IMPLEMENTATION GUIDELINE NO. 24

Ipswich Planning Scheme

Stormwater Management

Date of Council Resolution

These guidelines were originally adopted by Council on 20 September 2011 and took effect from the 26 September 2011 in accordance with section 2.3(2) of the Planning Scheme. The guidelines were amended by Council on:

- 4 December 2012 and took effect on 10 December 2012;
- 31 January 2014 and took effect on 14 February 2014; and
- 28 January 2016 and took effect on 29 January 2016.

Purpose of the Guidelines

This guideline is intended to assist with the implementation of the Planning Scheme by providing guidance for the management of stormwater runoff as a resource.

These guidelines compliment other information available that support integrated water management planning through the provision of specific guidance for flood and disaster management, waterway health objectives and acceptable outcomes for development.

Council's Implementation Guidelines are intended to apply a standard approach to the interpretation and implementation of the relevant aspects of the Planning Scheme. They offer a degree of certainty to applicants, Council and the community. Where an applicant is proposing a solution that is different from the guidelines the onus is on the applicant to demonstrate the facts and circumstances to support the solution. This guideline does not preclude alternative innovative solutions proposed by the developer or applicant.

Guidelines

1 Background

The continued implementation of conventional water management systems will result in increasing pressure on, and further degradation to, existing water resources as well as perpetuating and adding to nuisance flows and potential flood hazard situations affecting people, vehicles and property.

Ipswich City Council is committed to the successful implementation of integrated water management within the Ipswich local government area. Fundamental to such a strategy is achieving satisfactory management of stormwater runoff from both a quality and quantity perspective. The main principles of stormwater management are as follows:

(i) protect existing natural features and ecological processes;
(ii) maintain the natural hydrologic behaviour of catchments;
(iii) flood control or mitigation measures and to avoid the creation of nuisance flow/flood hazard situations as a result of development;
(iv) erosion and sediment control; and
(v) protect water quality of surface and ground waters.

2 State Planning Policy – Water Quality

The State Planning Policy *July 2014* (SPP) seeks to ensure that development is planned, designed, constructed and operated to manage stormwater and waste water in ways that supports the protection of environmental values identified in the *Environmental Protection (Water) Policy 2009*. The SPP sets out what outcomes are to be achieved by the scale and types of development to which the policy applies.

Council interests as the assessment manager for development requires that stormwater management address the objectives and goals of this statutory policy. Notably, the SPP does not prevent a local government and assessment manager from addressing the water quality outcomes more stringently or in greater detail than sought by the policy. Accordingly where there is a difference between the SPP and this guideline, this guideline provides the necessary identification, information and trigger relating to the proposed development.

3 Integrated Water Management Objectives and Outcomes

This section outlines the 'objectives' that proposed developments must achieve within the Ipswich local government area, in relation to:

(i) stormwater quantity and flood management; and
(ii) stormwater quality and flow management.

3.1 Stormwater Quantity and Flood Management

With reference to the Ipswich Planning Scheme and the *Queensland Urban Drainage Manual* (QUDM), all development and works are to deliver a 'no-worsening' (zero net balance) outcome with respect to stormwater management. The definition of 'no-worsening' applies to:

(a) flood levels;
(b) flood volumes and storage;
(c) velocities;
(d) timing;
(e) flow characteristics;
(f) duration; and
(g) cumulative flooding impact.

The acceptable outcome for potential impacts is for zero change to all the above parameters but may be determined otherwise in consultation with Council and other stakeholders. Reference should also be made to Part 11 – Overlays, Division 4 – Development Constraints Overlays, Section 11.4.7 – Flooding and Urban Catchment Flow Paths..

3.2 Stormwater Quality and Flow Management

Under the SPP and where required by this guideline, Ipswich City Council requires particular development to satisfy or exceed the design objectives for stormwater quality and flow (quantity) management as outlined in Chapter 2, particularly Tables 2.1, 2.2 and 2.3 of the *Urban Stormwater Quality Planning Guideline 2010* for the Ipswich local government area for both the construction and operational phase of development.

The determination of these design objectives must be in accordance with Chapter 2 of the *Urban Stormwater Quality Planning Guideline 2010*.

3.2.1 Sensitive Receiving Areas

For the purpose of applying this Implementation Guideline, specific catchments may be identified as sensitive receiving areas. These have a high sensitivity to producing adverse outcomes in terms of water quality or water quantity management with small or incremental changes from development activity. Additionally, such areas may include catchments where discharge is to an unlined gully or stream and in-situ soil conditions which are determined to be of a high dispersion classification. Where sensitive receiving areas exist, the proposed development must demonstrate negligible change in terms of water quality and flow management measures, ie maintain pre-development conditions in terms of natural hydrology and environmental flows.

The identification of sensitive receiving areas is an output of an ongoing sequence of planning studies across the city. Sensitive receiving areas may include, but are not limited to, a waterway corridor (stream orders 1 to 8 inclusive), the Bremer River and Brisbane River corridors, or the catchment of a naturally occurring wetland. Clarification should be sought from Council's Engineering and Environment Branch on telephone number 3810 6980 concerning specific identified catchments prior to undertaking any detailed stormwater quality assessment.

3.2.2 Stormwater Quality Treatment Design Requirements

The following requirements apply for stormwater quality management within the Ipswich local government area where development meets or exceeds the thresholds in Table 4.1:

(a) Private and Municipal Treatment Devices (General)

The design of all stormwater treatment measures including sediment forebays and scour protection should be undertaken in accordance with *Healthy Waterways* (2006 or current version) *Water Sensitive Urban Design – Technical Guidelines for South East Queensland* or in the case of bio-retention systems the Water by Design (2012) *Bioretention Technical Design Guidelines*. Design calculation summaries, design checklists and conceptual design drawings should be provided.

(b) Developer Contributed Assets

(i) Locations for Stormwater Treatment Measures

Stormwater treatment measures should not be located in unlined waterways with a stream order of 1 to 8 (based on South East Queensland Healthy Waterways' mapping) including declared riparian corridors. Additionally, treatment areas should be positioned to satisfy the following assessment criteria:

(A) duration of complete vegetation inundation for the critical 5% AEP storm event must be less than seven days;

(B) duration for inundation of the surface of bio-retention filter media by the critical 1 Exceedance per Year (EY) storm event must be less than two days; and

(C) where bio-retention basin is proposed within a large 'regional or sub-regional' scale, open channel or retardation basin, the surface of bio-retention filter media must be above the peak 1-year ARI flood level;

velocities over the bio-retention area for all storm events up to and including peak 5% AEP must be less than 1m/s. For storm events with AEP greater than 5% and up to 1%, velocities over the bio-retention area must be less than 2m/s.

(c) Gross Pollutant Pre-treatment

Any stormwater discharge pipe that is greater than 525mm diameter must have some form of suitable above-ground Gross Pollutant Trap (GPT) eg trash rack, with sediment forebay which incorporates the provision of a constructed maintenance access track and hardstand area.

(d) Maintenance Access

Maintenance access tracks and hardstand areas (including ramp to bio-basin base where access into the bio-basin is required) must extend from the street to the device and must have a minimum width of 4m with longitudinal grade maximum of 1V:6H, be constructed from reinforced concrete, have a hardstand area with a maximum slope of 1V:10H and suitable bearing capacity to support standard maintenance machinery (eg excavator, vacuum truck). Where a minor gross pollutant pre-treatment is provided (ie pipe discharge <=525mm) in conjunction with a stormwater treatment measure, a free-draining reinforced turf access (eg grassed gravel track) extending from the street to the concrete access ramp to the device is to be provided for maintenance access with a maximum 1:6 grade.

(e) Batter Slopes

The following minimum requirements must be satisfied in relation to batter slopes for stormwater quality treatment measures with either permanent water or extended detention (including sedimentation basins or forebays, wetlands and bio-retention systems):

(i) for water depths (including permanent water and extended detention depths) greater than 150mm and maximum slope of 1V:5H or less, no fencing is required. This maximum slope should extend at least 3m (horizontally) from the extended detention level (away from the measure) and/or at least 3m (horizontally) from the permanent water edge (towards the device invert).

(ii) for water depths (including permanent water and extended detention depths) greater than 150mm and maximum slope > 1V:5H, fencing is required.

(f) Swales

Swales are not to be provided in areas with gradients less than 1% or greater than 5%, and where a bio-retention filter is included in the swale, the proposed grade shall be zero for extended detention areas and velocity less than 0.5m/s. Road-side swales will only be accepted along public open space areas such as park or drainage land. Where a road swale is proposed consideration must be given to necessary treatment (eg longitudinal grade, scour protection and sub-surface drainage) to satisfactorily manage flow conveyance extending from the swale through open space to end-of-line discharge location.

(g) Infiltration Systems

Infiltration systems such as sand filter or porous pavement are not accepted within the public space.

(h) GPTs

Propriety in-ground GPT's (such as dry/wet-sump type devices or gully pit litter basket) are not to be provided in public space, however such devices are permitted for internal private development.

(i) Water Body

Water bodies (eg constructed urban lake) are not to be provided excepting where a small permanent or semi-permanent body of water (eg sediment pond) is proposed in conjunction with a constructed wetland. Council may consider an open water body where it provides a high amenity community value (eg a significant landscape and recreational feature, such as a focal point within a town centre) and satisfies hydrology, ecological and water balance requirements. In particular, water balance and system reliability must be demonstrated during prolonged periods of drought.

(j) Residential Reconfiguration Treatment Areas

Stormwater quality treatment devices (eg swales etc) are not accepted within a future residential lot for lot scale solutions (excepting rainwater tanks).

3.2.3 Voluntary Stormwater Quality Offset Payment

The strategic, city wide delivery of stormwater quality treatment provides a range of opportunities to maximise the achievement of overall water quality objectives in Ipswich, while also minimising land and on-going maintenance requirements associated with individual treatment devices.

Where development for urban purposes exceeds the thresholds outlined in Table 4.1 and is located within the Eligible Offset Area as identified in Appendix A – Voluntary Stormwater Quality Offset Map, a voluntary payment may be made in lieu of providing nutrient on-site water quality treatment as outlined in this guideline.

NOTE 3.1

For the purpose of this guideline the Voluntary Stormwater Quality Offset Payment applies to post construction pollutant reduction requirements for total suspended solids (TSS), total phosphorus (TP) and total nitrogen (TN) in accordance with the State Planning Policy and Planning Scheme Policy 3 – General Works, Part 2, Stormwater Drainage Table 2.3.1.

Subject to the agreement of Council, this voluntary payment may also be provided for development for urban purposes that exceeds the thresholds outlined in Table 4.1 in the Possible Offset Area as identified in Appendix A – Voluntary Stormwater Quality Offset Map where:

(a) the catchment is mostly urbanised or is a small parcel of land within a broad land release area (in essence, infill development); or

(b) the waterway downstream is in a poor condition; or

(c) the waterway downstream is not sensitive to hydrologic change resulting from development (ie no risk of increased waterway erosion); and

(d) the voluntary payment will contribute to an improved sub-catchment solution.

The voluntary payment is to be calculated based on the charge rate per square metre of water quality treatment area (bio-retention filter area) that would otherwise be required by the development.

The bio-retention filter area is to be determined for residential development in accordance with Table 3.1. For other development types refer to the Healthy Waterways Deemed to Comply Solutions for determination of filter area. The voluntary payment rate is as specified in Council's Register of General Charges.

Where a voluntary payment is elected to be made the management of gross pollutants in accordance with this guideline will also be required for the development.

Table 3.1: Filter area determination percentages for residential development

Proposed Residential Density (dwellings/ha)	Percentage of Contributing Catchment
Large Lot Residential	0.25%
Less than 15 (excluding large lot)	0.8%
15 to < 20	1.0%
20	1.1%
>20 to < 40	Range between 1.1 to 1.5%[1]
> 40	1.5%

Note[1] Linear interpolation is to be used to establish the percentage.

NOTE 3.2

(1) Voluntary payment in lieu of on-site provision of stormwater quality treatment devices are intended to provide cost savings for development, including forgoing construction costs, reduced impact on the development footprint and reduced costs for on-going maintenance.

(2) Where a voluntary payment is elected to be made, developments must achieve the following outcomes on-site in accordance with this guideline and relevant legislation and other statutory guidance:

(a) stormwater quantity management requirements;

(b) construction phase pollutants management and best practice erosion and sediment control;

(c) management of gross pollutants; and

(d) other stormwater quality requirements (eg hydrocarbons, metals, pathogens) as required by the *Environmental Protection Act 1994*.

3.2.4 Model for Urban Stormwater Improvement Conceptualisation (MUSIC) Modelling and Reporting

Model for Urban Stormwater Improvement Conceptualisation (MUSIC) models where required as a component of the Stormwater Management Plan (SMP) must be undertaken and prepared in accordance with Water by Design MUSIC Modelling Guidelines as applied to Ipswich local government area, unless otherwise specifically stated as follows:

(a) Infiltration Systems

The infiltration node must be used for non-vegetated infiltration systems. Any proposed vegetated 'infiltration system' must be modelled as bio-retention systems with a maximum filter depth of 2m (or less if groundwater is anticipated at shallower depths), with filter media properties representative of measured soil conditions (either in-situ or imported) at the site of the proposed infiltration system.

(b) Gross Pollutant Traps

Council will only support removal efficiencies (up to the predicted design flow-rate for the GPT, which is typically the Q3-month peak flow rate) of:

(i) 90% for gross pollutants (ie input 100, output 10);

(ii) 10% for total suspended solids (ie input 100, output 90);

(iii) 0% removal for total nitrogen; and

(iv) 20% total phosphorus.

Council will only accept pollutant load removal rates above the values stipulated within the GPT node from an independent peer-reviewed assessment of the selected device following continuous monitoring of the product for at least 15 to 20 separate rainfall events and also quantify performance in inter-event periods.

(c) Life Cycle Costing

Unless information is available that is likely to be more accurate than the cost estimates provided within MUSIC, 'expected values' should be used for acquisition, annual maintenance, annualised renewal and decommissioning costs.

(d) Non Structural Measures

MUSIC modelling must assume that non-structural measures (eg education, signage) will not result in any reduction in pollutant loads.

4 Thresholds and Stormwater Quality and Flow Management Solutions

4.1 Thresholds for Stormwater Quality and Flow Management

Development that meets or exceeds the thresholds set out in Table 4.1 below is required to satisfy or exceed the design objectives for stormwater quality and flow (quantity) management as identified in Section 3.2.

Development that is less than the thresholds is required to meet the requirements of the Queensland Development Code rather than the stormwater quality and flow (quantity) management requirements.

Reference should be made to Figure 1 – Threshold and Development Requirements Flowchart for additional guidance.

Table 4.1 Thresholds for Stormwater Quality and Flow Management

Development Type	Threshold
Material change of use for urban purposes	(a) Includes newly constructed road (previously unformed road) exceeding 30m in total length[1]. (b) Greater than 2500m^2 of land[2]. (c) 6 or more additional dwellings (attached or unattached). (d) Located within an identified sensitive receiver area. (e) Consists of 300m^2 or more uncovered[3] impervious car park area including parking bays and circulation driveways for high pollutant generators such as Business Use - Fast Food Premises and Business Use - Service Station. (f) Consists of 600m^2 or more uncovered[3] impervious car park area including parking bays and circulation driveways for all other uses.
Reconfiguration of a lot for urban purposes	(a) Includes newly constructed road exceeding 30m in total length[1]. (b) Would result in 6 or more residential allotments or that provides for 6 or more dwellings. (c) Involves greater than 2500m^2 of land[2] and will result in six or more lots. (d) Located within an identified sensitive receiver area. (e) Is associated with operational work disturbing greater than 2500m^2 of land[2].
Operational works for urban purposes	(a) Disturbing greater than 2500m^2 of land. (b) Located within an identified sensitive receiver area.

Note:

1. *Where a terminating road with no potential for further extension.*
2. *Where Land means areas to be disturbed as well as the balance area.*
3. *A carpark is deemed covered where the carpark is integral to a permanent structure (for example a basement carpark) and not directly exposed to rainfall or runoff. Covered carpark excludes semi-permanent shade type structures.*

5 Deemed to Comply Requirements for Stormwater Quality

5.1 Purpose of Deemed to Comply Requirements

Deemed to comply solutions simplify the design, development assessment, implementation and compliance processes for managing stormwater quality for certain development (generally smaller scale and straightforward development that presents a lower risk). They provide a standard solution that can be applied in the prescribed circumstances, forgoing the need for full assessment through a Stormwater Management Plan including pollutant source modelling such as MUSIC.

5.2 Healthy Waterways – Deemed to Comply Solutions

(a) Healthy Waterways have developed Deemed to Comply Solutions – Stormwater Quality Management (South East Queensland) guidelines (DTCG) for certain developments, providing the following:

(i) criteria for specifying development categories that are eligible for 'deemed to comply' solutions; and

(ii) a range of acceptable solutions for developments that satisfy the above.

(b) Development in the Ipswich local government area that meets or exceeds the thresholds in Table 4.1 and is consistent with the criteria/categories in the DTCG can make use of the acceptable solutions in the DTCG with the following limitations/exceptions:

(i) the proposed development is not located in a critical catchment that has been identified as a sensitive receiving area;

(ii) the proposed development is not located within a development area where Council has an pre-existing catchment strategy in terms of water quality and flow management;

(iii) where applicable, the bio-retention basin filter media depth is a minimum of 500mm and maximum of 800mm; and

(iv) the DTCG checklist is completed, signed by a Registered Professional Engineer of Queensland (RPEQ) or similar and submitted to Council with any development application.

5.3 When a Stormwater Quality Management Plan (SQMP) is Required

Development that meets or exceeds the thresholds in Table 4.1 and do not satisfy the DTCG application criteria are required to provide a Stormwater Quality Management Plan (SQMP) in conjunction with pollutant source modelling in accordance with the relevant State and local government requirements covered in this guideline. The SQMP format and presentation should satisfy the Stormwater Management Plan presentation requirements (refer Section 6).

6 Stormwater Management Plans

This section outlines Council's expectations in relation to the reporting and presentation requirements for the preparation of a Stormwater Management Plan (SMP).

An SMP must be prepared for all development applications made to Council that meet or exceed the thresholds in Table 4.1, unless the application falls within the category noted as 'Deemed to Comply' (refer Section 5.2) and the developer intends:

(a) to implement the prescribed deemed to comply solutions; and

(b) the development does not trigger the assessment of stormwater quantity and flood management.

SMP's are required to be submitted with the initial Material Change of Use and Reconfiguration of Lot application.

6.1 Reporting Template

Table 6.1 provides a recommended reporting template for any SMP submitted to Council. This template is not prescriptive, but provides an indication of the type of information that Council will typically require for most developments. It should be noted however, that conformity with the template does not guarantee that all relevant issues have been addressed.

Figure 1 – Threshold and Development Requirements Flowchart

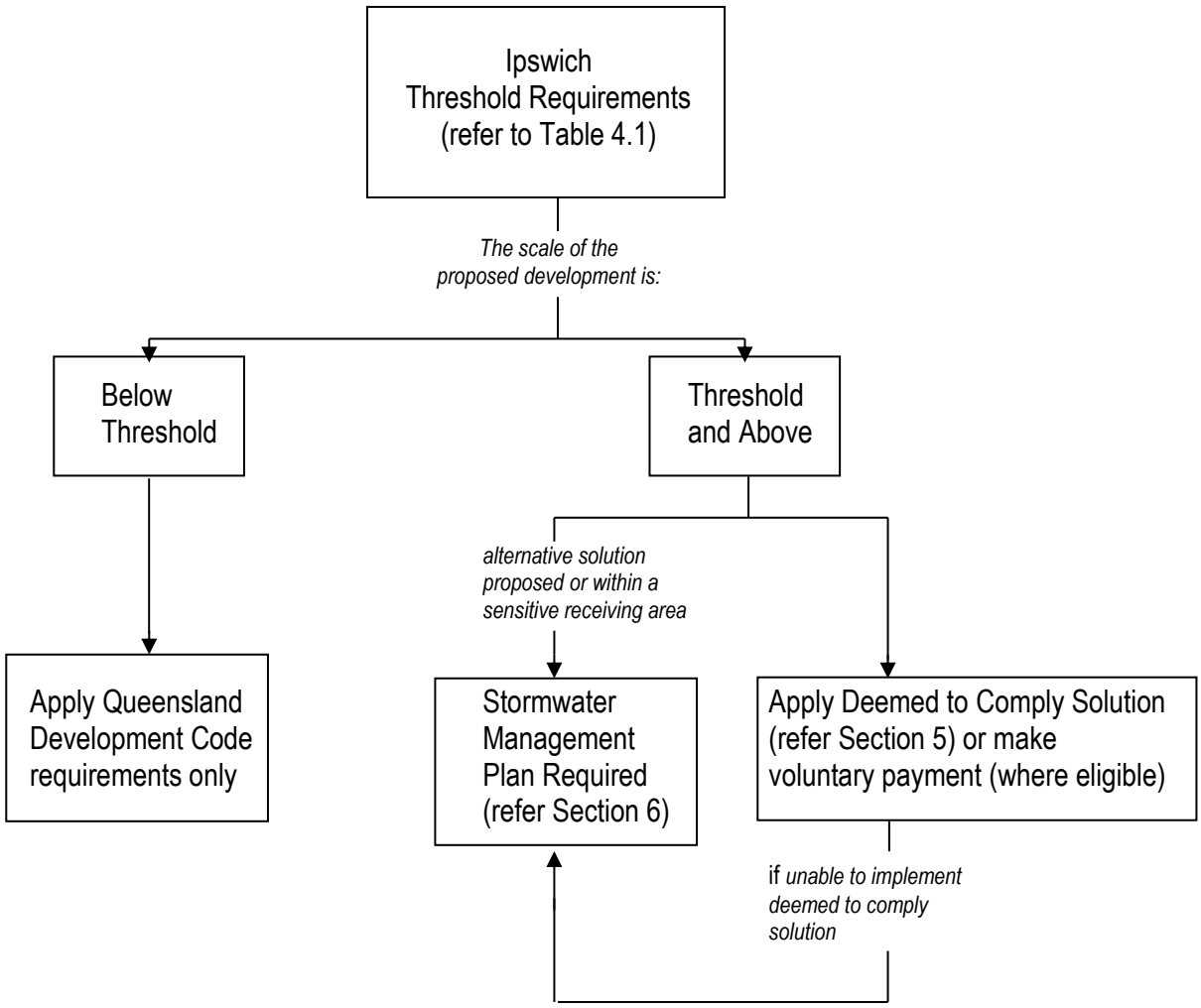


Table 6.1 Recommended Reporting Template for SMP's Submitted to Council

Section	Contents
Cover Page	
Document Information Page	This page should outline information relevant to the authorship of the SMP (ideally provided in tabular form), including document title (reference number, date and version tracking), document ownership (including names of personnel that have issued and checked the SMP), RPEQ Certification plus registration number and name of client.
Summary	Concise summary of study methodology and findings.
Responses to Information Request	Details of how (if any) previous information requests from Council have been addressed.
Table of Contents	
1 Introduction	General description of the proposed development/works, existing site, scope of the SMP and names of the project team members.
2 Flood Impact Assessment	Assessment of flooding issues at the site of the proposed development (with supporting calculations and accepted modelling technique) for the existing site conditions and 'ultimate development' of the site and including management of required quantities at each development stage/phase.
2.1 Site Details	General description of the site and vicinity, including relevant hydrological/drainage features and flood behaviour.
2.2 Methodology Used	General description of the methodology used in the flood impact assessment.
2.3 Hydrologic Model Establishment	Description of the hydrological modelling methodology, catchment delineation, input parameters and assumptions.
2.4 Hydraulic Model Establishment	Description of the hydraulic modelling methodology, model calibration, catchment delineation, input parameters and assumptions.
2.5 Calibration and Validation	Description of the calibration and validation process.
2.6 Design Event Modelling	Description of the design event modelling, including critical duration analysis.
2.7 Sensitivity Analysis	Description of sensitivity analyses including climate change scenarios.
2.8 Predicted Impact Assessment	Description of proposed development scenarios including modelling results and proposed mitigation measures.
2.9 Floodplain Risk Management	Where land is situated within flood prone land (ie situated below the Adopted Flood Regulation Line) or identified as being constrained by an urban catchment flow path, a Flood Risk Management Plan (FRMP) identifying areas of the site affected by a range of floods up to and including Probable Maximum Flood PMF (for both regional or local stormwater flooding) and associated flood hazards and flood hazard assessment. This should consider the nature and severity of all flood impacts, people and vehicles moving in floodwater, vulnerability of buildings and potential for isolation, eventual inundation and planned evacuation route(s). The plan should also address, amongst other risks, the consequences of blockage, implications of floods larger than the design event, likely hydraulic effects of proposed hydraulic structures and their behaviour in higher flows, and the provision for controlled overland flow paths in the event of major drainage system (including retardation basin) failure. All flood hazard categorisation is required to be undertaken in accordance with SCARM 73.
2.10 Conclusions of Flood Impact Assessment	Summary of flood assessment, hazards and outcomes.

Section	Contents
3 Stormwater Quality Management Plan	Description of how it is possible for the development to meet the Stormwater Quality and Flow Management targets (refer Section 3.2).
3.1 Opportunities and Constraints for Stormwater Management	Description of the opportunities and constraints presented by the site for the application of stormwater quality and quantity controls (eg steep topography preventing the application of devices like swales).
3.2 Pollutants of Concern	Identification of pollutants likely to be generated during the (i) construction phase and (ii) operational phase of the proposed development.
3.3 Stormwater Management Objectives	Identification of stormwater management objectives for both the (i) construction phase and (ii) operational phase of the proposed development.
3.4 Design/Modelling Approach	Description of design/modelling methodology, including information on modelling parameters/ properties applied (eg source and treatment nodes, meteorological data) and catchment plan that replicates the source of treatment nodes utilised in MUSIC or equivalent software.
3.5 Operational Phase Stormwater Management Options	Description of selected stormwater management options for the site for the operational phase of the development. This section should include modelling results and dimensions of stormwater treatment measures.
3.6 Life Cycle Costs	Life cycle costs of the proposed operational phase stormwater management options. The life-cycle costing tool available in MUSIC (version 3 and later) may be utilised to provide indicative life-cycle costing information, refer Section 3.2.4(c).
3.7 Asset Hand-Over	Identification of proposed organisation or person(s) who will be responsible for ongoing maintenance activities of the stormwater treatment measures (after the 'on maintenance' period).
3.8 Conclusion of Stormwater Management Plan	Summary of overall report objectives and outcomes.
4 References	Detailed list of all source documents and models.
Appendix A Modelling Files	CD or DVD containing all modelling files to enable checking of all modelling calculations. The CD or DVD shall include a 'readme' text file, containing a description of the contents and details of any naming conventions used for model files.
Appendix B Design Drawings	For areas proposed for development, a layout plan should be provided to clearly illustrate the location/extent of the proposed stormwater treatment measures, quantity mitigation devices (eg detention basin) and the direction of flow through these measures. Where flood assessment is undertaken the submitted drawings should also include flood routing map(s) which clearly identify pre and post-development inundation, velocity vectors discharge flows and flood hazard categorisation for inundation areas. Additionally, detention basin stage discharge curves for major design events are required. A full layout plan and a section drawing (at least a longitudinal section and a cross section) should be provided for each stormwater quantity and quality treatment or mitigation device showing integration with the existing or proposed drainage system, benching levels (and if appropriate standing water, extended detention and peak water levels), bunding, planting layouts and other conceptual features such as maintenance access, monitoring access (if proposed) and safety precautions (eg fencing and dense vegetation restricting public access).

Section	Contents
Appendix B (continued) Design Drawings	For sites with multiple small stormwater quality treatment devices (eg streetscape bio-retention 'pods'), a full layout plan and a section drawing of a selected representative sample (eg minimum of two) of the devices should be provided. Layout plans should consider the integration of the stormwater treatment measures into the surrounding landscape. These designs should be prepared as preliminary design drawings suitable for the subsequent preparation of detailed civil design drawings for construction.
Appendix C Design Checklists and Calculation Summaries	Completed design calculation summaries and checklists (as provided in *Healthy Waterways 2006* or current version) must be provided for any stormwater treatment measure. For sites with multiple small treatment measures that are very similar in design (eg streetscape bio-retention 'pods'), a completed 'design calculation summary' checklist of a selected representative sample (eg minimum of two) of the measures must be provided. If any of the items outlined in the checklist is not satisfied (ie receives a 'No'), the checklist must include a detailed description as to why this item has not been satisfied.
Appendix D Maintenance Plans	Maintenance Plans for all proposed stormwater treatment measures proposed for the site.
Appendix E Erosion and Sediment Control Plan	A Concept Erosion and Sediment Control (CESC) plan prepared in accordance with *Best Practice Erosion and Sediment Control* (2008 or current version) by International Erosion Control Association of Australia (IECA), Planning Scheme Policy 3 and must give regard to in-situ soil conditions (refer to Appendix B in this guideline) in terms of likely treatment or construction and operational practices.
Appendix F Construction and Establishment Plan	Description of how each of the proposed stormwater treatment measures are to be constructed and established in accordance with the *Construction and Establishment Guidelines* (2009 or current version) as prepared by Water by Design.
Appendix G Water Body Design	Where a constructed wetland containing a permanent or semi-permanent body of water is part of the stormwater management system, a 'Water Body Design' section will be required, addressing items such as (but not limited to): (a) design objectives and rationale; (b) site specific constraints which may affect design, construction and ongoing operation/management/maintenance; (c) a summary of the design methodology used for the hydrological, hydraulic, water quality and water balance calculations/modelling undertaken, and associated results; (d) demonstrated compliance with design performance criteria and relevant guidelines; (e) detailed procedures for the construction, establishment and ongoing management of the water body; (f) public access and public safety; (g) renewal and retrofit options; and (h) operational/maintenance access.
Other Appendices	Any further supporting documentation, as required.

7 Stormwater Quantity and Flood Management

7.1 General

Flood impact assessment is required where the proposed development is constrained by flood prone land and urban catchment flow paths (refer Planning Scheme Map OV5) and where demonstration of management objectives (refer Section 7.2) is mandated.

The following general rules apply to any flood management modelling undertaken for projects within the Ipswich local government area.

(a) References

Techniques used for flood modelling applications should be in accordance with the latest version of the following documents:

(i) Queensland Urban Drainage Manual (QUDM) prepared by the Queensland Department of Environment and Resources Management (DERM) should be used for assessments of urban catchments smaller than 500 hectares.

(ii) Australian Rainfall and Runoff (ARR) prepared by the Institution of Engineers Australia should be used for assessment of urban catchments exceeding 500 hectares, rural catchments, and vegetated waterways.

(b) Methodology

There exists a range of considerations when selecting the type of analysis to apply for flood modelling applications. The practitioner should liaise with Council regarding the most appropriate form of analysis to apply to a particular project, particularly for projects at a local/limited level in a non-critical catchment (as distinct from a sub-catchment, catchment, or regional basis). Available flood modelling methodologies are summarised in Table 7.1.

(c) Design Events

Council's policy on floodplain development is that no earthworks shall occur within the 5% AEP flood extents unless directly related to riparian rehabilitation or approved prescribed tidal works. Compensatory earthworks may be acceptable between the 5% AEP event and the Adopted Flood Regulation Line, however, modelling is required to determine the likely flood impacts including flood storage. Where no information is currently available regarding these extents, modelling shall be undertaken. Where there is a risk of loss of life and/or significant damage to property and infrastructure, the Probable Maximum Flood (PMF) shall also be modelled.

Table 7.1 Summary of Available Flood Modelling Methodologies

Flood Modelling Methodology	Application
Steady State versus Unsteady Flow Analysis	For non-complex watercourses with few branches and no inter-catchment flow, a steady state flow analysis may be acceptable. Such analysis may involve application of a peak flow rate to a watercourse using a one-dimensional modelling scheme. Where complex flood behaviour is expected, and particularly in larger watercourses with numerous tributaries, unsteady flow analysis should be used.
One-Dimensional versus Two-Dimensional	(a) The decision to use either a 1D or 2D hydraulic model may involve the following considerations: (i) complexity of the watercourse and floodplain; (ii) complexity of the proposed development; (iii) ability to represent the development adequately in 1D; (iv) availability of data; and (v) type of mapping output required. (b) Should a 2D approach be selected, further consideration should be given to whether a fully 2D hydraulic model or a dynamically linked 2D/1D hydraulic model will be most appropriate. Further considerations may include: (i) relative importance of creek flow compared with total system flow; and (ii) availability of accurate in-bank data. (c) Representation of a channel in 2D shall not be undertaken where the in-bank width of the channel is less than three 2D elements wide.

(d) Compensatory Earthworks

Where cut and fill works are proposed 'no negative impact' must be demonstrated. It is expected that this would take the form of a sensitivity analysis for a wide range of AEP's and storm durations to gauge the effects of the proposed cut/fill on the subject site and surrounding catchment areas, especially in relation to areas in close proximity to local waterways. Relevant Assessment Criteria include afflux, increases in local and average velocities, component stability, flood storage, accumulative changes, peak flow timing and magnitude. The developer must provide details of the proposed earthworks for each stage of the development site including cut/fill depths, batter slopes, retaining wall heights, typical cross-sections, etc in association with the relevant application. Written comments from any affected owners should also be submitted to Council for consideration (or at least the supporting documentation of notification and consultation with the adjoining property owners to the Council's satisfaction). Notably, placement of fill (including structures such as levees or basins) within floodway or flood storage areas will not generally be accepted.

(e) Lawful Point of Discharge

Reference should be made to the latest edition of QUDM for guidelines pertaining to lawful points of discharge. When land is subdivided or developed, the roof and surface water runoff from that land and the external catchment (through the development site) must be discharged to a Lawful Point of Discharge (LPD) acceptable to Council. Where a LPD is not possible or practical the development must either divert or manage flows that would otherwise adversely affect, obtain relevant consent from downstream owner(s), provide infrastructure to mitigate adverse effects or provide a combination thereof. Conceptual SMP or designs that result in concentration of stormwater runoff onto an adjoining property or rely on construction of drainage through adjoining property will not be accepted unless written landowner approval is obtained and provided to Council.

(f) Nomenclature

All digital model files should be named using a logical naming convention which includes the watercourse name, reach name or number, existing/developed/mitigation scenario, event ARI and duration, or year of historical event, and the simulation version number. An example model runfile name for the 1% AEP 3 hour event on the existing catchment conditions of Iron Pot Creek could be 'IPC_exg_1% AEP3hr_001'.

7.2 Objectives

(a) Hydrological and Hydraulic Impacts

Development must not increase the flood risk to people or property or reduce existing drainage capacity (pipe or overland). Further, the impacts to flood evacuation efficacy must not be compromised by development. The flood behaviour of the whole catchment should not change as a result of development, at nominated nodes throughout the catchment, whereby the following flood hazard parameters should not be materially worsened for the critical duration at each node:

(i) levels;

(ii) velocity;

(iii) depths;

(iv) VxD ratio;

(v) volumes;

(vi) time of inundation;

(vii) rate of rise;

(viii) rate of flood recession; and

(ix) accumulation impacts.

Opportunities to reduce the existing flood hazard and improve flood evacuation efficacy as a result of the development should be maximised. In all instances Council will establish permissible tolerance for compliance as it is unlikely a development solution exists with absolutely no increase in flood risk (for all parameters and flood events considered).

(b) Flood Evacuation and Emergency Response

For development located on flood prone land (ie situated within the area of PMF inundation for both regional flooding and local stormwater flooding) and critical evacuation route(s) crosses a drainage path, the design immunity standard applied for the associated cross-drainage shall be that required concerning a 1% AEP storm event. Additionally streets should be configured so as to lead uphill (continuously rising) away from the floodplain connecting into a legible local street hierarchy. The use of cul-de-sacs should be minimised as they limit the interconnection and hence available route options in an evacuation.

7.3 Data Requirements

Data typically used for flood modelling applications includes, topography (detailed airborne survey and/or ground survey), land use (for the determination of imperviousness and surface roughness), rainfall and stream flow (for model calibration and verification) and field data of past flooding. It is important to recognise that the quality of the input data has a direct influence on the quality of the modelling output. Input data with high uncertainties will produce flood modelling output with high uncertainties, which may need to be taken into account when setting freeboards and assessing estimated flood impacts. The requirements for this data is summarised in the following table.

Table 7.2 Data Requirements for Flood Modelling

Data	Requirements
Topography	(a) Topographical survey requirements are typically a function of the modelling purpose and complexity of the watercourse. For one-dimensional modelling (1D) applications, a series of surveyed cross sections perpendicular to the watercourse must be used. Cross section locations must be selected giving consideration to: (i) variations in channel conveyance (which is function of flow area, roughness and shape); (ii) location of hydraulic structures and controls; (iii) location of proposed development; and (iv) proximity to area of interest (ie a higher resolution of data would be expected within the study area). (b) In addition, the extents of the watercourse to be modelled must be selected giving consideration to: (i) appropriate location of upstream and downstream boundary conditions; and (ii) extent of impacts of the proposed development. (c) For more complex watercourses where two-dimensional (2D) or linked 2D/1D schemes are required, detailed ground survey and airborne survey may be required. This may be in lieu of, or in addition to, cross section survey of the in-bank areas of the watercourse. (d) Where airborne survey is used, data must be verified on-ground to determine the accuracy of the data. The verification must cover a range of land-uses surveyed. Typically airborne data are reliable on clear hard surfaces (eg roads), less reliable in areas of vegetation and unsuitable over water. The effectiveness of any filtering (eg of buildings) must also be ascertained. (e) For model calibration, survey representative of the time of each historical flood should be sourced and used where possible. Consideration may be limited to key hydraulic controls such as embankments, hydraulic structures and filling/changes in land-use for development.
Land Use	Categorisation of land use must be based on the following cases where required: (a) Calibration Case(s) – Land use shall be determined based on aerial photography captured at a time similar to the time of flood event and/or on anecdotal evidence. (b) Existing Case – Land use shall be based on the most recent aerial photography, with on-ground verification. (c) Developed Case – Land use shall be based on the most recent aerial photography incorporating the ultimate catchment development in accordance with the Ipswich Planning Scheme. For impact assessments, the Pre-Developed Case will be based on the ultimate catchment development scenario.
Historical Rainfall and Stream Flow	Where model calibration is required/possible, rainfall and stream flow data shall be sourced from the relevant authorities.
Field Data	Local residents and land owners can add significant value to a flood modelling exercise. Collection of field data is of particular importance to model calibration, and can also be beneficial for the verification of smaller un-calibrated models. Field data collection should be undertaken in liaison with Council. Consideration should be given to the following: (a) method of survey; (b) content and mode of delivery of questionnaires; and (c) sensitivity of the project.

7.4 Hydrological Modelling

The following methodology should apply to any hydrological modelling undertaken for projects within the Ipswich local government area.

(a) Methodology

The method of hydrological analysis will be driven by the method proposed for hydraulic modelling. All design hydrological modelling should assume unmitigated ultimate catchment development in accordance with the Planning Scheme. For calibration events, the catchment conditions at the time of the event should be used based on available data.

(b) Design Rainfall

Design rainfall intensities and temporal patterns for all events other than the Probable Maximum Precipitation (PMP), shall be determined in accordance with ARR or as supplied by the Bureau of Meteorology. Design rainfall intensities and temporal patterns for the PMP shall be determined in accordance with the Generalised Short Duration Method (GSDM) or Generalised Tropical Storm Method (GTSM). Amended ARR information is to be used when it is made available.

(c) Rational Method

The rational method for the estimation of peak flow rates can only be used for 1D steady state hydraulic modelling applications (refer to QUDM and ARR for guidance on use of the rational method). Additionally the rational method shall not be used where the time of concentration exceeds 30 minutes. For catchments where the time of concentration exceeds 30 minutes, and for unsteady flow applications, a hydrological model must be used and appropriately calibrated and verified. Additionally, the rational method cannot be used to provide input and verification simultaneously.

(d) Hydrological Models

Preference for use of an individual runoff-routing software package is not given. Rather, software should be selected that is the most appropriate for the individual project. Selection of appropriate software should include, but not be limited to, consideration of the following:

(i) recognised as an industry standard package in Australia;

(ii) ongoing support and development offered by the software developers;

(iii) applicability to the project;

(iv) future use of the model;

(v) modelling assumptions;

(vi) ease of checking and review;

(vii) compatibility with Council GIS; and

(viii) compatibility with hydraulic modelling software.

(e) Common Hydrological Models

Notwithstanding the considerations above, the most commonly used software packages include:

(i) Watershed Bounded Network Model (WBNM);

(ii) XP-RAFTS;

(iii) URBS; and

(iv) RORB.

(f) Loss Models

Typically the initial loss/continuing loss concept is applied when using runoff-routing software. Values for initial and continuing losses should be selected in accordance with ARR. Due consideration should be given to the influence of the initial loss on the hydrograph, recognising the likelihood of lead-up rainfall prior to the design rainfall burst. Where the initial loss has a significant influence on the flow rate and timing, zero initial loss should be used. Alternative loss models maybe used subject to their validation.

(g) Model Parameters

Model parameters should be used in accordance with the software user guidelines and most recent literature applicable to the study location.

(h) Direct Rainfall Modelling

Direct rainfall onto 2D hydraulic model domains may be used as an alternative to hydrologic modelling provided that validation of the approach is provided by means of calibration to a range of historical events over a number of locations upstream and downstream of the subject location, and if no calibration data exists, comparison with an industry standard hydrologic model of the same or similar catchment. The validation must demonstrate adequate performance at a range of locations throughout the catchment in terms of peak flows, travel times and hydrograph shape.

(i) Sensitivity Requirements

Refer to comments in Table 7.4 Sensitivity Testing requirements for Hydraulic Modelling for details.

7.5 Hydraulic Modelling

The following rules apply to any hydraulic modelling undertaken for projects within the Ipswich local government area.

(a) Methodology

The nature of the flood problem will typically dictate the hydraulic modelling methodology. This document offers guidance for one-dimensional (1D), two-dimensional (2D) and linked 2D/1D schemes. Refer to Table 7.1 for a list of considerations when deciding on modelling methodology. Where 2D modelling schemes are employed, a suitable compromise between model resolution and simulation run times must be established.

(b) Boundary Conditions

Boundaries of hydraulic models must be selected with consideration of the following:

(i) extent of impacts caused by the proposed development;

(ii) type and location of the boundary condition does not undesirably influence flood behaviour across the study area; and

(iii) backwater effects are suitably represented.

(c) Coincident Flood Events

Where the flow within a local watercourse is influenced by regional flooding, joint probability of events should be applied for conservatism. Recommended coincident flood events based on the ratio of the local catchment area (AL) to the regional catchment area (AR) are shown in Table 7.3.

(d) Sensitivity Testing

Table 7.4 outlines the sensitivity testing requirements for hydraulic modelling in the Ipswich local government area.

(e) Models

It is not Council's intention to nominate a preference for hydraulic software. However, it is important that the software selected meets all project requirements. The most commonly used hydraulic software modelling packages are outlined in Table 7.5.

Table 7.3 Coincident Regional Flood Events for Local Tributary Modelling

(adapted from Table B-1 of the Maroochy Shire Council IWM Guidelines, October 2006)

Ratio of Local to Regional Catchment Area (A_L/A_R)	Regional Event Combination to Define 1% AEP Flood Level in Local Tributary (AEP)
<0.001	50
0.001-0.01	20
0.01-0.1	5
0.1-0.2	2.5
>0.2	1

Table 7.4 Sensitivity Testing Requirements for Hydraulic Modelling

Parameter	Sensitivity Testing Requirements
Surface Roughness	The sensitivity of hydraulic roughness must be tested for all models. As a minimum, it is required to test the sensitivity of the model by adjusting all in-bank sections of the modelled watercourses to have a Manning's 'n' equal to 0.15. This is to account for future obstructions and vegetation growth. A considered approach is recommended in the selection of Manning's 'n' for the riparian zone of the waterway. Published references recommend manning's 'n' values of 0.15 for minor stream on floodplain with very weedy reaches, deep pools, or floodways with heavy stand of timber and underbrush, and 0.16 for floodplains with heavy stand of timber, a few down trees, little undergrowth and flood stage reaching tree branches or higher (Chow, 1959). Any proposal for lower values of Mannings 'n' would need to be supported with details of plant types/zones, and a continuity management plan (noting that Council may not have any direct control over the affected areas and is reliant on others to provide a sustainable outcome).

Parameter	Sensitivity Testing Requirements
Blockages	Above QUDM requirements, the following blockage factors are to be applied to structures across all watercourses when calculating design flood level: (a) 100% blockage for structures with a major diagonal opening width of less than 6m; (b) 25% bottom up blockage for structures with a major diagonal opening width of greater than 6m. For bridge structures involving piers or bracing, the major diagonal length is defined as the clear diagonal opening between piers/bracing, not the width of the channel at the cross-section; (c) 100% blockage for handrails over structures covered in (i) and for structures covered in (ii) when overtopping occurs. Sensitivity testing of the hydraulic model must be investigated and include at least one scenario consistent with the blockages stated above. Additionally, this analysis must also include the effects of staging/phasing of the proposed development. Where the hydraulic model covers multiple watercourses, further blockage scenarios are to be investigated to establish the 'worst case scenario' for blockages. A combination of full, partial and unblocked structures may affect the timing or flow patterns within a catchment. Thus, the combined scenario may result in higher flood levels and velocities, or different hazard categories than the fully blocked scenario.
Hydraulic Structure Losses	Where hydraulic structures play a critical role in local flood behaviour, losses applied to the modelled structures should be sensitivity tested.
Climate Change and Parameter Change	Climate change is an area of considerable interest amongst the scientific community. As such, estimates of changes to rainfall intensities are likely to change throughout the life of this document. Sensitivity testing of climate change scenarios shall be at the discretion of Council.
Calibration and Verification Issues	Additionally, the Australian Rainfall and Runoff (ARR) review project team recommend, *due to the large number of solutions that can match any one historical calibration level; and, the uncertainty of the application of the Rational Method in certain circumstances (particularly developed/urban situations), to produce consistent and sustainable results it may be necessary to include a verification stage which would include verifying the model over a number of sub catchments against other independent models, such checks as volume in equals volume out, sensitivity checks and the like*. It is important to note that hydrologic/hydraulic modelling is an evolving science and best practice recognises due consideration should be given to addressing discrepancies between observed and predicted results.

Table 7.5 Commonly Used Hydraulic Software Packages in Australia

Hydraulic Modelling Methodology	Most Commonly Used Packages
1D	(a) HEC-RAS (b) ESTRY (The 1D computational engine of TUFLOW) (c) MIKE 11 (d) Sobek
2D and 2D/1D	(a) TUFLOW (b) MIKEFlood (c) MIKE 21 (d) Sobek

7.6 Waterway Considerations

The importance of maintaining natural flow paths is fundamental to flood plain management and should be preserved. Where open artificial channels are proposed these must be designed and constructed in accordance with Ipswich City Council Waterway and Channel Rehabilitation Guidelines and QUDM.

The following specific methodology applies to any hydraulic waterway design undertaken for projects within the Ipswich local government area.

(a) Flood Celerity

The reconstruction of a waterway must not affect the flood celerity to the detriment of upstream or downstream sections of the watercourse.

(b) Staged Channel Construction

Construction of new channels or the reconstruction of existing channels should incorporate the principals outlined in QUDM and Ipswich City Council Waterway and Channel Rehabilitation Guidelines. This should be aligned with phases and timing determined through the development process.

(c) Earth Retaining Structures

Such structures are not preferred adjacent to waterways, but where accepted must, amongst other matters, be designed as a structural wall (excluding gravity type structures) capable of withstanding flood (including rapid drawdown), debris and lateral earth loading and include wall toe scour protection.

(d) Riparian Vegetation Considerations

Riparian corridor space as defined by the ICC Water Health Strategy, is to be rehabilitated/revegetated in accordance with the Ipswich City Council Riparian Corridor Revegetation Guideline. It must be noted that this guideline does not override the planning scheme requirement for provisions of riparian vegetation to a prescribed width on either side of a waterway. Areas retained for stormwater treatment devices must be detailed and it must be demonstrated that stormwater treatment areas are external to the required Riparian Corridor.

7.7 Mapping

As a minimum the following results should be presented graphically in the form of flood maps (2D models), and longitudinal profiles, graphs and tables at key locations:

(a) Peak Flood Level (m AHD).

(b) Velocity (m/s).

(c) Depth (m).

(d) Velocity Depth Product (m2/s) and/or Flood Hazard.

(e) Peak Flood Level Flood Impacts (m) – as required.

(f) Flood storage – as required.

All mapping results should be contoured at an interval appropriate to the project requirements.

7.8 Municipal Flood Mitigation Devices (Retardation Basin)

Detention or retention basins should generally be designed and constructed in accordance with QUDM excepting:

(a) batters shall not exceed 1 in 6 other than where localised around an inlet or outlet structure in which case maximum 1 in 4 is accepted;

(b) woody vegetation (trees and shrubs) planting on water retaining embankments is not permitted;

NOTE 7.8

(1) Trees should not be allowed to grow on or near the basin embankment unless the embankment is oversized to provide for a root zone.

(1) A dense cover of low-growing grassy vegetation is required to provide protection from surface erosion.

(2) Planting of vegetation in the vicinity of spillways or outlet structures may interfere with the hydraulic performance of the retardation basin.

(c) earth retaining structures are not permitted;

(d) incorporate 4.0m wide concrete maintenance access strip extending between road pavement and for either the trash rack/inlet sediment forebay or a screened outlet structure;

(e) basin floor shall have minimum 1.5% fall from inlet to outlet or include the provision of low flow capture system such as invert sub-drainage infiltration coupled with collection pipes. Notwithstanding floor grade, the immediate area surrounding the outlet shall include provision of low flow capture and disposal system;

(f) basin length/width ratio within desired range of 3 to 10;

(g) for flood hazard management purposes, all flood detention systems shall be located off-line from regional floodways (ie beyond the Adopted Flood Regulation Line concerning tributaries, creeks and rivers); and

(h) basins must be modelled to determine their performance over the full spectrum of possible flooding events up to and including PMF. This modelling must check for sensitivities to parameter selection and consequences.

Rainwater tanks may not be used for mitigation of stormwater runoff and to form a case to reduce the existing requirements of traditional major/minor stormwater infrastructure or satisfy stormwater quantity objectives.

8 Other Considerations

8.1 Qualified Persons

The SMP must be prepared and reviewed by someone with appropriate experience in water engineering or another appropriate related discipline.

All flood modelling and flood assessments must be undertaken by a suitably qualified person practising in the field of hydraulic engineering. A suitably qualified person for engineering aspects is defined as someone having status as a Registered Professional Engineer of Queensland (RPEQ).

8.2 Construction and Establishment

During the construction phase, the Consultant should have inspection systems in place to ensure that the works are constructed in accordance with the approved Engineering Drawings and Specifications. The 'Concept Erosion and Sediment Control Plan' and 'Construction and Establishment Plan' documented in the SMP must be implemented and adhered to.

8.3 Asset Handover

'Asset Handover Guidelines' for stormwater treatment measures are currently being prepared by Water by Design. When these guidelines become available, they must be adhered to for any stormwater treatment measures being handed over to Council (or, if the asset is not to be handed over to Council, the party responsible for the ongoing maintenance of the device).

In the absence of these guidelines, the following information must be provided to Council (or, if the asset is not to be handed over to Council, the party responsible for the ongoing maintenance of the device) for all stormwater treatment measures prior to 'Off Maintenance' inspections:

(a) as constructed information, ie drawings and digital models;

(b) certification letter stating that (if correct) the given stormwater treatment measure has been constructed in accordance with the approved design drawings;

(c) completed 'Asset Transfer Checklists' as included in Healthy Waterways (2006 or current version). If an item receives an 'N' (or 'No') in satisfactory criteria then appropriate actions must be specified and delivered to rectify the issue before final inspection sign-off is given;

(d) maintenance plans and records of maintenance performance;

(e) copies of all required permits (both constructional and operational);

(f) proprietary information (if applicable); and

(g) digital files (eg location plan, other drawings, survey, models).

9 Booval On-site Detention Strategy

9.1 General

The Booval On-site Detention Strategy (OSD Strategy) provides for the mitigation of potential stormwater and flooding impacts arising from intensification and infill residential development in the Booval catchment.

The OSD Strategy objectives are to:

- reduce the need for the preparation and lodgement of individual stormwater management plans for each development application;
- provide a coordinated catchment scale on-site detention strategy for residential medium density development consistent with QUDM;
- ensure the existing stormwater network and urban catchment flow path capacities are maintained; and
- improve flooding outcomes and efficiencies in the catchment.

9.2 Booval Catchment

The Booval catchment is approximately 200 hectares, of which the combined Residential Medium Density zoned areas represent approximately 56 hectares (28%) of the total catchment.

The upper Booval catchment has two distinct parallel urban catchment flow paths to the east and west, which merge downstream of the railway line. The catchment generally flows in a north/north easterly direction before joining Bundamba Creek.

9.3 Booval On-site Detention Strategy

(a) OSD Strategy Application

The OSD Strategy applies to all Material Change of Use (MCU) applications in the Booval catchment proposing residential medium density development (RMD development) on a site of 2,500m^2 or less in the Residential Medium Density (RM1 and RM3) Zone or the Character Housing (Mixed Density) Zone that results in additional impervious area (refer to Figure 2 – Booval Catchment and Applicable Land).

The OSD strategy is designed to mitigate the 1 and 2 year AEP events to pre-development levels.

For RMD development on a site greater than 2,500 m^2, a separate stormwater management plan (SMP) is required to be provided.

This SMP is required to detail a detention scheme that demonstrates catchment wide non-worsening of stormwater management and flooding.

Council may request that non-worsening be demonstrated at locations of interest for a range of AEP's and durations consistent with QUDM.

(b) OSD Strategy Requirements

On-site stormwater detention details are required to be provided with each applicable MCU application consistent with this section.

The applicant must determine the required minimum detention volume using the Volume / Discharge Equation (refer clause 9.4). The applicant must also demonstrate that the proposed OSD arrangement provides the corresponding storage / discharge relationship consistent with Figure 3 – Volume / Discharge Requirements.

It is recognised that it may not be possible to exactly match the storage / discharge curves and a tolerance of 10% for flows may be used in determining compliance with this OSD strategy. The selection of a detention system type will be at the engineer(s) discretion as identified in Note 9.3.

The OSD strategy assumes 80% of the site runoff is captured by on-site detention. Where a smaller fraction is captured, the storage is required to be increased to account for the difference in accordance with the Volume / Discharge Equation.

The minimum capture rate permissible is 60%.

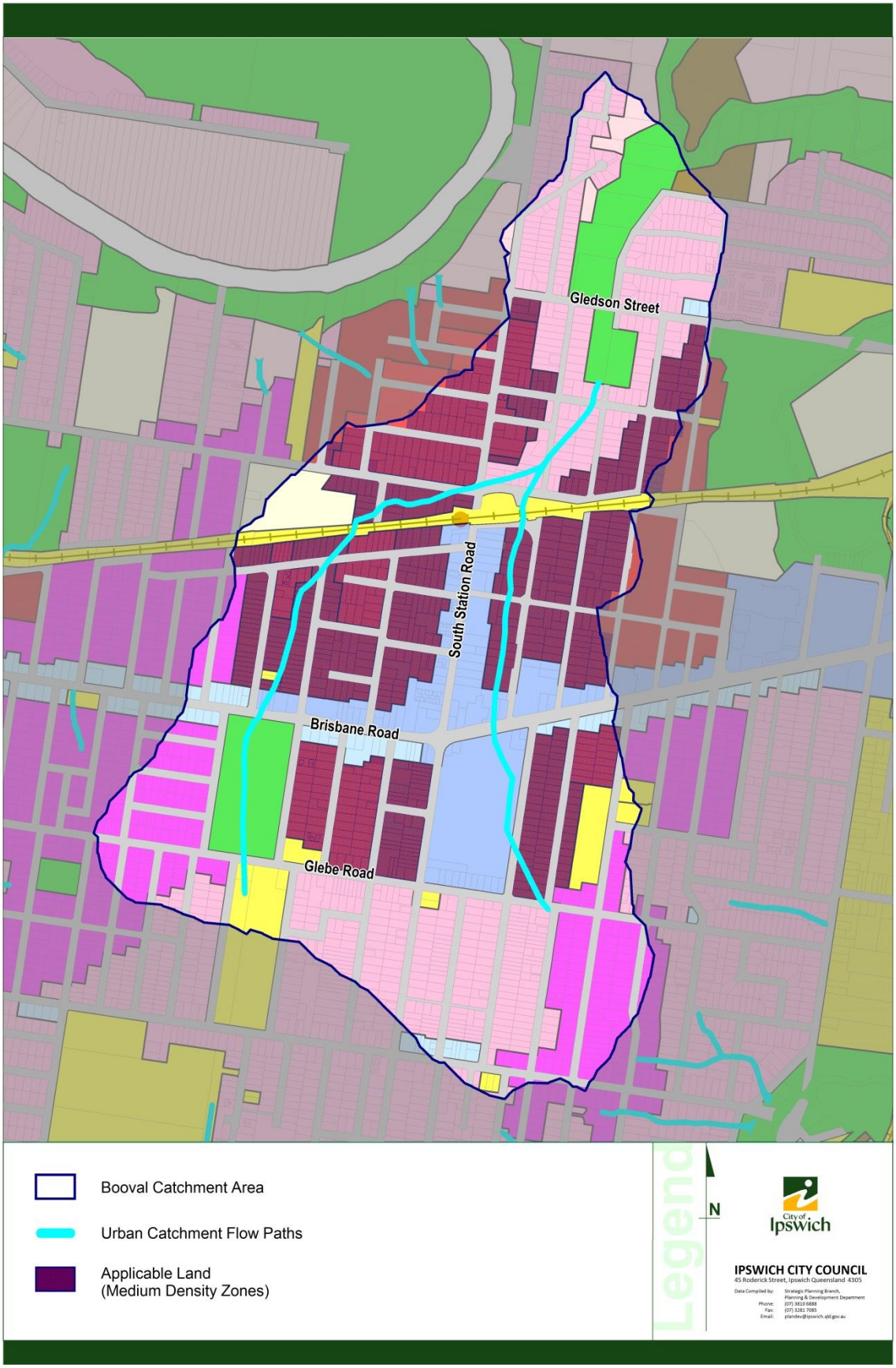
Stormwater management of RMD development on a site greater than 2,500 m^2 should also use the catchment scale critical storm duration of 60 minutes as adopted in the Booval Catchment Study, rather than using on-site critical duration. The SMP for such development will also need to consider other durations as required by Council, consistent with QUDM.

(c) OSD Strategy Design

The required storage volume and outlet configuration for applicable RMD development (with allowance for capture rates and existing case impervious fraction) is to be calculated using the Volume / Discharge Equation.

The design details are to be provided as supporting information with each applicable MCU application consistent with the Volume / Discharge Equation.

Figure 2 – Booval Catchment and Applicable Land



NOTE 9.3

(1) The modelling results for the Booval Catchment Study suggest that the function of the OSD concept is not dependent on the physical location and shape of the detention structure, as long as the rate of discharge and volume of detention are in keeping with the OSD Strategy. This provides a degree of flexibility in the design and operation of the detention structure.

9.4 Volume / Discharge Equation

$$OSD\ Volume\ Requirement\ (m^3) = A \times B \times Site\ Area\ (m^2) \times 0.024$$

Where *A* is the correction for low rates of capture and is given by:

$$A = \frac{80\%}{Capture\ Percentage}$$

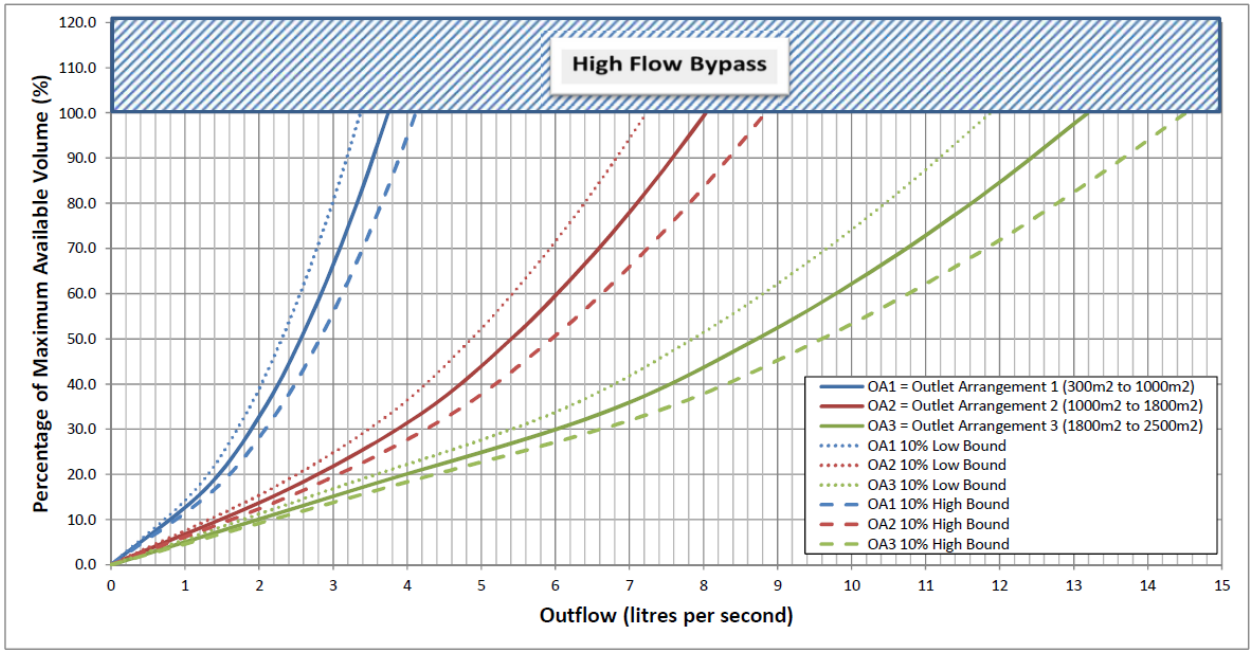
and, *B* is the correction for varying existing case of impervious fraction and is given by:

$$B = \frac{(90\% - Impervious\ percentage\ for\ Existing\ Case)}{55\%}$$

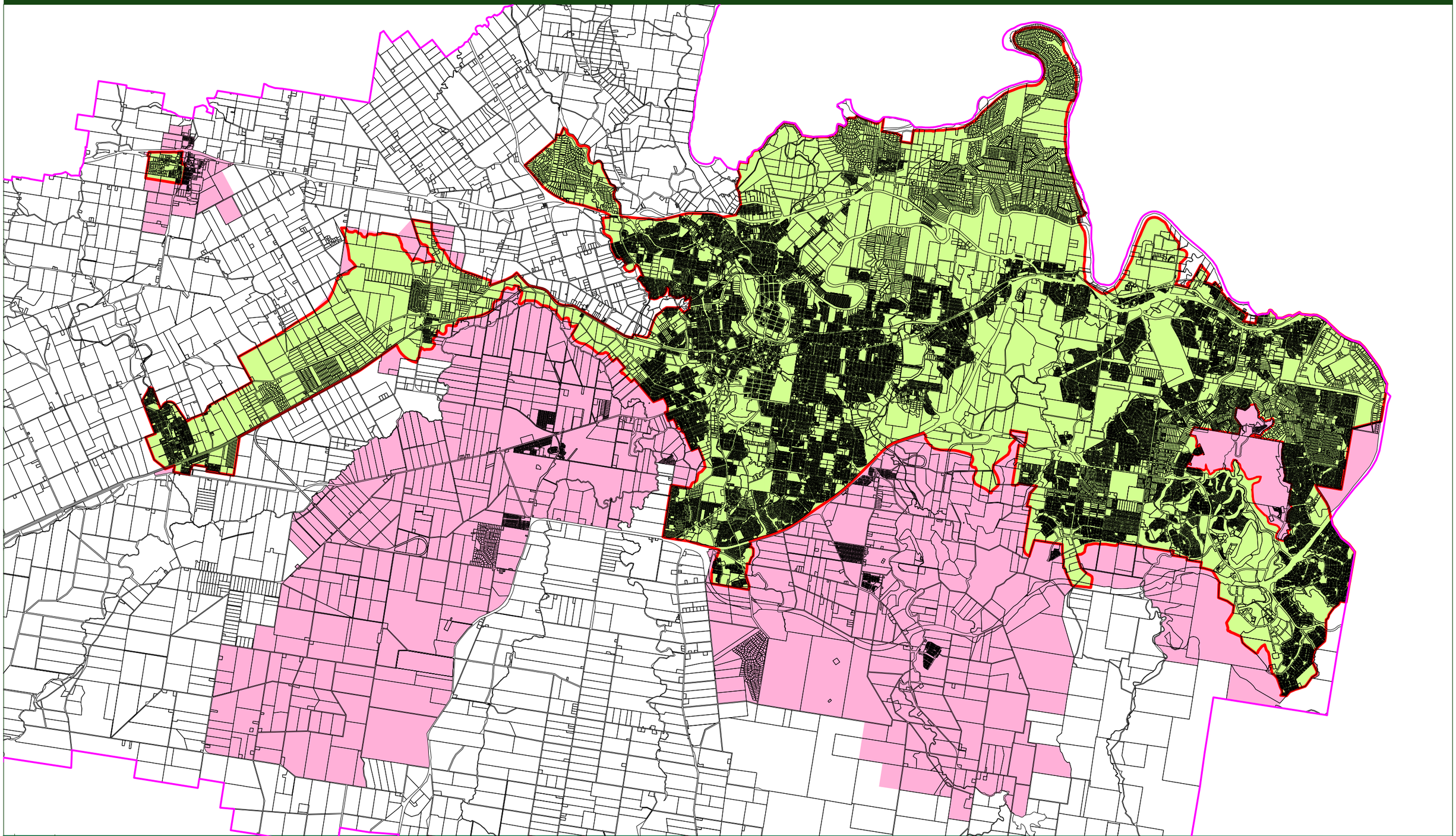
NOTE 9.4

(1) Variable *A* is to have a maximum value of 1.

Figure 3 – Volume / Discharge Requirements



APPENDIX A: Voluntary Stormwater Quality Offset Map



Legend

N

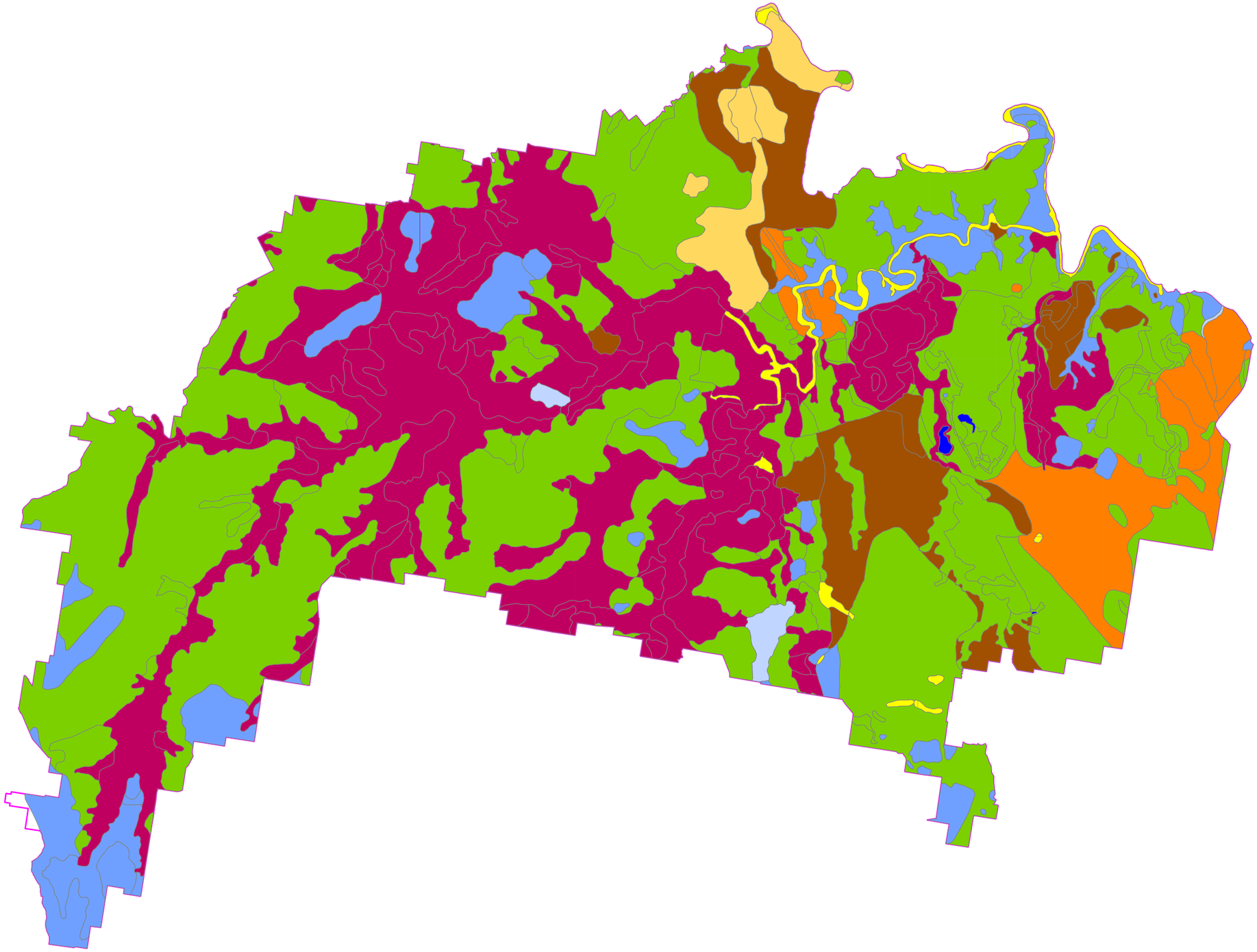
City of Ipswich

IPSWICH CITY COUNCIL
45 Roderick Street, Ipswich Queensland 4305

Data Compiled by: Strategic Planning Branch, Planning & Development Department
Phone: (07) 3810 6888
Fax: (07) 3281 7085
Email: plandev@ipswich.qld.gov.au

- Eligible Offset Area
- Possible Offset Area
- Ipswich LGA Boundary

APPENDIX B: Soils of Ipswich Map



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- Dermosols
- Hydrosols
- Kandosols
- Kurosols
- Leptic Rudosols
- Sodosols/Chromosols
- Stratic Rudosols
- Tenosols
- Vertosols
- Water

APPENDIX C: Glossary of Terms

"AEP" Annual Exceedance Probability, the likelihood of occurrence of a flood of a given size or larger occurring in any one year.

"Bioretention/Biofiltration" Biological removal of contaminants or nutrients as fluid passes through a media or a biological system.

"Construction Phase" Period of a development where bulk earthworks or significant building activities are occurring. For large residential developments, the construction phase is assumed to be completed when approximately 10% or less upstream lots are occupied.

"Extended Detention Depth" The extended detention depth is the depth between the permanent pool volume surface level and the overflow level.

"Life Cycle Costing" A process to determine the sum of all expenses associated with a product or project, including acquisition, installation, operation, maintenance, refurbishment, discarding and disposal costs (Standards Australia, 1999 – as cited in CRC for Catchment Hydrology's (2006) "MUSIC User Guide")

"MUSIC" Model for Urban Stormwater Improvement Conceptualisation, developed by the MUSIC Development Team of the CRC for Catchment Hydrology.

"Nutrients" Substances such as nitrogen and phosphorus which promote the growth of plants and algae. Excessive nutrients in waterways contribute to algal blooms and degrade our waterways.

"Operational Phase" Period of a development when all bulk earthworks have been completed and the vast majority of lot-scale works have been completed (ie immediately following the completion of the 'construction phase') . For large residential developments, the operational phase is assumed to commence when approximately 10% of all upstream lots are occupied.

"Receiving Waters" Water bodies (such as rivers, lakes, estuaries or oceans) into which treated wastewater and stormwater is discharged.

"Stormwater" Rainfall that runs off roofs and roads and other surfaces and flows into gutters, rivers, creeks, bays and oceans. This water can carry a wide range of contaminants. Some are obvious such as plastic bags or oil from roads. Others are not so obvious, such as nutrients, pathogens and heavy metals.

"Stormwater Treatment Measure" Device designed to prevent or minimise pollutants from entering stormwater runoff or reduce the volume of stormwater requiring management.