

STRATEGY 1: BIODIVERSITY CONSERVATION

Put in place measures as necessary to protect and enhance the ecological viability and biodiversity of all riparian areas within the Study Area of this Plan.

1a. Endangered Ecological Communities

Existing remnant riparian vegetation should be protected from future impacts, and as a minimum maintained to prevent further degradation until regeneration programs can be put in place. Conservation is vital, as the level of biodiversity found in nature cannot be recreated in a constructed ecosystem.

To conserve Sydney Coastal River-Flat Forest, the establishment of a continuous riparian vegetation corridor along the banks of the Hawkesbury-Nepean River should be prioritised (Benson and Howell 1993; NPWS 1997; SREP 20).

1b. Biodiversity Inventory

Incorporate all natural resource information into one comprehensive GIS/database system and make this information accessible throughout Council and the community. This would include:

- mapping of endangered ecological communities and all remnant vegetation which currently doesn't show up on the 'Native Vegetation of the Cumberland Plain' mapping (NPWS, 2000), e.g. Elderslie Banksia Scrub Forest (currently being mapped as part of the Elderslie Infill) and Freshwater Wetlands (including an assessment of condition);
- recording and mapping all sightings and locations of threatened species in Camden LGA, and
- mapping all natural assets of local, regional, state and national conservation significance, e.g. SREP 20 wetlands.

1c. Habitat Corridors and Connectivity

Revegetation should be carried out in cleared areas as part of any future stream rehabilitation works to link currently disjunct bushland corridors.

Priority for rehabilitation should be placed on those areas that form part of the bushland corridor proposed by Camden Council, and areas categorised as primary biological constraint areas (Gunninah, 1999).

Ensure that Council's planning caters for adequate riparian buffer zones to future developments. Provisions must be incorporated into the design process and DA requirements for new developments, for biodiversity (natural assets) protection. As is currently required by Council, proposed developments should not only consider the development site, but also surrounding land and assess long-term as well as short term impacts in line with provisions of SREP 20 (Policy 6, Strategy e).

Where feasible, Council should consider retro-fitting existing channelisation and low-flow pipe systems.

1d. Nepean River Weirs

Council should lobby the Sydney Catchment Authority to finalise its investigations in to the removal of wiers impacting upon the Camden LGA (see section 4.1.4) to facilitate the reintroduction of a pool and riffle system to parts of the Nepean River.

1e. Opportunities

Decommissioning of old dams should incorporate ecological transfer of valuable native flora and fauna (e.g. macro-invertebrates), as was successfully undertaken at The Cascades, Mount Annan. On-site nurseries or staging of decommissioning is required to transplant native vegetation from existing farm dams for inclusion in newly constructed water bodies.

STRATEGY 2: VEGETATION MANAGEMENT

Protect and enhance the ecological viability and biodiversity of existing riparian bushland remnants.

2a. Weed Management Program

A Weed Management Program should be undertaken for all riparian lands within the Study Area of this Plan, for both aquatic and terrestrial weeds, to:

- identify and broadly map key weed species (i.e. noxious and environmental),
- nominate priorities and timeframe for eradication / suppression;
- develop an on-going monitoring program sufficient to ensure new infestations can be controlled before they reach problematic levels, and
- provide incentives and assistance to private landholders to eradicate / suppress significant infestations of noxious and environmental weeds, as on private land this can not be enforced under current legislation.

In addition to 'noxious weeds', the list of 'environmental weeds' can be a very long one. There will need to be a determination made at the beginning of the WMP process as to which 'environmental weeds' are essential to target with regard to the management of riparian areas, e.g. *Juncus acutus*.

In constructed wetlands and watercourses, manual removal of weeds following early detection will not only minimise expenditure but will reduce the impacts of using chemicals on ecosystems. Riparian maintenance personnel must be well educated in the identification of all aquatic, semi-aquatic and woody weeds that are either already present or likely to impact on these areas. In remnant areas, where weeds have established and in some cases dominated the vegetation for a long time, clearing will first need to be carried out with regular weeding to follow, in order to remove new weed growth before it establishes again.

As control of noxious and environmental weeds is expensive and they are difficult to eradicate, the source of noxious weeds (e.g. *Salvinia* and Alligator weed) must be determined (if not already) and controlled at source in accordance with (and applying to private land-occupiers) the *Noxious Weeds Act, 1993*.

2b. Communication

Facilitate communication between private land-occupiers and Council to manage noxious and specific environmental weeds on an LGA / catchment wide basis.

2c. Stream Restoration Vegetation Management Program

Undertake condition survey to supplement existing information on the health of riparian corridors (e.g. Adams 2000) for all land parcels covered by this Plan. This information will facilitate the preparation of a Stream Restoration Vegetation Management Program (SRVMP) for all remnants (including those without riparian vegetation but still with intact stream morphology [s.4.6.2.1]), with the aim of improving biodiversity, erosion control, habitat, corridor, water quality and aesthetic values, and prioritise for actions and areas to be treated. Document to be based upon Lovett and Price (1999) and Rutherford *et al.* (2000) (refer Appendix 5 for summary).

The SRVMP should commence in those areas nominated as the highest two priority areas within the Nepean River Riparian Health Assessment (Adams 2000 - refer Appendix 5 for summary), i.e.:

- Priority No.1: Bergins Weir to Thurns Weir (due to the range of significant species found), and
- Priority No.2: Thurns Weir to Camden Weir (due primarily to its proximity to the Camden Town Centre).

2d. Algae Management

Where practical, promote the establishment of native macrophytes in wetlands to assist in ecosystem balancing.

Where algal blooms occur undertake the following:

- follow strategies and procedures set out in the DLWC/MSCRACC *Algal Contingency Plan* (Nancarrow & Wood, 2000), namely:
 - use the decision tree for "Response to Algal Blooms in Freshwater Areas", and
 - fulfill Council's responsibilities as an agency under the plan (s.3.6);
- have samples analysed for identification;
- if blue-green algae is present, erect signage immediately and seek specialist advice;
- where excessive filamentous (non-toxic) algae becomes a persistent problem, investigate the following:
 - nutrient content of waters, and potential use of 'Phosloc'(*) to remove phosphorus
 - water temperatures throughout the water column over a moderate period of time to determine whether stratification is a contributing factor
 - feasibility and costs of installing aerators to alleviate any prevailing stratification problems.

(*) 'Phosloc' is a patented modified clay developed by the CSIRO in Western Australia. Trials in 2001 resulted in 95% of phosphorus being adsorbed within 24 hours, and scientists are expanding trials to the eastern states and overseas. However, it should be noted that Council would need to fund for repetitive treatment for treating phosphorus in a particular system, which would be very expensive and therefore, would only be a feasible management solution for urgent short term solutions.

STRATEGY 3: FAUNA MANAGEMENT

Put in place measures to manage pest fauna sufficient to ensure the ecological viability and biodiversity of all riparian areas covered by this Plan.

3a. Mosquito Fish

Other than through the provision of diverse habitat opportunities that support predators such as Long-finned eels, Australian bass, Freshwater herring, and some large Gudgeon species, there is currently no effective, simple and regular management technique for suppressing mosquito fish numbers. Wetland systems should be designed and managed such that they facilitate the suppression of mosquito fish in this way. Site specific measures will be directed by Specific Area Plans of Management.

In closed systems (i.e. where system is off-line and with full drainage capabilities), a combination of drainage and application of "Rotenone", in consultation with the Dept of Fisheries may eradicate a population of mosquito fish. However, the current best practice method of protecting against re-infestation is through the use of a filtering unit (comprises a series of very fine rotating screens) which are very expensive (approx. \$40,000 a unit to install at the time of writing this Plan). This method is currently employed by the Sydney Olympic Park Authority to protect core habitat within the Brickpit for the endangered Green and Golden Bell Frog.

3b. Carp

Council should monitor the draining of Lake Harrington as described in s.4.3.2.2 and consider its response thereafter. If after investigation, it is determined that the fish is a problem, a carp management program needs to be put in place, particularly for wetlands. The program should aim generally to contain numbers, e.g. to a level such that it does not have a significant impact upon water clarity. Where feasible as part of the program, the species should be completely eradicated from water bodies. Experience from a number of Western Sydney local government areas suggests electro-fishing to be a feasible control method without the need to drain the water body, or netting following drainage (pers. comm., Geoff Hunter, Penrith City Council).

This program of control should be upgraded in accordance with the requirements of Specific Area Plans of Management, when implementing programs of ecological enhancement, e.g. stocking with native fish and / or the introduction of attached aquatic water plants. In these cases, more regular control to consistently maintain very low numbers may be necessary, or it may be possible to achieve complete eradication.

3c. Mosquitoes

In light of the increasing trend to incorporate wetlands into urban settings, the issue of mosquito hazard risk needs to be understood at a regional level. Within the Sydney Basin, the different regions provide suitable habitat for different mosquito species. Further, it is now well understood within the medical field which species comprise health and/or serious nuisance risks, and what their habitat requirements are. Council should be aware, and able to provide information to developers, on:

- those mosquito species that have both the potential to be found within the LGA, and present a serious hazard risk, and

- what design and management measures should be put in place to minimise public risk.

This type of assessment can be undertaken by the Department Medical Entomology, Westmead Hospital (Attention: Dr. Richard Russell, Director, pH: 9845 7279).

Any design and management measures recommended in a mosquito Hazard Risk Assessment should be incorporated into developer guidelines for the design and management of constructed wetlands and watercourses, and management of remnant wetlands.

Ensure all drainage swales (particularly those planted with water couch) completely drain following rainfall to avoid ponding of water. Infilling or regrading may be necessary where this is not being achieved.

Avoid using aquatic vegetation that forms floating mats on water such as *Paspalum distichum* (water couch).

Ensure water level control is implemented in all future constructed wetland developments (refer Strategy 11a: Design Guidelines for Wetlands and Watercourses). Ensure water level control so that at a bare minimum, water levels in open water zones can be drained lower than emergent vegetation, however, preferably full drainage of water should be achievable from these systems.

Where existing wetlands have no water level control, promote diverse habitats for predators and/or seed predators into system (e.g. larvivorous fish), and / or retrofit with water level control device (Note. These actions should be included as part of Specific Area Plans of Management).

3d. Nuisance Native Water Birds

Council will need to liaise with the NSW National Parks and Wildlife Service (NPWS) with regard to limiting Purple swamp hen (*Porphyrio porphyrio*) numbers. An agreed policy and process for management of this species will need to be established, that can then be applied on a site specific basis, as determined necessary by Specific Area Plans of Management. If adverse impacts on macrophyte establishment and growth is observed, trapping and relocation may need to be undertaken in consultation with NSW National Parks and Wildlife Service.

3e. Domestic Ducks

Discourage the release of domestic water fowl and feeding of ducks. Impounding of domestic ducks may need to be considered, followed by destruction if not claimed.

3f. Other Feral Animals

Feral cats and foxes in particular can cause serious impacts upon local biodiversity, and these should be eradicated on a continuous basis as they are identified. Assess presence and abundance of feral foxes, cats and rabbits and assess impacts.

Where rabbits and feral cats reach problematic numbers, suppression measures should be put in place. Contact with the Rural Lands Protection Board will provide specialist advice in this area.

3g. Companion Animals

Council needs to have in place measures that minimise predation upon native fauna by cats.

Educate residents on responsible pet ownership and the potential impacts of companion animals on the ecological functions of riparian systems.

STRATEGY 4: WATER QUALITY**4a. Water Clarity**

A range of measures need to be instituted to trap sediment before it reaches water bodies, including:

- strict enforcement of erosion and sediment controls for new development
- improvements with regard to sediment control infrastructure and maintenance (refer below - Stormwater Treatment Infrastructure)
- recognition of the highly dispersive nature of the clay soils within the LGA and within this context, the inclusion of water clarity as a primary objective in a design guideline document for constructed wetlands and watercourses (refer Strategy 11)
- incorporation of sufficient buffer planting widths to wetlands and watercourses to effectively filter overland flow
- spreading of overland flow over grassed banks to encourage dropping out of sediments

Additionally, trials of attached / submerged aquatic plants need to be undertaken to assess their suitability for use within the LGA.

4b. Litter

The strategy for litter management needs to incorporate a number of aspects, as follows:

- education;
- provision and management of litter trapping devices, and
- provision of a boat (or commissioning of a contractor with a boat) to enable access to water borne litter.

Catchment Generated Litter

The vast majority of this material tends to lie beyond the reach of Council's current maintenance procedures. The problem is twofold as follows:

- litter needs to be controlled prior to reaching the water bodies by a combination of source controls and the comprehensive installation and maintenance of litter traps within the stormwater system, and
- new maintenance techniques are required to facilitate the collection of floating litter along the fringing vegetation / open water edge such as:
 - maintenance staff wading in waterproof attire (e.g. wetsuits) in conjunction with puncture proof footwear (OH&S issues would obviously need to be carefully considered before adopting this type of measure), or
 - collection of litter from the water using a purpose specific boat. Use of a boat would have the added advantage of facilitating:
 - removal of litter from the edge of habitat islands, as well as from within the water body itself,
 - access to floating vegetative material for removal or testing,

- regular maintenance / monitoring of the islands themselves,
- an educative role for the local community where Council is seen to be actively concerned with the detailed management of these areas, and thereby emphasising their high value.

To meet a range of possible uses, a boat should be suitable for:

- litter collection, particularly along shallow edges and amongst fringing vegetation;
- removal of floating vegetative material or surface scum;
- transport of staff and tools to habitat islands for maintenance, and
- ease of regular transport and launching without a formal boat ramp.

4c. Stormwater Treatment Infrastructure

The strategy for stormwater treatment infrastructure needs to incorporate the following:

- with regard to existing infrastructure:
 - upgrading or replacement of existing inefficient GPTs and litter traps (e.g. within the context of the proposed Garden Gates Estate upstream of Lake Annan),
 - supplementing the extent of GPT and litter trapping infrastructure in existing catchments sufficient to ensure that no stormwater inlet points to the riparian areas are untreated. This will require the installation of litter trapping devices, either at all stormwater outlet points, or where this is not possible (e.g. Lake Annan, where the outlet pipe is 70% submerged), then further up within the catchment e.g. using a stormwater inlet pit litter trap system;
- implementation of comprehensive GPT and litter trapping infrastructure for all new developments
- improvements with regard to sediment control and maintenance, including:
 - regular maintenance of sediment traps (refer Strategy 9d)
 - requiring new GPTs to be effective at sediment removal
 - promotion of the use of sediment control methods that reduce colloidal material reaching downstream water bodies, e.g. the use of sand filters in detention basins upstream of water bodies or sub-surface water wetlands (refer Strategy 11)
 - emphasis on the objective of water clarity in design guidelines for wetlands and watercourses (refer Strategy 11)
 - design features into wetlands such as macrophyte plugs and sediment forebays at wetland inflow points (refer Strategy 11)
- investigation of appropriateness of continuing to use 'wet well' type systems in light of recent literature
- a formalised maintenance program needs to be developed for all GPTs and litter traps (refer Strategy 9)

4d. Erosion

The strategy for erosion needs to incorporate the following:

- undertake rehabilitation works in the riparian zone along reaches of the Nepean River as prioritised by the Nepean River Riparian Health Assessment (Adams, 2000) (refer Strategy 2c - SRVMP);
- implement a re-vegetation program for all remnant riparian open space areas where vegetation has been cleared e.g. Matahil Creek where it flows through Bicentennial Park (refer Strategy 2c - SRVMP);
- where banks are failing due to bank scour, 'soft engineering' approaches should be encouraged instead of more traditional engineering approaches (HNCMT, 2000). Temporary, biodegradable

structures can provide initial protection to the bottom of the bank until vegetation becomes established (refer Strategy 2c - SRVMP), and

Council needs to maintain vigilance with regard to its Erosion and Sediment Control Policy and development within the LGA, by the issuing of appropriately harsh fines for breaching set conditions.

4e. Salinity

The strategy for salinity needs to incorporate the following:

- Council to formally adopt the WSROC Salinity Code of Practice when it is finalised;
- establish buffer zones to protect riparian land throughout the LGA on public land and encourage the same on private land;
- rehabilitate and revegetate riparian land;
- promote extensive native tree planting throughout the catchment, and
- implement WSUD principles in future developments.

STRATEGY 5: RECREATION

5a. Appropriate Types of Recreational Usage

The following strategies are recommended:

- encourage passive recreational use of riparian reserves, subject to recreational use being subsidiary to the primary objective of management of the land to protect and enhance its natural features and values. It needs to be made clear which recreational activities are acceptable and which are not e.g. by means of signage;
- provide facilities for passive recreational use, and
- cycling is encouraged on formed and constructed roads, tracks and designated cycleways. Cycling is not to be permitted on informal tracks where it may cause damage to natural vegetation, or may contribute to soil erosion or track damage.

5b. Public Access

The following strategies are recommended:

- user access points should be limited and restricted to locations where the environmental impacts can be minimised and managed;
- public access to selected riparian areas should be enhanced, and integration with the surrounding environment improved in order to develop a sense of community ownership and encourage greater community involvement in their management;
- a masterplan for regional/district walking/cycling trails should be put in place to inform future planning decisions and development consent conditions, and
- interpretative signage should be incorporated with new access provisions detailing issues such as:
 - associated proposed programs for bush regeneration in the area;
 - the type and significance of the communities being travelled through or observed, e.g. the benefits of retaining bank vegetation and identification/information about endangered ecological communities,
 - historical relics if present, or interesting facts about the past history area.

An open space network along the Nepean River from Thurns Weir and the Macarthur Homestead could extend through to Cobbitty, inline with recommendations made in the *Camden Structure Plan* (Don Fox Planning, 2001 (pg 107)), and link up Macquarie Grove Reserve. This section of the river from Thurns Weir to Cobbitty would incorporate existing facilities from Elizabeth Macarthur Reserve, north to Cowpasture Reserve, Cowpasture Bridge and Macquarie Grove Bridge, and could also link with the historic precinct of Camden Town Centre.

Other opportunities for access to the Nepean River include (as described in Section 4.14.1):

- Cobbitty Walk – Nepean River;
- Ellis Reserve – Nepean River;
- Reserve near Sharpes Weir, and
- Macquarie Grove Reserve – Nepean River.

STRATEGY 6: LANDSCAPE CHARACTER

6a. The Nepean River

The following strategies are recommended:

- scenic landscapes are to be protected and enhanced, particularly with regard to new development that can be seen from within the corridor, and detracts from the 'naturalness' of the view;
- increase opportunities for public access to the Nepean River (refer Strategy 5b) and integrate it visually into the wider landscape at selected key points to increase the visibility of the river corridor, and
- ensure opportunities to screen urban development from distant locations using riparian vegetation are maximised.

6b. Catchment Drainage Lines

The following strategies are recommended:

- increase opportunities for formalised public access to selected riparian open space areas (refer Strategy 5b);
- rehabilitate and revegetate riparian areas (refer Strategy 2c), and
- develop new riparian open space areas in association with road bridges, weirs, other riparian open space areas and link up with the cycleway. This will improve natural corridor values of riparian areas and recreational opportunities (refer Strategy 5b).

6c. Stream Morphology

Where existing remnant stream morphology is still substantially intact, even where no riparian vegetation remains, conserve and restore this (refer Strategy 2c).

6d. Landscape Character

The following strategies are recommended:

- locally occurring native vegetation communities (or modified forms thereof for constructed facilities) are to be re-established in any restoration works to preserve the natural character of the riparian corridors (refer Strategy 2c);
- any new watercourse and wetland rehabilitation has to be consistent with a prescribed character that references the pre-european natural communities that would have occurred at that place, unless Council puts in place an alternative specific Desired Future Character in response to other factors, e.g. cultural heritage (refer Strategy 11), and
- identify and conserve all remaining riparian remnants that still exhibit strong natural visual qualities (even if heavily modified from pre-european communities) such as the previously mentioned wetland remnant in Smeaton Grange [s.4.8.4] (Note: Remnants associated with the Nepean River will have been identified in previous reports).

STRATEGY 7: CULTURAL HERITAGE

The following strategies are recommended:

- Aboriginal and European cultural and historic sites are to be protected and maintained, and
- Cultural and historic sites should be managed as focus points within the riparian corridor system, including the use of interpretative material.

STRATEGY 8: PUBLIC SAFETY & HEALTH

Ensure “Due Care and Diligence” is in place with regard to the management of all existing wetlands and watercourses, and design and management of all future constructed wetlands and watercourses.

8a. Safety to Operators.

The *Occupational Health and Safety Act 1983* (OH&S) applies to employers and employees. There is a requirement that all reasonably practicable steps be taken to protect employees’ health and safety at work.

The employer, managers and directors are responsible for the safety of staff working in wetlands and watercourses. Those responsible must ensure that with regard to riparian areas (wetlands and watercourses):

- an occupational health and safety policy is in place;
- the policy is documented;
- the policy is communicated to staff who are doing the work;
- the staff are using the policy, and
- the policy provides for review, monitoring and improvement.

Council currently has a generic policy in place, but it should be augmented to deal with specific issues relevant to wetlands and watercourses as described below.

The policy must contain clauses related to specific problems and specific tasks, such as:

- preventing as far as practicable, workers catching diseases such as hepatitis;
- managing toxic substances;
- safety procedures;
- the maintenance of gradual slopes in the vicinity of the foreshore. The littoral areas should remain as a shallow, vegetated bench;
- the provision of lockable accesses to all pits and underground structures, and safety fencing on the embankments and pathways adjacent to vertical edges, and
- signage should be erected in accordance with AS 2899.0-1986, AS 2899.1-1986, AS 2899.2-1986 (Australian standards). This should be multi-directional and descriptive as well as diagrammatic.

Maintenance Equipment

The availability of Roundup Biactive and a knapsack sprayer is also important. Ideally a small spray unit is desirable. Staff must be trained in herbicide application.

Protective Clothing

Work within the wetland will require the use of waterproof boots. Thigh boots and gumboots present problems in hot weather, and thigh boots can be dangerous in deep water. Nevertheless safety procedures recommend that skin exposure to water in urban wetlands should be kept to a minimum.

Clothing should include wet weather gear, gloves, hats, hazardous chemicals protective clothing, change of overalls. Washing and showering facilities should also be available to personnel involved in the handling of hazardous chemicals. Insect repellent and sunscreen should also be made available to all maintenance staff.

STRATEGY 9: MAINTENANCE

9a. Maintenance Mapping

All existing wetlands and watercourses and associated stormwater infrastructure such as GPTs need to be clearly mapped and detailed in a formal Council document that indicates all relative useful information such as catchment boundaries, drainage inflows and outflows, access routes and design intent (water quality treatment, aesthetics, flood mitigation etc).

This documentation should then be distributed to all Council divisions/personell involved in managing and maintaining these areas. This includes Council representatives that coordinate or are responsible for liaising with the community.

9b. Maintenance Responsibility

Definitive divisional responsibilities need to be detailed within Council. Each division allocated responsibility for any operational or maintenance activities within riparian open space areas, and in particular constructed areas, should be briefed so that design intents, operational features and maintenance requirements are clear. Communication between divisions must be facilitated where more than one division is involved.

9c. Funding & Maintenance Costs

Ongoing operational/maintenance costs associated with constructed riparian areas must be considered for all capital works in future developments. Adequate funding for each division's responsibilities must be allowed for following handover from the developer. Council should estimate its annual costs for maintaining these developments.

Maintenance of open space is reported to consume on average 75% of the parks budget in Sydney councils. It is generally perceived that maintenance costs associated with dual or multiple use drainage open space is higher than other types of open space. It is not possible to provide other than a general indication of annual maintenance costs on a per hectare basis due to the wide variety of local conditions and costs for various consumables throughout the State (Department of Urban Affairs and Planning 1995).

Given this situation, it is important that council departments record the costs associated with maintaining various types of open space annually to determine budgets for maintenance (Department of Urban Affairs and Planning 1995). Assessment of maintenance costs for riparian areas should include all expenditure incurred by the relevant departments responsible for monitoring, cleaning, weed control, infrastructure maintenance, and other components such as community programs.

9d. Maintenance Programs

Maintenance schedules for all GPTs should be developed and based on individual GPT capacity, catchment size and relative catchment activities (e.g. rural, residential, industrial) and catchment loads.

Council should revise its current inspection regime for GPTs sufficient to ensure that they are cleared at appropriate intervals (e.g. on a monthly basis and following significant rainfall events) by Council personnel. As a general rule GPTs should be cleaned when >50% full and trash racks when >20% full.

Council should investigate what efficiencies may be gained by limiting the numbers and type of GPT and litter trapping devices used in future developments, as a means of minimising maintenance costs.

9e. Staff Skills

Council should ensure it has adequate resources and skills to undertake wetland inspections/monitoring, associated maintenance works and facilitate community education and involvement in the management of riparian areas. These resources and skills could also incorporate native vegetation management responsibilities.

Council should undertake training for all current maintenance and management staff to better inform them of management issues associated with riparian areas and ways to treat problems when they arise. Staff should also be informed of the objectives for the management of these areas in terms of ecosystem protection and enhancement, and educated about maintenance techniques that should be carried out to protect these natural values (e.g. conserve and enhance habitat by not mowing native grass areas and grass cover in native woodland; use of herbicides near waterbodies).

STRATEGY 10: MONITORING AND EVALUATION

Water quality sampling should be undertaken, particularly before and after data where new developments are to be constructed. ANZECC guidelines cannot be adhered to without sufficient baseline data, i.e. new guidelines require that sufficient data be collected so that landowner can define what is “normal” background sediment and nutrient loads, so that pre-development goals can be identified and where possible achieved.

Alternatively, the use of biological parameters in water quality monitoring, is another approach that could be adopted. Macroinvertebrates are aquatic animals including insect larvae, snails and worms, which live amongst aquatic vegetation, wood debris and bed material. They can provide an indication of water quality as well as a measure of the diversity and sensitivity of the aquatic ecosystem. Two biotic indices are available for macroinvertebrates within Australia. The first, the SIGNAL index has been especially developed for freshwaters of South Eastern Australia. The second, AUSRIVAS (<http://ausrivas.canberra.edu.au>) is an Australia wide index using reference sites for specific regions. As animal diversity and abundance are relatively slow to change when compared to chemical parameters, biological data has the advantage of reflecting the long-term average condition of a system rather than at a single point in time. The monitoring usually needs to be undertaken on a twice yearly frequency as opposed to chemical sampling which can be monthly or weekly.

STRATEGY 11: URBAN DEVELOPMENT PROCESS

11a. Development Controls

In the design and construction of new wetlands and watercourses, emphasis should be placed on protecting existing aquatic habitat and riparian vegetation and encourage rehabilitation of riparian lands in a way that the natural values are protected.

All new development must incorporate WSUD principles, and aim to achieve pre-development water quality and quantities through appropriate technology.

Prepare a set of readily understood design and management guidelines that detail Council's preferred approach to constructed wetlands and watercourses. The aim of the guidelines will be to provide for a consistent approach by developers to the future design, construction and maintenance of constructed wetlands and watercourses. Guidelines are to include:

- goals and objectives for constructed wetlands and watercourses;
- incorporation of existing riparian remnants into new developments and protection of their values;
- consistency of landscape character;
- plant species composition and community structure relevant to location within catchment;
- preferred wetland and watercourse configurations, including issues such as:
 - water level control (ability to fully drain),
 - maintenance access,
 - off-line systems,
 - GPT and litter control methods,
 - Aquatic and riparian habitat creation;
- typical management approach required to meet goals and objectives of the DCP;
- range of recreation types appropriate to riparian areas;
- provision for regional linkages;
- designing to minimise maintenance;
- aquatic and terrestrial habitat creation, and
- ecological transfer to new riparian treatments where decommissioning old farm dams.

The guidelines would address the overall planning and design of new neighbourhoods and urban precincts and other development throughout the Camden LGA.

Prescriptive measures such as source controls, conveyance controls and discharge controls will be guided by the Water Sensitive Urban Design Position Paper (Camden Council, 2001), and incorporated into Council's proposed comprehensive LEP.

11b. Hand Over Process

All Council departments with maintenance / management responsibilities for constructed wetlands and watercourses:

- are to be involved in the assessment of these proposals, and
- are to be issued with design documentation (including Council representatives that coordinate or are responsible for undertaking liaison with the community).

Peer review of all proposed wetlands and watercourse constructions should be sought from experts in the field (e.g. CRCCH, LWRRDC, CRCFE).

Developers should be held accountable for supplying 'correct' information in all retail aspects of new release areas. Retail information by developers should be monitored by Council staff to allow for the countering of incorrect information at the earliest opportunity.

Factor in operational periods to assess and identify management issues in order to make developers accountable (post-development) where flaws in design adversely effect maintenance. etc. and retrofitting is required.

Council must determine which division(s) / branch(s) have infrastructure/equipment and relevant personnel to undertake maintenance and ensure that inter-departmental communication is facilitated where more than one department is involved.

Review Council structure with regard to the maintenance / management of riparian areas in light of need to manage on a biologically driven basis.

STRATEGY 12: COMMUNITY ISSUES

The community needs to be better informed both about the vision with regard to watercourses and wetlands within the LGA and the 'mechanics' of what that entails, e.g. maintenance requirements, bush management issues, implementation of WSUD principles, etc. An expansion of the current Cross Street Sub-catchment newsletter process to cover the remainder of the LGA is recommended. The use of mapping within the newsletter to both locate the sub-catchment boundary for the target audience and describe the larger vision on an LGA (and wider) basis is important. Additionally, a description of the maintenance issues and subsequent necessary operations associated with these areas would be instructive.

Council should facilitate opportunities for community involvement at the local, sub-catchment and catchment level with regard to the issue of riparian corridors, to facilitate community involvement, including participation in LandCare type projects and community based grant funding applications.

The development of selected parcels of land to provide views to currently difficult to access reaches of the River, would provide an opportunity to increase community awareness of the extent and beauty of the still substantially vegetated banks of the River.

STRATEGY 13: CATCHMENT ISSUES

Council needs to continue to look holistically at total catchment with respect to areas of development, drainage, pollutant loads and suitable treatments and sizing of treatments to prevent construction of water bodies or installation of GPTs that are inefficient.

The provision of WSUD within all new developments is critical (e.g. water reuse, separation of clean rainwater from polluted stormwater where practicable, achievement of pre-development water quantities and quality, e.g. aim to treat both water quality and quantity up to the 2 year Average Recurrence Interval storm, etc).

Develop and implement a catchment wide riparian protection policy for public and private lands. Put in place legislative controls and incentives to facilitate effective management and protection of riparian land by private landowners. Incorporate controls into Council LEP/DCP (as per Action 13.3).

Develop and implement a catchment wide Stream Restoration and Vegetation Management Program (SRVMP) as per Action 2.3.

Retain and where possible expand the amount of riparian lands under public ownership in order to protect biodiversity and enhance scenic and recreational values of such land, as advocated in the Shaping Western Sydney Planning Strategy (DUAP, 1998) and the HNCMT Advocacy Position on Riverbank Management (HNCMT 2000). Where this is not practicable, aim to set in place other protection mechanisms such as environmental protection zones, voluntary conservation agreements, etc.

Alternatively, where it is impractical to acquire riparian land, Council should designate relevant areas of privately owned land as 'environment protection zones' (Healthy Rivers Commission, 1998). The environmental sensitivities of riparian land is well documented in the scientific literature, and confirmed by provisions made under the RFI Act and SREP 20. This knowledge may help Council to substantiate decisions to apply environmental protection zoning to riparian lands