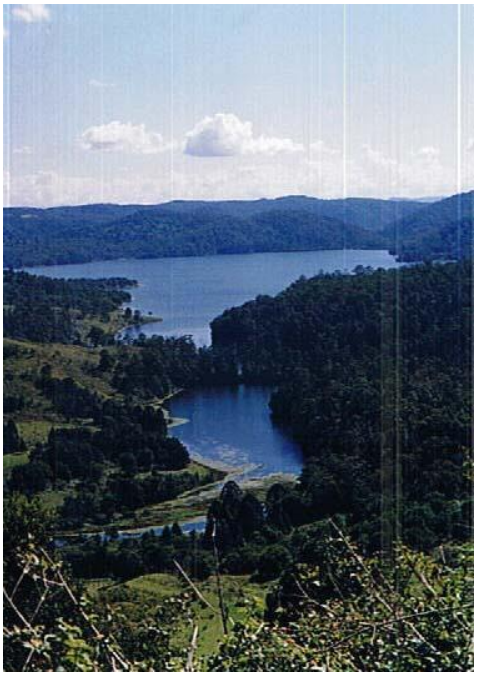
Lake Baroon Catchment

Management Strategy

Volume 2,Version 4

December 2004



Published by AquaGen

ISBN (Complete set) 0 646 31436 X

ISBN (Volume 1) 0 646 31449 1

ISBN (Volume 2 revised)

ISBN (Volume 3) 0 646 31451 3

Available from:

AquaGen Water and Renewable Energy

28 McKillop Road

Palmwoods Queensland 4555

Australia

Cover, clockwise from top left):

Lake Baroon

Platypus in Obi Obi Creek

Leaking pipe

Gathering by the Obi Obi Creek

Printed in Australia by

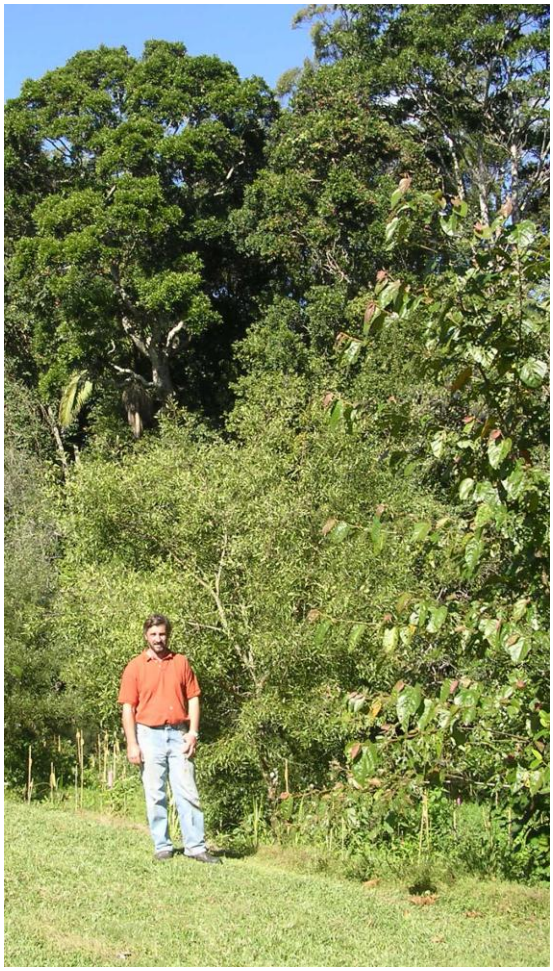
Preface – President’s Overview – Peter Stevens

Since formation in 1991 the LBCCG has worked to raise public awareness of water quality issues within the catchment and to encourage individuals and community groups to implement appropriate water and land use practices to minimise in-stream and groundwater pollution. The original catchment management strategy developed in 1997 was an essential tool in guiding the group to recognise the catchment for what it is, identifying areas of concern and providing a framework for future efforts to maintain the catchment in good health.

Since 1997 many factors have contributed to changing how the catchment is used and what future impacts may occur. Significantly, dairy deregulation in Australia has meant that fewer dairy farms now operate in the catchment with some switching production to beef or horticulture which will bring new challenges. The increase of urbanisation and population within the catchment has been driven by the sea-change phenomena and proximity to Brisbane for rural lifestylers is also a growing threat. The areas surrounding Montville and Maleny have continued to gain a profile as a tourist destination which has led to an increase in the number of accommodation providers and demands of tourists themselves that provide a permanent increase to the number of people using the catchment. Increasingly, the public is also being made more aware of Australia's limited water resources and the need to protect catchments and make the most efficient use of the available water resource. The Sunshine Coast which our catchment supplies is now considered one of the highest growth rate areas in Australia demanding an ever increasing supply of clean, fresh, drinking water.

Since becoming president of the LBCCG in 2002, I have been impressed by the community’s enthusiasm and commitment to improving water quality in our catchment. As the local population increases, more and more people will become part of the shared responsibility to care for and nurture our catchment as a living organism. My hope is that the community rises to this challenge and I encourage people to become more involved in caring for our catchment.

I would like to thank AquaGen for funding further development of this strategy and providing financial support to the LBCCG over the last thirteen years to implement real projects undertaken by real people making a real difference to our catchment. Part of the success of the LBCCG is that it is one of the few groups that landholders can directly approach for small grants through a relatively uncomplicated application procedure. This is complimented by the advice and support of our project officer who is able to assist landholders with practical, local knowledge.



Peter Stevens, President, LBCCG,

His riparian plantings (foreground) with remnant riparian rainforest in the background.

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Development of this Strategy

To coincide with the United Nations International Year of Freshwater, the Lake Baroon Catchment Care Group Inc. (LBCCG) in conjunction with the Caloundra Maroochy Water Supply Board trading as 'AquaGen' Water and Renewable Energy decided to review the 1997 edition of the Lake Baroon Catchment Management Strategy.

This strategy is an amended and updated version of the 1997 Volume 2: Policies, Strategies and Further Information of the Lake Baroon Catchment Management Strategy. This document does not repeal the 1997 Strategy as the background details, technical information and issues remain contemporary and relevant. This updated Strategy will build upon the policies developed for the 1997 publication to incorporate:

- Changing community values and perceptions regarding natural waterways and catchment management
- The various environmental Codes of Practice endorsed under Section 548 of the *Environmental Protection Act 1994* which include: Agriculture, Sustainable Cane Farming, Sustainable Fruit and Vegetable Production, Queensland Piggeries, Diary Farming, Forestry on State Lands and Prawn Farming.
- New state legislation including the *Integrated Planning Act 1997* which requires planning schemes to address ecologically sustainable development through managing and controlling impacts of land use upon environmental values; *Water Act 2000* regulating water flows and protecting vegetation within watercourses; and the range of policies and regulations under the *Environmental Protection Act 1994* that regulate impacts upon water quality.
- New state policies, codes, strategies and guidelines such as the Qld Dept of Natural Resources and Mines and Dept of Local Government and Planning On Site Effluent Disposal Code, the Queensland Water Recycling Strategy (2001), South East Queensland Regional Water Quality Monitoring Strategy (2001), Stormwater Quality Control

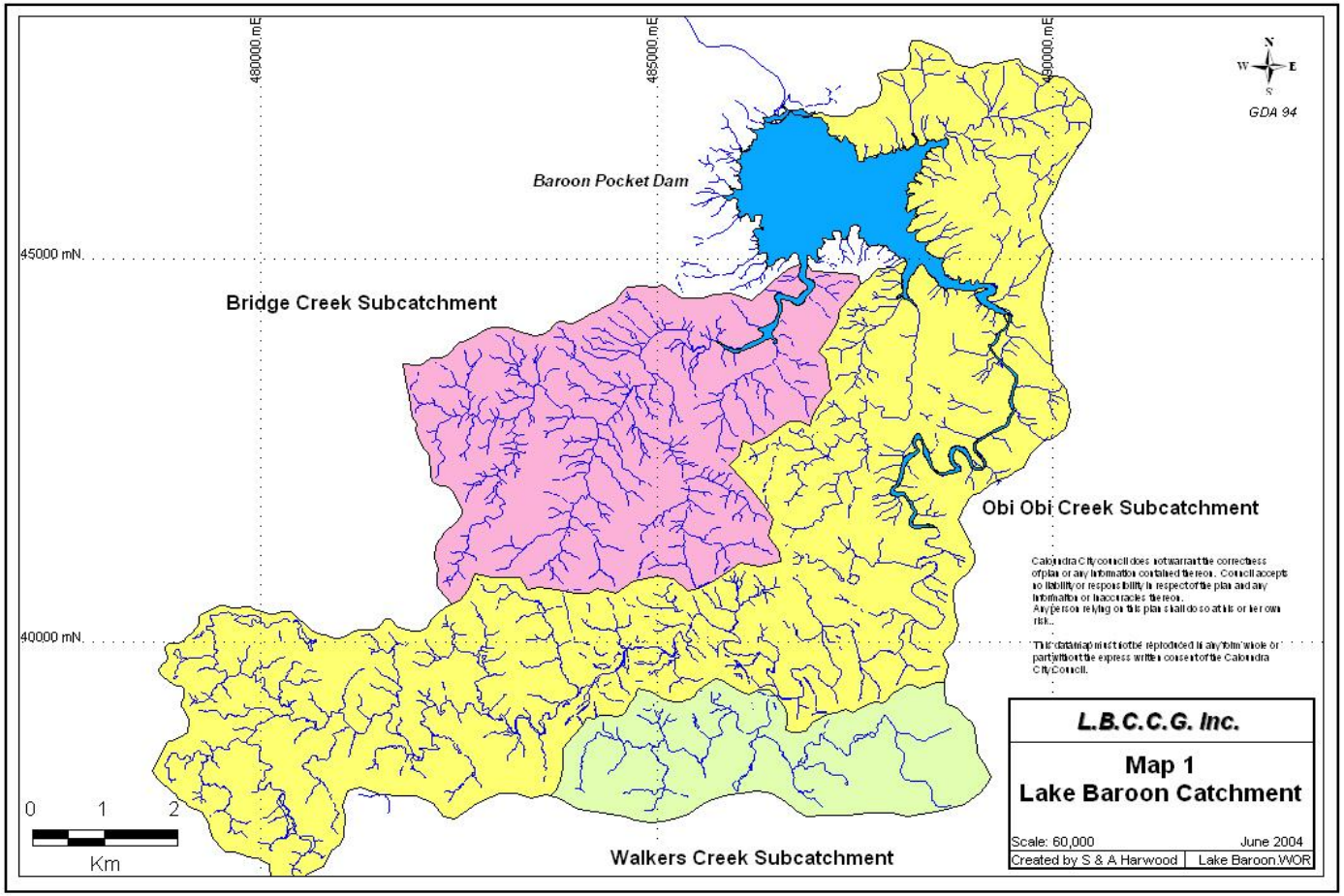
Guidelines for Local Government (Dept of Natural Resources and Mines and Dept of Environment) (1998), the Environment Protection Agency Queensland Model Urban Stormwater Management Plan and Guidelines (1999).

- Strategic Catchment Management Plans such as the Mary River Catchment Management Strategy (1998), Mary River and Tributaries Rehabilitation Plan (2001), the Draft Mary River Water Resource Plan (2002), and the Burnett Mary Regional Group for Natural Resource Management Inc Regional Investment Strategy (2003).
- New Federal government initiatives such as the National Water Quality Monitoring Strategy, National Water Initiative, National Guidelines for Water Recycling and the National Water Efficiency Labelling System.
- The revised 1996 ANZECC Fresh and Marine Water Quality Guidelines (2000) particularly aquatic ecosystem requirements and revised guideline values for primary contact recreation.

Identifying Priority Issues

Prior to the development of this strategy, the community were asked to make submissions to assist in identifying the environmental values of the Lake Baroon Catchment as they relate to water quality. A newspaper advertisement was placed in the Range News on the 25th of November 2003 and a media release was developed for publication in January 2004. No formal submissions were received. Council officers from Caloundra City Council were interviewed (as 95% of the catchment is within Caloundra Shire) to gain an understanding of current Council led water quality initiatives being undertaken and to gain an understanding of relevant issues to be addressed in the revised strategy. The members of the Lake Baroon Catchment Care Group Inc. have been involved throughout the entire strategy development phase.

An extensive literature review on all relevant issues has been undertaken and an Issues Statement has been prepared to guide the development of this strategy.



Map 1 – Lake Baroon Catchment

About this Strategy

The Lake Baroon Catchment Care Group and AquaGen enjoy a successful partnership united by the common goal of protecting and enhancing the quality of water entering the Lake Baroon Catchment. Members of the Lake Baroon Catchment Care Group include representatives from local and regional environment organisations, Queensland Dairy Organisation, urban and rural residents, local businesses and beef producers/breeders.

This strategy is not a statutory document. The plan preparation was undertaken by choice and is the result of community based ‘citizen science’ efforts to achieve sustainable and balanced use of land, water and biological resources that are contained within and defined purely by the flows of surface water into the Baroon Pocket Dam.

AquaGen has generously provided the funds to develop and publish this Strategy. Caloundra City Council kindly provided the digital data that form the basis of the Strategy maps.

The focus has been on developing a planning methodology that enables a monitoring system to measure the progress of the strategy in terms of protecting and enhancing the environmental values associated with water quality in the Lake Baroon catchment. Specific targets have been set to enable the implementation of the strategy to be monitored over time, to provide data for State of the Environment reporting and to provide for and adapt to new information and changing circumstances.

This strategy has been written in two sections the first relates to the priority issues affecting the entire catchment and the second relates specifically to each of the sub-catchments contained within the Lake Baroon Catchment.

1.1 Water Quality Monitoring

Goal

A locally based water quality monitoring program that incorporates relevant biological, physical and chemical indicators, provides quality assured results and establishes a universally agreed set of guideline values.

Background:

Different levels of water quality are required for different uses such as drinking, ecological health, recreation, industry and agriculture. Although AquaGen undertakes most of the water quality monitoring, a variety of other government and non government organisations test the quality of water in the Lake Baroon catchment. This has resulted in a range of parameters being tested with different guideline values (numerical values) attached to particular parameters such as faecal coliform counts, total phosphorous, turbidity, and oxidised nitrogen. The water quality in Lake Baroon requires a consistent approach to the collection of data to ensure an efficient and uniform approach to the management of all land uses that have the potential to impact upon water quality.

The ANZECC Guidelines for Fresh and Marine Water Quality (2000) include provisions for community involvement in the setting of environmental values and subsequent water quality objectives (numerical values). To date no such

process has been established for the Lake Baroon Catchment, with several entities collecting water quality data and no central agency being responsible for collating, quality assurance or the establishment of Water Quality Objectives consistent with ANZECC (2000).

It is therefore imperative that all organisations involved in the collection and analysis of data have the same guideline values so that all organisations including the community are able to work together towards the attainment of a common goal.

According to Gutteridge Haskins and Davey Pty Ltd (2001) the amount of developed area for urban residential purposes within the Obi Obi and Walkers Creek catchments will increase by 10% (372 hectares) over the forthcoming 10 years (not including the proposed golf course residential development on North Maleny Road). Bridge Creek Catchment will experience approximately 35 hectares further urban residential development. Overall this represents an additional 402 hectares or 6% of the total area of the Lake Baroon Catchment.

As the development intensifies within Lake Baroon catchment so does the potential for major impacts upon the physical structure of the natural waterways and associated water quality. Baseline data needs to be established against which all subsequent development (urban or otherwise) can be evaluated to at least ensure the protection of water quality and to ultimately aim for its enhancement.

According to Roux, Kempster, Kleynhans, Van Vliet and Du Preez (1999), biological surveys show that considerable biological impairment may occur downstream from a discharge (relative to upstream condition) even when the discharge complies with water quality standards. This is due entirely to current policy on water quality monitoring focusing on physical and chemical indicators of water quality and not on aspects such as aquatic habitats and ecological integrity.

There is little to no research conducted within the Lake Baroon Catchment that examines base line data of macro invertebrate diversity, aquatic ecosystem requirements (such as canopy cover, in stream plant structure, and environment flows). The Caloundra City Council, Waterwatch, AquaGen,

state government departments including QEPA and QDNRM and CalAqua do not collect any data on aquatic ecosystem requirements of the Lake Baroon Catchment. It remains largely unknown as to which instream species are more susceptible than others to pollutant concentration levels and have what (if any) injurious impacts upon in stream health. Therefore water quality monitoring needs to shift from its focus on collecting information on chemical and physical parameters alone, to establishing and incorporating biological indicators to develop a more holistic perspective of water quality.

Specific Outcome	Acceptable Solutions	Key Performance Indicators
WQ1. The development and implementation of a water quality monitoring program that is consistent with ANZECC (2000) Guidelines for Fresh and Marine Water Quality	**WQ 1.1**: Develop environmental values for the water quality of Lake Baroon catchment in consultation with the community and relevant stakeholders (AquaGen, CalAqua, relevant state government departments, Caloundra City Council and Maroochy Shire Council). **WQ 1.2:** Expand physical and chemical parameters to establish guideline values in sediment for heavy metals, phenols, polycyclic aromatic hydrocarbons, petroleum hydrocarbons, organochlorine pesticides, oil and grease. **WQ 1.3:** Apply the AusRivAS (the nationally standardised approach to biological assessment of stream condition using macroinvertebrates) rapid bio assessment process.	1. By the year 2007 a locally relevant Water Quality Monitoring Strategy that is consistent with the ANZECC (2000) Guidelines for Fresh and Marine Water Quality for the Mary River Basin is developed for Lake Baroon catchment. 2. The Caloundra and Maroochy Shire Councils Planning Schemes and associated Policies require all assessable development to demonstrate compliance with the guideline values set within the locally relevant Water Quality Monitoring Strategy for Lake Baroon catchment. 3. All local government owned recreation infrastructure and facilities complies with the guideline values set within the locally

	WQ 1.4: All water quality analyses are performed by suitably trained and qualified personnel. **WQ 1.5:** A quality assured (ISO 9001 compliant) process is applied to the collection, analysis and reporting of all water sample testing. **WQ1.6:** Work in conjunction with CCC to plan how the water quality data will be collected, analysed, interpreted and disseminated and where the data will be stored. **WQ1.7:** To encourage Councils to develop a locally relevant environmental support system to model and manage land use changes that impact on water quality and ecosystem health.	relevant Water Quality Management Strategy to be developed for Lake Baroon catchment.

	WQ1.8: To encourage Councils to collect and report on environmental flows, ground water, as well as load based and event mean concentration data in their monitoring programs. **WQ1.9:** To work in partnership with Council to regularly review and update it USWQMP, DDPSP and other relevant documents to include information on water quality guidelines, objectives, Environmental values, event mean concentrations, compliance standards or acceptable target ranges in accordance with international, national, state, regional and local guidelines and best practices.	

1.2 Health and Safety

Goal:

Impacts of land use and associated surface water runoff and sub surface flows are effectively managed to ensure minimal risk to the health and safety of residents and visitors in the Lake Baroon catchment.

Background:

The creeks and tributaries of the Lake Baroon Catchment have a long history of being used as a recreation resource by residents and visitors. More notably the creeks for swimming in the warmer months of the year and the Lake itself for year round activities such as sailing, walking, picnicking, nature appreciation, swimming and fishing. In addition to the recreational and aesthetic qualities of the waterways, water within the Lake Baroon Catchment

provides for the irrigation of crops and drinking water for stock and human consumption.

It is of paramount importance that the quality of the water be appropriate for the end uses. The water must be sufficiently free from faecal contamination, pathogenic organisms and other hazards to protect the health and safety of the community at large.

The Australian and New Zealand Guidelines for Fresh and Marine Water Quality (2000) provide guidance to local government authorities on establishing guideline values for a range of contaminants, with the NHRMC providing guidelines for the provision of safe drinking water.

Particular issues that need to be addressed that have the potential to deleteriously impact on the health and safety of the community include:

1.2.1 Blue Green Algae:

Blue green algae are microscopic organisms that thrive in nutrient enriched waters. Where they occur in great numbers the concentration is referred to as a 'bloom'. When the algae die, they produce toxins. Three basic types of toxins are produced:

Hepatoxins which attack the liver, kidneys and other internal organs of poisoned victims. Hepatoxins are in the *Microcystin* group and to a lesser extent *Anabaena*.

Neurotoxins affect the nervous system of the victim leading to respiratory failure. *Anabaena* is the most common genus to produce neurotoxins in Australia.

Lipopolysaccharides are toxins that create irritants such as eye irritants, cause gastrointestinal upsets and asthma and skin irritations to people whom come in contact with them externally.

The main genera of blue green algae having toxic species present in Australia according to the New South Wales Department of Land and Water Conservation (1998) include *Microcystis, Anabaena*, *Nodularia* and *Cylindrospermopsis*. Lake Baroon has experienced a range of algal blooms

including *Microcystis*, *Cylindrospermopsis* and *Anabaena*. AquaGen regularly monitor the water quality for the presence of blue green algae and implements a public health risk strategy that is activated when blooms present themselves at potentially toxic levels within the dam.

1.2.2 Sediment associated Pathogens

Sediment associated pathogens are known to maintain their infectivity and humans can become infected if they inadvertently ingest sediment. These pathogens originate from animal faeces, leachate from tips and septic tanks and can bind with sediments that wash off the land surface into the waterways after storm events or extended durations of rainfall. These pathogens include Cryptosporidium, Hepatitis *A., Rotovirus* and poliovirus.

1.2.3 Wastewater Disposal Systems

AquaGen's database indicates that the Maleny Wastewater Treatment Plant is a point source of nutrients in the catchment. This source of nutrients is ameliorated by the irrigation of treated effluent.

Faulty household on site wastewater disposal systems that leach bacteria, viruses, protozoan parasites and helminths have the potential to concentrate in underground water reserves. Caloundra City Council estimates that approximately 30% of all household sewage treatment plants and 70% of all septic systems within the shire do not meet water quality standards. The health of the end user has the potential to be compromised where the underground water reserves, dams and streams become contaminated with harmful concentrations of pathogenic organisms and are subsequently used for domestic and stock drinking water supplies. The setback distances for the locating of on site wastewater disposal systems should comply with the new viral die back method developed by Cromer, Beaver and Gardner (2001) which includes the provision for:

- temperature range of groundwater;
- travel time for vertical infiltration; and
- radius of influence of water bore.

1.2.4 Stormwater runoff

Stormwater runoff contains sediments, nutrients, oil, detergents, gross pollutants and pesticides. The concentration of these toxins ultimately determines the impacts upon human and animal health and safety.

Constructed wetlands that store stormwater runoff have the potential to contain harmful concentrations of toxins in addition to a range of pathogenic

organisms (New South Wales Department of Land and Water Conservation 1998). Stormwater detention basins must be monitored for quality and actively managed to mitigate against risk to human health and safety. Forman (1995) cautions using wetlands for wastewater treatment simply because it is unknown how long it takes to saturate soils (ie organic matter and clay), with nutrients. It is essential that where these artificial wetlands are used for the treatment of wastewater, that they are also intensively managed to monitor nutrient levels and ensure their containment or removal prior to entering any waterway within the Lake Baroon Catchment.

1.2.5 Cattle access to Waterways

Animal borne pathogenic organisms such as tapeworms and *Cryptosporidium* enter the waterways where cattle have free access to streams. Research by

Wohlsen and Katouli (2003) indicated that the risk of large numbers of *Cryptosporidium* and *Giardia* entering the Landers Shute Advanced Water Treatment plant are relatively low. However, results from their research quantified the risk of contamination to the catchment from the occurrence of *Cryptosporidium* and *Giardia* (water samples were analysed for the presence of *E.Coli* and enterococci as indicator organisms of faecal contamination) and found the following:

Location	Level of Risk
Aplin Road	Moderate
Fryers Creek	Moderate
Maleny Weir Up Stream	Moderate
Maleny Urban	High
Walkers Creek	Moderate
Bridge Creek	High
Gardners Falls	Moderate
Maleny STP Raw Sewerage	High
Maleny STP Treated Effluent	High
Raw Water Ex Pipe line	Moderate

Table 1. Risk to Catchment for each sample Collection Site

Cattle crossing at Maleny High School

Results from AquaGen water quality monitoring and research by Wohlsen and Katouli (2003) further suggest that Faecal Coliform counts exceed the Australian and New Zealand Guidelines for Fresh and Marine Water Quality

for primary contact recreation (150 counts per 100mL sample) at the following collection sites:

- Aplin Road
- Fryers Creek
- Maleny Weir Up stream
- Maleny Urban
- Walkers Creek
- Bridge Creek and
- Gardners Falls

It is not known whether or not the point source of the faecal matter is of animal or human origin. Results from water testing by AquaGen, generally indicate that faecal coliform counts exceed the Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2000 guideline values for primary contact recreation in reaches where cattle have access to streams within the catchment such as the dairy farms within Walkers Creek and grazing within Bridge Creek and the upper catchment of the Obi Obi (above the Weirs). Overall, Walkers Creek experiences high levels of both faecal coliform counts, in addition to high levels of nitrate and ammonia that suggests septic systems are failing, but is more probably attributed to dairy farms in this sub-catchment.

Generally, Gardners Falls and the swimming areas located at Lake Baroon are the only locations where primary contact recreation occurs on a regular basis. All other locations generally meet the guideline for secondary contact recreation of 1,000 organisms per 100 mL sample.

Specific Outcome	Acceptable Solution	Key Performance Indicator
HS 1 Current and proposed stormwater quality strategies, infrastructure and actions prevent risk to public health and safety	**HS 1.1** A public health and safety risk assessment of stormwater quality (surface runoff) and associated infrastructure is conducted.	1 Risks to public health and safety from stormwater runoff and infrastructure are addressed in a comprehensive risk management strategy.
HS 2 Prevent public health risk from malfunctioning on site wastewater disposal systems.	**HS 2.1** Assist and support the CCC and MSC in the implementation of an education program on the operational procedures and maintenance requirements for the Maleny and on-site wastewater disposal systems. The program should include information on: an overview of the operation and maintenance of the systems and the pollutants that discharge from a poorly operating system and subsequent impacts upon water quality and aquatic ecosystems. (For the septic inspection/maintenance schedules refer to Appendix 1).	1 90% of physical and chemical parameters and biological indicators are to meet relevant standards for unimpacted streams by year 2010 (eg. SIGNAL Score =>6) with gradual improvements recorded every two years. Reductions in Faecal coliform, nitrate, ammonia and oxidised nitrogen levels in Obi, Walkers, Fryers and Bridge Creek catchments are reduced by 10% from 2003 levels by the year 2010. 2 Groundwater reserves are monitored to ensure compliance with water quality objectives

Specific Outcome	Acceptable Solution	Key Performance Indicator
	HS 2.2 Continue to support tertiary research programs to detect pathogen hot spots. **HS 2.3** Develop, support and implement research projects that maximise the opportunity for nutrient and water quality reuse by filtering vegetation uptake. **H2 2.4** Local and state government agencies conduct a water bore mapping and water quality-monitoring program to develop an understanding of underground reserves within the catchment.	
HS 3 Actively manage stock access within riparian lands	**HS 3.1** Maintain adequate riparian buffers and erect riparian fencing and exclude or actively manage stock access, including the provision of off stream watering and shade, and hardened access points (cattle crossings)	1. Riparian lands on all grazed lands (where stock is likely) is protected through management controls by 2015. 2. All primary producers comply with relevant industry Environmental Codes of Practice (endorsed under S548 of Environmental Protection Act 1994) by 2010.

Specific Outcome	Acceptable Solution	Key Performance Indicator
HS 4 Effective management techniques are used within the catchment area to reduce nutrient within the water supply and the possibility of blue green algal blooms.	**HS 4.1** Implementation of the revised Lake Baroon Catchment Management Strategy by MSC, CCC and the community	1. 90% of physical and chemical parameters and biological indicators are to meet relevant standards for unimpacted streams by the year 2010 (eg. SIGNAL Score =>6) with gradual improvements recorded every two years on all parameters tested.

1.3 New Developments

Goal

All new developments within the Lake Baroon Catchment implement best practice environmental management to protect and enhance the quality of the receiving environment.

Background:

Both the Maroochy Shire Council and the Caloundra City Council have developed *Integrated Planning Act (1997)* compliant planning schemes. These schemes are required to address ecologically sustainable development to ensure that all developments manage their potential impacts upon environmental values including water.

Management of riparian lands continues to be a major concern for both scientists and community alike. Planning schemes (*Integrated Planning Act 1997*) should address riparian lands as ‘core matters’ in their planning schemes. The strategic component of the planning scheme should designate the capability of various lands to support different types of land use and development that may impact upon riparian lands. Infrastructure Charge Plans should include the provision to protect and restore riparian lands regardless of the associated land use. Until these changes are made, catchment management will continue to depend on the will of the community to undertake actions on a voluntary basis.

The Mary River Catchment Co-ordinating Committee (2001) describes the overall condition of the Obi Obi Creek as being a ‘Deteriorating Strategic Reach’ of the Mary River. With an expected 407 hectares planned to undergo an intensification or change in land use for urban development set to take place in the Lake Baroon Catchment it is imperative that all forms of new development address potential impacts upon water quality to abate cumulative problems further downstream such as water treatment at Landers Shute. Each development must address point of source pollution as opposed to after the waste/pollution has been generated.

1.3.1 Water Sensitive Urban Design

An example of insensitive design

Water Sensitive Urban Design is an integrated approach to stormwater management and addresses all aspects of urban design including lot layouts, road design, public open space networks, streetscaping and water supply (ie. Use of rainwater tanks). The stormwater in the catchment currently enters all creeks and natural waterways untreated.

1.3.2 Soil erosion and sediment control

New development with less than adequate erosion control

Development proposals should include a soil and water management program that details how the short term and long term management of runoff quality and quantity will be achieved. A detailed plan is required for stormwater management, during and after construction, and should conform with Soil Erosion and Sediment Control Engineering Guidelines for Queensland Construction Sites, Depts of Natural Resources and Mines and Environment Stormwater Quality Control Guidelines (1998) and the Caloundra City Council Development Design Planning Scheme Policy (DDPSP). The following should be addressed:

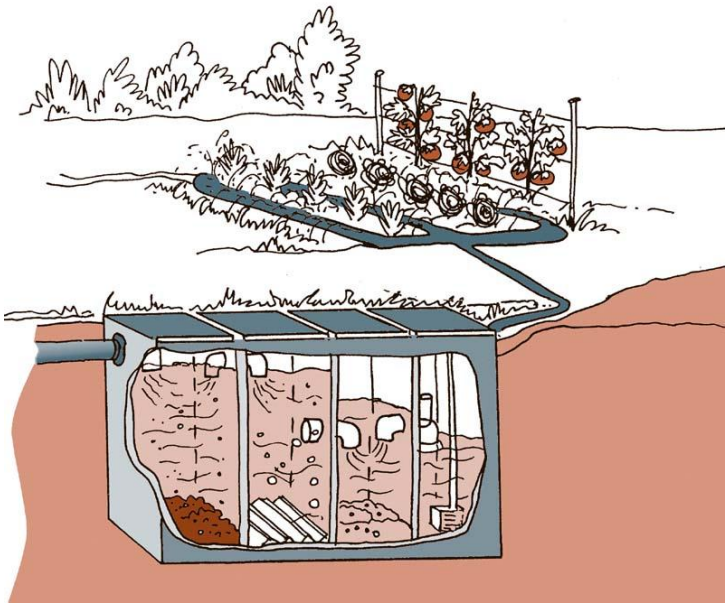
- Diversion of stormwater away from the construction site.
- Use of erosion and sediment control techniques during development.
- Minimum clearing of vegetation.
- Minimum soil disturbance.
- Containment and treatment of stormwater.

- Re-vegetation of disturbed areas as soon as possible.
- Monitoring and maintenance of soil and water management devices for an appropriate period after construction.
- Education of all the contractors employed to work on the site; earth moving equipment operators, surveyors, plumbers, builders, etc, of the above and their specific requirements for prevention of soil erosion and sedimentation of watercourses.

The expected construction period, i.e. month and year of commencement, and expected month and year of completion, should be outlined. Land clearing and soil exposure is discouraged during the wet season which is January to April.

1.3.3 New on site wastewater disposal systems

In this water supply catchment, a high level of management in terms of nutrients, pathogens and stormwater control is required for sewage treatment and effluent disposal.



The proponent of every proposed development shall investigate whether connection to the sewerage system for wastewater disposal is viable. In cases where connection to the sewer is not practical, the proponent must demonstrate that on-site sewage treatment and disposal, including the use of septic systems, is sustainable at the proposed site and complies with the Queensland Dept of

Local Government, Planning, Sport and Recreation '*On site Sewerage Code*' 2003 (and subsequent amendments), *AS/NZS 1546.1;1546.2; 1546.3* and the *Environmental Protection (Waste Management) Regulation 2000.*

1.3.4 Pre and Post Development Water Quality Monitoring

Developments within the Caloundra City Council are required by the Development Design Planning Scheme Policy to ensure that their development complies with the set water quality parameters and associated guideline values (numerical values). However, development is not required to establish the quality of water in adjacent waterways and bores prior to the application or the post development environmental flows. The actual impact upon the water quality from the development is unable to be established and therefore it remains largely unknown what impact (maintain, enhance or injurious) that the development has upon water quality.

1.3.5 Water Bores

Water bores continue to remain a significant issue for the water quality of the Lake Baroon Catchment and subsequent necessary environmental flow requirements of tributaries to maintain aquatic ecosystems. This is particularly relevant where extraction rates exceed aquifer recharge. Furthermore, where existing on site wastewater disposal systems have been inappropriately located or poorly maintained, ground waters can contain high concentrations of pollutants including pathogens, bacteria and nutrients.

1.3.6 Trade Waste

Trade wastewater refers to trade waste and any liquid (including any substance contained within the liquid), which is produced from an industrial or commercial activity.

It is essential that industries be encouraged to reduce and pre-treat their wastewater. A more contemporary approach to managing waste is to reduce waste throughout the production process (the volume and type of pollutants), reduce the resources used (inc. energy, waste and other raw materials including water) in the production process and to maximise the reuse potential of waste water.

Approval from Caloundra City is required to discharge trade waste into the sewerage system.

The provisions of the Environmental Protection Act 1994, Environmental Protection (Waste Management) Policy 2000, Environmental Protection (Waste Management) Regulation 2000 and Environmental Protection (Water) Policy 1997 work towards ensuring that environmental values are protected and enhanced (including the diversity of ecological process and associated ecosystems) through minimising potentially harmful impacts.

Specific Outcome	Acceptable Strategy	Key Performance Indicator
ND 1 All new developments implement the key concepts of Water Sensitive Urban Design to protect and enhance the water quality entering the Lake Baroon Catchment	**ND 1.1** All new developments manage their activities in accordance with an Environmental Management Plan which ensures the protection and enhancement of water quality within Lake Baroon Catchment. **ND 1.2** Developments are required to monitor water quality prior to operational works phase and post development and submit results of monitoring to CCC to ensure overall compliance with the CCC Urban Stormwater Quality Management Plan. Water quality tests shall be performed by a NATA accredited laboratory approved by CCC. **ND 1.3** Adopt and implement urban stormwater management system including reuse options from detention ponds to reduce diffuse source urban pollution. **ND 1.4** Settling ponds/stormwater detention basins must incorporate design specifications to treat all nutrients prior to release into natural waterways.	1. Amendments to CCC Urban Stormwater Quality Management Plan and DDPSP to ensure that water quality objectives are based upon environmental values for waterways based upon community aspirations. 2. Amendments to CCC Urban Stormwater Quality Management Plan and DDPSP to ensure that parameters of water quality objectives reflect data collected by AquaGen to reflect realistic benchmarks. 3. Amendments to CCC Urban Stormwater Quality Management Plan and DDPSP to include biological indicators relevant to aquatic ecosystem protection for organisms present within Lake Baroon Catchment.

Specific Outcome	Acceptable Strategy	Key Performance Indicator
		4. Monitor water quality using the CCC Urban Storm Water Quality Management Plan Water Quality objectives (and subsequent amendments) prior to and post construction. Water quality tests shall be performed by a NATA accredited laboratory approved by CCC. Report results to the Urban Development Institute of Australia and the Planning Institute of Australia. In particular highlight design characteristics that do not deliver stated water quality objectives.

Specific Outcome	Acceptable Strategy	Key Performance Indicator
ND 2 Development in unsewered areas provides on site effluent disposal systems that do not lead to environmental harm or pose a threat to public health.	**ND 2.1** Support and assist research activities that identifies presence of pathogenic organisms and quantifies risk to public health and water quality. **ND 2.2** Encourage CCC and MSC to apply the Cromer, Gardner and Beaver (2001) viral die off method to more accurately calculate setback distances for the siting of on site effluent and wastewater disposal systems. **ND 2.3** Systems design comply with the Queensland Dept of Local Government, Planning, Sport and Recreation 'On site Sewerage Code' 2003 (and subsequent amendments), AS/NZS 1546.1;1546.2; 1546.3 and the Environmental Protection (Waste Management) Regulation 2000.	1. 90% of physical and chemical parameters and biological indicators are to meet relevant standards for unimpacted streams by year 2010 (eg. SIGNAL Score =>6) with gradual improvements recorded every two years. Reductions in faecal coliform counts after storm event by 10% each year from 2003 levels. 2. Nitrogen and phosphorous levels meet the wastewater system manufacturers Nutrient Compliance Criteria pursuant to the QDLGPSR On Site Sewerage Code.

Specific Outcome	Acceptable Strategy	Key Performance Indicator
ND 3 Impacts of development (urban, industrial and agricultural) upon water quality are quantified to measure the effectiveness of design features and soil erosion control devices	**ND 3.1** Developments are required to monitor water quality pre and post development and submit results of monitoring to CCC to ensure overall compliance with the CCC Urban Stormwater Quality Management Plan. **ND 3.2** To encourage CCC and MSC to work in collaboration to develop an integrated approach for the protection of watercourses within Lake Baroon Catchment that considers the multiple functions of riparian lands. **ND 3.3** Delineate key ecological processes performed by the riparian lands to identify habitat requirements of terrestrial and aquatic keystone species, determine the width required for each stream type by linking the most sensitive ecological processes to ensure connectivity to sensitive vegetation areas and to re-establish ecological values of riparian lands.	1. Amendments to CCC Urban Stormwater Quality Management Plan to include biological indicators relevant to aquatic ecosystem protection for organisms present within Lake Baroon Catchment. 2. Monitor water quality using the CCC Urban Storm Water Quality Management Plan Water Quality objectives (and subsequent amendments) prior to and post construction. 3. 90% of physical and chemical parameters and biological indicators are to meet relevant standards for unimpacted streams by year 2010 (eg. SIGNAL Score =>6) with gradual improvements recorded every two years. 4. Reductions in turbidity, dissolved oxygen, faecal coliform, reductions in sediments for oil and grease, petroleum hydrocarbons, organochlorine, pesticides and heavy metals.

Specific Outcome	Acceptable Strategy	Key Performance Indicator
ND 4 New residential developments are not dependent upon water from underground water reserves for domestic consumption or garden application.	**ND 4.1** All new residential dwellings have AAAA water efficiency rated fittings and appliances comply with the National Water Efficiency Labelling Standards. **ND 4.2** Inform and educate owners of water bores about sustainable use of water bores. **ND 4.3** Encourage Councils to develop a scheme that contributes to the purchase of rainwater tanks for all households where: **ND 4.4** Development that is not connected to reticulated water supply, install rainwater collection tanks to the capacity of 45 000 litres **ND 4.5** Development that is connected to the reticulated supply install rainwater collection tanks to the capacity of 10 000 litres to supplement domestic use ie toilets and gardens.	1. Groundwater reserves are monitored to ensure compliance with water quality objectives. 2. Water consumption by households is reduced by 5% (on 2004 levels) by 2010.

Specific Outcome	Acceptable Strategy	Key Performance Indicator
ND 5 Commercial entities adopt and implement the principles of Cleaner Production to minimise impacts upon water quality	**ND 5.1** To encourage Caloundra City Council and Maroochy Shire Council to develop, implement and report on progress of their environmental plans pursuant to the Environmental Protection Act 1994, Environmental Protection (Waste Management) Policy 2000, Environmental Protection (Waste Management) Regulation 2000 and Environmental Protection (Water) Policy 1997. **ND 5.2** Work with Caloundra City Council and Maroochy Shire Council to develop an awareness amongst the business and commercial sectors within the catchment of the principles of Cleaner Production. Establish a process that rewards businesses for their efforts to improve their production standards and application of innovative techniques to minimise impacts upon water quality. **ND 5.3** All wastewater recycling processes have the capacity to treat contaminated sediment, nutrients and toxins prior to entering natural waterways.	1. 90% of physical and chemical parameters and biological indicators are to meet relevant standards for unimpacted streams by year 2011 (eg. SIGNAL Score =>6) with gradual improvements recorded every two years. Reductions in heavy metal concentrations in sediments. 2. Businesses display their reward certificates for being 'Catchment Caring enterprises' and are aware of the principles of Cleaner Production.

1.4 Riparian Lands

Revegetation of Fryers Creek

Goal

Remnant vegetation is protected and reclaimed. Threatening processes to riparian lands are addressed to ensure that these lands perform the following functions:

- Stabilise the bank against erosion;
- Reduce sediment delivery to streams;
- Modify water quality by filtering nutrients and other pollutants;
- Control plant growth in streams
- Maintain in stream habitat
- Provide food for aquatic ecosystems;
- Provide terrestrial habitat and wildlife corridors;
- Provide aesthetic value and recreation; and
- Provide economic value.

Background

Riparian Lands are defined by Karassies and Prosser (1999) as that part of the landscape adjacent to streams that exert a direct influence on streams or lake margins and on the water and aquatic ecosystem contained within them. Riparian lands include both the stream banks and a variable size belt of land alongside the banks.

There is no one law that defines the width of riparian land alongside the banks to perform the above functions. Rather, this is dependent upon a range of variables including the sensitivity of the instream species to contaminants contained within runoff from adjacent land uses.

The riparian lands within the Lake Baroon Catchment have experienced a diverse range of human activities. Some of these past activities have seen the removal of all vegetation within the riparian zone for agriculture and urban based land uses. This has had a number of overall effects upon the function of the creek system including the narrowing of the waterway, increased erosion, sedimentation, nutrient flows, weed invasion, species extinction and increased impacts of flood peaks through increased impervious surface areas (ie. likelihood of ‘natural disasters’ from water flows).

However, the most often overlooked aspect of catchment hydrology is the contribution that first order streams make to reduce downstream flooding and the control of inputs from dissolved substances (nitrogen, phosphorous and pesticides). It is the first order streams that receive the bulk of the water and perform a sponge effect through vegetated buffers that extend around the first order stream that provide the greatest protection against downstream flooding (Forman 1995).

While most of the riparian vegetation within the Lake Baroon Catchment has been removed, those areas where it has been retained (most notably the reach of the Obi Obi between Gardners Falls and the Dam) have subsequently been classified as a reach of 'Regional Significance' by the Mary River Catchment Co-Ordinating Committee and as 'Significant Vegetation' by the CCC (draft City Plan) and MSC.

Research indicates (Davies and Bunn 1999), that there is a significant relationship between complexity of riparian cover and diversity of in stream plant species. Moreover, where the canopy cover is reduced by 50%, there is a major decline in instream health. In stream species (plant and macroinvertebrates) require lower light levels to restrict macrophyte growth and encourage micro algae.

To protect and enhance in stream health requires creek banks to be stabilised, vegetation to be established along creek banks, filtering buffers to prevent nutrients entering the creek which subsequently reduce macrophyte growth and filamentous algal growth, and remnant vegetation to be reclaimed.

Specific Outcome	Acceptable Solution	Key Performance Indicators
RL 1 Remnant vegetation is protected and reclaimed. Remnant riparian vegetation on privately owned land is voluntarily managed and protected by agreement.	**RL 1.1** Conserve and restore habitats of species of regional significance. All potential habitats of species and population of target species of regional significance are rehabilitated. **RL 1.2** Provide incentive, advice and encouragement for riparian landholders to retain and manage all existing native vegetation within the riparian buffers and support the conservation of key areas. **RL 1.3** Maintain adequate buffers and erect riparian fencing and exclude or actively manage stock access to waterways. Include the provision for off stream watering and shade and hardened access points **RL 1.4** All remnant/significant vegetation within 100m either side of a watercourse should be protected. **RL 1.5** Utilisation of voluntary conservation agreements to protect regional conservation assets in private ownership	1. 90% of physical and chemical parameters and biological indicators are to meet relevant standards for unimpacted streams by year 2011 (eg. SIGNAL Score =>6) with gradual improvements recorded every two years. Reductions in turbidity, dissolved oxygen and colour 2. Reduced threat from invasive environmental weeds. 3. Riparian lands supporting significant vegetation within 100m either side of a natural water course are protected and rehabilitated by 2020. 4. Amendments to the CCC DDPSP to ensure that all storm water detention basins treat all nutrients prior to release into natural waterways.

Specific Outcome	Acceptable Solution	Key Performance Indicators
RL 2 Revegetate and rehabilitate riparian lands to ensure the protection and ongoing maintenance of instream plant health and aquatic ecosystem function, filtration of nutrients, reduce power of flood events, slow the flow of surface water runoff and stabilise creek banks.	**RL 2.1** Adopt and implement urban stormwater management system including reuse options from detention ponds to reduce diffuse source urban pollution. **RL 2.2** Settling ponds/stormwater detention basins must incorporate design specifications to treat all nutrients prior to release into natural waterways. **RL 2.3** Maintain adequate riparian buffers and erect riparian fencing and exclude or actively manage stock access, including the provision of off stream watering and shade, and hardened access points (cattle crossings), particularly within the Walkers Creek sub-catchment. **RL 2.4** Support Council initiatives to reduce polluted wastewater from existing on site wastewater disposal systems.	1. 90% of physical and chemical parameters and biological indicators are to meet relevant standards for unimpacted streams by year 2011 (eg. SIGNAL Score =>6) with gradual improvements recorded every two years. Reductions in turbidity, sediment (suspended solids) dissolved oxygen, phosphorous, faecal coliform counts and colour 2. Conduct household surveys to ascertain knowledge levels and behaviour. Adjust education program accordingly. 3. All agricultural enterprises implement Industry relevant Environmental Codes of Practice (endorsed under S548 of Environmental Protection Act 1994) by 2010

Specific Outcome	Acceptable Solution	Key Performance Indicators
	RL 2.5 Implement revegetation initiatives focusing on building linkages with remnants of conservation significance and increasing vegetation on floodplains and hill slopes to slow the flow of water and assist in the retention of nutrients as opposed to releasing untreated wastewater into the waterways. **RL 2.6** Educate and inform landholders and residents of appropriate land management techniques and impacts of household routines upon nutrient loads. In particular on site wastewater disposal systems; use of fertilisers; designing vegetation filter buffers to waterways and use of underground water reserves. **RL 2.7** Develop information brochures to be sent with each rates notice that informs residents of the impacts of nutrient loads upon water quality, and describes what household actions can be taken to reduce their contributions.	

Specific Outcome	Acceptable Solution	Key Performance Indicators
RL 3 Control aggressive environmental weeds that impact upon the functioning of riparian lands	**RL 3.1** Control and detain the spread of Salvinia within the Walkers Creek/Fryers Creek sub-catchments Target and prioritise reaches of Obi Obi and Bridge Creek catchments that have been invaded by woody and viny environmental weeds eg Camphor laurel, privet etc that impact upon the aquatic ecology of the creek system and appropriate action taken to remove and control weed species. (see Information Sheet 3). **RL 3.2** Control aggressive environmental weeds, commencing with those threatening reaches of regional or local conservation significance. **RL 3.3** Implement the Queensland Weed Strategy, Caloundra City Council and Maroochy Shire Council Pest and Weed Management Plan.	1 Invasion is minimised through target reaches by 2010.

Specific Outcome	Acceptable Solution	Key Performance Indicators
RL 4 Land Use planning controls recognise the role of riparian lands in the protection and enhancement of water quality including aquatic ecosystem requirements.	**RL 4.1** To encourage CCC and MSC to work in collaboration to develop an approach to the protection of watercourses within Lake Baroon Catchment that considers the multiple functions of riparian lands. **RL 4.2** Delineate key ecological processes performed by the riparian lands to identify habitat requirements of terrestrial and aquatic keystone species, determine the width required for each stream type by linking the most sensitive ecological processes to ensure connectivity to sensitive vegetation areas and to re-establish ecological values of riparian lands	1 90% of physical and chemical parameters and biological indicators are to meet relevant standards for unimpacted streams by year 2011 (eg. SIGNAL Score =>6) with gradual improvements recorded every two years. Reductions in turbidity, dissolved oxygen, faecal coliform and colour. 2. Keystone terrestrial and aquatic species are identified and monitored. Greater widths of riparian land ensures the protection of sensitive ecological processes. Riparian buffers are in place on all Assessable development adjacent to any natural waterway within the Lake Baroon 3. An increase in the size of buffers which are dependent upon slope (length and angle), soil permeability, surface runoff, subsurface flow, water table depth, rainfall, soil erodability, channel curvilinearity, and stream order.

1.5 Community Awareness Knowledge and Participation

Goal:

The community within the Lake Baroon Catchment is empowered with the knowledge and skills of sustainable land and water use practices that enhance the quality of the water entering natural waterways.

Background

Empowering individuals with the information necessary to promote changes in land and water use practices which enhance environmental quality requires an in-depth understanding of a community's attitudes. For example, research on attitudes of riparian landholders in the Mary River found that 'an awareness of issues' is the strongest motivating force for better management (Mary River Catchment Coordinating Committee 2001). This notion is further supported by Syme (1998) who maintains that there is effective support for environmental conservation in rural communities, just disagreement about how to go about it.

The LBCCG with financial support from AqaGen has been particularly successful over the past ten years with developing relationships with the rural community and subsequent implementation of riparian land management projects including the exclusion of cattle from riparian lands and revegetation of riparian lands.

However, according to research on urban stormwater management by Nancarrow et al (1995), urban based populations demonstrated that knowledge of what pollutes stormwater did not relate to their potential to act to

reduce these sources of pollution. Interestingly enough, Nancarrow's research also concluded that respondents between the ages of 30 to 64 with lower levels of education (ie. Trade qualifications and junior high school certificates) were significantly more inclined to community action. This raises three issues for developing education strategies on water quality for the Lake Baroon Catchment, namely:

- 39% of the Maleny township population within Maleny is aged between the 30-64 age group, and 53% of the population of the Maleny Plateau (outside the township area are aged between 30-64).
- According to the 2001 ABS census 44% of the population have attained at least a Year 12 education, almost 20% have attained a certificate course, while 12% have a Bachelors degree from a tertiary institution and 4% have received a post graduate degree or diploma.
- Just over one quarter (29%) of residents have lived within the area under four years.
- Planning projections until the year 2015, have provided for a doubling of the number of people within the Maleny Township and Maleny Plateau Planning Areas (according to the Draft CCC City Plan).

In a recent study of the Maleny population (Maleny Working Together) conducted by Jordan and Haydon (2004) only 3% of those surveyed live/work on a working farm. Nearly one quarter of those surveyed live in the urban area (23%), and 38% live on a small rural block. Furthermore, the Maleny district has a relatively high proportion of managers, administrators and professionals/associate professionals (almost 50%) and 12% are tradespeople. Education strategies for the township and rural residential areas will need to focus heavily on what basic household actions can be taken to prevent pollution to waterways. These strategies will need to take into account the high number of new residents coming to live within the catchment ie. repeat every four years.

In essence the on ground projects associated with cattle grazing are particularly successful due mainly to rural landholders becoming increasingly aware of the environmental and economic benefits of a high standard of water

quality. The rural sector is requiring compliance with quality assurance programs to ensure minimal impacts upon environmental values in addition to voluntary compliance with relevant Codes of Practice (to demonstrate due diligence).

There are no legal or institutional mechanisms available to reduce the high concentrations of chemical (Nitrogen and Phosphorous) pollution emanating from existing urban and rural residential land uses or to subsequently protect the in stream plant species diversity. This issue remains unaddressed by any government institution, piece of legislation or community organisation including the Lake Baroon Catchment Care Group.

Reducing nutrient loads from poorly performing on site waste water disposal systems, reducing pollutant loads from entering waterways from stormwater, and demand management strategies to reduce water consumption will require an integrated education strategy and a commitment to Total Water Cycle Management Planning. This requires substantial resource, expertise, commitment and collaboration with key agencies including CCC, MSC, CalAqua, AquaGen and state government departments.

Specific Outcome	Acceptable Solution	Key Performance Indicator
CAK 1 On Site Wastewater Systems are operated in a manner that ensure public health and environmental quality is protected.	**CAK 1.1** To assist and support the CCC and MSC in the implementation of an education program on the operational procedures and maintenance requirements on site effluent treatment and disposal systems. The program should include information on: an overview of the operation of the septic system and the pollutants that discharge from a poorly operating system and subsequent impacts upon water quality and aquatic ecosystems, how to feed the septic system, trench maintenance and inspection/maintenance schedule (Appendix 1).	1. 90% of physical and chemical parameters and biological indicators are to meet relevant standards for unimpacted streams by year 2011 (eg. SIGNAL Score =>6) with gradual improvements recorded every two years. Reductions in Faecal coliform, nitrate, ammonia and oxidised nitrogen levels in Obi Obi, Walkers, Fryers and Bridge Creek catchments are reduced by 10% from 2003 levels. 2. Residents knowledge and awareness of their individual impact increases
CAK 2 Inform and educate owners of water bores about sustainable use of water bores and potential risks associated with contaminants.	**CAK 2.1** Public Education program that addresses demand management through household actions to reduce water bore consumption for garden use (eg mulching, greywater systems) and health risks associated with consuming contaminants from water bores.	1. Reduced reliance upon groundwater reserves by owners of water bores is measured by the replacement of water bores with rainwater tanks. Owners of water bores are aware of the health risks associated with contaminated water bores.

Specific Outcome	Acceptable Solution	Key Performance Indicator
CAK 3 Provide incentives, advice and encouragement for riparian landholders to retain and manage all existing native vegetation within the riparian buffers and support the conservation of key areas.	**CAK 3.**1 LBCCG continue to manage on ground projects via devolved grant system that concentrates on: * Excluding cattle from having access to waterways; * Reclaiming and rehabilitating habitats of species and vegetation of regional significance; and collaborate with other non government and government entities on projects that enhance native vegetation within riparian lands including revegetation initiatives.	1. 90% of physical and chemical parameters and biological indicators are to meet relevant standards for unimpacted streams by year 2011 (eg. SIGNAL Score =>6) with gradual improvements recorded every two years. Reductions in turbidity, dissolved oxygen and colour
CAK 4 Residents of the Lake Baroon Catchment are able to identify aggressive environmental weed species that threaten riparian lands.	**CAK 4.1** In collaboration with Councils, Landcare and community organizations, develop and implement a weed species identification education kit and process for reporting locations of threatening infestations to appropriate authorities.	1. Residents are able to identify environmental weeds that threaten riparian lands and take appropriate action. 2. Invasion is minimised through target reaches by 2010 and significantly controlled by 2015.

Specific Outcome	Acceptable Solution	Key Performance Indicator
CAK 5 Residents have an understanding of stormwater pollutants and are prepared to take individual responsibility to improve the quality of water in Lake Baroon Catchment.	**CAK 5.1** Educate and inform landholders and residents of appropriate land management techniques and impacts of household routines upon nutrient loads. In particular on site wastewater disposal systems; use of fertilisers; designing vegetation filter buffers to water ways and use of underground water reserves. **CAK 5.2** Develop innovative information transfer techniques including videos/DVD's that describes what household actions can be taken to reduce their contributions. Information brochures are developed to be sent with each rates notice that informs residents of the impacts of nutrient loads upon water quality, and what actions they can implement to reduce pollutant loads.	1 90% of physical and chemical parameters and biological indicators are to meet relevant standards for unimpacted streams by year 2011 (eg. SIGNAL Score =>6) with gradual improvements recorded every two years. Reductions in turbidity, sediment (suspended solids) dissolved oxygen, phosphorous, faecal coliform counts and colour 2. Residents are aware of the impacts that stormwater has upon the Catchment and implement household actions to reduce pollutant loads. 3. All Primary producers comply with relevant Industry Environmental Code of Practice (endorsed under S548 of Environmental Protection Act 1994) by 2006.

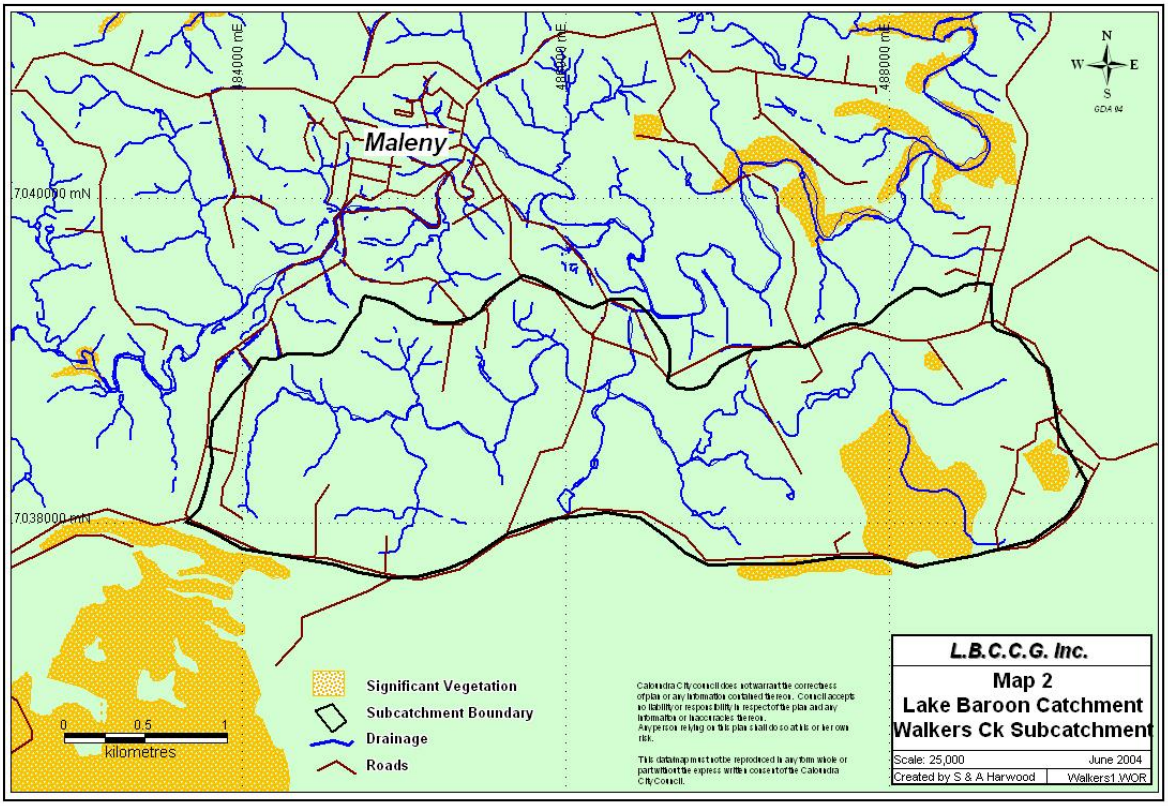
Specific Outcome	Acceptable Solution	Key Performance Indicator
CAK 6 Landholders are aware of the impacts that unstable slopes, stock grazing within riparian lands and application of pesticides and fertilisers adjacent to riparian lands has upon downstream water quality.	**CAK 6.1** Encourage and support land holders to stabilise unstable slopes and slip zones through on ground projects. **CAK 6.2** Landholders maintain adequate buffers and erect riparian fencing and exclude or actively manage stock access to waterways. Include the provision for off stream watering and shade and hardened access points **CAK 6.3** LBCCG and Councils identify riparian lands that contain creek bank erosion and its causes (ie. External processes; scour or slumping) and landholders are encouraged through incentives to conduct creek bank stability works with appropriate design and width of vegetation.	1. 90% of physical and chemical parameters and biological indicators are to meet relevant standards for unimpacted streams by year 2011 (eg. SIGNAL Score =>6) with gradual improvements recorded every two years. Reductions in turbidity, dissolved oxygen, colour, suspended solids and faecal coliform counts. 2. Net increase in area (ha) of native riparian vegetation by 2010. 3. All Primary producers comply with relevant Industry Environmental Code of Practice (endorsed under S548 of Environmental Protection Act 1994) by 2006. 4. Erosion hot spots are identified and addressed with management controls by 2010.

Section 2

Priority Management Strategies for Sub-catchments

- Walkers Creek
- Bridge Creek
- Obi Obi Creek

2.1 Walkers Creek



Map 2 – Walkers Creek Catchment

Background

Walkers Creek catchment is the smallest sub-catchment within Lake Baroon and contains both the Fryers and Walkers Creek tributaries of Obi Obi Creek. The catchment is approximately 761 hectares in area and is bounded by Landsborough – Maleny Roads, Mountain View and Maleny and Stanley River Roads. Riparian lands have been predominantly cleared up to the creeks edge with only one area of intact remnant vegetation remaining namely Mary Cairncross Park (65ha).

According to Gutteridge Haskins and Davey (2002), a further 161 hectares have been approved for urban development within the Walkers Creek subcatchment. The Draft Caloundra City Council City Plan (Maleny Plateau Planning Area) requires future development within the Walkers Creek Rural Residential Settlement Precinct to not impact upon Walkers Creek. Development is required to provide for:

- On site wastewater disposal system pursuant to the Queensland Dept of Local Government, Planning, Sport and Recreation '*On site Sewerage Code*' 2003 (and subsequent amendments), *AS/NZS 1546.1;1546.2; 1546.3* and the *Environmental Protection (Waste Management) Regulation 2000.*
- A 100 metre wide open space buffer to Walkers Creek;
- Rainwater collection tanks with a minimum capacity of 20 000 litres per dwelling unit.

Of the five dairy farms operating within this catchment in 1997, only two remain operational. Despite the cessation of many dairy farms within Walkers Creek, results of water quality monitoring continue to indicate that faecal coliform counts exceed the ANZECC guideline for primary contact recreation. These faecal coliform counts are further exacerbated after storm events.

Poorly performing on site wastewater disposal treatment systems (including septic systems) continue to be one of the major contributors to faecal coliform counts (this is further supported by nitrate and ammonia samples taken at monitoring sites).

Since the 1997 publication of the Catchment Management Strategy:

- less than 2 hectares of riparian buffers have been planted in Walkers Creek subcatchment,
- one cattle crossing has been constructed by LBCCG and 2 have been installed by landholders in Walkers Creek,
- no actions taken by any organisation to address poorly performing wastewater systems
- untreated stormwater enters Walkers Creek from adjacent residential development (Avocado Lane)
- an invasion of Salvinia (*Salvinia molesta*) threatens to create a serious threat of invasion to Walkers and Fryers Creek and a potential threat to the Obi Obi Creek if not immediately addressed.

2.1.1 Priority Actions for Walkers Creek

(listed in priority order)

i. Provide incentive, advice and encouragement to landholders to maintain adequate riparian buffers and erect riparian fencing and exclude stock access to waterways. Including the provision for off stream watering, shade and hardened access points.

ii. LBCCG in partnership with AquaGen and CCC <u>immediately</u> control the Salvinia (*Salvinia molesta*) infestation.

iii. LBCCG, residents and Caloundra City Council address the untreated stormwater runoff from residential developments approved under previous planning schemes (notably Avocado Lane).

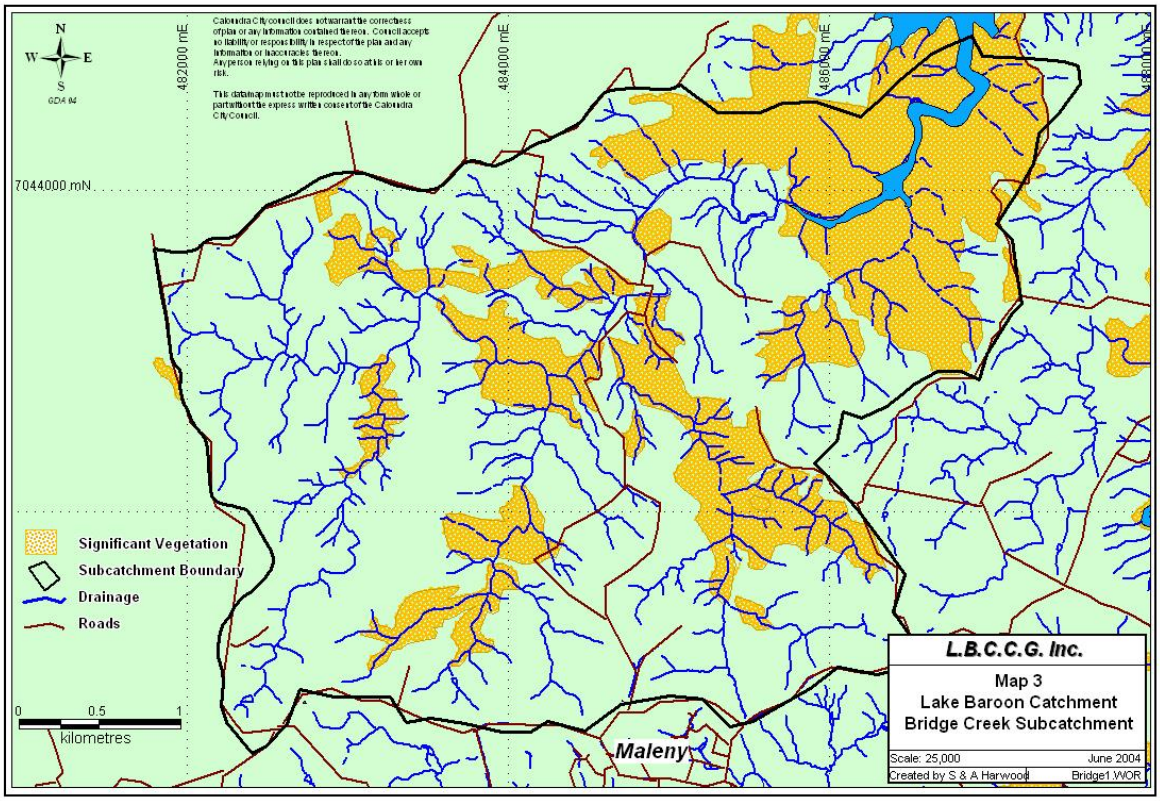
iv. Reduce faecal counts within the Walkers Creek Catchment by targeting education programs to residents within Walkers Creek to address existing on site effluent and wastewater disposal systems and their maintenance requirements (refer to Appendix 1 for details), including brochures in mailboxes, develop DVD/Video that demonstrates ‘how to’ maintain and associated maintenance

schedules. Also include information that specifically addresses actions to reduce nutrients in surface water runoff.

v. Developers, Council, LBCCG and Barung develop a vegetation plan to address potential nutrient flows, stormwater systems (including the treatment of nutrients prior to release into natural waterways) and revegetation of the 100 metre wide open space buffer to Walkers Creek to include the provision for rehabilitating and maintaining riparian lands.

vi. Encourage all residential dwellings to have AAAA water efficiency rated fittings and ensure that appliances comply with the National Water Efficiency Labelling Standards.

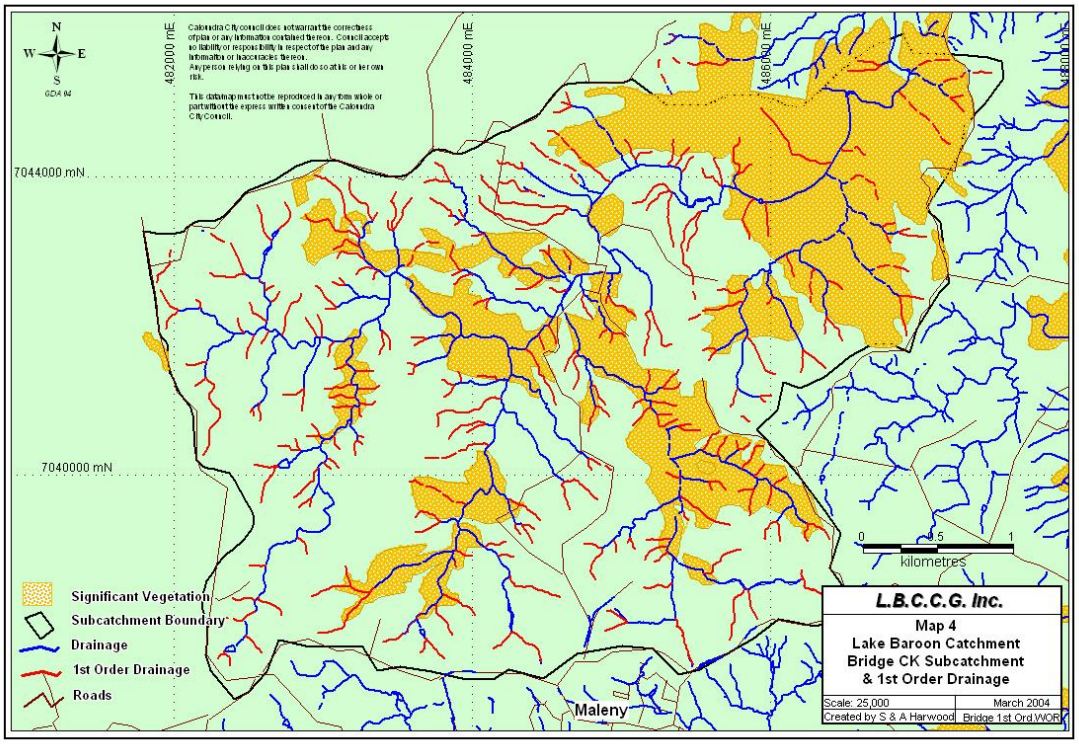
2.2 Bridge Creek



Map 3 – Bridge Creek Catchment

Background

Bridge Creek is approximately 2413 hectares in area and is bounded by Lake Baroon, Tesch Road, Maleny Kenilworth Road, Macadamia Drive, North Maleny Road and Baroon Pocket Road (Map 3). Bridge Creek is characterised by its steep slopes, lack of vegetation around its headwaters, and the inability of the soil to absorb nutrients and moisture. The unique soil properties of the Bridge Creek sub catchment contribute to the water quality monitoring results collected by AquaGen, including high loads of Total Phosphorous, oxidised nitrogen, ammonia and faecal coliform levels which exceed guideline values (ANZECC (2000). It is essential to protect first order streams with riparian vegetation because the soil and topography of the Bridge Creek sub-catchment is prone to releasing nutrients into the streams as part of the erosion process. Water quality results are generally exacerbated after periods of high rainfall and are attributed to cattle having free access to waterways, leachate from septic systems, inefficient fertiliser application, and steep areas that lack soil binding vegetation, particularly the first order streams (Map 4).



Map 4 – First Order Streams of Bridge Creek

The Bridge Creek catchment is experiencing a reduced number of operational dairy farms, an increase in urban development nodes at its headwaters and an increase in dwellings being constructed on lands once used solely for agricultural purposes (ie. no previously constructed dwellings).

The new urban developments at the headwaters of Bridge Creek are included within the Maleny Township Planning Area (Area B - *Township Residential Precinct*) and as such are connected to the reticulated water supply and the Maleny sewerage treatment plant. The total increase in area to urban intensification (zoned rural at the time of the 1997 Catchment Management Strategy) equates to approximately 35 hectares. Developments are also required to supplement their water supply through the installation of rain water collection tanks with a minimum capacity of 10,000 litres. Area B (according to the Draft City Plan) is required to provide for a total site stormwater drainage system that drains towards a treatment area, located adjacent to a tributary of Bridge Creek. These treatment areas (detention basins) do not include measures to treat nutrients prior to release into the natural waterways, nor is there any requirement to test the quality of the receiving waters prior to and post construction to ensure the 'enhancement and protection' of water quality.

Dwellings constructed on rural lands within Bridge Creek will be required to:

i. install an on site wastewater disposal system pursuant to the Queensland Dept of Local Government, Planning, Sport and Recreation '*On site Sewerage Code*' 2003 (and subsequent amendments), *AS/NZS 1546.1;1546.2; 1546.3* and the *Environmental Protection (Waste Management) Regulation 2000.*

ii. Install a rain water collection tank with a minimum capacity of 20 000 litres per dwelling unit.

Since the 1997 publication of the Catchment Management Strategy:

- Approximately 10 hectares of riparian lands have been revegetated and fenced off to ensure that stock are excluded from accessing natural water ways.
- AquaGen have revegetated approximately 4 hectares of their own land within this catchment.

- CCC has initiated a research project to establish residents' knowledge on septic system maintenance with the intention of using this information to develop an education strategy to improve knowledge on how to maintain on site wastewater disposal systems.

2.2.1 Priority Actions for Bridge Creek (in priority order):

i. Revegetate first order streams throughout the sub catchment to maximise buffer capacity and reduce erosion potential (refer to Map 4 for first order streams).

ii. Provide incentives, advice and encouragement to landholders to maintain adequate riparian buffers, erect riparian fencing and exclude stock access to waterways. Including the provision for off stream watering and shade and hardened access points.

iii. Monitor quality of stormwater infrastructure (pre and post development) from new developments on overall water quality particularly sediment, turbidity, and Total Phosphorous.

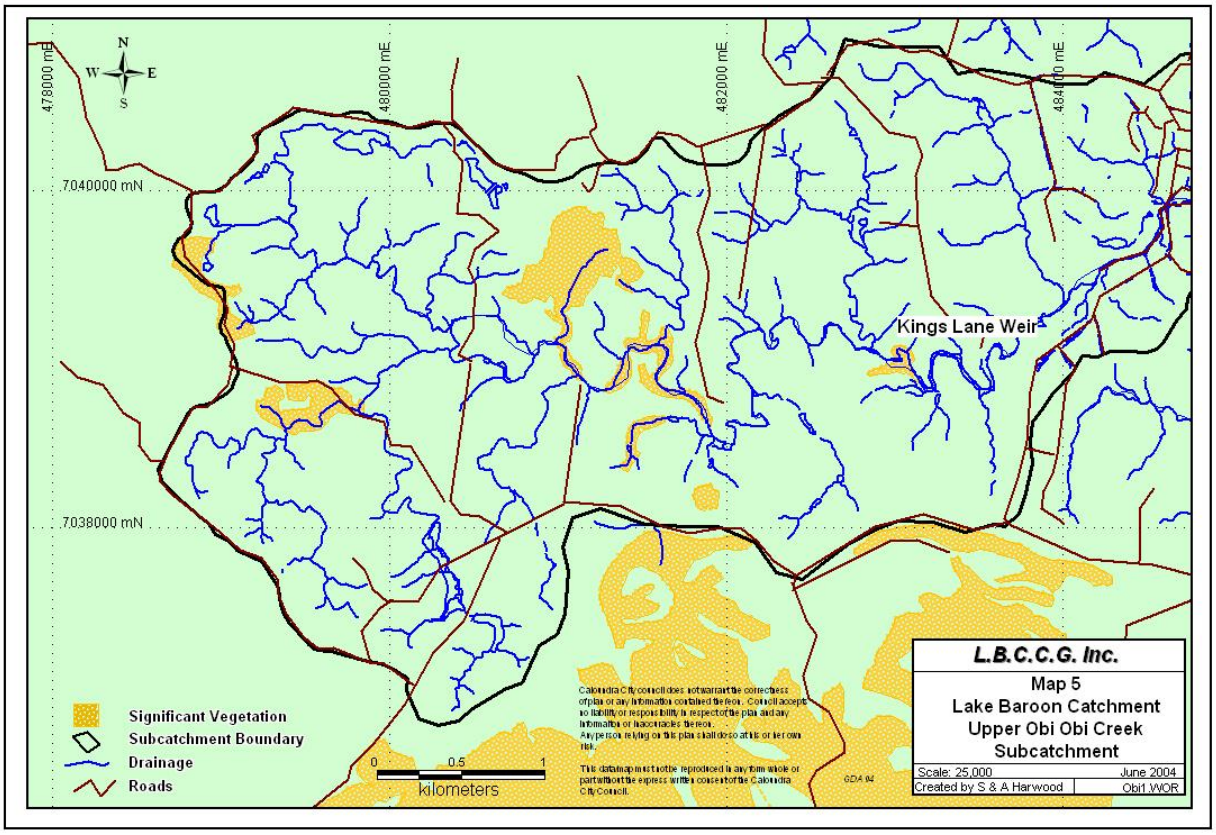
iv. Encourage good farming practice, particularly on floodplains and steep slopes which reduces the rate of soil loss to below that of natural soil forming processes.

v. Actively support CCC Land for Wildlife, Natural Resource Management Small Grants scheme and legal agreement covenant initiatives that protect and rehabilitate remnant vegetation and Corridors of Green projects that make linkages with remnant vegetation to develop and enhance riparian wildlife corridors.

vi. Target education programs to residents within Bridge Creek to address existing on site wastewater disposal systems (including septic systems) and their maintenance requirements (Refer to Appendix 1 for details), including brochures in mailboxes, develop DVD/Video that demonstrates 'how to' maintain with associated maintenance schedules. Also include information that specifically addresses actions to reduce nutrients in surface water runoff ie. Household actions (Refer to Appendix 2 for details).

vii. Encourage all residential dwellings to have AAAA water efficiency rated fittings and ensure that appliances comply with the National Water Efficiency Labelling Standards

2.3 Obi Obi Creek



Map 5 – Upper Obi Creek Catchment

Background

The Obi Obi Creek has three distinct reaches commencing from its head waters to the Baroon Pocket dam. The first reach is from the head waters to the township weirs, the second from the weirs to Gardners Falls and the third from Gardners Falls to the Dam ending at the Narrows Gorge. Each reach has similar physical characteristics, experiences similar land uses and each requires its own unique strategy to address its particular attributes.

The Mary River and Tributaries Rehabilitation Plan (MRCCC) (2001) conducted a comprehensive analysis of the Mary River and its tributaries with the overall aim to develop key strategies to be implemented by the Mary River catchment community to halt degradation of the waterways and achieve a shared vision of the future.

The reaches of the Obi Obi Creek were assessed according to their potential for recovery, conservation status (riparian land and instream) and physical characteristics. The following description and management strategies for the three reaches of the Obi Obi Creek have been adapted from the MRCCC (2001) to ensure consistency with strategic catchment management initiatives.

Obi Obi Creek Headwaters to the Weir and the Weir to Gardners Falls

The Mary River CCC (2001) identified the reaches from the headwaters of the Obi Obi Creek through to Gardners Falls as containing areas with creek bank instability that has resulted from riparian clearing, cattle tracking (and other reasons) that were potentially contributing to increased sedimentation of waterways. Furthermore, the MRCCC (2001) has classified the two reaches of the Obi Obi from its headwaters to the Weir and the Weir to Gardners Falls as a ‘Deteriorating Strategic Reach’ of the Mary River with the overall management aim to rehabilitate and stabilise.

The problems identified (in priority order):

i. Elevated nutrient levels from catchment land use, stock access and fragmented poor riparian buffers leading to poor water quality, blue green algal blooms and colonisation of aquatic weeds.

ii. Bank instability resulting from riparian clearance, cattle tracking (and other reasons). Potentially increasing sedimentation of waterways.

iii. Invasion of woody and viny environmental weed eg. Camphor laurel, cats claw, and privet impacting upon aquatic ecology.

2.3.1 Obi Obi from its headwaters to the Weir

(Refer to Map 5 for Upper Obi Obi Creek subcatchment) 65% of the reach contains no native vegetation within the riparian zone ie bare soil, with an invasion of grasses and/or weeds. Of the remaining 35% of the reach, 30% is described as experiencing a major impact on the riparian zone and only 5% of this reach is rated in good condition.

Of the four dairy farms that were operational in this subcatchment in 1997, only two remain. This particular reach has seen an increase in active participation by rural landholders in riparian management activities such as excluding cattle from accessing waterways, the erection of riparian fencing, provision of off stream watering and shade and stabilising slip prone slopes.

No future urban based land use development have been identified in the Draft City Plan for this reach. This does not preclude Changes in Use for diversifying agriculturally based businesses.

Water quality samples taken at Aplin Road suggest that residues from fertilisers and surface water runoff further upstream contribute to high levels of nitrates and total phosphorous. Further downstream from the Aplin Road sample site at the (upstream) weir, water quality monitoring results indicate lower levels of nitrates and phosphorous, and generally lower faecal coliform counts (this can vary slightly depending on timing of rain events).

2.3.1.1 Priority Actions for Headwaters of Obi Obi Creek to the Weir

(in priority order):

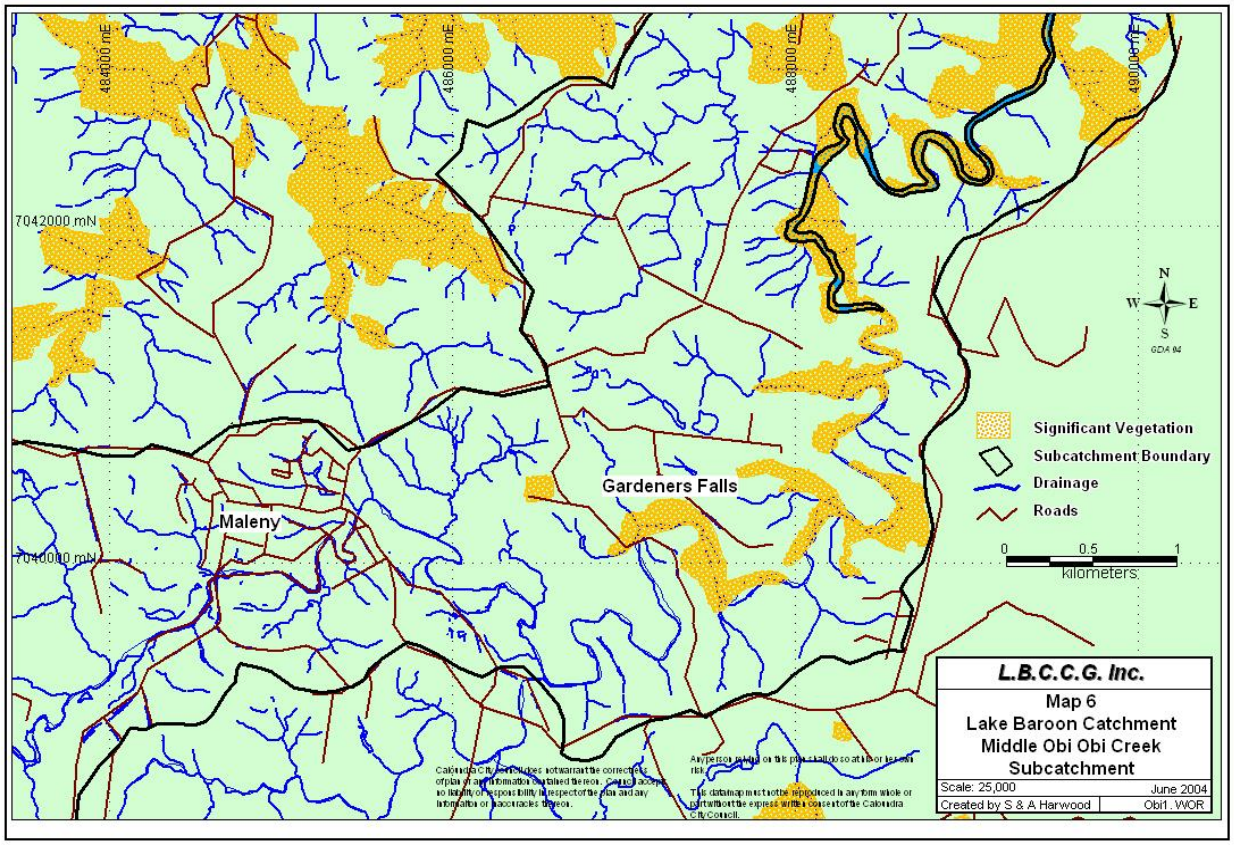
i. Maintain adequate riparian buffers and erect riparian fencing and exclude or actively manage stock access to waterways, including the provision for off stream watering and shade and hardened access points.

ii. Actively promote the implementation of Industry relevant Environmental Codes of Practice.

iii. Provide incentives, advice and encouragement for riparian landholders to retain and actively manage existing native vegetation within riparian buffers.

iv. Encourage good farming practices, particularly on floodplains and steep slopes which reduces the rate of soil loss to below that of natural soil forming processes.

2.3.2 Weir to Gardners Falls



Map 6 – Middle Obi Obi Creek Catchment

Background

60% of the riparian zone within this reach of the Obi Obi Creek has had a major disturbance ie. Verge vegetation removed only leaving bank vegetation intact. Of the remaining 40% of the reach, 35% is severely disturbed and only 5% is rated as being in good condition. The impacts of associated land uses within the area of influence are predominantly related to stormwater pollution. More particularly an absence of treatment devices such as stormwater quality improvement devices (SQID), petroleum hydrocarbons entering (deliberate and unintentional) the Obi Obi Creek via the stormwater system, overloaded stormwater infrastructure in storm events and polluted surface water runoff from impervious surfaces.

Current water quality monitoring does not test sediment for heavy metals, phenols, polycyclic aromatic hydrocarbons, petroleum hydrocarbons, organochlorine pesticides, oil and grease. The CCC Urban Stormwater Quality Management Plan makes reference to establishing guideline values for sediment testing, yet no agency to date collects, analyses or interprets data regarding these parameters within the Lake Baroon Catchment.

Future and intensified development within the Maleny Township Planning Area should include provision for SQIDs, to treat and reduce pollutants from Erowal, Porters Farm Estate and adjacent to Teak Street (Willow Lane area), light industrial estate (Lawyer Street), Myrtle Street and Bicentenary Lane.

The CCC Infrastructure Charges Plan should incorporate the revegetation and stabilisation of creek banks within this reach.

The Maleny sewerage treatment plant treats sewage to secondary standards, disinfects with chlorine and then irrigates on adjacent land. The Sewerage treatment plant is capable of phosphorous removal by adding alum and should be encouraged to minimise phosphorous loads wherever possible.

2.3.2.1 Priority Actions for Weir to Gardners Falls

(in priority order):

i. Encourage the Caloundra City Council to develop and implement risk management strategies, public education programs and encourage

Caloundra City Council to protect the health and safety of recreational users (swimming hole adjacent to the showgrounds).

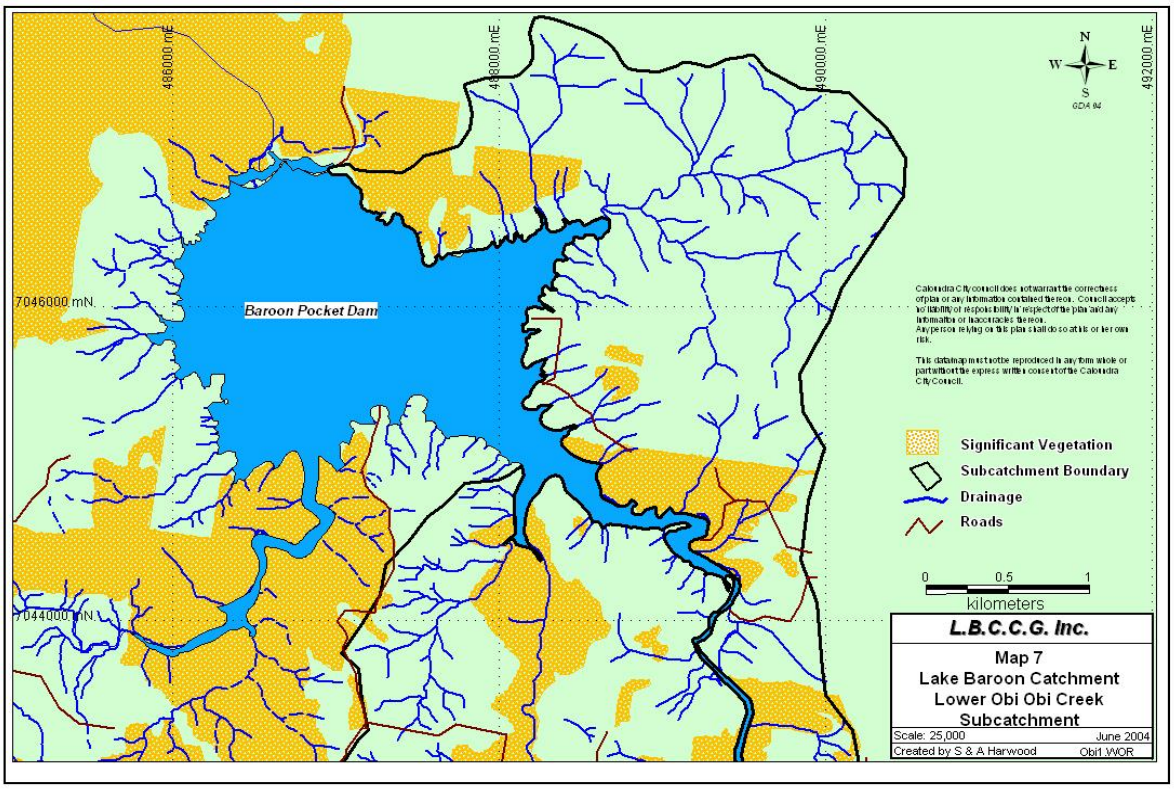
ii. Actively encourage CCC to install SQIDs to treat stormwater pollutants from Erowal, Porters Farm Estate and adjacent to Teak Street (Willow Lane area), light industrial estate (Lawyer Street), Myrtle and Bicentenary Lane.

iii. To encourage Councils to develop a locally relevant environmental management system to model and manage land use changes that impact on water quality and ecosystem health.

iv. Encourage CCC to establish monitoring guideline values for sediment testing for heavy metals, phenols, polycyclic aromatic hydrocarbons, petroleum hydrocarbons, organochlorine pesticides, oil and grease.

v. Encourage CalAqua to remove phosphorous from waste water prior to irrigation.

2.3.3 Obi Obi from Gardners Falls to below the Dam



Map 7 – Lower Obi Obi Creek Sub-Catchment

Background

The MRCCC (2001) classified the reach from Gardners Falls through to the dam and ending at the Baroon Pocket Gorge as an 'Unprotected reach of Regional Significance' with the overall management aim to protect and reclaim.

Problems identified (in priority order):

i. Impact of unmanaged cattle access

ii. Small to moderate understorey disturbance and environmental weed problems of limited spatial distribution

iii. Occasional clearing of riparian zone

iv. Minor nutrient enrichment pollution.

55% of this riparian zone is described as being in good condition, ie. Native vegetation present on the bank and verge vegetation with an intact canopy. Of the remaining 45%, 10% has minor disturbance (overstorey of native vegetation on the bank and verge vegetation, but there is some disturbance in the middle or ground layers), 25% has experienced major disturbance and 15% is severely disturbed.

While this reach has experienced less disturbance to its canopy and vegetative composition, biological indicators suggest:

- the SIGNAL score (water quality based on pollution sensitivity of stream macro invertebrates) indicates possible to mild pollution;
- the PET richness (number of families present from pollution sensitive invertebrate orders) indicates a moderate to major disturbance; and
- Macroinvertebrate richness indicates a relatively minor disturbance.

Reconfiguring lots in the Rural Residential Settlement Precinct (Area B on Map MPP3 – CCC Draft City Plan) within this reach of the Obi Obi Creek will require:

- On site wastewater disposal system pursuant to the Queensland Dept of Local Government, Planning, Sport and Recreation '*On site*

Sewerage Code' 2003 (and subsequent amendments), *AS/NZS 1546.1;1546.2; 1546.3* and the *Environmental Protection (Waste Management) Regulation 2000*;

- Installation of a rainwater collection tank with a minimum capacity of 20 000 litres;
- Land adjoining the Obi Obi Creek to provide for an ecological corridor along the creek to protect significant vegetation; and
- The construction of a catchment stormwater drainage system draining towards a treatment area adjacent to Obi Obi Creek.

The AquaGen water quality results for Gardners Falls indicate that faecal coliform counts exceed the guideline value for primary contact recreation after rainfall events and are generally within the guideline values in dry times. Total phosphorous levels vary according to upstream activities and after rainfall events.

2.3.3.1 Priority Actions for Obi Obi from Gardners falls to below the Dam

(in priority order):

i. Establish biological indicators using the AusRivaAS to enable ongoing monitoring of macroinvertebrate populations and their sensitivity to pollutants in the waterways.

ii. Developers, Caloundra City Council, LBCCG and Barung develop a vegetation plan to address potential nutrient flows, stormwater systems (including the treatment of nutrients prior to release into natural waterways) and rehabilitation of the 100 metre wide buffer to Obi Obi Creek to include the provision for rehabilitating significant vegetation and maintaining riparian lands.

iii. Develop and implement a public education program on *Cryptosporidium* and *Giardia*, and encourage Caloundra City Council to implement risk management strategies to protect the health and

safety of recreational users of Gardners Falls and swimming holes downstream.

iv. Develop guideline values for sediment testing within the CCC Urban Stormwater Quality Management Plan, in particular testing for heavy metals, phenols, polycyclic aromatic hydrocarbons, petroleum hydrocarbons, organochlorine pesticides, oil and grease.

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Appendix 1

Information Sheet 1: Septic System and Grease Traps

What does a septic system do?

A septic system is a relatively basic sewage treatment system. It has two major components: a holding tank and absorption trenches. The holding tank separates solids from liquids, and allows anaerobic breakdown of the organic solids. Absorption trenches further treat the liquid effluent by aerobic microbial digestion, phosphorus adsorption and filtering.

Why maintain your septic system?

- To ensure that your septic system is healthy, long-lasting, and trouble-free.
- To minimise the potential for pollution of nearby waterways.
- To prevent costly absorption trench replacement.

Feeding your septic system

To ensure that the system is healthy, long-lasting and trouble-free, it is essential that the system is fed correctly. Therefore the following should be avoided in a septic system:

	Keep out toxic and hazardous chemicals. Chemicals include paints, varnishes, thinners, oil, pesticides and any organic chemicals that will inhibit the biological digestion process.

	Keep out items not readily degraded. Because they will result in the holding tank filling up rapidly which decreases the efficiency and requires more regular pump out maintenance. These items include but are not limited to plastics, cigarette filters, condoms, sanitary napkins and paper towels.
	Keep out grease and fats. Because they solidify and accumulations will result in blockages of the system
	Keep out strong disinfectants and caustic substances Because they are capable of destroying bacteria that are essential for digestion in the holding tank.
	Keep out excess water As this will reduce the life of a healthy septic system, therefore water conservation measures should be applied. The following actions may be taken: use of 6/3 litre dual flush systems for toilets use devices that have Australian Water Conservation Ratings of AAAA or better.

What does a grease trap do ?

A grease trap separates oils and greases from the kitchen in a specially designed holding tank that allows oils and greases to float to the surface to form a crust whilst heavy solids are able to settle to the bottom. The water carrying the wastes is released from the system through an outlet in the tank between the surface crust and the bottom sediments to the absorption trenches.

MAINTENANCE: Vegetable oils and grease should be emptied from the household grease trap by a Council approved person every 6 months.

Looking after your absorption trench

In general, absorption trenches require little maintenance. However to prolong the life of the trenches, the following practices should be adhered to:

	Do not drive on the absorption trench.
	Do not plant trees and shrubbery on the trench because their roots will clog up the trench.
	Do not cover the trench with a hard surface. Grass will help with the removal of excess water.
	Divert runoff water away from the absorption trench .

	Use phosphate-free washing powders or detergents, and the minimum amount. Phosphorus compounds in detergents will be adsorbed onto the soil in the trenches and ultimately reduce the capacity of the trench.

When should your septic system be inspected and pumped out ?

Septic tanks should be inspected every two years and include checking the quantity of sludge and scum.

The pump-out frequency of septic tanks can be estimated by using average sewage sludge and scum accumulation rates, i.e. 55 and 28 litres per head per year, respectively. Table 1 shows the estimated frequency for pumping out septic tanks depending on the number of individuals in the household, and the size of the tank.

Table 1: Estimated frequency for septic tank pump-outs (years) *

	Household Size					
Tank Size	1 person	2 people	3 people	4 people	5 people	6 people
(litres)	Pump Out Frequency (years)					
1600	7.3	3.6	2.5	1.8	1.5	1.2
2500	11.4	5.7	3.8	2.9	2.3	1.9
3900	17.7	8.8	6.6	4.4	3.6	3.3

To be used as a general guide

Information Sheet 2:

Household Actions for Catchment Care

What you can do around your home...

	Maximise your vegetation coverage. More vegetation coverage means less surface runoff, and less potential for contamination of waterways
	If paving areas, try to allow an area for stormwater to soak in before entering drains.
	Ensure that gutters and down pipes are connected to stormwater drains (not the sewer).
	Do wash vehicles on grassed areas. This fertilises the lawn and detergents will soak into the ground instead of flowing into the stormwater system and eventually into our waterways
	Store chemicals e.g. fertilisers and pesticides, away from drains
	Compost garden clippings and vegetable scraps and use mature compost as soil conditioner

	Do not sweep leaves, litter or animal droppings down the stormwater drain
	Do not over fertilise lawns and gardens. Excess fertiliser will waste your money and end up in the stormwater system and eventually into our waterways.
	Do not pour unwanted chemicals or oil down stormwater drains or sewers, as they will eventually enter our waterways or disrupt the sewage treatment process
	Do not use oil on ground or vegetation for dust suppression, weed control or timber preservation. Spillages should also be cleaned up, as oil is a dangerous pollutant

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Information Sheet 3: Riparian Weed Control

Weed species:

(Removal Techniques adapted from Big Scrub Rainforest Landcare Group and Queensland Dept Natural Resources and Mines Fact Sheets)

Abbreviations:

CS&P – cut scrape and paint	F/I = frill/stem inject/ spear or drill
S&P – scrape and paint	Numbers in brackets are G+ Glyphosate; MM = Metsulfuron Methyl dilution ratios
C&P – cut and paint	LI = LI 700 and denotes the use of surfactant
	Ag = Agral and denotes use of wetting agent

Common Name	Scientific name	Removal Techniques
Salvinia	*Salvinia molesta*	Hand and chemically remove all floating plants. Herbicides should not be applied to streams and potable water sources.
Water hyacinth	*Eichhornia crassipes*	Hand or mechanically remove all floating plants. Herbicides should not be applied to streams and potable water sources. For farm dams: (Vegetrol 50-100L/ha or 4L/100L water); (Reglone – 5 – 10L/ha or 400ml/100L water + 15ml non ionic wetting agent) do not use water for 10days after application. G (1-1.3L/100ml water or Amitrole (Weedeath) 280ml/100L

Common Name	Scientific name	Removal Techniques
Privet – narrow leaf	*Ligustrum sinense*	Seedlings: hand pull or spray (G 200ml/10L + LI 50ml/10L or G 200ml/10L +MM 1.5gms/10L + Ag 2ml/10L or MM 1-2gms/10L + Ag 2ml/L; Saplings CS&P or C&P (G 1:1.5); Trees F/I (G 1:1.5).
Privet - broad leaf	*Ligustrum lucidum*	Seedlings: hand pull or spray (G 200ml/10L + LI 50ml/10L or G 200ml/10L +MM 1.5gms/10L + Ag 2ml/10L or MM 1-2gms/10L + Ag 2ml/L; Saplings CS&P or C&P (G 1:1.5); Trees F/I (G 1:1.5).
Camphor laurel	*Cinnamom-mum camphora*	Seedlings: hand pull or spray (G 200ml/10L + LI 50ml/10L or G 200ml/10L +MM 1.5gm/10L + Ag 2ml/10L; Saplings CS&P (G1:1.5); Trees F?I (G 1:1.5) or C&P (G 1:1.5).
Morning glory	*Ipomoea indica*	Vines and runners: hand pull, rollup and hang to dry; CS&P (G 1:1.5) larger stems, root and nodes. Spray (G 100ml/10L + MM 1.5gms/10L + Ag 2ml/L). Foliar spray with dicamba =MCPA (Kamba M) – 350ml/100L. Foliar spray with dicamba (Kamba) – 500ml/100L.
Maderia vine	*Anredera cordifloia*	Ascending stems: S&P (G undiluted); Tubers: gouge, scrape and paint (G undiluted). Ground infestations: spray (G 200ml/10L + LI 50ml/10L or G 200ml/10L +MM 1.5gm/10L + Ag 2ml/10L); hand weed tubers and small vines; bag and compost or

		place in bin. Foliar spray with flurozpyr (Starane) – 500ml/100L. Basal bark spray with fluroxypyr (Starane) – 35ml/1L diesel.
Mistflower	*Eupatorium riparium*	Hand pull and hang to dry or spray (G 100ml/10L or MM 1-2 gms/10L + Ag 2ml/L)
Lantana	*Lantana camara*	Seedlings: hand pull or CS&P (G 1:1.5): shrubs : spray or cut down and spray regrowth (G 200ml/10L +LI 50ml/10L)
Cumbungi (bullrush)	*Typha spp, Typha latifolia*	Mechanical or hand pull is preferred. Herbicides should not be applied to streams and potable water sources. For farm dams: Foliar spray with – 1.3l/100L – spray when actively growing and before seed is set -
Slash Pine	*Pinus Elliotii*	Seedlings: hand pull; Saplings and trees: cut close to ground or ring bark or F/I (G 1:1.5) ensuring thick bark is penetrated.
Wild Tobacco Tree	*Solanum mauritianum*	Seedlings: hand pull or spray (G200ml/10L + LI 50ml/10L); or F/I (G 1:1.5)
Balsam	*Impatiens walleriana*	Hand Pull. Spray (G 100ml/10L + LI 20ml/10L).
Singapore daisy	*Sphagneticola tribolbata*	Hand pull and/or spray (MM 1gms/10L + G Ag 2ml/L)
Cats claw	*Macfadyena unguis-cati*	Stems: CS&P (G 1:1.5; Regrowth and tuberlings: spray (G 100mL/10/L +LI 20ml/10L or G100ml + MM1.5 gms/10L +Ag 2ml/L); Tubers: crown or dig up, bag and remove