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Engineering

Working Beyond Expectations

Stormwater Management Plan

Chisholm Residential Subdivision

Property:
Lot 100 DP 847510
523 Raymond Terrace Road, Chisholm

Applicant:
ACG Clovelly Road Pty Ltd

Date:
May 2023

Document Control Sheet

Issue No.	Amendment	Date	Prepared By	Checked By
A	Draft	02/05/23	S Warburton	ND
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Limitations Statement

This report has been prepared in accordance with and for the purposes outlined in the scope of services agreed between ADW Johnson Pty Ltd and the Client. It has been prepared based on the information supplied by the Client, as well as investigation undertaken by ADW Johnson and the sub-consultants engaged by the Client for the project.

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The Client should be aware that this report does not guarantee the approval of any application by any Council, Government agency or any other regulatory authority.

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1.0 Introduction

ADW Johnson has been engaged by the ACG Clovelly Road (ACG) to prepare a Stormwater Management Plan (SWMP) for the proposed 108 lot subdivision, located within Lot 100 DP 847510, Raymond Terrace Road, Chisholm (the site). The preparation of this management plan has been undertaken to accompany a Development Application required for the proposed subdivision.

This report documents the means of stormwater treatment and disposal from the proposed 108 lot subdivision in accordance with Maitland City Council (MCC) requirements current at the time of this report.

This report documents the proposed stormwater system required to capture and convey the stormwater from the proposed development and upstream catchments efficiently and effectively, ensuring that there are no adverse effects from the proposed development on water quality to the receiving waters or flooding of downstream properties or infrastructure.

2.0 Site Description

The subject site is identified as Lot 100 DP 847510, 523 Raymond Terrace Road, Chisholm.

The site, as depicted in **Figure 1**, is approximately 10.2 ha and is currently zoned as R1 General Residential.

The existing site is bound to the south by Raymond Terrace Road, to the east by DA approved residential subdivision, to the north and west by rural land currently seeking DA approval for residential subdivision.

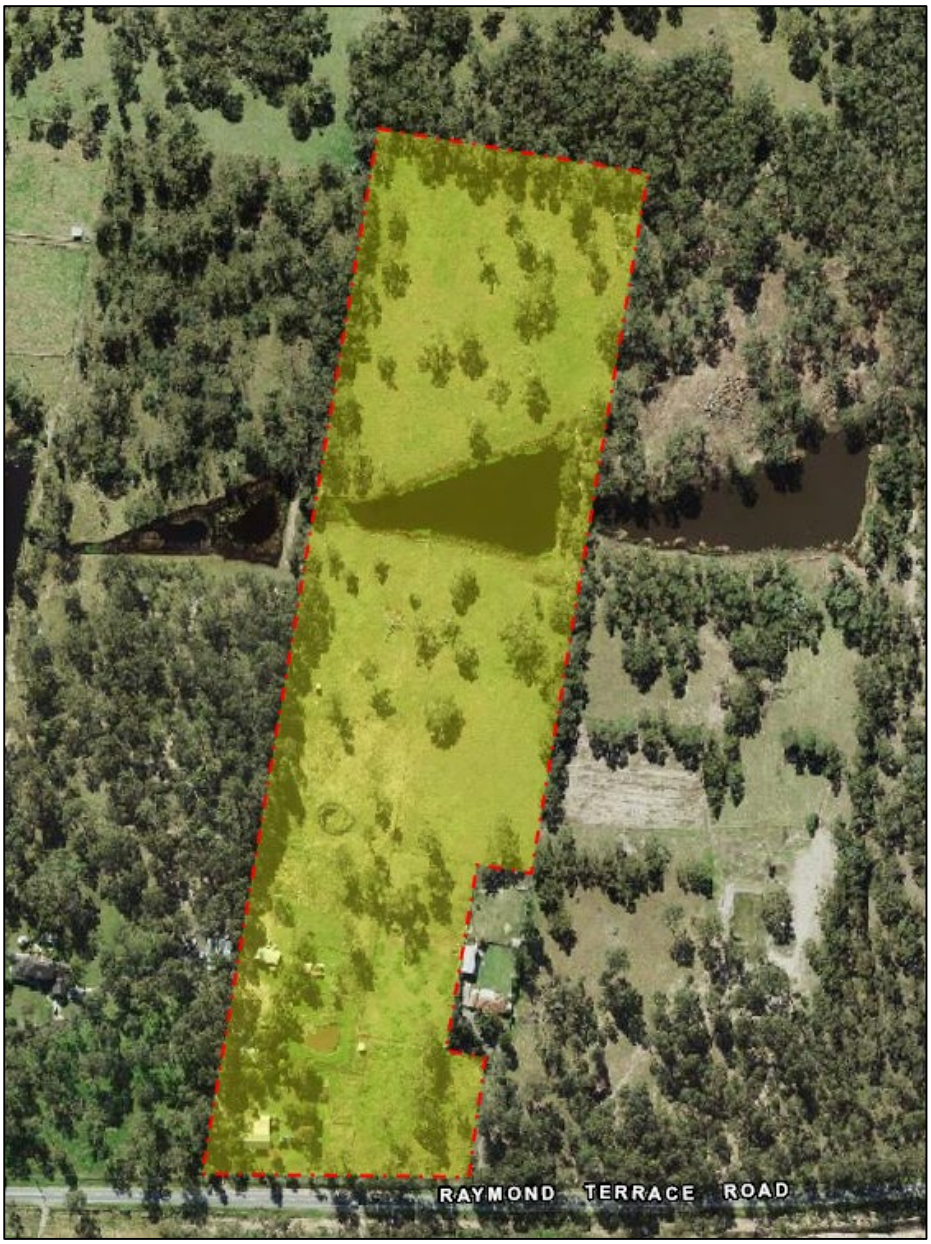

Figure 1 - Existing Site
(Source: https://maps.six.nsw.gov.au/)

2.1 TOPOGRAPGHY AND EXISTING INFRASTRUCTURE

The site as shown in **Exhibit A,** is currently occupied by one (1) dwelling, and associated minor structures including sheds, driveways, and services. Overall, the site is relative clear with maintained grasslands and scattered trees across the site.

There are two remnant dams from previous farming activities in the southern section of the site and a large basin/ dam in the northern section of the site. The Raymond Terrace Road frontage has an existing table drain grading in an easterly direction.

The site contains a ridgeline which runs west to east through the southern third of the site. A defined gully exists in the same direction in the northern third of the site. The existing gully contains the large dam/ basin that connects a series of basins from adjacent properties.

This topography divides the site into two (2) overall catchments.

The northern catchment is approximately 7.8ha and grades towards the existing gully at grades between 2% and 10%. Runoff from the northern catchment drains to the existing large dam/ basin. The basin contains a low flow outlet pipe and high-level embankment weir that conveys flows downstream to the next basin in the drainage line.

The southern catchment is approximately 2.5ha and grades to the south east towards Raymond Terrace Road at grades between 2% and 7%. Runoff from the southern catchment drains to the existing table drain in the northern verge of Raymond Terrace Road. There is an existing inlet headwall and DN 600 stormwater pipe that crosses Raymond Terrace Road and discharges flows to the existing stormwater infrastructure on the southern side of Raymond Terrace Road.

A review of the site and surrounding area has determined that runoff from upstream properties will contribute to flows in both the northern and southern catchments. The upstream catchments will be catered for in terms of drainage through the site but will not be assessed for water quality or quantity requirements as the adjoining development will need to consider their own measures.

The soil profile is expected to be generally residual silty and sandy clays overlying weathered sedimentary rock as outlined in '*Report on Geotechnical Investigation*' prepared by Cardno dated February 2016.

2.2 PROPOSED DEVELOPMENT

The proposed development will comprise of 108 residential lots. Typical urban residential elements such as roads, drainage infrastructure, services and landscaping will also be incorporated. **Exhibit B** illustrates the proposed development.

The stormwater from the proposed development and upstream catchments will be captured by a pit and pipe network and conveyed to the discharge locations.

It is proposed to remove the large dam/ basin from the existing drainage line and reconstruct a drainage channel and riparian corridor to convey upstream flows through the site to the downstream receiving waters.

The northern catchment will be conveyed to the reconstructed channel and riparian corridor via stabilised headwalls.

The southern catchment will be conveyed to a detention/ biofiltration basin to limit the peak flows leaving the site to predeveloped flows before discharging to the existing table drain in the northern verge of Raymond Terrace Road via a stabilised headwall.

2.3 BACKGROUND DOCUMENTATION

The subject site is part of the larger Thornton North Urban Release Area (TNURA) Eastern Precinct. The TNURA is a large rezoned area of residential land under fragmented ownership. As such several catchment wide studies have been completed over the area to deal with servicing, traffic, and stormwater.

An approved Stormwater Management strategy was completed by ADW Johnson for the initial subdivision of the TNURA tilted Stormwater Management Plan – Chisholm Residential Subdivision dated September 2016. Since then, a number of addendums have been submitted and approved by Council including:

- Addendum 1 – Stormwater Management Plan #1 by ADWJ dated October 2016;
- Addendum 2 – TNURA Stormwater Management Plan by ADWJ dated July 2019;
- Addendum 3 – Stormwater Management Plan Addendum #3 by ADWJ dated April 2020; and
- Addendum 4 – Stormwater Management Plan Addendum #4 by ADWJ dated November 2022.

The most recent addendum "Thornton North URA Eastern Precinct Stormwater Management Plan Addendum 5" is in the process of being lodged with Council.

This addendum has been prepared to consolidate the number of detention and water quality basins within the drainage corridor running through the northern portion of the subject site. Outcomes of the investigation show that a single additional basin on the downstream "Munro" site will be sufficient to cater for the detention and water quality needs of the proposed developments in the upstream contributing catchments.

As a result of this investigation, it was determined that the subject site does not require detention or water quality facilities for the northern catchment allowing the large dam/ basin to be removed and the corridor be reconstructed into a drainage channel and riparian corridor.

The southern catchment within the subject site has not been catered for and as such will require an investigation into detention and water quality measures.

The catchment area included within the Addendum 5 investigation is shown in **Figure 2** and the report in its entirety is included in **Appendix A**.

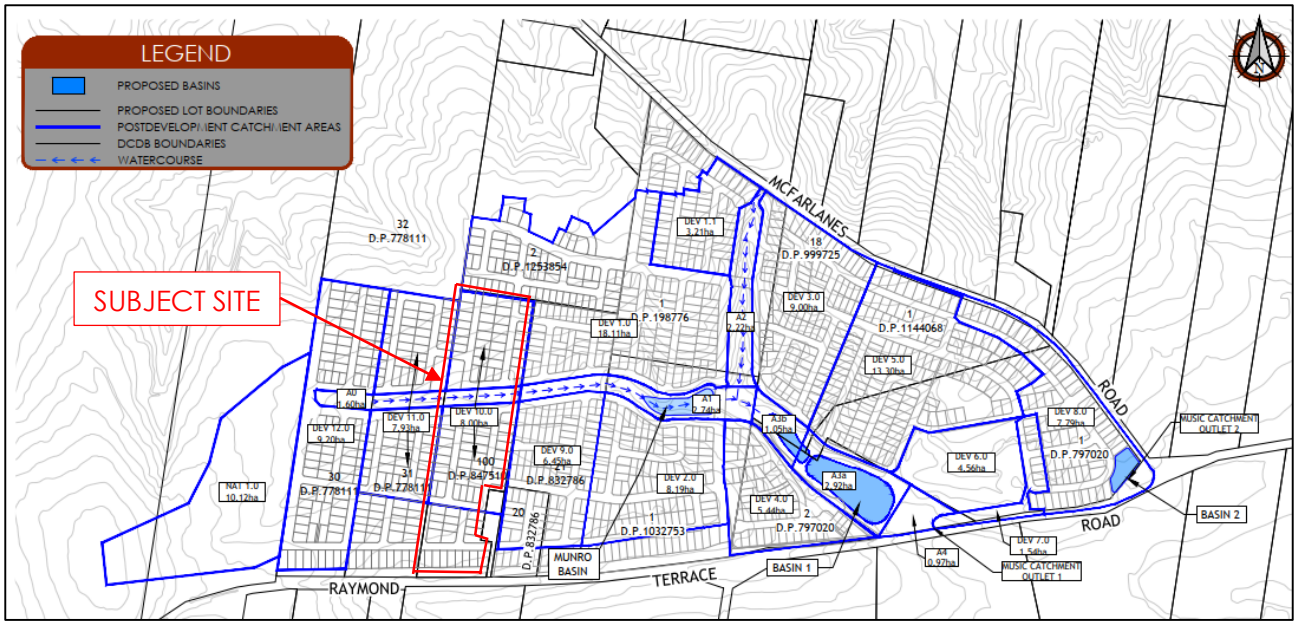

Figure 2 – Catchment Area of TNURA Study
(Source: Thornton North URA Eastern Precinct Stormwater Management Plan Addendum 5)

3.0 Council Requirements

Council outlines the engineering requirements for stormwater management within their *'Manual of Engineering Standards'* (MOES), Section DC.3 of the Maitland Development Control Plan (Part C), and Section F7 of the Maitland Development Control Plan – Thornton North Urban Release Area. DCP Compliance tables have been provided in ***Section 8.2.***

3.1 CONCEPT STORMWATER DESIGN

Maitland DCP requires new developments to provide concept plans as part of the development application.

A concept stormwater design is required to demonstrate that stormwater runoff can be effectively and efficiently conveyed from the proposed subdivision to the existing receiving waters.

3.2 STORMWATER QUANTITY

Council's DCP requires that onsite detention is required to protect downstream properties and infrastructure from increased stormwater flows due to new developments. Council requires that the proposed development does not exceed predeveloped runoff for all storm events up to the 100-year storm.

The pit and pipe network needs to cater for the minor storm event (10yr ARI) without any surcharging within the system and minimising flow widths and ponding. The overland flow paths need to cater for the major storm event (100yr ARI) with freeboard to adjacent habitable floor levels.

The purpose of this study is to limit post-development critical peak flows to less than or equal to existing flows for all design storms up to the 1% design storm event leaving the site.

3.3 STORMWATER QUALITY / WATER SENSITIVE URBAN DESIGN

The stormwater drainage system must effectively remove the nutrients and gross pollutants from the site prior to the runoff entering the existing downstream waterways.

The proposed development will include water quality treatment devices within the catchment to reduce pollutant loads to the downstream watercourse. Council's stormwater quality targets are shown in ***Table 3.1***.

Table 3.1 - Water Quality Targets (Maitland City Council, 2014)

Pollutant	Targets
Total Suspended Solids (TSS)	80% of average annual load
Total Phosphorus (TP)	45% of average annual load
Total Nitrogen (TN)	45% of average annual load
Gross Pollutants (GP) (>5mm)	70% of average annual load
Litter (>50mm)	Retention up to the 3 month ARI peak flow
Oil and Grease	90% of average annual load

3.4 SOIL & WATER MANAGEMENT

Soil and Water Management (SWM) is to be undertaken according to Landcom's *Blue Book* (2004) and Council's Manual of Engineering Standards, specifically Appendix B. The intent of this requirement is to mitigate erosion and prevent sediment-laden run-off from leaving the site during site preparation and construction.

3.5 PRE DA MEETING

A pre-DA meeting was held with Council on 23rd March 2023. Below is a list of the stormwater requirements raised by Council in the pre-DA meeting minutes:

- Stormwater Management – Detention (southern catchment): Council can confirm that the stormwater detention basin constructed on the southern side of Raymond Terrace Road does not cater for the proposed development site. Detention for the southern catchment will need to be provided prior to discharge to Raymond Terrace Road.
- Stormwater Management – Detention (Main Catchment): Part F of the DCP 2011 identifies a stormwater management basin being provided within this site. Any proposal to delete this basin would need to be supported by appropriate details being submitted for assessment at DA stage.

4.0 Concept Stormwater Design

4.1 OVERALL STRATEGY

A stormwater drainage concept plan has been prepared to demonstrate how the stormwater runoff for the proposed development and the upstream catchments is captured and transported to the receiving waters. Refer to **Exhibit C** for the stormwater management plan.

The stormwater system contains a combination of conventional pit and pipe networks and WSUD elements to effectively convey stormwater runoff to the downstream waterways.

Roof runoff is proposed to be captured via the use of rainwater tanks. The rainwater tanks will allow the reuse of stormwater for indoor and outdoor uses. Overflow from the tanks will be conveyed to the stormwater system via an overflow pipe. It is expected that each tank will consist of a first flush system to further improve stormwater runoff quality prior to discharge.

A pit and pipe stormwater system has been designed to convey the stormwater runoff from the developed catchments to two discharge locations. This network has been designed to cater for the minor storm (10yr ARI) without surcharging within the system and minimizing flow widths and ponding. The road network has been designed to cater for the major storm (100yr ARI).

Inter-allotment drainage has been provided in the lots that cannot drain to the street to allow runoff to be captured and conveyed to the discharge locations.

4.2 UPSTREAM CATCHMENTS

There are upstream properties that contribute to flows in both the northern and southern catchments. Where flows would logically connect from upstream catchments within the road network the proposed road drainage has been extended to the boundary to allow for future connection.

The drainage channel has been designed to tie in with the proposed reconstructed channel on both the western and eastern boundaries to allow continuous flow without impediment.

4.3 NORTHERN CATCHMENT

The northern catchment collects and conveys runoff via a pit and pipe network before discharging to the reconstructed drainage channel via stabilized headwall outlets where possible.

Some of the catchment drains to the stormwater network in the proposed development downstream of the site before discharging to the proposed basin in the Munro site.

The stormwater network will be sized to cater for the developed flow from upstream catchments as the detention requirements are proposed to be catered for downstream in the Munro site.

4.4 SOUTHERN CATCHMENT

The southern catchment collects and conveys runoff via a pit and pipe network before discharging to a proposed detention/ biofiltration basin in the south east corner of the development.

The stormwater systems will split into a high flow and low flow system. The low flow system will convey stormwater flows up to and including the three (3) month ARI storm event through a GPT and into a temporary detention/biofiltration basin. The high flows will bypass the GPT and be discharged directly into the temporary detention/biofiltration basins.

Discharge from the basin will be conveyed to the existing table drain in the northern verge of Raymond Terrace Road via a stabilized headwall.

The stormwater network will be sized to cater for the predeveloped flow from upstream catchments as it is assumed that upstream developments will need to cater for their own detention and water quality requirements.

5.0 Stormwater Quantity

As discussed in **Section 2.3** the northern catchment has been included in the "Thornton North URA Eastern Precinct Stormwater Management Plan Addendum 5" stormwater assessment and has been catered for within the proposed basin in the Munro site. Therefore, only the southern catchment will be assessed in this section.

The proposed stormwater system has been designed to protect downstream properties and infrastructure from increased stormwater flows as a result of the development. To ensure there are no adverse impacts on the downstream properties and infrastructure, the stormwater system has to be designed to ensure that the post-development peak flows leaving the site are less than the pre-development peak flows for all storm events up to the 100yr ARI event.

As the development of the site will result in an increased impervious area, on-site detention will be required to reduce the peak median flows back to existing conditions.

The proposed stormwater system, as detailed in **Section 4**, uses a combination of pit and pipe networks and WSUD elements to capture and convey stormwater runoff from the site.

The subject site is subdivided into a series of sub-catchments for the post development scenarios. Parameters of sub-catchment areas, imperviousness, and times of concentration are used to simulate the catchment response to storm events to generate hydrographs and estimate the peak median discharge flows.

5.1 MODELLING PARAMETERS

XP-RAFTS modelling was used to demonstrate that the on-site stormwater detention reduces post-development peak flows back to or less than pre-development peak flows for various design storms.

The model diagram and parameters used for the modelling can be found in the subsequent sections and within **Appendix B.**

5.1.1 Rainfall Intensity

The Rainfall Intensity Frequency Duration (IFD) data adopted was sourced from the Bureau of Meteorology website (IFD AR&R87 application). This was then checked against the IFD data contained in Appendix C of Council's *'Manual of Engineering Standards'*.

5.1.2 XPRAFTS Parameters

The key parameters utilised within the XPRAFTS model are summarised in ***Table 5.1*** below.

Table 5.1 - XPRAFTS Modelling Parameters

Parameter	Pervious Area	Impervious Area
Manning's 'n'	0.05 – Natural	0.015
	0.035 - Developed	
Initial Loss (IL)	5.0mm	1.0mm
Continuing Loss (CL)	2.5mm/hr	0mm/hr

The parameters outlined in ***Table 5.1*** were sourced from both Council's '*Manual of Engineering Standards'* and Australian Rainfall and Runoff (Edition 3 – 1987) '*A Guide to Flood Estimation'* (Pilgrim, 1987).

5.2 CATCHMENT DATA

Subcatchments were delineated by analysis of the field survey undertaken as well as (Lidar) topographical survey information and then confirmed by ground truthing inspection. It was decided to investigate the catchment upstream of the existing DN600 stormwater crossing of Raymond Terrace Road downstream of the subject site.

5.2.1 Predeveloped Catchment

The predeveloped catchments, as shown in **Exhibit A,** were modelled as 5% impervious to account for the existing structures and accesses on site.

A summary of the subcatchment parameters used are shown in ***Table 5.2.***

Table 5.2 - Pre-Developed Catchment Parameters

Subcatchment	Total Area (ha)	% Impervious
Subject Site	2.19	5
Upstream Catchment	1.60	5
Downstream Catchment	1.35	5
TOTAL	**5.14**	

5.2.2 Developed Catchment

Developed catchments were delineated utilising the proposed site grading plan and concept stormwater layout. The catchment areas external to the subject site were modelled in their existing state as it is assumed that they will need to cater for their own detention requirements or not be developed.

Maitland City Council's Manual of Engineering Standards includes standard impervious fractions for different land uses as shown in ***Table 5.3.***

Table 5.3 - Fraction Impervious Rates for Land Uses

Land Use	Fraction Impervious
Residential Lot Size < 1000 m^2	0.6
Road Reserve	0.7
Public Recreation Areas (mowed and with improvements)	0.5
Parkland, Natural Public Reserve	0.1

A summary of the developed catchment parameters is shown in **Table 5.4.**

Table 5.4 - Post Developed Catchment Parameters

Subcatchment	Total Area (ha)	% Impervious	Area (ha) Impervious	Area (ha) Pervious
Subject Site	2.02	60	1.22	0.80
Upstream Catchment	1.6	5	0.08	1.52
Downstream Catchment	1.35	5	0.07	1.28
TOTAL	**4.97**		**1.37**	**3.61**

From **Table 5.4** it can be seen that the post developed catchment is smaller than the pre developed catchment. This is due to some of the catchment being taken to the north to reflect the proposed road grading.

5.3 PROPOSED DETENTION BASIN

The proposed development requires a detention basin to meet Council's requirements for the southern catchment. The basin will be utilised for stormwater quality in addition to stormwater detention so will have a biofiltration component.

The proposed detention basin will be accessible from the adjoining road for maintenance purposes.

The onsite detention basin has been sized and a concept outlet configuration has been prepared to enable modelling of the site and demonstrate that the basin reduces post-development peak flows back to or less than pre-developed peak flows.

General arrangements of the stormwater controls within the ACG site can be found in ***Exhibit D.***

The basin design details are summarised in ***Table 5.5.***

Table 5.5 - The basin

Basin Parameter	Detail
Levels	21.7m AHD – Invert Level
	22.0m AHD – Extended Detention Level
	23.5m AHD – Crest Level
Basin Area	Extended Detention Surface Area 199m^2
Batters	1:4 internal batters
	1:4 external batters
Outlet Controls	0.3m high x 0.6m wide cut out at RL22.0 0.6m high x 0.6m wide cut out at RL22.35
	Weir (Spillway) – 4m length, 1:4 sides – IL 23.2m AHD
Total Storage at 100yr Stage (above the permanent water level)	400.43 m^3

Appendix B contains the storage table for this basin.

5.4 STORMWATER DETENTION RESULTS

In accordance with Council's requirements, modelling was undertaken to demonstrate compliance of post development flows being less than or equal to the pre development flows prior to discharge of stormwater into the downstream waterways.

The results of the modelling are shown in **Table 5.6.**

Table 5.6 - Catchment of The basin Modelling Results

Storm Event (ARI)	Peak Runoff (m^3/s)		
	Pre Developed	Post Developed (w/o detention)	Post Developed (with detention)
1yr	0.38	0.484	0.357
10yr	1.185	1.355	1.057
20yr	1.437	1.617	1.278
50yr	1.662	1.834	1.476
100yr	1.911	2.093	1.687

As shown in ***Table 5.6***, Council's requirement to reduce the post developed runoff to equal or less than the predeveloped runoff was successfully.

The basin top water level and storage for each AEP event are shown in ***Table 5.7*** for the detention basin.

Table 5.7: Basin Top Water Level and Storage

ARI	Basin Stage (m)	Basin Storage (m^3)
1yr	0.392	106.87
10yr	0.882	264.56
20yr	0.941	312.20
50yr	1.039	356.19
100yr	1.133	400.43

6.0 Stormwater Quality

The proposed stormwater system, as detailed in **Section 4**, uses a combination of pit and pipe networks and water sensitive urban design elements to convey stormwater runoff from the site. It is intended to use a combination of treatment devices within the drainage system to remove nutrients and sediments from the stormwater prior to the runoff leaving the site.

6.1 TREATMENT DEVICES

The stormwater design for the proposed subdivision proposes to use a combination of at source, conveyance, and end of line controls to treat the stormwater runoff from the site. The treatment train will be modelled for demonstration of compliance with MCC – key performance objectives.

At Source

Half of the roof runoff for each of the future dwellings will be captured by rainwater tanks where the stormwater will receive at source treatment via a first flush system and a portion of the stormwater will be used for reuse.

Conveyance

The low flows will be conveyed through a GPT which will be the conveyance control used to treat the stormwater. The GPT is the primary pollution control device in the treatment train after the stormwater is conveyed via the pit and pipe network. The GPT will primarily remove litter, large debris and the nutrients attached to particles.

The **Ecosol In-Line GPT** was modelled as the GPTs treatment device. The treatment node was sourced from the Ecosol website. (Ecosol Pty Ltd, 2018). It is proposed that at construction certificate stage, gross pollutant traps will be positioned throughout the development to intercept the majority of stormwater discharging from the development, ensuring that the GPTs are serviceable and remain efficient during smaller duration storm events.

The removal efficiency of the GPT is summarised in **Table 6.1**.

Table 6.1 - GPT Removal Efficiencies

Pollutant	% Removal Efficiency *
Total Suspended Solids	61
Total Phosphorus	29
Total Nitrogen	1
Gross Pollutants	98
Total Petroleum/Hydrocarbon	99

* (Ecosol Pty Ltd, 2018)

The high flow bypass for the modelled GPTs has been set to the calculated 3 month flow (approx. ½ of 1 year ARI) from each subcatchment.

End of Line

Low flows are conveyed from the GPT's to the end of line controls being a detention/biofiltration basin. The detention/biofiltration basin promotes sedimentation of particles larger than 125 µm and promote filtration of the stormwater through a filter media. The detention/biofiltration basin will be planted with vegetation that provides some biological uptake.

The basin details are provided in **Table 6.2**.

Table 6.2 - The basin Parameters

Parameter	Bio retention Basin
Surface Area (m^2)	199
Extended Detention Depth (m)	0.3
Exfiltration Rate (mm/hr)	0
Filter Area (m^2)	65.5
Filter Depth (m)	0.4
Saturated Hydraulic Conductivity	150
Base Lined	yes
Vegetated with Nutrient Removal Plants	yes
Underdrain Present	yes
Submerged Zone	no

The bio filtration component of the basin has been sized to achieve the required treatment targets and is not required over the entire footprint of the basin.

6.2 MUSIC MODELLING PARAMETERS

The software used for the water quality modelling is MUSIC. This program is well regarded as industry best practice for analysis of the effectiveness of treatment mechanisms on the quality of stormwater runoff from a development site of this size.

The model diagram and parameters used for the modelling can be found in the subsequent sections and within **Appendix B.**

6.2.1 Rainfall and Evapotranspiration

The rainfall data from Tocal, Paterson weather station was input into the MUSIC model. Six (6) minute rainfall information for the year 1989 was analysed and deemed to be a reasonable representation of the average yearly rainfall and rainfall event distribution.

The rainfall data file was reviewed and it was noted that the rainfall for 1989 (904.6mm) was comparable to the annual average for the 47 year period from 1967 to 2015 being 930.4mm. During 1989 there were 89 days of rainfall which is equivalent to the long term average of 89.9.

The annual rainfall and evapo-transpiration time series graph for 1989 is shown in ***Figure3 .***

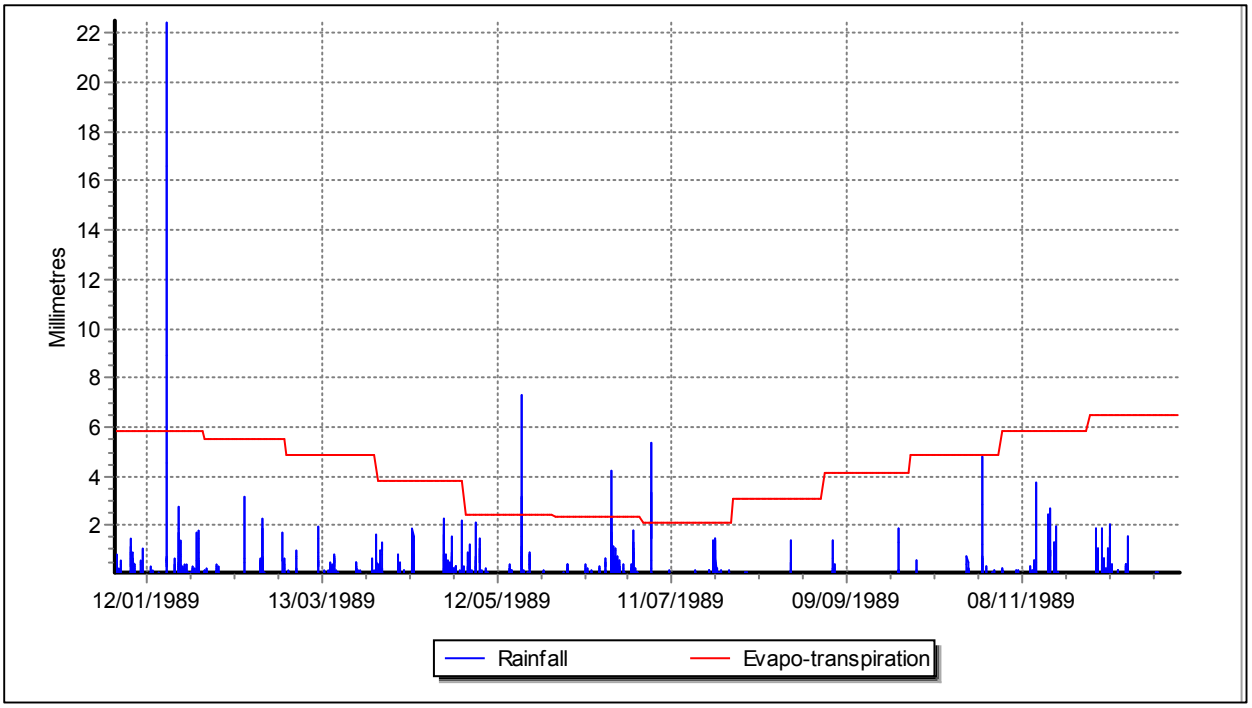

Figure 3 - Rainfall and Evapo-transpiration Graph

6.2.2 Time Step

A time step of six (6) minutes was specified prior to any modelling. This is recommended by the software to increase reliability and output sensitivity.

6.2.3 Catchments

The sub-catchments used in ***Section 5.2.1*** have been adopted for the MUSIC modelling.

6.2.4 Land Use

The MUSIC model defined the following land uses:

- Roof (Urban) – This land use defines the impervious roof area of each lot, it has been assumed to be 100% impervious and accounts for:
  - 60% of the total lot area;
- Lots (Urban) – This land use defines the lot area after the removal of the roof area, it has been assumed to be:
  - 5% impervious of 40% of the remaining lot area;
- Road (Urban) – This land use defines the road reserve area, it has been assumed to be 70% impervious accounting for pervious road verge;
- Basin Area (Urban) – This land use defines the basin area, it has been assumed to be 100% impervious;
- Landscaping (Urban) – This land use defines parklands and general open space, it has been assumed to be 10% impervious; and
- Upstream Natural (Urban) – This land use defines the upstream natural catchments and it has been assumed to be 0% impervious.

Total lot area equates to 62% impervious area.

Table 6.3 summarises the land use areas for each subcatchment.

Table 6.3 - Subcatchment Land Use Areas

SUBCATCHMENT	LAND USE	TOTAL AREA (ha)	% IMPERVIOUS	IMPERVIOUS AREA (ha)	PERVIOUS AREA (ha)
Subject Site	ROADS	0.554	70%	0.388	0.166
	ROOF	0.46	100%	0.460	0.000
	LOTS	0.916	40%	0.366	0.549
	OPEN SPACE	0.091	5%	0.005	0.087
SUB TOTAL		**2.021**		**1.219**	**0.802**
Upstream Catchment	RURAL	1.6	5%	0.080	1.520
Downstream Catchment	RURAL	1.35	5%	0.068	1.283
TOTAL		**4.971**		**1.366**	**3.605**

6.2.5 Rainfall-Runoff Parameters

Pollutant source inputs were obtained from the *'Draft NSW MUSIC Modelling Guidelines'* (BMT WBM, 2010). The parameters adopted for the varying land uses were implemented in accordance with Table 3-2 and 3-7 of the above stated document assuming a CLAY soil description.

The parameters used within the MUSIC model are presented in ***Table 6.4.***

Table 6.4 - MUSIC Rainfall-Runoff Parameters

Parameter	Roof	Lot	Road	Basin	Open Space
Areas - Impervious (%)	100	5	70	100	10
Rainfall Threshold (mm/day)	0.3	1	1.5	1	1
Soil Storage Capacity (mm)	93				
Initial Storage (% of Capacity)	30				
Field Capacity (mm)	68				
Infiltration Capacity Coefficient	135				
Infiltration Capacity Exponent	4				
Initial Depth (mm)	10				
Daily Recharge Rate (%)	10				
Daily Baseflow Rate (%)	10				
Daily Deep Seepage Rate (%)	0				

6.3 WATER QUALITY RESULTS

To show compliance with Council's requirements, the following modelling results are to be compared against Council's pollution reduction targets outlined in ***Table 3.1***.

The petroleum/hydrocarbon target reductions required by Council's are to be achieved through the use of GPTs. GPTs are not specifically designed to capture hydrocarbons, though they may do so during emergency spill events. The petroleum/hydrocarbon pollutant reduction of 99% for the GPT as outlined in ***Section 6.1*** exceeds Council's requirements and therefore shows qualitative compliance provided maintenance is undertaken immediately after an emergency spill event. Simulations of these pollutants are beyond the functionality of the MUSIC program and therefore no quantitative results can be provided.

The average annual pollutant loads downstream of catchments is summarised in ***Table 6.5.***

Table 6.5 - Treatment Train Effectiveness

Catchment	Pollutant	Developed Untreated Load (kg/yr)	Developed Treated		Council Target Reduction (%)
			Load (kg/yr)	Reduction (%)	
D	TSS (kg/yr))	2000	221	**89**	**80**
	TP (kg/yr)	3.88	1.24	**68**	**45**
	TN (kg/yr)	25.6	12.6	**50.9**	**45**
	GP (kg/yr)	389	1.98	**99.5**	**70**

From ***Table 6.5***, it can be seen that the treatment train successfully reduced the pollutant loading from the development.

7.0 Erosion and Sediment Control

Erosion and sedimentation control measures need to be implemented during any construction on the proposed subdivision to minimize the risk of erosion to disturbed areas and limit the transport of sediments from the construction site to downstream waterways. A preliminary Erosion and Sediment Control Plan is presented as **Exhibit D.** Typical erosion and sediment control details and notes are shown in **Exhibit E**.

The attached Erosion and Sediment Control Plan is only an indicative plan as another Erosion and Sediment Control Plan will be provided as part of the construction certificate drawings and a further plan will be provided by the contractor before construction takes place.

During the construction period, it is recommended that the detention portion of the basins are constructed early and used as a temporary sediment basin. It is also recommended that an appropriate Erosion and Sedimentation Control Plan is implemented throughout the entire construction period to minimize the quantity of sediments being conveyed to the temporary sediment basin.

8.0 Key Compliances

8.1 PRE DA MEETING

Below is a list of the stormwater requirements raised by Council in a pre DA meeting. Following the requirements are the responses and actions that have been taken to meet these requirements.

- Stormwater Management – Detention (southern catchment): Council can confirm that the stormwater detention basin constructed on the southern side of Raymond Terrace Road does not cater for the proposed development site. Detention for the southern catchment will need to be provided prior to discharge to Raymond Terrace Road.

A detention basin has been sized to provide adequate detention for the southern catchment.

- Stormwater Management – Detention (main catchment): Part F of the DCP 2011 identifies a stormwater management basin being provided within this site. Any proposal to delete this basin would need to be supported by appropriate details being submitted for assessment at DA stage.

Thornton North URA Eastern Precinct Stormwater Management Plan Addendum 5 caters for the northern catchment. This report is included in **Appendix A**.

8.2 DCP REQUIREMENTS

Section DC.3 of the Maitland Development Control Plan (Part C) relates to drainage, water quality and soil erosion controls. ***Table 8.1*** details each DCP requirement with commentary relating to the subject development.

Table 8.1 - Maitland DCP Controls

No.	Control	Response
DC.3.1	Existing topography and natural drainage lines should be incorporated into drainage designs for larger proposals, and enhanced through provision of additional landscaping, detention areas, artificial wetlands and the like.	The developed conditions of the site will largely be in line with the existing topography to reduce the cut/fill balance. Therefore, the basin will be built at the natural pre-developed drainage point of southern catchment.
DC.3.2	Drainage from proposed lots should be consistent with the pre-development stormwater patterns. An analysis of the downstream drainage system, to the receiving area or waters, may be required.	Hydrologic modelling has been undertaken to compare peak site discharges under existing and developed conditions. Modelling has confirmed that the development will not intensify peak flows at either point of discharge, and that peak flows are well correlated to predeveloped magnitudes.

No.	Control	Response
DC.3.3	Best management practices should be implemented to control runoff and soil erosion and to trap sediment on the subject land to ensure there is no net impact on downstream water quality. The quality of runoff water from the subject land should be the same or better than the quality of water prior to the subdivision taking place.	A stormwater quality treatment train has been developed comprising of Gross Pollutant Traps and bioretention basin. MUSIC modelling has confirmed that the proposed treatment train meets Council's load-based objectives in relation to runoff quality improvement.
DC.3.4	Where possible, design multiple use drainage and treatment systems incorporating gross pollutant traps, constructed wetlands and detention basins.	While the footprint of the basin is mostly required to handle pre to post development flow rates, the basin is also designed to work in conjunction with GPTs to meet Council water quality targets.
DC.3.5	The subdivision should be designed so as to minimise disturbance of the subject land especially in circumstances where there are topographical constraints.	The site levels are as close as practical to the natural surface level, in order to reduce the amount of earthworks required, and to keep as much vegetation as possible during construction.
DC.3.6	Adequate provision should be made for implementation of measures during subdivision construction to ensure that the landform is stabilised and erosion controlled.	Conceptual Soil and Water Management Plans are provided within the concept engineering plans. To ensure downstream waters and adjacent properties are protected, appropriate erosion and sediment controls are to be undertaken during construction. Controls are to be implemented and monitored in accordance with Landcom's 'Blue Book' and Council's engineering guidelines.
DC.3.7	All trunk drainage is to be located in publicly owned land, (reserves), in open space land or in an appropriate easement.	The basin is to be dedicated as public drainage reserve.
DC.3.8	Where the drainage impacts of the subdivision proposal cannot be limited to pre-development stormwater levels by retention or other approved methods, drainage easements will be required over all necessary properties and watercourses. In such circumstances, the easement must be the subject of a signed agreement prior to issue of development consent. Such easements shall be created with, or prior to issue of the Subdivision Certificate.	Hydraulic modelling has confirmed that the proposed basin will be sufficient to detain the peak flows to be in line with, or less than, the predeveloped conditions.

No.	Control	Response
DC.3.9	Where site topography in new residential subdivisions prevents discharge of storm water directly to the street gutter or a Council controlled pipe system, inter allotment drainage should be provided to accept run off from all existing or future parcels of land. The design and construction of the inter allotment drainage system should be in accordance with the requirements of Council's Manual of Engineering Standards.	The concept engineering plans show inter-allotment drainage and appropriate easements on all rear-draining lots.
DC.3.10	Where inter-allotment drainage is required, easements having a general minimum width of 1.5m are to be identified on plans submitted.	The concept engineering plans show inter-allotment drainage and appropriate easements on all rear-draining lots.
DC.3.11	A soil and water management plan (SWMP) should be prepared by a properly qualified practitioner with the aim of minimising erosion and maximising the quality of any water leaving the site. Applicants should refer to Council's Manual of Engineering Standards.	Conceptual Soil and Water Management Plans are provided within the concept engineering plans. To ensure downstream waters and adjacent properties are protected, appropriate erosion and sediment controls are to be undertaken during construction. Controls are to be implemented and monitored in accordance with Landcom's 'Blue Book' and Council's engineering guidelines.

From ***Table 8.1*** it is seen that Council's DCP requirements are met.

In addition to the general Maitland Council requirements, the site is located in the Thornton North Urban Release Area (*URA*), and as such has additional requirements

Table 8.2 - Thornton North DCP Controls

No.	Control	Response
1.5.1	The stormwater and water quality management controls shall be consistent with the Thornton North Structure Plan in the use of Water Sensitive Urban Design (WSUD).	A WSUD treatment train has been developed which meets Council's pollutant reduction targets.
1.5.2	The number and location of WSUD elements should be determined by modelling to develop the WSUD strategy for the site, and be integrated with the overall design.	MUSIC modelling has been undertaken to affirm the suitability of the proposed WSUD strategy.
1.5.3	Parking areas can be located adjacent to WSUD elements where they are designed to prevent damage by vehicles.	No WSUD elements have been designed to be under a location viable to vehicular access.

No.	Control	Response
1.5.4	Bollards or castellated kerbs are required to allow distributed flow to WSUD elements.	Road cross sections are designed to have water drain into the kerb and gutter network as access into the pit and pipe network.
1.5.5	Parking areas may be interspersed between WSUD elements.	Not Applicable
1.5.6	Long-term maintenance costs are to be identified in the design of the WSUD elements and are to be submitted to Council for consideration prior to acceptance of the WSUD strategy.	The proposed treatment train is typical of Council's existing assets, the number of basins and GPTs has been minimised to reduce long-term maintenance costs.
1.5.7	Swales may be acceptable where it can be demonstrated that they will meet Council's performance and maintenance objectives and facilitate safe and effective movement of pedestrians and vehicles.	No new swales have been proposed to service the development's internal road network. A swale is being cut into the drainage corridor to replace the existing dam, however this has been accommodated in the Sophia Waters report.
1.5.8	No change to the minimum width of roads on account of WSUD is permissible.	Road widths do not deviate from Council's norms.
1.5.9	Flow control measures shall be used where grades in swales exceed 4%.	No swales on site are graded at more than 3.0%.
1.5.10	Where practical, WSUD elements may be incorporated in a centre depressed median of dual carriage roads.	There are no dual carriageway roads proposed for this site.
1.5.11	Wherever possible, existing natural drainage gullies should form part of a stormwater and runoff drainage management system incorporating detention basins and/ or wetlands to alleviate stormwater peaks and retain pollutants.	The existing watercourse is being reshaped and embellished to create a riparian corridor through the site. The dam is being removed and water quality and detention is being provided downstream to cater for the developed catchment.
1.5.12	Wetlands should be well-designed creating an attractive and safe amenity, and be highly visible for both the adjoining residents and passers-by.	No wetlands are proposed by the subject development.
1.5.13	Walking paths should have frequent contact adjacent to the wetland edge.	Both sides of the drainage corridor have full length walking paths.
1.5.14	Vegetation should be designed such that generous unobstructed view of the wetland is available.	Refer to landscape plans for detail.
1.5.15	Emergent macrophytes should be minimal and manageable.	Permanent waterbodies will be discouraged to minimise macrophyte growth.

No.	Control	Response
1.5.16	Slopes surrounding wetlands should be gentle and offer convenient tractor-mowing access.	No wetlands are proposed by the subject development. However, all batters are not steeper than 1V:4H and therefore considered mowable by a tractor.
1.5.17	Flat grassed areas that potentially may be water-logged should be avoided.	This should not be an issue, due to the site having generally a 4% slope.
1.5.18	Gullies intended to be left in their natural state should be assessed, and if necessary enhanced to offset the need for maintenance.	The drainage corridor is to be reshaped and revegetated.
1.5.19	In general, grassed areas must be kept to a minimum for maintenance purposes, and wetland and gullies should offer a sense of ownership to the public.	Grassed areas have been kept to a minimum. No wetlands are proposed. Footpaths will front the drainage corridor to create a sense of public ownership.

As seen in ***Table 8.2***, the Thornton North URA requirements have been met.

9.0 Conclusion

The stormwater system has been designed to safely convey the minor and major flows from within the development and upstream catchments to the receiving waters without adversely impacting downstream properties and infrastructure.

The northern catchment drains to the existing drainage corridor that is being catered for by proposed downstream infrastructure.

The stormwater detention provided by the proposed OSD basin in the southern catchment will allow the limiting of the post-development critical peak discharges leaving the site to less than that of pre-development for all design storm events up to the 1% AEP storm event; thereby not increasing the risk of flood inundation to existing downstream development and not increasing the demand on the downstream stormwater infrastructure.

The treatment train process of rainwater tanks, GPTs, and a detention/ bioretention basin have been designed to effectively reduce the nutrients and gross pollutants from stormwater runoff from the proposed development.

Hydrological and hydraulic modelling has shown that the stormwater measures proposed meet or exceed the water quantity and quality objectives set by MCC.

An Erosion and Sedimentation Control Plan has also been prepared for construction of the proposed development also complying with Council's requirements.

10.0References

Bureau of Meteorology. (2015). *Climate Data*. Retrieved from *http://www.bom.gov.au/climate/data/index.shtml.*

Ecosol Pty Ltd. (2015). *Primary Treatment Solutions*. Retrieved February 2015, from Ecosol Wastewater Filtration Systems: http://www.ecosol.com.au/category/primary-treatment-solutions/.

ADW Johnson. (2023) Thornton North URA Eastern Precinct Stormwater Management Plan Addendum 5.

Landcom. (2004). *Managing Urban Stormwater.* NSW Department of Housing.

Maitland City Council. (2014). *Manual of Engineering Standards.* Maitland.

Exhibits

190873-EX-001

M.G.A.

LEGEND
- LIMIT OF WORKS
- PROPOSED LOT BOUNDARY
- EXISTING LOT BOUNDARY
- FUTURE LOT BOUNDARY

DA/2020/173
(DA UNDER ASSESSMENT)

NORTHERN CATCHMENT

EXISTING GULLY

EXISITNG BASIN

DA/2019/574
(DA APPROVED)

DA BEING PREPARED

FARM DAM

RIDGELINE

SOUTHERN CATCHMENT (UPSTREAM)

FARM DAM

DA/2019/573
(DA APPROVED)

SOUTHERN CATCHMENT (SUBJECT SITE)

EXISTING DN450 STORMWATER PIPE

EXISTING DN600 STORMWATER PIPE

SOUTHERN CATCHMENT (DOWNSTREAM)

working beyond expectations

drawing title:

EXHIBIT 1
EXISTING SURVEY

location: 523 RAYMOND TERRACE ROAD CHISHOLM

council: CHISHOM

dwg ref: 190873-EX-001

client: ACG CLOVELLY ROAD PTY LTD

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ver.	date	comment	drawn	pm	level information	scale (A1 original size)	notes
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190873-EX-002

M.C.A.

DA/2020/173
(DA UNDER ASSESSMENT)

DA BEING
PREPARED

DA/2019/574
(DA APPROVED)

DA/2019/573
(DA APPROVED)

ROAD 1
ROAD 2
ROAD 3
ROAD 4
ROAD 5
ROAD 6
ROAD 7
ROAD 8
ROAD 9
ROAD 10
ROAD 11

LOT 662

PT. 507

141

315

LEGEND

- LIMIT OF WORKS
- PROPOSED LOT BOUNDARY
- EXISTING LOT BOUNDARY
- FUTURE LOT BOUNDARY

STAGE SUMMARY

STAGE	NUMBERING	LOT YIELD
1	101 – 141	40 LOTS + 1 DRAINAGE RESERVE (LOT 141)
2	201 – 242	42 LOTS
3	301 – 315	13 LOTS + 1 DRAINAGE RESERVE (LOT 314) + 1 ROAD WIDENING (LOT 315)
4	401 – 407	7 LOTS
5	501 – 507	6 LOTS + 1 RESIDUE LOT (LOT 507)
TOTAL		108 RESIDENTIAL LOTS 2 DRAINAGE RESERVES 1 ROAD WIDENING LOTS 1 RESIDUE LOT

ver.	date	comment	drawn	pm	level information	scale (A1 original size)	notes
A	03.05.23	INITIAL ISSUE	AE	ND	DATUM: N/A CONTOUR INTERVAL: N/A	A1 1:1500 — 0 30 60 75m — A3 1:3000	

drawing title:
EXHIBIT 2
PROPOSED DEVELOPMENT

location: 523 RAYMOND TERRACE ROAD CHISHOLM

council: CHISHOM

dwg ref: 190873-EX-002

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190873-EX-003

M.C.A.

LEGEND
- LIMIT OF WORKS
- PROPOSED LOT BOUNDARY
- EXISTING LOT BOUNDARY
- FUTURE LOT BOUNDARY

DA/2020/173
(DA UNDER ASSESSMENT)

DA BEING
PREPARED

DA/2019/574
(DA APPROVED)

DA/2019/573
(DA APPROVED)

EXTEND STORMWATER FOR FUTURE CONNECTION

EXTEND STORMWATER FOR FUTURE CONNECTION

PROPOSED GPT

DISCHARGE TO EXISTING TABLE DRAIN VIA STABILISED HEADWALL

PROPOSED GPT

CONNECT TO EXISTING STORMWATER

EXTEND STORMWATER FOR FUTURE CONNECTION

PROPOSED GPT

DETENTION / BIOFILTRATION BASIN

DISCHARGE TO EXISTING TABLE DRAIN VIA STABILISED HEADWALL

SOUTHERN CATCHMENT (SUBJECT SITE)

SOUTHERN CATCHMENT (UPSTREAM)

SOUTHERN CATCHMENT (DOWNSTREAM)

ROAD 1
ROAD 2
ROAD 3
ROAD 4
ROAD 5
ROAD 6
ROAD 7
ROAD 8
ROAD 9
ROAD 10
ROAD 11

LOT 662
PT.507
PT.307

201 202 203 204 205 206 207 208 209 210 211 212 213 214 215 216 217 218 219 220 221 222 223 224 225 226 227 228 229 230 231 232 233 234 235 236 237 238 239 240 241 242 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 127 128 129 131 132 133 134 135 136 137 138 139 140 141 301 302 303 304 305 306 307 308 309 310 311 312 313 314 315 401 402 403 404 405 406 407 501 502 503 504 505 506

working beyond expectations

drawing title:
EXHIBIT 3
CONCEPT
STORMWATER LAYOUT

location: 523 RAYMOND TERRACE ROAD CHISHOLM
council: CHISHOM
dwg ref: 190873-EX-003
client: ACG CLOVELLY ROAD PTY LTD

ver.	date	comment	drawn	pm	level information	scale (A1 original size)	notes
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190873-EX-004

14 305 306 307 310 311 312 313 314 315

ROAD 10

ROAD 11

PT.507

PROPOSED BASIN No.1

BASE R.L.21.7

4:1

22

24

SW

SHAPE VERGE TOWARDS BASIN

GPT

INLET HEADWALL WITH SCOUR PROTECTION

BIOFOLTRATION AREA 65.5m2

DISCHARGE CONTROL PIT

WEIR R.L.23.2

CREST R.L.23.5

STABILISED SPILLWAY

B

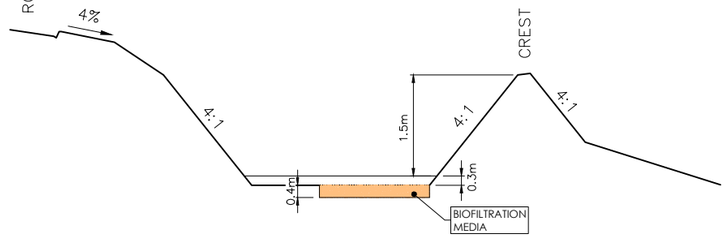
DA/2019/573
(DA APPROVED)

M.G.A.

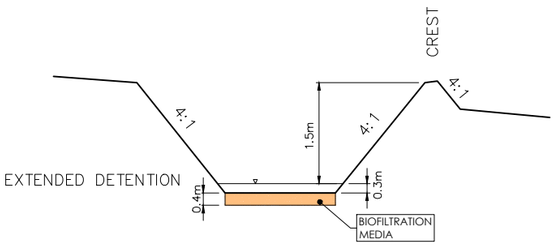
LEGEND

- PROPOSED LOT BOUNDARY
- ADJOINING LOT BOUNDARY
- PROPOSED STORMWATER
- PROPOSED SW PIT
- PROPOSED GPT
- PROPOSED LINTEL
- PROPOSED HEADWALL

NOTES:-
1. THIS PLAN HAS BEEN PREPARED FOR THE PURPOSE OF INFORMATION ONLY AND SHOULD NOT BE USED FOR ANYTHING OTHER THAN THAT PURPOSE.
2. BOUNDARIES HAVE BEEN DETERMINED BY PLAN DIMENSIONS ONLY, AND HAVE NOT BEEN SURVEYED. ALL BEARINGS, DIMENSIONS, AREAS AND EASEMENTS ARE SUBJECT TO FINAL SURVEY.



SECTION A–A
HORIZONTAL SCALE 1:500
VERTICAL SCALE 1:100



SECTION B–B
HORIZONTAL SCALE 1:500
VERTICAL SCALE 1:100

working beyond expectations

drawing title:
EXHIBIT 4
BASIN DETAIL

location: 523 RAYMOND TERRACE ROAD CHISHOLM
council: CHISHOM
dwg ref: 190873-EX-004
client: ACG CLOVELLY ROAD PTY LTD

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190873-EX-005

M.G.A.

LEGEND

- PROPOSED LOT BOUNDARY
- EXISTING LOT BOUNDARY
- FUTURE LOT BOUNDARY
- MAJOR CONTOURS
- MINOR CONTOURS
- PROPOSED KERB
- EXTENTS OF BATTER
- SW — PROPOSED STORMWATER
- ex sw — EXISTING STORMWATER
- SEDIMENT/SILT FENCING
- NO-GO FENCING
- PROPOSED PIT INLET FILTER
- PROPOSED LINTEL INLET FILTER
- STRAWBALES
- GRAVEL/SAND BAGS
- SITE ACCESS/SHAKER RAMP
- STOCKPILE LOCATION
- SEDIMENT BASIN
- EXISTING TREE TO REMAIN
- EXISTING TREE TO BE REMOVED

EROSION AND SEDIMENTATION CONTROL NOTES:

1. EROSION AND SEDIMENT CONTROL MEASURES ARE TO BE CONSISTENT WITH THE APPROVED MASTERPLAN DOCUMENTS AND THE "MANAGING URBAN STORMWATER" - 3RD EDITION (1998) PREPARED BY THE NSW DEPARTMENT OF HOUSING.
2. DISTURBED AREAS TO BE KEPT TO A MINIMUM. NO MORE THAN 2.5HA OF THE SITE SHALL BE EXPOSED TO EROSION AT ANY ONE TIME.
3. CONTROL CLEAN WATER FROM ABOVE THE SITE, THROUGH THE SITE.
4. KEEP CLEAN WATER SEPARATE FROM DIRTY WATER.
5. CONSERVE ALL TOPSOIL, STOCKPILE AND PROTECT FOR REUSE ON SITE.
6. PROTECT ALL DISTURBED AREAS FROM EROSION.
7. MINIMISE SEDIMENTATION.
8. MAINTAIN ALL EROSION AND SEDIMENT CONTROL MEASURES UNTIL COMPLETE REHABILITATION IS ACHIEVED.
9. CONSTRUCT STABILISED EARTH BERMS TO DIRECT CLEAN RUNOFF FROM ENTERING THE DISTURBED SITE.
10. WATER QUALITY BASIN TO BE USED AS A TEMPORARY SEDIMENT BASIN DURING CONSTRUCTION
11. CONSTRUCT STABILISED DIVERSION BANKS TO COLLECT RUNOFF FROM DISTURBED AREAS AND DIRECT IT TO A SEDIMENT BASIN.
12. PLACE SEDIMENT INLET TRAPS AROUND ALL PITS WITHIN AND DOWNSTREAM OF THE DEVELOPMENT.
13. PLACE GRAVEL BAG GROYNES IN GUTTERS AT 20 - 25m INTERVALS.
14. PLACE STRAWBALES IN SWALES AT 40 - 50m INTERVALS.
15. PLACE STRAWBALES ACROSS OVERLAND FLOW PATH PRIOR TO THE RUNOFF ENTERING DRAINAGE SYSTEM.
16. STOCKPILES OF MATERIAL TO BE PLACED AWAY FROM DRAINAGE FLOW PATHS AND HEAVILY TRAFFICABLE AREAS AND TO BE SURROUNDED BY SILT FENCING AT ALL TIMES.
17. CONSTRUCT AN ALL WEATHER CONSTRUCTION ACCESS TO THE SITE.
18. ALL DISTURBED AREAS ARE TO BE REVEGETATED OR OTHERWISE PROTECTED AS SOON AS PRACTICAL.
19. ERECT AND MAINTAIN SILT FENCES AT THE DOWNSLOPE SIDE OF DISTURBED AREA DURING CONSTRUCTION.
20. AREAS OUTSIDE THE BOUNDARIES OF THE PROPOSED DEVELOPMENT WILL BE FENCED WITH NO GO FENCING TO KEEP THE AREAS FREE FROM DISTURBANCE OF MACHINERY, PARKED VEHICLES AND WASTE MATERIAL.
22. TREES TO BE RETAINED WITHIN THE CONSTRUCTION AREAS ARE TO BE PROTECTED BY TREE PROTECTION FENCING IN ACCORDANCE WITH THE APPROVED CMP.
23. ESTABLISH A RESTRICTION BOUNDARY AROUND PROTECTED PLANT WITH PARAWEB FENCING, TEMPORARILY RELOCATE FENCE TO ALLOW CONSTRUCTION OF REQUIRED WORKS AND RE-ESTABLISH PROTECTION ZONE AFTER WORKS COMPLETES.
24. THE SEDIMENT BASINS WILL REQUIRE MAINTENANCE THROUGHOUT THE CONSTRUCTION PROCESS. ADDITIONALLY, THE SEDIMENT BASINS WILL REQUIRE FLOCCULATION IN ACCORDANCE WITH APPENDIX E OF THE 'BLUE BOOK'. THE CONTRACTOR IS TO ABIDE BY APPENDIX E OF THE 'BLUE BOOK' TO ENSURE ADEQUATE FLOCCULATION OCCURS.
25. THE CONTRACTOR IS TO INSPECT, CLEAN AND REPAIR ALL EROSION AND SEDIMENT CONTROL MEASURES THROUGHOUT THE CONSTRUCTION PERIOD. IT IS EXPECTED THAT THE EROSION AND SEDIMENT CONTROL MEASURES ARE INSPECTED DAILY AS WELL AS AFTER STORM EVENTS BY THE CONTRACTOR. THE CONTRACTOR IS TO CLEAN AND REPAIR EROSION AND SEDIMENT CONTROL MEASURES TO ENSURE THEY ARE ABLE TO COMPLETE THE REQUIRED TASK AS PER FIRST INSTALLATION.
26. EROSION CONTROL SHOWN IS INDICATIVE ONLY AND SHALL BE A GUIDE FOR THE CONTRACTOR TO PREPARE THEIR OWN EROSION CONTROL DOCUMENTATION PRIOR TO CONSTRUCTION.

EROSION AND SEDIMENT CONTROL PLAN

SCALE 1:1000

working beyond expectations

ver.	date	comment	drawn	pm	level information	scale (A1 original size)	notes
A	03.05.23	INITIAL ISSUE	AE	ND	DATUM: N/A CONTOUR INTERVAL: N/A	A1 1:1500 — 0 30 60 75m — A3 1:3000	

drawing title:
EXHIBIT 5
EROSION &
SEDIMENT CONTROL
PLAN

location: 523 RAYMOND TERRACE ROAD CHISHOLM

council: CHISHOM

dwg ref: 190873-EX-005

client: ACG CLOVELLY ROAD PTY LTD

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Plotted By: Nathan Delaney Plot Date: 04/05/23 1:39:17PM Cad File: S:\190873\DWG\REPORT DRAWINGS\SWMP\190873-EX-005.DWG

This plan includes coloured information. If you have a black and white copy you do not have all of the information. This note is coloured RED.

Appendix A

THORNTON NORTH URA EASTERN PRECINCT STORMWATER MANAGEMENT PLAN ADDENDUM 5

Our Ref: CC:190205E

25th January 2023

Maitland City Council
PO Box 220
Maitland NSW 2320

RE THORNTON NORTH URA EASTERN PRECINCT
STORMWATER MANAGEMENT PLAN ADDENDUM 5

To whom it may concern,

I am writing with regards to stormwater management for the Eastern Precinct of the Thornton North Urban Release Area (TNURA). This letter accompanies the Construction Certificate Plans for Stage 4A of the Munro development (DA2019-652) and the Development Application for Lots 31 & 32 DP 778111. It serves as an addendum to the approved '*Stormwater Management Plan – Chisholm Residential Subdivision*' dated September 2016. A series of addenda have been submitted and approved by Council to date:

- Addendum 1 – Stormwater Management Plan #1 by ADWJ dated October 2016;
- Addendum 2 – TNURA Stormwater Management Plan by ADWJ dated July 2019;
- Addendum 3 – Stormwater Management Plan Addendum #3 by ADWJ dated April 2020; and
- Addendum 4 – Stormwater Management Plan Addendum #4 by ADWJ dated November 2022.

1.0 INTRODUCTION

The intent of this document is to demonstrate that the previous outcomes relating to stormwater detention and runoff quality are preserved or improved by the alterations described below.

- Introduction of the "Munro Basin" to cater for the stormwater management requirements of the "Romanelli", "May" and "Williams" developments.

This addendum to the Stormwater Management Plan proposes to consolidate the future stormwater basins to be located on Lot 100 DP 847510 (herein referred to as "Romanelli"), Lot 31 DP 778111 (herein referred to as "May"), and Lot 30 DP 778111 (herein referred to as "Williams") with the construction of a stormwater basin (Munro Basin) in Stage 4A of the Munro development.

It is expected that future upstream development of Williams, May, and Romanelli will drain to the regional 'Basin 1' (detailed in the original approved report and aforementioned addenda). However, 'Basin 1' has been constructed, and as such cannot viably be altered to account for any additional inflows. Thus, the construction of the proposed Munro Basin will accommodate the future upstream stormwater detention requirements of the developments; Williams, May, and Romanelli (refer to ***Appendix 1*** for the proposed basin).

The design approach for this addendum is to satisfy Council's stormwater management requirements whilst preserving the performance and integrity of Basin 1. The updated catchment plan can be found in ***Attachment 1.***

2.0 STORMWATER DETENTION

The XPRAFTS model created as part of the original approved SMP has been updated to reflect the additional development catchment runoff from Williams, May and Romanelli. An updated catchment plan is provided in ***Attachment 1***. It is noted that previously determined peak predeveloped flows remain relevant and therefore will not be revisited. Updated developed catchment areas are provided in ***Table 1***.

Table 1 – Developed XPRAFTS Catchment Areas

Subcatchment	Total Area (ha)	% Impervious	Area (ha) Impervious	Area (ha) Pervious
NAT 1.0	10.12	0	0.00	14.06
NAT 2.0	0.55	0	0.00	9.70
DEV 1.0	18.11	60	10.87	7.24
DEV 1.1	3.21	60	1.93	1.28
DEV 2.0	8.19	63	5.19	3.00
DEV 3.0	9.90	60	5.77	4.13
DEV 4.0	5.44	63	3.45	1.99
DEV 5.0	13.30	63	8.33	4.97
DEV 6.0	5.43	10	0.46	4.97
DEV 7.0	1.54	60	0.93	0.61
DEV 8.0	7.79	60	4.67	3.11
DEV 9.0	6.45	63	4.05	2.40
DEV 10.0	8.00	63	5.00	3.00
DEV 11.0	7.93	62	4.93	3.00
DEV 12.0	9.20	64	5.90	3.30
A0	1.60	10	0.16	1.44
A1	2.73	10	0.27	2.46
A2	2.21	10	0.30	1.91
A3	3.97	52	2.08	1.89
A4	0.98	10	0.10	0.88
TOTAL	**126.65**		**64.39**	**75.35**

2.1 Munro Basin

As discussed above, the proposed Munro Basin will be located online to a first-order watercourse. It is proposed that levels within the creek are maintained in order to preserve the existing vegetation within the riparian corridor. Proposed Ballymore Road will be constructed on the downstream side of the basin, acting as a berm.

Table 2 summarises the properties and the outlet configuration of the Munro Basin. Kerb levels within the low points of Ballymore Road and the future unnamed road to the north are also provided in order to demonstrate that sufficient freeboard is provided in the 100-year storm event.

Table 2 – Munro Basin Properties

Basin Parameter	Munro Basin
Basin Invert Level	RL 6.30m
Goodwin Road Kerb Level	RL 10.78m
Ballymore Road Kerb Level	RL 11.22m
Batters	1:4 – Constructed Internal Batters
Outlet Controls	450mm RCP – IL 6.30m
	2 x 0.9m (H) x 1.8m (W) RCBC – IL 8.30m

2.2 Stormwater Detention Results

XPRAFTS modelling for a range of storms was undertaken with the updated input parameters. ***Table 3*** provides the peak stage and water level within the already constructed Basin 1 with previously reported levels shown in parentheses. ***Table 4*** summarises the peak discharges estimated from the TNURA precinct, with previously reported results also shown in parentheses. ***Table 5*** summarises the peak discharge from the Munro Basin and peak water levels within the Munro Basin.

Table 3 – Basin 1 Peak Stages

Storm Event (ARI)	Basin 1 Peak Stage and Water Level
1yr	3.42 m (3.49)
	5.42 m AHD (5.49)
10yr	3.89 m (3.92)
	5.89m AHD (5.92)
20yr	4.00 m (4.03)
	6.00m AHD (6.03)
50yr	4.12 m (4.15)
	6.12m AHD (6.15)
100yr	4.21m (4.25)
	6.21m AHD (6.25)

Table 3 shows that with the increased developed catchment and the inclusion of the Munro Basin, peak water levels within the existing Basin 1 have reduced in all storm events and the integrity of Basin 1 has been maintained.

Table 4 –Basin 1 Catchment Peak Discharges

Storm Event (ARI)	Peak Discharge (m^3/s)	
	Predeveloped	Developed
1yr	2.13	1.89 (2.14)
10yr	9.03	7.46 (7.77)
20yr	11.62	9.50 (9.67)
50yr	14.55	11.83 (12.00)
100yr	17.19	13.79 (13.94)

Table 4 shows that the developed peak runoff from the TNURA Eastern Precinct satisfies Council's objectives in relation to stormwater detention and that runoff has decreased from previous reporting.

Table 5 – Munro Basin Results

Storm Event (ARI)	Peak Discharge (m^3/s)	Water Level
1yr	2.95	8.78m AHD
10yr	8.37	9.43m AHD
20yr	9.65	9.50m AHD
50yr	10.56	9.85m AHD
100yr	11.47	10.09m AHD

Table 5 shows that there is more than 500mm freeboard to the proposed road reserves in the 100-yr ARI event, and therefore the Munro Basin satisfies Council's freeboard requirements.

3.0 WATER QUALITY

The approved SMP used MUSIC software to estimate pollutant loads and verify the effectiveness of Stormwater Quality Improvement Devices (SQIDs). The approved SMP adopted a holistic approach to water quality where modelling confirmed that the proposed stormwater treatment successfully reduced pollutant concentrations in accordance with Council's *Manual of Engineering Standards*. As discussed above, modelling has been revisited to account for the increased developed catchment. It is proposed that no additional treatment devices are provided, except for rainwater tanks for each development lot and a gross pollutant trap for each developed catchment draining towards the watercourses. Updated MUSIC catchment areas are provided in ***Table 5***.

Land Use	Catchment (ha)				
	1	2	3	4	5
Roof	24.097	2.86	0.26	8.352	-
Lot	16.198	1.91	0.17	5.34	-
Road	19.139	2.1	0.38	5.78	0.27
Basin	7.0367	0.17	-	1.57	-
Open Space	6.72	0.74	0.72	6.91	5.26
Upstream Natural	10.678	-	-	-	-
Total	**83.8687**	**7.78**	**1.53**	**27.952**	**5.53**

3.1 Water Quality Results

The average annual pollutant loads for Catchment 1 are presented in ***Table 6***. Previously reported pollutant reductions are shown in parentheses.

Table 7 – Catchment 1 Treatment Train Effectiveness

Pollutant	Developed	Developed Treated % Change		Council Target Reduction (%)
	Load	Load	Reduction (%)	
TSS (kg/yr))	77500	12500	**83.9 (86.3)**	**80**
TP (kg/yr)	168	56.6	**66.3 (64.8)**	**45**
TN (kg/yr)	1240	613	**50.4 (49.3)**	**45**
GP (kg/yr)	17800	307	**98.3 (99.7)**	**70**

From ***Table 6***, it is evident that the development successfully reduces runoff pollutants surpassing Council's requirements.

4.0 CONCLUSION

The approved *Stormwater Management Plan – Chisholm Residential Subdivision* has been revised to reflect changes to the developed catchment area draining through the TNURA Eastern Precinct. With the construction of the Munro Basin, the Williams, May and Romanelli development sites can be adequately catered for in terms of stormwater detention and water quality requirements.

Modelling has confirmed that the addition of the Munro Basin ensures that the integrity of the existing Basin 1 is maintained, with no increase in peak water levels in Basin 1 or peak discharge from the site. Adequate freeboard is provided within the Munro Basin.

The proposed treatment train for the site successfully reduces pollutant loadings from the TNURA Eastern Precinct in accordance with Council's requirements.

The results of this addendum letter confirm that Council's requirements in relation to stormwater detention and runoff quality are upheld.

Should you have any questions or require any further advice please do not hesitate to contact the undersigned on 4978 5100 or email angusl@adwjohnson.com.au.

Regards,

Angus Lim
CIVIL ENGINEER
ADW JOHNSON PTY LTD
HUNTER OFFICE

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Attachments

- REP-002 – Post-development catchment plan.

190205-REP-002-F

LEGEND

- PROPOSED BASINS
- PROPOSED LOT BOUNDARIES
- POSTDEVELOPMENT CATCHMENT AREAS
- DCDB BOUNDARIES
- WATERCOURSE

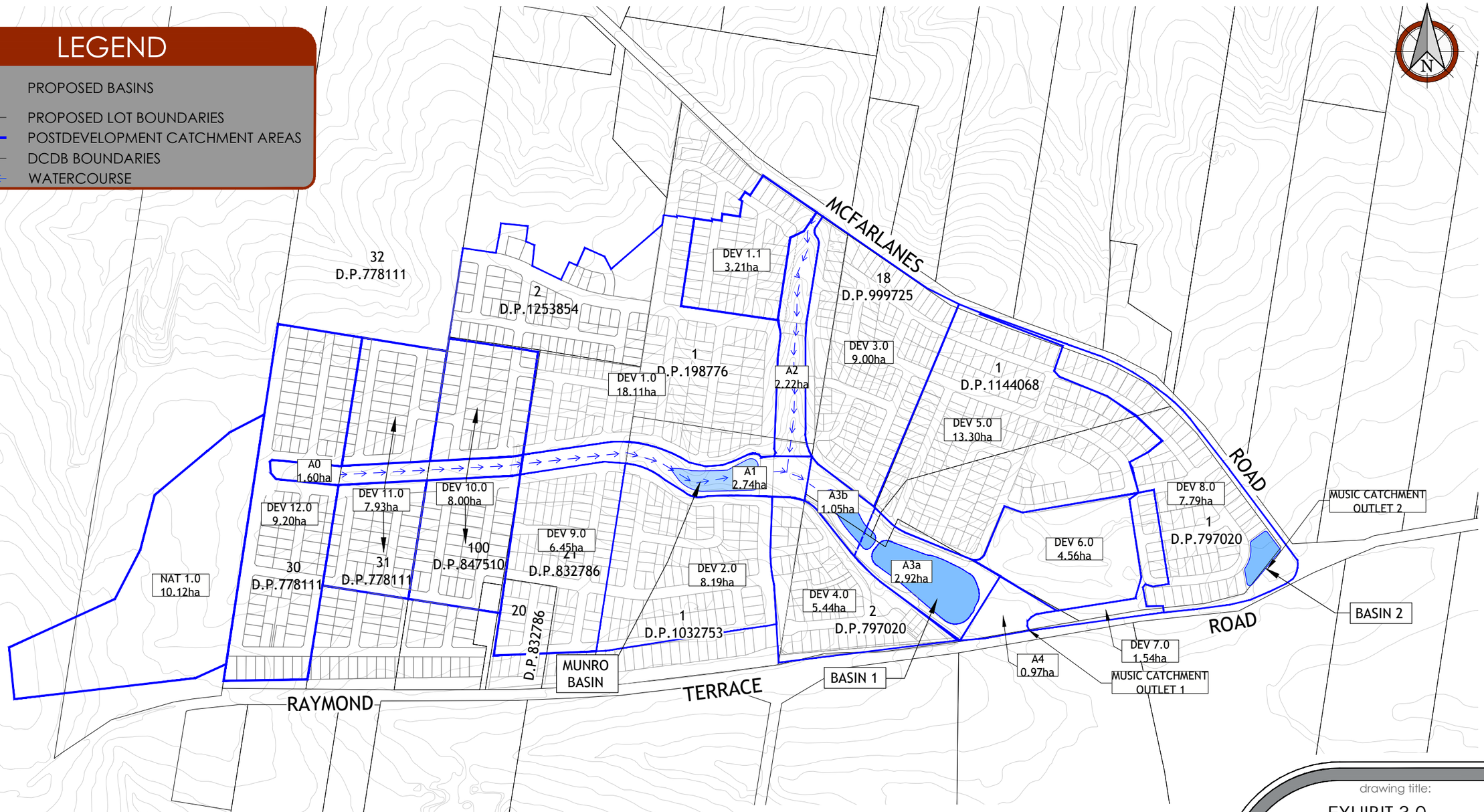

TABLE E1: MUSIC AND CORRESPONDING RAFTS SUBCATCHMENTS

MUSIC SUBCATCHMENT (SECTION 5)	CORRESPONDING RAFTS SUBCATCHMENTS (SECTION 4)
1	NAT 1.0, DEV 1.0 - 3.0, DEV 9.0-12.0 & A0 - A3a
2	DEV 8.0
3	DEV 7.0
4	DEV 4.0-5.0, A3a, A4
5	DEV 6.0

ver.	date	comment	drawn	pm	level information	scale (A3 original size)	notes
F	25.01.23	UPDATE CATCHMENTS	A.L.	C.M.	DATUM: AHD (LIDAR) CONTOUR INTERVAL: 2.0m	0 150 300 375m SCALE: 1:7500 (FULL)	

drawing title:

EXHIBIT 3.0 POST DEVELOPMENT SUBCATCHMENTS

location: CNR OF MCFARLANES ROAD & RAYMOND TERRACE ROAD, CHISHOLM

council: MAITLAND

dwg ref: REP-002

client: ALLAM PROPERTY GROUP

adw johnson
central coast office ph: (02) 4305 4300
hunter office ph: (02) 4978 5100
www.adwjohnson.com.au

working beyond expectations

Plotted By: Angus Lim Plot Date: 25/01/23 11:24:02AM Cad File: N:\190205\DWG\190205-REP-002-F.DWG

Appendix B

WATER QUANTITY

FIGURE B-1 – RAFTS LAYOUT

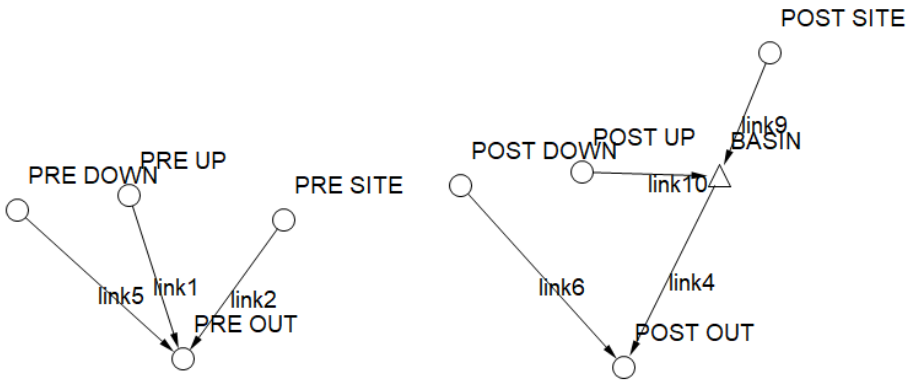

Table B1- BASIN VOLUMES

RL (AHD)	DEPTH (m)	VOLUME (m3)
21.7	0	0
21.8	0.1	24.378
21.9	0.2	50.696
22	0.3	79.008
22.1	0.4	109.376
22.2	0.5	141.862
22.3	0.6	176.521
22.4	0.7	213.408
22.5	0.8	252.578
22.6	0.9	294.085
22.7	1	337.986
22.8	1.1	384.334
22.9	1.2	433.186
23	1.3	484.596
23.1	1.4	538.618
23.2	1.5	595.309
23.3	1.6	654.659
23.4	1.7	716.642
23.5	1.8	781.271

Appendix C

STORMWATER QUALITY

FIGURE C-1 – MUSIC LAYOUT