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Status: Final
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Dear Tanja,

Reference # 13142.505.L1.Rev0

**RE: NORTH NARRABEEN SLSC - COASTAL ASSESSMENT AND MANAGEMENT
REPORT FOR DEVELOPEMENT APPLICATION (ALTERATIONS & ADDITIONS TO
EXISTING BUILDING)**

Baird Australia Pty Ltd (Baird) have been engaged to prepare a Coastal Assessment and Management Report for a Development Application (DA) associated with the North Narrabeen Surf Life Saving Club (SLSC). The DA involves Alterations and Additions to the existing SLSC to improve amenities and building facilities, and to extend the functional life of the SLSC building but this DA does not extend the ultimate life of the SLSC building structure.

The North Narrabeen SLSC is located at the northern end of Narrabeen Beach, to the south of the ocean entrance of Narrabeen Lagoon as outlined in Figure 1. The SLSC is located within the coastal management area of the Coastal Zone Management Plan (CZMP) for Collaroy-Narrabeen Beach and Fisherman's Beach (NBC & Royal Haskoning, 2016). The 2016 CZMP was developed in accordance with the NSW Coastal Protection Act 1979 and NSW Coastal Policy 1997 and is the current management plan applied for the development and management of Collaroy-Narrabeen Beach. This Coastal Assessment and Management Report has utilised data and coastal hazard assessment information presented in CZMP.

This report is structured into the following sections:

- Overview of DA and summary of interaction with coastal hazards.
- Summary of requirements for this Coastal Assessment
- Summary of coastal hazards relevant to the DA.
- Coastal engineering assessment of impacts of coastal erosion and inundation on the SLSC over a relevant planning period up to 2050.
- Design and management recommendations for the DA.



Figure 1: Locality Plan of the North Narrabeen SLSC.

Development Application Details

The proposed alterations and additions to the SLSC is presented in the drawing set numbered DA01 to DA16 Revision D (Issued November 2023). A site plan of the development area, including applicable coastal hazard lines from the CZMP is presented in Figure 2, and Figure 3 presents a plan view of the ground floor development. The proposed alterations and additions do not extend the SLSC beyond the current footprint occupied by the building and associated fixtures. The ground elevations immediately seaward of the building are typically 9.5 to 9.7 m AHD and those would not be altered by the planned development.

In July 2023, JK Geotechnics completed a geotechnical investigation of the site as part of the design and planning for preparation of the DA. The scope of the geotechnical investigation was to examine the subground conditions at the site, and to document and assess the foundations of the SLSC. Two test pits were excavated to 0.5 m depth, and four Dynamic Cone Penetration (DCP) tests were completed and terminated at 4 m depth (below the surface).

The investigations indicated that the SLSC is founded on conventional pad footings that are embedded 0.4 m (approximately) below the ground level. To the depth of the DCP tests, the subsurface was comprised of fine to medium sands ranging in density from very loose to medium density (JK Geotechnics, 2023). The geotechnical assessment confirmed that the SLSC is founded on marine sands, as expected, and that the conventional foundations of the SLSC are dependent on the bearing capacity of the surface and near-surface soil layers.

Northern Beaches Council (NBC) maintains an asset register for all buildings that they are responsible for which includes an assessment of the remaining functional life of the building structure. Based on advice from NBC, the SLSC, including after the planned alterations and additions, is expected to have a functional life up to 2050. After that time, due to the age and expected condition of underlying building structure, a substantial structural renovation or replacement of the building would be expected. This Coastal Assessment and Management Plan has focused on the potential coastal impacts up to the year 2050.

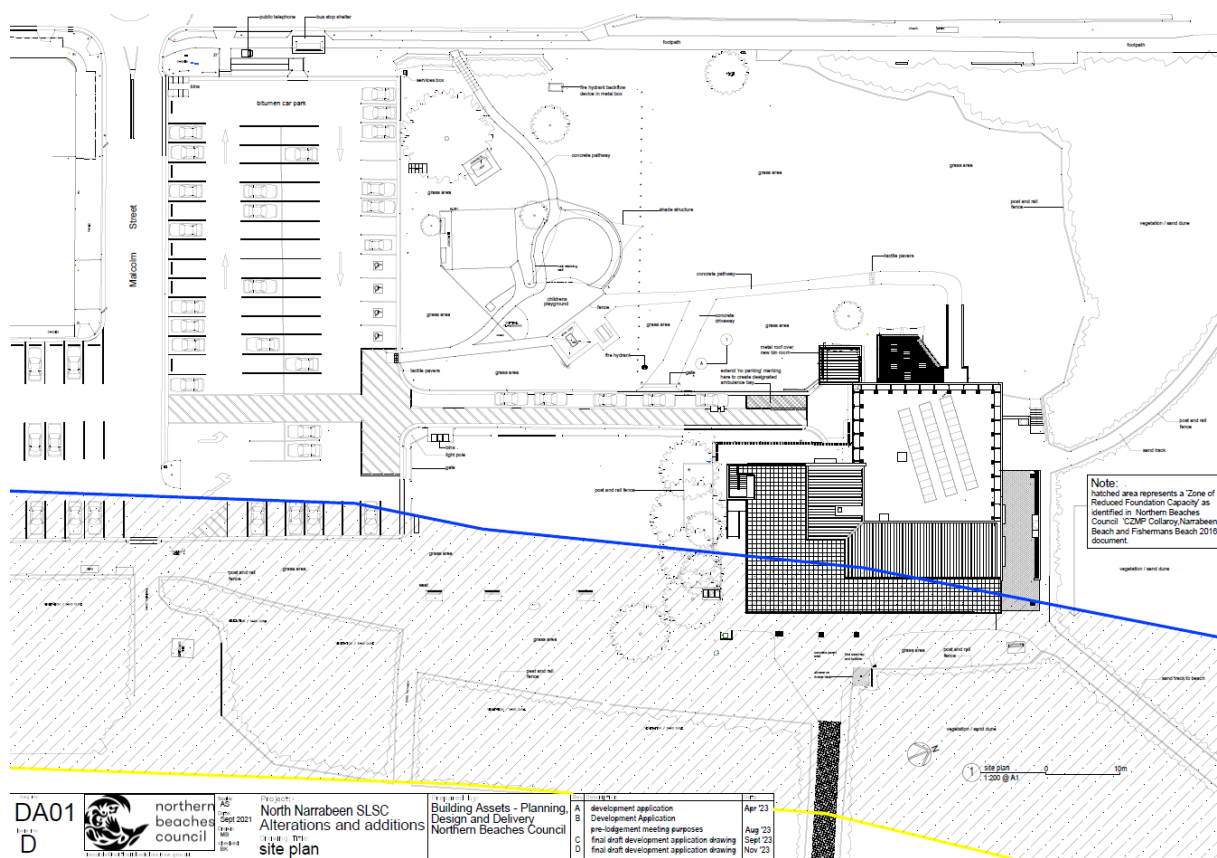


Figure 2: Site Plan for North Narrabeen SLSC Alterations and Additions (DA01-D)

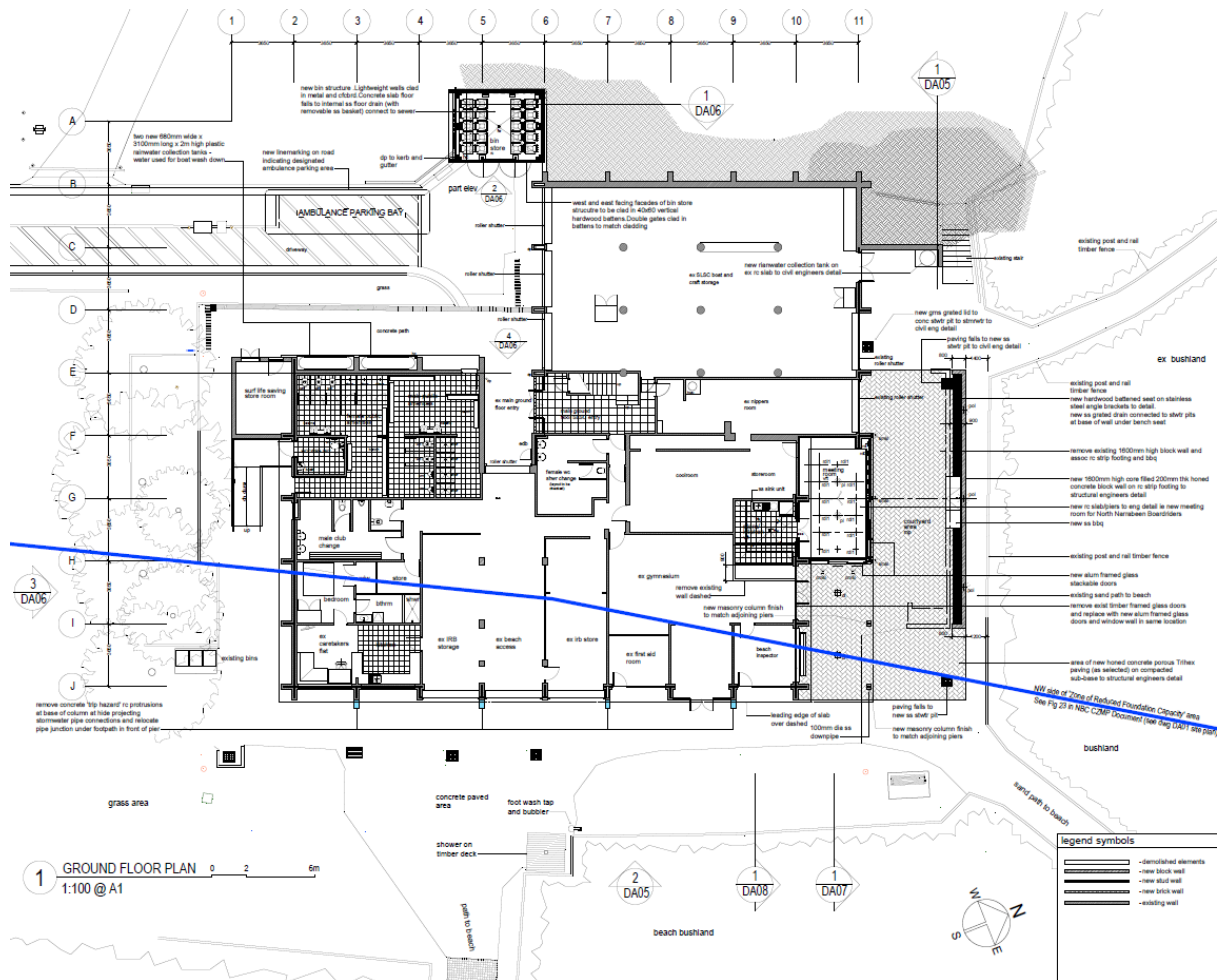


Figure 3: Ground Floor Plan for North Narrabeen SLSC Alterations and Additions (DA02-D)

Requirements for Coastal Assessment

This report has been prepared to meet NBC's planning requirements in accordance with the NSW Coastal Management Act 2016. The Coastal Management Act 2016 requires seven coastal hazards to be considered with respect to their potential impact on planned development, as well as the impact of development on surrounding coastal processes relevant to those hazards. Table 1 summarises the coastal hazards considered in the preparation of this report and a summary of their potential impacts on the SLSC.

Table 1: Coastal hazards considered in this report in accordance with the Coastal Management Act 2016

Coastal Hazard	Applicability to SLSC DA	Description of Hazard Assessment Methodology
Beach Erosion	For future planning horizons, beyond 2050, the SLSC may be impacted by beach erosion in combination with shoreline recession.	Review of 2016 and 2014 CZMP's. Calculation of Zone of Reduced Foundation Capacity (ZRFC) completed for the SLSC.
Shoreline Recession	For future planning horizons, beyond 2050, the SLSC may be impacted by shoreline recession in combination with beach erosion.	Considered in assessment of impact of beach erosion.
Coastal Lake or Watercourse Entrance Instability	The SLSC is located south of the ocean entrance to Narrabeen Lagoon.	Review of relevant documents, including 2022 EMP.
Coastal Inundation	The SLSC is located on relatively high, stable dunes at an elevation of 9.5 m AHD. Over the planning period to 2074 as defined in the CZMP, the CZMP assesses that at an elevation above 8 m AHD are unlikely to be impacted by coastal inundation.	Review of 2016 and 2014 CZMP's and additional analysis presented in Baird (2021). No further assessment completed.
Coastal Cliff or slope instability	Not applicable to the site.	Review of geology and ground conditions at site. No further assessment completed.
Tidal Inundation	The SLSC is located on relatively high, stable dunes at an elevation of 9.5 m AHD. Not applicable to the site for any relevant planning period.	Review of 2016 and 2014 CZMP. No further assessment completed.
Erosion or inundation of foreshores by tidal water and impact of waves and catchment floodwaters	Not applicable to the site.	Review of 2016 and 2014 CZMP. No further assessment completed.

Summary of Coastal Hazards Relevant to the DA

Beach Erosion and Shoreline Recession

Based on the CZMP, the SLSC is calculated as been beyond the present-day impact zone from coastal erosion and coastal inundation based on the 2014 CZMP. The potential for direct erosion impacts on the SLSC was identified as possible in the time frame of 2050 and beyond, depending on the rate of sea level rise. In the 2016 CZMP, the *Acceptable Risk* assessment of coastal erosion and its impact on development controls up to 2074 identified that the direct impact line of coastal erosion from a severe erosion event lies 26 to 33 m seaward of the SLSC (see yellow line on Figure 2), but that within the 2074

planning period, the Zone of Reduced Foundation Capacity (ZRFC) may impact on the SLSC. The ZRFC was included in the 2016 CZMP based on the beach erosion and slope adjustment model of Neilson *et al* (1992) which is schematically presented in Figure 4. The coastal engineering assessment summarised in the following section has focused on the potential impact of the ZRFC on the SLSC, particularly in the context of remaining asset life to 2050.

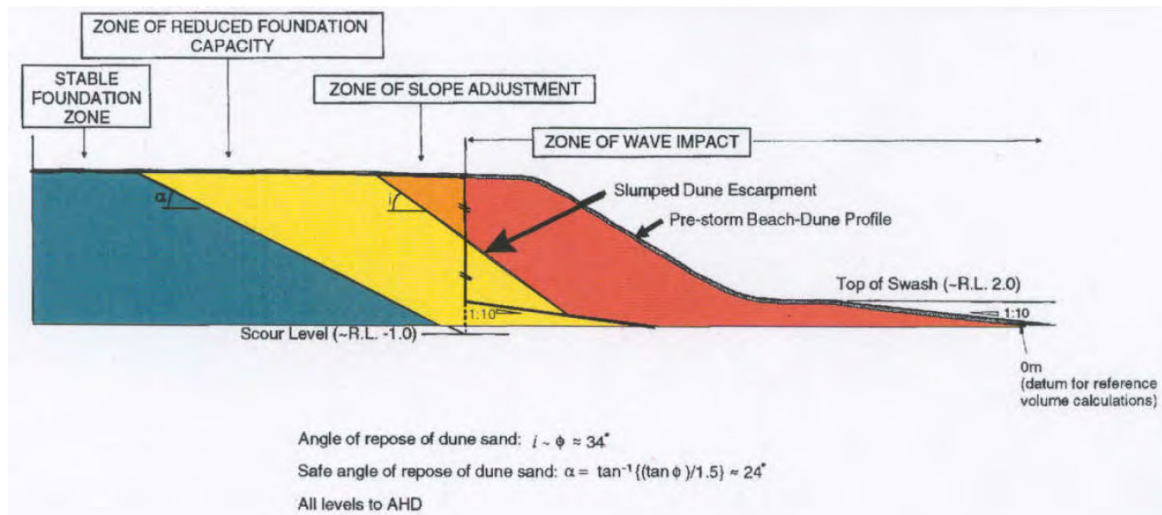


Figure 4: Erosion hazard zones including the Zone of Reduced Foundation Capacity (ZRFC) as defined by Nielsen *et al* (1992).

Whilst the 2016 CZMP defined that the SLSC was potentially impacted by coastal erosion in the 2074 planning period, the 2014 CZMP which adopted a similar erosion hazard assessment as the current 2016 CZMP defined that at present day, and for the planning horizon to 2050, the SLSC was landward of the Zone of Reduced Foundation Capacity (ZRFC) as referred to in Figure 4. Figure 5 presents the immediate (2014), 2050 and 2100 coastal hazard lines from the 2014 CZMP. Based on that assessment, the SLSC is landward of the ZRFC at present (2023) and it is expected that between 2040 and 2050, the SLSC may be in the area where erosion hazard could impact on the capacity of the building foundations, but the SLSC is not expected to be in the active erosion zone.



Figure 5: Immediate, 2050 and 2100 Coastline Hazard Lines (located at landward edge of ZRFC) at northern end of Narrabeen Beach (Figure I17, Warringah Council & Royal Haskoning, (2014).

Narrabeen Lagoon Entrance Morphology and Impacts on SLSC

Various assessments of the entrance morphology and channel migration, including the recent Entrance Management Strategy (Royal Haskoning, 2022) have indicated that the entrance has historically been on the northern end of the beach and has not migrated south towards the SLSC over the period of photographic records. The stable, high dunes comprised of marine sand that the SLSC is founded on also indicates that the SLSC has not been impacted by the entrance position over a prolonged period of time. No further assessment of entrance morphology impacts has been considered in this report.

Coastal Engineering Assessment of Coastal Erosion and Inundation

Coastal Erosion

A coastal engineering assessment has been completed for the proposed SLSC alterations and additions based on the 2074 *Acceptable Risk* hazard lines. As indicated previously, based on the CZMP, the SLSC is potentially within the ZRFC for the 2074 planning period but is located well landward of the current erosion hazard risk zone defined in the 2014 CZMP.

An assessment of the lower level of the ZRFC has been completed using LiDAR and site survey data, and the hazard lines presented in the CZMP as indicated in Figure 2. Figure 6 presents two cross-sections that have been analysed to determine the minimum vertical level where soil bearing capacity can be assumed. This is generally referred to as the minimum vertical level where piled foundations can assume soil strength based on Neilson et al (1992). Figure 7 presents the calculated maximum vertical level where soil capacity can be assumed based on the 2074 hazard lines in the CZMP. If erosion resilient foundations were required for the SLSC for the 2074 planning period, the foundations would need to be founded in soil layers below the levels indicated on Figure 7. However, based on the 2014 and 2016 CZMP's, it is estimated that by 2050, there is approximately a 1% per annum probability that the SLSC may be impacted by the ZRFC during or following a severe erosion event.

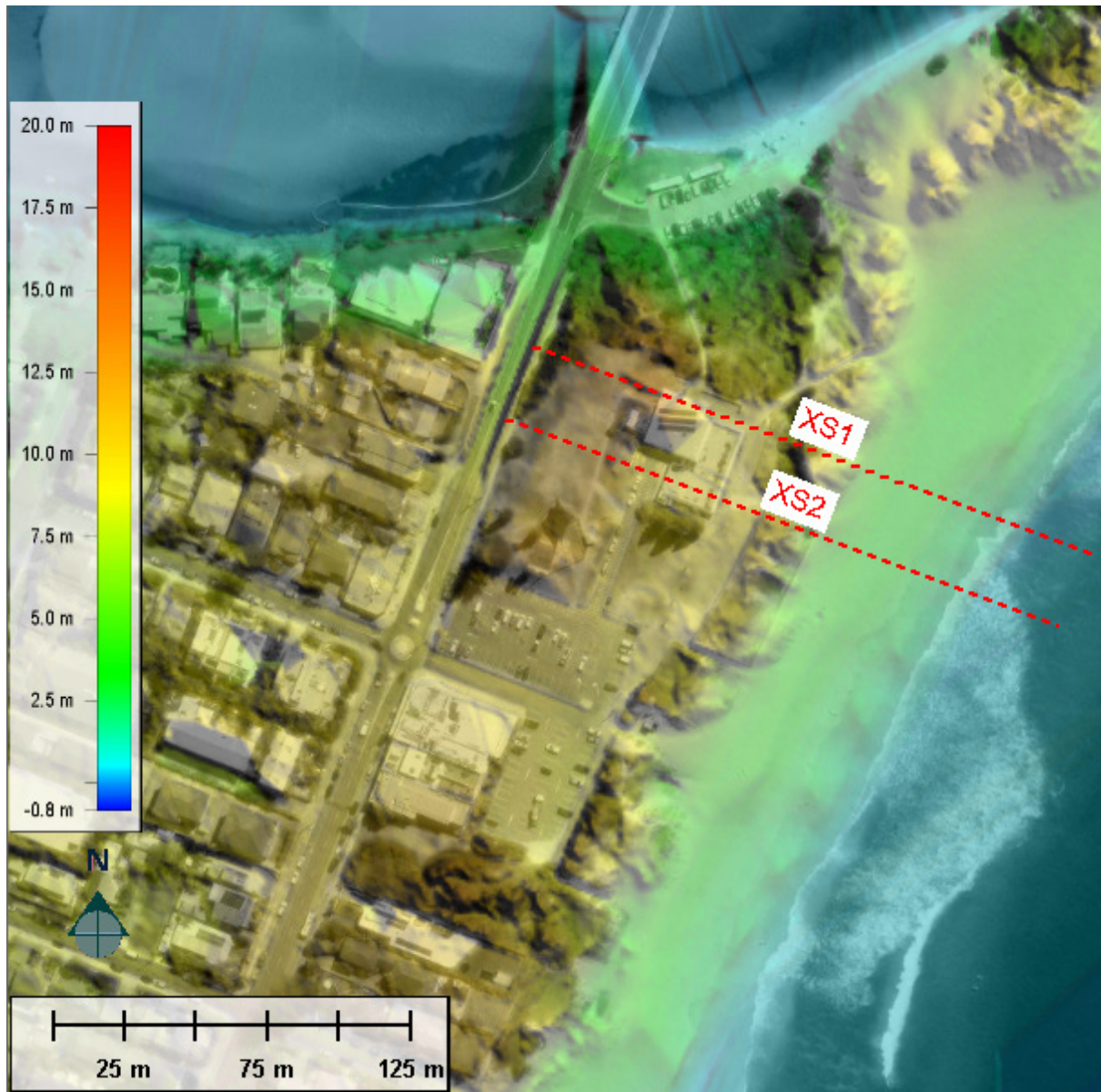


Figure 6: Cross sections analysed for Zone of Reduced Foundation Capacity (ZRFC).

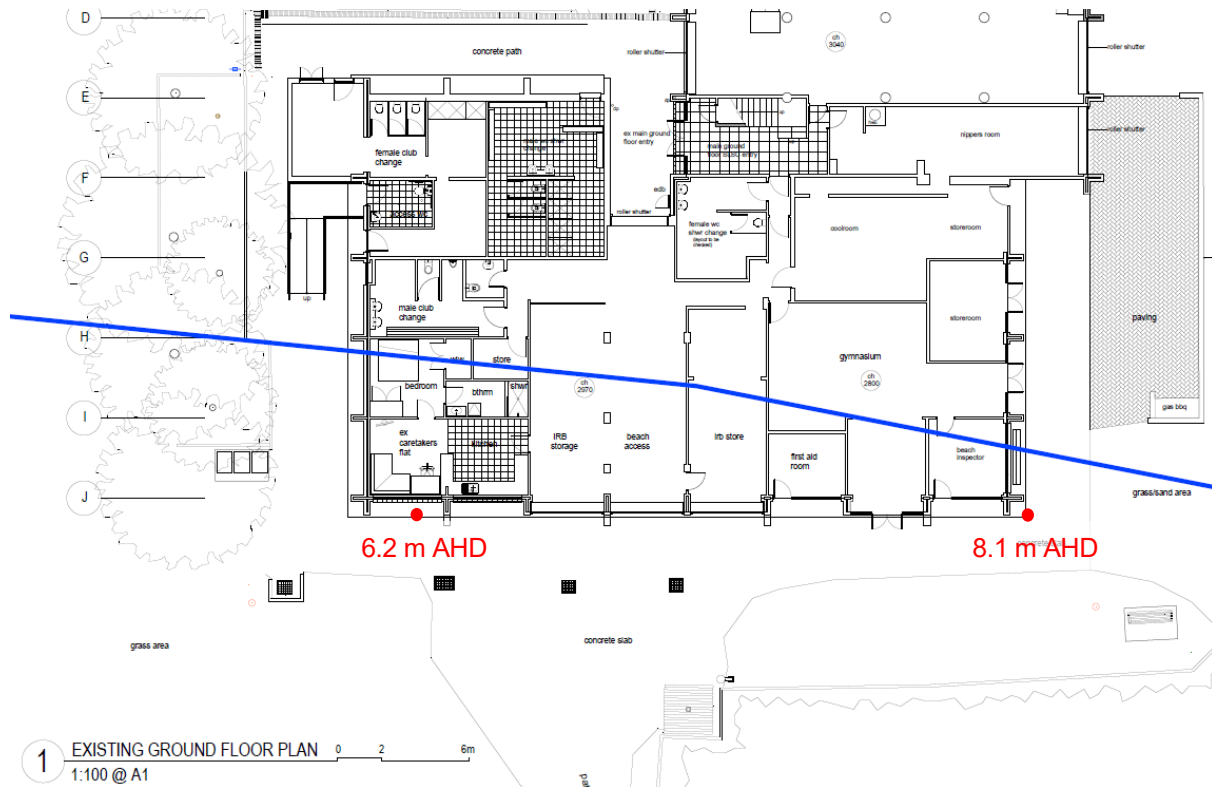


Figure 7: SLSC Existing ground floor: maximum vertical elevation for piled foundations to assume soil capacity based on ZRFC (see Figure 4).

Coastal Inundation

The 2016 CZMP addresses the potential for coastal inundation along Collaroy-Narrabeen in a cursory manner despite the shorelines along the beach potentially being subjected to predicted and observed wave run-up up to levels of 8 m AHD. The most severe wave run-up scenario along the sandy beach areas of Collaroy-Narrabeen occurs following significant erosion of the beach and the formation of a steep beach scarp at the back of the beach. This scenario has frequently occurred in major storms at Collaroy-Narrabeen over the last 80-years, including the June 2016 storm.

Baird completed a detailed case study report on the June 2016 storm and its impact on the Collaroy-Narrabeen, including from wave dominated inundation (Baird, 2021). The assessment included analysis of historical wave run-up and inundation back to the 1970's based on measured and hindcast data. That assessment indicated that extreme wave run-up levels can reach up to 8 m AHD for present sea level conditions and can impact up to the Zone of Slope Adjustment as indicated in Figure 4 when the elevation of the crest of the ZSA is less than 8 m AHD. Within the planning horizon applicable to this development application (i.e. 2050), the ZSA will be seaward of the SLSC and be located at an elevation of around 9 m AHD. It is not expected that the SLSC will be subject to coastal inundation from wave action or elevated coastal water levels.

Design and Management Recommendations for the Development Application

Based on a review of the development details for the planned alterations and additions to the North Narrabeen SLSC, the coastal hazards impacting the site, and the remaining structural life of the SLSC building (which is not expected to exceed 2050), Baird would recommend that no additional consideration of coastal hazards needs to be incorporated into the DA design. The following summarises the basis for this assessment:

- The SLSC is not expected to be within the active coastal erosion zone up to a planning horizon of 2074. It is currently landward of the erosion hazard impact area, including the current ZRFC following a severe erosion event.
- By 2050, it is estimated that with beach recession dominated by expected sea level rise, there is approximately a 1% per annum probability that the SLSC may be impacted by the ZRFC during or following a severe erosion event. For a public use asset such as the SLSC that is essential for the ongoing safe community use of the beach, and provides entertainment and recreational opportunities near the coast for the wider community, this level of risk exposure by 2050 is considered low.
- Additionally, the planned alterations and additions to the SLSC proposed in the DA will not extend the structural life of the SLSC, which is not expected to exceed 2050 before a major structural renovation or replacement of the building will be required.

As part of this coastal assessment, the stormwater drainage and its potential impact on coastal processes, particularly with respect to contributing to additional erosion has been considered. The storm water infrastructure is planned to be upgraded in this DA will drain towards the coastline from the northern and southern extents of the SLSC building. Within a planning period to 2050, it is not expected that stormwater from the SLSC building will have an adverse impact on the coastal hazards impacting the SLSC or any surrounding infrastructure and buildings.

It is recommended that the ongoing management and consideration of the impact of coastal hazards on the SLSC be reviewed by Northern Beaches Council on a periodic basis. This could occur at each update to the coastal management framework for the beach. This will ensure that if coastal processes or risk exposure of the SLSC to erosion increases in a manner not expected based on the current 2016 CZMP, any increased exposure to coastal hazards will be identified early and adaptive management of erosion risk to the SLSC could be implemented.

As a matter of precaution, Northern Beaches Council should ensure that the SLSC is included within the potential properties subject to emergency response actions during and following a major coastal storm event. Whilst the present risk the SLSC is considered extremely low, in the future as sea level rise increases including the SLSC in the properties potentially subject to emergency response actions will minimise risk to life and property because of possible damage to the SLSC.

Should you have any questions or comments regarding this report, please contact the signing engineer to this report.

With thanks,

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References

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Document Approval and Revision History

Revision	Status	Comments	Prepared	Reviewed	Approved
A	Draft	Sent to Rhelm for Review	RW / DT	DT	DT
0	Final	Issued for DA	RW / DT	DT	DT