NEW BEITH, FLAGSTONE CREEK FLOOD STUDY

VERSION 2

DesignFlow
Prepared for Frasers Property
September 2025

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Table of Contents

List of Tables

List of Figures

1 INTRODUCTION

New Beith is a greenfield development site located within the Flagstone Priority Development Area. The development will involve the creation of mostly residential landuse set amongst recreational and open space precincts. Flagstone Creek lies to the south of the development zone and will represent important feature within the development.

The approved *Stormwater Infrastructure Master Plan Context Area 2 – Lot 4 (New Beith) - Version 4.0* (14 February 2023) defines the stormwater/flood management principles and objectives for the New Beith development.

This report outlines the flood study and modelling prepared to support the Reconfiguring a Lot (RAL) development applications for all catchments within the New Beith development which drain to Flagstone Creek (i.e. southern half of the New Beith development). The report demonstrates how development in the southern catchments draining to Flagstone Creek will meet the flood management objectives defined in the *Stormwater IMP*.

The report focuses on flood management only and supersedes or builds upon the previous flood modelling discussed in the follow section.

1.1 PDA APPROVALS

1.2 PREVIOUS FLOOD STUDIES

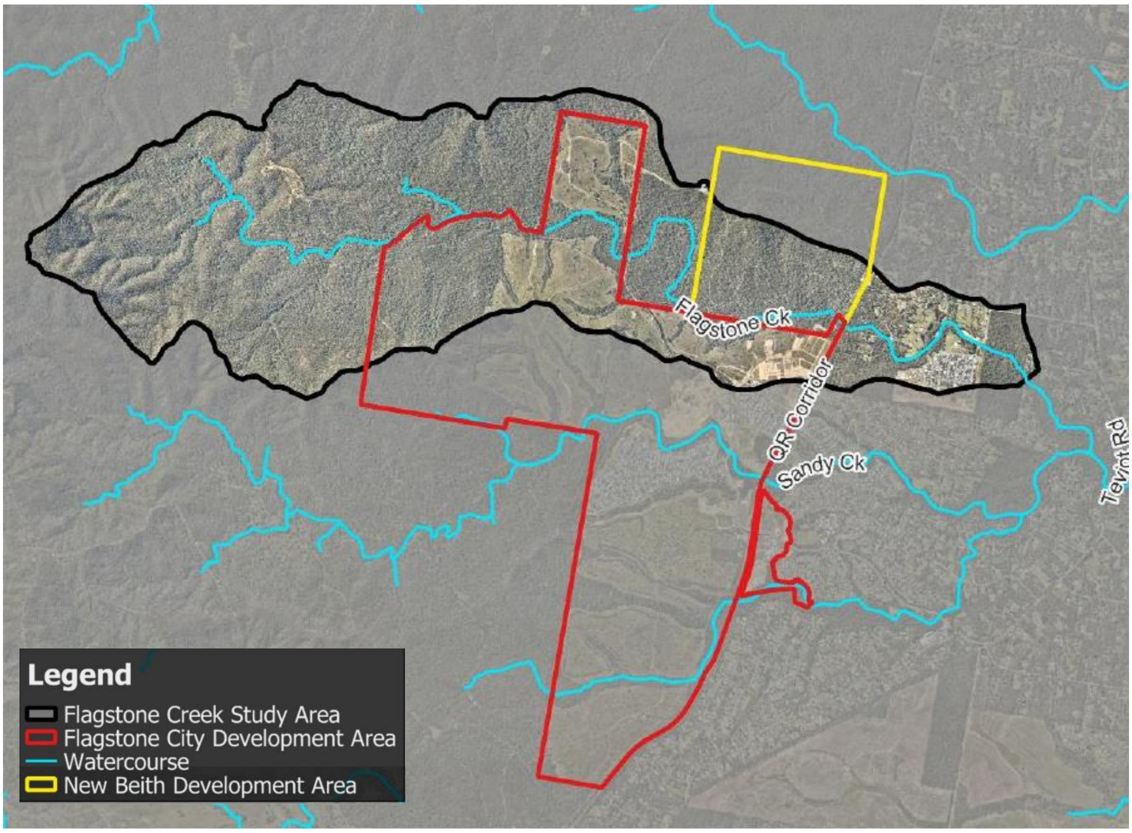
Previous flood studies or modelling includes the following:

- *Flagstone City Masterplan Flooding Assessment* (Cardno, September 2014) – Provides the masterplan flood modelling assessment for Flagstone development based on Australia Rainfall Runoff 1987. The findings for the basis of the food strategy for Flagstone Creek but have been updated as part of the New Beith flood modelling.
- *Flagstone Creek Baseline Flood Study – New Beith* (Engeny, 2023) – Provides an updated base case (undeveloped) modelling for Flagstone Creek based on ARR 2019. The model was created specifically to allow Frasers to complete flood modelling of the New Beith Development and design the flood management strategy. We understand the model is used by Peet and Engeny are part of the broader Flagstone masterplan delivering so Frasers we keen to adopt the same model to ensure consistency. DesignFlow have adopted this model and improved the detail of the model for the New Beith assessment. The report is provided in Appenidx E.

2 SITE CHARACTERISTICS

2.1 SITE LOCALITY

The proposed New Beith development is located on the north side of Flagstone Creek within the Flagstone PDA. The site is rural in nature with existing developments immediately to the east and south. Queensland Rail borders the site to the east. Figure 1 shows the location of the New Beith Development area in yellow with the.



(Source of figure: Engeny, 2023)

Figure 1 Site locality

2.2 TOPOGRAPHY AND DRAINAGE

The site is dominated by moderate to steep topography (typ. 4-12%) with ground elevations ranging from ~RL150 at the high point to ~RL35 at the south eastern corner of the site. The site is dominated by a ridge line running east-west that directs site runoff either northward or south to Flagstone creek. Minor tributaries also occur at the eastern side of the development, with discharges to the railway. Figure 2 shows the topography and drainage for the site.

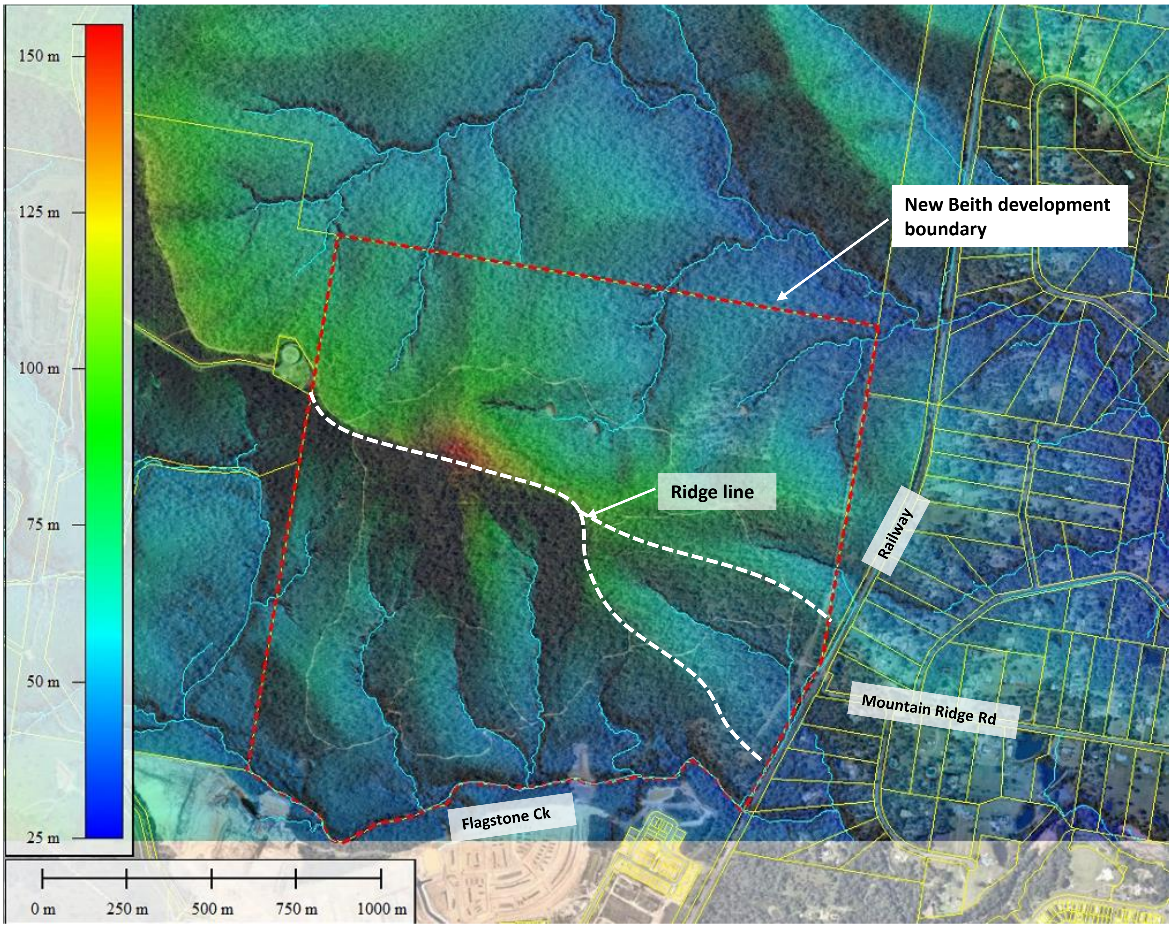


Figure 2 Topography and drainage – New Beith Development

2.3 PROPOSED DEVELOPMENT

The New Beith development site covers a total area of ~246ha. Figure 3 show the proposed structure plan. An approximate 80 ha of development drains south to Flagstone Creek (refer to Figure 6 later).

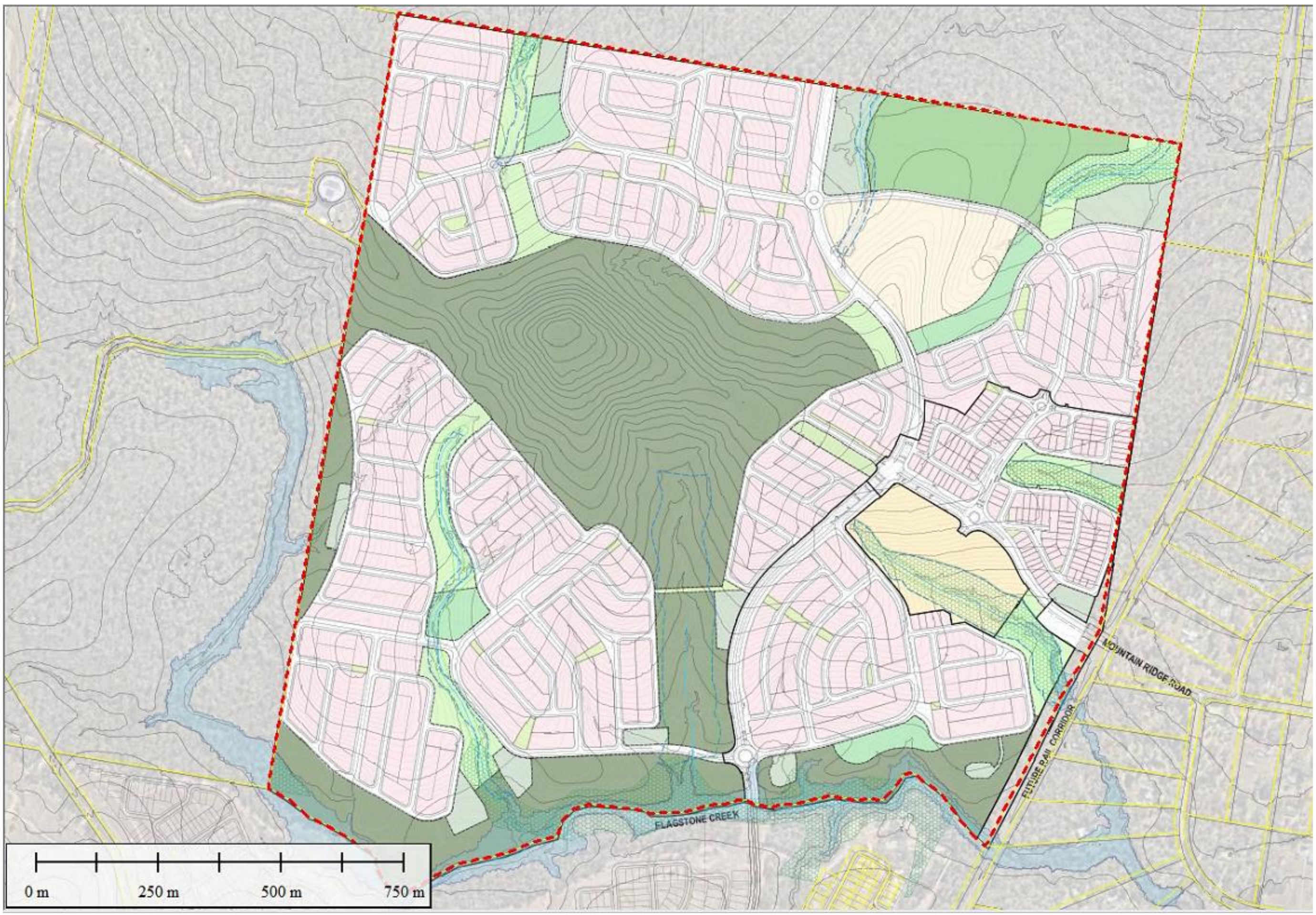


Figure 3 New Beith Preliminary Structure Plan (source: Urbis)

3 DESIGN OBJECTIVES

The approved *Stormwater Infrastructure Master Plan (SIMP) Context Area 2 – Lot 4 (New Beith) - Version 4.0* (14 February 2023) defines the stormwater/flood management principles and objectives for the New Beith development.

3.1 FLOODING

The flood management objectives adopted for New Beith are provided in Table 1. In addition, the performance outcome outlined in Table 2 are applicable to development in a railway environment.

Table 1 Flood management objectives

Criterion	Design Objective
Peak flows / levels	Mitigate flood impacts on people, property and infrastructure external to New Beith by ensuring no material worsening in peak site flows and flood levels upstream and downstream of the site to predevelopment conditions for all events from 50% to 1% AEP. This also includes discharge points to the Brisbane Sydney Railway.
Flood immunity	Maintain flood conveyance through the site while providing 1% AEP plus freeboard flood immune development.

Table 2 Stormwater performance outcomes for development in a railway environment (State Code 2, SDAP Version 3.0)

Performance Objective	Acceptable Outcome
Stormwater and overland flow	
PO12 Stormwater run-off or overland flow from the development site does not create or exacerbate a safety hazard in a railway corridor.	No acceptable outcome is prescribed.
PO13 Stormwater run-off or overland flow from the development site does not result in a material worsening of operating performance of the railway corridor, rail transport infrastructure or other rail infrastructure.	No acceptable outcome is prescribed.
PO14 Stormwater run-off or overland flow from the development site does not interfere with the structural integrity or physical condition of the railway corridor, rail transport infrastructure or other rail infrastructure.	No acceptable outcome is prescribed.
Flooding	
PO15 Development does not result in a material worsening of flooding impacts within a railway corridor.	No acceptable outcome is prescribed.
Drainage Infrastructure	
PO16 Drainage infrastructure does not create a safety hazard in a railway corridor.	**AO16.1** Drainage infrastructure is wholly contained within the development site. AND **AO16.2** Drainage infrastructure can be maintained without requiring access to a railway corridor.

3.1 WATERWAY STABILITY

The waterway stability objective is based on protecting waterways and drainage lines from erosion because of increase flow from urban development. This applies to waterways and drainage lines within the site as well as downstream receiving waterways beyond the development boundary.

Table 3 provides a summary of the waterway stability objectives applied, based on the requirements of the *State Planning Policy* (DLGIP, 2017).

Table 3: Waterway stability objectives

Waterway classification	Waterway Stability Criteria
Site waterway/gully reach in good condition (i.e. well vegetated and stable waterway)	Limit post development 1 year ARI flows (63% AEP) in waterway to pre-development conditions
Site waterway/gully reach in poor condition[1] (i.e. poorly vegetated or active erosion)	Where ecological assessment justifies the retention of the waterway/drainage line, either: Reconstruct/ rehabilitate waterway to convey the <u>post</u> development 1 year ARI flows without the risk of erosion[2]; or
External waterways	Limit 63% AEP (1 year ARI flows) at site boundary for critical duration event to pre-development conditions

Notes:

1. Ephemeral waterways which are poor condition may be assessed in further detail to identify if they should be retained and rehabilitated or removed and greater resources/efforts put into rehabilitation of adjacent/downstream waterway reaches. This shall be undertaken in accordance with the PDA Guideline no. 12 – Environmental values and sustainable resource use (EDQ, 2015).
2. The approach supports the rehabilitation of degraded waterways and allows local increases in 63% AEP (1 year ARI) provided the rehabilitation design provides an appropriately stable waterway for the increased 63% AEP (1 year ARI) flows. The maximum velocity in the waterway should not exceed the recommendations of QUDM and BCC Natural Channel Design recommendations. The rehabilitation is to be reviewed by a suitable qualified geomorphologist.

4 FLOOD MODELLING

The primary objective of the flood modelling is to demonstrate that the waterway stability and flood management objectives listed in Section 3 are achieved.

4.1 APPROACH

The flood modelling undertaken for this assessment utilises the 'baseline' models setup and presented in *Flagstone Creek Baseline Flood Study – New Beith* (Engeny, 2023). The Engeny baseline models were established to facilitate flood assessment for both the Peet and Frasers development areas within Flagstone Creek.

DesignFlow have undertaken model refinements to the Engeny baseline model to create fit for purpose models against which development can be appropriately assessed. However, the overall flood modelling methodology remains consistent with that of the Engeny baseline flood models. DesignFlow modelling tasks have included:

- Model refinements to a create fit for purpose Base Case TUFLOW model.
- Setup an ultimate development case incorporating development within Flagstone Creek catchment proposed by both Peet and Frasers.
- Setup a New Beith development only case.
- Refinement of the mitigation flood storages, particularly the Flagstone Creek crossing adjacent to New Beith to achieve flood objectives for both development scenarios.

Modelling for this assessment uses ARR2019 methodology with full ensembles modelled hydrodynamically in TUFLOW.

Unless stated otherwise in this report, all modelling assumptions and methodologies remain consistent with those presented in *Flagstone Creek Baseline Flood Study – New Beith* (Engeny, 2023).

4.2 HYDROLOGIC MODEL

Hydrologic modelling of the catchment has been carried out using WBNM software developed jointly by the University of Wollongong, Rienco Consulting and Balance R & D. WBNM is an event based hydrologic model which calculates flood hydrographs from storm rainfall hyetographs. It can be used for modelling natural, part urban and fully urban catchments. The WBNM model is version 2017 and it has been run using CSS Storm Injector (v1.3.8.0).

The base case WBNM model remains un-changed from that provided by Engeny for the baseline modelling.

Updates to landuse fraction impervious and catchment boundaries have been undertaken where necessary to reflect the two development scenarios described in this report.

4.2.1 XPSWMM Model

Detention sizing for the minor tributary of Flagstone Creek that discharges from the eastern boundary of the New Beith site at the railway has been completed using XPSWMM (Precinct A Bio 2 Flood Basin). This tributary is associated with base case sub-catchment F016. Details of the XPXWMM modelling are provided in *New Beith Precinct A Local Flood Management Plan* (DesignFlow, Sep 2024).

XPSWMM has been used for the local tributary assessment to account for details in the catchments (i.e. change in catchment slope and drainage as a result of earthworks) which can not be replicated in WBNM. For consistency with the detailed XPSWMM modelling of this local catchment, the XPSWMM flows have been input to the TUFLOW model for this tributary for base case and development cases.

4.2.2 Design Event Modelling Approach

The design event modelling approach remains generally consistent with that used in the Engeny (2023). Baseline modelling is described in the dot points below that have been extracted from the Engeny (2023) report.

- Storm initial loss of 24mm, as per ARR19 specifications, for all pervious surfaces.
- Storm continuing loss of 1.6mm/h, as per ARR19 specifications, for all pervious surfaces.
- Application of initial and continuing losses of 1mm and 0mm/h, respectively, for all impervious surfaces.
- Application of ARR19 rainfall depths sourced from the Bureau of Meteorology (BoM), as per ARR19 specifications.
- Application of ARR19 median pre-burst rainfall depths, as per ARR19 specifications, prior to main burst.
- Simulation of the full ensemble of ten (10) temporal patterns for the East Coast North region, as per ARR19 specifications.
- No application of Aerial Reduction Factors.
- WBNM default value of C = 1.6 was adopted.

Modelling has been carried out for the 1%, 2%, 5%, 10%, 20%, 50% and 63% AEP design events using ARR 2019 ensemble methodology. Climate change runs have also been completed for RCP8.5 and RCP 4.5 for the year 2090.

Modelling has been carried out for design bursts durations of 60, 90, 120, 180 and 360 minute events. The smaller, more frequent (63%, 50% and 20% AEPs) have also been run with a 720 minute duration as this longer event was found to be critical these smaller floods.

For each duration, an ensemble of 10 different temporal patterns has been simulated. Post processing of result grids has then been undertaken to create grids representing the ensemble median values for each duration. The median value result grids are then combined to create a maximum value grid enveloped across all durations. The enveloped grid is then used to set peak design event flood levels, depths, velocities etc.

Probable Maximum Precipitation (PMP) flood modelling has also been carried out based on the BoM guidelines for 'The Estimation of Probably Maximum Precipitation in Australia: Generalised Short Duration Method' (BoM,2003) for storm durations less than 6 hours. PMP modelling is also consistent with the Engeny Baseline Study.

4.2.2.1 Base Case

Base Case (existing land use) catchments remain unchanged from those provided by Engeny (2023) from the Baseline modelling. The exception to this is that some very minor changes to sub-catchments near the Precinct A Bio 2 Flood Basin have been adjusted to align with the detailed local XPSWMM modelling of this tributary. These minor adjustments affect catchment F016 and the sub-catchments immediately adjacent to it. Sub-catchment areas are presented in Figure 4 with catchment areas and impervious percentages provided in Table 4.

Another minor change to pre-burst rainfall has been applied to provide consistency with the XPSWMM modelling. The original WBNM modelling by Engeny applied pre-burst rainfall over 4 hyetograph timesteps. Modelling for this assessment applied pre-burst rainfall over 10 timesteps for consistency with the XPSWMM modelling.

Table 4: Base Case Catchments.

Catchment ID	Total area (ha)	Percent Impervious
F006	56.21	11.6%
F007	12.19	3.0%
F008	35.09	32.5%
F009	14.82	3.6%
F010	50.25	21.2%
F011	60.39	24.4%
F012	23.58	1.9%
F013	5.78	8.9%
F014	13.15	12.5%
F016	24.2	0.0%
F017	4.93	8.3%
F018	48.89	0.0%
F019	72.61	0.0%
F020	27.95	0.0%
F021	48.74	0.0%
F022	14.45	0.0%
F023	34.86	0.0%
F024	59.69	0.0%
F025	13.1	0.0%
F026	41.73	0.0%
F027A	26.3	1.0%
F027B	21.01	0.0%
F028	15.91	0.0%
F029	40.71	0.0%
F030A	35.86	0.0%
F030B	29.66	0.0%
F031	77.28	0.0%
F032	29.48	0.0%
F033	69.71	0.0%
F034	19.45	0.0%
F035	35.18	0.0%
F036	117.66	0.0%
F037	64.09	0.0%
F038	47.46	0.0%
F039	32.02	0.0%
F040	103.08	0.0%
F041	38.29	0.0%
F042	34.04	0.0%
F043	31.56	0.0%
F044	94.03	0.8%
F045	2.26	0.0%
F046	32.38	0.9%
F047	6.62	0.0%
F048	77.85	0.5%
F049	64.77	1.6%
Total	1809.27	2.8%

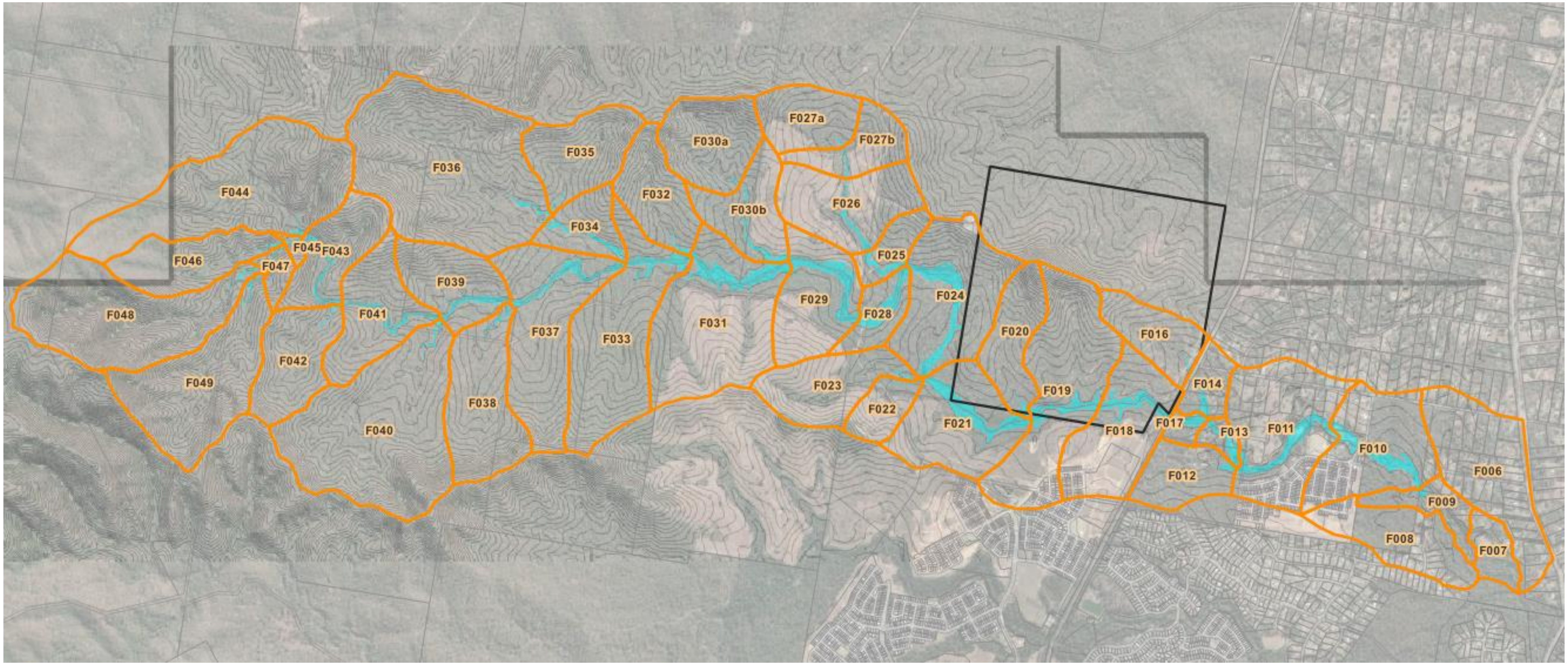


Figure 4 Base case catchments

4.2.2.2 Ultimate Development Case (New Beith Plus Flagstone Developments)

The Ultimate Case Hydrology remains generally un-changed from that of the Engeny Masterplan modelling (model reference: 'M01 Rev G') except for the following adjustments.

- New Beith development areas have been assigned a fraction impervious of 70% (up from 55% assumed for the Engeny Masterplan modelling).
- Adjustments to sub-catchment delineation of the minor eastern tributary to align with the XPSWMM modelling.
- Pre-burst rainfall applied over 10 hyetograph time steps instead of 4 (for consistency with XPSWMM).

The sub-catchment areas within the vicinity of the proposed development sites are presented in Figure 5 with catchment areas and impervious percentages provided in Table 5.

The Flagstone development areas have been assigned a percentage impervious of 55% which is consistent with the Engeny (2023) modelling.

Table 5: Ultimate Development Case Sub-Catchments

Catchment ID	Total area (ha)	Percent Impervious
F006	56.21	11.6%
F007	12.19	3.0%
F008	35.09	32.5%
F009	14.82	3.6%
F010	50.25	21.2%
F011	60.39	24.4%
F012	23.58	1.9%
F013	5.78	8.9%
F014	13.1	11.6%
F015	9.51	21.2%
F016	7.65	69.8%
F017	4.93	8.3%
F018	46.95	37.1%
F019a	16.61	57.8%
F019b	65.97	36.8%
F020	34.8	47.3%
F021	41.86	39.6%
F022	14.45	49.5%
F023	34.86	49.3%
F024	58.33	11.2%
F025	28.92	14.7%
F026	31.5	54.4%
F027a	26.3	13.7%
F027b	15.42	40.4%
F028	14.3	9.7%
F029	42.32	33.8%
F030a	35.86	0.0%
F030b	29.66	23.0%
F031	77.28	36.7%
F032	29.48	0.0%
F033	69.71	49.3%
F034	19.45	0.0%
F035	35.18	0.0%
F036	117.66	0.0%
F037	64.09	28.6%
F038	47.46	4.4%
F039	32.02	0.0%
F040	103.08	0.0%
F041	38.29	0.0%
F042	34.04	0.0%
F043	31.56	0.0%
F044	94.03	0.8%
F045	2.26	0.0%
F046	32.38	0.9%
F047	6.62	0.0%
F048	77.85	0.5%
F049	64.77	1.6%
Total	**1808.82**	**17.1%**

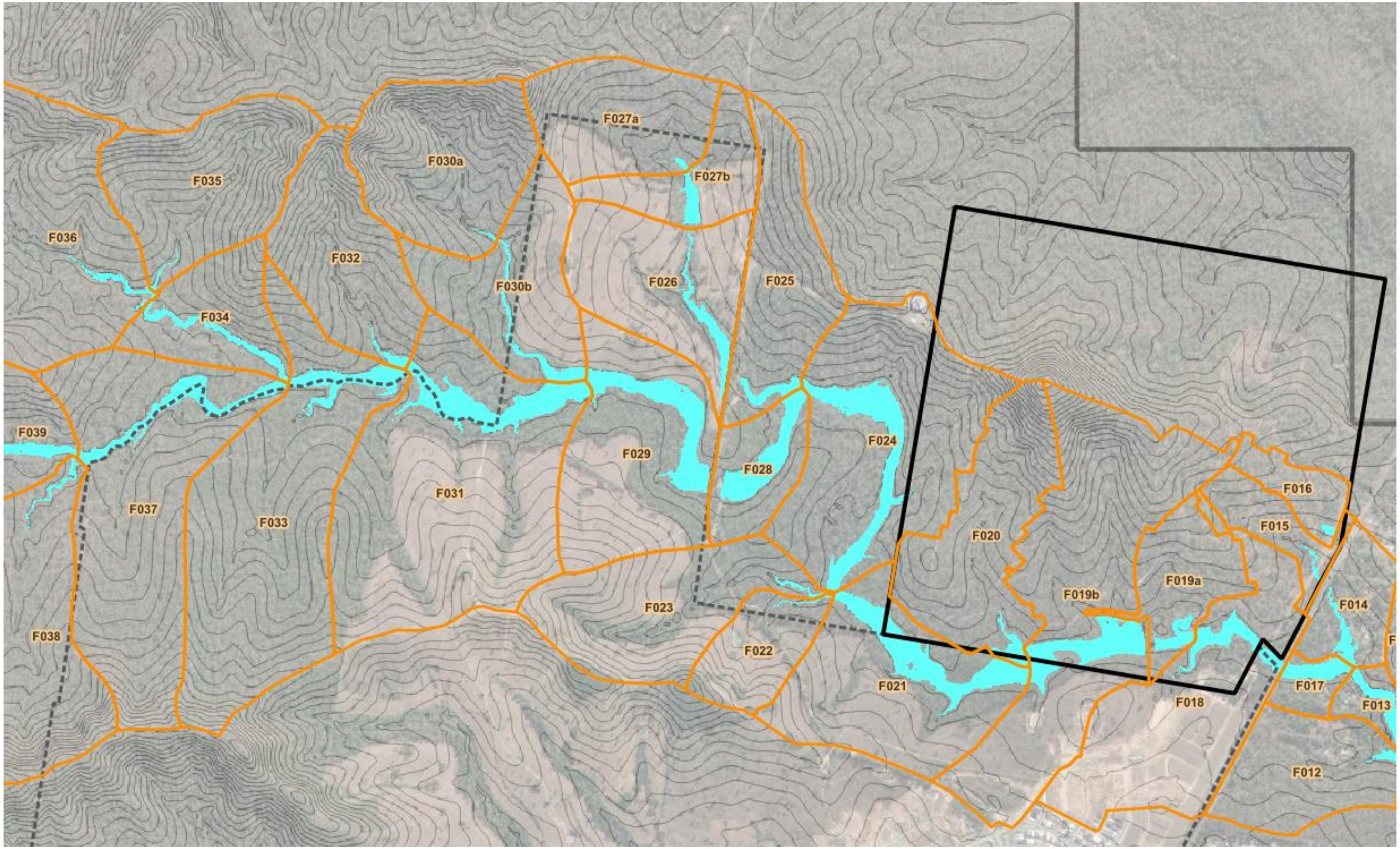


Figure 5 Ultimate development (Post development) catchments

4.2.2.3 New Beith Development Only Case

A WBNM model representing the landuse scenario in which New Beith Master Plan is developed without the broader Flagstone development was setup to reflect this New Beith only landuse scenario. This is a theoretical scenario carried out to assess the New Beith development in isolation of other external development areas.

The sub-catchments that have been updated for this scenario are shown on Figure 6. No other changes external to these sub-catchments have been applied to the WBNM model. Figure 6 also includes development areas (in yellow) which have been applied a Fraction Impervious value of 70%.

Sub-catchment areas and fraction impervious values for these updated sub-catchments are provided in Table 6.

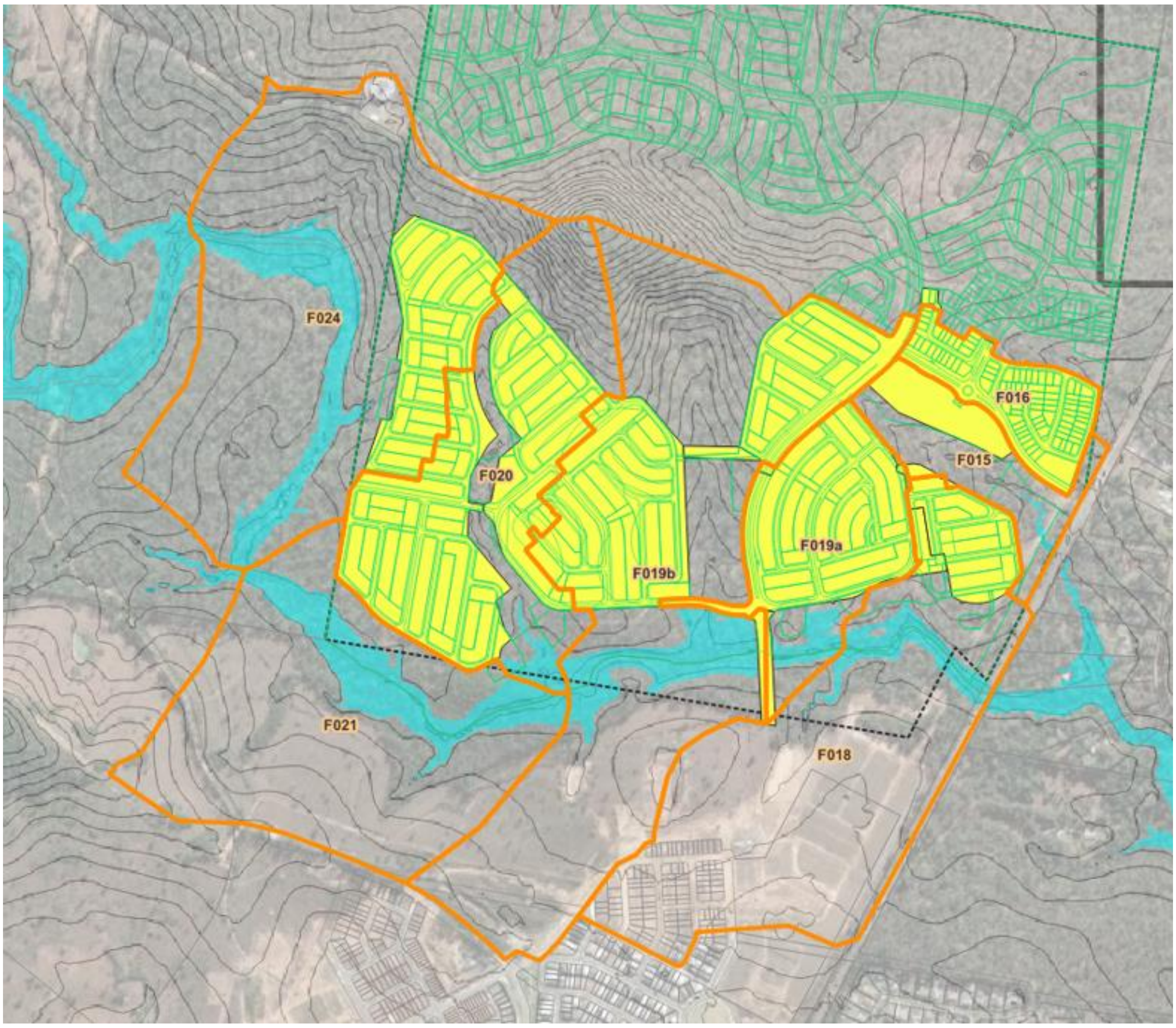


Figure 6 New Beith Development Only case WBNM catchment updates (developed areas in yellow)

Table 6: Sub-catchments Updated for the New-Beith Development Only Case

Catchment ID	Total area (ha)	Percent Impervious
F015	9.51	21.2%
F016	7.65	69.8%
F018	46.95	7.9%
F019a	16.61	57.8%
F019b	65.97	22.4%
F020	34.80	47.3%
F021	42.62	0.0%
F024	58.33	11.2%

4.3 HYDRAULIC MODELLING

The following updates have been made to the Engeny Baseline flood models to create the TUFLOW models used for this assessment.

- Reduce grid size to 6m (down from a 10m grid used in the Engeny models).
- Apply sub-grid sampling with a 1.5m sampling increment.
- Apply ridgeline to the railway embankment downstream of the site so that the sub-grid sampling does not allow flow to 'leak' through the embankment.
- Slight adjustments to inflow locations (2d_sa polygons)
- Apply XPSWMM inflows for the local tributary discharging to the railway from Precinct A.

4.3.1 Software

Hydraulic modelling has been undertaken using TUFLOW HPC which is software developed by BMT. TUFLOW is a computational engine that provides one-dimensional (1D) and two-dimensional (2D) solutions for the free-surface flow equations to simulate flood and tidal wave propagation. TUFLOW HPC version 2023-03-AB-iSP-w64 has been used for this investigation.

4.3.2 Terrain and Cell Size

The TUFLOW model uses a 6m cell size. This cell size provides a satisfactory trade-off between hydraulic model detail and computational run times.

TUFLOW's Sub Grid Sampling (SGS) has been applied at a 1.5m spacing within each 2D cell. This ensures that floodplain features are represented at a high resolution within each 2D cell. Application of SGS enables the 6m grid cells to accurately represent floodplain characteristics and perform well at conveying flows through the catchment.

Floodplain ground levels are largely based on aerial lidar survey captured in 2021. These is also a local region where 2013 lidar is stamped over to set Flagstone development areas back to existing.

The base case TUFLOW model layouts is shown on Figure 7 and model topography is shown thematically on these Figures.

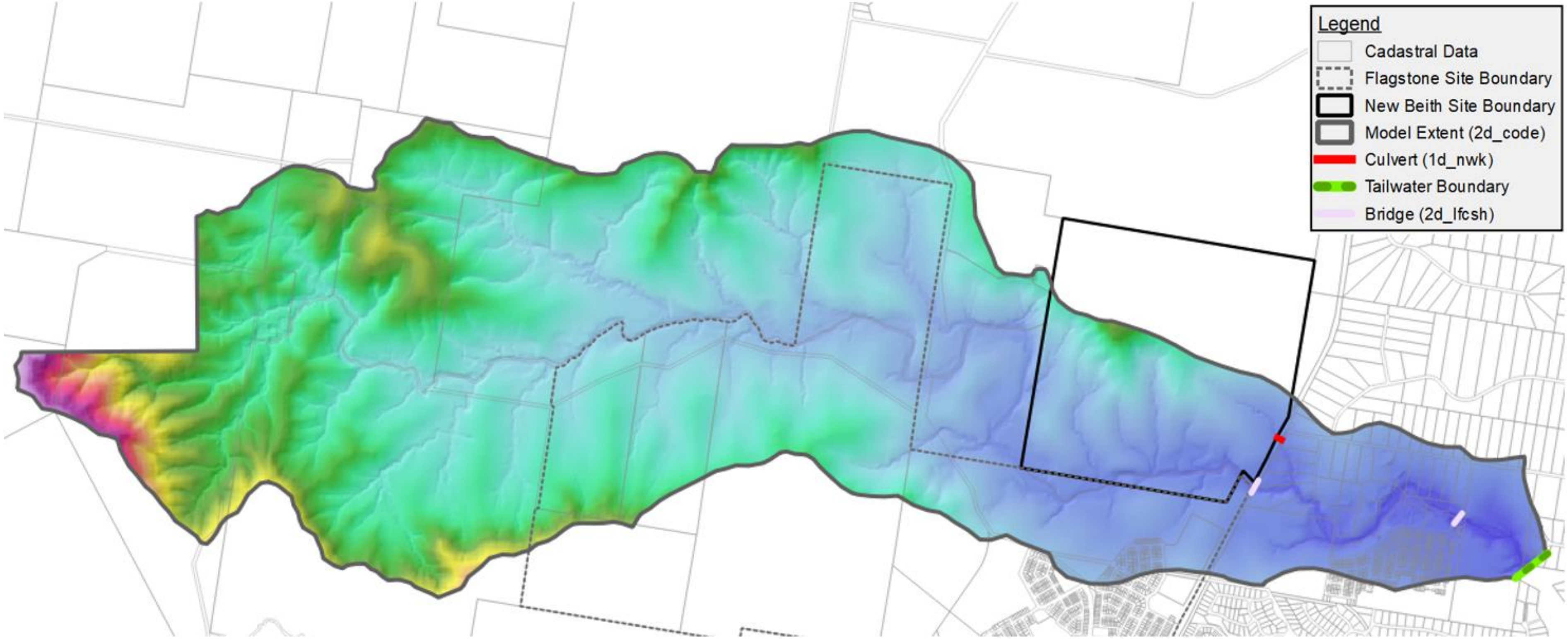


Figure 7 TUFLOW model layout existing base case

4.3.3 Hydraulic Roughness

Hydraulic roughness mapping for the base case model remains un-changed from that of the Engeny Baseline Model. The existing New Beith site has been assigned a manning 'n' value of 0.08 which is associated with the model's 'highly vegetated' roughness category.

4.3.4 Structures

Culverts have been represented in the model using 1D network elements. The location of these structures in the base case model are shown on Figure 7.

4.3.5 Inflows

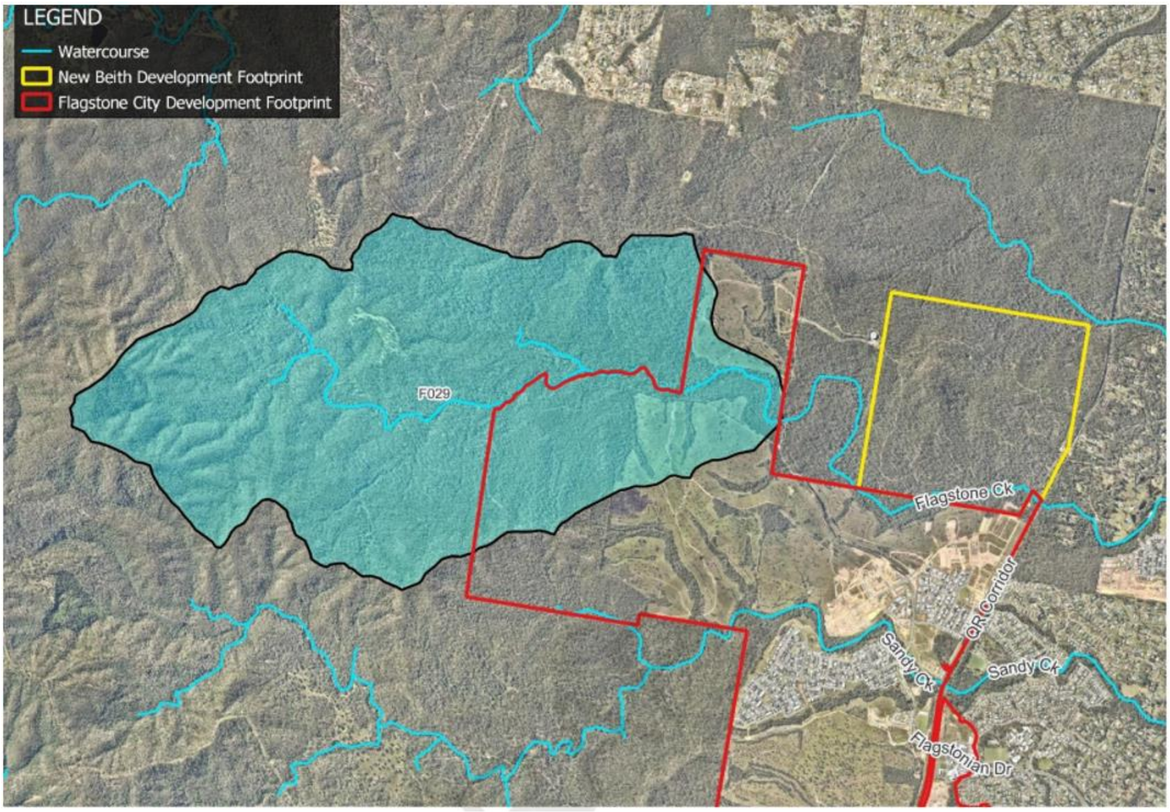
Local catchment inflow hydrographs for the various WBNM and XPSWMM models have been applied to the respective TUFLOW models using 2d_sa polygons. All inflow hygrographs are from local catchment runoff and therefore channel routing is undertaken hydrodynamically in the TUFLOW model.

4.3.6 Downstream boundary conditions

The downstream boundary conditions is located approximately 2km downstream of the New Beith site boundary. The downstream boundary condition is a normal depth rating curve which is automatically generated by TUFLOW based on an assumed flood slope of 0.4%.

4.4 RATIONAL METHOD VALIDATION

The peak flows reported by Engeny in their Rational Method validation have been used to validate peak flows in the updated base case TUFLOW model. The validation catchment selected by Engeny is shown on Figure 8 which is an extract from their report. The comparison of peak flows is shown in Table 7 and results confirm a good consistency of flow rates which is considered an acceptable validation of the peak flow rates in the TUFLOW model.



(Source of figure: Engeny, 2023)

Figure 8 Rational method validation catchment

Table 7: Rational Method Peak Flow Validation

AEP	Engeny Rational Method Peak Flow (m3/s)	TUFLOW Peak Flow (m3/s)	Percentage Difference
1%	137.1	145.1	6%
2%	111.6	115.2	3%
5%	79.2	88.4	12%
10%	64.1	70.3	10%
20%	49.4	46.8	-5%
50%	30.3	25.6	-16%

4.5 ULTIMATE DEVELOPMENT CASE

The Ultimate Development Case modelling includes full development of the New Beith and Flagstone Master Plan within Flagstone Creek catchment.

All details of the Flagstone development remain unchanged from those of the Engeny Baseline modelling. This includes the Flagstone development flood detention basin. New Beith development details have been updated and refined to ensure flood objectives are achieved.

4.5.1 Model Setup

The ultimate development model setup has involved:

- Update the base case model with the ultimate Flagstone development details extracted from the Engeny Master Plan modelling (TUFLOW case M01_024). Flood detention storages for the Flagstone development have been included in the modelling without adjustment.
- Update inflows using the Ultimate Development case WBNM and XPSWMM models.
- Incorporated updated design tins for the New Beith development. Where necessary, TUFLOW ridge lines have been used to enforce hydraulic controls such as detention basin walls and road embankments.
- Undertake iterative sizing of hydraulic structures to achieve project flood objectives in relation to road immunity, non-worsening of flooding and waterway stability.

The sag level of the Flagstone Creek road crossing is 42.9 mAHD at the road centre line. This has been increased by 100mm from the civil design tin provided for this assessment. The road was raised 100mm to comply with flood immunity requirements.

Developed Case Model Topography for the New Beith Site is shown on Figure 9 including the proposed crossing of Flagstone Creek.

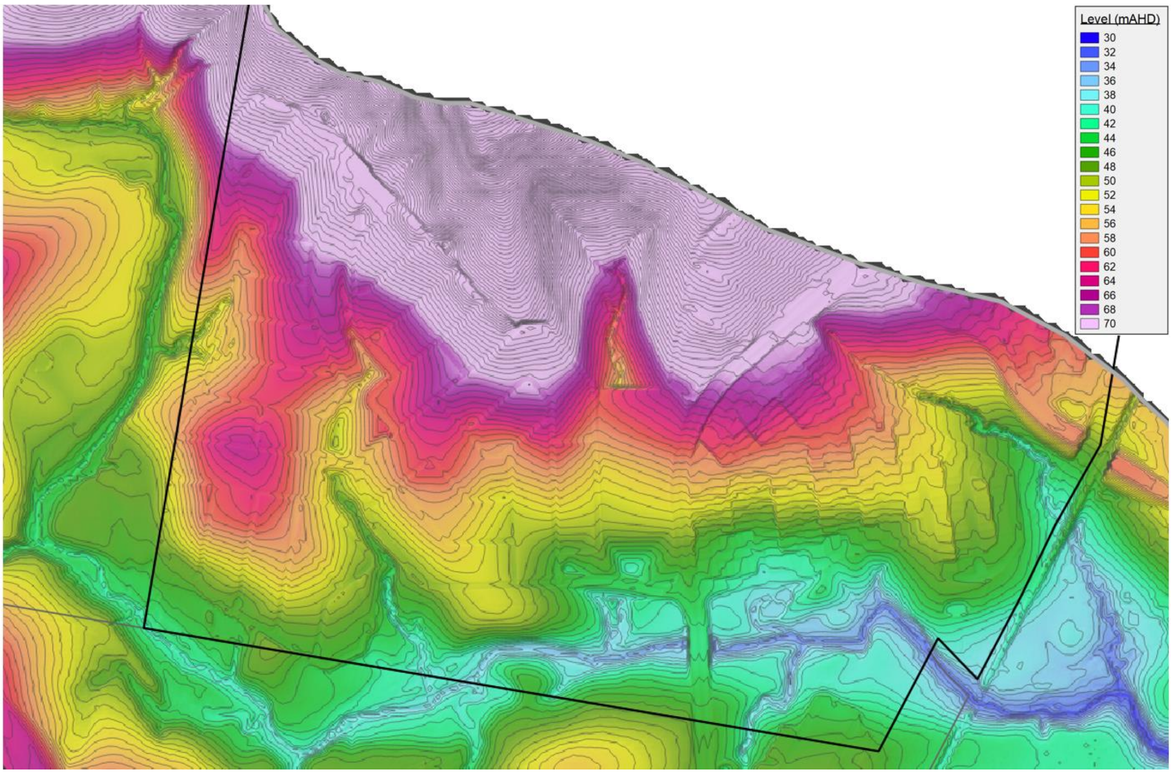


Figure 9 Developed model topography in the vicinity of the New Beith site (1m contours)

4.5.2 Flood Storage Details Including the Flagstone Creek Road Crossing

There are two flood storages within the New Beith Site that drain to the Flagstone Creek catchment as per Figure 10.

The largest flood storage is created by the Flagstone Creek New Beith Road Crossing. The sizing of the culverts associated with this crossing has been undertaken iteratively using the TUFLOW model.

A second smaller flood storage basin, referred to as the Precinct A Bio2 Flood Basin, is included within the minor tributary of Flagstone Creek which flows across the railway corridor slightly to the north of Flagstone Creek. Sizing of this basin has been completed using the XPSMM modelling described in the New Beith Precinct A Local Flood Management Plan (DesignFlow, Sep 2024).

The location of the flood storages is shown on the flood mapping provided with this report and details of the outlet structures are provided in Table 8 and Table 9.

Table 8 Flagstone Creek Crossing - Outlet Configuration

Culvert Size	Length	USIL	DSIL
2 / 3600 x 3000 RCBC	35m	39.45	39.35
2 / 3600 x 3600 RCBC	37m	38.2	38.1
3/ 2400 x 900 RCBC (two outside barrels include 150mm fish baffles)	50m	34.4	34.35
1 / 2400 x 900 RCBC	50m	34.1	34.05

Table 9 Precinct A Bio 2 Flood Basin - Outlet Configuration

Culvert Size	Length	USIL	DSIL
1 / 400mm Orifice into Outlet Pit	-	53.5	-
1 / 1200 x 1200 Field Inlet	-	54.3	51.0
1 / 900 RCP (From base of field inlet to the creek)	80m	51.0	41.5
30m Wide Emergency Spillway to the East	-	55.2	-

The Precinct A Bio 2 Flood Basin has been assigned an initial water level of 53.5 which is the extended detention level for this bioretention system.

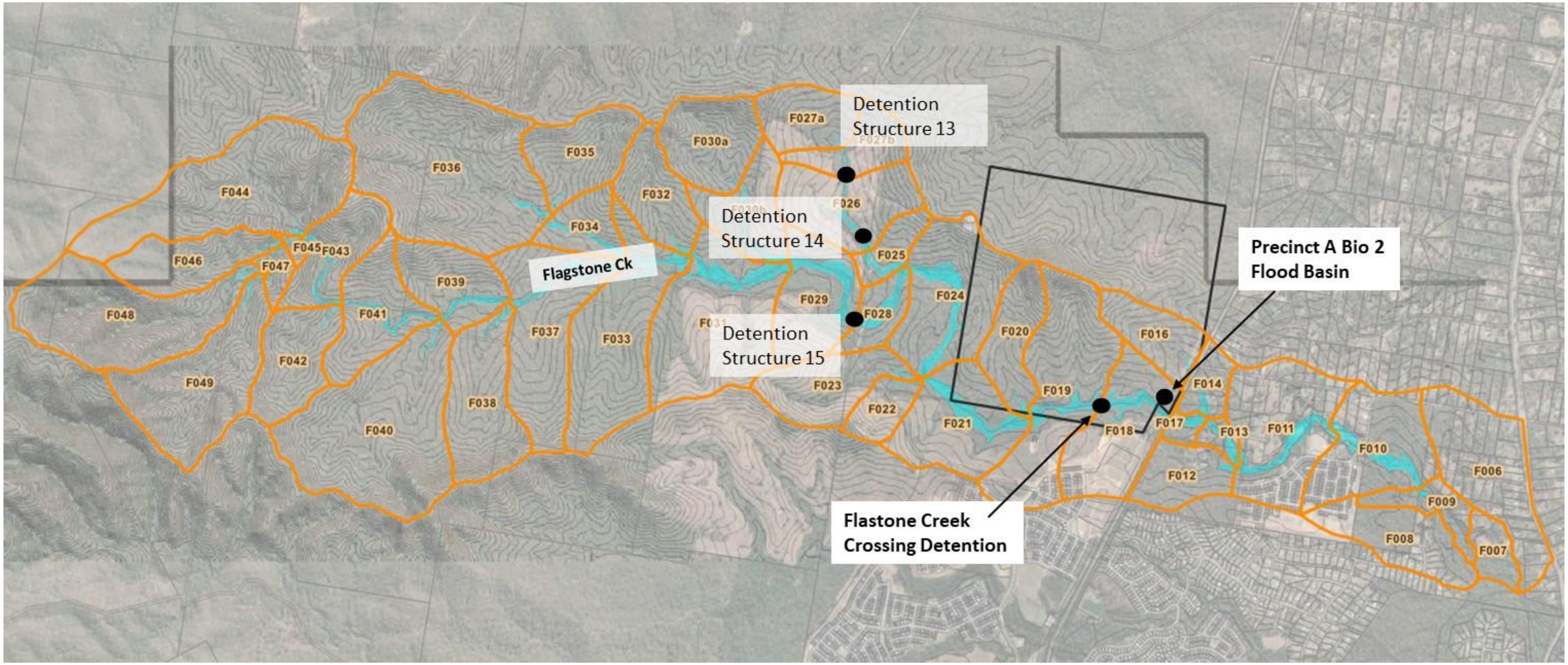


Figure 10 Location of flood detention systems – Ultimate Development

4.6 NEW BEITH DEVELOPMENT ONLY CASE

The New Beith Development Only Case modelling is consistent with the modelling for the Ultimate Development Case except for the following differences:

- All areas external to the New Beith site have been set back to base case conditions (e.g. Peet and other land assumed to be undeveloped).
- Inflows to the TUFLOW model have been applied using the New Beith Master Plan hydrology described in Section 4.2.2.3 of this report.
- The two flood detention systems shown in Figure 11 were applied to the model with the remainder of the basins in the Peet land removed.

Note: The New Beith master plan development scenario includes the Flagstone Creek road crossing as this is intended to be delivered with the Precinct A development.

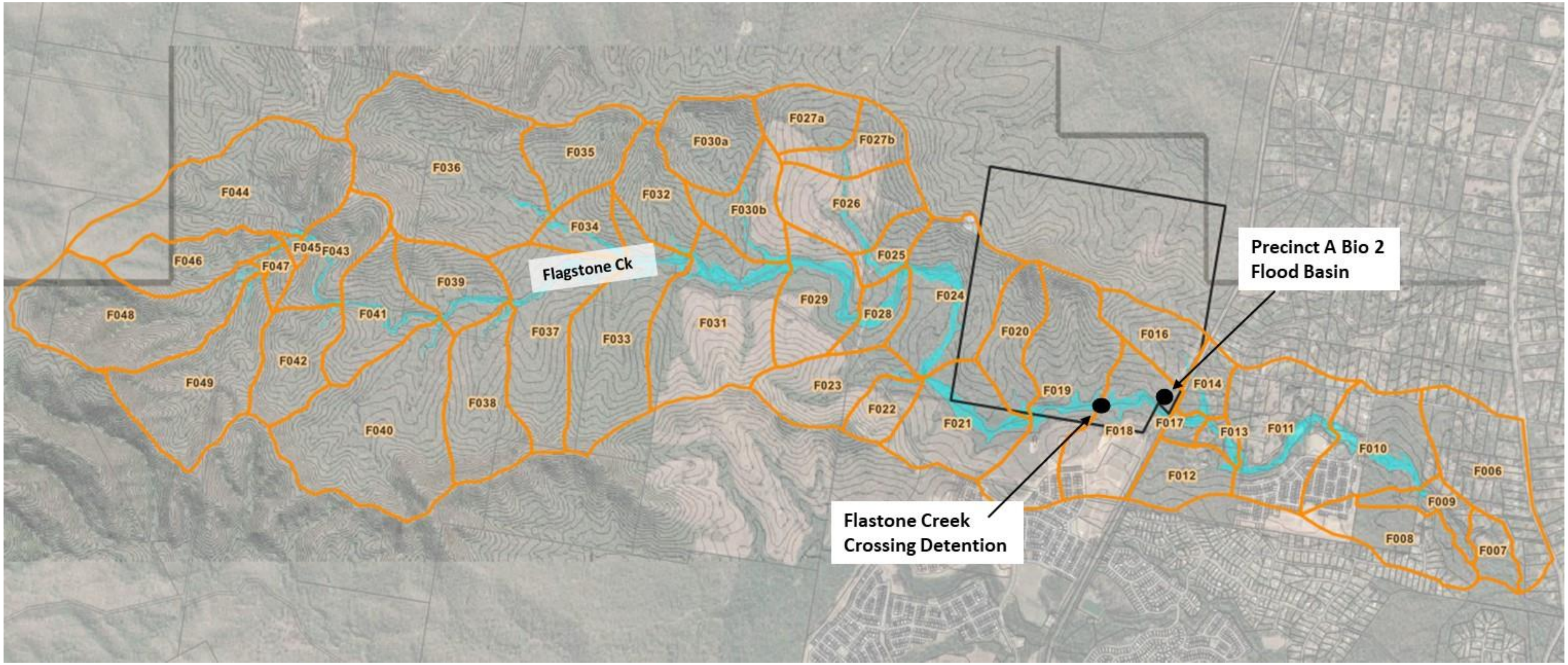


Figure 11 Location of flood detention systems – New Beith Development Only

4.7 RESULTS

4.7.1 Peak flood maps

Detailed flood mapping has been prepared for the various scenarios modelled for this assessment and maps are provided in the appendices of this report. A description of the flood maps is provided described in Table 10.

Table 10 Flood map scenarios

Appendix	Case	Description of Maps
Appendix A	Base Case	Peak Depth and Peak Velocity maps for suite of events ranging from 63% AEP to 1% AEP
Appendix B	Ultimate Development Case	Peak Depth, Velocity, Flood Level and Flood Level Impacts for suite of events ranging from 63% AEP to 1% AEP. Mapping is also provided for the 1% AEP Year 2090 RCP 4.5 climate change event.
Appendix C	New Beith Development Only Case	Peak Depth, Velocity, Flood Level and Flood Level Impacts for suite of events ranging from 63% AEP to 1% AEP. Mapping is also provided for the 1% AEP Year 2090 RCP 4.5 climate change event.
Appendix D	Blockage Sensitivity Runs (Ultimate Development)	1% AEP flood hazard maps for three hydraulic structure blockage scenarios.

4.7.2 Peak flood levels

Peak flood level mapping for the Ultimate Development case is provided in Appendix B. Peak flood level mapping for the New Beith Development Only case is provided in Appendix C. The flood levels of Flagstone Creek through the New Beith site are slightly lower in the Ultimate Development case due to the effect of the Flagstone development flood detention basins upstream (in the Peet land). In the 1% AEP event, flood levels reduce by approximately 50mm to 100mm in the ultimate development case. Sizing of the Flagstone Creek New Beith crossing has ensured that flood immunity requirements are achieved under both development scenarios.

An extract from the New Beith Development Only Case peak flood level mapping is provided on Figure 12.

The predicted change in peak flood levels due to each of the development cases modelled are shown in the respective Appendices of this report. Figure 13 shows an extract of the 1% AEP Ultimate Development Case flood level difference mapping and Figure 14 shows differences associated with the New Beith Development Only Case. The mapping illustrates that each of the proposed development scenarios modelled do not cause increases in peak flood levels downstream in the Flagstone Creek catchment.

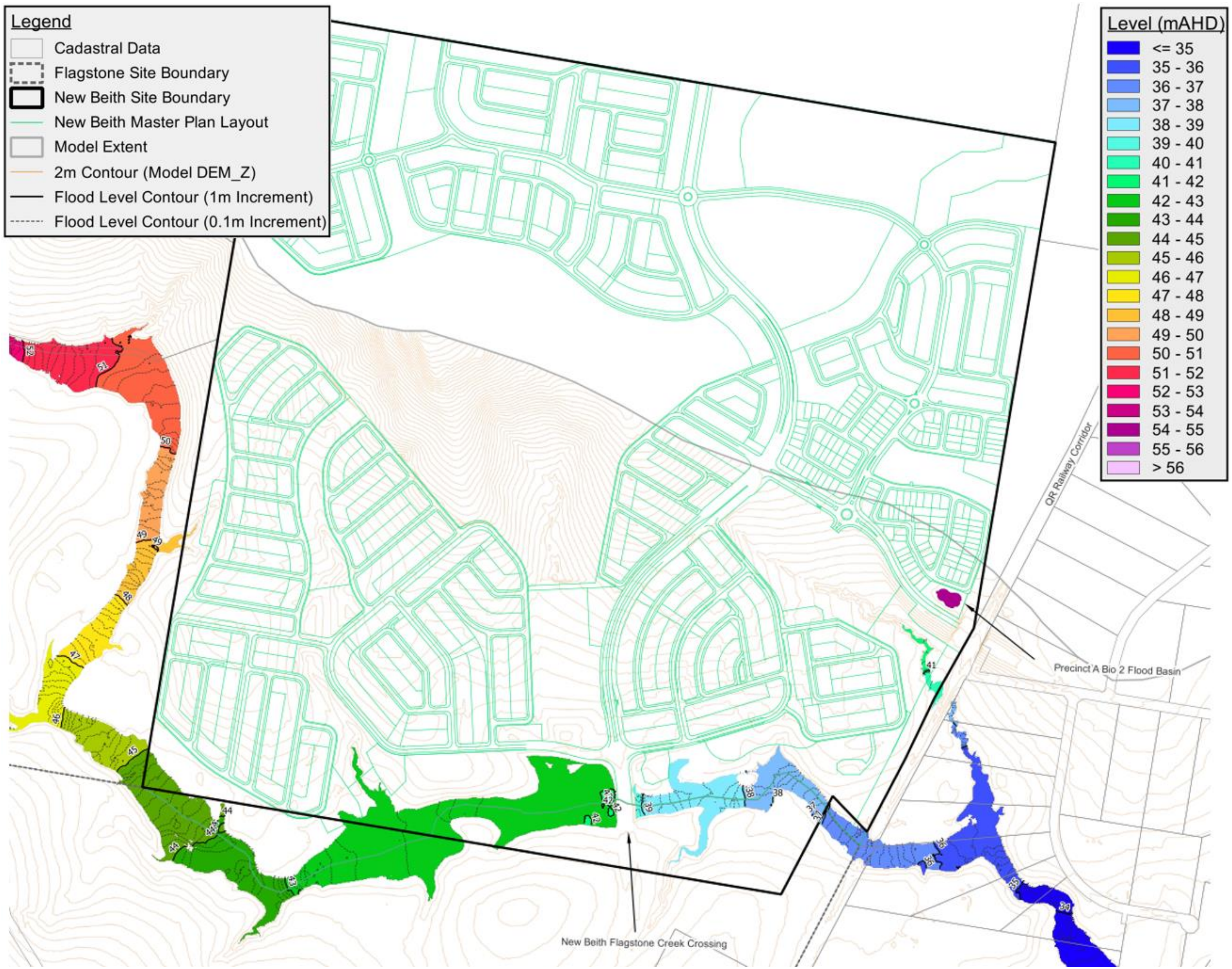


Figure 12 1% AEP New Beith Development Only case peak flood level mapping

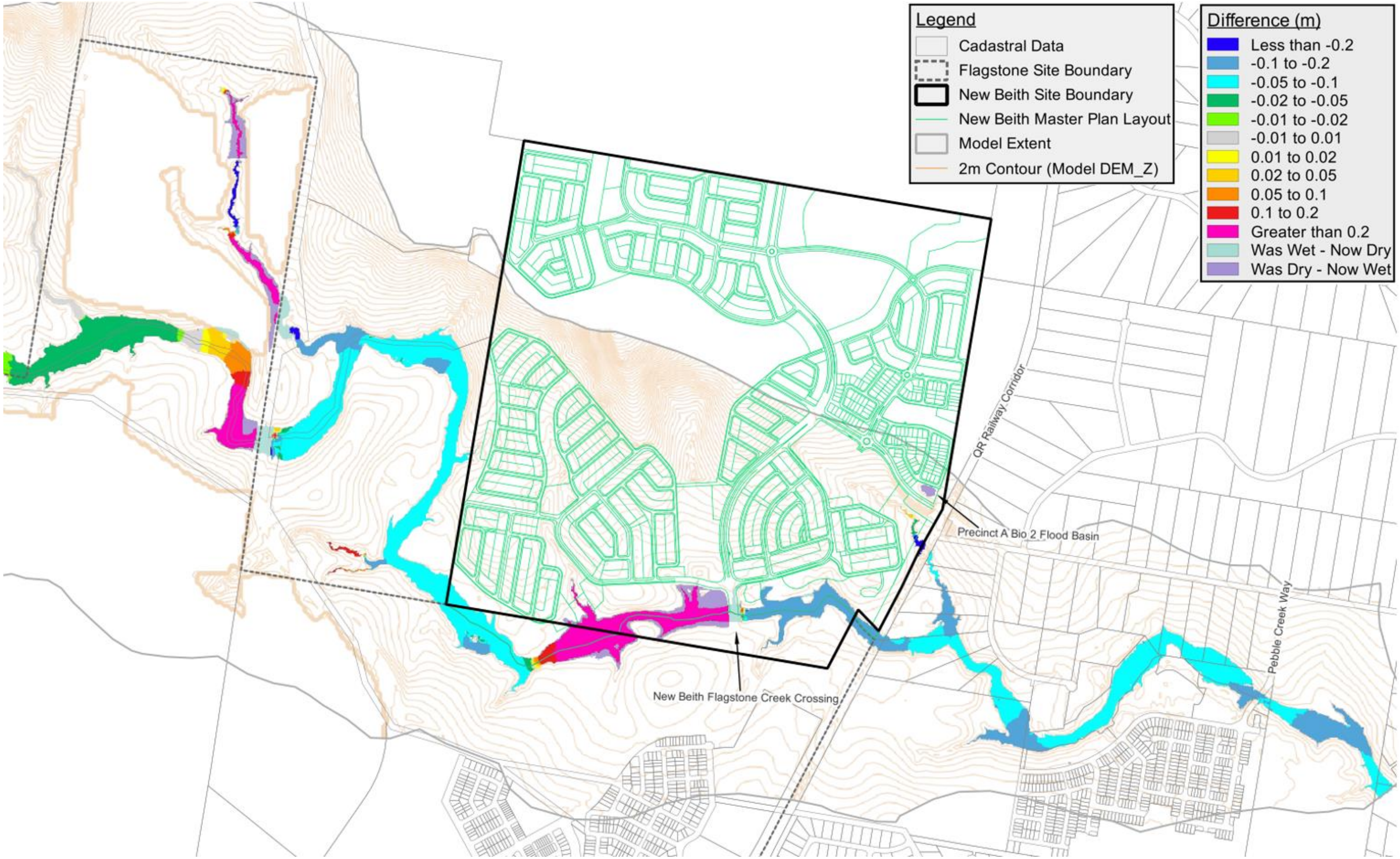


Figure 13 1% AEP Ultimate development case peak flood level difference mapping

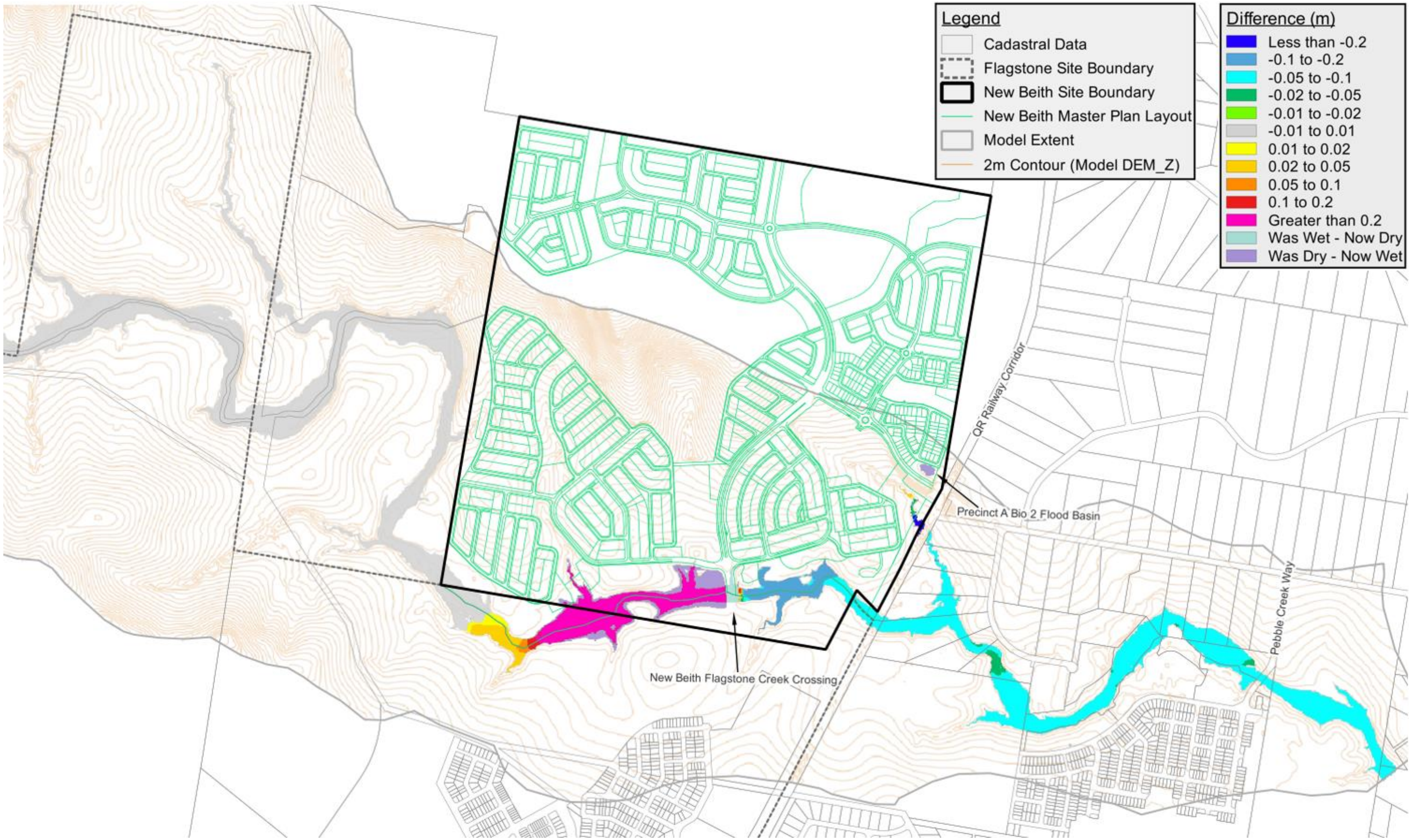


Figure 14 1% AEP New Beith Development Only case peak flood level difference mapping

4.7.3 Peak flows

Peak flows at key locations and for key AEP events are tabulated below. Results demonstrate that the peak flows downstream of the site for both development cases are at or below the base case scenario. The reduction in flows is further demonstrated by the flood level reductions illustrated on the flood level impact maps in Appendix B and C for all events modelled.

These results demonstrate that the peak flow management objectives for waterway stability and flooding outlined in Section 3 are achieved.

Table 11. Peak flows at New Beith Flagstone Creek Road Crossing (PO Line L_75)

Event	Existing base case (m^3/s)	Ultimate Development Case (m^3/s)	New Beith Development Only case (m^3/s)
1% AEP	160.0	145.1	148.1
5% AEP	102.7	93.4	96.2
50% AEP	29.5	27.6	28.1
63% AEP	24.5	23.0	23.2

Table 12. Peak flows at Flagstone Creek Railway (PO Line L_1)

Event	Existing base case (m^3/s)	Ultimate Development Case (m^3/s)	New Beith Development Only case (m^3/s)
1% AEP	160.2	149.3	152.6
5% AEP	103.4	93.7	96.7
50% AEP	29.8	28.3	28.5
63% AEP	24.7	24.0	24.2

Table 13. Peak flows at Railway Crossing Downstream of Precinct A Bio 2 Flood Basin (PO Line L_12)

Event	Existing base case (m^3/s)	Ultimate Development Case (m^3/s)	New Beith Development Only case (m^3/s)
1% AEP	5.7	4.7	4.7
5% AEP	3.7	3.0	3.0
50% AEP	1.1	1.0	1.0
63% AEP	0.7	0.7	0.7

4.7.4 New Beith Flagstone Creek Crossing

Peak flows and flood levels Immediately upstream of the New Beith Flagstone Creek road crossing are provided in Table 14 for the New Beith Development Only Case. The results from this case are provided because flows are slightly higher than for the Ultimate Development Case which includes upstream flood storages associated with the Flagstone Development.

Table 14. Peak flows and Flood Levels at New Beith Flagstone Creek Road Crossing

Event	Peak Flows (m^3/s)	Peak Flood Levels Immediately Upstream - Zero Blockage (mAHD)
Year 2090 1% AEP RCP 8.5	175.9	42.58
Year 2090 1% AEP RCP 4.5	160.3	42.27
1% AEP	146.7	42.00
2% AEP	121.8	41.53
5% AEP	94.1	40.95
10% AEP	75.3	40.46
20% AEP	49.8	39.69
50% AEP	28.0	38.52
63% AEP	22.9	38.01
Road Level (Lowest)		42.77

The road centre line sag level at the Flagstone Creek road crossing is 42.77 mAHD so results confirm that under zero blockage conditions there is no overtopping for all events up to the 1% AEP RCP 8.5.

Results of the blockage assessment described in Section 4.8.2 show that under design blockage conditions (20% culvert blockage), the Year 2090 1% AEP RCP 4.5 event will overtop the road embankment however flood hazard will remain at ARR hazard classification 1. Blockage assessment results are provided in Appendix D.

4.7.5 Precinct A Bio 2 Flood Basin

Peak flood levels in the Precinct A Bio 2 Flood Basin are provided in Table 15 for the Development Case. The results of the XP-SWMM modelling of the detention basin are also provided from *New Beith Precinct A Local Flood Management Plan* (DesignFlow, 2024) are also provided an illustrate good agreement.

Events up to the 1% AEP discharge from the basin via the outlet pit and then discharge to the local gully via a 900mm RCP. The peak 1% AEP flow rate from the basin is 2.3 m^3/s.

An emergency high flow weir at 55.2 mAHD is provided along the eastern embankment of the basin to convey flows in the case of outlet structure blockage or very extreme events.

Table 15. Peak Flood Levels at the Precinct A Bio 2 Flood Basin

Event	Peak Flood Levels (mAHD) - TUFLOW	Peak Flood Levels (mAHD) - XP-SWMM
Year 2090 1% AEP RCP 8.5	54.80	
Year 2090 1% AEP RCP 4.5	54.75	
1% AEP	54.72	54.73
2% AEP	54.67	54.70
5% AEP	54.62	54.63
10% AEP	54.57	54.57
20% AEP	54.54	54.51
50% AEP	54.41	54.37
63% AEP	54.36	54.30

4.7.6 Probable Maximum Flood

Peak hazard mapping is provided on Figure 15 for the Probable Maximum Flood (PMF) for the New Beith Development Only Case. Results confirm that the development is largely free from inundation during the PMF.

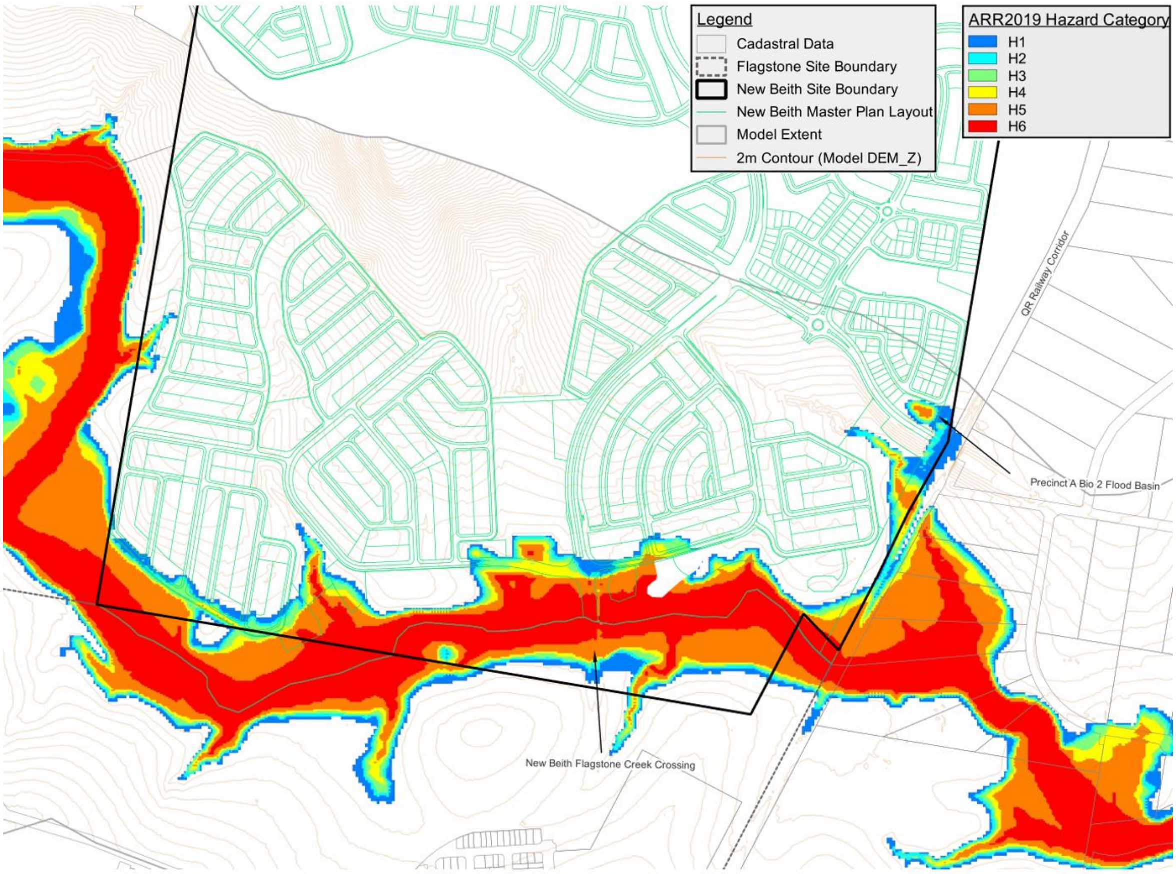


Figure 15 – Increase to 1% AEP 2090 RCP4.5 Flood Levels Associated with High Roughness Sensitivity

4.8 SENSITIVITY TESTING

Sensitivity testing has been completed using the New Beith Development Only case because this is the design scenario that experiences the largest flows and flood levels due to there being no flood detention basins incorporated upstream.

4.8.1 Increased Hydraulic Roughness

A high roughness sensitivity test has been completed by applying a manning's 'n' roughness value of 0.15 to the floodplain in the vicinity of the site and for approximately 800m downstream. This sensitivity case also incorporates design blockage to hydraulic structures (20% blockage to culverts and 50% blockage to field inlets).

Figure 16 shows the increase to peak 1% AEP Year 2090 RCP4.5 flood levels caused by the increased floodplain hydraulic roughness. Flood mapping for this scenario is provided in Appendix D.

The modelling demonstrates that there are substantial increases (up to approximately 1.0m) to design flood levels through the site however no new flow paths are created and flood waters remain in the waterway. Design flood levels from this sensitivity case should be checked against development levels to ensure lots remain flood free under this scenario.

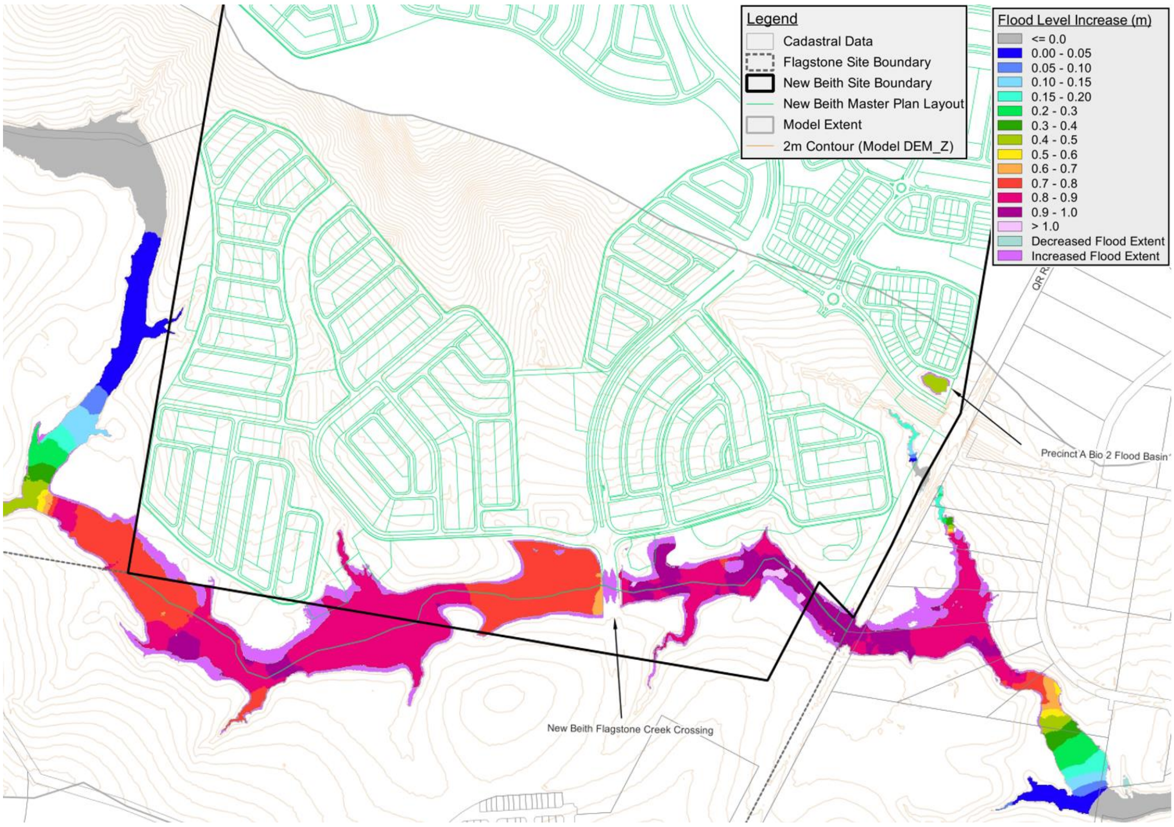


Figure 16 – Increase to 1% AEP 2090 RCP4.5 Flood Levels Associated with High Roughness Sensitivity

4.8.2 Culvert Blockage Sensitivity

The design runs completed for the impact assessment assume zero blockage of hydraulic structures so as to not interfere with the detention storage outlet sizing. Three blockage scenarios have been modelled as follows:

- Scenario 1 – Culvert blockage of 20% and Field Inlet blockage of 50% (as per 'Design Value' Table 10.4.1 of Queensland Urban Drainage Manual)
- Scenario 2 – Culvert blockage of 50% and Field Inlet blockage of 100%
- Scenario 3 – Culvert blockage of 100% and Field Inlet blockage of 100% (as per 'Severe Storm' Table 10.4.1 of Queensland Urban Drainage Manual)

The purpose of these scenarios is to provide an understanding of flood risks associated with different levels of structure blockage.

The blockage scenarios have been run for the 1% AEP Year 2090 RCP4.5 event and the various flood maps are provided in Appendix D to describe the results.

Blockage Scenario 1 is the considered the design blockage case and therefore results from this scenario should be used to set minimum development heights for flood immunity requirements. Flood hazard mapping for this scenario is provided for 1% AEP Year 2090 RCP4.5 and 1% AEP Year 2090 RCP8.5. An extract of the hazard mapping for 1% AEP Year 2090 RCP4.5 is provided on Figure 17.

Key outcomes of the Scenario 1 blockage modelling (design blockage) are as follows:

- The New Beith Flagstone Creek crossing does not overtop under blockage scenario 1 for the current climate 1% AEP event.
- The New Beith Flagstone Creek crossing overtops marginally under blockage scenario 1 in the 1% AEP Year 2090 RCP4.5 event however flood hazard remains at Category 1 (ARR2019 hazard classification).
- The New Beith Flagstone Creek crossing overtops with Hazard category 2 under blockage scenario 1 in the 1% AEP Year 2090 RCP8.5 event.

Key outcomes of the Scenario 2 and 3 blockage modelling are as follows:

- There are no new Flagstone Creek breakout flow paths created under these high and extreme blockage scenarios and the development remains flood free.

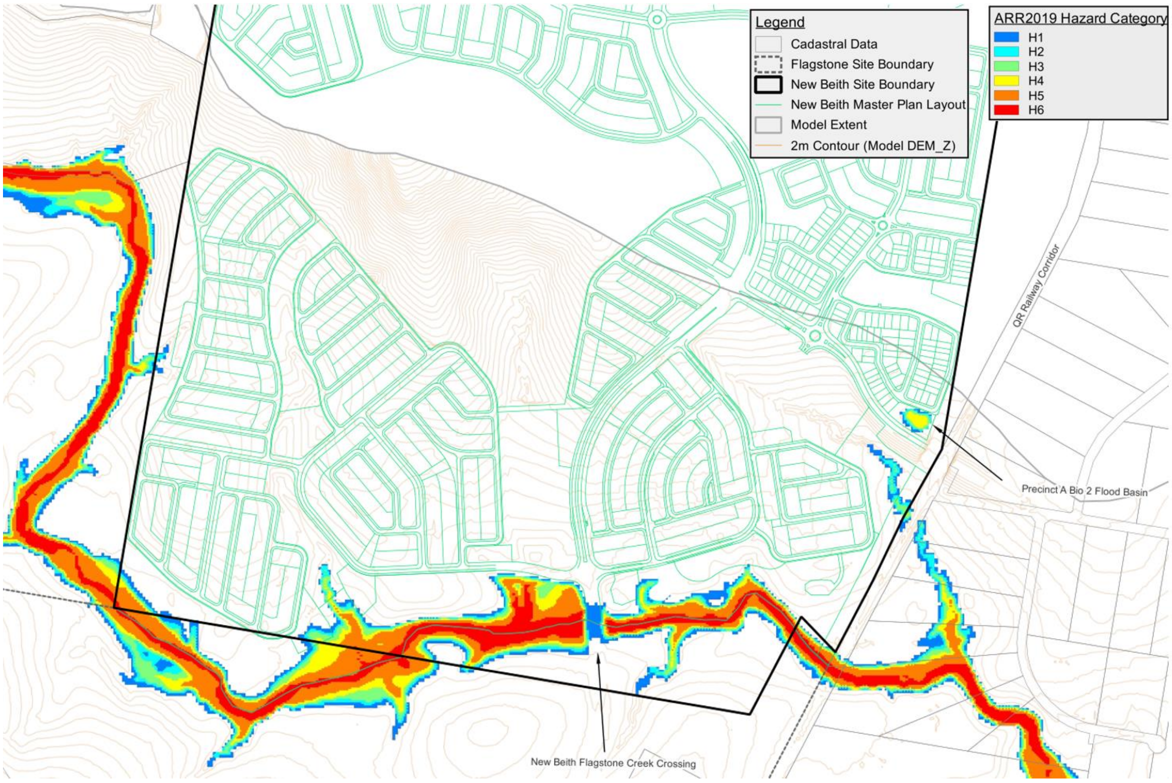


Figure 17 – 1% AEP year 2090 RCP4.5 flood hazard mapping associated with blockage scenario 1.

4.8.3 Climate Change Sensitivity

The 1% AEP event with blockage scenario 1 (design blockage) has been run for two climate change scenario as follows:

- RCP 4.5 Year 2090
- RCP 8.5 Year 2090

The predicted change in peak flood levels for each of these climate change scenarios are shown on Figure 18 and Figure 19. Results show that peak flood levels in Flagstone Creek through the site increase by up to 300mm for the RCP 4.5 scenario and by up to approximately 600mm for the RCP 8.5 scenario.

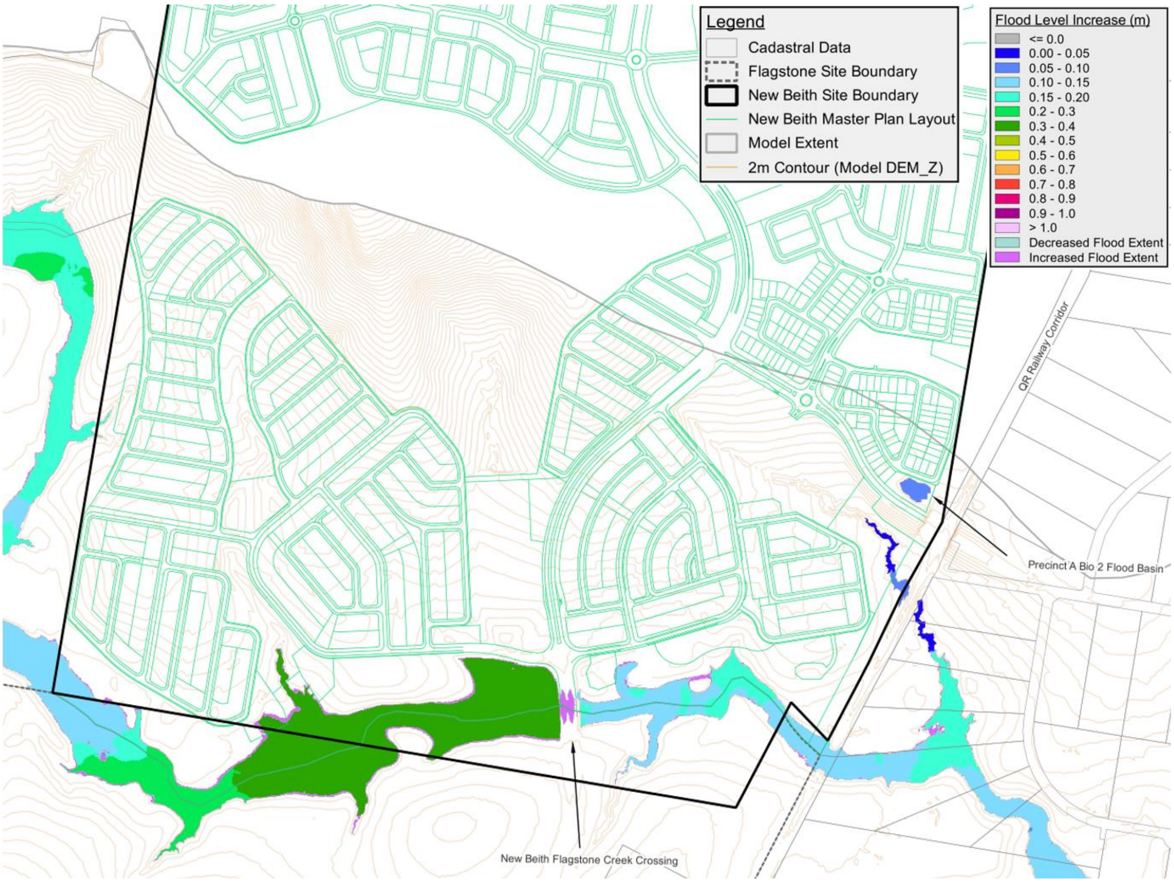


Figure 18 – Increase to 1% AEP Flood Level at Year 2090 Associated with RCP4.5 (Design Blockage)

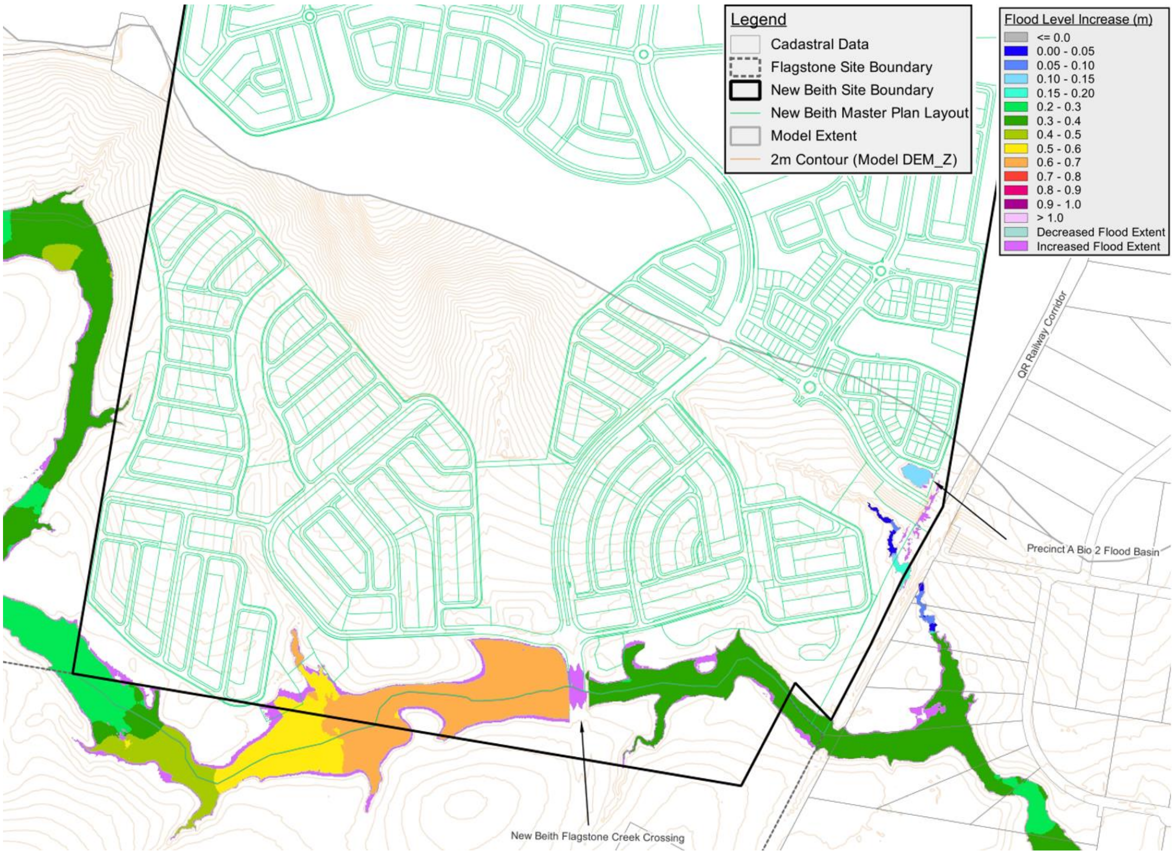


Figure 19 – Increase to 1% AEP Flood Level at Year 2090 Associated with RCP8.5 (Design Blockage)

5 FLOOD MODELLING – COUNCIL MODEL

In March 2025, Logan City Council released the *Flagstone and Sandy Creek Flood Study 2025* (Water Technology, 17 February 2025). EDQ then requested that the proposed design for New Beith responds to this flood study and where required amend the design to ensure consistency with the Council flood study.

The following section presents the flood modelling completed for the New Beith only scenario using Council's new Flagstone Creek Flood Model (Water Technology, 2025 model).

5.1 APPROACH

DesignFlow have undertaken model refinements to the Council model to create fit for purpose models against which development can be appropriately assessed. However, the overall flood modelling methodology remains consistent with that of the Council flood models. DesignFlow modelling tasks have included:

- Model updates to create a fit for purpose Urbs and TUFLOW models.
- Setup a New Beith development only case incorporating development within New Beith catchment proposed Frasers. Development assumptions are consistent with those used in the DesignFlow Assessment.
- Testing of the proposed mitigation flood storages, particularly the Flagstone Creek crossing adjacent to New Beith to achieve flood objectives.

Modelling for this assessment uses ARR2019 methodology as per the WATER TECHNOLOGY (2025) model. A key difference between the WATER TECHNOLOGY (2025) model and the DesignFlow model, is that the DF model simulates full ensembles modelled hydrodynamically in TUFLOW, whereas the Council model is only run for the representative ensembles selected by Water Technology.

Unless stated otherwise in this report, all modelling assumptions and methodologies remain consistent with those presented in *Flagstone and Sandy Creek Flood Study 2025* (Water Technology, 17 February 2025).

5.2 HYDROLOGIC MODEL

Hydrologic modelling of the catchment in the Council model uses Urbs software. The following sections describe the modelling details and updates completed to support the New Beith development assessment.

5.2.1 Design Event Modelling Approach

The design event modelling approach remains generally consistent with that used in the Water Technology (2025). A summary is provided below.

- Global initial loss of 24mm, as per ARR datahub, for all pervious surfaces.
- Storm continuing loss of 1.6mm/h, as per datahub, for all pervious surfaces.
- Application of ARR19 rainfall depths based on BoM 2016 IFD

- No areal reduction factors have been applied (point rainfall intensity adopted)
- 50% of the median pre-burst rainfall has been subtracted from the global initial loss rate.

Modelling has been carried out for the 1%, 2%, 5%, 10%, 20%, 50% and 63% AEP design events. The event durations and ensemble numbers (TP) applied to the modelling are as per those selected by Water Technology (2025) and shown in the table below.

Table 16: WATER TECHNOLOGY (2025) Model Selected Design Events

AEP	Critical Storms	Temporal Pattern Bin
50%, 20%	30min TP05, 45min TP07, 60min TP04, 90min TP08, 120min TP08, 180min TP01, 180min TP07, 270min TP05, 540min TP07	Frequent
10%, 5%	30min TP08, 45min TP06, 60min TP05, 90min TP06, 180min TP04, 360min TP10	Intermediate
2%, 1%,	30min TP07, 60min TP05, 90min TP03, 120min TP02, 180min TP09, 270min TP03	Rare

No climate change, blockage or PMF runs been completed because the flood levels predicted in the Water Technology (2025) model are lower than those predicted in the model presented in Sections 4. As the certifying Registered Professional Engineers for the modelling, we have adopted the more conservative (i.e. higher) flood model results particularly for the climate change runs (refer Section 4.8.3).

5.2.1.1 Base Case

It was necessary to undertake model updates to the Water Technology (2025) URBS model to make it suitable for this assessment.

The key reason that the URBS model has been updated is that the Water Technology (2025) model assumes full development of the Priority Development Areas within the catchment. For the purpose of this impact assessment, the base case model has been updated assuming that the full Flagstone Creek catchment upstream of the railway is undeveloped with zero Impervious Area.

Figure 20 shows the URBS model catchments that have been updated for this assessment.

In addition to updating catchment development assumptions, some minor adjustments have also been made to sub-catchments within the New Beith site and the immediate surrounds. This has occurred to reflect the details on the site (refined catchments) and allowed the updated modelling to align with the detailed XPSWMM modelling that DesignFlow has previously undertaken for the local tributary containing the Precinct A Bio 2 Flood Basin. These catchment adjustments are located around URBS sub-catchment 174 and 175.

URBS Sub-catchment details for the updated catchments are provided in Table 17.

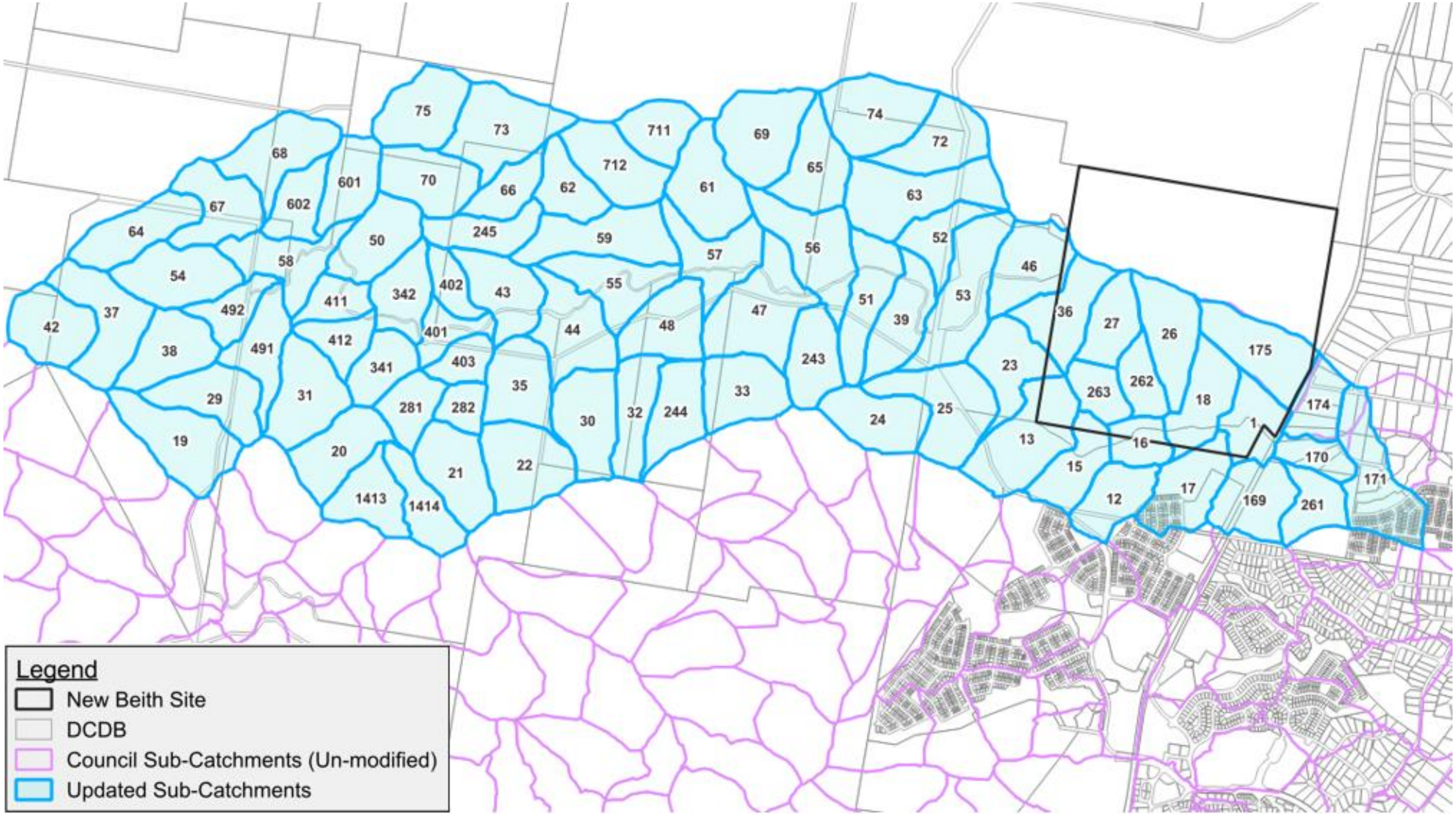


Figure 20 – URBS Sub-Catchments

Table 17: URBS Sub-Catchment Details for Updated Catchments

Catchment ID	Total area (ha)	Percent Impervious	Percent Urbanised
1	15.58	0.0%	0.0%
12	16.01	0.0%	0.0%
13	30.11	0.0%	0.0%
15	16.36	0.0%	0.0%
16	10.34	0.0%	0.0%
17	20.92	0.0%	0.0%
18	19.03	0.0%	0.0%
19	26.98	0.0%	0.0%
20	20.34	0.0%	0.0%
21	21.68	0.0%	0.0%
22	24.88	0.0%	0.0%
23	19.78	0.0%	0.0%
24	20.11	0.0%	0.0%
25	28.18	0.0%	0.0%
26	21.31	0.0%	0.0%
27	15.04	0.0%	0.0%
29	20.44	0.0%	0.0%
30	22.37	0.0%	0.0%
31	23.51	0.0%	0.0%
32	16.90	0.0%	0.0%
33	20.49	0.0%	0.0%
35	20.29	0.0%	0.0%
36	20.41	0.0%	0.0%
37	25.54	0.0%	0.0%
38	19.96	0.0%	0.0%
39	20.00	0.0%	0.0%
42	20.17	0.0%	0.0%
43	19.80	0.0%	0.0%
44	23.54	0.0%	0.0%
46	21.65	0.0%	0.0%
47	32.10	0.0%	0.0%
48	19.86	0.0%	0.0%
50	20.09	0.0%	0.0%
51	20.37	0.0%	0.0%
52	12.90	0.0%	0.0%
53	30.27	0.0%	0.0%
54	23.45	0.0%	0.0%
55	20.60	0.0%	0.0%
56	26.81	0.0%	0.0%
57	20.13	0.0%	0.0%
58	20.34	0.0%	0.0%
59	25.75	0.0%	0.0%
61	23.79	0.0%	0.0%
62	14.11	0.0%	0.0%
63	31.28	0.0%	0.0%
64	20.22	0.0%	0.0%
65	20.15	0.0%	0.0%
66	11.88	0.0%	0.0%
67	20.26	0.0%	0.0%
68	22.52	0.0%	0.0%
69	26.41	0.0%	0.0%
70	20.60	0.0%	0.0%

Table 17 Continued

Catchment ID	Total area (ha)	Percent Impervious	Percent Urbanised
72	20.04	0.0%	0.0%
73	27.36	0.0%	0.0%
74	25.55	0.0%	0.0%
75	21.52	0.0%	0.0%
169	19.99	8.9%	100.0%
170	9.15	15.0%	47.6%
171	27.68	24.1%	61.4%
174	13.11	13.4%	41.5%
175	24.14	0.0%	0.0%
243	17.19	0.0%	0.0%
244	17.86	0.0%	0.0%
245	15.00	0.0%	0.0%
261	13.03	15.0%	100.0%
262	10.66	0.0%	0.0%
263	10.62	0.0%	0.0%
281	12.67	0.0%	0.0%
282	7.79	0.0%	0.0%
341	13.50	0.0%	0.0%
342	16.23	0.0%	0.0%
401	9.63	0.0%	0.0%
402	8.86	0.0%	0.0%
403	8.96	0.0%	0.0%
411	10.05	0.0%	0.0%
412	11.04	0.0%	0.0%
491	17.04	0.0%	0.0%
492	11.30	0.0%	0.0%
601	16.53	0.0%	0.0%
602	13.65	0.0%	0.0%
711	14.19	0.0%	0.0%
712	21.65	0.0%	0.0%
1413	17.01	0.0%	0.0%
1414	15.45	0.0%	0.0%

5.2.1.2 New Beith Development Only Case

The Urbs model was updated to represent the landuse scenario in which New Beith Master Plan is developed. The URBS sub-catchments in the vicinity of the site for this scenario are shown on Figure 21. Details of these sub-catchments are provided on Table 18. The following changes have been made to reflect the proposed development:

- Fraction Impervious value of 70% applied to New Beith Development Areas (shown in yellow on catchment figure)
- URBS Urbanisation Parameter of 1.0 assigned to New Beith Development Areas (shown in yellow on catchment figure)
- Adjustments to sub-catchment delineation to align with proposed development.

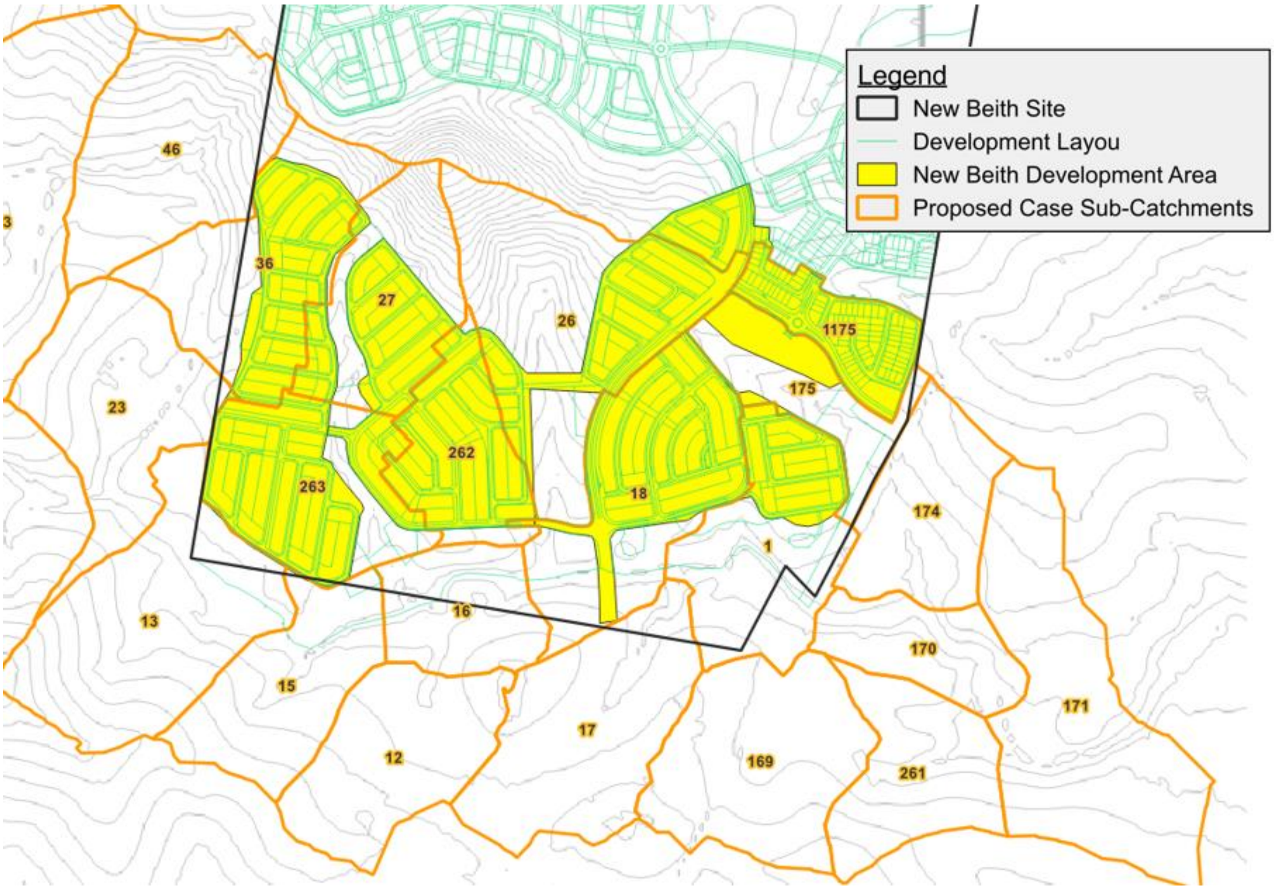


Figure 21 Council Model - New Beith Development Only case Urbs catchment updates

Table 18: Proposed Case Sub-catchments in Vicinity of Site

Catchment ID	Total Area (ha)	Percent Impervious	Percent Urbanised
1	17.51	22.0%	31.8%
12	16.01	0.0%	0.0%
13	25.36	0.2%	0.3%
15	14.65	0.2%	0.3%
16	10.34	0.0%	0.0%
17	20.92	0.0%	0.0%
18	21.06	47.3%	67.6%
23	18.92	0.2%	0.3%
26	27.72	26.7%	38.1%
27	15.56	38.1%	54.4%
36	19.95	34.1%	48.7%
46	21.34	0.0%	0.0%
169	19.99	8.9%	100.0%
170	9.15	15.0%	47.6%
171	27.68	24.1%	61.4%
174	13.11	13.4%	41.5%
175	9.68	23.0%	32.8%
261	13.03	15.0%	100.0%
262	11.50	63.7%	91.0%
263	17.25	57.6%	82.3%
1175	7.65	69.8%	99.7%

5.3 HYDRAULIC MODELLING

The Water Technology (2025) TUFLOW model was adopted for this assessment. The following minor updates have been made to the model for this assessment:

- Use of the updated URBS modelling described in the previous Section.
- Minor adjustments to inflow locations in vicinity of the site to make suitable for the New Beith impact assessment.
- Replace URBS inflow hydrographs (pre and post development) with those from the detailed XPSWMM model that has previously been completed by DF for the minor tributary near base case catchment '175' (Precinct A)

The New Beith development details incorporated into the Council model are consistent with those of the DF modelling.

5.4 RESULTS

5.4.1 Comparison of DesignFlow v Council Models

Figure 22 and Figure 23 present a comparison of the 1% Peak Flood Levels between the DesignFlow model outlined in Section 4 and the refined Council model. These comparisons have been made to the Council's (Water Technology) model that has been updated for this assessment which has included setting catchment landuse back to existing conditions.

The comparisons illustrate that DesignFlow's model produces flood levels that are higher than Council's (Water Technology) model. 1% AEP Flood level's in DesignFlow's modelling are typically in the range of 300mm to 700mm higher than Council's model.

The reason for the difference appears to be related to the Urbs model assumptions in the Water Technology (2025) modelling which generates lower peak flows than the WBNM model for local catchment runoff from bushland catchments.

DesignFlow have adopted the model results presented in Section 4, based on the WBNM modelling, for setting development levels and completing sensitivity testing as these are higher than the Water Technology (2025) results.

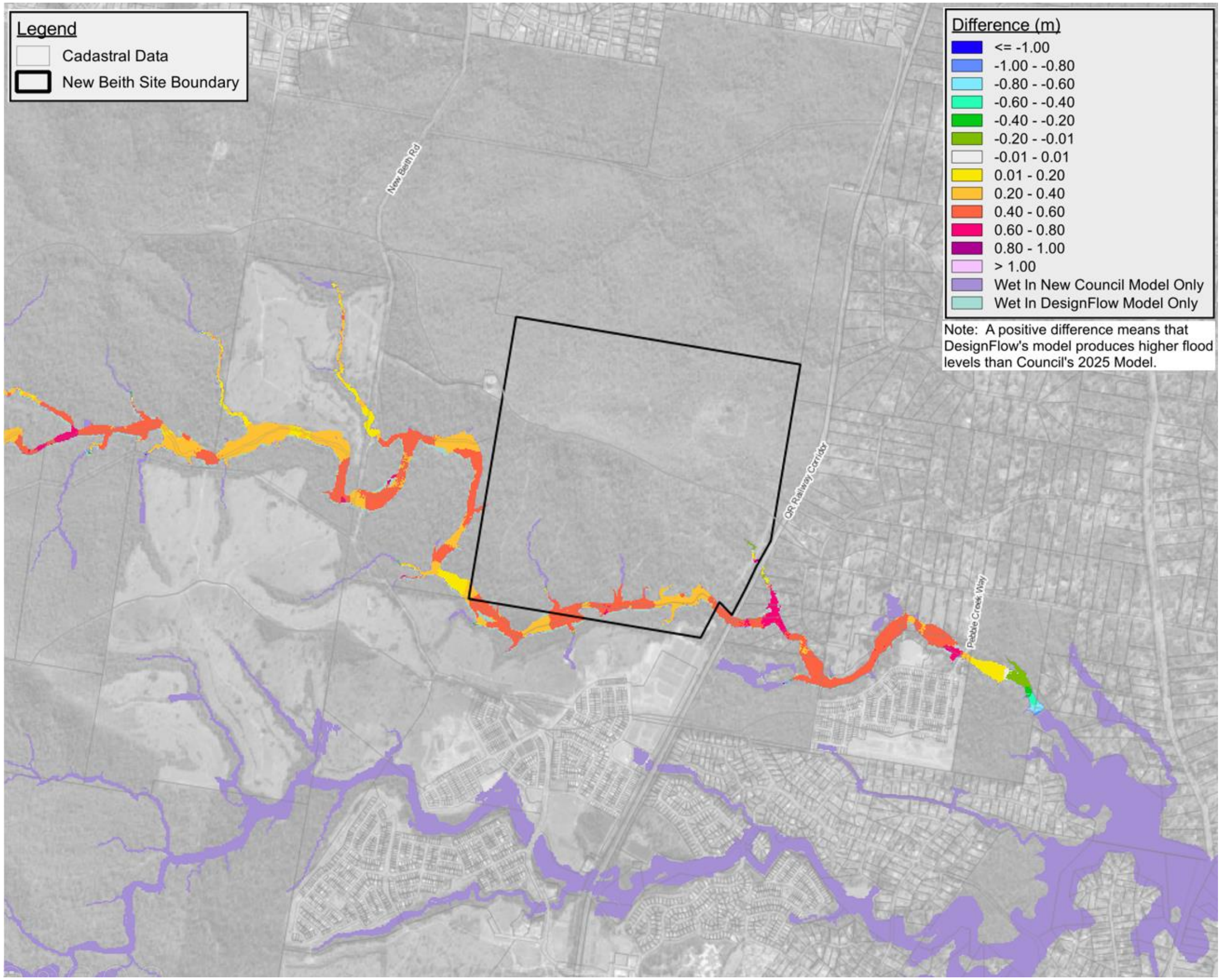


Figure 22 Comparison of Base Case Peak Levels 1% AEP (DesignFlow model versus Council Model)

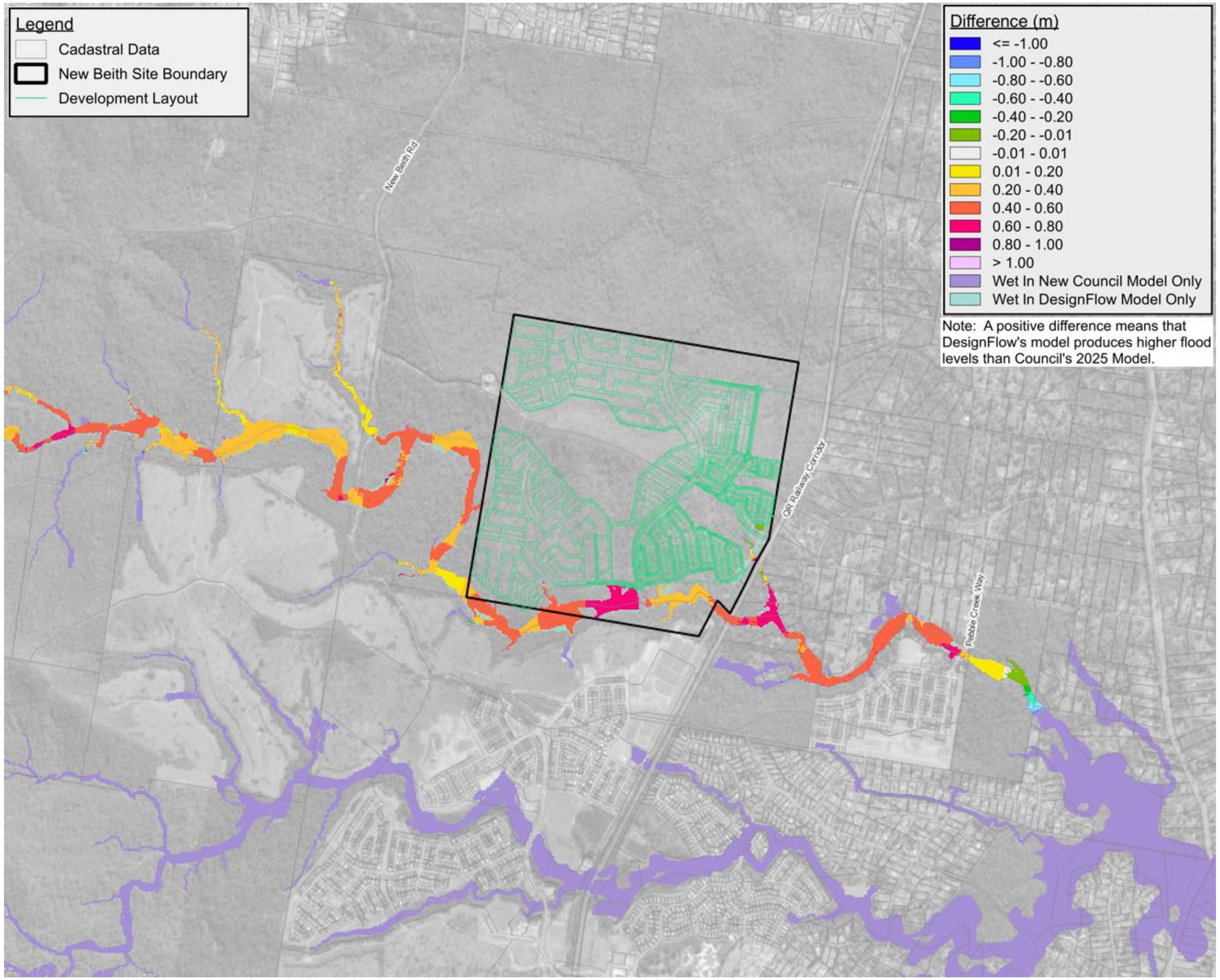


Figure 23 Comparison of New Beith Only Peak Levels 1% AEP (DesignFlow model versus Council Model)

5.4.2 Peak Flood level Impacts

Peak flood level impacts mapping for the New Beith Only case (compared to the updated Council model Base Case) is provided in Appendix F. In the 1% AEP event, flood levels reduce by approximately 50mm to 100mm. Sizing of the Flagstone Creek New Beith crossing has ensured that there are no impacts using both the DesignFlow and Council flood models. Also given the flood levels in the Council (Water Technology) model are lower than the DesignFlow mode, flood immunity requirements are achieved under both models.

An extract from the New Beith Development Only Case peak flood level mapping from the Council model is provided on Figure 24.

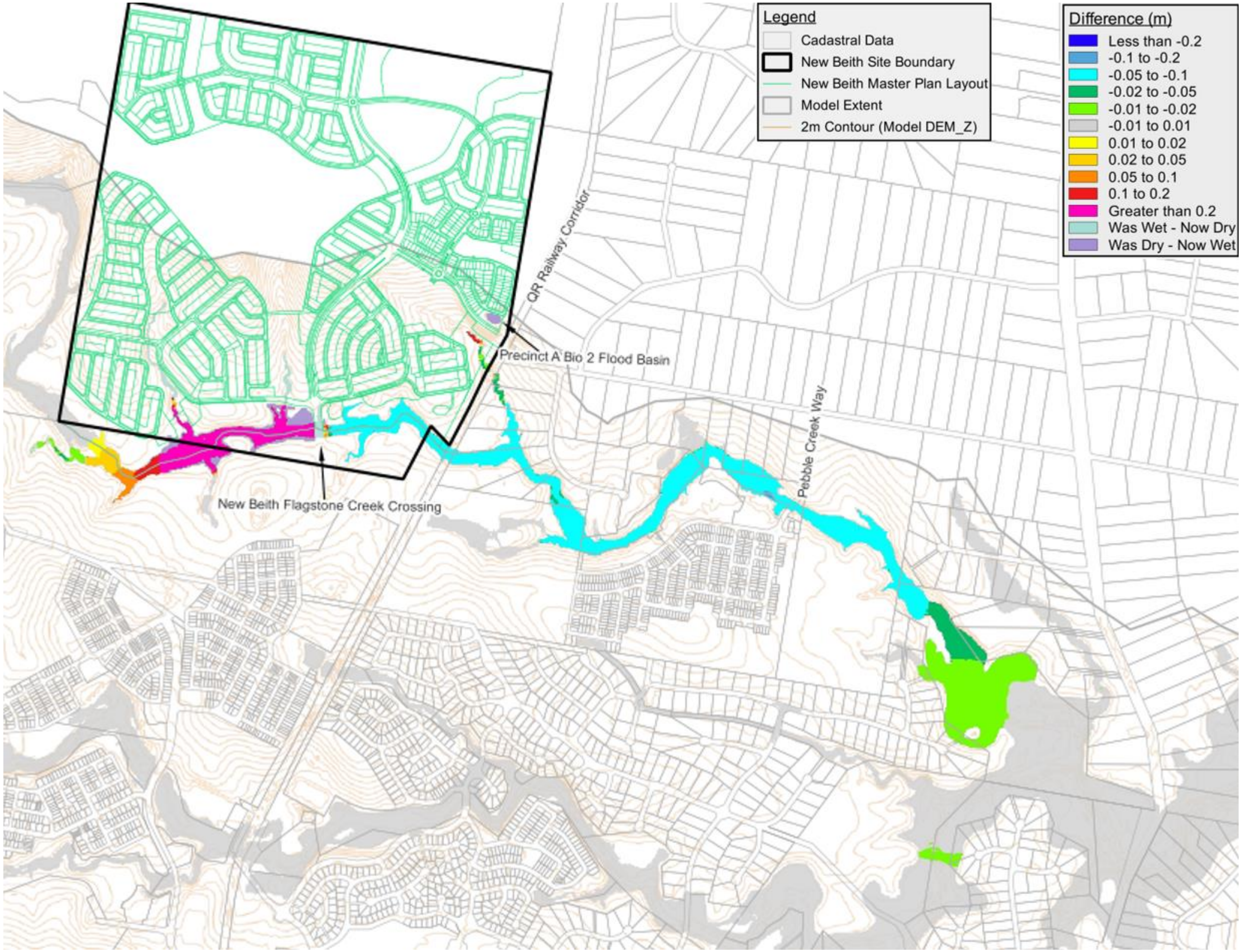


Figure 24 1% AEP New Beith Development Only case peak flood level difference mapping – Council model

6 BRIDGE VELOCITIES

As part of the design process for the Flagstone Creek crossing, potential changes in velocity where considered. **Figure 25** presents the change in velocity around the crossing predicted by the Council adopted model (refer Section 5) for the 63%, 10% and 1% AEP events.

The results indicate that velocity generally decrease as a result of the flood bund. There are some minor increases on the outer banks but scour protection has been provided in these locations in the civil design.

The civil design (Colliers) has provided scour protection to cater for pipe flows of 3 - 4m/s at the pipe headwalls which quickly transitions to lower velocities <2m/s) over the rock scour protection.

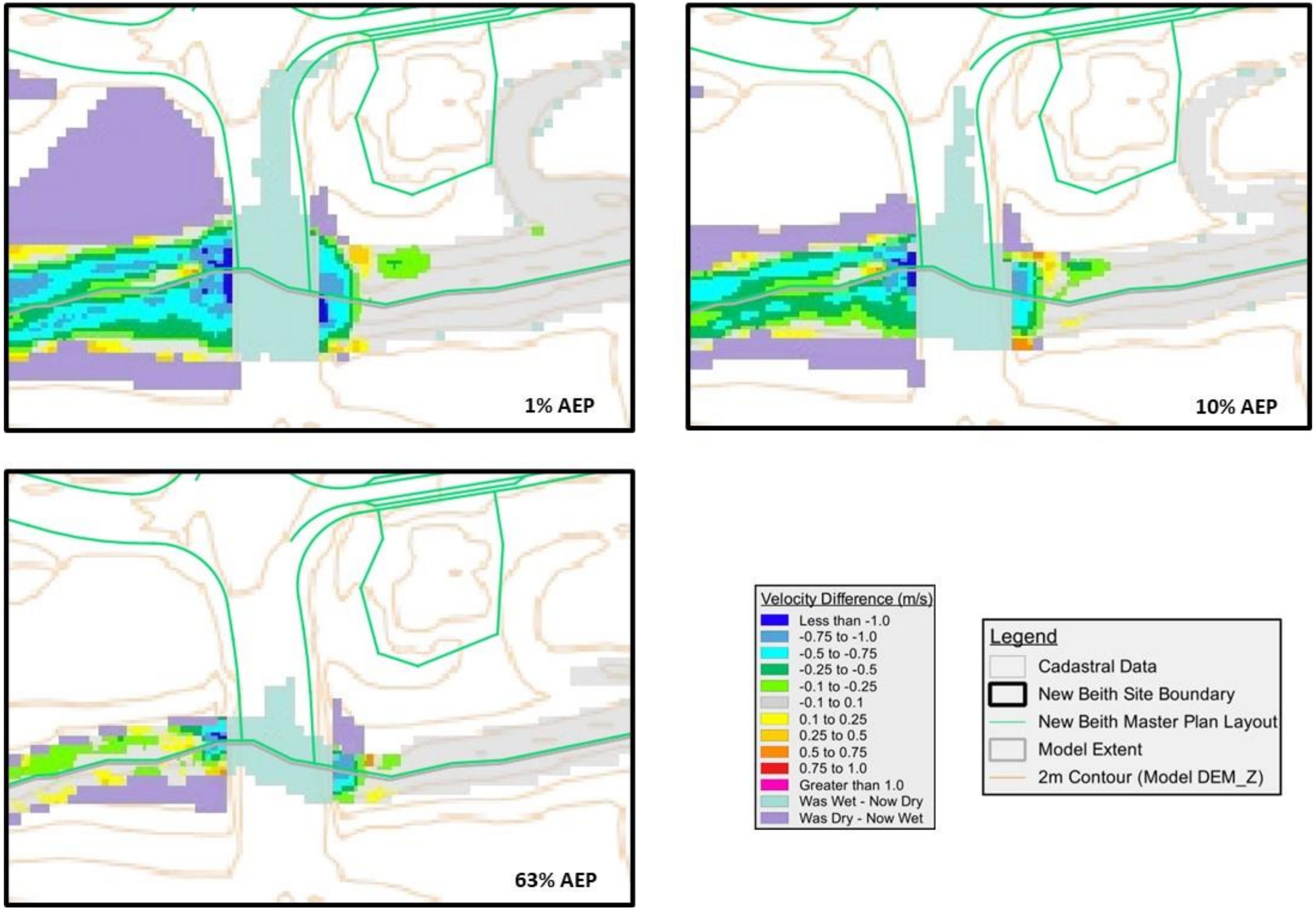


Figure 25 Flagstone Creek Crossing – Velocity Changes

7 CONCLUSION

This report presents the outcomes of flood modelling for all catchment within the New Beith development which drain to Flagstone Creek (i.e. the southern half of the New Beith development) to demonstrate compliance with the flood management objectives defined in the *Stormwater IMP*. Modelling presented in this report builds upon and supersedes previous flood modelling completed for the site.

Model runs have considered ultimate development conditions, with regional flood basins installed across the Flagstone PDA and an interim development scenario with only the New Beith area developed within the Flagstone PDA. The interim development scenario accounts for the Flagstone Creek crossing adjacent to the development but excludes other regional basins throughout the PDA.

The proposed development has been tested in two flood models:

- DesignFlow (Engeny) Flood model – Section 4
- Council Flood model (Water Technology 2025) – Section 5

Flood levels

The predicted change in peak flood levels due to each of the development cases modelled illustrates that each of the proposed development scenarios modelled do not cause increases in peak flood levels downstream in the Flagstone Creek catchment.

The flood levels of Flagstone Creek through the New Beith site are slightly lower in the Ultimate Development case due to the effect of the Flagstone development flood detention basins upstream. In the 1% AEP event, flood levels reduce by approximately 50mm to 100mm in the ultimate development case. Sizing of the Flagstone Creek New Beith crossing has ensured that flood immunity requirements are achieved under both development scenarios.

Flood levels at the Flagstone Creek road crossing indicate no overtopping for all events up to the 1% AEP RCP8.5 (zero blockage conditions). Results of the blockage assessment show that under design blockage conditions (20% culvert blockage), the Year 2090 1% AEP RCP 4.5 event will overtop the road embankment however flood hazard will remain at ARR hazard classification 1.

Under extreme blockage scenario runs no new Flagstone Creek breakout flow paths are created and the development remains flood free.

Flood model results confirm that the development is largely free from inundation during the PMF.

Sensitivity modelling demonstrates that there are substantial increases (up to approximately 1.0m) to design flood levels through the site with increased hydraulic roughness values applied, however no new flow paths are created and flood waters remain in the waterway. Design flood levels from this sensitivity case should be checked against development levels to ensure lots remain flood free under this scenario.

Climate change scenario runs with design blockages applied show that peak flood levels in Flagstone Creek through the site increase by up to 300mm for the RCP 4.5 (2090) scenario and by up to approximately 600mm for the RCP 8.5 (2090) scenario.

Testing of the flood management strategy using Councils Flagstone Creek Model (Water Technology, 2025) found:

- Flood levels predicted by the Council model are lower than the DesignFlow model
- No flood impacts are predicted by the Council model

Peak flows

Results demonstrate that the peak flows downstream of the site for both development cases are at or below the base case scenario for all events from 50% to 1% AEP. This includes discharge locations at the Sydney-Brisbane railway crossings.

The results also demonstrate that the peak flow management objectives for waterway stability (63% AEP) are achieved.

8 REFERENCES

Australian Rainfall and Runoff (2016-2019). *A Guide to Flood Estimation*. Engineers Australia.

Cardno (2014). *Flagstone City Masterplan Flooding Assessment* (September 2014)

DILGP (2017). *State Planning Policy*

Engeny (2023). *Flagstone Creek Baseline Flood Study – New Beith*

Frasers Property (2023). *Stormwater Infrastructure Master Plan Context Area 2 – Lot 4 (New Beith) - Version 4.0* (14 February 2023)

Queensland Urban Drainage Manual (QUDM, 2013). Department of Natural Resources and Water

APPENDIX A: BASE CASE FLOOD MAPS

APPENDIX B: ULTIMATE DEVELOPED CASE FLOOD MAPS

APPENDIX C: NEW BEITH DEVELOPED ONLY CASE FLOOD MAPS

APPENDIX D: SENSITIVITY FLOOD MAPPING

APPENDIX E: FRASER PROPERTY NEW BEITH PTY LTD – FLAGSTONE CREEK BASELINE FLOOD STUDY (ENGENY, 2023)

APPENDIX F: COUNCIL MODEL – NEW BEITH ONLY IMPACT MAPS