Fitzroy Region Urban Scoping Report

December 2015

John Gunn

Earth Environmental

Queensland, Australia

FITZROY BASIN ASSOCIATION

Our country, Our future

www.fba.org.au

Disclaimer

This document does not represent the views, policy or practice of the Fitzroy Basin Association (FBA), Rockhampton Regional Council, Gladstone Regional Council, Livingstone Shire Council or other organisations or individuals mentioned herein. The information has been compiled from a variety of sources which have not been verified using primary data and as such the document should not be relied upon as a reference tool for decision making or other purposes.

This report can be cited as:

Gunn, J. 2015, *Fitzroy Region Urban Scoping Report* (for the Fitzroy Basin Water Quality Improvement Plan), Earth Environmental, Mackay, Queensland.

For further information contact:

John Gunn
Earth Environmental
Email: earth@mackay.net.au
Phone: 0413 019 359

Contents

List of Figures

List of Tables

Executive summary

Urban water quality has not been seriously considered as a component of water quality improvement in the Great Barrier Reef catchment in the past except perhaps for point source discharges from wastewater (sewage) treatment plants.

The most recent Reef Scientific Consensus statement associated with the Reef Plan (2013) states "*that the impact from urban areas may be locally and, over short time periods, highly significant*". The highly significant short term impacts mentioned are due to land development and construction activities while ongoing impacts result from stormwater run-off in modified urban catchments and increased discharge from wastewater treatment plants as a direct result of population increase.

The quantum of the urban impact has been modelled for the Great Barrier Reef (GBR) catchment (Waters et al 2014) however the actual impacts have not been monitored or defined well enough to prepare a solid business case for investment in urban water quality improvement. The modelling however suggests that urban areas, covering 0.57 percent of the GBR catchment, contribute nearly 4 percent of the total nutrient (nitrogen and phosphorus) load to the GBR lagoon. Impacts from urban areas will continue to accumulate and become more significant in the future as a result of inevitable population increase and the associated expansion of the urban footprint and infrastructure.

The responsibility for total water cycle management in the urban setting sits squarely with local government through heads of power contained in Queensland legislation. This includes the responsibility for wastewater treatment (point source), installation and maintenance of stormwater management systems (diffuse source) and the management of coastal development through the assessment processes inherent in planning schemes. Local government is also tasked with ensuring compliance with development approval conditions in the short term for longer term outcomes.

The capacity of local government to deliver urban water quality improvement outcomes in the Fitzroy region is limited by available resources and a lack of experience and skills resulting partly from the historic focus on flood mitigation rather than stormwater quality management. Local government is in a transition phase between the old engineering based stormwater quantity management approach and the new total water cycle management approach recently mandated in legislation (2010) for urban diffuse sources. Local government is struggling to meet the socio-economic and environmental challenges associated with this change and a new way of doing things.

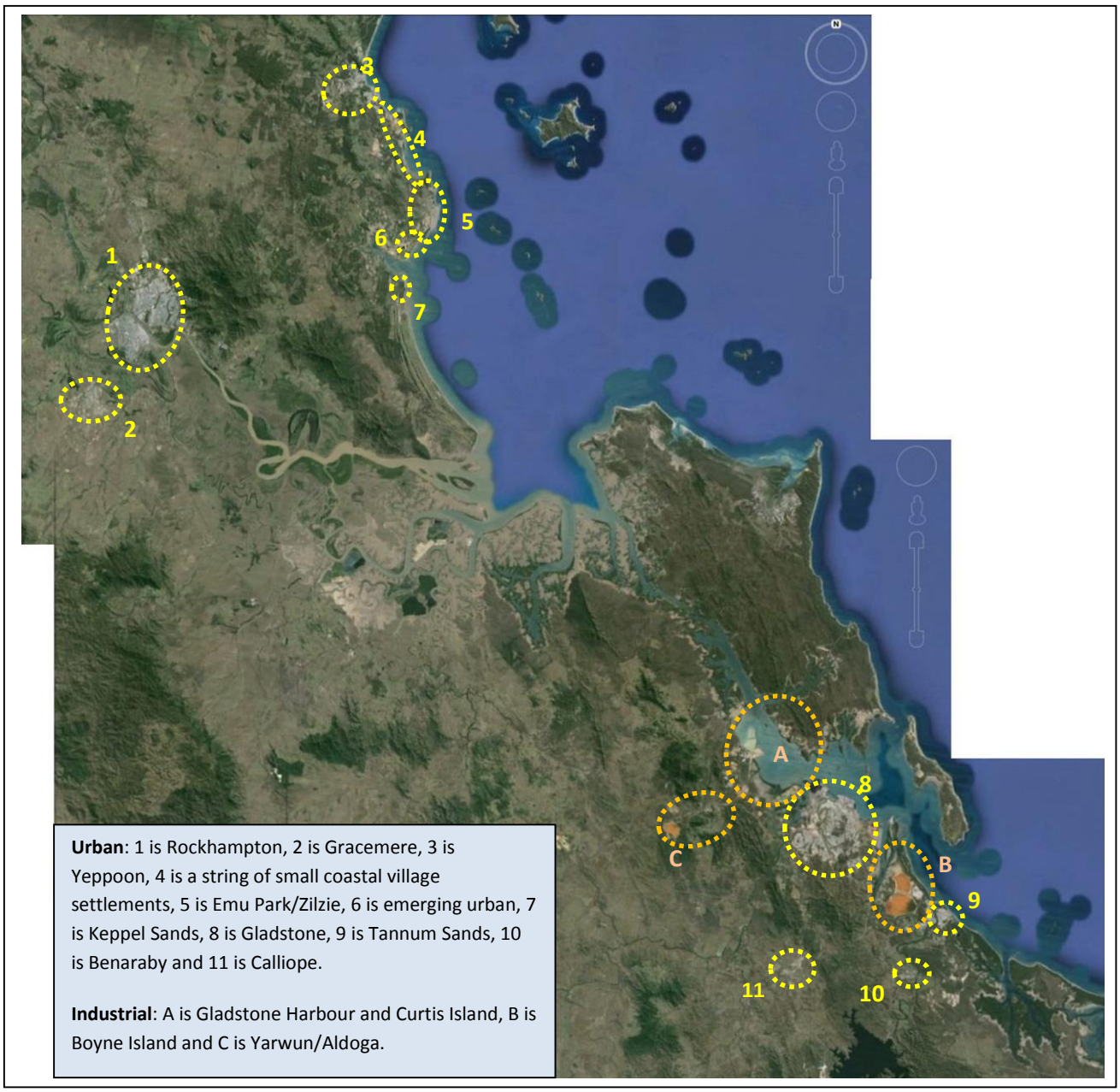
Given the lack of resources devoted to urban water quality improvement in the past much of the data required to quantify urban water quality impacts and prioritise actions is not available for decision making. Therefore urban water quality improvement actions necessarily start with a series of foundation activities. These should be coordinated across the whole GBR catchment to achieve maximum resource efficiency and to enable the most appropriate strategic responses to be devised locally. No regrets on-ground system repair actions, capacity building and behaviour change activities can be immediately implemented also for known GBR catchment wide and local priorities.

1. Introduction

1.1. Background

The Fitzroy Basin Association (FBA) prepared the *Fitzroy Basin Water Quality Improvement Report* in 2008 when Water Quality Improvement Plans (WQIPs) were being prepared for other Great Barrier Reef catchments through the Australian Government's Coastal Catchments Initiative (CCI) program. Findings from the 2008 FBA report have now been combined with up to date science to produce a web based WQIP for the Fitzroy Basin natural resource management (NRM) region.

Figure 1-1:Fitzroy Region Main Urban Centres



The first round of Reef WQIPs (2002-2010) focused on agricultural land use with urban and industrial (including mining and ports) areas not considered significant enough contributors to Great Barrier Reef (GBR or the Reef) water quality issues to be included in funding allocations.

Urban land use is now being considered as a component of the Fitzroy WQIP through this scoping report, which commences the process of defining the impacts of population growth and urban development on local waterways and the Reef for the main urban centres of Rockhampton and Gladstone. The main near coastal urban areas of the Fitzroy region considered in this scoping report are illustrated in Figure 1-1 along with Gladstone industrial area locations.

2. Urban Water Quality responsibility

2.1. Historic Context

The main Fitzroy region urban centres, Rockhampton and Gladstone, have an interesting history dating back to the 1840's when a proposed settlement at Port Curtis (later to become Gladstone) was intended as the administrative centre of a separate Northern Australia colony. Agriculture (wool and beef production) and mining (gold and copper) played a pivotal role in the early development of Rockhampton and Gladstone. Both industries initially required suitably accessible port facilities, which would later be linked to inland and then coastal rail transport routes.

The history of settlement in Rockhampton and the Central Queensland region is a function of the prevailing technology and socio-economic drivers at the time. One of the main drivers during the 1800's was the need to provide infrastructure to support the colony's expanding agricultural and mining industries. This was initially based around the establishment of port facilities as there was no reliable road or rail infrastructure on Australia's east coast extending much beyond the hinterland of the main urban centres i.e. Sydney, Melbourne and Brisbane. Coastal shipping was the main form of transport for people and goods during the pioneering years and this was particularly important for 'opening up' Central and North Queensland considering the distances and land transport barriers created by its rivers and coastal wetlands.

Rockhampton gained the ascendency over Gladstone as a port facility in the late 1850s due mainly to its proximity to Queensland's first gold rush at Canoona and as the main gateway for the subsequent slower rush to the Peak Downs (Clermont) gold field and copper mine. Rockhampton was also better situated geographically for the construction of an inland rail line to service the expanding pastoral and mining industries to the west. The rivalry between Rockhampton and Gladstone for port trade continued until the Second World War disrupted coastal shipping and rail freight became more influential for the conveyance of commodities and goods to and between coastal centres.

Gladstone emerged as the dominant port in the Fitzroy region in the 1950s and has continued its expansion with growth spurts in the 1960s and more recently with major infrastructure projects associated with coal and gas exports. A history of coastal urban development in the Fitzroy region is included in the *Fitzroy Urban Background Report* (Gunn 2015) prepared to inform this scoping report and the Fitzroy Basin WQIP.

2.2. Urban Governance and Local Government

The responsibilities of local government have changed with the passage of time as has their area of influence. Up until 1879 the maximum local government area (municipality) was 130km^2. At the time the principal responsibility of local government was to provide public services and amenities for Queensland's growing townships and to regulate town building construction. The legislated roles and responsibilities of local government were an acknowledgement by the Queensland colonial government that the orderly expansion of the colony could only proceed effectively in population centres distant from Brisbane with a system of local governance in place to guide the expansion.

The *Divisional Boards Act 1879* extended the influence of local government to the whole of Queensland with the creation of Divisions which are the modern equivalent of Shires. The main role of local government outside the town areas of these large Divisions was the construction and maintenance or roads. In most cases the Queensland colonial government was responsible for financing the construction of the railway system.

A short history of local government in Queensland is included in the *Fitzroy Urban Background Report* (Gunn 2015) including a map showing the location of Divisions, Municipalities and Boroughs in the vicinity of Rockhampton and Gladstone in 1902, immediately prior to the introduction of the *Local Authorities Act 1902*.

2.3. Legislation and Local Government Responsibilities

Many of the original responsibilities of local government from the 1800s still apply under the current *Local Government Act 2009* albeit with relevant changes associated with technological advances and prevailing socio-economic circumstances. Familiar local government responsibilities carried over from early legislation include; waste disposal and public health, water supply, sanitation services including waste water disposal, stormwater management and the maintenance of local roads. Local government also shares some of their previous responsibilities with the Queensland Government e.g. fire prevention and land use management (via local and regional planning instruments), while other responsibilities now rest with the State e.g. issuing leases and other land titles.

As bodies which obtain their legitimacy from an Act of the Queensland Parliament local government is subordinate to the State of Queensland and subject to compliance with all other State legislation. The main state legislation associated with the operation of local government in Queensland, including their responsibilities with regard to water quality, is discussed below.

2.3.1. Local Government Act 2009

Local government derives its authority and assumed roles from the *Local Government Act 2009* (Qld) (LG Act), which defines "*the way in which a local government is constituted and the nature and extent of its responsibilities and powers*" (LG Act, s.3 (a), p.18). The LG Act also states that a "*local government has the power to do anything that is necessary or convenient for the good rule and local government of its local government area*." (LG Act, s.9 (1), p.20). Key aspects of the LG Act include:

- Chapter 2 Local governments;
    - Part 1 Local governments and their constitution, responsibilities and powers,
- Chapter 3 The business of local governments;
    - Part 1 Local laws,
    - Part 2 Beneficial enterprises and business activities,

- Part 3 Roads and other infrastructure,
  - Division 1 Roads,
  - Division 2 Stormwater drains.

Amongst other things the LG Act:

- Places all public roads in a local government area under the control of that local government (excluding State roads, private roads and public thoroughfare easements);
- Enables local government to require property owners to connect their stormwater installations to the local government's stormwater system (drains) and to set conditions for such connections including through development approval conditions;
- Precludes the connection of sewerage to stormwater installations or local government's stormwater system (drains);
- Precludes trade waste being put into stormwater drains from any source;
- Restricts interference with the flow of stormwater that may result in water to collect and become stagnant.

Relevant extracts from the LG Act are included in Appendix A.

2.4. Environment Protection and Planning Legislation

The main Queensland Acts and subordinate legislation relevant to coastal development and/or water management are listed below:

- *Environmental Protection Act 1994*;
  - *Environmental Protection Regulation 2008*,
  - *Environmental Protection (Waste Management) Regulation 2000*,
  - *Environmental Protection (Water) Policy 2009,*
  - [Great Barrier Reef Protection Amendment Act 2009 incorporated in the Act].
- *Water Act 2000*;
  - *Water Regulation 2002,*
  - *Water Resource (basin/catchment name) Plan.*
- *Water Supply (Safety and Reliability) Act 2008;*
  - *Water Supply (Safety and Reliability) Regulation 2011.*
- *Sustainable Planning Act 2009*;
  - *Sustainable Planning Regulation 2009,*
  - *State Planning Policy 2013 (as amended July 2014).*

Other state legislation that can influence development, environmental protection and water quality includes:

- *Aboriginal Cultural Heritage Act 2003*
- *Coastal Protection and Management Act 1995*
- *Environmental Offsets Act 2014*
- *Fisheries Act 1994*
- *Land Act 1994*
- *Marine Parks Act 2004*
- *Nature Conservation Act 1992*
- *Vegetation Management Act 1999*

Queensland's environment protection and planning legislation is discussed briefly below with regard to urban land use and associated water quality implications.

2.4.1. Environmental Protection Act 1994

The *Environmental Protection Act 1994* (EP Act) is Queensland's principal piece of environmental legislation and is, amongst other things, responsible for the regulation of point source and diffuse source (in part) water quality pollutants emanating from urban areas.

The object or intent of the EP Act is "*to protect Queensland's environment while allowing for development 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 (ecologically sustainable development)*" (EP Act, p.41). The EP Act emphasises everyone's responsibility for the environment through a general duty of care not to cause environmental harm (see text box below).

> **"319 General environmental duty**
> (1) A person must not carry out any activity that causes, or is likely to cause, environmental harm unless the person takes all reasonable and practicable measures to prevent or minimise the harm (the ***general environmental duty***)."
>
> "(2) In deciding the measures required to be taken under subsection (1), regard must be had to, for example—
> (a) the nature of the harm or potential harm; and
> (b) the sensitivity of the receiving environment; and
> (c) the current state of technical knowledge for the activity; and
> (d) the likelihood of successful application of the different measures that might be taken; and
> (e) the financial implications of the different measures as they would relate to the type of activity."
> (EP Act, p.246)

The main components of the EP Act that relate to local government, coastal development, urban land use and water quality impacts include:

- Environmental protection policies (EPPs) (Chapter 2);
- Environmental impact statements (Chapter3);
- Great Barrier Reef protection measures - agricultural activities (Chapter 4A);
- Environmentally relevant activities (Chapter 5);
- Environmental management (Chapter 7) including;
    - Environmental duties including duty to notify environmental harm,
    - Environmental evaluations and audits,
    - Temporary emission licences,
    - Environmental protection notices,
    - Direction notices,
    - Clean up and cost recovery notices,
    - Contaminated land and notifiable activities.
- Environmental offences (Chapter 8);
- Devolution of powers (Chapter 11);
- Making of guidelines and Regulations (Chapter 12).

2.4.2. Environmental Protection Regulation 2008

The *Environmental Protection Regulation 2008* (EP Reg.) provides the detail to complement the concepts embedded in the EP Act. This includes:

- The list of prescribed ERAs in Schedule 2 (pp.126-178) (see Appendix A);
- Codes of environmental compliance (Schedule 3, p.189);
- Matters relating to environmental management and environmental offences (Chapter 5, pp.37-47) including;
    - Prescribed water contaminants (Part 4, p.42 and Schedule 9, pp.214-5) (see Appendix A);
    - Wetland environmental values (Part 7, pp.45-6);
- Devolution of powers to local government (Chapter 7, Part 1, pp.59-61) (see Appendix A).

2.5. Point Source and ERAs

2.5.1. Environmentally relevant activities

In general terms an environmentally relevant activity (ERA) will or may result in a contaminant being released into the environment that will or may cause environmental harm when the activity is carried out (EP Act s19, p.49). Section 18 (EP Act, p.49) defines types of environmentally relevant activity (ERAs) as:

1) An agricultural ERA (Chapter 4A) (see Appendix A);
2) A resource activity which consists of; a geothermal activity, a greenhouse gas (GHG) storage activity, a mining activity, or a petroleum activity (Chapter 5) (see Appendix A);
3) A prescribed activity (Chapter 5 and section 19) (see Appendix A).

Agricultural ERAs (1 above) and resource activities (2) are not relevant to urban residential and commercial areas however port and industrial areas may include activities associated with a resource activity. Prescribed activities (3) are listed in Schedule 2 in the Environmental Protection Regulation 2008.

Prescribed activities often involve point source emissions. This includes wastewater treatment plants (ERA 63 Sewage treatment), which is the main ERA that potentially discharges pollutants to receiving waters from urban centres. The list of prescribed activities from the Environmental Protection Regulation 2008 is included in Appendix A.

ERAs are licensed under the EP Act and Regulation including permitted conditions for ERA operations such as the allowable discharge of environmental pollutants. In addition to licence conditions for wastewater treatment plants under the EP Act local government is also subject to regulation under the *Water Supply (Safety and Reliability) Act 2008* (WSSR Act). The WSSR Act requires "*a local government that owns infrastructure for supplying water or sewerage services*" to apply for registration as a service provider (WSSR Act, p.31). The WSSR Act also applies to recycled water schemes, generally associated with wastewater treatment plants, and recycled water management planning.

2.5.2. Water supply

The *Water Act 2000* and *Water Regulation 2002* are responsible for the regulation of the taking of water from the environment including through the preparation of Water Resource Plans (WRP) and Resource Operation Plans (ROPs). This is the legislation that enables the supply of raw water to urban and industrial areas as well as to irrigation areas. The actual treatment of supplied raw water is an ERA (64 Water treatment) and is subject to the EP Act and Regulation and the WSSR Act.

The Water Act also makes provision for working in waterways (freshwater) including through the approval of Riverine Protection Permits (see Appendix A), the preparation of self-assessable codes and providing advice and setting conditions under planning legislation. Water authorities can also be created under the Water Act (see Appendix A) with the Gladstone Area Water Board (GAWB) being one such authority.

2.6. Urban Diffuse Source

2.6.1. Environmental Protection (Water) Policy

Environmental Protection policies (EPPs) have been made under section 26 of the EP Act for; Air (2008), Noise (2008), and Water (2009).

The initial *Environmental Protection (Water) Policy 1997* was made under the EP Act with the purpose being "*to achieve the object of the Act in relation to Queensland waters*" (see section 2.4.1 above) (EPP Water, p.3). The EPP Water 1997 required local governments to prepare an urban stormwater quality management plan (USQMP) to address diffuse source water quality issues associated primarily with stormwater systems in existing urban areas.

The *Environmental Protection (Water) Policy 2009* (EPP Water) replaced the 1997 policy and in the new version USQMPs were included as a component of a Total Water Cycle Management Plan (TWCMP), which local government were required to prepare. A guideline for the preparation of TWCMPs for South East Queensland (SEQ) was published by the Queensland Government in 2010.

The EPP Water 2009 was amended in December 2013 with requirements for local government to develop USQMPs or TWCMPs removed. This coincided with the introduction of the single State Planning Policy 2013 (amended July 2014) (see section 2.6.4). There is an option under section 24 of the EPP Water for the chief executive, or a recognised entity in conjunction with the chief executive, to develop and implement a healthy waters management plan (HWMP). This is the urban equivalent of a water quality improvement plan (WQIP).

The purpose of the EPP Water is achieved in part by identifying environmental values and management goals for Queensland waters and stating water quality guidelines and water quality objectives (WQOs) to enhance or protect the environmental values.

The processes to identify EVs and to determine water quality guidelines (WQGs) and WQOs are based on the *National Water Quality Management Strategy* (NWQMS, 2000) including the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (2000) (AWQG). The process is reiterated in the *Queensland Water Quality Guidelines* (2009) (QWQG).

Environmental values (EVs) and water quality objectives (WQOs) adopted by the Queensland Government for Queensland waters are gazetted and included in Schedule 1 of the EPP Water. EVs and WQOs have been gazetted for the catchments and marine waters adjacent to Rockhampton,

Gladstone and Livingstone Shire urban areas (see section 4.4 in the *Fitzroy Urban Background Report* Gunn 2015)).

2.6.2. Sustainable Planning Act 2009

The *Sustainable Planning Act 2009* (SP Act) is the other key piece of legislation influencing water quality outcomes in and from urban land use. The purpose of the SP Act is "*to seek to achieve ecological sustainability*"… by managing development and the effects of development on the environment including by coordinating and integrating planning at the local, regional and State levels (SP Act, pp.43-4). The meaning of ecological sustainability as defined by the SP Act is provided in the text box below.

> **8 Meaning of *ecological sustainability***
> ***Ecological sustainability*** is a balance that integrates—
> (a) protection of ecological processes and natural systems at local, regional, State and wider levels; and
> (b) economic development; and
> (c) maintenance of the cultural, economic, physical and social wellbeing of people and communities. (p.47)
> (**Note**: Current as at 28 May 2014)

The purpose of the SP Act is achieved in part through a planning and development assessment framework which includes State and local planning instruments and the related integrated development assessment system (IDAS).

Planning instruments under the SP Act are:

State:
- A State planning regulatory provision
- A State planning policy
- A regional plan
- The standard planning scheme provisions

Local:
- A planning scheme
- A temporary local planning instrument
- A planning scheme policy

2.6.3. Local planning instruments

Local planning instruments are the main pathway for the regulation of development by local government in their local government area (LGA). Planning schemes are the principal local planning instrument. The SP Act describes the process for preparing a planning scheme including the general structure of the planning scheme and the 'core matters' that the planning scheme must address. This includes State and regional dimensions of the core matters which are defined through state planning instruments (see Appendix A also). Core matters for planning schemes are:

(a) Land use and development;
(b) Infrastructure;
(c) Valuable features.

Valuable features include "*features contributing to the quality of air, water (including catchments or recharge areas) and soil*" (SP Act, p.94). Planning schemes therefore need to incorporate provisions that protect landscape elements that contribute to the maintenance of water quality. Planning scheme policies (PSP) are the accompanying local planning instrument supporting and clarifying matters in a planning scheme. Appendix A includes information from the SP Act about PSPs.

2.6.4. State planning policies

State planning policies (SPPs) need to be incorporated in planning schemes to ensure State dimensions of core matters are appropriately reflected in a planning scheme. Until relatively recently (December 2013) there were a number of SPPs for Queensland including SPP 4/10 Healthy Waters, which included urban water quality protection in the development assessment process for the first time. Prior to 2010 urban water quality protection was principally a function of the EP Act and the EPP Water (see section 2.4.1 and 2.6.1).

The inclusion of water quality protection provisions was not mandatory for planning schemes prior to the introduction of SPP 4/10 however development approvals often had some conditions designed to reduce impacts during the construction phase e.g. erosion and sediment control and/or site based stormwater management plans.

Planning reforms by the Queensland Government commencing in 2012 saw all the previous SPPs rolled into the single State Planning Policy in December 2013 (SPP 2013) (see text box below). The water quality state interest component of SPP 2013 (as updated July 2014), which incorporates former SPP 4/10 Healthy Waters components, is the most influential legislative instrument in Queensland with regard to urban development and future urban water quality protection.

> "*The State Planning Policy (SPP) contains 16 state interests* [see Appendix A] *that are important to protect and enhance through Queensland's continued development. It is a key component of the State's land use planning system that enables responsible development, contributing to a livable, sustainable and prosperous Queensland.*
>
> *The SPP provides clarity to local governments when making and amending local planning instruments and assessing development applications and assists applicants in preparing development applications. The comprehensive presentation of the State's interests in one document makes it easier for local governments to reflect and balance state interests 'up front' in local planning schemes, ensuring the right developments are approved in the right locations without undue delays. For more information on the SPP, please refer to the State Planning Policy fact sheet.*
>
> *The SPP is supported by state interest guidelines which are provided to assist the implementation of policy*."
>
> http://www.dilgp.qld.gov.au/planning/state-planning-instruments/state-planning-policy.html (Accessed October 2015. Last updated 11 August 2015)

State Planning Policy—state interest guideline Water quality (Department of State Development, Infrastructure and Planning August 2014) was prepared to assist local government incorporate the water quality state interest when making or amending a planning scheme. The SPP combined with any additional local water quality related core matters in planning schemes provides local

government with its main tool for managing water quality through the development assessment and development approval process.

Amongst other things the SPP includes the SPP code: Water quality (Appendix 3) "*to ensure development is planned, designed, constructed and operated to manage stormwater and wastewater in ways that support the protection of environmental values identified in the Environmental Protection (Water) Policy 2009*." (SPP, p.69). The SPP code: Water quality includes "Construction phase—stormwater management design objectives" (Table A, p.74) and "Post construction phase—stormwater management design objectives" (table B, p.75).

Development applications are assessed with reference to these design objectives to ensure urban water quality impacts are minimised during the construction phase and after construction by incorporating effective stormwater quality management measures in development designs, including water sensitive urban design (WSUD) principles. Water quality state interest components of SPP 2013 (as amended July 2014) are included in Appendix A (Sustainable Planning Act 2009 section). Other state interests may also be relevant to water quality, ecosystem health and community amenity e.g. Liveable communities theme (see Appendix A).

N**ote**: Information for section 2 above has been derived principally from Gunn, J. 2014a (*Urban Land Use in Great Barrier Reef Water Quality Improvement Plans: Background Report and Considered Guidance*, Reef Urban Stormwater Management Improvement Group (RUSMIG), Water by Design and Creek to Coral, Townsville.), with relevant updates post 2014.

3. Fitzroy Region Urban Council Basics

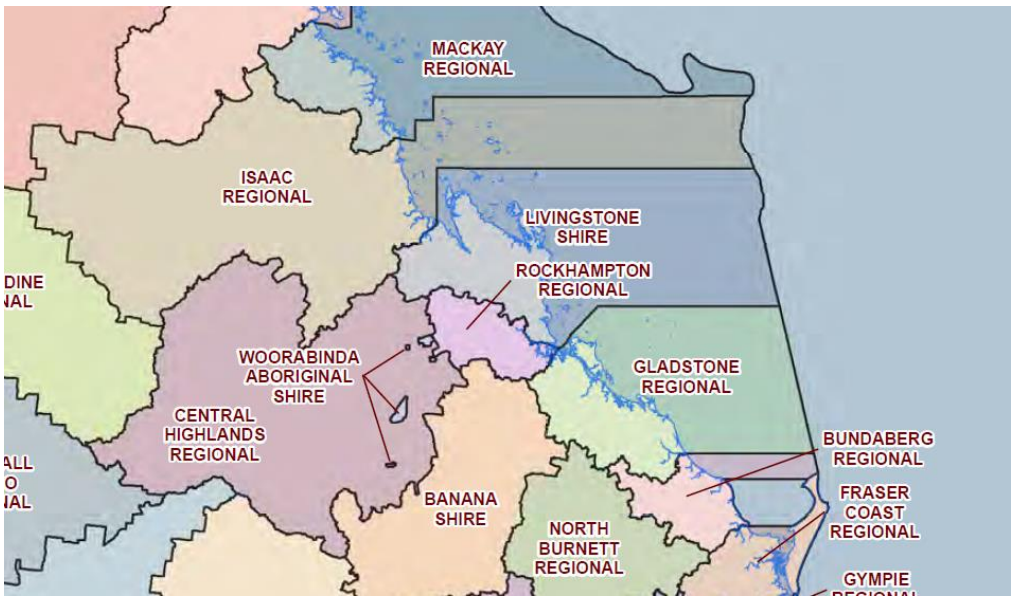
3.1. Basic Information

Basic information about Rockhampton Regional Council, Gladstone Regional Council and Livingstone Shire local government areas and Councils is provided in Table 3-1. Local government areas amalgamated in 2008 are shown in Figure 3-1 with current LGA boundaries shown in Figure 3-2.

Figure 3-1: LGA Amalgamation 2008

Note: Source map is QLD Local Government Authorities (current and pre-reform) © Copyright the State of Queensland (Department of Infrastructure and Planning) 2010.

Figure 3-2: Local Government Area Boundaries



Note: Map produced by the Department of State Development Infrastructure and Planning - Spatial Services Unit 1/05/2014. © Copyright the State of Queensland

Table 3-1: Local Government Area Basics

	Gladstone Regional Council	Rockhampton Regional Council	Livingstone Shire Council
Area	10,400 square kilometres	6,600 square kilometres	11,700 square kilometres
Amalgamated LGAs	Gladstone City, Calliope Shire and Miriam Vale Shire	Rockhampton City, Fitzroy Shire and Mount Morgan Shire	De-amalgamated from Rockhampton Regional Council on 1 January 2014
Adjoining LGAs	Livingstone SC, Rockhampton RC, Banana SC, North Burnett RC and Bundaberg RC	Livingstone SC, Banana SC, Central Highlands RC and Gladstone RC	Isaac RC, Central Highlands RC, Rockhampton RC, Gladstone RC
Electoral divisions	Undivided	Seven divisions	Undivided
Elected representatives	Mayor and eight Councillors	Mayor and seven Councillors	Mayor and six Councillors

Organisational structure – main departments and potential water quality related sub components	• Corporate and Community Services;
	  ○ Customer relations (GIS and mapping).
	• Engineering Services;
	  ○ Water services,
	  ○ Technical services,
	  ○ Road services.
	• Planning and Environment;
	  ○ Parks and environment,
	  ○ Development services
	• Mayor, Councillors and CEO support.
		• Regional Services;
		  ○ Civil Operations,
		  ○ Engineering,
		  ○ Planning,
		  ○ Fitzroy River Water,
		  ○ Rockhampton Regional Waste and Recycling.
		• Community Services;
		  ○ Parks.
		• Corporate Services;
		  ○ Corporate and technology.
		• CEO Office support.
			• Community and Planning Services;
			  ○ Strategy and development,
			  ○ Community well-being.
			• Infrastructure Services;
			  ○ Infrastructure operations,
			  ○ Infrastructure planning and design,
			  ○ Water and waste operations,
			  ○ Construction and maintenance.
			• Corporate Services;
			  ○ Information systems.
			• CEOs Office.

Population 2004[1] [urban]	49,517 [37,154]	72,420 [59,152]	28,159 [21,000[3]]
Population 2014[2] [urban]	66,097 [47,983]	83,439 [64,614]	36,378 [28,537[3]]
Population 2050[4] [urban]	155,877 [115,070]	132,225 [96,594]	78,220 [68,299[3]]
Dwellings 2050[4] [urban]	59,950 [44,250]	54,474 [40,208]	31,280 [27,320]
Urban land use 2014[5]	185km^2	220km^2 [370km^2][8]	150km^2
Broadhectare studies[6]	5,000 hectares	3,600 hectares	
Urban land use 2050[4]	230km^2	270 km^2 [330km^2][8]	160km^2
FBA sub catchments[7]	B1, B4, B6, B7 and B13	F12, F13, F19, F20 and F21	F9, F14 and F15

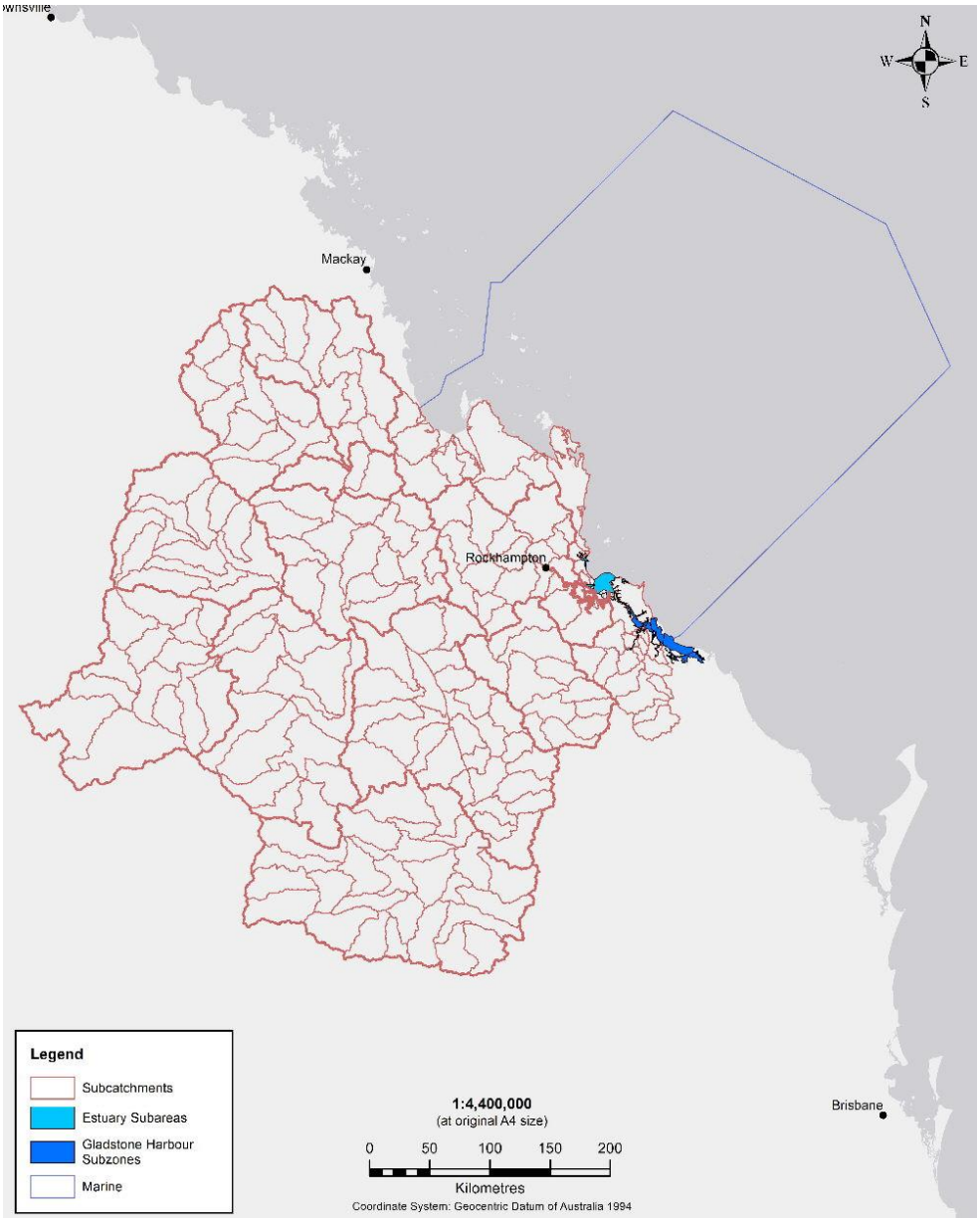
Notes: [1] is pre amalgamation. [2] is post amalgamation. [3] Livingstone Shire Council urban areas include Emu Park, Yeppoon and Glenlee-Rockyview SA2 units. [4] these are initial projections only and require more rigorous interrogation. Dwellings average household size was 2.6 for Gladstone and 2.5 for Rockhampton/Livingstone. [5] is based on statistical areas. Areas shown in section 4 are a closer areal estimate. [6] is additional areas required for urban expansion from 2016 to 2050 as extrapolated from Queensland Government Broadhectare Studies (RRC and LSC are combined as the study was carried out prior to de-amalgamation). [7] is FBA WQIP sub catchments containing urban and industrial areas. [8] [ ] is inclusive of Rockhampton and Gracemere urban areas.

4. Urban Catchments and Pressures

4.1. Fitzroy Basin Catchment Context

The urban areas of Gladstone Regional Council (185km^2), Rockhampton Regional Council (280km^2) and Livingstone Shire Council (150km^2) combined (615km^2) are insignificant in terms of land area (0.43%) when viewed in the context of the whole Fitzroy Basin (142,665 km^2) (see figure 4-1).

Figure 4-1: Fitzroy Basin and Sub Catchments



At a finer scale, when the sub catchments of the Fitzroy WQIP are viewed, the influence of urban land use can be seen in the context of local waterways and wetlands and the impacts on downstream water quality and ecosystem health become more meaningful and contextually measurable. Gladstone's urban catchments are illustrated in figure 4-4. Rockhampton and Livingstone urban catchments are illustrated in Figure 4-2 and Figure 4-3 respectively.

Figure 4-1: Gladstone Urban Catchments

Note: FBA sub catchments are labelled in yellow. The Baffle Creek catchment is in the Burnett Mary natural resource management region.

4.2. Population Growth

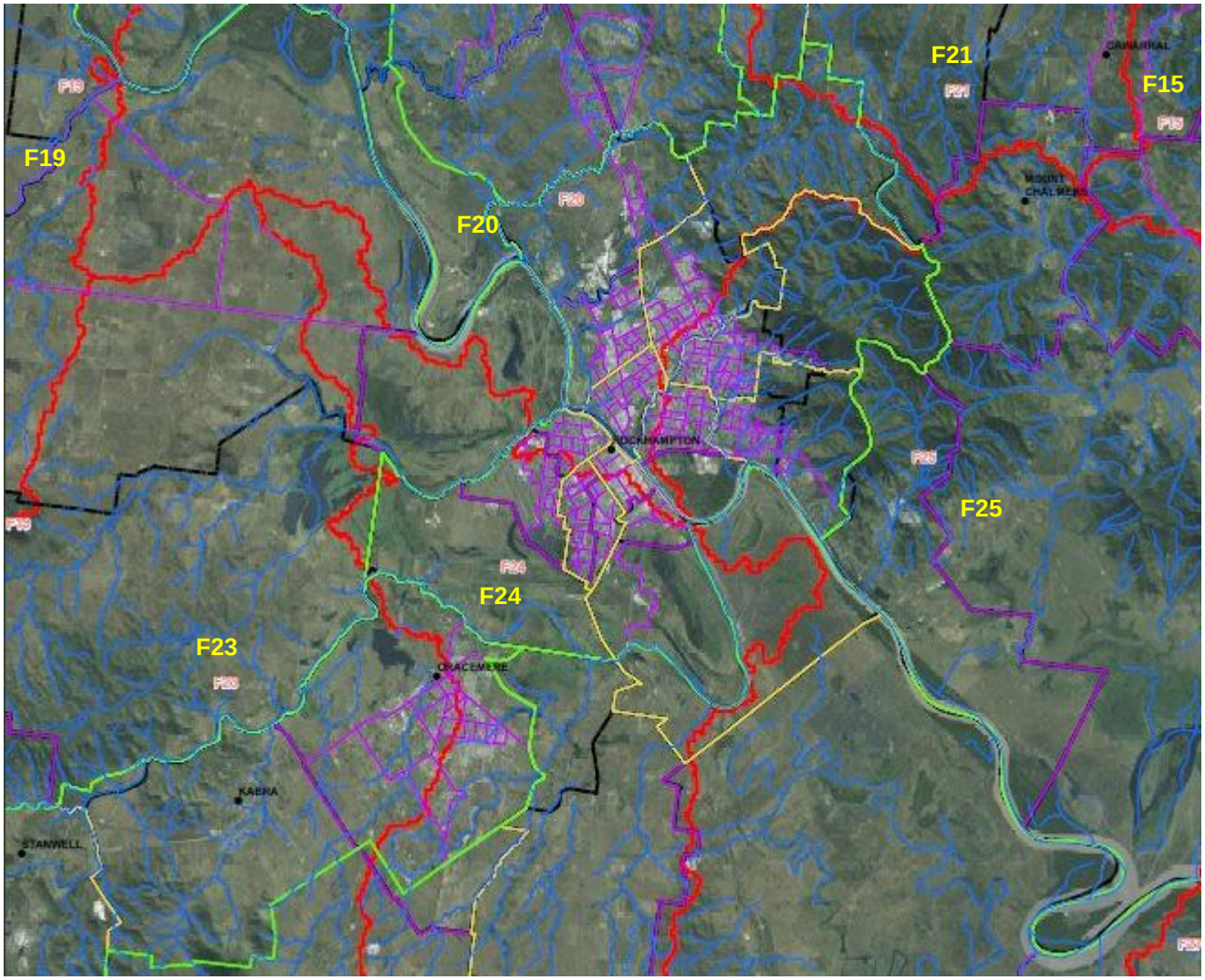
Increasing pressure on water quality from urban areas is a direct result of population growth driving the expansion of urban areas. Population growth creates a demand for housing and associated infrastructure and services including; electricity, roads (transport), stormwater systems, sewerage systems, water supply, wastewater treatment and solid waste disposal. Education, health, retail and other public and commercial facilities also expand to meet the extra demand generated by increasing population.

Summary population growth information is provided in Table 3-1 in the form of preliminary extrapolations of population growth to 2050 based on Australian Bureau of Statistics (ABS) projection data for Fitzroy urban statistical areas to 2036. The combined Rockhampton, Gladstone and Capricorn Coast (Livingstone Shire) urban population is anticipated to grow from 141,000 in 2014 to almost 280,000 by 2050. This doubling of the population could see a similar increase in the urban footprint i.e. 100%. With no intervention this would result in urban water quality impacts and the urban contribution to end of catchment nutrient loads doubling by 2050 i.e. from 3.8% to 7.5%.

The urban expansion process results in real and potential water quality impacts due to:

1. Land disturbance which creates potential for soil erosion and sediment discharge, with associated nutrients, mostly during the development and construction phase;
2. Increased impervious surfaces associated with the built environment (roofs and pavements) creating;
   a. Changes in catchment hydrology with increased runoff volume and velocity (flow intensity),
   b. Increased diffuse source water pollutant discharge in stormwater.
3. Increased volumes of wastewater (sewage) with a corresponding increase in nitrogen and phosphorus loads delivered to wastewater treatment plants and potential pollutant discharge (point source) loads.

Figure 4-2: Rockhampton Urban Catchments

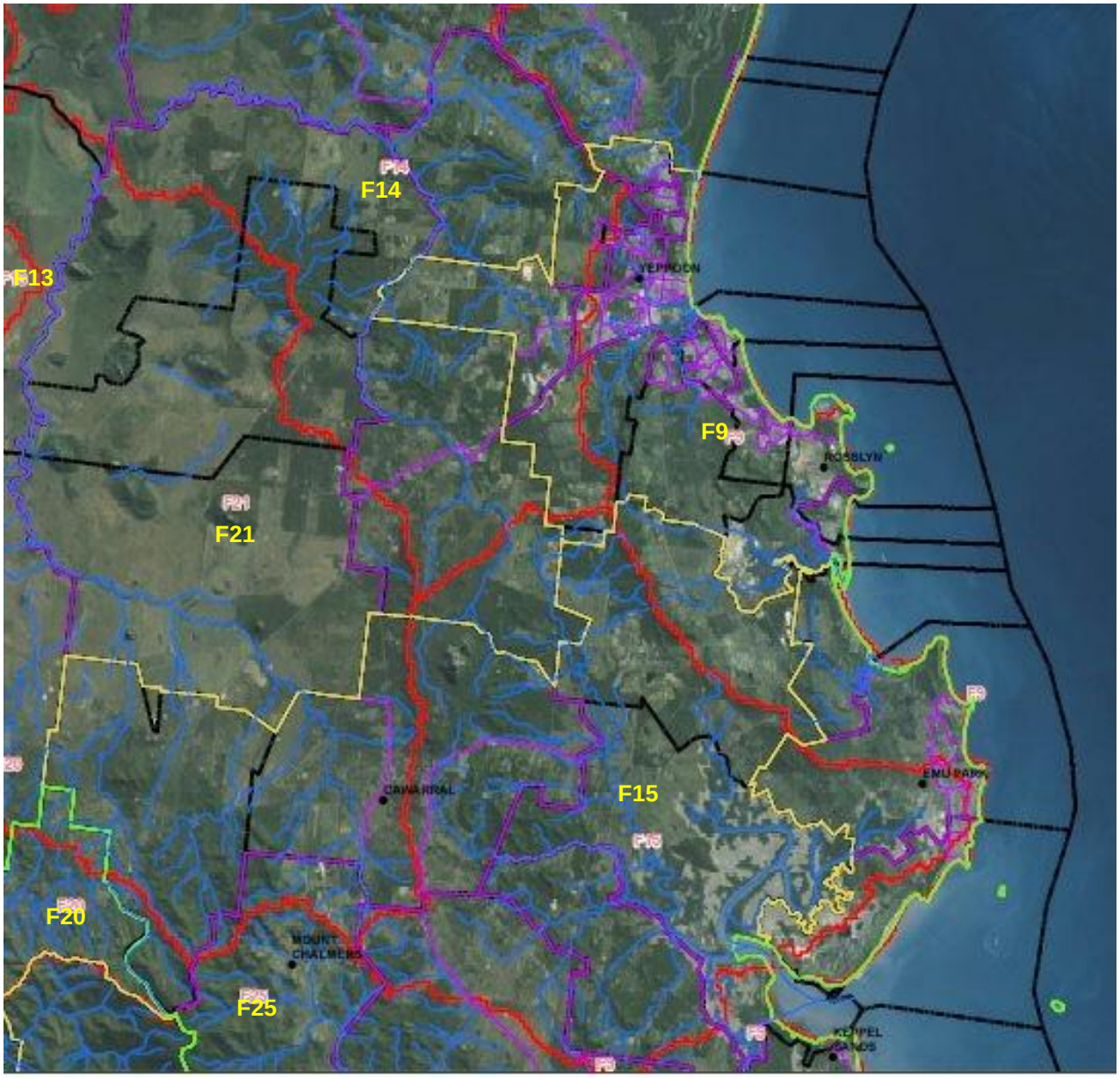


Note: FBA sub catchment boundaries are shown in red and labelled F No. Purple, green and yellow lines indicate ABS statistical area boundaries.

4.3. Urban Land Use by Catchment

Across Australia and particularly in the urban setting statistical areas and units are used to estimate population growth and housing demand by location, which can then be used to calculate the quantum of urban land use expansion. More detailed information about statistical areas, population projections and housing demand estimates (including broadhectare studies) are included in the *Fitzroy Urban Background Report* (Gunn 2015).

Figure 4-3: Livingstone Urban Catchments



Note: FBA sub catchment boundaries are shown in red and labelled F No. Purple, green and yellow lines indicate ABS statistical area boundaries.

Population estimates from statistical areas and localities need to be combined with locally relevant factors including; land use constraints, recent development patterns, local development policy and local planning instrument requirements to provide a realistic indication of urban expansion trends.

Urban expansion areas then need to be related to water catchments to provide the baseline information to enable water quality issues and scenarios associated with population growth and urban expansion to be mapped with reference to receiving waters. The baseline information, with relevant timeframes, is used as input data for catchment models to quantify urban land use pressures on water quality and assist with decision making when designing urban water quality improvement interventions.

This quantification of impacts is relevant to both point source and diffuse source discharges and to the development and construction phase as well as the 'operational' stage (post construction) of new urban areas.

Statistical areas (level 2) containing urban and industrial land use by FBA WQIP sub catchment are included in Table 4-1, Table 4-2 and Table 4-3 for Gladstone Regional, Rockhampton Regional and Livingstone Shire Councils respectively.

Table 4-1 Gladstone Statistical Area (SA2) by Sub Catchment

	Gladstone level 2 statistical area (SA2) – urban (hectares)								
Sub Catchment	**BI/TS**	**Cal.**	**C/NA**	**Gla.**	**KK/SV**	**ST**	**T/T**	**WG**	**Total**
Calliope River B6 (SCA 77km^2)		189							189
	Includes the urban 'spine' on the main road between Gladstone and Calliope								
Calliope River B7 (SCA 91km^2)		1,879	2,121	326	269		1,539	673	6,807
	Includes the Auckland Creek catchment and most of the Gladstone urban area								
Calliope River B1 (349km^2)		1,085		5					1,090
	Includes Yarwun and adjoins the Western Basin industrial development								
Calliope River B4 (SCA 123km^2)			1						1
	Mostly rural land use with a small portion of the Aldoga industrial site								
Boyne River B13 (SCA 235km^2)	7,363			671		1,562	797		10,441
	Encompasses Boyne Island, Tannum Sands, Barney Point and east Gladstone								
Calliope River B3 (SCA 420km^2)									0
	Contains the majority of the Aldoga refinery tailings dam/s								
Calliope River B11 (SCA 61km^2)									0
	Includes the main area of Calliope. Drainage runs west to the Calliope River								
Curtis Island B2 (SCA 568km^2)									0
	Mostly industrial including infrastructure associated with natural gas production								
Boyne River B12 (SCA 229km^2)									0
	Awoonga Dam catchment upstream and south of B13								

Notes: Sub catchment is FBA WQIP sub catchment. SCA is the sub catchment area in km^2 Total area is 875km^2). Level 2 statistical areas are: BI/TS is Boyne Island / Tannum Sands (SA2 308021196), Cal. is Callemondah (SA2 308021197), C/NA is Clinton / New Auckland (SA2 308021198), Gla. is Gladstone (SA2 308021199), KK/SV is Kin Kora / Sun Valley (SA2 308021201), ST is South Trees (SA2 308021202), T/T is Telina / Toolooa (SA2 308021203) and WG is West Gladstone (SA2 308021204). Total SA2 area is 21% of the total sub catchment area.

Table 4-2: Rockhampton Statistical Area (SA2) by Sub Catchment

Sub Catchment	Total	Ber.	F/MA	LC	NG	PA	P/K	RW	RC	TR/A	SCA[1]
Fitzroy R. F20	6,947	182	21		2,871	485	2,843	322	203	20	324
Fitzroy R. F21	262				262						257
Fitzroy R. F23	23							23			826
Fitzroy R. F24	7,060							3,114	3,417	529	292
Fitzroy R. F25	7,491	820	2,996	1,681	482	11			1,500		510
Total hectares	**21,783**	1,020	3,017	1,681	3,615	496	2,843	3,459	5,120	549	

Notes: [1] is sub catchment area in km^2. Total sub catchments area is 2,209 km^2. Other figures are hectares. Ber. is Berserker (SA2 308031205), F/MA is Frenchville - Mount Archer (SA2 308031208), LC is Lakes Creek (SA2 308031211), NG is Norman Gardens (SA2 308031213), PA is Park Avenue (SA2 308031214), P/K is Parkhurst – Kawana (SA2 308031215), RW is Rockhampton – West (SA2 308031216), RC is Rockhampton City (SA2 308031217) and TR/A is The Range – Allenstown (SA2 308031222). Total SA2 area is 9.9% of the total sub catchment area (Does not include Gracemere SA2 area of 15,415 ha i.e. 11,078ha in F23 and 4,336ha in F24. With Gracemere the SA2 area is ~17% of the total sub catchment area).

Table 4-3: Livingstone Shire Statistical Area (SA2) by Sub Catchment

Sub Catchment	F9	F13	F14	F15	F19	F20	F21	Totals
SC area[1]	1,608	1,392	208	152	444	324	257	
Emu Park	2,332			1,717				4,049
Yeppoon	5,237		2,432	133				7,802
Cap. Coast urban	7,569		2,432	1,850				11,851
Glenlee - Rockyview		2,613			639	17,155	395	20,803
Livingstone total	7,569	2,613	2,432	1,850	639	17,155	395	32,654

Note: Sub catchments are Fitzroy River and denoted by F number. [1] SC area is sub catchment area in km^2 (total sub catchment area is 4,385km^2). Other figures are hectares for Emu Park (SA2 308031207), Yeppoon (SA2 308031223) and Glenlee – Rockyview (SA2 308031209) level 2 statistical areas and represent urban, peri-urban and some rural areas. Cap. Coast urban is the sum of Emu Park and Yeppoon. Livingstone total is the sum of Emu Park and Yeppoon (Cap. Coast urban) and Glenlee – Rockyview. Total SA2 area is 7.5% of the total sub catchment area.

4.3.1. Catchments and existing urban land use

The characteristics of existing urban areas also need to be defined as relatively homogeneous areas in terms of impervious surface connectedness to stormwater systems e.g. old residential, new residential, high and low density, commercial and industrial. This enables more accurate pollutant runoff coefficients to be assigned for urban land use variants as inputs for modelling purposes. Categorised urban areas then need to be related to water catchments and receiving waters to determine the impact of existing urban areas on receiving waters and assist with decision making with regard to retrofitting water quality improvement measures.

The main water quality impacts associated with urban areas, heightened by population growth and urban expansion, are described briefly below. Water quality issues, pressures and threats are also described in *Urban Land Use in Great Barrier Reef Water Quality Improvement Plans: Background Report and Considered Guidance* (Gunn 2014).

4.4. Urban Land Use Impact

Land use in the GBR catchment is dominated by grazing (75% of the GBR catchment), followed by nature conservation (13%) and forestry (5%). Dry land and irrigated cropping accounts for 3% with sugarcane occupying 1.3% of the GBR catchment area. According to Waters et al (2014) the dominant land use in the Fitzroy Basin is grazing (78%) followed by forest and nature conservation (14%) and cropping (6%), which is 76% of the total GBR cropping area (Waters et al 2014, pp.25-27). The dominant land uses account for 98% of the Fitzroy Basin land area with urban land use included in the remaining 2% i.e. “Other”.

Urban land use has been calculated by Waters et al (2014) to be 0.57% of the GBR catchment area. This is a relatively insignificant land area (2,430km^2) in the context of the GBR catchment (423,134km^2) however the urban contribution of water quality pollutants to local waterways and the near coastal environment is highly significant and disproportionate to the areal extent of urban land use when compared to more extensive land uses i.e. grazing, nature conservation and cropping.

The contribution ratio of water quality pollutants from urban areas in the GBR catchment is illustrated in Table 4-4 as a land use contribution ratio derived by dividing the percentage pollutant load contribution of the land use by the percentage land use of the GBR catchment.

The contribution ratio of urban land use is shown in relation to other land uses in Table 4-5 for the main GBR water quality pollutants.

Table 4-4: Urban Water Quality Pollutants

	TSS*	TP	PP	DIP	DOP	TN	PN	DIN	DON
Modelled annual load	79	237	70	126	40	1,393	368	621	404
Percentage of GBR load	0.9	3.8	1.5	10.9	6.6	3.8	3.1	5.9	2.8
Contribution ratio	1.6	6.6	2.7	19	12	6.7	5.5	10	5.0

Notes: Source is Waters et al (2014). Urban contributions include sewage treatment plants. Quantities (Modelled annual load) are tonnes per year except for TSS* which is kilo tonnes per year. Contribution ratio is the percentage pollutant load contribution divided by the urban land area as a percentage of the total GBR catchment.

Table 4-5: Pollutant Load Ratios by Land Use

Land use	Area (km^2)	% GBR	TSS	TN	DIN	TP
Horticulture	59	0.01	50 (0.5)	170 (1.7)	300 (3)	150 (1.5)
Sugarcane	5,406	1.3	4.1 (5.3)	15 (19.5)	28 (36.6)	1.1 (13.7)
Urban	2,430	0.57	1.6 (0.92)	6.7 (3.8)	10 (5.9)	6.6 (3.8)
Other	1,962	0.46	1.3 (0.6)	1.5 (0.7)	2.2 (1)	2.0 (0.9)
Cropping (all)	12,015	2.84	0.8 (2.2)	0.6 (1.8)	0.7 (1.9)	0.9 (2.6)
Grazing (all)	316,826	74.9	0.6 (44.7)	0.6 (44.5)	0.4 (28)	0.5 (39.3)
Nat. Conserve	~55,000	14.9	0.01 (10.7)	0.02 (22.8)	0.001 (20)	0.001 (14.9)

Notes: Source information is derived from Waters et al (2014) including *Table 32 Contribution to total baseline export by land use for each constituent for whole of GBR* (p.120) and *Table 4 GBR land use grouping and areas* (p.27).Nat. Conserve is Nature conservation. Figures in the pollutant columns (TSS, TN, DIN and TP) are land use contribution ratios i.e. the percentage pollutant load contribution divided by the land use area as a percentage of the GBR catchment. Figures in brackets in pollutants columns are load contribution percentage. TSS is total suspended solids/sediment. TN is total nitrogen. DIN is dissolved inorganic nitrogen. TP is total phosphorus.

Land use contributions previously modelled for the Mackay Whitsunday WQIP (2008) are shown in Table 4-6. With the exception of TSS urban land use has the highest pollutant contribution ratio of all the modelled land uses.

Table 4-6: Mackay Whitsunday Land Use Pollutant Modelling

Land use	%	DIN		PN		FRP		PP		TSS	
		%	CR	%	CR	%	CR	%	CR	%	CR
Conservation	17	1	<0.1	6	0.9	0	-	2	0.1	39	2.3
Grazing	56	12	0.2	34	0.6	5	<0.1	28	0.5	29	0.5
Horticulture	<1	1	~1	1	~1	1	~1	1	~1	<1	~1
Cane	19	77	4.0	53	2.8	84	4.4	62	3.3	98	5.2
Intensive uses	1	4	4.0	3	3.0	5	5.0	4	4.0	<1	<1
Urban	1	4	4.0	3	3.0	5	5.0	4	4.0	<1	<1

Notes: Source is MWNRM 2008, p.12, in Gunn and Barker 2009. Land use % is for the MW WQIP area. PN is particulate nitrogen, FRP is filterable reactive phosphorus and PP is particulate phosphorus. % is of total pollutant contribution. CR is contribution ratio as calculated for Table 4-5.

4.5. Point Source Urban Pressures

4.5.1. Wastewater treatment and discharge

Treated wastewater (sewage) discharge is the main point source water quality pressure associated with population growth and urban areas. Summary information for wastewater treatment plants (WWTPs) in the main Fitzroy urban centres is provided in Table 4-7. Projected increases in pollutants delivered to WWTPs for treatment are provided in Table 4-8. Details and assumptions are included in the *Fitzroy Urban Background Report* (Gunn 2015).

Table 4-7 Wastewater Treatment Plant Summary

WWTP/STP	Built	Type	Capacity	Utilisation	TN	TP	Reuse
Rockhampton RC							
Rockhampton North	1986	Extended Aeration	50,000	46,000[2]			0%
Rockhampton South[1]	1983	Activated Sludge	34,000	19,120[2]			0%
Rockhampton West[1]	1962	Trickling Biofilter	11,000	6,172[2]			0%
Rockhampton total			95,000	71, 292[2]	72t/yr [3]	52t/yr [3]	0%
Gracemere	1984	Extended Aeration	8,100	8,000[2]	na	na	100%
Livingstone SC							
Yeppoon		3 stage Bardenpho	21,000	16,500[4]	13t/yr [5]	3.6t/yr [5]	50%
Emu Park		Extended aeration	5,000	3,300[4]	7t/yr [5]	2.8t/yr [5]	100%
Gladstone RC							
Gladstone			57,400		133t/yr[6]	13t/yr[6]	100%
South Trees			5,000		0.4t/yr[7/6]	0.4t/yr[6]	100%
Tannum Sands			15,000		1.8t/yr[6]	0.4t/yr[6]	100%

Notes: Capacity and utilisation is in equivalent persons (EP). [1] not designed for Nitrogen removal. Rockhampton South will be upgraded and Rockhampton West throughput will be transferred to Rockhampton South prior to Rockhampton West being decommissioned. [2] figures are at 2012. [3] is annual load (tonnes) allowed to be released to the Fitzroy River according to the shared environmental licence for Rockhampton's three STPs based on the long term average (50 percentile). Maximums are 4,140kgTN/week and 3,000kgTP/week. [4] figures are circa 2009/10. [5] annual loads (tonnes) are theoretical and calculated from the maximum effluent standard multiplied by average day flow. [6] loads are tonnes per year and are based on typical nutrient concentrations and (approximate) discharge volumes supplied by GRC. [7] is ammonia-N not TN. Average (2010 to 2013) combined Rockhampton STP discharge was TN 68,445kg/year and TP 26,312kg/year.

Table 4-8: Population and Pollutant Increase

	Rockhampton (combined)				Yeppoon[1]			
Year	**Population**	**Amm.-N**	**TN**	**TP**	**Population**	**Amm.-N**	**TN**	**TP**
2011	75,200 EP	247	357	63	16,815	55	80	14
2016	79,746 EP	262	378	67	20,201	66	96	17
2027	90,553 EP	297	430	76	27,714	91	132	23
2042	107,880 EP	354	512	91	42,000	138	199	35
2050	116,313 EP	382	552	98	46,736	154	222	39

Note: Amm.-N is ammonia as a component of total nitrogen (TN). Loads are tonnes per year based on assumptions in SKM 2013 (see Gunn 2015). [1] 50% of the 2011 pollutant load is reused and needs to be subtracted from projections.

4.5.2. Raw water and potable (drinking) water

Another urban related population growth issue is the availability and provision of raw water to treat for household and commercial use. As with wastewater treatment the provision of potable water is a responsibility of local government and/or a water authority created under the Water Act (see section 2.5.2). Water treatment is an Environmentally Relevant Activity (ERA) and is subject to environmental regulation as well as strict health standards. Some of the potable water, as supplied to residential and commercial premises, becomes part of the waste stream delivered to wastewater treatment plants. Raw water provision, potable water supply and wastewater treatment are therefore connected parts of the urban water cycle.

While the provision of raw water is normally not a direct or ongoing pressure on water quality the water storage infrastructure is usually situated in-stream and can impact river function and ecosystem health. More information about urban raw water supply is included in the *Fitzroy Urban Background Report* (Gunn 2015).

4.6. Diffuse Source Urban Pressures

Urban expansion generally has a negative impact on local water quality, ecosystem health and in-stream function as well as contributing to downstream (end of catchment) pollutant loads.

Short-term water quality pressures are primarily associated with soil erosion and sediment movement from development sites to receiving waters. Post-development to long-term diffuse source urban water quality pressures are primarily associated with the increase in impervious surface area and the effects of changes to catchment hydrology (see Figure 4-5).

4.7. Development and Construction

The land development and construction phase is generally responsible for generating the initial water quality pressure associated with urban expansion. This is particularly relevant to residential land development as large areas (in the urban context) are often cleared of vegetation and disturbed thereby exposing soils and substantially increasing the risk of erosion (See Figure 4-5). The increased possibility of soil erosion during the land development and construction phase increases the likelihood of sediment and associated nutrients being transported to receiving waters either at the same time as the erosion event or during subsequent more intense rainfall events.

Figure 4-7: Urban Development North Rockhampton 2015

Event water quality monitoring undertaken for the Black Ross (Townsville) WQIP (see Gunn and Manning 2010) showed that developing urban areas had the highest sediment generation rate (see Figure 4-4) and the highest concentration of sediment in stormwater runoff when compared to all other land uses.

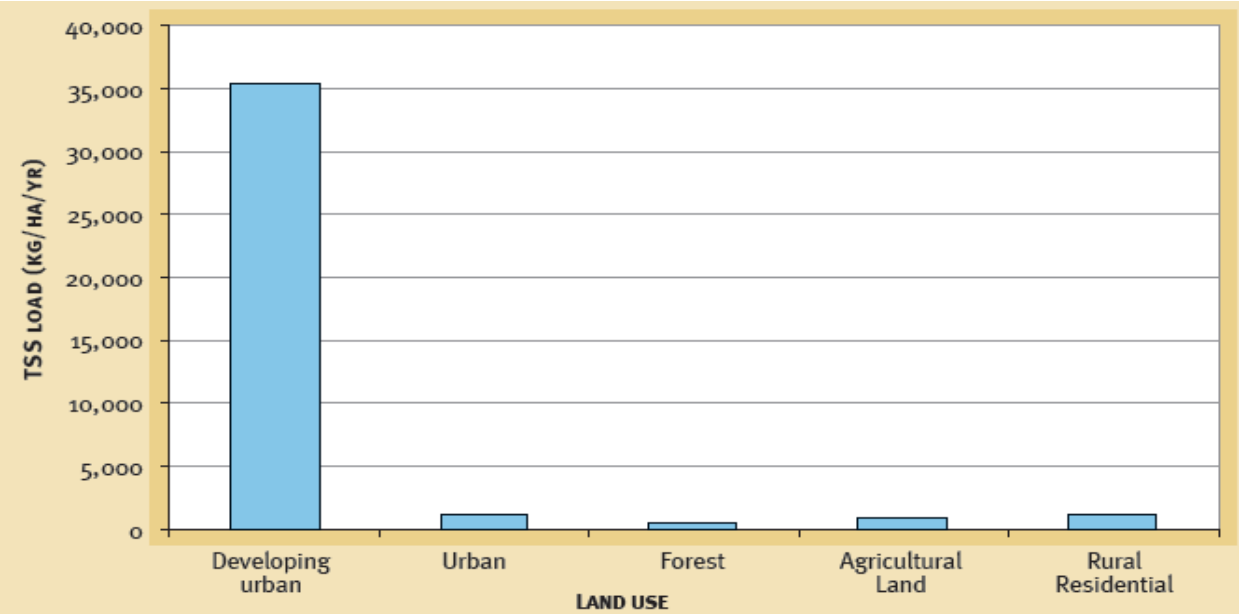
Defining urban expansion areas associated with population growth will provide a starting point for estimating the potential risk from sediment laden run-off during the land development and construction phase. An added modelling complexity for the land development and construction phase is that it is often staged over a number of years, especially for larger developments. This will require a number of assumptions to be made about the amount of soil exposed over time and the associated water quality and ecosystem health risk factors from developing urban areas.

Present catchment modelling focuses on broad land use type and assigns run-off pollutant coefficients for a variety of land uses. This does not take the urban land development and construction phase into account as it is a 'short term' anomaly and not readily quantifiable. This phase however has the potential to cause significant local water quality and ecosystem health impacts. A suitable mechanism is required to incorporate this urban land use phase into water quality risk calculations relative to sub catchments and receiving waters.

Whether impacts and risk are quantified or not site based stormwater management incorporating erosion prevention and sediment movement control is necessary during the land development and

construction phase to reduce the risks to water quality from all forms of development associated with urban growth e.g. residential, commercial, industrial and infrastructure.

Figure 4-4: TSS Generation Rate by Land Use



Source: Townsville WQIP, Figure 3.5 Relative Annual Areal Sediment Generation Rate by Land Use, p.33.

4.8. Existing Urban Areas (Post-development)

Water quality pressures associated with existing urban areas (post-development operational phase) are generated by anthropogenic structures and actions which may be exacerbated by historic socio-economic policy and patterns of development and an historic preference for hard engineered surfaces in stormwater systems for flood mitigation.

4.8.1. Impervious surfaces

Urban land use has larger impervious surface areas than other land uses, which results in:

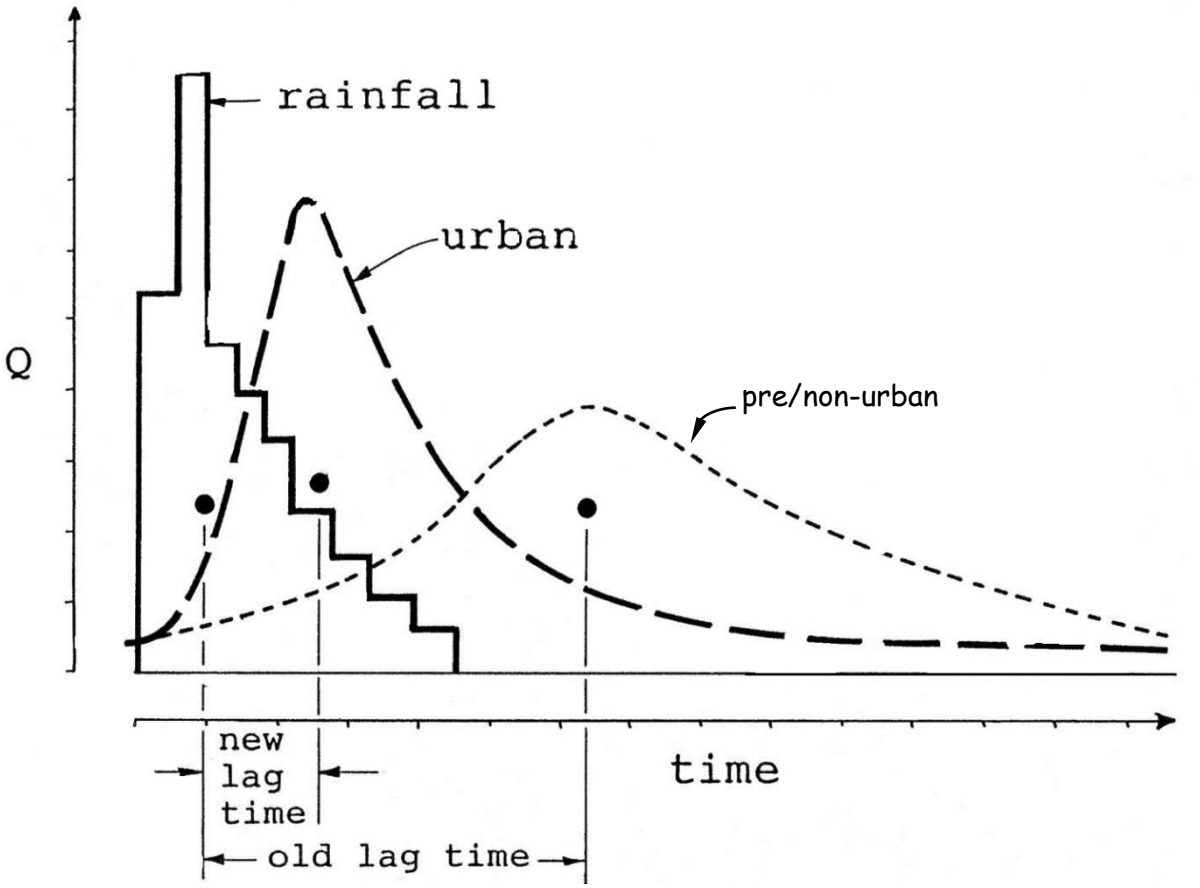
- Increased run-off rates;
- Lower water infiltration and pollutant interception rates;
- Increased flow velocity with increased erosion impacts on waterways;
- Faster and higher flood peaks;
- Higher delivery rate of pollutants to receiving waters.

Differences in the permeability of urban and rural/non-urban land surfaces leads to changes in urban catchment hydrology as illustrated graphically in Figure 4-5. As can be seen in Figure 4-5 urban streams have 'spikey' hydrographs compared to the more 'gentle' hydrograph of rural (pre/non-urban) streams as a result of the reduced lag time between rainfall events and peak stream flow. The greater impervious surface area causes urban stream flow to go up quickly during a rain storm event and then down relatively quickly when the rain stops. Non-urban stream flow goes up more slowly and falls over a longer period after the rain event is over. The reduced lag time in urban areas

results in more intense and potentially highly erosive peak flows in local waterways, which can have significant impacts on stream geomorphology and waterway health.

As well as the changes to catchment hydrology when impervious surfaces are connected directly to 'hard' stormwater systems (pipes and concrete drains) (see Figure 4-6) there is potential for virtually all the pollutants from urban areas to be transported directly to receiving waters.

Figure 4-5: Urban and Non-urban Hydrograph



Notes: Q is quantity. Lag time is the interval between the mean rainfall event and mean run-off response i.e. flow peak. Source graphic is from http://web.mst.edu.

4.8.2. Pollutant types, sources and pathways

Water quality pollutants emanating from urban areas include; nutrients (principally nitrogen and phosphorus), sediments, oxygen demanding materials (biodegradable organic material), metals, toxic organic wastes (garden and household chemicals), pathogenic micro-organisms (bacteria, viruses etc.), hydrocarbons and litter. Nutrient concentrations in urban stormwater are generally less than those from areas of intensive agriculture and significantly greater than from forested catchments (P is two to ten times greater) and undeveloped catchments (N is two to five times greater) (Chiew et al (1997) in Gunn 2014).

Duncan (1995) identified the main process of stormwater contamination being from the accumulation of pollutant material on impervious surfaces during dry weather (dry deposition and buildup) including:

- Settling of fine particles from the atmosphere (distributed sources);
- Accumulation of fine particles and gross pollutants from local sources; and
- Redistribution of surface pollutants by wind and traffic.

Figure 4-6: Hard Stormwater System Elements

Some of the more significant local sources of pollutants are associated with motor vehicles and roadways. Local and distributed sources of urban pollutants are listed in Table 4-9.

Table 4-9: Urban Stormwater Pollutants

Local Sources
Leaf litter, grass clippings and other vegetation (typically 80-90% of gross pollutants)
Litter – plastic, glass and metal containers, plastic, foam etc. (gross pollutants)
Dog and other domesticated animal faeces
Sewer overflows
Sewer outlets illegally connected to stormwater systems
Septic tank leakage (principally peri-urban areas)
Pesticides, herbicides and fertilisers
Leakage and spillage of materials from; vehicles, storage tanks and bins
Seepage from land fill waste disposal sites
Waste water from cleaning operations
Corrosion of roofing and other metallic materials
Industrial emissions
Vehicle emissions
Vehicle component wear e.g. tyres and brakes
Wear of road surfaces
Erosion from construction activity, vegetation removal and disturbed and bare areas

Distributed Sources
Ash and smoke from bush fires
Sea spray
Swamp gases
Windblown pollen, insects and micro-organisms
Dust from agricultural activities and roads
Dust, ashes and emissions from industry
Agricultural pesticides, herbicides and chemicals

Note: Derived from Gunn and Barker (2009).

The next part of the process involves rainfall which depending on intensity and period of falls can result in:

1. Wet deposition and wash down with no or minimal run-off entering stormwater systems (light falls);
2. Wet deposition and wash down with run-off to stormwater systems reaching receiving waters i.e. first flush (moderate falls, small storms and showers);
3. Wet deposition and wash down with large volumes of run-off to stormwater systems and receiving waters (heavy and/or extended falls, large storms and cyclonic lows).

The first event type has little impact on water quality as pollutants are transported short distances within the catchment and do not reach receiving waters. The second event type has implications for local waters as a significant proportion of accumulated pollutants are flushed from impervious surfaces (including road systems) and transported via stormwater systems to local receiving waters. This 'first flush' event has relatively high pollutant concentrations and can result in localised impacts including eutrophication, fish kills and build-up of pollutants in sediments.

The third event type collects and transports most of the accumulated pollutants and wet deposition pollutants to local receiving waters before flushing them through local waterways and estuaries to the marine environment. These larger events deliver the bulk of stored pollutants to receiving waters and contribute disproportionally to end of catchment loads (see section 4.4). For additional information on the quantum of sediment and nutrients delivered to receiving waters from urban and other land uses see section 2.15 in *Urban Land Use in Great Barrier Reef Water Quality Improvement Plans* (Gunn 2014) and Gunn and Barker (2009).

4.8.3. Atmospheric deposition

In addition to the flushing of accumulated dry deposition pollutants from urban catchments rainfall also contains nutrients and particles. Known as wet atmospheric deposition, rainfall is more significant and impactful in urban areas than most other land uses due to the higher percentage of impervious surfaces. The majority of the pollutants in rainfall falling on impervious surfaces and entering 'hard' stormwater systems are transported to receiving waters. The story is different where there are 'soft' components in stormwater systems e.g. grassed swales, bioretention pods and wetlands (see section 6.3.3), where nutrients can be filtered out as happens in natural systems.

"*Atmospheric deposition is one of the most important pollutant pathways for urban stormwater pollution. Atmospheric deposition can be in the form of dry and wet depositions which have distinct characteristics in terms of pollutant types, pollutant sources and influential parameters*." (Gunawardena et al 2011).

The combination of dry deposition and pollutant build up in urban areas and subsequent rainfall events with wet deposition of pollutants on impervious surfaces results in higher concentrations of nutrients in stormwater being transported to receiving waters than for undeveloped areas and other land uses with much lower percentages of impervious surfaces (see section 4.4). Results from studies of atmospheric deposition are included in Gunn and Barker (2009) with additional material included in the *Fitzroy Urban Background Report* (Gunn 2015, pp.52-55).

"*Atmospheric deposition is among the least understood pathways of nutrient transport. Wet deposition occurs through rain and snowfall, while dry atmospheric deposition arises from gaseous and particulate transport from the air to the surfaces of aquatic and terrestrial landscapes*."

Atmospheric emissions are another part of the equation and "*wind, burning, planting and tillage can cause nitrogen (N) and phosphorus (P) bearing particles to become airborne. Nitrate/nitrite (NOx) and ammonia (NHx) can also enter the atmosphere as gases*." (Anderson and Downing 2006, p.351).

The main anthropogenic source of oxides of nitrogen (NOx) are produced by combustion of fossil fuels and these enter the atmosphere as vehicle and industrial emissions while agricultural fertilisers are the principle anthropogenic source of NHx emissions.

The increase in anthropogenic emissions translates to an increase in atmospheric depositions with the quantum of deposition being dependent on the type of emission and associated chemical and physical behavioural characteristics. For urban land use the percentage of impervious surfaces and their connectedness to stormwater systems along with the proximity to emission sources and deposition rates is relative to the amount of pollutants entering receiving waters.

Anthropogenic emissions added to background rates of atmospheric deposition provide a starting point for interpreting potential pollutant loads in urban stormwater run-off from impervious surfaces. Indicative atmospheric deposition rates for urban areas are included Table 4-10.

Table 4-10: Atmospheric Deposition Rates

Pollutant	Background	Anthropogenic	Total	Implication
Particulates	7kg/ha/year	8kg/ha/year	15kg/ha/year	A source of P and metals
Nitrogen	2kg/ha/year	4kg/ha/year	6kg/ha/year	Significant source of urban N
Phosphorus	0.1kg/ha/year	0.2kg/ha/year	0.3kg/ha/year	Importance may be underestimated

Note: Multiply the total atmospheric deposition rate by the urban impervious surface area directly connected to stormwater systems to estimate pollutant loads to receiving waters. e.g. 10,000 hectares urban x 40% connected impervious surface is 24,000 kg N / year. This does not include pollutants from the other 60% of urban areas.

Atmospheric deposition is closely related to climate due mainly to the influences of wind and rain determining to a large degree the amount of dry deposition and was the subsequent wash off rates.

4.9. Climatic Pressures

Climate pressures are linked to the variability of the tropical weather patterns experienced in the Fitzroy region and the potential for the amplification of these patterns as a consequence of climate change. This includes the threat from severe tropical cyclones as experienced by the region in 2014 when Cyclone Marcia crossed the coast to the north of Yeppoon causing significant damage.

4.9.1. Tropical weather patterns

Apart from hot summers and mild winters tropical weather patterns are typified by a distinct wet season and dry months from July to September. Mean monthly rainfall figures for Gladstone, Rockhampton and Yeppoon are shown in Table 4-11.

Table 4-11: Mean Monthly Rainfall

Urban centre	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Gladstone	143	143	83	46	61	39	35	32	27	62	74	129	**880**
Rockhampton	132	143	101	44	48	39	30	29	24	50	69	108	**815**
Yeppoon	133	174	137	74	79	56	30	36	37	46	71	123	**982**

Note: Rainfall is millimetres.

The climate of the Fitzroy region near coastal urban areas is somewhat similar in terms of average annual rainfall (815mm to 982mm) and average temperature range (28°C to 17°C). Climate variations are associated with local geography and topographic features. Rockhampton is approximately 40 kilometres from the coast while Gladstone and Yeppoon are located on the coast. Rockhampton tends to be hotter and drier and less prone to cyclone damage however its location on the banks of the Fitzroy River means it is subject to greater impacts from flooding.

While average annual totals vary precipitation patterns are similar for all three centres (see Table 4-11) with 65% to 68% of the average precipitation falling during the wet season (November to March) and 44% to 47% of the annual rainfall usually occurring between December and February. This highly seasonal rainfall pattern has significant erosion implications for urban development and also for the design and maintenance of vegetated stormwater quality management measures.

4.9.2. Climate change

Climate change projections for the Fitzroy region's urban centres have not been prepared. The most recent regional science is the East Coast Cluster Report (Dowdy, A. et al 2015) part of the Climate Change in Australia Technical Report (CSIRO and BoM 2015) (see Gunn 2015 for more detail). Key projection findings for the East Coast Cluster (ECC) terrestrial areas include:

- Substantial warming for mean, maximum and minimum temperatures (*very high confidence*);
- Substantial increase in the temperature reached on the hottest days, the frequency of hot days and the duration of warm spells (*very high confidence*);
- Sea level will continue to rise during the 21st century (*very high confidence*);
- Natural climate variability will remain the major driver of rainfall changes in the next few decades (*high confidence*) (20-year mean changes of -15 to +10% annually);
- The intensity of heavy rainfall events will increase (*high confidence*);
- Evapotranspiration increases in all seasons by 2090 (*high confidence*);
- Harsher fire-weather climate in the future (*high confidence*);

- Greater time spent in meteorological drought by 2090 (*medium confidence*);
- Less frequent tropical cyclones with proportion of most intense storms increasing (*medium confidence*);
- Soil moisture overall seasonal decreases for 2090 (*medium confidence*).

The ECC experienced prolonged periods of extensive drying in the early 20th century however there was no long-term annual rainfall trend evident throughout the 20th century. This provides a level of uncertainty associated with climate change projections with implications for soil moisture, run-off, flood and drought. Investigations will need to take multiple scenarios into consideration when estimating the risk to urban water quality associated with climate change and amplified tropical weather patterns.

5. Water Quality

5.1. Local Authority Water Quality Monitoring

In general local government undertakes water quality monitoring as a function of two of its primary responsibilities i.e. potable water production and distribution, and wastewater treatment and disposal. Details of local government statutory water quality monitoring is discussed in more detail in the *Fitzroy Urban Background Report* (Gunn 2015).

Apart from the monitoring associated with statutory requirements Rockhampton Regional Council, Livingstone Shire Council and Gladstone Regional Council do not conduct any additional water quality, environmental or ecosystem health monitoring programs for the waterways and wetlands in their local government areas.

Community groups such as Creekwatch may collect and record water quality data for some urban areas and development permit conditions may also contain water quality monitoring requirements.

5.2. State of the Waters

Determining the state of urban water quality and its contribution to end of catchment pollutant loads requires access to water quality monitoring data that measures pollutant concentrations in urban diffuse stormwater run-off as well as a reasonable estimate of the volume of run-off discharged to local waterways. This data either does not exist or is not readily available at this time.

Point source discharges to receiving waters also need to be factored into calculations to give the total urban contribution of pollutants to local waters and ultimately to the Great Barrier Reef lagoon.

In the absence of urban specific water quality monitoring it is difficult to determine the real influence urban land use has on the state of the waters and we therefore rely on assumptive catchment modelling (see section 4.4) to provide us with some indication. The modelling however does not take the impacts of the development and construction phase into account (see section 4.7) and may also underestimate the diffuse source contribution from existing urban areas (see section 4.8) depending on assumptions about impervious surfaces and atmospheric deposition rates.

This significant information gap needs to be addressed to better understand past and current urban water quality impacts and to predict future impacts associated with population growth, coastal development and the continually expanding urban footprint. What is known about water quality impacts in Rockhampton and Gladstone from a cursory review of available information relevant to those urban areas is discussed briefly below.

5.3. Point Source Influence

The influence of point sources on water quality can be profound in the urban setting as a result of the discharge of treated wastewater to receiving waters. As mentioned previously (see section 2.5) wastewater treatment is an environmentally relevant activity and subject to strict licence conditions.

The influence of point source discharge on receiving waters and the larger end of catchment loads can be relatively easily calculated using current and historic water quality monitoring information and catchment modelling. Point source influence, as with diffuse source inputs, is relative to the size of the catchment and is most impactful closer to the the discharge point. A preliminary estimate of future nutrient (nitrogen and phosphorus) discharge from wastewater (sewage) treatment plants (STP) to receiving waters is included in section 4.5.1.

5.3.1. Rockhampton

The most recent report that considers the influence of Rockhampton's STPs on receiving waters i.e. the Fitzroy River below the Rockhampton barrage, was prepared as part of Rockhampton Regional Council's review of its STP infrastructure and operations. "*Published data on water quality in the estuary indicates that ammonia, nitrogen and phosphorus concentrations exceed the Queensland water quality objectives in various locations and at various times*." (SKM 2013, p.3). As could be expected the upper reaches of the estuary in the vicinity of the STP discharge points have the highest nutrient concentrations and water quality objective exceedances.

A report by the Department of Environment and Resource Management (DERM 2012) concluded that the STP discharges resulted in significant nutrient enrichment of the estuary especially in the less turbid reaches. The report also found that there were no statistically significant trends for any of the water quality indicators in the Fitzroy River for the period from 1993 to 2006. "*This seems to indicate that changes in water quality due to changes in catchment land use, if they are occurring at all, occur over very long periods (perhaps 20 years or more)*" (DERM 2012, p.80).

Another interpretation of the data would be that the damage has already been done at the broad catchment scale and things aren't getting any worse, or better, at that scale. At the local (sub catchment) scale however the influence of STP discharge is noticeable and is likely to have a greater influence over time as Rockhampton's population increases (see section 4.2).

It is obvious that the combined discharge from the Rockhampton STPs influences water quality results particularly during drier periods however the influence during times of high flow and during floods is a smaller percentage of the overall pollutant load from the large Fitzroy catchment.

The influence of Rockhampton's STPs on the Fitzroy River end of catchment load should be of particular interest for the Fitzroy region WQIP as it is one of the main areas of potential urban water quality improvement at the sub catchment scale, and potentially at the broader scale.

Table 5-1 shows total estimated nutrient loads in wastewater delivered to the three Rockhampton STPs (2011 population) as a percentage of the estimated Fitzroy River catchment nutrient loads

along with adjusted end of catchment loads showing anthropogenic contributions only. Anthropogenic contribution to catchment nutrient loads have been adjusted as per Dougall et al (2014) by subtracting estimated pre-development (background) loads from the total end of catchment loads.

Table 5-1: Fitzroy River Catchment and Rockhampton Point Source Nutrient Load Comparison

	Modelled				Monitored			
Reference	**Br 2003[1]**	**Urban**	**Do 2014[2]**	**Urban**	**Tu 2012[3]**	**Urban**	**Wa 2014[4]**	**Urban**
Total N (t/y)	8,071	4.4%	4,244	8.4%	12,989	2.7%	6,400	5.6%
Total P (t/y)	2,140	2.9%	1,093	5.8%	5,321	1.2%	2,700	2.3%
Anthropogenic load only								
Total N (t/y)	4,840	7.4%	1,013	35.2%	9,758	3.7%	3,169	11.3%
Total P (t/y)	1,659	3.8%	612	10.3%	4,840	1.3%	2,219	2.8%

Notes: Urban is based on estimated annual delivery of 357 tonne of nitrogen (N) and 63 tonne of phosphorus (P) to Rockhampton's STPs (see Table 4-8) as a percentage of end of catchment nutrient loads as measured and/or modelled in the reference studies. Reference studies are; [1] Brodie et al 2003, [2] Dougall et al 2014, [3] Turner et al 2012 (Reef 2009/10 monitoring period) and [4] Wallace et al 2014 (Reef 2011/12 monitoring period). Estimated Fitzroy River region pre-development (background/natural) loads from Dougall et al 2014 are 3,231 tonne N per annum and 481 tonne P per annum. These numbers have been subtracted from the reference study total end of catchment load figures to derive anthropogenic loads. Dougall et al estimate total urban land use area for the Fitzroy as 465km^2.

Approximately 290 tonnes of N and 35 tonnes of P are removed from Rockhampton's wastewater prior to the release of the treated effluent to the Fitzroy River. Based on these figures from the SKM (2013) report Rockhampton's STPs are removing approximately 80% of the nitrogen and 52% of the phosphorus from the wastewater prior to its release. Rockhampton STP discharge loads are shown in Table 5-2 as a percentage of the total anthropogenic load for the larger Fitzroy River catchment.

Table 5-2: Fitzroy River Catchment Anthropogenic Nutrient Load

	Modelled				Monitored			
Reference	**Br 2003[1]**	**Urban**	**Do[2] 2014**	**Urban**	**Tu 2012[3]**	**Urban**	**Wa 2014[4]**	**Urban**
Total N (t/y)	4,840	1.4%	1,013	6.9%	9,758	0.7%	3,169	2.2%
Total P (t/y)	1,659	1.8%	612	4.9%	4,840	0.6%	2,219	1.4%

Notes: Rockhampton STPs average discharge to the Fitzroy River between 2010 and 2013 i.e. 70 tonne N and 30 tonne P per annum, as a percentage of the estimated anthropogenic loads for the Fitzroy River catchment.

It should be noted that the calculations in the tables above are preliminary figures interpreted from a number of reports e.g. Dougall et al 2014 and SKM 2013, and have not been verified using primary data. It should also be noted that the point source contributions have been compared to the larger Fitzroy River catchment and any comparison at a sub catchment level would significantly increase the percentage contribution from urban point sources in relation to land area.

If Rockhampton's point source nutrient loads are expressed as a yield i.e. kilogram/area, the influence of this pollutant source is more pronounced. The urban catchment area for Rockhampton's STPs is approximately 20,000 hectares (200km^2). The nutrient yield equates to approximately 1,800 kg N/km^2 and 320 kg P/km^2 delivered to STPs and 350 kg N/km^2 and 150 kg P/km^2 discharged to receiving waters.

In comparison the average yield for the total Fitzroy River catchment was 93 kg N/km^2 and 31 kg P/km^2 for the 2009/10 monitoring period and 46 kg N/km^2 and 22 kg P/km^2 for the 2011/12 monitoring period. As can be seen in these figures catchment yields are highly dependent on rainfall

and run-off while point source loads are fairly consistent and increase incrementally as a function of population increase or are reduced as a function of wastewater treatment plant upgrades.

5.3.2. Livingstone Shire

The majority of the treated wastewater from Livingstone Shire's two Capricorn Coast STPs is reused for irrigation purposes. Access to discharge and water quality monitoring data is required to determine the impact of the 50% of the treated wastewater discharged from the Yeppoon STP to receiving waters i.e. Corduroy Creek (Water Park sub catchment). This would require an agreement with Livingstone Shire Council to access the data.

5.3.3. Gladstone

Point source water quality monitoring data is not relevant at this point in time as there is no direct discharge of pollutants from Gladstone's STPs to receiving waters. The majority of Gladstone's treated wastewater is reused locally by industry.

5.4. Diffuse Source Influence

While the influence of point sources on water quality can be relatively easily measured given access to the water quality monitoring data the influence of urban diffuse sources on local waterways and end of catchment loads has not been seriously investigated to date. This may be due to the relatively small area occupied by urban land use (0.57%) in the context of the GBR catchment and/or the lack of a concerted effort to engage with local government to address urban water quality issues.

As previously discussed (see section 4.4) the modelled contribution of urban land use to end of catchment pollutant loads (point source and diffuse source combined) is disproportionately high per hectare when compared to grazing and most other land uses. With a land area of less than 1% of the GBR catchment urban land use contributed 3.8% of TP, 10.9% of DIP, 6.6% of DOP, 3.8% of TN and 5.9% of DIN loads.

Sugar cane farming is the only significant land use (1.3% of the GBR catchment) that has a greater pollutant contribution ratio per hectare for nitrogen and sediment than urban land use. Horticulture had the highest pollutant contribution ratio of all land uses however the land area for horticulture was ~0.01% of the GBR catchment and the overall percentage contribution to end of catchment loads was less than for both sugar cane and urban areas.

A review of available literature has not uncovered any reliable information that could quantify the influence of urban diffuse source pollutants on the waters of the Fitzroy region. Unravelling point source and diffuse source urban water quality influences requires additional water quality monitoring information and/or a comprehensive review and analysis of existing water quality data possibly combined with modelling of known factors associated with Fitzroy region urban land use impervious surfaces.

5.4.1. Rockhampton

The Fitzroy Partnership for River Health (FPRH) has issued four report cards to date for (2010-2014) with the first report released in May 2013 (2010-11). These report cards however do not provide an indication of water quality influenced by urban areas. The urban relevant component of the report card is for treated drinking water quality. This however is relevant to the efficiency of water treatment plants rather than the impacts of urban land use on catchment water quality.

As with the FPRH report cards water quality monitoring undertaken by the Queensland government is relevant to the Fitzroy River only and does not consider urban areas as a separate land use.

5.4.2. Livingstone Shire

No specific studies were discovered for the Capricorn Coast catchments and waters as part of the scoping study.

5.4.3. Gladstone

Of the three LGAs Gladstone has the most potential for at least a partial interpretation of urban influences on water quality as a result of the recent focus on water quality issues associated with Gladstone Harbour.

Of particular interest is the Port Curtis Integrated Monitoring Program (PCIMP) established in 2011 to monitor the long term ecosystem health of Port Curtis. The PCIMP produces the EcoCard to report on the health of the harbour with a monitoring focus on the two main themes of; water quality, and intertidal zone ecosystem health.

The first EcoCard was released in 2008 for the monitoring period of 2005 to 2007. The second EcoCard (July 2008 to November 2010) focused on eight consolidated key zones in the Port Curtis region (see Vision Environment 2011) being:

1	The Narrows	**3**	Calliope Wiggins	**5**	Mid Harbour	**7**	Boyne Tannum
2	Fisherman's Landing	**4**	Auckland Creek	**6**	South Trees	**8**	Reference

The most relevant zone for potential reporting on urban impacts on water quality entering Port Curtis is Auckland Creek (zone 4). Other zones may also provide some insights into urban land use influences however the differentiation would need to be made between residential, commercial, industrial and rural areas to be meaningful.

A modelling exercise was undertaken as reported in *Gladstone Regional Council Stormwater Quality Management Plan Phase 2 Broad Scale Quality and Quantity Assessment* (O2 Environmental Pty Ltd 2012) as part of preparation of the draft Gladstone Regional Urban Stormwater Quality Management Plan however no actual water quality monitoring was undertaken.

More information on water quality monitoring associated with Gladstone Harbour and Port Curtis is provided in section 6.6 of the *Fitzroy Urban Background Report* (Gunn 2015).

5.5. Water Quality Trends

At the time of writing the three Councils did not have any urban diffuse water quality monitoring programs in place nor did other organisations. In addition there were no Council or FBA resources available to interrogate existing water quality data, studies and reports to determine if there were any discernible urban specific water quality trends associated with broader catchment data.

It is assumed but not confirmed that water quality trends for waters in the vicinity of Fitzroy region urban areas would have been negative i.e. worsening, as a result of urban expansion and the lack of any real legislative requirements for water quality protection measures up until the introduction of the Healthy Waters SPP (4/10) in 2010.

As urban water quality has not been systematically monitored there is no reliable way of determining water quality trends associated with urban land use for the Fitzroy region apart from the use of assumptive modelling as was done for the draft Gladstone Regional Urban Stormwater Quality Management Plan and the Great Barrier Reef catchment (see section 4.4).

Relevant water quality information that could be reviewed as part of a package of foundation activities (see section 9.1.1) for Fitzroy region urban areas is included in section 6 of the *Fitzroy Urban Background Report* (Gunn 2015).

6. Urban Response

6.1. Introduction

The responsibility for total water cycle management in the urban setting principally presides with local government through heads of power contained in Queensland legislation (see section 2.3). This includes responsibility for potable water supply, wastewater treatment (point source), solid waste disposal, installation and maintenance of stormwater management systems (traditionally for flood mitigation), assessment of development applications and ensuring compliance with development approval conditions.

Local government activities can also impact water quality including community infrastructure development and construction e.g. roads, stormwater systems and parks, as well as maintenance works associated with community assets.

Most of these Council responsibilities have traditionally been implemented using a 'hard' engineering approach however recent devolution of responsibility to local government through the State Planning Policy 4/10 Healthy Waters (now part of the single State Planning Policy (SPP) 2013 (updated 2014)) (see section 2.6.4) flagged the need to review and amend the traditional way of doing things. Responses to urban water quality issues are discussed briefly below to provide context for subsequent report sections.

6.2. Point Source

The obvious and most realistic option to reduce urban point source discharges to receiving waters from wastewater treatment plants is land based re-use. Upgrades to wastewater treatment plants, which would reduce the concentration of nutrients in treated wastewater released to receiving waters, is an expensive option and will not address load increases associated with population growth.

Using treated wastewater for irrigation, perhaps the most sustainable re-use option, could reduce wastewater treatment plant costs via reducing nutrient removal requirements (licence conditions) while reducing the need for synthetic fertilizer use at irrigation sites and removing some of the vagaries associated with reliance on unpredictable seasonal rainfall. It is assumed that the set-up costs for land based re-use would be offset over time by reduced wastewater treatment plant costs and increased productivity associated with irrigation areas. This needs to be investigated.

6.3. Diffuse Source

The *Sustainable Planning Act 2009* now requires local government to incorporate state interests described in the single state planning policy (SPP 2014) in their planning schemes. This is inclusive of the water quality state interest which was originally legislated in 2010 in SPP 4/10 Healthy Waters. Local government is then tasked with assessing development applications against their planning scheme and enforcing the development permit conditions including those formulated by state government departments responsible for enforcing the protection of state interests. Compliance with development permit conditions commences at the land development and construction phase principally involving erosion and sediment control and/or implementation of site based stormwater management plans.

6.3.1. Erosion and sediment control

As illustrated in section 4.7 erosion and the subsequent movement of sediment to receiving waters is a significant issue associated with urban development. Reducing impacts requires awareness and a coordinated effort on the part of many players with local government having a key role to help control erosion and sedimentation through the development assessment process. Solutions are well known and development approval conditions generally include the requirement to develop and implement a site based stormwater management plan and/or an erosion and sediment control plan.

There is a great deal of high quality information available on the subject including:

- Best Practice Erosion and Sediment Control (https://www.austieca.com.au/publications/best-practice-erosion-and-sediment-control-bpesc-document) (costs apply)
- Principles of Construction Site ESC (https://www.austieca.com.au/publications/principles-of-construction-site-esc)
- Managing urban stormwater (MUS): soils and construction vol. 1 (commonly known as the Blue Book) – (http://www.environment.nsw.gov.au/resources/water/BlueBookVol1.pdf)
- http://www.environment.nsw.gov.au/stormwater/publications.htm
- http://healthywaterways.org/resources/
- Controlling stormwater pollution on your building site http://healthywaterways.org/u/lib/mob/20150319120359_1c5e46fc9a8a322ac/factsheet_stormwaterkit-complete.pdf
- Road drainage manual - July 2015 edition (http://www.tmr.qld.gov.au/business-industry/Technical-standards-publications/Road-drainage-manual.aspx)
- Introductory Erosion and Sediment Control Guidelines for Queensland Councils, Local Government Association of Queensland, Brisbane (https://www.lgaq.asn.au/c/document_library/get_file?uuid=46dd4f4f763c8fe12381e8e1df16a884&groupId=10136)
- http://www.yourhome.gov.au/housing/sediment-control
- Erosion and Sediment Control – A field guide for construction site managers (version 2 2010) (www.catchmentsandcreeks.com.au/)
- Hunt, J.S. 1992, *Urban Erosion and Sediment Control Handbook*, NSW Department of Conservation and Land Management.

Education and behaviour change activities are useful at the broader community scale and necessary as targeted campaigns for the development and construction sector as a pre-cursor activity to

complement monitoring and compliance enforcement of development approval conditions associated with site based stormwater management and erosion and sediment control.

6.3.2. Urban stormwater quality management

Traditional urban stormwater quality management involves the installation and maintenance of stormwater systems designed for water conveyance rather than stormwater quality improvement. Concrete drains and pipes generally result in reduced erosion within the stormwater system and were seen as an efficient way of transporting water away from urban areas to reduce flood impacts. Impacts on receiving waters and waterway health associated with hydrological change however were not usually considered (see section 4.8.1). As a result of this traditional focus most urban areas with dated (pre-2010) stormwater systems have a limited capacity to remove water quality pollutants or mitigate hydrological impacts on local waterways.

Addressing this legacy issue requires a strategic approach to identify possibilities for retrofitting water quality improvement measures in existing urban areas as well as ensuring water sensitive urban design principles are incorporated in infill and re-development.

6.3.3. Water sensitive urban design

Water Sensitive Urban Design (WSUD) is a set of principles that can be applied to sustainably manage water in the urban setting and reduce adverse impacts on the natural water cycle associated with urban development (see Figure 6-1 and section 4.8.2).

By considering a site's natural features and water movement WSUD seeks to minimise the impacts of development while promoting a total water cycle management (TWCM) approach involving the integration of stormwater, water supply and wastewater (sewage) management. For WSUD to be effective and cost efficient it needs to be incorporated at a development's conceptual design stage and be integrated with both the built environment and open space i.e. parklands and natural areas.

Figure 6-1: Natural to WSUD Water Cycle

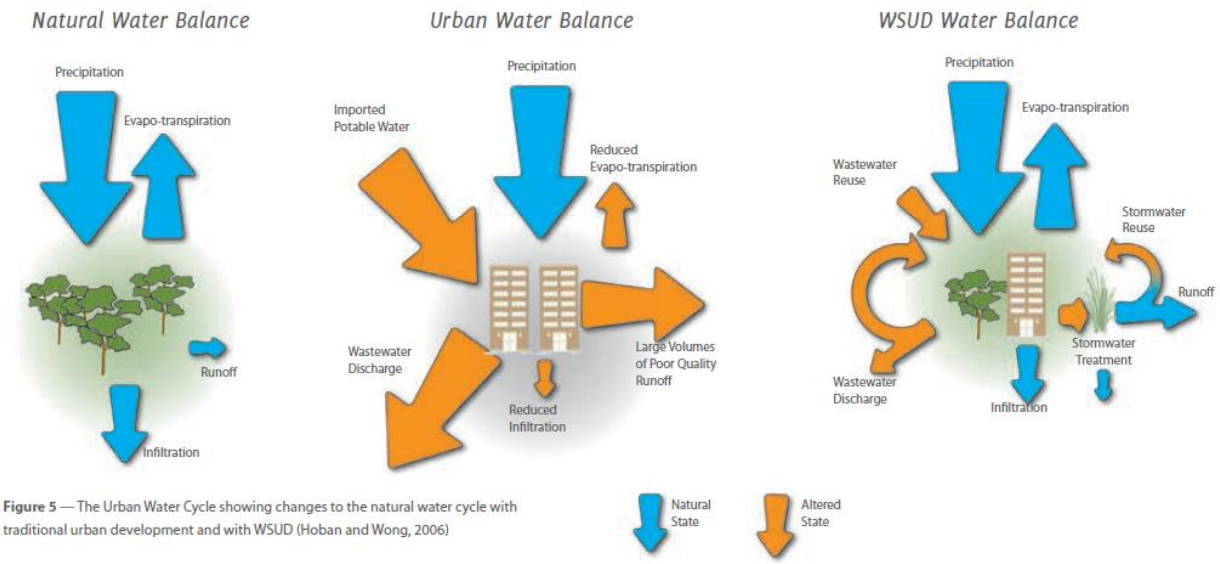


Figure 5 — The Urban Water Cycle showing changes to the natural water cycle with traditional urban development and with WSUD (Hoban and Wong, 2006)

Source is Water by Design 2009, Figure 5 (p.5).

SPP 2014 requirements include the adherence to stormwater management objectives during development. The construction phase objectives are generally met through erosion and sediment control conditions (see section 6.3.1) while the broader operational objectives are usually met by incorporating water sensitive urban design (WSUD) measures in new developments. When properly incorporated WSUD measures reduce hydrological changes to the landscape and remove water quality pollutants from stormwater prior to it reaching receiving waters (see Figure 6-1) without compromising flood mitigation outcomes.

Common WSUD measures attempt to reproduce natural water filtering and infiltration processes and include:

- Conveyance of stormwater by vegetated (usually grass) swales rather than pipes or concrete drains;
- Constructed wetlands;
- Bioretention systems.

WSUD measures are generally combined in a 'treatment train' designed to meet the SPP 2014 stormwater management objectives while minimising the overall area within developments used for stormwater quality treatment. The model for urban stormwater improvement conceptualisation (MUSIC) is the most commonly used tool to assist with design and for 'proving' stormwater quality measures as a requirement of development applications. Further information about WSUD including Water by Design products can be found in Gunn (2014a) and the *Fitzroy Urban Background Report* (Gunn 2015).

6.4. Cultural and Policy Challenges

As indicated above it is only in recent times (2010) that the SPP 4/10 Healthy Waters required urban water quality to be taken into account as a component of the development assessment and approval process. The single SPP 2014 (incorporating SPP 4/10) is now a primary 'risk reduction' mechanism for urban water quality impacts through its incorporation in local government planning schemes (see section 2.6.4).

How the SPP is applied through local planning instruments influences developing urban areas through the imposition of development approval conditions for the land development and construction stage as well as approving appropriate stormwater management measures (quantity and quality) to reduce ongoing, long-term water quality impacts.

Without appropriate policy settings and adequate resources for water quality improvement local government may not be in a position to ensure development permit conditions and compliance with conditions is adequate to protect receiving waters in either the short-term or long-term. A fundamental cultural change is required to enable the appropriate policy to be enacted by local government and accepted by the development and construction sector. The cultural change could be described as '*from service provision to stewardship*' (and service provision).

6.4.1. New stormwater assets or liabilities?

Another significant result of local government's new water quality responsibilities under the SPP 2014 is the 'inheritance' of WSUD measures included in new developments e.g. bioretention basins, swales and wetlands, generally two years after their construction. These are added to the existing

stormwater system and local government becomes responsible for the ongoing maintenance and remediation of any inherent issues associated with the measures e.g. poor design or installation.

Local government, especially in rural and regional areas, is not familiar with the management of these stormwater system assets and is finding it difficult to adjust to a new multi-layered stormwater quality management regime. The new regime involves the regulation of the development and construction industry and the subsequent long term maintenance of stormwater management assets local government has approved during the development assessment process.

As a result of these difficulties local government is looking for 'easier' short term solutions including the possibility of stormwater quality 'offsets' i.e. off-site treatment. Parts of the development industry are encouraging this line of investigation as a potential cost reduction option as opposed to smarter integration of stormwater management options into the concept and detailed design of the development to reduce overall costs, or at least to keep costs at current levels.

A cultural shift is also required in the development and construction industry to embrace the protection of community goods as an integral part of the profit making process.

6.4.2. Embedded change resistance

As previously mentioned the prevailing priorities associated with stormwater management focus on flood mitigation. This has become embedded in the culture of local government and is reinforced by a lack of resources to test and implement 'new' stormwater management concepts that incorporate water quality, flood mitigation and community amenity.

The introduction of SPP 4/10 highlights the struggle encountered by an organisation when looking at a fundamental change to embedded cultural norms. The whole organisation from the elected representatives through the various management levels to the ganger responsible for maintaining Council assets e.g. roads and parks, need to come to terms with a new way of doing things beyond business as usual.

Local government in regional Queensland is currently in the transition phase between the old and the new stormwater management regimes and there is the inevitable resistance which accompanies a fundamental cultural shift. The resistance is supported by the development and construction industry as they also have to adapt to the new regime and integrate new ideas into their 'tried and true' formulas.

Underpinning the resistance, apart from the thought of having to learn about and adopt new ideas, is the assumption that the bottom line will somehow be adversely affected i.e. if you are required to do something 'extra' then there must be extra costs. This form of thinking is deeply ingrained in most people as it part of our unconscious survival kit. New, different and unknown is an unconscious threat just as the old, same and known i.e. what works, is 'safe'.

The transition from the old through integration with the new is 'unproven' in terms of life experience and will be avoided by all but the most mindful innovators and early adopters. Change is an impediment to the safe way of doing things and will be resisted until the new way of doing things is proven to be safe i.e. socially (peer pressure) and economically. This applies to the development and construction industry as well as local government and the government agencies responsible for implementing the changes as a result of the new legislation.

The issue is that the resistance to change perpetuates the old systems and promotes actions to 'prove' that the old system works by defaming the new system. This merely diverts energy and

resources from ensuring the new system works and is integrated effectively with the old system. The resistance to change reduces the potential for water quality improvement in the short to medium term and also delays longer term outcomes.

6.4.3. Working together

There has been considerable investment by all levels of government to improve outcomes from the water quality part of the SPP 2014 and deliver integrated outcomes to development that add value and reduce overall costs. This includes recent initiatives by Water by Design and RUSMIG and the products developed and/or initiated as part ***Collaboration to the rescue project***.

A major consideration of that project was to refocus the current perception of water sensitive urban design (WSUD) to look at broader, integrated landscape based options and effective, flexible regional solutions. A current view of the SPP 2014 water quality requirements is that it is an onerous imposition on the development industry with subsequent flow-on cost implications for new home owners and investors.

As mentioned above a fundamental cultural shift is required across all sectors to implement urban water quality improvement and it will only be through a collaborative approach that the real and perceived obstacles to urban water quality improvement currently being encountered will be overcome.

7. Local Government Response

7.1. Policy

7.1.1. Corporate Plan

Local government policy is embedded in its five year Corporate Plan which guides the preparation of annual Operational Plans and Council's budget. The Corporate Plan generally includes:

- Council's Vision;
- Council's Mission;
- Council's Values;
- Plan context including the annual Operational Plan;
- Monitoring and review process;
- Outcomes and objectives, strategies (activities) and performance indicators.

The Vision, Mission and Values form the base of Council's policy position. This policy is then translated into outcomes, objectives and strategies in the Corporate Plan and subsequently into actions in the annual Operational Plan.

7.1.2. Environmental policy

In addition to the policy position presented in the Corporate Plan local government may also have stand-alone environmental policies. An initial and ongoing commitment is required to ensure the environmental policy is embedded in the Corporate Plan and flows through to operational actions.

Rockhampton Regional Council (RRC) has an Environmental Policy (adopted 25 January 2011) which amongst other things states that "*Rockhampton Regional Council will incorporate ecologically*

sustainable development into its business and decision making processes to ensure the region's environment is protected and enhanced over time". Livingstone Shire Council adopted the RRC Environmental Policy in 2015 following its de-amalgamation from RRC in 2014.

Gladstone Regional Council (GRC) also has an Environmental Policy which was adopted during the term of the current Council (October 2013) as an update to the policy originally adopted in 2010. "*Gladstone Regional Council's Environmental Policy is central to meeting our vision and recognising environmental responsibilities related to our region's growth and sustainable development*." The vision referred to is in the Corporate Plan and is "*to be the best local government in Queensland*".

7.1.3. Planning scheme policies

Planning schemes policies (PSPs), prepared as an integral part of the planning scheme, may contain policy and concepts that inform and influence the development assessment process, which may not otherwise be obvious or included in Council's general policy position. Both RRC and GRC adopted new planning schemes incorporating new planning scheme policies in 2015.

Rockhampton and Gladstone Regional Councils publicly available policies including values in the Corporate Plans and other relevant policies are reviewed in the *Fitzroy Urban Background Report* (Gunn 2015).

7.2. Practice

7.2.1. Operational Plans

Putting Council's policy as expressed in the Corporate Plan into practice is principally a function of the annual Operational Plan. Components of Rockhampton and Gladstone Regional Councils' Corporate Plans that could lead to water quality improvement if appropriately integrated and implemented through Operational Plans and other associated Council programs, activities and collaborations are listed in Table 7-1.

Table 7-1: Corporate Plan Outcomes and Strategies

Gladstone
strategy 1.1.2 - Provide for innovative planning approaches to growth challenges and development opportunities
strategy 1.1.3 -- Ensure enabling infrastructure is available in identified growth greenfield and in-fill areas
strategy 1.2.2 - Implement an asset renewal strategy that keeps pace with technology and the changing way the community uses public facilities
strategy 1.2.3 - Ensure the provision of a sustainable and cost effective water and wastewater network that meets community needs
strategy 1.3.3 - Engage and advocate for responsible economic, environmental and social outcomes when external authorities approve large scale industrial development projects
Outcome 3.1 A Council workforce that operates with a reduced environmental impact and seeks to enhance and preserve the region's natural environment
strategy 3.1.1 - Foster the balance between growth and conservation
strategy 3.1.3 - Foster the preservation of the region's green belts, wildlife corridors and natural assets
strategy 3.1.4 - Encourage the reduction of environmental risks within the region
Outcome 3.2 Council and the community exhibit positive attitudes and behaviours toward the environment
strategy 3.2.1 - Form alliances with, and provide opportunities for community members and groups to participate in events and initiatives that have a green focus

strategy 3.2.3 - Foster community attitudinal change, personal responsibility and respect for the environment
Rockhampton
Civil Operations Service: Responsible for construction and maintenance of transport, stormwater and related assets for both urban and rural operations, and management of and response to asset related customer requests
Activity: Provide value for money construction, maintenance and community response services for transport and drainage assets
Fitzroy River Water (FRW): The key objectives of FRW are to deliver commercially viable water and sewerage services that satisfy adopted customer service standards
Activity: Protect the environment, encourage water conservation and effluent re-use
Environment Outcome - A healthy and liveable environment for everyone to enjoy
Activities: • Provide regulatory and compliance services in line with statutory requirements and best practice; • Plan and deliver programmes, partnerships, regulation and education relevant to Environment and Public Health; • Achieve land rehabilitation and mitigation through direct action, education and volunteer programme delivery; • Promote the sustainable development of natural and physical resources and the maintenance of ecological processes and genetic diversity.
Economy Outcome - Grow a strong, resilient and diversified economy
Strategic Planning Activities: • Promote the sustainable development of natural and physical resources and the maintenance of ecological processes and genetic diversity; • Promote the sharing of responsibility for resource management and planning between the different spheres of government, the community and industry

Note: Livingstone Shire Council's Corporate Plan and Operational Plan have not been reviewed.

7.2.2. Practice participation

Rockhampton Regional Council and Gladstone Regional Council are also Reef Guardian Councils and have developed action plans as part of that program to complement Operational Plan strategies and activities. Both Councils also participated in capacity building activities delivered through the RUSMIG / Water by Design project titled ***Collaboration to the rescue***.

Further information about Council water quality improvement related practices including Reef Guardian Council activities and involvement in the RUSMIG / Water by Design collaborative project is included in the *Fitzroy Urban Background Report* (Gunn 2015).

7.3. Capacity

7.3.1. Corporate outcomes

In general terms the capacity of local government may be measured against the achievement of Corporate Plan outcomes and objectives as reflected in completion of the strategies and activities in the annual Operational Plans within the allocated budgets. Some of the strategies and outcomes in the Corporate Plan will be relevant to water quality improvement however determining the actual capacity of the organisation cannot be done by reference to the plan content alone.

7.3.2. Water quality improvement outcomes

Determining the capacity of local government to implement water quality improvement goes beyond identifying Corporate Plan and Operational Plan components that could potentially lead to water quality improvement outcomes.

Capacity assessment requires both a commitment from the organisation to undertake such an assessment as well as a source of objective external guidance and/or facilitation such as that provided by Water by Design through the RUSMIG ***Collaboration to the rescue*** project. The main areas of capacity assessment offered through the ***Collaboration to the rescue*** project were:

- Erosion and Sediment Control (ESC) compliance and review tools including;
    - ESC Internal Management System Review Tool: A tool to assist Councils review their internal processes with the aim of improving ESC implementation across the region.
- Water Sensitive Urban Design (WSUD) capacity building workshops.

The ESC internal management system review tool was implemented as a pilot study with Townsville City Council during the project while the WSUD capacity building workshops were delivered to four regional Councils to help them assess their institutional capacity to deliver WSUD outcomes and develop action plans to address high priority capacity building needs. Rockhampton Regional Council (RRC) and Gladstone Regional Council (GRC) were two of the four regional Councils that took part in the Water by Design facilitated WSUD workshops (see text box below).

Water Sensitive Urban Design capacity workshop series
Conduct workshops with local governments to facilitate self-assessments of their organisations' capacity for Water Sensitive Urban Design and potential management strategies that they could undertake to drive Water Sensitive Urban Design incorporating:

Stage 1 - workshops using the Rapid Assessment of Institutional Capacity in Local Government Agencies Tool delivered to Rockhampton (13 March 2014), Gladstone (14 March 2014), Mackay (27 March 2014) and Tablelands (Atherton) (4 April 2014) Regional Councils.

Stage 2 - follow up action planning workshops with Rockhampton (30 April 2014), Gladstone (31 April 2014), Mackay (8 May 2014) and Tablelands (9 May 2014) Regional Councils.

Councils are identifying and committing to key actions to build staff and executive capacity and support, share resources within council and the region to better deliver WSUD.

Results of the Rockhampton and Gladstone WSUD capacity workshops are included in Appendix B of the *Fitzroy Urban Background Report* (Gunn 2015).

What was evident from the Water by Design WSUD capacity workshop results was that RRC and GRC, along with the other Great Barrier Reef local governments assessed, are in a transition phase and do not have the additional resources required to implement the required cultural change and up-skill its workforce to meet the new challenges associated with incorporating water quality improvement into current frameworks and operations.

More specifically it was also evident that WSUD is generally viewed as an imposition aimed at water quality protection only and was not seen as part of an integrated stormwater management system approach involving quantity, quality and amenity.

These findings were confirmed during the limited discussions with Council staff during the collection and collation of the information for this scoping report. This was also consistent with the issues and needs uncovered through various RUSMIG meetings involving the Great Barrier Reef catchment Councils between 2010 and 2014.

Both Rockhampton Regional Council and Gladstone Regional Council are on the path to water quality improvement as evidenced by the practices in place and being worked on. This, however, is not at the velocity required to provide any significant improvement in urban water quality in what is an emerging and relatively unfamiliar field for Queensland's regional local governments due to a lack of resources and expertise and an underlying resistance to change.

8. Information Gaps

8.1. Requested and Accessed Information

Lists of information requested from and provided by Rockhampton Regional Council, Gladstone Regional Council and Livingstone Shire Council are included in the *Fitzroy Urban Background Report* (Gunn 2015).

8.2. WQIP Information Requirements

Great Barrier Reef (GBR) water quality improvement plans (WQIP) have some underlying components that drive the delivery of remediation activities including:

1. Identification of affected natural assets (aquatic);
2. Identification of land based threats to the assets;
3. Quantification of risks to the assets from different land use and associated hazards;
4. Identification and quantification of effective measures to nullify threats and hazards and/or reduce risks;
5. Prioritisation of measures to achieve the 'best' outcomes and return on investment;
6. Monitoring to prove the efficacy of measures and improve predictive knowledge for wise future investments.

Items 1 and 2 are reasonably well documented and were the basis for the development of the first Reef Plan released in 2003. The first Reef Plan recognised urban land use as one of the threats to GBR water quality and ecosystem health particularly with regard to discharge of treated wastewater from sewage (wastewater) treatment plants (STP). Investment in wastewater treatment plants was seen as the responsibility of local government, as mandated by State legislation, and provided a simple answer to the most obvious urban water quality issue. This point source focus meant the impact of urban diffuse stormwater run-off was not seriously investigated or considered for Reef Plan funding especially given the relatively small urban footprint compared to agricultural land use in the GBR catchment.

As urban land use has not previously been a feature of GBR WQIPs, with the exception of the Black Ross (Townsville) WQIP, listed items 3, 5 and 6 above have been largely unaddressed by local, state or Federal governments. Consequently the monitoring and quantification of urban land use impacts on water quality has not progressed. This reduces confidence in the identification and prioritisation of effective measures (item 4) to reduce urban water quality impacts and negates the ability to build a sound business case for investment in urban water quality improvement.

While gathering information to inform an urban WQIP is complicated by legislative, governance and socio-economic issues not encountered in the rural and agricultural context the underlying components (above) remain the same.

As with other matters related to urban land use the information requirements for items 1 to 6 need to be addressed in the context of; point sources, developing urban areas and existing/mature urban areas.

8.3. General Information Gaps

There are a number of areas common to all three Councils that present as information gaps. The key upper level information gaps relevant to all Councils include:

- Specific knowledge of urban catchment characteristics;
- Water quality monitoring;
- Knowledge of where diffuse source sediment, TN and TP are coming from in urban areas and quantities;
- Knowledge of the most effective and/or efficient place/s and ways to invest in water quality improvement in urban areas (**Note**: This knowledge gap is driving stormwater offset policies

however there is not yet any evidence to suggest that there are better places to invest in stormwater management measures than on development sites);
- Linking improvement in urban management practice to actual water quality improvement (**Note**: An important gap that needs to be filled so that managers can plan for cost-effective interventions and obtain resources).

Some of the information gaps that need to be addressed to provide a better understanding of the impacts of developing and existing urban areas on water quality for all Councils are listed below.

8.4. Developing Urban

Information gaps associated with developing urban areas are associated with making connections between population growth, dwelling demand projections, increase in urban land use (urban footprint) and the subsequent increase in water quality impacts. More specifically this includes:

- Quantification of population increase by dwellings required over time;
- Location of expected urban expansion by catchment;
- Assumptions about infrastructure associated with population/dwellings i.e. percentage/area increase;
- Physical properties of expected urban expansion areas/development sites including soil type and erosion potential;
- Values and characteristics of receiving waters associated with urban expansion areas;
- The likely amount of soil exposed and/or disturbed at any point in time during the development phase;
- Capacity of the development and construction industry to prepare appropriate erosion and sediment control plans;
- Implementation rates of effective management practices by the development and construction industry;
- Current development approval conditions protecting water quality;
- Capacity to ensure compliance with development permit conditions.

8.5. Existing Urban

As previously discussed diffuse source urban pressures and threats are primarily associated with the increase in impervious area and changes to catchment hydrology. Understanding the impact of existing urban areas on water quality therefore requires the following information:

- Accurate location of waterways;
- Accurate location of stormwater system catchments;
- Urban stormwater sub catchments in relation to WQIP sub catchments;
- The values and characteristics of receiving waters;
- History of development and associated impervious surface patterns as a percentage of total area;
- The ratio of impervious surfaces by urban stormwater sub catchment;
- Impervious surface connectedness to hard stormwater system (pipes and concrete drains);
- Relationships between 'hard' and 'soft' stormwater systems;
- Presence/absence of stormwater quality treatment measures by stormwater sub catchment;
- Efficacy of stormwater quality treatment measures including maintenance regimes;
- Potential location of regional stormwater quality treatment measures.

As with developing urban areas all Councils have information gaps that need to be addressed to enable retrofitting and regional solution decisions to be made. Some of the information however is available from Councils and only needs to be accessed, collated and analysed using GIS and/or catchment water quality models.

8.6. Point source

The main urban point source threat is discharge of treated wastewater to receiving waters from sewage treatment plants (STP). Information required to calculate the impacts of STPs is more of an information access matter than an information gap. Preliminary information has been provided by Rockhampton Regional Council (RRC) and Gladstone Regional Council (GRC) with some generic information available in the public domain for all Councils (see section 4.5).

This point source information needs to be consolidated and integrated with diffuse source information to determine the overall water quality impacts from urban areas and the most cost effective mitigation measures including land based re-use of treated wastewater.

8.6.1. RRC and LSC

Detailed discharge information is required for Rockhampton's three operating STPs to enable calculations of the nutrient contribution of the STPs in the context of the sub catchments where discharge takes place and the overall load contribution to the lower Fitzroy River catchment.

Discharge information is required for Livingstone Shire Council's Yeppoon STP, which discharges to Corduroy Creek. The Emu Park STP is relatively small and reuses all the treated wastewater for irrigation (golf course) and as such is not relevant when calculating discharge loads to receiving waters.

8.6.2. GRC

The main STP servicing the Gladstone urban area (see section 4.5.1) currently recycles all its treated wastewater and as such is not impacting water quality.

Information required to calculate potential future STP point source discharges in the absence of reuse (as a result of industry closure/downsizing and no/less re-use demand) include:

- Discharge volumes and nutrient loads associated with current STPs including monitoring data associated with GRC STPs;
- Forward forecasts of population growth and STP infrastructure requirements.

8.6.3. Environmentally Relevant Activities

Environmentally relevant activities (ERAs) have not been investigated in this scoping report as they are unlikely to be of importance in terms of water quality pollutant discharge based on the authors experience during investigations undertaken when preparing background reports for the Townsville WQIP.

The greatest potential impact of ERAs on water quality may come from the Gladstone region where there is a high level of industrial activity. The Ports Synthesis report prepared by CQUniversity reviews Gladstone Port activities and may provide some additional information on the subject.

8.7. Water Supply

The influence of water supply infrastructure on the supply of sediment and nutrients to the marine environment and the relative contribution of urban areas to end of catchment loads as a result of the altered catchment characteristics is an information gap.

Greater knowledge of opportunities to harvest stormwater, acknowledging that rainfall patterns in CQ are challenging, could have a dramatic improvement on urban WQ. Investigations have not been undertaken to determine potential improvements specific to the Fitzroy region.

8.8. Conclusion

An historic local government focus on flood mitigation and limited legislative responsibility for stormwater quality management has resulted in a wealth of information within Councils associated with point source regulatory requirements and very little associated with general urban catchment water quality and stormwater management measures.

Some of the baseline information required to assess the impacts of urban stormwater run-off and prioritise actions is available from Councils in the Fitzroy region e.g. stormwater system location, and needs to be systematically collated.

Basic water quality monitoring data, the characterisation of urban catchments and the efficacy of stormwater management measures comprises a significant information gap which local government is currently incapable of filling with current resources.

While some of this information may be embedded in individual reports and studies or can be partially interpreted from sources external to Councils a concerted effort is needed to analyse the available information and fill the missing baseline information gaps.

Without this basic information it is difficult to assess the overall impact of urban areas on GBR water quality and ecosystem health or to prioritise cost effective management actions in appropriate locations.

At this stage local government has no real incentive to address the information gaps as it is an additional cost that is not seen as necessary to achieve outcomes associated with its core responsibilities of service provision.

9. Draft Urban WQIP Actions

9.1. Preliminary Actions

As evident in previous sections of this scoping study urban land use in the GBR catchment has a knowledge and resource disadvantage when compared to agricultural land uses. This is particularly noticeable in terms of:

- Water quality monitoring and modelling;
- Risk assessment to define the location, quantum and impact of water quality pollutants being delivered to receiving waters;
- Identifying and prioritising areas and physical measures for water quality improvement intervention;
- Developing a business case and policy settings for urban water quality improvement;
- Allocating resources to address urban water quality issues beyond legislative responsibilities.

While generic pressures on water quality associated with urban land use (see section 4) and effective responses to the main pressures are well known (see section 6) it is the state of specific urban catchments and the level of the threat and risk by catchment and receiving waters that remains unknown. Without this knowledge it is difficult to make the business case for urban water quality improvement and the subsequent allocation of resources at the local, State and Federal levels.

It should be noted that local government in the Fitzroy region is fulfilling its legislative responsibilities with regard to potable water supply, urban stormwater management, wastewater treatment and point source discharges. Progressing water quality improvement beyond these core responsibilities to encompass receiving waters of the Great Barrier Reef (GBR) is unlikely given resource constraints, community expectations and local government priorities to provide essential services and expand community infrastructure in line with population increases.

Apart from filling the information gaps local government requires specific support to transition from a water quantity management culture to a total water cycle management culture incorporating water quantity, water quality, community amenity and environmental protection. This will need to be planned in conjunction with key local government champions and is a significant action for RUSMIG and Water by Design to plan and implement as a cross GBR undertaking.

9.1.1. Foundation activities

The first step for including urban land use in GBR water quality improvement programs is the collation and analysis of relevant information to use as a foundation for decision making, as has been done for agricultural land use over the last decade or more of Reef Plans. In essence this is about filling information gaps (see section 8) required to logically and strategically progress water quality improvement measures with a high level of confidence that appropriate and effective actions are being implemented to provide the best value outcomes for local waters, regional communities and the GBR.

The foundation activities will inform; the risk assessment process, the rating and prioritisation of effective interventions, the development of a logical business case and provide practical long term

strategic direction for urban water quality improvement. There are also identified low cost actions that can be implemented in the short to medium term to progress urban water quality improvement including; realignment of policy settings, education and behaviour change programs and commencement of previously identified 'no regrets' measures.

9.2. Regional Approach

There are a number of foundation activities that are common to all local governments with large urban populations within the GBR catchment as identified through the RUSMIG/Water by Design Collaboration to the rescue project and the GBRMPA Reef Guardian Councils program. The need for these foundation activities to progress urban water quality improvement was reinforced during the preparation of this scoping report.

These activities could be delivered across the GBR through a RUSMIG/Water by Design style collaborative project in conjunction with local government in the GBR catchment, State and Federal government agencies and NGOs. A draft model for delivering urban water quality improvement has been developed by the RUSMIG - Water by Design collaboration, which in the absence of any existing relevant mechanism may provide the most effective pathway for future investment in the under resourced land uses of the Great Barrier Reef catchment i.e. existing urban and industrial areas and coastal development. The draft urban delivery model is included in Appendix B.

The main foundation activities relevant to Fitzroy region local government that are required to fill information gaps and provide a base for urban water quality improvement decisions are listed in Table 9-1.

Table 9-1: GBR Regional Foundation Activities

Component	Strategic direction and action for Reef 2050 LTSP outcomes
Regionally coordinated and/or delivered foundation activities	
Water quality data collation and analysis	Coordinated collation of water quality and ecosystem health monitoring data for urban and peri-urban areas within the GBR catchment. This task needs to be coordinated across the GBR with data collected at the local level using existing partnerships and contacts. Data includes for point sources and diffuse source for established and developing urban areas A consistent format needs to be established to enable integration with the GBR integrated monitoring and modelling program. Collected and collated data needs to be analysed to identify trends and characteristics of urban areas over time including discharge loads and event mean concentrations from different urban land use types e.g. residential, commercial and industrial and peri-urban. This may include accessing hidden data associated with development assessment and approvals i.e. water quality monitoring conducted privately to meet development approval conditions where it is available.
Developing locally relevant water quality guidelines	Commence the definition of local water quality guidelines to enable setting of locally relevant WQOs and water quality targets matched to receiving waters and associated EVs. Conduct the necessary studies including water quality and ecosystem health monitoring to satisfy the requirements of and advance the purpose of the *Environmental Protection (Water) Policy 2009* (EPP Water).The process would be a partnership between EHP and local government and/or regional NRM groups using guidelines developed by EHP and/or guidance from EHP.
Identifying local and regional stormwater	A coordinated Reef wide project delivered at the local level to identify priority locations for water quality improvement measures in urban catchments for both emerging and existing urban areas with reference to receiving waters and their environmental values.

quality improvement solution locations	This needs to be done in conjunction with catchment and sub catchment scale water quality modelling and could include adoption/adaptation of the mapping prioritisation process developed by the FNQROC and Terrain partnership as well as GBRMPA 'blue mapping' for hydrological connectivity. This project would identify urban sites for: • Retrofitting stormwater quality measures; • Regional constructed wetland, bioretention sites and other WSUD and stormwater management measures; • Off-site flexible delivery options; • Connectivity and resilience. Commencing with large urban centres and progressively addressing all urban areas.
Coordination and Network connections – RUSMIG	At a minimum, the Reef Urban Stormwater Management Improvement Group (RUSMIG) secretariat should be funded to ensure that regional networks are actively maintained in between periods of intense activity i.e. base funding as opposed to project funding. Funding to ensure continuity of product development is also desirable to maintain urban water quality improvement momentum and support and promote much needed cultural change within local government and the development and construction industry.
Capacity increase	
Erosion and Sediment Control self-assessment audit tool	Consolidate the learning from the pilot and extend the use of the auditing tool to other GBR Councils (Townsville City so far) to increase local government ability to evaluate its own performance to manage Erosion and Sediment Control (ESC) and identify how to improve compliance for improved water quality outcomes.
Monitoring and reporting	
Urban water quality pollutant monitoring and modelling program	Develop the Paddock to Reef style monitoring and modelling program for urban land use (Suburb to Reef) i.e. developing urban areas (primarily sediment peaks with associated nutrients) and existing urban areas (primarily nutrients and gross pollutants with potential for heavy metals, hydrocarbons and pesticides). This requires the collation of water quality monitoring data for urban areas and/or analysis of existing data
Calibration (or recalibration) of water quality models	Calibration (or recalibration) of urban water quality e.g. MUSIC, and catchment models e.g. SOURCE, used to estimate impacts of urban development and urban land use and the effects of WSUD and other stormwater quality management measures. Improve the predictive capacity of water quality models in the urban setting for use in bioeconomic modelling, target setting and monitoring outcomes/progress of water quality improvement practices. Include climate change after initial short to medium term impacts are assessed.

Note: LTSP is the Reef 2050 Long Term Sustainability Plan.

9.3. Local Delivery

Some of the activities above could also be delivered by RRC and LSC and GRC if adequately resourced and guided by RUSMIG/Water by Design to ensure a consistent approach is achieved across all GBR Councils. Common activities, mostly foundation activities, which could be appropriately delivered at the local level by RRC and LSC and GRC, are listed in table 9-2

Table 9-2: Common Actions for Local Delivery

Component	Strategic direction and action for LTSP outcomes
Foundation activities (with regional guidance and/or coordination)	
Waterways and wetlands location by sub catchment	Accurately map the location of waterways and wetlands within the urban footprint and adjoining sub catchments using LIDAR data to produce a base GIS layer. Use the information and GIS tools to accurately locate watercourses and sub catchment boundaries within the urban footprint and future urban growth.
Stormwater system and management measures profiling and WSUD inventory	Identify and collate information on all stormwater management and WSUD measures by catchment and sub catchment for delineation of similarities and differences in stormwater systems and stormwater management measures within the existing urban footprint and developing urban areas. The profiling is required to identify and group areas by impervious surface, stormwater system connectedness and stormwater quality management features as input to GIS for: • Defining pollutant outputs; • Risk assessment and catchment planning; • Monitoring and modelling purposes including defining event mean concentrations; • Gathering data for showing the efficacy of WSUD measures; • Assisting with defining regional solutions; • Prioritising action areas.
Matters of local environmental significance	Identify matters of local environmental significance (MLES). Utilise existing studies and reports as well as information from other urban foundation activities to identify matters of local environmental significance (MLES) in urban areas to complement matters of national and state environmental significance (MNES) and MSES). This could include environmental features such as waterways, wetlands, connecting corridors and remnant vegetation.
State of the urban streams	Assessment of the condition of urban streams including in-stream habitat, beds and banks and riparian vegetation. The state of the streams needs to be assessed to help prioritise system repair works and to enable modelling to apportion pollutant discharge levels to the relevant source.
WSUD measures effectiveness monitoring and evaluation	• Collation and analysis of available of existing baseline data that could be used to illustrate the effectiveness of stormwater quality measures (includes WSUD treatment trains); • Baseline monitoring of WSUD measures at identified sites as part of the urban Paddock to Reef monitoring and modelling program. (**Note**: This is a sub component of the Suburb to Reef water quality monitoring and modelling program. Results of monitoring and data analysis to be used to enable local government and the development industry to incorporate appropriate and cost-effective stormwater management and water quality improvement measures in new developments, re-development and retrofits to existing stormwater systems as components of innovative regional and catchment solutions)
Capacity increase	
Erosion and Sediment Control (ESC) self-assessment auditing tool	Utilise the auditing tool to evaluate RRC, LSC and GRC performance to manage erosion and sediment control and identify what can be done to improve compliance and improve water quality outcomes.
Training	Arrange and participate in Water by Design and other relevant training including for: • Bioretention design and maintenance;

	• Construction and establishment of vegetated stormwater assets; • Erosion and sediment control compliance.
Integration	
Reef Guardian Councils (RGC)	• Review RGC Action Plans and identify areas of complementarity with the Fitzroy WQIP especially outside the core responsibilities of Councils. Utilising foundation activity findings prioritise local and regional water quality improvement actions and estimate resources required to accelerate implementation as part of an urban water quality improvement implementation plan; • Include the Fitzroy WQIP actions and principles in future updates of Reef Guardian Council Action Plans.
Planning scheme	Work with Councils' planning staff to identify key areas of capacity deficiency to enable the incorporation of relevant guidance material and tools to promote water quality improvement outcomes through the development approval process including compliance monitoring and enforcement.
RUSMIG	Continue participation in RUSMIG and confirm Council commitment by nominating a staff member as the key contact with a proxy also nominated.

Activities specific to RRC and LSC and GRC are listed in Table 9-3.

Table 9-3: Council Specific Local Delivery Actions

Component	Strategic direction and action for LTSP outcomes
Foundation activities (with regional guidance and/or coordination)	
Population growth projections and urban expansion predictions	Work individually with RRC, LSC and GRC planning departments to quantify population growth projections to 2050 and identify/delineate emerging urban areas and predicted urban expansion for risk assessment purposes. • For Rockhampton and Livingstone Shire North Rockhampton, Gracemere, Yeppoon and areas south of Zilzie are of particular interest (**Note**: It may be appropriate to assume the northern Rockhampton developing urban areas will be included in Rockhampton Regional Council LGA in the future and to work conjointly with RRC and LSC in determining potential urban expansion in that area); • For Gladstone Calliope and the area between Gladstone and Calliope are of particular interest.
Point Source	
Wastewater reuse as part of total water cycle management	Collate data on wastewater treatment plants (Rockhampton x3, Gracemere, Yeppoon and Emu Park) including predicted load increase over time associated with population growth, type of upgrades required to meet licence conditions and reuse options. Review studies that have considered wastewater reuse and map a pathway for implementation with associated costing.
	Collate data on wastewater treatment plants at Gladstone and Calliope including predicted load increase over time associated with population growth and investigate scenarios for: • Continued wastewater reuse by industry; • Discontinuation of industry reuse.
Capacity increase	
Water Sensitive Urban Design (WSUD) capacity	Review the ***Collaboration to the rescue*** Water Sensitive Urban Design (WSUD) Action Plans (see Appendix B in the *Fitzroy Urban Background Report*) and allocate resources to drive urban stormwater management and water quality improvement through greater adoption of WSUD principles and effective stormwater management measures.

	• For Rockhampton this may include developing guidance tools for maintaining vegetated stormwater quality assets; • For Gladstone this will include funding for priority actions included in the draft GRUSQMP.
Integration	
GRUSQMP benefit and cost analysis	• Review the recommended actions in the draft Gladstone Region Urban Stormwater Quality Management Plan (GRUSQMP) and identify actions that are outside the core responsibility of Council and/or are beyond the capacity of Council to implement and/or require additional resources to accelerate implementation. • Conduct a benefit and cost analysis related to local and regional water quality improvement outcomes and risk of doing nothing and include relevant priority water quality improvement actions in an urban implementation plan for the Fitzroy WQIP. • Link and integrate the draft GRUSQMP with the Reef Guardian Council Action Plan review for Gladstone. (**Note**: Actions identified in the draft GRUSQMP also need to be reviewed in terms of relevance and priority for inclusion in or integration with foundation activities in Table 9-2 above)
Healthy Waters Management Plan (HWMP) and WSUD	In the absence of an urban stormwater quality management plan (USQMP) for Rockhampton Regional Council or Livingstone Shire Council determine the need to prepare a Healthy Waters Management Plan (HWMP) as per the EPP Water. (**Note**: Any HWMP or other strategy listing and linking water quality improvement activities would need to be included in Council's Corporate Strategy and annual Operational Plans)

9.3.1. System repair

Local system repair efforts will be reliant on priorities previously identified by local government and/or be a secondary stage of a risk and prioritisation process undertaken as part of the foundation activities. As a result of the limited investigation of urban water quality improvement measures in the Fitzroy region to date preliminary system repair activities are likely to be limited. Table 9-4 includes some generic system repair activities that could be implemented in the short term if adequate resources are made available. Consultation with local government is the necessary first step for both foundation actions and system repair activities.

Table 9-4: Preliminary System Repair Activities

Component	Strategic direction and action for LTSP outcomes
On Ground	
Pilot projects and preliminary system repairs	Implement 'no regrets' stormwater improvement projects previously identified including amelioration of existing stormwater management measures passed onto Councils in poor condition and/or make inappropriately designed measures more effective. Following consultation with each local government to determine if system repair activities have been previously identified activities may include: • Installation of new demonstration sites; • Commence pilot projects to prove large scale investment value; • Commence implementation of high priority off-site regional solutions; • Detailed design for the construction of regional solutions; • Updates to or integration of stormwater management guidance material for Council works and maintenance of vegetated stormwater assets; • Other necessary precursor activities required to implement on-ground works.

Litter (marine debris) reduction	Installation of trash racks and 'socks' including innovative and multi-purpose systems within parklands and as part of WSUD treatment trains as identified in the CQUniversity litter surveys for Gladstone.

9.3.2. Other matters

In addition to the activities suggested in this section there is a range of issues associated with urban water quality management that remain unresolved which will require additional investigation and/or consultation with local government and other key stakeholders.

One such issue is the concept of water quality 'offsets' which may be more appropriately labelled off-site and regional stormwater management solutions. This particular issue arises from the struggle local government is having coming to terms with the new responsibilities emanating from the introduction of the Healthy Waters SPP in 2010. There is no easy solution to this period of transition from the 'old' to the 'new' however strategic support could be provided to local government as was done with the RUSMIG/Water by Design ***Collaboration to the rescue*** project in 2013/14.

9.4. Implementation Planning

The majority of the urban water quality improvement actions require regional coordination and/or involve collation of information as part of a group of foundation activities. Preparation of an implementation plan has not been attempted as considerable consultation is still required with local government in the Fitzroy region to meaningfully engage them in water quality improvement activities beyond their core responsibilities.

As identified in this scoping study and from previous work undertaken through the RUSMIG network and in conjunction with Water by Design, local government does not have the capacity to take on additional responsibilities without being appropriately resourced and guided.

Meaningfully engaging local government in water quality improvement in the Fitzroy region will necessarily involve the provision of new resources and a commitment to a collaborative partnership that enables local government to extend its field of activity without compromising its statutory service delivery role.

Any process that seeks to 're-organise' or add to local government's current activities without the provision of additional resources is likely to be seen as a redundant exercise involving an unnecessary use of Council's resources (staff time) that detracts from Council's ability to implement its core responsibilities.

Developing an implementation plan for urban water quality improvement in the Fitzroy region would depend on the commitment to a process by both the FBA and the Fitzroy region's local governments and the allocation of adequate resources by the and/or Federal governments.

The two most likely pathways for urban water quality improvement would involve:

1. A GBR wide approach utilising a delivery model proposed by RUSMIG/Water by Design with the support of GBRMPA and the FBA (see Appendix B);
2. Local delivery as a component of the Fitzroy region WQIP.

The RUSMIG approach has been successful as it closely aligns with local government needs to meet their new responsibilities and provides useful and relevant information, guidance and support for stormwater managers within GBR Councils to extend themselves beyond the old 'business as usual' scenario. This supportive approach enables new concepts and innovative stormwater management solutions to be actively disseminated throughout the rest of their organisation to promote cultural change.

The GBR wide approach would require a Queensland and/or Australian government funding allocation to re-enable the RUSMIG/Water by Design collaborative process (in conjunction with GBRMPA) to develop and implement a GBR wide 'work plan' for advancing urban water quality improvement including:

- Reactivation of the RUSMIG network and communication and consultation processes;
- Continuation of unfinished projects commenced by ***Collaboration to the rescue***;
- Coordination and standardisation of baseline data collation;
- Continue the collation of baseline data through the RUSMIG network;
- Implement additional GBR wide actions identified by RUSMIG and Water by Design during implementation of the ***Collaboration to the rescue*** project and previously by RUSMIG;
- Provision of coordinated second stage funding to GBR Councils with large urban populations (Cairns, Townsville, Mackay, Rockhampton, Gladstone and Bundaberg) to implement foundation activities and priority local actions (see delivery model in Appendix B).

Local delivery through the Fitzroy region WQIP would initially involve the FBA securing a commitment from the Australian government and/or Queensland government to allocate resources for urban water quality improvement in the Fitzroy region. The FBA could then confidently approach the local governments involved in the Fitzroy region urban scoping study to develop a memorandum of understanding (MoU) to participate in a review and prioritisation of the proposed water quality improvement actions (above) and the subsequent preparation of an implementation plan.

9.5. Scoping Study Consultation

Consultation with Rockhampton and Gladstone Regional Councils was instigated through the RUSMIG network and was confined to accessing information not readily available in the public domain. It was obvious from the response of both Councils that any commitment to future involvement in the Fitzroy region WQIP would be contingent on the benefit to each Council of such involvement in comparison to the cost to them.

Livingstone Shire Council did not respond to requests for their participation in the provision of information for inclusion in the scoping study. This was due mainly to the need to deal with the aftermath of Cyclone Marcia.

10. References

Anderson, K.A. and Downing, J.A. 2006, Dry and Wet Atmospheric Deposition of Nitrogen, Phosphorus and Silicon in an Agricultural Region*, Water, Air, and Soil Pollution (2006) 176*: 351-374, © Springer 2006.

Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) and Australian and New Zealand Environment and Conservation Council (ANZECC) 1994a, *National Water Quality Management Strategy Water Quality Management – An Outline of the Policies (Paper 1)*, ARMCANZ and ANZECC

ARMCANZ and ANZECC 1994b, *National Water Quality Management Strategy Policies and Principles - A Reference Document (Document 2)*, ARMCANZ and ANZECC

ANZECC and ARMCANZ 2000, *National Water Quality Management Strategy Australian and New Zealand Guidelines for Fresh and Marine Waters Quality, Draft Guidelines Volume 1*. Prepared under the auspices of the Australia and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand, Canberra.

BMT WBM 2015, (Draft) *Gladstone Regional Urban Stormwater Quality Management Plan (GRUSQMP) Phase 3 Report*, Gladstone Regional Council, Gladstone.

Brodie, J., McKergow, L.A., Prosser,I.P., Furnas, M., Hughes A.O. and Hunter, H. 2003, *Sources of Sediment and Nutrient Exports to the Great Barrier Reef World Heritage Area*, ACTFR Report No. 03/11, Australian Centre for Tropical Freshwater Research (James Cook University), Townsville.

Brodie, J., Waterhouse, J., Schaffelke, B., Kroon, F., Thorburn, P., Rolfe, J., Johnson, J., Fabricius, K., Lewis, S., Devlin, M., Warne, M. and McKenzie, L. 2013, *Scientific Consensus Statement: Land use impacts on Great Barrier Reef water quality and ecosystem condition*, Published by the Reef Water Quality Protection Plan Secretariat, © The State of Queensland.

Chiew, F., Mudgway, L., Duncan, H., and McMahon, T. 1997, *Urban Stormwater Pollution Industry Report: 97/5,* Cooperative Research Centre for Catchment Hydrology.

CSIRO and Bureau of Meteorology 2015, *Climate Change in Australia Information for Australia's Natural Resource Management Regions: Technical Report*, CSIRO and Bureau of Meteorology, Australia.

Department of Environment and Heritage Protection 2009, *Queensland Water Quality Guidelines*, Version 3, Queensland Government, Brisbane.

Department of Environment and Resource Management (DERM) 2012, *Report on the Long-term Water Quality Monitoring of Estuaries and Inshore Coastal Waters in Central Queensland 1993 to 2006*, State of Queensland.

Department of State Development, Infrastructure and Planning August 2014, *State Planning Policy—state interest guideline Water quality*, Queensland Government.

Department of Sustainability, Environment , Water and Community (Commonwealth) 2013, Dougall, C., McCloskey, G.L., Ellis, R., Shaw, M., Waters, D., Carroll, C. 2014, *Modelling reductions of pollutant loads due to improved management practices in the Great Barrier Reef catchments – Fitzroy NRM region, Technical Report, Volume 6*, Queensland Department of Natural Resources and Mines, Rockhampton, Queensland.

Dowdy, A. et al 2015, East Coast Cluster Report, Climate Change in *Australia Projections for Australia's Natural Resource Management Regions: Cluster Reports*, eds. Ekström, M. et al, CSIRO and Bureau of Meteorology, Australia. (http://www.climatechangeinaustralia.gov.au/en/publications-library/cluster-reports/)

Duncan, H. 1995, *A Review of Urban Stormwater Quality Processes: Report 95/9*, Cooperative Research Centre for Catchment Hydrology.

Fitzroy Partnership for River Health (FPRH), *Fitzroy Basin Report Card 2010-11*, FPRH, Rockhampton.

Fitzroy Partnership for River Health (FPRH), *Fitzroy Basin Report Card 2011-12*, FPRH, Rockhampton.

Fitzroy Partnership for River Health (FPRH), *Fitzroy Basin Report Card 2012-13*, FPRH, Rockhampton.

Fitzroy Partnership for River Health (FPRH), *Fitzroy Basin Report Card 2013-14*, FPRH, Rockhampton.

Gladstone Regional Council 2013, *Environmental Policy* (P-2013/9), Gladstone Regional Council, Gladstone.

Gladstone Regional Council 2013, *Gladstone Regional Council 2013/2017 Corporate Plan*, Gladstone Regional Council, Gladstone.

Gooding, K. 2014, Brief Report – Rapid Assessment of Gladstone Regional Council's Institutional Capacity for Delivering Water Sensitive Urban Design (Workshop 1) and Gladstone Regional Council WSUD Action Plan (unpublished), Water by Design (Healthy Waterways), Brisbane.

Gooding K. 2014, Brief Report – Rapid Assessment of Rockhampton Regional Council's Institutional Capacity for Delivering Water Sensitive Urban Design (Workshop 1) and Rockhampton Regional Council WSUD Action Plan (unpublished), Water by Design (Healthy Waterways), Brisbane.

Gunawardena, J., Egodawatta, P., Ayoko, G.A., and Goonetilleke, A. 2011, Atmospheric deposition as a source of stormwater pollution in Gold Coast, Australia, in *Proceedings of the 34th IAHR World Congress, 33rd Hydrology and Water Resources Symposium and 10th Conference on Hydraulics in Water Engineering*, Engineers Australia, Brisbane Convention and Exhibition Centre, Brisbane, Qld, pp. 1849-1856. Copyright 2011 Engineers Australia.

Gunn, J. and Barker, G. 2009, *Water Quality Pollutant Types and Sources Report: Black Ross Water Quality Improvement Plan,* Creek to Coral/Townsville City Council, Townsville.

Gunn, J. and Manning, C. 2010, *Black Ross (Townsville) Water Quality Improvement Plan*, Creek to Coral/Townsville City Council, Townsville.

Gunn, J. 2014, *Urban Land Use in Great Barrier Reef Water Quality Improvement Plans: Background Report and Considered Guidance*, Reef Urban Stormwater Management Improvement Group (RUSMIG), Water by Design and Creek to Coral, Townsville.

Johnston, N., Peck, G., Ford, P., Dougall, C. and Carroll, C. (eds) 2008, *Fitzroy Basin Water Quality Improvement Report*, Fitzroy Basin Association, Rockhampton.

Livingstone Shire Council 2015, Environmental Policy (Community Policy), Livingstone Shire Council, Yeppoon.

Mackay Whitsunday NRM 2008, Mackay Whitsunday Water Quality Improvement Plan Report, Mackay Whitsunday NRM, Mackay.

O2 Environmental Pty Ltd 2012, *Gladstone Regional Council Stormwater Quality Management Plan Phase 2 Broad Scale Quality & Quantity Assessment*, Gladstone Regional Council, Gladstone.

Reef Water Quality Protection Plan Secretariat 2013, *Reef Water Quality Protection Plan 2013: Securing the health and resilience of the Great Barrier Reef World Heritage Area and adjacent catchments*, Australian Government and Queensland Government, © The State of Queensland 2013.

Rockhampton Regional Council 2011, *Environmental Policy* (Community Policy) (No.Pol.P1.1), Rockhampton Regional Council, Rockhampton.

SKM 2013, *Sewage Treatment Plants Strategy Planning Study: Final report*, Fitzroy River Water / Rockhampton Regional Council, Rockhampton.

Turner R, Huggins R, Wallace R, Smith R, Vardy S, Warne M. 2012, *Sediment, Nutrient and Pesticide Loads Great Barrier Reef Catchment Loads Monitoring 2009-2010*, Department of Science, Information Technology, Innovation and the Arts, Brisbane.

Vision Environment 2011, *Port Curtis Ecosystem Health Report Card 2008 – 2010*, Port Curtis Integrated Monitoring Program (PCIMP), Gladstone.

Wallace, R., Huggins, R., Smith, R., Turner, R., Vardy, S. and Warne, M. St. J. 2014, *Total suspended solids, nutrient and pesticide loads (2011–2012) for rivers that discharge to the Great Barrier Reef – Great Barrier Reef Catchment Loads Monitoring Program 2011–2012*, Department of Science, Information Technology, Innovation and the Arts, Brisbane.

Waters, D.K., Carroll, C., Ellis, R., Hateley, L., McCloskey, G.L., Packett, R., Dougall, C., Fentie 2014, *Modelling reductions of pollutant loads due to improved management practices in the Great Barrier Reef catchments – Whole of GBR, Technical Report, Volume 1*, Queensland Department of Natural Resources and Mines, Toowoomba.

Queensland Legislation

Aboriginal Cultural Heritage Act 2003

Coastal Protection and Management Act 1995

Divisional Boards Act 1879

Environmental Offsets Act 2014

Environmental Protection Act 1994

Environmental Protection Regulation 2008

Environmental Protection (Waste Management) Regulation 2000

Environmental Protection (Water) Policy 1997 and *2009* (amended 2013)

Fisheries Act 1994

Great Barrier Reef Protection Amendment Act 2009

Land Act 1994

Local Authorities Act 1902

Local Government Act 2009

Marine Parks Act 2004

Nature Conservation Act 1992

State Planning Policy 2013 (as amended July 2014)

State Planning Policy 4/10 Healthy Waters

Sustainable Planning Act 2009

Sustainable Planning Regulation 2009

Vegetation Management Act 1999

Water Act 2000

Water Regulation 2002

Water Supply (Safety and Reliability) Act 2008

Water Supply (Safety and Reliability) Regulation 2011

Appendix A: Legislation extracts and notes

Local Government Act 2009

4 Local government principles underpin this Act

(1) To ensure the system of local government is accountable, effective, efficient and sustainable, Parliament requires—

(a) anyone who is performing a responsibility under this Act to do so in accordance with the local government principles; and

(b) any action that is taken under this Act to be taken in a way that—

(i) is consistent with the local government principles; and

(ii) provides results that are consistent with the local government principles, in as far as the results are within the control of the person who is taking the action.

(2) The ***local government principles*** are—

(a) transparent and effective processes, and decision-making in the public interest; and

(b) sustainable development and management of assets and infrastructure, and delivery of effective services; and

(c) democratic representation, social inclusion and meaningful community engagement; and

(d) good governance of, and by, local government; and

(e) ethical and legal behaviour of councillors and local government employees. (LG Act, p.18)

9 Powers of local governments generally

(1) A local government has the power to do anything that is necessary or convenient for the good rule and local government of its local government area. (LG Act, p.20)

Note— Also, see section 262 (Powers in support of responsibilities) for more information about powers.

(2) However, a local government can only do something that the State can validly do. (LG Act, p.21)

12 Responsibilities of councillors

(1) A councillor must represent the current and future interests of the residents of the local government area. (LG Act, p.22)

Division 2 Making, recording and reviewing local laws

28 Power to make a local law

(1) A local government may make and enforce any local law that is necessary or convenient for the good rule and local government of its local government area. (LG Act, p.40)

Part 3 Roads and other infrastructure

Division 1 Roads

59 What this division is about

(1) This division is about roads.

(2) A ***road*** is—

(a) an area of land that is dedicated to public use as a road; or
(b) an area of land that—
(i) is developed for, or has as 1 of its main uses, the driving or riding of motor vehicles; and
(ii) is open to, or used by, the public; or
(c) a footpath or bicycle path; or
(d) a bridge, culvert, ford, tunnel or viaduct.
(3) However, a ***road*** does not include—
(a) a State-controlled road; or
(b) a public thoroughfare easement.

60 Control of roads
(1) A local government has control of all roads in its local government area.
(2) This control includes being able to—(LG Act, p.59)
(a) survey and resurvey roads; and
(b) construct, maintain and improve roads; and
(c) approve the naming and numbering of private roads; and
(d) name and number other roads; and
(e) make a local law to regulate the use of roads, including—
(i) the movement of traffic on roads, subject to the *Transport Operations (Road Use Management) Act 1995*; and
(ii) the parking of vehicles on roads, subject to the *Transport Operations (Road Use Management) Act 1995* (including the maximum time that a vehicle may be parked in a designated rest area that adjoins a road, for example); and
(iii) by imposing obligations on the owner of land that adjoins a road (including an obligation to fence the land to prevent animals going on the road, for example); and
(f) make a local law to regulate the construction, maintenance and use of—
(i) public utilities along, in, over or under roads; and
(ii) ancillary works and encroachments along, in, over or under roads; and
(g) realign a road in order to widen the road; and
(h) acquire land for use as a road.

(3) Nothing in subsection (1) makes a local government liable for the construction, maintenance or improvement of a private road.

(4) A ***private road*** is a road over land that is owned by a person who may lawfully exclude other persons from using the road. (LG Act, p.60)

Division 2 Stormwater drains [part only]
76 What this division is about
(1) This division is about stormwater drains and stormwater installations.

(2) A ***stormwater drain*** is a drain, channel, pipe, chamber, structure, outfall or other works used to receive, store, transport or treat stormwater.
(3) A ***stormwater installation*** for a property—
(a) is any roof gutters, downpipes, subsoil drains or stormwater drain for the property; but
(b) does not include any part of a local government's stormwater drain.

77 Connecting stormwater installation to stormwater drain
(1) A local government may, by written notice, require the owner of a property to connect a stormwater installation for the property to the local government's stormwater drain in the way, under the conditions and within the time stated in the notice.
(2) The way, condition and time stated in the notice must be reasonable in the circumstances. (LG Act, p.73)

78 No connecting sewerage to stormwater drain
(1) The owner of a property must not connect the sewerage installation for property, or allow the sewerage installation for the property to be connected, to any part of—
(a) the stormwater installation for the property; or
(b) the stormwater drain of the local government. (LG Act, p.74)

79 No trade waste or prohibited substances in stormwater drain
(1) A person must not put trade waste into a stormwater drain.
Maximum penalty—1000 penalty units.
(2) ***Trade waste*** is waterborne waste from business, trade or manufacturing property, other than—
(a) stormwater; and
(b) a prohibited substance.
(3) A person must not put a prohibited substance into a stormwater drain.
Maximum penalty—1000 penalty units.
(4) A ***prohibited substance*** is— (LG Act, p.76)
(a) a solid or viscous substance in a quantity, or of a size, that can obstruct, or interfere with the operation of, a stormwater drain; or
Examples for paragraph (a)—
• ash, cinders, sand, mud, straw and shavings
• metal, glass and plastics
• paper and plastic dishes, cups and milk containers
• rags, feathers, tar and wood
• whole blood, paunch manure, hair and entrails
• oil and grease
• cement-laden wastewater, including, wash down from exposed aggregate concrete surfaces
(b) a flammable or explosive solid, liquid or gaseous substance; or
(c) sewage, including human waste; or
(d) a substance that, given its quantity, is capable alone, or by interaction with another substance put into a stormwater drain, of—
(i) inhibiting or interfering with the stormwater drain; or

(ii) causing damage or a hazard to the stormwater drain; or
(iii) causing a hazard for humans or animals; or
(iv) creating a public nuisance; or
(v) creating a hazard in waters; or
(vi) contaminating the environment in places where stormwater is discharged or reused; or
Example for paragraph (d)—
a substance with a pH lower than 6.0 or greater than 10.0, or having another corrosive property
(e) a substance that has a temperature of more than— (LG Act, p.77)
(i) if the local government has approved a maximum temperature for the substance—the approved maximum temperature; or
(ii) otherwise—38ºC.
(5) If—
(a) a person puts a prohibited substance in a local government's stormwater drain; and
(b) the prohibited substance causes damage to the stormwater drain;
the local government may perform work to fix the damage, and may recover the reasonable costs for the work from the person who put the prohibited substance in the stormwater drain.
(6) The costs for the work are in addition to any penalty imposed for the offence.

80 Interference with path of stormwater
(1) A person must not restrict or redirect the flow of stormwater over land in a way that may cause the water to collect and become stagnant.
Maximum penalty—165 penalty units.
(2) However, this section does not apply to water collected in a dam, wetland, tank or pond, if no offensive material is allowed to accumulate. (LG Act, p.78)

sustainable development is development that is designed to meet present needs while also taking into account future costs (including costs to the environment and the depletion of natural resources, for example). (LG Act, p.281)

Environmental Protection Act 1994

Chapter 4A Great Barrier Reef protection measures
Part 1 Preliminary
74 Purpose of ch 4A
The purpose of this chapter is to—
(a) reduce the impact of agricultural activities on the quality of water entering the reef; and
(b) contribute to achieving the targets about water quality improvement for the reef under agreements between the State and the Commonwealth from time to time.
Note—
At the commencement of this section the current agreement was the 'Reef Water Quality Protection Plan: For catchments adjacent to the Great Barrier Reef World Heritage Area October 2003'.

75 What is an *agricultural ERA*
(1) An activity is an ***agricultural ERA*** if—
(a) it is—
(i) commercial sugar cane growing; or
(ii) cattle grazing carried out on an agricultural property of more than 2000ha; and
Note—

For part 3, see also section 87A (Extended meaning of agricultural ERA for pt 3).
(b) it is carried out on an agricultural property in 1 or more of the following catchments (each a ***priority catchment***)—
(i) the Wet Tropics catchment; (EP Act, p.81)
(ii) the Mackay–Whitsunday catchment;
(iii) the Burdekin dry tropics catchment.

(2) However, if only part of the agricultural property is in 1 or more of the priority catchments, the activity is only an agricultural ERA if—
(a) more than 75% of the lot on which it is carried out is in 1 or more of the priority catchments; or
(b) the part of the lot within 1 or more of the priority catchments is more than 20000ha.

(3) For subsection (1)(b), the priority catchments—
(a) are identified on the map held by the department called 'Map of Great Barrier Reef Catchments covered by the Queensland Government Reef Protection Package', Map No. g090514-01; but
(b) also include any other land prescribed under a regulation.

(4) A regulation may be made under subsection (3)(b) only if—
(a) the other land forms part of an agricultural property that is only partly within any of the catchments identified on the map; and
(b) each priority catchment will, after the making of the regulation, be a contiguous parcel of land.

(5) In this section—
lot means—
(a) a lot under the *Land Title Act 1994*; or
(b) a separate, distinct parcel of land for which an interest is recorded in a register under the *Land Act 1994*.

76 Who *carries out* an agricultural ERA
A person ***carries out*** an agricultural ERA only if the person—
(a) carries it out personally; or (EP Act, p.82)
(b) employs or engages someone else to carry it out on the person's behalf. (EP Act, p.83)

Chapter 5 Environmental authorities and environmentally relevant activities
Note—
The *Strategic Cropping Land Act 2011*, chapter 3, part 4, division 2 imposes restrictions on the issuing of environmental authorities for SCL and potential SCL under that Act.

Part 1 Preliminary
Division 1 Key definitions for chapter 5
106 What is a *prescribed ERA*
A ***prescribed ERA*** is an environmentally relevant activity prescribed under section 19.
107 What is a *resource activity*
A ***resource activity*** is an activity that involves—
(a) a geothermal activity; or
(b) a GHG storage activity; or
(c) a mining activity; or

(d) a petroleum activity.

108 What is a *geothermal activity*
A ***geothermal activity*** is an activity that, under the Geothermal Act, is an authorised activity for a geothermal tenure. (EP Act, p.99)

109 What is a *GHG storage activity*
A ***GHG storage activity*** is an activity that, under the GHG storage Act, is an authorised activity for a GHG authority under that Act.

110 What is a *mining activity*
A ***mining activity*** is—
(a) an activity that is an authorised activity for a mining tenement under the Mineral Resources Act; or
(b) another activity that is authorised under an approval under the Mineral Resources Act that grants rights over land.

111 What is a *petroleum activity*
A ***petroleum activity*** is—
(a) an activity that, under the *Petroleum Act 1923*, is an authorised activity for a 1923 Act petroleum tenure under that Act; or
(b) an activity that, under the P&G Act, is an authorised activity for a petroleum authority under that Act; or
(c) exploring for, exploiting or conveying petroleum resources under a licence, permit, pipeline licence, primary licence, secondary licence or special prospecting authority granted under the *Petroleum (Submerged Lands) Act 1982*. (EP Act, p.100)

Environmental Protection Regulation 2008

Chapter 7 Administration, Part 1 Devolution of powers
Division 1 Matters devolved to local government
98 Environmental nuisance
The administration and enforcement of the following provisions of the Act is devolved to each local government for its local government area—
(a) section 440;
(b) section 443, to the extent it relates to environmental nuisance.(EP Reg., p.59)

99 Noise standards
The administration and enforcement of the following provisions of the Act is devolved to each local government for its local government area—
(a) section 440Q;
(b) chapter 8, part 3B, division 3.

100 Water contamination
The administration and enforcement of chapter 8, part 3C of the Act is devolved to each local government for its local government area.

101 Particular prescribed ERAs

(1) The administration and enforcement of the Act in relation to the following prescribed ERAs is devolved to a prescribed local government where the activity is, or is to be, carried out in its local government area—
(a) each of the following prescribed ERAs—
(i) asphalt manufacturing;
(ii) plastic product manufacturing;
(iii) metal forming;
(b) each of the following prescribed ERAs carried out within the stated threshold mentioned for the activity—
(i) metal recovery, for—
(A) recovering less than 100t of metal in a day; or
(B) recovering, without using a fragmentiser, 100t or more of metal in a day or 10000t or more of metal in a year; (EP Reg., p.60)
(ii) surface coating, for anodising, electroplating, enamelling or galvanising using 1t to 100t of surface coating materials in a year;
(iii) waste incineration and thermal treatment, for incinerating waste vegetation, clean paper or cardboard;
(c) boat maintenance or repair, but only to the extent the activity is, or is to be, carried out at a boat maintenance or repair facility.
Editor's note—
schedule 2, sections 6 (Asphalt manufacturing), 12 (Plastic product manufacturing), 19 (Metal forming), 20 (Metal recovery), 38 (Surface coating), 49 (Boat maintenance or repair) and 61(Waste incineration and thermal treatment)
(2) In this section—
prescribed local government means a local government, other than a local government mentioned in schedule 8A.

102 Devolution includes statutory instruments under Act
To remove any doubt, it is declared that the administration and enforcement of the Act in relation to a matter devolved to a local government under this division includes the administration and enforcement of statutory instruments made under the Act in relation to the matter. (EP Reg., p.61)

Part 2 Enforcement
109 Authorised persons—Act, s 445
For section 445(1)(c) of the Act, each of the following classes of persons is declared to be an approved class of persons—
(a) employees of a local government who are appointed as authorised persons by the local government's chief executive officer;
(b) for the purposes only of sections 440J and 463A of the Act—
(i) authorised officers appointed under the *Brisbane Forest Park Act 1977*, section 42; or
(ii) authorised officers appointed under the *Recreation Areas Management Act 2006*, section 143; or
(iii) conservation officers appointed under the *Nature Conservation Act 1992*, section 127(1); or
(iv) inspectors appointed under the *Marine Parks Act 2004*, section 52. (EP Reg., p.64)

Note: From the *Environmental Protection Regulation 2008* current as at 9 May 2014.

Schedule 2 Prescribed ERAs and aggregate environmental scores (pp.126-178)

Part 1 Aquaculture and intensive animal industry (pp.126-130)
1 Aquaculture
2 Intensive animal feedlotting
3 Pig keeping
4 Poultry farming

Part 2 Chemical, coal and petroleum products activities (pp.130-8)
5 Alcohol production
6 Asphalt manufacturing
7 Chemical manufacturing
8 Chemical storage
9 Hydrocarbon gas refining
10 Gas producing
11 Oil refining or processing
12 Plastic product manufacturing
13 Tyre manufacturing or retreading

Part 3 Energy related services (pp.139-140)
14 Electricity generation
15 Fuel burning

Part 4 Extractive activities (pp.140-2)
16 Extractive and screening activities
17
18

Part 5 Fabricated metal product activities (pp.143-4)
19 Metal forming
20 Metal recovery

Part 6 Food processing (pp.144-148)
22 Beverage production
23 Bottling and canning
24 Edible oil manufacturing or processing
25 Meat processing
26 Milk processing
27 Seafood processing
28 Sugar milling or refining

Part 7 Metal production and mineral processing activities (pp.149-151)
29 Metal foundry operation
30 Metal smelting and refining
31 Mineral processing

Part 8 Miscellaneous activities (pp.151-156)
32 Battery manufacturing
33 Crushing, milling, grinding or screening

34
35 Plaster manufacturing
36 Pulp or paper manufacturing
38 Surface coating
39 Tanning
40 Textile manufacturing

Part 9 Non-metallic mineral product manufacture (pp.156-158)
41 Cement manufacturing
42 Clay or ceramic products manufacturing
43
44 Glass or glass fibre manufacturing
45 Mineral wool or ceramic fibre manufacturing

Part 10 Sawmilling, woodchipping, and timber and laminated product manufacturing (pp.158-160)
46 Chemically treating timber
47 Timber milling and woodchipping
48 Timber and laminated product fabrication

Part 11 Transport and maritime services (pp.160-163)
49 Boat maintenance or repair
50 Bulk material handling
51 Road tunnel ventilation stack operation

Part 12 Waste management (pp.163-174)
52 Battery recycling
53 Composting and soil conditioner manufacturing
54
55 Regulated waste recycling or reprocessing
56 Regulated waste storage
57 Regulated waste transport
58 Regulated waste treatment
59 Tyre recycling
60 Waste disposal
61 Waste incineration and thermal treatment
62 Waste transfer station operation

Part 13 Water treatment services (pp.174-8)
63 Sewage treatment
64 Water treatment

Note: From the *Environmental Protection Regulation 2008* current as at 9 May 2014. Not all numbers have a corresponding ERA.

Schedule 9 Prescribed water contaminants (pp.212-215

section 77

1 a chemical, or chemical waste containing a chemical
Examples—

- biocide, including herbicide, fungicide and pesticide
- chemical that causes biochemical or chemical oxygen demand
- chemical toxicant for which guidelines are prescribed in the document 'Australian and New Zealand guidelines for fresh and marine water quality'
- degreasing agent

2 a gas other than oxygen
3 a liquid containing suspended or dissolved solids
4 a liquid that has a temperature different by more than 2ºC from ambient water temperature
5 animal matter, including dead animals, animal remains and animal excreta, and water used to clean animals, animal enclosures or vehicles used for transporting animals
6 ashes, clay, gravel, sediment, stones and similar organic or inorganic matter
7 a substance that has a pH outside the range 6.5 to 8.5
8 building and construction materials, including bitumen, brick, cement, concrete and plaster
9 building, construction and demolition waste, including bitumen, brick, concrete cuttings, plaster and waste water generated by building, construction or demolition
10 clinical waste
11 glass, metal parts, paper, piping, plastic and scrap metal
12 industrial waste
13 oil, including, for example, petroleum or vegetable based oil
14 paint, paint scrapings or residues, paint sludge, water used for diluting paint or washing painting utensils, and waste from paint stripping
15 plant matter, including, for example, bark, lawn clippings, leaves, mulch, pruning waste, sawdust, shavings, woodchip and other waste from forest products
16 putrescible waste, including, for example, food scraps
17 sewage and sewage residues, whether treated or untreated, and any other matter containing faecal coliforms or faecal streptococci, including, for example, waste water pumped out from a septic tank
18 vehicles and components of vehicles, including, for example, batteries and tyres
19 waste and waste water, generated from indoor cleaning, including, for example, waste from carpet or upholstery cleaning and steam cleaning
20 waste and waste water, generated from outdoor cleaning, including, for example, waste generated from high pressure water blasting of commercial or industrial premises, fuel dispensing areas, plant or equipment, roofs, streets, vehicles and wharves
21 waste generated from repairing or servicing motor vehicles, including, for example, engine coolant, grease, lubricants and oil
22 waste water, including backwash from swimming pools, condensate from compressors, water from air-conditioning or cooling systems and waste water from grease traps

Note: From the *Environmental Protection Regulation 2008* current as at 9 May 2014.

Water Act 2000

Current as at 18 February 2015

Chapter 2 Allocation and sustainable management

Part 1 Preliminary

10 Purpose of ch 2

(1) The purpose of this chapter is to advance sustainable management and efficient use of water and other resources by establishing a system for the planning, allocation and use of water.

(2) For subsection (1), ***sustainable management*** is management that—
(a) allows for the allocation and use of water for the physical, economic and social wellbeing of the people of Queensland and Australia within limits that can be sustained indefinitely; and
(b) protects the biological diversity and health of natural ecosystems; and
(c) contributes to the following—
(i) improving planning confidence of water users now and in the future regarding the availability and security of water entitlements; (p.49)
(ii) the economic development of Queensland in accordance with the principles of ecologically sustainable development;
(iii) maintaining or improving the quality of naturally occurring water and other resources that benefit the natural resources of the State;
(iv) protecting water, watercourses, lakes, springs, aquifers, natural ecosystems and other resources from degradation and, if practicable, reversing degradation that has occurred;
(v) recognising the interests of Aboriginal people and Torres Strait Islanders and their connection with the landscape in water planning;
(vi) providing for the fair, orderly and efficient allocation of water to meet community needs;
(vii) increasing community understanding of the need to use and manage water in a sustainable and cost efficient way;
(viii) encouraging the community to take an active part in planning the allocation and management of water;
(ix) integrating, as far as practicable, the administration of this Act and other legislation dealing with natural resources.

(3) For subsection (1), ***efficient use*** of water—
(a) incorporates demand management measures that achieve permanent and reliable reductions in the demand for water; and
(b) promotes water conservation and appropriate water quality objectives for intended use of water; and
(c) promotes water recycling, including, for example, water reuse within a particular enterprise to gain the maximum benefit from available supply; and (p.50)
(d) takes into consideration the volume and quality of water leaving a particular application or destination to ensure it is appropriate for the next application or destination, including, for example, release into the environment. (p.51)

Chapter 2

Part 2 Water rights
Division 1 Preliminary
19 Rights in all water vests in State

All rights to the use, flow and control of all water in Queensland are vested in the State.

Division 1A Authorised taking of, or interference with, water without water entitlement

Note—

See, however, section 972C (Offence to take or interfere with water if development permit required).

20 General authorisations

(1) A person may do the following—

(a) take water for a public purpose in an emergency situation;

(b) take water for fighting a fire;

(c) take water for undertaking routine testing of firefighting equipment;

(d) take, or interfere with, water to construct a bore to be used for firefighting;

(e) take water from a watercourse, lake or spring for camping purposes;

(f) take water from a watercourse, lake or spring for watering travelling stock;

(g) interfere with overland flow water. (Water Act, p.52)

Chapter 2

Part 6 Water licences and permits

Division 1 Preliminary

203 Definition for pt 6

In this part— (p.214)

owner, of land, means any of the following—

(a) the registered proprietor of the land;

(b) the lessee, sublessee or licensee of the land under the *Land Act 1994*;

(ba) the trustee of a reserve over the land or the holder of a permit to occupy the land under the *Land Act 1994*;

(c) the lessee of the land under a registered lease under the *Land Title Act 1994*;

(d) an applicant for, or the holder of, a mineral development licence or mining lease under the *Mineral Resources Act 1989*;

(e) the holder of a geothermal tenure under the *Geothermal Energy Act 2010* relating to the land;

(ea) the holder of a GHG tenure under the *Greenhouse Gas Storage Act 2009* relating to the land;

(f) the plantation licensee of a plantation licence under the *Forestry Act 1959*.

204 Purpose of pt 6

Under this part, the chief executive may grant—

(a) water licences for taking water and interfering with the flow of water, for example, by a weir; or

(b) water permits for taking water.

205 Decisions to be in accordance with plans

(1) If a water resource plan or a resource operations plan has been approved for an area, the chief executive must make decisions under this part in accordance with the plan.
(2) If the chief executive makes a decision under this part, in accordance with a water resource plan or a resource (p.215) operations plan, the chief executive is required to give, for the decision—
(a) to the extent a different decision, consistent with the plan, could have been made—an information notice; or
(b) otherwise—a notice stating the decision and the reasons for the decision.
(3) In this section—
decision includes a part of a decision.

Division 2 Water licences
Subdivision 1 Granting water licences
206 Applying for a water licence
(1) An owner of a parcel of land, or the owners of contiguous parcels of land, may apply for a water licence for the parcel or parcels and any other land of the owner or owners contiguous to the parcel or parcels—
(a) for taking water and using the water on any of the land; or
(b) to interfere with the flow of water on, under or adjoining any of the land.

(2) An application under subsection (1)(a) may be only for taking water from any of the following—
(a) a watercourse, lake or spring on or adjoining any of the land;
(b) an aquifer under any of the land;
(c) water flowing across any of the land. (p.216)

Chapter 2

Part 8 Riverine protection
Division 1 Granting permits for excavating or placing fill in a watercourse, lake or spring
266 Applying for permit to excavate or place fill in a watercourse, lake or spring
(1) A person may apply to the chief executive for a permit to do either or both of the following activities—
(a) excavate in a watercourse, lake or spring;
(b) place fill in a watercourse, lake or spring.

(2) Subsection (2A) applies if the applicant is neither of the following in relation to land that wholly contains the watercourse, lake or spring or the part of the watercourse, lake or spring where the activity is to take place—
(a) the registered owner of the land;
(b) the holder of a mineral development licence or a mining lease under the *Mineral Resources Act 1989* for the land.

(2A) The application must include the written consent of the registered owners of land—
(a) wholly containing the length of the watercourse in which the activity is to take place or the part of the lake or spring where the activity is to take place; or
(b) adjoining the watercourse, lake or spring where the activity is to take place.

(3) The application must—
(a) be made to the chief executive in the approved form; and
(b) state the proposed activity and the purpose of the activity; and (p.253)
(c) be accompanied by the fee prescribed under a regulation.

267 Additional information may be required
(1) The chief executive may require—
(a) the applicant to give additional information about the application, including, for example, a statement of environmental effects; or
(b) any information included in the application, or any additional information required under paragraph (a), to be verified by statutory declaration.
(2) If the applicant fails, without reasonable excuse, to comply with the requirement within the reasonable time stated in the requirement, the application lapses. (p.254)

Chapter 4 Water authorities
Part 1 Preliminary
542 Purposes of ch 4
The main purpose of this chapter is to establish a framework for the operation of water authorities that provides for the following—
(a) efficiency in carrying out water activities by the application of commercial principles;
(b) appropriate governance arrangements and accountability requirements;
(c) community involvement in making and implementing arrangements for using, conserving and sustainably managing water. (p.382)

Part 2 Water authorities
Division 1 General
548 Establishing water authorities
(1) A regulation may establish a water authority to carry out water activities—
(a) generally in the State; or
(b) for a particular area (the ***authority area***) identified in the regulation.

(2) The authority area may comprise 2 or more non-contiguous areas.

(3) The regulation must name the authority and, if the authority is established for an authority area, identify the authority area.

(4) After the commencement of this subsection, a regulation under subsection (1) may amend an establishment regulation but cannot establish a new water authority.

549 Categories of water authorities

A water authority may be a category 1 water authority or a category 2 water authority.

Schedule 4 Dictionary

category 1 water authority means—
(a) the Gladstone Area Water Board; or (p.676)
(b) the Mount Isa Water Board.

category 2 water authority means a water authority other than a category 1 water authority. (p.677)

Sustainable Planning Act 2009

Chapter 3 Local planning instruments

Part 2 Planning schemes
Division 1 Preliminary
79 What is a *planning scheme*
A ***planning scheme*** is an instrument that— (p.86)
(a) is made by a local government under division 2 and part 5; and
(b) advances the purpose of this Act by providing an integrated planning policy for the local government's planning scheme area.

80 Status of planning scheme
A planning scheme is a statutory instrument under the *Statutory Instruments Act 1992* and has the force of law as provided for under this Act.

81 Effects of planning scheme
A planning scheme for a planning scheme area—
(a) becomes the planning scheme for the area; and
(b) replaces any existing planning scheme applying to the area.

82 Area to which planning scheme applies
(1) A local government's planning scheme applies to all of the local government's area (the ***planning scheme area***).
(2) The local government also may apply its planning scheme for assessing prescribed tidal work in its tidal area to the extent stated in a code for prescribed tidal work.

83 Relationship with planning scheme policies
If there is an inconsistency between a planning scheme and a planning scheme policy for a planning scheme area, the planning scheme prevails to the extent of the inconsistency.
Note— For the relationship between planning schemes and State planning instruments, see sections 19 (Relationship with other instruments), 25 (Relationship with local planning instruments), 36 (Relationship with (p.87) other instruments) and 53 (Relationship with local planning instruments).

Division 2 General provisions about planning schemes
84 Power to make planning scheme
A local government may make a planning scheme for its planning scheme area.

85 Documents planning scheme may adopt
(1) The only documents made by a local government that the local government's planning scheme may, under the *Statutory Instruments Act 1992*, section 23, apply, adopt or incorporate are—
(a) a planning scheme policy; or
(b) an LGIP [local government infrastructure plan].
(2) In this section—
documents does not include the following—
(a) a development approval;
(b) an approval for an application mentioned in repealed IPA, section 6.1.26. (p.88)

Division 3 Key concepts for planning schemes
88 Key elements of planning scheme
(1) A local government and the Minister must be satisfied the local government's planning scheme—
(a) appropriately reflects the standard planning scheme provisions; and
(b) identifies the strategic outcomes for the planning scheme area; and
(c) includes measures that facilitate achieving the strategic outcomes; and
(d) coordinates and integrates the matters, including the core matters, dealt with by the planning scheme, including any State and regional dimensions of the matters. (p.90)
Note — State and regional dimensions of matters are explained in section 90.

(2) Measures facilitating achievement of the strategic outcomes include the identification of relevant—
(a) self-assessable development; and
(b) development requiring compliance assessment; and
(c) assessable development requiring code or impact assessment, or both code and impact assessment; and
(d) prohibited development, but only if the standard planning scheme provisions state the development may be prohibited development.

89 Core matters for planning scheme
(1) Each of the following are ***core matters*** for the preparation of a planning scheme—
(a) land use and development;
(b) infrastructure;
(c) valuable features.
(2) In this section—
infrastructure includes the extent and location of proposed infrastructure, having regard to existing infrastructure networks, and their capacities and thresholds for augmentation.

land use and development includes each of the following—
(a) the location of, and the relationships between, various land uses;
(b) the effects of land use and development;
(c) how mobility between places is facilitated; (SP Act, p.91)

(d) accessibility to areas;
(e) development constraints, including, but not limited to, population and demographic impacts.

valuable features includes each of the following, whether terrestrial or aquatic—
(a) resources or areas that are of ecological significance, including, for example, habitats, wildlife corridors, buffer zones, places supporting biological diversity or (p.93) resilience, and features contributing to the quality of air, water (including catchments or recharge areas) and soil;
(b) areas contributing significantly to amenity, including, for example, areas of high scenic value, physical features that form significant visual backdrops or that frame or define places or localities, and attractive built environments;
(c) areas or places of cultural heritage significance, including, for example, areas or places of indigenous cultural significance, or aesthetic, architectural, historical, scientific, social or technological significance, to the present generation or past or future generations;
(d) resources or areas of economic value, including, for example, extractive deposits, fishery resources, forestry resources, water resources, sources of renewable and non-renewable energy and good quality agricultural land.

90 State, regional and local dimensions of planning scheme matters
(1) A matter, including a core matter, in a planning scheme may have local, regional or State dimensions.
(2) A local dimension of a planning scheme matter is a dimension that is within the jurisdiction of local government but is not a regional or State dimension. (p.92)
(3) A regional dimension of a planning scheme matter is a dimension—
(a) about which a regional planning committee report makes a recommendation; or
(b) reflected in a regional plan; or
(c) that can best be dealt with by the cooperation of 2 or more local governments.
(4) A State dimension of a planning scheme matter, including a matter reflected in a State planning policy, is a dimension of a State interest. (SP Act, p.93)

Chapter 3 Local planning instruments

Part 4 Planning scheme policies
Division 1 Preliminary
108 What is a *planning scheme policy*
A ***planning scheme policy*** is an instrument that—
(a) is made by a local government under division 2 and part 5; and
(b) supports the local dimension of a planning scheme; and
(c) supports local government actions under this Act for IDAS and for making or amending its planning scheme.
109 Status of planning scheme policy
A planning scheme policy is a statutory instrument under the *Statutory Instruments Act 1992* and has the force of law as provided for under this Act. (p.102)

110 Effect of planning scheme policy
A planning scheme policy for a planning scheme area—
(a) becomes a policy for the area; and
(b) if the policy states that it replaces an existing policy—replaces the existing policy.

111 Area to which planning scheme policy applies
A planning scheme policy may apply to all or only part of a planning scheme area.

112 Relationship with other planning instruments
To the extent a planning scheme policy is inconsistent with another planning instrument, the other planning instrument prevails.

Division 2 General matters about planning scheme policies
113 Power to make planning scheme policy
A local government may make a planning scheme policy for all or a part of its planning scheme area.

114 Content of planning scheme policy
(1) A planning scheme policy may only do 1 or more of the following— (p.103)
(a) state information a local government may request for a development application;
(b) state the consultation the local government may carry out under section 256;
(c) state actions a local government may take to support the process for making or amending its planning scheme;
(d) contain standards identified in a code;
(e) include guidelines or advice about satisfying assessment criteria in the planning scheme.
(2) Subsection (1) applies despite section 109. (p.104)

State Planning Policy (2013) [with relevant July 2014 amendments as noted]

Part A: Introduction and policy context (pp.4-8)

Applying and implementing the SPP
Through the SPP, the state sets out the interests that must be addressed through local government planning schemes, regional plans and when making decisions about the designation of land for community infrastructure.

Rather than mandate prescriptive processes, the SPP has a strong emphasis on finding solutions which are regionally, locally and site appropriate. It does this by outlining what outcomes must be achieved in relation to state interests, while enabling local government to determine how best to do this for their particular community. It encourages flexible and locally appropriate approaches to planning that reflect the state's interests while meeting the needs and priorities of local government and their communities.

While the policies around matters of state interest included in the SPP must be integrated into local government planning schemes, some state interests also include development assessment requirements for certain applications. These development assessment requirements apply only if the planning scheme has not yet appropriately integrated the SPP. This will usually be because the preparation of a local planning scheme preceded the SPP. Over time, as new planning

schemes are introduced or existing ones are amended to integrate the SPP, these development assessment provisions will progressively become redundant.

Making or amending a local planning scheme
Under section 117(1) of the planning Act, which refers to making or amending a planning scheme, a local government must follow the process stated in a guideline.

In addition to setting out the minimum requirements a local government must follow for making or amending a local planning instrument, the guideline also outlines the participation of the state in the process. The overall focus is to ensure that state interests in land use planning and development are appropriately integrated in new or amended planning schemes.

At the time of formal state interest review, the local government must demonstrate to the Minister that they have considered and integrated the interests, using an evidence-based approach to forming the planning scheme.

The state will work with local government to determine the level and type of evidence required to demonstrate that the state interests in the SPP have been appropriately considered and integrated.

Relationship to other planning instruments and processes
The SPP operates as part of Queensland's broader planning and development assessment system. The diagram opposite shows the hierarchy of planning instruments, and where the SPP sits in relation to other planning instruments. (p.6)

Sustainable Planning Act 2009
The Sustainable Planning Act 2009 (the planning Act) is the overarching framework for Queensland's planning and development system.
Sustainable Planning Regulation 2009
The regulation supports the application of the planning Act.

State Planning Regulatory Provisions
State planning regulatory provisions (SPRP) are statutory instruments that regulate development and can apply to all or part of the state.

State Planning Policy
The State Planning Policy (SPP) is a single whole-of-government document that expresses the state's interests in land use planning and development in a comprehensive manner.

Regional Plans
Regional plans provide the strategic direction to achieve regional outcomes that align with the state's interest in land use planning and development.

Standard Planning Scheme Provisions
(Queensland Planning Provisions)
Standard planning scheme provisions provide a consistent format and structure for local government planning schemes across Queensland.

Local Planning Instruments
(Planning Schemes)
Planning schemes describe a local government's plan for the future direction of its local government area. Planning schemes provide a detailed direction focusing on community planning and aspirations, while ensuring the needs of the state and the region are incorporated.

(p.7)

The state interests (from Part D, pp.15 - 43)

Liveable communities and housing

- Liveable communities
- Housing supply and diversity

Economic growth

- Agriculture
- Development and construction
- Mining and extractive resources
- Tourism

Environment and heritage

- Biodiversity
- Coastal environment
- Cultural heritage
- Water quality

Safety and resilience to hazards

- Emissions and hazardous activities
- Natural hazards, risk and resilience

Infrastructure

- Energy and water supply
- State transport infrastructure
- Strategic airports and aviation facilities
- Strategic ports

(Included in diagrams on p.5 and 15)

The preamble about the **water quality state interest** is included in the text box below.

Water quality

Why is water quality of interest to the state?

Queensland is home to a diverse range of waters from the upland streams of the Great Dividing Range and inland waters out to the coastal waters of the iconic Great Barrier Reef and Moreton Bay.

Healthy lakes, streams, wetlands, groundwaters, coastal waters and catchments are an integral part our lifestyle and economy, to which we associate many environmental values, including aquatic ecosystems, agriculture, industry (including mining), recreational use, drinking water, fishing, and cultural and spiritual values.

In order to protect this valuable resource, and enhance the environmental values of Queensland waters, catchments should be managed sustainably. This means that the planning, design,

construction and operation of development should be undertaken in a manner that protects water environmental values and maintains or enhances water quality.

All elements of the water cycle are interdependent. Therefore, it is important that water use is managed on a total water cycle basis, balancing uses of water, maximising opportunities for recovery and reuse and avoiding or minimising impacts of stormwater and waste water discharge to receiving waters. This will lead to the protection and enhancement of the environmental values of receiving waters including high ecological value (HEV) waters, freshwaters, estuaries, rivers and creeks, bays, groundwaters and the Great Barrier Reef.

Water sensitive urban design (WSUD) is an important approach to the planning and design of urban environments. WSUD measures (such as bio-retention basins, grassed swales and artificial wetlands) can help to protect environmental values by managing the impacts of stormwater runoff. Stormwater and erosion management controls during the construction phase are key to minimising impacts during land development.

Protecting Queensland's water quality can strengthen the Queensland economy and support positive social and environmental outcomes by:

- maintaining and/or enhancing opportunities for economic development including agriculture, fisheries, mining and tourism activities;
- reducing demand/impacts on drainage infrastructure and water supply treatment costs;
- improving amenity and opportunities for recreation and tourism in urban and rural environments;
- supporting the natural water cycle, ecological health and a healthy drinking water supply.

(SPP 2013, p.30)

The section of SPP 2013 about incorporation of state interests in planning schemes, with respect to water quality, is provided in the text box below. Additional guidance is provided in State Planning Policy Guideline: State interest—water quality (State of Queensland, December 2013).

State interest—water quality

The environmental values and quality of Queensland waters are protected and enhanced.

Making or amending a planning scheme and designating land for community infrastructure

The planning scheme is to appropriately integrate the state interest by:

For receiving waters:

(1) facilitating the protection of environmental values and the achievement of water quality objectives for Queensland waters, and

(2) identifying land for urban or future urban purposes in areas which avoid or minimise the disturbance to natural drainage and acid sulfate soils, erosion risk, impact on groundwater and landscape features, and

(3) including requirements that development for an urban purpose is located, designed, constructed and/or managed to avoid or minimise:
(a) impacts arising from:
i. altered stormwater quality or flow, and
ii. waste water (other than contaminated stormwater and sewage), and
iii. the creation or expansion of non-tidal artificial waterways, such as urban lakes, and
(b) the release and mobilisation of nutrients that increase the risk of algal blooms, and
(4) adopting the applicable stormwater management design objectives relevant to the climatic region[8], outlined in Tables A and B (Appendix 3), or demonstrate current best practice environmental management for development that is for an urban purpose, and
(5) facilitating innovative and locally appropriate solutions for urban stormwater management that achieve the relevant urban stormwater management design objectives, and
(6) planning for safe, secure and efficient water supply, and
(7) including requirements that development in water resource catchments is undertaken in a manner which contributes to the maintenance and enhancement (where possible) of water quality to protect the drinking water and aquatic ecosystem environmental values in those catchments, and

For development in a water supply buffer area[9]:
(8) including requirements that development complies with the specific outcomes and measures contained in the Seqwater Development Guidelines: Development Guidelines for Water Quality Management in Drinking Water Catchments 2012 or similar development assessment requirements, and

Acid sulfate soils:
(9) in an acid sulfate soil affected area, protecting the natural and built environment (including infrastructure) and human health from the potential adverse impacts of acid sulfate soils by:
(a) identifying areas with high probability of containing acid sulfate soils, and
(b) providing preference to land uses that will avoid or minimise the disturbance of acid sulfate soils, and
(c) including requirements for managing the disturbance of acid sulfate soils to avoid or minimise the mobilisation and release of contaminants.

Notes:
8. Mapping of climatic regions for stormwater management design objectives is available on the SPP Interactive Mapping System.
9. Water supply buffer areas are relevant to South East Queensland only and are mapped in the SPP Interactive Mapping System. The requirements of the Seqwater Development Guidelines do not apply within urban areas (as defined by the Sustainable Planning Regulation 2009). (SPP 2013, p.31)

Part E of the single SPP "*includes interim development assessment requirements to ensure that state interests are appropriately considered by local government when assessing development applications where the local government planning scheme has not yet appropriately integrated the state interests in the SPP*." (SPP, p.44)

The Part E components of SPP 2013 relevant to water quality and the development assessment process are shown in the text box below (generally carried over from SPP 4/10 Healthy Waters).

State interest—water quality

These requirements apply to development applications as follows:

Receiving waters—a development application for any of the following:

(1) a material change of use for urban purposes that involves a land area greater than 2500 square metres that:

(a) will result in an impervious area greater than 25 per cent of the net developable area, or

(b) will result in six or more dwellings, or

(2) reconfiguring a lot for urban purposes that involves a land area greater than 2500 square metres and will result in six or more lots, or

(3) operational works for urban purposes that involve disturbing more than 2500 square metres of land.

Water supply catchment in South East Queensland (Note: development applications not relevant to the GBR catchment and not included here)

Acid sulfate soils—a development application that relates to:

(1) an acid sulfate soils affected area, and

(2) land at or below five metres Australian Height Datum (AHD) where the natural ground level is below 20 metres AHD, if the application is for a material change of use, or operational works, involving:

(a) excavating or otherwise removing 100 cubic metres or more of soil or sediment, or

(b) filling of land with 500 cubic metres or more of material with an average depth of 0.5 metres or more.

The development application is to be assessed against the following requirements:

For a development application mentioned under the heading 'Receiving waters'

Development:

(1) avoids or otherwise minimises adverse impacts on the environmental values of receiving waters, arising from:

(a) altered stormwater quality or flows, and

(b) wastewater (other than contaminated stormwater and sewage), and

(c) the creation or expansion of non-tidal artificial waterways, and

(2) by demonstrating it complies with the SPP code: Water quality (Appendix 3).(SPP July 2014, p.48)

For a development application mentioned under the heading 'Water supply catchment in South East Queensland' (Note: requirements not relevant to the GBR catchment and not included here)

For a development application mentioned under the heading 'Acid sulfate soils'
Development:
(1) avoids the disturbance of acid sulfate soil by:
(a) not excavating or otherwise removing soil or sediment that contains acid sulfate soil (ASS), and
(b) not permanently or temporarily extracting groundwater that results in aeration of previously saturated ASS, and
(c) not undertaking filling that results in moving ASS below the water table, or
(2) ensures that the disturbance of ASS avoids or minimises the mobilisation release of acid and metal contaminants by:
(a) neutralising existing acidity and preventing the generation of acid and metal contaminants, and
(b) preventing the release of surface or groundwater flows containing acid and metal contaminants into the environment. (SPP July 2014, p.49)

The SPP code: Water quality (Appendix 3), that a development application for 'receiving waters' must comply with to be approved is provided in the text box below.

Appendix 3
SPP code: Water quality
Purpose
The purpose of the SPP code: Water quality (see Table 1) is to ensure development is planned, designed, constructed and operated to manage stormwater and wastewater in ways that support the protection of environmental values identified in the *Environmental Protection (Water) Policy 2009*. (p.69)

Table 1: SPP Code for Water Quality State Interest

Performance outcomes	Acceptable outcomes
Plan to avoid/minimise new impacts	
PO1 The development is planned and designed considering the land use constraints of the site for achieving stormwater design objectives	**AO1.1** A site stormwater quality management plan (SQMP) is prepared, and: a. is consistent with any local area stormwater management planning, and b. provides for achievable stormwater quality treatment measures meeting design objectives listed below in Table A (construction phase) and Table B (post construction phase), or current best practice environmental managements, reflecting land use constraints, such as: • erosive, dispersive, sodic and/or saline soil types • landscape features (including landform) • acid sulfate soil and management of nutrients of concern • rainfall erosivity. Editor's note: Local area stormwater management planning may include Urban Stormwater Quality Management Plans, or Catchment or waterway management plans, Healthy Waters Management Plans, Water Quality Improvement Plans, Natural Resource Management Plans. (p.69) [***added*** July 2014]
PO2 Development does not discharge wastewater to a waterway or off site unless demonstrated to be best-practice environmental management for that site	**AO2.1** A wastewater management plan (WWMP) is prepared by a suitably qualified person and addresses: a. wastewater type, and b. climatic conditions, and c. water quality objectives (WQOs), and d. best-practice environmental management, and **AO2.2** The WWMP provides that wastewater is managed in accordance with a waste management hierarchy that: a. avoids wastewater discharges to waterways, or b. if wastewater discharge to waterways cannot practicably be avoided, minimises wastewater discharge to waterways by re-use, recycling, recovery and treatment for disposal to sewer, surface water and groundwater.
PO3 Any non-tidal artificial waterway is located in a way that is compatible with the land use constraints of the site for protecting water environmental values in existing natural waterways	**AO3.1** If the proposed development involves a non-tidal artificial waterway: a. environmental values in downstream waterways are protected, and b. any groundwater recharge areas are not affected, and c. the location of the waterway incorporates low lying areas of a catchment connected to an existing waterway, and d. existing areas of ponded water are included, and **AO3.2** Non-tidal artificial waterways are located: a. outside natural wetlands and any associated buffer areas, and b. to minimise disturbing soils or sediments, and c. to avoid altering the natural hydrologic regime in acid sulfate soil and nutrient hazardous areas.
PO4 Any non-tidal artificial waterway is located in a way	**AO4.1** Where a non-tidal artificial waterway is located adjacent to, or is connected to, a tidal waterway by means of a weir, lock, pumping system or similar:

that is compatible with existing tidal waterways	a. there is sufficient flushing or a tidal range of >0.3 m, or b. any tidal flow alteration does not adversely impact on the tidal waterway, or c. there is no introduction of salt water into freshwater environments. (p.70)
Design to avoid/minimise new impacts	
PO5 Stormwater does not discharge directly to a non-tidal artificial waterway without treatment to manage stormwater quality management	**AO5.1** Any non-tidal artificial waterway is designed and managed for any of the following end-use purposes: a. amenity including aesthetics, landscaping and recreation, or b. flood management, or c. stormwater harvesting as part of an integrated water cycle management plan, or d. aquatic habitat, and **AO5.2** The end-use purpose of any non-tidal artificial waterway is designed and operated in a way that protects water environmental values.
Construct to avoid/minimise new impacts	
PO6 Construction activities for the development avoid or minimise adverse impacts on stormwater quality.	**AO6.1** An erosion and sediment control plan (ESCP) demonstrates that release of sediment-laden stormwater is avoided for the nominated design storm, and minimised when the nominated design storm is exceeded, by addressing design objectives listed below in Table A (construction phase) or local equivalent, for: a. drainage control, and b. erosion control, and c. sediment control, and d. water quality outcomes, and **AO6.2** Erosion and sediment control practices (including any proprietary erosion and sediment control products) are designed, installed, constructed, operated, monitored and maintained, and any other erosion and sediment control practices are carried out in accordance with local conditions and appropriate recommendations from a suitably qualified person, or **AO6.2** The ESCP demonstrates how stormwater quality will be managed in accordance with an acceptable regional or local guideline so that target contaminants are treated to a design objective at least equivalent to Acceptable Outcome AO6.1. (p.71)
Operate to avoid/minimise new impacts	
PO7 Operational activities for the development avoid or minimises changes to waterway hydrology from adverse impacts of altered stormwater quality and flow.	**AO7.1** Development incorporates stormwater flow control measures to achieve the design objectives set out below in Table A (construction phase) and Table B (post construction phase). Both the construction and operational phases for the development comply with design objectives in Table A (construction phase), and Table B (post construction phase), or current best practice environmental management, including management of frequent flows, peak flows, and construction phase hydrological impacts.
PO8 Any treatment and disposal of waste water to a waterway accounts for:	**AO8.1** Implement the WWMP prepared in accordance with AO2.1.

• the applicable water quality objectives for the receiving waters, and • adverse impact on ecosystem health or receiving waters, and • in waters mapped as being of high ecological value, the adverse impacts of such releases and their offset.	
PO9 Wastewater discharge to a waterway is managed in a way that maintains ecological processes, riparian vegetation, waterway integrity, and downstream ecosystem health	**AO9.1** Wastewater discharge waterways is managed to avoid or minimize the release of nutrients of concern so as to minimize the occurrence, frequency and intensity of coastal algal blooms, and **AO9.2** Development in coastal catchments avoids or minimises and appropriately manages soil disturbance or altering natural hydrology, and **AO9.3** Development in coastal catchments: a. avoids lowering groundwater levels where potential or actual acid sulfate soils are present, and b. manages wastewaters so that: (i) the pH of any wastewater discharged is maintained between 6.5 and 8.5 to avoid mobilisation of acid, iron, aluminium, and metals, and (ii) holding times of neutralised wastewaters ensures the flocculation and removal of any dissolved iron prior to release, and (iii) visible iron floc is not present in any discharge, and (iv) precipitated iron floc is contained and disposed of, and (v) wastewater and precipitates that cannot be contained and treated for discharge on site are removed and disposed of through trade waste or another lawful method. (p.72)
PO10 Any non-tidal artificial waterway is managed and operated by suitably qualified persons to achieve water quality objectives in natural waterways.	**AO10.1** Any non-tidal artificial waterway is designed, constructed and managed under the responsibility of a suitably qualified registered professional engineer, Queensland (RPEQ) with specific experience in establishing and managing artificial waterways, and **AO10.2** Monitoring and maintenance programs adaptively manage water quality in any non-tidal artificial waterway to achieve relevant water-quality objectives downstream of the waterway, and **AO10.3** Aquatic weeds are managed in any non-tidal artificial waterway to achieve a low percentage of coverage of the water surface area (less than 10%). Pests and vectors (such as mosquitoes) are managed through avoiding stagnant water areas, providing for native fish predators, and any other best practices for monitoring and treating pests, and **AO10.4** Any non-tidal artificial waterway is managed and operated by a responsible entity under agreement for the life of the waterway. The responsible entity is

	to implement a deed of agreement for the management and operation of the waterway that: a. identifies the waterway, and b. states a period of responsibility for the entity, and c. states a process for any transfer of responsibility for the waterway, and d. states required actions under the agreement for monitoring the water quality of the waterway and receiving waters, and e. states required actions under the agreement for maintaining the waterway to achieve the outcomes of this code and any relevant conditions of a development approval, and f. identifies funding sources for the above, including bonds, headworks charges or levies. (**p.73**)

Table A (construction phase) and Table B (post construction phase) design objectives for stormwater management mentioned in Acceptable outcome AO1.1 are reproduced below as Table 2 (Table A) and Table 3 (Table B).

Table 2: Construction Phase Design Objectives

Issue		Design objectives
Drainage control	Temporary drainage works	1. Design life and design storm for temporary drainage works: • Disturbed area open for <12 months—1 in 2-year ARI event • Disturbed area open for 12–24 months—1 in 5-year ARI event • Disturbed area open for > 24 months—1 in 10-year ARI event 2. Design capacity excludes minimum 150 mm freeboard 3. Temporary culvert crossing—minimum 1 in 1-year ARI hydraulic capacity
Erosion control	Erosion control measures	1. Minimise exposure of disturbed soils at any time 2. Divert water run-off from undisturbed areas around disturbed areas 3. Determine the erosion risk rating using local rainfall erosivity, rainfall depth, soil-loss rate or other acceptable methods 4. Implement erosion control methods corresponding to identified erosion risk rating
Sediment control	Sediment control measures	Design storm for sediment control basins Sediment basin dewatering 1. Determine appropriate sediment control measures using: • potential soil loss rate, or • monthly erosivity, or • average monthly rainfall 2. Collect and drain stormwater from disturbed soils to sediment basin for design storm event: • design storm for sediment basin sizing is 80th% five-day event or similar 3. Site discharge during sediment basin dewatering: • TSS < 50 mg/L TSS, and • Turbidity not >10% receiving waters turbidity, and • pH 6.5–8.5
Water quality	Litter and other waste, hydrocarbons and other contaminants	1. Avoid wind-blown litter; remove gross pollutants 2. Ensure there is no visible oil or grease sheen on released waters 3. Dispose of waste containing contaminants at authorised facilities

Waterway stability and flood flow management	Changes to the natural waterway hydraulics and hydrology	1. For peak flow for the 1-year and 100-year ARI event, use constructed sediment basins to attenuate the discharge rate of stormwater from the site

Note: Construction phase stormwater management design objectives apply to all climatic regions. (SPP July 2014, p.74)

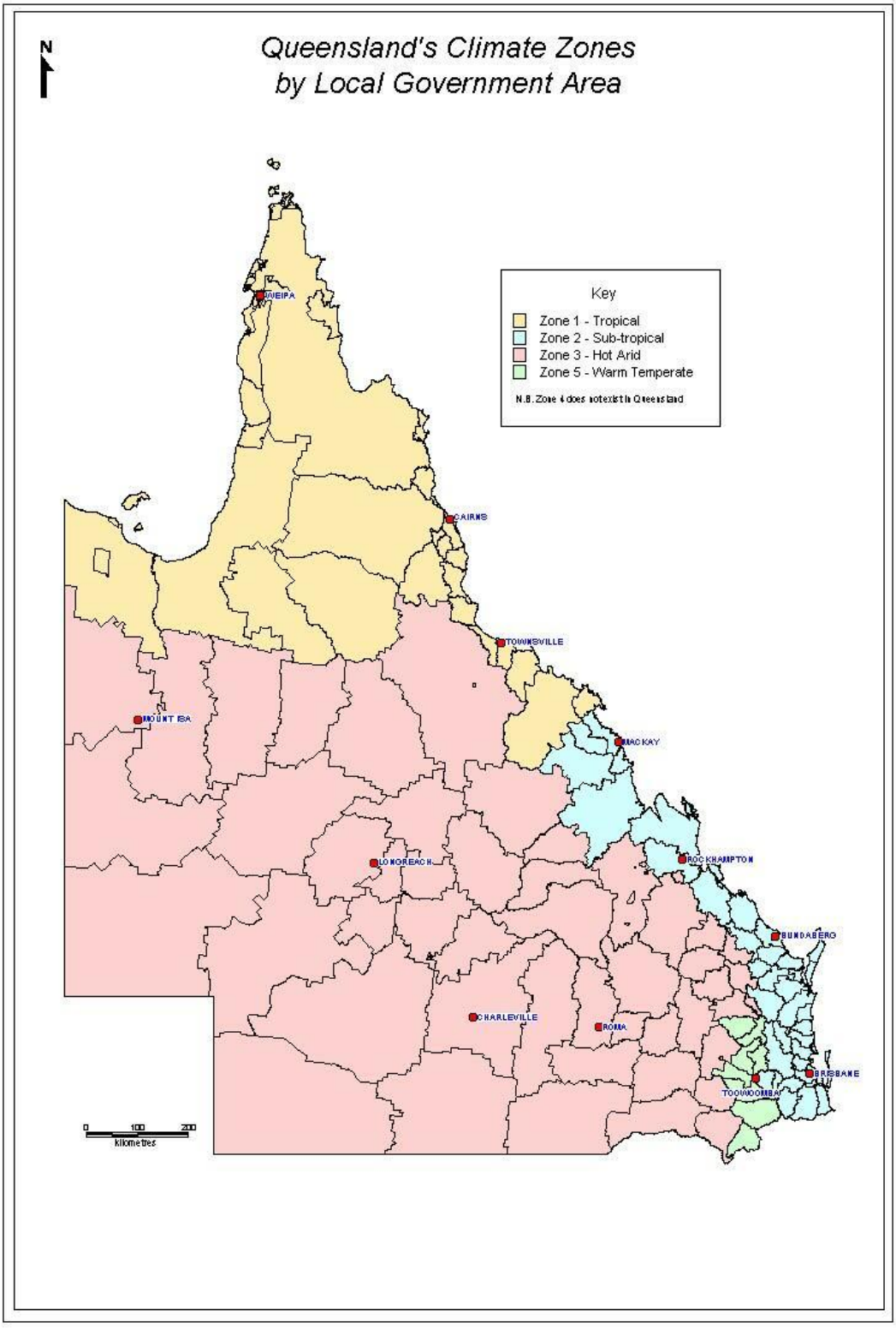
Table 3: Post Construction Phase Design Objectives

Climatic region (Refer SPP Interactive Mapping System)	**Design objectives** Minimum reductions in mean annual load from unmitigated development (%)				**Application**
	Total suspended solids (TSS)	**Total phosphorus** (TP)	**Total nitrogen** (TN)	**Gross pollutants >5 mm**	
South East Queensland	80	60	45	90	Development for urban purposes within population centres greater than 3000 persons.
Central Queensland (south)	85	60	45	90	As above.
Central Queensland (north)	75	60	40#	90	As above. # Mackay Regional Council has adopted a 35% reduction for TN.
Dry Tropics	80	60*	40	90	As above. *Townsville City Council has adopted a 65% reduction for TP.
Wet Tropics	80	60	40	90	As above.
Cape York/FNQ	80	60	40	90	Development for urban purposes within population centres greater than 25,000 persons.
Western Queensland	85	60	45	90	As above.
All	NA	NA	NA	NA	Excludes development that is less than 25% impervious. In lieu of modelling, the default bio-retention treatment area to comply with load reduction targets for all Queensland regions is 1.5% of the contributing catchment area.
	Waterway stability management • Limit the peak 1-year ARI event discharge within the receiving waterway to the pre-development peak 1-year ARI event discharge.				Catchments contributing to un-lined receiving waterway. Local government may not require compliance if the waterway is degraded. For peak flow for the 1-year ARI event, use collocated storages

		to attenuate site discharge rate of stormwater. (SPP July 2014, p.75)

Note: Climatic regions for post construction phase stormwater management design objectives are shown in Figure 1.

Figure 1 Climatic Zones



Note: Source is http://www.ehp.qld.gov.au/media/management/sustainability/housing/climate_zones_map.jpg

Appendix B: Urban Water Quality Delivery Model

Local Government Responsibility for Urban Water Cycle Management
Local government responsibility for total water cycle management in the urban setting includes; potable water supply, wastewater treatment (point source), installation and maintenance of stormwater management systems (principally for flood mitigation), assessment management of coastal development applications and ensuring compliance with development approval conditions.

Reef Scientific Consensus
The Reef Scientific Consensus statement associated with the Reef Plan (2013) states "*that the impact from urban areas may be locally and, over short time periods, highly significant*". The statement says "may" as the real impacts of urban land use have not been adequately investigated or documented due to the Reef Plan focus on agricultural land use issues. With the inevitable population increase and ongoing coastal development it is essential to direct investment to first understand the impacts of urban development and urban land use on Reef water quality and then provide strategic support for local government to manage and reduce the impacts of population growth and the expanding urban footprint.

Reef 2050 Long Term Sustainability Plan
The release of the Reef 2050 Long Term Sustainability Plan (LTSP) in March 2015 and the inclusion of urban, industry and port specific management actions appeared to mark the start of a concerted effort to protect the GBR from the pressure and impacts of population growth and coastal development.

A summary of the Reef 2050 LTSP actions by action themes that involve local government is provided in Table 1. As with previous Reef Plans local government is expected to be actively involved in water quality improvement above and beyond its legislative responsibilities with no injection of resources to meet the challenge.

Table 1: Key Urban Reef 2050 LTSP Management Actions

Action theme	No.	1	2	3	T	%
Ecosystem Health (EH)	32	5	3	11	19	59%
Biodiversity (B)	25	1	1	3	5	20%
Heritage (H)	11	0	0	4	4	36%
Water Quality (WQ)	24	12	0	1	13	54%
Community Benefits (CB)	13	7	3	2	12	92%
Economic Benefits (EB)	18	0	0	1	1	6%
Governance (G)	16	3	0	8	11	69%

Note; The actions from Appendix I of the Reef 2050 LTSP have been grouped according to the three categories below.
1 is local government is nominated as a lead partner and the action is clearly relevant to local government;
2 is actions nominating local government as a lead where local government relevance is unclear and/or there are insufficient resources and/or capacity for local government to be meaningfully involved;
3 is actions relevant to Local government and/or LGAQ where local government is not specifically mentioned (LGAQ may be nominated).
No. is the number of theme actions. T is total actions that are or could be relevant to local government and will or may require local government involvement and/or leadership. % is T as a percentage of the No. of actions for each theme.

Old Model - New Model

The recent inclusion of urban specific water quality improvement actions in the Reef 2050 LTSP has generated a need to develop the most effective delivery model for urban areas to maximise Reef outcomes from the use of taxpayer/community funds (see Reef 2050 LTSP Governance actions and Community Benefit actions in particular GA2 to GA7, GA10 and GA12 to GA15 and CBA4 to CBA9 and CBA11 to CBA13 in Table 1 above and Attachment 2).

Providing urban water quality improvement funding directly to the key urban water cycle managers i.e. local government, regional organisation of Councils (ROC) and collaborations such as RUSMIG/Water by Design and Reef Guardian Councils, is the most efficient and effective delivery model. The model, amongst other things, reduces the 'traditional' expenditure of 15% off total NRM funding on project administration, monitoring and reporting to an estimate of between 3% and 8%, depending on the funding amount. The proposed delivery model for urban water quality improvement is illustrated in Figure 1.

Great Barrier Reef catchment scale delivery

The GBR catchment scale delivery component will extend the work commenced by the RUSMIG/Water by Design ***Collaboration to the rescue*** project and regain the momentum generated by RUSMIG through that project. It will also provide some much needed coordination and guidance for foundation activities that to date have been piecemeal, incomplete or not undertaken due to local government resource limitations and capacity constraints.

As the previous focus of Reef Rescue was agricultural land uses urban and industrial areas have been relatively neglected with data about the overall contribution of these intensive land uses to GBR pollutant loads and to water quality improvement being relatively sparse. The cumulative impacts of population growth and coastal development into the future also needs to be analysed as this growth will be ongoing and will continue to contribute a greater proportion of the GBR pollutants over time if left unaddressed This lack of knowledge is particularly acute at the sub catchment level where urban land use and coastal development is dominant or co-dominant and applies to both diffuse source and point source discharge to receiving waters (see Gunn 2014).

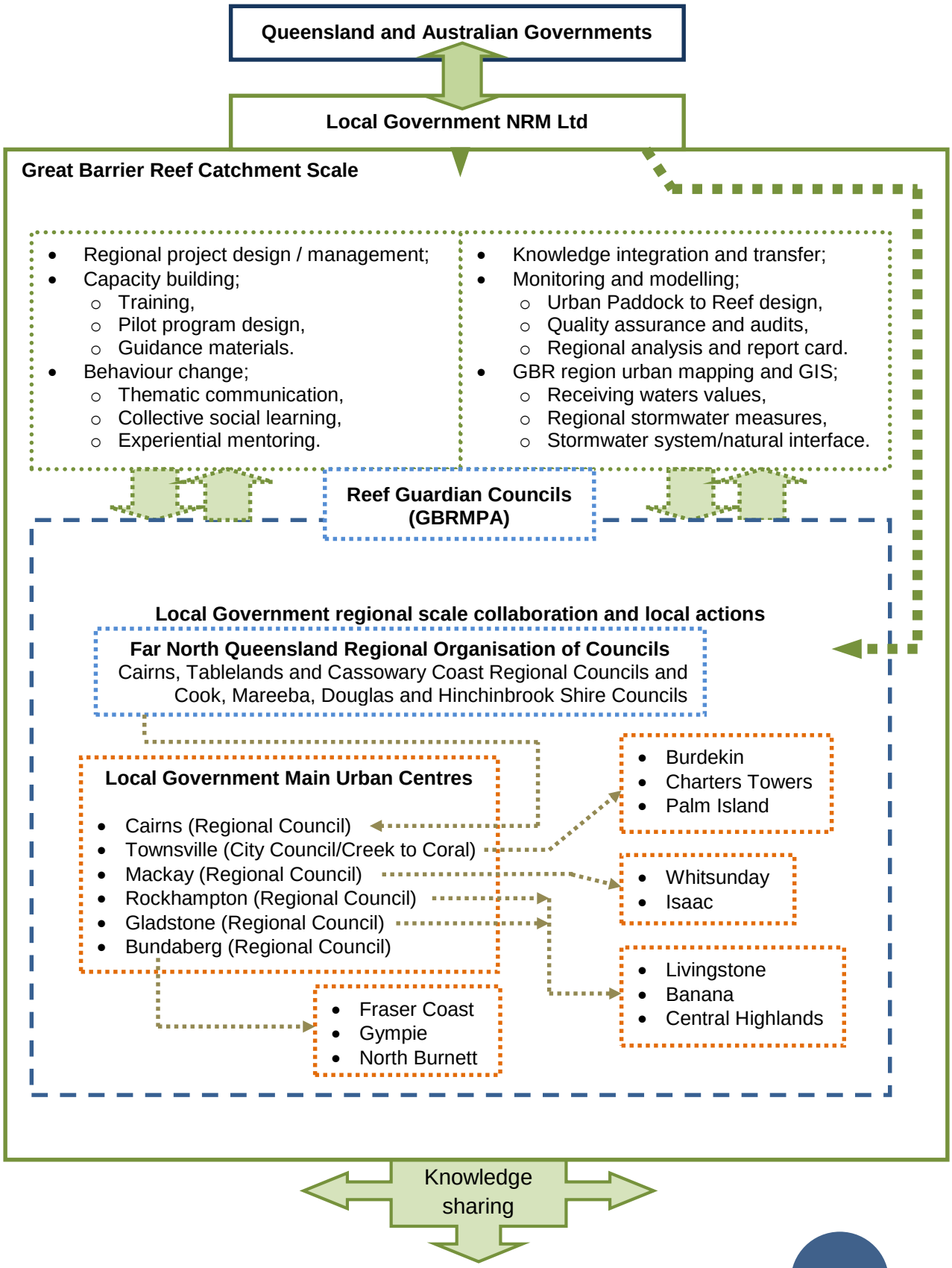
Cross GBR and/or foundation activities include:

- Profiling urban sub catchments in the context of the GBR catchment to identify water quality issues, pollutant sources and potential contributions to end of catchment loads discharging to the GBR;
- Defining population growth trends and identifying emerging urban areas and coastal development and the likely impact of these over time (diffuse source and point source);
- Collation and analysis of water quality and ecosystem health data relevant to urban sub catchments to contribute to a better understanding of water quality and ecosystem health condition and trends;
- Development of the urban (Suburb) Paddock to Reef monitoring and modelling program to be nested in the GBR Integrated Monitoring and Reporting Program;
- Quantification of the effectiveness of water sensitive urban design (WSUD) measures and other stormwater management practices as part of the Suburb to Reef monitoring and modelling program;Calibration (or recalibration) of urban water quality e.g. MUSIC, and catchment models e.g. SOURCE, used to estimate effects of WSUD and other stormwater quality management

measures for use in bioeconomic modelling, target setting and monitoring outcomes/progress of water quality improvement practices;

- Identification and prioritisation of locations for local and regional urban water quality improvement measures in a catchment planning and total water cycle management context (as per the NWQMS);
- Further development and refinement of the urban land use ABCD management practice framework for water quality improvement and ecosystem health outcomes commenced through ***Collaboration to the rescue*** including weighting and scoring environmental and socio-economic related management practices;
- Further development and refinement of the urban land use water quality improvement plan guidance commenced through ***Collaboration to the rescue*** including a an urban WQIP summary and/or template;
- Development of a Communication and Implementation Strategy for Urban (Community and Industry) Awareness, Engagement and Behavior Change.

Figure 1: Draft Urban Water Quality Improvement Delivery Model



Local and regional scale delivery
The second component of the local government delivery model is to provide the main urban local governments in the GBR catchment (see below) with funds to implement local urban water quality improvement actions.

- Cairns Regional Council via FNQROC;
- Townsville City Council via the Creek to Coral initiative;
- Mackay Regional Council;
- Rockhampton Regional Council and Livingstone Shire Council (de-amalgamated 2014);
- Gladstone Regional Council;
- Bundaberg Regional Council.

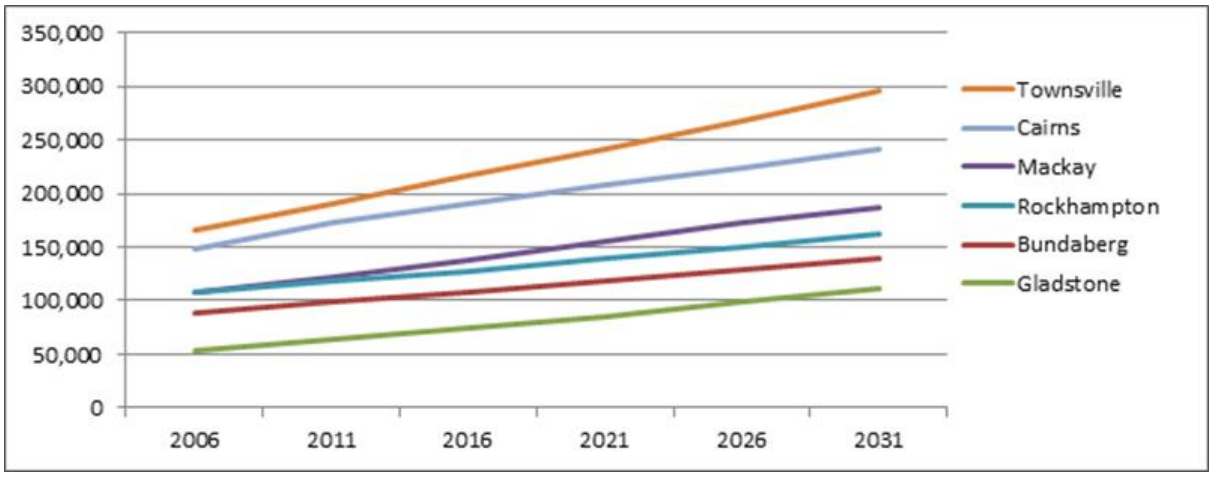
(**Note**: This component will also involve regional collaboration of larger Councils with neighbouring Councils with smaller urban centres as happened in the ***Collaboration to the rescue*** project)

Council specific implementation will involve local components of foundation activities and on ground actions along with collaborative involvement in the design of GBR wide urban initiatives and the agglomeration of local and regional data. This will help provide a GBR wide picture of the pollutant contribution of urban and industrial land use to local and GBR waters while advancing urban water quality improvement through immediate implementation of previously identified no regrets actions.

Foundation Activity Focus - Main Urban Centres
In terms of pollutant generation capacity per hectare and the social context urban water quality is a significant issue in the Great Barrier Reef catchment. The impact of urban areas on water quality is now reasonably well understood and these impacts are set to increase significantly over the next 30 years. While urban areas constitute only 0.6% of the GBR catchment they contain over 80% of the GBR catchment's population.

Projected population growth for the main urban GBR centres is shown in Figure 2. These projections will be updated as part of the foundation activities as centres with higher growth rates are associated with mining and industrial centres (Mackay, Gladstone and Townsville) and given the downturn in economic activity in those sectors the growth projections may have been downgraded.

Figure 2: Main GBR Urban Centres Projected Population Growth



These centres will be the initial focus of foundation activities as they representative the greatest risk to local and GBR water quality and ecosystem health from urban land use.

Specific Local Government actions

A preliminary list of specific local government actions has been compiled from sources including:

- Feedback at previous RUSMIG meetings;
- Feedback from the ***Collaboration to the rescue*** project including prioritisation workshops and surveys;
- Urban actions included in Water Quality Improvement Plan (WQIP) updates;
- Discussions with Council staff about water quality issues and implementation of the State Planning Policy (stormwater management objectives) and the Environmental Protection (Water) Policy;
- Generic foundation urban water quality urban activities identified through the Townsville WQIP and RUSMIG.

The results of this initial compilation will be more closely explored with each local government during the first phase of the Urban Water Quality Improvement Program (UWQIP) and a resource allocation and implementation plan prepared for overall delivery of urban water quality improvement outcomes to assist achieve the outcomes of the Reef 2050 LTSP.

Urban Equity and Contribution to Water Quality Improvement

Urban expansion due to population growth is inevitable. In a country where the majority of the population lives in urban centres in relatively close proximity to the coast it is desirable that the urban population supports efforts to protect the GBR. Working on urban water quality issues as well as rural water quality issues in proportion to the issue will increase the equity of urban taxpayers in the outcome and allow the 'forgotten' GBR land use to catch up in terms of contributing to solutions.

Our country, Our future.

Fitzroy Basin Association Incorporated
PO Box 139, Rockhampton QLD 4700
Phone: (07) 4999 2800
Fax: (07) 4921 2860

www.fba.org.au

FITZROY BASIN ASSOCIATION