Shoalhaven CITY COUNCIL

PLAN OF MANAGEMENT

COMMUNITY LAND PLAN NO. 3

MAHOGANY CREEK RESERVE

JUDITH DRIVE, NORTH NOWRA

Adopted 26 October 1999

File reference 4429

CONTENTS

1 INTRODUCTION

1.1 Background

Shoalhaven City Council is developing a community based Plan of Management for the area to be known as the Mahogany Creek Reserve, Judith Drive, North Nowra.

The reserve is located approximately three kilometres northwest of the Nowra CBD as illustrated in the location plan (Figure 1). The reserve is a narrow strip of flat to gently sloping land, running approximately east west, and covering an area of approximately 2.27 hectares. A tributary of Bomaderry Creek runs through the site from west to east then drains to Bomaderry Creek about seven hundred and fifty metres further to the east. The reserve is bounded by residential dwellings to the north and south, Illaroo road to the east and Judith Drive to the west.

The reserve to which this Plan of Management applies consists of Lot 18 DP 247225, Lot 103 DP 773679, Lot 8 DP 789881, and Lot 31 in subdivision of lot 52 DP 712019. The first three of these lots are public reserves owned by Shoalhaven City Council. Lot 31 in subdivision of lot 52 DP 712019 is in private ownership but will soon be incorporated into the reserve, as part of the subdivision of adjoining land for residential use.

Residents and conservation groups in the area have expressed concern about the impact of nearby developments on the residential amenity of the area, and, in particular, the effects on vegetation and fauna habitat.

Council resolved on 17 October 1995 that:

> *A Plan of Management be prepared for the Council managed land to address:*
>
> *(a) regeneration and restoration of the vegetation for the benefit of residents and local fauna;*
> *(b) enhancement of the creek channel through the resolution of drainage and water quality issues;*
> *(c) environmentally sensitive development options for Council's land (DP 394706) Zoned Residential 2C in Judith Drive.*

Forbes Rigby Pty Ltd was subsequently commissioned by Shoalhaven City Council on 8 November 1995 to prepare the Plan of Management.

Council has used the draft plan prepared by those consultants as the basis of this plan. This plan includes amendments to the consultant's draft that ensure compliance with the provisions of the Local Government Act 1993. This plan also incorporates more detailed concept design for watercourse rehabilitation, based on documentation provided in July 1998 by Storm Consulting Pty Ltd.

1.2 Purpose of the Plan

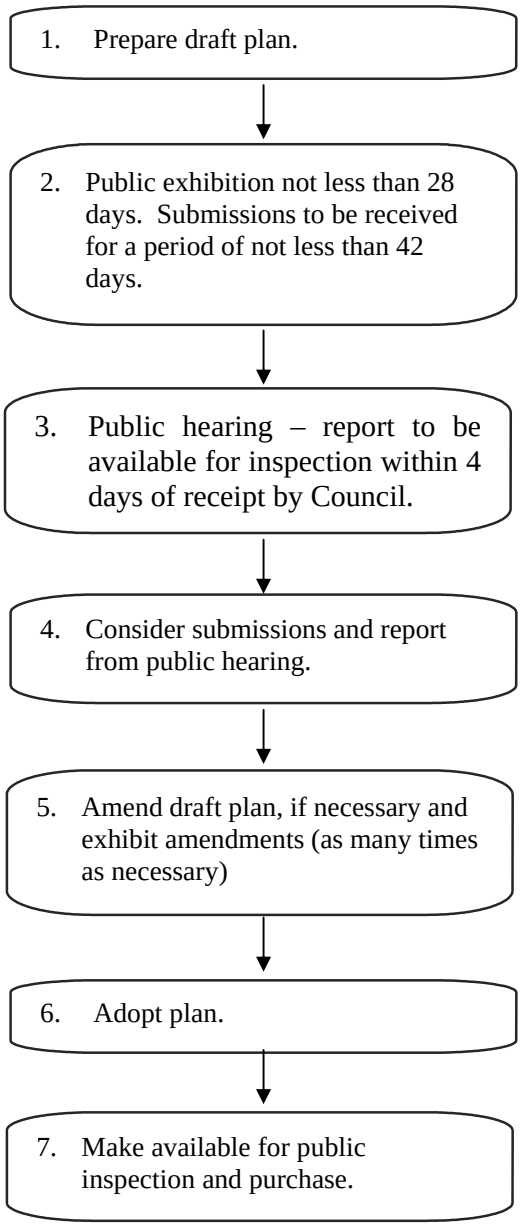
Council has identified the need to prepare a Plan of Management to ensure that development of the Mahogany Creek Reserve is carried out in a coordinated and environmentally sympathetic manner.

The Plan also ensures that Council's obligations with respect to the Local Government Act 1993 are taken into account. The Local Government Act 1993 requires that all community land be used and managed in accordance with of a plan of management. Council is required by the Local Government Act 1993 to properly manage, develop, protect, restore, enhance and conserve the environment, in a manner that is consistent with and promotes the principles of ecologically sustainable development.

Figure 1. Location of Mahogany Creek Reserve, North Nowra

1.3 The Process

This plan has been prepared in accordance with the process specified in the Local Government Act 1993. The process can be summarised in the following diagram. This draft of the plan is at the public exhibition stage of the process (Step 2). Because the plan categorises the community land, it is necessary to hold a public hearing at some stage in the process. The public hearing must be presided over by a person who is not a Councillor, nor an employee of Council, nor a person who has been a Councillor or employee of Council within the previous five years.



2 EXISTING CONDITIONS

2.1 Regional Reserve Setting

The Mahogany Creek Reserve is part of a system of public reserves in the North Nowra area. To the east, the reserve is continuous (apart from interruption by roads) with other public reserves that continue along the same drainage line toward Bomaderry Creek. To the west of Judith Drive it is proposed that a new reserve be created by utilising a 25m wide strip of Department of School Education land and a 40m wide strip of Shoalhaven City Council land.

2.2 Current Land Use

A review of current land uses within the catchment was undertaken in 1995 to assess the relative distribution of different land use types. The results are depicted in Table 1 below and indicate that about 70% of the catchment has been developed for urban purposes with the remaining 30% being equally shared between existing bushland and/or 'rural'. With the development of the Crown Land subdivision and the Council, Tovedale and School Sites, 8% of the catchment will remain in an open-space/bushland setting. This figure roughly corresponds with the old threshold planning limits as set by the then Department of Environment and Planning of 2.85 ha open-space per one thousand head of population. Many of the recreation needs for this community are located just outside of this catchment.

TABLE 1
DISTRIBUTION OF LAND USE TYPES WITHIN THE CATCHMENT

LAND USE	1995		2000	
	AREA (HA)	% OF CATCHMENT	AREA (HA)	% OF CATCHMENT
Bushland	8.8	13.7	5.1	8
Rural	9.7	15.2	0	0
Urban	45.5	71.1	58.9	92
Totals	**64.0**	**100**	**64.0**	**100**

2.3 Topography, drainage and soils

The site is level to gently sloping and falls to the east. A creek (now know as Mahogany Creek) runs through the reserve area. The length of creek within the reserve is approximately 400 metres. It flows on private land adjacent to the reserve before crossing Illaroo Road and ultimately flowing into Bomaderry Creek.

The creek can be divided into two distinct sections. The upstream portion extends from Judith Drive to Farrar Drive (referred to hereafter as the upstream portion). Here pipes deliver stormwater from sub-catchments to the drainage line. The drainage line in this section has a broad trapezoidal channel excavated to a depth of about one metre. The existing headwall appears to be insufficient to prevent erosion behind it.

The depth to bedrock is up to 3.5 m.

In the downstream portion of the creek (from Farrar Drive to the Illaroo Road culvert) the watercourse has a different character. It has a more defined channel with often abundant riparian vegetation. The stream channel is eroding by way of active headcutting into the clay soil. Increased peak flows have caused the clays to erode down to bedrock. Lateral erosion and bank underutting is beginning to become evident. Bed erosion exists in

the form of deep gullies with vertical sidewalls.

Increasing urbanisation in the catchment over time will likely exacerbate the erosion problem in this section of the watercourse. One Council initiative that will tend to prevent a worsening of the existing erosion in the system is the construction of the Judith Drive detention basin, immediately upstream of the planning area.

A sediment trap exists to the south of the downstream portion of the planning area. It is unattractive and poses a public safety risk. The outflow from the sediment trap is via pipes which discharge into the stream channel. Some headcut erosion is evident at this point.

Soils in the area generally range from poorly developed sandy soils on high ground to deep sandy clay loams developed in colluvium. Soil depth varies from less than 30cm to the east of the site to more than 1.5m in the centre. There is a small amount of humus in the top layer. In the areas of the construction of the adjacent Tovedale subdivision, clays were observed at depth.

2.4 Flora and Fauna

The flora and fauna of the planning area are described in the reports by Mills (1994) and Leonard (1994). The following description is taken mainly from those documents. The reports by Goldingay (1994) and Mitchell McCotter (1995) also provide some relevant information in their descriptions of adjacent land.

Plant Communities

The vegetation in the study area includes plant species and plant communities of regional conservation significance. The vegetation could provide a habitat link between bushland on private and public land to the west, through a section of North Nowra towards Bomaderry Creek. The habitat would be enhanced if weed species were managed, if more trees and shrubs were planted and if further disturbance and clearing were discouraged.

The site is located on the boundary between the gully forest vegetation, typical of the creek lines east of Illaroo Road, and the woodland of the sandstone plateau. The remnants of natural vegetation on the site represent these forest and woodland communities. Additionally, the drainage line area supports a distinctive group of swamp species. The delineation of vegetation types on the site appears to have been influenced to a considerable extent by soil type and moisture regime. Sedgeland occurs in low-lying areas, swamp mahogany woodland and turpentine open forest along the eastern end of the creek-line and remnants of scribbly gum/red bloodwood woodland on the areas with sandy soils. The structure and species composition of the sedgeland and scribbly gum/red bloodwood woodland approximates those described by Mills (1992) at Bomaderry Creek, although the swamp mahogany woodland is not recorded at Bomaderry Creek.

Most vegetation on the site would appear to have been subjected to varying degrees of disturbance, including fires, clearing and mowing as well as excavation and infilling. Weed species are common in many areas, although in most cases native plant species are dominant. The Mahogany Creek Bushcare Group is actively removing weeds and replanting.

A description of main vegetation types follows. A plant species list was compiled from the above sources and is attached as Appendix 1. The vegetation communities grade into one another making accurate demarcation between communities difficult. For this reason no map of the vegetation communities has been prepared.

SEDGLAND Schoenus spp*: Juncus* spp*; Lepyrodia gracilis.*

Structure
Sedges and rushes to 1m. Woody plants and herbs are rare, and generally prostrate.
Occurrence
This vegetation type occurs along the low-lying section of the site, and extends through the existing public reserve in the north-west corner of the site then following the creek-line towards the turpentine forest.
Floristics
Dominant sedge and rush species are *Schoenus melanostachys, S.brevifolius, Juncus continuus, J. usitatus, Lepyrodia gracilis* and *Xyris gracilis* subsp *gracilis*. Occasional herb species include *Gonocarpus micranthus* subsp *micranthus, Drosera spathulata, D. pygmaea, Villarsia exaltata* and *Centella asiatica*. Only two orchid species were recorded, *Thelymitra ixioides* and *T.nuda*. Woody plants commonly occurring near the margins of this vegetation type included *Pultenaea daphnoides, P. elliptica, Leptospermum polygalifolium* subsp *polygalifolium* and *L. juniperinum.*

WOODLAND Eucalyptus robusta

Structure
Trees to 20 metres, but generally 8 to 12 metres Trees are generally high-branching and narrow-domed. Shrub cover varies in height between 0.5 and 2.0 m, and is generally sparse, although regular disturbance may be a contributory factor. Grasses and sedges are common, especially if shrub cover is sparse.
Occurrence
This vegetation type occurs as an ecotone between the sedgeland and scribbly gum/red bloodwood woodland. This vegetation type is rarely extensive or complete in the study area, consisting mainly of disjunct remnant stands.
Floristics
The dominant tree species is swamp mahogany (*Eucalyptus robusta).* Shrub understorey varies according to location, the more common species being *Pultenaea daphnoides, Kunzea ambigua, P. elliptica, Leptospermum polygalifolium* subsp *polygalifolium* and *L. juniperinum.* Where shrub cover is sparse herb and sedge ground covers include *Lomandra longifolia, Xyris gracilis* subsp *gracilis, Lepyrodia gracilis* and *Empodisma minus.*

WOODLAND Eucalyptus sclerophylla./ E. gummifera

Structure
Trees between 10 to 25 metres. Trees are generally low-branching and broadly spreading, with bent trunks. Shrub cover varies in height between 1 and 3 m, and is generally dense where disturbance is not apparent. Grasses and ground covers are more common on sandy soils, where shrub cover tends to be sparse.
Occurrence
This vegetation type occurs as remnant stands long the southern boundary of the study area. More complete stands occur to the west of Judith Drive.
Floristics
Dominant tree species are scribbly gum (*E. sclerophylla)*, red bloodwood (*E. gummifera)* and stringybarks (*E. imitans* and *E. globoidea*). Some specimens of grey gum *(E. punctata)* occur close to, and within residential properties on Page Avenue. Commonly occurring shrubs are black oak (*Allocasuarina littoralis),* prickly moses *(Acacia ulicifolia),* paperbark teatree *(Leptospermum trinervium)* and hairpin banksia *(Banksia spinulosa* var. *Spinulosa).* Common herbs include *Cyathochaeta diandra, Lomandra spp* and redleg *(Bothriochloa macra)*. Groundcovers include *Kennedia prostrata, K. rubicunda* and *Hardenbergia violacea.*

OPEN FOREST Eucalyptus pilularis/Syncarpia glomulifera.

Structure
Trees to 30m. Trees generally have tall, straight trunks and high branching, broadly-spreading canopies. Where turpentine *(Syncarpia glomulifera)* is dominant, canopy cover is dense, and understorey is sparse. Understorey is variable where blackbutt (*Eucalyptus pilularis*) is dominant varying between mesic and sclerophytic native species or exotic shrub species. Ferns are occasional occurrences.

Occurrence
This vegetation type only occurs at the eastern end of the study area. The section dominated by turpentine occurs in the proposed public reserve but the stand of blackbutts is located within the area proposed for residential development.

Floristics
Weed infestation is common in the understorey, the more common species being honeysuckle *(Lonicera japonica)* and privet *(Ligustrum* spp.*)*. Common native understorey species are cheese tree *(Glochidion ferdinandi)*, bush daphne *(Pittosporum undulatum)* and blueberry ash *(Elaeocarpus reticulatus)*. One adult and several younger individuals of magenta lilly pilly *(Syzygium paniculatum)* occur near the creek-line.

Fauna

According to Mills (1994), the fauna of the North Nowra area has been described in the reports relating to the proposed North Nowra Link Road, located not far from the present planning site. However, all of these studies concentrated on the endangered species and there still has not been a broad-scale fauna survey in the North Nowra area. A small number of birds was recorded on and adjacent to the site in July 1994 by Mills; these are listed in Table 2. These are all common to moderately common and widespread species.

TABLE 2
LIST OF BIRD SPECIES RECORDED AT MAHOGANY CREEK RESERVE (MILLS, 1994)

Australian King Parrot	*Alisterus scapularis*
Australin Magpie	*Gymnorhina tibicen*
Australian Magpie-lark	*Grallina cyanoleuca*
Common Mynah*	*Acridotheres tristis*
Crested Pigeon	*Ocyphaps lophotes*
Crimson Rosella	*Platycercus elegans*
Eastern Rosella	*Platycercus eximilis*
Galah	*Cacatua roseicapilla*
Grey Butcherbird	*Cracticus torquatus*
House Sparrow*	*Passer domesticus*
Pied Currawong	*Strepera graculina*
Rainbow Lorikeet	*Trichoglossus haematodus*
Red Wattlebird	*Anthochaera carunculata*
Spotted Pardalote	*Pardalotus punctatus*
Spotted Turtle-Dove	*Streptopelia chinensis*

*Introduced species

2.5 Water Quality

As part of this Plan of Management, Forbes Rigby were required to collect water quality samples (both wet and dry weather) from the Illaroo Road culvert and test for:

- Suspended Solids (SS)
- Total Kjeldahl Nitrogen (TKN)
- Total Oxidised Nitrogen ($NO_{3/2}$-N)
- Total Phosphorus (TP)
- Dissolved Reactive Phosphorus (DRP)
- Faecal Coliforms (FC)
- Total Nitrogen (TN; = TKN + $NO_{3/2}$-N)

The laboratory data are attached in Appendix 2. Results show that, in dry weather conditions, export of total phosphorus from the catchment is low, but that export of nitrogen is quite high, especially considering the catchment is only 71% urbanised (refer to Table 1). It is noted that most of the nitrogen (74%) is in the nitrate form. This is quite unusual for such a small catchment (64 ha) with no intensive rural component and suggests that most of the exported nitrogen is contributed by minor sewer leaks (the ammonia and organic nitrogen having been nitrified in the aerobic zone of sandy soils). Faecal coliform concentrations of 400 organisms per 100 ml (under dry-weather conditions), possibly indicating sewage contamination of stormwater.

Data collected during wet weather shows that the creek, which discharges to the Bomaderry Creek system, provides a significant phosphorus load to the system, as is common with urban or urbanising catchments. On the day of sampling under wet weather conditions clarity of water exiting the Illaroo Road culvert was higher, but still quite good (10 mg/L SS), and there was no evidence of oil and grease, detergent foam or plastic litter debris. The rise in faecal coliform concentrations (from 400 to 4000 organisms per 100 ml) was in line with the rate of increase in suspended solids, possibly indicating that washoff from soil contaminated with faecal bacteria is the operating mechanism. This is in accord with the above suggestion that a surface

expression of seepage from a sewer leak or leaks is occurring in this catchment. Considering the small catchment size concentrations are too high to ascribe to washoff of dog and cat excreta from lawns and pavements.

2.6 Recreational and Access Resources

The Reserve provides a limited recreational resource principally for the adjoining residents. There is an informal system of pathways running through the site in an east-west direction (such as the one shown on the cover of this Plan). The unformed section of Judith Drive provides access in a north-south direction. There are no formalised recreational facilities in the Reserve. There is a strong sense of community ownership of the Reserve, based on the community concern about the proposed developments in the area.

2.7 Scenic/Aesthetic Resources

The Reserve provides a vegetated backdrop to adjoining residences in an area which has generally only a moderate tree cover. The heavily treed canopy contrasts strongly with the surrounding residential development. The community sees the Reserve as providing a significant aesthetic resource.

2.8 Educational Resources

The Reserve provides a limited educational resource, principally for adjoining residents. The community has recognised the educational values of the Reserve. The education potential of the Reserve is more important with the development of the school site.

3 CONSULTATION & IDENTIFICATION OF ISSUES

3.1 Consultation

Community consultation took place through a public meeting and through meetings with individuals and groups. Comments have been received from public authorities and representatives of specialist groups, landowners surrounding the planning area, and other interested persons. A number of site visits with stakeholders have been held. Comments relevant to the Plan have been summarized below in Table 3.

TABLE 3
CONSULTATION PROGRAM

ORGANISATION	SUMMARISED COMMENTS
North Nowra Community Action Group	• Arrest Creek bed deterioration particularly due to current development construction. • Define the reserve boundary with bollards and sign posting such as "public reserve, please do not dump rubbish, grass clippings or plants". Signs should also convey a message that the reserve has been maintained for future generations because of the determined effort of our action group. • Continued community consultation and participation in the reserve regeneration project. • All of the community must have access to the reserve via wheelchair/walk/cycle ways and children must be able to play in the reserve. Picnic areas are not really needed. Trail bikes and horses should be restricted from using the reserve • Regeneration must be in keeping with the existing native species naturally specific to this reserve. • Protect sedge land with elevated wheelchair/walk/cycle board walks. • Support the environmentally `friendly' water course treatments proposed by the consultants. • Flooding and child safety issues of proposed wet detention areas • The reserve needs a sensitive approach to water retention and storm water control because its creek is part of the Shoalhaven Catchment. That is, no gross pollution traps and no gabions. Opposed to concrete channel works and Gross Pollution Traps. • The potential wildlife corridor of this reserve must be enhanced and retained. Our reserve with its creek is appreciated by the community for its biodiversity. The reserve has native flora species consisting of swamp mahoganies, blackbutts and an impressive stand of turpentines. Fauna species include: wallabies, wombats, blue tongue lizards, echidnas, frogs, bats, cockatoos, gliders, tiger quolls, king parrots and numerous other bird species. All species are integral to the reserve and they enhance the well being of the people who are utilising this community amenity. • Hope that Council land to the west of Judith Drive will be set aside for public reserve. • Concerned that the extension of Judith Drive is being constructed especially since this will interrupt travel by Tiger Quoll through to Bomaderry Creek Reserve. • Garry Leonard (1994) recognises the importance of the Judith Drive wildlife corridor. • Ross Goldingday (1994) indicates that the Judith Drive corridor could be improved by tree planting and could be used as a migratory route for the endangered Tiger Quoll. • Kevin Mills (1994) values the corridor but recognises that future development will decrease its viability.
Australian Conservation Foundation	• The site forms a significant wildlife corridor leading from the Bomaderry Creek Bushland to the vegetated lands to the west of Pitt Street, Bangalee Reserve and the Gypsy Point area. • The significance of the corridor has been recognised in a fauna and flora report done by Dr Goldingay. • The wetland area must be maintained. Concern that the catchment will be overdeveloped and the wetland turned into an urban drain.
Environment Protection Authority	• Concerned about general pollution of the watercourse • The provisions of the Rivers and Foreshores Improvement Act must be adhered to
National Parks and Wildlife Service	• A broader investigation of the North Nowra area be undertaken to determine the location, viability and requirements of wildlife corridors in the North Nowra area. • The [Judith Drive] corridor…is an important link between the Bomaderry Creek bushland with other bushland sites. • A study should be undertaken to establish mechanisms to maintain and, if possible, enhance the wildlife corridor values of the area. • A broad planning strategy for the whole area should be established.

3.2 Summary of Management Issues

The Judith Drive Reserve is adversely affected by the following current conflicts and problems:

- weed infestation, especially near the perimeter of the School and Council sites;
- physical degradation, presumably by motor bikes, cars and horses on land to the north of the Council land;
- destruction of vegetation on the Council and Tovedale lands;
- evidence of tipping of grass clippings and prunings over the 'back fence' by residents;
- anecdotal evidence of trail bikes and horses using the reserve;
- anti-social behaviour; for example, clearing and mowing of land, dumping rubbish, storing of trailers and wood.
- evidence of poor water quality derived from one or more sewer leaks.
- concern that further development within the catchment will cause problems;
- concern that the extension of Judith Drive will be a problem for the maintenance of habitat; (note: the decision to extend Judith Drive to link with the proposed subdivisions by Council and The Department of Land and Water Conservation has already been made as part of Council's Section 94 Contributions Plan)
- past 'channelling' of the creek has caused it to be cut deeper resulting in trees being undermined and the development of a 'drain' rather than a creek.

4 BASIS FOR MANAGEMENT

4.1 Council's Environment Goals for the City

Shoalhaven City Council has adopted the following Environmental Goal for the City:

- *To caretake, protect and improve our environment for present and future generations.*

4.2 The Role of Judith Drive Reserve

The role of the Judith Drive Reserve is as follows:

- A controlled urban drainage area.
- An environmental facility which provides some ability to act as a vegetated link leading from the Bomaderry Creek Bushland to the vegetated lands to the west of Pitt Street, Bangalee Reserve and the Gypsy Point area (Goldingay, 1994).
- An environmental facility which contains some vegetation which is listed as being regionally significant (Leonard, 1994).
- An environmental facility with a capacity to treat urban pollutants.
- A recreational facility for passive recreation in close proximity to existing and planned urban development.
- A local scenic attraction for visitors and residents alike.
- An educational facility for nearby residents and school children from the proposed North Nowra Primary School.
- A pedestrian linkage.

4.3 The Values of Judith Drive Reserve

The core values of the Judith Drive Reserve are:

Environment

The natural environment of the reserve, the wetland, the dense stands of vegetation, the watercourse, the clean water and wildlife corridor surrounded by residences.

Scenic

The scenic quality of the reserve when viewed from within the reserve and from adjoining residences and public places.

Recreational

The quality of the reserve for year round passive recreation.

Educational

The quality of the reserve for educational benefit.

4.4 Planning Instruments and Policies

The land is not identified on any maps accompanying Illawarra Regional Environmental Plan No.1. The land is zoned 6(a) Open Space and 2(c) Residential, under Shoalhaven City Council's Local Environmental Plan 1985.

4.5 Land Classification

The Local Government Act 1993 provides Councils with a specific responsibility to classify (as either operational or community land) and manage public land. The Mahogany Creek Reserve is classified as community land. The Act requires that all community land be the subject of a Plan of Management and this Plan of Management has been prepared in accordance with the requirements of the Act.

4.6 Community Land Categories

Community land is required to be categorised as a natural area, a sportsground, a park, an area of cultural significance or as general community use. Community land categorised as a natural area is required to be further categorised as bushland, wetland, escarpment, watercourse or foreshore. For each category of community land the Local Government Act specifies core objectives that determine how the land is to be managed. These are set out in Table 4.

4.6.1 Prior Community Land Categories

The Mahogany Creek Reserve comprises four lots. Three lots (Lot 18 DP 247225, Lot 8 DP 789881 and Lot 103 DP 773679) were categorised by Council's Community Land Plan of Management No. 1 (which applied to all community land in the City of Shoalhaven) as Park. Lot 31 in subdivision of lot 52 DP 712019, which is the largest lot and which will soon be dedicated to Council, has not previously been categorised.

4.6.2 New Community Land Categories

Part 2A of the Local Government (General) Regulation (1993) sets out guidelines for the categorisation of community land. Based on application of the guidelines set out in the regulation (see definitions in Table 4) and on more detailed investigation of the land than was able to be done for Council's Community Land Plan of Management No. 1, this plan categorises the land as follows:

- part Natural Area Watercourse (Lot 18 DP 247225, Lot 103 DP 773679 and Lot 31 in subdivision of lot 52 DP 712019)
- part Park (Lot 8 DP 789881)

4.7 Permitted Uses, Leases and Licences

The Local Government Act also requires that this Plan of Management specify the purposes for which land is to be permitted to be used or developed. The permitted uses are set out in Table 4. Some of these permitted uses require a lease, licence or other estate under the Local Government Act 1993.

Leases, licences or other estates may be granted, if deemed appropriate by Council, but only where these are in accordance with the provisions of the Local Government Act 1993, the Environmental Planning and Assessment Act 1979 and/or any other acts as may be relevant.

Table 4
Community land categories, definitions, core objectives and permitted uses.

Community Land Category	**Community Land Subcategory**	**Definition (based on guidelines in Local Government (General) Regulation)**	**Core Objectives (from Local Government Act)**	**Permitted Uses**
Park		Land that is improved by landscaping, gardens or the provision of non-sporting equipment and facilities, for uses that do not unduly intrude on the peaceful enjoyment of the area by others.	a) To encourage, promote and facilitate recreational, cultural, social and educational pastimes and activities, and b) To provide for passive recreational activities or pastimes and for the casual playing of games, and c) To improve the land in such a way as to promote and facilitate its use to achieve the other core objectives for its management.	Purposes that are consistent with the core objectives for park, including: • recreation • playgrounds • landscaping • mowing of grass outside protected native vegetation islands • drainage • utility installations, • bushfire hazard reduction • buildings or structures associated with any of the above uses
Natural Area		Land that possesses a significant geological feature, geomorphological feature, landform, representative system, or other natural feature or attribute that would be sufficient to further categorise the land as bushland, wetland, escarpment, watercourse or foreshore.	a) To conserve biodiversity and maintain ecosystem function in respect of the land and b) To maintain the land in its natural state and setting, and c) To provide for the restoration and regeneration of the land, and d) To provide for community use of and access to the land in such a manner as will minimise and mitigate any disturbance caused by human intrusion, and e) To assist in and facilitate the implementation of any provisions restricting the use and management of the land that are set out in a recovery plan or threat abatement plan prepared under the	See below

Community Land Category	**Community Land Subcategory**	**Definition (based on guidelines in Local Government (General) Regulation)**	**Core Objectives (from Local Government Act)**	**Permitted Uses**
			Threatened Species Conservation Act 1995 or the Fisheries Management Act 1994.	
	Watercourse	Any stream of water, whether perennial or intermittent, flowing in a natural channel, or in a natural channel that has been artificially improved, or in an artificial channel that has changed the course of the stream of water, and any other stream of water into or from which the stream of water flows, and associated riparian land or vegetation.	a) To manage watercourses so as to protect the biodiversity and ecological values of the instream environment, particularly in relation to water quality and water flows, and b) To manage watercourses so as to protect the riparian environment, particularly in relation to riparian vegetation and habitats and bank stability, and c) To restore degraded watercourses, and d) To promote community education, and community access to and use of the watercourse, without compromising the other core objectives of the category.	Purposes that are consistent with the core objectives for natural area watercourse, including: • bush regeneration • erosion control • watercourse rehabilitation • water quality improvement • recreation • education • drainage • utility installations • bushfire hazard reduction • buildings or structures associated with any of the above uses

4.8 Objectives of the Plan of Management

In addition to the core objectives specified in the Local Government Act for each category of land (see Table 4), the future use and management of the Mahogany Creek Reserve will be guided by the following objectives. These are based on the stakeholder values outlined above, and on the management requirements of the planning area.

Environmental Objectives

- Enhance and protect natural conservation values.
- Improve water quality.
- Identify and repair discontinuities in the wildlife corridor.
- Repair eroding sections of the watercourse

Scenic/Aesthetic Objectives

- Preserve scenic backdrop to residential areas.
- Ensure that new works are aesthetically appealing when viewed from the reserve and public places.

Recreational Objectives

- Maximise passive recreational opportunities.
- Enhance the recreational experience for local residents and any visitors to the area.
- Ensure that the area is able to accommodate an increase in visitation without a corresponding reduction in the quality of the recreation experience.
- Enable the choice of a recreational experience that is nature-based and low-key.
- Maximise accessibility to all areas within the reserve for all people.
- Minimise conflict between user groups, such as pedestrians and motorists using Judith Drive.
- Maximise pedestrian linkages between residential areas.

Educational Objectives

- Maximise the educational opportunities within the reserve.
- Provide appropriate interpretive signage within the reserve.

Management and Maintenance Objectives

- Develop initiatives to foster a community based management scheme for the reserve.
- Manage the reserve to ensure that the above goals and objectives are fulfilled.

5 DEVELOPMENT PLAN

Figure 2 is a concept plan showing the essential features of the proposed development of the reserve. The details of development may vary slightly from that shown on the concept plan. The proposed development consists of watercourse rehabilitation, vegetation rehabilitation and development of recreational and educational facilities such as walking tracks, seating and interpretive signs. More detailed actions are described in section 6.

The proposed watercourse rehabilitation is described briefly below. Design details will be based on documentation provided by Storm Consulting (1998), from which the following information is extracted.

5.1 Approach to the watercourse rehabilitation design

5.1.1 Upstream portion of the creek

The upstream portion will be rehabilitated to provide it with features including;

- rock sills;
- variable batter slopes;
- access for plant;
- varied stream and terrestrial habitats;
- landscaping (including retention of existing vegetation);
- a gross pollutant trap (GPT);
- a sediment trap (deep pond); and
- wetland areas (shallow ponds with open water, reed beds and littoral = edge plants).

The sediment trap will be designed so that it is quite deep and likely to hold water through dry spells. However, the permanency of water in this pond will be dependent on catchment hydrology (the amount and frequency of flows). Sealing of the base of the pond is proposed to prevent excessive seepage from the sediment pond.

This type of rehabilitation would not be dependent on the provision of perennial flows. In periods of low/no flow, the stream would retain its character and aesthetic appeal. The stream would be provided with some meanders consistent with the boundaries of the reserve. Landscaping will include the provision of a beach area near to the first pond, i.e. the sediment trap.

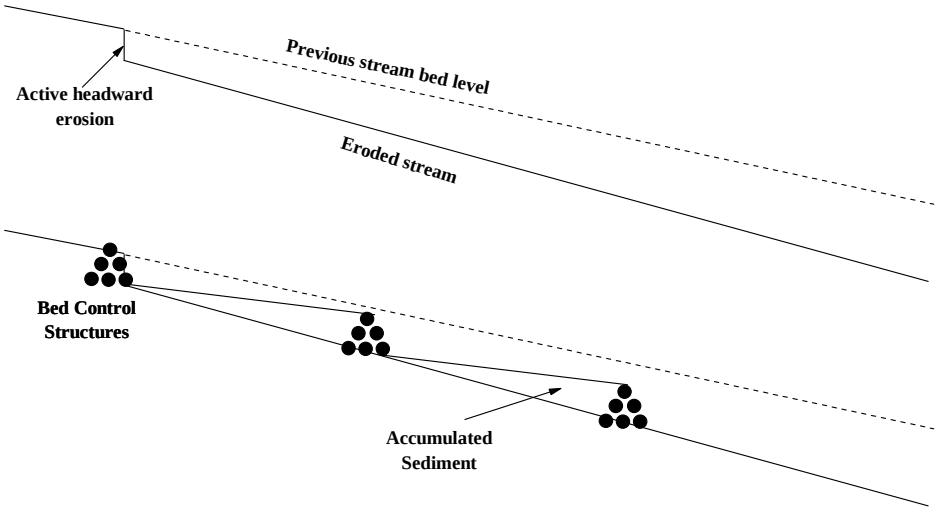
The stream will be attractive and stabilised (preventing further erosion and downstream sediment deposition) allowing for increased recreational use and interpretation (education).

5.1.2 Downstream portion of the creek

The approach to rehabilitating the watercourse between Farrer Drive and Illaroo Road is based on an understanding of the processes at play. The type of erosion occurring is known as headward erosion. This means that the erosion is occurring at an active face (headcut) that advances upstream over time.

This type of erosion can be checked and the stream stabilised by installing bed control structures. Bed control structures are devices that allow pooling to occur behind them. They are placed strategically allowing flow to change slope without affecting stream stability.

The pooled water behind the bed control structures allows sedimentation to occur, such that the bed level of the stream rises to the top level of the downstream bed control structure (see sketch).



This type of stabilisation work tends to raise the stream bed level to that approaching its original, or pre-erosion level. The need for laying back stream batters is minimised. This is important to protect the existing dense vegetation in this section of the stream.

The stream lends itself to such an approach because the erosion gully is so narrow, thus reducing the required width (and cost) of bed control structures. Bed control structures will be made from logs, fill and rock. The specific bed control structures that have been designed are called rock ramps.

The existing sediment trap will be decommissioned and flow will be conveyed to the stream by way of a stable channel.

5.2 Configuration and description of the works

The design incorporates three distinct rehabilitated sections of the stream as listed below:

1. A series of ponds in the upstream portion;
2. A riffle to convey flows from the decommissioned sediment trap to the stream; and
3. The stabilised downstream portion of the stream.

5.2.1 A series of pools in the upstream portion

The current engineered drain in no way mimics natural stream features. The design of a series of ponds re-establishes stream features to the upstream portion. Streams generally exist in the environment as a series of pools and riffles. Pools, or Ponds as they are hereafter referred to, are deeper areas where the water is still and of constant slope. Riffles are where streams change slope and water flows at relatively high velocity over shallow and rocky sections of stream. Another aspect of streams is that because they have energy, they tend to meander to reduce this. Aquatic plants are generally present in streams, both on banks, and in shallow sections of ponds.

General Configuration

Ponds, riffles (rock sill type), meanders and aquatic plants are a feature of the design of the rehabilitated stream in the upstream portion. Other components include a Gross Pollutant Trap (GPT) to enable management of litter and a stilling pond to provide for a rapid change in stream slope before flow enters the downstream portion of the planning area.

The meanders in the stream were selected to preserve regenerating native vegetation and existing mature vegetation (only one mature tree will be removed). In addition, a 6 m buffer on the northern boundary of the reserve has been observed. In this buffer zone, maintenance access for plant is proposed.

Ponds

The ponds are similar in that each has areas of open water, and aquatic plants. **Open water areas** are used in the design to delineate the sedimentation zone in the first pond, and to delineate inlet and outlet zones in the other ponds (in these ponds, the open water areas are created by the rock sills, and are up to 2,000 mm in depth).

Open water facilitates pathogen removal from the water column by way of ultraviolet disinfection from sunlight. It also enhances aesthetic and habitat values. The open water areas, located adjacent to the reed beds, will enhance the mixing process of stream. Areas of open water and vegetated reed beds are controlled by water depth.

The **reed beds** perform numerous functions, including trapping and removing pollutants (e.g. heavy metals, suspended solids, nutrients) by a combination of biological, physical and chemical processes. Reed beds also provide habitat as well as enhance the aesthetic value of the wetland, especially in association with open water areas.

With urbanisation increasing in the catchment, it will be important for the rehabilitated stream to function enabling the removal of accumulated sediment. The first pond is designed primarily as a **sediment trap** to reduce settleable solids. This will allow Council to periodically remove accumulated sediment, thus prolonging the function of the reed beds, preventing them from smothering.

The riparian areas on the southern side of the ponds have gentle batters to form a beach/recreation area, and also a place for waterbirds to be able to walk into the water. The ponds themselves have gentle **batters** for first 500 mm depth which will facilitate public safety. Below this depth, batters are steeper to enable the ponds to retain a relatively constant presence of water, even in dry periods.

Water level control is critical for allowing construction, plant establishment and efficient operation and maintenance of the stream ponds. For instance draining the ponds to enable replanting may be required. Plants cannot be placed into water at depth – they will not live. They must be planted into shallow water, and as the plant grows, so the water level should be raised. In addition, removal of accumulated sediment is facilitated by having a substantially drained pond.

Water level control is provided by having a pipe at depth below the ponds, and a means by which water level can be raised or dropped within ponds. Dropping water level simply means that the Pond drains to the **underground pipe**. Water level control will be provided in ponds by manually controlled **"twister" device**. Note that water level control is provided in infinite increments to 100 mm below the reed bed levels in Ponds 2 & 3; and to 1.4 m below operating water level in Pond 1, i.e. 100 mm above the bed of the Pond to facilitate "dry" removal of sediment.

Rock sills are required to provide changes in stream slope between Pools 1 & 2, and Ponds 2 & 3. They are a form of riffle. The rock sills will be constructed of large rock so that erosion is minimised, and energy dissipation is maximised. Rock sills provide aeration of stream flows which is important in maintaining healthy ecosystems within streams.

Stilling pond

The stilling pond is a structure that forms the link between the upstream and downstream portions of the stream and is shown in Sheet L1. It is incorporated to provide stability to the existing steep change in stream slope. It is a rock lined chute with a stilling pond at the lowest point. It consists of a **steep rock lined batter**, and a **rock lined pond**. The water depth in the pond can vary from 300 – 500 mm depth. Like riffles, stilling ponds also provide aeration to stream flows.

5.2.2 A riffle to convey flows from the decommissioned sediment trap to the stream

The urban subdivision above the downstream portion of the stream is drained by two stormwater pipes. These pipes converge in an energy dissipater (wall of concreted rock) before flowing into the sediment trap. It is proposed to modify and extend the existing rock wall so that flows enter a stilling pond, before flowing into a new riffle section that will safely convey flows into the stream. The new stilling pond will be constructed of concreted rock, consistent with the current construction of the wall. The existing sediment trap will be decommissioned. Its pipework will be removed and the area revegetated.

The new stilling pond and rock riffle section will provide a stable channel for conveying flows from the subdivision into the stream. They will prevent any further headward erosion that is occurring in this area. The stilling pond will provide a large amount of energy dissipation.

5.2.3 The stabilised downstream portion of the stream

Rehabilitation of the downstream portion of the stream commences at a point where the new rock riffle discharge (see above) meets the eroded stream channel. At this point, a **stilling pond** will be installed to prevent further headward and to dissipate flow energy. Below this point, the stream will be provided with two **rock ramp structures** to provide stable changes of stream slope. **A second stilling pond** is required below the two rock ramps, and this structure signifies the end of structural rehabilitation works in the planning area.

Stilling ponds

These structures have the same conceptual design as that described in the upstream portion of the planning area. Both ponds are 500 mm deep.

Rock Ramps

Rock ramps are required to prevent further headward erosion in the stream. The existing stream environment poses challenges of anchoring and interfacing rock ramp structures, i.e. the structures must be stably anchored to prevent downstream movement, and they must interface with bedrock. Two rock ramp structures are required.

Pools

Two pools will be formed by the rock ramps. Stream banks will need to be battered off accordingly to provide the design criteria described. The steeper batters on the northern side of the stream will prevent excessive disturbance of native vegetation. The gentler batter on the southern side is for public safety reasons, and to facilitate revegetation. The disturbed batters will be lined with jute mesh to aid stabilisation and revegetation. The fill derived from battering off will be used to fill the pools to design bed levels. Additional fill will be required (using clay derived from the Ponds excavation from the upstream portion).

The very bottom section of the stream (below the last stilling pond) will be revegetated with native vegetation.

5.2.4 Maintenance

A maintenance schedule is included in the documentation provided by Storm Consulting (1998). It lists tasks and their likely frequency for aquatic plantings (irrigation of plants, water level control to facilitate plant establishment, weed management, and plant thinning); litter removal; accumulated sediment removal; structural integrity; and earthworks. The periodic maintenance of the ponds is likely to result in some short-term impacts on the aesthetics and ecology of the area, but is essential for the long term viability and integrity of the system.

6 ACTION AND EVALUATION

6.1 ACTION, MONITORING AND EVALUATION

Specific actions made in this Plan of Management have been categorised under respective headings of Environmental, Recreational, Scenic/Aesthetic and Educational values and are set out in the Plan of Action in Table 5. The responsible party for implementing and monitoring the recommended actions is also nominated. Where appropriate estimates of capital costs likely to be incurred in implementing the plan are provided.

Under the Local Government Act it is necessary for Council to monitor and evaluate the success of this Plan of Management. The monitoring program is based on a set of performance measures that relate directly to the Plan of Management objectives and recommendation outlined above. A major tool in the monitoring program is the opinion of key stakeholders. Regular visitor inspection and maintenance is also critical.

TABLE 5 – MAHOGANY CREEK RESERVE - PLAN OF ACTION

Core Value	Action	Priority	Capital ($)	Performance Targets	Performance Measure	Responsibility
Environment	Rehabilitate the water course in accordance with the development plan set out in this plan of management	High	120,000	Works completed by September 2000	Degree of completion	Council
	Establish a weed invasion and rubbish dumping maintenance program to remove weed species and rubbish from the reserve.	Medium	Nil	Program established by Jan 2000	Weeds and rubbish removal underway	Council, Bushcare
	Revegetate parts of the reserve with the local native species according to the species list and concept plan	Medium	2,000	All areas revegetated by Dec 2001	Amount of revegetation	Council, Bushcare
	Protect existing native vegetation (especially threatened species *Syzigium paniculatum*) during construction works by identifying work areas and installing temporary vehicle barriers	High	200	Most native vegetation protected	Amount of vegetation protected	Council, contractors
	Remove exotic species and replace with local native vegetation in accordance with concept plan (figure 2).	Low	1,000	Most exotic species removed by Dec 2002	Number of exotic plants	Council, Bushcare
	Monitor dry and wet weather stream water quality at the Illaroo Road culvert (eastern side) before and after proposed works and future developments. Particularly test for suspended solids, nitrogen and phosphorus forms.	Medium	2,000	Water quality meets ANZECC guidelines	Test results	Council, EPA
	Encourage a stream school `bug counting' exercise perhaps as part of the Streamwatch Program.	Medium	Nil	At least one bug counting exercise per year	Number of bug counting exercises	North Nowra School
	Request Shoalhaven Water conduct leak testing of sewer lines in the catchment and address any issues found.	High	Nil	Sewer lines tested and leaks repaired	Faecal coliform levels in creek	Shoalhaven Water
Recreation	Develop formalised walkways and seating arrangements in accordance with the concept plan.	Medium	2,000	Track completed by Dec 2002	Length of track completed	Council, Bushcare
	Erect timber bollards to define the edge of the Reserve in accordance with the concept plan.	Medium	1,500	Bollards installed by Sep 2000	Installation of bollards	Council, Bushcare
Education	Develop a system of interpretive signage for the reserve in accordance with the concept plan.	Low	2,000	Signs placed at strategic points by Dec 2002	Placement of signs	Council, Bushcare
	Undertake a public education program to increase awareness of the values of the reserve and the effects that community activities can have on those values and on downstream values. Provide people with appropriate skills and knowledge to allow them to protect and restore the reserve's values.	High	20,000	Completion of education program by Sep 2000	Completion of education program	Council
	Provide the bushcare group with a copy of *Planting Plan and Planting Considerations*, section 5, Storm Consulting 1998.	High	Nil	Document distributed by Jan 2000	document distributed	Council
Scenic Aesthetic	Ensure that new structures are designed to maintain the aesthetic values of the reserve	High	Nil	Aesthetics considered in all design work	Visual character of proposed structures	Council, contractors
Management	Support the existing Bushcare Group to provide a suitable working forum which can apply for grant money for further rehabilitation works.	Medium	Nil	Successful functioning of group	Functioning of group	Bushcare
	Maintain instream structures and other facilities in serviceable condition.	Medium	Nil	Structures and facilities serviceable	Serviceability of facilities	Council
	Adjoining land owners to maintain a clear area of reserve 3 metres wide adjacent to their property boundary for fire protection purposes.	High	Nil	Continuous 3 metre wide break adjacent to private properties	Standard of fire break	Adjoining land owners

7 FUNDING

A Stormwater Trust Grant has been received to enable the implementation of the main features of this plan, including additional educational initiatives. The balance of funds required will be provided by Council either as part of the Bushcare Program or Walking Track Program. Additional grant funds will be sought if considered necessary or appropriate.

8 REFERENCES

Forbes Rigby (1994) Drainage Investigations for Proposed Section 94 Contributions Plan, North Nowra Draft Report for Shoalhaven City Council

Forbes Rigby (1996) Judith Drive Reserve Plan of Management. Prepared on Behalf of Shoalhaven City Council

Goldingay, R.L. (1994) Fauna and Flora Assessment of the Proposed School Site at North West Nowra for Public Works Department

Leonard, G. (1994) Flora Assessment of a Proposed Subdivision of Lot 52 DP 712019 at Judith Drive, North Nowra for Australian Conservation Foundation, Shoalhaven Branch

Mills, K and Associates (1992) Vegetation Survey and Assessment, Crown Land at Bomaderry Creek, North Nowra. Report to CALM

Mills, K and Associates (1994) Fauna Assessment Lot 52 DP 712019 Judith Drive, North Nowra, City of Shoalhaven for Tovedale Pty Ltd

Mitchell McCotter (1995) Ecological Assessment of Proposed School Site at North West Nowra for Public Works Department

Storm Consulting Pty Ltd (1998) Detailed Concept Design Documentation for Watercourse Rehabilitation – Judith Drive Reserve, North Nowra. Consultancy for Shoalhaven City Council