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Updated Estuarine Risk Management Advice on 76b St Georges Crescent Drummoyne, in Relation to DA2020/349

1. INTRODUCTION AND BACKGROUND

Horton Coastal Engineering has provided advice on this matter in two previous reports, dated 31 March and 10 May 2021 respectively.

In the report herein, an updated assessment of the design elevated estuarine still water level is provided, based on Canada Bay Council's stipulation that a 2100 event must be used for design. Furthermore, this level is reassessed on the basis that the Intergovernmental Panel on Climate Change (IPCC) has released revised sea level rise projections since completion of the previous Horton Coastal Engineering report.

The report author is Peter Horton [BE (Hons 1) MEngSc MIEAust CPEng NER]. Peter has postgraduate qualifications in coastal engineering and 29 years of coastal engineering experience, including numerous estuarine risk and foreshore risk management studies along the Sydney Harbour foreshore and its tributaries. 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.

Note that all levels given herein are to Australian Height Datum (AHD). Zero metres AHD is approximately equal to mean sea level at present.

2. DESIGN ELEVATED ESTUARINE STILL WATER LEVEL

2.1 Present Day Elevated Estuarine Still Water Level

As noted in the previous Horton Coastal Engineering report, the 100-year Average Recurrence Interval (ARI) ocean (estuarine) still water level (in the absence of wave action) as of 2010 in Sydney Harbour is 1.44m AHD, as derived from Department of Environment, Climate Change and Water [DECCW] (2010). This is similar to a corresponding value of 1.42m AHD reported by Manly Hydraulics Laboratory [MHL] (2018). Note also that the 1.44m AHD level was adopted as the present day tailwater condition in the *Exile Bay Catchment Flood Study* completed for Council in December 2020.

2.2 Sea Level Rise Over Design Life to 2100

It is considered to be most appropriate to derive sea level rise values from IPCC (2021), which is widely accepted by competent scientific opinion. Using a base year of 2010, as the 1.44m AHD level noted in Section 2.1 applies at 2010, the sea level rise values presented in Table 1 (at 2100) were determined for the five illustrative scenarios (shared socioeconomic pathways, SSP's[1]) considered in IPCC (2021)[2].

This includes regional sea level rise variations at Sydney as reported by the Physical Oceanography Distributed Active Archive Center (PO.DAAC), a NASA Earth Observing System Data and Information System data centre operated by the Jet Propulsion Laboratory in Pasadena, California. The sea level rise values were determined at 2100, relative to the average sea level from a 1995-2014 baseline (taken to be at 2005).

Table 1: Mean sea level rise (m) at Sydney from a 1995-2014 average level (taken at 2005) to 2100 derived from IPCC (2021) and PO.DAAC

Emissions Scenario (Shared Socioeconomic Pathway)	Exceedance Probability		
	95% exceedance	Median	5% exceedance
SSP1-1.9	0.13	0.34	0.68
SSP1-2.6	0.18	0.39	0.75
SSP2-4.5	0.31	0.53	0.94
SSP3-7.0	0.42	0.68	1.13
SSP5-8.5	0.50	0.78	1.30
Average	0.31	0.54	0.96

Taking the median exceedance probability and average of the 5 SSP's, a sea level rise value of 0.54m at 2100 (relative to 2005) was derived. The corresponding 5% exceedance sea level rise is 0.96m. Given that DECCW (2010) water levels were derived at 2010, the sea level rise should be determined relative to 2010. Watson (2020) found that the rate of sea level rise from satellite altimetry in the SE Australia region was 3.5mm/year from 1992-2019. Applying this rate from 2005 to 2010, the projected sea level rise from 2010 to 2100 at Sydney is 0.53m (median) and 0.94m (5% exceedance).

2.3 2100 Elevated Estuarine Still Water Level

Using the sea level rise values derived in Section 2.2, the 100 year ARI estuarine still water level at 2100 is 1.97m AHD (median) and 2.38m AHD (5% exceedance).

Although this is considered to be overly conservative, to avoid argument, a 2.38m AHD design estuarine still water level at 2100 has been adopted herein.

Note that a 2.335m AHD level was adopted as the 2100 tailwater condition in the *Exile Bay Catchment Flood Study* completed for Council in December 2020, which is 45mm below the design level adopted herein.

[1] Known as representative concentration pathways in the previous IPCC (2013) assessment.
[2] The five illustrative scenarios represent varying projected greenhouse gas emissions, land use changes and air pollutant controls in the future.

2.4 Implications for Development

A solid barrier wall across the subject property and along its side boundaries is proposed with a crest level of 2.4m AHD, located 44m landward of the foreshore. This would prevent estuarine inundation impacting on the proposed residential flat building for the design event.

A separate report has been prepared by Xavier Knight, to discuss how the stormwater system can effectively operate if the 1% AEP rainfall-runoff flood event occurs at the same time as the design 2100 estuarine still water level. Note also that the peak estuarine still water level would only persist for around 2 hours at high tide, before falling due to the astronomical tide falling.

2.5 Effect of Wave Action

It is recognised that wave action would temporarily increase water levels further, and it is possible that some occasional wave overtopping of the barrier wall may occur at times of extreme estuarine water levels, although wave action is expected to be limited at 44m landward of the foreshore. This limited overtopping would only result in water locally ponding adjacent to the barrier wall prior to draining away, and would have no impact on the proposed residential flat building.

2.6 Freeboard

With a design still water level of 2.38m AHD, and proposed barrier wall level of 2.4m AHD, an estuarine freeboard of 20mm has been achieved. This is more than adequate, as in this instance it would be acceptable to have a zero freeboard.

Use of a freeboard in an estuarine inundation situation in Sydney Harbour is generally overly conservative. As defined in the *Floodplain Development Manual* (NSW Government, 2005), freeboard provides a factor of safety to compensate for uncertainties in the estimation of flood levels, such as wave action, localised hydraulic behaviour, and other effects such as climate change. It is usually applied as an increase to a design flood level to set a minimum habitable floor level.

It is common practice and appropriate to adopt a freeboard for catchment flooding. However, with estuarine inundation at the subject property and understanding the purpose of freeboard, it is evident that the design still water level generally takes account of the components that comprise freeboard. Specifically:

- there is a high level of confidence in the design still water level estimate, as it was based on analysis of over 100 years of data from Fort Denison;
- water levels only increase slightly for rarer events (eg 0.2m increase for the 10,000 year ARI event compared to the 100 year ARI event);
- wave action is completely disconnected from the proposed residential flat building in the design event (ie, it would not reach it), so no wave-related freeboard component is required;
- there are no significant tributaries near the subject property that would be expected to cause localised hydraulic behaviour such that the design still water level would increase above the value adopted; and
- climate change (sea level rise) is included in the estimate of still water level, for a conservative 5% exceedance projection.

The proposed barrier wall level at 2.4m AHD is considered to be a conservative measure to reduce the risk of estuarine inundation entering the proposed residential flat building in the design event.

3. CONCLUSIONS

A 2.38m AHD design estuarine still water level at 2100 has been adopted herein. A solid barrier wall across the subject property and along its side boundaries is proposed with a crest level of 2.4m AHD, located 44m landward of the foreshore. This would prevent estuarine inundation impacting on the proposed residential flat building for the design event.

4. REFERENCES

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

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

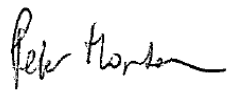
Manly Hydraulics Laboratory [MHL] (2018), "NSW Ocean Water Levels", *Report MHL2236*, Final, 3 December

NSW Government (2005), *Floodplain Development Manual, the management of flood liable land*, Department of Infrastructure, Planning and Natural Resources, DIPNR 05_020, ISBN 0 7347 5476 0, April

5. 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



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