Lake Baroon Catchment Care Group

Working with our community...for our waterways

Projects 2015-16

Northern Alcorn Creek (Colley)

seqwater WATER FOR LIFE

Sunshine Coast. COUNCIL

PROJECT PLAN

Project No. 1516-006

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

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Disclaimer

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

How to read this Plan

This Plan is split into three distinct sections.

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

The **Project Plan** (pp. 7-18) outlines the detail involved in implementing the project and in most cases should explain the project sufficiently.

The **Attachments** (pp. 20-42) 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.
Landslide and land slip are used interchangeably throughout the document. Land slip is the more commonly used term in the Lake Baroon catchment while Seqwater documents use the term landslides.

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	12/4/2016	Draft LBCCG Project Proposal completed. Project emailed to LBCCG Committee for comments and in principle approval.	n/a
1.0	18/4/2016	Project Plan will be presented at April LBCCG Meeting for approval.	Approved (Minutes 87.7.3)
1.0	26/4/2016	Project Proposal forwarded to Seqwater for approval (email)	Approved 5/5/2016
2.0	Apr 2016	Application to Sunshine Coast Council Landholder Environment Grants	TBD

AUTHORISATIONS

Name	*Signature*	*Date*
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Approved by (LBCCG): Peter Stevens President, LBCCG		18/4/2016
Approved by (Seqwater): Tim Packer Senior Planner, I & CM		5/5/2016
Approved by (Seqwater): Andrew Watkinson Principal Source Protection Planning		5/5/2016

Cover photo: *Alcorn Creek on the Colley property.*

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Sunshine Coast COUNCIL
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PART A EXECUTIVE SUMMARY

PROJECT NUMBER & TITLE: **1516-006 Northern Alcorn Creek (Colley)**

Northern Alcorn Creek will be implemented in a high priority sub-catchment that delivers high levels of nutrients and high volumes of sediment to Bridge Creek and ultimately Baroon Pocket Dam. The Colley property has recently changed ownership with plans to operate as a viable grazing enterprise, with supplementary income from farm-stay accommodation. The property is large for the catchment and can support grazing however there are several key management issues – steep, unstable hillslopes and benches (landslips), moderately fertile soils that are easily compacted and eroded, and multiple watercourses fed by springs and soaks. The project will commence the address of several issues considered high priority, with the key aims of reducing soil loss; management of livestock in riparian zones and on unstable slopes, remediation of landslips and improve property access.

APPLICANT/LANDMANAGER DETAILS

Names	[redacted]
Postal Address	
Phone Number	

PROJECT / SITE LOCATION

Property Address	Witta Road, Witta	**Property Name**	n/a
Latitude/longitude	-26.732409 152.831330		
RP Numbers (Lot)	SP 180347 (11)	***Property Size***	90 hectares
Existing Land-use	Beef	***Stock Carried***	100 +
Sub-Catchment	Bridge Creek	***Management Unit***	BR1
M.U. Priority *(LBCCG IP)*	**Low**	***M.U. Priority*** *(Pollution)*	**Very High**
Water Quality	More than 95% of samples between 1991-2005 exceeded ANZECC guideline levels (Traill 2007)		

PROJECT PARTNERS/STAKEHOLDERS & ROLES

Lake Baroon Catchment Care Group (Seqwater 2015-16 CORE Project Funding)	On ground project implementation **($43,179**)
Lake Baroon Catchment Care Group (Seqwater 2015-16 CORE Administration Funding)	Project coordination, administration, reporting, monitoring & evaluation (**In kind $8,000**)
Seqwater (2015-16 Lake Baroon Landslide Mitigation Program)	Landslide project funding **($26,744)**
Sunshine Coast Council (Landholder Environment Grants)	Project funding Landholder Environment Grants application submitted in April 2016 **($7,215.46)**
Nathan Colley	Landowner, labour, cash and in-kind contributions (**$25,235.00** cash & in-kind)

PROJECT DETAILS

Start Date	May 2016	***Completion***	June 2017	**Duration** (implementation)	1 year (Stage 1)
OUTPUTS					
Stream crossings	2	***Laneway rehabilitation***	100 m	***Laneway realignment***	325 m
Riparian fencing		550 m	***Landslide fencing***		650 m
Drainage	3 ha	***Weed management***	5 ha	***Landslide revegetation***	800 stems
OUTCOMES					
Length of watercourse fenced (stock managed)					220 metres
Area of weed management					5 hectares
Area of landslip drained					3 hectares
Area of landslip revegetated					2 hectares + (tbd)
Priority Landholder engagement					1 landholder

1516-006 Northern Alcorn Creek (Colley)

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 Colley property lies in a high priority sub-catchment (Management Unit) in the Bridge Creek catchment – MU BR1. This MU is characterised by steep slopes, heavy black cracking clays, intensive livestock grazing, and numerous permanent watercourses fed by springs and soaks. As a result, the Management Unit contributes very high volumes of sediments generated by numerous landslips, high levels of nutrients (and likely pathogens) and threats to remnant vegetation and habitat.

The proposed project aims to complete ten components from four contributors:

Activity	Description	Funded by
Riparian fencing	550 metres	LBCCG Core funding
Stream crossings	2	LBCCG Core funding
Rehabilitate livestock laneway	100 metres	LBCCG Core funding
Block unnecessary access to Alcorn Creek	1 gate/fencing	LBCCG Core funding
Extend existing off stream watering system	4 troughs	LBCCG Core funding & Sunshine Coast Council LEG funding
Landslide fencing	650 metres	Seqwater Landslide Mitigation Program
Revegetation of landslip prone hillslope	800 local pine species	Seqwater Landslide Mitigation Program
Drainage of waterlogged areas & re-profile	3 hectares	Nathan Colley
Weed management	5 hectares	Nathan Colley
Realign livestock laneway	325 metres	Nathan Colley

The project will engage multiple Contractors, each selected on their ability to provide a specific service. The project supports and is linked to the upcoming 2015/16 Lake Baroon Landslide Mitigation Program (Seqwater) and indeed some of the outcomes of the Lake Baroon Core funding, and contributions from the landholder will assist in the delivery of the Landslide program (drainage, weed management and access).

The project will achieve multiple benefits including:

- manage grazing of riparian zones;
- stabilise stream banks and beds;
- reduce erosion and associated sediments from livestock laneways;
- stabilise landslip prone hillslopes;
- establish riparian buffers to trap and filter contaminants;
- enhance aquatic habitat;
- improve property management;
- protect property infrastructure; *and*
- reduce risk to water quality by limiting sedimentation and nutrient enrichment.

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

PART B PROJECT PLAN

i. INTRODUCTION

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

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

The project will be implemented over one property and likely be staged over multiple years (landslide mitigation and further property management activities, monitoring and evaluation) 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 construct stream crossings, rehabilitate and construct laneways, install riparian fencing and undertake landslip remediation (drainage, fencing and revegetation) are considered sensible to support.

ii. BACKGROUND

The Alcorn Creek catchment has been targeted for on ground activities (projects) since 2011 as this sub-catchment is recognised as delivering high volumes of sediment, nutrients and other contaminants. Prior to 2011 no LBCCG projects had been implemented in this largely hidden valley as it was dominated by large agricultural properties that had little concern for water quality and the environment.

A concerted effort to engage landholders, followed by the sale of key properties, including the Colley property, has enabled LBCCG to build several projects on adjacent properties and build widespread engagement.

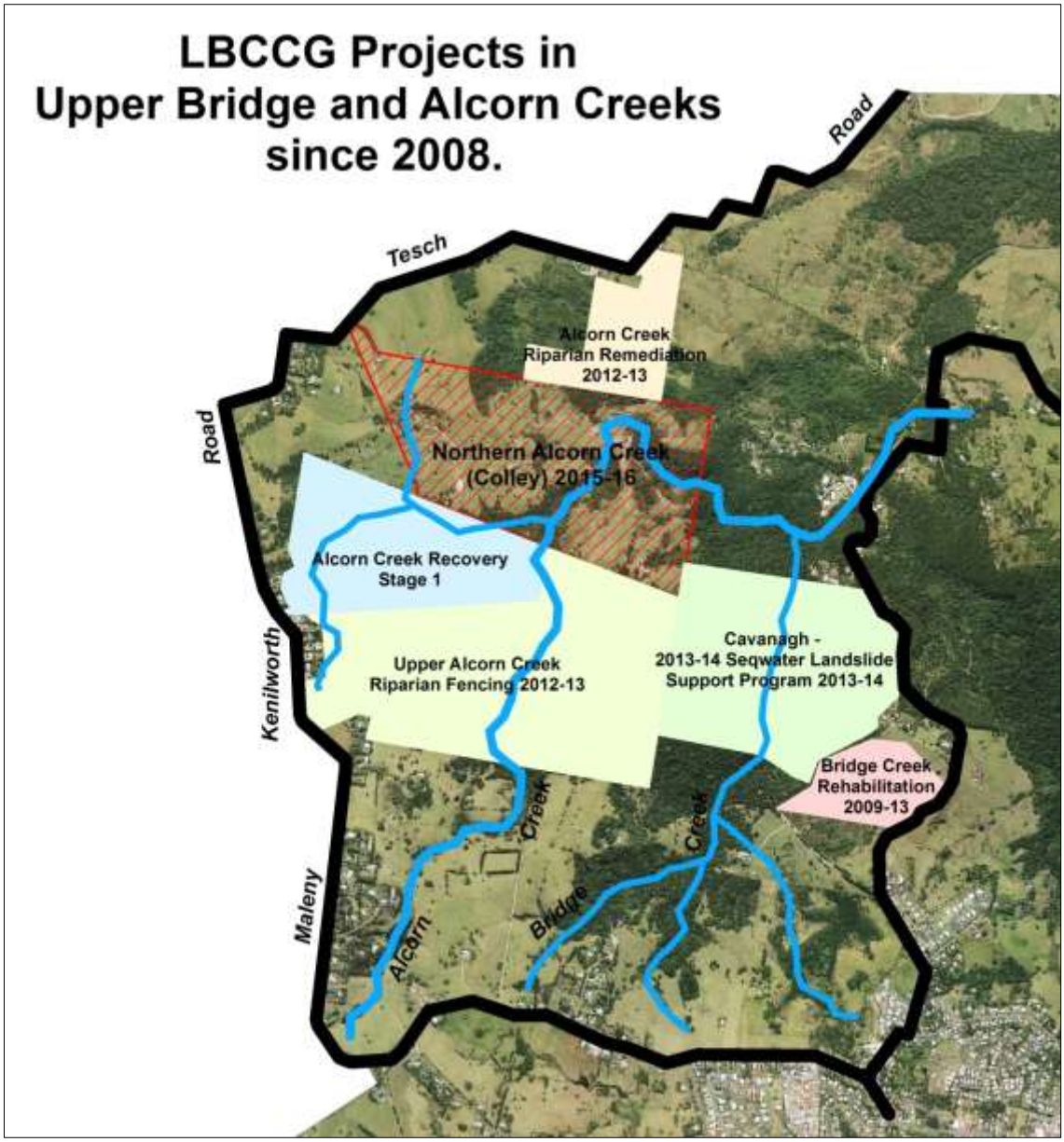
The key land management issues for landholders in Alcorn Creek include the steepness of the catchment, extensive landslips and instability, and severe flooding damaging infrastructure such as stream crossings and fencing.

For LBCCG and Seqwater the key concerns are the large volumes of sediment leaving the catchment, high levels of nutrients (often mobilised by the erosion), livestock access to waterways and inaccessibility, due to the topography. The Lake Baroon Implementation Plan (2007) considered this part of the catchment as low priority for works as it was deemed virtually beyond repair, or at least would cost significant levels of investment to make any difference. Recent (2009/10) changes to how catchments are assessed for priority, has resulted in a greater emphasis on areas that are identified as higher contributors of contaminants.

iii. PREVIOUS PROJECTS IN AREA/CATCHMENT

LBCCG projects in the immediate location include:

Project Name	*Years implemented*	*Project outputs*	*Total Project Value*
Bridge Creek Rehabilitation (Watter)	2008-13	Riparian fencing and revegetation	$52,636
Upper Alcorn Creek Riparian Fencing	2012-13	Riparian fencing, stream crossings	$85,648
Alcorn Creek Riparian Remediation	2012-14	Riparian fencing and revegetation (landslip & riparian)	$25,637
Cavanagh – 2013-14 Seqwater Landslide Support Program	2013-14	Stream crossing, drainage	$28,312
Alcorn Creek Recovery – Stage 1	2015-16	Riparian fencing, stream crossings, laneway rehabilitation and landslip remediation (drainage, fencing and revegetation)	$96,772



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 shading.

1.0 WHAT

(What activities will be implemented)

The proposed project aims to complete ten components before June 30, 2017 (weather dependent):

1. Install 550 metres riparian fencing (Alcorn Creek);
2. Install major and a minor stream crossings on Alcorn Creek;
3. Rehabilitate 100 metres of livestock (and essential access) laneway;
4. Install gate and associated fencing to block unnecessary Alcorn Creek access by livestock;
5. Extend existing off stream watering system to replace Alcorn Creek access and supply landslide zone with water;
6. Install 650 metres landslide management fencing;
7. Plant 800 pine species on identified landslide areas (as part of the Seqwater Landslide Remediation Program 2015-16);
8. Drain and profile approximately 3 hectares of landslip to enable access for revegetation and remove excessive saturation;
9. Undertake weed management in the Alcorn Creek riparian zone;
10. Realign 325 metres of laneway to improve access and safety;

The Colley property – the northern paddocks where the bulk of activities will be implemented.

1.1 LBCCG CORE FUNDING

1.1.1 Riparian fencing

Livestock have uncontrolled access to Alcorn Creek. This is currently necessary for a water source however the banks and bed of the creek are severely degraded resulting in excessive erosion. The fencing of Alcorn Creek will reduce damage to the bed and banks of the creek reducing erosion, and reduce nutrient and pathogen inputs.

Fencing of watercourses will commence in Stage 1 of the project.

Reach of Alcorn Creek to be fenced.

1.1.2 Major stream crossing

A low level concrete crossing to replace a failed bridge over Alcorn Creek. The crossing will require significant removal of material on the approach and potentially a thicker than usual concrete base to minimise the steepness into the crossing and allow access for heavy equipment.

The construction of the crossing will permit access to the northern paddocks of the property for the installation of the minor crossing, fencing and off stream watering.

Site for major stream crossing. Note the steep approach on the far bank. The laneway/approach in the background will be modified to reduce steepness.

1.1.3 Minor stream crossing

A low level concrete crossing to replace the current degraded informal crossing. This crossing will improve access to the northern paddock reducing the impacts of livestock - primarily erosion, but also direct faecal deposition.

Site for minor stream crossing.

1.1.4 Rehabilitate laneway

Laneways constructed when the property was used for dairy grazing have fallen into disrepair and are eroding during high rainfall events. A short section (100 metres) requires rehabilitation to minimise ongoing sediment loss and allow access for other components of the project, including the Landslide Mitigation Program. The laneway will be widened, profiled and will have the steepness removed to improve safety and reduce erosion.

Laneway is narrow, dangerously steep, has sharp humps and when wet is extremely slippery.

1.1.5 Off stream watering

Note: An *application has been submitted to SCC Landholder Environment Grants program in April 2016 for OSW materials (header tank, troughs and delivery).*

The fencing of Alcorn Creek necessitates the provision of alternative livestock water. Additionally the fencing of the landslip into a separate paddock that can manage grazing requires water access.

An existing OSW system on the property (servicing the southern paddocks will be accessed and extended to the northern side of the property. Increased header tank storage (23,500 litres), four troughs and approximately 1,500 metres of variously pressure rated poly pipe (to account for a head pressure of approximately 180 metres) is required.

Header tank location for off stream watering system.

1.2 SEQWATER LANDSLIDE PROGRAM

1.2.1 Landslide fencing

The landslip will be permanently fenced to manage grazing - standard cattle fencing can be utilised as it can be placed immediately outside the landslip envelope on stable ground. This will provide long term management and the area will require revegetation over multiple years.

The new OSW piping will run immediately beside the fencing permitting the installation of a trough inside the fence.

Fencing of landslips permits managed grazing which can be a valuable management tool.

1.2.2 Landslide revegetation

Research suggests (Reid & Page 2002; Marden & Rowan 1994) reforestation remains the most effective strategy to reduce the occurrence of landslides in rural areas where infrastructure is not at risk.

There are several approaches to revegetate landslips but the best solution for highly mobile sites and areas required for managed grazing is the planting of local pine species that tolerate moderate soil movement and are unpalatable to livestock once established

Landslide revegetation area.

1.3 LANDHOLDER FUNDED ACTIVITIES

1.3.1 Drainage

The key to stabilising landslips is the management of water. Landslip areas tend to trap and hold water, raising static pore water pressure which is exacerbated during high rainfall events, often beyond the ability of the soil to remain stable.

Carefully constructed drains can help remove trapped water from the landslip and during heavy rainfall channel flows safely away.

Furthermore landslips by their very nature are very uneven with wide cracks in the soil surface and mounds of rock and clay. Levelling of these sites improves access for revegetation activities including weed management and maintenance.

Erosion prone hillslopes require drainage to remove excess water. Pictured above is an area of poorly drained slope that is retaining water as seasonal soaks

1.3.2 Realign laneway

The current laneway is in fair condition however it has an extremely tight corner that will not permit access for heavy machinery (required for the construction of the stream crossings, riparian fencing and extension of off stream watering system. By moving the laneway a short distance to the west the gradient will be more acceptable and remove the tight hairpin bend.

1.4 FUTURE STAGES AND ACTIVITIES

The current project is planned to be the first stage of a multiple year program. It is expected landslide funding will continue into the future with further revegetation and maintenance.

There will be the opportunity for LBCCG to continue to implement activities such as further riparian fencing and revegetation in partnership with Sunshine Coast Council.

Landslide remediation is expected to continue in future years including on the adjacent properties to the west (Sommers and Donovan).

2.0 WHERE

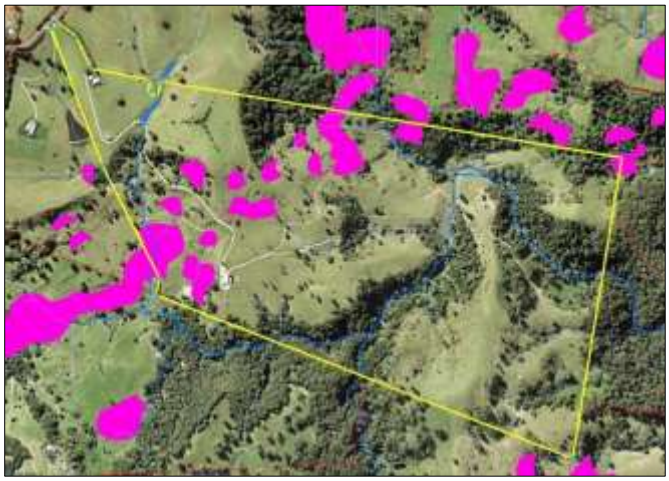
(Where in the catchment will the project occur)

The project will be implemented on the Colley property in the Alcorn (Bridge) Creek catchment.

(a) Colley property (dairy until early 2000s, horses and beef currently).
70 Witta Rd, Witta

Property is approximately 90 hectares – comprising the following:

- 55 ha of improved and unimproved pasture (including approximately 9.5 ha of potentially unstable slopes – ***see figure below***);
- 16 ha remnant vegetation;
- 18 ha regrowth vegetation (including weeds);
- 1 ha of residential;



Colley property highlighted with pinks areas denoting recognised landslips.

Alcorn Creek (a major Bridge Creek tributary) enters the property on the southern boundary, flowing through remnant bush most of the way for a distance of 1,420 metres. Other unnamed permanent streams total 580 metres while there is a further 2,661 metres of minor intermittently flowing watercourses.

Riparian vegetation cover varies, with most of Alcorn Creek well vegetated, while the majority of other streams have very little canopy cover.

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.

3.1 BRIDGE CREEK

Bridge Creek (2,413 hectares) is characterised by its steep slopes that lack stabilising vegetation. The soils of the catchment are predominantly black clays lacking the ability to absorb nutrients and rainfall, resulting in minimal filtering of run-off. Although there are significant areas of natural vegetation and most of the waterways have good riparian vegetation, the sub-catchment contributes high volumes of sediments, nutrients and potentially pathogens to Baroon Pocket Dam (Dunstan 2007).

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

- reduce erosion of the bed and banks of Alcorn Creek reducing turbidity and sedimentation;
- reduce direct faecal deposition (nutrients and pathogens) to Alcorn Creek and improve the buffer to overland flows;
- minimise erosion of livestock laneways and the delivery of sediments to the properties' watercourses;
- commence stabilisation of landslip prone hillslopes through drainage, livestock management and revegetation;
- improve livestock management (important for gaining landholder acceptance);
- build land manager engagement (previously unengaged high priority property – see *Priority Landholders: 2015-16 Annual Investment Strategy*);
- provide access for 2015/16 Seqwater Landslide Mitigation Program (ongoing).

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.

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.

4.0 HOW

(How will the activities be implemented)

4.1 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. Two suitable crossings will be constructed on Alcorn Creek tributary allowing vehicle and livestock passage. The crossings are critical to access the northern-most paddocks for riparian fencing and OSW installation.

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 significantly 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.

4.2 LANEWAY REHABILITATION AND ALIGNMENT

Some laneways were constructed when the property was a dairy farm but have fallen into disrepair once land use changed. To improve property management and permit access for LBCCG and Seqwater activities, laneways will be repaired where possible (300 metres) and reconstructed where necessary.

New laneways require stripping of the layer of grass and soft topsoil, profiling of the soil to ensure run off and digging of drains to channel water away from the laneway. Locally sourced road-base which has a mixture of variable sized stone and sufficient clay to bind the stone when compacted is laid at a thickness of 150 mm (compacts to a minimum 100 mm).

A grader is necessary to achieve the correct profile and on steeper sections (and near watercourses) diversion banks (whoa-boys) are inserted into the laneway to ensure run off is diverted to pasture areas and not permitted to flow directly to watercourses. Additionally this will prevent erosion of the laneway surface.

It is essential the road-base is compacted with a suitable heavy roller while sufficiently damp to achieve adequate compaction. Compaction using tracked earthmoving equipment is not effective.

4.3 RIPARIAN FENCING

Fencing will consist of standard cattle fencing – timber 'split 'posts at four metre spacings and four strands of barb wire. This may be modified where necessary according to site conditions such as inaccessibility for heavy equipment (tractor).

Site conditions will dictate alignment.

4.4 LANDSLIDE FENCING

The fencing to manage livestock access to the landslide remediation zone will be erected on stable ground. This will permit the use of standard cattle fencing – timber 'split 'posts at four metre spacings and four strands of barb wire. This may be modified where necessary according to site conditions such as inaccessibility for heavy equipment (tractor).

4.5 DRAINAGE

Drainage is designed to allow surface water to flow away from unstable landslide areas reducing seasonal soaks and minimising pore pressure. Springs, seasonal soaks and otherwise waterlogged areas are drained by cutting shallow trenches downslope to either stable areas or to watercourses.

Currently the site is almost inaccessible due to unevenness and requires profiling. The landholder owns an excavator and will perform profiling, drainage and initial weed management.

4.6 LANDSLIDE REVEGETATION

Landslides are notoriously difficult to establish native vegetation. The continued movement of the soil profile, nutrient deficiencies, and heavy clay nature of these sites make them difficult to access and are usually hostile to all but a few key species of native vegetation.

Local pine species are the best solution as they are hardy and tolerate root disturbance, but can be slow to establish. Unlike most rainforest species, pines have a vertical taproot that can assist in stabilising soil masses by anchoring to bedrock or clay at the base of the landslip.

Additionally, due to their spiky foliage, local pine species are less likely to be browsed by livestock and native herbivores (wallabies), although hungry cattle are likely to nip small trees and may even lift freshly planted trees from the ground. As the majority of landslip sites are also grazed it is essential to install temporary fencing to manage grazing, bearing in mind light grazing can be a useful management tool to control weeds and grasses within the planted area.

4.7 OFF STREAM WATERING

The property currently has an existing off stream watering system to water the southern paddocks. The system does not have enough storage capacity and requires the addition of a further 5,000 gallons (23,500 litres).

Various pressure-rated poly pipe (1,200 metres) is required to reach the northern trough locations with one trough requiring a pressure reducer (approximately 18 bar of pressure is predicted at the trough placed in the north west paddock).

As herd size will be up to 150 head, eight foot diameter concrete troughs have been quoted (to achieve appropriate capacity and access for enough cattle to drink at any time) although the difficulty in getting these troughs onto site may mean a change to six foot diameter troughs (will be easier to move in the body of a tip truck). Regardless of trough size used, access to two of the trough sites will likely be through the neighbouring property/s.

5.0 WHEN

(When will the activities be implemented)

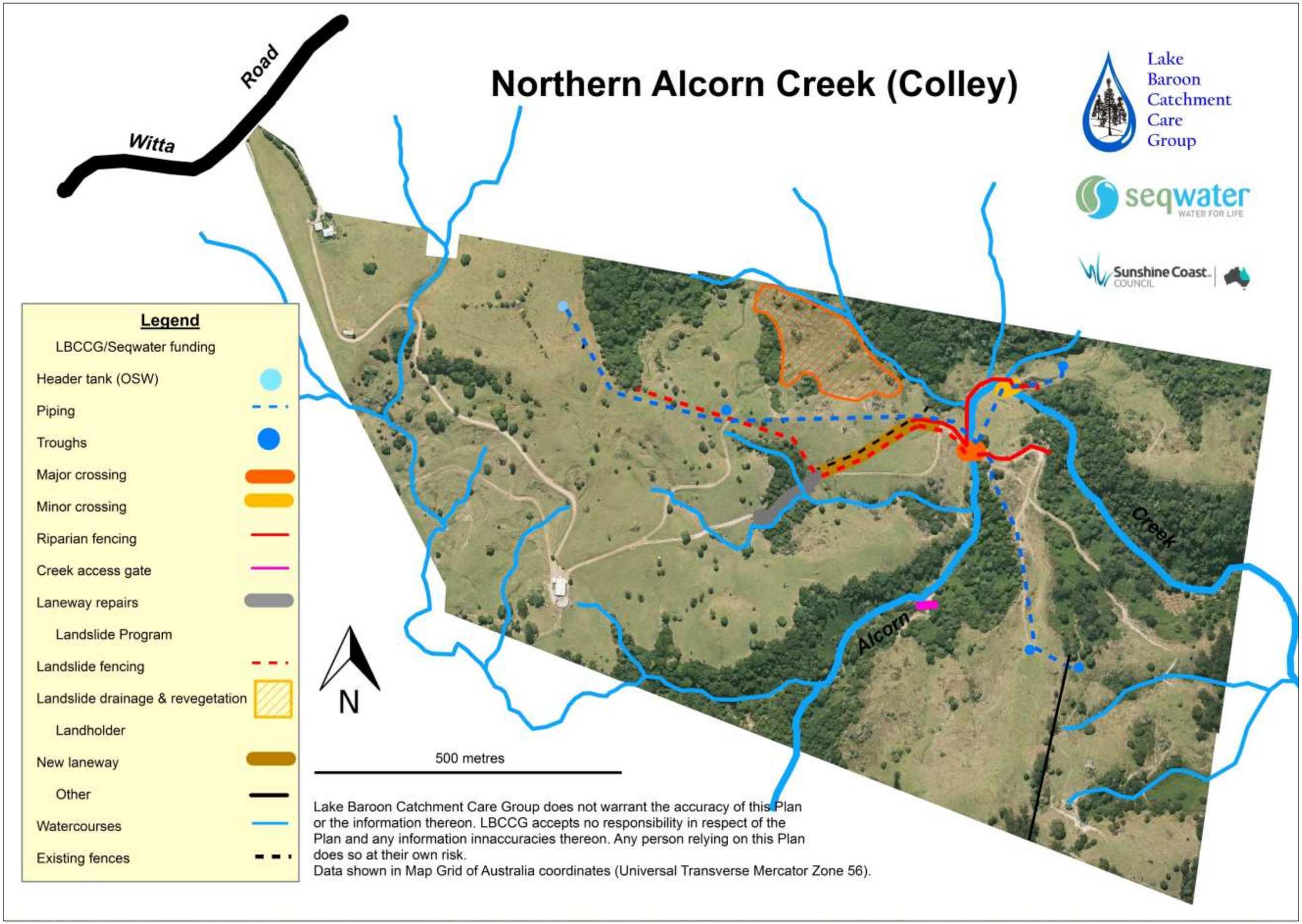
An application to Sunshine Coast Council Landholder Environment Grants in April 2016 has delayed the completion of the Project Plan. Therefore the project is unlikely to be fully completed by 30 June, 2016. There

will be delays between concrete crossing construction and the installation of the off stream watering simply as we need the concrete to be hardened to a point where machinery and trucks can cross Alcorn Creek.

At the time of developing this Plan it is still unclear when the 2015/16 Seqwater Landslide Mitigation Program which funds a significant proportion of the project.

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


Northern Alcorn Creek (Colley)
Witta
Road
Lake Baroon Catchment Care Group
seqwater
WATER FOR LIFE
Sunshine Coast
COUNCIL
Legend
LBCCG/Seqwater funding
Header tank (OSW)
Piping
Troughs
Major crossing
Minor crossing
Riparian fencing
Creek access gate
Laneway repairs
Landslide Program
Landslide fencing
Landslide drainage & revegetation
Landholder
New laneway
Other
Watercourses
Existing fences
N
500 metres
Alcorn
Creek
Lake Baroon Catchment Care Group does not warrant the accuracy of this Plan or the information thereon. LBCCG accepts no responsibility in respect of the Plan and any information innaccuracies thereon. Any person relying on this Plan does so at their own risk.
Data shown in Map Grid of Australia coordinates (Universal Transverse Mercator Zone 56).

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 C ATTACHMENTS

1.0 PROJECT RATIONALE

1.1 INTRODUCTION

In an ideal world, all waterways in the Lake Baroon catchment would be rehabilitated to provide riparian buffers 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.

1.2 STREAM CROSSINGS

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).

1.3 LANEWAY REHABILITATION

An estimated 80% of sediment and 35% of nitrogen in the waterways in South East Queensland come from non-urban diffuse loads. Dairy farms are an intensive form of agriculture with high levels of livestock movement (to and from the milking facility) and therefore have significant impacts on property laneways.

Poorly designed or constructed laneways are prone to erosion. The farm environment is greatly improved by hardening laneways, not only because erosion is minimised but also cows tend to move faster between

Laneway construction utilising locally sourced road base

paddock and dairy resulting in less manure deposited on laneways and therefore reduces the risk of faecal material entering drainage lines and watercourses.
Rehabilitated laneways significantly reduce erosion in high stock traffic areas resulting in less sediment run-off. Carefully designed laneways are shaped with strategic cross drainage (whoa-boys) to shed water to the sides (onto pasture) and direct run-off contaminated with faecal material (nutrients) to pasture that can trap and filter nutrients, rather depositing directly to watercourses.

Laneway construction

Mud from boggy laneways pose health risks for the dairy herd and for raw milk and must be washed from udders before milking, requiring increased labour and water use. Boggy laneways increase the time taken (and energy expended) to travel between the paddock and dairy (for cows and vehicles). Poor access to grazing pastures, particularly during wet periods, limits efficient pasture use which can have a detrimental effect on run-off (overgrazed paddocks increase nutrient and sediment run-off).

Mastitis can be significantly reduced when dairy cows have reduced contact with mud and contaminated water (such as natural water bodies). Mastitis in dairy cattle is the persistent, inflammatory reaction of the udder tissue. Milk from cows suffering from mastitis has an increased somatic cell count and usually occurs in response to bacteria invading the teat canal.

1.4 RIPARIAN FENCING

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.

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 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).

1.5 LANDSLIDE FENCING

Landslip sites are characterised by steep, unstable hillslopes that are often inaccessible to heavy equipment. The combination of access difficulties and

unpredictable movement means that conventional livestock fencing is usually not effective.

To effectively manage livestock access (bearing in mind livestock are a useful management tool) ideal fencing consists of semi-permanent electric fencing. The use of stretchable braid wire permits the use of simple end assemblies and gates, while allowing for some soil movement. Star pickets are utilised at relatively wide spacings and can be easily realigned following movement. This type of fencing does not require specialised equipment to erect, is cost effective and movable. The disadvantage is that solar energisers are relatively expensive and have a limited life span (3 - 5 years).

Most landslip revegetation sites that utilise local pine species are likely to be advanced and resilient enough after three years that the fencing can be removed and salvable fencing materials re-used on other activities.

1.6 DRAINAGE

The presence of water within a rocky hillside is one of the major factors leading to instability and subsequent slipping. Hoek and Bray (1981) suggest that it is not necessarily the amount of water that activates land slips but rather the pressure brought to bear by the water, and propose three principles need to be taken into account to improve the stability of circumspect hill slopes:

- Prevent water entering the hill slope through open cracks;
- Reduce water pressure in the vicinity of potential breakage surfaces through drainage; *and*
- Place drainage in order to reduce water pressure in the immediate vicinity of the hillside.

Shallow drainage work has the main function of intercepting surface runoff water and keeping it away from potentially unstable areas. In reality, on rocky hillsides this type of measure although contributing to reducing the amount of infiltration, alone is insufficient to stabilise a hillside. Deep drainage is the most effective with this type of slope. Sub horizontal drainage is very effective in reducing pore-pressure along crack surfaces or potential breakage surfaces. Only by intercepting the mostly drained discontinuities can there be an efficient result. The sub horizontal drains are accompanied by surficial collectors which gather the water and take it away through networks of small surface channels.

Drainage improvements may often be the most cost-effective means of reducing the likelihood of landslides. They may include simple measures such as inspecting and repairing existing drainage systems or directing runoff to safe areas. Drainage measures can also be more complex, requiring the drilling of wells and installation of pumps to lower groundwater levels (Dept of Ecology).

Groundwater is a major factor in both shallow and deep land sliding, but is much harder to control than surface water. Shallow groundwater, which typically flows several feet below the ground surface, can often be captured with a trench or interception drain. Such systems need to be designed and constructed carefully and require regular inspection and maintenance. Collected water must be directed to a safe location (Dept of Ecology).

1.7 LANDSLIDE REVEGETATION

Research suggests (Reid & Page 2002; Marden & Rowan 1994) reforestation remains the most effective strategy to reduce the occurrence of landslides in rural areas where infrastructure is not at risk.

Revegetation has several positive impacts on soil movement. Finer roots bind soil together creating cohesion and reducing surface movement. Deep roots anchor this mass to bedrock. Equally significant vegetation also reduces the total mass of water through transpiration and can help direct surface flows into defined channels speeding the rate of water leaving the site.

On sites which are actively moving, species selection is important as not all species will tolerate movement in the root zone. Local Araucanian species *Araucaria cunninghamii* and *bidwillii* are known to have a deep root system and can withstand some movement of the soil profile. They have been shown to be effective locally and have been used for this purpose for at least 30 years. Other factors which increase their suitability include, the prickly foliage is not readily eaten by livestock or local fauna, they are hardy and drought resistant, and being a local species fit within broader ecological strategies (Bateman 2015).

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 km^2 (including the dam surface).

2.2 THE BRIDGE CREEK CATCHMENT

Bridge Creek (2,413 hectares) is characterised by its steep slopes that lack stabilising vegetation. The soils of the catchment are predominantly black clays lacking the ability to absorb nutrients and rainfall, resulting in minimal filtering of run-off. Although there are significant areas of natural vegetation and most of the waterways have good riparian vegetation, the sub-catchment contributes high volumes of sediments, nutrients and potentially pathogens to Baroon Pocket Dam (Dunstan 2007).

Bridge Creek varies widely in topography, land use and threats to water quality. Upper reaches are largely grazed, mid reaches support a mix of natural bush and rural residential properties with some grazing again in the lower reaches.

Dairy grazing was the dominant land use until relatively recently (2000) however due to the widely varying topography, poorer soils and consequently relatively poorer pasture, dairy grazing has been restricted to three properties that have a larger proportion of grazing outside the catchment (Sommers, Oehmichen [recently leased by Maleny Cheese to run dry dairy cattle] and R. Cork dairies).

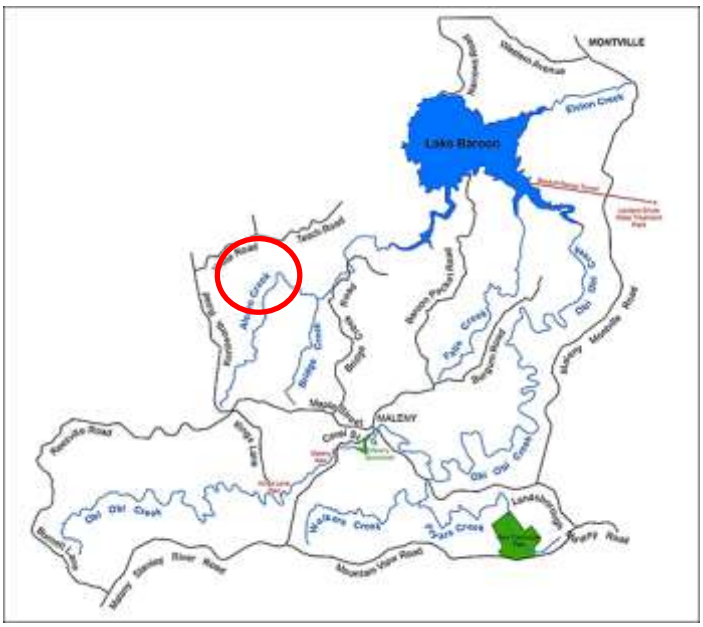
Bridge Creek has been divided into six Management Units that reflect property boundaries, physiography, vegetation, land use and point and diffuse pollution sources. This provides administrative convenience and the ability to prioritise stream zones more accurately according to various threats.

The proposed project is located within Management Unit BR1 – Alcorn Creek.

Management Unit BR1 is characterised by intensive beef grazing in the upper catchment on the better soils, to poorer, heavy soils and steep slopes in the lower reaches.

BR1 covers an area of 450 hectares with beef grazing the dominant land use with dairying (7%) and rural residential (including small scale horticulture) a small but significant use at 6% (Amos assessment 2015). Riparian cover is present along 27% of the creeks (although the mid to lower reaches of Alcorn Creek has excellent coverage, some of which is remnant vegetation, including *Of Concern* and *Endangered Regional Ecosystems*) (Dunstan 2007).

2.3 LOCATION



The Colley property is located in LBCCG Management Unit BR1 which lies in Alcorn Creek – the western tributary of Bridge Creek. This MU is a significant contributor of sediments nutrients primarily due to land use and the instability of the catchment.

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; *and*
- 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 (and where Baroon Pocket Dam wall was constructed).

The North Arm Volcanics underlay the entire Maleny plateau and extend as far south as the Glasshouse Mountains. Between 210 and 180 MYA the North Arm Volcanics 'sagged' into broad depressions that were subsequently filled with sediment, forming the deep Landsborough Sandstone formation (Willmott 2007). 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.

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, Bridge and Falls 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).

Soils on the site predominantly consist of heavy black clays. The bed of the watercourses on the site consists of thin, black alluvial soils that have been deposited by a combination of mass movement (landslips), hill slope (paddock) erosion and gullying. The velocity and

volume of the local streams however limits sediment deposits forming.

However, clay soils erode easily and tend to reach their infiltration capacity faster than other soils, promoting overland flow. A potential consequence is that both bound and unbound nutrients will enter the watercourses via erosion and runoff (Lake Baroon Catchment Management Strategy & Caloundra City Council 2007).

Native vegetation is an indicator of soil types. The vegetation over the site therefore would have originally been a mix of rainforest (particularly in the gullies and wet and dry sclerophyll (eucalypt) forest.

2.4.3 Landslips

Landslides (landslips) are common on the cleared slopes of the Maleny plateaux – particularly on the flanks that have formed by the deep cutting of watercourses and the edges of the lava (basalt) flows. The basalts are volcanic lavas that were poured out during the Tertiary period about 25 million years ago. They were originally much more extensive, but have been reduced in area by the gradual erosion of streams. Basalt forms a sensitive geological formation which is in a delicate balance under natural conditions. Clearing of the original forest has dramatically altered the balance resulting in the failure of the slopes (Willmott 1983).

Basalt is a rock which breaks down readily to deep fertile soils. On the Maleny plateaux these soils have combined with high rainfall to allow the growth of dense rainforest. In the early decades of this century, the fertile soils were cleared for dairying and intensive grazing. Unfortunately, the small size of the properties necessitated the clearing of even the steepest slopes with very little of the original forest remaining (Willmott 1983).

The basalt occurs as numerous individual lava flows that are roughly horizontal. While the thick, harder flows resist erosion and form scarps and cliff lines, the softer or more fractured lavas, or bands of sediments, form gently sloping benches or shelves on the flanks and valleys of the plateaux (Willmott 1983).

Following erosion of the edges of the plateaux over long periods of time, large volumes of rock and soil debris (colluvium) derived from disintegration of the scarps have accumulated as benches and extensive aprons. Red Ferrosol soils are common on the plateaux surfaces, and dark grey to black, clayey prairie soils; chocolate soils and black earths are usual on their benched flanks. Such dark soils are typical of areas mantled by colluvium. Many of these contain large quantities of swelling clay minerals (montmorillonite) which cause the soils to crack on drying and to swell on wetting. The swelling is accompanied by a marked decrease in strength. The presence of sodium cations in some of these clays tends to accentuate the loss of strength that accompanies the wetting (Willmott 1983).

The low permeability of this subsoil is evidently an important factor in promoting mass movement, causing water to flow laterally within the upper portions of the mantle and lubricate a slip surface. This, as is indicated by the sliding and flowing that occurs on the terraces with their low gradients, is evidently the chief reason for the greater incidence of landslides on the shallower, dark soil of the sides of the plateau than on the deep red soils at the top (Ellison & Coaldrake 1954).

Most of the landslides occur on slopes and benches on the flanks of the plateaux and ranges, and few occur on the actual flat surfaces of the plateaux.

2.4.4 Catchment land-use

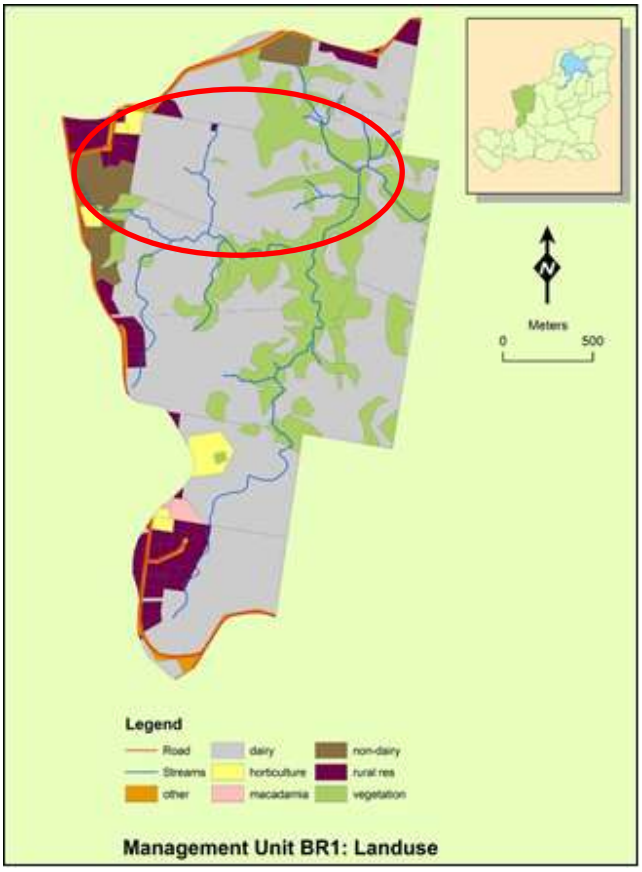
Despite the extensive clearing, 17% of the Lake Baroon catchment is still heavily forested; a significant proportion in the immediate area around the dam, although much of this is degraded by environmental weeds. Today, the catchment is susceptible to impacts associated with an increasing diversity of land use (Keys 2009).

The area closest to the lake is popular with “tree changers” and has seen land use change from intensive grazing to smaller rural residential properties. This has resulted in the fragmentation of larger tracts of agricultural land into smaller parcels with a large increase in the number of on-site wastewater treatment systems in the catchment (Keys 2009).

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

- poorly managed 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 and proliferation of weeds (including emerging weeds); *and*
- varying pollution sources related to increased population.

2.4.5 Land-use in Management Unit BR1



Land use in MU BR1 is overwhelmingly beef grazing, with minor dairying and rural residential. Note the figure above was produced from 2005 data which at that time was inaccurate - overwhelmingly the grey shaded area is actually beef grazing.

Land use in the Management Unit is dominated by beef grazing (85% of the management unit), with dairy grazing (including dry cow grazing) a minor use (7%) with rural residential properties making up the balance of land (6%).

2.5 COLLEY PROPERTY REVIEW

2.5.1 Land use and property management

The property is a very large, moderately productive parcel of land with several major management issues (instability, steep slopes, moderately fertile soils etc). Up until 2000 the property was utilised for dairy grazing (by G. Newton) and then beef grazing when dairying on this part of the Maleny plateau became unviable. Nathan Colley purchased the property in 2014 with intentions to continue beef grazing, minor horse agistment and eco-tourism with the construction of farm-stay cabins.

2.5.2 Hydrology

2.5.2.1 Drainage Lines, Watercourses & Wetlands

Alcorn Creek splits the property in two with around 60% of the property to the west and north. It appears Alcorn Creek has formed along a change in geology/soil type with soils to the east of the watercourse lighter in colour and supporting eucalypt vegetation as opposed to darker soils to the west and greater incidence of rainforest vegetation.

The natural drainage lines of the property flow directly into Alcorn Creek which is a tributary of Bridge Creek. Bridge Creek flows into Baroon Pocket Dam, the region's principal water supply and major recreational and scenic resource. The majority of the major drainage lines have excellent to fair woody vegetation present but most of the minor, intermittent watercourses have little vegetation and where they do, are dominated by woody weeds such as large leaf privet. All of the watercourses suffer from extreme sediment loads generated during high rainfall events (landslips).

There is currently no riparian fencing on any of the drainage lines on the property, however steep slopes

and existing vegetation naturally exclude livestock from the majority of Alcorn Creek.

2.5.2.2 Flooding

Flooding is of moderate concern as the property is high in the catchment and flooding, although high velocity is largely confined to defined channels. Nevertheless stream crossing placement and design, as well as riparian fencing will require careful placement to avoid damage.

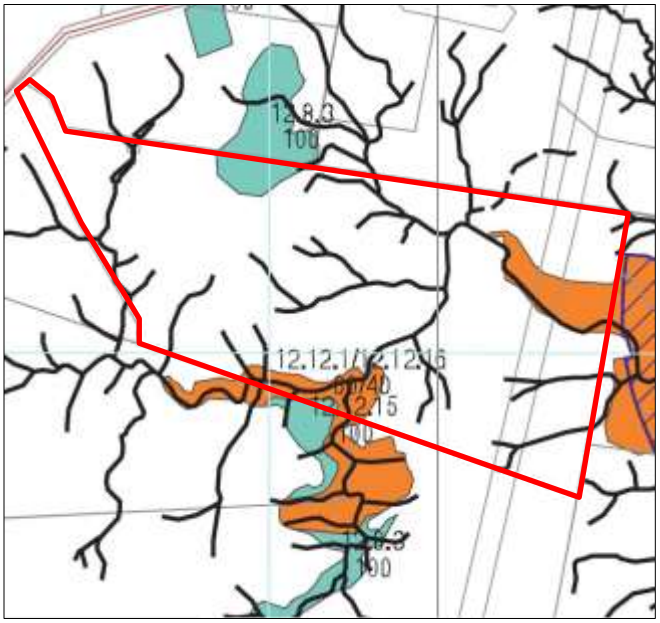
2.5.3 Environmental Factors

2.5.3.1 Significant Vegetation & Ecosystems

The eastern part of the property has a significant area of remnant vegetation, some of which is classified as Of Concern by the Queensland Government.

RE 12.12.1/12.12.16 (60/40%)
This mixed Regional Ecosystem takes into account the presence of Brush box (*Lophostemon confertus*), Piccabeen palm (*Archontophoenix cunninghamiana*) Myrtaceae and Elaeocarpaceae families (12.12.1 - Simple notophyll vine forest); and Eucalypt species (12.12.15 – Notophyll vine forest). Although RE 12.12.16 is classified as *Not of Concern*, RE 12.12.1 is classified as *Of Concern* and therefore high priority for conservation. This RE intergrades with RE 12.8.3 along Alcorn Creek.

Re 12.8.3
Complex notophyll vine forest would have covered a significant proportion of the property, particularly the watercourses.



The Colley property supports several significant stands of remnant vegetation. The remnant on Alcorn Creek is in reality more extensive and almost creates an unbroken link through the property.

2.5.3.2 Flora, Fauna & Corridors

It is not a priority to establish vegetation beyond the planting of local pine species to mitigate landslips. However there is currently fair connectivity to vegetation both upstream and downstream of the property.

Remnant vegetation on the property provides significant habitat for native fauna.

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 Wells Road 1991-2005

Water quality monitoring and analysis sampled at the Bridge Creek crossing (Wells Road) between 1991-2005 by AquaGen shows, that despite a relatively dense coverage of vegetation, the catchment contributes significant nitrates, ammonia, phosphates, total phosphorus and faecal coliforms.

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	8.2	85.6	0.316	0.166	0.068	0.335	1480
Min	6.7	0.6	0.000	0.000	0.001	0.005	0
Mean	6.9	3.6	0.059	0.026	0.023	0.043	233
Median	6.9	1.4	0.036	0.010	0.013	0.027	60
Std Dev	0.3	16.0	0.214	0.183	0.047	0.068	4627
20th Percentile	6.8	1.0	0.003	0.006	0.008	0.020	20
80th Percentile	7.0	2.3	0.118	0.040	0.041	0.050	390
Count outside GV	0	1	23	24	17	22	20
% outside GV	0.00	1.96	**46.00**	**48.00**	**33.33**	**44.00**	**39.22**

Alcorn Creek is a rugged and remote watercourse with large primary production properties the norm. Access is difficult when dry and impossible during wet weather – particularly in the 1990s/early 2000s - therefore AquaGen sampling sites were confined to the very upstream (Porters Farm) and downstream on Wells Road close to where the creek enters Lake Baroon. A short lived (1994-98) site on Wilson's Farm (unknown location) provides some mid-section data however this almost mirrors the data collected at the Wells Road site. Therefore even though the Wells Road site is a considerable distance downstream of the project site, it provides the best source of data.

The routine sampling programs (CalAqua, AquaGen, Seqwater and others) are suspected of not adequately capturing the major pollution events that regularly occur in the catchment. Conducted either monthly (1991 – 1998) or 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.

As previously mentioned Wells Road is downstream in the catchment and is affected by numerous impacts – urban Maleny, rural residential impacts (septic tanks etc), minor dairy and beef grazing and large areas of vegetation. High volumes of sediment delivered to Lake Baroon from soil erosion also occur in the catchment

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).

Livestock in waterways are high risk to water quality.

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

3.3 WATER SUPPLY CATCHMENT

The Colley property is within the Lake Baroon Pocket Dam Catchment. Bridge Creek (2,134 hectares) comprises one of Lake Baroon's three major sub-catchments. Consequently it is the major supplier of total water to the dam.

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

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

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

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

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

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

Lake Baroon catchment	= 74 km^2 or 7,400 ha
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 Colley property	= 90 hectares
Gross value of raw water originating from the property	**= $729,720 annually**

Tourism has become the dominant economic driver in the catchment but relies on both the agricultural landscape (rolling green hills) and natural values equally. This is demonstrated by the popularity of Maleny Dairies milk processing plant and farm tours (in excess of 20,000 visitors per year; pers. comm. Keith Hopper) 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 water quality improvements are desired; into activities that reduce risks to water quality and its maintenance and protection, and broad 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. Between 2010 and 2014 unseasonal dry periods followed by intense high rainfall events have seen an increase in erosion (reactivation of land slips), turbidity and flood damage.

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

3.4 OBJECTIVES

Northern Alcorn Creek (Colley) is designed to reduce the impacts of livestock access on watercourses and reduce the delivery of sediment to Bridge Creek and Baroon Pocket Dam. The project is addressing high priority issues in this part of the Lake Baroon catchment – landslips, livestock access to, and impacts on watercourses. The project is directly 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;
- protect and improve aquatic habitats;
- raise community awareness (including water quality issues);
- support and work cooperatively with like-minded community organisations;
- protect and enhance habitat;
- contribute to the conservation of threatened species;
- contribute to climate change adaptation; *and*
- demonstrate best management practice of riparian zones, landslips and remnant vegetation.

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

3.5 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.**
   Managing livestock in riparian zones and rehabilitating livestock laneways reduces the volume of faecal material reaching waterways.

Managing livestock in the riparian zone reduces the opportunity for direct deposition of faecal material into the watercourses. Vegetative buffers intercept run-off contaminated with excessive nutrients from diffuse paddock sources.
Properly constructed laneways direct run-off contaminated with faecal material (and associated

pathogens) onto pasture areas where it can be trapped and filtered before reaching waterways.

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

Managing livestock in the riparian zone reduces the opportunity for direct deposition of faecal material into the watercourses. Vegetative buffers intercept run-off contaminated with excessive nutrients from diffuse paddock sources.

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

Drainage, revegetation and livestock management of landslips reduces mass movement and loss of valuable top soil to catchment waterways. Improved management of livestock movement (laneways and stream crossings) maintain stability of riparian zones and managing livestock in the riparian zone reduces soil erosion from trampling.

4. **Improve aquatic habitat.**
   Improved management of sediments, nutrients and pathogens improves instream habitat..

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

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 livestock management. 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. **Contribute to the viability and resilience of primary production in the Lake Baroon catchment.**
   Primary production has been in decline since 2000.

For long term water quality outcomes it is preferential to work with experienced landholders who understand the catchment and are skilled land managers. New landholders to the area are often ill equipped to manage land and are high risk to water quality.

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

6. **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, over time, valuable habitat for a variety of native fauna. The project will significantly reduce livestock access to a significant area of riparian and vegetation.

3.6 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.

The Colley (then Newton) property was identified as a priority due to its size, land use and position within Bridge Creek.

3.7 ALIGNMENT WITH KEY PLANS & STRATEGIES

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

Fencing will consist of standard cattle fencing – timber 'split 'posts at four metre spacings and four strands of barb wire. This may be modified where necessary according to site conditions such as inaccessibility for heavy equipment (tractor).

Site conditions will dictate alignment.

4.2 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.

4.3 – LANEWAY REHABILITATION

Laneways were constructed when the property was a dairy farm but have fallen into disrepair once land use changed. To improve property management and permit access for LBCCG and Seqwater activities, laneways will be repaired where possible (300 metres) and reconstructed where necessary.

New laneways require stripping of the layer of grass and soft topsoil, profiling of the soil to ensure run off and digging of drains to channel water away from the laneway. Locally sourced road-base which has a mixture of variable sized stone and sufficient clay to bind the stone when compacted is laid at a compacted thickness of 150 mm.

A grader is necessary to achieve the correct profile and on steeper sections (and near watercourses) diversion banks (whoa-boys) are inserted into the laneway to ensure run off is diverted to pasture areas and not permitted to flow directly to watercourses. Additionally this will prevent erosion of the laneway surface.

It is essential the road-base is compacted with a suitable heavy roller while sufficiently damp to achieve adequate compaction. Compaction using tracked earthmoving equipment is not acceptable.

4.4 OFF STREAM WATERING

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.

Even without exclusion fencing of riparian zones, off-stream water sources reduce the amount of time free ranging cattle spend in or immediately adjacent to watercourses. Cattle prefer to drink from a trough over other sources of water available to them, resulting in a significant reduction in time spent in the stream (watering) and adjacent stream side area (grazing and loafing).
Studies in North America have shown that following the installation of the off-stream watering (OSW) infrastructure, stream bank erosion decreased by 77% and concentrations of total suspended solids, total nitrogen and total phosphorous decreased by 90, 54 and 81% respectively (Sheffield et al, in McIver 2004). More recent studies indicate that although the installation of OSW by itself is effective, providing livestock supplements and shade near troughs reduced riparian zone pressures even further (Ganskopp 2001, McInnis and McIver 2001, Porath et al. 2002 in McIver 2004). Porath et al. (2002) also found that the provision of supplements increased weight gain in cows and calves.

Cattle when drinking at streams and dams enter the water to reduce bending; resulting in the stirring up of

suspended solids (turbidity), 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).

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

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

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

4.5 LANDSLIDE FENCING

Fencing used solely to manage livestock access to landslide mitigation areas will be electric. This will be to account for unpredictable soil movement and also the semi-permanent nature of the fencing.

Fencing will be installed on two separate sites and will therefore require two solar energisers. Fencing will consist of star picket (steel) posts, nylon braid (able to stretch to maintain tightness and tolerate soil movement) with simple end assemblies and gates.

4.6 LANDSLIDE REVEGETATION

Landslides are notoriously difficult to establish native vegetation. The continued movement of the soil profile, nutrient deficiencies, and heavy clay nature of these sites make them difficult to access and are usually hostile to all but a few key species of native vegetation.

Local pine species are the best solution as they are hardy and tolerate root disturbance, but can be slow to establish. Unlike most rainforest species, pines have a vertical taproot that can assist in stabilising soil masses by anchoring to bedrock or clay at the base of the landslip.

Additionally, due to their spiky foliage, local pine species are less likely to be browsed by livestock and native herbivores (wallabies), although hungry cattle are likely to nip small trees and may even lift freshly planted trees from the ground. As the majority of landslip sites are also grazed it is essential at least temporary fencing is installed to manage grazing, and grazing can be a useful management tool to control weeds and grasses within the planted area.

4.7 DRAINAGE

Drainage is designed to allow surface water to flow away from unstable landslide areas reducing seasonal soaks and minimising pore pressure. Springs, seasonal soaks and otherwise waterlogged areas are drained by cutting shallow trenches downslope to either stable areas or to watercourses.

5.0 ACTION PLAN

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

Action		Responsibility	Start Date	Completion Date	Measurable Output
LBCCG Project Plan		LBCCG Project Manager	Feb 16	Apr 16	Project Plan
Project presented to LBCCG Committee for in principle approval (emailed)		LBCCG Project Manager & Committee	Apr 16	Apr 16	Approved Plan
Project presented to LBCCG Committee for approval (Management Committee meeting)		LBCCG Project Manager & Committee	Apr 16	Apr 16	Approved Plan
Project Plan sent to Seqwater for final approval		LBCCG Project Manager	Apr 16	Apr 16	Approved Plan
Pre-works monitoring (including photo points)		LBCCG Project Manager	Feb 16	May 16	Photo & data set
IMPLEMEMNTATION	Riparian fencing (LBCCG)	Contractor, landholder	May 16	Aug 16	550 metres
	Rehabilitate laneway	Contractor, landholder	Feb 16	Mar 16	100 metres
	Realign laneway (new)	Contractor, landholder	Feb 16	Mar 16	325 metres
	Stream crossings	Contractor, landholder	Feb 16	Mar 16	2 crossings
	Landslip drainage	Landholder	Feb 16	Mar 16	3 hectares
	Landslip fencing	Contractor	Feb 16	Apr 16	650 metres
	Landslip revegetation	Contractor	Mar 16	May 16	800 stems
	Off stream watering	Contractor, landholder	Apr 16	Jun 16	4 troughs
Post-works monitoring		LBCCG Project Manager	May 16	Aug 16 ongoing	Photo & data sets
Progress Reports		LBCCG Project Manager	Jun 16	Dec 16	7 Reports
Final Report (LBCCG/Seqwater)		LBCCG Project Manager	Sep 16	Dec 16	Final Report
Further stages		LBCCG Project Manager, landholder	Sep 16	ongoing	TBD

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)***
Fencing	Bald Knob Fencing	Tim Simpson
	Ferriday Fencing	Fred Ferriday
Stream crossing	P&K Nash Excavations	Phil Nash
	Sommers Bros. Earthmoving	Ron Sommers
Off stream watering	P&K Nash Excavations	Phil Nash
	Sommers Bros. Earthmoving	Ron Sommers
Laneway construction	Sommers Bros. Earthmoving	Ron Sommers
	Maleny Bobcat	Richard Hood
Revegetation	TBD	n/a

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. Drainage and profiling activities;
2. Fencing;
3. Stream crossing;
4. Off stream watering;
4. Laneway construction and rehabilitation; *and*
5. Revegetation

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. Drainage and profiling activities – potentially excavation up to two metres deep, however landslip sites are extremely disturbed areas;
2. Fencing – holes up to one metre deep;
3. Stream crossing– shallow excavation up to 300 mm within bed, banks and riparian zone of Walkers Creek;
4. Off stream watering – trenching up to 600 mm deep, shallow excavation up to 300 mm deep;
5. Laneway construction and rehabilitation – shallow excavation up to 300 mm deep and up to 400 mm deep where pipes are installed (previously disturbed); *and*
6. Revegetation – shallow holes up to 250 mm deep on highly disturbed landslip areas.

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	Ron Sommers	Contractor
	Tim Simpson	Contractor
	Phil Nash	Contractor
	Tim Odgers	Seqwater
	Matt Bateman	LBCCG Project Officer
	Alan Wynn	Sunshine Coast Council
	-	The Pump House - Beerwah

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