PART N - STORMWATER MANAGEMENT

Note: (D) = definition included in Part A8 of this DCP

N1. INTRODUCTION

What is the purpose of this Part?

The primary purpose of this Part of DCP2002 is to provide controls and guidelines for stormwater management for development within Byron Shire.

What are the Objectives of this Part?

The objectives of this Part are:

- To promote the adoption of on-site stormwater management practices that support a 'pre-development' hydrological regime in surface flow, streams and groundwater.

- To ensure that new development does not reduce the effectiveness of existing drainage infrastructure.

- To minimise the impacts of stormwater runoff from a site on adjoining properties.

- To provide an acceptable level of protection against personal injury and property damage due to localised stormwater runoff.

- To promote the adoption of on-site retention, detention and infiltration of stormwater where this is feasible.

- To promote stormwater harvesting and other forms of innovative water conservation.

- To promote better integration of stormwater management into new development proposals.

- To ensure that on-site stormwater management facilities can be economically maintained, and that adequate arrangements are made for on-going maintenance.

N2 STORMWATER APPROVAL

N2.1 Development Applications

Development applications must contain sufficient information to assess whether the proposed stormwater management system is feasible, both within the site and in its connection to the public drainage system.

An approval of the stormwater management system may be required under Section 68 of the Local Government Act 1993 or Section 138 of the Roads Act 1993.

An applicant may lodge detailed stormwater management construction plans with the development application for concurrent approval under Section 68 of the Local Government Act 1993 and Section 138 of the Roads Act 1993, as necessary. Alternatively stormwater management concept plans must be lodged with the development application and a condition of consent will require the relevant approvals prior to issue of the Construction Certificate.

N2.2 Section 68 of the Local Government Act 1993

Under Section 68(1) of the Local Government Act 1993, a person may only carry out a *stormwater drainage work* with the approval of Council.

A *stormwater drainage work* is defined by the Act as:

"the construction, alteration, extension, disconnection, removal, maintenance, repair, renewal, flushing, cleansing or clearing of any stormwater drain communicating or intended to communicate, directly or indirectly, with any stormwater channel of a council."

N2.3 Section 138 of the Roads Act 1993

Under Section 138 of the Roads Act 1993, a person may only carry out works in the road reserve with the consent of the roads authority. Council is the roads authority for all roads within the Shire, except any freeways. Council requires concurrence from the RTA for approval of works in the road reserve of main roads.

N2.4 Stormwater Concept Plan

Development applications not seeking concurrent approvals for the stormwater management system must be supported by a Stormwater Concept Plan containing the following information, as applicable:

- Existing and proposed finished surface contours at relevant intervals (ie 0.1m for flat sites to 1.0m for sloping sites) and spot levels.
- Proposed and existing building locations and floor levels.
- Street levels including gutter.
- Proposed infiltration measures (eg soakage trenches, swales, landscaping, permeable pavements, etc.). Where infiltration failure will affect a neighbouring property and the development involves more than a single dwelling (eg multi unit residential, commercial, industrial etc) then detailed infiltration test results and design are required. Refer to Off-site discharge.
- Proposed discharge points to the public stormwater drainage system (show levels at these locations).
- Site constraints such as trees, services or structures that may affect the drainage system.
- Existing or proposed drainage easements.
- Any surface flow paths or flood-affected areas.
- Conceptual location and levels of proposed stormwater pipes and drainage pits.
- Conceptual location and approximate area of proposed on-site detention facilities.
- Proposed on-site detention stored water invert levels and emergency spillways.
- Proposed management controls for flows entering, within and leaving the site.

- Preliminary on-site detention calculations.
- Justification that the proposed design measures will not cause adverse stormwater impacts on adjoining properties

Copies of Deposited Plan(s) and section 88B Instruments, showing details of easements over downstream properties, must also be submitted with the development application.

N2.5 Detailed Stormwater Management Construction Plans

Detailed Stormwater Management Construction Plans must contain sufficient information to assess whether the proposed stormwater management system:

- Satisfies all relevant objectives and requirements of this DCP.
- Satisfies any relevant conditions of the development consent.
- Will function as designed.

Section 68 and/or Section 138 applications must be accompanied by detailed engineering drawings that contain the following stormwater information where applicable:

- Location, layout and dimensions for all stormwater management structures and measures (A1, A2 or A3 drawings).
- All information and specifications necessary to enable the stormwater management system to be constructed in accordance with the design intent, and to enable a 'works as executed' plan to be prepared.
- Description of the proposed work.
- Existing and proposed contours at relevant intervals (ie 0.1m for flat sites to 1.0m for sloping sites).
- Existing and proposed surface and floor levels on the site and on adjoining properties.
- Vertical information sufficient to assess the impact of runoff from adjacent properties and demonstration that existing surface flows on adjacent properties will not be altered as a result of the proposed development.
- Catchment area draining to each on-site detention storage and bypass drainage.
- Location, extent, depth, volume and maximum storage level of each on-site detention storage.
- Location and level of spillways.
- Location and details of each discharge control device.
- Orifice plate dimensions and centreline levels.
- Pit locations, dimensions and levels (surface and invert).
- Location and levels of internal drainage system.
- Pipe inverts and grades.
- Levels and locations of the discharge points for each storage.
- Levels, location and type of connection to the public drainage system.
- Kerb heights and levels.
- Overflow structures and surcharge paths.
- Final site or lot layout, including drainage easements.
- Location and extent of any floodways or surface flowpaths.
- Cross sections through storages, orifice pits and tanks as necessary.
- Structural details (including reinforcing where applicable).
- Location and detail of any proposed infiltration trenches.
- A maintenance schedule that clearly and simply sets out the routine maintenance necessary to keep the OSD system working.

Section 68 and/or Section 138 applications must be supported by all hydrological and hydraulic calculations that are required by this DCP. Proposals involving an on-site detention system must be accompanied by a structural certificate in respect of the design of any structural components of an on-site detention system.

N3. STORMWATER DISCHARGE

N3.1 Element – Lawful Point of Discharge

Element Objective

To ensure that stormwater is discharged from development sites in a manner that minimises both hazards to the public and environmental impacts.

To ensure collected stormwater is discharged to a lawful point.

To minimise impacts on adjoining properties by requiring any stormwater discharges from a development site to be conveyed:

- *To a public drainage system; or*
- *To public land, but only where environmental, public safety, tenure and other criteria can be satisfied.*

Performance Criteria

A lawful point of discharge exists at a particular location, if:

- The location of the discharge is under the lawful control of the Council or other statutory authority from whom permission to discharge has been received; and
- That in discharging in that location, the discharge will not cause an actionable nuisance.

An easement over a downstream property may need to be acquired to direct collected stormwater to a lawful point of discharge. Negotiations with property owners must be undertaken along all feasible easement routes to determine whether an easement can be obtained to provide stormwater system that will drain by gravity to a public drainage system.

Prescriptive Measures

For properties generally at a higher level than the adjoining road, where the site drainage system can be piped under gravity to the road drainage system, then the discharge is to be connected to the street drainage system in accordance with Element M3.2.

For properties generally at a lower level than the adjoining road, where the site drainage system cannot be piped under gravity to the road drainage system, the discharge is to be carried out in accordance with one of the following options, where the requirements of that option can be satisfied:

- Discharge to a public drainage system within the development site in accordance with Element N3.3. This applies only where a Council drainage pipe or channel or a natural watercourse is located within or at the boundary of the development site.
- Private drainage easement across neighbouring properties in accordance with Element N3.4.
- Charged systems in accordance with Element N3.5. This applies only for residential developments up to and including a single dwelling where it can be demonstrated that an easement cannot be obtained and where the roof gutters are sufficiently above the road gutter to permit drainage by sealed system.
- Dispersion trenches in accordance with Element N3.6. This applies only for residential developments up to and including a single dwelling where it can be demonstrated that an easement cannot be obtained.
- Infiltration trenches in accordance with Element N3.7. This applies for all development, except subdivision, where it can be demonstrated that an easement cannot be obtained and where the underlying soil is sandy enough to infiltrate all runoff up to the 50 year ARI storm and where infiltration will not lead to soil contamination of the groundwater.
- Pump-out systems in accordance with Element N3.8. Applies only for basement carpark areas where it can be demonstrated that, if gravity drainage is not possible, an easement cannot be obtained and where the contributing catchment is the

driveway ramp only, up to a maximum of 60 m^2, and pump failure will not cause overflow affecting neighbouring properties or habitable floor areas.

N3.2 Element – Connection to Street Drainage System

Element Objective

To ensure that drainage works carried out on public lands do not cause inconvenience or safety hazards to pedestrian or vehicular traffic.

Performance Criteria

All drainage works carried out on public land or connecting to a public drain (open or piped) must be constructed so that:

- Stormwater flows are controlled to recognised best practice limits.
- Stormwater infrastructure will withstand expected traffic loads.
- Stormwater infrastructure will not impede other uses of public land (eg. access to adjoining properties, other service authority allocations, etc.).

Prescriptive Measures

Stormwater may be discharged to the street kerb and gutter subject to the following requirements:

- Single pipe point discharges may not exceed 30 l/s per 15 m length of kerb. The number of discharge points is to be minimised. Maximum total piped site discharge to the kerb is 60 l/s. These discharges may be increased if a full catchment analysis prepared by a Consulting Engineer is submitted demonstrating that immediately downstream of the proposed discharge point(s) that the width of gutter flow would not exceed the maximum width specified in Council's engineering specifications.
- For standard kerb, one of the following pipe crossings, from boundary line to kerb, are used:
  - 100 mm diameter sewer grade uPVC pipe(s).
  - 200mm x 100mm x 6mm thick RHS galvanised.
  - 150mm x 50mm x 4mm thick RHS galvanised where brick paved footways are proposed.
- Connection to the kerb must be via a suitably manufactured galvanised steel adaptor that matches the kerb profile.
- Pipe connections across the footway to the street gutter are at a maximum of 45 degrees to the kerb.

Stormwater may be discharged to the street piped drainage system subject to the following requirements:

- Connection must be to the pipe obvert and in accordance with Council's engineering specifications.
- The hydraulic grade line of the street pipe during the 5 year ARI event is lower than the property drainage system.

Where there is no kerb or pipe available in the street, then the downstream street drainage system is to be extended by a minimum 375mm diameter rubber ring jointed reinforced concrete pipe to a new grated pit with lintel outside the development site. This will be subject to a design prepared by a Consulting Engineer or Registered Surveyor. Design criteria to be in accordance with Council's engineering specifications.

N3.3 Element – Connection to Public Drainage System within the Development Site

Element Objective

To ensure that drainage works connecting to public systems is permanent and does not have any negative impact on stormwater flows, infrastructure or the environment.

Performance Criteria

All drainage works connecting to a public drain (open or piped) must be constructed so that:
- Stormwater flows within the public drain are not disrupted.
- Stormwater connections are neat and of solid construction.
- Stream bank erosion does not occur.

Prescriptive Measures

Any connection to a Council stormwater channel must be designed so that:
- The design tailwater level for a sealed pipe drainage system is the top of the channel.
- The angle of entry of the pipe is a maximum of 30° (in the horizontal plane) to the direction of flow in the channel.

Any connections to a Council stormwater pipe must be designed so that:
- Connections are to the pipe obvert and in accordance with Council's engineering specifications.
- Connections must be neatly joined using a suitable mortar mix and must not protrude into the main stormwater pipe.
- Standard junction pits are to be constructed for connections exceeding 100mm diameter.

Any connections to a natural watercourse must be designed so that:
- The receiving watercourse has sufficient capacity to cater for the additional flow without adversely affecting upstream or downstream flooding.
- Discharge is at one point only.
- Adequate measures are provided to prevent streambank erosion, scour and other damage for flows up to the 100 years ARI event

N3.4 Element – Easements

Element Objective

To ensure that easements of sufficient width are created when draining across downstream properties.

Performance Criteria

Suitable drainage easements must be created where it is necessary to discharge stormwater across downstream properties to access the public drainage system. (Note: this includes stormwater surface overflow.)

Easements must have sufficient width having regard to:
- Proposed pipe diameter.
- Structural requirements of pipes and any adjoining structures.
- Stormwater surface flowpath capacity requirements.
- Any maintenance requirements.

Prescriptive Measures

Piped drains within private inter-allotment drainage easements must have a minimum pipe diameter of 150mm or the diameter of the pipe required to carry the 100 year ARI impervious area runoff, whichever is greater. The 100 year ARI requirement can be reduced to 20 year ARI if a long-term overland flow path, such as a paved driveway with kerbing, is secured over the length of the easement and is of sufficient capacity to carry the major flow.

Where a site is traversed by a drain (under the control of Council) that is not within an easement, a suitable easement must be created in favour of the Council.

Easements in favour of Council must be in accordance with Council's policy.

Inter-allotment drainage easements, benefiting private property(s), must be the greater of 1.5 metre wide or of a width that will ensure the pipeline is not impacted upon by the zone of influence of any structures, or of a width necessary to contain the overland flow path. Where the easement is an easement benefiting private property(s) only, the easement is not to be to the benefit of Council.

Where an easement is required to be created a written agreement must be made between all relevant parties agreeing to its creation. Evidence of the written agreement to the creation of the easement is to be submitted with a Development Application. In this case the Council may grant deferred commencement consent subject to easement creation.

N3.5 Element – Charged Systems

Element Objective

To allow an alternate method of drainage for single dwellings.

Performance Criteria

Charged drainage systems may be provided for residential developments up to and including a single dwelling where it can be demonstrated that an easement cannot be obtained and where the roof gutters are sufficiently above the road gutter to permit drainage by a sealed system.

Prescriptive Measures

A charged drainage system for residential developments up to and including a single dwelling must satisfy the following criteria:

- A minimum of 1.5 m head must be available from roof gutter to discharge point.
- The piped system must be completely sealed.
- The pipe system including downpipes must be constructed from suitably durable materials.
- A cleaning eye must be provided at the lowest point of all pipes.
- Gravity drainage to the street kerb can be provided from a stormwater pit suitably located within the development site.
- The system is designed by a Consulting Engineer who undertakes a Hydraulic Grade Line analysis to demonstrate that the system can discharge the 20 year ARI storm runoff without roof gutter surcharge.
- A design plan is prepared by a Consulting Engineer which shows a longitudinal section of the entire piped system from roof gutter to street gutter showing invert levels, flowrates and hydraulic grade lines. Hydraulic grade line calculations are to be shown.

N3.6 Element – Dispersion Trenches

Element Objective

To allow an alternate method of drainage for single dwellings.

Performance Criteria

Dispersion trenches may be provided for residential developments up to and including a single dwelling where it can be demonstrated that an easement cannot be obtained.

The trench must be of adequate volume to disperse stormwater without having a negative impact on adjoining properties or adjacent structures.

Prescriptive Measures

A dispersion trench drainage system for residential developments up to and including a single dwelling must satisfy the following criteria:

- The trench must have a cross-sectional area of at least 600mm x 600mm, with a length of one metre for every 25 m^2 of roof or surface area drained.
- The trench must be oriented parallel to the ground surface contour.
- The trench must be lined with woven geofabric to prevent silt entering the trench from the base, top and side walls.
- The top of the trench must be covered by woven geofabric with a 150mm overlap beyond the trench walls, on top of which is placed further 40-75mm aggregate.
- The trench must be filled with 40-75 mm aggregate to as near as practicable to the surface.
- Trees covered by Council's Tree Preservation Order must not have their root systems damaged.
- Stormwater must be dispersed by a slotted pipe laid across the full length of the trench at the half-depth level.
- Trenches must be offset at least 2 m from boundaries and 3 m from buildings unless a structural engineer certifies the adequacy of the footings in closer proximity to the trenches.

N3.7 Element – Infiltration Trenches

Element Objective

To allow drainage via infiltration where site conditions are suitable.

Performance Criteria

Infiltration as an urban stormwater management technique must be limited to sites with permeable soils, such as those with a sandy, loamy and gravely texture. Such soils allow rainfall to percolate rapidly.

Infiltration is unsuitable and can not be used in areas that have a high water table; or where elevated soil moisture levels could cause landslip, shrink-swell or other geotechnical hazards; or on contaminated sites where groundwater contamination and off-site contaminant migration may occur.

The adoption of infiltration techniques is therefore dependent upon a careful analysis of the site's soil conditions.

Infiltration may be suitable as the primary means of discharge of stormwater from a development site. However, even where unsuitable as the primary technique, infiltration may be used to supplement other stormwater management techniques.

Infiltration devices are easily clogged by fine sediment particles, greases, detergents and biological material. Their continued operation is dependent upon preventing such matter from entering the system.

Prescriptive Measures

Site testing must be undertaken, and a report prepared, by a geotechnical engineer in accordance with the following:

- A minimum of two (2) tests are to be made at the location of the proposed infiltration trench(s) and at the invert level of the proposed trench(s).
- Infiltration is to be measured in pre-saturated soil by a double-ring infiltrometer test or equivalent.
- Permeability is to be reported in m/d or cm/s and also in l/s/m^2 for a mid-depth level of water in the proposed trench.

- The depth to any underlying rock stratum or water table is to be determined if within 2m of the proposed trench invert level.
- Provision of borehole log evaluation of soil types.
- Recommended offset of trench from buildings.
- The likely impact, if any, to neighbouring properties including footings and basement areas.

Infiltration trench design must be undertaken in accordance with the following:

- Designed by a Consulting Engineer with documented experience in stormwater disposal via infiltration.
- The trench system must fully infiltrate the 50 year ARI runoff from all impervious areas for all storm durations without surcharge onto neighbouring properties. The minimum impervious area to be used should be 80% of the total site area to cater for future development.
- Impervious areas include all roofs, paved areas and pools.
- Any proposed additional pervious area must also be included.
- The design method is to be a suitable time-area computer model such as ILSAX or the mass-curve technique in ARR 1987. Such methods can accurately assess adequacy of proposed storage volumes.
- A 20% clogging or siltation factor is to be added to the trench area.
- 40-75 mm gravel can be assumed as being 40% void.
- The base of the trench is to be at least 1.0 m above the underlying watertable or rock stratum if present.
- Trenches are to be offset at least 2 m from boundaries and 3 m from buildings unless a structural engineer certifies the adequacy of the footings in closer to the trenches.
- An upstream siltation and trash arresting pit must be provided.
- The design infiltration area is the area of the base(s) of the trench(s) only and must not include the sides of the proposed trench(s).

N3.8 Element – Pump-out Systems

Element Objective

To provide a means of stormwater discharge for minor areas where gravity drainage is not possible.

Performance Criteria

Pump-out drainage systems must be designed by a Consulting Engineer and must be in accordance with minimum Australian Standards.

Prescriptive Measures

Pump-out drainage systems shall be used for minor areas (60 m^2 or less) for which gravity drainage is not possible.

Pump-out drainage systems must be designed by a Consulting Engineer to be in accordance with the relevant Australian Standard (currently AS/NZS 3500.3).

Overflow during times of pump failure must not affect neighbouring properties or habitable floor areas.

Noise levels must not affect neighbouring properties above recognised standards.

The Council may impose a requirement to create a Positive Covenant on the title of the property requiring regular maintenance, and reporting to Council, of the pump-out system by a suitable independent practitioner.

N4. SITE DRAINAGE

N4.1 Element – Site Drainage

Element Objective

To ensure that stormwater capture and conveyance within a development site is properly managed through the provision of drainage infrastructure to appropriate capacity and standard.

To ensure that stormwater capture and conveyance within a development site is provided so that stormwater does not constitute a potential hazard or nuisance to persons or property including adjoining property.

Performance Criteria

No performance criteria – refer to prescriptive measures.

Prescriptive Measures

The piped property drainage system is to capture and convey to a lawful point of discharge all stormwater runoff from the following areas of the development site:

- impervious areas including roofs, paved areas and driveways
- areas subject to changes to natural ground level including cut or filled areas
- areas where the natural or pre-development overland flow regime is disrupted to the potential detriment of an adjoining property.

Carrying out of the development must not introduce, impede or divert stormwater runoff in such a manner as to increase the rate or concentration of stormwater flow across a boundary onto adjoining private property. Any proposed flow onto adjoining properties is only permissible where an easement is obtained, where other requirements of this DCP are met and if it can be managed so as to not exceed pre-development flow rates and concentrations.

Piped systems shall meet the minimum pipe diameter, cover and gradient criteria specified in the current relevant Australian Standard. Such systems shall be designed so that any overflows will not pond against, or enter into buildings.

Elements shall be designed to contain within surface drains, gutters or formed flow paths minor storm events of the appropriate average recurrence interval (ARI) specified in the current relevant Australian Standard. Surface drainage systems shall be designed to ensure overflows, in storm events with an ARI of 100 years, do not present a hazard to people or cause significant damage to property.

Design methods, layout, overland flow path, average recurrence interval (ARI), time of concentration, rainfall intensity, runoff coefficients, inlet pits, pipe drains, open drains, and design flows shall be in accordance with the relevant Australian Standard.

The relevant Australian Standard is currently, but not limited to, AS/NZS 3500.3.

N5. ON-SITE STORMWATER DETENTION (OSD)

N5.1 Element – Where is On-site Stormwater Detention (OSD) Required?

Element Objective

To avoid increased incidence of downstream flooding that may be caused by increased stormwater runoff.

Performance Criteria

On-site stormwater detention systems, based on the total roofed and paved areas, must be provided for all development that may cause a negative impact on adjoining properties due to increased peak stormwater flows.

Prescriptive Measures

Development carried out for the following purposes must incorporate an on-site detention system based on the total roofed and paved areas:

- residential (except additions, alterations or single dwelling-houses).
- commercial and industrial (except alterations and additions where the total net increase in hard surface is less than 150 m^2).
- schools, hospitals, community services and other institutions (except where total net increase in hard surfaces is less than 150 m^2).
- impervious car parks over 150 m^2.
- tennis and other impervious playing courts over 150 m^2.

However, an on-site detention system is not required in the following circumstances:

- the site drains directly to a trunk drainage system within the tidal reach of a river or stream
- the site is located within a catchment within which a regional detention structure has been provided for the ultimate development of the catchment.
- where infiltration is used as the means of stormwater discharge from the site in accordance with the requirements of Element I3.8 – Infiltration Trenches.
- where a Consulting Engineer undertakes a detailed analysis of the entire catchment by a time-area model and demonstrates that the provision of detention on the subject property, including consideration of the cumulative affect of detention provision across the catchment, will provide no benefit to any downstream drainage system for all storm frequencies up to 100 year ARI.

N5.2 Element – Siting of On-site Stormwater Detention Systems

Element Objective

To ensure that on-site detention systems are designed and constructed to be compatible with other aspects of site planning.

Performance Criteria

No performance criteria – refer to prescriptive measures.

Prescriptive Measures

On-site stormwater detention storage areas must be located:

- at an appropriate location, generally near the lowest point of the site.
- so as to collect runoff from all roofed and paved areas. A maximum of 15% of the roofed and paved area are permitted to bypass the detention system provided that it is not practicable to drain these areas through the proposed detention system or to relocate the detention system to capture these areas.
- clear of any surface flow path conveying stormwater runoff from adjoining land. If overland flow from adjoining properties will enter the detention system then this flow

should be collected up to the 100 year ARI event and conveyed by suitable means to bypass the detention system. Alternatively the detention system can be enlarged to cater for the additional catchment area.

- as part of the overall development scheme for the site.
- so that pedestrian movements will be clear of the top water level for storms up to the 5 year ARI.
- on common property in the case of development within strata or community title schemes. Below ground storage can be provided under private courtyards provided that the surcharge point from the storage area and the primary means of access for maintenance is clearly provided from common property.
- on each lot in a torrens title development unless drainage easements are provided over the entire shared drainage and detention system up to the full extent of ponding.
- to ensure that no upstream pits have grate levels lower than the detention top water level.
- so that access to the system is readily available and not via any enclosed structures.

N5.3 Element – Storage Volume and Permissible Site Discharge

Element Objective

To ensure that development is compatible with the design capacity of the existing public drainage system, so as not to increase the incidence of downstream flooding.

Performance Criteria

The total post-development 20 year ARI site runoff, for all storm durations, is controlled to be no greater than the pre-development 5 year ARI site runoff

Prescriptive Measures

Stormwater flows, average recurrence interval (ARI), time of concentration, and runoff coefficients shall be in accordance with the relevant Australian Standard. The relevant Australian Standard is currently, but not limited to, AS/NZS 3500.3.

Rainfall intensity shall be in accordance with the following tables.

Byron Bay & Bangalow

Duration	Average Recurrence Interval						
	1	2	5	10	20	50	100
5 min	128	160	190	215	240	260	300
6 min	120	150	180	200	222	250	280
10 min	98	125	150	165	180	210	235
20 min	72	90	110	125	140	155	170
30 min	60	75	90	100	115	130	140
1 hr	40	50	63	70	80	90	100
2 hrs	26	34	42	47	54	62	78
3 hrs	20	26	34	38	43	50	54
6 hrs	12	16	21	24	28	32	34
12 hrs	8	10	14	15	18	21	22
24 hrs	5.5	7.7	9	10.5	12.5	14.5	16
48 hrs	3.5	4.6	6.5	7.5	8.7	10.8	12
72 hrs	2.7	3.6	5.1	6	7.2	9.2	10.5

Ocean Shores, Brunswick Heads & Mullumbimby

Duration	Average Recurrence Interval						
	1	2	5	10	20	50	100
5 min	130	161	200	220	245	285	305

Duration	Average Recurrence Interval						
	1	2	5	10	20	50	100
6 min	120	151	186	210	230	270	290
10 min	100	125	155	170	190	225	240
20 min	72	90	115	130	145	170	185
30 min	59	74	94	105	120	140	153
1 hr	40	50	65	75	85	100	110
2 hrs	27	34	44	51	60	70	76
3 hrs	21.5	27	35	40	47	55	60
6 hrs	14	17.5	23	26	30	36	40
12 hrs	9.2	11.7	15.2	17.5	20	24	26
24 hrs	6	7.8	10.3	11.8	13.8	16	18
48 hrs	4	5	6.7	8	9.2	11	13.5
72 hrs	3	3.8	5.3	6.4	7.5	9.2	12.1

Huonbrook, Wilsons Creek & Main Arm

Duration	Average Recurrence Interval						
	1	2	5	10	20	50	100
5 min	121	160	198	220	245	290	320
6 min	115	150	185	208	233	275	300
10 min	93	122	150	170	190	222	250
20 min	68	90	112	127	144	160	185
30 min	55	73	93	105	120	140	155
1 hr	38	50	65	74	85	102	111
2 hrs	23	34	45	53	59	71	79
3 hrs	21.3	27.5	36	42	46.5	57	63
6 hrs	14.7	19	25.5	30	32	40	44
12 hrs	10	13	17	21.7	22.1	28	30.9
24 hrs	7	9	11.7	15	16	20	23
48 hrs	4.8	6.3	8.3	10.4	11.8	14.9	16.7
72 hrs	3.7	5	7	8.5	9.8	12	13.6

Designs are to be prepared by a suitably qualified person with documented experience in hydraulic analysis.

Designs are to be submitted in accordance with the following format and requirements:

On -site Stormwater Detention Design Summary Sheet

Developed Area = m^2 (Refer Element N4.1)

Pre Development

Catchment Areas (Must be shown on engineering drawings)

Roof Area (A_r) = m^2 (coefficient of runoff, $c_r = 1.0$)

Paved Area (A_p) = m^2 (coefficient of runoff, $c_p = 0.9$)

Vegetated Area (A_v) = m^2 (coefficient of runoff, $c_v = 0.66$)

Total Area = m^2 (Must equal post development area)

Stormwater Flows (For 5 year storm event)

Duration = 5 min (refer AS/NZS 3500.3:2003)

Rainfall Intenisty ($^5I_5$) = mm/hr (select from above rainfall intensity charts)

Stormwater flow (Q_5) = $(A_r c_r + A_p c_p + A_v c_v) \times {}^5I_5 / 3600$

= l/s

Post Development

Catchment Areas (Must be shown on engineering drawings)

Roof Area (A_r) = m^2 (coefficient of runoff, $c_r = 1.0$)

Paved Area (A_p) = m^2 (coefficient of runoff, $c_p = 0.9$)

Vegetated Area (A_v) = m^2 (coefficient of runoff, $c_v = 0.73$)

Total Area = m^2 (Must equal pre development area)

Stormwater Flows (For 20 year storm event)

Duration = 5 min (refer AS/NZS 3500.3:2003)

Rainfall Intensity ($^{20}I_5$) = mm/hr (select from above rainfall intensity charts)

Stormwater flow (Q_{20}) = $(A_r c_r + A_p c_p + A_v c_v) \times {}^{20}I_5 / 3600$

= l/s

Stormwater Detention Requirements

Storage Volume = $(Q_{20} - Q_5) \times 5 \times 60 / 1000$

= m^3

PSD = l/s (Permissible Site Discharge = Q_5)

Orifice Plate Controlled Discharge (N/A if using choke pipe)

Head (H) = m (max. water level to orifice centre)

Orifice Diameter = $1000 \times \sqrt{[(0.464 \times Q_5 / 1000) / \sqrt{H}]}$

= mm

Outlet Pipe Diameter = mm (min. 3 x orifice diameter)

Choke Pipe Controlled Discharge (N/A if using orifice plate)

Calculate by trial & error using the following formulas

Q_d (pipe capacity) = $1000 A_p \sqrt{[2 \times 9.8 (H/K_t)]}$ (l/s)

Where,

- A_p = Cross-sectional area of pipe (m^2)
- H = Head of water (m) from max. water level to tailwater level
- K_t = $K_f + K_p$
- K_f = $L/(50\ D)$
- L = Length of pipe (m)
- D = Diameter of pipe (m)
- K_p = $\sum$ pipe component head losses (Pipe entry = 0.5, Pipe Exit = 1.0, 45° Bend = 0.35 & 90° Bend = 0.9)

Storage Provided

Storage Volume = m^3

A separate sheet is to be attached showing all workings for the storage volumes proposed on the engineering drawings.

N5.4 Element – Drainage System Design

Element Objective

To ensure that on-site detention systems are designed in accordance with recognised engineering practices.

To ensure that on-site detention systems are designed so as:
- *to be compatible with other aspects of site planning*
- *to minimise the need for maintenance*
- *to reduce the potential for unauthorised modification.*

Performance Criteria

No performance criteria – refer to prescriptive measures.

Prescriptive Measures

Detention tanks

Storage tanks must meet the following design criteria:
- minimum 1% grade on the base of the tank, with the lowest point at the outlet sump.
- no permanent storage of water.
- tank is free draining by gravity to the public drainage system.
- tank levels are such that water cannot flow from the public drainage system into the tank.
- pipework connecting directly to the tank has sufficient hydraulic capacity for the 20 year ARI flow.
- provision of hydrostatic valve in areas subject to high water table.
- provide adequate internal ventilation.
- surface flows are directed to the tank, with suitable provision for their inlet.
- tanks are connected to inlets and outlets in accordance with other Requirements of this DCP.
- tanks that are more than 1.2m deep incorporate step irons to enable access.
- access to the tank outlet can be gained by a lockable access grate (minimum opening 600mm x 600mm).
- tanks of clear internal depth less than 0.9m are to be designed to require no internal maintenance. All inlet pipes must enter the tank under the access grate over the tank outlet. Additional grated accesses are required at tank extremities to allow ventilation and remote flushing of the tank floor.
- structural design of the tank is compatible with vehicular, hydraulic, soil and other loadings on the tank.
- provides at least 300mm of soil cover where proposed under landscaped areas.
- excavation influence line does not affect footings of adjacent or neighbouring structures.

Driveways and parking areas

Storage areas located within sealed driveways or parking areas must meet the following design criteria:
- ponding depth is less than 200mm.
- the top level of kerbs or other water-retaining structures is at least 50mm above the level of flow over the spillway.
- inlet and control pits are at least 450mm square.

Landscaped areas

Detention storages incorporated into landscaped areas must satisfy the following criteria:
- the design demonstrates compatibility with the overall site layout and landscaping.
- perimeter ponding depth is not greater than 300mm for at least 1.0 m into the basin. Where perimeter depths are greater than 300mm or where basin depths elsewhere in the basin exceed 1.2m, fencing to recognised pool fencing standards is required. Notwithstanding these requirements, in areas subject to high pedestrian usage the Council may require fencing for depths lower than those nominated above.

- the storage incorporates an additional volume of 20% by area and not depth to compensate for vegetation growth and ensure that the design volume is maintained for the life of the structure.
- Grassed surfaces with a minimum grade on the floor of the storage to the outlet of 2%.
- batter slopes do not exceed 1V:4H.
- batter slopes allowing maintenance access do not exceed 1V:6H.
- at least 0.15m freeboard to the top of the perimeter wall is provided from the spillway invert level.
- sediment or other debris from adjoining landscaping is prevented from entering the storage area and drainage system.

Freeboard to floor levels

Floor levels of adjacent buildings are to have a freeboard above the top water level of the detention storage in accordance with Table 1.

Table 1 Freeboard requirements

Building type	Freeboard type	
	Overland flowpaths[(1)]	On-site detention system top water level[(2)]
Dwelling	0.30m	0.3m
Garage	0.15m	0.15m
Carport	-0.10m	0.0m
Commercial	0.30m	0.3m
Industrial	0.30m	0.3m

(1) Due to surface flows from localised stormwater runoff.

(2) Defined as the top of flow over a spillway.

Pipework

Minimum pipe grades and pipe installation within the property, where not otherwise specified, must be in accordance with AS 3500.3.

Control devices and outlets

Hydraulic control devices must be non-removable.

Screens must be fitted to storage outlets so as to meet the following criteria:
- discharge control devices are totally enclosed
- the screen area is a minimum of 450mm x 450mm, or 50 times the area of the orifice outlet, whichever is the greater
- mesh spacing is equivalent to galvanised Lysagts RH 3030 Maximesh
- screens are designed to retain leaf litter and other trash without blocking the outlet
- screens are at least 100mm away from the discharge control device
- screens are easily removable, durable and provided with a handle for cleaning.

A silt trap must be provided underneath the outlet control, unless the site has heavy clay or a watertable above detention invert level, in accordance with the following:
- minimum depth of 200mm below the invert of the orifice or choke pipe.
- minimum surface area of 450mm x 450mm.
- provision of seepage holes (maximum diameter 20mm) in the base slab of the silt trap with blue metal underneath.

A grated outlet is provided to cater for surcharge during major storm events and to provide access for inspections and maintenance of the silt trap and litter screen. The opening has a minimum size of 450mm x 450mm, and is fitted with a removable galvanised steel grate.

Orifice plates are:
- manufactured from minimum 200mm x 200mm flat stainless steel, 3mm thick
- machined to the dimensions as calculated, with edges smooth and sharp (not rounded)
- securely fixed over the outlet pipe by at least four M6 stainless steel masonry anchors
- minimum control diameter 25mm

Water surface level calculations must take account of the effect of downstream controls (including controls that are external to the site).

Where downstream water levels vary depending upon channel flows, calculations utilise either:
- the 100 years ARI level of the external system being connected to; or
- joint probability calculations are performed.

Where an orifice plate is used to control site discharge:
- the on-site detention system is designed so that the conditions at the inlet side of the control device (ie inlet control) govern under all conditions
- the outlet pipe that the orifice discharge is connected to has a capacity of at least 1.5 times that of the permissible site discharge

Where a choke pipe is used to control the site discharge, tailwater levels are as follows:
- for systems draining directly to the street drainage system:
  - the top of kerb level, for connections to the kerb
  - 150mm below the street gutter invert, for connections to street drainage pits or pipes
  - surface level at the point of connection, for connections to footway drainage pipes or pits
- for systems draining directly to an open channel:
  - the top of the channel
- for systems draining to another on-site detention system:
  - the stored water level in the downstream storage
- where there are intermediate surface inlet pits, changes in pipe diameter or known affects by flooding:
  - levels determined by hydraulic grade line analysis in accordance with Australian Rainfall and Runoff.

N5.5 Element – Maintenance of On-site Stormwater Detention Systems

Element Objective

To ensure that on-site detention systems are maintained in accordance with recognised engineering practices.

To ensure that on-site detention systems are maintained regularly to keep the system working

Performance Criteria

A maintenance schedule must be prepared that clearly and simply sets out the operating/maintenance instructions for future property owners and occupiers. Maintenance system must be permanent, fail-safe and not rely on particular individuals.

Prescriptive Measures

A maintenance schedule must be prepared as part of the detailed stormwater management construction plans.

The majority of OSD systems, particularly those where a large proportion of the storage is located above ground, will be able to be maintained by property owners, residents or handymen. Larger underground systems, particularly those with limited access and/or substantial depth, may require the owner to engage commercial cleaning companies with specialised equipment.

The owner must be provided with advice on how frequently the system needs to be inspected and approximately how often it will require cleaning. The frequencies of both inspections and maintenance will be highly dependant on the nature of the development, location of the storage and the occurrence of major storms. Suggested frequencies are:

- Residential
  - inspect system every six months and after heavy rainfall
  - clean system as required, generally at least once a year.
- Commercial/Industrial
  - inspect system every three months and after heavy rainfall.
  - clean system as required. generally at least once every six months.

The maintenance schedule must set out, simply and clearly, the routine maintenance necessary to keep the OSD system working. Some of the issues that must be addressed are:

- where the storages are located.
- which parts of the system need to be accessed for cleaning and how access is obtained.
- a description of any equipment needed (such as keys and lifting devices) and where they can be obtained.
- the location of screens and how they can be removed for cleaning.
- permanent signs to indicate the maintenance requirements.

N5.6 Element – Construction and Final Approval of On-site Stormwater Detention Systems

Element Objective

To ensure that on-site detention systems are constructed in accordance with the approved stormwater management construction plans.

To improve construction standards by supervision of critical stages of construction by the OSD designer.

To minimise delays and additional expenditure on rectification works by ensuring adequate construction supervision.

To increase community acceptance of OSD by eliminating nuisances created by poor construction.

Performance Criteria

Construction supervision is essential in achieving a properly working OSD system. OSD construction is often multi-disciplined with many tradesmen (such as brick layers, landscapers and concrete finishers, who may be unfamiliar with stormwater drainage) being responsible for constructing critical features of the system. OSD systems require closer attention to set-out and level information than a conventional drainage system. Without adequate supervision during construction, expensive and time consuming rectification works are often necessary. Upon completion of system and prior to the occupation the OSD designer must issue a Certificate of Compliance to the Principal Certifying Authority.

Work-as-Executed (WAE) plans must be submitted with a Certificate of Compliance from the designer. A registered surveyor or the OSD designer must prepare the WAE plans. It is important that the WAE plans provide the OSD designer with sufficient information to certify that the as-constructed system will function in accordance with the approved design.

Prescriptive Measures

Certificates of Compliance

Certificates of Compliance must confirm that the drainage and on-site stormwater detention (OSD) works have been carried out in accordance with the approved design. To avoid delays in obtaining certification, developers and builders are encouraged to have the OSD designer supervise the construction of these systems. Defects are expensive to repair once the development is completed.

Certificates of Compliance are to be attached to the Work-As-Executed plans and submitted to the Principal Certifying Authority prior to the issue of Subdivision Certificates, Certificates of Occupation and/or Final Approval. A separate structural certification will be required for any structural elements. The Certificate of Compliance must:

- state that the system will function in accordance with the approved designs, subject to satisfactory maintenance.
- identify any variations from the approved design.
- state that these variations will not impair the performance of the OSD system.

Alternatively, where variations are identified that impair the performance of the OSD system, the OSD designer must complete an Outstanding Works form. This form lists the variations from the approved design and the required remedial works. Where significant remedial works are necessary, discussions should be held with the relevant Council officers and arrangements made to have these works carried out prior to the issue of a Certificate of Compliance by the OSD designer.

The Certificate of Compliance is the principal means by which adequate construction standards are ensured and certification needs to be conducted in a professional manner. Whilst the Certificate will be based on the work-as-executed plans, the OSD designer will need to inspect the site to check critical design features.

Some of the important considerations to be addressed when certifying compliance are:

1. Discharge Control Pits
   - a plate with a sharp-edged orifice of the correct diameter and the specified material has been securely fitted.
   - the discharge control pit dimensions satisfy minimum parameters, eg. width, design head, and clearance from screen.
   - the orifice is screened and the screen is properly fixed, located and able to be removed for cleaning.
   - outlet pipes from the discharge control pit are the correct size, level and grade to ensure there is free discharge through the orifice.
   - the levels of the top water surface, storage invert and discharge control pit are such that the design discharge from the storage is achieved
   - where the design assumes 'high early discharge', run-off from sufficient areas of the site is directed to the discharge control pit to ensure that the design permissible site discharge is achieved soon after the commencement of heavy rainfall
   - the flap valve, if specified, is fitted correctly.

2. Storage
   - actual storage volumes achieved are adequate.
   - the actual top water surface level of the basin will not cause either unintended surcharge of the internal drainage system or inundation of/or inadequate freeboards to finished floor levels.

- the base of the storage is well graded and drains to the discharge control pit.
- spillways and overflows paths are the correct level and free from obstructions.

3. Internal drainage
   - site gradings are correct.
   - the internal drainage lines are of a sufficient size, level and grade to convey flows to the storage.
   - if a blockage occurs or the internal drainage lines cannot convey all run-off in a 100 year rainfall event, the site is graded to direct surcharging flows to the storages.
   - storages cannot be by-passed by overflows from the internal drainage system or by overflows from any surface area designed to drain to the storages.
   - flowpaths designed to divert upstream flows around the basin have been properly constructed and will function as designed.
   - workmanship is adequate to prevent long-term failure of the system.

4. Freeboards
   - the levels of structures (such as garages, factories, offices and dwellings) are sufficiently above the as-constructed maximum water surface levels in the storage and flowpaths.
   - an emergency spillway or overflow path is provided to ensure that surcharge of the drainage system and storage (even in the event of an extreme storm or accidental blockage of pits, pipes etc.) will not cause stormwater to enter buildings where significant damage would occur.

Standard Certificate of Compliance Form and Outstanding Works Form are included at the end of this Section of the DCP.

Structural Certification

Due to loadings, certain on-site stormwater detention storage components may require specific structural certification for design and construction. The following list is typical but not exhaustive:

1. Free standing walls
   These are subject to hydrostatic loads when a storage is full or filling. The significance will depend on the maximum ponding depth.

2. Retaining walls
   In addition to the normal earth and hydrostatic loadings, it may be necessary to consider the possibility of saturated sub-soil conditions.

3. Underground storages
   These may be subject to a combination of earth pressures, hydrostatic loadings, traffic loadings and buoyancy forces.

Work As Executed Plans (WAE)

WAE plans must provide the OSD designer with sufficient information to certify that the as-constructed system will function in accordance with the approved design. The following information must be included on the WAE plans, however in some projects there will be site-specific features, which may require additional details:

1. Discharge Control Pit
   - internal pit dimensions
   - the diameter of the orifice plate or control device.
   - verification that a screen has been fitted, as well as its location, dimensions and the minimum distance from the control device.
   - verification that an appropriate flap valve has been fitted (if specified).

- levels on the top and invert of the pit.
- internal diameter of the outlet pipe.

2. Storage
   - type of storage -roof, above ground, below ground or combination.
   - calculations of the actual volume achieved for each storage.
   - level and location of any overflow structures (eg. spillways, weirs).
   - sufficient levels and dimensions to verify storage volumes.

3. Internal drainage
   - pit surface levels.
   - invert levels and diameters of pipes.
   - location and levels of any floodways and/or overland flowpaths.
   - sufficient spot levels to show site gradings and extent of areas not draining to the storage(s).

4. Freeboards
   - The finished floor levels of structures, such as garages and dwellings, are to be shown to ensure they are sufficiently above the maximum storage water surface levels and overland flowpaths.

Construction Tolerances

Because of the importance of OSD systems in protecting downstream areas from flooding, every effort should be made to avoid, or at least to minimise, construction errors. Whilst an OSD system with slightly less than the specified storage volume will mitigate flooding in most storm events, it will not be fully effective in a major storm. For this reason, the design should allow for a potential reduction in the storage volume due to common post-construction activities such as landscaping, top dressing and garden furniture.

Notwithstanding this, it is recognised that achieving precise levels and dimensions may not always be possible in practice. It is therefore considered that an OSD system could be certified as meeting the design intent where the storage volume is at least 90% of the specified volume and the design discharge is within plus or minus 5% of the PSD.

ON-SITE STORMWATER DETENTION SYSTEM

CERTIFICATE OF HYDRAULIC/HYDROLOGICAL COMPLIANCE

BYRON SHIRE COUNCIL

DA No: .....

S68 No: .....

Project: .....

Location: .....

.....

.....

Designed by: .....

Construction certified by: .....

Qualifications: .....

Telephone: .....

1.0 WORKS CONSTRUCTED IN ACCORDANCE WITH DESIGN.

I _____ of _____ (professional engineer/registered surveyor being competent to practice in the field of stormwater drainage design) have inspected the above on-site stormwater detention system and certify that the works have been constructed in accordance with the approved design details for the above mentioned project.

Signature: _____ Date: _____

(Delete if not applicable)

2.0 CONSTRUCTION VARIATIONS NOT AFFECTING DESIGN PERFORMANCE.

I _____ of _____ (professional engineer/registered surveyor being competent to practice in the field of stormwater drainage design) have inspected the above on- site stormwater detention system and certify that the works have been constructed in accordance with the approved design details for the above mentioned project, except for the variations listed below which do not affect the performance of the system, subject to satisfactory maintenance.

Variations:

_____

_____

_____

_____

Signature: _____ Date: _____

(Delete if not applicable)

ON-SITE STORMWATER DETENTION SYSTEM

LIST OF OUTSTANDING WORKS

BYRON SHIRE COUNCIL

DA No: .....

S68 No: .....

Project: .....

Location: .....

.....

.....

Designed by: .....

Construction certified by: .....

Qualifications: .....

Telephone: .....

CONSTRUCTION VARIATIONS AFFECTING DESIGN PERFORMANCE.

I _____ of _____ (professional engineer/registered surveyor being competent to practice in the field of stormwater drainage design) have inspected the above on-site stormwater detention system and the following variations to the approved design. The listed remedial works will be necessary to make the system function according to the approved design.

VARIATION	REMEDIAL WORK NECESSARY

Signature: _____ Date: _____

N6. EROSION AND SEDIMENT CONTROL

N6.1 Element – Erosion and Sediment Control

Element Objective

To ensure that building and construction activities do not have a negative impact on waterways.

To ensure that sediment and waste materials derived from construction sites do not cause blocked stormwater pipes, silted streams, poor water quality, degraded aquatic communities.

Performance Criteria

Any development involving earthworks or soil surface disturbance must:
- manage environmental and public safety risks during construction work;
- control erosion, stabilise exposed soil surfaces and divert stormwater away from exposed soil surfaces;
- intercept, detain and remove water-borne pollutants prior to the discharge of stormwater from the site;
- minimise exposure and disturbance of sensitive soil materials, such as sodic soils, saline soils and acid sulfate soils; and
- prevent damage to stormwater devices installed prior to site works, including swales, infiltration devices, filtration and bio-retention devices.

Prescriptive Measures

Plan Preparation

An erosion and sediment control plan is required where the area of soil surface disturbance is in the range 250m^2 – 2 500m^2, or is less than 250m^2 but the site has a slope exceeding 18 degrees or immediately adjoins a watercourse.

A soil and water management plan is required where the area of soil surface disturbance exceeds 2 500m^2. Sites of this scale typically require sediment retention basins to minimise sediment pollution.

Plans must be prepared in accordance with “Managing Urban Stormwater: Soils and Construction” (Landcom, Sydney, 2003). An approval must be obtained for the plan from Council, under Section 68 of the Local Government 1993, prior to issue of a Construction Certificate.

Installation

Erosion and sediment controls are to be in place in accordance with the approved plan prior to commencement of construction works. Where there is soil disturbance and no plan is required by the above requirements, erosion and sediment controls are to be in place in accordance with Council’s “Guidelines for Erosion & Sediment Control on Building Sites” (a copy can be downloaded from Council’s website at www.byron.nsw.gov.au.

Particular attention is to be given to the provision of the following measures:
- establish a single stabilised entry/ exit point;
- divert up-slope water around the work site and stabilise channels;
- install sediment fence(s) along the low side of the site;
- clear land only where necessary (fence off uncleared areas);
- place sediment controls around stockpiles;
- install temporary downpipes immediately after the roof has been erected;
- stabilise exposed earth;
- security fencing must be installed to exclude the public from the site;
- temporary fencing must be installed to protect stormwater devices from damage by
- vehicles, earthmoving equipment, building materials, stockpiles and waste; and

- appropriate warning signs should be displayed on all protected devices.

Maintenance

Regular maintenance on the erosion and sediment control measures must be undertaken to:

- remove collected sediment;
- stabilise entrance ways;
- repair erosion in drainage channels;
- sweep up sediment from roadways and gutters; and
- ensure operability of pollution controls.

The erosion and sediment control measures must also be checked after heavy rain.

Finalisation

The site must be fully stabilised before erosion and sediment controls are removed.

N7. STORMWATER QUALITY CONTROL

N7.1 Element – Stormwater Quality Control

Element Objective

To minimise the impact of new development (including redevelopment) upon receiving waterways and areas of urban bushland.

Performance Criteria

Water quality from development sites must be improved by capturing and treating stormwater flows during regular rainfall events to meet the requirements of the adopted Byron Shire Stormwater Management Plan.

Prescriptive Measures

The "key" pollutants to be addressed from new development (including redevelopment) are to be in accordance with the following table.

Development Type	Litter	Coarse Sediment	Fine Particles	Total Phosphorous	Total Nitrogen	Hydrocarbons, motor fuels, oils & grease
Low Density Residential	Y	N	N	Y	Y	N
Medium Density Residential	Y	Y	Y	Y	Y	?
Commercial, Shopping & Retail Outlets	Y	Y	Y	N	N	N
Industrial	Y	Y	Y	?	?	Y
Car Parks, Service Stations & Wash Bays	Y	Y	Y	N	?	Y

Y - Key pollutant, needs to be addressed.
? - Variable, requires site specific assessment.
N - Not significant
(Source: Byron Shire Urban Stormwater Management Plan)

Subdivisions and developments involving an area greater than 2,500m^2 must provide measures to address the "key" pollutants in accordance with the following table for all stormwater flows up to 25% of the 1 year ARI peak flow from the development site.

Pollutant / Issue	Retention Criteria
Litter	70% of average annual load greater than 5mm.
Coarse Sediment	80% of average annual load for particles 0.5mm or less.
Fine Particles	50% of average annual load for particles 0.1mm or less.
Total Phosphorous	45% of average annual load.
Total Nitrogen	45% of average annual load.
Hydrocarbons, motor fuels, oils & grease	90% of average annual load.

Runoff from both roofs and paved areas needs to be treated. Significant water quality improvements can be achieved by configuring a sequence of treatment measures (a 'treatment train'). Measures may include roofwater tanks, infiltration devices, filtration & bio-retention devices, porous paving, grassed swales, better landscape practices, ponds &

wetlands and stormwater tanks. The suitability of treatment measures will depend largely on site conditions. For example, Infiltration devices are not suitable in areas with heavy clay soils.