Lake Baroon Catchment Care Group

Working with our community...for our waterways

Projects 2014-15

Erowal Riparian Fencing & Off Stream Watering (Stage 3)

PROJECT PLAN

Project No. 1415-008

(see also 1314-008 & 1213-008

seqwater WATER FOR LIFE

BlueCare™

This Project Plan has been prepared by:

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Disclaimer

While every effort has been made to ensure the accuracy of this Project Plan, Lake Baroon Catchment Care Group makes no representations about the accuracy, reliability, completeness or suitability for any purpose or situations other than the described activities herein and disclaims all liability for all expenses, losses, damages and costs which may be incurred as a result of the Plan being inaccurate or incomplete in any way.

How to read this Plan

It is recommended to read this Plan in conjunction with the 2012/13 LBCCG Project *Erowal Riparian Fencing and Off Stream Watering* (Project No. 1213-008) which will provide greater detail and background to this project. *Erowal Riparian Fencing and Off Stream Watering* can be viewed at *Erowal Riparian Fencing and Off Stream Watering*

This Plan is split into three distinct sections.

The **Summary** (pp. 5-6) is a two page brief description of the project and includes details of the stakeholders, budgets, outputs and outcomes.

The **Project Plan** (pp. 7-16) outlines the main details involved in implementing the project and in most cases should explain the project sufficiently.

The **Attachments** (pp. 16-44) provides additional information to support the Project Plan. The various numbered Contents in the Project Plan directly correspond with the numbered sections in the Attachments.

Terms used in this Plan

Lake Baroon and Baroon Pocket Dam are used interchangeably, although *Lake Baroon* is usually used when referring to the catchment and *Baroon Pocket Dam* refers to the dam as commercial water storage.

PROJECT VERSIONS & APPROVALS

Date	*Version/Description*	*Result*
June-July 2013	Stage 1 (2013-13) of Project approved by LBCCG Management Committee & Seqwater	LBCCG Approval (Minutes 63.6.6); Seqwater Approval 12/7/2013 (B. Heck)
November 2013	Draft Project Plan Stage 2 (2013-14)	n/a
14/11/2013	Project ratified at LBCCG Management Committee meeting	Approved (Minutes 65.7.5)
15/11/2013	Project Proposal forwarded to Seqwater for approval (email)	Approved (A. Purdy) 22/11/2013
June 2015	Draft Project Plan Stage 3 (2014-15)	n/a
18/6/2015	Project ratified at LBCCG Management Committee meeting	Approved (Minutes)
tbd	Project Proposal forwarded to Seqwater for approval (email)	

Cover photo: *Extension of off stream watering system completed in 2014-15.*

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PART A: EXECUTIVE SUMMARY

PROJECT NUMBER & TITLE: 1415-008 Erowal Riparian Fencing and Off Stream Watering Stage 3

Maintaining water quality is critical to providing safe bulk drinking water for the population of South east Queensland. All of the raw water storages managed by Seqwater are located in catchments which are developed to varying extents and support active and growing communities, including important industrial and rural economic activity. To provide a multi-barrier approach to the supply of drinking water, Seqwater must influence the management of land not owned by, but which exert an influence on Seqwater's core business.

This Plan is Stage 3 of the project – continued weed management and installation of the extension of the off stream watering system.

Erowal Riparian Fencing and Off Stream Watering is a multi-year project designed to address unmanaged livestock access to major watercourses, degraded riparian buffers and the proliferation of environmental weeds that provide limited protection to creek banks and associated water quality.

The first Stage (2012-13) of the project funded the fencing of the Obi Obi Creek riparian zone and initial weed management. The second stage (2013-14) installed the off stream watering infrastructure and continued weed management. The current Stage (2014-15) proposes to continue the third and final year of the project with planned continued weed management and additional activities (extension of the existing off stream watering system and riparian fencing), funded through weed management efficiencies and utilisation of surplus fencing materials, and a greater landholder in-kind contribution.

The project aims to:

- implement an on-ground project that mitigates threats to water quality;
- promote integrated catchment management in the Lake Baroon catchment;
- reduce nutrient delivery to waterways;
- reduce sediment delivery to waterways;
- improve aquatic habitats;
- raise community awareness (including water quality issues);
- support and work cooperatively with like-minded community organisations;
- reduce the impact of weeds;
- restore links between vegetation and re-establish corridors;
- contribute to the conservation of threatened species;
- contribute to climate change adaptation; *and*
- demonstrate best management practice of riparian zones.

The project will protect and enhance the vegetation buffers on the Obi Obi Creek on the Erowal property. Riparian buffer zones are important for a number of reasons:

- they often contain diverse vegetation communities which provide a habitat heterogeneity for terrestrial and semi-aquatic organisms;
- they can influence water flow, both surface and subsurface, contributing to the improvement of water quality;
- they provide shade, which in turn helps control water temperature, algal growth and provides shelter for aquatic species;
- they are a source of leaf matter as a source of food, and woody debris for habitat;
- they improve bank stability; *and*
- they provide corridors for movement of native fauna and flora between geographically separate areas.

Effective riparian zones can improve water quality by trapping sediment, reducing erosion, storing nutrients and filtering contaminants before they reach Lake Baroon. Riparian zone health is a key factor in a riparian area's ability to protect and enhance water quality.

The original project has removed livestock access to 850 metres Obi Obi Creek on the Erowal/Uniting Church property, established an off stream watering system and controlled environmental weeds in 2 hectares, improving the buffering ability of the riparian zone and contributing to the extensive revegetation occurring on the Maleny Community Precinct – immediately across the Obi Obi Creek from Erowal.

The additional activities has excluded livestock from a further 140 metres of watercourse and managed weeds in a further 0.5 hectares riparian zone.

APPLICANT/LANDHOLDER DETAILS

Name	The Uniting Church in Australia (Erowal Aged Care Facility)				
Postal Address	1274 Landsborough Rd, Maleny, 4552				
Region Property Manager	[redacted]	***Phone***	[redacted]	***Email***	[redacted]
Site Manager	[redacted]	***Phone***	[redacted]	***Email***	

PROJECT / SITE LOCATION

Property Address	1274 Landsborough Rd, Maleny				
RP Numbers (Lot)	SP115563 (2)	MCH 3013 (6)	RP 165654 (1)	***Property Size (ha)***	25.8 ha
Land-use	Dry dairy cattle grazing		***Stock Carried***		40
Sub-Catchment	Obi Obi Creek		***Management Unit***		OB6
M.U. Priority *(LBCCG IP)*	**Low**		***M.U. Priority*** *(Pollution)*		**High**

PROJECT PARTNERS/STAKEHOLDERS & ROLES *(Stage 2 of Project only).*

Lake Baroon Catchment Care Group (Seqwater 2014-15 Project Funding)	On ground project implementation cash - **$5,255**
Lake Baroon Catchment Care Group (Seqwater 2013-14 Administration Funding)	Project management, coordination, administration, reporting, monitoring & evaluation - **$4,400**
Keith & Sonya Hopper	Property land manager [agistee], fencing **- $2,400 in-kind**
Erowal	Landholder **- $780 cash & in-kind**
Eco-theologians	Uniting Church volunteers **- $1,800 cash & in-kind**

PROJECT DETAILS

Project Start Date		June 2013	***Project Completion Date***	June 2016
		Planned		**Completed**
OUTPUTS (3 year project)	***Fencing***	850 metres		990 metres
	Weed Management	2 hectares		2 hectares
	Off Stream Watering	1 tank & 1 trough		1 tank & 3 troughs
OUTCOMES (3 year project)	***Stream length protected***	850 metres		990 metres
	Vegetation protected/enhanced	3.25 hectares		3.5 hectares
	Reduced erosion, nutrient and pathogens	20 % reduction (estimate)		25 % reduction (estimate)

PART B: PROJECT PLAN

i. INTRODUCTION

Lake Baroon Catchment Care Group (LBCCG) is a not for profit community group focussed on reducing the risks to water quality in the Lake Baroon catchment - primarily through the implementation of on-ground remediation projects. This aim is consistent with Seqwater's objectives of efficiently producing high quality potable water for the Sunshine Coast (and greater South east Queensland) region.

Maintaining water quality is critical to providing safe bulk drinking water for the population of SEQ. All of the storages managed by Seqwater involve catchments which are developed (to varying extents) and support active and growing communities, along with important industrial and rural economic activity (SKM 2012).

As this project is consistent with the LBCCG (and Seqwater) aim of reducing risks to water quality from erosion, nutrients and pathogens, the activities to stabilise landslips and the installation of a formal waterway crossings are considered sensible to support.

This Plan is Stage 3 of the project – continued weed management. Stage 1 was approved and funding allocated in the 2012-13 financial year, however final approval from Bluecare (the owners of the Erowal facility) was not finalised until October 2013, delaying the project. Consequently the fencing and initial weed management was delayed, however as the fencing of the Obi Obi Creek riparian zone would result in the loss of livestock water, it was necessary to implement both Stage 1 and 2 of the project concurrently (riparian fencing and installation of off stream water infrastructure).

The project has excluded livestock access to the Obi Obi Creek on the Erowal property through the re-establishment of riparian fencing. Alternative off stream watering has been installed for the agisted livestock and the riparian zone has been managed to control environmental weeds, encouraging natural regeneration of indigenous species. The project has assisted (and enhanced) the revegetation efforts currently underway on the Maleny Community Precinct (MCP) on the northern bank of the Obi immediately across the waterway from Erowal.

ii. BACKGROUND

The Maleny Community Precinct (MCP) on the northern bank of the Obi Obi Creek, opposite Erowal Aged Care, is undergoing major redevelopment. Along with a Golf Course, sporting fields and community facilities, the site is also the focus of major environmental activities – the most visible being extensive revegetation on the bank of Obi Obi Creek. This will provide wildlife corridors, broad biodiversity benefits and improve water quality in the creek.

The lead environmental community group on the MCP, Green Hills, secured long term funding to establish seven hectares of riparian vegetation – much of it on the opposite bank to Erowal. This has significant community support with over 400 people attending a community tree plant in 2010 and a further 125 attending a similar event in 2013 as well as regular events since.

Previously livestock from Erowal could cross the creek and access the revegetation sites on the MCP, hence the necessity of establishing fencing and associated off stream watering. Weed management of the fenced riparian zone was critical to ensure environmental weeds did not dominate and impact the environmental and water quality benefits of the site.

1.0 WHAT

The proposed project (over three years) aimed to complete three components:

1. Replace riparian fencing on Obi Obi Creek (2012-13 – approved and funding allocated);
2. Weed management within fenced area (riparian zone) – particularly upstream zone that has been revegetated in the past. Lower zone (primarily large mature camphor laurel) to be managed to allow installation of fencing with possible future removal (2012-1015 – initial management approved and funding allocated);
3. Provide alternative watering points for agisted livestock – off stream watering system comprising tank and trough utilising existing pump from Obi Obi creek (2013-14 – current proposal).

However efficiencies in the implementation of the weed management component have led to significant savings and the ability to expand the project. Recent regular and severe flooding have damaged flood fences upstream and downstream on Walkers Creek permitting livestock to enter an old Barung Landcare revegetation site and cross the Obi Obi Creek onto the MCP and also upstream onto the LBCCG project, *Mid Obi Riparian Corridor.*

Consequently the project has completed a further three additional components:

1. Extended existing off stream watering system (two troughs);
2. Install fencing (80 metres) on Obi Obi Creek; and
3. Install permanent fencing (60 metres) on Walkers Creek.

2.0 WHERE

Erowal Aged Care (Uniting Church of Australia)
1274 Landsborough – Maleny Road, Maleny

Site is approximately 26.5 hectares – comprising of the following:

- 5.0 ha of aged care facilities and grounds;
- 15.4 ha of pasture utilised for dry dairy cow grazing;
- 6.0 ha riparian zone and past revegetation (including a wetland).

The shape of the property results in a frontage to Obi Obi Creek of approximately 1,250 metres; 350 metres of Walkers Creek and a combined 700 metres of frontage to minor (ephemeral) tributaries.

The Erowal property is immediately upstream of the Maleny Sewage Treatment Plant and shares the Obi Obi Creek boundary with the Maleny Community Precinct. The MCP has significant riparian vegetation (including remnant vegetation) and is currently undergoing major revegetation programs (7 hectares of riparian revegetation linking urban Maleny with vegetation in the lower reaches of Obi Obi Creek).

Numerous activities have occurred in the past. The upper Reach of the Obi Obi Creek was revegetated many years ago and has created an effective riparian corridor (although the vegetation is predominantly Eucalypt species). Walkers Creek has been revegetated – particularly on the south side of the Maleny – Landsborough Road, and a minor tributary of the Obi has also been revegetated linking with activities on the Maleny High School. A waterway crossing has also been constructed on the tributary (LBCCG contributed to this project).

LBCCG is currently implementing projects immediately downstream of Erowal (*Mid Obi Riparian Corridor 2013-15*) and immediately upstream on walkers Creek (*Walkers Creek Rehabilitation and Enhancement 2014-2017*).

3.0 WHY

3.1 Original Project (2012-13)

The current agistee (Keith Hopper) was keen to see the creek fenced in its entirety (provided alternative water sources are established) to improve livestock management. Repairing fences in the riparian zone of Obi Obi Creek following flooding is labour intensive and when the creek is at a low level livestock can cross. The riparian zone provided some feed resource however its benefit is outweighed by the increased management of the site.

The re-establishment of fencing on the Obi Obi Creek:

- prevents livestock from crossing the creek and into revegetation on the MCP;
- improves livestock management on Erowal;
- enhances the wildlife corridor on Obi Obi Creek;
- contributes to environmental activities on the MCP;
- enhances the old revegetation on the Erowal side of the creek – particularly through the proposed three years of weed management funding;
- improves water quality in the Obi Obi Creek (and Lake Baroon) by removing livestock from the riparian zone; *and*
- improves the aesthetic and visual appeal of Obi Obi Creek (important as the MCP is gradually opened up to public access and walking trails).

It is good practice to manage livestock in riparian zones to reduce pathogen, nutrient and sediment inputs into the waterway and ultimately Lake Baroon – the Sunshine Coast's most important water supply.

Although not actually on Erowal property there is a significant area of remnant vegetation on the downstream Reach of Obi Obi Creek on the northern bank. This Gallery rainforest (12.3.1) is considered endangered in SE Queensland and is therefore considered high priority for conservation. The fencing of Obi Obi Creek is contributing to the protection of the remnant.

3.2 Additional Activities

Although the previous LBCCG project has fenced 850 metres of Obi Obi Creek, established an off stream watering system and is implementing a weed management program, livestock could still access 80 metres of Obi Obi Creek and approximately 60 metres of Walkers Creek (necessary for water access).

Recent flooding highlighted the need to improve property management and it was identified that further fencing and associated off stream watering system extension was required. Initially deemed excessively expensive, cost reduction measures were identified and a permit from DTMR was gained. This has removed all fences crossing watercourses and excluded livestock.

The completion of fencing on the Obi Obi and Walkers Creeks will:

- prevent livestock from crossing the creek and into revegetation on the Maleny Community Precinct, Maleny Sewage Treatment Plant and adjoining private properties;
- improve livestock management on Erowal;
- enhance the wildlife corridor on Obi Obi Creek;
- improve management of Department of Main Roads infrastructure;
- improve water quality in the Obi Obi and Walkers Creeks (Lake Baroon) by removing livestock from riparian zones;
- improve the aesthetic and visual appeal of Obi Obi Creek; *and*
- Benefit DTMR by reducing erosion around the culvert by excluding livestock and encouraging stabilising vegetation and through the removal of upstream flood fencing that has the potential to trap debris and block the culverts.

4.0 HOW

The following refers only to Stage 3 of the project. For details on the preceding two stages please refer to *Erowal Riparian Fencing and Off Stream Watering*.

4.1 ORIGINAL PROJECT

4.1.1 Weed management

Total removal of livestock from riparian zones can result in a proliferation of weeds (primarily lantana and privet, but also camphor laurel and other environmental weeds).

Above: Weedy riparian zone.

Above: The posi-track mulcher is very effective clearing heavy coverage of weeds. The success of this component has enabled significant savings to be realised.

Weeds require at least a medium term management program. The project allocated three years of weed control to ensure the fenced riparian zone did not transition into an area that was not only of limited aesthetic appeal but also did not provide environmental and water quality benefits.

Initially the smaller patches of woody weeds were mulched (upper section only), with follow up to stem inject larger woody weeds, cut and paint smaller isolated trees/shrubs and discretionary spot spraying of groundcover weeds.

In the downstream Reach, the existing large camphor laurels were only trimmed to enable the erection of the new fencing and they will be retained in the medium term as they provide waterway stability (from erosion) and shade the water and banks, discouraging further weed invasion. Minor discretionary management of lantana and privet however has occurred on an as needed basis.

4.2 ADDITIONAL ACTIVITIES

4.2.1 Obi Obi Creek riparian fencing

2012-13 project fencing. The two floods of autumn 2015 were extreme and completely covered the fences however the quality of the fencing ensured its survival. LBCCG does not compromise on fencing quality or standards.

Approximately 80 metres of standard cattle fencing (timber splits at 5 metre spacings, 4 strand wire; 3 barb and top plain) and one steel gate where required. This will complete the full exclusion of livestock from Obi Obi Creek provided the fencing of Walkers Creek is also completed (livestock can enter the Obi Obi Creek from Walkers Creek by traversing through an old riparian revegetation buffer whose fencing is damaged beyond repair where Walkers Creek enters the plot).

Fencing materials will be funded from surplus materials (*Maleny Community Precinct Revegetation Fencing*) and will be erected by the agistee Keith Hopper.

4.2.2 Walkers Creek riparian fencing

There are two short sections of Walkers Creek that remained unfenced – approximately 30 metres on each side of the Landsborough Maleny Road. These sections will be fenced with standard cattle fencing with gates installed to enable full access to the Department of Main Roads and Transport infrastructure (culverts etc). This will exclude livestock from the riparian zone and negate the need to fence across Walkers Creek to stop livestock from entering the above described riparian revegetation sites.

Fencing materials will be funded from surplus materials (*Maleny Community Precinct Revegetation Fencing*) and will be erected by the agistee Keith Hopper.

North side of Maleny Landsborough Road. Installing fencing on the far side of Walkers Creek we will exclude livestock from all watercourses on the Erowal property, reducing risk to water quality and improving livestock management.

4.2.3 Extended off stream watering

The OSW system installed in 2013-14 consists of a 5,000 gallon (23,000 litres) holding tank and a single concrete trough that services the grazing paddocks around the Erowal facility. As the new trough sites are downstream of the existing system water can be piped by gravity downhill to the new sites. To cross over the Landsborough Maleny Road however required running the water pipe through the Department of Main Roads culverts.

The pipe was laid in the base of the culvert against the side wall. There will be no impact to the culvert and it is unlikely if the pipe lies on the floor of the culvert and is adequately secured at the entrance and exit to the culvert that flooding will damage the pipe or culvert. The pipe running immediately through the culvert consists of galvanised steel which ensures it lays flat and enables sufficient anchoring on entry and exit.

Trough installed in north east paddock.

5.0 WHEN

This project has effectively been completed except for continuing weed management. As the project was approved in a previous year (multiyear project) we have continued to expend on the project and apply for reimbursement at the end of the financial year rather than at the start of the year.

There was some delay to the start of the project thus weed management activities did not commence as anticipated therefore there remains a moderate level of funds to continue weed management.

It is expected the weed management and on ground implementation of the project to be completed by 31 December 2015.

Obi Obi Creek forming northern boundary of the Erowal site. The project has excluded livestock from the riparian zone and prevented livestock from crossing onto the Maleny Community Precinct and other LBCCG projects.

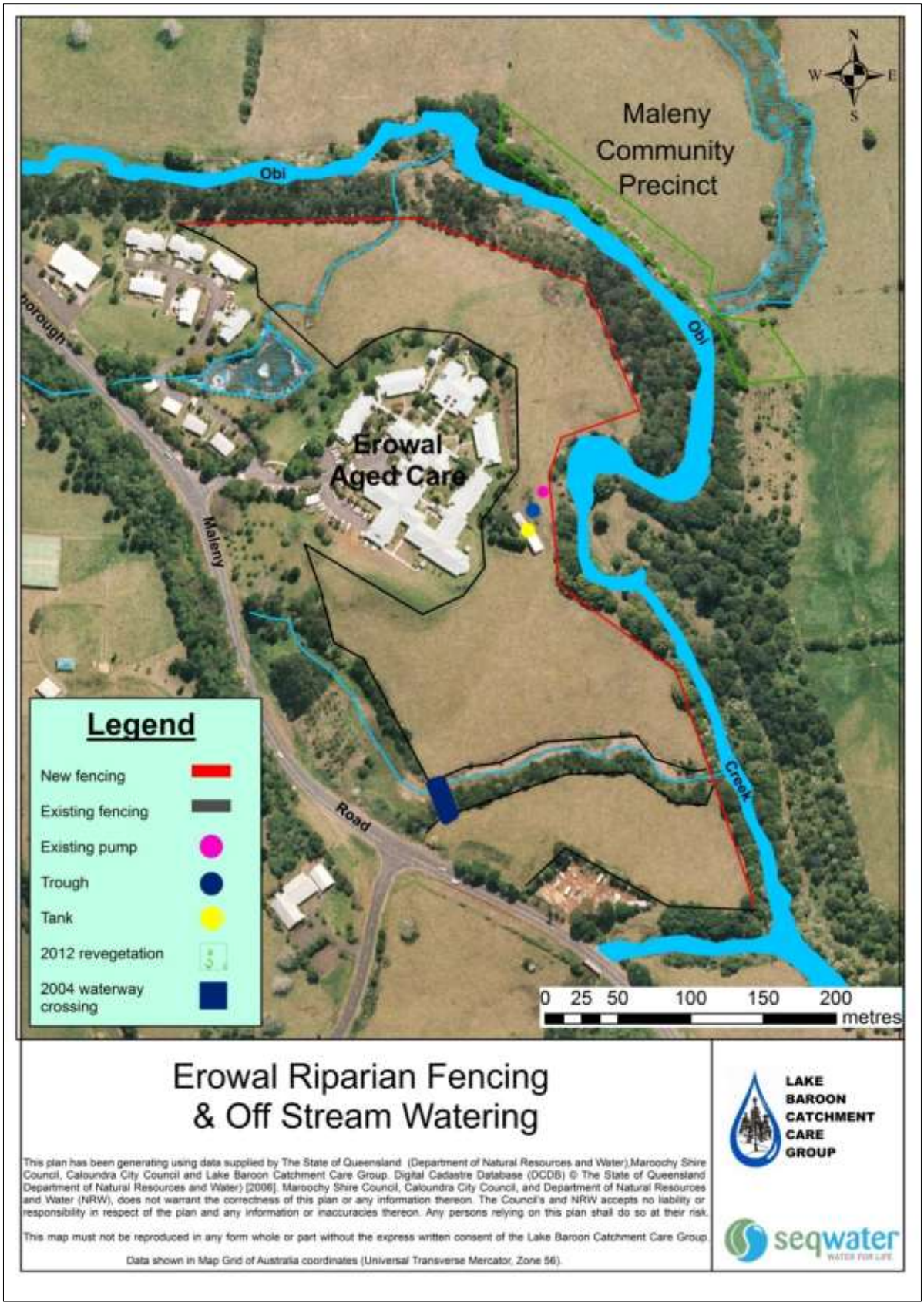
6.0 PROCUREMENT

6.1 BUDGET 2014-15

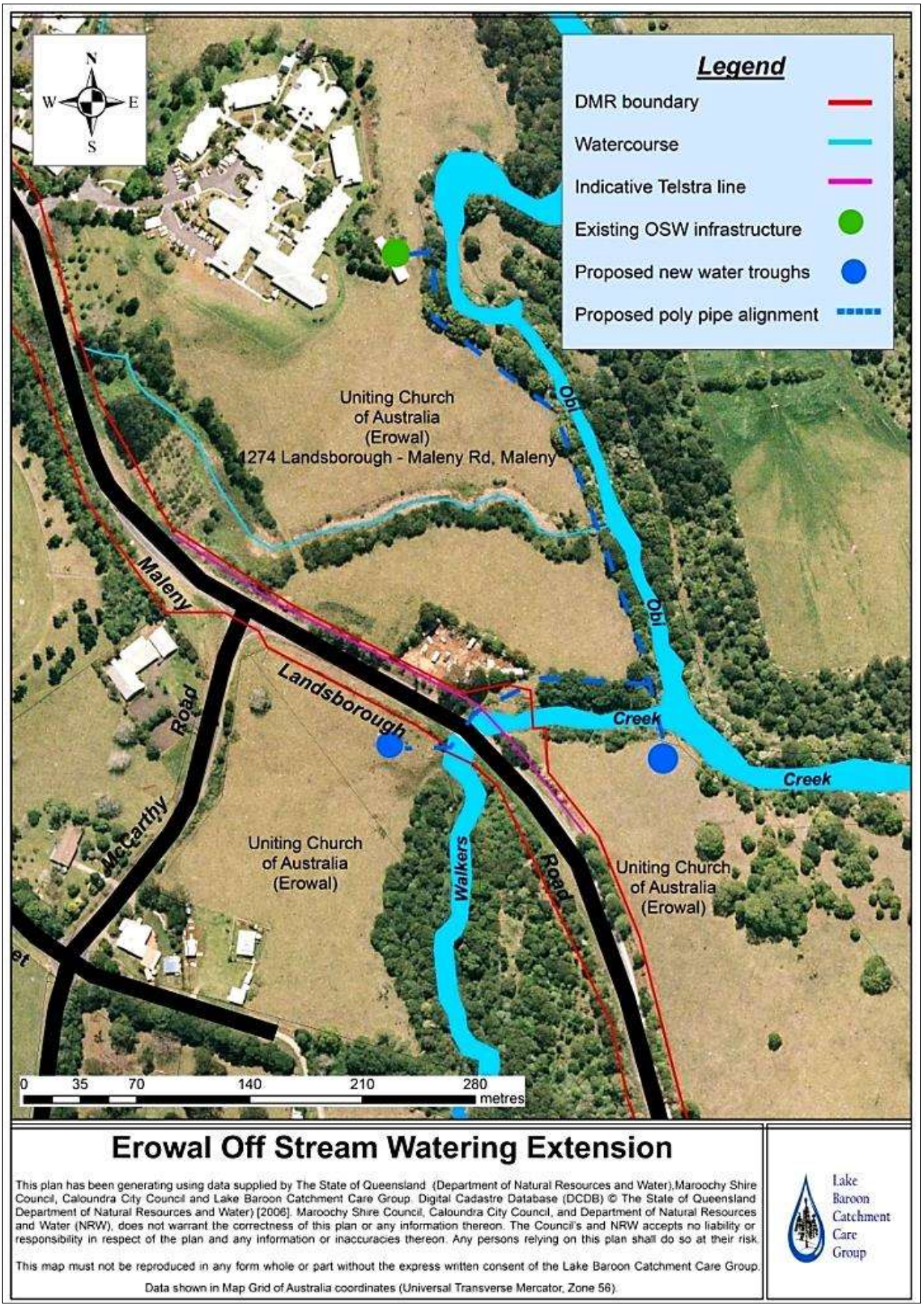
LBCCG has a policy of keeping Project Budgets confidential as individual project costings vary and can give misleading information. Detailed Budgets can be supplied on request. Please contact the LBCCG Project Manager on info@lbccg.org.au for further information

7.0 PROJECT MAP

7.1 ORIGINAL OUTPUTS



7.2 ADDITIONAL OUTPUTS



8.0 PROJECT MANAGEMENT

Action		Responsibility	Projected Completion Date	Completion Date	Planned Output	Actual Output
Project Plan Stage 1		LBCCG Project Manager	Jun 13	Jun 13	Project Plan	Project Plan
Project presented to LBCCG Committee for approval (includes Seqwater Rep.)		LBCCG Project Manager & Committee	Jul 13	Jul 13	Approved Plan (LBCCG)	Approved Plan (LBCCG)
Pre-works monitoring (including photo points)		LBCCG Project Manager	Nov 13	Nov 13	Photo & data set	Photo & data set
PROJECT IMPLEMENT.	Riparian fencing	Contractor	Dec 13	Jan 14	850 metres	850 metres
	Weed Management	Contractors	Jun 15	Dec 15	2 hectares	2 hectares
Project Plan Stage 2		LBCCG Project Manager	Nov 13	Nov 13	Project Plan	Project Plan
Project presented to LBCCG Committee for approval		LBCCG Project Manager & Committee	Dec 13	Dec 13	Approved Plan (LBCCG)	Approved Plan (LBCCG)
Project forwarded to Seqwater for approval		LBCCG Project Manager	Dec 13	Dec 13	Approved Plan (Seqwater)	Approved Plan (Seqwater)
PROJECT IMPLEMENT.	Weed Management	Contractors	Jun 15	Dec 15	2 hectares	2 hectares
	Off Stream Watering	Contractor	Dec 13	Jan 14	1 system	1 system (1 trough)
Project Plan Stage 3		LBCCG Project Manager	June 15	June 15	Project Plan	Project Plan
Project presented to LBCCG Committee for approval		LBCCG Project Manager & Committee	June 15	June 15	Approved Plan (LBCCG)	Approved Plan (LBCCG)
Project forwarded to Seqwater for approval		LBCCG Project Manager	June 15	June 15	Approved Plan (Seqwater)	Approved Plan (Seqwater)
PROJECT IMPLEMENT.	Weed Management	Contractor	Jun 15	Dec 15	2.5 hectares	2.5 hectares
	Additional Off Stream Watering	Contractor	May 15	May 15	2 troughs	2 troughs
	Additional Fencing	Landholder/agistee	Jun 15	Jun 15	140 metres	140 metres
Progress reports.		LBCCG Project Manager	Jun 15	Dec 15	12 Progress Reports	10 Progress Reports
Post-works monitoring.		LBCCG Project Manager	Dec 14 (ongoing)	Dec 15	Photo & data sets	ongoing
Project completed/signed off. Final Report.		LBCCG Project Manager & Committee	Dec 15	n/a	Final Report	-

Completed **Continuing** (as per plan) **Behind schedule**

PART C: ATTACHMENTS

1.0 PROJECT RATIONALE

1.1 INTRODUCTION

An estimated 80% of sediment and 35% of nitrogen in the waterways in south east Queensland comes from non-urban diffuse loads. Reduction of these loads clearly represents a major target for action if significant improvements in water quality are to continue to be achieved in South East Queensland (DERM 2010).

In an ideal world, all waterways in the Lake Baroon catchment would be rehabilitated to provide riparian buffers, lower in-stream temperatures and provide appropriate habitat for aquatic ecology. However the limited resources available means the catchment must be prioritised into areas where the greatest gains can be achieved through the smallest investment. We cannot realistically completely restore cleared riparian zones to pre-European conditions, but we can improve the ability of the zone to maintain the quality of water delivered downstream.

The Lake Baroon Catchment Implementation Plan (2007) prioritisation of sub-catchments for works is effective and useful for rehabilitating waterways in the catchment through fencing and revegetation but does not reflect the nutrient and sediment inputs to the waterways through land use, particularly intensive grazing (dairying and beef production). An alternative Management Unit Prioritisation was developed by LBCCG that utilises MU stability; pollution and the degree of riparian vegetation present to determine the need for on-ground investment. In this context the proposed project rates HIGH in priority (Dunstan 2007).

The Maleny Community Precinct Environmental Scoping Document (2009) suggested “A revegetated buffer area of 40 m should be provided at a minimum along the Obi Obi Creek throughout the remainder of the site, in areas not containing "endangered" or "of concern vegetation".”

Maintaining a healthy riparian system is essential for a productive landscape. When a riparian area is healthy it contains lush, thick vegetation, provides habitat for wildlife and aquatic species and potentially a source of forage for livestock. Healthy, primary vegetation in a riparian area stabilizes streambanks, influences bank morphology, aids in reducing streambank damage and provides shade which in turn lowers water temperatures, increasing the oxygen carrying capacity of the stream. As well, riparian vegetation filters utilizes and stores nutrients, thus preventing them from entering water systems. When a riparian area is properly functioning and healthy, it can influence an increase in groundwater recharge.

1.2 VEGETATION AS A BUFFER

The project will enhance vegetation buffers on the Obi Obi Creek. The effectiveness of a riparian buffer to provide multiple environmental and water quality benefits varies depending on several key factors, namely bank slope, vegetation species composition and age, and sediment type. Slope gradient appears to be the most important variable in removal of sediment or particulate pollutants, whereas buffer width is most important for the effective removal of dissolved nutrients (Barwick et al 2009).

Riparian buffers comprising grassed buffer strips are effective at trapping sediments and nutrients adsorbed to sediments (such-as phosphorus), but tend to be relatively poor at trapping dissolved nutrients, or for the provision of shade, food sources, in-stream structure or corridors for many species. Riparian buffers comprising taller, woody vegetation are typically good at providing shade, as a source of food and woody habitats, as a screen for light and noise, as corridors for terrestrial fauna (to a varying extent depending on species composition), and as a means for reducing soluble nutrient inputs. Designed riparian buffers usually incorporate multi-tiered systems of both native woody vegetation to enhance ecological function, and vegetated filter strips for the management of water quality. In essence, this approach seeks to mimic the complexity and effectiveness of a natural riparian buffer system, and often the best approach is to provide the required buffer width to enable a self-sustaining buffer of native vegetation (Barwick et al, 2009).

1.3 GRAZING AND RIPARIAN ZONES

Livestock grazing is a land use activity that has the potential to alter the condition of a stream and riparian area if not managed properly. Improper livestock use of riparian areas can negatively affect riparian areas by changing, reducing or eliminating the vegetation within them.

The direct effects of improperly managed livestock grazing on riparian vegetation include:

- change, reduce, or eliminate vegetation
- decrease the vigour, biomass and alter species composition and diversity
- change the channel morphology by widening and shallowing of the streambed
- alter the stream channel through trenching or braiding depending on soil and substrate composition
- alter the water column by increasing water temperatures, nutrients, suspended sediments and bacterial counts
- alter the timing and volume of water flow
- cause bank sloughing leading to accelerated sedimentation and erosion
- decrease wildlife habitat and species

Fencing is an essential tool to manage grazing in riparian zones whether permanent exclusion or managed grazed is performed.

1.4 OFF STREAM WATERING AND RIPARIAN FENCING

In the sub-tropics, the majority of overland flow events occur during the summer runoff. Consequently during the winter and spring months, most faecal contamination in water channels occurs from an animal defecating directly into the water. Any practice that reduces the amount of time cattle spend in a stream will therefore reduce the manure loading and decrease the potential for adverse effects on water from grazing livestock.

Even without exclusion fencing of riparian zones, off-stream water sources reduce the amount of time free ranging cattle spend in or immediately adjacent to watercourses. Cattle prefer to drink from a trough over other sources of water available to them, resulting in a significant reduction in time spent in the stream (watering) and adjacent stream side area (grazing and loafing).

Studies overseas have shown that following the installation of the off-stream watering (OSW) infrastructure, stream bank erosion decreased by 77% and concentrations of total suspended solids, total nitrogen and total phosphorous decreased by 90, 54 and 81% respectively (Sheffield et al, in McIver 2004). More recent studies indicate that although the installation of OSW by itself is effective, providing livestock supplements and shade near troughs reduced riparian zone pressures even further (Ganskopp 2001, McInnis and McIver 2001, Porath et al. 2002 in McIver 2004). Porath et al. (2002) also found that the provision of supplements increased weight gain in cows and calves.
Cattle when drinking at streams and dams enter the water to reduce bending, resulting in the stirring up of suspended solids (turbidity). Additionally riparian zones can be difficult places for livestock to access (steep, muddy or rocky banks) placing greater effort and stress on individual animals. Additionally when cattle enter a water source they tend to defecate directly into the waterbody.

Troughs provide a level, relatively dry watering point where the animal does not have to bend excessively, reducing stress by providing improved footing, increased visibility and reduced physical effort. This can lead to healthier animals with less risk of injury.

Cattle use riparian areas for resources other than water - crossing points, forage, shade, grooming sites (scratching posts) and general loafing. A well designed OSW system needs to take into account all these factors. Research by Gillen et al 1984 (in McIver 2004) shows that cattle prefer to graze within 200 metres of water. Therefore to optimise uniform grazing and water efficiencies, cattle should not have to walk more than 200 -300 metres to water.

Season and time of day also have an effect on the effectiveness of an off-stream water source in reducing degradation to a riparian area. In the warmer summer months, riparian areas give shade and protection from the heat and the coolness of the water often draws the animals to the water's edge. It is essential to ensure that alternative shade is provided within the paddock – preferably near the OSW trough and ideally on a high point exposed to cooling breezes.

Left: Lake Baroon from Cork's hill.
Although the dam and immediate surrounds are owned and managed by Seqwater, the vast majority of the catchment is privately owned. To influence land management that reduces the risk to water quality in the storage, Seqwater must engage the community. The most effective method to do this is work with existing community groups.

2.0 PROJECT LOCATION

2.1 BACKGROUND

Lake Baroon is situated on the Maleny Plateau in the headwaters of the Mary River, located inland from the Sunshine Coast approximately 13 km south west of Nambour and 7 km north east of Maleny. Obi Obi Creek forms both the primary inflow and outflow of the dam. Walkers, Falls, Bridge and Elston Creeks constitute the remaining creeks within the catchment providing water to Lake Baroon. The catchment encompasses an area of 74 km^2 (including the dam surface).

2.2 THE OBI OBI CREEK CATCHMENT

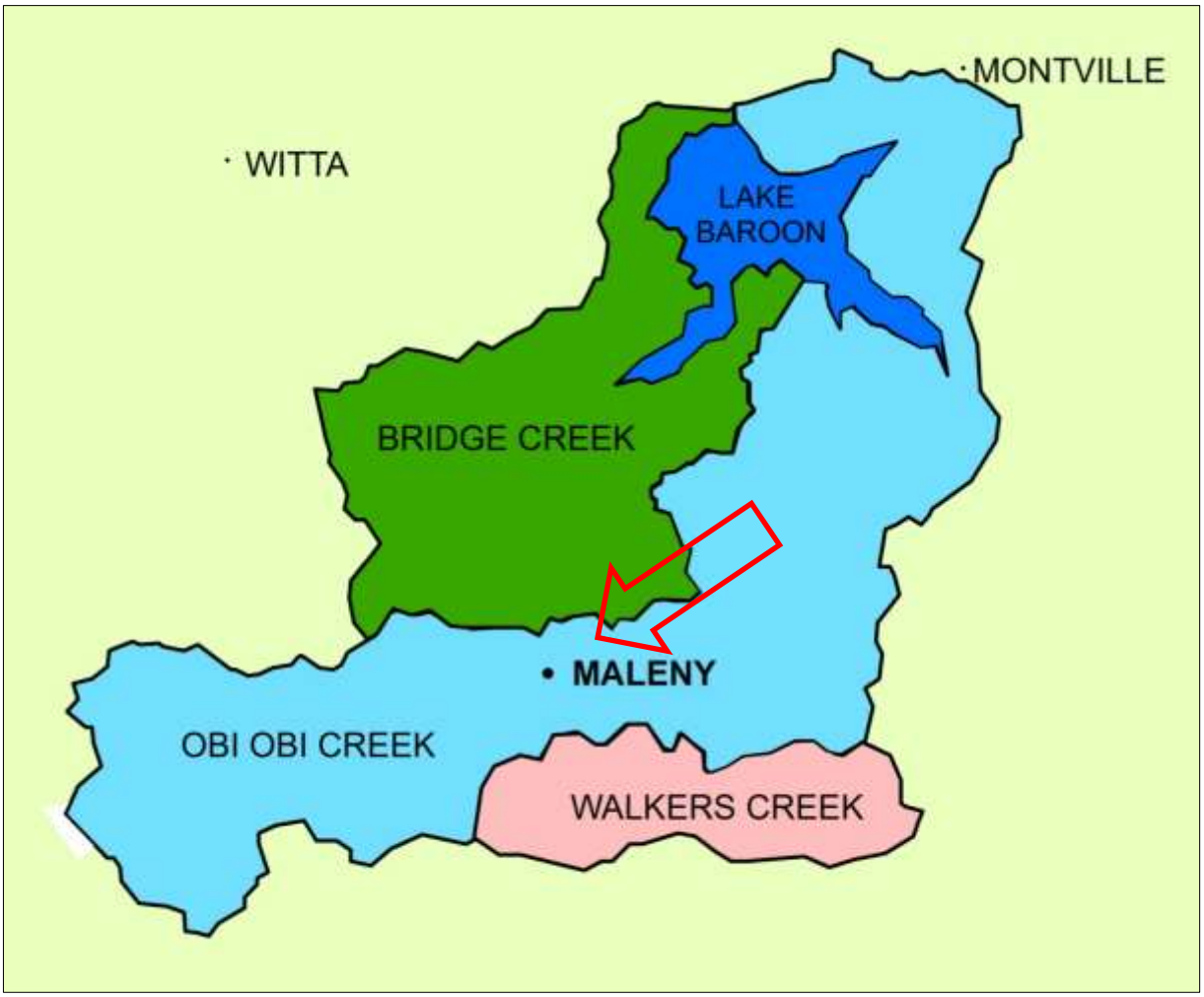
The sub-catchment supplies both surface runoff and ground water to the dam. Obi Obi Creek continues to flow from the dam wall north-west until it reaches the Mary River at Kenilworth. The Mary River continues north to north-east until it eventually meets the ocean at Hervey Bay.

The Obi Obi Creek is the most significant watercourse in the Lake Baroon catchment, consisting of 71 km of waterway in a sub catchment of 2,880 ha. A mere 18.45% of the sub catchment is covered in vegetation, with much of the area significantly disturbed, mostly supporting beef or dairy cattle; but also including urban Maleny (Dunstan 2007).

Obi Obi Creek has been divided into nine management units that reflect property boundaries, physiography, vegetation, land use, point and diffuse source impacts, and administrative convenience. Erowal is in Management Unit OB6.

Left: A typical reach of the Obi Obi Creek near Erowal.

2.3 LOCATION MAP



2.4 CATCHMENT REVIEW

2.4.1 Background

Since the arrival of European settlers, Lake Baroon and its catchment area have undergone significant change. Timber cutters first moved into the region in 1853 and selectively cleared the best timber from the area. Following the removal of the most valuable timber (1906), the majority of remaining vegetation was cleared for beef and dairy cattle (1918) (Dunstan, 2007).

As a result riparian zones have been irreparably impacted such as:

- vegetation fragmentation (as a result of clearing)
- increased erosion and sediment loads due to clearing and land use practices
- changes to hydrology and water quality
- altered natural processes such as grazing and urban development
- introduction of foreign fill materials
- introduction of weeds, exotic plantings and exotic fauna.

2.4.2 Geology, soils & stability

The geology of the Maleny plateau is dominated by basalt lava flows occurring between 31 and 25 million years ago (MYA). However there are several other significant geological formations that influence the catchment – particularly soil type and consequently vegetation and stability.

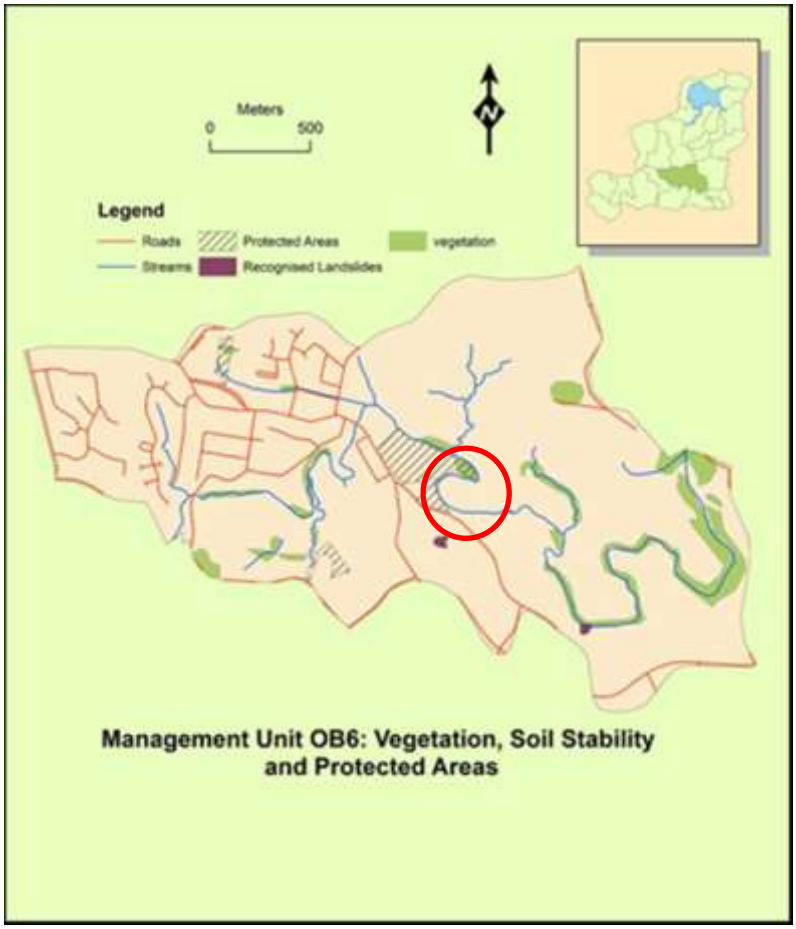
The oldest rocks visible on the plateau are known as the North Arm Volcanics and originated somewhere in the North Arm region around 210 MYA. Multiple lava flows consisting of andesite and dacite to rhyolite form the northern bank of Lake Baroon and are visible in the lower reaches of Bridge Creek where erosion has exposed them. Rhyolite is very hard and resistant to erosion evidenced by the Narrows where the Obi Obi Creek was forced to cut a narrow gorge through. The North Arm Volcanics underlay the entire Maleny plateau and extend as far south as the Glasshouse Mountains (Willmott 2007).

Between 210 and 180 MYA the North Arm Volcanics 'sagged' into broad depressions that subsequently filled with sediment, forming the deep Landsborough Sandstone formation.

Other geological formations in the catchment include small areas of Cedarton Volcanics – visible in the upper reaches of Obi Obi Creek; andesite rock that produces lighter coloured moderately fertile soils; and an area of Amamoor Beds – 315 MYA of hard meta-sediment rocks that were historically folded and steeply inclined exposed at Howells Knob. Composed of quartzite, these rocks weather to variable cream or yellow soils (Willmott 2007).

Maleny plateau basalts, although outwardly appearing very hard, have high concentrations of iron which promotes fracturing and therefore can be very prone to erosion. The Obi Obi and Bridge Creeks have gradually cut channels into the basalt plateau revealing the described layers underneath. The edges of the plateau have also eroded to form escarpments (Willmott 2007).

The Erowal site has an elevation of approximately 450 metres above sea level with gentle slopes falling to Obi Obi Creek. Walkers Creek enters the property from the south and joins the Obi Obi Creek near the downstream boundary. For comparison to where the property lies in the landscape, Lake Baroon is 217 metres above sea level, Howells Knob the highest point in the catchment is 560 metres above sea level, while Maleny is between 410 and 450 metres above sea level.



Soils on the site predominantly consist of basalt-derived red (Krasnozem or Ferrosol) soils. The bed of the watercourses on the site consists of black alluvial soils that have been deposited by a combination of hill slope (paddock) erosion and gullying. Some sediment is likely having originated from development sites in urban Maleny (historically and currently). The velocity and volume of the Obi Obi Creek however limits sediment build up.

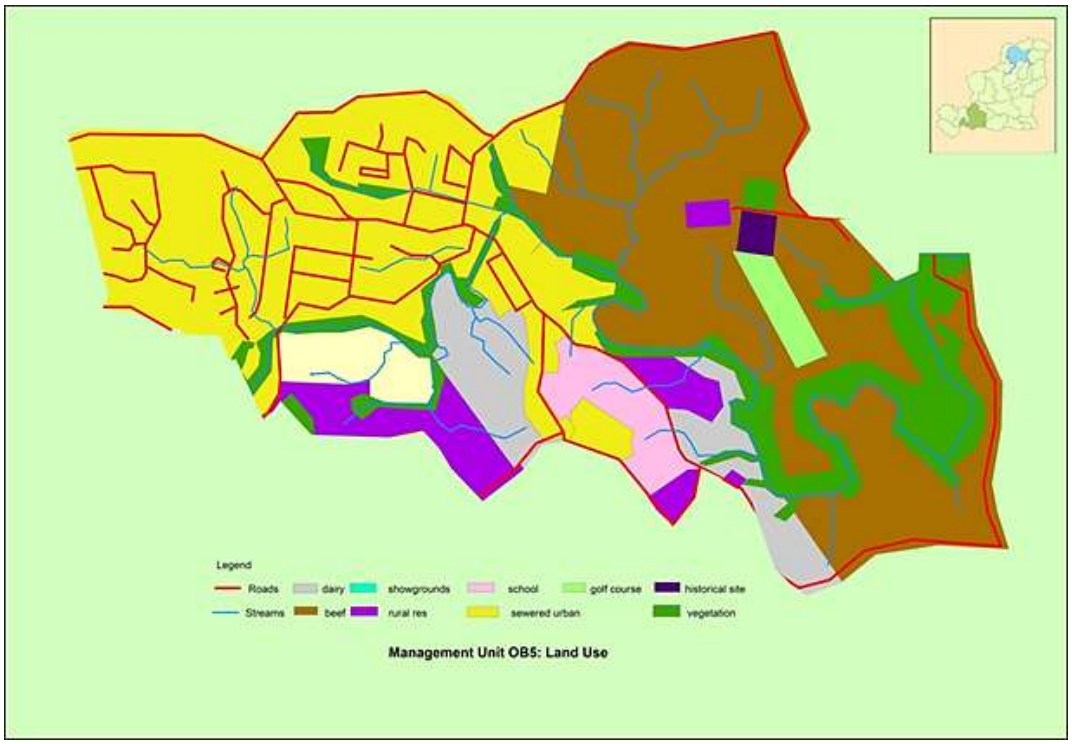
Native vegetation is an indicator of soil types. The vegetation over the site therefore would have originally been consistent with RE 12.8.3 – as evidenced by the existing small remnant on the Porter Sisters property and several small pockets or strips adjacent to the Obi Obi Creek. The endangered RE 12.3.1 is found in narrow strips immediately across the creek on the MCP.

The underlying geology of the Erowal site is tertiary olivine basalts. The southern portion of the site, along Obi Obi and the central drainage line is composed of kraznozems, characterised by uniform of gradational red, friable structured clay soils. The soil contains aluminium oxyhydroxides and iron with the soil having considerable capacity to absorb and retain phosphate. However, clay soils erode easily and tend to reach their infiltration capacity faster than other soils, promoting overland flow. A potential consequence is that both bound and unbound nutrients will enter the watercourses via erosion and runoff (Lake Baroon Catchment Management Strategy & Caloundra City Council 2007).

Preliminary studies by the University of Queensland in the catchment however indicate the exclusion of livestock and revegetation rapidly reduces compaction and improves infiltration.

2.4.3 Land Use

Despite the extensive clearing, 17% of the Lake Baroon catchment is still heavily forested; a significant proportion in the immediate area around the dam. Today, the catchment is susceptible to impacts associated with an increasing diversity of land use. The area closest to the lake is popular with "tree changers" and has seen land use change from intensive grazing to smaller rural residential properties. This has resulted in the fragmentation of larger tracts of agricultural land into smaller parcels with a large increase in the number of on-site wastewater treatment systems in the catchment (Keys 2009).



Presently the catchment is susceptible to a number of land use impacts (Traill, 2007; Dunstan, 2007) including:

- dairying and cattle grazing;
- new developments and increased stormwater runoff;
- runoff from impervious surfaces of existing developed areas;
- irrigation of treated effluent associated with the Maleny sewage treatment plant;
- uncontrolled stock access to the lake and its tributaries;
- lack of riparian vegetation and integrity – a result of extensive vegetation clearing within the catchment since 1853;
- abundance of weeds – shift in land ownership from land managers (e.g. farmers) to inexperienced residents has potentially lead to the spread of weeds; and
- varying pollution sources – e.g. introduction of domestic on-site sewage treatment systems to rural properties.

Land use in the Management Unit (OB6) is roughly split between cattle grazing and urban/rural residential. Other land minor uses include small industry and horticulture.

A large part of Erowal is currently grazed by beef cattle under an agistment arrangement. This is essential to maintain the site and minimise the need for costly and labour intensive management – particularly grass slashing. In the past this property was a dairy farm with grazing on the site occurring continuously for the past 80 years.

2.4.4 Property Management

Bluecare or Erowal do not run livestock but agist the pasture areas of the property to nearby Maleny Dairies, owned and operated by Keith and Sonya Hopper. Dry dairy cows, breeding heifers and calves are rotated through Erowal. Dairy cattle are generally docile and relatively easy to manage however young stock are considered more likely to shed pathogens and therefore it is good practice to keep appropriate distances from water bodies. Keith and Sonya graze the property in line with the practices followed on Maleny Dairies.

Keith and Sonya Hopper completed an LBCCG Property Management Plan in 2009. The PMP identified the strengths and weaknesses of the Maleny Dairies business and provided an adaptable plan for the management of the property into the near future. The Plan identified numerous activities that would provide productivity gains, improved lifestyle outcomes but also water quality benefits. Consequently LBCCG with its partnership with Seqwater were able to offer support to implement win-win works.

A viable dairy, the property is run with the future in mind with strict rotational grazing and exceptional pasture management which ensures as far as practicable all run off is filtered and buffered before entering the watercourses.

2.4.5 Hydrology

2.4.5.1 Drainage Lines, Watercourses & Wetlands

The natural drainage lines of the site flow directly into the Obi Obi Creek, which flows into Baroon Pocket Dam, the region's principal water supply and major recreational and scenic resource. The majority of these drainage lines have minimal vegetation along them.

Obi Obi Creek which runs along the northern perimeter of Erowal has a moderately degraded riparian zone with Eucalypt-based revegetation (approximately 20 years of age) and weed dominated lower reaches (mature camphor laurel). Several drainage lines run through the site flowing directly into the creek, the majority of which have been revegetated. Quality of runoff from the site is affected by moderate slopes, erosion, urban pollution and cattle grazing (Caloundra City Council 2007).

Due to the topography of the large site, stream form is varied and has been impacted by historical land use. Despite some siltation, the Obi Obi Creek provides a diverse range of characteristics and habitats. Many relatively large and deep pools connected by narrow gorges and riffles and runs not only provides habitat but also assists in the preservation of water quality.

2.4.5.2 Flooding

Due to the steepness of the terrain, flooding is generally confined to within the banks of the Obi Obi Creek. There is no recent evidence of major flooding outside the banks. Velocities of floodwaters in the Obi Obi Creek are typically high, creating significant hazard (Obi Obi Creek Flood Study, GHD 2001 & Caloundra City Council 2007). Management of the riparian zone will have negligible impact on flooding, both on Erowal and upstream in urban Maleny.

2.4.5.3 Fauna & Fauna Corridors

Remnant vegetation along the banks of the Obi Obi Creek, and the creek itself, provide key habitat areas and corridors for both arboreal and ground dwelling animals, birds and aquatic species. The continued presence

of species on the site will be dependent upon the maintenance of habitat, weed control and the provision of adequate habitat linkages (Caloundra City Council 2007).
The enhancement and revegetation of the site will provide an almost continuous link (in conjunction with the Green Hills MCP activities) of vegetation in the lower Obi Obi Creek to vegetation upstream of Maleny.

2.4.6 Significant Vegetation & Ecosystems

The site has been predominantly cleared of vegetation to accommodate previous pastoral and agricultural activities. The majority of the remaining vegetation is located adjacent to Obi Obi Creek.
A portion of remnant vegetation along the Obi Obi Creek has been identified as an "endangered" regional ecosystem - RE 12.3.1 - Gallery rainforest notophyll vine forest (Caloundra City Council 2007).

The Maleny Community Precinct Environmental Management Scoping Document completed by Australian Wetlands in 2009 looked closely at the remnant vegetation on the MCP, but relevant to the Erowal site identifying:

RE12.8.3 – Complex notophyll vine forest

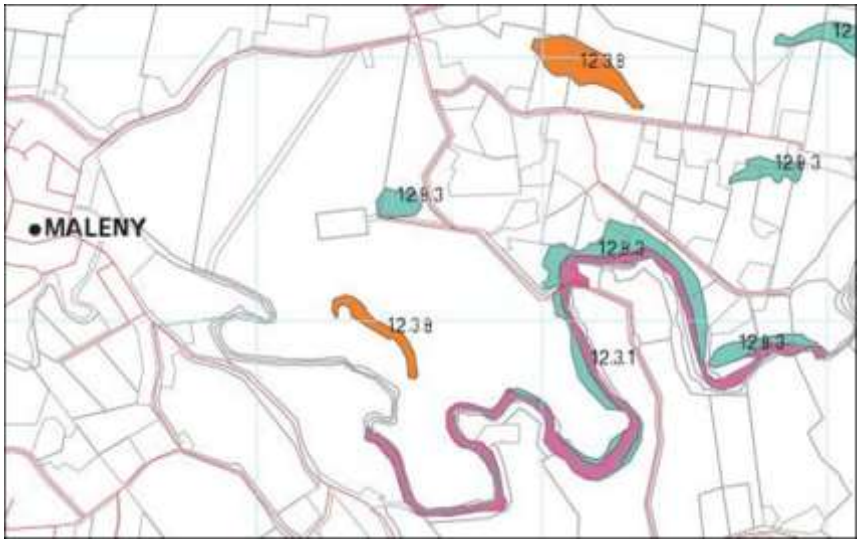
The majority of the Erowal site would historically have been covered by this Ecosystem. An example of this vegetation can be seen immediately adjacent to the MCP (Porter Sisters Wood) although considered to be at least partially re-growth and degraded from cattle access, it provides an indication what would have existed on the site prior to clearing.

Although not considered a high priority in Queensland, there are few areas of this RE within the Lake Baroon catchment assessed as in good condition.

RE12.3.1 – Gallery rainforest on alluvial plains

This RE usually occurs in narrow linear corridors associated with major watercourses on the Maleny plateau. Due to its reliance on alluvial soils and subsequently narrowness this RE is difficult to map, suffers from degradation more readily than many other Ecosystems and usually intergrades with the similar 12.8.3 Complex notophyll vine forest. A strip exists along part of the Obi Obi Creek.

This ecosystem is considered endangered and therefore is considered high priority for protection.



Left: Map showing the remnant vegetation on the MCP and the proximity to urban Maleny.
Note the red coloured endangered remnant 12.3.1.

3.0 PROJECT PURPOSE , OBJECTIVES & OUTCOMES

3.1 BACKGROUND

A healthy aquatic ecosystem is stable and sustainable; maintaining its physical complexity, biodiversity and resilience. It has the ability to provide ecosystem services that in turn contributes to good water quality, wildlife habitat and recreation.

Riparian areas are the transition zones between land and water environments. They are generally more productive in terms of total biomass than the adjoining area (which contributes to their clearing) and are critical for biological diversity. The protection, enhancement and rehabilitation of riparian zones is essential for sustainable catchment management and reducing risks to water quality.

3.2 WATER QUALITY

The environmental health of the Lake Baroon catchment is considered generally poor, and in some respects declining. A State of the Rivers Assessment (Johnson, 1996) indicated that significant sections of the waterways appear to be in moderately poor condition, with moderately to highly disturbed reach environs and considerable lengths of unstable banks and bed-streams. These were characterised by lack of native vegetation displaced by clearing, grass banks or exotic vegetation (Keys 2009).

Pollutants entering Obi Obi Creek occur from three main sources:

- Diffuse run-off from traditional grazing practices provides nutrient inputs (animal manure and fertiliser application) and sediments from paddock erosion;
- Urban run-off carries nutrients derived from fertilisers, car washing, heavy metals and hydrocarbons from road run-off, litter and organic matter; and
- There is also the potential for sewer overflows (from the urban sewer system and individual wastewater treatment systems such as septic tanks) with high nitrogen, phosphorus and pathogens.

The sheer volume of excrement produced by cattle, horses, and to a far lesser extent other domestic animals, when in large herd sizes renders them significant contributors within an open drinking water catchment. Reducing connectivity (paddock to stream), through the management of riparian fencing and revegetation, would reduce the likelihood at almost all of the sites identified as high likelihood (pers. comm. A. Smolders 2012).

Less than 6% of the sub-catchment is vegetated, though 20% of the waterways have riparian cover of varying quality. Naturally the MU is highly disturbed and consequently contributes a large nutrient load to Obi Obi Creek, with more than 95% of samples exceeding guideline levels (Dunstan 2007). Other significant issues include the presence of aquatic passage barriers although some of these are naturally occurring (Gardners Falls).

The Lake Baroon Catchment Implementation Plan (2007) rates OB6 a LOW priority for rehabilitation works. When assessing the Management Unit using a modified version of the Prioritisation Process, which prioritises MU's on pollution input levels and land instability parameters, OB6 rates as a HIGH priority primarily due to urban impacts on the watercourse.

3.2.1 Statistical Analysis of the Raw Water Quality Data Recorded from Gardners Falls (Obi Obi Creek) 1992-2005

Parameter	*pH*	*Turbidity*	*NOx (N)*	*NH3 (N)*	*PO4 (P)*	*Total P*	*Faecal Coliforms*
(units)	*(pH units)*	*(NTU)*	*(mg/L)*	*(mg/L)*	*(mg/L)*	*(mg/L)*	*(number/ 100 mL)*
Guideline Value	*6.5-8.2*	*<25.0*	*<0.040*	*<0.010*	*<0.030*	*<0.030*	*<100*
Max	8.6	33.6	1.047	0.370	0.102	0.305	30,000
Min	6.7	0.6	0.003	0.054	0.000	0.000	4
Mean	7.6	3.7	0.127	0.019	0.018	0.044	755
Median	7.5	2.1	0.084	0.073	0.010	0.030	115
Std Dev	0.3	5.2	0.138	0.008	0.019	0.046	3,163
20^{th} Percentile	7.4	1.3	0.026	0.100	0.006	0.021	40
80^{th} Percentile	7.7	3.6	0.211	0.040	0.027	0.050	406
Count above GV	6	3	80	77	21	58	60
Count	120	119	119	116	119	117	118
% above GV	5.00	2.52	67.23	66.38	17.65	49.57	50.85

Above: Gardners Falls on Obi Obi Creek.

Water quality analysis sampled at Gardners Falls (Obi Lane) between 1992 – 2005 indicates the catchment contributes significant nitrates, ammonia, phosphates, phosphorus and faecal coliforms to Obi Obi Creek

The routine sampling programs (CalAqua, AquaGen, Seqwater and others) are suspected of not accurately capturing major pollution events. Conducted monthly (1992 – 1998) or bi-monthly (1999 – 2005), significant rainfall events in the catchment have likely been missed with the data collected over-estimating the catchment's water quality (Traill, 2007).

The following data assessment has been sourced from Traill, 2007.

From the data pH appears to be stable, although it is higher than other catchment sampling sites, including Maleny urban and Walkers Creek sites both relatively short distances upstream. This suggests a significant

source of alkalinity – potentially from Maleny STP. pH is a measure of alkalinity or acidity of water bodies and is important for two reasons:

- extremely low or high pH can cause direct adverse effects on aquatic organisms;
- pH changes can result in significant increase in toxicity of pollutants such as ammonia and heavy metals.

Turbidity does not appear in the data as a major concern. All sampling sites throughout the catchment have recorded low turbidity despite evidence to the contrary (sediment slugs and visible extremely dirty water during rainfall events). Turbidity is a measure of the degree of scattering light, related to the amount of particulate matter suspended in water. Nutrients such as phosphorus adsorb onto soil particles suspended in the water column. Turbid waters can contain fine clay colloids that are difficult to remove from the water column. These clay colloids reduce light penetration into the water.

Ammonia levels more often than not exceeded guideline levels during the period although the records suggest there has been significant improvement over time. This can be attributed to a reduction in waste being delivered to the watercourse and/or ammonia is being oxygenated and converted in nitrate. Ammonia is the initial product of the decay of nitrogenous organic wastes - high concentrations of ammonia can be toxic to aquatic life.

Total Phosphorus has remained constantly high over the sampling period although significant rainfall events have probably been missed which would be expected to provide even higher levels. Phosphorus is an essential plant and animal nutrient, however, increased levels of phosphorus can contribute to excessive algal growth and aquatic weeds.

Nitrate levels are consistently high with inputs likely to be largely as a result of upstream contamination. Nitrogen is essential for plant growth; however, increased levels of nitrogen can contribute to excessive algal growth and aquatic weeds.

Similar to the nitrate levels, the majority of faecal coliforms appear to be originating from further up the catchment. Faecal coliforms are microorganisms found in animal and human excreta. Their measurement is used to indicate the potential presence of pathogens within water. Faecal coliform numbers are an important factor when determining the suitability of a water body for primary and secondary human contact.

Left: Excessive erosion and nutrients delivered from the catchment contribute to cyanobacteria (algae) blooms in Lake Baroon.

3.3 WATER SUPPLY CATCHMENT

The whole of the property is within the Lake Baroon Pocket Dam Catchment. The Obi Obi Creek (42.55 km^2) which runs along the southern border of the site, comprises one of Lake Baroon's three major sub-catchments. Consequently it is a major supplier of total water to the dam.

Baroon Pocket Dam (BPD) is a key source of water supply for Seqwater. Minimum flow volumes from BPD through the Northern Pipeline Interconnector (NPI) northwards are 7 ML/day (subject to availability if BPD falls below 60% capacity) to Noosa NTP; and 30 ML/day (20 ML/day if BPD falls below 70% capacity) southwards to Caboolture, Morayfield and Narangba. This indicates both surety of supply, location and cost effectiveness of Landers Shute Treatment Plant (AOP 2013).

BPD, along with Image Flat (South Maroochy System) is the predominant source of water supply for northern South east Queensland with Ewan Maddock Dam (EMD), Lake McDonald and Mary Valley Water Supply Scheme are considered additional intermittent sources (AOP 2013).

EMD operates on an as needed basis, typically during high demand periods or when raw water quality in BPD is compromised by algal blooms (and possibly turbidity). EMD, relative to Landers Shute (LSTP) is more expensive to produce potable water (despite its recent construction), hence the reliance on BPD and LSTP (AOP 2013).

It's important to note that the NPI (and all pipelines for that matter) require minimum transfer flows at all times to maintain operation and water quality. Typically this is a minimum of 5 ML/day (AOP 2013).

BPD is a reliable source of raw water (volume) but is plagued by quality issues. These issues were somewhat expected when BPD was constructed and hence the design of LSTP, however demand for supply was never intended beyond the southern half of the Sunshine Coast region.

The value of the raw water that originates in the catchment as a whole greatly exceeds the value of primary production.

Lake Baroon catchment	= 74 km^2 or 7,400 hectares
Gross yearly value of water sold by Seqwater (Saxton et al, 2013)	= $60,000,000
Value of water per hectare	= $8,108 per hectare
Gross value of water originating from Erowal	**= $210,808 annually**

Tourism has become the dominant economic driver in the catchment but relies on both the agricultural landscape (rolling green hills) and the natural values equally. This is demonstrated by the popularity of Maleny Dairies milk processing plant and farm tours (in excess of 12,000 visitors per year) and the popularity of Mary Cairncross Park (500,000 visitors per year?).

Seqwater who receive the benefits of raw water flowing from the catchment into BPD, have an obligation to invest back into the catchment if improvements are desired; into activities that reduce risks to water quality and its maintenance and protection, and general environmental health.

The likely scenario under climate change modelling suggests more variable and possibly severe weather events; longer and more severe droughts (below average rainfall per month) and more intense rainfall events. This will undoubtedly impact on both raw water quality entering BPD and on the storage itself. Since 2009-10 unseasonal dry periods followed by intense high rainfall events have seen an increase in erosion (land slips), turbidity and flood damage.

The community expects good water quality at their tap – free from discolouration, odours and the guarantee it will not impact their health, and increasingly demands the environment is protected as part of supply.

3.4 OBJECTIVES

Erowal Riparian Fencing and Off Stream Watering is a project designed to address livestock access to Obi Obi Creek, degraded riparian buffers and the proliferation of environmental weeds that provide little protection to creek banks and the resultant decline in water quality.

The project aims to:

- implement an on-ground project that delivers water quality benefits
- promote integrated catchment management in the Lake Baroon catchment
- reduce nutrient delivery to waterways
- reduce sediment delivery to waterways
- improve aquatic habitats
- raise community awareness (including water quality issues)
- support and work cooperatively with like-minded community organisations
- reduce the impact of weeds
- restore links between vegetation and re-establish corridors
- contribute to the conservation of threatened species
- contribute to climate change adaptation
- demonstrate best management practice of riparian zones

Effective riparian areas can improve water quality by trapping sediment, reducing erosion, storing nutrients and filtering contaminants before they reach water storages (Lake Baroon). Riparian zone health is a key factor in a riparian area's ability to improve water quality.

3.5 TARGETS

- remove livestock access to 850 metres of Obi Obi Creek;
- improve the condition of 3.25 hectares of riparian buffer to enhance filtering capacity;
- reduce erosion , nutrient and pathogen delivery to Obi obi Creek;
- raise community awareness by implementing project in a high visibility area.

3.6 OUTCOMES

Healthy catchments lead to healthy waterways. By improving the health of riparian zones we ultimately aim to mitigate the impacts that can affect water quality. Seqwater provides generous funding and LBCCG offers appropriate incentives to landowners to implement activities that are designed to reduce risks to water quality. Through the prioritisation and implementation of riparian protection and rehabilitation throughout rural catchments – particularly headwaters, we provide multiple beneficial outcomes.

Outcomes are the ‘end product’ of our activities – what we actually achieve. It can be very difficult to measure outcomes as they may take many years to be fully realised and can be enormously expensive to quantify – potentially far more than the actual implementation of the project. We must rely on best management practice, anecdotal evidence and preferably partnerships with universities and/or Seqwater to produce ‘hard’ data to prove the effectiveness of projects.

Our project will:

1. **Reduce nutrient delivery to waterways.**
   Nutrient delivery to waterways is continuous and increases during episodic rain events.

Vegetative buffers intercept run-off contaminated with excessive nutrients from diffuse rural and urban sources (stormwater). The project will protect and enhance the existing riparian zone, improving its buffering ability.

2. **Reduce sediment delivery to waterways.**
   Soil from erosion leads to high turbidity and is transported to Lake Baroon and beyond.

Vegetative buffers stabilise eroding riparian zones and intercept run-off contaminated by sediments. The project will enhance and modify (weed management and replacement) riparian vegetation that will slow flows reducing erosive potential while filtering sediments.

3. **Improve aquatic habitat.**
   Riparian vegetation plays a critical role in the creation and maintenance of aquatic habitats in freshwater ecosystems.

Riparian vegetation provides shade, limits nuisance aquatic plant growth, provides vegetative inputs that serve as habitat and food, and provides bank and bed stability. The project will protect and enhance existing riparian vegetation (including useful weed species).

4. **Raise community awareness.**
   The majority of land in the Lake Baroon catchment is privately owned and without landholder and community support activities improving catchment health and water quality is impossible.

The project will demonstrate the importance of excluding livestock from riparian zones and the enhancement and reestablishment of vegetation to reduce risks to water quality – both throughout the catchment and Lake Baroon. On-ground works provide the opportunity for land managers to apply their knowledge and experience at the local level whilst contributing to landscape scale outcomes, increasing the skills in the community. Green Hills on the neighbouring MCP are conducting numerous community events (Field Days, Field Walks and community tree planting events) engaging, raising awareness and skilling the community.

5. **Reduce impacts of weeds.**
   Weed sources in the upper catchment contribute to the proliferation of weeds through seed and vegetative material.

The project sits in the mid-Reaches of Obi Obi Creek and through staged and appropriate weed management will remove weed sources – particularly WONS lantana and blackberry, and to a lesser extent local priority camphor laurel, privet and chinese elm.

6. **Restore links between vegetation and create corridors.**
   Riparian zones provide wildlife corridors so that fauna can safely move from one area to another.

The project will enhance a link between the remnant vegetation on lower Obi Obi Creek and vegetation adjacent to and within urban Maleny. In linking areas of otherwise isolated habitat, wildlife corridors facilitate gene flow and colonization of suitable sites, and are critical in the modern disturbed landscape, helping to maximise the biodiversity of a given area can support. Research has shown that small habitats which are physically interconnected to larger source pools of organisms will support and maintain greater species richness than comparable habitats that are not physically connected (Barwick et al, 2009).

7. Provide terrestrial habitat.
Riparian vegetation provides important habitat for the adult stages of aquatic insects and amphibious organisms such as frogs and turtles.

The project will enhance riparian and associated vegetation improving the habitat for a variety of native fauna.

8. Reduce chemical delivery to waterways.
Improved water quality monitoring and analysis by Seqwater has identified pesticide and herbicide contamination at Gardners Falls.

The project will reinstate riparian vegetation on a 3rd Order stream adjacent to agricultural land (and urban Maleny) providing a buffer to pesticides and herbicides.

9. Establish a healthy, diverse and resilient environment that will address climate change variability.
Future climate change impacts may impact on the survival of threatened and vulnerable wildlife, increase the occurrence of significant storm events leading to pressure on the environment and subsequently affect catchment water quality.

The project addresses key threats predicted by climate change by increasing the resilience of the catchment to predicted climate change impacts.

3.7 ALIGNMENT WITH KEY PLANS & STRATEGIES

Reducing the risk to water quality is particularly critical for the supply of bulk drinking water to the population of south-east Queensland. All of the storages managed by Seqwater involve catchments which are developed (to varying extents) and support active and growing communities, along with important industrial and rural economic activity. If these catchments are not managed properly, the risk of exposure to water quality hazards is heightened as development continues and the population increases. As a pre-emptive measure, Seqwater is undertaking initiatives to minimise and manage the risks to water quality in its storages. Identifying and engaging stakeholders on water quality issues is critical to developing robust risk mitigation strategies and achieving good water quality outcomes in the broader catchments (Keys 2009).

The primary area LBCCG and other community groups can manage risk is in the area of land use – essentially livestock grazing and the associated issues, particularly pathogens. A number of factors can contribute to pathogen contribution by livestock. A high likelihood ranking has been attributed by Keys 2009 to any site where the following conditions exist:

- direct animal access to waterways;
- intensive feed lots and dairies;
- heavy broad scale grazing; *and*
- animal deposition (including bio-solids piles) possible within 50 metres of intermittent or permanent waterways.

The sheer volume of excrement produced by cattle, horses, and to a far lesser extent other domestic animals, when in large herd sizes renders them significant contributors within an open drinking water catchment (Baker 2011).

With current control measures in place, water quality is still at high risk from sources dominated by land use activities and human access. Keys issues include hazards associated with the population growth in the area and the increasing rural lifestyle, urban and peri-urban land uses. Possible future mitigation measures are dominated by improved land management practices, land acquisition (especially close to the dam's edge), reduced access to the dam wall, increased public education and enforcement, as well as monitoring and research (Keys 2009).

The project's outcomes are consistent with:

- Lake Baroon Catchment Implementation Plan (2007);
- Lake Baroon Catchment Management Strategy (2004);
- Seqwater Natural Assets Management Plan – Lake Baroon Catchment (2012);
- Catchment and In-Storage Risk Assessment for Water Quality – Baroon Pocket Dam (2009);
- Sunshine Coast Council Waterways and Coastal Management Strategy 2011-2012 (2011);
- Mary River and Tributaries Rehabilitation Plan (2001)

3.7.1 Lake Baroon Catchment Implementation Plan (2007)

The LBCIP was developed in 2007 – a joint initiative of AquaGen (pre-Seqwater) and BMRG, and was delivered via LBCCG. The document aligns the summarised actions from the Lake Baroon Catchment Management Strategy (2004) with actions from the NRM plan Country to Coast - a healthy sustainable future. Relevant actions include the development of on-ground works that address water quality, aquatic biodiversity, habitat recovery and particularly community involvement and engagement.

The project's outcomes are consistent with the Lake Baroon Catchment Implementation Plan (2007).

3.7.2 Lake Baroon Catchment Management Strategy (2004)

An LBCMS was initially developed in 1997 by AquaGen and LBCCG in an attempt to identify the causes of poor water quality in Lake Baroon and consequently guide catchment investment. Updates have occurred in 2004 and 2007 although the most recent version remains in draft form. The 2004 LBCMS identifies priority management actions similar to the LBCIP – the active management of riparian lands throughout the catchment, reducing nutrient delivery to Lake Baroon, negating the impacts of development, addressing the loss of remnant vegetation, weed management and the engagement of the community – particularly large landholders.

3.7.3 Natural Assets Management Plan – Lake Baroon Catchment (Seqwater 2012)

The recent Seqwater NAMP (2012) reviewed the current and historical management plans for the Lake Baroon catchment and documented clear actions to improve the water quality in Lake Baroon, particularly through the development and strengthening of partnerships. Relevant actions relating to the project include weeds, erosion, catchment management, livestock management, stakeholder partnerships, erosion and biodiversity.

3.7.4 Catchment and In-Storage Risk Assessment for Water Quality – Baroon Pocket Dam (2009)

Seqwater conducted an extensive review of the risks to water quality in Lake Baroon and associated catchment in 2009. The project addresses the following identified risks:

Risk No. 3.6.2. High Inflow Events

High rainfall events in the catchment upstream of the dam can have a significant impact on the water quality of the lake. During and subsequent to a high rainfall event, the water quality of the lake is likely to be impacted due to an increase in nutrients, turbidity, colour, TOC, BOD, gross pollutants, pathogens, petroleum hydrocarbons and changes in temperature.

Management controls in place to manage the event of high rainfall include land, pasture and pest management, sediment and erosion controls, Seqwater's involvement in development within the catchment, rehabilitation and community involvement.

Risk No. 3.6.5. Intensive Animal Husbandry

Intensive animal husbandry can impact on the water quality of the storage. Potential problems include waste streams, pesticide use, chemical residues, erosion, fertilisers and animal carcasses.

Current management practices in place include monitoring, community involvement, local planning, industry BMP and farm management plans, education, and rehabilitation and farm improvement within specific areas of the catchment.

Risk No. 3.6.7. Livestock Management

Grazing management issues that may impact water quality include the use of pesticides and fertilisers, overgrazing of paddocks leading to accelerated erosion, livestock having direct access to streams, trampling of riparian vegetation, animal faecal contamination and animal carcasses.

Current management practices in place include BMP, covenants, rehabilitation, education and awareness and landholder engagement.

Risk No. 3.6.14. Cyanobacterial Blooms

Cyanobacterial blooms (blue-green algae) can produce extremely potent toxins that present a risk to potable water supply and direct contact recreation. Potential causes of cyanobacterial blooms include increased nutrient loads, temperature, drought, dam water turnover events and light.

Current management controls include dam monitoring and research and effective catchment management to prevent inflows to the dam carrying contaminants from occurring.

Risk No. 3.6.15. Land Use Changes (intensification)

The Sunshine Coast and Maleny in particular is popular with tourists and new residents. The Sunshine Coast area is experiencing unprecedented levels of population growth and intensification of housing developments. This is resulting in subdivision and development of rural residential blocks from farming lands. Intensification of land use can have detrimental effects on water quality through increased erosion, increased stormwater runoff and increased pollutant loads.

Current key management controls in place include education, community involvement, covenants for conservation and riparian and land initiatives from the LBCCG.

Risk No. 3.6.22. Pest Flora and Fauna

Pest flora and fauna can impact upon Lake Baroon and its catchment through a range of environmental factors. A change in trophic conditions may present one species with greater availability of suitable habitat over another species. Interaction and competition between species may also result in the introduction of pests and breakdown in ecosystem function reducing their ability to improve and protect water quality. Pest flora and

fauna can be detrimental to water quality by lowering dissolved oxygen, increasing total suspended solids, nutrients, turbidity and algal toxins.

Current management controls include community education and involvement to assist with the management of impacts in the Lake Baroon catchment.

3.7.5 Sunshine Coast Council Waterways and Coastal Management Strategy 2011-2021 (2011)

Sunshine Coast Council, particularly through the Rivers Initiative program, and various funding programs is committed to supporting community groups to improve the region's environment. The project addresses the following Strategy goals:

Natural waterways	***Goal: To provide a coordinated, integrated and informed approach to the protection, rehabilitation, sustainable use and enjoyment of natural waterways.***
NW3	Develop and sustain partnerships with government, industry, universities, regional natural resource management bodies and community groups.
NW8	Develop land management initiatives in partnership with the rural industry and state government to improve waterway health.
NW13	Undertake and support activities to improve the condition of riparian and in stream habitats.
NW16	Promote and inform the community about natural waterway values and management initiatives.

3.7.6 Mary River and Tributaries Rehabilitation Plan (2001)

The MRTRP is a Mary River wide rehabilitation plan. The Obi Obi Creek is a major tributary of the Mary River and therefore an integral part of Mary River planning and rehabilitation. The project addresses riparian vegetation management, the conservation of remnants, revegetation, weed management, enhancing habitat for vulnerable and threatened species and building the capacity of both landholders and community groups.

3.8 PRIORITY LANDHOLDERS/LAND IN THE LAKE BAROON CATCHMENT

Priority landholders were identified in 2007 based on land-use, property size, and proximity to Seqwater infrastructure (Baroon Pocket Dam, Maleny Weir, and King's Lane Weir) - primarily their potential to impact on catchment water quality. The Erowal site was not identified as a priority landholding at this time as due to the size of the property (under 30 hectares). However its location in relation to the MCP which is currently undergoing extensive redevelopment, gives Erowal a renewed importance and priority in the catchment.

It is important LBCCG (and Seqwater by extension) become a partner and stakeholder on both Erowal and the MCP to ensure water quality considerations are at the forefront of planning and development.

4.0 IMPLEMENTATION

4.1 METHODOLOGY – RIPARIAN BUFFER WIDTH

It is difficult to derive a general 'rule of thumb' regarding buffer width, as this will vary depending on the desired functions of the buffer, volume of water and sediment being transported, and vegetation composition. Whilst a 5-10 metre vegetated filter strip buffer may be adequate for removing the majority of sediment and adsorbed nutrients, it has been shown to be insufficient for removing soluble nutrients (Barwick et al 2009), and would likely serve limited ecological value. A combination of 10 metres of grass buffer and 10 metres of natural vegetation adjacent to the stream has been recommended as effective in many situations from a water quality perspective. However, a 10 metre wide buffer of woody vegetation has been shown to be insufficient to protect Australian streams from changes in algal, macroinvertebrate and fish biomass and diversity (Barwick et al, 2009).

The Department of Primary Industries recommends buffers of 50 – 100 metres to freshwater systems to maintain ecological processes (Barwick et al, 2009). The DNR&M Regional Vegetation Management Code: South East Qld specifies that clearing does not occur within 25 metres of each high bank of each stream order 3 and 4.

This project will provide between 25 and 40 metres of riparian buffer, with the maintenance of grass strips as much as possible.

4.2 ACTIVITIES

4.2.1 Fencing

Fencing will be erected between 15 and 40 metres from the Obi Obi Creek (closely following the alignment of the existing ineffectual fence) to provide a substantial area of buffer zone. Approximately 850 metres of standard cattle fencing (timber splits at 5 metre spacings, 4 strand wire; 3 barb and top plain) with steel gates where required (approximately 5). On the upstream Reach of creek the new fence will closely align to the existing ineffectual/damaged fence. The downstream Reach of the fence will have to be aligned marginally further up the bank as large camphor laurel trees compromise the original alignment. It is expected no grazing will be lost as a consequence as the mature camphors discourage pasture growth anyway.

The existing ineffectual/damaged fencing will require removal.

4.2.2 Weed Management

Major environmental weeds pose a serious and immediate threat to native vegetation and water quality due to their ability to alter the structure and composition of plant communities. Small leaf privet can thrive in low-light conditions and over time will dominate riparian zones, out-competing native species and effectively developing mono-culture systems. Similarly lantana and blackberry form dense thickets but provide limited soil stability or ground protection benefits. Natural regeneration is reduced below sustainable levels and only mature individual native flora species persist.

LBCCG has a policy of only managing weeds as part of a larger project such as revegetation or if the weeds are threatening a high value asset (in this case revegetation sites and remnant vegetation).

Currently livestock are assisting to manage weeds in the riparian zone. Total removal of livestock may result in a proliferation of weeds (primarily lantana and privet, but also probably camphor laurel and other environmental weeds).

Weeds will require a medium term management program. Initially the smaller patches of woody weeds will be mulched (upper section only), with follow up to stem inject larger woody weeds, cut and paint smaller isolated trees/shrubs and discretionary spot spraying of groundcover weeds.

In the downstream Reach, the existing large camphor laurels will be trimmed to enable the erection of the new fencing however they will be retained in the medium term as they provide waterway stability (from erosion) and shade the water and banks discouraging further weed invasion. Minor discretionary management of lantana and privet however would be beneficial in this Reach and will be approached on an as needed basis.

Weed management funding will be provided for 3 years (2012-13; 2013-14; 2014-15). It is envisaged that this will be sufficient to manage weeds with any surplus budget utilised to enhance the riparian zone with enhancement plantings (which in the long term will assist in the management of the site).

4.2.3 Off Stream Watering Infrastructure

This component of the project will be implemented in 2013-14 and consequently is the subject of this Project Plan (Stage 2). It is anticipated the off stream watering will closely follow the erection of the fencing.

With livestock access to the Obi Obi Creek removed, a reliable alternative supply of water is required for the livestock. It is proposed to utilise the existing pump on the creek bank to supply a minimum 5,000 gallon tank (22,500 litres) that ideally would be installed adjacent to the small machinery shed 25 metres from the pump. Rainwater from the shed could be (but not essential) directed into the tank to further supplement available water. A single concrete trough (approximately 600 litre capacity) would be installed between the pump and tank – within the small set of cattle yards

4.2.4 Other Activities

As part of the Commonwealth Government's Clean Energy Future Biodiversity Fund, Green Hills are revegetating the whole riparian zone of the Obi Obi Creek on the MCP. The local community is involved in all aspects of the project from the planting of tubestock, maintenance, monitoring and community awareness. This builds community capacity and skills, while raising awareness of multiple environmental issues including the importance of water quality.

Unitywater is currently modifying the Northern wetland to accommodate the disposal and treatment of treated effluent of the soon to be upgraded sewage treatment plant. As part of their project the watercourse leading from the Northern wetland to Obi Obi Creek has been fenced and partially revegetated in 2013 by Unitywater and community volunteers.

5.0 ACTION PLAN

Activity Start and Completion dates are indicative only and will be dependent on weather conditions.

Action		*Responsibility*	*Start Date*	*Completion Date*	*Measurable Output*
Project Plan Stage 2		LBCCG Project Manager	Nov 13	Nov 13	Project Plan
Project presented to LBCCG Committee for approval		LBCCG Project Manager & Committee	Nov 13	Dec 13	Approved Plan (LBCCG)
Project forwarded to Seqwater for approval		LBCCG Project Manager	Nov 13	Dec 13	Approved Plan (Seqwater)
Pre-works monitoring (including photo points)		LBCCG Project Manager	Feb 13	Nov 13	Photo & data set
PROJECT IMPLEMENTATION	Riparian fencing	Contractor	Nov 13	Dec 13	850 metres
	Weed Management	Contractors	Nov 13	Jun 15	2 hectares
	Off Stream Watering (Year 2)	Contractor	Nov 13	Dec 13	1 system
Progress reports.		LBCCG Project Manager	Dec 13	Jun 15	12 Progress Reports
Post-works monitoring.		LBCCG Project Manager	Dec 13	Dec 14 (ongoing)	Photo & data sets
Project completed/signed off. Final Report.		LBCCG Project Manager & Committee	Jun 15	Dec 15	Final Report

Note – the Project Action Plan will be used as the basis for Quarterly Reporting

6.0 PROCUREMENT

6.1 SERVICES & PRODUCTS

The Project Manager will have the authority to engage and arrange payment for services and products for all activities once the Project Plan is approved. Any deviation over $300 from the approved Project Budget requires approval from the Project Committee. Services and products will be sourced locally wherever possible and from not-for–profit community organisations if applicable.

Service/Product	*Supplier*	*Contact (if applicable)*
Fencing installation	Mark Franks Fencing & Slashing	Rob Ludwig
	Langdale Rural Fencing	Tim Simpson
Fencing removal	P & K Nash	Phil Nash
Weed management	D & K Slashing	
	Barung Landcare	Matt Bateman
Off stream watering	P & K Nash	Phil Nash
	The Pump House (Beerwah)	

Multiple service and product providers are listed to ensure timelines are met. In the event of a provider being unable to supply the requested service or product an alternative source will be selected from the Procurement list of preferred suppliers. All suppliers (where appropriate) must demonstrate insurance and liability requirements and that all staff or personnel on site are appropriately accredited and/or experienced.

6.2 COST ESTIMATION METHODOLOGY

6.2.1 Off Stream Watering Infrastructure Costs

Figures are indicative only and dependent on site conditions.

Item	*Unit*	*Cost (GST exclusive)*
10,000 gallon tank	each	$5,000.00
600 litre trough	each (including freight)	$1,000.00
50 mm poly pipe	100 metre roll	$250.00
Fittings	each	$25.00
Machine hire	per hour	$120.00
Road base & sand	per m^3	$35.00
Labour	per hour	$50.00

6.2.2 Weed Management

The initial weed management Stage of the project has been approved and funding allocated (2012-13).

Weed management costs have been estimated from rates provided by Barung Landcare and Totem Fauna & Flora, previous revegetation project expenditure and confirmed by the first year of the project expenditure.

All figures exclusive of GST.

Activity	Description	Cost
Weed management	Various methods employed – hand pulling, cut & paint, spot spray.	Standard rate is approximately $300 to $350 per day per man dependent on methods, project site and contactor engaged.
Mulching machine hire	Posi-track with mulching head	$175 per hour/2 hectares per day (plus $175.00 float hire) - Minimum of 1 day hire

6.2.3 Fencing

This Stage of the project has been approved and funding allocated (2012-13).

The standard cost for fencing material supply and erection is approximately $13.00 per metre plus $380.00 per gate with approximately half the cost attributed to labour. This is variable depending on site conditions, fencing alignment and materials used.

Figures are based on materials quoted and purchased in June 2013 from Maleny Town and Country.

Item	*Unit*	*Cost (GST exclusive)*
12’ steel gate - mesh	each	93.60
Gate fittings kit	each	24.55
Timber strainer post	each	40.00
Timber strainer post stay	each	28.55
Timber split posts	each	15.45
165cm galvanised steel posts (heavy Australian made)	each	9.95
2.5mm high tensile wire (high visibility electric red)	1,000 m	195.45
Barb wire	500 m	100.00
Machine hire for fencing removal (includes truck hire)	hour	100.00

7.0 N/A

8.0 MONITORING AND EVALUATION

8.1 INTRODUCTION

Monitoring and evaluation strategies are essential components of any environmental rehabilitation project. Evaluation is the best way to improve our knowledge about what works, what doesn't and how we can best direct our rehabilitation efforts. Monitoring strategies are key components of the overall evaluation process that allows you and others to learn from the project and assess whether rehabilitation aims have been met.

Furthermore, monitoring results and information will be used to:

1. Raise awareness and encourage further remediation works with priority landholders (primary producers and large landholders in the Lake Baroon catchment).
2. Promote cooperative projects between Lake Baroon Catchment Care Group, Seqwater, Sunshine Coast Council and other Natural Resource Management organisations.
3. Critically examine techniques and methods used throughout the project to continually improve the service to landholders conducting on-ground works in the catchment and improve best practice management.
4. Develop cost-effective strategies and techniques to perform on-ground activities.
5. Continue to develop monitoring and evaluation program that meets the requirements of funding bodies, but also provides the relevant information and feedback to the LBCCG and Seqwater to improve project delivery.

It can be very difficult to measure outcomes as they may take many years to be fully realised and can be enormously expensive to quantify – potentially far more than the actual implementation of the project. We must rely on best management practice, anecdotal evidence and sometimes partnerships with universities and/or Seqwater to produce 'hard' data to the actual effectiveness of the project.

8.2 MONITORING PROGRAM

Monitoring of rehabilitation activities, particularly the LBCCG funded component – fencing, will be split into periodic and episodic monitoring.

Periodic monitoring is important to measure the effectiveness of the fencing over time and will occur on a biannual basis by LBCCG.

Episodic monitoring will occur following significant storm/rainfall events (or extended dry periods or frosts) and will check all the fencing integrity. This may, depending on the severity of the event, be achieved by a phone call to the landholders.

Photo point monitoring will provide valuable evidence of works completion, a record of changes over time, and provide an important assessment tool to evaluate the project.

9.0 REPORTING

Project updates will be provided at monthly LBCCG meetings. A Progress Report will be produced once all Seqwater funded activities have been completed with a Final Report produced once all on-ground activities and monitoring and evaluation is completed.

A modified version of the Project Plan (specific financial details and landholder contact details deleted) will be placed on the LBCCG website www.lbccg.org.au.

The project will also be included in the LBCCG newsletter.

10.0 REPONSIBILITIES & ROLES

The Project Manager will be responsible for project implementation, management, reporting, evaluation and general management of the project. Other contributions will be on an as-needed basis and the following register of roles will ensure the project is implemented efficiently, effectively and follow best practice.

Role	***Individual***	***Organisation***
Project Manager	Mark Amos	LBCCG
Project Owner	Peter Stevens	LBCCG (President)
Project Sponsor		Seqwater
Project Committee	TBC	LBCCG (Management Committee)
	TBC	
	TBC	
Technical advice	Matt Bateman	Barung Landcare
	Susie Duncan	Hinterland Bush Links
	Rob Ludwig	Fencing contractor
	Bob Philpott	
	Steven Lang	Green Hills/MCP project

11.0 REFERENCES

Abal, E.G., Bunn, S.E & Denison, W.C. (Eds.) 2005, *Healthy Waterways Healthy Catchments: Making the connection in South-east Queensland, Australia*, Moreton Bay Waterways and Catchments Partnership, Brisbane.

Alt, S., Jenkins, A. & Lines-Kelly, R 2009, *Saving Soil – A landholder's guide to preventing and repairing soil erosion*, Northern Rivers Catchment Management Authority, NSW.

Baker, D. 2011, *Sanitary Survey of Somerset and Obi Obi Catchments*, ALS Water Resources Group, Penrith, NSW.

Barwick, M, Wassman, D & Pitman, K. 2009. *Maleny Community Precinct Environmental Management Scoping Document*, Australian Wetlands Pty Ltd, Caloundra, Qld.

Caloundra City Council, 2007, *Maleny Community Precinct Background Report – Starting With a Clean Slate Draft,* Caloundra City Council, Caloundra, Qld.

Department of Environment and Resource Management, *Development of a water quality metric for south east Queensland*, 2010

Dudgeon, S & Dunstan, M. 2007 *Large Scale Waterway Rehabilitation Business Case: Final Report*, Natural Solutions Environmental Consultants, Noosa Heads, Qld.

Dunstan, M 2007, *Lake Baroon Catchment Implementation Plan*, AquaGen Water & Renewable Energy, Palmwoods.

Keys, S., Murton, S., Costanzo, S. & Thompson, A. 2009, *Catchment and In-Storage Risk Assessment for Water Quality – Baroon Pocket Dam*, Sinclair Knight Merz, South Brisbane.

Murton, S. & Keys, S. 2012, *Seqwater Natural Asset Management Plan – Lake Baroon*, Sinclair Knight Merz, Brisbane

Saxton, N., Olley, J., Burford, M., Ellison, T., Polson, Wallace, L. & Stewart, M., 2013, *Efficiency of Riparian Zones in Trapping Sediment and Nutrients*, Australian Rivers Institute Griffith University, Nathan.

Seqwater, 2013, *Annual Operations Plan May 2013*, Seqwater, Brisbane.

Stockwell, B., 2001, *Mary River and Tributaries Rehabilitation Plan – Implementation Edition*, Mary River Catchment Coordinating Committee, Gympie, Australia.

South East Queensland Healthy Waterways Partnership 2007, *South East Queensland Healthy Waterways Strategy 2007-2012*, South East Queensland Healthy Waterways, Brisbane.

South-east Queensland Regional Water Quality Management Strategy Team, 2001. *Discover the waterways of South-east Queensland: Waterways health and catchment management in South-east Queensland, Australia*, South East Queensland Healthy Waterways, Brisbane.

Stringybark Consulting 2011, *Maleny Community Precinct Terrestrial Rehabilitation Plan*, Stringybark Consulting, Mooloolah Valley, Qld

Sunshine Coast Council 2011, *Sunshine Coast Waterways and Coastal Management Strategy 2011-2021*, Sunshine Coast Council, Nambour, Qld.

Traill, C.B. 2007, *State of the Lake Baroon Catchment, Volume 2: Appendices*, AquaGen Water and Renewable Energy, Palmwoods.

Willmott, W., 2007, *Rocks and Landscapes of the Sunshine Coast Second Edition*, Geological Society of Australia, Brisbane.

Ziebell, D & Richards, PL 199, *Gully Erosion in South Gippsland*, Landcare Note SC0039, State of Victoria, Department of Natural Resources and Environment.