Lake Baroon Catchment Care Group

*Working with our community...for our waterways*

# Projects 2014-15

## Obi Obi Creek Fencing & Revegetation (Macleod)

seqwater WATER FOR LIFE

Sunshine Coast COUNCIL

## PROJECT PLAN

**Project No. 1415-006**

This Project Plan has been prepared by:

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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 particular purpose 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 use this Plan**

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. 7-13) outlines the main details involved in implementing the project and in most cases should explain the project sufficiently.

The **Attachments** (pp. 14-42) 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 and provides further information.

**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*** |
|---|---|---|
| April 2014 | Sunshine Coast Council Landholder Environment Grant | Approved June 2014 |
| November 2014 | Draft LBCCG Project Proposal | n/a |
| 11/12/2014 | Project presented to LBCCG Committee | TBA (Minutes) |
| | Project Proposal forwarded to Seqwater for approval (email) | TBA (A. Purdy) |

***Cover photo:*** *Obi Obi Creek on the Macleod property.*

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# PART A EXECUTIVE SUMMARY

**PROJECT NUMBER & TITLE:** **1415-006 Obi Obi Creek Riparian Revegetation (Macleod)**

Obi Obi Creek Riparian Revegetation will be implemented in the upper reaches of Obi Obi Creek – an area of intensive agriculture with significant risks to water quality. We will complete the fencing and revegetation of the Obi Obi Creek on the Macleod property and establish a controlled watering point for livestock watering. The project will exclude livestock from 315 metres of Obi Obi Creek through the installation of 100 metres of permanent fencing, revegetate the riparian zone and improve property management by strictly controlling water access. The wildlife corridor will be extended linking areas of remnant vegetation, regrowth vegetation and revegetation projects. The riparian vegetation will stabilise creek bank, shade the watercourse reducing temperature and enhancing dissolved oxygen levels, and enhance the watercourse's ability to mitigate the effects of pollutants originating further upstream. Other benefits include provision and enhancement of habitat, improving aesthetic appeal (raising awareness of the value of riparian restoration) and reduce weed sources. This will reduce risks to water quality in the catchment (and ultimately Lake Baroon) by reducing key contaminants including nutrients, pathogens, pesticides and gross pollutants.

**APPLICANT/LANDMANAGER DETAILS**

| | | | |
|---|---|---|---|
| ***Names*** | [redacted] | ***Postal Address*** | [redacted] |
| ***Phone Number*** | | ***E-mail*** | |

**PROJECT / SITE LOCATION**

| | | | |
|---|---|---|---|
| ***Property Address/Name*** | [redacted] | | |
| ***Latitude/longitude*** | -26.771501 152.810566 | | |
| ***RP Numbers (Lot)*** | SP156790 (6); SP156790 (7) | ***Property Size (ha)*** | 54 |
| ***Existing Land-use*** | Beef & alpaca grazing | ***Stock Carried*** | 60 |
| ***Sub-Catchment*** | Obi Obi Creek | ***Management Unit*** | OB3 |
| ***M.U. Priority*** *(LBCCG IP)* | **Moderate** | ***M.U. Priority*** *(Pollution)* | **Moderate** |
| ***Water Quality*** | 88% of samples between 1999-2005 exceeded ANZECC guideline levels | | |

**PROJECT PARTNERS/STAKEHOLDERS & ROLES**

| | |
|---|---|
| ***Lake Baroon Catchment Care Group (Seqwater 2014-15 Project Funding)*** | On ground project implementation **Cash $10,980** |
| ***Lake Baroon Catchment Care Group (Seqwater 2014-15 Administration Funding)*** | Project coordination, administration, reporting, monitoring & evaluation. In kind **$8,000** |
| ***Sunshine Coast Council (Landholder Environment Grants)*** | Project funding **$3,148** (2014-15 only), technical advice |
| ***Neil & Gillian Macleod*** | Landowner, labour, funding **$8,680** over 3 years cash & in-kind |

**PROJECT DETAILS**

| | | | | | |
|---|---|---|---|---|---|
| ***Start Date*** | July 2014 | ***Completion*** | June 2015 | **Duration** (implementation) | 1 year |
| ***OUTPUTS*** | | | | | |
| ***Riparian fencing*** | 100 metres | ***Revegetation*** | 200 plants | ***Watering point*** | 1 |
| ***OUTCOMES*** | | | | | |
| ***Length of creek fenced*** | 100 metres (will exclude stock from total of 315 metres) | | | | |
| ***Length of wildlife corridor*** | 315 metres | | | | |
| ***Area of habitat created/enhanced*** | 0.4 hectare/2 hectares | | | | |
| ***Landholder engagement*** | 1 land manager | | | | |

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.

The proposed project aims to complete three components:

1. Install 100 metres of fencing on Obi Obi Creek ;
2. Revegetate riparian zone;
3. Install a controlled watering point for livestock.

The project is a continuation of previous projects on the property (1998 – 2004) fencing and revegetating the Obi Obi Creek riparian zone and establishing a formal waterway crossing to improve livestock management and reduce risks to catchment water quality.

Vegetated buffers enable us to manage risks to water quality effected by livestock grazing and access, restore riparian zones to a more 'natural' condition reducing water temperatures, improving dissolved oxygen levels, reducing nutrients, pathogens and sedimentation. The fencing of riparian zones is the key to reducing risks to water quality however in cases where native vegetation is lacking and there is little likelihood of natural regeneration, revegetation is required to provide long term management. Indeed many landholders' primary motivation for erecting fencing is to enable revegetation and the associated benefits (other than water quality) of habitat and wildlife corridors, long term management of weeds, improved property and livestock management or simply aesthetic appeal. Regardless of the motivations, the exclusion of livestock and the revegetation of riparian zones provide multiple environmental benefits with water quality certainly at the forefront.

The implementation of the planned activities will reduce threats to catchment water quality by:

- reducing erosion of the bed and banks of Obi Obi Creek reducing turbidity and sedimentation;
- reduce direct faecal deposition (nutrients and pathogens) to Obi Obi Creek;
- extend wildlife corridors linking vegetation throughout the upper catchment;
- return Obi Obi Creek to a more natural watercourse which in turn improves its ability to mitigate water quality threats originating upstream;
- improve livestock management;
- continue to develop land manager engagement; *and*
- provide demonstration site (this part of the catchment is high priority due to intensive grazing and the number of disengaged landholders).

# 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).

The project will complete the fencing and revegetation of the Obi Obi Creek riparian zone on the Macleod property – a beef and alpaca grazing property in the upper reaches of Obi Obi Creek. An alternative controlled watering point will be installed to provide livestock water. Sunshine Coast Council is funding the fencing and revegetation while LBCCG will fund the establishment of the watering point.

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 fence and revegetate riparian zones are considered sensible to support.

## *ii.* BACKGROUND

Neil and Gillian completed a cattle crossing project with funding from LBCCG in approximately 1998. Further projects included minor fencing and revegetation in partnership with the Mary River Catchment Coordinating Committee (MRCCC) and Caloundra City Council. A project in 2004 further extended the Obi Obi Creek fencing and revegetation with these projects now at a stage where they are self-sustaining and only require minor maintenance.

In early 2014 Neil and Gillian applied for funding from Sunshine Coast Council under the Landholder Environment Grants program. Community Partnerships officer, Alan Wynn then contacted LBCCG enquiring about the possibility of co-funding the project and in particular technical advice regarding alternative watering for livestock.

The project is a suitable investment for LBCCG and Seqwater as it will exclude livestock from a significant length of high priority waterway on a large grazing property while providing improved stock management for the landholder. Sunshine Coast Council are providing a significant contribution to the project.

This part of Obi Obi Creek is important to LBCCG as there are a significant number of unengaged landholders. The implementation of successful projects in the area will demonstrate to neighbouring landholders the benefits of rehabilitation and remediation and lead to engagement and participation in further projects. Eventually it is LBCCG's aim to 'capture' as much of the Obi Obi Creek catchment as possible, providing not only water quality benefits but also broader environmental outcomes such as establishing or enhancing wildlife corridors throughout the catchment.

## 1.0 WHAT

The proposed project aims to complete three components on the Macleod property:

1. Install 100 metres fencing on Obi Obi Creek ;
2. Revegetate riparian zone (200 plants);
3. Install controlled watering point on Obi Obi Creek.

***Previous projects on the Macleod property have fenced and revegetated most of Obi Obi Creek.***

## 2.0 WHERE

The project will be implemented on Neil & Gillian Macleod's beef and alpaca property, 75 Aplin Lane, Reesville.

Property is approximately 54 hectares – comprising the following:

- 24.3 ha of improved pasture and lightly vegetated areas;
- 6 ha of moderately vegetated areas and wetlands (grazed);
- 0.7 ha of residential, sheds and stock yards;
- 22 hectares of remnant vegetation and good quality regrowth vegetation;
- 1 ha of revegetation;

Obi Obi Creek forms the southern boundary of the property and provides a frontage of 1,160 metres. Along with the natural wetlands on the property, the watercourses have traditionally provided watering for livestock. Other minor watercourses on the property total approximately 1,685 metres.

***Nattaginni Alpacas***

## 3.0 WHY

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

The implementation of the planned activities will reduce threats to catchment water quality by:

- reducing erosion of the bed and banks of Obi Obi Creek reducing turbidity and sedimentation;
- reduce direct faecal deposition (nutrients and pathogens) to Obi Obi Creek;
- continue the establishment of wildlife corridors linking remnant vegetation, regrowth vegetation and revegetation sites throughout Obi Obi Creek;
- return Obi Obi Creek to a more natural watercourse which in turn improves its ability to mitigate water quality threats originating upstream;
- improve livestock management;
- continue to develop land manager engagement; *and*
- provide demonstration site (this location on the Obi Obi Creek has been a priority for LBCCG due to the intensive agriculture);

***Baroon Pocket Dam in September 2013 (storage has remained closed since). Cyanobacteria blooms disrupt recreational use of the storage and create difficulties in the production of potable water.***

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.

Sunshine Coast Council through its progressive environmental programs (Landholder Environment Grants program funded by an environmental levy) seek broad environmental benefits such as wildlife habitat and corridors, water quality improvements, weed management, endangered species protection and particularly community partnerships. This project satisfies all of these aims.

## 4.0 HOW

### 4.1 – Riparian fencing

The Macleod's have been progressively fencing and revegetating the Obi Obi Creek riparian zone – particularly Lot 6, the eastern half of the property. Only 100 metres of riparian zone remains to be fenced and revegetated. Sunshine Coast Council through its Landholder Environment Grants program have funded all fencing materials and revegetation materials with the Macleod's providing labour to complete the activities.

***Fencing and revegetation project implemented in 2004. The new project will complete livestock exclusion of Obi Obi Creek and establish a riparian buffer and wildlife corridor.***

Fencing will consist of standard cattle fencing; timber 'split' posts at five metre spacings with four barbed wires (wildlife friendly may be considered; top and possibly bottom wire replaced by plain wire). The alignment will follow the high bank ensuring flooding does not adversely impact the fence.

Although the planned fencing is only 100 metres, livestock will be excluded from a total of 315 metres and extend the riparian fencing and revegetation project to a total of 560 metres.

### 4.2 – Revegetation

***Looking downstream from the Aplin Road bridge. The fencing and revegetation project lies on the left hand bank.***

Sunshine Coast Council through the LEG program are funding all revegetation materials including tubestock for the project with the landholders providing planting labour and maintenance.

Two hundred plants, appropriate for the site (consistent with the Regional Ecosystem, flooding issues) will be planted. No guards will be utilised due to the high risk of flooding however flood stakes will be installed immediately upstream of the seedlings to protect from flood debris.

***New controlled watering point for livestock. An historical disused crossing over the Obi, the site was fenced and revegetated in the early 2000s.***

Historically livestock have relied on this reach of the Obi for water. The fencing and revegetation of the reach will necessitate the provision of an alternative water supply or the establishment of a stable watering point.

With no dams or bores present on this side of the property the most effective solution is the establishment of a watering point in the Obi Obi Creek.

We will utilise an old disused crossing over the Obi downstream of the current fencing and revegetation site. This reach has previously been revegetated however there will be minimal disturbance of established trees. The creek at this point has a stable rocky bed with a gentle slope to the water's edge (as a result of being used as a crossing in the past).

We will suspend two parallel steel cables across the creek between strainer posts installed above the high water mark. Lengths of galvanised chain are hung from the cable. The assembly is electrified to stop livestock pushing through the vertical chains.

The suspended cable remains taut during flooding while the suspended chains remain flexible and move out of the way when contacted by water flow and debris. A floodgate controller connected to the fence will limit the amount of power flowing through the fence during a flood.

The location and previous use of the crossing provides a stable watering point however to ensure erosion is kept to a minimum the approach to the water's edge will be concreted and the paddock entry hardened with compacted road-base.

Livestock will be able to access the Obi for watering but will not be able to move either upstream or downstream. Only low numbers of livestock will have access to this area.

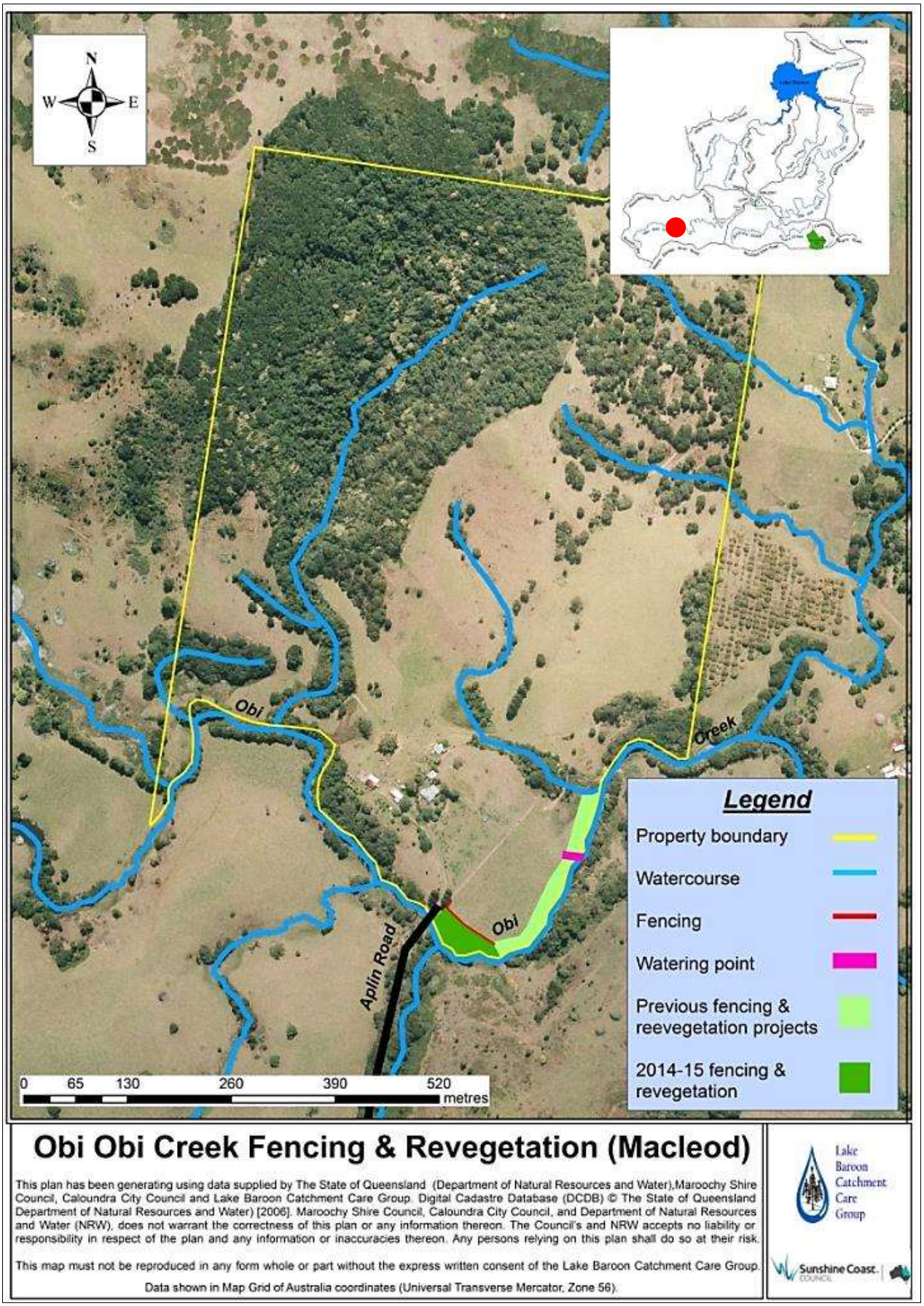
## 5.0 WHEN

Fencing was completed in September 2014 and revegetation will occur when the season 'breaks'. A temporary watering point utilising electric fencing has been established but will not survive flooding. The construction of the permanent watering point will occur once funding is approved and sufficient dry conditions exist – low flows in the Obi, dry paddocks to permit heavy earthmoving equipment and concreting access.

**6.0 BUDGET** (includes maintenance by landholder for 3 years) All figures exclusive of GST.

*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 MAP


N
W
E
S
Obi
Creek
Obi
Aplin Road
0
65
130
260
390
520
metres
Legend
Property boundary
Watercourse
Fencing
Watering point
Previous fencing & reevegetation projects
2014-15 fencing & revegetation
Obi Obi Creek Fencing & Revegetation (Macleod)
This plan has been generating using data supplied by The State of Queensland (Department of Natural Resources and Water),Maroochy Shire Council, Caloundra City Council and Lake Baroon Catchment Care Group. Digital Cadastre Database (DCDB) © The State of Queensland Department of Natural Resources and Water) [2006]. Maroochy Shire Council, Caloundra City Council, and Department of Natural Resources and Water (NRW), does not warrant the correctness of this plan or any information thereon. The Council's and NRW accepts no liability or responsibility in respect of the plan and any information or inaccuracies thereon. Any persons relying on this plan shall do so at their risk.
This map must not be reproduced in any form whole or part without the express written consent of the Lake Baroon Catchment Care Group.
Data shown in Map Grid of Australia coordinates (Universal Transverse Mercator, Zone 56).
Lake Baroon Catchment Care Group
Sunshine Coast Council

## PART C:

## ATTACHMENTS

# 1.0 PROJECT RATIONALE

## 1.1 INTRODUCTION

In an ideal world, all waterways in the Lake Baroon catchment would be rehabilitated to provide riparian buffers, lower in-stream temperatures and provide suitable 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.

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

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 adequately reflect the nutrient and sediment inputs to the waterways through land use, particularly intensive grazing (dairying and beef production) (Dunstan 2007). An alternative Management Unit Prioritisation was developed by LBCCG that focusses on 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.

Maintaining a healthy riparian system is essential for a productive landscape. When a riparian area is healthy it contains lush, thick vegetation, providing habitat for wildlife and aquatic species, maintains stream bank stability, influences morphology and provides shade which in turn lowers water temperatures and increases the oxygen carrying capacity of the stream. Additionally, riparian vegetation filters, utilizes and stores nutrients, thus preventing them from entering water systems.

Anecdotal evidence (raw water quality data analysis and recent Griffith University investigations) suggests that water pollution and contamination from land use in the upper Lake Baroon catchment is mitigated as it travels through the mid to lower reaches of Obi Obi Creek. These lower reaches are heavily vegetated and flows pass through varying hydrology (riffles and pools), through swathes of native (and exotic) macrophytes effectively 'cleaning' the water naturally. Oxygenation, removal of nutrients, pesticides and sediments all occur and probably aided by dilution. Therefore any activity that manages livestock and enhances the riparian buffer is likely to benefit raw water quality before it enters the storage (pers. comm. Peter Pollard, Griffith University).

## 1.2 GRAZING AND RIPARIAN ZONES

Livestock grazing is a land use 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.

In the sub-tropics, the majority of overland flow events occur during the summer to early autumn period. Conversely 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.

Cattle when drinking at streams and dams enter the water to reduce bending; resulting in the stirring up of suspended solids (turbidity), and 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 water body (pers. comm. Colin Cork).

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; *and*
- decrease wildlife habitat and species.

However when tightly controlled, fencing can be an invaluable, and sometimes essential tool to manage grazing in riparian zones whether permanent exclusion or strictly managed grazed is performed.

The project will enhance vegetation buffers on the Walkers 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 soil 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).

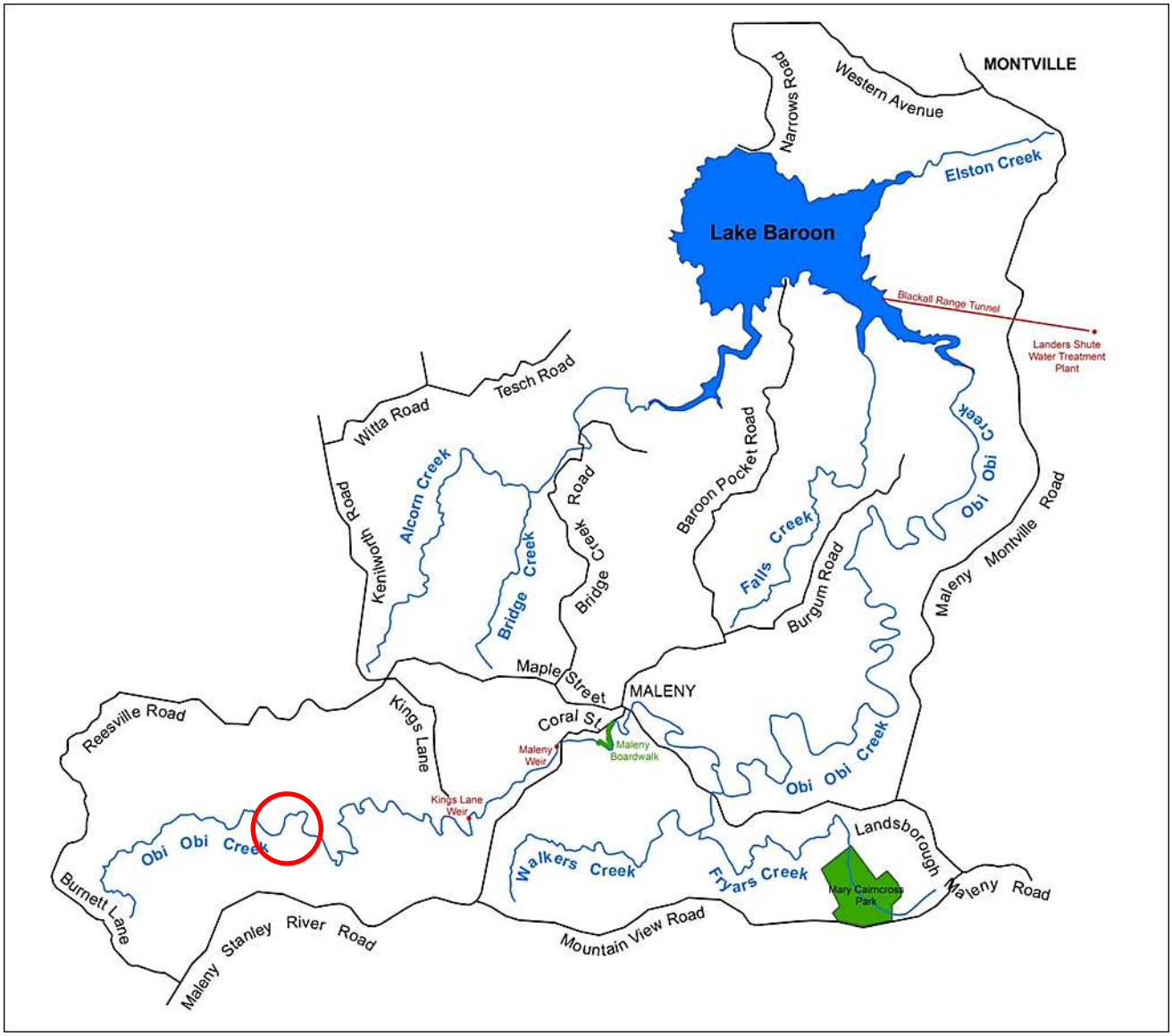
Riparian buffers comprising grassed buffer strips are effective at trapping sediments and nutrients adsorbed to sediments (such as phosphorus), but tend to be relatively poor at trapping dissolved nutrients, or for the provision of shade, food sources, in-stream structure or corridors for many species. 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).

## 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 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 significant creeks within the catchment providing water to Lake Baroon. The catchment encompasses an area of 74 km2 (including the dam surface).

### 2.2 LOCATION MAP




***The Macleod property is located in Management Unit OB3, which lies in the upper reaches of Obi Obi Creek. This part of the Lake Baroon catchment is a significant contributor of high nutrients primarily due to the land use (both currently and historically) and the lack of filtering and buffering riparian vegetation.***

## 2.3 CATCHMENT REVIEW

### 2.3.1 Background

Since the arrival of European Settlers, Lake Baroon and its catchment area have undergone significant change. Timber operators first settled in 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.

### 2.3.2 The Obi Obi Creek Catchment

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% 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. This provides administrative convenience and the ability to prioritise stream zones more accurately according to various threats.

The project lies in Management Unit OB3.

***Above left: The upper Obi Obi Creek catchment has historically been the most important agricultural area on the Maleny plateau due to the good soils, relatively flat landscape and plentiful water. The decline of grazing has led to increasing rural residential and hobby farming properties but grazing remains the dominant land use.***

***Left: Obi Obi Creek on the Macleod property. Installing a short length of fencing (100 metres) will exclude livestock from a total 315 metres of riparian zone.***

### 2.3.3 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).

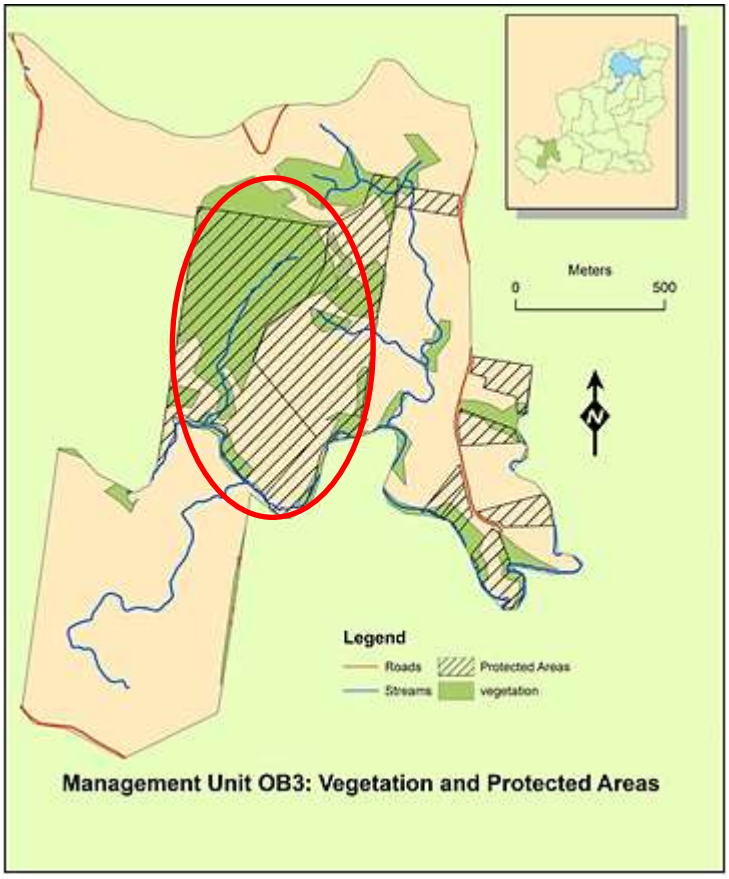
Between 210 and 180 MYA the North Arm Volcanics 'sagged' into broad depressions that subsequently filled with sediment, forming the deep Landsborough Sandstone formation.

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 Macleod property ranges in elevation between 432 metres above sea level in the bed of Obi Obi Creek to 536 metres at the highest point in the north western corner. Most of the property rises steeply and the remnant vegetation existing on the property is probably more a reflection of the difficulty clearing rather than conservation. The flatter areas of the property are found adjacent to Obi Obi Creek. 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 (just to the north of the Macleod property) is 560 metres above sea level, while Maleny is between 410 and 450 metres above sea level.

Soils are predominantly Red Ferrosols – a deep red clay soil, strongly structured and slightly acidic. These soils are typical of the land to the south and west of Maleny and form rolling low hills. The soil has a strong granular structure promoting infiltration, can store very high levels of carbon (commonly around 7.5%). Both nitrate nitrogen ($NO_3$-N) and total nitrogen are very high with mineral N readily released from organic N by microbial action. Available phosphorus (P) and sulphate sulphur ($SO_4$-S) are very high while available potassium (K) is very low. Generally trace elements are all adequate for improved pasture or remain so due to historical superphosphate, NPK, lime and urea fertiliser application. The sub soil is well drained and acts as a recharge zone (springs and groundwater) and as a result has low fertility – likely to have been exacerbated by the recent wet summers and high rainfall events (Biggs & Harms 2008).




***The Macleod property supports the majority of vegetation in the Management Unit.***

Soils on the site predominantly consist of basalt-derived red (krasnozem or ferrosol) soils. The bed of the watercourses on the site consists of thin, black alluvial soils that have been deposited by a combination of hill slope (paddock) erosion and gullying. The velocity and volume of the Obi Obi Creek however limits sediment deposits forming.

Native vegetation is an indicator of soil types. Several types of different vegetation remain on the site reflecting both Tertiary basalt and older sandstone geology.

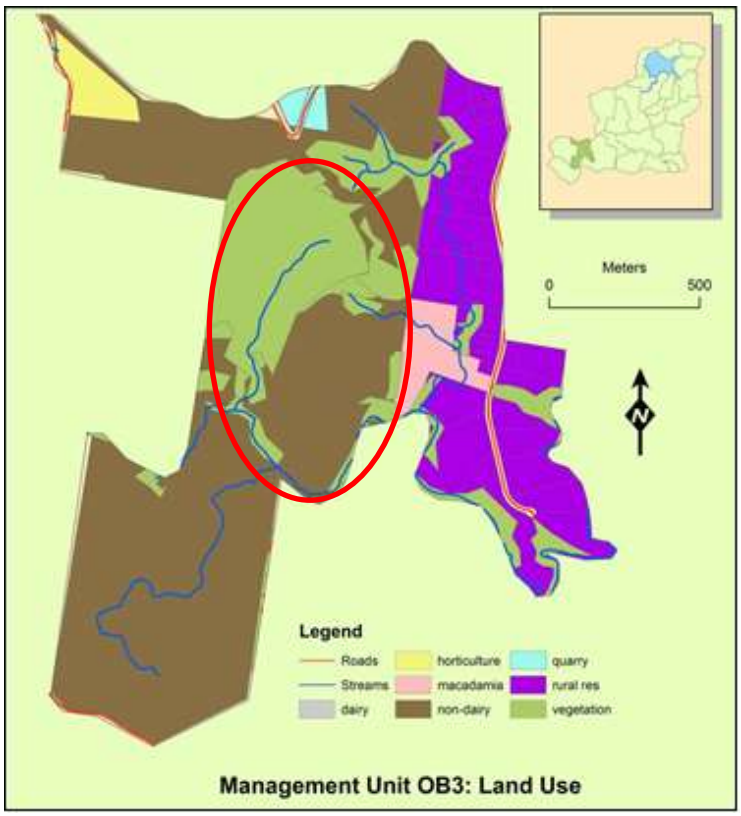
The underlying geology of the properties is tertiary olivine basalts. The majority of the properties are composed of kraznozems, characterised by uniformly of gradational red, friable structured clay soils. The soil contains aluminium oxyhydroxides and iron with the soil having considerable capacity 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 (Gageler et al 2014) which can assist with the maintenance of water quality and water quantity.

### 2.4.4 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).




***Land use in Management Unit OB3 with the Macleod property circled.***

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;
- abundance of weeds – shift in land ownership from land managers (e.g. farmers) to inexperienced residents has potentially led to the spread of weeds;
- varying pollution sources related to increased population.

Land use in Management Unit (OB3) is increasingly rural residential, although non-dairy grazing remains the dominant land use with native vegetation covering approximately 20% of the MU. Other minor land use includes horticulture and an abandoned quarry.

The majority of native vegetation (remnant) in the MU is protected and approximately 21% of waterways have riparian cover. LBCCG has assisted landholders in Ruddle Drive and Neil and Gillian Macleod in the past to control weeds, replant riparian vegetation and install creek crossings. The MU is very stable, however high loads of nutrients have historically entered the waterways with 88% of samples exceeding guideline levels likely due to land use and lack of vegetation – particularly riparian vegetation.

Historically this part of the upper Obi Obi Creek supported intensive dairying with potentially ongoing impacts.

### 2.3.5 Flooding

The project is fencing and revegetating riparian zones that are likely to flood at least once per year and probably several times each year. Fencing will be erected above flood heights and revegetation will take into account the likelihood of flooding – hence the Plant Pink guards not being utilised however flood stakes will provide seedling protection during flooding. Species selection will also reflect the flooding nature of the site.

### 2.3.6 Environmental Factors

#### 2.3.6.1 Significant Vegetation & Ecosystems

The property has been partially cleared of vegetation to accommodate pastoral and agricultural activities. Remaining vegetation consists of substantial areas of remnant vegetation – most of which is unusual for the Maleny plateau. The grazed paddocks support scattered mature remnant trees and several wetlands, although degraded provide habitat diversity. Previous revegetation efforts have concentrated on the Obi Obi Creek riparian zone.

**RE12.8.3 – Complex notophyll vine forest**

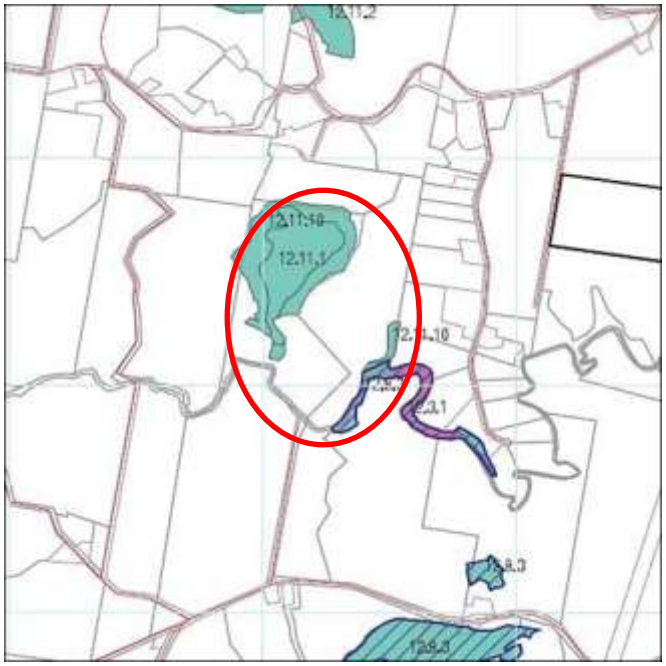
The majority of the Obi Obi Creek riparian zone and substantial areas of the lower slopes would historically have been covered by this Ecosystem. A degraded example of this vegetation can be seen in the riparian zone adjacent and downstream to the project on the neighbouring property. Although not considered 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 occurs almost exclusively in narrow linear corridors associated with major watercourses on the Maleny plateau. Due to its reliance on alluvial soils and subsequent 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 narrow strip exists along the Obi Obi Creek downstream of the Macleod property. This ecosystem is endangered and therefore considered high priority for protection.

**RE12.11.10 – Notophyll vine forest**

A significant stand of this RE lies on the southern slopes of Howells Knob and a smaller (unverified) stand straddles the eastern property boundary on a gentle slope rising from Obi Obi Creek. This RE is not considered a priority for State protection.



**RE12.11.1- Simple notophyll vine forest**

Similar to RE12.11.10 a relatively large remnant lies on the southern slopes of Howells Knob. The RE is occupying the drier soils but is still largely made up of rainforest species (southerly aspect) with Lophostemon confertus probably a major species. This RE is not considered a priority for State protection.

***The property has substantial areas of remnant vegetation. The project will address uncontrolled livestock access to Obi Obi Creek and extend the riparian vegetation (create a buffer) linking vegetation.***

#### 2.3.6.2 Fauna & Fauna Corridors

This reach of Obi Obi Creek is significant for wildlife corridors as it is critical for the continuing establishment of a link between remnant vegetation and revegetation efforts upstream and downstream.

## 3.0 PROJECT PURPOSE & OBJECTIVES

### 3.1 BACKGROUND

A healthy aquatic ecosystem is one that is stable and sustainable; maintaining its physical complexity, biodiversity and resilience. It has the ability to provide ecosystem services that provide 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 a critical source of biological diversity. By improving effluent management the riparian zones and associated water is protected from potentially damaging contaminants.

### 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).

Approximately 20% of the sub-catchment is vegetated, though many 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 88% of samples exceeding guideline levels (Dunstan 2007).

The Lake Baroon Catchment Implementation Plan (2007) rates OB3 a MODERATE 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, OB3 still rates as a MODERATE priority.

### 3.2.1 Statistical Analysis of the Raw Water Quality Data Recorded from Aplin Road 1991-2005

This monitoring site lies immediately upstream of the project site.

Water quality monitoring and analysis sampled at Aplin Road between 1991-2005 by AquaGen shows the catchment contributes excessive nitrates, ammonia, total phosphorus and faecal coliforms.

| *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* | 7.7 | 39.5 | 1.100 | 0.550 | 0.617 | 0.219 | 26,000 |
| *Min* | 6.6 | 1.2 | 0.004 | 0.000 | 0.001 | 0.010 | 6 |
| *Mean* | 7.3 | 4.2 | 0.121 | 0.065 | 0.035 | 0.060 | 856 |
| *Median* | 7.3 | 2.5 | 0.061 | 0.032 | 0.019 | 0.052 | 180 |
| *Std Dev* | 0.2 | 5.4 | 0.166 | 0.083 | 0.062 | 0.032 | 2,679 |
| *20th Percentile* | 7.1 | 1.8 | 0.015 | 0.010 | 0.012 | 0.040 | 58 |
| *80th Percentile* | 7.5 | 4.2 | 0.190 | 0.110 | 0.045 | 0.071 | 598 |
| *Count above GV* | 0 | 2 | 78 | 99 | 50 | 117 | 93 |
| *Count* | 134 | 135 | 133 | 127 | 133 | 124 | 133 |
| *% above GV* | **0.00** | **1.48** | **58.65** | **76.38** | **37.59** | **92.74** | **69.92** |

The routine sampling programs (CalAqua, AquaGen, Seqwater and others) are suspected of not accurately capturing the major pollution events that regularly occur in the catchment. Conducted bi-monthly (1999 – 2005), significant rainfall events in the catchment have probably been missed and the data collected may over-estimate the catchment's water quality (Traill, 2007).

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

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 visibly extremely turbid 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.

Nitrate levels are consistently high with inputs likely to be largely as a result of oxidation of ammonia nitrogen (faecal matter and ammonia based fertiliser). It would be expected with the dramatic decline in dairies within the catchment there should be a corresponding decline in nitrates detected. Nitrogen is essential for plant growth. However, increased levels of nitrogen can contribute to excessive algal growth (particularly in the Lake Baroon storage) and weeds.

Ammonia levels have remained consistently very high. Ammonia is the initial product of the decay of nitrogenous organic wastes - high concentrations of ammonia can be toxic to aquatic life. The likely cause of high ammonia levels is the loss of ammonia based fertilisers and direct access to watercourses by cattle.

Phosphate levels have remained high over the 1991-2005 period although appeared to decline significantly with the majority of guideline exceedances occurring pre 1996. This is probably likely due to a change in land use from dairying to beef grazing (and subsequent reduction in fertiliser use). However as phosphates are usually bound to sediment and with the low turbidity recorded it is possible the high phosphate loads have not been captured by the sampling program.

Total Phosphorus has remained generally excessive over the sampling period and can be attributed to a wide variety of sources including dairying, beef grazing, sewage sources, catchment erosion, fertiliser and stormwater. Generally expected in areas of intensive grazing, the high results could also be indicative of the density of rural residential properties and their associated wastewater treatment systems. Phosphorus is an essential plant and animal nutrient, however, increased levels of phosphorus can contribute to excessive algal growth (particularly in the Lake Baroon storage) and weeds.

***Livestock in waterways are high risk to water quality.***

Faecal coliforms have remained relatively high. There have been considerable changes in land use over the sampling period (and since) and a growth in rural residential properties. It appears that much of this can be attributed to organic sources (faecal matter) by the high total phosphorus results. 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. Faecal coliforms and the associated pathogens are high risk for water quality.

## 3.3 PROPERTY MANAGEMENT

The Macleod property is utilised for mixed grazing – beef cattle and alpacas. With a high percentage of vegetation remaining on the property grazing intensity is maintained at moderate levels and most of the waterway vegetation has been retained. Natural wetlands have been retained, or allowed to form which trap sediments, nutrients and other contaminants and contribute to their neutralisation.

### 3.4 WATER SUPPLY CATCHMENT

The whole of the property is within the Baroon Pocket Dam catchment. Walkers Creek is a major tributary (4,255 hectares and 15 kilometres major stream length) of the storage. Consequently it is a significant 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).

Its 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 |
| Area of Macleod property | 54 hectares |
| **Gross value of water originating from Macleod property** | **= $437,832 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 (300,000 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 (including land slips and mass movement), 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.

### 3.5 OBJECTIVES

Obi Obi Creek Riparian Revegetation is a project designed to reduce the impacts of livestock access on a major watercourse. The water quality benefits are expected to be significant and an integral part of the larger aim of protecting the Lake Baroon resource, addressing the issues and risks associated with the production of a safe water supply to the Sunshine Coast and beyond. However the project provides far broader environmental benefits that increasingly the community demands and expects.

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 (through the enhancement of riparian zones by revegetating);
- 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.

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.

### 3.6 TARGETS

The project aims to:

- exclude livestock access to 315 metres of Obi Obi Creek;
- improve the condition of 0.2 hectares of riparian buffer to enhance filtering capacity;
- establish 1 hectare of riparian vegetation;
- extend wildlife corridor by 100 metres;
- reduce erosion , nutrient and pathogen delivery to Walkers Creek;
- build land manager skills and capacity; *and*
- raise community awareness.

### 3.7 OUTCOMES

Healthy catchments lead to healthy waterways. By improving the health of riparian zones we ultimately aim to reduce 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 the risk to water quality. Through the prioritisation and implementation of riparian protection and rehabilitation throughout rural catchments – particularly headwaters, we can provide multiple beneficial outcomes.

Outcomes are the 'end product' of the project – 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 sometimes partnerships with universities and/or Seqwater to produce 'hard' data to the actual effectiveness of the project.

**1. Reduce pathogen delivery to waterways.**
*Excluding livestock from riparian zones reduces the volume of faecal material reaching waterways.*

Vegetative buffers intercept run-off contaminated with faecal material (potentially pathogens) from diffuse rural sources.

**2. 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.

**3. Reduce sediment delivery to waterways.**
*Soil from erosion leads to high turbidity and is transported to Baroon Pocket Dam 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.

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

A reduction in turbidity, sediments, nutrients and pathogens will improve water quality and contribute to greater in-stream biodiversity. 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).

**5. 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 value and importance of effective effluent management. Although the scale and complexity of the installed system will be beyond other local dairy farmers, it provides an excellent demonstration site. 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 and capacity of the community.

**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 contribute to the linkage between the remnant vegetation downstream on Obi Obi Creek, and isolated vegetation upstream. 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. 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 enhance 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.

For landholders to implement water quality improvement project there needs to be a cost benefit rather than a burden on available resources. This project provides a win-win scenario where all stakeholders benefit.

## 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) and/or their potential to adversely impact on catchment water quality. The Macleod property was identified as a priority landholding in 2007, due to size (over 50 hectares), land use (grazing) and location in the catchment (upper Obi Obi Creek).

## 3.9 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 catchment (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 key issue of 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 m 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 risk sources dominated by land use activities and human access. Key issues in this section include hazards associated with the population growth in the area and the increasing rural lifestyle and 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)

### 3.9.1 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).
**Alignment of relevant summarised actions from the Lake Baroon Catchment Management strategy with actions from the NRM plan Country to Coast – a healthy sustainable future.**

| ***LBCIP Activity Theme*** | | ***Implementation Activity*** | ***BMRG Program*** |
|---|---|---|---|
| On ground | OG1 | Develop on ground works for water quality improvement and aquatic biodiversity maintenance & improvement | Water Quality & Equitable Use<br>Biodiversity Conservation |
| Catchment management | CM1 | Develop a program where by all landholders involved in on ground activities initiate PMP's as part of application process | Biodiversity Conservation |
| Catchment management | CM2 | Property Management Planning Toolkit | Sustainable Use |
| Catchment management | CM4 | Adoption of BMP for point and concentrated diffuse pollution | Community Capacity and Partnerships |

| | | | |
|---|---|---|---|
| Catchment management | CM6 | Community involvement | Community Capacity and Partnerships |
| Catchment management | CM7 | Stakeholder Survey | Community Capacity and Partnerships |
| Catchment management | CM8 | Transition in NRM practice | Community Capacity and Partnerships |
| Catchment management | CM11 | Industry involvement in NRM | Community Capacity and Partnerships |
| Catchment management | CM12 | Training and skilling stakeholders in NRM | Community Capacity and Partnerships |
| Monitoring & research | MR1 | Water quality hotspots | Water Quality & Equitable Use |

### 3.9.2 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.

### 3.9.3 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.

### 3.9.4 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, planning and regulation, dam operation and management, 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 dairy runoff, waste streams, pesticide use, chemical residues, erosion, fertilisers and animal carcasses.

Current management practices in place include licensing and conditions, enforcement, monitoring, community involvement, local planning, industry BMP and farm management plans, education, and rehabilitation and farm improvement within specific area 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 (also referred to as 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 operation protocols, recreational management including closure if necessary, monitoring and research, signage about cyanobacterial blooms and effective catchment management to prevent blooms 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 and 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 regional and local growth management strategies and plans, education, community involvement, advice from Seqwater in development assessment processes, development offsets, covenants for conservation and riparian and land initiatives from the LBCCG.

### 3.9.5 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. |

### 3.9.6 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.

# 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 contaminant 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 10 and 35 metres of riparian buffer, with an average of approximately 20 metres.

## 4.2 ACTIVITIES

### 4.2.1 Fencing

Fencing will be erected between 10 and 35 metres from Obi Obi Creek above the flood zone providing a moderate area of buffer zone. Approximately 100 metres of standard cattle fencing (timber splits at 5 metre spacings, 4 strand wire) with a steel gates where required.

### 4.2.2 Revegetation

The revegetation component of the project is minor with a mere 200 stems to be planted. Materials have been funded by Sunshine Coast Council and the landholders will provide the labour to prepare the site, plant trees and effect maintenance.

Species selected will take into account the appropriate Regional Ecosystem, likelihood of flooding and level of maintenance required. Alan Wynn, Community Partnerships Officer with Council will provide advice on all aspects of revegetation and maintenance.

### 4.2.3 Controlled watering point

The exclusion of livestock from the remaining access to Obi Obi Creek necessitates the provision of an alternative watering point. There are no farm dams on this part of the property and the establishment of an off stream watering system utilising pumps, tanks and troughs is not cost effective or practical.

Replacing fencing can be one of the most expensive and laborious elements of rebuilding after a flood. Fencing riparian zones involves careful construction to ensure fences can survive the considerable force of floods. Fencing across watercourses should be avoided as much as possible but will always be necessary in some circumstances (boundary fences, watering points etc).

To minimise maintenance following flooding, fencing should:

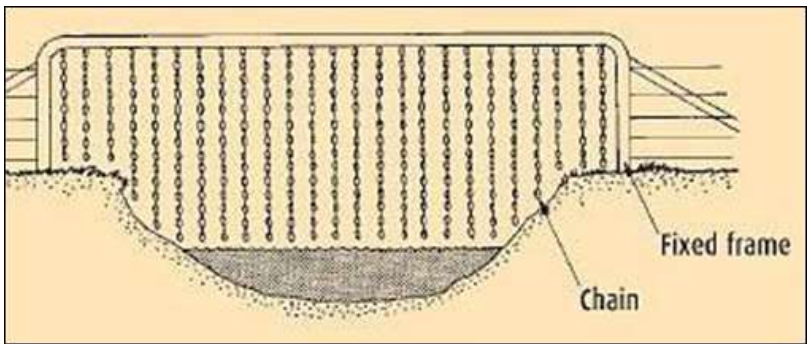
- Reduce fence resistance to floodwaters.
- Increase post resistance to over-turning.
- Maintain wire tension.
- Isolate high-risk lengths of fence.

Electrified flood fences/gates are ideal for use in larger, higher flow creeks, riverbeds and other areas prone to regular flooding. By constructing this type of fence maintenance following flooding is minimal and usually will continue to operate as an effective fence even during flooding.

The ideal design for fencing across valley shaped waterways is the electrified suspension cable fence. A steel cable is suspended across the waterway between two posts secured above the high water mark. From the cable a fence made of suspended galvanised chain (or for less critical sites – plain wire). The suspended cable remains taut during flooding while the suspended chains remain flexible and move out of the way when contacted by water flow and debris.

With all suspended fences, it is essential to have as few vertical supporting posts across the floodway as possible. Debris can get trapped against the post and can cause extra pressure during flooding. The vertical chains are spaced between 250 – 300 mm apart and suspended approximately 250 – 300 mm above average base-flow water height. Minimum galvanised chain diameter should be 4 mm although larger sizes may need to be considered. Larger diameter chain will suspend better but will substantially increase the weight placed on the cable.

***The electrified flood fence is designed to survive most floods with minimal repairs and maintenance.***




An alternative to galvanised chain on smaller watercourses is using heavy plain wires (or lighter wire double twitched) although the flexibility of the wire will be less. The supporting cable should be 10 mm minimum with a breaking strain suitable to support the suspended chain and any extra pressure exerted by flood waters.

A floodgate controller connected to the fence will limit the amount of power flowing through the fence during a flood. This is particularly important if the flood fence is connected to further fencing for stock control.

## 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 application (Sunshine Coast Council LEG) | | Landowners | Apr 14 | Jun 14 | Approved funding |
| LBCCG Project Proposal | | LBCCG Project Manager | Nov 14 | Nov 14 | Project Plan |
| Project presented to LBCCG Committee for approval | | LBCCG Project Manager & Committee | Dec 14 | Dec 14 | Approved Plan (LBCCG) |
| Project forwarded to Seqwater for approval | | LBCCG Project Manager | Dec 14 | Dec 14 | Approved Plan (Seqwater) |
| Pre-works monitoring (including photo points) | | LBCCG Project Manager | Apr 14 | Feb 14 | Photo & data set |
| *PROJECT IMPLEMENTATION* | Fencing | Landholder | Jun 14 | Dec 14 | 100 metres |
| | Revegetation | Landholder | Sep 14 | Jan 15 | 200 plants |
| | Watering point | Landholder, LBCCG PM, contractor | Jan 15 | Jun 15 | 1 watering point |
| Progress report | | LBCCG Project Manager | Jul 14 | Jun 15 | 10 Reports (LBCCG meetings) |
| Post-works monitoring | | LBCCG Project Manager | Jan 15 | Jun 2015 ongoing | Photo & data sets |
| Project completed/signed off.<br>Final Report | | LBCCG Project Manager & Committee | Jun 15 | Sep 15 | Final Report |

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

**Project schedule is dependent on weather conditions**

## 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 materials | Maleny Town & Country | Paul Mackay |
| Revegetation (tubestock supply) | Barung Landcare Nursery | Wayne Webb |
| | Brush Turkey Enterprises | Karen Shaw |
| Revegetation materials | BD Products | Tony Paton |
| | Fernland Nursery Supplies | - |
| | Brush Turkey Enterprises | Spencer Shaw |
| Earthmoving | P & K Nash | Phil Nash |
| | Sommer Brothers Earthmoving | Ron Sommers |

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 supplier will be selected from the list of preferred suppliers. All suppliers (where appropriate) must demonstrate full insurance and liability requirements and that all staff or personnel on site are appropriately licenced and/or experienced.

### 6.2 COST ESTIMATION METHODOLOGY

#### 6.2.1 Fencing

Fencing costs have been estimated according to pricing supplied by Maleny Town and Country supplies for materials and Fencing Contractor rates for installing standard cattle fencing.

#### 6.2.2 Revegetation materials

Materials are at prices provided by Brush Turkey Enterprises (website).

http://www.brushturkey.com.au/wp-content/uploads/2013/08/BTE-July-Price-List.pdf

#### 6.2.3 Controlled watering point

Material costs are estimated from pricing supplied by Air & Lift Gear, Maroochydore.
Concreting and road-base costs are estimated from previous similar projects and costings.

## 7.0 N/A

## 8.0 HAZARD & RISK ASSESSMENT (HRA)

LBCCG has a comprehensive Safety Management System that clearly directs all aspects of Projects; Project selection (on the basis of safety), Project development, Contractor and/or volunteer engagement, Landholder expectations and requirements, Project implementation and ongoing Project monitoring and evaluation.

LBCCG adheres to the relevant legislation, policy and standard requirements:

- **AS/NZS Risk Management Standard 4360:1999**
  Establishes and implement a risk management process that involves the identification, analysis, evaluation, treatment and ongoing monitoring of risks.
- **AS/NZS 4084:2001 Occupational Health and Safety Management Systems – General Guidelines on Principles, Systems and Supporting Techniques**
  Provides guidance on the development and implementation of occupational health and safety management systems (OHSMS) and principles, and their integration with other management systems.
- ***Workplace Health and Safety Act 2011*** **(Qld)**
  To prevent a person's death, injury or illness being caused by a workplace, by a relevant workplace area, by work activities, or by plant or substances for use at a workplace.

### 8.1 ASSUMPTIONS AND LIMITATIONS

Assessment of hazard and risks associated with the project was undertaken as part of the project development process. As a result, the risks and hazards identified are based on existing information about the project at the time of writing, and proposed construction and operational features. Further risks and hazards may be identified in future stages or identified risks could be downgraded or upgraded in terms of the level of risk they pose. Additional mitigation measures as required will be developed and documented in the Implementation Risk Management Plans for the project which will remain live documents throughout the relevant project phases. The consideration of natural hazards is based on existing information about the project area including overlay mapping from the former Caloundra and Maroochy Shire Councils (now Sunshine Coast Council). This enables a high level assessment to be made of the risk of natural hazards in the project area, however, detailed modelling or prediction of natural hazards has not been undertaken.

### 8.2 IDENTIFICATION OF RISKS

Hazards (and related risks) have been identified relating to the three on-ground phases of the project:

- Fencing;
- Revegetation;
- Watering point installation

The project is believed to be both a safe and efficient landslip remediation activity. All activities and phases present some level of risk however, which can be identified through a HRA so that appropriate management measures can be implemented to reduce or remove the risk.

All site visitors will be provided with a site specific induction. Contractors engaged complete with the LBCCG Project Manager, a *Contractor Field Safety Induction Form* (LBCCG Form No. 007) providing current Insurances, accreditations and acknowledgement of Contractor responsibilities.

## 9.0 CULTURAL HERITAGE

The Native Title Determination in November 2012 awarded the Jinibara People non-exclusive title of the Maleny area including Baroon Pocket.

The paramount legislation in Queensland, with regard to Aboriginal cultural heritage issues, is the *Aboriginal Cultural Heritage Act 2003*, which states that a person who carries out an activity must take all reasonable and practicable measures to ensure the activity does not harm Aboriginal cultural heritage (the 'cultural heritage duty of care') (Section 23[1]). The Act defines cultural heritage as (S8):

- a significant Aboriginal area or Aboriginal object
- evidence, of archaeological or historic significance, of Aboriginal occupation of an area.

A significant Aboriginal area is 'an area of particular significance to Aboriginal people' because of either or both of the following:

- Aboriginal tradition
- the history, including contemporary history, of any Aboriginal party for the area (S9).

The Act states that it is an offence for a person to harm, remove or possess cultural heritage if the person 'knows or ought reasonably to know that the object is Aboriginal cultural heritage' (S26).

The Maleny area and particularly the Baroon Pocket area have significant cultural heritage values for a long period of time. Items of cultural heritage significance can be discovered anywhere in the catchment however riparian zones are a likely location.

The project will involve three phases that could potentially unearth artefacts:

1. Fencing – augering and hand digging of post holes up to one metre deep;
2. Revegetation activities – digging of planting holes up to 300 mm deep and regularly spaced throughout the riparian zone of Obio Obi Creek; *and*
3. Earthmoving activities – removing of up to 500 mm of top soil to establish a flat base for concreting and road base access in Obi Obi Creek riparian zone.

All activity locations have been largely disturbed since European settlement (deforestation) and have undergone disturbance in the recent past with crossing construction, revegetation and fencing. Visual inspection of the sites before and during activities will be carried out and if artefacts or suspected features are unearthed activities immediately suspended and the relevant representatives contacted ( James Bulbert, Burnett Mary Regional Group, Ken Murphy, Jinibara Elder).

## 10.0 MONITORING AND EVALUATION

### 10.1 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 occur or reach the final result 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.

### 10.2 MONITORING PROGRAM

Monitoring of rehabilitation activities will be split into periodic and episodic monitoring.

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

Episodic monitoring will occur following significant storm/rainfall events (or extended dry periods) 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.

## 11.0 COMMUNICATIONS

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.

## 12.0 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 Committee | tbc | LBCCG (Management Committee) |
| | tbc | |
| | tbc | |
| Technical advice | Alan Wynn | Sunshine Coast Council |
| | Phil Nash | P & K Nash Earthmoving |
| | | Air and Lift Gear Maroochydore |

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