Wamberal Lagoon Catchment Area: Watershed Analysis and Associated Vegetation.

Report submitted to Gosford City Council October 2005.

A. W. Sweeney PhD, M.Sc.Agr. Biologist
10 Peter Avenue
Forresters Beach 2260
Ph 02 43858774

Adjunct Professor
Institute for the Biotechnology of Infectious Diseases
University of Technology Sydney
email: tony.sweeney@uts.edu.au

Introduction:

Estuarine paperbark scrub-forest, characterised by a closed canopy of *Melaleuca nodosa* and swamp mahogany (*Eucalyptus robusta*) on alluvial floodplains is recognised as ecologically sensitive wetland vegetation in the Gosford Local Government Area. Rural and urban residential development has progressively cleared it from most of its former range in the Central Coast. There are small isolated fragments in the Davistown and Green Point areas but almost all of the remaining stands are at Wamberal and Forresters Beach (Bell, 2004). The present study was undertaken to investigate the association between this vegetation community and Wamberal Lagoon. This involved a three stage process: (1) computer modelling of the catchment watershed basins; (2) ground truthing to determine concordance of the computer generated flow paths with the actual drainage lines; and (3) computer overlay of the final model on the digital vegetation map of the Gosford Local Government Area (Bell, 2004).

The overall objective has been to contribute towards understanding the significance of this vegetation for the continued health of the flora, fauna and waters of the Wamberal Lagoon ecosystem. A corollary to this objective is to present data, capable of independent scientific scrutiny, as an aid to view the environmental impacts of development applications in the catchment area.

Methods:

1. Computer Modelling: The computer program used for this work was the watershed analysis procedure of TNTmips GIS software version 7.0 (www.microimages.com). The watershed process models the movement of water over the terrain. The input file for the area of interest is a digital elevation model (DEM) - a grid of cells (pixels) georeferenced to the land surface with cell values corresponding to the elevation above sea level. For this study I used a DEM with cell lengths and widths of 25 m. The watershed algorithm computes the local directions of water flow across the grid to determine the boundaries of the catchment and then subdivides the total catchment area into the drainage basins associated with particular branches of the stream network. Outputs of this process include the boundaries and area of each basin as well as the flow paths of the different streams.

2. Ground truthing: A hand held GPS (Geographical Positioning System) device (GARMIN GPS model MAP 76), was used to determine how well the computer generated flow paths corresponded with the actual drainage lines on the ground. Waypoints (individual positions on the ground) were selected with the GPS at locations where the catchment streams cross the Entrance Road. The tracks of 2 streams were plotted on the GPS from the road to Wamberal Lagoon. The waypoints and tracks were then imported into TNTmips and overlaid on the computer generated flow paths to determine their concordance with the actual stream lines on the ground.

3. Vegetation map: The digital vegetation map used for this study was the Mapinfo version of the Natural Vegetation of the Gosford Local Government Area (Bell, 2004). This was imported into TNTmips. The Wamberal – Forresters Beach area of the map was cropped and saved as a separate file. This was then queried in TNTmips to highlight the vegatation Unit E43a which corresponds to Estuarine Paperbark Scrub Forest. The computer flow paths were then overlaid over this vegetation for visual analysis.

4. Outputs: Computer generated output data will be exported to ARCINFO shape files and be publically available. The vector data for basins and flow paths will be provided to Gosford City Council.

Results

Watershed Analysis: The watershed model showed that there are 8 drainage basins in the Wamberal Lagoon catchment area (Figure 1) ranging in size 160 hectares for basin 1 to 32 hectares for basin 2 with a total catchment area of 506 hectares (Table 2). Forresters Creek, the major stream which flows into Wamberal Lagoon, originates in basin 1.

Streams from 5 of the 8 basins cross the Entrance Road between Tumbi Road and Bellevue Road. The geographic coordinates of the points at which these streams crossed the road were verified by GPS and their positions were compared with those of the computer generated flow paths (Table 1). Four of these stream points (from waypoints A, B, D and E) were within 20 m of the computer generated flow path (Table 1). The fifth stream point at Crystal Street roundabout (waypoint C) was 40 m from the computer flow path.

After crossing the Entrance Road the main flow paths of basins 6 and 7 flow through Wamberal Lagoon Nature Reserve . Both of these were tracked by GPS from the road to the lagoon. The basin 6 flow path was within 20 m of the actual stream and the flow path for basin 7 was within 50 m of the actual stream. These results show that there was good agreement between the computer flow paths and the actual stream lines commensurate with the spatial accuracy of the 25 m DEM from which the watershed model was derived. The larger discrepacies between actual and computer derived stream flow of Forresters Creek at Crystal Street can be explained by extensive engineering works associated with the roundabout construction which interfered with the normal path of the creek. Similarly the stream track of basin 7 flowing under Entrance Road near Tumbi roundabout has also been subjected to major engineering works

The computer flow paths were overlaid on the vegetation map unit 43a, corresponding to Estuarine Paperbark Scrub Forest. All of the flow paths from each drainage basin cross through this map unit (Figure 2). This indicates that all of the streams in the Wamberal Lagoon catchment pass through through Estuarine Paperbark Scrub Forest before they enter the lagoon.

Discussion

Bell (2004) considered that the estuarine paperbark scrub-forest (map unit E43a) in the Gosford City Council area might be included within the Sydney Coastal Estuary Swamp Forest Complex (SCESF) Endangered Ecological Community (EEC). In January 2005 Gosford City Council sought clarification from the NSW Scientific Committee of the Dept of Conservation as to whether this vegetation, which includes *Melaleuca nodosa*, might be included within the Swamp Sclerophyll Forest on Coastal Floodplains (SSFCF) Endangered Ecological Community which has replaced the SCESF community (letter Pennington to Chate dated 17 Jan 2005). The Scientific Committee replied in June 2005 that by examining their records they were able to confirm that the geographic coordinates of map unit 43a in the Wamberal Lagoon Nature Reserve was included within the EEC (letter Hughes to Pennington dated 18 June 2005). This patch of vegetation is within basin 8 and is floristically consistent with the other patches of estuarine paperbark scrub-forest (map unit E43a) within the other basins of the catchment.

The final determination of the NSW Scientific Committee relating to the SSFCF Endangered Ecological Community found that

> "this ecological community is associated with humic clay loams and sandy loams, on waterlogged or periodically inundated alluvial flats and drainage lines associated with coastal floodplains. Floodplains are level landform patterns on which there may be active erosion and aggredation by channelled and overbank stream flow with an average recurrence interval of 100 years or less (adapted from Speight 1990). …. [SSFCF] generally occurs below 20 m (though sometimes up to 50 m) elevation." (Threatened Species Conservation Act, 1995).

All of the vegetation classified as map unit E43a of the Wamberal-Forresters Beach area is associated with the drainage lines of the Wamberal Lagoon Catchment and is less than 20 m elevation above sea level. On this basis it should all be considered to be within the SSFCF Endangered Ecological Community.

The results of the present study imply that the SSFCF Endangered Ecological Community acts as a crucially important filter of the entire drainage system of

Wamberal Lagoon. There are only 66 hectares of this vegetation in the catchment of which 32 hectares are on private lands. Clearly, any further degradation of this threatened remnant vegetation would have serious consequences for water quality of Wamberal Lagoon and on the health of the entire ecosystem of the surrounding area.

The environmental sensitivity of the Wamberal Lagoon catchment area is well recognised by Gosford City Council (Gosford City Council, 1995; Laxton, 1999). This study reinforces that recognition and also reinforces the pressing imperative to protect the catchment by careful, detailed and independent expert scrutiny of any development proposals relating to this area. Such proposals should not be considered solely in relation to the actual subject land of an individual development application but in relation to the effect that it may have on the Endangered Ecological Community, on the Lagoon and on the surrounding environment. Piecemeal degradation of even small parcels of land in this area would have cumulative adverse consequences and ultimately lead to irretrievable loss of a priceless natural resource.

References

Bell, Stephen A.J. 2004. The natural vegetation of the Gosford Local Government Area. Digital data version 2.0.

Gosford City Council. 1995. Coastal Lagoons Management Plan.

Laxton, J.H. 1999. Water quality of Gosford Lagoons and Brisbane Water (1996-1998). Gosford City Council, 1999.

Threatened Species Conservation Act, 1995. Swamp sclerophyll forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East corner bioregions – Endangered Ecological Listing. From part 3 of Schedule 1 of the Act.

Speight, J.G. 1990. Landform. In: Australian soil and land survey. Field Handbook. Eds: R.C. McDonald et al., Inkata Press, Melbourne.

Acknowledgements:

I wish to acknowledge the help of Darren Santer, GIS Administrator, Gosford City Council who provided the 25 m DEM of Gosford Local Government Area.

Table 1. Overlay of waypoints on flow paths at points crossing the Entrance Road.

point	basin	position of stream crossing Entrance Road	GPS point distance from flowpath
A	7	Tumbi roundabout drain (east side road)	directly on flow path
B	6	near Wamberal/Forresters Beach road sign at stream drain under east side of Road	18 m south of flow path
C	1	At Crystal St roundabout directly over canalised creek line flowing out from under the road	40 m west of flow path
D	3	Putt Putt golf drain (west side of road)	14 m north of flow path
E	2	F/B Retirement Village drain (west side of road)	8 m south of flow path

Table 2. basin areas

basin	Area (Hectares)
1	160
2	32
3	42
4	34
5	42
6	67
7	46
8	83
total	506

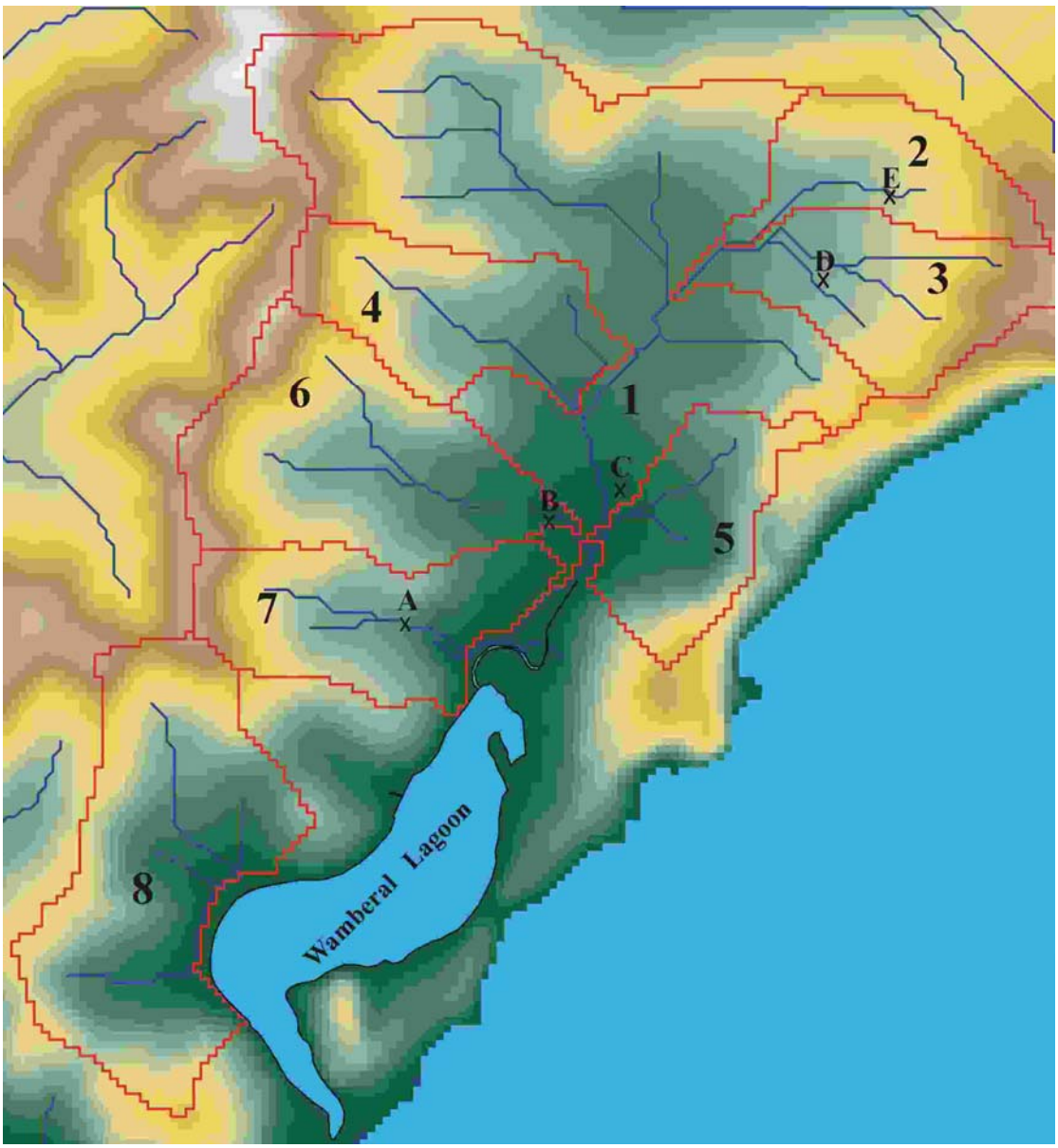

Figure 1. Wamberal Lagoon watershed analysis

LEGEND

blue lines = stream flow paths

red lines = basin boundaries

1,2,3,4,5,6,7,8 = basin numbers

A,B,C,D E = waypoint positions

basin	Area (Hectares)
1	160
2	32
3	42
4	34
5	42
6	67
7	46
8	83
total	506

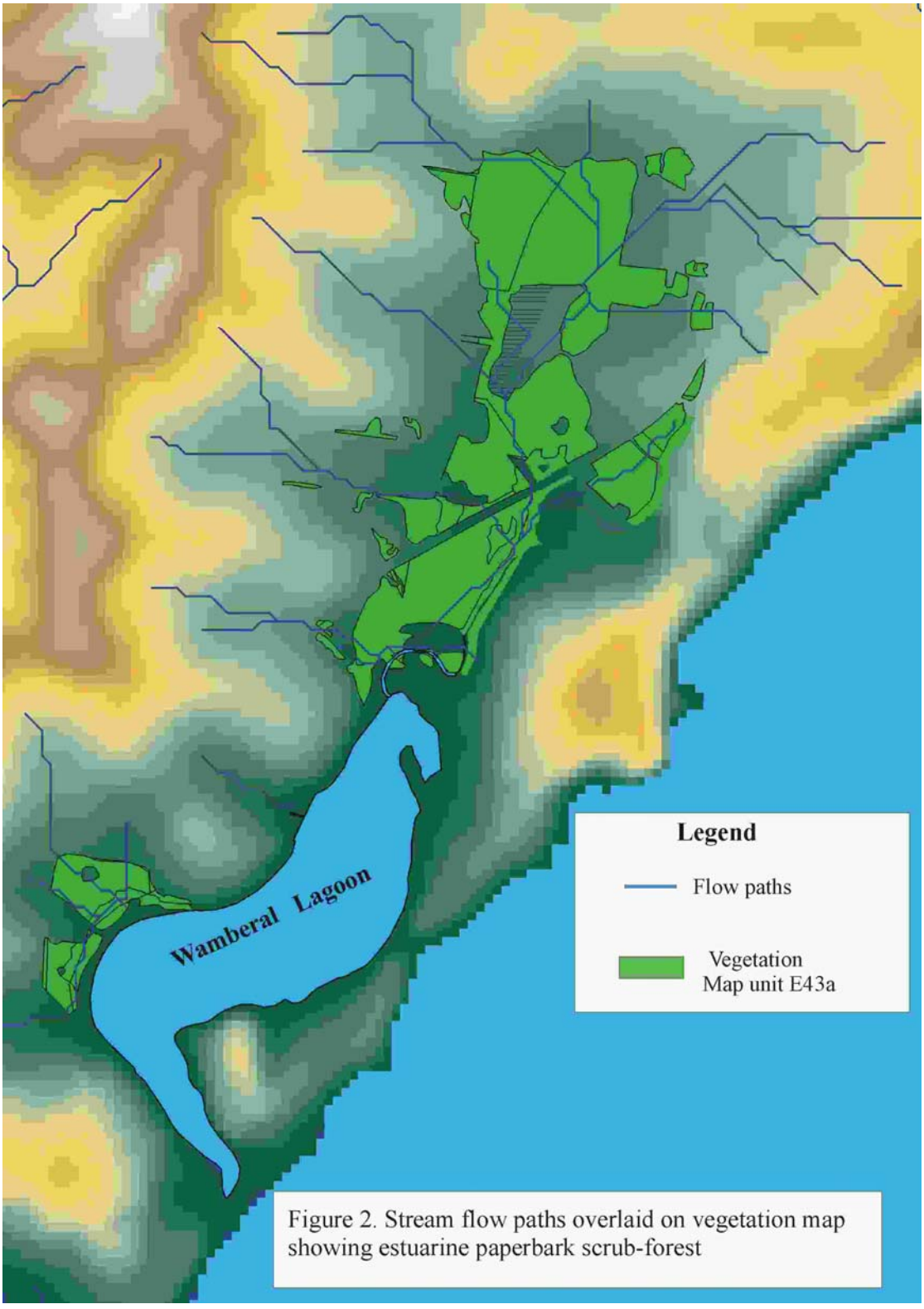

Figure 2. Stream flow paths overlaid on vegetation map showing estuarine paperbark scrub-forest