North Byron Parklands

Technical Paper

Q

Stormwater Management Plan

ARDILL PAYNE & PARTNERS

Civil & Structural Engineers – Project Managers – Town Planners – Surveyors

STORMWATER MANAGEMENT PLAN

Prepared for:

North Byron Parklands

Tweed Valley Way & Jones Road,
Yelgun

A project of:
Billinudgel Property Pty Ltd
(Billinudgel Property Trust)

June 2010

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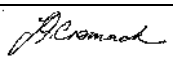
1	27.07.10			T. Cromack	
2					

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1 Introduction

Ardill Payne and Partners (APP) has prepared a Stormwater Management Plan (SWMP) for the proposed development of a world class sustainable cultural events site within an enhanced ecological setting at North Byron Parklands, Tweed Valley Way and Jones Road, Yelgun. The development includes the construction of new road pavements and site accesses, the upgrade of existing road pavements, the construction of a new crossing of Jones Road, and associated infrastructure works.

The SWMP employs the principles of Water Sensitive Urban Design (WSUD), which focuses on reducing pollutant export and storm flows as well as improving visual aesthetics of the urban landscape as a part of the greater concept of Ecologically Sustainable Design (ESD). A stormwater quantity and quality assessment has been undertaken as part of the WSUD treatment train selection process. The on-site detention and stormwater quality improvement devices chosen for the development will reduce post-development stormwater pollutant loads and storm flows in accordance with the compliance objectives in Byron Shire Council's Development Control Plan 2002 – Part N – Stormwater Management.

2 Director General's Requirements

The Director General of the Department of Planning determined that the proposal was a Major Project pursuant to Part 3A of the Environmental Planning and Assessment Act 1979, and issued Environmental Assessment Requirements (DGRs) on 25 August 2009. The DGRs that are addressed in this report are as follows:

- *Attachment 2, Concept Plan, 7.0 Stormwater Concept Plan – illustrating the concept for stormwater management from the site and must include details of any major overland flow paths through the site and any discharge points to the street drainage system. Where an on-site detention system is required, the type and location must be shown and must be integrated with the proposed landscape design. Site discharge calculations should be provided.*
- *Attachment 2, Project Application, 3.0 Stormwater Plan – a detailed stormwater management plan for the site and must include details of any major overland flow paths through the site and any discharge points to the street drainage system. Where an on-site detention system is required, the type and location must be shown and must be integrated with the proposed landscape design. Site discharge calculations should be provided.*

3 Objectives

The objectives of the Stormwater Management Plan are as follows:

- Reduce post-development stormwater flows to pre-development rates
- Improve post-development stormwater quality
- Provide aesthetic integration of stormwater infrastructure into the built environment
- Provide opportunity for stormwater reuse
- Provide a stormwater management system which embodies the principles of ESD, WSUD and industry best management practices.

The proposed Stormwater Management Plan will maximise the use of grassed and vegetated swales, and provide for infiltration where possible, to increase the level of pollutant removal and flow attenuation generated by the proposed development.

4 Existing Stormwater Situation

The site is located on the eastern side of the Tweed Valley Way at Jones Road, approximately 6.5km south of Mooball, 5.5km north of Brunswick Heads north turnoff, and 23.5km north of Byron Bay. A topographic map of the site is included in **Attachment 1**.

The application area comprises an area of approximately 155.9 ha. A large proportion of the site is low lying, low relief alluvial plains. Levels range from approximately RL.2.0m AHD in the east, gently rising to approximately RL.3.5m AHD in the west. A network of surface agricultural drains dissect the low lying areas of the site draining into Yelgun and Billinudgel Creeks.

The southern portion of the site (south of Jones Road) is located within the lower catchments of Yelgun and Billinudgel Creeks which form part of the Marshall's Creek floodplain. The northern portion of the site is within the Crabbe's Creek floodplain. The central portion of the overall site incorporates a low east-west ridge upon which Jones Road is located.

Numerous farm dams are located around the site. The most significant dam on the property has an estimated storage volume of 15.9ML.

Approximately 66% of the site is pasture land used for cattle grazing, while the balance is identified in Council mapping as High Conservation Vegetation.

Stormwater runoff pollutants which could typically be expected from the proposed development would be similar to those from a rural residential environment, due to the presence of roads, parking and landscaping areas. These pollutants would include:

- Suspended solids
- Gross Pollutants
- Nitrogen
- Phosphorus
- Hydrocarbons

5 Proposed Development

The proposed development of the site involves the following main construction activities:

- Site earthworks including filling of existing shallow grassed drains in event areas
- Internal road construction (spine road and event laneways)
- External road construction and widening, including new intersections
- A new crossing of Jones Road (either an underpass or an at-grade intersection)
- Stormwater drainage, including piped culverts, open drains and stormwater management facilities
- Wastewater treatment system, including the construction of a sewage treatment plant, effluent holding dams, effluent polishing wetlands, effluent irrigation areas and reticulation mains
- Water supply, including the construction of a water treatment plant, bulk water storage tanks and reticulation mains, and the construction of a new dam
- Electricity and telecommunication distribution cables (overhead and/or underground)
- Construction of an administration building and gatehouse
- Pedestrian pathways and bridges.

It is not proposed to construct all of the wastewater treatment system and water supply infrastructure in the initial stages – for further details and the proposed staging, refer to *'Integrated Water Cycle Assessment and Management, North Byron Parklands, Tweed Valley Way and Jones Road, Yelgun, NSW'*, Gilbert & Sutherland, May 2010.

An event area and land use structure plan is included in **Attachment 2**.

6 Proposed Stormwater Management

APP has undertaken a detailed review of the WSUD options available at the subject site. The selection criteria utilised in the decision making process included:

- Site constraints – including landform, existing flow paths, soil landscape and groundwater depth.
- Proposed design layout – aesthetics, new road and structure layouts and landscaping
- Construction / implementation costs
- Maintenance requirements – long term sustainability and costs
- Engineering– hydraulic / civil design requirements

Stormwater management concepts and management strategies are also discussed in the *'Integrated Water Cycle Assesment and Management, North Byron Parklands, Tweed Valley Way and Jones Road, Yelgun, NSW'*, Gilbert & Sutherland, May 2010.

7 Catchment Hydraulics

The 5, 10, 20, 50 and 100 year ARI flow for the subject site was calculated using the Probabilistic Rational Method (refer to **Attachment 3** for calculations). Australian Rainfall and Runoff 1987 recommends the use of the Probabilistic Rational Method for small catchments up to 250 km^2 in eastern NSW. **Table 1** details the Q100 parameters determined using this method.

Table 1: Summary of Q100 results from the Probabilistic Rational Method analysis for the subject site.

Time of Concentration	54 minutes
Rainfall Intensity	106 mm/hour
C_{10}	0.69
C_{100}	0.828
Catchment Area	155.9 Ha
Q_{100} Flow	**38 m^3/s**

Table 2: Results from the Probabilistic Rational Method analysis of pre and post-development conditions.

ARI Event	Pre-development (m^3/s)	Post-development (m^3/s)
5 year	18.6	18.6
10 year	23.6	23.6
20 year	29.1	29.1
50 year	32.5	32.5
100 year	38.0	38.0

It has been assumed for the purpose of this assessment that the catchment area includes only new permanent structures and impervious surfaces such as roads. All other factors affecting stormwater on the site are to remain as per the status quo and will thus not affect peak flows.

The post-development site will contain predominantly narrow gravel roads, approximately 600m^2 of permanent roof area, and several grassed carparking areas. The post-development site will have an increase in impervious area of less than 0.5%. This negligible increase in impervious areas has resulted in no measurable increase in post-development runoff from the subject site.

8 Open Drain Management

The principal man-made drains existing on the site will be retained. Some minor man-made drains (depth approx 300mm) in the public areas (areas of high pedestrian activity) will present operational difficulties for the site operators and will be a public hazard during events. These minor drains will be filled to improve the function of these areas. Only the shallow drains will be filled and only for the extent of the public areas. This filling will comprise free-draining crushed rock aggregate and subsoil drain pipes, with a topsoil overlay from site-won material. Shallow diversion drains will direct unpolluted upstream surface waters away from the drains being filled.

Generally new drains, other than the drain located north of Forest Block C (see below), will be shallow diversion drains (nom. 150mm deep). These diversion drains are to divert unpolluted runoff from upstream catchments around construction areas and event areas, and will discharge into existing drains.

A new open drain will be constructed in the eastern part of the site, approx. 5m north of Forest Block C, to duplicate an existing open drain which is 'embedded' in the edge of the forest. The existing drain has ceased to operate efficiently due to the accumulation of sediment, vegetation and detritus, and growth of trees in the drain. The existing drain is unable to be maintained as it supports endangered native vegetation. Construction of the new open drain will reduce the likelihood of any adverse environmental outcomes associated with the maintenance of the existing drain.

The dimensions of the proposed new open drain are of similar dimensions to the existing drain (approx 2m wide and from 0.6-0.8m deep, and approx 210m in length). It is possible that PASS will be encountered in the construction of the drain, however flora and fauna present in nearby drains of similar dimensions indicates that they are not subject to severe acid sulfate influences. It is recommended that the proposed drain be as shallow as practical to achieve the drainage effect required, and that drain maintenance avoids any deepening of the drain.

9 On-Site Detention

Byron Shire Council's Development Control Plan 2002 – Part N5 – Stormwater Management – Onsite Stormwater Detention provides guidelines to engineers and consultants when calculating on site detention requirements for new developments within the Byron Shire region. The guidelines stipulate on Page N12 of the document that an on-site detention system is not required in the following circumstances:

'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 the 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 the 100 year ARI event.'

The post-development site will have an increase in impervious area of less than 0.5% of the total site area. This minor increase in impervious areas results in the post-development runoff peak remaining virtually unchanged from that of the pre-development peak for all storm events up to the Q100 ARI event.

Rainwater tanks are proposed to attenuate stormwater flows from all permanent structures, with reuse proposed in buildings and landscaping. Tank water shall be utilised as potable supply for the building and for other uses such as toilet flushing. Overflow from rainwater tanks shall be directed to other on-site storage facilities. Final sizing of rainwater tanks shall consider

proposed reuse requirements and shall be determined at Construction Certificate stage.

As mentioned in Section 4, there is an existing dam on the property with an estimated storage volume of 15.9ML. To enable the collection of the required volume of water demand for the site, and to ensure adequate performance of the supply network, Gilbert & Sutherland have proposed that a second dam be constructed with a minimum capacity of 6ML to capture additional surface water runoff. It is not proposed that this dam will be constructed in the initial stages of the project – staging of infrastructure is discussed in the Gilbert & Sutherland report. The dams will provide some OSD of stormwater runoff volumes, due to drawdown as water is reused around the site.

10 Water Sensitive Urban Design

In recent years there have been an increasing number of initiatives to manage the urban water cycle in a more sustainable way. The integration of the urban water cycle within the concept of Ecologically Sustainable Design is termed Water Sensitive Urban Design.

10.1 Grassed or Vegetated Swales

Grassed swales are a shallow, low gradient, grass lined drainage channel used to convey and treat concentrated stormwater runoff. The swale may be landscaped and vegetated (vegetated swale), or include subsoil filtration media and an underdrain (bio-retention swale).

Bio-retention swales provide both stormwater treatment and conveyance functions. The swale component provides pre-treatment of stormwater to remove coarse to medium sediments while the bio-retention system removes finer particulates and associated contaminants. **Figure 1** is a typical section for a bio-retention swale.

Grassed and vegetated swales treat stormwater by settling, filtration and infiltration. They remove pollutants such as coarse and medium sediment, nutrients and hydrocarbons. The interaction between flow and the vegetation along swales facilitates pollutant settlement and retention. **Figure 2** is a typical section for a vegetated swale.

Figure 1– Typical Bio-retention Swale Section

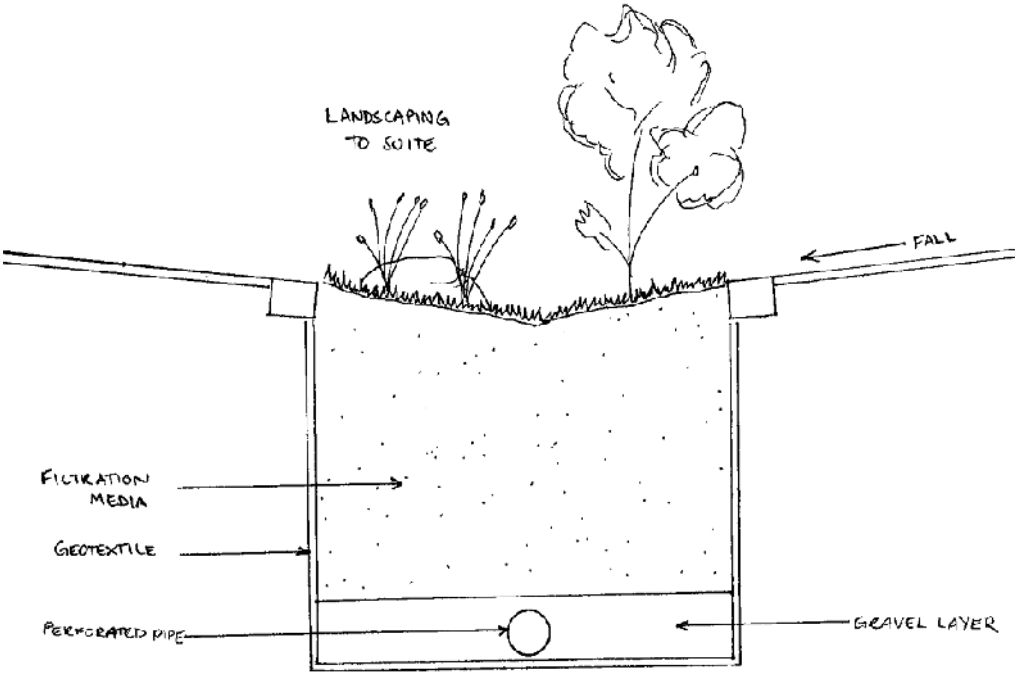
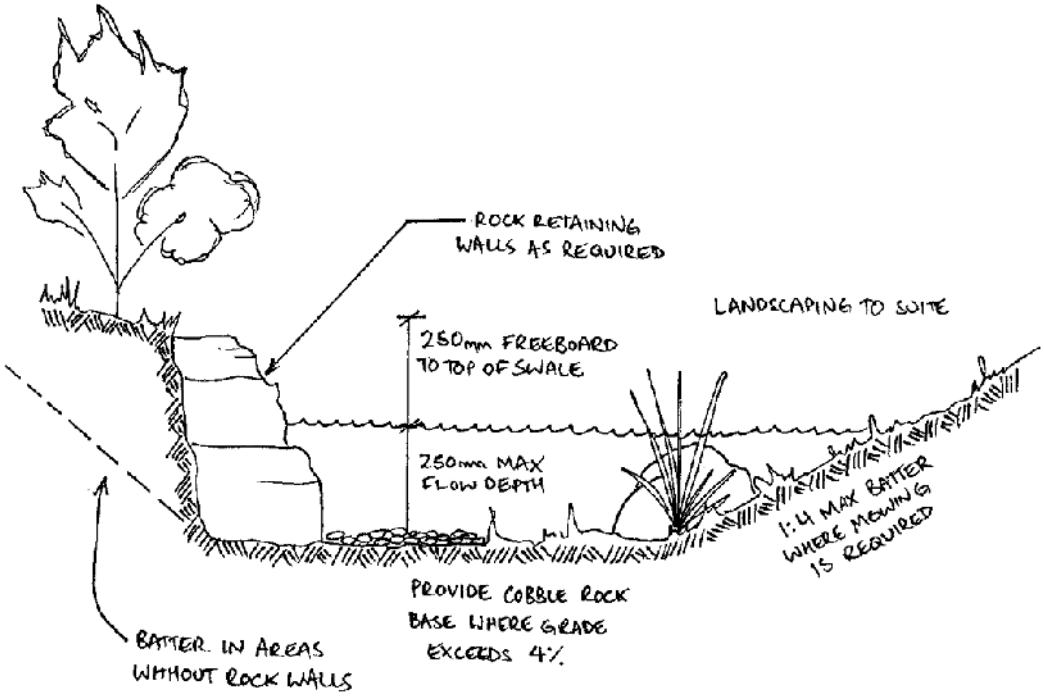


Figure 2– Typical Vegetated Swale Section



10.2 Rainwater Tanks

Rainwater tanks are proposed to attenuate and treat stormwater from all permanent structures. Rainwater tanks provide excellent attenuation of flows and reduction in nutrients (through gaseous exchange and settlement of suspended solids) when water is reused in buildings and landscaping. The provision of a rainwater tank with a permanent storage volume will also reduce the water demand of the building. Tank water shall be utilised as potable supply for the building and for other uses such as toilet flushing.

Where possible, overflow from rainwater tanks shall be directed to other on-site storage facilities. Final sizing of the rainwater tanks shall be determined at Construction Certificate stage.

Rainwater tanks are low maintenance systems. Maintenance consists of the following:

- Routine inspection (half yearly) of roof areas to ensure that they are kept relatively free of debris and leaves.
- Cleaning out first flush devices once every three to six months.
- Regular inspection of all screen inlet and overflow points every six months.
- Removal of sediments and sludge accumulated at base of tank every two to three years.

10.3 Gross Pollutant Traps

Gross pollutant traps (GPTs) are effective primary treatment measures and will be provided upstream of the main stormwater drains to collect larger items from the water, such as food containers, plastic bottles and plastic bags. Smaller pollutants, such as dirt, chemicals, heavy metals and bacteria are not collected directly by the GPTs; however, some small particles are caught up in the larger items in the trap and thus prevented from leaving the site.

Collection and disposal is via an environmentally controlled waste management plan. There is also the risk of further pollution occurring if the trap is cleaned infrequently; biochemical reactions take place between pollutants in the store area and the by-products can be washed into the waterway, especially in overflow conditions. Gross pollutants shall be removed every three to six months and daily during events.

GPT's will generally be in the form of a litter screen in the drains, however the following factors shall be considered in GPT design:

- Size of pollutants to be caught in that location
- Physical space available for the trap
- Maintenance access
- Estimated loading in the area

Final locations and product selection shall be determined at Construction Certificate stage.

11 Stormwater Quality

Gilbert & Sutherland undertook an assessment of potential Integrated Water Cycle Management options for the North Byron Parklands site. Their report concluded that *"MUSIC modeling has been used to demonstrate the proposed development will have no adverse impacts on the quality of waters discharging from the site."*

It is impractical to establish a detailed model of the post development site using MUSIC to determine changes in the post development water quality for the following reasons;

1. The site is 155.9 Ha with an expected increase in impervious area of less than 0.5%
2. Any decrease in post development water quality as a result of the increase in impervious areas would be negligible
3. A treatment train comprising of rainwater tanks, GPT's and vegetated swales will provide more than sufficient treatment of event areas and roads and any pollutants generated as a result of the development.

Table 3 provides typical removal efficiencies of the proposed stormwater treatment devices.

Table 3: Typical removal efficiency of stormwater treatment devices (Managing Urban Stormwater: Treatment Techniques, NSW EPA 1997)

Treatment Device	Litter (%)	Nutrients (%)	Oil and Grease (%)	Sediments (%)
Rainwater Tanks	80 – 90	10 – 20	Nil	80 - 90
Vegetated Swales	50 - 60	40 - 50	70 - 80	75 - 85
GPT's	85 - 95	10 - 20	Nil	70 - 80

Table 3 highlights the effectiveness of each treatment device under normal urban conditions (i.e large sediment, nutrient, grease and oil loads). The expected pollutant loads from road and roof areas within the development will be similar to a rural environment. With scheduled maintenance and proper care of all treatment devices it is expected that pollutant removal rates will comply with those established in Table 3.

12 Conclusion

The SWMP developed by Ardill Payne and Partners has determined that there will be no measurable increase in runoff volumes and pollutant concentrations discharging to the existing drainage network.

To achieve these improvements, stormwater flows have been directed to grassed or vegetated swales rather than standard pits and pipes. Litter screens provided in open drains will capture gross pollutants before they leave the site. Rainwater tanks will be provided on all permanent buildings, with reuse proposed throughout the building. New and existing dams will reduce the volume of stormwater runoff leaving the site.

A comprehensive water cycle management strategy for the site has been proposed in the *'Integrated Water Cycle Assesment and Management, North Byron Parklands, Tweed Valley Way and Jones Road, Yelgun, NSW'*, prepared by Gilbert & Sutherland.

The approaches adopted provide attenuation of flows and are aesthetically congruent within the rural setting.

13 Scope of Engagement

This report has been prepared by Ardill Payne & Partners (APP) at the request of Billinudgel Property Trust for the purpose of preparing a Stormwater Management Plan for the proposed cultural events site at North Byron Parklands, and is not to be used for any other purpose or by any other person or corporation.

This report has been prepared from the information provided to us and from other information obtained as a result of enquiries made by us. APP accepts no responsibility for any loss or damage suffered howsoever arising to any person or corporation who may use or rely on this document for a purpose other than that described above.

APP declares that it does not have, nor expects to have, a beneficial interest in the subject project.

To avoid this advice being used inappropriately it is recommended that you consult with APP before conveying the information to another who may not fully understand the objectives of the report. This report is meant only for the subject site/project and should not be applied to any other.

14 Attachments

Attachment 1 Topographic Map

Attachment 2 Event Layout and Land Use Structure Plan

Attachment 3 Rational Method Calculations

Attachment 4 Site Drainage Plans

ATTACHMENT 1

Attachment 1
Topographic Map

Do not scale drawing. Use written dimensions only
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Client: Billinudgel Property Trust

Title: North Byron Parklands - Regional Location

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Scale at A4	NTS	Datum	-
Design	TC	Date	June 2010
Drawn	NB	File	6883 LocPlan.dwg
Dwg No.	LP.01	Job No.	6883

ATTACHMENT 2

Attachment 2
Event Layout and Land Use
Structure Plan

Legend:

The Site | Extents of Application Area (Dashed) | Car Parking

Event Area | Conference Centre Uses | Cultural Centre/Administration Uses | Gatehouse

Spine Road (7m wide) | Event access lane (6m wide) | Main pedestrian route

North Byron Parklands

0 160m

1:8000 (@ A3)

Prepared by

design team ink

Date 21.07.10

Author SDR

Reference 09_120

IMPORTANT NOTE |
Cadastral information is subject to survey. The alignment of the aerial photograph and vectorial overlays is approximate only. This plan is conceptual only and subject to detailed survey and design.

Sources | Aerial Photography: Bill Mills (2009) | **Cadastre:** Ardill Payne (2009) | Major contour = 5m | Minor contour = 1m

Plan | **1.2**

Event Area and Land Use Structure 14

North Byron Parklands | Tweed Valley Way & Jones Road

ATTACHMENT 3

Attachment 3
Rational Method Calculations

ARDILL, PAYNE & PARTNERS

JOB NO. 6883
PAGE: 1
DATE: 15/6/2010
ENGR: A.F

JOB NAME: PARKLANDS BYRON BAY
SUBJECT:

AREA = 155.9 Ha

$t_c = 0.76A^{0.38}$

$= 0.76(1.559\ km^2)^{0.38}$

$= 0.899$ hours

$= 54$ minutes

$C'_{10} = 0.1 + 0.0133(^{10}I_1 - 25)$

$= 0.1 + 0.0133(70-25)$

$= 0.69$

$\therefore C_{10} = 0.69$

$C_5 = FF_y C_{10}$

$= 0.92 \times 0.69$

$= 0.64$

$Q_5 = 1/360 CIA$

$= 0.00278 \times 0.64 \times 67 \times 155.9$

$= 18.6\ m^3/sec$ PEAK

$C_{10} = 0.69$

$Q_{10} = 23.6\ m^3/sec$ PEAK

$C_{20} = 1.07 \times 0.69$

$= 0.738$

$Q_{20} = 29.1\ m^3/sec$ PEAK

$C_{50} = 1.15 \times 0.69$

$= 0.79$

$Q_{50} = 32.5\ m^3/sec$ PEAK

$C_{100} = 1.2 \times 0.69$

$= 0.828$

$Q_{100} = 38.0\ m^3/sec$ PEAK

$I_5 = 67$ mm/hr

$I_{10} = 74$ mm/hr

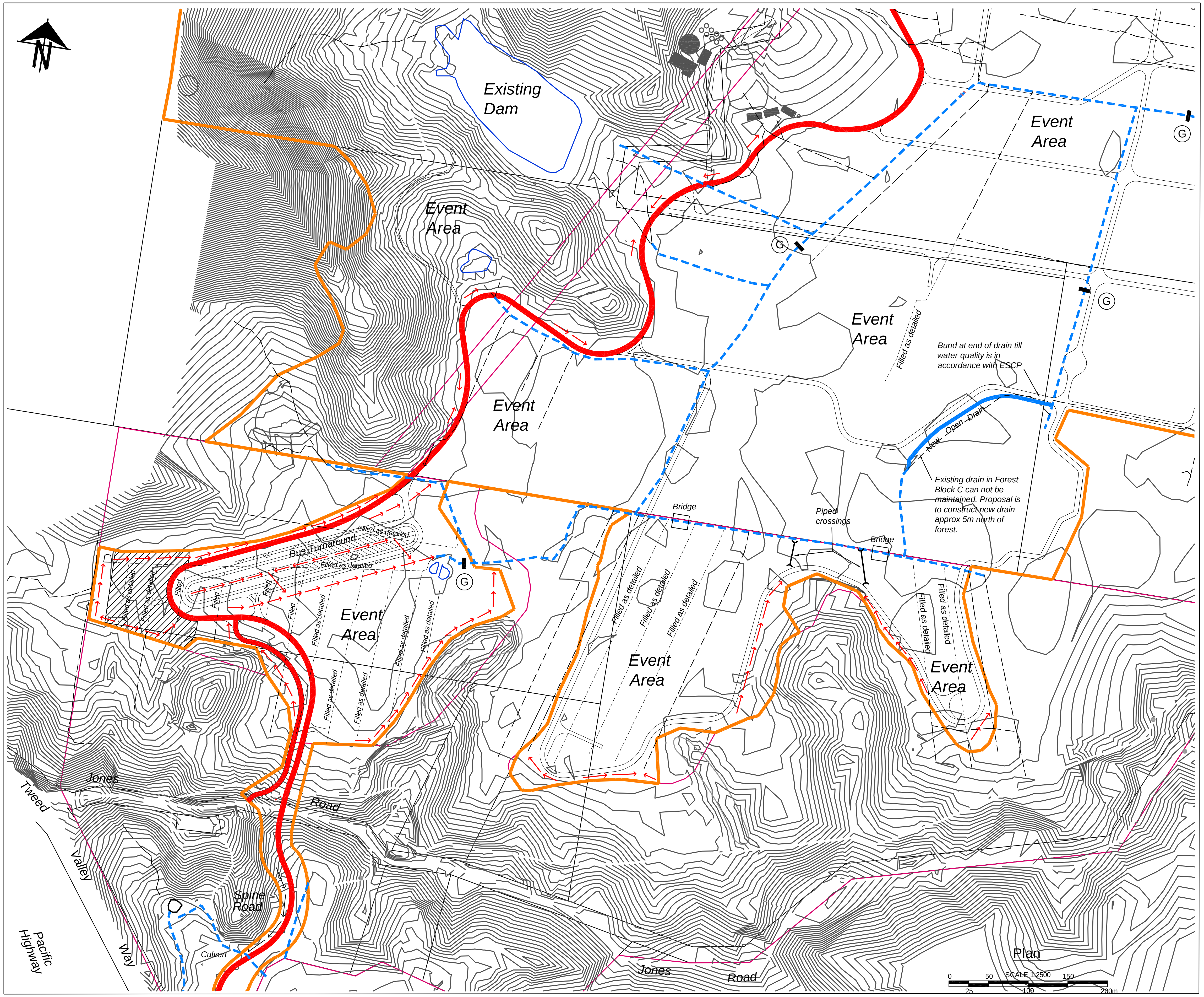
$I_{20} = 85$ mm/hr

$I_{50} = 95$ mm/hr

$I_{100} = 106$ mm/hr

ATTACHMENT 4

Attachment 4
Site Drainage Plans



Legend

- Spine Road
- Event Laneways
- Diversion drains & vegetated swales
- New open drains
- Existing main drains
- Existing minor drains
- Existing drains to be fille
- G Gross pollutant traps (coarse mesh screen in drain, or similar)

Shallow Diversion Drains:
to divert unpolluted surface runoff from upstream catchments around event areas and into existing drains.

New Open Drain:
to duplicate an existing open drain in Forest Block 'C' that cannot be maintained. The new drain is necessary for the efficient operation of the site drainage network.

Existing Main Drains:
to be retained. Convey main stormwater flows through and off the site.

Existing Minor Drains:
to be retained where noted on plan. Convey surface flows from small site catchments to the main drains.

Filled Drains:
some minor drains in public areas (high pedestrian activity) will be filled to improve the function of these areas. Subsoil drains will convey runoff to the main drains

Issue	Date	Amendment	App'd

Client: Billinudgel Property Trust

Project: **North Byron Parklands**
Tweed Valley Way & Jones Road
Wooyung

Title: Site Drainage Plan

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Design	TC	Scale at A1	as shown
Drawn	TC	Datum	-
Date	June 10	Filename	6883-SWMP
Checked		Approved	
Job No.	6883	Dwg. No.	SW3
Issue			