



WIAL Southern Seawall Renewal

Option Assessment & Design Summary Report

Prepared for Wellington International Airport Limited

Prepared by Beca Limited

22 October 2025



**make
everyday
better.**

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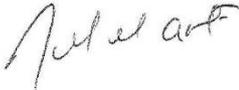
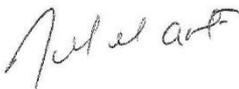
Appendix D – Drawings

Appendix E – Geotechnical Assessment of MGC Yard Cut Batter Slopes

Revision History

Revision N°	Prepared By	Description	Date
A	Tate Kimpton	Issue for consent application	29/08/2025
B	Jennifer Hart	Updated for consent application	22/10/2025

Document Acceptance

Action	Name	Signed	Date
Prepared by	Tate Kimpton Jennifer Hart (Section 4.5 update)		22/10/2025
Reviewed by	Jennifer Hart Mona Liao (Section 4.5 update)		22/10/2025
Approved by	Jennifer Hart		22/10/2025
on behalf of	Beca Limited		

1 Introduction

This report has been prepared by Beca Ltd for Wellington International Airport Ltd (“**WIAL**”) to summarise the Southern Seawall options assessment and design process. The report is provided to support an application for approvals under the Fast-track Approvals Act 2024 by WIAL for the Southern Seawall Renewal Project (“**the Project**”) and may be used by the panel appointed under that Act in assessing the application.

The report is divided into the following sections:

- Southern Seawall options assessment.
- Southern Seawall and Eastern Bank Remediation design.
- Miramar Golf Course Yard (“**MGC Yard**”) development.

Establishment of a kororā colony forms part of the effects management scheme for the Project and is covered in ecological and landscape assessments, rather than this document.

The Southern Seawall at Wellington International Airport (“**the Airport**”) has reached the end of its functional life. The Project will help safeguard the long-term operation of the Airport against natural hazards, increase the Airport’s resilience to climate change, and reduce the increasing maintenance demands of the existing seawall. The seawall location is shown in **Figure 1-1**.

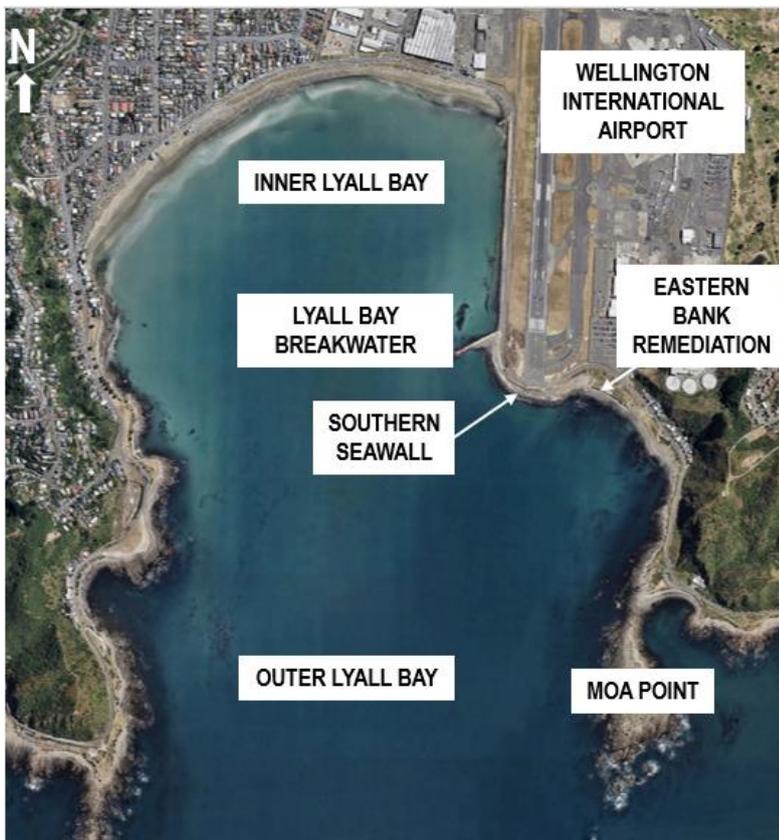


Figure 1-1: Southern Seawall location, Lyall Bay, Wellington

The authors of this report are Jennifer Hart and Tate Kimpton. We have the qualifications and expertise set out in **Appendix A** and confirm that we have read the Code of Conduct for expert witnesses contained in the Environment Court Practice Note 2023. This report has been prepared in compliance with that Code, as if it was expert evidence presented in proceedings before the Environment Court. Unless we state otherwise, this report is within our area of expertise, and we have not omitted to consider material facts known to us that might alter or detract from the opinions expressed in this report.

2 Southern Seawall Options Assessment

Options for the Southern Seawall renewal were assessed using a phased process in 2022 and 2023. This included a series of “filters” to narrow the options from a long list to shortlisted concepts and finally a preferred solution. The process included multi-criteria analysis of seawall options and review of armour units for the preferred option. Affordability and value for money were key project considerations and airline consultation was an important part of the project.

The multi-disciplinary project team for the options assessment phase included:

- WIAL.
- Beca Ltd (coastal, geotechnical, structural and civil engineering; environmental science; quantity surveying).
- Professor Jentsje van der Meer (international coastal engineering specialist).
- Mitchell Daysh Ltd (resource management planning).
- McConnell Dowell Constructors Ltd and Heron Construction Ltd (construction contractors, acting as constructability advisers), and HEB Construction Ltd (additional constructability adviser for the final options workshop).

2.1 Review of Fundamentals

An initial review was undertaken to identify the project objectives, evaluate existing information and identify gaps, establish functional requirements and assess project constraints.

The agreed project objectives are:

- Safeguard the long-term operations of Wellington Airport and adjacent council infrastructure against natural hazards, e.g. coastal inundation, coastal erosion.
- Provide for continued safe airport operation during the sea defences construction period.
- Deliver a sustainable solution that is adaptable for any future Wellington Airport development opportunity and delivers prudent use of capital.

Initial functional requirements for the sea defences, which provide a basis for option identification, concept development and assessment, included:

- A design working life of 50 years.
- Provision for 50 years of climate change.
- Adaptability for up to 100 years of climate change.
- A 1% Annual Exceedance Probability (“AEP”¹) design wave and water level event.

Existing engineering reports were reviewed, including a previous concept design, wave modelling, geotechnical investigations and analysis, seawall inspection and maintenance reports, and historic aerial photos and records. This body of information allowed constraints to be well-understood at an early stage of the project and facilitated option identification and assessment. A gap analysis was completed to identify areas where further information was needed for future design (geotechnical investigation and analysis, marine investigations, numerical wave modelling, refer to Section 3.1).

Project constraints were then identified by the team. Key constraints are set out in Table 1-1.

¹ Annual Exceedance Probability (“AEP”) is the probability of an event being equalled or exceeded in any given year. An 1% AEP event has a 1 in 100 probability of being exceeded in a given year.

Table 1-1: Key constraints

Constraint	Description
Airport Obstacle Limitation Surface (“OLS”) and clearway	Height of seawall limited by OLS and clearway Height of construction plant limited during airport operating hours / limited night time hours for using large construction plant
Wind and wave exposure	Frequent high winds and wave conditions limit operating windows for construction plant and pose risk of damage to construction workforce, particularly if seawall slope armour is removed
Water depths at the seawall toe of up to 11m	Water depths limit the types of construction plant that can be used; specialist plant required
Moa Point Road closure limitations	Construction plant access to seawall limited by need to minimise lane and road closures
Existing utilities	Utilities to be protected, avoided, etc by construction activities
Local ecology	Effects on local ecology to be mitigated
Planning rules and requirements	Limits on construction noise, construction traffic, construction lighting, footprint of works, etc
Land ownership	Land without title potentially constrains construction access and/or activities

2.2 Option Identification, Shortlisting and Concept Development

2.2.1 Option identification

The initial review was followed by identification and scoping of potential options for the sea defences. The purpose of this second phase was to:

- Select a rational number of options for detailed assessment.
- Make sure that options were sufficiently well-considered and that the option selection process was robust, reducing the risk of re-assessment.
- Draw a distinction between describing fundamental options for assessment and continuing to refine option details that would be better developed through design processes, later in the project.

The engineering team identified a longlist of options, taking a ‘blue sky’ approach, and prepared initial concepts for each longlisted option. The longlisted options for the Southern Seawall included:

- “Monitor and manage” the existing seawall, which was designed and built in the early 1970s.
- Maintain the existing seawall with 12t Akmon units, the existing armour type.
- Seawall overlay with new armour units.
- Submerged caisson breakwater, located several hundred metres south of the Southern Seawall.
- Emerged caisson breakwater, located several hundred metres south of the Southern Seawall.
- Submerged rubble mound breakwater, located several hundred metres south of the Southern Seawall.
- Emerged rubble mound breakwater, located several hundred metres south of the Southern Seawall.
- Emerged berm breakwater, located several hundred metres south of the Southern Seawall.
- New conventional seawall, where some of the existing seawall armour is removed and replaced with new armour using a steeper or milder seawall face.
- New berm seawall, where some of the existing seawall armour is removed and replaced with new armour using a berm seawall cross section.
- Artificial reef (5m high, 150m wide, 200m long) at the seawall toe to break incoming waves seaward of the seawall, and maintenance of the existing seawall.

- Large artificial reef (5m high, 150m wide, 300m long), extending around the central and western sections of the seawall, and maintenance of the existing seawall.

WIAL representatives, and engineering, cost, and constructability leads examined the longlisted options at a Constructability and Innovation Workshop. Key issues considered included engineering performance, airport operational requirements, site conditions, construction (materials, sources/transport to site/handling, construction methodologies, temporary works), costs and sustainability opportunities. Feedback from the workshop was used to update the longlisted options taken into the shortlisting and challenge workshop.

2.2.2 Shortlisting and challenge workshop

A high-level shortlisting and challenge workshop (Filter 1) was held to inform shortlisting of options for further assessment. It was attended by a multidisciplinary team, with planning and environmental specialists in addition to client, engineering and constructability representatives. The workshop examined the longlisted options across a broad range of pre-agreed criteria based on the project objectives and functional requirements. The criteria included:

- Potential concerns for mana whenua, stakeholders and interested parties (“wider parties”).
- Consent-related considerations including long term and construction-phase environmental effects, and sustainability including qualitative comparative embedded carbon, waste, energy and resource utilisation.
- Impact of construction on airport operations.
- Qualitative comparative cost.
- Constructability.
- Engineering performance and design risk, including durability and maintenance, and climate and natural hazard resilience and adaptability.

The option scores from the workshop are summarised in **Table 2-1**. The workshop scoring was used as a tool to inform selection of shortlisted options. The workshop agreed that two longlisted options (overlay with larger akmons; overlay with other larger armour units) were effectively the same option and should be combined. Five options, which are described in **Section 0**, were shortlisted. The discounted options included:

- The “monitor and manage” option, involving no further physical works to the seawall, which had a high risk of seawall failure within the next 50 years, would result in increasing disruption to airport operations from wave overtopping and damage as the seawall deteriorated, and would not provide an acceptable level of resilience against extreme events with climate change.
- Continuing to maintain the existing seawall using the present armour units, which similarly had a high risk of seawall failure, would result in increasing disruption to airport operations, would not provide an acceptable level of resilience, and would also require more frequent and increasingly difficult maintenance.
- “Filling” the seabed to create an artificial reef between existing natural reefs had also uncertainties around the indirect protection provided to the existing seawall by the new structure (noting that the existing seawall has experienced damage in the natural reef areas), a significant footprint, and required a large volume of material with associated costs.
- Highly unlikely sub-variants of the “monitor and manage” and “continue to maintain” options were included for completeness only but were not considered further because of their very low likelihood of meeting the project objectives and functional requirements.
- Submerged breakwater options were subsequently also removed from further consideration following review because of the uncertainties and risks (e.g. uncertain level of protection, novel/untested solution for exposed wave environment), coupled with the potential for effects on coastal processes, surf breaks, and ecology plus potential concerns for mana whenua, and surfing and fishing groups.

Table 2-1: Shortlisting (Filter 1) scoring

Option	Wider parties	Environmental effects	Airport operations	Cost	Constructability	Engineering	Score
Monitor & manage - does not result in failure within the next 50 years (highly unlikely)	0	0	2	2	2	-2	4
Monitor & manage - results in failure of the structure within the next 50 years (highly likely)	0	0	-2	-2	-2	-2	-8
Continue to maintain with 12t akmons - does not result in failure within the next 50 years (highly unlikely)	0	0.5	2	1	2	-1	4.5
Continue to maintain with 12t akmons - results in failure of structure within the next 50 years (highly likely)	0	0.5	-2	-2	-2	-2	-7.5
Overlay with larger akmon or other units (combined option)	0	0	1.5	-1.5	0	0	0
Offshore breakwater submerged caisson	-1	-1	1	-1	0	0	-2
Offshore breakwater emerged caisson	-1.5	-2	1	-2	1.5	1.5	-1.5
Offshore breakwater submerged rubble mound with armour units	-1	-1	0.5	-1	1	0.5	-1
Offshore breakwater emerged rubble mound with armour units	-1.5	-2	0.5	-1	2	1	-1
Offshore breakwater rubble mound with berm with rock armour	-1	-2	0	-1	2	1	-1
Modify existing seawall with steep slope and new armour units	-0.5	-0.5	-2	0	-1	0	-4
Modify existing seawall with flatter slope and new armour units (larger)	-0.5	-0.5	-2	0	-2	0	-5
Modify existing seawall with berm and new armour units	-0.5	-0.5	-2	0	-1	1	-3
Modify existing seawall - rebuild above water, overlay below water, with new armour units	-0.5	-0.5	-2	-1	-2	1	-5
Modify by filling seabed between reefs, and continuing with 12t akmons on existing seawall	-1.5	-2	-0.5	-0.5	0	1	-3.5
Modify by filling seabed between reefs and extending fill around Lyall Bay Breakwater, and continuing with 12t akmons on existing seawall	-1.5	-2	-0.5	-1	0	1.5	-3.5

2.2.3 Shortlisted options and concept development

Initial outline concepts were developed for the shortlisted options using empirical calculations, with reference to design guidelines and standards. Key references included the current climate change information at the time (e.g. Ministry for the Environment guidance), and coastal engineering standards and design guidance (e.g. BS 6349:1 Maritime Works; CIRIA (2007) The Rock Manual, the use of rock in hydraulic engineering; Van der Meer, J. and Sigurdarson, S (2017) Design and Construction of Berm Breakwaters; Takahashi, S (1996) Design of Vertical breakwaters, Port and Airport Research Institute, Japan).

Design inputs included available wave, water level and survey information, Relative Sea Level Rise associated with climate change and Vertical Land Movement, and depth-limited wave conditions. The inputs were sourced from publications such as: LINZ (2022) Standard port tidal levels; NIWA (2016) Technical Report on Coastal Hydrodynamics and Sediment Processes in Lyall Bay; and New Zealand SeaRise Te Tai Pari O Aotearoa (<https://searise.takiwa.co/map>).

The five shortlisted options are described below and shown in **Figure 2-1 (a) to (e)**.

Seawall overlay with new concrete armour units: Overlaying the seawall with concrete armour units re-uses the existing structure with minimal removal of material. It reduces exposure and loss of underlayer and core material, and shortens the construction duration as most of the existing seawall remains in place. In addition, it reduces demolition waste and the quantity of new material (rock, concrete, etc) needed for the seawall. Recognising the variable nature of the existing seawall, the exposed site, and local seismicity, a 2-layer armour system that could be placed rapidly was selected. The option adopted a nominal 16t concrete armour unit, placed on a 1V:1.5H slope, with a 1.4t rock underlayer of variable thickness to reprofile the existing seawall.

Emerged caisson breakwater: A caisson breakwater, located 300m-400m offshore and 400m-480m long, protects the existing Akmon seawall from wave attack for the 50 year design life. The existing seawall is rehabilitated using the 12t Akmons, the existing armour units. The caisson is 20m wide, based on initial stability calculations. The caisson crest is at Mean Sea Level, balancing function with effects on the landscape and natural character of outer Lyall Bay. The offshore location and shorter construction period lessen potential construction impacts on airport operations but the caisson is in a more exposed location compared to the existing seawall. All the breakwater options could potentially affect the inner Lyall Bay wave climate and surf characteristics.

Emerged rubble mound breakwater: The layout and function of the rubble mound breakwater option is as for the caisson option and is also combined with rehabilitation of the Akmon seawall. The breakwater is approximately 75m wide at the seabed. The crest is approximately 3m above Mean Sea Level, to provide stability under wave overtopping, with associated landscape and natural character effects. The breakwater is armoured with two layers of concrete armour units (represented by nominal 30t units) over rock underlayer and core. Large quantities of rock and concrete are required compared to the seawall overlay and caisson options. As for other breakwater options, the location reduces construction impacts on airport operations but means the construction site and permanent structure are exposed to larger waves. The breakwater also potentially affects waves and surf in inner Lyall Bay.

Emerged berm breakwater: The berm breakwater option is similar to the rubble mound breakwater but uses nominal 8t, 13t and 20t rock to form a higher crest (approximately 11m above Mean Sea Level) and a wide berm on the seaward side of the breakwater. The footprint of the berm breakwater is the largest of all the options (approximately 140m wide). Very large quantities of rock are required and armour rock sizes would likely require development of new quarries. Overall, however, the berm breakwater offers the opportunity to efficiently utilise quarry output. Again, the breakwater location reduces construction impacts on airport operations but means the construction site and permanent structure are exposed to larger waves. As noted above, the breakwater also potentially affects waves and surf in inner Lyall Bay.

New berm seawall: The berm seawall option combines a concrete armour unit (represented by nominal 30t unit) with a berm profile, extending approximately 50m seaward of the existing seawall toe. The wide, lowered berm provides greater working height beneath the OLS for placing the concrete armour units, compared to the seawall overlay option. The footprint and materials quantities are the second-highest of the options considered, however.

An options report was prepared summarising concept level information, option sketches and key features (e.g. footprint area, crest level, quantities of materials, construction method, rough order comparative cost, initial programme estimate, and safety in design and sustainability considerations).

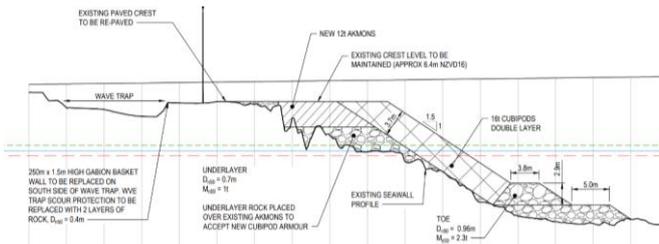


Figure 2-1 (a): Seawall overlay with new concrete armour units

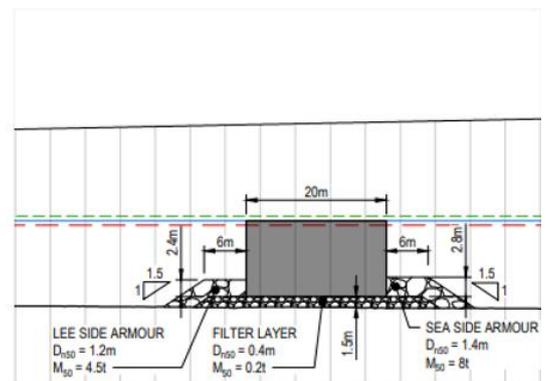
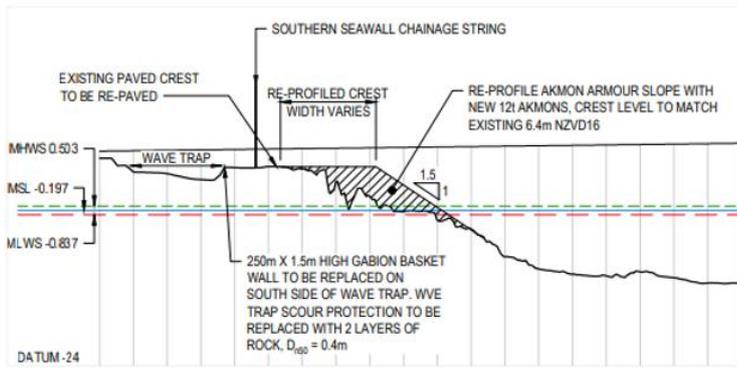


Figure 2-1(b): Emerged caisson breakwater

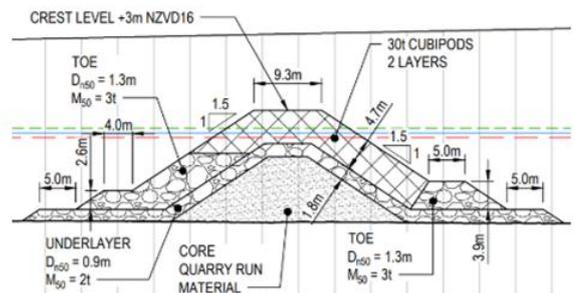
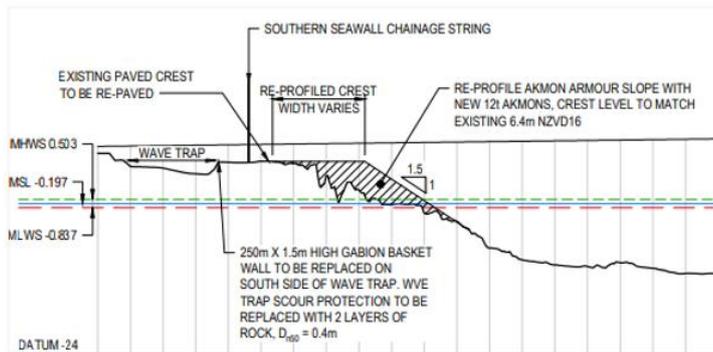


Figure 2-1 (c): Emerged rubble mound breakwater

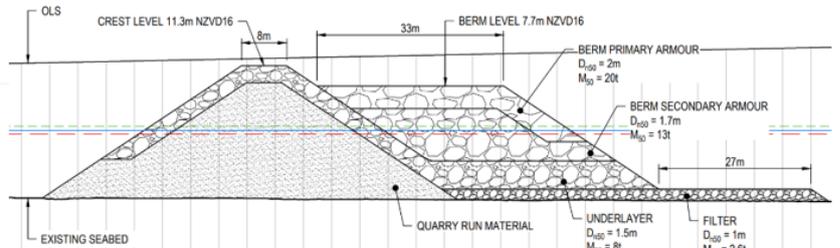
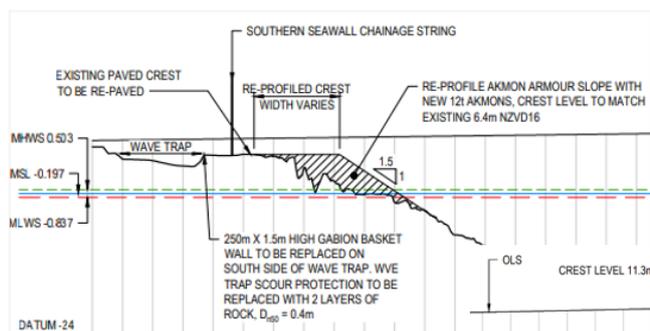


Figure 2-1 (d): Emerged berm breakwater

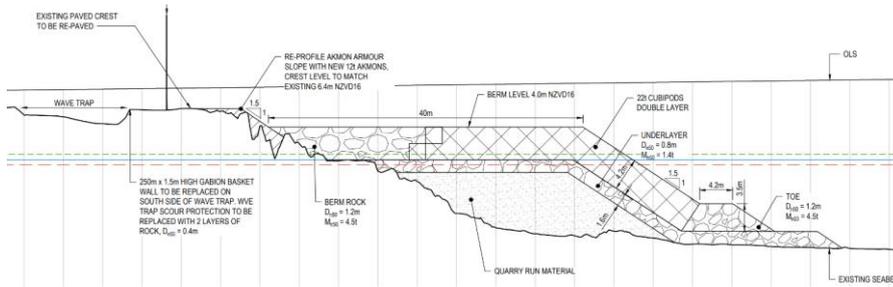


Figure 2-1 (e): Berm seawall

2.3 Seawall Options Assessment

The project team used a Multi-Criteria Analysis (“MCA”) as a tool to help identify options to take forward for further consideration. This MCA process was referred to as Filter 2. The team developed an MCA framework comprising MCA criteria aligned with the project objectives and functional requirements, a 10-point scoring system, and a detailed process including pre-scoring led by ‘criteria owners’. The criteria included:

- Environmental and social impacts during construction and long term and opportunities.
- Sustainability and future development (including embedded carbon).
- Construction impacts on airport operations.
- Constructability and construction risk.
- Engineering feasibility, performance and risk (including Safety in Design and maintenance).
- Adaptability for climate change.
- Mana whenua partner considerations, which were considered in relation to previous and current mana whenua views, however were not formally scored pending further discussions with mana whenua.
- Affordability (comparative order of cost), which was considered but not formally scored.
- Integration with options for the other sea defences, which again was considered but not formally scored.

Criteria owners undertook an initial assessment and scoring of the options in advance of the workshop. This involved documenting key assumptions, assessment and scoring. The initial scoring was presented at the MCA workshop and tested by the multi-disciplinary workshop team. The workshop scoring is summarised in **Table 2-2**.

Table 2-2: Summary of MCA workshop (Filter 2) scoring

Option	Environmental & social impacts	Sustainability & future development	Airport operations	Constructability	Engineering (averaged)	Adaptability	Score
Seawall overlay	-3 (constructn) -1 (long term)	-1 (sustainab) 3 (future dvpt)	-3	-1	0.4	2	-3.6
Caisson breakwater	-2 (constructn) -3 (long term)	-2 (sustainab) 5 (future dvpt)	-1	1	2.8	4	4.8
Rubble mound breakwater	-4 (constructn) -4 (long term)	-3 (sustainab) 5 (future dvpt)	-3	-2	3	4	-4
Berm breakwater	-5 (constructn) -5 (long term)	-5 (sustainab) 5 (future dvpt)	-4	-3	2.4	5	-10
Berm seawall	-4 (constructn) -3 (long term)	-3 (sustainab) 2 (future dvpt)	-4	-2	1.4	2	-11

The option rankings by MCA scoring (highest to lowest) were: caisson breakwater, seawall overlay, rubble-mound breakwater, berm breakwater, berm seawall.

The option rankings by comparative rough order costs (lowest cost to highest cost) were: seawall overlay, caisson breakwater, berm seawall, rubble-mound breakwater, berm breakwater.

Rankings, scores and specialists' comments were reviewed and the relative scores under each criterion were carefully considered. Two options to take forward for final selection were identified, with the decision informed by the workshop and rough order comparative costs. The selected Southern Seawall 'take forward' options were:

- Seawall overlay with new armour units.
- Emerged caisson breakwater.

These two options were selected because, while they have different constructability benefits, risk profiles and environmental effects considerations, they are both relatively adaptable and provide efficient use of existing and new materials. The large scale of the other three options (rubble mound breakwater, berm breakwater, and berm seawall) resulted in significant seabed footprints and environmental and social effects, substantial quantities of rock and/or concrete armour units, and higher costs. The three larger options were therefore discarded.

The MCA workshop also identified specific areas to investigate to refine the 'take forward' options before a final MCA process to select the preferred option (refer to **Section 2.4**).

2.4 Seawall Option Refinement and Final Selection

One of the investigations identified by the Filter 2 MCA workshop was an engineering and constructability review of reclamation between the Southern Seawall and Lyall Bay Breakwater to reduce the curvature of the seawall, protect the breakwater, and potentially provide an additional construction staging/laydown area. The review compared the increased construction cost (due to increased additional seawall materials and construction process) with potential savings from improved construction productivity from the laydown area, laydown area alternatives, and non-cost considerations such as potential landscape and project footprint impacts. The construction saving achieved by a 10-month reduction in programme was outweighed by the significant additional construction cost. The reclamation was ruled out of further consideration.

The offshore caisson foundation concept was confirmed based on existing geotechnical ground investigations undertaken in 2014. It was noted that further investigations would be required if the offshore caisson was selected as the preferred option. Potential ground improvement measures were identified if investigations indicated more adverse ground conditions.

An assessment of quarry rock sources was also completed. The Wellington region is not able to supply suitable rock due to tectonic faulting. An engineering geologist and coastal engineer visited quarries in nearby regions to assess rock properties and suitability for seawall armour (e.g. rock size gradings, density), logistics, production rates, and storage. Multiple potential rock sources were identified in South Taranaki and Tākaka, 200-300km from the site.

Mana whenua partner and stakeholder engagement also continued during this period, including face to face and on-line meetings, newsletters and on-line information. Feedback was sought from mana whenua partners and stakeholders including the local community, local authorities and stakeholder groups.

A final MCA workshop (Filter 3) was held to select the preferred Southern Seawall option for preliminary design. The process followed the same approach as the Filter 2 MCA described in **Section 2.3**. A briefing pack was pre-circulated to inform assessment and option scoring in advance of the MCA workshop. The options were re-scored for each criterion taking into account the updated information. An additional sub-criterion was included for environmental and social opportunities, to help reflect partner and stakeholder feedback. Consensus scores were then agreed at the workshop, as summarised in **Table 2-3**. A sensitivity check was also conducted, which determined that the option selection was not sensitive to moderate changes in scoring or averaging/direct calculation of scores.

Table 2-3: Summary of MCA workshop (Filter 2) scoring

Option	Environmental & social impacts	Sustainability & future development	Airport operations	Constructability	Engineering (averaged)	Adaptability	Score
Seawall overlay	-3 (constructn) -1 (long term) 1 (opportunit)	-1 (sustainab) 3 (future dvpt)	-1	2	1.2	2	-3.6
Caisson breakwater	-3 (constructn) -3 (long term) 1 (opportunit)	-2 (sustainab) 5 (future dvpt)	-1	-1	1.2	2	4.8

Following further engagement with mana whenua, the preferred option for the Southern Seawall was confirmed as:

- Seawall overlay with new concrete armour units.

The seawall overlay option was selected because of its higher scoring and better ranking for environmental and social impacts (less impact on coastal processes and landscape/visual amenity than the breakwater option), comparative rough order costs (lower cost than the breakwater option), local construction capability and experience (offshore caissons of the scale required to protect the seawall have not previously been designed or constructed in New Zealand, while several large rock and/or concrete armour units structures have been delivered over the past decade), and sustainability (smaller volumes of material required for the seawall overlay than for construction of the new breakwater and maintenance of the existing seawall).

2.5 Armour Unit Options Review

While Cubipod® units were used as a proxy concrete armour unit for the options assessment stage, it was important to undertake a deliberate armour review and selection process. This was completed by the engineering and constructability representatives in the project team.

The concrete armour units assessed were Accropode II®, Akmon, Cube, Cubipod® (1- and 2- layer), Ecopode®, Hanbar, Xbloc® and Xbloc Plus®. The review considered armour features including:

- Interlocking or mass-based stability.
- 1- or 2- layer armour systems.
- Design slope.
- Engineering performance and failure modes.
- Casting complexity and production rate.
- Transport and logistics.
- National availability of plant required for placement.
- Placement method, ease and rate of placement at an exposed site.
- Underlayer tolerance.
- Ability to be placed on a curved alignment.
- Licence/patent arrangements and technical support.

Armour unit mass, approximate number of units, and concrete volumes were estimated for comparative purposes based on design water levels and depth-limited wave conditions.

Units that were not available in the required size (e.g. Ecopode®) were removed from further consideration. Units with strict placement and underlayer tolerances, such as Accropode II®, Xbloc® and XblocPlus®, were also not considered further. Engineering performance, comparative cost, performance and constructability risks, and efficient use of resources were assessed for the remaining four units.

A two-layer Cubipod® system was identified as the most suitable armour unit to overlay the existing Southern Seawall for the following reasons:

- A smaller unit, which is easier to handle and place, can be used compared with other options (approximately 45% to 55% the mass of other units).
- The unit has more tolerant underlayer requirements, which is advantageous for overlay of an existing structure such as the 50-year old Southern Seawall.
- Placement is relatively straightforward and efficient because units are placed on a grid and do not need to achieve a specific orientation or interlocking between units.
- The comparative concrete volume is similar to other units, for the same design conditions.
- The unit is compact, with routine casting and handling requirements.
- Cubipod® armour can “self-repair”.
- A two-layer system is also more resilient to possible damage, compared with a one-layer as it has an extra layer of armour units.

2.6 Selected Seawall and Armour Option

The Southern Seawall renewal option selected through the progressive MCA assessments is:

- Seawall overlay using two-layer Cubipod® armour and rock underlayer to re-profile the existing seawall to a 1V: 1.5H slope.

3 Southern Seawall & Eastern Bank Remediation Investigations & Design

Between 2023 and 2025, investigations and design were progressed for the Southern Seawall. Investigations were undertaken to provide additional data as identified in the earlier gap analysis (refer to **Section 2.1**). Preliminary design, including two-dimensional (“**2D**”) physical modelling, was then carried out. This was followed by detailed design including three-dimensional (“**3D**”) physical modelling. The investigation and design activities are described below.

3.1 Investigations and Analysis

3.1.1 Ground Investigation and Geotechnical Analysis

Multiple landside and marine investigations have been carried out at Wellington International Airport over the past 30 years. In addition, seabed probing, underwater videos, and sediment grain size analysis were completed in 2023 and 2024 to characterise the seabed at the seawall toe (refer to **Figure 3-1**).

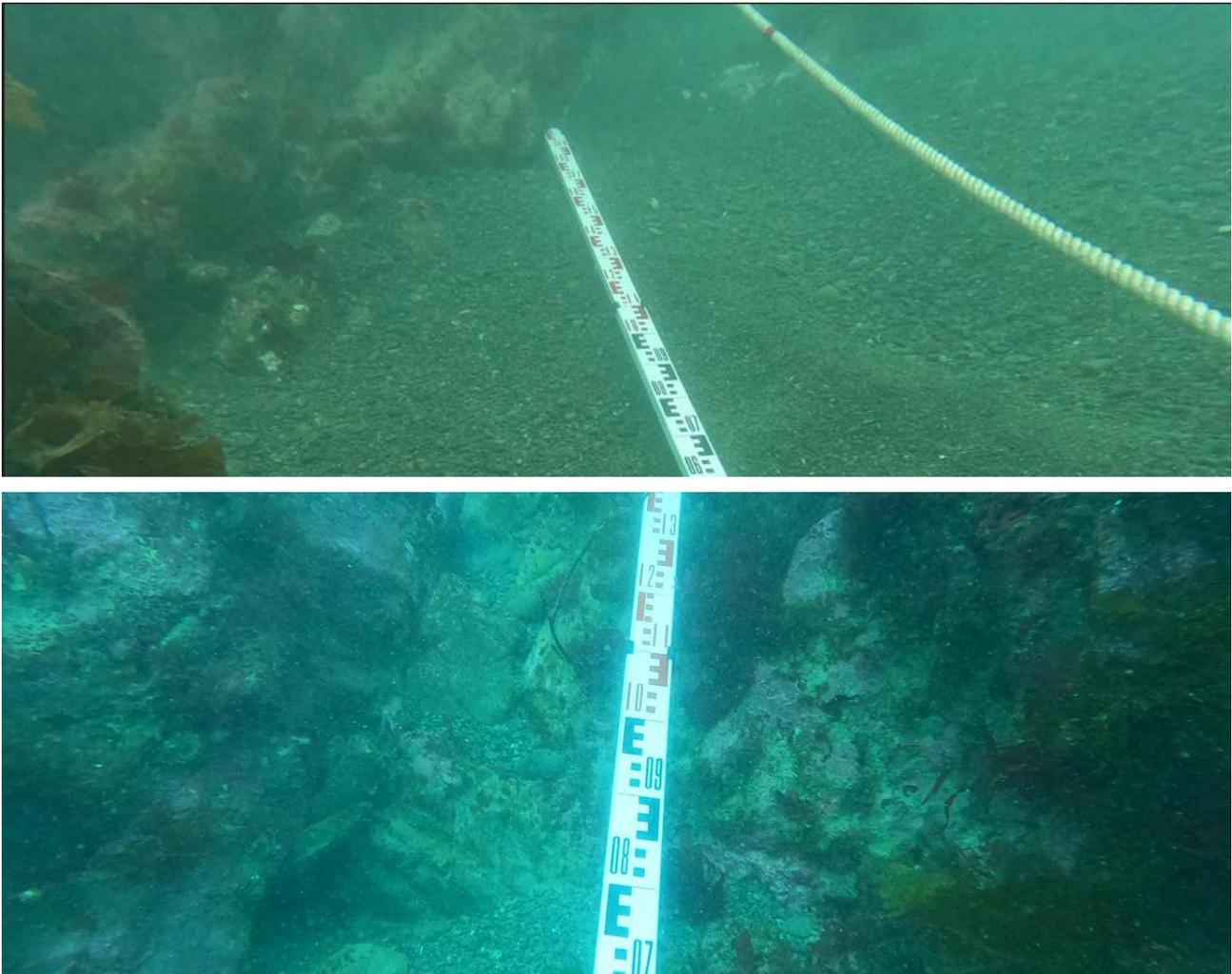


Figure 3-1: Outcropping rock and sandy gravel seabed. Top: approximately 20m south-west of existing seawall toe. Bottom: approximately 20m south of existing seawall toe.

These investigations and existing geological maps indicate the site is underlain by reclamation fill (placed variously during the 1950s and 1970s) and Holocene marine deposits. A borehole at the Southern Seawall encountered greywacke beneath the fill and marine deposits, and in-situ Late Triassic Rakaia Terrane greywacke and argillite rock outcrops to the north and east. Historical aerial photographs and present day site observations also show rock outcropping at Lyall Bay Breakwater and south of the Southern Seawall. Potential extension of the Evans Bay and Aotea faults into central and western Lyall Bay has been inferred in recent research papers.

A 3D digital ground model was established for the project using the investigation findings and Leapfrog software. Geotechnical and seismic parameters were developed (summarised in **Appendix B**). Liquefaction assessments did not indicate liquefaction under Serviceability Limit State 1 (“**SLS1**”, 1 in 25 year earthquake) but did point to layers of liquefiable soils landward of and potentially below the Southern Seawall under Serviceability Limit State 2 (“**SLS2**”, 1 in 500 year earthquake) and Ultimate Limit State (“**ULS**”, 1 in 2,500 year earthquake) cases.

Global slope stability assessments were carried out using the Slope/W 2023 programme. The stability assessment indicated the target Factors of Safety are achieved for the static long term case, static short term case with groundwater drawdown, SLS1 case and post-seismic case. The assessment suggested the slope is sensitive to the presence of liquefiable soils under SLS2 and ULS seismic events. Rock level was found to be less critical to global stability.

Indicative potential extent and magnitude of seismic slope displacements were identified from a range of seismic cases using simplified slope stability software. The analysis indicated that no slope displacement is expected in the SLS1 case. The assessments suggested the potential for slope displacement to extend well landward of the Southern Seawall due the liquefaction of historic fill material which forms the southern-western part of the airport. The findings were discussed by WIAL and Beca designers. WIAL expect seismic displacements to occur potentially within this area during a large earthquake and have contingency planning in place. Noting the behaviour of the airport fill and existing seawall during larger earthquakes over the past fifty years and considering the wider effects of a large seismic event on the airport and city infrastructure and the practicality and cost of engineering a seawall to withstand liquefaction of the historic fill landward of it, it was decided that the seawall would not be required to resist seismic loads and retain the hinterland reclamation.

3.1.2 Marine Field Investigations

A remote camera was deployed from July to December 2023 to record video footage of storm events in Lyall Bay. The footage provides information on wave breaking in outer Lyall Bay and overtopping at the Southern Seawall for use in design and for comparison with numerical and physical modelling. Observed wave breaking and overtopping was correlated with wave measurements at the Baring Head wave buoy.

Three wave measurement devices were deployed by NIWA from September to December 2023. The devices were located at the entrance to Lyall Bay, south of the Southern Seawall, and north of Lyall Bay Breakwater. The wave measurements were used to calibrate numerical wave modelling (refer below).

3.1.3 Numerical Wave Modelling

Numerical wave modelling was undertaken by MetOcean Solutions (a division of MetService Ltd) to provide inputs to the seawall design. Hindcast water level data was extracted from the Moana Backbone and Moana nowcast data sets, which together covered the 1993 to 2023 period. The Moana Backbone is a 3D hydrodynamic hindcast model for New Zealand, which has been calibrated and validated against field data around the country. Hindcast wave modelling was carried out for the site using a SWAN model with hourly wind conditions from Climate Forecast System Reanalysis products. The hindcast wave modelling covered a 40 year period from 1980 to 2023. The model was validated using the NIWA field measurements.

Extreme value analysis of the hindcast water level and wave data yielded extreme event Average Recurrence Intervals (“ARI”)² for waves and water levels, which were then converted to the equivalent AEP by the design team. The hindcast data was also analysed to produce ambient wave climate statistics in Lyall Bay. Key outputs for use in the seawall design included water levels and offshore wave heights, periods and directions for 0.1% AEP to 63% AEP extreme events³.

Two different nearshore wave models, a SWASH phase-resolving model and a nearshore SWAN phase-averaged model, were set up to determine which model was the best suited for this application. The model outputs for different wave events were compared with the NIWA field measurements. The SWAN model performed better and was selected for nearshore modelling for the project. Additional calibration and validation were undertaken to further refine the SWAN nearshore model.

Hindcast water level and offshore wave conditions for the 0.1%, 1% and 10% AEP events were adjusted to allow for Relative Sea Level Rise including Vertical Land Movement (0.87m by 2080 and 2.02m by 2130, based on the Shared Socio-economic Pathway SSP5-8.5 83rd percentile), a 2.5% increase in wave height and period by 2080, and a 5% increase in wave height and period by 2130. These values are taken from the climate change references listed in **Appendix A**. The climate change-adjusted extreme wave and water level conditions were then simulated within Lyall Bay using the SWAN nearshore model (refer to **Figure 3-2**).

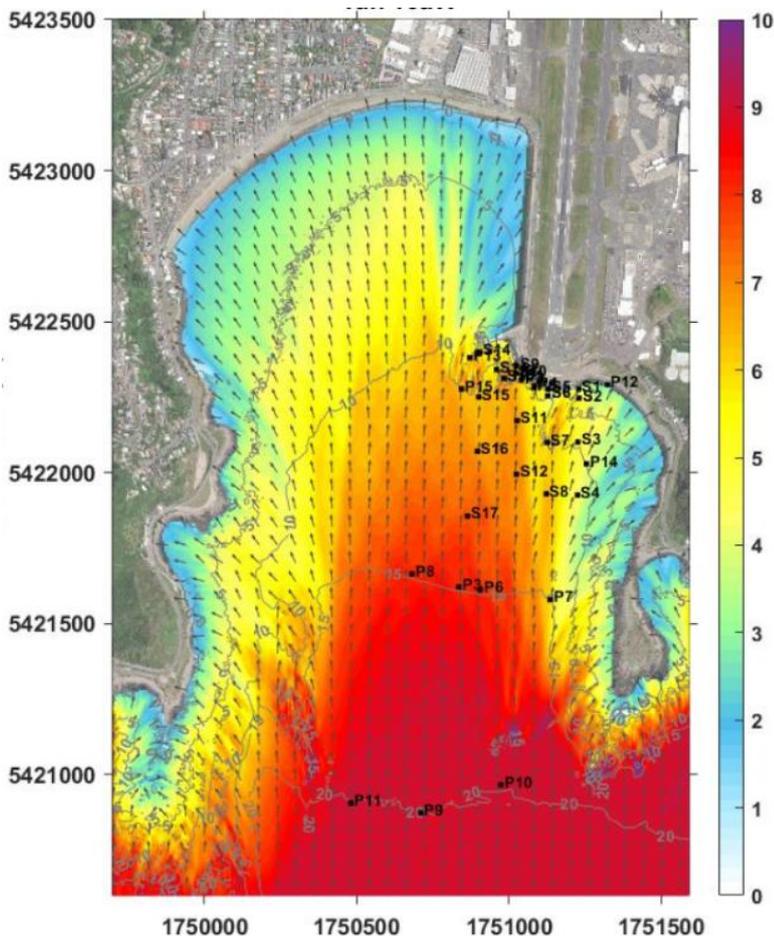


Figure 3-2: Significant wave height and wave direction vectors as modelled for the 1% AEP wave condition in 2080 (MetOcean Solutions, 2025)

² Average Recurrence Intervals (“ARI”) is the average time period between events of a given magnitude.

³ An 0.1% AEP event has a 1 in 1000 probability of being exceeded in a given year and a 1000 year ARI. A 63% AEP event has a 63% probability of being exceeded in a given year and a 1 year ARI (i.e. an “annual storm event”).

3.2 Preliminary Design

3.2.1 Southern Seawall

A Design Basis document was prepared to establish the design guidance and references, client's functional requirements, design criteria and design inputs (e.g. wave heights, water period, water levels). Offshore hindcast modelling data, combined with depth-limited wave heights and allowance for Relative Sea Level Rise due to climate change and Vertical Land Movement, was used for preliminary design while nearshore wave modelling proceeded in parallel. Refer also to **Section 3.3.1**.

The Beca design team sized the concrete armour unit, underlayer rock, and toe rock for the Southern Seawall using empirical formulae and following the Cubipod® licence-holder's design guidance. Armour sizes also were independently assessed by Professor van Der Meer, and by SATO, the Cubipod® licence-holder. Based on the results, both 15.5t units and 21t units were considered in preliminary design. Rock protection for the rear slope at the western section of the seawall and a crest wall and wave trap were approximately sized.

3.2.2 Eastern Bank Remediation

Noting the longstanding active erosion of the 1970s fill east of the existing Southern Seawall, the project team identified an improvement measure for the existing eroding area and mitigation for potential end effects from the Southern Seawall renewal. The Eastern Bank Remediation is therefore included in the project.

The Design Basis document described above for the Southern Seawall also covers the Eastern Bank Remediation. The preliminary design was based on offshore wave hindcast data, combined with depth-limited wave heights and allowance for Relative Sea Level Rise due to climate change and Vertical Land Movement.

The Eastern Bank Remediation entails re-grading the vertical bank to a milder slope and placing rock protection (two layers of armour rock over geotextile). A relatively low crest was adopted, with the upper 2m of the slope protected by grass and turf reinforcement matting. The armour rock was sized as nominal 0.7t rock using the Van der Meer equations from The Rock Manual (CIRIA, 2007). A 1V: 2H slope was adopted based on geotechnical guidance, considering the nature of the fill material from nearby borehole information and site observations.

3.2.3 2D Physical Modelling

The initial preliminary design was built at a 1: 37.5 scale and tested in a 2D wave flume at the University of New South Wales Water Research Laboratory ("UNSW WRL") in Manly, Australia. 2D model testing at the preliminary design stage is considered a good practice approach for complex sea defences exposed to large waves, and has been used for sea defences at the Chatham Islands, Opotiki, Wellington Harbour and Napier. The model tests included 1% AEP design waves and water levels for present day and 2080 including allowances for climate change (**Appendix C**). It also included 0.1% AEP "over design" waves and water levels for 2080 with climate change allowances. A total of 32 hours of cumulative testing under 1% AEP or greater storm conditions was completed. Both 15.5t units and 24.5t units (the latter as a contingency) were tested at model scale. The test results were successful, with no displacement of Cubipod® units in any of the tests, minor intermittent rocking of the units under design conditions, and large rocking of 3% of the units in the overload test. A rock toe option was tested and an acceptable level of minor damage was observed (1 rock out of 450 toe rocks displaced in the low water toe stability test).

Wave overtopping was measured in the model for a range of scenarios including the 10% AEP, 1% AEP and 0.1% AEP wave and water level conditions allowing for climate change to 2080. Large overtopping volumes of up to 60 litres per second per metre were recorded for the baseline case with the armour crest at the same height as the existing seawall and a vertical crest wall extending 1m higher. The modelling showed overtopping discharges could be reduced by 50 to 65% by raising the armour crest by 1 metre and/or raising the vertical crest wall by 0.8m, but were still significant. Wave forces on the vertical crest wall were also measured for 1% AEP wave and water level conditions.

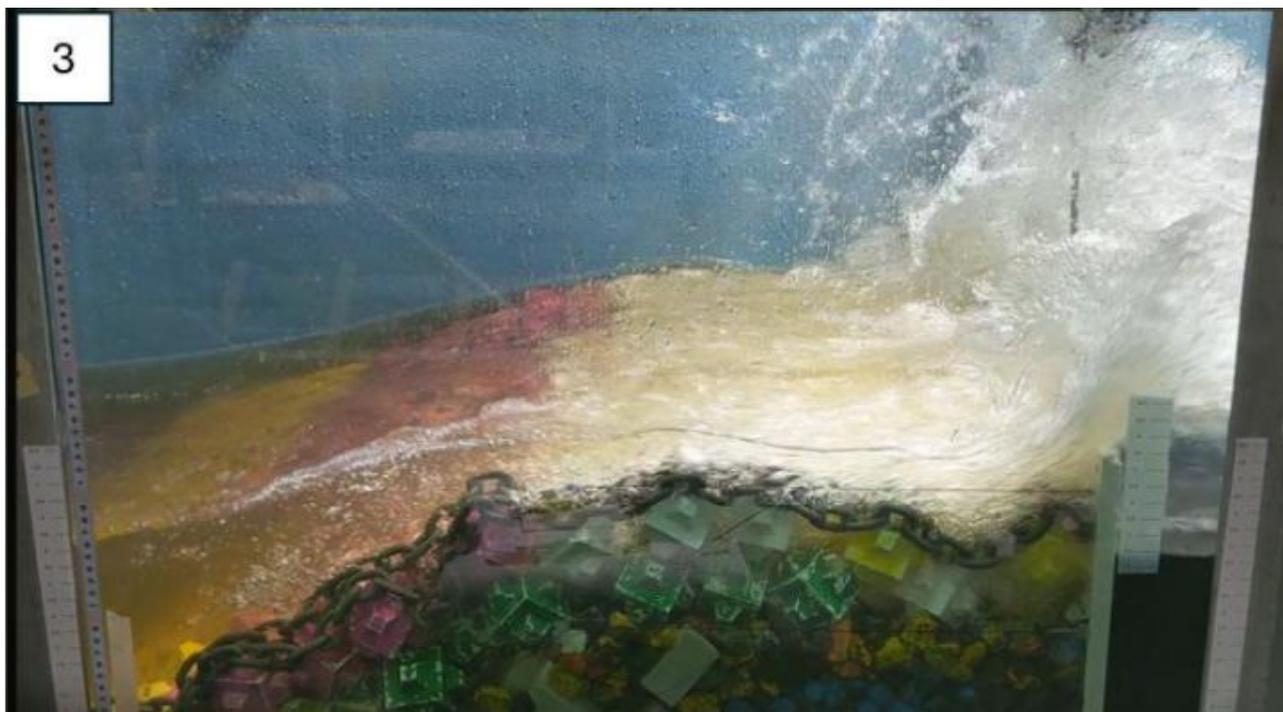


Figure 3-3: Overtopping with 1% AEP 2080 wave and water level conditions with seawall armour crest at existing seawall level and a vertical crest wall (UNSW WRL, 2024)

3.2.4 Design Refinement, Peer Review and Reporting

The preliminary design for the Southern Seawall was refined and confirmed following the physical modelling, including:

- Two-layer 15.5t Cubipod® armour for the seawall with nominal 2.65t rock underlayer.
- An excavated toe, but also retaining the option of a rock toe in case water depths at the central section of the seawall posed constructability issues for excavation.
- A seawall crest level at 7.4m NZVD16 to help to reduce wave overtopping. This level is approximately 1m higher than the existing seawall crest, and approximately 1m lower than the existing railings at the wave wall, landward of the seawall.
- A vertical reinforced concrete crest wall, also to 7.4m NZVD16, to retain the landward side of the crest armour and help to reduce wave overtopping.
- A wave trap landward of the crest wall to collect wave overtopping discharges and direct them eastward, returning the water to the sea at the eastern corner of the seawall.

The preliminary design reports, drawings and draft specifications for the Southern Seawall and Eastern Bank Remediation were issued in mid-2024. The coastal and geotechnical engineering aspects were peer reviewed by Tonkin+Taylor Ltd “**Tonkin+Taylor**”, with outstanding comments being carried forward for resolution during detailed design. The preliminary design documents were also issued to the Pre-Construction Services contractor, McConnell Dowell, for further constructability feedback.

3.3 Detailed Design

3.3.1 Southern Seawall

The Design Basis document was updated with the nearshore wave modelling results. Key detailed design references are listed in **Appendix B** and key detailed design inputs, which include climate change and Vertical Land Movement allowances, are summarised in **Appendix C**. The design cases considered are set out in **Table 3-1**.

Table 3-1: Southern Seawall design cases

Design wave event	Design water level event	Design time horizon	Description
1% AEP	Mean Low Water Springs	2024	<ul style="list-style-type: none"> Toe design case
1% AEP	1% AEP	2024	<ul style="list-style-type: none"> Overtopping case
1% AEP	1% AEP	2080	<ul style="list-style-type: none"> Armour stability & crest wall wave load design case Overtopping case
0.1% AEP	0.1% AEP	2080	<ul style="list-style-type: none"> Over-design case for armour stability

The design team and SATO independently checked the concrete armour unit, underlayer rock, and toe rock sizes using the nearshore wave information. The 15.5t Cubipod® from preliminary design was retained, providing a degree of conservatism for the curved seawall alignment, the potential for complex wave patterns at the seawall due to the site bathymetry and seawall layout, and the challenges of placing armour at the site. The seawall was also modelled using Civil3D digital software.

Multiple constructability workshops were held during the detailed design process. Feedback was incorporated into the detailed design, including:

- A rock toe at the deeper, central section of the seawall and an excavated toe at the western and eastern seawall sections.
- A smaller rock size for the main seawall underlayer (reduced to nominal 1t) to assist in meeting Cubipod® underlayer tolerances, facilitating Cubipod® placement, as well as incrementally improving handling safety, and potentially reducing costs.
- Avoiding gabion baskets on the rear slope and limiting gabion baskets on the seawall crest.

Rock protection for the rear slope at the west section of the seawall was checked for the updated wave data and confirmed as two layers of nominal 2.65t armour rock with two layers of nominal 0.3t underlayer rock with geotextile.

The west end of the seawall has been designed with a 9m wide crest between the Cubipod®-armoured crest and the rear slope protection. The design comprises a similar concept to much of the existing seawall crest: seaward and landward gabion baskets and a core of reinforced earth fill, protected by reno mattresses and in situ concrete surfacing. The design provides an impermeable crest at the same level as the existing crest. This, in combination with the widened Cubipod®-armoured crest, will reduce wave overtopping over the west crest compared with the existing situation. The engineered fill also allows material from the existing fill crest to be re-used on site. The gabion baskets, reno mattresses and concrete surfacing protect the impermeable fill, in the same manner as the existing 30-year old crest. The west crest, similar to the existing crest, varies in level from 3m NZVD16 at Lyall Bay Breakwater to 6.4m NZVD16 over the west 70m of the seawall. It provides inspection access and light vehicle access for maintenance to the airport windsock and west section of the seawall.

The detailed design also assessed two different layouts for the west and east ends of the seawall, seeking to reduce the number of armour units used and limit any seawall damage under design wave conditions. Straight seawall alignments at the east and west ends of the seawall were selected as these performed similarly to the curved alignments in the 3D physical modelling and reduced the quantity of materials required (estimated 10% reduction in concrete armour units).

Following the first round of 3D physical modelling (**Section 3.3.3**), it became clear that enhanced measures to limit overtopping were required. This was further emphasised by significant wave overtopping which flooded the Airways NZ control room (a bunker located underneath the very end of the runway) during a May 2025 storm. A raised vertical crest wall and armour crest level had been assessed in preliminary design and reduced overtopping by 50-65%. A widened, raised Cubipod® crest and higher vertical wall further landward was assessed in initial 3D physical modelling, with similar or slightly greater levels of overtopping. The project team decided to trial a third option, using a recurve crest wall and crest “reservoir”. Initial crest wall and reservoir geometry was established in discussion with Professor van der Meer, drawing on international experience. The revised design was tested in the physical modelling as described in **Section 3.3.3**.

The crest wall and reservoir were designed drawing on discussions with SATO, international coastal engineering research, and New Zealand design standards. Wave loads were calculated empirically using the Pedersen formula and the 1% AEP design wave and water level condition. Imposed vertical loads from plant and vehicles, and earth loads calculated in accordance with NZS 1170.0 and New Zealand Building Code Verification Method B1/VM4, were also considered in design. Global stability checks reported in the Geotechnical Interpretive Report indicated that under the ULS design earthquake, global stability governs the seawall performance (refer to **Section 3.1.1**). External stability checks for the crest wall therefore considered the SLS earthquake only. Seismic loadings for structural design of the crest wall were based on MBIE Module 1 (MBIE/NZGS, 2021) for IL2 structures with a 50-year design life, for both ULS and SLS design earthquakes. Input from the contractor and precast supplier on unit mass for safe handling and logistics influenced the precast unit dimensions.

Tsunami conditions are not a design requirement for the Southern Seawall, however, an assessment of seawall performance under tsunami has been undertaken to inform WIAL’s resilience and recovery planning. The assessment used information from a recent tsunami modelling report by Geological and Nuclear Sciences (“**GNS**”, now Earth Sciences New Zealand). Inundation maps were generated from the tsunami wave amplitudes from the GNS report, which indicated partial inundation of the Southern Seawall and Eastern Bank Remediation under a 1% AEP tsunami; and complete inundation under less frequent events. Stability of individual Cubipod® units against sliding and overturning was also considered using the GNS tsunami conditions. Assessed Factors of Safety for sliding and overturning were greater than 1 (i.e. nominally stable) for the 1% and 0.2% AEP tsunami given in the GNS report.

The detailed design is shown in the drawings in **Appendix D** and comprises:

- A 380m-long seawall overlay, generally following the alignment of the existing seawall, with a crest level of 7.4m NZVD16 and a 1V:1.5H slope.
- Two-layer 15.5t Cubipod® armour on the seaward face and crest and one layer 15.5t Cubipod® armour on the west crest and east end of the seawall, with a nominal 1t rock underlayer to re-profile the existing seawall.
- Rear slope protection at the west end of the seawall using two layers of nominal 2.65t rock armour and two layers of nominal 0.3t rock underlayer, with a subsoil drain connecting to the existing stormwater network on Moa Point Road
- A 145m-long western crest with 2 of 3m x 3m gabion baskets, a 2m x 0.5m reno mattress, a 3m-wide core of engineered fill, and 9m-wide in situ concrete surfacing.

- A 140m-long reinforced concrete crest wall, approximately 6.5m high and 6.5m wide, with a recurve seaward face and crest level of 7.4m NZVD16; and a 110m-long reservoir seaward of the crest wall and constructed from Cubipods®.
- A rock-armoured crest landward and east of the crest wall, at 7m NZVD16 to 7.4m NZVD16, using two layers of nominal 2.65t rock and two layers of nominal 0.3t underlayer.
- Clay-capped, topsoiled and grassed backshore, landward of the eastern crest.
- A two-layer rock toe using nominal 2.65t rock with a 3m toe crest width in the central, deeper section of the seawall; and a toe excavated into in situ rock at the shallower west and east ends of the seawall.

3.3.2 Eastern Bank Remediation

The updated Design Basis document described above for the Southern Seawall, including the nearshore wave data, also covered the Eastern Bank Remediation. **Appendix B** and **Appendix C** list key detailed design references and detailed design inputs, which include climate change and Vertical Land Movement allowances. The design cases considered are set out in **Table 3-2**.

Table 3-2: Eastern Bank Remediation design cases

Design wave event	Design water level event	Design time horizon	Description
1% AEP	1% AEP	2024	<ul style="list-style-type: none"> • Overtopping case
1% AEP	1% AEP	2080	<ul style="list-style-type: none"> • Armour stability & crest wall wave load design case • Overtopping case examined also

The Eastern Bank Remediation design was reviewed for the nearshore wave information and outcropping rock levels at the toe of the beach. Requirements for kororā enhancement (rock protection extending to the top of the existing bank, and accommodating kororā paths) and peer review comment regarding potential future beach levels were also considered. Rock armour size was reassessed using the Van der Meer shallow water equations in The Rock Manual (CIRIA, 2007) considering an increased water depth at the seawall toe, in the event that the beach lowered to rock level in future. The detailed design, shown in the drawings in **Appendix D**, comprises:

- Rock protection for the full height of the bank, extending 40m along the existing bank, with an additional 40m transition section to the Cubipod® seawall.
- A crest level varying from approximately 7.4m NZVD16 to 7m NZVD16 and a 1V: 2H slope.
- Two layers of nominal 2.65t armour rock and two layers of nominal 0.3t underlayer rock, to accommodate kororā paths within the rock protection and potential future beach lowering.
- Kororā paths comprising lengths of approximately 0.5m high precast reinforced concrete channel or equivalent placed through and up the rock protection; located at 10m centres along the Eastern Bank Remediation.
- A replacement stormwater outfall, connecting to the existing stormwater line, at the east end of the rock protection; details of this have been discussed with and provided to Wellington Water and no further comments have been received.

3.3.3 3D Physical Modelling

The seawall was built at a 1: 60 scale for testing in a 3D wave basin at UNSW WRL. Several seawall configurations were tested, seeking to progressively improve the design, as set out in **Table 3-3**. The models were constructed by UNSW WRL, with on-site involvement and support from the Cubipod® licence-holder, SATO, and McConnell Dowell.

Table 3-3: 3D Physical Modelling Configurations

Build	Base build	Variants
Build 1	<ul style="list-style-type: none"> Curved alignment at the east end of the seawall Straight alignment at the west end of the seawall Two-layer Cubipod® armour on the seaward slope and crest 	<ul style="list-style-type: none"> Raised rock toe High density armour units (18t) on the landward crest and west end of the seawall Single-layer Cubipod® armour on the west crest and at the east end of the seawall Extended rock toe at the east end of the seawall
Build 2	<ul style="list-style-type: none"> Straight alignment at the east end Curved alignment at the west end of the seawall Two-layer Cubipod® armour on the seaward slope and crest Single-layer Cubipod® armour on the west crest and east end of the seawall Recurve crest wall and armoured reservoir seaward of the crest wall 	<ul style="list-style-type: none"> Milder reservoir slope Larger rock armour in the base of the reservoir

Multiple tests were run for settling, design and over-design cases (10% AEP, 1% AEP and 0.1% AEP) for present day and 2080 conditions with climate change. As a further check, high energy tests were also undertaken using waves calibrated offshore in deep water.

Similar results were observed throughout the model runs, with one to two Cubipods® (out of a total of approximately 2500 units per layer) displaced in individual runs. Minor intermittent rocking of units was observed across the seawall, as well as progressive settling over the series of 8 to 15 model runs.

Specific instances of damage and the design improvements actioned by the project team included:

- Up to three units per run were displaced from the crest in individual design and over-design runs (1% AEP and 0.1% AEP), and 12 units displaced from the landward crest in the high energy over-design run (0.1% AEP); this was addressed in the final design by detailing to support the landward row of units.
- The inboard reservoir slope sustained damage under a 10% AEP settling run, and was rebuilt using a milder slope and improved support for the landward row of Cubipods®.
- Armour rock on the base of the reservoir was displaced during design events, even when increased in size. This was addressed in the final design by using 15.5t Cubipods® on the base of the reservoir.

There was minimal toe damage throughout all the tests, except where the rock toe was extended into very shallow water at the far east end of the seawall. An excavated toe will be used, as originally planned, at the west and east ends of the seawall.

Wave overtopping was measured in the model for a range of scenarios including the 10% AEP, 1% AEP and 0.1% AEP wave and water level conditions allowing for climate change to 2080. Overtopping volumes of approximately 40 litres per second per metre were recorded for the widened, raised armour crest and higher vertical wall further landward under 2080 design conditions (though noting 2D and 3D results are not directly comparable). The recurve wall and reservoir significantly reduced overtopping, to almost nil. **Figure 3-5** shows the different crest arrangements and wave overtopping.

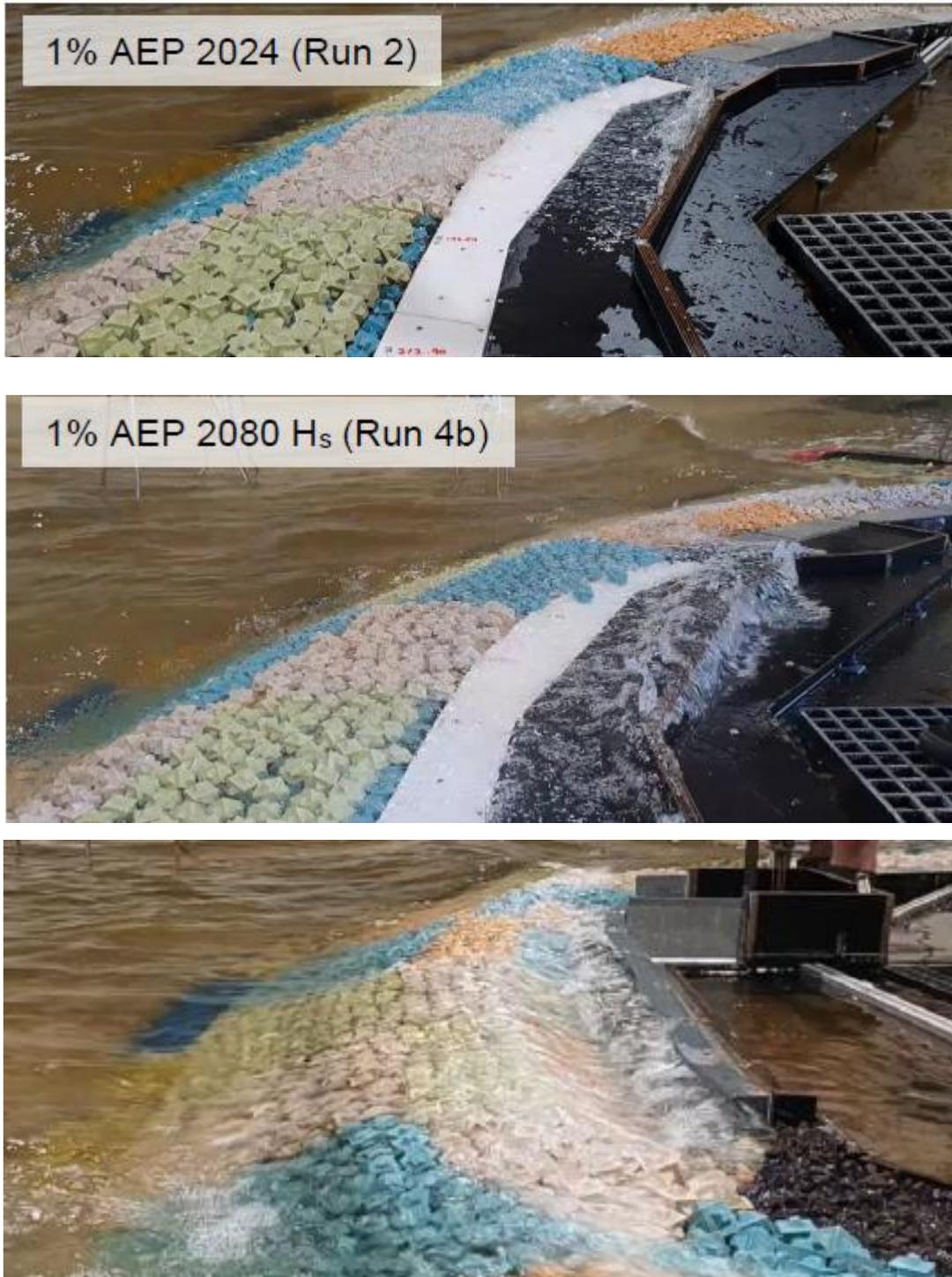


Figure 3-5: Crest arrangements and wave overtopping. Top – 1% AEP 2024 condition, with raised armour crest and higher vertical wall further landward. Centre - 1% AEP 2080 condition, with raised armour crest and higher vertical wall further landward. Bottom - 1% AEP 2080 condition, with recurve wall and reservoir.

The Eastern Bank Remediation was modelled at the interface with the Southern Seawall using nominal 1t rock. No notable damage was observed for either Build 1 or Build 2. Scaling effects due to the comparatively small rock size at a 1:60 model scale limit the validity of damage observations, however. Very minor shuffling of rock units was identified and no rock loss or major movement was noted when comparing pre- and post-run images.

3.3.4 Future Adaptation for Climate Change

The functional requirements required provision for 50 years of climate change, to conform with the required design life. A 50 year design life is standard industry practice for maritime structures such as seawalls and breakwaters. The functional requirements also required adaptability for up to 100 years of climate change, based on the timeframe for consideration of coastal hazard risk set out in Policy 25 of the New Zealand Coastal Policy Statement 2010.

Climate change effects over the 50 year design life including sea level rise and increased wave height and period have been allowed for in design of the Southern Seawall and Eastern Bank Remediation, as described in the preceding sections and in **Appendix C**.

Potential climate change adaptation measures for the seawall beyond the design life (or if the rate of climate change effects exceed the upper bound scenario used for design) have been identified and investigated, including using 2D physical modelling. These measures include:

- Increasing the crest wall level – for example by retrofitting the crest wall, and noting that the increase in height will depend on airport operational requirements, such as the OLS, at the time of adaptation.
- Increasing the Cubipod® crest level - by adding an additional layer of Cubipods® to the crest, although noting this is also dependent on the OLS level at the Cubipod® crest at the time of adaptation.
- Increasing the Cubipod® crest width - by adding an additional layer of Cubipods® to the slope and modifying the toe using additional, larger toe rock and/or excavation (noting that in many locations the present design for the excavated toe can accept an additional layer of Cubipods).
- Increasing the size of the Cubipod® units – for example, by adding an additional rock underlayer and additional layer of larger Cubipods® to the slope and modifying the toe, and replacing the crest Cubipods ® with larger units.

Potential climate change adaptation measures for the Eastern Bank Remediation beyond the design life (or if the rate of climate change effects exceed the upper bound scenario used for design) include:

- Increasing the crest level of the rock protection and landward area, noting that stormwater drainage will need to be considered as part of this (e.g. stormwater continues to drain south-eastward). The OLS is higher in the Eastern Bank Remediation area and is unlikely to restrict levels.
- Increasing the width of the rock protection, both overall and at the crest by adding additional layers of rock armour and/or Cubipods® to the slope. There are multiple ways this can be achieved and will be dependent on the water level at the time of construction. Either a direct overlay with additional Cubipods® and increased toe level or using a similar approach as currently with a rock underlayer and larger Cubipods® over the top.

3.3.5 Peer Review and Reporting

Detailed design reports, drawings and specifications were issued to Tonkin+Taylor for coastal engineering and geotechnical peer review, and to McConnell Dowell for constructability feedback, in the first half of 2025. McConnell Dowell had no specific feedback on the detailed design documents. The peer review comments received from Tonkin+Taylor have been addressed.

4 Construction Support Areas

4.1 Options for Construction Support Areas

Areas are required to accommodate plant and materials associated with the seawall construction. While the seawall overlay solution involves significantly lower quantities than the other seawall options, construction yard space is still needed for efficient transport of materials to and from site and to help optimise construction productivity and timeframes. Several construction yard options were considered for the project including:

- Moa Point Road, east of the existing seawall.
- George Bolt Yard (existing), west of the airport runway.
- Southern section of Miramar Golf Course (“**MGC**”), east of the airport.
- Bridge Street, on the northwest side of the airport runway.

The Moa Point Road site is needed as the main operational hub during seawall construction, including for a rock stockpile directly supplying the workface and setup/storage space for construction plant and equipment. This supports construction efficiency and helps to minimise overnight truck movements. The extent of the yard has been limited to the area between Moa Point Tunnel and Stewart Duff Drive, on the seaward side of Moa Point Road. The adjoining Wellington City Council (“**WCC**”) and Crown land to the eastern provides a buffer between the construction yard and residential properties, and also continues to provide a public recreation area of some 9,000m² during construction (the yard occupies approximately 8,400m² of Crown and reserve land between the Tunnel and Stewart Duff Drive).

The George Bolt Street site is relatively small (3,250m²) and includes an existing yard and adjacent area with direct access to the airport taxiways. It is needed as a staging and workshop area prior to and during construction because it is connected by road and airport routes to Moa Point Yard and the workface. As for Moa Point Yard, this supports construction efficiency and helps to minimise overnight truck movements by road. The adjacent commercial properties and the airport itself provide a buffer between this yard and residential properties, which was a key reason for selecting the site.

The Moa Point Road and George Bolt Street site do not have sufficient capacity to accommodate all the materials storage and facilities required for the seawall construction, however. A larger area is also needed for progressive stockpiling of materials, to help to reduce local traffic impacts.

WIAL-owned land on the eastern side of Bridge Street and the southern part of the MGC were both considered as options for this larger storage and office area. The Bridge Street yard has direct access to the airport taxiways and is located 1.7km from Moa Point Yard and the seawall, while the MGC is on a private (WIAL-owned) road and is 300m from Moa Point Yard. Both sites are proximate to and overlooked by residential areas (nearest residential properties are approximately 10-20m from the Bridge Street site and approximately 80m from the MGC site). The Bridge Street site has an area of approximately 10,000m² and is subject to tighter OLS restrictions (approximately 3m stockpile height). It has significantly less capacity than the southern MGC site, which has an area of 44,000m² and is able to accommodate stockpiles 4-6m high. A further site would be required in addition to Bridge St. The southern MGC site was selected over the Bridge St site because of the greater capacity and efficiency it provided and the greater distance from residential areas.

The following sections describe the design for the MGC Yard. Moa Point Yard will be recontoured and all-weather unbound access roads will be formed, with the design of these temporary works undertaken by the contractor prior to the start of construction. Similarly, any temporary works for George Bolt Yard will be designed by the contractor prior to construction.

4.3 MGC Yard Investigations and Analysis

A concept level geotechnical assessment of cut batter slopes for the MGC Yard was undertaken in 2024 and 2025. The assessment utilised data from geotechnical investigations in 1989 and 2023, historical aerial photographs of the original airport construction, groundwater monitoring and published geological and slope stability maps. A site walkover was also undertaken by an engineering geologist 2024 to visually assess the conditions of the existing slopes from ground level and from the top of ridges. The report is included in **Appendix E** and conclusions are summarised below. These points have been taken into account in the design of the yard, as described in **Section 4.4**.

- The southwestern slope can be cut to at a slope angle of 1V:1H in moderately to highly weathered greywacke, with a maximum cut height up to 10m total cut height. The overlying fill material should be cut at 1V:1.5H up to a height of 3m.
- The proposed cutting between the southwestern and southeastern slopes should be cut no steeper than 1V:2H. Rock is not anticipated in this 7.5m cut.
- The southeastern slopes can be cut to 1V:1H in moderately to highly weathered greywacke up to 10m, and to 1V:1.5H for cuts over 10m high. The slope should be benched if fill or colluvium over 3m thickness is found overlying the rock. The benches should have a minimum width of 3m.
- For areas where access to the toe of the slopes will be required, a separation bund e.g. shipping containers should be placed to prevent localised rockfalls extending into the construction yard. The risk from larger rockfalls should be identified by further investigation and during construction observation, as detailed in the last bullet below.
- A cut-off swale should be installed at each bench and at the crest of the cut slopes to capture stormwater runoff and divert it into the stormwater network.
- The slopes should be hydroseeded after completion.
- If groundwater seepage is encountered during excavation, the above slope angle recommendations should be reviewed. Dewatering should be allowed for during excavation.
- Small rockfalls on the benches or toes of the slopes may be expected after heavy rainfall. Therefore, we recommend that the slope should be inspected routinely (e.g., quarterly) and following significant rainfall or seismic events.
- Further investigations could be completed prior to earthworks to further inform the rock level and the nature of greywacke. Alternatively, the earthworks could proceed without further site investigations, with an Engineering Geologist or Geotechnical Engineer based on-site full-time to observe and monitor the excavation, and to pause the works to reassess slope angles and benching if actual conditions encountered differ from assumptions.

An investigation was undertaken by McConnell Dowell in 2025 to locate and identify services in the MGC Yard area. The results of this investigation were taken into account in the yard design described in **Section 4.4**, and also provided to Wellington Water.

4.4 MGC Yard Development

The MGC Yard will have a functional life of 5 to 10 years for the Southern Seawall and Eastern Bank Remediation works. The yard layout has been developed in conjunction with the Pre-Construction Services contractor, McConnell Dowell, and with reference to national and local design standards and guidelines (**Appendix B**). Key inputs are summarised in **Appendix C**.

The MGC Yard layout was developed as follows:

- General layout: The overall yard layout was based on the storage and stockpile requirements for construction materials, a laydown area, offices and parking for the contractor.
- Services: There are several services crossing the MGC from Strathmore Park in the east to the airport in the west as shown in **Figure 4-1** and the drawings in **Appendix D**. The northern end of the yard extends just to the south of the existing pond and wastewater and stormwater pipelines and high voltage cables to avoid these services being relocated or lowered at this stage. Wellington Electricity Ltd high and low voltage and fibre-optic cables on the western side of the yard are expected to be relocated along the yard boundary for easier access.
- Proposed yard levels: The proposed yard levels were based on the 2040 Masterplan apron levels, and the yard extent aimed to optimise stockpile and storage area without encroaching into the adjacent landscape buffer zone. The construction yard levels were set at approximately 1m above the future apron level to protect the subgrade. The yard grading was slightly adjusted to create a free draining surface, sloping towards the northwest and centre of the yard. The general storage area and topsoil stockpile area to the north of the yard and around the existing stormwater pond was graded and levelled only to provide a flat free draining area.
- Proposed cut batter slopes: Cut batter slope and height recommendations were given in the geotechnical assessment (refer to **Section 4.2**). Consistent with these recommendations, batter slopes were set at 3H :1V in soft material (milder than the maximum slope, and allowing for mowing) and 1H:1V in the short-term rock cuts.
- Earthworks: The layout avoids large cuts in the general storage area and topsoil stockpile area to the north of the yard and around the existing stormwater pond, to avoid the existing services. The earthworks, including the proposed yard levels and cut batter slopes, were modelled with 12D civil engineering software. Earthworks volumes were estimated using existing ground levels from Wellington City Council's GIS portal.
- Rock storage: The indicative rock stockpiles provide a total estimated storage volume of 42,000m³ (calculated from the external dimensions of the stockpiles as solid surfaces and not allowing for any voids or bulking), nominated by McConnell Dowell. The indicative stockpile layout is based on stockpiling 4m to 6m high with side batter slopes at 1H:1V and 10-metre-wide separations between stockpiles for access roads.
- Yard access: Development of the yard layout considered WIAL's requirements for car transporter access (not public access) to the future proposed rental carparking storage area, and McConnell Dowell's requirements for a one-way ring road through the yard, with a northern entrance and southern exit on Stewart Duff Drive, and 8m wide roads within the yard. Vehicle swept paths were confirmed by vehicle tracking using a semi-trailer in accordance with the New Zealand LTSA RTS 18 design vehicles. Tracking was also checked with an 8m medium rigid truck. The northern entrance from Stewart Duff Drive is shared with the airport rental carpark. A wheel wash, with a recycled water connection from the existing pond and clean water supply connection, has been allowed for at the southern exit to Stewart Duff Drive. In addition to the southern vehicle exit, a pedestrian gate has been provided for worker access to the seawall site.
- Laydown area and potential office: The laydown and office area have been located at the southern exit to be closer to the seawall site. Connections for wastewater, potable water, low voltage power and communications have been allowed for.

4.5 Stormwater Management

This section covers temporary stormwater management and erosion and sediment control for the three construction yards. The yards are shown, shaded yellow, in **Figure 4-2**.

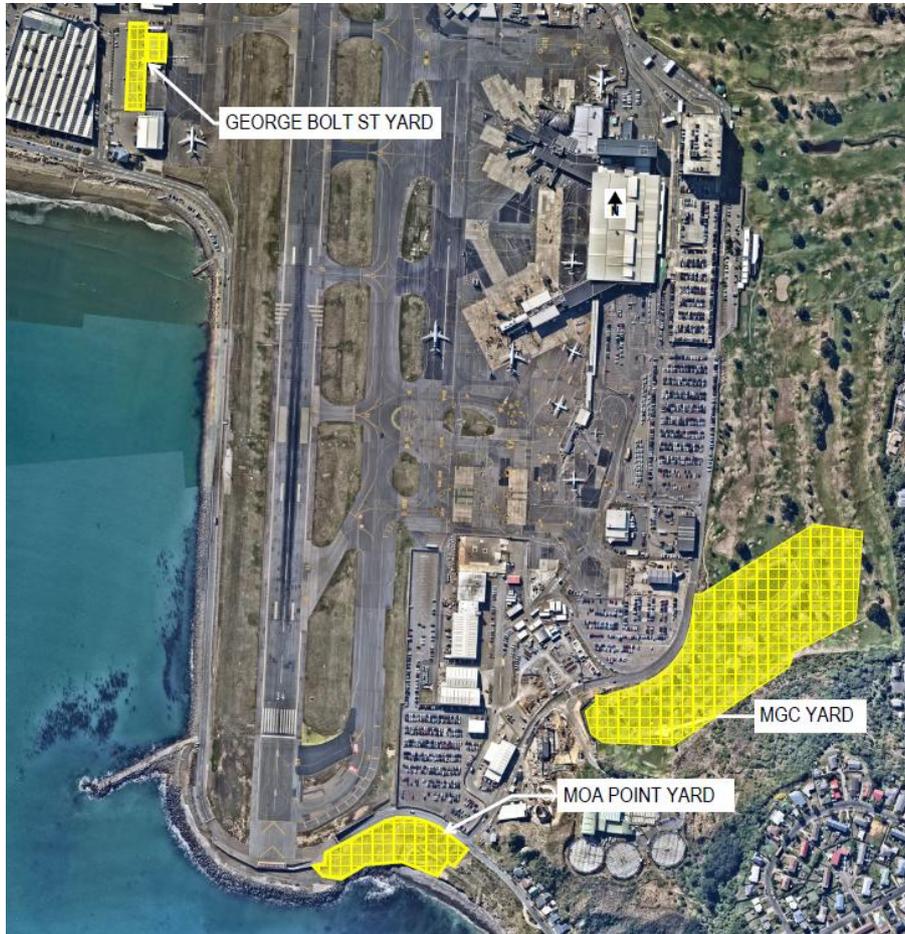


Figure 4-2: Project construction yards

4.5.1 MGC Yard

As described above and in the Project Description in the consent application, the MGC Yard will be used on a temporary basis to store construction materials, primarily rock, and accommodate a construction site office and access roads. Finished ground levels in the temporary yard are typically below the level of the surrounding slopes to the northeast, east and south, and below Stewart Duff Drive to the west. The majority of the rock for the seawall construction is expected to be sourced from South Taranaki. While the andesitic rock chemistry may include copper and zinc, these are bound into the rock matrix as trace elements within stable mineral compounds (e.g. titanomagnetite) and are not readily available for release into the environment. Additional stormwater treatment or monitoring targeted to these elements is therefore not warranted in this instance.

The specific erosion, sediment and temporary stormwater management and monitoring controls proposed during the construction and the operation of the MGC Yard are set out below. WIAL will also maintain an additional level of responsibility as the owner and operator of the stormwater system that will receive flows from the MGC Yard.

During yard construction

During the construction of the MGC Yard, stormwater will be managed in accordance with the Erosion and Sediment Control Assessment Report (“**ESCAR**”) and the MGC Yard Site Specific Erosion and Sediment Control Plan (“**SSESCP**”) prepared by Southern Skies on behalf of the contractor, McConnell Dowell.

Surface runoff (clean water) from the vegetated slope on the southern side of the MGC Yard will be collected by a cut-off drain (clean water diversion) around the southern border of the site and discharged to soakage through the sandy base of the yard. It is proposed that a sediment retention pond or decanting earth bund be constructed at the outlet of the southern cut-off drain to attenuate peak flows and regulate out flows to soakage.

Stormwater runoff (clean water) from the vegetated slopes on the eastern and north-eastern sides of the MGC Yard will be collected by stormwater cut-off drains (clean water diversions) on the eastern and north-eastern borders of the site and conveyed to the existing stormwater pond. The outlet of the existing pond is connected to the downstream piped stormwater network.

The stormwater cut-off drains were designed in accordance with Auckland Council’s GD2016/005, which has been adopted by Greater Wellington Regional Council (as set out in Greater Wellington Erosion and Sediment Control Guide for Land Disturbing Activities in the Wellington Region, Greater Wellington Regional Council, 2021). The stormwater channels were designed as clean water diversion channels as per GD2016/005 Section E2.1 for a 5% AEP (20-year ARI) rain event. Stormwater flows were calculated in accordance with the Reference Guide for Design Storm Hydrology (Wellington Water, 2019) using NIWA HIRDS v4 rainfall depth. All cut-off drains and channels are to be topsoiled and grassed where possible to prevent scouring and sediment generation.

Dirty water diversions will be formed using perimeter bunds to direct sediment laden runoff to the sediment retention pond. The ESCAR and SSESCP describe the design process and details of the dirty water diversions and sediment retention pond, including that these have been designed for the site’s sandy soils and a 20% AEP (5-year ARI) rain event in accordance with the New Zealand Transport Agency *Erosion and sediment control guidelines for state highway infrastructure*, September 2014. As set out in the ESCAR and SSESCP, it is intended that the sediment retention pond will be chemically treated if necessary to enhance the sediment retention efficiency and monitored in accordance with the Chemical Treatment Management Plan appended to the ESCAR.

The erosion and sediment control measures will be maintained and monitored as described in the ESCAR and SSESCP:

- The control measures will be maintained in accordance with the New Zealand Transport Agency *Erosion and sediment control guidelines for state highway infrastructure*, September 2014.
- The control measures and methodologies will be monitored in accordance with the Erosion and Sediment Control Monitoring Plan appended to the ESCAR.
- Any required maintenance or improvements to control measures will be undertaken immediately.
- The sediment retention pond will be cleaned out before accumulated sediment volume reaches 20% of the total volume.
- Forebays will be cleaned out if there is any evidence of sediment deposition.
- Relevant SSESCP control measures (e.g. dirty water channels) will be decommissioned when the yard construction is complete and the contributing catchment is stabilised. Greater Wellington Regional Council (“**GWRC**”) will be informed prior to the control measures being decommissioned.

Sediment removed from the sediment retention pond will be disposed to Silverstream Landfill or alternative suitably permitted landfills.

During yard operation

Stormwater will continue to be managed while the MGC Yard is in operation, once construction of the yard is complete and the yard surface has been stabilised with unbound aggregate surfacing and paved access roads. The measures below are proposed to manage stormwater quantity and quality appropriately at the MGC Yard during yard operation.

Stormwater from the surrounding slopes outside the yard will continue to be diverted around the yard via the clean water cut-off drains described in the preceding section. The eastern and northeastern cut-off drains will continue to discharge into the existing stormwater pond, which is connected to the downstream piped stormwater network. The southern cut-off drain will continue to discharge into the sediment retention bund or decanting earth bund, which will attenuate peak flows and regulate out flows to soakage.

Stormwater within the yard will ultimately drain to soakage and the existing stormwater pond, as occurs presently with stormwater on the golf course. Any surface runoff generated by a rain event will flow northward, following the yard contours. Runoff from the northeastern topsoil stockpile will flow towards the existing stormwater pond. Runoff from the rock stockpile areas and access roads will flow to a low point in the northern part of the yard. The low point is at approximately 5.8m NZVD16, which is below the level of Stewart Duff Drive, which is at approximately 6.7m NZVD16 at this location. Temporary ponding may occur at the low point during and immediately after a rain event while any stormwater infiltrates the underlying sandy soils.

The control measures will be decommissioned when yard operation activities have ceased and a separate project commences to construct permanent works in the southern MGC. Greater Wellington Regional Council (“**GWRC**”) will be informed prior to the control measures being removed.

4.5.2 Moa Point Yard

For the majority of the Project, the Moa Point Yard area will continue as at present, with stormwater draining diffusely seaward across the site, combined with infiltration. During the Southern Seawall construction period, Moa Point Yard will be used for storing construction materials and general plant set-up and maintenance facilities adjacent to the seawall workforce as described above and in the Project Description. Moa Point Yard will also be used for servicing large equipment that cannot easily be transported to George Bolt Yard.

Stormwater on the Moa Point Yard will be managed in accordance with the ESCAR and the Moa Point Yard SSES CP prepared by Southern Skies of behalf of the contractor, McConnell Dowell. The Moa Point Yard SSES CP will remain in place throughout the construction and operation of the yard in order to manage stormwater appropriately, given the nature of the site and proposed activities at the Moa Point Yard.

The SSES CP describes the erosion and sediment control measures including:

- The Moa Point Yard will be constructed using a ‘cut and cover’ approach in accordance with the New Zealand Transport Agency *Erosion and sediment control guidelines for state highway infrastructure*, September 2014. This approach means that the contractor can only work an area where the surface will be stabilised on the same day. Stabilisation measures include spreading of aggregate and the use of geotextiles.
- A perimeter bund installed around the extent of the yard as a contingency measure. The bund will be designed and constructed in accordance with New Zealand Transport Agency *Erosion and sediment control guidelines for state highway infrastructure*, September 2014.
- Moa Point Road acting as a clean water diversion on the northern border of the yard.
- Temporary protection to stormwater inlets on Moa Point Rd during the Moa Point Yard and Southern Seawall construction.

The erosion and sediment control measures will be maintained and monitored as described in the SSES CP:

- The control measures will be maintained in accordance with the New Zealand Transport Agency *Erosion and sediment control guidelines for state highway infrastructure*, September 2014.
- Control measures and methodologies will be monitored in accordance with the Erosion and Sediment Control Monitoring Plan appended to the ESCAR.
- Any required maintenance or improvements to control measures will be undertaken immediately.

Control measures will be decommissioned when the construction and yard activities have ceased and the contributing catchment is stabilised. GWRC will be informed prior to the control measures being removed.

4.5.3 George Bolt Yard

The George Bolt Yard will be used for general storage of rock and armour units, construction plant and equipment, as the site of a workshop and staff facilities, and other miscellaneous construction material storage associated with the Project. An existing hangar at the site will be removed and the hangar footprint paved to match with the existing paved storage yard.

The yard is located at the western edge of Catchment Five, as set out in the WIAL Stormwater Management Plan, 2024, prepared by GHD. The area presently drains to the local piped stormwater network, with overland flow paths operating once the capacity of the piped network is exceeded. The measures below are proposed to manage stormwater quantity and quality appropriately at the George Bolt Yard during yard establishment and operation.

Stormwater on the George Bolt Yard will continue to drain to the local piped network and via overland flow paths. There will be no change in impervious area because paved yard surface will replace the existing hangar roof when the hangar is removed such that there is no anticipated change to stormwater quantity.

Stormwater will be managed in accordance with the existing WIAL Stormwater Management Plan and the contractor's management plans, including plant refuelling and maintenance procedures and emergency spill response plan. The Stormwater Management Plan sets out requirements for site cleanliness and litter control, monitoring inspections, operational procedures, activity-specific controls, and spill response protocols.

5 Safety in Design and Circular Design

5.1 Safety in Design

Safety in Design (“SiD”) is the integration of hazard identification, risk assessment and control methods in the design process to eliminate or minimise risks to health and safety throughout the construction and life of the element being designed.

Safety in Design was included in the option assessment process, with Safety in Design criteria incorporated into the MCA workshops. SiD workshops were completed in 2024 and 2025 for preliminary and detailed design. The workshops were attended by WIAL, McConnell Dowell and Beca. A SiD Risk Assessment Register containing identified risks, existing and proposed controls, and residual risks was prepared and updated through the workshop process. Design-related controls have been implemented through the design process. The Key SiD risks and controls for the project are summarised in **Table 5-1**.

Table 5-1: Key SiD risks and management measures

Key SiD risks	Key controls
People / plant / materials interface – lifting heavy materials, Cubipod® and rock size and mass, moving plant, materials stockpiles, tipping / roll over risks of trucks / cranes / forklifts	<ul style="list-style-type: none"> • Pre-Construction Services contractor and suppliers (e.g. rock quarries, precast manufacturer, specialised plant supplier) involved in design and resource consenting • Underlayer rock size reduced • Crest wall precast unit dimensions take into account contractor and precast manufacturer input • SATO clamp design, with trial ahead of main renewal project • Pre-Construction Services contractor temporary works investigation and design in advance of construction • Multiple yards providing for safe materials storage, access etc
Weather – wind, waves including spray and overtopping especially if unsighted	<ul style="list-style-type: none"> • Wave buoys installed by Pre-Construction Services contractor • Analysis of long term weather data to assess construction workability/access • Site- and project-specific weather and marine conditions forecasting and nowcasting, refined using wave buoy information
Slope stability during placement – excavator / crane working on existing seawall	<ul style="list-style-type: none"> • Pre-Construction Services contractor provided with existing geotechnical investigations during design phase • Pre-Construction Services contractor temporary works investigation and design in advance of construction
Damage to / destabilisation of work face – from swell or storm event	<ul style="list-style-type: none"> • Seawall overlay option (existing armour remains in place except for crest armour) • Pre-Construction Services contractor provided with long-term wave analysis during design phase • Storm measures to make site secure in advance of event • Wave buoys installed by Pre-Construction Services contractor • Analysis of long term weather data to assess construction workability/access • Site- and project-specific weather and marine conditions forecasting and nowcasting, refined using wave buoy information
Night time work – fatigue, poor visibility, short working windows	<ul style="list-style-type: none"> • Pre-Construction Services contractor and suppliers involved in resource consenting – provision for suitable construction lighting • Opportunity for on-site accommodation for construction team, using client-owned properties • Specific construction team measures (fatigue monitoring & response systems in construction plant, additional spotters, training)

Key SiD risks	Key controls
Airport / construction activities interface – construction plant and team, and aircraft potentially in proximity	<ul style="list-style-type: none"> • Pre-Construction Services contractor project- and site-specific experience developed through seawall maintenance prior to renewal project • Detailed planning between airport operations team, Airways and Pre-Construction Services contractor • Work Safety Officer on site during construction • Plant breakdown contingency plans • Automatic Dependent Surveillance Broadcast (ADS-B) installed on large / high construction plant at seawall to provide information for air traffic control & pilots and reduce risk of plane strike

5.2 Circular Design

Sustainability (materials reuse, waste minimisation, regeneration of natural systems), environmental impacts and resilience were included in the concept option assessment process, as part of the MCA workshops.

Project-specific Circular Design workshops and reviews were held in 2024 and 2025 for preliminary and detailed design, involving WIAL, McConnell Dowell, Mitchell Daysh and Beca. The workshops identified Circular Design opportunities and actions using project Sustainability Focus Areas based on WIAL's Kaitiakitanga targets and the Engineering New Zealand Circular Design Framework. The workshops also determined which opportunities to progress and which to investigate further.

The opportunities and actions were captured in a Circular Design Innovation & Opportunity Register. The associated design actions were then mainstreamed into the design process. Key Circular Design opportunities and outcomes achieved to date are summarised in **Table 5-2**.

Table 5-2: Summary of Circular Design opportunities and outcomes to date
(Green shading: Achieved; Yellow shading, in progress; Grey shading, planned)

Focus Area	Opportunity	Outcomes to date
Materials	Overlay existing seawall	Achieved, resulting in reduction in materials compared to new build options
	Reduce scope of enabling works	Achieved, construction of a materials load-in wharf and onsite concrete batching plant and casting yard not required (these elements previously considered in early project planning)
	Design for minimal maintenance during design life	Achieved, based on results of physical modelling for 1% AEP design event and 0.1% AEP overdesign event to 2080 (nominal 50 year design life)
	Refine design to reduce seawall quantities	Achieved, with estimated 10% reduction in concrete armour units as a result of design refinements based on physical modelling
	Adaptable for future climate change	Achieved, options identified for future adaption of seawall (e.g. armour overlay, raise crest wall) without rebuild of structure
Energy utilisation	Overlay existing seawall	Achieved, see above
	Use existing offsite batching plant and casting yard	Achieved, co-located Otaki batching and casting facilities. Net energy benefit to be

Focus Area	Opportunity	Outcomes to date
		assessed for offsite production with precast unit transport to site, compared with onsite production and materials transport to site
	Refine design to reduce seawall quantities	Achieved, see above
	Use river aggregate for concrete and paddock rock for armour and underlayer – reduced processing energy	In progress, specifications allow for river aggregate and paddock rock. Rock supply procurement underway at present with selected tenderers
	Consider truck capacity as part of selecting armour unit size	Achieved, 15.5t Cubipods® allow 2 armour units per truckload
Waste	Overlay existing seawall	Achieved, see above
	Re-use material removed from seawall	Achieved, in terms of seawall overlay In progress, for the limited quantity of akmons and armour rock and the gabions removed as part of the works
	Minimise cut in 1970s fill material (potential waste)	Achieved, cut to fill re-use on site
	Reduce casting waste	Planned, adopting batching and casting plant waste minimisation practices
	Repurpose / re-use construction plant	In progress, as part of construction planning
Cultural	Cultural partnership with mana whenua for project	In progress, building on existing mana whenua-WIAL relationships
Natural systems	Habitat creation	Achieved, with kororā and terrestrial ecologists leading on habitat improvement opportunities
Resilience & adaptation	Design for climate change and improved resilience to swell/storm hazards	Achieved: - design event: 1% AEP wave event with projected 2080 climate change - overdesign event: 0.1% AEP wave event with projected 2080 climate change
Socio-economic benefits	Create Construction Liaison Committee	Planned, drawing on WIAL and McConnell Dowell experience

5.3 Post-Construction Monitoring and Maintenance

5.3.1 Southern Seawall and Eastern Bank Remediation

The Southern Seawall and Eastern Bank Remediation will require regular monitoring and maintenance. The following sections outline monitoring and maintenance requirements, which will be formalised in an Operation and Maintenance Plan.

Monitoring

Throughout the design life of the sea defences, inspections are required to assess their condition and to establish if any maintenance is required. It is recommended that visual inspections by an experienced coastal/maritime engineer are conducted:

- Annually for the first two years; and
- Five-yearly thereafter; and
- After significant storm events (e.g. 10% AEP event or greater) and earthquake events. Based on the findings from the physical modelling, settling and minor movement is anticipated during early storm/s including 10% AEP events.

The visual monitoring should include:

- A baseline inspection at completion of construction.
- Use of a checklist to assess each element of the sea defences for defects.
- Reference photographs from set locations for each structure to allow for objective measurement and comparison of profiles, armour displacement, armour condition (e.g. abrasion, breakage).
- Monitoring surveys of the crest wall as required, for example after significant earthquake events.

Monitoring of actual climate change against the climate change projections used in design is a further monitoring option. The purpose of this monitoring would be to assess when future adaptation of the sea defences would be required based on the actual rate of sea level rise and changes in extreme wave conditions. Such assessments might be undertaken on a 10-yearly basis.

Maintenance

Maintenance requirements will be identified through the monitoring described above and are expected to include:

- Replacement of the western crest gabions and reno mattresses approximately 20 to 25 years after construction.
- If needed, reprofiling of Cubipods® and rock armour (i.e. relocation/replacement of displaced units or rock), for example following a storm with characteristics exceeding the design event.

5.3.2 Construction Support Areas

The construction support areas are short-term facilities that will be used for the construction of the Southern Seawall project, and monitoring and maintenance will be the responsibility of the contractor. The existing access roads and existing public services on the site will require monitoring during the construction period.

Monitoring

Routine inspections throughout the construction works period and during the use of the construction support areas are required to assess the condition of road and yard pavements and establish if any maintenance is needed. Visual inspections should be undertaken by an experienced civil engineer and conducted as follows:

- After and during high volumes of heavy truck movements and after significant rainfall events.
- CCTV inspections of the existing wastewater and stormwater pipelines crossing or adjacent to the construction support areas prior to any earthworks commencing to confirm the current condition.
- CCTV inspections of existing drainage (as above) and any construction support area connections at the end of the works.
- The above monitoring to cover all existing services and short term services included in the construction support areas, access roads including Stewart Duff Drive and Moa Point Road, and internal yard roads.
- Photographic and written records of the above monitoring to be prepared by the contractor and provided to asset owners for each round of monitoring.

Investigation and monitoring of the cut slopes in the MGC Yard, as set out in **Appendix E**, includes:

- Further investigations (e.g., machine drilled boreholes) could be completed prior to earthworks to further inform the rock level and the nature of greywacke. Alternatively, the project could proceed with earthworks without further site investigations, with provisions for site inspections (refer to below bullet point), and pause the works to reassess slope angles and benching if actual conditions encountered differ from assumptions.
- An Engineering Geologist or Geotechnical Engineer based on-site full-time during the MGC Yard excavations.
- Review of slope angle recommendations if groundwater seepages are encountered during excavation.
- Inspection of MGC Yard slopes at a regular frequency (e.g. quarterly) and following significant rainfall or seismic events, during and following excavation.

Maintenance

The above monitoring will identify maintenance requirements. Typical maintenance is expected to include:

- Fixing potholes or damage to road pavements.
- Road markings and road signs reinstatement and repainting.
- Maintaining security fencing.
- Mowing and maintaining grassed areas.



Appendix A – Authors’ Qualifications and Experience



Appendix A – Authors’ Qualifications and Expertise

Author	Qualifications	Expertise
Jennifer Hart	<p>Master of Engineering specialising in Coastal Engineering and Port Development, IHE Delft Institute for Water Education, Delft, the Netherlands, 1998</p> <p>Master of Civil Engineering specialising in Coastal Engineering, University of Auckland, 1993</p> <p>Bachelor of Civil Engineering (Hons), University of Canterbury, 1990</p> <p>Member, Engineering New Zealand</p> <p>Beca Ltd is a corporate member of the New Zealand Coastal Society, a Technical Group of Engineering New Zealand</p>	Port and coastal engineering (30 years’ experience)
Tate Kimpton	<p>Doctor of Civil and Environmental Engineering, University of Auckland, 2025</p> <p>Bachelor of Civil and Environmental Engineering, University of Auckland, 2020</p> <p>Beca Ltd is a corporate member of the New Zealand Coastal Society, a Technical Group of Engineering New Zealand</p>	Port and coastal engineering (1 years’ experience)

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Appendix B – Key Design Standards, Guidelines & References

Appendix B – Key Design Standards, Guidelines & References

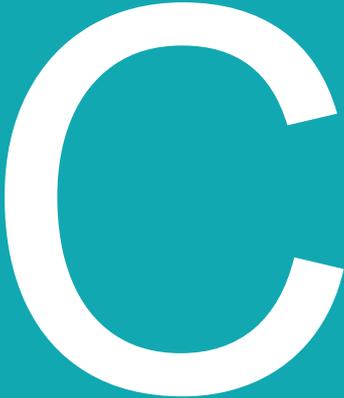
B.1 Key Detailed Design Standards and Guidelines

Discipline	Details
Climate Change	<ul style="list-style-type: none"> Intergovernmental Panel on Climate Change (“IPCC”) (2021) Sixth Assessment Report Ministry of the Environment (“MfE”) (2024) Coastal Hazards and Climate Change: Guidance for Local Government
Coastal Engineering	<ul style="list-style-type: none"> BS 6349:1 Maritime Works CIRIA (2007) The Rock Manual, the use of rock in hydraulic engineering EurOtop II (2018) Wave Overtopping of Sea Defences and Related Structures Assessment Manual SATO (2016) Cubipod Manual SATO (2020) Cubipod Mold, Handling, Stacking and Placing Manual. SATO (2025) Cubipod Placing Tolerances SATO (2025) Cubipod Technical Specifications United States Army Corps of Engineering (“USACE”) (2011) Coastal Engineering Manual
Geotechnical Engineering	<ul style="list-style-type: none"> AS/NZS 1170.0:2004 Structural design actions – General principles AS/NZS 1170.5:2004 Structural design actions – Earthquake actions DZ TS 1170.5:2024 Structural design actions – Earthquake actions Ministry of Business, Innovation and Employment (“MBIE”)/ New Zealand Geotechnical Society (“NZGS”) (2021) Earthquake Geotechnical Engineering Practice - Module 1: Overview of the Guidelines Ministry of Business, Innovation and Employment (2023) Acceptable Solutions and Verification Methods for New Zealand Building Code Clause B1 Structure
Structural Engineering	<ul style="list-style-type: none"> New Zealand Building Code Clause B1 Structures AS/NZS 1170.0:2002 Structural design actions – General principles AS/NZS 1170.1:2002 Structural design actions – Permanent, imposed and other actions AS/NZS 1170.2:2021 Structural design actions – Wind actions NZS 1170.5:2004 Structural design actions – Earthquake actions BS 6349-Part -1-2: Maritime works. General. Code of practice for assessment of actions AS/NZS 4671:2019 Steel for the reinforcement of concrete AS 4497:2005 Guidelines for the design of maritime structures NZS 3101.1&2:2006 Concrete structures standard. NZS 3114:1987 Specification for concrete surface finishes
Civil Engineering	<ul style="list-style-type: none"> NZS 4404:2010 Land Development and Subdivision Infrastructure Wellington City Council Code of Practice for Land Development (December 2012) Wellington City Council Code of Practice for Land Development (July 2022) Draft for Consultation Erosion and Sediment Control Guide for Land Disturbing Activities in the Wellington Region (This guideline has drawn on Auckland Council's guideline 'GDO5 - Erosion and Sediment Control Guide for Land Disturbing Activities in the Auckland Region'.) Wellington City Council, Regional Standard for Water Services, November 2012 – Section 4 Stormwater. Reference Guide for Design Storm Hydrology Standardised Parameters for Hydrological Modelling, 9 April 2019

B.2 Key Detailed Design References

Discipline	Details
Climate Change	<ul style="list-style-type: none"> • Albuquerque, J., Antolinez, J. A. A., Mendez, F. J., Coco, G. (2022) On the projected changes in New Zealand's wave climate and its main drivers • Department of Conservation (2010) New Zealand Coastal Policy Statement. • NIWA (2021) Update on sea-level rise projections for Wellington City, Wellington City Council • NIWA (2021) Coastal hazards and sea-level rise in Wellington City, Wellington City Council • NZ SeaRise (2024, 2025) NZ SeaRise: Te Tai Pari O Aotearoa (https://searise.takiwa.co/map)
Coastal Engineering	<ul style="list-style-type: none"> • AECOM (2020) Southern Sea Defences Renewal – Southern Seawall, Lyall Bay Breakwater and Western Seawall • AECOM (2017) Tsunami Hazard Study - WIAL Runway Extension Study • Beca (2023a) Sea Defence Structures Review, Close Out Report • Beca (2023b) Sea Defence Structures Review, End Report • Beca (2024a) WIAL Sea Defences Renewal, Southern Seawall Preliminary Design • Beca (2024b) Sea Defence Structures Renewal – Summary of Historical Seawall Information • Beca (2025) Sea Defence Structures Renewal – Southern Seawall Detailed Design. • Doherty, Y., Flocard, F. (2024) Wellington International Airport 2D physical modelling, WRL TR 2024/21, dated December 2024 • Dong, S., Salauddin, Md., Abolfathi, S., Pearson, J. M. (2021) Wave Impact Loads on Vertical Seawalls: Effects of Geometrical Properties of Recurve Retrofitting • Gomez-Martin, M. E., Medina, J. R. (2014) Heterogeneous Packing and Hydraulic Stability of Cube and Cubipod Armor Units • Klabbers, M., van der Meer, J., Yong, Y. M. (2023) Wave Overtopping Mitigation by a Vertical Wall or a Wave Return Wall at the End of a Pitched Rock Slope • Kortenhaus, A., Pearson, J., Bruce, T., Allsop, N. W. H., van der Meer, J. (2004) Influence of parapets and recurves on wave overtopping and wave loading of complex vertical walls • Lawson, C.R. (1992) Geotextile Revetment Filters, Geotextiles and Geomembranes • LINZ (2024, 2025) Standard port tidal levels (https://www.linz.govt.nz/guidance/marine-information/tide-prediction-guidance/standard-port-tidal-levels) • Llodra (2016) Wave overtopping and crown wall stability of cube and Cubipod armoured mound breakwaters, PhD Thesis Universitat Politecnica De Valencia. • MetOcean Solutions (2025a) Lyall Bay Hindcast MetOcean Study Update • MetOcean Solutions (2025b) Nearshore Wave Study – Southern Seawall • Molines Llodra, J., (2016) Wave Overtopping and Crown Wall Stability of Cube and Cubipod Armored Mound Breakwaters. PhD thesis, Universitat Politecnica de Valencia • Molines, J., Herrera Gamboa, MP., Medina, JR. (2018). Estimations of wave forces on crown walls based on wave overtopping rates. Coastal Engineering. 132:50-62. doi:10.1016/j.coastaleng.2017.11.004

Discipline	Details
	<ul style="list-style-type: none"> • Molines, J., Medina, JR. (2019) Crown Wall Stability of Cube and Cubipod Armored Mound Breakwaters. In: Goseberg, Nils; Schlurmann, Torsten (Hg.): Coastal Structures 2019. Karlsruhe: Bundesanstalt für Wasserbau. S. 3-9. https://doi.org/10.18451/978-3-939230-64-9_001. • NIWA (2012) Joint probability of storm tide and waves on the open coast of Wellington, Greater Wellington Regional Council • NIWA (2016) Technical Report on Coastal Hydrodynamics and Sediment Processes in Lyall Bay • Pedersen, J. (1996) Wave Forces and Overtopping on Crown Walls of Rubble Mound Breakwaters. PhD thesis Aalborg University • Walters, R. A., Gillibrand, P. A., Bell, R. G., Lane, E. M. (2010) A study of tides and currents in Cook Strait New Zealand, NIWA • Doherty, Y., Flocard, F. (2024) Wellington International Airport 2D Physical Modelling, University of New South Wales Water Research Laboratory • Doherty, Y., Fellowes, T.E., Flocard, F. (2025) Wellington International Airport 3D Physical Modelling, University of New South Wales Water Research Laboratory
Geotechnical Engineering	<ul style="list-style-type: none"> • AECOM (2020) Southern Sea Defences Renewal - Southern Seawall, Lyall Bay Breakwater and Western Seawall • Beca (2023) WIAL Sea Defences Renewal - 3D Geological Model • Beca (2024b) Sea Defence Structures Renewal – Summary of Historical Seawall Information • Beca (2024c) WIAL Sea Defences Renewal – Geotechnical Interpretive Report • PDP (2023) Miramar Golf Club Redevelopment - Wellington International Airport Limited (WIAL) - 1 Stewart Duff Drive, Miramar, Wellington - Stormwater Soakage and Geotechnical Assessment Report. • Underwater Solutions Ltd (2023) Inspection Report Wellington International Airport Ltd Southern Seawall and Lyall Bay Breakwater • URS (2014) Wellington International Airport Limited Runway Extension
Civil Engineering	<ul style="list-style-type: none"> • McConnell Dowell (2025) MGC Yard Services Location Drawings – Plans 1, 2, 3 • WIAL (2024) Wellington Masterplan 2020 for Apron Development Project levels

A large, white, sans-serif letter 'C' is centered on the right side of a teal rectangular background. The letter is thick and has a slight shadow effect, giving it a three-dimensional appearance.

Appendix C – Summary of Key Design Inputs



Appendix C – Summary of Key Design Inputs

Item	Requirement																				
Design Life	<table border="1"> <thead> <tr> <th>Structure</th> <th>Design life</th> </tr> </thead> <tbody> <tr> <td>Southern Seawall, including crest wall</td> <td>50 years</td> </tr> <tr> <td>Eastern Bank Remediation</td> <td>50 years</td> </tr> <tr> <td>MGC Yard</td> <td>10 years</td> </tr> </tbody> </table>	Structure	Design life	Southern Seawall, including crest wall	50 years	Eastern Bank Remediation	50 years	MGC Yard	10 years												
	Structure	Design life																			
	Southern Seawall, including crest wall	50 years																			
	Eastern Bank Remediation	50 years																			
	MGC Yard	10 years																			
<ul style="list-style-type: none"> The 50-year sea defences design life is consistent with similar structures in NZ and internationally. The MGC Yard is a short-term facility supporting the construction of the Southern Seawall and Eastern Bank Remediation. 																					
<p>Climate Change including Relative Sea Level Rise</p> <ul style="list-style-type: none"> Relative Sea Level Rise (“RSLR”⁴) for the Southern Seawall design considers SSP5-8.5 H+ (83rd Percentile) Sea Level Rise plus Vertical Land Movement (3.99mmm/year value). RSLR values for eastern Lyall Bay baselined against the present day are shown in the table below. These are taken from the values published by the NZ SeaRise Programme in early 2024 (NZ SeaRise programme searise.takiwa.co, 2024). <table border="1"> <thead> <tr> <th>Year</th> <th>RSLR (m)</th> </tr> </thead> <tbody> <tr> <td>2024 to 2060</td> <td>0.51</td> </tr> <tr> <td>2024 to 2080</td> <td>0.87</td> </tr> <tr> <td>2024 to 2130</td> <td>2.02</td> </tr> </tbody> </table> <ul style="list-style-type: none"> Projected increases in wave height and period for the south coast of Wellington for RCP8.5 (equivalent to SSP5-8.5), from Albuquerque et al (2022) are as follows: <table border="1"> <thead> <tr> <th>Year</th> <th>% increase in wave height and period</th> </tr> </thead> <tbody> <tr> <td>2060</td> <td>1.5%</td> </tr> <tr> <td>2080</td> <td>2.5%</td> </tr> <tr> <td>2130</td> <td>5%</td> </tr> </tbody> </table>	Year	RSLR (m)	2024 to 2060	0.51	2024 to 2080	0.87	2024 to 2130	2.02	Year	% increase in wave height and period	2060	1.5%	2080	2.5%	2130	5%					
Year	RSLR (m)																				
2024 to 2060	0.51																				
2024 to 2080	0.87																				
2024 to 2130	2.02																				
Year	% increase in wave height and period																				
2060	1.5%																				
2080	2.5%																				
2130	5%																				
<p>Design Water Level</p> <ul style="list-style-type: none"> The Design Water Level (“DWL”) for each design case comprises the Extreme Water Level (storm-tide level) plus RSLR. DWLs for the design cases are tabulated below. <table border="1"> <thead> <tr> <th>DWL event</th> <th>Year</th> <th>DWL (m NZVD16)</th> </tr> </thead> <tbody> <tr> <td>MLWS</td> <td>2024</td> <td>-0.73</td> </tr> <tr> <td>1% AEP</td> <td>2024</td> <td>+1.10</td> </tr> <tr> <td>1% AEP</td> <td>2060</td> <td>+1.61</td> </tr> <tr> <td>1% AEP</td> <td>2080</td> <td>+1.97</td> </tr> <tr> <td>1% AEP</td> <td>2130</td> <td>+3.12</td> </tr> <tr> <td>0.1% AEP</td> <td>2080</td> <td>+2.09</td> </tr> </tbody> </table>	DWL event	Year	DWL (m NZVD16)	MLWS	2024	-0.73	1% AEP	2024	+1.10	1% AEP	2060	+1.61	1% AEP	2080	+1.97	1% AEP	2130	+3.12	0.1% AEP	2080	+2.09
DWL event	Year	DWL (m NZVD16)																			
MLWS	2024	-0.73																			
1% AEP	2024	+1.10																			
1% AEP	2060	+1.61																			
1% AEP	2080	+1.97																			
1% AEP	2130	+3.12																			
0.1% AEP	2080	+2.09																			

⁴ Relative Sea Level Rise (RSLR) is the projected change in sea level due to climate change, combined with Vertical Land Movement (VLM) at a given location. Current climate change guidance (MfE, 2024) recommends that RSLR be applied to projects, including SLR projections plus VLM estimates as published by the NZ SeaRise (2024) (i.e. RSLR = SLR + VLM).

Item	Requirement
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Nearshore Design Wave Conditions

Southern Seawall

- Wave conditions are taken at extraction point S11 (**Figure C-1**), approximately 100m seaward of the proposed toe of the seawall in 12.5 water depth (present day water depth).

Design element	Design wave event	DWL event	Year	Near-shore wave height Hs (m)	Near-shore wave period Tp (s)	DWL (m NZVD16)
Armour size	1% AEP	1% AEP	2080	6.76	14.73	1.97
	1% AEP	1% AEP	2080	6.03	17.70	1.97
Toe design	1% AEP	MLWS	2024	5.77	14.61	-0.73
Over-topping	1% AEP	1% AEP	2024	6.44	14.46	1.10
	1% AEP	1% AEP	2080	6.76	14.73	1.97
	1% AEP	1% AEP	2080	6.03	17.70	1.97
	1% AEP	1% AEP	2130	7.13	15.02	3.12
Over-load	0.1% AEP	0.1% AEP	2080	7.05	15.24	2.09

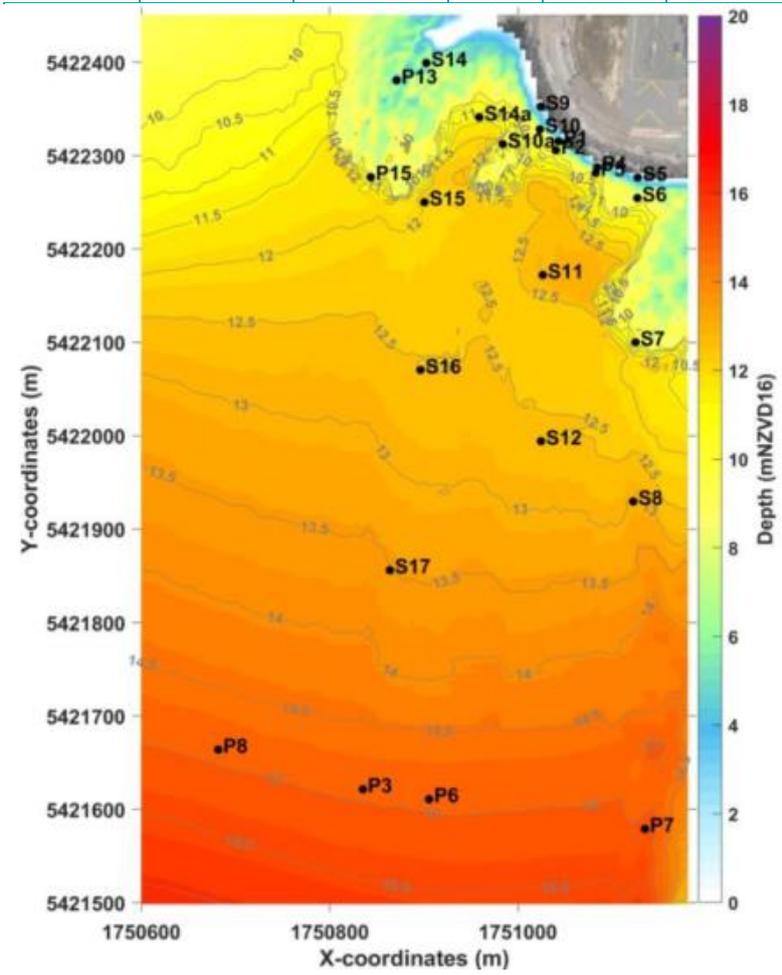


Figure C-1 – Nearshore model Extraction Points (MetOcean solutions, 2025b)

Item	Requirement																								
Geotechnical Conditions	<ul style="list-style-type: none"> Site soil class for the site is assessed as Class C (GIR 2024). Soil parameters for the site are shown in the table below. 																								
	<table border="1"> <thead> <tr> <th>Geological Unit</th> <th>Soil Description</th> <th>Unit Weight, γ (kNm⁻³)</th> <th>Friction Angle, Φ' (°)</th> <th>Cohesion, c' (kPa)</th> </tr> </thead> <tbody> <tr> <td>Fill: BOULDERS</td> <td>BOULDERS with some sands, 300-400 mm diameter</td> <td>20</td> <td>35</td> <td>0</td> </tr> <tr> <td>Fill: sandy/silty GRAVEL</td> <td>Medium dense, sandy/silty GRAVEL</td> <td>19</td> <td>32</td> <td>0</td> </tr> <tr> <td>Marine Deposits</td> <td>Medium dense, sandy GRAVEL</td> <td>18</td> <td>30</td> <td>0</td> </tr> <tr> <td>Greywacke</td> <td>Very weak to moderately strong, highly to moderately weathered SANDSTONE</td> <td>21</td> <td>35</td> <td>65</td> </tr> </tbody> </table>	Geological Unit	Soil Description	Unit Weight, γ (kNm ⁻³)	Friction Angle, Φ' (°)	Cohesion, c' (kPa)	Fill: BOULDERS	BOULDERS with some sands, 300-400 mm diameter	20	35	0	Fill: sandy/silty GRAVEL	Medium dense, sandy/silty GRAVEL	19	32	0	Marine Deposits	Medium dense, sandy GRAVEL	18	30	0	Greywacke	Very weak to moderately strong, highly to moderately weathered SANDSTONE	21	35
Geological Unit	Soil Description	Unit Weight, γ (kNm ⁻³)	Friction Angle, Φ' (°)	Cohesion, c' (kPa)																					
Fill: BOULDERS	BOULDERS with some sands, 300-400 mm diameter	20	35	0																					
Fill: sandy/silty GRAVEL	Medium dense, sandy/silty GRAVEL	19	32	0																					
Marine Deposits	Medium dense, sandy GRAVEL	18	30	0																					
Greywacke	Very weak to moderately strong, highly to moderately weathered SANDSTONE	21	35	65																					
Seismic Conditions	<ul style="list-style-type: none"> Rock and armour parameters for the seawall are shown in the table below. 																								
	<table border="1"> <thead> <tr> <th>Unit Name</th> <th>Unit Weight, γ (kNm⁻³)</th> <th>Friction Angle, Φ' (°)</th> <th>Cohesion, c' (kPa)</th> </tr> </thead> <tbody> <tr> <td>Existing Rock Bund</td> <td>18</td> <td>43</td> <td>0</td> </tr> <tr> <td rowspan="2">Existing Akmon</td> <td>16 (sat.)</td> <td rowspan="2">45</td> <td rowspan="2">0</td> </tr> <tr> <td>10 (dry)</td> </tr> <tr> <td>Proposed Rock Underlayer</td> <td>15.7</td> <td>42</td> <td>0</td> </tr> <tr> <td rowspan="2">Proposed 15.48t Cubipods</td> <td>18 (sat.)</td> <td rowspan="2">34</td> <td rowspan="2">0</td> </tr> <tr> <td>14 (dry)</td> </tr> </tbody> </table>	Unit Name	Unit Weight, γ (kNm ⁻³)	Friction Angle, Φ' (°)	Cohesion, c' (kPa)	Existing Rock Bund	18	43	0	Existing Akmon	16 (sat.)	45	0	10 (dry)	Proposed Rock Underlayer	15.7	42	0	Proposed 15.48t Cubipods	18 (sat.)	34	0	14 (dry)		
Unit Name	Unit Weight, γ (kNm ⁻³)	Friction Angle, Φ' (°)	Cohesion, c' (kPa)																						
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Proposed Rock Underlayer	15.7	42	0																						
Proposed 15.48t Cubipods	18 (sat.)	34	0																						
	14 (dry)																								
MGC Yard Services	<ul style="list-style-type: none"> The seismic loadings for slope stability and design of crest wall are based on MBIE Module 1 (MBIE/NZGS, 2021) for IL2 structures with a 50-year design life are outlined in the table below. 																								
	<table border="1"> <thead> <tr> <th>Design Event</th> <th>Annual Exceedance Probability</th> <th>Peak Ground Acceleration a_{max} (g)</th> <th>Earthquake Magnitude (M)</th> </tr> </thead> <tbody> <tr> <td>ULS</td> <td>0.2% (1/500)</td> <td>0.68</td> <td>7.7</td> </tr> <tr> <td>SLS</td> <td>4% (1/25)</td> <td>0.13</td> <td>6.5</td> </tr> </tbody> </table>	Design Event	Annual Exceedance Probability	Peak Ground Acceleration a_{max} (g)	Earthquake Magnitude (M)	ULS	0.2% (1/500)	0.68	7.7	SLS	4% (1/25)	0.13	6.5												
Design Event	Annual Exceedance Probability	Peak Ground Acceleration a_{max} (g)	Earthquake Magnitude (M)																						
ULS	0.2% (1/500)	0.68	7.7																						
SLS	4% (1/25)	0.13	6.5																						
MGC Yard Levels	<ul style="list-style-type: none"> McConnell Dowell (2025) MGC Yard Services Location Drawings – Plans 1, 2, 3 Wellington City Council (2024) GIS Water and Drainage Map (https://gis.wcc.govt.nz/LocalMapsViewer/) Wellington City Council (2024) LIDAR WIAL (2024) Wellington Masterplan 2020 																								

Item	Requirement	
MGC Yard Cut Slopes	Location & Material Type	Cut Slope
	Southwest slope – weathered greywacke	1V:1H up to 3m batter height
	Southwest slope – overlying fill	1V:1.5H up to 10m batter height
	Southeast slope– weathered greywacke	1V:1H up to 10m batter height 1V:1.5H over 10m batter height
	Southwest slope – overlying fill / colluvium	Benched if fill/colluvium over 3m thick 3m minimum width benches
	Slope between southwest and southeast areas – fill	1V:2H batter height expected to be up to 7.5m

A large, white, sans-serif capital letter 'D' is centered on the right side of a teal rectangular background. The letter is bold and has a clean, modern appearance.

Appendix D – Drawings

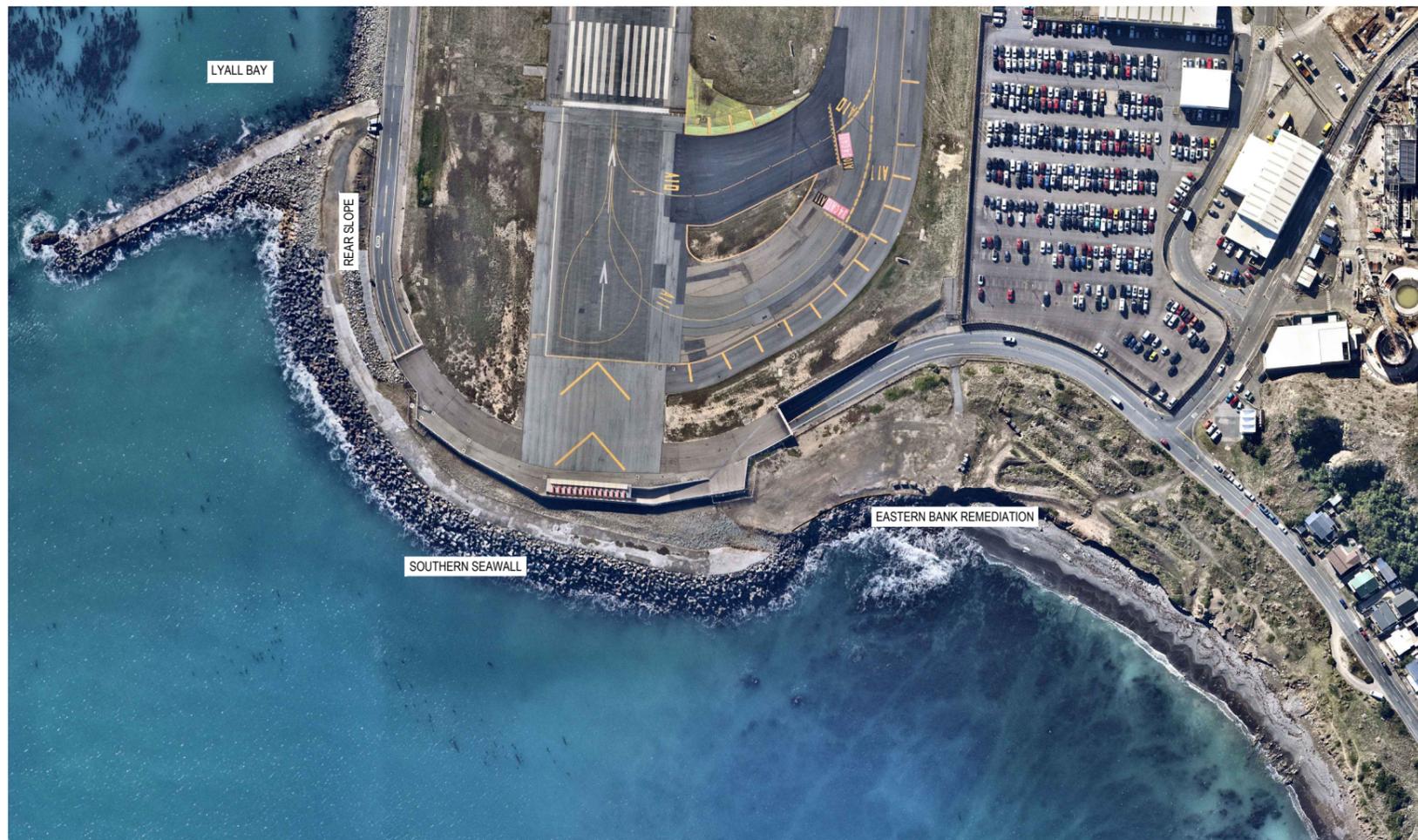


WIAL SEA DEFENCE STRUCTURES RENEWAL SOUTHERN SEAWALL

CIVIL ENGINEERING

Prepared for Wellington International Airport Limited (WIAL)
Prepared by Beca Limited (Beca)
At: Wellington International Airport

Project No.: 3324338
29 AUGUST 2025
Issue for Resource Consent



DRAWING LIST

DRAWING No.	REV	DRAWING TITLE
3324338-CA-SK000	I	COVER SHEET AND DRAWING LIST
3324338-CA-SK001	F	EXISTING BATHYMETRIC AND TOPOGRAPHIC SURVEY
3324338-CA-SK002	H	EXISTING LAYOUT
3324338-CA-SK003	H	EXISTING SECTIONS SHEET 1 OF 3
3324338-CA-SK004	H	EXISTING SECTIONS SHEET 2 OF 3
3324338-CA-SK005	H	EXISTING SECTIONS SHEET 3 OF 3
3324338-CA-SK006	G	EXISTING STRUCTURES TYPICAL SECTIONS
3324338-CA-SK007	I	GENERAL ARRANGEMENT SOUTHERN SEAWALL
3324338-CA-SK008	J	GENERAL ARRANGEMENT EASTERN BANK REMEDIATION
3324338-CA-SK009	L	GENERAL ARRANGEMENT MOA POINT RD YARD
3324338-CA-SK100	H	SOUTHERN SEAWALL SECTIONS SHEET 1 OF 3
3324338-CA-SK101	H	SOUTHERN SEAWALL SECTIONS SHEET 2 OF 3
3324338-CA-SK102	J	SOUTHERN SEAWALL SECTIONS SHEET 3 OF 3
3324338-CA-SK104	J	EASTERN BANK REHABILITATION SECTION
3324338-CA-SK105	F	EXISTING AND PROPOSED SEAWALL TOE AND MHWS LOCATIONS
3324338-CA-SK106	C	LAND USE ZONES PLAN
3324338-CA-SK120	D	STAGE 1 KORORA HABITAT GENERAL ARRANGEMENT & UNDERPASS SECTION
3324338-CA-SK121	C	STAGE 1 KORORA HABITAT UNDERPASS LONG SECTION AND ELEVATION
3324338-CA-SK200	B	MGC CONSTRUCTION YARD EXISTING CONTOURS & SERVICES LAYOUT PLAN
3324338-CA-SK201	B	MGC CONSTRUCTION YARD GENERAL ARRANGEMENT & EXISTING SERVICES
3324338-CA-SK211	B	MGC CONSTRUCTION YARD STORAGE AREAS & STORMWATER DRAINAGE
3324338-CA-SK215	C	MGC CONSTRUCTION YARD LAYOUT PLAN: ROADS, SERVICES & STOCKPILES
3324338-CA-SK216	B	MGC CONSTRUCTION YARD ADDITIONAL EARTHWORKS AREAS
3324338-CA-SK217	C	MGC CONSTRUCTION YARD ISOPACH - CUT AND FILL PLAN
3324338-CA-SK221	C	MGC CONSTRUCTION YARD BULK EARTHWORKS CROSS SECTIONS #1
3324338-CA-SK222	A	MGC CONSTRUCTION YARD BULK EARTHWORKS CROSS SECTIONS #2

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- NOTES:**
- HORIZONTAL COORDINATE SYSTEM: NEW ZEALAND TRANSVERSE MERCATOR (NZTM2000).
 - VERTICAL DATUM TO NEW ZEALAND VERTICAL DATUM 2016 (NZVD16).
 - BATHYMETRIC SURVEY DATA:
 - DISCOVERY MARINE LIMITED (DML) CONDUCTED APRIL TO MAY 2021.
 - TOPOGRAPHIC DATA:
 - BECA DRONE SURVEY JAN 2024.

- LEGEND:**
- 5.0 — MAJOR CONTOURS (5.0m INTERVALS)
 - — — MINOR CONTOURS (0.5m INTERVALS)

ORIGINAL DRAWING
IN COLOUR
RESOURCE CONSENT
NOT FOR CONSTRUCTION

F	FOR RESOURCE CONSENT	TS	AS	JH	08.04.25
E	FOR RESOURCE CONSENT	AF	AS	JH	28.02.25
D	FOR RESOURCE CONSENT	TS	AS	JH	06.12.24
C	FOR RESOURCE CONSENT	TS	AS	JH	02.12.24
No.	Revision	By	Chk	Appd	Date

Original Scale (A1)	Design	AS & WP	08.04.25	Approved For Construction*
1:750	Drawn	TS	08.04.25	
Reduce Scale (A3)	Design Verifier	JH	08.04.25	
1:1500	Design Check	JH	08.04.25	Date

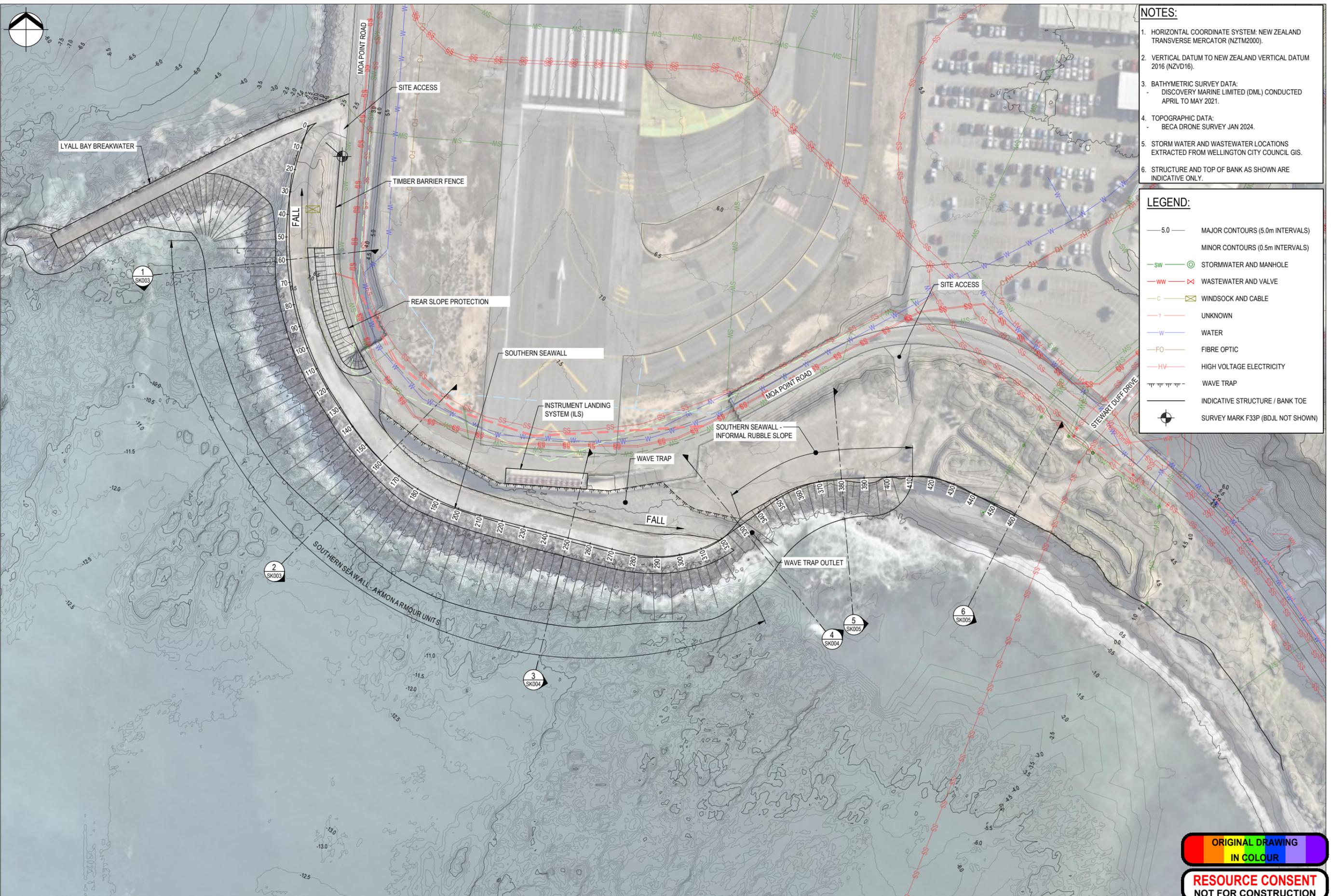
* Refer to Revision 1 for Original Signature



Client: **WIAL SEA DEFENCE STRUCTURES RENEWAL**

Title: **EXISTING BATHYMETRIC AND TOPOGRAPHIC SURVEY**

Discipline	CIVIL ENGINEERING
Drawing No.	3324338-CA-SK001
Rev.	F



- NOTES:**
- HORIZONTAL COORDINATE SYSTEM: NEW ZEALAND TRANSVERSE MERCATOR (NZTM2000).
 - VERTICAL DATUM TO NEW ZEALAND VERTICAL DATUM 2016 (NZVD16).
 - BATHYMETRIC SURVEY DATA: DISCOVERY MARINE LIMITED (DML) CONDUCTED APRIL TO MAY 2021.
 - TOPOGRAPHIC DATA: BECA DRONE SURVEY JAN 2024.
 - STORM WATER AND WASTEWATER LOCATIONS EXTRACTED FROM WELLINGTON CITY COUNCIL GIS.
 - STRUCTURE AND TOP OF BANK AS SHOWN ARE INDICATIVE ONLY.

- LEGEND:**
- 5.0 — MAJOR CONTOURS (5.0m INTERVALS)
 - — MINOR CONTOURS (0.5m INTERVALS)
 - SW — STORMWATER AND MANHOLE
 - WW — WASTEWATER AND VALVE
 - C — WINDSOCK AND CABLE
 - ? — UNKNOWN
 - W — WATER
 - FO — FIBRE OPTIC
 - HV — HIGH VOLTAGE ELECTRICITY
 - — WAVE TRAP
 - — INDICATIVE STRUCTURE / BANK TOE
 - — SURVEY MARK F33P (BDJL NOT SHOWN)

ORIGINAL DRAWING
IN COLOUR
RESOURCE CONSENT
NOT FOR CONSTRUCTION

H	FOR RESOURCE CONSENT	CFP	JH	JH	28.07.25
G	FOR RESOURCE CONSENT	CFP	JH	JH	30.07.25
F	FOR RESOURCE CONSENT	TS	AS	JH	08.04.25
E	FOR RESOURCE CONSENT	AF	AS	JH	28.02.25
No.	Revision	By	Chk	Appd	Date

Original Scale (A1)	1:750	Design	AS & WP	08.04.25	Approved For Construction*
Reduced Scale (A3)	1:1500	Drawn	TS	08.04.25	
		Design Verifier	JH	08.04.25	
		Design Check	JH	08.04.25	Date

* Refer to Revision 1 for Original Signature



Client: **WIAL SEA DEFENCE STRUCTURES RENEWAL**

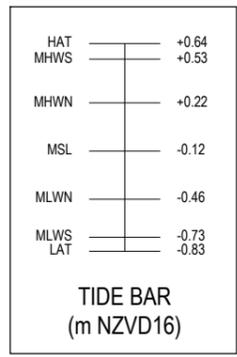
Project: **EXISTING LAYOUT**

Discipline: **CIVIL ENGINEERING**
Drawing No.: **3324338-CA-SK002**
Rev.: **H**

www.beca.com

- NOTES:**
- HORIZONTAL COORDINATE SYSTEM: NEW ZEALAND TRANSVERSE MERCATOR (NZTM2000).
 - VERTICAL DATUM TO NEW ZEALAND VERTICAL DATUM 2016 (NZVD16).
 - BATHYMETRIC SURVEY DATA:
 - DISCOVERY MARINE LIMITED (DML) CONDUCTED APRIL TO MAY 2021.
 - TOPOGRAPHIC SURVEY DATA:
 - BECA DRONE SURVEY JAN 2024.
 - CREST AND TOE MARKS ARE INDICATIVE ONLY.

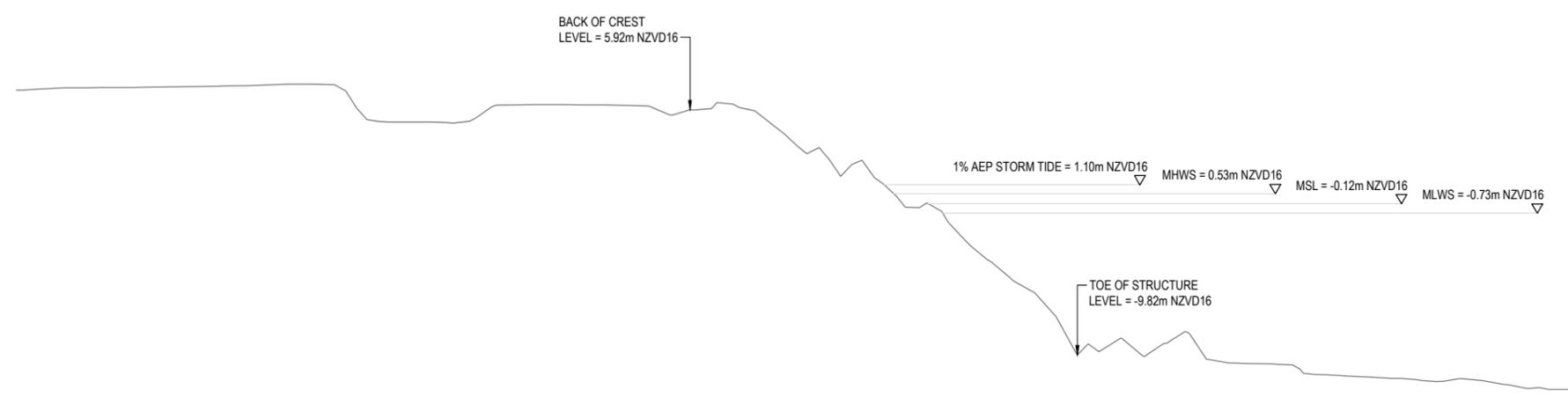
- LEGEND:**
- EXISTING GROUND
 - TIDE LEVELS



Datum -10.00

CHAINAGE	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80	82	84	86	88	90	92	94	96	98
EXISTING SURFACE LEVEL	5.42	4.42	3.75	2.16	2.14	2.26	2.37	2.45	2.57	3.15	4.11	5.40	6.02	6.71	6.78	6.71	6.68	6.67	6.74	7.00	6.51	5.42	5.14	5.33	4.61	3.81	2.38	1.72	0.53	-0.16	-0.46	-1.25	-2.30	-2.80	-2.51	-2.79	-3.67	-3.44	-4.13	-3.67	-4.43	-4.76	-4.41	-4.94	-4.93	-5.07	-5.07	-5.09	-5.13
OLS LEVEL	8.27	8.56	8.86	9.15	9.45	9.74	10.03	10.33	10.62	10.91	11.21	11.50	11.79	12.09	12.38	12.67	12.95	13.23	13.51	13.79	14.07	14.35	14.63	14.91	15.19	15.47	15.75	16.02	16.30	16.58	16.87	17.15	17.44	17.73	18.02	18.30	18.59	18.88	19.16	19.44	19.72	20.00	20.28	20.56	20.84	21.12	21.40	21.68	21.96

1 SECTION AT SS-CH 60
SK002 SCALE 1:200



Datum -15.00

CHAINAGE	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80	82	84	86	88	90	92	94	96	98
EXISTING SURFACE LEVEL	7.28	7.34	7.36	7.37	7.41	7.43	7.46	7.52	7.58	7.55	5.89	5.14	5.13	5.07	5.72	6.24	6.25	6.23	6.23	6.18	5.61	5.95	6.30	5.46	3.80	3.04	2.52	0.92	-0.36	-1.39	-3.35	-4.98	-6.42	-9.46	-9.38	-9.53	-9.05	-9.31	-10.34	-10.40	-10.46	-11.10	-11.21	-11.31	-11.42	-11.48	-11.45	-11.76	-11.94
OLS LEVEL	8.29	8.31	8.32	8.34	8.36	8.38	8.40	8.42	8.44	8.46	8.48	8.50	8.52	8.54	8.56	8.57	8.59	8.61	8.63	8.65	8.67	9.15	9.18	9.21	9.24	9.27	9.31	9.34	9.37	9.40	9.43	9.46	9.49	9.52	9.55	9.58	9.69	9.88	10.06	10.24	10.42	10.60	10.78	10.96	11.15	11.33	11.50	11.68	11.86

2 SECTION AT SS-CH 160
SK002 SCALE 1:200

ORIGINAL DRAWING
IN COLOUR
RESOURCE CONSENT
NOT FOR CONSTRUCTION

H	FOR RESOURCE CONSENT	CFP	JH	JH	14.08.25	Original Scale (A1)	Design	AS & WP	08.04.25	Approved For Construction*
G	FOR RESOURCE CONSENT	CFP	JH	JH	28.07.25	AS SHOWN	Drawn	TS	08.04.25	
F	FOR RESOURCE CONSENT	TS	AS	JH	08.04.25	Reduction	Day Verifier	JH	08.04.25	
E	FOR RESOURCE CONSENT	AF	AS	JH	28.02.25	Scale (A3)	Day Check	JH	08.04.25	Date
No.	Revision	By	Chk	Appd	Date	HALF SHOWN	* Refer to Revision 1 for Original Signature			



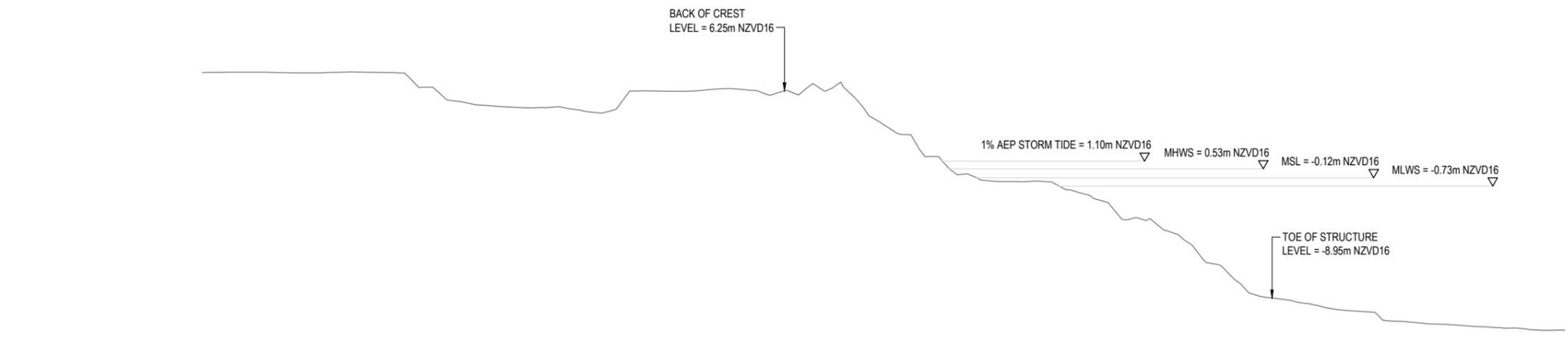
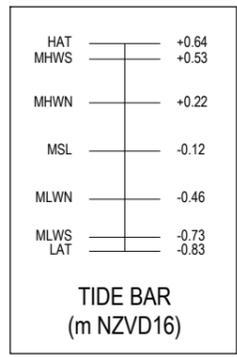
Client: WIAL SEA DEFENCE STRUCTURES RENEWAL

Title: EXISTING SECTIONS SHEET 1 OF 3

Discipline	CIVIL ENGINEERING
Drawing No.	3324338-CA-SK003
Rev.	H

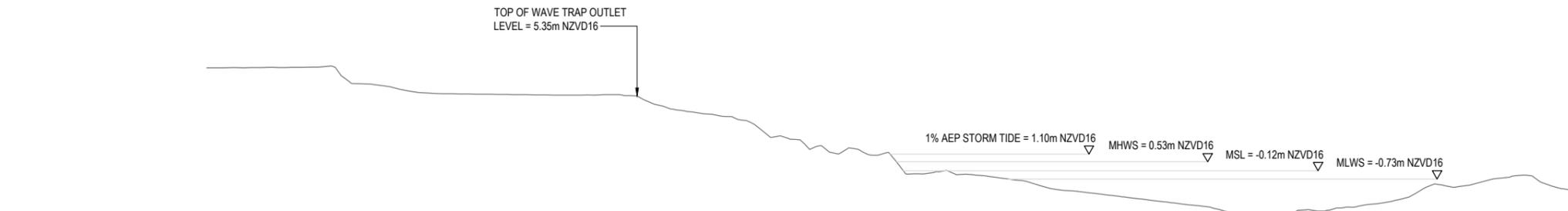
- NOTES:**
- HORIZONTAL COORDINATE SYSTEM: NEW ZEALAND TRANSVERSE MERCATOR (NZTM2000).
 - VERTICAL DATUM TO NEW ZEALAND VERTICAL DATUM 2016 (NZVD16).
 - BATHYMETRIC SURVEY DATA:
 - DISCOVERY MARINE LIMITED (DML) CONDUCTED APRIL TO MAY 2021.
 - TOPOGRAPHIC SURVEY DATA:
 - BECA DRONE SURVEY JAN 2024.
 - CREST AND TOE MARKS ARE INDICATIVE ONLY.

- LEGEND:**
- EXISTING GROUND
 - TIDE LEVELS



CHAINAGE	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80	82	84	86	88	90	92	94	96	98
EXISTING SURFACE LEVEL	7.63	7.63	7.59	7.58	7.62	7.63	7.59	6.52	5.58	5.25	5.10	5.00	5.08	4.76	4.79	6.25	6.23	6.24	6.40	6.32	6.03	6.15	6.35	5.62	3.78	3.04	1.45	0.15	-0.37	-0.41	-0.41	-1.11	-1.81	-3.17	-3.48	-4.64	-6.39	-7.76	-8.88	-9.15	-9.54	-9.87	-9.98	-10.66	-10.83	-10.93	-11.05	-11.16	-11.30
OLS LEVEL	8.53	8.56	8.58	8.61	8.63	8.65	8.68	8.70	8.73	8.75	8.78	8.80	8.83	8.85	8.88	8.90	8.92	8.95	8.97	9.00	9.02	9.05	9.07	9.10	9.12	9.15	9.17	9.19	9.22	9.24	9.27	9.29	9.32	9.34	9.37	9.39	9.42	9.44	9.46	9.49	9.51	9.54	9.56	9.59	9.61	9.64	9.66	9.69	9.71

3 SECTION AT SS-CH 250
SK002 SCALE 1:200



CHAINAGE	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80	82	84	86	88	90	92	94	96	98
EXISTING SURFACE LEVEL	7.42	7.43	7.44	7.46	6.74	6.22	5.88	5.58	5.51	5.47	5.46	5.43	5.42	5.42	5.45	5.12	4.43	4.12	3.86	3.38	2.41	1.73	1.18	1.35	1.22	-0.35	-0.16	-0.40	-0.62	-0.87	-1.44	-1.65	-1.88	-2.12	-2.36	-2.60	-2.90	-3.24	-3.40	-3.08	-3.06	-2.80	-2.52	-2.11	-1.14	-1.27	-0.84	-0.50	-0.99
OLS LEVEL	8.54	8.56	8.58	8.60	8.62	8.63	8.65	8.67	8.69	8.71	8.73	8.75	8.77	9.15	9.34	9.37	9.40	9.43	9.46	9.49	9.52	9.55	9.58	9.62	9.65	9.68	9.71	9.74	9.77	9.82	10.01	10.19	10.37	10.55	10.74	10.91	11.10	11.28	11.46	11.64	11.82	12.00	12.19	12.37	12.55	12.73	12.91	13.09	13.28

4 SECTION AT SS-CH 330
SK002 SCALE 1:200



H	FOR RESOURCE CONSENT	CFP	JH	JH	14.08.25	Original Scale (A1)	Design	AS & WP	08.04.25	Approved For Construction*
G	FOR RESOURCE CONSENT	CFP	JH	JH	28.07.25	AS SHOWN	Drawn	TS	08.04.25	
F	FOR RESOURCE CONSENT	TS	AS	JH	08.04.25	Reduction	Design Checker	JH	08.04.25	
E	FOR RESOURCE CONSENT	AF	AS	JH	28.02.25	Scale (A3)	Design Checker	JH	08.04.25	Date
No.	Revision	By	Chk	Appd	Date	HALF SHOWN	* Refer to Revision 1 for Original Signature			



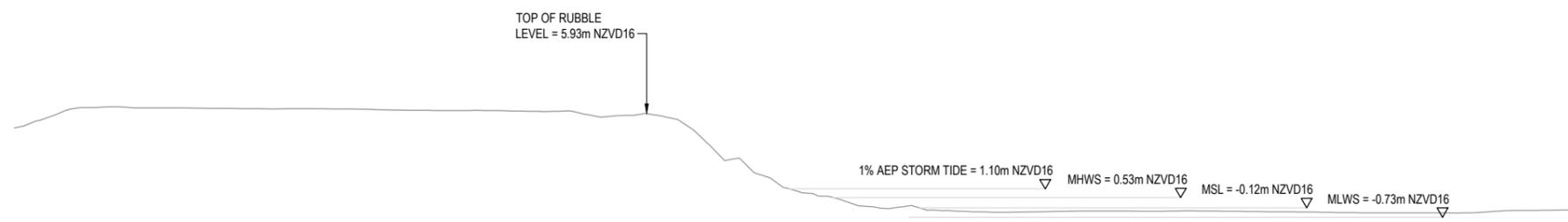
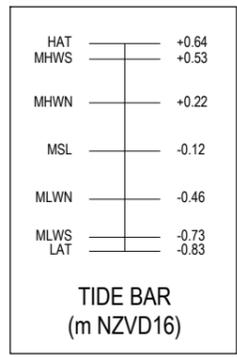
Client: **WIAL SEA DEFENCE STRUCTURES RENEWAL**

Title: **EXISTING SECTIONS SHEET 2 OF 3**

Discipline: **CIVIL ENGINEERING**
Drawing No: **3324338-CA-SK004** Rev: **H**

- NOTES:**
- HORIZONTAL COORDINATE SYSTEM: NEW ZEALAND TRANSVERSE MERCATOR (NZTM2000).
 - VERTICAL DATUM TO NEW ZEALAND VERTICAL DATUM 2016 (NZVD16).
 - BATHYMETRIC SURVEY DATA:
 - DISCOVERY MARINE LIMITED (DML) CONDUCTED APRIL TO MAY 2021.
 - TOPOGRAPHIC SURVEY DATA:
 - BECA DRONE SURVEY JAN 2024.
 - CREST AND TOE MARKS ARE INDICATIVE ONLY.

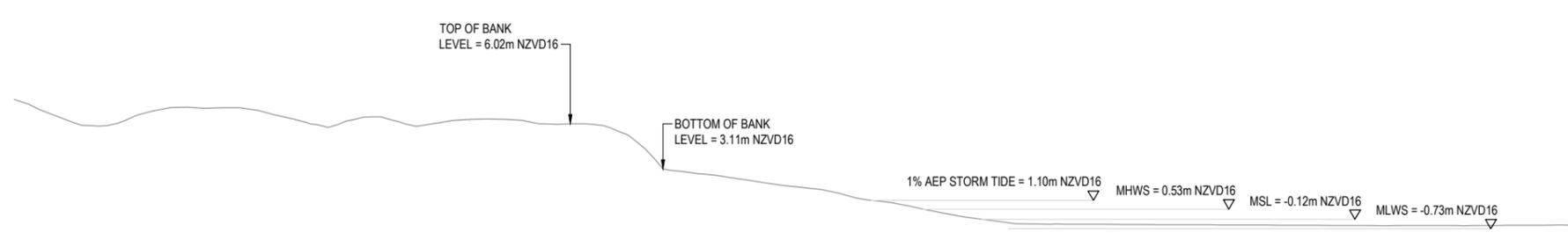
- LEGEND:**
- EXISTING GROUND
 - TIDE LEVELS



Datum -10.00

CHAINAGE	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80	82	84	86	88	90	92	94	96	98
EXISTING SURFACE LEVEL	5.63	6.28	6.35	6.29	6.29	6.27	6.26	6.24	6.24	6.24	6.21	6.16	6.14	6.12	6.13	6.10	6.06	6.05	5.72	5.85	5.68	4.57	2.97	2.00	1.05	0.63	0.10	-0.17	-0.06	-0.30	-0.38	-0.40	-0.37	-0.33	-0.32	-0.33	-0.32	-0.34	-0.36	-0.38	-0.41	-0.44	-0.44	-0.44	-0.44	-0.42	-0.31	-0.29	
OLS LEVEL	14.29	14.32	14.34	14.37	14.39	14.41	14.44	14.46	14.48	14.51	14.54	14.57	14.60	14.62	14.65	14.68	14.71	14.74	14.77	14.80	14.83	14.86	14.89	14.91	14.94	14.97	15.00	15.03	15.06	15.08	15.11	15.13	15.16	15.18	15.21	15.24	15.27	15.30	15.33	15.36	15.39	15.42	15.45	15.47	15.50	15.53	15.56	15.59	15.62

5 SECTION AT SS-CH 380
SK002 SCALE 1:200



Datum -10.00

CHAINAGE	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80	82	84	86	88	90	92	94	96	98
EXISTING SURFACE LEVEL	6.80	6.04	5.91	6.61	7.06	7.04	7.06	6.80	6.32	5.84	6.33	6.35	5.88	6.22	6.33	6.28	6.03	6.03	5.87	4.88	3.06	2.81	2.57	2.26	1.99	1.77	1.29	1.00	0.62	0.23	-0.09	-0.36	-0.43	-0.44	-0.45	-0.46	-0.47	-0.48	-0.49	-0.50	-0.51	-0.52	-0.53	-0.54	-0.53	-0.53	-0.53	-0.52	-0.51
OLS LEVEL	28.11	27.99	27.87	27.75	27.63	27.51	27.39	27.27	27.15	27.03	26.91	26.79	26.67	26.55	26.43	26.31	26.19	26.07	25.95	25.83	25.71	25.59	25.47	25.35	25.23	25.11	24.99	24.87	24.75	24.63	24.51	24.39	24.27	24.15	24.03	23.91	23.79	23.67	23.55	23.43	23.31	23.19	23.07	22.95	22.83	22.71	22.59	22.47	22.35

6 SECTION AT SS-CH 460
SK002 SCALE 1:200

ORIGINAL DRAWING
IN COLOUR

RESOURCE CONSENT
NOT FOR CONSTRUCTION

H	FOR RESOURCE CONSENT	CFP	JH	JH	14.08.25
G	FOR RESOURCE CONSENT	CFP	JH	JH	28.07.25
F	FOR RESOURCE CONSENT	TS	AS	JH	08.04.25
E	FOR RESOURCE CONSENT	AF	AS	JH	28.02.25
No.	Revision	By	Chk	Appd	Date

Original Scale (A1)	Design	AS & WP	08.04.25	Approved For Construction*
AS SHOWN	Drawn	TS	08.04.25	
Reduced	Day Verifier	JH	08.04.25	
Scale (A3)	Day Check	JH	08.04.25	Date
HALF SHOWN	* Refer to Revision 1 for Original Signature			

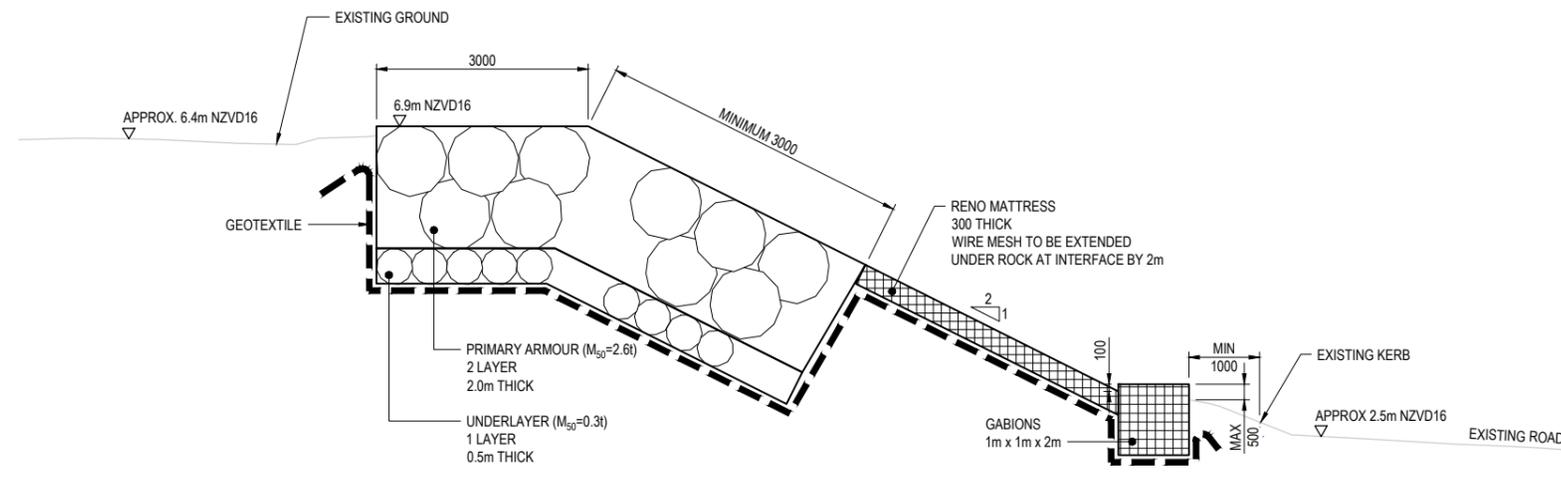


Client: **WIAL SEA DEFENCE STRUCTURES RENEWAL**

Title: **EXISTING SECTIONS SHEET 3 OF 3**

Discipline	CIVIL ENGINEERING	
Drawing No.	3324338-CA-SK005	Rev.
		H

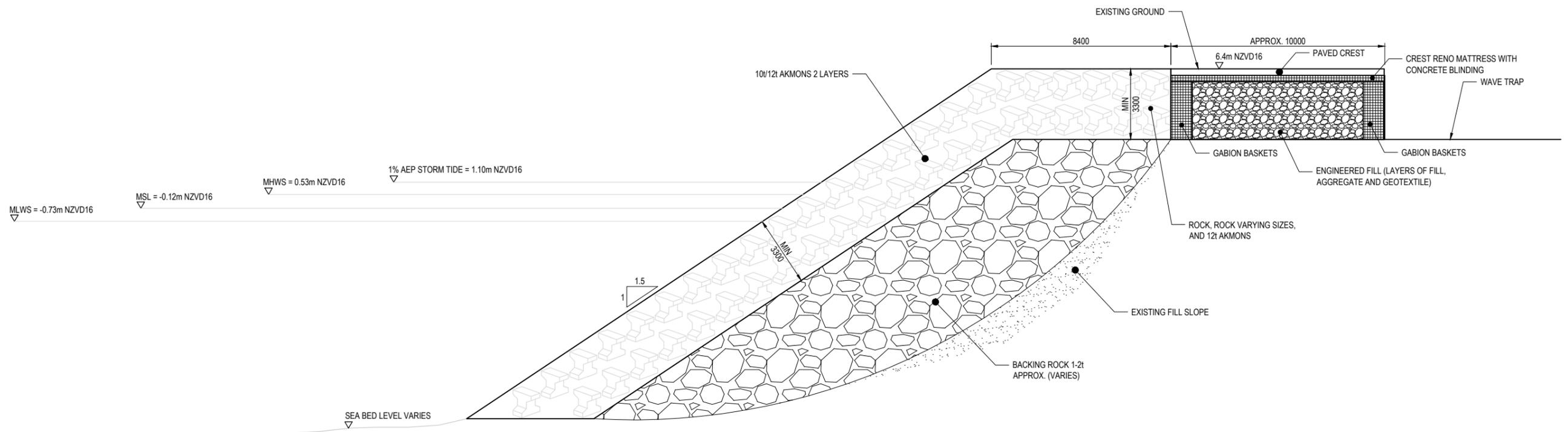
- NOTES:**
1. VERTICAL DATUM TO NEW ZEALAND VERTICAL DATUM 2016 (NZVD16).
 2. ALL DIMENSION ARE IN MILLIMETRES UNLESS STATED OTHERWISE.
 3. REAR SLOPE PROTECTION DESIGNED BY BECA IN 2016. TYPICAL SECTION SHOWS DESIGN NOT AS BUILT STRUCTURE.
 4. EXISTING AKMON ARMoured SEAWALL IS INDICATIVE ONLY. THE AS-BUILT DRAWINGS ARE NOT AVAILABLE AND INFORMATION IS LIMITED



HAT	+0.64
MHWS	+0.53
MHWN	+0.22
MSL	-0.12
MLWN	-0.46
MLWS	-0.73
LAT	-0.83

TIDE BAR
(m NZVD16)

TYPICAL DESIGN SECTION OF EXISTING REAR SLOPE PROTECTION
SCALE 1:50



INDICATIVE DESIGN SECTION OF EXISTING SOUTHERN SEAWALL (PRESENT DAY ACTUAL SEAWALL DIFFERS)
SCALE 1:100

G	FOR RESOURCE CONSENT	CFP	JH	JH	30.06.25
F	FOR RESOURCE CONSENT	TS	AS	JH	08.04.25
E	FOR RESOURCE CONSENT	AF	AS	JH	28.02.25
D	FOR RESOURCE CONSENT	TS	AS	JH	06.12.24
No.	Revision	By	Chk	Appd	Date

Original Scale (A1)	Design	AS & WP	08.04.25	Approved For Construction*
AS SHOWN	Drawn	TS	08.04.25	
Reduced Scale (A3)	Design Checker	JH	08.04.25	
HALF SHOWN	Drawn	JH	08.04.25	

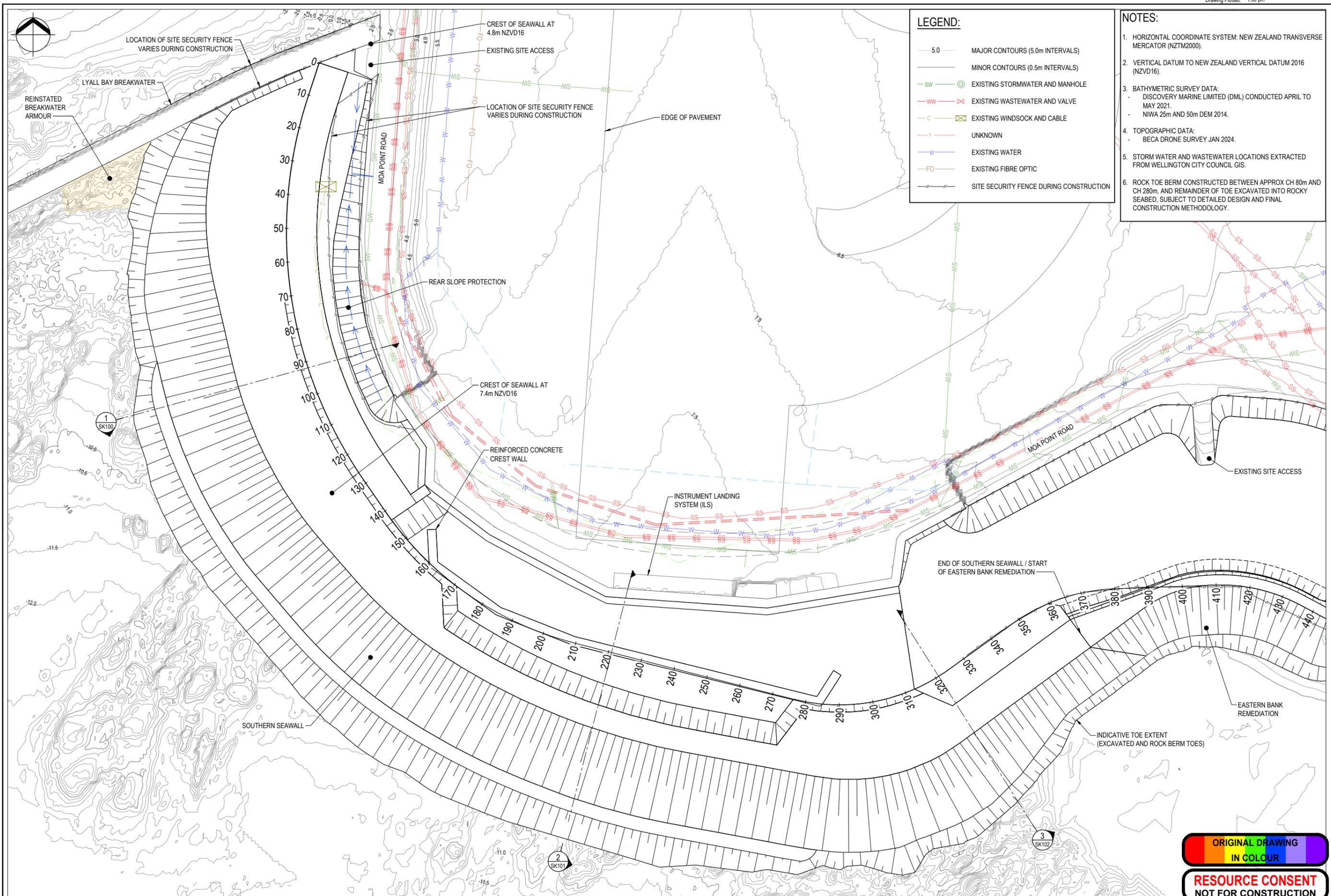
* Refer to Revision 1 for Original Signature



Client: **WIAL SEA DEFENCE STRUCTURES RENEWAL**

Title: **EXISTING STRUCTURES TYPICAL SECTIONS**

Discipline	CIVIL ENGINEERING
Drawing No.	3324338-CA-SK006
Rev.	G



LEGEND:

- 5.0 MAJOR CONTOURS (5.0m INTERVALS)
- MINOR CONTOURS (0.5m INTERVALS)
- SW EXISTING STORMWATER AND MANHOLE
- WW EXISTING WASTEWATER AND VALVE
- C EXISTING WINDSOCK AND CABLE
- UNKNOWN
- W EXISTING WATER
- FO EXISTING FIBRE OPTIC
- SITE SECURITY FENCE DURING CONSTRUCTION

NOTES:

1. HORIZONTAL COORDINATE SYSTEM: NEW ZEALAND TRANSVERSE MERCATOR (NZTM2000).
2. VERTICAL DATUM TO NEW ZEALAND VERTICAL DATUM 2016 (NZVD16).
3. BATHYMETRIC SURVEY DATA:
 - DISCOVERY MARINE LIMITED (DML) CONDUCTED APRIL TO MAY 2021.
 - NIWA 25m AND 50m DEM 2014.
4. TOPOGRAPHIC DATA:
 - BECA DRONE SURVEY JAN 2024.
5. STORM WATER AND WASTEWATER LOCATIONS EXTRACTED FROM WELLINGTON CITY COUNCIL GIS.
6. ROCK TOE BERM CONSTRUCTED BETWEEN APPROX CH 80m AND CH 280m, AND REMAINDER OF TOE EXCAVATED INTO ROCKY SEABED, SUBJECT TO DETAILED DESIGN AND FINAL CONSTRUCTION METHODOLOGY.

I	FOR RESOURCE CONSENT	CFP	JH	JH	14.08.25
H	FOR RESOURCE CONSENT	CFP	JH	JH	28.07.25
G	FOR RESOURCE CONSENT	CFP	JH	JH	30.06.25
F	FOR RESOURCE CONSENT	TS	AS	JH	08.04.25
No.	Revision	By	Chk	Appd	Date

Original Scale (A1)	Design	AS & WP	08.04.25	Approved For Construction*
1:500	Drawn	TS	08.04.25	
Reduced Scale (A3)	Day Verifier	JH	08.04.25	
1:1000	Dwg Check	JH	08.04.25	Date

* Refer to Revision 1 for Original Signature

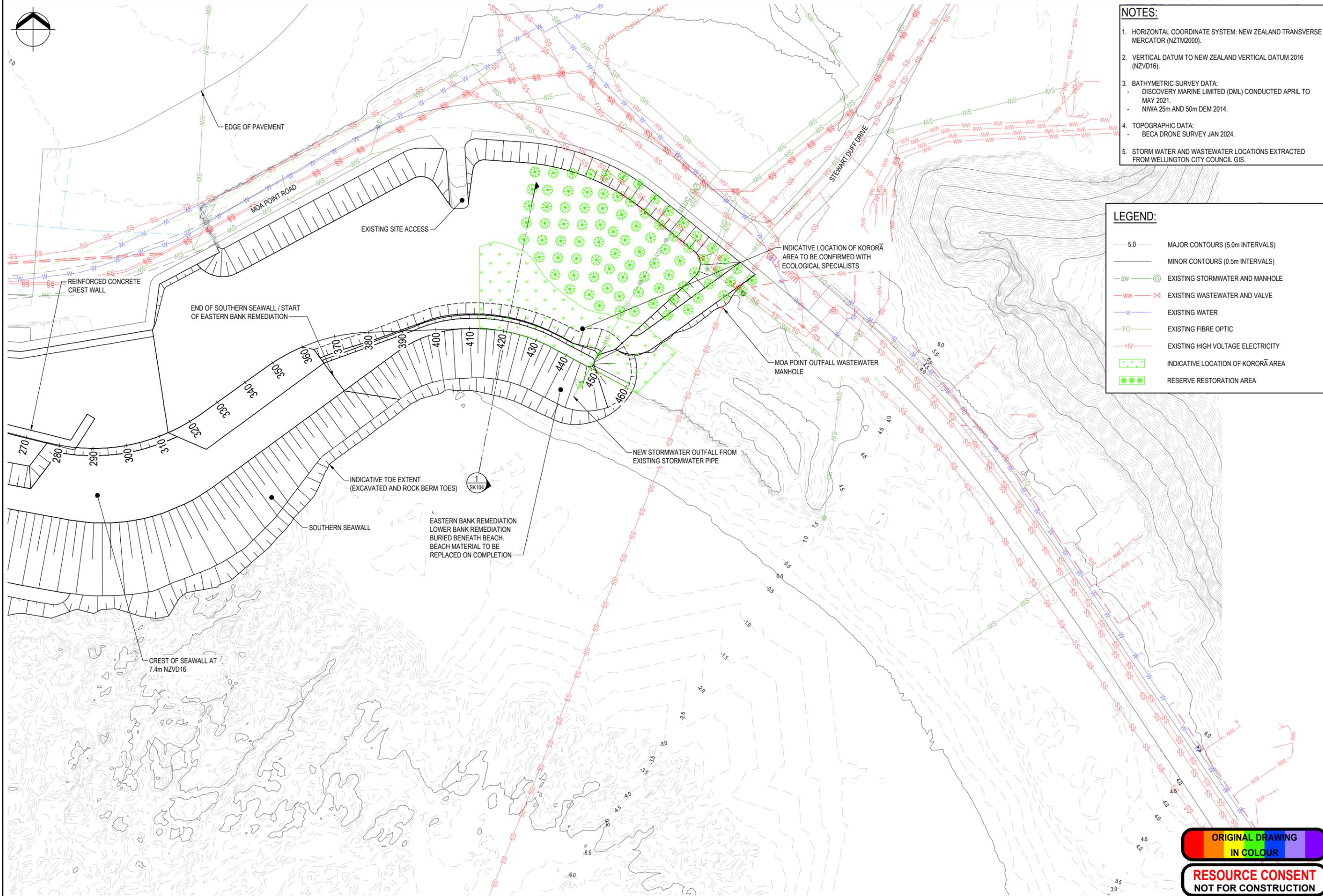


Client: **WIAL SEA DEFENCE STRUCTURES RENEWAL**

Title: **GENERAL ARRANGEMENT SOUTHERN SEAWALL**

Discipline: **CIVIL ENGINEERING**
 Drawing No: **3324338-CA-SK007**
 Rev: **1**





- NOTES:**
- HORIZONTAL COORDINATE SYSTEM: NEW ZEALAND TRANSVERSE MERCATOR (NZTM2000).
 - VERTICAL DATUM TO NEW ZEALAND VERTICAL DATUM 2016 (NZVD16).
 - BATHYMETRIC SURVEY DATA:
 - DISCOVERY MARINE LIMITED (DML) CONDUCTED APRIL TO MAY 2021.
 - NIWA 25m AND 50m DEM 2014.
 - TOPOGRAPHIC DATA:
 - BECA DRONE SURVEY JAN 2024.
 - STORM WATER AND WASTEWATER LOCATIONS EXTRACTED FROM WELLINGTON CITY COUNCIL GIS.

- LEGEND:**
- 5.0 MAJOR CONTOURS (5.0m INTERVALS)
 - MINOR CONTOURS (0.5m INTERVALS)
 - SW EXISTING STORMWATER AND MANHOLE
 - WW EXISTING WASTEWATER AND VALVE
 - W EXISTING WATER
 - FO EXISTING FIBRE OPTIC
 - HV EXISTING HIGH VOLTAGE ELECTRICITY
 - INDICATIVE LOCATION OF KORORĀ AREA
 - RESERVE RESTORATION AREA

J	FOR RESOURCE CONSENT	CFP	JH	JH	25.08.25	Original Scale (A1)	Design	AS & WP	08.04.25	Approved For Construction*
I	FOR RESOURCE CONSENT	CFP	JH	JH	14.08.25	1:500	Drawn	TS	08.04.25	
H	FOR RESOURCE CONSENT	CFP	JH	JH	28.07.25	Reduced Scale (A3)	Day Verifier	JH	08.04.25	
G	FOR RESOURCE CONSENT	CFP	JH	JH	30.06.25	1:1000	Day Check	JH	08.04.25	Date
No.	Revision	By	Chk	Appd	Date		* Refer to Revision 1 for Original Signature			

Original Scale (A1)	Design	AS & WP	08.04.25	Approved For Construction*
1:500	Drawn	TS	08.04.25	
Reduced Scale (A3)	Day Verifier	JH	08.04.25	
1:1000	Day Check	JH	08.04.25	Date

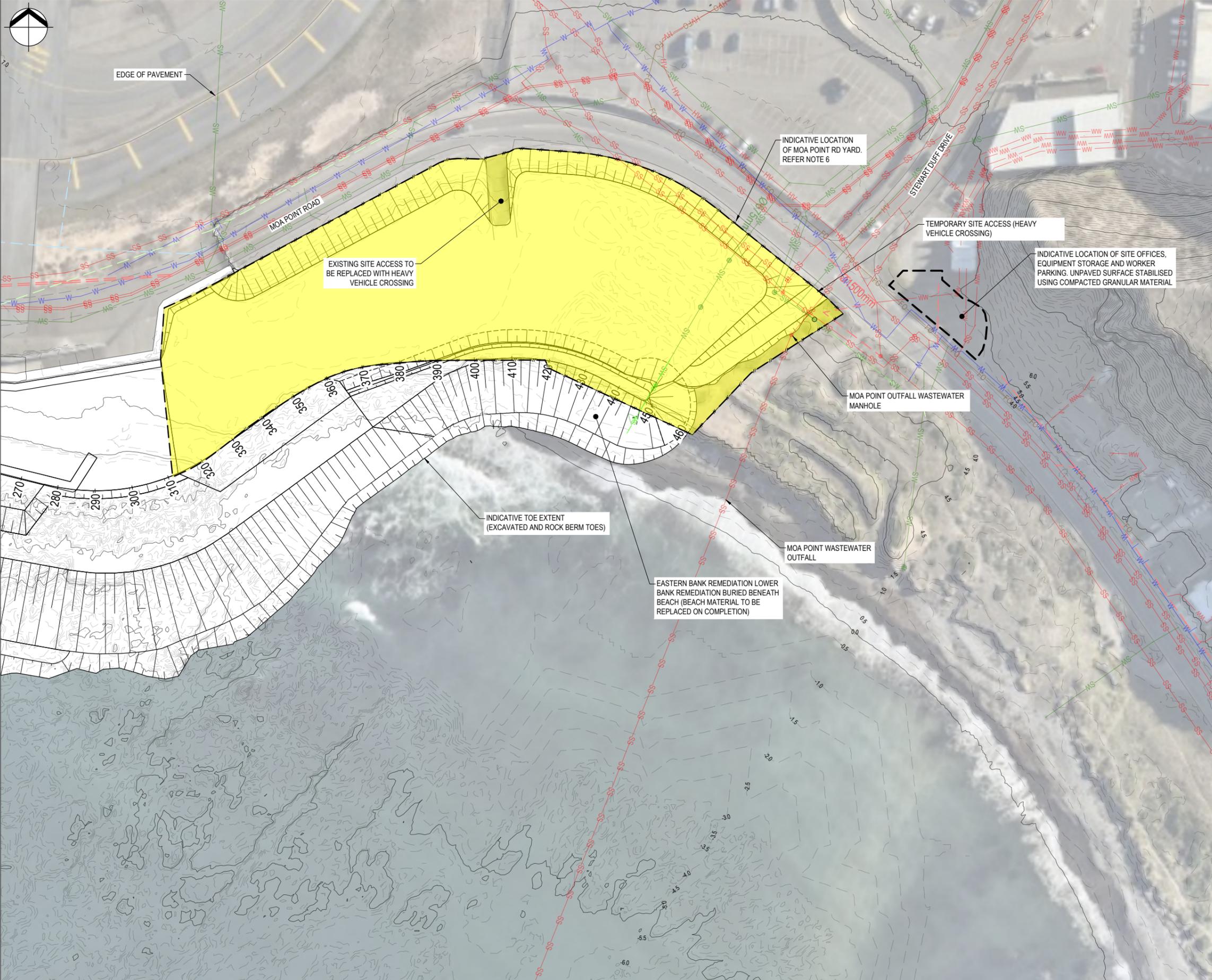


Client: **WIAL SEA DEFENCE STRUCTURES RENEWAL**

Title: **GENERAL ARRANGEMENT EASTERN BANK REMEDIATION**

Discipline: **CIVIL ENGINEERING**
 Drawing No.: **3324338-CA-SK008**
 Rev.: **J**





- NOTES:**
- HORIZONTAL COORDINATE SYSTEM: NEW ZEALAND TRANSVERSE MERCATOR (NZTM2000).
 - VERTICAL DATUM TO NEW ZEALAND VERTICAL DATUM 2016 (NZVD16).
 - BATHYMETRIC SURVEY DATA:
 - DISCOVERY MARINE LIMITED (DML) CONDUCTED APRIL TO MAY 2021.
 - NIWA 25m AND 50m DEM 2014.
 - TOPOGRAPHIC DATA:
 - BECA DRONE SURVEY JAN 2024.
 - STORM WATER AND WASTEWATER LOCATIONS EXTRACTED FROM WELLINGTON CITY COUNCIL GIS.
 - LARGE PLANT TYPICALLY PARKED EAST OF EXISTING SITE ACCESS. OTHER PLANT AND STOCKPILED MATERIALS TYPICALLY LOCATED WEST OF EXISTING SITE ACCESS. PLANT AND STOCKPILE LOCATIONS WILL VARY DURING CONSTRUCTION AND MAY OCCUPY ANY PART OF SITE BETWEEN SECURITY FENCE AND SEAWALL.

- LEGEND:**
- 5.0 MAJOR CONTOURS (5.0m INTERVALS)
 - MINOR CONTOURS (0.5m INTERVALS)
 - SW EXISTING STORMWATER AND MANHOLE
 - WW EXISTING WASTEWATER, VALVE AND MANHOLE
 - W EXISTING WATER
 - FO EXISTING FIBRE OPTIC
 - HV EXISTING HIGH VOLTAGE ELECTRICITY
 - YARD, SITE OFFICES, ETC BOUNDARY
 - SITE SECURITY FENCE DURING CONSTRUCTION
 - AREA RECONTOURED TO PROVIDE EVEN SURFACE, GENERALLY GRADING FROM 7.4m NZVD16 AT WEST END TO EXISTING GROUND LEVEL AT EAST END.

EDGE OF PAVEMENT

INDICATIVE LOCATION OF MOA POINT RD YARD. REFER NOTE 6

TEMPORARY SITE ACCESS (HEAVY VEHICLE CROSSING)

INDICATIVE LOCATION OF SITE OFFICES, EQUIPMENT STORAGE AND WORKER PARKING. UNPAVED SURFACE STABILISED USING COMPACTED GRANULAR MATERIAL

EXISTING SITE ACCESS TO BE REPLACED WITH HEAVY VEHICLE CROSSING

MOA POINT OUTFALL WASTEWATER MANHOLE

INDICATIVE TOE EXTENT (EXCAVATED AND ROCK BERM TOES)

MOA POINT WASTEWATER OUTFALL

EASTERN BANK REMEDIATION LOWER BANK REMEDIATION BURIED BENEATH BEACH (BEACH MATERIAL TO BE REPLACED ON COMPLETION)

ORIGINAL DRAWING
IN COLOUR
RESOURCE CONSENT
NOT FOR CONSTRUCTION

L	FOR RESOURCE CONSENT	CFP	JH	JH	29.08.25	Original Scale (A1)	Design	AS & WP	08.04.25	Approved For Construction*
K	FOR RESOURCE CONSENT	CFP	JH	JH	25.08.25	1:500	Drawn	TS	08.04.25	
J	FOR RESOURCE CONSENT	CFP	JH	JH	28.07.25	Reduced Scale (A3)	Design Verifier	JH	08.04.25	
I	FOR RESOURCE CONSENT	CFP	JH	JH	30.06.25	1:1000	Design Check	JH	08.04.25	Date
No.	Revision	By	Chk	Appd	Date		* Refer to Revision 1 for Original Signature			

Original Scale (A1)	Design	AS & WP	08.04.25	Approved For Construction*
1:500	Drawn	TS	08.04.25	
Reduced Scale (A3)	Design Verifier	JH	08.04.25	
1:1000	Design Check	JH	08.04.25	Date



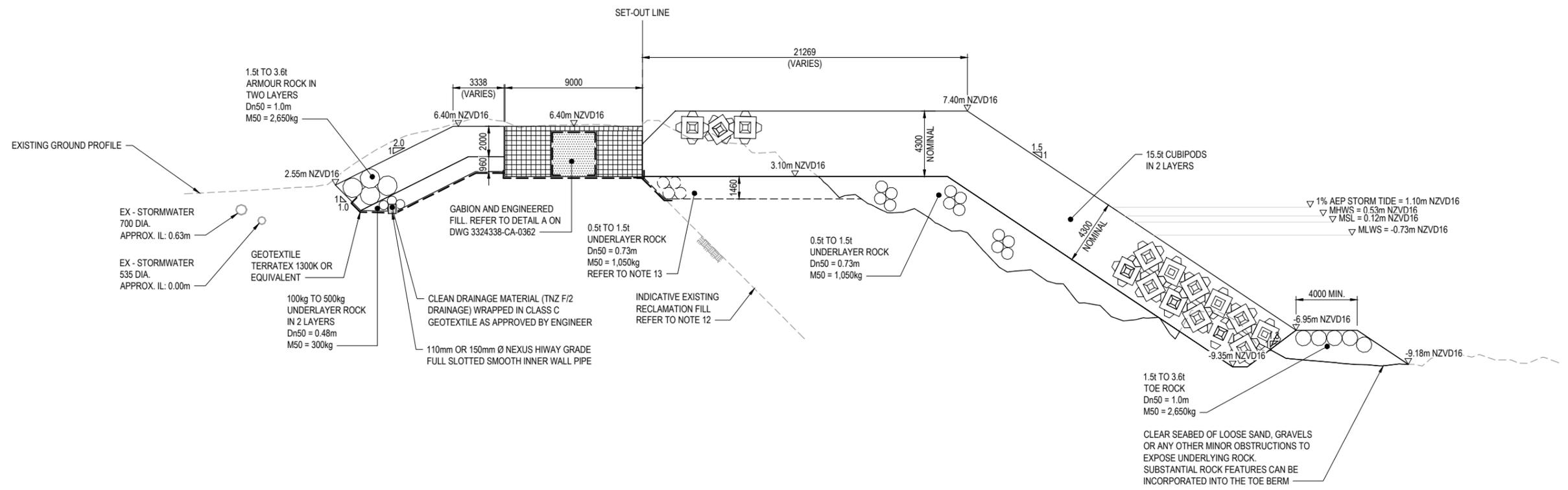
Client: **WIAL SEA DEFENCE STRUCTURES RENEWAL**

Title: **GENERAL ARRANGEMENT MOA POINT RD YARD**

Discipline: **CIVIL ENGINEERING**
Drawing No: **3324338-CA-SK009**
Rev: **L**

NOTES:

1. VERTICAL DATUM TO NEW ZEALAND VERTICAL DATUM 2016 (NZVD16).
2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS STATED OTHERWISE.
3. BATHYMETRIC SURVEY DATA:
- DISCOVERY MARINE LIMITED (DML) CONDUCTED APRIL TO MAY 2021.
4. ANY EXCAVATED UNSUITABLE MATERIAL FROM THE BANK TO BE REMOVED OFF SITE AND DISPOSED OF APPROPRIATELY.



1 SECTION AT CH90 - REAR SLOPE PROTECTION AND SEAWALL
SK007 SCALE 1:150

H	FOR RESOURCE CONSENT	CFP	JH	JH	28.07.25
G	FOR RESOURCE CONSENT	CFP	JH	JH	30.06.25
F	FOR RESOURCE CONSENT	TS	AS	JH	08.04.25
E	FOR RESOURCE CONSENT	AF	AS	JH	28.02.25
No.	Revision	By	Chk	Appd	Date

Original Scale (A1)	Design	AS & WP	08.04.25	Approved For Construction*
AS SHOWN	Drawn	TS	08.04.25	
Reduced Scale (A3)	Design Checker	JH	08.04.25	
HALF SHOWN	Design Check	JH	08.04.25	Date



Client: **WIAL SEA DEFENCE STRUCTURES RENEWAL**

Project: **SOUTHERN SEAWALL SECTIONS SHEET 1 OF 3**

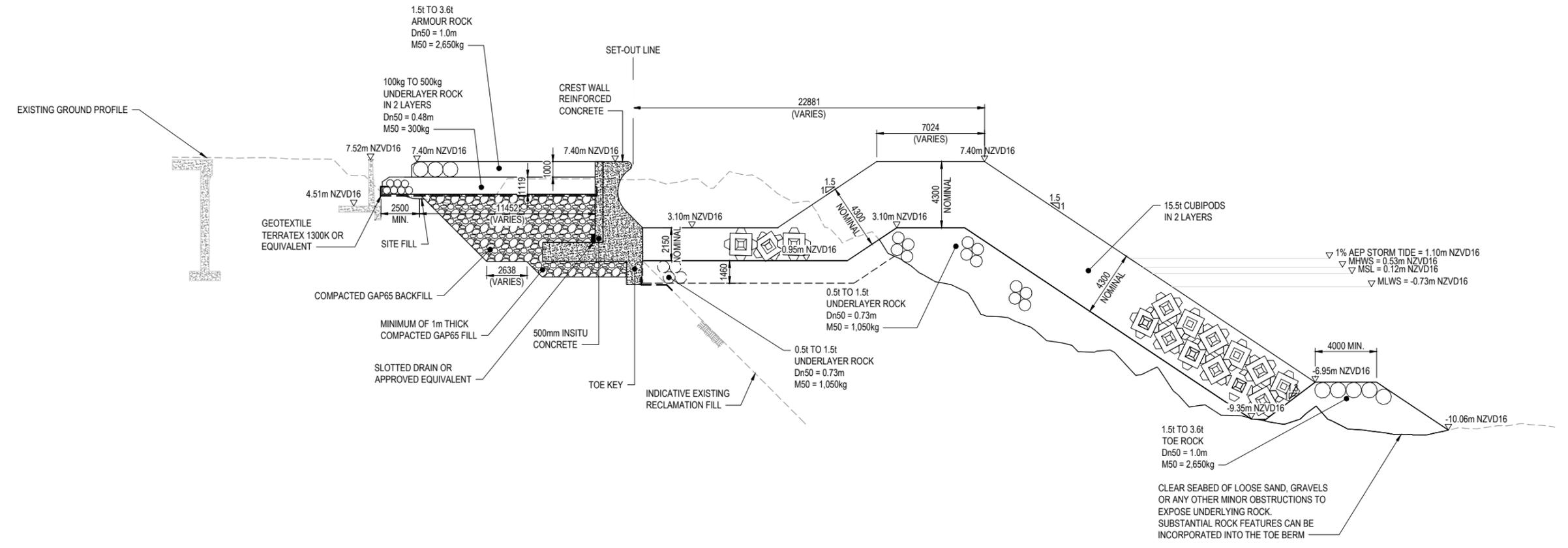
Discipline: **CIVIL ENGINEERING**
Drawing No.: **3324338-CA-SK100**
Rev.: **H**

RESOURCE CONSENT NOT FOR CONSTRUCTION

HAT	+0.64
MHWS	+0.53
MHWN	+0.22
MSL	-0.12
MLWN	-0.46
MLWS	-0.73
LAT	-0.83

TIDE BAR
(m NZVD16)

- NOTES:**
- VERTICAL DATUM TO NEW ZEALAND VERTICAL DATUM 2016 (NZVD16).
 - ALL DIMENSIONS ARE IN MILLIMETRES UNLESS STATED OTHERWISE.
 - BATHYMETRIC SURVEY DATA:
- DISCOVERY MARINE LIMITED (DML) CONDUCTED APRIL TO MAY 2021.
 - UNDERLAYER ROCK WILL BE USED TO FORM AN EVEN REGULAR 1V:1.5H SLOPE. THE UNDERLAYER SURFACE MAY HAVE EXPOSED AKMON SURFACES AS WELL AS ROCK.
 - SATO CUBIPOD PLACEMENT GRID AND EXISTING PROFILE TO CONFIRM CREST DIMENSIONS.
 - DEPTH OF SAND AND GRAVEL ABOVE ROCK LEVEL VARIES FROM 0.0m TO APPROXIMATELY 0.5m TO 1m.



2 SECTION AT CH220 - SOUTHERN SEAWALL
SK007 SCALE 1:150

H	FOR RESOURCE CONSENT	CFP	JH	JH	28.07.25
G	FOR RESOURCE CONSENT	CFP	JH	JH	30.06.25
F	FOR RESOURCE CONSENT	TS	AS	JH	08.04.25
E	FOR RESOURCE CONSENT	AF	AS	JH	28.02.25
No.	Revision	By	Chk	Appd	Date

Original Scale (A1)	Design	AS & WP	08.04.25	Approved For Construction*
AS SHOWN	Drawn	TS	08.04.25	
Reduced Scale (A3)	Design Verifier	JH	08.04.25	
HALF SHOWN	Design Check	JH	08.04.25	Date

* Refer to Revision 1 for Original Signature



Client: **WIAL SEA DEFENCE STRUCTURES RENEWAL**

Project: **SOUTHERN SEAWALL SECTIONS SHEET 2 OF 3**

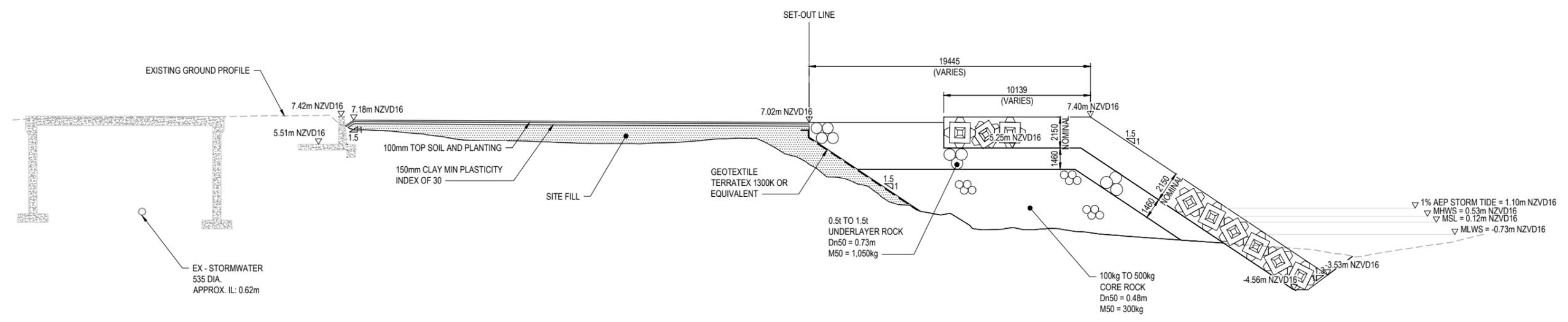
Discipline: **CIVIL ENGINEERING**
Drawing No.: **3324338-CA-SK101**
Rev.: **H**

RESOURCE CONSENT
NOT FOR CONSTRUCTION

HAT	---	+0.64
MHWS	---	+0.53
MSL	---	-0.12
MLWN	---	-0.46
MLWS	---	-0.73
LAT	---	-0.83

TIDE BAR
(m NZVD16)

- NOTES:**
- VERTICAL DATUM TO NEW ZEALAND VERTICAL DATUM 2016 (NZVD16).
 - ALL DIMENSIONS ARE IN MILLIMETRES UNLESS STATED OTHERWISE.
 - BATHYMETRIC SURVEY DATA:
- DISCOVERY MARINE LIMITED (DML) CONDUCTED APRIL TO MAY 2021.
 - UNDERLAYER ROCK WILL BE USED TO FORM AN EVEN REGULAR 1V:1.5H SLOPE. THE UNDERLAYER SURFACE MAY HAVE EXPOSED AKMON SURFACES AS WELL AS ROCK.
 - SATO CUBIPOD PLACEMENT GRID AND EXISTING PROFILE TO CONFIRM CREST DIMENSIONS.



3 SECTION AT CH330 - SOUTHERN SEAWALL - EAST END
SK007 SCALE 1:150

J	FOR RESOURCE CONSENT	CFP	JH	JH	25.08.25	Original Scale (A1)	Design	AS & WP	08.04.25	Approved For Construction*
I	FOR RESOURCE CONSENT	CFP	JH	JH	28.07.25	AS SHOWN	Drawn	TS	08.04.25	
H	FOR RESOURCE CONSENT	CFP	JH	JH	30.06.25	Reduction Scale (A3)	Design Verifier	JH	08.04.25	
G	FOR RESOURCE CONSENT	MJVR	AS	JH	10.06.25	HALF SHOWN	Dwg Check	JH	08.04.25	Date
No.	Revision	By	Chk	Appd	Date					

* Refer to Revision 1 for Original Signature



Client: **WIAL SEA DEFENCE STRUCTURES RENEWAL**

Project: **SOUTHERN SEAWALL SECTIONS SHEET 3 OF 3**

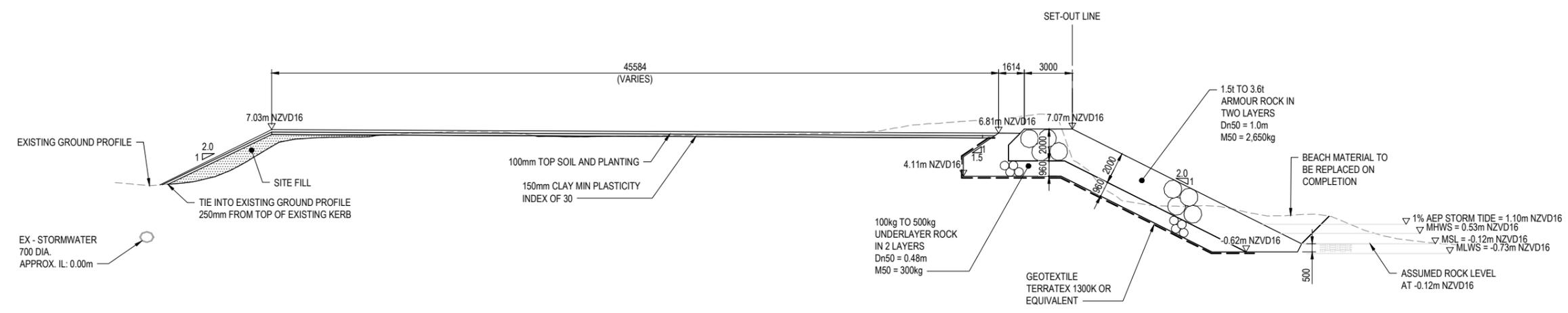
Discipline: **CIVIL ENGINEERING**
Drawing No: **3324338-CA-SK102**
Rev: **J**

RESOURCE CONSENT
NOT FOR CONSTRUCTION

HAT	+0.64
MHWS	+0.53
MHWN	+0.22
MSL	-0.12
MLWN	-0.46
MLWS	-0.73
LAT	-0.83

TIDE BAR
(m NZVD16)

- NOTES:**
- VERTICAL DATUM TO NEW ZEALAND VERTICAL DATUM 2016 (NZVD16).
 - ALL DIMENSIONS ARE IN MILLIMETRES UNLESS STATED OTHERWISE.
 - BATHYMETRIC SURVEY DATA:
- DISCOVERY MARINE LIMITED (DML) CONDUCTED APRIL TO MAY 2021.
 - TOE TO BE A MIN. 1650 BELOW EXISTING BEACH LEVEL IF ROCK SEABED IS ENCOUNTERED KEY TOE IN BY A MIN 0.5Dn50.
 - EXISTING BANK AND HINTERLAND TO BE LANDSCAPED FOR TEMPORARY LAY DOWN AREA AND PENGUIN HABITAT IN THE EXTENTS SHOWN ON SK009.



1 SECTION AT CH 420 - EASTERN BANK REMEDIATION
SK-008 SCALE 1:150

J	FOR RESOURCE CONSENT	CFP	JH	JH	25.08.25	Original Scale (A1)	Design	AS & WP	08.04.25	Approved For Construction*
I	FOR RESOURCE CONSENT	CFP	JH	JH	28.07.25	AS SHOWN	Drawn	TS	08.04.25	
H	FOR RESOURCE CONSENT	CFP	JH	JH	30.06.25	Reduction Scale (A3)	Design Verifier	JH	08.04.25	
G	FOR RESOURCE CONSENT	MJVR	AS	JH	10.06.25	HALF SHOWN	Design Check	JH	08.04.25	Date
No.	Revision	By	Chk	Appd	Date		* Refer to Revision 1 for Original Signature			



Client: **WIAL SEA DEFENCE STRUCTURES RENEWAL**

Project: **EASTERN BANK REHABILITATION SECTION**

Discipline	CIVIL ENGINEERING
Drawing No.	3324338-CA-SK104
Rev.	J

RESOURCE CONSENT
NOT FOR CONSTRUCTION



- NOTES:**
- HORIZONTAL COORDINATE SYSTEM: NEW ZEALAND TRANSVERSE MERCATOR (NZTM2000).
 - VERTICAL DATUM TO NEW ZEALAND VERTICAL DATUM 2016 (NZVD16).
 - BATHYMETRIC SURVEY DATA:
 - DISCOVERY MARINE LIMITED (DML) CONDUCTED APRIL TO MAY 2021.
 - TOPOGRAPHIC DATA:
 - BECA DRONE SURVEY JAN 2024 AND WCC LIDAR 2024.
 - TOE, MHWS LINE AND STRUCTURES AS SHOWN ARE INDICATIVE ONLY. EXISTING AND PROPOSED MHWS LINE ON EASTERN BANK REHABILITATION VARY, DEPENDING ON BEACH LEVELS.

LEGEND:

5.0	MAJOR CONTOURS (5.0m INTERVALS)
	MINOR CONTOURS (0.5m INTERVALS)
---	WAVE TRAP
- - - -	INDICATIVE STRUCTURE / BANK TOE

PARAMETER	QUANTITY
INCREASE IN PROPOSED SEAWALL WIDTH (AT EXISTING FORMAL SEAWALL)	-20-30m
INCREASE IN PROPOSED SEAWALL FOOTPRINT	UP TO 12,000m ²

ORIGINAL DRAWING
IN COLOUR
RESOURCE CONSENT
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
F	FOR RESOURCE CONSENT	CFP	JH	JH	28.07.25
E	FOR RESOURCE CONSENT	CFP	JH	JH	30.06.25
D	FOR RESOURCE CONSENT	MJVR	AS	JH	10.06.25
C	FOR RESOURCE CONSENT	TS	AS	JH	08.04.25

Original Scale (A1)	Design	AS & WP	08.04.25	Approved For Construction*
1:750	Drawn	TS	08.04.25	
Reduced Scale (A3)	Design Checker	JH	08.04.25	
1:1500	Design Checker	JH	08.04.25	

* Refer to Revision 1 for Original Signature



Client: **WIAL SEA DEFENCE STRUCTURES RENEWAL**

Title: **EXISTING AND PROPOSED SEAWALL TOE AND MHWS LOCATIONS**

Discipline	CIVIL ENGINEERING
Drawing No.	3324338-CA-SK105
Rev.	F



- NOTES:**
- HORIZONTAL COORDINATE SYSTEM: NEW ZEALAND TRANSVERSE MERCATOR (NZTM2000).
 - VERTICAL DATUM TO NEW ZEALAND VERTICAL DATUM 2016 (NZVD16).
 - BATHYMETRIC SURVEY DATA:
 - DISCOVERY MARINE LIMITED (DML) CONDUCTED APRIL TO MAY 2021.
 - TOPOGRAPHIC DATA:
 - BECA DRONE SURVEY JAN 2024 AND WCC LIDAR 2024.
 - TOE, MHS LINE AND STRUCTURES AS SHOWN ARE INDICATIVE ONLY. EXISTING AND PROPOSED MHS LINE ON EASTERN BANK REHABILITATION VARY, DEPENDING ON BEACH LEVELS.

- LEGEND:**
- MAJOR CONTOURS (5.0m INTERVALS)
 - MINOR CONTOURS (0.5m INTERVALS)
 - CADASTRAL BOUNDARY
 - GENERAL INDUSTRIAL ZONE
 - MEDIUM DENSITY RESIDENTIAL ZONE
 - NATURAL OPEN SPACE ZONE
 - SPECIAL PURPOSE ZONE (AIRPORT)



ORIGINAL DRAWING
IN COLOUR
RESOURCE CONSENT
NOT FOR CONSTRUCTION

C	FOR RESOURCE CONSENT	CFP	JH	JH	28.07.25
B	FOR RESOURCE CONSENT	CFP	JH	JH	30.06.25
A	FOR RESOURCE CONSENT	MJVR	JH	JH	10.06.25
No.	Revision	By	Chk	Appd	Date

Original Scale (A1)	Design	MJVR	10.06.25	Approved For Construction*
1:1500	Drawn	MJVR	10.06.25	
Reduced Scale (A3)	Design Checker	JH	10.06.25	Date
1:3000	Dwg Check	JH	10.06.25	

* Refer to Revision 1 for Original Signature



Client: **WIAL SEA DEFENCE STRUCTURES RENEWAL**

Project: **LAND USE ZONES PLAN**

Discipline: **CIVIL ENGINEERING**
Drawing No: **3324338-CA-SK106** Rev: **C**



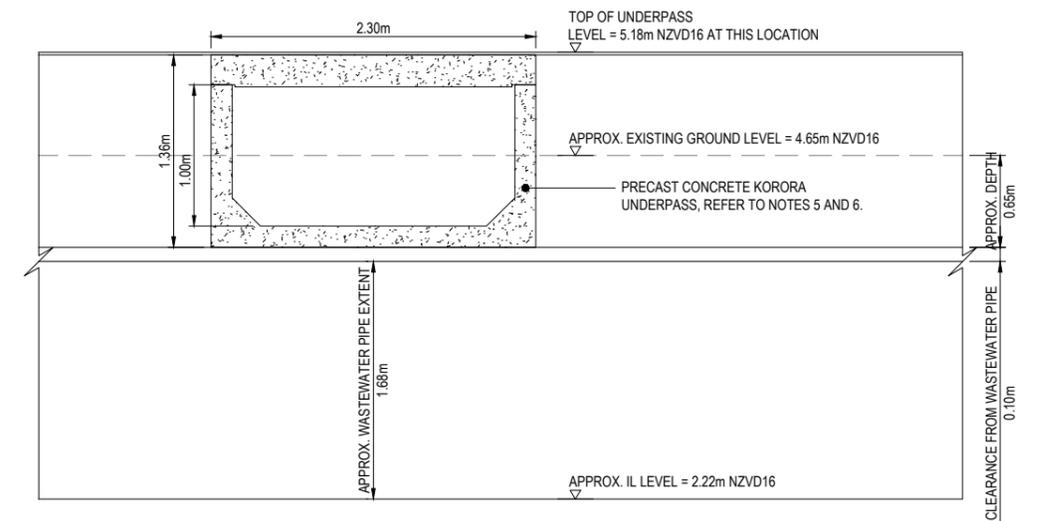
PLAN OF STAGE 1 KORORA HABITAT LOCATION
SCALE 1:250

NOTES:

- ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE STATED.
- HORIZONTAL COORDINATE SYSTEM: NEW ZEALAND TRANSVERSE MERCATOR (NZTM2000).
- VERTICAL DATUM TO NEW ZEALAND VERTICAL DATUM 2016 (NZVD16).
- ALL EXISTING SERVICES SHALL BE LOCATED AND MARKED PRIOR TO START OF CONSTRUCTION ON SITE. ALL EXISTING SERVICES SHALL BE PROTECTED OR RELOCATED TO AVOID DAMAGE DURING AND AFTER CONSTRUCTION.
- THE KORORA UNDERPASS SHALL BE DESIGNED TO MEET THE KORORA SPECIALIST'S REQUIREMENTS. THE UNDERPASS SHALL BE DESIGNED TO COMPLY WITH THE NZTA BRIDGE MANUAL, NZS 3101:2006 PART 1, AND THE NZ BUILDING CODE. THE UNDERPASS SHALL WITHSTAND HN-HO-72 TRAFFIC LOADING WITH 0mm COVER (20mm AC SURFACING AND TACK COAT LAID DIRECT ON UNDERPASS). THE UNDERPASS DESIGN LIFE SHALL BE MIN. 50 YEARS. CONCRETE SHALL BE MARINE GRADE CONCRETE MIN. 40 MPa. SURFACE FINISHES SHALL COMPLY WITH NZS 3114:1986 F3 UNLESS OTHERWISE REQUIRED BY THE KORORA SPECIALIST. PRECAST MANUFACTURE SHALL COMPLY WITH NZS 3109:1997.
- UNDERPASS INSTALLATION INCLUDING BEDDING AND BACKFILL SHALL BE IN ACCORDANCE WITH THE UNDERPASS DESIGNER'S SPECIFICATIONS.

LEGEND:

- LAND PARCEL BOUNDARY
- SS- EXISTING WASTEWATER
- W- EXISTING WATER
- FENCING
- ▬▬▬ ROAD GRADIENT
- SECURITY FENCING
- - - LANDWARD BOUNDARY OF KORORA AREA



1 CROSS SECTION THROUGH UNDERPASS
SCALE 1:25

**ORIGINAL DRAWING
IN COLOUR**

**FOR PRICING
NOT FOR CONSTRUCTION**

D	FOR RESOURCE CONSENT	CFP	JH	JH	14.08.25	Original Scale (A1)	Design	WP/AS	08.07.24	Approved For Construction*
C	FOR RESOURCE CONSENT	CFP	JH	JH	28.07.25	AS SHOWN	Drawn	WP	08.07.24	
B	FOR RESOURCE CONSENT	CFP	JH	JH	11.07.25	Reduced Scale (A3)	Design Verifier	JH	08.07.24	
A	FOR PRICING (2025)	WP	AS	JH	08.07.24	HALF SHOWN	Design Check	WN	08.07.24	Date
No.	Revision	By	Chk	Appd	Date	* Refer to Revision 1 for Original Signature				



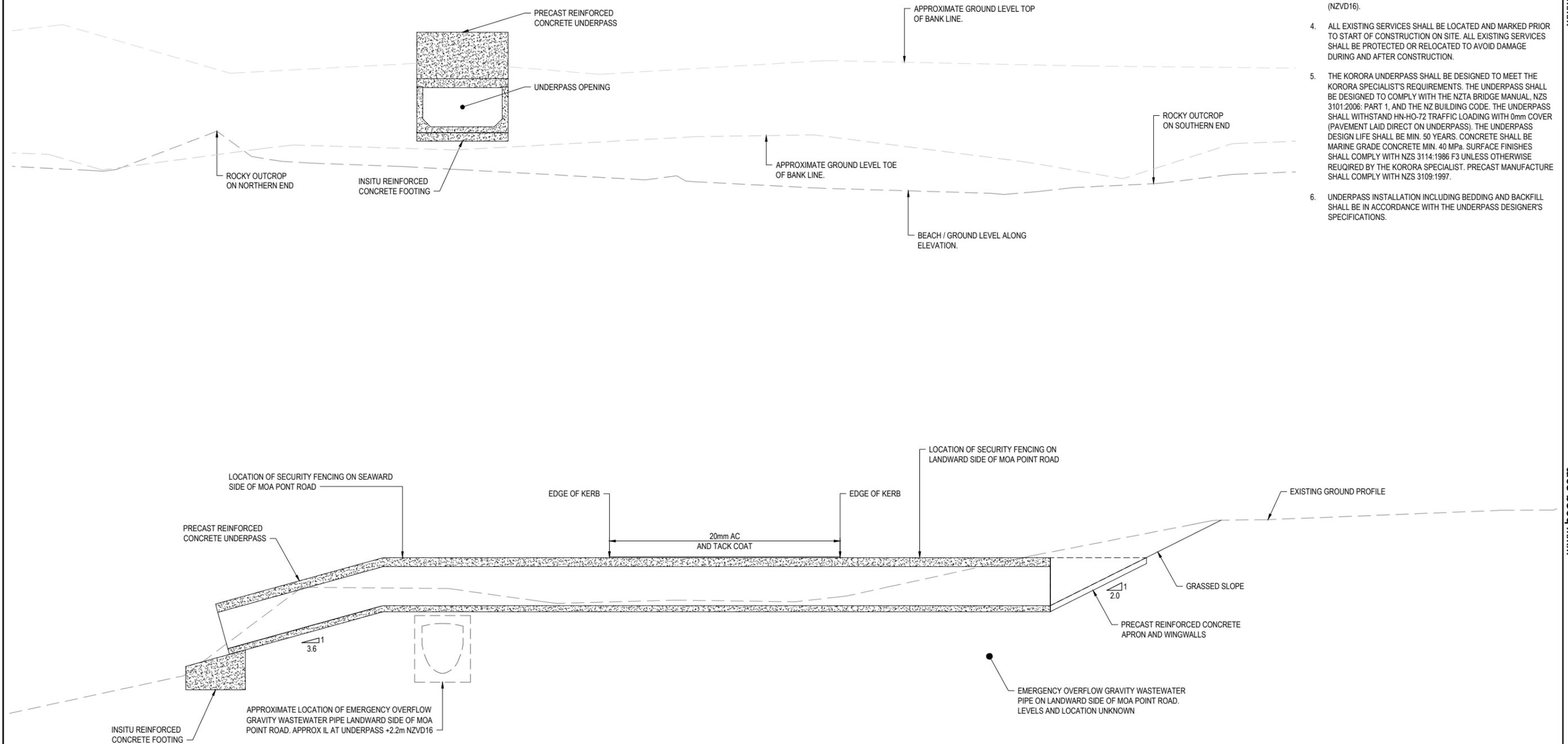
Client: **WIAL SEA DEFENCE STRUCTURES RENEWAL**

Title: **STAGE 1 KORORA HABITAT GENERAL ARRANGEMENT & UNDERPASS SECTION**

Discipline: **CIVIL ENGINEERING**
Drawing No.: **3324338-CA-SK120**
Rev.: **D**

NOTES:

1. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE STATED.
2. HORIZONTAL COORDINATE SYSTEM: NEW ZEALAND TRANSVERSE MERCATOR (NZTM2000).
3. VERTICAL DATUM TO NEW ZEALAND VERTICAL DATUM 2016 (NZVD16).
4. ALL EXISTING SERVICES SHALL BE LOCATED AND MARKED PRIOR TO START OF CONSTRUCTION ON SITE. ALL EXISTING SERVICES SHALL BE PROTECTED OR RELOCATED TO AVOID DAMAGE DURING AND AFTER CONSTRUCTION.
5. THE KORORA UNDERPASS SHALL BE DESIGNED TO MEET THE KORORA SPECIALIST'S REQUIREMENTS. THE UNDERPASS SHALL BE DESIGNED TO COMPLY WITH THE NZTA BRIDGE MANUAL, NZS 3101:2006 PART 1, AND THE NZ BUILDING CODE. THE UNDERPASS SHALL WITHSTAND HN-HO-72 TRAFFIC LOADING WITH 0mm COVER (PAVEMENT LAID DIRECT ON UNDERPASS). THE UNDERPASS DESIGN LIFE SHALL BE MIN. 50 YEARS. CONCRETE SHALL BE MARINE GRADE CONCRETE MIN. 40 MPa. SURFACE FINISHES SHALL COMPLY WITH NZS 3114:1986 F3 UNLESS OTHERWISE REQUIRED BY THE KORORA SPECIALIST. PRECAST MANUFACTURE SHALL COMPLY WITH NZS 3109:1997.
6. UNDERPASS INSTALLATION INCLUDING BEDDING AND BACKFILL SHALL BE IN ACCORDANCE WITH THE UNDERPASS DESIGNER'S SPECIFICATIONS.



2 LONG SECTION THROUGH UNDERPASS
3324338-CA-0501 SCALE 1:50

**ORIGINAL DRAWING
IN COLOUR**

**FOR PRICING
NOT FOR CONSTRUCTION**

No.	Revision	By	Chk	Appd	Date
C	FOR RESOURCE CONSENT	CFP	JH	JH	28.07.25
B	FOR RESOURCE CONSENT	CFP	JH	JH	11.07.25
A	FOR PRICING (2025)	WP	AS	JH	08.07.24

Original Scale (A1)	Design	WP/AS	08.07.24	Approved For Construction*
AS SHOWN	Drawn	WP	08.07.24	
Reduced Scale (A3)	Day Verifier	JH	08.07.24	
HALF SHOWN	Dwg Check	WN	08.07.24	

* Refer to Revision 1 for Original Signature



Client: **WIAL SEA DEFENCE STRUCTURES RENEWAL**

Title: **STAGE 1 KORORA HABITAT UNDERPASS LONG SECTION AND ELEVATION**

Discipline	CIVIL ENGINEERING
Drawing No.	3324338-CA-SK121
Rev.	C

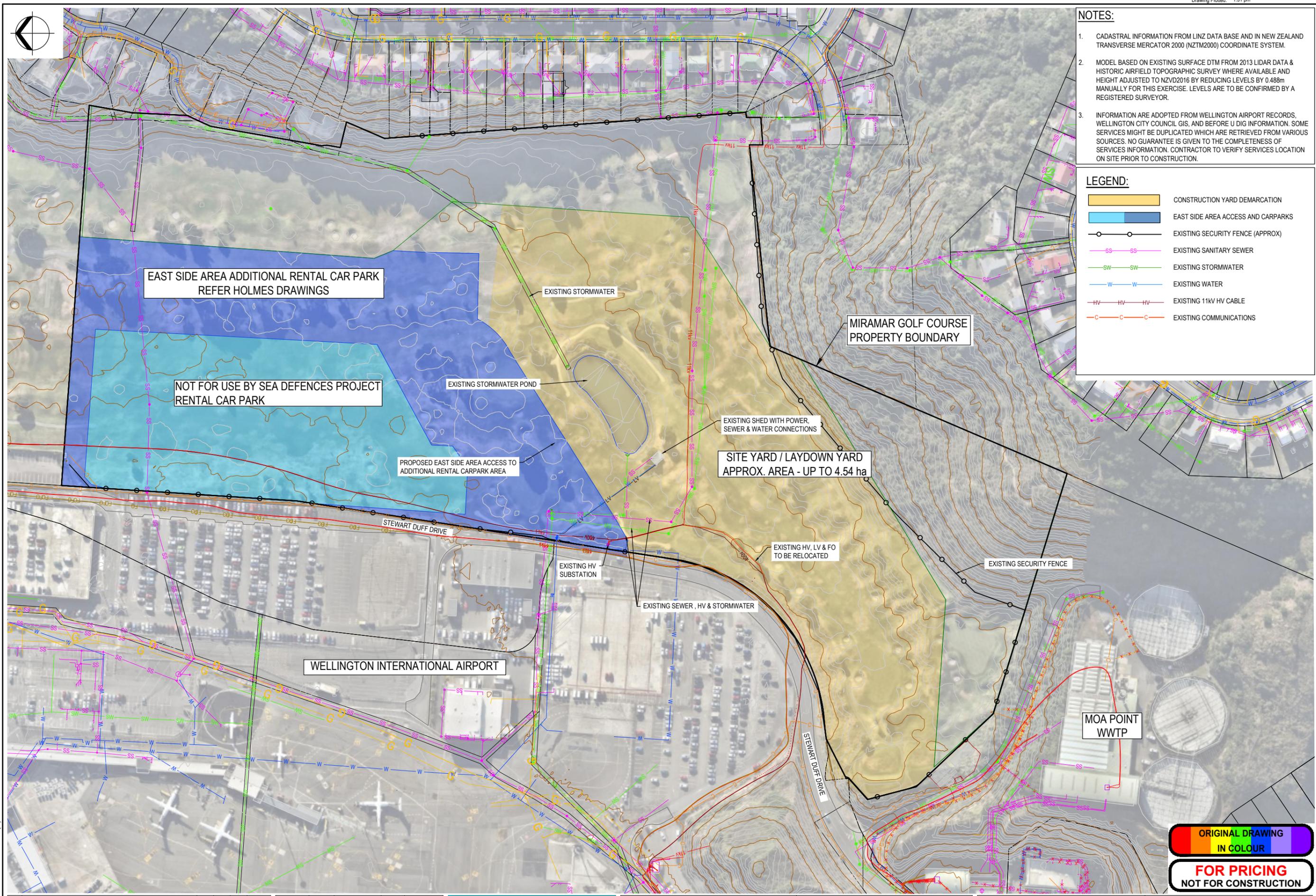


NOTES:

- CADASTRAL INFORMATION FROM LINZ DATA BASE AND IN NEW ZEALAND TRANSVERSE MERCATOR 2000 (NZTM2000) COORDINATE SYSTEM.
- MODEL BASED ON EXISTING SURFACE DTM FROM 2013 LIDAR DATA & HISTORIC AIRFIELD TOPOGRAPHIC SURVEY WHERE AVAILABLE AND HEIGHT ADJUSTED TO NZVD2016 BY REDUCING LEVELS BY 0.488m MANUALLY FOR THIS EXERCISE. LEVELS ARE TO BE CONFIRMED BY A REGISTERED SURVEYOR.
- INFORMATION ARE ADOPTED FROM WELLINGTON AIRPORT RECORDS, WELLINGTON CITY COUNCIL GIS, AND BEFORE U DIG INFORMATION. SOME SERVICES MIGHT BE DUPLICATED WHICH ARE RETRIEVED FROM VARIOUS SOURCES. NO GUARANTEE IS GIVEN TO THE COMPLETENESS OF SERVICES INFORMATION. CONTRACTOR TO VERIFY SERVICES LOCATION ON SITE PRIOR TO CONSTRUCTION.

LEGEND:

-  CONSTRUCTION YARD DEMARCATION
-  EAST SIDE AREA ACCESS AND CARPARKS
-  EXISTING SECURITY FENCE (APPROX)
-  EXISTING SANITARY SEWER
-  EXISTING STORMWATER
-  EXISTING WATER
-  EXISTING 11KV HV CABLE
-  EXISTING COMMUNICATIONS



60
40
20
0
FULL SIZE 1:1000; HALF SIZE 1:2000
SCALE (m)

**ORIGINAL DRAWING
IN COLOUR**

**FOR PRICING
NOT FOR CONSTRUCTION**

No.	Revision	By	Chk	Appd	Date
B	FOR RESOURCE CONSENT	CFP	JH	JH	11.07.25
A	FOR RESOURCE CONSENT	SZ	TNM	JH	08.04.25

Original Scale (A1)	Design	TNM	08.04.25	Approved For Construction*
1:1000	Drawn	SZ	08.04.25	
Reduce Scale (A3)	Design Checker	CGK	08.04.25	Date
1:2000	Drawn	CGK	08.04.25	

* Refer to Revision 1 for Original Signature



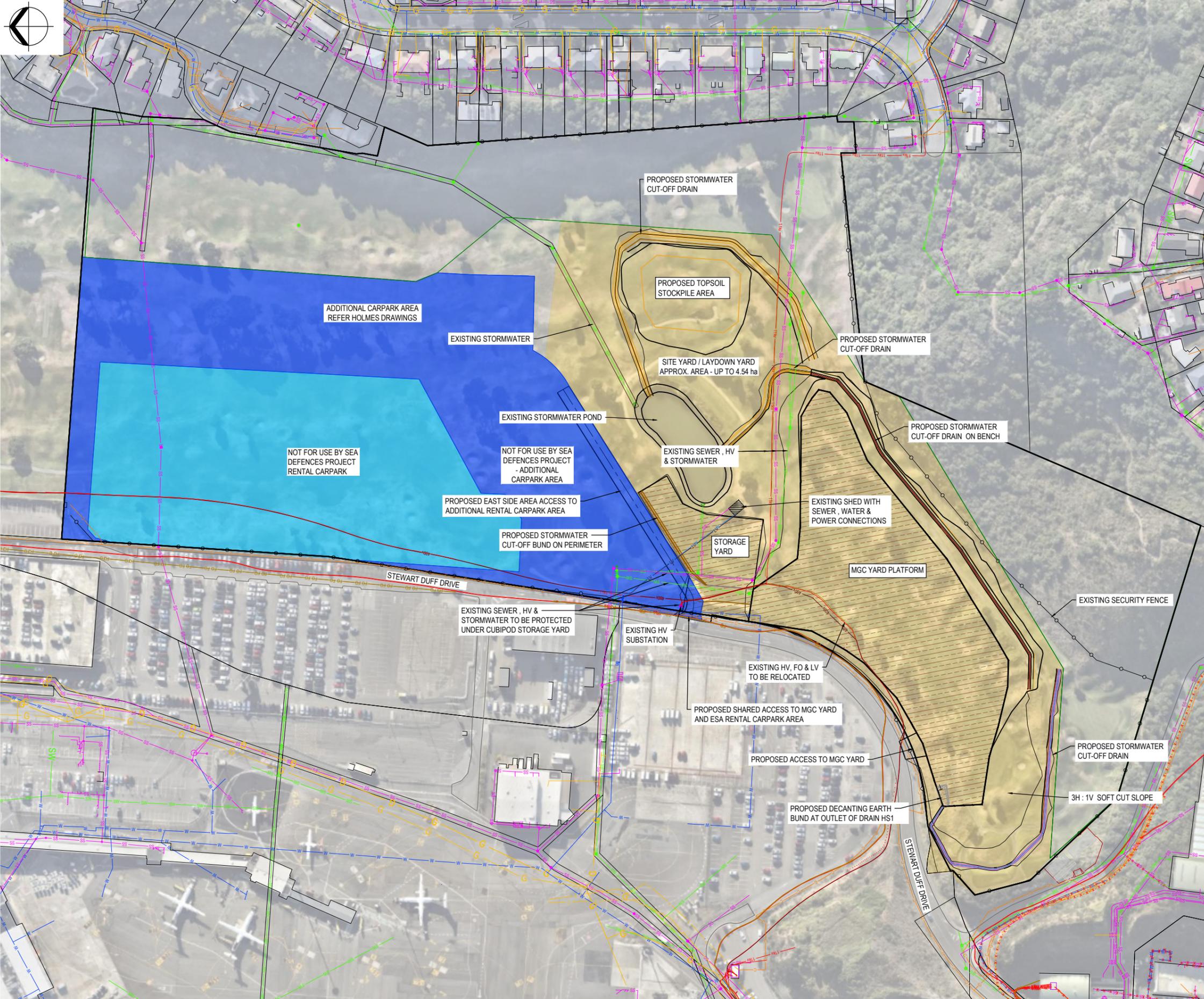
Client: **WIAL SEA DEFENCE STRUCTURES RENEWAL**

Project: **MGC CONSTRUCTION YARD EXISTING CONTOURS & SERVICES LAYOUT PLAN**

Discipline: **CIVIL ENGINEERING**

Drawing No: **3324338-CA-SK200**

Rev: **B**



- NOTES:**
- CADASTRAL INFORMATION FROM LINZ DATA BASE AND IN NEW ZEALAND TRANSVERSE MERCATOR 2000 (NZTM2000) COORDINATE SYSTEM.
 - MODEL BASED ON EXISTING SURFACE DTM FROM 2013 LIDAR DATA & HISTORIC AIRFIELD TOPOGRAPHIC SURVEY WHERE AVAILABLE AND HEIGHT ADJUSTED TO NZVD2016 BY REDUCING LEVELS BY 0.488m MANUALLY FOR THIS EXERCISE. LEVELS ARE TO BE CONFIRMED BY A REGISTERED SURVEYOR.
 - INFORMATION ARE ADOPTED FROM WELLINGTON AIRPORT RECORDS, WELLINGTON CITY COUNCIL GIS, AND BEFORE U DIG INFORMATION. SOME SERVICES MIGHT BE DUPLICATED WHICH ARE RETRIEVED FROM VARIOUS SOURCES. NO GUARANTEE IS GIVEN TO THE COMPLETENESS OF SERVICES INFORMATION. CONTRACTOR TO VERIFY SERVICES LOCATION ON SITE PRIOR TO CONSTRUCTION.

- LEGEND:**
- CONSTRUCTION YARD DEMARCATION
 - MGC YARD
 - EAST SIDE AREA ACCESS AND CARPARKS
 - EXISTING SECURITY FENCE (APPROX)
 - EXISTING SANITARY SEWER
 - EXISTING STORMWATER
 - EXISTING WATER
 - EXISTING 11kV HV CABLE
 - EXISTING COMMUNICATIONS

0 10 20 40 60
FULL SIZE 1:1000; HALF SIZE 1:2000
SCALE (m)

ORIGINAL DRAWING
IN COLOUR
**FOR PRICING
NOT FOR CONSTRUCTION**

B	FOR RESOURCE CONSENT	CFP	JH	JH	11.07.25
A	FOR RESOURCE CONSENT	SZ	CGK	JH	08.04.25
No.	Revision	By	Chk	Appd	Date

Original Scale (A1)	Design	TNM	08.04.25	Approved For Construction*
1:1000	Drawn	SZ	08.04.25	
Reduce Scale (A3)	Design Checker	CJB	08.04.25	Date
1:2000	Dwg Check	CGK	08.04.25	

* Refer to Revision 1 for Original Signature



Client: **WIAL SEA DEFENCE STRUCTURES RENEWAL**

Title: **MGC CONSTRUCTION YARD GENERAL ARRANGEMENT & EXISTING SERVICES**

Discipline	CIVIL ENGINEERING
Drawing No.	3324338-CA-SK201
Rev.	B

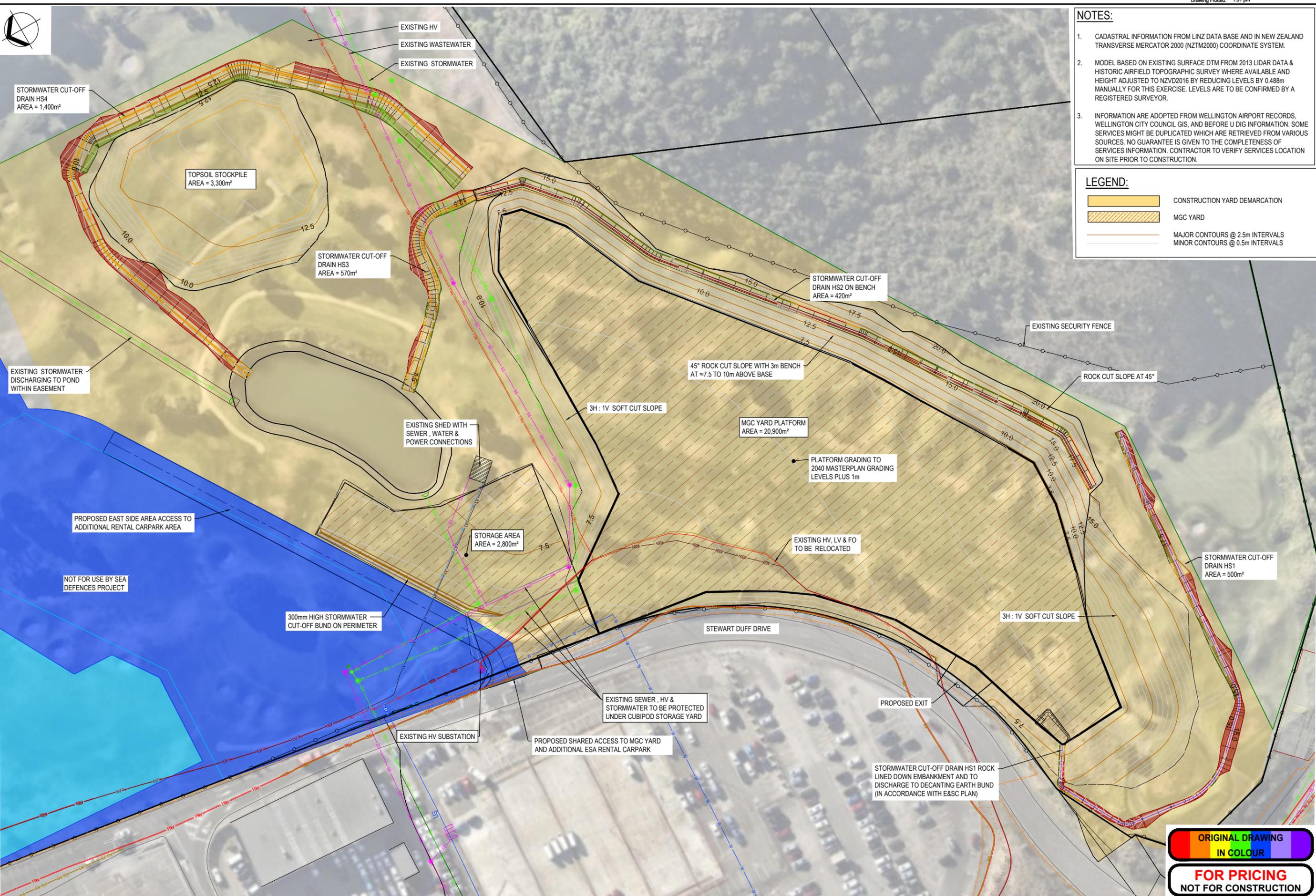


NOTES:

- CADASTRAL INFORMATION FROM LINZ DATA BASE AND IN NEW ZEALAND TRANSVERSE MERCATOR 2000 (NZTM2000) COORDINATE SYSTEM.
- MODEL BASED ON EXISTING SURFACE DTM FROM 2013 LIDAR DATA & HISTORIC AIRFIELD TOPOGRAPHIC SURVEY WHERE AVAILABLE AND HEIGHT ADJUSTED TO NZVD2016 BY REDUCING LEVELS BY 0.488m MANUALLY FOR THIS EXERCISE. LEVELS ARE TO BE CONFIRMED BY A REGISTERED SURVEYOR.
- INFORMATION ARE ADOPTED FROM WELLINGTON AIRPORT RECORDS, WELLINGTON CITY COUNCIL GIS, AND BEFORE U DIG INFORMATION. SOME SERVICES MIGHT BE DUPLICATED WHICH ARE RETRIEVED FROM VARIOUS SOURCES. NO GUARANTEE IS GIVEN TO THE COMPLETENESS OF SERVICES INFORMATION. CONTRACTOR TO VERIFY SERVICES LOCATION ON SITE PRIOR TO CONSTRUCTION.

LEGEND:

- CONSTRUCTION YARD DEMARCATON
- MGC YARD
- MAJOR CONTOURS @ 2.5m INTERVALS
- MINOR CONTOURS @ 0.5m INTERVALS



FULL SIZE 1:500; HALF SIZE 1:1000
 SCALE (m)
 0 5 10 20 30

ORIGINAL DRAWING
IN COLOUR

FOR PRICING
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
B	FOR RESOURCE CONSENT	CFP	JH	JH	11.07.25
A	FOR RESOURCE CONSENT	SZ	CGK	JH	08.04.25

Original Scale (A1)	Design	TNM	08.04.25	Approved For Construction*
1:500	Drawn	SZ	08.04.25	
Reduced Scale (A3)	Design Checker	CGK	08.04.25	Date
1:1000	Dwg Check	CGK	08.04.25	

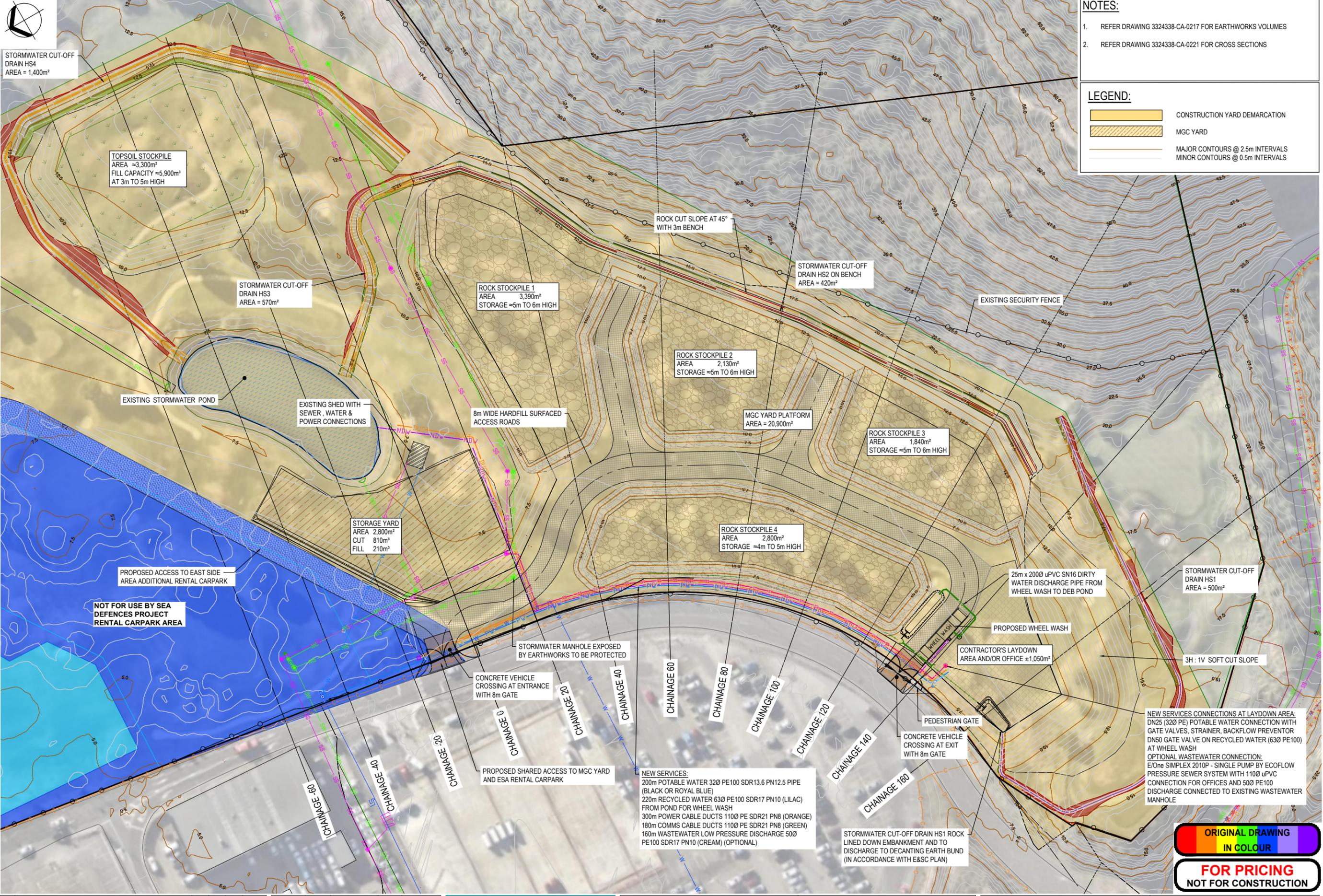


Client: **WIAL SEA DEFENCE STRUCTURES RENEWAL**

Project: **MGC CONSTRUCTION YARD STORAGE AREAS & STORMWATER DRAINAGE**

Discipline: **CIVIL ENGINEERING**
 Drawing No.: **3324338-CA-SK211**
 Rev: **B**

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NOTES:

- REFER DRAWING 3324338-CA-0217 FOR EARTHWORKS VOLUMES
- REFER DRAWING 3324338-CA-0221 FOR CROSS SECTIONS

LEGEND:

- CONSTRUCTION YARD DEMARCATION
- MGC YARD
- MAJOR CONTOURS @ 2.5m INTERVALS
- MINOR CONTOURS @ 0.5m INTERVALS

NEW SERVICES CONNECTIONS AT LAYDOWN AREA:
 DN25 (320 PE) POTABLE WATER CONNECTION WITH GATE VALVES, STRAINER, BACKFLOW PREVENTOR
 DN50 GATE VALVE ON RECYCLED WATER (630 PE100) AT WHEEL WASH
 OPTIONAL WASTEWATER CONNECTION:
 E/One SIMPLEX 2010P - SINGLE PUMP BY ECOFLOW
 PRESSURE SEWER SYSTEM WITH 1100 uPVC CONNECTION FOR OFFICES AND 500 PE100 DISCHARGE CONNECTED TO EXISTING WASTEWATER MANHOLE

**ORIGINAL DRAWING
 IN COLOUR**

**FOR PRICING
 NOT FOR CONSTRUCTION**

30
20
10
0
5
FULL SIZE 1:500; HALF SIZE 1:1000
SCALE (m)

No.	Revision	By	Chk	Appd	Date
C	FOR RESOURCE CONSENT	CFP	JH	JH	28.07.25
B	FOR RESOURCE CONSENT	CFP	JH	JH	11.07.25
A	FOR RESOURCE CONSENT	SZ	CGK	JH	08.04.25

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1:500	Drawn	SZ	08.04.25	
Reduced Scale (A3)	Design Verifier	CJB	08.04.25	
1:1000	Dwg Check	CGK	08.04.25	Date

* Refer to Revision 1 for Original Signature



Client: **WIAL SEA DEFENCE STRUCTURES RENEWAL**

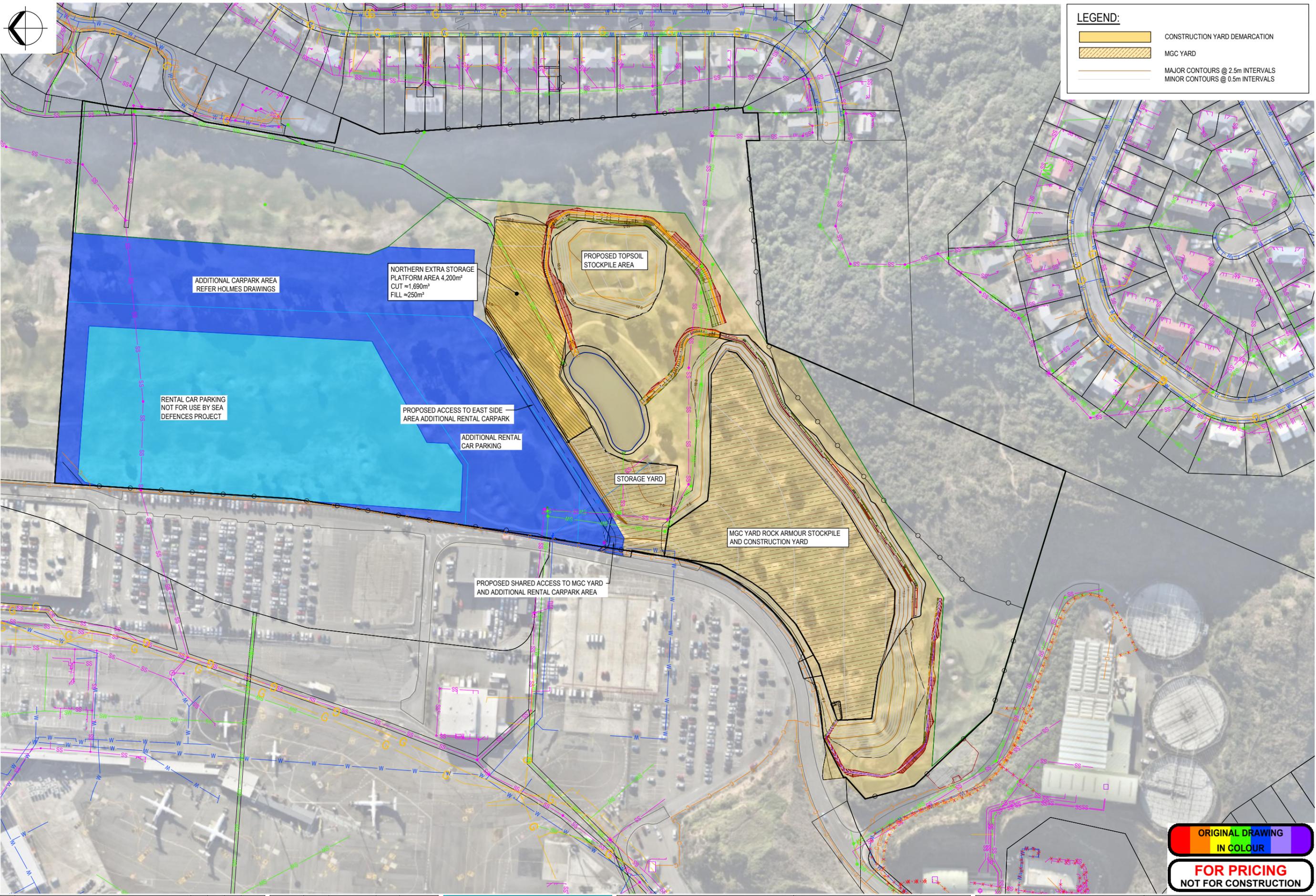
Project: **MGC CONSTRUCTION YARD LAYOUT PLAN: ROADS, SERVICES & STOCKPILES**

Discipline: **CIVIL ENGINEERING**
 Drawing No: **3324338-CA-SK215**
 Rev: **C**



LEGEND:

- CONSTRUCTION YARD DEMARCATION
- MGC YARD
- MAJOR CONTOURS @ 2.5m INTERVALS
- MINOR CONTOURS @ 0.5m INTERVALS



0 10 20 40 60
 FULL SIZE 1:1000; HALF SIZE 1:2000
 SCALE (m)

**ORIGINAL DRAWING
 IN COLOUR**

**FOR PRICING
 NOT FOR CONSTRUCTION**

No.	Revision	By	Chk	Appd	Date
B	FOR RESOURCE CONSENT	CFP	JH	JH	11.07.25
A	FOR RESOURCE CONSENT	SZ	CGK	JH	08.04.25

Original Scale (A1)	Design	TNM	08.04.25	Approved For Construction*
1:1000	Drawn	SZ	08.04.25	
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1:2000	Dwg Check	CGK	08.04.25	

* Refer to Revision 1 for Original Signature



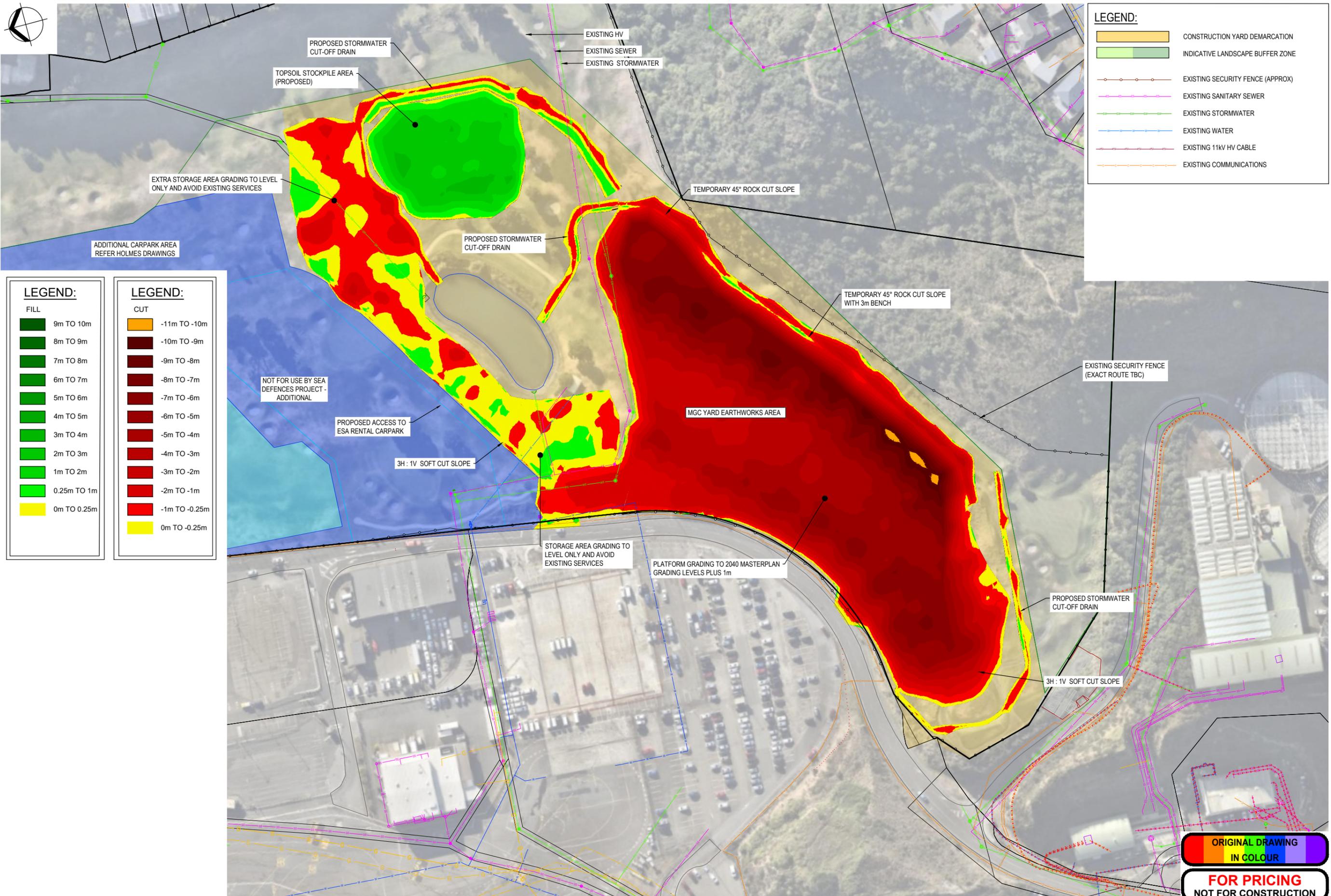
Client: **WIAL SEA DEFENCE STRUCTURES RENEWAL**

Title: **MGC CONSTRUCTION YARD ADDITIONAL EARTHWORKS AREAS**

Discipline: **CIVIL ENGINEERING**

Drawing No: **3324338-CA-SK216**

Rev: **B**



LEGEND:

- CONSTRUCTION YARD DEMARCATION
- INDICATIVE LANDSCAPE BUFFER ZONE
- EXISTING SECURITY FENCE (APPROX)
- EXISTING SANITARY SEWER
- EXISTING STORMWATER
- EXISTING WATER
- EXISTING 11KV HV CABLE
- EXISTING COMMUNICATIONS

LEGEND:

FILL

- 9m TO 10m
- 8m TO 9m
- 7m TO 8m
- 6m TO 7m
- 5m TO 6m
- 4m TO 5m
- 3m TO 4m
- 2m TO 3m
- 1m TO 2m
- 0.25m TO 1m
- 0m TO 0.25m

LEGEND:

CUT

- 11m TO -10m
- 10m TO -9m
- 9m TO -8m
- 8m TO -7m
- 7m TO -6m
- 6m TO -5m
- 5m TO -4m
- 4m TO -3m
- 3m TO -2m
- 2m TO -1m
- 1m TO -0.25m
- 0m TO -0.25m

ORIGINAL DRAWING
IN COLOUR
FOR PRICING
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR RESOURCE CONSENT	CFP	JH	JH	28.07.25
B	FOR RESOURCE CONSENT	CFP	JH	JH	11.07.25
A	FOR RESOURCE CONSENT	SZ	CGK	JH	08.04.25

Original Scale (A1)	Design	TNM	08.04.25	Approved For Construction*
1:750	Drawn	SZ	08.04.25	
Reduce Scale (A3)	Design Verifier	CJB	08.04.25	
1:1500	Drawn Check	CGK	08.04.25	Date

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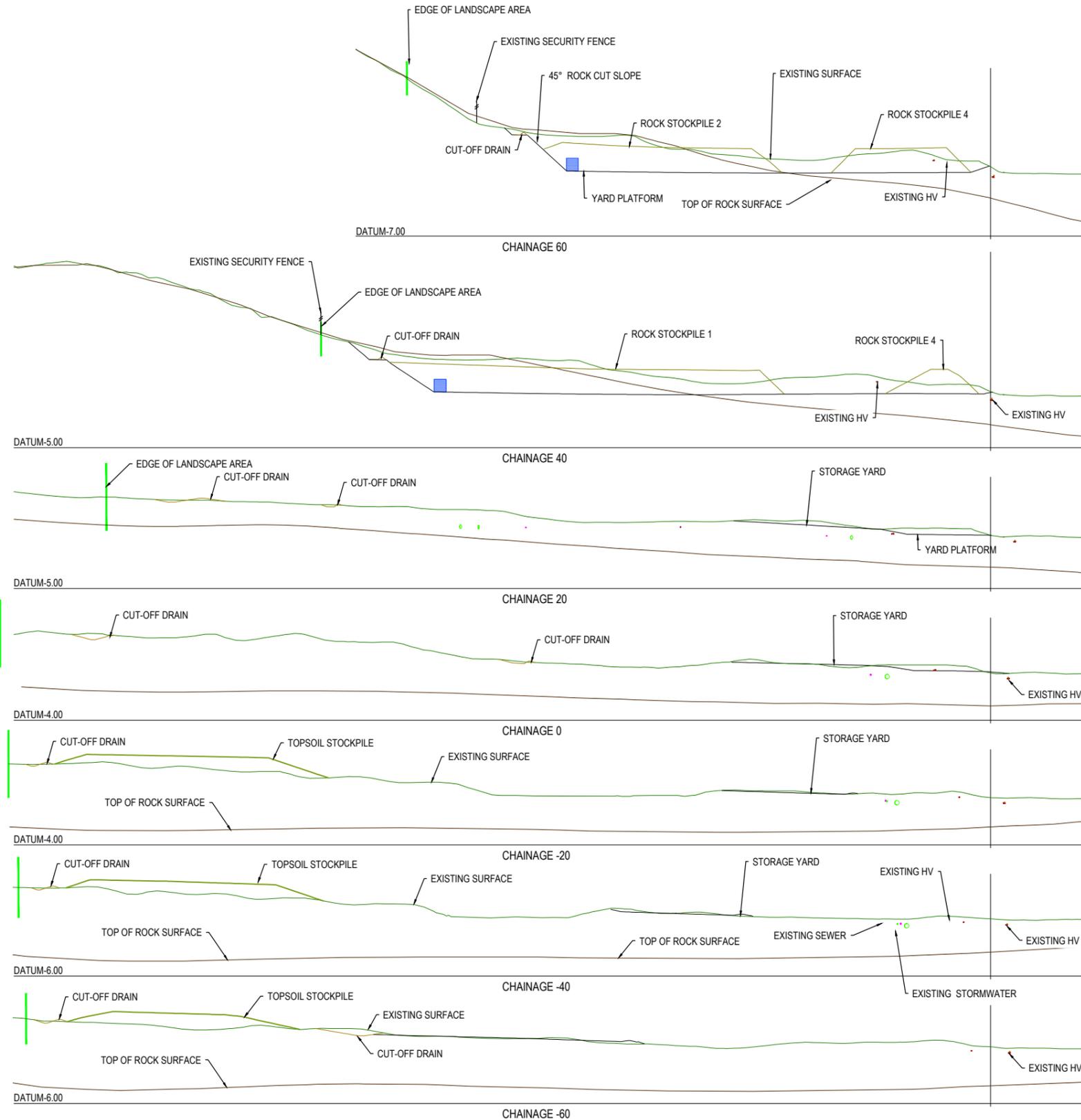
Client: **WIAL SEA DEFENCE STRUCTURES RENEWAL**

Project: **MGC CONSTRUCTION YARD ISOPACH - CUT AND FILL PLAN**

Discipline: **CIVIL ENGINEERING**
 Drawing No: **3324338-CA-SK217**
 Rev: **C**

NOTES:

1. REFER TO 3324338-CA-0001 FOR DRAWING LIST.
2. REFER TO 3324338-CA-0002 FOR GENERAL NOTES AND LEGEND.
3. REFER TO DRAWING 3324338-CA-0215 FOR CROSS SECTION LOCATIONS.
4. MAXIMUM CUT SLOPE IN ROCK IS 1V:1H UP TO A MAXIMUM CUT SLOPE HEIGHT OF 10m; AND 1V:1.5H FOR CUT SLOPE HEIGHT GREATER THAN 10m. MAXIMUM CUT SLOPE IN OVERLYING FILL OR COLLUVIUM IS 1V:1.5H UP TO A MAXIMUM BATTER SLOPE HEIGHT OF 3m. OVERLYING FILL OR COLLUVIUM GREATER THAN 3m IN THICKNESS SHALL BE BENCHED WITH MINIMUM BENCH WIDTH OF 3m.
5. SEPARATION BUNDS (E.G. SHIPPING CONTAINERS) AT THE TOE OF THE CUT SLOPES ARE REQUIRED AT ALL TIMES DURING YARD OPERATION DUE TO THE RISK OF ROCKFALL FROM THE CUT FACES.
6. AN ENGINEERING GEOLOGIST OR GEOTECHNICAL ENGINEER APPOINTED BY THE PRINCIPAL WILL MONITOR EXCAVATION OF THE CUT SLOPES. DEPENDING ON ACTUAL CONDITIONS ENCOUNTERED ON SITE (E.G. GROUNDWATER SEEPAGES, LOCATION OF ROCK, THICKNESSES OF OVERLYING FILL/COLLUVIUM), WORK MAY BE PAUSED TO ALLOW FOR GEOTECHNICAL REVIEW, AND SLOPE AND BENCHING REQUIREMENTS MAY BE REVISED.
7. DEWATERING SHOULD BE ALLOWED FOR DURING EXCAVATION.
8. CUT SLOPES SHALL BE HYDROSEEDED AFTER COMPLETION.



No.	Revision	By	Chk	Appd	Date
C	FOR RESOURCE CONSENT	CFP	JH	JH	28.07.25
B	FOR RESOURCE CONSENT	CFP	JH	JH	11.07.25
A	FOR RESOURCE CONSENT	SZ	CGK	JH	08.04.25

Original Scale (A1)	Design	TNM	08.04.25	Approved For Construction*
1:500	Drawn	SZ	08.04.25	
Reduced Scale (A3)	Design Checker	CGK	08.04.25	
1:1000	Design Checker	CGK	08.04.25	



Client: **WIAL SEA DEFENCE STRUCTURES RENEWAL**

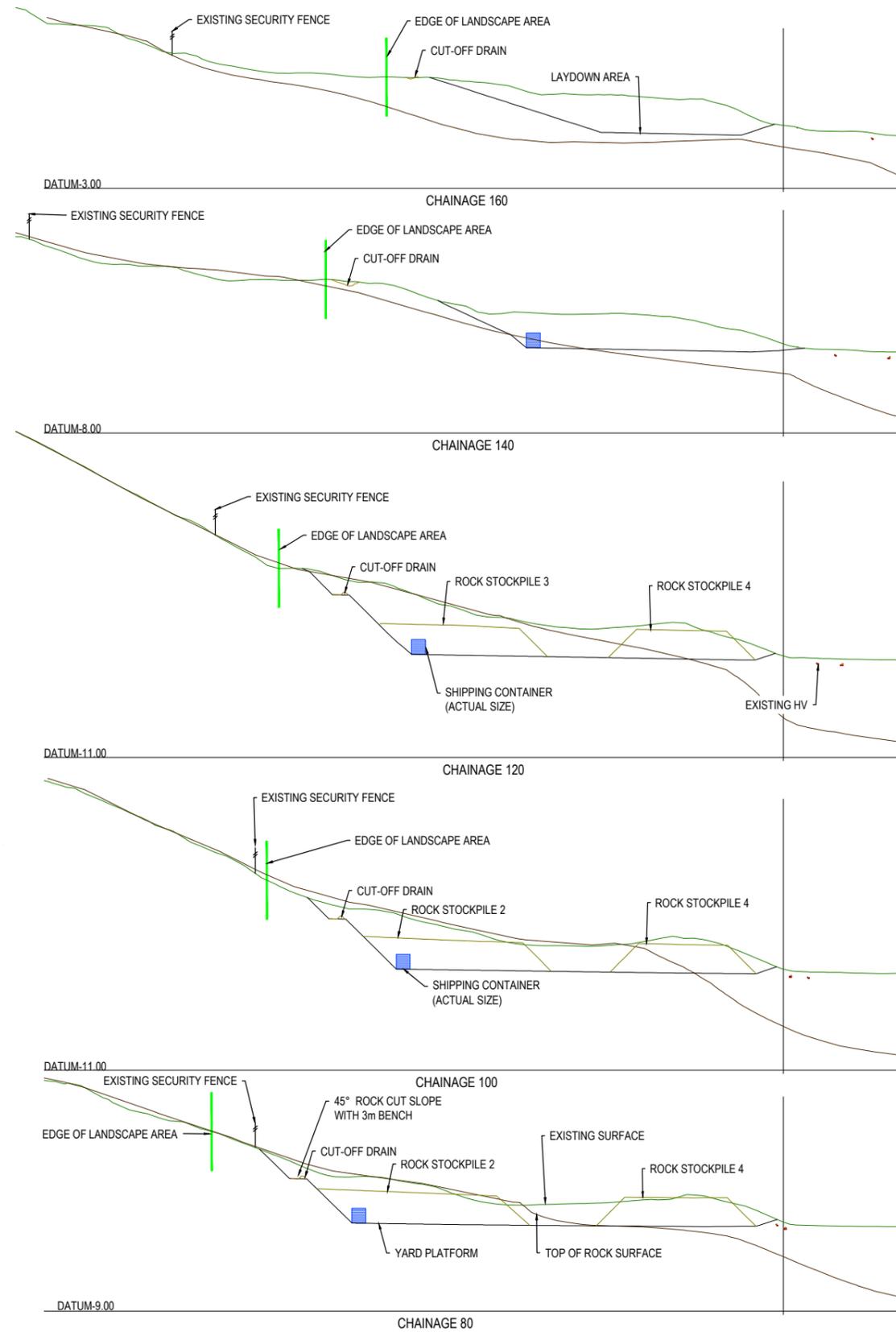
Project: **MGC CONSTRUCTION YARD BULK EARTHWORKS CROSS SECTIONS #1**

Discipline	CIVIL ENGINEERING
Drawing No.	3324338-CA-SK221
Rev.	C



NOTES:

1. REFER TO 3324338-CA-0001 FOR DRAWING LIST.
2. REFER TO 3324338-CA-0002 FOR GENERAL NOTES AND LEGEND.
3. REFER TO DRAWING 3324338-CA-0215 FOR CROSS SECTION LOCATIONS.
4. MAXIMUM CUT SLOPE IN ROCK IS 1V:1H UP TO A MAXIMUM CUT SLOPE HEIGHT OF 10m; AND 1V:1.5H FOR CUT SLOPE HEIGHT GREATER THAN 10m. MAXIMUM CUT SLOPE IN OVERLYING FILL OR COLLUVIUM IS 1V:1.5H UP TO A MAXIMUM BATTER SLOPE HEIGHT OF 3m. OVERLYING FILL OR COLLUVIUM GREATER THAN 3m IN THICKNESS SHALL BE BENCHED WITH MINIMUM BENCH WIDTH OF 3m.
5. SEPARATION BUNDS (E.G. SHIPPING CONTAINERS) AT THE TOE OF THE CUT SLOPES ARE REQUIRED AT ALL TIMES DURING YARD OPERATION DUE TO THE RISK OF ROCKFALL FROM THE CUT FACES.
6. AN ENGINEERING GEOLOGIST OR GEOTECHNICAL ENGINEER APPOINTED BY THE PRINCIPAL WILL MONITOR EXCAVATION OF THE CUT SLOPES. DEPENDING ON ACTUAL CONDITIONS ENCOUNTERED ON SITE (E.G. GROUNDWATER SEEPAGES, LOCATION OF ROCK, THICKNESSES OF OVERLYING FILL/COLLUVIUM), WORK MAY BE PAUSED TO ALLOW FOR GEOTECHNICAL REVIEW, AND SLOPE AND BENCHING REQUIREMENTS MAY BE REVISED.
7. DEWATERING SHOULD BE ALLOWED FOR DURING EXCAVATION.
8. CUT SLOPES SHALL BE HYDROSEEDDED AFTER COMPLETION.



No.	Revision	By	Chk	Appd	Date
A	FOR RESOURCE CONSENT	CFP	JH	JH	23.07.25

Original Scale (A1)	Design	TNM	08.04.25	Approved For Construction*
1:500	Drawn	SZ	08.04.25	
Reduced Scale (A3)	Design Verifier	CJB	08.04.25	
1:1000	Dwg Check	CGK	08.04.25	Date

* Refer to Revision 1 for Original Signature



Client: **WIAL SEA DEFENCE STRUCTURES RENEWAL**

Project: **MGC CONSTRUCTION YARD BULK EARTHWORKS CROSS SECTIONS #2**

Discipline: **CIVIL ENGINEERING**
 Drawing No.: **3324338-CA-SK222**
 Rev: **A**



A large, stylized white letter 'E' is centered on the right side of a teal rectangular background. The letter is composed of three horizontal bars and a vertical stem on the left.

Appendix E – Geotechnical Assessment of MGC Yard Cut Batter Slopes



WIAL Southern Seawall Renewal

Geotechnical Assessment of MGC Yard Cut Batter Slopes

Prepared for Wellington International Airport Limited
Prepared by Beca Limited

29 August 2025



**make
everyday
better.**

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Appendices

Appendix A – Qualifications and Experience

Appendix B – Layout Plan and Cross Sections

Appendix C – Annotated Site Photographs

Revision History

Revision N°	Prepared By	Description	Date
A	Garry Zhang	Issue for consent application	29/08/2025

Document Acceptance

Action	Name	Signed	Date
Prepared by	Garry Zhang	 pp	29/08/2025
Reviewed by	Anna Punt		29/08/2025
Approved by	Jennifer Hart		29/08/2025
on behalf of	Beca Limited		

1 Introduction

1.1 Project Summary

The Southern Seawall at Wellington International Airport (“**the Airport**”) has reached the end of its functional life. The proposed Southern Seawall Renewal Project (“**the Project**”) will help safeguard the long-term operation of the Airport against natural hazards, increase the Airport’s resilience to climate change, and reduce the (otherwise increasing) maintenance demands of the existing seawall.

The Project includes the following key elements:

- Establishing two construction yards (Miramar Golf Course Construction Yard (“**MGC Yard**”), and Moa Point Construction Yard (“**Moa Point Yard**”), and using them, along with the existing George Bolt Street Construction Yard (“**George Bolt Yard**”), for storage and construction activities;
- Reconstructing the Southern Seawall with rock and Cubipods;
- Remediating the eroding Eastern Bank with rock protection; and
- Establishing two new kororā colonies to support kororā habitation and breeding.

Overall, the Project is expected to take 6 to 8 years, with the seawall construction itself taking 24 to 30 months. Construction will be managed to maintain airport operations, minimise nighttime noise, and work around adverse weather and sea conditions. The Project must also appropriately manage constraints arising from sourcing, transporting and stockpiling the significant volumes of rock and Cubipods required to complete the seawall works.

The MGC Yard will serve as the primary storage area for the Project. It will be used to stockpile rock, Cubipods and other materials, and store plant and equipment. The MGC Yard is needed in advance of the seawall works to facilitate the gradual stockpiling of rock and small numbers of Cubipods over multiple years. The yard will also house a site office and staff welfare facilities. Site establishment will begin as soon as consents are granted and will require extensive earthworks and associated activities to level the site to an appropriate grade and provide services, drainage, erosion and sediment control, and to form unbound access roads and construct concrete entry / exit crossings.

Once the Project is complete, the site will be demobilised and disestablished by removing all construction facilities, including yard buildings on site.

1.2 Purpose and Scope of Report

The purpose of this report is to summarise the findings from existing information and site walkover and provide concept-level geotechnical commentary to inform the detailed design of rock cut batter slopes in the MGC Yard. This report will be used to support a resource consent application approvals process.

This report should be read in conjunction with the following reports:

- WIAL Sea Defences Renewal – 3D Geological Model (Beca, 2023).
- WIAL Sea Defences Renewal – Southern Seawall Geotechnical Interpretive Report (Beca, 2024).

The scope of work is summarised below:

- Assess potential geohazards based on publicly available geological/geotechnical information and site-specific geological/geotechnical data.
- Undertake a walkover to observe the accessible slopes on site and in close proximity.
- Comment on stability of slopes in the vicinity of the proposed rock cuttings.
- Provide discussion relating to the feasibility of the proposed rock cut, and commentary on residual risk

The proposed MGC Yard is located at the southwestern end of the Miramar Links Golf Course, in an area owned by the Airport. For the purposes of this Project, the proposed slope stabilisation reflects the temporary use of the site as a construction and storage yard. We understand that a longer-term solution will be implemented by WIAL at a later date when the area is developed as aircraft apron, in accordance with their 2040 Masterplan. The proposed cut slopes will have a design life of 10 to 20 years, after which the slopes will be cut further and stabilised.

This report presents a concept geotechnical assessment based on existing site investigation data (e.g. a Leapfrog three-dimensional model and logs), publicly available information, and site observations by an Engineering Geologist on 13 September 2024. No site investigations or slope stability analyses were conducted during this assessment.

1.3 Report Authors

The author and technical reviewer of this report are Garry Zhang and Anna Punt, respectively. We have the qualifications and expertise set out in **Appendix A** and confirm that we have read the Code of Conduct for expert witnesses contained in the Environment Court Practice Note 2023. This report has been prepared in compliance with that code, as if it was expert evidence presented in proceedings before the Environment Court. Unless we state otherwise, this report is within our area of expertise and we have not omitted to consider material facts known to us that might alter or detract from the opinions expressed in this report.

2 Site Description

The proposed MGC Yard (“the site”) is located at the southwestern end of the Miramar Golf Course, approximately 550m southeast of the Wellington International Airport terminal building (**Figure 2-1**). The site is slightly elevated and bounded by two main slopes to the southeast and southwest. The elevation gently dips toward the northwest, with a 1m steep drop from the site to Stewart Duff Drive. The geomorphology of the site appears to have been modified for the golf course and is characterised by small hummocks, and a pond is located immediately north of the site.



Figure 2-1: Site location, with outline of main cut area in MGC Yard (Nearmaps, 2024)

2.1 Historical Photographs

A number of historical aerial photographs (Retrolens, 2024), dating from the late-1930s to mid-1970s were reviewed using a stereoscope and QGIS version 3.38.0. **Figure 2-2** below shows the reviewed photos, where the approximate crests of the proposed southeastern and southwestern cuts are shown by the red polygon).

The geomorphology of the site has changed significantly due to the construction of the Airport and its maintenance facilities. Based on historical photographs taken before and after construction, the current southeastern slopes were formed by cut and fill. However, the extent of the earthworks is unknown due to a lack of elevation information. A southeast - northwest trending gully running between the southeastern and southwestern slopes was infilled during the construction of the golf course. The southwestern slopes were cut during the development of Moa Point Quarry directly west of site. Stewart Duff Drive, northwest of the site was constructed by cutting through the fill platform between 1988 and 2000.



Figure 2-2: Historical photographs with outline of main cut area in MGC Yard (Retrolens, 2024)

3 Ground Conditions

3.1 Published Geology

The 1:250,000 scale published geological maps of the area (Begg and Mazengarb, 1996; Begg and Johnston, 2000) show that the far northwestern corner of the site is underlain by Holocene beach deposits, which consist of marine gravel and sands. The remainder of the site is underlain by Rakaia Terrane (Wellington greywacke) rock, which comprises interbedded sandstone (greywacke) and mudstone (argillite). The Wellington greywacke is typically faulted, tilted, and folded, with very closely to closely spaced discontinuities. **Figure 3-1** below shows the published geology of the site.

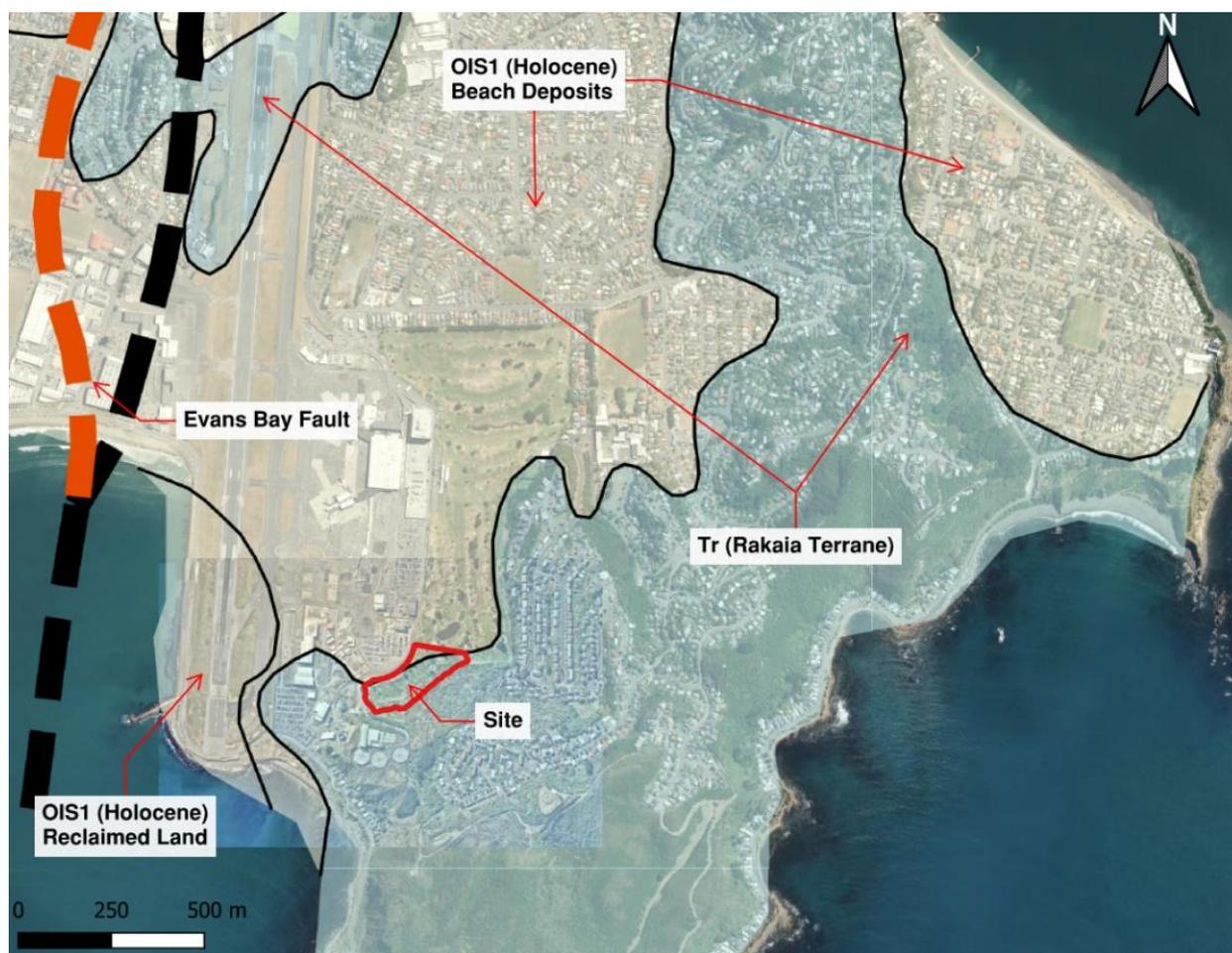


Figure 3-1: Published geology of the site, with outline of main cut area in MGC Yard (GNS, 2025)

3.2 Relevant Previous Investigations

A three-dimensional geological model was developed to support design of the seawall renewals proposed at the Airport. The details of the model are provided in the ‘WIAL Sea Defences Renewal 3D Geological Model report’, dated 20 December 2023.

Key geotechnical investigations within the site are discussed in **Table 3-1**, in relation to the locations shown in **Figure 3-2**.

Table 3-1: Geotechnical Investigations Summary

Year	Location	Investigation ID	Findings
1989	Southwest of the site	1989_TP 12-15 1989_BH 7-9	<p>Greywacke was encountered at 1989_BH08 at about 8m bgl (5.6m NZVD16), approximately 60m east of the Moa Point Wastewater Treatment Plant access road cutting. 1989_BH07, located in the grassed area between the southwestern and southeastern slopes, rock was encountered at approximately 10m bgl (9.9m NZVD16). No rock was encountered at 1989_BH09 (approximately 100m northeast of the road cutting), suggesting that the head of rock is below 15.45m (5.65m NZVD16).</p> <p>At 1989_TP13 and 1989_TP14 (near the road cutting at the Moa Point Wastewater Treatment Plant access road), the top of rock was encountered at 1.6m bgl and 1.7m bgl, respectively (11.7m NZVD16 and 12.4m NZVD16).</p>
2023	Southwest of the site	HA102 HA103 HA107 HA108 HA109 HA110 HA111	<p>Seven hand augers drilled by Pattle Delamore Partners Ltd are located within the site, reaching depths between 0.2m and 2.6m.</p> <p>The Quaternary beach deposits typically consist of medium-dense sand/silty sand.</p> <p>Silt/silty sand/sandy silt with some gravel was encountered in the hand augers where fill was identified.</p> <p>None of these hand augers encountered rock.</p>
2023	Southwest of the site	CPT103 CPT104 CPT105 CPT106	<p>Four Cone Penetration Tests (“CPTs”) drilled to depths between 2.05m and 13.91m (all CPT tests were terminated when cone tip resistance (qc) exceeded 35MPa or when the CPT reaction screw anchors failed).</p> <p>None of these CPTs proved rock was encountered as soil was not recovered, however it is likely the CPTs have terminated on rock.</p>



Figure 3-2: Historical investigations, with outline of main cut area in MGC Yard (Basemap source: Nearmaps, 2024)

3.3 Groundwater

Groundwater monitoring instrumentations were installed in boreholes (“BH”) BH10 and BH15 at the Wellington Sludge Minimisation Facility (“SMF”) site, 80m southwest of the site, above and below the northern slope cut (**Figure 3-2**). Piezometers were measured on 16/01/2023 following a two-month monitoring period.

BH15 is located in front of the inlet pump station, which shows a groundwater level between 1.9m NZVD16 and 3.0m NZVD16. BH10 is located at the ridgeline near the thrust block, which shows a groundwater level between 9.1m NZVD16 and 10.9m NZVD16.

3.4 Anticipated Rock Profile

A map of the top of the rock profile relative to NZVD16 (NZVD, 2016) is shown in **Figure 3-3** below, suggesting that the rock head level within the site dips to the northwest toward the Airport. The estimated elevation of the top of the rock on site ranges from 20m NZVD16 to 0m NZVD16.



Figure 3-3: Contour map of top of the rock, with outline of main cut area in MGC Yard (Beca, 2023)

3.5 Geohazards

3.5.1 Slope Stability

According to the Greater Wellington Regional Council (“GWRC”) GIS map (Figure 3-4), the southeastern slope of the site is in an area of ‘low-moderate’ to ‘high’ seismic slope failure risk. The southeastern ridges are mapped within the ‘low-moderate’ seismic slope failure zone. The NW-SE trending gully between these two ridges is mapped within a ‘moderate’ risk of seismic slope failure. The remainder of the site is mapped within the ‘low’ seismic slope failure risk zone.

Seismic Hazard Map



Figure 3-4: Seismic slope stability hazard map, with outline of main cut area in MGC Yard (GWRC, 2024)

4 Site Walkover Observations

The site walkover was undertaken by a Beca Engineering Geologist on 13 September 2024 to visually assess the conditions of the existing slopes from ground level and from the top of ridges. The site observations are summarised below, and annotated photographs showing some of the features described are attached to this report as **Appendix B**.

4.1 Southeastern Slope

- The southern slope reaches a height of approximately 50m high, with an average slope angle of 30°-35°. This slope consists of two ridges and a gully in the middle. A few ramps (possibly made of fill) were observed at the toe of the slope, extending toward the golf course.
- A NW-SE trending gully is located between the two ridges, which is heavily vegetated with trees and gorse. No exposure was observed along this section to confirm the presence of rock.
- A few ramps (possibly made of fill) were observed at the toe of the slope, extending toward the golf course. The angles of the ramps at the bottom of the slope range from 25° to 35°. A few spots of soil erosion and creeping were observed on the grassed surface.

4.2 Southwestern Slope

- A road cutting was observed at the intersection of Stewart Duff Drive and the SMF access road.
- This road cutting is about 6 to 8m high and dips at 40° to 45°.
- The road cutting predominantly comprises moderately strong to strong, moderately weathered to highly weathered greywacke with closely to very close spaced (20-200mm) defects. The orientations of the defects were not measured due to hydroseeding and excavation disturbance.
- Minor erosion on this road cutting was observed.
- About 300mm of fill, comprising gravel with minor silt and sand, overlies the greywacke. The contact between the fill and greywacke gently dips toward the golf course (305/14°).
- The greywacke cutting terminates at the layby area of the SMF access track. The layby area consists of sandy gravel with cobbles.
- On the far (southwestern) side of the access road cut above the water valve for the SMF site, the greywacke is cut more steeply (approximately 60°) and has been stabilised with anchors and mesh.
- Greywacke was observed in the hydro-excavated trench near the water valve on the southwestern side of the SMF access road, approximately 300mm below the road level.

4.3 Both Top of Ridges

The following observations were made along the walking tracks to Tukanae Street and Kekerenga Street at the southeastern boundary of the site:

- A layer of sand (0.9m to 1.0m), was observed overlying the colluvium at about 58m NZVD16. No exposure of rock was found beneath the colluvium.
- At the top of the gully, the slope is much shallower (10°-15°) and heavily vegetated (trees and gorse). Few concrete blocks and pipes were also observed on the ground.
- The remainder of the track to Tukanae Street is covered by track fill or colluvium.
- On the track to Kekerenga Street (approx. 61m NZVD16), greywacke outcrop was observed underlying a sand layer 0.7m to 0.8m thick.
- The remainder of the track to the viewing bench (74m NZVD16) is founded on greywacke.

5 Anticipated Soil/Rock Profile

Based on historical investigations, photographs, and site observations, the anticipated ground profile is described as follows:

- The proposed southwestern cutting (**Figure 5-1**) near the road intersection is entirely on greywacke, with up to 1.7m of fill on top. The thickness of fill around the proposed southwestern cutting increases toward the east. The greywacke on this cut slope is likely to be moderately strong, moderately to highly weathered, with closely to very closely spaced defects (20-200mm).
- At the flat area between the proposed southwestern and southeastern cutting, the thickness of the fill generally increases to the south, with a maximum thickness potentially up to 10m.
- Due to the lack of investigation at the southeastern slopes, the exact thickness of the fill cannot be determined. The fill ramps at the toe of the slopes may consist of sand overlying colluvium. The rock underlying the fill is likely to consist of weak to very weak, completely to highly weathered greywacke with extremely to very closely spaced defects in the upper metres, while moderately strong to strong, moderately weathered greywacke may be present at greater depths.

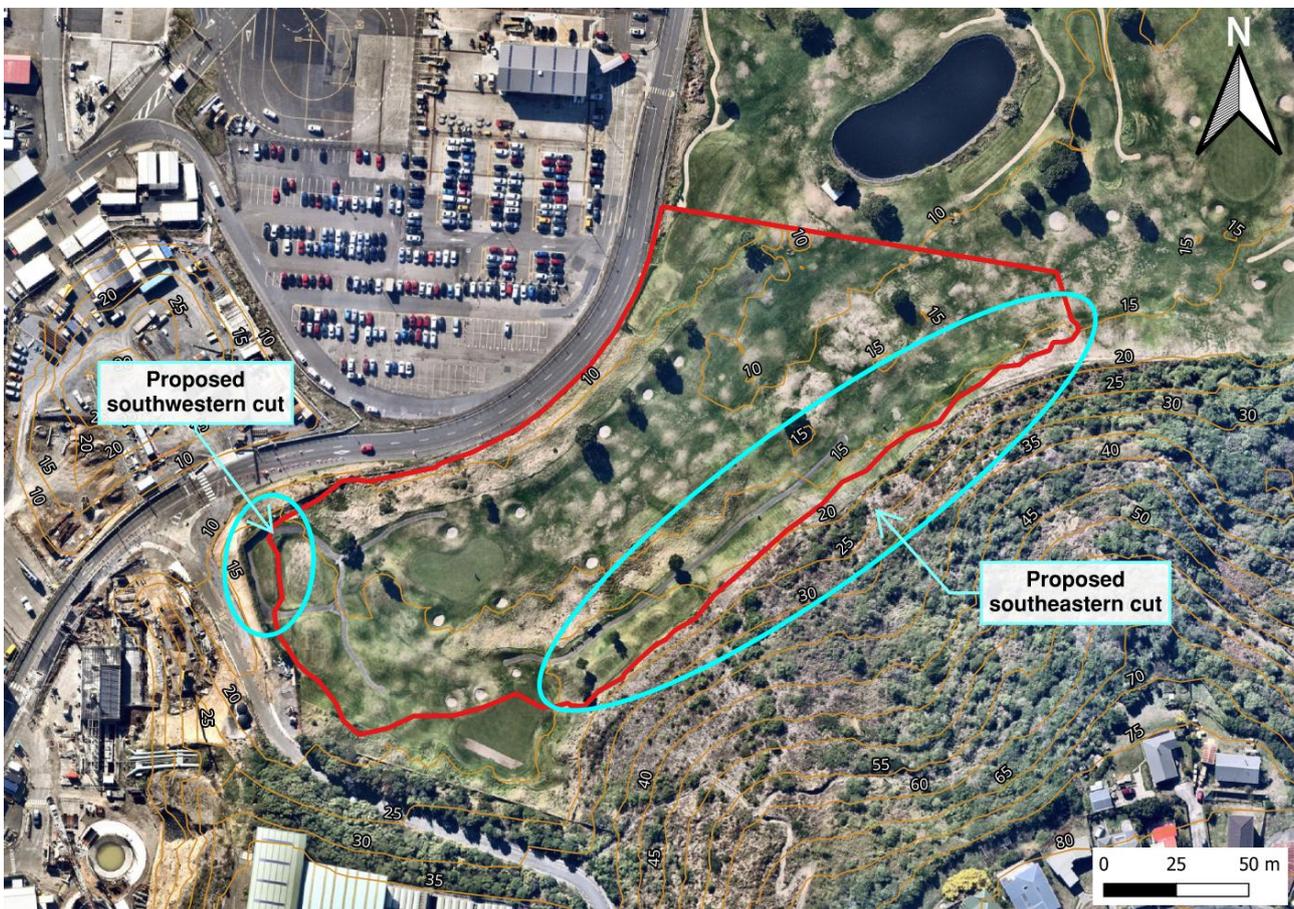


Figure 5-1: Proposed cut locations and outline of main cut area in MGC Yard (Basemap source: Nearmap, 2024)

6 Rock Cut Considerations

For the purposes of this Project, the proposed slope stabilisation reflects the temporary use of the site as a construction and storage yard. We understand that a longer-term solution will be implemented by WIAL at a later date when the area is developed as aircraft apron, in accordance with their Masterplan.

The following recommendations are made to support the concept design of the proposed rock cut, which should be read in conjunction with the residual risks detailed in **Section 7**:

- The southwestern slope can be cut to at a slope angle of 1V:1H in moderately to highly weathered greywacke, with a maximum batter height up to 10m total cut height. The overlying fill material should be battered at a lower angle (i.e., 1V:1.5H), up to a height of 3m.
- The proposed cutting between the southwestern and southeastern slopes should be battered more shallowly (no steeper than 1V:2H) due to thicker fill cover. Rock is not anticipated in this 7.5m cut.
- The southeastern slopes can be cut to 1V:1H in moderately to highly weathered greywacke up to 10m, and to 1V:1.5H for batters over 10m. The slope should be benched if fill or colluvium over 3m thickness is found overlying the rock. The benches should have a minimum width of 3m.
- Due to the anticipated presence of closely spaced defects, the rock mass has the potential to undergo continued frittering and spalling as the cut face relaxes and weathering occurs along the open defects.
- For areas where access to the toe of the slopes will be required, a separation bund should be placed to prevent localised rockfalls extending into the construction yard. Shipping containers would be appropriate for this purpose. Note: the containers will protect against small rockfalls but will not prevent larger slope failure extending across the construction yard. The risk from larger rockfalls should be identified by further investigation and during construction observation, as detailed below).
- A cut-off swale should be installed at each bench and at the crest of the cut slopes to prevent surface water runoff. This water should be captured and diverted into the stormwater network. Cut-off drains designed for a 1 in 20-year event (5% AEP), in accordance with erosion and sediment control requirements are included in the MGC yard design.
- The slopes should be hydroseeded after completion.
- If groundwater seepages are encountered during excavation, the above slope angle recommendations should be reviewed.
- Dewatering should be allowed for during excavation.
- Small rockfalls on the benches or toes of the slopes may be expected after heavy rainfall. Therefore, we recommend that the slope should be inspected routinely (e.g., quarterly) and following significant rainfall or seismic events.
- Further investigations (e.g., machine drilled boreholes) could be completed prior to earthworks to further inform the rock level and the nature of greywacke. Alternatively, WIAL could proceed with earthworks without further site investigations, with provisions for site inspections (refer to below bullet point), and to pause the works to reassess slope angles and benching if actual conditions encountered differ from assumptions.
- We also recommend that an Engineering Geologist or Geotechnical Engineer should be on-site full-time during the excavations.

The above points should be confirmed during detailed design.

7 Residual Risk

The ground profile and assumed properties presented in this report have been assumed based on site observations and review of available data. Therefore, the assumptions made in this report are conceptual, and the recommendations regarding the cut slope angles are based on past experiences with Wellington greywacke cut slopes and 'rules of thumb'. The weathering grade of greywacke will affect the batter angle and height of cutting. Site investigations would help to reduce the risk of uncertainty.

Based on experience with other greywacke cut slopes, the most likely failure mechanism within the greywacke is defect-controlled failures, (e.g., wedge failures, rockfalls). Deep-seated slope failures are less common and typically associated with persistent defects or faults. The presence of such features is difficult to assess until the slope is exposed.

There is a risk that if the rock is locally less competent than has been assumed or if persistent defects or faulting are present, additional support measures or an amended slope design may be required.

8 Applicability Statement

This report has been prepared by Beca Ltd (Beca) on the specific instructions of Wellington International Airport Ltd (Client). It is solely for our Client's use for the purpose for which it is intended in accordance with the agreed scope of work as listed in **Section 1.2**. Any use or reliance by any person contrary to the above, to which Beca has not given its prior written consent, is at that person's own risk and Beca accepts no liability to any other person for their use of or reliance on this report.

Beca acknowledges the Practice and Procedure Guidance, dated 22 July 2025, provided by the Panel Conveners appointed under the Fast-track Approvals Act 2024, which states that "reports that are intended to be relied on by the panel should not be submitted with a disclaimer stating that the report is not for use by persons other than the applicant". This report, however, serves a dual purpose, both in supporting the Southern Seawall resource consent application, and as a technical report to inform yard excavation design. Beca gives its consent, pursuant to the statements above, for the panel convened under the Fast-track Approvals Act 2024 to rely on this report to assist it to determine an application for an approval. Beca does not assume any liability or responsibility to the panel that would be greater than any liability or responsibility Beca has to its Client.

Should you be in any doubt as to the applicability of this report and/or its recommendations for the proposed development as described herein, and/or encounter materials on site that differ from those described herein, it is essential that you discuss these issues with the authors before proceeding with any work based on this document.

- WIAL Sea Defences Renewal – 3D Geological Model (Beca, 2023).
- WIAL Sea Defences Renewal – Southern Seawall Geotechnical Interpretive Report (Beca, 2024).
- Wellington Sludge Minimisation Facility – SMF – Geotechnical Design Report (Beca, 2023).

Unless specifically stated otherwise in this report, Beca has relied on the accuracy, completeness, currency and sufficiency of all information provided to it by, or on behalf of, the Client, including the information listed above, and has not sought independently to verify the information provided.

This report should be read in full, having regard to all stated assumptions, limitations and disclaimers. No part of this report shall be taken out of context and, to the maximum extent permitted by law, no responsibility is accepted by Beca for the use of any part of this report in any context, or for any purpose, other than that stated herein.

9 References

Beca. (2023). Wellington Sludge Minimisation Facility – SMF – Geotechnical Design Report.

Beca. (2023). WIAL Sea Defences Renewal - 3D Geological Model.

Beca. (2024). WIAL Sea Defences Renewal – Southern Seawall Geotechnical Interpretive Report.

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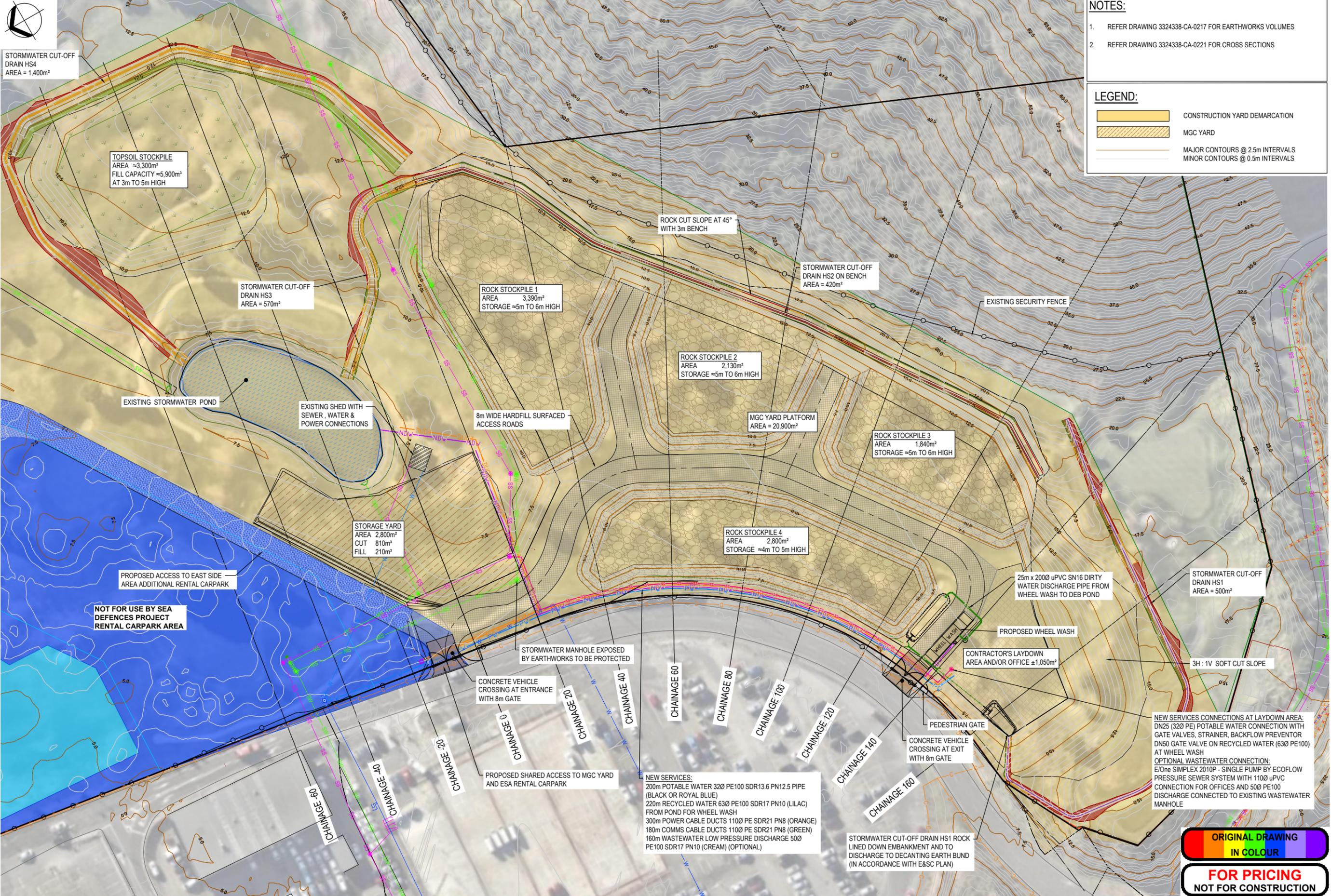
Appendix A – Qualifications and Experience

Appendix A – Authors’ Qualifications and Expertise

Author / Reviewer	Qualifications	Expertise
Anna Punt	<p>BSc (Hons) Geology - University of Portsmouth, UK, 2001</p> <p>MSc Geohazard Assessment - University of Portsmouth, UK, 2003 (Distinction).</p> <p>Master of Mining Engineering in Mine Geomechanics - UNSW, 2011 (High Distinction)</p> <p>CMEngNZ (PEngGeol)</p>	Transport, Infrastructure & mining (21 years' experience)
Garry Zhang	<p>BSc (Geology) – University of Canterbury (2019)</p> <p>Professional Master of Engineering Geology (PMEG) - University of Canterbury (2021)</p>	Transport & Infrastructure (3 years' experience)

B

Appendix B – Layout Plan and Cross Sections



NOTES:

- REFER DRAWING 3324338-CA-0217 FOR EARTHWORKS VOLUMES
- REFER DRAWING 3324338-CA-0221 FOR CROSS SECTIONS

LEGEND:

- CONSTRUCTION YARD DEMARCATION
- MGC YARD
- MAJOR CONTOURS @ 2.5m INTERVALS
- MINOR CONTOURS @ 0.5m INTERVALS

30
20
10
0
5
10
FULL SIZE 1:500; HALF SIZE 1:1000
SCALE (m)

No.	Revision	By	Chk	Appd	Date
C	FOR RESOURCE CONSENT	CFP	JH	JH	28.07.25
B	FOR RESOURCE CONSENT	CFP	JH	JH	11.07.25
A	FOR RESOURCE CONSENT	SZ	CGK	JH	08.04.25

Original Scale (A1)	Design	TNM	08.04.25	Approved For Construction*
1:500	Drawn	SZ	08.04.25	
1:1000	Design Verifier	CJB	08.04.25	
	Dwg Check	CGK	08.04.25	

* Refer to Revision 1 for Original Signature



Client: **WIAL SEA DEFENCE STRUCTURES RENEWAL**

Project: **MGC CONSTRUCTION YARD LAYOUT PLAN: ROADS, SERVICES & STOCKPILES**

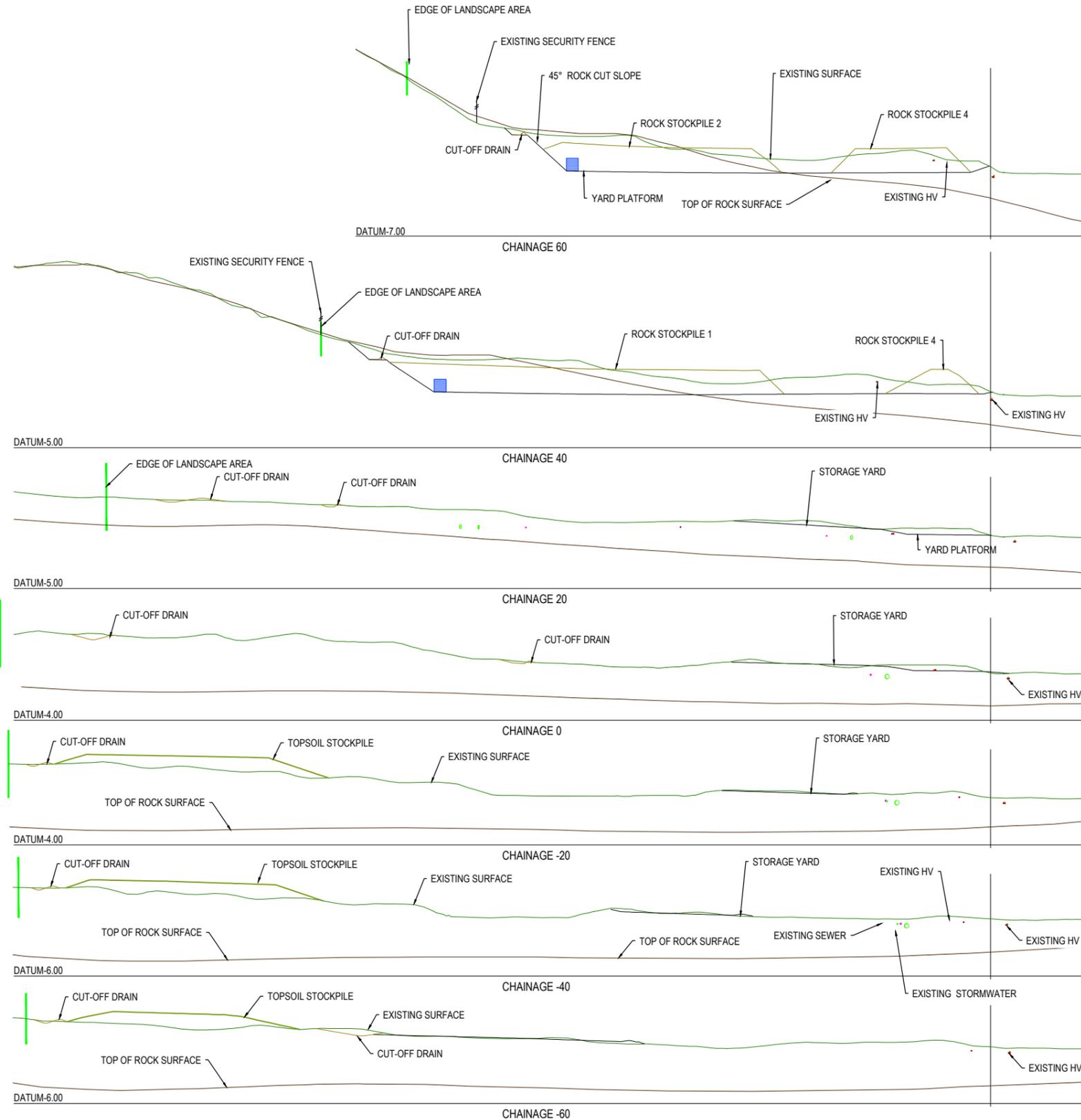
Discipline: **CIVIL ENGINEERING**
 Drawing No: **3324338-CA-SK215**
 Rev: **C**

ORIGINAL DRAWING IN COLOUR

FOR PRICING NOT FOR CONSTRUCTION

NOTES:

1. REFER TO 3324338-CA-0001 FOR DRAWING LIST.
2. REFER TO 3324338-CA-0002 FOR GENERAL NOTES AND LEGEND.
3. REFER TO DRAWING 3324338-CA-0215 FOR CROSS SECTION LOCATIONS.
4. MAXIMUM CUT SLOPE IN ROCK IS 1V:1H UP TO A MAXIMUM CUT SLOPE HEIGHT OF 10m; AND 1V:1.5H FOR CUT SLOPE HEIGHT GREATER THAN 10m. MAXIMUM CUT SLOPE IN OVERLYING FILL OR COLLUVIUM IS 1V:1.5H UP TO A MAXIMUM BATTER SLOPE HEIGHT OF 3m. OVERLYING FILL OR COLLUVIUM GREATER THAN 3m IN THICKNESS SHALL BE BENCHED WITH MINIMUM BENCH WIDTH OF 3m.
5. SEPARATION BUNDS (E.G. SHIPPING CONTAINERS) AT THE TOE OF THE CUT SLOPES ARE REQUIRED AT ALL TIMES DURING YARD OPERATION DUE TO THE RISK OF ROCKFALL FROM THE CUT FACES.
6. AN ENGINEERING GEOLOGIST OR GEOTECHNICAL ENGINEER APPOINTED BY THE PRINCIPAL WILL MONITOR EXCAVATION OF THE CUT SLOPES. DEPENDING ON ACTUAL CONDITIONS ENCOUNTERED ON SITE (E.G. GROUNDWATER SEEPAGES, LOCATION OF ROCK, THICKNESSES OF OVERLYING FILL/COLLUVIUM), WORK MAY BE PAUSED TO ALLOW FOR GEOTECHNICAL REVIEW, AND SLOPE AND BENCHING REQUIREMENTS MAY BE REVISED.
7. DEWATERING SHOULD BE ALLOWED FOR DURING EXCAVATION.
8. CUT SLOPES SHALL BE HYDROSEEDED AFTER COMPLETION.



No.	Revision	By	Chk	Appd	Date
C	FOR RESOURCE CONSENT	CFP	JH	JH	28.07.25
B	FOR RESOURCE CONSENT	CFP	JH	JH	11.07.25
A	FOR RESOURCE CONSENT	SZ	CGK	JH	08.04.25

Original Scale (A1)	Design	TNM	08.04.25	Approved For Construction*
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Reduced Scale (A3)	Design Checker	CGK	08.04.25	
1:1000	Design Checker	CGK	08.04.25	



Client: **WIAL SEA DEFENCE STRUCTURES RENEWAL**

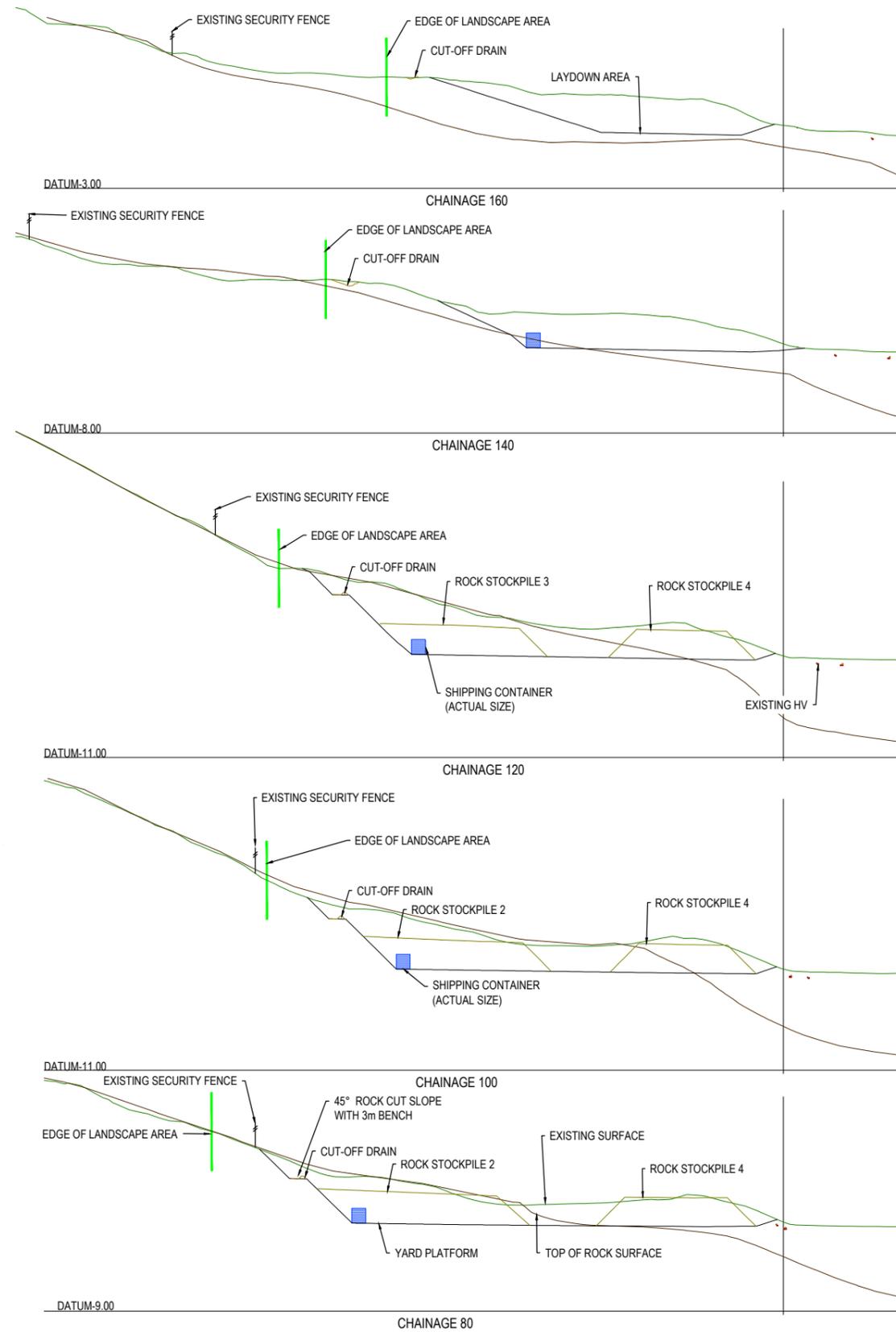
Title: **MGC CONSTRUCTION YARD BULK EARTHWORKS CROSS SECTIONS #1**

Discipline	CIVIL ENGINEERING
Drawing No.	3324338-CA-SK221
Rev.	C



NOTES:

1. REFER TO 3324338-CA-0001 FOR DRAWING LIST.
2. REFER TO 3324338-CA-0002 FOR GENERAL NOTES AND LEGEND.
3. REFER TO DRAWING 3324338-CA-0215 FOR CROSS SECTION LOCATIONS.
4. MAXIMUM CUT SLOPE IN ROCK IS 1V:1H UP TO A MAXIMUM CUT SLOPE HEIGHT OF 10m; AND 1V:1.5H FOR CUT SLOPE HEIGHT GREATER THAN 10m. MAXIMUM CUT SLOPE IN OVERLYING FILL OR COLLUVIUM IS 1V:1.5H UP TO A MAXIMUM BATTER SLOPE HEIGHT OF 3m. OVERLYING FILL OR COLLUVIUM GREATER THAN 3m IN THICKNESS SHALL BE BENCHED WITH MINIMUM BENCH WIDTH OF 3m.
5. SEPARATION BUNDS (E.G. SHIPPING CONTAINERS) AT THE TOE OF THE CUT SLOPES ARE REQUIRED AT ALL TIMES DURING YARD OPERATION DUE TO THE RISK OF ROCKFALL FROM THE CUT FACES.
6. AN ENGINEERING GEOLOGIST OR GEOTECHNICAL ENGINEER APPOINTED BY THE PRINCIPAL WILL MONITOR EXCAVATION OF THE CUT SLOPES. DEPENDING ON ACTUAL CONDITIONS ENCOUNTERED ON SITE (E.G. GROUNDWATER SEEPAGES, LOCATION OF ROCK, THICKNESSES OF OVERLYING FILL/COLLUVIUM), WORK MAY BE PAUSED TO ALLOW FOR GEOTECHNICAL REVIEW, AND SLOPE AND BENCHING REQUIREMENTS MAY BE REVISED.
7. DEWATERING SHOULD BE ALLOWED FOR DURING EXCAVATION.
8. CUT SLOPES SHALL BE HYDROSEEDDED AFTER COMPLETION.



No.	Revision	By	Chk	Appd	Date
A	FOR RESOURCE CONSENT	CFP	JH	JH	23.07.25

Original Scale (A1)	Design	TNM	08.04.25	Approved For Construction*
1:500	Drawn	SZ	08.04.25	
Reduced Scale (A3)	Design Verifier	CJB	08.04.25	
1:1000	Dwg Check	CGK	08.04.25	Date

* Refer to Revision 1 for Original Signature



Client: **WIAL SEA DEFENCE STRUCTURES RENEWAL**

Project: **MGC CONSTRUCTION YARD BULK EARTHWORKS CROSS SECTIONS #2**

Discipline: **CIVIL ENGINEERING**
 Drawing No.: **3324338-CA-SK222**
 Rev: **A**



C

Appendix C – Annotated Site Photographs



Photo taken on 13 September 2024

Looking southeast, overview of the southeastern slope



Photo taken on 13 September 2024

Looking northeast, overview of the southeastern slope



Photo taken on 13 September 2024

Looking northwest, overview of the southwestern slope



Photo taken on 13 September 2024

Looking south, overview of the southwestern slope

Photo taken on 13 September 2024



Looking northwest, overview of SMF road cutting (slope angle at 45°)



Photo taken on 13 September 2024

Greywacke outcrop on the cut slope



Photo taken on 13 September 2024

Looking east (towards golf course), overview of SMF layby area



Photo taken on 13 September 2024

Filling around the SMF layby area



Photo taken on 13 September 2024

Looking northwest, overview of the southwestern slope from upper track



Photo taken on 13 September 2024

Looking northeast, overview of the southeastern slope from upper track A large sealed car park has since been established in the rear of the photo



Photo taken on 13 September 2024

Sand outcrop on the upper track



Photo taken on 13 September 2024

Concrete blocks and pipes on the top of gully



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everyday
better.**