Desk Based Review

State of the Region Study

Volume 1

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Prepared by

For

Burnett Mary Regional Group for Natural Resource Management Inc.

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Compilation Note

This report results from a desk based review of extant information and the assembling of various natural resource data sets.

The report has been compiled and edited by Bill Thompson of LRAM using reports prepared for LRAM by the following persons:

- Adrian Webb who has extensively reviewed the water related issues
- Peter Shields who has compiled various common mapping data sets from diverse data sets
- Dr Vince Montgomery who has reviewed the agricultural land use and industry issues
- Danial Pagenham of QDNRM who compiled an extensive review of internal state agencies data sets and reports

The report has been prepared for BMRG and has benefited from the support of the BMRG as well as the cooperation of a large number of QDNRM, QDPI and EPA staff and scientists. The report remains limited in its ability to arrive at definitive statements on the State of the Region - partly because of extremely wide ranging resource issues involved but primarily because coverage from extant assessment remains incomplete in both spatial and/or thematic contexts.

The report is in four parts – all distributed on CD labelled as BMRG DRV2:

- Main Report v1.pdf – is volume 1
- Main Report v2.pdf – is volume 2
- Figure Directory on CD of maps and figures not included in this report in pdf format. All figures are formatted to A3 page layout but can be printed on A4 paper.

Where conclusions are drawn in this report, they reflect the views of LRAM based on these incomplete coverages.

Summary

Planning For NRM Outcomes

This State of the Region study has been primarily desk based. In this study, the initial focus was on determining what is known of the natural resource condition of the region and what are the main drivers which will or have effected change to that condition. With a few notable exceptions of varying degrees of utility to regional NRM planning (as discussed latter in this summary), the majority of what is known is project or thematic type knowledge – information and assessments assembled for a specific limited purpose or place. As a result significant gaps do exist.

In the latter stages of this review the study team has focussed on existing planning arrangements – in an attempt to determine the type of planning framework which would be most appropriate for using the known information to firstly develop a NRM plan and to then implement, monitor and evaluate such a plan. Whereas knowledge of condition trends is relatively complete, major gaps exist in the understanding of process links between land use, land management condition and trend and ultimately NRM outcomes. Whilst much of the planning is able to identify desirable NRM outcomes (eg reduction in nutrient loads) translating these outcomes into intervention strategies that can be sustained at the land user level requires a clear understanding of process. These process understanding gaps will mitigate the development of an NRM plan by firstly limiting the capacity of BMRG to prioritise implementation initiatives for their effectiveness in terms of outcomes, and, secondly by making it difficult to identify priority initiatives that are in fact feasible within the constraints that land users face.

Until and unless the key process understanding gaps are filled, regional NRM interventions run the risk of being largely project and site specific based focussing on the most obvious locations of degradation as opposed to the highest priority in terms of overall impacts.

Current planning initiatives include the following.

The Great Barrier Reef Water Quality Action Plan and its subsequent Reef Water Quality Protection Plan These plans identify targets and associated actions for managing the export of pollutants and sediments to the Great Barrier Reef Lagoon. The plans envisage a reduction of between 33 and 66% in current nutrient and sediment loads – to be achieved via a wide range of initiatives many of which require implementation within the terrestrial and freshwater aquatic environment of the catchments. Some initiatives target point sources of pollutants, however, the major targets of sediment and nutrient reduction would appear to be only achievable by interventions aimed at reducing diffuse sources and/or improving the capacity of rivers and streams to filter terrestrially derived pollutants.

These plans pre date the formation of BMRG. Under these plans the NRM regional bodies, such as BMRG, have stakeholder status in a number of strategies and direct implementing roles in a lesser number.

Environmental Values and Water Quality Objectives The EV and WQO planning process is relatively new in Queensland and is at a draft stage for the Mary and Burrum catchments. The process involves the establishment of environmental values at various points within the catchments and the nomination of appropriate water quality objectives. The process will undoubtedly prove of direct value in regulating point sources which are associated with environmentally referrable land developments and will ultimately reinforce other planning processes such as the various GBRMP initiatives as well as planning for coastal and marine

habitat areas which fall outside of the GBRMP. Initially the EV's and WQO's will focus their regulatory impact on the coastal and estuarine areas (coincidently areas where the existing water quality data sets are more extensive and there is a greater concentration of point sources). In the freshwater inland environments this process is likely to contribute to an advisory framework to guide other planning and implementation initiatives.

The roles of regional NRM bodies such as BMRG in this planning process are evolving. The State of the Region Review has concluded that the regional body should be actively involved in the process and that consideration should be given to extending the process to the Baffle catchment. Extending the process to the Burnett/Kolan catchments is seen as being more problematic until the various ecological and aquatic ecosystems studies under way as part of the Water Infrastructure planning process in the Burnett are substantively completed.

Water Resource Planning These planning processes deal with the issues of water allocation and environmental flows within the context of Queensland Water Act. The planning process is complete for the Burnett and Kolan and is in its final stages for the Mary. The planning process also pre dates the formation of BMRG. These plans are developed to their implementation stages with detailed targets. As a result, the direct role for BMRG in the context of Water Resource Planning remains unclear at this stage.

Regional Vegetation Management Planning This process has been undertaken within the framework provided by the Vegetation Management Act. Biodiversity planning is still in process. The current moratorium on broadscale land clearing has altered the framework environment in which such planning now occurs. The review has identified a number of key gaps to improving biodiversity outcomes – gaps which in the main will dictate the focus for improved biodiversity outcomes under any regional NRM plan.

Community Based Planning A number of catchment community based plans pre date the formation of BMRG. In the main, these are strategic initiatives rather than implementation focused plans. The main exception is the Mary River Rehabilitation Plan which involves a large number of individual projects. This review has concluded that the Mary River initiatives could be encapsulated into the regional NRM plan if the large number of projects were strategically prioritised.

Local Authority Planning Local Authority Planning for NRM outcomes takes place within Queensland Integrated Planning Act framework. Whilst these plans are required to reference and acknowledge other state planning implements and policies (eg land development aspects related to Water and Vegetation use) and in future may also have reference to EV's and WQO's as well as the various GBRMPA plans, IPA based planning remains largely shire based and focussed on land development as opposed to land management. Despite the fact that IPA based planning may lack a regional perspective, it is the primary formal planning process with the capacity to directly regulate freehold land use outcomes at the individual land user level. Using the IPA framework to deliver significant implementation components of a regionally based NRM plan is highly desirable and unavoidable. However, the utility of this important vehicle is constrained by:

- Its minimal focus on land management outcomes
- Overlapping sub regional frameworks that pre date the formation of the BMRG region.

GAPS within the Planning Framework

The obvious gaps in the above frameworks are two fold:

- Firstly, the existing plans deal with land use change and not land management. Land use changes such as water extraction and land clearing and point based pollutant flows to streams are explicitly dealt with in all of the above frameworks. Land management which generates diffuse pollutant loads or incrementally diminishes environmental values is not as well addressed by most of these plans.
- Even allowing for the fact that the focus in many of the plans is directed at land development, IPA based planning has yet to develop a format that has a regional perspective. Control and management of land development (particularly in the coastal plains) has yet to benefit from the regional direction and focus which should be flowing from the other initiatives.

BMRG Role in NRM Planning

Constraints to BMRG contributing significantly to the above frameworks include:

- Differences in the spatial mandate of BMRG versus other planning agencies
- Differing timelines across each of the above frameworks. In most cases BMRG post dates many of the above plans and as a result BMRG's own NRM plan whilst likely to benefit from these established frameworks will be restricted in its capacity to influence other planning outcomes

Opportunities however do exist to offset these constraints. As discussed above, some of the above plans will rely at least in part on BMRG initiatives for implementation of core activities and in the particular area of diffuse sources of NRM impacts.

There will be a need for BMRG to play a leadership role in facilitating changes to land management by establishing strong links to stakeholders and land managers as well as the institutional agencies. For this to be effective, land management options that contribute to NRM targets and which are socially and economically sustainable at the stakeholder and industry levels and which are based on process understanding between NRM outcomes and land management will have to be identified. There is also a need for an implementing framework to foster such change.

Just as there is a need for a framework and implementation plans with respect to land management, there is also a need for a more effective regional planning framework that addresses regional issues. In particular local governments not only need targets and objectives for NRM outcomes, but they also require assistance in inculcating methods for achieving these outcomes in their planning process. There is therefore likely to be a significant role for BMRG in this area of planning.

Communication, Understanding, Research and Development Needs

The above discussion high lights the challenges facing the transposition of condition based assessments into implementation plans via an understanding of the processes that operate in the landscapes of the region. The challenge is one of moving from an understanding of what needs to be done to how it can be done. The extensive use of and/or reliance of modelling and subjective indices algorithms in the State of the Rivers, the NLWRA and in some of the Water Resource Planning plans, contributes significantly to an understanding of what needs to be done, but ultimately not how it can be done. The IQQM modelling that underpins the WRP process is an obvious exception to this. This simplest example of this is the SedNet modelling that underpins the estimates of sediment and nutrient exports. It does identify grazing land uses as being important sources but provides limited insight into the land management interventions than could be employed.

There is an urgent need to rapidly move from description and depiction of the state of the environment to how interventions for better outcomes can be implemented. This will require an improved understanding of process. Unfortunately, the logic of this is somewhat circular. If there was a better understanding of process for NRM issues, there would be no need to use algorithmic indices and models to identify intervention strategies. What the current indices and modelling approach does do is assist in identifying the key gaps and threats. These gaps and threats will require further research and evaluation before effective communication and understanding can be undertaken.

Threats and Gaps of Priority to a Future NRM Plan

The review has identified a number of threats and gaps which the future NRM plan is likely to have to address.

Dryland Salinity

The current distribution of salinity outbreaks is reasonably well understood, however, the scale in terms of land area affected, realistic intervention strategies and resultant off site negative impacts remains unclear.

Further investigations of this theme are required in order to support its inclusion in any subsequent NRM plan. Priority needs to be placed on accumulating this data to support the NRM plan development. A review of the Priority Action Plans has indicated that some of this supporting information could be gathered in 2004 using existing data sets and the accumulation of new data.

Land and Wind Erosion

Land and wind erosion have not been identified as specific issues within the study area with the exception that modelling has indicated that that sediment from the grazing and forested lands supplies the majority of the sediment to the basins. These land uses comprise up to 80% of the land use area within the basins. In order for the Reef Water Quality Protection Plan targets to be achieved, there is an urgent need to identify the location and scale of management practises and current erosion so that these issues can be targeted under plan implementation.

A review of the Priority Action Plan has indicated that the Grazing Land Management issues could be dealt with in 2004 under a modified PAP; however, identifying spatial targets for intervention will remain a major gap.

Acid Sulphate Soils

This review has identified that the mapping of acid sulphate soils is incomplete for the study area, but that existing soils mapping when combined with the acid sulphate soils mapping may be sufficient to provide a regional hazard assessment. The Reef Water Quality Protection Plan has identified acid sulphate as an area of concern. An appropriate target for such an activity would be the compilation of existing data into a format that would allow the formulation of management recommendations by local authorities as part of their development assessment processes.

Terrestrial Ecosystems and Biodiversity

The regional ecosystems mapping and the biodiversity planning assessment provide an adequate regional database for this theme. The Vegetation Management Act and state policies and regulations that follow from that act provide a powerful basis (in terms of condition status) on which to regulate land clearing. Target setting based on maintaining the

conservation status and current distribution and linkages between these ecosystems should be feasible, but will require the transposition of the current inventory/condition assessment approaches into formats that identify clear targets and objectives.

Both this review and the various catchment strategic plans have identified a number of land management issues within this theme:

- Condition status with respect to weeds remains unclear.
- Land Management impacts (eg grazing and forestry as well as fire management) on biodiversity and condition remain poorly understood.
- Given that broadscale clearing ceases in the region, the major threats from land development to the biodiversity values at a site level and to the integrity of the ecosystem estate is within the coastal lowlands where there is a conjunction of population growth, large reserves of non rural future residential land and extensive remnant and intact terrestrial ecosystems.

Following a reviewing the PAP's, it has been concluded that with appropriate redesign of some of the PAP's, some of the necessary information on which to base NRM Plan interventions can be obtained in 2004.

Coastal, Marine and Estuarine Ecosystems

The wetlands, fisheries and dugong mapping for the area would appear to adequately categorise these ecosystems at a regional level. Unlike the inland aquatic ecosystems where the lack of data on the actual distribution and the linkages between ecosystems components mitigates against basin specific planning, management planning with supporting legislative and regulatory bases are in place for these coastal and marine areas. The major challenges for these areas lie in achieving land use development and management outcomes in catchment areas that supports management in these areas by reducing export of pollutants to these areas.

Inland Aquatic Ecosystems

Whereas terrestrial ecosystems (and to a lesser extent coastal and marine systems) are reasonably well understood, inland aquatic ecosystems are far less comprehensively assessed and the assessments often have adopted differing methodologies and approaches.

In the case of the Burnett and those parts of the Kolan to which the Burnett findings can be extrapolated, there are a significant number of knowns and a considerable amount of on going research concerning the inland fisheries habitats and the management requirements to facilitate fish movement and provide sustainable aquatic conditions both for important species such as the lung fish as well a maintenance of biodiversity.

The Baffle and Burrum basins are less problematic that the Burnett – primarily because on most condition assessment criteria, these Basins are less degraded than the Burnett and the inland aquatic systems remain relatively intact.

In the Mary Basin, the Mary Catchment Rehabilitation Plan provides a starting point for future investment in inland aquatic ecosystems. This plan identifies specific projects targeting degraded sections of the system. The plan probably needs revising and abstracting into the BMRG NRM plan. No such specific project level plans exist for the other basins. In the case of the Mary, the PAP which focuses on River care initiatives for implementation under a future NRM plan should complete these requirements.

The development of an inland freshwater aquatic management and rehabilitation plan is likely to be feasible once all of the above on going studies are completed and should be given a high level of priority under the NRM plan.

Environmental Values and Water Quality Objectives

These methods of prioritising investment in water quality outcomes involve the establishment of both what the water at certain points is suited for as well as the stakeholder's use of the water (EV) and nominating targets (WQO) for water quality. EV's and WQO's are likely to be the main process which underpins management of aquatic environment in the future.

In the Burnett and Kolan, competition and trade off in values and the commercial importance of water resources will complicate the development of Environmental Values (EV's) and Water Quality Objectives (WQO's).

The development of EV's and WQO's for the Baffle and Burrum should be a much less complex process than in the Burnett and in the strategic medium to long term could be argued as being of higher priority due to land use and development pressures which are likely to arise within the coastal lowlands

Draft EV's and WQO's for the Mary and Burrum based on a process of community consultation are in preparation and due for release in 2004. Subject to the success of this process, it would seem appropriate that a similar process be extended to include the Baffle Basins in 2004 and subsequently to the Burnett/Kolan. This process offers the best opportunity to establish Basin and subcatchment specific targets for inland aquatic ecosystem outcomes.

It is imperative that an EV based approach be supported and indeed guided by an adequate water quality and monitoring data base that covers both ambient and longitudinal monitoring. One of the PAP's planned for 2004 will address community water quality monitoring programs (primarily ambient), however the desk based review has identified considerable gaps in both ambient and longitudinal monitoring data sets of the line agencies. A review of these is critically required and has recently commenced under a state wide state initiative.

Weeds and Feral Fisheries

A key sub theme within the inland aquatic environment is that of Aquatic and Riparian Zone Weeds and Feral fisheries. Little is known about the distribution of these as issues of concern – except that a number of aquatic species have been identified, many of which have a preference for impoundments, whilst environmental weeds are endemic and occasionally dominant along parts of the River systems – particularly the Mary River.

Management strategies to slow and or eliminate the invasion of these species are required; however, there is a lack of data on the distribution of these communities within the region as whole which would allow other than aspirational targets to be set at this stage.

There is almost no data on the distribution of exotic aquatic weeds/pests/fisheries in the Burnett Mary region outside of the impoundments on the Burnett system. This aspect is seen as a high priority (at an aspirational level of target setting) to establish the current level of risks posed by exotic weeds, particularly in the upper parts of the river systems.

Stream Hydrology

Within stream hydrology impacts on water quality relate primarily to the management of the low flow regimes. The Mary River in its middle and lower reaches above the barrage currently has elevated nutrient levels, whilst the low flow regime and management within the Burnett/Kolan Basin impoundments is also of concern. As most of the upper reaches of the Burnett sub catchment are currently unregulated by structures, and where storages do exist, the levels of allocation are relatively high; there may be limited scope for proactive manipulation of the Burnett system.

The series of studies underway within the Burnett (eg Boardman recommendations) in conjunction with the WRP process is expected to provide a heightened level of understanding of these issues and ultimately result in targets under the NHT2/NAP framework.

Water Use Efficiency

This issue aims primarily at the reducing extraction from rivers and storages for non environmental uses. Improved water use efficiency practises have been identified by a number of industries; however, the contribution of adoption of these processes to within stream outcomes remains unclear, whilst the level of actual adoption also remains unclear.

There are a number of partially or unlined header command systems in the region and losses may well be of local significance irrespective of their basin wide significance. Storage and transmission losses within the irrigation network have been estimated in the Burnett at between 20 and 25% of diversion within channels between the pump station and the irrigation farm gate. These loses translate to approximately 500 ML/day out of a total pumping capacity of approximately 2000 ML/day. The contribution of any reduction in these losses to improved within stream outcomes remains unclear. The impact of these loses on improved groundwater availability also appears to be a matter of some speculation as is the potential negative impact on salinisation within the coastal lowlands.

Further studies on water use efficiency are required before identifiable targets can be set. In particular these studies should be co-ordinated and integrated with the assessment of groundwater salt water intrusion within the extended Bundaberg groundwater area.

Coastal Development

The region has yet to experience the levels of coastal development that have come to characterise southern Basins.

The scant monitoring network that is in place does not suggest at this stage that the current levels of development are major causes for concern. However, the projected level of urban, non rural and industrial land use is high and the region is reputed to be experiencing significant non rural based population growth.

Ultimately however, the local authorities under the Integrated Planning Act will have to adopt and implement targets for coastal development. It is critically important that the development of these targets be done in conjunction with the existing regional planning and advisory structures.

Groundwater pollution

Within the groundwater management areas of the region, the major threats and issues are associated with salt water intrusion within the groundwater provinces where the groundwater is an important economic asset (eg Bundaberg Irrigation Area) or potentially important for

depended coastal ecosystems (in the coastal sand mass areas). Whilst negative impacts of intrusion are well known, much of this information would appear not to have been collated into a format that would inform future investment in mitigation strategies.

The Bundaberg District Groundwater Advisory Committee in submissions to NRM, Sunwater and the Department of State Development (Sept 2003), have indicated that an integrated plan is urgently required and that the substantial amount of investigations undertaken since 1996 should be able to form the basis of a suitable plan.

Desk Based Review

1 Introduction

This report covers the results of a desk based review of documentation and reports covering natural resource values and management issues within the Burnett Mary Catchment.

The context adopted for this desk based review is that provided in the National Framework for Natural Resource Management Standards and Targets. This framework outlines approaches to establishing NRM standards and targets for the National Action Plan for Salinity and Water Quality (NAP) and its Intergovernmental Agreement (IGA) as well as NHT2. The Burnett Mary Regional Group for Natural Resource Management Inc. (BMRG) is one of a number such groups established under the NAP.

A large number of reports and strategic analyses have been accessed in compiling this desk based review. Most if not all of these reports pre date the NAP/NHT2 and associated framework and have used frameworks and methods of presentation applicable to particular regional requirements and strategies. This desk based review has been undertaken to:

- Compile existing reported knowledge into a context and framework that is consistent with the NAP framework
- Identify content of existing knowledge which is consistent with NAP requirements
- At a preliminary level identify regionally specific issues or targets which would add value to the NAP requirements
- At a preliminary level, identify core gaps in the existing assessments.

During the latter stages of this review, the Guidelines for Target Setting for Regional Natural Resource Management Planning were released. Whilst it is important to the ultimate development of the BMRG NRM plan that these guidelines be followed, we have been unable to incorporate these guidelines substantively into this desk based review given the constricted timeframe.

2 Overview of Burnett Mary

2.1 Catchments within the Burnett Mary

The Burnett Mary area contains a number of independent surface hydrology systems (Figure 2.1). The area has been divided into subcatchments under the Water Resource (WRP) and Resource Operations Plan (RoP) of NRM as well as under the State of Rivers reports. These are summarized in Table 2.1a-e.

Figure 2.1 River Basins

Table 2.1a Baseline Statistics Baffle Basin

Subcatchment	Total Area '000 ha	Percentage Cleared (c)	Average Runoff '000 ML/year (g)	Runoff as mm from Total Area (g)	Total Surface Water Extractions (Allocations) ML/year (a)
Baffle Ck	257	47	266	190	7822
Baffle Coast	144	24	ND	ND	ND
	401	38			

g= data from stream gauging stations, ND= No Data, a= NLWRA Surface Water and Groundwater – availability and quality c = calculated as the area mapped as cleared or disturbed in Version 4 of Regional Ecosystems mapping coverage as a percentage of the sub catchment area.

Table 2.1b Baseline Statistics Burrum Basin

Subcatchment	Total Area '000 ha	Percentage Cleared	Average Runoff '000 ML/year (g)	Runoff as mm from Total Area (g)	Surface Water Mean Annual Diversions '000 ML/year (a)	Extractions as % of Mean Annual Flow (r)
Cherwell R	20	93				
Burrum R	71	77				
Burrum Coast	31	45				
BURRUM R	122	72	40	177		
Elliot R	39	27	40	180	6.8-8.0	87-89
Elliot Coast	32	65				
ELLIOT R	71	44				
GREGORY R	88	56	52	114	3.2-5.9	96-98
ISIS R	53	73	64	142	1-1.3	99
BURRUM	333	62				

g= data from stream gauging stations, ND= No Data, a= NLWRA Surface Water and Groundwater – availability and quality r= Burnett WRP Conditions and Trends NRM 2000

Table 2.1c Baseline Statistics Kolan Basin

Subcatchment	Total Area '000 ha	Percentage Cleared	Average Runoff '000 ML/year (g)	Runoff as mm from Total Area (g)	Surface Water Mean Annual Diversions '000 ML/year (a)	Extractions as % of Mean Annual Flow (r)
Gin Gin Ck	73	61	64	122		
Kolan R	206	52	138	57		
Kolan Coast	11	84	6	150		
KOLAN	217	54			84	76

g= data from stream gauging stations, ND= No Data, a= NLWRA Surface Water and Groundwater – availability and quality r= Burnett WRP Conditions and Trends NRM 2000, c = calculated as the area mapped as cleared or disturbed in Version 4 of Regional Ecosystems mapping coverage as a percentage of the sub catchment area.

Table 2.1d Baseline Statistics Mary Basin

Subcatchment	Total Area '000 ha	Percentage Cleared	Average Runoff '000 ML/year (g)	Runoff as mm from Total Area (g)	Surface Water Mean Annual Diversions '000 ML/year (a)	Extractions as % of Mean Annual Flow (r)
Yabba Ck	75	61	132	212	ND	ND
Wide Bay Ck	75	33	66	100	ND	ND
Kandanga Ck	19	48	55	398	ND	ND
Glastonbury Ck	15	39	29	122	ND	ND
Upper Mary R	177	41	654	312	ND	ND
Munna Ck	147	46	200	168	ND	ND
Tinana Ck	129	29	233	199	ND	ND
Lower Mary R	308	43			ND	ND
MARY	1054	44	1174	160	ND	ND
SANDY STRAITS	106	65			ND	ND

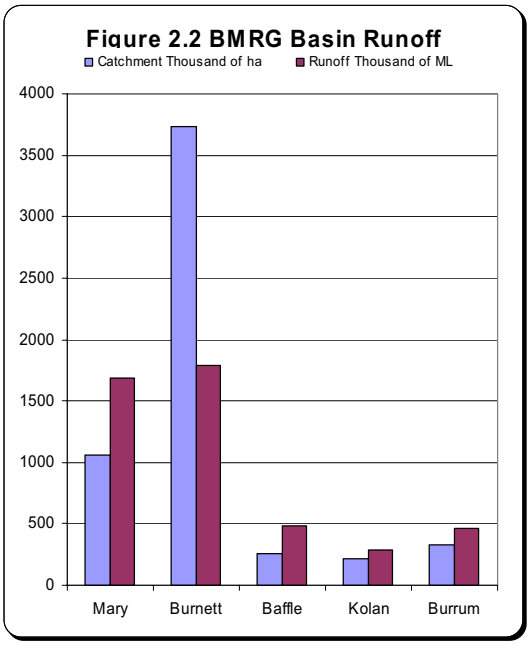
g= data from stream gauging stations, ND= No Data, a= NLWRA Surface Water and Groundwater – availability and quality r= Burnett WRP Conditions and Trends NRM 2000, c = calculated as the area mapped as cleared or disturbed in Version 4 of Regional Ecosystems mapping coverage as a percentage of the sub catchment area.

Table 2.1e Baseline Statistics Burnett Basin

Subcatchment	Total Area '000 ha	Percentage Cleared	Average Runoff '000 ML/year (g)	Runoff as mm from Total Area (g)	Surface Water Mean Annual Diversions '000 ML/year (a)	Extractions as % of Mean Annual Flow (r)
Barker Ck	167	77	48	33		91-93
Boonara Ck	151	70	56	40		96-100
Barambah Ck	278	70				
BARKER BARAMBAH	596	72	223	40	40-57	80-84
Stuart R	174	85	46	30		84-90
Cadarga Ck	174	91	13	11		100
Auburn R	561	43	161	30		100
Boyne R	394	67				
BOYNE	1304	63	169	36	48-55	69-71
Bayullla Ck	24	32	14	81		
Three Moon Ck	160	51	60	33	12-14	75-77
Nogo R	253	75	2	9		68
St John Ck	72	61				
Reid Ck	79	75	24	108		
Upper Burnett	353	54	775	33	36-47	89-87
Lower Burnett	489	75				
BURNETT	1430	66				
	3731	63	1434	48	230-242	89-90

g= data from stream gauging stations, ND= No Data, a= NLWRA Surface Water and Groundwater – availability and quality r= Burnett WRP Conditions and Trends NRM 2000, c = calculated as the area mapped as cleared or disturbed in Version 4 of Regional Ecosystems mapping coverage as a percentage of the sub catchment area.

The main river basins total some 5.6 million ha with the Burnett alone of 3.7 million ha (Figure 2.2). Whilst the Burnett is the largest catchment in terms of both area and runoff, it has a relatively lower runoff yield of under 50 mm per ha compared with the other basins at between 100 and 200 mm/ha/year. The coastal and Mary catchments all have much higher rainfall than the Burnett which derives most of it runoff water from the lower rainfall inland.



The Baffle, Kolan and Burrum Basins all have coastal catchments which flow directly to the sea. Data on flow regimes and extractions from these coastal catchments are scant whilst the Mary River has yet to complete its Water Resource Planning activities.

Allocation and extraction from the Burnett and the Kolan have been estimated at between

70 and 90% of mean annual flow. It is likely that the Mary River with its higher catchment yields will have lower percentage water extractions than the Burnett and Kolan Basins.

2.2 Irrigation and Groundwater Areas

The extent to which stream flows in the Burnett Mary are regulated by physical structures and associated operation and management plans varies widely (Figure 2.3 within Map Folio). The Burnett declared irrigation area extends across the lower end of the Burnett Basin and into the Burrum Basin as well as the regulated sections of the Kolan Basin. This irrigation area primarily supports cane and horticulture and is augmented by the Bundaberg declared groundwater area.

Other declared irrigation areas include the Mary River irrigation area associated with the cane industry of the Maryborough area and a small declared area at Pie Creek upstream of Gympie.

The sand mass of Fraser Island is a declared groundwater area as is the Monto/Mulgildie area in the Upper Burnett where irrigation of field and forage crops dominates groundwater use.

The Great Artesian Basin and Callide groundwater areas extend into the western edge of the study area.

2.3 Land Use

2.3.1 Land Uses within the Region

The distribution of land use for the study area is shown in Figure 2.4 (within Map Folio) and summarized in Table 2.4.

Table 2.4 Summary of Land use

	Conservation ha	Forestry ha	Grazing ha	Intensive and Dairy ha	Dry Crop ha	Horticulture ha	Other Irrigation ha	Industrial and Mining ha	Urban and Rural Residential ha
Baffle	76218	8023	280805	700	1430	1200	1540	260	23040
Burnett	186567	410448	2873134	29760	82590	8800	64260	6200	49330
Burrum	46647	66638	166595	370	949	2273	33775	2202	7818
Kolan	17415	19591	156732	341	353	888	17874	222	10828
Mary	242526	210892	453418	29967	1204	8523	25265	7480	55410
Sandy Strait	70	26	3	6		9	122	431	873
Total excl. Sandy Strait	569373	715592	3930684	61138	86526	21684	142714	16364	146426
%	10	12	69%	1	1.5	<1	2.5	<1	2.6

Grazing is the dominate land use in area terms followed by conservation and forestry uses. These uses also contain the greater part of the remnant vegetation of the study area and their land management is therefore important to the protection of the terrestrial ecosystem values.

Dryland cropping forms are largely restricted to the Barambah, Stuart and Boyne subcatchments within the Burnett Basin – principally in the Proston/Durong area (where some of the Central Queensland/Dawson Callide dryland farming system are extensive) and in the peanut, corn and pulse crop farming systems of the Kingaroy, Kumbia and Wondai areas. Whilst dryland cropping is a small land use in overall basin and study area terms, its

concentration in particular areas makes it locally significant. As discussed elsewhere in this review, it is these inland areas which currently show secondary salinisation outbreaks.

Intensive livestock and dairying occupies a similar proportion of the study area to dryland cropping. In the main these uses are highly dependent on access to irrigation water. In the Mary Basin these uses are as extensive as all other forms of irrigation (largely cane farming systems) and are commonly contiguous to the riparian zone. In the Burnett these uses are proportionally less important, however, they are possibly of significance in the middle and upper reaches of the system (particularly the Barker/Barambah area) where they tend to dominate land use in the riparian zone as in the Mary but stream flows are less reliable than in the Mary.

Horticulture (predominately irrigated) takes a number of forms. It is common in the Burnett Basin but is restricted largely to the riparian irrigated orchards in the Gayndah/Mundubbera area and to annual based crops within the Bundaberg irrigation areas where it extends over into the Burrum basin. Horticulture within the Mary basin is dominated by perennial tree crops and is less reliant on irrigation supplies.

Irrigated cropping (largely cane) is concentrated in the main irrigation areas of the Burnett and Mary. Cropping extends along the key riparian reaches of streams such as the Barker Barambah and Three Moon Creeks where farming systems including cotton, grain and legumes dominate.

The areas allocated to the two non rural forms of land use (industrial and mining) and urban/rural residential currently exceed that of irrigated cropping. These uses occur throughout the catchment but are disproportionably represented in the Baffle and Kolan Basins where there has been extensive subdivision of rural lands as well as in the Mary and in the upper Barambah/Barker Creek areas. In the Baffle basin, these subdivisions are also coincident with extensive areas of remnant vegetation within the coastal plains.
Whilst residential and industrial uses have yet to develop totally over this area, current land tenure and planning arrangements indicate that up to 3.5% of the study area is allocated to these uses. Developmental pressures are likely to increase along the coastal areas associated with the tourism sector and the land based servicing of this sector. Apart from the Whale Watching industry and Fraser Island, the coastal region has long been recognised as an important recreational fishing and boating resource serving both tourism and an increasing residential population.

2.3.2 Rural Land Use Management

Graziers and farmers are the land managers for over 75% of the Burnett/Mary region. Climatic influences have led to the development of intensive continuous crop systems in coastal areas with rainfall in excess of 1000mm and less intensive fallow-crop systems further inland with rainfall in the 700-800mm range. On poorer soils or steeply sloping land, cattle production from native or sown pasture is the major enterprise. Overall, 69% of the region is devoted to extensive grazing of cattle, with intensive livestock and dairy production occupying 1% of the region. Dryland crop production (peanuts, maize, grain sorghum) with 1.5%, horticultural tree and annual cropping, <1%, and irrigated crops (sugarcane, soybeans, cotton) 2.5% are the remaining major agricultural land uses. The grazing industry as a percentage of land use is more significant in the Burnett, Baffle and Kolan catchments (>70%) with 43% in the Mary catchment. Dryland crop production is significant in the south Burnett, while irrigated cropping and horticulture are more significant in the lower Mary, Burnett, Burrum and Kolan catchments.

Current Land Management Practices

Current land management practices for the region and their potential consequences for land and water degradation are comprehensively reviewed in the Productivity Commission report "Industries, Land Use and Water Quality in the Great Barrier Reef Catchment" (2003). These are summarized in table 2.5, which is adapted from table 5.4 of the Productivity Commission Report.

Table 2.5 Current management practices relevant to the Burnett/Mary Region

Water Quality and salinity possible causes	Main industries/ activities	Potentially harmful practices	Potentially beneficial practices
Sediments and rising saline water tables			
Loss of groundcover	•Beef •Dairy •Sugar •Horticulture	•Overstocking •Land clearing •Frequent and intensive crop cultivation •Leaving ground bare during fallow	•Spelling •Spreading cattle via feed and watering points •Keeping or planting natural vegetation •Minimum tillage •Cover crops between rows and during fallow periods •Harvesting leaving debris (eg green cane trash harvesting) •Buffer zones between activity and waterways •Alternative watering points
Streambank erosion	•Beef •Dairy •Sugar •Horticulture	•Excessive cattle access to waterways •Cultivation close to waterways	•Fence riparian strips •Moderate riparian grazing pressure •Erosion control structures •River bank restoration and revegetation •Buffer zones between activity and waterways
Nutrients (mainly N and P)			
Overuse or misapplication of fertilisers	•Sugar cane •Horticulture •Cotton	•Application beyond plant needs •Application near waterways	•Precision methods and scheduling application (eg soil tests, account for weather and irrigation timing) •Use of more benign fertilisers
Loss of riparian filters	•Beef •Dairy •Sugar cane •Horticulture	Activity close to waterways (eg cropping, grazing)	•Moderate grazing pressure near riparian zones •Buffer zones between activity and waterways
Urban sewage and stormwater	•Coastal development	•Discharge into rivers or directly into the GBR World Heritage Area •Leakage from septic tanks or overflow of sewage system	•Secondary and tertiary treatment of sewage •Use of gross pollutant traps and artificial and natural wetlands
Other pollutants			
Overuse or misapplication of herbicides and pesticides	•Sugar cane •Horticulture •Cotton	•Over application of chemicals	•Weed and pest monitoring •Integrated Pest Management •Use of more benign chemicals •Coordinating application with irrigation activities
Disturbing potential acid sulphate soils	•Coastal development •Aquaculture	•Poor site selection	•Planning site selection •Maintaining vegetation and ground cover

Water Quality and salinity possible causes	**Main industries/ activities**	**Potentially harmful practices**	**Potentially beneficial practices**
	•Sugar cane •Horticulture		
Irrigation	•Sugar cane •Horticulture •Cotton	•Over irrigating	•Irrigation scheduling •Use of more efficient irrigation systems (eg drip irrigation and retention of tailwater)
Increased impermeable surfaces and fresh water runoff	•Coastal development	•Poor urban planning	•Effective stormwater systems (eg gross pollutant traps, artificial wetlands)

Sustainable Management Initiatives

Primary producers face increasing pressure from government and the wider community to adopt sustainable production systems. A general "environmental duty of care" by producers is required under the "*Environmental Protection Act 1994*".

The preparation of industry Codes of Practice has been documented by QFF (2003). These codes, as well as Best Management Practice (BMP) and similar initiatives are voluntary actions taken by industries toward greater environmental responsibility. The Minister for Environment may approve Codes of Practice providing they state "ways of achieving compliance with the general environmental duty for any activity that causes or is likely to cause environmental harm".

The following Codes of Practice have been approved:

- CANEGROWERS *Codes of Practice for Sustainable Cane Growing in Queensland*
- Queensland Fruit and Vegetable Growers *Code of Practice for Sustainable Fruit and Vegetable Production in Queensland*
- Queensland Pork Producers Inc *Environmental Code of Practice for Queensland Piggeries*
- CANEGROWERS *Fish Habitat Code of Practice*
- Queensland Dairyfarmers' Organization *Queensland Dairy Farming Environmental Code of Practice*
- Australian Prawn Farmers' Association *Environmental Code of Practice for Australian Prawn Farmers*
- The cotton industry has taken a slightly different approach by developing and promoting a Best Practice Management program in order to minimize the environmental risks associated with pesticide use.

Agrilink manuals are produced by DPI (Horticulture) for the major tree and vegetable crops in the region. These provide growers with best practice management information to achieve positive economic and environmental outcomes.

Similarly, although no codes of practice have been developed for the dryland broad-acre crops such as winter cereals, grain sorghum, maize and peanuts, DPI has produced Crop Notes which contain grower friendly information on best management practices.

Activities involved in managing ground cover in extensive grazing systems were outlined in The Productivity Commission Report (2003) and include:

- conservative grazing pressure
- adequate distribution of water, food and shelter
- control of weeks and pests
- reclamation of degraded land and maintenance of riparian zones and conservation areas.

Two of the above are addressed specifically in the strategies of the Mary River and tributaries Rehabilitation Plan (2001) viz: "Maintain adequate riparian buffers and erect riparian fencing and exclude or actively manage stock access to stream, include provision for off-stream watering and shade, and hardened access points.

In addition, Best Management Practices for grazing lands in the BMRG are being developed within the Grazing Land Management Information Package (Elphinstone, pers com 2003).

Adoption of Sustainable Management Practices

Data on adoption rates of sustainable (and other) management practices are not readily available for most industries in the region or for the rest of Queensland.

A number of initiatives to improve adoption of industry codes of practice and other management options leading to industry sustainability are current or planned in the near future. They include:

COMPASS – COMbining Profitability And Sustainability in Sugar.
The COMPASS program was launched by CANEGROWERS and SRDC in 2002. It is a self-assessment process to assist growers to review their farming practices, offering both financial and environmental outcomes. Delivery is by one-day workshops for growers.

Best Practice Harvesting of Sugarcane. Juice losses of up to 28% and which represent a potential source of water pollution have been dramatically reduced with resulting improved profits for growers and millers and minimize adverse environmental effects.

Green cane harvesting and trash blanketing are widely adopted in the sugar industry (SRDC, 2002). Retention of trash on the soil surface dramatically reduces run-off and soil loss and in 2002, over 72% of the cane area was harvested green, 79% in the Burnett and 43% in the Mary.

The Australian Cotton Industry "Best Management Practices Manual". The manual recommends a management cycle of "Assess, Plan, Do, Check, Review". Growers rate themselves and following completion of the manual, growers are audited by CRDC-approved auditors.

Queensland Fruit and Vegetable Growers has not assessed the adoption of elements of the Code of Practice for sustainable Fruit and Vegetable Production in Queensland. However, a program to assess adoption of the code is to commence in 2004, with some activity planned for the Burnett/Mary region (Muller, QF&VG, pers com 2003).

In addition, DPI, through AGSIP (Cawley, pers com 2003), is proposing appointment of a suitably qualified person in 2004 to work with horticultural growers in the Burnett/Mary

region to benchmark movement of pesticides and nutrients and identify priority at risk practices (Maltby, pers com 2003).

A related initiative through AGSIP to commence in 2004 will benchmark pesticide and nutrient movement in horticultural (tree, vegetable and amenity), and new cane farming systems (reduced tillage, legumes and controlled traffic). This is to provide better quantification and understanding of type and amount of movement from horticultural and new cane systems.

Reduction of run-off and soil loss in the dryland cropping areas of the south Burnett can be achieved through reduced frequency of tillage (including substitution of herbicides for tillage) and retention of crop residues on the soil surface (Montgomery and Leslie, 1986). More recently, Claridge *et al*. (2001) used a range of modeling tools to investigate catchment water balance with various crop/pasture/eucalypt plantation combinations on permeable red soils of the south Burnett. They showed that:

- Improving infiltration with ley phases and zero tillage changed water losses from run-off to deep drainage
- Depth of water extraction was similar from crops or pastures but trees increased the depth three-fold.

The solution to rising watertables and saline outbreaks appeared to lie in land management changes within the intake/recharge areas of outbreaks. The economics of the required changes to these practices is yet to be assessed. This work is to be followed up in 2004 with funding through AGSIP to further assess the impact of land use change on salinity and water quality at a property or sub-catchment scale.

A major theme from AGSIP is Landscape Management which is about further developing and applying processes for multiple industries and stakeholders to engage in meaningful dialogue and subsequent action at a landscape level. This is planned to be done primarily through the existing vehicle of the Integrated Area Wide Management (IAWM) model which has operated successfully in the Emerald area. It is anticipated that work in IAWM will extend to the BMRG by about mid 2005.

Constraints to Adoption

Positive changes in land management practices towards environmental sustainability are constrained by a number of issues including climate variability, particularly rainfall (and consequent irrigation water availability); social attitudes such as lifestyle; and level of profitability of farming operations.

Low profitability may negatively affect the ability to adopt management practices which give low negative returns in the short term but which are essential for long term maintenance of soils and water quality (Montgomery and Leslie, 1986). Many of the natural resource management issues described in Table 2.5 as well as implicated in negative impacts on habitats and ecosystems elsewhere in this review will require investment in change at the rural landholder level. This factor combined with the ongoing changes in the dairy and cane industry means than an improved understanding of the production and value of agricultural commodities is required as part of the implementation planning for any investment. This would allow evaluation of economic importance to region and a better focus on where to direct and how to distributes costs and benefits from such changes.

3 Condition Assessments

A number of studies have developed indices or ranking schema for the condition of Basins and Riparian Resources. These assessments are at varying levels of detail but they do include:

- NLWRA 2000 Catchment/Basin Condition Assessments
- State of the Rivers and subsequent Water Resource Planning Environmental Assessments of River Condition

These condition ratings were developed by amalgamation of rankings for specific condition themes and at the higher levels of amalgamation much of the objective sensitivity of the source data may be lost. The rankings do however provide a broad regional base for comparison between catchments and within larger catchment reaches.

3.1 Basin Condition Assessments

Basin condition assessments carried out for the National Land & Water Resources Audit (NLWRA, 2002) were based on the premise that:

- ecological integrity is the fundamental measure of river condition; and
- aquatic biota demonstrates an ecological response to changes in physical and chemical features of their environment.

The full report on the catchment river and estuary assessments including descriptions of the underlying approaches can be found at:
http://audit.ea.gov.au/ANRA/coasts/docs/estuary_assessment/Est_Ass_Contents.cfm

The river assessments involved calculation of an index of condition for key measures affecting river condition, and included an aquatic biota index (macro-invertebrate), based on AUSRIVAS (Australian River Assessment System), macro-invertebrate data collected under the National River Health Program and an environment index that combines the:

- catchment disturbance subindex;
- riverine habitat subindex;
- hydrological disturbance subindex; and
- nutrient and suspended sediment load subindex

The *aquatic biota index* represents the response of macro-invertebrates to changes in the environment. The index is based on extensive national sampling of aquatic macro-invertebrates collected by State/Territory agencies under the National River Health Program.

The *environment index* brings together the cumulative effects of catchment-scale features and local features including habitat, hydrology, and nutrients and suspended sediment loads.

The *catchment disturbance subindex* focuses on anthropogenic changes to land surfaces that influence rivers.

The *habitat subindex* uses measures of sediment inputs, riparian vegetation clearing and connectivity (dams, weirs, levee banks) to assess the state of local habitat and its probable ability to support aquatic life.

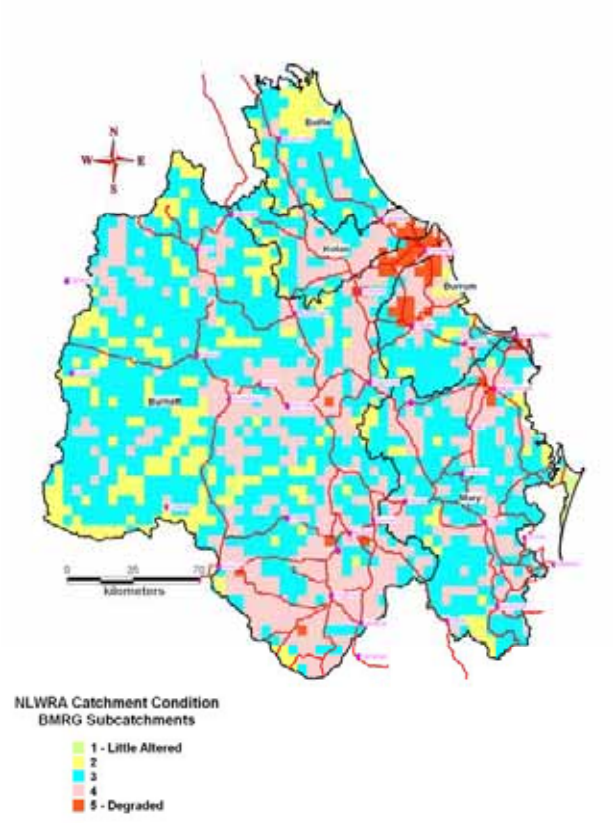
The *hydrological disturbance subindex* assesses the change to flow regimes that typically result from river regulation and/or substantial flow diversion or extraction. The subindex is based on comparisons of the current flow regime to the natural or pre-European settlement flow regime.

The *nutrient and suspended sediment load subindex* considers the effects of long-term changes in suspended sediment and total nutrient loads, and the effects of short-term changes in toxicant levels.

The indices were derived through the use of dispirit sets of data in each basin, and relied heavily on expert opinion in terms of aspects such as assessing the hydrologic disturbance. This approach may not be the most useful for regional managers to manage investment in the region but it did allow for evaluations of the natural resources conditions nationally.

Catchment condition is shown Figure 3.1.

Figure 3.1 Subcatchment Conditions



The basin condition assessment from the NLWRA (2002) indicates that:

- Environmental conditions are at best moderate in all catchments,
- Biota conditions are good,
- Catchment disturbance is moderate,
- Nutrient conditions are very poor to poor,
- The Burnett and Kolan are the worst in terms of river condition,
- The Burnett and Baffle are the best in terms of catchment condition

The catchment condition index shown in Figure 3.1 is consistent with the varying intensities of land use mapped independently by NRM (refer Section 2).

3.2 Water and Riparian Zone Resource Condition Assessments

The major sources of information on water quality and stream conditions are the National Land & Water Resources Audit reports, the water planning reports and the State of River reports developed by the Queensland Department of Natural Resources and Mines. The State of River assessments for the Mary and Burnett rivers covered reach environs, stream bank stability, stream bed condition, channel habitat diversity, riparian vegetation, aquatic vegetation, aquatic habitats and conservation value. These condition ratings were amalgamated to give an overall rating for each catchment.

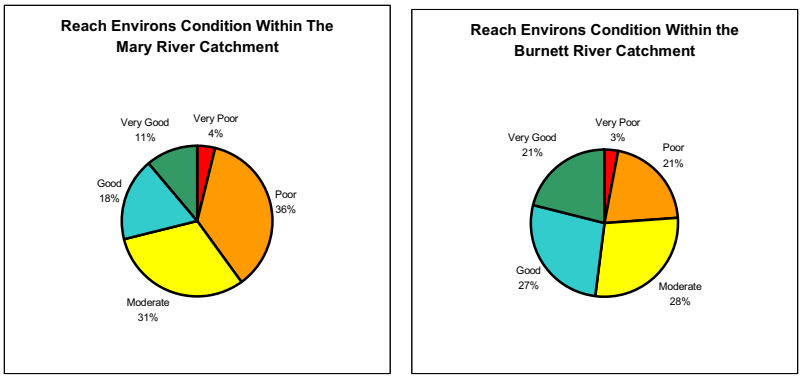
3.3 Reach Environs

The reach environs (lands immediately beside the riparian zone) in the Burnett and Mary Basins Catchments have similar ranges with substantial proportions poor or very poor.

Those sections of these streams with the more intense land use systems adjoining the riparian reaches have the lowest rankings with the Mary over most of its length and Barker Barambah and Burnett systems also ranking low. Outside of the irrigation areas, the Kolan and Burrum Basins have generally better reach environ conditions.

Whilst the site data from the State of the Rivers report (Figure 3.2) indicates that over 50% of sites rate moderate or worse on this indices, preliminary analysis indicates that when the data is extrapolated across stream lengths, a majority of all stream lengths reach environs remain in good or better condition.

Figure 3.2 Reach Environ Conditions (% of Sites)



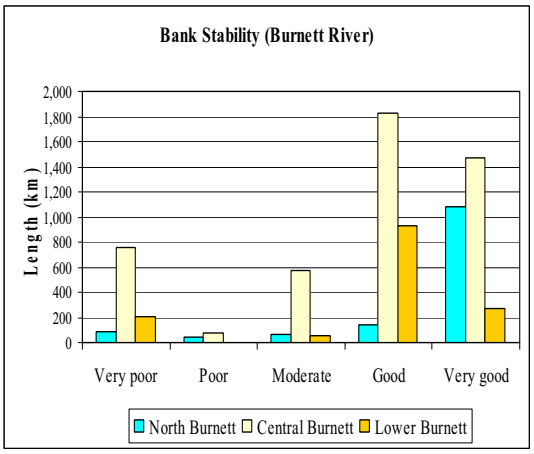
3.4 Bank Stability

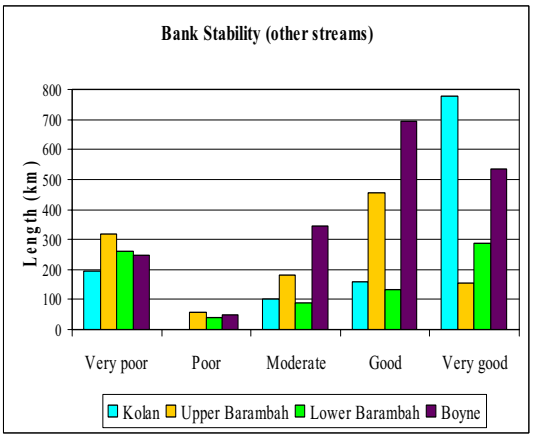
Less than 15% of sites within the Burnett and Mary Basins are ranked as moderate to very poor levels of bank stability. However, the Mary River has a relatively low amount of both stream length and sites ranked as Very Good when compared with the Burnett Basin (Figures 3.3 and 3.4.

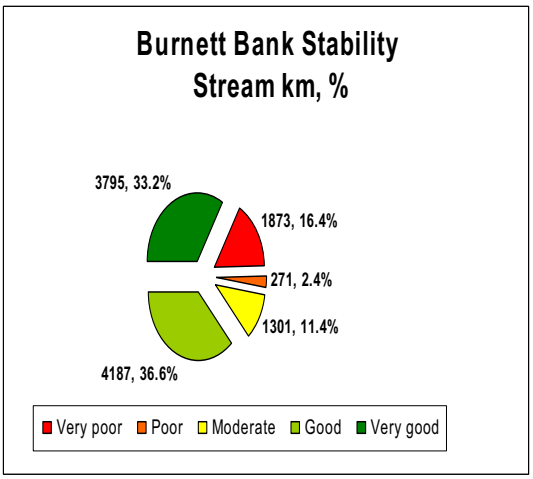
The Kolan upper catchment and the majority of the Burrum Basin are in good or better condition.

Figure 3.3 Bank Stability – Burnett and Kolan Basins

River Condition Assessments
Burnett and Kolan Bank Stability







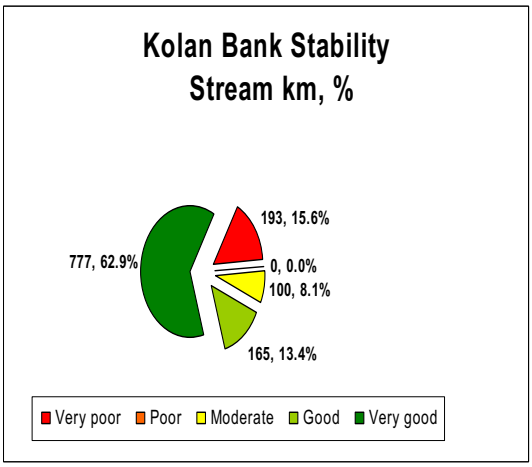
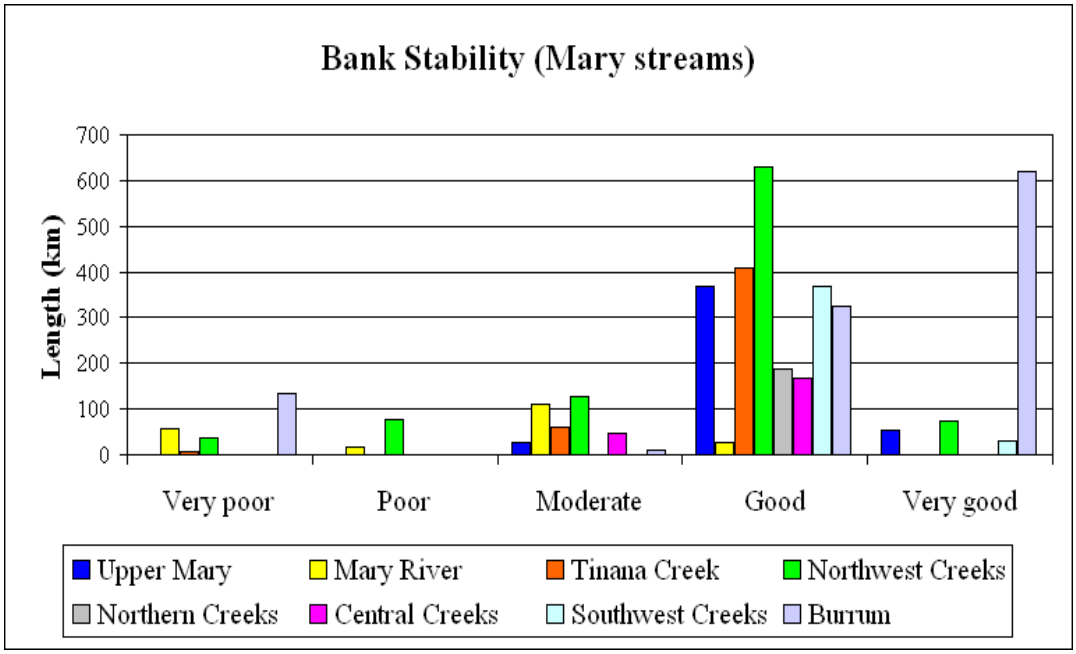
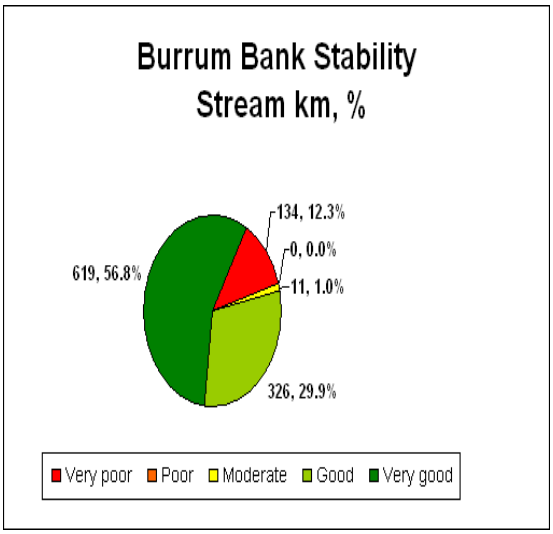
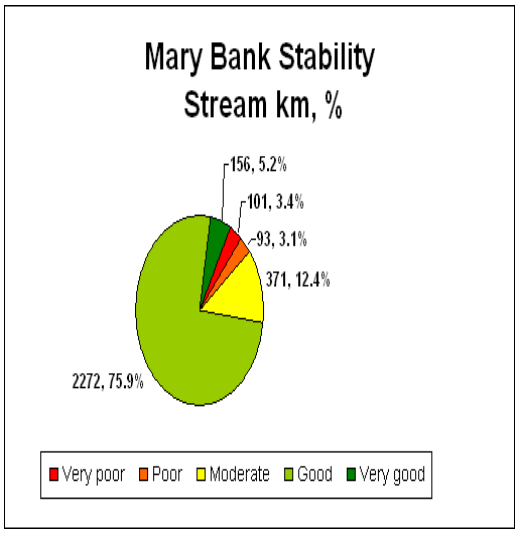


Figure 3.4 Bank Stability Mary and Burrum

River Condition Assessments
Mary and Burrum Bank Stability







3.5 Riparian Vegetation

Almost two thirds of the Mary Basin has a poor or very poor ranking with just under 50% of the Burnett in the same categories. The Upper and Lower Barambah Subcatchments received the worst ratings of all subcatchments in the Burnett region, whilst the main Burnett and Mary River are generally poor over most of their lengths (Figure 3.5 and 3.6).

The poor ratings attained in both catchments stems from clearing of riparian vegetation and the displacement of native vegetation by exotic plant species.

Figure 3.5 Riparian Vegetation Condition – Burnett and Kolan

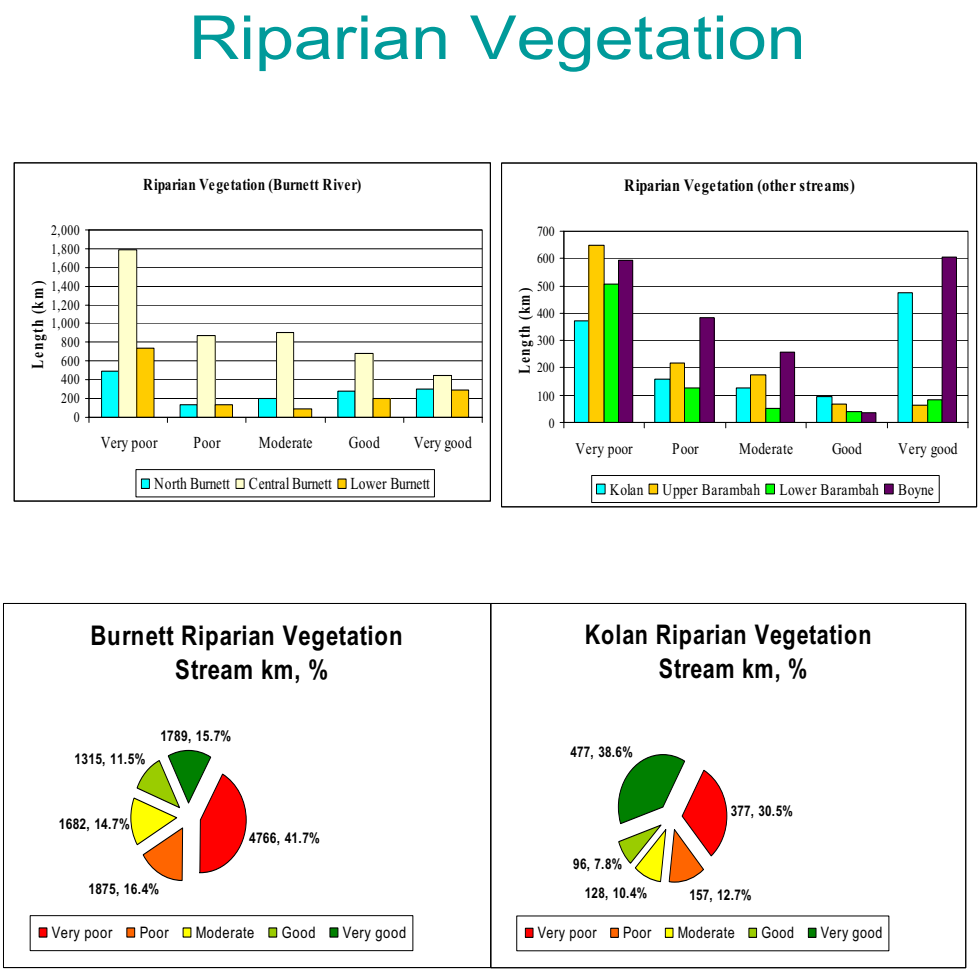
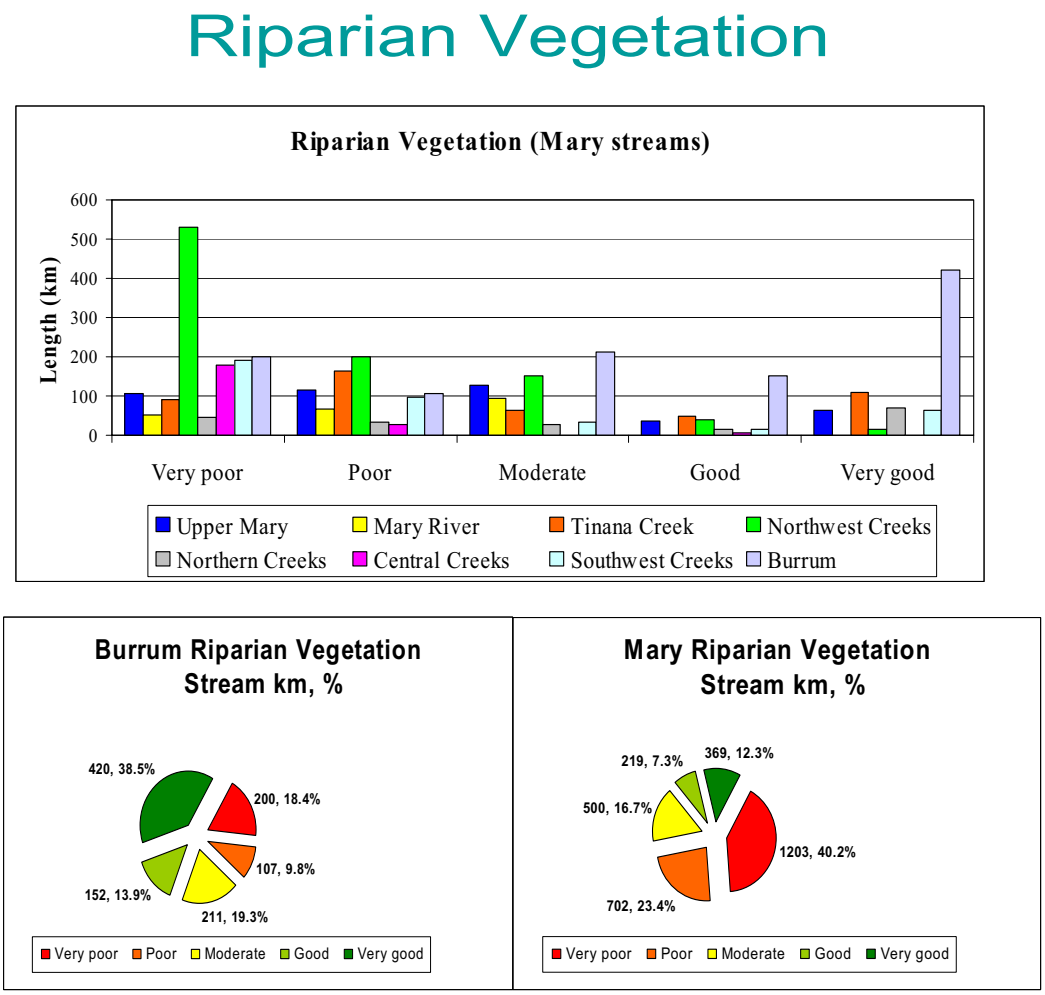


Figure 3.6 Riparian Vegetation Condition – Mary and Burrum

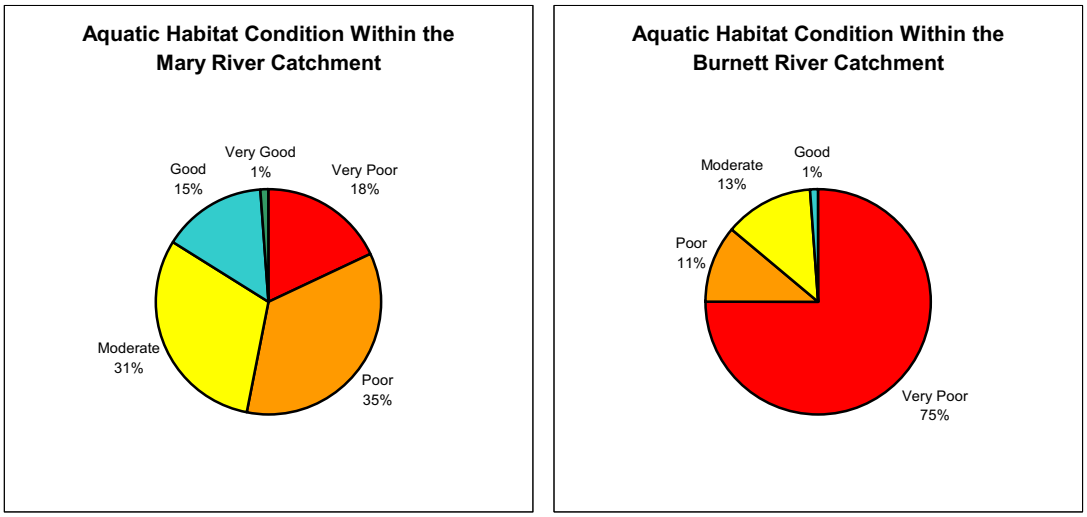


3.6 Aquatic Vegetation

Aquatic vegetation was rated poorly in both the Mary and Burnett Catchments. In the Burnett catchment, aquatic vegetation was rated as poor to very poor in 86% of stream lengths. The poor rating arose from a low abundance of aquatic vegetation, however, it should be noted that although abundance was low, diversity was good. Similarly, in the Mary Catchment, aquatic vegetation was mainly rated as poor as a result of a low percentage cover of vegetation and a high proportion of exotic species.

3.7 Aquatic Habitats

Figure 3.7 Aquatic Habitat Condition



Aquatic habitats were mainly rated moderate to poor across the Mary catchment and very poor to moderate across the Burnett (86% of sites). In the Burnett River Catchment, 74% of streams had restricted passage for aquatic organisms as a result of blockages caused by weirs, log jams and bridge and ford structures. Several streams in the Mary Catchment were described as being obstructed by similar obstacles.

3.8 Estuary and Coastal Environs

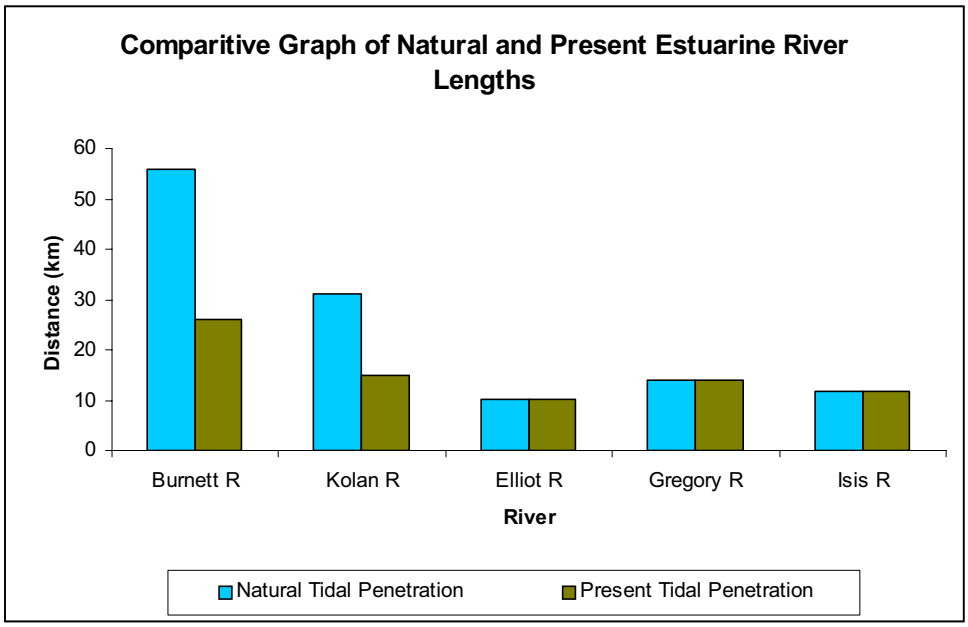
Key estuarine and coastal marine environments are shown in Figure 3.8 (within Map Folio).

All Basins in the study area drain to important coastal environments. Whilst the Mary drains to the Sandy Straits complex of dugong, fisheries habitat and coastal wet lands complexes, all streams including the Burrum Baffle Kolan and Burnett have a direct coastal interface to similar habitat areas.

The impacts upon the estuarine reaches of the Rivers in the Burnett WAMP region are shown in Figure 3.9. The impact to the Burnett and the Kolan River are primarily the result of barrage construction. The Elliot Gregory and Isis have remained fairly constant as no barrages have been constructed for these rivers.

Maintenance dredging is carried out in the Burnett during periods of low flow to remove material deposited by the tidal processes. The estuary is also dredged after floods to remove flood deposits. Volumes of sediment removed have varied from year to year, for example, MacDonald, Wagner and Priddle (1976) reported that over the period from 1969 to 1971, annual sediment removal by dredging ranged from 75000m3 to 518000m3.

Figure 3.9 Change in Estuarine lengths



The Kolan River barrage, as well as changes in flow regime stemming from river regulation (Fred Haigh Dam, Bucca Weir) and water use in the catchment has resulted in direct physical changes to the estuary. The Kolan barrage has reduced the length of the estuary by about half and low medium and high flows have been significantly reduced. Hydrologic regime changes have been greater in the Kolan than in the Burnett River. No dredging has occurred in the Kolan estuary for at least 30 years. Entrapment of sediment by the barrage will have reduced the fluvial sediment input to the estuary.

In the Elliot estuary, the only impacts of water resource development are related to unregulated extraction. Mean annual flow is 88% of undeveloped and there is a small private barrage at AMTD 9.8km. The level of water resource development is believed to have little significant effect upon physical processes in the estuary. No dredging has occurred in the Elliot for at least 30 years.

The Gregory and Isis estuaries are affected by weirs situated just upstream of the natural tidal limit, as well as unregulated water extraction in their catchments. Flow regime changes for both rivers have been relatively minor. Neither of the Gregory or Isis Rivers has been dredged for at least 30 years, however, the weirs on these rivers do have implications for downstream sediment delivery.

3.9 Export of Nutrients to the Great Barrier Reef Lagoon

The vast majority of the 2900 reefs that make up the Great Barrier Reef are in good condition but some of the 450 inshore reefs are showing impacts consistent with a decline in water quality. The majority of chemical, sediment and nutrient pollutants affecting water quality in the waterways entering the Reef come from diffuse sources arising through land use activities in the Reef catchments.

Catchment management practises within the Burnett, Mary, Baffle and Kolan River catchments have the capacity to impact upon the coastal marine environment and the Great Barrier Reef. Marine areas and associated tidal wetlands of Hervey Bay, the Great Sandy Strait and adjacent beaches support a diverse range of Tran equatorial migratory wading birds that depend upon the region for roosting and staging during their annual migrations. These represent important marine ecosystems that need to be protected.

The potential impacts of elevated pollutant concentrations in Great Barrier Reef waters range from reduced growth and reproduction in organisms, to major shifts in community structure and health of coral reef and seagrass ecosystems. Coastal and inshore coral reefs and seagrass communities adjacent to human activity are most threatened from the pollutants contained in run-off from the land.

The quality of water entering the coastal environment is partly determined by;

- Land Use and Land Management within the catchments, and
- The capacity of the catchment to filter (such as wetlands and riparian zones) and therefore reduce the levels of pollutants.

Protection of the Great Barrier Reef is a continuing high priority for both the Australian and Queensland Governments. A Reef Water Quality Protection Plan (RWQPP) has been developed by the Great Barrier Reef Marine Park Authority (2003) as a joint initiative and approved by both governments. The RWQPP is aimed at minimising pollutants from broadscale land use and reducing the entry of those pollutants to the Reef and follows earlier reports on water quality issues. An earlier Great Barrier Reef Catchment Water Quality Action Plan (2001) sets minimum targets for reef catchments.

3.9.1 Great Barrier Reef Catchment Water Quality Action Plan

The Great Barrier Reef Marine Park Authority has identified minimum targets for pollutant loads that would halt the decline in water quality entering the Great Barrier Reef World Heritage Area. These targets form the basis for the Great Barrier Reef Catchment Water Quality Action Plan 2001. The water quality targets are the first step in reversing the decline in water quality.

This Action Plan suggests specific actions that need to be taken to improve the quality of water entering the Great Barrier Reef World Heritage Area, namely:

- Water quality targets set out in this report should be specifically incorporated into relevant plans under the NAP (in the Burdekin, Fitzroy and Burnett River Catchments).
- For catchments not covered by the NAP, the Queensland Government should prepare, and submit to the Great Barrier Reef Ministerial Council, integrated catchment management plans that that specifically recognise the targets in this report and set out the actions required to meet the water quality targets. the

In order to meet the defined water quality targets, the relevant plans (both NAP and catchment plans) will need to include or be accompanied by an appropriate mix of

regulatory and non-regulatory measures. Some reform of Queensland legislation or the manner in which it is administered may be necessary.

In this way, the water quality targets for the Great Barrier Reef will be delivered within a framework that ensures strategic Commonwealth input but with the responsibility for on ground implementation devolved to the appropriate level.

3.9.2 Reef Water Quality Protection Plan (RWQPP)

The RWQPP reinforces the initiatives of the Action Plan by identifying the wide raft of actions, mechanisms and partnerships that will be required to build on existing Government policies and industry and community initiatives to assist in halting and reversing the decline in the quality of water entering the Reef. The focus of actions in the RWQPP is on relatively low cost measures to encourage good planning and to assist landholders in adopting best management practices that are both profitable and environmentally sustainable. The RWQPP focuses on decreasing inputs of pollutants, and on rehabilitating and conserving areas of the reef catchment that has a role in removing water borne pollutants.

Structure of the RWQPP

The RWQPP has an overall goal of halting and reversing the decline in water quality entering the Reef within 10 years by:

- reducing the load of pollutants from diffuse sources in the water entering the Reef; and
- rehabilitating and conserving areas of the Reef catchment that has a role in removing water borne pollutants.

The Plan contains nine key strategies. Each of these strategies is supported by actions or activities that support the objectives of the Plan and ultimately the goal. The first five strategies describe the five main approaches to achieving the objectives of the Plan:

A Self Management Approaches
B Education and Extension
C Economic Incentives
D Planning for Natural Resource Management and Land Use
E Regulatory Frameworks

The last four are underpinning strategies necessary to effectively target, inform and support the first five approaches:

F Research and Information Sharing
G Partnerships
H Priorities and Targets
I Monitoring and Evaluation

The RWQPP outlines the actions, with the details of the implementation stage to be developed in consultation with key stakeholders.

The RWQPP is intended to be a working document that is used collaboratively to develop regional plans, support existing and new initiatives and to monitor progress, by Landholders, Industry groups, Government agencies, Local government, Community groups, Indigenous people, and Regional Natural Resource Management (NRM) Bodies.

The regional planning process currently being undertaken by the Regional NRM bodies will be particularly important in implementing the RWQPP. Regional NRM Bodies have responsibility for undertaking some actions to implement all 9 strategies and have a lead role for specific actions in Strategies D (Planning for Natural Resource Management and Land Use), F (Research and Information Sharing) and G (Partnerships).

Reef Targets

The RWQPP incorporates a risk management approach to identify and target high priority Reef catchments. Each catchment was assessed against Bio-physical risk, Social risk, Development risk, and Risk to marine industries. The risk assessment for regions basins is listed in Table 3.1 with the targets nominated for some of the catchments in Table 3.2.

Table 3.1 RWQPP Risk Assessment

Basin name	Biophysical Risk	Risk related to (lack of) capacity to change	Risk from development pressures	Risk to marine industries
Baffle Basin	M	H	M	L
Kolan Basin	L	H	M	L
Burnett Basin	MH	H	M	MH
Burrum Basin	M	MH	H	L
Mary Basin	MH	L	H	MH

Sediment and nutrient export rates and action plan targets are shown in Table 3.3. movement rates in Table 3. The Mary and Burrum Basins which do not directly drain to the GBRMP do not as yet have defined targets.

Table 3.2 Action Plan Targets for Reef Water Quality Action Plan

	Sediment kt/yr (% of all GBRMPA Basins)			N t/yr (% of all GBRMPA Basins)			P t/yr (% of all GBRMPA Basins)		
	1850	Current	Target	1850	Current	Target	1850	Current	Target
Baffle Basin	3 (0.2%)	103 (0.9%)	52 (0.7%)	190 (1.8%)	844 (2.1%)	565 (2.3%)	10 (1.9%)	185 (2.5%)	123 (3.1%)
Kolan Basin	2 (0.2%)	62 (0.5%)	31 (0.4%)	100 (0.9%)	444 (1.1%)	297 (1.2%)	5 (0.9%)	97 (1.3%)	49 (1.2%)
Burnett Basin	8 (0.6%)	729 (6.2%)	364 (5%)	280 (2.6%)	1244 (3.2%)	833 (3.4%)	14 (2.6%)	272 (3.7%)	136 (3.4%)

	Sediment kt/yr (% of all GBRMPA Basins)			N t/yr (% of all GBRMPA Basins)			P t/yr (% of all GBRMPA Basins)		
	1850	**Current**	**Target**	**1850**	**Current**	**Target**	**1850**	**Current**	**Target**
Total All GRMPA Basins	1286	11666	7324	10633	39334	24437	530	7391	3939

Brodie et al (2003) undertook extensive modeling of the catchments discharging into the lagoon of the Great Barrier Reef Marine Park, using SedNet. Their estimates highlighted that dominant contributions came from grazing lands (which occupy the greatest areas), and also highlighted the loads from the forests and what were termed savannah lands. The SedNet modeling approach also forms the basis of the target setting in Table 3.3 which is largely derived from studies undertaken for the NLWRA.

The Burnett Basin whilst contributing between 40 and 50% of the suspended sediment nitrogen and phosphorous gross yield to the marine environment had export rates on a per hectare basis that were between one quarter and one half of the Mary Basin.

The Burnett River ranks tenth on the list of Queensland Coastal catchments in terms of exports to the Great Barrier Reef Marine Park. The Mary and Burrum Basins which directly drain to the critical near marine and coastal habits of the Sandy Straits which are not covered under the RWQPP targets in Table 3.2 are however ranked as having moderate to high biophysical risk and risk to marine industries.

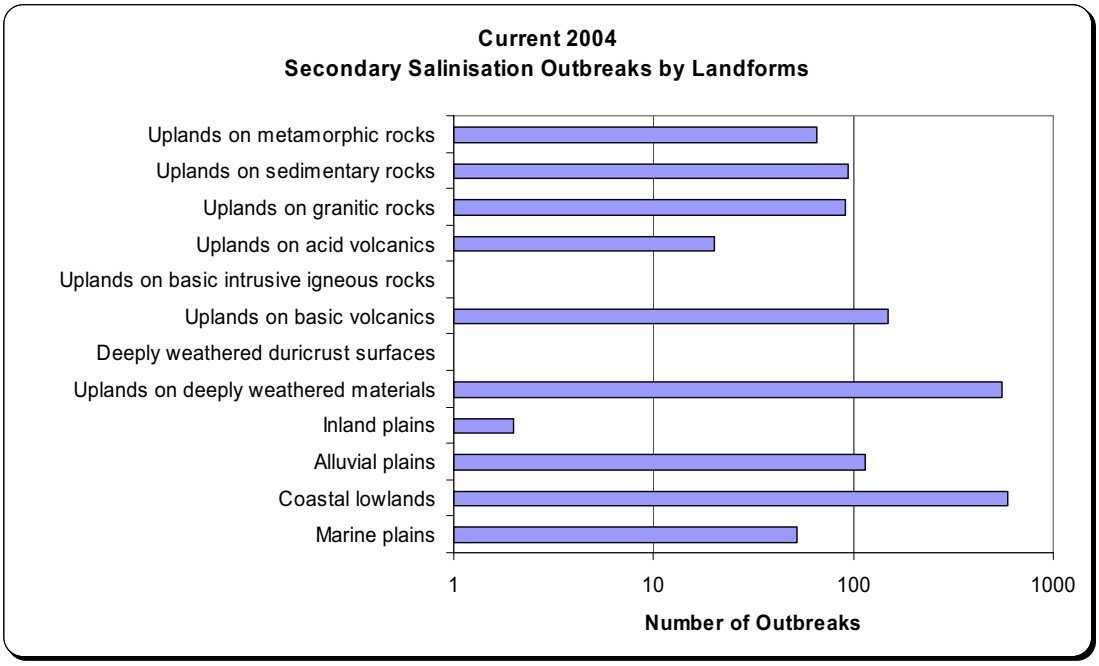
4 Landscape and Groundwater Salinisation

4.1 Landscape Salinisation

A range of Land Resource mapping data sets cover the study area. These data sets vary in the classification methods used as well as the scales of the survey work. For the purposes of this project LRAM has compiled a common mapping layer for the study area (Figure 4.1 within Map Folio).

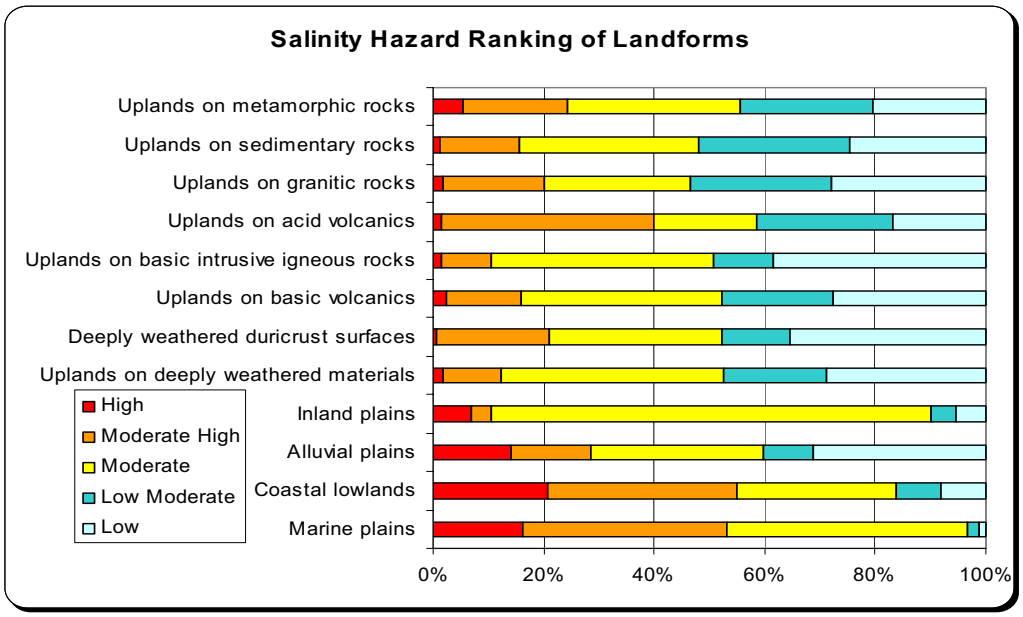
There are currently 1700 known salinisation outbreak sites in the region. Of these almost half are associated with the Coastal lowlands in the Burnett Burrum and Mary Basins where they have been identified during recent soil surveys by NRME. The majority of the remainder are located in western and northern sub catchments of the Burnett with the majority of these identified by the Kingaroy Land Care Group (Figure 4.2 and 4.3).

Figure 4.3 Distribution of Salt Outbreaks by Landform



Very few of these outbreaks have been fully monitored to assess the actual groundwater flow conditions at the sites. The actual areas of land directly affected are not known although estimates range from 10,000 ha to over 20,000 ha.

Figure 4.4 Salinity Hazard Rankings of Landforms



Land uses associated with the outbreaks are primarily dryland cropping on the up slope areas of deeply weathered geologies in the Kingaroy, Barker Barambah and Monto area of the Burnett, irrigated cane farming on deeply weathered basalt landscapes at Childers and cane farming on the coastal lowlands dominated by the Maryborough Formation of complex geologies. The salinity hazard mapping of QDNRM (Figure 4.2 within Map Folio) also indicates that the landforms showing current salinisation have moderate to high levels of hazards. Notable exceptions include the inland plains which have amongst the highest level of hazard but have only 2 currently known outbreak sites.

The majority of the groundwater monitoring sites in the region are directed at those aquifers which have historically been considered of economic importance for extractive use. Further groundwater monitoring sites are to be drilled in 2004 with the sites selected partly on the basis of the groundwater flow systems in the region.

Groundwater flow systems are generally divided into three broad groups:

- Local systems which have relatively close spatial relationships between the intake areas and the discharge areas. Salinisation from these types of flow systems may be reasonably well correlated to local land use (such as upslope clearing.
- Intermediate systems where the spatial relationship between intake and discharge areas is of the order of many tens of kilometers
- Regional systems where the relationship may extend over hundreds of kilometers.

The type of flow system involved in secondary salinisation is an important aspect in determining both prevention and mitigation strategies. In general, local systems respond relatively quickly to management interventions that reduce intake or recharge and hence investments in land use changes will normally produce on site benefits within a relatively short period of time.

Intermediate systems and in particular regional systems have much longer response times to intervention and there may be a poor correlation between current land use and outbreaks.

Figure 4.2 shows the current distribution of outbreaks over the groundwater flow systems interpolated from the salinity hazard mapping of NRM. This data presentation re-enforces the concerns which arise from the salinity hazard mapping in that the complex geologies of the coastal lowlands which currently have some of the highest occurrences of salinity outbreaks in the region are also associated with both regional and intermediate groundwater flow systems. The Maryborough Formation of largely consolidated sediments and metasediments (along with outcrops of basalt as at Childers) contain a diverse mix of geologies ranging from economically important and exploited systems such as the freshwater Elliot sandstones, to saline Burrum Coal Beds and weathered and reworked Tertiary sediments. High groundwater levels (including aquifers with potentiometric surfaces above ground level) are known to occur at various locations in the area[1], however, only those occurrences which fall within the monitoring network of the Bundaberg and Maryborough Irrigation areas are within the current NRM monitoring network. Hydrogeological and water quality investigations have been undertaken in these areas over the last 3 decades – the most notable being the unpublished work of Pearce (NRM 1983) and the work of Kingston, which investigated the base ground water quality, earth materials salt loads and geological conditions related to the expression of salinity[2].

4.2 Groundwater

Within the region, salt water intrusion into the Bundaberg irrigation and groundwater areas has been the subject of considerable investigation by NRM, whilst the Fraser Island sand mass series of unconfined aquifers have also been the subject of investigations.

Within the Bundaberg area, the current regulated groundwater area has recently been extended to incorporate areas north to the Kolan River and south to the Gregory River (Figure 4.5 within Map Folio). Groundwater currently supplies approximately 20% of the irrigation water needs in the irrigation area, however in parts of the irrigation area not serviced by riparian water diversions via channels and pipelines, irrigation relies largely on groundwater reserves. Water supplies for coastal communities as well as Bundaberg city itself are also heavily dependent of the ground water reserves.

Saltwater intrusion along the coast from Bargara to Moore Park has increased over 30 years of monitoring such that significant impacts are now evident in both the urban and irrigation community. Management of this intrusion has tended to focus on two strategies:

- Restricting allocations (groundwater pumping) to between 15% and 60% of announced allocations – depending on effect of extractions on the intrusion interface in specific areas. Whilst this has had some positive impacts, the initial extent of declared and hence regulated area did not cover the full extent of groundwater

[1] Woodgate, Howard and Elliot areas investigated independently by G Kingston of BSES and Bill Thompson of LRAM all have relatively high salinity and groundwater levels away from the Elliot Sandstones

[2] Kingston G Geohydrology of soil and water salinity in the Maryborough Basin PhD Thesis.

pumping area. The recent extension of the groundwater regulated area should allow this approach to be better managed.

- Substitution of groundwater allocations with surface water allocations. This is currently done on a relatively ad hoc basis by allocation holders who have access to both surface and groundwater resources. It is estimated that approximately 22,000 ML of additional surface water allocation would be required to offset the over exploitation of the groundwater system.

The Bundaberg District Groundwater Advisory Committee in submissions to NRM, Sunwater and the Department of State Development (Sept 2003), have indicated that an integrated plan is urgently required and that the substantial amount of investigations undertaken since 1996 should be able to form the basis of a suitable plan.

The review teams discussions with agency groundwater staff suggest that the current approaches of restricting groundwater allocations is arguably slowing the rate of advance of salt water instruction, but is unlikely to return the saltwater interface to its pre-development position. Whilst negative impacts of intrusion are well known, much of this information would appear not to have been collated in formats that would inform future investment in mitigation strategies.

5 Acid Sulphate Soils

ASS is likely to be an issue of future concern given the non rural development pressures along parts of the coast.

The coverage for Acid Sulphate Soils (ASS) inventory for the region is incomplete and further work appears to be required but is as yet unfunded. The ASS mapping done as part of the Hervey Bay to Maryborough Land Resource mapping work is complete for the Toogum to Boonooroo area. The Bundaberg area (Coonar to Kolan River) has also been mapped, however the quantification of the depth to pyrite and soil pH is incomplete due to the complexity of the area. The remaining coastal lands of the region have essentially no ASS information, other than what can be inferred from existing soils mapping.

6 Riverine Stream Conditions and Water Quality

Water Quality monitoring is carried out by state agencies such as NRM and EPA as well as community groups (Water and Coast Watch projects) and local authorities. The monitoring network of both NRM and EPA is shown in Figure 6.1 (within Map Folio). Data from local authorities (primarily at intakes and off takes from water treatment plants) and from community groups is believed to be of a similar scope but no locational data is available and the data sets have not been evaluated under past programs.

The Testing of the Waters study (DEH/NRM 1992) reviewed existing data sets for their accuracy, time longitudinal coverage and sampling/analysis methods. The data from that report is summarized in the tables below. Subsequent NLWRA studies further reviewed the data set and used what were believed to be representative sites to reach a number of conclusions. Reviews of the data sets have also been done within the various water resource planning exercises for the Mary and Burnett. As is the case with the Testing of the Waters study, the water resources reviews also found that whilst site coverage was extensive (as shown in Figure 6.1), the content and longitudinal nature of the data set limits the effectiveness of the monitoring network.

It is only in recent timeframes that monitoring for purposes other than commercial use and extraction at gauging stations and pump sites has been a priority. As a result the discontinuous nature of the older data sets as well as types of analyses undertaken can restrict the applicability of the data.

It is also clear from the existing data that whilst some relationships between land uses, reach environs and water quality may be apparent at certain locations, monitoring that specifically relates to diffuse or point sources of water quality problems is less emphatic at many locations. Furthermore, the data sets do not appear at this stage to be sufficient to show that there are major cumulative down stream affects on water quality for parameters such as nutrient and salinity. As indicated in the summary given below, there does appear to be evidence of localized water quality problems.

6.1 Kolan Basin

6.1.1 Stream Condition

The Kolan River Basin condition was non-assessed by the hydrological disturbance index (Table 1, NLWRA 2002), moderately modified based on the catchment disturbance index, moderately modified based on the habitat index and severely modified based on the nutrient and suspended load index. The Queensland river condition workshop expert panel assessed the hydrology to be severely modified and its catchment to be substantially modified from natural.

6.1.2 Water Quality

Table 6.1 Testing the Waters – Kolan Basin (DEH/NRM 1999)

Parameter	Turbidity	Oxygen	Salinity	N	P
Gin Gin Ck	G	ND	M	ND	ND
Kolan R					
Riverine	G	G	F	G	G
Estuarine	G	G		G	G
Kolan Coast	ND				

(ND = No data or insufficient data, G = Good, F = Fresh, M = Moderate)

Turbidity levels exceed NHMRC (1996) guidelines for drinking water, however, turbidity remain within ANZECC guidelines for ecosystem protection at all times (Bloedel et al 2000). Conductivity, pH and nutrients fall within the prescribed standards for Kolan. The moderate levels of salinity in Gin Gin Creek may be associated with existing salinity outbreaks in the area, however, this has not been confirmed.

In their assessment of water quality in sugar cane growing areas of Queensland, Hunter et al (2003) Total Phosphorus was rated as good in the Kolan, while Total Nitrogen was poorer in the upper catchment than in the lower part, possibly because of tidal flushing.

6.2 Mary River

6.2.1 Stream condition

The Mary River basin condition was non-assessed by the hydrological disturbance index (Table 1, NLWRA 2002), was ranked as moderately modified based on the catchment disturbance index, largely unmodified based on the habitat index and substantially modified based on the nutrient and suspended load index.

Bank erosion is widespread along the Mary River, including the estuary. Natural contributing factors include high hydraulic loadings, steep high banks and erodible bank material. Human actions that have exacerbated this process include: riparian vegetation loss, uncontrolled stock access, sand/gravel extraction and in the Mary Barrage pondage, elevated ambient water levels and power boating. Sand and gravel extraction has led to significant geomorphic changes in parts of the Mary River, particularly between Conondale and Gympie. Impacts include the direct modification

of channel morphology as well as increased bedload mobility and the infill of pools as a result of reduced gravel armour materials in the sediment matrix. The Mary Barrage has also acted as a partial sediment trap, altering the supply of sediment to the estuary.

In their modelling of erosion sources in the Mary catchment, DeRose et al (2002) proposed that 87% of the total predicted supply of sediment was derived from riverbank erosion. This phenomenon was believed to stem from increased channel capacity and stream power as a result of channel incision and widening.

The accumulation of sand and gravel on the bed of rivers was not found to be a concern with respect to the degradation of aquatic habitat. This is because most of the river reaches were deemed capable of transporting increases in bedload derived from riverbank and gully erosion. It was anticipated, however, that in the lower third of the Mary River there might be a significant accumulation of sand and gravel. DeRose et al also predicted that the sediment loads described, as well as dissolved contributions in runoff water, carried nutrients into the waterways of the Mary River basin. The model predicted that 344 t/y and 1541 t/y of total phosphorous and total nitrogen respectively were exported to the coast. (DeRose et al 2002). These estimates compare favourably with the modelled estimates by Moss et al (1992) of 366t/yr Phosphorus, and 2543 t/yr Nitrogen.

The modelling exercise concluded that reducing the supply of sediment to streams will go a long way to reducing total phosphorous supply, whilst a major reduction in the supply of total nitrogen would require reduction of dissolved sources as well. In addition, it was apparent that the various erosive processes (surface wash, gully erosion, riverbank erosion) are significant and highly focussed, with much of the sediment and attached nutrients derived from relatively small areas. It was concluded that attention directed towards such hotspots, should generate large benefits in reducing sediment and nutrient loads.

The Mary River Catchment Coordinating Committee, in their 2001 report suggested that the results of the Mary River State of the Rivers Report should be treated with caution. It was suggested that there was some error in the classification of sites within the Six Mile Creek, Tinana Creek and Gutchy Creek Subcatchments. It was proposed that discrepancies may have resulted from deficiencies in methodology, data manipulation, inexperienced data collectors or the paucity of data collection points. The report stated that the results consistently under valued intact streams and those with a relatively undisturbed condition.

It was suggested that the rapid growth of the Sunshine Coast and Hervey Bay urban areas, resulted in more than a four-fold increase in aggregate production/extraction in the fifteen year period from 1980 to 1995 (DPI, 1995).

6.2.2 Water Quality

Table 6.2 Testing the Waters Mary River (DEH/NRM 1999)

Parameter	Turbidity	Oxygen	Salinity	N	P
Yabba Ck	M-G	ND	F	P	ND
Wide Bay Ck	M-G	ND	M	M-P	G
Kandanga Ck	G	ND	M	M	ND
Glastonbury Ck	ND				
Upper Mary R	M-G	G	F	M-G	P-G
Munna Ck	G	ND	M	M	M
Tinana Ck					
Riverine	M	ND	M	G	G
Estuarine	M	M		ND	ND
Lower Mary R					
Riverine	M-G	G	F	M-P	M-P
Estuarine	G	M-G		M-P	M
SANDY STRAITS					
Coastal	G	M-G	ND	G	G

(ND = No data or insufficient data, G = Good, F = Fresh, M = Moderate, P=Poor)

Five monitoring sites (representing 72% of the catchment) along the Mary river and Obi Obi creek were used for the Audit review of exceedence of water quality standards (Bloedel et al 2000). Fourteen sites representing 72% were used for trend analysis. Salinity values were within standards for ecosystem protection, drinking water and agricultural uses. Turbidity exceeded drinking water standards but satisfied ecosystem protection standards at all times. Very high Total Phosphorus levels exceeded the ANZECC aquatic ecosystem protection standards in the lower to middle reaches of the Mary River. Possible causal agents identified included land clearing for urban and farming development, agricultural practices or point sources such as mining. In other areas Total Nitrogen and Total Phosphorus concentrations were within ANZECC standards. Ph values were all within standards.

The Mary River Catchment Coordinating Committee (2001) reported nitrogen and phosphorus levels exceeding ANZECC (1992) at more than half the sites surveyed in the catchment. Elevated levels of phosphorus and nitrogen have been implicated in cyanobacterial blooms in Lake Baroon and Boorumba Dam on Yabba creek. The Gympie sewage treatment plant was the largest outfall from point sources for nutrients.

In contrast with the MRCCC report, the Mary Basin Draft Water Resource Plan (Qld NR&M 2002) states that total nitrogen and phosphorus levels although higher than in undisturbed systems, but not to an extent that suggests uncontrolled inputs.

Salinity has not been identified as a serious issue in the Mary catchment, although Wide Bay Munna and Kandanga Creeks which drain the western hinterland areas where there are relatively minor soil salinisation outbreaks record moderate salinity levels.

The Mary River Barrage was responsible for changes in water quality compared to the natural pre-barrage state. Downstream of the barrage, salinity levels would naturally be affected by tidal influence, whilst turbidity levels were much greater than the natural situation (NRM draft Water Plan).

6.3 Burnett River

6.3.1 Stream condition

The Burnett basin condition (Table 1, NLWRA 2002) was moderately modified based on the hydrological disturbance index, moderately modified based on the catchment disturbance index, moderately modified based on the habitat index and severely modified based on the nutrient and suspended load index. The Burnett was assessed as being in substantially modified condition as a result of the barriers, water quality, catchment condition and hydrology.

6.3.2 Water quality

Table 6.3 Testing the Waters – Burnett Basin (DEH/NRM 1999)

Parameter	Turbidity	Oxygen	Salinity	N	P
Barker Ck	G	ND	M	M	ND
Boonara Ck	ND				
Barambah Ck	G-M	ND	F-M	M-P	M-P
Stuart R	ND		B		
Cadarga Ck	ND				
Auburn R	M		F	M	M
Boyne R	ND				
Bayullla Ck	ND				
Three Moon Ck	ND				
Nogo R	ND				
St John Ck	ND				
Reid Ck	ND				
Upper Burnett	G	ND	ND	M	ND
Lower Burnett					
Riverine	M-G	ND	F	M	G
Estuarine	G	G		M-G	M-P

(ND = No data or insufficient data, G = Good, F = Fresh, M = Moderate, P=Poor, B = Brackish)

In general, in the inland sub-basins of the major rivers, the water is low to moderate in salinity and relatively hard, being dominated by calcium, magnesium and bicarbonate. Turbidity levels are also moderately high although the number of subcatchments with adequate records appears low.

Routine water monitoring at 6 sites representing 98% of the catchment formed the basis of the NLWRA water quality assessments. Conductivity levels exceed ANZECC (1992), NHMRC (1996) and Gill's (1986) guidelines in the middle reaches of Barambah creek, an area where dryland salinity incidence is high. Salinity decreases downstream of this area. Conductivity levels were within ANZECC (1992) and NHMRC (1996) targets throughout the rest of the catchment monitoring area.

Turbidity levels in all sites exceed the NHMRC guidelines for drinking water, but are within the ANZECC guidelines for ecosystem protection. Total Phosphorus concentrations were within ANZECC guidelines. Total Phosphorus and Total N were considered as poor or moderate by Hunter et al (2003), and pH levels were within both ANZECC and NHMRC guidelines and show no trends over the previous 10 years.
Permanent water holes in this environment are prone to algal blooms during dry spells, and this would be exacerbated in some cases by nutrients contributed by human activities and grazing.

The naturally high turbidity and hardness levels, in conjunction with locally excessive salinity or iron, tend to make the water moderate to poor for domestic use. It generally supports irrigation, although levels of iron may exceed guidelines. Sub-catchments of the Stuart River and Barker-Barambah Creek have salinity and chloride levels that exceed levels recommended for some crops (including citrus). The water is suitable for stock, except when pH and dissolved Oxygen are low. The water in the whole catchment is rated as poor for aquaculture because of the natural levels of hardness, dissolved ions, and some metals.

Storages which are scattered throughout the highly regulated Burnett-Kolan region, (these including Boondooma Dam, Cania Dam, Bjelke-Petersen Dam, Fred Haigh Dam, Wuruma Dam, and Walla Weir) have a generally poorer quality of water than those of the Fitzroy Basin. All except Walla Weir are strongly stratified in summer, and therefore prone to blue green algal problems, as well as low oxygen levels in the hypolimnion. This implies that manganese, nutrients, and hydrogen sulphide can be released from the sediments. Some of these storages also regularly record nitrogen levels in excess of environmental guidelines, or salinities which are unsuitable for sensitive crops.

6.4 Burrum River

6.4.1 Stream condition

The Burrum River Basin condition was largely unmodified based on the hydrological disturbance index (Table 1, NLWRA 2002), moderately modified based on the catchment disturbance index, largely unmodified based on the habitat index and substantially modified based on the nutrient and suspended load index.

The overall condition assessment for the Burrum (by combining condition ratings of all attributes) indicates that approximately half of the stream length was in good condition; No section of stream length was rated as being in overall very good condition. Habitat diversity of the channel was generally low or very low, and aquatic vegetation conditions and aquatic habitat were generally very poor. Riparian vegetation was classed as good or very good over a majority of the catchment.

6.4.2 Water quality

Table 6.4 Testing the Waters (DEH/NRM 1999) Burrum Basin

Parameter	Turbidity	Oxygen	Salinity	N	P
Cherwell R	ND				
Burrum R					
Riverine	M	M	F	G	G
Estuarine	G	G		G	G
Burrum Coast	ND				
Elliot R					
Riverine	M	M	F	P-G	G
Estuarine	G	G		G	G
Elliot Coast	ND				
GREGORY R					
Riverine	ND		ND	ND	G
Estuarine	G	M-G		G	ND
ISIS R					
Riverine	ND		ND		
Estuarine	G	G		G	G

(ND = No data or insufficient data, G = Good, F = Fresh, M = Moderate, P=Poor)

Three sites on the Elliott, Isis and Burrum rivers (40% of the basin) were available for NLWRA water quality exceedence evaluations. The coverage was not sufficient to provide an assessment of the whole catchment condition. The Isis river site is extremely saline possibly due to its location 22km from the river mouth and the Isis was rated in the Testing of the Water report as insufficient salinity data. Turbidity levels exceeded NHMRC guidelines for drinking water, but were within the ANZECC ecosystem protection standards. Total Nitrogen and Total Phosphorus were within ecosystem and health guidelines. Acidic ph levels were found in the Elliot River

6.5 Water Quality Objectives (WQO) and Environmental Values (EV)

The Testing of the Waters study and the subsequent NLWRA assessments used only a proportion of water sampling data sets available from the basins. Whilst for some subcatchments, there are no sampling sites (eg Cherwell River), for others, data sets are incomplete (Gregory River) or cover too short a time series to allow reliable conclusions to be drawn (longitudinal series is insufficient). This desk based review has not been tasked to review the adequacy of the data sets, however, given the large number of sampling sites (Figure 6.1) and the gaps in data adequacy which can be inferred from the above reports, a review of adequacy and efficiency of the water quality and monitoring network would appear to be warranted.

The importance of such a review is heightened given the recent emphasis placed on establishing Water Quality Objectives (WQO) based on Environmental Values (EV) of the water resources. This approach is part of the National Water Quality Management Strategy (ANZECC, 2000) as well as the Queensland Environmental Protection (Water) Policy 1997 (EPP Water).

Under these approaches, WQO which are related to EV's which in turn are based on a range of biological, consumptive, recreational, irrigation and industrial uses. The approach has a number of advantages and challenges:

- Once established, the EV and their associated WQO's serve as an assessment tool for evaluation of Environmentally Relevant Activities. In terms of aquatic systems, these are mostly land uses which generate point source type water quality problems and require specific licensing and approvals under the EPA in Queensland. In essence, the EV and WQO set a standard which such licensed uses would have to meet.
- Similarly, these same EV and WQO's can be used to guide land management decisions which relate to diffuse sources of water quality problems.
- Establishing the EV and associated WQO's, however, requires access to suitable monitoring data sets and the use of these data to define the limits of the WQO's. In systems where data is longitudinally insufficient or partly lacking, it may be somewhat difficult to establish what the actual baseline conditions are and hence what types of EV the aquatic system can sustain.
- When applied to basins, there is a need to understand the relationships between not only land use (whether ERA/point source or diffuse land use) and water quality, but also the relationships between discharge/stream flow and water quality. This may become increasingly more complex where systems are highly regulated as in the case of the Burnett. In any case an understanding of these cause and effect type relationships will be critical to any intervention strategies based on this approach.

Within the BMRG area, EV and WQO's have been under evaluation for both the Burnett and Mary.

In the case of the Burnett (Burnett Catchment Infrastructure EIS), probable (ie. draft) Environmental Values and resultant Water Quality Objectives (Section 7 of the EIS) were identified, but were qualified by the fact that the establishment of EV's had not been subject to stakeholder consultation. The resultant draft WQO's included both median, 10 and 90 percentile thresholds for seven criteria (EC, N, P, Turbidity, Fe and pH) as well as mean and maximum criteria for a number of biological contaminants. The draft EV and WQO's were nominated for both Walla Weir and the Burnett generally. Unfortunately, these draft EV/WQO's do not appear to have been evaluated to determine the extent and locations where the current monitoring data set would exceed the proposed criteria or indeed whether the current data set is an adequate basis for a monitoring and evaluation system based on this approach.

In an unrelated report within the Burnett ROP, ecosystem monitoring sites at six freshwater locations have been proposed along with 8 sites within the Burnett Estuary. These sites will be monitored for both water quality and a range of habitat and ecological conditions. It is unclear as to whether the EV and WQO approach will be followed at these sites.

The approach adopted in the Mary Basin by EPA appears to differ in significant aspects from that used in the Burnett. The EV's were the subject of stakeholder

consultation and covered up to 50 locations selected to cover the whole of the Basin. Under this approach, the EV (and presumably resultant WQO's) are more likely to reflect both the ambient water qualities and actual uses of the aquatic environment in various parts of the catchment. The approach infers and will require an extensive monitoring system. The public release of this draft study is due in the first quarter of 2004.

7 Biodiversity Values

7.1 Terrestrial Biodiversity Frameworks

Regional Biodiversity assessments in draft form are available from the Biodiversity Planning Assessment project of EPA (2003). This assessment draws largely on the Regional Ecosystem mapping data of EPA augmented by data on listed species under the Environment Protection Biodiversity and Conservation Act (EPBCA), the Nature Conservation Act, ranking for wetlands and algorithms related to the size shape and relationships of contiguous areas of remnant vegetation.

Figure 7.1 (within Map Folio) contains a simplified legend of the resultant classification whilst wetlands data combined with coastal environment mapping is shown in Figure 3.8 (within Map Folio).

The ecosystem values shown in Figure 7.1 (within Map Folio), are currently protected from the effects of clearing under the Queensland government moratorium on broadscale clearing with a stated future intention of ceasing all broadscale clearing. Under the current arrangements this level of protection would apply to the following proportions of each basin:

- For the Mary Basin, 49% of the area has remnant vegetation, of which less than 2% is dominated by endangered regional ecosystems
- For the Burnett Basin, 38% of the area has remnant vegetation, of which less than 2.5% is dominated by endangered regional ecosystems
- For the Baffle Basin, 61% of the area has remnant vegetation, of which less than 10% is dominated by endangered regional ecosystems
- For the Burrum Basin, 49% of the area has remnant vegetation, of which less than 3% is dominated by endangered regional ecosystems
- For the Kolan Basin, 43% of the area has remnant vegetation, of which less than 15% is dominated by endangered regional ecosystems

The effect of the biodiversity assessment is to potentially significantly increase the proportion of the remnant vegetation which would be subject to future protection because of its important biodiversity values. In the Baffle Basin, where almost 60% of the area is ranked as not of concern or of concern under the regional ecosystems mapping, the greater majority of the vegetated area is ranked as of state level of significance on biodiversity values. Similar proportionate shifts are evident across all of the basins as a result of the biodiversity assessments.

The scales of these assessments are however limited by the accuracy of the mapping. It is generally considered that a scale of 1:100,000 is the limit at which these data can be used in the field.

Apart from the issue of scale, classification schema with supporting legislation framework would appear to be in place to control the loss of important terrestrial biodiversity assets from at least the impacts of broadscale clearing. However, biodiversity values are also potentially threatened by bush fire management regimes, clearing exemptions within the urban and built environment sector as well as weeds and the general land management environment. There would appear to be no substantive framework for managing these impacts.

7.2 Aquatic Ecosystems Framework

Whilst ecosystems have been identified and classified within the terrestrial environment, little work appears to have been done on specific habitats. Conversely for the aquatic environment much of what is known and much of what is ongoing is aquatic habitat related. The difficulty for a region or for large segments of a stream within a region is whether management of specific habitats will address the larger scale ecosystem issues. This section summarizes the results of a workshop held with line agency staff to review and discuss the implications of the current levels of knowledge.

The workshop agreed that an ecosystem framework would provide the most logical approach to evaluate the current knowledge and assess the gaps in knowledge and monitoring systems for the aquatic environment. A number of reports on wetlands, terrestrial biodiversity and assessment of conservation values were identified by EPA and NRM which appear to be important resources for understanding the requirements for managing ecosystems in the region.

The broad ecosystems identified and agreed to were as follows:

River Freshwater Aquatic which includes a number of habitat types such as pools, poll and riffle, impoundments etc.
Wetlands
Estuaries
Marine
Coastal Sand Masses dependent on groundwater systems (eg Fraser Island)
Inland groundwater dependent systems (eg Ban Ban Springs)

Some National and State frameworks have been developed for evaluating /assessing the condition of the natural assets within these systems; these require specific datasets (e.g. AUSRIVAS, State of the Rivers). In the study area the State of Rivers assessment (essentially a snapshot in time) has been completed, however, this snapshot has not been used to identify future monitoring and evaluation requirements. In addition the State of the Rivers did not cover impoundments which are key feature of the Burnett Basin.

7.2.1 River Freshwater Aquatic Ecosystems

The most comprehensive reviews of components of this ecosystem are those undertaken by Boardman and these focus primarily on within stream infrastructure of the Burnett. As yet however there does not appear to be a delineation of key ecosystems locations although it is likely that the various Environmental Impact studies on the Burnett in conjunction with the works recommended by Boardman would provide a reasonable basis for delineating specific ecosystems within various reaches of the Burnett.

The independent review by Boardman (1996) of the of the environmental impacts of the proposed Walla Weir on the Queensland lungfish and the Elseya turtle recommended a series of baseline studies be implemented prior to any further infrastructure development. This led to a series of studies which investigated the habitat and reproduction and migration requirements of lungfish and the effects of fluctuating water levels on lungfish populations and survival of macrophytes in the Burnett river. They also included studies on the habitat, abundance and biology of the Elseya turtle to ascertain the likely long term effects of the

Walla weir proposal on the long term survival of the turtle. In 2001 Boardman undertook a review of the research findings from these studies and concluded that:

- The studies provided valuable information on assessing the long term impacts of the Walla weir on the lungfish populations of the Burnett river basin but also the cumulative impact of weirs.
- Research methodology constraints limited the ability to determine some of the habitat requirements and the elements of a lungfish management plan.
- The viability of the lungfish population is dependent on the survival of suitable macrophyte beds for spawning and hatching of lungfish and the survival of recently hatched lungfish under conditions of fluctuating flow and water levels.
- The studies have indicated that any lungfish management plan must contain a water management plan that is not detrimental to the establishment and maintenance of suitable macrophyte beds
- Ecological studies on the Elseya turtle indicated a reduction of turtle biodiversity in impounded areas because of changes in habitat and diets of the turtles. Data obtained provides a useful baseline for monitoring the impacts of the Walla weir on the turtles, and for assessing the cumulative impacts of weirs and dams on the habitat of turtles.

Further work recommended by Boardman included:

- the monitoring of the whole length of the Burnett river for structure and density of macrophyte beds and identification of sections suitable for lungfish spawning, hatching and recruitment.
- Determination on whether water levels in storages can be regulated to establish and maintain macrophyte beds in impounded areas.
- Continuation of the turtle monitoring program to establish the impacts of the Walla weir on turtles.

A detailed list of EIS reports on infrastructure development in the Burnett catchment is available on the Burnett Water website. www.burnettwater.com.au/news/documentarchive/). The reports relate to the Burnett River Dam, Raising of Walla Weir, the Eidsvold Weir and the Burnett River Dam Recreational Facilities Scoping Study. These studies include environment management plans generally pre date the Boardman studies and progress reports on fish biodiversity associated with Walla Weir are available.

In overall terms however no strategic management plan for management of the freshwater ecosystem and its core habitats appear to have been formulated – other than issues related to the design and operation of in stream structures and water allocation.

The Boardman most recent recommendations however would indicate that there still remains insufficient understanding of the ways in which all components the fresh water stream ecosystem function to allow for the development of strategic plans at other than a specific project level.

Within the Mary Catchment a number of studies on the Mary River Cod are also available and the MCCC has a number of strategies in place to address degradation of the habitat in areas considered critical for this species as well as the overall condition of various reaches of the river system. However, as in the case of the Burnett, the available data does not appear to have been collated at a regional aquatic level.

For the Kolan, Burrum and Baffle Basin, little appears to be known or documented about the fresh water ecosystems.

Choy et al (2002) identified specific research needs in inland aquatic ecosystems in Queensland across a range of topics including:

- Environmental flows
- Environmental health – assessment and monitoring
- Ecosystem processes and function
- Ecological impacts and remediation technologies

Specific aspects identified in the report that are common to issues identified in the State of Region report include:

- Indicators of early river health change in response to water resource planning implementation
- Techniques for the removal or eradication of exotic pest species:
- Impacts of land use on water quality and coastal ecosystems
- Impacts of acid sulfate soils
- Impacts of dryland salinity and saline groundwater intrusion
- Effects of sediment extraction

7.2.2 Wetlands, Estuaries and near Coastal/Marine systems

The distribution of coastal wetland is shown in Figure 3.8 (within Map Folio). The wetlands shown in Figure 3.8 include the following areas

- RAMSAR declared wetlands – mainly within the Great Sandy Straits area
- Intertidal wetlands (largely Mangrove and associated systems) whose distribution has been inferred from the regional ecosystems mapping
- Wetlands including all of Fraser Island and various Mangrove and related systems classified under the Directory of Important Wetlands

Also shown on Figure 3.8 are the Dugong Protected Areas covering the receiving estuarine and near coastal environment of the Mary, Burrum and Baffle Basins and the declared fish habitat areas of the Mary, Burrum, Kolan and Baffle Basins.

The Burnett and Mary series of Water Resource Planning exercises have investigated estuary conditions whilst a number of fisheries studies by QDPI have also dealt with these areas. The major streams all have barrages or weirs which tend to limit tidal fluxes with consequent impacts on the estuary ecosystems (refer section 6). However, a number of the smaller streams are unregulated and most of these as well as significant parts of the regulated estuaries fall within declared wetland, fish habitat or dugong protected areas. Given that up catchment influences on estuary conditions can be managed, there would appear to be a substantive framework in place for management of these ecosystems.

7.2.3 Coastal Sand Mass Ecosystems

The best known and the most exhaustively assessed of these is the Fraser Island sand mass where freshwater lakes (largely 'windows in the unconfined aquifers') are a discrete ecosystem now largely protected under the National Park tenure and Fraser Island Management Plan. The coastal lowlands however also comprises smaller sand mass assemblages often within a complex mosaic of estuary and other coastal terrestrial ecosystems. Many of these areas do not have protected area status and little is known of their hydrogeology and general environmental and habitat conditions. In parts of the coast these area are under development pressure along the foreshores and estuaries.

7.2.4 Inland Groundwater Dependent Ecosystems

Little is known of these systems – either in terms of their distribution or values. The possible location of these is being assessed by EPA using the regional ecosystems mapping and it is likely that they may form part of the wetlands group of ecosystems. At this stage the most well known occurrence is Ban Ban Springs in the lower Barambah catchment and this easily accessible site is under some pressure from surrounding agricultural and tourist visitation.

8 Existing Planning Frameworks

A number of regional planning frameworks and associated groups existed prior to the establishment of the BMRG. None of these groups covered the whole of the subsequent BMRG area, but most of these groups in their published documentation and strategies have considered many of the issues raised in this desk based review. These groups and their web site addresses for their strategy plans are given below:

Burnett Catchment Care Association Inc - whose strategic plan was released in 2000. <http://www.wb2020.qld.gov.au/icm/bcca/>

Baffle Creek Catchment Management Group Inc – whose strategy was released in 2003 <http://www.wb2020.qld.gov.au/icm/baffle/bccmg.htm>

Mary River Catchment Coordinating Committee - whose strategy was released in 1997, revised in 2002. A Catchment Rehabilitation Plan has also been recently released. <http://www.wb2020.qld.gov.au/icm/mrccc/strat.html>

In addition the Wide Bay Regional Planning Advisory Committee released a *Regional Growth Management Framework in* 1998. <http://www.wb2020.qld.gov.au>

Apart from these documents, draft regional Vegetation Management Plans have been released covering part of the BMRG area and the current series of WAMP/WRP and ROP studies of NRM is due for completion in the next 18 months by which time all basins other than the Baffle will have been covered.

Whilst the WAMP/WRP, ROP and Regional Vegetation Management Plans have been completed within a legislative framework (namely, the Vegetation Management Act and the Water Act), these other studies lack a mandated setting. In terms of Natural Resource Management for themes not addressed within the Water or Vegetation Acts, it is the legislation associated with environmental licensing (administered largely by the EPA) and Integrated Planning Act (largely administered by the DLGP) , which allows regulation of land use and development and less directly land management on freehold land. In the case of IPA, it is the local authority level which develops strategic plans which determine land development outcomes. Land management (along with its presumed resource condition impacts such as loss of ecosystem/habitat biodiversity and diffuse impacts on water quality) have tended to fall into the area of specific industry actions and/or within the various community and catchment management groups.

Despite the wide jurisdictional basis for the existing strategic planning documents, there is a significant level of commonality amongst the various published reports – at least at the superficial issues level. Only those documents which have an operational focus (eg ROP) provide a Basin or River wide implementation strategy and these generally focus on a limited set of NRM outcomes. The significant exception to this is the Mary River Rehabilitation Plan, which identifies project level activities focussing on a variety of enhanced NRM outcomes for the riverine and riparian environs of the Mary River.

One of the initial activities undertaken by the BMRG was to overview the issues raised in the non mandated strategic planning documents – augmented by a range of workshops and consultations (BMRG unpublished 2003). The following summarises the results of that study with particular reference to issues raised in this desk based review.

8.1 Institutional Arrangements and Integration of Management Issues

The institutional responsibilities for enhanced NRM outcomes have become clearer over recent years with the passing of the Integrated Planning, Water and Vegetation Management Acts. The implementation of these Acts along with such embryonic processes as the Environmental Values approach to water quality objectives under the EPP (Water) Act should ultimately improve the situation and reduce inconsistency. However, there is a perception of a lack of co-ordination particularly for those issues which are not covered by the improving legislative environment. Since many of these issues relate to land management, this concern is of significance to communities.

Greater need for user-friendly policy documents and appropriately timed consultation processes to ensure valued input from community. Impractical and inappropriate rules and regulations, duplication across agencies and increasing pressure on the community to understand and accept changes to legislation. Need for streamlined processes and coordinated approaches

8.2 Social & Economic Outcomes

Apart from various studies undertaken as part of the Burnett Water Infrastructure investigations, this desk based review has not found any significant studies which evaluate the social and economic impacts and outcomes of NRM strategies. Such analyses are normally applicable only at the project level and hence commonly form a part of the development assessment process, it is therefore not surprising that these areas of NRM interventions have been overlooked. However, as BMRG as well as implementing line agencies move closer to designing and implementing NRM intervention strategies, there will be a heightened and more urgent need for these assessments.

Develop commonality of visions, actions, networks, trust, partnerships, reciprocity and cohesion. Change values, outlook and culture. Monitor and evaluate impacts and outcomes

8.3 NRM Outcomes and Issues

The review by BMRG identified issues related to land, water and vegetation management, water quality, and biodiversity protection both in the terrestrial and aquatic ecosystems. Many of these same issues are reflected at a relatively high level of priority within the various technical documents available to this review. It is however significant that a number technical unknowns covering these same issues exist which would make identification of defensible NRM outcomes problematic.

Whereas much of various condition assessment type studies have focussed on establishing a baseline for natural resource conditions, it is noteworthy that the various community and regional group strategies have clearly identified a number of broad NRM issues as being of priority:

- coastal zone development pressures are noted as priority issues – irrespective of the fact that much of the baseline type studies have indicated that it is the inland and middle reaches of the river system that have the more problematic baseline conditions. At a purely technical level this desk based review has also identified a number of potentially intractable issues within this zone. The zone is the area of the most intense high value commercial cropping is subject to considerable development pressure due to population growth and has relatively large reserves of land set aside for future residential and non rural population growth. At an NRM level, these areas contain the greatest density of residual terrestrial biodiversity in the region, have aquatic and marine assets of regional and national significance, have the most consistent water quality problems within the riverine environs of the region and have the greatest hazards for potentially intractable future landscape salinity hazards.

- Sustainable land management that sustains both commercial land use and environmental values are also noted as priority issues. Much of the baseline investigations have focussed on condition assessments and have generally not specifically addressed land management issues. The community based strategy documents all empathises that a number of land management issues do not appear to be adequately understood – or at least there appears to be limited viable solutions available to land holders. These concerns fall into two broad areas. The first of these areas is the control of pests and weeds which traditionally has been the responsibility of land holders. However, with increased recognition of the impacts of pests and weeds on biodiversity values of both the aquatic and terrestrial systems, the issue is perceived to be beyond the control of land holders alone. Whilst this desk based review has noted reference in various technical and baseline studies to the impact of weeds, a strategic approach to identification of the distribution of pests and weeds is not as readily apparent, nor are strategies to mitigate their spread. The second area of concern is the productive sustainability of commercial rural activities – be they farming or grazing. The twin demands of increasing farm productivity to accommodate fluctuations in commodity prices and at the same time to maintain the fertility and biodiversity of the resource which provides that productivity whilst protecting off farm environmental values (particularly within stream water quality and environmental flow requirements) is of concern.

8.4 Communication, Knowledge and Education

These are common themes not only in this region but in most of the regional strategy documents which have been prepared over the last decade. In part, they reflect the increased complexity of the technical issues of biodiversity and environmental values and the often qualitative (or soft data type) nature of the technical assessments (eg the use of condition statement indexes). The use of indices to concatenate a number of highly technical (and often semi quantitative) assessments does have a degree of utility for communication across a region. However, unless these indices are translatable into acceptable, implementable and sustainable strategies at the land holder level, communication, knowledge and education barriers to improved NRM outcomes will be consistently identified.

Community ownership, awareness, cooperation, coordination, access and quality of information

Greater understanding of sustainable NRM, educational/training needs, knowledge gaps and access

9 Threats and Gaps

This section uses the September 2003 draft Guidelines for Target Setting for Regional Natural Resource Management Planning to order threats and gaps by themes. In addition, the section indicates where additional investigations may be needed in order to develop the types of targets and outcomes required under the draft guidelines.

9.1 Dryland Salinity

The current distribution of salinity outbreaks is reasonably well understood, however, the scale in terms of land area affected and resultant off site negative impacts remains unclear. Whilst some outbreaks appear to be related to local groundwater flow systems and hence a relatively rapid response to land management change could be anticipated an aspirational target aimed at reducing the areas affected is feasible but insufficient information is available to determine hard targets. Other outbreaks appear to be related to more complex regional and intermediate groundwater flow systems, which will require a more detailed understanding of the hydrogeology of the systems before intervention strategies can be adequately identified.

The priority allocated to this issue will ultimately depend on a number of factors:

- The extent to which the outbreaks are increasing in area
- The extent to which stream water quality is being impacted – there is some evidence that base flow inputs are a factor in elevated salinity levels in Barker Barambah and some of the western catchment of the Mary, but this has not been adequately assessed and the water quality monitoring network is poor.
- The extent to which any impact on water quality has significant downstream/catchment effects. The relatively limited data available to date does not indicate that this is currently occurring at other than a subcatchment level.
- The extent to which remediation as opposed to prevention of the development of further outbreaks is the priority option. Such an assessment is particularly relevant to the coastal lowlands.

Further investigations of this theme are required in order to support its inclusion in any subsequent NRM plan.

The minimum requirements would aim firstly at establishing whether dryland salinity is exporting significant salt loads out of their subcatchments. This would require the analysis of all stream flow and EC monitoring data available from NRM gauging stations to establish representative relationships between within stream salinity and stream flow conditions. The results should then be evaluated against the existing salinity outbreak mapping and the hazard mapping in order to prioritise those catchments where the NRM plan should focus its activities.

The second minimum requirement would be to access all groundwater data within the NRM data base as well as unpublished data on the coastal zone systems of high salinity hazards and intermediate and regional groundwater systems in order to provide a better understanding of, and ability to predict the future direction under a do nothing scenario of salinisation in these critical areas.

9.2 Soil Acidity

Soil acidity has not been identified in this desk based review as an issue of significant concern. Whilst acidity is believed to be a problem on some of the highly weathered soils of

dryland crop lands of the inland as well as the sandier soils of some of the coastal lowlands, it is likely that current land management practises are able to manage this problem.

9.3 Land and Wind Erosion

Land and wind erosion have not been identified as specific issues within the study area with the exception that the SedNet modelling has indicated that that sediment from the grazing and forested lands supplies the majority of the sediment to the basins. It is arguably overly simplistic to ascribe this to unacceptable land management in the absence of any hard data on rates of erosion or density of unstable gullies etc within these lands as these land uses also comprise up to 80% of the land use area within the basins.

Historically, erosion has been a major issue within the undulating crop lands of Isis, Gin Gin and Kingaroy and in each of these locations the more erosion prone lands have been lost to cultivation. The impacts of this historical erosion on current stream conditions is however unknown.

On the basis of the currently available SedNet information and because grazing and forested land also contain the greatest percentage of relatively intact terrestrial ecosystems, the focus in the NRM plan should arguably be on the broad hectare grazing and forested land management systems. However in order to spatially target these approaches, the existing stream flow and somewhat limited turbidity stream gauging data would need detailed review.

9.4 Soil Organic Carbon, Physical Condition, Hydrophobocity and Biology

The desk based review has not identified these issues as of regional significance.

9.5 Acid Sulphate Soils

This review has identified that the mapping of acid sulphate soils is incomplete for the study area, but that existing soils mapping when combined with the acid sulphate soils mapping may be sufficient to provide a regional hazard assessment. Given the proximity of ecologically significant estuarine coastal and terrestrial ecosystems to the suspected acid sulphate soils areas and the potential future development pressures in these areas, the preparation of acid sulphate soils coverage with associated management guidelines which incorporate protection of the sensitive ecosystems should be given priority. An appropriate target for such an activity would be the adoption of the management recommendations by local authorities as part of their development assessment processes.

9.6 Terrestrial Ecosystems and Biodiversity

The regional ecosystems mapping and the biodiversity planning assessment provide an adequate regional database for this theme. The Vegetation Management Act and state policies and regulations that follow from that act provide a powerful basis (in terms of condition status) on which to regulate land clearing. Target setting based on maintaining the conservation status and current distribution and linkages between these ecosystems should be feasible.

Both this review and the various catchment strategic plans have identified a number of issues within this theme:

- Condition status with respect to weeds remains unclear. For some regional ecosystems, weeds are one of the major threats to system integrity

- Land Management impacts (eg grazing and forestry as well as fire management) on biodiversity and condition remain poorly understood. Integration of improved biodiversity outcomes to grazing and forest land commercial outcomes and management is a complex task but if successful would have the largest single impact on the biodiversity of remnant vegetation estate
- Given that broadscale clearing ceases in the region, the major threats from land development to the biodiversity values at a site level and to the integrity of the ecosystem estate is within the coastal lowlands where there is a conjunction of population growth, large reserves of non rural future residential land and extensive remnant and intact terrestrial ecosystems. The existing mapping is unlikely to be accurate enough to adequately guide this future development in a way that ensures key ecosystem values are preserved. This issue when combined with the juxtaposition of salinity hazards and adjoining significant wet lands, aquatic and marine ecosystems suggest that the development of terrestrial ecosystem management plans for use by shires in these areas should be a priority.

9.7 Inland Aquatic Ecosystems

One of the factors which have complicated this review is that the region is not a homogeneous entity. In many ways there is more variation in natural resource attributes within the region than there is across the region boundaries. The individual River Basins are not linked hydrologically to any significant extent and with the exception of the recent Water Resource Planning studies, most of field investigation work has been either project based or focussed on basin wide condition indices assessments. As a result, past assessments (and this review) which aim to take a whole of region overview approach are faced with the reality of a disjointed hard information base for the majority of the inland aquatic ecosystems.

In the case of the Burnett and those parts of the Kolan to which the Burnett findings can be extrapolated, there are a significant number of knowns and a considerable amount of on going research concerning the inland fisheries habitats and the management requirements to facilitate fish movement and provide sustainable aquatic conditions both for important species such as the lung fish as well a maintenance of biodiversity. The development of an inland fisheries management plan is likely to be feasible once these on going studies are completed. However, the inland aquatic ecosystem values are likely to be significantly offset in substantial parts of the Burnett by other values relating to demands and uses for the water resources.

Despite these difficulties, a draft set of environmental values for the Burnett was proposed in the EIS of the water infrastructure development. As these EV's and their associated WQO's do not appear to have been validated by community consultation or by reference to existing baseline conditions throughout the catchment, they would be unlikely to constitute defensible targets for the Basin. It is primarily the competition and trade off in values and importance for water resources which will complicate the development of Environmental Values and Water Quality Objectives within the Burnett and Kolan Basins.

The Baffle and Burrum basins are less problematic that the Burnett – primarily because on most condition assessment criteria, these Basins are less degraded than the Burnett and the inland aquatic systems remain relatively intact. The development of EV's and WQO's should be a much less complex process than in the Burnett and in the strategic medium to long term could be argued as being of higher priority due to land use and development pressures which are likely to arise within the coastal lowlands

The Mary River Basin is however a different situation to the other basins. Like the Burnett the inland aquatic environment has suffered considerable impact from degradation of the riparian zone, but it has fewer impoundments and a much higher and less regulated discharge regime.

Draft EV's and WQO's for the Mary based on a process of community consultation are in preparation and due for release in early 2004. Subject to the success of this process, it would seem appropriate that a similar process be extended to include the Burrum and Baffle Basins in 2004 and subsequently to the Burnett/Kolan. This process offers the best opportunity to establish Basin and subcatchment specific targets for inland aquatic ecosystem outcomes.

Discussions with line agency staff and review of existing available documentation indicates that there are a number of threatening processes currently active across the region which are either damaging likely EV's or are considered to have the potential to endanger values in the future if not adequately managed. Associated with these issues are data and information gaps. The capacity to determine which of these scenarios is in fact the case and to adequately proportion priorities is determined by both the gaps in knowledge as well as the disjointed nature of existing knowledge.

Key process of concern appears to be:

- Riparian zone destabilisation as a result of adjoining land use/infrastructure. This is primarily a concern in the Mary River and the Burnett and is localised. It is implicated in sediment loads and loss of habitat for key species – including the Mary Cod and Lungfish. The Mary River Rehabilitation Plan identifies specific projects targeting this issue – this plan probably needs revising and abstracting into the BMRG NRM plan. No such specific project level plans exist for the other basins.
- Processes related to Water Quality issues. Hotspots can be identified from the existing monitoring data sets (eg Mary River below Gympie, Baroon Pocket Catchment, Barker Barambah, Three Moon Creek and Lower Burnett). The role of diffuse versus point sources in these hot spots remains unclear. The monitoring regime required to support and implement an EV based approach should however be targeted and designed to clearly differentiate between these types of sources. It is imperative that an EV based approach be supported and indeed guided by an adequate water quality and monitoring data base.

A key sub theme within the inland aquatic environment is that of Aquatic and Riparian Zone Weeds and Feral fisheries. Little is known about the distribution of these as issues of concern – except that a number of aquatic species have been identified, many of which have a preference for impoundments, whilst environmental weeds are endemic and occasionally dominant along parts of the River systems – particularly the Mary River. The State of the Rivers and the various catchment strategy studies all indicate that environmental weeds within the riparian environs are of significant concern. The major species of concern are laurels and elms which in parts of the Mary dominate the river banks. Invasion and subsequent dominance of the environ vegetation is predicated on relatively high levels of disturbance, and in some parts of the Mary system, these species arguably contribute to riverbank stability at an environmental cost of loss of biodiversity within the stream banks environ. Their effects on biodiversity and on the adjoining aquatic ecosystem are less clear.

Management strategies to slow and or eliminate the invasion of these species are required; however, there is a lack of data on the distribution of these communities within the region as whole which would allow other than aspirational targets to be set at this stage.

Whereas replacement of degraded native communities on river banks by environmental weeds has an arguably negative biodiversity impact and possibly some bank stabilisation benefits, aquatic weeds are believed to have no positive environmental outcomes. Aquatic weeds are endemic in the region, however their distribution is poorly understood and their management even within controlled storages poses a number of challenges. The control studies of Cabomba weed on Lake Macdonald being carried out by the MRCCC have highlighted the

difficulties in managing exotic aquatic weeds, and provide some insights into the ecological threats posed by such weeds. There is almost no data on the distribution of exotic aquatic weeds in the Burnett Mary region outside of the impoundments on the Burnett system (Tom Anderson NRM pers comm.). This aspect is seen as high priority (at an aspirational level of target setting) to establish the current level of risks posed by exotic weeds, particularly in the upper parts of the river systems.

9.8 Coastal, Marine and Estuarine Ecosystems

The wetlands, fisheries and dugong mapping for the area would appear to adequately categorise these ecosystems at a regional level. Unlike the inland aquatic ecosystems where the lack of data on the actual distribution and the linkages between ecosystems components mitigates against basin specific planning, management planning with supporting legislative and regulatory bases are in place for these coastal and marine areas. The review has not been able to identify significant gaps in the data for these areas which would mitigate effective management of the threats which arise directly within these ecosystems. Rather, the major gaps relate to an understanding of sources and effects of nutrient and sediment inputs into these ecosystems from the aquatic and terrestrial ecosystems.

This review has identified a number of threats related to contiguous coastal land development which require further work – these are discussed in other section above. However, at a more general level, a better understanding of the factors which impact on the end of Basin water quality objectives would greatly enhance priorities and objectives for management of the inland and terrestrial ecosystems. Such an understanding should be a core requirement of the design of a monitoring and evaluation systems set in place under the EV and WQO processes proposed for the region.

9.9 Stream Hydrology

Within stream hydrology impacts on water quality relate primarily to the management of the low flow regimes. The Mary River in its middle and lower reaches above the barrage currently has elevated nutrient levels, whilst the low flow regime and management within the Burnett Basin impoundments is also of concern. As most of the upper reaches of the Burnett sub catchment are currently unregulated by structures, and where storages do exist, the levels of allocation are relatively high, there may be limited scope for proactive manipulation of the Burnett system.

The series of studies underway within the Burnett (eg Boardman recommendations) in conjunction with the WRP process is expected to provide a heightened level of understanding of these issues and ultimately result in targets under the NHT2/NAP framework. However, manipulation of flow regimes specifically for the purposes of providing enhanced water quality outcomes as well as enhanced within stream habitat/biodiversity outcomes is unlikely to be of a high priority in the other basins where the proportion of discharge which is regulated and diverted for other uses is much lower than in the Burnett.

9.10 Water Use Efficiency

This issue aims primarily at the reducing extraction from rivers and storages for non environmental uses. Improved water use efficiency practises have been identified by a number of industries; however, the contribution of adoption of these processes to within stream outcomes remains unclear, whilst the levels off adoption also remain unclear.

Despite the fact that significant sections of the Mary River and Bundaberg irrigation areas are already supplied by pipelines, there are a number of partially or unlined header command systems in these areas and loses in these areas may well be of local significance irrespective of their basin wide significance. Storage and transmission losses within the irrigation network have been estimated in the Burnett WRP/ROP. The IQQM modelling assumed losses of between 20 and 25% of diversion within channels between the pump station and the irrigation farm gate. These loses translate to approximately 500 ML/day out of a total pumping capacity of approximately 2000 ML/day. The contribution of any reduction in these losses to improve within stream outcomes remains unclear. The impact of these loses on improved groundwater availability also appears to be a matter of some speculation as is the potential negative impact on salinisation within the coastal lowlands.

Further studies on water use efficiency are required before identifiable targets can be set. In particular these studies should be co-ordinated and integrated with the assessment of groundwater salt water intrusion within the extended Bundaberg groundwater area.

9.11 Coastal Development

The region has yet to experience the levels of coastal development that have come to characterise southern Basins. What is known about the BMRG coastal environs is that its has a relatively good coverage of existing regional ecosystems, does have a largely unquantified acid sulphate soils problem, has extensive coastal wet lands, fisheries and dugong habitats and a number of largely unstudied coastal sand mass environments. These resource pre conditions are not all that dissimilar to the Noosa, Maroochy and Caboolture River Basins to the south some 3 to 5 decades ago.

The scant monitoring network that is in place does not suggest at this stage that the current levels of development are major causes for concern. However, the projected levels of urban and industrial land use are high and the region is reputed to be experiencing significant non rural based population growth.

Aspirational objectives to maintain and protect current levels of water quality in the streams, estuaries and marine areas are feasible and arguably defensible on at least the basis of a precautionary approach. However, converting these aspirational objectives into targets and strategies which can be implemented will require a far more enhanced understanding of the coastal environs than currently exist. Themes and issues identified in previous sections will go a significant way towards identifying hard targets for coastal development. Ultimately however, the local authorities under the Integrated Planning Act will have to adopt and implement these targets. Accordingly it is critically important that the development of these targets be done in conjunction with the existing regional planning and advisory structures.

9.12 Groundwater pollution

Within the groundwater management areas of the region, the major threats and issues are associated with salt water intrusion within the groundwater provinces where the groundwater is an important economic asset (eg Bundaberg Irrigation Area) or potentially important for depended coastal ecosystems (in the coastal sand mass areas). Whilst this review has not reviewed the status of knowledge in these areas, it appear likely that a combination of both aspirational targets (eg reduction in extractive use from coastal sand masses aquifer) and hard targets (eg reduction in volumetrically weighted salinity levels of aquifer derived irrigation water in the Bundaberg Irrigation Area) may be feasible.

The Bundaberg District Groundwater Advisory Committee in submissions to NRM, Sunwater and the Department of State Development (Sept 2003), have indicated that an integrated plan is urgently required and that the substantial amount of investigations undertaken since 1996 should be able to form the basis of a suitable plan.

The review teams discussions with agency groundwater staff suggest that the current approaches of restricting groundwater allocations is arguably slowing the rate of advance of salt water instruction, but is unlikely to return the saltwater interface to its pre-development position. Whilst negative impacts of intrusion are well known, much of this information would appear not to have been collated in a format that would inform future investment in mitigation strategies.

It does appear that there is limited knowledge about the coastal sand mass (beyond the Fraser Island groundwater area) which would allow other than aspirational targets to be set. Further monitoring is required in these areas.

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