Integrated Design - Appendix C

Stormwater Management

Moreton Bay Regional Council

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1.1 Introduction

The waterways and coastal areas of the Moreton Bay Region are central to the values and lifestyles of its residents and visitors. These natural assets are vital to the ecological, social and economic wellbeing of the community.

Across the region, waterway health has been in decline in both urban and rural areas; demands on water have increased, the landform is becoming more urbanized, pollutant loads are rising and flow regimes are becoming more variable. The impacts of flooding and climate change are also important considerations when planning for future communities.

Council recognizes the importance of taking an integrated approach to managing land development, waterway health, floodplains and coastal areas. This includes the protection of natural ecosystems, meeting the community's expectations for flood protection and delivering liveable communities.

A strong vision is required for the planning, development and management of all water resources across the Moreton Bay Region. The Moreton Bay Regional Council Water Strategy 2012-2031 has been developed to safeguard water security and increase waterway health and resilience. Council is committed to the Moreton Bay Region becoming a showcase of a Water Sensitive City.

WATER SENSITIVE CITIES ARE RESILIENT, LIVEABLE, PRODUCTIVE AND SUSTAINABLE. THEY INTERACT WITH THE URBAN HYDROLOGICAL CYCLE IN WAYS THAT: PROVIDE THE WATER SECURITY ESSENTIAL FOR ECONOMIC PROSPERITY; ENHANCE AND PROTECT THE HEALTH OF WATERCOURSES AND WETLANDS; MITIGATE FLOOD RISK AND DAMAGE; AND CREATE PUBLIC SPACES THAT HARVEST, CLEAN AND RECYCLE WATER.

CRC FOR WATER SENSITIVE CITIES

A water sensitive city is one that is resilient to low water availability and the impacts of climate change. It is a city that utilises many different water sources. It manages its water to meet the needs of the environment and the community and improves the health of our waterways.

1.2 General

Moreton Bay Regional Council is committed to managing stormwater based on best practice principles that ensure integrated solutions with the associated place types. These design standards have been prepared to guide new development and are to be read in conjunction with the MBRC Planning Scheme.

Key design principles that must be considered include:

a) Integrated and fit for purpose
b) Manageable and financially sustainable
c) Adaptable to growth
d) Safe
e) Promote diversity and community values
f) Improve water security
g) Improve waterway health
h) Protect coastal areas

The Queensland Urban Drainage Manual (QUDM) has been adopted as the basis of drainage design by the Moreton Bay Regional Council subject to any variation contained in this document.

All proposed designs are to be certified by a qualified *Registered Professional Engineer Queensland* (RPEQ) to ensure the design is fit-for-purpose, safe, minimises lifecycle costs including ongoing maintenance, and is constructed to a high standard. An RPEQ must inspect the works during construction to ensure that the design intent is achieved and certify the same prior to Council's acceptance of works "on maintenance".

The other aspects of stormwater design will be based on a range of guiding documents as listed in Section 1.5 of this appendix. Council is a partner of the Healthy Waterways and Catchments and supports their Water By Design documentation which is recognised as current best practice.

It is expected that a wide range of disciplines will be involved in an integrated stormwater design and the team may include (but may not be limited to) town planners, urban designers, architects, landscape designers/architects, civil engineers, ecologists, soil scientists, developers, construction contractors, operators and Certified Practitioner in Erosion and Sediment Control (CPESC).

1.3 Designer opportunities and obligations

The stormwater management system must minimise the impact of urban development and serve four key purposes:

a) Conveyance of storm surface run-off with minimal flood damage;
b) Protection of (or minimise impact to) water quality;
c) Protection of biodiversity and ecological function;
d) Groundwater management and protection

Designers are to consider all four aspects in the planning and engineering design and endeavour to achieve them with minimal adverse effects on the environment. Potential adverse effects include flood damage, erosion, sedimentation, water pollution, loss of biodiversity and damage to all aquatic ecosystems.

Designers must consider the following to provide holistic integrated design outcomes:

a) Safety during construction, operation and maintenance
b) Integration with the urban form
c) Integration with other Council objectives e.g. public open space and roads
d) Cost minimisation
e) Maintenance requirements
f) Reuse potential for stormwater (TWCM objectives)
g) Landscape/amenity
h) Ecological/habitat
i) Social values
j) Legislation
k) Industry best practice

The extent to which design flexibility can be exercised in practice varies with the type of development and/or stormwater design element being considered. Opportunities exist for the designer to apply an innovative and cost-effective approach to stormwater design, without the "strait-jacket" of older prescriptive standards.

While the approach to using only the "specific design criteria" provided may be valid for minor, straight forward developments, it is hoped that it will NOT be the general means of applying the standards.

A thorough understanding of the intent and performance criteria and satisfaction of these criteria by application of a design solution appropriate to the specific circumstances is preferred. This places the obligation on the designer to exercise good professional judgement at all times, and the responsibility to justify their decision.

The standards listed in the document are therefore expected to provide an example of an outcome acceptable to Council, however innovative solutions that meet the design principles and integrate water into the landscape to enhance a range of values will be considered by council.

It is strongly recommended that consultants have initial discussions with Council staff to agree on design concepts, particularly in the case of major or unusual projects.

Consultants are expected to have systems in place to assure the quality of the design drawings and reports that they produce. Detailed checking of engineering designs by Council Officers does not take the place of the consultants' quality assurance and professional responsibilities.

1.3.1 Documentation

Designers must provide suitable documentation that allows Council to review the background, methodology, thought process and expected outcomes of the proposed stormwater management system. The level of detail will vary based on the type of application however *Planning Scheme Policy - Stormwater Management* describes the format of a Site Based Stormwater Management Plan that must be included in development applications.

The documentation needs to detail the expected performance of the infrastructure, the correct operation and the maintenance requirements to ensure continued performance. An estimate of maintenance requirements including lifecycle costs is required to be included.

1.4 Legislative Requirements

1.4.1 Environmental Protection (Water) Policy 2009

The Environmental Protection (Water) Policy 2009 (EPP Water) seeks to protect Queensland waters while allowing for development that is ecologically sustainable and achieves the objectives of the Environmental Protection Act.

It achieves this by:

a) identifying environmental values for aquatic ecosystems and for human uses (e.g. water for drinking, farm supply, agriculture, industry and recreational use)
b) determining water quality guidelines, water quality objectives and management goals to enhance or protect the environmental values
c) providing a framework for making consistent, equitable and informed decisions about Queensland waters
d) monitoring and reporting on the condition of Queensland waters.

EPP Water Schedule 1 includes water quality objectives for various waterways within Queensland. The three relevant to Moreton Bay Regional Council include:

a) Pumicestone Passage including Elimbah Creek and Ningi Creek
b) Caboolture River and associated tributaries
c) Pine Rivers and Redcliffe Creeks including, Hays Inlet and all tributaries of the North and South Pine Rivers

These documents must be referenced to obtain water quality objectives for the listed waterways.

1.4.2 State Planning Policy

The Queensland Government State Planning Policy (SPP) covers all interests of the state, including water quality and stormwater management. The policy provides a comprehensive set of principles which underpin Queensland's planning system to guide local government and the state government in land use planning and development assessment. The SPP sets out the State interests that must be addressed through local government planning schemes.

State planning policy includes stormwater relevant requirements under three State Interests:

a) Environment and Heritage - Water Quality
b) Environment and Heritage – Coastal Environment
c) Hazards and Safety – Natural Hazards

1.4.2.1 Water quality State Interest

The Water Quality interest looks to protect healthy lakes, streams, wetlands, groundwaters, coastal waters and catchments. The policy promotes WSUD as an important approach to the planning and design of urban environments. The SPP objectives support the protection of environmental values identified in the Environmental Protection (Water) Policy 2009.

The SPP requires development to achieve the state interest by:

a) Protecting environmental values and the achievement of water quality objectives;
b) Achieving the applicable stormwater management design objectives as outlined in Tables A and B (Appendix 2); or demonstrate current best practice environmental management for development that is for an urban purpose;
c) Providing innovative and locally appropriate solutions for urban stormwater management that achieve the relevant urban stormwater management design objectives;
d) Avoiding or minimising the disturbance of land for urban or future urban purposes in areas with natural drainage, acid sulphate soils, erosion risk, groundwater and landscape features;
e) Protecting the natural and built environment (including infrastructure) and human health from the potential adverse impacts of acid sulphate soils;
f) Locating, designing and constructing/managing development for an urban purpose to avoid or minimise:
    i. Impacts arising from:
        A. Altered stormwater quality or flow rate, and
        B. Wastewater (other than contaminated stormwater and sewage), and
        C. The creation or expansion of non-tidal artificial waterways, such as urban lakes, and
        D. The release and mobilisation of nutrients that increase the risk of algal blooms.

g) Ensuring development in water 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;
h) Ensuring development within a water supply buffer area complies with the specific outcomes and measures contained within the Seqwater Development Guidelines: Development Guidelines for Water Quality Management in Drinking Water Catchments 2017 or similar development assessment requirements.

The SPP provides additional detail for each policy element and includes a discussion on the issues and requirements for a strategic framework, development assessment, zoning and overlays.

The guideline states that the Urban Stormwater Quality Planning Guideline (EHP 2010) provides best practice information for the management of development and construction activities in accordance with the SPP design objectives.

1.4.2.2 Coastal Environment State Interest

This state has an interest in the coastal environment, including off-shore islands, as they are important for their natural processes and resources, and economic, social and aesthetic values. The policy seeks to protect and enhance the coastal environment while supporting opportunities for coastal-dependent development, compatible urban form, and safe public access along the coast.

The policy applies to all local government areas partially or wholly located within the coastal zone.

The SPP requires development to meet the state interest by:

a) Protecting coastal processes and coastal resources, and
b) Maintaining or enhancing the scenic amenity of important natural coastal landscapes, views and vistas, and
c) Consolidating coastal settlements by:
    i. Concentrating future development in existing urban areas through infill and redevelopment, and
    ii. Conserving the natural state of coastal areas outside existing urban areas, and
d) Focusing coastal-dependent development in areas adjoining the foreshore in preference to other types of development, where there is competition for available land on the coast, and
e) Maintaining or enhancing opportunities for public access and use of the foreshore in a way that protects public safety and coastal resources, and
f) Including the SPP code: Ship-sourced pollutants reception facilities in marinas (Appendix 1) or similar development assessment requirements.

1.4.2.3 Natural Hazard Management

A natural hazard is a naturally occurring event that may cause harm to people and our social wellbeing, damage to property and/or infrastructure and impact our economy and the environment. The natural hazards that can be prepared for through land use planning and development decisions are flood, bushfire, landslide, storm tide inundation and coastal erosion.

The state has the interest to avoid or mitigate risks associated with natural hazards to protect people and property and enhance the community's resilience to natural hazards.

The SPP requires development to achieve the state interest by:

For all natural hazards:

a) Avoiding natural hazard areas or mitigate the risks of the natural hazard, and
b) Supporting, and not unduly burden, disaster management response or recovery capacity and capabilities, and
c) Directly, indirectly and cumulatively avoid an increase in the severity of the natural hazard and the potential for damage on the site or to other properties, and
d) Maintaining or enhancing natural processes and the protective function of landforms and vegetation that can mitigate risks associated with the natural hazard, and
e) Facilitating the location and design of community infrastructure to maintain the required level of functionality during and immediately after a natural hazard event.

For coastal hazards—erosion prone areas:

a) Maintaining erosion prone areas within a coastal management district as development-free buffer zones unless:

   i. The development cannot be feasibly located elsewhere, and
   ii. It is coastal-dependent development, or is temporary, readily relocatable or able to be abandoned development, and

b) Redeveloping existing permanent buildings or structures in an erosion prone area to, in order of priority:
   i. Avoid coastal erosion risks, or
   ii. Manage coastal erosion risks through a strategy of planned retreat, or
   iii. Mitigate coastal erosion risks.

1.5 Other Council documents

1.5.1 Strategic Framework

The Moreton Bay Region Strategic Framework is the vision and strategy component of the MBRC planning scheme to accommodate growth and development to 2031. The framework has been developed using key values identified by residents through the Community Plan.

The Moreton Bay Regional Council Strategic Framework:

a) Sets policy position for the Moreton Bay Region
b) Identifies future development intent for places throughout the Moreton Bay Region
c) Implements the Queensland Government's South East Queensland Regional Plan 2009-2031
d) Is used in the assessment of impact assessable development
e) Is used where a development does not comply with an applicable code

A key component of the plan is the definition of place types; the different locations where we work, live and play. Each place type includes a combination of elements including location, liveability, local population and employment targets in addition to infrastructure and environmental values. They create a blueprint for the categories of growth and planning that is expected in different neighbourhoods, communities and precincts.

1.5.2 Moreton Bay Regional Council Planning scheme

Council has a range of development codes that accompany the planning scheme and provide a range of requirements that must be met. The codes are contained within the MBRC Planning Scheme and they provide provisions for earthworks, waterways, stormwater, erosion prone areas. Separate codes have been developed for the Precincts of North Lakes.

These codes must be referenced when applying this policy.

1.5.3 Moreton Bay Regional Council Water strategy

The Water Strategy 2012-2031 has been developed to safeguard water security and increase waterway health. It provides guidance for the Moreton Bay Region to transition to a region with Water Sensitive Cities.

The Water Strategy has been created using key values identified by residents of the Moreton Bay Region in the Community Plan, including:

a) A healthy natural environment;
b) Quality recreation and cultural opportunities;
c) Increasing the resilience of communities

The Water Strategy establishes the vision, fundamental principles and strategic outcomes to guide Council's integrated water management into the future. The Strategy is endorsed as a primary policy and will assist Council in making informed decisions to become a region with water sensitive cities.

This strategy will also inform and lead the development of subsequent strategies and plans, including the Total Water Cycle Management Plan, Floodplain Risk Management Framework, and Shoreline Erosion Management Plans. These documents will outline the key actions and targets required to achieve a sustainable water future.

1.5.4 Total Water Cycle Management

Councils Total Water Cycle Management (TWCM) Plan presents the findings from the detailed planning phase in a TWCM planning process for the Moreton Bay Regional Council area. It has been developed in accordance with the TWCM Planning Guideline for South East Queensland in order to satisfy requirements of the Environmental Protection (Water) Policy 2009.

The studies have identified the key drivers for TWCM, existing and future water accounts, key catchment constraints, and key catchment issues. Solutions were developed and assessed using a multi-criteria analysis approach. An implementation plan has documented the identified catchment management solutions, strategies and actions to achieve TWCM outcomes. The strategies were developed in consultation with key stakeholders and included Unitywater, the Department of Environment and Heritage Protection, the Department of Agriculture Fisheries and Forestry, SEQWater, Pine Rivers Catchment Association and SEQ Catchments.

1.5.5 Open Space Strategy

The Moreton Bay Region has a diverse and complementary network of open space ranging from expansive national parks and state forests to recreational parkland, sporting fields and civic spaces.

Many of these spaces are managed by Council for the benefit of the public. The Open Space Strategy contains:

a) Council's vision and principles for open space provision;
b) Desired standards of service for public parks;
c) A future open space infrastructure list with identified land acquisitions and park upgrades; and
d) An action and delivery program to achieve Council's vision for open space.

Any multi-use of open space to incorporate stormwater management must also be consistent with Appendix B – Open and Civic Space Design.

1.5.6 Floodplain risk management framework

In 2010 Council commenced work on a floodplain management framework including new and updated floodplain modelling - the Regional Floodplain Database (RFD) project. In early 2013, Council released floodplain mapping to the community.

1.5.7 Green Infrastructure Strategy

The Green Infrastructure Strategy has the vision of a healthy and productive network of natural, semi-natural and engineered green spaces and assets valued for what they are, the ecosystem services they provide, and the contribution to regional biodiversity and environmental resilience.

1.5.8 Integrated Regional Infrastructure Strategy

The Integrated Regional Infrastructure Strategy (iRIS), will combine Council's infrastructure priorities with the priorities of other infrastructure providers in the region, such as water, sewerage and energy. iRIS will coordinate the planning, design and construction process for all infrastructure networks. This will assist Council in prioritising infrastructure projects based on a quadruple bottom line assessment that stimulates economic development, is socially equitable, environmentally robust and has a governance framework based on excellence and value for money.

1.5.9 Catchment Management Plans

Catchment Management Plans (CMPs) such as the Caboolture River Catchment Management Plan provide a review of all aspects of the water cycle. They review catchment opportunities and constraints, potential impacts of future development and mitigation measures. They develop solutions which seek to reduce the risk to people and property from flood and storm tide and enhance the environment to protect the lifestyles of residents and visitors.

These documents must be referenced where available as they list specific requirements that must be addressed to allow future development to occur.

1.6 Design Issues, Opportunities and Constraints

1.6.1 Introduction

The following section provides guidance on the relevant issues, opportunities and constraints that inform successful project delivery for the region.

1.6.2 Design Issues, Opportunities and Constraints

1.6.2.1 Water Sensitive Urban Design

Water Sensitive Urban Design (WSUD) is about integration of the urban water cycle into urban design to minimise environmental degradation and improve aesthetic and recreational appeal. The guiding principles of WSUD are centred on achieving integrated water cycle management solutions for new urban areas and infill developments. WSUD encourages stormwater elements to be at the forefront of the development and add to the aesthetics of the development rather than be hidden from view as a treatment or end of pipe solution.

Although WSUD principles are primarily concerned with improving waterway health outcomes for the region they also have many other benefits. The principles highlight that the traditional approach of collecting and conveying stormwater runoff within hydraulically efficient conduits in underground pipe networks is not the only means of stormwater management.

WSUD can include the application of several types of stormwater best management practices in series to achieve successful stormwater outcomes. WSUD techniques for stormwater conveyance do not usually conflict with traditional stormwater networks and can be integrated to ensure a holistic approach to the management of stormwater runoff to achieve multiple benefits. Stormwater treatment and reuse can both save potable water and assist in meeting water quality and flow management objectives in a development.

Water by Design have developed highly effective guidelines (Water Sensitive Urban Design Guidelines for South East Queensland) to assist interdisciplinary teams to conceptualise and develop design solutions that integrate best practice sustainable urban water management within the urban form. These guidelines plus others listed in Section 1.7.1 include design details for:

a) Bio-retention systems and devices
b) Constructed wetlands
c) Constructed waterways / Natural Channel Design
d) Swales
e) Gully baskets
f) Online Proprietary stormwater quality improvement devices
g) Stormwater harvesting
h) Sediment basins

These guidelines and technical standards must be consulted and clearly understood when undertaking development in the region.

1.6.2.2 Urban Stormwater Quantity

The Queensland Urban Drainage Manual (QUDM) has been adopted as the basis of drainage design by the Moreton Bay Regional Council subject to any variation contained in this document.

The Queensland Urban Drainage Manual (QUDM) has been prepared for the purpose of assisting engineers and stormwater designers in the planning and design of urban drainage systems.

The aim of QUDM is to provide details of technical and regulatory aspects to be considered during the planning, design and management of urban stormwater drainage systems, and to provide details of appropriate design methods and computational procedures. Both hydrologic and hydraulic procedures are considered as well as environmental and legal aspects.

The prime objectives of QUDM are to address:

- the design of stormwater conveyance structures (not water quality) that exist from the down-slope allotment boundary to the edge of the defined watercourse
- the hydraulic design of structures that cross floodplains, such as constructed open drains and cross-drainage structures.

QUDM also provides guidance on the design of detention basins.

Australian Rainfall and Runoff must be referenced for larger flood studies involving estimation of hydrographs, runoff routing methods, rainfall analysis, flood frequency analysis etc.

1.6.2.3 Constructed Lakes

Historically, constructed water bodies have not performed well and suffered from a range of issues including weed ingress, sediment build-up, poor water quality, stratification, high turbidity, algal blooms, poor hydraulic performance and aesthetic issues resulting in a significant maintenance burden on Council. Any use of a constructed lake within a stormwater system will need strong justification and must be designed based on the Waterbody Management Guideline developed by Water By Design.

Constructed lake systems within urban developments are usually designed for amenity or recreational purposes. This contrasts with wetland systems, which are typically designed primarily for stormwater quality management. Constructed lakes have specific management needs as they hold open water which is sensitive to external pressures such as changes in land use, quality of water inflows, weed ingress, and loss of connectivity of adjacent water bodies.

The design of constructed lakes needs to consider their complex behaviour. In particular, the design needs to consider the alternate states that lakes can operate under depending on a number of influences and stressors. The designer must also be aware that constructed lakes are community assets and issues such as public safety, pest and weed control and integration into the overall landscape design must be considered at the planning stage, concept-detailed design and construction.

1.6.2.4 Erosion and Sediment Control

Suspended sediments have a major impact on the aquatic environment, altering habitats for aquatic organisms and reducing light penetration for plant growth. Water quality is also degraded due to the addition of pollutants such as nutrients, heavy metals and microbes, which can be attached to sediment particles.

Other stormwater pollutants can be attached to sediment particles, therefore large amounts of sediment result in additional pollutants in creeks and rivers. Sedimentation is arguably one of the most devastating impacts on waterways requiring immediate attention.

Consideration of erosion and sediment control measures is a key element of any stormwater management plan for all phases of a development. Refer to PSP Stormwater Management and International Erosion Control Associations, Best Practice Erosion and Sediment Control guidelines for further information.

Council is embarking on a proactive program to promote and improve the implementation, education and enforcement of best practice Erosion and Sediment Control on construction sites.

1.6.2.5 Waterway Corridors and Revegetation

Waterway corridor management refers to revegetation and the stabilization of watercourse banks to improve water quality by controlling sediment and erosion and capturing nutrients. Waterway corridor management provides for specific environmental outcomes centred on habitat connectivity and integrity.

Developments adjoining waterway corridors must:

a) Maintain natural structures and functions that are essential to waterway health;
b) Maintain natural diversity;
c) Maintain natural stream flow characteristics to support the health of target species/communities;
d) Protect rare or threatened structures and functions;
e) Provide appropriate buffers and landscape integration between the artificial and natural elements.

The design and integration of the landscape immediately adjoining the Waterway corridor also requires careful attention if the transition is not to appear artificial or lacking in structure. This transition area must incorporate native plantings similar to those within the natural waterway corridor. A more structured planting design approach to this transition zone can provide higher amenity values.

Existing watercourse erosion and bank stability problems within or adjoining the subject land are required to be repaired and corrected with suitable best management practises, including revegetation.

A well vegetated creek line has many benefits such as:

a) Improving water quality
b) Increasing plant and animal diversity
c) Improving livestock condition
d) Stabilising banks
e) Controlling erosion
f) Providing habitat for native wildlife
g) Increasing property value

Natural riparian vegetation helps to stabilise banks, shade streams, reduce evaporation, provide food and habitat for wildlife, and most importantly, act as a buffer for water run-off within catchments. Revegetation can also offer potential flood risk benefit. When water flows through anchored vegetation, the increased roughness results in a lower flow velocity which decreases the probability of erosion. The flow resistance caused by any vegetation increase is dependent upon the overall maturity, thickness/stiffness, distribution and type.

The establishment of sustainable riparian vegetation is critical to the successful construction of waterways in urban developments.

It is important to plant species that are native to local waterways because they maintain biodiversity, provide suitable habitat and food for native wildlife.

1.6.2.6 Floodplain management

A major flood can be devastating for communities and industry, while a minor flood can be beneficial to the natural environment and agricultural industries. The planning and design of development within floodplains is highly complex and needs to consider both the needs of the community and the natural environment.

Development of land affected by flooding requires detailed assessment of the existing flood risk and catchment hydrology prior to design. If the development is located within a floodplain a detailed flood hazard assessment is required to identify the potential impacts of the development on the flood hazard and demonstrate that the flood plain management requirements have been satisfied.

The choice of hydrologic analysis must be appropriate to the type of catchment and the required degree of accuracy. When a full design hydrograph is required for flood mapping or to assess flood storage requirements, simplified hydrologic calculation methods such as the Rational Method are not acceptable.

1.6.2.7 Safety in Design

Public safety is an essential objective of stormwater system planning and design. Stormwater systems can include open channels, ponded treatment measures, and basins that can provide a significant safety risk where human interaction is likely to occur. Access to flooded areas and infrastructure must be discouraged during and after large rainfall events.

All stormwater management infrastructure is to be designed with reference to Safe Work Australia's Code of Practice for safe design of structures.

QUDM, Australian Rainfall and Runoff (including associated revision project reports) and the Water By Design / Healthy Waterways WSUD Technical Design Guidelines for SEQ include information on safety issues for stormwater infrastructure. QUDM includes a discussion on a risk management approach that must be adopted for activities that are expected to have a high risk. These documents must be referenced for further advice on safety.

The safety of the constructors, operators, maintenance personal and the general public must be considered during the design of stormwater infrastructure. Fencing or other means to prevent/manage unauthorised access may be required by Council.

1.7 Design Parameters

1.7.1 Technical Documents

Broadly, the technical documents to be used for stormwater management design are listed in the table below. The current editions of all documents are to be used unless specified otherwise.

Table 1: Technical Documents

Stormwater Management Element	Reference
Policy, planning, legal and technical requirements	• State Planning Policy (and associated guidelines)

	• Environmental Protection (Water) Policy 2009
Major and minor drainage design methodologies	• Queensland Urban Drainage Manual
Culvert and bridge hydraulics	• Austroads Waterway Design Guidelines • Queensland Urban Drainage Manual
Scour protection and drop structures design (chute blocks not permitted)	• Queensland Department of Main Roads – Urban Road Design Manual – Volume 2 • Queensland Urban Drainage Manual
Sediment and erosion controls, BMPs including sediment retention ponds	• International Erosion Control Association – Best Practice Erosion and Sediment Control Guideline
Water quality standards	• State Planning Policy (and associated guidelines), • Environmental Protection (Water) Policy 2009, • Queensland Water Quality Guidelines 2009
Best Management Practices for Water Quality / Total Water Cycle Management / Water Sensitive Cities	Healthy Waterways – Water by Design Guidelines including • Water Sensitive Urban Design Technical Design Guidelines for South East Queensland 2006 • Concept Design Guidelines for Water Sensitive Urban Design 2009 • Construction and Establishment Guidelines: Swales, Bioretention Systems and Wetlands 2010 • The Waterbody Management Guideline 2013 • Transferring Ownership of Vegetated Stormwater Assets 2012 • Draft Rectifying Vegetated Stormwater Assets 2012 • Maintaining Vegetated Stormwater Assets 2012 • Total Water Cycle Management Planning 2010 • Draft Stormwater Harvesting Guidelines 2009 • MUSIC modelling Guidelines 2010 • Framework for the Integration of Flood and Stormwater Management into Open Space 2011 • Stormwater Infrastructure Options to Achieve Multiple Water Cycle Outcomes 2009, Queensland Water Commission • Australian Run-off Quality—A guide to Water Sensitive Urban Design 2006, Engineers Australia
Runoff routing methods, hydraulic modelling, rainfall analysis, flood frequency analysis etc	• Australian Rainfall and Runoff (and associated revision reports)
Data Management	• Data Capture Guideline 2010 • Asset Management Guideline 2010

Note: Where more than one of these documents covers the same issues, consultants must evaluate and justify the selected design.

Consultants design reports must clearly state the reference to the specific document (by title, section number and page number) that relates to each design procedure.

1.7.2 Lawful Point of Discharge

Stormwater runoff shall be conveyed to a point at which it may be lawfully discharged. The lawful point of discharge shall be determined using QUDM.

Approval in the form of an easement (size as described in Section 1.7.3) shall be obtained from downstream property owner/s of any property affected as a result of the discharge. A letter from the downstream property owner granting "discharge approval" as described in QUDM will not be accepted.

In staged developments, easement provisions shall be made in a logical sequence ensuring that the runoff from each individual stage is discharged at a lawful point of discharge. Easement provisions must be identified for downstream properties proposed for development in future stages during each stage of the development.

Discharge approval (as per QUDM) are not to be used.

1.7.3 Easements

Stormwater management infrastructure, other than inter-allotment drainage lines, must be located within roads, pathways, park or drainage reserves. Open drains shall not be located within private allotments in the General residential zone in all Precincts.

However, where site constraints restrict designs such that any Council and inter-allotment pipelines, overland flow paths and open drains must be located through private property, they shall be contained within easements.

Easements shall be connected to a point of lawful discharge.

Minimum easement widths for underground drainage are show in Table 2 below.

Table 2 Minimum Easement Widths – underground pipes

Pipe Diameter	Easement Width*
Stormwater pipe ≤ 825mm diameter	3.0 m
Stormwater pipe ≤ 825mm diameter and any other service	4.0 m
Stormwater pipe > 825mm diameter	Easement boundary to be 1m clear of the outside wall of the stormwater pipe (each side).
* A Moreton Bay Regional Council engineer may require additional easement width to be provided, in certain circumstances, in order to facilitate maintenance access to the stormwater system.	

All open channel works must be located within easement boundaries or on Council owned land. For the construction of large open channels, consideration must be given for access by Council maintenance vehicles and equipment. The minimum easement widths for open channels are shown in Table 3.

Table 3 Minimum Easement Widths – open channels

Channel Type	Easement Width*
Concrete lined	Channel width + 3m
Grassed lined	Channel width + 6m
Grassed swale batter slopes <1V:4H	Swale width + 3m
Catch drain/bank	3m minimum (completely contained within the easement)

Any water quality or WSUD elements must not be constructed in private property that manage stormwater flows from roads or public areas,

Where an outlet discharges into private property (including balance lots), an easement is to be provided for the greater of:

a) 20 metres; or
b) a sufficient distance to enable the discharge volume to return to sheet flow and of sufficient width to encompass the full flow width.

1.7.4 Minimum Stormwater Drainage Works

All drainage systems shall be designed in accordance with the major/minor drainage concept as discussed in QUDM.

The minor drainage system includes kerbs and channels, roadside channels, drainage swales, inlets, underground drainage, junction pits, access chambers and outlet structures designed to fully contain and convey the discharge from the minor storm.

The major drainage system is that part of the overall drainage system designed to convey the specified major storm flow. This system may comprise:

a) Open space floodway channels, road reserves, pavement expanses and other flow paths designed to carry flows in excess of the capacity of the minor drainage system;
b) Natural or constructed waterways, detention/retention basins and other major water bodies;
c) Major underground piped systems installed where overland flow is impractical, unacceptable, or incapable of carrying the required discharge.

The major storm flow is carried through the subdivision or development clear of allotments within required freeboard limits.

1.7.4.1 Major System

The major system for all place types shall be the Defined Flood Event.

The Defined Flood Event (DFE) is a flood scenario adopted by Moreton Bay Regional Council in order to establish certain development controls within the floodplain. The Defined Flood Event is similar to the 1% annual chance flood but with a further allowance for factors such as blockage, sea level rise and increased rainfall intensity. The further allowances include:

a) 1% AEP flood event using ARR design rainfalls
b) 1% Moreton Bay Design Storm (MDS) event which is a 15 minute in 270 minute embedded design storm (15 minute burst inside a 270 minute burst with storm 'wings' scaled down to preserve overall volume of an ARR design burst)
c) 1% MDS event with Moderate structure blockage - refer to report Regional Floodplain Database - Floodplain Parameterisation (SKM, 2012) report downloadable from the Council website.
d) 1% MDS event with 20% Increase in rainfall
e) 1% MDS event with 20% Increase in rainfall and increased downstream boundary (0.8m sea level rise for coastal models and 0.02% AEP event for inland models)
f) 1% MDS event with Medium Dense Vegetation changed to High Dense Vegetation and Low grass/grazing changed to Medium Dense Vegetation within the 1% AEP floodplain to reflect future revegetation.
g) 1% MDS event with Medium Dense Vegetation changed to High Dense Vegetation and Low grass/grazing changed to Medium Dense Vegetation within the 1% AEP floodplain and impact of increased residential development (Change in minor catchment fraction impervious) (this applies only to selected minor basins where urban development is a feature).

The major system design event may be increased in special circumstances as described in QUDM section 7.3.1.

1.7.4.2 Minor System

Kerb and channel is required on both sides of all roads except where swale drains or rain gardens are approved as part of an integrated stormwater management system. Kerb and channel is not expected in rural areas.

Catchpits are to be located to ensure that the flow in the channel does not exceed specified width and depth limits.

Field inlets are required at the lowest point of all commercial, industrial and multi-unit residential lots, and at the lowest point of residential lots where the lot drains one or more upstream properties. Inter-allotment drainage is to be designed in accordance with QUDM and an easement is required over all downstream pipe work to the downstream legal point of discharge.

Full piped drainage is required from all catchpits and other inlets to the boundary of the subdivision, or approved point of discharge, unless otherwise permitted by these design standards or approved by a Moreton Bay Regional Council engineer.

1.7.5 Design Storm – Annual Exceedance Probabilities (AEP)

For design under the "major/minor" concept, the design AEPs to be used are given in Table 4. The drainage system is to be designed to cater for a fully developed upstream catchment.

Table 4: Minor System Design ARI and AEP

Development Category / MBRC Planning Scheme Zone/Precinct		AEP
Centre zone		10%
Emerging Community zone		Refer to relevant Zone/Precinct identified in the Structure Plan
General residential zone - Suburban neighborhood precinct General residential zone - Coastal communities precinct Township zone (all precincts)		10%
General residential zone - Next generation neighborhood precinct* General residential zone - Urban neighborhood precinct*		10%
Industry zone (all precincts)		10%
Recreation and open space zone		63%
Rural zone		18%
Rural residential zone		18%
	Kerb and channel flow	10%

Major road - longitudinal / cross drainage	Cross drainage	2%
Minor road - longitudinal / cross drainage	Kerb and channel flow	As per land use
	Cross drainage	10%
Active Transport (Bikeways/Pathways)	Cross drainage	10%
Car parking	Kerb and channel flow	As per land use
	Cross drainage	10%

*Where a development's lawful point of discharge is constrained by existing development, Council may agree to an alternative design AEP.

1.7.6 Road definitions

QUDM adopts major / minor terminology for assessing the drainage requirements of roads. Table 5 below must be used to assign major/minor road categories for the Moreton Bay Regional Council functional road hierarchy for stormwater design purposes.

Table 5: Road Definitions

QUDM	Road Classification
Major road	Arterial, Sub-arterial, District Collector
Minor road	Local Collector, Access Street

1.7.7 Rational Method

The requirements of QUDM shall apply. Methods and equations identified in QUDM as 'preferred' or 'recommended' shall be adopted for minor drainage.

1.7.7.1 Design rainfall data

Design Intensity-Frequency-Duration (IFD) Rainfall shall be obtained from the Bureau of Meteorology website for the specific location of interest.

1.7.7.2 Coefficient of Runoff

The runoff coefficient (C values) shall be as defined in section 1.11.5 and QUDM.

1.7.7.3 Time of Concentration

The time of concentration calculations (including standard inlet times) shall be as defined in section 1.11.5 and QUDM.

1.7.8 Hydraulic Calculations

The requirements of QUDM apply.

The use of computer models is to be as described in Section 1.12.

Any additional calculations in support of overland flow path capacities, weir flows over kerbs, and flood fill studies are also to be submitted with the design for approval.

Drainage calculations and catchment plans shall be prepared in accordance with QUDM and presented to Council.

1.7.9 Mannings 'n'

Refer to QUDM for the applicable Manning's roughness coefficient.

1.7.10 Development levels and freeboard

An appropriate freeboard is to be added to the calculated Defined Flood Event (DFE) flood level. The freeboard allows for unmeasurable uncertainty in the hydrological and hydraulic calculations and modelling.

Freeboard is to be provided as specified in the Moreton Bay Regional Council planning scheme (refer to Part 8 - Overlays, 8.2.1 Coastal hazard overlay code and 8.2.2 Flood hazard overlay code).

1.7.11 Major Drainage System Design Criteria

The major and minor drainage system described in QUDM forms the basis of the drainage system within the urban area.

1.7.12 Cross drainage culverts

Road cross drainage structures (bridges, culverts and floodways) must be designed to satisfy the trafficability criteria as detailed in QUDM in the major storm event. Road cross drainage structures shall be designed with sufficient capacity to convey the minor storm event without the road being overtopped.

Trafficability will depend upon the combination of depth and velocity of flow over the road and shall meet the requirements as listed in QUDM.

The requirement may be increased subject to the assessment of the importance of the road, the significance of interruptions to traffic, and the economics of providing a higher level of serviceability.

All culverts must include provision for blockage as recommended by QUDM.

The likely effects of a storm event in excess of the major design storm must be considered and the consequences discussed with Council. This process requires the development of a 'Severe Storm Impact Statement' prepared in accordance with the requirements of QUDM. The 0.1% AEP is the desired severe storm to be considered.

All cross road drainage culverts/structures are to be free draining.

1.7.13 Roof and allotment drainage

The requirements of QUDM shall apply.

1.7.14 Roadway flow width

The requirements of QUDM shall apply.

1.7.15 Master Plans

Where applicable, Council may provide a drainage master plan/catchment management plan that includes specific requirements for the local catchment.

1.7.16 Technical Drawings

Applicable standard drawings for stormwater infrastructure including Water Sensitive Urban Design are listed in Appendix H. These drawings will provide a basis for construction details required to apply to stormwater infrastructure within the region.

1.7.17 Stormwater Quality

Stormwater quality shall be managed to meet the requirements of the Environmental Protection (Water) Policy 2009 and the State Planning Policy.

The stormwater system is to meet the requirements of the SPP and TWCMP as listed in Section 1.4 and 1.5.

Development must also consider and adopt any recommendations from local studies or Site Based Stormwater Management Plans or Catchment Management Plans for the receiving waters.

The development is to address water quality issues during operation and construction.

1.7.18 Integrated Stormwater Management Systems

An integrated stormwater management system is to be designed around the three pillars of a Water Sensitive City:

a) Cities as water supply catchments
b) Cities providing ecosystem services
c) Cities comprising water sensitive communities

The stormwater system must form part of an integrated system that will address water cycle management issues based on environmental, economic, social and cultural considerations. The design of an integrated system is to:

a) provide the water security essential for economic prosperity through efficient use of diverse available resources;
b) enhance and protect the health of waterways and wetlands, the river basins that surround them, and the coast and bays;
c) mitigate flood risk and damage; and
d) create public spaces that collect, clean, and recycle water.

1.8 Application to zones

1.8.1 General

a) Lot layouts, street design and earthworks must accommodate the at-source/surface collection, transportation and treatment of stormwater.
b) Development must maximise the resource value of urban water systems by capturing all available opportunities to recycle and re-use water as it moves throughout the urban environment.
c) End of pipe stormwater treatment devices may be an appropriate solution where at-source and surface treatment is not practical, provided there is suitable open space available for larger treatment devices.
d) The design of constructed waterways must mimic the natural stream forms in the immediate region.
e) The integration and location of larger treatment devices within the open space network must be guided by a number of general principles. These are:
   I. Do not impact on the primary function of the open space and maximise visual interest and amenity while adhering to guiding principles for optimal stormwater treatment.
   II. Are located to avoid any risk of operational problems (e.g. scour, erosion) due to high velocity flows. As a minimum, flow velocities through constructed wetlands, bioretention systems and vegetated swales must not exceed 2m/s for events up to a 1% AEP (Refer to Water by Design technical guidelines). A high flow bypass is to be provided as a component of all designs.
   III. High flow bypasses are to have a minimum grade of 0.5%.
   IV. Do not remove remnant vegetation to accommodate stormwater.
   V. Look for opportunities to collect treated stormwater to re-use for irrigation or public water features.

1.8.2 Quantity Outcomes

a) Development must not result in water being diverted onto land that is not normally subject to overland flow.
b) All detention basins must be designed and constructed to appropriately manage stormwater discharge by limiting post development peak flows to the pre development flow rates.
c) Must covey a fully developed external catchment through the site.

1.8.3 Quality Outcomes

To improve bank stability and resilience of the Region's waterways, areas identified within Overlay Map - Riparian Setbacks are rehabilitated/revegetated with native species in accordance with the minimum requirements outlined in 1.10.11.

a) Council's adopted TWCM Plan is implemented.
b) Development achieves the minimum stormwater management design objectives of the State Planning Policy as outlined in Schedule 10 of the MBRC planning scheme.
c) Development contributes to the achievement of the water quality objectives as outlined in Environmental Protection (Water) Policy 2009.

1.8.4 General Residential and Emerging Communities

1.8.4.1 General

The General Residential and Emerging Communities area comprises the majority of land holding in the region and therefore provides the greatest opportunity to reduce stormwater runoff and pollution. Topography is the most important influencing factor when planning for residential subdivisions. Topography defines water shed boundaries, the pre-existing pathways for water movement, and establishes ecological corridors that support regional biodiversity. Urban design that responds sympathetically to topography will generally deliver better environmental outcomes.

1.8.4.2 Specific Guidelines

a) Street lengths (typically 75 -100m) from high points to low points, longitudinal grades, and pavement cross-falls ensure stormwater is conveyed within the road carriageway to stormwater treatment devices located at low points, so that stormwater is treated before entering the piped drainage network.
b) A minor and major drainage system that achieves desirable flow widths, depths, velocities and freeboards as described previously
c) Road side swales are only used where adequate separation between the swale and lot frontages can be achieved, as per MBRC standard drawing MBRC-1105.

1.8.5 Industry and Centre

1.8.5.1 General

Industrial areas are developments that generally have large impervious areas and often discharge large volumes of stormwater containing a more variable range of pollutants than stormwater from residential or commercial areas. There are many challenges associated with industrial developments that need to be addressed on a site specific basis at the design stage of a subdivision. Some industrial buildings (such as bulk warehouses) often generate significant roof water runoff and have minimal on site demand for recycled water. Provide stormwater harvesting opportunities for on-site landscaping, non-potable uses such as toilet flushing or other adjoining compatible land uses that demand higher recycled water such as sporting fields.

Centres are urban areas that are well connected by transport routes and contain buildings and infrastructure of high quality urban design. Centres accommodate larger building footprints, higher density and more compact development. In commercial buildings water use is dominated by toilet flushing and there is little demand for drinking water and garden irrigation. Roof water harvesting at the allotment scale, supplemented by a precinct-scale treated grey water or sewer mining source must be investigated.

1.8.5.2 Specific Guidelines

a) Planning and design of industry and centre developments should co-locate land uses that generate recycled water with compatible land uses that demand recycled water.
b) Building design must minimise stormwater runoff across contaminated work and storage areas.
c) Oil/Grit Separators are to be provided for car parks or hardstand areas of Industrial or relevant commercial development where other catchment based water quality treatment devices are not available.
d) Design of industrial and centre developments incorporate mechanisms to capture spills before entering the stormwater drainage system.

1.8.6 Environmental Management and Conservation, Recreation and Open Space

1.8.6.1 General

Natural areas are important ecological landscapes that are crucial to protecting the biodiversity within the region. Development adjoining these areas must take a whole of catchment approach during planning and design so that the environmental values are preserved and conserved in their natural state.

1.8.6.2 Specific Guidelines

1.8.6.2.1 Waterway corridors

a) Development does not adversely impact on the hydraulic performance of a flood channel.
b) Existing watercourses or drainage features are to be re-vegetated with native species.
c) An investigation into the stability of banks is required for any development within a waterway corridor to ensure that any development will not be subject to erosion or landslip. The investigation needs to cover site geology, stream hydraulics, creek morphology and the remediation of buffer works.

1.8.6.2.2 Floodplains

a) Flood modelling (including flood storage calculations) must demonstrate that any proposed works or structures within the floodplain do not result in any adverse changes to the flood storage capacity, flood levels or behaviour of the floodplain.
b) Building works or structures are not to result in the loss of functional flood plain.
c) Earthworks/fill within a flood plain does not to occur without the provision of compensatory flood plain storage (refer to Planning Scheme Policy - Flood hazard, coastal hazard and overland flow).
d) Site earthworks must not compromise the functional flood plain or conveyance of flow or adversely impact the hydraulic characteristics of the watercourse/floodplain.
e) Development shall provide for safe evacuation from the floodplain to an area of refuge above the Probable Maximum Flood.

1.9 Design Details – Water Quality

1.9.1 Introduction

Water Sensitive Urban Design infrastructure is to be designed in accordance with Moreton Bay Regional Council standard drawings unless otherwise approved in writing.

Any proprietary product to be used in Moreton Bay Regional Council must be submitted to Council for assessment of its suitability for a particular application. When Council is satisfied that a particular product has conformed to all the technical specifications, performance and maintenance objectives, the proprietor or manufacturer will be advised in writing of its suitability of use. Notwithstanding this acceptance advice, Moreton Bay Regional Council reserves the right to withdraw the approval for use of any product at any time.

The following WSUD elements have proven to be effective and applicable for use. Alternative or innovative measures may also be appropriate based on catchment characteristics, performance, maintenance, costs and receiving environment.

a) Constructed wetlands
b) Bioretention systems
c) Swales
d) Gully baskets / gross pollutant traps
e) Online Stormwater Quality Improvement Devices (SQIDs)

In keeping with the recent trends in WSUD, these devices focus on treating run-off from local catchments 'at source', rather than offering 'end-of-pipe' solutions. They are designed to treat small, frequent stormwater flows prior to discharge to underground stormwater pipe networks, channels or natural waterways.

All devices are unobtrusive, maintainable, cost effective and proven by experience to be the most suitable for road and street projects within the Moreton Bay region.

All measures must be selected based on site constraints and opportunities and consider topography, cost, safety, maintenance requirements, multiple benefits, etc.

1.9.2 Key design criteria

Technical guidance on the selection and design of WSUD elements is to be obtained from the Healthy Waterways Water Sensitive Urban Design Technical Design Guidelines for South East Queensland and any associated updated technical documents developed by Healthy Waterways and Catchments (Water by Design).

1.9.3 Construction and Establishment

The construction and establishment of vegetated systems is critical to their performance. Design documentation must include a discussion on any specific requirements and potential risks to the infrastructure and water quality during these phases. The Water by Design Construction and Establishment Guidelines must be referenced.

1.9.4 Maintenance

The maintenance of poorly designed and executed vegetated assets can be timely and cost prohibitive. The design of these assets must consider suitable maintenance access to all key areas of the asset. Design documentation must include a discussion on any specific maintenance requirements and an inspection and maintenance checklist for each piece of infrastructure. The checklist must include inspection and maintenance frequency and required maintenance activities. The Water by Design's Maintaining Vegetated Stormwater Assets guideline must be referenced for all vegetated assets.

1.9.5 Natural Channel Design

Natural Channel Design is based on providing the required hydraulic conveyance of a drainage channel and floodway while maximising its potential environmental values. It is a holistic approach that combines the disciplines of hydraulic engineering, fluvial geomorphology and in-stream and riparian ecology.

The design of the channel considers the regional importance of the waterway, the local plan form of the watercourse, the channel cross-section, and finally the design of in-channel features.

Natural channel design is to be undertaken in accordance with QUDM.

1.9.6 Stormwater Harvesting

The harvesting of stormwater allows the capture and reuse of stormwater for non-potable uses. This not only provides a valuable water resource, it also assists with the management of stormwater quality. Capturing and reusing stormwater reduces the volume of contaminated stormwater entering local waterways, reduces the frequency and the magnitude of frequent runoff events.

Stormwater harvesting is included for specific greenfield areas within the MBRC Total Water Cycle Management Plan. The Water by Design Stormwater Harvesting Guidelines are to be referenced for additional technical guidance. The adoption of any stormwater harvesting off take system must not impact adjacent flood levels.

1.10 Design Details - Drainage infrastructure

Stormwater drainage infrastructure is to be designed in accordance with Moreton Bay Regional Council Standard Drawings unless otherwise approved in writing by a Moreton Bay Regional Council Development Assessment Engineer.

Any proprietary product to be used in Moreton Bay Regional Council must be submitted to Council for assessment of its suitability for a particular application. When Council is satisfied that a particular product has conformed to all the technical specifications, performance and maintenance objectives, the proprietor or manufacturer will be advised in writing of its suitability of use. Notwithstanding this acceptance advice, Moreton Bay Regional Council reserves the right to withdraw the approval for use of any product at any time.

1.10.1 Gully Inlets. Field Inlets and Manholes

The requirements of QUDM shall apply.

Provision for blockage as recommended by QUDM shall be adopted.

Access chamber cover locations in carriageways are to avoid bike lanes and wheel paths and are to comply with the table below:

Road width	Distance from Kerb
≤ 6.0m	At least 1.5m off invert of kerb
> **6.0m**	At least 2.0m of invert of kerb

Inlets capacities for standard gully inlets shall be based on Brisbane City Council hydraulic capture charts as provided on their webpage for technical documents.

The maximum diameter of stormwater pipes under the kerb is 600mm.

Stormwater pipe connections around road corners are not to be extended behind the back of kerb more than 300mm.

Maximum gully pit to pipe connection is to be 600mm diameter. In locations constrained by services (e.g. gas corridor or street light footings) a gully pit to pipe connection is to be a maximum of 450mm diameter.

Gully pit to manhole to gully pit connections are not acceptable unless the final gully pit is a sag pit prior to the outlet (i.e. once the system enters a manhole it cannot return to gully pit only connections regardless of pipe size).

Gully pits shall be located on a section of straight kerb and channel, wherever possible and located so as to reduce the likelihood of conflict with future driveway locations. Overland flow paths shall be provided at all sag points and directed to a lawful point of discharge.

Anti-ponding gullies in curves shall be side entry type, chamber and grate only.

1.10.2 Pipes/Box Culverts

General requirements:

a) Pipes used may be made from either reinforced concrete or fibre reinforced concrete type[1].
b) Minimum longitudinal pipe size – 375 mm diameter.
c) Minimum gully pit connections – 300mm diameter.
d) Minimum cross drainage size – 450mm diameter.
e) Pipes up to and including 600mm diameter shall be rubber ring joined (regardless of location).
f) Pipes greater than 600mm diameter, where not located in sandy soils, shall be internal flush jointed with pipe manufacturers proprietary external bands.
g) Minimum clear cover shall be 600mm in all instances, unless approval otherwise by a Moreton Bay Regional Council engineer.
h) Pipe class and bedding type to be determined based on the current Australian Standard 3725 - Design for installation of buried concrete pipes.

[1] Alternative products may be used subject to approval by Moreton Bay Regional Council Engineer.

i) The minimum vertical and horizontal clearance between any stormwater pipe and any other pipe or service conduit shall be 300mm.

Pipe trenching is to be designed and constructed in accordance with I.P.W.E.A.Q. standard drawings and subject to the following requirements:

a) In sandy subsoil areas the bed zone material is to be 20mm screenings.

Where backfill materials are located onsite then testing information is to be provided to Council's delegated officer to demonstrate the suitability of the material in accordance with PSP Operational Works, Inspection and Bonding Procedures prior to the works being undertaken.

All pipelines located in sandy locations (Bribie Island, Beachmere etc) are to be rubber ring jointed. Reinforced concrete box culverts are not permitted in these locations unless appropriate steps (as agreed by Council) are taken during construction to prevent the ingress of sand through the joints.

Sandbands are required when flush jointed pipes are used.

In locations where the drainage system will be subject to a salt water environment and/or aggressive groundwater conditions, Consultants must liaise with the relevant suppliers for an appropriate product designed to comply with the current Australian Standard and meet the specific site conditions. In particular, special consideration shall be given to material selection in areas affected by tidal waters at levels less than RL1.5mAHD. In these circumstances, sizing of the applicable pipe diameter must consider the internal diameter to cater for increased external thickness.

1.10.3 Kerb adaptors

Only approved full height kerb adaptors are permitted. The kerb adaptors must be placed in a location where the service pits on the footpath will not conflict with the future pipe location. A minimum of two (2) kerb adapters are to be provided per allotment that drains to the road in accordance with Council's standard drawing (refer to Appendix H). Where a lot has side crossfall of up to 1.5%, one (1) kerb adaptor shall be located at each side of the lot. Where a lot has side crossfall of greater than 1.5%, both kerb adaptors shall be located at the low side of the lot.

For lots with a concrete footpath at the frontage, the kerb adaptors shall be connected to the front boundary of the lot with Class SN8 uPVC stormwater pipe.

The opening in the kerb must be sawcut and kerb adaptors must be installed flush with the top of the kerb. Kerb adaptors must be fixed in accordance with the manufacturer's specification and all gaps must be filled with approved materials.

Any damage to Council kerb and channel as a result of installing a kerb adaptor is to be repaired by the contractor/developer at the cost of the contractor/developer.

Where roofwater is proposed to be piped directly in through the back wall of a gully then an inspection of the opening and finish shall be carried out by a Moreton Bay Regional Council inspector. Council may request alternative locations to be adopted based on structural issues.

1.10.4 Discharge to Tidal and Other Waterways

The requirements of QUDM apply except minimum tailwater.

Levels for discharge to Tidal Waterways shall be as follows:

Design Condition	Design Tailwater Level
Minor storm	0.8m AHD + 0.8m greenhouse effect
Major storm	1.2m AHD + 0.8m greenhouse effect

Note: In existing urban areas, alternative design tailwater conditions may be considered by Council.

1.10.5 Open channels

The requirements of QUDM shall apply, except for the following:

a) Afflux due to bridges, culverts and other structures shall be calculated using methods outlined in QUDM.

b) In the analysis of soft faced channels, two roughness coefficients must be used to represent the well maintained and vegetated (unmaintained) state to check velocity and freeboard requirements respectively.
c) All hydrologic and hydraulic calculations for the purpose of determining ultimate flood levels and development fill and flood levels shall be based on 1% AEP flows for a fully developed catchment and a fully vegetated waterway corridor using minimum Manning's n of 0.15, unless otherwise approved by Council's Flood Engineer.
d) A maximum velocity of 1.5m/s is to be maintained within grassed sections of any drain. Where drop structures are used within the grassed section of open drains to dissipate energy and ensure velocities do not exceed 2m/s, details of the proposed energy dissipation measures must be submitted to Council for approval.
e) Within open drains a low-flow drainage pipe is required which complies with the following criteria
   i. Nominal one half of the one Exceedance per Year (EY) design flow (1 year ARI capacity)
   ii. Minimum diameter 375mm
   iii. Surcharge manholes into the open channel
   iv. Maximum velocity within pipe as per QUDM
f) In lieu of low-flow drainage pipe, a formed concrete invert (vee or dished) must be used which meets the following criteria:
   i. Minimum width 2m
   ii. Maximum velocity 2m/s
   iii. Energy dissipation at drop structures
   iv. At least 1m wide strip of turf each side of invert
   v. Minimum longitudinal grade 1 in 200.
g) Open drains are to be vegetated with robust native grasses that form a mat of grass rather than growing in clumps.
h) Maximum side slopes 1 in 4. Batters between 1 in 4 and 1 in 6 are to be turfed.
i) Open drains within private property must follow the property boundaries. Where this cannot be achieved, open drains across the property are not permitted within the initial 40 metres of the allotment measured from the front road/street boundary. Under no circumstances can open drains straddle allotment boundaries.
j) Except where open drains follow a property boundary or as otherwise approved in writing, the applicant is required to construct a vehicle crossing to navigate the open drain. Calculations showing the impact on the drainage design are required.
k) A combined system using a low flow drainage pipe and concrete invert will be required where the minimum channel grade of 1 in 200 cannot be achieved in the overland flow path.
l) Overland flow paths must be located immediately opposite sag points.
m) All concrete aprons are to have cut-off walls a minimum of 600mm in depth.
n) Stormwater quality treatment devices may be required prior to overland stormwater flow entering a stream, creek, park, open space etc.
o) All systems are to be designed with approved erosion and sediment control measures.
p) Where pathways are designed as overland flow paths, they are to be provided with a concrete footpath of a minimum 1.5m width and the remainder of the pathway shaped and turfed to provide a suitable flow path. A review of the hazard must be undertaken to confirm that the safety criteria as described in AR&R and QUDM (i.e. flow depth and flow velocity) are acceptable
q) In coastal environments:
   i. the channel inverts must not penetrate any acid sulphate soil layers; or
   ii. the acid sulphate soils are at least 0.5m below the channel invert.

The above requirements are not intended to exclude alternative designs which would result in water quality treatment benefits.

Where the minimum invert level of an open channel is below HAT, the channel must be concrete lined to prevent increasing tidal zone and to prevent establishment of mangroves.

1.10.6 Safety

Depth-velocity product indicates the safety of overland and channel flow. The requirements of QUDM shall apply.

1.10.7 Rear of allotment drainage

Refer to QUDM (Level III) for design details of a rear of allotment drainage system.

1.10.8 Conveyance of Flows from External Catchments

Overland flow, whether in concentrated or broad sheet flow form, is not to cause an increase in flow on upstream or downstream properties, does not result in any other area to be wet, does not concentrate flow, and discharges to a legal point of discharge.

The following are a list of possible solutions:

a) Diversion drains
b) Bunding
c) Field inlets and pipe systems
d) Property fencing (*property fencing may form part of the wetted perimeter of an overland flow path only if it is designed by a structural engineer and is of a permanent nature and constructed of masonry brick or similar materials to a height of 600mm above ground level in the flow path. The maximum height of the calculated water surface elevation above the ground level shall be no more than 300mm. Consideration must be given to reducing the permeability of fencing to avoid adjacent property damage. Any fencing used to contain overland flow is to be constructed as part of the development works*).
e) Swale drains

1.10.9 Waterway Corridors

Where development adjoins a waterway corridor and revegetation is required for bank stabilisation, to maintain/improve stream integrity, to restore areas disturbed by construction or as otherwise required by a site based stormwater management plan, riparian corridors are to be revegetated a minimum of 1.5 times the bank height or 7 meters (whichever is greater) from the top of bank/bank full level.

Species are to be selected from the appropriate Regional Ecosystem list for the site and planted at a density consistent with that Regional Ecosystem. Plant stock is to be sourced from the local provenance in the first instance.

Unless otherwise approved by Council, plants are to be randomly spaced (not in rows). Unless otherwise specified for the Regional Ecosystem, the following minimum densities are to be used:

- Groundcover – 2 per 1m2
- Shrubs – 1 per 1m2
- Low tree – 1 per 3m2
- Canopy tree – 1 per 5m2

In areas where steep banks or erosion is likely, jute mat/ net and increased planting densities will be required.

1.10.10 Fauna Crossings

Fauna passage is required to be considered in the design of stormwater management infrastructure.

Refer to QUDM (Section 11.2.5) for guidance on when and how fauna crossings are to be applied within a stormwater management system.

1.11 Design Details - Stormwater detention

Urban development has the potential to increase both stormwater runoff volumes and peak discharge rates. Stormwater detention and retention can limit flooding impacts however it is preferred to adopt water sensitive development to minimise changes to the hydrologic regime.

Basins provided for quality treatment only or detention and quality treatment are to be treated as dry detention basins for design purposes as described in the following sections.

The design and location of basins will influence if they have a negative or a positive impact to stormwater flows and great care must be taken in their design and integration with the surrounding catchments. Poorly located and designed basins may cause flows from different tributaries to peak at the same time, increasing peak flow rates for downstream locations. Assessing the performance of a basin may include modelling to a key/sensitive downstream location or junction.

QUDM must be referenced for the design of any detention/retention system. The potential problems associated with detention/retention systems as outlined in QUDM must be considered by the designer.

Legal point of discharge is required for all detention basins.

1.11.1 Detention basin application and function

Detention basins are typically designed to provide temporary storage for increased surface runoff. Stored water is subsequently released at a controlled rate. The outlet is typically located on the bottom of the basin which is designed to restrict the outflow. Dry basins are designed to empty completely between storms and are therefore dry except during storm events

1.11.2 Location of Basins

Detention basis are to be located in natural depressions, where available, requiring minimal disturbance to existing vegetation and minimal excavation.

On flat sites or where extensive works are required, basins shall be designed so that they appear to be a natural land form. This will generally require a curved or serpentine form with side slopes having variable gradient to provide contour relief.

Landform, geology and soils at the proposed site must be suitable for the development of the basin. If significant quantities of sediment are estimated to enter the storage area, there must be scope for periodic de-silting (including maintenance access). Areas showing evidence of land instability or with a high water table must be avoided.

The basin shall ultimately be located in a drainage reserve unless otherwise approved by Council. The drainage reserve must be located adjacent to recreational parks to facilitate maintenance. Where possible, the basin is to be integrated into the design of open space and form part of the overall landscape plan for the development without distracting from the functionality of the open space.

QUDM shall be used to provide guidance on the general placement of detention systems within a catchment.

1.11.3 Design Objective

The design requirements of QUDM apply.

In general, (unless modelling indicates that a basin will cause a negative impact), a detention facility shall be provided to control the discharge of stormwater from a development area so as to restrict the post- development flows to pre-development flows, for all storm events up to and including the 1% AEP event.

Any discharge onto downstream properties must not result in an increase of concentration of the stormwater.

The objective of stormwater management is to ensure no worsening of the site discharge conditions. Where a site discharges to a floodway in a much larger external catchment, the objective will remain as non-worsening of the site run-off, rather than non-worsening of the major floodway flow, unless otherwise accepted by Council.

1.11.4 General Constraints

For dry detention basins, no part of the basin including the embankment or retaining wall is to be closer than 3m from any adjoining property boundary or road reserve.

For wet detention basins, no part of the basin, including the embankment and/or retaining wall, is to be closer than 10m from any adjoining property boundary or road reserve.

A maximum 1:4 crossfall and longitudinal slope is required for the perimeter of all basins.

Grassed embankment slopes are to be 1 in 6 or flatter. Landscaped batters or structural elements at steeper slopes will be subject to Council approval.

The design and layout of detention basins in open and civic spaces must consider the useability of the space, integrating into the surrounding landscape and all ability access.

Floor slopes to accord with QUDM unless otherwise accepted by Council and be self-draining at a minimum grade of 1 in 100.

Ongoing maintenance is to be considered in the design of the basin including the provision for maintenance access to inlets, outlets and the basin base.

Basins with retaining walls exceeding 600mm in height are not to be provided.

Upstream properties are not to be impacted by the basin outlets becoming fully blocked.

1.11.5 Flow Calculations and Volume Determinations

Simplified hydrologic methods such as the rational method must not be used whenever a full design hydrograph is required to assess flood storage issues.

Unless otherwise directed a method that generates a hydrograph must be adopted for the design of those components of the drainage system which are volume dependant, such as detention basin.

Flow calculations associated with sizing and designing a detention basin must be undertaken in accordance with the relevant chapter of QUDM.

Specifically, the design of the basin and its outlet structures must be based on a range of storm durations and appropriate temporal patterns in order to identify the critical hydraulic dimensions. If the basin is required to prevent an increase in flooding at a given location, then the performance of the basin needs to be checked for a storm duration equal to the critical storm duration at this location. If the basin is required to prevent an increase in flooding at all locations downstream to the basin, then the performance of the basin needs to be checked for a range of storm durations up to the critical storm duration of the most downstream location.

It is Councils preference that all detention basins designed using a hydrologic method as stated above are tested and validated using an industry standard hydraulic model.

Where an existing floodway storage and/or existing attenuation volume (e.g. farm dam) is to be used to provide attenuation, the existing storage volume cannot be considered in the attenuation calculation. The basin design inlet shall provide the developments detention volume, as derived above, over and above the existing storage volume i.e. the existing storage must be modelled as full prior to the storm event.

Where the proposed development will alter the time to peak of external runoff through the site (for example by piping the external runoff or reducing the volume of floodway storage traversed by that runoff) is to;

a) Include both the external catchment and the development area in the calculations.
b) Calculations for the post development case shall allow for the increased impervious area of the development area and a reduction of the overall catchment time of concentration.

Where the proposed development will not alter the time to peak of external runoff through the site, the attenuation requirement and the consequent detention volume for the development is to:

a) Be based on just the subject development area’s increase in impervious area and changed time of concentration
b) Consider flow attenuation facilities within the catchment (e.g. farm dam) and the calibration of the pre-development scenario with their exclusion
c) Calibrate a storage routing model using the Rational Method calculation for post development flows
d) Provide detention volume over and above any existing floodway storage.

Where the proposed detention basin is to be located in an existing floodway, the basin's outlet works must be designed to ensure that the required detention volumes are achieved (for all storm events), over and above the existing floodway volumes.

Council may require the application of a hydraulic routing model (XP-SWMM, MIKE11 or similar) to both the pre developed and post developed scenarios to verify non-worsening, particularly in cases where the basin is proposed to be formed by alteration of an existing floodway.

1.11.5.1 Rational Method Calculation of Peak Flows

In the calculation of pre development flows, overland sheet flow time must be calculated by Friend's equation as described in QUDM. In calculation of post development flows, QUDM standard inlet times must be adopted or sheet flow times must be calculated by Friend's equation and combined with segmental travel times, whichever is more appropriate to the particular circumstances.

Rainfall intensity tabulation must be used. Rainfall intensities are to be calculated using methods provided in AR&R. The adopted method, supporting tables/ calculations and relevant co-ordinates are to be provided.

Coefficient of Discharge must be calculated using QUDM.

Fraction impervious for each zone and/or precinct is as per the table below:

Development Category / MBRC Planning Scheme Zone/Precinct	Fraction Impervious (%)	
Centre zone - All precincts	90	
Community facilities zone - all precincts	50	
Emerging community zone	Refer to relevant zone/precinct identified in the Structure plan	
Environmental management and conservation zone	0	
Extractive industry zone	25	
General residential zone - Coastal communities precinct General residential zone - Suburban neighbourhood precinct	50	
General residential zone - Next generation neighbourhood precinct	With road layout	85
	Without road layout	80
General residential zone - Urban neighbourhood precinct	90	
Industry zone	90	
Mixed industry and business zone - All precincts	With road layout	90
	Without road layout	85
Rural zone - All precinct	0	
Recreation and open space zone Recreation and open space zone - Sport and recreation precinct	0 15	
Rural residential zone - lot sizes > 2Ha Rural residential zone - lot sizes 6000m2 - 2Ha Rural residential zone - lot sizes < 6000m2	10 15 20	
Township zone - Centre precinct Township zone - Convenience precinct Township zone - industry precinct	90	
Township zone - Residential precinct	50	
Road reserves - where not otherwise specified	70; or Fraction of width paved	

1.11.6 Existing Site Storage

The impacts of the proposed development on the existing storage of floodways which convey the flow through the site must be considered. The development must not result in a net loss of flood storage. Where a basin is proposed to be located in a natural floodway, the required detention volume shall be provided over and above the natural floodway volume.

1.11.7 Flow spread from basin outlet to downstream property

Any discharge onto downstream properties must not result in an increase of concentration of the stormwater onto that property.

Hydraulic calculations must be undertaken to determine the pre developed width of flow at the downstream property boundary to ensure that it is not increased following the development. The outlet of the basin will need to be located far enough from the property boundary, to ensure that the pre developed flow width, depth and velocity at the boundary is not exceeded.

1.11.8 Public Safety

For dry detention basins the depth of water shall be restricted to 1.2m at the 5% AEP.

For wet detention basins, public safety and access must be considered in the design.

1.11.9 Embankment Protection / Freeboard

A minimum of 0.3m freeboard must be provided above the 1% AEP storage depth to protect the embankment crest and includes considerations of a fully developed upstream catchment.

1.11.10 Commercial and Industrial Development – On-site detention

Commercial and industrial development shall install On-Site Detention (OSD) unless alternative treatments are approved by Moreton Bay Regional Council.

Site specific design or proprietary systems may be used provided they incorporate high early discharge devices. The minimum discharge outlet diameter is 100mm. A 10% AEP storm event is required to be partially captured and temporarily stored underground. For 1% AEP storm events, suitable sized overland flow paths with lawful points of discharge shall be designed to allow for the full 1% AEP peak discharge. A check must be made that blockage of inlets does not result in above floor flooding. All OSD systems are to include a water quality treatment system e.g. oil/grit separators and/or sediment trap. The minimum requirement is that this system shall capture and treat the first 150m^3/ha of development runoff.

1.11.11 Retention systems

QUDM states that stormwater retention systems can be designed to reduce the 'total annual runoff volume', and/or reduce the runoff volume from a specified design storm. Reducing the total annual runoff volume provides water quality benefits by reducing pollutant loads entering waterways. Reducing the runoff volume from a specific storm event can be beneficial for the control of erosion and flooding in minor watercourses such as creeks.

Retained stormwater may be made available for non-potable uses through a stormwater harvesting system or removed from the surface drainage system through infiltration and/or evaporation.

1.11.12 Scour protection

The discharge of stormwater from outlets shall consider the dissipation of energy and scour protection. The following are minimum requirements.

Outlet Characteristics	Recommended Outlets Treatment
Outlet Q < 2 m^3 /s and/or Outlet V < 3 m/s and/or Outlet slope < 3%	Headwall plus concrete apron plus 600 mm deep apron cut-off wall and rock protection as provided in QUDM
Outlet Q > 2 m^3 /s and/or Outlet V > 3 m/s and/or Outlet slope > 3%	Headwall plus concrete apron plus 1200 mm deep apron cut-off wall plus an approved energy dissipation device as provided in QUDM

There are several types of energy dissipation devices ranging from plunge pools, extended aprons, ramps that induce hydraulic jumps etc. Chute blocks are however not permitted as an energy dissipation device.

Designers shall utilise the most up to date QUDM for the design of all energy dissipation structures. Energy dissipation structures must be avoided in urban areas due to their inherent size. Otherwise access must be limited through appropriate fencing.

The area surrounding outlet structures must be stone pitched. Dumped rock is not an acceptable alternative.

1.12 Design Details – Computer Modelling

The use of computer models is common place and expected during the planning and design of a stormwater management system. Good modelling practice is required to ensure accurate and reliable outcomes. Modellers must understand the limits and sensitivities of their models and the accuracy of the predicted outcomes. Models must be acknowledged as a coarse simplification of complex processes with their accuracy limited by terrain data and uncertainty in key parameters that can vary such as rainfall, roughness and blockage. Models must be calibrated or validated against a number of varying storms where data is available to provide confidence in the results. Although absolute flows and water levels can be subject to varying degrees of uncertainty, the difference or afflux between the model outputs for the before and after scenarios is expected to be reasonably accurate as any assumptions or inaccuracies will be present in both scenarios.

Each design that utilises model results will need, as a minimum, to be accompanied by a technical report that includes the following details:

a) modelling software utilised, including the version/revision number;
b) design/data inputs, including their source;
c) modelling methodology;
d) modelling parameters, assumptions and limitations;
e) results of any sensitivity testing of key parameters;
f) calibration/verification results;
g) model modifications undertaken if using Council's model packages (refer to Section 1.12.3);
h) quality checks including model log and error reporting;
i) results including any relevant mapping;
j) interpretation and recommendations

Council is to receive the final models with all associated input data files and results. A model log describing the relevant model names, scenarios and key differences is to be included with the model.

Additional guidance on best practice computer modelling can be referenced in Australian Rainfall and Runoff (AR&R) and Australian Runoff Quality (ARQ).

Council has internal modelling expertise and prefers the use of runoff routing and hydraulic models as described below. Alternative models will be considered but it is recommended to receive Council's acceptance of the use of these alternative models prior to their adoption.

1.12.1 Hydrological modelling

Hydrological modelling is used to predict peak flow rates, flow volumes and hydrograph shapes for varying storm events and durations. Models can be based on individual rainfall events or continuous, long term simulations. Continuous models are usually used for assessing the impact to the hydrological cycle. Individual rainfall event simulations are typically used for the design of major stormwater systems. Dynamic or unsteady modelling is required to assess peak flow and storm volumes to understand the impact of changing floodplain storage and the time for flows to peak.

Hydrological modelling is to be completed based on the recommendations provided in AR&R.

Council's preferred hydrologic model is the Watershed Bounded Network Model (WBNM) developed by Michael Boyd, Ted Rigby & Rudi van Drie.

1.12.2 Hydraulic modelling

Hydraulic models are used to determine the area of inundation, flood level and flow velocity to assist with identifying flood hazards. Models can be either one dimensional with a defined flow path (either a pipe or surface/overland flow), two dimensional with an undefined flow path, or a combined one/two dimensional model. Specialist three dimensional models may be applicable for complex hydraulic structures or water quality modelling.

It is recommended that all hydraulic modelling should be undertaken in accordance with the Regional Floodplain Database methodology. Relevant reports describing this methodology are downloadable from Council's website.

The DFE for Flood comprises the upper envelope of a number of storm/catchment scenarios as follows:

a) 1% AEP flood event using ARR design rainfall

b) 1% Moreton Bay Design Storm (MDS) event which is a 15 minute in 270 minute embedded design storm (15min burst inside a 270 minute burst with storm 'wings' scaled down to preserve overall volume of an ARR design burst)
c) 1% MDS event with Moderate structure blockage – refer to report *Regional Floodplain Database - Floodplain Parameterisation* (SKM, 2012) report downloadable from the Council website.
d) 1% MDS event with 20% Increase in rainfall
e) 1% MDS event with 20% Increase in rainfall and increased downstream boundary (0.8m sea level rise for coastal models and 0.02% AEP event for inland models)
f) 1% MDS event with Medium Dense Vegetation changed to High Dense Vegetation and Low grass/grazing changed to Medium Dense Vegetation within the 1% AEP floodplain to reflect future revegetation.
g) 1% MDS event with Medium Dense Vegetation changed to High Dense Vegetation and Low grass/grazing changed to Medium Dense Vegetation within the 1% AEP floodplain and impact of increased residential development (Change in minor catchment fraction impervious) (this applies only to selected minor basins where urban development is a feature).

Council's preferred hydraulic model is TUFLOW developed by Bill Syme. However, in some cases alternate software may be justified depending on the nature of the hydraulic behaviour being assessed. The model complexity must match the complexity of the floodplain and catchment.

1.12.3 Regional Floodplain Database Model Packages

The Regional Floodplain Database model library includes fourteen coupled hydrologic and hydraulic models, one for each of the fourteen 'minor basins' within the Moreton Bay Regional Council area. These model packages are available for purchase and can be requested online via Council's Flood Check website https://www.moretonbay.qld.gov.au/floodcheck/

The following is provided when purchasing a model package for the chosen minor basin:

Hydrologic model - WBNM.

a) GIS files - Minor Catchments, Stream Reaches and Stream Junctions
b) Model run files
c) Model result files
    i. 14 ARI's for 10 storm durations;
    ii. Moreton Bay Design Storm (MDS) simulations.

Hydraulic model - TUFLOW.

a) GIS Files - MapInfo MID/MIF input files
b) Model input files, run files
c) Model results files
    i. 14 ARI's for 3-4 durations (varies depending on the minor basin)
    ii. 10 scenarios using the MDS (including DFE scenarios)
d) Result file formats
    i. flt max grids for h, d, V, Z0, ZQRA, ZMBRC (Flood modelling) and Z9 (Storm Tide modelling)
    ii. xmdf - Time series data for h, d, V, q, SP, Z0, ZQRA, ZMBRC (Flood modelling), Z9 (Storm Tide modelling) and any standard TUFLOW outputs
    iii. WRB - WaterRIDE file containing information regarding DEM, velocity and water level
e) Landuse input files based on 2013 Aerial photography
f) Latest LiDAR (2014) (within the model code boundary) as well as modifiers for post LiDAR developments where applicable and available. One or more of the following formats can be used for the modifiers: txt, 12da, asc, MID/MIF, grd and tin.

MBRC does not provide models for the estimation of Overland Flow.

1.12.4 Water Quality Modelling

Site Based Stormwater Management Plans and development applications are to be assessed to meet the operational pollutant reduction targets of the State Planning Policy and Schedule 10 of the MBRC Planning Scheme using the Model for Urban Stormwater Improvement Conceptualisation (MUSIC). The models must be developed in accordance with the Water by Design MUSIC Modelling Guidelines.

There are numerous modelling platforms for detailed catchment and in-stream water quality assessment and sediment transfer. Adoption and appropriate design methodologies are to be discussed with Council prior to undertaking detailed in-stream analysis.

1.12.5 Other models

Council may require as part of development conditions the modelling and assessment of other natural processes such as coastal erosion, groundwater and tidal dynamics. Computer models for these purposes shall be verified by an appropriately qualified expert as suitable for the intended application. Discussion with Council prior to selecting a modelling package is required.

1.13 Erosion and Sediment control

Development and associated construction activities generally removes vegetation and exposes soils to erosive forces of wind and water. Although erosion is a natural process, accelerated erosion that produces large quantities of sediment is a considered a pollutant that can transport additional contaminants.

The prevention of erosion will provide better outcomes than simply managing sediment conveyed by stormwater. Development must be avoided in land areas identified with a higher risk of erosion. Direct stormwater discharges into waterways susceptible to bank erosion must also be avoided.

Erosion and sediment control for all phases (clearing, bulk earthworks, civil works etc.) and stages of development must be part any stormwater management strategy.

An Erosion and Sediment Control Plan (ESCP) is required to demonstrate that the release of sediment-laden stormwater achieves the design objectives listed in Schedule 10 of the MBRC Planning Scheme and PSP - Stormwater Management.

All erosion and sediment control practices (including any proprietary erosion and sediment control products) are to be 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 (CPESC).

Alternative or additional performance criteria for discharges from development sites as specified in local studies (i.e. a SBSMP or CMP) must be included in the ESCP. An ESCP forms part of a Site Based Stormwater Management Plan outlined in PSP - Stormwater Management.

The Best Practice Erosion and Sediment Control Guideline developed by the International Erosion Control Association must be referenced in the preparation of Erosion and Sediment Control Plans and the design of associated management and mitigation measures, including temporary sediment basins.

1.14 Design Details - Coastal

1.14.1 Canals

All canals, revetment walls and associated facilities required in a canal subdivision shall be designed and constructed in accordance with the Canals Act and in accordance with the canal layouts approved by Council at the time of consideration of the preliminary approval under the Canals Act. Such design and construction shall meet the following minimum requirements:

a) The canal access from the adjacent channel shall be constructed to the approved depth and shall include appropriate structures to prevent infilling and siltation, ensuring stability of adjoining properties and improvement.
b) The beach profile shall be constructed for long term stability with due consideration to tides, boat wash and wind induced waves. Additional consideration of beach construction shall allow for ease and access to perform maintenance.
c) The seaward face of revetments (reinforced or mass concrete wall) shall align with the allotment Boundary. Reinforced concrete walls must be designed, with a minimum design life in accordance with Australian standards AS4997. The footing of the wall shall be located a minimum of 300mm below L.A.T. for the site.
d) The location of revetments / walls shall be such to ensure that:-
    i. The waterway provides a suitable navigation channel
    ii. Provides for reasonable boat storage on pontoons or jetties for each waterfront property.
    iii. Maintains the water quality within the waterway during normal tidal flows.
    iv. Midge populations can be controlled.
    v. Maintains flood conveyance and flood storage requirements during flood flows.

Engagement

Engagement with public authorities is necessarily more comprehensive in the case of waterfront developments. Design proposals shall not be reviewed by Council until all relevant approvals required by public authorities have been obtained.

Council shall provide allocated locations for services, but all further approvals are conducted through the relevant authority.

It is the responsibility of the developer to comply with all State relevant acts and requirements. It shall not be the responsibility of the Council or any acting officers to verify all details are in compliance. Some relevant agencies include:

i. Department of Environment and Heritage Protection
ii. Queensland Transport
iii. Department of National Parks, Sports and Racing
iv. Department of Natural Resources & Mines

1.14.1.1 General Requirements

There are general requirements pertinent to waterfront development which are applied by Council or other public authorities. These requirements include:

a) No adverse effect to flood levels in the area.
b) No adverse effect to erosion or deposition conditions within the existing environment.
c) Revetment walling is to be located within the property boundary.
d) Design of canals shall be undertaken to minimise maintenance including no exposed beaches and submerged rock armour at the revetment wall toe.
e) Design shall allow for maintenance access
f) Design shall allow for wet dredge spoil management including temporary storage, solar drying and off-site removal.
g) Maintenance of water quality
h) Requirements of all State government compliance is achieved.

1.14.1.2 Land reclamation

A detailed foundation investigation shall be carried out by a Registered Professional Engineer Queensland (RPEQ) practising geotechnical engineer to determine the long term bearing capacity of the site. The investigation shall include the bearing capacity of the in-situ and fill components of the foundation. It shall predict the settlement of the finished surface through time (without structural loading). The foundation investigation shall specify any procedures or provisions to ensure that the foundation performance of the site will be suitable for the proposed types of site development in accordance with AS3798.

During construction of the site fill testing shall be carried out in accordance with the nominated processes in Australian Standards AS3798. All details shall be inspected by Moreton Bay Regional Council. The Council reserves the right to engage a qualified geotechnical engineer during the construction process to monitor the earthworks operations. All associated costs are to be borne by the developer.

The design of structural foundations must be carried out by a qualified practising structural engineer to ensure compatibility with the inherent foundation properties of the proposed site. Provision shall be made for the developer to provide certification that all allotments have met the bearing capacity strength of the original design characteristic for residential construction.

1.14.1.3 Planning Concepts

Consideration must be given to design of artificial waterways which are more natural in appearance than conventional rectilinear key type canal developments, exhibit superior mixing and tidal exchange performance and which permit straightforward maintenance.

The location of parks and reserves within the development must be judiciously selected. Location of parks and reserves at the head of canals is desirable.

Depths shall be constructed and maintained consistent with navigation and other requirements, in order to maximise tidal flushing and mixing by wind action. The development is to ensure that the construction and design provides long term access and usage of the canals without costly dredging maintenance. Canal depths shall allow for movement of siltation into and around the canal development and the effect the siltation has on canal batter shapes and pontoon placement.

The factors involved in selection of water depth for navigation and mooring areas are as follows:

a) draught of boat
b) underkeel clearance (UKC)
c) allowance for sedimentation.
d) batter slope
e) width of boat (deeper allowance to be made under boat)
f) width and make of pontoon (now and future designs)

Water quality within canals must be such that the following are not adversely affected:

a) occasional swimming and wading
b) boating
c) passive recreation
d) visual aesthetic acceptability
e) freedom from excessive plant and algal growth
f) the maintenance of a complete aquatic fauna and flora community.

1.14.1.4 Plan Geometry

Wherever possible, the design of the canal development must incorporate the following factors to promote optimal mixing and exchange:

a) Provision of bends and meandering canals, and elimination of poorly flushed pockets and coves;
b) Provision of additional tidal prism at the head of canals by creation of a lake or basin;
c) Modify any existing entrances if the canal development increases from that of original concept
d) Orientate channel openings to factor principal wind directions. Canal orientation with prevailing winds, tidal currents and wave action to minimise impact on canal banks

1.14.1.5 Waterway Depths

Canal centre depths throughout the canal system shall be uniform.

Depths must be sufficient for safe navigation by craft likely to use the waterway. Reference to be made Queensland Transport – Regional Harbour Master

The waterway depth shall be the greater of:

a) A minimum of 2.0 metres at Lowest Astronomical Tide; or
b) Subject to approval of a "design vessel" for the waterway, the minimum depth shall be determined by the draught of this vessel plus suitable allowances for:
    i. Under keep clearance;
    ii. Siltation; and
    iii. Applicable wave height or vessel wake.

Suitable allowance shall be made for sedimentation and bank stability in establishing the design canal depth.

1.14.1.6 Waterway (Canal) Widths

Two measurements for canal width can be distinguished:

a) Navigation Width: width of canal at the navigation depth
b) Overall Canal Width: width of canal between the top of the revetment walls.

The navigation widths for Main Canals and Side Canals shall be sufficient for safe navigation by two way boat traffic respectively, taking into account the size of craft likely to use the waterway. Minimum navigation widths shall be used as a guide:

a) Main Canal 5 x Bmax or 20m whichever is the greater
b) Side Canal 3 x Bmax or 15m whichever is the greater

Note: Where Bmax is the maximum beam of the craft likely to use the waterway.

Where any structures or moored craft encroach into the navigation width, a clear distance of 5 x Bmax and 3 x Bmax shall be provided in Main Canals and Side Canals respectively, measured between structures or craft moored on opposite sides of the canals.

The navigation width of the entrance channel shall be sufficient for safe navigation by craft likely to use the waterway taking into account the degree of exposure of the entrance, but shall not be less than 25m.

The overall canal width of any canal shall not be less than 50m.

The Department of Transport and Main Roads / Department of Environment and Heritage Protection may require that the overall width of canals be increased above the minimum value where it is considered that such widening is necessary to improve mixing and flushing characteristics.

Determination of the navigation and overall canal widths shall take into account bank and bed stability considerations. An allowance for pontoon design and type shall be considered for all tide levels and materials transported

Width of the canal shall allow for revetment wall on either side of the canal and the positioning of the moorings / pontoons at low tide for boats to anchor safely in the water and allow access to occur.

1.14.1.7 Waterway Length

Determination of the design canal length(s) shall take into account the following main factors:

a) flushing and water quality considerations
b) bank and bed stability
c) boat travel times.
d) Disturbance of PASS (Potential Acid Sulphate) material. Discussions to be held with Council regarding disposal locations and process for PASS material prior to implementation.

The maximum distance from the host waterbody to the end of the canal(s) shall not exceed 1 kilometre unless studies are undertaken which establish that water quality will be satisfactory. All details are to be provided under the Development Application.

1.14.1.8 Waterway Cross Sections

The canal cross-section and edge treatment shall be designed in accordance with sound engineering practice by a registered Professional Engineer Queensland (RPEQ) civil engineer, taking into account the type of soil conditions, the likely range of water levels including long term variations, and the applied forces. All details outlining the tide access to pontoons attached to private properties (or potential for) and the need to reduce maintenance dredging. Engineering studies demonstrating the adequacy of the canal cross-sections and edge treatment shall be made available to the Department of Environment and Heritage Protection.

1.14.1.9 Underwater batters at canals and shorelines

Stormwater outlets into beach type canals are to be submerged in the canal waters. All sections of stormwater pipe submerged or subject to full flow conditions shall be increased by one standard size to allow for long term growth of marine build up or sediment.

All pipes shall comply with material required for salt water conditions.

1.14.1.10 Stormwater management

The proponent is required to adequately demonstrate that the proposed method of stormwater management will not adversely affect water quality within the canal development and host waterbody, or lead to problems associated with siltation and erosion.

The canal allotment shall be graded to ensure as much runoff as possible is directed to the street where it may be collected and then directed into the canals through properly designed stormwater outlets. The preferred system of stormwater discharge is by means of a "drowned outlet" constructed below beach level, incorporating suitable scour protection.

Wherever practical, stormwater outlets shall be located at points of maximal flushing, or directly within the host waterbody.

For canals over 150m in length it is preferred that stormwater outlets shall not be located at the heads of dead-end canals. Outlets must be located a distance from the canal ends (i.e. 25% from the end) to ensure stormwater can move with tidal action, and not present any health concerns with water quality and length of canal.

Suitable allowance for sedimentation near stormwater outlets shall be made in the design of the canal cross-section and/or access made available for future maintenance dredging.

Suitable temporary sediment control devices shall be installed during the construction phase to ensure that sedimentation within the canal system is minimised and sedimentation does not occur within the host waterbody

1.14.1.11 Flood control structures

Flood control structures usually include a system of canals and weirs which are to be approved by the Environmental Protection Agency. Usually detailed designs for flood control structures are commenced only after the overall canals and flood structures have been mathematically and physically modelled and approved by the Environmental Protection Agency and Council. Preliminary plans are usually prepared as part of a flood study which involves modelling procedures.

Designs must ensure that the proposed works and any raising of the land will not result in any significant increase in flood levels in the area.

1.14.1.12 Tidal Influences

The level of study of tidal hydraulics necessary to adequately demonstrate the impact of the proposed development on tidal hydraulics, and the effects of the tidal hydraulics on the development, is dependent on a number of factors. It is important that the proponent seek early consultation with the Environmental Protection Agency

The proponent shall assess variations in the tidal characteristics of the host estuary at the development site taking into account cyclic and long term changes in: estuary shoaling and scour, entrance stability, hydrologic input, mean sea level, and any engineering works (such as large scale estuary dredging, entrance works, or other canal subdivisions) proposed or approved by all government authorities. The implications of these changes to the design and functionality of the canal subdivision shall be established and accommodated.

The proponent shall establish the tidal levels at the proposed development site. These levels may be based on existing information supplied by the EPA, where available, or measurements undertaken on behalf of the proponent by a suitably qualified surveyor or civil engineer.

There is no minimum acceptable tidal range below which canal developments would not be considered. The degree of tidal flushing will however reduce as tidal range decreases, and this effect must be considered in the water exchange and mixing studies required by the EPA and outlined elsewhere in the guidelines.

1.14.1.13 Water Quality Influences

Consideration must be given to enhancement of water circulation and/or exchange by the following additional means:

a) provision of an additional entrance(s), not necessarily navigable
b) provision of additional tidal prism by creation, for example, of a lake or basin at the head of the canal(s)
c) provision of bends, curves and island features
d) elimination of poorly flushed end canals
e) alignment of the canals in the direction of prevailing winds
f) mechanical assistance.

There would appear to be benefit in aligning canals in the direction of prevailing winds if this is possible, in order to maximise mixing and exchange processes.

Fetch lengths in the direction of strong winds must be minimised to mitigate the potential adverse impacts of wind-generated waves.

The effectiveness of the wind in developing vertical secondary mixing circulation is increased by increasing the width of the water surface in the canals. It follows that broad canals, and lake-type developments, will exhibit enhanced vertical secondary mixing

1.14.1.14 Erosion and sedimentation influences

Canal developments are to be constructed to requirements set out as guidelines by Council.

Long canals with sandy shorelines, and aligned with prevailing winds, are likely to experience littoral drift. Generally speaking, the length and alignment of canals must be carefully considered and the potential for littoral drift balanced against the advantages of wind action for promotion of mixing of canal waters.

Shoreline structures which extend across the littoral drift zone, e.g. some stormwater outlet designs, must be avoided where relatively high littoral drift rates are anticipated, except where special provision has been made to mitigate beach erosion.

In assessing the sediment load carried by stormwater outlets from a given catchment area, it is reasonable to adopt the following sediment quantities per hectare of catchment area per year:

a) partially developed urban catchment 5.5 tonnes/ha/yr
b) fully developed urban catchment 1.5 tonnes/ha/yr
c) rural areas 0.3 tonnes/ha/yr

Stormwater outlets must be arranged so as not to directly or indirectly cause erosion or local scour. Consideration is to be given to construction of the stormwater outlets and their location.

1.14.2 Revetment Walls

Revetment walls are to be designed as retaining walls certified by a practicing registered Structural Engineer (RPEQ) and submitted to Council for approval. This does not apply to non-load bearing concrete edge strips.

Filling is to be composed of material not injurious to the health of the neighbourhood and shall comply with Council's requirements. Fill to be constructed with good engineering and construction practice.

Determination of the full construction height, structural adequacy and stability of the wall or edge strip shall take into account an erosion allowance in front of the wall or edge strip.

1.14.3 Jetties, Pontoons and Boat Ramps

Where jetties and pontoons are proposed for canals which serve as floodways, the effect of these structures on the hydraulic performance of the canals shall be taken into account in the hydraulic design of the canals.

Jetties, pontoons and boat ramps shall be designed in accordance with sound engineering practice by a registered Civil Engineer (RPEQ) to satisfactorily resist all dead loads and applied live loads.

Floating pontoons shall be designed to safely accommodate grounding without damage to the structure. Alternatively they shall be designed to float under design load conditions at all tides and with a further minimum allowance of 200mm of siltation above the design bed profile at the pontoon location.

Consideration shall be given to the effect of flood currents and debris loading on structures proposed to be located within canals which will serve as floodways.

Account shall be taken of jetty pontoon, ramp, etc. design in assessing the required width of the canals.

Public boat launching facilities and marina facilities are generally regarded as unsuitable to a residential canal development because of the difficulty of ensuring adequate privacy for residents. Such facilities must only be considered where adequate and comprehensive environmental safeguards can be incorporated in the design of the development.

Public boat launching facilities and marina facilities shall be developed in accordance with the Guidelines in Section 86 of the Harbours Act.

Where it is proposed to construct public boat launching facilities within a canal development, consideration shall be given to siting of the launching facilities so as to minimise any adverse noise impacts on adjacent development due to the particular hours of use of the facilities.

Where it is proposed to construct marina facilities within a canal development, consideration shall be given to siting of the marina and design of the marina so as to maximise tidal exchange between the marina basin and the host waterbody. Ideally, marina basins must be located separately from residential canals and close to the entrance of the overall development. Canals shall be designed such that commonly available pontoons (3.5 metres wide, dry berth type) shall have a minimum clearance at LAT of 0.5m from any part of the pontoon and any part of the canal embankment.

1.14.4 Canal Bridges and Structures

Bridges and structures shall be designed in accordance with the Specification for Structures and Bridge Design. The design life shall be 100 years and the serviceability design flood shall be the 5% AEP storm event. The ultimate limit state, that is the capability of the bridge to withstand a flood without collapse, shall be the 0.05% AEP storm event.

Where canals are narrowed at bridge locations, it is likely that complete rock protection of the banks and bed of the canal will be required. Lowering of the canal bed to reduce velocities may also be required.

The vertical clearance of any proposed bridge must be checked with the Waterways Authority, and shall not be less than height required for the “design vessel” at HAT. The Design vessel for canal / waterway is to be considered, this may vary.

There must be sufficient clearance between the canal invert and the bridge to allow for maintenance equipment to pass under the bridge.

Where a canal entrance cuts pedestrian access along a public foreshore (e.g. by removing the intertidal area) then a footbridge must be provided to ensure continuance of public access and amenity.