-Head) for P2=18m
Pile-head Shear Force (kN)
35000
30000
25000
20000
15000
10000
5000
0
0
5
10
15
20
25
Lateral Deflection (mm)
Lower Estimate
Upper Estimate

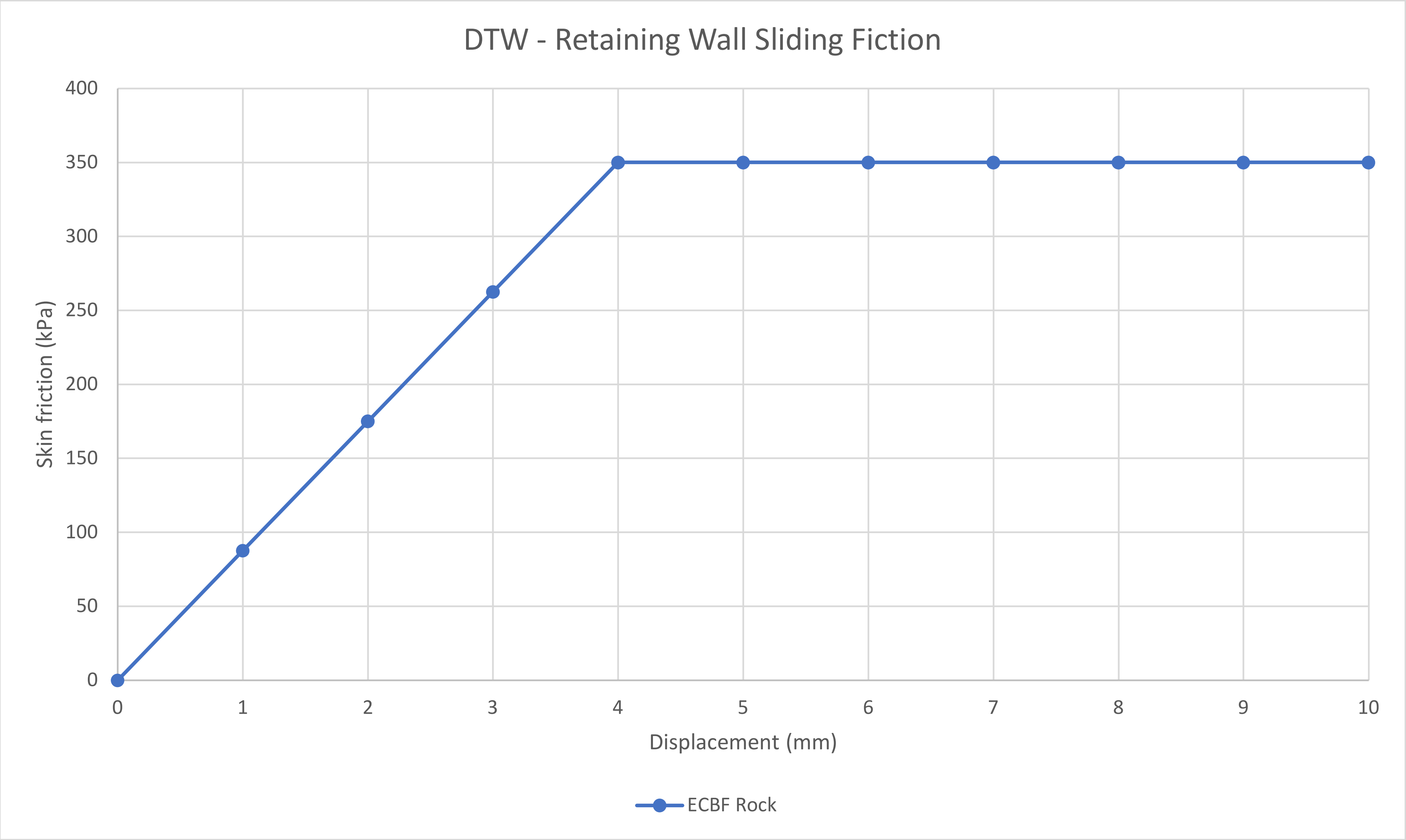

Lateral Spring(pin-Head) for P2=18m
16000
14000
12000
10000
8000
6000
4000
2000
0
Pile-head Shear Force (kN)
0
5
10
15
20
25
Lateral Deflection (mm)
Lower Estimate
Upper Estimate

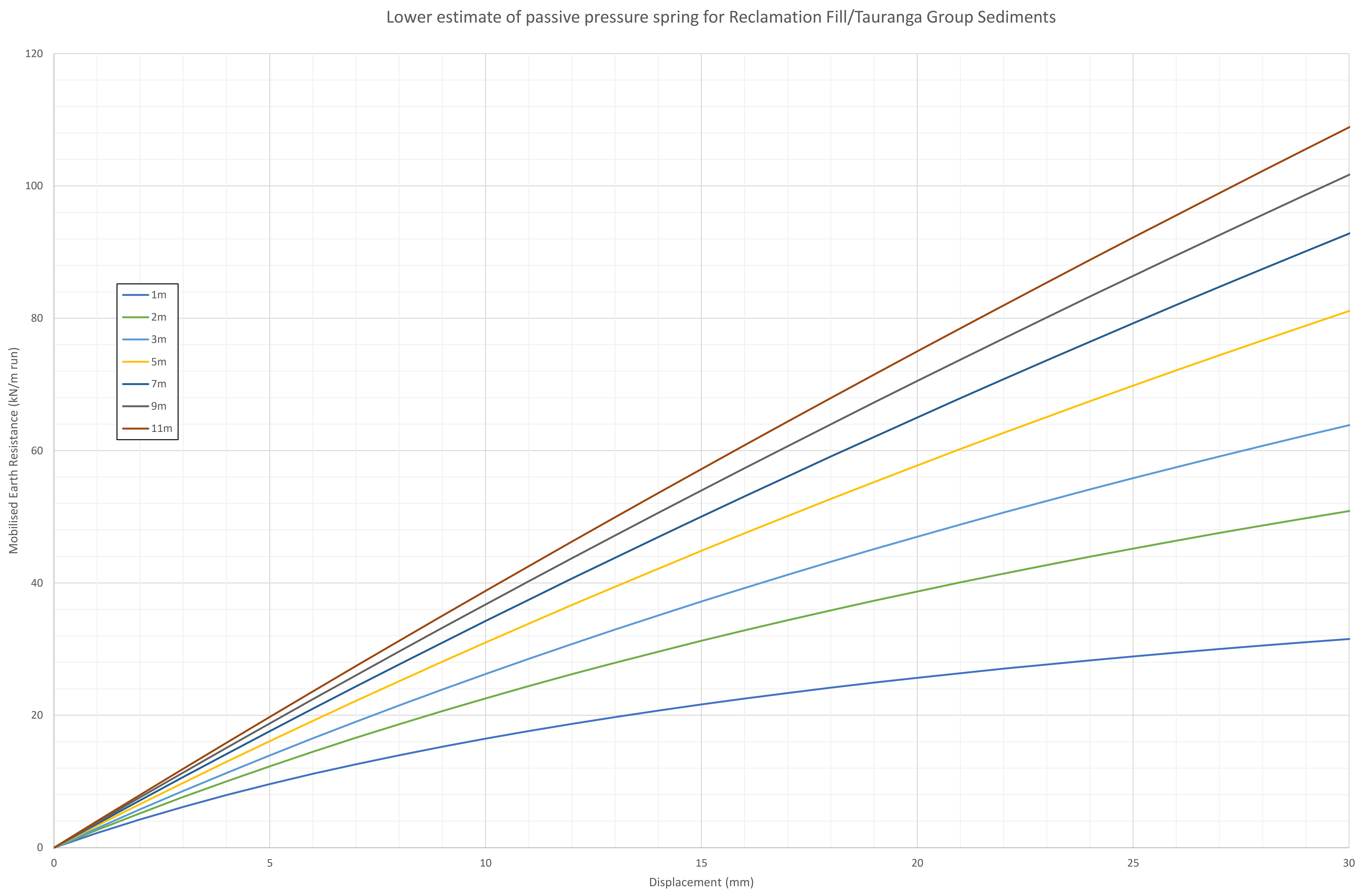

Lateral Spring(Fixed-Head) for P3=12m
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
Pile-head Shear Force (kN)
0
5
10
15
20
25
Lateral Deflection (mm)
Lower Estimate
Upper Estimate



Lateral Spring (pin-Head) for P3=12m
Pile-head Shear Force (kN)
0
1000
2000
3000
4000
5000
6000
7000
8000
0
5
10
15
20
25
Lateral Deflection (mm)
Lower Estimate
Upper Estimate

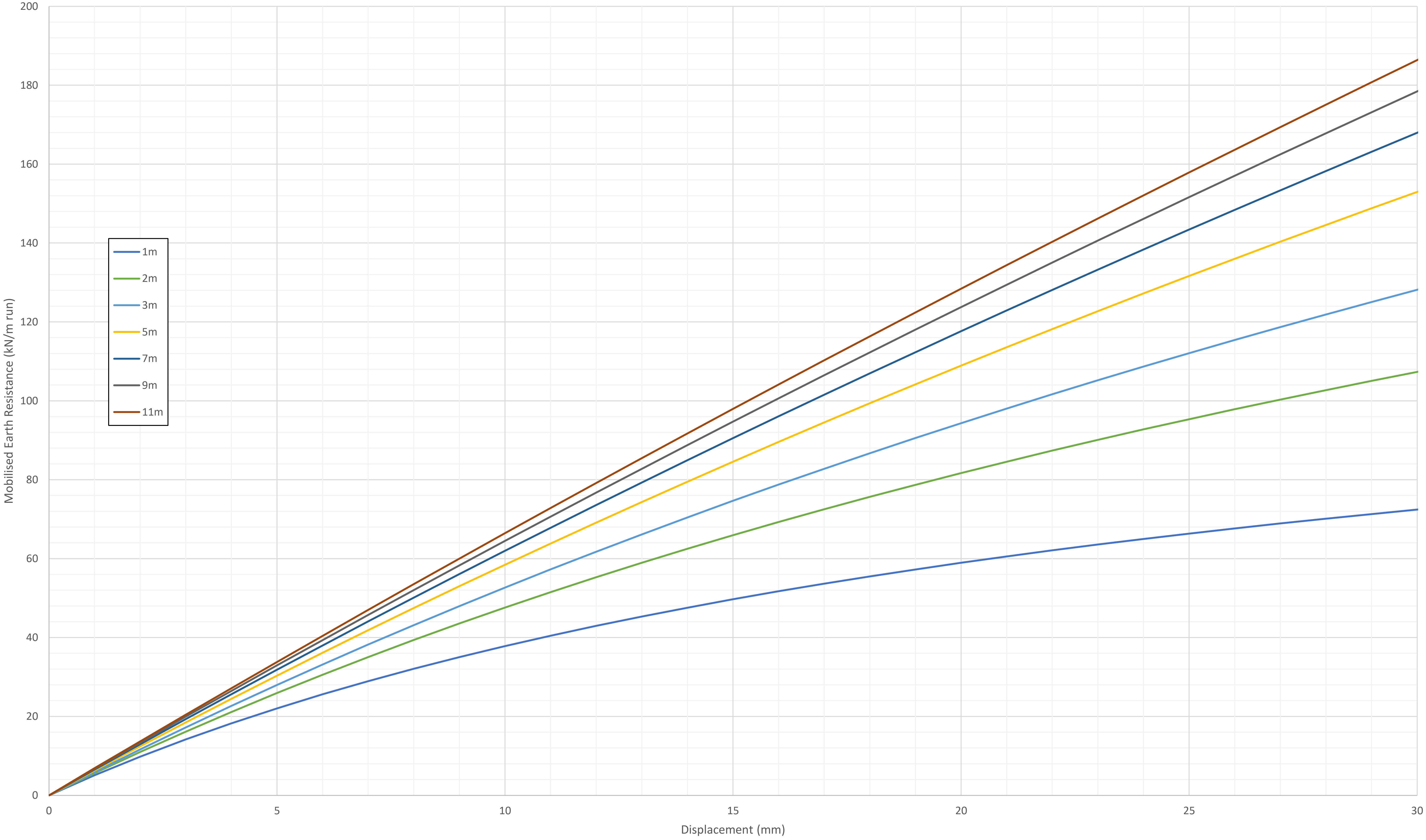

Cohesion and frictional springs for retaining wall
Skin friction (kPa)
10
9
8
7
6
5
4
3
2
1
0
0
1
2
3
4
5
6
7
8
9
10
Displacement (mm)
Reclamation Fill / Tauranga Group Sediments

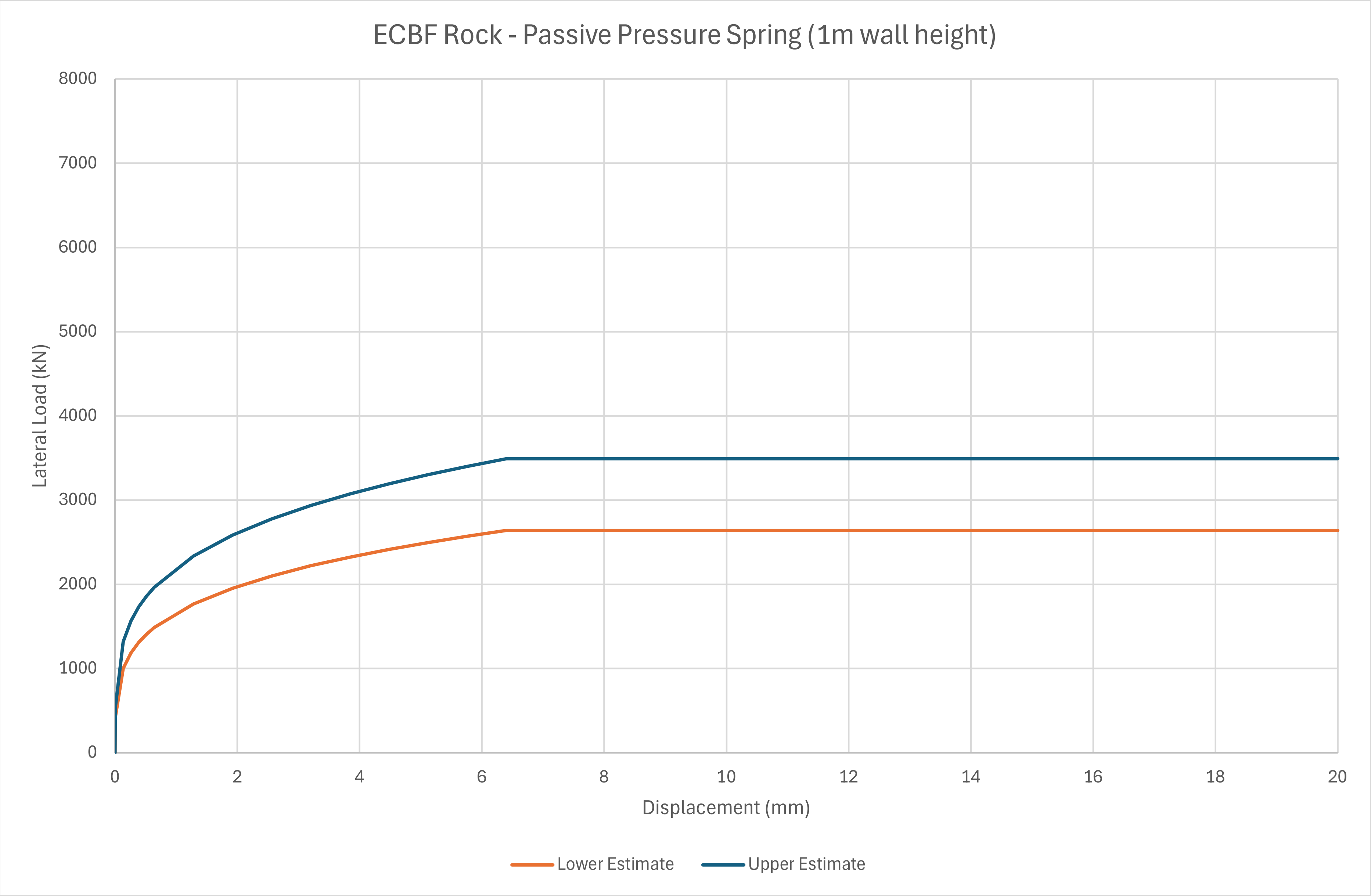

DTW - Retaining Wall Sliding Fiction
Skin friction (kPa)
400
350
300
250
200
150
100
50
0
0
1
2
3
4
5
6
7
8
9
10
Displacement (mm)
ECBF Rock

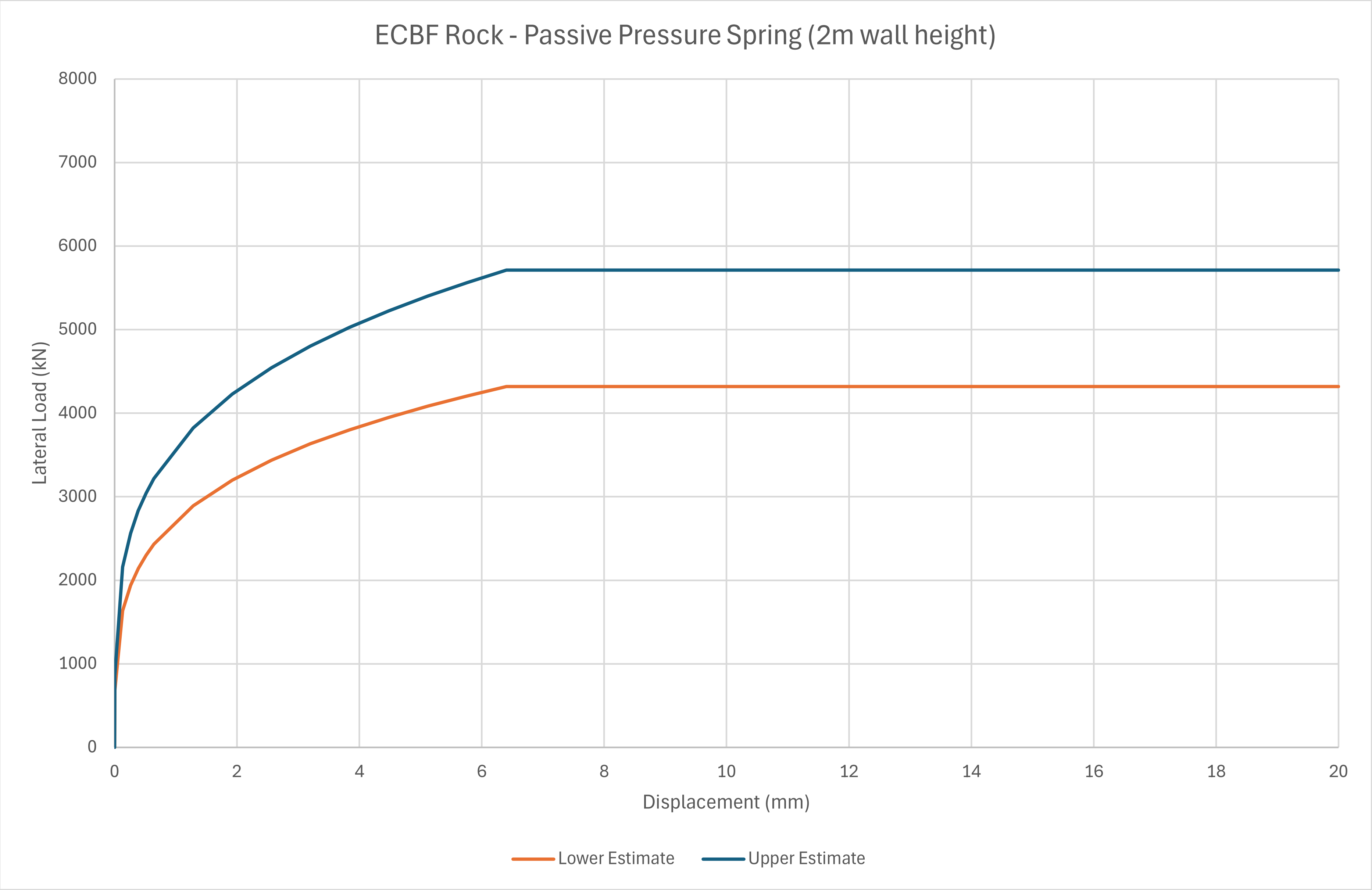


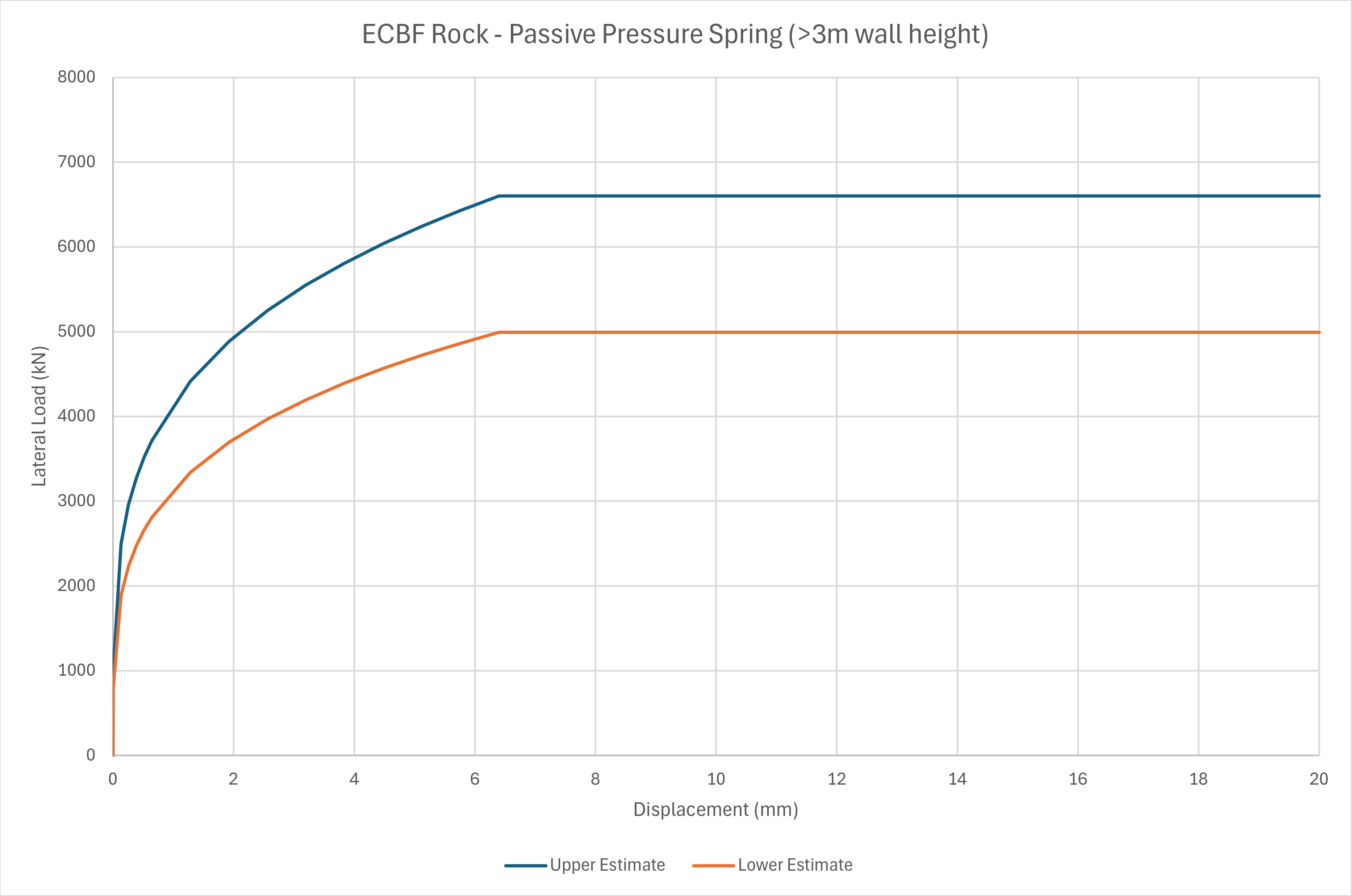
Lower estimate of passive pressure spring for Reclamation Fill/Tauranga Group Sediments
Mobilised Earth Resistance (kN/m run)
Displacement (mm)
0
20
40
60
80
100
120
0
5
10
15
20
25
30
1m
2m
3m
5m
7m
9m
11m

Upper estimate of passive pressure spring for Reclamation Fill/Tauranga Group Sediments




ECBF Rock - Passive Pressure Spring (1m wall height)
Lateral Load (kN)
8000
7000
6000
5000
4000
3000
2000
1000
0
0
2
4
6
8
10
12
14
16
18
20
Displacement (mm)
Lower Estimate
Upper Estimate


ECBF Rock - Passive Pressure Spring (2m wall height)
Lateral Load (kN)
8000
7000
6000
5000
4000
3000
2000
1000
0
0
2
4
6
8
10
12
14
16
18
20
Displacement (mm)
Lower Estimate
Upper Estimate


ECBF Rock - Passive Pressure Spring (>3m wall height)
Lateral Load (kN)
8000
7000
6000
5000
4000
3000
2000
1000
0
0
2
4
6
8
10
12
14
16
18
20
Displacement (mm)
Upper Estimate
Lower Estimate

www.tonkintaylor.com