14 May 2021

WRL Ref: WRL2021004 JTC LR20210514

UNSW SYDNEY
Water Research Laboratory
School of Civil and Environmental Engineering

Bernard Koon
Senior Project Officer
Northern Beaches Council
PO Box 82
Manly NSW 1655

bernard.koon@northernbeaches.nsw.gov.au

Dear Bernard,

DRAFT Newport SLSC coastal hazard peer review

1. Introduction

The Water Research Laboratory (WRL) of the School of Civil and Environmental Engineering at UNSW Sydney is pleased to provide an expert peer review of the following document:

- Horton (2020a), "*Coastal Engineering Report and Statement of Environmental Effects for Buried Coastal Protection Works at Newport SLSC*", prepared by Horton Coastal Engineering Pty Ltd for Adriano Pupilli Architects, Issue 2 dated 16 November 2020.

As part of this review process, the following feeder documents were sourced and sighted, but not reviewed in detail:

- Horton (2018) *"Initial Coastal Engineering Advice on Newport SLSC Development",* prepared by Horton Coastal Engineering Pty Ltd for Adriano Pupilli Architects, dated 14 August 2018.

- Horton (2020b) *"Assessment of Options for Redevelopment of Newport SLSC, with Updated Consideration of Risk from Coastal Erosion/Recession",* prepared by Horton Coastal Engineering Pty Ltd (Horton) for Adriano Pupilli Architects, Issue A, dated 17 February 2020.

- Horton (2020c), *"Coastal Engineering and Flooding Advice for Newport SLSC Clubhouse Redevelopment",* prepared by Horton Coastal Engineering Pty Ltd (Horton) for Adriano Pupilli Architects, Issue 2, dated 9 November 2020.

The review has been undertaken by WRL's Principal Coastal Engineer James Carley. James has over 28 years' experience in coastal engineering, serves on Engineers Australia's NSW Coasts, Ocean and Port Engineering Panel (COPEP), and is chair of Engineers Australia's National Committee on Coastal and Ocean Engineering (NCCOE). James is familiar with the site and is a long term surfer and surf life saver.

2. Peer review summary

The Horton coastal engineering reports are generally of a high professional standard. Due to the uniqueness and non-standard nature of such studies, there will always be differences between the work of different practitioners.

A summary of the key design parameters adopted by Horton and WRL's concurrence or otherwise is provided in Table 1. More detailed review comments are provided in Section 3 and 4.

For the quantitative parameters derived in Horton, some values are accepted by WRL, some are more conservative while others are less conservative than would be adopted by WRL. The net effect is that the differences may balance out.

However, some parameters have not been quantified in Horton and have been deferred until detailed design. This may be normal practice, but in the case of Newport SLSC, the quantification may affect the overall viability or geometry of the project, so additional quantification is recommended.

While the decision to retain the existing clubhouse and add a new portion on the ocean front appears to have been made within the project planning process, the philosophy adopted at Freshwater Beach was to construct the new building landward of the old. If the present Newport clubhouse is to be protected to an engineering degree of certainty over 60 years, a seawall will be required.

There are numerous examples where seawalls have survived but infrastructure behind them has been damaged through wave overtopping. Examples of buildings which were damaged/destroyed behind undamaged seawalls occurred in the June 2016 storm include Dee Why (café), Fairy Bower (toilet block and cafe) and Coogee (SLSC clubhouse).

Illustrations of the application of recommendations in this letter (for other sites) are shown in Appendix A.

Table 1: Summary of WRL concurrence

Parameter	Value adopted by Horton	Concurrence or suggested alternative value from WRL	Comment and/or recommendation
Structure design life	60 years	Agree	
Design ARI	500 to 2000 year ARI suggested, but 100 year ARI used	500 ARI indicated	500 to 2000 year ARI suggested, but 100 year ARI used
Extreme water levels	100 year ARI of 1.44 m AHD	Agree but other ARIs needed	Derive other ARI water levels
Extreme offshore wave heights	Hs = 9.5 m for 1 hour Hs = 8.7 m for 6 hour	Agree with values, but these are for S to SE direction. Additional directions and transformation could be considered	Derive other ARI waves and directions, and consider wave transformation
Wave transformation to shore	South to south-east direction considered	Wave transformation modelling recommended and consideration of other directions	Wave transformation modelling is likely to reduce nearshore wave heights and wave setup
Sea level rise	0.44 m by 2080	Acceptable	The sea level rise adopted would be at the end of the design life, so provided a reasonable value is adopted, it is not critical
Recession due to sea level rise	Bruun Factor of 31 13.6 m recession by 2080	Bruun Factor accepted Recession by 2080 can be reduced by 1.9 to 3.8 m	Future recession can be discounted by sea level rise over historic monitoring period
Design scour level	-1 to -2 m AHD	Acceptable as initial estimate, but additional techniques are recommended	Additional techniques as outlined in Carley et al (2015) are recommended to be applied
Local wave height at structure	Plunge distance = 10 m No local wave height or wave setup stated	Agree with plunge distance. Local wave height and wave setup calculations required	Local wave height and wave setup calculations required
Wave forces	Addressed qualitatively only	Initial desktop assessment recommended, with physical model at some point in the design process	This would often be deferred until detailed design, but in this case it may affect the viability of the project
Wave runup and overtopping	Addressed predominantly qualitatively	Additional quantitative techniques should be applied – initially desktop, and later physical modelling	The present design geometry may be too low to act as a wave return wall – additional calculations are recommended
Seawall end effect	No long term impacts, but addressed qualitatively only	Agree with no long term impacts, but short term impacts need to be assessed	Apply a quantitative technique for short term impacts

3. Detailed review of Horton (2020a), "*Coastal Engineering Report and Statement of Environmental Effects for Buried Coastal Protection Works at Newport SLSC*"

Horton (2020a), Section 1, Page 1, Paragraph 4

Given the age of the present clubhouse, advice from a structural engineer and/or piling expert should be sought regarding the feasibility and risk of piling near and installing ground anchors beneath the building.

Horton (2020a), Section 2, Page 3, Paragraph 3

WRL concurs that the existing rock revetment would provide a degree of protection to the existing clubhouse, but this would not be to a certifiable level of engineering certainty over a 60 year design life.

Horton (2020a), Section 2, Page 3, Paragraph 4

The analysis of long term change, which found that there is not a detectable trend is accepted by WRL. We note that during the analysis period of long term change (1941 or 1951 to 2018), mean sea level for Sydney has increased by 1 to 2 mm per year (Watson, 2020). Figure 5 of Watson (2020) is reproduced as Figure 1 in this WRL letter.

That is, Newport Beach has been broadly stable with sea level rise of 1 to 2 mm per year, therefore the predicted future response (recession) to sea level rise could be discounted by the quantum of sea level rise which occurred but produced no recession. Neither the Horton reports nor this WRL review are a detailed processes study, but an onshore or alongshore feed of sand has been postulated at other locations, noting that sea level rise may outpace this feed in the future.

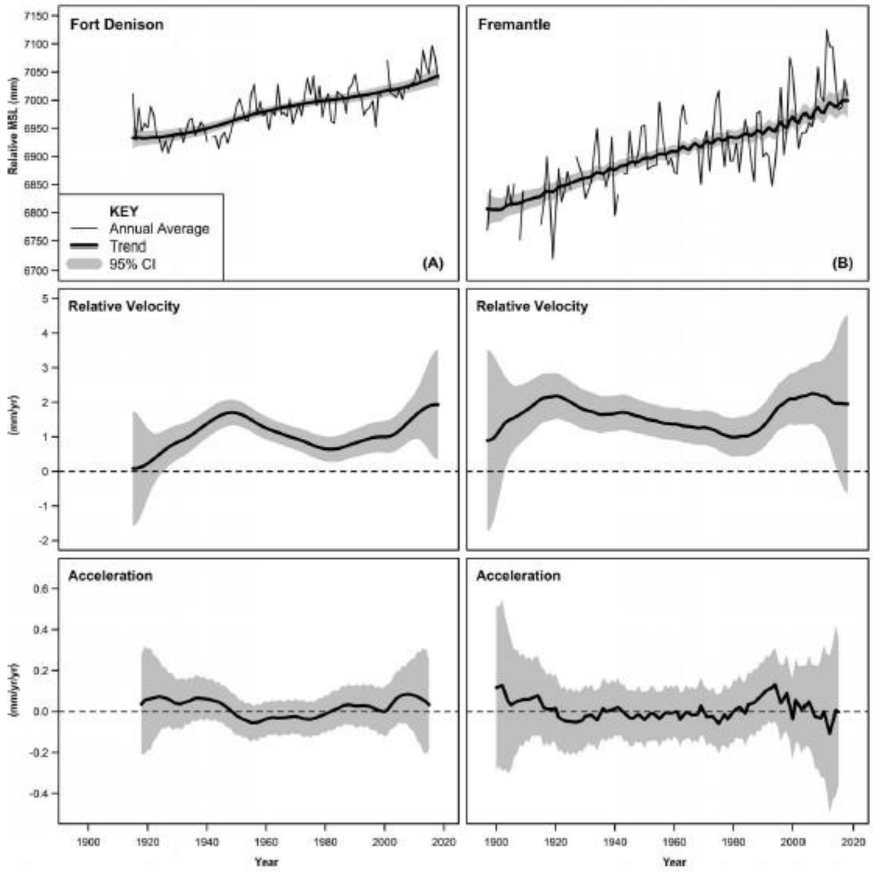


Figure 5. "Relative" mean sea level (trend), velocity, and acceleration for Fort Denison and Fremantle. The scales associated with each of the three panel charts for the respective tide gauge records are equivalent for direct comparison between records. "Relative" mean sea level (top panels) is based on revised local reference datum (PSMSL, 2019) with +200 mm offset applied to Fremantle to align graphic with the Fort Denison panel. See Figure 1 and Table 1 for station details.

Figure 1: Observed sea level rise at Fort Denison (Watson, 2020)

Horton (2020a), Section 3, Page 4, Paragraph 7 and Figure 1; and Section 3, Page 7, Paragraphs 1 and 2

Whether the proposed protection works extend to protect the Norfolk Island pine trees at each end of the clubhouse is a decision beyond coastal engineering. While the cost of this is somewhat addressed, the potential additional seawall end effect of this should be presented. The installation of ground anchors in the vicinity of the trees also needs consideration.

Horton (2020a), Section 3, Page 7, Paragraph 6

The impracticality of disabled beach access at this location is accepted by WRL, but additional reconciliation is required between the stair gradient and a safe gradient for a ramp.

Horton (2020a), Section 3, Page 8, Paragraph 1

This paragraph refers to a separate Horton report regarding the risk of inundation damage. This component is reviewed separately below in this WRL letter.

Horton (2020a), Section 4, Page 9, Paragraph 6

WRL concurs that if the present clubhouse is to be retained for approximately 60 years, some form of seawall is required to provide an engineering level of certainty to the clubhouse. It should be noted that the seawall would protect the existing clubhouse from erosion and undermining, however, may not protect the clubhouse from wave overtopping damage. It should also be realised that this protection afforded may only be for up to a certain quantum of sea level rise over the design life, beyond which protection of the club house may no longer be feasible.

Horton (2020a), Section 5.1 and 5.2, Page 11
The design life stated is accepted by WRL, noting that the standards quoted are more within the expertise of structural engineering.

Horton (2020a), Section 5.3, Page 12, Paragraph 2
The lowest profile recorded in the photogrammetry from 1941 to 2020 was 1974. Horton notes that this elevation "would have been limited by the emergency placement of rock boulders at that time".

From the NSW beach profile database (http://www.nswbpd.wrl.unsw.edu.au/photogrammetry/nsw/) and Foster et al (1975), the following information is added by WRL:

- A level of 3.74 m AHD was measured just seaward of the clubhouse on 19 June 1974
- There is ample evidence of the construction of an ad hoc rock revetment and beach scraping following the 1974 storms
- From the test pit data, the rock revetment is indicated to be founded at 2.5 m AHD or lower
- The May 1974 storm extended from about 25 to 28 May 1974, with peaks on 25 and 26 May 1974
- The June 1974 storm extended from about 3 to 15 June 1974, with a peak on 13 June 1974

Given the above dates, revetment construction and beach scraping, it is almost certain that the sand level fronting the clubhouse at some time in May or June 1974 was lower than 3.74 m AHD, and possibly lower than 2.5 m AHD, but the actual minimum level is unknown.

Foster et al also documented the following damage at Newport:

> *"Severe erosion along northern end of beach. Waves lapped foundation of club house, boatshed 50 per cent destroyed, pavement washed away. Homes at southern end threatened and pines lost. Dunes overtopped causing back flooding. Some rock protection placed after storms offshore sand bed completely removed exposing extensive areas of old lagoon deposits and erosion of clay beds is still occurring. Swimming club house at rock pool completely demolished."*

Horton (2020a), Section 5.4, Page 13
The adopted "Bruun Factor" of 31 and its derivation is accepted.

The sea level rise of 0.44 m by 2080 is within the plausible range. As this is at the end of the initial design life, excessive rumination regarding the actual design sea level rise is unwarranted.

The estimated sea level rise recession of 13.6 m by 2080 may be an overestimate. This is because the lack of underlying recession over the monitoring period, despite 1 to 2 mm per year of sea level rise, has not been considered. Discounting for the sea level rise that has already occurred (and resulted in no recession) would reduce the recession by 1.9 to 3.8 m.

Horton (2020a), Section 5.7, Page 16
The probability (500 to 2000 year ARI) values canvassed and adopted are accepted by WRL, but there is little evidence of the adopted value being used in design, apart from a design scour level

being described as “barely credible” and equated to 2000 year ARI. However, we note that the adopted value is reasonably plausible. Most design parameters within Horton (2020a) have been considered at 100 year ARI.

Horton (2020a), Section 5.8.3, Page 16 and 17
While there are many opinions and scenarios for sea level rise, the value of 0.44 m by 2080 within the plausible range.

Horton (2020a), Section 5.8.4 and 5.8.5, Page 17
The calculations regarding design water level and plunge distance are accepted.

The water levels adopted by Horton are 100 year ARI, versus longer ARIs required by some design standards.

The adoption of an eroded bed level of -1 m AHD for calculating the plunge length (with a deeper scour hole fronting the wall) matches some field observations of WRL engineers, but has limited precedent and has not attached a probability to the level.

Horton (2020a), Section 5.8.6, Page 17
There are no explicit design standards relating to the use of either 1 hour or 6 hour duration wave heights. Different practitioners favour either option. The difference in wave height between 1 hour and 6 hour durations may be important for offshore structures, but for structures well inside the surf zone, the offshore height only influences the nearshore wave setup (see below).

The wave heights adopted by Horton are 100 year ARI, versus longer ARIs required by some design standards.

The wave heights quoted by Horton are offshore deep water waves from a south to south-east direction. They are derived from credible studies. No attempt has been made by Horton to consider refraction of these waves into Newport which will reduce the height of south to south-east waves, or alternatively consider smaller design wavers from the east. However, as above, for structures well inside the surf zone, the offshore height only influences the nearshore wave setup.

Horton (2020a), Section 5.8.7, Page 18
Horton lists credible methods for estimating the design wave height at the structure and highlights the potential for large forces. However, the application of these has been deferred until detailed design.

It is accepted by WRL that some parameters are best calculated after approval and within detailed design, however, we recommend that some initial desktop estimates and opinions be developed, as these could affect the feasibility of the project.

Furthermore, we recommend that estimates of wave overtopping and wave forces on the clubhouse be undertaken, as a scenario could arise such that the seawall prevents the clubhouse being undermined, but the building is damaged or destroyed through wave overtopping. Examples of buildings which were damaged/destroyed behind undamaged seawalls occurred in the June 2016 storm include Dee Why (café), Fairy Bower (toilet block and cafe) and Coogee (SLSC clubhouse).

These overtopping calculations may also result in design changes to the wall crest and/or steps.

Horton (2020a), Section 6.1, 6.2, 6.3, Page 19
These are planning matters outside of WRL's expertise.

Horton (2020a), Section 6.4, Page 19, 20
It is noted in Horton that the PWD (1985) "Coastal Management Strategy, Warringah Shire" was to consider relocating the clubhouse further landward. WRL notes that this strategy was adopted at Freshwater Beach.

As stated elsewhere in this WRL letter, we concur that if the existing clubhouse is to be retained for up to 60 years with an engineering degree of certainty, a seawall engineered to contemporary standards is required.

Horton (2020a), Section 6.6.2 Item (a), Page 21
WRL accepts that the works are likely to have minor end effects due to the substantial sand buffer fronting them. Based on the Carley et al (2013) work cited by Horton, comparable sites such as Curl Curl and Cronulla indicate that there will be no long term end effect, but this does not preclude short term end effect erosion. Nevertheless, an attempt should be made to convey this and identify any unprotected assets affected. Methods to estimate end effects are provided in Horton but not applied.

Horton (2020a), Section 6.7 to 6.10, Page 22 to 29
These sections are primarily policy and/or interpretation of legislation, so have not been reviewed by WRL.

4. Horton (2020c), *"Coastal Engineering and Flooding Advice for Newport SLSC Clubhouse Redevelopment"*

Most coastal engineering components of Horton (2020c) are reproduced in Horton (2020a).

Horton (2020c), Section 6
This provides a good discussion of measures to reduce the risk of inundation damage, but is predominantly qualitative. A generic wave runup level (7.2 m AHD) is cited, but there is little other quantification. Additional techniques, ranging from initial desktop estimates to physical modelling are recommended to be utilised, as this may affect the viability of the project.

5. Other comments relating to coastal engineering matters noted in public submissions

Detailed comments on all public submissions are beyond the scope of this WRL review. Brief responses to themes in the submissions relating to coastal engineering matters which were not addressed in the Horton reports are provided below.

Theme: The seawall will cause erosion
One of the world's most eminent coastal engineers, Professor Bob Dean, noted that: "seawalls don't cause erosion, erosion causes seawalls".

For beaches experiencing high rates of recession, a common response was to construct a seawall. This could lead to no beach being present seaward of the wall. However, there is no identified recession trend at Newport, with the seawall only being required to resist erosion in extreme storm events, with the beach recovering after these events.

A rock rubble seawall has existed on the Newport site since 1974. Seawalls coexist with many iconic beaches, including Noosa, most Gold Coast beaches, Manly and Bondi.

Theme: The seawall works will adversely impact the surrounding surf breaks
Large breakwater or groyne structures may alter surfing conditions, however, the proposal at Newport is for a seawall at the back of the beach. The seawall works will only be impacted by waves on rare occasions with the coincidence of an eroded beach, high tides and large waves. There are scores of examples surf breaks (ranging from world class to locally significant) that coexist with seawalls. Some of these are deemed suitable for international surf contests such as the Gold Coast, Merewether and Manly.

Theme: Newport Reef protects the clubhouse from large waves
Commentary is made by WRL above that more comprehensive wave modelling could be undertaken to account for protection from the south. However, this would have only a minor impact on nearshore wave heights due to its impact on wave setup.

6. Conclusions

A summary is provided at the start of this letter. Please contact James Carley on +61414385053 should you require further information.

Yours sincerely,

Grantley Smith
Director, Industry Research

7. References

Foster, D., Gordon, A.D. and Lawson, N.V. (1975), "The Storms of May-June 1974", Proceedings of the 2nd Australian Conference on Coastal and Ocean Engineering, The Institution of Engineers Australia.

Watson, P.J. (2020), Updated Mean Sea-Level Analysis: Australia. *Journal of Coastal Research*, 36(5), pp.915-931.

8. APPENDIX A: Examples of studies recommended

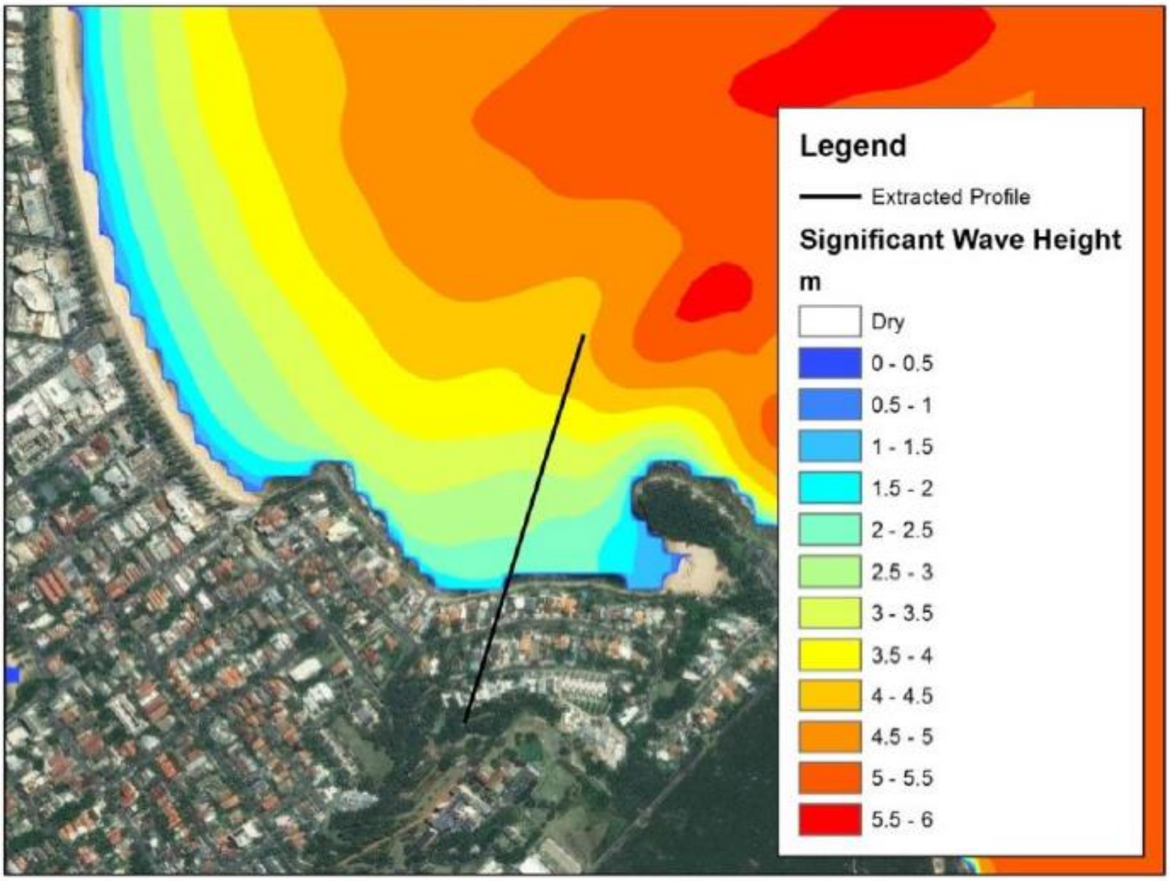


Figure 2: Example of wave transformation modelling

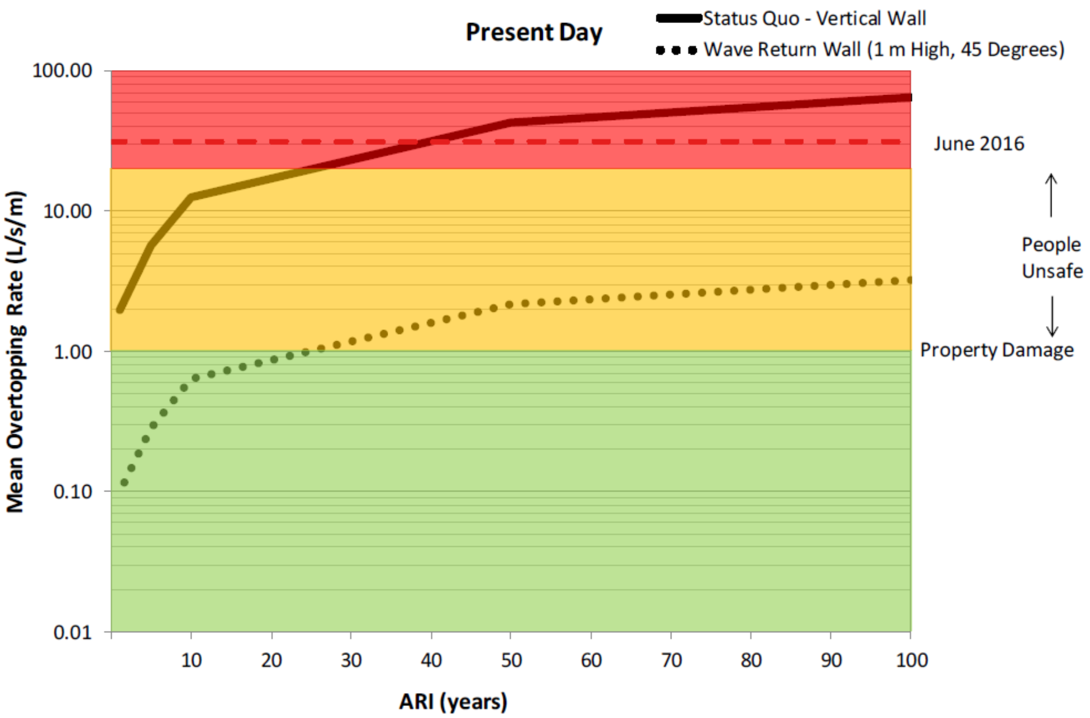


Figure 3: Example of wave overtopping and reduction due to wave return wall

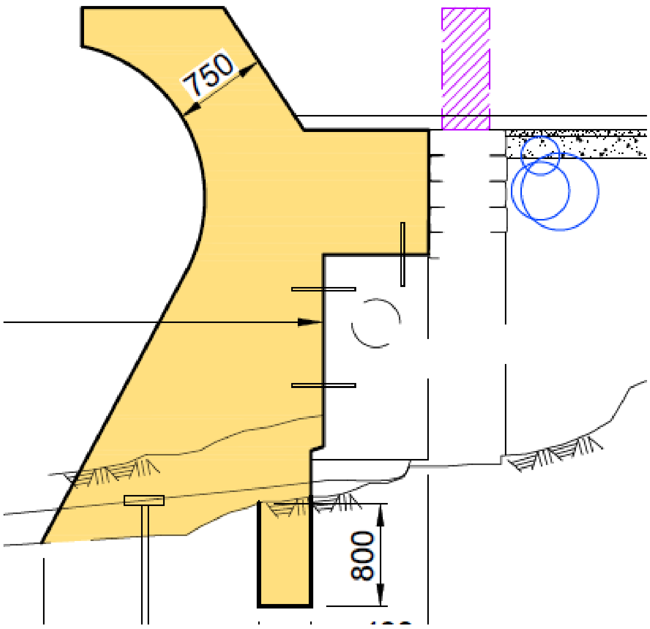


Figure 4: Example of wave return wall required to reduce wave overtopping to acceptable levels

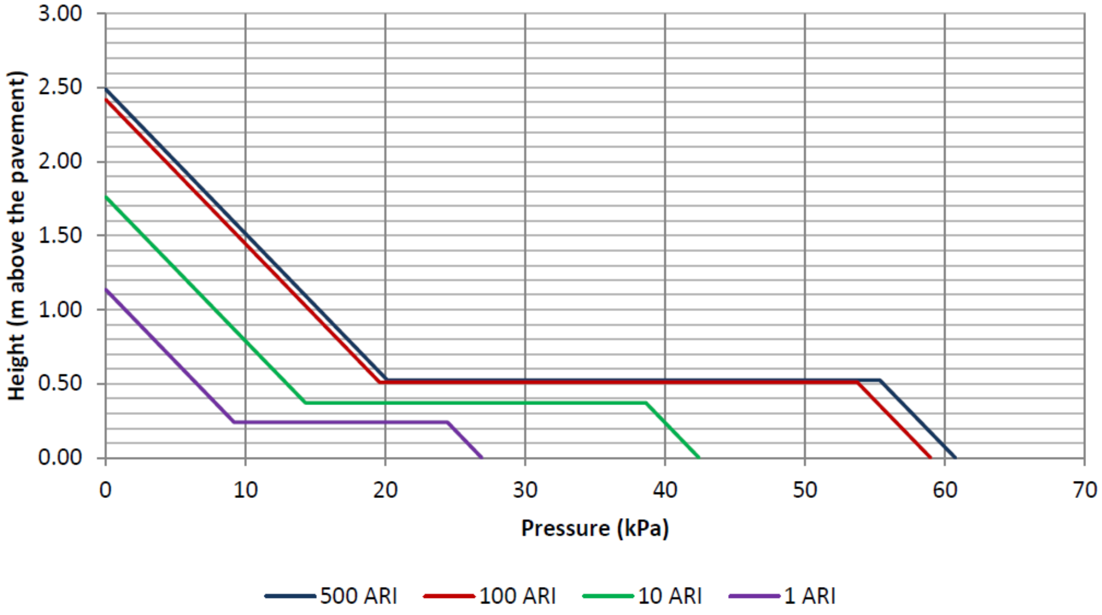
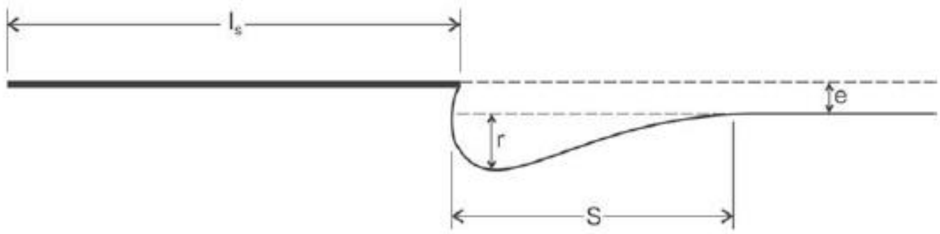


Figure 5: Example of calculated wave forces on building behind seawall



(Source: McDougal et al, 1987)

Gold Coast, 1967 (Source: Delft, 1970)

Figure 6: Example of seawall end effect and calculation method

Figure 7: Example of calculated seawall end effect (red line is erosion extent without seawall)

Figure 8: Example of physical model examining wave forces on a building