WETLAND DESIGN AND CONSTRUCTION PRINCIPLES AND GUIDELINES

Lower Goulburn Rehabilitation Scheme

Prepared for the
Snowy Mountains Engineering Corporation

on behalf of

the Goulburn-Broken Catchment Management Authority

by

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May 1999

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1 INTRODUCTION

The Snowy Mountains Engineering Corporation (SMEC), on behalf of Goulburn-Broken Catchment Management Authority (CMA), wish to develop wetland design and construction guidelines that will increase the flora and fauna values of the proposed floodway for the lower Goulburn River downstream of Loch Garry.

1.1 Scope of Report

This report develops and assesses opportunities that, as part of the Lower Goulburn Rehabilitation Scheme, would potentially increase the ecological values of the Deep Creek and Bunbartha Creek systems. Important considerations for designing and constructing wetlands in the area are also given to ensure that the existing high ecological values of the area are protected and enhanced. Detailed wetland design and ultimately construction would need to involve further survey work to ensure that areas with high values are protected.

In order that an understanding of how the ecology of the area is likely to be affected by the engineering and hydraulic design of the Lower Goulburn Rehabilitation Scheme an overview of the ecological requirements for instream, riparian and wetland vegetation is also given.

What is a wetland?

The universally adopted definition of a wetland is namely;

"areas of marsh, fen peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres." (Ramsar Convention)

Under this broad definition any body of water constitutes a wetland. The opportunities identified in this report to enhance the ecological values of the lower Goulburn floodway have been developed under this definition.

2 METHODOLOGY

The following tasks were undertaken during this project:

1. Assessment of current floodplain flora and fauna values, based on the report prepared by Ecology Australia (White, 1999). As the scope of Ecology Australia's study was limited to the flora and fauna of the floodplain area, specific consideration of the ecological value of the aquatic or semi-aquatic areas was not possible.

2. Discussions with appropriate contacts (Ken Fung of SMEC, George Mallory of SMEC, Matt White of Ecology Australia, Lance Lloyd, consultant to the Murray-Darling Basin Commission) were held to ensure all relevant issues were addressed.

3. The development of wetland design scenarios and construction guideline.

3 AN OVERVIEW OF WETLAND ECOLOGY

The following overview of wetland ecology is given in order that the basis for the various scenarios developed for the Lower Goulburn Rehabilitation Scheme is apparent. For clarity, separate sections have been devoted to flora and fauna, however, both are integral to the ecological health of a wetland.

Flora

The composition of a wetland community is determined by the frequency and extent of inundation, as different plant species have different growing preferences that relate to these two parameters. For example, some plant species have a preference for growing in permanent shallow water (macrophytes), whereas others prefer areas that are only occasionally inundated (riparian vegetation). Amongst the class of shallow water species, species also differ in their preferred water depths (see figure 1). A wetland with diverse flora that also offers a range of food and shelter to fauna, will have a variety of water depths within a range of 0 – 1.5 m for most of the year, with the shallower depths of approximately 0 - 0.5 m have the greatest species diversity.

A further factor in determining species composition in a wetland is the occurrence and extent of dry periods (ie. drawdown). Many species set seed during such periods and consequently these periods are important to the viability of a wetland community. The variation in growth preferences of wetland plants means that the greater the variation of depths in an area, the greater the species diversity.

Wetlands can be of any size, and given that it is the water regime that largely determines their characteristic community, very different sized wetlands can have similar plant communities. The corollary is that similar sized wetlands can differ greatly with respect to their plant communities because of their different water regimes.

The dependence of fauna on flora for habitat means that it is critical to ensure good management of flora values of an area. For this reason, the various opportunities identified in this report for protecting and/or enhancing the ecological values of the area involve protecting and/or enhancing flora.

Fauna

In general, a diverse range of flora will result in a diverse range of fauna if sufficient area is available to sustain viable populations. That is, a high plant biodiversity will be correlated with high fauna diversity as there will be numerous habitats available (i.e. a variety of food and shelter) that will suit the requirements of a range of fauna species. Habitat variation is important in offering a variety of opportunities to animals for feeding, nesting or roosting. As with wetland plants, little variation in habitat will favor a limited number of species.

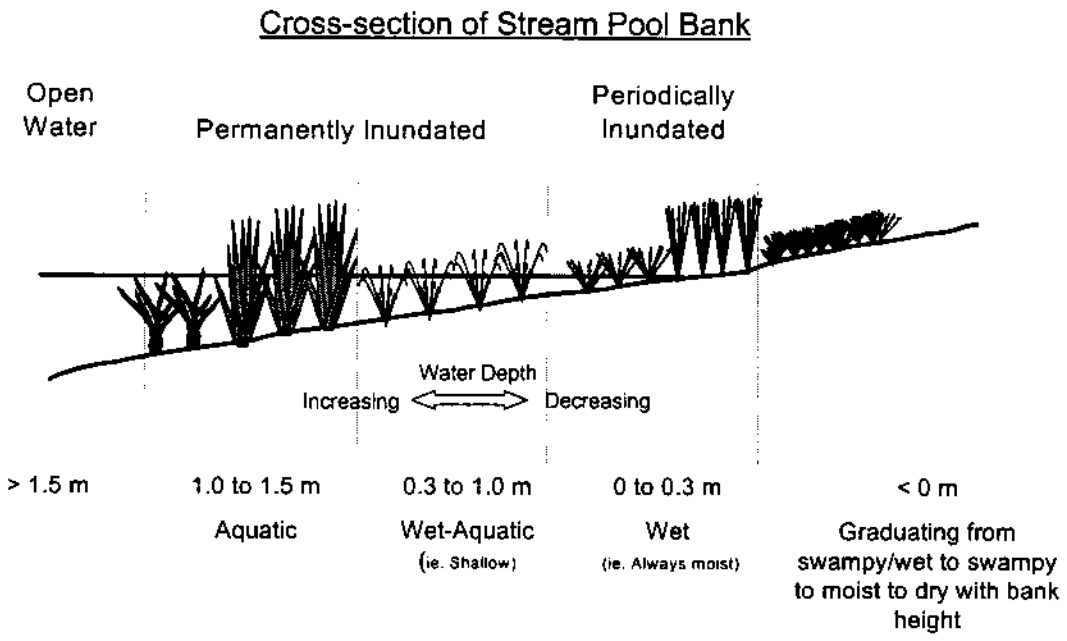

Figure 1. **Idealized vegetation structure for a shallow wetland**

4 INCREASING ECOLOGICAL VALUES ALONG THE LOWER GOULBURN RIVER FLOODWAY

George Mallory of SMEC has indicated that the proposed changes in hydrology to the Deep Creek and Bunbartha Creek systems will increase the frequency of their inundation from a 1 in 3 year flood event to a 1 in 2 year flood event. The creeks, nonetheless, will still remain ephemeral systems. It is also expected that there will be a reduction in the interval between inundation of the floodplain.

These changes in hydrology present an opportunity to increase the habitat diversity and, hence ecological value of the area, if some changes to the morphology of the area are made, and management initiatives such as reduced grazing pressure are instigated. However, while these changes may enhance the ecological value of the area, it is important that those areas that have been identified as currently of high ecological values are protected. The extent of areas to be protected needs to be determined by undertaking more extensive field surveys than conducted to date (see below for area already identified by Ecology Australia). Similarly, accurate identification of areas that offer the best opportunities for enhancement will require further surveys of the area.

4.1 Protection of ecological values

Several areas were identified by Ecology Australia (White 1999) as being of high ecology value and, hence, worthy of protecting. These areas were:

1. Riverine Plains Grassy Woodland associated with Deep Creek, Sheepwash Creek, Wallala Creek and Skeleton Creeks

2. Remnant Riverine Plains Grassy Woodland and regrowth associated with Kaarimba Creek (north of Bunbartha Creek)

3. Remnant Riverine Plains Grassy Woodland located on several blocks of public land to the east of the Goulburn River levee

4. Freshwater meadows (beyond the scope of Ecology Australia's project, but likely to be occurring in the area).

If possible, prior to changes in hydrology to the creeks, detailed modelling should be undertaken to ascertain the likely extent and frequency of the new flows in the areas identified above. This information would allow for a prediction of how significant the changes in flow regime are likely to be to the flora.

In addition, more detailed flora surveys should be conducted so that baseline information is available with which to compare potential future changes to the plant communities. Following changes to the hydrology of the creeks, monitoring of key areas (e.g. annually) should be conducted and the results used as a decision making tool in protecting the area. That is, if the characteristics of the plant communities appear to be changing, and/or the flora (notably trees) appear to be stressed, initiatives could be undertaken to mitigate the likely causal factors of these changes.

Inundation that is too frequent or too long to maintain the plant community could potentially be reduced by constructing low earth banks and/or upstream wetlands that restrict water flow to the area to be protected. Alternatively, depressions surrounding such areas could be created, where water can be rapidly shed.

4.2 *Enhancement of ecological values*

The following initiatives are suggested in order to enhance the existing ecological values of the area:

1. Promote recruitment and establishment of indigenous plants within the floodplain, riparian zones and instream zones by reducing stock grazing pressure. Light grazing at certain times of the year within the floodplain may be acceptable/beneficial as part of a weed control program.

2. Develop and initiate a weed control program.

3. Investigate the viability and benefit of undertaking selective planting in key locations to link existing plant communities and create corridors.

4. Create a mosaic of water regimes through the construction of strategically placed low earth banks, or possibly by limited excavation, with channels to connect different aquatic habitats. A mosaic of water regimes could include: permanent pools of water grading into shallow wetlands that are inundated annually or every 2 years; semi-permanent shallow wetlands inundated annually or every 2 years; and shallow wetlands inundated approximately every 5 years.

   The water depth of these water bodies ideally should range from 0 to 1.5 m+ when fully inundated (see notes on drawdown above and in glossary). Areas shallower than 1.5 m will be vegetated, while areas deeper than 1.5 m will be open water. Both types of areas promote fauna diversity as some species prefer feeding in vegetated areas, whereas some prefer open water. The presence of vegetation, however, is particularly important as it offers not only food, but also shelter to a wide range of species. An alternative shelter to vegetation for some birds is a roosting island. Where possible, islands should be incorporated into a wetland design.

   Construction of low earth banks would be preferable to any excavation of wetlands, as it would minimize any damage to the structure of the soil of the area and minimize erosion (see below in design section).

5. Create permanent water, as habitat for fish, within the channel of the creeks by deepen the creek(s) in key areas (excavating). Extreme care would need to be exercised in doing this to ensure that the stream channel(s) is not destabilized and that any erosion is minimized.

6. Ensure that fish are not isolated in water bodies for excessive time periods (i.e. greater than 2 years).

7. Ensure that there are migratory paths for fish between the floodplain water bodies and the creeks, so that as water recedes from the semi-permanent water bodies on the floodplain (resulting in them drying out) fish do not become stranded.

8. Increase habitat values for fish in the permanent and semi-permanent water bodies by introducing snags. Emergent snags will also be used as perching location by birds.

5 WETLAND CONSTRUCTION GUIDELINES TO PROTECT AND ENHANCE EXISTING ECOLOGICAL VALUES

5.1 Wetland Design

The ecological values of the Deep Creek and Bunbartha Creek systems will be protected and enhanced in a cost effective manner, if when designing the wetlands consideration is given to the following:

1. A mosaic of wetlands with varying water regimes and water depths is created (see above).

2. Wetlands are designed to offer, in addition to a variety of water regimes and depths, a variety of structural habitat features, such as roosting islands, areas where snags can strategically be placed, and complex shorelines (e.g. numerous small inlets or projections).

3. Contour maps are investigated and site surveys conducted to explore opportunities to take advantage of natural variations in the landscape that can be utilized in creating a wetland (e.g. depressions, drainage lines).

4. Site surveys are conducted so that not only are natural features of the landscape utilized, but areas currently of high ecological values are protected. Degraded areas should be the prime areas consider for creating wetlands.

5. The location of the wetlands takes into consideration the whole local landscape. Opportunities to link areas of high ecological value should be maximized (i.e. providing wildlife corridors).

6. Semi-permanent wetlands are designed with connectivity with the creeks so that after a flood event, and particularly during draw down, fish are not isolated.

7. Areas subject to water flows of high energy are identified (e.g. in channels) and protected from erosion (e.g. strategically placed snags, piles of local rocks, strategic planting).

5.2 Wetland Construction

The simplest manner in which to create a wetland is to construct low earth banks capable of holding and/or diverting water. This type of wetland construction makes it expedient to investigate contour maps and conduct site surveys of proposed wetland areas to identify opportunities for creating low earth banks offered by the natural morphology of the area. This method for creating a wetland is cost effective and has the advantage of minimizing potential damage to the soil structure of the area, while minimizing erosion.

Creating a wetland via excavation is a more costly exercise that must be carefully managed to minimize disruption to soil structure and erosion. Maintaining the integrity of the soil structure is particularly important as the majority of wetland plants (both riparian and macrophyte species)

are similar to most terrestrial plant species in that their growth and viability will be maximized in soils that have an open structure and appropriate organic content and nutrients. To maximize the potential for successful establishment and maintenance of plant communities in wetlands where excavation and/or soil movement has been necessary the following should occur:

1. Topsoil should be removed during construction of wetland and stockpiled for later redistribution

2. Compaction of topsoil should be avoided

3. Where possible at least 300 mm of topsoil should be redistributed wherever it is intended that plants will grow. This includes areas that will be permanently or regularly inundated that will have plantings of macrophytes.

5.3 Plant Establishment

Plant establishment in permanent or semi-permanent water bodies, on the relatively large landscape scale proposed as part of the Lower Goulburn Rehabilitation Scheme, is in general, effectively achieved through natural recruitment. Plant seeds or propagules are dispersed predominantly via birds, wind or water. When seeds or propagules encounter favorable conditions they readily establish. By creating a wetland, new conditions favorable to aquatic and semi-aquatic species will have been created. The dispersal process can be accelerated in some areas by transferring mud, and its associated seed bank, from existing wetlands in the area.

Initial establishment of plants, however, can be undermined by competition from weeds and grazing pressure. Hence, it is important that weed control and grazing control programs need to be instigated once wetlands have been created.

Natural recruitment may be ineffective in areas where soil disruption has been unavoidable during the construction process, or where there are relatively high water velocities. Under these circumstances planting tube stock, possibly with a stabilizing material such as "jutemat", may be beneficial.

The ecological values of the floodplain and riparian zones would be improved not only by reducing or removing grazing pressure and weeding, but also by undertaking direct seeding. In particular, this technique could be used to increase plant establishment in strategic locations, such as between two stands of remnant woodlands or created wetlands, hence creating wildlife corridors.

GLOSSARY

Wetland	The definition of a wetland given by the Convention on Wetlands of International Importance (Ramsar) is an, area of marsh, fen peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres. Wetlands can be of any size.
Riparian species/zones	River bank and river channel vegetation/zones that are infrequently inundated
Macrophytes	Plants visible to the naked eye that are permanently or regularly inundated. The term encompasses aquatic and semi-aquatic species.
Water Regime	The extent and frequency that a wetland is inundated
Inundation	Wetting of an area
Wetland/Plant Community	A collection of species that share similar habitat preferences and typically co-exist
Species diversity	The number of different species
Viability	The ability of a plant or animal to grow and reproduce
Drawdown	A slow lowering of the water level in a wetland. In southern Australia this typically occurs in late summer. During such a time a wetland can become completely dry.

Reference

White, M.D. (1999). A Preliminary Assessment of Nature Conservation Values in the Proposed Lower Goulburn Rehabilitation Scheme. Report prepared by Ecology Australia for Snowy Mountains Engineering Corporation.