NSW GOVERNMENT Planning & Environment

Gateway Determination Review Application Form

Date received: Reference No.

LODGEMENT

Instructions to users

This form is to be completed if you wish to request an independent review related to plan-making under Part 3 of the *Environmental Planning and Assessment Act 1979*. This form relates to Gateway determination review requests.

A **Gateway determination review** can be sought following a Gateway determination where a determination is made that:

a) the planning proposal should not proceed;
b) the planning proposal should be resubmitted to the Gateway; or
c) imposes requirements (other than consultation requirements) or makes variations to the proposal that the proponent or council thinks should be reconsidered.

Note: With reference to point 'c' above, a request to review a Gateway determination can only be made prior to the commencement of community consultation on the planning proposal.
Note: Gateway reviews can only be sought if the **original** Gateway determination was made by a delegate of the Minister or the Greater Sydney Commission.

Before lodging a request for review, it is recommended that you consult the Planning Circular *'Independent reviews of plan-making decisions'* and *'A guide to preparing local environmental plans'*, which can be found on the department's website www.planning.nsw.gov.au. The guide gives a step-by-step explanation of the review procedure and necessary requirements.

To ensure that your request for review is accepted, you must:

- complete **all** relevant parts of this form
- submit **all** relevant information required by this form
- provide **one hard copy** of this form and required documentation
- provide the form and documentation in **electronic format** (e.g. CD-ROM)

Note: The department may request further information if your request for review is incomplete or inadequate.

A fee is not charged for a Gateway determination review.

All requests **must be lodged** with the department's relevant Regional Office. Please refer to www.planning.nsw.gov.au for contact details.

PART A – APPLICANT AND SITE DETAILS

A1 – Applicant Details

Principal contact

☒ Mr ☐ Ms ☐ Mrs ☐ Dr ☐ Other

First name: DANIEL B

Family name: BENNETT

Name of company *(N/A if an individual)*: BELLINGEN SHIRE COUNCIL

Street address

Unit/street no.: 33-39 Street name: HYDE STREET

Suburb/town: BELLINGEN State: NSW Postcode: 2447

Postal address *(or mark 'as above')*

PO Box or Bag: PO BOX 117 Suburb or town:

State	Postcode	Daytime telephone	Fax
		6655 7352	

Email: dbennett@bellingen.nsw.gov.au

Mobile:

A2 – Site Details

Identify the land that is to be the subject of the planning proposal and for which you seek a review

Street address: Unit/street no. | Street name

Suburb/town | State | Postcode

NAME OF THE SITE

NOT RELEVANT - LAND WITHIN ZONES RU1, RU2, RU4 + E4

REAL PROPERTY DESCRIPTION

AS ABOVE

*The **real property description** is found on a map of the land or on the title documents for the land. If you are unsure of the real property description, you should contact the Department of Finance and Services, Land and Property Information. Please ensure that you place a forward slash (/) to distinguish between the lot, section DP and strata numbers. If the proposal applies to more than one piece of land, please use a comma (,) to distinguish between each real property description.*

PROVIDE DETAILS OF ALL AFFECTED LANDOWNERS WHERE THEY ARE NOT THE DIRECT APPLICANT

NOT RELEVANT / NECESSARY. COUNCIL INITIATED PROPOSAL

HAVE ALL OWNERS OF LAND TO WHICH THIS PLANNING PROPOSAL APPLIES BEEN NOTIFIED?

- ☐ Yes
- ☐ No
- ☐ Some have but not all
- ☐ N/A (Applicant is owner)

Note: If some land owners, but not all, have been notified, list below those notified:

CURRENT ZONING OF THE LAND AT THE SITE

NO SPECIFIC SITE - APPLIES TO ZONES RU1, RU2, RU4 + E4

CURRENT LAND USE AT THE SITE

PART B – REASON FOR REVIEW AND THE PLANNING PROPOSAL

B1 – Reason for Gateway Review

WAS THE ORIGINAL GATEWAY DETERMINATION MADE BY A DELEGATE OF THE MINISTER OR GREATER SYDNEY COMMISSION

- ☒ Yes
- ☐ No

Note: Requests for the review of Gateway determination will only be considered if the original Gateway determination was made by a delegate of the Minister or Greater Sydney Commission.

Indicate below the reason for seeking a review of the Gateway determination. A review can only proceed if one of these three circumstances has occurred.

☒ **A determination has been made that the planning proposal should not proceed**

In the case of the above, will this request for review be submitted no more than 42 days from the date of the original notification of the Gateway determination?

- ☒ Yes
- ☐ No

☐ **A determination has been made that the planning proposal should be resubmitted to the Gateway**

In the case of the above, will this request for review be submitted no more than 42 days from the date of the original notification of the Gateway determination?

☐ Yes
☐ No

☐ **A determination has been made that has imposed requirements (other than consultation requirements) or makes variations to the proposal**

In the case of the above, have you indicated your intent to submit a request for review no more than 14 days from the date of the original notification of the Gateway determination?

☐ Yes
☐ No

Will this request for review itself be submitted no more than 42 days after this date from the date of the original notification of the Gateway determination?

☐ Yes
☐ No

B2 – The Planning Proposal

DEPARTMENT'S REFERENCE NUMBER:

PP - 2017 - BELLI - 001 - 00

NAME OF THE LOCAL GOVERNMENT AREA

BELLINGEN

DESCRIPTION OF PROPOSAL

BLUEBERRY REGULATION

LOCAL ENVIRONMENTAL PLAN (LEP) TO BE AMENDED BY THE PLANNING PROPOSED

BELLINGEN LOCAL ENVIRONMENTAL PLAN 2010

IS THE LEP TO BE AMENDED (ABOVE) A STANDARD INSTRUMENT LEP?

☒ Yes
☐ No

INFORMATION REQUIREMENTS

Requests should be accompanied by:

- an application form
- a copy of the planning proposal as submitted to the Gateway
- a copy of all additional information and documentation provided at the Gateway
- justification for why an alteration of the Gateway determination is warranted (if applicable), including, where relevant, responses to issues raised by the original Gateway decision maker
- if relevant, disclosure of reportable political donations under section 147 of the Act.

Please refer to '*A guide to preparing local environmental plans*' for the necessary information requirements.

List below all the documents, maps, plans, studies, information and any other supporting information that comprises your proposed instrument and request for pre-gateway review.

INFORMATION PROVIDED

- THE PLANNING PROPOSAL AS SUBMITTED TO GATEWAY
- JUSTIFICATION FOR ALTERATION OF THE GATEWAY DETERMINATION
- REPORT ON WATER QUALITY ON BUCCA BUCCA CREEK

PART C – DISCLOSURE AND SIGNATURES

C1 – Donation and Gift Disclosure

Section 147 of the Environmental Planning and Assessment Act 1979 requires the public disclosure of *reportable political donations* or gifts when lodging or commenting on a *relevant planning application*. This law is designed to improve the transparency of the planning system.

DO YOU HAVE ANY DONATIONS OR GIFTS TO DISCLOSE?

☐ Yes

☒ No

How and when do you make a disclosure?

The disclosure to the Minister or the Secretary of a *reportable political donation* or gift under section 147 of the Act is to be made:

(a) in, or in a statement accompanying, the relevant planning submission if the donation is made before the submission is made, or

(b) if the donation is made afterwards, in a statement of the person to whom the relevant planning submission was made within 7 days after the donation is made.

What information needs to be included in a disclosure?

The information requirements of a disclosure of reportable political donations are outlined in section 147(9) of the Act. A Disclosure Statement Template which outlines the information requirements for disclosures to the Minister or to the Secretary can be found on the department's website: www.planning.nsw.gov.au/donation-and-gift-discloure

C2 – Signature(s)

By signing below, I/we hereby declare that all information contained within this application form is accurate at the time of signing.

Signature(s)

Name(s)

DANIEL BENNETT

In what capacity are you signing

SENIOR STRATEGIC PLANNER. BELLINGEN SHIRE COUNCIL

Date

20 APRIL 2018

BELLINGEN SHIRE COUNCIL
PLANNING PROPOSAL 13
(Version 1 – October 2017)

BLUEBERRY REGULATION

THE PLANNING PROPOSAL

Pursuant to Section 55(1) of the *Environmental Planning and Assessment Act 1979* (EP&A Act), a planning proposal must be prepared before a draft Local Environmental Plan (LEP) amendment is made. The proposal must explain the intended effect of the draft LEP amendment and provide justification for the amendment. The proposal must address those matters identified by Section 55(2) of the EP&A Act, which is considered below. Council must then determine whether or not to proceed with the proposal.

History

Council resolved to proceed with the proposal at its meeting of 27 September 2017 The relevant resolution is reprinted below and the report to Council is included as Attachment 2.

ITEM: **13.1**
SUBJECT: **OPTIONS FOR THE POTENTIAL REGULATION OF BLUEBERRY GROWING IN BELLINGEN SHIRE**
FILE/INDEX: **RURAL LANDS PLANNING POLICY REVIEW**
PRESENTED BY: **DANIEL BENNETT, ACTING MANAGER LAND USE SERVICES**

MOVED (Cr King/Cr Wright-Turner)

That Council:
1. Resolves to prepare a planning proposal specifying that development consent is required for the establishment of blueberry farms in Zones RU1, RU2, RU4 and E4, unless the farm complies with the following criteria, in which case it will be considered as a form of ''exempt development''.

   Blueberry farming is exempt development if it complies with following criteria.

   - Blueberry plants & associated infrastructure (such as poles and netting) are located a minimum of 200m from any dwelling (not including a dwelling on the same property) and a minimum of 50m from any property boundary not held in the same ownership.

   - Blueberry plants & associated infrastructure (such as poles and netting) are located the following minimum distances away from watercourses, based upon the Strahler method of stream ordering.

Stream Order	Minimum distance either side of watercourse
1st order	10 metres
2nd order	20 metres
3rd order	30m
4th order and greater	40m

   - Where it is necessary to apply the setback distances specified in subclause b), and those setbacks are vegetated, the setback distances must be retained in their vegetated state, with the exception of the removal of any non-native species.

   - Blueberry plants & associated infrastructure such as poles and netting are not located within any area mapped as ''core koala habitat'' in any adopted Koala Plan of Management.

   - Any netting proposed for the protection of the crop must be black.

2. Resolves to forward the Planning Proposal to the Department of Planning & Environment in accordance with Section 56(1) of the Environmental Planning and Assessment Act 1979 and request the issuing of a Gateway Determination to allow for the exhibition of the proposed amendment.

3. Resolves to advise the NSW Minister for Planning & Environment that it considers the proposed amendment to be of minor significance and that it intends to use its delegations to permit the General Manager to make the Local Environmental Plan.

4. Endorses the Engagement Strategy that has been proposed in this report for the public exhibition of the Planning Proposal.

For: **Cr King, Cr Fenton and Cr Wright-Turner.**
Against: **Cr Carter, Cr Harrison and Cr Jenkins.**

CARRIED

Mayor King utilised his casting vote to vote for the motion meaning the motion was carried.

Objectives

The objectives of the proposed LEP amendment are as follows:

1. To address concerns regarding the environmental impact of blueberry farming in Bellingen Shire by requiring development consent for new blueberry farms in certain rural areas of the Shire, unless those farms are located to minimise their impact on the environment and surrounding properties.
2. To protect the contribution that is made to the local economy by agricultural activities, by ensuring that any regulatory option is quarantined to blueberry growing only, and does not impact upon other forms of horticulture or agriculture.

Proposed provisions

The provisions of the proposed LEP amendment will include:

The objectives of the proposed LEP Amendment are proposed to be met by implementing the following amendments to Bellingen Local Environmental Plan 2010 (BLEP 2010).

"Horticulture'' will be made permissible with development consent in Zones RU1, RU2, RU4 and E4, however an additional category of ''exempt development'' will also be inserted into Schedule 2 of BLEP 2010.

This will make ''horticulture'' an exempt form of development in all instances, except for a blueberry farm that does not comply with the following exemption criteria.

Proposed exempt development criteria

Blueberry farming is exempt development if it complies with following criteria.

a) *Blueberry plants & associated infrastructure (such as poles and netting) are located a minimum of 200m from any dwelling (not including a dwelling on the same property) and a minimum of 50m from any property boundary not held in the same ownership.*
b) *Blueberry plants & associated infrastructure (such as poles and netting) are located the following minimum distances away from watercourses, based upon the Strahler method of stream ordering.*

Stream Order	*Minimum distance either side of watercourse*
1st order	*10 metres*
2nd order	*20 metres*
3rd order	*30m*
4th order and greater	*40m*

c) *Where it is necessary to apply the setback distances specified in subclause b), and those setbacks are vegetated, the setback distances must be retained in their vegetated state, with the exception of the removal of any non-native species.*

d) *Blueberry plants & associated infrastructure such as poles and netting are not located within any area mapped as ''core koala habitat'' in any adopted Koala Plan of Management.*

e) *Any netting proposed for the protection of the crop must be black.*

An Information Checklist, Project Timeline & Delegation Request Checklist are included as Attachments 1 ,3 & 4 in accordance with the requirements of 'A *Guide to preparing planning proposals''.*

SPECIFIC JUSTIFICATION FOR PLANNING PROPOSAL

A. Need for Planning proposal

Is the planning proposal a result of any strategic study or report?

The planning proposal has had regard to the findings of community consultation that was recently undertaken by Council regarding potential blueberry regulation in Bellingen Shire. The outcomes of this consultation are fully documented in the Council Report included as Attachment 2 to this proposal.

In summary, 65% of respondents to a survey undertaken as part of the Rural Lands Planning Policy Review supported an increased level of regulation of blueberries, however only 46% of respondents supported this if it meant that other forms of horticulture (e.g.: garlic growing, potatoes etc..) would then be captured as part of a consent mechanism.

Is the planning proposal the best means of achieving the objectives or intended outcomes, or is there a better way?

It is acknowledged that the blueberry industry is making moves towards developing a revised code of practice to avoid adverse impacts on surrounding land uses, however there is no timeframe provided for finalisation at this stage, and no indication that this will compel any farmer to observe the provisions of that Code.

The planning proposal addresses a pervasive concern that reliance upon a voluntary Code of Practice does not provide an adequate level of protection to environmental assets or surrounding properties, and that State Government agencies are not adequately resourced to undertake environmental compliance.

For example, the recent release of the ''Investigation into water compliance and enforcement 2007-17'' by the NSW Ombudsman confirms the chronic under-resourcing of the compliance and enforcement roles regarding water extraction in NSW.

The proposed regulatory approach is considered to be the optimal means to provide some basic guidelines for the establishment of new blueberry farms, without the need to go through a development consent process.

B. Relationship to strategic planning framework

Prior to addressing the specific headings in ''A Guide to preparing Planning Proposal'' it is important to emphasise that the planning proposal is consistent with the highest level expression of strategic planning intent in NSW.

Specifically, blueberry growing is defined as ''horticulture'' under the Standard Instrument Principal Local Environmental Plan (SIPLEP). Horticulture is also defined as a type of ''Intensive Plant Agriculture''.

Both definitions are reprinted below.

horticulture *means the cultivation of fruits, vegetables, mushrooms, nuts, cut flowers and foliage and nursery products for commercial purposes, but does not include a plant nursery, turf farming or viticulture.*

Note.
Horticulture is a type of intensive plant agriculture—see the definition of that term in this Dictionary.

intensive plant agriculture *means any of the following:*

(a) the cultivation of irrigated crops for commercial purposes (other than irrigated pasture or fodder crops),
(b) horticulture,
(c) turf farming,
(d) viticulture.
Note.
Intensive plant agriculture is a type of agriculture—see the definition of that term in this Dictionary.

The SIPLEP is in effect, the highest level expression of State Government policy regarding what uses must be allowed in various zones and the way in which they should be permitted (e.g.: with development consent or without development consent).

Horticulture is currently permissible without development consent in Zones RU1 – Primary Production, RU2 – Rural Landscape, RU4 – Primary Production Small Lots, & E4 – Environmental Living in Bellingen Local Environmental Plan 2010 (BLEP 2010).

Should Council wish, to make horticulture permissible with development consent in these zones, there is no obstacle presented by the SIPLEP because it only requires that ''intensive plant agriculture'' is included as either "Permitted without consent" or "Permitted with consent" in Zones RU1 & RU4. It also allows Council to determine a local policy position in Zones RU2 and E4.

Is the proposal consistent with the objectives and actions contained within the North Coast Regional Plan?

A summary table documenting the proposals compliance with the NCRP is provided below, with detailed commentary on relevant matters provided at the end of the Table.

North Coast Regional Plan – Statement of applicability to Planning Proposal 13			
Goal	**Direction**	**Relevant (Yes/No)**	**Comment**
Goal 1 – The most stunning environment in NSW			
	Direction 1 – Deliver environmentally sustainable growth	Yes	Complies
	Direction 2 – Enhance biodiversity, coastal and aquatic habitats, and water catchments	Yes	See comment below
	Direction 3 – Manage natural hazards and climate change	Yes	See comment below
	Direction 4 – Promote renewable energy opportunities	No	
Goal 2 – A thriving, interconnected economy			
	Direction 5 – Strengthen communities of interest and cross regional relationships	No	
	Direction 6 – Develop successful centres of employment	No	
	Direction 7 – Coordinate the growth of regional cities	No	
	Direction 8 – Promote the growth of tourism	No	
	Direction 9 – Strengthen regionally significant transport corridors	No	
	Direction 10 – Facilitate air, rail and public transport infrastructure	No	
	Direction 11 – Protect and enhance productive agricultural lands	Yes	See comment below
	Direction 12 – Grow agribusiness across the region	Yes	See comment below
	Direction 13 – Sustainably manage natural resources	Yes	See comment below
Goal 3 – Vibrant and engaged			
	Direction 14 – Provide	No	

North Coast Regional Plan – Statement of applicability to Planning Proposal 13			
Goal	**Direction**	**Relevant (Yes/No)**	**Comment**
communities	great places to live and work		
	Direction 15 – Develop healthy, safe, socially engaged and well connected communities	No	
	Direction 16 – Collaborate and partner with Aboriginal communities	Yes	See comment below
	Direction 17 – Increase the economic self-determination of Aboriginal communities	No	
	Direction 18 – Respect and protect the North Coast's Aboriginal heritage	Yes	See comment below
	Direction 19 – Protect historic heritage	No	
	Direction 20 – Maintain the regions distinctive built character	No	
	Direction 21 – Coordinate local infrastructure delivery	No	
Goal 4 – Great housing choices and lifestyle options		No	
	Direction 22 – Deliver greater housing supply		
	Direction 23 – Increase housing diversity and choice		
	Direction 24 – Deliver well planned rural residential housing areas		
	Direction 25 – Deliver more opportunities for affordable housing		

Direction 2 – Enhance biodiversity, coastal and aquatic habitats, and water catchments

Action 2.1 of this direction requires Council to focus development to areas of least biodiversity significance within the region, and Action 2.2 aims to ensure that local plans manage water catchment areas to avoid potential development impacts.

It is submitted that the proposed exemption criteria will assist with implementing these actions through directing new farms away from Core Koala Habitat and from riparian zones, unless a careful consideration of impact is made via a Development Assessment process.

Direction 3 – Manage natural hazards and climate change

The Integrated Regional Vulnerability Assessment, undertaken by the Office of Environment & Heritage for the North Coast, has identified a range of climate change vulnerabilities in the region, and potential actions in response.

For example, Appendix C of this document discusses the expected physical responses to climate change and projects that it is very likely that there will be a ''substantial increase in runoff depths, and the magnitude of high flows'', in summer.

When documenting regionally specific impacts, it is also stated that ''higher rainfall is likely to increase sheet and rill erosion, leading to increased sedimentation of coastal floodplains.''

The planning proposal responsibly aims to direct blueberry farms away from riparian zones to avoid exacerbating the projected impacts of climate change on these areas.

Direction 11 – Protect and enhance productive agricultural lands

Direction 11 notes that agricultural activities such as horticulture are growing rapidly on smaller holdings across the North Coast and that local planning controls can help support these industries by identifying potentially suitable locations for small lot primary production.

The planning proposal is consistent with this direction in that it identifies those locations, on any property, where a blueberry farm can operate without the need for obtaining any further approval from Council.

By observing the nominated buffer zones, it is expected that the likelihood of conflict with neighbours, or inadvertent breaches of legislation will be minimised, thereby leaving farmers with more time to work on core farming activities and growing their businesses.

Direction 12 – Grow agribusiness across the region

This direction is not considered directly relevant to this planning proposal as it is more focused upon facilitating agricultural support industries.

Direction 13 – Sustainably manage natural resources

This direction is not considered directly relevant to this planning proposal, as it is more focused upon the use of natural, mineral and forestry resources.

Direction 16 – Collaborate and partner with aboriginal communities & Direction 18 – Respect & protect the North Coast's Aboriginal heritage

Council acknowledges the importance of engaging with Aboriginal communities and will engage with relevant local aboriginal organisations as part of the public exhibition of the planning proposal.

The NSW Government recognise that riparian zones have high levels of landscape value when considering whether aboriginal objects are likely to be present. For example, Section 8 of the Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales states as follows regarding landscapes that are likely to obtain objects.

''Aboriginal objects are often associated with particular landscape features as a result of Aboriginal people's use of those features in their everyday lives and for traditional cultural activities. Examples of such landscape features are rock shelters, sand dunes, waterways, waterholes and wetlands. Therefore it is essential

to determine whether the site contains landscape features that indicate the likely existence of Aboriginal objects."

The planning proposal seeks to provide a higher level of protection to landscape features such as waterways, waterholes and wetlands. In this respect, it is submitted that the planning proposal will help to respect and protect the North Coast's Aboriginal Heritage.

Is the proposal consistent with Council's strategic plans?

Growth Management Strategy:

Councils existing Growth Management Strategy was adopted in 2007. Its principle focus was on the investigation of potential residential and rural residential land release areas, however it did include a Chapter 9 that was entitled Rural Land Strategy. A copy of Chapter 9 is included as Attachment 5 to this report.

A review of Chapter 9, which was drafted prior to the introduction of the NSW Standard Instrument Local Environmental Plan, confirms that it did not make any explicit provisions regarding what types of agricultural uses should be permitted with, or without consent in the various rural zones in the Shire

Accordingly, the provisions that are proposed in Planning Proposal 13 are not contradictory to Councils existing Growth Management Strategy.

Is the proposal consistent with applicable state environmental planning policies?

A summary table documenting the proposals compliance with relevant SEPPs is provided below, with detailed commentary on relevant matters provided at the end of the Table.

State Environmental Planning Policies – Statement of applicability to Planning Proposal 13		
SEPP	**Relevant (Yes/No)**	**Comment**
1 – Development Standards	No	
14 – Coastal Wetlands	No	
21 - Caravan Parks	No	
26 – Littoral Rainforests	No	
30 – Intensive Agriculture	No	Relates to feedlots & piggeries only
33 – Hazardous & Offensive Development	No	
36 – Manufactured Home Estates	No	
44 – Koala Habitat Protection	Yes	See comment
50 – Canal Estate Development	No	
55 – Remediation of Land	No	
64 – Advertising & Signage	No	
65 – Design Quality of Residential Apartment Development	No	
70 – Affordable Housing (Revised Schemes)	No	
Affordable Rental Housing (2009)	No	
Building Sustainability Index: BASIX (2004)	No	
Educational Establishments & Child	No	

State Environmental Planning Policies – Statement of applicability to Planning Proposal 13		
SEPP	**Relevant (Yes/No)**	**Comment**
Care Facilities (2017)		
Exempt & Complying Development Codes (2008)	Yes	See comment
Housing for Seniors or People with a Disability (2004)	No	
Infrastructure (2007)	No	
Integration & Repeals (2016)	No	
Mining, Petroleum Production & Extractive Industries (2007)	No	
Miscellaneous Consent Provisions (2007)	No	
Rural Lands (2008)	Yes	See comment
State & Regional Development (2011)	No	
State Significant Precincts (2005)	No	
Vegetation in Non-Rural Areas (2017)	No	

SEPP 44 – Koala Habitat Protection

The planning proposal proposes to direct blueberry farms away from land that has been mapped as core koala habitat under Councils Comprehensive Koala Plan of Management for the Bellingen Coastal Area.

This is consistent with the central aim of the SEPP, which is to encourage the proper conservation and management of areas of natural vegetation that provide habitat for koalas.

SEPP Exempt & Complying Development Codes (2008)

The proposed exemption for ''horticulture'' is not provided for elsewhere within this SEPP.

SEPP Rural Lands (2008)

Section 7 of this SEPP specifies a series of rural planning principles that must be observed in the exercise of plan making functions. These principles are discussed below, in the context of Planning Proposal 13.

The Rural Planning Principles are as follows:

(*a) the promotion and protection of opportunities for current and potential productive and sustainable economic activities in rural areas,*

Comment:

The planning proposal does not prohibit any form of agriculture. In most instances, no additional consent will be required to undertake agricultural activities in Bellingen Shire.

The NSW Governments central planning framework is the Standard Instrument Local Environmental Plan. This allows Councils to choose whether or not they require development consent for horticulture in the zones affected by this proposal.

The approach that Council has elected to pursue protects all types of horticulture from the need to obtain development consent, with the exception of blueberry farms that choose to locate in areas where there is a greater likelihood of impact to either surrounding properties, or the local environment.

It is considered that this approach will allow for the continuation of environmentally sustainable agricultural activities in Bellingen Shire.

(b) recognition of the importance of rural lands and agriculture and the changing nature of agriculture and of trends, demands and issues in agriculture in the area, region or State,

Comment:

The objectives of this planning proposal are to address concerns regarding a recent trend for the establishment of blueberry farms and to address some of the impacts that are being associated with this trend.

A further issue that has arisen in agriculture is an apparent lack of resources to undertake environmental compliance by key NSW Government agencies. The recent release of an ''Investigation into water compliance and enforcement 2007-17'' by the NSW Ombudsman confirms, for example, the chronic under-resourcing of the compliance and enforcement roles regarding water extraction in NSW.

This has prompted calls from the community for Council to introduce local planning controls, capable of local enforcement by Council Officers, if necessary.

Council recognises the central role that agriculture plays in the local economy, and this is reflected in Objective 2 of the planning proposal, which aims to ensure that any regulatory option is quarantined to blueberry growing only, and does not impact upon other forms of horticulture or agriculture.

(c) recognition of the significance of rural land uses to the State and rural communities, including the social and economic benefits of rural land use and development,

Comment:

The report that was presented to Council regarding this matter documented, and acknowledged, the role that agriculture plays in the local economy. For example, the Agriculture Forestry & Fishing Industry Sector (as a whole) added $32 million value to the local economy in 2015/16. Of this $32 million, $30.5 million was attributable to agriculture alone. Furthermore, the Agriculture Forestry & Fishing Industry Sector (as a whole) currently generates the highest number of Full Time Equivalent jobs in Bellingen Shire, as of 2015/16.

(d) in planning for rural lands, to balance the social, economic and environmental interests of the community,

Comment:

The proposed policy response respects the value of agricultural activity to the local economy and the important role that it plays in the social structure and identity of Bellingen Shire. It is not a broad brush reactive response to agriculture as a whole, but a selective refinement of existing policy.

Should a local government area consider that the economic benefits of a particular model of agriculture do not justify the potential environmental impacts of that activity, then it is reasonable to respond with a policy position that looks to address that disparity.

It is submitted that the proposed policy position effectively balances the social, economic and environmental interests of the community.

(e) the identification and protection of natural resources, having regard to maintaining biodiversity, the protection of native vegetation, the importance of water resources and avoiding constrained land,

Comment:

The planning proposal seeks to divert new blueberry farms away from environmental assets such as riparian zones, and core koala habitat. It does not seek to prohibit farms from establishing in these areas, however will require a more careful consideration of impact if it is proposed to locate within those areas. It is considered that this is a responsible and reasonable response to this planning principle.

(f) the provision of opportunities for rural lifestyle, settlement and housing that contribute to the social and economic welfare of rural communities,

Comment:

The planning proposal does not look to provide new opportunities for rural lifestyle, settlement and housing.

(g) the consideration of impacts on services and infrastructure and appropriate location when providing for rural housing,

Comment:

The planning proposal does not look to provide new opportunities for rural housing.

(h) ensuring consistency with any applicable regional strategy of the Department of Planning or any applicable local strategy endorsed by the Director-General.

Comment:

The planning proposal is considered to be consistent with the North Coast Regional Plan. This has been addressed earlier in this planning proposal.

Is the proposal consistent with applicable Section 117 directions?

A summary table documenting the proposals compliance with relevant Section 117 Directions is provided below.

Section 117 Directions – Statement of applicability to Planning Proposal 13			
117 Category	**117 Direction**	**Relevant (Yes/No)**	**Comment**
Employment & Resources			
	1.1 – Business & Industrial Zones	No	
	1.2 – Rural Zones	Yes	Complies. Does not rezone existing rural land or include provisions that will increase the permissible density of land within a rural zone.
	1.3 – Mining, petroleum & Extractive Industries	No	
	1.4 – Oyster Aquaculture	No	Planning proposal would reduce potentially adverse impacts on Oyster aquaculture areas.
	1.5 – Rural Lands	Yes	The planning proposal will, in accordance with Clause 3(a) of the Direction, affect land within an existing rural zone. Clause 4 of the Direction requires that a planning proposal to which clause 3(a) applies, must be consistent with the Rural Planning Principles listed in State Environmental Planning Policy (Rural Lands) 2008. It is considered that the planning proposal is consistent with the Rural Planning Principles. This has been addressed in a previous section of the planning proposal.

Section 117 Directions – Statement of applicability to Planning Proposal 13			
117 Category	**117 Direction**	**Relevant (Yes/No)**	**Comment**
Environment & Heritage			
	2.1 – Environment Protection Zones	Yes	The planning proposal includes provisions that facilitate the protection and conservation of environmentally sensitive areas such as riparian corridors and core koala habitat.
	2.2 – Coastal Protection	Yes	Proposed provisions are consistent with relevant coastal planning guidelines.
	2.3 – Heritage Conservation	Yes	The planning proposal will positively impact upon the conservation of aboriginal cultural heritage, by virtue of the proposed setbacks to watercourses. Watercourses are recognised as landscapes that are more likely to contain evidence of aboriginal occupation.
	2.4 – Recreation Vehicle Areas	Yes	Complies
Housing, Infrastructure & Urban Development			
	3.1 – Residential Zones	No	
	3.2 – Caravan Parks & Manufactured Home Estates	No	
	3.3 – Home Occupations	No	
	3.4 – Integrating Land Use & Transport	No	
	3.5 – Development Near Licensed Aerodromes	No	
	3.6 – Shooting Ranges	No	
Hazard & Risk			
	4.1 – Acid Sulfate Soils	Yes	The planning proposal will affect land that is mapped as containing acid sulphate soils. In general terms, riparian zones in these areas are more likely to have acid

Section 117 Directions – Statement of applicability to Planning Proposal 13			
117 Category	**117 Direction**	**Relevant (Yes/No)**	**Comment**
			sulphate soils. The planning proposal will direct blueberry farms away from these areas.
	4.2 – Mine Subsidence & Unstable Land	No	
	4.3 – Flood Prone Land	Yes	The planning proposal will affect flood prone land. In general terms, riparian zones in these areas are more likely to be affected by flooding than other areas. The planning proposal will direct blueberry farms away from these areas.
	4.4 – Planning for Bushfire Protection	Yes	The planning proposal will affect bush fire prone land. Consultation with the Commissioner of the RFS will be required pursuant Clause 4 of this direction.
Regional Planning			
	5.1 – Implementation of Regional Strategies	No	
	5.4 – Commercial & Retail Development along the Pacific Highway, North Coast	Yes	No commercial or retail provisions are proposed. Complies.
	5.10 – Implementation of Regional Plans	Yes	Complies. Addressed elsewhere in this planning proposal.
Local Plan Making			
	6.1 – Approval & referral Requirements	Yes	Complies. No additional concurrence, consultation or referral requirements are proposed.
	6.2 – Reserving Land for Public Purposes	Yes	Complies. No land reserved for public purposes.
	6.3 – Site Specific Provisions	No	The planning proposal does not relate to a particular development proposal.

C. Environmental, social and economic impact

Is there any likelihood that critical habitat or threatened species, populations or ecological communities, or their habitats, will be adversely affected as a result of the proposal?

It is considered that the proposed planning proposal will have a positive impact in this regard.

Are there any other likely environmental effects as a result of the planning proposal and how are they proposed to be managed?

The planning proposal is designed to reduce the environmental effects of blueberry farming in Bellingen Shire by directing farms away from areas of relatively high environmental value.

How has the planning proposal adequately addressed any social and economic effects?

It is Councils experience to date that a blueberry farm that is established without due regard to its proximity to adjoining dwellings or property, has the potential to result in a range of undesirable social impacts. This includes the potential for ongoing conflict between neighbours, when the impacts of blueberry farming extend beyond the property boundary because there are inadequate buffer zones in place.

It is acknowledged that the planning proposal may result in a reduced level of interest in establishing blueberry farms in Bellingen Shire, and that the short term economic benefits of establishing those farms in Bellingen Shire would be foregone. Council is willing to forego those benefits in the long term interest of the environmental assets of Bellingen Shire and, furthermore, sees no reason why this planning proposal should give rise to concerns regarding precedent elsewhere.

State and Commonwealth interests

Is there adequate public infrastructure for the planning proposal?

The planning proposal does not impact significantly upon public infrastructure.

Views of State and Commonwealth authorities

NSW Department of Primary Industries

Council has received correspondence from the NSW Department of Primary Industries raising their concerns with the planning proposal. This was received after Council resolved to proceed with the planning proposal, and a copy is included as Attachment 6 to this planning proposal.

Having regard to the matters raised in this submission, it is Councils view that the planning proposal can proceed without impacting upon any other forms of horticulture besides blueberries. This has been demonstrated in the ‘’Proposed Provisions’’ section of this report.

The suggestion that Council uses the buffer zones in ‘*Living and Working in Rural areas’* on a case by case basis, and to minimise land use conflict, overlooks the fact that there is no compulsion for a blueberry farmer to have any regard to this guide in establishing a farm, nor any commitment from industry to using this as a guideline.

Also, it is considered relatively unlikely that, upon a situation of land use conflict emerging, blueberry farmers will voluntarily remove plantings and infrastructure as part of a discussion facilitated by Council around the Guidelines, and what a suitable buffer should have been, after the fact. It should also be noted that Bellingen Shire Council does not have the level of resourcing necessary to facilitate bespoke negotiations regarding each particular farm, and to mediate every potential breakdown in relations between neighbours that may occur into the future.

It is for this reason that buffer zones have been nominated as the most suitable land-use planning tool for Bellingen Shire. Compliance with the buffer zones will not require the submission of a Development Application, however any intention to extend into the buffer zones can still be considered by Council, in the context of the Land Use Conflict Risk Assessment Guide that is recommended by the Department.

Other

Consultation with relevant state authorities will occur as relevant and where specified as part of the Gateway Determination.

It is expected that consultation will be required with the following agencies.

Issue	**Agency**
Agriculture	NSW Department of Primary Industries
Agriculture	Local Land Services
Water	NSW Office of Water
Environment	NSW Office of Environment & Heritage
Pollution	NSW Environment Protection Authority
117 Direction 4.4 Planning for Bushfire Protection	NSW Rural Fire Service
Aboriginal Cultural Heritage	NSW Office of Environment & Heritage

Proposed Community consultation

The NSW Government publication ‘’A guide to preparing local environmental plans’’ categorises planning proposals into ‘’low impact proposals’’ or ‘’All other planning proposals’’ for the purpose of determining the level of community consultation that should be undertaken.

It is submitted that the proposed Planning Proposal meets the criteria for ‘’All other planning proposals’’, for which a minimum exhibition period of 28 days is specified.

In addition to the NSW Government guidelines, the Bellingen Shire Council Community Engagement Strategy was adopted by Council at its Meeting 22 February 2012, and revised on 24 June 2015. This strategy is designed to outline the approach Bellingen Shire takes towards engaging with our community.

Having regard to the Strategy, it is considered that the planning proposal would be appropriately categorised as Level 3 – Lower impact – Shire Wide. This requires Council to ‘’Inform, Consult & Involve the community.

Noting the specific consultation that has already taken place with the community by virtue of the Rural Lands Planning Policy Review process, it is proposed that the following additional actions be undertaken to consult with the community.

- Advertise the Planning Proposal for a period of 28 days in the Bellingen Courier Sun and the Don Dorrigo Gazette.
- Place notice of the Planning Proposal on the ‘’Create’’ website for the duration of the exhibition period.
- Display the planning proposal, and relevant documentation, at the following locations for the duration of the exhibition period.

    - Bellingen Council Administrative Centre
    - Bellingen Library
    - Urunga Library
    - Dorrigo Library

It is noted though that the gateway determination will ultimately specify the community consultation that must be undertaken on the planning proposal and Council will undertake consultation in accordance with the conditions of the Gateway Determination.

Delegations to make plan

Council resolved as follows at the Ordinary Meeting of Council 28 November 2012 regarding the Delegation of Ministerial Functions to Council.

"RESOLVED (Cr Scott/Cr Manning)

- *That Council advise the Minister for Planning and Infrastructure that it formally accepts the proposed delegations for plan making under the provisions of Section 59 of the EP and A Act 1979.*
- *That, pursuant to Section 381(a) of the Local Government Act 1993, Council approve the delegation of plan making functions to the General Manager.*
- *That Council advise the Minister for Planning and Infrastructure that the nominated Council Officer for the exercising of the proposed delegations for plan making is Liz Jeremy, General Manager."*

Given the minor nature of this proposed amendment, Council has resolved to use its delegations for the making of the Plan and to inform the Department of its intention to use its delegation to make the Plan.

A copy of the Evaluation Criteria for delegated authority has also been included as Attachment 4, in further support of Council's adopted position on this matter.

PLANNING PROPOSAL 13

VERSION 1 ATTACHMENTS INDEX

November 2017

Attachment 1 – Information Checklist
Attachment 2 - Report to Council & Recommendation to proceed
Attachment 3 – Project Timeline
Attachment 4 – Evaluation Criteria for Delegated Authority
Attachment 5 – Rural Land Strategy
Attachment 6 – Department of Primary Industries correspondence

INFORMATION CHECKLIST

Attachment 1

> STEP 1: REQUIRED FOR ALL PROPOSALS

(*under s55(a) – (e) of the EP&A Act)*

- Objectives and intended outcome
- Mapping (including current and proposed zones)
- Community consultation (agencies to be consulted)
- Explanation of provisions
- Justification and process for implementation (including compliance assessment against relevant section 117 direction/s)

> STEP 2: MATTERS - CONSIDERED ON A CASE BY CASE BASIS

(Depending on complexity of planning proposal and nature of issues)

PLANNING MATTERS OR ISSUES	To be considered	N/A	PLANNING MATTERS OR ISSUES	To be considered	N/A
Strategic Planning Context			**Urban Design Considerations**		
• Demonstrated consistency with relevant Regional Strategy	☒	☐	• Existing site plan (buildings vegetation, roads, etc)	☐	☒
• Demonstrated consistency with relevant sub-regional strategy	☐	☒	• Building mass/block diagram study (changes in building height and FSR)	☐	☒
• Demonstrated consistency with or support for the outcomes and actions of relevant DG endorsed local strategy	☒	☐	• Lighting impact	☐	☒
• Demonstrated consistency with Threshold Sustainability Criteria	☐	☒	• Development yield analysis (potential yield of lots, houses, employment generation)	☐	☒
Site Description/Context			**Economic Considerations**		
• Aerial photographs	☐	☒	• Economic impact assessment	☒	☐
• Site photos/photomontage	☐	☒	• Retail centres hierarchy	☐	☒
Traffic and Transport Considerations			• Employment land	☐	☒
• Local traffic and transport	☐	☒	**Social and Cultural Considerations**		
• TMAP	☐	☒	• Heritage impact	☒	☐
• Public transport	☐	☒	• Aboriginal archaeology	☒	☐
• Cycle and pedestrian movement	☐	☒	• Open space management	☐	☒
Environmental Considerations			• European archaeology	☐	☒
• Bushfire hazard	☒	☐	• Social and cultural impacts	☒	☐
• Acid Sulphate Soil	☒	☐	• Stakeholder engagement	☒	☐
• Noise impact	☒	☐	**Infrastructure Considerations**		
• Flora and/or fauna	☒	☐	• Infrastructure servicing and potential funding arrangements	☐	☒
• Soil stability, erosion, sediment, landslip assessment, and subsidence	☒	☐	**Miscellaneous/Additional Considerations**		
• Water quality	☒	☐	*List any additional studies*		
• Stormwater management	☒	☐			
• Flooding	☒	☐			
• Land/site contamination (SEPP55)	☐	☒			
• Resources (including drinking water, minerals, oysters, agricultural lands, fisheries, mining)	☒	☐			
• Sea level rise	☒	☐			

ITEM: **13.1**
SUBJECT: **OPTIONS FOR THE POTENTIAL REGULATION OF BLUEBERRY GROWING IN BELLINGEN SHIRE**
FILE/INDEX: **RURAL LANDS PLANNING POLICY REVIEW**
PRESENTED BY: **DANIEL BENNETT, ACTING MANAGER LAND USE SERVICES**

MOVED (Cr King/Cr Wright-Turner)

That Council:

1. Resolves to prepare a planning proposal specifying that development consent is required for the establishment of blueberry farms in Zones RU1, RU2, RU4 and E4, unless the farm complies with the following criteria, in which case it will be considered as a form of ''exempt development''.

   Blueberry farming is exempt development if it complies with following criteria.

   - Blueberry plants & associated infrastructure (such as poles and netting) are located a minimum of 200m from any dwelling (not including a dwelling on the same property) and a minimum of 50m from any property boundary not held in the same ownership.

   - Blueberry plants & associated infrastructure (such as poles and netting) are located the following minimum distances away from watercourses, based upon the Strahler method of stream ordering.

Stream Order	**Minimum distance either side of watercourse**
1st order	10 metres
2nd order	20 metres
3rd order	30m
4th order and greater	40m

   - Where it is necessary to apply the setback distances specified in subclause b), and those setbacks are vegetated, the setback distances must be retained in their vegetated state, with the exception of the removal of any non-native species.

   - Blueberry plants & associated infrastructure such as poles and netting are not located within any area mapped as ''core koala habitat'' in any adopted Koala Plan of Management.

   - Any netting proposed for the protection of the crop must be black.

2. Resolves to forward the Planning Proposal to the Department of Planning & Environment in accordance with Section 56(1) of the Environmental Planning and Assessment Act 1979 and request the issuing of a Gateway Determination to allow for the exhibition of the proposed amendment.

3. Resolves to advise the NSW Minister for Planning & Environment that it considers the proposed amendment to be of minor significance and that it intends to use its

delegations to permit the General Manager to make the Local Environmental Plan.

4. Endorses the Engagement Strategy that has been proposed in this report for the public exhibition of the Planning Proposal.

For: **Cr King, Cr Fenton and Cr Wright-Turner.**
Against: **Cr Carter, Cr Harrison and Cr Jenkins.**

CARRIED

Mayor King utilised his casting vote to vote for the motion meaning the motion was carried.

EXECUTIVE SUMMARY

In response to concerns regarding the impacts of blueberry farms in Bellingen Shire, Council has recently undertaken consultation to determine community attitudes to the potential regulation of blueberry growing in Bellingen Shire.

This report documents the outcomes of the community consultation and recommends that Council amend its Local Environmental Plan to regulate blueberry growing in Bellingen Shire. The recommended regulatory approach allows for blueberry growing to continue as a form of exempt development, provided certain criteria are met. If those criteria are not met, then blueberry growing will remain a permissible use of land, however will require the submission of a Development Application to Council in order to establish a new blueberry farm.

REPORT DETAIL

This report will address the following matters in order to arrive at a recommended course of action regarding blueberry growing in Bellingen Shire.

1) Background

2) What are the potential approaches that Council could adopt to address concerns regarding blueberry growing in Bellingen Shire?

3) Key matters informing the potential for a local regulatory response to Blueberry Growing

    - How has the State Government considered blueberry growing and its potential impacts through the planning framework and other relevant guidelines?

    - What has the blueberry industry done so far to promote best practice amongst growers?

    - What contribution is made to the Regional Economy by blueberry production?

    - What contribution does agriculture currently make to employment figures and economic activity in Bellingen Shire?

    - What do the community think regarding blueberry growing in Bellingen Shire?

4) Recommended policy position on Blueberry Growing in Bellingen Shire and factors justifying the recommendation

1. Background

Bellingen Shire Council first received complaints regarding blueberry farming in the Shire in late 2014. Since that time, the blueberry industry has continued to expand however most of this expansion has taken place around Coffs Harbour and Woolgoolga and, more recently, south towards Nambucca and to the north between Halfway Creek & Grafton.

Although there are only 3 blueberry farms in Bellingen Shire at this stage, there continues to be a level of concern expressed by the community regarding blueberry growing in general, and more specifically, regarding particular operations that have established in the Shire. The main concerns regarding blueberry farming include chemical spray drift, water pollution, water extraction, erosion and vegetation removal.

In view of these concerns, Council sought the views of the community on blueberry farming in Bellingen Shire as part of the recent Rural Lands Planning Policy Review process. In summary, 65% of respondents to a survey on this matter supported an increased level of regulation of blueberries, however only 46% of respondents supported this if it meant that other forms of horticulture (e.g.: garlic growing, potatoes etc..) would then be captured as part of a consent mechanism.

Since this time, motions contemplating the regulation of blueberry growing in Coffs Harbour and Nambucca local government areas have been presented to both of the respective Councils. At this stage, both those Councils have not elected to proceed with further regulation of the industry in their local government areas.

At both a Federal and State level, the preference of government appears to be for non-regulatory responses to issues of concern, active promotion of industry growth, the development of collaborative relationships between government agencies and industry, and the promotion of industry self-regulation through initiatives such as a Code of Practice.

The NSW Department of Primary Industries on 5 June 2017, following a Blueberry & Greenhouse Horticulture Development Workshop issued the following media release.

> *The NSW Department of Primary Industries (DPI) is actively working with industry, councils and state agencies to promote best practice for blueberry developments to avoid and reduce land use conflicts in the north coast region.*
>
> *DPI Manager Agricultural Land Use Planning, Liz Rogers said a collaborative forum between state agencies, Local Government and the Australian Blueberry Growers Association recently held in Coffs Harbour was a great success.*
>
> *"The DPI supports the sustainable growth of agricultural industries, including the blueberry industry in northern NSW, which contributes significantly to the local and regional economies," Ms Rogers said.*
>
> *"NSW accounts for more than 90 per cent of Australia's blueberry production. The blueberry industry has grown significantly to meet the demand for fresh berries for the Australian domestic and the emerging Asian export markets.*
>
> *"The key areas for discussion at the forum included communication and engagement between industry and government; informing operational practice and compliance; and identifying strategic long and short term actions for the future."*

Representatives from Bellingen Shire Council have actively participated in these various initiatives, including ongoing representation on the Blueberry & Greenhouse Horticulture Interagency Working Group, and attendance at the 5 June Workshop.

Anecdotally, the increased focus on industry support and promotion has occurred in parallel with a progressive removal of compliance resources from state agencies tasked with enforcing key legislation relating to matters such as water extraction and allocation and removal of native vegetation. This continues to fuel a perception that the State Government is unable, or unwilling, to enforce relevant legislation and that local authorities should consider intervening with a local policy response.

Accordingly, this report addresses the potential options for a local policy response to blueberry growing in Bellingen Shire.

2. What are the potential approaches that Council could adopt to address concerns regarding blueberry growing in Bellingen Shire?

There are a number of potential approaches to the regulation of blueberry growing in Bellingen Shire. These include;

- No further regulation
- All forms of horticulture to require development consent
- Blueberry farming only to require development consent
- Blueberry farming to be made permissible as ''exempt development'' provided that it complies with a set of predetermined criteria.

To effectively analyse the merits of these options, there are a number of matters that Council could consider.

The most relevant matters are documented in the next section of the report.

3. Key matters informing the potential for a local regulatory response to Blueberry Growing

How has the State Government considered blueberry growing and its potential impacts through the planning framework and other relevant guidelines?

Blueberry growing is defined as ''horticulture'' under the Standard Instrument Principal Local Environmental Plan (SIPLEP). Horticulture is also defined as a type of ''Intensive Plant Agriculture''.

Both definitions are reprinted below.

> ***horticulture*** *means the cultivation of fruits, vegetables, mushrooms, nuts, cut flowers and foliage and nursery products for commercial purposes, but does not include a plant nursery, turf farming or viticulture.*
>
> *Note.*
> *Horticulture is a type of intensive plant agriculture—see the definition of that term in this Dictionary.*
>
> ***intensive plant agriculture*** *means any of the following:*

(a) the cultivation of irrigated crops for commercial purposes (other than irrigated pasture or fodder crops),
(b) horticulture,
(c) turf farming,
(d) viticulture.
Note.
Intensive plant agriculture is a type of agriculture—see the definition of that term in this Dictionary.

The SIPLEP is in effect, the highest level expression of State Government policy regarding what uses must be allowed in various zones and the way in which they should be permitted (e.g.: with development consent or without development consent).

Horticulture is currently permissible without development consent in Zones RU1 – Primary Production, RU2 – Rural Landscape, RU4 – Primary Production Small Lots, & E4 – Environmental Living in Bellingen Local Environmental Plan 2010 (BLEP 2010).

Should Council wish, to make horticulture permissible with development consent in these zones, there is no obstacle presented by the SIPLEP because it only requires that ''intensive plant agriculture'' is included as either "Permitted without consent" or "Permitted with consent" in Zones RU1 & RU4. It also allows Council to determine a local policy position in Zones RU2 and E4.

The recently released North Coast Regional Plan (NCRP) continues to advocate the Governments position that productive agricultural lands are protected and utilised through the inclusion of *Direction 11: Protect & enhance productive agricultural lands*.

The NSW Government have also released a Right to Farm Policy that further enshrines the notion that farmers should be supported in exercising their right to farm (see Attachment 1), but also states that the NSW Government will '*'work with local councils to identify any additional measures required to assist their efforts in best practice land use planning to address land use conflict issues.''*

One of the main threats to the ongoing use of productive lands is land use conflict. This especially occurs when the potential impacts of new (especially intensive) agricultural pursuits have not been adequately considered and planned for in the design, and ongoing operation, of that pursuit. In this regard, Council has received complaints that the impacts of certain blueberry farms on adjoining land uses have not been adequately considered in the layout and operation of those farms. It is also the case that land use conflict occurs when people buy in rural areas but are not sufficiently aware of the types of land uses that can occur in rural areas and the impacts that can arise from utilising land for agricultural purposes.

In most cases, the key issue underpinning the conflict is a lack of suitable buffers between more intensive pursuits and sensitive adjoining land uses.

The NSW Government have released several documents that advocate the use of buffers to sensitive adjoining land uses, and consider the potential impacts of intensive plant agriculture .

The key documents that are considered relevant to this discussion are discussed below.

Living & working in Rural Areas – A handbook for managing landuse conflict issues on the NSW North Coast (Published by NSW Department of Primary Industries 2007)

A buffer zone is an area of land that is set aside between one use and another, to allow for the impacts of one use on the other to be lessened by virtue of the distance between them.

Table 6 from this document summarises recommended minimum buffers for primary industries. This is partially reproduced below.

As can be seen, a minimum buffer of 200m is recommended between horticulture operations and rural dwellings. There is no setback specified to the property boundary for general horticulture, however there is a 50m setback specified for controlled environment horticulture. This is considered to be a reasonable point of comparison with blueberry growing, notwithstanding that there is a degree of concern regarding the extent to which matters such as chemical spray drift is being effectively ''controlled'' to limit off-site migration during application.

Table 6: Recommended minimum buffers (metres) for primary industries

(NB: The desirable buffer in the circumstances will be the separation distance and conflict avoidance strategy that protects: community amenity, environmental assets, the carrying out of legitimate rural activities in rural areas and the use of important natural resources.)

		Residential areas & urban development	Rural dwellings	Education facilities & pre-schools	Rural tourist accommodation	Watercourses & wetlands	Bores & wells	Potable water supply/ catchment	Property boundary	Roads
Piggeries[1]	Housing & waste storage	1000	500	1000	500	100	SSD	800	100	100
	Waste utilisation area	500	250	250	250	100	SSD	800	20	20
Feedlots[2]	Yards & waste storage	1000	500	1000	1000	100	SSD	800	100	100
	Waste utilisation area	500	250	250	250	100	SSD	800	20	20
Poultry[3]	Sheds & waste storage	1000	500	1000	500	100	SSD	800	100	100
	Waste utilisation area	500	250	250	250	100	SSD	800	20	20
Dairies[4]	Sheds & waste storage	500	250	250	250	100	SSD	800	100	100
	Waste utilisation area	500	250	250	250	100	SSD	800	20	20
Rabbits[5]	Wet shed, ponds & irrig.	300	150	150	150	100	SSD	800	50	50
	Dry shed	120	60	120	60	100	SSD	800	20	20
Other intensive livestock operations[6]		500	300	500	300	100	SSD	800	100	100
Grazing of stock		50	50	50	50	BMP	SSD	BMP	NAI	BMP
Sugar cane, cropping & horticulture		300	200	200	200	BMP	SSD	BMP	NAI	BMP
Greenhouse & controlled environment horticulture		200	200	200	200	50	SSD	SSD	50	50

NAI: Not an issue.

SSD: Site specific determination (no standard or simple buffer distance applies).

BMP: Best management practice to apply given site circumstances. Buffer and/or management practice should represent duty of care to the environment and the public and include measures necessary to protect bank stability, maintain riparian vegetation and protect water quality. The incorporation of best management practice measures in property and farm plans is encouraged.

STRC: Subject to relevant codes.

Buffer distances represent the recommendations of the North Coast Land Use Conflict Working Group following a synthesis of existing guidelines and policy. In some cases, specific and relevant guidelines may require larger buffers or lesser buffers than those prescribed may be appropriate in the circumstances.

Controlled activities on waterfront land – Guidelines for riparian corridors on waterfront land (NSW Department of Primary Industries – Office of Water 2012)

A riparian corridor is an area of land that is set aside either side of a watercourse to provide a level of protection to the watercourse and to preserve its functioning as a watercourse

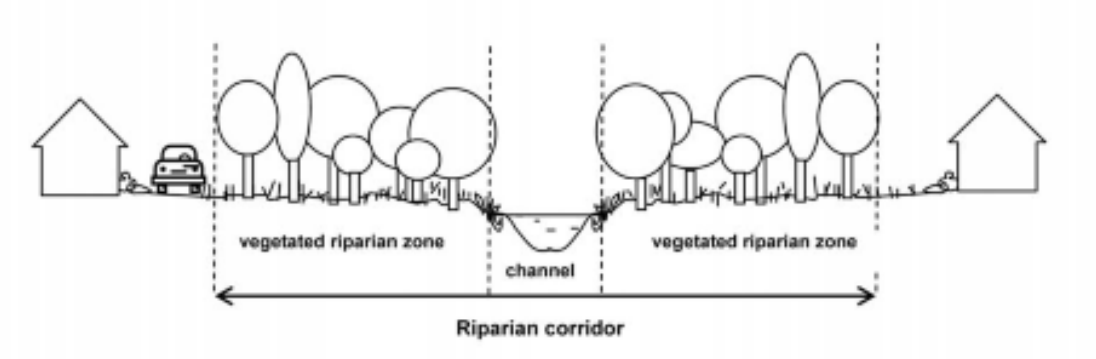
This document provides guidelines for the public and approval authorities regarding what riparian corridors should be preserved for different types of watercourses. The Guidelines are included as Attachment B to this report.

The Guidelines are used in conjunction with the requirement for landholders to obtain a ''Controlled Activity Permit'' (under the Water Management Act 2000) for certain types of activities if they occur with 40m of waterfront land.

In essence, the approach for riparian corridor management is that as a stream becomes more significant, so too should the setback between the stream and any development that may be proposed in its vicinity. This relies upon a system called the ''Strahler System'' which orders the stream based upon how many other streams flow into it.

The illustration below shows how stream order is determined, and the table shows the buffer widths that have been recommended by the Office of Water.

Figure 1. The riparian corridor



Riparian corridor widths

The Officer of Water recommends a VRZ width based on watercourse order as classified under the Strahler System of ordering watercourses and using current 1:25 000 topographic maps (see Figure 2 and Table 1). The width of the VRZ should be measured from the top of the highest bank on both sides of the watercourse.

Figure 2. The Strahler System

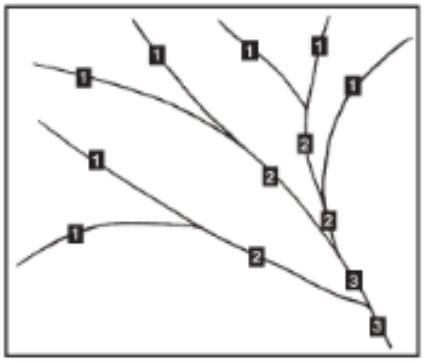


Table 1. Recommended riparian corridor (RC) widths

Watercourse type	VRZ width (each side of watercourse)	Total RC width
1st order	10 metres	20 m + channel width
2nd order	20 metres	40 m + channel width
3rd order	30 metres	60 m + channel width
4th order and greater (includes estuaries, wetlands and any parts of rivers influenced by tidal waters)	40 metres	80 m + channel width

It is considered that the work of DPI in nominating suitable buffers to different order watercourses is of significant value when determining a potential regulatory regime for blueberry growing.

For example, this could be used to nominate standards that must be observed in order to take advantage of an exemption from the need for a Development Application, or be used as best practice Guidelines to observe in the event that a Development Application was required.

NSW Department of Primary Industries Factsheets – ''Preparing Intensive Plant Agriculture Development Applications'' and ''Assessing Intensive Plant agriculture Developments'' (Published by NSW Department of Primary Industries December 2011)

As previously documented, the SIPLEP provides clear provision for Council's to determine whether they allow for ''Intensive Plant Agriculture'' as either "Permitted without consent" or "Permitted with consent" in relevant zones within the local government area.

To support Councils who choose to exercise their discretion to require consent, the NSW Department of Primary Industries have developed a series of Factsheets. These assist applicants, and consent authorities, in determining what the potential impacts of intensive agriculture may be and important matters that should be considered for intensive agricultural operations. These are included as Attachments C & D to this report.

The factsheets are valuable in that they provide an ''off the shelf'' framework that Council could adopt if it wished to require consent for the growing of blueberries, without needing to invest significant time and resources in framing its own set of development controls at this stage. Should Council determine that it wants to develop its own set of development controls at some point in the future, then this could take place through a future amendment to its Development Control Plan.

The existence of the fact sheets also provides a level of recognition, by the NSW Government;

- that the adoption of a regulatory approach to horticultural operations is an acceptable and normal option should local government wish to pursue it.
- of the level of planning that should be undertaken, in a best practice sense, to properly consider the environmental impacts of a horticultural operation and the way in which it should be mindful of the impacts that this may have on adjoining properties.

The items below are an example of just some of the matters that the DPI recommend should be addressed in a DA, as extracted from the Factsheet on 'Preparing Intensive Plant Agriculture Development Applications''

- *land use history on the site and an assessment of the potential impact of the subdivision on such land use*
- *local climatic conditions and the suitability / risks for the proposed intensive plant development*
- *existing and proposed vegetation (cropping areas, improved pastures, windbreaks, plantations, native vegetation remnants, riparian zones etc.)*
- *soils of the property and providing an overview of their suitability and value for the proposed use including soil testing results and an estimate of productive or carrying capacity*
- *environmentally sensitive features of the property such as wetlands, remnant vegetation, groundwater resources, important fish habitat, heritage items or places*
- *an assessment of the risk of contaminated land (e.g. due to previous chemical applications, dip sites, storage facilities) and how this will be managed*
- *ground and surface water resource quality, availability and relevant licence details. Include current water sharing plan and access conditions. This should document / tabulate the amount of water available from all sources (e.g. dams, bores, tanks, effluent re-use, town water and harvestable rights). This can be verified by a copy of all water licences setting out their volumes and conditions. For bores a copy of recent pump test showing water recovery should also be provided. For new horticultural developments evidence should also be provided of consultation with the NSW Office of Water.*
- *an overview of water quality test results relevant to irrigation methods and crop suitability*
- *research into the production systems proposed, the suitability of these for this location, available processing facilities in the region and market prospects. Where*

relevant this should include details of contracts to process or purchase food grown on site and proposed sales outlets.

- *services (power, water, communications) and current farm infrastructure (e.g. dwellings, sheds, yards, fences, dams, bores, pumps, tracks, bridges). This should include an assessment of condition and suitability for the proposed development, and*
- *proposed adaptations, monitoring proposals and Environmental Management Plans to ensure environmental values are protected.*

Soil & Water Management Practices for Blueberry Growers in Northern NSW (NSW Department of Primary Industries & Northern Rivers Catchment Authority – December 2008)

There are a wide range management practices documented in this publication that can be utilised to minimise the off-site impacts of blueberry growing. Given though that these are only advisory practices, there is no legal obligation to implement them. These are summarised below.

BMP	AREA	GOAL	PROCESS	GROWERS CAN
1	Managing run-on water	Diverting clean water	Build diversion banks	Maintain groundcovers
2	Minimising disturbance	Minimising erosion	Progressively disturb area	Choose the correct time of the year
3	Capturing water	Transfer water to drains	Build cross slope catch banks	Maintain cross slope banks
4	Groundcovers	Minimising disturbance	Re-establish quickly	Intensively manage
5	Irrigation design	Irrigation orchard design	Consult irrigation expert	Follow irrigation design
6	Moisture monitoring	Minimising runoff	Maximise water use	Use moisture monitoring devices
7	Nutrient management	Minimising nutrient runoff	Match plant nutrient demands	Use regular soil, leaf and water tests

In the case of some farms that have established within Bellingen Shire, certain management techniques were clearly not observed. For example, when undertaking bulk earthworks to establish the farms there was no progressive disturbance of earthworks to minimise disturbance and erosion, and the earthworks took place in the summer months where the potential for significant rain events was most significant.

Some concern has been expressed that the drainage solutions advocated in this publication direct run-off directly to watercourses, rather than firstly diverting those flow to a retention feature that would allow for water quality polishing prior to discharge into any natural systems.

Notwithstanding this, the document remains potentially valuable as another point of reference for Council if it wished to require consent for the growing of blueberries, without needing to invest significant time and resources in framing its own set of development controls. A copy is included as Attachment E to this report.

What has the blueberry industry done so far to promote best practice amongst growers?

Australian Blueberry Industry Code of Practice October 2013 (the Code). *(Phillip Wilk, Industry Development Officer – Blueberries; in conjunction with Australian Blueberry Growers Association, NSW Government Primary Industries, Horticulture Australia Limited)*

Although noting that blueberry orchards need to be managed to ensure that there are no adverse off site impacts on neighbours and the surrounding environment, the existing Code states that it ‘*’is designed to identify key areas that need to be addressed in blueberry production rather than to be a prescriptive guide to sustainable management of blueberries in Australia.’’*

The Code includes reference to many of the management practices included in the 2008 DPI Guide and is included as Attachment F to this report. In the event that the blueberry industry had observed all of the recommendations in the Code, it is possible that many of the complaints regarding matters such as soil erosion & spray drift would perhaps not have eventuated. In this regard, there is some doubt as to the Codes effectiveness at influencing the actions of farmers within the industry.

This has given rise to recent discussions regarding the need for a more effective position and stance to be taken by industry. This would emphasise the importance of sound environmental practice, and result in some degree of pro-active influence being asserted, by industry, on growers who do not observe relevant legal requirements or best practice farming techniques.

To this end, Blueberry Industry representatives attended a recent workshop at Coffs Harbour where the issue of a revised Code of Practice was discussed between all stakeholders. The summary report from this workshop is discussed below.

Blueberry & Greenhouse Horticulture Development Workshop, June 2017 Coffs Harbour, Notes & Insights. (*NSW Government Department of Primary Industries)*

The Notes & Insights Report is included as Attachment G to this report. Section 3b of the Report deals specifically with the development of a new Best Practice Guide / Code of Practice. Section 3b is reproduced below.

3b. Best practice guide / code of practice

The group were asked to explore the concept of a best practice guide for working in and with the industry. While this is clearly only one of numerous potential actions to enhance the industry it enabled the audience an opportunity to problem solve, create and build opportunities together. This will also contribute to work the Blueberry industry is currently undertaking to create a code of practice.

Implementation of this guide (particularly given it is supported by industry, and would be industry led) is likely to be an effective countermeasure to the small number of unconscionable producers currently trading in the region, particularly if it is linked to marketability of produce.

Workshop participants were asked three questions regarding a potential model of best practice: (1) What would be the purpose of a best practice guide? (2) What issues would it solve? And (3) How would it work? Results are shown below:

Question	Responses
What would be the purpose of a best practice guide?	• To ensure the long-term sustainability of the industry through social, economic & environment outcomes • Manage/minimise impacts • Measure impacts • Communication of Best Practice and community • Set agreed, consistent and achievable benchmarks • Allow for self-compliance • To establish a benchmark for sustainable industry growth into the future, across all growth phases of industry • Establish legislative obligations • All stakeholders need to be inv. In development Consolidate Best Practice to ensure compliance regulatory framework
What issues would it solve?	• Manage/clarify expectations • Conflict • Environment protection • Maximise production • Sustain social licence • Reduce complexity • Improve certainty • Education tool • Allows compliance with Legislation • Communication • Clarification • Sets boundaries • Address community & industry expectations • An idea of what a good form looks like, how it works • Access to key regulations • Reduce risk of land use conflict • Inform planning decisions • Point of reference for influencing regulatory control • Proof of doing the right thing • User friendly, pesticide, green and clean • Demonstrates sustainability
	• All Industry knows responsibility
How would it work?	• Regularly updated • Industry Code of Practice > regulation • Implement through industry groups • Code of practice/MOU • By process of engagement • An incentive for compliance to the code for growers • Provide signposts for specific advice

Since the workshop, a meeting of the Blueberry Interagency Group has also been held at which Australian Blueberry Growers Association (ABGA) representatives provided an update on progress towards developing a Code of Practice. The Code of Practice would promote

best practice blueberry operations and given that 80-90% of the industry contributes to the ABGA, is likely to have a wide reach across industry.

Advice received from the ABGA on 9 September 2017 indicates that the draft Code of Practice is underway, however there is no timeframe provided for finalisation at this stage. This advice is reprinted below.

''We have made good progress on the Code of Practice. At the last Interagency Committee meeting we shared the table of contents, and received feedback from various parties which we have since addressed. We have basically finished the draft document. The next step is to consult with our members to ensure member buy in, following which we will continue consultation with members of the Interagency Committee and then look to releasing the document.''

The governance arrangements associated with any Code of Practice are, understandably, central to addressing community concerns regarding blueberry growing. For example, what will happen in the event that an ''unconscionable producer'' ignores recommended management techniques because it is only held in a voluntary code of practice and there are no punitive or other consequences for non-compliance.

What contribution is made to the Regional Economy is made by blueberry production?

A recent report commissioned by Regional Development Australia (on behalf of the NSW Government Department of Regional Industry & Development) made the following assertions regarding the blueberry industry on the north coast of NSW.

- *Generates more than $250 million of revenue*
- *Employs more than 600 full-time employees*
- *Employs approximately 5000 seasonal workers*
- *Makes more than a billion dollar contribution to the regional economy, when the standard economic multiplier of 3.4 is applied to the industry in the Northern Rivers and Woolgoolga regions.*

Source: Blueberry Industry Business Barriers Review NSW Northern Rivers *(Regional Development Australia – on behalf of NSW Government Department of Regional Industry & Development)*

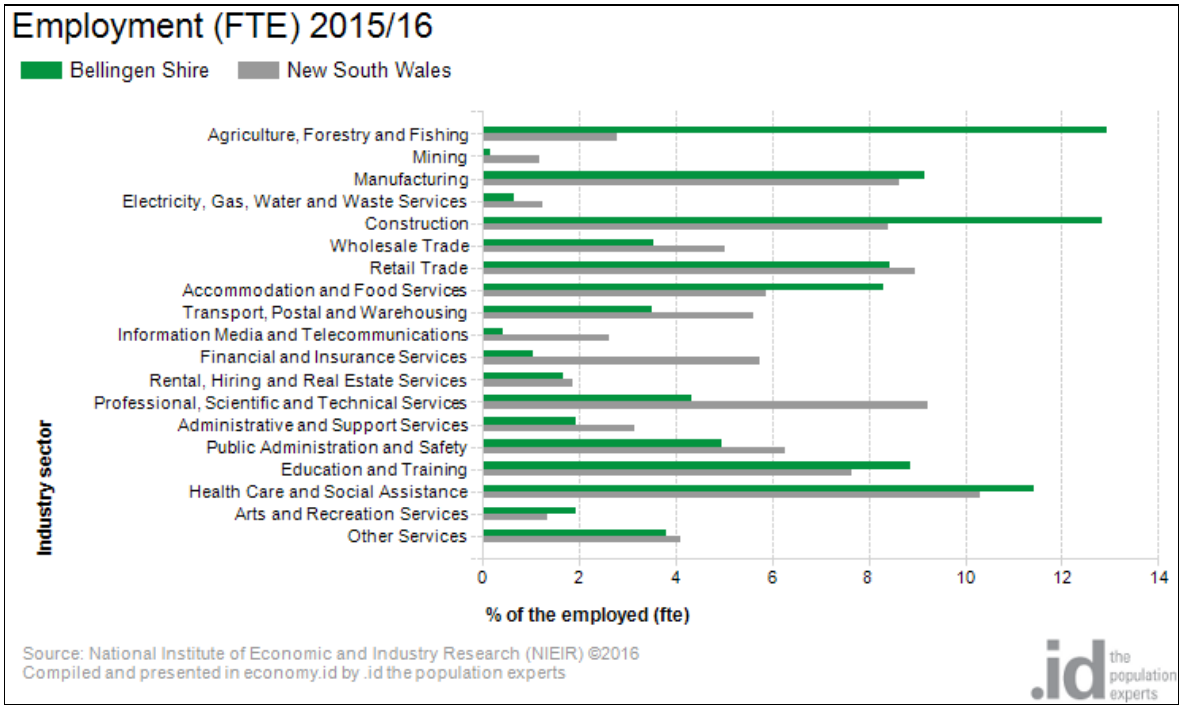
What contribution does agriculture currently make to employment figures and economic activity in Bellingen Shire?

Figures documenting the contribution made by the blueberry industry in Bellingen Shire to the local economy are not available, however the Agriculture Forestry & Fishing Industry Sector (as a whole) added $32 million value to the local economy in 2015/16. Of this $32 million, $30.5 million was attributable to agriculture alone.

Value added by industry sector

Bellingen Shire - Constant prices	**2015/16**			**2010/11**			**Change**
Industry	**$m**	**%**	**New South Wales%**	**$m**	**%**	**New South Wales%**	**2010/11 to 2015/16**
Agriculture, Forestry and Fishing	32.0	8.8	1.7	36.2	12.3	2.1	-4.2
Mining	5.2	1.4	2.3	3.1	1.1	2.1	+2.1
Manufacturing	23.7	6.5	7.1	28.9	9.8	9.6	-5.2
Electricity, Gas, Water and Waste Services	6.9	1.9	2.9	7.4	2.5	3.2	-0.5
Construction	87.5	24.1	7.4	29.7	10.1	6.6	+57.7
Wholesale Trade	11.9	3.3	5.3	9.4	3.2	5.2	+2.5
Retail Trade	19.1	5.3	5.2	18.3	6.2	5.0	+0.8
Accommodation and Food Services	19.4	5.4	3.3	18.8	6.4	3.4	+0.6
Transport, Postal and Warehousing	10.0	2.8	5.1	9.4	3.2	5.2	+0.6
Information Media and Telecommunications	1.9	0.5	4.8	2.6	0.9	4.7	-0.7
Financial and Insurance Services	10.9	3.0	15.2	11.3	3.8	14.2	-0.4
Rental, Hiring and Real Estate Services	17.2	4.7	4.2	12.7	4.3	3.2	+4.5
Professional, Scientific and Technical Services	15.2	4.2	8.8	15.2	5.2	8.6	-0.1
Administrative and Support Services	7.8	2.2	3.6	8.4	2.9	3.8	-0.6
Public Administration and Safety	15.2	4.2	6.1	15.1	5.1	6.2	+0.1
Education and Training	25.8	7.1	5.7	24.7	8.4	6.1	+1.1
Health Care and Social Assistance	38.2	10.5	7.8	29.3	9.9	7.2	+8.9
Arts and Recreation Services	7.4	2.0	1.2	7.3	2.5	1.3	+0.1
Other Services	7.9	2.2	2.4	7.3	2.5	2.4	+0.6
Total Industries	**363.2**	**100.0**	**100.0**	**295.4**	**100.0**	**100.0**	**+67.8**

Figures documenting the number of people employed by the blueberry industry in Bellingen Shire are not available, however the Agriculture Forestry & Fishing Industry Sector (as a whole) currently generates the highest number of Full Time Equivalent jobs in Bellingen Shire, as of 2015/16.



Both of these data sets are important to consider in the context of any regulatory response that proposes a ‘’one size fits all’’ approach to regulation of agricultural activities, versus a specific policy response to those agricultural industries that are a source of concern to the local community.

For example, should Council consider that a uniform approach to regulating agricultural activities is warranted then it would need to be mindful of the potential impacts that a higher level of regulation would have on an industry sector that currently generates the most jobs in the Shire and generates in the order of $30 million of revenue towards the local economy on an annual basis.

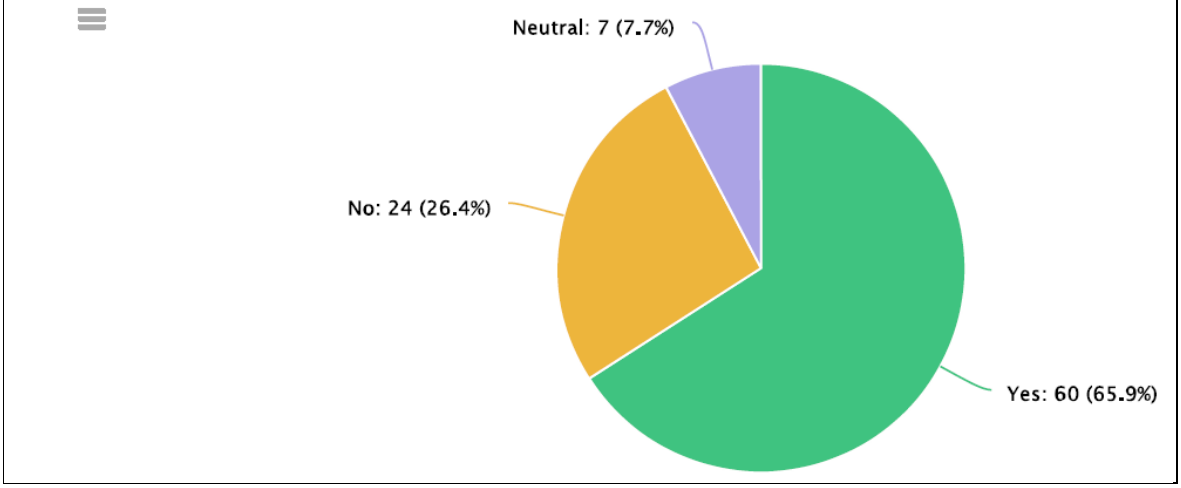
What do the community think regarding blueberry growing in Bellingen Shire?

Council sought the views of the community on blueberry farming in Bellingen Shire as part of the recent exhibition Rural Lands Planning Policy Review process.

The following graphs provide an indication of the communities' opinions regarding blueberry growing in Bellingen Shire.

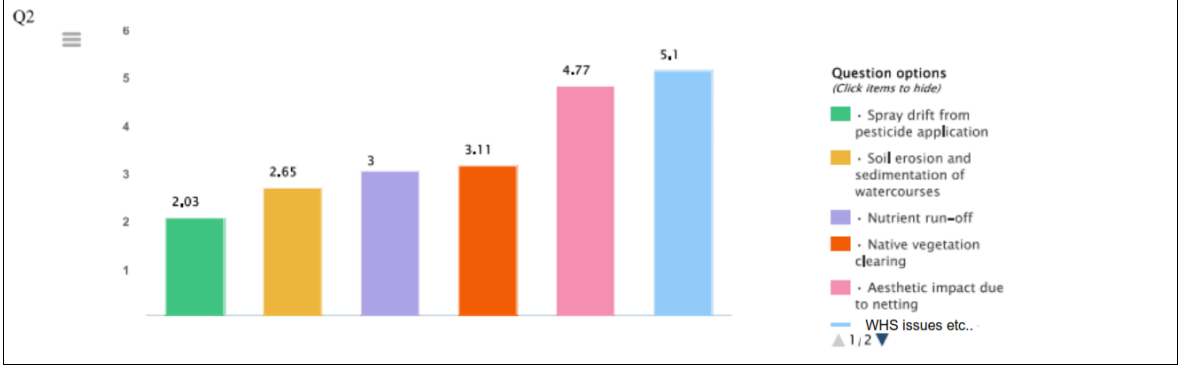
1. Do you support the increased regulation of blueberry growing in Bellingen Shire? Optional question

Q1



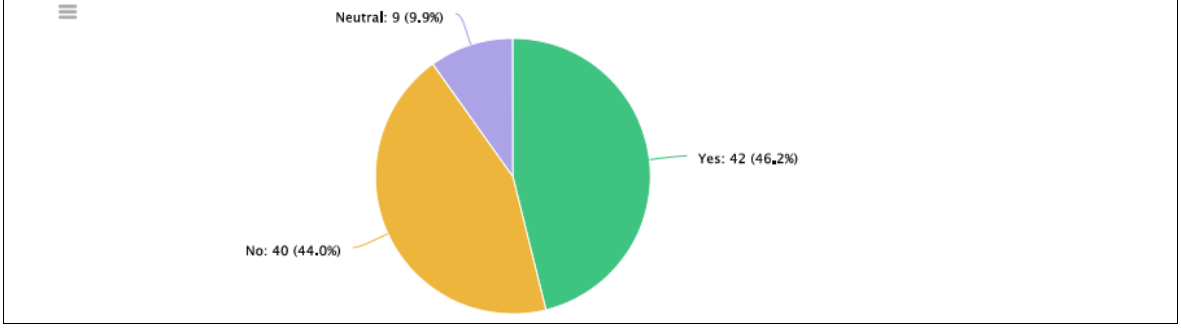
2. If yes, please rank from 1-6 the matters that concern you most about blueberry growing with 1 being the matter of greatest importance, and 6 being the matter of least importance. Optional question

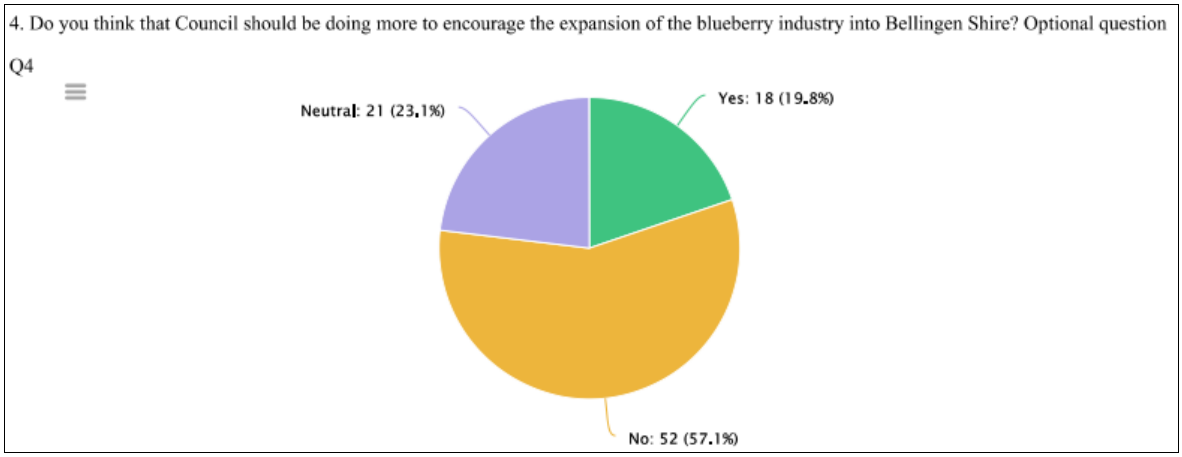
Q2



3. Would you support the increased regulation of blueberry growing if it meant that other types of horticulture (eg: growing garlic or potatoes) would also then be subject to the same type of... Optional question

Q3





In addition to Questions 1-4, Question 5 of the survey asked the question ''Do you have any suggestions as to how the impacts of growing blueberries could be managed by Council?''.

A summary of comments received in response to this question is provided below.

Summary of comments regarding potential blueberry regulation Rural Lands Planning Policy Review Survey	
Comments supporting regulation	**Comments supporting status quo**
Should only be allowed if organic – pesticide application should be banned - conventional chemically assisted farming is the issue	Council should be encouraging local food with low food miles
Farms should be required to contour mounds across slop rather than downhill	Blueberry growing is already heavily regulated by numerous tiers of government.
Owners of blueberry farms should be required to provide suitable buffers to adjoining properties on their land	Council should concentrate on fixing roads etc. rather than harassing farmers.
Can lead to increased traffic generation	It is private land – people should be able to do what they want and Council should mind its own business
Should encourage alternative types of employment generation	More chemicals are used by Landcare when doing riverbank protection works
Needs strict and consistent enforcement of both existing legislation and new legislation designed to limit impacts.	Better communication between growers and the community would help
Irrigation and spray drift are major issues	Same as growing potatoes / cattle – as long as chemicals and sediment don't leave the site should be treated same as any other type of agriculture.
Clearing of native vegetation is an issue	

In summary, 65% of respondents to the survey supported an increased level of regulation of blueberries, however only 46% of respondents supported this if it meant that other forms of horticulture (e.g.: garlic growing, potatoes etc..) would then be captured as part of a consent mechanism.

The matter of greatest concern to the community regarding blueberry growing was spray drift from pesticide application, which is a matter that is not actually regulated by local government. In this instance, the NSW Environment Protection Authority is the appropriate regulatory authority.

Comments in support of further regulation of the industry also re-iterated concerns regarding spray drift, run-off, clearing of vegetation and inadequate buffers between blueberry farms and adjoining properties. Other comments suggested that only organic blueberry farming should be permitted, however this is not a matter capable of realistic implementation or regulation by Council.

Comments supporting the status quo point to the existence of state government legislation that already regulates the industry, the benefits of local food production, the rights of private land ownership and the suggestion that Council should focus its attentions elsewhere, such as fixing roads.

4. Recommended policy position on Blueberry Growing in Bellingen Shire and factors justifying the recommendation

Having regard to the matters discussed in this report, it is recommended that Council resolves to prepare a planning proposal to amend Bellingen Local Environmental Plan 2010 in order to implement the following policy position on blueberry growing in Bellingen Shire.

That development consent is required for the establishment of blueberry farms in Zones RU1, RU2, RU4 and E4, unless the farm complies with the following criteria, in which case it will be considered as a form of ''exempt development''.

<u>Exempt development criteria</u>

Blueberry farming is exempt development if it complies with following criteria.

a) *Blueberry plants & associated infrastructure (such as poles and netting) are located a minimum of 200m from any dwelling (not including a dwelling on the same property) and a minimum of 50m from any property boundary not held in the same ownership.*
b) *Blueberry plants & associated infrastructure (such as poles and netting) are located the following minimum distances away from watercourses, based upon the Strahler method of stream ordering.*

Stream Order	*Minimum distance either side of watercourse*
1st order	*10 metres*
2nd order	*20 metres*
3rd order	*30m*
4th order and greater	*40m*

c) *Where it is necessary to apply the setback distances specified in subclause b), and those setbacks are vegetated, the setback distances must be retained in their vegetated state, with the exception of the removal of any non-native species.*
d) *Blueberry plants & associated infrastructure such as poles and netting are not located within any area mapped as ''core koala habitat'' in any adopted Koala Plan of Management.*
e) *Any netting proposed for the protection of the crop must be black.*

This policy position is considered to be a reasonable and practical position for Bellingen Shire Council to adopt for the following reasons:

1 The policy does not unduly restrict agriculture within the Shire

The proposed policy does not act to prohibit blueberry growing and provides an element of certainty for growers wishing to move into Bellingen Shire regarding Council's expectations. Rather than taking a definition based approach to regulation (that would crudely capture all forms of horticulture) the proposed position minimises the impact of the policy on agriculture more broadly, thereby recognising and protecting the important contribution that agriculture makes to local employment and economic activity.

It is acknowledged that the industry is making moves towards a greater level of self-regulation to avoid adverse impacts on surrounding land uses, however the proposed policy position provides Council with a fall-back position in the event that this does not occur.

2 *The policy relies upon, and is consistent with, existing work undertaken by the NSW Government*

The NSW Government have developed a wide variety of publications (as discussed in previous sections of this report) that point to the benefits of buffer zones between potentially incompatible land uses, and the kinds of matters that should be considered when planning an intensive horticulture operation. The recommended approach acknowledges the work that has been invested in this policy area by agencies such as the Department of Primary Industries and proposes a regulatory approach that is clearly provided for in key legislation developed by the Department of Planning & Environment, such as the Standard Instrument Local Environmental Plan.

3 *The policy is capable of simple comprehension by proponents, and enforcement by Council*

The proposed policy position is built upon a series of very simple tests to determine whether a blueberry farm can be considered as exempt development. This is mindful of concerns expressed by the blueberry industry that there are already a large number of legislative controls that need to be complied with and that Government, in general, should not introduce an additional layer of regulation that is difficult to comprehend.

On the contrary, it is more than likely that observation of the recommended buffers will actually reduce the likelihood of blueberry farmers inadvertently breaching other types of legislation. For example, the retention of a vegetated buffer zone to a watercourse would reduce the likelihood of sediment entering a watercourse during the crop establishment phase because it serves a filtering function.

From a resourcing perspective, Council also needs to be able to make simple objective determinations of compliance or non-compliance. The proposed exemption criteria will assist in this regard by not diverting scarce Council resources towards complex and time consuming investigations of compliance. This will allow regulatory officers to focus upon performing the core requirements of their position, such as assessing Development Applications.

4 *The policy is considered to be legally capable of implementation*

Preliminary discussions held with the Department of Planning & Environment have indicated that it is not necessary for Council, at this stage, to nominate the precise legal framework by which this policy position can be implemented in Bellingen Shire.

This is because the NSW Parliamentary Counsel can assist with drafting the requisite legal instrument.

Notwithstanding this, it is considered that an appropriate legal avenue does exist that could give effect to this policy position (if adopted by Council). This would involve making ''horticulture'' permissible with development consent in Zones RU1, RU2, RU4 and E4, and inserting an additional category of ''exempt development'' in Schedule 2 of BLEP 2010 that made ''horticulture'' an exempt form of development in all instances, except for a blueberry farm that did not comply with the nominated exemption criteria.

Alternatively, it is considered that a local clause could be inserted into BLEP 2010 that would give effect to the intended policy position of Council

5 *The policy gives effect to the strategic direction of Council and is a legitimate expression of local preferences for sustainable development*

Council has resolved to pursue a number of strategic directions as it works towards achieving its overall Community Vision.

Some of the directions that are considered to justify the proposed policy response include;

- *CL1.4 – Best practice, sustainability principles, accountability and good governance are incorporated in all that we do.*
- *CL 1.4.1 – Identify and respond to changes in National, State, Regional and local land use planning principles, statutes and guides.*
- *LE 1.1 – Our waterways are valued, protected and enhanced.*
- *LE2 – Our surroundings are quite and clean*
- *LE4 – We live sustainably and reduce our ecological footprint and contribution to climate change.*
- *LE 5 - We protect and enhance our biodiversity.*
- *Planning controls to improve our biodiversity and protect threatened species are developed and / or refined and adopted by Council as required.*
- *RE1 – We have meaningful work and vibrant businesses within our community*
- *RE 1.3 – Businesses within our shire are ethical and sustainable*
- *RE3.3 – Farming practices are financially and environmentally sustainable*
- *RE 3.4 – Agriculture is a valued part of our economy.*

The proposed policy response respects the value of agricultural activity to the local economy and the important role that it plays in the social structure and identity of Bellingen Shire. It is not a broad brush reactive response to agriculture as a whole, but a selective refinement of existing policy.

Should a local government area consider that the economic benefits of a particular model of agriculture do not justify the potential environmental impacts of that activity, then it is entirely reasonable to respond with a policy position that looks to address that disparity.

It is submitted that the proposed policy position will serve this function.

What does Council need to do to commence the process of amending the BLEP?
Should Council resolve to prepare a planning proposal, Council Officers will prepare an explanation of, and justification for the proposed instrument under the provisions of Sections 55(1) and (2) of the Environmental Planning and Assessment Act 1979 (the Act).

This requires Council to address the following key matters.

- a statement of the objectives or intended outcomes of the proposed instrument,
- an explanation of the provisions that are to be included in the proposed instrument,
- the justification for those objectives, outcomes and provisions and the process for their implementation (including whether the proposed instrument will comply with relevant directions under section 117),
- if maps are to be adopted by the proposed instrument, such as maps for proposed land use zones, heritage areas or flood prone land—a version of the maps containing sufficient detail to indicate the substantive effect of the proposed instrument,
- details of the community consultation that is to be undertaken before consideration is given to the making of the proposed instrument.

Once completed, the planning proposal will be forwarded to the DPE under the provisions of Section 56 of the Act, requesting that the Minister issue Council with a ''Gateway determination''. The issuing of a Gateway determination by the DPE would recognise that there are no fundamental policy objections to the planning proposal, confirm any necessary consultation that is required and allow Council to place the planning proposal on public exhibition. Should the DPE have concerns with the planning proposal then they would not issue a Gateway determination and Council would be required to address those concerns in order for the proposal to proceed.

In addition to Council resolving to prepare a planning proposal, it is also necessary for Council to indicate its intention (or otherwise) to exercise delegations for parts of the plan making process that have been issued to the General Manager. By opting to exercise these delegations, Council removes an additional external referral from the plan making process and this leads to improved timeframes for the eventual making of the plan.

Council resolved as follows at the Ordinary Meeting of Council 28 November 2012 regarding the Delegation of Ministerial Functions to Council.

"RESOLVED (Cr Scott/Cr Manning)

- *That Council advise the Minister for Planning and Infrastructure that it formally accepts the proposed delegations for plan making under the provisions of Section 59 of the EP and A Act 1979.*
- *That, pursuant to Section 381(a) of the Local Government Act 1993, Council approve the delegation of plan making functions to the General Manager.*
- *That Council advise the Minister for Planning and Infrastructure that the nominated Council Officer for the exercising of the proposed delegations for plan making is Liz Jeremy, General Manager."*

It is recommended, given the minor nature of this proposed amendment, that Council inform the Department of its intention to use its delegation to make the Plan.

BUDGET IMPLICATIONS
There are no direct budgetary implications for Council. The processing of the planning proposal can occur within existing budgetary allocations.

SUSTAINABILITY ASSESSMENT
This report has documented all relevant social, economic and environmental factors that underpin the recommendation to Council.

ENGAGEMENT
The NSW Government publication ''A guide to preparing local environmental plans'' categorises planning proposals into ''low impact proposals'' or ''All other planning proposals'' for the purpose of determining the level of community consultation that should be undertaken.

A low impact planning proposal is a planning proposal that, in the opinion of the person making the Gateway determination, is:

- Consistent with the pattern of surrounding land use zones and/or land uses
- Consistent with the strategic planning framework
- Presents no issues with regard to infrastructure servicing
- Does not reclassify public land

It is submitted that the proposed Planning Proposal meets the criteria for a low impact planning proposal, for which a minimum exhibition period of 14 days is specified.

The Bellingen Shire Council Community Engagement Strategy was adopted by Council at its Meeting 22 February 2012, and revised on 24 June 2015. This strategy is designed to outline the approach Bellingen Shire takes towards engaging with our community.

Having regard to the Strategy, it is considered that the planning proposal would be appropriately categorised as Level 3 – Lower impact – Shire Wide. This requires Council to ''Inform, Consult & Involve the community.

Noting the specific consultation that has already taken place with the community by virtue of the Rural Lands Planning Policy Review process, it is proposed that the following additional actions be undertaken to consult with the community.

- Advertise the Planning Proposal for a period of 28 days in the Bellingen Courier Sun and the Don Dorrigo Gazette.

- Place notice of the Planning Proposal on the ''Create'' website for the duration of the exhibition period.

- Display the planning proposal, and relevant documentation, at the following locations for the duration of the exhibition period.

    - Bellingen Council Administrative Centre
    - Bellingen Library
    - Urunga Library
    - Dorrigo Library

Bellingen Planning Proposal 13 – Blueberry Regulation

The proposed project timeline for this Planning Proposal is 6 months.

Stage	Estimated completion date
Commencement (date of Gateway Determination)	22 December 2017
Obtaining technical information	12 January 2018
Government agency consultation	26 January 2018
Public exhibition period	9 March 2018
Consider submissions	30 March 2018
Council to consider submissions & Planning Proposal	18 April 2018
Anticipated date RPA will make Plan	27 April 2018
Anticipated date RPA will forward to Department for notification	4 May 2018

ATTACHMENT 4 – EVALUATION CRITERIA FOR THE DELEGATION OF PLAN MAKING FUNCTIONS

Checklist for the review of a request for delegation of plan making functions to councils

Local Government Area:Bellingen

Name of draft LEP:Planning Proposal 13 - Blueberry Regulation

Address of Land (if applicable):N/A

Intent of draft LEP: To require development consnet for blueberry farms in rural zones unless they comply with a set of exempt development criteria

Additional Supporting Points/Information: None

Evaluation criteria for the issuing of an Authorisation **(Note: where the matter is identified as relevant and the requirement has not been met, council is attach information to explain why the matter has not been addressed)**	**Council response**		**Department assessment**	
	Y/N	**Not relevant**	**Agree**	**Not agree**
Is the planning proposal consistent with the Standard Instrument Order, 2006?	Y			
Does the planning proposal contain an adequate explanation of the intent, objectives, and intended outcome of the proposed amendment?	Y			
Are appropriate maps included to identify the location of the site and the intent of the amendment?		N/A		
Does the planning proposal contain details related to proposed consultation?	Y			
Is the planning proposal compatible with an endorsed regional or sub-regional planning strategy or a local strategy endorsed by the Director-General?	Y			
Does the planning proposal adequately address any consistency with all relevant S117 Planning Directions?	Y			
Is the planning proposal consistent with all relevant State Environmental Planning Policies (SEPPs)?	Y			
Minor Mapping Error Amendments	**Y/N**			
Does the planning proposal seek to address a minor mapping error and contain all appropriate maps that clearly identify the error and the manner in which the error will be addressed?	N			
Heritage LEPs	**Y/N**			
Does the planning proposal seek to add or remove a local heritage item and is it supported by a strategy/study endorsed by the Heritage Office?	N			
Does the planning proposal include another form of endorsement or support from the Heritage Office if there is no supporting strategy/study?	N			
Does the planning proposal potentially impact on an item of State Heritage Significance and if so, have the views of the Heritage Office been obtained?	N			

Reclassifications	**Y/N**			
Is there an associated spot rezoning with the reclassification?	N			
If yes to the above, is the rezoning consistent with an endorsed Plan of Management (POM) or strategy?	N/A			
Is the planning proposal proposed to rectify an anomaly in a classification?	N			
Will the planning proposal be consistent with an adopted POM or other strategy related to the site?	N/A			
Will the draft LEP discharge any interests in public land under section 30 of the Local Government Act, 1993?	N			
If so, has council identified all interests; whether any rights or interests will be extinguished; any trusts and covenants relevant to the site; and, included a copy of the title with the planning proposal?	N/A			
Has the council identified that it will exhibit the planning proposal in accordance with the department's Practice Note (PN 09-003) Classification and reclassification of public land through a local environmental plan and Best Practice Guideline for LEPs and Council Land?	N/A			
Has council acknowledged in its planning proposal that a Public Hearing will be required and agreed to hold one as part of its documentation?	N/A			
Spot Rezonings	**Y/N**			
Will the proposal result in a loss of development potential for the site (ie reduced FSR or building height) that is not supported by an endorsed strategy?	N/A			
Is the rezoning intended to address an anomaly that has been identified following the conversion of a principal LEP into a Standard Instrument LEP format?	N/A			
Will the planning proposal deal with a previously deferred matter in an existing LEP and if so, does it provide enough information to explain how the issue that lead to the deferral has been addressed?	N/A			
If yes, does the planning proposal contain sufficient documented justification to enable the matter to proceed?	N/A			

Does the planning proposal create an exception to a mapped development standard?	N/A			
Section 73A matters				
Does the proposed instrument a. correct an obvious error in the principal instrument consisting of a misdescription, the inconsistent numbering of provisions, a wrong cross-reference, a spelling error, a grammatical mistake, the insertion of obviously missing words, the removal of obviously unnecessary words or a formatting error?; b. address matters in the principal instrument that are of a consequential, transitional, machinery or other minor nature?; or c. deal with matters that do not warrant compliance with the conditions precedent for the making of the instrument because they will not have any significant adverse impact on the environment or adjoining land? (NOTE – the Minister (or Delegate) will need to form an Opinion under section 73(A(1)(c) of the Act in order for a matter in this category to proceed).	Y			

NOTES

- Where a council responds 'yes' or can demonstrate that the matter is 'not relevant', in most cases, the planning proposal will routinely be delegated to council to finalise as a matter of local planning significance.
- Endorsed strategy means a regional strategy, sub-regional strategy, or any other local strategic planning document that is endorsed by the Director-General of the department.

9. Rural Land Strategy

This chapter considers the rural land within the Shire. The rural lands are considered to be a significant part of the Shire and contribute to its productive potential for a wide range of agricultural uses as well as rural housing. The rural lands also make up the scenic rural landscape that is so valued by tourists.

9.1 Rural Land Uses

This section provides a discussion on the following land uses that have been identified in the research and discussions conducted in the formulation of this study as requiring specific management due to particular issues:

- Agricultural Uses
- Housing in Rural Areas
- Rural tourist facilities

A table at the end of this section summarises the uses and gives an indication of how they are to be dealt with in relation to the proposed land use zones.

9.1.1 Agricultural Uses

This section covers the various terms used to describe agriculture and sustainable agriculture. It has been included because it is considered that there is confusion and contradiction in the way that they are used in current rural planning documents.

The term “sustainable agriculture” has many connotations and is linked to the concept of Ecologically Sustainable Development, which embodies the 3 themes of Environment, Economics and Social.

A definition of sustainable agriculture in the ' Strategic Plan for Sustainable Agriculture - Sydney Region' is

> *”Agriculture that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends”*

Another definition is provided by the Standing Committee on Agriculture of the Australian Agriculture Council Working Group on Sustainable Agriculture:

> *“Sustainable Agriculture is the use of farming practices and systems which maintain and enhance the economic viability of agricultural production; the natural resource base; and other ecosystems which are influenced by agricultural activities”*

All of these definitions embrace the concepts of environmental and economic issues, but do not consider the social aspects of sustainable agriculture. These include the capacity of agriculture to meet the demands of the population for healthy and fresh food and fibre products, as well as its ability to have a minimal impact on the amenity and peace of mind of community members, thus reducing rural land use conflict.

A land use planning definition for sustainable agriculture, which incorporates the environmental, economic and social aspects of agriculture as a land use is as follows.

Sustainable Agricultural use of land means the use of land for animal boarding or training establishments, cattle feedlots, extensive agriculture, intensive horticulture, intensive livestock keeping establishments, opportunity feedlots or turf farming, which can be maintained and managed so that the land remains:

- environmentally sustainable (that is, environmental pollution and land degradation arising from the use is minimised);

- socially sustainable (that is, land use conflict and loss of amenity of the surrounding area arising from the use is minimised); and

- economically sustainable (that is, there is a capability of making a net farm profit from the use).

Whilst the above definition can not be added to the new LEP, it provides suitable objectives for the RU1 Primary Production zone.

9.1.2 Housing in Rural Areas

Housing in rural areas takes four forms from a planning point of view and these are as follows:

- Dwelling Houses
- Dual Occupancies
- Multiple Occupancies
- Rural Workers accommodation

Dwelling Houses

The LEP does not provide for a dwelling-house on each and every allotment of land in the Shire. In this regard, it is consistent with State planning principles. The intent of the LEP is to provide the potential for the erection of a dwelling-house on land that complies with the criteria set out in Clause 50 (3) of the LEP. In **some** circumstances there exists justification for some of these allotments to be given a dwelling potential where such dwelling potential does not exist.

Properties identified for dwelling potential as part of Council's Rural Land Audit include:

- Lot 3 DP755541 (Parish of Dingle)
- Lot 3 DP 578284 and Lot 4 DP755542 (Parish of Dudley) - a dwelling-house, following consolidation of those allotments.
- Lot 23 DP755542 (Parish of Dudley)
- Lot 13 DP559561, 104 Gordonville Rd, Gleniffer.

The following properties where identified by the Rural Land Audit however due to the land use zoning the issue of dwelling potential shall be resolved through Amendment No 9 to BLEP 2003.

- Lots 483, 484 & 485 DP755557 (Parish of South Bellingen)
- Lot 139 DP755557
- Lot 130 DP755557
- Lot 80 & 388 DP755557
- Lot 129 DP755557

- Existing Use Rights:
  - Lot 2 DP845116, Whisky Creek Rd, Dorrigo
  - Lot 117 DP755551, 2660 Waterfall Way, Thora
  - Lot 227 DP752830, 206 Lower Bielsdown, Dorrigo
  - Lot 1 DP417324, 283 Roses Road, Bellingen
  - Lots 24 & 45 DP755543, 1128 Kalang Road, Bellingen
  - Lot 136 DP755551, Little North Arm Road, Thora
- Additional Properties
  - Lot 6 DP264514, 2239 Waterfall Way, Thora
  - Lot 234 DP752830, 26 Darley and Bains Road, North Dorrigo
  - Lot 7 DP264514, 2233 Waterfall Way, Thora
  - Lot 49 DP752813, 270 Whisky Creek Road, Dorrigo

In addition to those properties listed above Council has received legal advice from its solicitors that a specific amendment should be made to BLEP 2003 to address a number of abnormalities surrounding dwelling potential within the Shire. As such it is proposed that an amendment be made to Clause 50(3) of BLEP 2003 to permit dwellings on land the subject of a building approval for a dwelling, or extensions to a dwelling. An example of the clause may read:

> *"(u) is land subject to a building approval for a dwelling, or extensions to a dwelling, granted between [insert period]"*

- *North Dorrigo*.

North Dorrigo is a rural centre approximately 10 km north of the town of Dorrigo. It has an existing subdivision pattern with a number of dwellings on the land at present. It is not serviced by a reticulated water or sewer system. Residents are reliant upon water from bores and rain tanks and effluent is disposed of on-site. Concern has been raised regarding the potential impact on bores if the number of dwellings increased. Current guidelines also prohibit the disposal of effluent within 200 metres of a bore. The construction of a reticulated water and sewer system for the village would be expensive and would need to be borne by existing residents. Given the fact that North Dorrigo is over 5 km from the services and facilities within Dorrigo and for the reasons outlined above it is not recommended that a dwelling right be given to each of the lots.

Dual Occupancies

Dual occupancy, in its most traditional form, is the construction of a second dwelling on a property for accommodation of a family member (either aged or young people) and is commonly referred to as a granny flat.

The concept of a dual occupancy is to have the second dwelling as a small addition to the house or be a smaller building and not to be as large as the main dwelling. However this has not occurred and in both urban and rural situations, 2 new dwelling houses (of equal size) can been constructed side by side on a single lot. In an urban context, there has been the ability to subdivide these 2 dual occupancies. This has caused a considerable amount of community unrest where it has been proposed in new urban release

areas where such small lots were not planned. In rural zones, dual occupancies are often required to be attached by use of a garage / carport or breezeway. However the outcome is often one long building whose bulk and scale is not consistent with the rural streetscape character that consists of residential buildings and sheds separated by large spaces.

Provisions exist within the North Coast Regional Environmental Plan for the erection of an attached second dwelling on rural land, only for purposes other than to accommodate rural workers. Such provisions can be incorporated into the new LEP.

Multiple Occupancies

There are 25 approved Rural Land Sharing Communities (multiple occupancies (MO) in the Shire with a total of 193 approved dwelling sites. Since the reintroduction of SEPP 15, Council has received only two applications. The first application involves the addition of two dwelling sites to an already approved MO. The second involves the establishment of a new MO with three dwelling sites. Both applications are pending.

Council officers has received a few enquiries regarding the community title subdivision of existing MOs. Preliminary advice from the DOP has indicated that any such subdivision would require a rezoning of the land. In light of this, Council is not prepared to support community title subdivision where it is inconsistent with the criteria used for determining suitable rural-residential land. The DOP has also advised that Rural Land Sharing Communities remain a significant form of affordable housing on the Mid North Coast and allowing community title subdivision of these lands would mean a significant reduction in the amount of available affordable housing stocks.

If multiple occupancies are to continue in the future then the type of controls and guidelines that are offered by SEPP 15 need to be strictly adhered with to ensure Council is not allowing defacto rural residential development. Development controls like those offered by SEPP 15 ensure that the overriding principles and objectives of MOs are achieved and people have a clear expectation and an understanding of what they are entering into. Furthermore, amendments to Section 94 Contributions Planning offer new opportunities for Council to ensure that MO developments make appropriate contributions to infrastructure etc relative to their impact.

Council has resolved to assess applications for conversion of Multiple Occupancies to Community Title on their merits. Council will investigate other models adopted by other Councils within the region and undertake stakeholder and public consultation on the matter to allow further consideration of the issue.

Rural Workers Accommodation

Rural workers accommodation are additional dwelling houses that are permitted only to house people who are required to work on a property. They are required for mainly intensive forms of agriculture or large extensive agricultural holdings which need more than one family to operate them.

They have become defacto dual occupancies in some areas where the use has changed so that there is no longer a need for the employment of a worker on the land. They have also been a reason given for subdivision of rural land. The option exists to abolish them completely as they are not considered necessary in the current context where settlements are close by and farm workers have access to transportation. This is considered to be the appropriate course of action.

9.1.3 Rural Tourism

Farmgate Sales

Farmgate sales or roadside stalls occur throughout the rural lands and are defined in the LEP as follows:

> *roadside stall means a building or place not exceeding 20 square metres in floor space or area, respectively, where only primary products produced on the property on which the building or place is situated are exposed or offered for sale or sold by retail.*

They are generally permitted in rural zones. They have the potential to cause traffic hazards if they are located too close to the road and if there is not sufficient area for the cars to pull off the road completely. There is a need therefore to provide some guidelines for them.

Rural Tourist Development

It is recognised that rural tourism can provide a boost to the economic development in the rural area. There is a need therefore to encourage it by ensuring that the planning controls have sufficient flexibility in them.

The current provisions in the Bellingen LEP for tourist related developments are ambiguous and contradictory. The source of the problem is the definition of the term 'tourist facility" which is defined as follows:

> *"tourist facility means an establishment providing for holiday accommodation or recreation and may include a boatshed, boat landing facilities, camping ground, caravan park, holiday cabins, hotel, houseboat, marina, motel, playground, refreshment room, water sport facilities or a club used in conjunction with any such activities, but does not include a total destination resort".*

It can be seen that this includes a number of other uses which are separately defined in the LEP. Of note are the terms 'camping ground', 'caravan park', 'hotel', 'motel' and refreshment room (restaurant). Total destination resorts are defined separately and do not conflict with these uses.

Each of the zones treats these differently and in a contradictory manner. All permit tourist facilities with development consent but prohibit some of the component parts of them. This is shown in Table 9-1.

Table 9-1 Treatment of Tourist Facility in each zone

Zone	Prohibitions
1(a1) Agricultural Protection	Motels and Refreshment Rooms
1(a2) Secondary Agriculture	Hotels
1(c1) Rural Residential	Tourist facilities
1(c2) Small Holdings	All permitted
1(c3) Rural Settlement	All permitted
2(a) Residential	Hotels
2 (b) Village	All permitted
7(s) Special Emphasis	All except tourist facilities

Source: Bellingen LEP 2003

It can be seen that in each of these zones, although the specific uses are prohibited by themselves, they are permitted as a tourist facility. Case law interprets such a situation as permitting the use where there is an ambiguity in the zoning table where a use is prohibited under one definition and permitted under another. So it can be seen that the prohibitions in certain zones are in fact ineffective. These contradictions can be remedied as part of the new LEP in line with the Standard LEP template.

The adoption of the term 'tourist accommodation' will enable the matter to be simplified. It can cover such activities as cabins, farmstays and ecotourism facilities that are currently being provided in the rural areas. It also deals with the issue of the length of stay.

9.2 Rural Lot Sizes

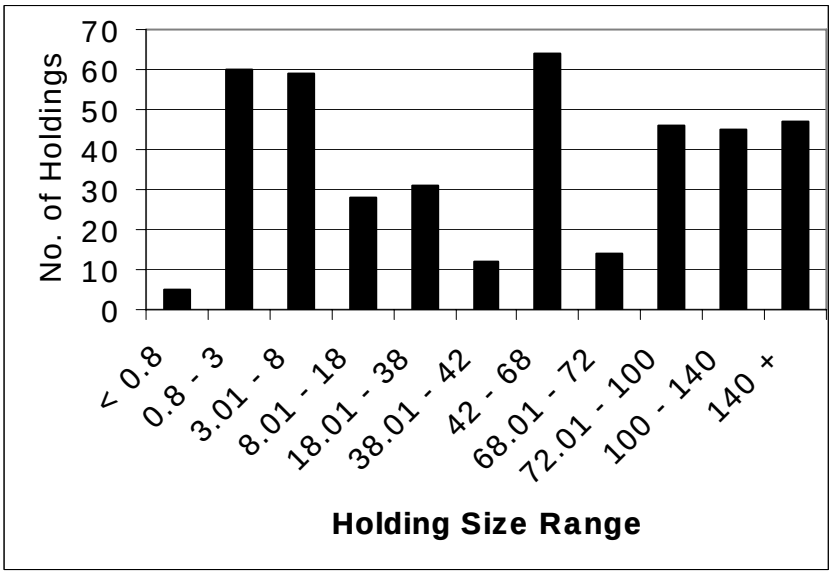
During the community consultation there was a desire to see the minimum lot size reduced from 70 ha to 40 ha on the Dorrigo Plateau. The reasons given were that it is not very productive land and it therefore can sustain more subdivision. It should be noted that the issue of subdivision minimums is related to two components. The first is the capability of the land to sustain the smaller holding size and the other is the provision of services to the area, which is usually provided in an adjoining town or village.

There are a number of issues that have to be taken into consideration when considering the most appropriate subdivision minimum for the proposed rural landscape designation. They area as follows:

- Current fragmentation and holding pattern
- Potential to increase the fragmentation
- Number of potential subdivisions at the current minimum
- Impact on the ability to provide services and facilities
- The impact on the ability to do boundary adjustments

Figure 9-1 shows the number of holdings in each range of holding sizes. This illustrates the existing fragmentation of the rural land on the plateau. It can be seen that there are a large number of holdings less than 18 ha and in the 42 to 68 range. It is also significant to note the numbers greater than 72 ha.

Figure 9-1 Existing holding pattern on Dorrigo Plateau



The first matter to consider is whether the current minimum is adequate and whether it should be decreased or increased. The best way to gain an indication of this is to analyse the current holding pattern and assess the number of potential lots that could be created if all current holdings were subdivided to the existing minimum in the LEP, which for the current Rural zone on the plateau is 70 ha. A range of holding sizes below this is then also analysed. The results for this can be seen in Figure 9-2. It can be seen that at the current subdivision minimum there are still 151 lots that can be created. If the minimum is lowered to 40 and 20 ha the additional lots are 443 and 1207 respectively. The analysis can also provide the average holding size of the area which is currently 68 ha whilst the median is 44 ha. This suggests that there are a number of holdings that are less than the minimum of 70 ha already.

There are a number of options associated with the rural lot sizes. They are discussed below:

- *Decrease the minimum lot size*. Decreasing the minimum lot size will allow for a larger number of lots to be created. This can have an impact on the amount of traffic (each rural lot generates between 6 to 8 vehicle trips per day for the average family), pressure to seal unsealed roads, potential increase in pollution in surrounding streams, potential loss of vegetation and habitat and extra demand on the services and facilities provided by the Council.
- *Increase the minimum lot size*. This will stop any further subdivision occurring and depending on the new minimum, can allow for some subdivision.
- *No change in the minimum lot size*. This will keep the environmental attributes as they are and will not create any more lots than are permitted at present.
- *Variable minimum lot sizes across the LGA*. This is an option that can allow various parts of the LGA to have some more subdivision. It needs to be assessed in relation to the potential environmental, social and economic costs and benefits to ensure that it does not create problems for future generations.

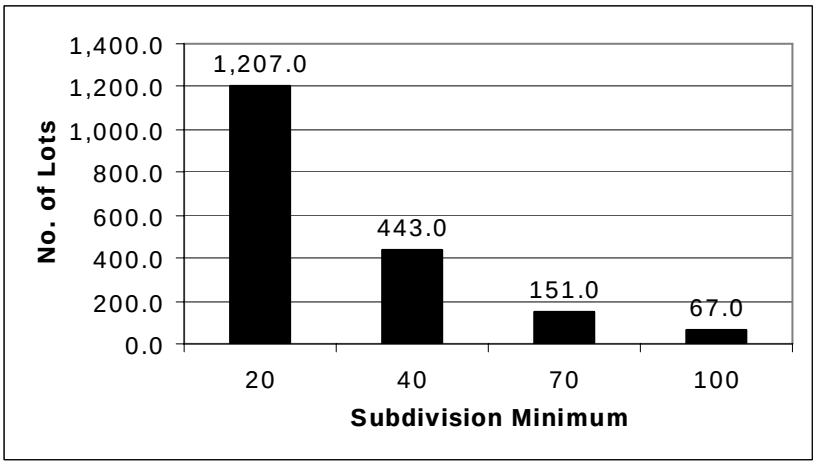


Figure 9-2 Rural subdivision scenarios on Dorrigo Plateau

Having regard to the above discussion and the potential additional lots that would result from a reduction in the lot size as well as the current oversupply of suitable land in Dorrigo, it is not considered that there is any need to reduce the minimum subdivision size on the plateau.

NSW GOVERNMENT | Department of Primary Industries

Office of the Director General
DGPO17/119

17 OCT 2017

Ms Liz Jeremy
General Manager
Bellingen Shire Council
PO Box 117
BELLINGEN NSW 2454

Attention: Daniel Bennett, Strategic Planner

Dear Ms Jeremy

Proposed LEP amendments affecting horticultural industries

I wish to raise my concerns that Bellingen Shire Council has resolved to prepare a planning proposal requiring blueberry developments to seek consent in rural zones. This will cause significant and negative impact to many local horticultural enterprises not just those enterprises which produce blueberries. This is because the definition of the land use of 'horticulture' within the planning framework covers a broad range of fruits and vegetable products. As such I do not believe that the proposed amendments are minor in nature and I have requested my staff raise this issue directly with the Department of Planning & Environment.

Additionally, the inclusion in the LEP amendments that some developments be exempt if the development proposal is consistent with particular buffer distances is of concern. The buffer distances were taken from Chapter 6 of the 'Living and Working in Rural Areas - A handbook for managing land use conflict issues on the NSW North Coast'. The Living and Working in Rural Areas handbook is a useful resource for local councils, agencies and industry but it is only a guideline and should be used in its intended manner. Any decision about appropriate buffers for a development should take into account the nature of each proposed site and potential for land use conflict risk and not be standardised in the Local Environmental Plan.

I strongly encourage Bellingen Council to use the Department of Primary Industries' (DPI) Land Use Conflict Risk Assessment Guide to help determine appropriate buffer distances and to minimise land use conflict. This guide can be found at www.dpi.nsw.gov.au. DPI is currently reviewing current information around buffer distances and will make this available in a statewide form by early 2018 for use by industries and councils.

NSW DPI will continue to work with industry and councils to progress actions that prevent land use conflict. For example, the Australian Blueberry Growers Association is currently finalising the Blueberry Industry Code of Conduct. I look forward to seeing both industry and council work together to deliver effective solutions that result in beneficial outcomes for both industry and the community.

Yours sincerely

SCOTT HANSEN
DIRECTOR GENERAL

GPO Box 5477, Sydney NSW 2001, Australia
Level 48 MLC Centre, 19 Martin Place, Sydney NSW 2000
Tel: 02 9338 6666 Fax: 02 9338 6890 www.dpi.nsw.gov.au ABN: 72 189 919 072

BELLINGEN SHIRE COUNCIL

33-39 Hyde Street, Bellingen NSW
All communications to be addressed to the General Manager
P.O. BOX 117 BELLINGEN NSW 2454

ABN: 26 066 993 265
TELEPHONE: (02) 6655 7300
FAX: (02) 6655 2310
EMAIL: council@bellingen.nsw.gov.au
WEBSITE: www.bellingen.nsw.gov.au

Our Ref: Planning Proposal 13
DB:klb
Contact: Customer & Business Services
Phone: (02) 6655 7300
Your Ref: PP_2017_BELLI_001_00

20 April 2018

NSW Department of Planning & Environment
Locked Bag 9022
GRAFTON NSW 2460

Dear Sir/Madam

Justification for Request for Review of Gateway Determination – Planning Proposal 13 – Blueberry Regulation

I refer to the abovementioned matter.

Council was advised on 16 March 2018 by Marcus Ray (Deputy Secretary, Planning Services), Delegate of the Minister for Planning, that Councils request for a Gateway determination in respect of Planning Proposal 13 was not supported for the following reason.

1. **The planning proposal does not adequately demonstrate the need or justification for the proposed provisions or its inconsistencies with s117 Direction 1.5 Rural Lands, State Environmental Planning Policy (Rural Lands) 2008 and the North Coast Regional Plan 2036 as it will not protect the agricultural production value of rural land.**

In arriving at this determination, Mr Wray had regard to a memorandum prepared by Stephen Murray (Executive Director, Regions), the purpose of which was to *''provide an alternative recommendation to the Planning Team Report, which supports Bellingen Councils proposal…''*.

Bellingen Shire Council resolved at its meeting of 28 March 2018 to request a review of this determination. This resolution is reprinted below.

MOVED (Cr Fenton/Cr Wright-Turner)

That Council
1 *requests that the decision to refuse Planning Proposal 13 is reviewed by the Department of Planning & Environment*
2 *that Council determine not to appoint a represenativitve for Joint Regional Planning Panel with respect to this matter.*

For: Cr King, Cr Klipin, Cr Harrison, Cr Fenton and Cr Wright-Turner.
Against: Cr Carter and Cr Jenkins.

Council, in requesting a review, is required to include *"a justification for why an alteration of the Gateway Determination is warranted including, where relevant, responses to issues raised by the original Gateway decision maker."*

The issues raised by the original Gateway decision maker are taken, for the purposes of this request, to be those discussed in the Memorandum prepared by Mr Murray and formalised in the official Gateway Determination.

It is Council's contention that the following matters justify an alteration of the gateway determination to allow Council to proceed with the Planning Proposal.

The disparity in opinions emanating from professional officers within the DPE
Prior to discussing specific aspects of the refusal, it is important to note that there are two fundamentally different recommendations emanating from different sections of the Department with respect to this Planning Proposal.

Specifically, the Regional Planning Team who are based in Grafton and who have a strong understanding of regional issues regarding blueberry growing consider that the proposal is worthy of support and complies with relevant legislative requirements. In contrast to this, the Executive Team within Sydney, who have elected to intervene in this matter for reasons not stated, consider that the proposal is fundamentally at odds with relevant legislative requirements.

The Department have pointed to the existence of a strong policy position on this matter in support of their refusal, however it is Councils contention that a well-defined policy position should not be capable of eliciting such fundamentally different recommendations from professional officers within the Department.

Furthermore, it is Councils contention that the professional opinion of regional planning officers with firsthand knowledge of the issues regarding blueberry growing in the region should hold greater stead in the circumstances

The existence of numerous State Government Publications supporting the request
It is submitted that the Gateway Determination neglects to consider the reasonableness of the request with regard to numerous best practice documents issued by the NSW Government.

For example, the Planning Proposal demonstrates that;

- the proposed buffer distances to property boundaries and adjoining dwellings have been selected with reference to the well regarded publication "Living & Working in Rural Areas – A handbook for managing landuse conflict issues on the NSW North Coast (Published by NSW Department of Primary Industries 2007)
- the proposed buffer distances to riparian zones have been selected with reference to the document "Controlled activities on waterfront land – Guidelines for riparian corridors on waterfront land (Published by NSW Department of Primary Industries – Office of Water 2012)
- the proposal to make "horticulture" permissible with consent is in fact explicitly allowed for the by the NSW Standard Instrument Principle Local Environmental Plan, which is considered to be the highest level expression of planning policy in the State.

- The proposed buffer distances to watercourses are a credible policy response to regional climate change projections for increased sheet and rill erosion leading to sedimentation, as documented in the "Integrated Regional Vulnerability Assessment", published by the NSW Office of Environment & Heritage.

The evidence base to support regulation of blueberry growing

The Gateway Determination suggests that there is inadequate evidence to warrant the regulation of the blueberry industry. It is Councils contention that there is compelling evidence to support the Planning Proposal in a recent report prepared by Southern Cross University that looked at water quality impacts downstream of blueberry farms in the Coffs Harbour area.

Some of the findings of this report, titled *"Water Quality on Bucca Bucca Creek and the potential impacts of intensive plant agriculture"*, are documented below.

- There was a significant difference in NOx (nitrate & nitrite) between sites downstream of blueberry farms and control sites.
- 24% of NOx samples downstream of blueberries were between 50 and 800 fold higher that the ANZECC trigger values
- Increasing riparian buffer zones by planting trees, shrubs and macrophytes is an important management consideration and has been shown to reduce N exports to creeks by every 4% for every m of planting.

It is Councils view that the findings of this report further validate the environmentally responsible intent of the Planning Proposal. Of particular relevance is the recommendation to increase riparian buffer zones, which accords with the approach advocated by Council to observe buffer zones to riparian features and retain them in their vegetated state if currently vegetated.

Whilst making reference to the water quality report, the justification for the Gateway Determination instead elects to adopt a disinterested approach to these findings, observing that impacts including *"increased nitrogen in waterways are commonly associated with many other forms of horticulture, intensive plant agriculture and agriculture"* and *"it is not reasonable to regulate this industry in isolation…without a more detailed evidence base justifying the proposed changes."* It is of concern to Council that impacts of this nature seem to have been dismissed as the price of undertaking agriculture, and that affected communities should passively accept such impacts in the interest of not impacting upon the profitability of growers.

Objective (b) of the NSW Environmental Planning & Assessment Act 1979 requires decision makers to facilitate ecologically sustainable development by integrating relevant economic, environmental and social considerations into their decision making processes. A universally accepted principle of ecologically sustainable development is the "precautionary principle" which states that where there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.

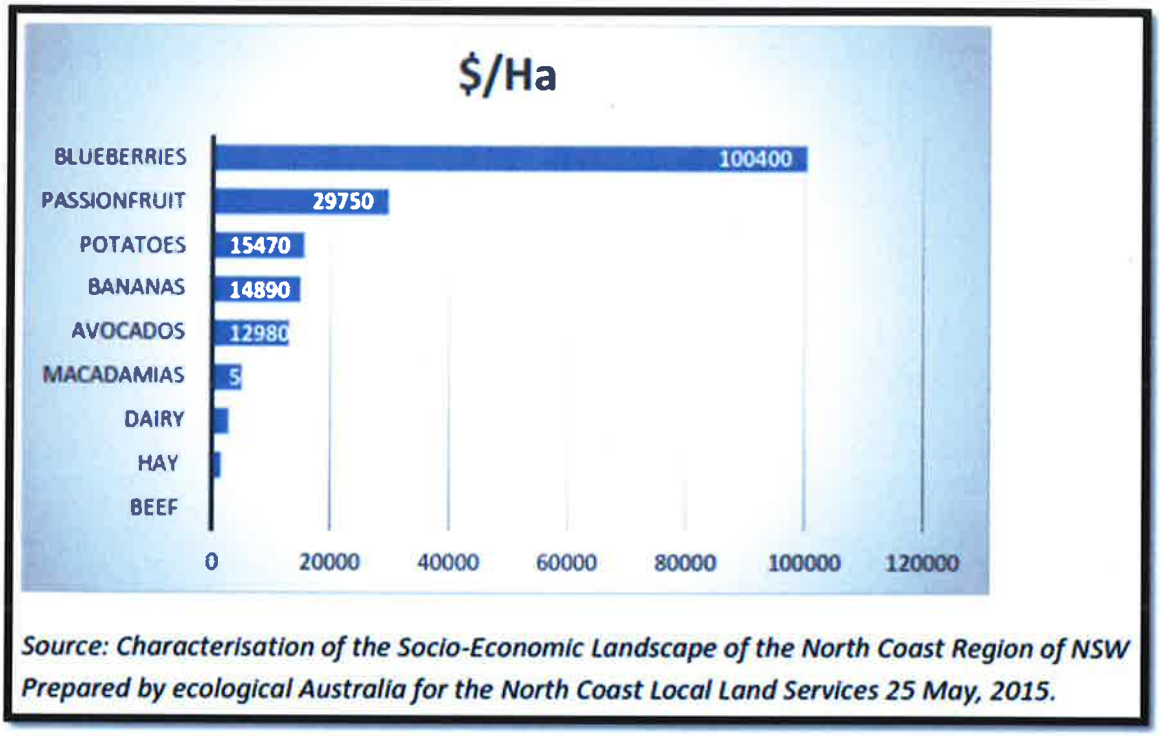
It is submitted that the arguments presented by DPE regarding lack of evidence are contrary to the findings of the Water Quality Report, contrary to the precautionary principle, contrary to the principles of ecologically sustainable development and contrary to the objectives of the Act.

The centrality accorded to economic factors and protecting the agricultural production value of rural land

Council acknowledges that agricultural and economic viability are key matters for consideration in this Planning Proposal. Council made an informed assessment in the Planning Proposal of the contribution that agriculture makes to the economy in Bellingen Shire and deliberately designed it to avoid unintended impacts upon other forms of agriculture by making most horticulture exempt development. Furthermore, Council explicitly acknowledged that the planning proposal may result in a reduced level of interest in establishing blueberry farms in Bellingen Shire, and that the short term economic benefits of establishing those farms in Bellingen Shire may be foregone.

As illustrated in the graph below, the returns per ha for other forms of agriculture on the north coast are significantly less than for blueberry farms. It is Councils contention that this graph;

- Reinforces the need for the Planning Proposal to avoid potential adverse impacts on profitability in other horticultural / agricultural sectors that may arise due to regulation, and
- Serves to illustrate the capacity for minor regulatory changes to be accommodated by the industry without impacting significantly upon profitability.



Source: Characterisation of the Socio-Economic Landscape of the North Coast Region of NSW Prepared by ecological Australia for the North Coast Local Land Services 25 May, 2015.

In the circumstances, Council has carefully weighed up the economic impact of the decision against the environmental and social impacts of allowing blueberry farms to establish without adequate safeguards in place, and has concluded that, for Bellingen Shire, the best solution is to proceed with the minimal level of regulation advocated in the Planning Proposal.

The objectives of the NSW Environmental Planning & Assessment Act 1979 obligate decision makers to consider this full range of matters. Objectives (a) and (b) of the Act are particularly relevant in the circumstances, and these are reprinted below.

The objects of this Act are as follows:

(a) to promote the social and economic welfare of the community and a better environment by the proper management, development and conservation of the State's natural and other resources,

(b) to facilitate ecologically sustainable development by integrating relevant economic, environmental and social considerations in decision-making about environmental planning and assessment,

In addition to this, the Rural Planning Principles included in State Environmental Planning Policy (Rural Lands) obligate decision makers *"in planning for rural lands, to balance the social, economic and environmental interests of the community."*

It is submitted that the Gateway Determination selectively focuses on agricultural production values, to the exclusion of other matters that must be taken into consideration such as environmental values. It also takes the view that any diminution of productive value renders the proposal unsupportable, rather than considering whether that diminution of value is reasonable in the circumstances, with reference to economic, environmental and social factors.

It is Councils contention that there are reasonable concerns regarding the environmental impacts of blueberry growing, and that the economic interests of the blueberry industry can continue to be met in Bellingen Shire with the requested buffers in place.

The lack of focus on the specific impacts of the proposal

It is Councils contention that the Gateway Determination neglects to carefully consider the actual terms and impacts of the planning proposal, preferring instead to forecast a range of outcomes that are not actually proposed by Councils request, and that may never actually eventuate.

This stands in contrast to the detailed assessment of the actual likely impacts of the proposal that was undertaken by the Regional Planning Team, who provided the following summary of recommendations.

"It is considered that the planning proposal should proceed, except for the requirement for netting to be black and with clarification around the clearing provision, for the following reasons:

- *the proposal seeks to ensure new blueberry farms comply with DPI guidelines;*
- *the proposal does not change the permissibility of most horticultural land uses in the Bellingen LGA;*
- *the proposal does not prohibit blueberry framing in the Bellingen LGA and permits blueberry farming as exempt development in most instances;*
- *the proposed exempt development standards for blueberry farms relating to distances from property boundaries, neighbouring houses, watercourses and core koala habitat are considered to be well founded and appropriate; and*
- *the colour of the netting and its aesthetic impact is not considered to be an appropriate standard for exempt development."*

For example, Council is not seeking approval to regulate any other form of agriculture, and the actual impact of the proposal on horticulture is considered to be minimal. Notwithstanding this, the determination builds justification for the recommended position by contemplating its future extension to other forms of horticulture, intensive plant agriculture and agriculture.

The determination also suggests that a requirement to retain vegetated buffers should not be supported because landowners may undertake "unnecessary" pre-emptive clearing to preserve a right to farm.

It is Councils contention that the merit of this planning proposal should not be decided with reference to future scenarios that may never eventuate, or because a landowner may undertake unnecessary pre-emptive clearing of koala habitat or riparian vegetation. The specific impacts of the request are minor, as detailed in the Regional Planning Team Report, and should be allowed to proceed as per their recommendation.

A failure to identify specific non-compliances

The justification for the Gateway determination suggests that the Planning Proposal should not be supported because it is contrary to provisions in the North Coast Regional Plan 2036, State Environmental Planning Policy (Rural Lands) (2008) and Section 117 Direction 1.5 Rural Lands.

Councils original Planning Proposal provided specific responses to each of the relevant criteria within these documents, as did the Regional Planning Teams Report on this matter.

It is submitted that the justification report for the Gateway Determination, instead of rigorously addressing the specifics of each of the relevant criteria, instead attempts to rely upon generalised determinations of strategic intent (eg: *"these principles primarily aim to protect the agricultural production value of rural land and facilitate the orderly and economic development of rural lands"*) that overlook other matters of relevance.

The following section details compliance with specific criteria in the relevant documents.

1. Direction 11 of the North Coast Regional Plan 2036

Direction 11 of the Plan is to *"Protect and enhance productive agricultural lands"*. The specific actions to be observed in plan making are documented below.

In general terms, it is considered that these actions are primarily of relevance to Councils undertaking wider scale policy reviews such Growth Management Strategies. These reviews require a significant investment in time and resources.

It is submitted that these actions should not be used to compel Council to commit to undertaking such reviews given that the planning proposal request has been made in accordance with NSW Government Policy, as expressed through the NSW Standard Instrument Principle Local Environmental Plan. This is considered to be the highest level expression of planning policy in the State and allows Councils to make the determination as to whether horticulture is listed either as permissible with consent, or without consent, in the relevant zones.

11.1 *Enable the growth of the agricultural sector by directing urban and rural residential development away from important farmland and identifying locations to*

support existing and small-lot primary production, such as horticulture in Coffs Harbour.

Comment:
It is submitted that this action is of principle relevance to Planning Proposals that are considering locations for potential new urban and residential development. This is not the intent of the Planning Proposal.

Notwithstanding this, the Planning Proposal identifies locations on individual properties where horticultural activities can occur with reduced likelihood of conflict with adjoining residences. The Planning Proposal is cognisant of the subdivision pattern of rural areas in Bellingen Shire, whereby many small lifestyle allotments exists as a result of historical subdivision permissibility's for concessional allotments, and the landscape is dissected by numerous drainage lines.

Whilst the proposed planning controls would likely not be justified for broad scale agricultural activities on large allotments, it is submitted that the controls are appropriate in the local context and are designed to help new blueberry farms establish and thrive in a manner that reduces the likelihood of conflict occurring with surrounding properties.

11.2 *Deliver a consistent management approach to important farmland across the region by updating the Northern Rivers Farmland Protection Project (2005) and Mid North Coast farmland Mapping Project (2008).*

Comment:
This action is not relevant to this planning proposal.

11.3 Identify and protect intensive agriculture clusters in local plans to avoid land use conflicts, particularly with residential and rural residential expansion.

Comment:
It is submitted that this action is of principle relevance to Planning Proposals that are considering residential and rural residential expansion. This is not the intent of the Planning Proposal.

Notwithstanding this, there are no intensive agriculture clusters known to Council that would warrant protection in any case.

11.4 *Encourage niche commercial, tourist and recreation activities that complement and promote a stronger agricultural sector, and build the sectors capacity to adapt to changing circumstances.*

Comment:
This is not the intent of the Planning Proposal.

11.5 Address sector specific considerations for agricultural industries through local plans.

Comment:
By definition, the Planning Proposal does not propose any change to existing arrangements for *"agricultural industries"*.

2. Section 117 Direction 1.5 Rural Lands.

The objectives of this direction are to:
(a) Protect the agricultural production value of rural land,
(b) Facilitate the orderly and economic development of rural lands for rural and related purposes.

The direction applies when a relevant planning authority prepares a planning proposal that will affect land within an existing or proposed rural or environment protection zone, which is relevant for this matter.

In these circumstances, a planning proposal must be consistent with the Rural Planning principles listed in State Environmental Planning Policy (Rural Lands) 2008.

It is Councils contention that the Gateway Determination has only documented its consideration of the objectives of the direction, without viewing them through the "lense" of the Rural Planning Principles, as is required by Clause 4 of the Direction.

This is contrary to both the approach adopted by Council in the original Planning Proposal and the approach adopted by the Regional Planning Team in its report on this matter. These assessments are included in the subsequent section of this correspondence, and are included to illustrate that Council has credibly demonstrated compliance with Direction 1.5 and the Rural Planning Principles.

3. State Environmental Planning Policy (Rural Lands) (2008)

The Rural Planning Principles, as addressed by Council in its original Planning Proposal are reprinted below.

a) *the promotion and protection of opportunities for current and potential productive and sustainable economic activities in rural areas,*

Comment:
The planning proposal does not prohibit any form of agriculture. In most instances, no additional consent will be required to undertake agricultural activities in Bellingen Shire.
The NSW Governments central planning framework is the Standard Instrument Local Environmental Plan. This allows Councils to choose whether or not they require development consent for horticulture in the zones affected by this proposal.

The approach that Council has elected to pursue protects all types of horticulture from the need to obtain development consent, with the exception of blueberry farms that choose to locate in areas where there is a greater likelihood of impact to either surrounding properties, or the local environment.

It is considered that this approach will allow for the continuation of environmentally sustainable agricultural activities in Bellingen Shire.

(b) recognition of the importance of rural lands and agriculture and the changing nature of agriculture and of trends, demands and issues in agriculture in the area, region or State,

Comment:
The objectives of this planning proposal are to address concerns regarding a recent trend for the establishment of blueberry farms and to address some of the impacts that are being associated with this trend.

A further issue that has arisen in agriculture is an apparent lack of resources to undertake environmental compliance by key NSW Government agencies. The recent release of an "Investigation into water compliance and enforcement 2007-17" by the NSW Ombudsman confirms, for example, the chronic under-resourcing of the compliance and enforcement roles regarding water extraction in NSW.

This has prompted calls from the community for Council to introduce local planning controls, capable of local enforcement by Council Officers, if necessary.

Council recognises the central role that agriculture plays in the local economy, and this is reflected in Objective 2 of the planning proposal, which aims to ensure that any regulatory option is quarantined to blueberry growing only, and does not impact upon other forms of horticulture or agriculture.

(c) recognition of the significance of rural land uses to the State and rural communities, including the social and economic benefits of rural land use and development,

Comment:
The report that was presented to Council regarding this matter documented, and acknowledged, the role that agriculture plays in the local economy. For example, the Agriculture Forestry & Fishing Industry Sector (as a whole) added $32 million value to the local economy in 2015/16. Of this $32 million, $30.5 million was attributable to agriculture alone. Furthermore, the Agriculture Forestry & Fishing Industry Sector (as a whole) currently generates the highest number of Full Time Equivalent jobs in Bellingen Shire, as of 2015/16.

(d) in planning for rural lands, to balance the social, economic and environmental interests of the community,

Comment:
The proposed policy response respects the value of agricultural activity to the local economy and the important role that it plays in the social structure and identity of Bellingen Shire. It is not a broad brush reactive response to agriculture as a whole, but a selective refinement of existing policy.

Should a local government area consider that the economic benefits of a particular model of agriculture do not justify the potential environmental impacts of that activity, then it is reasonable to respond with a policy position that looks to address that disparity. It is submitted that the proposed policy position effectively balances the social, economic and environmental interests of the community.

(e) the identification and protection of natural resources, having regard to maintaining biodiversity, the protection of native vegetation, the importance of water resources and avoiding constrained land,

Comment:
The planning proposal seeks to divert new blueberry farms away from environmental assets such as riparian zones, and core koala habitat. It does not seek to prohibit farms from establishing in these areas, however will require a more careful consideration of impact if it is proposed to locate within those areas. It is considered that this is a responsible and reasonable response to this planning principle.

(f) the provision of opportunities for rural lifestyle, settlement and housing that contribute to the social and economic welfare of rural communities,

Comment:
The planning proposal does not look to provide new opportunities for rural lifestyle, settlement and housing.

(g) the consideration of impacts on services and infrastructure and appropriate location when providing for rural housing,

Comment:
The planning proposal does not look to provide new opportunities for rural housing.

(h) ensuring consistency with any applicable regional strategy of the Department of Planning or any applicable local strategy endorsed by the Director-General.

Comment:
The planning proposal is considered to be consistent with the North Coast Regional Plan. This has been addressed earlier in this planning proposal.

The assessment made by the Regional Planning Team, that also concluded that the Planning Proposal was consistent with the Rural Planning Principles, is included below.

The planning proposal is consistent with the principles for the following reasons:

- *the proposal will continue to protect opportunities for current and future productive horticultural pursuits in rural areas. The proposal does not prohibit horticulture or blueberry farms in the RU1, RU2, RU4 or E4 zones. The proposal will maintain the ability for most horticultural land uses to operate without development consent, including blueberry farms that meet the specified criteria;*
- *the proposal recognises the importance of agriculture and its economic benefits in the Bellingen LGA by continuing the ability for most horticultural land uses to be undertaken without development consent;*
- *the proposal recognises the changing nature, trend and issues relating to horticulture in the Bellingen LGA by introducing provisions to require development consent for some blueberry farms where land-use conflict may occur;*
- *the proposed standards by which blueberry farms can be exempt development are considered to be a balanced approach to addressing the concerns of the community about blueberry farming while enabling farms that comply with the buffer distance criteria to be established as exempt development; and*

- *the proposal considers the protection of native vegetation and water resources by specifying appropriate buffer distances between blueberry farming activities and watercourses and preventing blueberry activities on land mapped as core koala habitat unless the impacts are addressed through a development application.*

In conclusion, it is submitted that the Gateway Determination has not demonstrated that the Planning proposal is contrary to the Rural Lands Planning Principles, in contrast to the detailed analyses provided by Council and the Regional Planning Team which align in their conclusions regarding this matter.

Reliance upon a Code of Conduct in preference to regulatory measures
The justification for the Gateway Determination references the development of a revised Code of Conduct by the Blueberry Industry and asserts that *"the proposed revised code of conduct is supported and will help address any potential issues with the sector across a number of Local Government Areas and is more appropriate than making ad hoc local provisions in a single Council area".*

Council has reviewed the new Code of Conduct and commends the work undertaken by the Australian Blueberry Growers association to raise awareness of potential matters that may arise during the establishment and operation of a blueberry farm. Despite this, the Code does not compel any grower to abide by its contents, provides no mechanisms to censure growers who do not observe it and nominates no standards to observe when considering buffers to adjoining dwellings or areas of environmental constraint.

As repeatedly emphasised, the "ad hoc" local provisions that the Department refer to are explicitly provided for in the NSW Standard Instrument Local Environmental Plan and Council sees no reason why it should be obstructed from exercising its local discretion in applying them.

A question of calibration
Council acknowledges that it is important for the ongoing vitality of the agricultural sector that the majority of agricultural pursuits are not subject to further regulation by the planning system. Accordingly, the Planning Proposal is deliberately designed to insulate the vast majority of agricultural pursuits form this eventuality.

Notwithstanding this, the NSW Government have indicated their strategic intent for the NSW Planning System to be better calibrated, to ensure that activities with only minor impacts are not unnecessarily burdened by bureaucracy, whilst activities with greater impacts are subject to greater levels of assessment.

In this regard, it is difficult to reconcile that the industrial scale of landscape transformation that can arise due to the establishment of a blueberry farm is not considered to warrant any intervention by the planning system, whilst a wide range of routine and small scale residential development is considered to warrant intervention through the inclusion of any number of restrictions. The image below shows the nature of this landscape transformation on a farm that has recently been established in Bellingen Shire.

Again, whilst this type of activity may be of relatively minor concern in areas with limited ecological value, large lot sizes, relatively few drainage lines and lack of immediate neighbours, these characteristics are not typical of land within Bellingen Shire.

In this regard, it is submitted the Planning proposal is a reasonable response to the impacts of this type of agriculture, and the land constraints that exist in Bellingen Shire, and should therefore be permitted to proceed.

Should you have any further enquiries please do not hesitate to contact Councils Senior Strategic Planner, Daniel Bennett, on (02) 6655 7352.

Yours faithfully

Liz Jeremy
GENERAL MANAGER
BELLINGEN SHIRE COUNCIL

Water Quality on Bucca Bucca Creek and the potential impacts of intensive plant agriculture

Final Report - Coffs Harbour City Council Environmental Levy Program

Shane A. White and Isaac R. Santos

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Southern Cross University
School of Environment, Science and Engineering

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Contact:

Professor Isaac R. Santos

Phone: 02 6648 3938

Email: isaac.santos@scu.edu.au

Address: National Marine Science Centre

2 Bay Drive

Charlesworth Bay

Coffs Harbour, NSW

Australia, 2450

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Executive summary

The blueberry industry is the fastest growing horticultural sector in the Coffs Harbour City Council Local Government Area. However, the influence of this intensive industry on water quality remains unknown. Coffs Harbour City Council engaged Southern Cross University to perform water quality investigations in creeks within the Bucca Bucca Creek catchment, a tributary of the Orara River.

Creek water sampling was conducted on 11 occasions between the 7th February and 7th May 2017, covering a wide range of hydrological conditions. Eight blueberry farms were paired to a nearby control site without any blueberry activity. In the 90 day sample period, there were three rain events >90 mm day^{-1} that produced runoff sufficient to create flooding in the sample sites.

Overall, the results revealed a clear link between blueberry farming and nitrogen runoff in headwater streams.

While NO_X (nitrate + nitrite) was the dominant nitrogen species downstream of blueberry farms, dissolved organic nitrogen [DON] was the dominant species in control sites. NO_X at both non-blueberry and blueberry site means were above the ANZECC maximum trigger value (1.071 µmol L^{-1}). However, there was a highly significant difference between non-blueberry (6.3±2.0 µmol L^{-1}) and blueberry (56.9±14.2 µmol L^{-1}) sites. 51% of blueberry samples and 56% of non-blueberry samples were below the ANZECC trigger values, yet 24% of NO_X samples at blueberry sites measured were between 50 and 800 fold higher than the ANZECC trigger value.

NO_X measurements were highest following rain events. Radon (a natural groundwater tracer) observations and low nitrogen concentration in groundwater samples imply groundwater discharge was not a major source of nitrogen to the creeks. We suggest that surface runoff dominates the delivery of nitrogen to the creeks investigated.

NO_X loads were on average >13-fold higher at blueberry sites (21.8 kg N-NO_X ha yr^{-1}) than non-blueberry sites (1.6 kg N-NO_X ha yr^{-1}). NO_X concentrations and loads in creeks clearly increased with increasing blueberry density. At <15% of blueberry land use, there was no detectable influence in NO_X concentrations and loads in the headwater streams. We estimate that creeks within a catchment with 15% blueberry land use may have mean NO_X concentrations >25 fold higher than the ANZECC trigger value.

Assuming that our load estimates over 90 days of observations can be upscaled to annual nitrogen creek exports, and that local farmers use the recommended amount of fertiliser (121 kg N ha yr^{-1}), between 18 and 25% of the used fertiliser was lost to the creeks. This implies that there are opportunities for decreasing the use of fertilisers in the Bucca Bucca catchment as well as managing any nitrogen that escapes to the creeks.

With the rapid growth of the blueberry industry and the established link between blueberry farming and nitrogen runoff, we strongly recommend site-specific management approaches to reduce farm nitrogen runoff, and the assessment of potential impacts of blueberry nitrogen runoff to downstream habitats such as estuaries and the Solitary Islands Marine Park.

1. Introduction

Coffs Harbour City Council engaged Southern Cross University to perform water quality investigations within the Bucca Bucca Creek catchment, a tributary of the Orara River. This project was motivated by community concerns over the impacts of intensive plant agriculture (primarily blueberries) on the water quality of many waterways within the Coffs Harbour Local Government Area ([LGA]. Blueberry farms are the fastest growing horticultural industry in the Coffs Harbour LGA, with many banana famers converting land use to blueberries (Bevan, 2006; Rural Lands Council, 2016).

Coffs Harbour City Council has an environmental and planning responsibility under the Coffs Harbour City Council Biodiversity Action Strategy 2012–2030 to know if any land use change is detrimentally affecting local waterways (Coffs Harbour City Council [CHCC], 2012c). To date, no work has been done to assess potential nutrient pollution from blueberry farms in the Coffs Harbour LGA into surrounding streams. With the growing sprawl of blueberry farming, scientific knowledge is required to manage any nutrient runoff that may be detrimental to valuable freshwater creeks and downstream estuaries.

As an intensive horticulture industry, blueberries require a vast array of nutrients, primarily nitrogen (N), phosphorus (P) and potassium (K). Therefore, fertilisers are used to supplement these nutrients in cultivated monocultures (Barker & Pilbeam, 2015). Some of the fertiliser may escape farms and enter nearby waterways. Waterway nutrient runoff may be difficult to quantify since pathways and sources are often complex and site specific. Possible nutrient sources to creeks include horticultural fertiliser runoff, groundwater seepage, geologic erosion, atmospheric deposition, detritus decomposition and other environmental factors (Conley, 1999; Galloway et al., 2004; Seitzinger et al., 2006; Vitousek et al., 1997).

In this report, we describe the findings of observations performed during various flows to establish baseline data and identify whether water quality may be linked to agricultural practices in the Bucca Bucca catchment. We specifically test whether runoff from blueberry farms may deliver excess nutrients to local streams. To assess this hypothesis, we performed detailed sampling of 16 sub-catchments. Our analysis includes:

1) A comparison to Australia and New Zealand Environment and Conservation Council [ANZECC] pollution trigger values for upland streams in NSW.
2) A comparison between creeks potentially influenced by blueberry and nearby creeks without any potential impacts.
3) An assessment of nutrient pathways into creeks, i.e., whether nutrients are delivered via surface runoff following rain events or by steady groundwater inflows.
4) An assessment of land use percentage contribution, i.e., if percentage of a watershed occupied by blueberry farms will determine the level of nutrient load in downstream creeks.

While we focus on dissolved nutrient runoff, we also report the results of a preliminary pesticide survey in creeks that can be used to inform future, more detailed investigations.

2. Methods

2.1. Study area

Bucca Bucca Creek is ideal for sampling as it does not have a history of land contamination or banana cultivation and has a rapidly increasing area under blueberry cultivation. The Bucca Bucca Creek catchment (lat.-30.12°S, long. 153.03°E) is 117.27 km^2 and lies about 15 km north-northwest of Coffs Harbour, in the NSW north coast bioregion on Gumbaynggirr Aboriginal Country (NSW Office of Water, 2014). The catchment is 72% forested, is dominantly owned by NSW forestry corporation for timber harvest, though contains freehold lands used for pasture, cropping and horticulture (CHCC, 2012d; NSW Office of Water, 2014). Within the catchment there are 15 blueberry farms, however horticulture is one of the smallest land uses. The catchment receives 1485.6 mm mean precipitation per year with an average of 71.3 days with >1 mm of rain (Australian Government Bureau of Meteorology [BOM], 2017a). Bucca Bucca Creek is 29.3 km long, with 77 smaller tributary sub-catchments, releasing >1.67 ML day^{-1} of water to the Orara River (NSW Office of Water, 2014). Bucca Bucca Creek catchment drains from the south to the north west with an elevation profile of 557 m ASL to 67 m ASL. Water flows to the Pacific Ocean via the Orara and Clarence Rivers. Observed watercourse depths within the catchment range from <0.05 m to >3.2 m and observed widths from <0.1 m to >12 m, although these figures can triple in flood periods. Annual mean temperatures are 11.9 ºC minimum and 24.3ºC maximum (BOM, 2017a).

This catchment is considered a low hydrological stress (based on total stream flow) and a high environmental stress (based on land use, point source discharges, turbidity, salinity, pH, algal blooms, fish kills, erosion, riparian vegetation, fish barriers and macro invertebrates) (CHCC, 2012d). The Bucca Bucca Creek catchment forms part of the Great Eastern Ranges Corridor, a national strategy to protect biodiversity (Mackey, Watson, & Worboys, 2010).

The dominant soil type in the Australian Soil Classification (Isbell, 2016) is Kandosol, with five other major soil groups present along the creek sediment areas (NSW Office of Environment and Heritage, 1999). Kandosol soils are not calcareous, Kandosols are siliceous in composition, have a sandy to loamy upper horizon and porous subsoils that are sandy to light clay textured (Isbell, 2016; Schroeder, Panitz, Sullivan & Wood, 2014). These soils have low fertility, low water holding capacity and nutrients are easily leached from the subsoil (Isbell, 2016; Queensland Government, 2015; Schroeder, Panitz, Sullivan & Wood, 2014).

The catchment contains important stands of old growth rainforest and tall open forest dominated by Tallowwood (*Eucalyptus microcorys*), Grey Ironbark (*Eucalyptus paniculata)*, Blackbutt (*Eucalyptus pilularis*) and Flooded Gum (*Eucalyptus grandis*) (CHCC, 2012b). The habitat within the catchment is home to twenty vulnerable or endangered species (Appendix 1; CHCC, 2012a; CHCC, 2012b). The main creek and associated tributaries contain freshwater habitat for the Eastern Freshwater Cod (*Maccullochella ikei*) listed as endangered under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* [EPBC Act] and NSW *Fisheries Management Act 1994* (CHCC, 2012a; CHCC, 2012b). The catchment also provides riparian habitat for the Giant Barred Frog (*Mixophyes iteratus*), listed as endangered under the EPBC Act and NSW *Threatened Species Conservation Act 1995* (CHCC, 2012a; CHCC, 2012b: Murphy & Murphy, 2011).

2.2. Site Selection and experimental Strategy

Sampling was conducted on 11 occasions between the 7th February and 7th May 2017, covering a wide range of hydrological conditions. Environmental Systems Research Institute [ESRI] ArcGIS™ mapping software, field scouting, aerial imagery, consultation with CHCC staff and local

landholders were used to examine the study area and identify eight blueberry farms (n=16 sites) as suitable study sites (ESRI, 2016; Land and Property Information NSW, 2016).

Each blueberry farm was paired to a nearby control site without any blueberry activity. Sites downstream of a blueberry farm were labelled "treatment" ($_T$), while sites adjacent or upstream of blueberry farms were labelled "control" ($_C$) (Figure 1). Two control sites were used for farm B and one control site was used for two treatment sites at farm D. Farm G was not accessible twice during the sample period. Samples G_C1 and G_T1 were not collected due to access issues. Samples G_C8 and G_T8 were not collected due to road flooding. The selection of control sites depended on local morphology and access and followed two strategies:

(1) For farms A, B, C, D and E, an adjacent creek was used as control,

(2) For farms F, G and H, a sample from the same creek just upstream of the blueberry farm was used as control.

Catchments upstream of each site were identified by creating polygons following the upper limits of 1 m interval contours surrounding the waterways, then using light detection and ranging [LIDAR] elevation data to create an upstream watershed delineation in ArcGIS (CHCC, 2016; Geoscience Australia, 2015). Land use (m^2 and % catchment) was classified using field observations and remote sensing imagery (CHCC, 2016; Geoscience Australia, 2015; Land and Property Information NSW, 2016).

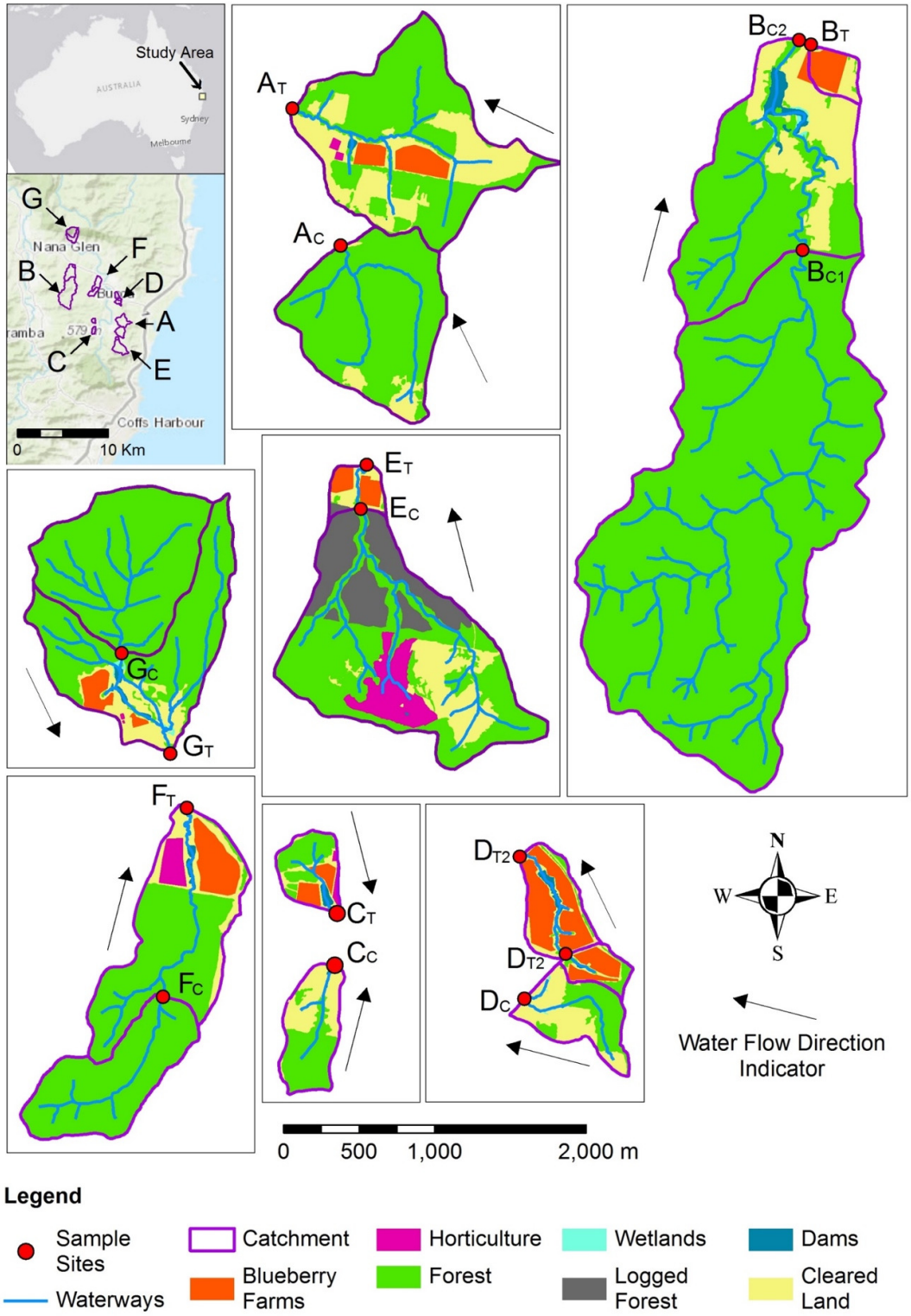

Figure 1: Classification of land uses upstream of sample sites in Bucca Bucca Creek catchments. Sites were chosen as treatment (X_T) or control (X_C) sites. Treatment sites are those that contain >1% blueberry farm land use upstream of a sample site. The classification Forest incorporates wet and dry sclerophyll, rainforest, introduced species and plantation forestry. The classification Horticulture incorporates banana, macadamia, raspberry and cucumber horticulture. Cleared land incorporates pasture, houses and roads.

Table 1: Locations, stream orders and upstream land uses of control (X_C) and treatment (X_T) sites in the Bucca Bucca Creek catchment, NSW.

Site	Coordinates	Stream Order	Forested Land Use (%catchment)	Cleared Land Use (%catchment)	Blueberry Land Use (%catchment)	Blueberry Farm Area (m^2)	Watershed Area (m^2)
A_C	-30.2117 153.1178	3	93	7	0	0	932606
A_T	-30.2008 153.1138	3	61	32	7	89708	1303466
B_{C1}	-30.1550 153.0559	4	100	0	0	0	4154927
B_{C2}	-30.1472 153.0620	4	92	6	0	2622	5555599
B_T	-30.1455 153.0640	1	6	35	59	54598	92343
C_C	-30.2068 153.0921	2	56	44	0	0	265610
C_T	-30.2064 153.0919	2	48	21	26	45574	175979
D_C	-30.1828 153.1128	2	44	53	0	0	280367
D_{T1}	-30.1804 153.1159	1	27	20	51	49844	96873
D_{T2}	-30.1744 153.1127	2	9	17	65	164997	254065
E_C	-30.2206 153.1157	3	51	38	0	0	1573939
E_T	-30.2182 153.1161	3	49	38	3	47536	1676872
F_C	-30.1693, 153.0919	2	100	0	0	0	552097
F_T	-30.1579, 153.0933	3	80	9	10	144609	1418434
G_C	-30.1185 153.0631	3	100	0	0	0	894515
G_T	-30.1260 153.0668	3	87	9	3	47061	1755389

2.3. Sampling methods

Nutrients (phosphate [PO_4], nitrate + nitrite [NO_X], ammonium [NH_4], dissolved organic nitrogen [DON], dissolved organic phosphorus [DOP]) and ancillary parameters (temperature, pH, dissolved oxygen [DO] and electrical conductivity [EC]) were sampled from surface creek water at each sample site. A calibrated EcoSense EC300a probe measured pH (±0.02) and water temperature (±0.1°C). A HQ40D multi probe was used to measure EC (±0.02 µs cm^{-1} @ 25°C) and DO (±0.2 mg L^{-1}). Probes were recalibrated every two weeks using standard calibration solutions per the manufacturers specifications. Dissolved nutrients were sampled at each site using a sample rinsed 60 mL polyethylene syringe. Samples were immediately filtered through a 0.45 µm cellulose acetate syringe filter into a 10 mL rinsed and capped polyethylene sample tube. Sample tubes were labelled, kept in the dark on ice for <5 hours and frozen for laboratory analysis.

2.4. Hydrology

Rainfall and runoff data (30.15S, 153.10E) was acquired from the Australian Bureau of Meteorologys' [BOM] Australian Landscape Water Balance model (BOM, 2017b). Rainfall data was produced as daily precipitation grids interpolated to a 5 km^2 national grid (Jones et al., 2009). Runoff was a modelled assessment calculated by estimating surface runoff, combining soil infiltration and soil saturation. Baseflow was factored based on groundwater stores and deep soil drainage (BOM, 2017b). The BOM uses the AWRA-L model calibrated by streamflow observations and remotely sensed soil moisture and evapotranspiration (BOM, 2017b).

2.5. Groundwater tracing

Groundwater inflow was assessed using the radiogenic isotope radon [^{222}Rn; $T_{1/2}$=3.83 days] at Farm F only. ^{222}Rn is an excellent tracer for groundwater inflows (Burnett, 2006) and has been used extensively to assess groundwater and surface water interactions in rivers and streams (Cook, et al., 2003; Ellins et al., 1990; Hamada, et al., 1997). In addition to the regular sampling described above, Farm F was heavily sampled over a six day period following a rain event of 31 mm in a day. The farm (sites F_C and F_T) was sampled 5 times before the rain event, ≈3 hourly for the first 12 hours after the rain, ≈6 hourly the day following the rain, ≈12 hourly for the third day and ≈24 hourly for the following three days to establish a temporal scale and hydrological drivers (i.e., surface runoff vs groundwater seepage).

^{222}Rn sampling was conducted by collecting ≈6 L of creek water in specialised HDPE plastic bottles with custom gas analysis tubing (Stringer & Burnett, 2004). Gas detection was done using a RAD7 (Durridge Company) radon in air measurement device, connected in a closed loop via desiccant (Lee & Kim, 2006). Air was circulated through the closed loop for a minimum of 2 hours and a sample taken every 10 mins. Calculations of ^{222}Rn (dpm L^{-1}) were done using polonium [^{218}Po ; $T_{1/2}$=3.10 min] counts inside the RAD7 and accounting for air and water volumes, efficiency, sample time and time lag between collection and sampling. The detection limits and further analytical approaches are described in detail elsewhere (Burnett, et al., 2001; Lee & Kim, 2006).

2.6. Groundwater sampling

In addition to the 16 surface water sites, 10 groundwater bores were sampled. Bores were purged for at least 10 minutes to replace standing groundwater. Groundwater was then pumped and sampled for nutrients, water quality and ^{222}Rn, consistent with the above methods. Bore depths were between 26 m and 108 m.

2.7. Pesticide sampling and analysis

Pesticides were sampled at each site once during spatial survey sample 11 on 7/5/17. Two unfiltered 750 mL acid washed brown glass bottles were sample rinsed from each site three times, then filled and capped underwater to eliminate any air in the samples. Bottles were kept on ice (<5 °C) for <5 hours, refrigerated overnight (<5 °C) and sent to EnviroLab Group (Chatswood, NSW) to be analysed within 9 days. Pesticide samples were extracted with dichloromethane and analysed with Gas Chromatography – Mass Spectrometry [GCMS] using methods from USEPA 8081 (organochlorides), USEPA 8141 (organophosphates) and USEPA 8270 (speciated carbamates). Table 2 shows the pesticides analysed and the detection limits using this methodology.

Table 2: Pesticide chemicals tested and minimum detection limits at control and treatment sites in the Bucca Bucca Creek catchment on 7/5/17.

Chemical Family	Chemical name	Minimum detection limit (ppb)	Chemical Family	Chemical name	Minimum detection limit (ppb)
Nitrile-organo-chloride	Chlorothalonil	5	Organo-phosphate	Azinphos-methyl	0.02
Organo-chloride	HCB	0.01	Organo-phosphate	Bromophos ethyl	0.2
Organo-chloride	Alpha-BHC	0.05	Organo-phosphate	Chlorpyriphos	0.01
Organo-chloride	Gamma-BHC	0.05	Organo-phosphate	Chlorpyriphos-methyl	0.2
Organo-chloride	Beta-BHC	0.05	Organo-phosphate	Diazinon	0.01
Organo-chloride	Delta-BHC	0.05	Organo-phosphate	Dichlorovos	0.2
Organo-chloride	Aldrin	0.01	Organo-phosphate	Dimetholate	0.15
Organo-chloride	Heptachlor	0.01	Organo-phosphate	Ethion	0.2
Organo-chloride	Heptachlor Epoxide	0.01	Organo-phosphate	Fenitrothion	0.2
Organo-chloride	Gamma-Chlordane	0.01	Organo-phosphate	Malathion	0.05
Organo-chloride	Alpha-Chlordane	0.01	Organo-phosphate	Ronnel	0.2
Organo-chloride	Endosulfan I	0.02	Organo-phosphate	Parathion-ethyl	0.01
Organo-chloride	Endosulfan II	0.02	Organo-phosphate	Parathion-methyl	0.2
Organo-chloride	Endosulfan sulphate	0.02	Polychlorinated Biphenyl (PCB)	Arochlor 1016	0.01
Organo-chloride	pp-DDE	0.01	Polychlorinated Biphenyl (PCB)	Arochlor 1221	0.01
Organo-chloride	pp-DDD	0.01	Polychlorinated Biphenyl (PCB)	Arochlor 1232	0.01
Organo-chloride	DDT	0.006	Polychlorinated Biphenyl (PCB)	Arochlor 1242	0.01
Organo-chloride	Dieldrin	0.01	Polychlorinated Biphenyl (PCB)	Arochlor 1248	0.01
Organo-chloride	Endrin	0.01	Polychlorinated Biphenyl (PCB)	Arochlor 1254	0.01
Organo-chloride	Methoxychlor	0.02	Polychlorinated Biphenyl (PCB)	Arochlor 1260	0.01
Triazole	Propiconazole	4	Speciated carbamate	Methomyl	3
Triazole	Tebuconazole	2			

2.8. Nutrient analysis

Laboratory analysis of dissolved nutrients (NO_X, NH_4, PO_4) was carried out colourimetrically using a Lachat Flow Injection Analyser [FIA]. Levels of total dissolved N [TDN] and total dissolved P [TDP] were determined colourimetrically using an FIA. Dissolved organic nitrogen (DON) and dissolved organic phosphorus (DOP) were determined as the difference between the total dissolved nutrients (TDP and TDN) and dissolved inorganic nutrients (PO_4 and (NO_X + NH_4)). The analytical approach and detection limits are described in detail elsewhere (Eyre and Ferguson, 2005).

2.9. Interpretation

Ancillary water parameters (EC, pH and DO%) and nutrient concentrations (TDN, NO_X, NH_4, TDP and PO_4) of surface water from control (n=86) and treatment (n=86) sites were analysed using a t-test (two tailed independent samples t-test assuming equal variances) to determine significant differences in control and treatment sample means. Histograms were used to compare against ANZECC trigger values for upland streams (south eastern NSW) in slightly disturbed ecosystems (ANZECC, 2000). All values are summarised using means and standard deviations unless otherwise noted.

The load (flux per area, per time) of nutrients were calculated for each sample by the equation after:

$$\boldsymbol{F = \frac{M(RA)}{A}}$$

where F is the flux of nutrients (µmol ha day^{-1}), M is the concentration of nutrient (µmol L^{-1}), R is surface runoff (mm day^{-1}) and A is catchment area (ha). Appropriate unit conversion were applied to data. Fertiliser loss was calculated as the recommended fertiliser added per year (Doughty, et al., 1988) divided by the mean creek flux of nitrogen.

The ratio between surface water and groundwater radon concentrations were used to estimate groundwater contribution to streams using the equation:

$$\mathbf{GW_{\%SW}} = \frac{\mathbf{SW_{Rn}}}{\bar{x}\mathbf{GW_{Rn}}}$$

where $GW_{\%SW}$ is an estimation of groundwater contribution to each surface water sample, SW_{Rn} is the ^{222}Rn (dpm L^{-1}) in each creek water sample and GW_{Rn} is the average ^{222}Rn (dpm L^{-1}) of the ten groundwater samples taken across the Bucca Bucca Creek catchment. This approach provides the minimum groundwater contribution to stream runoff and is semi-quantitative (Peterson et al., 2010; Santos and Eyre, 2011).

3. Results and discussion

3.1. Hydrological conditions

Overall, the sampling captured contrasting hydrological conditions from baseflow to flooding. In the 90 day sample period (Table 3) there were three rain events >90 mm day^{-1} (16/3/17, 119 mm; 18/3/17, 92.2 mm; and 31/3/17, 90.3 mm) that produced runoff (>12.3 mm day^{-1}) sufficient to create flooding in the sample sites (Figure 2). The maximum runoff observed was 35.9 mm day^{-1} on 19/3/17, following 318 mm of rain in the previous 7 days. Prior to these large rainfall events (31/1/17 to 14/3/17), rainfall did not exceed 31.3 mm day^{-1} and runoff did not exceed 0.53 mm day^{-1}. After the 31/3/17, there were no rain events greater than 12.4 mm day^{-1} and runoff fell from 12.3 mm day^{-1} on the 1/4/17 to 0.2 mm day^{-1} on 16/4/17 and stayed below 0.15 mm day^{-1} for the remainder of the sampling period.

Table 3: Sample dates and hydrology for the 16 selected sites in the Bucca Bucca Creek catchment (BOM, 2017b).

Sample Number	Sample date	Rain on sample day (mm)	Rain within 48hrs prior to sample (mm)	Rain within 7 days prior to sample (mm)	Runoff on sample day (mm day^{-1})	Runoff within 3 days prior to sample (mm day^{-1})
1*	7/2/17	1.5	1.5	1.5	0.01	0.03
2	14/2/17	7	7	22.5	0.09	0.19
3	21/2/17	0	28.1	47.4	0.29	0.8
4	28/2/17	31.3	47.9	48.2	0.52	0.76
5	4/3/17	1	3.4	64.3	0.2	0.88
6	15/3/17	119	166.3	166.3	0.53	0.74
7	22/3/17	1.8	35.1	306.4	18.18	77.41
8*	31/3/17	90.3	95.7	96.3	13.8	16.22
9	9/4/17	0.1	13.2	39.8	1.64	7.35
10	21/4/17	1	4.8	6.2	0.05	0.19
11	7/5/17	0.1	1.6	10.5	0.04	0.18

* samples were not able to be taken at farm G

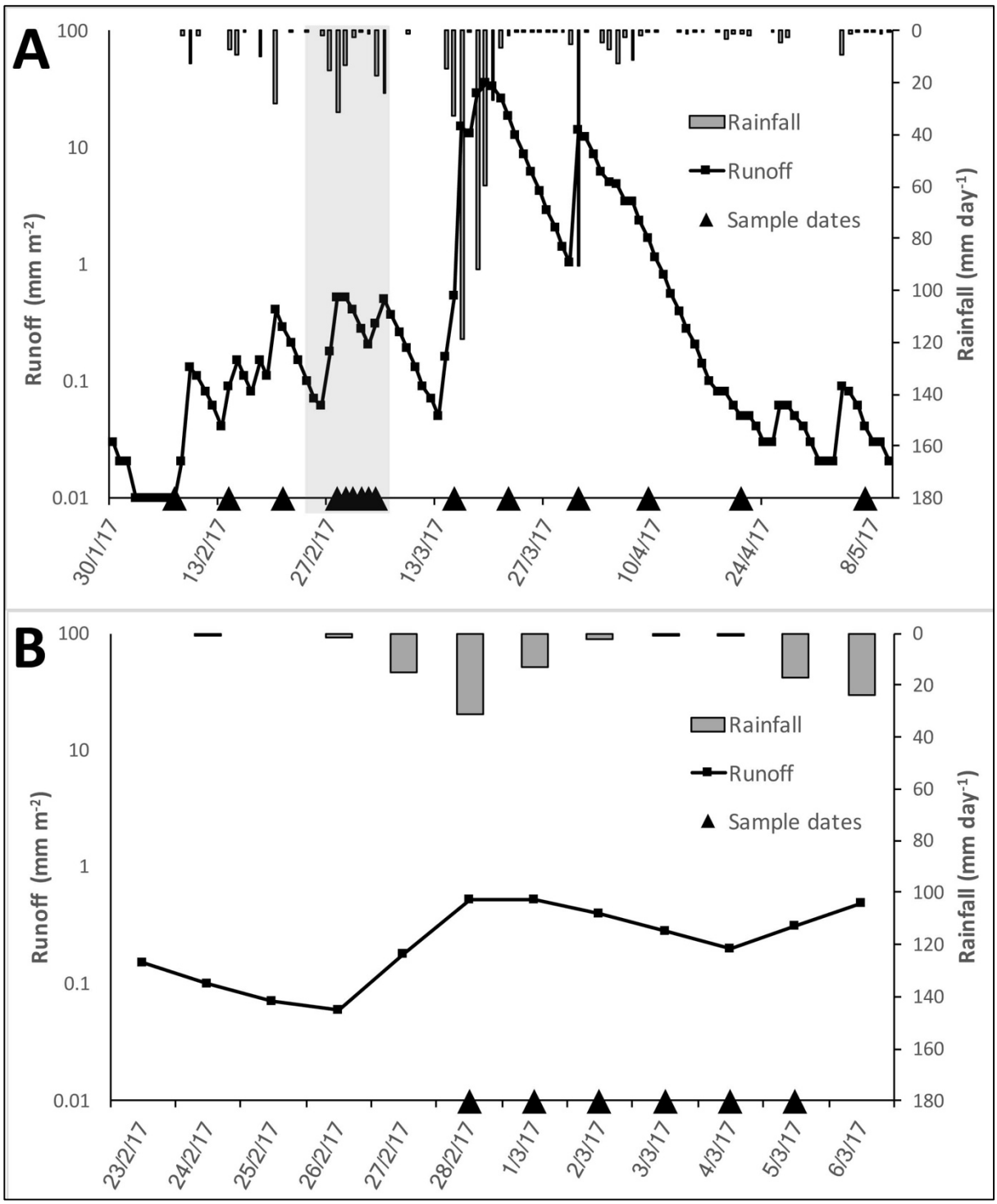

Figure 2: A) Hydrograph of rainfall and runoff in the Bucca Bucca Creek catchment. Sample dates are shown along the bottom as triangles. Greyed area indicates intensive sampling period at farm F (BOM, 2017b). **B)** Intensive sampling period at farm F from 28/217 to 5/3/17 during a rain event of 79.7 mm in 7 days. (BOM, 2017b). This rain event was not significant enough to produce runoff >0.52 mm day^{-1}.

3.2. Pesticides

All results of dissolved pesticides were below the measurable limits listed in Table 2. Because these samples were taken in baseflow conditions only, they are inconclusive as to whether blueberry farms are contributing pesticides to creeks. It is recommended that further pesticide sampling be undertaken following rain events in the creeks. Pesticide in sediment sampling would build confidence in the fate of any pesticides used in blueberry farms and the possible export pathways of these pesticides.

3.3. Surface water quality

Below we compare water quality observations to ANZECC guidelines. Raw data are reported in Appendix 2.

pH -Sample means for both control sites and treatment sites were below the minimum pH of the ANZECC trigger values (pH 6.5 to pH 7.5) (ANZECC, 2000; Figure 3A). There were 22% of treatment samples and 19% of control samples within the trigger values (Figure 4A). Only 1 sample ($D_{T2}1$, pH 8.1) was >pH 7.5, however there were 4 control samples and 5 treatment samples between pH 5 and pH 5.5. The control samples were sample D_C4 with pH 5.2, G_C4 with pH 5.5, A_C4 with pH 5.2 and A_C6 with pH 5.5. The treatment samples were sample C_T4 with pH 5.1, C_T5 with pH 5.4, C_T6 with pH 5.3, A_T6 with pH 5.4 and A_T7 with pH 6.5. There was no significant difference ($t_{(170)}=1.84$, $p=0.068$) between control (pH 6.1±0.04) and treatment (pH 6.3±0.05) sites.

Electrical conductivity [EC] - The means of both control and treatment sites were within the maximum and minimum ANZECC trigger values (30 – 350 µs cm^{-1} @ 25°C) for electrical conductivity (ANZECC, 2000; Figure 3B). There was no significant difference ($t_{(170)}=0.65$, $p=0.516$) between control (229.0±17.5 µs cm^{-1} @ 25°C) and treatment (214.9±12.7 µs cm^{-1} @ 25°C) sites. Only 8% of treatment sites were above 350 µs cm^{-1} @ 25°C, these were all at site F_T (maximum sample F_T1, 630 µs cm^{-1} @ 25°C) (Figure 4B). These high conductivity results correlate with baseflow periods in the creek. When creek flow increased with rain events, the lowest sample here was F_T9 (93.6 µs cm^{-1} @ 25°C). There was 17% of control sites above 350 µs cm^{-1} @ 25°C. Seven of these samples were at site D_C (maximum D_C2, 867 µs cm^{-1} @ 25°C), two samples were at site AC (maximum AC1, 535 µs cm-1 @ 25°C), one sample at site EC (EC1, 397.6 µs cm-1 @ 25°C) and three samples at site CC (maximum CC11, 534 µs cm-1 @ 25°C). All high EC samples were in baseflow conditions, likely due to groundwater inflow through the riparian sediments (Schuetz & Weiler, 2011).

Dissolved oxygen [DO] - DO was generally low at the sites sampled and the means of both control and treatment sites were below the maximum and minimum ANZECC trigger values (90 DO % sat. to 110 DO % sat.) (ANZECC, 2000; Figure 3C). There was a significant difference ($t_{(170)}=2.3$, $p=0.022$) between control (50.4±2.6 DO % sat.) and treatment (59.7±3.0 DO % sat.) sites. Only 3% of treatment sites were within the ANZECC trigger values, these were samples B_T7 (94.1 DO % sat.), E_T6 (91.2 DO % sat.) and E_T8 (91.8 DO % sat.) (Figure 4C). Similarly, only 5% of control sites were within the ANZECC trigger values, these were samples $B_{C1}8$ (91.4 DO % sat.), $B_{C2}7$ (97.0 DO % sat.), $B_{C2}8$ (98.6 DO % sat.), G_C5 (94.6 DO % sat.) and C_C4 (90.3 DO % sat.). The highest result was from sample DT21 (198.6 DO % sat.) and the lowest result was from sample BT2 (3.5 DO % sat.).

Phosphate [PO_4] - There was no significant difference ($t_{(170)}=1.08$, $p=0.282$) between control (0.2±0.01 µmol L^{-1}) and treatment (0.4±0.1 µmol L^{-1}) sites in PO_4 measurements, and the mean of both control and treatment samples were below the ANZECC maximum trigger value (0.5 µmol L^{-1}) (ANZECC, 2000; Figure 3D). There was a greater mean and variability at the treatment sites.

Only 8% of treatment samples were above the ANZECC trigger value, though 3 of these samples were at site D_{T2}. These were samples $D_{T2}1$ (0.6 µmol L^{-1}), $D_{T2}7$ (0.7 µmol L^{-1}) and $D_{T2}9$ (10.8 µmol L^{-1}) (Figure 4D). $D_{T2}9$ was the highest observed sample in both control and treatment sites. Samples 7 and 9 were in high flow periods and sample 1 was in a baseflow period. Only 4.6% of control samples were above the ANZECC trigger value. These were F_T1 (0.6 µmol L^{-1}), F_T2 (0.8 µmol L^{-1}), D_C1 (0.6 µmol L^{-1}) and A_C2 (0.6 µmol L^{-1}), these samples were all in baseflow periods.
These results are not surprising, in that most P is stable when applied as an inorganic fertiliser, dominantly in the form of orthophosphates [PO_4]. PO_4 adsorbs to soils quickly and is relatively insoluble, therefore unable to leach through groundwater (Vimpany & Lines-Kelly, 2004). It is however mobile when eroded as part of a soil. Hence, when continuous erosion occurs, PO_4 is a pollution issue to streams (Vimpany & Lines-Kelly, 2004).

Total dissolved phosphorus [TDP] - Similar to PO_4, the mean of TDP in both control and treatment sites were below the maximum ANZECC trigger value (0.67 µmol L^{-1}) (ANZECC, 2000; Figure 3E) and there was no significant difference ($t_{(170)}$=0.6, p=0.549) between control (0.5±0.1 µmol L^{-1}) and treatment (0.6±0.1 µmol L^{-1}) sites. There were 17% of treatment sites above the ANZECC trigger value, dominantly at sites D_{T1} (maximum $D_{T1}2$, 1.1 µmol L^{-1}) and D_{T2} (maximum $D_{T2}9$, 13.5 µmol L^{-1}) (Figure 4E). Sample $D_{T2}9$ was the highest overall sample and was in a high flow period. In control samples, 22% were above the ANZECC trigger value, dominantly at sites D_C (maximum D_C1, 2.4 µmol L^{-1}) and C_C (maximum C_C4, 1.1 µmol L^{-1}).

Ammonium [NH_4] - Ammonium had a significantly higher ($t_{(170)}$=2.39, p=0.018) mean in control sites (20.5±6.2 µmol L^{-1}) than treatment (5.6±0.7 µmol L^{-1}) sites. The means of control and treatment sites were above the ANZECC maximum trigger value (0.929 µmol L^{-1}) (ANZECC, 2000; Figure 3F). Mean and variability was higher in control sites, driven by baseflow at sites A_C, B_C, D_C and F_C. These samples may be driven by groundwater inputs or bacterial breakdown of organic material. There were 24% of treatment samples and 31% of control samples within the ANZECC trigger value (Figure 4F). The maximum value at a treatment site was 31.6 µmol L^{-1} in sample $D_{T1}2$. The maximum value at a control site was 322.7 µmol L^{-1} in sample D_C2. Both of these samples were in baseflow conditions.

Nitrate + nitrite [NO_X] - Both control and treatment site means were above the ANZECC maximum trigger value (1.071 µmol L^{-1}) and there was a highly significant difference ($t_{(170)}$=3.52, p=0.00055) between control (6.3±2.0 µmol L^{-1}) and treatment (56.9±14.2 µmol L^{-1}) sites (ANZECC, 2000; Figure 3G). Treatment sites showed a high variability within each site, this was driven by hydrology. There were 51% of treatment samples and 56% of control samples below the ANZECC trigger value (Figure 4G). The highest samples measured were between 50 and 812 µmol L^{-1}. During baseflow conditions (<25 mm rain in 48 hrs), all treatment sites had ≥2 samples below the ANZECC trigger value. When rainfall and runoff increased in rain events (>25 mm rain in 48 hrs), NO_X measurements were highest. The highest and lowest measurement for each site is given in Table 4.

Total dissolved nitrogen [TDN] - There was no significant difference ($t_{(170)}$=1.62, p=0.107) between control (61.6±10.1 µmol L^{-1}) and treatment (93.2±16.6 µmol L^{-1}) sites, though the mean of treatment samples was >30 µmol L^{-1} greater than the mean of control samples. Both treatment and control sample means were >40 µmol L^{-1} greater than the ANZECC maximum trigger value (17.86 µmol L^{-1}) (ANZECC, 2000; Figure 3H). This is driven by the above NO_X and NH_4 measurements, combined with dissolved organic nitrogen. There were 28% of treatment samples and 23% of control samples within the ANZECC trigger values (Figure 4H). The highest treatment sample was 855.7 µmol L^{-1} in samples $D_{T2}6$ and the highest control sample was 551.9 µmol L^{-1} in sample D_C1.

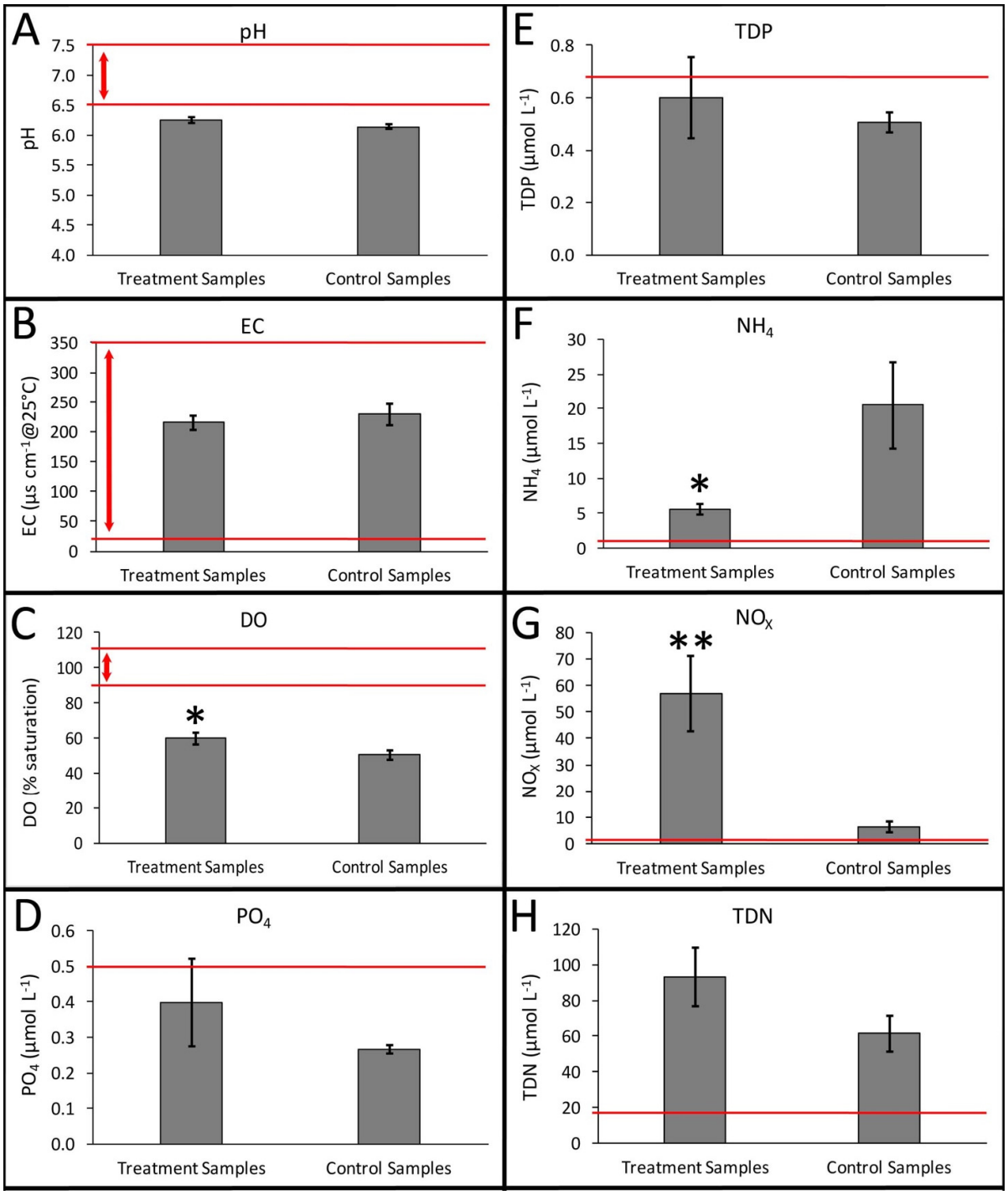

Figure 3: Plots of mean ancillary water parameters (EC, pH and DO) and nutrients (TDN, NO_X, NH_4, TDP and PO_4) in surface water from control (n=86) and treatment (n=86) samples in the Bucca Bucca Creek catchment, NSW. Error bars are standard error, * indicates significant (p=<0.05) statistical difference, ** indicates highly significant (p=<0.001) statistical difference. Single red bars (Boxes D, E, F, G and H) and dual red bars with arrows (Boxes A, B and C) indicate ANZECC threshold trigger values for slightly disturbed upland streams in NSW (ANZECC, 2000).

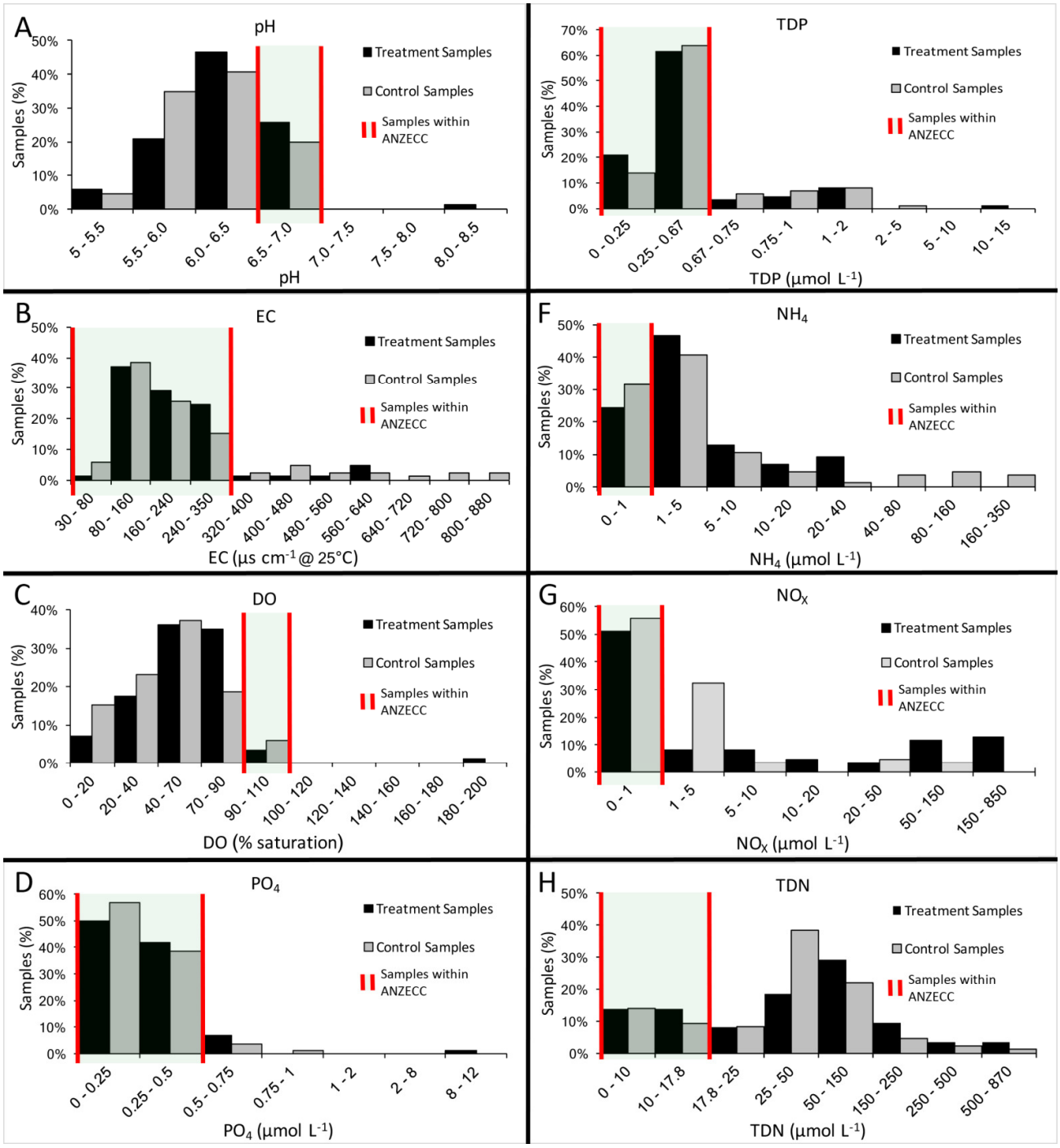

Figure 4: Histograms of mean ancillary water parameters (EC, pH and DO) and nutrient concentrations (TDN, NO_X, NH_4, TDP and PO_4) of surface water from control (n=86) and treatment (n=86) samples in the Bucca Bucca Creek catchment, NSW. Dual red bars indicate maximum and minimum ANZECC threshold trigger values for slightly disturbed upland streams in NSW.

Table 4: Maximum and minimum NO_X concentrations in samples taken at control (n=86) and treatment (n=86) sites in the Bucca Bucca Creek catchment, NSW.

Site	Maximum Sample		Minimum sample	
	Date sampled	NO_X (µmol L^{-1})	Date sampled	NO_X (µmol L^{-1})
A_C	15/3/17	9.2	9/4/17	0.4
A_T	15/3/17	16.3	21/2/17	0.5
B_{C1}	15/3/17	49.1	7/5/17	0.4
B_{C2}	7/5/17	9.9	7/2/17	0.1
B_T	22/3/17	293.3	21/2/17	0.1
C_C	28/2/17	4.2	14/2/17	0.1
C_T	4/3/17	215.1	21/2/17	0.1
D_C	21/2/17	4.5	28/2/17	0.3
D_{T1}	15/3/17	811.1	14/2/17	0.6
D_{T2}	15/3/17	549.8	7/5/17	0.1
E_C	15/3/17	131.9	28/2/17	0.1
E_T	15/3/17	149.0	14/2/17	0.1
F_C	4/3/17	1.6	22/3/17	0.4
F_T	15/3/17	24.6	14/2/17	0.1
G_C	28/2/17	22.6	4/3/17	0.4
G_T	15/3/17	78.5	21/4/17	0.3

3.4. Groundwater quality

Groundwater samples were taken between 2/5/17 and 4/5/17 from an average depth of 57.2 m (Table 5). Groundwater constituents are compared to ANZECC guidelines (ANZECC, 2000) for slightly disturbed upland streams in NSW rather than drinking water, irrigation or livestock guidelines. ^{222}Rn in water varied from 5544 ± 36 dpm L^{-1} to 150 ± 6 dpm L^{-1} with an average of 2852 ± 24 dpm L^{-1}. PO_4 was above the ANZECC trigger value (0.5 µmol L^{-1}) in 80% of samples. The maximum PO_4 sample was 1.9 µmol L^{-1} and minimum was 0.3 µmol L^{-1}. The average PO_4 in the 10 groundwater samples was 0.9 µmol L^{-1}. NO_X results were above the ANZECC trigger value (1.07 µmol L^{-1}) in 70% of samples with an average of 21.4 µmol L^{-1} (Figure 5). The maximum NO_X was 104.9 µmol L^{-1} and the minimum 0.2 µmol L^{-1}. NH_4 varied between <0.01 µmol L^{-1} and 0.8 µmol L^{-1} with an average of 0.2 µmol L^{-1}. All NH_4 samples were below the ANZECC trigger value (0.929 µmol L^{-1}). pH of samples was between pH 5.81 and pH 6.73, only 40% of samples were within the ANZECC trigger values (pH 6.5 to pH 7.5)

Groundwater is often high in dissolved nutrients and can deliver these nutrients to surface waters through seepage (Burnett et al., 2006; Su et al., 2014). Pollution of groundwater through leaching of soluble nutrients may be a serious long term issue (Li & Zhang, 1999; Spalding & Exner, 1993) and many previous studies have found groundwater pollution and agricultural landscapes (Eckhardt & Stackelberg, 1995; Helena et al., 2000; Zhang, et al., 1996). Surprisingly, groundwaters in the Bucca Bucca Creek catchment had nitrogen concentrations that were usually lower than surface waters, implying that any contamination may not have reached the aquifers yet. Groundwater recharge and therefore contamination, often occurs over long time scales (years to centuries; Santos et al., 2017). Since the blueberry industry is recent in this catchment, our observations may serve as a baseline for future assessments of any impacts brought about by the new industry.

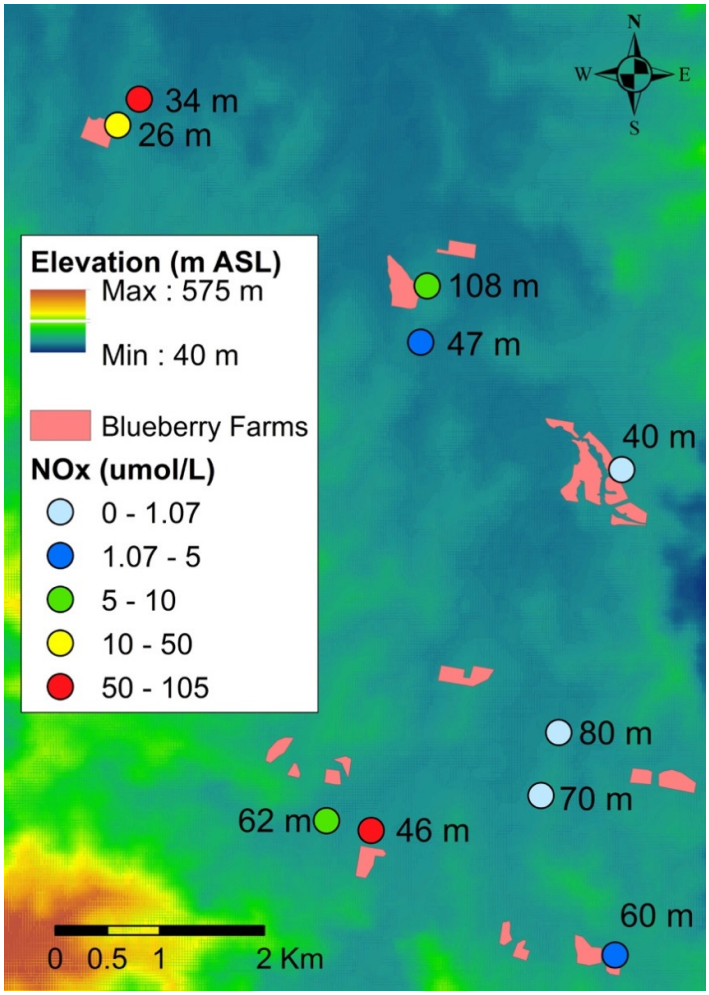

Figure 5: NO_X (µmol L^{-1}) in groundwater samples overlying an elevation map. Bore depths are shown near each sample. Depths were given by the landowner at each bore and are assumed to be correct. Elevation data source: CHCC, 2016.

Table 5: Results and coordinates of 10 groundwater samples in the Bucca Bucca Creek catchment, NSW. Bore depths were given by the landowner at each bore and are assumed to be correct.

Site	Coordinates	Date Sampled	Depth (m)	pH	EC (µs @25°C)	DO (%sat.)	^{222}Rn in water (dpm L^{-1})	NO_X (µmol L^{-1})	NH_4 (µmol L^{-1})	DON (µmol L^{-1})	TDN (µmol L^{-1})	PO_4 (µmol L^{-1})	DOP (µmol L^{-1})	TDP (µmol L^{-1})
1	-30.199, 153.110	2/5/17 7:42	80	6.73	1022	16.1	1334.7 ± 14.7	0.4	0.8	0.0	1.1	0.6	0.3	0.9
2	-30.205, 153.109	2/5/17 9:33	70	6.48	1345	15.2	2320.7 ± 22.3	0.3	0.4	0.0	0.6	0.8	1.1	1.9
3	-30.219, 153.116	2/5/17 12:55	60	6.51	721	18.7	4952.8 ± 33.6	1.7	0.0	2.6	4.3	1.0	0.4	1.4
4	-30.207, 153.087	2/5/17 14:23	62	6.17	567	42.2	1450.0 ± 5.8	9.8	0.6	3.6	14.0	1.1	0.4	1.4
5	-30.208, 153.092	2/5/17 14:49	45	6.64	233.3	87	3874.8 ± 32.8	57.3	0.0	2.7	60.0	0.4	0.0	0.4
6	-30.177, 153.117	3/5/17 11:54	40	6.66	391.3	12.8	1163.3 ± 19.3	0.2	0.4	0.0	0.6	1.9	7.8	9.8
7	-30.161, 153.098	3/5/17 13:32	108	5.92	707	65.7	3911.2 ± 29.3	5.3	0.0	0.3	5.6	0.7	0.3	1.0
8	-30.166, 153.096	3/5/17 14:26	47	5.95	118.9	13.6	1818.5 ± 20.0	2.9	0.0	3.3	6.1	1.2	0.3	1.5
9	-30.144, 153.069	4/5/17 11:36	34	5.81	238.1	31.5	3455.5 ± 25.1	104.9	0.0	2.2	107.2	0.3	0.3	0.6
10	-30.147, 153.067	4/5/17 12:54	26	6.01	174.4	63.8	5544.2 ± 35.9	31.8	0.1	0.0	31.8	1.1	0.3	1.5
Mean			57.2	6.3	551.8	36.7	2852.6 ± 23.9	21.4	0.2	1.5	23.1	0.9	1.1	2.0
St dev			24.4	0.4	402.6	26.8	1764.0	34.7	0.3	1.5	35.0	0.5	2.4	2.7

3.5. Nutrient speciation

While NO_X was the dominant nitrogen species in treatment sites, DON was the dominant species in control sites (Figure 6). This clear separation in nitrogen speciation is consistent with our suggestion that blueberry farms modify the composition of nearby creeks. The exception was farm E downstream of a banana farm with a dam between the control site and the treatment site. We suspect that the dam influences the N species composition by increasing residence time and allowing for denitrification to remove NO_X from solution. Groundwater nitrogen was 93% NO_X.

Nitrogen is environmentally available in aqueous, gaseous and solid forms, bound in organic material or in inorganic elemental compounds (De Boer & Kowalchuk, 2001). Limiting nutrients for primary production have been well studied: P is often limiting in freshwater and N is often limiting in coastal seawater and estuaries, based on the Redfield Ratio of 1P:16N (Fabricius, 2005; Smith et al., 2006; Redfield, 1934). Therefore, large N increases in freshwater systems that drain to estuaries can quickly cause eutrophication or algal blooms downstream (Howarth, 1988; Howarth et al., 1996; Nixon et al., 1996). Eutrophication is caused by the rapid growth of aquatic algae and can cause habitat loss, marine and freshwater plant death, coral death and the forfeiture of aquatic biodiversity (Jeppesen et al., 1998; Seehausen et al.; 1997). While we have no data on the downstream impacts, we speculate that nitrate may travel from the headwater streams to estuaries.

Inorganic ammonium [NH_4] based fertiliser is the most common fertiliser applied to blueberry crops (Krewer & NeSmith, 1999). When NH_4 is applied to soils, small losses of gaseous N occur through volatilisation, whilst most of the NH_4 is converted to nitrates + nitrites [NO_X], within a few days (De Boer & Kowalchuk, 2001). The two step process of converting NH_4 to NO_X is dominantly carried out by autotrophic bacteria in the soil. Ammonia-oxidising bacteria convert NH_4 to NO_2^-, followed by nitrite-oxidising bacteria converting NO_2^- to NO_3^- (De Boer & Kowalchuk, 2001). Heterotrophic nitrification is also possible through a phylogenetic array of bacteria and fungi, transforming both inorganic and organic nitrogen compounds to NO_X, or gaseous N_2O and N_2 (De Boer & Kowalchuk, 2001; Knowles, 1982; Shoun et al., 1992). NH_4 is relatively insoluble, when compared to the highly soluble NO_X, resulting in significant NO_X losses through leaching (Puckett, 1994). As a result of the conversion of NH_4 to NO_X and the mobility of NO_X, farmers must factor these losses of NO_X when applying NH_4 based fertilisers to combat N deficiencies and leaching losses in the root zone (Krewer & NeSmith, 1999; Puckett, 1994). Thus, due to leaching and solubility, inorganic N in waterways and groundwater from the application of fertiliser is most evident as NO_X (De Boer & Kowalchuk, 2001; Puckett, 1994; Vimpany & Lines-Kelly, 2004).

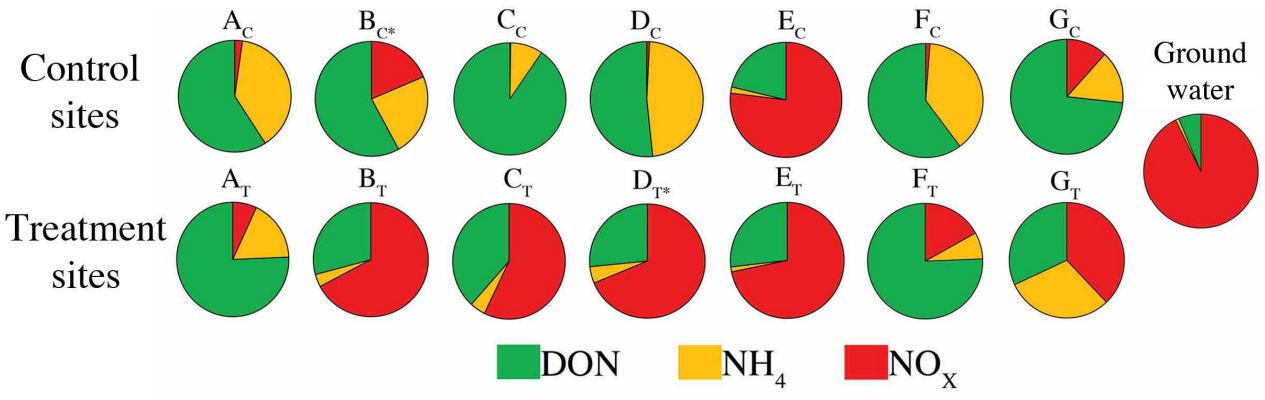

Figure 6: Mean ratio of N species (NO_X:NH_4:DON) as a percentage of TDN at control and treatment sites in the Bucca Bucca Creek catchment, NSW, showing that in all farms except farm E, NO_X (% TDN) increased from control sites to treatment sites. Groundwater is a mean of all groundwater bore sites sampled. * indicates the mean of two sites (B_C1 and B_C2; D_T1 and D_T2).

3.6. Nitrate pathways: Groundwater versus surface runoff

Radon (^{222}Rn), a natural groundwater discharge tracer, was measured in Farm F only. Overall, radon changed from 113.2 ± 4.2 dpm L^{-1} to 0.8 ± 0.4 dpm L^{-1}, with higher values during baseflow as expected. There was an inverse relationship between ^{222}Rn and runoff, and a positive relationship between NO_X and runoff (Figure 7). This shows that groundwater discharge was not a likely source of NO_X to the creek. The intensive time series on a weekly scale failed to show any increase in NO_X as rainfall was not sufficient to flush the catchment. The estimation of groundwater in surface water (GW%) was done based on the average groundwater ^{222}Rn in the groundwater bore samples. The GW% in samples at Farm F_T are shown in Figure 8 and indicate that groundwater contributes <4% of water flow to the creek. When the highest NO_X results were measured (sample F_T6, 24.6 µmol L^{-1} and sample F_T7, 20.5 µmol L^{-1}), the GW% in the creek was <0.1%, further indicating that groundwater is not likely to be a major source of NO_X to surface waters.

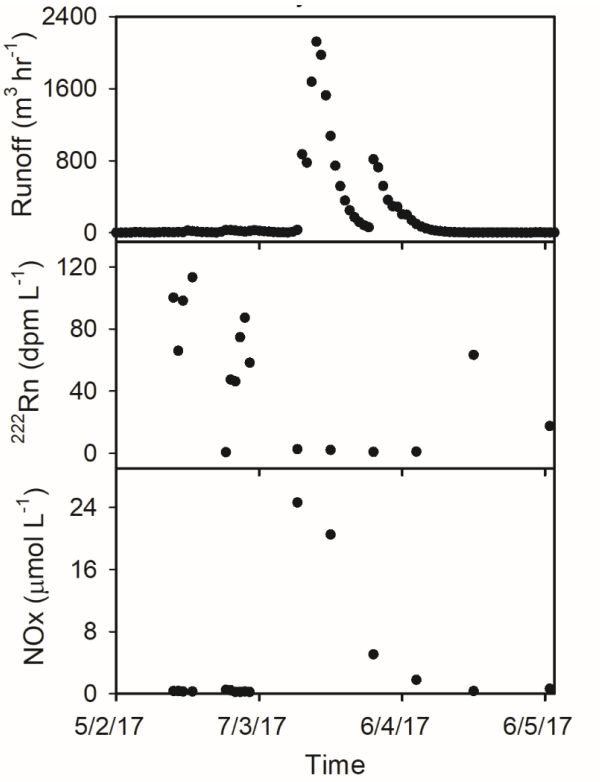

Figure 7: Time series of surface runoff, ^{222}Rn and NO_X at site F_T over the 90 day sampling period, highlighting that NO_X is not driven by groundwater as traced by ^{222}Rn.

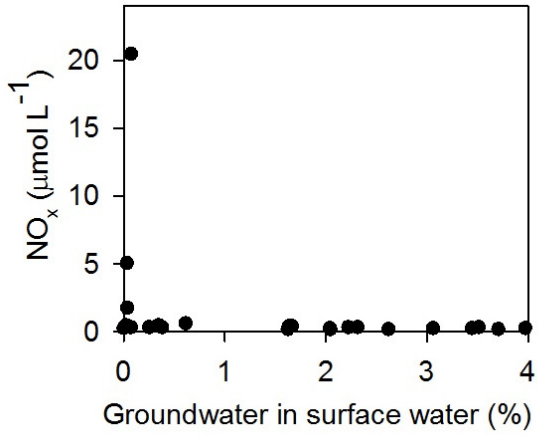

Figure 8: NO_X versus the minimum groundwater contribution to surface water runoff at site F_T. The highest NO_X were seen when groundwater was not a contributor (<0.1%).

Since groundwater does not seem to be a major contributor to NO_X concentrations at site F_T, flushing events may be the primary driver of NO_X concentrations in the creeks sampled. Headwater stream nutrient concentrations are often driven by storm events, creating overland runoff and flushing the nutrients accumulated in the soils during dry periods (Vink, et al., 2007). Indeed, our observations revealed that NO_X follows a similar pattern to runoff in treatment samples (Figure 9). This same pattern was seen in the control samples, though concentrations of NO_X were significantly lower. Therefore, we suggest that surface runoff dominates the delivery of nitrogen to the creeks investigated regardless of the presence of blueberries.

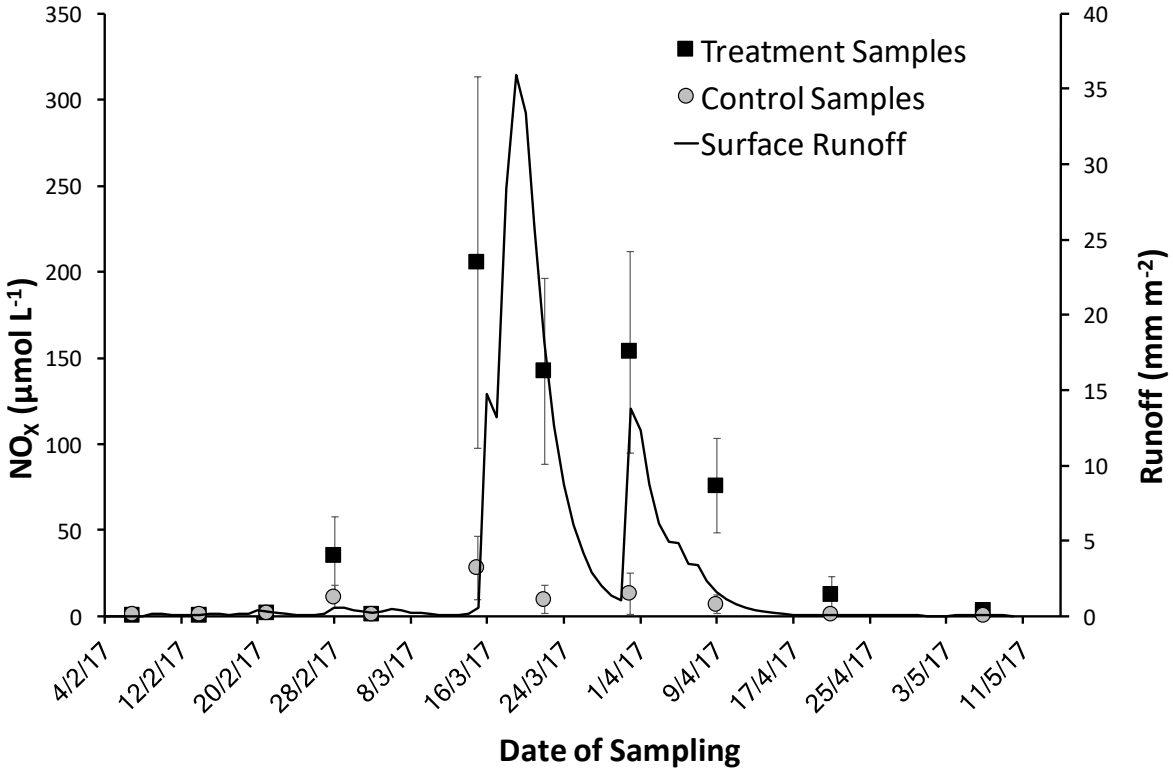

Figure 9: Plot of mean NO_X at control and treatment sites against runoff, showing that NO_X follows runoff strongly at treatment sites and weakly at control sites.

To further obtain insights into the importance of surface runoff, results were separated into rain event (>25mm rain in 48 hrs prior to sample) and baseflow (<25mm rain in 48 hrs prior to sample). The means at all sites following rain events were higher than baseflow (Figure 10). The highest NO_X concentrations during rain event conditions were found at farms B, C and D. These farms have the highest upstream land use dedicated to blueberries (farm B, 59% of catchment; farm C, 26% of catchment; and farm D, up to 65% of catchment), implying they would be priority areas for managing nitrogen runoff.

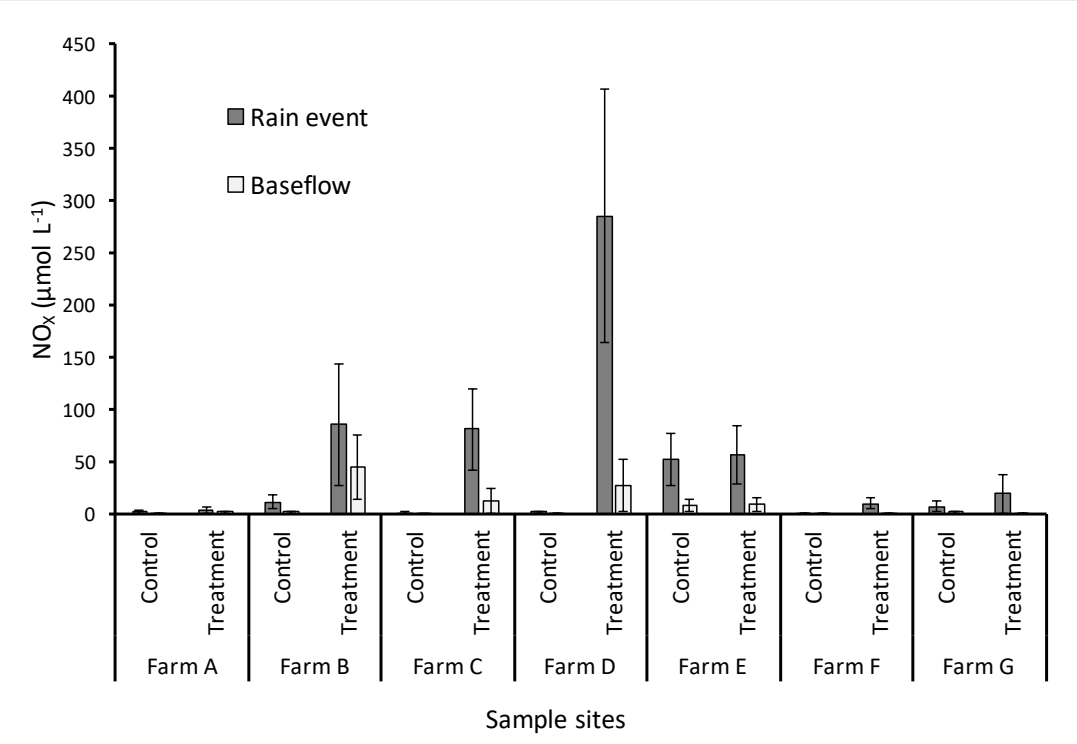

Figure 10: Bar graph of mean NO_X concentrations at control and treatment sites in rain event (>25mm rain in 48 hrs prior to sample) and baseflow (<25mm rain in 48 hrs prior to sample), showing that farms B, C and D are the have the highest NO_X concentrations during rain events.

3.7. Nutrient loads

Nutrient load is a measurement of a constituent based on the flow of a stream and the area of upstream catchment. Our results indicate that the average load of NO_X, NH_4, DON, TDN, PO_4 and TDP at treatment sites was greater than control sites (Table 6). The only nutrient load that was lower at treatment sites was DOP. NO_X was the highest contributory load in our calculations and was on average >13 fold higher at treatment sites (21.8 kg N-NO_X ha yr^{-1}) than control sites (1.6 kg N-NO_X ha yr^{-1}).

Nitrogen loads are highly variable throughout the world and are dependent on geology, population, atmospheric deposition and land use (Seitzinger, et al., 2002). Average loads on the Australian east coast have been estimated to be <1 kg N ha yr^{-1}, though can be >5 fold higher in India, China and Europe (>5 Kg N ha yr^{-1}) (Seitzinger, et al., 2002). Comparatively, Sadat Noori, et al. (2016) studied an estuary at Hat Head, NSW and found that loads were 0.3 kg N-NO_3 ha yr^{-1} and 15 kg N-TDN ha yr^{-1}. Santos et al. (2013) reported TDN loads of 8.5 kg N-TDN ha yr^{-1} in the Tuckean Swamp, NSW. We found that the control site average was 1.6 fold higher than the Australian east coast average and the treatment site average was >20 fold higher than the Australian east coast average. These differences may be related not only to the presence of blueberries, but also the scale of the different investigations. While our study focuses on small catchments in headwater streams, Santos et al. (2013) and Sadat-Noori et al. (2016) focused on a much larger area with a lower proportion of intensive land uses such as horticulture.

Table 6: Mean nutrient loads from control and treatment sites over the 90 day sampling period.

Site	NO_X load (Kg N-NO_X ha yr^{-1})	NH_4 load (Kg N-NH_4 ha yr^{-1})	DON load (Kg N-DON ha yr^{-1})	TDN load (Kg N-TDN ha yr^{-1})	PO_4 load (Kg P-PO_4 ha yr^{-1})	DOP load (Kg P-DOP ha yr^{-1})	TDP load (Kg P-TDP ha yr^{-1})
A_C	0.1	0.5	4.8	5.4	0.08	0.06	0.14
A_T	0.3	0.5	4.5	5.3	0.08	0.02	0.10
B_{C1}	0.7	0.1	2.9	3.8	0.08	0.03	0.11
B_{C2}	0.8	0.4	3.9	5.1	0.09	0.02	0.11
B_T	34.9	0.3	7.7	42.9	0.12	0.08	0.20
C_C	0.1	0.4	5.0	5.5	0.09	0.12	0.21
C_T	21.0	1.2	7.6	29.8	0.06	0.04	0.11
D_C	0.2	0.8	10.2	11.2	0.12	0.23	0.35
D_{T1}	61.8	1.2	15.8	78.9	0.09	0.01	0.10
D_{T2}	42.5	0.9	12.1	55.4	0.37	0.21	0.58
E_C	10.2	0.1	1.7	12.0	0.08	0.06	0.14
E_T	10.6	0.1	2.3	12.9	0.09	0.04	0.13
F_C	0.1	0.2	4.7	5.0	0.08	0.05	0.13
F_T	2.1	0.5	6.4	9.0	0.08	0.04	0.12
G_C	0.5	0.2	3.1	3.9	0.06	0.03	0.10
G_T	1.3	0.3	1.7	3.2	0.06	0.00	0.06
Control Mean	1.6	0.3	4.5	6.5	0.08	0.08	0.16
Treatment Mean	21.8	0.6	7.3	29.7	0.12	0.06	0.17

The N fertilisers used in blueberry horticulture include ammonium nitrate, ammonium sulfate and urea (Krewer & NeSmith, 1999). Concentrated superphosphate, potassium chloride and di-ammonium phosphate are the main forms of P and K applied to blueberries, but pose significantly less environmental risk than N fertilisers (Krewer & NeSmith, 1999; Vimpany & Lines-Kelly, 2004). The southern highbush and rabbiteye blueberry varieties native to the USA are well suited to the Coffs Harbour climate (Bevan, 2006). These varieties require fertilization of 121 kg N ha yr^{-1} and 83 kg P ha yr^{-1} plus other micronutrients (Doughty et al., 1988). The rate of N addition in blueberries is similar to pineapples (up to 150 kg N ha^{-1}, Omotoso & Akinrinde, 2013), sugarcane (128 kg N ha yr^{-1}, Schroeder et al., 2010) and bananas (100 kg N ha yr^{-1}, Newley, et al., 2008). Assuming that our 90 days of observations can be upscaled to annual exports, and that local farmers use the recommended amount of fertiliser (121 kg N ha yr^{-1}), an average between 18.0% (calculated on N-NO_X) and 24.5% (calculated on N-TDN) of this fertiliser is lost to the creeks.

3.8. Influence of blueberry area on NO_X

We plotted farm land use (% catchment) against mean NO_X concentrations to examine whether the percentage of catchment occupied by blueberries has influence on nutrient concentrations (Figure 11A). At <15% of blueberry land use, there was no detectable influence in mean NO_X concentrations. With increasing blueberry density, mean NO_X concentrations in creeks clearly increased. For every 1% of upstream catchment occupied by

a blueberry farm, it is expected that mean NO_X concentrations would increase by 1.8 µmol L^{-1} (p=<0.001). Based on these calculations, a catchment with 15% blueberry land use will have mean NO_X concentrations >25 fold higher than the ANZECC trigger value downstream. The minimum percentage of a catchment one land use occupies to be considered the dominant nutrient contributor has not been strictly defined in the literature. Percentages of dominant nutrient contribution in a catchment land use have been reported as low as 5% for bananas (Bainbridge et al., 2009), up to 100% for forestry (Hunter & Walton, 2008). Sugar cane has been classified as the major nutrient contributor (Rohde et al., 2008) when representing >25% of the catchment land use. We suggest that any catchment with >15% blueberry land use will create a measurable impact on downstream nutrient concentrations.

The loads of NO_X also correlated to the percentage of blueberry farms in the catchment (Figure 11B). Similar to the NO_X concentrations in Figure 11A, we suggest that catchments with >15% blueberry land use will have downstream nutrient loads dominated by this land use. Based on our load calculations, a catchment with 15% of blueberry farm land use may have downstream nutrient loads of 11.1 kg N-NO_X ha yr^{-1} (p=<0.001). Changes in land use have been shown to be the key factor in alteration of nutrient concentrations downstream (Harris, 2001) and runoff from surrounding lands are the primary nutrient inputs to streams (Puckett, 1994; Seitzinger et al., 2005).

Little is known about blueberry horticulture runoff, though loads, cycling and storage of nutrients is expected to be similar to other agricultural practices (Carpenter et al., 1998; Howarth et al., 1996; Jordan et al., 1997; Puckett, 1994). Hunter & Walton (2008) reported N fluxes of 0.7 kg N ha yr^{-1} from unsewered areas, 0.38 kg N ha yr^{-1} from sugar cane and 0.42 kg N ha yr^{-1} from bananas in the Johnstone River system in north eastern Australia. Land use in tropical Australia has been estimated to have a significant impact on N exports when compared to undisturbed land, particularly in cropland (13.7 fold N export increase), horticulture (28.9 fold N export increase) and urban areas (7.3 fold N export increase) (Young et al., 1996). Our calculated N exports are significantly higher than those reported elsewhere, though similar to expected increases related to horticultural land use.

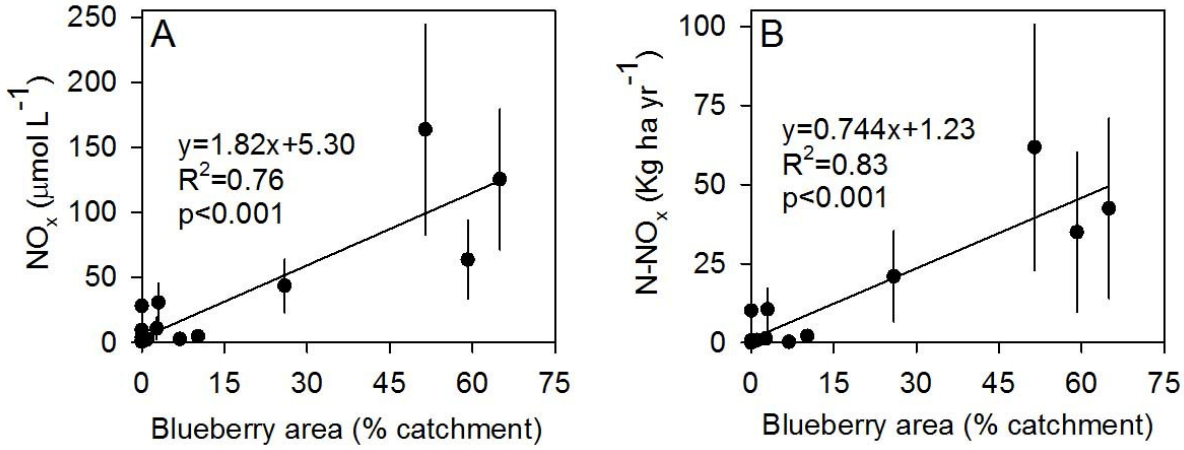

Figure 11: A) Plot of mean NO_X concentrations against the percentage of catchment occupied by blueberry land use, showing highly significant correlation (p=<0.001). Error bars are standard error. **B)** Plot of mean NO_X loads from control (n=8) and treatment (n=8) sites against the percentage of catchment occupied by blueberry land use, showing a highly significant correlation (p=<0.001). Error bars are standard error.

4. Conclusions

1) The 43 pesticides sampled in baseflow conditions were below detection limits. These observations are inconclusive as to whether blueberry farms are a source of pesticides to creeks. Further sampling is required both in storm events and in sediments to examine the fate and impact of pesticides used in blueberry farms.

2) There was a significant difference in NO_X between sites downstream of blueberry farms and control sites. We showed that 24% of NO_X samples downstream of blueberries were between 50 and 800 fold higher than the ANZECC trigger values, primarily after rain events. Dissolved phosphorus was below the ANZECC guidelines.

3) The main pathway of nutrient loss from farms was surface runoff rather than groundwater discharge. The highest NO_X concentrations were measured when surface runoff increased with a storm event after a period of dry weather.

4) Groundwater nitrogen concentrations were generally lower than those in the creeks downstream of blueberry farms. While we cannot identify whether the source of nitrogen to groundwater is natural or anthropogenic, we speculate that fertilisers have not yet reached the aquifers underlying the farms due to the longer time often required to contaminate aquifers.

5) There was a significant correlation between blueberry area and creek NO_X concentrations and loads. A catchment with >15% blueberry land use created a change in downstream nutrient concentrations and loads. Catchments with >15% blueberries may produce NO_X concentrations >25 fold higher than the ANZECC trigger values. Therefore, any initial water quality management should focus on catchments with >15% blueberries.

Overall, this report represents the first attempt to assess the impact of blueberry farms on creek water quality in the Coffs Harbour region. Several lines of evidence demonstrated a strong influence of blueberry farming on creek water quality, in particular nitrate.

We strongly recommend management of nitrogen runoff and an assessment of potential impacts to downstream waterways.

5. Recommendations

5.1. Water quality monitoring needs

- Develop baseline monitoring of nutrients in soils and creeks before, during and after land development.
- Incorporate monitoring into any future planning capacities.
- Investigate creek self-purification capacity and impacts in downstream waterways such as estuaries, fisheries and the Solitary Islands Marine Park.
- Focus on rain events for monitoring.
- Focus monitoring and management on catchments with >15% blueberry farming.
- Pesticide monitoring is needed both in sediments and sampling following rain events.
- Create reporting mechanisms to understand what is applied on the farms and what may be lost to creeks and downstream waterways.

5.2. *Management options*

We recommend management of nitrogen runoff to prevent local and downstream impacts including algae blooms, estuarine contamination, fisheries losses and impacts to the Solitary Islands Marine Park. The management of nitrate in agricultural lands has been well researched and the options available to land and water managers are vast. The following approaches may be required to minimize nutrient runoff from blueberry farms:

1) Woodchip bioreactors (as denitrification beds or denitrification walls) can be installed instream or in constructed drainage ditches and have been shown to remove up to 22 g N m^3 of bioreactor day^{-1} (Schipper, 2010 and references therein; Figure 12).

2) The use of constructed wetlands and macrophyte plants or rice crops have been shown to reduce NO_X loads downstream by up to 2 kg N ha of wetland day^{-1} (Bachand & Horne, 1999; Kirk Kronzucker, 2005; Lindau et al, 1990; Figure 12).

3) Increasing riparian buffer zones by planting trees, shrubs and macrophytes is also an important management consideration and has been shown to reduce N exports to creeks by 4% for every m of planting (Hill, 1996).

4) Tail-water recovery systems have been used extensively downstream of farms in the U.S.A. to recover leached NO_X and reuse waters with high NO_X concentrations to irrigate farms (Carruth et al., 2014; Rice et al., 2001). These systems have been recommended as part of a best management practice design on farms that are susceptible to NO_X leaching (Waskom, 1994). This management option could reduce the downstream concentrations of leaching NO_X, whilst also increasing irrigation and water holding capacity on the farms.

The efficiencies and costs of those approaches have not been assessed in a blueberry context in northern NSW. However, the efficiency of each approach is likely to be site specific, and a combination of approaches may be necessary. Further research is required to identify suitable management approach and to engage farmers in improving nutrient retention in their farms.

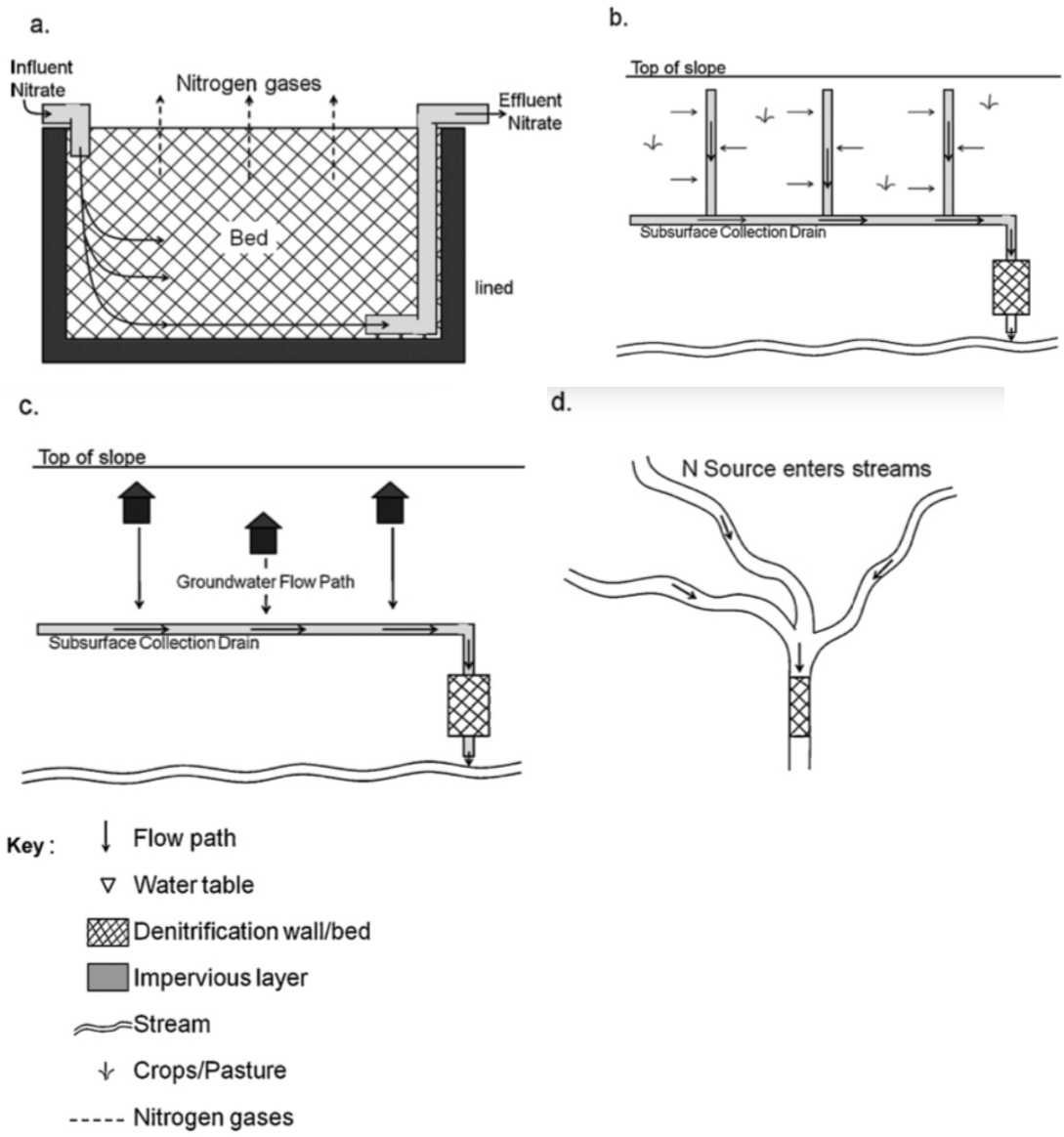

Figure 12: Conceptual diagram of the possible designs of denitrification bioreactors A) Side view of woodchip bioreactor. B) Top view of woodchip bioreactor designed to capture water from agricultural land use. C) Top view of woodchip bioreactor designed to collect surface and subsurface runoff. D) Top view of an instream woodchip bioreactor. (Source: Schipper, 2010)

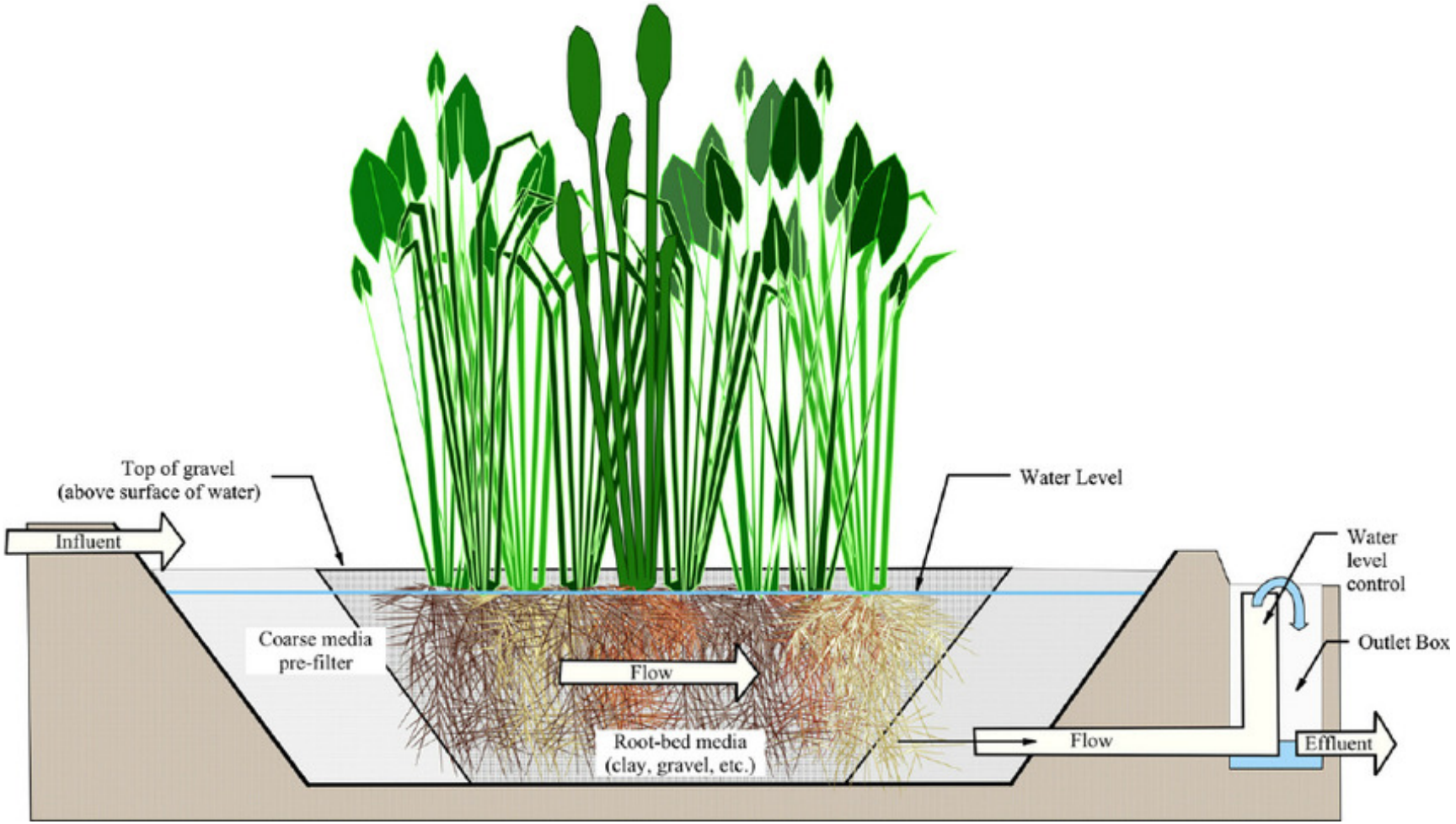

Figure 13: Conceptual model of constructed wetland deigned to increase residence time, uptake N via macrophytes and allow denitrification of N to inert gases (Source: White, 2013).

6. References

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7. Appendices

Appendix 1: Table of threatened and endangered species that are known to inhabit the Bucca Bucca Creek Catchment. These species are listed as vulnerable (V) or endangered (E) under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* [EPBC Act], *NSW Threatened Species Conservation Act 1995* [TSC Act] and/or *NSW Fisheries Management Act 1994* [FM Act] (CHCC, 2012a; CHCC, 2012b).

Type	Common name	Scientific name	EPBC Act status	TSC Act status	FM Act status
Plants	Moonee Quassia	*Quassia sp.* Moonee Ck	E	E	
	Orara Boronia	*Boronia umbellata*	V	V	
	Rusty Plum	*Niemeyera whitei*		V	
Amphibians	Giant Barred Frog	*Mixophyes iteratus*	E	E	
Reptiles	Stephens' Banded Snake	*Hoplocephalus stephensii*		V	
Birds	Swift Parrot	*Lathamun discolor*	E	E	
	Sooty Owl	T*yto tenebricosa*		V	
	Masked Owl	*Tyto novaehollandiae*		V	
	Powerful Owl	*Ninox strenua*		V	
	Glossy Black Cockatoo	*Calyptorhynchus lathami*		V	
Fish	Eastern Freshwater Cod	*Maccullochella ikei*	E		E
Mammals	Spotted-tailed Quoll	*Dasyurus maculatus*	E	V	
	Koala	Phascolarctos cinereus	V	V	
	Grey-headed Flying Fox	Pteropus poliocephalus	V	V	
	Yellow-bellied Glider	*Petaurus australis*		V	
	Rufous Bettong	*Aepyprymnus rufescens*		V	
	Eastern Freetail Bat	*Mormopterus norkolkensis*		V	
	Broad-nosed Bat	*Scoteanax ruepellii*		V	
	Little Bentwing Bat	*Miniopterus australis*		V	

Appendix 2: Results of ancillary water parameters and nutrient analysis at control (n=8) and treatment (n=8) sites in the Bucca Bucca Creek catchment between 7/217 and 7/5/17. Dates of each sample are given in Table 3. All nutrients (NO_X, NH_4, DON, TDN, PO_4, DOP and TDP) are given in units of µmol L^{-1}.

Site & Sample		pH	Temp. (°C)	EC (µs/cm @25°C)	DO (%sat.)	NO_X	NH_4	DON	TDN	PO_4	DOP	TDP
A_C	1	6.25	22.6	535.0	55.6	0.6	43.1	64.2	107.9	0.3	0.3	0.6
A_C	2	6.52	22.3	405.8	9.7	1.3	132.3	82.6	216.2	0.5	0.6	1.1
A_C	3	6.38	19.4	246.2	37.8	0.9	72.7	59.0	132.6	0.3	0.4	0.7
A_C	4	5.22	20.2	237.2	69.1	1.2	2.4	42.9	46.5	0.2	0.2	0.4
A_C	5	6.40	21.0	207.8	18.6	1.1	31.0	60.0	92.1	0.4	0.1	0.5
A_C	6	5.48	21.7	195.2	58.1	9.2	0.8	23.3	33.3	0.2	0.1	0.3
A_C	7	5.61	22.5	217.5	32.4	0.6	2.2	24.0	26.8	0.2	0.1	0.4
A_C	8	5.74	21.6	130.4	71.2	0.9	1.4	34.9	37.1	0.2	0.2	0.4
A_C	9	6.00	18.6	240.1	33.9	0.4	2.1	23.8	26.2	0.2	0.5	0.7
A_C	10	6.09	17.3	297.8	19.7	0.4	7.4	30.1	37.9	0.2	0.2	0.5
A_C	11	6.39	15.9	344.3	10.3	0.5	9.9	20.4	30.8	0.3	0.2	0.5
A_T	1	6.28	24.1	317.1	37.1	0.6	27.1	48.0	75.6	0.4	0.2	0.6
A_T	2	6.26	22.1	291.3	21.0	0.7	24.3	73.0	97.9	0.6	0.6	1.2
A_T	3	6.00	19.8	107.2	24.8	0.5	8.0	16.8	25.3	0.3	0.2	0.4
A_T	4	5.51	19.6	108.1	79.5	2.5	1.5	22.9	26.9	0.2	0.1	0.4
A_T	5	5.54	20.7	285.6	24.0	0.4	1.0	33.4	34.8	0.2	0.4	0.6
A_T	6	5.40	22.7	198.3	70.4	16.3	1.0	34.2	51.5	0.2	0.1	0.3
A_T	7	5.50	23.6	218.6	68.3	1.9	1.8	24.3	27.9	0.2	0.1	0.3
A_T	8	6.20	23.5	111.6	86.7	1.2	3.8	30.3	35.3	0.2	0.0	0.2
A_T	9	6.27	20.1	181.2	50.4	0.8	4.4	36.6	41.8	0.2	0.0	0.3
A_T	10	5.95	17.7	285.0	23.2	7.7	6.5	24.1	38.3	0.2	0.0	0.2
A_T	11	6.13	16.4	309.6	14.8	0.5	4.5	19.3	24.3	0.2	0.1	0.3
B_{C1}	1	6.57	24.7	287.7	33.9	0.5	130.9	12.2	143.6	0.5	0.0	0.5
B_{C1}	2	6.56	25.0	182.4	59.9	0.6	7.8	51.5	59.8	0.3	0.3	0.6
B_{C1}	3	6.51	21.6	67.7	66.7	0.3	1.9	38.8	41.0	0.2	0.1	0.4
B_{C1}	4	6.05	20.5	173.5	42.9	47.9	7.5	10.4	65.7	0.2	0.0	0.2
B_{C1}	5	6.43	21.4	167.3	28.2	0.6	1.1	42.3	44.0	0.4	0.2	0.6
B_{C1}	6	5.85	20.5	156.4	69.8	49.1	1.6	34.5	85.2	0.3	0.0	0.3
B_{C1}	7	6.46	21.1	148.4	84.8	3.4	0.6	13.3	17.3	0.2	0.1	0.3
B_{C1}	8	6.76	20.7	85.6	91.4	2.7	0.6	23.2	26.6	0.2	0.1	0.3
B_{C1}	9	6.69	18.9	145.9	67.2	2.6	0.6	8.5	11.6	0.2	0.1	0.3
B_{C1}	10	6.27	18.4	181.7	34.3	1.0	1.1	8.5	10.6	0.2	0.0	0.2
B_{C1}	11	6.45	17.3	208.2	31.4	0.4	0.8	5.4	6.6	0.2	0.0	0.2

Site & Sample	pH	Temp. (°C)	EC (µs/cm @25°C)	DO (%sat.)	NO_X	NH_4	DON	TDN	PO_4	DOP	TDP
B_{C2} 1	6.00	25.3	170.2	54.3	0.1	1.8	8.6	10.4	0.2	0.0	0.2
B_{C2} 2	6.42	23.3	186.2	15.5	0.3	3.1	10.1	13.4	0.4	0.1	0.4
B_{C2} 3	6.37	21.3	143.7	34.4	0.2	0.9	12.9	14.1	0.2	0.1	0.3
B_{C2} 4	6.28	20.3	120.0	42.1	0.4	0.1	37.9	38.3	0.2	0.2	0.4
B_{C2} 5	6.33	21.3	134.4	32.3	0.5	0.3	23.3	24.1	0.3	0.1	0.4
B_{C2} 6	6.33	20.2	159.5	69.2	2.8	0.6	5.6	9.1	0.2	0.0	0.2
B_{C2} 7	6.36	21.9	115.4	97.0	4.3	1.9	21.1	27.3	0.2	0.1	0.3
B_{C2} 8	6.95	22.2	77.6	98.6	6.8	3.1	28.5	38.4	0.3	0.0	0.3
B_{C2} 9	6.56	20.9	98.6	82.6	2.8	3.4	21.2	27.3	0.2	0.1	0.3
B_{C2} 10	6.22	19.7	113.3	72.9	3.8	2.2	14.6	20.6	0.2	0.0	0.2
B_{C2} 11	6.31	17.8	130.3	63.3	9.9	3.3	3.4	16.6	0.3	0.0	0.3
B_T 1	6.44	25.2	167.7	24.2	0.4	3.4	0.0	3.7	0.3	0.0	0.3
B_T 2	6.70	23.7	94.0	3.5	0.3	6.6	2.6	9.4	0.3	0.1	0.4
B_T 3	6.36	21.4	157.6	24.4	0.1	3.3	1.1	4.5	0.2	0.1	0.4
B_T 4	6.50	20.5	140.9	51.7	0.3	3.3	2.9	6.4	0.3	0.0	0.3
B_T 5	6.52	21.6	152.7	35.7	0.3	1.7	8.0	10.0	0.3	0.1	0.4
B_T 6	6.13	20.6	140.1	81.3	1.0	0.9	50.6	52.5	0.3	0.3	0.6
B_T 7	6.35	22.6	100.3	94.1	293.3	1.3	53.5	348.2	0.3	0.2	0.5
B_T 8	6.55	20.9	78.3	68.2	136.3	2.1	43.2	181.5	0.4	0.3	0.7
B_T 9	6.54	21.0	97.9	79.6	184.5	1.0	31.8	217.3	0.2	0.3	0.5
B_T 10	6.55	18.7	92.6	75.7	82.5	0.9	31.8	115.3	0.2	0.2	0.4
B_T 11	6.81	16.6	101.9	64.7	3.1	4.5	46.1	53.7	0.5	0.6	1.1
C_C 1	5.93	24.3	280.7	31.6	0.2	0.6	1.5	2.4	0.2	0.0	0.2
C_C 2	5.84	22.8	290.9	14.1	0.1	2.4	4.9	7.4	0.2	0.2	0.3
C_C 3	6.34	22.0	139.5	54.0	1.2	10.5	48.1	59.8	0.2	0.7	1.0
C_C 4	6.14	19.8	72.6	90.3	4.2	3.6	65.5	73.4	0.5	0.6	1.1
C_C 5	5.95	22.8	477.4	38.1	0.4	0.4	38.1	38.9	0.2	0.5	0.7
C_C 6	5.91	20.5	296.8	67.3	1.0	4.1	59.8	65.0	0.4	0.5	0.9
C_C 7	5.96	23.2	210.6	48.3	0.4	2.2	29.5	32.1	0.3	0.4	0.7
C_C 8	6.03	23.5	106.1	67.9	0.4	2.6	29.9	32.9	0.3	0.2	0.5
C_C 9	6.01	19.3	309.5	51.0	0.1	0.5	24.3	24.9	0.2	0.3	0.5
C_C 10	5.90	17.9	470.9	45.9	0.2	2.1	4.3	6.6	0.2	0.1	0.3
C_C 11	5.65	16.0	534.0	43.1	0.3	2.4	0.6	3.4	0.1	0.2	0.3

Site & Sample	pH	Temp. (°C)	EC (µs/cm @25°C)	DO (%sat.)	NO_X	NH_4	DON	TDN	PO_4	DOP	TDP
C_T 1	5.78	25.0	292.3	41.0	0.3	2.6	0.0	2.9	0.2	0.0	0.2
C_T 2	5.92	23.6	273.1	43.9	0.4	0.1	5.1	5.6	0.2	0.0	0.2
C_T 3	6.16	23.6	270.6	71.8	0.1	0.4	6.7	7.3	0.2	0.0	0.2
C_T 4	5.06	20.1	242.5	53.4	103.2	2.2	33.1	138.5	0.3	0.2	0.5
C_T 5	5.37	20.5	225.1	22.5	0.4	0.6	45.0	46.0	0.2	0.3	0.5
C_T 6	5.29	20.5	116.2	66.1	12.1	1.8	37.3	51.3	0.2	0.1	0.3
C_T 7	5.55	23.6	202.2	63.1	75.6	3.9	69.0	148.5	0.2	0.2	0.4
C_T 8	6.11	23.9	104.5	85.9	215.1	11.9	21.6	248.6	0.1	0.0	0.1
C_T 9	6.16	20.0	140.0	63.6	73.2	10.3	22.9	106.4	0.2	0.0	0.2
C_T 10	5.54	17.4	107.6	47.1	0.3	1.9	4.9	7.1	0.1	0.0	0.1
C_T 11	5.61	14.9	82.7	55.5	0.1	1.9	76.8	78.8	0.1	0.2	0.3
D_C 1	6.57	28.9	617.0	61.7	0.8	297.7	253.4	551.8	0.6	1.8	2.4
D_C 2	6.77	22.7	867.0	50.1	1.5	322.7	159.1	483.3	0.3	0.9	1.2
D_C 3	6.64	21.4	623.0	47.4	4.5	229.4	209.1	443.0	0.4	1.1	1.4
D_C 4	5.24	21.8	671.0	63.8	0.3	3.5	38.0	41.8	0.2	0.6	0.8
D_C 5	5.80	24.1	808.0	23.1	0.6	12.7	37.8	51.0	0.2	0.3	0.5
D_C 6	5.78	24.0	193.4	84.6	4.2	0.5	51.2	55.9	0.3	0.3	0.6
D_C 7	5.97	22.6	202.5	74.7	0.5	2.3	67.0	69.7	0.4	0.9	1.3
D_C 8	6.26	23.3	133.5	85.8	1.6	1.8	56.8	60.2	0.3	0.3	0.5
D_C 9	6.51	19.9	235.4	67.0	0.4	0.6	40.5	41.4	0.2	0.5	0.7
D_C 10	6.17	16.0	362.4	53.4	0.4	3.4	29.6	33.3	0.3	0.1	0.4
D_C 11	6.28	14.6	424.9	53.3	0.5	7.4	17.7	25.6	0.0	0.1	0.1
D_{T1} 1	6.41	24.9	177.6	16.5	0.7	21.3	43.8	65.9	0.5	0.2	0.6
D_{T1} 2	6.66	22.9	178.2	48.4	0.6	31.6	22.1	54.2	0.6	0.4	1.1
D_{T1} 3	6.31	20.6	137.8	52.0	5.1	23.5	24.0	52.6	0.4	0.6	1.0
D_{T1} 4	6.38	21.4	88.7	80.3	5.8	2.5	60.9	69.2	0.3	0.5	0.8
D_{T1} 5	6.48	22.7	120.3	82.4	2.1	7.8	55.3	65.2	0.3	0.5	0.8
D_{T1} 6	5.87	23.4	215.7	87.4	811.1	1.8	0.0	812.9	0.2	0.2	0.4
D_{T1} 7	5.99	22.5	173.3	75.9	351.6	9.4	117.2	478.2	0.2	0.0	0.2
D_{T1} 8	6.19	22.6	233.5	85.9	450.7	5.1	85.9	541.8	0.3	0.0	0.3
D_{T1} 9	6.50	19.3	157.8	78.1	159.0	6.1	22.2	187.3	0.2	0.1	0.3
D_{T1} 10	6.45	17.5	219.0	72.3	0.8	13.4	6.9	21.1	0.3	0.2	0.4
D_{T1} 11	6.64	17.9	189.7	82.5	14.1	11.1	14.3	39.4	0.3	0.0	0.3

Site & Sample	pH	Temp. (°C)	EC (µs/cm @25°C)	DO (%sat.)	NO_X	NH_4	DON	TDN	PO_4	DOP	TDP
D_{T2} 1	8.13	25.9	343.4	198.6	0.7	17.8	67.8	86.3	0.6	0.1	0.7
D_{T2} 2	6.67	22.1	345.6	17.0	0.5	10.6	56.8	68.0	0.4	0.5	0.8
D_{T2} 3	6.19	21.0	309.2	49.3	2.1	21.4	35.9	59.4	0.2	0.4	0.6
D_{T2} 4	5.63	20.9	315.4	53.1	166.3	1.3	60.3	227.9	0.3	1.1	1.3
D_{T2} 5	5.97	23.0	289.7	55.6	0.6	4.3	42.7	47.6	0.2	0.4	0.6
D_{T2} 6	6.05	25.8	161.6	70.8	549.8	7.0	298.8	855.7	0.2	0.9	1.1
D_{T2} 7	6.09	23.4	144.4	51.4	325.2	3.1	102.1	430.5	0.7	0.6	1.4
D_{T2} 8	6.90	24.0	142.2	80.8	189.7	8.0	34.0	231.7	0.4	0.2	0.5
D_{T2} 9	6.71	20.6	121.7	48.3	145.3	3.0	36.3	184.6	10.8	2.6	13.5
D_{T2} 10	6.39	16.2	224.3	13.8	0.4	3.6	25.2	29.2	0.3	0.3	0.6
D_{T2} 11	6.72	16.0	299.3	13.3	0.1	4.2	18.6	22.9	0.4	0.3	0.6
E_C 1	5.81	21.3	397.6	13.4	0.2	0.5	8.2	8.9	0.1	0.1	0.2
E_C 2	5.89	21.4	253.9	18.3	0.5	0.0	4.0	4.5	0.2	0.1	0.4
E_C 3	5.94	20.1	246.1	17.7	0.2	3.6	0.0	3.8	0.2	0.0	0.3
E_C 4	6.05	20.0	242.2	34.8	0.1	1.0	4.6	5.7	0.2	0.0	0.2
E_C 5	5.97	21.6	259.9	24.8	3.6	0.5	5.1	9.2	0.2	0.1	0.3
E_C 6	6.14	21.2	163.2	82.1	131.9	0.1	23.0	154.9	0.2	0.2	0.4
E_C 7	6.38	21.4	138.1	74.8	58.3	0.1	8.0	66.3	0.2	0.1	0.3
E_C 8	6.69	21.2	116.4	87.9	73.0	0.6	14.5	88.1	0.3	0.3	0.5
E_C 9	6.53	19.4	156.0	70.1	37.2	0.3	8.9	46.4	0.3	0.1	0.4
E_C 10	6.16	18.1	184.5	53.1	5.4	0.5	7.6	13.5	0.2	0.1	0.3
E_C 11	6.37	17.8	227.7	50.6	1.1	0.0	2.6	3.7	0.2	0.0	0.2
E_T 1	5.86	24.5	246.7	23.1	0.4	0.4	3.5	4.3	0.1	0.0	0.1
E_T 2	5.89	23.3	250.7	20.1	0.1	0.6	19.0	19.7	0.2	0.2	0.4
E_T 3	6.01	23.2	244.2	39.9	0.2	0.7	5.4	6.4	0.2	0.1	0.3
E_T 4	6.43	21.6	252.2	73.4	0.3	1.9	13.1	15.3	0.5	0.2	0.7
E_T 5	6.48	26.8	256.3	89.3	0.7	0.3	9.8	10.8	0.2	0.0	0.2
E_T 6	6.23	22.9	175.6	91.2	149.0	0.4	25.8	175.1	0.3	0.2	0.4
E_T 7	6.44	21.8	145.7	88.3	60.3	0.6	7.6	68.5	0.2	0.0	0.3
E_T 8	7.00	22.3	121.5	91.8	75.1	0.4	22.9	98.4	0.3	0.2	0.5
E_T 9	6.80	19.3	164.7	89.1	40.1	0.5	5.1	45.7	0.3	0.0	0.3
E_T 10	6.34	18.4	192.1	74.7	8.0	0.4	6.9	15.3	0.2	0.0	0.2
E_T 11	6.51	18.0	218.6	77.0	6.7	0.4	8.1	15.2	0.3	0.0	0.3

Site & Sample	pH	Temp. (°C)	EC (µs/cm @25°C)	DO (%sat.)	NO_X	NH_4	DON	TDN	PO_4	DOP	TDP
F_C 1	6.19	22.7	158.5	18.0	1.2	119.9	76.2	197.3	0.5	0.4	1.0
F_C 2	6.13	22.6	118.6	16.2	1.3	115.9	88.8	206.0	0.8	0.4	1.1
F_C 3	5.95	20.8	126.1	25.3	1.3	54.3	60.7	116.2	0.4	0.4	0.8
F_C 4	5.63	20.6	39.9	73.9	1.5	2.4	29.1	33.0	0.3	0.0	0.3
F_C 5	5.82	20.9	69.5	56.4	1.6	4.9	65.0	71.5	0.4	0.2	0.6
F_C 6	5.59	20.7	222.3	72.7	1.1	1.6	42.3	45.0	0.2	0.2	0.4
F_C 7	5.54	22.0	153.5	42.9	0.4	0.5	20.2	21.1	0.2	0.1	0.3
F_C 8	5.89	21.6	83.2	72.8	0.4	0.9	36.8	38.0	0.2	0.3	0.5
F_C 9	6.01	18.4	159.1	27.1	0.4	0.3	29.1	29.7	0.2	0.1	0.3
F_C 10	5.68	17.7	220.5	14.8	0.4	7.7	28.4	36.5	0.2	0.2	0.4
F_C 11	5.85	15.8	226.4	9.7	0.6	9.9	20.1	30.6	0.2	0.1	0.3
F_T 1	6.64	24.9	630.0	35.0	0.4	4.9	14.4	19.7	0.5	0.0	0.5
F_T 2	6.63	23.9	587.0	31.8	0.1	0.1	12.7	12.9	0.4	0.0	0.5
F_T 3	6.64	22.5	577.0	59.3	0.3	0.4	10.1	10.8	0.4	0.0	0.4
F_T 4	6.46	21.0	518.0	66.5	0.4	1.2	10.4	12.0	0.3	0.0	0.3
F_T 5	6.54	22.3	565.0	71.8	0.3	0.4	17.6	18.3	0.3	0.0	0.3
F_T 6	5.90	20.9	254.9	81.7	24.6	2.2	43.4	70.2	0.4	0.2	0.5
F_T 7	5.97	22.7	184.2	89.3	20.5	4.0	35.9	60.4	0.2	0.1	0.3
F_T 8	5.97	23.1	93.6	71.7	5.1	2.4	45.8	53.3	0.2	0.1	0.3
F_T 9	6.37	21.0	178.5	64.4	1.8	3.7	30.3	35.8	0.2	0.1	0.3
F_T 10	6.21	19.0	374.1	43.6	0.4	1.8	15.3	17.5	0.2	0.0	0.2
F_T 11	6.43	16.9	439.8	66.5	0.6	2.9	7.3	10.8	0.2	0.0	0.2
G_C 2	6.53	23.3	165.9	24.2	0.6	12.1	33.4	46.1	0.4	0.7	1.1
G_C 3	5.65	22.0	121.3	23.8	1.6	5.5	38.5	45.7	0.4	0.5	0.9
G_C 4	5.47	21.6	135.7	41.5	22.6	9.7	29.3	61.5	0.3	0.0	0.3
G_C 5	5.79	21.8	136.8	32.2	0.4	2.5	21.3	24.2	0.3	0.2	0.5
G_C 6	6.21	20.7	112.4	94.6	1.0	1.1	36.6	38.7	0.3	0.3	0.5
G_C 7	5.97	22.6	100.1	36.3	3.4	1.7	25.4	30.6	0.2	0.1	0.4
G_C 9	6.76	22.0	99.5	89.8	7.0	1.7	21.8	30.6	0.2	0.0	0.2
G_C 10	6.43	21.2	112.8	76.8	0.7	2.0	19.2	21.9	0.2	0.1	0.3
G_C 11	6.55	20.4	112.1	55.4	0.5	11.5	9.8	21.8	0.3	0.0	0.3

Site & Sample	pH	Temp. (°C)	EC (µs/cm @25°C)	DO (%sat.)	NO_X	NH_4	DON	TDN	PO_4	DOP	TDP
G_T 2	6.48	23.2	231.5	42.5	0.5	29.2	0.0	29.7	0.4	0.0	0.4
G_T 3	6.35	22.4	175.5	50.2	7.1	21.1	0.0	28.2	0.2	0.0	0.2
G_T 4	6.39	20.6	152.1	61.9	0.9	3.9	19.3	24.1	0.3	0.0	0.4
G_T 5	6.76	22.7	191.6	68.3	0.4	5.8	5.1	11.2	0.2	0.1	0.3
G_T 6	6.16	20.8	168.6	68.5	78.5	6.1	28.9	113.4	0.4	0.5	0.9
G_T 7	6.19	22.0	107.3	87.3	10.4	1.5	13.7	25.6	0.2	0.0	0.2
G_T 9	6.61	20.2	111.6	84.1	0.7	2.5	9.4	12.6	0.2	0.0	0.2
G_T 10	6.47	19.0	147.5	37.9	0.3	4.8	7.1	12.1	0.2	0.1	0.2
G_T 11	6.63	18.3	142.1	63.0	0.3	4.0	0.0	4.3	0.3	0.1	0.3
Min.	5.1	14.6	39.9	3.5	0.1	0.0	0.0	2.4	0.0	0.0	0.1
Max.	8.1	28.9	867.0	198.6	811.1	322.7	298.8	855.7	10.8	2.6	13.5
Mean	6.2	21.2	222.0	55.1	31.6	13.1	32.7	77.4	0.3	0.2	0.6
Std. Dev.	0.4	2.4	141.6	26.7	97.3	41.7	38.6	128.2	0.8	0.3	1.0