

Bayview Golf Club
Attention: Craig Pocklington
1825 Pittwater Road
Bayview NSW 2104
(sent by email only to craigpocklington@yahoo.com.au)

1 August 2021

Estuarine Risk Management and Water Management Report for Drainage Works at Bayview Golf Club

1. INTRODUCTION AND BACKGROUND

It is proposed to install subsurface agricultural drainage and pipes to transfer rainfall-runoff induced elevated groundwater and surface ponding at Bayview Golf Club to pumping tanks and ponds, or to Cahill Creek. A Development Application (DA) is to be submitted to Northern Beaches Council for these works.

As the property is potentially affected by estuarine hazards, it is subject to the *Pittwater 21 Development Control Plan (DCP)*¹, in particular Chapter B3.9. It is also subject to the *Estuarine Risk Management Policy for Development in Pittwater* (Estuarine Policy, which is Appendix 7 of Part D of the DCP). *State Environmental Planning Policy (Coastal Management) 2018* (SEPP Coastal) should also be considered.

As part of Pre-lodgement Meeting Notes of Council (PLM2020/0254), various water management issues were identified, as discussed further in Section 9.

Horton Coastal Engineering Pty Ltd was engaged to complete the estuarine risk management and water management report required by Council, as set out herein. Catchment flooding is also considered herein, as this is more significant with regard to inundation of the golf course than estuarine inundation for severe events (and noting that estuarine processes would not extend into the golf course if tidal gates under Pittwater Road are maintained).

The report author is Peter Horton [BE (Hons 1) MEngSc MIEAust CPEng NER]. Peter has postgraduate qualifications in coastal and water engineering and 29 years of coastal and water engineering experience. He is a Member of Engineers Australia and Chartered Professional Engineer (CPEng) registered on the National Engineering Register. Peter 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. He undertook specific recent site inspections of the property on 15 March and 5 April 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.

¹ The version up to Amendment 27 (effective from 18 January 2021) was considered herein.

2. INFORMATION PROVIDED

Horton Coastal Engineering was provided with:

- 19 drawings of the proposed development prepared by Crisp Consulting (Revision F, dated 17 March 2021); and
- an Arboricultural Impact Assessment prepared by Bellevue Tree Consultants and dated 19 March 2021.

3. EXISTING SITE DESCRIPTION

An aerial view of the majority of Bayview Golf Course on 25 January 2021 is provided in Figure 1. Based on LiDAR point cloud data captured in 2020 (obtained from the NSW Department of Customer Service), most of the course is at a level between 0.5m and 1.0m AHD, as depicted in Figure 2.

Bayview Golf Course links to the Pittwater waterway via Cahill Creek (which passes through the course) and Winnererremy Bay. However, tidal gates traversing culverts under Pittwater Road at the downstream end of the course essentially disconnect Winnererremy Bay from Cahill Creek and prevent estuarine flow and inundation from entering the course, while they are functioning as designed.

A view of these tidal gates at a low tidal level (estuary level below the gates, with the head of water in Cahill Creek flowing downstream keeping the gates open) is provided in Figure 3. A view of the gates at a high tidal level (estuary level above the gates, with the head of the elevated Winnererremy Bay water level forcing the gates closed) is provided in Figure 4. It is understood that the gates are a Council responsibility, but are maintained by the Club to ensure reliable operation.

4. PROPOSED DEVELOPMENT

It is proposed to install subsurface agricultural drainage and pipes to transfer rainfall-runoff induced elevated groundwater and surface ponding to pumping tanks and ponds, or to Cahill Creek. This a drainage scheme to reduce ponding on the course after rainfall events, which causes damage to or kills grass (see Figure 5). The proposal is divided into 10 zones, as depicted in Figure 2. These zones can be described as follows:

1. subsoil drainage towards underground 10,500L holding tank and then transfer pipe to pond to west;
2. subsoil drainage towards tributary of Cahill Creek to south (existing outlet);
3. subsoil drainage towards Cahill Creek to east;
4. subsoil drainage towards Cahill Creek to south (existing outlet);
5. subsoil drainage towards pond to SE;
6. subsoil drainage towards pond to north;
7. subsoil drainage towards tributary of Cahill Creek to east (two outlets);
8. subsoil drainage towards central pressure pipe attached to bridge across Cahill Creek and transferring to an underground 10,500L holding tank in Zone 1;
9. subsoil drainage towards ponds in the southern portion of the zone, and to Cahill Creek to north (new outlet), with an additional new adjacent outlet for pumping from a pond if required;
10. subsoil drainage towards Cahill Creek to north (existing outlet).



Figure 1: Aerial view of majority of Bayview Golf Club, with proposed development zones shown



Figure 2: Elevations (up to 3m AHD) over majority of Bayview Golf Club as captured in June 2020



Figure 3: Tidal gates at downstream end of course at low tide, on 15 March 2021



Figure 4: Tidal gates at downstream end of course at high tide, on 5 April 2021



Figure 5: Example of water ponding on golf course after rainfall, on 24 March 2021

Note that ground levels are not proposed to be altered as part of the development.

The only known part of the proposed development to potentially be at risk of damage due to estuarine inundation or catchment flooding is the power control cabinet depicted in Figure 2. The appropriate elevation of this cabinet to reduce its risk of damage is considered in subsequent sections. The current ground elevation at this proposed cabinet is about 0.7m AHD.

5. DESIGN LIFE

In the Estuarine Policy, it is noted that a design project life of 100 years should be adopted, unless otherwise justified. A 25-year design life (that is, at 2081) is considered to be appropriate for the proposed non-habitable development.

6. ESTUARINE PROCESSES

In Cardno (2015), the 100-year Average Recurrence Interval (ARI) present day water level in the region covering the subject property is reported as 1.54m AHD. This includes the effects of astronomical tide and storm surge (combined level of 1.44m AHD), plus local wind setup (0.1m). Significant wave action cannot propagate up Cahill Creek, so the Estuarine Planning Level at the subject property only consists of the still water level. That stated, while the tidal gates are operational, estuarine inundation cannot propagate into the subject property.

If the tidal gates are not operational, Mean High Water is approximately 0.5m AHD and Mean High Water Springs is about 0.6m AHD at present at the subject property. The combined astronomical tide and storm surge level for a monthly and bi-annual event is about 1.0m and 1.2m AHD respectively, which would inundate most of the golf course (which demonstrates the importance of the tidal gates in allowing the golf course to function). Corresponding water levels only increase slightly for rarer events, eg 1 year ARI level of 1.24m AHD, 10 year ARI level of 1.34m AHD and 50 year ARI water level of 1.41m AHD (Department of Environment, Climate Change and Water [DECCW] (2010).

In Cardno (2015), sea level rise values of 0.4m at 2050 and 0.9m at 2100 were applied relative to 2010 (based on DECCW, 2010), which is not correct as those benchmarks were derived relative to 1990, and historical sea level rise has not been discounted. Appropriate sea level rise values (relative to 2010) with discounting of historical sea level rise would be 0.34m at 2050 and 0.84m at 2100.

Given the non-linear rate of sea level rise, it is considered most appropriate to derive sea level rise for the proposed design life of 25 years (at 2046) from Intergovernmental Panel on Climate Change [IPCC] (2013), which is widely accepted by competent scientific opinion.

Using the same methodology as applied in the acceptable risk assessment in the *Coastal Zone Management Plan for Bilgola Beach (Bilgola) and Basin Beach (Mona Vale)* prepared by the author for Council in 2017, and using a base year of 2010 as Cardno (2015) water levels were derived at 2010, the sea level rise values presented in Table 1 (at 2046) were determined for various greenhouse gas emissions scenarios.

Table 1: Global mean sea level rise (m) from 2010 to 2046 derived from IPCC (2013)

Emissions Scenario	Exceedance Probability		
	95% exceedance	Median	5% exceedance
SRES A1B	0.12	0.17	0.22
RCP2.6	0.12	0.16	0.21
RCP4.5	0.12	0.17	0.21
RCP6.0	0.11	0.16	0.20
RCP8.5	0.14	0.19	0.24
Average	0.12	0.17	0.22

Taking the median exceedance probability, and average of the 5 emissions scenarios, and adding 15% for local sea level rise variation based on IPCC (2013), a sea level rise value of 0.19m at 2046 (relative to 2010) was derived. Therefore, the 100 year ARI still water level at 2046 is 1.73m AHD, if the tidal gates are not operational. Conservatively assuming failure of the tidal gates, this can be assumed to be the design still water level at the end of the design life, and the Estuarine Planning Level, for the purpose of the report herein.

7. CATCHMENT FLOODING

Based on the *McCarrs Creek, Mona Vale and Bayview Flood Study Review* (Haskoning Australia, 2017), approximate design flood levels at Bayview Golf Club (in the vicinity of the proposed works) for various Annual Exceedance Probability (AEP) events are presented in Table 2.

Table 2: Design flood levels in vicinity of proposed works

AEP	Flood level (m AHD)
20%	1.48
10%	1.58
5%	1.68
2%	1.80
1%	1.92
0.5%	2.03
0.2%	2.21
Probable Maximum Flood	3.14

Therefore, for events more severe than about 2% AEP, catchment flooding produces more elevated water levels than the Estuarine Planning Level (and note that catchment flooding would be more severe than estuarine inundation over all probability events while the tidal gates are in place).

8. RISKS OF DAMAGE TO PROPOSED POWER CONTROL CABINET AND MITIGATION OF THOSE RISKS

It is recommended that the power control cabinet, and any other proposed components that could be damaged by water inundation, are placed above the 1% AEP flood level of 1.92m AHD (or higher if practical). Materials that are inundation compatible should be selected below this level.

9. WATER MANAGEMENT ISSUES

As part of Pre-lodgement Meeting Notes of Council (PLM2020/0254), various water management issues were identified, and it was requested that these issues be addressed as follows:

1. provide evidence that the works would not impact groundwater provision to the Swamp Sclerophyll EEC by extracting water that would normally go to groundwater;
2. provide evidence that the works would not impact the geomorphology of the creek by changing the water balance of the site;
3. any vegetation to be removed in the riparian zone as a result of the proposed work would need to be replaced or supplemented by plantings in other areas, and a Vegetation Management Plan should be provided to address this requirement;
4. any work in the creek area to install pipes etc should be accompanied by a controlled activity permit from the Natural Resources Access Regulator;
5. provide a Water Harvesting Balance Model demonstrating that the water supply (from drainage) and water usage (irrigation) are adequate, including volumes of the storage tank;
6. describe water movement into the soil as well as the impact on the water table; and
7. the irrigation system should be documented as well as the proposed water quality system required for safety of the public potentially in contact with the water.

Council subsequently advised (email from David Hellot to Craig Pocklington dated 29 March 2021) that Item 5 was not required.

With regard to Item 1, the Swamp Sclerophyll EEC is partially located around the wider section of Cahill Creek to the north of Zone 8, Zone 9 and Zone 10, but mainly to the north and south of Zone 4. The water levels in Cahill Creek and the watercourse to the north of Zone 4, which are the main drivers of surface water and groundwater levels in the EEC, would not be altered as a result of the proposed works. Furthermore, the localised lowering of groundwater levels in the drainage zones is only subtle, with the centre of the agricultural subsurface pipes only located 300mm below the ground surface.

With regard to Item 2, the proposal is simply transferring shallow depths of ponding water after rainfall via subsurface agricultural drainage in selected areas of the course to ponds and Cahill Creek. It will not significantly alter the water table level averaged over the entire course, noting that irrigation of the course will continue to be undertaken and that all ponds on the course are unlined (and hence are linked to the groundwater system). The proposal will not

change the physical features (geomorphology) of Cahill Creek as it will not significantly alter the water level or water velocity in the creek.

With regard to Item 3, as noted in the Arboricultural Impact Assessment referred to in Section 2, the proposal would result in 4 trees being removed. Of these trees, 1 is dead and the remaining 3 have been selected due to their low retention value, low useful life expectancy, poor vigour and structure.

With regard to Item 4, a controlled activity permit from the Natural Resources Access Regulator (NRAR) shall be obtained after development consent². It is understood that NRAR will provide General Terms of Approval with the consent.

As noted above, Item 5 is not required to be addressed.

With regard to Item 6, the proposed drainage system comprises 100mm diameter agricultural pipes surrounded by drainage material and geofabric, and connected to drainage pipes. This will locally drain ponded areas, transferring this water to ponds or Cahill Creek, but would not alter the broad-scale water table level over the golf course as noted above. The centres of the drainage pipes (agricultural subsurface pipes) are only located 300mm below the ground surface, so can only subtly and locally drain ponded areas without significantly altering groundwater levels over the entire golf course.

With regard to Item 7, a separate document has been prepared by the Club to address how irrigation water quality is managed at the golf course.

10. MERIT ASSESSMENT

10.1 Section B3.9 of the Pittwater 21 DCP

With the proposed power control cabinet above the adopted Estuarine Planning Level (EPL) of 1.73m AHD (assuming failure of the tidal gates), this meets the requirements of Section B3.9 of the DCP. Based on the DCP (numbering added herein for convenience):

1. All development or activities must be designed and constructed such that they will not increase the level of risk from estuarine processes for any people, assets or infrastructure in surrounding properties; they will not adversely affect estuarine processes; they will not be adversely affected by estuarine processes; and
2. All structural elements below the Estuarine Planning Level shall be constructed from flood compatible materials; and
3. All structures must be designed and constructed so that they will have a low risk of damage and instability due to wave action and tidal inundation; and
4. All electrical equipment, wiring, fuel lines or any other service pipes and connections must be waterproofed to the Estuarine Planning Level; and
5. The storage of toxic or potentially polluting goods, materials or other products, which may be hazardous or pollute the waterway, is not permitted to be stored below the Estuarine Planning Level; and
6. For existing structures, a tolerance of up to minus 100mm may be applied to the Estuarine Planning Level in respect of compliance with these controls.

² A controlled activity approval application for a development which requires development consent must be submitted after consent is obtained.

7. To ensure Council's recommended flood evacuation strategy of 'shelter in place' it will need to be demonstrated that there is safe pedestrian access to a 'safe haven' above the Estuarine Planning Level.

With regard to Item 1, the proposed development would not significantly change estuarine processes nor increase the level of risk in surrounding areas for the design event, an event where water depths over the course would generally exceed 1m (greatly exceeding the scale of the drainage scheme).

As stipulated in Section 8, with the power control cabinet above the EPL and selection of materials that are inundation compatible below this level, the risk of the proposed development being adversely affected by estuarine processes would be suitably mitigated, satisfying Item 1.

Item 2 is satisfied with all materials below the EPL (and indeed the higher flood level of 1.92m AHD) being tolerant of inundation.

The supports for the power control cabinet should be designed to withstand hydrostatic and water movement forces for the 1% AEP event, say assuming a velocity of 0.2m/s, exceeding reported values of Haskoning Australia (2017). This would satisfy Item 3.

Items 4 and 5 should apply to the proposed development as conditions of consent.

Item 6 is not applicable.

With regard to Item 7, the golf course would not be accessible in a severe inundation event and any person on the site at that time could shelter-in-place in the elevated clubhouse, if required. That stated, there would be several hours of warning time for both severe estuarine and catchment flooding events, ie sudden unexpected inundation of people on the golf course would not occur.

10.2 Estuarine Risk Management Policy for Development in Pittwater

The requirements of the *Estuarine Risk Management Policy for Development in Pittwater* (Estuarine Policy) have been met herein by consideration of:

- estuarine processes and the Estuarine Planning Level in Section 6; and
- the controls in Section B3.9 of the Pittwater 21 DCP in Section 10.1.

Furthermore, although the current Estuarine Policy does not have a form that is required to be filled in, Council has in the past requested that a form provided in a former Estuarine Policy be filled in, as provided at the end of the document herein.

10.3 State Environmental Planning Policy (Coastal Management) 2018

10.3.1 Preamble

Based on *State Environmental Planning Policy (Coastal Management) 2018* (SEPP Coastal) and its associated mapping, parts of the subject property are within a "coastal wetlands" area (see Section 10.3.2), "proximity to coastal wetlands" area (see Section 10.3.3), "coastal environment area" (see Section 10.3.4), and "coastal use area" (see Section 10.3.5). The mapping of these areas is depicted in Figure 6.

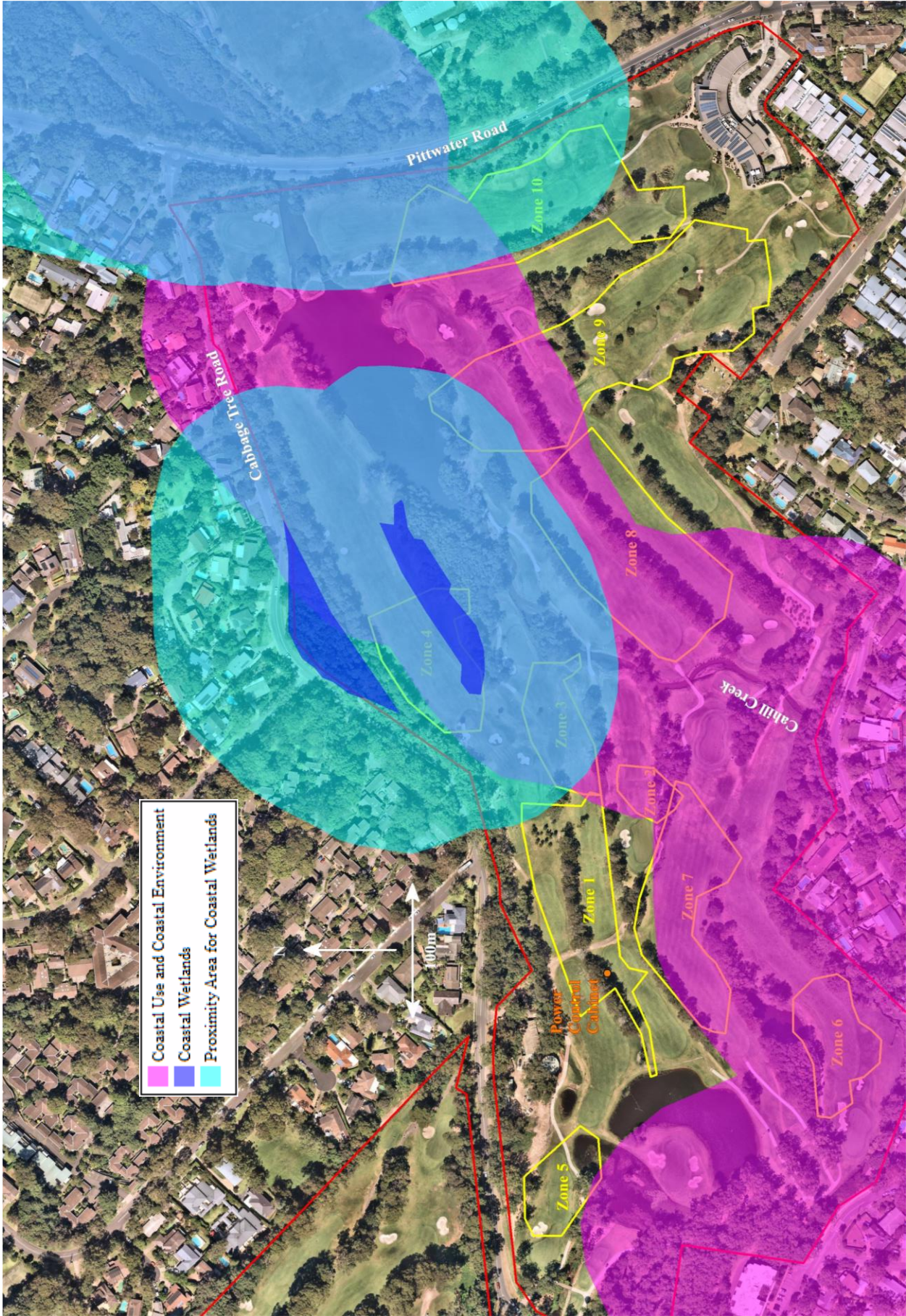


Figure 6: Coastal management areas from SEPP Coastal at Bayview Golf Club

10.3.2 Clause 10

Based on Clause 10(1)(iii) of SEPP Coastal, “draining the land” may be carried out on land identified as “coastal wetlands” with development consent.

Based on Clause 10(4) of SEPP Coastal, “a consent authority must not grant consent for development referred to in subclause (1) unless the consent authority is satisfied that sufficient measures have been, or will be, taken to protect, and where possible enhance, the biophysical, hydrological and ecological integrity of the coastal wetland or littoral rainforest”.

As evident in Figure 6, the two “coastal wetlands” areas at Bayview Golf Club are near Zone 4, and are equivalent to the Swamp Sclerophyll EEC discussed in Section 9. As discussed therein, the water levels in Cahill Creek and the watercourse to the north of Zone 4, which are the main drivers of surface water and groundwater levels in the “coastal wetlands” areas, would not be altered as a result of the proposed works. Furthermore, no vegetation is to be removed in these areas. Therefore, the proposed works would not be expected to adversely impact on the biophysical, hydrological nor ecological integrity of the coastal wetlands.

10.3.3 Clause 11

Based on Clause 11(1) of SEPP Coastal, “development consent must not be granted to development on land identified as ‘proximity area for coastal wetlands’ ...unless the consent authority is satisfied that the proposed development will not significantly impact on:

- (a) the biophysical, hydrological or ecological integrity of the adjacent coastal wetland or littoral rainforest, or
- (b) the quantity and quality of surface and ground water flows to and from the adjacent coastal wetland or littoral rainforest”.

As evident in Figure 6, the “proximity area for coastal wetlands” areas at Bayview Golf Club extend over Zones 3, 4, 8, 9 and 10. As discussed in Section 9, the proposed development will not significantly alter the water table level averaged over the entire course, and the localised lowering of groundwater levels in the drainage zones is only subtle. The proposal is simply transferring shallow depths of ponding water after rainfall via subsurface agricultural drainage in selected areas of the course to ponds and Cahill Creek.

The distant works in the Zone 3, 8, 9 and 10 proximity areas would not affect the “coastal wetlands” areas. As discussed in Section 10.3.2, the works in Zone 4 would not adversely impact on the biophysical, hydrological nor ecological integrity of the coastal wetlands.

The works in Zone 4 would subtly increase the quantity of groundwater flow to the southern coastal wetland, and subtly decrease the quantity of groundwater flow to the northern coastal wetland. However, as stated previously, the water levels in Cahill Creek and the watercourse to the north of Zone 4, which are the main drivers of surface water and groundwater levels in the “coastal wetlands” areas, would not be altered as a result of the works. That is, the quantity of surface and ground water flows to and from the adjacent coastal wetlands would not be significantly altered. The agricultural drains are to be wrapped in drainage material and geofabric, so sediment is unlikely to be conveyed along these drains, and the quality of surface and ground water flows to and from the adjacent coastal wetland is unlikely to be altered.

10.3.4 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”.

With regard to (a), these matters have been discussed in Section 10.3.2 and 10.3.3 in relation to coastal wetlands. The broader works away from the wetlands would also not significantly alter the water table level averaged over the entire course, and hence would not adversely affect the biophysical, hydrological (surface and groundwater) and ecological environments. The proposed works would not be a source of pollution as long as appropriate construction environmental controls are applied.

With regard to (b), the proposed works would not be expected to adversely affect estuarine processes in Pittwater, downstream of the tidal gates.

With regard to (c), the proposed works would not adversely impact on water quality as long as appropriate construction environmental controls are applied.

With regard to (d), there are no undeveloped headlands, rock platforms nor marine vegetation in proximity to the proposed development, and the acceptable impacts on native vegetation have been discussed in the Arboricultural Impact Assessment.

With regard to (e), the proposed works would not impact on public open space and access to and along the foreshore, being entirely within private property.

With regard to (f), a search of the (former) Office of Environment and Heritage “Aboriginal Heritage Information Management System” (AHIMS) was undertaken on 1 August 2021. This resulted in no Aboriginal sites being recorded nor Aboriginal places being declared within the golf course.

With regard to (g), there is no significant or practical surf zone offshore of the subject property, so this is not applicable. That stated, the proposed works would not be expected to alter wave and water level processes offshore of the property.

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 the adverse impacts referred to in Clause 13(1).

10.3.5 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 (a)(i), the proposed works would not impact on foreshore access, as discussed previously.

With regard to (a)(ii), (a)(iii), and (c), these are not coastal engineering matters so are not considered herein.

With regard to (a)(iv), there are no Aboriginal sites recorded nor Aboriginal places declared within the subject property, as noted in Section 10.3.4.

With regard to (a)(v), the nearest environmental heritage item as per Schedule 5 of *Pittwater Local Environmental Plan 2014* is a house at 2 Binnowee Place Bayview, which is located about 50m north of the golf course. The proposed development would not be expected to impact on this site.

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

10.3.6 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”.

The golf course is located landward (upstream) of tidal gates and hence would not generally interact with estuarine (coastal) processes.

10.3.7 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.

11. CONCLUSIONS

It is proposed to install subsurface agricultural drainage and pipes to transfer rainfall-runoff induced elevated groundwater and surface ponding at Bayview Golf Club to pumping tanks and ponds, or to Cahill Creek.

It is recommended that the power control cabinet, and any other proposed components that could be damaged by water inundation, are placed above the 1% AEP flood level of 1.92m AHD (or higher if practical). Materials that are inundation compatible should be selected below this level.

The proposed development satisfies the requirements of Section B3.9 of the Pittwater 21 DCP, the *Estuarine Risk Management Policy for Development in Pittwater*, and *State Environmental Planning Policy (Coastal Management) 2018*, for the matters outlined herein.

12. REFERENCES

Cardno (2015), *Pittwater Estuary Mapping of Sea Level Rise Impacts*, LJ2882/R2658v7, Revised Draft, for Pittwater Council, February

Department of Environment, Climate Change and Water [DECCW] (2010), *Coastal Risk Management Guide: Incorporating sea level rise benchmarks in coastal risk assessments*, DECCW 2010/760, August, ISBN 978 1 74232 922 2

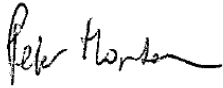
Haskoning Australia (2017), *McCarrs Creek, Mona Vale and Bayview Flood Study Review*, Revision 04, Final, 7 July

Intergovernmental Panel on Climate Change [IPCC] (2013), *Climate Change 2013, The Physical Science Basis, Working Group I Contribution to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, [Stocker, TF; Qin, D; Plattner, G-K; Tignor, M; Allen, SK; Boschung, J; Nauels, A; Xia, Y; Bex, V and PM Midgley (editors)], Cambridge University Press, Cambridge, United Kingdom and New York, New York, USA

13. 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

This report has been prepared by Horton Coastal Engineering Pty Ltd on behalf of and for the exclusive use of Bayview Golf Club (the client), and is subject to and issued in accordance with an agreement between the client and Horton Coastal Engineering Pty Ltd. Horton Coastal Engineering Pty Ltd accepts no liability or responsibility whatsoever for the report in respect of any use of or reliance upon it by any third party. Copying this report without the permission of the client or Horton Coastal Engineering Pty Ltd is not permitted.

Estuarine Risk Management Policy for Pittwater Form No. 1 is provided overleaf

FORM NO. 1

To be submitted with Estuarine Risk Management Report

Development Application for Bayview Golf Club Name of Applicant
Address of site 1825 Pittwater Road Bayview

Declaration made by a Coastal Engineer as part of an Estuarine Risk Management Report

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

on this the 1st August 2021 (date)

certify that I am a Coastal Engineer as defined by the Estuarine Risk Management Policy for Development in Pittwater 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 \$2 million.

Please mark appropriate box

- I have prepared the detailed Estuarine Risk Management Report referenced below in accordance with the Estuarine Risk Management Policy for Development in Pittwater
- I am willing to technically verify that the detailed Estuarine Risk Management Report referenced below has been prepared in accordance with the Estuarine Risk Management Policy for Development in Pittwater
- I have examined the site and the proposed development/alteration in detail and, as detailed in my report, am of the opinion that the Development Application only involves Minor Development/Alterations or is sited such that a detailed Estuarine Risk Management Report is not required.

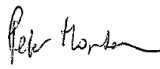
Estuarine Risk Management Report Details:

Report Title: Estuarine Risk Management and Water Management Report for Drainage Works at Bayview Golf Club Report Date: 1 August 2021 Author: Horton Coastal Engineering Pty Ltd
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Documentation which relate to or are relied upon in report preparation:

See Section 2 and Section 12 of report

I am aware that the above Estuarine Risk Management Report, prepared for the above mentioned site is to be submitted in support of a Development Application for this site and will be relied on by Northern Beaches Council as the basis for ensuring that the estuarine 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 all reasonable and practical measures have been identified to remove foreseeable risk.

Signature	
Name	Peter Horton
Chartered Professional Status	MIEAust CPEng
Membership No.	452980