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**Lexies Cafe, Stockton - Coastal Risk Assessment Review**

## 1.0 Introduction

Lexie's on the Beach Café building (Lexie's) is located directly south of the Surf Life Saving Club (SLSC) carpark in the beachside suburb of Stockton, located in the City of Newcastle (CN) Local Government Area (LGA). CN requested RHDHV undertake a preliminary coastal risk assessment to assess the present-day immediate level of risk to Lexie's from storm erosion.

Site measurements were undertaken by RHDHV on 14 February 2020 to capture the beach profile along the Lexie's café frontage.

The preliminary coastal risk assessment and findings are outlined below.

## 2.0 Preliminary Coastal Risk Assessment

### 2.1 Storm Demand

Storm demand represents the volume of sand removed from a beach (defined herein as the volume lost above 0m AHD) that could be expected due to a severe storm, or from a series of closely spaced storms.

Based on measurements at NSW beaches, Gordon (1987) derived relationships between storm demand and Average Recurrence Interval (ARI), at both 'high demand' areas (rip heads) and 'low demand' areas (away from rip heads). It was estimated that the storm demand was about 220m$^3$/m for the 100 year ARI event, for exposed NSW beaches at rip heads. Although the southern end of the Stockton embayment is protected from southerly storm events it remains exposed to east and north-easterly storm events. A storm demand of 220 m$^3$/m is considered appropriate for the site due to the exposure to events from the north-eastern sector and the location of the property adjacent to the SLSC revetment which could induce a 'rip head' formation during an event.

Nielsen et al (1992) delineated various coastline hazard zones, as depicted in **Figure 1**, assuming an entirely sandy (erodible) subsurface.

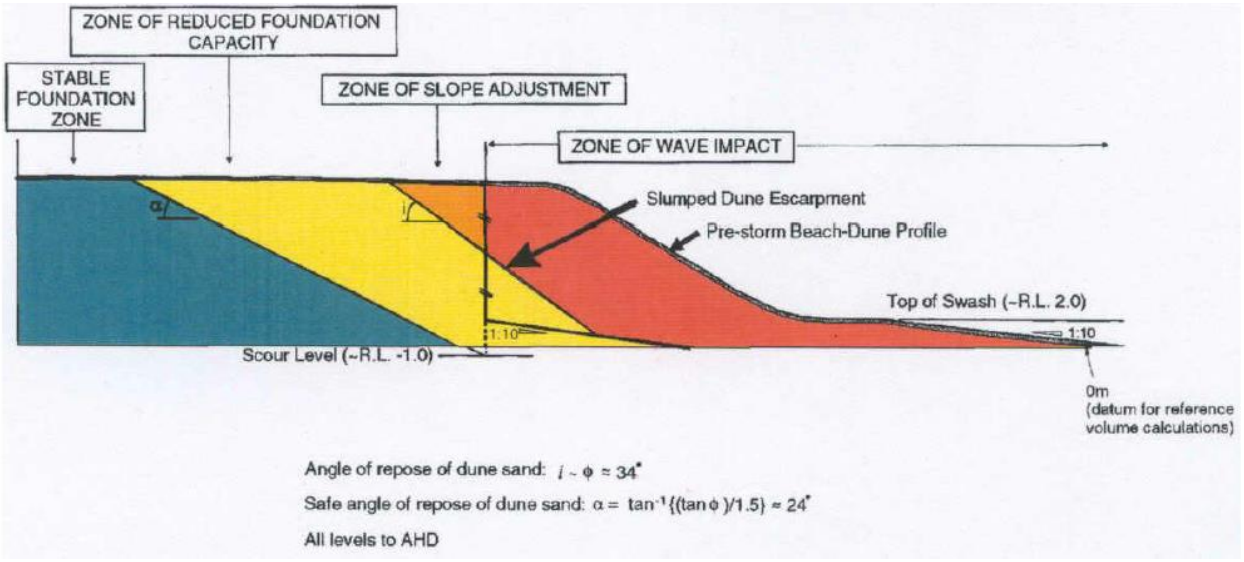


*Figure 1: Schematic representation of coastline hazard zones (after Nielsen et al, 1992).*

The method of Nielsen et al (1992) has been used to define the landward edge of the various coastline hazard zones. In the method, a $\phi$ value (natural angle of repose of sand, also known as friction angle) of 33° was conservatively adopted.

Typically, an 'average beach full' profile would be adopted as the pre-storm profile to assess coastline hazard zones as it is thought that an eroded profile would typically mean there would be offshore bars formed which would effectively reduce the actual storm demand volume by dissipating wave energy during the storm. These bars would subsequently migrate shoreward afterwards to recover the average beach full profile state. However, in this case, recent erosion losses at Stockton have not resulted in this typical pattern of offshore bar formation and/or subsequent recovery of an average beach full profile, suggesting a sediment deficit coastal system. Accordingly, it is considered appropriate (albeit conservative) to use the most recent (eroded) profile as the basis of the assessment of present-day immediate hazards. It is believed the lack of sand supply that is a factor in this ongoing recession is contributed to by the presence of the Newcastle Harbour breakwaters and entrance channel (now in place in some form for over 100 years) that impede longshore sediment transport supply from the south (Nobby's Beach).

In lieu of a site survey, measurements of the current erosion scarp location on 14/2/20 were used to develop the base pre-storm beach dune profiles to assess the current coastal hazard at the site.

The Zone of Wave Impact (ZWI), Zone of Slope Adjustment (ZSA) and Zone of Reduced Foundation Capacity (ZRFC) for a 100 year ARI event were calculated for two measured profiles (refer Figure 2). On this basis the locations of the landward edge of these zones are illustrated in **Figure 3** (ZSA only) and in a schematic section in **Figure 4**.

*Figure 2: Pre-storm measured beach profile locations (in red)*

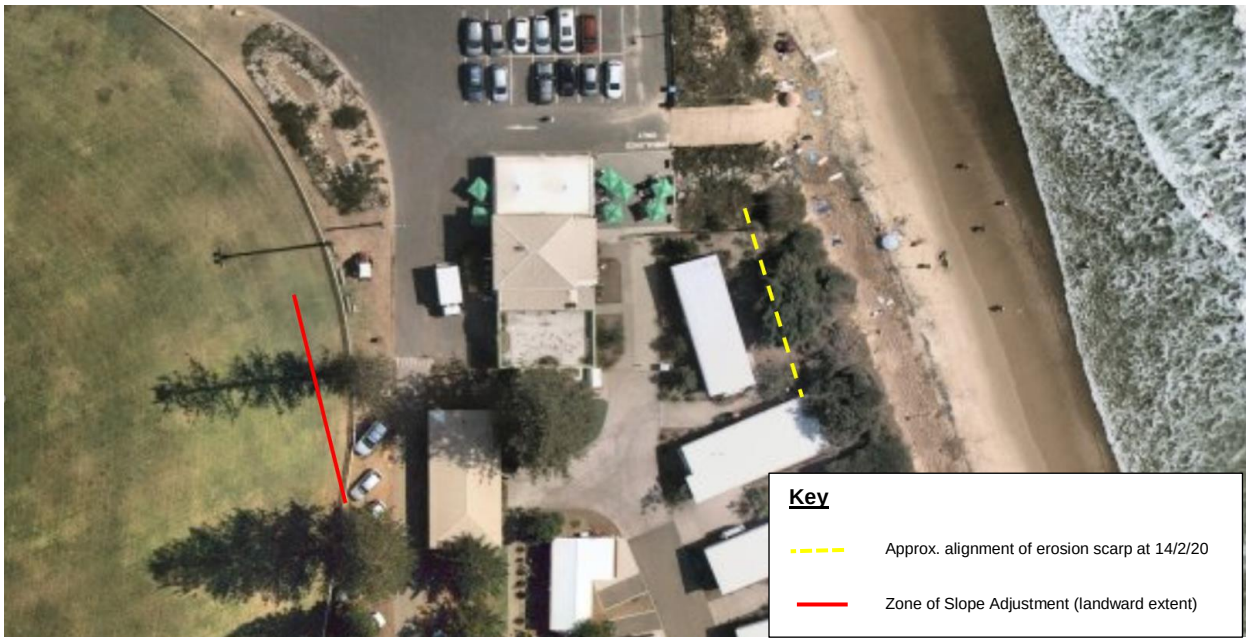


*Figure 3: Updated hazard lines estimated for Lexie's frontage (based on 14/2/20 measured profiles).*

The 'immediate' hazard line referred to in Coastline Hazard Definition Studies and Management Plans is generally defined at the landward edge of the Zone of Slope Adjustment (the red line in **Figure 3**). It is evident from **Figure 3** and **Figure 4** that Lexie's is well seaward of this immediate hazard line. By definition, this indicates that during and immediately following the design event (100 year ARI) this area would be undermined by coastal erosion. It is our understanding that Lexie's is founded on conventional foundations and, as such, is at risk of significant damage/failure if the design storm event was to occur.

The volume of sand currently available in front of the Lexie's to accommodate storm demand is less than 70m$^3$/m. In accordance with (Gordon, 1987), this approximately equates to a storm demand for a 2 year ARI storm event, i.e. the seaward edge of Lexie's would be on the edge of the slumped erosion scarp and the building would be in the Zone of Reduced Foundation capacity for a 2 year ARI storm event, posing a risk to the structural stability of the building.

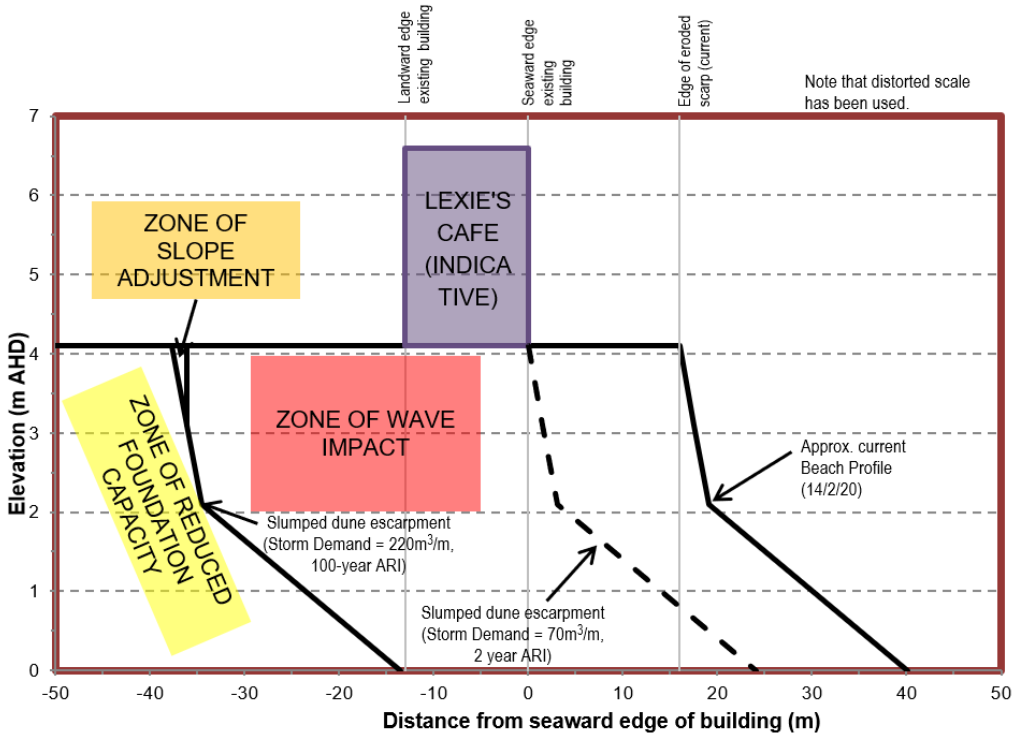


*Figure 4: Schematic of updated coastal hazard zones at Lexie's Cafe, Stockton.*

## 2.2 Long Term Recession

There has been historical recession in this location over the previous 55 years (1965 – 2020). However, this recession occurs as a number of episodic events, with significant erosion scarp movements in each event and limited recovery in the intervening periods, and not as a steady recession. Over time due to the recessive nature of the beach, the risk to Lexie's will increase, as the building and its foundations will be undermined in the event of storms of lesser ARI. As indicated in **Section 2.1**, it is already at risk from an event significantly less severe than the typically considered design storm event (100 year ARI).

To quantify this future risk, it is considered leading practice to undertake a probabilistic coastal hazard assessment incorporating Monte Carlo simulation of the variability in influencing factors, such as:

- climate change factors (e.g. sea level rise trajectory and associated Bruun Rule factors),
- recession rates due to net sediment loss (underlying recession),
- storm arrival time, and
- storm demand,

Information relating to the probability distribution functions of these influencing factors should be sourced from the most recent science and data.

A probabilistic assessment is beyond the scope and required timing of this advice.

## 3.0 Conclusion

On the basis of the present day immediate coastal hazard line shown in **Figure 3** and the coastal hazard zones depicted in **Figure 4,** it is evident that Lexie's is at immediate risk of significant damage/failure in the event of a design storm (100 year ARI) as it is in the Zone of Wave Impact (ZWI), seaward of the line defined as the immediate hazard.

Based on the present day erosion scarp location, the building is within the ZRFC, and therefore at risk, in a 1 in 2 year storm event (based on our understanding, as noted earlier, that the building is not founded on piles that extend through to the stable foundation zone).

This risk will increase in the future if the presently apparent recessive nature of the beach in this location continues.

Kind regards,

Principal Coastal Engineer
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**References**

Gordon (1987), ''Beach Fluctuations and Shoreline Change'' - NSW

Nielsen, A.F., D.B.Lord & H.G. Poulos (1992). "Dune Stability Considerations for Building Foundations", ", IEAust., Aust. Civ. Eng. Trans., Vol. CE 34, No. 2 pp 167-173.