HOW WIDE IS A WETLAND BOUNDARY ?

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Introduction

New South Wale's State Environmental Planning Policy 14 - Coastal Wetlands (SEPP 14), which was introduced in 1985, is accompanied by a series of 1:25000 maps which delineate coastal wetlands for the purposes of controlling development. The wetlands were mapped by interpretation of botanical indicators using colour aerial photography at an approximate scale of 1:25000 (Adam *et al.*, 1985). For this scale of map the actual boundary line of the wetland areas is 10 to 20 metres wide, a feature which invoked immediate criticism. This criticism was countered in an amendment to SEPP 14 which stated that the outside edge of the boundary line was the edge of the wetland. Nevertheless, the scale of mapping still led to difficulty in accurately transcribing the wetland boundary to a larger scale map. In addition, many errors have been found in comparing SEPP 14 boundaries to the actual extent of wetlands on the ground (Winning, 1991; Payne & Harty, 1998).

In order to more accurately define the extent of wetlands, some Councils and developers have undertaken ground surveys of wetland boundaries. The techniques used have generally involved the delineation of a boundary by a wetland specialist interpreting vegetation or some other feature, with that boundary being subsequently plotted on a map of appropriate scale using various surveying techniques (Winning, 1991; Payne & Harty, 1998). This results in a sharp line which is then used to delineate the wetland's edge for planning and legal purposes.

As pointed out by Winning (1991), there are many problems associated with attempting to accurately delineate wetlands, not the least of which is that few wetlands have sharp boundaries that lend themselves to such accurate delineation. This point was demonstrated for a wetland west of Newcastle, New South Wales (Woodberry Swamp). The boundary of a portion of Woodberry Swamp was delineated in August 1997 as part of a development planning study for the site, using the methods described by Winning (1991). Subsequent vegetation sampling was undertaken in October 1998 as part of a student exercise to demonstrate the natural variability across the delineated boundary.

Woodberry Swamp

Woodberry Swamp is a floodplain wetland on the lower Hunter River floodplain (Figure 1). As is typical of most of the wetlands in this area, the surrounding vegetation has been removed to create grazing paddocks, and ongoing grazing at the upper wetland margin maintains a herbaceous vegetation. Past modifications to the drainage of that part of the wetland covered by this study has resulted in a relatively stable water regime. The vegetation essentially varies with water depth/permanence, with areas inundated by more than about 10 cm of water supporting aquatic species such as *Triglochin procerum, Eleocharis equisetina, Isolepis prolifera* and *Eichhornia crassipes.* Areas inundated by shallower water or with exposed mud support more amphibious species, particularly *Paspalum vaginatum*

and *Cotula coronopifolia.* The immediately upland areas support a range of pasture grasses and weeds, most notably *Cynodon dactylon, Paspalum dilatatum, Lolium* spp. and *Senecio madagascariensis.*

Wetland delineation

Delineation of the wetland boundary was undertaken in August 1997 following the methods described by Winning (1991). This involved placing pegs along a line such that the vegetation within the boundary was dominated (ie. greater than 50% aereal cover) by wetland plant species, and the vegetation outside of the boundary was dominated by non-wetland plant species. The main indicator non-wetland species on this site was *Cynodon dactylon.* These pegs were later accurately located and plotted on a plan at scale 1:2500 by a surveyor. The delineated boundary is shown on Figure 1. As with all cases of surveying a line on the ground, natural topological variation was necessarily replaced with a series of straight lines. Also, the reality of providing a readily surveyed line required the exclusion of small 'lobes' or 'islands' of wetland vegetation from the delineated wetland and inclusion of small 'lobes' or 'islands' of non-wetland vegetation in the delineated wetland. Winning (1991) described this as a 'line of best fit' rather than a true edge.

Vegetation sampling across the boundary

As mentioned above, vegetation sampling was undertaken in October 1998 to demonstrate the natural variability across the delineated boundary. This involved placement of a series of nine transects across and perpendicular to the boundary delineated in 1997. A transect was placed at each of the nine of the 58 initial delineation pegs, that remained after the 14 month period since the original delineation. Thus, the study area was effectively determined by those pegs that remained after the 14 month period (see Figure 1). Each transect comprised a belt of twenty one metre by one metre quadrats centred on the peg, such that ten quadrats were located on either side of the boundary peg.

The areal coverage of 'wetland' or 'non-wetland' species in each quadrat was estimated to the nearest 10%. The wetland / non-wetland assignation of each species encountered in the quadrats, as show in Table 1, was subjectively based on empirical knowledge of the authors of the ecology of these species in the central coastal region of NSW. The relative areal coverage of these two classes in each quadrat was plotted as a column graph for each transect to give a visual representation of the variability in wetland vegetation across the delineated boundary at each transect point (non-wetland vegetation was assigned a negative percentage to better facilitate graphing) (Figures 2 - 10).

Discussion

Few of the transects exhibited a distinct transition from wetland to non-wetland vegetation coinciding with the delineated boundary. Transect W40 (Figure 10) exhibited a sharp transition across the delineated boundary, and transects W20 (Figure 2) and W27 (Figure 4) exhibit a gradual change from wetland to non-wetland vegetation generally coinciding with the delineated boundary.

The remaining six transects did not demonstrate a clear change from wetland to non-wetland vegetation along the 20 metre band of each transect. Transects W24, W31 and W32 (Figures 3, 6 and 7)

displayed examples of outliers on either side of the delineated boundary, and transects W30, W33 and W37 (Figures 5, 8 and 9) showed an unclear distinction between wetland and non-wetland vegetation on either side of the delineated boundary.

These results clearly demonstrate the lack of sharpness in the delineated boundary of a portion of Woodberry Swamp. At many of the sampling locations it can be said that rather than forming a sharp line, the wetland boundary is at least 20 metres wide (i.e. the length of the transect), and at some locations (e.g. W33 and W37) even wider as the wetland vegetation appeared to continue, if not dominate, beyond the upper limit of the 20 metre transect.

In the case of this limited case study, it can be stated that for that part of the delineated boundary that was quantitatively sampled, the delineated boundary generally coincided with the quantitatively measured boundary at 3 of the 9 sample sites. With the remaining 6 sites, the measured boundary differed by ± 20 metres or more from the delineated boundary.

Pressey & Adam (1995) stated that an immovable wetland boundary sharply defined on paper and on the ground is a legal fiction, a premise well supported by the results of this study. In seeking to reduce a natural zone of intergradation between two ecosystems to a line on a plan, the methods developed to delineate wetlands in New South Wales (e.g. Winning, 1991; Payne & Harty, 1998) produce a line which, in most cases, is effectively an average of the wetland boundary rather than a true edge. Extending this statistical analogy, this average boundary should also be seen as having an error band, the size of which would vary from site to site, generally depending on site physiography.

It should also be remembered that the methods presently used to delineate wetlands in New South Wales are based on a rapid 'walk-about' interpretation of the wetland boundary and are therefore open to subjective interpretation. There have been no studies of the precision (i.e. repeatability) of these techniques, especially as relates to seasonal or long term climatic changes.

Thus, although a delineation may be accurately plotted, it is potentially misleading to say that such a delineation accurately represents the boundary of a wetland, rather it approximates the wetland boundary. Statements, such as by Payne & Harty (1998) that high orders of accuracy could be obtained using their GPS technique (i.e. ± 1.5 m) only reflect the accuracy of the delineation and not necessarily the accuracy of the boundary interpretation.

It is important, therefore, that planners and administrators are not misled into believing that wetlands have sharp boundaries and that these boundaries can be accurately plotted. While there is a legal and planning need to prepare plans of wetland boundaries these should be qualified. Ideally, planners and administrators should be encouraged to adopt an approach in which a wetland protection zone encompasses the total wetland rather than to seek to accurately map an artificial average boundary for the wetland.

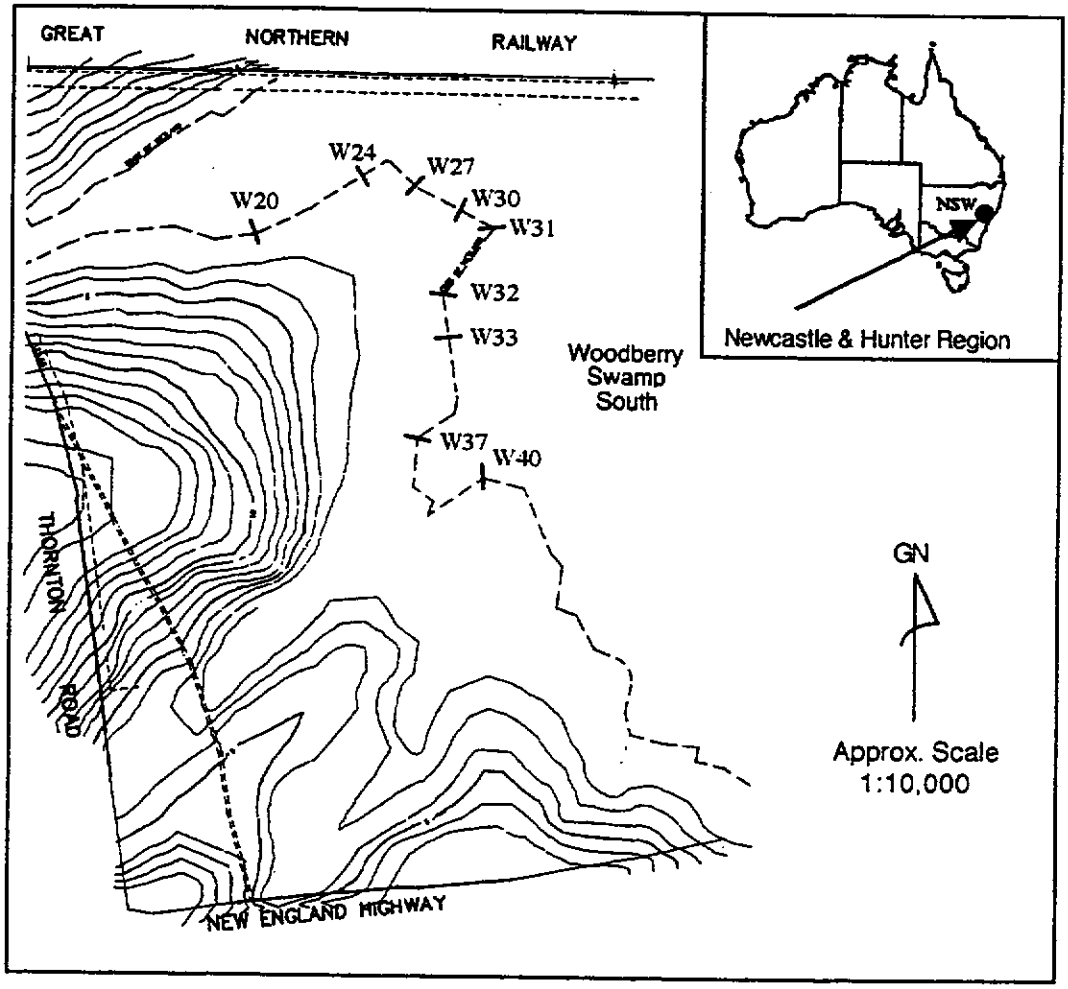

Figure 1 Delineated wetland boundary (dashed) and location of transects

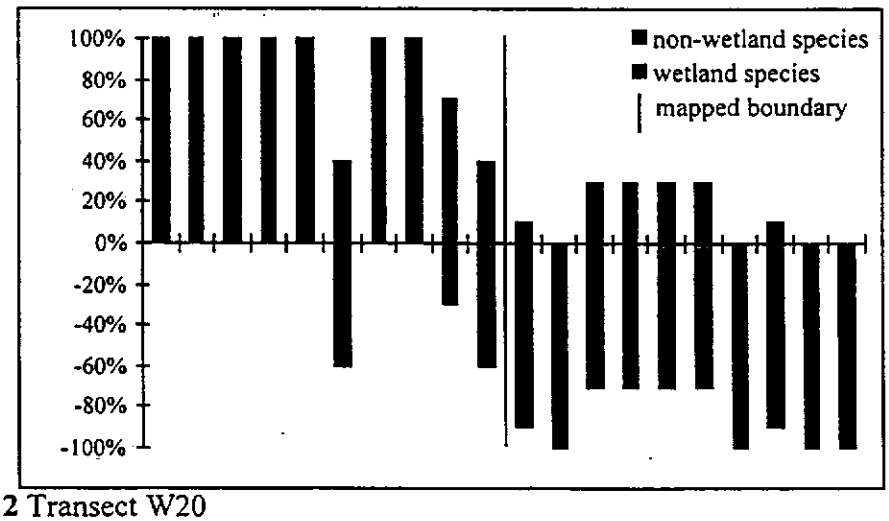

Figure 2 Transect W20

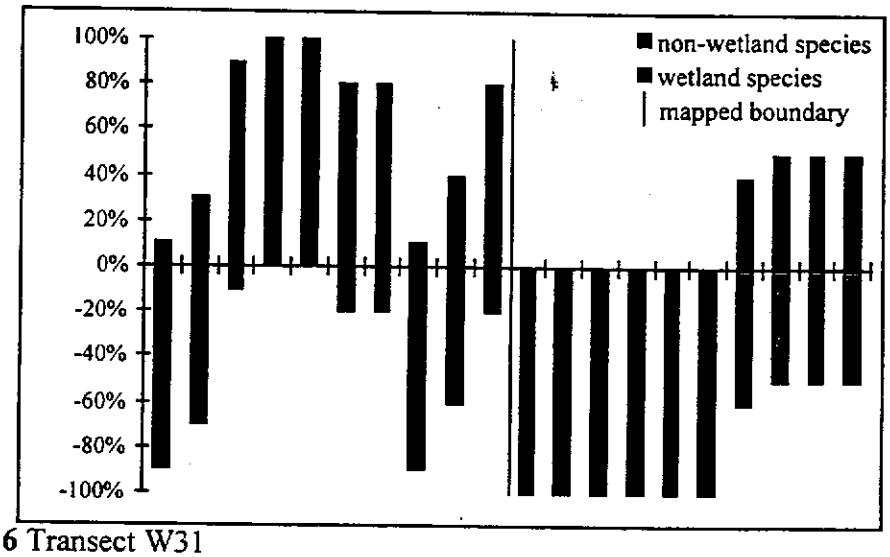

Figure 6 Transect W31

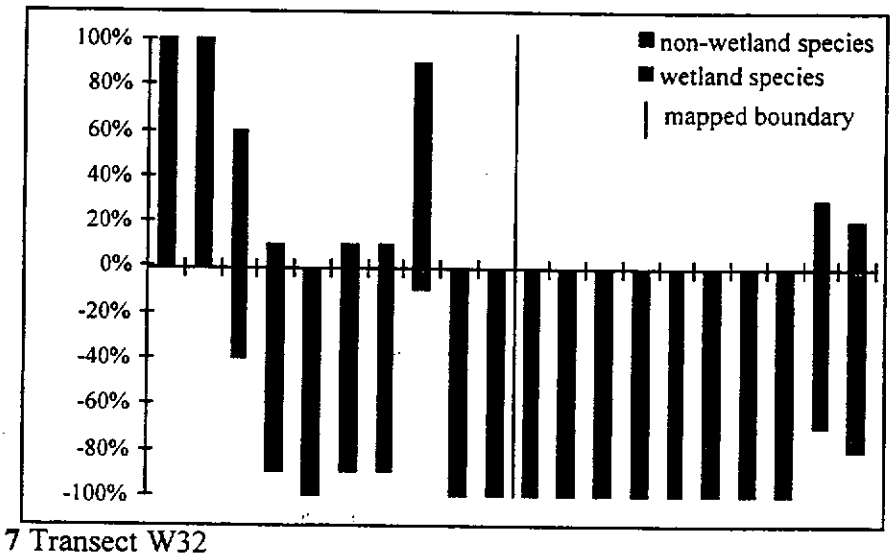

Figure 7 Transect W32

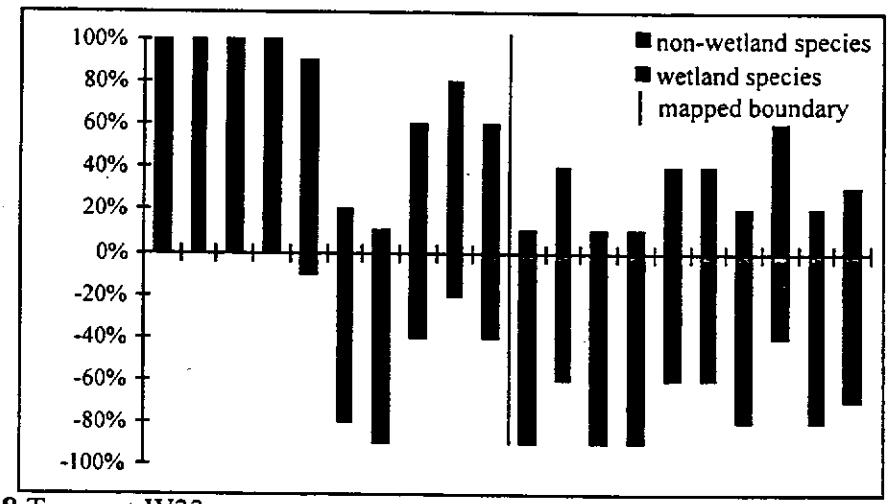

Figure 8 Transect W33

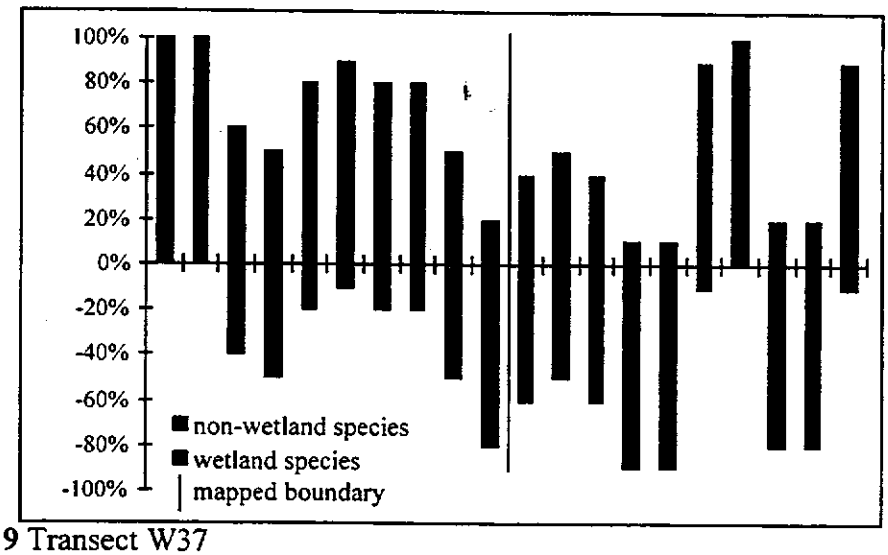

Figure 9 Transect W37

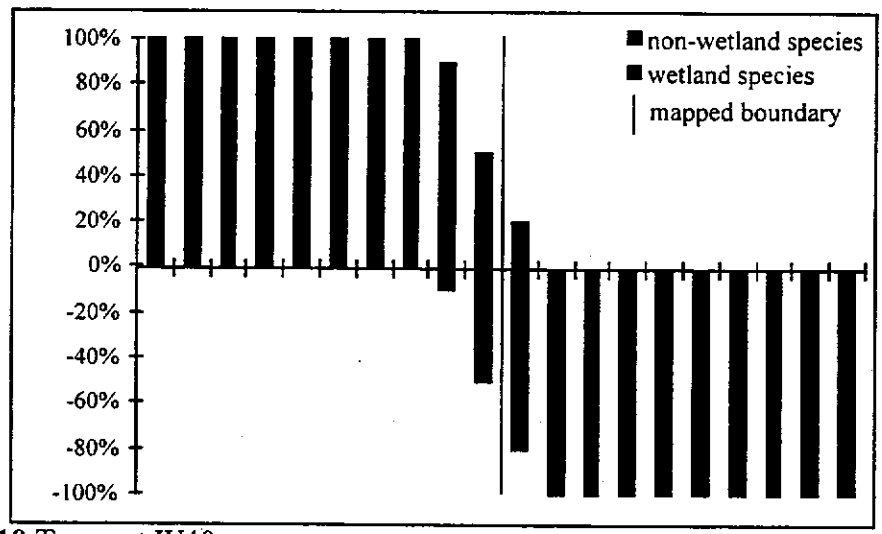

Figure 10 Transect W40

Table 1. Plant species recorded along transects at Woodberry Swamp, Oct 1998.

SUBCLASS MAGNOLIIDAE			
RANUNCULACEAE	*Ranunculus inundatus*	Buttercup	w
	Ranunculus sceleratus	Celery Buttercup	w i
AMARANTHACEAE	*Alternanthera denticulata*	Lesser Joyweed	w
CARYOPHYLLACEAE	*Cerastium glomeratum*	Mouse-ear Chickweed	n i
	Stellaria media	Common Chickweed	n i
POLYGONACEAE	*Persicaria lapathifolia*	Pale Knotweed	w
	Persicaria orientalis	Princes Feathers	w
	Polygonum arenastrum	Common Wireweed	n
	Rumex crispus	Curled Dock	n i
PRIMULACEAE	*Anagallis arvensis*	Pimpernell	n i
LYTHRACEAE	*Lythrum hyssopifolia*	Hyssop Loosestrife	w
FABACEAE, FABOIDEAE	*Trifolium repens*	White Clover	n i
APIACEAE	*Ciclospermum leptophyllum*	Slender Celery	n
ASTERACEAE	*Aster subulatus*	Wild Aster	w i
	Conyza bonariensis	Fleabane	n i
	Cotula coronopifolia	Water Buttons	w
	Gnaphalium sp.	Cudweed	n i
	Hypochoeris radicata	Flatweed	n i
	Senecio madagascariensis	Fireweed	n i
	Sonchus oleraceus	Common Sow-thistle	n i
PLANTAGINACEAE	*Plantago lanceolata*	Plantain	n i
VERBENACEAE	*Verbena bonariensis*	Purple Top	n i
CALLITRICHIACEAE	*Callitriche stagnalis*	Common Starwort	w
SUBCLASS LILIIDAE			
ALISMATACEAE	*Sagittaria graminea*	Sagittaria	w i
JUNCAGINACEAE	*Triglochin procerum*	Water Ribbons	w
IRIDACEAE	*Sisyrinchium* sp. A	Scourweed	n i
JUNCACEAE	*Juncus bufonius*	Toad Rush	w i
	Juncus usitatus	Common Rush	w
CYPERACEAE	*Isolepis inundata*	Club-rush	w
	Isolepis prolifera	Club-rush	w i
POACEAE	*Agrostis avenacea*	Blown Grass	n
	Briza minor	Shivery Grass	n i
	Bromus catharticus	Prarie Grass	n i
	Cynodon dactylon	Common Couch	n
	Lolium spp. (hybrid swarm)	Rye Grass	n i
	Paspalum dilatatum	Paspalum	n i
	Paspalum vaginatum	Salt-water Couch	w
	Pennisetum clandestinum	Kikuyu	n i
	Poa annua	Winter Grass	n

ABBREVIATIONS:
w = wetland species
n = non-wetland species
i = introduced (i.e. not indigenous to Australia)

For simplicity, author citations for scientific names are not given, these follow Harden (1990-93).

References

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