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Andrew Fraser
Glen Isla Protection Society

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Dear Andrew,

Waihi Beach – Glen Isla Protection Society Peer Review

NuWave Coastal have been engaged to provide a peer review of the proposed coastal protection works at Glen Isla Place, Waihi Beach. The review is limited to the coastal process and engineering aspects of a proposed rock revetment structure and is required to support a resource consent application submitted to Western Bay of Plenty Council ("WBOP").

1. Scope of works

The peer review is limited to the coastal process and engineering aspects of the proposal and the documents and links provided by Morgan Slyfield in an email dated the 29th May 2025, namely;

- Coastal Process Assessment, Appendix B, Western Bay of Plenty District Council (WBOP DC) online depository.
- Location of MHWS Assessment, Appendix E, WBOP DC online depository.
- Engineering Design Report, Appendix F, WBOP DC online depository.
- Construction Methodology, Appendix H, and subsequent response to S92 request, Attachment F, WBOP DC online depository.
- Response to second s92 request, email attachment, 'Attachment C - Davis Coastal Consultants second s92 engineering response.pdf'
- Glen Isla Reserve Coastal Protection Structure, Coastal Engineering Review, Beca Consultants. Supplied on 21st July 2025.

The findings of the peer review are provided below and are summarised based on an assessment on whether the work completed to date conforms with latest available guidance and policies, and where required uses industry standard engineering methodologies. The conclusions of the review are concisely set out in the attached table to allow for the consultants, primarily Davis Coastal, to comment or provide clarification on the issues raised.

2. Coastal process assessment

Waihi beach is one of the most surveyed and studied beaches in New Zealand. The coastal process assessment used the available data sets and previous reporting to assess the likely risk to seaward properties along Glen Isla Place. The results of the assessment demonstrate that the most seaward properties are potentially at risk in 0-10 years, with all properties at risk within 50 years. It should be emphasised that the risk to properties closest to Three Mile Creek is largely dependant on whether the existing training wall is maintained and does not catastrophically fail or get removed over the design life of the structure.

The erosion risk assessment relied on a report produced for WBOP District Council in 2015 by Tonkin and Taylor Limited. It is worth noting that this study was updated in 2024 and the results are available publicly although not yet adopted on the WBOP website hazard mapping. A review of this report shows that the results are commensurate with the original for this section of coastline, although have a slightly larger setback at the 50 and a 100 year timeframes.

There is a lot of uncertainty in the future rates of erosion, however in terms of the proposed structure the key takeaway is that some properties are potentially at risk in the short term (0-10) and all properties may be at risk within a 50 year time horizon if existing structures are not maintained.

3. Design Conditions

Extreme water levels and design wave heights were reviewed and found to be reasonable and use the latest guidance on seal level rise and vertical land movement.

4. Structure Design

A review of the design report found the structure to be designed in line with industry standard guidance using well established empirical equations. Specific comments on the structure design are presented in the sections below.

4.1 Structure rationale

Based on the options assessment provided in the design report we are in agreement that the rock revetment option is most appropriate at this site.

As demonstrated in the coastal process assessment and supporting hazard assessments it is evident that the sections, and ultimately property structures, are at risk of erosion. There is some uncertainty on when this may occur and it is largely dependent on the prevailing

conditions, the number and magnitude of storm events and the speed of sea level rise over time. However, there is a credible risk to the most seaward properties at the southern end (12, 14 and 16) in the short-term (0-10 years), with the risk profile to the remaining properties being tied to the 3-mile creek training wall being maintained as discussed in section 4.2. For these reasons we do not consider the do nothing option appropriate if the intention is to protect the existing properties.

Soft engineering options, typically beach renourishment and planting are considered preferable to hard engineered structures where they can be shown to provide an adequate standard of protection. Their efficacy is largely dependent on site specific topography and the hydrodynamic climate. Localised replenishments on wide open beaches have frequently been shown to be ineffective with sediment rapidly redistributed along the adjacent beach to form an equilibrium profile. In order to maintain an adequate standard of protection regular maintenance and additional replenishments would likely be required, proving prohibitively expensive and impractical. There is also a residual risk of a large storm occurring during periods of low beach levels prior to maintenance that could result in erosion beyond the section boundaries. The effectiveness of this approach also reduces over time as the wider beach contours erode landward, requiring more frequent and potentially larger sand renourishments.

A number of hard engineering options were considered in the design report, we support the rationales presented there in for the options that were considered inappropriate. These included increased adverse effects, risk of catastrophic failure, absence of design guidance, health and safety issues and recommendations in the Council's coastal erosion policy against the use of certain structure types.

Rock revetments have well established design guidance, typically fail incrementally not catastrophically allowing for maintenance to be conducted, and if required are easier to upgrade or adapt in the future. A number of rock revetments have also been constructed elsewhere along the Waihi coastline and have performed well during recent storm events.

4.2 Structure extent and location

The proposed works consist of a rock revetment that runs parallel to the coast in front of properties 12 – 16 and then continues at an angle landward parallel to the property boundaries to the point it intersects with the bank of Three Mile Creek (Figure 1). The revetment is composed of two wall types, 'Type 1' that runs from the southern end to the midpoint of property number 15 and 'Type 2' that covers the remaining length to the intersection of Three Mile Creek.

Figure 1: Location and extent of proposed rock revetment as presented in the design report

Given the current beach topography and proposed renourishment the rock revetment would be completely covered following construction, with the 'Type 1' wall described as being *infrequently exposed* and the 'Type 2' section as *near permanently buried*.

At the northern end of the structure the setback from the vegetated dune is so large that, based on the information provided in the coastal process assessment, by the time it was exposed the more seaward southern section would have long since failed. This raises the question as to whether it is currently required or could be constructed at a later date. The stability of the dune, and accretion of material, at the northern end of the site is largely a consequence of the training wall on the southern side of Three Mile Creek. Should this fail or be removed then a natural widening of the creek mouth and the potential for the channel position to migrate could result in exposure of this wall in a much smaller timeframe.

Given there is no guarantee that the training wall consent will be renewed, or that funding to maintain and potentially upgrade it is available, it is may be preferable the wall is built in its entirety in one construction stage. In addition, building the northern section of the wall at a later date if deemed necessary would result in disturbance of the dune and potentially insufficient time for vegetation to establish before being subjected to wave action.

It is recommended to build the full extent of the wall in one stage, this will allow for dune vegetation to become fully established at the northern end of the works. The fact that the structure is buried will also result in no adverse effects on the dune system except in the unlikely event the wall is exposed. No future works or disturbance of the dune would be required and the option would constitute a stand alone option that is not reliant on the continued presence and maintenance of another structure.

The position of the revetment is offset by 5m from the property boundaries at the southern end of the site and approximately 7m at the northern half. The northern offset is supported by an arborist report, and due to it being far less likely to be exposed there is limited benefit on repositioning it closer to the property boundaries. However, the southern end will be exposed over a shorter timeframe and progressively more frequently. Consideration may be given to moving this section of wall landward to increase the sand dune buffer in front of the

structure and reduce the frequency and extent of exposure over the lifetime of the structure. The benefits of the 5m offset include allowing space for construction vehicles to operate, maintaining a strip of naturally vegetated dune and potentially space to maintain or upgrade the wall if required.

4.3 Design elements

Following the review of the structure design we have the following comments on the rock revetment cross sections presented in the design report (Figure 2):

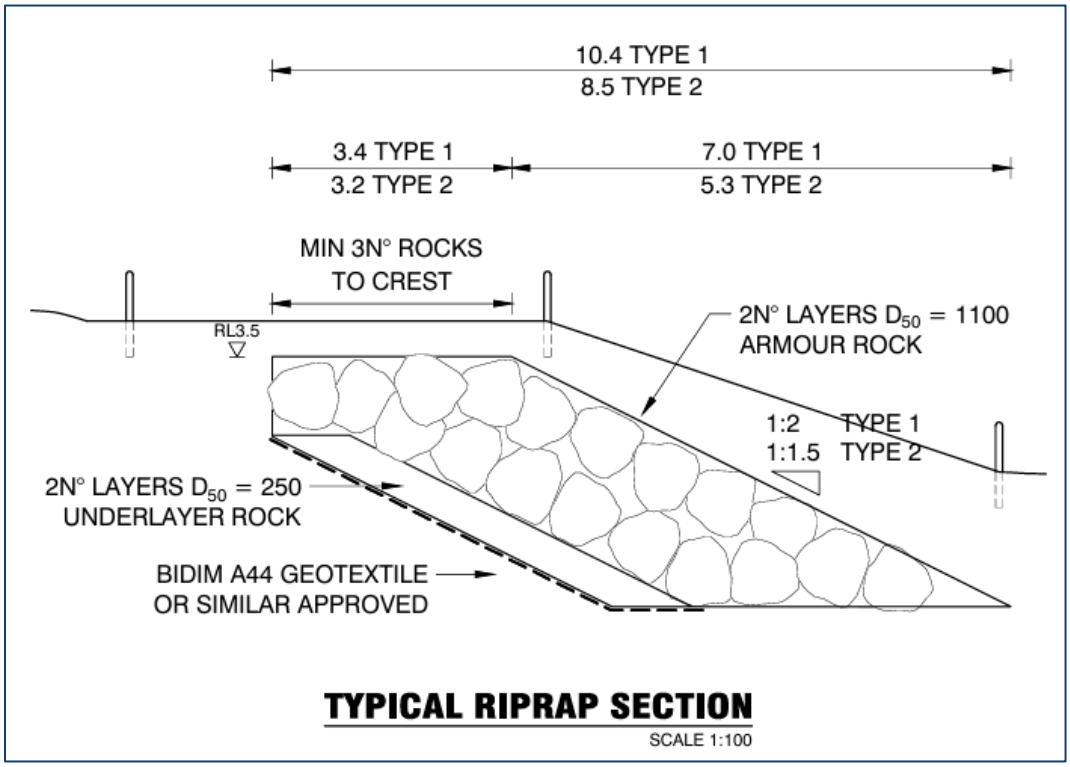

Figure 2: Typical rock revetment cross section provided in the design report.

Armour rock – Rock dimensions are appropriate given the design wave climate, however no rock testing information has been provided for the local quarry so there is an assumption that the rock is of a suitable density and complies with the statistical tolerances in the rock manual. It is recommended that testing is carried out prior to construction.

Underlayer rock – Rock size is appropriate for the size of the armour rock

Slope gradient – For the Type 1 wall a 2(H):1(V) slope is considered standard for structures on the open coast. The Type 2 structure has a 1.5(H):1(V) slope, with steeper slopes usually requiring larger rock. However, due to the increased setback of this wall being subject to a relatively smaller wave climate larger rock is not required. In addition the oblique orientation of the wall to the predominant wave direction reduces the required rock size.

Crest width – The crest meets the minimum requirement of 3 rocks wide ($3xD_{50}$).

Foundation level – Foundation depth is considered as deep as practical for a sand beach based on the site tide levels. We support the addition of additional rock to form a falling toe if beach levels drop low enough to risk undermining of the toe.

Geotextile – Armour rock is considered semi permeable for overtopping calculations, as drawn the geotextile only comes up to RL 2.0. The consequence of this is likely to be water flowing through the revetment crest when exposed and eroding the dune behind. It is recommended that the geotextile is raised to the crest level of the revetment. It is further recommended to extend the seaward extent of the geotextile to the structure toe.

4.4 Structure performance

Based on the information provided we have the following comments on the likely performance of the structure;

Northen end effects – Due to the landward setback of the wall termination no end effects are considered.

Southern end effects – Following construction no end effects are envisaged due to the structure being covered. Over time as the structure is exposed it is likely that a small eroded embayment will form to the south of the structure. Empirical formula can be used to approximate the width and depth of the eroded zone, which represents an equilibrium contour. No maintenance is likely to prove worthwhile as the beach contours would quickly realign back to the equilibrium position. Sediment eroded would not be lost from the wider beach system, and the eroded area would not represent a risk to any built assets.

Northern wall alignment – Due to the northern section of the revetment being aligned at an angle to the beach contours it is likely that once exposed wave run-up will be focused northwards along the revetment creating a small concave setback in the beach contours. No sediment is lost from the beach system and mitigation would be short lived unless the works buried the whole revetment.

Sediment impoundment – When the revetment is exposed it prevents erosion of the land behind the structure. This prevents sediment being eroded that would otherwise enter the beach system. Initially there will be no effect due to the revetment being buried, when it is partially exposed the effect is considered less than minor. Towards the end of the structures design life there will be a larger sediment deficit and the lowering of the profile will start to inhibit natural dune formation. However, given that the width of land between the property boundaries is relatively small, we consider the material excavated during construction and placed on the revetment and beach face to mitigate this deficit.

Wave reflection and scour – Rock revetments are porous structures with a sloping face that compared to vertical walls cause less wave reflection and scour that can erode sediment in front of the structure due to their ability to dissipate wave energy. They do however still have an effect, this will impede the ability for dunes to recover and rebuild following a storm event, albeit to a lesser extent than other hard structures. Provided there is enough sediment in the wider beach system, beach levels will recover in front of the structure following storm events, although potentially at a slower rate. This is evidenced by beach monitoring elsewhere in New Zealand where rock structures are exposed and subsequently recovered.

Undermining – The design report recognises that when the structure becomes mostly exposed there may be a risk of undermining of the toe causing the armour rock to sink. This is mostly likely to occur along the seaward section of the southern wall. The proposed mitigation of placing additional armour rock at the toe when beach levels are low is considered adequate mitigation.

Overtopping – No overtopping calculations are presented in the report, however given the revetment crest height is lower than the dune height it is likely that a combination of erosion of the beach profile, exposure of the structure and seal level rise will eventually result in significant overtopping flows that could erode the sediment behind the structure. This could potentially undermine the integrity of the structure. It may be prudent to add some compacted fill or underlayer rock behind the revetment at the time of construction to reduce the risk of erosion. We note that the design report does state that the revetment crest height may need to be raised in 40-50 years.

Flood Risk – Submissions on the application highlighted a perceived increase in flood risk as a consequence of the wall being constructed. While we acknowledge the present and future flooding risks around Three Mile Creek and the wider Waihi coastline, the view that the wall will increase flooding risks is unfounded. Should the dune system erode back to the position of the wall then this would have an equivalent effect in terms of funnelling or directing surging waves. The presence of the wall may have a minor positive effect in that it will reduce wave overtopping and the extent of overland flows compared to a natural dune system. In addition, due to the increased turbulence of the porous angular structure, there would be a localised reduction in water velocities next to the rock revetment.

5. Construction Methodology

Having reviewed the construction methodology we have no additional comments.

6. Summary and Conclusions

A review of the supplied documents was undertaken limited to the coastal process and engineering aspects of the application. In general the work undertaken was found to be comprehensive and to a standard that is appropriate for an application of this type. All available datasets, previous reporting and relevant literature was considered at the time of the application. We note that an update to the coastal erosion hazard risk was released in late 2024, however on review this does not fundamentally affect the conclusions of the report or the anticipated performance of the structure.

The review highlights some potential improvements to the rock revetment design to improve the performance of the structure and reduce the potential maintenance required. These do not fundamentally change the type, form or footprint of the structure and may be addressed at the detailed design stage.

Effects of the structure on the wider dune system following construction are only likely to occur if, or when, the structure is exposed. This is likely to happen in the short-term (0-10 years) at the southern end of the wall. The northern end of the wall is set back further landward and is unlikely to be exposed as a consequence of continued erosion of the wider coastline for many more years. However, the protection afforded to this area is contingent on the presence and continued maintenance of the Three Mile Creek training groyne. Removal or failure of this structure could result in erosion reaching the proposed revetment footprint in a much shorter timeframe.

It is anticipated that the effects of the wall on coastal processes will increase as more of the wall is exposed. These are however limited to end effects at the southern end of the wall which will result in a small eroded embayment south of the structure, and a small concave setback in the dune contours at the point where the dune intersects the angled section of the northern half of the wall. These are considered minor and will not adversely effect built assets or result in a loss of sediment to the beach system.

It is possible to increase the buffer and time it would take to expose the more seaward section of the wall by moving the seawall closer to the property boundaries. This short distance is not considered to make any difference to the engineering performance of the wall or standard of protection afforded. There are some benefits to both options, including access, defended natural dune widths and space for upgrading the wall in the future if a 5m boundary offset is used. Compared to the reduced chance and frequency of exposure of a structure set further back. Ultimately this is a decision for the applicants and consent authority.

Yours sincerely,

Jonathan Clarke
Principal Coastal Engineer