Lake Baroon Catchment Care Group

Working with our community...for our waterways

Projects 2015-16

Walkers Creek Rehabilitation & Enhancement

(Quick & Gray) Year 2

seqwater WATER FOR LIFE

Sunshine Coast. COUNCIL

PROJECT PLAN

Project No. 1516-010

Lake Baroon Catchment Care Group

This Project Plan has been prepared by, and all enquiries to be directed to:

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Disclaimer

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How to read this Plan

This Plan is split into three distinct sections.

PART A: Executive Summary (pp. 5-6) is a two-page brief description of the project and includes summarised details of the stakeholders, budgets, outputs and outcomes.

PART B: Project Background & Previous Stages (pp. 7-11) is a brief report on project progress and status.

PART C: Project Plan (pp. 12-20) outlines the detail involved in implementing the project and in most cases should explain the project sufficiently.

PART D: Attachments (pp. 21-44) provide 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.

Confidentiality

Much of the information contained herein is confidential and must not be reproduced or passed on to any person outside Seqwater without prior written permission from Lake Baroon Catchment Care Group.

DOCUMENT VERSIONS & APPROVALS

Version	*Date*	*Version/Description*	*Result*
1.0	9/5/2016	Draft LBCCG Project Proposal completed. Project emailed to LBCCG Committee for comments and in principle approval.	n/a
1.0	19/5/2016	Project Plan will be presented at May LBCCG Meeting for approval.	Approved (LBCCG Minutes 88.7.3)
1.0	23/5/2016	Project Proposal forwarded to Seqwater for approval (email)	Approved 6/6/2016 (via email T. Packer)

AUTHORISATIONS

Name	*Signature*	*Date*
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Approved by (LBCCG): Peter Stevens President, LBCCG	[redacted]	19/5/2016
Approved by (Seqwater): TIM PACKER. SENIOR PLANNER – SPP.	[redacted]	6/6/16
Approved by (Seqwater): ANDREW WATKINSON PRINCIPAL – SPP	[redacted]	6/6/16

Cover photo: *TAFE revegetating project site.*

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Sunshine Coast COUNCIL
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PART A EXECUTIVE SUMMARY

PROJECT NUMBER & TITLE: **1516-010 Walkers Creek Rehabilitation and Enhancement (Quick & Gray) Year 2**

Walkers Creek Rehabilitation and Enhancement is being implemented over two adjoining properties, staged over three years and is effectively a continuation of recent projects on neighbouring properties both upstream and downstream (this Plan covers Year 2 of the Project). The project has excluded livestock from 385 metres of Walkers Creek, controlled invasive environmental weeds and replaced them with native vegetation, establishing a vegetated buffer. The riparian vegetation over time will reduce erosion, shade the watercourse reducing temperature, enhancing dissolved oxygen levels and enhance the watercourses ability to mitigate the effects of pollutants originating further upstream. Other benefits include extending wildlife corridors, provision of habitat, improved aesthetic appeal (important to raise awareness of value of riparian restoration) and a reduction in 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	
Phone Number	
E-mail	

PROJECT / SITE LOCATION

Property Address	Bryce Lane, Maleny, 4552	McCarthy Road, Maleny, 4552	
Latitude/longitude	-26.770501 152.862891	-26.771459 152.861088	
RP Numbers (Lot)	RP159524 (1)	RP226879 (15)	
Property Size (ha)	2.5	1.2	
Existing Land-use	Residential/grazing	***Stock Carried***	15
Sub-Catchment	Walkers Creek	***Management Unit***	WA2
M.U. Priority *(LBCCG IP)*	**Moderate**	***M.U. Priority*** *(Pollution)*	**Moderate**
Water Quality	98% 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 (**$26,909** over 3 years) **$9,372** in 2015/16 (increase of $3,477 from original proposal)
Lake Baroon Catchment Care Group (Seqwater 2014-15 Administration Funding)	Project coordination, administration, reporting, monitoring & evaluation (**In kind $6,000**)
Sunshine Coast Council (Landholder Environment Grants)	Technical advice (previously funded $8,988 in 2014/15)
Graeme Quick	Landowner, labour, funding (**$12,120**)
Matthew Gray	Landowner, labour, funding (**$4,920**)
East Coast TAFE	Labour (estimated $1,800 per year)

PROJECT DETAILS

Start Date	July 2014	***Completion***	June 2017	**Duration** (implementation)				3 years	
TOTAL OUTPUTS (2015/16)									
Riparian fencing	470 m (0)	***Reveg-etation***	2,050 plant (1,000)	***Weed mgt***	10,000 m^2 (0)	**Plants maintained**	(1,050)	**Stream crossing**	(1)
OUTCOMES									
Length of watercourse fenced/protected	385 metres								
Length of wildlife corridor	385 metres								
Area of habitat created/enhanced	1 hectare								
Landholder engagement	2 land managers								

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 (2015/16 stage) aims to complete three components:

1. Plant 1,000 stems in the Walkers Creek riparian zone;
2. Continue weed management activities;
3. Maintain plants installed in 2014/15 (1,050 stems); *and*
4. Install low level concrete stream crossing.

The project is a continuation of several recent projects on neighbouring properties. These projects include:

1. Walkers Creek Restoration (Stage 1 & 2) – immediately upstream on Walkers Creek;
2. Erowal Riparian Fencing & Off Stream Watering – immediately downstream on Walkers and Obi Obi Creeks;
3. Mid Obi Riparian Corridor – downstream on Obi Obi Creek; *and*
4. Maleny Community Precinct Revegetation Fencing (Stage 1, 2 & 3) – upstream on Obi Obi Creek.

All of these projects, including Walkers Creek Rehabilitation and Enhancement aim to exclude livestock from the Walkers and Obi Obi Creek riparian zones, installing fencing and off stream watering where required, managing environmental weeds, and revegetating banks to establish buffers. Vegetated buffers enable us to manage risks to water quality effected by livestock grazing and access, restore riparian zones to a 'natural' condition reducing water temperatures, improving dissolved oxygen, reducing nutrients, pathogens and sedimentation. The act of fencing 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 naturally regenerating, revegetation is required to provide long term management. Indeed many landholders' primary motivation for erecting fencing is to enable revegetation and the associated benefits (in addition to 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 Walkers Creek reducing turbidity and sedimentation;
- reduce direct faecal deposition (nutrients and pathogens) to Walkers Creek;
- extend wildlife corridors linking Obi Obi Creek, Walkers Creek and Fryars Creek (eventual linking MC Park);
- return Walkers 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;
- provide demonstration site (previous nearby projects has led to greater landholder awareness and a series of related projects); *and*
- provide learning opportunities for Conservation and Land Management students (East Coast TAFE);

***NOTE – VARIATION TO PROJECT*. Graeme Quick passed away in 2015, significantly affecting the project as Graeme was originally planned to be responsible for much of the revegetation, weed management and maintenance on his reach of Walkers Creek. As a consequence LBCCG has assumed a greater role in the project to ensure it continued as planned. It is proposed to increase the project budget so that appropriate maintenance can be continued. This will be funded by completing the Restoring Bridge Creek project (1516-003) one year early (the project is sufficiently advanced and a small budget remains from 2014/15 to continue minor maintenance) thus freeing up $3,477.00. These funds will be transferred to the proposed project.**

Note: the project was identified as a priority in the LBCCG 2015-16 Annual Investment Strategy.

PART B PROJECT BACKGROUND & PREVIOUS STAGES

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 is being implemented over two properties staged over three years (primarily to ensure adequate control of invasive bamboo and to ensure the landholders can effectively maintain the sites) and is effectively a continuation of recent projects on neighbouring properties both upstream and downstream (*see Table below*).

The activities of LBCCG are supported by Seqwater as they align with Seqwater's commitment to the NHMRC Framework and to environmental stewardship by supporting catchment planning and targeted remediation for reduction of catchment based risks to water quality (Smolders 2011).

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 install riparian fencing, control invasive environmental weeds and the revegetation of riparian zones are considered sensible to support.

ii. BACKGROUND

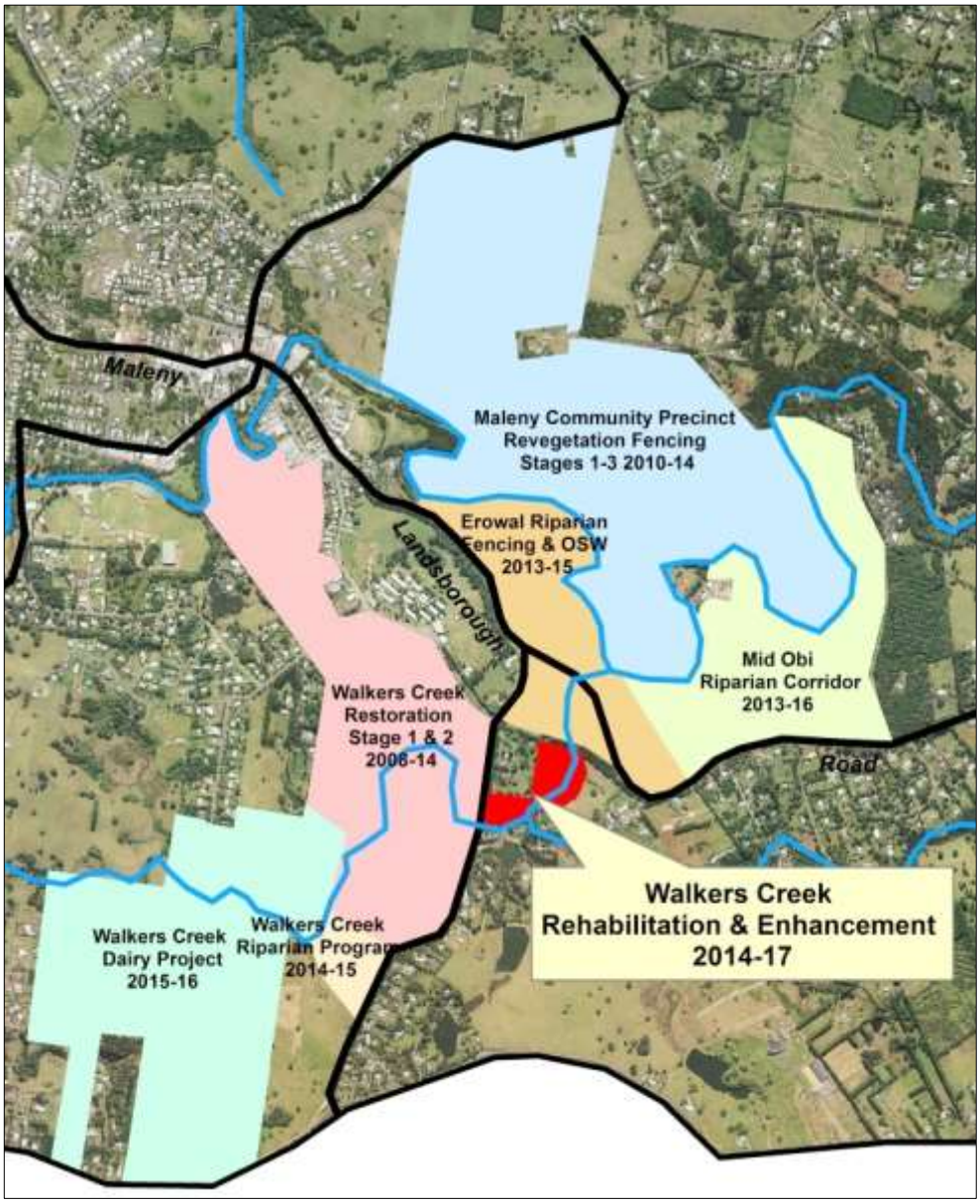
The project developed from a partnership between the landowners (Graeme Quick and Matthew Gray), Lake Baroon Catchment Care Group and Sunshine Coast Council. A successful application by the landholders to the Sunshine Coast Council Landholder Environment Grants (LEG) program led to LBCCG supporting and providing resources to the project to provide greater outcomes.

Over the past several years LBCCG have been very active in this location (the confluence of Obi Obi and Walkers Creeks). These projects have demonstrated to neighbouring landholders the benefits of rehabilitation and remediation leading to further enquiries about being involved in remediation activities. Eventually it is LBCCG's aim to 'capture' as much of the Walkers and Fryars Creek catchments providing not only water quality benefits but also broader environmental outcomes such as linking Mary Cairncross Park with remnant vegetation in the lower Obi Obi Creek.

iii. PREVIOUS PROJECTS IN AREA/CATCHMENT

LBCCG projects in the immediate location include:

Project Name	*Years implemented*	*Project outputs*	*Total Project Value*
Walkers Creek Restoration Stage 1	2008-09	Waterway crossings, laneway hardening, dairy hardstand concreting, riparian fencing, riparian revegetation	$196,057
Maleny Community Precinct Revegetation Fencing Stages 1-3	2010-2014	Riparian fencing	$353,314
Erowal Riparian Fencing & Off Stream Watering	2013-2015	Riparian fencing, off stream watering, weed management	$47,910
Walkers Creek Restoration Stage 2	2013-14	Dairy hardstand concreting, dairy effluent management	$54,289
Mid Obi Riparian Corridor & Mid Obi Riparian Corridor Protection	2013-14	Riparian fencing, off stream watering, weed management	$119,872
Walkers Creek Riparian Program	2014-15	Riparian fencing, off stream watering, revegetation	$24,583
Walkers Creek Dairy Project	2015-16	Dairy laneway construction & rehabilitation, stream crossing	$95,550



LBCCG projects since 2008 in the immediate area of the proposed project. Note the figure indicates the property individual projects occurred – not the actual on-ground activity. Proposed project is identified by red.

1.0 CURRENT STATUS

Project commenced in 2014/15 (see 1415-010 Walkers Creek Rehabilitation & Enhancement). Originally designed as a three stage project taking into account the ability of the landholders to implement and maintain works, unfortunately the passing of Graeme Quick has meant an adaptive approach is required to continue the project.

All fencing was completed as per the original plan. Weed management has continued as planned although the success of the bamboo control was somewhat unexpected. East Coast TAFE have been utilised to plant the majority of the revegetation (instead of the landholders) and has been brought forward to accommodate their availability and to provide maintenance flexibility.

Originally the revegetation was designed around the risk of frost, however circumstances has meant we are taking a higher risk approach with the advantage being we can reduce overall cost and when the project is completed the revegetation will be further advanced meaning less maintenance burden for the landholders.

1.1 FENCING

Riparian fencing was completed as planned and within budget.

Fencing being installed. Note the fence (to be removed) in the foreground with debris from a flooding event experienced in April 2015.

1.2 WEED MANAGEMENT

Several methods of weed management have been utilised. A posi-track mulcher was used to slash the running bamboo and mulch into a coarse ground covering layer. When the bamboo re-shot it was sprayed. It was initially expected the bamboo would require up to two years of respraying to control, however it appears to have taken far less.

Posi-track mulcher slashing bamboo at ground level and mulching.

Totem Fauna & Flora clearing privet and lantana (and other environmental weeds) from the Walkers Creek riparian zone.

Privet and lantana was removed in the planting areas however it has been retained on the water's edge to provide protection for the freshly planted tubestock,

continue to shade the stream and provide bank protection. When the revegetation has established the remaining privet will be stem injected and allowed to decompose in-situ.

1.3 REVEGETATION

Originally planned to be primarily completed by the landholders, the unfortunate passing of Graeme Quick has meant East Coast TAFE have been utilised to revegetate the Quick reach.

East Coast TAFE in-fill planting.

Several methods of revegetation have been used. Stems planted higher up the bank have utilised corflute guards and Recover weed mat. These are unlikely to be washed away in a flood event.

Plants unlikely to be severely affected by flooding were protected by corflute guards.

Stems planted on the lower bank have not been guarded but have had a Recover weed mat pinned down with a 25 mm x 25 mm flood stake installed immediately on the upstream side. The stake will collect any debris during a flood event protecting the freshly planted stem.

Plants on the lower bank do not have guards but rather have a 'flood' stake installed to catch debris during flood events.

Revegetation twelve months from planting. Pioneer species planted to shelter the slower growing long-lived species have performed very well.

1.4 OTHER ACTIVITIES

Weed management of the site was initially planned to be completed over a three year period. This was designed to reduce the water quality impacts on the site, ensure weed control was sustainable, effective and manageable.

An unforeseen consequence has been the discovery of the endangered Giant barred frog on both sites (Quick and Gray). Thought to require near pristine stream conditions, it has been found in both heavy privet cover (Quick) and revegetation area (Gray).

Photo by Matt Gray (29/2/2016) – Gray property.

Photo by Jason Flynn (16/2/2015) – Quick property.

The discovery on the Quick site in early 2015 while clearing small leaf privet led to a modification of the weed management component of the project. More cover than normal was retained and debris was left in the riparian zone.

The discovery on the Gray site occurred in early 2016 essentially when all components of the project have been completed (except for ongoing revegetation maintenance and minor weed management. Therefore there has been no change to the project on the Gray property.

The Giant Barred Frog (*Mixophyes iterates*) is a very large frog listed as Endangered in Queensland and nationally.

The species occurs from south east Queensland to mid-east New South Wales and has experienced significant decline – particularly during the 1980s. Although some of the decline can be attributed to chytrid fungus disease, the frog is thought to require specialised environmental conditions such as shallow rocky rainforest streams with intact vegetation and good water quality.

Threats include loss and fragmentation of habitat, declining water quality and flow regimes, introduced fish, livestock trampling of riparian zones and faecal deposition, and weed invasion.

Recovery actions include the protection and restoration of riparian zones including improving connectivity, implement ecologically sensitive weed management in riparian zones and population monitoring.

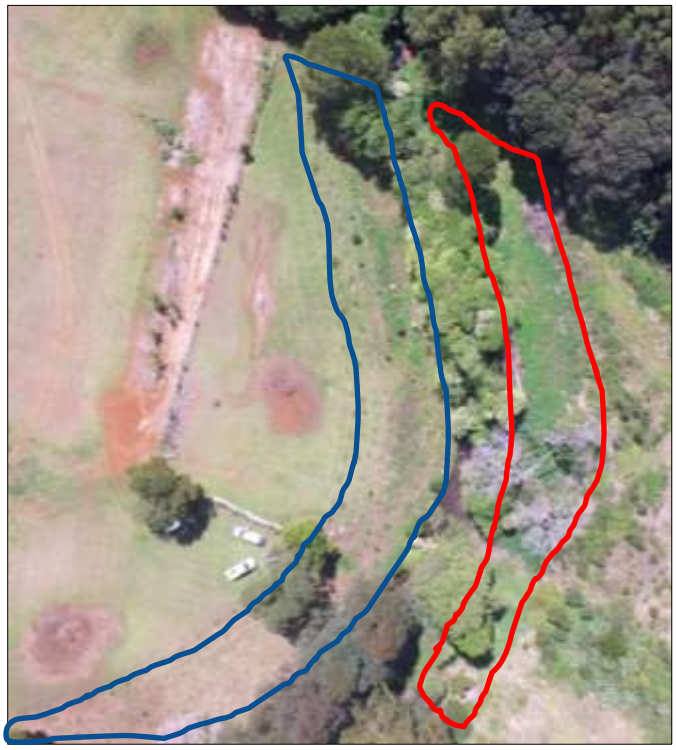
PART C PROJECT PLAN

1.0 WHAT

(Activities to be implemented)

The proposed project stage aims to complete four components before June 30, 2016 (weather dependent):

1. Plant 950 stems in the Walkers Creek riparian zone);
2. Continue control of woody weeds, including running bamboo;
3. Maintain 450 stems planted in 2014/15; *and*
4. Install low level concrete stream crossing to enable landholder to assume larger proportion of maintenance.



Quick property with areas marked for revegetation in 2015/16. Red area is eastern bank. Blue area is completion of in-fill on the western bank.

2.0 WHERE

(Project location)

The project will be implemented on two adjoining properties in the Walkers Creek catchment, although in 2015/16 activities will predominantly occur on the Quick property..

(a) Graeme Quick rural residential property
16 Bryce Lane, Maleny

Property is approximately 2.5 hectares – comprising the following:

- 1.6 ha of unimproved pasture and lightly vegetated areas;
- 0.3 ha of residential;
- 0.6 ha of riparian zone including Walkers Creek;

Walkers Creek splits the property in two with a total length of approximately 235 metres. The riparian zone is virtually devoid of native vegetation and degraded by several environmental weed species (in order of priority) – bamboo spp., small leaf privet, lantana and camphor laurel. Isolated native species include Blackwood wattle (*Acacia melanoxylon*) and *Eucalypt spp*. (appear to have been planted). Currently livestock from the neighbouring property to the east access the riparian zone although they do not rely on the creek as their only source of water.

(b) Matthew Gray residential property
53 McCarthy Road, Maleny

Property is approximately 1.2 hectares – comprising the following:

- 0.86 ha of residential;
- 0.34 ha of riparian zone including Walkers and Fryars Creeks;

The property includes the confluence of Walkers and Fryars Creeks. Due to the size of the property there is currently no livestock grazing. Maleny Dairies lies immediately upstream.

3.0 WHY

(What benefits will the project provide)

Lake Baroon Catchment Care Group is focussed on improving raw water quality in the Lake Baroon catchment and achieves this by working with private landholders in the catchment. Supporting landholders to improve land management, in turn provides multiple beneficial outcomes; water quality and broader environmental benefits while providing productivity gains. Catchment activities not only benefit the raw water flowing into one of south east Queensland's most important water storages (hence Seqwater's significant support) but also provides a range of other environmental outcomes which generates support from other funding providers (most notably Sunshine Coast Council).

Seqwater have a clear core business of providing high quality water to the population of the Sunshine Coast Council and to the greater south east Queensland via the Northern Pipeline Interconnector. The project will support the 2015-16 Seqwater Project *"Baroon Pocket Dam – Landslide Remediation Program"* through the provision of access to revegetation sites and the improvement of drainage on the property which will contribute to the stabilisation of land slip prone areas.

LBCCG does not normally implement projects on properties of this size however the proximity to previous projects which effectively builds on previous achievements and the length of watercourse involved means this project will achieve worthwhile outcomes.

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. The land downstream of urban Maleny is generally steep, has relatively poorer soils and is difficult to access which precludes it from being valuable agricultural land. This has resulted in a gradual land use change back to natural vegetation (including weeds) and the rise of 'lifestyle' blocks (including nature refuges). As these landholders do not require an income from the land and have purchased the properties primarily for their natural values, it is straightforward to support these landholders to restore the native vegetation – particularly riparian zones. In the short term it may be more cost effective to support landholders to restore their riparian zones and properties rather than tackle the origin of the contaminants in the upper catchment where all land is valuable for primary production.

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 Walkers Creek reducing turbidity and sedimentation;
- reduce direct faecal deposition (nutrients and pathogens) to Walkers Creek;
- extend wildlife corridors linking Obi Obi Creek, Walkers Creek and Fryars Creek (with the eventual aim of linking Mary Cairncross Park;
- return Walkers 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 (previous nearby projects has led to greater landholder awareness and a series of related projects).

3.1 WALKERS CREEK

Walkers Creek is the most disturbed and polluted waterway in the Lake Baroon catchment, consisting of 15 km of waterway in a sub catchment of 697 ha. Less than 10% of the sub catchment is covered in vegetation, with much of the area significantly disturbed mostly supporting beef or dairy cattle (Dunstan 2007).

Walkers Creek (including its tributary Fryars Creek) has been divided into four Management Units that reflect property boundaries, physiography, vegetation, land use and point and diffuse pollution sources. This provides administrative convenience and the ability to prioritise stream zones more accurately according to various threats.

The proposed project is located within Management Unit WA1. This MU is 340 ha in size and has 8 km of significant waterways.

Riparian vegetation is virtually absent alongside the waterway length, and what is present is largely degraded by environmental weeds.

3.2 RISKS TO WATER QUALITY

In excess, faecal material and associated nutrients (largely nitrogen and phosphorus) and pathogens are high risk to water quality. High levels of nutrients in surface water contribute to algae blooms that result in hypoxic or oxygen-deprived dead zones in water bodies (Baroon Pocket Dam). Throughout history, consumption of drinking water supplies of poor sanitary quality has been linked to illnesses in human populations. These illnesses most commonly present as gastrointestinal-related symptoms, such as diarrhea and nausea (Health Canada 2013).

Sampling for these pathogens is difficult and largely impractical due to the number of types and distribution variability of bacterial pathogens that can be present in animal and/or human wastes, and because detection requires significant resources. As a result, monitoring for a broad indicator of faecal contamination such as *Escherichia coli* is useful in verifying the microbiological quality and safety of the drinking water supply.

Although livestock in watercourses are an obvious risk, contamination can originate in many ways; failing or poorly performing wastewater systems, wildlife and birds, stormwater and so on.

Faecal material can also contain pharmaceuticals — anti-bacterials and hormones — given to some livestock to fight disease and promote growth. (Health Canada 2013).

3.3 WATER QUALITY MONITORING

Analysis of the raw water sampled from the Bridge Creek (Wells Road) sampling site between 1991 – 2005 (Traill 2007) shows:

- Turbidity levels exceeded guideline levels only once however it is unlikely the sampling program is accurately capturing the likely events;
- Nitrate levels exceeded the guideline value 46% of the time although this was falling as dairy farms converted to beef;
- Ammonia levels exceeded the guideline value 48% of the time and varied throughout the sampling period making it difficult to pin point causes;
- Phosphate levels exceeded the guideline level 33% of the time although this is likely to be higher in reality as phosphates attach to sediment and turbidity levels have already been identified as unusually low;
- Total phosphorus levels exceeded the guideline level 44% of the time; *and*
- Faecal coliforms exceeded the guideline level 39% of the time although widely fluctuated during the sampling period.

3.4 OBJECTIVES

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 remnant and regrowth vegetation);
- 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.

3.5 PRIORITY ACTIONS FOR BRIDGE CREEK (AquaGen 2004):

1. Revegetate first order streams throughout the sub-catchment to maximise buffer capacity and reduce erosion potential.
2. Provision of advice, encouragement and incentives to landholders to maintain adequate riparian buffers and erect riparian fencing and manage stock access to waterways. This includes the provision for off stream watering, shade and hardened waterway access points and livestock laneways *(see figure below).*
3. LBCCG in partnership with AquaGen, monitor the quality of stormwater infrastructure (pre and post development) from new developments on overall water quality – particularly sediment, turbidity, and Total Phosphorus.
4. Encourage good farming practices, particularly on floodplains and steep slopes which reduces the rate of soil loss to below that of natural soil forming processes.
5. Actively support SCC Land for Wildlife, NRM Small Grants Scheme (now Landholder Environment Grants) and legal covenant agreement initiatives that protect and rehabilitate remnant vegetation and enhancement projects.
6. Reduce faecal counts within the Bridge Creek catchment by targeting education programs to residents to address existing on-site effluent and wastewater disposal systems and their maintenance requirements.

Baroon Pocket Dam in September 2013 (storage remained closed for almost 12 months). Cyanobacteria blooms disrupt recreational use of the storage and create difficulties in the production of potable water.

4.0 HOW

(How will the activities be implemented)

4.1 REVEGETATION

4.1.1 Quick property

Stage 1 of the planting program consisted of the double spacing of 450 stems on the eastern side of Walkers Creek. These fast growing pioneer species including a high proportion of frost tolerant species are intended to provide a protective canopy from the risk of frost. Stage 2 will involve planting longer lived more desirable species (that generally have little frost tolerance) in between to eventually provide a sustainable and effective riparian buffer.

Stage 1 of revegetation was completed in 2014/15 (double spacing of predominantly 'pioneer' and frost tolerant species in preparation for Stage 2 where longer lived species are planted under the protective canopy).

Stage 3, originally planned for 2016/17 will be brought forward to 2015/16 (late in the year) to take advantage of the labour provided by East Coast TAFE.

4.1.2 Gray property

Revegetation on the Gray property was completed in 2014/15 with minor infill planting throughout 2015/16 by the landholder. No further revegetation is necessary or planned.

Completed revegetation on Gray property.

4.2 WEED MANAGEMENT

4.2.1 Quick property

Weed management is ongoing on the Quick property. Staged to ensure the gradual conversion from weed dominated riparian zone to a sustainable rainforest buffer with minimal impacts to water quality, loss of shade, erosion etc.

The running bamboo was expected to take numerous follow up sprays to control however it appears it is currently under control.

The removal of privet has been a gradual process particularly those trees that form part of the bank of Walkers Creek. These tweed trees are essential for the maintenance of bank stability, providing habitat for aquatic species (the root systems have created overhanging, diverse bank structure), and also keep the water shaded (maintaining water quality).

Weed management will involve the continued gradual removal of woody weeds, control of volunteers and management of new and emerging weeds to the site.

Riparian zone on Quick property.

4.2.2 Gray property

Weed management on the Gray property was completed in 2014/15 with minor ongoing maintenance throughout 2015/16 by the landholder. No further weed management is necessary or planned.

Mulched clumping bamboo on Gray property with revegetation.

4.3 REVEGETATION MAINTENANCE

Good maintenance is an extremely important component of re-establishing vegetation particularly within the first 3 years of planting. Weed growth is very rapid on the Maleny plateau – particularly over the summer months where maintenance must be performed every six weeks. Failure to do so can result in plant mortality, weed infestation and frustrating labour – all of which results in excessive costs to 're-capture' the site.

It is desirable, if not essential, to employ specialists who have the equipment, skills and knowledge to successfully manage revegetation sites and ultimately establish a functioning buffer. Landholders are rarely capable of managing all the maintenance required on large revegetation sites (more than 500 plants) and therefore in an effort to ensure success, LBCCG provides the bulk of support for maintenance. Contractors are selected on their experience, value for money, landholder engagement skills and landholder preferences.

Grass is maintained between the rows of revegetation to reduce erosion and to act as a filter and trap sediments and nutrients during high rainfall events. Glyphosate herbicide is sprayed immediately around the 'Think-Pink' guards reducing competition whilst weed mats placed under the guards minimises weed growth inside the guard. The grass between the rows is occasionally brush-cut so that access is maintained and the site does not become over-grown.

4.3.1 Quick property

In the original Project Plan LBCCG was responsible for only minor revegetation maintenance – mainly during the summer months when the burden was greatest. With the passing of Graeme Quick LBCCG has had to provide more assistance to ensure the initial investment in the property is not lost and the original objectives continue to be met.

It is planned to continue to provide the bulk of maintenance support and will require a greater funding commitment.

4.3.2 Gray property

Matt Gray was always expected to maintain his own revegetation sites with minimal support from LBCCG beyond assisting with the annual purchase of herbicide.

There is no expectation that LBCCG will provide any revegetation maintenance beyond what was planned in the original Project Plan.

4.4 STREAM CROSSING

There is no formal crossing on Walkers Creek to access the eastern side of the watercourse on the Quick property. Currently there is no way of getting a mower across to assist with revegetation maintenance etc.

A low level concrete crossing will be constructed to permit mower access to the eastern bank of Walkers Creek. It is proposed to split the cost of the crossing with Marlene Quick.

4.5 FUTURE STAGES AND ACTIVITIES

The project is scheduled to run for three years, ending in June 2017.

With the discovery of the Giant barred frog there is the possibility minor activities will continue although these will be funded from sources other than Seqwater.

Activities may include monitoring, minor weed management and minor vegetation enhancement.

5.0 WHEN

(When will the activities be implemented)

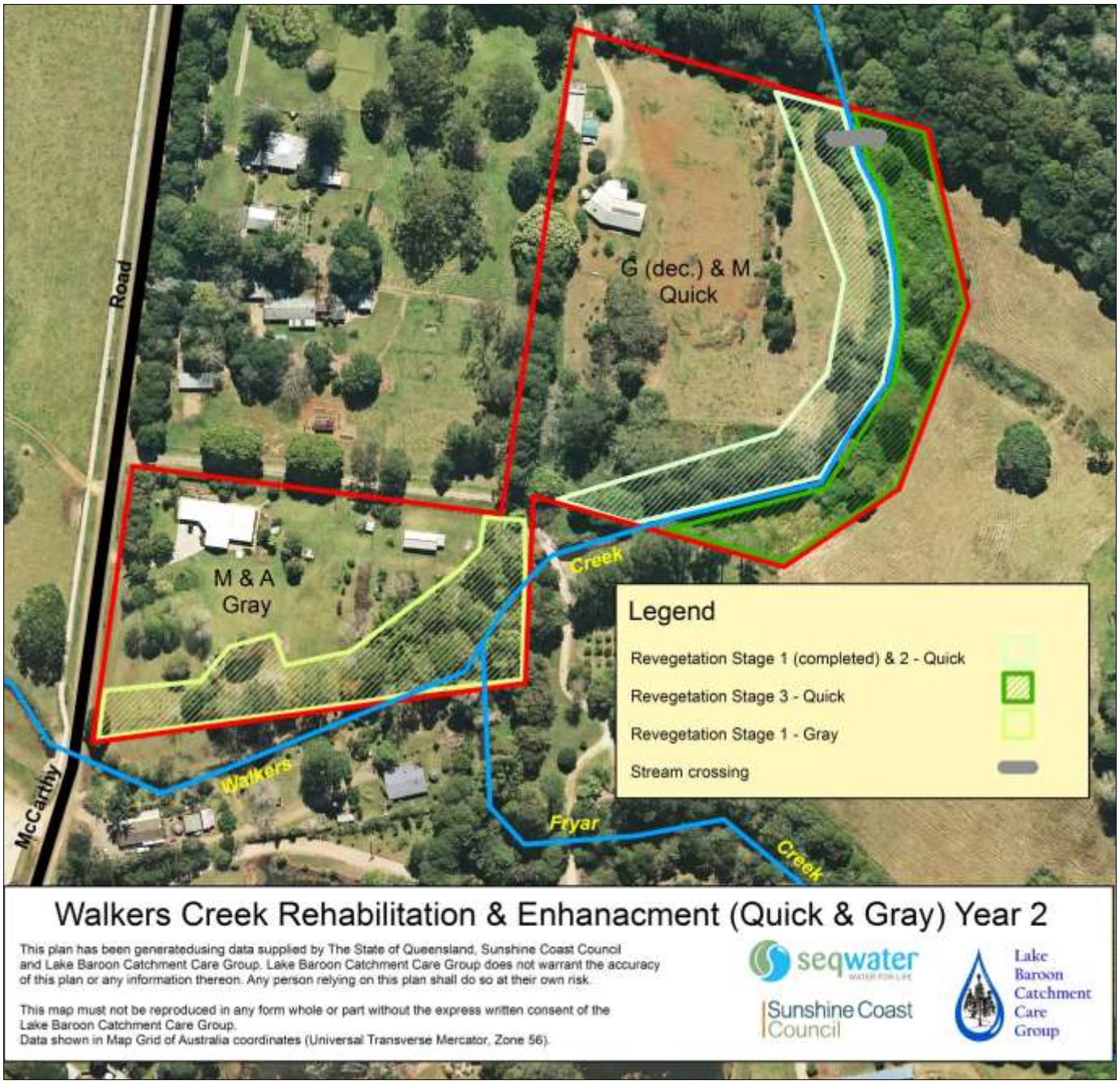
Maintenance and minor weed management has been continuing throughout 2015/16. As the project was approved in a previous year we are essentially proposing the reimbursement of expenditure.

The project has been varied with the increased maintenance assumed by LBCCG and the inclusion of the stream crossing.

It is expected all new works (stream crossing) will be completed by June 30, 2016, and continuing maintenance and weed management will be on schedule.

As per ALL LBCCG projects, completion of activities is weather dependent. We will not compromise the quality of the completed work by adhering to inflexible financial deadlines.

6.0 MAP


Road
McCarthy
G (dec.) & M
Quick
M & A
Gray
Walkers
Creek
Ftyar
Creek
Legend
Revegetation Stage 1 (completed) & 2 - Quick
Revegetation Stage 3 - Quick
Revegetation Stage 1 - Gray
Stream crossing
Walkers Creek Rehabilitation & Enhanacment (Quick & Gray) Year 2
This plan has been generatedusing data supplied by The State of Queensland, Sunshine Coast Council and Lake Baroon Catchment Care Group. Lake Baroon Catchment Care Group does not warrant the accuracy of this plan or any information thereon. Any person relying on this plan shall do so at their own 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).
seqwater
Sunshine Coast Council
Lake Baroon Catchment Care Group

7.0 BUDGET

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

PART D 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 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.

Baroon Pocket Dam. Although the dam and most of the 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.

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).

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. Weed invasion is an indicator that the riparian system is in decline and has the potential to alter the vegetation structure to such an extent that habitat and water quality outcomes are threatened.

The Lake Baroon Catchment Implementation Plan (2007) prioritisation of sub-catchments for works is effective and useful for rehabilitating waterways in the catchment through traditional fencing and revegetation but does not adequately reflect the nutrient and sediment inputs to the waterways through land use, particularly intensive dairy and beef grazing (Dunstan 2007). This method follows traditional 'bush restoration' techniques where sub catchments that are in the best condition that require minimal intervention to realise improvements. However an example of this theory and its application in the Lake Baroon catchment would result in the largely protected, Sunshine Coast Council managed and natural Mary Cairncross Park sub catchment receiving the highest priority for works.

Analysis of raw catchment water quality data (and targeted sampling and analysis) suggests that the Obi Obi Creek downstream of Maleny plays a significant and important role of improving water quality before it reaches Lake Baroon. It has been suggested this is due to a combination of aeration and vegetated riparian buffers over a considerable length of waterway. 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 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 THE WALKERS CREEK CATCHMENT

The Walkers Creek catchment has a high proportion of rural residential properties with associated wastewater systems, roads and stormwater infrastructure – all likely contributing to the poor water quality results.

Walkers Creek on Maleny Dairies. This is largely typical of the MU – little to no riparian vegetation.

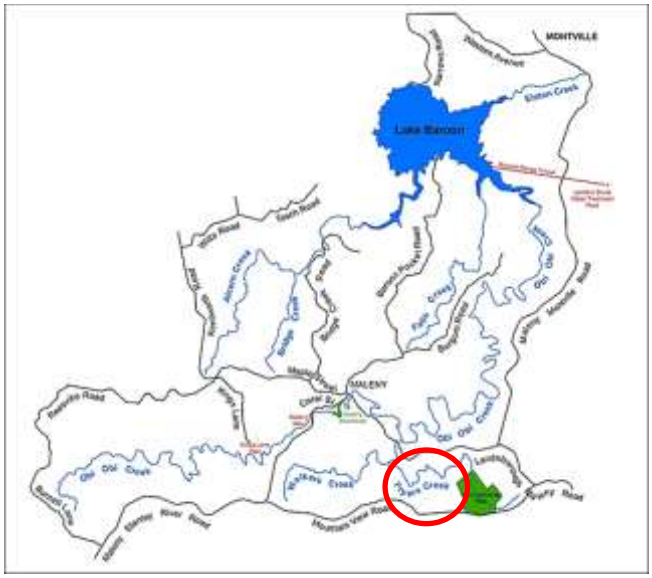
Walkers Creek is the most disturbed and polluted waterway in the Lake Baroon catchment, consisting of 15 km of waterway in a sub catchment of 697 ha. Less than 10% of the sub catchment is covered in vegetation, with much of the area significantly disturbed mostly supporting beef or dairy cattle (Dunstan 2007).

Walkers Creek (including its tributary Fryars Creek) has been divided into four Management Units that reflect property boundaries, physiography, vegetation, land use and point and diffuse pollution sources. This provides administrative convenience and the ability to prioritise stream zones more accurately according to various threats.

The proposed project is located within Management Unit WA1. This MU is 340 ha in size and has 8 km of significant waterways.

Riparian vegetation is virtually absent alongside the waterway length, and what is present is largely degraded by environmental weeds.

2.3 LOCATION



The Quick and Gray properties are located in Management Unit WA2, which encompasses upper Walkers Creek including the headwaters. This MU is a significant contributor of excessive nutrients due to land use and possibly the lack of filtering and buffering riparian vegetation.

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 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.

2.4.2 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 Quick and Gray properties range in elevation between 400 metres above sea level in the bed of Walkers Creek to 405 metres at the highest point. Both properties are relatively flat and have minor flooding issues while the eastern bank on the Quick parcel has a relatively steep bank. 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 are predominantly Red Ferrosols – a deep red clay soil, strongly structured and slightly acidic. These soils are typical of the land to the south 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

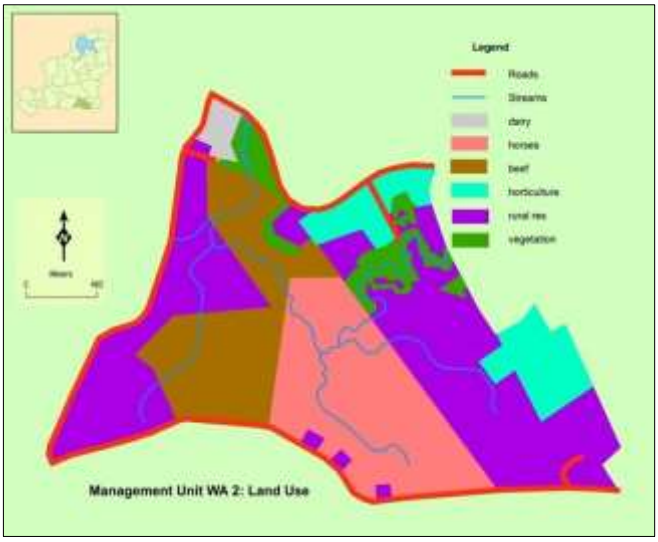
acts as a recharge zone (springs and groundwater) and as a result has low fertility – likely to have been exacerbated by the recent wet summers and high rainfall events (Biggs & Harms 2008).

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).

Land use impacts (Traill, 2007; Dunstan, 2007) include:

- 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 WA2 with the Quick and Gray properties circled.

Land use in Management Unit (WA2) is increasingly rural residential, mainly at the expense of small horticultural blocks. The largest property in the MU is the equestrian property off Mountain View Road.

Beef grazing still occupies around 15-20 % of the MU with dairy grazing restricted to a very small area in the north west corner of the MU. Very little vegetation remains in the MU and the majority that does is the result of revegetation efforts. The MU is very stable, however high loads of nutrients have historically entered the waterways with 98% of samples exceeding ANZECC guideline levels likely due to land use and lack of vegetation – particularly riparian vegetation.

The Quick and Gray properties were traditionally horticulture properties with kiwi fruit the main crop on the Gray property.

2.4.4 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 – impacting on both the use of Plant Pink guards, flood stakes and species selection.

2.4.5 Environmental Factors

2.4.5.1 Significant Vegetation & Ecosystems

Both sites have been predominantly cleared of vegetation to accommodate pastoral and agricultural activities. Remaining vegetation consists of scattered mature remnant trees – primarily on the steeper eastern bank of Quicks. The remaining native vegetation present is regrowth and as expected consists of pioneer species – blackwood wattle, sandpaper fig, callistemon and native quince. Previous revegetation efforts have not necessarily followed correct Regional Ecosystem planting hence varied results. With no remnant vegetation of note existing on site we would assume (taking into account nearby remnant vegetation) that the site would have probably supported RE 12.3.1 and RE12.8.3.

RE12.8.3 – Complex notophyll vine forest

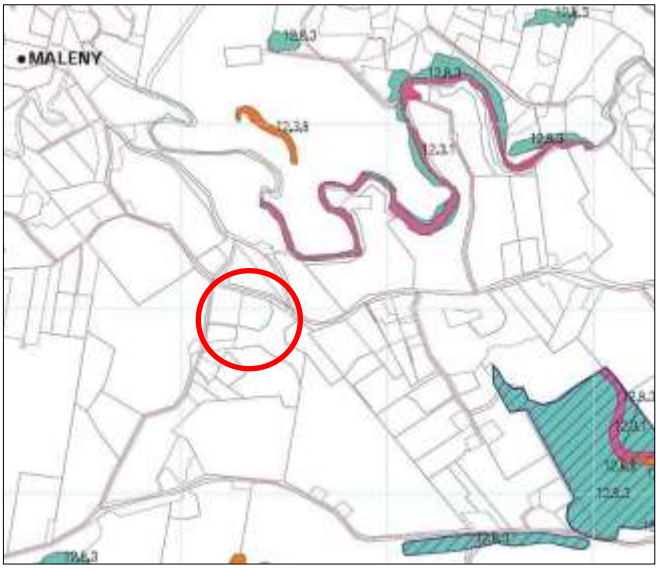
The majority of the two properties would historically have been covered by this Ecosystem. An example of this vegetation can be seen in the riparian zone downstream and upstream in Mary Cairncross Park.

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 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 and upstream in Mary Cairncross Park.

This ecosystem is endangered and therefore considered high priority for protection. Project revegetation will utilise species from these Regional Ecosystems.



Despite the absence of remnant vegetation on the project properties, Walkers Creek provides the best opportunity to re-establish a vegetated linkage between the remnant vegetation in Mary Cairncross Park and vegetation along Obi Obi Creek.

2.4.5.2 Fauna & Connectivity

Although remnant vegetation is absent from both properties, the reinstatement of riparian vegetation on the properties will contribute to the long term goal of linking Mary Cairncross Park with vegetation along Obi Obi Creek.

3.0 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 (personal communications with Seqwater water quality staff). 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 Bridge 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 10% of the sub-catchment is vegetated; with minimal length of waterways supporting riparian cover of varying quality (mostly poor). The MU contributes a large nutrient load to Bridge Creek, with more than 98% of samples exceeding guideline levels (Dunstan 2007). This is most likely due to the number of rural residential properties combined with intensive grazing although the area utilised for dairying has dramatically reduced since 2007 (fall from 66% of the MU to less than 10%). Recent water quality sampling is not available but it is suspected there has been little improvement and most likely a deterioration as rural residential properties have increased and dairy grazing converting to beef grazing is high risk due to the sharp reduction in investment (pasture management, erosion etc). The MU is noted for its poor water quality but this is probably exacerbated by the fact there is insufficient riparian vegetation to filter nutrients originating in the catchment.

The Lake Baroon Catchment Implementation Plan (2007) rates BR1 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, BR1 rates as VERY HIGH; due to the contribution of nutrients and sediments to Bridge Creek.

3.2.1 Statistical Analysis of the Raw Water Quality Data Recorded from Walker's / Fryer's Creeks Junction 1999-2005

This monitoring site lies between the two project properties.

Water quality monitoring and analysis sampled at Walker's / Fryer's Creeks Junction between 1999-2005 by AquaGen shows the catchment contributes excessive nitrates, ammonia, total phosphorus and faecal coliforms.

The Walker's / Fryer's Creeks Junction monitoring site is situated immediately downstream of the confluence of Walkers and Fryars Creeks. The monitoring site was originally placed to monitor the impacts of both intensive agriculture (particularly dairying) and rural residential land use, including the impacts of septic tanks/wastewater treatment systems (estate upstream of Mary Cairncross Park).

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 – see figure). 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 very high with inputs likely to be largely as a result of local and upstream contamination. The land use in the catchment suggests the source of the nitrate nitrogen is from 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.

Parameter	*pH (pH units)*	*Turbidity (NTU)*	*NOx (N) (mg/L) (NITRATES)*	*NH3 (N) (mg/L) (AMMONIA)*	*PO4 (P) (mg/L) PHOSPHATE)*	*Total P (mg/L) (TOTAL PHOSPHORUS)*	*Faecal Coliforms (number/ 100 mL)*
Guideline Value (GV)	***6.5-8.2***	***<25.0***	***<0.040***	***<0.010***	***<0.030***	***<0.030***	***<100***
Max	7.5	200	0.860	1.440	0.258	0.373	60,000
Min	7.5	2.7	0.000	0.000	0.000	0.002	30
Mean	7.5	12.2	0.133	0.203	0.020	0.065	2,586
Median	6.8	8.3	0.099	0.110	0.012	0.057	655
Std Dev	0.2	21.2	0.120	0.255	0.030	0.051	7,948
20th Percentile	6.6	5.3	0.049	0.044	0.003	0.036	240
80th Percentile	6.9	12.3	0.190	0.260	0.035	0.080	1,936
Count outside GV	0	3	91	102	25	96	99
% outside GV	**0.00**	**2.73**	**84.26**	**95.33**	**22.94**	**89.72**	**90.00**

Ammonia levels have remained consistently excessive. 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 level is the dairying in the catchment – notably Maleny Dairies located immediately upstream (ammonia based fertilisers and faecal contamination)

Phosphate levels have remained high over the 1999-2005 period although appeared to decline. 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 with wild variation, although significant rainfall events have probably been missed which would be expected to provide even higher levels. 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 extremely 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.

Note: The routine sampling programs (CalAqua, AquaGen, Seqwater and others) are suspected of not accurately capturing major pollution events. Conducted monthly (1991-1998) 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).

3.3 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.

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.

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 the Quick & Gray properties	**= 3.7 hectares**
Gross value of raw water originating from the properties	***= $30,000 annually***

3.4 PROPERTY MANAGEMENT

Both properties have been recently purchased with the intent to provide rural residential land use. The Quick property will likely carry low numbers of livestock to manage pasture areas.

3.5 OBJECTIVES

Walkers Creek Rehabilitation and Enhancement 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 remnant and regrowth vegetation);
- 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 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 – 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 ideally partnerships with universities and/or Seqwater to produce 'hard' data to prove the effectiveness of projects.

Our project will:

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 (and associated 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 on lower Obi Obi Creek, vegetation adjacent to and within urban Maleny and Mary Cairncross Park. 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 large rural residential areas) 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 projects 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.

3.7 PRIORITY LANDHOLDERS/LAND IN THE LAKE BAROON CATCHMENT

Priority landholders were initially identified in 2007 (updated in 2014) 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.

Neither landholder has been identified as a Priority Landholder due to the small size of their properties. However the proximity to p[previous large LBCCG projects effectively means that we are extending the already substantial length of waterways protected and subsequent reduction in risks to water quality. Sunshine Coast Council have contributed a significant level of funding to the project through the Landholder Environment Grants program.

3.8 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 assist in the management of risk is 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 objectives and outcomes are consistent with:

- 2015-16 LBCCG Annual Investment Strategy (Lake Baroon Catchment Care Group 2014)
- Lake Baroon Catchment Implementation Plan (AquaGen/LBCCG 2007)
- Lake Baroon Catchment Management Strategy (AquaGen/LBCCG 2004)
- Seqwater Natural Assets Management Plan – Lake Baroon Catchment (Seqwater 2012)
- Sanitary Survey of Baroon Pocket Catchment Report (Seqwater 2014)
- Catchment and In-Storage Risk Assessment for Water Quality – Baroon Pocket Dam (Seqwater 2009)
- Sunshine Coast Council Waterways & Coastal Management Strategy 2011-12 (Sunshine Coast Council 2011)
- Mary River and Tributaries Rehabilitation Plan (Mary River Catchment Coordinating Committee 2001)

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 15 and 25 metres of riparian buffer, with an average of approximately 20 metres (property boundaries dictate buffer widths).

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 fencing alignment and protection, and remnant vegetation).

4.2 ACTIVITIES

4.2.1 Revegetation

Revegetation will be planned with the likelihood of severe frost taken into account. With most rainforest species highly susceptible to frost the revegetation program will be staged over three years to allow, initially, the establishment of a frost resilient 'cover crop' (primarily blackwood wattle) and following up with RE appropriate rainforest species. The cover crop will provide a canopy and a barrier to frost, and contribute to the early capture of the site – reducing maintenance burdens as the developing canopy shades weeds.

Planting plan key points (provided by Nick Clancy, Sunshine Coast Council):

- Due to the site being prone to frosts a 50% cover crop planting of Blackwood wattle is recommended.
- Ultimate spacing's to be dictated by width of mower deck being used for maintaining grass/weeds around trees.
- Recommended that lateral braches of wattles to be pruned annually for first 3-4 years.
- The preferred option is to plant wattles at double spacing 4-5M & then infill with additional species in years 2-3.
- Numbers of each species to be used indicated as H (High), M (Medium) or L (Low) expressed as a percentage of total plant numbers.
- If a more diverse planting is preferred in the first instance then species with a 'H' in the notes column to be used.

4.2.2 Weed management

Major environmental weeds that pose a serious and immediate threat due to their ability to alter the structure and composition of a plant community over time, or inhibit natural regeneration will be targeted for management. Environmental weeds currently degrade both properties and provide limited water quality benefits.

These include, but are not limited to:

Weed Species	***Botanical Name***	***Occurrence/Distribution***
Creeping bamboo	*Bambuseae sp.*	Major weed – downstream reach, eastern bank (Quick). Will require ongoing management.
Small-leaf privet	*Ligustrum sinense*	Extensive infestations throughout Quick reach. Minor infestations on Gray property (treated in past). Will require ongoing management.
Camphor laurel	*Cinnamomum camphora*	Isolated individual trees throughout Quick reach. Will be retained to provide protection for establishing revegetation – controlled in final year of project.
Lantana	*Lantana camara*	Light to moderate infestations throughout the project site – minor problem.

The Quick property – particularly the banks of the creek support a heavy infestation of small leaf privet and a spreading bamboo species, along with minor stands of lantana and camphor laurel. Native vegetation is sparse with mature Blackwood wattle, Eucalypt species (likely planted around 10-15 years ago to provide bank stability) and occasional Ficus coronata, Callistemon salignus, Cryptocarya sp.?, and Alphitonia sp.

Normally weeds are not a priority for LBCCG however the proliferation of the spreading bamboo presents a high risk to the environmental value of both the Quick property but also the likelihood it will spread downstream into neighbouring properties and other LBCCG projects. The bamboo forms a monoculture by outcompeting native species which may improve the stability of watercourse banks in the short to mid-term, but is likely in the long term to alter the hydrology of the bed and banks and affect water quality by altering dissolved oxygen levels and habitat.

To successfully manage and ultimately control these woody weeds will require a staged approach. The bamboo will be the most difficult to manage and therefore will require several methods of control. In the first year of the project (2014-15) it will be mulched utilising a tractor, or posi track mounted mulcher converting the bamboo from standing material to coarse mulch. Disturbance to surface roots may affect the vigour of the weed. As the bamboo reshoots it can be carefully spot sprayed although it is likely it will take an extended period before control is achieved (2015-16).

The majority of the privet present is growing immediately on the water's edge and will be controlled over a three year period to ensure that bank stability and habitat is maintained. In situ stem injection will be the primary control method although isolated stands away from the water's edge will be mulched when the bamboo is mulched.

The small infestation of lantana will be removed by hand. The several mature camphor laurels will be retained until 2016-17 as they are providing some protection (particularly from frost) while the revegetation establishes. In situ stem injection will be utilised to treat the individual trees.

The Gray property has had revegetation programs occur over the years – including some inappropriate plantings resulting in poor establishment. Several weed species have also been planted in an attempt to provide landscaping and have become difficult to manage including a stand of clumping bamboo (different species than on the Quick property). Many of these weeds will be treated over an extended period so as to continue to provide protection for the establishing revegetation.

Follow up woody weed management (from six to thirty six months) will be regularly performed to ensure weeds do not re-establish or new weeds appear and establish.

4.2.3 Revegetation maintenance

Good maintenance is an extremely important component of re-establishing vegetation particularly within the first 3 years of planting. Weed growth is very rapid on the Maleny plateau – particularly over the summer months where maintenance must be

performed every six weeks. Failure to do so can result in plant mortality, weed infestation and frustrating labour – all of which results in excessive costs to 're-capture' the site.

It is desirable, if not essential, to employ specialists who have the equipment, skills and knowledge to successfully manage revegetation sites and ultimately establish a functioning buffer. Landholders are rarely capable of managing all the maintenance required on large revegetation sites (more than 500 plants). However on this project, with planting staged over three years, the relatively level conditions and the landowners owning ride on mowers, maintenance can be largely managed by them. LBCCG however will, when necessary provide some support for maintenance to ensure the landholders, in particularly Graeme Quick maintains control over the site.

Grass is maintained between the rows of revegetation to reduce erosion and to act as a filter and trap sediments and nutrients during high rainfall events. Herbicide is sprayed immediately around the 'Plant-Pink' guards reducing competition whilst weed mats placed under the guards minimises weed growth inside the guard.

The grass between the rows is regularly mown so that access is maintained and the site does not become over-grown. This is particularly important on this site as considerable effort is expended on keeping weeds and long grass under control. This may also limit the impacts from frost.

4.2.4 Stream crossings

Effective crossings are essential for safe negotiation of watercourses for livestock, vehicles and people. Crossing design can vary greatly but due to the hydrology and topography of the Lake Baroon catchment the low level crossing is usually the ideal design. One suitable crossing will be constructed on Walkers Creek allowing vehicle and livestock passage.

Low level crossings sit at bed level and therefore provide little to no obstruction to water flow and are therefore unlikely to be damaged by floods and/or debris. Furthermore they do not greatly obstruct aquatic passage – relative to natural obstructions commonly found throughout the catchment.

Constructed with reinforced concrete the expected useful life of these crossings are anticipated to be at least fifteen years but more likely 20 years, resulting in these crossings being very cost effective.

Formalised crossings protect livestock and watercourses from the issues associated with unrestricted access. The benefits include (Water and Rivers Commission 2000):

- improved water quality by limiting sedimentation and nutrient enrichment;
- enhanced livestock health through access to cleaner water;
- reduced loss of productive land and livestock deaths;
- provision of a relatively cheap option for providing livestock watering;
- maintaining river pools to provide a water source that is available for longer periods of year;
- stabilisation of the river banks and bed; *and*
- improved riparian vegetation and riverine habitats.

Crossings can be designed to provide many other ecological benefits such as (Water and Rivers Commission 2000):

- having a riffling effect which aerates the water and provides a variety of riverine micro- habitats;
- allowing for aquatic passage;
- maintaining stream pools that are important in providing summer refuges and breeding areas for certain aquatic animal species, such as platypus, fish and crayfish; *and*
- contributing to channel stability by controlling the velocity of flow and reducing the downstream movement of sediments.

Low level concrete crossing construction

Installation of a stream crossing will reduce risks to water quality, reducing nutrient, sediment, pathogen, and organic matter loads to streams. A formal crossing will also reduce streambank and streambed erosion. Stream crossings can provide cattle with improved access to pastures thereby improving grazing distribution while reducing the likelihood that cattle will be injured. Stream crossings also improve vehicle access for weed management, pasture improvement, erosion management and other activities that influence the quality of water flowing off properties. Stable stream crossings can help prevent farm equipment damage by providing a smooth entrance and exit.

A good crossing is one that serves the purpose for a long time and requires minimal maintenance. The design must allow for a range of flow conditions and sustain as little damage as possible when flooding occurs. It is also essential to ensure that the crossing will have negligible environmental impacts.

Other than providing access across a stream for people, vehicles and livestock, a well-designed crossing provides environmental benefits. Restricting crossings to one point will greatly reduce local erosion and protect riparian vegetation from stock; further stabilising stream banks, and can greatly assist in managing nutrient input to the stream system (Janicke & Murray 2008).

5.0 ACTION PLAN

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

Action Plan refers to Year 2 of the Project only (2015/16).

Action		***Responsibility***	***Start Date***	***Completion Date***	***Measurable Output***
LBCCG Project Proposal Year 2		LBCCG Project Manager	May 16	May 16	Project Plan
Project presented to LBCCG Committee for approval		LBCCG Project Manager & Committee	May 16	May 16	Approved Plan (LBCCG)
Project forwarded to Seqwater for approval		LBCCG Project Manager	May 16	May 16	Approved Plan (Seqwater)
Pre-works monitoring (including photo points)		LBCCG Project Manager	Apr 14	May 16	Photo & data set
PROJECT IMPLEMENTATION	Continuing weed management	Contractor, landholders	Jul 15	Jun 16	1 hectare
	Continuing revegetation maintenance	Contractor	Jul 15	Jun 16	450 stems maintained
	New revegetation	Landholder, TAFE	May 16	June 16	950 plants
	Stream crossing	Contractor, landholder	May 16	Jun 16	1 crossing
Progress report.		LBCCG Project Manager	Jan 15	Jun 17	30 Reports (LBCCG meetings)
Post-works monitoring.		LBCCG Project Manager	Feb 15	Jun 2015 ongoing	Photo & data sets
Project completed/signed off. Final Report.		LBCCG Project Manager & Committee	Jun 17	Sep 17	Final Report

Note – the Project Action Plan will be used as the basis for Monthly Reporting (LBCCG Management Committee meetings)

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)***
Stream crossing	P&K Nash Excavations	Phil Nash
	Sommers Bros. Earthmoving	Ron Sommers
Weed management	Totem Fauna & Flora	Jason Flynn
	J & J Bateman	Jono Bateman
Revegetation materials	BD Products	Tony Paton
	Fernland Nursery Supplies	-
Tubestock	Barung Landcare	Wayne Webb
	Brush Turkey Enterprises	Karen Shaw
Revegetation maintenance	J & J Bateman	Jono Bateman
	Totem Fauna & Flora	Jason Flynn
Revegetation	East Coast TAFE	Chris Townsend

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 must demonstrate full insurance and liability requirements and that all staff or personnel on site are appropriately trained and/or experienced.

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 need to 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

Landholder to coordinate Contractors and liaise with LBCCG where required.

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

1. Stream crossing;
2. Revegetation;
3. Weed management; *and*
4. Revegetation maintenance

The project is believed to be both a safe and efficient livestock management project. 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 five activities that could potentially unearth artefacts:

1. Stream crossing– shallow excavation up to 300 mm within bed, banks and riparian zone of Walkers Creek; *and*
2. Revegetation – shallow holes up to 250 mm deep in riparian zone.

All activity locations other than the areas of intact remnant vegetation have been largely disturbed since European settlement (deforestation) and have undergone significant movement of soil layers – particularly the areas to involve earthmoving activities. 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 representative contacted (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, particularly the LBCCG funded component – the waterway crossing and drainage works 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 REPORTING

Project updates will be provided at monthly LBCCG meetings.

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.

Reporting will be ongoing until the monitoring phase of the project is complete (December 31, 2016). PowerPoint presentations presented at LBCCG Management Committee meetings will be converted to PDF and placed on the LBCCG website and forwarded to Seqwater.

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	Jason Flynn	Contractor
	Phil Nash	Contractor
	Tim Odgers	Seqwater
	Matt Bateman	LBCCG Project Officer
	Alan Wynn & Nick Clancy	Sunshine Coast Council

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