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Coastal & Water Consulting

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10 January 2022

Coastal Engineering Advice on 73 Marine Parade Avalon

1. INTRODUCTION AND BACKGROUND

It is proposed to demolish the existing dwelling and to construct a new dwelling and pool at 73 Marine Parade Avalon, for which a Development Application is to be submitted to Northern Beaches Council.

The property is located within a "Bluff/Cliff Instability" area designated on the *Coastal Risk Planning Map* (Sheet CHZ_016) that is referenced in *Pittwater Local Environmental Plan 2014*. Therefore, the property is subject to Chapter B3.4 of the *Pittwater 21 Development Control Plan* (DCP)[1], and the *Geotechnical Risk Management Policy for Development in Pittwater*. Based on Chapter 6.5(i) of this policy, "a coastal engineer's report on the impact of coastal processes on the site and the coastal forces prevailing on the bluff must be incorporated into the geotechnical assessment as an appendix and the Coastal Engineer's assessment must be addressed through the Geotechnical Report and structural specification". Accordingly, this coastal engineering report is set out herein.

The report author, Peter Horton [BE (Hons 1) MEngSc MIEAust CPEng NER], is a professional Coastal Engineer with 29 years of coastal engineering experience. He has postgraduate qualifications in coastal engineering, and is a Member of Engineers Australia and Chartered Professional Engineer (CPEng) registered on the National Engineering Register. He is also a member of the National Committee on Coastal and Ocean Engineering (NCCOE) and NSW Coastal, Ocean and Port Engineering Panel (COPEP) of Engineers Australia. Peter has prepared coastal engineering reports for numerous cliff/bluff properties along the former Pittwater Council coastline in recent years, including several along Marine Parade. He undertook a specific site inspection of the subject property on 7 April 2018, including inspection of the cliff face and rock platform on the seaward side of the property, and has inspected the area in the vicinity of the property occasionally over the last 15 years. He has also reviewed vertical and oblique aerial photography of the property for numerous dates since the site inspection, the most recent image being captured on 4 October 2021.

Note that all levels given herein are to Australian Height Datum (AHD). Zero metres AHD is approximately equal to mean sea level at present. Completed Form No. 1 as given in the *Geotechnical Risk Management Policy for Pittwater* is attached at the end of the document herein.

[1] The Pittwater 21 DCP up to Amendment No. 27, which came into effect on 18 January 2021, was considered herein.

2. INFORMATION PROVIDED

Horton Coastal Engineering was provided with a total of 9 Gartner Travato Architects drawings, namely Drawing Nos. A-00 to 08 (all Revision A and dated 22 December 2021). A site survey completed by Stutchbury Jaques Pty Ltd was also provided, Reference 5108/03 and dated 14 May 2021.

3. EXISTING SITE DESCRIPTION

The subject property is located along a rocky cliff section of coastline that extends from North Avalon (Avalon Beach) to Whale Beach, including Bangalley Head and Careel Head, with broad and zoomed aerial views in Figure 1 and Figure 2 respectively[2]. An oblique aerial view is provided in Figure 3. Photographs of the cliff face at the property from the rock platform at the base of the cliff are provided in Figure 4 and Figure 5.

Based on the site survey, and Airborne Laser Scanning (ALS) data held by Horton Coastal Engineering that was collected in 2007, ground elevations at and adjacent to the subject property approximately vary as follows:

- 33m AHD at Marine Parade;
- 35m AHD at the landward property boundary;
- 39m AHD at the landward edge of the existing dwelling;
- 42m AHD at the seaward edge of the existing dwelling;
- 50m AHD at the seaward fenceline (near the top of cliff);
- 1.9m AHD at the toe of the cliff (top of rock platform), with boulders at the toe of the cliff (where present) extending up to about 3m AHD;
- 1.2m to 1.7m AHD at the seaward property boundary; and
- 0m AHD at the visible subaerial seaward extent of the rock platform in Figure 1 and Figure 2.

A cross-section through the property, derived from the ALS data, is depicted in Figure 6. This section was positioned along the southern property boundary, south of the extent of boulders on the rock platform at the toe of the cliff.

From Figure 6, it is evident that the overall average slope angle between the cliff top (at 50.1m AHD) and cliff toe (at 1.7m AHD) is about 64°. The average slope angle of the upper portion (above about 37m AHD) is about 55°, with a steeper slope angle of about 75° between 37m AHD and 5.8m AHD, and flatter slope angle of about 36° between 5.8m AHD and the cliff toe at 1.7m AHD. The near-horizontal rock platform extends about 8m further at a level of about 1.7m to 1.9m AHD, before stepping down to around 0m AHD over a further distance of about 13m.

Offshore of the rock platform, bed elevations reduce to about -13m AHD around 120m offshore (based on the Seabed Information Chart *Broken Bay 82310-575* prepared by the Public Works Department in 1989), representing an offshore slope of about 1:9 (vertical:horizontal).

[2] Note that the property boundary depicted in Figure 1 and Figure 2 is not survey accurate.

Figure 1: Broad aerial view of subject property on 6 April 2016

Figure 2: Zoomed aerial view of subject property on 6 April 2016

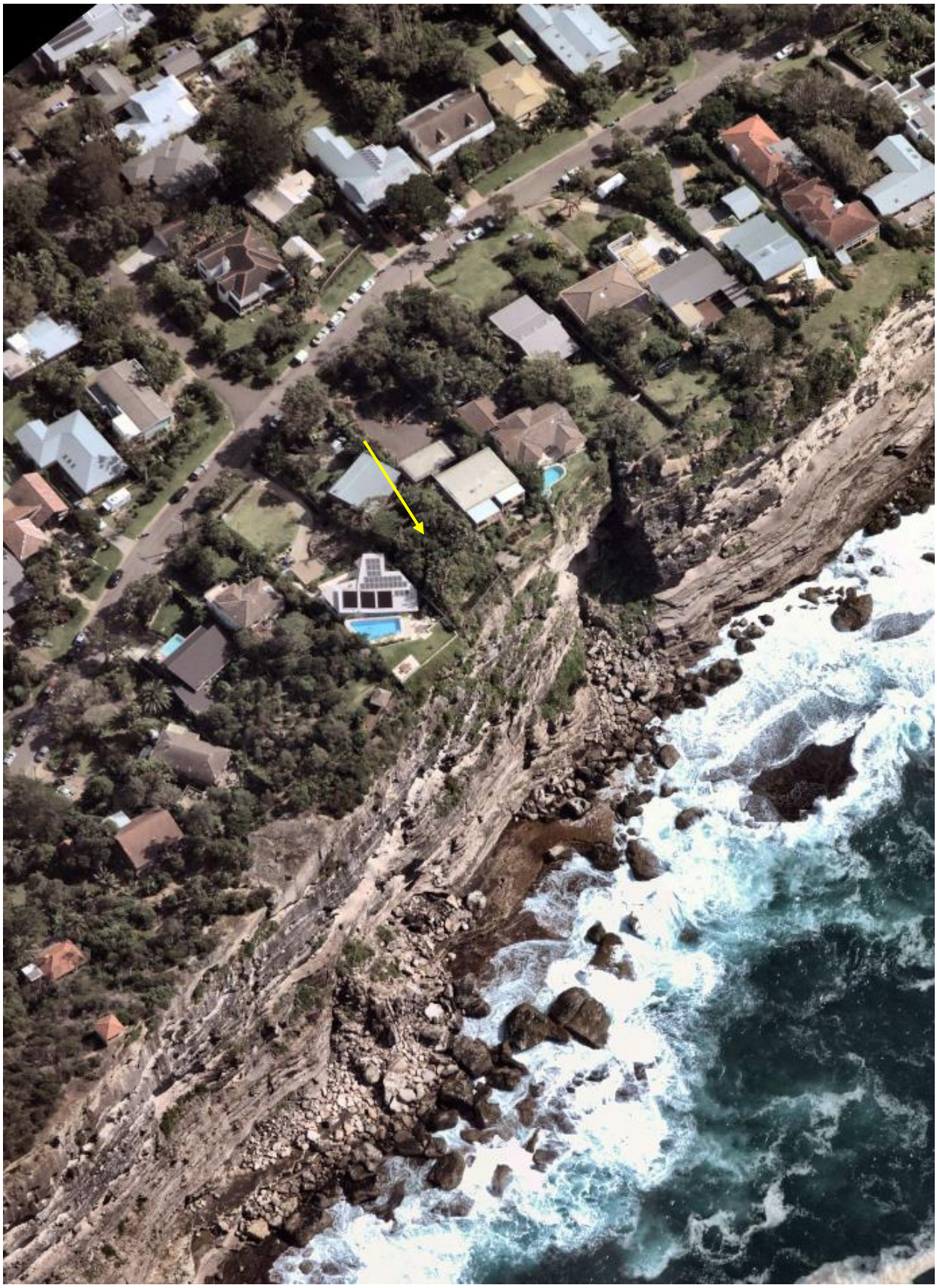


Figure 3: Oblique aerial view of subject property (at arrow), looking NW, on 13 April 2020

Figure 4: View of cliff face and rock platform at subject property on 7 April 2018, looking NW, with approximate lot boundary depicted, and St Michaels Cave visible in background at "A"

Figure 5: View of cliff face and rock platform at subject property on 7 April 2018, looking SW, with approximate lot boundary depicted

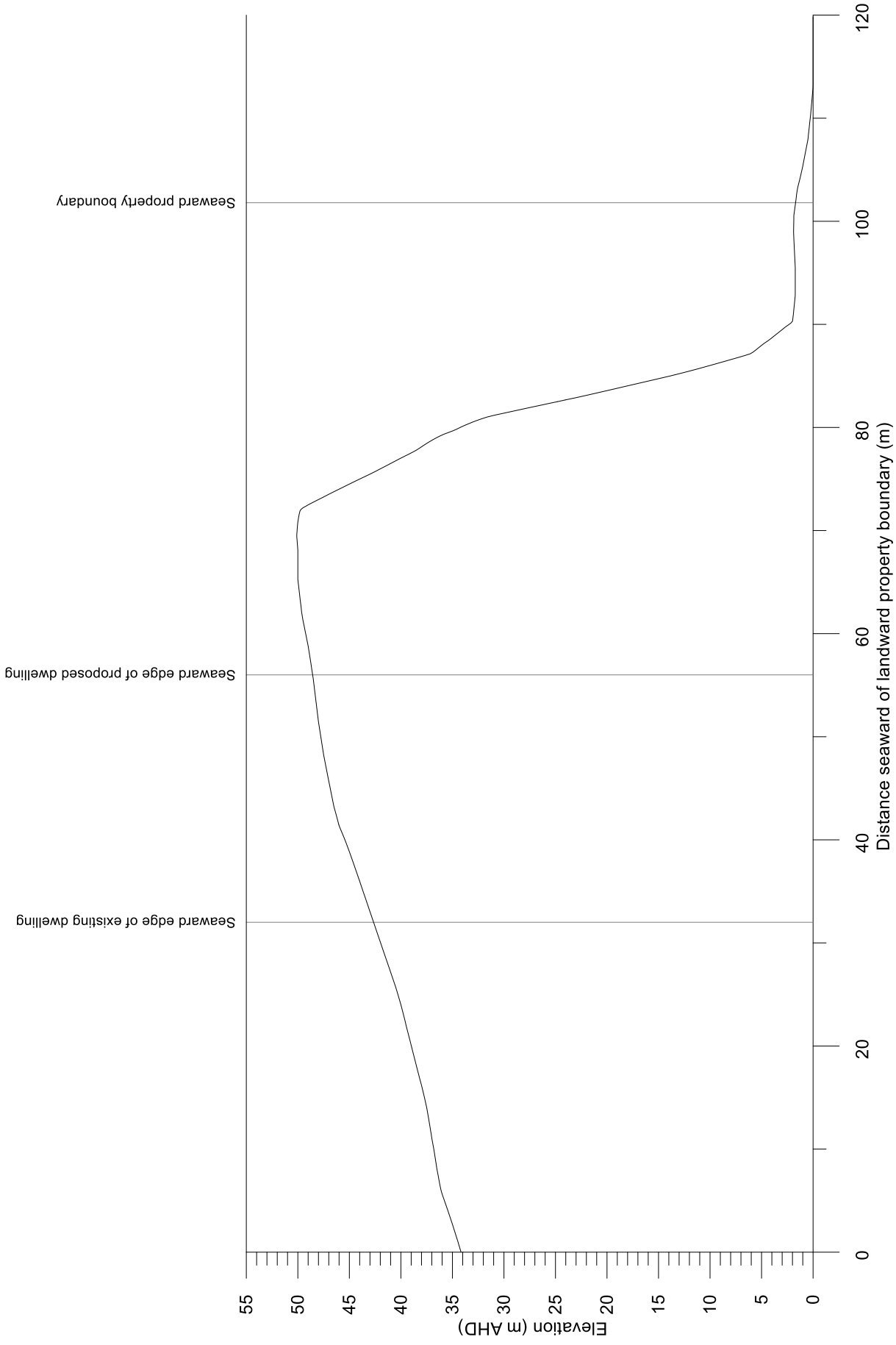


Figure 6: Cross-section through subject property

Coffey & Partners (1987) noted that the cliff profiles in the vicinity of the subject property (from Avalon Beach to Careel Head) were composed of massive sandstone and interbedded siltstone/sandstone beds with slope angles of about 80°. Undercutting in the sandstone units was found to have produced local overhangs and slope angles as low as 45° in the interbedded units. Cliff formation was seen to be primarily controlled by jointing, with undercutting in the less resistant interlaminated beds and toppling of large blocks of sandstone which line the cliff base.

St Michaels Cave, evident in Figure 2, Figure 3 and Figure 4, was described by Coffey & Partners (1987) as having formed from weathering of a vertical dolerite dyke and along a horizontal siltstone bed below the present cave floor level. At that time, the cave extended about 110m into the cliff face, with a height of up to 15m and width of up to 10m. It is understood that rocks regularly fall from the roof of the cave (Morcombe, 2017). It does not appear that the cave has affected cliff stability at the subject property, but this is a matter for the geotechnical engineer to assess.

4. PROPOSED DEVELOPMENT

It is proposed to demolish the existing dwelling and to construct a new dwelling and pool at the subject property. The lowest floor level proposed, at the garage and entry level, is 40.0m AHD.

5. MECHANISMS FOR CLIFF RECESSION

5.1 Preamble

Erosion/recession of sheer cliffs can occur in two forms (Public Works Department, 1985), either:

- a slow, relatively gradual attrition of cliff material due to the effects of weathering; or
- relatively infrequent but sudden collapse of large portions of cliff face, due to undercutting, wave impact forces, changed groundwater conditions, rock shattering or increased loadings related to construction, and other processes.

Weathering may induce undercutting and toppling failure of overhanging blocks if the rate of weathering is highest near the base of the cliff or at other levels below the top of the cliff. Erosion/recession of steep slopes tends to occur suddenly in association with heavy rainfall or changes to drainage patterns, slope undercutting, and increases of load on the slope.

5.2 Weathering and Erosion

Both chemical and mechanical weathering can reduce the strength of cliff material (Sunamura, 1983). Chemical weathering includes hydration and solution, caused by the interaction between cliff material and sea water. Mechanical weathering comprises:

- the wetting and drying process in the intertidal zone;
- generation of repeated stresses in cliff material by periodic wave action (particularly waves that break on the cliff); and
- frost effects in cold latitudes.

The base of the cliff seaward of the subject property, at a level of about 1.7m AHD, is above the intertidal zone (above 1m AHD). However, the base of the cliff would be impacted by wave runup at most high tides, particularly towards the southern end of the property where rock

boulders are not present to dissipate the wave runup. This wave runup could extend up to levels of about 8m AHD at present in a 100 year Average Recurrence Interval (ARI) storm, increasing to around 9m AHD in 100 years if projected sea level rise is realised.

Given this, it should be assumed that both chemical and mechanical weathering would apply at this site. A weathering rate (in the absence of waves), based on chemical weathering rates in coastal environments, of about 2mm per year is considered to be appropriate. An additional allowance of 5mm per year of wave-induced recession/weathering is considered to be reasonable (that is, a total allowance of 7mm per year).

This is consistent with, and at the upper end of historical rates of recession for softer beds of Sydney coastline sandstone cliffs, which include chemical weathering, of 2mm to 5mm per year determined by Dragovich (2000). It is also consistent with average rates of recession for Sydney Northern Beaches coastline sandstone cliffs of 4mm per year determined by Crozier and Braybrooke (1992). An approximate 40m of cliff recession (observed in aerial photography from the seaward edge of the rock platform) at the subject property over the last 6,400 years (since sea levels stabilised around their present levels) represents an average rate of 6mm/year, consistent with these values.

Therefore, an allowance for recession/weathering of the cliff base (up to 9m AHD) of 7mm per year is considered to be reasonable, but for planning purposes could be applied over the entire cliff face. This rate is considered to be reasonable to apply over a design life of 100 years, including allowance for projected sea level rise. Sensitivity testing could be undertaken applying the maximum rates of recession for Sydney Northern Beaches coastline sandstone cliffs of 12mm per year as determined by Crozier and Braybrooke (1992).

Therefore, an allowance for recession/weathering of the cliff face of about 7mm to 12mm per year should be considered and assessed by the geotechnical engineer. The geotechnical engineer should consider these estimated rates in conjunction with an understanding of the particular nature of the cliff materials east of the subject property, their resistance to erosion, and potential failure planes related to geotechnical issues such as the joint spacing[3]. The geotechnical engineer should also specifically consider the effect of the dyke at St Michaels Cave and surrounding cavity formation in their stability assessment.

This should be confirmed by the geotechnical engineer, but it is expected that the erosion/weathering described above would lead to undercutting and collapse of blocks on the cliff face over the long term, with failure planes at the joints.

6. COASTAL INUNDATION

With development located landward of a cliff escarpment level of 50.1m AHD, and with a minimum floor level of 40.0m AHD, coastal inundation is not a significant risk for the proposed development over a planning period of well over 100 years.

[3] Coffey & Partners (1987) noted that the controlling feature of interbedded sandstone/siltstone cliffs (as per east of the subject property) was the bedding spacing and relative proportion of sandstone/siltstone.

7. MERIT ASSESSMENT

7.1 Preamble

The merit assessment herein has been undertaken assuming that the geotechnical engineer will find that the proposed development is at an acceptably low risk of damage from coastal erosion/recession of the cliff seaward of the property for a design life of at least 100 years.

7.2 *State Environmental Planning Policy (Coastal Management) 2018*

7.2.1 Preamble

Based on *State Environmental Planning Policy (Coastal Management) 2018* (SEPP Coastal) and its associated mapping, most of the subject property is within a "coastal environment area", and entirely within a "coastal use area".

7.2.2 Clause 13

Based on Clause 13(1) of SEPP Coastal, "development consent must not be granted to development on land that is within the coastal environment area unless the consent authority has considered whether the proposed development is likely to cause an adverse impact on the following:

(a) the integrity and resilience of the biophysical, hydrological (surface and groundwater) and ecological environment,
(b) coastal environmental values and natural coastal processes,
(c) the water quality of the marine estate (within the meaning of the *Marine Estate Management Act 2014*), in particular, the cumulative impacts of the proposed development on any of the sensitive coastal lakes identified in Schedule 1,
(d) marine vegetation, native vegetation and fauna and their habitats, undeveloped headlands and rock platforms,
(e) existing public open space and safe access to and along the foreshore, beach, headland or rock platform for members of the public, including persons with a disability,
(f) Aboriginal cultural heritage, practices and places,
(g) the use of the surf zone".

This is not a coastal engineering matter, but it can be noted that with regard to (a), the proposed development would not be expected to adversely affect the biophysical, hydrological (surface and groundwater) and ecological environments, being in an existing developed area and having standard residential stormwater infrastructure such as rainwater tanks.

With regard to (b), the proposed development would not be expected to adversely affect coastal environmental values or natural coastal processes over an acceptably long design life, as it would be founded on a cliff well above wave action for an acceptably rare storm.

With regard to (c), the proposed development would not be expected to adversely impact on water quality, with the residential land use, as long as appropriate construction environmental controls are applied. No sensitive coastal lakes are located in the vicinity of the proposed development.

With regard to (d), the proposed development would not impact marine vegetation, undeveloped headlands and rock platforms, with none of these items in proximity to the

development (being on an already developed headland, and being well above and landward of the adjacent rock platform for an acceptably rare storm and acceptably long life). No significant impacts on marine fauna and flora would be expected as a result of the proposed development, as the development would not interact with subaqueous areas for an acceptably rare storm and acceptably long life. Assuming that there are no species of native vegetation and fauna and their habitats of significance that would be impacted at the property, (d) is satisfied.

With regard to (e), it can be noted that the proposed development is entirely within the subject property boundary and will not alter existing public access arrangements outside of the property (that stated, the rock platform seaward of the property is not typically accessed by the public).

With regard to (f), a search of the Heritage NSW "Aboriginal Heritage Information Management System" (AHIMS) was undertaken on 10 January 2022. This resulted in no Aboriginal sites nor Aboriginal places being recorded or declared within at least 50m of the subject property.

With regard to (g), the proposed development would not interact with the surf zone for an acceptably rare storm occurring over an acceptably long life, so would not impact on use of the surf zone.

Based on Clause 13(2) of SEPP Coastal, "development consent must not be granted to development on land to which this clause applies unless the consent authority is satisfied that:

(a) the development is designed, sited and will be managed to avoid an adverse impact referred to in subclause (1), or
(b) if that impact cannot be reasonably avoided—the development is designed, sited and will be managed to minimise that impact, or
(c) if that impact cannot be minimised—the development will be managed to mitigate that impact".

The proposed development has been designed and sited to avoid any potential adverse impacts referred to in Clause 13(1).

7.2.3 Clause 14

Based on Clause 14(1) of SEPP Coastal, "development consent must not be granted to development on land that is within the coastal use area unless the consent authority:

(a) has considered whether the proposed development is likely to cause an adverse impact on the following:
    (i) existing, safe access to and along the foreshore, beach, headland or rock platform for members of the public, including persons with a disability,
    (ii) overshadowing, wind funnelling and the loss of views from public places to foreshores,
    (iii) the visual amenity and scenic qualities of the coast, including coastal headlands,
    (iv) Aboriginal cultural heritage, practices and places,
    (v) cultural and built environment heritage, and
(b) is satisfied that:
    (i) the development is designed, sited and will be managed to avoid an adverse impact referred to in paragraph (a), or

(ii) if that impact cannot be reasonably avoided—the development is designed, sited and will be managed to minimise that impact, or
(iii) if that impact cannot be minimised—the development will be managed to mitigate that impact, and
(c) has taken into account the surrounding coastal and built environment, and the bulk, scale and size of the proposed development".

With regard to Clause (a)(i), the proposed development is entirely on private property and will not affect public foreshore, beach, headland or rock platform access.

Clauses (a)(ii) and a(iii) are not coastal engineering matters so are not considered herein.

With regard to (a)(iv), as noted in Section 7.2.2, there are no Aboriginal sites nor Aboriginal places recorded or declared within at least 50m of the subject property.

With regard to (a)(v), the nearest environmental heritage items to the subject property listed in Schedule 5 of *Pittwater Local Environmental Plan 2014* are sandstone road remnants and associated landscaping adjacent to 640, 642 and 644 Barrenjoey Road Avalon Beach. These heritage items are located at least about 580m from the subject property. The proposed development would not be expected to impact on these heritage items.

With regard to (b), the proposed development has been designed and sited to avoid any potential adverse impacts referred to in Clause 14(1) for the matters considered herein.

Clause (c) is not a coastal engineering matter so is not considered herein.

7.2.4 Clause 15

Based on Clause 15 of SEPP Coastal, "development consent must not be granted to development on land within the coastal zone unless the consent authority is satisfied that the proposed development is not likely to cause increased risk of coastal hazards on that land or other land".

Assuming that the geotechnical engineer will find that the proposed development is at an acceptably low risk of damage from erosion/recession over a 100 year design life, and given that the proposed development is well above and landward of projected wave runup to 2100, the proposed development would not even be expected to interact with coastal processes over its design life, let alone affect any other land. That is, the proposed development is unlikely to cause increased risk of coastal hazards on that land or other land over its design life.

7.2.5 Clause 16

Based on Clause 16 of SEPP Coastal, "development consent must not be granted to development on land within the coastal zone unless the consent authority has taken into consideration the relevant provisions of any certified coastal management program that applies to the land".

No certified coastal management program applies at the subject property.

7.2.6 Synthesis

The proposed development satisfies the requirements of *State Environmental Planning Policy (Coastal Management) 2018* for the matters considered herein.

7.3 Clause 7.5 of *Pittwater Local Environmental Plan 2014*

Clause 7.5 of *Pittwater Local Environmental Plan 2014* (LEP 2014) applies at the subject property, as the property is identified as "Bluff/Cliff Instability" on the Coastal Risk Planning Map Sheet CHZ_016. Based on Clause 7.5(3) of LEP 2014, "development consent must not be granted to development on land to which this clause applies unless the consent authority is satisfied that the development:

(a) is not likely to cause detrimental increases in coastal risks to other development or properties, and
(b) is not likely to alter coastal processes and the impacts of coastal hazards to the detriment of the environment, and
(c) incorporates appropriate measures to manage risk to life from coastal risks, and
(d) is likely to avoid or minimise adverse effects from the impact of coastal processes and the exposure to coastal hazards, particularly if the development is located seaward of the immediate hazard line, and
(e) provides for the relocation, modification or removal of the development to adapt to the impact of coastal processes and coastal hazards, and
(f) has regard to the impacts of sea level rise, and
(g) will have an acceptable level of risk to both property and life, in relation to all identifiable coastline hazards".

With regard to (a) and (b), the proposed development would not increase coastal risks nor alter coastal processes and the impacts of coastal hazards, as it would not affect the wave impact process at the base of the cliff.

Items (c), (d) and (g) are for the geotechnical engineer to assess, with consideration of the findings herein. Assuming that they find that the proposed development is at an acceptably low risk of damage over a 100 year planning period with appropriate measures incorporated in design and construction, (c), (d) and (g) would be met. On this basis, (e) should not be necessary, noting that this would be more applicable in a sandy beach environment.

With regard to (f), sea level rise has been considered herein.

8. FORM

Completed *Geotechnical Risk Management Policy for Pittwater* Form No. 1 is attached at the end of the document herein. Note that the declaration on Form No. 1 is not appropriate for a coastal report, with the revised declaration below:

> "I am aware that the above Coastal Report, prepared for the abovementioned site is to be submitted to assist with a geotechnical investigation for a Development Application for this site, with that geotechnical investigation relied on by Northern Beaches Council as the basis for ensuring that the Geotechnical Risk Management aspects of the proposed development have been adequately addressed. No declaration can be made on the geotechnical investigation as this has not been prepared nor reviewed by me, and nor do I have geotechnical engineering expertise".

9. CONCLUSIONS

An allowance for erosion/weathering of about 7mm to 12mm per year of the cliff face seaward of 73 Marine Parade Avalon should be considered and assessed by the geotechnical engineer.

The geotechnical engineer should consider these estimated rates in conjunction with an understanding of the particular nature of the cliff materials east of the subject property, their resistance to erosion, and potential failure planes related to geotechnical issues such as the joint spacing. The geotechnical engineer should also specifically consider the effect of the dyke at St Michaels Cave and surrounding cavity formation in their stability assessment.

Coastal inundation is not a significant risk for the proposed development over a planning period of well over 100 years.

Given this, and assuming that the geotechnical engineer will find that the development is at an acceptably low risk of damage from erosion/recession over a 100 year design life, the proposed development satisfies the requirements of *State Environmental Planning Policy (Coastal Management) 2018* (Clauses 13, 14, 15 and 16), and Clause 7.5 of *Pittwater Local Environmental Plan 2014* for the matters considered herein.

10. REFERENCES

Coffey & Partners (1987), "Coastal Management Study, Assessment of Bluff Areas", *Report No. S8002/1-AA*, March, for Warringah Shire Council

Crozier, PJ and JC Braybrooke (1992), "The morphology of Northern Sydney's rocky headlands, their rates and styles of regression and implications for coastal development", *26th Newcastle Symposium on Advances in the Study of the Sydney Basin*, University of Newcastle

Dragovich, Deirdre (2000), "Weathering Mechanisms and Rates of Decay of Sydney Dimension Sandstone", pp. 74-82 in *Sandstone City, Sydney's Dimension Stone and Other Sandstone Geomaterials*, edited by GH McNally and BJ Franklin, Environmental, Engineering and Hydrogeology Specialist Group (EEHSG), Geological Society of Australia, Monograph No. 5

Morcombe, John (2017), "Rock 'n' Window into Peninsula's Past", *Manly Daily*, 14 October, pp. 24-25

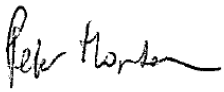
Public Works Department (1985), "Coastal Management Strategy, Warringah Shire, Report to Working Party", *PWD Report 85016*, June, prepared by AD Gordon, JG Hoffman and MT Kelly, for Warringah Shire Council

Sunamura, Tsuguo (1983), "Processes of Sea Cliff and Platform Erosion", Chapter 12 in *CRC Handbook of Coastal Processes and Erosion*, editor Paul D Komar, CRC Press Inc, Boca Raton, Florida, ISBN 0-8493-0208-0

11. SALUTATION

If you have any further queries, please do not hesitate to contact Peter Horton via email at peter@hortoncoastal.com.au or via mobile on 0407 012 538.

Yours faithfully
HORTON COASTAL ENGINEERING PTY LTD



Peter Horton
Director and Principal Coastal Engineer

Geotechnical Risk Management Policy for Pittwater Form No. 1 is attached overleaf

GEOTECHNICAL RISK MANAGEMENT POLICY FOR PITTWATER

FORM NO. 1 – To be submitted with Development Application

Development Application for Lincoln Courtney
Name of Applicant

Address of site 73 Marine Parade Avalon

Declaration made by geotechnical engineer or engineering geologist or coastal engineer (where applicable) as part of a geotechnical report

I, Peter Horton *on behalf of* Horton Coastal Engineering Pty Ltd
(Insert Name) (Trading or Company Name)

on this the 10 January 2022 certify that I am a geotechnical engineer or engineering geologist or coastal engineer as defined by the Geotechnical Risk Management Policy for Pittwater - 2009 and I am authorised by the above organisation/company to issue this document and to certify that the organisation/company has a current professional indemnity policy of at least $2million.
I:

Please mark appropriate box

☐ have prepared the detailed Geotechnical Report referenced below in accordance with the Australia Geomechanics Society's Landslide Risk Management Guidelines (AGS 2007) and the Geotechnical Risk Management Policy for Pittwater - 2009

☐ am willing to technically verify that the detailed Geotechnical Report referenced below has been prepared in accordance with the Australian Geomechanics Society's Landslide Risk Management Guidelines (AGS 2007) and the Geotechnical Risk Management Policy for Pittwater - 2009

☐ have examined the site and the proposed development in detail and have carried out a risk assessment in accordance with Section 6.0 of the Geotechnical Risk Management Policy for Pittwater - 2009. I confirm that the results of the risk assessment for the proposed development are in compliance with the Geotechnical Risk Management Policy for Pittwater - 2009 and further detailed geotechnical reporting is not required for the subject site.

☐ have examined the site and the proposed development/alteration in detail and I am of the opinion that the Development Application only involves Minor Development/Alteration that does not require a Geotechnical Report or Risk Assessment and hence my Report is in accordance with the Geotechnical Risk Management Policy for Pittwater - 2009 requirements.

☐ have examined the site and the proposed development/alteration is separate from and is not affected by a Geotechnical Hazard and does not require a Geotechnical Report or Risk Assessment and hence my Report is in accordance with the Geotechnical Risk Management Policy for Pittwater - 2009 requirements.

☑ have provided the coastal process and coastal forces analysis for inclusion in the Geotechnical Report

~~Geotechnical~~ Coastal **Report Details:**

Report Title: Coastal Engineering Advice on 73 Marine Parade Avalon

Report Date: 10 January 2022

Author: Peter Horton

Author's Company/Organisation: Horton Coastal Engineering Pty Ltd

Documentation which relate to or are relied upon in report preparation:

See Section 2 and Section 10 of coastal report

~~I am aware that the above Geotechnical Report, prepared for the abovementioned site is to be submitted in support of a Development Application for this site and will be relied on by Pittwater Council as the basis for ensuring that the Geotechnical Risk Management aspects of the proposed development have been adequately addressed to achieve an "Acceptable Risk Management" level for the life of the structure, taken as at least 100 years unless otherwise stated and justified in the Report and that reasonable and practical measures have been identified to remove foreseeable risk.~~

See revised declaration in Section 8 of report

Signature ……

Name Peter Horton

Chartered Professional Status MIEAust CPEng NER

Membership No. 452980

Company Horton Coastal Engineering Pty Ltd