



Equinox Marulan – Stage 3 Development Application

Civil Infrastructure Report

Darraby Pty Ltd

16/10/2023

23-1098

Commercial in Confidence

All intellectual property rights, including copyright, in designs developed and documents created by AT&L remain the property of this company. Any use made of such design or document without the prior written approval of AT&L will constitute an infringement of the rights of the company which reserves all legal rights and remedies in respect of any such infringement.

The information, including any intellectual property, contained in this proposal is confidential and proprietary to the Company. It may only be used by the person to whom it is provided for the stated purpose for which it is provided and must not be imparted to any third person without the prior written approval of the Company. The Company reserves all legal rights and remedies in relation to any infringement of its rights in respect of its confidential information.

This report has been prepared in accordance with the terms and conditions of appointment. AT&L cannot accept any responsibility for any use of or reliance on the contents of this report by any third party.

This report may be based upon information supplied by other consultants and contractors. To the extent that the report incorporates such material, AT&L takes no responsibility for any loss or damage caused by any error or omission arising from reliance on it.

Document Registration

Document Title	Equinox Marulan – Stage 3 Civil Infrastructure Report
Document File Name	REP002-02-23-1098 Civil Design Report
Section	Civil
Document Author	James Clare

Issue	Description	Date	Author	Checked	Approved
01	Draft	09/06/23	James Clare	<input checked="" type="checkbox"/>	<input type="checkbox"/>
02	Draft	16/10/23	James Clare	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
				<input type="checkbox"/>	<input type="checkbox"/>
				<input type="checkbox"/>	<input type="checkbox"/>
				<input type="checkbox"/>	<input type="checkbox"/>

Contents

1.	Introduction	1
1.1.	Site Description.....	1
1.2.	Scope of DA	2
1.3.	Supporting Documentation	2
1.4.	Design Criteria	3
2.	Earthworks and Retaining Walls	4
2.1.	Proposed Earthworks Strategy	4
2.2.	Batter Design	5
2.3.	Retaining Walls.....	5
3.	Road Design	6
3.1.	External Road Network.....	6
3.2.	Internal Road Network	7
3.3.	Pavement Design	9
4.	Flooding.....	10
5.	Stormwater Drainage.....	11
5.1.	Stormwater Drainage Design Criteria.....	11
5.2.	Existing Site Stormwater Drainage	12
5.3.	Proposed Site Stormwater Drainage	13

Figures

Figure 1:	Site Locality (Source: Google Earth)	1
Figure 2:	Proposed subdivision layout	2
Figure 3:	Typical retaining wall – sleeper wall	5
Figure 4:	View of Goulburn Street looking west of Portland Avenue (Google Streetview, 2 nd June 2023)	6
Figure 5:	Goulburn Street road reserve (Mecone Mosaic, June 2023)).....	6
Figure 6:	Typical Section of the Goulburn Street extension (Collector Road).....	7
Figure 7:	1% AEP flood map excerpt, Marulan Flood Study (grc, Jan 2023)	10
Figure 8:	Pre-development catchment plan	12
Figure 9:	Post development catchment plan	13

Tables

Table 1:	Civil Design Criteria.....	3
Table 2:	Summary of proposed cut and fill volumes across the site.....	4
Table 3:	General road design criteria	7
Table 4:	General stormwater drainage design criteria	11

1. Introduction

This Civil Design Report has been prepared by AT&L on behalf of Darraby Pty Ltd in support of a Development Application for the proposed development of Equinox Marulan – Stage 3 (the Site).

1.1. Site Description

The site is located 26km east of Goulburn at Wilson Drive, Marulan, is in the Goulburn Mulwaree Council LGA and is bound by existing residential lots and public open space to the east, Wilson Drive to the south, the Main Southern Rail line to the north and Marulan Waste Management Centre to the west. The site is currently farmland and includes a small watercourse and several dams.

Refer to **Figure 1** below for the site location.

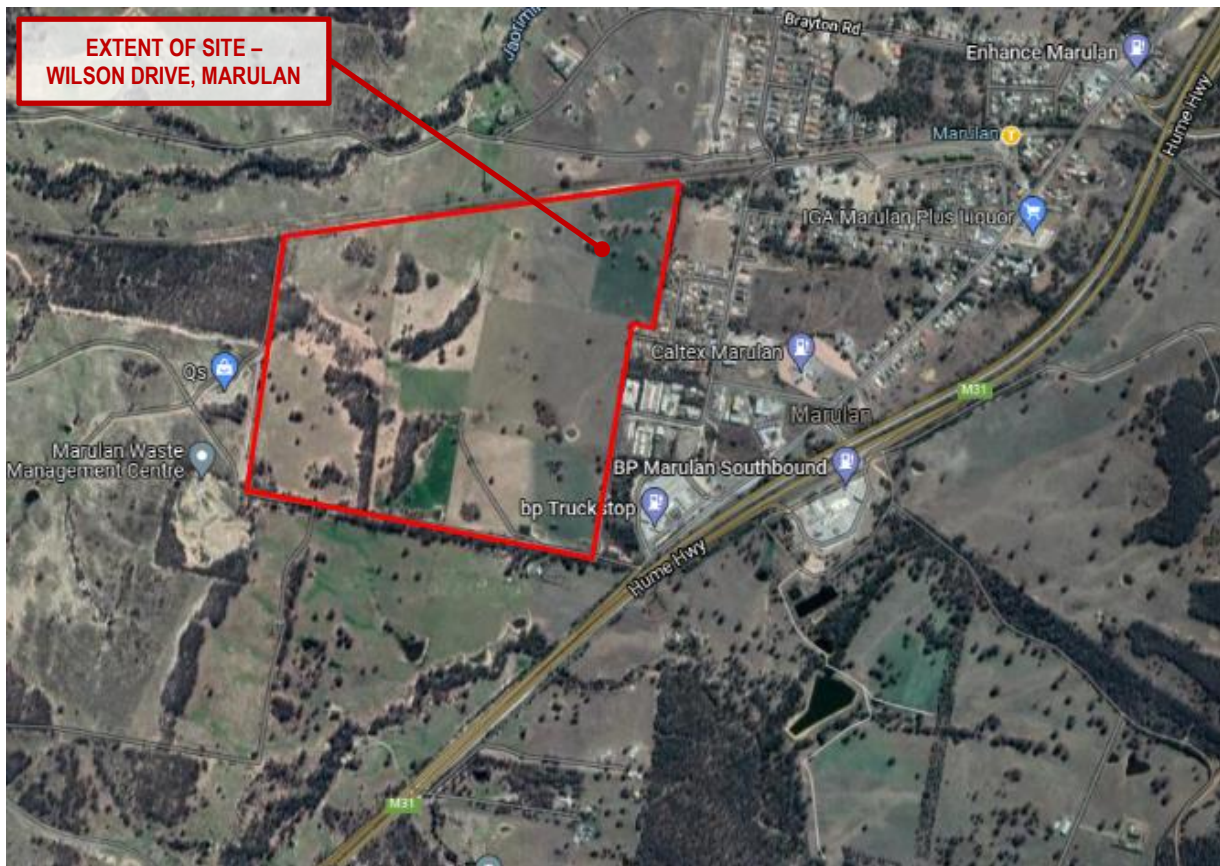


Figure 1: Site Locality (Source: Google Earth)

The site has been the subject to two previous Development Applications with the scope of this report relating to a third stage of development at the north eastern corner of the site immediately south of the Main Southern Railway.

1.2. Scope of DA

This Development Application seeks approval for the following scope of development:

- Site infrastructure works, including:
 - ▶ Demolition, vegetation clearing and removal of existing farm dams.
 - ▶ Bulk earthworks to establish residential lots and box out for proposed road network.
 - ▶ Construction of internal roads including kerb and gutter, vehicle pavement footpaths and verge landscaping
 - ▶ Construction of stormwater infrastructure, utility services and landscaping.
- Implementation of construction-phase erosion and sediment controls.
- Subdivision to create 125 residential lots, 1 drainage lot and 1 residual lot
- Extension of Goulburn Street from Portland Avenue to the site

Figure 2 below presents the proposed subdivision layout.

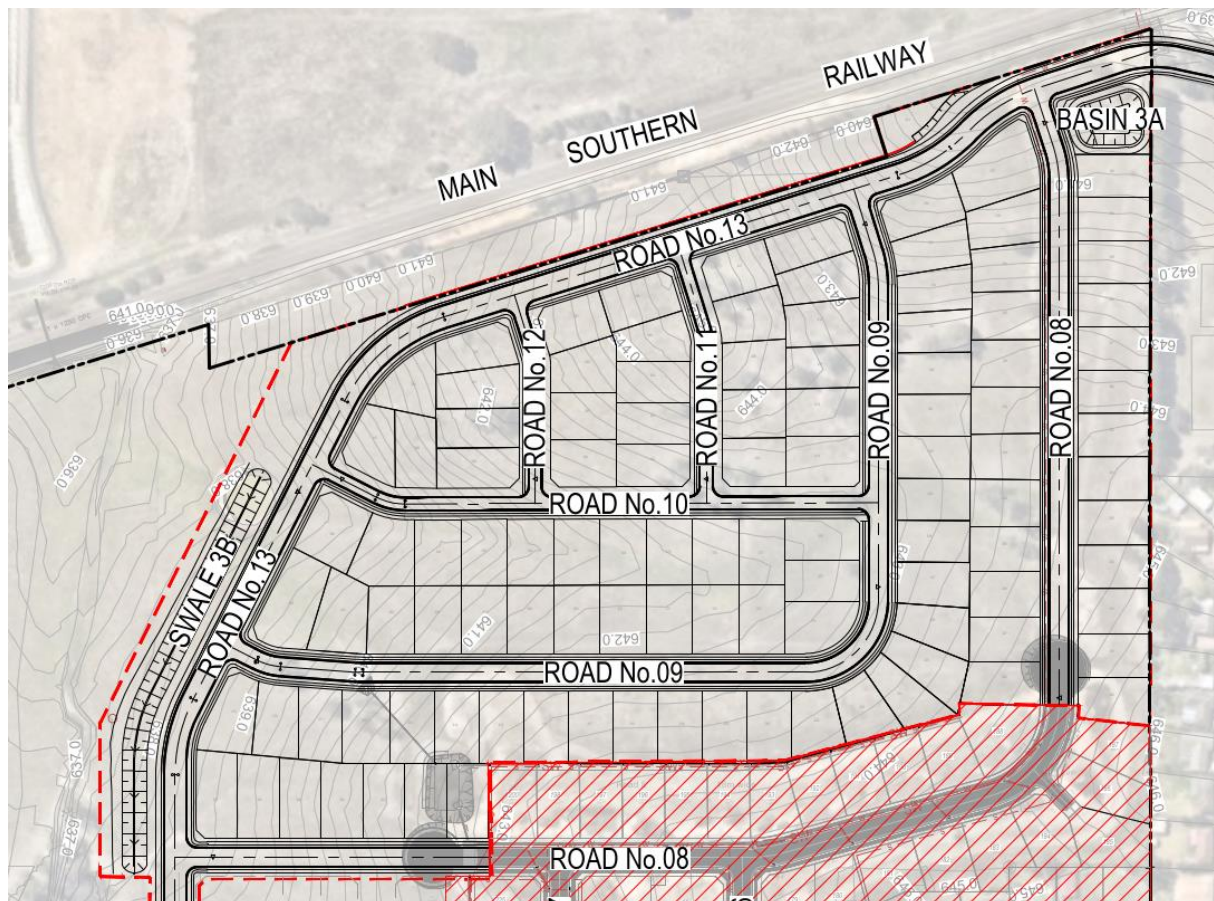


Figure 2: Proposed subdivision layout

1.3. Supporting Documentation

This report should be read in conjunction with Civil Drawings (AT&L), 23-1098-C1000 and Stormwater Management Report (AT&L) REP003.

1.4. Design Criteria

Table 1: Civil Design Criteria

Item	Design Criteria
Earthworks and Retaining Walls	AS 3798-2007 Guidelines on earthworks for commercial and residential developments AS 4678-2002 Earth retaining structures Goulburn Mulwaree Council Development Control Plan 2009 Goulburn Mulwaree Council - Standards for Engineering Works 2013 - D6
Road Geometry (Vertical and Horizontal)	Austroads Guide to Road Design – Part 3 Goulburn Mulwaree Council - Standards for Engineering Works 2013 – D1
Pavement Design	Austroads Guide to Pavement Design – Part 2 Goulburn Mulwaree Council - Standards for Engineering Works 2013 – D2
Flooding	NSW Floodplain Development Manual Goulburn Mulwaree Council Development Control Plan 2009
Water and Sewer	Water Supply Code of Australia – WSA 03-2011 Version 3.1 Gravity Sewerage Code of Australia – WSA 02-2014 Version 3.1

2. Earthworks and Retaining Walls

2.1. Proposed Earthworks Strategy

The intent of the proposed development is to create 125 residential lots. The creation of these lots generally allows existing levels to be maintained across the extent of the site.

The cut and fill requirements within the site have been defined through multiple design iterations and careful consideration of the following:

- Gently sloping topography in some parts of the site, resulting in difficulty achieving gravity services grades without excessive fill volumes.
- Provision for connectivity to Goulburn Street and associated extension to the site.
- Matching into existing levels along adjacent lands to the north and east.
- Achieving a balance of cut to fill to minimise the volume of material that needs to be imported or exported, allowing for management of topsoil and over-excavation (desilting) required within existing farm dams.
- Avoiding cut in bedrock sub-surface units.
- Meeting the requirements for the end-use of the site
- Provision of a final design solution that addresses water management requirements, including stormwater quantity and quality management, external catchments, stormwater drainage (major and minor system), flooding and discharges.

It is recommended that the proposed earthworks design contained within the AT&L documentation provides the most contextually and economically appropriate design in consideration of the above requirements.

Refer to drawing 23-1098-C1040 for the proposed Cut and Fill Plan. A summary of the estimated cut and fill volumes across the site is presented in **Table 2**.

Table 2: Summary of proposed cut and fill volumes across the site

Item	Volume (m ³) (approximate only)
Stripping of topsoil	20,600
Excavation of existing farm dams (allowing for 1m deep excavation of accumulated sediment)	500
Net cut (excluding topsoil stripping)	-34,660
Net fill	31,550
Balance	3,110 export (excluding topsoil)

NB: These volumes exclude allowances for bulking and compaction, excavation of footings and services trenches, select materials (e.g., retaining wall backfill) and engineered fill.

The volumes presented in **Table 2** are based on the current design at the time of DA submission, and further detailed design of the infrastructure and on-lot works may alter these volumes. It is assumed that topsoil from the site will be respread on lots once earthworks are complete.

All imported materials will comply with the requirements of the Import Fill Protocol and geotechnical specifications for the development. Topsoil stripping and placement will be undertaken in accordance with the geotechnical and landscape specification for the project.

2.2. Batter Design

Any permanent batters have been limited to no steeper than 1 in 4 in accordance with Goulburn Mulwaree Council requirements.

Any temporary batters constructed during the works will be in accordance with recommended maximum batter slopes as per the geotechnical investigation report and ongoing advice from the Level 1 geotechnical engineer. All temporary batters will be stabilised with appropriate methods and vegetated where required.

2.3. Retaining Walls

Where possible, batter slopes will be provided to accommodate level changes. Where this is not possible, retaining walls will be constructed adjacent to the road reserve, lots and basins based on the current civil and earthworks design. A timber sleeper product or other similar sleeper wall will be adopted for all retaining walls and will be detailed on the civil drawings. Refer to **Figure 3** below for a typical section of the proposed retaining walls. Refer to Drawings 23-1098-C1051 for the proposed retaining wall location along the Main Southern Railway interface.



Figure 3: Typical retaining wall – sleeper wall

Retaining walls will be designed and constructed using standard industry practices, standards and guidelines. All retaining walls will be constructed on a staged basis and as required to suit the development earthworks.

All retaining walls will have pedestrian and vehicular safety barriers (if required) in accordance with Austroads Guidelines as required.

3. Road Design

3.1. External Road Network

The existing Council owned, Goulburn Street, terminates at Portland Avenue approximately 200m east of the site boundary. The existing road corridor east of the Portland Avenue intersection is 20m wide and consists of an 11m wide carriageway and 4.5m wide verges. The southern edge of the carriageway consists of a layback kerb and footpath. The northern edge of the carriageway consists of a concrete dish drain along the edge of bitumen (refer to **Figure 4** below).



Figure 4: View of Goulburn Street looking west of Portland Avenue (Google Streetview, 2nd June 2023)

The development will require an extension of Goulburn Street, identified in the DCP as a Collector Road requiring a 20.0m wide road reserve. The road reserve already exists between the existing parkland and Marulan Fire Station as shown in **Figure 5** below.

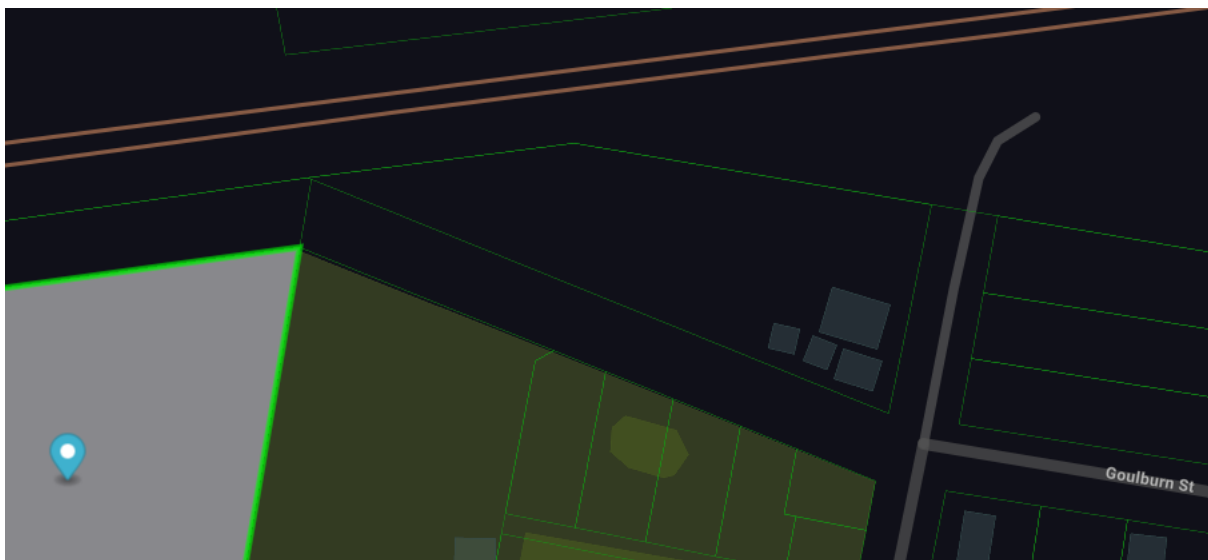


Figure 5: Goulburn Street road reserve (Mecone Mosaic, June 2023)

The extension of Goulburn Street will adopt a cross section generally as shown in concept in Figure 6. A slight departure is proposed from the typical Collector Road cross section with a 4.0m and 5.0m wide verge proposed to accommodate an existing Endeavour Energy substation located on the northern side of the road reserve.

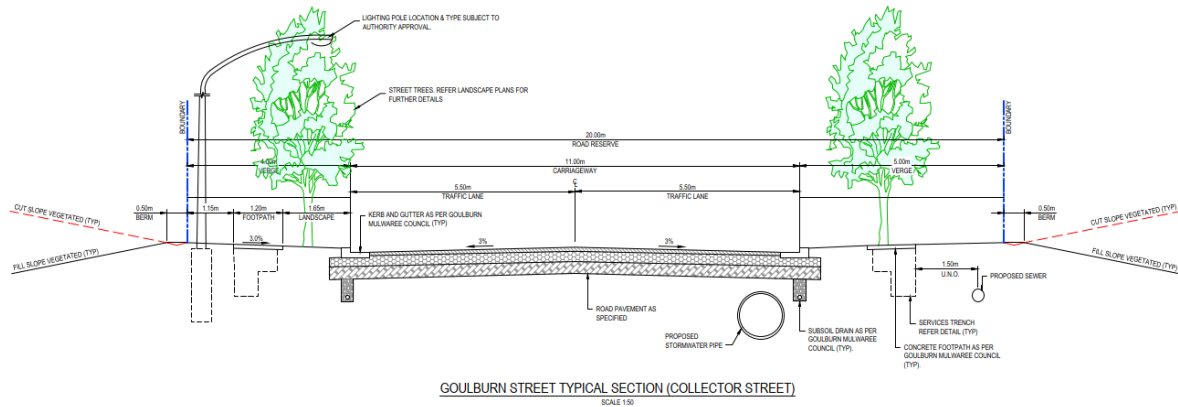


Figure 6: Typical Section of the Goulburn Street extension (Collector Road)

NOTE: The design and construction of the Goulburn Street extension is proposed to be delivered under Works In Kind (WIK) or Voluntary Planning Agreement (VPA) arrangement. A concept design has been provided with this Development Application and will need to be finalised with stakeholders, and once agreed will proceed to the detailed design phase.

3.2. Internal Road Network

The proposed internal road network has been designed to service the intended land use within the site, being residential lots. The road hierarchy consists of Collector Streets, Local Streets and Access Streets.

A large proportion of the traffic within the site will be passenger vehicles however allowance needs to be made for heavy vehicles to provide access for public buses, garbage collection, emergency services, etc. These vehicles are typically Service Vehicles or Heavy Rigid Vehicles (up to 12.5m long) and occasionally semi-trailers (typically up to 19m long). These vehicles are on average 2.5m wide and when navigating the local road network, can regularly consume all the travel lane.

A summary of the general design criteria adopted for the internal estate roads, which is consistent with the Goulburn Mulwaree Council Standards for Engineering Works – Section D1, is summarised in **Table 3**.

Table 3: General road design criteria

Road Type	Collector Street (20.0m)
Roads within the estate	Road No.13
Design Speed	60 km/h
Design Vehicle	12.5m Heavy Rigid Vehicle
Check Vehicle	19.0m Semi Trailer
Pedestrian and cycle path (within verge width)	Verge 1 – 1.2m Verge 2 – 2.0m
Through traffic lanes	2 x 3.5m
Kerbside lanes	1 x 4.0m
Median width	N/A
Road carriageway width (kerb to kerb)	11.0m
Verge width	Verge 1 – 4.5m Verge 2 – 4.5m
Road Reserve	20.0m

Road Type	Local Street (18.0m)
Roads within the estate	Road No.08 and 09
Design Speed	40 km/h
Design Vehicle	8.8m Service Vehicle
Check Vehicle	12.5m Heavy Rigid Vehicle
Pedestrian and cycle path (within verge width)	Verge 1 – 1.2m Verge 2 – 2.0m
Through traffic lanes	2 x 3.0m
Kerbside lanes	1 x 3.0m
Median width	N/A
Road carriageway width (kerb to kerb)	9.0m
Verge width	Verge 1 – 4.5m Verge 2 – 4.5m
Road Reserve	18.0m

Road Type	Access Street (15.0m)
Roads within the estate	Road No.10, 11 and 12
Design Speed	25 km/h
Design Vehicle	8.8m Service Vehicle
Check Vehicle	12.5m Heavy Rigid Vehicle
Pedestrian and cycle path (within verge width)	Verge 1 – 1.2m Verge 2 – 1.2m
Through traffic lanes	2 x 3.0m
Kerbside lanes	N/A
Median width	N/A
Road carriageway width (kerb to kerb)	6.0m
Verge width	Verge 1 – 4.5m Verge 2 – 4.5m
Road Reserve	15.0m

The design criteria nominated above reflects the requirements nominated in the Goulburn Mulwaree Council - Standards for Engineering Works 2013 – Section D1 or similar road classification.

Road No 13 terminates immediately after Road No 08 as part of this stage of the subdivision. Concrete jersey kerbs and chevron signage will be provided at the termination of the road. A temporary turning facility is not proposed as drivers can turn right into Road No. 08 from the end of Road No. 13.

3.3. Pavement Design

Pavement will be designed based on the requirements of *Austrroads Pavement Design Guide – A Guide to the Structural Design of Road Pavements* and recommendations provided by Douglas Partners Geotechnical reports for previous stages of the subdivision.

The basis of this design has been taken from Goulburn Mulwaree Council Design Specification – Part D2 as follows:

- Design Traffic Loading:
 - ▶ N =6x10⁴ ESA (Access Street)
 - ▶ N =3x10⁵ ESA (Local Street)
 - ▶ N =1x10⁶ ESA (Collector Street)

Based on these design traffic loads the indicative pavement design is as follows:

- 30mm AC 10 320 Bitumen
- 7mm Spray Seal
- 100mm base course (DGB 20)
- 200mm sub-base course (DGS 40)

The subgrade CBR required to achieve the indicative pavement profile for the nominated DESAs is as follows:

- Access Street – CBR = 4.5% min
- Local Street – CBR = 7% min
- Collector Street – CBR = 8% min

CBR testing will be undertaken at the completion of bulk earthworks at the subgrade level to confirm this pavement design.

Where minimum CBR values are not achieved subgrade replacement will be undertaken by removing 300mm of material below subgrade level and replacing with select fill of minimum CBR = 10%. Subgrade improvement may also be undertaken through tyning the subgrade to a depth of 300mm and adding gypsum or lime to increase the subgrade strength.

Council and/or a suitably qualified and experienced civil engineer should be notified, and proposals and methodologies submitted for review and approval prior to any subgrade replacement or improvement works being undertaken.

4. Flooding

Goulburn Mulwaree Council have recently commissioned the *Marulan Flood Study* by grc. This study is currently on exhibition as a final draft dated January 2023. **Figure 7** below presents the 1% AEP flood extent within the site.

The figure below shows a gully through the western side of the site before turning north and flowing under the Main Southern Railway through an existing DN1200 culvert. This gully is considered a riparian corridor and will be retained and enhanced as part of the proposed subdivision.

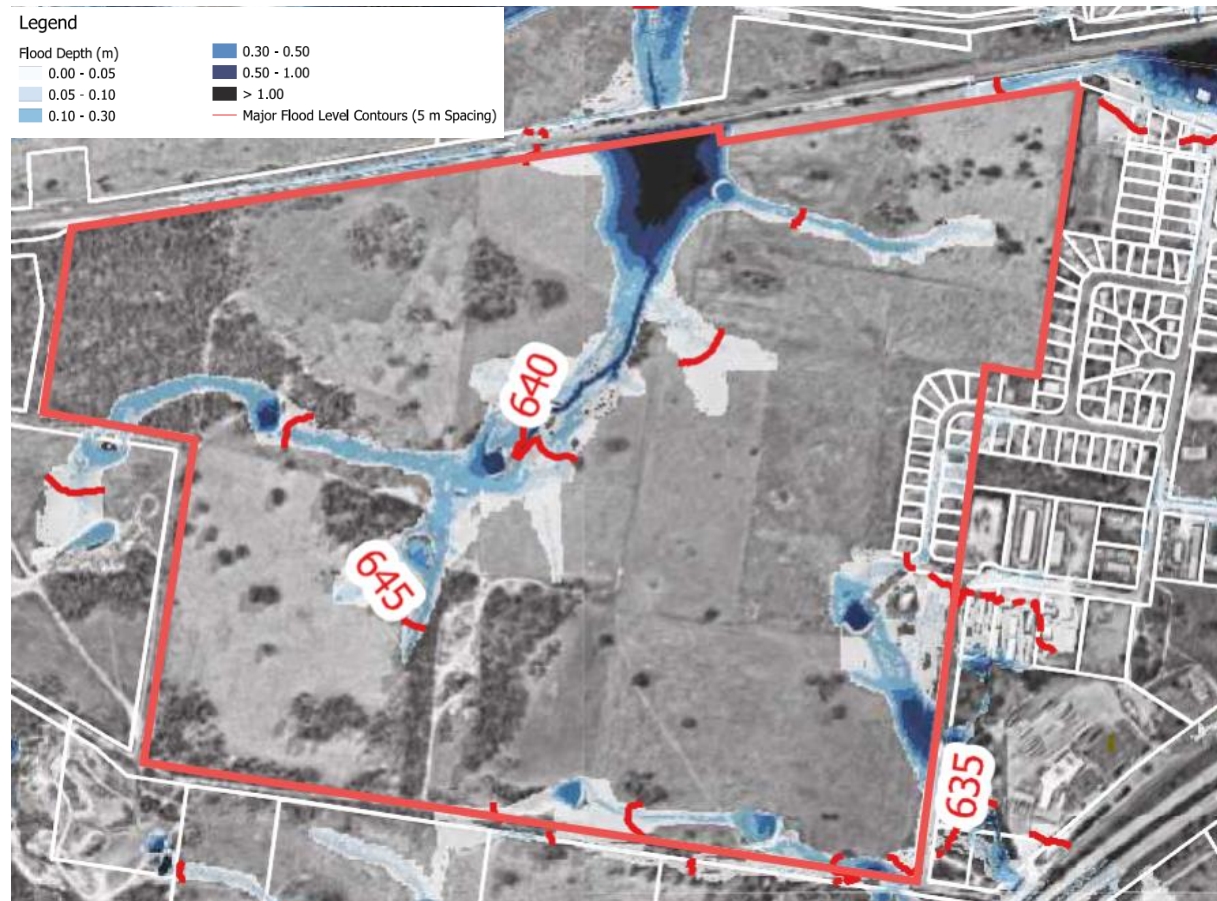


Figure 7: 1% AEP flood map excerpt, Marulan Flood Study (grc, Jan 2023)

Refer to AT&L Stormwater Management Report for further discussion regarding flood impact on the proposed subdivision.

5. Stormwater Drainage

5.1. Stormwater Drainage Design Criteria

Design criteria and requirements for the proposed site stormwater management are outlined in the following documents:

- AS 3500.3 – Plumbing and drainage – Stormwater drainage
- Commonwealth of Australia (Geoscience Australia), *Australian Rainfall and Runoff*, 2019.
- Goulburn Mulwaree Council Development Control Plan 2009
- Goulburn Mulwaree Council – Stormwater Drainage Design Handbook revised 2020
- Goulburn Mulwaree Council - Standards for Engineering Works 2013 D5 and D7
- WaterNSW NorBE Water Quality Assessment Guideline 2022
- Adoption Guidelines for Stormwater Biofiltration Systems Version 2 (FAWB, 2009)

An extract of the prescriptive controls adopted for the site are summarised in **Table 4**.

Table 4: General stormwater drainage design criteria

Stormwater Component	Design Criteria
Hydrology	<ul style="list-style-type: none"> ■ Time of concentration values 5 minutes (minimum) and 20 minutes (maximum). ■ Design Storm events: 20% AEP, 10% AEP, 5% AEP, 2% AEP and 1% AEP.
Minor and Major System	<ul style="list-style-type: none"> ■ Minor system: 20% AEP conveyed by way of pit and pipe drainage. ■ Major system: 1% AEP conveyed by way of pit and pipe drainage and overland flow.
Pipes	<ul style="list-style-type: none"> ■ Minimum pipe diameter (road reserve): 375mm ■ Minimum pipe diameter (inter allotment): 150mm ■ Minimum pipe grade: 1% (desirable), 0.5% (absolute minimum) ■ Minimum pipe cover: 450mm (grassed area), 600mm (under carriageway) ■ Where minimum cover cannot be achieved due to physical constraints the pipe class shall be suitably increased. ■ All pipes in trafficable areas will be Reinforced Concrete Pipes (RCP) or Fibre Reinforced Cement (FRC) equivalent. ■ Pipes discharging to an overland flow path shall adopt a minimum tailwater level equivalent to respective overland flow level. ■ A hydraulic grade line HGL design method shall be adopted for all road pipe drainage design.
Pits	<ul style="list-style-type: none"> ■ Minimum pit freeboard: 150mm from HGL to surface level in the minor event. ■ Where trapped low points are unavoidable and potential for flooding private property is a concern, an overland flow path capable of carrying the total 1% AEP storm event has been provided. Alternatively, the pipe and inlet system has been upgraded to accommodate the 1% AEP storm event. ■ Maximum pit spacing: 100 metre intervals. ■ Blockage factors of 20% and 50% shall be adopted for on-grade and sag pits respectively.
Gutter flow widths	<ul style="list-style-type: none"> ■ Maximum flow width: 2.5m

Stormwater Component	Design Criteria
Overland flow paths	<ul style="list-style-type: none"> Velocity x depth product shall not exceed 0.4 m²/s for all storms up to and including the 1% AEP event.
Scour Protection	<ul style="list-style-type: none"> D₅₀ = 200mm rock rip rap to all stormwater outlets up to DN600, spillways and emergency overland flows paths with flow velocities of up to 3.5m/sec.

5.2. Existing Site Stormwater Drainage

This stage of the subdivision has a crest dividing the site into two catchments falling to the north east and north west. Existing external catchments discharge across the southern boundary which consists of the current Stage 2 and future stage of the subdivision. These catchments are characterised by either residential lots or agricultural land.

An existing gully is located along the western edge of the site which forms the western boundary of the subdivision. Stormwater runoff flows across the site towards the gully in the west before discharging under the Main Southern Railway through a DN1200 culvert. The north eastern catchment sheet flows across the north eastern boundary towards the Main Southern Railway. Refer to 23-1098-C1070 for a pre-development stormwater catchment plan and **Figure 8** below for existing catchment details.

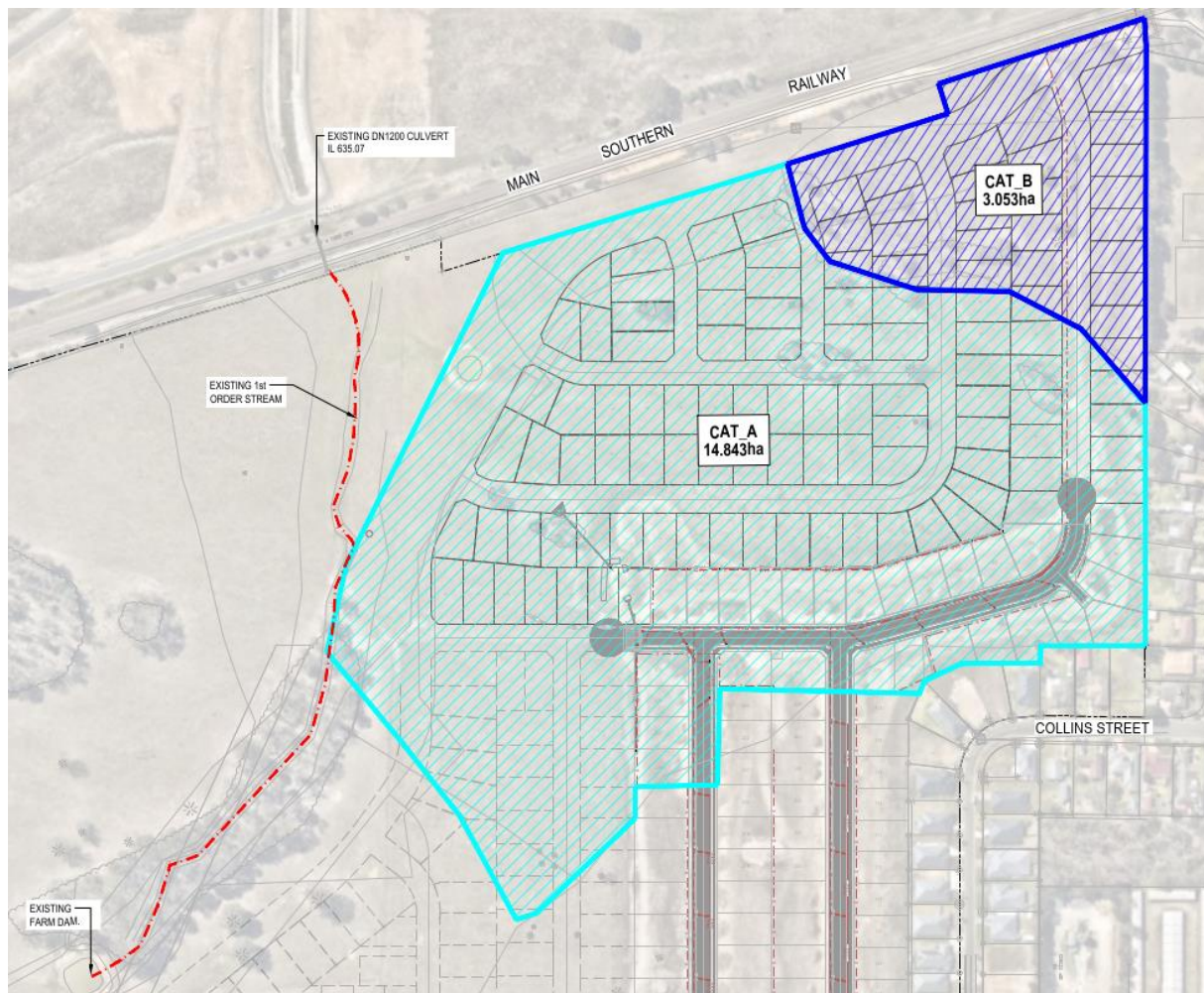


Figure 8: Pre-development catchment plan

5.3. Proposed Site Stormwater Drainage

The proposed drainage network within the estate has been designed to safely convey major and minor flows prior to discharging to adjacent lands to the north east and north west. The following criteria have been adopted for the proposed drainage system:

- Major system (pit and pipe network, overland flow paths and channels): 1% AEP
- Minor system (pit and pipe network): minimum 20% AEP and increased where required to address major system design requirements.

The site is divided into two broad catchments with the following configuration as shown in **Figure 9**:

- Catchment 1 discharges north east to the proposed Goulburn Road extension and through to an existing culvert under the Main Southern Railway, north of the existing fire station.
- Catchments 2, part of previous stage (catchment 3) and future catchment 4 discharges north west to the western gully and through the existing culvert under the Main Southern Railway

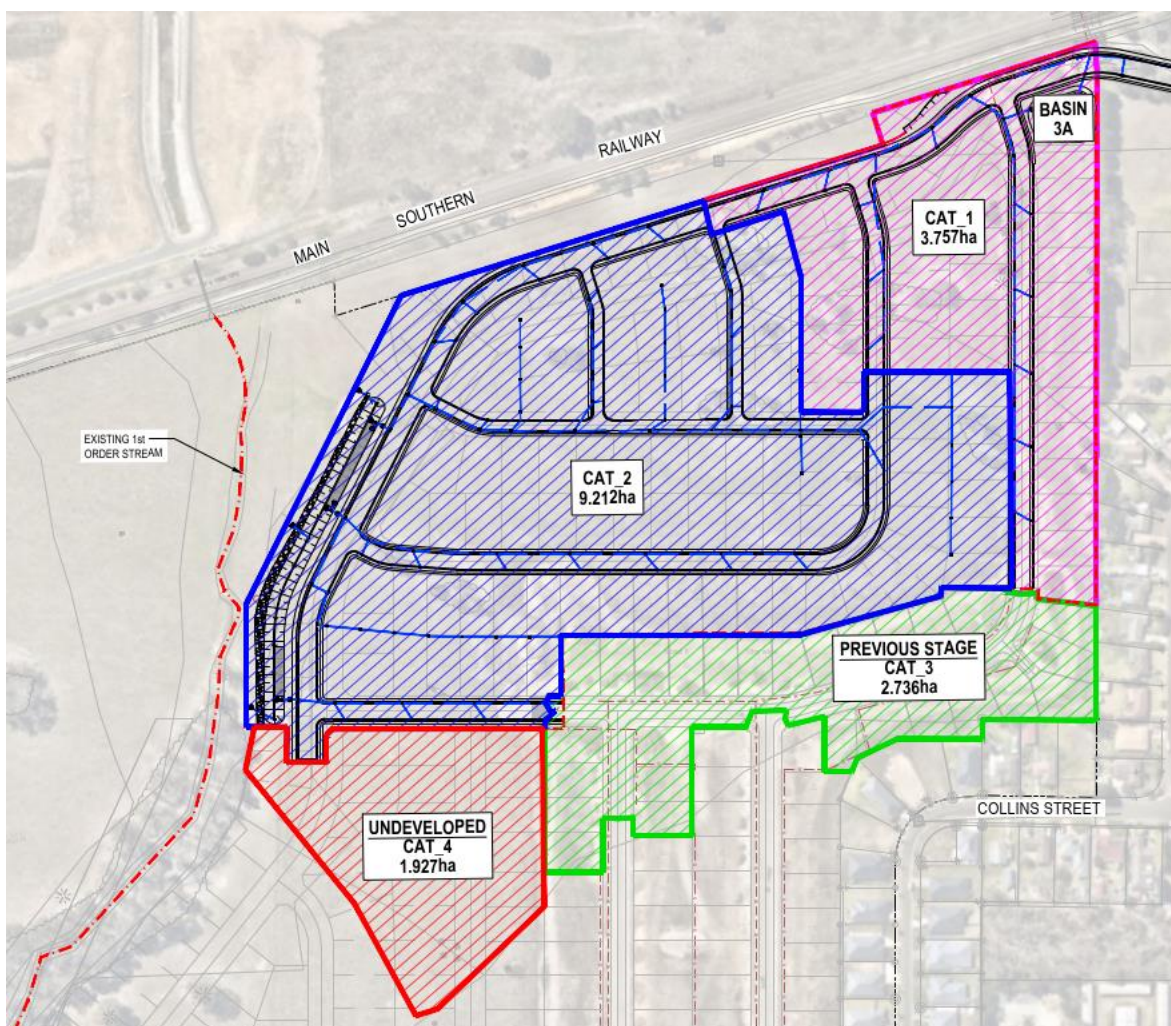
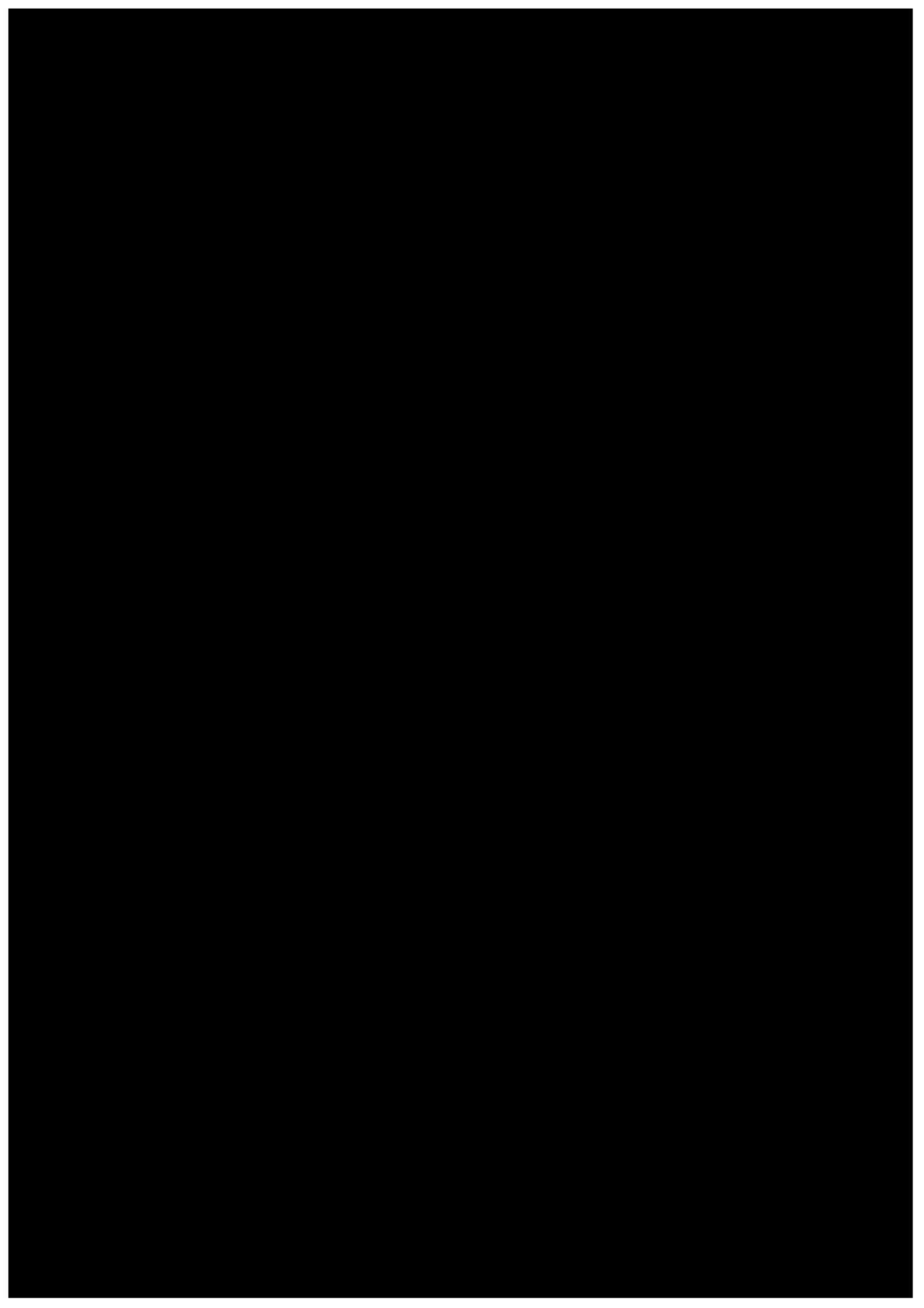


Figure 9: Post development catchment plan

Refer to AT&L Stormwater Management Report for further details relating to Soil and Water Management, On-Site Detention and Water Quality measures proposed for the development.





NORTH SYDNEY

LEVEL 7
153 WALKER STREET
NORTH SYDNEY NSW 2060
02 9439 1777
INFO@ATL.NET.AU

PARRAMATTA

SUITE 4 LEVEL 4
17-21 MACQUARIE STREET
PARRAMATTA NSW 2150
02 9068 8517
INFO@ATL.NET.AU

BRISBANE

SUITE A1 LEVEL 20
127 CREEK STREET
BRISBANE QLD 4000
07 3211 9581
INFO-QLD@ATL.NET.AU

MELBOURNE

LEVEL 24
570 BOURKE STREET
MELBOURNE VIC 3000
INFO-VIC@ATL.NET.AU

atl.net.au