Stormwater Management Strategy

Friends, Williams, Hoopers and Willung Roads Rosedale

Client

[redacted]

Issued

12/11/2024

Melbourne Office

1 Glenferrie Road

PO Box 61

Malvern VIC 3144

Tel: (03) 9524 8888

beveridgewilliams.com.au

Beveridge Williams

Client:	[redacted]
Issued:	12/11/2024
Version:	D
Prepared by:	[redacted]
Checked by:	[redacted]
Project Manager:	[redacted]
Project Number:	2100603

Surveying
Asset Recording
Civil Engineering
Infrastructure Engineering
Traffic & Transport Engineering
Environmental Consulting
Water Resource Engineering
Strata Certification (NSW)
Town Planning
Urban Design
Landscape Architecture
Project Management

Revision Table

REV	DESCRIPTION	DATE	AUTHORISED
A	Stormwater Strategy	**7/09/21**	[redacted]
B	Stormwater Strategy	**11/10/22**	[redacted]
C	Stormwater Strategy	**01/08/24**	[redacted]
D	Stormwater Strategy	**12/11/2024**	[redacted]

Contents

Tables

Figures

Appendix

Glossary of terms

Alphabetical list of terms and abbreviations used in report

AHD	Australian Height Datum
	A common national surface level datum approximately corresponding to mean sea level.
AEP	Annual Exceedance Probability.
	Probability of a flood event occurring in any year.
Authorities	Organisations responsible for supply and management of sewer, water, gas, electricity and telecommunications, roads and transport
BPEMG	Best Practice Environmental Management Guidelines
BWCo	Beveridge Williams & Co Pty Ltd
[redacted]	[redacted]
Council	Wellington Shire
DSS	Drainage Services Scheme
Q_{10}	Stormwater flow generated from 10% AEP (1 in 10 year) storm event.
Q_{100}	Stormwater flow generated from 1% AEP (1 in 100 year) storm event.
Q_{gap}	Flow difference between Q_{10} and Q_{100} storm event.

1 INTRODUCTION

Beveridge Williams has been commissioned by [redacted] to prepare a Stormwater Management Strategy (SWMS) for a proposed development located at Friends, Williams, Hoopers and Willung Roads Rosedale. The total site area is approximately 75.84 ha and is proposed to be developed into 85 residential lots.

This SWMS is intended to provide sufficient evidence that the stormwater discharges from the proposed development can meet stormwater Best Practice Environmental Management guidelines (BPEMG) and that stormwater discharging from the proposed development shall be to the satisfaction of West Gippsland Catchment Management Authority (WGCMA), Wellington Shire Council and other stakeholders.

1.1 SITE OVERVIEW

The existing site is a large low-density rural residential area located approximately 1.5 km south of the township of Rosedale. It is bounded by Williams Road to the north, Friends Road to the west, Willung Road to the east and Hoopers Road to the south. Along the eastern boundary, there is a property which is not part of the current site extents (refer to **Figure 1**). The site contains several residential properties and associated driveways as well as various dams, however it is primarily vacant land. Additionally, Blind Joe Creek is located approximately 500 m west of the site. The site locality is displayed in **Figure 1**.

The site is covered by an easement for the regional outfall sewer that crosses the central part of the site, as shown in **Figure 3**.

Figure 1: Site Locality

2 EXISTING CONDITIONS

2.1 TOPOGRAPHY AND DRAINAGE

The site grades in a northerly direction, with a slope of approximately 1 in 80. The site has an external catchment to the south which drains into the site. Site surface water flow follows topographic conditions and is expected to flow from south to north, eventually draining offsite into farmland north of Williams Road.

Site topography and surface water drainage is shown in **Figure 2**.

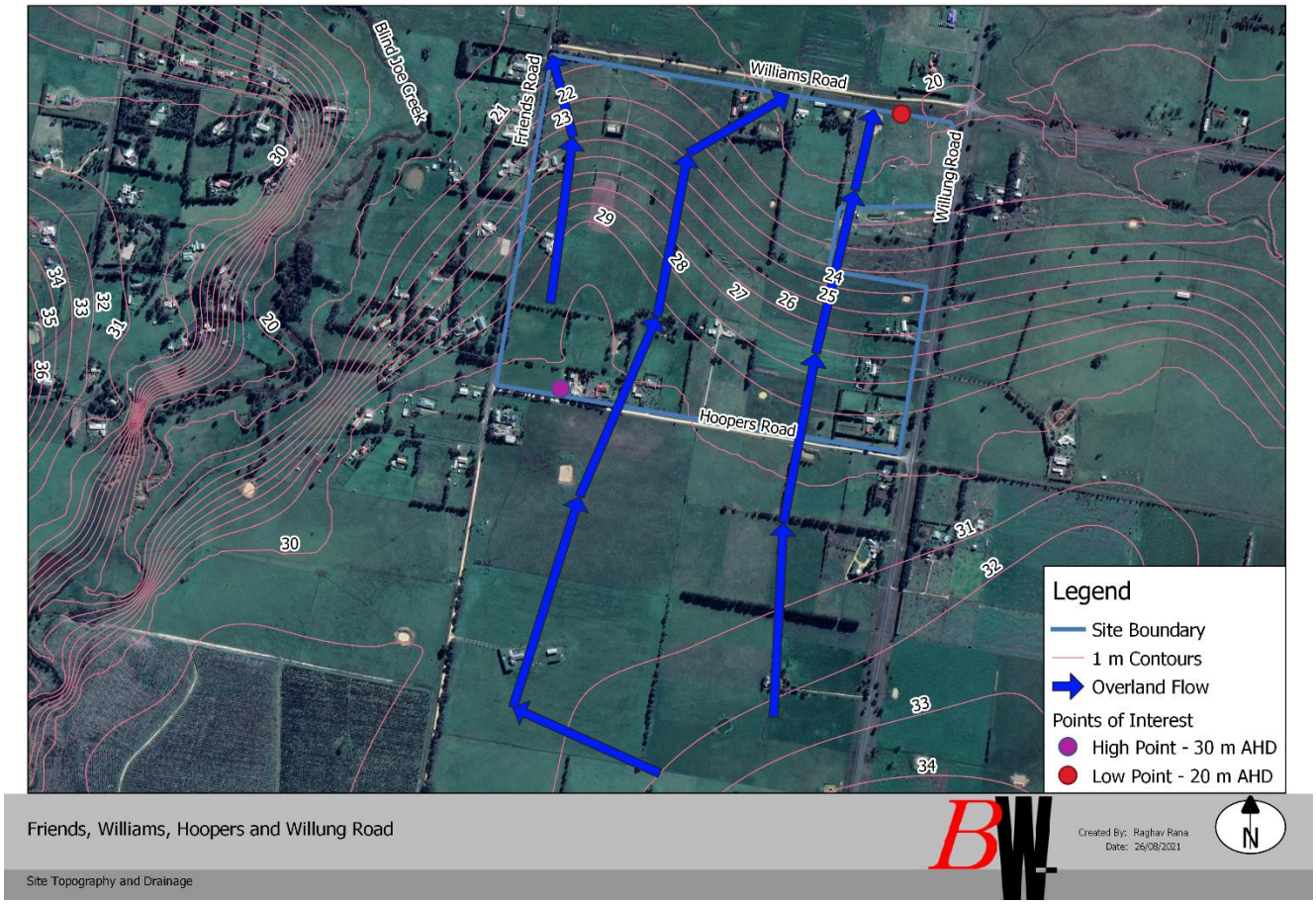

Figure 2: Surface Water Flow Direction

3 DESIGN INTENT

3.1 PROPOSED DEVELOPMENT

The preliminary proposal of the development site intends to develop the site into 85 lots, with an average size of 8,541 m² and associated internal road network. The indicative development plan is presented in **Figure 3** and **Appendix A**.

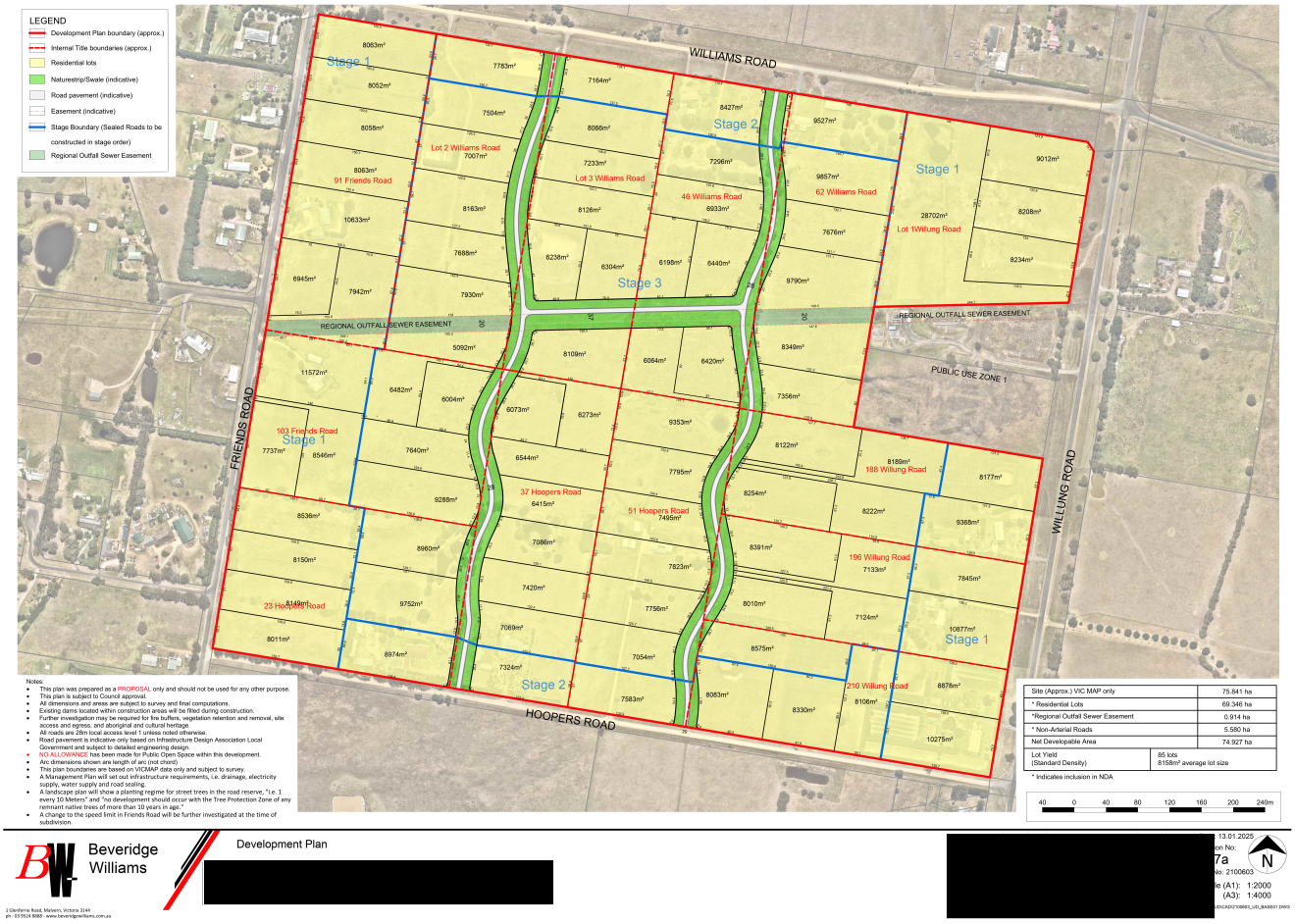

Figure 3: Indicative Development Layout

The area allocation is presented in **Table 1**.

Table 1: Proposed Development Summary

Land Use	Area
Residential Lots	72.600 ha
Roads	3.241 ha
Total	**75.841 ha**

3.2 PROPOSED STORMWATER MANAGEMENT STRATEGY

The site does not currently fall into any drainage schemes. Once developed, the fall across the site is assumed to follow the existing natural features of the site. To manage stormwater quantity, it is proposed that rainwater tanks are used as storage to cater for the additional flows due to development of the site. Stormwater quantity management is further discussed in **Section 4**. To manage stormwater quality, rainwater tanks and Water Sensitive Urban Design

(WSUD) assets are suggested to be installed at each lot to meet best practice. Stormwater quality management is further discussed in **Section 5.**

4 STORMWATER QUANTITY MANAGEMENT

4.1 CATCHMENT AREAS

4.1.1 PRE-DEVELOPED CATCHMENTS

The pre-developed catchments were delineated using the best available elevation data from the online Elevation Information System (ELVIS). The site has a considerable upstream catchment of approximately 107.2 ha. There appear to be no culverts underneath Hoopers Road apart from a small one downstream of a farm dam, hence the upstream catchment discharges to site predominantly via sheet flow. There are three inferred outlet points along the northern boundary of the site (refer to **Figure 4**).

The pre-developed catchment plan and flow paths are shown below in **Figure 4**.

Figure 4: Pre-Developed Catchment Plan (Not to scale)

The post-developed catchments delineated are based on the indicative subdivision plan (refer to **Figure 3**). It is assumed that the external southern catchments remain unaltered, and that these flows will still enter the site. Given the indicative subdivision plan, there are four outlet points in the post developed scenario (refer to **Figure 5**). Additionally, sub-catchment M has been separated out, as this offsite area is not being altered as part of the development. Catchments F, G, J and K will have flow redirected to the two internal roads, whereas catchments L, M, N, H and I will flow in a northerly direction through each respective sub catchment.

The post-developed catchment plan is shown in **Figure 5.**

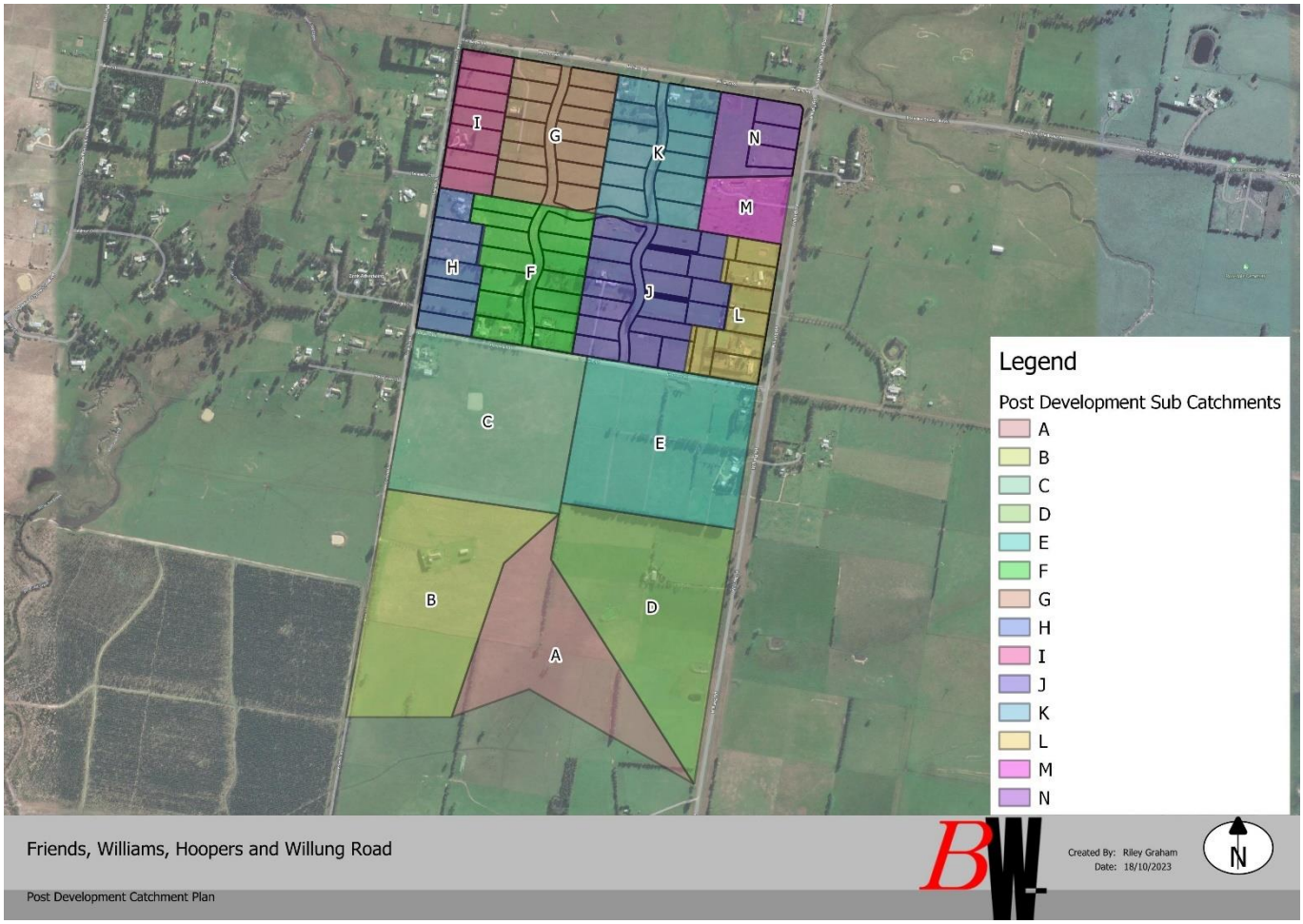

Figure 5: Post-Developed Catchment Plan (Not to scale)

4.2 HYDROLOGY

The RORB runoff-routing model was utilised to calculate the stormwater runoff flows for both the pre- and post-developed conditions using the Australian Rainfall & Runoff 2019 (AR&R) methodology. The runoff routing characteristics of the catchment are represented by the parameter's kc and m, where kc represents the delay in runoff response from rainfall and m represents the non-linearity in the storage-discharge relationship for the catchment. Input rainfall data was obtained from the AR&R Data Hub and Bureau of Meteorology (BoM) websites.

Calibration of the predeveloped RORB model (refer to **Figure 4** for catchment plan) was conducted against results obtained using the Regional Flood Frequency Estimation (RFFE) Model and the Rational Method. These results are attached in **Appendix B.** Various k_c estimation methods were trialled and the results of the calibration are presented in **Table 2**. Given the size of the total catchment (1.88 km²) and to obtain an upper estimate of runoff (greater flows compared to the Rational Method), the pre-developed RORB model was calibrated against the RFFE Model. As such the VIC Mean Annual Rainfall (MAR) <800 mm calculation for k_c was selected, to establish a flow of 16.40 m³/s for the total catchment. This value is within 16% of the RFFE result and therefore deemed suitable and appropriate for the purposes of further modelling.

Table 2: Pre-Developed RORB Model Calibration

Location	Rational	RFFE	RORB (VIC MAR <800 mm)	RORB (Areal Equation)	RORB (Pearse et. al.)
Total catchment	9.62 m³/s	14.2 m³/s	16.40 m³/s	5.04 m³/s	10.81 m³/s
k_c	-	-	0.74	3.01	1.28

The post-developed RORB model was established based on the indicative subdivision plan (refer to **Figure 3**) and the post-development catchment plan (refer to **Figure 5**). The change in sub catchment layout is also accompanied by changes in the fraction impervious (f. imp). Within the predeveloped scenario, all sub catchments were given a f. imp of 0.1 due to the predominantly vacant nature of the land. In the post-developed scenario, external sub- catchments (A-E and M) maintained a f. imp of 0.1, however due to the planned development the internal sub catchments were given a f. imp of 0.15. This assumes that all lots have residential properties of 500 m³ and associated driveways and considers the two internal roads traversing the site. This is displayed in **Table 3**.

Table 3: Post Developed Catchment Areas and Corresponding f. imp

Sub Catchment	Area (Ha)	Post Developed – f. imp
A-E	107.14	0.1
F	12.55	0.15
G	12.15	0.15
H	5.84	0.15
I	6.07	0.15
J	16.31	0.15
K	11.97	0.15
L	6.59	0.15
M	4.25	0.15
N	5.42	0.15

To calibrate the post-developed RORB model, the k_c parameter was changed to maintain the k_c/d_{ave} ratio as per the pre-developed model, where d_{ave} is the average flow length through the catchment. The parameters for both models are presented in **Table 4**.

Table 4: RORB Input Parameters

Parameter	Pre-Developed	Post-Developed
d_{ave}	1.02	0.98
k_c	0.74	0.71
m	0.8	0.8
IL (mm)	22	22
CL (mm/hr)	3.6	3.6

The results of the RORB modelling are presented below in **Table 5** and attached in **Appendix C.**

Table 5: 1% AEP Peak Flows

1% AEP Flow	Pre-Developed	Post-Developed (Undetained)
Total Catchment	16.48 m³/s (1.5 hr)	16.64 m³/s (1.5 hr)

4.3 DETENTION REQUIREMENTS

Boyd's method was used to determine the storage requirement of 864 m^3 to detain the 1% AEP peak post-development flow back to pre-development levels (refer to **Table 5**). This total storage volume was then spread out over 85 lots, therefore requiring 10 m³ of storage at each lot. This will be done using rainwater tanks and section 173 agreements will be placed on all lots requiring the connection and maintenance of the proposed rainwater tanks. Detailed calculations are provided in **Appendix D.**

4.4 SUBJECT SITE OVERLAND FLOW

Overland flow from the site will be directed via the roads for the central portion of the site (catchments F, G, J and K) with the outer portions following natural topographical conditions (catchments L, M, N, I and H). Ultimately the site will continue to discharge to the vacant land abutting the northern boundary of the site. The proposed overland flow path is presented in **Figure 6**.

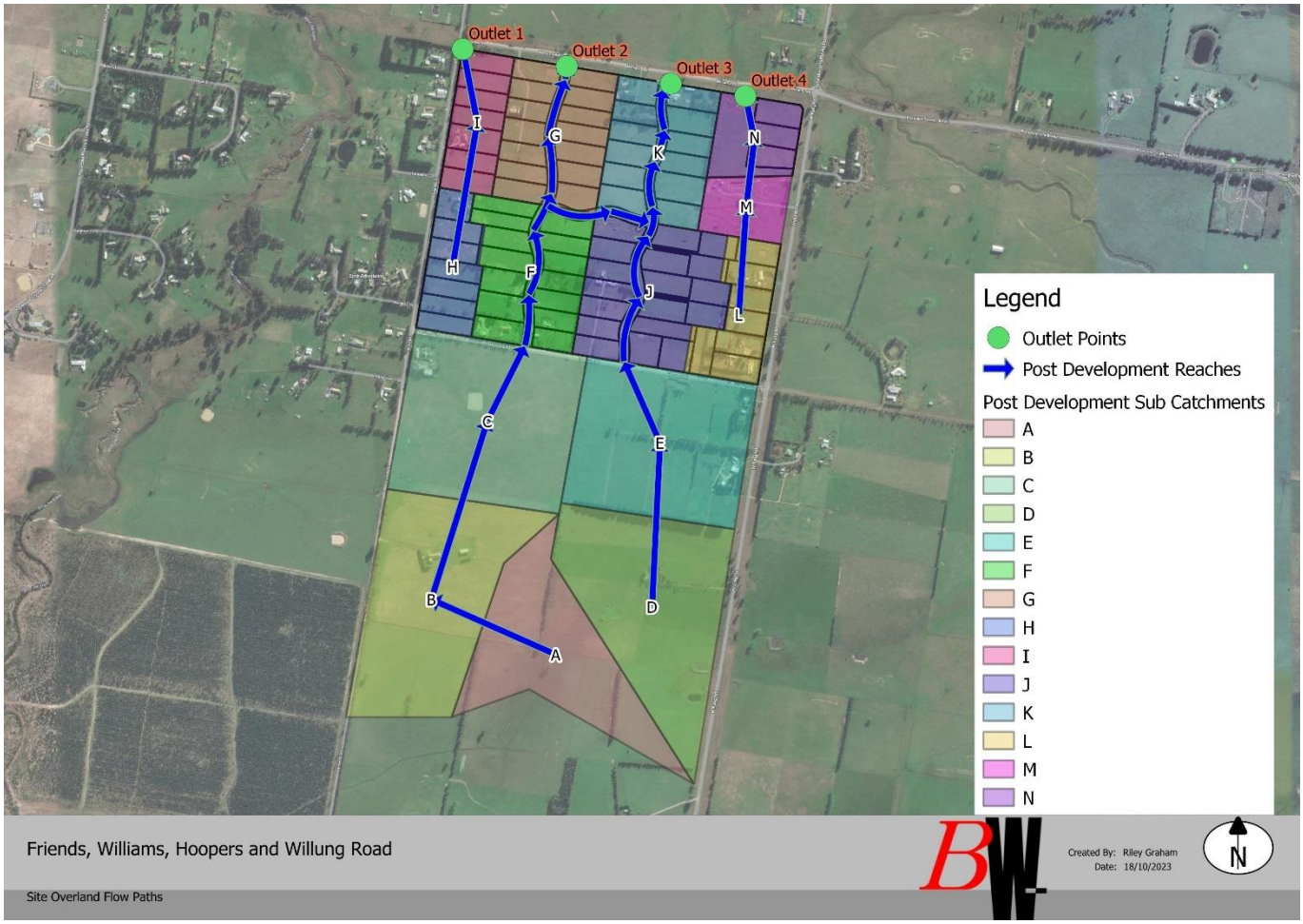

Figure 6: Site Overland Flow Path

4.5 GAP FLOW - PC CONVEY ASSESSMENT

Given that the site will not have any subsurface drainage, and flows are to be conveyed using roadside swales, the gap flow is the same as the 1% AEP flow. The gap flow results at the locations highlighted in **Figure 6** are presented in **Table 6**. Note that Points A and B are equivalent to the flows at Outlets 2 and 3 respectively, this is done to provide an upper estimate of flow depth. The results below are from the original RORB model which includes the external catchments.

Table 6: Gap Flow Results

Location	1% AEP
Point A	7.41 m^3/s (1.5 hr)
Point B	6.60 m^3/s (1.5 hr)

The above results (**Given that** the site will not have any subsurface drainage, and flows are to be conveyed using roadside swales, the gap flow is the same as the 1% AEP flow. The gap flow results at the locations highlighted in **Figure 6** are presented in **Table 6.** Note that Points A and B are equivalent to the flows at Outlets 2 and 3 respectively, this is done to provide an upper estimate of flow depth. The results below are from the original RORB model which includes the external catchments.

Table 6) indicate that Point A would have the highest expected gap flow, therefore a PC convey assessment was completed at this location. As this location has the largest peak gap flow it would also be expected to provide the most conservative results. The PC convey assessment of a 28 m road reserve with a conservative longitudinal slope of 1 in 200, has the capacity to contain a peak gap flow of 7.41 m^2/s as well as satisfy the flood safety criteria. A typical cross section is shown below in **Figure 7** and the calculation results is included in **Appendix E.**

For the road pavement area only, the average velocity (v_{av}) × average depth (d_{av}) is 0.33 m^2/s, which is less than 0.35 m^2/s, the d_{av} of 0.30 m is not higher than 0.30m and the v_{av} of 1.07 m/s is less than 1.5 m/s. The gap flow is therefore considered to be within flood safety criteria.

The swale provides 180 mm freeboard which is higher than the minimum freeboard of 150 mm. Freeboard requirement of 300mm to floor level of residence to be catered for within individual lots..

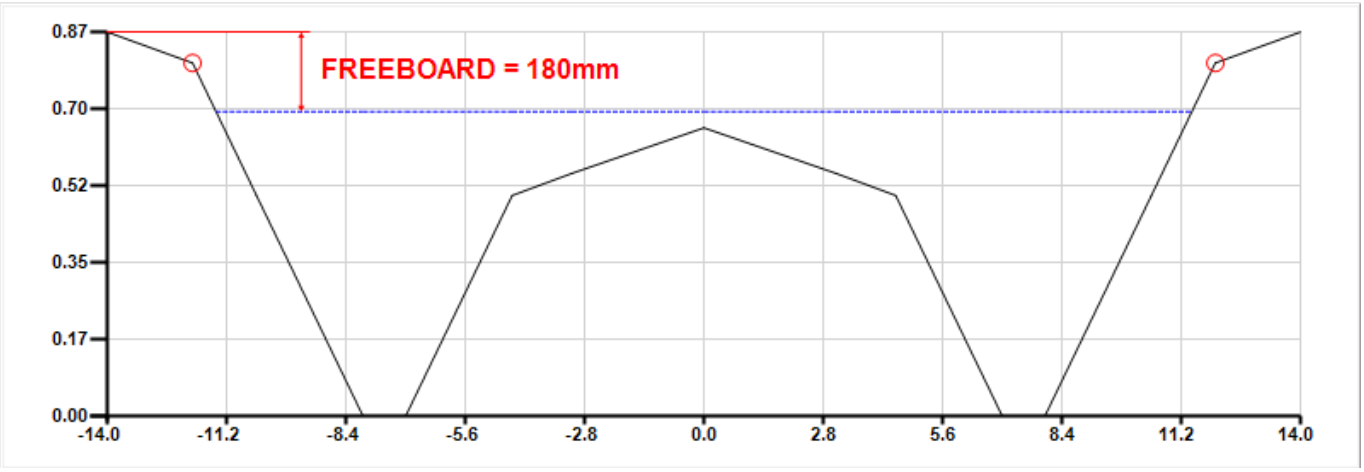

Figure 7: PC Convey Result – Gap Flow at Point A for a 20 m Road Reserve with Swales (Typical Section)

4.6 ONSITE FLOODING

The 'Rosedale Flood Study – Summary Report', confirms that the northeastern corner and other parts of the eastern boundary will be impacted by a 100-year flooding event (**Figure 8**).

Figure 8: 1%AEP Flood Extent

To effectively mitigate this flooding and manage overland flow paths, building envelopes for the entire development will be restricted to areas outside of the flood extent. Therefore, the existing overland flow path on the east side will remain as is, and the buildings within the lots will be restricted to allocated areas outside of the flood extent as shown in **Figure 9**.

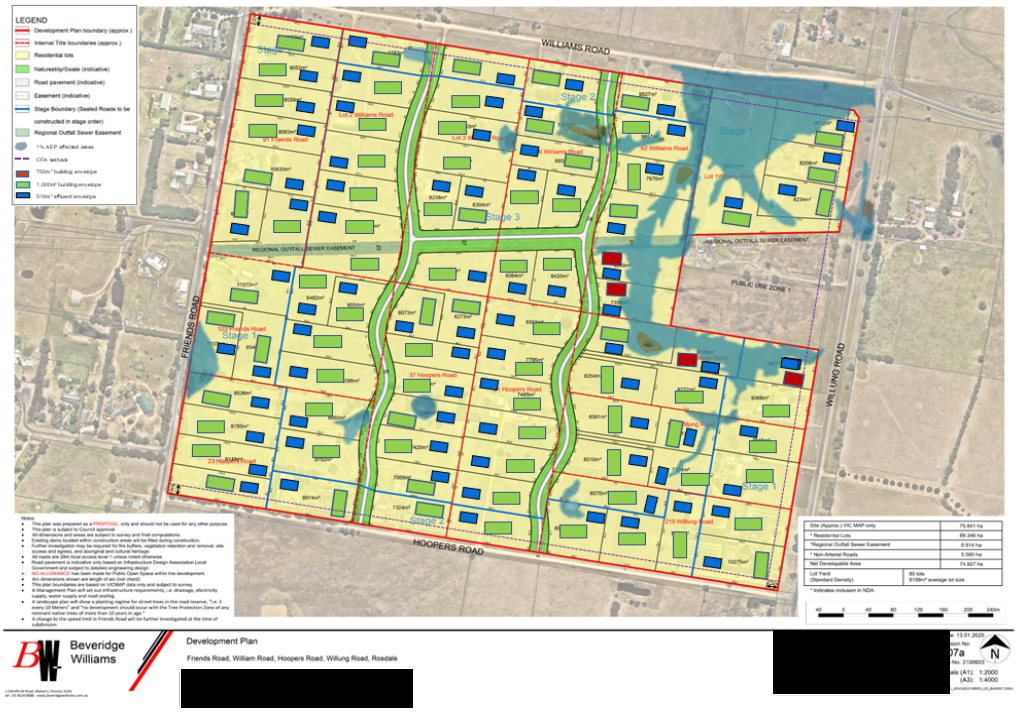

Figure 9: Proposed Building Envelope Plan

5 STORMWATER QUALITY MANAGEMENT

5.1 STORMWATER QUALITY MANAGEMENT OBJECTIVES:

It is a Victorian Government requirement that quality of stormwater runoff from the proposed development meets the Urban Stormwater Best Practice Environmental Management Guidelines (BPEMG), which are required under Clause 56 of the Victorian Planning Provisions (VPP). The targets are:

- 70% removal of the Total Gross Pollutant Load (Litter);
- 80% removal of Total Suspended Solids (TSS);
- 45% removal of Total Phosphorous (TP); and
- 45% removal of Total Nitrogen (TN).

This site will meet the water quality treatment requirements through each lot achieving best practice via the use of a rainwater tank and/or proprietary product to meet best practice targets.

5.2 WSUD ASSETS MAINTENANCE

Section 173 agreements will be placed on all lots to ensure they meet best practice stormwater treatment requirements when developed with a dwelling and that the connection and maintenance of rainwater tanks and WSUD assets will be undertaken by property owners.

As for the swales with road reserves, the developer will undertake maintenance during the defect liability period of 24 months prior to handover to Council. A maintenance plan will be provided as part of the detailed design for the Council approval. This maintenance plan will be in accordance with Melbourne Water WSUD Maintenance Guidelines and will address the following:

- Responsibilities, requirements (including frequencies and system performance) and indicative costs;
- Asset Handover Arrangements, including defects liability period and timeframes; and,
- Sufficient access for staff and/or machinery for maintenance requirements.

The design of the swales will include maintenance considerations such as:

- Swale batter shall not be higher than 1 in 5m to allow for mowing;
- Velocity during major events shall not exceed 2m/s;
- Water ponding at entry points to the swale will not occur for longer than 1 hr after the cessation of rainfall as prescribed in Clause 56.07-04 of the Victorian Planning Provisions;
- The gradient of swale batter slopes will follow Council regulations and will relate to traffic access and driveway crossings; and,
- A velocity-depth check should be undertaken to ensure public safety.

The maintenance plan will include the inspection and maintenance schedules and forms in accordance with Melbourne Water WSUD Maintenance Guidelines as provided in **Appendix F.**

6 CONCLUSION

This report has identified an overall drainage management strategy for the proposed development site located at Friends, Williams, Hoopers and Willung Roads Rosedale. The strategy provides a Stormwater Management Strategy that is constructible and implementable. The strategy covers the following investigations:

- The 20% AEP post-developed flow from the site will be detained to pre-developed levels via onsite detention rainwater tanks. 10 m^3 of storage within each lot will be required.
- Stormwater quality treatment from the proposed development will be catered for through burdening the developer/owner with a section 173 agreement to install a WSUD treatment/Rainwater tanks to meet BEPM targets and to maintain these assets.
- To manage stormwater quality each lot will require a combined 10 kL of storage within rainwater tanks..
- All lots have building envelopes outside of the 1%AEP flood extent.

The above strategy can be implemented, and all Council's development requirements can be achieved in line with the regulatory requirements for both Council and CMA.

BEVERIDGE WILLIAMS & CO PTY LTD

Prepared by

Water Resources Engineer

Reviewed by

Senior Water Resources Engineering

Project Manager

APPENDIX A: INDICATIVE DEVELOPMENT PLAN

APPENDIX B: RFFE AND RATIONAL METHOD

APPENDIX C: RORB CALCULATIONS

APPENDIX D: DETENTION CALCULATION

APPENDIX E: PC CONVEY ASSESSMENT

APPENDIX F: SWALE MAINTENANCE SCHEDULE – MELBOURNE WATER WSUD MAINTENANCE GUIDELINES