

Our Ref: B:\00-3655_Lot 490 Casuarina Way, Kingscliff\
Enquiries to: Brad Comley, Steven Chamberlain, and Kristina Entwistle

30 September 2010

Level 8 Australia Fair Tower,
42 Marine Pde
SOUTHPORT QLD 4215
Mail: PO Box 3766 Australia Fair,
SOUTHPORT 4215
P: +61 7 5509 6400
F: +61 7 5509 6411
E: enquiries@vdmgroup.com.au
W: www.vdmconsulting.com.au

Leighton Properties Pty Ltd
Level 2, HQ South Tower
520 Wickham Street
FORTITUDE VALLEY QLD 4006

Attention: Cameron Binney

Dear Cameron

Re: Proposed Development – Lot 490 Casuarina Way

Please find below responses to comments issued by the New South Wales Department of Planning (DOP) and other relevant agencies in correspondence dated 4 June 2010.

The referral agency comments have been provided in blue text and the response to the comments in black text. For ease of interpretation we have grouped the comments into the following issues:

- Coastal Management;
- Stormwater and Flooding; and
- Civil Engineering.

Coastal Management

(Department of Planning: Page 2 of 4)

Coastal Floodplain Issues

As advised in the DECCW submission the proponent is to further consult with Tweed Council in relation to compliance with minimum requirements for fill and floor levels and coastal hazard impact lines.

Response:

Please note we have further consulted with Tweed Shire Council regarding compliance with minimum requirements with respect to fill and floor levels* and coastal hazard impact lines. We have spoken with Jane Lofthouse of Tweed Shire Council on the 21st July, 29th July, and the 4th August regarding revised coastal hazard lines which have been prepared by an external consultant. An image showing the revised hazard lines including an immediate hazard line, 2050 hazard line, and 2100 hazard line was provided by Jane Lofthouse on the 4th August 2010. The revised hazard lines are shown as being further landward than those provided in the previous *Tweed Shire Coastline Hazard Study 2002* (see Figure 1 provided by Jane Lofthouse of Tweed Shire Council below).

The TSC Development Control Plan (DCP) requires that minimum floor levels provide 0.5m freeboard to the Q₁₀₀ event. Therefore, the 3.10m AHD minimum floor level provides the necessary 0.5m freeboard and therefore satisfies the requirement of the TSC.

CONSULTING ENGINEERS AND SCIENTISTS

■ **AUSTRALIA**
Western Australia
Victoria
New South Wales
Queensland
Northern Territory

■ **INTERNATIONAL**
Abu Dhabi, UAE
Dubai, UAE
Hanoi, Vietnam



The minimum fill level for roadways within the site is defined as the Q₁₀₀ flood level. Therefore, all roads within the site must be constructed at an elevation of at least 2.60m AHD.

Discussions with TSC Officer (Danny Rose) on Friday 13th August confirmed the flood levels and fill requirements provided are accurate. Danny was able to confirm that the previously provided information relating to the high level climate change impacts remains valid and the minimum fill and floor levels stated above satisfy the requirements of the TSC in terms of flood immunity.

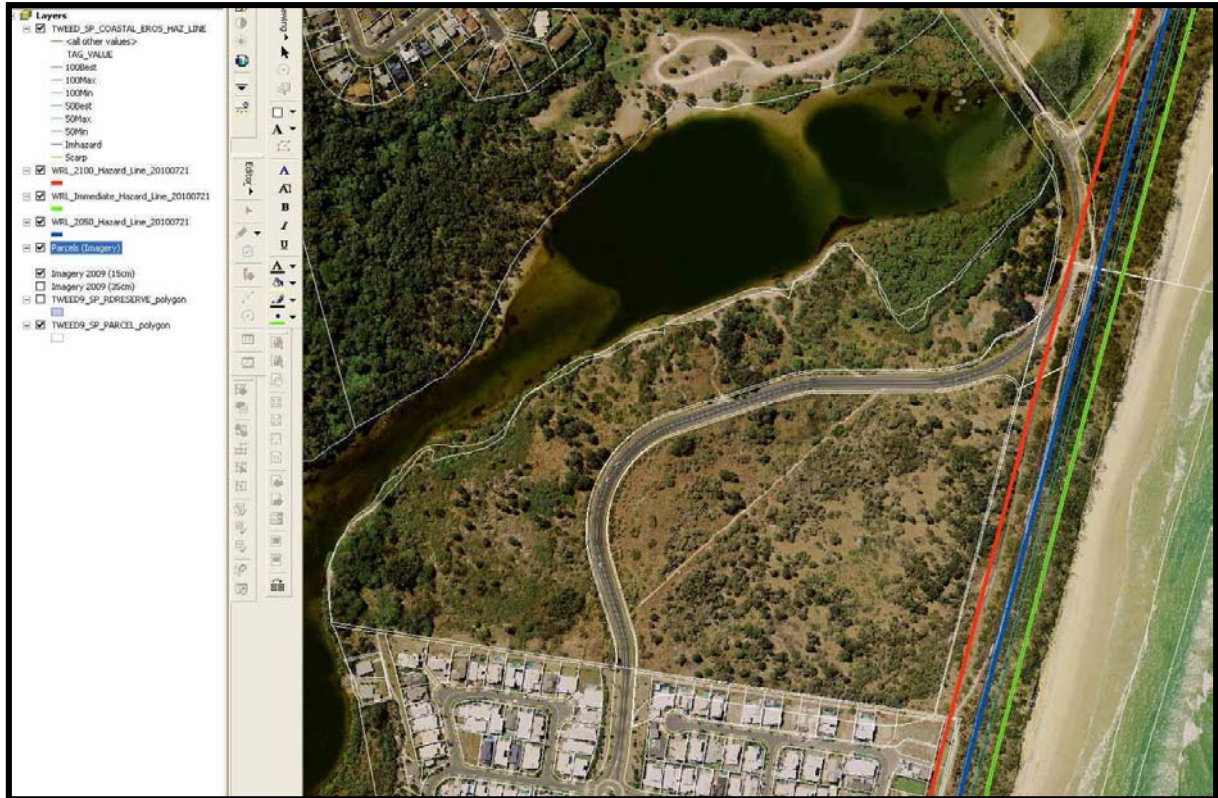


Figure 1. Revised Coastal Hazard Lines provided by Tweed Shire Council 2010

We have amended the Coastal Hazard Assessment (attached) so that the revised hazard lines (2010) have been overlaid onto the new development layout. Whilst it is understood the layout has been amended in places response to the comments provided by the Department of Planning and referral agencies amendments were not required for coastal hazard purposes.

It is noted that some public amenities are located seaward of the revised 2100 hazard line (2010), specifically road and car parking, public amenities block, picnic shelters, play ground and circuit training facilities and beach access. Given the non-critical and relatively minor nature of the infrastructure, and that infrastructure is being provided for public use this incursion is considered acceptable provided the balance of Lot 500 is utilised for dune rehabilitation.

(Tweed Shire Council: Page 11 of 19)

Coastal Hazards

The applicants report relies heavily upon the 2001 Tweed Shire Coastline Hazard Study and subsequent Tweed Coastline Study and Management Plan (2005). There are a few mistakes in the information provided and new information to be taken into account.

The Tweed Shire Coastline Hazard Study (2002) used a climate change component in the assessment of long term shoreline retreat specifically the Bruun rule assumptions with estimates of Sea Level Rise (from a 1990 base level) of 0.20m for 2050 and 0.50m for 2100. The predicted regional shoreline recession due to Sea Level Rise was incorporated as 10 metres for 2050 to 25 metres for 2100.

In October 2009, the NSW Government adopted the NSW Sea Level Rise Policy Statement which adopted a planning benchmark above 1990 mean sea level of 40 cm by 2050 and 90 cm by 2100.

In accordance with the *Draft Coastal Risk Management Guide: Incorporating sea level rise benchmarks in coastal risk assessments* (2009) Council is now in the process of reviewing the adopted Tweed Shire coastline hazard bands and these will be modified to conform with the NSW Government sea level rise benchmarks. Therefore, the revised Coastal Hazard Lines for 2050 and 2100 are likely to align more closely with the existing 7(f) zone than the current lines.

All amenities are provided on the landward side of the existing bike path and this is adequate given the current erosion hazard lines. It would be preferable for all public amenities to be located on Lot 490 rather than Lot 500 (which would then be utilised for dune restoration only).

The applicant's documentation at Section 1.2.2 refers to the beach adjacent to the development site as "Bogangar Beach". The official name of this beach is "South Kingscliff Beach".

The applicant's documentation at Section 3.7.5 last paragraph provides incorrect information regarding the lines represented in Figure 3.2. The TSC hazard lines were based on a SLR of 0.20m for 2050 and 0.50m for 2100. As discussed above these lines are currently being reviewed.

The applicant should be required to review this data and amend their application accordingly.

Response:

As previously stated we have further consulted with Tweed Shire Council regarding compliance with coastal hazard impact lines (see response to Department of Planning comments above).

We have also amended our documentation within the Coastal Hazards Assessment at Section 1.2.2 which refers to "Bogangar Beach", which now refers to "South Kingscliff Beach", and provided revised information in Section 3.7.5 with respect to sea level rise and revised coastal hazard line mapping.

(Department of Environment, Climate Change and Water: Page 4 of 14)

Coastal Floodplain Issues

Recommended Conditions of Approval for Coastal Floodplain Issues

- The proponent must further consult Tweed Shire council regarding minimum fill and floor level requirements and ensure that this proposal is consistent with these requirements.
- The proponent must further consult Tweed Shire Council regarding coastline hazard impact lines to ensure that this proposal is consistent with those.

Response:

Please see response to Department of Planning comments above.

(Department of Environment, Climate Change and Water: Page 11 of 14)

Coastal Hazards

The DGRs required the environmental assessment to address coastal hazards and in particular consider the impacts associated with wave and wind action, coastal erosion, sea level rise and more frequent and intense storms.

Coastal hazards are substantially covered by Belleng VDM Consulting in its Coastal Hazard Assessment report (April 2009). This report references the Tweed Coastline Hazard Definition Study (WBM, 2001) in regards to the assessment of coastal hazards.

It is noted from Figure 3.1-Subject Site Coastline Hazard Zones of the Belleng VDM report that the predominant development area of Lot 490 is sited landward of the 7(f) zone and the maximum 100 year hazard zone identified in the Tweed Coastline Hazard Definition Study (Figure D.18 of WBM, 2001 refers).

It should be understood that the coastline hazard definition work undertaken by WBM 2001 used the intergovernmental Panel on Climate Change (IPCC) predictions for sea level rise (SLR) from its 1996 report and adopted the medium or “best estimate” of 50cm for 2100 relative to 1990 sea level (not 9.95m as stated in the Belleng VDM report – Section 3.7.5 Sea Level Rise p20). This was conventional practice at the time.

In October 2009 the NSW Government released its NSW Sea Level Rise Policy Statement. The Policy Statement includes sea level rise planning benchmarks that can be used for sea level rise adaptation and also for consideration when land-use planning and development decisions are made for coastal areas.

The Policy Statement's sea level rise planning benchmarks are an increase above 1990 mean sea level 0.40 metres by 2050 and 0.90 metres by 2100.

Application of the SLR benchmarks and coastal hazard assessment assumptions of WBM, 2001 would subsequently move the 50 year and 100 year coastline hazard zones landward from those shown in Figure 3.1 of the Belleng VDM report.

It is understood that Tweed Shire Council is currently revising its coastline hazard impact lines to incorporate the Government's SLR benchmarks. DECCW therefore recommends that the proponent further consult Council regarding coastline hazard impact lines to ensure that this proposal is consistent with those.

Response:

Please see response to Department of Planning above.

(Land and Property Management Authority: Page 6 of 6)

The maximum 100 year coastal hazard line as displayed in Figure 3.1 ‘Subject Site Coastline Hazard Zones’ (‘Flood/Coastal Hazard Assessment’, Volume 5) generally corresponds to the alignment of the existing cycleway. The amount of public space to the east of Lot 490 is likely to be significantly diminished if this prediction is realised. If a private pathway and stormwater swale are constructed between the eastern boundary of Lot 490 and the cycleway, in addition to the car park access road and asset protection zone, then the area available for the rehabilitation of pre-sand mining vegetation communities on Lot 500 is restricted.

Response:

It is acknowledged that the private pathway and stormwater swale, as well as some non-critical infrastructure (specifically road and car parking, public amenities block, picnic shelters, play ground and circuit training facilities and beach access) are located partially seaward of the revised hazard 2100 hazard line (2010); restricting the area available for rehabilitation within Lot 500.

Given that these facilities are being provided for community use and that the majority of the lot will remain undeveloped, this incursion is considered acceptable provided the balance of Lot 500 is utilised for dune rehabilitation.

Stormwater and Flooding

(Department of Planning: Page 2 of 4)

Coastal Floodplain Issues

As advised in the DECCW submission the proponent is to further consult with Tweed Council in relation to compliance with minimum requirements for fill and floor levels and coastal hazard impact lines.

Response:

Considerable consultation with the Tweed Shire Council (TSC) has already taken place in relation to flooding issues for the site and the associated minimum fill requirements. The TSC Tweed-Byron Coastal Creeks Flood Study includes modelling of Cudgen Creek and has simulated a range of climate change scenarios. The "High Level" climate change scenario results in a peak water level of 2.90m AHD. This includes the Q_{100} level for the site plus an additional 0.90m rise that accounts for sea level rise and a 10% increase in rainfall intensity.

The TSC Development Control Plan (DCP) requires that minimum floor levels provide 0.5m freeboard to the Q_{100} event. Therefore, the 3.10m AHD minimum floor level provides the necessary 0.5m freeboard and therefore satisfies the requirement of the TSC.

The minimum fill level for roadways within the site is defined as the Q_{100} flood level. Therefore, all roads within the site must be constructed at an elevation of at least 2.60m AHD.

Further consultation with TSC Officer (Danny Rose) took place on Friday 13th August to confirm the flood levels and fill requirements previously provided were still accurate. Danny was able to confirm that the previously provided information relating to the high level climate change impacts remains valid and the minimum fill and floor levels stated above satisfy the requirements of the TSC in terms of flood immunity.

The floodlines provided as part of our previous submission remain unchanged and have been included again as part of this response (refer to the attached Floodlines and Emergency Access Routes - VDM Consulting Drawing Number 00-3655-N500-B).

In summary, the minimum levels are:

- **Minimum Floor level = 3.10m AHD**
- **Minimum Road level = 2.60m AHD**

Discussions with Jane Lofthouse of the TSC took place on the on the 21st July, 29th July, and the 4th August regarding revised coastal hazard lines. An image showing the revised hazard lines including an immediate hazard line, 2050 hazard line, and 2100 hazard line was provided by Jane Lofthouse and indicate the revised hazard lines are further landward than those provided in the previous Tweed Shire Coastline Hazard Study 2002.

The Coastal Hazard Assessment (attached) has been amended so that the revised hazard lines (2010) have been overlaid onto the new development layout. It is noted that some public amenities are located seaward of the revised 2100 hazard line (2010), specifically an amenities block and picnic shelters. Given the non-critical and relatively minor nature of the infrastructure, this incursion is considered acceptable provided the balance of Lot 500 is utilised for dune rehabilitation.

(Tweed Shire Council: Page 6 of 19)

Flooding

Council's DCP Section A3 – Development of Flood Liable Land specifies that land for the purposes of "residential flat buildings/dual occupancy shall be filled to a minimum level of the design flood level" (DFL) of RL 2.6m AHD.

There are portions of the development site either side of Casuarina Way that are below DFL. No filling of land on the western (creek) side of the road is necessary, other than for the proposed recreation courts. If these are to be transferred to Council ownership, minimum fill level is 1.6m AHD (DFL – 1m).

The applicant should provide additional fill in and around dwelling sites on the eastern side of the road, taking into account areas for stormwater detention, environmental areas etc. Other options for pierced structures connected by raised walkways would also be acceptable, provided they are of flood compatible design.

Otherwise the flooding commitments are adequate for development of the site.

Response:

The dwellings will be pierced structures and the minimum floor levels will be 3.10m AHD, providing additional clearance to the high level impacts of climate change, including potential for sea level rise, increased storm severity and changes to the rainfall patterns.

Filling below the defined flood level is primarily confined to internal roads, to provide emergency access/egress routes.

(Tweed Shire Council: Page 6 of 19)

Stormwater Management

No objection to the proposed stormwater management system. Stormwater management and Erosion and Sediment Control Plans should be prepared and submitted with an s68 application for Council approval prior to issue of a construction certificate.

Response:

A detailed Stormwater Management Plan (SMP) and Erosion Sediment Control Plans will be submitted as part of the detailed design phase and will include the s68 application.

(Land and Property Management Authority: Page 3 of 6)

Stormwater Management

Appendix G 'Stormwater Drainage System Plan' (under 'Infrastructure/Stormwater Management') is inconsistent with Figure 3.3 'Operational Control Concept Plan' (under 'Infrastructure/Stormwater Management'), in relation to the number and configuration of stormwater swales.

Response:

The Operational Control Plan and Appendix G 'Stormwater Drainage System Plan' have been revised to remove any inconsistencies between the two plans. Please find a copy of both of these plans as an attachment to this letter.

(Land and Property Management Authority: Page 3 of 6)

Figure 15 'Existing Site Vegetation' in the EA shows an area of Vegetation Community 3, which is representative of the EEC 'Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions' occurring within the Resort Premises (that is, on the eastern side of Casuarina Way). It is not entirely clear how this area will be managed, given its small size and relative isolation. It is noted the 'Stormwater Drainage System Plan' in Appendix G of the 'Infrastructure Provision Report' (Volume 3) shows two stormwater swales draining into this Community. LPMA does not support any proposals that would see concentrated stormwater flows directed towards this or any other EEC.

Response:

The proposed stormwater system has been revised to ensure the swales do not enter the EEC area. Please refer to the revised Operational Control Plan and Appendix G 'Stormwater Drainage System Plan' included as an attachment to this letter.

(Land and Property Management Authority: Page 5 of 6)

Groundwater

It is stated on Page 68 of the EA: “No disturbance of existing groundwater is expected due to the development”, and on Page 73: “It is proposed that any groundwater impacts would be managed in consultation with the geotechnical engineer should any be encountered during the execution of earthworks”. It is considered the Proponent should know by now whether groundwater will be affected by the proposed development, and what measures should be put in place to address the possible worst-case groundwater impact scenario.

Response:

The *Preliminary Geotechnical Investigation* carried out by Soil Surveys on the 26th September 2008 and identified Groundwater was noted in several boreholes across the development, at depths of between 1.2m and 5.0m, and was not encountered in Borehole 5. As noted in the Soil Surveys report, “typically the standing groundwater level in coastal areas is expected to be at about RL0.5m to 1.0m with fluctuations of ± 0.5 m under normal conditions (non-flood). Under heavy and prolonged rainfall (flood conditions) rises in groundwater level could well be expected in this coastal area. Groundwater levels may fluctuate with climatic conditions and may show a damped response with tidal variations close to the foreshore and adjacent to Cudgen Creek.”

Therefore, subject to the condition of the catchment and rainfall prior to the construction activities commencing, it is expected that groundwater will be encountered during the excavation required for piers and that of the stormwater treatment devices. Groundwater will be managed on site by pumping to a temporary bunded containment system where it will be allowed to infiltrate back into the in-situ soils. Further information regarding the management of groundwater will be provided in a Dewatering Management Plan to be developed as part of the detailed design phase and will provide testing and treatment requirements for groundwater (if required).

(Land and Property Management Authority: Page 6 of 6)

It is unclear how many legal points of discharge exist for the Resort Premises. The ‘Stormwater Drainage System Plan’ (Appendix G, ‘Infrastructure Provision Report’) shows two, but a number of other plans only show one.

Response:

The “primary” Legal Point of Discharge (LPD) is located at the existing culvert under Casuarina Way at the outlet of the proposed treatment wetland. A “secondary” LPD is provided by another existing culvert under Casuarina Way. However, due to the work to be undertaken on the site and the redirection of flows towards the treatment devices, only a very small portion of the site that remains undeveloped will continue to flow to the “secondary” LPD. The revised Operational Control Plan and Appendix G ‘Stormwater Drainage System Plan’ both indicate the two LPDs.

(Land and Property Management Authority: Page 6 of 6)

LPMA considers all stormwater infrastructure must be located on Lot 490. Figure 13 ‘Stormwater Control Plan’ of the EA shows a swale on Lot 500. No stormwater infrastructure is to be placed on Lot 500, in order for revegetation opportunities`

Groundwater

Impacts to groundwater may arise from the stormwater sediment basins. The EA outlines the water table is at approximately 1.2 metres deep in the area of the proposed bio-retention basins. Potential localised seasonal water level fluctuations of up to 1 metre could result in the water table being at or near the surface. The proposed bio-retention basins require a depth below the surface of up to 1.6 metres as detailed in Figure 3.2 of the Stormwater Management Report No. 18, with an impervious layer if required. Based on this information, the potential exists for the bio-retention basins to be up to approximately 1.5 metres within the water table.

NOW considers that any interaction between the groundwater and the bio-retention basins between the entry and discharge points is short circuiting the treatment process and therefore compromising the water quality objectives. It should be noted that based on all levels provided for review, the current proposed bio-retention basins will be situated within the water table. Such a structure positioned within the water table would require a licence under Part 5 of the Water Act 1912. However, NOW does not consider this approach to meet NSW water policy and legislative objectives and as such would not support the issue of a licence.

Considering the above, it is recommended that the Applicant provide further information on how the bio-retention basins will be excluded from interaction with groundwater, using the best practice such as through the provision of an impervious lining of the structure. Relative surface and maximum predicted groundwater levels should be provided as part of this information, as well as basin specifications and any proposed liner details.

Furthermore, should any temporary dewatering be required as part of this development for the installation of infrastructure, a licence under Part 5 of the Water Act 1912 must be applied for an approved from NOW, prior to commencement of dewatering work or inception of the aquifer.

Response:

As part of the detailed design phase of the project, the depth of bioretention systems will be reviewed and where possible decreased to reduce the interaction of the systems with groundwater.

Where necessary, the bioretention systems will incorporate an impervious liner to eliminate any potential short circuiting of the treatment process. The minimum thickness of the buried HDPE liner is 1.5 mm. Further details regarding the liner, relative surface and maximum predicted groundwater levels will be provided as part of the detailed design phase of the project.

Relative surface and maximum predicted groundwater levels will be provided along with any proposed liner details. As previously stated, groundwater was encountered across the site at depths between 1.2 m and 5.0 m. These levels are likely to vary with climatic conditions and therefore a Dewatering Management Plan will be developed as part of the detailed design phase along with the application for the licence to undertake the dewatering activities.

(NSW Office of Water: Page 2 of 3)

Surface Water and Stormwater Management

The development site is located within the sensitive catchment of Cudgen Creek and Cudgen Lake, therefore the containment and appropriate treatment of runoff is critical to the mitigation of the project and its potential to increase lake nutrients and sediment levels. It is particularly important to ensure any runoff leaving this site is treated to an appropriate standard.

The Tweed Coast Estuaries Management Plan 2004-2008 developed by Tweed Shire Council for Cudgen Lake identifies stormwater impacts from Kingscliff and Bogangar. Currently stormwater flows through the site under Casuarina Way to Cudgen Creek. It is proposed in the EA to allow for the natural flows and post-development flows to move through the site in an open flow path. To achieve this a number of stormwater measure are proposed, including the one-way crossfall and flush kerbs, table drains, cut off drains, bio-retention basins and water tanks.

NOW considers stormwater management on the site should follow water sensitive urban design and be in conjunction with the requirements outlines in the Tweed Urban Stormwater Quality Management Plan 1999 and the stormwater measures outlines in the EA, to ensure the water leaving the site is at an appropriate standard.

Response:

The conceptual Stormwater Management Plan (SMP) provided for the development identified an appropriate treatment train to satisfy the relevant water quality objectives for runoff exiting the site. The treatment train includes buffer strips, swales/naturalised channels and bioretention systems.

The recommended treatment train incorporates various aspects of Water Sensitive Urban Design (WSUD). As part of the detailed design phase, additional information will be provided to demonstrate compliance with the Tweed Urban Stormwater Quality Management Plan 1999 and any other relevant guidelines.

Civil Engineering

(Tweed Shire Council: Page 7 of 19)

Water & Sewer Infrastructure

The Environmental Assessment (EA) lodged for this proposed development has not adequately addressed issues that have previously been raised by Tweed Shire Council Water Unit (this includes comments on the proposed development and also the subdivision application DA07/0716 previously lodged by the Department of Lands). These include works that would have been required at subdivision stage under the provisions of the Tweed DCP Part B9. It appears that despite Council advice to the proponents, no commitment to these works is included in the draft Statement of Commitments.

It is noted that proposed public amenity block on Lot 500 is proposed to be serviced by the tourist developments internal water supply and sewerage systems. Unless this land is aggregated with the proposed Lot 1 (Tourist Development Site), this does not comply with the normal requirement to provide separate connections to water supply and sewer.

Water Supply

As noted in the application, Tweed Shire Council's DCP Part B9 provides guidelines for water supply works associated with development in this locality.

Water is available through a main in Casuarina Way at the Southern Boundary of this site. This main has been progressively relocated and upgraded as the road in which it was located has been realigned and constructed as Casuarina Way (B9.6.3 Planning Strategies TSC.S.6.5 & 6.6). At this location, a temporary connection from the new main at the northern end of the Salt Village development and its original alignment in Lot 500 is in place.

When the realigned Casuarina Way was constructed ahead of the development of Lot 490, the realignment was deferred until the development of Lot 490 was to proceed.

Although the development may not require an upgrade of the main to provide Peak Instantaneous Demand (PID), Council desires to upgrade this section of the main to complete an upgraded alternative supply route through which water may be supplied to Kingscliff or to Tweed Coast in the event of supply interruptions through the normal mains. Council will be prepared to contribute the marginal cost difference to provide this upgrade between the Cudgen Creek Bridge and the northern end of Salt Village development.

It is not appropriate that this development realign the water main within the new road reserve. TSC will require it to be constructed as 450 dia and will be prepared to contribute the marginal difference in cost.

It is required that realignment of this trunk water main to the road reserve from the Cudgen Creek Bridge to the end of the 450 dia main in Casuarina Way be included in the Statement of Commitments and as a condition of consent for this development.

When this relocation proceeds, the location shown by the EA Infrastructure Provision Report for the water connection will be abandoned and another connection to the main would be required. As it stands at the moment, the section of main that has been indicated as the connection point is on the Kingscliff pressure zone side or a closed valve and has a much lower pressure than that available in the 450 dia main. It may be possible however, to use a portion of this 250 dia main to provide the connection to the development. Details of this connection can be determined when the water connection application is lodged.

Response:

A suitable water connection point to service the proposed development is located at the southwest corner of the site. This connection is an existing 250 mm diameter pipe running off and existing 450 mm diameter pipe which extends south along Casuarina Way.

As such the 450 mm diameter main line requested by Council to be located within Casuarina Way adjacent to the development is not required to service the development.

(Tweed Shire Council: Page 8 of 19)

As noted above, the public amenity block is located on a separate lot and hence, a separate water service is required for this amenity block

It is required that provision of a water supply connection of a suitable size to each lot requiring a water service be included in the Statement of Commitments and as a condition of consent for this development.

Response:

A 250 mm dia. water main current exists adjacent to the proposed amenities block. We suggest that this line be used to service the building to provide an independent connection separate to the remainder of the development.

(Tweed Shire Council: Page 8 of 19)

Sewerage

As it stands at present, neither of the lots in this development are connected to sewer. The point of connection to Councils Sewerage System is the intersection Tweed Coast Road and Cudgen Road (DCP Section B9.6.3 Planning Control/Action TSC.6.9).

The previous development of Salt Village has provided much of the necessary infrastructure, but still required the upgrading of the Sewerage Pump Station SPS4060, Point Break Circuit and duplication of the Cudgen Creek Sewer Rising Main crossing.

Council will be providing the necessary augmentation of pumping capacity at SPS4030 from S64 Developer Contributions, but the duplication of the Cudgen Creek crossing is to be provided by the developers of Salt and/or Lot 490. A steel enveloper was placed under Cudgen Creek when the original crossing was constructed for the purpose of the future installation of the duplicate main. This is required before Seaside City of Lot 490 can be connected, and may be provided by either development or both developments jointly.

It is requested that installation of this sewer rising main across Cudgen Creek be included in the Statement of Commitments and as a condition of consent for this development.

The actual connection of the sewer may be at the collector manhole or SPS4030 or if it can be demonstrated that there is adequate capacity, at the 225 sewer in Casuarina Way at the northern boundary of Salt Village as shown in the EA Infrastructure Provision Report.

As noted above, the public amenity block is located on a separate lot and hence, a separate sewer connection is required for this amenity block. It is also noted that the internal sewerage system was proposed to service the public amenity block on Lot 500, a separate parcel of land. Council will not take responsibility for the internal sewage pump station and internal collection system on proposed Lot 1. Accordingly, a separate public sewer connection should be provided to Lot 500 and the amenity block connected to that connection.

It should be noted by the applicant that approval under Section 68 of the local Government Act will be required for the construction and operation of the internal sewage pump station (Health and Environment Unit responsibility).

It is requested that installation of this sewer rising main across Cudgen Creek be included in the Statement of Commitments and as a condition of consent for this development.

The actual connection of the sewer may be at the collector manhole of SPS4030 or if it can be demonstrated that there is adequate capacity, at the 225 sewer in Casuarina Way at the northern boundary of Salt Village as shown in the EA Infrastructure Provision Report.

Response:

It is agreed that Council include the installation of the sewer rising main across Cudgen Creek within the Statement of Commitments and as a condition of consent for the development.

(Tweed Shire Council: Page 8 of 19)

As noted above, the public amenity block is located on a separate lot and hence, a separate sewer connection is required for this amenity block. It is also noted that the internal sewer system was proposed to service the public amenity block on Lot 500, internal sewerage system was proposed to service the public amenity block on Lot 500, a separate parcel of land. Council will not take responsibility for the internal sewage pump station and internal collection system on proposed Lot 1. Accordingly, a separate public sewer connection should be provided to Lot 500 and the amenity block connected to that connection

It should be noted by the applicant that approval under Section 68 of the local Government Act will be required for the construction and operation of the internal sewage pump station (Health and Environment Unit responsibility).

It is requested that provision of outfall sewerage to each lot requiring connection to sewer in accordance with Council's Standards be included in the Statement of Commitments and as a condition of consent for this development.

Response:

In order to address Council's concerns, it is proposed to locate a nutrient pump within the amenities block to pump sewage by a small diameter main to existing Council sewers located south of the site. The detailed design of this system is to be addressed within subsequent approval stages.

(Tweed Shire Council: Page 8 of 19)

Council also seeks the dedication of an easement covering the portions of the existing and new sewer rising mains from SPS4030 where they traverse the south west corner of Lot 490 (proposed Lot 2).

It is requested that the dedication of an easement over the existing and proposed sewer rising mains within Lot 490 (proposed Lot 2) be included in the Statement of Commitments and as a condition of consent for this development.

Response:

It is agreed that Council include a provision for the dedication of easements over existing and new sewer rising mains within the Statement of Commitments and as a condition of consent for the development.

(Tweed Shire Council: Page 9 of 19)

Public Infrastructure Works

Works on Council water supply and sewerage systems require approval under s68 of the Local Government Act and work within a road require Council approval under s138 of the Roads Act. With the magnitude of works required by Council above, the most appropriate mechanism for this approval and supervision of the works is by way of a Construction Certificate application through Council's Development Engineering Section.

Given the magnitude of the works, it is requested that a condition of consent require the developer to lodge a Construction Certificate application for all public infrastructure works, or at least, all public water

supply and sewerage infrastructure works to enable suitable design review and construction supervision for works which will become Council assets.

Response:

The requirement to lodge a Construction Certificate application for public infrastructure works is considered reasonable.

(Tweed Shire Council: Page 18 of 19)

Council's Development Engineer has specifically stated that the proposed dust and airborne control measures contained within the Construction Management Plan are unsatisfactory. The Management Plan should include a requirement for a wind meter to be installed on site and if wind velocity exceeds 36 km/h (10 m/sec), construction activity must cease until the wind velocity falls below this level.

Response:

The submitted Construction Management Plan has specifically considered the requirements for dust management presenting reasonable precautionary measures to minimise airborne pollution by dust from construction activities. The dust management procedure is presented in Table 4.1.2.

All the dust control measures proposed are based on the relevant air quality management documents in force in New South Wales and consider the scale and the type of construction activities associated with the proposed resort development.

VDM Consulting has extensive experience in dust monitoring and management and is aware that the emissions to air from construction activities can be readily controlled by adherence to the reasonable precautionary measures such as wetting of the work areas and dampen/cover any temporary stockpiling to reduce dust generation.

Research in the USA and Europe, on large scale quarries and mines, has shown that dust control measures, such as wet suppression during excavation, transport and handling of the excavated material, can achieve dust control efficiency of 56% to 81% (Buonicore and Davis, 1992).

Operation of a meteorological station at the proposed construction site is impractical as most portable meteorological stations operate on the basis of unattended monitoring with field inspection and download of data at regular intervals. This means that events of high wind speed may not be identified until after the event, thus completely missing the intent of having a meteorological station on site.

Experience by VDM Consulting on such projects as the construction of the 'Soul' High Rise Building at Surfers Paradise, operation of a speedway on an unsealed track at Maryborough and motocross races on unsealed track at the 'Reedy Creek' Motocross Park, indicate that the dust generation from exposed surfaces is governed mainly by the wet-suppression measures undertaken. Irrespective of the meteorological conditions, the primary factor influencing the dust concentration measured near the activities with a potential to generate dust has been the implementation or otherwise of wet dust suppression measures.

Based on the above, it is recommended that the Construction Management Plan (CMP) as prepared by VDM Consulting is accepted and the contractor should carry out the construction work with commitment to proper dust management measures as presented in Table 4.12 of the CMP dated 17th of April 2009.

(Land and Property Management Authority: Page 2 of 6)

Appendix D 'Road and Access Layout Plan' (under 'Infrastructure/Stormwater Management' in Volume 5) is inconsistent with Figure 6 'Proposed Development Layout' (under 'Ecological Assessment' in Volume 5), in relation to the number and configuration of beach access pathways. LPMA expects Figure 6 will be adhered to in this respect.

Response:

Appendix D has been amended to be consistent with the revised layout plan. Please see attached.

(Land and Property Management Authority: Page 2 of 6)

Appendix G 'Stormwater Drainage System Plan' (under 'Infrastructure/Stormwater Management') is inconsistent with Figure 3.3 'Operational Control Concept Plan' (under 'Infrastructure/Stormwater Management'), in relation to the number and configuration of stormwater swales.

Response:

We have revised both Appendix G and Figure 3.3 so as they are consistent. Please see attached.

(Land and Property Management Authority: Page 6 of 6)

Every attempt must be made to ensure sewer lines and other infrastructure avoids significant vegetation, including the 'Intensive Littoral Rainforest Node' (Drawing No. LP-03, 'Master Plan 1 – Kingscliff Resort').

Response:

Every effort will be made to locate sewer lines and other infrastructure to avoid significant vegetation.

Yours faithfully



BRAD COMLEY

State Manager – Specialist Services

Encl:

Floodlines and Emergency Access Routes - VDM Consulting Drawing Number 00-3655-N500-B

Coastal Hazard Assessment

Operational Control Plan - VDM Consulting Drawing Number 00-3655-N400-A

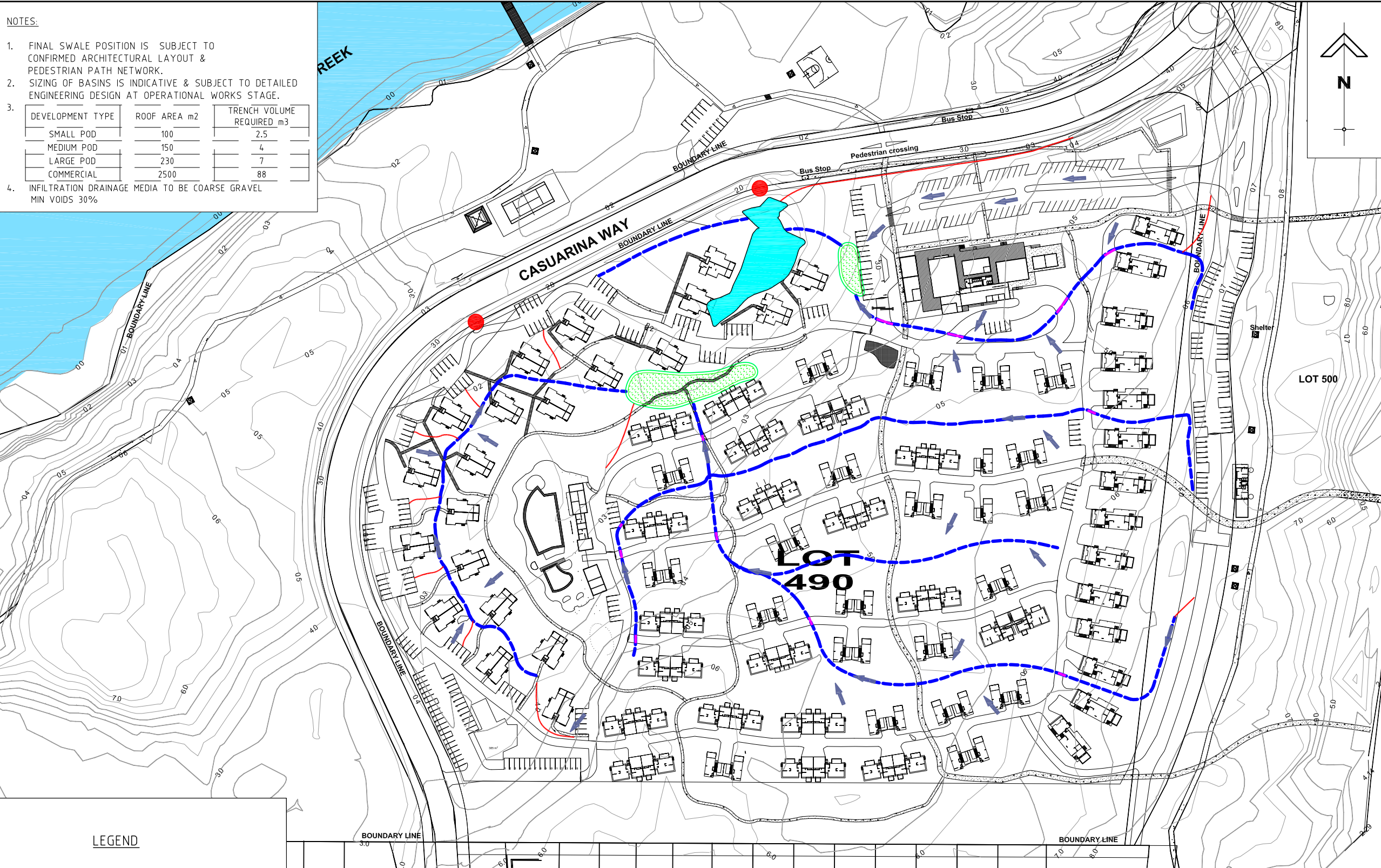
Stormwater Drainage System Plan' – APPENDIX G

1. FINAL SWALE POSITION IS SUBJECT TO CONFIRMED ARCHITECTURAL LAYOUT & PEDESTRIAN PATH NETWORK.
2. SIZING OF BASINS IS INDICATIVE & SUBJECT TO DETAILED ENGINEERING DESIGN AT OPERATIONAL WORKS STAGE.
3.

DEVELOPMENT TYPE	ROOF AREA m ²	TRENCH VOLUME REQUIRED m ³
SMALL POD	100	2.5
MEDIUM POD	150	4
LARGE POD	230	7
COMMERCIAL	2500	88
4. INFILTRATION DRAINAGE MEDIA TO BE COARSE GRAVEL
MIN VOIDS 30%

DEVELOPMENT TYPE	ROOF AREA m2	TRENCH VOLUME REQUIRED m3
SMALL POD	100	2.5
MEDIUM POD	150	4
LARGE POD	230	7
COMMERCIAL	2500	88

4. INFILTRATION DRAINAGE MEDIA TO BE COARSE GRAVEL
MIN VOIDS 30%



CASUARINA WAY
FOR
LEIGHTON PROPERTIES
PTY LTD

A	CHANGE IN LAYOUT	SC	28.09.10
VER.	DESCRIPTION	APPR.	DATE



Level 8, Australia Fair Tower
42 Marine Parade, Southport QLD 4215
PO Box 3766, Australia Fair, Southport QLD 4215

Phone +61 7 5509 6400
Fax +61 7 5509 6411
Email goldcoast@vdmgroup.com.au

COPYRIGHT ©

These designs and drawings are copyright and are not to be used or reproduced without the written permission of VDM Consulting (OLD) Pty Ltd.

The contents of this drawing are electronically generated, are confidential and may only be used for the purpose for which they were intended.

This is an uncontrolled document issued for information purposes only, unless the checked sections are signed and approved.

Figured dimensions take precedence over scale. Do not scale from this drawing. Verify dimensions prior to commencing any works.

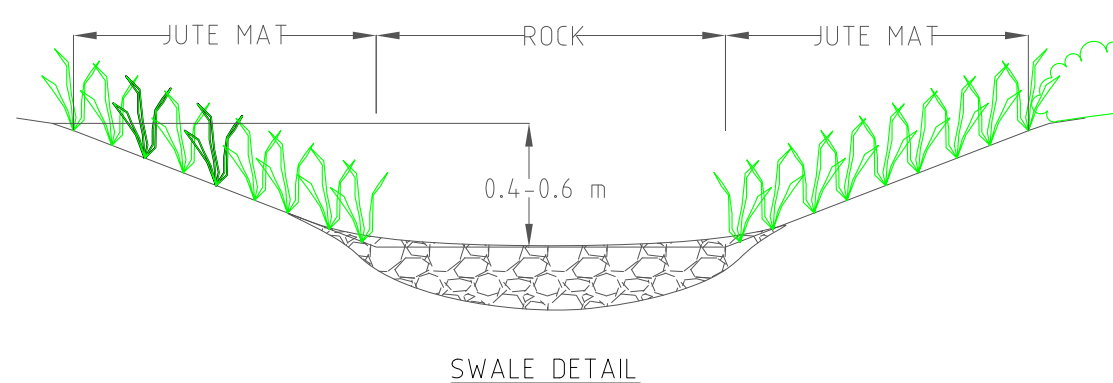
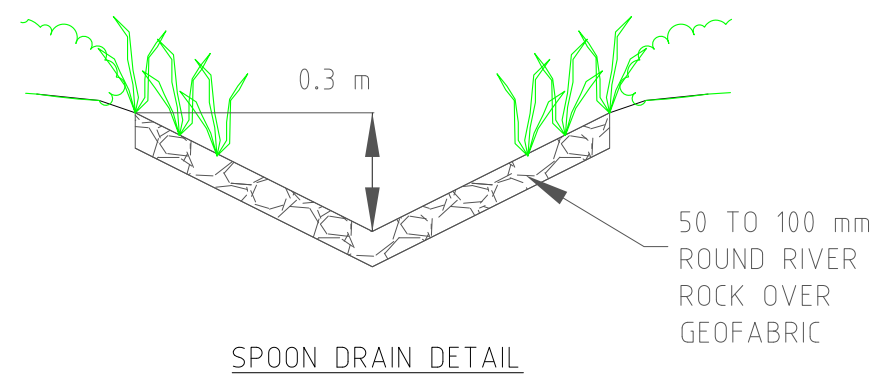
DRAWING TITLE :

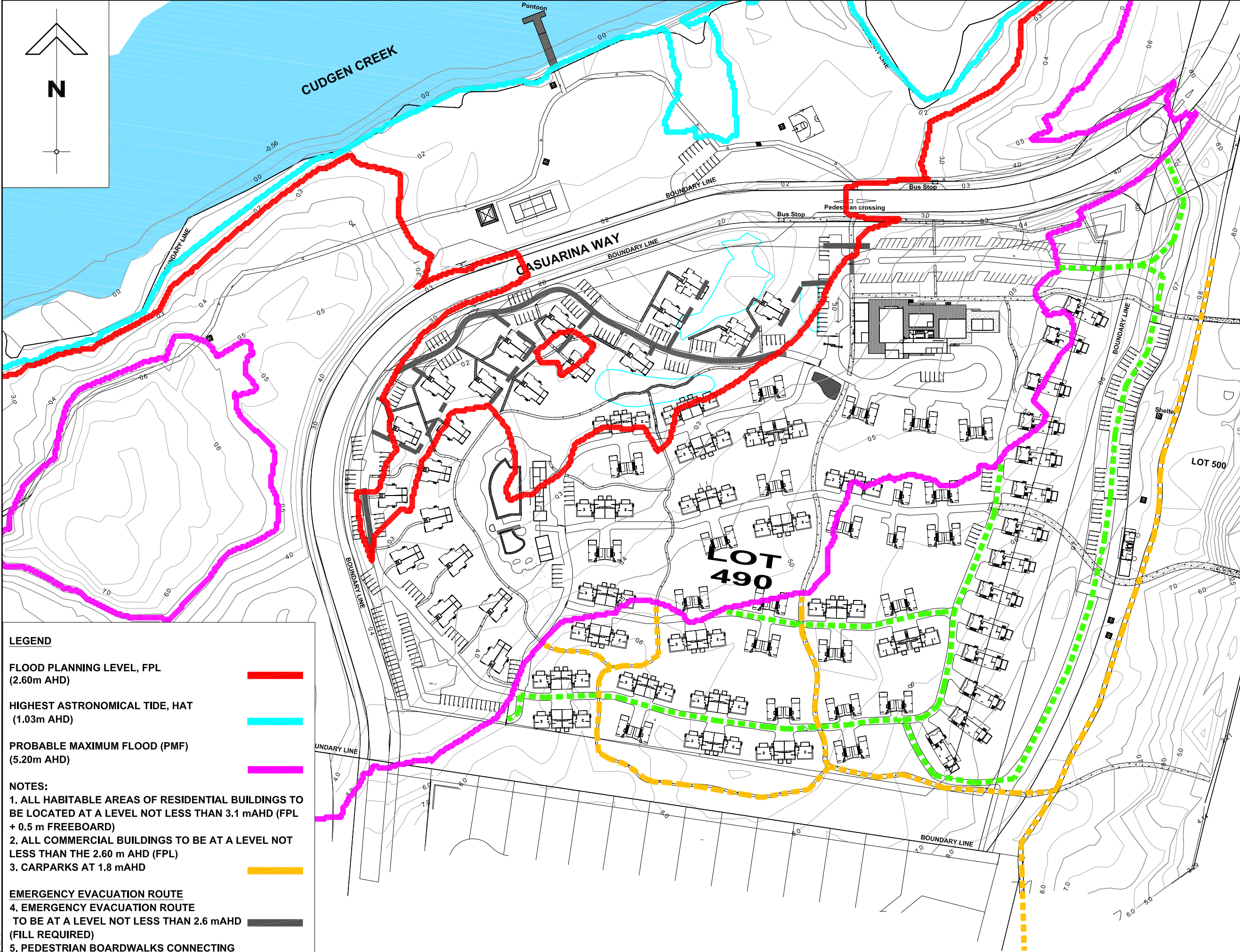
FIGURE 4.4 -
OPERATIONAL CONTROL
PLAN

DEVEL. APPLIC. No. :		DATE : 28.09.10	
PROJECT LEADER : STEVE CHAMBERLAIN			
DESIGNER : STEVE CHAMBERLAIN			
DRAFTSPERSON : DAVID HLATKY			
CHECKED : STEVE CHAMBERLAIN			
APPROVED FOR AND ON BEHALF OF VDM CONSULTING (QLD) PTY LTD ACN 087 601 296			
R.P.E.Q. No. :			
SCALE : 1:2000	DATUM :	FULL SIZE : A3	
PROJECT No. : 00-3655	DRAWING No. : N400	VERSION : A	

- LEGEND

 - SPOON DRAIN
 - - - SWALE DRAIN
 - CULVERTS
 - ➔ FLOW DIRECTION
 - LEGAL POINT OF DISCHARGE
 - ▢ BIORETENTION SYSTEM
 - TREATMENT WETLAND





ECOTOURISM DEVELOPMENT

LOT 490 CASUARINA WAY
KINGSCLIFF

FOR

LEIGHTON PROPERTIES
PTY LTD

B	FOR APPROVAL - REVISED LAYOUT	SC	28-09-10
A	FOR APPROVAL	SC	16-10-09
VER.	DESCRIPTION	APPR.	DATE

REVISIONS

VDM CONSULTING

Level 8, Australia Fair Tower
42 Marine Parade, Southport QLD 4215
PO Box 3766, Australia Fair, Southport QLD 4215

Phone +61 7 5509 6400
Fax +61 7 5509 6411
Email goldcoast@vdmgroup.com.au

COPYRIGHT (C)

These designs and drawings are copyright and are not to be used or reproduced without the written permission of VDM Consulting (QLD) Pty Ltd.

The contents of this drawing are electronically generated, are confidential and may only be used for the purpose for which they were intended.

This is an uncontrolled document Issued for Information purposes only, unless the checked sections are signed and approved.

Figured dimensions take precedence over scale. Do not scale from this drawing. Verify dimensions prior to commencing any works.

DRAWING TITLE :

FLOODLINES AND
EMERGENCY ACCESS
ROUTES

DEVEL. APPLIC. No. :		DATE :28.09.10
PROJECT LEADER : BRAD COMLEY		
DESIGNER : STEVEN CHAMBERLAIN		
DRAFTSPERSON : STEVEN CHAMBERLAIN		
CHECKED : PHILIP BELL		
APPROVED FOR AND ON BEHALF OF VDM CONSULTING (QLD) PTY LTD ACN 087 601 296		
R.P.E.Q. No. :		
SCALE : 1:2000	DATUM :	FULL SIZE : A
PROJECT No.: 00-3655	DRAWING No.: N500	VERSION: B

PLOTTED: 28 Sep 2010

PROPOSED
ECO-TOURISM
DEVELOPMENT
LOT490
KINGSCLIFF

FOR

LEIGHTON PROPERTIES
RESORTS PTY LIMITED

AREA :

ASSOCIATED CONSULTANTS :

E	Sep 10	Revised Layout	
D	Dec 09	Minor Amendments	
C	April 09	Revised layout	
B	29.10.08	S.M.P NOTES AMENDED	
A	011108	Original submission	
AMEND	DATE	DESCRIPTION	APPR.

AMENDMENTS

THESE DESIGNS AND DRAWINGS ARE COPYRIGHT AND ARE NOT TO BE USED OR REPRODUCED WITHOUT THE WRITTEN PERMISSION OF BURCHILL VDM PTY LTD.

DO NOT SCALE FROM THIS DRAWING

FULL SIZE : A1

DRAWING TITLE :

INFRASTRUCTURE PROVISIONS REPORT

STORMWATER DRAINAGE
SYSTEM PLAN

BURCHILL VDM
PTY LIMITED

ACN 010 140 495

CIVIL & STRUCTURAL CONSULTING ENGINEERS & PLANNERS

13 James Street, Beenleigh, Qld. 4207

Phone (07) 3807 4737

Fax (07) 3807 4757

Email info@kempes.burchillvdm.com.au

DESIGNED : DRAWN :

CHECKED : DATE : 081008

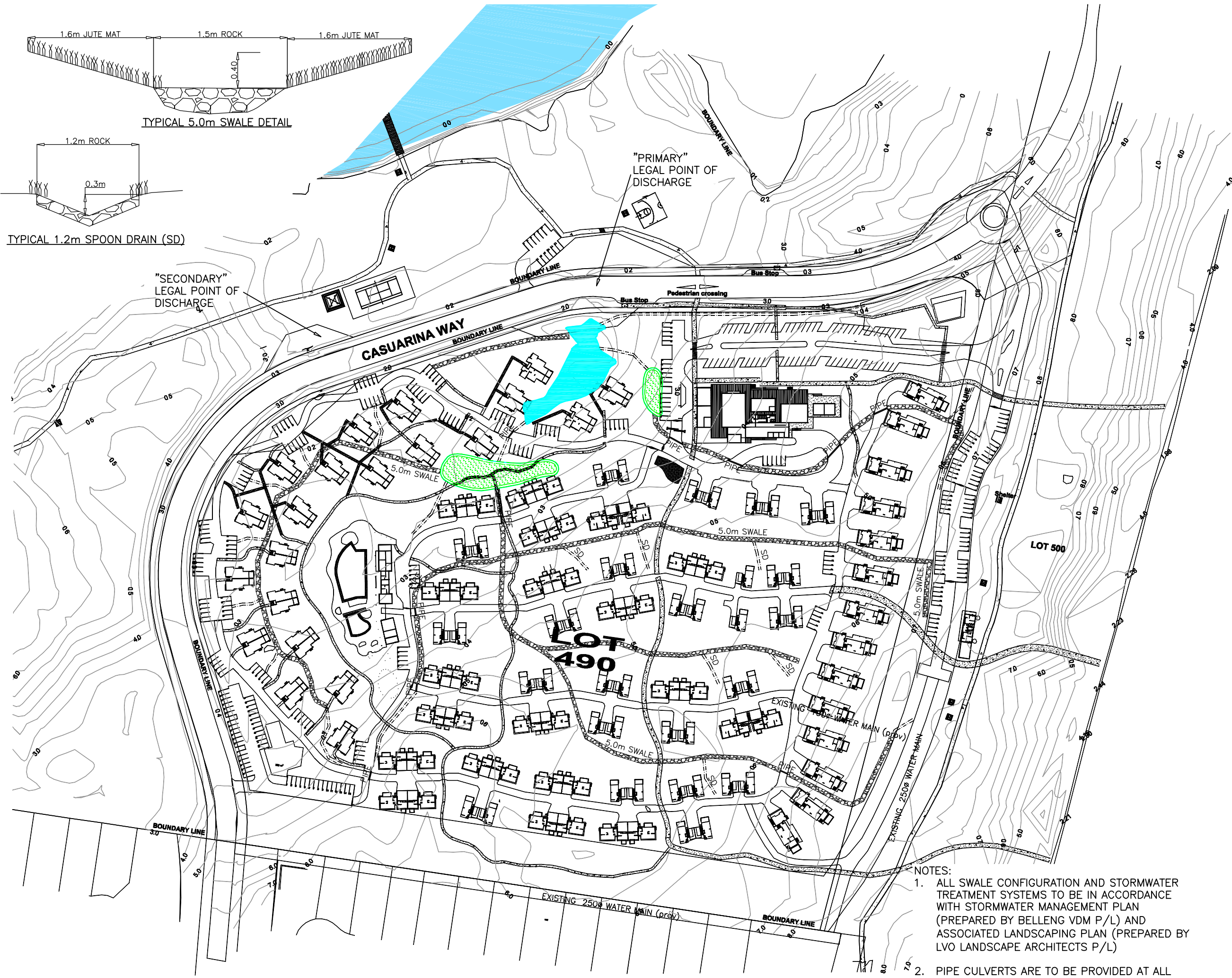
FILENAME : KE3655-SK1

APPROVED FOR AND ON BEHALF OF

BURCHILL VDM PTY LIMITED :

DRAWING No. : APPENDIX G

E



PROPOSED TOURIST RESORT- CASUARINA WAY, KINGSCLIFF

**COASTAL HAZARD ASSESSMENT
ISSUE 3**

**LOT 490 DP1095234
PART OF LOT 489 DP47021
PART OF LOT 500 DP1095235**

**CASUARINA WAY KINGSCLIFF
REPORT FOR ENVIRONMENTAL ASSESSMENT**

**LEIGHTON PROPERTIES PTY LTD
LEVEL 11, 1 EAGLE ST
BRISBANE Q 4000**

SEPTEMBER 2010

QC003655

Document Control Sheet

Proposed Tourist Resort, Casuarina Way, Kingscliff

Report Details:

Title:	Coastal Hazard Assessment
Author(s):	Kristina Entwistle
File reference:	B:\0000\00-3655_Lot 490 Casuarina Way, Kingscliff\Admin\1614_Reports\1614.7 Environmental Reports
Project Leader:	Brad Comley
Phone:	07 5510 3655
Email:	brad.comley@vdmgroup.com.au
Client:	Leighton Properties Pty Ltd
Client Contact:	Mr Cameron Binny
Synopsis:	This report presents a Coastal Hazards Assessment for the proposed tourist resort at Lot 490 on DP1095234, Part of Lot 489 DP47021 and Part of Lot 500 DP727470 Casuarina Way, Kingscliff. The report has been prepared in accordance with the provisions of the NSW Coastline Management Manual and addresses all potential coastal hazards affecting the site.

Revision History:

Issue	Date	Author	Reviewer	Approved
Issue 1	April 2009	Kristina Entwistle Environmental Scientist	Brad Comley Manager, Environmental Services	Brad Comley Manager, Environmental Services
Issue 2	August 2009	Kristina Entwistle Environmental Scientist	Brad Comley Manager, Environmental Services	Brad Comley Manager, Environmental Services
Issue 3	September 2010	Kristina Entwistle Environmental Scientist	Brad Comley Manager, Environmental Services	Brad Comley Manager, Environmental Services

Recipients are responsible for eliminating all superseded documents in their possession. The information contained within this report is provided in good faith in the belief that no information, opinions or recommendations made are misleading. All comments and opinions given in this report are based on a limited survey of the study site or on information supplied by the client, their agent and third parties. Belleng VDM Pty Limited, its agents and employees, expressly disclaim any and all liability for representations, expressed or implied, contained in, or omissions from, this report or any of the written or oral communications transmitted to the client or any third party. Acceptance of this document denotes acceptance of these terms. © Copyright of Belleng VDM Pty Limited
No part of this document can be reproduced without the prior permission in writing of a Director / Principal of Belleng VDM Pty Limited.

Contents

Proposed Tourist Resort, Casuarina Way, Kingscliff

Glossary of Terms.....	ii
Glossary of Acronyms.....	viii
Executive Summary.....	ix
1. Introduction.....	1
1.1. Scope and Objectives.....	1
1.2. Description of Subject Site	2
1.2.1. General.....	2
1.2.2. Coastal Features	4
1.3. Description of Development Proposal	6
2. Coastal Management Framework	8
2.1. NSW Coastal Policy	8
2.2. Coastline Management Manual.....	9
2.2.1. Tweed Shire Coastline Hazard Definition Study	10
2.2.2. Tweed Shire Coastline Management Study Stage 1 & Stage 2.....	10
2.2.3. Tweed Coastline Management Plan	10
2.2.4. Tweed Coast Estuary Management Plan 2004-2008	11
3. Coastal Hazards.....	12
3.1. Tweed Coastline Processes	16
3.2. Erosion and Shoreline Recession	16
3.2.1. Short Term Erosion (Storm Bite)	16
3.2.2. Shoreline Recession.....	17
3.2.3. Dune Slope Instability.....	17
3.2.4. Bank Erosion	17
3.3. Coastal Entrance Behaviour.....	18
3.4. Sand Drift.....	19
3.5. Stormwater Erosion	19
3.6. Oceanic Inundation (Flooding)	19
3.7. Climate Change.....	20
3.7.5. Sea Level Rise	20
3.7.6. Storm Surge	21
3.7.7. Frequent and Intense Storms and Wind and Wave Action	21
4. Assessment of Development against relevant Planning Instruments.....	22
4.1. Environmental Planning and Assessment Act 1979	22
4.1.8. State Environmental Planning Policy 71-Coastal Protection.....	22
4.1.9. Coastal Design Guidelines for NSW	23
4.1. Local & Regional Planning Instruments and Plans of Management	24
4.1.1. North Coast Regional Environmental Plan 1999.....	24
4.1.2. Tweed Local Environmental Plan 2000.....	25
4.1.3. Tweed Shire Development Control Plan	26
4.1.4. Lot 490 Plan of Management 2005	26
5. Conclusion	27
6. References	28

Figures

Figure 1-1.Site Locality Plan	5
Figure 1-2. Aerial Photography (source: James Warren and Associates, 2008)	5
Figure 1-3 Development Proposal	7
Figure 2-1 Coastal Policy-Key Roles and Implementation Mechanisms	9
Figure 3-1 Subject Site Coastline 2001 and 2010 Hazard Zones (Source WBM 2001 and TSC 2010)	14
Figure 3-2 Subject Site Showing HAT, MHWS for Cudgen Creek and Pacific Ocean	15
Figure 4-1 Tweed LEP Zoning Map	25
Figure 4-2 Development Parameters (source-Lot 490 Plan of Management, Department of Lands, 2005)	26

Glossary of Terms

Source: Coastline Management Manual (NSW Government, 1990)

Accredited Profile	The profile (cross-section) of a sandy beach that develops in the “calm” periods between major storm events. During such periods, swell waves move sediment from the offshore bar beach onto the beach to rebuild the beach berm.
Barometric Setup	The increase in mean sea level caused by a drop in barometric pressure.
Bathymetry	The measurement of depths of water, also information derived from such measurements
Beach Berm	That area of shoreline lying between the swash zone and the dune system
Beach Erosion	The offshore movement of sand from the sub-aerial beach during storms
Beach Nourishment	The supply of sediment by mechanical means to supplement sand on an existing beach or to build up an eroded beach
Blowout	The removal of sand from a dune by wind draft after protective dune vegetation has been lost. Unless repaired promptly, the area of blowout will increase in size and could lead to the development of migrating sand dune and its associated problems.
Breaking Waves	As waves increase in height through the shoaling process, the crest of the wave tends to speed up relative to the rest of the wave. Waves break with the speed of the crest exceeds the speed of advance of wave as a whole. Waves can break in three modes: spilling, surging and plunging.
Breakwater	Structure protecting a shoreline, harbour, anchorage or basin from ocean waves.
Buffer Zone	An appropriately managed and unalienated zone of unconsolidated land between beach and development, within which coastline fluctuations and hazards can be accommodated in order to minimise damage to the development.
Coastal Structures	Those structures on the coastline designed to protect and rebuild the coastline and/or enhance coastal amenity and use.
Coastline Hazards	Detrimental impacts of coastal processes on the use, capability and amended of the coastline. This manual identifies seven coastline hazards: • Beach erosion • Shoreline recession • Entrance Instability • Sand drift • Coastal inundation • Slope and cliff instability • Stormwater erosion

Damage Potential	The susceptibility of coastline development to damage by coastline hazards.
Diffraction	The “spreading” of waves into the less of obstacles such as breakwaters by the transfer of wave energy along wave crests. Diffracted waves are lower in height than the incidental waves.
Dune Fields	The system of incipient dunes, foredune and hind dunes that is formed on sandy beaches to the rear of the beach berm.
Dune Maintenance	The management technique by which dune, dune vegetation and dune protective structures are kept in good “working order”, activities may include weed/pest/ fire control, replanting, fertilising, repair of fences and accessways, and publicity.
Dune Management	The general term describing all activities associated with the restoration and/or maintenance of the role and values of beach dune systems, dune management activities and techniques include planning, dune reconstruction, revegetation, dune protection, dune maintenance, and community involvement.
Dune Protection	The management technique by which the dune system is protected from damage by recreational and development activities; dune protection activities generally include the use of fences, accessways and signposts to restrict and control access to dune systems.
Entrance Instability	Refer to the tendency of entrances to estuaries and coastal lakes to migrate along the shore, close up, reopen, from new entrances, etc in responses to wave and current action and freshwater flows.
Ebb Tide	The outflow of coastal waters from bays and estuaries caused by the falling tide.
Flood Tide	The inflow of coastal waters into bays and estuaries caused by the rising tide.
Foredune	The larger and more mature dune lying between the incipient dune and hinddune area. Foredune vegetation is characterised by grasses and shrubs. Foredunes provide an essential reserve of sand to meet erosion demand during storm conditions. During storm events, the foredune can be eroded back to produce a pronounced dune scarp.
Greenhouse Effect	A term used to describe the likely global warming predicted to accompany the increasing levels of carbon dioxide and other “greenhouse” gases in the atmosphere.
Groynes	Low walls build perpendicular to a shoreline to trap longshore sediment. Typically, sediment buildup on the updrift side of a groyne is offset by erosion on the downdrift site.
Groyne Field	A system of a regularly spaced groynes along a section of shoreline.
Hinddunes	Sand dunes located to the rear of the Foredune. Characterised by mature vegetation including rees and shrubs.

Incipient Dune	The most seaward and immature dune of the dune system. Vegetation characterised by grasses. On an accreted coastline, the incipient dune will develop into a Foredune.
Littoral Zone	Area of the coastline in which sediment movement by wave, current and wind action is prevalent. The littoral zone extends from the onshore dune system to the seaward limit of the offshore zone and possibly beyond.
Longshore Currents	Currents flowing parallel to the shore within the inshore and nearshore zones. Longshore currents are typically caused by waves approaching the beach at an angle. The "feeder" currents torip cells are another example of longshore currents.
Mass Transport	The net shorewards current associated with the movement of waves through the nearshore and inshore zones. Sediment transport from the offshore bar by this current is responsible for the rebuilding of storm eroded beaches during inter-storm periods.
Nearshore Zone	Coastal waters between the offshore bar and the 60m depth contour. Swell waves in the nearshore zone are unbroken, but their behaviour is influenced by the presence of the seabed. (This definition is adopted for simplicity in this Manual and is based on wave motion considerations rather than sedimentology).
Offshore Bar	Also known as a longshore bar. Submerged sandbar formed offshore by the processes of beach erosion and accretion. Typically, swell waves break on the offshore bar.
Offshore Zone	Coastal waters to the seaward of the nearshore zone. Swell wavein the offshore zone are unbroken and their behaviour is not influenced by the presence of the seabed. (See note to "Nearshore Zone").
Onshore/Offshore Transport	The process whereby sediment is moved onshore and offshore by wave, current and wind action.
Pocket Beaches	Small beach systems typically bounded by rocky headlands. Because of the presence of the headlands and the small size of these beaches, longshore currents are relatively insignificant in the overall sediment budget.
Reflected Wave	That part of an incident wave that is returned seaward when a wave impinges on a steep beach, barrier, or other reflecting surface.
Refraction	The tendency of wave crests to become parallel to bottom contours as waves move into shallower waters. This effect is caused by the shoaling processes which slows down waves in shallower waters.
Revetment	(Refer to Seawall)
Rip Currents	Concentrated currents flowing back to sea perpendicular to the shoreline. Rip currents are caused by wave action piling up water on the beach. Feeder currents running parallel to the shore (longshore currents) deliver water to the rip current.

Sand Bypassing	A procedure whereby sand deposited on the updrift side of a training wall or similar structure is mechanically delivered to the downdrift side. This facilitates the natural longshore movement of the sediment.
Sand Drift	The movement of sand by wind. In the context of coastlines, "sand drift" is generally used to describe sand movement resulting from natural or man-induced degradation of dune vegetation, resulting in either nuisance or major drift. Sand drift damage, buildings, roads, railways and adjoining natural features such as littoral rainforest or wetlands; sand drift can be a major coastline hazard.
Sand Drift Control	The repair and maintenance of sand dunes to minimise sand drift. The protection and fostering of dune vegetation is an important element of such programs.
Sand Dunes	Mounds or hills of sand lying to landward of the beach berm. Sand dunes are usually classified as an incipient dune, a foredune or hinddunes. During storm conditions, incipient and foredunes may be severely eroded by waves. During the intervals between storms, dunes are rebuilt by wave and wind effects. Dune vegetation is essential to prevent sand drift and associated problems.
Scarp	Also known as the Dune Scarp and Backbeach Erosion Escarpment. The landward limit of erosion in the dune system caused by storm waves. At the end of a storm the scarp may be nearly vertical; as it dries out, the scarp slumps to a typical slope of 1V:1.5H.
Seawalls	Walls build parallel to the shoreline to limit shoreline recession.
Sea Waves	Waves in coastal waters resulting from the interaction of different wave trains and locally generated wind waves. Typically, sea waves are of short wavelength and of disordered appearance.
Sediment Budget	An accounting of the rate of sediment supply from all sources (credits) and the rate of sediment loss to all sinks (debits) from an area of coastline to obtain the net sediment supply.
Sediment Sink	A mode of sediment loss from the coastline, including longshore transport out of area, dredging, deposition in estuaries, windblown sand, etc.
Sediment Source	A mode of sediment supply to the coastline, including longshore transport into the area, beach nourishment, fluvial sediments from rivers, etc.
Semi-Diurnal Tides	Tides with a period, or time interval between two successive high or low waters, of about 12.5 hours. Tides along the New South Wales coast are semi-diurnal.
Shoaling	The influence of the seabed on wave behaviour. Such effects only become significant in water depths of 60m or less. Manifested as a reduction in wave speed, a shortening in wave length and an increase in wave height.
Shoreline Recession	A net long term landward movement of the shoreline caused by

	a net loss in the sediment budget.
Shadow Area	Areas behind breakwaters and headlands in the less of incident waves. Waves move into shadow areas by the process of diffraction.
Significant Wave Height	The average height of the highest one third of waves recorded in a given monitoring period. Also referred to as H1/3 or Hs.
Slope Readjustment	The slumping of a backbeach erosion escarpment from its near vertical post-storm profile to a slope of about 1V:3H.
Storm Profile	The profile (cross-section) of a sandy beach that develops in response to storm wave attack. Considerable volumes of sediment from the beach berm, the incipient dune and the Foredune can be eroded and deposited offshore. The landward limit of the storm profile is typically defined by a backbeach erosion escarpment (dune scarp).
Storm Surge	The increase in coastal water level caused by the effects of storms. Storm surge consists of two components: the increase in water level caused by the reduction in barometric pressure (barometric setup) and the increase in water level caused by the action of wind blowing over the sea surface (wind setup).
Storm Bar	An offshore bar formed by sediments eroded from the beach during storm conditions.
Surf Zone	Coastal waters between the breaker zone and the swash zone characterised by broken swell waves moving shorewards in the form of bores.
Swash Zone	That area of the shoreline characterised by wave uprush and retreat.
Swell Waves	Wind waves remote from the area of generation (fetch) having a uniform and orderly appearance characterised by regularly spaced wave crests.
Swept Prism	The active area of the coastal system in which sediment may be mobilised by the forces of wind and wave action. On a sandy beach, it extends into the dune system and offshore to the limit of the nearshore zone.
Tidal Prism	The volume of water stored in an estuary or tidal lake between the high and low tide levels; the volume of water that moves into and out of the estuary over a tidal cycle.
Tides	The regular rise and fall of sea level in response to the gravitational attraction of the sun, moon and planets. Tides along the New South Wales coastline are semi-diurnal in nature, ie. They have a period of about 12.5 hours.
Training Walls	Walls constructed at the entrances of estuaries and rivers to improve navigability.
Vegetation Degradation	The process by which coastal vegetation is "degraded" or damaged; this reduces the effectiveness of vegetation in protecting coastal landforms and increases the potential for erosion of underlying soil materials by wind (resulting in sand