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29 January, 2008

Cowman Stoddart Pty Ltd
P O Box 738
NOWRA NSW 2541

Attention: Mr Stephen Richardson

Dear Stephen

KIOLOA BEACH HOLIDAY PARK
23 ADDITIONAL SHORT-TERM SITES AND 93 ADDITIONAL CAMP SITES
COASTAL HAZARD ASSESSMENT

We refer to recent discussions between Mr Gary Blumberg of Gary Blumberg & Associates *(GBA)* and Mr Stephen Richardson of Cowman Stoddart Pty Ltd *(CS)* regarding the above. CS has retained GBA to prepare a coastal hazard assessment for the Kioloa Beach Holiday Park.

We are pleased to report here in this matter, set out under the following main headings:

- Introduction
- Collation and Review of Background Information
- Site Inspection
- Coastal Planning and Management Context
- Planning Period
- Coastal Hazard Assessment
- Summary
- References

Please note that reference to Relative Level *(RL)* made in this report refers to Australian Height Datum *(AHD)*. AHD is approximately Mean Sea Level.

Principal Gary Blumberg BSc(Eng)Civil MSc(Eng) MIEAust CPEng NPER3

1 INTRODUCTION

1.1 Background

Kioloa Beach Holiday Park is a leased 9 ha facility located south of Ulladulla on the NSW South Coast. The park is privately operated under licence from the NSW Government. CS has been retained by the proprietor of the Kioloa Beach Holiday Park to seek approval for the legitimisation of 23 short-term caravan sites and 93 camping sites within the facility. These sites, which have been in existence for many years, take the total for the Holiday Park to 243 short-term sites and 143 camping sites. The approved and subject additional sites are shown in **Appendix A**. The project comprises a “major project” for the purposes of Part 3A of the Environmental Planning & Assessment Act. The Department of Planning *(DoP)* is the consent authority.

DoP requires the Development Application be supported by a Coastal Hazard Assessment. A submission by the former Department of Natural Resources *(DNR)* dated 28/4/06 outlined the requirement for this study. CS has referenced the O’Hara Head Plan of Management prepared by Shoalhaven City Council *(SCC)* in relation to coastal hazard for the site, however the current Department of Environment and Climate Change *(DECC)* takes the view that a specific Coastal Hazard Assessment should be undertaken for this project.

The Coastal Hazard Assessment must satisfy DECC and DoP.

1.2 Study Area

The study area includes Kioloa Beach and its immediate foreshore adjoining Kioloa Beach Holiday Park in Shoalhaven LGA, NSW South Coast.

1.3 Scope of Work

The agreed Scope of Work for this consultancy comprised the following main tasks:

- Collation and Review of Background Information
- Site Inspection
- Adoption of suitable Planning Period
- Coastal Hazard Assessment
- Reporting

In developing the Scope of Work, GBA reviewed briefing documents provided by Cowman Stoddart in November 2007, in particular the letter from DNR dated 28/4/06. This letter identified Effluent Management, Adjoining Crown Reserves and NSW Coastal Policy as three areas requiring further assessment. This investigation relates mainly to the NSW Coastal Policy elements.

In developing the Scope of Work, GBA discussed the matter with DECC's coastal assessment officer in Wollongong Mr Habib Uller *(13/11/07 pers comm).*

2 COLLATION AND REVIEW OF BACKGROUND INFORMATION

GBA has searched its records and liaised with the Holiday Park, CS, SCC and DEC to collate relevant background information. This has included the following:

- Aerial photographs and orthophotomap
- Site surveys and caravan park layouts
- Requirements of DECC and DoP *(DNR letter dated 28/4/06 refers)*
- NSW Coastline Management Manual *(NSW Government, 1990)*
- SCC Coastline Risk Management Report *(SMEC, 2004)*
- O'Hara Head Plan of Management *(SCC, 2006)*
- Draft Beach Management Plan, Foreshore Reserve, Kioloa Beach *(Cowman Stoddart, 2007)*

We note that SCC is currently finalising its Coastal Zone Management Plan for the Shoalhaven. This document is to build on SMEC (2004), focusing on priority coastal hazard locations and detailing a management response. At the time of preparing this report, the Coastal Zone Management Plan was yet to be released (**Section 4.2**).

The 1:4,000 orthophotomap is reproduced in **Figure 1**. Based on January 1985 aerial photography, it is apparent that the 4 m contour shown to cross the dune mid way along Kioloa Beach is not correct. For this section of the site, our assessment defers to the ground survey information and our appraisal of relative levels from our site inspection.

3 SITE INSPECTION

A site inspection was made by Mr Gary Blumberg on 10 January 2008. Weather during the inspection was fine, winds were fresh from the NE and the swell sight. Breaking waves on the beach fronting the park were approximately 0.5 m in height. No rain had fallen in the few days prior to the inspection, and the tide at the time was spring low *(RL -0.6)*. Selected photos taken during the inspection are included below.

Our inspection covered the following:

- General layout of the park and proximity to the coast
- Beach and dune condition and stabilisation
- Creeks, stormwater and coastal flooding
- Wind blown sand

We were accompanied at our inspection by park operator Mr Tony van Bergen.

3.1 General Layout and Proximity to Coast

The park is located between Murramarang Road and Kioloa Beach, immediately north of O'Hara Head. At approximately 600 m long by 150 m wide, the park runs almost the full length of Kioloa Beach (**Figure 1** and **Photo 1**). The beach dune essentially forms the eastern long boundary of the park. A small basalt outcrop at Butlers Point marks the northern end of Kioloa Beach (**Photos 2** and **6**).

Three boarded pedestrian accessways cross the dune (**Photos 3** to **5**), all of which we understand are well used.

3.2 Beach and Dune Condition and Stabilisation

Kioloa Beach is highly compartmentalised, typical of may beaches along the NSW South Coast. The beach faces due east. The beach enjoys a reasonable level of protection from ocean swells, this achieved by its closely spaced rocky headlands and Belowla Island. This island is of comparable size to Kioloa Beach *(and is significantly larger if its surrounding reefs are accounted for)*, and is located some 800 m offshore (**Figure 1** and **Photos 5** and **6**).

Kioloa Beach appeared in good condition at the time of our inspection. Low tide beach width to the toe of the foredune measured some 50 to 60 m. No residual erosion was evident within the berm, and the well developed foredune (**Photo 2**) showed no damage from the significant storms which affected the NSW coast in late June 2007. Investigations and reports on these storms in and about the Sydney Region cited their recurrence as nominally a 1 in 10 year event. We understand from Mr van Bergen that wave run up from the June storms reached the toe of the foredune, but the feature itself was not impacted. We would expect ESE incident swells to be the critical wave direction for Kioloa Beach, although significant dissipation of wave energy would occur due to refraction, diffraction and wave breaking around the southern headland and island (**Figure 4**).

To characterise the beach profile at Kioloa, Mr Blumberg gauged two beach sections fronting the park, one opposite the southern beach access *(Profile S-S)* and the other close to the northern end of the beach *(Profile N-N)*. These profiles, located and sketched in **Figures 1** and **3**, are summarised below in **Table 1** *(chainages in metres)*.

TABLE 1 SUMMARY OF BEACH SECTIONS

Description	Profile S-S	Profile N-N
• Water line *(spring low)*	Ch 0	Ch 0
• Former HWM	Ch 32	Ch 40
• Edge exposed bedrock at Butlers Point	-	Ch 50
• Toe foredune	Ch 54	Ch 65
• Crest foredune	Ch 67	-
• Former erosion scarp *(expect from storms of mid-1970s)*	Ch 84	-
• Edge steps on timber boardwalk	Ch 93	-
• Dune crest *(approx)*	Ch 100	Ch 75
• Seaward boundary of Lot 128 *(approx)*	Ch 110	Ch 90

Surface levels along the profiles have been estimated having regard to the orthophotomap and other available survey (**Figure 1**), and our site inspection.

The foredune at Kioloa Beach exhibits a healthy cover of spinifex grass and other groundcovers *(eg pennywort and pigface)*. Coastal rosemary, swordgrass and beard heath then merge to stands of 5 m high banksia trees located on the primary dune (**Photos 2**, **3** and **8**). Terrestrial grass thickly covers the lee of the dune, in areas penetrating seaward of the dune crest.

3.3 Creeks, Stormwater and Coastal Flooding

The Holiday Park is drained via a gully located on the western edge of the camping sites. This gully drains north-south into a small dam (**Figure 1**, **Photos 8** and **9**). The dam then drains to a larger creek, the catchment of which extends to the west side of Murramarang Road. The host creek widens below this dam, turning southwards within the dune complex before spilling across the southern end of Kioloa Beach. This creek entrance would be mostly closed, only breaking-out after

Photo 1 – Kioloa Beach looking south from east end of southern-most accessway. Coastal Patrol facilities shown at O'Hara Head.

Photo 2 – Kioloa Beach looking north from southern accessway. Foredune appears healthy and accreting, and hind dune well stabilised with vegetation.

Photo 3 – View along boardwalk at southern-most accessway.

Photo 4 – Boardwalk and steps at southern-most accessway.

Photo 5 – View along a central accessway. Belowla Island 800 m offshore.

Photo 6 – Basalt outcrop at Butlers Point, and Belowla Island.

Photo 7 – Typical layout of camping sites on east side of Holiday Park.

Photo 8 – Drainage gully flows north to south along west edge of camping sites.

Photo 9 – Drainage gully connects to this small dam, which overflows to the creek at the south end of Kioloa Beach.

Photo 10 – Closed entrance to creek at southern end of Kioloa Beach.

sufficient rainfall (**Photo 10**). The topography of the park site and adjoining dune ensures that drainage onto Kioloa Beach is confined to this single creek outlet. Butlers Creek drains to the beach on the north side of Butlers Point, however there would appear to be minimal drainage from the Holiday Park to this system *(note contours in* **Figure 1***)*.

We understand that localised flooding of the Holiday Park occurred in October 1999 as a result of the stormwater system in Murramarang Road overflowing onto the site. From diary records prepared by Mr van Bergen, 195 mm of rain fell over the weekend prior to Monday 25 October 1999. Later on that Monday, at about 3.00 pm, approximately 100 mm of rain fell in one hour. Localised flooding occurred from 4.00 pm, and by 8.00 pm the majority of the flooding had passed. Photos taken during this event, together with a copy of Mr van Bergen's diary entry and his appraisal of the extent of localised flooding, are included in **Appendix B**. GBA understands that 100 mm of rain falling in one hour would constitute a rainfall intensity more extreme than a 1 in 100 year event in Sydney *(CPAA, 1991)*. Whist we have no information for the Kioloa area, a comparable recurrence could be expected. An appraisal of the contribution of elevated coastal water levels to flood egress from the park is made in **Section 6.2**.

3.4 Wind Blown Sand

Our site inspection was carried out under a fresh NE breeze. While sand was being blown across the beach and over the foredune, in the lee of the main dune the wind was barely noticeable and wind blown sand was non-existent. There were no accumulations of exposed beach sand in the park, a typical indicator of any wind blown sand issues.

4 COASTAL PLANNING AND MANAGEMENT CONTEXT

It is useful to briefly mention the key State and Local coastal planning and management policies relevant to this assessment.

4.1 State Planning

4.1.1 NSW Coastal Policy

The NSW Government adopted its Coastline Hazard Policy in 1988. The primary objective of the policy is to reduce the impact of coastline hazards on individual owners and occupiers of land and to reduce private and public losses resulting from such hazards. The Coastline Management Manual was released with the policy (**Section 4.1.2**), to assist local councils better understand coastal processes, hazards and coastline management (**Section 6**).

In 1997 the NSW Government adopted a revised NSW Coastal Policy and this remains current. This policy is based on two fundamental principles: ecologically sustainable development and integrated coastal zone management.

4.1.2 NSW Coastline Management Manual

The Coastline Management Manual *(NSW Government, 1990)* sets down a framework for local councils to manage the coastline in accordance with State Government requirements. The Coastline Management Manual forms part of the implementation of the NSW Coastal Policy. The Coastline Management Manual is the subject of a current review by the Department of Environment and Climate Change *(DECC)*.

The coastal hazard assessment for the site, set out in **Section 6**, is based on the methodology outlined in the current Coastline Management Manual.

4.1.3 SEPP 71 – Coastal Protection

The NSW Department of Planning and SCC may refer this application to DECC under SEPP 71 – Coastal Protection. SEPP 71, gazetted in November 2002, was made to ensure consistency in respect of coastal planning and management in NSW, particularly for new development. Matters prescribed under the SEPP include suitability of development, public access, amenity and overshadowing, scenic qualities, habitat and wildlife corridors, coastal processes and hazards, conflict between land and water-based activities, heritage, water quality and energy efficiency.

SEPP 71 makes the Minister for Planning the consent authority for State significant development in the coastal zone.

4.2 Coastline Risk Management in Shoalhaven LGA

SCC has developed a coastal hazard overview for developed coastal areas within the Shoalhaven *(SMEC, 2004)*. The hazards identified comprised coastal erosion, coastline recession and oceanic inundation. Risks were assessed for the 1% event occurring today *(2004)*, and at the end of 50 and 100 year planning periods.

Kioloa Beach attracts brief mention in the report. In their analysis of the site, SMEC identifies Belowla Island as inducing significant nearshore wave diffraction *(protection through physical shielding)*. They also note that the beach does not appear to be experiencing long-term recession, and using modelling procedures estimate 1% AEP *(Annual Exceedence Probability)* oceanic inundation at RL 4.4, increased to RL 4.7 with Greenhouse sea level rise. SMEC had no information on ground levels in the Holiday Park, and recommended a coastal hazard study with particular reference to wave impact and inundation.

As a follow-on from SMEC (2004), SCC is currently completing a comprehensive shire-wide Coastal Zone Management Plan *(CZMP)*. At the time of preparing this assessment no documentation in relation to this plan was publically available *(Ray Massie, SCC Coastal Assessments Officer, 10/1/08 pers comm)*.

Neither SCC, nor their consultants preparing the CZMP *(SMEC Engineers),* hold historical air photos covering Kioloa. Furthermore, we understand from SMEC that Kioloa Beach attracts no specific treatment in the CZMP. There is no DECC photogrammetry which covers the site, and no data *(Chris Adamantedis, SMEC, 15/1/08 pers comm).*

5 PLANNING PERIOD

SCC typically requires a 50 year planning period for inclusion in coastal engineering assessments for individual residential developments. Subdivisions may typically require a longer planning period. For recent GBA coastal assessments carried out for private properties at Mollymook and Vincentia *(Jervis Bay)*, a 100 year planning period has been specified for the Zone of Reduced Foundation Capacity associated with design back-beach erosion. Earlier this year, GBA adopted a 100 year planning period for a coastal hazard assessment for a new 71 lot residential subdivision at Manyana on the NSW South Coast.

We consider it appropriate to apply the SCC "residential standard" for coastal hazard assessment at the Holiday Park *(ie 50 year planning period, increased to 100 years for any foundation design)*, for the following reasons

- the DA relates to the allocation of areas for short-term occupation by caravans and tents;

- the risk posed by exposure to coastal hazard is heavily mitigated in that persons and property can be readily evacuated from the site if required. Short warning times will be sufficient for holiday makers to pack up their belongings and depart.

6 COASTAL HAZARD ASSESSMENT

The NSW Coastline Management Manual identifies the following potential coastal hazards for consideration in a Coastal Hazard Assessment *(NSW Government, 1990)*:

- beach erosion
- shoreline recession
- coastal entrance instability
- sand drift
- coastal inundation
- stormwater erosion hazard
- slope and cliff instability
- climate change

Beach erosion, shoreline recession and coastal entrance instability can markedly alter the shape of the coastline. If not properly catered for, these hazards can imperil coastal developments and reduce amenity. Sand drift may contribute to a permanent loss of sand from the beach. It is at best a nuisance, although it too can overwhelm nearby developments. Low-lying areas of the coast may be threatened by coastal inundation caused by storm surges and the action of large waves. Slope and cliff stability problems are a threat to the structural integrity of buildings constructed on coastal bluffs and steep sand dunes. Climate change attributed to the Greenhouse Effect can exacerbate all of the above hazards, but in particular shoreline recession and coastal inundation.

We have applied existing information and available data, current desk-top analytical coastal assessment procedures and our 25 years coastal engineering experience in NSW to address the above hazards.

6.1 Beach Erosion and Shoreline Recession

Beach erosion refers to the loss of beach and dune sand in a storm or closely-linked series of storms. Shoreline recession refers to the long-term retreat of the shoreline, often attributed to incomplete beach recovery following erosion events. Sea level rise due to the Greenhouse Effect also contributes to shoreline recession.

6.1.1 Beach Erosion

Beach erosion is commonly measured in volumetric terms above AHD. For the adopted 50 and 100 year planning periods, design beach erosion on the NSW open coast typically ranges from 120 to 195 m^3/m, and 140 and 225 m^3/m respectively, depending on level of exposure *(Gordon, 1987)*.

Given its highly compartmentalised planform and the proximity and scale of Belowla Island, we would consider Kioloa as a "low-demand open beach" for which lower-bound erosion values would reasonably apply. For this assessment we have selected 120 and 140 m^3/m as the design erosion demands.

As is common *(and conservative)* practice, GBA has assumed that the design storm erosion is applied at the end of the planning period, following predicted shoreline recession (**Section 6.1.2**) and including the effects of Greenhouse Sea Level Rise *(SLR)* (**Section 6.7**).

During a storm, beach erosion nominally consumes beach sand down to approximately Mean Sea Level *(MSL).* Fluidisation of the sand up to 1 m below MSL can also occur along an eroding beach. Localised scour at a hard shore structure may even extend to lower levels. Also, the back-beach erosion escarpment will be steep *(almost vertical)* during the height of the storm, but will slump to a more gentle slope as the storm subsides and embankment dries out. To account for the effects of toe scour and post-storm slumping, it is common practice to apply slope stability techniques to define a so-called Zone of Slope Adjustment, Zone of Reduced Foundation Capacity, and Safe Foundation Zone *(Nielsen et al, 1992)* (**Section 6.6)**.

6.1.2 Shoreline Recession

Shoreline recession may be quantified in volumetric terms *(as above for beach erosion but in m^3/m per yr)* or in terms of horizontal retreat *(simply m/yr)*.

SMEC (2004) notes that Kioloa Beach does not appear to be experiencing long-term recession (**Section 4.2**). This would be consistent with our observation of a highly compartmentalised beach with no obvious conduits for long-term sand losses. Indeed, we observe a well developed foredune which appears to be accreting (**Photo 2**). It is reasonable to neglect sand imbalance losses in quantifying shoreline recession. However, recession due to Greenhouse sea level rise *(SLR)* must be accounted for.

As described in **Section 6.7**, we estimate shoreline recession at Kioloa Beach of 9 m over 50 years attributed to SLR, extending to 19 m over 100 years.

6.1.3 Combined Beach Erosion and Shoreline Recession

The combination of design beach erosion and shoreline recession, including the effects of SLR, are depicted in **Figures 2** and **3**.

6.2 Coastal Inundation

Coastal inundation is the flooding of coastal lands by ocean waters. Elevated coastal water levels during storms, and wave run up and overtopping, both contribute to coastal inundation. The impact of coastal inundation on drainage from the park must also be considered.

6.2.1 Elevated Coastal Water Levels

Apart from local water level fluctuations due to waves, coastal water levels in storms can be elevated considerably above normal tide levels. Having regard to the degree of coastal protection enjoyed by Kioloa Beach, to other reported investigations up and down the NSW coast, and making allowance for astronomical tide, storm surge and wave setup, we estimate design elevated coastal water level at Kioloa Beach at approximately RL 2.3. This so-called Still Water Level *(SWL)* exceeds the peak spring tide level by approximately 1.3 m.

6.2.2 Wave Run up and Overtopping

Wave run up is the upward rush of water on a beach or coastal structure, attributed solely to wave breaking. Wave run up is measured as the vertical height above SWL to which the rush of water reaches. If the wave runup level exceeds the dune or structure crest, then wave overtopping will occur.

There are a range of methods for estimating wave run up and overtopping, however few procedures apply to beaches. To make our assessment of design wave run up for the site, we have adopted procedures outlined in Hanslow and Nielsen (1995). Based on their field measurements of run up made at five NSW beaches, Hanslow and Nielsen propose a modification to the established method of Hunt (1959) to estimate wave run up based on wave height *(H)*, wave length *(L)* and beach slope *(ß).* Noting a literature review reported in MHL (2002), we have assumed the run up slope to equal the average slope between a nominal wave break point and the limit of wave run up. The procedure is iterative with respect to run up level, however the solution converges rapidly. A summary of our adopted parameters and estimated design wave run up is given in **Table 2**. The full calculation is presented in **Appendix B**.

Since the design wave run up level *(RL 4.5 to 5.0)* is estimated to fall below the dune crest level at Kioloa Beach *(RL 5.5 to 6.0)*, wave overtopping would not be expected. SLR over 50 years is predicted at 0.25 m (**Section 6.7**). Given that it is reasonable to simply add SLR to the

TABLE 2 DESIGN WAVE RUN UP ASSESSMENT

Still Water Level	RL 2.3	Allows for tide, surge and wave setup
"Scaled" significant offshore breaking wave height	8.7 m	Incorporates a reduction coefficient to account for wave direction changes from offshore to nearshore
Significant wave period	13 s	
Run up slope	3 – 4 degrees	Average slope between inshore break point and runup limit
Design 2% wave run up above design Still Water Level	2.2 – 2.7 m	Run up exceeded by 2% of waves. Implicitly accounts for beach permeability and roughness
Design 2% wave run up level	RL 4.5 to 5.0	
Dune crest level	~RL 5.5 – 6.5	Based on GBA interpretation of orthophotomap and available survey
Overtopping depth	Nil	Zero overtopping since dune crest level exceeds design wave runup level

Notes Based on Hanslow and Nielsen (1995) having regard to a discussion on beach slope presented in MHL (2002)

design run up level, it follows that protection from wave overtopping would be preserved after allowance for SLR.

6.2.3 Impact of Coastal Inundation on Drainage from Holiday Park

The Holiday Park experienced a localised flooding event on 25 October 1999 attributed to overflow from the local stormwater drainage system in Murramarang Road. We understand that this is the most serve flood on record to have affected the park. Any influence of the downstream creek entrance and ocean tail water level on flood egress are relevant to the coastal inundation hazard. Based on ground levels shown in **Figure 1** and information in **Appendix C**, we estimate the maximum ponding level across the park during the October 1999 event at between RL 4.0 and RL 4.5. GBA appraises the rainfall during the storm and its local flood impact as in the order of a 1 in 100 year event for the Holiday Park (**Section 3.3** and **Appendix C)**.

The small dam at the downstream end of the main north-south drainage gully readily fills during rainfall. The overflow for this dam comprises a 20 m long culvert tunnel some 750 mm wide by 500 mm high, with inlet invert set around RL 3.5. We understand that this dam was almost full when Mr Blumberg made his inspection on 10/1/08 (**Photo 9**). During the peak of the 1999 storm the dam wall overflowed *(100 to 150 mm flow depth, 2 to 3 m wide, T van Bergen, pers comm)*. We estimate a peak culvert discharge during this event at approximately 1.0 m^3/s, plus a further 1.0 m^3/s of dam overflow.

The beach berm which normally blocks the entrance to the creek would have fully scoured out during the two days preceding the Monday 25 October 1999 flood during which some 200 mm of rain is understood to have fallen. The predicted tide on 25 October 1999 was RL -0.3 at 4.00 pm *(onset of flooding)* rising to almost high tide of RL 0.75 at 8.00 pm *(majority of flooding passed,* **Section 3***)*. It is noteworthy that the peak of the flooding in the park did not coincide with the peak of the tide. While we have no information on wave setup or storm surge, there is no record or recollection that a severe coastal storm event coincided with the October 1999 flood (**Appendix C**).

During our site inspection we observed the blocked entrance to the southern creek (**Photo 10**). Based on our understanding of typical back-beach creek pondage behaviour and our appraisal of back-beach levels at Kioloa, we estimate the water level in the closed off creek entrance at approximately RL 1.0, or some 2 m below the existing water level in the small dam.

During the October 1999 flood event, the water level in the broken-out creek entrance would have been controlled by the water level in the ocean. Even allowing for substantial creek flows *(steep headlosses in the creek entrance)*, we would not expect the water level in the creek entrance *(downstream of the dam)* to have exceeded say RL 2 during the event.

Since the October 1999 flood levels in the Holiday Park would therefore have been 2 m or more above the peak water level in the creek entrance, it follows that the ocean level would have had no bearing on the flooding in the park. Indeed, this same behaviour would be expected for elevated coastal water levels up to and exceeding the adopted design level of RL 2.3, levels which clearly are sufficiently below flood levels in the park and dam such as to have no backwater influence.

It is therefore our submission that coastal inundation is independent of flooding behaviour in the Holiday Park which is fully controlled by local rainfall.

6.3 Coastal Entrance Instability

Entrances can migrate along a beach in response to freshwater flooding and coastal storm effects. This may threaten adjacent developments. Training works will stabilise the location of an entrance *(NSW Government, 1990).*

The entrance to Butlers Creek is separated from Kioloa Beach by Butlers Point, hence there is no opportunity for this entrance to migrate southwards towards the Holiday Park. Bedrock is not apparent at the southern creek entrance and potential instability at this entrance requires some comment.

The downstream section of the southern creek sweeps northwards adjacent to the SE corner of the Holiday Park. It then turns sharply to the east before looping back to the south. With historical aerial photography not readily available, we refer here to our discussions with others, our observations on the morphology of the back-beach and dune in the vicinity, and the proximity to development.

Firstly, there is no suggestion from our discussions with Council, its consultant charged with the shire-wide Coastal Zone Management Plan, or the current park operator, that entrance instability here poses a threat. The system is small, and its capacity to migrate is contained.

Bank erosion, a precursor to any instability, is not mentioned. If bank erosion was an issue, its likely that it would have become apparent after the 1999 flood, at substantial local event at Kioloa. In our opinion, any alteration to the lower creek as a consequence of future extreme floods and storms would be confined seaward of the dune crest which is outside the boundary of the Holiday Park.

6.4 Sand Drift

Sand drift refers to beach sand which is blown landward from the beach and dune.

The Holiday Park has constructed four boardwalk accessways, three of which link directly to Kioloa Beach. These are well used, limiting problematic informal walking tracks. We understand that the park is proposing to rationalise and formalise existing access tracks through the dune, including the construction of an additional timber boardwalk (CS, 2007).

We observed good protection from onshore winds in the lee of the main dune. This is attributed to the substantial existing buffer between the beach and the park *(approx 40 m)*, and the well developed native vegetation across the dunal corridor. We note that the O'Hara Head Reserve Plan of Management recognises the improvements to native vegetation management on the dune implemented by the park operator *(SCC,* 2006).

We observed no blow-outs or accumulation of wind blown sand landward of the dune crest, and it is our submission that sand drift is not a significant hazard along Kioloa Beach.

6.5 Stormwater Erosion Hazard

Stormwater erosion hazard is a local problem and should not be confused with regional freshwater flooding. Where stormwater outlets discharge at the back of a beach, major runoff events can result in concentrated erosion of the berm. This may be a short-term amenity issue, or could have more serious implications adding to the erosion demand in severe storms.

Stormwater discharge to Kioloa Beach from the Holiday Park is confined to the southern creek. There are no other outlets to the beach because of the dunal ridge running along the park's eastern boundary.

A break-out of the creek outlet would concentrate erosion of the berm, however any influence on erosion behaviour would be localised *(say within 50 m of the outlet)*. While this may locally contribute to the erosion hazard, the magnitude of the impact would be such as to have no bearing on park infrastructure which is well removed from the SE corner of the site (**Figure 4**).

The stormwater erosion hazard is thus accounted for in respect of the coastal entrance instability (**Section 6.3**) and localised and manageable in relation to erosion hazard (**Section 6.1**).

6.6 Slope and Cliff Instability

Slope and cliff instability hazards refer to possible structural incompetence of these features and related potential problems with foundations of buildings, seawalls and other coastal works. The hazard for Kioloa Beach is limited to slope instability.

Wave erosion leads to the removal of beach and dune sand from the Zone of Wave Impact (**Section 6.1.1**). For a major event, the landward limit of this zone forms a near-vertical scarp at the peak of the storm. Within hours to days of the storm passing, the back-beach erosion escarpment dries out and slumps. The slumped slope is taken to equal the angle of repose of marine sand, nominally taken as 35 degrees. The slumped escarpment gives rise to a Zone of Slope Adjustment which extends further landward. The Zone of Reduced Foundation Capacity accounts for a reduced Factor of Safety from that which would normally be considered stable in the area immediately landward of the Zone of Slope Adjustment. These various zones were conceptualised in Nielsen et al (1995), and this model is currently adopted by DECC to represent the slope instability hazard at an eroding sandy coast (**Figure 2**).

In the absence of subsurface soil information it is conservative to assume marine sand as comprising the shore profile fronting the site, with inerodible materials absent above RL -1. It is appropriate therefore to apply the DECC's slope instability model to the Holiday Park site.

We have used our site appraisal of the two beach sections fronting the park, one opposite the southern beach access *(Profile S-S)* and the other close to the northern end of the beach *(Profile N-N)*, to characterise the shore profile. Reference was also made to the ground levels shown on the 1:4,000 orthophotomap and the level survey supplied by CS, reproduced in **Figures 1**.

This advice has adopted SCC's "residential standard" for coastal hazard assessment at the Holiday Park *(ie 50 year planning period, increased to 100 years for any foundation design)* (**Section 5**). While foundations are not required as part of the subject DA *(limited short-term caravan and camping sites)*, it is instructive nevertheless to locate the Zone of Reduced Foundation Capacity in accordance with the 100 year planning horizon.

The application of the DECC model at Kioloa Beach is shown in **Figure 3** with the key outcomes summarised below in **Table 3**.

According to Nielsen et al (1992) which sets out the current approach adopted by the NSW Government in respect of coastal foundation design, either shallow or deep foundations can be used to support building structures in the Zone of

Reduced Foundation Capacity. These foundation must be designed to support the axial and lateral structural loadings. However, in the absence of adequate theoretical procedures, Nielsen et al (1992) recommend that the required load capacity of the foundation be developed within the underlying Safe Foundation Zone, and that no allowance be made for resistance of the soil above this zone. This can be achieved with pile foundations which suitably penetrate the Safe Foundation Zone.

TABLE 3 KEY OUTCOMES OF DECC SLOPE INSTABILITY MODEL

Description	Assessed Distance Seaward from Seaward Boundary of Lot 128 (m)	
	Profile S-S	Profile N-N
Landward limit of 50 year Zone of Slope Adjustment *(commonly referred to as the Coastal Hazard Line)*	30 m	10 m
Landward limit of 100 year Zone of Reduced Foundation Capacity	5 m	-15 m

Structural engineering advice would be required to prepare detailed designs for any building foundations falling within the Zone of Reduced Foundation Capacity. With note that this is not a requirement of the subject DA.

6.7 Hazards of Climate Change

The Intergovernmental Panel on Climate Change has recently reported its SLR scenarios to the years 2090/2099 *(IPCC, 2007)*. IPCC's current predictions are considered by DECC to be the best information available to assess the likely impact of climate change on sea levels. For coastline hazard assessments in NSW, it has been common practice to consider the average of the SLR scenarios which, for the current IPCC revision, translates to a conservative postulated rise of 0.49 m over the 100 years to 2090/2099. This is based on:

(i) 0.34 m as the combined average of the model ranges *(Table SPM-3, IPCC 2007);*

(ii) plus 0.15 m to account for uncertainties in carbon feedback and changes in ice sheet flow *(p14, 3rd bullet, IPCC 2007)*

Since SLR predictions exhibit larger increases over the second half of the 21st century compared to the first half, it follows that it adopting 50% of 0.49 m over 50 years is a prudent assessment.

Shoreline recession is predicted to occur as a consequence of SLR. According to the "Bruun Rule", the currently accepted methodology for estimating SLR recession, the coastal profile will translate landward by a distance equal to the product of the SLR and the slope of the active profile *(ie average slope between the offshore limit of significant onshore/offshore transport in storms, and the crest of the dune)*. For the purposes of this assessment we have appraised the slope of the active coastal profile at 1:40 *(v:h)*.

The 50 year SLR shoreline recession applicable at the site is thus 9 m *(50% x 0.49 m x 40)* (**Section 6.1.2**).

7 SUMMARY

Kioloa Beach Holiday Park is a leased 9 ha facility located south of Ulladulla on the NSW South Coast. The park is seeking approval for legitimisation of 23 short-term caravan sites and 93 camping sites within the facility (**Figure 1** and **Appendix A**). These sites have been in existence for many years. The project comprises a "major project" under Part 3A of the Environmental Planning & Assessment Act. The Department of Planning is the consent authority. The Department requires the application be supported by a Coastal Hazard Assessment.

A site inspection was made by Mr Gary Blumberg in January 2008. This covered general layout of the park and proximity to the coast, beach and dune condition and stabilisation, creek, stormwater and coastal flooding, and wind blown sand.

The assessment has summarised the coastal planning and management context, addressing the NSW Coastal Policy, the Coastline Management Manual, SEPP 71, and status of coastline risk management in Shoalhaven LGA. Council's "residential standard" planning periods for coastal assessment have been adopted, ie 50 years for all hazards except for foundation design which is increased to 100 years.

The investigation has examined beach erosion, shoreline recession, coastal entrance instability, sand drift, coastal inundation, stormwater erosion hazard, slope and cliff instability, and the hazards of climate change. Kioloa is assessed as a "low-demand open beach" for which 120 and 140 m^3/m design erosion demands have been adopted for 50 and 100 year planning periods respectively. Our observation of a highly compartmentalised beach with no obvious conduits for long-term sand losses is consistent with SMEC (2004) which notes that Kioloa Beach does not appear to be experiencing long-term recession due to beach erosion/recovery imbalances. Sea level rise *(SLR)* recession is predicted at 9 to 19 m over 50 to 100 years. Design wave run up level estimated at *RL 4.5 to 5.0 m AHD* falls below the dune crest level *(RL 5.5 to 6.5 m AHD)*, thus wave overtopping is not expected. This protection is preserved after design *SLR.* An appraisal of the localised flood event of October 1999 attributed to overflow from the local stormwater drainage system within Murramarang Road has found that there is no hydraulic connection between ocean level and flooding in the Holiday Park.

Alteration to the entrance section of the small creek at the southern end of the park as a consequence of future extreme floods and storms would be confined seaward of the dune crest which is outside the park boundary. Stormwater erosion hazard pertains only to this creek entrance, and is considered localised and manageable. Sand drift is not an issue.

The investigation has applied DECC's back-beach and dune slope instability model to assess the impact on the Holiday Park of combined beach erosion and shoreline recession (**Figures 2** and **3**). The hazard zones are found to mainly reside mainly reside in the dune. They are sufficiently seaward of sites within the Holiday Park such as to be readily manageable.

Figure 4 presents a summary of the key coastal hazards.

GBA is of the opinion that there would be no impediments in respect of coastal hazard that would preclude the legitimisation of the subject caravan and camping sites.

8 REFERENCES

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Draft Beach Management Plan, Foreshore Reserve, Kioloa Beach
Kioloa Beach Holiday Park, Lot 128 DP 40869, Murramarang Road, Kioloa
June 2007

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Beach Fluctuations and Shoreline Change – 1987
8 th Australian Conference on Coastal and Ocean Engineering, Nov 1987

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Field Measurements of Runup on Natural Beaches
12 th Australasian Coastal and Ocean Engineering Conference
Melbourne, May 1995

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Design of Seawalls and Breakwaters
Proc ASCE, Vol 85, pp 123 - 152

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Climate Change 2007 – The Physical Science Basis
Summary for Policy Makers
Fourth assessment report of Intergovernmental Panel on Climate Change, February 2007

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Report MHL1045, DPWS Report No. 00005, May, for Maclean Shire Council,

Nielsen, AF, DB Lord, HG Poulos (1992)
Dune Stability Considerations for Building Foundations
Aust. Civ. Eng. Trans., IEAust., Vol. CE 34, 2

NSW Government (1990)
Coastline Management Manual
ISBN 0730575063, September 1990

Shoalhaven City Council (1986)
O'Hara Head Reserve Plan of Management – No 15
Adopted April 2006

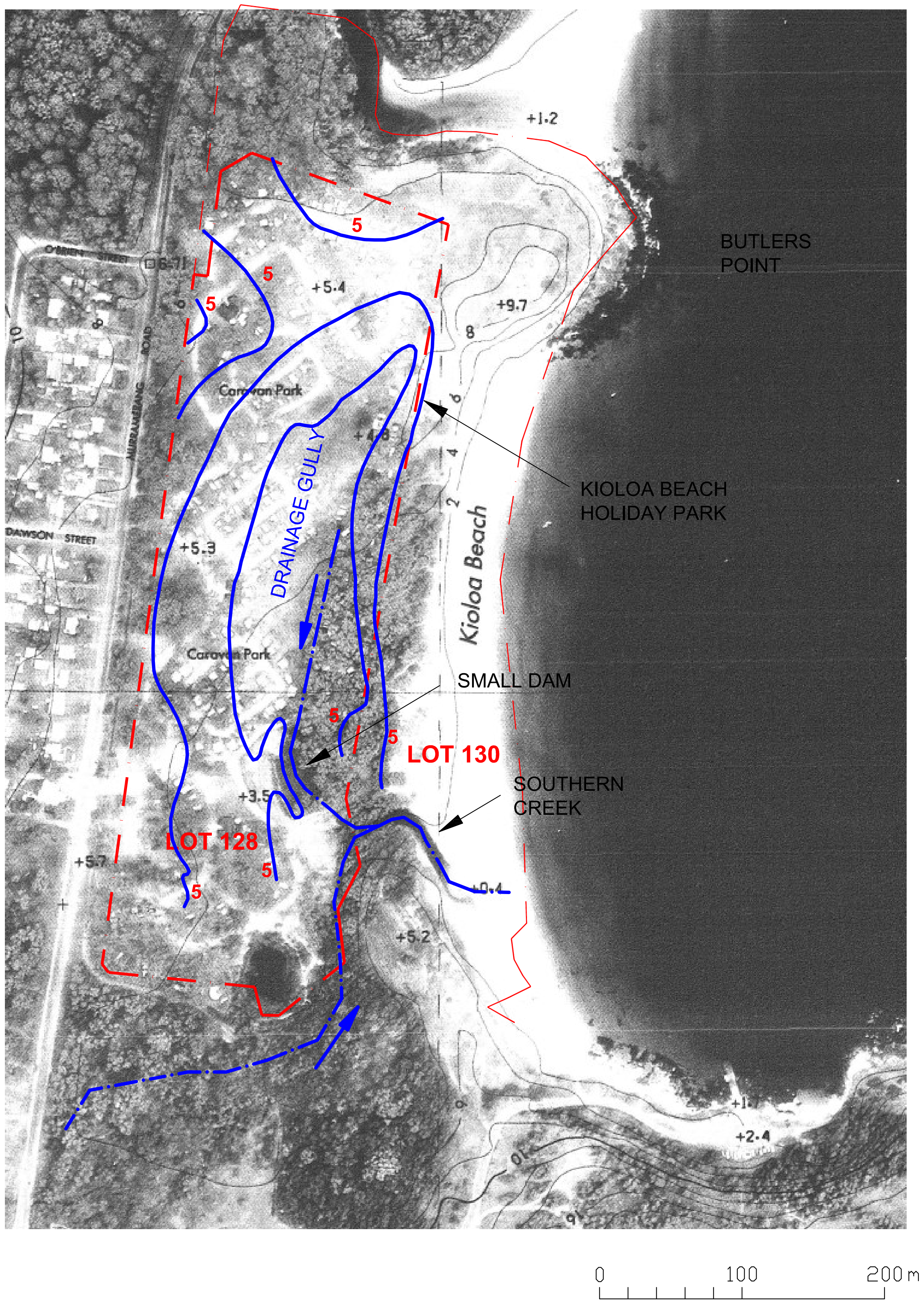
We trust that the above report meets your immediate requirements in this matter. Should you wish to discuss or clarify any aspects, please do not hesitate to call the undersigned.

Yours faithfully
GARY BLUMBERG & ASSOCIATES

G P Blumberg
Principal

FIGURES

FIGURE 1



NOTES

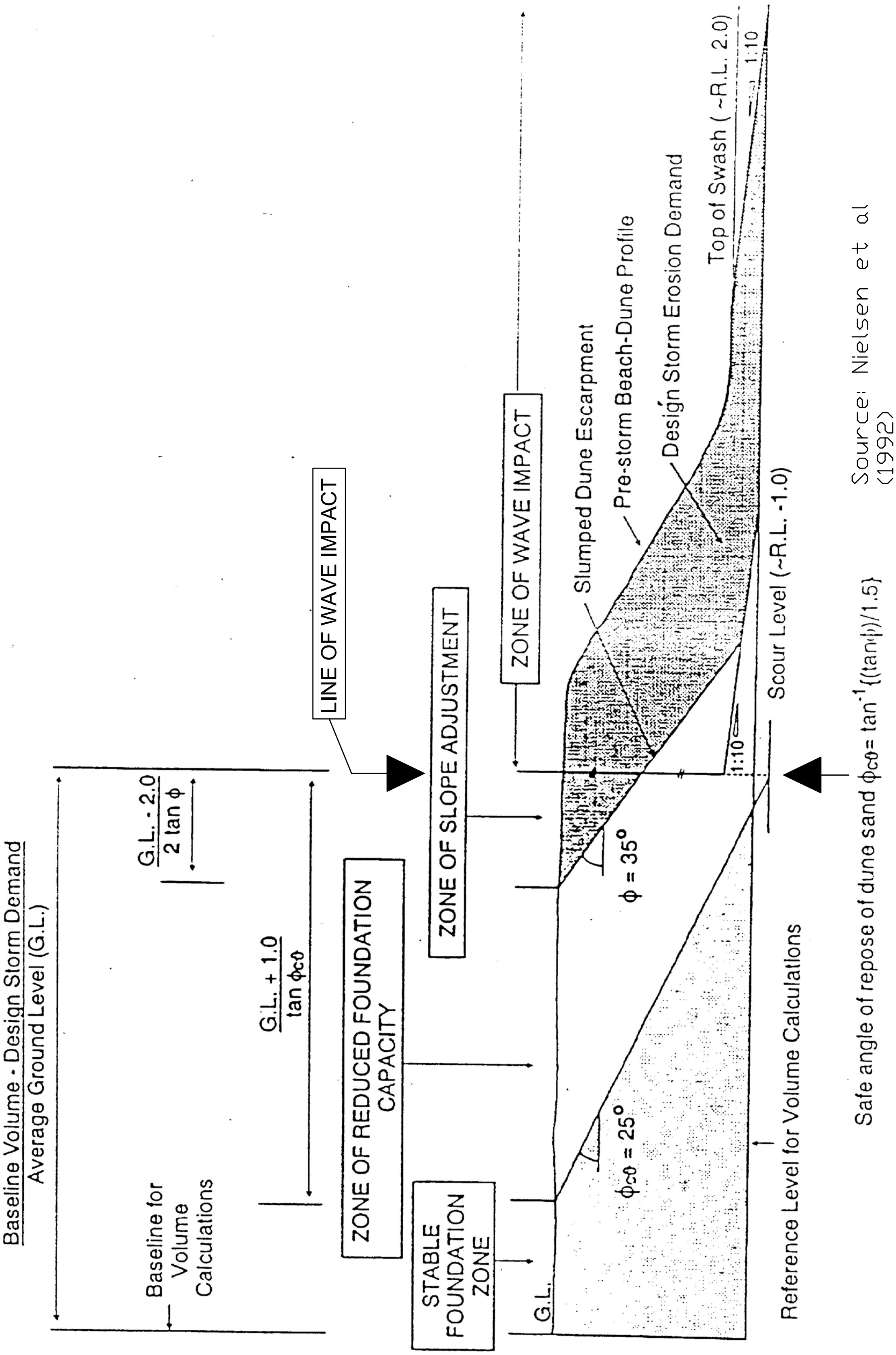
1. 1:4000 ORTHOPHOTOMAP - SNAPPER POINT W 3757-3 CMA (1985)
2. GROUND SURVEY OF KBHP SUPPLIED BY COWMAN STODDART
3. GOOGLE EARTH IMAGE, JANUARY 2008

AUSTRALIAN HEIGHT DATUM

Gary Blumberg & Associates
J07-33/lr775.
Plot Date: 17/1/08

STUDY AREA

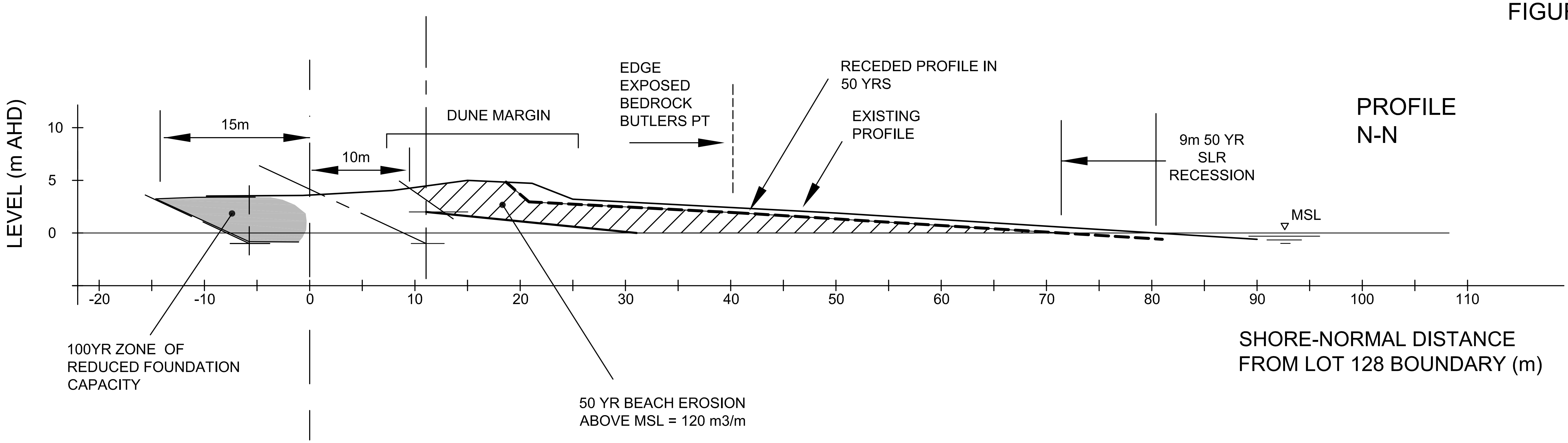
FIGURE 2

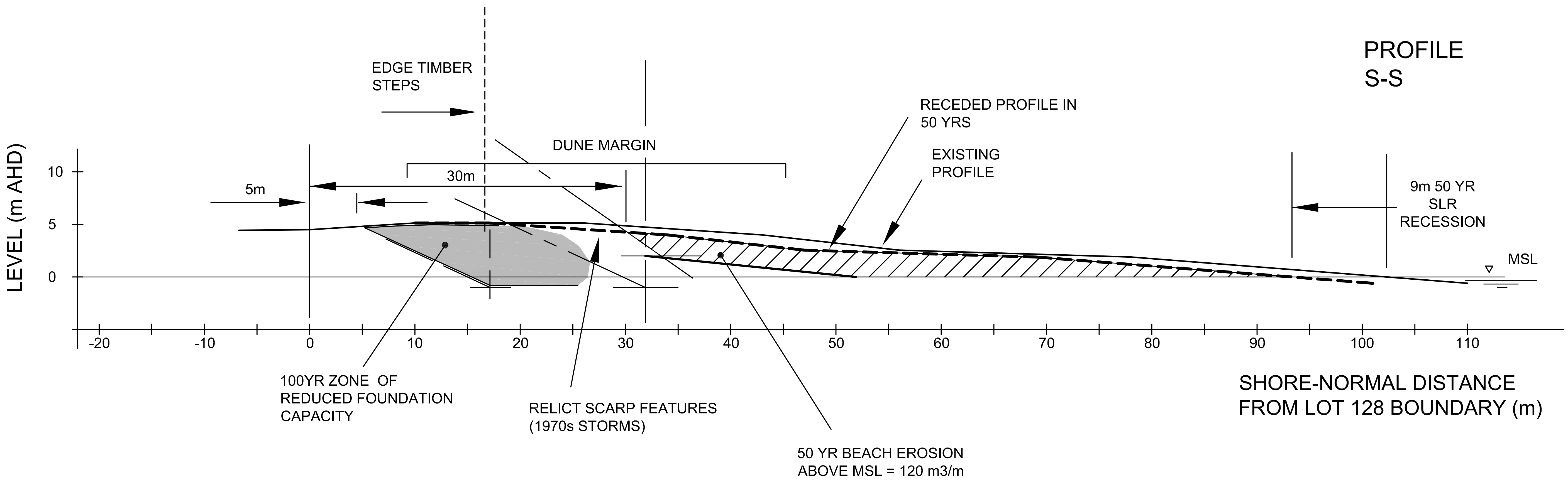


GENERIC BEACH AND DUNE INSTABILITY MODEL ADOPTED BY DECC

Gary Blumberg & Associates
J07-33/lr775
Plot date: 15/1/08

FIGURE 3





AUSTRALIAN HEIGHT DATUM

NOTES

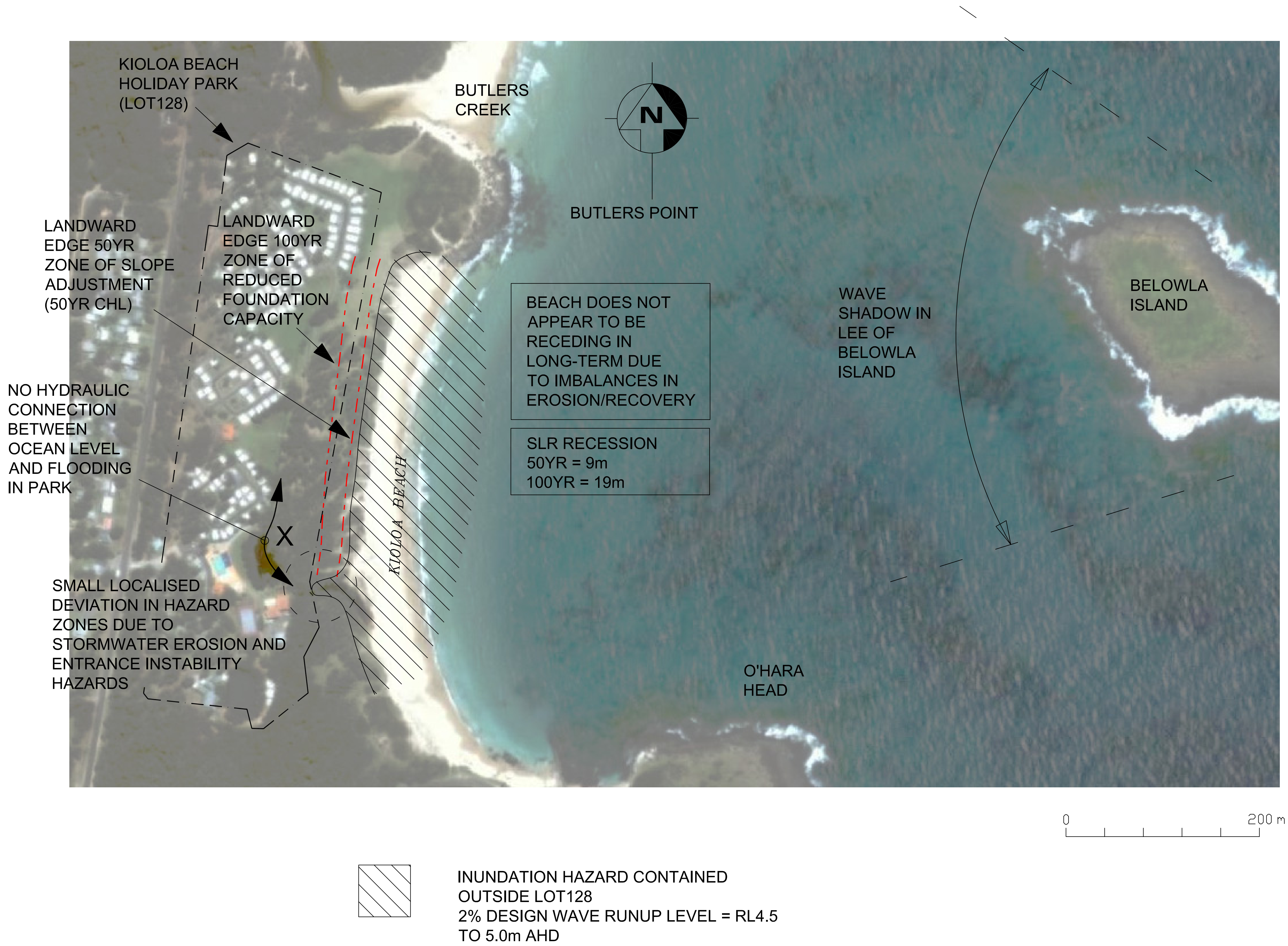
1. FIGURE 3 TO BE READ IN CONJUNCTION WITH FIGURES 1 AND 2

2. COASTAL INSTABILITY MODEL AFTER NIELSEN ET AL (1992) APPLYING 50 YR AND 100YR HAZARDS FOR RECESSION (INCLUDING EFFECTS OF SLR) AND BEACH EROSION

Gary Blumberg and Associates
J07–33/lr775
Plot date 17/1/08

APPLICATION OF DECC INSTABILITY MODEL TO KIOLOA BEACH HOLIDAY PARK

FIGURE 4



Gary Blumberg & Associates
J07-33/lr775.
Plot Date: 14/1/08

SUMMARY OF COASTLINE HAZARDS AT KIOLOA BEACH HOLIDAY PARK

APPENDICES

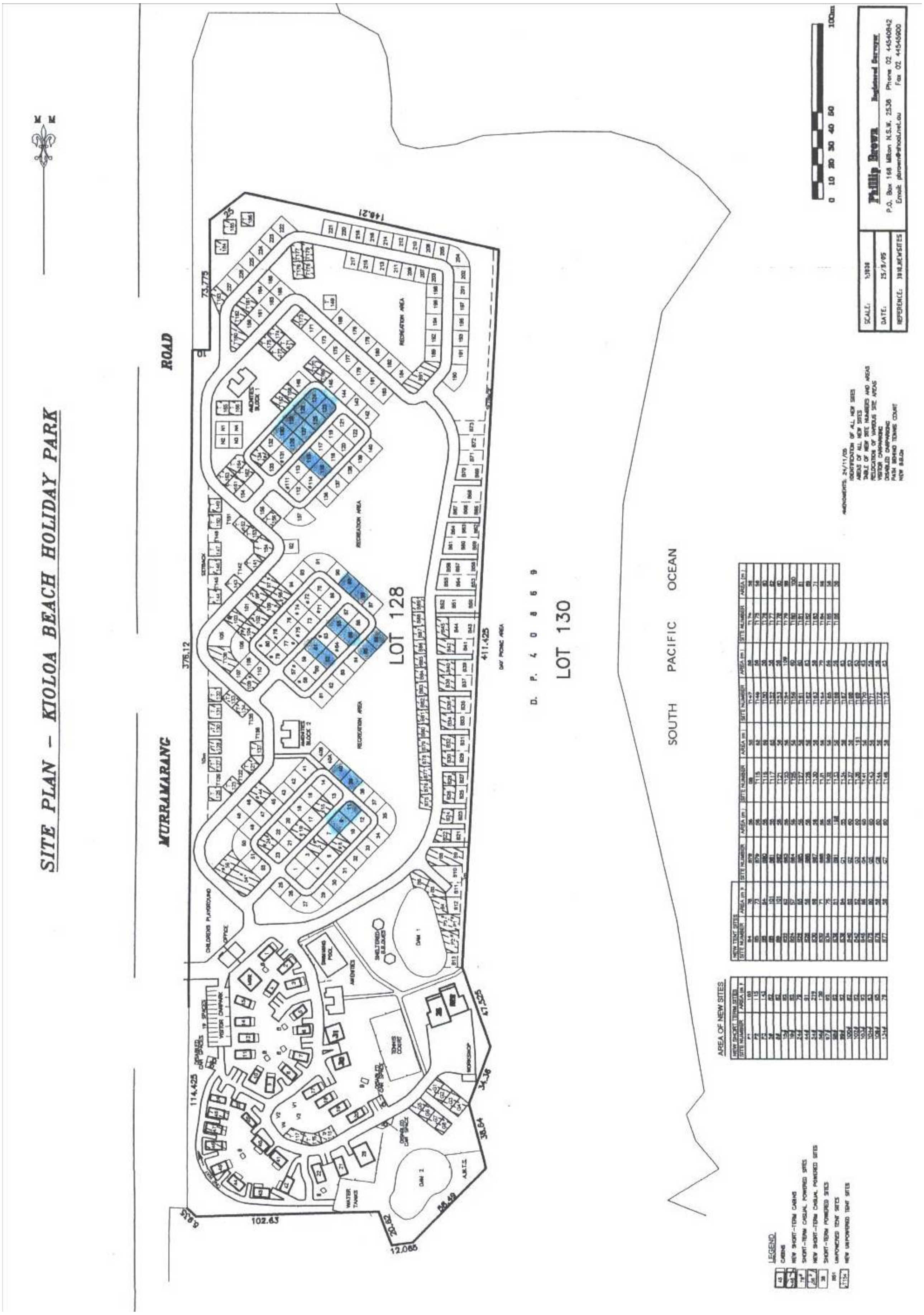
A PARK PLAN SHOWING EXISTING AND SUBJECT SHORT TERM AND TENT SITES

B DESIGN WAVE RUN UP CALCULATION

C INFORMATION ON LOCAL FLOOD EVENT, 25/10/99

APPENDIX A

PARK PLAN SHOWING EXISTING AND SUBJECT SHORT TERM AND TENT SITES


SITE PLAN – KIOLOA BEACH HOLIDAY PARK
MURRAMARANG ROAD
LOT 128
LOT 130
D. P. 4 0 8 6 9
SOUTH PACIFIC OCEAN
RECREATION AREA
AREA OF NEW SITES
LEGEND

APPENDIX B

DESIGN WAVE
RUN UP CALCULATION

DESIGN WAVE RUNUP ON NATURAL BEACHES

GBA Job **07-33**

Source and assumptions

1 Based on procedures outlined by Hanslow and Nielsen (1995)

Hanslow DJ and Nielsen P (1995)
Field Measurements of Runup on Natural Beaches
12th Australasian Coastal and Ocean Engineering Conference
Melbourne, 28 May - 2 June 1995

2 Two percent (near maximum) runup transgression data (exceedance stats) were obtained for 6 beaches ranging from steep (reflective) to flat (dissipative): Brunswick Heads, Pearl and Ocean Beach, Palm Beach, Dee Why Beach, and Seven Mile Beach

3 Data collected for Horms = 0.5-3.8m, Ts=6-12s

4 Wave heights were scaled accoring to offshore wave direction

5 Beach slope determined by averaging the slope across the swash zone, from lowest point of wave rundown to runup limit

6 Results demonstrate importance of Iribarren number for describing wave runup, and generally confirm Hunt's formula with the inclusion of a 0.9 coefficient. Hunt is applicable to relatively steep slopes where dissipation of wave energy by spilling breakers far from the shore is insignificant.

Variables

Parameters

alpha	Hos	m	Deepwater significant wave height
	Ts	s	Signicant wave period
	α_o	degrees	Angle between offshore and nearshore wave direction - nearshore waves would exist immediately seaward of the break poin
	β	degrees	Beach slope (average of slope of lowest point rundown to runup limit), typically 1:50 to 1:5, or 1 to11 degrees used in H&N
			However, 'Yamba Coastline Management Study' [MHL 2002] adopt a composite slope defined as "average slope between inshore break point and runup limit" as giving more realistic results - see my email from P Horton 28/11/07
	Hs	m	"Scaled significant wave height" - essentially an offshore condition adjusted for wave direction
zzeye	ξ_s		Iribarren No based on scaled significant wave height
	L_s	m	Deepwater significant wave length (as reported in Yamba Coastline Management Study, MHL 2002)
	Z_2	m	2% runup level

Calculation

	Run		1		2	3	4	5
Adopted elevated coastal SWL		m AHD	2.3		2.3			
Assumed wave setup component		m AHD	1.4		N/A	N/A	N/A	N/A
	Hos	m	9.0		8.0			
	Ts	s	13		13			
	α_o	degrees	20		20			
		Consider varied trial parameters based on **Run 1** outputs						
First estimate bed RL at inshore breakpoint (SWL-wave set up - Hos/0.8)		m AHD	-10.3					
Trial bed RL at inshore breakpoint					-6.0			
Trial runup limit		m AHD	5		4			
Assumed breaker bed slope - allow for steepened section at back beach		1:x	20					
First estimate distance between wave break point and runup limit from breaker bed slope		m	306					
Trial separation		m			150			
	β	degrees	3		4	#DIV/0!	#DIV/0!	#DIV/0!
	Hs	m	8.7		7.8	0.0	0.0	0.0
Eckart (1952)	L_s	m (+/- 5%)	264		264	0	0	0
	ξ_s		0.27		0.39	#DIV/0!	#DIV/0!	#DIV/0!
	Z_2		2.2		2.7	#DIV/0!	#DIV/0!	#DIV/0!
2% Runup Level		**m AHD**	**4.5**		**5.0**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**

APPENDIX C

INFORMATION ON LOCAL FLOOD EVENT, 25/10/99

10/1/08

25/10/99

PHOTOS C-1

10/1/08

25/10/99

PHOTOS C-2

10/1/08

25/10/99

PHOTOS C-3

10/1/08

25/10/99

PHOTOS C-4

THU 21 OCT 99 Sunny

FRI 22 Sunny Morning 12.5 mm

SAT 23 Int. Rain 18.5 mm

SUN 24 Heavy rain all day
at 7^30 AM → 195 m/m.

MON 25 OVERCAST

SUNNY – WINDY

October 195 mm to 7^30 AM!

WEEK 43

August 1999					
M	30	2	9	16	23
T	31	3	10	17	24
W		4	11	18	25
T		5	12	19	26
F		6	13	20	27
S		7	14	21	28
S	1	8	15	22	29

September 1999					
M		6	13	20	27
T		7	14	21	28
W	1	8	15	22	29
T	2	9	16	23	30
F	3	10	17	24	
S	4	11	18	25	
S	5	12	19	26	

October 1999					
M		4	11	18	25
T		5	12	19	26
W		6	13	20	27
T		7	14	21	28
F	1	8	15	22	29
S	2	9	16	23	30
S	3	10	17	24	31

25 Monday 298/067

Bank Holiday (Republic of Ireland) Labour Day (New Zealand) Retrocession Day (Taiwan)

7.00 am ALL WEEKEND WAS RAINY. ≠ 3 PM SUNDAY
VERY STRONG WINDS, VERY HEAVY RAIN
8.00 APPROX 4" IN 1 HOUR!

9.00 BY 4 PM FLOODS BY 8PM MAJORITY GONE.

10.00 MOST VANS ~~TO EAST OF LINE~~ 2nd AMENITY
AND THRU HUNTER TO THE POOL
11.00 PROBABLY SUFFERED WATER FLOODING TO
ANNEXES
Noon BIG TREE AT MURRAMARANG ROAD SIDE
OF N AMENITIES DOWN ACROSS ROAD
1.00 AND DAMAGED DONNELLY VAN. ROOF
DAMAGED, FLOOD/RAIN DAMAGE
2.00
ALL HANDS ON DECK FOR THE CLEANUP!!
3.00

TVB → GB 10/1/08

28

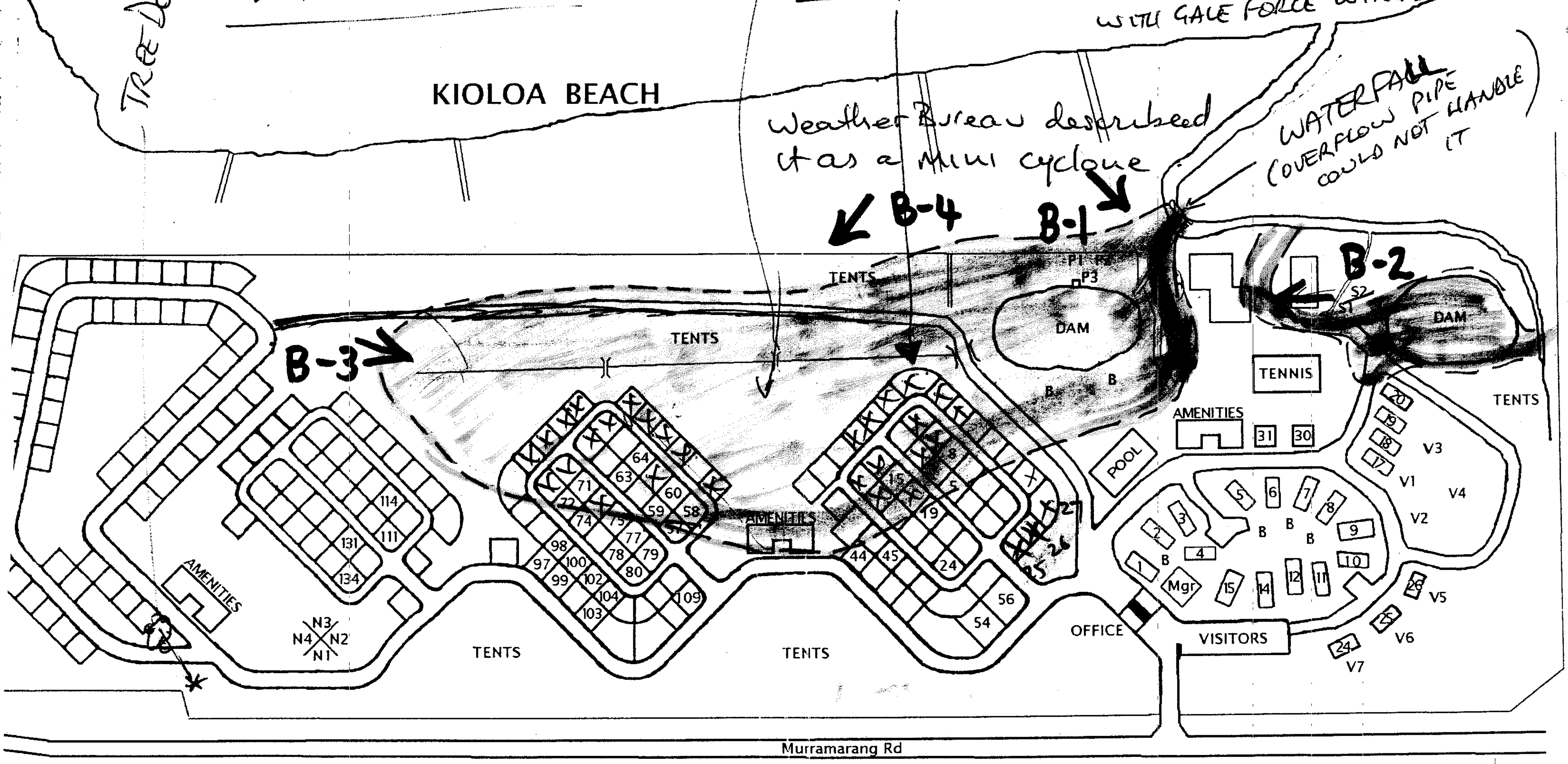
7.00 | 8.00 | 9.00 | 10.00 | 11.00 | Noon | 1.00 | 2.00 | 3.00 | 4.00 | 5.00 | 6.00 | 7.00 | 8.00 p

OCTOBER 1999

LAKE KIOLOA !!

AT FLYNN VAN WATER WAS MORE THAN KNEEDEEP.

RAIN 7AM SUN – 7AM MON
195 mm (±8")
APPROX 1/2 IN 2 HOURS
2³⁰ till 4³⁰ SUN.
WITH GALE FORCE WINDS

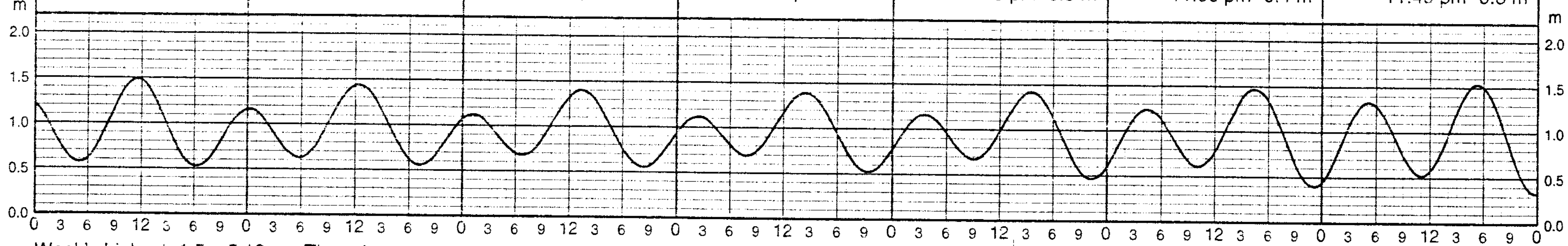


TREE DOWN. DAMAGE + FLOODING TO DONNELLY

→ PHOTOS

TJB → GB 10/1/08

			1st Quarter 1.01 am			
High 11.36 am 1.5 m	High 12.12 am 1.2 m 12.24 pm 1.4 m	High 1.13 am 1.1 m 1.22 pm 1.4 m	High 2.23 am 1.1 m 2.26 pm 1.4 m	High 3.30 am 1.2 m 3.30 pm 1.4 m	High 4.26 am 1.2 m 4.27 pm 1.5 m	High 5.13 am 1.3 m 5.19 pm 1.5 m
Low 5.04 am 0.6 m 6.17 pm 0.5 m	Low 5.51 am 0.6 m 7.16 pm 0.6 m	Low 6.47 am [illegible] m 8.21 pm 0.6 m	Low 7.54 am 0.7 m 9.23 pm 0.5 m	Low 9.03 am 0.7 m 10.18 pm 0.5 m	Low 10.06 am 0.6 m 11.06 pm 0.4 m	Low 11.02 am 0.5 m 11.49 pm 0.3 m

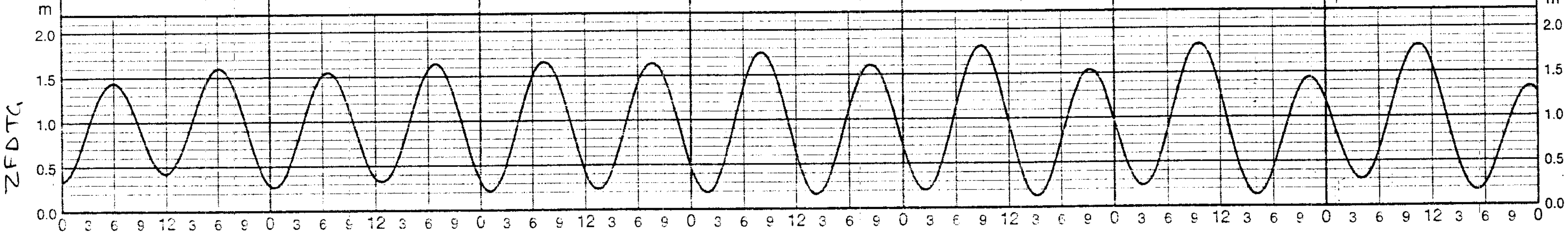


Week's highest: 1.5m 5.19 pm Thursday Week's lowest: 0.3m 11.49 pm Thursday

October 22-28 1999

All times to Australian Eastern Standard Time. All heights in metres.

Friday 22	Saturday 23	Sunday 24	Monday 25	Tuesday 26	Wednesday 27	Thursday 28
Sunrise 5.06 am Sunset 6.13 pm Moonrise 3.18 pm Moonset 3.31 am	Sunrise 5.05 am Sunset 6.14 pm Moonrise 4.22 pm Moonset 4.08 am	Sunrise 5.04 am Sunset 6.15 pm Moonrise 5.29 pm Moonset 4.45 am	Sunrise 5.03 am Sunset 6.16 pm Moonrise 6.38 pm Moonset 5.23 am **○ Full Moon 7.05 am**	Sunrise 5.02 am Sunset 6.17 pm Moonrise 7.48 pm Moonset 6.05 am	Sunrise 5.01 am Sunset 6.18 pm Moonrise 8.58 pm Moonset 6.50 am	Sunrise 5.00 am Sunset 6.19 pm Moonrise 10.05 pm Moonset 7.40 am
High 5.57 am 1.4 m 6.06 pm 1.6 m	**High** 6.39 am 1.5 m 6.53 pm 1.6 m	**High** 7.21 am 1.7 m 7.40 pm 1.6 m	**High** 8.05 am 1.8 m 8.28 pm 1.6 m	**High** 8.50 am 1.8 m 9.19 pm 1.5 m	**High** 9.37 am 1.8 m 10.12 pm 1.4 m	**High** 10.28 am 1.8 m 11.10 pm 1.3 m
Low 11.53 am 0.4 m	**Low** 12.29 am 0.3 m 12.42 pm 0.3 m	**Low** 1.09 am 0.2 m 1.31 pm 0.2 m	**Low** 1.49 am 0.2 m 2.21 pm 0.2 m	**Low** 2.31 am 0.2 m 3.13 pm 0.1 m	**Low** 3.15 am 0.2 m 4.08 pm 0.1 m	**Low** 4.02 am 0.3 m 5.07 pm 0.2 m



Week's highest: 1.8m 9.37 am Wednesday Week's lowest: 0.1m 3.13 pm Tuesday, 4.08 pm Wednesday

ZFDTG = −0.925m AHD.

GJ. 16/1/03