BUNDABERG
REGIONAL COUNCIL

Building Australia's best regional community

Stormwater Management Guidelines

Part 2 – Stormwater Quality Assessment

Revision 3 – July 2023

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Revision History

Rev	Revision Date	Author	Details	Approved
3	11/07/2023	Tim Fichera Bundaberg Regional Council	For Industry Use	Digitally signed by Dwayne Honor Date: 2023.07.11 17:37:46 +10'00'
2	24/06/2022	Richard Corbett AECOM Australia Pty Ltd	Industry Review Feedback Addressed	
1	17/09/2021	Richard Corbett AECOM Australia Pty Ltd	Council Comments (12/08/2021) Addressed	
0	16/02/2021	Richard Corbett AECOM Australia Pty Ltd	Draft for Discussion	

Preface

Background to the Guidelines

These guidelines were developed by AECOM Australia Pty Ltd (AECOM) on behalf of Bundaberg Regional Council (Council). During the guideline development, a number of Council staff and external consultancies were consulted.

Purpose of the Guidelines

These Stormwater Management Guidelines have been prepared to assist developers and practitioners by providing further guidance to support Council's Planning Scheme and Planning Scheme Policy for Development Works (Section SC6.3.5). The current requirements as set out in the Planning Scheme Policy for Development Works continue to have effect and in the event of any inconsistency override these guidelines. Application of these guidelines will promote a consistent approach to stormwater management studies, mapping and reporting throughout the Bundaberg region.

Intended Users of the Guide

The guidelines are primarily intended to assist private developers and their engineering consultants when preparing a Stormwater Management Report, and by Council's officers when interpreting outputs. It is anticipated that all users have some technical background, preferably in flood and stormwater management.

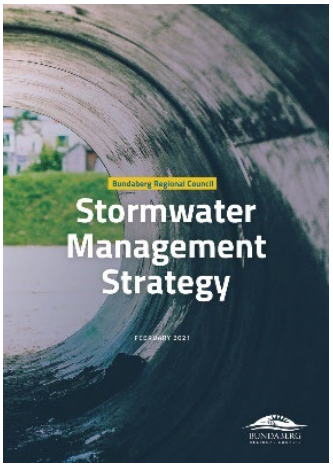
1.0 Introduction

1.1 Background

Bundaberg Regional Council (Council) provides and maintains stormwater drainage infrastructure (such as roadway kerb and channel, pits, pipes and open drains) on public land to collect and convey stormwater to creeks and rivers.

Council assesses development within the Local Government Area (LGA), including impacts to stormwater infrastructure, flooding impacts, changes to water quality as well as proposed mitigation works. Council is focused on ensuring development does not cause an actionable nuisance, while considering potential flooding impacts at the whole-of-catchment level. Assessment of stormwater quantity and quality impacts from development are to consider local and whole-of-catchment influences.

1.1.1 Bundaberg Regional Council Stormwater Management Strategy



The Bundaberg Regional Council Stormwater Management Strategy, February 2021, aims to manage Council's stormwater network in a sustainable and holistic way. It sets the direction for managing the many aspects of stormwater in the region including the environmental health of our waterways, social amenity, pollution control, affordability, minimising impacts of a changing climate and catering for future growth.

The Strategy establishes a logical, justified approach to Council's long-term management of natural and built stormwater assets to minimise impact on Council's forward operations and risk to life, property, community well-being, the environment, and the economy. It also demonstrates Council's desire to become an integrated, water sensitive city.

Further details on the Strategy can be found at https://www.bundaberg.qld.gov.au/water-services/stormwater-drainage/2.

1.1.2 Reef 2050 Water Quality Improvement Plan

"*The Great Barrier Reef (the Reef) is precious to all Australians as well as to citizens across the globe who recognise its scale, beauty and biodiversity. For Australia's Traditional Owners, it is an integral part of their culture and identity. The Reef's economic, social and iconic value as a global asset is estimated at $56 billion. It supports 64,000 jobs and contributes $6.4 billion annually to the Australian economy.*

Scientific evidence shows that the most pervasive and persistent risk to coral reefs worldwide, including the Great Barrier Reef, is climate change. Damage to reefs associated with climate change arises from sea surface temperature increases, ocean acidification, altered weather patterns (such as more intense storms and cyclones) and rising sea levels. This means that now, more than ever, it is important to reduce the pressures on the Reef; and ***poor water quality*** *is chief among them.*

The Reef 2050 Water Quality Improvement Plan is included as an action within the water quality theme of the Reef 2050 Plan. Its specific purpose is to identify management and monitoring requirements for all land-based pollution to improve the quality of water flowing from catchments adjacent to the Reef.

It builds on almost 15 years of efforts by governments at all levels working in partnership with landholders, natural resource managers, industry, and research and conservation groups. Much has already been achieved by landholders and the community to change and improve their practices to protect the Reef.

We can still do more, and a step change is needed. We must accelerate our collective efforts to improve the land use practices of everyone living and working in the catchments adjacent to the Reef. We can all improve the quality of water flowing into the Reef. In this way, we help ensure the Reef is more resilient to the effects of climate change and will remain a site of economic, social, and natural resource value into the foreseeable future." (Australian & Queensland Governments, 2018)

Key Reef ecosystems continue to be in poor condition. This is largely due to the collective impact of land run-off associated with past and ongoing catchment development, coastal development activities, extreme weather events and climate change impacts." (Australian & Queensland Governments, 2018)

The Reef 2050 Water Quality Improvement Plan notes that "***Current initiatives will not meet the water quality targets***" (Australian & Queensland Governments, 2018) set out in the plan. Therefore, consideration should be given to treatment philosophies capable of achieving higher pollutant load reductions. This is important to highlight given the Bundaberg Regional Council Local Government Area is situated within the Great Barrier Reef Marine Park catchment.

Council is proud to be an official Reef Guardian Council and is committed to protecting the Reef in partnership with the Great Barrier Reef Marine Park Authority.

1.1.3 Our Current Challenges

There is growing evidence throughout the Bundaberg region to suggest that many of our WSUD assets (e.g. urban lakes/wetlands and bioretention basins) are performing poorly with significant vegetation loss and poor water quality due to inappropriate design, implementation, establishment, maintenance or application.

Our current challenges with respect to these assets include:

- Provide little value to development.
- Poor water quality, integration and amenity.
- High maintenance and whole of life costs.
- Odour and biodiversity issues.
- Not resilient to change.
- Unsustainable.

Figure 1 – Urban Lake at Bargara

Figure 2 – Bioretention Basin at Kepnock

1.1.4 Addressing our Current Challenges

To address the current challenges we are facing, Council is proactively piloting innovative nature-based stormwater projects that seek to provide value to the community, the environment, the development industry and the asset owner.

The Belle Eden Park Waterway Naturalisation project (https://www.ourbundabergregion.com.au/belle-eden-park-waterway-naturalisation) is the first of these projects that Council has implemented, and we are proactively monitoring and evaluating its performance over time (e.g. water quality / resilience etc.) to help inform outcomes, future decision making and continuous improvement.

Other pilot nature-based projects that Council is in the process of implementing (including monitoring and evaluating to help inform our future decision making) are as follows:

- Washpool Creek Naturalisation – https://www.ourbundabergregion.com.au/washpool-creek-naturalisation-project
- Beach Milieu Urban Wetland - https://www.ourbundabergregion.com.au/feedback

Furthermore, for continuous improvement and to help inform our understanding and future decision making, Council intends to undertake the following in the future:

- Work with industry experts to better understand why our existing WSUD assets (e.g. urban lakes/wetlands and bioretention basins) are performing poorly and what needs to be done to improve the performance and sustainability of these assets.
- Pilot and understand the benefits of other innovative stormwater quality treatment devices (such as engaged floodplains / ephemeral wetlands and passively irrigated streetscapes) that provide value to the community, the environment, the development industry and the asset owner.

Through proactive monitoring and evaluation of these (and future) piloted nature-based projects, Council's intent is to have an evidence-based understanding of the most appropriate, well-performing, sustainable, and resilient stormwater treatment devices for implementation in the Bundaberg region.

1.1.5 What are Council's Learnings to Date?

Based on outcomes so far from the monitoring and evaluation of the piloted projects noted above, Council's key learnings to date are as follows:

- Generally, the development industry is seeking improved changes in the approach to stormwater quality management, when compared to current practices.
- Good design, construction, establishment, inspection, and certification of WSUD assets prior to asset handover, and appropriate ongoing maintenance is critical for the future sustainability and performance of the asset.
- Monitoring and evaluating stormwater treatment devices is critical to help inform our understanding of the most appropriate stormwater treatment devices for the Bundaberg region.
- Community education is critical to manage expectations and help manage at-source pollutants.
- The community highly values WSUD and quality nature-based infrastructure.
- Natural assets, such as creeks and waterways, must be protected, maintained, and valued.
- Sediment and water quality sampling of exiting urban wetlands / lakes in the region is generally indicating elevated levels of heavy metals which rainwater collection systems (such as rainwater tanks) will assist in managing.

We must be open to continually learn and innovate to improve and optimise stormwater treatment devices from an up-front capital cost, whole-of-life cost, and pollutant reduction perspective.

1.2 Introduction

These guidelines seek to establish a standardised approach which facilitates greater consistency for stormwater management reports throughout the Bundaberg region, including assessment of Stormwater Quantity and Stormwater Quality.

These guidelines comprise two sections:

- **Part 1: Stormwater Quantity Assessment** – Provides guidance on stormwater management and modelling for quantity assessments.

- **Part 2: Stormwater Quality Assessment (this document)** – Provides guidance on stormwater management and modelling for quality assessments.

It should be noted that these guidelines are considered to be a dynamic document which will continue to be updated as stormwater management practices and the needs of Council evolve. Whilst every effort has been made to develop a clear and consistent document, it remains the responsibility of the Developer / Consultant to identify any key deficiencies and seek clarification from Council officers as required.

1.2.1 Water Quality in Context

Water quality should form an early phase of the development planning process, particularly in relation to existing natural assets, such as waterways and wetlands. Wherever possible, steps should be taken to integrate development without changing the natural function of in-situ systems. Council would be pleased to collaborate with developers throughout the development planning process to ensure water quality objectives are met in an efficient, sustainable manner.

1.3 Purpose of this Document

These guidelines are intended to improve consistency and efficiency for modelling, designing, and assessing water quality aspects associated with development in the Bundaberg region.

Guidance on water quality modelling to assess impacts to the quality of stormwater runoff is provided, including appropriate ranges for modelling parameters, along with requirements for assessment of development impacts, assessment of mitigation solutions, and reporting.

1.4 Document Structure

The structure of this document is as follows:

- Section 2.0 - sets out definitions relative to stormwater quality assessments.
- Section 3.0 - presents the data available in the region.
- Section 4.0 - discusses treatment measure technologies and Council's preferential outcomes.
- Section 5.0 - discusses modelling requirements for stormwater quality assessments.
- Section 6.0 - explains considerations which cover long-term ownership and maintenance of stormwater quality assets.
- Section 7.0 - explains modelling quality assurance requirements.
- Section 8.0 - presents a recommended documentation structure for stormwater quality assessments.
- Section 9.0 – lists handover requirements during project closure.
- Section 10.0 - lists references used in this document.

2.0 Definitions

2.1 Strategic Vision

Council's vision for stormwater management in the region is as follows:

As an organisation Council aspires to lead regional practice of:

- **Sustainable, holistic management of all catchments.**
- **Reduce risk and improve public safety for future stormwater flooding.**
- **Connecting informed communities with our catchments and waterway assets.**

We will be recognised as a Council that proactively implements appropriate practice that demonstrates care for the community and our catchments.

(Bundaberg Regional Council Stormwater Management Strategy, 2021)

2.2 Relevant Literature

The planning and design of the developments within the Bundaberg Regional Council local government area must be undertaken in accordance with the current edition of the following key reference documents, unless specifically outlined in this chapter or other Council references dictate otherwise:

- Queensland Government – at the time of writing this document the series was listed below:
  - State Planning Policy (SPP) 2017 – state interest guidelines on water quality.
  - Urban Stormwater Quality – Planning Guidelines (2010).
  - Environmental Protection (Water) Policy (2009) – Burrum, Gregory, Isis, Cherwell, and Elliott Rivers environmental values and water quality objectives – Basin 137 at Plan WQ1371 at Burrum River EV Plan 2010 .
- IPWEA – Queensland Urban Drainage Manual Fourth Edition, 2016.
- Environment Protection Agency's (EPA) Guideline – EPA Best Practice Urban Stormwater Management – Erosion and Sediment Control http://www.derm.qld.gov.au/register/p02301aa.pdf .
- Engineers Australia – at the time of writing this document, the series relating to development was as listed:
  - Australian Runoff Quality – A guide to water sensitive urban design.
- Healthy Land and Water, Water by Design – At the time of writing this document, the series relating to development was as listed:
  - MUSIC Modelling Guidelines (2018).
  - Construction and Establishment Guidelines – Swales, Bioretention Systems, and Wetlands.
  - Living Waterways – Version 3 (2020).
- Bundaberg Regional Council:
  - Bundaberg Regional Council Urban Stormwater Quality Management Plan (BMT WBM 2013).

- Standard Drawings at https://www.bundaberg.qld.gov.au/development-infrastructure-and-charges:
- Other plans in development by Council at the time of writing this document:
  - Saltwater Creek Master Plan (expected completion September 2023)
  - Washpool Creek Master Plan (expected completion December 2023)

The primary technical resources for designing stormwater quality management systems are noted below and are to be followed unless superseding requirements are noted in this guideline or the Planning Scheme.

2.2.1 Low Stormwater Risk Development

Low stormwater quality risk developments should consider treatment philosophies and measures outlined in:

- Low Impact Design Discussion Paper (Water by Design, 2021)

2.2.2 Concept Design

Concept design of water sensitive urban design treatment measures is to be undertaken in accordance with the latest version of the following:

- Concept Design Guidelines for Water Sensitive Urban Design (Water by Design, 2009).
- MUSIC modelling supporting concept development is to be undertaken in accordance with the latest version of the MUSIC Modelling Guidelines (Water by Design, 2018)

2.2.3 Detailed Design

Detailed design of water sensitive urban design treatment measures is to be undertaken in accordance with the latest version of the following:

- Water Sensitive Urban Design Technical Design Guidelines for South-East Queensland (Water by Design, 2006), including the Bioretention Technical Design Guideline (Water by Design, 2014) and Wetland Technical Design Guidelines (Healthy Land and Water, 2017);
- IPWEAQ Standard Drawings DS-070 to DS-080 and
- Specific Council requirements detailed in this guideline.

2.2.4 Construction, Establishment and Handover

The construction, establishment, and handover of water sensitive urban design treatment measures is to be undertaken in accordance with the latest version of the following:

- Construction and Establishment Guidelines: Swales, Bioretention Systems and Wetlands (Water by Design, 2010)
- Maintaining Vegetated Stormwater Assets (Water by Design, 2012)
- Transferring Ownership of Vegetated Assets (Water by Design, 2012)

2.3 Site-Based Stormwater Management Plan (SBSMP) Requirements

High stormwater risk developments trigger the necessity to identify Environmental Values (EVs) and Water Quality Objectives (WQOs) and demonstrate how they are achieved through the provision of site-based stormwater management plans (SBSMP). An SBSMP must:

1. Address both quality and quantity control issues at the pre-development (approval) stage.
2. Integrate permanent stormwater management features into the overall development landscape plan.
3. Identify legal points of discharge, which need to be identified before development approval is given.
4. Address ecological protection issues that are influenced by the management of stormwater (e.g. waterway corridor vegetation and habitat management issues).
5. Clearly identify pollutants of concern and their sources for both the construction and operational phases of development.
6. Be updated and submitted for operational works (post-approval) stages, which will include Erosion and Sediment Control Plans (ESCPs).

The format of the SBSMP is to be determined along with the EVs and WQOs at a pre-lodgement meeting. However, the format can generally be in accordance with Section 8.0 of this document and Brisbane City Council Subdivision and Development Guidelines Part C – Water Quality Management Guidelines.

2.4 Water Quality Objectives

The stormwater quality design objectives and their application are detailed in the State Planning Policy (SPP, June 2017). Table 1 details the issues and desired outcomes taken from the SPP (2017).

Table 1 Appendix 2, Table A - Stormwater management design objectives - Construction phase, taken from the SPP (2017).

Issue	Desired Outcome
Drainage control	1. Manage stormwater flows around or through areas of exposed soil to avoid contamination. 2. Manage sheet flows in order to avoid or minimise the generation of rill or gully erosion. 3. Provide stable concentrated flow paths to achieve the construction phase stormwater management design objectives for temporary drainage works. 4. Provide emergency spillways for sediment basins to achieve the construction phase stormwater management design objectives for emergency spillways on temporary sediment basins.
Erosion control	1. Stage clearing and construction works to minimise the area of exposed soil at any one time. 2. Effectively cover or stabilise exposed soils prior to predicted rainfall. 3. Prior to completion of works for the development, and prior to removal of sediment controls, all site surfaces must be effectively stabilised using methods which will achieve effective short-term stabilisation.
Sediment control	1. Direct runoff from exposed site soils to sediment controls that are appropriate to the extent of the disturbance and level of erosion risk. 2. All exposed areas greater than 2500m^2 must be provided with sediment controls which are designed, implemented, and maintained to a standard which would achieve at least 80% of the average annual runoff volume of the contributing catchment treated (i.e. 80% hydrological effectiveness) to 50mg/L Total Suspended Solids (TSS) or less, and pH in the range 6.5-8.5).

Issue	Desired Outcome
Litter, hydrocarbons, and other contaminants	1. Remove gross pollutants and litter. 2. Avoid the release of oil or visible sheen to released waters. 3. Dispose of waste containing contaminants at authorised facilities.
Waterway stability and flood flow management	1. Where measures are required to meet post-construction waterway stability objectives (specified in Table B), these are either installed prior to land disturbance and are integrated with erosion and sediment controls, or equivalent alternative measures area implemented during construction. 2. Earthworks and the implementation of erosion and sediment controls are undertaken in ways which ensure flooding characteristics (including stormwater quantity characteristics) external to the development site are not worsened during construction for all events up to and including the 1% AEP.

Taken from the SPP (2017) Table B: Post construction phase – stormwater management design objectives, the post construction phase requires the following pollutant load reduction targets relative to an unmitigated development case for the Central Queensland (south) Climatic Region:

- Total Suspended Solids (TSS): 85%
- Total Phosphorus (TP): 60%
- Total Nitrogen (TN): 45%
- Gross Pollutants: 90%

In addition, waterway stability management must limit the peak 63% AEP event discharge within the receiving waterway to the pre-development peak 63% AEP discharge.

Notes:

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.

Water stability objective applies if development drains to an unlined waterway within or downstream of the site where a risk of increased erosion exists due to changes in hydrology. Local government may also require application of the waterway stability objective where there are planned future rehabilitation works to return a lined channel to a natural channel design.

The SPP Water quality guidance material provides advice on the measures that demonstrate compliance with pollutant load reduction targets.

For low stormwater risk development which falls outside the triggers identified in the Planning Scheme Policy for Development Works, there is no requirement to demonstrate compliance with these objectives provided that the minimum requirements stipulated in PSPDW SC6.3.5 are met.

Alternative pathways to demonstrate compliance with the stormwater quality design objectives should be developed in collaboration with Council and may include the following:

- Living Waterways – is a flexible environmental management approach that assists practitioners and government to deliver water management systems which are integrated with outdoor spaces. It does this through a subjective scoring system that encompasses and incentivises the broader objectives of WSUD. The Living Waterways approach is currently not accepted by Council.

- Off-site stormwater solutions (off-site solutions) – is the consideration of locally applied alternative solutions that achieve an equivalent or improved water quality outcome to the stormwater management design objectives of the State Planning Policy. At this time, this off-site solutions concept is not able to be supported and this compliance approach is not applicable.
- Reducing imperviousness – may assist in minimising stormwater runoff and reducing stormwater management requirements. Concept designs should be based on the Concept Design Guidelines for Water Sensitive Urban Design (Water by Design, 2009). To encourage low impact design that minimises stormwater runoff, Material Change of Use developments with less than 25% effective imperviousness are excluded from achieving the stormwater quality design objectives.

3.0 Data

3.1 Regional Datasets

The following datasets are available from Council and may be of assistance in the design and assessment of stormwater treatment devices.

- Stormwater Features (pits, pipes, culverts and the like).
- Regional Building Footprint and Floor Level Database.
- Fraction Impervious Database (within the Bundaberg city and coastal urban catchment areas only.

3.2 Other Sources of Data

Other data that may be required is available from the following sources:

Table 2 Other Datasets

Source	Description	Notes
Bundaberg Regional Council Interactive Mapping https://www.bundaberg.qld.gov.au/interactive-mapping-system	Online Interactive Mapping	-
Australian Rainfall and Runoff (ARR) Data Hub https://data.arr-software.org/	Hydrologic Parameters, Design Storms.	Parameters should not be adopted without review – the RPEQ should provide justification in the Stormwater Management Report.
Bureau of Meteorology (BOM) http://www.bom.gov.au/climate/data/	Climate data (e.g. rainfall records)	-
QLD Globe / QSpatial http://qldspatial.information.qld.gov.au/catalogue/	State-managed datasets.	-
ELVIS - Elevation and Depth - Foundation Spatial Data Website, https://elevation.fsdf.org.au/	Open source LiDAR and LAS datasets.	Does not have all available LiDAR.
QImagery website – Queensland Government online aerial photograph library, https://qimagery.information.qld.gov.au/	Georeferenced historic imagery.	Georeferencing quality may vary.
Nearmap website, https://www.nearmap.com/au/en	High-resolution, recent aerial imagery.	Subscription required.

3.3 Review of Data Adequacy

All data must be reviewed for suitability, accuracy and data gaps. Where data gaps exist, assumptions and limitations are to be documented by the Developer / Applicant. In all cases, a site visit for the area of interest is **strongly recommended**.

3.3.1 Assumptions

Where data is missing from a GIS database or is not available for a specific area, all reasonable steps must be taken to complete the data (e.g. via survey). It is the responsibility of the RPEQ to justify all assumptions made.

3.4 Accuracy of the Data Supplied

Council will take care to ensure that the information supplied is accurate, however, the accuracy of the information cannot be guaranteed. If the information supplied, or any part of it, is used, the Developer / Applicant must satisfy themselves as to the completeness, adequacy, accuracy and content of the information and shall make their own interpretations, deductions or conclusions and shall accept full responsibility therefore.

3.5 Continuous Improvement Initiative

Council is actively working to bridge gaps and develop confidence across asset databases. This recurring initiative is in place to promote a future single point of reference for stormwater data which is live and up to date with the best available information.

To assist the Continuous Improvement Initiative, Council strongly encourages Developers / Applicants to share erroneous data or updates to stormwater models / databases by emailing engineering@bundaberg.qld.gov.au.

Through this process, future modelling and assessments can have increased confidence in database integrity and completeness.

4.0 Treatment Measures

4.1 Approach to Treatment

Council's preferred approach towards the treatment of runoff involves two primary methods: at-source, and end-of-line treatments. Regional facilities may be considered in close collaboration with Council.

- **At-source treatment** is defined as the treatment of runoff at its catchment of origin, through the removal of the pollutants to the minimum requirements outlined in section 2.4.
- **End-of-line treatment** is defined as the treatment of runoff at its point of discharge from the catchment or development area.

Treatment option overviews are detailed in Table 3 to Table 5 and discussed further in subsequent sections.

Table 3 Typical Scale (Y = Yes/applicable, - = generally not applicable or feasible)

Treatment Measure	Allotment Scale	Street Scale	Precinct Scale
Buffer Strips	Y	Y	Y
Vegetated Swales	-	Y	Y
Wetlands	-	-	Y
Sedimentation Basins	-	-	Y
Infiltration Systems	Y	Y	-
Passive Watering of Landscapes	Y	Y	-
Gross Pollutant Traps (GPT)	Y	Y	Y
Bioretention Basins	Y	Y	Y
Rainwater Tanks	Y	-	-
Scour Protection	-	Y	Y

Table 4 Typical Effectiveness (H = High, M = Medium, L = Low)

Treatment Measure	Peak Attenuation	Volume	TSS	TP	TN
Buffer Strips	L	L	H	M	L
Vegetated Swales	L	L	H	M	L
Wetlands	H	L	H	H	H
Sedimentation Basins	M	L	H	M	L
Infiltration Systems	H	H	-	-	-
Passive Watering of Landscapes	L	L	-	-	-
Gross Pollutant Traps (GPT)	L	L	H	L	L
Bioretention Basins	M	L	H	H	H
Rainwater Tanks	M	M	-	-	-
Scour Protection	L	-	L	L	L

Table 5 Typical Constraints (C = Significant Constraint, M = Manageable Constraint, G = Generally Not a Constraint)

Treatment Measure	Slope (>5%)	Non-Rippable Material	Acid Sulfate Soils	Low Permeability	High Permeability	High Water Table	High Sediment Load	Land Area
Buffer Strips	C	M	M	G	G	M	M	M
Vegetated Swales	C	M	M	G	G	C	M	M
Wetlands	C	C	C	G	M	M	M	M
Sedimentation Basins	C	G	G	G	G	M	M	M
Infiltration Systems	C	C	C	C	G	C	C	M
Passive Watering of Landscapes	C	M	M	G	G	C	M	G
Gross Pollutant Traps (GPT)	G	G	G	G	G	G	M	G
Bioretention Basins	M	M	M	G	G	C	C	M
Rainwater Tanks	G	G	G	G	G	G	G	M
Scour Protection	M	G	M	G	G	M	M	M

4.2 Local Preferences

When selecting treatment measures, the following local preferences currently apply:

- Currently, nature-based solutions are the preferred stormwater treatment measure by Council (e.g., naturalisation, vegetated swales, bioretention basins etc.).
- Generally, given their continued poor performance in the Bundaberg region, constructed wetlands will not be accepted by Council unless it can be demonstrated that a constructed wetland is the most appropriate treatment measure for the site and the asset owner.
- Passively irrigated street trees are not currently accepted by Council as part of the treatment train for demonstrating compliance with the post construction phase pollutant load reduction targets set by the SPP. Council is actively working towards understanding the benefits that passively irrigated streetscapes can provide from stormwater quality treatment point of view, and from an asset ownership point of view, to help inform our future decision making regarding the use of passively irrigated street trees as part of the treatment train.

  However, **all street trees should be passively irrigated** to increase soil moisture content and improve vegetation health (which helps reduce urban heat through evapotranspiration and shade), and to help reduce volumes of runoff entering downstream waterways due to urbanisation.

The following outcomes associated with stormwater treatment measures will generally not be accepted by Council and should be avoided where possible:

- Artificial diversion of water to an adjoining catchment.
- Relocation, removal or replacement of an existing riparian corridor (e.g. creeks, vegetated gullies).
- Clearing or relocation of existing natural assets (e.g. wetlands, waterways).
- Increased or damaging flow velocities.
- High quantities of gully pit baskets (decreasing maintainability at scale).
- Deep bioretention basins (standing water) and standing waterbodies (e.g. lakes).
- Reduction of very frequent (4 EY or 3-month event) runoff volume being delivered to existing vegetated channels (e.g. creeks) due to excessive detention of runoff. This is also the case for modified urban waterways (i.e. concrete drains) so opportunities for the rehabilitation of urban waterways are not hindered further.

4.3 Open Space Integration

Open space integration should made in accordance with the principles described in the Concept Design Guidelines for Water Sensitive Urban Design (Water by Design, 2009).

The design of stormwater treatment facilities in public open space areas is to be complementary to and integrated within the public realm, as well as align with the Bundaberg Regional Council Parks and Open Space Strategy 2019-2026. Fences or retaining walls are not to be used unless it can be demonstrated these features do not detract from the landscape amenity.

Land within parks or amenity reserves that is below the 5% AEP flood level and/or required for stormwater management devices such as bioretention basins, wetlands, detention basins, GPT's and pipes should be designated for a stormwater purpose. Land designated for a stormwater purpose is to be located outside of the required riparian buffer areas and is separate from the minimum land required for open space.

Open space areas are to be protected from utility encroachment. If the open space use is compromised, the land associated with the works shall be redesignated for a stormwater purpose and Council shall be compensated for the loss to the Open Space Network.

4.4 Technical Design of Stormwater Treatment Devices

Stormwater treatment devices should be designed in accordance with the following guidelines from Water by Design (Healthy Land and Water):

- Water by Design. (2006a). Water Sensitive Urban Design Technical Design Guidelines for South-East Queensland
- Water by Design. (2009). Concept Design Guidelines for Water Sensitive Urban Design
- Water by Design. (2010a). MUSIC Modelling Guidelines
- Water by Design. (2010b). Construction and Establishment Guidelines: Swales, Bioretention Systems and Wetlands
- Water by Design. (2012c). Maintaining Vegetated Stormwater Assets
- Water by Design. (2012d). Transferring Ownership of Vegetated
- Water by Design. (2014). Bioretention Technical Design Guideline

- Water by Design. (2017) Wetland Technical Design Guidelines

Exceptions to these guidelines are described in Section 4.5.

4.5 Requirements for Specific Technologies

4.5.1 Vegetated Swales

The following are the requirements for the implementation of vegetated swales:

- Species selection for vegetated swales is to minimise future maintenance requirements.
- Mature vegetation in swales should not put other assets (e.g. driveways or underground pipes) at risk or restrict property access.

4.5.2 Bioretention

All bioretention systems are required to achieve the following minimum performance requirements in addition to the requirements of the Bioretention Technical Design Guidelines (Water by Design, 2014):

- Must not be reliant on fencing or other physical barriers to address safety risks.
- Bioretention devices are to be provided with pre-treatment incorporating either a swale or coarse sediment forebay or GPT if high gross pollutant load.
- Bioretention devices treating catchments >5ha are provided with pre-treatment incorporating either a sediment basin or GPT followed by sediment basin if high gross pollutant loads are expected.
- Generally, retaining walls in bioretention basins are not acceptable however, in highly constrained locations, retaining walls may be provided but can only occupy a maximum of 50% of the device perimeter.
- Filter Media - specification for the filter media is to be in accordance with CRC for Water Sensitive Cities (2015).

4.5.3 Constructed Wetlands

All constructed wetland systems are required to achieve the following performance requirements:

- Vegetation design must carefully consider the longevity of species and risks associated with bird populations such as swamp hens and sacred ibis, and these design considerations must be documented in design reporting.

4.5.4 Sediment basins

All sediment basins are required to achieve the following performance requirements:

- Sediment storage volume sized for a minimum 5-year clean out frequency.
- Sediment cleanout, dewatering and loading for disposal must be considered in design and appropriate access provided.

4.5.5 Gross Pollutant Traps (GPTs)

GPTs are to be designed and constructed so that:

- The GPT is located in an accessible location (not in swampy areas, at the bottom of embankments or other inaccessible locations).

- The GPT is not located near electrical equipment.
- The GPT can be fitted with a suitably designed lockable access cover approved by Council that prevent entry of unauthorised persons.
- Re-suspension of captured pollutants during flows in excess of the SQID design event is prevented.

4.5.6 Pit Baskets

Pit baskets that are privately owned assets must be designed so that:

- An appropriate degree of blockage is accounted for in the hydraulic design of the system.
- A regular maintenance program is developed for emptying and cleaning of the baskets, particularly after rain events.
- The system is designed so that in the case of a blockage the overflow or bypass from the inlet does not cause an actionable nuisance.

4.5.7 Media Filtration Devices

Media filtration devices are suitable for use only where they will remain as private assets and only if the following criteria are met:

- Use is within the high-density residential zone, commercial, or industrial zone development.
- Constrained site where other stormwater treatment measures are not practicable.

For example:

- Sites being re-developed (brownfield);
- Smaller sites (<2,500m2);
- Sites with an allowable site cover of buildings greater than 70%; and
- Sites which are required to achieve an activated street frontage.

4.6 Other Considerations

4.6.1 Emerging and Proprietary Technologies

The Stormwater Quality Improvement Device Evaluation Protocol (SQIDEP) of Stormwater Australia is the basis for demonstrating performance claims of treatment devices that are proposed to be contributed public assets. Council will consider emerging and proprietary technologies on a case-by-case basis.

4.6.2 Designing for Maintenance

All proposed designs for stormwater treatment devices should be accompanied by reporting that describes how the design proposes to accommodate the required maintenance activities. This reporting should include:

- A description of all required maintenance activities for the treatment device, and frequency of maintenance cycles as per Water by Design (2012) Maintaining Vegetated Stormwater Assets or manufacturers' instructions. This information should be provided in an Asset Handover Plan that is part of the SBSMP (refer Section 6.3)

- A description of how maintenance access has been incorporated into the design, and what types of access are proposed for all activities
- A description of the species selection and planting density and how the design is based on bush reconstruction landscapes with sufficient density and diversity to enable resilience to varying climatic conditions and 'self-repair' after disturbance.

4.6.3 Construction-Phase Water Quality

Erosion and sediment control must be designed in accordance with the recommendations contained within the EPA's Guideline – EPA Best Practice Urban Stormwater Management – Erosion and Sediment Control, the International Erosion Control Association's (IECA) Best Practice Erosion and Sediment Control.

4.6.4 Waterway Stability

The waterway stability objective is defined in the Planning Scheme Policy for Development Works as limiting the post-development peak 63% AEP event discharge within the receiving waterway to the pre-development peak 63% AEP discharge and is applicable when runoff from the site passes through or drains to natural channels, non-tidal waterways or wetlands, and modified urban waterways (i.e. concrete drains) so opportunities for the rehabilitation of urban waterways are not hindered further.

Compliance with the objective is demonstrated through hydrologic calculations, with the level of complexity appropriate to the catchment context and scale of development. The following compliance methodology has been adapted from the Gold Coast City Council Planning Scheme (2016) and Healthy Waterways (2006).

4.6.4.1 Frequent Flow Hydrology

Proposals that seek to increase imperviousness in the catchment of high value waterways with low existing imperviousness will be subject to considerable scrutiny. Such proposals will be required to derive site-specific objectives which relate to the individual characteristics of the receiving environment.

For example, proposals which discharge to a high value wetland which is sensitive to changes in runoff volume would need to demonstrate no change in mean annual runoff volume. Other parameters such as number of surface flow days and baseflow proportion and rate may also be critical depending on the receiving environment.

4.6.5 Preservation of Natural Waterways

Consideration must be given to the preservation and enhancement of existing natural waterways/channels, particularly in the following circumstances:

- waterways identified as important within a Waterway Corridor Plan, Catchment Management Plan, or similar strategic plan (such as Council's Stormwater Management Strategy),
- waterways recognised as fish passage corridors or covered under MSES overlays,
- natural waterways with well-defined bed and banks, and their associated floodways.

4.6.6 Rehabilitation of Modified Waterways

Urban planners and stormwater designers must avoid land use planning and design decisions that remove opportunities for the rehabilitation of natural waterways that have been channelised as part of historical urban development. Urban planning and design should encourage the rehabilitation of these 'low-value' waterways back to stable waterways that are consistent with the long-term hydrologic and desirable ecological conditions of the catchment.

The past channelisation of an urban waterway does not prevent the future rehabilitation of that waterway and return of ecological values to the urban area.

Moving forward, urban creeks must be considered as more than concrete channels. Urban creeks offer significant potential for both Council and the community due to aspects such as social and environmental benefits, hazard reduction and increasing sustainability over time.

Urban creeks must be elevated beyond a stormwater infrastructure improvement or engineering undertaking.

Creek naturalisation and rehabilitation projects are rich in opportunities to deliver an integrated public open space to the City of Bundaberg (and broader region) which balances its technical stormwater and drainage functions whilst also delivering significant water quality, ecological and environmental improvement to the immediate and wider context. As active and connected systems, urban creeks will become pleasant places to walk, play, explore and live nearby.

4.6.6.1 Belle Eden Park Waterway Naturalisation

Council has recently completed the Belle Eden Park Waterway Naturalisation project. The project involved the restoration of a man-made drain back to a natural state with the inclusion of park facilities to activate the area. A key objective of the project was to create a sustainable and resilient stormwater asset that provides multiple functions and benefits, including stormwater conveyance and quality functions, carbon sequestration, urban cooling, ecological and social benefits.

This project represents and is an example of Council's strategic intent for sustainable stormwater management in the Bundaberg region including:

- that the purpose of stormwater assets should be more than just for the conveyance of stormwater,
- that for improved stormwater asset sustainability and resilience, nature-based solutions are the preferred solution when compared to traditional hard infrastructure solutions (e.g. concrete-lined drains).

Further details on the project can be found at https://www.ourbundabergregion.com.au/belle-eden-park-waterway-naturalisation.

Figure 3 – Belle Eden Park Waterway Naturalisation – Before (Left) | After (Right)

5.0 Modelling

5.1 Approach

MUSIC (Model for Urban Stormwater Improvement Conceptualisation) software is used to demonstrate compliance with Stormwater Quality Design Objectives. Stormwater Quality Design Objectives are a requirement for a percentage reduction in the mean annual pollutant load from the unmitigated development case. The Design Objectives are defined in the current State Planning Policy and are also discussed in section 2.4 of this document. Bundaberg Regional Council Local Government Area is located solely within the Central Queensland (south) Climatic region.

MUSIC modelling is to be undertaken generally in accordance with the Water by Design (2018a) MUSIC Modelling Guidelines (version 3 Consultation Draft), with the exception of the following parameters required by Council.

5.1.1 Pluviographic Rainfall

The accepted time-period of pluviographic data is:

Table 6 Accepted Pluviographic Rainfall Data

Rainfall Station	Mean Annual Rainfall	Timestep	Period
Bundaberg Airport 39128	865mm	6-minute	01/01/1996 12:00 AM to 31/12/2005 11:54 PM

5.1.2 Potential Evapotranspiration

The accepted potential evapotranspiration is:

Table 7 Accepted Monthly Potential Evapotranspiration (PET)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Evapotranspiration	188	150	155	119	89	77	77	97	121	155	175	183

5.1.3 Lumped Modelling

Lumped catchment modelling is only suitable for large regional studies or for early assessment of potential development layouts (master planning).

5.1.4 Climate Change Considerations

Where stormwater harvesting is proposed (where reliability is in question), rainfall data from a dry period, such as 1993-2002, should be compared as a sensitivity test to test design viability under a more variable climate.

5.2 Treatment Properties

The following section provides guidance on generally acceptable methods of implementing treatment nodes into a MUSIC model in the Bundaberg Region.

5.2.1 Gross Pollutant Traps

GPT treatment node performance details are to be entered in accordance with the manufacturer's specifications. Manufacturers of these systems will typically provide template MUSIC treatment nodes. The

properties of these manufacturer template nodes are based on specific product testing and are not to be edited without justification. Gross pollutant traps (GPTs) should be modelled in accordance with section 4.8.1 of the Water by Design MUSIC Modelling Guidelines Version 3.0, 2018.

5.2.2 Media Filtration System

Manufacturers of these systems will typically provide template MUSIC treatment nodes. The properties of these manufacturer template nodes are based on specific product testing and are not to be edited without justification.

6.0 Asset Lifecycle Planning

6.1 Asset Ownership

As part of the development application, the developer must provide an Asset Handover Plan as part of the SBSMP, detailing all aspects of asset ownership including requirements of all aspects of the asset. This includes establishment, maintenance requirements, and whole-of-life costs of the asset.

6.1.1 Checklist

The Asset Handover Plan must include all recommended tasks deemed necessary to maintain the asset through its design life. This may include service schedules, replacement of spare parts, preventative maintenance, and responses to common problems or faults. For vegetated treatment devices, the Asset Handover Plan should be prepared in accordance with Transferring Ownership of Vegetated Assets (Water by Design, 2012) and handovers should employ the checklists provided in that guideline. A tool to assist Council and developers during the asset handover process for non-vegetated assets is included in Table 8.

Table 8 Asset Transfer Checklist

Asset ID:		
Asset Location:		
Construction by:		
Defects and liability period:		
Performance	**Y**	**N**
System appears to be working as designed visually		
Obvious signs of under-performance		
Maintenance	**Y**	**N**
Maintenance plans and indicative maintenance costs provided for each asset?		
Inspection and maintenance undertaken as per maintenance plan?		
Inspection and maintenance forms provided?		
Asset inspected for defects?		
Asset Information	**Y**	**N**
As constructed plans provided?		
Copies of permits (construction and operational) submitted?		
Proprietary information provided?		
Digital files provided?		
Asset listed on asset register / database?		

6.2 Establishment

Establishment of the vegetation to design condition must be outlined in the SBSMP. It is worth noting establishment may require more than two growing seasons, depending on the vegetation types, during which regular watering and removal of weeds will be required by the Developer.

Establishment should be undertaken in accordance with the recommendations of Water by Design. (2010). Construction and Establishment Guidelines: Swales, Bioretention Systems and Wetlands.

During construction, regular (minimum weekly) site inspections by a member of the design team are required to ensure the device is constructed in accordance with the design intent. Should the design intent or requirements change following development approval, the design team and Council's officers must be consulted for advice prior to construction.

6.3 Maintenance

The Asset Handover Plan is to include a description of all required maintenance activities for the treatment device, and frequency of maintenance cycles as per Water by Design (2012) Maintaining Vegetated Stormwater Assets or manufacturers' instructions.

The Asset Handover Plan and forms must address the following elements where applicable to the specific treatment technology:

- Inspection and maintenance frequency.
- Watering frequency
- Data collection/ storage requirements (i.e. during inspections)
- Detailed cleanout procedures including:
    - equipment needs
    - disposal requirements (of material removed)
    - access issues
    - stakeholder notification requirements
- For all maintenance activities, notes on public safety, maintenance techniques, wet waste disposal, equipment requirements, environmental management considerations and occupational health and safety and disposal requirements; and
- For each treatment device, an estimate should be provided for the maintenance requirements for staff (competencies and time) and machinery or equipment (type of plant and time) and estimated quantity, type and disposal requirements of any waste generated.

The relevant maintenance period and bonding procedures can be found in Section SC6.3.13 of the Bundaberg Regional Council Planning Scheme 2015.

6.3.1 Estimate of Annual Expenditure

The Asset Handover Plan must provide for each treatment device an estimate for the maintenance requirements for staff (competencies and time) and machinery or equipment (type of plant and time) and estimated quantity, type and disposal requirements of any waste generated.

Costs for these must be provided on a per annum basis, including any plant, tools, or equipment required, and any licencing or training required for Council staff. Estimated annual labour must also be included for the entirety of the expected life of the asset.

6.3.2 Monitoring

The Asset Handover Plan should outline a recommended monitoring program for the asset as per Water by Design (2012) Maintaining Vegetated Stormwater Assets or manufacturers' instructions.

7.0 Modelling Quality Assurance

7.1 Overview

This section provides guidance for 'good practice' and 'sense checks' within the Quality Assurance (QA) process, which aim to promote defensible modelling throughout the region.

7.2 Model Logs

A model log is to be set up for each model developed, containing the following information at a minimum (as relevant to the type of model):

- Software used and version.
- Model ID or Build.
- Date finished.
- Meteorological data used incl. rainfall station, time-period, time-step, and monthly PET.
- Model description.

Other relevant information and details should be included (as required).

7.3 Quality Assurance Checks

The applicable modelling parameters used, and modelling results must be documented as per the Reporting Table formats in Appendix B and Appendix C of the Water by Design (2018a) MUSIC Modelling Guidelines (version 3 Consultation Draft) and provided in the SBSMP for the purposes of modelling quality assurance.

8.0 Documentation

8.1 Overview

Where a development is required to demonstrate how proposed stormwater management is protecting water quality and quantity, an applicant will be requested to undertake and prepare a conceptual site based stormwater management plan (SBSMP) that addresses the likely impacts of the proposed development and identifies measures to avoid or mitigate against unacceptable risk and other impacts to the quality of stormwater runoff during the operational phase.

A Site-based Stormwater Management Plan (SBSMP) should address the water quality outcomes (refer to Section 2.4). The SBSMP should contain sufficient detail to demonstrate how stormwater controls are acceptable to address water quality, water quantity and waterway corridor issues. All SBSMP should consider if a development is staged, including the anticipated timeframes for the staged works.

For the construction phase, Erosion and Sediment Control Plans must be prepared in accordance with the IECA Best Practice Erosion and Sediment Control Manual.

8.2 Pre-lodgement Development Guidance

Prior to the lodgement of a development application it is **strongly recommended** that the applicant meet with Council to confirm acceptable stormwater management practices. It is recommended that applicants undertake a preliminary site assessment and provide baseline information to Council to assist and inform the pre-lodgement discussions, including:

- Accurate survey plans of pre-development site conditions.
- Identification of waterbodies, ecosystems and/or other Environmental Values of receiving waterways.
- Identification of key issues, constraints, and opportunities.
- Overview of groundwater conditions from relevant gauges available at https://water-monitoring.information.qld.gov.au/.
- (If available) Initial stormwater management concept, including proposed Legal Point of Discharge.

This baseline information is critical to facilitate designs which suitably respond to site constraints and opportunities.

The level of detail required for a particular development application should be determined in consultation with Council's development assessment officers.

8.3 Reporting

Site-based Stormwater Management Plans are to be RPEQ certified, with the following structure provided as a guide:

- Executive Summary
- Table of Contents
- Introduction

  The introduction should include a general description of the proposed development/ works, existing site, scope of the SBMP and the following information:

  - submission date;
  - developer's name;
  - consultant's name;
  - current and proposed land use of development site;
  - description of site location (including street directory reference); and
  - reference to associated documents.
  - Assumptions, Limitations and Exclusions
- Locality plan
- Site characteristics
  - An accurate site plan, to show appropriate development site details;
  - The plan should include the baseline information used to determine the layout including existing topography catchment/drainage information and vegetation.
  - If the development is to be constructed in stages these should also be shown on the site plan.
  - Supporting text should include detailed description of the site characteristics and any constraints, and should include discussion of how proposed clearing/earthworks will influence existing drainage.
- Proposed land uses
- Location conditions – rainfall and soil category
- Design objectives – The report is to identify the stormwater quality management objectives for both the construction phase and post-construction phase (operational-construction phase) of the proposed development.

- Strategy description and plan – The proposed treatment strategy should be presented in plan format (with scale bar) showing sub-catchment boundaries (including any untreated areas) and flow paths. The plan should include:
  - treatment area locations and indicative footprints;
  - requirements for maintenance access and fore bays;
  - description of how run-off will be conveyed to treatment systems; and
  - confirmation that treatment system can drain (that is, outlet can freely drain).
- Modelling approach – Reporting the modelling approach should be undertaken in accordance with Council's MUSIC modelling requirements (Section 5.0).
- Drawings (plans and sections) of proposed treatment devices should include:
  - Full layout plan and sections (longitudinal and cross sections) for each stormwater treatment measure showing integration with the existing or proposed drainage system, benching levels (and, if appropriate, standing water, extended detention and peak water levels), bunding and other conceptual features such as, but not limited to, maintenance access, monitoring access (if proposed) and safety precautions (for example, fencing and/ or dense vegetation restricting public access).
  - For sites with multiple small treatment devices, a full layout plan and a section drawing of a selected representative sample of devices must be provided.
  - Layout plans should consider the integration of the stormwater treatment measures into the surrounding topography.
  - These designs must be prepared as preliminary design drawings suitable for the subsequent preparation of detailed civil design drawings for construction.
- Professional preparation of Site Based Stormwater Management Plans – It is a requirement that all site-based stormwater management plans are prepared by suitably qualified and experienced professionals. A suitably qualified and experienced professional is defined as a person with the following attributes: relevant tertiary qualifications or equivalent, with at least 5 years' experience in the preparation of Site-based Stormwater Management Plans.
- MUSIC modelling should be documented as part of the SBSMP, and should include the following information:
  - Reporting is to specifically outline all modelling parameters used and modelling results including:
    - source node parameters.
    - meteorological and rainfall data.
    - catchment definition and split.
    - rainfall runoff parameters.
    - pollutant export parameters.
    - treatment node parameters.
    - life cycle costs.

- Modelling parameters and results must be documented as per the Reporting Table formats in Appendix B and Appendix C of the Water by Design (2018a) MUSIC Modelling Guidelines (version 3 Consultation Draft). Reference can be made to guidelines where applicable and all departures from guidelines should be noted.
- The report should record the version of MUSIC used.
- Models provided should include a pre-development condition as well as developed site with proposed stormwater treatment strategy.

8.3.1 Technical Appendices

Where it will make the main report more succinct, it is preferable for technical information and data to be attached to the report as appendices. This may include technical details modelling methodology, with only a summary table provided in the main body of the report.

9.0 Delivery Handover

Upon completion of the assessment, the developer/applicant is to provide Council with the following documentation:

- Technical report/s Site-based Stormwater Management Plan including an Asset Handover Plan, and associated GIS layers.
- Copy of MUSIC model and associated calculations / data.
- Where changes have been made to Council's GIS database, copies of updated files.

10.0 References

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