Policy 11: Land Development Guidelines

Section 13

13.1 Stormwater Quality Management Guidelines

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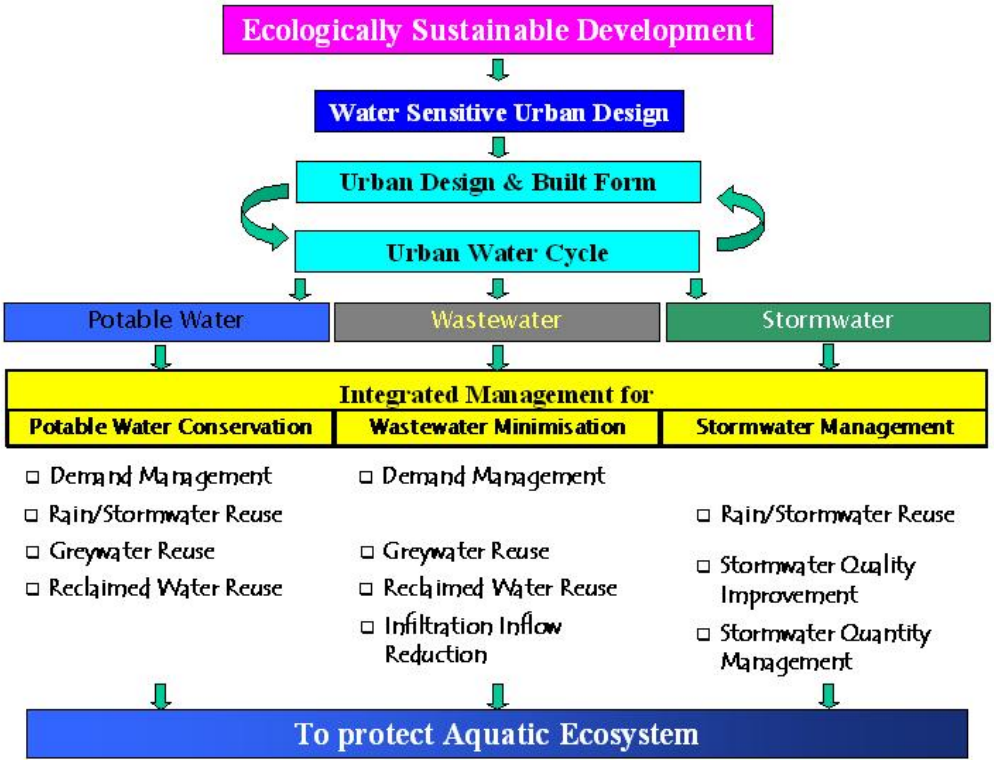
13.1.1 Water Sensitive Urban Design & Best Planning Practices

Water Sensitive Urban Design (WSUD) is a new approach to urban planning and design that embodies the principles of Ecologically Sustainable Development (ESD) with particular emphasis on providing more economical and environmentally appropriate ways of providing water, wastewater and stormwater solutions. In its broadest context WSUD encompasses all aspects of integrated urban water cycle management as illustrated in **Figure 13.1-A**.



Source: WSUD Guidelines, City of Melbourne

Figure 13.1-A: Key Elements of Urban Water Cycle

Figure 13.1-A shows how WSUD integrates the elements of the urban water cycle with both the urban design and built form components of land developments. To this end, WSUD requires careful consideration of the urban water cycle at the land use planning stage to ensure all possible opportunities for application of best practice water cycle management solutions can be realised.

There are a number of best planning practices (BPPs) and best management practices (BMPs) that support the principles of WSUD and these are documented in numerous texts and manuals. The reader is referred to **Chapter 4** of **Australian Runoff Quality** (**Institution of Engineers, 2003**) for a detailed overview of WSUD and its associated BPPs and BMPs. **Australian Runoff Quality** is a companion document to **Australian Rainfall and Runoff** (**Institutions of Engineers, 1987**) and is considered to be the current industry standard for the management of urban stormwater quality.

13.1.1.1 WSUD Objectives and Principles

WSUD aims to minimise the impact of urban development on the natural water cycle and its principles can be applied to single allotments or to whole sub-divisions.

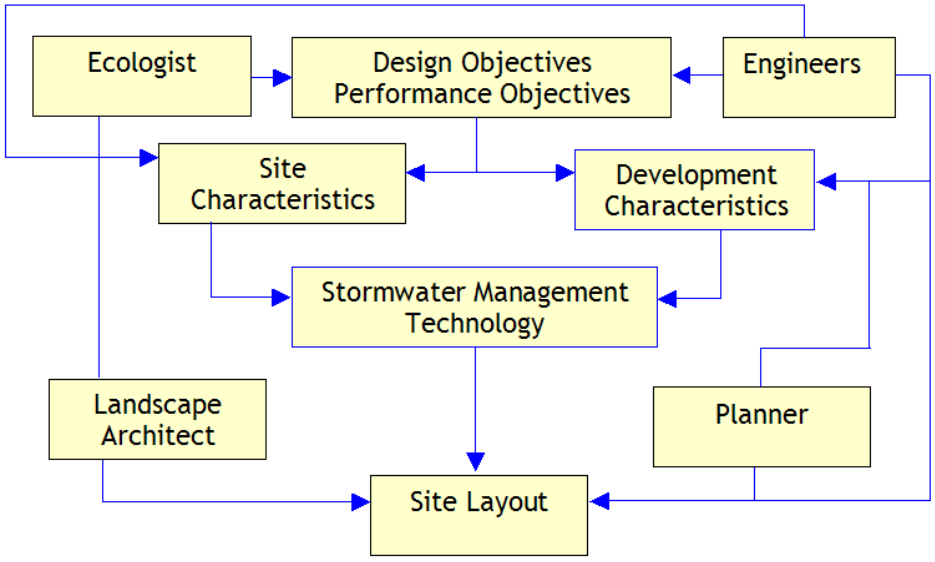
With regard to stormwater management, the core principle of WSUD includes:

- protect natural ecosystems;
- integrate stormwater treatment into the urban landscape;
- protect water quality;
- reduce runoff and peak flows;
- add value while minimising development costs.

These principles require a considered approach to urban development where sustainable land and water management decisions underpin all development proposals.

13.1.1.2 The Planning and Design Process

WSUD requires a multi-discipline approach as shown in **Figure 13.1-B**.



IE Aust 2003 Australian Runoff Quality

Figure 13.1-B: Inter-Disciplinary Planning and Design Process

WSUD responds to the site conditions and land capability and cannot be applied in a 'cookbook' way. Careful assessment and interpretation of the site conditions is therefore a fundamental element of developing a successful WSUD development. To this end, the breadth of technical expertise required to assess a given site will be dictated by the site itself and in many cases will require additional professional expertise as shown in **Figure 13.1-B**.

13.1.1.3 WSUD Best Planning Practices

WSUD Best Planning Practices (BPPs) are land-use planning techniques and concepts that provide a development layout that maximises the opportunities for implementing WSUD Best Management Practices. BPPs need to be considered at the initial site planning phase of an urban development and can enhance the aesthetic, amenity and recreation opportunities of an area as well as protecting its environmental values.

With regard to stormwater quality management WSUD promotes an 'at source' philosophy which is based on the premise that it is easier and more cost effective to control pollution at its source rather than removing it once it has made its way into a formal stormwater drainage system.

An 'at source' approach also allows for greater integration between stormwater management function and public realm landscape elements. Garden beds within building forecourt areas, street trees and other 'soft' streetscape elements can all be utilised as part of an integrated stormwater management system. Landscape elements can be designed to filter stormwater runoff from hard surfaces with the added benefit of having the first use of stormwater runoff for watering of the landscaped areas.

WSUD best management practices (BMP) are best provided as a series of 'fit for purpose' treatment measures placed in series to form a 'treatment train'. Rarely can one individual measure adequately address the full range of pollutants generated from a typical urban development and therefore the placement of individual treatment measures within the treatment train must reflect the optimal operating environment for each treatment measure taking into consideration hydraulic and pollutant loading, the treatment processes employed, and maintenance and public health issues.

Detailed information about conceptual planning, specifications and design drawings related to WSUD practices are available in Gold Coast City Council's **WSUD Guidelines**.

13.1.2 Preparation of a Stormwater Quality Management Plan (SWMP)

This section outlines Council's requirements for the preparation of a SWMP and is applicable to all types of land development and re-development.

A SWMP must be prepared for all development applications made to Council unless the application falls within the category noted as 'Deemed to Comply'.

Council requires that two SWMPs are to be submitted at two different stages of a development. The first SWMP is to be identified as a Conceptual SWMP (CSWMP) and is to be submitted with the initial lodgement of a development application (ie. MCU & ROL stages). Following the approval of the CSWMP, a Detailed SWMP (DSWMP) is to be submitted prior to lodgement of any Operational Works (OPW) Application to justify and support all detailed design considerations in accordance with the approved requirements of the CSWMP.

13.1.2.1 Deemed to Comply

Council acknowledges that not all development applications should warrant a full SWMP. It is accepted that some types of development may only require rainwater tanks (duplex lots) to promote the reuse of rainwater, whilst other more intense applications are required to allocate an appropriate area for stormwater management with detailed designs being signed off by Council prior to any works commencing on that site. From these considerations Council provides the following Deemed to Comply criteria. If an applicant can submit an evidence to justify that the proposed development application can comply with the criteria listed below then no formal SWMP is required.

The Deemed to Comply criteria are designed to simplify design requirements for various development applications. Any applicant may choose not to apply the following Deemed to Comply criteria and will then be requested by Council to submit the relevant CSWMP and DSWMP for approval within the relevant stages of the development application.

a) Attached/ Detached Dwelling < 1000 m^2

If a development application encompasses land area less than 1000 m^2 then the following requirements are to be included with the development proposal.

Traditional Areas

If any building is proposed in an area that was approved for development after 10 June 2005 a rainwater tank needs to be installed to supply water to certain fixtures around the home.

Type of Home	Size of Tank
Detached/ Freestanding home	5,000 litres
Attached (Duplex, Townhouse or Unit – up to 3 storey walk up)	3,000 litres

b) Dual Reticulated areas

If any building is proposed in a dual reticulated area (access to both drinking water and recycled water) that was approved for development after 29 August 2005 in that case a rainwater tank needs to be installed to supply water for washing machine cold-water tap and outdoor tap.

Type of Home	Size of Tank
Detached/ Freestanding home	3,000 litres
Attached (Duplex, Townhouse or Unit – up to 3 storey walk up)	3,000 litres

c) Attached/ Detached Dwelling > 1000 m^2 and < 5000 m^2

If a development application encompasses an area of land > 1000 m^2 and < 5000 m^2 then the following requirements are to be incorporated within the development proposal.

Requirements

- no impervious area runoff to discharge from the site without an appropriate treatment;
- rainwater tanks requirements as specified for lots < 1000 m^2; and
- all of the sites impervious areas including the overflow from rainwater storage devices are to discharge to bioretention device(s) that are not less than 2% of the total contributing catchment (including roof areas). These devices must satisfy the following requirements:
  - a maximum extended detention depth of 400 mm (preferably 300 mm) over the surface area of entire device;
  - filter media is to be generally in accordance with the attached diagram in **Figure 13.1-D**;
  - device design is to be in accordance with industry guidelines **Australian Runoff Quality** and GCCC **WSUD Engineering Guidelines**; and
  - detailed engineering diagrams and management requirements for the proposed development are to be submitted to Council for approval prior to any works commencing onsite with design certification prepared by a qualified stormwater engineer/ scientist.

d) Code or Impact Low/ High Rise Developments

High rise development applications resulting in works upon the site with areas < 2500 m^2 are required to provide the following treatment requirements:

Requirements

- no impervious area runoff to discharge from the site without an appropriate treatment;
- rainwater tanks are to be incorporated on the development site. These devices are to be sized via appropriate water balance modelling which shall be submitted to Council for approval prior to any works commencing onsite;
- all of the sites impervious areas including the overflow from rainwater storage devices are to discharge to bioretention device(s) that are not less than 2% of the total contributing catchment (including roof areas). These devices must satisfy the following requirements:
  - a maximum extended detention depth of 400 mm (preferably 300 mm) over the surface area of entire device;
  - filter media is to be generally in accordance with the **Figure 13.1-D**;
  - device design is to be in accordance with industry guidelines **Australian Runoff Quality** and GCCC **WSUD Engineering Guidelines**, **2006**; and
  - detailed engineering diagrams and management requirements for the proposed development are to be submitted to Council for approval prior to any works commencing onsite with design certification prepared by a qualified stormwater engineer/ scientist.
- any proposal of a high-rise development that includes a basement car park for > 10 cars a Gross Pollutant Trap (hydrocarbon and litter separator) are to be incorporated within the drainage design to treat water discharging into Council stormwater drainage infrastructure. This is required to ensure that any litter or hydrocarbons exposed to basement wash downs are treated prior to discharging into downstream waterways;

Note: ***Any designated carwash bays will require a trade waste permit to be issued for the development.***

- a maintenance management document is to be submitted to Council for approval prior to the commencement of use of the site. This document is to detail how the stormwater management devices are to be maintained by the property owner and/ or included within the Community Management Statement or Body Corporate bylaws.

e) Code or Impact Commercial Developments < 2500 m^2

Commercial development applications resulting in works upon the site with areas < 2500 m^2 are required to provide the following treatment requirements:

Requirements

- no impervious area runoff to discharge from the site without an appropriate treatment;
- rainwater tanks are to be incorporated on the development site. These devices are to be sized via appropriate water balance modelling which shall be submitted to Council for approval prior to any works commencing onsite;
- all of the sites impervious areas including the overflow from rainwater storage devices are to discharge to bioretention device(s) that are not less than 2.5% of the total contributing catchment (including roof areas). These devices must satisfy the following requirements:
  - a maximum extended detention depth of 400 mm (preferably 300 mm) over the surface area of entire device;
  - filter media is to be generally in accordance with the **Figure 13.1-D**;
  - device design is to be in accordance with industry guidelines **Australian Runoff Quality** and GCCC **WSUD Guidelines**, and
  - detailed engineering diagrams and management requirements for the proposed development are to be submitted to Council for approval prior to any works commencing onsite with design certification prepared by a qualified stormwater engineer/ scientist.
- in the proposal of a commercial development that includes a basement car park for > 10 cars a Gross Pollutant Trap (hydrocarbon and Litter separator) are to be incorporated within the drainage design to treat water discharging into Council stormwater drainage infrastructure. This is required to ensure that any litter or hydrocarbons exposed to basement wash downs are treated prior to discharging into downstream waterways;

Note: ***Any designated carwash bays will require a trade waste permit to be issued for the development.***

- a maintenance management document is to be submitted to Council for approval prior to the commencement of use of the site. This document is to detail how the stormwater management devices are to be maintained by the property owner and/ or included within the Community Management Statement or Body Corporate bylaws.

f) Code or Impact Industrial Development (excluding Heavy and Extractive Industries)

Industrial development applications resulting in works upon the site with areas < 2500 m^2 are required to provide the following treatment requirements:

Requirements

- no impervious area runoff to discharge from the site without an appropriate treatment;
- rainwater tanks are to be incorporated on the development site. These devices are to be sized using appropriate water balance modelling which shall be submitted to Council for approval prior to any works commencing onsite;
- all of the sites impervious areas including the overflow from rainwater storage devices are to discharge to bioretention device(s) that are not less than 2.5% of the total contributing catchment (including roof areas). These devices must satisfy the following requirements:
  - have a maximum extended detention depth of 400 mm (preferably 300 mm) over the surface area of entire device;
  - filter media is to be generally in accordance with the **Figure 13.1-D**;
  - device design is to be in accordance with industry guidelines **Australian Runoff Quality** and GCCC **WSUD Guidelines**; and
  - detailed engineering diagrams and management requirements for the proposed development are to be submitted to Council for approval prior to any works commencing onsite with design certification prepared by a qualified stormwater engineer/ scientist.
- a maintenance management document is to be submitted to Council for approval prior to the commencement of use of the site. This document is to detail how the stormwater management devices are to be maintained by the property owner and/ or included within the Community Management Statement or Body Corporate bylaws.

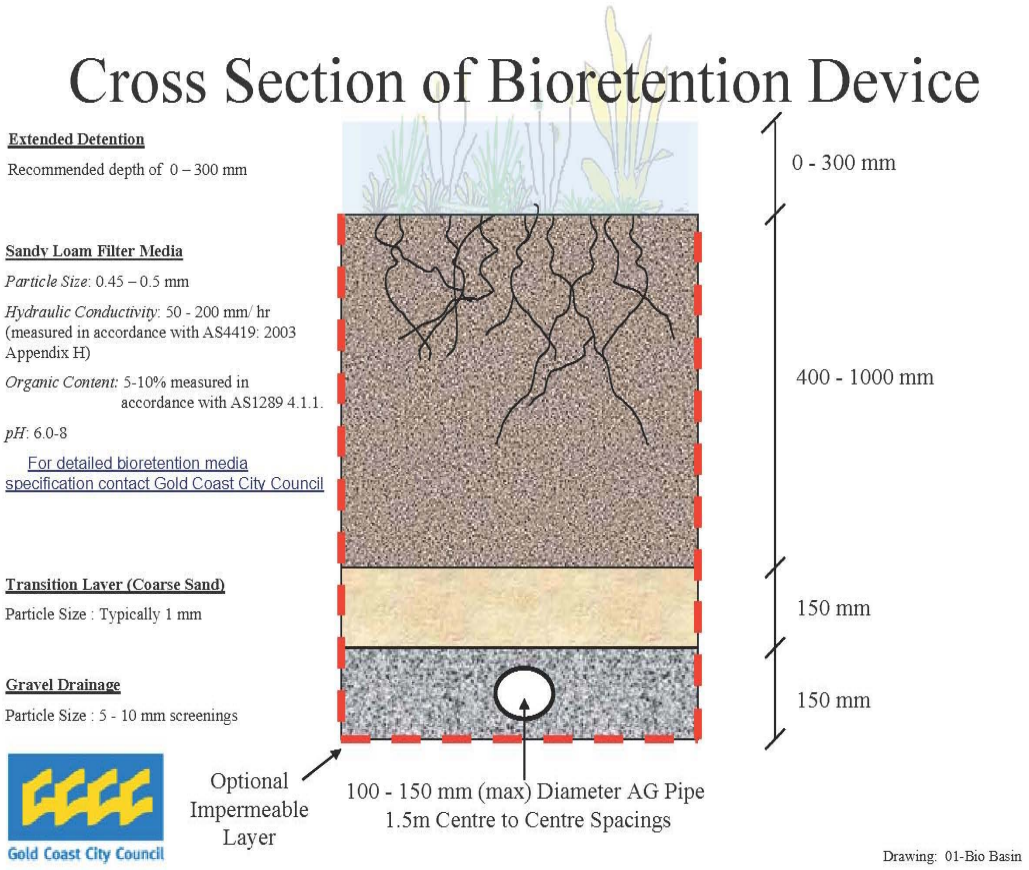


Figure 13.1-D: Typical cross-section of a Bioretention device

13.1.2.2 Preparation of a Conceptual Stormwater Management Plan (CSWMP)

The purpose of a CSWMP is to identify all potential environmental impacts, performance criteria and mitigation strategies together with relevant monitoring, reporting and where necessary, the appropriate corrective actions. A CSWMP contains clear commitments framed in a way that enables later assessment of the extent to which the commitments have been met. A CSWMP is structured to address the major issues, risks and key pollutants, for the life of the development.

A CSWMP is to be used as a stand alone manual for site managers, engineers, landscape professionals and others conducting detailed design. The CSWMP provides details of the proposed management options and allows Council to assess if the impacts of the proposed development have been adequately identified, mitigated and managed. Additionally, it identifies the required level of maintenance by the developer during the 'on maintenance' period and by Council after asset hand-over, and provides maintenance schedules and forecasted maintenance costs for the life of the stormwater system.

The level of detail required in a CSWMP may vary between developments based on the level of impact the proposed development is likely to have on the receiving waterways/ waterbodies. The level of detail required in a CSWMP is at all times the decision of Council and therefore early consultation between the proponent and Council's development assessment officers will be important to establish the required level of detail. In most cases the CSWMP will need to provide sufficient documented evidence to indicate satisfactory completion of each of the steps shown on **Figure 13.1-E**.

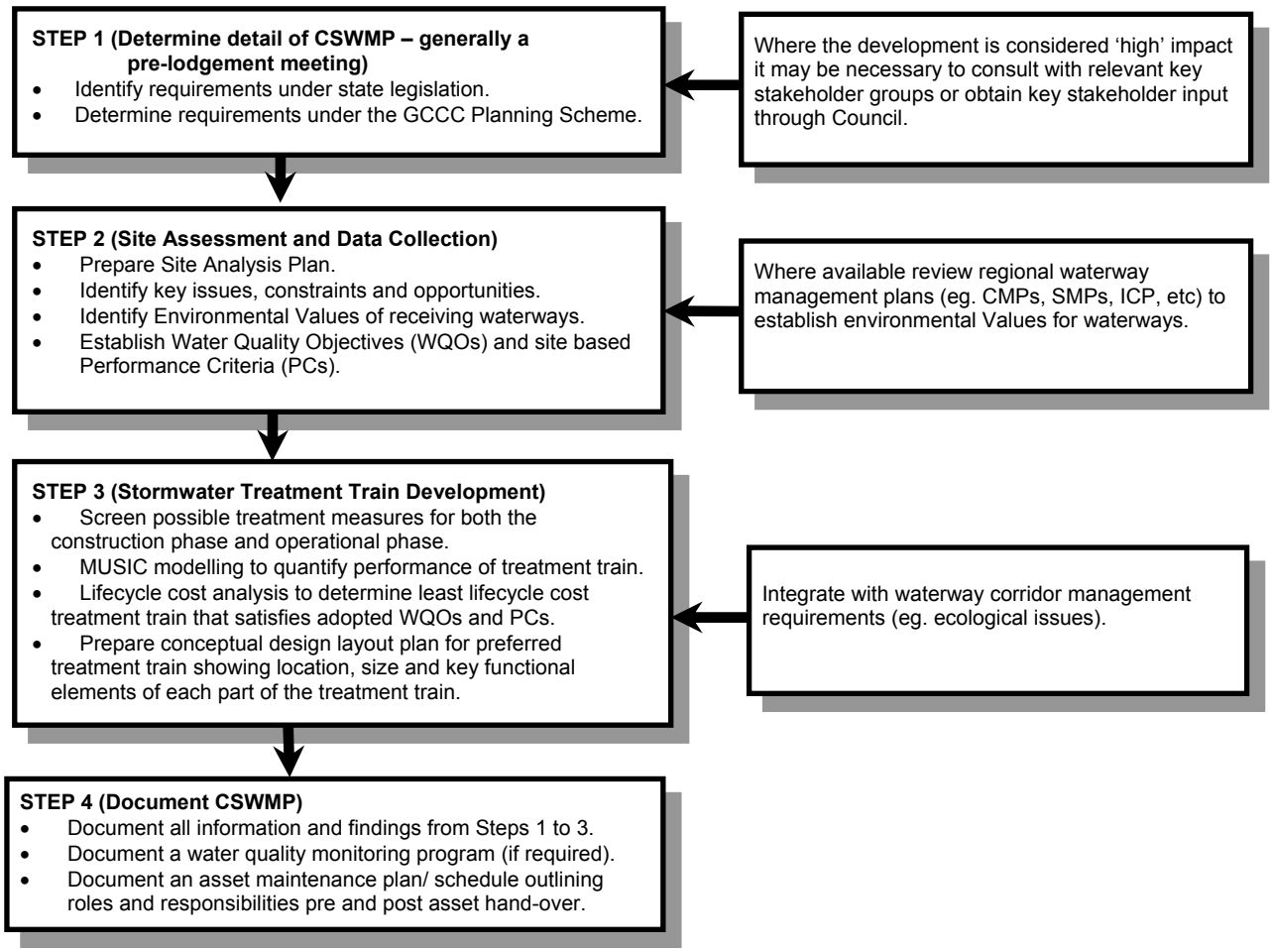


Figure 13.1-E: Preparation of a Conceptual Stormwater Management Plan (CSWMP)

Figure 13.1-E represents Council's requirements for the preparation of a CSWMP (unless otherwise directed by Council's development assessment officers) and should not be considered to be the limit of detail required in a CSWMP. Some high impact developments may require additional information to be provided and this should be established in consultation with Council's development assessment officers prior to commencing the preparation of the CSWMP.

Step 1: Determining the Level of Details for a CSWMP

Council's development assessment officers will determine the detail required in a CSWMP. **Figure 13.1-E** and the other provisions of Council's Planning Scheme Policy outline the level of detail to be provided in a CSWMP unless a lesser or greater amount of detail is explicitly requested (in writing) by Council's development assessment officers.

All development proponents are urged to arrange a pre-lodgement meeting with Council's development assessment officers to confirm the detail required for the CSWMP.

Step 2: Site Assessment and Data Collection

Site Analysis Plan

Reference should be made to the **Planning Scheme Policy 17** in the Gold Coast Planning Scheme for Council's expectations for preparation of a Site Analysis Plan.

Receiving Environment – Environmental Values and Water Quality Objectives (WQO)

The process of defining Environmental Values and ambient Water Quality Objectives for receiving waters is discussed by both **ANZECC** (**2000**) and the **Queensland Environmental Protection Policy** (**Water**), **Queensland State Government 1997b**. The Water Quality Objectives for a site's receiving waters shall be defined according to the following documents in order of priority:

1. Site Specific WQO's determined by Catchment Management Plans or Studies endorsed by Council;
2. Interim WQO's set by a city-wide Council document;
3. WQO's set by any other scientific study endorsed by Council (eg. **South East Queensland Regional Water Quality Management Strategy 2001**);
4. The **Queensland State Water Quality Guidelines** (**Queensland Government, 2006**); or
5. **ANZECC (2000) Guidelines** (select appropriate parameters and criteria from the guidelines with respect to the receiving environment, eg. fresh or estuarine, lakes and reservoirs or rivers and streams).

Once the WQO's for the receiving waters have been defined, these values should be compared to existing water quality data for the waterway in order to identify any existing water quality issues. Reference should be made to Council's latest **Health of the Waterways Report** (**GCCC, 2002**).

Site Based Performance Criteria

Performance Criteria may be either based on loads (mass per unit time) or concentration (mass per volume). For the purpose of development assessment Council has adopted:

- best-practice concentration discharge standards for use in the construction phase; and
- load-based criteria for the operational phase of development.

In addition, the implementation of best-practice stormwater treatment is required in accordance with the **Precautionary Principle** of ESD both during the construction and operational phases.

Construction Phase – Concentration Discharge Criteria

Construction Phase Performance Criteria are limited to those parameters that are directly linked to construction site management practices. Typical parameters include turbidity/ suspended solids, pH, dissolved oxygen, litter, hydrocarbons and specific cations and anions (recommended as part of an **Acid Sulfate Soil Management Plan** (**ASSMP**), if required).

Unless otherwise stated in a Council endorsed Catchment Management Plan or Study, the construction phase Performance Criteria for discharges from development sites are listed in **Table 13.1-A** below. These criteria are discharge standards, so applicable to runoff events or pumped discharges from development sites.

Table 13.1-A: Construction Phase Performance Criteria

Pollutant	Criteria
Total Suspended Solids	90th %ile <50mg/L
pH	6.5 – 9.0
Dissolved Oxygen	90th %ile >80% saturation or 6mg/L
Hydrocarbons	No visible sheen on receiving waters
Litter	No visible litter washed from site
Cations and anions	As recommended by Acid Sulfate Soil Management Plan

It is highly recommended that a site-specific relationship be developed between turbidity and suspended solids on high-risk development sites. This will enable the rapid feed back of turbidity monitoring into site management actions (such as flocculation and timing of discharge from a sedimentation basin).

Setting concentration-based criteria allows for compliance checks through water quality monitoring. Construction phase water quality monitoring will be required for sites where dewatering is required.

Operational Phase – Load-Based Criteria

Table 13.1-B below, presents the Performance Criteria required to be met for discharges from development sites during the 'operational' (post-construction) phase of the development. Load-reduction targets have been proposed for the City of Gold Coast.

The load-reduction targets were determined based on criteria specified by both the Victorian and New South Wales Environmental Protection Agencies as best-practice targets. These have been further refined by Gold Coast City Council and the SEQ Waterways Partnership through the assessment of a series of scenarios.

Table 13.1-B: Operational Phase Performance Criteria

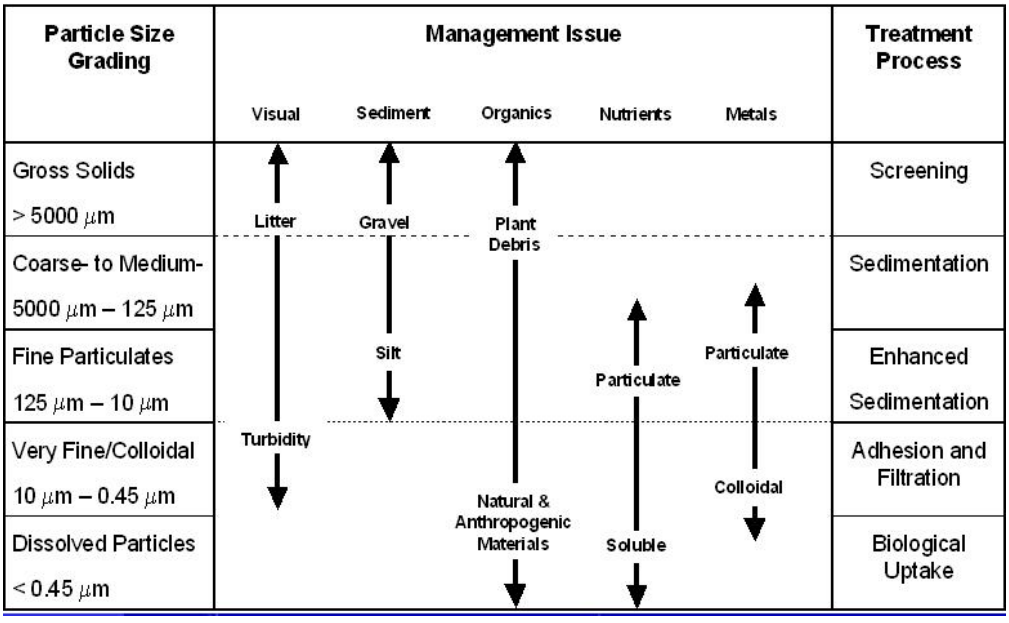
Best Management Practices (BMP) are required to be demonstrated for all development applications within the City of Gold Coast. The following load-reduction targets must be achieved when assessing the post-developed sites treatment train (comparison of unmitigated developed case versus developed mitigated case):

- 80% reduction in Total Suspended Sediment (TSS)
- 45% reduction in Total Nitrogen (TN)
- 60% reduction in Total Phosphorus (TP)
- 90% reduction in litter (sized 5mm or greater)

Step 3: Stormwater Treatment Train Development

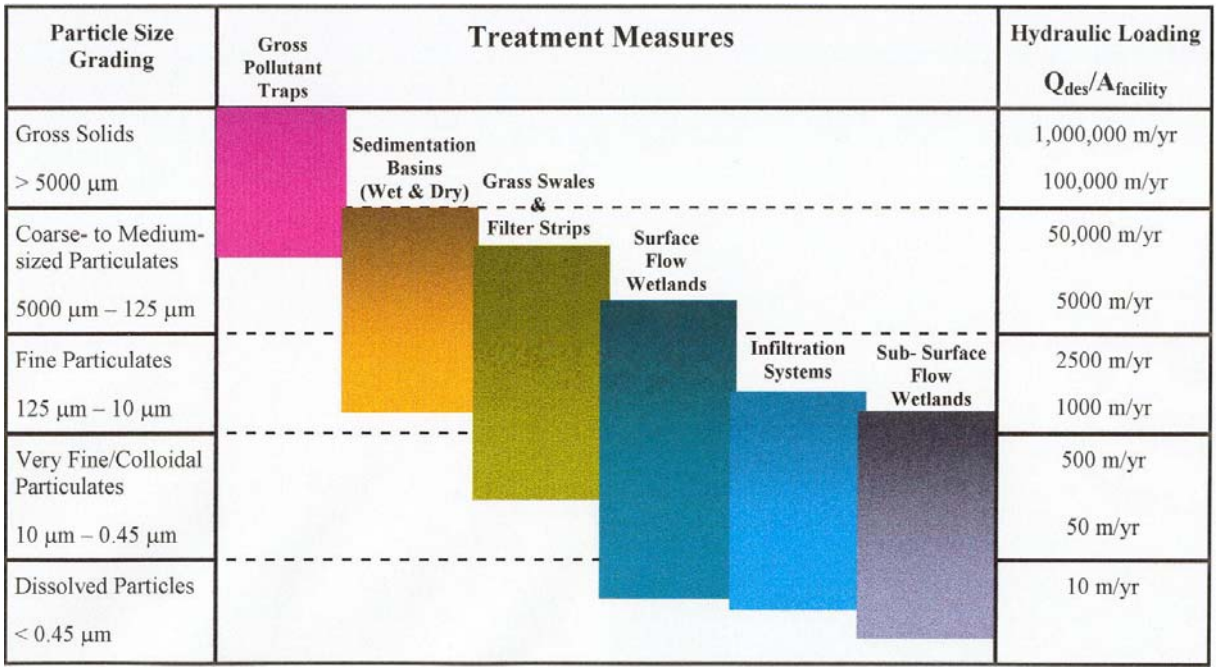
Stormwater can carry a wide range of pollutant types and sizes. The vast range of pollutants means that no single treatment measure can effectively treat all pollutants carried by stormwater. A series of treatment measures that collectively address all stormwater pollutants is termed a 'treatment train'. The selection and order of treatment measures is a critical consideration in developing a treatment train.

Figures 13.1-F and **13.1-G** show generalised relationship between stormwater pollutant characteristics (defined by particle size) and effective treatment processes. It can be seen from these figures that a stormwater treatment train needs to comprise a range of treatment measures in order to address the full range of pollutants likely to be found in urban stormwater runoff.



Breen, 1999

Figure 13.1-F: Stormwater pollutant management issues and appropriate treatment processes



Source: MUSIC User Manual, 2002

Figure 13.1-G: Stormwater quality improvement measures, target particle size range and operating hydraulic loading range

Tables 13.1-C and **13.1-D** outline the key pollutants to be addressed by the stormwater treatment trains developed for both the construction phase and operational phase of the development. These are general descriptions of the pollutants only and the site analysis should endeavour to obtain further site specific information on each pollutant type (where possible) to better define the pollutant characteristics such as particle size distribution (PSD) data for suspended sediment, and speciation for Nitrogen and Phosphorous. This additional information can help to inform the selection of treatment measures best suited to address the pollutant characteristics likely to be generated from the development.

Table 13.1-C: Typical Pollutants Generated During the Construction Phase

Pollutant	Sources	Priority
Litter	Paper, construction packaging, food packaging, cement bags, off-cuts	High
Sediment	Unprotected exposed soils and stockpiles during earthworks and building works	High
Hydrocarbons	Fuel and oil spills, leaks from construction equipment and temporary carpark areas	High
Toxic materials	Cement slurry, asphalt primer, solvents, cleaning agents, washwaters (eg. from tile works)	Medium
Acid or Alkaline substances or producing substances	Acid sulfate soils, cement slurry and washwaters	High

Table 13.1-D: Typical Pollutants Generated During the Operational (Post Construction) Phase

Pollutant	Land Use					
	Low Density Residential	High Density Residential	Commercial	Industrial	Service Stations	Car Parks
Litter	Yes	Yes	Yes	Yes	Yes	Yes
Sediment	Yes	Yes	Yes	Yes	No	Yes
Oxygen demanding substances (organic & chemical matter)	Yes	Yes	No	Yes	No	No
Nutrients (N & P)	Yes	Yes	Yes	Yes	No	No
Pathogens/ Faecal coliforms (bacteria & viruses)	Yes	No	No	Yes	No	No
Hydrocarbons (incl oil & grease)	No	Yes	Yes	Yes	Yes	Yes
Heavy metals (often associated with fine sediment)	Yes	Yes	No	Yes	Yes	Yes
Surfactants (eg. detergents from car washing)	Yes	Yes	Yes	Yes	Yes	Yes
Organochlorines & organophosphates (eg. pesticides, herbicides)	No	No	No	Yes	No	No
Thermal pollution (heat)	No	No	No	Yes	No	No
pH altering substances (other than Acid Sulfate Soils)	No	No	No	Yes	No	No

Legend:

- ***Shading denotes the key pollutant to be targeted for trapping/ treatment.***
- ***For industrial and commercial developments, site-specific assessment should be undertaken to identify other key pollutants that need to be targeted for the proposed development.***

Selection of Treatment Train

The following procedure is required to be followed for the selection of a stormwater treatment train. In all situations the onus is on the applicant to demonstrate that all planning and design issues have been addressed.

1. Using **Figures 13.1-E** and **13.1-F** as a guide and the GCCC **WSUD Guidelines**, develop a series of potential treatment trains for the proposed development based on the interpreted site conditions and site opportunities and constraints. Other issues (not specifically covered in the screening tools) that should also be taken into consideration in selecting appropriate treatment measures include workplace health and safety issues (for maintenance crews) and general public amenity and safety. Treatment measures to be located within Public Open Space must address the requirements of **Policy 16** and Council's **Land Development Guidelines**, **2005**. In brief, the following issues need to be addressed:
   - the visual impact of the device;
   - drowning risk;
   - potential for mosquito breeding;
   - potential for nuisance odours;
   - landscaping embellishments;
   - access requirements; and
   - potential for vandalism.
2. Undertake quantitative water quality modelling using Council's preferred modelling approach to determine the performance of each potential treatment train against the Performance Criteria.
3. Undertake lifecycle cost analysis to determine the least lifecycle cost treatment train to satisfy the Performance Criteria.

Water Quality Modelling

Water Quality modelling will be required for all development application other then development applications fall into Deemed to Comply categories. This modelling must achieve load reduction targets as described in **Table 13.1-B** of this document to ensure minimal impact on the receiving waterways/ waterbodies.

Recent developments in urban stormwater quality modelling software have resulted in a significant advancement in the ability to simulate the pollutant removal efficiency of a range of stormwater treatment devices configured to form stormwater treatment trains. Specifically, MUSIC (Model for Urban Stormwater Improvement Conceptualisation) developed by the Cooperative Research Centre for Catchment Hydrology now provides stormwater practitioners with a state of the art model that is available from CRC Melbourne and that complies with Council's water quality modelling requirements.

Details of MUSIC Modelling Guidelines are available on Council's website:

http://www.goldcoast.qld.gov.au/attachment/building/music_modelling_guidelines.pdf.

However, the following should be read in combination with **MUSIC Modelling Guidelines**:

1. Interpretation of Results – All interpretation of results of MUSIC modelling should include comparison with the Performance Criteria (PC) established for the site. In addition to reporting load based results at the site discharge locations, it is also necessary to report the following concentration data at each treatment node:
    a) The median and 90th percentile concentrations (mg/L) into and out of each treatment node (based on Daily Mean concentration statistics).
    b) The concentration values reported for each treatment node must show the treatments c* value is achieved at least 50% of the time.
2. Conceptual Design – A concept layout plan for the proposed development is to be provided with the location of treatment devices superimposed.
3. MUSIC Model Data files – Digital and hardcopy versions of the following should be provided to Council for checking and records:
    a) Clearly labelled catchment file (an un-run version of the catchment file is to be provided to avoid excessive file size).
    b) MUSIC Summary Report, clearly cross-labelling all nodes and treatment devices to the catchment file.
    c) Climate time series (digital only) – the rainfall and evaporation template file used for the simulation runs should be provided.

Note: ***If one of the default templates provided in MUSIC is used for the simulation runs, then it is not necessary to provide a digital copy of the rainfall and evaporation template file.***

4. Source Node Data – For each source node included in the catchment file identify:
    a) Areas with percentage imperviousness.
    b) Soil characteristics.
    c) Pollutant characteristics.
5. Drainage Links – For each drainage link the routing option selected and the associated properties is to be documented.
6. Treatment Devices – A description of the functional intent (supported by a concept layout plan/ and device drawings that are proposed for the site and not generic cross sections) is to be provided for each type of treatment device used. The design intent of the treatment device must be clearly documented with appropriate reference to best practice design texts/ guidelines. The following information is also required for each treatment device (in addition to the information contained in the MUSIC Summary Report):
    a) Gross Pollutant Trap
        1) Type of device
        2) Treatment performance data (quoting source of data)

b) Vegetated Swales
   1) Vegetation species and planting densities/ locations.

c) Bio-retention systems
   1) Justification for the selection of K and c* values for the surface storage component if altered from the default values.
   2) Vegetation species and planting densities/ locations.

d) Buffer
   1) Assumed buffer vegetation

e) Constructed wetlands
   1) Vegetation species and planting densities/ locations.

f) Generic Treatment Node
   1) Type of treatment measure being represented.
   2) Published reference for the performance of the treatment measure.

Step 4: Documentation of SWMP

Documentation of the Stormwater Management Plan provides Council with:

1. Evidence that practical and achievable solutions have been proposed for the site that comply with relevant environmental requirements;
2. Evidence that an integrated planning approach to the construction and operational impacts of the proposed development has been undertaken;
3. Documentation of the proponents commitments and agreement between Council and the proponent on strategies and standards to be achieved;
4. Confirmation that local and state requirements have been complied with; and
5. Demonstration to the community that the project has been undertaken in an environmentally sustainable manner.

Documentation of information and findings from Steps 1 and 2 of **Figure 13.1-E** is self-evident and therefore the following SWMP documentations requirements relate specifically to documentation of the stormwater treatment train development, water quality-monitoring program (if required), and asset management/ maintenance schedules.

For ease of interpretation and auditing it is required that the proposed stormwater treatment trains and associated water quality monitoring program(s) and management/ maintenance schedules for the proposed development be reported in the SWMP under the headings of 'Construction Phase' and 'Operational Phase'. The specific documentation requirements for each of these 'phases' of development are outlined below.

Construction Phase

1. Description of the proposed staging and programming of proposed development to minimise the area of disturbance and duration that the disturbed areas are exposed, including details of proposed stabilisation works;
2. Description of the proposed permanent/ temporary sediment and erosion controls designed installed and maintained in accordance with the **Sediment and Erosion Control Guidelines** (**Institution of Engineers Queensland**, **1996**) indicating the locations and sizing of sediment basins;
3. Description of the Performance Criteria to be met by the proposed stormwater treatment train;
4. Description of the screening process and quantitative modelling (or other computational method agreed by Council) undertaken to select the proposed stormwater treatment train and to demonstrate its performance against the Performance Criteria (see separate discussion below relating to specific documentation requirements for quantitative water quality modelling);
5. Concept layout plan showing the location, size and key functional elements of each part of the proposed treatment train;

6. Description of the proposed performance monitoring program, assessment and reporting provisions. Information required for inclusion in the submitted monitoring program includes:
   - agreed performance criteria;
   - monitoring and reporting frequency;
   - monitoring locations; and
   - monitoring parameters.

   Regular visual inspections/ monitoring are to be carried out on all developments during the construction phase. Additional quantitative water quality monitoring is required for developments disturbing >2,500 m^2 at any one point in time, with the monitoring required to be carried out for the duration of construction activities. Also, for developments involving constructed waterbodies, monitoring is required for the duration of construction activities as well as for the agreed on-maintenance period prior to hand-over of the asset.
7. An outline of the management/ maintenance requirements including predicted frequency and responsibility for all treatment elements and the overall treatment train during the construction phase of the development;
8. Implementation schedule of the proposed treatment train elements; and
9. A contingency plan if the treatment train, or particular elements of the treatment train, do not meet the Performance Criteria.

Operational Phase

1. Description of the Performance Criteria to be met by the proposed system;
2. Description of the screening process and quantitative modelling (or other computational method agreed by Council) undertaken to select the proposed stormwater treatment train and to demonstrate its performance against the Performance Criteria;
3. Description of the lifecycle cost analysis undertaken to determine the least lifecycle cost treatment train for the development;
4. Description of quantitative modelling (or other computational method agreed by council) undertaken to demonstrate performance of the proposed system against Performance Criteria (see separate discussion below relating to specific documentation requirements for quantitative water quality modelling);
5. Description of the proposed implementation schedule of the treatment elements comprising the proposed treatment train and the performance of the treatment train under its varying stages of implementation;
6. Concept layout plan showing the location, size and the key functional elements of each part of the proposed treatment train;
7. Description of the proposed performance monitoring program, assessment and reporting provisions. Information required for inclusion in the submitted monitoring program includes:
   - agreed performance criteria;
   - monitoring and reporting frequency;
   - monitoring locations; and
   - monitoring parameters.
8. An outline of the management/ maintenance requirements including predicted frequency and responsibility for all treatment elements and the overall treatment train during the pre and post hand-over periods of the operational phase of the development;
9. A contingency plan if the treatment train, or particular elements of the treatment train, do not meet the Performance Criteria.

13.1.2.3 Preparation of a Detailed Stormwater Management Plan (DSWMP)

The purpose of a DSWMP is to identify that all engineering and landscape requirements and ensure best practice designs have been incorporated within the proposed stormwater treatment devices.

A DSWMP is to be used as a stand-alone document for site managers, engineers, landscape professionals and others constructing stormwater treatment devices. The DSWMP provides details of various elements within the approved treatment train and allows Council to assess if the submitted information follows best practice design and has considered all potential design issues based upon further knowledge of site constraints (approved lot layout, final earthworks levels, pipe locations, etc). The DSWMP is to be submitted in conjunction with the detailed documentation as part of the Operational Works or Building Works applications, whichever is submitted first. Additionally, it identifies the required level of maintenance by the developer during the 'on maintenance' period and by Council after asset hand-over, and provides maintenance schedules and forecasted maintenance costs for the life of the stormwater system.

Figure 13.1-H represents Council's minimum requirements for the preparation of a DSWMP (unless otherwise directed by Council's development assessment officers) and should not be considered to be the limit of detail required in a DSWMP.

A DSWMP can be prepared using the following three steps:

Step 1: Treatment Train

- identify the approved treatment train from the CSWMP as approved and/ or amended by Council;
- identify the location of the conceptual devices and sizes as determined using the MUSIC package;
- identify any potential issues of the approved treatment train based upon site constraints from further engineering details. If approved treatment train not feasible then proposed amendments to the treatment train are required with detailed justification as to why the approved treatment train cannot function appropriately and submit MUSIC modelling to support the proposed treatment train amendments.

Step 2: Detailed Calculations

Council recommends reviewing the detailed calculation summaries provided within the following documentation for guidance:

- Gold Coast City Council **WSUD Engineering Guidelines** (**2006**).

Step 3: Detailed Engineering Drawings

Include detailed cross and long sections of the proposed devices along with a plan view depicting the exact surface area of the device(s). These drawings are to be clearly dimensioned, labelled and include an appropriate scale.

Include the relevant detailed engineering drawings that have been submitted within the OPW/ Building Works application as this will ensure the officer can assess the submitted drawings in conjunction with the report as well as determine if any discrepancies have occurred due to the amendment of drawings after the stormwater consultant has completed the DSWMP.

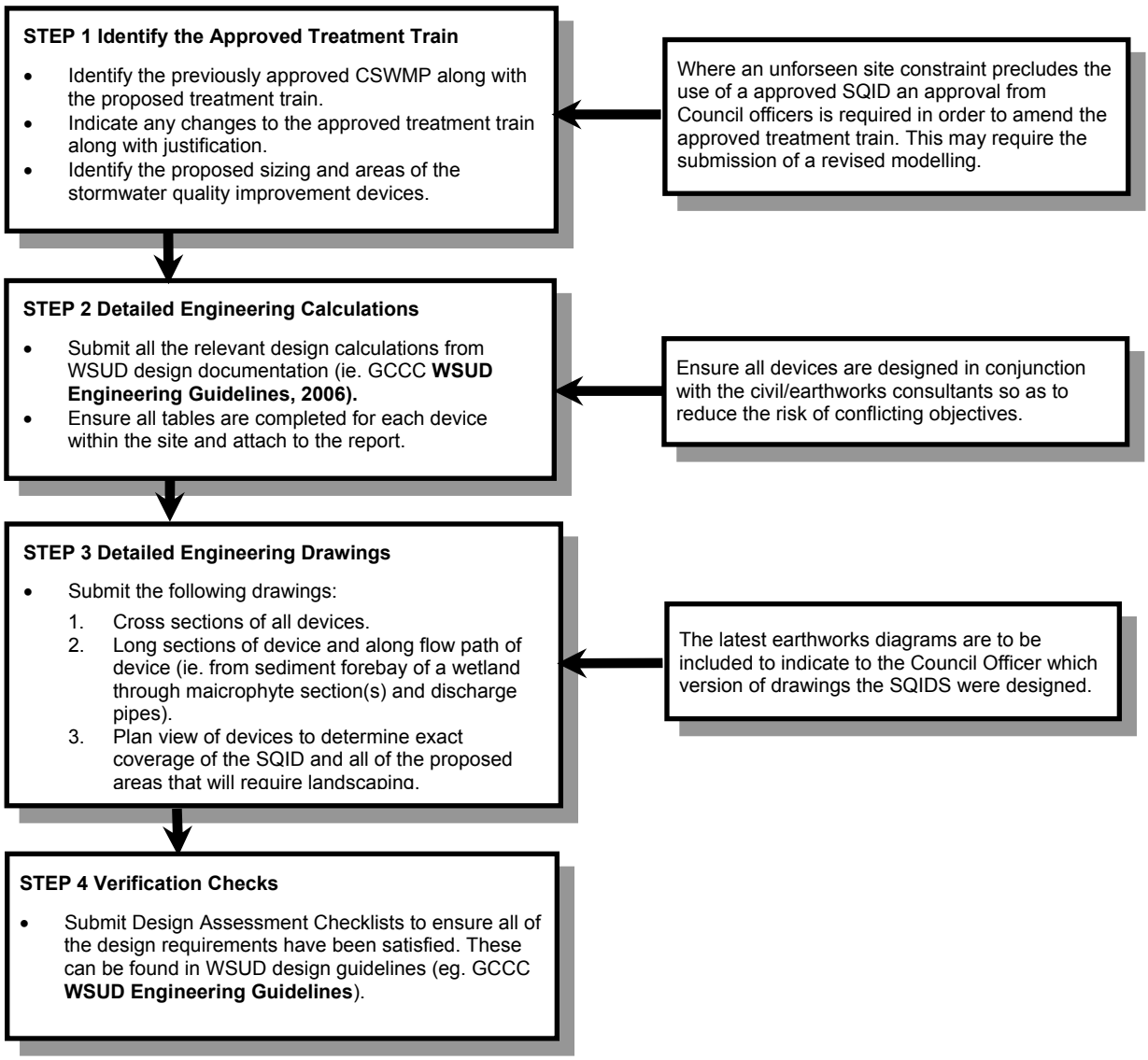


Figure 13.1-H: Detailed Design of Stormwater Management Plan (DSWMP)

Step 4: Verification Checks

Ensure that the vegetation will be protected from scour during flood events and that the final design will achieve the treatment performance identified within the CSWMP. Requirements for verification checks can be located within documents such as GCCC **WSUD Engineering Guidelines**.

If any aspects of the designed treatment devices (ie. areas, depths, filter media, etc) need to be modified an amended revised modelling may be required to ensure the treatment performance meets those approved within the CSWMP.

13.1.3 Alteration or Creation of a Waterbody

A constructed waterbody will be considered as a receiving waterbody and will not be accepted to be part of a stormwater treatment train. Treatment in accordance with **Table 13.1-B** must be demonstrated before discharging to the waterbody.

When this part of the guideline is deemed to apply then the application for creation or alteration or extension of a waterbody(s) must comply with the requirements of the following sections. Additionally reference should be made to **Chapter 10** of **WSUD Engineering Procedures** (**Melbourne Water**, **2005**).

13.1.3.1 Constructed Waterbodies – WQO and Performance Criteria

Constructed waterbodies are built for a defined purpose to fulfil a defined function. The intended use of the constructed waterbody defines the Environmental Values which will apply to the waterbody. This must be clearly stated and agreed to by Council prior to lodgement of development applications. Default Performance Criteria (concentration-based water quality objectives) are defined through national guidelines (**ANZECC**, **2000**) for a range of Environmental Values. These Performance Criteria shall be adopted.

In order to ensure that a proposed constructed waterbody will be a sustainable asset, the applicant must demonstrate in the development application that the Environmental Values and corresponding Performance Criteria are achievable. This may require detailed water quality modelling dependent on the intended use and characteristics of the waterbody and surrounding catchment. Reference should be made to **Water Quality Modelling Guidelines**, **2006** for information requirements and suggested modelling approaches. Compliance with receiving waterway water quality objectives and associated Performance Criteria with regard to the impacts of discharge from constructed waterbodies on downstream waterways will also be required.

In the case where assets are proposed for hand-over to Council, water quality monitoring and an extended 'on-maintenance period' (up to five (5) years) will be required prior to asset hand-over in order to demonstrate that the water quality is consistent with the intended use and the asset will not represent an excessive maintenance burden to Council.

Reference should be made to:

- **Chapter 10 WSUD Engineering Procedures** (**Melbourne Water**, **2005**).
- **Planning Scheme Part 7**:
  - **Division 2 – Specific Development Codes**:
    1) **Chapter 11 – Changes to Ground Level and Creation of New Waterbodies**.
  - **Division 3 – Constraints Codes**:
    1) **Chapter 3 – Canals and Waterways**;
    2) **Chapter 8 – Flood Affected Areas**;
    3) **Chapter 9 – Natural Wetland Areas and Natural Waterways**; and
    4) **Chapter 10 – Nature Conservation**.

13.1.3.2 Information Requirements for Creation, Alteration or Extension of Constructed Waterbodies

A detailed Waterbody Operational Plan and Water Quality Management Plan is required to be submitted in conjunction with the SWMP. The SWMP and Waterbody Operational Plan and Water Quality Management Plan shall demonstrate the achievement of the water quality objectives (ie. no risk of algal blooms) and Performance Criteria that have been established for the proposed development.

The Waterbody Operational Plan and Water Quality Management Plan shall be prepared in consultation with Council Officers and shall include (but not be limited to) the following:

1. Full details of the lake operation, including maintenance and management;

Note: ***Lakes shall be designed in such a way that does not require or rely on mechanical measures.***

2. Design concept for the waterbody including:
   a) Bathymetry (maximum depth 2 m);
   b) Any hard engineering structures including revetment or retaining walls;
   c) Public open space and property boundary locations in relation to the lake; and
   d) Proposed landscaping including wetland areas (incorporating lake edges).
3. State the water quality objectives/ environmental values and discharge Performance Criteria for the proposed lake during both the construction and the operational phases;
4. Water quality-monitoring program for construction, post construction and operational phase. Monitoring shall include rainfall;
5. Generally one-dimensional modelling shall be carried out to assess water quality performance of the lake. However, some instants, three dimensional modelling may be required;

6. Proposed hydrological regime including lake turnover rates, interchange, etc;
7. Financial costing of the lake operation, maintenance and management for the life of the development;
8. Staging and programme for lake construction, timing of excavation and timing of any connections to existing waterbodies;
9. Tenure for the waterbody and all associated infrastructure;
10. Detail the proposed time frame for commencement of 'on maintenance', length of 'on maintenance', the proposed timing of 'off maintenance' and dedication to Council, and the standards and water quality to be achieved at 'on' and 'off' maintenance;
11. Risk assessment to identify the likely circumstances of failing water quality and associated hazards and the emergency action and response time required to rectify the potential situation;
12. Management and contingency plans for aquatic growth, biting insects, fish kill response, pollution response and blue-green algal blooms, stratification and eutrophication;
13. Details of how public safety issues have been addressed;
14. A signage master plan and community education program;
15. Potential impacts on the amenity of adjoining residential areas from poor lake water quality such as odour, plant growth and biting insects and how these will be mitigated;
16. Other site or development specific issues identified by Council; and
17. Detail how all-State agencies' legislative requirements will be addressed.

Modelling Approaches

Developments involving constructed waterbodies or water quality treatment ponds require specialised modelling to demonstrate that the water quality within them will be acceptable and not pose an unacceptable maintenance or public health and safety risk to Council (ie. no algal bloom risk) and that the site discharge Performance Criteria are met.

Developments proposing or impacting upon constructed waterbodies are required to undertake detailed modelling to demonstrate that the waterbody will function effectively and the relevant Performance Criteria will be met. The choice of model will depend on the dominant physical and biological processes likely to occur in the waterbody. A discussion of appropriate models based on the key processes is provided below for a number of typical scenarios:

▪ **Large freshwater lake with overflow weir outlet**	Potential for vertical stratification (salinity or temperature gradients) and associated nutrient cycling, freshwater systems (no tidal exchange), possibly horizontally well-mixed.
▪ **River or canal that is shallow and well-flushed through tidal action**	Limited stratification potential, tidal exchange, narrow channel or linear flow (laterally well-mixed). Examples of models that may be appropriate include MIKE 11.
▪ **River or canal that is deep and poorly-flushed through tidal action**	Potential for vertical stratification, narrow channel or linear flow (laterally well-mixed). Examples of models that may be appropriate include CE-QUAL-W2.
▪ **Large shallow lake with tidal exchange**	Limited potential for vertical stratification, tidal exchange system, and potential for 2-D horizontal effects. Examples of models that may be appropriate include MIKE21, RMA 11 (2D).
▪ **Large deep lake with tidal exchange**	Potential for vertical stratification, tidal exchange system, potential for 3-D effects. Examples of models that may be appropriate include RMA 11 (3D).

Typical applications would include the above hydrodynamic-water quality models. The results from a catchment pollutant-export model such as MUSIC to be included as input to the above model(s).

Where modelling is undertaken on already constructed/ existing waterbodies then appropriate hydrodynamic and water quality data must be sourced or measured to enable calibration and verification of the model.

While examples of commonly used models are provided above for illustrative purposes, the list is not exhaustive and other models will be accepted by Council where it may be demonstrated that the basic model assumptions are valid for the situation being modelled and adequate supporting information can be provided with the model.

13.1.4 Water Quality Monitoring Guidelines

13.1.4.1 Minimum Requirements for Monitoring Programs

Monitoring Parameters

The monitoring parameters included in the program will depend on the agreed Performance Criteria which in turn will depend on the Environmental Values of the receiving waters and key pollutants generated by the development. For construction phase monitoring, a typical list of minimum parameters would include: pH, dissolved oxygen, turbidity/ suspended solids, hydrocarbons, aluminium and iron (in areas of potential acid sulfate soil disturbance).

Parameters to be included in operational phase monitoring will be directly dependent on the agreed Performance Criteria and requirements for asset handover in the case of constructed waterbodies.

Monitoring Frequency

Monitoring should be undertaken at least once per month following rainfall of at least 25mm in a 24hour period. Rainfall should be based on an on-site rain gauge if available or alternatively the nearest Bureau of Meteorology rainfall station. In the case of sedimentation basins requiring flocculation, monitoring is required to be undertaken and documented prior to all pumped-discharges.

Monitoring Locations

The location of monitoring sites will depend on the topographical site constraints and nature of the development. Potential monitoring locations which should be considered for inclusion in the monitoring program include:

- in the case of pumped-discharges from sedimentation basins, a representative sample is required from within the basin prior to discharge;
- where a creek or permanently flowing watercourse borders the site, then monitoring sites located upstream and downstream of the development may be beneficial in detecting any changes in receiving water quality associated with the development; and
- in situations where pumped discharges will not occur and the development is remote from any watercourse, then monitoring locations will be required at the discharge points from the development site. In practice the sampling and interpretation of discharges from sites can be very difficult. Devices such as stage-height samplers should be utilised to capture samples from sites with a short time-of-concentration.

Water Quality Monitoring and Analysis Standards

The Water Quality Monitoring Program should be designed in accordance with the **ANZECC Guidelines for Water Quality Monitoring and Reporting 2000**, with reference to **AS/NZS5667.1:1998 Water Quality-Sampling Part 1: Guidance on the design of sampling programs, sampling techniques and the preservation and handling of samples**.

The sampling of surface waters should be undertaken in accordance with:

1. **AS/NZS5667.1:1998 Water Quality-Sampling Part 1: Guidance on the design of sampling programs, sampling techniques and the preservation and handling of samples**;
2. **AS/NZS5667.4:1998 Water Quality-Sampling Part 4: Guidance on sampling from lakes natural and man-made**;
3. **AS/NZS5667.6:1998 Water Quality-Sampling Part 6: Guidance on sampling of rivers and streams**;
4. **Part 9: Guidance on sampling of marine waters**;
5. **Environmental Protection Agency: Water Quality Sampling Manual**, **1995**.
6. Analysis of water samples shall be undertaken at a NATA accredited laboratory. Sample preservation and handling techniques shall be undertaken as specified by the laboratory or by **AS/NZS5667.1:1998 Water Quality-Sampling Part 1: Guidance on the design of sampling programs, sampling techniques and the preservation and handling of samples**.

13.1.5 References

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