5.5 RIVERINE AND RIPARIAN VEGETATION

Objective VR: Protect, maintain & restore aquatic and riparian riverine vegetation

The riverine systems flowing to the estuary have been altered to varying degrees from their natural state, often as a by-product of flow extraction measures and farming practices.

Farmers often cleared native vegetation to the waters edge to provide maximum pastoral land and to improve access to the rivers. This loss of riparian vegetation has removed an important buffer, greatly increasing the impact that catchment activities have on riverine systems. The loss of riparian vegetation has led to erosion. There are a number of locations on streams in the catchment where this has occurred, potentially contributing significant volumes of sediment to the rivers and eventually, the estuary.

The rivers of the catchment provide the water source for the community of Wyong Shire (and through the Joint Water Supply, also to Gosford City). Sections 4.2 and 4.6 provide more detail on water supply and their operations. This works programme has produced a number of changes to the flow in the rivers. Water released from dams is potentially much colder than the receiving waters, and can also increase the flow downstream above natural flows. These disturbances have created pressures on instream and riparian vegetation. The aquatic vegetation provides an important habitat and is also a critical part of the processes that occur within a river system (especially bio-chemical processes). Changes to the coverage or health of this vegetation can have a flow-on effect to dependent organisms such as fish, platypus and birds. DPI (Forests) has recommended maintaining the connectivity of the riparian corridor by rehabilitating areas downstream of the forest boundary (Fawcett, 2005). DPI (Forests) already provides protected riparian buffers beside streams in its areas of operation.

The river systems are important for the processes that occur within an estuary and therefore loss of ecological function in the rivers can impact on the estuary. Estuarine impacts may be minimised by sustainably managing aquatic and riparian vegetation.

5.5.1 Issues & Threats

VR1. Changes to flow volumes and patterns

Flow volumes determine river size and therefore the total amount of instream habitat. The extent of habitat on the river bottom depends on stream width and therefore changes slowly. The amount of habitat along the banks is largely dependent on stream length and will therefore change only when the length of the stream changes (such as straightening or becoming more sinuous). Changes in the amount of habitat caused by changes in flow volume alter biological carrying capacity of the river system; that is the total biomass it will support. Changes in character and diversity of instream habitats often lead to

changes in species composition, as the new conditions favour a different range of species. Where habitat diversity is reduced, species diversity is usually also reduced.

Drought periods are times of high mortality for many instream plants and animals. But many native species have evolved mechanisms to survive drought periods. This gives them a competitive advantage over species introduced from less extreme environments. Where flows are regulated to provide continual base flows, this competitive advantage of the native species will be lost.

Many native species take their spawning and migration cues from changes to the rates of flow. Riparian vegetation may be undercut where rapid flow causes bank slumping. Some plants can extend to accommodate increase in water depth; however, if depth increases too fast then plants cannot respond quickly enough (MDBC, 2001).

VR2. Changes in water quality can affect aquatic and semi-aquatic vegetation

Phosphorus is usually the limiting nutrient in freshwaters. A review of data supplied by Wyong Council suggested that there may be potential problems with elevated levels of nitrogen (as NOx) in Ourimbah Creek and phosphorus (TP and OP) in the lower reaches of Jilliby Creek and Wyong River (TEL, 1999). Runoff from agriculture and urban stormwater in the rivers of the catchment can introduce excess nutrients. In addition to this, studies have found that there is a significant nutrient load sourced from forested areas after harvesting. There are examples in river systems throughout Australia, where in reduced flow and high nutrient load conditions, toxic algal blooms (e.g. blue-green) have occurred (Roberts et al., 1999).

Aquatic macrophytes, both submerged and emergent, rely on the quality of the water within the creek system. When there are changes in the water quality, then these species can be affected. As an example, increased turbidity will result in lower light in the water column leading to reduced biomass of submerged aquatic species. This has occurred in a number of river systems throughout NSW and the Wyong catchment is particularly at risk due to the high turbidity already present.

Thermal pollution is a particular risk for the Wyong river systems. Dam releases are potentially much colder than the flow they are being released into, and can also greatly increase the flow in rivers above what the surrounding climatic conditions are producing (potentially increasing turbidity).

VR3. Streambank erosion

Stormwater flowing from developed areas is often at a greater velocity than for the pre-existing drainage. As a result, the receiving streambanks are at a high risk of being undercut and contributing sediment loads to the waterway. Tumbi Creek is an example of the effect of developed stormwater damaging banks of an existing waterway and in turn greatly increasing the sediment load being conveyed to the estuary. The erosion of stream banks in Ourimbah Creek, Wyong River and Wallarah Creek could contribute a much greater load to the estuary due to their greater catchment sizes. A number of significant terrestrial habitats are at risk from streambank erosion, e.g., increasing stormwater volumes are having a significant effect on Porters Creek Wetland. Erosion of streambanks in the drainage lines of the catchment has the potential to further degrade the wetland by contributing significant sediment loads.

Forested areas may also contribute to streambank erosion. Immediately following harvesting, these areas contribute significantly higher water volumes than before. This has implications for the receiving waterways from forested catchments.

Retaining walls have been constructed along sections of the rivers. These walls encourage erosion at the upstream and downstream edges of the walls, increasing the potential for streambank collapse. Boat wash exacerbates this issue particularly when posted “no wash” signage is ignored.

VR4. Privately owned riparian zones are difficult to manage

There were once significant riparian zones along the rivers of Wyong Shire. These areas have been degraded or removed by various practices including land clearing, urbanisation, grazing etc. While Wyong Shire Council facilitates streambank rehabilitation programmes for degraded streambanks and riparian zones, many of these areas are located on private property. Council cannot force land holders to rehabilitate these areas and instead relies on the co-operation of the landholder. Where the landholder is unco-operative, rehabilitation is difficult because Council does not have care and control over the land.

VR5. Inadequate understanding of riverine ecological processes and riverine water quality to allow for environmental flow management

Without assessments of aquatic and riparian vegetation, it is difficult to determine appropriate management strategies. This has been discussed in detail in Section 3.2.1 under issue WF5.

5.5.2 Options

Issue	Option	Outcomes		Cost	Ability to address Issue?	Responsibility
		Benefits	Difficulties			
VR1. Changes to flow volumes and patterns	VR1a. Adopt Water Sharing Plans	• Responsibility of State Government not Wyong Shire Council • Criteria are prescriptive	• The targets are not based on local ecological data – perhaps not most appropriate for streams	Low	High	DIPNR
	VR1b. Implement Joint Water Supply Expert Panel Recommendations	• Local targets based on coarse ecological assessment	• Lack of detailed information & design flows for lower streams	Low	High	WSC, GWCWA, DIPNR
	VR1c. Remove existing barriers	• Restore ecological passage between the rivers and estuary • Allow for water quality changes through increased mixing	• Removing weirs creates threats to the water supply • Alteration to current flow patterns • Management of potential nutrient and sediment stores behind weirs	High	High	WSC, GWCWA, DIPNR
	VR1d. Modify existing barriers to improve flow mixing and allow for migration of key species	• Retain Water Supply access for pumping • Allow for water quality changes through increased mixing • Some ecological migration	• Does not allow for full migration • Could have impact on effectiveness of pumping for water supply	Medium	Medium	WSC, GWCWA, DIPNR
	VR1e. Ban mining under rivers	• River flow protected from draining • Protection of water quality and habitat	• Loss of potential employment in the shire • Loss of potential economic stimulus	Low	High	DIPNR

Issue	Option	Outcomes		Cost	Ability to address Issue?	Responsibility
		Benefits	Difficulties			
	VR1f. Manage damage to Riverine and Riparian Vegetation if and when it occurs	• Allows for the benefits of various types of development • Accepts the possibility of risk • Create management plans for high risk areas	• Difficult to correct damage once it occurs • Too late for treating • Resource intensive remediation required to fix	High	Low	WSC, DIPNR, Landholders
	VR1g. Increase accuracy and frequency of flow monitoring	• Increased data coverage of catchment streams • Improve ability to monitor water extractions under Water Sharing Plans	• Determining who would fund and undertake the increased monitoring • Will not improve actual environmental flow – needs to be combined with another option	Low	Medium	WSC, DIPNR
	VR1h. Conduct extensive ecological survey	• Strong ability to measure ecological change over time (especially response to environmental flows and changes in water quality) • Potential to redefine environmental flow requirements based on local ecology (may require less environmental flow than advocated by Water Sharing Plan)	• Baseline conditions have long since passed – would be assessing current conditions and in doing do, the study would be limited by spatial and temporal variability	Med-High	High	WSC, DIPNR, GWCWA
	VR1i. Use indicators to assess ecological conditions	• Provide a cheaper method of measuring change in the system • May be able to indicate current ecological health	• Does not provide a full picture, rather indicates likely positions • Relatively new methodology – full capability may not be realised	Low-Med	Medium – High	WSC, DIPNR, GWCWA

Issue	Option	Outcomes		Cost	Ability to address Issue?	Responsibility
		Benefits	Difficulties			
VR2. Changes in water quality can affect aquatic and semi-aquatic vegetation	VR2a. Implement sediment and nutrient controls for existing landuses • Education • Regulation • Retrofits	• Allows problem areas to be targeted based on evidence of degradation • Attempts to redress previous poor practice and bring in line with current best practice • Community involvement will produce local land "managers" and create a line of communication	• Very difficult to construct suitable structures in available land • Requires improved controls by Council operations to avoid the perception of "double standards"	Med-High *(depending on which type of control is selected)*	Medium-High	WSC, Landholders
	VR2b. Implement sediment and nutrient controls for new developments • Developers install controls & contrib. • Rate incentives • Education • Bonded development	• Minimises potential for degradation before it occurs • Structural controls are more likely to succeed as land can be set aside • Developers can be held to account on performance of treatment devices	• Sediment and nutrient controls are not 100% effective • There is often a lag between development and when the full catchment load comes "online" – developers responsibility is often discharged by this time	High	Medium-High	WSC, DIPNR, Developers, Community
	VR2c. Reduce contaminants in surface flow • Regulation • Education	• Minimise contaminants stored in the food web & sediments	• Difficult to determine sources before contaminants are released	Medium	Low	WSC, DEC, Landholders
	VR2d. Avoid disturbing sediments • Minimise activities • Minimise changes to flow	• Avoid release of sorbed chemicals (including nutrients) into the water column • Minimise turbidity increases	• Turbidity is a natural component of water quality – changes to it may impact on ecological processes • Flow changes may be necessary to increase environmental flows	Low	Low-Medium	WSC, DIPNR, GWCWA, Landholders

Issue	Option	Outcomes		Cost	Ability to address Issue?	Responsibility
		Benefits	Difficulties			
VR3. Streambank erosion	VR3a. Minimise water activities that contribute to erosion • Boat wash	• Return streambank erosion to more natural levels • Improve structure of streambanks • Minimise disturbance to habitats within streambanks	• Difficult to establish no wash zones • Difficult to enforce no wash zones	Low	Low-Medium *(depending on level of degradation)*	WSC, Maritime Authority, Community
	VR3b. Rehabilitate streambanks that are degraded • Planting • Landcare	• Target degraded areas • Can be used to harness the community and improve education • Minimise increases in turbidity • Restore bank habitats	• Does not prevent occurrence of streambank degradation	Medium	Medium-High	WSC, Landholders, DIPNR, GWCWA, Community
	VR3c. Encourage responsible land management practices • Build networks • Education • No livestock in rivers	• Allows community and landholders to be included in river management and will produce local land "managers" • Prevents degradation rather than fixes it	• Difficult to reinforce importance of land management without evidence of degradation • Can be difficult to change old habits without the potential application of punitive measures	Low	Medium	WSC, DIPNR, Landholders, GWCWA, Community
VR4. Privately owned riparian zones are difficult to manage	VR4a. Build landholder – Council networks	• Create partnerships with landholders • Negates some of the need for auditing and improves ability to educate • Opens a communication channel with land managers to allow rapid dissemination and assimilation of information	• Can be difficult to change old habits without the potential application of punitive measures	Low	Medium-High	WSC, Landholders

Issue	Option	Outcomes		Cost	Ability to address Issue?	Responsibility
		Benefits	Difficulties			
	VR4b. Conduct audits & issue orders to comply	• Enables targeted response to areas that appear to be degraded • Can force unco-operative landholders to improve their management activities	• Highly resource intensive • Likely to disaffect landholders found to be at fault	Medium	Low-Medium	WSC, Landholders
	VR4c. Do nothing	• Allows resources to be directed to obviously degraded areas • Ensure landholder activities are not adversely affected	• Likely to be missing significant sources of sediment, nutrients and other contaminants coming from poorly managed land areas	Low	Low	WSC, Landholders
VR5. Inadequate understanding of riverine ecological processes and riverine water quality to allow for environmental flow management	VR5a. Conduct extensive vegetation assessment	• Provides a benchmark • Future changes to vegetation structure from flow change can be mapped	• Resource intensive • Previous vegetation structures remain unknown – no temporal scale	High	High	WSC, GWCWA
	VR5b. Do nothing	• Resource intensive exercise is avoided	• Cannot determine if increased environmental flows, barrier removal have had an effect on Riverine and Riparian Vegetation (and to what degree) • Decline of Riverine and Riparian Vegetation communities cannot be quantified	Low	Low	WSC, GWCWA

5.6 RECOMMENDATIONS

5.6.1 Issues Identified by Reference Groups

The following issues were identified by business, community and technical reference groups as being most important to them out of a list of all vegetation management issues.

1. No existing plan for identifying, rehabilitating and managing significant foreshore habitats (VE1)
2. No active monitoring and management of important wetlands (VW1)
3. Activities in upstream catchments can change downstream wetlands (VW2)
4. Changes in water quality can affect aquatic and semi-aquatic vegetation (VE2, VR2)
5. Inadequate understanding of riverine ecological processes and riverine water quality to allow for environmental flow management (VR5)
6. Invasive species can degrade important habitats (VW3, VF3)

Issues 3, 4 and 5 relate to the impact of water quality and quantity on vegetation communities. The management response to these issues is covered in the water section. The remaining issues are covered by the programmes outlined below.

5.6.2 Suggested Programmes

Programme	Associated Options
Foreshore management programme including identification and passive/active rehabilitation of key habitats such as saltmarsh and fringing wetlands, and managing threatening processes on public and private lands	VE1a DT1a DT1c VE3c
Maintain identified foreshore rehabilitation areas, protect sensitive habitats and educate community about the habitats	VE4b VE4c VE3b
Monitor key wetlands for degradation and changes in condition	VW1a VW1c

6 Diversity and Threatened Species

6.1 INTRODUCTION

This section defines the overarching principle and sets future objectives for managing the diversity of species and environmentally significant areas of the estuary. Specifically, the objectives aim to manage catchment ecology, human disturbance, threatened communities, significant areas and sustainable fisheries. In order to meet these objectives, it is necessary to a) define any issues that currently prevent the objectives from being met and b) implement options to address these problems.

There are a range of human activities and disturbances that threaten the diversity of species in the estuary. Management activities such as mowing of saltmarsh (now an endangered community) and wrack collection can have impacts on important ecological processes. The degradation or removal of catchment ecology can interrupt nursery habitats and important links between the catchment and the estuary. There are also a number of environmentally significant areas in the estuary that are home to unique communities and may need protection.

The remainder of the section examines each objective in detail, focussing on the issues that prevent the objective from being met, and providing potential options to address such issues.

6.1.1 Principle

The Central Coast Catchment Blueprint identified a number of “first-order” objectives for ongoing catchment management. Biodiversity and threatened species was one of the first order objectives and was expressed as:

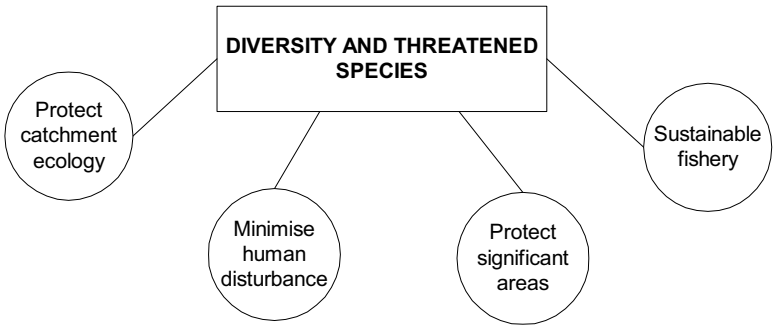
Biodiversity and ecological integrity are maintained and enhanced

During consultation with the Estuary and Coastal Management Committee, it was felt that this statement did not go far enough. The following statement was developed during the review process. The modified principle reads:

Conserve the diversity of all ecological habitats and viable populations of their constituent species and protect and assist the recovery of threatened and endangered communities and species

This principle relates to the catchment but is also applicable to sustainable management of the estuary. The following objectives provide greater focus and detail for estuarine managers.

6.1.2 Elements



6.2 CATCHMENT ECOLOGY

Objective DC: The biodiversity and ecological function of the catchment shall be maintained in a manner that protects the estuary

The impact on the estuary is often not considered when catchment disturbance is being assessed. Until recently, the Porters Creek Wetland was not managed with a view to protecting the downstream environments. The floodplain and catchment upstream of the wetland have been heavily developed. Following the development, there was an increased amount of ponding of water within the wetland and an associated increase in invasive weeds. Over time, the wetland will continue to undergo change associated with this upstream disturbance. The loss of significant parts of the wetland, or an overall change from native to invasive vegetation, could result in an increased flow of water, nutrients, sediment and invasive weeds to Wyong River and eventually Tuggerah Lakes.

While catchment managers may be actively trying to minimise the direct inputs to the estuary, it is important to ensure they consider the indirect inputs that result from degraded catchment environments which threaten the sustainability of estuarine health.

6.2.1 Issues & Threats

DC1. Loss, fragmentation or degradation of habitat

As the catchment of the estuary is developed, breaks in terrestrial habitats often occur. Parcels of land are usually divided into discrete units in terms of area and in relation to surrounding landscape or engineered features (rivers, roads etc). Only in recent years has the concept of designing around a terrestrial habitat or area of ecological significance been included in the planning process.

Where there are isolated remnants of vegetation within a region dominated by agricultural or urban landuses, ecological effects can result other than those caused by loss of habitat alone. Through time, this ecological degradation can lead to an alteration of fundamental ecosystem processes and challenges ecological sustainability. Typically, the remaining biota in a vegetation fragment, undergo alterations in population dynamics: this may include a reduction in the number of species present, altered species dominance, and invasion by exotic species. Furthermore, the isolation within fragments may have negative genetic consequences for any remaining biota, and small populations are at a greater extinction risk. Active management, particularly weed control may be necessary to maintain the biotic integrity within any of the preserved fragments (Kinhill, 1998).

DC2. No ecologically sustainable target for catchment development

The catchment will continue to undergo development. The estuary and rivers will continue to be affected by catchment development. Currently, there is no understanding of the level of development that can be achieved before the character of the estuary is changed. Over-development and over-population may produce a shift in the trophic status of the estuary, potentially returning the eutrophic condition of the 1980's.

DC3. Protective measures applied to development are difficult to monitor and enforce

Residential development, in terms of its effect on the environment, is possibly more damaging as a cumulative activity than many of the industries or designated developments that require consent and licensing from government authorities. The lack of a post development assessment programmes means that it is very difficult to resource monitoring of post development conditions, and also difficult to retrofit appropriate measures if degradation is observed.

6.2.2 Options

Issue	Option	Outcomes		Cost	Ability to address Issue?	Responsibility
		Benefits	Difficulties			
DC1. Loss, fragmentation or degradation of habitat	DC1a. Adopt and implement a conservation strategy	• Provides clear direction to developers and Council on developable land and that set aside for conservation • Protects viable communities for the long term	• Strong resistance from some landholders – land valuations perceived to be under threat • No allowances for compensation over loss of land	Low *(although potentially quite high for some land owners)*	High	WSC, Landholders
	DC1b. Do nothing	• Status quo is maintained • Stakeholders understand their rights and responsibilities • Less likely to upset developers and landholders	• A loss or degradation of habitats in the catchment reduces the ability of the catchment to buffer the estuary against development activity. • Highly contentious	Low	Low	WSC
	DC1c. Investigate alternative ways of combining property boundaries with surrounding ecology	• Provides an opportunity for landholders to be engaged in the decision process • Allows time for community to be consulted about the issue	• Time delays increase the likelihood that more degradation will occur •	Med	High	WSC

Issue	Option	Outcomes		Cost	Ability to address Issue?	Responsibility
		Benefits	**Difficulties**			
DC2. No ecologically sustainable target for catchment development	DC2a. Determine a population/development target that is sustainable for the catchment and estuary	• Provides a powerful tool for local and State Government to lobby and plan for development • Sets clear limits on development extent and type • Provides protection to the catchment and estuary in the long term – reduces rear guard nature of environmental protection	• Likely to be both time and resource intensive and operates in a rapidly changing eco-political environment • May limit future development industry in Wyong Shire	High	High	WSC, NSW Govt.
	DC2b. Do nothing	• Development industry is assured • Region can continue to take Sydney's population expansion • Development industry protected	• Development continues to be determined by State Government plans not based on ecological sustainability • No strategy basis to consider development proposals. Therefore subject to TSC Act • Natural features of estuary and catchment continue to be degraded or lost	Low	Low	WSC
DC3. Protective measures applied to development are difficult to	DC3a. Conduct audits & issue orders to comply	• Enables targeted response to areas that appear to be degraded • Can force unco-operative landholders to improve their management activities	• Highly resource intensive • Likely to disaffect landholders found to be at fault	Medium	Low-Medium	WSC, Landholders

Issue	Option	Outcomes		Cost	Ability to address Issue?	Responsibility
		Benefits	**Difficulties**			
monitor and enforce	DC3b. Developers deposit performance bonds to be refunded on evidence of compliant treatment devices	• Ensure any water quality measures work before developers are released from their obligations • In the event of poor or under designed systems, the funds in trust can be used to correct problems	• Strong disincentive for development in the area which has flow on effects for the local economy • Costs likely to be passed on to residents • Potential effects on land prices • Compliance may take months to evaluate	Medium	High	WSC, Developers
	DC3c. Establish resident action groups • Provide feedback on condition of treatment devices • Assist in weed management • Protect native vegetation in local area • Spread best practice message to residents	• Encourage community members to be engaged with local environment and the measures Council has introduced to protect it • Build sense of community in new areas • Groups can be utilised for other community/resident initiatives	• Who would train & support the groups • Potential liability if members are harmed conducting work • How would success be measured	Low	Medium	WSC, Community
	DC3d. Do nothing	• Developers are not encumbered with onerous development conditions • Conditions are clear and measurable	• Best practices established during design and development stages are not evaluated • Potential for continued degradation post development irrespective of pre-development controls	Low	Low	WSC, Developers

6.3 HUMAN DISTURBANCE

Objective DT: Minimise human disturbances that affect ecological function

Threatening processes are often considered under the legal definition that is applied under the schedules of the *Threatened Species Conservation Act 1995* and the *Fisheries Management Act 1994.* However, there are processes that can threaten the sustainability of sensitive communities and species within the Tuggerah Lakes estuary that have not been legislated. This should not preclude appropriate protective measures from being taken at a local level, particularly when these communities have significance for the estuary.

Entrance management is a human disturbance that has implications for the ecology of the estuary. Permanently opening the entrance (by use of breakwalls or via a second entrance) represents a disturbance that may have unintended ecological consequences.

6.3.1 Issues & Threats

DT1. Some local processes are threatening sensitive ecological communities and species but are not legally defined

The *Threatened Species Conservation Act 1995* defines a number of activities in the catchment as threatening processes. These include land clearing, the alteration/diversion of natural flows, and invasion of native plant communities by exotic perennial grasses. While there is a legal basis for protecting the ecology from these processes, this is not the case for many of the local activities and processes that affect local ecology. This includes mowing of saltmarsh, seagrass wrack harvesting, beach cleaning, mining and dredging.

DT2. The scales of impact from human disturbance are not adequately considered

Press disturbance refers to continuous long-term disturbances such as a sewage discharge. Pulse disturbances are short-term disturbances that may be unplanned or of short duration e.g. oil spill, dredging (Underwood et al., 2003).

Some management activities can constitute threatening processes. They are often only thought of in terms of objectives and outcomes and the disturbance to the rest of the system is often not considered. For example, mowing of foreshore areas, which may include saltmarsh habitat can have local and non-local effects. Saltmarsh removed from large tracts of the foreshore allows exotic semi salt-tolerant grasses to dominate. Hard or elevated edges may stop the migration of wrack shoreward. Without this migration, wrack accumulates in the shallows and decomposes anaerobically affecting amenity and ecology.

6.3.2 Options

Issue	Option	Outcomes		Cost	Ability to address Issue?	Responsibility
		Benefits	**Difficulties**			
DT1. Some local processes are threatening sensitive ecological communities and species but are not legally defined	DT1a. Document and manage processes that threaten the estuary and significant habitats • Sensitive foreshores • Saltmarsh • Seagrass beds • Birds • Structures	• Examine and evaluate real and potential processes that could be defined as threatening for this estuary • Can be administered at a local government level at specific sites for specific problems • Does not tie threatening processes to the legal definitions of State Government legislation	• Further delays before action is taken • Depending on approach, the local government administration may be invalidated by State decisions and legislation	Medium	High	WSC
	DT1b. Do nothing	• Unlikely to upset community by staying the current course • State continues to legislate threatening processes	• Continued degradation of foreshore ecology • Aesthetic issues (foreshore odours) will continue • Community understanding of f/shore habitat not improved	Low	Low	WSC, Community
	DT1c. Ban mowing & beach cleaning in public and private foreshores	• Will limit the damage to foreshore environments by maintenance activity	• Without careful management, cessation alone will not necessarily bring back degraded habitat – weed invasion is a risk • Likely to be highly unpopular • Not providing an objective determination of which sites require intervention, and which sites should continue with maintenance.	Low	Low-Medium	WSC

Issue	Option	Outcomes		Cost	Ability to address Issue?	Responsibility
		Benefits	**Difficulties**			
	DT1d. Ban water activities in sensitive foreshore areas	• Reduce risk of damage to existing seagrass habitats from boating or other recreational activities • Potentially encourage recruitment of seagrasses and redress the historic loss of seagrass in the estuary	• Likely to be highly unpopular with local community • Potentially damaging to elements of the tourist industry • Difficult to administer and will require a multi-department response	Med-High	Medium	WSC, Maritime Authority, DIPNR, DPI (Fisheries), Department of Lands
	DT1e. Educate land managers and community about threatening type processes	• Provides a positive forum for bringing people "on board" without being punitive	• Reliant on good will • Resource intensive and may not be able to use legal definitions to make the case for changing activities	Medium	Medium-High	WSC, Department of Lands, DEC (Parks & Wildlife)
DT2. The scales of impact from human disturbance are not adequately considered	DT2a. Develop model that provides qualitative assessment of system impacts from threatening processes	• Increase understanding of the links between catchment/estuarine management • Minimise risk of further estuarine/catchment degradation by unwise activities • Improve understanding of the processes that may lead to declines	• Resource intensive and would require specialised knowledge to create. • Could become a "white elephant" if model not sufficiently useful	High	Low-Medium	WSC
	DT2b. Do nothing	• Council can continue to provide well maintained and popular foreshore areas	• Little to no prospect for improvement in foreshore amenity (odour, wrack accumulation etc) • Further catchment or estuarine management issues may result from continuing to pursue threatening processes	Low	Low	WSC

6.4 ENVIRONMENTALLY SIGNIFICANT AREAS AND THREATENED SPECIES/COMMUNITIES

Objective DS: Maintain and protect environmentally significant areas and threatened species/communities

There are a number of areas within the estuary that are thought to have environmental significance and these require careful management to ensure their sustainability. Budgewoi Sandmass, Colongra Wetland and Tuggerah Bay (discussed in detail in Section 2.2.10) are three of these areas.

Budgewoi Sandmass is a relic tidal delta that was once open to the sea (approximately 1000 years ago) and has formed as a result of marine sands being deposited into the estuary through tidal exchange and storm events. The sandmass is a valuable ecological area within the estuary because it provides non-tidal areas for feeding and roosting for many migratory and local waterbirds (Mackey, 1999; Morris, 2005). There have been proposals to mine the sandmass and a number of Environmental Impact Studies have been prepared (Resource Planning Pty Ltd, 1991; Cheng, 1997).

Colongra Wetland is situated within Lake Munmorah, on land currently owned by Delta Electricity, and is to be donated to the Department of Conservation (Parks and Wildlife Division). The wetland is considered significant within the area because of its relative isolation, lack of urban development and its importance as a water bird habitat (Sainty, 1998; Mackey, 1999; Morris, 2005). Mine subsidence in the area has caused some problems for the wetland and associated fringing flora and fauna.

Tuggerah Bay has been identified as an important ecologically sensitive habitat within the Tuggerah Lakes estuary (Sainty, 1998; Roberts, 2001; Morris, 2005). There has been very little development around the shoreline of Tuggerah Bay, so much of the fringing wetlands are relatively undisturbed. The seagrass meadows within Tuggerah Bay are rich and support prolific birdlife, invertebrates and fish assemblages (Daley, 1997; Mackey, 1999; Cummins et al., 2000; Casey, 2001; Roberts, 2001).

Syngnathids are a unique family of fish, which includes seahorses, pipefish, pipehorses and seadragons. They are highly vulnerable to human impacts due to their low reproductive and dispersal rates and their sedentary nature. There are approximately 31 species of Syngnathids found in NSW and they are now protected under the *Fisheries Management Act 1994*. Saltmarsh has been discussed in detail in Section 2.2.10.2 however it is important to note that it has recently been declared a threatened ecological community under the *Threatened Species Conservation Act 1995.*

6.4.1 Issues & Threats

DS1. Recreational activity can damage sensitive habitats & species

Recreational activities that damage environmentally significant areas need to be discouraged with signs, denial of access and enforcement. An example is the riding of horses and motorbikes through the sensitive Tuggerah Bay saltmarsh habitat. Fishing and boating can have effects on seagrass habitats around the Budgewoi Sandmass. Foreshore ecology (especially saltmarsh) can be affected by the provision of public access ways for foreshore recreation (such as paths and cycleways). There are a number of sensitive bird habitats around the foreshores of Tuggerah Lakes that are under threat from recreational activity and require location and protection.

DS2. Assigning responsibility for managing environmentally significant areas

Once an environmentally significant area has been identified and a decision made to protect and maintain it, determining the appropriate land manager can be difficult. This is particularly true when determining who will fund the management of such areas.

DS3. Mine subsidence

Subsidence due to coal mining has been a problem in the Wyong Shire for many years, especially in the northern areas around Lake Munmorah. The effect of subsidence on the foreshore and freshwater wetland at Colongra (Lake Munmorah) was evaluated by Duchatel (1998). Approximately four hectares of foreshore wetland was subsided by 900 mm allowing saline water to flow into the freshwater swamp behind the elevated foreshore. Widespread mortality of plants and associated wildlife were predicted and management strategies to deal with the problem were recommended (Duchatel, 1998).

COAL Australia undertook exploratory drilling under the Tuggerah Lake with a view to mining in the future. Assessment of the environmental effects of these operations was done by COAL Australia in conjunction with consultants ERM Mitchell McCotter. Wyong Shire Council and ERM Mitchell McCotter have done some collaborative studies to gain baseline data on some of the more important ecological components that may be affected by subsidence. The results of those studies were to be reported in an EIS but the management plan for the Tuggerah Lakes estuary will need to consider the potential effects of mining. Important issues associated with subsidence include the effects on fringing wetland habitats and seagrass meadows. Seagrass meadows are important for commercial and recreational fisheries within the estuary as many fish species depend on these meadows at some stage in their life history.

Within these seagrass meadows there are also many invertebrate species, which are important to the ecology of the estuary. In general, mine subsidence could potentially alter the mean depth of seagrass habitats causing a net loss in seagrass within the estuary. Significant seagrass meadows occur within Tuggerah Bay and any increase in the overall depth of this area could cause changes to seagrass and fisheries. Furthermore, if sections of Tuggerah Lake were “made deeper” there is greater potential for stratification of the water column, which could lead to lower oxygen levels and the release of nutrients within “deeper pools” (Roberts, 2001).

6.4.2 Options

Issue	Option	Outcomes		Cost	Ability to address Issue?	Responsibility
		Benefits	Difficulties			
DS1. Recreational activity can damage sensitive habitats & species	DS1a. Evaluate whether recreational activities pose a real threat to environmentally significant areas & species (e.g. birds)	• Allows an assessment of real threats to environmentally significant areas • Can be undertaken in a transparent way, engaging the community and educating during the process	• Potentially delays actions that could limit damage that may already be occurring • The evaluation could be influenced by political objectives	Low-Med	High	WSC, Environmental interest groups (e.g. Birding NSW)
	DS1b. Restrict access to environmentally significant areas (e.g. Budgewoi Sandmass, bird habitats, saltmarsh)	• Provides an immediate response to threats from recreational activities	• May be an over-reaction if undertaken without an assessment of the real damage being caused by recreation • Who would physically restrict the access? • Responsibility for the sensitive areas may be multi-dimensional	Medium	High	WSC, Environmental interest groups (e.g. Birding NSW)
	DS1c. Do nothing	• Tourist industry remains unaffected • Community continues to have full access to the estuary • Public enjoyment of the estuary reinforces the good condition of the estuary	• Damaging activities will continue • Seemingly insignificant activities may impact vital processes in these areas, affecting wider estuarine characteristics	Low	Low	WSC

Issue	Option	Outcomes		Cost	Ability to address Issue?	Responsibility
		Benefits	**Difficulties**			
DS2. Assigning responsibility for managing environmentally significant areas	DS2a. Investigate the ownership, responsibility and funding for significant areas	• Before management of significant areas is begun, a clear picture of funding & responsibility is presented • Provides an opportunity to lobby for further funding if necessary	• Management of areas not always reflective of ownership e.g. Crown Land managed by WSC	Low-Med	High	WSC
DS3. Mine subsidence	DS3a. Ban Mining	• Ensure that habitats sensitive to depth change are not affected • Minimise risk of upsidence and subsidence – threats to river flow	• Potential flow on effects for the economy • Unlikely to be a local government decision due to provisions of SEPP45	Low	High	WSC, Department of Mineral Resources
	DS3b. Ban mining only under sensitive habitats	• Reduce possibility of damage to most at risk habitats • Allows limited mining to go ahead generating jobs and boosting economy	• Limitations of mining field may make it financially unviable • Unlikely to be a local government decision due to provisions of SEPP45	Low	Med-High	WSC, Department of Mineral Resources
	DS3c. Permit special mining types and require remediation of any damage	• Allows for a larger scale of mining to be undertaken increasingly profitability and boosting economy • Ensures that damaged areas will have remedial works undertaken	• Remedial works may not be able to reverse damage (too late) • Limitations of mining field may make it financially unviable	Low	Med	WSC, Department of Mineral Resources
	DS3d. Allow mining as per norms	• Mining companies and workers can operate with ease in the Tuggerah Lakes catchment • Flow on effects for economy and jobs	• Degradation of sensitive habitats much more likely to occur through upsidence and subsidence • Potential threats to water supply through upsidence	Low	Low	WSC, Department of Mineral Resources

6.5 SUSTAINABLE FISHERIES

Objective DF: Ensure fishery is sustainable

The fishery of Tuggerah Lakes is a valuable social, economic and environmental asset. The fishery is threatened by a number of practices including:

- Water quality - eutrophication
- Interruption to environmental flows
- Barriers to fish migration
- Anthropogenic disturbance (wrack, dredging, hard structures, wrack harvesting)
- Loss, fragmentation or degradation of habitat (damage to macroinvertebrates, meiofauna, nekton, seagrasses)
- Invasive species
- Fishing practices (overfishing, poor techniques, by-catch, inappropriate gear)
- Harvesting and wrack management
- Stock enhancement and aquaculture

Careful management of the fishery is required to sustain dependent industries, organisms and recreation.

6.5.1 Issues & Threats

DF1. Water Quality

The health and sustainability of the Tuggerah Lakes fishery is strongly influenced by water quality. For example, increased turbidity can impact the depth to which seagrasses can grow and therefore potential fish habitat. Some types of algal blooms could potentially result in fish kills as dissolved oxygen levels drop. The processes that can impact water quality in the fishery have been dealt with in detail in Section 4.3.1 – Water Quality for Ecology.

DF2. Changes to flow volumes and patterns

Patterns of flow and quantities of flow can affect water quality and species viability within the estuary. Increasing development in the catchment has altered both the patterns and volumes of surface water being received by the estuary. The regulation of the ocean entrance is believed to have a significant effect on the ecology of the estuary by influencing water quality. Changes to water quality (such as increased/decreased salinity) could have an effect on

organisms such as seagrasses and macroalgae, which are important for a healthy fishery.

DF3. Sedimentation, weirs, drains and river crossings can create migration barriers and affect natural flows

Migrations and breeding cycles have been altered by barriers across rivers, and habitats have been altered, creating favourable conditions for pest species. There have also been local extinctions upstream of some barriers. Improved management by providing effective fish ways, appropriate flows and removing redundant structures will provide increased habitat access to migratory fish and re-establish population distributions. The construction of new fishways and retrofitting or removal of old barriers needs to be done. The existing DPI (Fisheries) policy guidelines on barriers to fish needs to be more closely linked to the DA process within Council. At present the Fisheries guidelines are not thoroughly consulted to establish current best practice.

DF4. Human disturbance and built structures can threaten estuarine habitats

This includes dredging, harvesting, beach cleaning and impacts such as boating, littering, impacts on habitats from infrastructure (e.g. boat ramps and jetties), damage to seagrass from anchoring and propellers, and bank erosion from boating wakes.

DF5. Loss, fragmentation or degradation of habitat

Tuggerah Lakes estuary has a growing residential population as well as a seasonal influx of visitors, and concerns have been raised about the effects of increasing development and urbanisation. Reduction of water quality, decline of essential habitat, and commercial and recreational fishing all affect the fishery. Environmental factors influencing the fishery include habitat decline, urban and catchment development, water quality decline, acid sulphate soils, river flow regulation, dredging, and sea level rise caused by global warming.

DF6. Invasive species can degrade important habitats

The risk of introduced species and disease are high. Within the freshwater sections of the catchment, there are introduced species such as carp and mosquito fish which are considered threatening processes to native fish assemblages. Within the estuary, the potential for the invasive alga *Caulerpa* must also be considered. There needs to be an education programme on the problems associated with spreading introduced organisms such as aquatic weeds and fish species within the tributary creeks and estuary.

DF7. Some fishing practices can damage habitat and collect by-catch

Fishing, both commercial and recreational, can affect the environment. The extent varies depending on the type and intensity of fishing but includes effects on food webs and fish communities, by-catch of non-target species (including fish, crabs, squid and other invertebrates) and impacts on aquatic habitats (such as seagrass and benthic assemblages). There has been widespread agreement that some commercial fishing techniques can damage seagrass beds. In recent times, DPI (Fisheries) have moved to limit certain techniques, which cause damage to seagrass and which may also impact on non-target species (by-catch). Changes included reducing the length of hauling nets and increasing their mesh size to avoid catching undersized fish; banning fish spikes, clubs or other implements which could harm species which need to be released; banning all forms of hauling over seagrass beds to better protect aquatic habitats. The strategy put in place by DPI (Fisheries) has lowered the risk of damage to seagrass meadows and non-target species. Increased enforcement and education may also be required on the recreational sector in terms of bag limits, under size fish etc.

DF8. Stock enhancement and aquaculture practices

Aquaculture is a growing industry in NSW and includes methods such as farming fish in ponds, tanks and sea cages. Aquaculture has not been encouraged in the Tuggerah Lakes and proposals for stock enhancements have not been supported because of the unknown interactions with the ecology of the estuary.

DF9. Inadequate information on the Tuggerah Lakes fishery

Stock assessments are essential for a sustainable fishery. Fish catch records are not conclusive and indeed major fluctuations in fish catches have occurred since the early 1900's within all NSW estuaries. There are many processes that can influence the populations of fish within an estuary. These processes include the frequency and length of entrance opening, runoff and pollutants from catchments and over fishing. DPI (Fisheries) are developing frameworks for stock assessment. Community concern about commercial fishing is the key driver for changes to current practices within the Tuggerah Lakes estuary. The Recreational Fishing Trust was considering the closure of Tuggerah Lakes to commercial hauling. Research on the spatial and temporal patterns of variability in assemblages of fish is needed.

6.5.2 Options

Issue	Option	Outcomes		Cost	Ability to address Issue?	Responsibility
		Benefits	Difficulties			
DF1. Water Quality	See Water Quality Issues & Options in Section 3.3					
DF2. Changes to flow volumes and patterns	See Water Flow Patterns Section 3.2 and 3.5					
DF3. Weirs, drains and river crossings can create migration barriers and affect natural flows	DF3a. Build fishways	• Increase fish migration • Encourage interaction between freshwater and estuarine species • Potentially increase the populations of some fish species	• It is still not a natural pathway for migration of fish and other organisms	Med-High	High	DPI (Fisheries), DIPNR
	DF3b. Link Fisheries Policy with Development Assessment processes	• Allows the authority expect in fish to make the assessment of impacts and remedial measures	• Potentially another development "hoop to jump through"	Low	Low-High (depending on development, location, available space etc)	DPI (Fisheries), DIPNR, Consent Authority
DF4. Human disturbance and built structures can threaten estuarine habitats	DF4a. Stop all activities that cause disturbance	• Minimise threats to fish and habitat • Improve other affected species and habitats (especially by-catch)	• Maintenance programmes may cease with potential lose of amenity in some locations • If dredging is for flood control, potential flooding threats.	Low-Med	High	WSC, DPI (Fisheries), DIPNR
	DF4b. Continue with existing activities & disturbance	• Maintain aesthetics for residents and tourists	• Continue to impact on habitats and collect by-catch • Potentially produce a long term irrecoverable impact for some species	High	Low	WSC, DIPNR

Issue	Option	Outcomes		Cost	Ability to address Issue?	Responsibility
		Benefits	**Difficulties**			
	DF4c. Review current management practices	• Allows an assessment to be made for individual operations (i.e. no blanket rule) • Operations found to be sub-standard can be targeted for improvement or disbanding	• Does not necessarily remove the damaging operation immediately • No guarantee the assessment will collect all information required or see all damage	Low	Med-High	WSC, DPI (Fisheries)
DF5. Loss, fragmentation or degradation of habitat	See Estuarine Vegetation 4.3 and Riverine Vegetation 4.5					
DF6. Invasive species can degrade important habitats	DF6a. Restrict Access • allow entrance to close • refuse boat access to lakes	• Limit opportunity for Caulerpa to enter from marine waters • Boats with suspect growth can be prevented from entering waters	• Other changes to estuarine ecology from entrance change • Difficult to monitor and enforce all boat launchings	High	Medium	DPI (Fisheries), Maritime Authority, DIPNR
	DF6b. Education of fishers and community - could use aquariums and nurseries to ID invasive species	• Good method of building partnerships rather than adversaries • Reduced risk of invasive species being introduced • Increased likelihood of vigilance	• May not convince sceptics • Education may be ignored	Low	Medium-High	DPI (Fisheries), Maritime Authority, Fishing community
	DF6c. Target and eradicate	• Provides a programme targeted at identified species • No management until problem is evident	• Problem has to appear before you can target • Eradication of invasive species can be difficult	Low-Med	Low	DPI (Fisheries)
DF7. Some fishing practices can damage habitat and collect by-catch	DF7a. Increase enforcement	• Select offenders rather than trying to educate the whole • Sets a visible example for other offenders	• Can alienate fishers from Fisheries • Requires increased resources	Medium	Medium	DPI (Fisheries)

Issue	Option	Outcomes		Cost	Ability to address Issue?	Responsibility
		Benefits	**Difficulties**			
	DF7b. Educate fishers (commercial & recreational)	• Good method of building partnerships rather than adversaries • Reduced risk of invasive species being introduced • Increased likelihood of vigilance	• May not convince sceptics • Education may be ignored	Low	Medium-High	DPI (Fisheries), Maritime Authority, Fishing community
	DF7c. Research improvements in gear to reduce by-catch	• Opportunity to collaboratively develop solutions to local problems and issues • Potential to be combined with other estuarine programmes	• Time lag while solutions are researched with no guarantee they will be found	Low-Med	High	DPI (Fisheries), Universities ?
	DF7d. Restrict fishing types/zones to protect sensitive species/habitats	• Target type and level of activity to the sensitivity of the species in question • Provides for specific management measures	• Difficult to enforce	Med-High	Medium	DPI (Fisheries)
DF8. Stock enhancement and aquaculture practices	DF8a. Ban aquaculture	• Reduced potential for increases in sediment and nutrient loads from intensive fish farms • Reduced potential for cross-contamination of species • No competition with existing industry	• Possible economic impacts • Existing businesses	Low	Medium	DPI (Fisheries), Fishing pressure groups, DEC, WSC
	DF8b. Encourage aquaculture	• Provide boost to industry • Increase focus on fishery in Tuggerah	• Potential for increases in sediment and nutrient loads from intensive fish farms • Potential for cross-contamination of species • Feed supplied could be artificial	Low	Low	DPI (Fisheries), Fishing pressure groups, DEC, WSC

Issue	Option	Outcomes		Cost	Ability to address Issue?	Responsibility
		Benefits	**Difficulties**			
	DF8c. Release stocks to improve populations	• May boost numbers of species with low levels of reproduction	• Potential for impacts on other parts of the food web – influx of juveniles into the food chain	Low	Low	DPI (Fisheries), Fishing pressure groups, DEC, WSC
DF9. Inadequate information on the Tuggerah Lakes fishery	DF9a. Increase level of research into Tuggerah Lakes fish stocks and fishery	• Improved ability to track fish stocks through time • Useful indicator for some aspects of estuarine health • Improve the management of fishing operations • Opportunity to engage professional fishermen in estuarine management	• Lack of existing data • Who would fund the research? • How would research data be used in "on-the-ground" changes?	Med-High	High	DPI (Fisheries), Fishing pressure groups, WSC, DIPNR
	DF9b. Do nothing	• Less likely to be seen as interfering in fishing operations	• May be difficult to assess ongoing status of fish stocks through time • Difficult to assess if catchment and estuarine management practices are having positive/negative effects on fish stocks	Low	Low	DPI (Fisheries), Fishing pressure groups, WSC, DIPNR

6.6 RECOMMENDATIONS

6.6.1 Issues Identified by Reference Groups

The following issues were identified by business, community and technical reference groups as being most important to them out of a list of all diversity and threatened species management issues.

1. Loss, fragmentation or degradation of habitat (DC1, DF5)
2. No ecologically sustainable target for catchment development (DC2)
3. Protective measures applied to development are difficult to monitor and enforce (DC3)
4. Assigning responsibility for managing environmentally significant areas (DS2)
5. Changes to flow volumes and patterns (DF2)
6. Human disturbance and built structures can threaten estuarine habitats (DF4)
7. Some local processes are threatening sensitive ecological communities and species but are not legally defined (DT1)

Issue 5 relates to changes in patterns of water flow and how it affects diversity and threatened species. Patterns of water flow are handled in detail in the water section and therefore no special programme has been developed for this issue. Issue 2 is about balancing environmental resources with the social and economic needs of the catchment and estuary (i.e. development). As such, the programme recommended for this issue is addressed in the Social and Economic Needs section.

6.6.2 Additional Priorities

The following additional priority was also identified as important:

- Recreational activity can damage sensitive habitats (DS1)

6.6.3 Suggested Programmes

Programme	Associated Options
Undertake a programme of works to restore degraded or threatened habitat through rehabilitation, strategic land protection and active management of invasive species (e.g. weeds)	DT1a DT1c DT1d DC1c
Develop strategies to identify and manage key remaining catchment habitats	DC1a DC1c DC2a

	DC3c DT1e DT2a DS1a DS2a
Investigate need and where necessary limit public access to ecologically sensitive areas of the foreshore and estuary including saltmarsh (e.g. Tuggerah Bay) and seagrass habitat (e.g. Budgewoi Sandmass)	DT1a DS1a DS1b DF4a DF4c
Review recreational and management activities that could be threatening sensitive ecological communities in the estuary and catchment	DS1a DF4c DT1a

7 Land Use and Human Settlement

7.1 INTRODUCTION

This section defines the overarching principle and sets future objectives for sustainably managing the demands of human settlement and the associated land use requirements. In order to meet these objectives, it is necessary to a) define any issues that currently prevent the objectives from being met and b) implement options to address these problems.

The principle (listed below in 7.1.1) is a very broad collection of land-oriented aims. This has been sharpened in the management study by selecting very specific objectives that relate strongly to the estuary. The allocation of remaining land in the catchment and planning for settlement is of high importance to the estuary. A large-scale decline in catchment ecology or degradation of water quality flowing from the catchment is likely to impact on estuarine health. The focus objectives refer primarily to managing development activity, primary industries and protection of existing soil landscapes.

The remainder of the section examines each objective in detail, focussing on the issues that prevent the objective from being met, and providing potential options to address such issues.

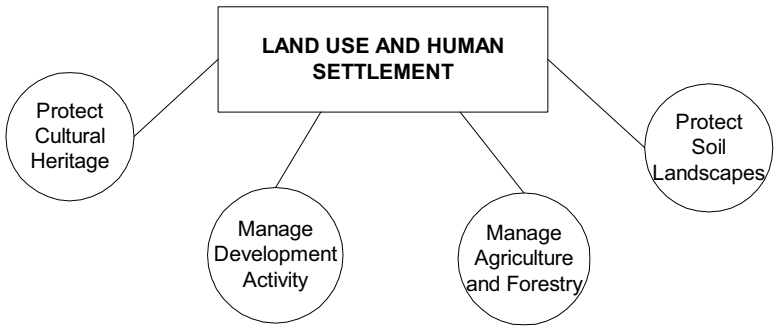
7.1.1 Principle

The Central Coast Catchment Blueprint identified a number of “first-order” objectives for ongoing catchment management. The management of the increasing amount of settlement and the associated demand for various land uses was one of the first order objectives and was expressed as:

Human settlement, primary production and other land use take place while protecting and enhancing Aboriginal cultural heritage, soil, water and ecosystem health

This principle relates to the catchment but is important for the sustainable management of the estuary. The following objectives provide greater focus and detail for estuarine managers.

7.1.2 Elements



7.2 CULTURAL HERITAGE

Objective LC: Ensure management of the estuary and catchment protects and enhances indigenous & non-indigenous cultural heritage

With catchment and estuarine management activity likely to increase over time, as the pressures on these environments increase, it is important to ensure that any proposed management action does not diminish or degrade the indigenous and non-indigenous cultural heritage. For example, if a management plan for Tuggerah Bay was prepared, it needs to consider the cultural importance of Pioneer Dairy and Tuggerah Bay Wharf. Where rehabilitation is undertaken in the catchment, care must be taken not to disturb sites of indigenous importance (such as middens and burial grounds).

The principle only makes reference to enhancing Aboriginal heritage. The Estuary and Coastal Management Committee decided to extend this to ensure that non-indigenous cultural heritage was also sustainably managed. This has been reflected in the revised objective above.

7.2.1 Issues & Threats

LC1. The location of important aboriginal sites are not well known and therefore difficult to account for in catchment and estuarine management

The locations of Aboriginal sites were not addressed as part of the EPS (Roberts, 2001), but are listed as a key objective within the Central Coast Catchment Blueprint. Any management proposal for the estuary and the catchment should ensure that Aboriginal sites are accounted for. Where there is a chance that they will be affected or altered in any way, local leaders should be fully informed and consulted about alternative options.

LC2. Local indigenous and non-indigenous cultural heritage are not promoted

There is little promotion of local indigenous and non-indigenous culture within the Wyong Shire region. This makes it difficult to celebrate the culture and combine it with estuarine management. If there are significant linkages, these should be celebrated.

7.2.2 Options

Issue	Option	Outcomes		Cost	Ability to address Issue?	Responsibility
		Benefits	Difficulties			
LC1. The location of important aboriginal sites are not well known and therefore difficult to account for in catchment and estuarine management	LC1a. Engage local Aboriginal groups & DEC (Parks & Wildlife) to determine location of sites	• Ensures that Aboriginal heritage is protected when catchment and estuarine management actions are undertaken	• The location of some sites may create problems for catchment and estuarine managers	Low	High	WSC, Local Aboriginal groups, DEC (Parks & Wildlife)
	LC1b. Undertake works without consultation	• Removes an extra constraint to planning and management	• Potentially damage sites of significance to indigenous Australians and national heritage • Isolate local indigenous groups who are significant land holders in the catchment • Lead to friction and litigation for WSC from the Aboriginal community under the Government Act that protect these sites and places	Low	Low	WSC, DEC (Parks & Wildlife)
LC2. Local indigenous and non-indigenous cultural heritage are not promoted	LC2a. Promote local cultural heritage in the community	• Sites of significance for cultural heritage of local area are more likely to be protected • Sites less likely to be overlooked during implementation of catchment and estuarine management activities	• Few sites remain after development	Low	Medium	WSC, Local heritage groups

Issue	Option	Outcomes		Cost	Ability to address Issue?	Responsibility
		Benefits	Difficulties			
	LC2b. Do nothing	• Removes another potential impediment to catchment and estuarine management activities	• Potentially damage sites of significance for local cultural heritage	Low	Low	WSC

7.3 DEVELOPMENT ACTIVITY

Objective LD: Provide economically and socially justified levels of development whilst containing ecological impacts

This objective recognises the importance of sustainable development in the catchment. It is an important part of the local economy, and also relates to housing in the Greater Sydney region (having flow on effects such as funding for public transport, roads etc).

This objective aims to ensure social and economic benefits of the development outweigh the ecological risks. The objective is not intended to provide an impediment to development, simply focussing the level of scrutiny that a development may undergo, on specific areas of importance to the catchment and estuary.

7.3.1 Issues & Threats

LD1. Insufficient settlement, employment and conservation strategies

One of the issues raised during the business consultation phase of the study, was that there was no overall plan for how many people would be placed in the shire, how many lots would be made available and for what type of development. Generally, it was felt that development was occurring on a case-by-case basis, which left little room for determining what is appropriate in the long term (Duncan and Smith, 2004). However, the Wyong Residential Development Strategy was adopted by Council in December 2002.

LD2. Environmental protection objectives can't always be met

While many of the options available to mitigate the impact of new development are being utilised within the shire, the constraints are often such that they can't reasonably be met without considerable impact on pricing. To treat stormwater in any rain event to a level that would ensure no net increase in nutrient or sediment loads to downstream environments, would require land sacrifices and ongoing maintenance costs that would prove prohibitive to developers.

LD3. Government pressure

Whilst Wyong Shire Council generally sets the trend and pace of development in the shire, the State Government can sometimes declare development areas (such as Urban Development Precincts) within the shire. Such decisions influence the level of development in the shire and the new Sydney Metropolitan Strategy currently being prepared for release by December 2004 will indicate expected growth numbers across the shire, especially in medium to long-term release areas.

LD4. Market forces drive development more than environmental protection

Strength of supply and demand drives prices and desirability of developments. Increased interest rates and changes to things like infrastructure planning can impact the desirability and price of property and therefore impact on development activity.

7.3.2 Options

Issue	Option	Outcomes		Cost	Ability to address Issue?	Responsibility
		Benefits	Difficulties			
LD1. Insufficient settlement, employment and conservation strategies	LD1a. Create a plan for the undeveloped land in Wyong Shire including: • Areas to be developed • Areas to be conserved • Consideration of targets for water, biodiversity& land that are sustainable for catchment, streams, wetlands & estuary	• Provides an opportunity to assess remaining land in terms of its impact on the catchment and estuary • Gives Council a powerful tool to use in negotiations with State over the populations that can be sustained in the area • Allows Council to make more accurate assessments of long term resource needs (roads, water supply) • Developers, investors and landholders are given a clear understanding of future opportunities	• Resource intensive • Assumes that sustainability targets are both quantifiable and accurate when in practice they can be very difficult • By pre-setting developable land, some landholders will benefit while others will not • Politically unpalatable for some levels of government due to budget implications	High	Medium-High	WSC, DIPNR
	LD1b. Do nothing	• Difficult decisions left to other organisations • Does not lock Council into land management arrangements that may change over time	• Frustrates developers and investors as the vision for long term development is not clear • Allows only for reactionary development based on market pressure or State decisions	Low	Low	WSC

Issue	Option	Outcomes		Cost	Ability to address Issue?	Responsibility
		Benefits	Difficulties			
	LD1c. Provide individual development plans that consider discrete ecological communities affected by the development	• Potentially allows highly customised development plans to be developed on an as-needed basis • Provides for assessment and mitigation of impacts for local ecology	• Assumes that protection of numerous discrete ecological units will in turn protect estuary • Does not allow for cumulative impacts and assessment against shire wide targets. Effectiveness of assessment is decreased • Does not provide for assessment of targets for long-term sustainability of estuary	Med-High	Medium	WSC
LD2. Environmental protection objectives can't always be met	LD2a. Engage developers in a co-operative approach to achieving ecological solutions - tradeoffs on site design to achieve larger environmental goals (e.g. use of fill in floodplains for development or treatment)	• Provides opportunity to use developers experience in land management and DA processes for environmental benefit • Greatly decreases potential for litigation between Council and developers • Should produce a system that is open, transparent and efficient	• Could be argued that developers are not partners in a development assessment sense. It is up to Council to impose conditions not have those subjected to the conditions assist in developing their own conditions • Needs policy basis to gain agreement with developers • Could lead to inconsistent approach and incompatible results if undertaken on site by site basis	Low	High	WSC, Developers

Issue	Option	Outcomes		Cost	Ability to address Issue?	Responsibility
		Benefits	Difficulties			
	LD2b. Do nothing	• Existing system is well understood (including benefits and flaws) • Both sides can claim due diligence in assessment of development – "Consent authority imposes conditions, developers respond to conditions"	• Monies spent by developers on contributions are wasted • Future monies to be spent by Council on maintenance activities may be wasted • Environmental degradation in affected habitats likely to continue	Low	Low	WSC
	LD2c. Initiate a rigorous post development assessment of environmental compliance	• Where development has not achieved measured compliance, a recourse is available to have developers correct treatments • Council is left with devices/treatments that are known to be functioning as designed – therefore maintenance cost is validated • Encourages developers to increase the design accuracy of treatments	• Environmental treatments are notoriously site specific and therefore difficult to design for, before they are installed • Evaluating compliance would be resource intensive and would require scientific rigour that would be defensible in court	Med-High	Med-High	WSC, Developers
LD3. Government pressure	LD3a. Lobby Local & State members to obtain moratorium on development that is not socially or economically justified	• Creates an urgency and momentum at the decision making level • Provides a new standard for measuring need for development rather than simply by available land	• Likelihood of succeeding depends on a number of factors including marginality of seat, status of politician in party, policies of the government in power • It is likely to be reversible	Low	Low	WSC

Issue	Option	Outcomes		Cost	Ability to address Issue?	Responsibility
		Benefits	Difficulties			
	LD3b. Challenge State to prove that development is socially and economically justified	• Acts as a checkpoint for landuse planning – assuming this criteria is met, then investigations can begin into environmental impacts	• In most respects, State is not subservient to local government as a consent authority • Likely that most development is socially and economically justified, as it would not occur unless the market were there to support it	Low	Medium	WSC
	LD3c. Do nothing	• State Governments can continue to control population movement and incentives throughout the state	• Allows State Government to continue to set aside development areas to house increasing populations without consideration for the sustainability of such actions	Low	Low	WSC
LD4. Market forces drive development more than environmental protection	LD4a. Create a plan for the undeveloped land in Wyong Shire including: • Areas to be developed • Areas to be conserved • Base decisions on sustainability of catchment & estuary	• Allows the market to assess potential of the region as future supply is clearly documented • Depending on how the developable land is made available Council could have a strong bearing on affordability	• External factors such as State Government decisions can override such plans • Market conditions are determined by a wide range of events and circumstances such as interest rates and government incentives (like first home buyers grant)	High	Medium-High	WSC, DIPNR
	LD4b. Do nothing	• Status quo maintained • Altering market forces or trying to indemnify the catchment from them will be both difficult and is unlikely to succeed	• Council is at risk of being unable to control demand for property and being put into a situation where providing for more land is inevitable	Low	Low	WSC

7.4 AGRICULTURE AND FORESTRY

Objective LA: Support forestry, agriculture and other industries in the catchment while viability of downstream ecology is maintained

It could be argued that it is not the place of an estuarine management programme to be recommending support for industries that have the potential to harm the catchment or estuary. However, these industries make important contributions to the local economy, and are unlikely to be moved or closed. With this in mind, it is important to build strong relationships with these industries to ensure that sustainable catchment management and sustainable estuarine management messages are passed on, and hopefully create a partnership role between Council and these industries.

This support will be maintained while the industries aid in maintaining downstream ecology (such as riverine systems, floodplains, wetlands and sensitive habitats).

7.4.1 Issues & Threats

LA1. Catchment managers do not always have input into forestry management

As a State authority, DPI (Forests) are not legally bound to development conditions that could otherwise be imposed on developments by Council. Forestry activity occurs under the conditions of the Integrated Forestry Operations Approval issued by the DEC. Council does have the opportunity to monitor flows from forested areas in their capacity as a catchment manager. There is opportunity for Council to have input into draft Forest Management Plans before they are adopted (Brookes pers com., 2004). Catchment managers are also invited to provide input into Ecologically Sustainable Forest Management plans which are developed by DPI (Forests) (Fawcett, 2005). While there is no formal agreement between Council and DPI (Forests), the two organisations do meet from time to time, when issues of significance for the catchment are discussed. There is potential for this communication to be strengthened if either party determines that there is a need.

LA2. Difficult to monitor activities of landholders

There are only limited opportunities to influence the activities of landholders once development is complete. On occasions, when there is development in agricultural areas, the administrative instruments that have been developed (Wyong Local Environmental Plan, Environmental Planning Assessment and Approvals Regulations and Rivers & Foreshores Improvement Act) are generally capable of delivering appropriate sediment and nutrient control. There are some recent studies of sediment and nutrient control in riverine

catchments that suggests that a combination of grassed and riparian forest buffer zones are the most effective treatment of surface runoff. However, as is often the case, there is a lack of information on what the discharge quantities of sediment and nutrients should be, other than ANZECC guidelines. Checking and enforcing development controls in agricultural areas can be more time consuming, but are an important part of limiting damage to riverine systems and the estuary.

7.4.2 Options

Issue	Option	Outcomes		Cost	Ability to address Issue?	Responsibility
		Benefits	Difficulties			
LA1. Catchment managers do not always have input into forestry management	LA1a. Strengthen information sharing and co-operation between Council and DPI (Forests) • DPI (Forests) advises that this should occur at Regional Manager	• Provides an opportunity for Council to voice concerns and/or catchment objectives • Organisations can seek co-operative solutions to problems – rather than be subjected to one's decisions	• DPI (Forests) is not obliged to produce management programmes to suit Council's objectives (but is willing to do so where there is an intersection of objectives)	Low	High	WSC, DPI (Forests)
	LA1b. Do nothing	• Nil	• Council is likely to continue to be unable to influence DPI (Forests) operations and engage in co-operative problem solving	Low	Low	WSC
LA2. Difficult to monitor activities of landholders	LA2a. Build landholder to Council networks	• Create partnerships with landholders • Negates some of the need for auditing and improves ability to educate • Opens a communication channel with land managers to allow rapid dissemination and assimilation of information	• Can be difficult to change old habits without the potential application of punitive measures	Low	Medium-High	WSC, Landholders

Issue	Option	Outcomes		Cost	Ability to address Issue?	Responsibility
		Benefits	Difficulties			
	LA2b. Conduct audits & issue orders to comply	• Enables targeted response to areas that appear to be degraded • Can force unco-operative landholders to improve their management activities	• Highly resource intensive • Likely to disaffect landholders found to be at fault	Medium	Low-Medium	WSC, Landholders
	LA2c. Do nothing	• Allows resources to be directed to obviously degraded areas • Ensure landholder activities are not adversely affected	• Likely to be missing significant sources of sediment, nutrients and other contaminants coming from poorly managed land areas	Low	Low	WSC, Landholders

7.5 SOIL LANDSCAPES

Objective LS: Protect and restore soil landscapes and improve understanding of land capability & suitability in the catchment

Soil landscapes are an important feature of the catchment. Unsustainable practices can affect the nature and diversity of both flora and fauna. Generally development has had the greatest effect on soil landscapes. In the early to mid 1900's, poor forestry and agricultural practices together with poor positioning of some housing development has led to increased exposure and erosion of soil landscapes. The loss of soils has a local ecological impact, however the estuary and rivers also directly suffer through bank destabilisation, increased sediment loads and associated turbidity.

There are a number of human activities that can increase the risk of soil erosion. In the catchment, this can include vegetation removal/loss and increased flooding, while for the rivers it includes boat wash, vegetation removal/loss and grazing. For the estuary, erosion of foreshore edges can occur where once shallow interfaces between the water and foreshore have been replaced with elevated interfaces. Foreshore management practices such as mowing and wrack removal can encourage the development of these elevated edges.

Land capability assessments provide an opportunity to address soil management into the future. The Estuary and Coastal Management Committee specifically requested the inclusion of land capability in the objective, to encourage the assessment of remaining developable land for its potential to provide sustainable soil landscapes after development.

7.5.1 Issues & Threats

LS1. Soil erosion enforcement is generally limited to the development process

Soil erosion mitigation is generally limited to inspection and enforcement of sediment and erosion controls during development activity. Council has assumed responsibility for rehabilitating some of the more degraded streambanks in rural catchments. These actions are aimed at minimising the sediment load being contributed to catchment waterways and ultimately the estuary.

There is a need for providing soil protection post-development. Activities by landholders (urban, agricultural and commercial) can contribute to soil loss. If these activities occur outside of a development setting, it is difficult for Council to monitor and where necessary target them.

LS2. Insufficient programmes in place to investigate and rehabilitate erosion sites

Generally, there are no programmes that research, identify and rehabilitate soil landscapes throughout the estuarine foreshore and catchment. There are some streambank rehabilitation works however these are limited to the water supply catchment. There are areas in the lower sections of the rivers and estuary which are at high risk of erosion. Contributing factors to this erosion include boat wash, vegetation removal and poor foreshore management practices.

LS3. Insufficient programmes or plans to determine land capability for the catchment

Land capability studies may provide good long term planning assessments of developable land. If combined with ecologically sustainable estuarine limits, it may be possible to produce a catchment wide plan for new development.

LS4. Limited funding for works to rehabilitate and manage land

It is important to consider who will pay for the protection of our natural resources. As most State land is devolved to Council to maintain and protect, it is likely that any increase in soil protection activity will have to be funded by Council. This funding may not be possible.

7.5.2 Options

Issue	Option	Outcomes		Cost	Ability to address Issue?	Responsibility
		Benefits	Difficulties			
LS1. Soil erosion enforcement is generally limited to the development process	LS1a. Ensure areas of responsibility are managed to best practice (including development of key performance indicators)	• Heightens priority of sediment & erosion control throughout the organisation • Council lead by example for those affected by sediment and erosion control requirements	• Resource implications when undertaking capacity building and associated support programmes	Med-High	Medium	WSC
	LS1b. Provide support and education for operators in the catchment • even where it is not in Council's administrative responsibility (DPI (Forests), DEC (Parks & Wildlife)) • become a centre of excellence	• Encourage interaction with designers and engineers operating in the catchment • May be able to influence practices by operators in the catchment over whom Council has no control (i.e. they turn to Council for design fact sheets and technical design criteria specific to the catchment)	• Resource intensive • Lack of available resources and/or skills in house • Question whether external agencies can be influenced to consult Council for design guidance	High	Low-Medium	WSC
LS2. Insufficient programmes in place to investigate and rehabilitate erosion sites	LS2a. Locate currently affected soil landscapes and target for remediation • Riverbanks • Wetlands • Agricultural areas • Forestry areas • Foreshores	• Ensures areas that require attention are addressed • Efficient use of limited funding	• Degradation has already occurred and is difficult to remediate • This approach represents an ongoing resource drain	Low-Med	High	WSC, DIPNR, Landcare

Issue	Option	Outcomes		Cost	Ability to address Issue?	Responsibility
		Benefits	Difficulties			
	LS2b. Investigate and assess "at risk" areas • Riverbanks • Wetlands • Agricultural areas • Forestry areas • Foreshores	• Allows measures to be taken before degradation occurs • Provides assessment and opportunity for intervention before degradation occurs • Potentially saves significant remediation costs in the long term	• Resource intensive • Determining responsibility for assessing and remediation (i.e. who should pay?)	Low	Medium-High	WSC, Department of Lands
	LS2c. Educate public on risks and how best to manage them	• Increases the number of people managing soil landscapes in the catchment • Strengthen landholder to Council networks which allow for rapid dissemination and receipt of catchment information	• Potential for liability if public takes advice and in implementing actions, damage to life or property occurs • Who should pay?	Low	Medium	WSC, Department of Lands
	LS2d. Increase funding to groups already undertaking such works	• Utilise existing experience and expertise to expand assessment and rehabilitation • Funding framework established • Organisations have proven success • Cheaper than consultants and potentially more attention to detail	• Could be seen as passing the buck • May be a reluctance among environmental groups to take on more responsibility • Who funds the additional monies?	Low-Med	Medium	WSC, Landcare, Department of Lands

Issue	Option	Outcomes		Cost	Ability to address Issue?	Responsibility
		Benefits	Difficulties			
	LS2e. Do nothing	• Minimise resource outlay • Maintain low risk of liability	• Degradation of soil landscapes will continue to degrade surrounding ecology and potentially downstream environs • Long term loss of soil productivity • Loss of habitat	Low	Low	WSC, Department of Lands
LS3. No programmes or plans to determine land capability for the catchment	LS3a. Conduct assessment of potentially developable areas for land capability	• Could be used to tie in with the sustainability assessments from the Diversity options – provide an overall picture of estuarine and catchment development limits • Allows intervention before unsuitable land is developed	• Who pays? • Would likely require multi-organisational involvement – potentially more difficult to manage and determine funding	High	High	WSC, Department of Lands, DIPNR
	LS3b. Do nothing	• Existing development processes remain intact	• Land likely to be developed in inappropriate areas resulting in increased potential for degradation of soil landscapes • Potential increase in liability for organisation with administrative responsibility	Low	Low	WSC, Department of Lands, DIPNR

Issue	Option	Outcomes		Cost	Ability to address Issue?	Responsibility
		Benefits	Difficulties			
LS4. Limited funding for works to rehabilitate and manage land	LS4a. Lobby State Government for funding	• Funding can be obtained through the government departments with administrative responsibility for soils – rather than compete with other un-related programmes (as in some grant programmes)	• Success will vary with political environment • Environment administration is being restructured at State level – uncertain of final arrangements	Low	Low-Medium	WSC
	LS4b. Lobby Federal government for funding	• Likely to be more successful in the local area – new CMA will be funded through the Federal NHT programme. Local electorates are marginal, and more open to election funding	• Funds may have to be shared centrally through the CMA – possible that funds could be channelled into other programmes in the CMA area concerned to be more important	Low	Medium	WSC
	LS4c. Do nothing	• Nil	• Council and Landcare will continue to rely on limited budgets for protecting and rehabilitating soil landscapes	Medium	Low	WSC, Landcare

7.6 RECOMMENDATIONS

7.6.1 Issues Identified by Reference Groups

The following issues were identified by business, community and technical reference groups as being most important to them out of a list of all land use and human settlement issues.

1. Difficult to monitor activities of landholders (LA2)
2. Insufficient programmes in place to investigate and rehabilitate erosion sites (LS2)
3. Insufficient programmes or plans to determine land capability for the catchment (LS3)
4. Market forces drive development more than environmental protection (LD4)
5. Limited funding for works to rehabilitate and manage land (LS4)

Issue 3 is about understanding how much land in the catchment is physically capable of supporting development. This assists in setting aside development and un-developable land and could be combined with an overall sustainable settlement strategy. A programme addressing this issue is more appropriately handled along with other social and economic issues in the following section. This is also true for Issue 4. Issue 5 is a general problem about funding studies and works for environmental programmes. It is addressed in the knowledge improvement section.

7.6.2 Suggested Programmes

Programmes	Associated Options
Audit sub-catchments for environmental compliance including sediment/erosion and contaminant controls	LA2b LS2b LS3a WE2e SC3a
Develop partnerships with developers and business operators to get innovative approaches to managing the catchment and estuary in a sustainable manner	LA1a LA2a LS1b

8 Social and Economic Needs

8.1 INTRODUCTION

This section defines the overarching principle and sets future objectives for managing social and economic needs in a way that is compatible with the estuary. In order to meet these objectives, it is necessary to a) define any issues that currently prevent the objectives from being met and b) implement options to address these problems.

The social and economic needs of Wyong shire are an important consideration in the management of the estuary. Where economic benefits can be obtained without either degrading or being likely to degrade the estuary, industry should be supported. Providing public access to the estuary is an important consideration for estuarine managers. The current level of access and amenity at lake beaches and recreational areas could be improved to encourage an increased level of public usage.

The remainder of the section examines each objective in detail, focussing on the issues that prevent the objective from being met, and providing potential options to address such issues.

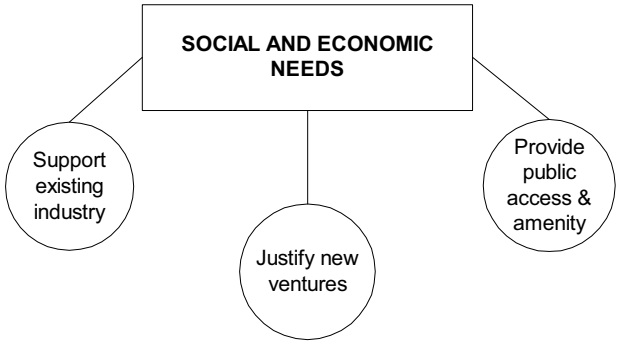
8.1.1 Principle

The Central Coast Catchment Blueprint identified a number of “first-order” objectives for ongoing catchment management. Social and economic needs in the coastal zone were one of the first order objectives and were expressed as:

The coastal zone environment is protected whilst providing for the social and economic needs of the community

This principle relates to the catchment but is also applicable to sustainable management of the estuary. The following objectives provide greater focus and detail for estuarine managers.

8.1.2 Elements



8.2 EXISTING INDUSTRY

Objective SE: Support existing industry where it is ecologically compatible

There are a number of industries operating in the coastal zone that both depend on a healthy estuary and are also in a position to influence the sustainability of the estuary.

Commercial fishing is an example of an industry that currently relies heavily on the estuary. This industry is a valuable part of the local economy, providing employment and stimulating other related businesses. There have been numerous calls by the community to ban commercial fishing in estuaries of NSW including Tuggerah Lakes. While there has not been a recommendation for the closure of the commercial fishery in Tuggerah Lakes, the objective allows for this occurrence should evidence of fishery-induced ecological decline be discovered.

This objective is not intended to set down new measures or threaten businesses operating in the coastal zone. It is intended to show support for existing industry, but to ensure that their operations are not damaging the estuary and ultimately the livelihood of other estuarine dependent businesses.

8.2.1 Issues & Threats

SE1. Little understanding of what existing industries need from the estuary

It is difficult to support and encourage existing industry if their needs are not well documented. There may be a number of opportunities to increase industry activity without detrimental effects on the estuary. Increasing dialogue between estuarine managers and business communities has the potential to find solutions that work for both.

SE2. Compatibility of businesses with the estuary is not well understood

There are a number of estuarine dependent businesses that operate in Wyong Shire. The Estuarine management process does not aim to end types of business activity. It is however, important to understand the risks that various businesses pose to estuarine health. Currently, there is insufficient information to assess this risk.

SE3. Environmental degradation is difficult to reverse once it has occurred

If an industry group or particular business has been found to have caused environmental degradation, it could be expected that responsible parties will be made to make appropriate reparations. There are a number of problems with this expectation. Firstly, it is generally very expensive to rehabilitate a degraded environmental feature or function. Secondly, the original industry activity would

most likely have been licensed to operate with certain conditions. If the activity is likely to produce environmental degradation, there is an argument that it is the responsibility of the appropriate authority to set conditions that limit the environmental degradation. In the event that an industry was found to be operating outside of appropriate licences and had caused environmental damage, the cost of rehabilitation may bankrupt the industry which then moves the cost onto the land or estuarine managers.

8.2.2 Options

Issue	Option	Outcomes		Cost	Ability to address Issue?	Responsibility
		Benefits	Difficulties			
SE1. Little understanding of what existing industries need from the estuary	SE1a. Increase dialogue between Chambers of Commerce and estuarine managers	• Existing industries that depend on the estuary are given an active role in influencing estuarine management (e.g. tourism and fishing) • Industries increase their understanding of estuarine issues and may become partners in estuarine management • Through their dealings with other businesses and clients, they can be used to channel correct information about the estuary, minimising conjecture about estuarine health and management actions	• Currently there is no vehicle for the kind of dialogue that can have on the ground outcomes – risks becoming a talk fest • Potential to become highly political • Requires the stakeholders to be open to learning and able to approach estuarine management with an open mind (difficult to separate when outcomes may harm business earnings) •	Low	High	WSC, Chambers of Commerce, Estuary and Coastal Management Committee
	SE1b. Undertake survey or research into needs of existing industries in relation to the estuary	• Provides a clear definitive account of industry needs • Gives industry an opportunity to air grievances, discuss concerns etc.	• Without corresponding education, risk industry making requests based on incorrect or outdated information on the estuary	Medium	Medium	WSC, Chambers of Commerce

Issue	Option	Outcomes		Cost	Ability to address Issue?	Responsibility
		Benefits	**Difficulties**			
	SE1c. Manage the estuary solely for ecology	• Minimise risks of repeating historic mistakes where community and resource wants were given priority	• Likely to alienate the community and business groups in relation to estuarine management • Without a corresponding education campaign, likely to become highly contentious within the community • Will require significant resources to monitor and implement estuarine management policies without the support of current estuarine users	Medium	Low	WSC
SE2. Compatibility of businesses with the estuary is not well understood	SE2a. Research and document areas of the estuary that are at risk or are likely to be at risk from business operations • Mining • Boat hire/charter • Caravan Parks • Golf Courses	• Target and document areas of the estuary considered to be degraded in terms of water quality, habitat, foreshore etc • Allows for specialised remediation programmes where necessary • Provide an indication of whether some business operations are contributing to the degradation	• Without a picture of "before" conditions –it may be difficult to assess degradation for some areas • Definitions of degradation may vary – white beaches may be barren in terms of diversity, but is pristine according to community • Could alienate business operators	High	Medium	WSC, DEC

Issue	Option	Outcomes		Cost	Ability to address Issue?	Responsibility
		Benefits	Difficulties			
	SE2b. Conduct ongoing monitoring in high risk areas of the estuary & catchment	• Could provide an ongoing picture of catchment/estuarine heath • Allows rapid assessment of level of degradation if it occurs • Could be used to provide benchmarking for remediation programmes	• Resource intensive • Defining "high-risk" areas is difficult • Potentially expending significant resources on sites that don't become problems – reduces funds for remediation sites that do become problems	High	Low-Medium	WSC, DIPNR
	SE2c. Do nothing	• Resources remain in tact – funds available to rehabilitate degraded areas • Less likely to alienate business operators	• Increased likelihood of degradation occurring • No definitive measure of ecological conditions that a degraded area would need to be returned to	Low	Low	WSC
	SE2d. Conduct review of estuarine dependent businesses and assess operations and potential impacts on estuary • Tourist operators • Sand mining • Commercial Fishing • Coal mining	• Target the businesses that benefit from a healthy estuary and ensure they are managing their operations in a way that will keep it healthy • Provides a dataset which will allow more targeted co-operation with businesses • Can utilise existing legal powers available to Council	• Could alienate business operators • It is not a co-operative approach to a problem, more a punitive approach	Med-High	Med-High	WSC

Issue	Option	Outcomes		Cost	Ability to address Issue?	Responsibility
		Benefits	**Difficulties**			
SE3. Environmental degradation is difficult to reverse once it has occurred	SE3a. Consider implementing estuarine and catchment friendly controls on business operators thought to be a potential risk	• Provides a first line of defence • Controls can be tailored to location and industry depending on perceived threat	• May stifle some businesses • Determining real risk posed is difficult • Who would pay for controls, implementation and ongoing support & monitoring • Does Council have the legal authority to implement retrospective controls on operating businesses	High	Medium	WSC, Local business
	SE3b. Increase funds and expertise available for remediation works	• Maximise potential for success of rehabilitation programmes	• Where would the expertise be built (i.e. in Council ?) • Where would the funding come from? • Remediation is still only possible after damage is done	Medium *Related to cost of increasing expertise not cost of increasing funds*	Medium	WSC

Issue	Option	Outcomes		Cost	Ability to address Issue?	Responsibility
		Benefits	Difficulties			
	SE3c. Increase dialogue between Chambers of Commerce and estuarine managers	• Existing industries that depend on the estuary are given an active role in influencing estuarine management • Industries increase their understanding of estuarine issues and may become partners in estuarine management • Through their dealings with other businesses and clients, they can be used to channel correct information about the estuary, reducing likelihood for further degradation	• Currently there is no vehicle for the kind of dialogue that can have on the ground outcomes – risks becoming a talk fest • Potential to become highly political • Requires the stakeholders to be open to learning and able to approach estuarine management with an open mind (difficult to separate when outcomes may harm business earnings)	Low	High	WSC, Chambers of Commerce, Estuary and Coastal Management Committee

8.3 NEW COMMERCIAL VENTURES

Objective SC: Ensure any new commercial venture is socially and economically justified and is ecologically compatible with the estuary

Mining is an example of where this objective would apply. Mining provides significant economic benefits to governments and local communities. Should mining be permitted, this objective would require that it is ecologically compatible with, and does not affect the sustainability of the estuary. This may be difficult for some mining techniques (such as longwall) that allow for subsidence. Subsidence of seagrass beds in the estuary could have significant implications for the ecology.

Again, this objective is not intended to prevent new ventures from taking place in the coastal zone. It does however provide a focus for which of the triple-bottom line objectives are being met.

8.3.1 Issues & Threats

SC1. Insufficient settlement, employment and conservation strategies

One of the difficulties for new commercial ventures in Wyong Shire is the lack of clear settlement, employment and conservation strategies. Without these tools, entrepreneurs are unable to assess the likely success of their venture and therefore less likely to invest in the local area.

SC2. Insufficient environmental impact modelling or pre-development ecological assessments

Before endorsing a new venture where estuarine impacts are possible, it is appropriate to understand both the type and the level of impact that the venture may have. One of the more significant new ventures being introduced in the catchment is large-scale residential development. Unfortunately, the pre-development conditions in the sub-catchment are not assessed. It is difficult to determine the level of impact a new development may have, or the design criteria that will be required if the existing conditions are not well understood.

SC3. Protective measures applied to development are difficult to monitor and enforce

One of the most effective ways of managing water quality and quantity from new development is through the use of prescriptive criteria set down as development conditions. It is generally very difficult to monitor and enforce these conditions post development.

Monitoring generally involves event-based sampling of nutrients and other physico-chemical variables. This is an expensive and resource intensive operation. Enforcing the conditions post-development is problematic because the responsibility of developers currently ends with the transfer of title to private landholders. This occurs well before the construction of houses and therefore before the water quality and quantity variables have stabilised to final levels.

8.3.2 Options

Issue	Option	Outcomes		Cost	Ability to address Issue?	Responsibility
		Benefits	Difficulties			
SC1. Insufficient settlement, employment and conservation strategies	SC1a. Investigate and produce a Development Blueprint that defines all aspects of future development in the shire	• Brings together the social, economic and environmental needs and wants of the shire • Allows for a balanced plan with complimentary outcomes (i.e. meet social, economic and environmental needs) • Strong tool for negotiating with developers & State	• Resource intensive • Who would fund? • Outcomes may disadvantage some industries • Councils plans for the shire may be overridden by State planning laws or legislation	High	High	WSC, DIPNR
	SC1b. Develop population and business development targets	• Provides a picture of what the estuary and catchment are expected to absorb • Long term planning allows for long-term environmental protection measures • Potential for economic mechanisms to be introduced to influence methods and rates of development (given that an final vision is articulated)	• Resource intensive • Who would fund? • Councils plans for the shire may be overridden by State planning laws or legislation • Outcomes may disadvantage some industries	High	Medium-High	WSC, DIPNR
	SC1c. Do nothing	• Difficult and potentially unpopular decisions are delayed	• Risks of further degradation of land, water and biodiversity • Resources can be directed to addressing existing estuarine and catchment problems	Low	Low	WSC, DIPNR

Issue	Option	Outcomes		Cost	Ability to address Issue?	Responsibility
		Benefits	Difficulties			
SC2. Little environmental impact modelling or pre-development ecological assessments	SC2a. Investigate use of models to determine appropriateness of proposed businesses • Environmental impact • Economic benefits • Social impacts	• Provide a quantitative figure on impacts and benefits of development • Allows a relative assessment to be made of the social, economic, and environmental benefits and how they relate to each other	• Resource intensive • Models generally only return data as accurate as the data that is entered • Council not likely to have quality data	Low	Medium	WSC
	SC2b. Convene a group responsible for validating the environmental, social and economic impacts of proposed businesses	• Applies a more holistic assessment of proposed commercial ventures – rather than just relying on landuse zonings and development conditions • Decisions will be strengthened by data as it is assimilated	• Legality of applying such an assessment which is outside the usual DA assessment considerations • Who would fund and support the committee • The absence of prescriptive criteria leaves the process open to emotional judgements	Medium	Medium	WSC
SC3. Protective measures applied to development are difficult to monitor and enforce	SC3a. Conduct audits & issue orders to comply	• Enables targeted response to businesses that appear to be impacting on estuary • Can force unco-operative businesses to improve controls	• Highly resource intensive • Likely to disaffect businesses found to be at fault	Medium	Low-Medium	WSC, Business Operators

Issue	Option	Outcomes		Cost	Ability to address Issue?	Responsibility
		Benefits	**Difficulties**			
	DC3b. Businesses that will operate in high risk areas of the catchment and estuary shall deposit performance bonds to be refunded on evidence of compliant treatment devices	• Ensure any protection measures work before damage is done • In the event of poor or under designed systems, the funds in trust can be used to correct problems	• Strong disincentive for business in the area which has flow on effects for the local economy • Costs likely to be passed on to consumers • Compliance may take months to evaluate	Medium	High	WSC, Business Operators
	DC3c. Educate new business operators in the importance of environmental controls	• Encourage business operators to be engaged with local environment and the measures Council has introduced to protect it • Contact can be used for other initiatives	• How would success be measured	Low	Medium	WSC, Business Operators
	DC3d. Do nothing	• Businesses are not encumbered with onerous red tape • Conditions are clear and measurable	• Best practices are never evaluated after being installed • Potential for continued degradation post development irrespective of pre-development controls	Low	Low	WSC, Business Operators

8.4 PUBLIC ACCESS

Objective SP: Provide for public access and amenity at designated beaches and in designated recreation areas

A difficult balance to achieve in estuarine management is that between ecological processes and public amenity. The above objective aims to ensure certain areas of the estuary are reserved and maintained for recreation, while others shall be reserved and rehabilitated where necessary for sustainable foreshore and estuarine management.

In areas of the estuary where recreation is most common, Council can apply for licences to maintain the area for maximum public benefit, including beach cleaning, wrack removal etc. Suggested areas where this may take place include: Canton Beach, Long Jetty, Chittaway Bay, Elizabeth Bay and Toukley Beach (near the Aquatic Club). This list is not definitive and is only intended as a guide. In areas designated for rehabilitation, public access to the waters edge could be restricted along with foreshore mowing, beach cleaning and wrack removal. This would have to be undertaken with considerable public consultation and engagement in a transparent manner.

The rationale for this objective is that the recreational areas of the estuary are already heavily modified and unlikely to be successfully rehabilitated for many reasons. This being the case, these areas could be improved (aesthetically) by undertaking more focussed maintenance programmes within tightly defined boundaries.

8.4.1 Issues & Threats

SP1. Insufficiently defined recreation areas

Designated recreation areas allow the public to enjoy a reasonable standard of amenity as a first consideration. In these areas, ecological considerations are secondary. Beach cleaning, seagrass and macroalgae wrack harvesting are all permissible provided they are contained within a designated zone. This allows the public to have an expectation of a standard level of amenity, while protecting the remainder of the estuaries ecological habitats. There would need to be provisions for identifying appropriate recreation areas and ensure that there is no overall threat to threatened species or communities (as discussed in section 5.3)