AURA PRECINCTS 6 - 10 & 16

STORMWATER QUALITY MANAGEMENT PLAN

PLANS AND DOCUMENTS
referred to in the PDA
DEVELOPMENT APPROVAL

Approval no: DEV2013/469

Date: 09/11/2016

DesignFlow

Prepared for Stockland

June 2016

Document Control Sheet

Report Title:	Aura Precincts 6 - 10 & 16 Stormwater Quality Management Plan
Suggested Reference:	DesignFlow, 2016, *Aura Precinct 6 - 10 & 16 Stormwater Quality Management Plan*
Version:	01
Client:	Stockland
Author(s):	Robin Allison, Shaun Leinster
Approved By:	Shaun Leinster
Date:	10 June 2016
File Location:	S:\Projects\4290
Circulation:	Stockland

Disclaimer

SUMMARY

Precincts 6-10 & 16 of the Aura masterplan development cover 642ha of which 253ha is to be a mix of residential, town centre, commercial, school and parkland. The area drains into a State Government declared High Ecological Value area (Pumicestone Passage) as well as Ramsar listed wetlands. Consequently requirements for comprehensive stormwater quality improvement from the site are imperative. Stormwater quality objectives for development runoff from Aura have been determined as part of a wider water quality assessment of Bells Creek and Pumicestone Passage.

This document describes the stormwater quality management strategy for Aura Precincts 6 – 10 and 16 to meet the stormwater quality objectives. This strategy builds on previous stormwater quality management proposals for the site by proposing wetland and bioretention stormwater treatment systems around the perimeter of the development prior to discharge into Bells Creek (north & south reaches). It has less reliance on at source streetscape stormwater treatments and therefore greater flexibility to adjust the design in response to unforeseen constraints.

The principles of the strategy focus on not treating already treated water. The end of pipe wetlands direct treated flows into nearby waterways and pass their overflows into bioretention systems. The bioretention systems direct treated flows to the creeks and overflows pass through swales before entering the creeks. This approach for the treatment systems requires less hydraulic head to operate (than the previous strategy) and has been integrated with the earthworks and drainage for the site to ensure these system can function.

In addition to the end of pipe systems, rainwater tanks are proposed for all residential areas (for toilets, laundry and outdoor uses), GPTs are proposed for ground level runoff from commercial lots and biopods are proposed within the town centre car parks. Space has also been allowed in the development layout for streetscape biopods.

The treatment strategy meets the requirements for stormwater quality improvement to ensure there are no adverse impacts on Bells Creek and Pumicestone Passage. This includes reducing annual pollutant loads by 93% for suspended solids, 83% for total phosphorus and 62% for total nitrogen.

The load of stormwater pollutants will be further reduced when the stormwater harvesting proposal for the site is implemented.

Table of Contents

Figures

Tables

1 Introduction

The Aura development site has been the focus of extensive water quality and stormwater quality management investigations over the last 10 years. This work has established the water quality characteristics of the receiving waterways (i.e. Bells Creek), monitored the quality of stormwater quality exiting the site, completed extensive catchment and receiving waterbody modelling, established water quality objectives and defined stormwater treatment strategies to meet these objectives. These requirements are now included in Federal and State Government approvals for the site.

The *Caloundra South Precincts 6 to 10 & 16: Stormwater Quality Management Plan* (BMT WBM, October 2015) was completed and submitted to Economic Development Queensland (EDQ) to support a development application. The report outlined the stormwater treatment strategy for Precincts 6-10 & 16.

This report presents a refined stormwater quality management strategy for Precinct 6 – 10 & 16 of Aura reflecting more recent investigations and further consideration of site constraints and proposed development levels. The revised strategy ensures the stormwater quality objectives for Aura are achieved using treatment measures that respond to the site constraints while providing flexibility through future detailed design.

The report builds on the MUSIC modelling presented in earlier stormwater quality management plans and focuses on achieving required stormwater quality improvements to meet the nominated objectives. This report does not present any new receiving water quality modelling as the modelling presented in BMT WBM (2015) is still considered relevant.

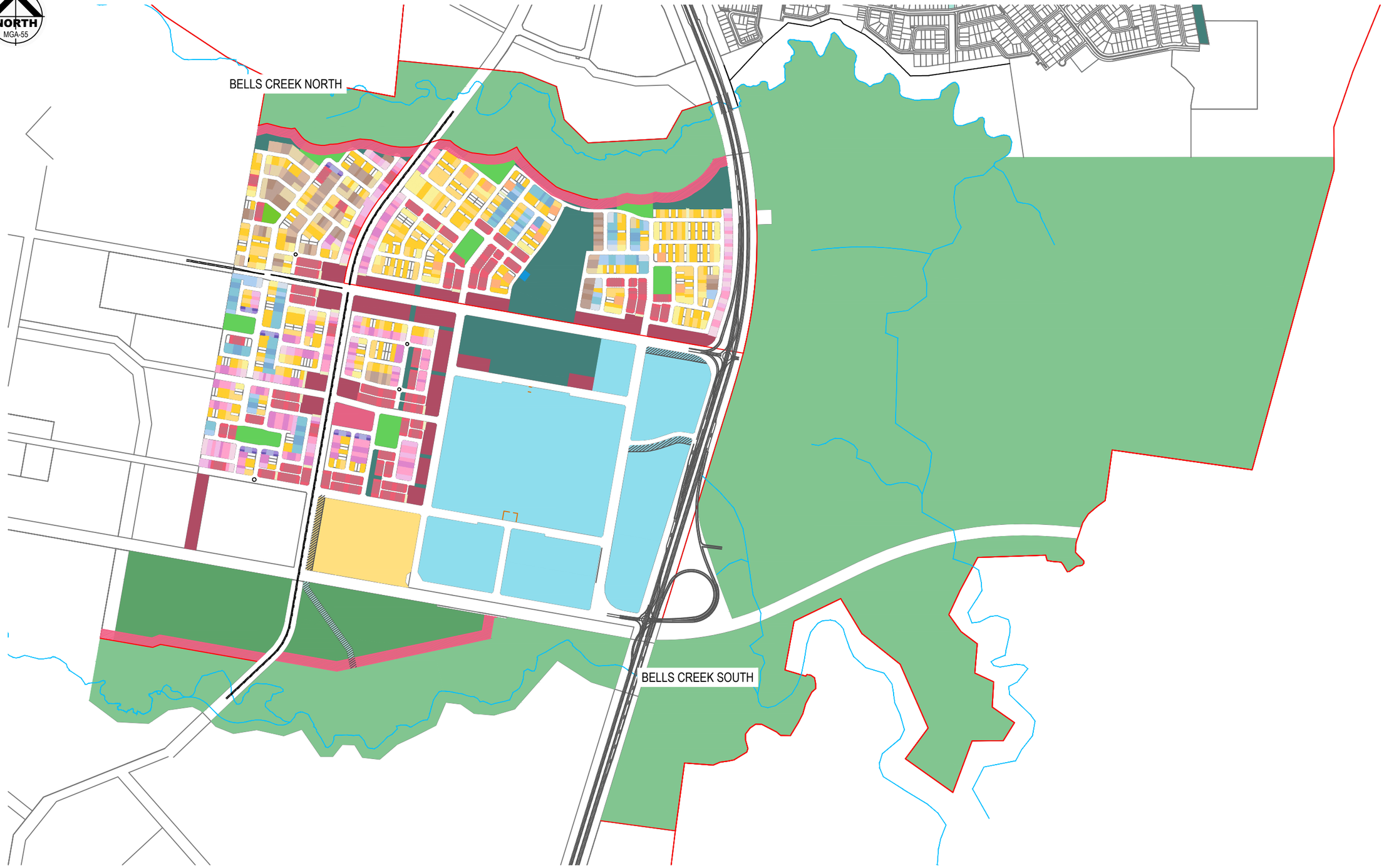
1.1 Precinct 6 - 10 & 16 Development

Precinct 6 – 10 & 16 is located in the middle of the Aura development site and south of Precinct 2 which is under construction (Figure 1). The development will involve the creation of 642 ha of urban development including 253ha of residential, commercial, town centre and major parkland areas (Figure 2). The remaining area will consist of infrastructure corridors (rail etc.) and ~360ha of conservation including Environmental Protection Zone, waterways, waterway buffers, frog zones and frog buffers.

REVISION	DESCRIPTION	DRAFTED BY INITS	DRAFTED BY DATE	CHECKED BY INITS	CHECKED BY DATE
D					
C					
B					
A	PRELIMINARY ISSUE	MJM	10.06.16	SL	10.06.16

DesignFlow
7 BAUER STREET, SOUTHPORT QLD 4215
P.O. BOX 1250 SOUTHPORT BC, SOUTHPORT QLD 4215
Ph: (07) 5528 1148
www.designflow.net.au

CLIENT	STOCKLAND
DRAWN	MJM
DATE	10.06.16
DESIGNED	SL
DATE	10.06.16
SCALE	NOT TO SCALE
	A3
PROJECT	AURA PRECINCTS 6 - 10 & 16 SWQMP
DRAWING TITLE	AURA PRECINCTS 6 -10 & 16 LOCATION
PROJECT No	4290
DRAWING No	FIGURE 1
REVISION	A



REVISION	DESCRIPTION	DRAFTED BY INITS	DRAFTED BY DATE	CHECKED BY INITS	CHECKED BY DATE
D					
C					
B					
A	PRELIMINARY ISSUE	MJM	10.06.16	SL	10.06.16

ISSUED FOR
PRELIMINARY
NOT FOR CONSTRUCTION

DesignFlow
7 BAUER STREET, SOUTHPORT QLD 4215
P.O. BOX 1250 SOUTHPORT BC, SOUTHPORT QLD 4215
Ph: (07) 5528 1148
www.designflow.net.au

CLIENT	STOCKLAND
DRAWN	MJM
DATE	10.06.16
DESIGNED	SL
DATE	10.06.16
SCALE	NOT TO SCALE
	A3
PROJECT	AURA PRECINCTS 6 - 10 & 16 SWQMP
DRAWING TITLE	EXISTING LAND USE, TOPOGRAPHY AND DRAINAGE
PROJECT No	4290
DRAWING No	FIGURE 2
REVISION	A

DATE PLOTTED: 10 June 2016 2:02 PM BY: MICHAEL MATHERS
XREF: SURF4290_DESIGN; XREF4290_AERIAL; XREF4290_DF BASE_LOCAL; XREF4290_Cal South ROL 05-05-2016-Local Grid; XREF4290_FROG HABITAT; XREF4290_CONSTRAINTS; XREF4290_CATCHMENTS AND WATERWAYS
FILE: S:\PROJECTS\QLD ACTIVE\4290 CALOUNDRA SOUTH\DRAFTING\WORKING\WORKING DRAWINGS\4290_D9998_SWQMP FIGURES.DWG

2 Site Characteristics

The description of the site presented here relates to elements that the affect stormwater quality management strategy for Precincts 6 - 10 & 16. More thorough site descriptions of soils, geology, climate, vegetation and habitats are not replicated as these are covered in other reports relating to the site.

2.1 Landuse

Precincts 6 - 10 & 16 cover approximately 642 hectares of predominantly cleared grazing land. The area is bordered by Bells Creek to the north, south and east with the creek and riparian edge being well vegetated with mature vegetation (Figure 3).

2.2 Topography and drainage

The site slopes generally from west to east with small parts of the site shedding flows both north and south into the reaches of Bells Creek. With such a large site with mild grades, there is some flexibility to direct runoff to different areas where it suits the overall stormwater management approach.

Existing elevations of the proposed development pad range from approximately 10m AHD in the west to 3m AHD on the eastern edge of the area. Bells Creek North and Bells Creek South have invert levels of approximately 4m & 1.5m AHD respectively at the eastern edge of the development area.

The development pad will need to be raised above predicted flood levels along Bells Creek and this offers some flexibility in shaping the area to direct stormwater flows to where there are suitable areas for treatment. This is discussed further in Section 4.1.

2.3 Bells Creek (north and south reaches)

Bells Creek is a healthy waterway which supports a range of wetland and riparian flora and fauna (see photo below). The condition of the creek, including water quality, has been extensively monitored and presented in other reports and is not covered here.

The total catchment of Bells Creek including the Aura development is 4444ha (Figure 4). Precinct 6-10 & 16 form 642ha of this catchment with the actual residential, commercial and parkland urban footprint being 253ha (5.7% of the catchment).

Protection of Bells Creek and the downstream Pumicestone Passage are a critical component of the Aura development and stormwater runoff from the whole area is required to meet a general "no worsening" water quality condition in Pumicestone Passage. This is discussed further with regard to the stormwater treatment objectives (Section 3).

2.4 Frog Habitat

Frog habitat has been identified across the Aura development for the following frogs which have federal or state significance:

- Wallum Sedgefrog
- Wallum Froglet
- Wallum Rocket Frog

Appendix A shows the location of Wallum Sedgefrog habitat. The management of the Wallum Sedgefrog is to occur in accordance with the approved *Caloundra South Wallum Sedge Frog Management Plan* (Stockland, December 2015). Sedgefrog habitat areas within the development footprint will be removed and compensatory sedgefrog habitat area recreated within the Aura development site (typically in frog zones and buffers as per Section 2.5). The existing sedgefrog habitat zones outside the development footprint, in particular in the Environmental Protection Zone (EPZ) east of the Bells Creek Arterial Road, will be preserved and stormwater treatment measures are required to avoid these areas where possible.

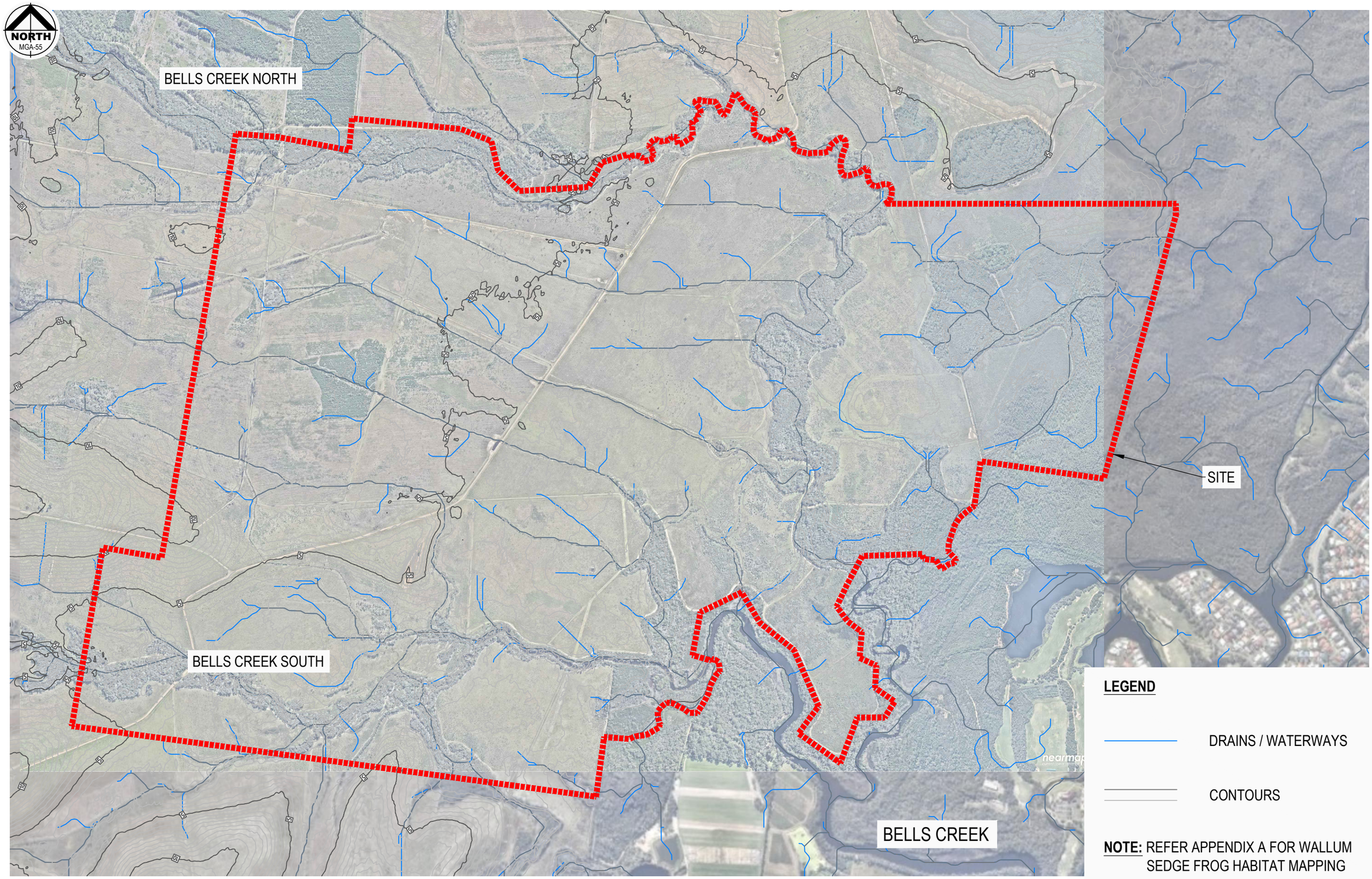
The Wallum Froglet and Wallum Rocket Frog will be managed in accordance with the *Caloundra South Acid Frog Management Plan* (Stockland, December 2015), the requirements of which are very similar to the Wallum Sedgefrog outlined above.

2.5 Waterway and Frog Buffers

To preserve and enhance the riparian function of Bells Creek and meet the requirements of the *Caloundra South Wallum Sedge Frog Management Plan* (Stockland, December 2015) and *Caloundra South Acid Frog Management Plan* (Stockland, December 2015), the development edges in Precincts 6 -10 are required to incorporate the following:

- 25m wide riparian buffers from top of waterway banks (for preservation and rehabilitation of riparian vegetation)
- 50m width Frog Zone (for creation of Wallum Frog habitat)
- 50m Frog Buffer (buffer to the Frog Zone and additional space for creation of Wallum Frog Habitat).

The Frog Buffer can incorporate some stormwater management as per *Caloundra South Wallum Sedge Frog Management Plan* (Stockland, December 2015). These areas are discussed further later in the report and are shown in Figure 8.



LEGEND

DRAINS / WATERWAYS

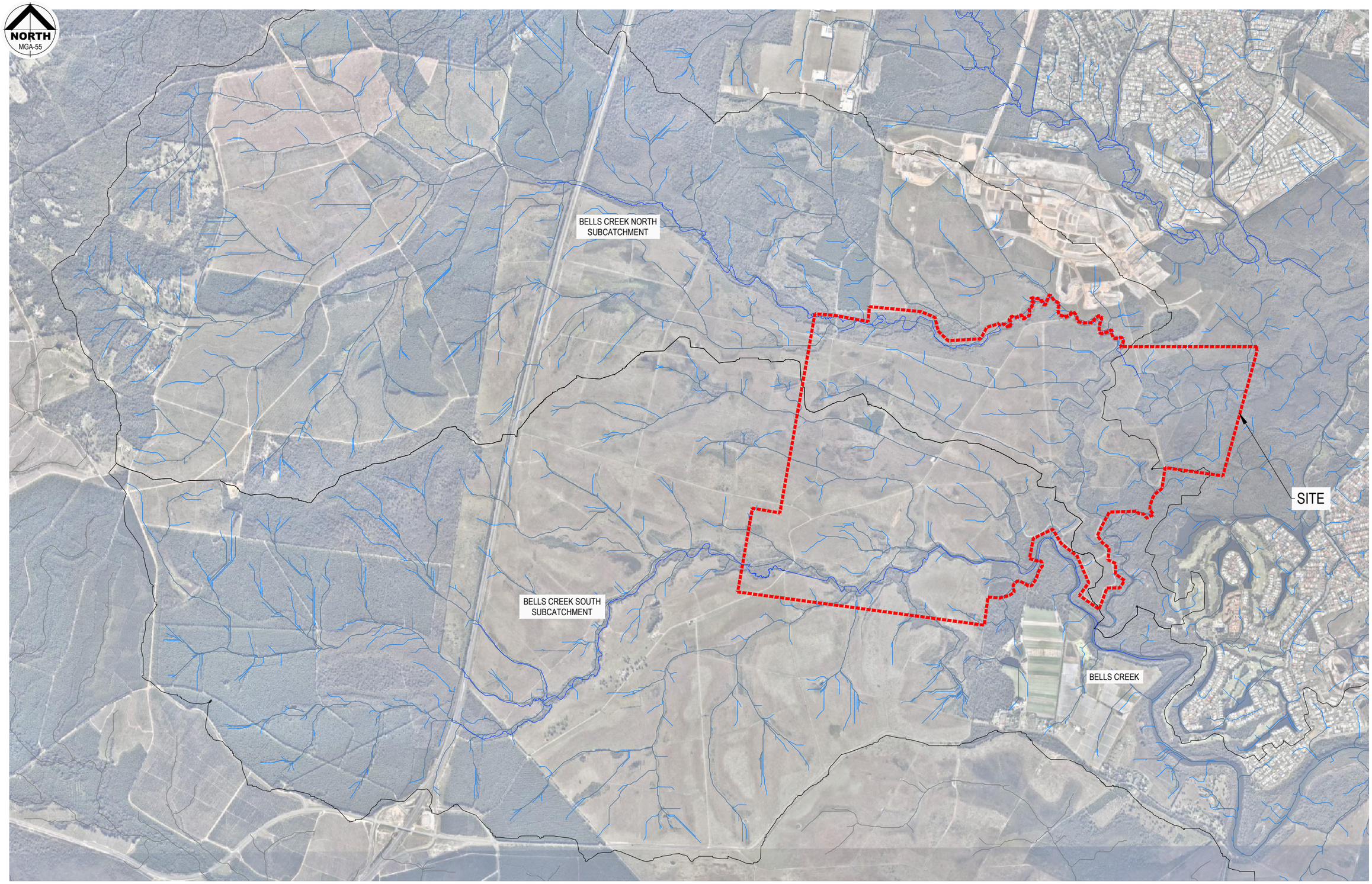
CONTOURS

NOTE: REFER APPENDIX A FOR WALLUM SEDGE FROG HABITAT MAPPING

REVISION	DESCRIPTION	DRAFTED BY INITS	DRAFTED BY DATE	CHECKED BY INITS	CHECKED BY DATE
D					
C					
B					
A	PRELIMINARY ISSUE	MJM	10.06.16	SL	10.06.16

DesignFlow
7 BAUER STREET, SOUTHPORT QLD 4215
P.O. BOX 1250 SOUTHPORT BC, SOUTHPORT QLD 4215
Ph: (07) 5528 1148
www.designflow.net.au

CLIENT	STOCKLAND
DRAWN	MJM
DATE	10.06.16
DESIGNED	SL
DATE	10.06.16
SCALE	NOT TO SCALE
A3	
PROJECT	AURA PRECINCTS 6 - 10 & 16 SWQMP
DRAWING TITLE	EXISTING LAND USE, TOPOGRAPHY AND DRAINAGE
PROJECT No	4290
DRAWING No	FIGURE 3
REVISION	A



REVISION	DESCRIPTION	DRAFTED BY INITS	DRAFTED BY DATE	CHECKED BY INITS	CHECKED BY DATE
D					
C					
B					
A	PRELIMINARY ISSUE	MJM	10.06.16	SL	10.06.16

DesignFlow
7 BAUER STREET, SOUTHPORT QLD 4215
P.O. BOX 1250 SOUTHPORT BC, SOUTHPORT QLD 4215
Ph: (07) 5528 1148
www.designflow.net.au

CLIENT	STOCKLAND		
DRAWN	MJM	DATE	10.06.16
DESIGNED	SL	DATE	10.06.16
SCALE	NOT TO SCALE		A3

PROJECT	AURA PRECINCTS 6 - 10 & 16 SWQMP		
DRAWING TITLE	BELLS CREEK CATCHMENT		
PROJECT No	4290	DRAWING No	FIGURE 4
REVISION	A		

3 Stormwater Treatment Objectives

There are several fundamental drivers for managing stormwater quality from Aura.

The adjacent sections of Pumicestone Passage which receive runoff from the site have been defined as having High Ecological Value (HEV) status in the *Environmental Protection Policy (EPP) – Water* (2009). Water quality objectives that accompany HEV status are of the nature of 'no worsening', but more specifically are quantified as maintain existing water quality (20th, 50th and 80th percentiles) in the receiving waterway (Department of Environment and Heritage Protection).

Pumicestone Passage and the estuarine sections of Bells Creek have also been defined as having Ramsar wetland status. The associated significance criteria which accompany this designation include:

- Areas of the wetland being destroyed or substantially modified
- A substantial and measurable change in the hydrological regime of the wetland (e.g. volume, timing, duration and frequency of surface and groundwater flows)
- The habitat or lifecycle of native species being seriously affected
- A substantial and measurable change in the water quality of the wetland that may adversely impact on biodiversity, ecological integrity, social amenity or human health
- An invasive species that is harmful to the ecological character of the wetland becoming established, or an existing invasive species spreading.

With such significant high value environmental areas downstream of Aura, considerable investigation and planning has gone into protecting these areas from the impacts of urbanisation as outlined in a range of previous reports (not reproduced here). These reports have attempted to establish load base stormwater quality design objectives which will ensure the 'no worsening' receiving water quality requirement is achieved.

The load based objectives which have been applied to Precincts 6 – 10 & 16 are presented in Table 1. The objectives exceed the *State Planning Policy* requirements, reflecting the environmental significance of the receiving waters.

Table 1: Stormwater quality design objectives for Precincts 6 - 10 & 16

Pollutant	Objective - Minimum reduction in mean annual load from unmitigated development
Total Suspended Solids	91%
Total Phosphorus	83%
Total Nitrogen	60%
Gross Pollutants	90%

These objectives have been established by Tony McAlister of Water Technology (formerly BMT WBM) considering the whole of water cycle response to protecting downstream waterways including stormwater treatment and stormwater harvesting proposed for the site. Meeting these objectives is expected to provide suitable protection of downstream

waterways from urban runoff from Precinct 6 -10 & 16. Additional pollutant removal, above the objectives defined in Table 1, will occur when proposed stormwater harvesting and indirect potable reuse strategy is implemented.

4 Stormwater Quality Management Strategy

4.1 Design Principles

To develop a robust stormwater treatment strategy, a number of principles were applied for managing stormwater quality. These include:

1. Flexibility – The stormwater treatment strategy will have flexibility and redundancy to allow adjustment in response to site constraints and issues identified as part of future design. This allows the design to be modified during detailed design if an unforeseen constraint is identified.
2. Avoid double treating – As much as practically possible, stormwater that has been "treated" in a wetland or bioretention system should not flow into a downstream treatment, but rather be discharged to the receiving waterway. Treating already treated stormwater is inefficient, increases the size of stormwater treatment infrastructure and increases the risk of resuspension of collected pollutants.
3. Identify End of Pipe Treatment opportunities first – Explore all "end-of-pipe" treatment systems initially. In the context of Precinct 6-10 and 16, treatment systems are located around the perimeter of the development and need to work within the constraints of areas for frog habitat and operate with existing Bells Creek (North & South) levels. This approach reduces the number of treatment devices needing maintenance, increases opportunities for adaptive management and consolidates locations where treated water could be harvested.
4. At-source treatments – For these Precincts, Stockland requires rainwater tanks (plumbed to toilets, cold laundry and outdoor supply) for all residential properties and proposes raingardens/biopods in commercial car parks. These two at-source components were assumed in the treatment strategy before considering additional treatments. Additional at source treatment is considered where there is insufficient space for end of pipe wetlands and bioretention systems.
5. Frogs – Ensure the requirements of the *Caloundra South Wallum Sedge Frog Management Plan* (Stockland, December 2015) and *Caloundra South Acid Frog Management Plan* (Stockland, December 2015) are achieved.
6. Match catchments, earthworks and drainage to Precinct Scale Treatment – Consideration of slopes within the development area to direct surface runoff to areas with sufficient capacity to provide downstream treatment was undertaken. This involved revising the earthworks, catchments and drainage to match catchment areas with the precinct scale treatment measures. It also required careful considering of earthworks and drainage levels to account for operational hydraulic level requirements.

4.2 Stormwater Treatment Strategy

The stormwater treatment strategy for Precinct 6 – 10 & 16 is presented in a number of formats below:

- Figure 5 shows the conceptual treatment train flow diagram
- Figure 6 provides the location and size of the various treatment systems on the development layout.
- Table 2 presents catchment and treatment conceptual details.

The strategy adopts the same suite of treatment measures as previous stormwater strategies for Aura (i.e. predominantly bioretention and wetland systems in various forms). In this instance, the treatment measures have been applied using the principles presented in Section 4.1 resulting in a strategy that responds to the constraints of the site carefully while providing flexibility to achieve the stormwater quality objectives. Important aspects of the strategy are:

- The end of pipe treatment systems (i.e. wetlands and bioretention systems) have been sized to achieve the stormwater quality objectives in combination with the Town Centre car park biopods. Based on conceptual designs (Section 5) there is suitable space for the wetland and bioretention systems.
- Each treatment system delivers treated water to Bells Creek and only overflows (i.e. partly or untreated flows) are transferred to downstream treatment measures.
- At source biopods in the residential areas remain part of the strategy but there is no longer a requirement to have full site coverage of biopods. The coverage of at source biopods can vary depending on the final size of the end of pipe wetlands and bioretention systems.

Note the sizes nominated are the treatment areas (e.g. the wet areas of wetlands and the filter areas of bioretention systems). The conceptual design in Appendix B provides the total footprint of the system including batters, embankments and inlet ponds. The MUSIC modelling completed to assess the proposed strategy is presented in Section 7.

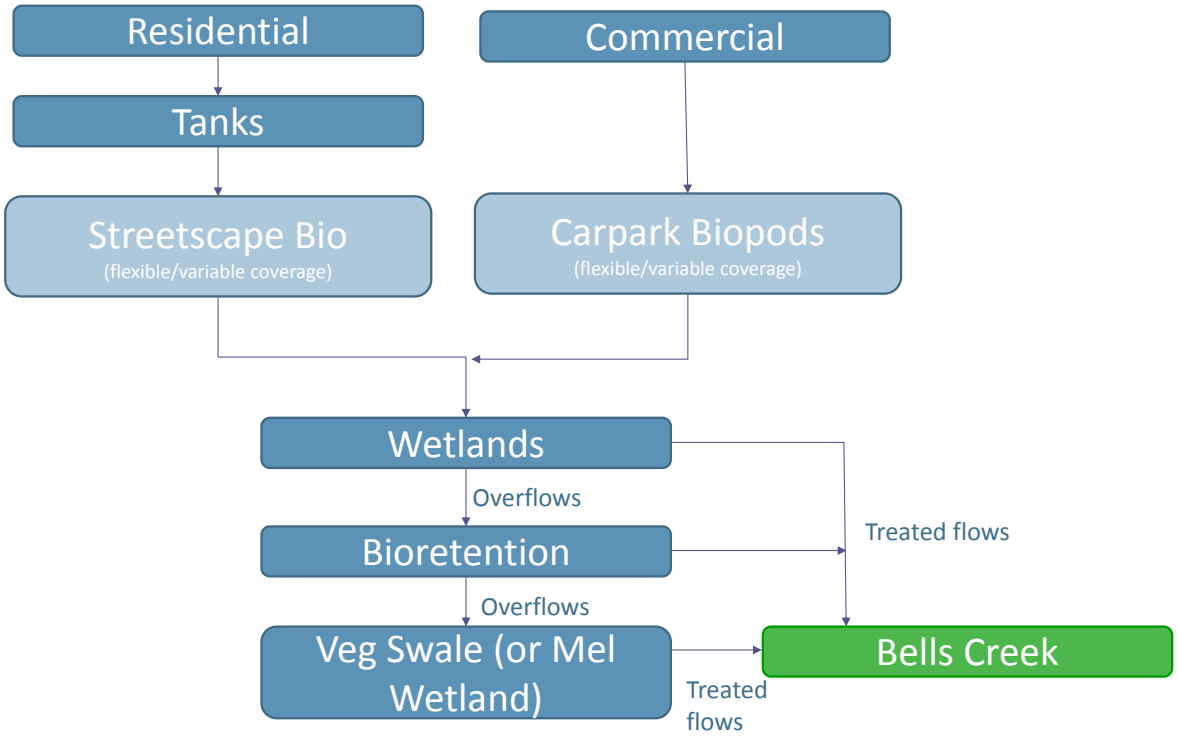
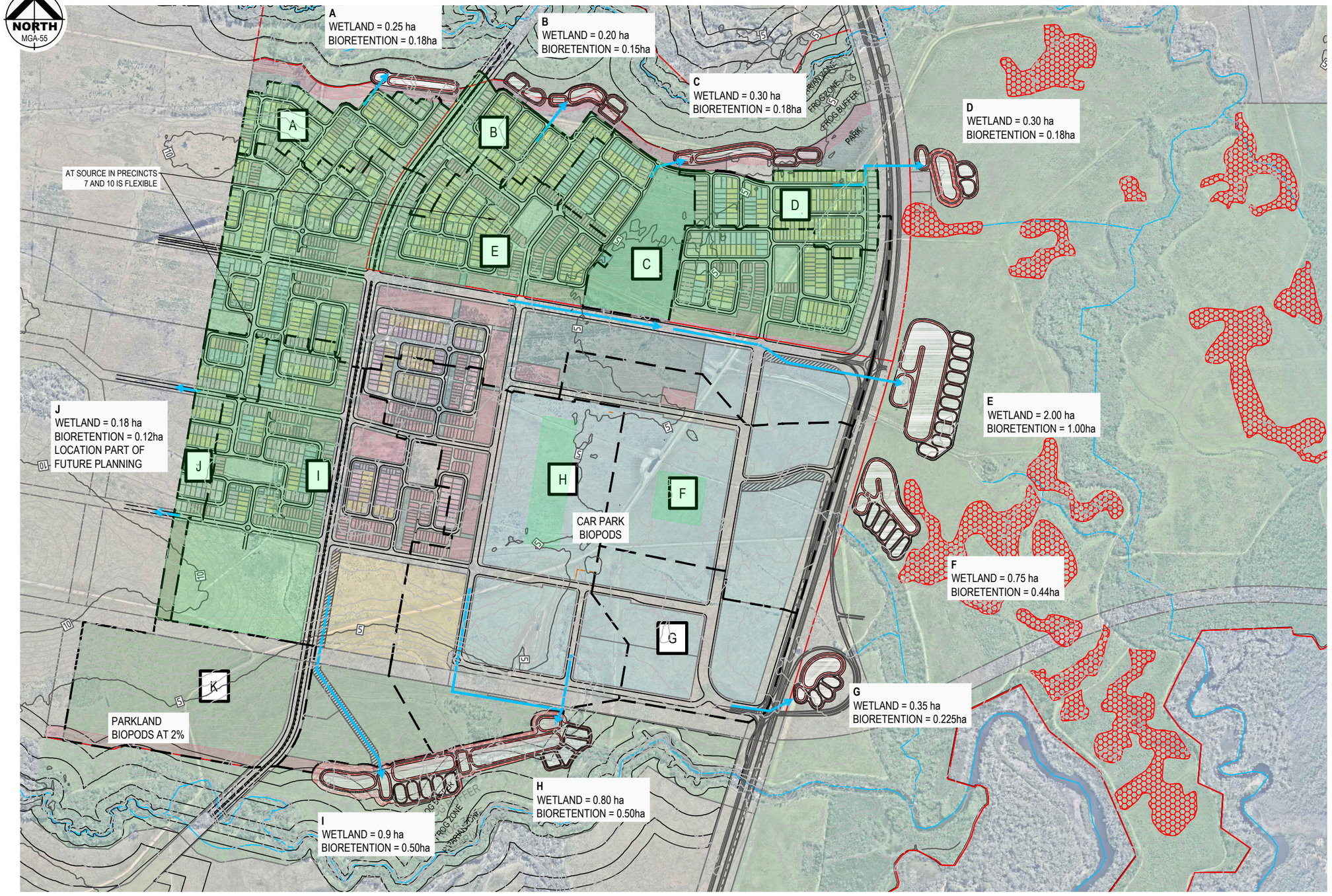


Figure 5 Stormwater treatment train flow diagram



REVISION	DESCRIPTION	INITS	DATE	INITS	DATE
D					
C					
B					
A	PRELIMINARY ISSUE	MJM	10.06.16	SL	10.06.16
		DRAFTED BY		CHECKED BY	

DesignFlow
7 BAUER STREET, SOUTHPORT QLD 4215
P.O. BOX 1250 SOUTHPORT BC, SOUTHPORT QLD 4215
Ph: (07) 5528 1148
www.designflow.net.au

CLIENT	STOCKLAND
DRAWN	MJM
DATE	10.06.16
DESIGNED	SL
DATE	10.06.16
SCALE	NOT TO SCALE
	A3
PROJECT	AURA APPLICATION 4 - WSUD
DRAWING TITLE	CONCEPT STORMWATER TREATMENT STRATEGY FOR PRECINCTS 6 - 10 & 16
PROJECT No	4290
DRAWING No	FIGURE 6
REVISION	A

Table 2 Stormwater catchment and treatment areas

Catchment ID	Area	Inlet Pond Volume			Wetland		Bioretention		Overflow Swale	Outlet to Creek
	ha	Volume (m3)	Area (m2)*	m AHD	Area (m2)	m AHD	Area (m2)	m AHD	m	m AHD
A	9.39	500	500	6.6	2500	6.6	1800	6.6	50	5.6
B	7.94	400	400	5.8	2000	5.8	1500	6	50	5.0
C	11.45	600	600	5.1	3000	5.3	1800	5.3	50	4.2
D	9.19	600	600	3.7	3000	3.7	1800	3.9	100	2.8
E	66.68	3750	2500	2.2	20000	2.2	10000	2.4	400	1.1
F	25.78	1400	930	2.1	7500	2.1	4400	2.3	100	1.0
G	14.31	450	450	2.1	3500	2.1	2250	2.3	100	1.0
H	43.0	1800	1200	1.9	8000	1.9	5000	2.1	100	1.0
I	43.0	1800	1200	2.2	9000	2.2	5000	2.4	100	1.0
J	5.61	400	400		1800		1200	Location to be defined as part of future planning		
K	17.5						4000	At source in park		
Total	**253.85**	**11,700**	**8,780**		**60,300**		**38,750**			

% Treatment	
Wetland	**Bioretention**
3.2%	1.9%
3.0%	1.9%
3.1%	1.6%
3.9%	2.0%
3.4%	1.5%
3.3%	1.7%
2.8%	1.6%
2.1%	1.2%
2.4%	1.2%
3.9%	2.1%
	2.3%
2.7%	**1.5%**

* For large inlet pond (>1000m3), underwater batters have little influence of volume so area = volume / 1.5m depth. For smaller inlet ponds (<1000m3), area approximately = volumes (average 1m depth).

Note: All areas, volumes and levels subject to change as part of detailed design.

4.3 Stormwater Treatment Measures

The table below briefly describes the stormwater treatments measures adopted for Precinct 6 – 10 and 16.

Table 3 Summary of Stormwater Treatment Measures

Measure	Description
Education and Awareness	Education of stormwater management approaches at Aura will be built into community communication through signs, kerb messages and other media. While education can play a role in reducing pollutants reaching waterways, the benefits of education on reduced pollutant loads have not been included in the MUSIC modelling presented in Section 7.
Rainwater Tanks	As part of Stockland's water conservation policy, 5 KL rainwater tanks accepting runoff from at least 50% of roof area are proposed for all residential properties. Water from the tanks is to be plumbed for toilet, cold laundry tap and outdoor uses. While the tanks serve an important water conservation role they also act to reduce the volume of stormwater (and associated pollutants) from reaching downstream waterways. Therefore, residential rainwater tanks have been included in the MUSIC modelling presented in Section 7. Tanks will also be adopted for Commercial Lots and the Town Centre for toilet flushing, irrigation and suitable non-potable demands. However, given the variability in tank demand for commercial landuses, these tanks have not been included in the MUSIC modelling presented in Section 7.
Gross Pollutant Traps (Commercial Lots only)	Commercial lots are a significant source of litter and sediment at ground level. Runoff from the ground level area on the Commercial lots will pass through gross pollutant traps prior to discharging from the lot. The GPTs will focus on litter and sediment. The GPTs will be owned and managed privately by the lot owners.
Biopods (Streetscape raingardens)	Biopods (referred to as streetscape raingardens in previous stormwater strategies) have formed an important part of the stormwater strategy for the Aura site and have been implemented as part of earlier Precincts including Bell Reach. The systems work by receiving runoff from the kerb in set down garden bed areas in the road verge. Stormwater then percolates through a vegetated soil matrix that promotes fine filtration and biological uptake of pollutants. Treated water is collected at the base and discharged in to the stormwater system. Biopods are proposed for the Town Centre to treat runoff from car parks which are open air (not rooved). These have been included in the MUSIC modelling presented in Section 7. Furthermore, an allowance has been made in the development layout for biopods within the residential areas of Precinct 7 (75% coverage) and Precinct 10 (50% coverage). This has involved adjusting the development layout, earthworks and road configuration in these precincts to allow for the proposed biopod coverage (refer to Section 6). In order to retain full flexibility in the design of the stormwater system for the site, the biopods in Precinct 7 and 10 have not been included in the MUSIC modelling presented in Section 7. This means that if any of the end of pipe wetlands or bioretention basins are difficult to deliver in detailed design, then the at source biopods in Precinct 7 and 10 can be introduced into the strategy to make up the shortfall in treatment. The approached provide a desired level of flexibility in the delivery of the stormwater treatment strategy with the ultimate coverage of biopods to be resolved through detailed design in response to site constraints.

Measure	Description
Constructed Wetlands	Constructed wetlands are proposed at the outlet of all sub-catchments from Precincts 6 - 10 & 16. The wetland areas vary across the site but on average are 2.7% of the catchment including the inlet pond. These areas will be refined during detailed design if further constraints are identified. Constructed wetland systems are shallow extensively vegetated water bodies that use enhanced sedimentation, fine filtration and pollutant uptake processes to remove pollutants from stormwater. Water levels rise during rainfall events (by up to 500mm) and outlets are configured to slowly release flows, typically over two to three days, back to dry weather water levels. Wetlands consist of an inlet zone (sediment basin to remove coarse sediments), a macrophyte zone (a shallow heavily vegetated area to remove fine particulates and facilitate the uptake of soluble pollutants) and a high flow bypass (to protect the macrophyte zone). The proposed operation of the wetlands and interaction with the subsequent bioretention basins is described in Section 5. Treated flows from the wetlands will be discharged to Bells Creek. Overflows from the wetland will enter bioretention basins located immediately around the wetland perimeter to receive further treatment. During large events, overflows from the inlet pond will drain via overflow swales to Bells Creek. The wetlands will all be designed in accordance with the WSUD Technical Design Guidelines for SEQ (Water by Design).
Bioretention Basins	Bioretention basins, typically sized at 1.5% of the catchment, are proposed to receive stormwater that overflows from the wetlands around the perimeter of Precincts 6 - 10 & 16. There are a number of advantages in considering the bioretention systems in this manner: • bioretention systems accept untreated stormwater thus avoiding double treating stormwater, • bioretention systems do not receive regular "trickle' flows (that can cause algal growth and block their surface) • allows the bioretention basins to be positioned higher than the wetland normal water level (as water only spills into them once the wetland is at full depth (i.e. 500mm higher than normal water level)). This approach reduces the head required to operate the wetland and bioretention treatment systems and thus reduces the level the development pad is required to be lifted to enable free draining to and from the treatment systems. Refer to Section 5 for more details. Treated flow that collects in the underdrainage pipes will combine with treated water from the wetlands and discharge into Bells Creek (or be diverted for harvesting). Large overflows from the bioretention basins will be directed into the overflow swale for treatment prior to reaching Bells Creek. Design of the bioretention systems will occur in accordance with Bioretention Technical Design Guideline (Water by Design).
Overflow Swales	Overflows from the wetland and bioretention systems will be directed to wide shallow vegetated areas that will convey flows to Bells Creek. The areas will act to filter the overflows and slow flows down before entering Bells Creek. Each buffer will be tailored to the available area between the bioretention basin and the creek. Buffers are only considered feasible for areas that drain to the north and east. The systems will essentially act like occasional flowing wide swales.

Measure	Description
Stormwater Harvesting	Stormwater harvesting will be an important initiative at Aura to manage flows reaching Bells Creek (and particularly for salinity management). A stormwater harvesting proposal is being developed in parallel to the stormwater treatment systems proposed in this document. While details of the harvesting are not described here, the treatment systems proposed are all complementary to harvesting. The stormwater harvesting will collect ~1.45GL/yr of water from the Bells Creek waterways with the aim of removing the excess stormwater created by the Aura development. The stormwater harvesting measure has not been included in the MUSIC modelling presented in Section 7, it will further increase the pollutant removal presented in this report.

5 Wetland and Bioretention System Concept Design

The conceptual design of the end of pipe treatment systems (i.e. constructed wetlands, bioretention basins and overflow swales) involved a number of steps:

- Resolving the function of the treatment systems (i.e. how they interact hydraulically to maximize treatment performance)
- Identifying the available space for treatment around the development edge
- Matching the development catchments to the treatment areas
- Completing MUSIC modelling to confirm required treatment areas and treatment performance for each catchment
- Completing survey of creek levels (top of bank and standing water level)
- Defining operating levels in the wetlands and bioretention systems
- Optimising earthworks and drainage in the development.

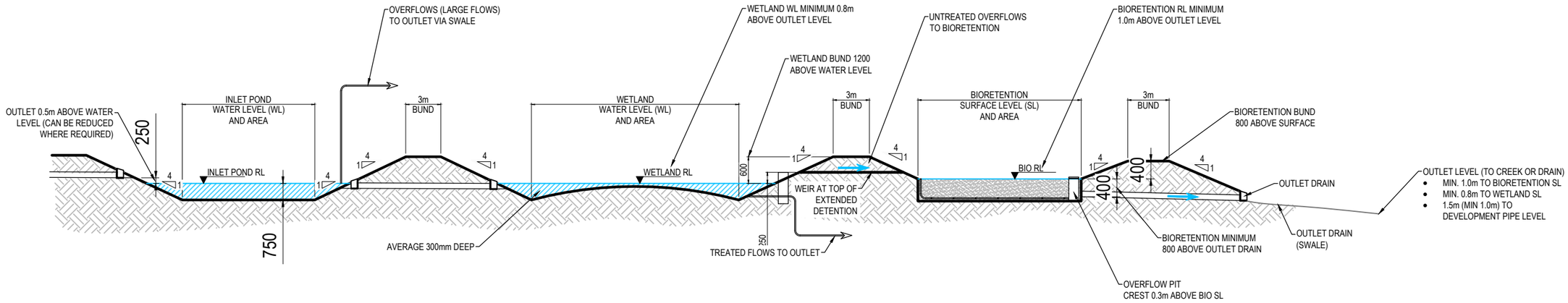
The following sections summarise the considerations and findings of this process.

5.1 Treatment system operation

The operating principles of the wetland, bioretention and overflow swales are presented in Figure 7 and described below:

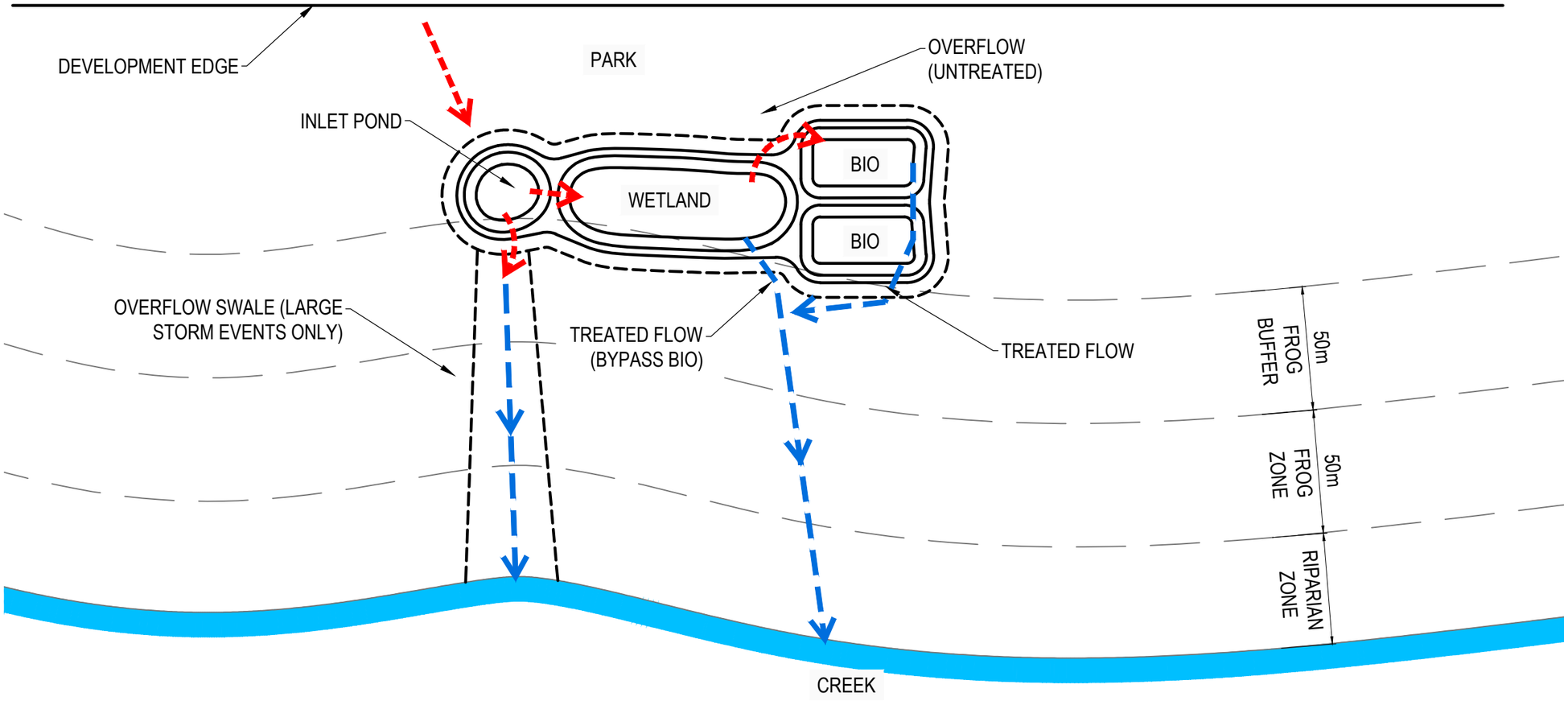
- **Inlet pond** - Flows from the development drainage enter the inlet pond where coarse sediment will settle out and flows will pass via a pit/pipe system to the wetland.
- **Wetland** - Flows will then enter the macrophyte zone of a wetland for treatment. The wetland will treat baseflows and small storm events with treated flows discharged to Bells Creek. Wetlands will typically have a 48hr notional detention time and 0.5m extended detention depth.
- **Bioretention** – During small to moderate rainfall events, the wetlands will fill to the top of extended detention (0.5m above normal water level) at which point any extra water entering the wetland will overtop weirs and enter the bioretention basins. The bioretention basins will be divided into "cells" of maximum 1,000m^2 (to provide management flexibility, promote better flow spreading and allow easier construction and maintenance). Each cell will be positioned to suit the available space and vegetation constraints. Treated flows from the bioretention basins will be discharged to Bells Creek.
- **Overflow swale** – The vast majority of stormwater will pass through the wetland and bioretention system to achieve the performance objectives listed in Section 3. Large storm events will overflow a weir in the inlet pond and pass through an overflow swale which will be vegetated with native grasses and potentially melaleuca. The swale will promote sedimentation and filtration of sediment and particulate phosphorus.

Hydraulic connections between the scale treatment measures will include control structures to enable the function of the systems to be modified in response to performance, climate change or the need for maintenance.



WETLAND AND BIORETENTION RL'S - INDICATIVE SECTION

NOT TO SCALE



REVISION	DESCRIPTION	DRAFTED BY INITS	DRAFTED BY DATE	CHECKED BY INITS	CHECKED BY DATE
D					
C					
B					
A	PRELIMINARY ISSUE	MJM	10.06.16	SL	10.06.16

DesignFlow
7 BAUER STREET, SOUTHPORT QLD 4215
P.O. BOX 1250 SOUTHPORT BC, SOUTHPORT QLD 4215
Ph: (07) 5528 1148
www.designflow.net.au

CLIENT	STOCKLAND
DRAWN	MJM
DATE	10.06.16
DESIGNED	SL
DATE	10.06.16
SCALE	NOT TO SCALE
	A3
PROJECT	AURA PRECINCTS 6 - 10 & 16 SWQMP
DRAWING TITLE	FUNCTION AND OPERATING LEVELS FOR WETLAND AND BIORETENTION SYSTEMS
PROJECT No	4290
DRAWING No	FIGURE 7
REVISION	A

5.2 Operating Levels

A critical consideration of the end of pipe treatment systems is the operating levels and how the systems will discharge into adjacent creeks. Figure 7 provides a conceptual cross section through the wetlands and bioretention systems to illustrate how water will move through the systems and drain freely into the adjacent creek.

It shows there needs to be a minimum 1.0m (preferably 1.5m) between the outfall level at the creek to the pipe invert entering the wetlands. Survey of the creek standing water level and top of bank was completed as part of the conceptual design to define outfall levels, which have been set at either 300mm above standing water in creek, 100mm above standing water in wetland or highest astronomical tide. Further survey will occur during the wet season to confirm the outfall levels for detailed design.

5.3 Space

The wetlands and bioretention systems have been located around the edge of the development carefully considering the constraints including:

- Existing wallum sedgefrog habitat (no stormwater management allowed)
- Riparian buffer of 25m (no stormwater management allowed)
- Frog zone of 50m (no stormwater management allowed)
- Frog buffer of 50m (stormwater management allowed)
- Existing vegetation
- Existing drainage
- Parkland
- Suitable discharge points for treated stormwater.

Figure 8 presents the consolidated constraints for the site.

The wetland and bioretention systems have been placed in a combination of the following:

- Unconstrained areas around the site perimeter
- Parts of the frog buffer in accordance with Section 5.3.1
- Up to 5% of parkland in accordance with the *Caloundra South Infrastructure Agreement* (Section 5.3.2)
- Environmental Protection Zone in accordance with the *Caloundra South Infrastructure Agreement*.

NORTH
MGA-55

LEGEND

- WALLUM SEDGEFROG HABITAT PROTECTED
- RL 1.25 — PRELIMINARY DRAINAGE OUTFALL LEVELS **
- DRAINS/CREEKS

** OUTFALL LEVELS SET ABOVE STANDING WATER LEVEL IN RECEIVING DRAINAGE OR ABOVE TIDE LEVEL

CONSTRAINTS PLAN

NOT TO SCALE

REVISION	DESCRIPTION	DRAFTED BY	INITS	DATE	CHECKED BY	INITS	DATE
D							
C							
B							
A	PRELIMINARY ISSUE	MJM		10.06.16	SL		10.06.16

ISSUED FOR
PRELIMINARY
NOT FOR CONSTRUCTION

DesignFlow
7 BAUER STREET, SOUTHPORT QLD 4215
P.O. BOX 1250 SOUTHPORT BC, SOUTHPORT QLD 4215
Ph: (07) 5528 1148
www.designflow.net.au

CLIENT	STOCKLAND	PROJECT	AURA PRECINCTS 6 - 10 & 16 SWQMP
DRAWN	MJM 10.06.16	DRAWING TITLE	CONSTRAINTS PLAN FOR STORMWATER SYSTEMS
DESIGNED	SL 10.06.16		
SCALE	AS SHOWN A3	PROJECT No	4290
		DRAWING No	FIGURE 8
		REVISION	A

5.3.1 Frog Buffer

Stormwater treatment systems have been placed in parts of the frog buffer based on the following criteria (developed in consultation with Australian Wetlands Consulting):

- No more than 40% of the Frog Buffer can be used for stormwater management devices, including drainage channels. Stormwater management devices must be placed uniformly along the length of the Frog Buffer to ensure no restriction to the overall connectivity of Wallum Sedgefrog (WSF) habitat within the Frog Zone and Frog Buffer.
- Where stormwater management is located within the Frog Buffer, an average minimum set back of 20m is required between all the edges of each stormwater management measure and the Frog Zone boundary. This set back distance does not apply to stormwater outlet drainage channels.
- Within the Environmental Protection Zone (EPZ), stormwater management devices upstream of mapped WSF habitat (refer to Figure 2.4d, *Caloundra South Wallum Sedge Frog Management Plan*, December 2015) must not impact on its pre development hydrology. This must be demonstrated during the detailed design phase through a frequent flow and/or hydraulic analysis. To ensure the protection of downstream mapped and potential WSF habitat, drainage solutions may be required and stormwater management devices may be required to perform some degree of onsite detention
- The final locations of the stormwater management devices will be determined during detailed design. The final location of stormwater management devices must include consideration of proposed WSF breeding ponds, foraging habitat and overall habitat connectivity to ensure compliance with Key Performance Criteria 5, listed in Table 6.2a within the Wallum Sedgefrog Management Plan.

5.3.2 Parklands

Stormwater treatment systems have been placed in parklands in accordance with the *Caloundra South Infrastructure Agreement*:

- Land provided for stormwater treatment facilities for the park are to have a minimal impact on the park's functionality.
- Max. 5% of total park area for stormwater treatment
- Where possible, stormwater treatment facilities are to be integrated with planting areas and form part of the overall vegetated area.
- 30% of the parkland area can be below the 5yr ARI
- Max grade 1:4, 1:6 preferred for maintenance requirements.

5.4 Concept Designs

Proposed sizes, shapes and configurations for wetland and bioretention systems were resolved by considering available areas for the treatment systems, catchments, required treatment areas and surveyed outfall levels.

Conceptual designs for the systems are presented in Appendix B which provide size, shape, conceptual earthworks and levels for each proposed treatment measure. These are conceptual only but illustrate that the wetland and bioretention systems work in the space that's available and that they have suitable grade to ensure proper hydraulic function.

It is possible that during design development, the designs may 'evolve' in response to catchment changes or other constraints. There is sufficient redundancy and flexibility in the proposed designs to accommodate these changes. On the basis of these conceptual designs, there is a high level of certainty that the proposed treatment strategy is feasible and can be implemented without changing the development layout.

6 Streetscape Biopod Concept Design

Biopods are to be integrated into the Town Centre car park system to accept and treat stormwater. These will be created as either linear systems between parking bays or as larger garden bed style systems at the end of parking bays. The photos below illustrate the form of these systems.

Photo: Linear Car Park Biopod

Photo: Biopods at end of parking bays

Where required to supplement the end of pipe wetland and bioretention systems, biopods will integrated into the residential streets in Precinct 7 and 10. The conceptual design of the systems is based on recent work completed by DesignFlow for Bells Reach. Photos of the recently delivered systems are provided in the photos below. Key design elements include:

- One-way cross fall pavement.
- Using the kerb and channel to convey flows to the end of the street where the biopods will be located (aim is to avoid mid block biopods).
- Ensuring 1 biopod treats 80-120m of road and lots either side of the road (up to 9000m^2) thus minimizing the number of biopods.
- Orienting the lots at the end of the street to allow the biopod to sit on the long side of the lot and avoid driveways.
- Moving pedestrian pathway and non-compatible services to the opposite verge from the biopod to create space.
- Moving the pavement over to create more space on the biopod side (for a 16m road reserve, a relatively unencumbered verge of 5m can be created by moving the pavement over and having a reduced verge of 3.5m with pathway).
- Where required, locally narrowing the pavement width below 7.5m at the biopod location at the end of the street.
- Biopod filter media set back 1m from the back of kerb.
- Biopod filter media minimum width of 1.5m
- Batters of 1 in 2 or flatter
- No safety fencing
- No conflict with services other than sewer which may pass under the biopod, with correct protection.

Conceptual design of the biopod solution is presented in Appendix C and photos of the recently constructed systems in Bells Reach are provided below. DesignFlow has reviewed the development layout for Precinct 7 and 10 and worked with the urban design team to adjust the design to ensure it supports biopods if required to support the bioretention and wetland treatment. In Precinct 7, a 75% coverage can be easily achieved and in Precinct 10, a 50% coverage is easily achieved.

Photo: Example of biopod with one-way cross fall, pavement moved over to create space for the biopod, treating a long stretch of road. Biopod with protective turf during house building.

Photo: Example of biopod with one-way cross fall, pavement narrowed locally around biopod to create space for the biopod, treating a long stretch of road. Biopod with protective turf during house building.

7 Performance Assessment (MUSIC Modelling)

7.1 MUSIC Modelling Approach

MUSIC modelling was undertaken to quantitatively assess the performance of the proposed stormwater strategy. MUSIC version 6.1 was used for the assessment and the parameters have been established in accordance with the *MUSIC Modelling Guidelines* (Water by Design, 2010).

7.1.1 Model structure

The Precincts 6 - 10 & 16 MUSIC model layout is shown in Figure 9. Details of the modelling assumptions, parameters and results are provided below.

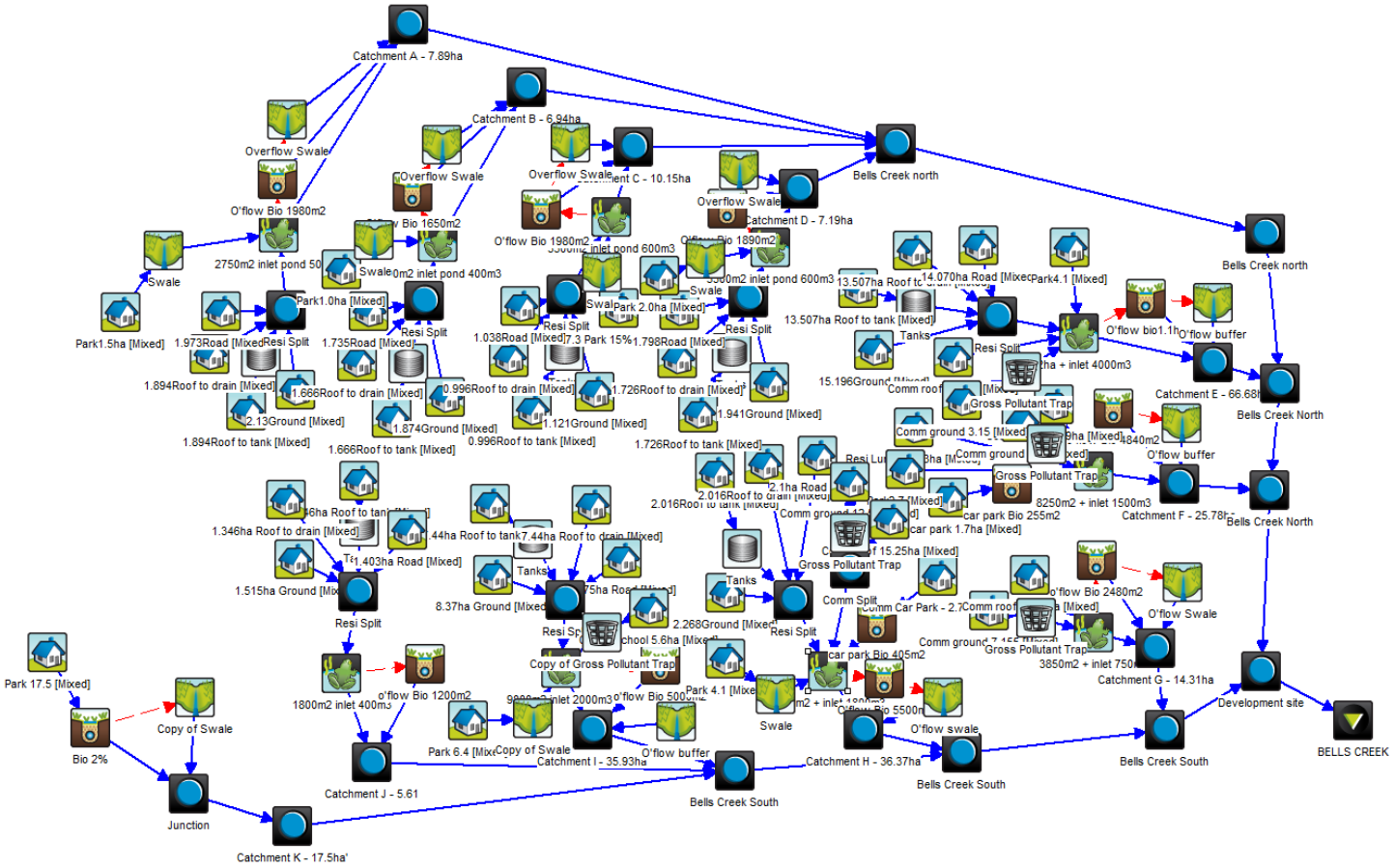


Figure 9 Precincts 6 - 10 & 16 MUSIC model layout

Table 4 provides a summary of the meteorological data on which the model is based.

Table 4 Meteorological and rainfall runoff data

Input	Data used in modelling
Rainfall station	40496 Caloundra
Time step	6 minute
Modelling period	1997 – 2007
Mean annual rainfall	1,348 mm (for the period used)
Mean annual evapotranspiration	1,628 mm
Rainfall runoff parameters	Per SEQ MUSIC Guidelines
Pollutant export parameters	Per SEQ MUSIC Guidelines

7.1.2 Catchments

The stormwater catchments presented in Figure 6 were reviewed and the various landuses (residential, commercial or parkland) within these catchments were measured. Two versions of the MUSIC model were setup:

- Split landuse
- Lumped landuse (at least partly lumped)

In some situations, the treatment performance predicted by MUSIC can vary depending on whether the landuse is lumped or split in the source nodes. Given the importance of achieving the stormwater objectives at Aura it was considered important to ensure the objectives are achieved under either catchment configuration.

Given rainwater tanks are part of the residential dwellings, a split catchment modelling approach was used for the residential catchments in both the scenarios modelled as per the *MUSIC Modelling Guidelines* (Water by Design, 2010) assuming 18 lots per hectare, excluding major parks.

Catchment characteristics for Catchments A – K are shown in Table 5 for the split catchment scenario and Table 6 for the lumped catchment version.

Table 5 Split catchment areas

Catchment ID	Commercial Lumped	Commercial Split		Residential Lumped	Residential Split				Park	Total
	(ha)	Roof (ha)	Ground/Road (ha)	(ha)	Roof to tank (ha)	Roof to drain (ha)	Road (ha)	Ground (ha)	(ha)	(ha)
A					1.89	1.89	2.13	2.13	1.50	9.39
B					1.67	1.67	1.87	1.87	1.00	7.94
C					1.00	1.00	1.12	1.12	7.30	11.45
D					1.73	1.73	1.94	1.94	2.00	9.19
E		3.15	3.15		13.51	13.51	15.20	15.20	4.10	66.68
F		11.39	9.69						2.70	25.78
G		7.16	7.16							14.31
H		15.25	12.55		2.2	2.02	2.10	2.3	4.10	43.0
I	5.6				7.44	7.44	7.75	8.37	6.4	43.0
J					1.35	1.35	1.51	1.51		5.61
K									17.50	17.50
Total		**33.15**	**28.75**		**30.78**	**30.78**	**34.63**	**34.63**	**49.20**	**253.85**

Table 6 Lumped (partly lumped) catchment areas

Catchment ID	Commercial Lumped	Commercial Ground to bio	Residential Split				Residential Lump	Park	Total
	(ha)	(ha)	Roof to tank (ha)	Roof to drain (ha)	Road (ha)	Ground (ha)	(ha)	(ha)	(ha)
A			1.89	1.89	1.97	2.13		1.50	9.39
B			1.67	1.67	1.74	1.87		1.00	7.94
C			1.00	1.00	1.04	1.12		7.30	11.45
D			1.73	1.73	1.80	1.94		2.00	9.19
E	6.30		13.51	13.51	14.07	15.20		4.10	66.68
F	21.08	1.70					0.30	2.70	25.78
G	14.31								14.31
H	27.80	2.70	2.02	2.02	2.10	2.27		4.10	43.00
I	5.60		7.44	7.44	7.75	8.37		6.40	43.00
J			1.35	1.35	1.40	1.51			5.61
K								17.50	17.50
Total	**75.09**	**4.40**	**30.59**	**30.59**	**31.87**	**34.41**	**0.30**	**46.60**	**253.85**

7.2 Treatment Systems

A summary of the treatment system sizes is shown in Table 7 and the characteristics of each treatment system are summarised after that.

Table 7 Treatment system sizes

Catchment ID	Area	Biopods	Inlet Pond Volume	Wetland	Bioretention	Overflow Swale
	(ha)	(m^2)	(m^3)	(m^2)	(m^2)	(m)
A	9.39		500	2500	1800	50
B	7.94		400	2000	1500	50
C	11.45		600	3000	1800	50
D	9.19		600	3000	1800	100
E	66.68		3750	20000	10000	400
F	25.78	255	1400	7500	4400	100
G	14.31		450	3500	2250	100
H	43.0	405	1800	8000	5000	100
I	43.0		1800	9000	5000	100
J	5.61		400	1800	1200	
K	17.5	4000				
Total	253.85		11,700	60,300	38,750	

* For large inlet pond (>1000m3), underwater batters have little influence of volume so area = volume / 1.5m depth. For smaller inlet ponds (<1000m3), area approximately = volumes (average 1m depth).

Note: All areas, volumes and levels subject to change as part of detailed design.

7.2.1 GPTs

GPTs were included in the MUSIC model as per the *MUSIC Modelling Guidelines* (Water by Design, 2010) for the ground level areas in the commercial lots.. The following treatment performance was adopted:

- Gross pollutants = 80%
- TSS = 20% removal
- TP = 10% removal
- TN = 0% removal

7.2.2 Wetland systems

Wetlands were modelled in accordance with the *MUSIC Modelling Guidelines* (Water by Design, 2010). The inlet pond volume was typically set at 10% of the macrophyte zone area and with a notional depth of 1.5m. Weir and bypass flows were directed to the bioretention basins and treated pipe flows bypass the bioretention.

7.2.3 Bioretention systems

The bioretention systems were modelled to only receive overflows from the wetlands with the adopted parameters in accordance with the *MUSIC Modelling Guidelines* (Water by Design, 2010). The only variation from the *MUSIC Modelling Guidelines* (Water by Design, 2010) is the bioretention media specifications Ortho-P of 20mg/kg and TN of 400mg/kg which have been justified previously by BMT WBM and previously accepted by EDQ reviewers.

The extended detention depth in the car park biopods in the Town Centre was limited to 200mm.

7.2.4 Overflow swale characteristics modelled

The swales that take untreated overflows from the bioretention systems have the following characteristics:

- Length = 50m (longer in some swales depending on concept design)
- 0.1-0.2% bed slope
- Base width = varies 5-20m
- Top width = varies 10-25m
- Depth = 500-700mm
- Vegetation height = 250mm
- Exfiltration = 0 mm/hour

Some small swales were also included in the MUSIC model downstream of the parklands. Stormwater runoff is typically conveyed in swales in parkland for a distance before entering any pit and pipe drain. In some cases there will be no pit and pipe drainage in the parks.

7.3 Results

The results of the MUSIC modelling for the proposed Precincts 6 - 10 & 16 development are shown in Table 8. The results demonstrate that the proposed stormwater strategy achieves the stormwater quality load reduction objectives.

Table 8 MUSIC modelling results – split catchment model

Parameter	Unmitigated	Mitigated	% Removal
Flow (ML/yr)	2440	2150	12.8%
TSS (kg/yr)	333000	24500	92.6%
TP (kg/yr)	812	141	82.7%
TN (kg/yr)	6060	2270	62.5%
Gross Pollutants (kg/yr)	55700	0	100%

Table 9 MUSIC modelling results – Lumped catchment model

Parameter	Unmitigated	Mitigated	% Removal
Flow (ML/yr)	2400	2090	13.1%
TSS (kg/yr)	400000	26100	93.5%
TP (kg/yr)	965	146	84.9%
TN (kg/yr)	5910	2260	62.1%
Gross Pollutants (kg/yr)	54700	0	100%

7.4 Sensitivity Testing

A number of sensitivity tests were completed using the split catchment model to illustrate that the treatment performance of the strategy is robust and that there is flexibility to change the design in the future and achieve the stormwater objectives.

7.4.1 Removal of GPT's

The table below shows the overall treatment performance with the GPT's removed from the MUSIC model.

Table 10 MUSIC modelling results – No GPTs

Parameter	Unmitigated	Mitigated	% Removal
Flow (ML/yr)	2440	2150	12.8%
TSS (kg/yr)	333000	25200	92.4%
TP (kg/yr)	812	143	82.4%
TN (kg/yr)	6060	2280	62.5%
Gross Pollutants (kg/yr)	55700	0	100%

7.4.2 Biopods in Precinct 7 & 10

The table below shows the treatment performance with biopods included in the residential areas of Precinct 7 and 10:

- Biopod area = 1% of catchment
- Precinct 7 = 75% coverage of residential area
- Precinct 10 = 50% coverage of the residential
- Extended detention 200mm

Table 11 Treatment performance - Including residential biopods in Precinct 7 and 10

Parameter	Unmitigated	Mitigated	% Removal
Flow (ML/yr)	2440	2120	13.1%
TSS (kg/yr)	333000	24900	92.5%
TP (kg/yr)	812	139	83.1%
TN (kg/yr)	6060	2250	62.9%
Gross Pollutants (kg/yr)	55700	0	100%

7.4.3 Increase in Wetland and Bioretention Treatment

The table below shows the treatment performance if the precinct scale treatment systems areas are increased by 20% (~2ha of extra treatment). The reality is these increased areas may not fit in the available space but the results indicate there is little increase in treatment performance for a significant land and cost impost (that is, money would be better spent on other initiatives such as stormwater harvesting which would have a greater water quality benefit).

Table 12 Treatment performance – Increase Wetland and Bioretention Treatment (by 20%)

Parameter	Unmitigated	Mitigated	% Removal
Flow (ML/yr)	2440	2100	14.0%
TSS (kg/yr)	333000	22000	93.3%
TP (kg/yr)	812	131	83.8%
TN (kg/yr)	6060	2200	63.7%
Gross Pollutants (kg/yr)	55700	0	100%

7.5 Flows and Loads to Bells Creek

To assess the relative contribution of Precinct 6 – 10 and 16 and also Precincts 2 -5 on the total sediment and nutrient load of Bells Creek, the results of the previous BMT WBM (October 2015) report were adopted and recalculated using the new loads leaving Precinct 6 – 10 and 16. The results are presented in the table below and illustrate that the loads to Bells Creek increase slightly. These results are consistent with the previous BMT WBM work which also illustrated that these loads result in essentially no change in receiving waterway concentrations which is the important requirement (refer BMT WBM (October 2015), *Caloundra South Precincts 6 to 10 & 16: Stormwater Quality Management Plan*, Rev. 6).

Table 13 MUSIC modelling results – Total Loads to Bells Creek

Parameter	Pre-Development	Precinct 2 – 10 and 16 Development	% Change
Flow (ML/yr)	20300	21785	7.3%
TSS (Tonnes/yr)	390	393	1.0%
TP (kg/yr)	1110	1226	10.5%
TN (kg/yr)	20700	22330	7.9%
Gross Pollutants (kg/yr)	7280	7280	0%

7.6 Modelling Review

To ensure the modelling approach and assumptions are reasonable and the outcomes will deliver the required level of stormwater treatment of Precinct 6 – 10 & 16, the MUSIC model was reviewed and this report by Tony McAlister of Water Technology.

Tony has been involved in assessing potential impacts on Bells Creek from the Aura development for many years and also set the stormwater quality discharge objectives.

8 Conclusion

This report provides an updated Stormwater Quality Management Plan for Precincts 6 - 10 & 16 following a thorough assessment of all constraints to stormwater treatment measures. This strategy builds on previous stormwater quality management proposals for the site.

The strategy takes advantage of available areas for stormwater treatment around the perimeter of the development prior to discharge into Bells Creek. The principles of the strategy focus on not treating already treated water and providing flexibility in the treatment train to adjust the design in response to constraints and other design requirements.

The strategy relies on at source systems including rainwater tanks and biopods with wetland and bioretention stormwater treatment systems. This proposed strategy provides flexibility in the overall achievement of the water quality objectives.

The wetlands direct treated flows into nearby waterways and pass their overflows into bioretention systems. The bioretention systems direct treated flows to the creeks and overflows pass through swales before entering the creeks. This approach for the treatment systems requires less hydraulic head to operate (than the previous strategy) and has been integrated with the earthworks and drainage for the site to ensure these system can function.

Rainwater tanks are proposed for all residential areas (for toilets, laundry and outdoor uses), GPTs are proposed for ground level runoff from commercial lots and biopods are proposed within the town centre car parks.

The treatment strategy meets the requirements for stormwater quality improvement to ensure there are no adverse impacts on Bells Creek and Pumicestone Passage. This includes reducing annual pollutant loads by 93% for suspended solids, 83% for total phosphorus and 62% for total nitrogen.

The load of stormwater pollutants will be further reduced when the stormwater harvesting for the site is implemented.

9 References

BMT WBM (October 2015), *Caloundra South Precincts 6 to 10 & 16: Stormwater Quality Management Plan*, Rev. 6

Corrs Chambers McGrath (2015) *Caloundra South Infrastructure Agreement*

Stockland (December 2015) *Caloundra South Wallum Sedge Frog Management Plan*

Stockland (December 2015) *Caloundra South Acid Frog Management Plan*

Water by Design (2009), *Construction and Establishment Guidelines: Swales, Bioretention Systems and Wetlands*, SEQ Healthy Waterways Partnership. Brisbane, Queensland.

Water by Design (2006), *Water Sensitive Urban Design Technical Design Guidelines for South East Queensland Version 1*. Moreton Bay and Waterways Catchments Partnership. Brisbane, Queensland.

Water by Design (2014), *Bioretention Chapter Technical Design Guidelines for South East Queensland*.

Water by Design (2010), *MUSIC Modelling Guidelines*. Water by Design - SEQ Healthy Waterways Partnership. Brisbane, Queensland.

Appendix C: Wallum Sedgefrog Habitat Mapping

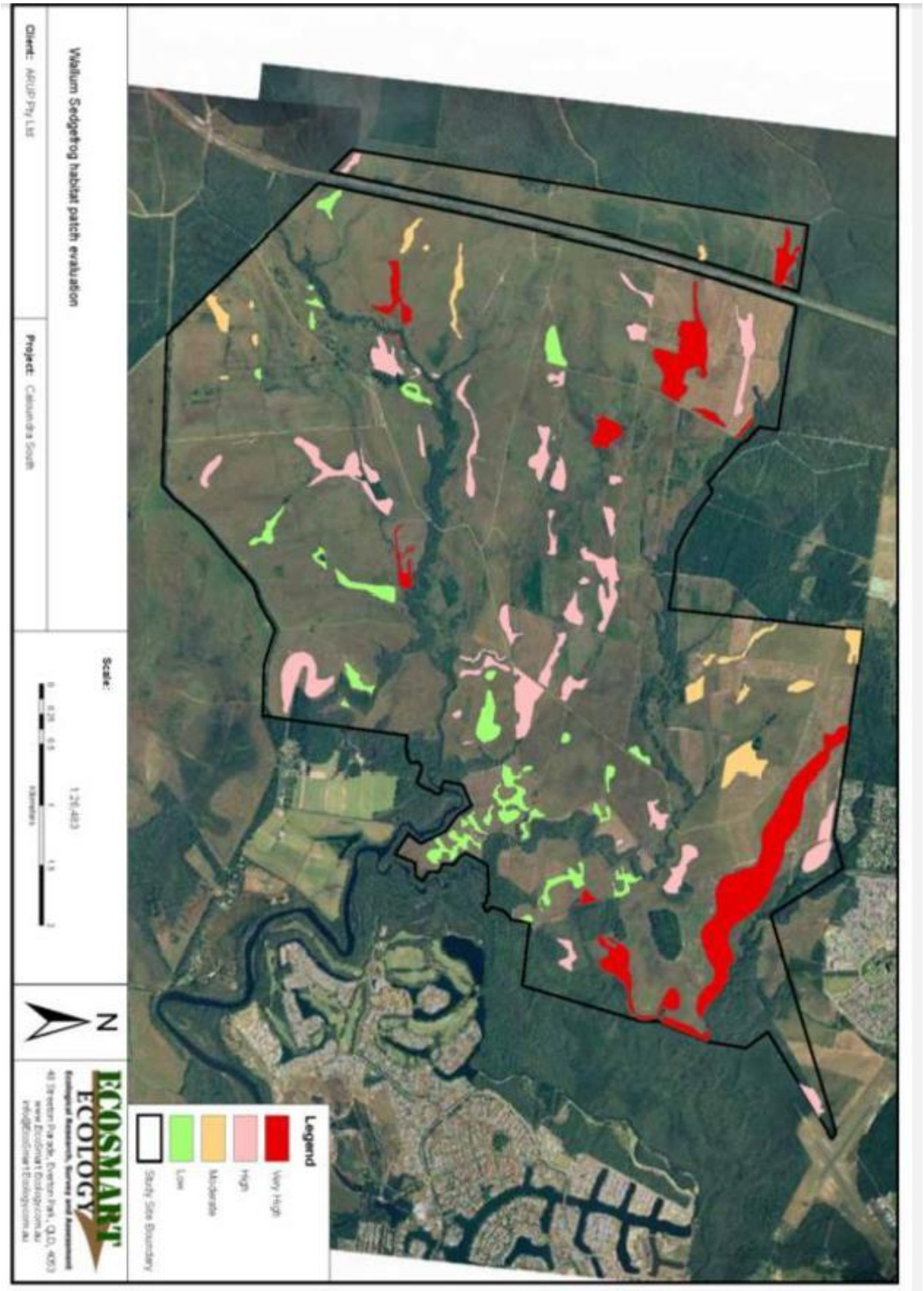


Figure 2.2a: Wallum Sedgefrog Habitat Patch evaluation (2012 WSF PER mapping)

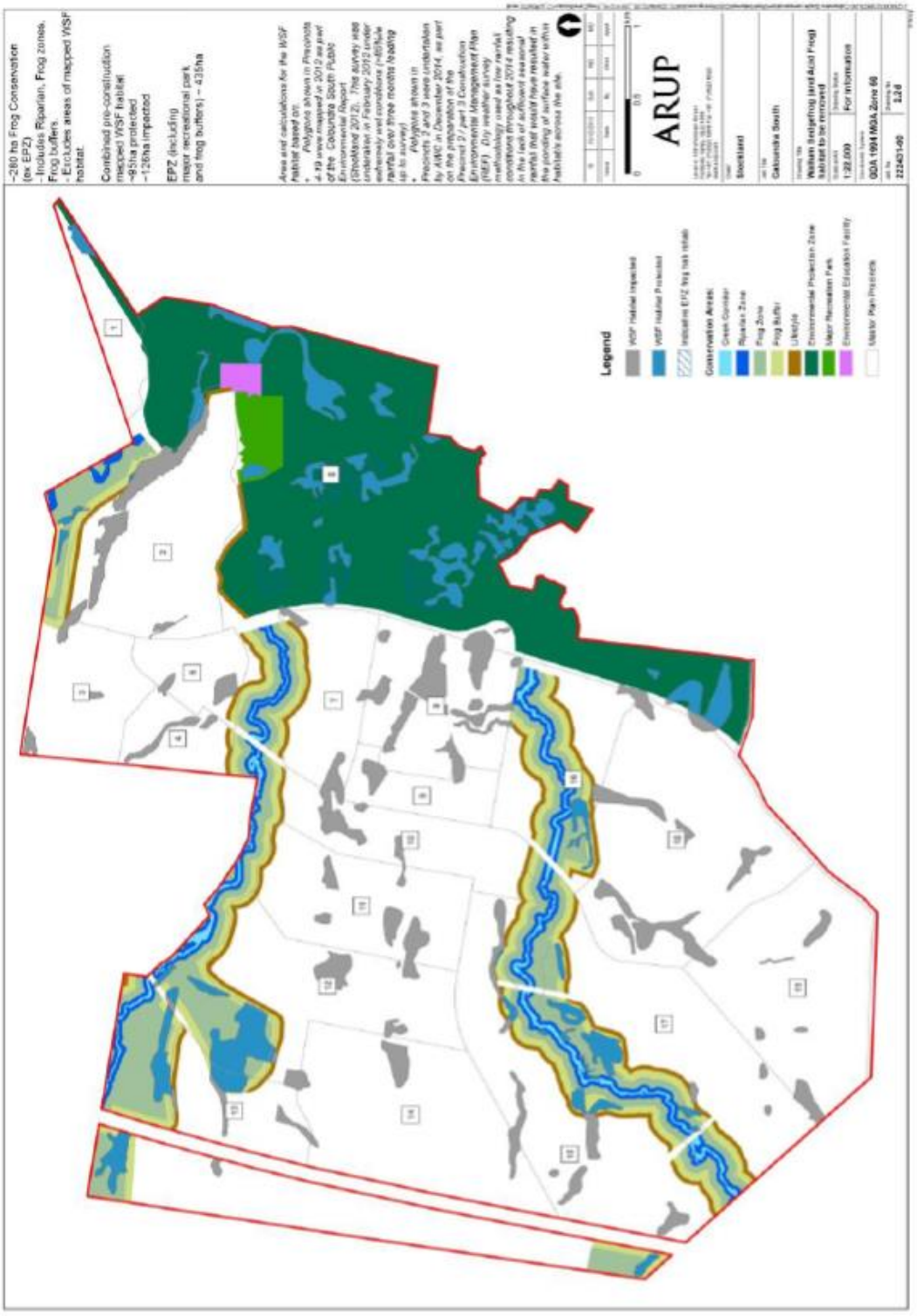
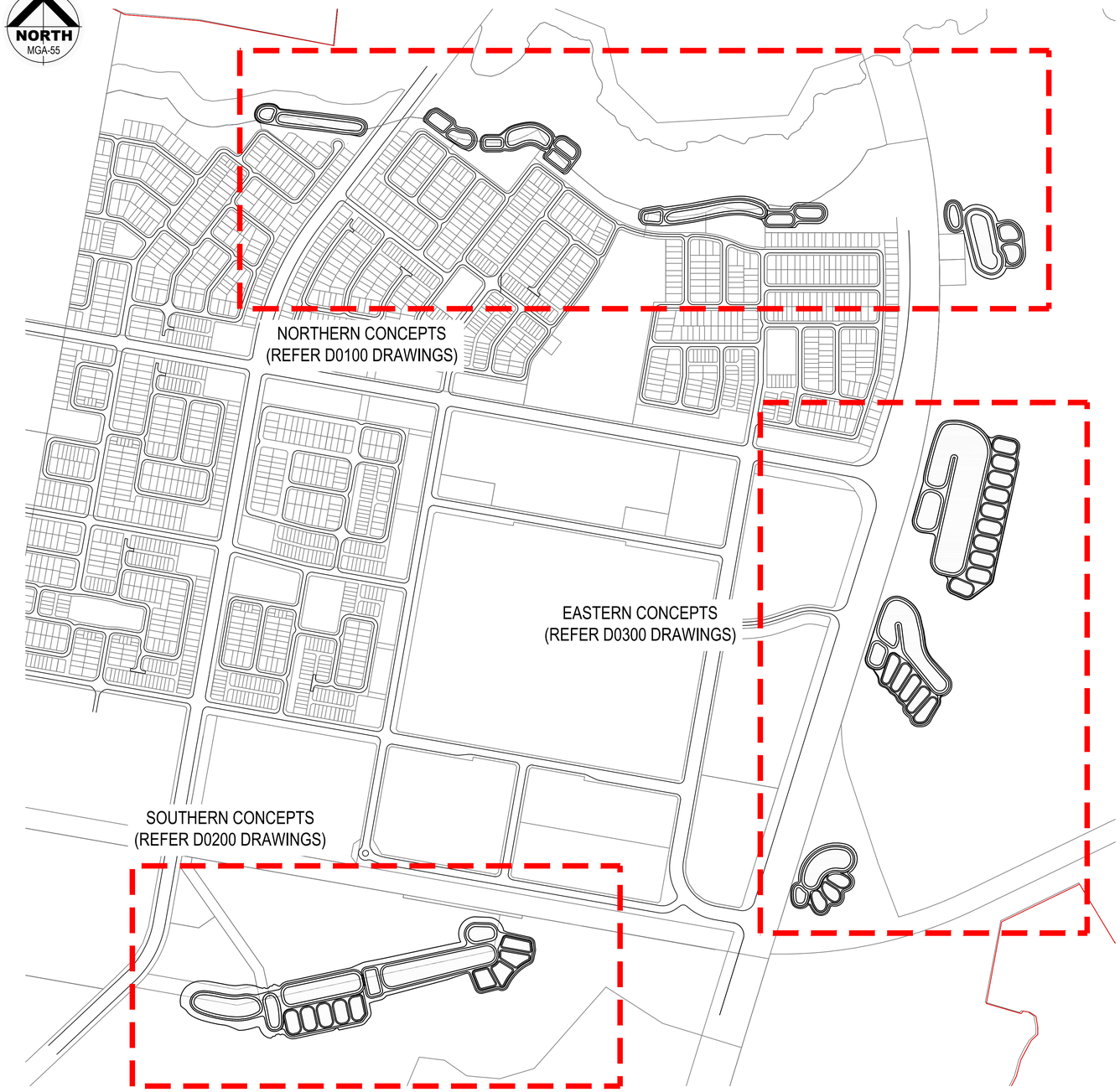


Figure 2.2d: Wallum Sedgefrog habitat (grey) to be removed updated ~~Feb~~ Dec 2015~~4~~)

Appendix B: Wetland and Bioretention System Concepts

AURA APPLICATION 4
WSUD CONCEPTS



SITE LOCALITY MAP
NOT TO SCALE

DRAWING LIST

REVISION	DESCRIPTION	INITS	DATE	INITS	DATE
		DRAFTED BY		CHECKED BY	
D					
C					
B					
A	PRELIMINARY ISSUE	MJM	10.06.16	SL	10.06.16

ISSUED FOR
PRELIMINARY
NOT FOR CONSTRUCTION

DesignFlow
7 BAUER STREET, SOUTHPORT QLD 4215
P.O. BOX 1250 SOUTHPORT BC, SOUTHPORT QLD 4215
Ph: (07) 5528 1148
www.designflow.net.au

CLIENT	STOCKLAND
DRAWN	MJM — DATE 10.06.16
DESIGNED	SL — DATE 10.06.16
SCALE	NOT TO SCALE — A1
PROJECT	AURA APPLICATION 4 - WSUD
DRAWING TITLE	SITE LOCALITY MAP AND DRAWING LIST
PROJECT No	4290
DRAWING No	D0001
REVISION	A

NORTH
MGA-55

LEGEND

- WALLUM SEDGEFROG HABITAT PROTECTED
- RL 1.25 — PRELIMINARY DRAINAGE OUTFALL LEVELS **
- DRAINS/CREEKS

** OUTFALL LEVELS SET ABOVE STANDING WATER LEVEL IN RECEIVING DRAINAGE OR ABOVE TIDE LEVEL

CONSTRAINTS PLAN

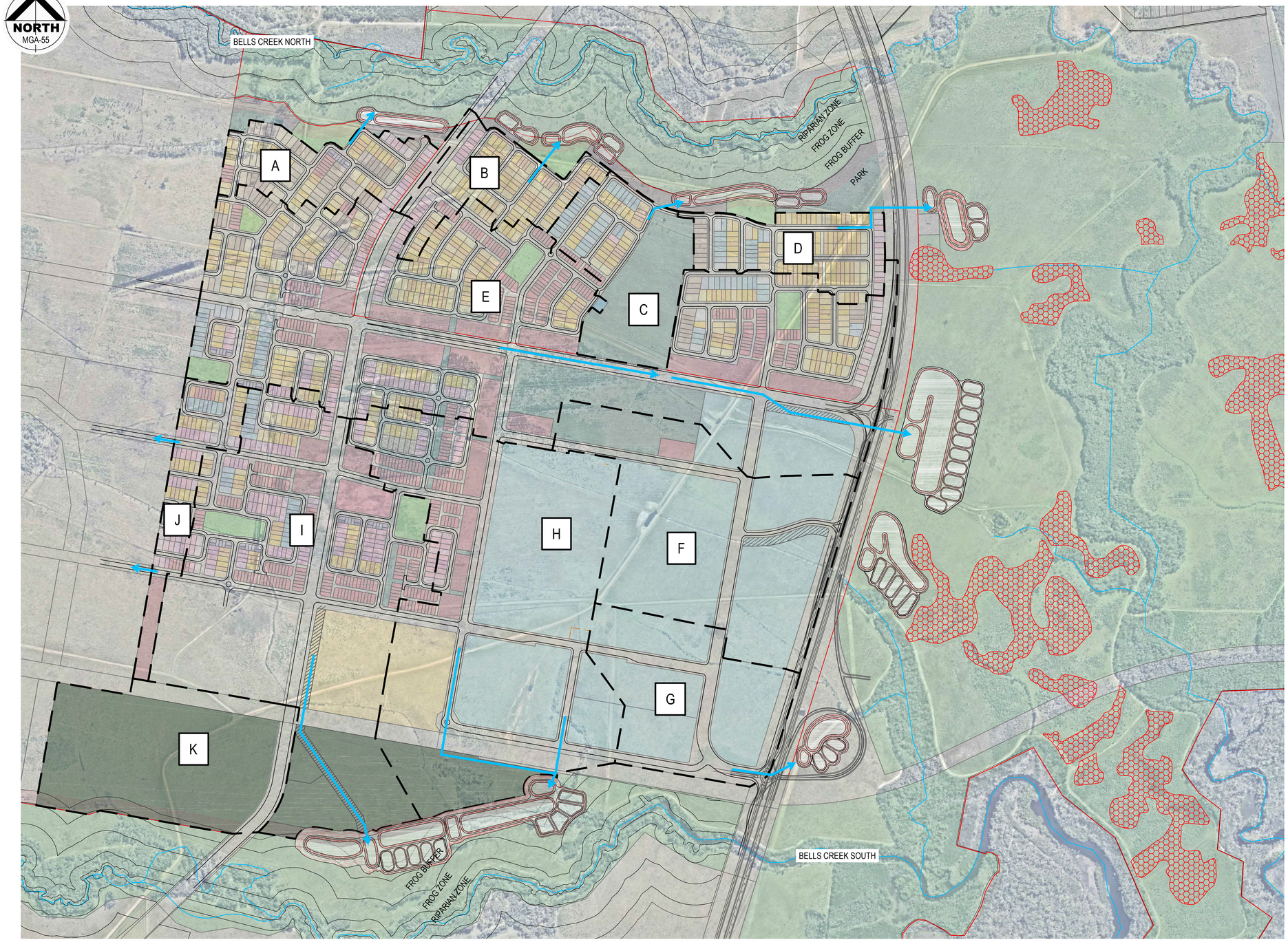
NOT TO SCALE

REVISION	DESCRIPTION	INITS	DATE	INITS	DATE
		DRAFTED BY		CHECKED BY	
D					
C					
B					
A	PRELIMINARY ISSUE	MJM	10.06.16	SL	10.06.16

ISSUED FOR
PRELIMINARY
NOT FOR CONSTRUCTION

DesignFlow
7 BAUER STREET, SOUTHPORT QLD 4215
P.O. BOX 1250 SOUTHPORT BC, SOUTHPORT QLD 4215
Ph: (07) 5528 1148
www.designflow.net.au

CLIENT	STOCKLAND
DRAWN	MJM
DATE	10.06.16
DESIGNED	SL
DATE	10.06.16
SCALE	AS SHOWN
	A1
PROJECT	AURA APPLICATION 4 - WSUD
DRAWING TITLE	CONSTRAINTS PLAN
PROJECT No	4290
DRAWING No	D0002
REVISION	A



LEGEND

- DRAINAGE DIRECTION
- MAJOR CATCHMENTS
- STORMWATER TREATMENT
- WATERWAYS / DRAINS
- WALLUM SEDGEFROG HABITAT PROTECTED

CATCHMENT AND DRAINAGE PLAN

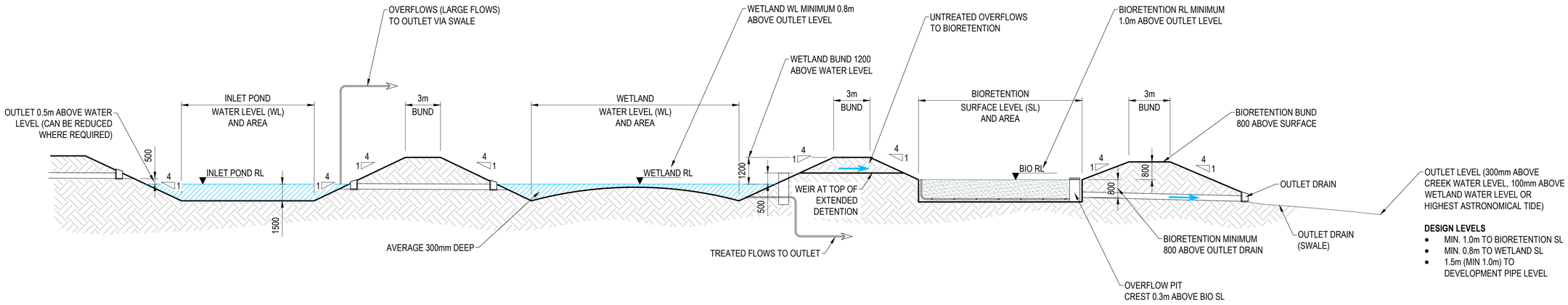
NOT TO SCALE

REVISION	DESCRIPTION	DRAFTED BY INITS	DRAFTED BY DATE	CHECKED BY INITS	CHECKED BY DATE
D					
C					
B					
A	PRELIMINARY ISSUE	MJM	10.06.16	SL	10.06.16

ISSUED FOR
PRELIMINARY
NOT FOR CONSTRUCTION

DesignFlow
7 BAUER STREET, SOUTHPORT QLD 4215
P.O. BOX 1250 SOUTHPORT BC, SOUTHPORT QLD 4215
Ph: (07) 5528 1148
www.designflow.net.au

CLIENT	STOCKLAND
DRAWN	MJM
DATE	10.06.16
DESIGNED	SL
DATE	10.06.16
SCALE	NOT TO SCALE
	A1
PROJECT	AURA APPLICATION 4 - WSUD
DRAWING TITLE	CATCHMENT AND DRAINAGE
PROJECT No	4290
DRAWING No	D0003
REVISION	A



WETLAND AND BIORETENTION RL'S - INDICATIVE SECTION

NOT TO SCALE

CATCHMENT AND TREATMENT TABLE

Catchment ID	Area	Inlet Pond Volume			Wetland		Bioretention		Overflow Swale	Outlet to Creek		% Treatment	
	ha	Volume (m3)	Area (m2)*	m AHD	Area (m2)	m AHD	Area (m2)	m AHD	m	m AHD		Wetland	Bioretention
A	9.39	500	500	6.6	2500	6.6	1800	6.6	50	5.6		3.2%	1.9%
B	7.94	400	400	5.8	2000	5.8	1500	6	50	5.0		3.0%	1.9%
C	11.45	600	600	5.1	3000	5.3	1800	5.3	50	4.2		3.1%	1.6%
D	9.19	600	600	3.7	3000	3.7	1800	3.9	100	2.8		3.9%	2.0%
E	66.68	3750	2500	2.2	20000	2.2	10000	2.4	400	1.1		3.4%	1.5%
F	25.78	1400	930	2.1	7500	2.1	4400	2.3	100	1.0		3.3%	1.7%
G	14.31	450	450	2.1	3500	2.1	2250	2.3	100	1.0		2.8%	1.6%
H	43	1800	1200	1.9	8000	1.9	5000	2.1	100	1.0		2.1%	1.2%
I	43	1800	1200	2.2	9000	2.2	5000	2.4	100	1.0		2.4%	1.2%
J	5.61	400	400		1800		1200	Location to be defined as part of future planning				3.9%	2.1%
K	17.5						4000	At source in park					2.3%
Total	**253.85**	**11,700**	**8,780**		**60,300**		**38,750**		**1,050**			**2.7%**	**1.5%**

* For large inlet pond (>1000m3), underwater batters have little influence of volume so area = volume / 1.5m depth.
For smaller inlet ponds (<1000m3), area approximately = volumes (average 1m depth)

Note: All areas, volumes and levels subject to change as part of detailed design.

REVISION	DESCRIPTION	DRAFTED BY INITS	DRAFTED BY DATE	CHECKED BY INITS	CHECKED BY DATE
D					
C					
B					
A	PRELIMINARY ISSUE	MJM	10.06.16	SL	10.06.16

ISSUED FOR
PRELIMINARY
NOT FOR CONSTRUCTION

DesignFlow
7 BAUER STREET, SOUTHPORT QLD 4215
P.O. BOX 1250 SOUTHPORT BC, SOUTHPORT QLD 4215
Ph: (07) 5528 1148
www.designflow.net.au

CLIENT: STOCKLAND
DRAWN: MJM — DATE: 10.06.16
DESIGNED: SL — DATE: 10.06.16
SCALE: AS SHOWN — A1

PROJECT: AURA APPLICATION 4 - WSUD
DRAWING TITLE: TREATMENT SYSTEM CONCEPT DETAILS (SECTIONS)
PROJECT No: 4290 — DRAWING No: D0004 — REVISION: A

NORTH
MGA-55

NOTES:

1. OUTLET LEVEL (OL) SET ~300mm ABOVE STANDING WATER IN CREEK OR LOCAL LEVEL ON FLOOD PLAIN OR AT HIGHEST ASTRONOMICAL TIDE
2. BUND LEVELS SET AT OR ABOVE 1yr ARI LEVEL
3. STORMWATER TREATMENT SYSTEMS HAVE BEEN LOCATED TO CONSIDER FROG HABITAT, FROG ZONE AND FROG BUFFER IN ACCORDANCE WITH CALOUNDRA SOUTH WALLUM FROGLET MANAGEMENT PLAN (DEC 2015)
4. DEVELOPMENT DRAINAGE AND EARTHWORKS HAS BEEN CONFIGURED TO DRAIN INTO INLET POND ABOVE STANDING WATER LEVEL (PREFERABLY AT TOP OF EXTENDED DETENTION). REFER CONCEPTUAL EARTHWORKS DRAWINGS (CALIBRE)
5. LOCATION, SIZE AND CONFIGURATION TO BE REFINED AS PART OF OPERATIONAL WORKS DESIGN

INLET POND A
AREA = 500 m²
RL = 6.6
BUND = 7.8
INFLOW PIPE ~RL 7.10

WETLAND A
AREA = 2500 m²
RL = 6.6
BUND = 7.8

OL 6.30

BIO-RETENTION BASINS A
AREA = 2x 900 m²
RL = 6.6
BUND = 7.4

OL 5.60

WETLAND B
AREA = 2000 m²
RL = 5.8
BUND = 7.0

OL 5.00

MINIMUM 10m FROM LOT OR ROAD VERGE TO TOP OF BATTER FOR PATHWAYS AND LANDSCAPE

INLET POND B
AREA = 400 m²
RL = 5.8
BUND = 7.0
INFLOW PIPE ~RL 6.30

BIO-RETENTION BASINS B
AREA = 2x 750 m²
RL = 6.0
BUND = 6.8

WETLAND C
AREA = 3000 m²
RL = 5.1
BUND = 6.3

OL 4.20

RIPARIAN ZONE
FROG ZONE
FROG BUFFER
PARK

INLET POND C
AREA = 500 m²
RL = 5.1
BUND = 6.3
INFLOW PIPE ~RL 5.60

MINIMUM 10m FROM LOT OR ROAD VERGE TO TOP OF BATTER FOR PATHWAYS AND LANDSCAPE

BIO-RETENTION BASINS C
AREA = 2x 900 m²
RL = 5.3
BUND = 6.1

INLET POND D
AREA = 600 m²
RL = 3.7
BUND = 5.9
INFLOW PIPE ~RL 4.20

BIO-RETENTION BASINS D
AREA = 2x 900 m²
RL = 3.9
BUND = 4.7

WETLAND D
AREA = 3000 m²
RL = 3.7
BUND = 5.9

EXISTING DRAIN

OL 2.80

PEOPLE'S PLACE

COMMUNITY FACILITY

LEGEND

- WALLUM SEDGEFROG HABITAT PROTECTED
- PARK
- OL 1.40 OUTLET LEVEL

A1 SCALE 1:2000 0 40 80 120 160 200m

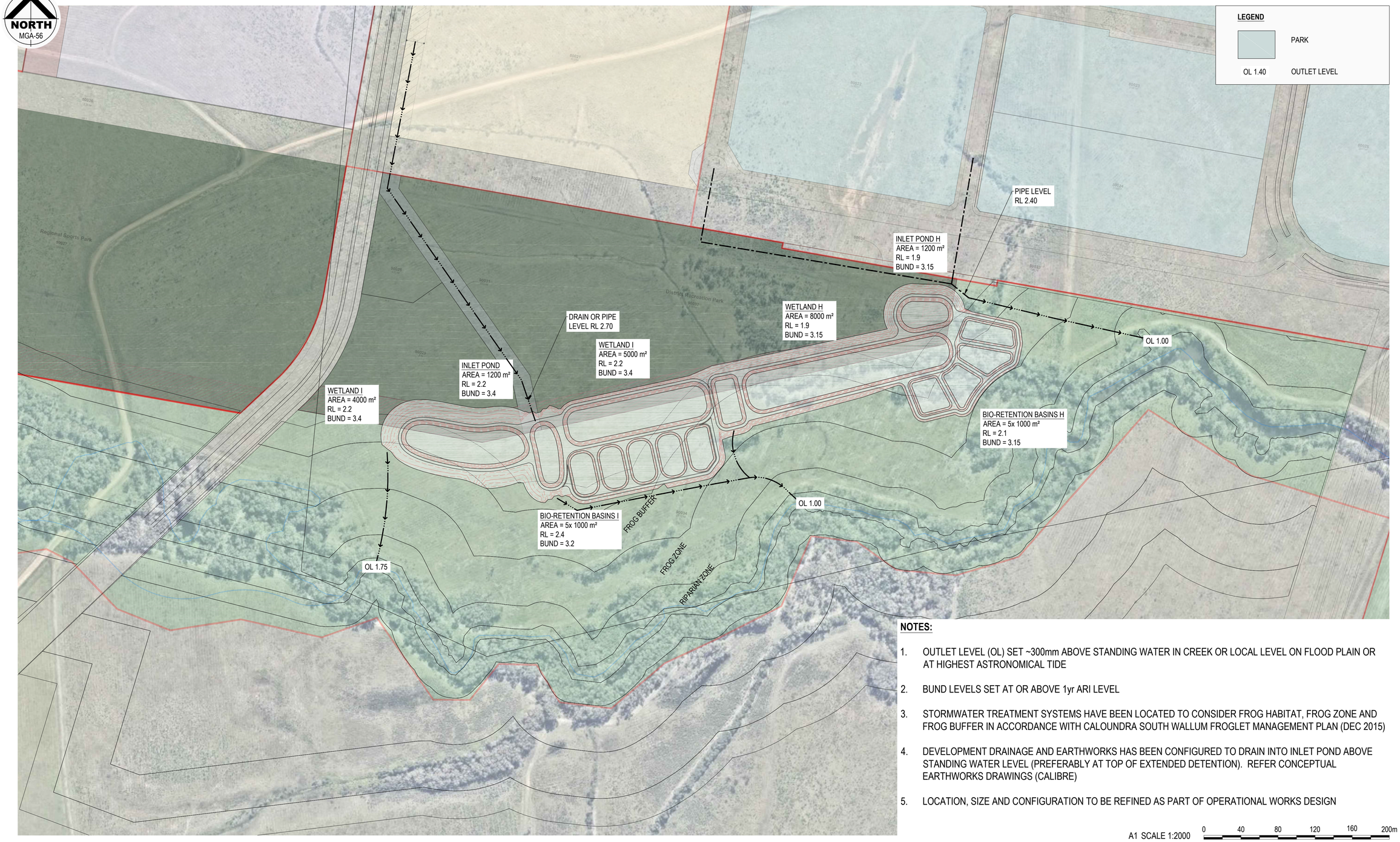
A3 SCALE 1:4000 0 80 160 240 320 400m

REVISION	DESCRIPTION	DRAFTED BY		CHECKED BY	
		INITS	DATE	INITS	DATE
D					
C					
B					
A	PRELIMINARY ISSUE	MJM	10.06.16	SL	10.06.16

ISSUED FOR
PRELIMINARY
NOT FOR CONSTRUCTION

DesignFlow
7 BAUER STREET, SOUTHPORT QLD 4215
P.O. BOX 1250 SOUTHPORT BC, SOUTHPORT QLD 4215
Ph: (07) 5528 1148
www.designflow.net.au

CLIENT	STOCKLAND
DRAWN	MJM
DATE	10.06.16
DESIGNED	SL
DATE	10.06.16
SCALE	1:2000
	A1
PROJECT	AURA APPLICATION 4 - WSUD
DRAWING TITLE	NORTHERN STORMWATER TREATMENT CONCEPT DESIGN
PROJECT No	4290
DRAWING No	D0101
REVISION	A



NOTES:

1. OUTLET LEVEL (OL) SET ~300mm ABOVE STANDING WATER IN CREEK OR LOCAL LEVEL ON FLOOD PLAIN OR AT HIGHEST ASTRONOMICAL TIDE
2. BUND LEVELS SET AT OR ABOVE 1yr ARI LEVEL
3. STORMWATER TREATMENT SYSTEMS HAVE BEEN LOCATED TO CONSIDER FROG HABITAT, FROG ZONE AND FROG BUFFER IN ACCORDANCE WITH CALOUNDRA SOUTH WALLUM FROGLET MANAGEMENT PLAN (DEC 2015)
4. DEVELOPMENT DRAINAGE AND EARTHWORKS HAS BEEN CONFIGURED TO DRAIN INTO INLET POND ABOVE STANDING WATER LEVEL (PREFERABLY AT TOP OF EXTENDED DETENTION). REFER CONCEPTUAL EARTHWORKS DRAWINGS (CALIBRE)
5. LOCATION, SIZE AND CONFIGURATION TO BE REFINED AS PART OF OPERATIONAL WORKS DESIGN

A1 SCALE 1:2000 0 40 80 120 160 200m

A3 SCALE 1:4000 0 80 160 240 320 400m

REVISION	DESCRIPTION	DRAFTED BY INITS	DRAFTED BY DATE	CHECKED BY INITS	CHECKED BY DATE
D					
C					
B					
A	PRELIMINARY ISSUE	MJM	10.06.16	SL	10.06.16

ISSUED FOR
PRELIMINARY
NOT FOR CONSTRUCTION

DesignFlow
7 BAUER STREET, SOUTHPORT QLD 4215
P.O. BOX 1250 SOUTHPORT BC, SOUTHPORT QLD 4215
Ph: (07) 5528 1148
www.designflow.net.au

CLIENT	STOCKLAND
DRAWN	MJM
DATE	10.06.16
DESIGNED	SL
DATE	10.06.16
SCALE	1:2000
	A1
PROJECT	AURA APPLICATION 4 - WSUD
DRAWING TITLE	SOUTHERN STORMWATER TREATMENT CONCEPT DESIGN
PROJECT No	4290
DRAWING No	D0201
REVISION	A

NORTH
MGA-56

WETLAND E
AREA = 20050 m²
RL = 2.2
BUND = 3.4

BIO-RETENTION BASINS E
AREA = 10x 1000 m²
RL = 2.4
BUND = 3.2

INLET POND E
AREA = 2500 m²
RL = 2.2
BUND = 3.4

OL 1.00 - 1.10

WETLAND F
AREA = 7500 m²
RL = 2.1
BUND = 3.3

INLET POND F
AREA = 930 m²
RL = 2.1
BUND = 3.3

BIO-RETENTION BASINS F
AREA = 5x 940 m²
RL = 2.3
BUND = 3.1

OL 1.00

WETLAND G
AREA = 3500 m²
RL = 2.1
BUND = 3.3

INLET POND G
AREA = 450 m²
RL = 2.1
BUND = 3.3

OL 1.00

BIO-RETENTION BASIN G
AREA = 3x 730 m²
RL = 2.3
BUND = 3.1

EXISTING DRAIN

NOTES:

1. OUTLET LEVEL (OL) SET ~300mm ABOVE STANDING WATER IN CREEK OR LOCAL LEVEL ON FLOOD PLAIN OR AT HIGHEST ASTRONOMICAL TIDE
2. BUND LEVELS SET AT OR ABOVE 1yr ARI LEVEL
3. STORMWATER TREATMENT SYSTEMS HAVE BEEN LOCATED TO CONSIDER FROG HABITAT, FROG ZONE AND FROG BUFFER IN ACCORDANCE WITH CALOUNDRA SOUTH WALLUM FROGLET MANAGEMENT PLAN (DEC 2015)
4. DEVELOPMENT DRAINAGE AND EARTHWORKS HAS BEEN CONFIGURED TO DRAIN INTO INLET POND ABOVE STANDING WATER LEVEL (PREFERABLY AT TOP OF EXTENDED DETENTION). REFER CONCEPTUAL EARTHWORKS DRAWINGS (CALIBRE)
5. LOCATION, SIZE AND CONFIGURATION TO BE REFINED AS PART OF OPERATIONAL WORKS DESIGN

LEGEND

- WALLUM SEDGEFROG HABITAT PROTECTED
- PARK
- OL 1.40 — OUTLET LEVEL

A1 SCALE 1:1000 0 20 40 60 80 100m

A3 SCALE 1:2000 0 40 80 120 160 200m

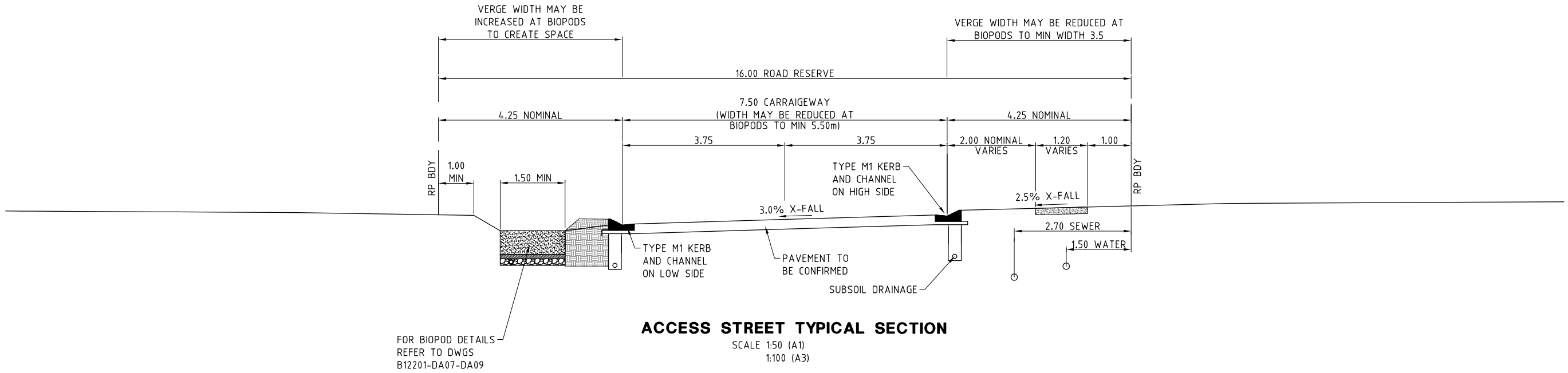
REVISION	DESCRIPTION	DRAFTED BY INITS	DRAFTED BY DATE	CHECKED BY INITS	CHECKED BY DATE
D					
C					
B					
A	PRELIMINARY ISSUE	MJM	10.06.16	SL	10.06.16

ISSUED FOR
PRELIMINARY
NOT FOR CONSTRUCTION

DesignFlow
7 BAUER STREET, SOUTHPORT QLD 4215
P.O. BOX 1250 SOUTHPORT BC, SOUTHPORT QLD 4215
Ph: (07) 5528 1148
www.designflow.net.au

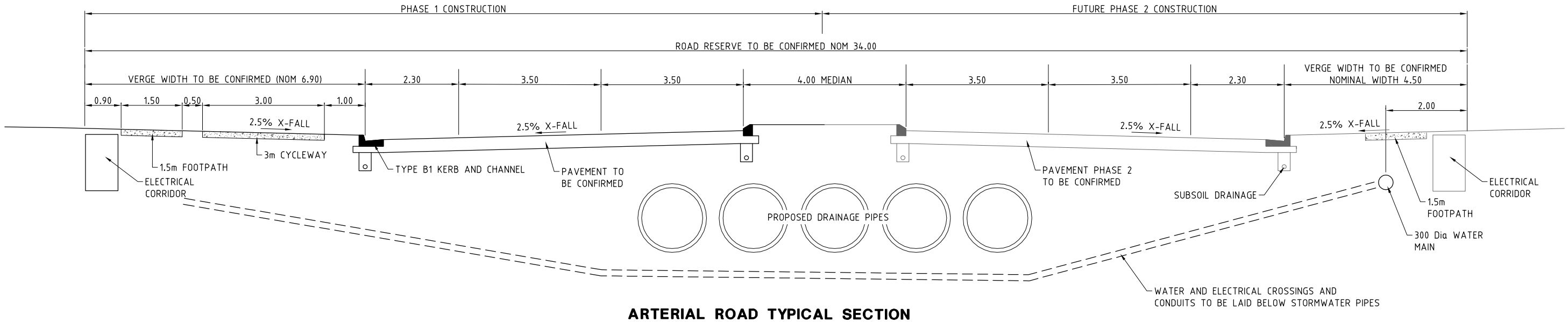
CLIENT	STOCKLAND
DRAWN	MJM
DATE	10.06.16
DESIGNED	SL
DATE	10.06.16
SCALE	1:1000
	A1
PROJECT	AURA APPLICATION 4 - WSUD
DRAWING TITLE	EASTERN STORMWATER TREATMENT CONCEPT DESIGN
PROJECT No	4290
DRAWING No	D0301
REVISION	A

Appendix C: Biopod Concepts



ACCESS STREET TYPICAL SECTION

SCALE 1:50 (A1)
1:100 (A3)



ARTERIAL ROAD TYPICAL SECTION

SCALE 1:50 (A1)
1:100 (A3)

DesignFlow
PO Box 1250 Southport BC QLD 4215
Ph (07) 5528 1148
Mobile 0414 849 587

FILE: B12201-DA06.dwg DATE: 02-06-2016 TIME: 16:35
Xref's: N12059-X-TITLE XREF-SK USR: wesley pike

AMENDMENTS	FIRST ISSUE	CALCS	DRAWN	DATE	AMENDMENT DETAILS
	A	WP	WP	27.04.16	
	B				
	C				
	D				
	E				
	F				

DESIGN CHECK
DRAWN CHECK

SCALE (METRES)
1:50 1 0.5 0 1 2 A1
1:100 A3

MICROFILM No.

PROJECT No. N12059

RPS Australia East Pty Ltd.
PO Box 149 Wurtulla QLD 4575
Ph (07) 5436 7888 Fax (07) 5493 6630

APPROVED
BRAD THOMPSON RPEQ 7818
FOR & ON BEHALF OF CALIBRE CONSULTING (QLD) PTY LTD

CLIENT: Stockland Caloundra Downs Pty Ltd

PROJECT: AURA APPLICATION 4 TOWN CENTRE

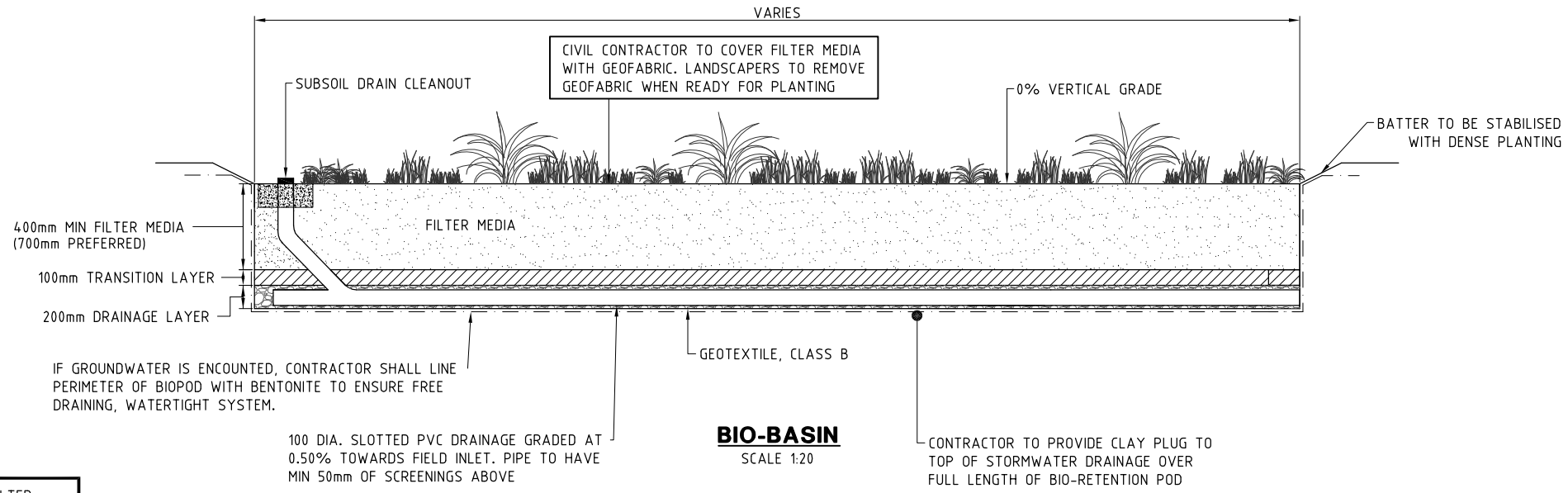
calibre CONSULTING

CONSULT AUSTRALIA
Calibre Consulting (QLD) Pty Ltd
Level 3, 16 Innovation Parkway, Birtinya QLD Australia 4575
Telephone 07 5314 2520 Facsimile 07 5314 2522
Brisbane Canberra Melbourne Sydney Singapore Sunshine Coast
Quality Endorsed Company ISO 9001 Lic 4084

DRAWING TITLE: APPLICATION 4 TYPICAL CROSS SECTION ARTERIAL ROAD 2

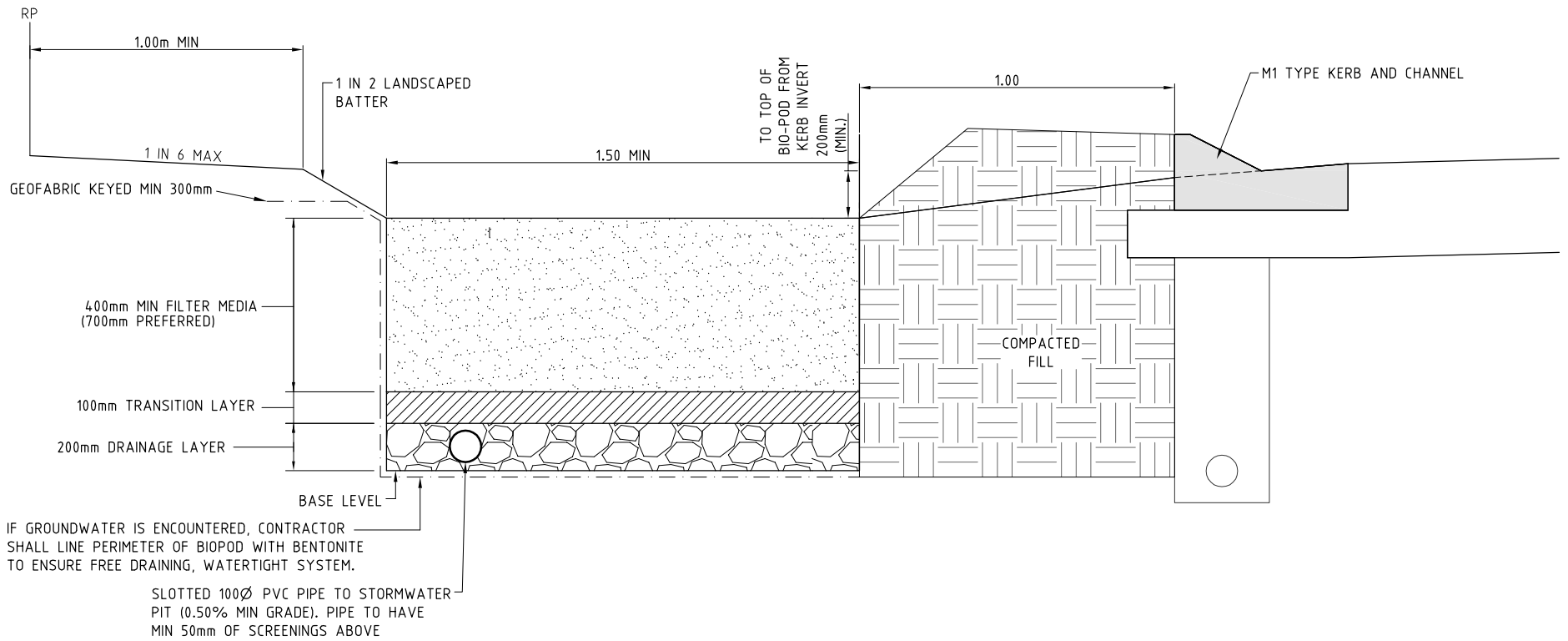
DRAWING NUMBER: B12201-DA06

ISSUE



BIO-BASIN
SCALE 1:20

CONTRACTOR TO ENSURE BIO-FILTRATION FILTER MEDIA, TRANSITION LAYER AND DRAINAGE LAYER. MEETS THE CRITERIA OUTLINED IN THE BIO-RETENTION TECHNICAL DESIGN GUIDELINES (WATER BY DESIGN) SECTION 4.3.



TYPICAL CROSS SECTION THROUGH BIO-POD PIT/FOREBAY (TYPE 1A)
SCALE 1:10

DesignFlow
PO Box 1250 Southport BC QLD 4215
Ph (07) 5528 1148
Mobile 0414 849 587

FILE: B12201-DA07.dwg DATE: 02-06-2016 TIME: 16:35
Xref's: N12059-X-TITLE XREF.DWG USR: wesley pike

FIRST ISSUE	CALCS	DRAWN	DATE
	CC	AS	08.03.16

AMENDMENTS

	AMENDMENT DETAILS
A	
B	
C	
D	
E	
F	

DESIGN CHECK

DRAWN CHECK

SCALE (METRES)
1:10 0.1 0.5 0 0.1 0.2 0.3 0.4 0.5 A1
1:20 A3

MICROFILM No.

PROJECT No.
N12059

RPS Australia East Pty Ltd.
PO Box 149 Wurtulla QLD 4575
Ph (07) 5436 7888 Fax (07) 5493 6630

APPROVED
BRAD THOMPSON RPEQ 7818
FOR & ON BEHALF OF CALIBRE CONSULTING (QLD) PTY LTD

CLIENT
Stockland Caloundra Downs Pty Ltd

PROJECT
AURA
APPLICATION 4
TOWN CENTRE

calibre CONSULTING

CONSULT AUSTRALIA
Calibre Consulting (QLD) Pty Ltd
Level 3, 16 Innovation Parkway, Birtinya QLD Australia 4575
Telephone 07 5314 2520 Facsimile 07 5314 2522
Brisbane Canberra Melbourne Sydney Singapore Sunshine Coast

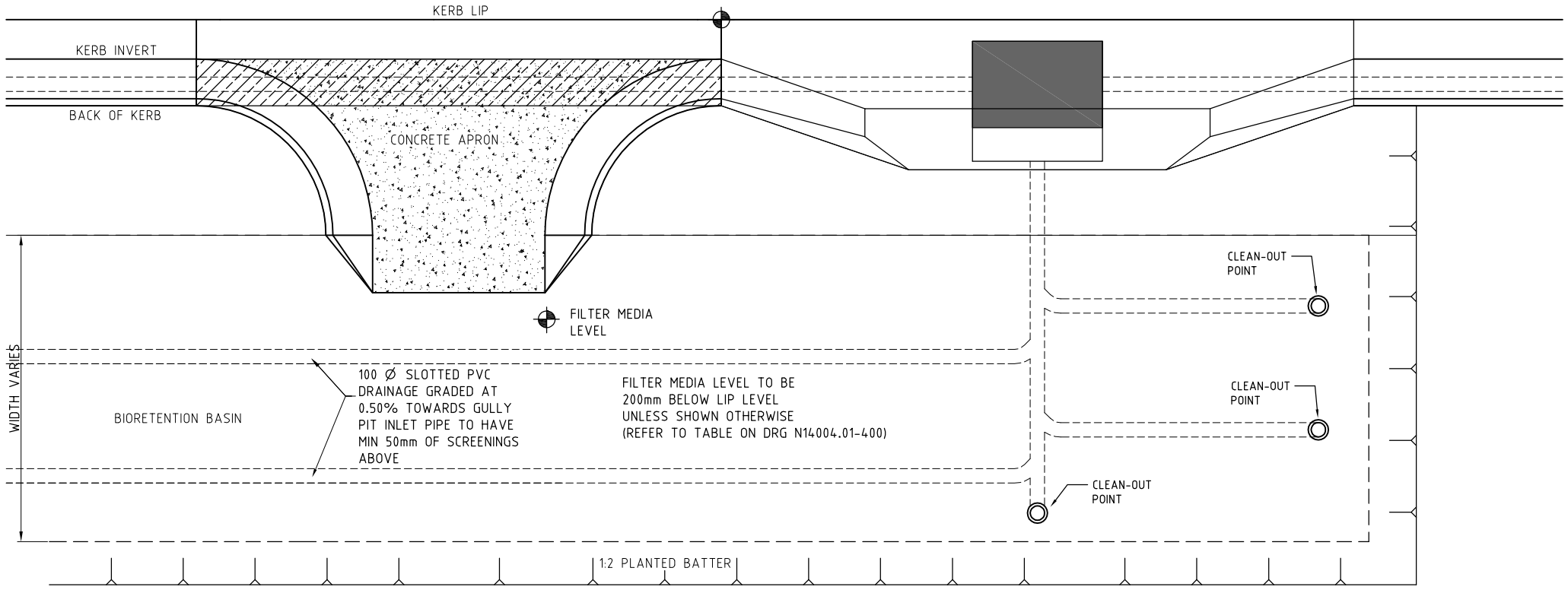
Quality Endorsed Company ISO 9001 Lic-10861

DRAWING TITLE
BIO RETENTION NOTES AND DETAILS SHEET 1 OF 3

DRAWING NUMBER
B12201-DA07

ISSUE

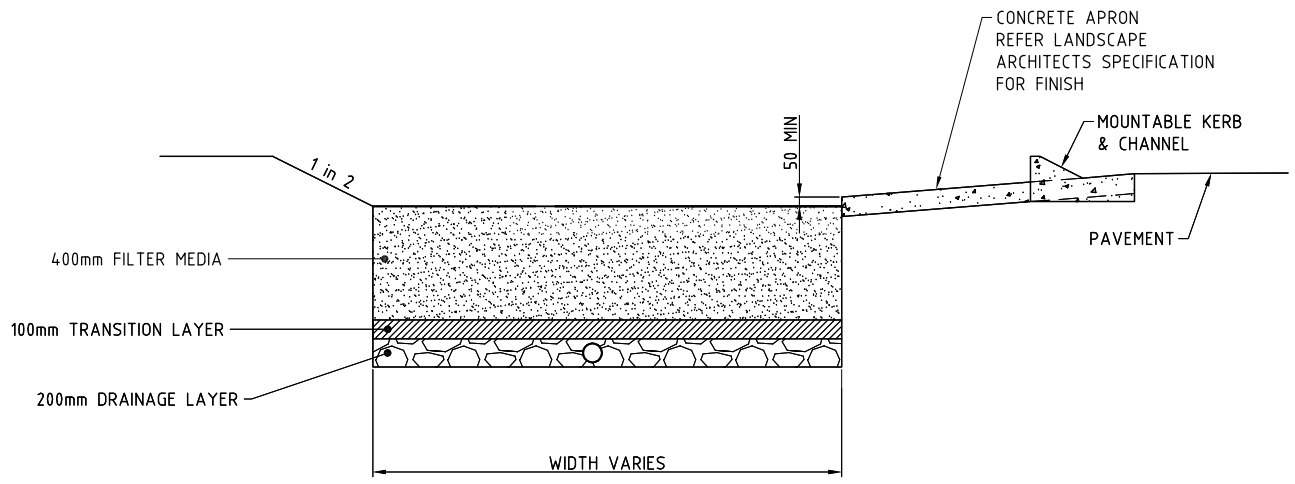
NOTE:
THIS DRAWING TO BE READ IN CONJUCTION WITH IPWEAQ STD DRG WSUD-005 & WSUD-007



TYPICAL COMPLETED BIO-POD TYPE 1B

SCALE 1:20

TYPE A BIO-PODS TO BE FULLY LANDSCAPED BY LANDSCAPE ARCHITECT AND CONCRETE BARRIER INSTALLED TO PREVENT FLOWS INTO BIO-POD UNTIL BUILDING CONSTRUCTION IS COMPLETED



TYPICAL BIOPOD SECTION

SCALE 1:20

FILE: B12201-DA08.dwg DATE: 27-05-2016 TIME: 13:42
Xref's: N12059-X-TITLE XREF-SK USR: wesley pike

AMENDMENTS	FIRST ISSUE	CALCS	DRAWN	DATE	AMENDMENT DETAILS
	A	CC	AS	08.03.16	
	B				
	C				
	D				
	E				
	F				

DESIGN CHECK

DRAWN CHECK

SCALE (METRES)

1:10 0.1 0.5 0 0.1 0.2 0.3 0.4 0.5 A1

1:20 A3

MICROFILM No.

PROJECT No. N12059

RPS Australia East Pty Ltd.
PO Box 149 Wurtulla QLD 4575
Ph (07) 5436 7888 Fax (07) 5493 6630

APPROVED
BRAD THOMPSON RPEQ 7818
FOR & ON BEHALF OF CALIBRE CONSULTING (QLD) PTY LTD

CLIENT
Stockland Caloundra Downs Pty Ltd

PROJECT
AURA
APPLICATION 4
TOWN CENTRE

calibre CONSULTING

CONSULT AUSTRALIA

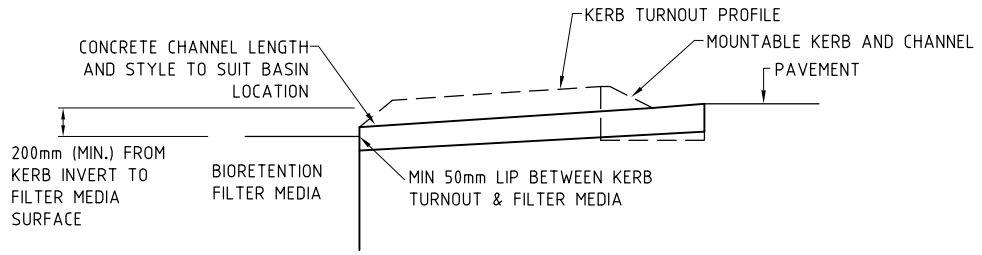
Calibre Consulting (QLD) Pty Ltd
Level 3, 16 Innovation Parkway, Birtinya QLD Australia 4575
Telephone 07 5314 2520 Facsimile 07 5314 2522
Brisbane Canberra Melbourne Sydney Singapore Sunshine Coast

Quality Endorsed Company ISO 9001 Lic 4084

DRAWING TITLE
BIO RETENTION NOTES AND DETAILS SHEET 2 OF 3

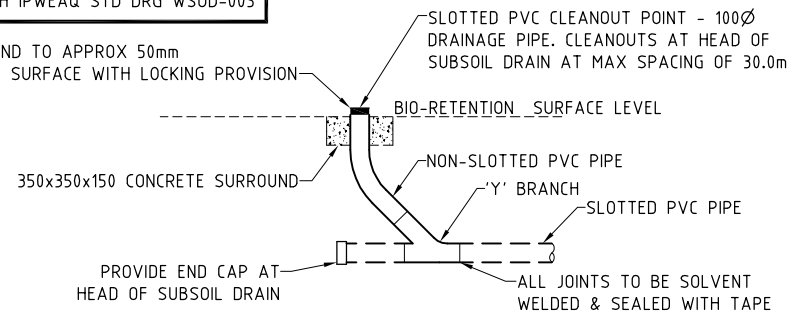
DRAWING NUMBER
B12201-DA08

ISSUE

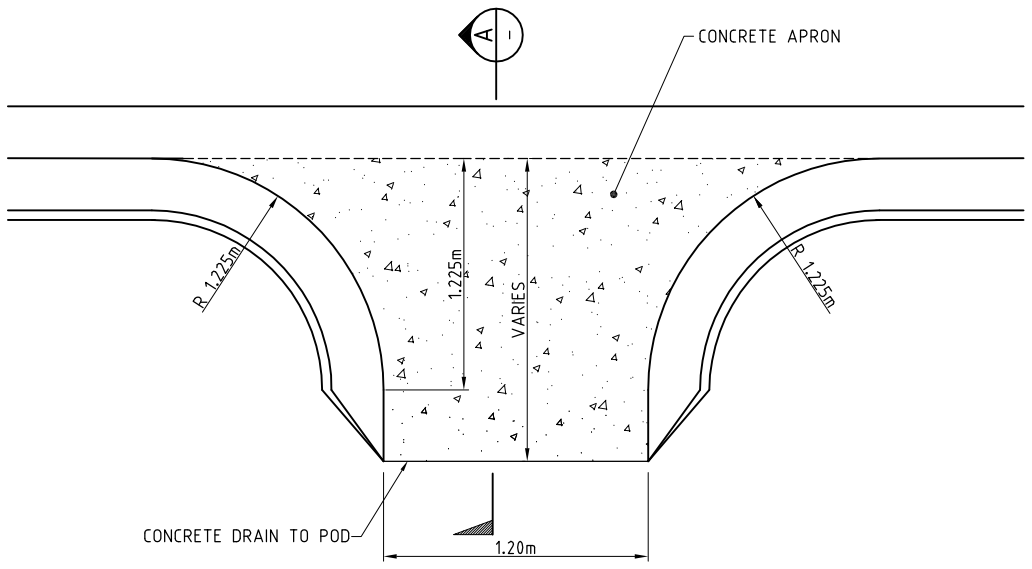


SECTION A – A
SCALE 1:20

ALL CLEANOUT POINTS TO BE CONSTRUCTED IN ACCORDANCE WITH IPWEAQ STD DRG WSUD-003



CLEANOUT POINT DETAIL
SCALE 1:20 ON A1



KERB TURNOUT DETAILS
SCALE 1:20

NOTE:
THE CIVIL CONTRACTOR AND LANSCAPE CONTRACTOR SHALL CO-ORDINATE THEIR WORK TO ENSURE THAT THE CIVIL AND LANDSCAPEING COMPONENTS OF ANY PARTICULAR BIO-POD ARE COMPLETED THE SAME DAY SO AS TO AVOID EXPOSURE OF THE BIOPOD TO POTENTIAL SEDIMENT IMPACTS.

NOTE:
THE CONTRACTOR SHALL NOT PROCEED WITH THE FINALISATION OF BIOPODS (IE. PLACEMENT OF SUB-SOIL DRAINS, FILTER MEDIA ETC.) UNTIL THE SUPERINTENDENT HAS APPROVED COMPLETION BASED ON SUFFICIENT STABILISATION OF UPSTREAM CATCHMENT.

BIOPOD CONSTRUCTION SEQUENCE AND NOTES:

1. ESTABLISH SEDIMENT AND EROSION CONTROL MEASURES IN CATCHMENT, INCLUDING SILT FENCES, SEEDING OF ALLOTMENTS, & FULL WIDTH VERGE TURFING.
2. SURVEY POD LOCATION.
3. INSTALL OVERFLOW PIT AND ENSURE PIT CREST IS AT DESIGN LEVEL. THIS PIT CREST WILL THEN BE USED AS A DATUM FROM WHICH OTHER LEVELS WITHIN THE POD WILL BE MEASURED. THE PIT REQUIRES HOLES FOR DRAINAGE PIPE CONNECTIONS WHICH CAN BE DRILLED AT THIS STAGE OR AFTER STEP 5 BELOW.
4. CONSTRUCT KERB TURNOUTS.
5. EXCAVATE SURROUNDING LANDFORM TO DESIGN SUBSOIL LEVEL (ACHIEVING SURROUNDING LEVEL AT THIS STAGE REDUCES THE NEED FOR EARTHWORKS ADJACENT TO THE PODS AFTER THEY HAVE BEEN CONSTRUCTED).
6. EXCAVATE POD TO DESIGN DEPTH ENSURING BASE OF POD HAS MINIMUM 0.5% GRADE TOWARDS PIT. ENSURE BASE OF POD IS FREE FROM DEBRIS.

SUPERINTENDENT INSPECTION AND SIGN OFF REQUIRED BEFORE PROCEEDING.

7. LINE SYSTEM WITH GEOFABRIC, AND EXTEND GEOFABRIC A MINIMUM OF 500 MM BEYOND TOP OF EXCAVATION. THESE ARE THE FLAPS REFERRED TO IN ITEM 13 BELOW.
8. PLACE DRAINAGE LAYER (USING CLEAN 5-7 MM AGGREGATE) TO DESIGN LEVEL.
9. NOTE THAT CORRECT FUNCTIONING OF THE DRAINAGE PIPES IS CRITICAL TO THE PERFORMANCE OF THE BIORETENTION SYSTEM. DIG TRENCHES IN DRAINAGE LAYER AND PLACE DRAINAGE PIPES. ENSURE PIPES ARE LAID AT MIN 0.5% SLOPE WITH NO LOCALIZED DEPRESSIONS VERIFIED USING LEVEL OR STRING LINE. ALL JOINTS AND JUNCTIONS IN PIPES TO BE SEALED. CONNECT CLEAN OUT POINTS ENSURING TOP OF CLEAN OUT POINTS ARE NOT LESS THAN 50 MM BELOW OVERFLOW PIT CREST.

SUPERINTENDENT INSPECTION AND SIGN OFF REQUIRED BEFORE PROCEEDING.

10. COVER DRAINAGE PIPES WITH DRAINAGE MEDIA, ENSURING DESIGN COVER.
11. PLACE TRANSITION LAYER (USING ONLY PRESCRIBED DRAINAGE MATERIAL: 2.0MM SAND) TO DESIGN LEVEL (REFER DRAWINGS).

SUPERINTENDENT INSPECTION AND SIGN OFF REQUIRED BEFORE PROCEEDING.

12. PLACE FILTER MEDIA (USING ONLY PRESCRIBED MATERIAL: 0.7MM SAND) TO DESIGN LEVEL (REFER DRAWINGS). SPREAD MATERIAL USING EXCAVATOR BUCKET OR HAND TOOLS TO OBTAIN LIGHT AND EVEN COMPACTION OF FILTER MEDIA. DO NOT DRIVE OVER FILTER MEDIA WITH ANY VEHICLE AS EXCESSIVE COMPACTION CAN IMPEDE DRAINAGE THROUGH THE FILTER MEDIA. FILTER MEDIA SURFACE MUST BE LEVEL (HORIZONTAL) AND FREE FROM LOCAL DEPRESSIONS AND SET AT 100 MM BELOW PIT CREST (EXCEPT FOREBAY AREA WHICH IS 200MM). AS SOON AS FILTER MEDIA IS PLACED IT MUST BE IMMEDIATELY COVERED WITH A GEOFABRIC COVER WHICH MUST REMAIN IN PLACE AT ALL TIMES EXCEPT WHEN ACCESS TO FILTER MEDIA IS REQUIRED.THIS PROTECTIVE COVER IS ONLY TO BE REMOVED BY LANDSCAPERS IMMEDIATELY PRIOR TO PLANTING.
13. LAY EXCESS GEOFABRIC FLAPS FROM POD OUTWARD ACROSS ADJACENT SUBSOIL AND PLACE LANDSCAPING TOPSOIL ON TOP OF THIS GEOFABRIC AND AROUND POD AS PER DESIGNS.
14. INSTALL PROTECTIVE PLYWOOD BARRIERS ENSURING THE CREST IS AT DESIGN LEVEL (MIN 100 MM ABOVE ELEVATION OF PIT CREST) AND EXTENDS LATERALLY TO POD BATTERS BY 300 MM, AND VERTICALLY INTO THE FILTER MEDIA BY 200 MM. THIS PLYWOOD BARRIER NEEDS TO REMAIN IN PLACE FOR 12 MONTHS AND PREVENT SEDIMENT LADEN RUNOFF FROM ENTERING THE MAJORITY FOR THE POD AREA. AFTER 12 MONTHS ONCE THE VEGETATION IS ESTABLISHED AND THE ALLOTMENT CONSTRUCTION IS COMPLETE THESE PLYWOOD BARRIERS WILL BE TAKEN OUT AND THE SYSTEM BROUGHT ONLINE.
15. COVER INLET ZONE WITH PROTECTIVE GEOFABRIC ENSURING GEOFABRIC EXTENDS OVER CREST OF PROTECTIVE PLYWOOD BARRIER. COVER GEOFABRIC WITH MIN 50 MM TOPSOIL SUITABLE FOR TURF GROWTH. SIMILAR TO THE PLYWOOD BARRIERS, THIS GEOFABRIC IS A TEMPORARY PROTECTIVE MEASURE TO PROTECT THE FILTER MEDIA IN THE INLET ZONE FROM BEING CLOGGED WITH CONSTRUCTION SEDIMENT, AND WILL BE REMOVED AFTER 12 MONTHS.
16. FLUSH DRAINAGE PIPES TO REMOVE ANY INITIAL INGRESS OF MATERIAL AND TO ENSURE ADEQUATE DRAINAGE.

FINAL SUPERINTENDENT INSPECTION AND SIGN OFF

NOTE THAT BETWEEN STEPS 5 – 16 ABOVE THE PODS WILL BE SUSCEPTIBLE TO STORM DAMAGE. THEREFORE ONCE COMMENCED PODS MUST BE COMPLETED AS SOON AS POSSIBLE TO MINIMISE THE RISK OF STORM DAMAGE.
INSPECTION IS REQUIRED IF RAINFALL EVENT OCCURS BETWEEN CONSTRUCTION STEPS 5 – 16 ABOVE.

FILE: B12201-DA09.dwg DATE: 02-06-2016 TIME: 16:35
Xref's: N12059-X-TITLE XREF-SK USR: wesley pike

AMENDMENTS	FIRST ISSUE	CALCS	DRAWN	DATE	AMENDMENT DETAILS
	A	CC	AS	08.03.16	
	B				
	C				
	D				
	E				
	F				

DESIGN CHECK
DRAWN CHECK

SCALE (METRES)
1:10 0.1 0.5 0 0.1 0.2 0.3 0.4 0.5 A1
1:20 A3
1:20 0.2 0 0.2 0.4 0.6 0.8 1 A1
1:40 A3

MICROFILM No.
PROJECT No. N12059

RPS Australia East Pty Ltd.
PO Box 149 Wurtulla QLD 4575
Ph (07) 5436 7888 Fax (07) 5493 6630

APPROVED
BRAD THOMPSON RPEQ 7818
FOR & ON BEHALF OF CALIBRE CONSULTING (QLD) PTY LTD

CLIENT: Stockland Caloundra Downs Pty Ltd
PROJECT: AURA APPLICATION 4 TOWN CENTRE

calibre CONSULTING

CONSULT AUSTRALIA
Calibre Consulting (QLD) Pty Ltd
Level 3, 16 Innovation Parkway, Birtinya QLD Australia 4575
Telephone 07 5314 2520 Facsimile 07 5314 2522
Brisbane Canberra Melbourne Sydney Singapore Sunshine Coast

Quality Endorsed Company ISO 9001 Lic 4084

DRAWING TITLE: BIO RETENTION NOTES AND DETAILS SHEET 3 OF 3
DRAWING NUMBER: B12201-DA09
ISSUE

KEY PLAN
SCALE 1:10000

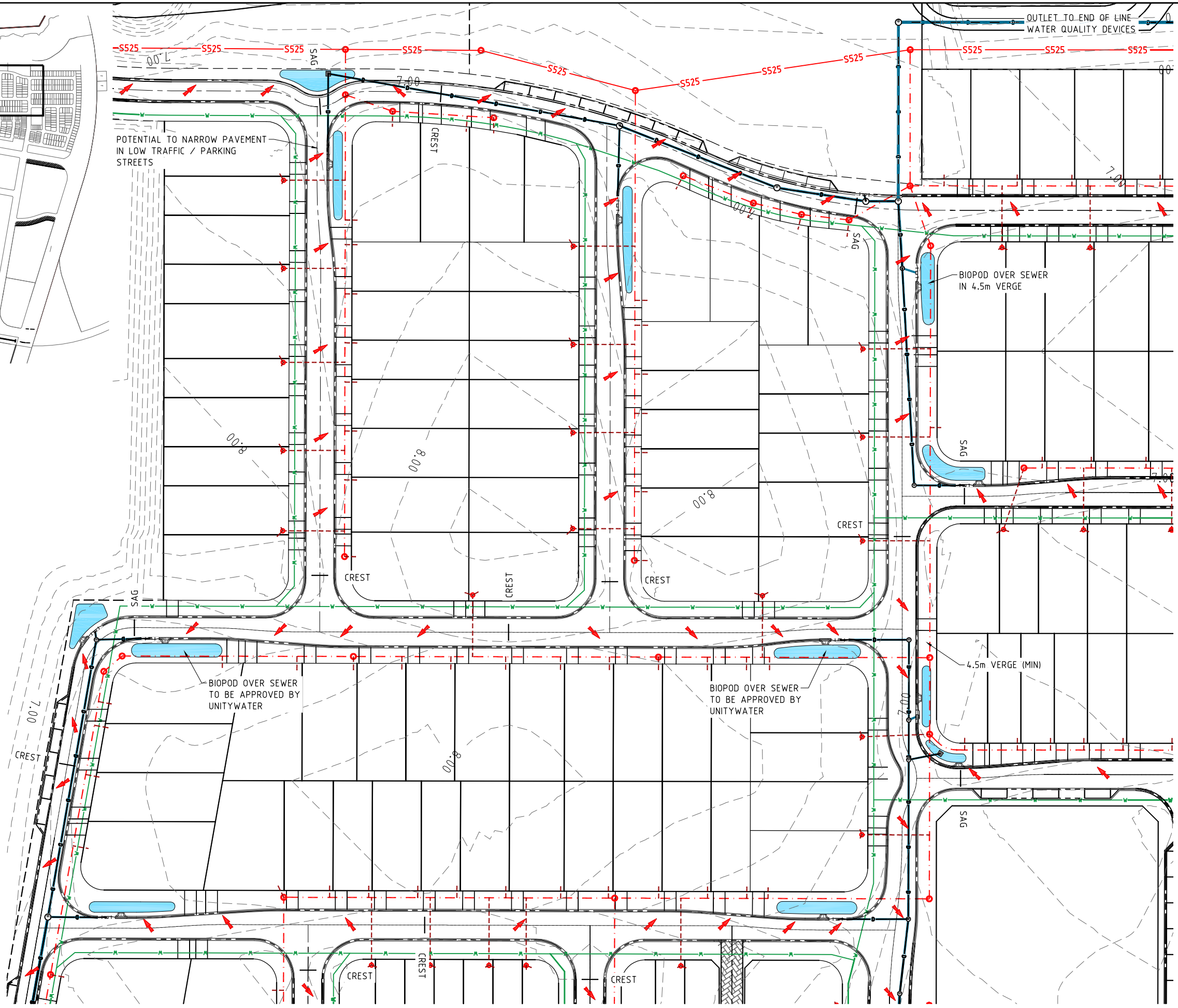
LEGEND

- S525 — PROPOSED TRUNK SEWER
- PROPOSED SEWER RETICULATION
- PROPOSED WATER RETICULATION
- 5.0 — PROPOSED DESIGN CONTOURS
- AT SOURCE BIORETENTION SYSTEM
- PROPOSED STORMWATER DRAINAGE
- PROPOSED STORMWATER GULLY PIT
- PROPOSED STORMWATER MANHOLE
- 900 x 900 FIELD INLET
- CREST — ROAD HIGH POINT
- SAG — ROAD LOW POINT

NOTE
50% - 75% COVERAGE OF BIOPOD REQUIRED ONLY

DesignFlow
PO Box 1250 Southport BC QLD 4215
Ph (07) 5528 1148
Mobile 0414 849 587

PRELIMINARY
FOR INFORMATION ONLY
NOT FOR CONSTRUCTION



FILE: B12201-DA59.dwg DATE: 02-06-2016 TIME: 16:35
Xref's: X_B12201_TITLE X-B12201-BASE USR: wesley pike

FIRST ISSUE	CALCS	DRAWN	DATE	AMENDMENT DETAILS
A	RD	JB	26.07.13	
B				
C				
D				
E				
F				

AMENDMENTS

DESIGN CHECK

DRAWN CHECK

SCALE (METRES)
1:1000 10 0 10 20 30 40 50 A1
1:2000 A3
1:10000 100 0 100 200 300 400 500 A1
1:20000 A3

MICROFILM No.

PROJECT No.
N12059

RPS Australia East Pty Ltd.
PO Box 149 Wurtulla QLD 4575
Ph (07) 5436 7888 Fax (07) 5493 6630

APPROVED
BRAD THOMPSON RPEQ 7818
FOR & ON BEHALF OF CALIBRE CONSULTING (QLD) PTY LTD

CLIENT
Stockland Caloundra Downs Pty Ltd

PROJECT
AURA
APPLICATION 4
TOWN CENTRE

calibre CONSULTING
CONSULT AUSTRALIA
Calibre Consulting (QLD) Pty Ltd
Level 3, 16 Innovation Parkway, Birtinya QLD Australia 4575
Telephone 07 5314 2520 Facsimile 07 5314 2522
Brisbane Canberra Melbourne Sydney Singapore Sunshine Coast
Quality Endorsed Company ISO 9001 Lic 4084

DRAWING TITLE
CONCEPTUAL STREETSCAPE BIOPOD AND DRAINAGE PLAN

DRAWING NUMBER
B12201-DA59

ISSUE