ENGENY

PROJECT SOUTH LLC PTY LTD

57 Stock Route Road Mansfield

Stormwater Management Strategy

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22 AUGUST 2025

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Rev	Date	Description	Author	Reviewer	Project Mgr.	Approver
0	22/08/2025	Client Issue	Pratheebh Sritharan / Maria Matamala	Paul Clemson	Maria Matamala	Paul Clemson
Signatures:			[signature]	[signature]	[signature]	[signature]

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1. INTRODUCTION

1.1 Background

Engeny has been engaged by Millar Merrigan on behalf of Project South LCC Pty Ltd to prepare a Stormwater Management Strategy (SWMS) to support the submission of a new planning application for the development at 57 Stock Route Road and part of 104 Dead Horse Lane in Mansfield (total site area of 8.3 hectares).

The development proposes a lifestyle village which includes a childcare centre and community centre as shown on the current masterplan attached as **Appendix A**. The current development's masterplan also includes an additional 2-hectare property to the north which is part of the property at 104 Dead Horse Lane. Figure 1.1 displays the subject site including the nearby Trib of Ford Creek and Ford Creek.

Engeny's scope was split into 2 stages where Stage 1 included data collation and review to confirm Council's key stormwater management requirements. Engeny's Stage 1 memo (dated 23 May 2025) presented preliminary stormwater management advice informed by the data review and discussions with Council. The previously issued memo has been considered in the preparation of this Stage 2 deliverable, the site's SWMS.

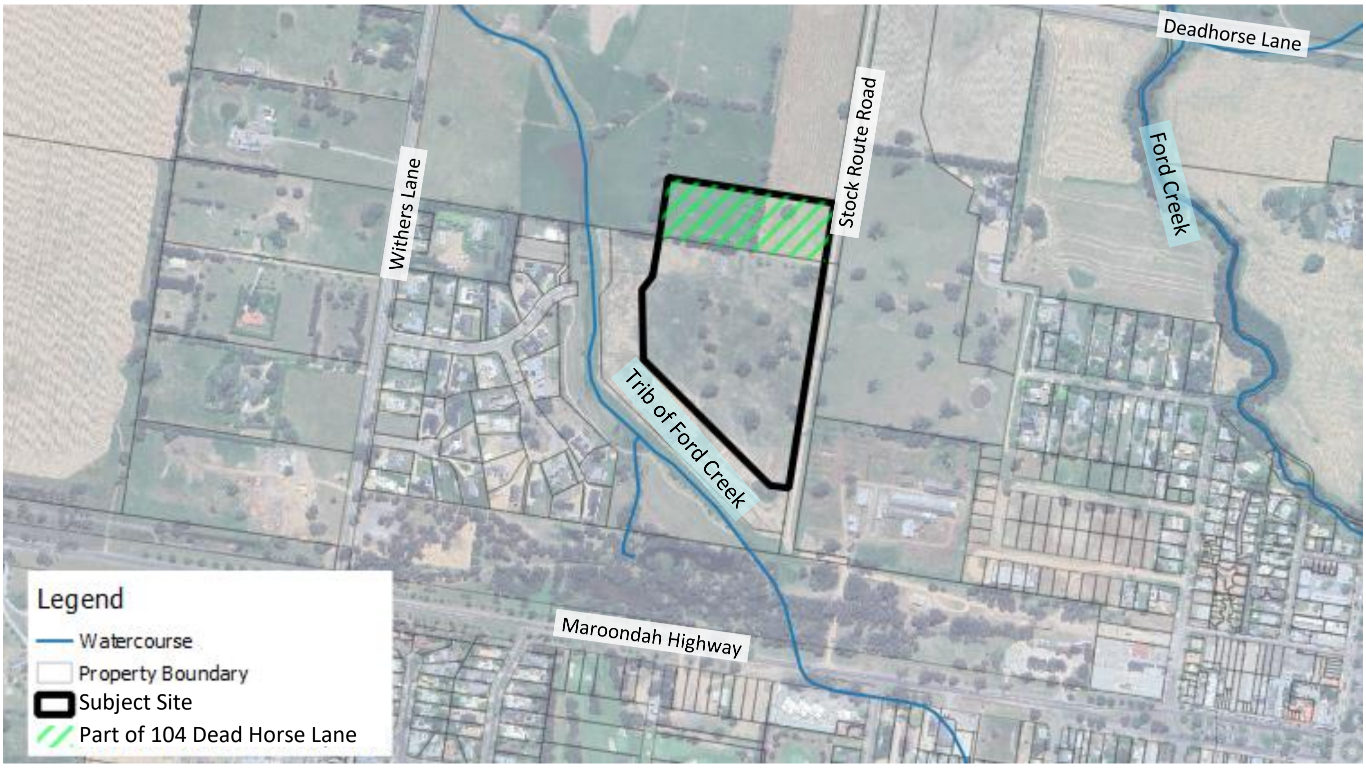


FIGURE 1.1: SITE LOCATION

1.2 Purpose

The purpose of the SWMS is to:

- Outline how the subject site will address the stormwater and flood management related conditions within Clause 56.07 of the Victorian Planning Provisions (VPP) and Clause 53.18 of the Mansfield Shire Planning Scheme.
- Support discussions between the landowner, Council and GBCMA regarding catchment-wide flood mitigation measures to help manage existing flooding issues.

1.3 Objectives

The SWMS aims to achieve the following objectives:

- Estimate changes in peak flows due to the proposed development and determine the required onsite detention volume using RORB hydrologic modelling in line with the latest Australian Rainfall and Runoff (ARR) Version 4.2 Guidelines.
- Determine how external catchment flows from the east could be safely conveyed through the subject site.
- Identify the loss of floodplain storage which would be caused by the development, with the preference for existing flooding issues to be addressed through Council and GBCMA's broader catchment-wide flood mitigation investigation given flooding affects multiple development areas.

1.4 Scope of SWMS

The following outlines the key tasks undertaken by Engeny:

- Collate and review available data including the flood modelling data provided by Stantec.
- Undertake RORB hydrological modelling for the Trib of Ford Creek Catchment to assess the peak flows for the 1% annual exceedance probability (AEP) and 20% AEP events under existing and developed conditions at the site's outfall and its confluence with the Trib of Ford Creek.
- Size an onsite detention asset within the RORB model to ensure the subject site's developed peak 1% AEP flows are attenuated and do not exceed existing conditions at the site's outfall and its confluence with the Trib of Ford Creek.
- Undertake RORB hydrological modelling for a climate change scenario to assess the changes in the peak 1% AEP storm event flows under existing and developed conditions for the Shared Socioeconomic Pathway 3-7.0 (SSP3-7.0) scenario for the year 2100.
- Undertake a high-level assessment of how the external eastern catchment inflows could be safely conveyed through the subject site, considering the magnitude of the peak 1% AEP inflow, the grade available and the proposed development's road layout.
- Identify the peak 1% AEP floodplain storage available within the existing subject site (based on the Stantec flood mapping outputs) and the volume that would be lost due to fill associated with the development.
- Discuss the site's stormwater and flood management related requirements with Council (meeting held 16th July 2025) and discuss the preference to consider catchment-wide flood mitigation measures as part of Council's current flood mitigation study.

Stormwater quality modelling to determine the Water Sensitive Urban Design (WSUD) assets required to achieve the Best Practice Environmental Management Guideline (BPEMG) targets has not been included in this SWMS and will be documented separately by Millar Merrigan.

Engeny has also not undertaken a flood impact assessment to quantify the effects of lost floodplain storage as this would require detailed hydraulic TUFLOW modelling. Council has indicated that the broader catchment-wide flood study (currently being undertaken by Stantec) will investigate potential mitigation measures, and Engeny recommends that resolving flooding issues for the various development areas discharging into the Trib of Ford Creek be explored as the relevant developers could contribute to funding the works.

2. DATA REVIEW

Table 2.1 provides a summary of the data collated, its purpose and the relevance for the SWMS prepared.

TABLE 2.1: SUMMARY OF DATA COLLATED & REVIEWED

Data	Source	Purpose / Relevance to SWMS
Masterplan Version 2 (32495P3_V2 Master plan DRAFT.pdf)	Millar Merrigan	Informed the subject site's fraction impervious values, external eastern catchment's overland flow path alignment and location of the onsite detention asset. Engeny's preliminary stormwater management advice has been considered within Version 2 of the Masterplan which now has allocated land for an onsite detention asset.
Architectural Plans of the proposed building footprints within proposed 250 m² lots, 300 m² lots and clubhouse sites dated May 2025.	Millar Merrigan	Informed the fraction impervious values adopted for the 250m² and 300m² lifestyle village lots (shown as the yellow and purple shaded lots respectively within the **Appendix A** Masterplan) as well as the fraction impervious for the community centre.
Survey dated 17 April 2025 (32495F1_V1.dwg)	Millar Merrigan	Provided an understanding of the topography within the subject site. Engeny confirmed that the survey data was similar to the LiDAR data with the LiDAR data providing improved definition within the subject site given it was based on a 10 cm vertical accuracy in comparison to the survey's 20 cm accuracy.
LiDAR data captured as part of the Mansfield LiDAR project dated 3/2/2022. (mansfield_2022feb03_dem1m_v10cm_epsg7855.tif)	Department of Transport & Planning	Used to delineate the Trib of Ford Creek catchment and inform the assessment of how the external eastern catchment's inflows could be safely conveyed through the subject development.
Latest Aerial Image captured 20 November 2023.	Google Satellite	Used to inform the fraction impervious inputs to the Trib of Ford Creek catchment RORB model.
Victoria Wide Freely Available 10-meter contour data	VicMap	Used to delineate the Trib of Ford Creek's upper catchment (areas not covered by the LiDAR data).
Mansfield Shire Flood Mapping Study Data including: • Peak 1% AEP flows along key plot output lines • 1% AEP base and climate change flood depth grids	Mansfield Shire Council and Stantec	Provided a better understanding of the existing flooding conditions affecting the subject site and the external eastern catchment's inflow. The 1% AEP peak flows were used to validate the Engeny hydrology model. The 1% AEP flood depth grid was used to estimate the floodplain storage within the existing subject site.

3. CATCHMENT CONTEXT

Figure 3.1 displays the subject site and the surrounding catchment context including:

(1) The current extent of development shown within Google Satellite aerial image captured 20/11/2023. The subject site is zoned General Residential Zone (GRZ) with nearby land also subject to future development based on the Mansfield Planning Scheme. There is also an approved subdivision located between the subject site and the Trib of Ford Creek (orange polygon), with construction yet to commence.

(2) 1% AEP base case (existing conditions) flood depth grid provided by Council as part of their municipal flood study which is currently being finalised by Stantec. This data forms the latest understanding of flooding within the catchment and is in accordance with the latest ARR guidelines (V4.2). The data highlights:

(a) The overland flow path entering the site at the eastern boundary. The local Trib of Ford Creek catchment has been delineated (pink polygon) however Council's flood mapping data indicates that the larger Ford Creek catchment would also overtop and contribute to the overland flows entering the subject site's eastern boundary.

(b) The overtopping of flows from the Trib of Ford Creek affecting the neighbouring approved subdivision and subject site's western boundary.

(c) The downstream flooding issues impacting future development areas.

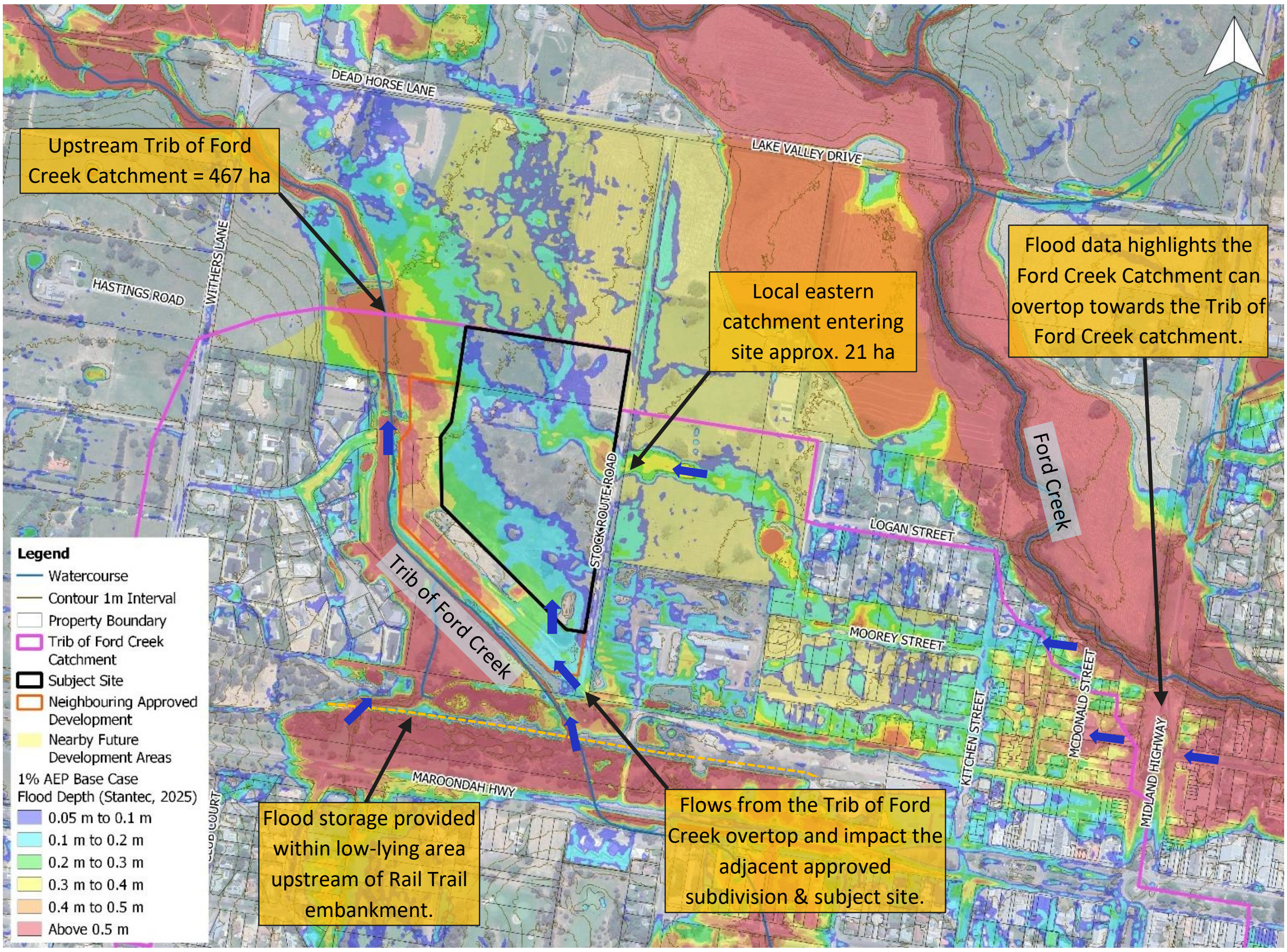


FIGURE 3.1: SITE & OVERALL CATCHMENT CONTEXT

4. HYDROLOGICAL MODELLING

4.1 Purpose

The proposed development will increase the imperviousness and accelerate the conveyance of flows through the subject site. Hydrological modelling was undertaken to assess changes to peak 1% AEP and 20% AEP event flows and to determine the required onsite detention volume by simulating the following scenarios for the year 2030 (defined as the base climate scenario):

- **Existing Conditions:** represents current catchment conditions (based on the 2023 Google Satellite Image). These results were adopted as the reference case to set the developed conditions peak flow targets.
- **Developed 'Do-nothing' Conditions:** represents the subject site with increased imperviousness and faster flow conveyance assuming no onsite detention asset is provided.
- **Developed Conditions with Onsite Detention:** represents the subject site with increased imperviousness and faster flow conveyance but includes an onsite detention asset to mitigate increases to downstream peak flows.

In addition, a year 2100 scenario was assessed for the 1% AEP event to understand the potential impacts of climate change based on SSP3-7.0 rainfall intensity increases (as well as predicted changes to hydrological losses). This assessment was undertaken as a sensitivity test only and did not inform the sizing of the onsite detention assets.

4.2 Approach

Engeny has undertaken hydrological modelling using RORB and in accordance with the latest ARR Version 4.2 guidelines. Details of the modelling inputs and parameters are provided within **Appendix B** with the following providing a summary of the approach.

The RORB models were created for the Trib of Ford Creek catchment only (total area of 4.67 km^2) and excluded consideration of the larger Ford Creek catchment (total area of 85.7 km^2). While Council's flood data indicated flows from the Ford Creek catchment would contribute to flows entering the subject site and Trib of Ford Creek, its exclusion was justified as the Ford Creek catchment is significantly larger and would have an extended time to peak in contrast to the local Trib of Ford Creek catchment. The magnitude of 1% AEP flow entering the subject site was considered using the Stantec provided peak inflow (from the Council flood study) and compared to the RORB model's peak flow generated from the local eastern catchment. Further discussion of this flow comparison is provided within **Section B.8 of Appendix B .**

- Catchment delineation was based on topography data, property boundaries and Stantec's 1% AEP flood depth grid displaying the overland flow paths.
- RORB Type 1 reaches (Natural) were generally applied to flow paths within undeveloped areas and RORB Type 2 reaches (Excavated and Unlined) were applied to flow paths within developed areas. An exception was made for reaches within undeveloped areas which contained a longitudinal slope greater than 2% as these were also assigned as Type 2 reaches to better represent the faster movement of flows due to the steep grades.
- The existing conditions RORB model fraction imperviousness values are based on a parcel's plan zone, lot size and 2023 aerial imagery. In developed conditions the fraction impervious value for the subarea containing the subject site (Subarea D) was updated to reflect the proposed development masterplan layout and the imperviousness shown within the architectural plans.
- Rainfall Intensity-Frequency Duration (IFD) data was obtained from the Bureau of Meteorology. The IFD data provides 2016 design rainfall intensities, which Engeny has increased for existing climate conditions using the factors provided for the year 2030 based on the SSP3-7.0 scenario.
- The 75$_{th}$ percentile pre-burst depths for each duration and storm event were obtained from the ARR Data Hub relevant to the catchment's centroid being located within loss region 3.
- Rural storm losses were obtained from the ARR Data Hub for the catchment's centroid and were factored and applied in line with the ARR Version 4.2 Guidelines for the year 2030 (base case climate scenario) and 2100 (SSP3-7.0 climate change scenario).
- Validation of the existing conditions RORB flows was undertaken to select an appropriate Kc routing parameter. The Kc value (2.71) derived from the Pearse equation was selected as it resulted in a 1% AEP flow similar to the Stantec provided peak flow. This is discussed further within **Section B.8 of Appendix B.**

Figure 4.1 displays the existing conditions RORB model with the key flow reporting locations labelled. The developed conditions RORB model has the same layout with the exception of an increased imperviousness applied to the subject site (subarea D) and the reaches within the subject site (AA2-D1, D1-D2 and D-D2) modified to Type 2 reaches to appropriately represent the proposed development and road network. The developed conditions RORB model focused on assessing the onsite detention requirement by including a Special Storage downstream of reach D-D2. The RORB model has assumed that the local eastern catchment would bypass the onsite detention asset and discharge directly into the Trib of Ford Creek.

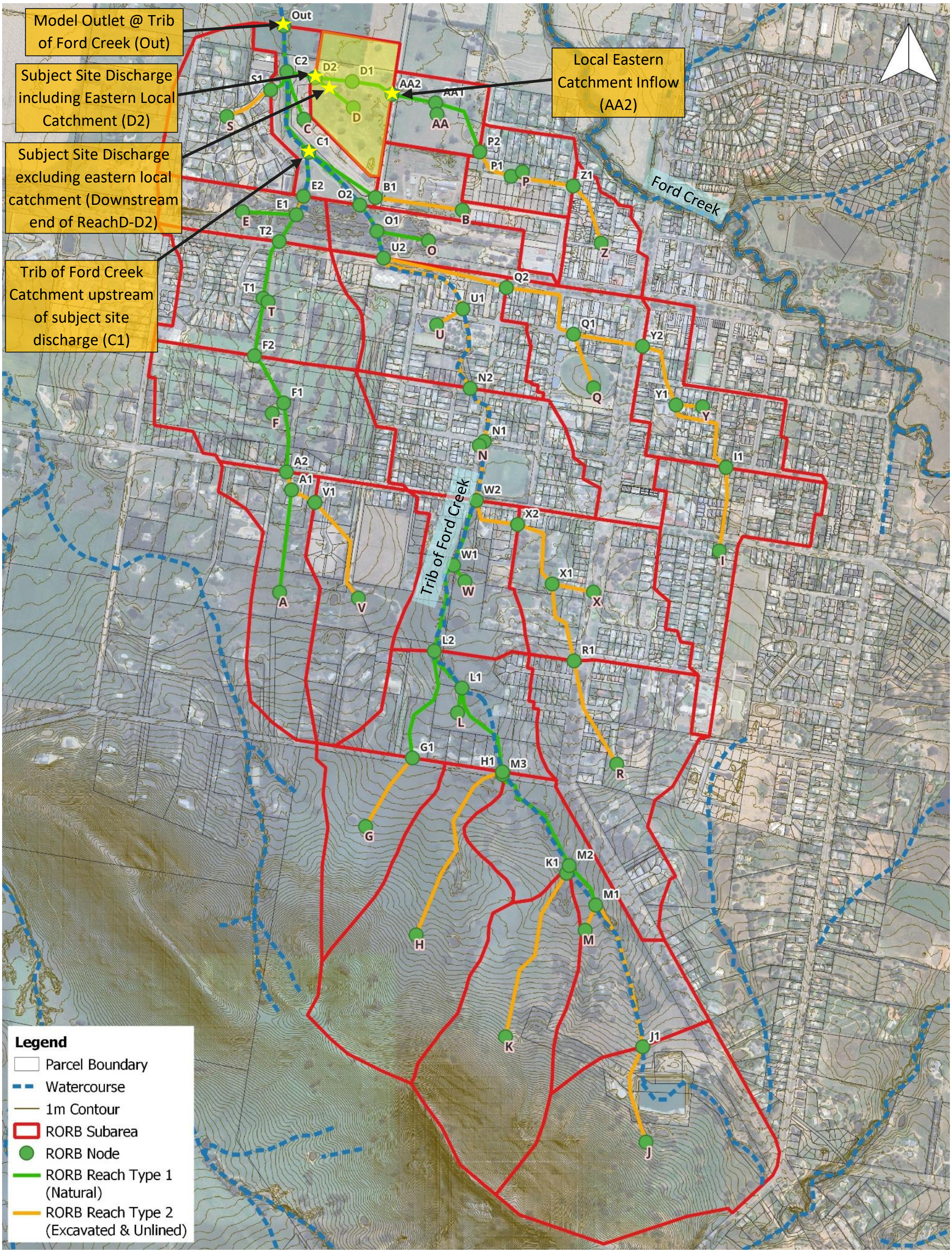


FIGURE 4.1: EXISTING CONDITIONS RORB MODEL LAYOUT

4.3 Existing Conditions Results

Table 4.1 provides a summary of the existing conditions 1% and 20% AEP peak outflows at key locations annotated within Figure 4.1. The subject site's 1% AEP outflow (generated by Subarea D and extracted from the downstream end of Reach D-D2) of 0.91 m^3/s is comparable to the site's rural Rational Method flow estimate of 0.85 m^3/s. This was achieved by increasing the RORB model's D-D2 reach length to account for the storage provided within the subject site and the resultant attenuation of overland flows. The increased reach length was only applied to the existing conditions model and was not sufficient to change the overall RORB model's distance average (d_{av}) and as such the K_c value of 2.71 discussed within **Section B.8** was retained.

These flows established the base / reference case when comparing the developed conditions do nothing and onsite detention scenarios.

TABLE 4.1: EXISTING CONDITIONS SSP3-7.0 2030 PEAK FLOWS FOR 1% AND 20% AEP STORM EVENT

Storm Event	Location	Peak Flow m^3/s	Critical Duration	Temporal Pattern
1% AEP	Subject Development Outflow to the Trib of Ford Creek excluding the eastern local catchment (Downstream end of Reach D-D2)	0.91	1 hour	tp26
	Subject Development Outflow to the Trib of Ford Creek including eastern local catchment (D2)	3.39	45 min	tp21
	Model Outlet at Trib of Ford Creek (OUT)	34.01	1 hr	tp22
20% AEP	Subject Development Outflow to the Trib of Ford Creek excluding the eastern local catchment (Downstream end of Reach D-D2)	0.50	1 hour	tp8
	Subject Development Outflow to the Trib of Ford Creek including eastern local catchment (D2)	2.12	45 min	tp8
	Model Outlet at Trib of Ford Creek (OUT)	20.96	1 hr	tp7

4.4 Developed Conditions Do Nothing Results

Table 4.2 summarises the 1% and 20% AEP peak outflows for the Developed 'Do Nothing' scenario at key locations (as reported above and shown on Figure 4.1). As expected, development of the subject site results in higher outflows compared to Existing conditions (shaded in red in Table 4.2). This occurs both for flows excluding and including the eastern external catchment (measured at the downstream end of Reach D-D2 and at Node D2 respectively).

TABLE 4.2: DEVELOPED CONDITIONS SSP3-7.0 2030 PEAK FLOWS FOR 1% AND 20% AEP STORM EVENT

Storm Event	Location	Peak Flow m^3/s	Critical Duration	Temporal Pattern
1% AEP	Subject Development Outflow to the Trib of Ford Creek excluding the eastern local catchment (Downstream end of Reach D-D2)	3.62	15 min	tp21
	Subject Development Outflow to the Trib of Ford Creek including eastern local catchment (D2)	4.10	45 min	tp22
	Model Outlet at Trib of Ford Creek (OUT)	33.39	1 hour	tp22
20% AEP	Subject Development Outflow to the Trib of Ford Creek excluding the eastern local catchment (Downstream end of Reach D-D2)	2.22	10 min	tp6
	Subject Development Outflow to the Trib of Ford Creek including eastern local catchment (D2)	2.59	45 min	tp6
	Model Outlet at Trib of Ford Creek (OUT)	20.75	1 hour	tp8

At the model outlet on the receiving Trib of Ford Creek (OUT), the hydrologic modelling shows a minor reduction in peak flows for both the 1% and 20% AEP events when compared to existing conditions (shaded in green in Table 4.2). This reduction is due to the loss of attenuation and storage within the developed subject site which results in faster conveyance of flows from both the site and the eastern catchment.

The timing of peak flow from the subject stie and eastern external catchment occurs marginally earlier than under existing conditions at the Trib of Ford Creek outlet. Figure 4.2 displays this change in time of concentration between the existing and developed 'do nothing' scenarios for the 1% AEP event (1-hour critical duration).

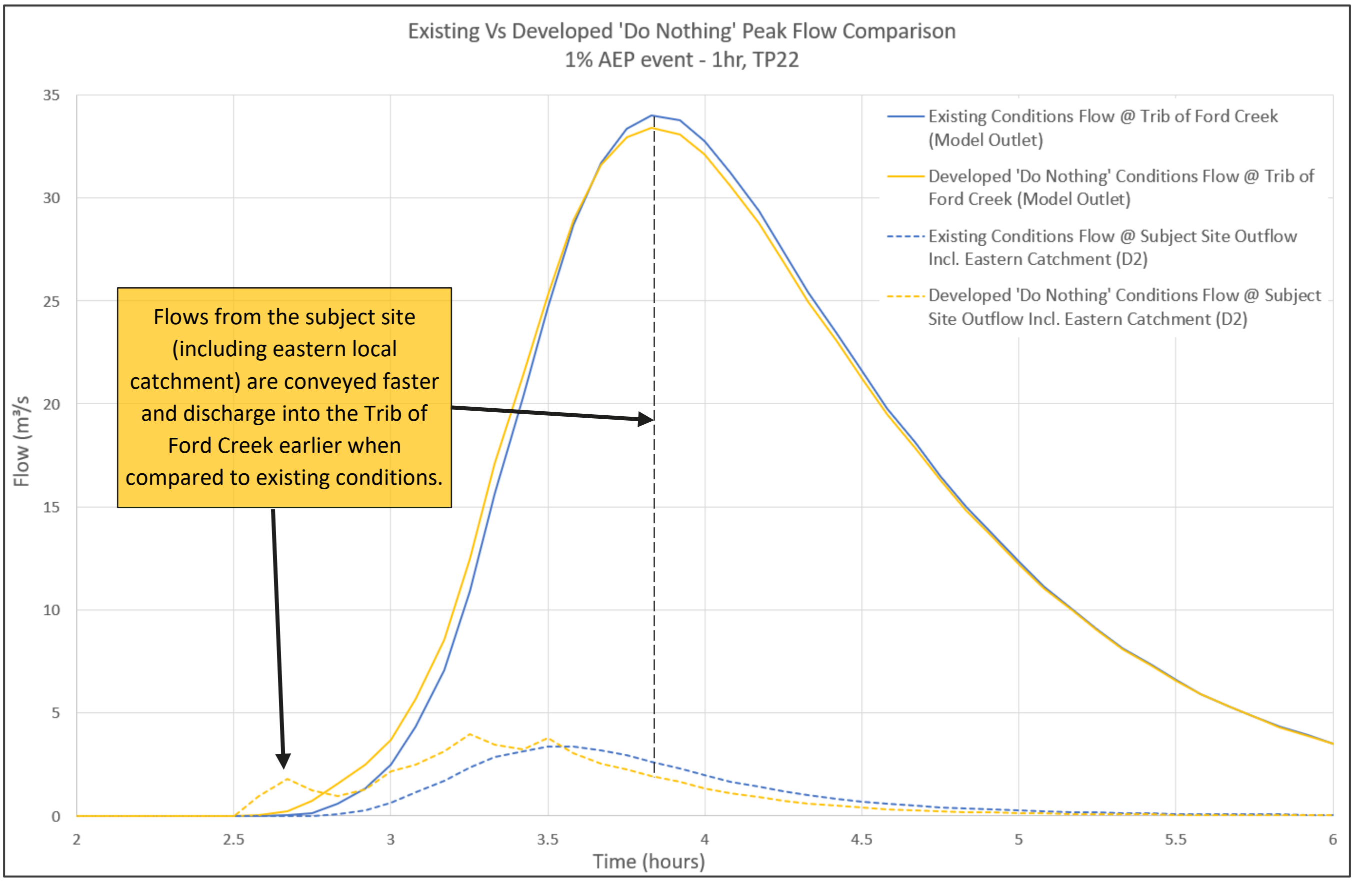


FIGURE 4.2: COMPARISON OF 1% AEP 1HR EXISTING VS DEVELOPED 'DO NOTHING' FLOWS

4.5 Developed Conditions with On-Site Detention Results

Table 4.3 summarises the 1% and 20% AEP peak outflows for the Developed with onsite detention scenario at key locations (as reported above and shown on Figure 4.1). Iterative modelling was undertaken in RORB to size the on-site detention asset with the objective of attenuating flows from the subject site to ensure flows across the 3 reported locations are less than existing conditions (shaded in green) or almost the same (shaded in orange).

The onsite detention basin included within the final revision of the model was based on the following concept-level assumptions:

- Base area = 1,670 m^2
- RB outfall = 400 mm dia pipe at 0.5% slope (or equivalent)
- Onsite detention 1% AEP storage height (excluding freeboard allowance and allowing for 1 in 5 batters) = 1.47 m
- Onsite Detention area at peak 1% AEP flood height = 3,315 m^2
- 1% AEP Onsite detention volume = 3,580 m^3

This volume was shared with Millar Merrigan and used to inform the revised Masterplan attached as **Appendix A**. Due to the proposed development's road layout, an area of 2,516 m^2 has been assigned for the onsite detention asset. Engeny understands that as part of the preliminary civil drainage design, Millar Merrigan confirmed the required onsite detention volume could be achieved within the designated footprint by assigning a greater area for the asset's base with steeper retaining wall batters. This alternative asset design will be defined as part of future design stages where an allowance for freeboard will also be accommodated in addition to confirming the revised asset's outfall arrangement to achieve the same or similar peak flows shown within Table 4.3.

TABLE 4.3: DEVELOPED CONDITIONS SSP3-7.0 2030 PEAK FLOWS FOR 1% AND 20% AEP STORM EVENT

Storm Event	Location	Peak Flow m^3/s	Critical Duration	Temporal Pattern
1% AEP	Subject Development Outflow to the Trib of Ford Creek excluding the eastern local catchment (Downstream end of Reach D-D2)	0.33	1.5 hour	tp23
	Subject Development Outflow to the Trib of Ford Creek including eastern local catchment (D2)	3.35	45 min	tp21
	Model Outlet at Trib of Ford Creek (OUT)	33.60	1 hour	tp22
20% AEP	Subject Development Outflow to the Trib of Ford Creek excluding the eastern local catchment (Downstream end of Reach D-D2)	0.28	1 hour	tp9
	Subject Development Outflow to the Trib of Ford Creek including eastern local catchment (D2)	2.18	45 min	tp8
	Model Outlet at Trib of Ford Creek (OUT)	20.79	1 hour	tp7

4.6 Climate Change Sensitivity Assessment

Table 4.4 summarises the 1% AEP results for the 2100 climate change (SSP3-7.0) sensitivity scenario under both existing conditions and developed conditions with onsite detention. Peak flows are predicted to increase by approximately 65-85% compared to the 2030 base climate results presented above. The exception is the subject site's developed conditions outflow, where the increase is substantially greater than the 2030 base climate outflow (0.33 m^3/s). This reflects the higher inflow volumes, which results in overtopping of the asset's designated spillway, reducing the attenuation provided by the onsite storage. While this leads to higher outflows at the subject site and at D2 (with the inclusion of eastern catchment inflows), a marginal reduction is observed at the Trib of Ford Creek (model outlet). This reduction occurs because flows from the subject site and eastern catchment discharge prior to the larger Trib of Ford Creek catchment's peak flow and marginally earlier than the existing condition peak flow.

TABLE 4.4: COMPARISON OF 1% AEP 2100 CLIMATE CHANGE PEAK FLOWS FOR EXISTING AND DEVELOPED CONDITIONS

Location	Existing Conditions (2100)			Developed Conditions with Onsite Detention (2100)		
	Peak Flow m^3/s	Critical Duration	Temporal Pattern	Peak Flow m^3/s	Critical Duration	Temporal Pattern
Subject Development Outflow to the Trib of Ford Creek excluding the eastern local catchment (Downstream end of Reach D-D2)	1.55	45 min	tp24	2.00	1 hour	tp26
Subject Development Outflow to the Trib of Ford Creek including eastern local catchment (D2)	5.58	45 min	tp21	6.22	45 min	tp27
Model Outlet at Trib of Ford Creek (OUT)	56.14	45 min	tp21	55.42	1 hour	tp22

5. EXTERNAL EASTERN CATCHMENT

A high-level assessment was undertaken to determine how the subject site could manage the conveyance of flows from the external eastern catchment adjacent to the proposed community centre within the subject site. The peak 1% AEP flow provided by Stantec was adopted as it considers both the local eastern catchment and the flows which overtop from Ford Creek. However, as noted within **Appendix B.8**, the local eastern catchment included within the RORB model also results in similar flows.

Figure 5.1 displays an overland flow path alignment which could be considered as part of future design stages. Preliminary spreadsheet calculations based on the assumptions annotated within the figure suggest the eastern catchment's 1% AEP peak flow (entering the subject site adjacent to the future community centre) can be safely conveyed within the development's road reserves. Future design stages will include terrain modelling to confirm the road reserves longitudinal grades and the interface with required lot fill levels in addition to the works required within the reserve between the subject site and Trib of Ford Creek. Future design stages will also ensure the following DELWP guideline (2019) thresholds are achieved along the overland flow path:

- 1% AEP flood depth less than 0.3 m
- 1% AEP flood velocity less than 2 m/s
- 1% AEP flood hazard (velocity x depth) less than 0.3 m^2/s

The flood mapping data also identifies overland flows entering the site's south-eastern corner. These flows originate from the local eastern catchment and overtopping flows from Ford Creek and the Trib of Ford Creek. With the need to fill these lots above the 1% AEP flood level, it has been assumed that these flows will be diverted towards the Trib of Ford Creek. Future stages need to ensure the introduced fill and subsequent re-direction of overland flows does not cause an adverse impact on adjacent properties (discussed further within Section 6).

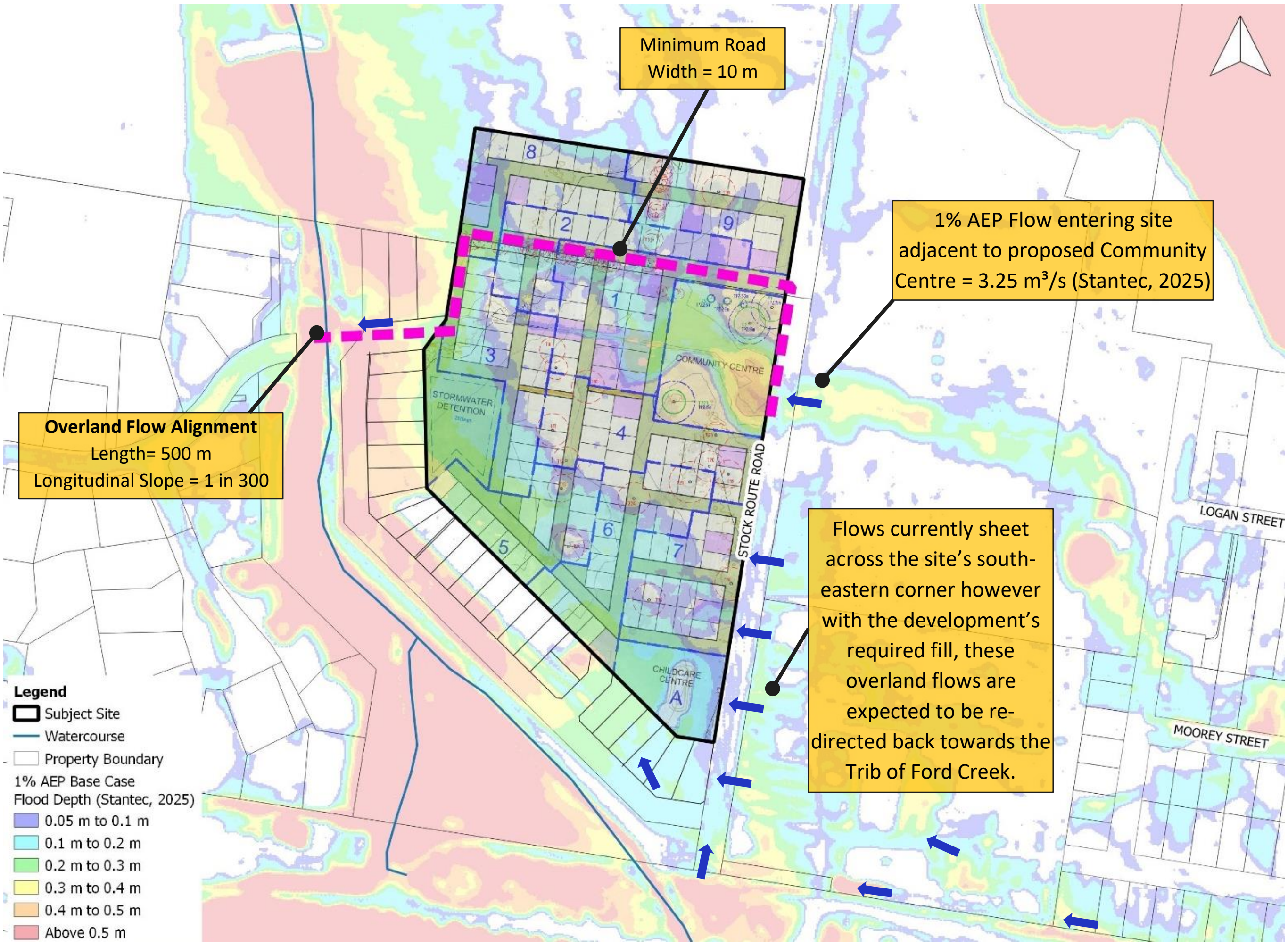


FIGURE 5.1: CONVEYANCE OF EASTERN CATCHMENT FLOW

6. FLOODPLAIN STORAGE

The subject site provides floodplain storage for the Trib of Ford Creek. Based on the Council provided flood depth grids, the following storage volumes were estimated within the subject site:

- 1% AEP base case flood storage: 9,505 m^3
- 1% AEP climate change flood storage: 8,016 m^3

The RORB modelling (refer Section 4) assessed changes in peak flow associated with the development's increased imperviousness and reduced attenuation of flows from both the site and eastern catchment. However, the RORB model is not suited to assessing the impacts of reduced floodplain storage on the Trib of Ford Creek or the adverse impacts on adjacent or downstream properties. These assessments require hydraulic TUFLOW modelling which was not part of Engeny's scope.

Flooding is impacting several nearby future development areas, and Engeny understands that Council, in collaboration with Stantec, are progressing with a catchment-wide flood mitigation study using their existing hydraulic TUFLOW model. Given the complexity of flooding in this area and its interaction with other future developments, Engeny recommends that Council engage with the CMA to develop a catchment-wide strategy to improve flood conditions. Potential works could be jointly funded by local developers and may include increasing the conveyance capacity and storage of the Trib of Ford Creek while managing downstream impacts. The flood modelling should assume future development areas are filled above the relevant peak flood levels, allowing impacts on existing properties to be quantified and feasible mitigation measures identified to offset these impacts.

7. CONCLUSION & NEXT STEPS

Engeny has completed a SWMS for the proposed development at 57 Stock Route Road and part of 104 Dead Horse Lane. The assessment included hydrological modelling (RORB) to estimate changes in peak flows, sizing of an onsite detention asset and a concept-level review of the external catchment's conveyance through the development. The SWMS also identified the potential loss of floodplain storage and the need for catchment-wide flood mitigation assessment. Hydraulic flood modelling was not undertaken as part of this SWMS, however Engeny understands that Stantec, Council and the CMA are progressing a catchment-wide flood mitigation study. Stormwater quality modelling was also not included as it will be documented separately by Millar Merrigan.

The following summarises the key outcomes of the SWMS:

(1) The proposed development will increase imperviousness and convey flows faster towards the Trib of Ford Creek. Hydrological modelling of the developed 'do nothing' 2030 scenario predicts an increase to 1% and 20% AEP peak flows discharging from the site. Due to the timing of flows, this scenario is predicted to result in a reduction of flows at the Trib of Ford Creek.

(2) The developed conditions scenario with an onsite detention asset (volume of approximately 3,580 m^3) mitigates increases to 1% and 20% AEP peak flows discharging from the subject site and at the Trib of Ford Creek to peak flows below or comparable with existing conditions.

(3) Climate change sensitivity testing (2100 SSP3-7.0) shows significantly higher peak flows (65–85% increases) compared with the base case climate scenarios. The discharge from the subject site is increased further due to high flows overtopping the onsite detention asset's spillway. However, similar to the developed 'do nothing' scenario, the timing of flows results in the 1% AEP peak flow at the Trib of Ford Creek being lower than the existing 2100 conditions peak flow.

(4) Based on the concept-level assessment, the external eastern catchment's peak 1% AEP flow can be safely conveyed through the subject development via the proposed road reserves. Future design stages will need to confirm the longitudinal grade, typical road profile and interface with surrounding lots as well as ensuring compliance with the DELWP flood hazard thresholds.

(5) Filling the proposed development above the 1% AEP flood level will result in a loss of floodplain storage within the Trib of Ford Creek. Quantifying this impact would require hydraulic TUFLOW modelling. Local developer contributions towards coordinated catchment-wide mitigation measures (e.g. increased conveyance or storage in the Ford Creek tributary) are likely to provide a more effective solution than a fragmented site-by-site approach.

Based on the findings of the SWMS, Engeny recommends:

(1) Council continues engaging with the CMA to develop a catchment-wide flood mitigation approach for the future development areas including:

    (a) Council to explore funding mechanisms for developer contributions towards catchment-wide flood mitigation works.

    (b) Council to work with Stantec, to quantify the impacts of introducing fill within future development areas and the lost floodplain storage using the existing hydraulic TUFLOW model.

    (c) Council to work with Stantec, to identify feasible mitigation works and quantify the benefits in reducing impacts to existing already developed properties adjacent to the waterway.

(2) Depending on the outcomes and direction provided by Council following the above engagement with CMA, the developer progresses with the site's future design stages including:

    (a) Confirm onsite detention asset design (area, base levels, outfall arrangement, freeboard allowance).

    (b) Define external catchment conveyance approach including undertaking terrain modelling of the proposed development to confirm the road's typical profile and longitudinal grade and ensure compliance with DELWP flood hazard thresholds.

    (c) Integrate the stormwater quality treatment asset which meets the BPEMG targets with the onsite detention asset if possible.

    (d) Ensure future lot fill levels are set above the 1% AEP flood levels, with consideration of the findings from Council's catchment-wide flood mitigation study.

8. QUALIFICATIONS

(a) In preparing this document, including all relevant calculation and modelling, Engeny Australia Pty Ltd (Engeny) has exercised the degree of skill, care and diligence normally exercised by members of the engineering profession and has acted in accordance with accepted practices of engineering principles.

(b) Engeny has used reasonable endeavours to inform itself of the parameters and requirements of the project and has taken reasonable steps to ensure that the works and document is as accurate and comprehensive as possible given the information upon which it has been based including information that may have been provided or obtained by any third party or external sources which has not been independently verified.

(c) Engeny reserves the right to review and amend any aspect of the works performed including any opinions and recommendations from the works included or referred to in the works if:

  (i) Additional sources of information not presently available (for whatever reason) are provided or become known to Engeny; or

  (ii) Engeny considers it prudent to revise any aspect of the works in light of any information which becomes known to it after the date of submission.

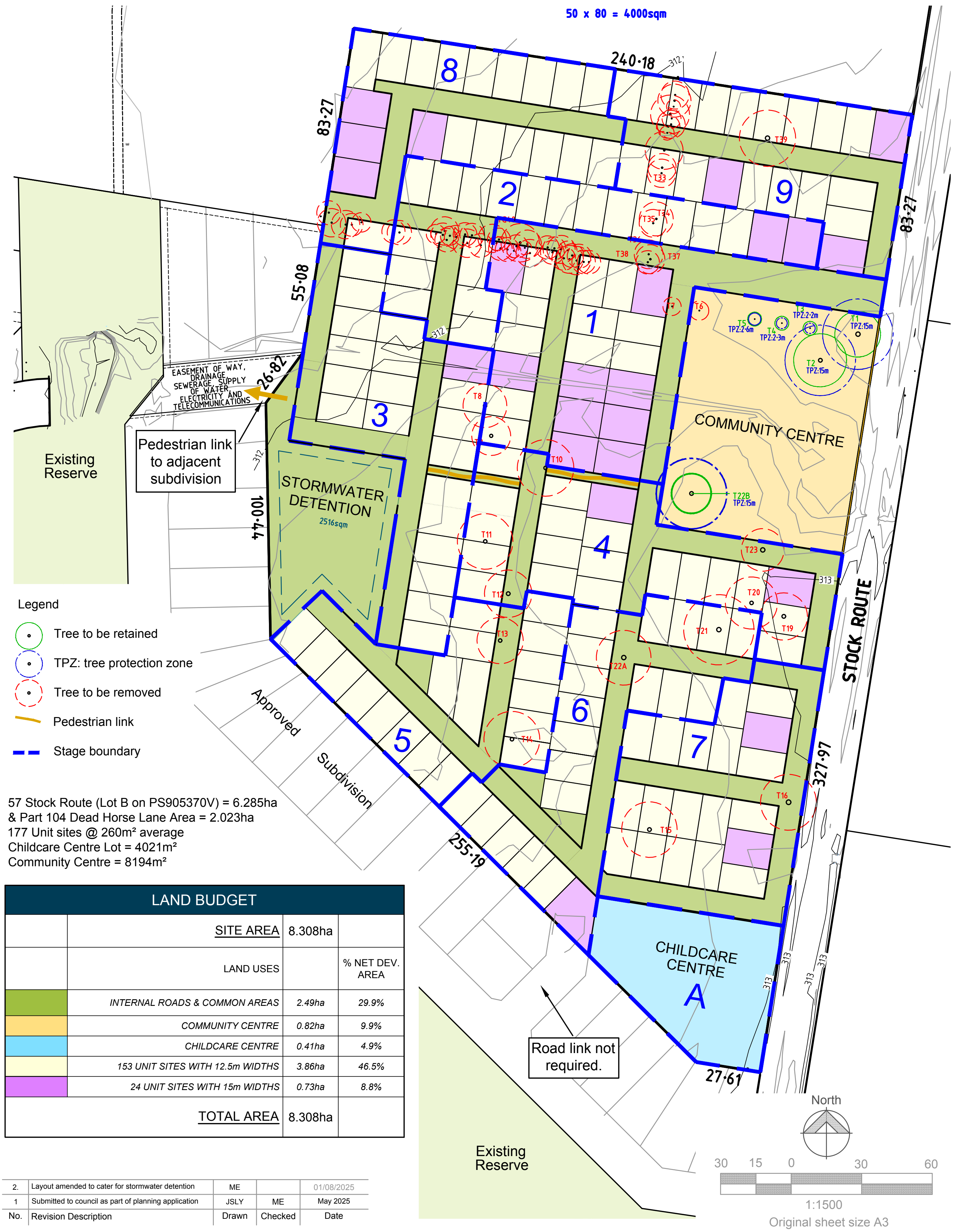
(d) Engeny does not give any warranty nor accept any liability in relation to the completeness or accuracy of the works, which may be inherently reliant upon the completeness and accuracy of the input data and the agreed scope of works. All limitations of liability shall apply for the benefit of the employees, agents and representatives of Engeny to the same extent that they apply for the benefit of Engeny.

(e) This document is for the use of the party to whom it is addressed and for no other persons. No responsibility is accepted to any third party for the whole or part of the contents of this Report.

(f) If any claim or demand is made by any person against Engeny on the basis of detriment sustained or alleged to have been sustained as a result of reliance upon the Report or information therein, Engeny will rely upon this provision as a defence to any such claim or demand.

(g) This Report does not provide legal advice.

APPENDIX A: DEVELOPMENT LAYOUT



Legend

- Tree to be retained
- TPZ: tree protection zone
- Tree to be removed
- Pedestrian link
- Stage boundary

57 Stock Route (Lot B on PS905370V) = 6.285ha
& Part 104 Dead Horse Lane Area = 2.023ha
177 Unit sites @ 260m² average
Childcare Centre Lot = 4021m²
Community Centre = 8194m²

LAND BUDGET			
	SITE AREA	8.308ha	
	LAND USES		% NET DEV. AREA
	INTERNAL ROADS & COMMON AREAS	*2.49ha*	*29.9%*
	COMMUNITY CENTRE	*0.82ha*	*9.9%*
	CHILDCARE CENTRE	*0.41ha*	*4.9%*
	153 UNIT SITES WITH 12.5m WIDTHS	*3.86ha*	*46.5%*
	24 UNIT SITES WITH 15m WIDTHS	*0.73ha*	*8.8%*
	TOTAL AREA	8.308ha	

No.	Revision Description	Drawn	Checked	Date
2.	Layout amended to cater for stormwater detention	ME		01/08/2025
1	Submitted to council as part of planning application	JSLY	ME	May 2025

FOR APPROVAL

Millar Merrigan
Land Development Consultants

Millar & Merrigan Pty Ltd | ACN 005 541 668
Croydon 2/126 Merrindale Drive, Croydon VIC 3136
Morwell 156 Commercial Road, Morwell VIC 3840
Yarrawonga 91 Belmore Street, Yarrawonga VIC 3730
mail@millarmerrigan.com.au | millarmerrigan.com.au
(03) 8720 9500 | SAI GLOBAL Quality ISO 9001

Civil Engineering
Land Surveying
Asset Recording
Landscape Architecture
Project Management
Town Planning
Building Design
Structural Engineering

MASTER PLAN

PROPOSED LIFESTYLE VILLAGE
57 Stock Route Road, Mansfield &
Part 104 Dead Horse Lane, Mansfield
Mansfield Shire Council
32495P3
Version 2
Sheet 1 of 1

APPENDIX B: RORB HYDROLOGICAL MODEL DETAILS

B.1 Fraction Impervious Values

The Effective Impervious Area (EIA) and Indirectly Connected Area (ICA) approach was adopted to proportion each subarea's imperviousness. This method is consistent with the ARR Version 4.2 Guidelines and enables for the appropriate application of losses discussed in Section B.6.

Each subarea's Total Imperviousness Area (TIA) fraction was estimated using an area-weighted average of parcels. Each parcel was assigned a fraction impervious value based on land use and for residential zones, lot size. These values were informed by industry recommendations and verified with spot checks of Google Satellite imagery for selected parcels.

Table B.1 presents the fraction impervious values applied to each land use and lot size.

TABLE B.1: FRACTION IMPERVIOUS VALUES APPLIED TO EXISTING LOTS

Plan Zone and Lot Size	Description / Lot Size	Fraction Impervious
General Residential	0 – 300 m^2	0.85
General Residential	300 – 600 m^2	0.75
General Residential	600 – 1200 m^2	0.6
General Residential	> 1200 m^2	0.1
Low Density Residential	< 4000 m^2	0.3
Low Density Residential	> 4000 m^2	0.2
Road Reserve	-	0.1
Open Space Area		0.05 – 0.1

The developed conditions RORB model involved an update of the subject site's fraction impervious value (represented by Subarea D). The update was informed by the provided Development's Masterplan (**Appendix A**) and the provided architectural plans for the clubhouse property and residential lots (250m^2 and 300m^2 lots). The fraction impervious value adopted for the childcare centre was assumed based on typical industry guidelines. Table B.2 summarises the fraction impervious values applied to the various lots within the subject site for developed conditions.

TABLE B.2: FRACTION IMPERVIOUS VALUES APPLIED TO PROPOSED DEVELOPMENT

Lot Type	Fraction Impervious
250 m^2 Residential Type A Lot (3 Bed 2 Bath Building)	0.68
300 m^2 Residential Type B Lot (3 Bed 3 Bath Building)	0.71
Clubhouse Property (Community Centre)	0.36
Childcare Centre	0.60

B.2 Intensity-Frequency-Duration (IFD) Data

The IFD data was sourced from the Bureau of Meteorology (BoM) using the online ARR 2016 Data Request Tool. The coordinates used for the tool were based on the geographic centroid of the catchment being modelled. As the IFD data was derived from historical rainfall records and global temperatures have risen since this period, ARR Version 4.2 recommends the application of scaling factors to the IFD design rainfall data to appropriately represent the present-day hydrology defined by the year 2030. A SSP3-7.0 climate projection has been adopted for both the base climate scenario (2030) and future climate change scenario (2100). The resultant IFD data (considering the climate change factors) are presented in Table B.3.

TABLE B.3: DEVELOPED SUBJECT SITE FRACTION IMPERVIOUS VALUES

Duration	20 % AEP (2030)	1% AEP (2030)	20% AEP (2100)	1% AEP (2100)
10 min	14.4	26.6	20.3	37.4
15 min	17.6	32.7	24.7	46.0
20 min	19.9	36.9	28.1	52.0
25 min	21.8	40.2	30.7	56.6
30 min	23.4	42.8	32.9	60.3
45 min	26.9	48.6	37.8	68.4
1 hour	29.6	52.7	41.7	74.2
1.5 hour	33.3	58.5	45.3	79.5
2 hour	36.2	62.9	48.4	84.0
3 hour	40.5	69.9	53.3	92.0
4.5 hour	45.9	79.4	58.9	101.9
6 hour	50.3	87.4	63.8	110.8
9 hour	58.0	102.4	72.0	127.0
12 hour	63.7	114.3	78.6	141.1

B.3 Areal Reduction Factor

The IFD data provided by the BoM is applicable for rainfall in small catchments. As catchment size increases the chance of that average intensity of rainfall occurring over the entire catchment decreases. To address this issue an Areal Reduction Factor (ARF) can be applied to the IFD data to account for the larger catchment area. ARR Version 4.2 provides procedures for the calculation of ARFs for catchments up to 30,000 square kilometres and durations up to and including 7 days.

While the total RORB catchment area is 4.67 km^2, the subject development and the local external eastern catchment has a combined area of less than 0.3 km^2. Given the focus is assessing the impacts of the subject development's discharge an ARF of 1 was considered appropriate.

B.4 Rainfall Temporal Patterns

An ensemble of ten temporal patterns, downloaded from the ARR Data Hub, was used for hydrological modelling. As the study catchment does not exceed 75 square kilometres, point temporal patterns were adopted in accordance with ARR Version 4.2 recommendations. The embedded bursts within temporal patterns, that have an AEP rarer than the burst as a whole, were removed using the built-in RORB filtering approach.

B.5 Spatial Variation

As this catchment does not exceed 20 square kilometres, a uniform spatial rainfall pattern was used in accordance with ARR Version 4.2 Guidelines.

B.6 Initial and Continuous Loss Values

The ARR Data hub extracted rural and continuing loss values for the catchment centroid coordinates. Engeny has applied the relevant climate change factors for the SSP3-7.0 climate projection scenario to the 2030 and 2100 years.

Table B.4 provides the resultant initial and continuing loss values considering the climate change factors for the year 2030 (base case climate scenario).

TABLE B.4: 2030 RORB MODEL INITIAL AND CONTINUOUS LOSS VALUES

RORB Surface Type	Initial Loss (mm)	Continuing Loss (mm/h)
Pervious / Rural Areas	27.04	4.64
Effective Impervious Areas	1.5	0
Indirectly Connected Impervious Areas	18.93	2.5

Table B.5 summarises the initial and continuing loss values applied for the 2100 climate change scenario.

TABLE B.5: 2100 RORB MODEL INITIAL AND CONTINUOUS LOSS VALUES

RORB Surface Type	Initial Loss (mm)	Continuing Loss (mm/h)
Pervious / Rural Areas	29.12	5.46
Effective Impervious Areas	1.5	0
Indirectly Connected Impervious Areas	20.38	2.5

B.7 Pre-burst Rainfall

The burst rainfall depths provided by the BoM are associated with rainfall bursts only. For this study, a complete storm approach has been modelled in RORB to account for pre-burst rainfall. This was done by prepending pre-burst rainfall depths obtained from the ARR Data Hub to the BoM IFD burst rainfall. Pre-burst rainfall temporal patterns estimated by Jordan et al. (2005) for pre-bursts less than 12 hours and Minty and Meighen (1999) for pre-bursts greater than 12 hours have been adopted.

The RORB model catchment falls within loss region 3, and as such the 75th percentile pre-burst rainfall depths provided by ARR Data Hub presented in Table B.6 have been adopted for this study. As the ARR Data Hub does not provide pre-burst depths for durations less than 60 minutes, these durations have adopted the 60-minute pre-burst depths in line with current industry recommendations.

TABLE B.6: 75TH PERCENTILE PRE-BURST RAINFALL DEPTHS

Duration	20 % AEP (2030)	1% AEP (2030)
10 min	19.3	10
15 min	19.3	10
20 min	19.3	10
25 min	19.3	10
30 min	19.3	10
45 min	19.3	10
1 hour	19.3	10
1.5 hour	16.7	12.6
2 hour	17.1	13.1
3 hour	17.9	17.7

ENGENY

Duration	20 % AEP (2030)	1% AEP (2030)
4.5 hour	17.9	17.7
6 hour	18.1	22.1
9 hour	18.1	22.1
12 hour	13.3	23.1

B.8 Routing Parameter & Model Validation

The RORB model routing parameter – Kc was selected by firstly identifying the applicable rural Kc equations suitable for the catchment. These included the RORB V6 Equation and the Pearse et al. equations shown within Table B.7. The existing conditions RORB model was then simulated with each of these Kc values to determine the resultant 1% AEP peak flow at key locations within the catchment.

TABLE B.7: APPLICABLE REGIONAL EQUATIONS FOR MODEL'S KC VALUE

Regional Equation	Application	Source	Resultant Kc Value
$Kc = 2.2 \times A^{0.5}$	General	RORB V6 User Manual Equation 2-5	4.75
$Kc = 1.25 \times d_{av}$	Victoria	Pearse et al. (2002)	2.71

The resultant flows from each of the above Kc values were compared against the peak flow data provided by Stantec. The Pearse equation with a Kc value of 2.71 produced the closest match to the Stantec peak flow at the Trib of Ford Creek, upstream of the subject site's discharge point.

A comparison was also undertaken for the eastern catchment inflow at location AA2. The results indicate that while the Engeny RORB model does not account for overtopping flows from the larger Ford Creek catchment, the modelled 1% AEP RORB peak flow is similar to the Stantec TUFLOW output. This suggests that overtopping flows from Ford Creek and into the site's north-eastern corner are expected to be of a similar magnitude to those generated from the local eastern catchment. The difference lies in timing, with overtopping peak flows from Ford Creek occurring under longer critical durations than those from the local eastern catchment. A summary of the peak flow comparisons is provided within Table B.7.

The comparable peak inflows at both the tributary of Ford Creek (C1) and the eastern catchment inflow (AA2) provide sufficient evidence to validate the Engeny RORB model. This validation confirmed the model is suitable for assessing the flows discharging from the subject site and for sizing the onsite detention asset.

TABLE B.8: RORB & STANTEC PEAK FLOW COMPARISON

Location	RORB 1% AEP Peak Flow	1% AEP Peak Flow from Stantec Flood Study
Trib of Ford Creek Upstream of Subject Site Discharge (RORB Node C1)	32.82 m^3/s	32.84 m^3/s (Stantec provided peak flow referenced as PO_E)
Eastern Catchment Inflow (RORB Node AA2)	3.12 m^3/s	3.25 m^3/s (Stantec provided peak flow referenced as PO_A)