TABLE OF CONTENTS

3.0 SITE BASED STORMWATER MANAGEMENT PLANS

3.1 BACKGROUND

The goal of ecologically sustainable development requires that stormwater management be considered at all stages of the planning, design, construction and operation of a site. This should be undertaken in a multi-disciplinary manner (refer Sections 1.5.1 and 1.5.2 of Part C of this document). It is not sufficient to consider site based stormwater management as an after-thought to planning the layout of the site.

A Site Based Stormwater Management Plan (SBSMP) is a plan that sets out how water quality, water quantity and waterway corridor issues are to be managed during all stages of a specific development. Such a plan may be required as a result of a development being assessed against Council's Stormwater Management Code (in the *City Plan*), or as a consequence of a development condition.

The SBSMP must integrate all components of stormwater management, including runoff quantity, quality control of both runoff and receiving waters, and waterway vegetation/habitat protection.

The plan must detail the infrastructure and management measures to be incorporated into the finished development to manage stormwater. The plan must also address the management of stormwater during the construction phase of a project.

SBSMP should be prepared in two stages:

1. ***Conceptual Design Stage***: At this stage the SBSMP will explain how the layout of the development and stormwater management measures will address the requirements of Council's *City Plan* and related technical guidelines. It will allow enough land for necessary stormwater quality best management practices, and for 'high risk' development, the Plan will include calculations (or model outputs) that demonstrate that WQOs can be met. At this Stage, the Plan should be used during pre-lodgement discussions with Council and must be used as part of the development application.
2. ***Detailed Design Stage***: At this stage the SBSMP will include all of the necessary detail in terms of the design of stormwater quality best management practices, monitoring programs, etc. At this Stage, the Plan will be required by Council via development conditions. 'High risk' developments will need to have such Plans approved by Council before works commence.

Site Based Stormwater Management Plans must be prepared by a suitably qualified professional[1]. The level of detail required will be dependent on whether the site is deemed high or low risk (see Glossary).

[1] A suitably qualified and experienced professional for stormwater quality management is defined as a person with a person with:
- tertiary qualifications in engineering, environmental engineering and/or science;
- professional affiliations with an engineering, environmental engineering and/or scientific organisation (eg the Institution of Engineers, the Stormwater Industry of Australia, the Australian Water Association); and
- at least 2 years experience in the management of stormwater quality.

Site Based Stormwater Management Plans are site-specific versions of Council's Stormwater Management Plans/Waterway Management Plans, which are prepared by Council on a catchment or regional basis. These Plans identify necessary regional infrastructure to manage flooding, water quality issues and waterway corridor issues in areas that are about to be developed.

Council is in the process of highlighting relevant waterway-related plans on Council's BIMAP (GIS) system which is available to the public. This initiative should simplify the process of locating relevant Stormwater Management Plans/Waterway Management Plans, which can then be obtained at Council's central reference library.

3.1.1 Stormwater Quality Management

Developments can be classified as being either high or low risk (see below). Water quality management requirements will be more rigorous for a 'high risk' development (refer Section 3.5) than for a 'low risk' development (refer Section 3.6), where best practice may suffice. The implications for a 'high risk' development are addressed throughout Chapters 3 and 4 of Part C of this document.

High Risk Development

A development (or development proposal) may be classified as 'high risk' if it falls within one of the following categories:

- any development (or development proposal) located in a waterway corridor, the Brisbane River corridor, or a wetland area as indicated on Council planning scheme maps; and/or
- multi-unit dwellings or commercial uses with an impermeable surface area (not including roof area) in excess of 2500 m^2; and/or
- subdivisions where greater than 6 lots are involved; and/or
- industrial activities that are not impact assessable (under Council's *City Plan*) and have at least 1000 m^2 in uncovered storage / working space; and/or
- industrial activities that are impact assessable (under Council's *City Plan*); and/or
- uncovered car parks with at least 100 spaces.

In addition, any developments which will discharge stormwater or wastewater to an area deemed by Council to have significant environmental value may also be classified as 'high risk' (eg a natural wetland as defined and mapped in Council's *City Plan*).

For 'high risk' developments, it will be necessary to identify a set of Water Quality Objectives, and then to demonstrate to Council how the measures outlined in the SBSMP will ensure that these objectives will be satisfied. Pollutant export modelling will normally be required. For more details on determining Water Quality Objectives, refer to Chapter 2 of Part C of this document.

It is acknowledged that *some* 'high risk' developments will be constrained due to either:

- the nature of the site (eg available area for stormwater quality management measures); and/or
- the inability of subdivision developers to always control the design of buildings on subdivided lots.

Such constraints may result in difficulty meeting WQOs for all key contaminants. In such circumstances, the development approval process will determine whether or not the development should be refused on water quality grounds.

Note that Council will review the above thresholds after implementation of the *Brisbane City Plan 2000* and amend them if necessary. Accordingly, reference should be made to the current version of *City Plan* to ensure these thresholds are up-to-date.

Low Risk Development

Low risk developments are subject to Council approval but are not specified as 'high risk development' (see above). Note that for these types of development, water quality impacts need to be minimised by identifying and adopting best practice techniques in accordance with Chapter 4 of Part C of this document. This involves ensuring that the relevant minimum acceptable solutions are specified, and are incorporated into the planning and design of a development.

That is, for 'low risk' developments, it will generally be sufficient to identify Stormwater Quality Best Management Practices, in keeping with the land use and size of development, rather than having to demonstrate to Council how the stormwater management system will protect WQOs in receiving waters. Reference should be made to Chapter 4 of Part C of this document on how to identify appropriate Stormwater Quality Best Management Practices (SQBMPs).

3.1.2 Stormwater Quantity Management

A SBSMP must integrate the management of water quality and water quantity. Key aspects of water quantity management are covered in relevant Chapters or Sections of Part B of this document. These include:

- Ensuring that the stormwater management system does not adversely impact on flooding of upstream and downstream properties. Generally flood levels are not allowed to be increased outside of the boundaries of the development, nor is flooding of developed or developable areas allowed to be increased, nor is erosion potential allowed to be increased, and nor is the general amenity of the area allowed to be degraded.
- Agreeing the legal point of discharge prior to design.
- Determining the potential for the development to modify catchment boundaries and the implications of such changes on peak flow rates at key locations.

As Council moves towards more 'water sensitive' stormwater management infrastructure, design guidelines and standards will need to be developed, reviewed and revised where necessary. It is acknowledged that this will take some time, and in the interim, detailed and BCC approved design information will not always be available for some measures (eg swales, infiltration systems). Council seeks patience from key stakeholders with respect to this matter.

3.1.3 Waterway Corridor Management

A SBSMP must address waterway corridor issues as well as stormwater quality and quantity, where relevant. Issues to consider should include:

- the protection and/or restoration of vegetation;
- use of riparian vegetation as buffers to treat stormwater;
- understanding the structural and ecological effects of alterations to the hydrologic regime;
- specification of buffer widths;
- faunal movement;
- continuity of vegetation in corridors; and
- prevention of creek bank erosion.

3.2 KEY ISSUES

Site Based Stormwater Management Plans must aim to:

- link water quantity controls with water quality controls;
- integrate permanent stormwater management features into overall development landscape plan;
- identify legal point(s) of discharge (these need to be identified before development approval is given);
- address ecological protection issues that are influenced by the management of stormwater (eg waterway corridor vegetation and habitat management issues);
- identify clearly pollutants of concern and their sources for both the construction and operational phases of development (refer Chapter 4 of Part C of this document);
- identify an optimum combination of structural and non-structural Stormwater Quality Best Management Practices (SQBMPs)[2] to limit the pollutant export potential of the site for both the construction and operational phases of development (refer Chapters 4 & 5 of Part C of this document);
- address the requirements of the construction phase with an emphasis on erosion and sediment control (refer Chapter 12 of Part C of this document);
- address the management of specific water quality issues (where relevant) such as:
  - the use of lakes, ponds and wetlands (refer to Chapter 6 of Part C of this document);
  - sewer overflows (refer to Chapter 7 of Part C of this document);
  - effluent reuse (refer to Chapter 8 of Part C of this document);
  - acid sulfate soils (refer to Chapter 9 of Part C of this document); and
  - bin and car washing areas (refer to Chapter 10 of Part C of this document);

[2] Structural SQBMPs include gross pollutant traps, infiltration areas, swales, etc, while non-structural measures include educational initiatives and source controls (eg controlling the use of lawn fertiliser or car washing on the development).

- specify a water quality monitoring program where necessary (refer to Chapter 13 of Part C of this document);
- outline maintenance requirements for SQBMPs, especially for large structural SQBMPs (refer to Chapters 5 & 14 of Part C of this document);
- ensure site-based measures complement regional water quantity and water quality management measures already delivered (or planned) through Council Stormwater Management Plans or Waterway Management Plans, where present[3]; and
- for 'high risk' developments, *demonstrate* how the proposed combination of SQBMPs will ensure that agreed Water Quality Objectives will be met (this process will typically require pollutant export modelling).

3.3 OVERVIEW OF METHODOLOGY FOR DEVELOPING SBSMPS

The method for developing SBSMPs is shown in Figure C3.1. The figure illustrates the following key tasks:

- Meet with Council at the pre-lodgement stage (highly recommended for 'high risk' developments). Items to be discussed are included in the remainder of this list. Additional meetings with the relevant Development Assessment Team may be required during the project in accordance with the risk rating and complexity of the site.
- Determine whether the site is classified as 'high' or 'low' risk.
- For 'high risk' developments with significant potential to impact upon waterways, consult with key stakeholders or obtain key stakeholder input through Council.
- Identify key issues (eg objectives from a water quality, water quantity and waterway corridor perspective). The objectives for water quality will depend upon whether the development is 'low risk' or 'high risk'. Key issues should include whether responsibility for large off-site assets such as wetlands, gross pollutant traps and ponds will be transferred to Council.
- Identify relevant waterway management plans (prepared by Council) and any implications for the development site (eg reduced need for stormwater quality treatment as a result of down-stream regional treatment).
- Assess the site (including data collection) in relation to:
  - contours (survey or topography);
  - soil types and condition;
  - design rainfall intensities;
  - evidence of erosion;
  - existing water quality data (if available); and
  - condition/values of waterway corridor.

[3] For example, regional studies may recommend that a certain level of on-site stormwater treatment is needed as well as regional measures to protect the environmental values of affected waterways.

- Agree with key stakeholders on site constraints and opportunities which may include:
  - open space requirements (ie whether land contributed as a parkland can be used for the location of stormwater quality or quantity management infrastructure and whether any of this land can be counted as part of the contribution[4]);
  - requirements for ecological protection/functionality in the corridor;
  - integration of stormwater measures within open space;
  - existing/known flooding problems;
  - existing on-site infrastructure; and
  - soil and vegetation types.
- Assess existing conditions of stormwater drainage pathways/channels and waterways (eg peak discharges, water quality, flood levels).
- For 'high risk' developments, determine the WQOs for the site (see Chapter 2 of Part C of this document).
- Evaluate and select an optimal combination of measures (structural and non-structural) to manage water quality, water quantity and waterway corridor issues during and after construction (this may include a range of ecological considerations, either in-stream or along the waterway corridor).
- Integrate stormwater management measures with management of the waterway corridor (where relevant).
- Design selected measures (first undertake a conceptual design to allow the development to be assessed, then undertake a detailed design).
- Assess the need to develop a water quality monitoring program and/or maintenance plans for large structural Stormwater Quality Best Management Practices (eg wetlands), then prepare these plans where required.
- Assess the need to develop an asset hand-over plan for large structural Stormwater Quality Best Management Practices (eg wetlands), then prepare such a plan where required.
- Prepare/document the SBSMP, ensuring that both the operational and construction phases of the proposed development have been addressed (this document should be developed for Council's development assessment and compliance staff, as well as those that will be responsible for its implementation).

[4] For Council's policy on this matter, see Section 3.5.2.

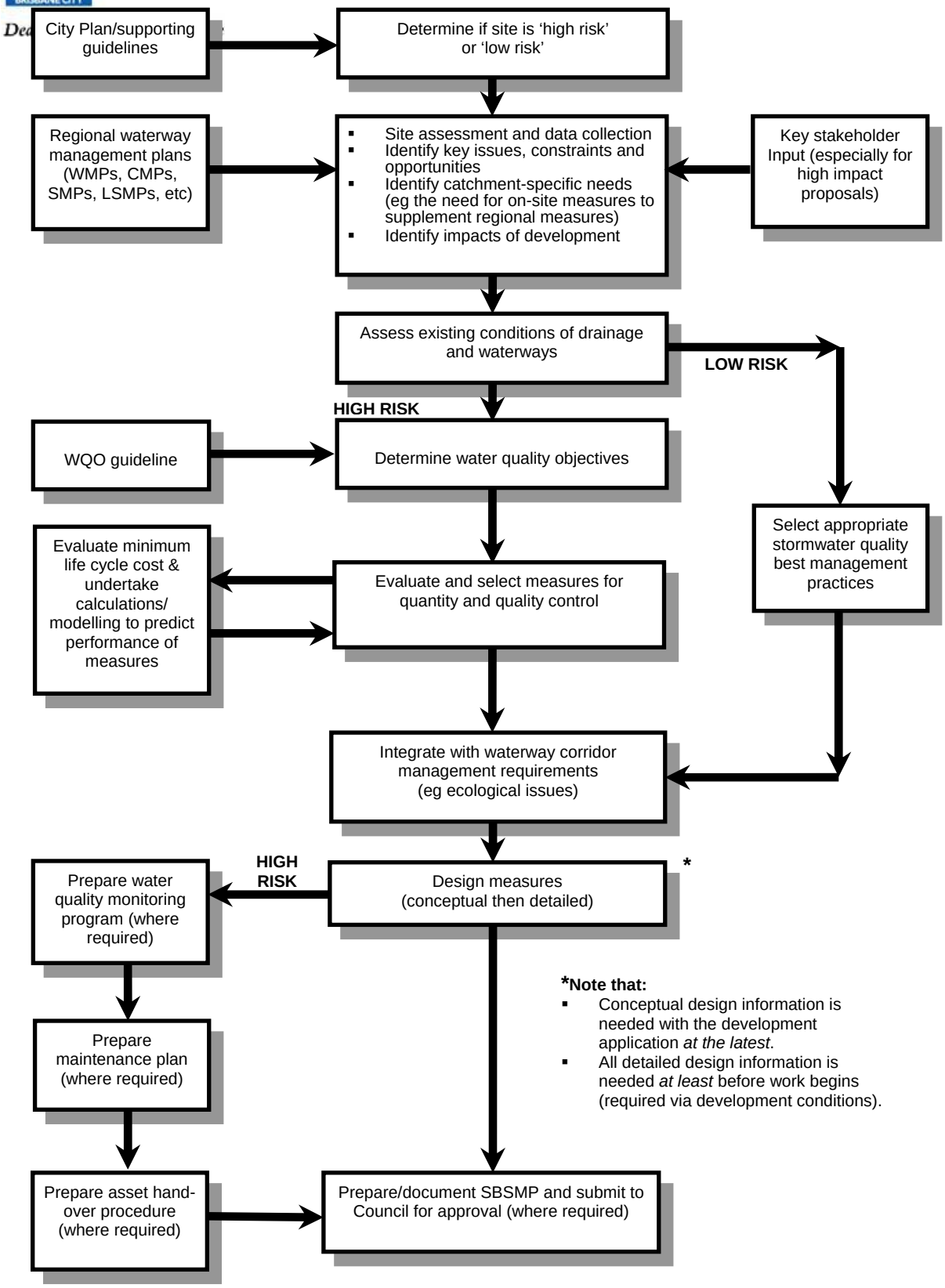

FIGURE C3.1
STEPS TO DEVELOP SITE BASED STORMWATER MANAGEMENT PLANS (SBSMPS)

3.4 PROJECT INCEPTION

At the time of project inception (ie pre-lodgement), the applicant and their design team is encouraged to meet with the relevant Council Development Assessment Team in order to discuss issues relevant to the development process. Items and actions for discussion should generally include those listed in Sections 3.2 and 3.3.

Note that other meetings with the Development Assessment Team may be required throughout the duration of the proposed project. The frequency of these meetings will be determined in accordance with the scale and complexity of the site, as will the size of the meetings (ie inclusion of all relevant parties). One of the aims of this guideline however, is to minimise the need for such interaction, by providing information at the earliest possible stage.

3.5 METHODOLOGY FOR 'HIGH RISK' DEVELOPMENTS

3.5.1 Site Assessment

Site assessment is required for the design of stormwater management practices during the operational and construction phases. In all cases, an understanding should be obtained of:

- Key water quality, flooding and waterway corridor issues within the catchment (refer to relevant Council Flood Studies, Stormwater Management Plans, Waterway Management Plans, Catchment Management Plans and Local Stormwater Management Plans).
- The existence of regional stormwater management facilities (refer to relevant Council Stormwater Management Plans).
- Guidelines or recommendations made in relevant Council Stormwater, Waterway or Catchment Management Plans about development in the catchment.
- Water quality, drainage and waterway corridor issues[5] within and immediately downstream of the development.
- What proportion of the site's surface is to be impervious.
- Soil condition, type and erosion potential.
- What activities are planned for the site.
- The nature of stormwater pollutants likely to be generated during the operational and construction phases (see Chapter 4 of Part C of this document).

The assessment of the site requires the completion of a number of different tasks as outlined below.

[5] The assessment of impacts of the proposed development on the affected waterway corridor may form part of the development's overall "ecological assessment" (see Council's draft *Ecological Assessment Guidelines* [BCC, 1999]).

Physically Inspect the Site

The site inspection should identify:

- The presence of watercourses, water bodies and overland flow paths.
- Water quality and stream health (based on visual evidence only at this stage) within or immediately downstream of the development.
- Evidence of water logging.
- Evidence of previous flooding and the state of waterway corridors.
- Evidence of erosion on land and along waterway bed and banks.
- Soil types (refer below).
- The nature of existing environmental assets (eg wetlands, waterway vegetation and natural detention basins).
- Existing stormwater infrastructure.
- The receiving environment and localised impact of any piped stormwater drainage (eg evidence of scouring, sedimentation or litter).

Identify Soil Types

Soil types need to be identified and assessed to evaluate erosion risk, to determine whether acid sulfate soils are likely to be an issue that requires early management, and to guide decisions on the selection of Stormwater Quality Best Management Practices.

The type of soil present on a site can exert a strong influence on the effectiveness of water quality controls during the construction and operational phases. For example, sediment basin sizing is dependent upon soil type (refer Chapter 12 of Part C of this document).

The existence of potential acid sulfate soils must also be assessed if the development is in a low-lying area (refer to Chapter 9 of Part C of this document).

Review Existing Plans/Studies

For many sites, Council reports or plans for the catchment are available, which may be applicable to the proposed development. It will be necessary to obtain copies from Council of any relevant Catchment Management Plans, Waterway Management Plans, Stormwater Management Plans, flood studies, Infrastructure Charges Plans for stormwater, Local Stormwater Management Plans or Site Based Stormwater Management Plans (SBSMPs) that have been developed.

Council is in the process of highlighting relevant waterway-related plans on Council's BIMAP (GIS) system which is available to the public. This initiative should simplify the process of locating relevant plans, which can then be obtained at Council's central reference library.

The plans (where available) will provide an indication of known flooding, water quality problems, and/or regional control measures that have been built or proposed. Note that it will be necessary to confirm with Council whether any of the nominated regional controls have been constructed.

Define Key Points of Interest
Locations where flows are to be determined should be established at all points of discharge from the site, and for any key points of interest located within the development site (eg at a major road crossing).

Assess Potential for Flooding
The assessment of whether the site is prone to flooding is to be undertaken in accordance with Australian Rainfall and Runoff (ARR) and the *Queensland Urban Drainage Manual* - QUDM – (including the BCC supplement). The assessment must be undertaken by a qualified specialist in hydrology and hydraulics, who will reference existing Stormwater Management Plans (where available) and other documents specified by the Development Assessment Team that have been prepared by Council.

Note that in addition to Council's BIMAP system (see above), Council's 'Flood Counter' is a source of information on historical and predicted flooding (ie information on the 1 in 100 year flood levels for a given area).

Assess Existing Water Quality
An understanding of existing water quality (of receiving water bodies or stormwater runoff) may have been derived from relevant Waterway Management Plans, Catchment Management Plans or Stormwater Management Plans. In addition, water quality data may be available for the nearest creek system (contact Council's Waterways Program or the Queensland Environmental Protection Agency). The assessment of likely impacts on water quality is covered in Section 3.5.4.

3.5.2 Identify Constraints and Opportunities

Constraints and opportunities for development must be determined in terms of the physical environment. The location of stormwater quality measures must be commensurate with the existing and proposed features of the development site as explained below.

The selection and location of both water quantity controls (eg detention basins) and water quality controls (eg swales or wetlands) is dependent on existing infrastructure, topography, soils and vegetation. It is necessary to understand:

- which existing features need to be retained for the location of controls (eg on a predominantly steep site, an area of flatter land may be required for a detention basin);
- where constraints may prevent the selection of measures (eg infiltration devices cannot be easily applied where rock, high groundwater levels or low permeability soils will prevent the device from operating effectively and where large water storage cannot be provided to accommodate these site limitations);
- ecological values to be protected in the affected waterway corridor (eg large ponds in a narrow waterway corridor may inhibit the movement of some fauna along the corridor)[6].

[6] For this aspect, the SBSMP needs to be consistent with other elements of the site's Environmental Management Plan (EMP).

This step forms a crucial element of the process of compiling a SBSMP, and should be carried out in conjunction with all other members of the developer's multi disciplinary team, who may identify additional constraints.

Parkland Contribution for Residential Subdivisions

Brisbane City Council requires 10% of the area to be developed to be set aside as a parkland contribution. Currently, this area must not be inundated for all storm events up to the 5 year average recurrence interval (ARI) event. This does not preclude the possible joint use of an area for parkland and the treatment of water quality or water quantity. For example, a detention basin may also be useable as a park, subject to the following:

- provision of required open space values;
- meeting minimum depth criteria;
- provision of safe egress;
- able to be cost-effectively maintained, and used shortly after a major storm event; and
- shaping of the basin to include a dry area during the 5 year ARI event.

Council's policy on this matter is that stormwater quality (or quantity) management infrastructure is not encouraged in open space/parkland. Note however, that as contributed parkland is typically above the 5 year ARI flooding contour, this issue should not arise frequently for new developments proposing stormwater management infrastructure (these structures are typically in lower-lying areas). Where the issue may arise as a significant one is in relation to large developments where ponds or wetlands are proposed (see Chapter 6 of Part C of this document). For these (and only these) types of stormwater quality management infrastructure, the design *may* provide significant open space values. Consequently, part of the land set aside for these structures *may* be counted as part of the development's mandatory parkland contribution[7]. For this to occur, the developer must clearly demonstrate to Council that the design will deliver significant open space values and the design will actually translate into a high quality asset.

Water Sensitive Urban Design

The potential for Water Sensitive Urban Design (WSUD) principles to be adopted at the site must also be assessed. Given that many of the principles of WSUD require consideration at the planning phase of a development, it is imperative that if any measures are adopted, they must be considered prior to the finalisation of lot layouts. Issues that should be addressed by the multi disciplinary team may include:

- setting lot levels such that drainage to infiltration devices can occur;
- the use of swales in some areas, rather than kerb and channel;
- linkage of the open space network to infiltration zones;
- disconnecting impervious surfaces; and
- incorporation of stormwater reuse infrastructure (eg ponds, underground tanks for roof water reuse).

[7] Note that there is no set percentage, as the nature of this infrastructure is highly variable. Thus, this issue must be negotiated on a site-by-site basis (preferably at the pre-lodgement stage), with the decision ultimately being made by Council's policy area for open space planning.

The merits (and maintenance requirements) of any measures considered for the development, should be discussed with the Development Assessment Team. As a general rule, Council will encourage the adoption of Water Sensitive Urban Design principles, and the application of innovative techniques.

An outline of the benefits of WSUD was provided in Section 1.5.2 of Part C of this document. Reference can also be made to:

- Department of Planning and Urban Development, et. al. (1994). *Planning and Management Guidelines for Water Sensitive Urban (Residential) Design*. Whelans, and Halpern Glick Maunsell, Perth.
- WBM Oceanics & Brisbane City Council, 1997. *Water Sensitive Urban Design Case Study*. WBM Oceanics, Brisbane.

3.5.3 Regional Controls

The term 'regional controls' can refer to either water quality or water quantity measures proposed for a creek catchment. These measures are specified in Stormwater Management Plans or Waterway Management Plans, and may negate the need for some site based measures or may reduce the required size for such measures. Where regional controls are required, an infrastructure charge may be levied by Council.

In general, optimal treatment of stormwater quality will be achieved by a combination of site based and regional controls.

3.5.4 Assess Impacts of Development

The assessment of the impacts of 'high risk' development in terms of water quality degradation and flooding will typically be addressed through modelling or numerical calculations. In this section, discussion is provided in relation to:

- Water Quality Assessment:
  - identifying pollutant export loads.
  - modelling water quality.
- Flooding Assessment.

This Section does not specifically address site-specific ecological assessment. For guidance on this issue, refer to Council's draft *Ecological Assessment Guidelines* (BCC, 1999). Note that ecological assessment will typically lead to an Environmental Management Plan (EMP) for 'high risk' development. The SBSMP will form part of the EMP and needs to be consistent with other elements in it.

Identify Contaminant Types and Loads

Water quality objectives set for the site will define which pollutants will need to be managed, and hence considered in the SBSMP. In most cases, pollutant export modelling will be required to estimate the concentration and load of pollutants washed from the site under:

- the existing land use condition; and
- the proposed final developed land use condition.

The concentration of pollutants estimated by the pollutant export modelling can be compared to the agreed WQOs (see Section 3.5.5) to assess the suitability of alternative stormwater treatment options. These will be used by the Development Assessment Team to assess the appropriateness of the proposed development. Council's *Guidelines for Pollutant Export Modelling in Brisbane* (BCC, 2000) provide recommended pollutant export equations for estimating the concentrations and loads of stormwater pollutants. The guidelines also describe Council's preferred modelling approach and method of comparing pollutant concentrations estimated by the AQUALM model to the site's WQOs[8].

Use may also be made of Chapter 4 of Part C of this document in determining which type of pollutants are likely to be generated for a given site.

It will be necessary to identify all significant risks to water quality arising during both the construction and operational phases. For example, accidental spillage of hydrocarbons or the release of asphalt prime to stormwater during the construction phase are issues that the SBSMP must identify measures to manage.

Flooding Assessment

Assessment of the impact of development on peak discharges and flood levels must be undertaken by a professional qualified in hydrology and hydraulics. This must be in accordance with the requirements of Australian Rainfall and Runoff (ARR) and the *Queensland Urban Drainage Manual* (including the BCC supplement), as noted in Section 3.5.1.

In most cases, an increase in flood level or peak discharge will not be allowed to occur beyond the boundary of the development site, with no adverse impacts allowed to affect adjacent properties.

3.5.5 Identify Water-Related Objectives

Water Quality Objectives

Following project inception, a site assessment and the identification of whether the site is classified as 'high risk' or 'low risk', the next major action in preparing a SBSMP is to identify the applicable Environmental Values (EVs) and Water Quality Objectives (WQOs) for affected waterways downstream from, or within, the development. The process to identifying a relevant set of WQOs is briefly described in Chapter 2 of Part C of this document and fully described in the *Guideline on Identifying and Applying Water Quality Objectives in Brisbane City* (BCC, 2000).

It is important that these objectives are *agreed* with the relevant Council Development Assessment team and documented at the beginning of the concept design phase as they will significantly influence the design of the stormwater infrastructure.

[8] Note that although AQUALM is the most commonly used pollutant export model in Brisbane, Council is working with the CRC for Catchment Hydrology on a model (linked with a decision support system) that may become more widely used in Brisbane for urban stormwater quality management.

Flooding Objectives

Flooding objectives should also be identified at this time. Issues to be considered (in conjunction with the findings of published regional Flood Studies, Stormwater Management Plans or Waterway Management Plans) should include:

- known flooding problems (either upstream or downstream of the proposed development site);
- whether any increase in discharge will be permissible (usually not);
- whether any increase in flood volume will be allowed;
- whether any increase in flood levels will be permitted;
- the location of flood regulation lines; and
- waterway corridor / habitat requirements.

3.5.6 Evaluate Stormwater Quality Management Options

Stormwater quality management options must be evaluated in conjunction with quantity control analysis, and should be sympathetic to waterway corridor requirements. Measures must be evaluated for both the construction and operational phases. Construction phase controls (erosion and sediment) are discussed in Chapter 12 of Part C of this document.

Evaluation of stormwater management options requires the following tasks to be completed:

- Determine future land use and the proportion of the development's surface that will be impervious.
- Investigate the connectivity of impervious areas and watercourses or water bodies. Water sensitive management techniques minimise the direct connection of impervious areas to watercourses.
- Select options considered appropriate for the site based upon an understanding of target pollutants and the strengths of various management measures (see Chapter 4 of Part C of this document).
- Where data allows, model the various options to check for the ability of the selected measures to meet the agreed WQOs at a reasonable cost (see below).
- Use specific design guidelines (eg wetland design guidelines) where appropriate (refer to preferred Reference List at the end of this Chapter, and also to Chapters 4, 5 & 6 of Part C of this document).
- Consider the life cycle costs of options.

Selection of Measures

The selection of measures considered appropriate for the development site must be linked to site constraints, target pollutants, stormwater flows, and the strengths/weaknesses of various options. Suitable references for the selection and design of measures are identified in Chapters 4, 5, & 6 of Part C of this document. Refer to:

- Chapter 4 of Part C of this document for an overview of Stormwater Quality Best Management Practices;
- Chapter 5 of Part C of this document for the selection of larger scale infrastructure (eg gross pollutant traps); and
- Chapter 6 of Part C of this document if a wetland, lake or pond is required.

Note that a quantitative evaluation process for large structural stormwater quality management practices is included in Council's *Design Guidelines for SQIDs* (BCC, 1999). Refer to Chapter 5 of Part C of this document for more details.

Council's *Guidelines for Pollutant Export Modelling in Brisbane* (BCC, 2000) provide pollutant removal efficiencies for various structural stormwater management devices to be used when assessing the performance of alternative stormwater 'treatment train' options. A treatment train may be defined as the use of a series of measures that act collectively to provide the target benefit.

The *Guidelines for Pollutant Export Modelling in Brisbane* (BCC, 2000) also describe Council's recommended approach to selection of the optimal (ie minimum life cycle cost) treatment train for the site.

Modelling

Mathematical modelling may be required to demonstrate to Council that the combination of stormwater quality management practices meets agreed WQOs. Such modelling can also be used to derive an optimal combination of stormwater quality management practices in terms of cost versus performance.

A commonly used program in Brisbane for pollutant export modelling is AQUALM. Guidelines for the selection of appropriate modelling parameters (for application in export relationships) may be found in Council's *Guidelines for Pollutant Export Modelling in Brisbane* (BCC, 2000). The modelling process should consider wet and dry years, and should involve simulation of at least a 10 year period.

Modelling must only be undertaken by qualified specialists, with demonstrated experience in modelling water quality, or expertise in the processes upon which the model is based. All assumptions and parameters used in the modelling process must be clearly explained along with the results of the modelling exercise.

3.5.7 Model SBSMPs

Council is in the process of preparing model SBSMPs (to the conceptual design stage) for at least two typical forms of development. Contact Council's Waterways Program for more details.

3.6 METHODOLOGY FOR 'LOW RISK' DEVELOPMENTS

The methodology for 'low risk' developments is based on a simplification of the approach for 'high risk' developments, as illustrated in Figure C3.1. Thus, the requirements consist of:

- Assessing the characteristics of the site and the potential impacts of development.
- Identifying constraints and opportunities to the use of stormwater quality or quantity measures.
- Assessing existing waterway conditions.
- Selecting appropriate Stormwater Quality Best Management Practices.

Demonstrating that relevant WQOs will be met is not necessary for 'low risk' developments.

Selection of appropriate SQBMPs will involve the following steps:

- Identify suitable permanent SQBMPs using Chapter 4 of Part C of this document (for large, structural devices, Chapter 5 of Part C of this document may also be required).
- Identify SQBMPs for the construction phase.
- Depending upon the proposed land use and potential sources of water pollution, use Chapters 7 to 12 of Part C of this document to determine how to manage discharges from the site to waterways.
- Prepare the SBSMP document[9] detailing the type, layout, installation sequence, expected pollutant removal performance, maintenance requirements, and maintenance responsibilities for each selected measure.

Any impacts on flooding (whether peak levels or peak discharges) must be addressed as for a 'high risk' plan.

3.7 CONSTRUCTION PHASE (CONTROLS)

The construction phase of a development has the potential to release significant amounts of high priority stormwater pollutants into the City's waterways (eg sediment and litter). While an Environmental Management Plan (EMP) will typically address issues such as fuel storage, spill clean-up procedures, vegetation protection, noise control and waste management, the issue of erosion and sediment control is significant enough to require a discrete Program.

Preparation and full implementation of a sound Erosion and Sediment Control (ESC) Program or ESC Management Plan is required for all subdivisions and developments, in accordance with Council's *Erosion and Sediment Control Standard* (refer to Appendix 2 of Part C of this document for a full copy of the ESC Standard).

[9] See Appendix 3 of Part C of this document for a suggested generic Table of Contents for SBSMPs.

The ESC Standard is applicable to all land disturbing activities that are subject to development assessment under the *City Plan*. These are defined as:

- Subdivisions, units, townhouses, commercial and industrial developments.
- Any other land disturbing activity that is deemed to be high risk.

For additional detail, refer to Chapter 12 of Part C of this document or Chapter 5 of the ESC Standard (Appendix 2 of Part C of this document). Note that Chapter 5 of the ESC Standard outlines the required contents of an ESC Program.

The ESC Program should be part of the SBSMP, and the SBSMP would typically be part of the EMP. Note that for developments like large residential subdivisions, the ESC Program must address all key phases of construction, not just one point in time. To do this, several plans showing the layout and sequencing of controls may be necessary. In normal circumstances, these must include:

- an ESC management plan for each bulk earthworks stage of a development (most important);
- an ESC management plan associated with road works; and
- an ESC management plan for the building phase (on maintenance)[10].

Changes to ESC measures (and plans) will be required as the topography and drainage patterns are altered. Where this occurs, a revised ESC management plan may be submitted along with engineering plans for each stage of development. However, wherever possible, large scale controls (eg sediment basins) should be located such that they remain in place for the duration of development works.

Note that construction phase erosion and sediment controls should:

- be used in locations where permanent stormwater controls will eventually be incorporated (eg sediment basins can become permanent wetlands, ponds or detention basins);
- be designed and implemented with recognition of the staging of construction activities;
- use a combination of drainage, erosion and sediment controls to form a 'treatment train';
- focus on minimising the load of fine sediment particles[11] that leave the site where possible (as these have the potential to kill seagrass meadows in Moreton Bay and transport a high proportion of nutrients and toxicants) by implementing erosion controls and designing adequate sediment basins (refer to Chapter 12 of Part C of this document); and
- be installed, regularly inspected and maintained by suitably qualified persons who have had input into the development of the ESC Program and who have access to relevant guidelines (refer to Chapter 12 of Part C of this document).

[10] Note that for class 1 and 10 residential buildings, an ESC Code is being prepared by the State Government that would apply under the *Building Act*. If enacted in Brisbane, this Code will require 'high risk' sites to prepare a basic ESC Management Plan.

[11] Fine sediment that causes harm to seagrass meadows in the Bay are in the order of 5-10 μm in diameter.

As with other water quality measures, the application of innovative techniques is encouraged for the prevention of erosion and trapping of sediment.

3.8 DOCUMENTATION

A SBSMP must provide the following information for the development:

- a summary of stormwater quality, quantity and waterway corridor management objectives (where possible they should be measurable);
- a description of those Stormwater Quality Best Management Practices (SQBMPs), stormwater quantity management measures, and waterway corridor protection measures that have been selected for the site for the operational phase[12];
- SQBMPs that have been selected for the site for the construction phase (focussing on erosion and sediment controls and including an Erosion and Sediment Control Program - see Chapter 12 of Part C of this document);
- site plans showing key features (eg drainage pathways) as well as the location of the above-mentioned measures;
- a program indicating the timing and sequence of installation of the above-mentioned measures;
- responsibilities for installation, inspection, maintenance and decommissioning of the above-mentioned measures;
- an inspection and maintenance program for the above-mentioned measures;
- Maintenance Plans for large structural Stormwater Quality Improvement Devices whether on private or Council land (see Chapter 14 of Part C of this document);
- a water quality monitoring program (where required - see Chapter 13 of Part C of this document)*;
- a simple audit program to check the installation and maintenance of SQBMPs that have been selected for the site during the construction phase (where required)*;
- a description of how records are to be kept on site performance (including incidents, complaints, etc);
- emergency procedures to protect stormwater quality (eg how to manage the collapse of a sediment basin or burst hydraulic hose);
- training requirements for construction and maintenance personnel (including an on-site induction program); and
- linkages with Environmental Management Systems (where relevant)*.

** 'High risk' development only*

A table of contents for model SBSMPs ['low risk' and 'high risk'] are provided in Appendix 3 of Part C of this document and Council is currently preparing two model SBSMPs (see Section 3.5.7).

12 For those sites where details of the ultimate land use are not known (eg an industrial estate), the SBSMP may recommend appropriate conditions of development that would apply to individual lots within the development, as they become subject to Council's development assessment process.

3.9 REFERENCES

Preferred References

Policy and Legislation

1. Brisbane City Council, 1999. *Urban Stormwater Management Strategy for Brisbane City Council (Version 2, 1999-2001).* Brisbane City Council, Brisbane.

Technical / Guidelines

1. Brisbane City Council, 2000. *Guidelines for Pollutant Export Modelling in Brisbane*. Brisbane City Council, Brisbane.
2. Department of Natural Resources and Department of Environment, 1998. *Stormwater Quality Control Guidelines for Local Government*. Department of Natural Resources, Brisbane.
3. Brisbane City Council, 1999. *Erosion and Sediment Control Standard (Version 8 or later version)*. Brisbane City Council, Brisbane.

Water Sensitive *Urban Design*

1. Brisbane City Council, 1997. *Water Sensitive Urban Design: Stage 1 - Discussion Paper.* Brisbane City Council, Brisbane.
2. Department of Planning and Urban Development, Water Authority of Western Australia & EPA, 1994. *Planning and Management Guidelines for Water Sensitive Urban (Residential) Design*. Whelans & Halpern Glick Maunsell.

Additional References

1. Brisbane City Council & GeoEng Pty Ltd, 1999. *Draft Design Guidelines for SQIDs.* Brisbane City Council, Brisbane.
2. Brisbane City Council, 1999 *Draft Brisbane River Corridor Management Plan.* Brisbane City Council, Brisbane.
3. Brisbane City Council, 2000. *Brisbane City Plan* (including Waterway Code & Stormwater Management Code). Brisbane City Council, Brisbane.
4. Victoria Stormwater Committee, 1999. *Urban Stormwater: Best Practice Environmental Management Guidelines*. CSIRO, Melbourne.
5. IE Aust, 1987. *Australian Rainfall and Runoff: A Guide to Flood Estimation Volume 1*. IE Aust, Australia.
6. Brisbane City Council, Queensland Department of Natural Resources & Institute of Municipal Engineering Association of Queensland, 1994. *Queensland Urban Drainage Manual*. Queensland Department of Natural Resources, Brisbane.