# Byron Shire Council

# Comprehensive Guidelines for Stormwater Management

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***Document History***

| Doc No. | Date Amended | Details Comments eg Resolution No. |
|---|---|---|
| #E2014/13360 | 28 Feb 2014 | Draft version – Ordinary Meeting 20 March 2014 |
| #E2014/20022 | 20 Mar 2014 | Res 14-118 - Public exhibition version |
| #E2014/33087 | | Draft to 26 June 2014 Extraordinary Meeting - for adoption |
| #E2014/43030 | 26 June 2014 | Adopted Version – Res 14-315 |

# 1. Introduction

The purpose of this document is to provide additional information to supplement the stormwater provisions contained in Chapter B3 Services of Byron Shire Development Control Plan (DCP) 2014 that applies to land to which Byron Local Environmental Plan (LEP) 2014 applies.

This document is also to be read in conjunction with Council's adopted engineering standards, currently the Northern Rivers Local Government Development Design and Construction Manuals (NRLG Manuals).

# 2. Objectives

The objectives of this document are:

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

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

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

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

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

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

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

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

# 3. Stormwater Approvals

## 3.1 Development Applications

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

A construction certificate issued with respect to the plans and specifications for any building work or subdivision work must also provide for any stormwater drainage work. An approval for the stormwater drainage work may also be required under *Section 68 of the Local Government Act 1993* and/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.

Plans showing the method of draining the land are to be in accordance with this document, the Northern Rivers Local Government Development Design and Construction Manuals, and any relevant Australian Standards.

## 3.2 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*

## 3.3 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 NSW Roads and Maritime Service (RMS) for approval of works in the road reserve of main roads.

## 3.4 Stormwater Concept Plan

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

1. Existing and proposed finished surface contours at relevant intervals (i.e. 0.1m for flat sites to 1.0m for sloping sites) and spot levels.

2. Proposed and existing building locations and floor levels.

3. Street levels including gutter.

4. Proposed infiltration measures (e.g. soakage trenches, swales, landscaping, permeable pavements, etc.). Where infiltration failure will affect a neighbouring property and the development involves more than a single dwelling (e.g. multi unit residential, commercial, industrial etc) then detailed infiltration test results and detailed designs are required.

5. Proposed discharge points to the public stormwater drainage system (show levels at these locations).

6. Site constraints such as trees, services or structures that may affect the drainage system.

7. Existing or proposed drainage easements.

8. Any surface flow paths or flood-affected areas.

9. Conceptual location and levels of proposed stormwater pipes and drainage pits.

10. Conceptual location and approximate area of proposed on-site detention facilities.

11. Proposed on-site detention stored water invert levels and emergency spillways.

12. Proposed management controls for flows entering, within and leaving the site.

13. Preliminary on-site detention calculations.

14. 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.

## 3.5 Detailed Stormwater Management Construction Plans

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

1. satisfies all relevant objectives and requirements of the relevant Development Control Plan (DCP);

2. satisfies any relevant conditions of the development consent; and

3. 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:

1. Location, layout and dimensions for all stormwater management structures and measures (A1, A2 or A3 drawings).

2. 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.

3. Description of the proposed work.

4. Existing and proposed contours at relevant intervals (i.e. 0.1m for flat sites to 1.0m for sloping sites).

5. Existing and proposed surface and floor levels on the site and on adjoining properties.

6. 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.

7. Catchment area draining to each on-site detention storage and bypass drainage.

8. Location, extent, depth, volume and maximum storage level of each on-site detention storage.

9. Location and level of spillways.

10. Location and details of each discharge control device.

11. Orifice plate dimensions and centreline levels.

12. Pit locations, dimensions and levels (surface and invert).

13. Location and levels of internal drainage system.

14. Pipe inverts and grades.

15. Levels and locations of the discharge points for each storage.

16. Levels, location and type of connection to the public drainage system.

17. Kerb heights and levels.

18. Overflow structures and surcharge paths.

19. Final site or lot layout, including drainage easements.

20. Location and extent of any floodways or surface flowpaths.

21. Cross sections through storages, orifice pits and tanks as necessary.

22. Structural details (including reinforcing where applicable).

23. Location and detail of any proposed infiltration trenches.

24. 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 in accordance with the requirements of the *Northern Rivers Local Government Handbook of Stormwater Drainage Design*. 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. Proposals should also be accompanied by the Design Submission Checklist of the *Northern Rivers Local Government Handbook of Stormwater Drainage Design*.

Sample drawings developed as part of the Northern Rivers Local Government Development Design and Construction Manuals provides guidance on the type of information that should be included in stormwater management plans for subdivision works. The NRLG Manuals, including standard and sample drawings, are available on Council's website.

AS/NZS 3500.3:2003 Plumbing and drainage - Stormwater drainage is the relevant Australian Standard at the time of writing this document. Appendices C and K of AS/NZS 3500.3:2003 provides guidance on the type of information that should be included in stormwater management plans for building works.

## 3.6 Properties adjacent to or containing watercourses or drainage lines

Lands containing or directly adjoining natural watercourses or trunk drainage lines may be subject to partial inundation during the 1 in 100 year ARI storm event. Development applications must demonstrate that the proposal complies with the requirements of the Northern Rivers Development and Design Manual. Development proposals in close proximity to watercourses or other areas of possible inundation must be accompanied by a hydrologic study submitted by an appropriately qualified person to demonstrate that the proposal or any future development will not interfere with the natural flowpath or be subject to flooding.

# 4. Stormwater Discharge

## 4.1 Lawful Point of Discharge

A lawful point of discharge is considered to exist at a particular location, if:

a) 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

b) That in discharging in that location, the discharge will not cause an actionable nuisance.

The following applies when connecting to a lawful point of discharge

1. 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.

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:

   a) Discharge to a public drainage system within the development site – this ONLY applies where a Council drainage pipe or channel or a natural watercourse is located within or at the boundary of the development site.

   b) Private drainage easement across neighbouring properties.

   c) Charged systems – this ONLY applies to 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.

   d) Dispersion trenches – this ONLY applies to residential developments up to and including a single dwelling where it can be demonstrated that an easement cannot be obtained.

   e) Infiltration trenches – this applies for all development 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 20 year ARI storm and where infiltration will not lead to contamination of the groundwater.

   f) Pump-out systems – this ONLY applies to 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, generally with a maximum area of 60 $m^2$, and pump failure will not cause overflow affecting neighbouring properties or habitable floor areas.

## 4.2 Connection to Street Drainage System

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

   a) 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 standards.

b) For standard kerb, one of the following pipe crossings, from boundary line to kerb, are used:

   i) 100 mm diameter sewer grade uPVC pipe(s).
   ii) 200mm x 100mm x 6mm thick RHS galvanised.
   iii) 150mm x 50mm x 4mm thick RHS galvanised where brick paved footways are proposed.

c) Connection to the kerb must be via a suitably manufactured galvanised steel adaptor that matches the kerb profile.

d) Pipe connections across the footway to the street gutter are at a maximum of 45 degrees to the kerb.

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

   a) Connection must be to the pipe obvert and in accordance with Council's engineering specifications.

   b) The hydraulic grade line of the street pipe during the 5 year ARI event is lower than the property drainage system.

3. 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 adopted engineering standards.

## 4.3 Connection to Public Drainage System within the Development Site

1. All drainage works connecting to a public drain (open or piped) must be constructed so that:

   a) Stormwater flows within the public drain are not disrupted.

   b) Stormwater connections are neat and of solid construction.

   c) Stream bank erosion does not occur.

2. Any connection to a Council stormwater channel must be designed so that:

   a) The design tailwater level for a sealed pipe drainage system is the top of the channel.

   b) The angle of entry of the pipe is a maximum of 30° (in the horizontal plane) to the direction of flow in the channel.

3. Any connections to a Council stormwater pipe must be designed so that:

   a) Connections are to the pipe obvert and in accordance with Council's engineering specifications.

   b) Connections must be neatly joined using a suitable mortar mix and must not protrude into the main stormwater pipe.

   c) Standard junction pits are to be constructed for connections exceeding 100mm diameter.

4. Any connections to a natural watercourse must be designed so that:

   a) The receiving watercourse has sufficient capacity to cater for the additional flow without adversely affecting upstream or downstream flooding.

   b) Discharge is at one point only.

   c) Adequate measures are provided to prevent streambank erosion, scour and other damage for flows up to the 100 years ARI event.

   d) Within tidal waterways, where possible the invert of outlets should be located at or above 1m AHD to facilitate their ongoing effective operation by limiting obstruction of the outlet by silt and inundation by tides.

**Notes:**

1. Outlet structures on waterfront land are a controlled activity under the *Water Management Act 2000* (WM Act). Currently, the NSW Office of Water administers the WM Act and is required to assess the impact of any proposed controlled activity to ensure that no more than minimal harm will be done to waterfront land as a consequence of carrying out the controlled activity. Waterfront land includes the bed and bank of any river, lake or estuary and all land within 40 metres of the highest bank of the river, lake or estuary. Outlet works in mapped waterways may also trigger the need for approvals under the *Fisheries Management Act 1994* for dredging and reclamation works or harm to marine vegetation.

2. The provisions of State Environmental Planning Policy No. 62 – Sustainable Aquaculture should be considered, which may include the water quality requirements outlined in *Amendment No. 3 to SEPP 62 - implications for development that may affect oyster acquaculture*. Refer to Planning Circular PS 07-013 (available on the NSW Department of Planning & Environment website) for more information.

## 4.4 Easements

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:

   a) Proposed pipe diameter.

   b) Structural requirements of pipes and any adjoining structures.

   c) Stormwater surface flowpath capacity requirements.

   d) Any maintenance requirements.

The following measures apply to easements

1. Easements are to be in accordance with the Northern Rivers Local Government Development Design and Construction Manuals, which includes of the *Northern Rivers Local Government Handbook of Stormwater Drainage Design*.

2. 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.

3. Where the easement is an easement benefiting private property(s) only, the easement is not to be to the benefit of Council.

4. 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.

## 4.5 Charged Systems

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.

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

a) A minimum of 1.5 m head must be available from roof gutter to discharge point.

b) The piped system must be completely sealed.

c) The pipe system including downpipes must be constructed from suitably durable materials.

d) A cleaning eye must be provided at the lowest point of all pipes.

e) Gravity drainage to the street kerb can be provided from a stormwater pit suitably located within the development site.

f) 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.

g) 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.

## 4.6 Dispersion Trenches

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

a) The trench must have a cross-sectional area of at least 600mm x 600mm, with a length of one metre for every 25 m2 of roof or surface area drained.

b) The trench must be oriented parallel to the ground surface contour.

c) The trench must be lined with woven geofabric to prevent silt entering the trench from the base, top and side walls.

d) 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.

e) The trench must be filled with 40-75 mm aggregate to as near as practicable to the surface.

f) Trees covered by the application of Chapter B2 Preservation of Trees and other Vegetation of Byron DCP 2014 must not have their root systems damaged.

g) Stormwater must be dispersed by a slotted pipe laid across the full length of the trench at the half-depth level.

h) 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.

## 4.7 Infiltration Trenches

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; poor soil conditions, in particular sodic/saline and dispersive soils, shallow saline groundwater, 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.

Soils with saturated hydraulic conductivity of 3.6mm/hr to 180mm/hr are preferred for infiltration application. Infiltration systems are not acceptable where the saturated hydraulic conductivity of the in-situ soils is less than 0.36mm/hr or greater than 360mm/hr.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.

Where infiltration is proposed the following is required

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

   a) 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).

   b) Infiltration is to be measured in pre-saturated soil by a double-ring infiltrometer test or equivalent.

   c) Permeability is to be reported in m/day or mm/s (and also in l/s/m2 for a mid-depth level of water in the proposed trench).

d) The depth to any underlying rock stratum or water table is to be determined if within 2m of the proposed trench invert level.

e) Provision of borehole log evaluation of soil types.

f) Recommended offset of trench from buildings.

g) The likely impact, if any, to neighbouring properties including footings and basement areas.

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

a) Designed by a Consulting Engineer with documented experience in stormwater disposal via infiltration.

b) The trench system must fully infiltrate the 20 year ARI runoff from all impervious areas for all storm durations without surcharge onto neighbouring properties. Impervious areas include all roofs, paved areas and pools.

c) Any proposed additional pervious area must also be included.

d) Design is to be by the Design Storm or Hydraulic Effectiveness Methods (refer Water Sensitive Urban Design Guidelines for South East Queensland)

e) The maximum saturated hydraulic conductivity value that may be used for design purposes is 360mm/hr.

f) 40-75 mm gravel can be assumed as being 40% void.

g) The base of the trench is to be at least 1.0 m above the underlying watertable or rock stratum if present.

h) 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.

i) An upstream siltation and trash arresting pit or other approved pre-treatment system to remove sediment and gross pollutants must be provided.

j) 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).

## 4.8 Pump-out Systems

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

2. 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).

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

4. Noise levels must not affect neighbouring properties above recognised standards.

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

# 5. Site Drainage

Appropriate site drainage via the capture and conveyance of stormwater needs to be suitably managed so that it does not constitute a potential hazard or nuisance to persons or property including adjoining property. The following measures are to apply:

1. Site drainage shall be in accordance with the Northern Rivers Local Government Development Design and Construction Manuals and relevant Australian Standards.

2. For building works, 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:

    a) impervious areas including roofs, paved areas and driveways;

    b) areas subject to changes to natural ground level including cut or filled areas; and

    c) areas where the natural or pre-development overland flow regime is disrupted to the potential detriment of an adjoining property.

3. 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. Concentrated, collected or diverted stormwater flow onto an adjoining property must be at a lawful point of discharge.

# 6. On-Site Stormwater Detention (OSD)

## 6.1 Where is On-site Stormwater Detention (OSD) Required?

On-site stormwater detention systems must be provided for all development that may cause a negative impact on adjoining properties due to increased peak stormwater flows. The following measures are to apply:

1. OSD shall generally apply to all development, including the following:
    a) residential, commercial and industrial;
    b) schools, hospitals, community services and other institutions;
    c) public buildings;
    d) impervious car parks; and
    e) tennis and other impervious playing courts.
2. OSD is not required in the following circumstances:
    a) where the total net increase in impervious area is less than 150 $m^2$
    b) for a dwelling house unless a restriction on title specifies otherwise;
    c) for development on land zoned rural or large lot residential unless needed to provide a lawful point of discharge;
    d) where the site drains directly to a trunk drainage system within the tidal reach of a river or stream;
    e) where the site is located within a catchment within which a regional detention structure has been provided for the ultimate development of the catchment;
    f) where infiltration is used as the means of stormwater discharge from the site; or
    g) 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.
3. Where subdivision works will not significantly increase undeveloped flow from the site, Council may accept on-site stormwater detention to be delayed until building works are carried out on the allotments. In such cases, a restriction on use must be created on each vacant allotment that prohibits building works until the proprietor has constructed or made provision for the construction of an on-site stormwater detention system to the requirements of Byron Shire Council.

## 6.2 Siting of On-site Stormwater Detention Systems

On-site detention systems are to be designed and constructed to be compatible with other aspects of site planning. On-site stormwater detention storage areas must be located:

    a) at an appropriate location, generally near the lowest point of the site;

b) so as to collect runoff from all roofed and paved areas of building works. 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;

c) 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;

d) as part of the overall development scheme for the site;

e) so that pedestrian movements will be clear of the top water level for storms up to the 5 year ARI;

f) 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;

g) wholly within the allotment unless drainage easements are provided over the entire shared drainage and detention system up to the full extent of ponding;

h) to ensure that no upstream pits have grate levels lower than the detention top water level; and

i) so that access to the system is readily available and not via any enclosed structures.

## 6.3 Storage Volume and Permissible Site Discharge

The total post-development stormwater flow is controlled to be no greater than the pre-development flow for all storm events up to the 1 in 100 year ARI. The following measures are to apply:

1. The peak flow from the proposed development for the 5, 10, 20, 50 and 100 year ARI events, for all durations from 5 mins to 3 hours, must not exceed the existing peak flow from the site i.e. post development flow must not exceed pre-development flow in accordance with the NRLG Development and Design Manual and handbook of Stormwater Drainage Design.

2. Stormwater flows, average recurrence interval (ARI), time of concentration, and runoff coefficients shall be in accordance with the NRLG Development and Design Manual and handbook of Stormwater Drainage Design and the relevant Australian Standard (currently AS/NZS 3500.3).

3. Rainfall intensity should be in accordance with the following tables.

   a) 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 |

| Duration | Average Recurrence Interval | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 5 | 10 | 20 | 50 | 100 |
| **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 |

b) 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 |
| **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 |

c) 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 |

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

5. For building works with catchment areas less than 2,500m$^2$, Council may accept on site stormwater detention to provide for the total developed 20 year ARI flow from the site to be controlled to be no greater than the undeveloped 5 year ARI flow from the site. The 1 in 100 year ARI developed flow from the site shall be checked to ensure it does not exceed the 1 in 100 year undeveloped flow from the site. OSD calculations are to be submitted in accordance with the On-site Stormwater Detention Design Summary Sheet.

## On-site Stormwater Detention Design Summary Sheet

**Developed Area** = $m^2$ (Refer Section 5)

**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 and calculations for the checking of the 100 year ARI pre and post development flows.**

## 6.4 On-site Stormwater Detention System Design

On-site detention systems are designed in accordance with recognised engineering practices, and be compatible with other aspects of site planning and to minimise the need for maintenance. The following measures are to apply.

1. Detention tanks

   Storage tanks should meet the following design criteria:

   a) Floors of tanks shall be graded at a minimum slope of 1:100 towards the outlet, to minimize ponding and depositing of debris.

   b) No permanent storage of water.

   c) Tank is free draining by gravity to the public drainage system.

   d) Tank levels are such that water cannot flow from the public drainage system into the tank.

   e) Pipework connecting directly to the tank has sufficient hydraulic capacity for the design ARI flow.

   f) Provision of hydrostatic valve in areas subject to high water table.

   g) Surface flows are directed to the tank, with suitable provision for their inlet.

   h) An inspection/access opening shall be provided above the location of the outlet with dimensions at least 600 mm x 600 mm or 600 mm diameter for storages up to 800 mm deep and 600 mm x 900 mm for deeper storages. There shall be no impediments to the removal of debris through this opening. Inspection shall be possible without residents or owners having to remove heavy access covers.

   i) When storages are not sufficiently deep to work in (i.e. less than 1.5 m deep), access shall be provided at intervals of approximately 10 m to allow the system to be flushed to the storage outlet. Adequate access shall be provided at the outlet.

   j) A sump (with a base level set below that of the main storage) shall be provided at the outlet point, set below the level of the main storage to collect debris. Where a discharge control pit is included in the storage, this shall be consistent with the requirements of control devices set out below. Sumps shall be provided with adequate weepholes to drain out to the surrounding soil, and shall be founded on a compacted granular base.

   k) Tanks of clear internal depth less than 0.75m are to be designed to require no internal maintenance. All inlet pipes must enter the tank under the access grate over the tank outlet.

   l) Provision of adequate internal ventilation.

   m) Tanks that are more than 1.2m deep incorporate step irons to enable access.

   n) Structural design of the tank is compatible with vehicular, hydraulic, soil and other loadings on the tank.

o) Provision of at least 300mm of soil cover where proposed under landscaped areas.

p) Excavation influence line must not affect footings of adjacent or neighbouring structures or properties.

2. Driveways and parking areas

Storage areas located within sealed driveways or parking areas must meet the following design criteria:

a) Ponding depth is less than 200mm.

b) Minimum paving slope of 1:100.

c) The top level of kerbs or other water-retaining structures is at least 50mm above the level of flow over the spillway.

3. Landscaped areas

Detention storages incorporated into landscaped areas should satisfy the following criteria:

a) The design demonstrates compatibility with the overall site layout and landscaping.

b) 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 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.

c) 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.

d) Grassed surfaces with a minimum grade on the floor of the storage to the outlet of 2%.

e) Subsoil drains are to be provided around outlets to prevent the ground becoming saturated during prolonged wet weather.

f) Where the storage is located in areas where frequent ponding could cause maintenance problems or inconvenience, the first 10% to 20% of the storage required be in an area which can tolerate frequent inundation, such as a paved outdoor entertainment area, a small underground tank, a permanent water feature, or a rockery.

g) At least 0.15m freeboard to the top of the perimeter wall is provided from the spillway invert level.

h) Sediment or other debris from adjoining landscaping is prevented from entering the storage area and drainage system.

i) Batter slopes do not exceed 1V:4H. Batter slopes allowing maintenance access do not exceed 1V:6H.

4. 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.

5. Pipework

Minimum pipe grade, cover and pipe installation, where not otherwise specified, must be in accordance with the relevant Australian Standards, currently AS/NZS 3500.3:2003.

6. Stormwater Pits

Minimum internal dimensions, fall across pits, inlets and installation, where not otherwise specified, must be in accordance with the relevant Australian Standards, currently AS/NZS 3500.3:2003.

7. Control devices and outlets

a) Hydraulic control devices must be non-removable.

b) Screens must be fitted to storage outlets so as to meet the following criteria:

i) discharge control devices are totally enclosed;
ii) the screen area is a minimum of 450mm x 450mm, or 50 times the area of the orifice outlet, whichever is the greater;
iii) mesh spacing is equivalent to galvanised Lysagts RH 3030 Maximesh;
iv) screens are designed to retain leaf litter and other trash without blocking the outlet;
v) screens are at least 100mm away from the discharge control device; and
vi) screens are easily removable, durable and provided with a handle for cleaning.

c) A sump 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:

i) minimum depth of 200mm below the invert of the orifice or choke pipe;
ii) minimum surface area of 450mm x 450mm; and

iii) provision of adequate weep holes (maximum diameter 20mm) in the base slab to drain out to the surrounding soil, and shall be founded on a compacted granular base.

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

e) Orifice plates are:

i) manufactured from minimum 200mm x 200mm flat stainless steel, 3mm thick

ii) machined to the dimensions as calculated, with edges smooth and sharp (not rounded)

iii) securely fixed over the outlet pipe by at least four M6 stainless steel masonry anchors

iv) minimum control diameter 25mm

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

g) Where downstream water levels vary depending upon channel flows, calculations utilise either:

i) the 100 years ARI level of the external system being connected to; or

ii) joint probability calculations are performed.

h) Where an orifice plate is used to control site discharge:

i) 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

ii) 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.

i) Where a choke pipe is used to control the site discharge, tailwater levels are as follows:

i) 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

ii) for systems draining directly to an open channel:

- the top of the channel

iii) for systems draining to another on-site detention system:

- the stored water level in the downstream storage

iv) 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.

## 6.5 Maintenance of On-site Stormwater Detention Systems

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

2. 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.

3. 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:

   a) Residential

      i) inspect system every six months and after heavy rainfall
      ii) clean system as required, generally at least once a year.

   b) Commercial/Industrial

      i) inspect system every three months and after heavy rainfall.
      ii) clean system as required. generally at least once every six months.

4. 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:

   a) where the storages are located.

   b) which parts of the system need to be accessed for cleaning and how access is obtained.

   c) a description of any equipment needed (such as keys and lifting devices) and where they can be obtained.

   d) the location of screens and how they can be removed for cleaning.

   e) permanent signs to indicate the maintenance requirements.

## 6.6 Construction and Final Approval of On-site Stormwater Detention Systems

The following is required for Certification and Final Approval for Onsite Stormwater Detention Systems.

1. Certificates of Compliance

   a) 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.

   b) 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:

i) state that the system will function in accordance with the approved designs, subject to satisfactory maintenance.

ii) identify any variations from the approved design.

iii) state that these variations will not impair the performance of the OSD system.

c) 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.

d) 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.

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

i) <u>Discharge Control Pits</u>

- 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.

ii) <u>Storage</u>

- 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.

iii) <u>Internal drainage</u>

- 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.

iv) 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.

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

2. 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:

a) 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.

b) Retaining walls

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

c) Underground storages

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

3. 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:

a) Discharge Control Pit

i) internal pit dimensions
ii) the diameter of the orifice plate or control device.
iii) verification that a screen has been fitted, as well as its location, dimensions and the minimum distance from the control device.

iv) verification that an appropriate flap valve has been fitted (if specified).
v) levels on the top and invert of the pit.
vi) internal diameter of the outlet pipe.
vii)

b) Storage

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

c) Internal drainage

i) pit surface levels.
ii) invert levels and diameters of pipes.
iii) location and levels of any floodways and/or overland flowpaths.
iv) sufficient spot levels to show site gradings and extent of areas not draining to the storage(s).

d) 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.

4. Construction Tolerances

a) 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.

b) 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: _____