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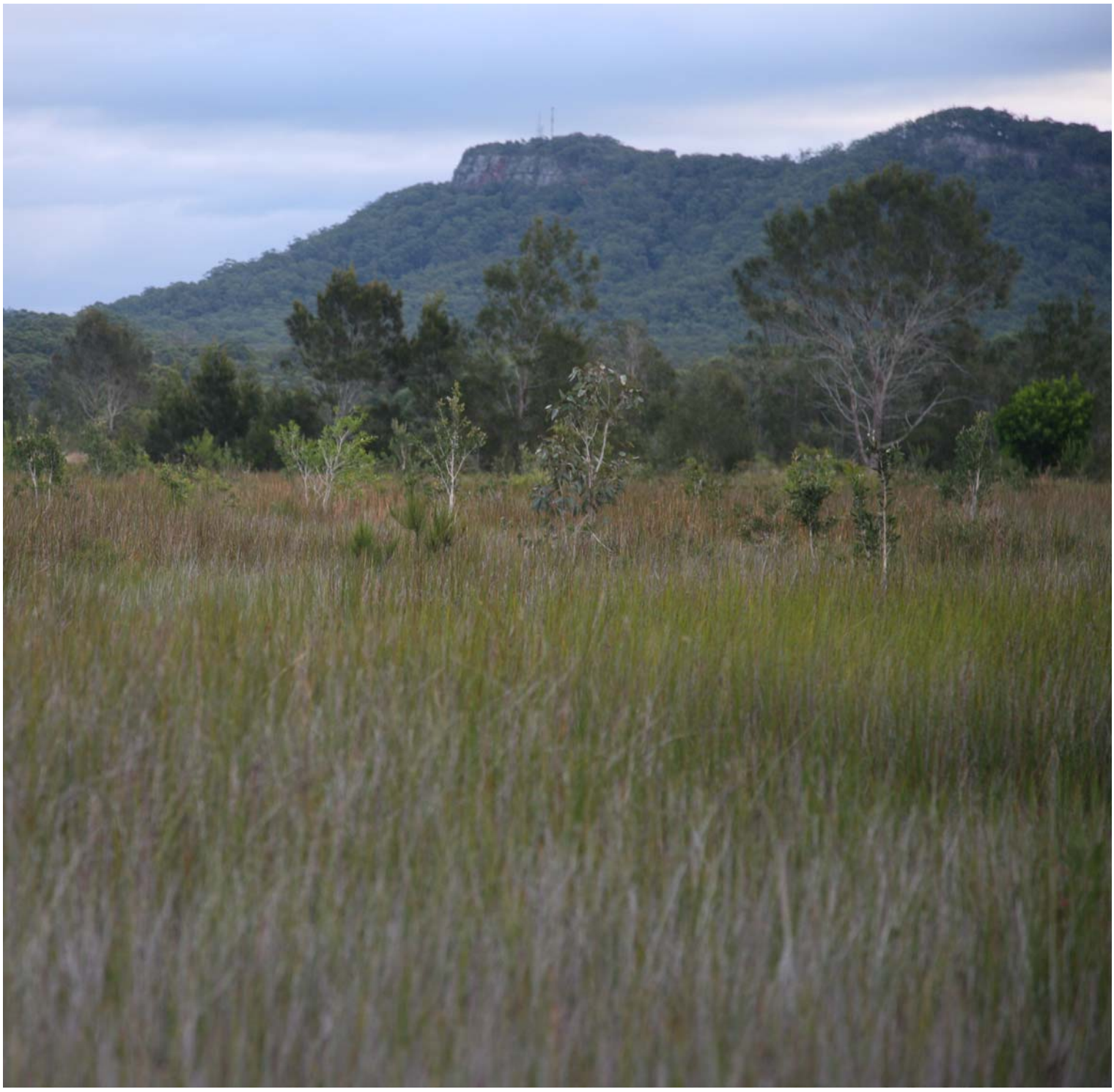
Assessment of the supporting hydrology of the Wallum Froglet Marshland at Rainbow Beach



Document Control Sheet

Project	Rainbow Beach	
Project No.	06503266.03	
Report Title	Assessment of the supporting hydrology of the Wallum Froglet Marshland at Rainbow Beach	
Location	Rainbow Beach, Bonny Hills, NSW,	
Prepared for	St Vincent's Foundation	
Revision	C	
Author(s)	Dr Courtney Henderson and Dr Peter Breen	
Approved by	Dr Peter Breen	
Date	6 July 2010	
File Location	P:\0650 PROJECTS\06502366 Rainbow Beach\2366.03 3A Application\03WRKG_DOCS_REFS\3.2Environ\Draft_Docs	
Distribution	Electronic Copies to: James Dunn	TPS

Revision History

Revision	Revision Date	Approved	Issue Reason
A	17 June 2010	Peter Breen	Draft for client review
B	5 July 2010	Peter Breen	Final draft for client review
C	6 July 2010	Peter Breen	Issue to Client

1. Background

St Vincent's Foundation Pty Ltd ("Owner"), as Owner and Applicant, has prepared Environmental Assessments for Part 3A Major Project's Concept Plan MP 06-0085 and Project Application MP 070001. The Development Site relates to part of Lot 1232 DP 1142133 Lots 1,2,3,4 DP 1150788 and Lot 5 DP 25886 located at Rainbow Beach, Bonny Hills. The total area of the Development Site is 177.4 hectares.

The Concept Plan for the development proposed for the Rainbow Beach site, makes provision for the integration of the following land uses:

- a residential subdivision consisting of approximately 900 lots (67.8ha);
- a business/retail village centre (4.8ha);
- two school sites (14.7ha total);
- a vegetated buffer to Ocean Drive (1.6 ha);
- an Ecotourism site (7.6ha); and
- an Open Space Corridor that encompasses a constructed wetland area (80.9ha).

In addition to the Concept Plan, and in much more detail, the Project Application sets out the proposed Open Space, Drainage and Wildlife Habitat Corridor ("Open Space Corridor") of 80.9 hectares, comprising 46% of the total Development Site. The Open Space Corridor includes the following existing and proposed features:

- District Sporting Fields (7.7 ha);
- an existing lagoon (4.9 ha);
- a large, proposed constructed wetland (10.5 ha);
- two smaller constructed wetlands (1.3 ha);
- 47.5 ha of general open space, including the Wallum Froglet Marshland of approximately 1 ha, and the catchment area that provides runoff to this Marshland (approximately 1.82 ha existing, 1.83 ha proposed);
- a pocket woodland (2.1 ha); and
- an eastern creek line and former nursery area (3.2 ha).

The Central Corridor comprises the major contiguous component of the Open Space Corridor running east-west through the Development Site and is 75.2 hectares in area. An Open Space Management Strategy (OSMS) has been prepared by Cardno (Qld) Pty Ltd (Cardno) for the site and this provides the framework within which the Central Corridor is to be managed by the Owner as part of the Rainbow Beach development.

The Wallum Froglet Marshland will be managed as part of the establishment and ongoing maintenance of the Central Corridor.

1.1 Aim

The Department of Planning have queried whether the proposed urban development at the Rainbow Beach estate may detrimentally change the hydrology of the rehabilitating Wallum Froglet Marshland. The aim of this work was to assess the supporting hydrology of the Wallum Froglet Marshland to determine if there was a risk that this would be impacted by the urban development.

1.2 Introduction

An area of marshland was identified as habitat for the Wallum Froglet in the area to the north-east corner of the existing lagoon. This marshland was reported to be habitat for approximately 50 individuals in an apparently constructed depression just north of the eastern large lagoon (Darkheart 2008). This was formerly a slashed paddock used for livestock grazing (refer Figure 1). At the time of the assessment by Darkheart (2008), this area supported vegetation comprising sedges such as Common Spike rush (*Eleocharis acuta*) with some Jointed Twig-Rush (*Baumea articulata*) and dense infestations of Torpedo Grass on the shallower margins, in addition to other weeds such as Kurnell Curse, Fireweed and Carpet Grass on the outskirts of the community.

Since that time the area has been actively regenerated. In 2006 fences were erected to exclude livestock. Bush regeneration crews have since assisted in suppressing infestations of Torpedo Grass and have undertaken supplementary planting in the area. Consequently, the density of native sedges has increased substantially, and

appears to be increasing with time (*pers.comm*. Wild Things Native Gardens (June 2010), the bush regenerator responsible for bush regeneration of the site) (refer to Figure 2, Figure 3, and Figure 4).

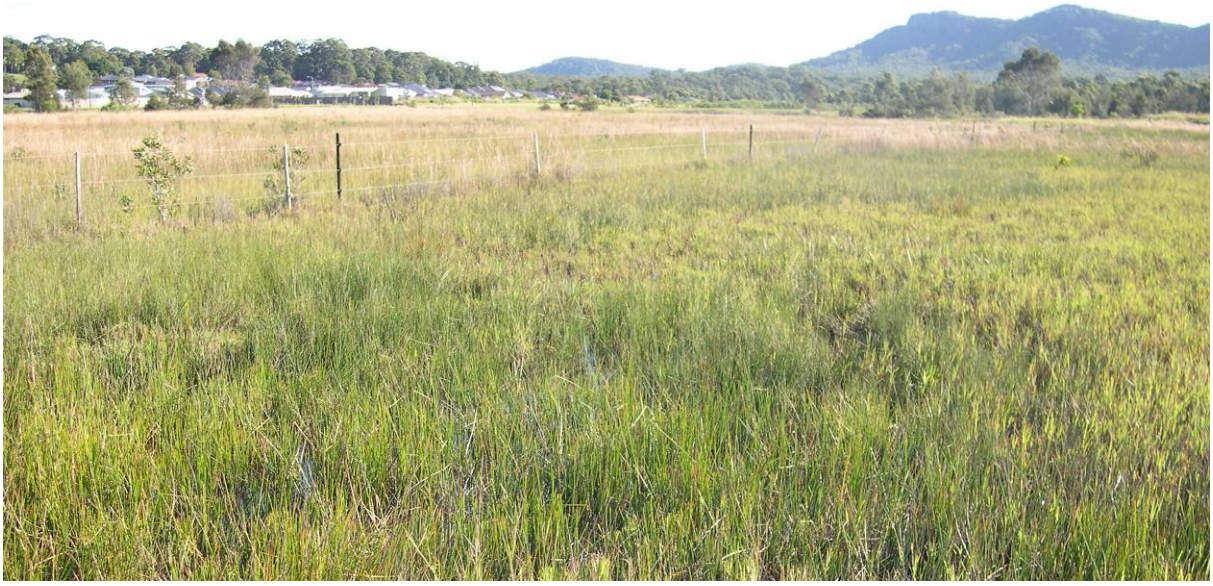


Figure 1 Wallum Froglet Marshland circa 2006. The Marshland is heavily infested with Torpedo Grass (Torpedo Grass has a light green colour with broader leaves than dark, grey-green sedges).

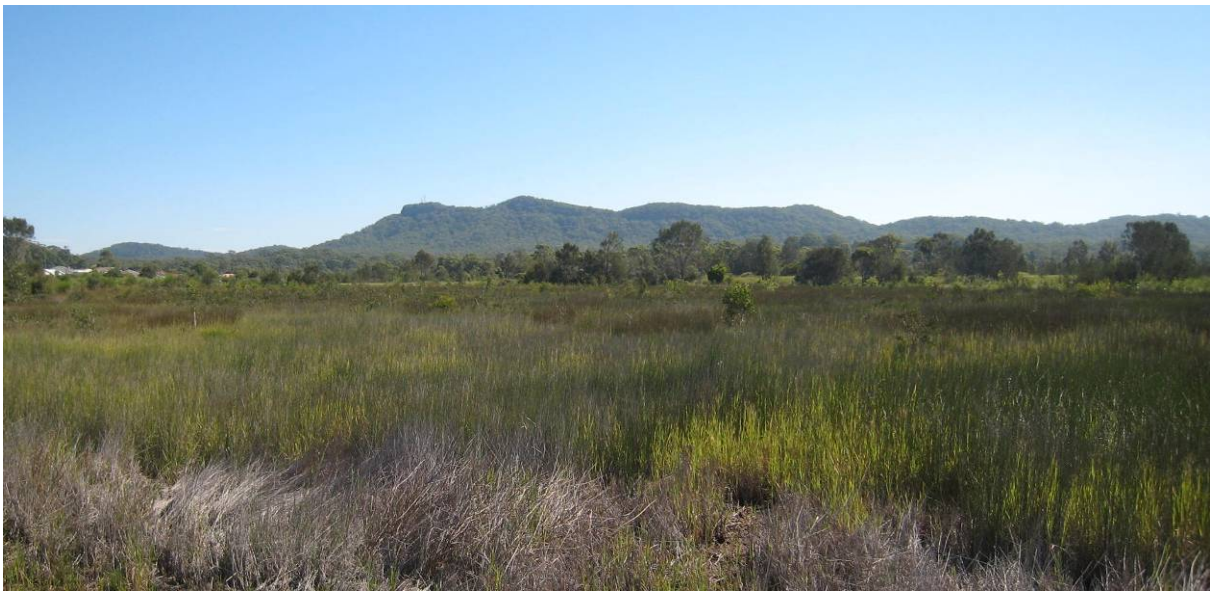


Figure 2 Wallum Froglet Marshland circa 2009. Note that Torpedo Grass is decreasingly visible (light green) and the dark grey-green sedges are increasingly dominant

Figure 3 Wallum Froglet Marshland June 2010. Note the increasing dominance of dark grey-green sedges, and the decreasing prevalence of light-green Torpedo Grass.

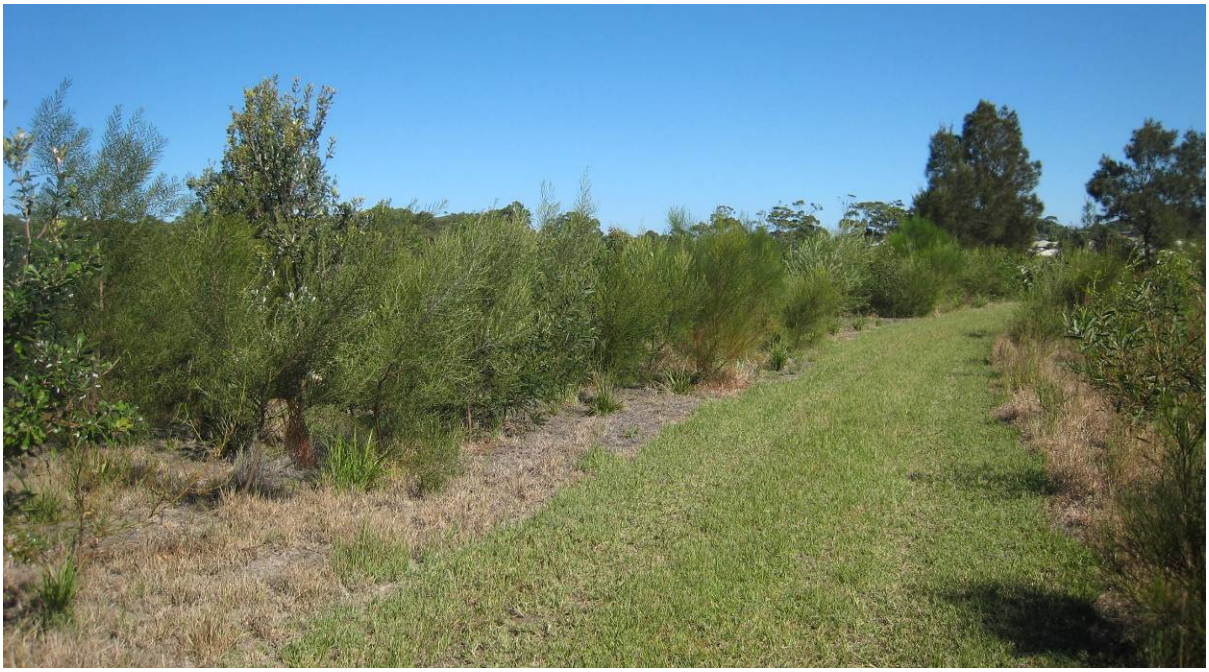


Figure 4 Regeneration adjacent to Wallum Area (to left of photo). This boundary planting is designed to exclude adventitious shoots of Torpedo grass.

2. Method

The following reports were reviewed to assess the existing information pertaining to the Wallum Froglet Marshland:

- **(WRL, 2010).** Groundwater Characterisation and Numerical Modelling for Rainbow Beach Estate Water Research Laboratory. This report identified that the groundwater in the location of the Marshland was approximately 1.6m below ground. Further, borehole soil data was reviewed that revealed that the Marshland grows upon a thick deposit of high plasticity clays. WRL concluded that the marshy conditions at the surface are perched and separate from the saturated water table at depth (Section 7.2 of the WRL report).

  "....This region has been identified as a potential habitat for a species of from with 'marshy' damp conditions found at the surface."

  "The saturated groundwater table in this location reflects the level of the adjacent lake, being approximately 1.6 m below ground. A borehole in this region showed a thick deposit of high plasticity clays extending from the surface. The 'marshy' conditions at the surface are thus believed to be perched, and are separate from the saturated water table. The numerical groundwater model predicts drawdown in the saturated water table in this region of approximately 0.1 m. This drawdown is not expected to impact on the moist 'marshy' nature of the surface soil conditions in this location."

- **Holmes and Holmes (2002)** – Bore log data for soil recovered from Bores BH1, BH2, BH3, BH4, BH5. BH3 is located amongst the Marshland. Soil from this bore indicated high plasticity clay occurring to a depth of 2m.
- **Chandler (2004)** - Bore log data for soil recovered from Bore BC2. This bore occurs slightly north-east of the Marshland. Log data indicates silty-clay soil with a medium to high plasticity from a depth of 0.8 m to 1.4 m.
- **Darkheart (2008).** Ecological survey and statutory assessments .This assessment identified the presence of Wallum Froglets in this depression that forms the Marshland.

  "*The Wallum Froglet has been recorded in two locations in the southern end of the property during previous surveys*:" (the location of concern to this report is) "*At least 50 individuals in an apparently constructed depression just north of the eastern large lagoon (just outside the proposed wetland and filling area)*."

- **Cardno (2010)** Water Engineering and Environment DGR Assessments (WEDGRA). This incorporates the Open Space Management Strategy which prescribes management measures for the protection of the Wallum Froglet population and their habitat. Cardno have assessed this habitat as follows:

  "The calculated average groundwater levels adjacent to the existing lagoon in the marshy area of a known frog habitat are at least a metre below surface level at this location. This is well below the base of the marshy habitat. Since this area is known to retain standing water most of the time, it was concluded that the habitat is a perched water body isolated from the underlying aquifer by impermeable material."(p46)

  "Anecdotal evidence from the site and recent photos show that the frog habitat depression remains waterlogged for extended periods even without major runoff in the lagoon and overflow into the depression. These waterlogged conditions can be maintained by rainfall directly onto the habitat area combined with the presence of an impermeable surface clay layer in this area (see the bore log for Borehole BH#3) which reduces infiltration losses."(p132).

  "On balance it appears that the existing frog breeding conditions are dependent on local rainfall rather than periodic overflows from the existing lagoon. It was also demonstrated in Section 2.11 .8.3 that the water levels in the frog habitat are not reliant on groundwater inflows. In that case, the proposed development is not expected to change conditions in the habitat. As a result the existing frog habitat site will continue to function as an opportunistic breeding site. In addition, the proposed constructed wetland and stormwater treatment wetlands will further increase frog breeding habitat." (p133)

- **Luke and Company (2010)** surveyed the Marshland to map the catchment of the Wallum Froglet Marshland. These data have been incorporated into Appendix A. This figure shows that the catchment of the Marshland is limited, and isolated from the surrounding upper catchments by topography and drainage channels. This survey also identified the drain that controls the discharge from the Marshland.

AECOM further investigated this issue by conducting a one day field inspection focusing on:

- Evaluating the surface water catchment
- Evaluating the potential groundwater catchment
- Reviewing the existing surface drains in the area
- Excavating by hand several shallow soil inspection pits
- Assessing the species composition of the existing and regenerating vegetation
- Assessing the health of the Froglet area and the methods of bush regeneration

3. Results and Discussion

The site visit confirmed the following:

- The existing surface drain network intercepts and directs surface runoff from the upper catchment away from the rehabilitating Wallum Marshland area towards Duchess Creek (refer Figure 5).

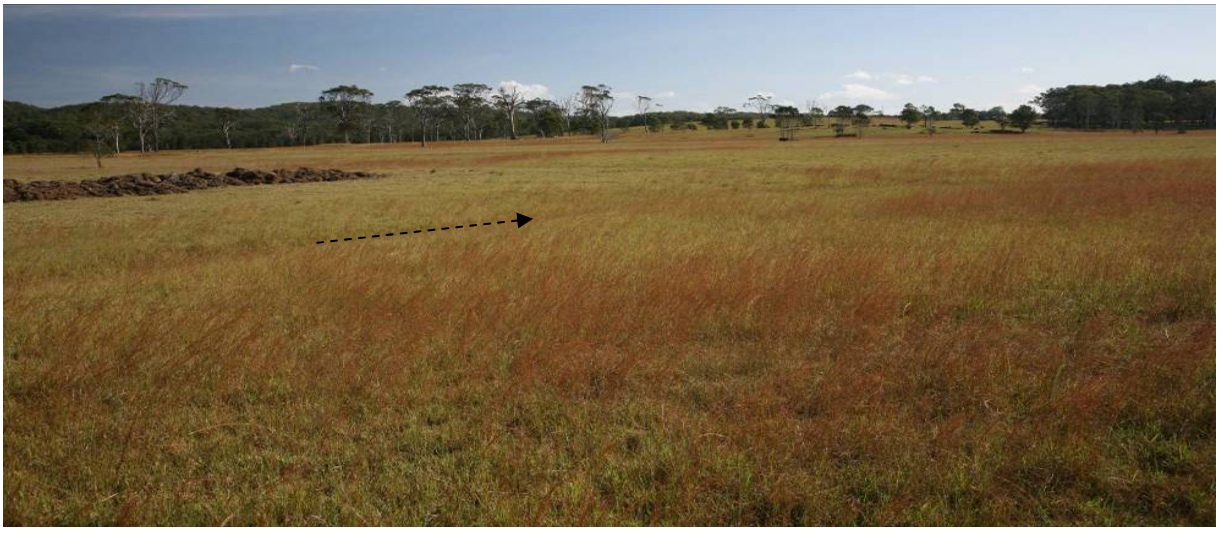


Figure 5 A channel or drain upstream of the Marshland that intercepts runoff from the upper catchment (location and direction of flow indicated by dashed line). Marshland lies off to the left of the photo. The mound on the left is decomposing Torpedo grass that was removed from the existing lagoon last year.

- Water levels within the Marshland are controlled by a surface drain that drains the Marshland basin. This drain controls the maximum depth of inundation and volume of runoff that is retained (refer Figure 6).

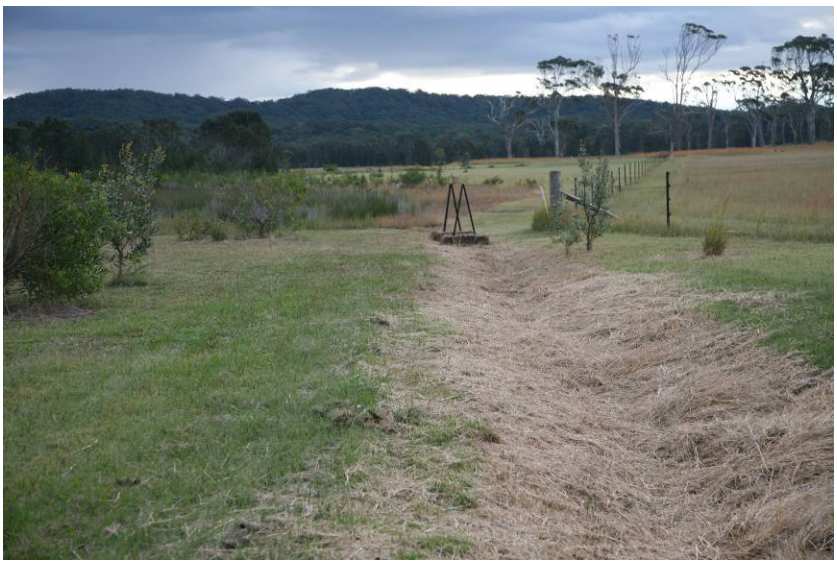


Figure 6 The surface drain that controls inundation depth and runoff from the Marshland (looking upstream). Note the Marshland in the background. Hay bales have been placed in the drain to compensate for the flow control that would have been provided by the grass prior to slashing.

- There was no evidence of groundwater expression in the vicinity of the Marshland.
- The plasticity of the clays that line the Marshland was investigated by hand excavation of several shallow pits. These revealed the occurrence of heavy plastic clays at the surface (refer Figure 7). These pits confirmed the description of soil parameters reported by WRL (in their Section 7.2), and the bore log data sheets of Holmes and Holmes (2002).

Figure 7 Heavy plastic clay dug from the surface of the Marshland. The low permeability of this soil is thought to be responsible for the impeded drainage of the Marshland.

- The Marshland area is set approximately 1.6 metres above the surface of the adjacent lake (WRL 2010). At this location the groundwater is known to occur at a depth approximately level with the height of the water in the lake. If the Marshland was supported by a more extensive local or regional aquifer, the steep cut of the lake batter would have drained the water down below the soil surface to near the lake surface. Since this has not occurred, it is thought that the high plasticity of the clays that make up the surface soil of the Marshland area are sufficiently impervious that rainfall that falls on the catchment is retained on or close to the soil surface and does not infiltrate into the soil (refer Figure 8).

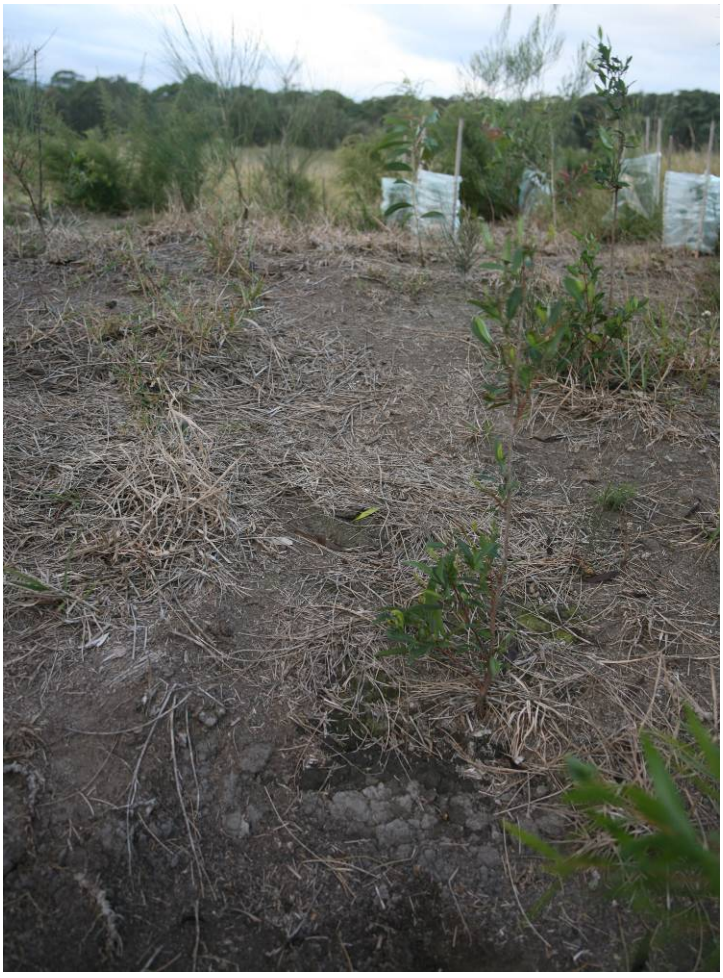


Figure 8 Heavy clays exposed high on the batter from the Marshland to the lagoon. These soils would prevent surface drainage from infiltrating to the groundwater below, approximately 1.6m below the surface.

- The presence of algae growing on the soil surface in bare patches amongst the Marshland vegetation, indicates that water ponds on the soil surface, and persists long enough to support the growth of algae (refer Figure 9). This supports the proposition that the Marshland is supported by impeded drainage at the soil surface.

Figure 9 Green algae growing on the soil surface in exposed areas of the Marshland, indicating that water is retained on the soil surface

- The plant species found in the Wallum Froglet Marshland are indicative of impeded drainage and saturated conditions. These species included sedges such as *Baumea articulata*, *Eleocharis acuta*, *Juncus spp*. *Cyperus polystachyos, Carex apressa, Fimbristylis dichotoma, Restio tetraphyllus* (refer Figure 10). Many of these species could not persist in this location if they were dependent on the groundwater 1.6 m below the surface.

Figure 10 Sedges including *Baumea articulata* and *Juncus usitatus* growing in the Marshland

4. Recommendations

The exclusion of Torpedo grass from the Wallum Froglet area should be facilitated by encouraging a shaded perimeter around the Wallum Froglet Marshland habitat. The shade can be provided by combinations of groundcovers, grasses, shrub and small trees. This approach has already been adopted for parts of the Marshland perimeter.

If it is determined that water is being lost from the Marshland due to erosion of the lagoon batters at any location other than the identified primary exiting drainage outlet, a spoon drain should be built in the unstable area to capture and re-direct water into the Marshland.

AECOM recommends a detailed construction plan be completed in conjunction with the documentation required for the construction certificate. This plan should indentify:

- Construction buffer zones around the wallum area;
- Detailed stormwater and sediment runoff control plans; and
- Dust suppression requirements.

4.1 Recommended Monitoring Requirements

4.1.1 Detailed Survey

The cut drain that controls the discharge of runoff from the Marshland should be surveyed to within 50mm accuracy in order to determine its height.

Additional detailed survey is recommended to map the contours of the Marshland. This should consist of 4 north-south transects spread out evenly across the Marshland, and at least one east-west transect through the middle of the Marshland (or equivalent or better as recommended by the surveyor) (indicated in).

4.1.2 Monitoring Regime

Three posts were installed during the site visit. These should be fit with a measurement gauge that will allow water levels to be measured. Water levels should be measured after each rain event. Once standing water is evident, water levels should be monitored each week until the Marshland has dried out (approximate location of monitoring posts indicated in Appendix A).

4.1.3 Analysis of Monitoring Data

The analysis of water level drawdown is only meaningful once the Marshland has significantly filled. The data from the monitoring of the drawdown of water levels should be compared with Pan A evaporation data for Port Macquarie for that time of year. The rate of drawdown (millimetres per day) should be approximately equivalent to the evaporation for the period considered. If the rate of drawdown is faster than evaporation then this may be due to transpiration by plants, surface water discharge and / or leaks in the confining clay layer. However if the rate of drawdown is slower than evaporation, then it would be expected that the Marshland is being recharged by subsurface groundwater flow.

5. Conclusion

It is our conclusion the Wallum marsh in question is largely an ombrotrophic system developed on heavy clay soils. Surface water pooling is the result of rainfall and impeded drainage. Infiltration into (or out of) the heavy clay soils is clearly minimal. A surface drain controls the depth of pooling in the basin. This pooling depth and the evapotranspiration rate results in the system being ephemeral and supporting the seasonally inundated sedgeland/marshland typical of Wallum habitats.

The observations made during our site visit lead us to concur with the WRL (2010 Section 7.2) and Cardno (2010) conclusion that the Wallum Marshland is supported by impeded drainage over an impermeable clay layer. The catchment for the Marshland is limited, and therefore largely rain fed, rather than fed by groundwater or runoff from other areas of the site. Due to the perched nature of the saturated soil, the construction of another wetland in proximity, but further away than the existing lagoon, is unlikely to have any impact on the Marshland. Similarly, the urban development is unlikely to have any impact because runoff from the urbanising catchments will not flow to the Marshland.

The surface water catchment that drains to the Marshland is limited and the proposed development will result in limited catchment loss, but this can be balanced by a similar catchment area of a similar landuse (refer to Appendix A).

6. References

Cardno (2010) Water Engineering and Environment DGR Assessments (WEDGRA). Rainbow Beach Estate, Bonny Hills. Prepared for St. Vincent's Foundation.

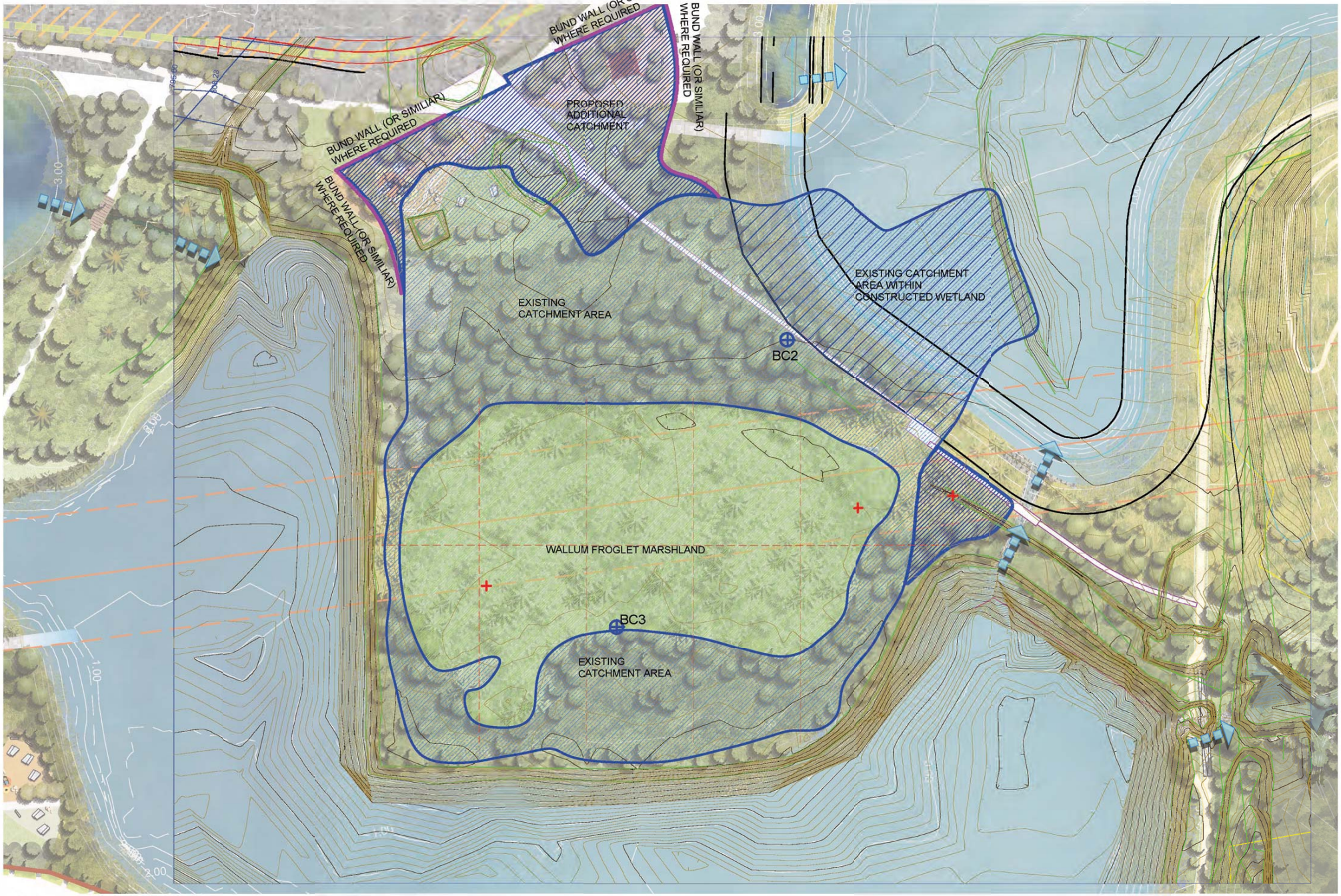
Chandler (2004) - Bore log data for soil recovered from Bore BC2. Rainbow Beach Estate, Bonny Hills.

Darkheart (2008). Ecological survey and statutory assessments of proposed constructed wetland and filling & concept plan on part lot 123 dp 1106943, & lot 5 dp 25886, Ocean Drive, Lake Cathie. For Luke and Company Pty Ltd Port Macquarie. Assessment Undertaken by Darkheart Eco-consultancy.

Holmes and Holmes (2002) – Bore log data for soil recovered from Bores BH1, BH2, BH3, BH4, BH5. Rainbow Beach Estate, Bonny Hills.

WRL (2010). Groundwater Characterisation and Numerical Modelling for Rainbow Beach Estate. Water Research Laboratory.

Appendix A
Wallum Froglet Marshland Detail



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KEY

- \+ Water Level Measuring Staff
- Proposed Survey
- Bore holes with soil profile information

WALLUM FROGLET MARSHLAND DETAIL
SCALE 1:1000@A3
AECOM 18/06/2010

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