Boyters Lane Playing Fields and Wetlands

Plan of Management

Ref: BB028

April, 2005

Prepared for

Kempsey Shire Council

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Sunset over the Boyters Lane Wetland

Project Identification

Project: Boyters Lane Playing Fields and Wetlands Plan of Management

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Project Area: Boyters Lane, South West Rocks, NSW

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File Name: BB028_report_Boyters Lane Management Plan
Location: *Transferred\Jobs and Admin\BB028 Boyters Lane \Reports*

Executive Summary

This document contains a Draft Management Plan for the Boyters Lane playing fields and wetlands, South West Rocks. The property has been purchased by Kempsey Shire Council for the purpose of constructing playing fields on one portion of the site, with the remainder to be managed for environmental objectives.

The Boyters Lane Playing Fields Wetlands Management Plan aims to provide a range of management options that integrate best available scientific knowledge with local community aspirations. The Draft Plan complies with relevant legislation and policies and attempts to achieve sustainable wetland management, whilst allowing for the operation of the proposed playing fields. A major goal of the Draft Plan is to provide guidance to proceed with an agreed management approach whilst retaining the ability to adaptively manage the land and waters in the light of information gained over time.

The primary community aim expressed at consultation meetings and individual communications is the reversion of the highly modified site to natural conditions as quickly as possible, consistent with maintenance of present ecological values. This process is to be integrated with the development and management of the playing fields.

As well as community use of the playing fields, a primary goal of the project should be to maximise community enjoyment and understanding of the ecological values of the site through communication. Options are presented for access paths, a bird hide, a viewing platform, a picnic area near Spencers Creek bridge, and interpretive signage to explain the purpose, layout and features of the site.

The inclusion of Aboriginal people in the ongoing environmental planning and management of the site is strongly recommended. The Booroongen Djugun College at Kempsey has expressed strong interest in participation, with benefits to Council and community from a two-way relationship involving College students providing traditional Aboriginal resource management knowledge and on-ground research capability, and Council providing site access and opportunity, and practical support where possible, for a collaborative project.

Complex issues surround the interaction of the proposed developed area of playing fields with the natural areas that feature substantial biodiversity values. These include the management of changing hydrology on several areas of the site, likely sea level rise, and potential ecological impacts from noise, visual disturbance, litter, night flood-lighting, stormwater quality and quantity management, and access.

Night flood-lighting has the potential for disturbance of waterbirds and other fauna, but the impacts can be largely overcome by installation of the appropriate light type with low horizontal spillage of light, combined with screen plantings around the perimeter of the playing fields.

An initial concept for an access bridge across Spencers Creek with a walkway/cycleway to the playing fields had the commendable aim of encouraging environmental education and greater community enjoyment of the wetlands. However, several constraints on this option have been identified. These include the expense of a bridge, disturbance to flora and fauna, potential for access for dogs, cats and feral animals, the deteriorating state of an artificial berm across the site, and site disturbance from machinery needed to work on a substantial earthworks project. Options for this concept and alternatives are presented.

One area of high conservation value on the site is Teal Lagoon, which is used regularly by numerous species of waterbirds, including threatened and migratory species. There are

varying views in the community on how the lagoon should be managed. There is a strong argument to maintain the existing management regime, although the issues of fish passage and long-term water quality must be addressed. Increased tidal flushing may improve water quality and fish passage, however this would also increase the number of mangrove seedlings entering the lagoon, which may have a detrimental affect on waterbird habitat.

Other management issues include: degradation and breakdown of the physical structure of the existing rubble-filled berm across the lagoon; the germination of mangrove seeds originating from mangroves within the lagoon; and the potential for disturbance of birds by vehicle and foot traffic along Boyters Lane and walkways within the site.

Options for Teal Lagoon are presented, including "do nothing" - resulting in the slow breakdown of the berm over time. The complete removal of the berm would restore natural estuary function but result in a loss of habitat currently used by many species of waterbirds. Another option is a flow control structure such as a dropboard weir to enable maintenance of existing flow patterns over the next decade, with periodic review. A fourth is to reinforce the rubble-filled berm with rock, enabling continuance of the present water regime.

Recommendations are made to remove mangroves within the lagoon and replace these with rainforest on higher soils along the road, in concert with natural regeneration of sedges closer to the lagoon edge.

Other estuarine zones include two embayments to the east of Teal Lagoon. These embayments are less important for waterbirds, but have high value as estuarine habitat, with extensive areas of saltmarsh. Recommendations are made to remove the barrier berm across the central embayment in the short term, observe the interactions between saltmarsh and mangroves then assess the third embayment for berm removal. A larger little-modified estuarine area in good condition exists in the west and northwest of the site. It is recommended to ‘do nothing’ in this zone except remove a concrete pipe.

Most areas of higher ground are presently covered by Kikuyu grass. The issues include fire risk and maintenance costs. The grassland habitat is known to be used for foraging by the threatened Grass Owl. Recommendations for the management of this land include trials of natural Swamp Forest revegetation techniques at lower elevations, mixed plantings of Swamp Forest and Rainforest on higher ground, and revegetation of native sedges to provide long-term foraging habitat for grass owls.

We recommend that Council call for members for a working group to manage the site. An adaptive management approach is strongly recommended. Monitoring and review of works and processes over time will ensure a flow of information for the site managers to adjust management in response to trends or emerging problems. The inclusion of water quality monitoring of Teal Lagoon in Council’s waterway monitoring program is recommended. Further monitoring of the status of vegetation and fauna is considered.

An options table is provided that lists and describes the complex issues, problems and possible solutions with indicative costings of the options to assist Council, community and government agencies to understand, assess and prioritise management actions required to maximise the social and environmental benefits from the purchase of the Boyters Lane property.

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1. Introduction

Kempsey Shire Council has acquired a 25.8ha block of land on Pelican Island, to the south of the South West Rocks township (Map BB028-1 below). Within this land is an area set-aside by Council for the creation of playing fields with an associated amenity block and lighting facilities. However, a majority of the site consists of wetlands in both natural and altered states.

The ecology of the site has been severely modified by past land use, including clearing of most of the indigenous vegetation and coverage with Kikuyu grass, and the building of berms or bunds across three estuarine embayments. The resulting hydrology and vegetation changes are seen as unnatural, and the proposal is to restore natural conditions as closely as possible while allowing the development of the playing fields.

The purpose of this Management Plan is to identify Council's responsibilities and define appropriate Management Strategies for the playing fields and wetland areas and proposed access ways.

1.1. Management Objectives

The management objectives for the site are:

1. To provide an area of playing fields suitable for future growth of South West Rocks
2. To reduce the impact of the playing fields on the surrounding wetland system and its inhabitants
3. To manage the wetlands as a natural system without degrading the existing values
4. To provide community environmental education opportunities on the site without impacting on the wetland values

Further to these objectives, management goals can be broken into the following sections:

Biodiversity

Ensure that management will result in a net gain in biodiversity over the entire site, with particular benefit in the terrestrial grasslands, and no loss of biodiversity values in existing wetlands.

Wetland Diversity

Promote the development of a mosaic of different wetland types that reflect the diversity of wetland habitats on the Macleay River Floodplain.

Education

Provide an educational experience that is both unique and informative and has a central aim of increasing the community's awareness of the role of floodplain and estuarine wetlands.

Australian Wetlands

North

0 5km 1:200,000 @ A4

Source: CMA Topographic Map
Date: November 2004

BB028 - 1

Site Locality

Provide opportunities for a hands-on wetland experience that has minimal impact on wetland values.

Community

- Provide playing fields to service future needs; and
- Provide facilities and interpretive material that enable the community to appreciate and learn about the Boyters Lane wetland, and wetland values in general.

Management

- Implement an adaptive management approach that balances the biodiversity values of the existing wetlands with the need to restore degraded wetland habitats, based on information gained from each phase of work as it is implemented and assessed; and
- To acquire Crown Land adjacent to the site and manage it in a manner consistent with the objectives of the Crown Lands Act, 1989.

1.2. Management Issues

Issues of concern for the community, as identified by Council and the Boyters Lane Working Group, are:

SEPP 71

The Pelican Island area is mapped under the State Environmental Planning Policy No. 71 (SEPP 71). SEPP 71 applies to land within the "coastal zone". SEPP 71 applies to development applications made after its commencement, and generally only applies to land within 1km of the coast or a coastal lake, lagoon, bay or river. Certain significant development, as outlined in the Policy (refer to Section 10.2.2), cannot be undertaken, whilst other development can only proceed under prescribed conditions. This is considered to affect the Boyters Lane proposal in relation to the following issues:

- Public access to the foreshore;
- Detrimental impact of development on amenity of the foreshore;
- Measures to conserve animals, plants and fish; and
- Potential impacts on water quality.

SEPP 14

The closest SEPP 14 wetland to the study site is Wetland No. 443, located north across Spencers Creek. Whilst not directly adjoining the site, the SEPP 14 wetland may be impacted upon through reduced water quality and interference with wildlife corridors.

Threatened and vulnerable birds inhabit or visit the area, and the impact on established biodiversity as a result of management changes

The Boyters Lane site contains significant bird populations that were probably present prior to any development of the land, and others that have colonised the habitat that has evolved in response to the disturbance of the soils, vegetation and hydrology. Management options for the site must not degrade the biodiversity of the area, and particular attention must be paid to threatened or vulnerable species.

Potential impacts on wetlands

Saltwater and, to a small extent, freshwater wetlands with substantial natural values are present on the site. The saltwater wetlands are predominantly composed of saltmarsh, recently listed as an endangered ecological community on the north coast by the NSW Scientific Committee. The Management Plan seeks to protect and enhance these values in the interests of biodiversity on the site and in nearby waterways. In particular, site hydrology has been assessed and designed for wetland sustainability.

Council is committed to the playing fields

Council and the general community have indicated a commitment that the playing fields be built. The goal of the Management Plan in this context is to devise an integrated management regime that can maximise community and environmental benefit from both recreational facilities and natural environmental values to the satisfaction of all stakeholders.

Lighting and night activities

With the likely installation of lights for sports training, the wildlife that require the refuge of, hunt in or otherwise use the cover of darkness are likely to be affected to varying degrees. During the course of preparation of this Plan, Council staff have advised that an added objective is the use of the lights for night play, as well as training. As a consequence, a higher standard of lighting with greater light intensity will be required. Management options such as screen planting, and correct design and orientation of lights, are assessed and recommended in this Management Plan.

Access: Council has indicated an interest in the construction of a boardwalk, and long-term plan to link the playing fields to main town

Council's initial proposal to build a boardwalk/track across the site would provide a relatively safe and logical entry to the playing fields, and a valuable opportunity for community education. However a number of constraints to this option have emerged during the study.

The passage of people to the playing fields near to and possibly through the wetlands has the potential to impact on the wildlife and environmental amenity of the site. A track through the wetland area would introduce noise, visual disturbance and possible vandalism of vegetation and/or facilities, which are likely to result in disturbance of wildlife feeding, resting, and breeding activities. There is also a potential issue of liability for night-time access and the requirement for lighting along the track.

Alternative arrangements are assessed, and options to avoid such disturbance while ensuring safe access, the welfare of wildlife, and environmental education opportunities are presented.

Feral and domestic animals

With the provision of playing fields comes the exacerbation of the introduction domestic and feral animals to the wetlands, with potentially serious consequences for site wildlife, particularly birds, which are known to be vulnerable to predation and disturbance by dogs, cats and foxes.

Dogs may be brought to the site for recreation, or with families attending weekend sport, or across the walkway/access and the originally proposed footbridge across Spencers Creek.

Salt water intrusion on private property

All private property surrounding the Council-owned site appears to be unaffected by any changes in hydrology that may or may not occur on the site.

The property to the south of the road currently has weirs to stop saltwater intrusion from Spencers Creek to the east. There are no known hydraulic connections between the southern property and the Boyters Lane site. The aftermath of a large rainfall event has been observed, with a depth difference of about 0.5m between the sites above and below the road, which acts as a barrier.

Sewer pumping station required

The Review of Environmental Factors for the sewer pump station suggests little impact on the site from installation of a sewerage pump station. The main concern is during the construction phase and during floods. Overflows from the pump station may result in raw sewage flowing into either Spencers Creek and/or the wetland.

Council investigating transfer of management of Crown Lands to Council

If achieved, this option would negate the requirement to obtain permission from NSW Lands (part of DIPNR) under the NSW Crown Lands Act (1989) for general public use and construction within Crown lands. Also of benefit is the opportunity for further environmental enhancement.

Short-term fire management

To date there is no fire management strategy for the site. Issues surround the site in regard to the long grass that Council must at present slash. The grass poses a fire risk from both accident and arson. Until the site is rehabilitated or native vegetation is re-established, Council will need to continue with its current maintenance regime.

Archaeological and cultural significance of site

There are no Indigenous or European heritage registered sites listed within the Australian Heritage Database for Boyters Lane or its immediate surrounds. On the site itself, there is a shed, barbed wire and possibly original fence posts.

Council wishes to re-establish native riparian vegetation to supplement the educational walkways

Re-establishing riparian vegetation along the banks of Spencers Creek will improve bank stability and increase the diversity of plants in the area, provided it is carried out with appreciation of the likely indigenous vegetation.

This revegetation could also add to the education component of the site management, through interpretive signs along the proposed walkway.

Council is developing an urban and industrial stormwater strategy for land immediately north of the site across Spencers Creek

Depending on the quality of stormwater leaving the land on the north side of Spencers Creek, the Boyters Lane wetland may or may not be impacted. If excessive quantities of untreated urban and industrial stormwater were to enter Spencers Creek, the water quality within the wetland could also decline.

2. Site Description

2.1. General

The Boyters Lane site on Pelican Island is situated in the lower Macleay River, with Spencers Creek forming the northern and eastern boundary of the island (Map BB028-2, Appendix 4). The Macleay River estuary has 5.2km^2 of mangroves, 1.1km^2 of seagrass and 3.65km^2 of saltmarsh, with over 150km^2 of wetlands. Commercial and recreational fishing forms a large industry for the Macleay region, with oyster production at 20t/km^2 each year (DIPNR, 2004).

The site acquired by Council has adjoining Crown Land, and together there are 28.4ha of wetlands, estuarine inlets and grassland.

2.2. Climate

The climate of the South West Rocks area is generally humid and is typical of a warm-temperate to subtropical zone. The area has a regular late winter-spring dry season and summer-autumn wet period (Figure 1), often characterised by rain depressions of tropical origins, when heavy rainfalls occur in intense events that often trigger environmental consequences such as large-scale acid sulfate runoff, soil erosion, and mobilisation of pollutants.

Although extended dry periods are uncommon, the subsoils will steadily dry out and streamflow will fall markedly. Atkinson (1999) reported that although the July-December dry period of each year was likely to produce a soil water deficit, Edwards (1979) had calculated a soil water surplus for all months. Growing conditions are probably generally favourable over much of the year in most years. The mean annual rainfall for South West Rocks is 1,367mm, with a mean annual evaporation of 1,502 mm. The mean annual number of rain days for the area is 138.

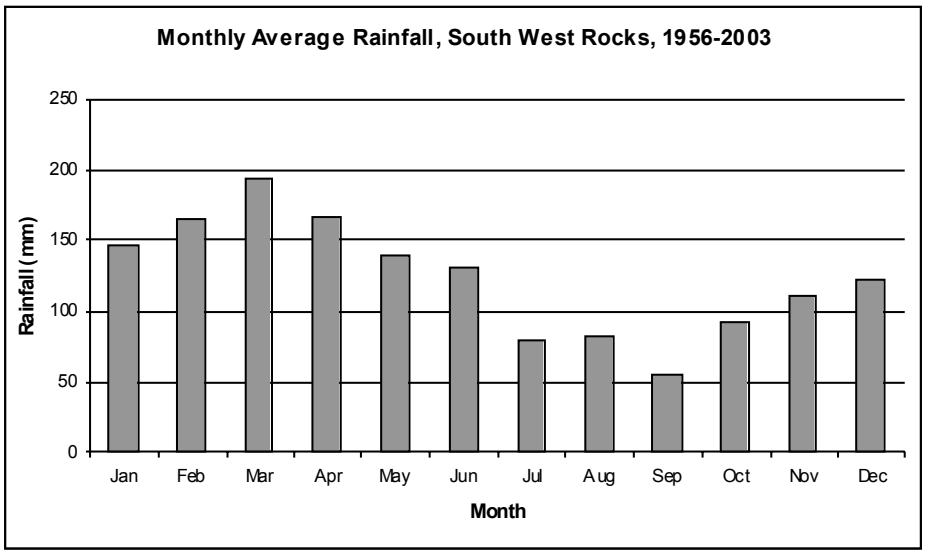


Figure 1: Monthly Average Rainfall for South West Rocks

2.3. Site Soils

2.3.1. Geomorphology

Atkinson (1999) and Eddie (2000) have mapped the soil landscapes and discussed the Quaternary fluvial sediments and barrier sands of the Lower Macleay system. The Boyters Lane area is part of the Gladstone Alluvial Plains, and contains two soil types – *tm* (Toormina) and *mr* (Maria River) (see 2.3.2 Soil Types, below). Although a detailed study of geomorphology of the Boyters Lane site is not known, a broad understanding of the natural history of the site can be inferred.

The extensive Pleistocene (roughly pre-10,000 years ago) and Holocene (within the last 10,000 years) riverine sediments of the lower Macleay floodplain consist of gravel beds overlain by silts and clays in the estuarine reaches (the Boyters Lane zone). These estuarine reaches, typified by the Boyters Lane landscape, contain complex patterns of sedimentation, with fluvial deltaic deposition over estuarine muds of coastal lagoons. With progressive infilling by alluvial sediments the estuarine lagoons become freshwater swamps and then alluvial backplains. Atkinson (1999) proposed a sedimentary model for the estuarine reaches of "complex interaction of fluvial deposition and floodtide deltaic deposits. Levees (raised banks either side of a channel) have prograded as deltaic deposits over the estuarine muds of coastal lagoons, with the height of the levees dropping progressively toward the lagoons". This explanation fits the observed landform well.

The three small estuarine embayments on the Boyters Lane site grade evenly from south to north, gradually deepening towards the water. Aerial photographs suggest the Boyters Lane site results from the development of point bars in the meander belt of the lower Macleay or a tributary. As the point bars built outwards towards the present-day Spencers Creek, 'sloughs' and meander scrolls were left behind (Figure 2).

At some point the Macleay appears to have formed a chute cut off, in which the main river broke through the floodplain sediments towards the west, and left Spencers Creek as a relict channel, with the Boyters Lane site as a series of curved point bars and levees. This model suggests that the belts of higher ground on the site are relict levee banks that would have been overtopped in flood events with new channels successively forming to the northeast. The Spencers Creek of today would be the latest channel.

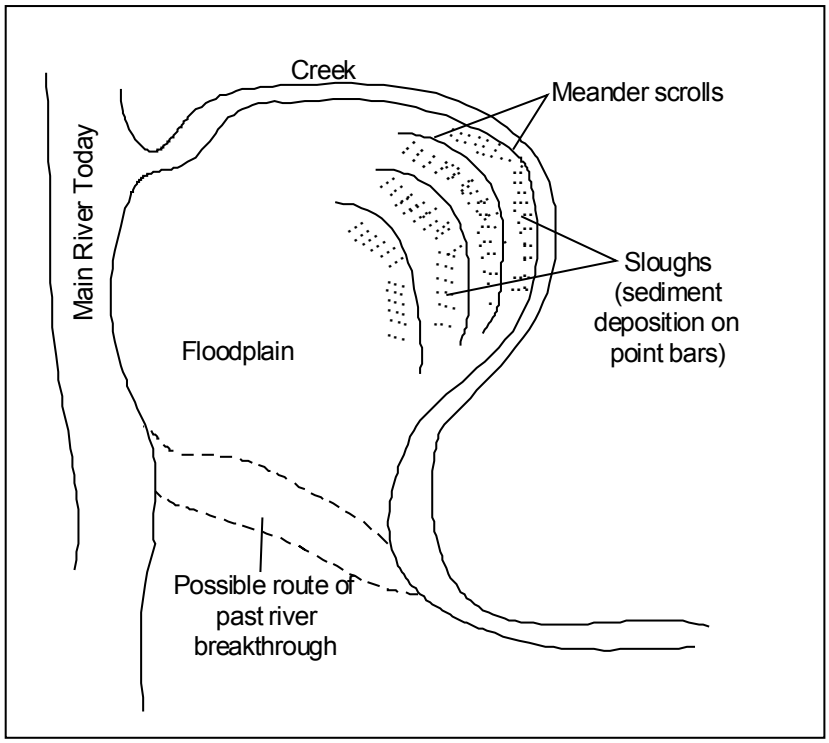


Figure 2: Conceptual diagram of possible landform development on the site

2.3.2. Soil Types

There are two types of soils that have been identified within the Council-owned Boyters Lane property and one on adjacent land not occurring on the site (kr: Korogoro). The soils found within the site are the Maria River (mr), as described by Atkinson (1999), and the Toormina (tm) soil types, described by Eddie (2000). These are shown in Map BB028-3 (Appendix 4).

Maria River (mr) (Atkinson, 1999)

Landscape - Extensive level plains, floodplains and backswamps on Holocene alluvium in the lower reaches of the major streams. Relief <1 m; elevation 1 - 3 m. Swamp species often cleared for grazing.

Soils - Various alluvial clays forming moderately deep (100 - 150 cm) Humic Gleys and grey and yellow duplex soils. These overlie buried Pleistocene barrier sands or Holocene estuarine sediments.

Limitations - Regular flooding hazard; waterlogging; foundation hazards; strongly acidic; sodic soils; low wet bearing strength; low permeability; organic soils (localised); salinity (localised); acid sulfate soils (localised).

Toormina (tm) (Eddie, 2000)

Landscape - Level intertidal and supratidal flats on Holocene sands and muds. Elevation <2 m. Bare sand and mud grading to mangroves, saltmarsh and swamp sclerophyll forests.

Soils - Sulfidic Intertidal and Supratidal Hydrosols (Humic Gleys and Solonchaks) on muddy sediments, with Arenaceous Intertidal Hydrosols (Siliceous Sands) on sand flats.

Significant Soil and Land Qualities - Organic soils with low wet bearing strength, sodicity, high erodibility, high subsoil permeability, extreme acid sulfate potential, strong salinity and low fertility. Poor drainage; tidal flood hazard; permanently high watertables; groundwater pollution hazard; non-cohesive soils; extreme engineering hazard; localised soil fire hazard (drained supratidal flats).

2.3.3. Acid Sulfate Soils

Acid sulfate soils (ASS) are sediments deposited under estuarine conditions such as in mangroves or seagrass beds, and which contain the sulfidic mineral pyrite (FeS_2 - iron and disulfide). These soils underlie many coastal floodplains, in coastal wetlands, and as bottom sediments in today's coastal estuaries. As long as ASS are not disturbed or drained, these materials are relatively harmless and are termed potential Acid Sulfate Soils (PASS). If the sediments are exposed to air, the pyrite is oxidised to sulfuric acid, ferric iron, and other metals. The reaction products can be not only toxic in the short and long term, but exert a very high oxygen demand upon entry to waterways.

Large fish kills and the death of other aquatic life often occur from ASS runoff. The pH can vary widely, and damaging impacts are often not accompanied by acidic water. In addition to the acute effects of ASS, other effects are common and widespread, and include diseases and other impacts such as reduced hatching, survival and growth rates across a wide range of aquatic species (Tulau, 2002).

Other impacts include habitat degradation, fish disease outbreaks, reduced aquatic food resources, reduced migration potential of fish, reduced fish recruitment, altered waterplant communities, weed invasion by acid-tolerant plants, secondary water quality changes, and reduced potability of water (Tulau and Naylor, 1999).

Large areas of the Macleay floodplain are affected by ASS. "Hotspots" include the Yarrahapinni, Collombatti-Clybucca, Belmore, Frogmore, Kinchela and Raffertys areas.

Boyters Lane is not within a Hotspot area, and is not regarded as a high-risk zone. However, the whole site is included on the ASS Risk Maps under different classifications. No indications of ASS runoff have been observed during preparation of this Plan, and no indications of past fish kills have been given, except for the large fish kills of 2001, which were widespread and generally considered to have been associated with broadacre floodplain processes.

Council's GIS information shows the risk of Acid Sulfate Soils on some portions of the site to be very high (Map BB028-4, Appendix 4). While there was no visible evidence of ASS on the site, such as iron oxides or black oozes, ASS is likely below the surface. There is also the possibility that ASS exists in low concentrations, or could already be at least partly oxidised and leached out of the more elevated soils. A detailed assessment for ASS should be carried out for relevant areas before any earthworks are undertaken.

The Boyters Lane site has had one drain constructed in the past, apparently to supply the fill to complete the main berm running across the site from south to north. This berm has two floodgated pipes to help drain the south-east section to make it more useable as grazing land (Bob Ford and Ken Shingleton, pers. comm., 2004).

In relation to ASS, the Coastal Policy notes that "consideration will be given to the need for environmental studies which address ASS early in the planning and development process". ASS Risk Maps and EPA Guidelines are to be used in assessing proposals likely to disturb ASS. Management plans are to be prepared to effectively manage project level impacts and

the remediation of ASS sites. It is expected that, following funding allocation, Council would call for tenders to prepare an Acid Sulfate Soils Management Plan.

2.4. Playing Fields

The site has been earmarked for sporting facilities to meet the recreational needs of future population growth (KSC, undated). The fields will be located in the south-west corner of the site, where the land is already flat and comparatively elevated. This fact is likely to result in a low requirement for substantial works to convert the site to playing fields. However, a small number of Casuarina trees will be removed from the playing fields area (Plate 1).

The site slopes towards the wetlands to the north and east, and is bordered by Boyters Lane to the south, and low-lying grazing land to the west. There is a width of at least 75m set aside as a barrier between the edge of the wetlands and the playing field area, allowing 5.6ha of the 7.3ha corner for the playing fields.

Plate 1: Playing field site, looking north.

2.5. Wetland

Boyters Lane wetland is tidally influenced, with a direct connection to Spencers Creek. The wetland is characterised by three parallel tidal inlets. A berm wall (Main Berm) extends from near the northern edge of the site across each of the inlets (Map BB028-2, Appendix 4)). Tidal movement through the Main Berm is restricted by 150mm diameter PVC pipes, although the wall across the Central Inlet has been eroded to create a narrow tidal channel. Inundation of all inlets occurs during high tides on springs (the twice monthly very high and very low tides around New Moon and Full Moon).

Grassland vegetation dominates the elevated land and covers the southwestern third of the site and the southeastern corner. Areas of grassland may become waterlogged after prolonged rainfall.

The Boyters Lane Wetland has not been mapped under State Environmental Planning Policy (SEPP) No. 14. The nearest SEPP 14 wetland (wetland No.443) is situated on the northern side of Spencers Creek (Map BB028-5, Appendix 4).

Detailed information on the historical management of the site is unavailable, although some information was obtained from discussion with long-term residents.

The wetland has a long history of modification. A berm was initially constructed in the 1960s by the placement of loose building rubble (broken concrete, bricks and soil) in a berm shape between two higher ridges on the site. This berm, herein referred to as Teal Berm, is about 3.5-4m wide and about 50m long. Shortly after construction tidal flows were almost halted. This resulted in a change from an estuarine system to a predominantly fresh or brackish system with limited or no tidal exchange through the bund wall. It was during this period that mangrove dieback occurred in Teal Lagoon.

PVC pipes were installed in the mid-1990s to restore some tidal exchange. This system has operated until the present time, although deterioration of pipes and the bund wall has resulted in increased tidal exchange in Teal lagoon and Central Inlet. Cattle have grazed the site for an extended period, which has influenced the distribution and extent of wetland vegetation.

Plate 2: Example of a 150mm pipe with floodgate attached, lying between the open environment and the bermed saltmarsh area.

Plate 3: A view of Teal Lagoon from within a 2m wide mangrove copse adjacent to the road.

Plate 3 shows the expansive area that waterbirds prefer, with long line-of-sight. Further edge-planting is required to provide a thick corridor of vegetation between the road and wetland, to reduce visual and noise impacts on waterbirds.

Plate 4: Tide-dominated area north of Teal Berm.

At low tide, extensive mudflats are exposed, providing feeding grounds for waterbirds and crabs. The short height of the mangroves along the edges show the time period since the removal of cattle – suggested by local residents as a key factor in mangrove regrowth.

3. Estuary Values and Processes

An estuary is defined as "a semi-enclosed body of water which has a free connection with the open sea water, which is measurably diluted with freshwater derived from land drainage" (Pierson *et. al.*, 2002)

Estuaries are dynamic productive coastal environments not only in terms of short-term responses to climate but at geological time scales, due to natural processes that progressively convert estuarine water areas to terrestrial flood plains, levees and backswamps.

As remnants of central mud basins, embayments and flats become increasingly important as estuaries evolve. Estuaries trap organic materials, act as nutrient processing systems, and are biologically highly productive (NSW Government, 1992; Roy *et. al.,* 2001).

The link between estuary form and function is based on interactions between:

- Depositional environments with various morphologies and types of sediment that determine rates of nutrient cycling and create biological substrates,
- Hydrological zones with characteristic water quality properties, such as mixing, sedimentation and flushing, and
- Habitats that support extensive and diverse estuarine life forms, often expressed in healthy fisheries.

Estuary hydrology is characterised by fluctuations in salinity due to inflows of freshwater and saltwater, ambient heating and cooling as seasonal weather conditions change, and mixing by currents. Mixing of water masses is influenced by tidal exchange, which is related to estuary type, and also by the size and shape of the estuary basin which determine the effectiveness of wave stirring and wind induced currents.

Salinity gradients become more pronounced as the estuaries approach maturity, mud basins infill, river and estuarine deltas merge, and riverine channel zones elongate. Salinity gradients are particularly enhanced in lower reaches of some semi-mature barrier estuaries where their tributaries experience more marine conditions than the main channel (Roy *et. al.,* 2001).

Tides flush the embayments, bringing food in for crabs, fish, prawns and birds, and renewing the water quality in most parts of the tidal range. High tides allow young fish to forage amongst the mangroves and saltmarsh. Saltmarsh also provides valuable habitat for fauna such as local and migratory wading birds, fish, invertebrates, and microbats (Saintilan and Rogers, 2002; Saenger, 1994).

4. Environmental Audit

Students from the Australian National University (ANU) carried out an environmental audit of the subject site in April 2004 (Walker *et. al.* 2004).

The purpose of reviewing the audit report was to assess the adequacy of information contained within the report for use in preparing management strategies for fauna. Whilst the audit report is appropriate for the purpose for which it was prepared it contains limited information to assist with the preparation of management strategies for fauna. Apart from some general information on invertebrates the report does not contain any new fauna records or information on the value of the subject site for fauna. The authors readily acknowledge the limitations of the report with respect to fauna (refer to sections 3.2, 6.2 and 6.3.1 of the audit report).

One of the recommendations of the audit report (section 6.3.1) was to prepare a comprehensive fauna audit before assessing any development proposals. It was considered unnecessary to carry out a full avifauna survey, as the species list compiled by local ornithologist, Mr Ken Shingleton, and supplemented with surveys undertaken by Sandpiper Environmental, is comprehensive. Opportunistic surveys for other fauna were carried out during site visits and community consultation meetings.

5. Flora

5.1. Present on site

Map BB028-6 (Appendix 4) outlines the vegetation communities within the site. The site appears to contain mainly grasslands, saltmarsh/*Juncus* and mangroves communities, from higher elevation to water level respectively. Table 1 lists the areas of each vegetation community on the site.

Table 1: Vegetation community areas on the Boyters Lane site

Vegetation Type	Area
Grassland	14.6ha
Saltmarsh	6.6ha
Juncus/Schoenoplectus complex	0.7ha
Mangroves	3.7ha
Mud Flat	0.3ha
Open Water	0.5ha
Teal Lagoon	2.2ha

The existing mangroves within Teal Lagoon appear to be sourced from the mangroves on the road edge, because of the limited potential for seeds to enter through the small channels in the berm wall. It is also possible that these older mangroves became established after the road was constructed, though before the Teal Berm was erected. There is a possibility that these mangroves could be removed and replanted elsewhere within the northern section of the larger wetland, to reduce the likelihood of mangroves spreading throughout Teal Lagoon over the long-term and thereby reducing waterbird habitat.

The environmental audit carried out by Walker *et. al.,* (2004) found the following plant species present on the site, listed in Table 2.

Table 2: Plant species recorded by Walker *et. al.* (2004)

Botanical Name	Common Name
Avicennia marina	Mangrove
Casuarina glauca	Swamp She-Oak
Cotula coronopifolia	Water Buttons
Cynodon dactylon	Bermuda Grass
Cynodon incompletes	Couch
Juncus pallidus	Pale Rush
Juncus sp	Rush
Lythrum salicaria	Purple Loosestrife
Paspalidium sp	
Paspalum dilatatum	Paspalum
Paspalum distichum	Water Couch
Pennisetum clandestinum	Grass
Trifolium spp	Clover (three species)

Further investigations by *Australian Wetlands* and *Sandpiper Environmental* in July and August produced the additional plant species detailed in Table 3.

Table 3: Additional plant species recorded in July-August, 2004

Botanical Name	Common Name
Baccharis halimifolia	Groundsel Bush
Cinnamomum camphora	Camphor Laurel
Conyza sp	Fleabane
Ipomea indica	Morning Glory
Juncus usitatus	Common Rush
Lantana camara	Pink Lantana
Pennisetum clandestinum	Kikuyu Grass
Phragmites australis	Common Reed
Rubus ulmifolius	Blackberry
Schoenoplectus validus	River Clubrush or Great Bulrush
Senecio sp	Fireweed
Triglochin procerum	Water Ribbons
Verbanea sp	Purple Top
	Green Tubular Algae (unidentified)

Plate 5: Mangroves (*Avicennia marina*) and saltmarsh (*Juncus usitatus*) to the west of the Main Berm, with a floodgated pipe designed to exclude salt water and drain the eastern saltmarsh area (left of picture)

Plate 6: *Schoenoplectus validus* emerging through cracked mud in south-eastern mud flat finger

Plate 7: Looking to the south up the middle of the eastern inlet.

Plate 7 shows an example of the complex of vegetation communities associated with the site. The foreground consists of *Juncus usitatus* and pasture grass, with *J. kraussii* (darker sedge) and *Schoenoplectus validus* (light patch – suffering light frost damage) in the middle of the photograph. *Casuarina glauca* trees (Swamp She-Oak) are on the left fringe of the wetland, with pasture grasses to the right and back.

Plate 8: Green algae along the northern shore of Teal Lagoon

5.2. Changes in Hydrological Regime

The hydrology, or process of water movement, across the Boyters Lane land has been extensively modified by construction of the main berm across all three inlets. The aim of berm construction was apparently to reduce or eliminate saltwater by blocking tidal inflows, and allow freshwater (rainfall runoff) to flow out to the estuary through the 150mm PVC pipes apparently originally fitted with small flapgates. Several of the pipes have lost flaps and are fully open, although in the Teal Berm appear to be blocked, possibly by oyster growth.

One ecological impact has probably been to prevent colonisation by mangroves of the eastern upper inlet areas. Several plant species that reflect a freshwater influence exist in Eastern Inlet, and these may result from both runoff retention in wet season, and fresh groundwater flows. Tidal inflows are now entering this inlet as the flapgate has apparently fallen from the single pipe recently. The flood tide runs into the inlet along a narrow shallow channel through Juncus, which seems to be effectively filtering mangrove seeds. Spring tides have been observed to flood the entire inlet, but only to a relatively shallow depth.

Central Inlet shows similar impacts from the berm construction, although a section of the berm wall has eroded and now allows a tidal stream about 1m wide to enter the inlet. The entire main berm is marked by minimal soil volume and berm integrity for the difficult task of holding back tidal flows. Spring tides were observed to almost overtop the berm in places. Because of the broken berm, tidal inflows to Central Inlet are greater in volume than Eastern Inlet, with depths of about 40cm on a 1.9m tide in the Juncus meadow.

Teal Lagoon is the westernmost inlet of the three, and appears to be situated at a lower elevation than the other two. This pattern fits the geomorphological explanation of the natural history of the site as a series of river levees and point bars successively overtaken by channel development in a northerly direction, probably as a result of flood-related breakthroughs. Each inlet may be a relict channel. Depths within the Teal Lagoon vary but are commonly 20-70cm in the middle, and the lagoon does not appear to dry.

The high ecological values of Teal Lagoon for waterbirds is likely to result from the action of the Teal Berm in restricting flood tide inflows and hence high tide depth inside. The berm is largely constructed of building rubble, and is permeable. Two 150mm PVC pipes appear to be blocked, probably by oysters. The resulting water regime in the lagoon therefore reflects a

largely accidental combination of factors. Any change to management should address these flow and depth patterns by mimicking them as closely as possible.

Changes in the type and distribution of habitats in the Boyters Lane wetland complex have occurred since the creation of the berm walls and in response to site management, which included grazing by cattle. The recent removal of cattle has resulted in further changes in habitat structure. The most obvious being the increased growth of mangroves and swamp oaks, which would have previously been browsed by cattle. In addition to the expansion of mangrove seedlings in the Mangrove habitat, seedlings are also noticeable within Teal Lagoon and Saltmarsh habitat.

Sheltered estuarine wetlands in nature tend to change slowly, a fact attributed to the protected nature of these systems. Modification of estuarine wetlands such as the Boyters Lane site can result in substantial changes in habitat structure and function. Changes are likely to ensue in all sectors of the site even if a "do nothing" option is followed in all cases. Berms are degrading, mangroves are advancing in some areas, and climate change appears to be a reality.

If the main berm were removed completely, the Eastern Inlet is likely to lose the freshwater-associated Triglochin and Schoenoplectus species. Saltmarsh is likely to reach further into the upper inlets, and mangroves may advance to colonise the saltmarsh.

The limited tidal exchange into Teal Lagoon may reduce the growth of mangroves, however, given the current level of seedling development and the occurrence of mature mangrove trees within the lagoon it is anticipated that mangrove cover will increase over time. Likewise, the occurrence of seedling mangroves in the saltmarsh habitat may provide an insight into future mangrove expansion as has occurred in other estuaries in NSW (Saintilan and Williams 1998; Saintilan 2003).

Saltmarshes are being reduced in many areas due to the migration of mangroves into the saltmarsh area, such as (DEH, 2004):

- Brisbane Water, NSW 1954 to 1995 – the mangrove coverage at increased by 3.8% and the saltmarsh coverage decreased by 78%;
- Botany Bay, NSW –1956 to 1996, the mangrove coverage at increased by 32.8% and the saltmarshes decreased by 78.7%;
- Rhyll Inlet on Phillip Island, Victoria – 1939 to 1999, the mangrove coverage at increased by 55% and the saltmarshes decreased by 19.7%;
- Barker Inlet, South Australia – mangroves at have migrated into saltmarsh communities at a rate of approximately 5 hectares per year with North Arm Creek, part of Barker Inlet having a loss of nearly two-thirds of saltmarsh (62.3 %).

A combination of local factors driven by human activity, such as increased urban and rural development within the catchment, influence the current changes in the distribution of mangrove and saltmarsh vegetation (Saintilan and Rogers, 2002; DEH, 2004).

6. Fauna

6.1. Atlas Of NSW Wildlife

A search was undertaken of the Atlas of NSW Wildlife to obtain historical and recent fauna species records for the locality (5km radius surrounding the subject site). The Atlas search encompassed an area of 100km^2 surrounding the subject site. The search was dated 27 July 2004. The search revealed records for 30 threatened fauna species (Table 4). Many of the threatened species recorded in the locality are unlikely to utilise the subject site at present. The list of threatened species is indicative of threatened species that may utilise the site if appropriate habitat is provided. For example, revegetation of elevated land with locally endemic fruiting trees would provide habitat for fruit-doves and flying foxes, whilst forested habitat in general would provide a food resource for insectivorous bats and square-tailed kites. Revegetation and rehabilitation of grassland is likely to benefit a wide range of species.

Table 4: Threatened fauna recorded from the locality of the subject site.

Species Name	Common Name	Status TSC	Last Record	No. Records
	AMPHIBIANS			
Crinia tinnula	Wallum Froglet	V	15/3/03	11
	REPTILES			
Caretta caretta	Loggerhead Turtle	E1	1/3/97	2
Dermochelys coriacea	Leathery Turtle	V	9/12/00	1
	MAMMALS			
Phascolarctos cinereus	Koala	V	30/6/99	1
Phascogale tapoatafa	Brush-tailed Phascogale	V	15/2/03	11
Syconycteris australis	Common Blossom-bat	V	22/1/98	2
Pteropus poliocephalus	Grey-headed Flying-fox	V	5/3/03	22
Petaurus norfolcensis	Squirrel Glider	V	15/3/03	29
Vespadelus troughtoni	Eastern cave Bat	V	19/5/00	1
Mormopterus norfolcensis	Eastern Freetail Bat	V	25/2/02	1
Chalinalobus nigrogriseus	Hoary-wattled Bat	V	17/10/01	1
Scoteanax rueppellii	Greater Broad-nosed Bat	V	11/10/94	1
Miniopterus australis	Little Bentwing-bat	V	26/10/94	3
	Australian Fur Seal	V	23/7/01	1
Megaptera novaeangliae	Humpback Whale	V	13/10/99	2
	BIRDS			
Anseranas semipalmata	Magpie Goose	V	20/1/92	1
Ixobrychus flavicollis	Black Bittern	V	5/3/03	1
Ephippiorhynchus asiaticus	Black-necked Stork	E1	9/5/01	7
Lophoictinia insura	Square-tailed Kite	V	27/7/00	2
Pandion haliaetus	Osprey	V	5/3/03	35
Limosa limosa	Black-tailed Godwit	V	18/4/00	1
Irediparra gallinacea	Comb-crested Jacana	V	28/9/00	2
Haematopus longirostris	Pied Oystercatcher	V	19/7/01	6
Haematopus fuliginosus	Sooty Oystercatcher	V	5/3/03	8
Sterna albifrons	Little Tern	E1	24/10/00	1
Ptilinopus magnificus	Wompoo Fruit-Dove	V	3/9/01	4
Ptilinopus regina	Rose-crowned Fruit-Dove	V	17/11/01	2
Calyptorhynchus lathami	Glossy Black-Cockatoo	V	15/3/03	37
Ninox strenua	Powerful Owl	V	23/10/00	1
Coracina lineata	Barred Cuckoo-shrike	V	1/12/99	1

6.2. Birds

A local ornithologist (Mr Ken Shingleton) has been surveying birds on the subject site on a regular basis for the past 12 years. These surveys have provided a good indication of the conservation value of the Boyters Lane Wetland for birds. During the survey period 143 species of bird have been recorded on or near the subject site (Appendix 1), including nine species listed on the NSW TSC Act and approximately 47 migratory species listed under the Commonwealth Environment Protection and Biodiversity Conservation (EPBC) Act 1999. Threatened species recorded on-site by Mr Shingleton include, blue-billed duck (*Oxyura australis*), black-tailed godwit, black-necked stork, osprey, square-tailed kite and brolga (*Grus rubicunda*). One grass owl (*Tyto capensis*) was recorded on the subject site during field surveys undertaken during the preparation of the management plan.

Birds utilise all habitats on the subject site, including the degraded grassland. A number of regionally significant bird species have been recorded on-site, including many inland species that use coastal wetlands as drought refuges. The high diversity of birds recorded at the Boyters Lane wetland indicates that the site represents one of a mosaic of wetland habitats on the Macleay floodplain.

6.3. Other Fauna

A general fauna habitat assessment was undertaken during the preparation of this plan (Sandpiper Environmental 2004). This assessment identified five broad habitat types. These habitats are likely to be used by a variety of fauna species, including both vertebrates and invertebrates.

Areas of dense vegetation, such as the grassland and sedgeland habitats, are used by a variety of small mammals, reptiles and amphibians. The small number of old growth mangroves adjacent to Spencers Creek, along the northern edge of the site, provide potential roosting habitat for insectivorous bats with several small branch and trunk hollows present. Insectivorous bats were recorded foraging over the subject site and grey-headed flying foxes (*Pteropus poliocephalus*) were recorded traversing the site after dusk. Small ground mammals were also recorded in the saltmarsh and grassland habitats.

Many of the faunal species that occur in mangroves and saltmarsh are not confined to these areas alone. They visit the habitats during the tidal cycles or their feeding regimes, whilst also venturing to nearby habitats such as forest or seagrass beds (Saenger, 1994).

Mangroves generally have more fish species inhabiting them on a regular basis than saltmarsh areas, due to the tide heights and length of coverage time. However, mudskippers are among the few species that are found on mudflats, saltmarsh and mangroves alike (Saintilan and Rogers, 2002 Saenger, 1994).

Other animals that may utilise or inhabit estuarine wetlands include Grey Kangaroos and Swamp Wallabies, insectivorous bats, spiders, crabs, molluscs, snakes and lizards (Saintilan and Rogers, 2002; Walker, *et. al.*, 2004). During site visits, *Litoria fallax*, the Eastern Dwarf Treefrog, were heard within the *Juncus* plants.

Foxes appear to be either recently or currently present on the Boyters Lane site, as burrows were sighted towards the northern end of the Main Berm. Foxes are also known to occur on Pelican Island (Bob Ford, pers. comm.). Dog tracks were also identified during site inspections.

6.4. Fauna requirements

Mangroves would reduce the line-of-sight for birds and other animals, and reduce the favourable roosting habitat for migratory wading birds – that of wide open areas without trees, and with many pools of water to reduce the likelihood of ambush (Saintilan and Rogers, 2002).

All habitats on the site have been modified by previous land management practices. Part of the value of the wetlands for waterbirds has occurred due to habitat modification resulting from the construction of bund walls and restrictions to tidal flow. Teal Lagoon provides an area of permanent habitat for waterfowl and favourable foraging conditions for a variety of waterbirds that would not have been present without the construction of the bund wall. The slow movement and warmer temperatures of water in the lagoon most likely provide good breeding conditions for some invertebrates, which represent a food resource for waterbirds.

The dense grass and sedge habitat is suitable for a variety of common small mammals, which provide a food resource for grass owls and diurnal birds of prey. Grassland and sedgeland habitats would be used by a variety of common reptiles, frogs and birds. Insectivorous bats are also expected to roost within mature mangroves and forage over all habitats. Insectivorous bats may also roost in the old building present on the subject site.

The biodiversity values of areas currently covered by grassland habitat could be substantially improved through active management, although this habitat is currently used for foraging by at least one grass owl. The extent to which grass owls rely on the grassland habitat within the subject site is unknown, although it may form part of an individual's foraging range. It seems unlikely that grass owls roost on-site as no individuals have been flushed during 12 years of bird surveys, which have involved regular traverses of the site (K. Shingleton pers comm.).

The saltmarsh and mangrove habitats provide important roost and foraging habitat for a variety of fauna and represent an integral component of what is a modified estuarine wetland. Saltmarsh represents potential habitat for Australasian bittern and black-necked storks may occasionally forage and roost in the estuarine habitat. The recent listing of Saltmarsh as an endangered ecological community under the NSW TSC Act is further recognition of the high conservation value of this habitat type. Furthermore, saltmarsh communities may now be classified as foreshore and protected under the *Fisheries Management Act 1994* (MacDonald, 2003).

Although mangroves provide habitat for a variety of fauna, their expansion into waterbird habitat would reduce visibility, which is considered important for many species (Lawler 1996). Whilst it is too early to conclude that mangroves would dominate Teal Lagoon there is evidence to suggest that further growth and expansion is likely. The % cover of mangroves already present in Teal Lagoon may be at a level that is unsuitable for some shorebirds (Lawler 1996).

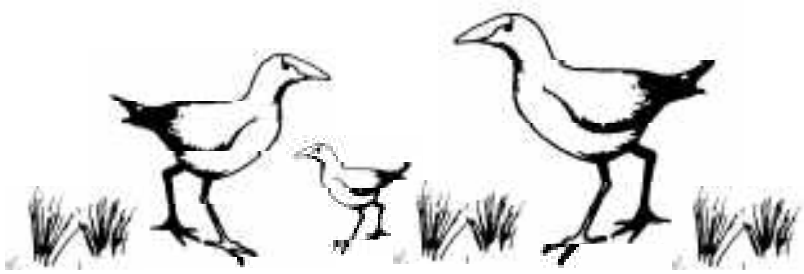
Quantitative studies on the visual distances required by waterbirds are limited, although Lawler (1996) provides some information for shorebirds. For roosting shorebirds Lawler (1996) recommends a minimum buffer of 30m and preferably 50m to vegetation over 2m high, with a distance of 75m required for vegetation over 5m tall. Although this information is of value in must be recognised that much of Lawler's data were gathered in more open habitats and on species that demand good visibility.

It is possible that shorebirds using brackish water habitats, such as sharp-tailed sandpiper, black-fronted and red-kneed dotterels, marsh sandpipers and greenshank may tolerate sites with greater vegetation cover. In considering visibility distances it is essential to recognise the limited number of studies and the fact that once vegetation is planted the impacts may be irreversible.

Saenger (1994) discussed that an increase in mangroves could lead to an increase in the presence of fish, crustaceans and molluscs. However, Saintilan and Rogers (2004) argued that faunal diversity is greater in areas that have a range of wetland habitat types, not just mangroves, and therefore a diversity of habitats should be encouraged.

Overall the recommendation to adaptively manage the wetland whilst discouraging the up-stream progression of mangroves in Teal Lagoon is encouraged.

Plate 9: Mud flats in south-eastern corner



7. Regional Significance

The wetlands are of importance to many threatened bird species, as well as many common birds.

A local ornithologist (Mr Ken Shingleton, who participated in the community consultation process) has been surveying birds on the subject site on a regular basis for the past 12 years. These surveys have provided a good indication of the conservation value of the Boyters Lane Wetland for waterbirds. During the survey period 143 species of bird have been recorded on or near the subject site (Appendix 1), including nine species listed on the NSW TSC Act and approximately 47 migratory species listed under the Commonwealth Environment Protection and Biodiversity Conservation (EPBC) Act 1999. Threatened species recorded on-site include, blue-billed duck, black-tailed godwit, black-necked stork, osprey, square-tailed kite and brolga.

A number of regionally significant species have also been recorded on-site, including many inland species that use coastal wetlands as drought refuges. The high diversity of birds recorded at the Boyters Lane wetland indicates that the wetland represents one of a mosaic of wetland habitats on the Macleay floodplain.

The subject site, and specifically the wetlands provide a variety of habitats for fauna and in particular birds. The site includes known habitat for several birds listed as threatened under the NSW *Threatened Species Conservatio*n (TSC) Act 1995 and several migratory species listed under the *Commonwealth Environment Protection and Biodiversity Conservation (EPBC) Act 1999*. The subject site represents a small area of modified wetland in a state and national context and despite the occurrence of migratory species it is unlikely that the subject wetland would be considered as a significant area of habitat under the EPBC Act. The known occurrence of eight species listed under the TSC Act increases the state importance of the site, although further surveys would be required to assess the extent to which these species rely upon the subject wetland.

The wetland is important in the context of the Macleay Floodplain and particularly the South West Rocks area as it most likely represents one of a matrix of wetlands used by waterbirds. Given the widespread removal and degradation of floodplain wetlands previously used by waterbirds (Pressey & Harris 1988) it is essential that sites such as Boyters Lane are protected and if possible enhanced.

Conservation of waterbirds relies upon maintaining a number of wetland habitats with different wetting and drying regimes (Kingsford & Norman 2000). Waterbirds that use the Boyters Lane wetland are likely to move between the estuary and other floodplain wetlands on a daily basis. The occurrence of numerous species typical of inland wetlands provides further evidence of the importance of the Boyters Lane Wetland, which may be used as a drought refuge (Kingsford & Norman 2000).

On a social level, the growing population means that pressure on existing playing fields in the South West Rocks area will increase, and the Boyters Lane site would satisfy this demand for the foreseeable future.

A search of the Australian Heritage Database on the 1st November 2004 showed no sites of European heritage within the Boyters Lane site. A wider search for South West Rocks revealed the following heritage sites:

- Boatmans Cottage No. 2, Pilot Station Group, 5 Ocean Drive South West Rocks;
- Smoky Cape Lighthouse Group, Lighthouse Road, South West Rocks;
- Trial Bay Gaol, Cardwell Street, South West Rocks;
- Arakoon House, Trial Bay;
- Pacific Guest House, 21-23 Livingstone Street; and
- Flagstaff at Flagstaff Headland.

These sites are located some distance from Boyters Lane, and are not considered to have any impact on the future management of the playing fields and wetland. No heritage sites were listed in searches for Jerseyville, Rainbow Reach or Pelican Island.

Glossary of listings:

Indicative Place = Data provided to or obtained by the Australian Heritage Council or the former Australian Heritage Commission has been entered into the database and the place is at some stage in the assessment process. A decision on whether the place should be entered in the Register has not been made.

Registered = The place is in the Register of the National Estate. Although some places may be legally registered because they are within a larger registered area they may not necessarily possess intrinsic significance.

Listed Place = The Council has sent an assessment to the Minister and the Minister has entered the place in the Commonwealth Heritage List. He does this by instrument published in the *Gazette*.

8. Aboriginal Significance

Before European settlement in the early 1800s, the peoples of the Dunghutti and Ngaku language groups lived in the Macleay valley (Atkinson, 1999). Aboriginal people have a powerful relationship with their country, based on spiritual and physical bonds forged over some 40,000 years of life in Australia.

The land, the natural environment and Aboriginal culture are strongly linked. Aboriginal people maintain a diversity of living cultures and a strong and continuing attachment to the land and the waters. Aboriginal peoples' association with the landscape is based on each Aboriginal community's own distinct culture, traditions and laws.

These cultural associations with country can relate to cultural practices, knowledge, songs, stories, art, paths, landforms, flora, fauna and minerals, and can also include custodial relationships with particular landscapes. These custodial relationships may determine who can speak for particular country (NPWS, 2004).

In this respect, natural area management should reflect Aboriginal aspirations by developing land and water management approaches that recognise Aboriginal cultural values of linkage with biodiversity and of the environment, and in turn benefit from the long experience and spirituality that Aboriginal people possess in relation to country.

Strategies that are being developed by NPWS that attempt to bridge the gap between 'natural' and 'cultural' heritage include:

- the joint management of national parks
- Aboriginal involvement in biodiversity surveys and research
- the mapping of people's attachment to landscapes using oral history and participatory planning techniques.

Aboriginal people have traditionally found abundant food and raw materials among the diverse and productive coastal environments of the NSW North Coast. Remains of Aboriginal life and activity are found all along the coast, particularly shell middens. Aboriginal people in many areas continue to live in their traditional areas and use coastal resources such as seafoods and bush foods. The continued use of bush foods and medicines allows people to pass on cultural knowledge, to use and maintain places of cultural value, and to generally benefit their physical and spiritual well-being.

These aspirations and themes are particularly appropriate for the restoration of the wetlands of the Boyters Lane site. Aboriginal people can contribute substantially to the management of the area, and Council and the community can listen and learn form accumulated Aboriginal wisdom. The Boyters Lane project provides an opportunity for a partnership in reconciliation that can be started with consultation on what happens to the site, and added to carefully and positively into the future.

A search of the Australian Heritage Database on the 1st November 2004 showed no sites of Aboriginal heritage within the Boyters Lane site. A wider search for South West Rocks revealed the Clybucca Aboriginal Area, a large midden site north west of Pelican Island, listed as *Registered* under the Register of the National Estate. This site is several kilometers from the Boyters Lane site, and is considered to have little impact on the future management of the playing fields and wetland.

Three other Indigenous Place sites, two listed as *Registered* and one as an *Indicative Place* under the Register of the National Estate database, occur in the region, although the locations of these sites are not available on the database. Aboriginal people consulted in the preparation of this Plan raised no issues of Indigenous Place sites. Before any works within the Boyters Lane site can be carried out, the locations of the three Indigenous Sites should be identified to determine any potential impacts.

No indigenous sites were listed in searches for Jerseyville, Rainbow Reach or Pelican Island.

Glossary of listings:

Indicative Place = Data provided to or obtained by the Australian Heritage Council or the former Australian Heritage Commission has been entered into the database and the place is at some stage in the assessment process. A decision on whether the place should be entered in the Register has not been made.

Registered = The place is in the Register of the National Estate. Although some places may be legally registered because they are within a larger registered area they may not necessarily possess intrinsic significance.

9. Land Use

9.1. Current Land Uses

The Kempsey Shire Local Environmental Plan has zoned the Boyters Lane site as Rural 1(a1) (Map BB028-7, Appendix 4). Under this zoning, playing fields are permissible but must comply with the zoning prescriptions of the LEP (Kempsey Shire Council, 1987 as amended).

The site is currently used only by local and regional ornithologists (bird-watchers). Until recently, cattle grazed the site, including the wetland areas. Grazing does occur in adjacent lands, however the fencing appears adequate to keep cattle out of the Council-owned land.

There are no immediate plans for future residential development in the Pelican Island area. There is, however, a proposal to install a sewage pump station in the south-east corner of the Boyters Lane site. The pump station would service 36 houses that are currently on septic systems.

A stormwater management strategy is being compiled for development land across Spencers Creek to the north of the study site.

Fishing and boating are popular pastimes in the lower river, and Spencers Creek is known as a productive crabbing stream. Anecdotal evidence suggests that local blackfish fishers, until recently, sourced much of their green weed bait from Teal Lagoon.

9.2. Future Land Uses

9.2.1. Playing Fields Issues

There are several issues surrounding the use of the playing fields and the potential impacts on the wetlands and its inhabitants. These are detailed below.

Lights

The Australian Standard for Sports Field Lighting (AS2460-2003) should be adhered to when constructing the playing field. The lights must be designed by specialist lighting engineers using light intensity, playing fields area, grass surface characteristics, power availability and other factors in calculations. The lights should be non-obtrusive to the maximum extent practical, with 'Type D' shades and light elements used to reduce horizontal light spillage. Lights should also be directed down towards the ground to increase their efficiency and reduce impacts on wildlife. Trees should be planted between the playing fields and the wetland to intercept light spillage and further reduce impacts on wetland fauna.

Increased illumination could affect fauna in two ways. Some species may be disturbed and subsequently leave the wetland, whilst others could benefit by having the foraging substrate illuminated. Many species of waterfowl and shorebird forage irrespective of day or night (McNeil *et al.* 1992), whilst most wading birds (i.e. egrets, herons, ibis, spoonbills) forage mainly during the day and occasionally on moonlit nights (Marchant & Higgins 1990; 1993; Higgins & Davies 1996: pers obs).

The use of directional lighting and screen plantings may reduce impacts. Even with these measures some illumination of Teal Lagoon is expected, and the end result may be the creation of a full moon affect. Lighting may also affect other species. For example, insectivorous bats may forage around lights (pers obs), whilst illumination may alter the behaviour patterns of small ground mammals and grass owl.

Noise

It is proposed that training will occur at night only, with games played on the weekend. Therefore, most noise impacts will occur during daylight hours on weekends,. Night training and associated vehicle movement will cause some noise disturbance, although this is expected to be low.

Stormwater

Drainage is likely to be installed, with possible fertiliser applications to the fields as a means of maintaining the site at playing standards. During storm events surface runoff from the playing fields will occur. The runoff will enter the wetlands, and carry with it concentrations of fertiliser containing nutrients, potentially hydrocarbons from vehicles, and droppings from dogs. Stormwater management needs to be taken into consideration in the final design of the site.

There was a provision made for 36 cars on the site in a previous development application (KSC Appn. No. T6/04/307). However, the road is not wide enough to accept verge parking should it be required. No provision was made in the DA for the improvement of stormwater quality leaving the parking area. This runoff would contain hydrocarbons from oil, petrol and grease deposited by vehicles.

Sewage Infrastructure

In order for the amenity block to be constructed in association with the playing fields, infrastructure for managing sewage is required. The proposed sewage pump station, located at the corner of Boyters Lane and South West Rocks Road, has had a Review of Environmental Factors (REF) written in regards to the potential impacts the pump station would have on the surrounding environment. Pipes must be laid from houses and the amenity block to the pump station, with a risk of exposing acid sulfate soils (Macleay Water, 2004).

9.2.2. Accessway Issues

Impacts on wetland

The Council-proposed accessway route (see Section 11.2.2 Accessway Routes), following the existing berms through the site, poses issues such as bird flushing and community safety.

By introducing quantities of people to the heart of the wetland, the associated increase in noise will scare or “flush” birds away from the site, thereby reducing the site’s value.

There is a potential safety issue if the levee is used as the walkway, with no widening or side barriers being constructed. It has steep sides with about a 700mm drop to the wetland floor in areas, and the narrow path could increase the risk of bikes falling off.

Impacts on Navigation

The construction of a pedestrian bridge over Spencers Creek could lead to navigational problems from boats. Allowances must be made for the overhead clearance of boats passing underneath, especially during high tides.

The structures on either side of Spencers Creek will need to take into account any erosion or accretion that occurs naturally, or that may occur as a result of the bridge.

Education Component

A proposal by Council for the boardwalk/walkway is to incorporate education of wetlands and their management. This has the potential to be taken into the local schools' education curricula, with field trips to the wetland. A properly designed walkway would reduce the impacts of bird flushing in these instances.

9.2.3. Acid Sulfate Soil Issues

Some of the options proposed for future management of the Boyters Lane site include works that may disturb the soils, although all options propose only shallow surface work. Any disturbance of the area must be accompanied by ASS assessment.

To obtain a preliminary indication of the ASS status of the site soils, one composite sample of soil was collected from three points along the main berm about 30cm below surface as a preliminary assessment, and analysed at the Environmental Analysis Laboratory, Southern Cross University, using the Chromium Reducible Sulfur (CRS) method.

The sample was classified "Not Potential or Actual Acid Sulfate Soil" (Appendix 3), with the CRS content 0.002%. A liming application of 1.7kg/m^3 of soil was calculated. Acid Sulfate Soils are often patch in extent and location, but from this result it appears likely that remediation works involving the surface soils at least would not present an environmental hazard.

All areas on the site where any disturbance of the soils is proposed would require an Acid Sulfate Soils Management Plan, beginning with detailed soils sampling.