

Our ref: L.N20951.007_Warriewood_Rd_FloodingRFI.docx

8 July 2022

Creative Planning Solutions Pty Ltd
Level 3 397 Riley Street
SURRY HILLS NSW 2010

Attention: Sonya Constantinou

Dear Sonya

RE: 45 WARRIEWOOD ROAD, WARRIEWOOD FLOOD IMPACT ASSESSMENT – RESPONSE TO COUNCIL COMMENTS ON FLOODING

The following letter report has been prepared in response to Northern Beaches Council's ("Council") request for further information in a letter dated 18 May 2022 pertaining to the flood impact assessment (FIA) undertaken as part of the 45 Warriewood Road, Warriewood (the "Site") Development Application (DA2021/2600). This letter report also supplements the '45 Warriewood Road, Warriewood Flood Impact Assessment' issued by BMT on 4 February 2021 as part of the DA (refer to hereafter as the "2021 FIA").

In the letter, Council identified the following list of issues:

- *In order to assess Control A1 in the Pittwater 21 DCP B3.11 Flood Prone Land the proposed 900mm stormwater pipe that will replace the existing open channel needs to be included in the TUFLOW model. This assessment should also include all existing and proposed drainage systems in the catchment.*

BMT: This is addressed in the "Local Catchment Flood Modelling" section of this letter report.

- *Long sections along the proposed 900mm stormwater pipe needs to be provided. Long sections must include the surface elevation, stormwater pipe and hydraulic grade line (HGL).*

BMT: This will be provided as a separate stormwater drainage plan.

- *The assessment needs to assess the worst case where there is a coincident local catchment and Narrabeen Creek event up to the PMF event.*

BMT: This is addressed in the "Local Catchment Flood Modelling" section of this letter report.

- *The Flood Management Report must demonstrate that there are no adverse impacts up to the PMF event. To meet control E1 and E3 it must also be demonstrated that flood-free evacuation above the PMF event is possible. We understand that Lot 1 and 2 are not part of the subject DA however details on how they will meet control E1 and E3 is required. This maybe through a shelter in place control on the lots.*

BMT: This is addressed in the "Local Catchment Flood Modelling" and "Flood Emergency Response" sections of this letter report.

This letter report outlines the methodology and findings of the additional FIA undertaken to address the issues outlined previously, as well as provides recommendation on the suitable flood emergency response for the proposed development.

Local Catchment Flood Modelling

Approach

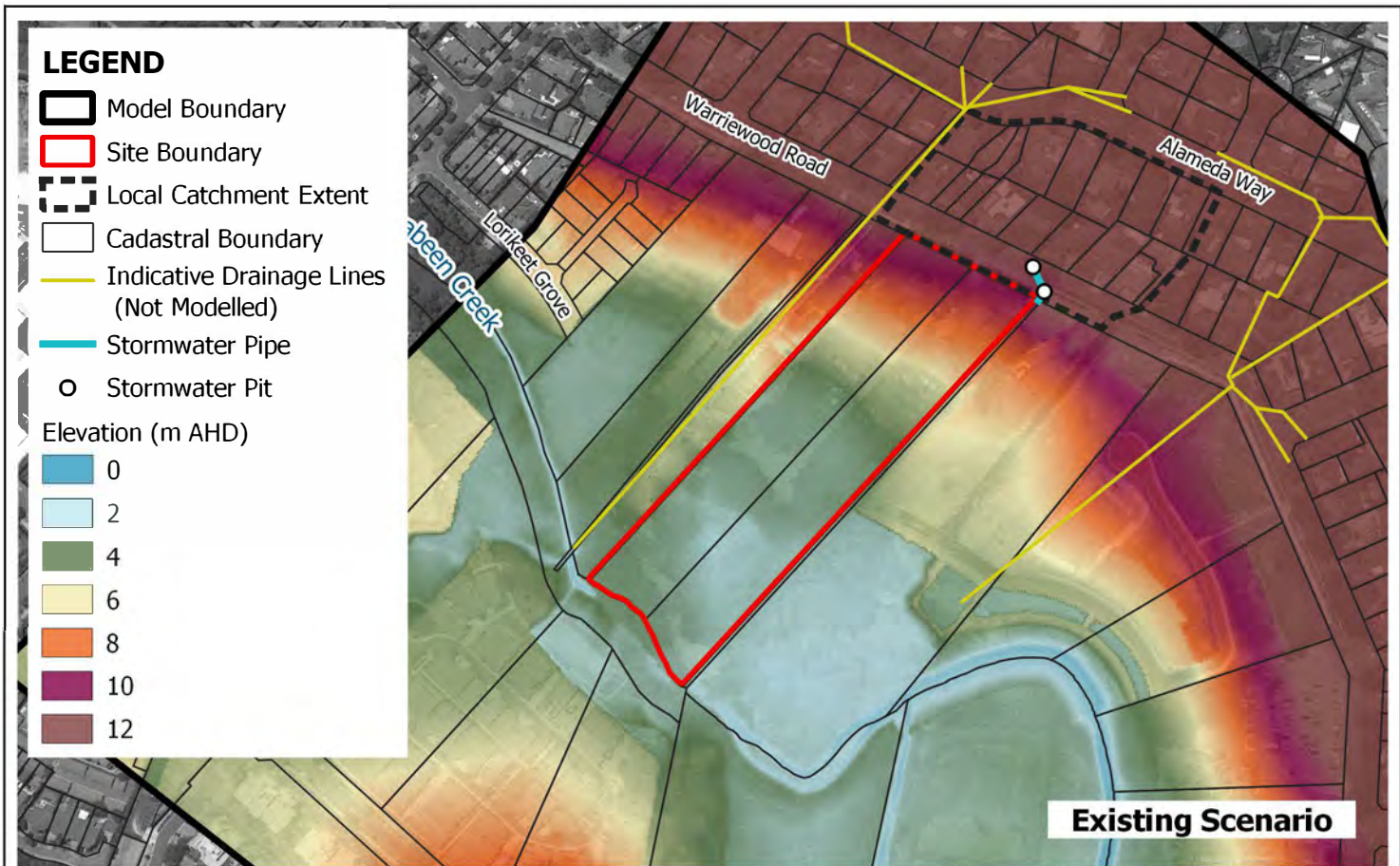
BMT previously undertook the FIA for the Site based on mainstream flooding from Narrabeen Creek, as documented in '*45 Warriewood Road, Warriewood Flood Impact Assessment*' (BMT, 2021). To assess the performance of the 900mm diameter trunk pipe that will replace the existing open channel along the eastern Site boundary, the TUFLOW hydraulic model developed as part of the 2021 FIA was refined to include the simulation of the local catchment flooding for the Site.

Simulation of the local catchment flooding was undertaken for the baseline/existing scenario with the existing open channel along the eastern Site boundary included in the model, as well as for the developed scenario with the 900mm diameter trunk pipe replacing the open channel. In addition to the trunk pipe, an overland flow channel was proposed above the pipe (refer Engineering Report prepared by C & M Consulting Engineers Pty Ltd, issued 4 June 2021). Both the trunk pipe and the overland flow channel have been designed to convey the 1% AEP local catchment flows. To assist with the modelling of the existing open channel under the existing scenario and the 900mm diameter trunk pipe and overland flow channel under the developed scenario, C & M Consulting Engineers Pty Ltd has provided the following:

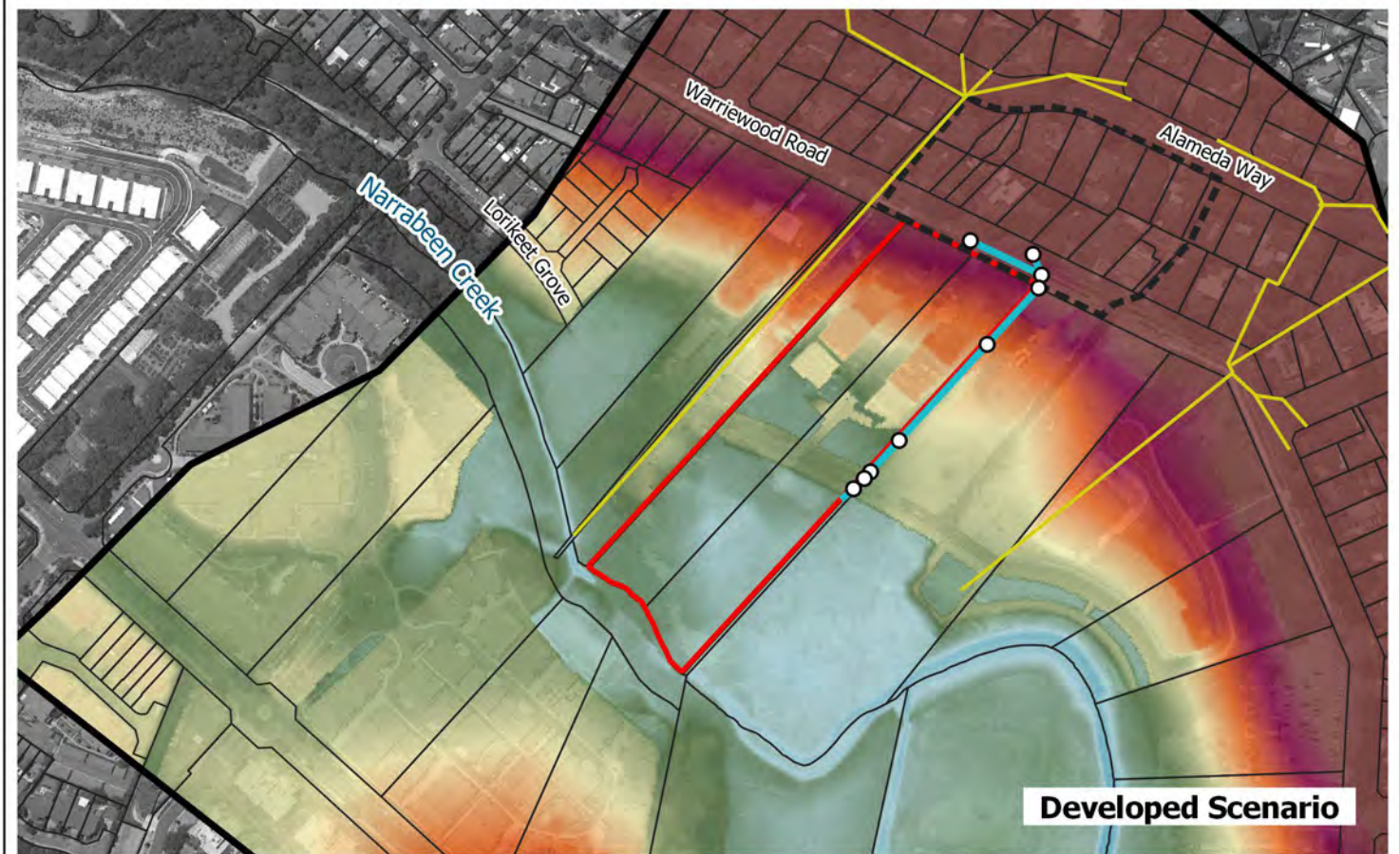
- '*Engineering Report for Proposed Residential Development at 45-49 Warriewood Rd, Warriewood*', Report No. R02192, Revision C, issued 4 June 2021;
- Civil Engineering Works plans for 45-49 Warriewood Road, Warriewood, issued for DA, dated 9 August 2021; and
- CAD file containing stormwater layout and surface tin for both existing and developed scenarios (CAD Reference: 02192_CivilBase.dwg).

The TUFLOW model was refined to include upstream drainage pits and pipes contributing flows to the open channel/900mm diameter trunk pipe along the eastern Site boundary, with the drainage information sourced from Council and the Site survey where available. BMT also developed a hydrologic model for the local catchment using the DRAINS software to derive inflows for application in the TUFLOW model. The hydrologic inflows were developed utilising Australian Rainfall and Runoff 1987 (AR&R 87) data and methodologies to be consistent with the mainstream flood modelling as well as Council's '*Ingleside, Elanora and Warriewood Overland Flow Flood Study*' (WMAwater, 2019) developed for the same catchment. The other parameters for the hydrologic model including losses and fraction impervious for land use were defined as per the WMAwater (2019) study. The hydrologic inflows were then applied on the surface of the drainage pits located in the proximity of the Warriewood Road low point fronting (north of) the Site. Council has confirmed the above-described approach to modelling local catchment flooding as acceptable following email correspondence dated 28 June 2022. The model schematisation is as illustrated in Figure 1.1.

The changes to the fraction impervious within the Site boundary and increases to the Site runoff were addressed as part of the Stormwater Management Plan developed for the Site (refer Engineering Report prepared by C & M Consulting Engineers Pty Ltd, Revision C, issued 4 June 2021).



Existing Scenario



Developed Scenario

<p>Title: TUFLOW Model Configuration</p>	<p>Figure: 1-1</p>	<p>Rev: A</p>
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Coincident local catchment and Narrabeen Creek flooding was assumed for all modelled events in simulating both the existing and developed scenarios (based on critical flows for both flood mechanisms). Simulations were undertaken for the 2 year Average Recurrence Interval (ARI), 5 year ARI, 10% Annual Exceedance Probability (AEP), 5% AEP, 2% AEP, 1% AEP, 1% AEP with climate change (2100 sea level rise and 30% increase in rainfall intensity, also refer to hereafter as the 1% AEP+CC event) and the Probable Maximum Flood (PMF) events (similar suite of events as per the 2021 FIA).

Results

Assessment of the local catchment and mainstream flooding impacts resulting from the proposed development (including the conversion of the existing open channel into a 900mm diameter trunk pipe and the overland flow channel above) was undertaken by comparing the peak flood levels and velocities for the developed scenario against those of the existing scenario, for all modelled events. The flood modelling results are presented as flood maps enclosed in the annexures of this letter report, as follows:

- Annex A- Existing scenario flood conditions mapping including peak flood depths, levels and velocities for the 2 year ARI to PMF events, as well as peak flood hazards for the 1% AEP to PMF events;
- Annex B- Developed scenario flood conditions mapping including peak flood depths, levels and velocities for the 2 year ARI to PMF events, as well as peak flood hazards for the 1% AEP to PMF events;
- Annex C- Flood impact mapping including peak flood level and velocity impacts for the 2 year ARI to PMF events.

Under the existing scenario, the low point on Warriewood Road located upstream (north) of the Site generally experience shallow overland flow flooding (i.e. <0.2m flood depths) and flows in excess of the existing drainage capacity spill over into the Site prior to discharge into Narrabeen Creek.

Under the developed scenario, whereby the southern half of Warriewood Road fronting the development will be regraded and new kerb and gutter will be installed, the shallow overland flow will be captured by the proposed pits and pipes system (in lieu of spilling over into the Site) and the flow will be conveyed via the 900mm diameter trunk pipe prior to discharge into Narrabeen Creek.

Based on the peak flood level impact results for all modelled events as presented in Annex C, it is evident that the proposed development has no significant impact on peak design flood levels either adjacent to or downstream of the Site, based on the coincident local catchment and Narrabeen Creek flooding scenario. In all modelled events there is generally a reduction of flood extent and level on the Site and on the neighbouring lot to the east. The localised “increase” in flood levels exhibited on the Warriewood Road corridor is mainly due to the regrading works proposed along the southern half of the road carriageway, with the peak flood depth at this area remains shallow, i.e. below 0.2m, up to the 1% AEP+CC event.

In terms of peak flood velocity impact, there is generally minimal change to the off-site peak flood velocities other than a localised area immediately downstream of the 900mm diameter trunk pipe outlet. It should be noted that rock lined energy dissipator is proposed at the trunk outlet (not modelled in the TUFLOW model) to protect downstream areas from scour and erosion by reducing the flow velocity to acceptable limits (refer Stormwater Drainage Plan prepared by C & M Consulting Engineers Pty Ltd, dated 2 December 2021, also attached as Annex D).

Flood modelling was also undertaken for the PMF event to assess the flood hazard for this extreme event under developed scenario flood conditions and plan for flood emergency response. The PMF

hazard map is enclosed as Figure B-19 for the developed scenario, with the flood hazard defined based on the composite six-tiered hazard classification in the 'Australian Disaster Resilience Handbook 7 Managing the Floodplain: A Guide to Best Practice in Flood Risk Management in Australia' (AIDR, 2017) and reproduced in Figure 1.2.

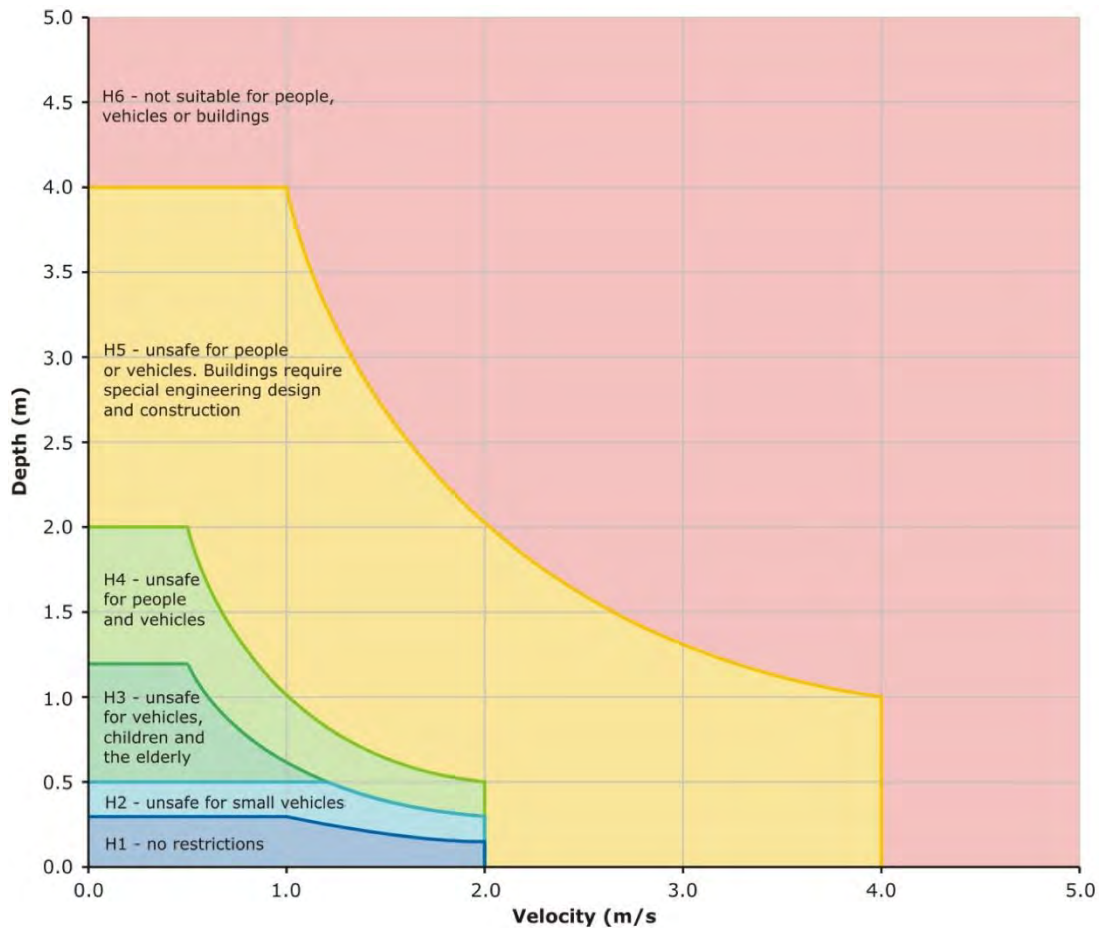


Figure 1.2 Flood Hazard Curves

Flood Emergency Response

Given the small size of the upstream catchment there will be no practical flood warning available at the Site. Therefore, people on-Site will have to react and respond to flood events as and when they occur, which is similar for all other flood affected locations in the area. However, the proposed development platform and upper floors (minimum Finished Floor Level of 6.02mAHD, also refer Annex D plan) and adjoining flood free land means that the majority of the lots remain flood free in the PMF event. Therefore, there is on-Site flood-free refuge and a shelter-in-place approach is recommended as the preferred flood emergency response for the proposed development. A Flood Emergency Response Plan or Flood Evacuation Plan can be prepared during the next stage of the project if deemed necessary.

Conclusions

This letter report has been prepared in response to Northern Beaches Council's request for further information dated 18 May 2022 for the proposed development at 45 Warriewood Road, Warriewood. In preparing this letter report, a flood impact assessment has been undertaken based on coincident local catchment and Narrabeen Creek flood conditions for the Site. The assessment found that:

- The proposed development has no significant impact on peak design flood levels either adjacent to or downstream of the Site, based on the coincident local catchment and Narrabeen Creek flooding scenario.
- There is generally minimal change to the off-site peak flood velocities other than a localised area immediately downstream of the 900mm diameter trunk pipe outlet. Rock lined energy dissipator has been proposed at the trunk outlet to protect downstream areas from scour and erosion by reducing the flow velocity to acceptable limits.

With regards to a suitable flood emergency response for the proposed development, a shelter-in-place approach is recommended as the preferred flood emergency response in view of the availability of on-Site flood-free refuge, i.e. upper floors above the PMF level and adjoining flood free land (outside of the PMF extent).

We trust the above information sufficiently addresses Council's queries. Please do not hesitate to contact the undersigned if further information is required.

Yours Sincerely,

BMT



Nathan Cheah

Associate Principal Engineer

References

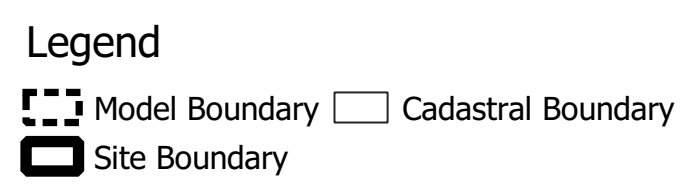
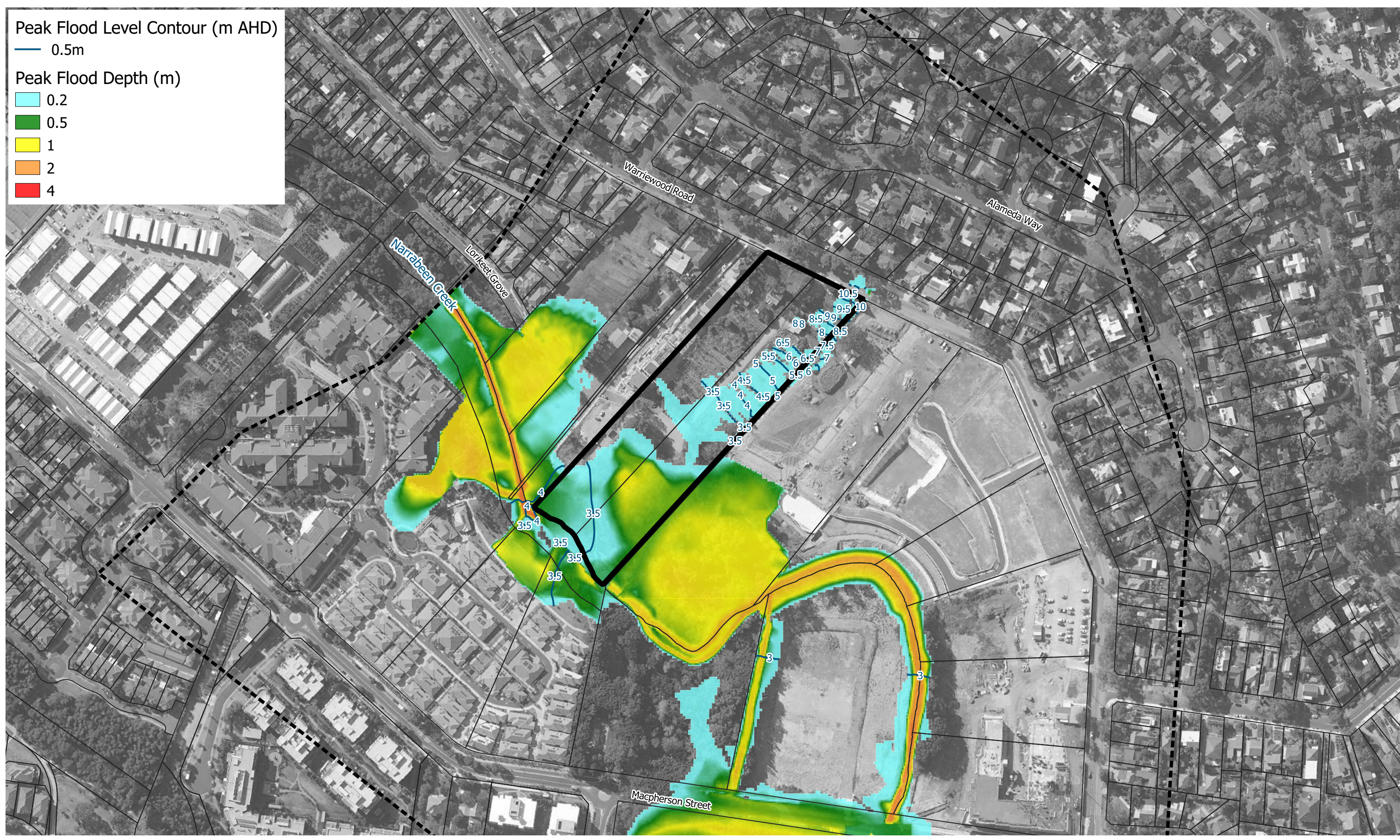
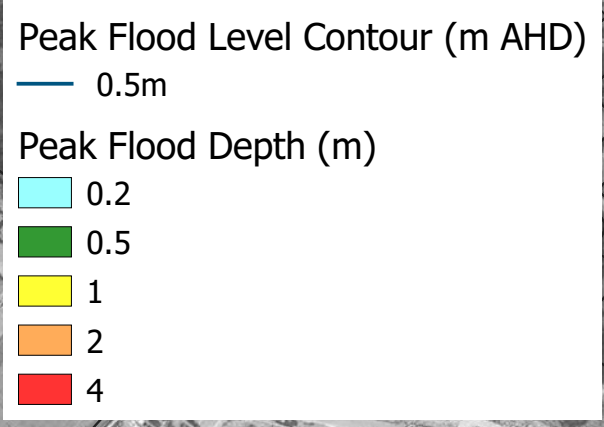
AIDR (2017) '*Australian Disaster Resilience Handbook 7 Managing the Floodplain: A Guide to Best Practice in Flood Risk Management in Australia*'.

BMT (2021) '*45 Warriewood Road, Warriewood Flood Impact Assessment*'.

C & M Consulting Engineers Pty Ltd (2021) '*Engineering Report for Proposed Residential Development at 45-49 Warriewood Rd, Warriewood*', Report No. R02192, Revision C.

WMAwater (2019) '*Ingleside, Elanora and Warriewood Overland Flow Flood Study*'.

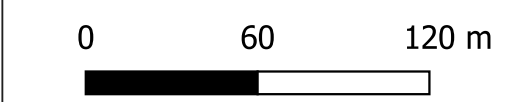
Annex A Flood Mapping for Existing Scenario



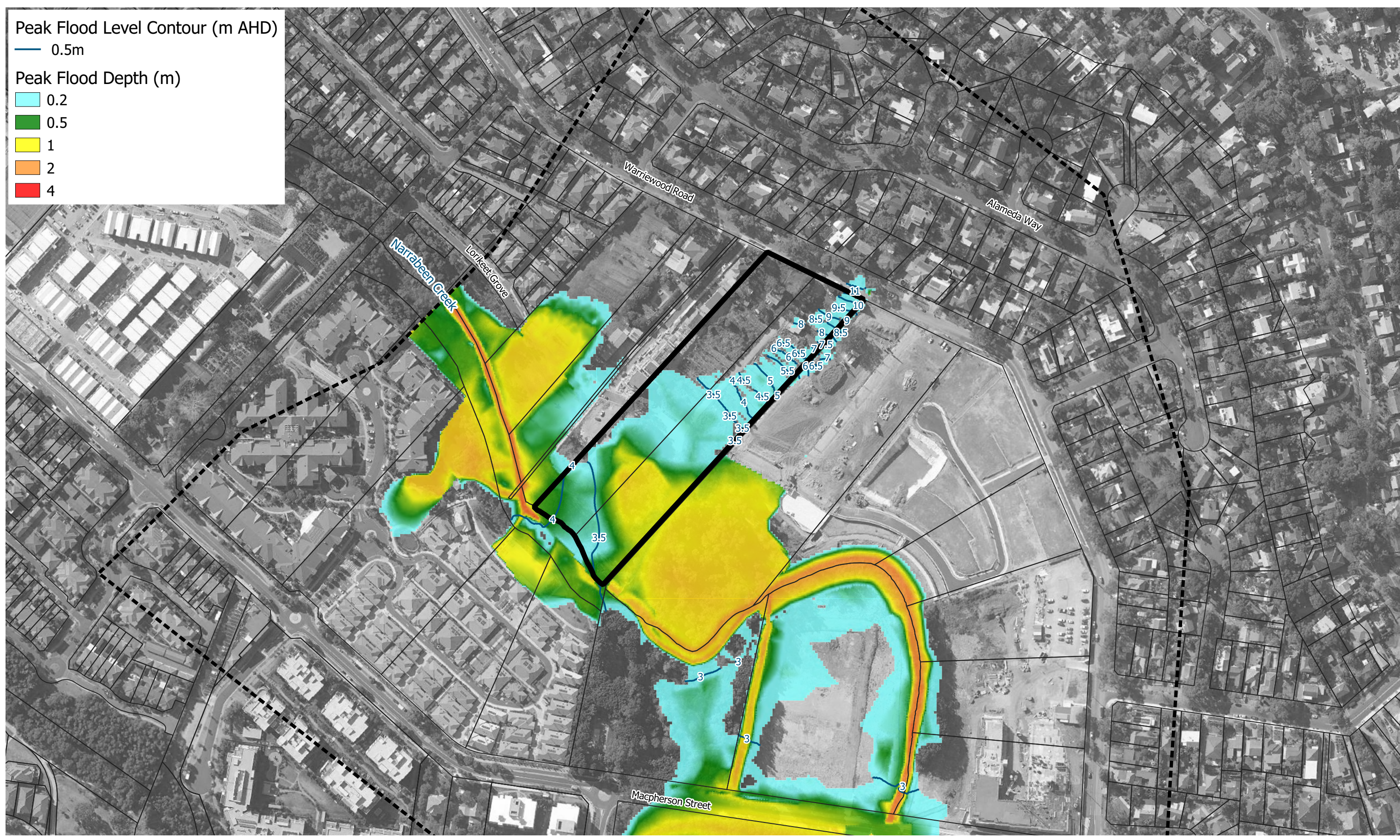
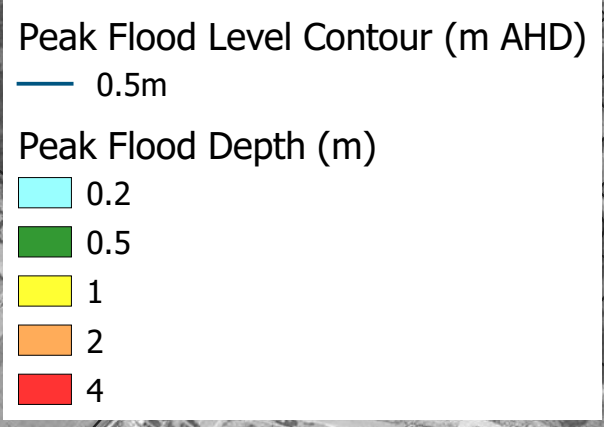
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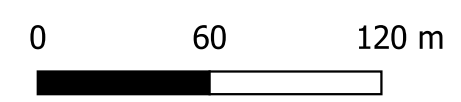
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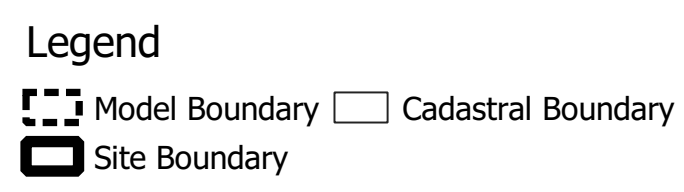
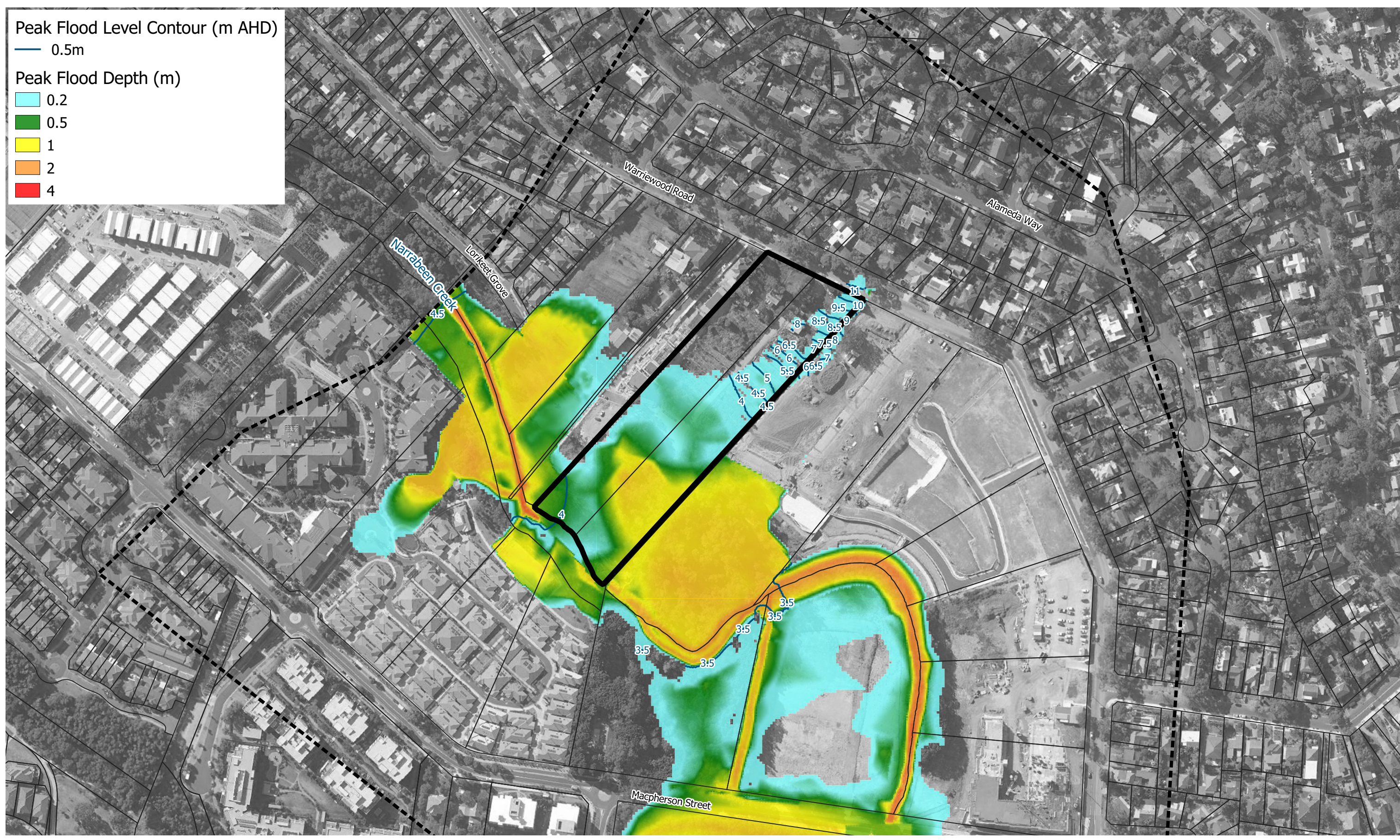
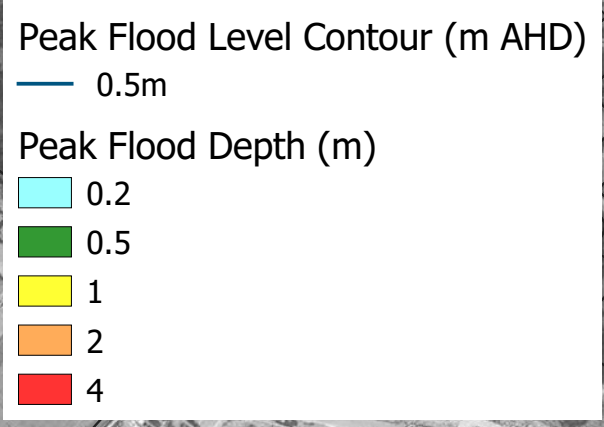
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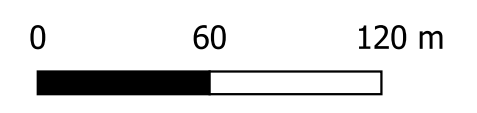
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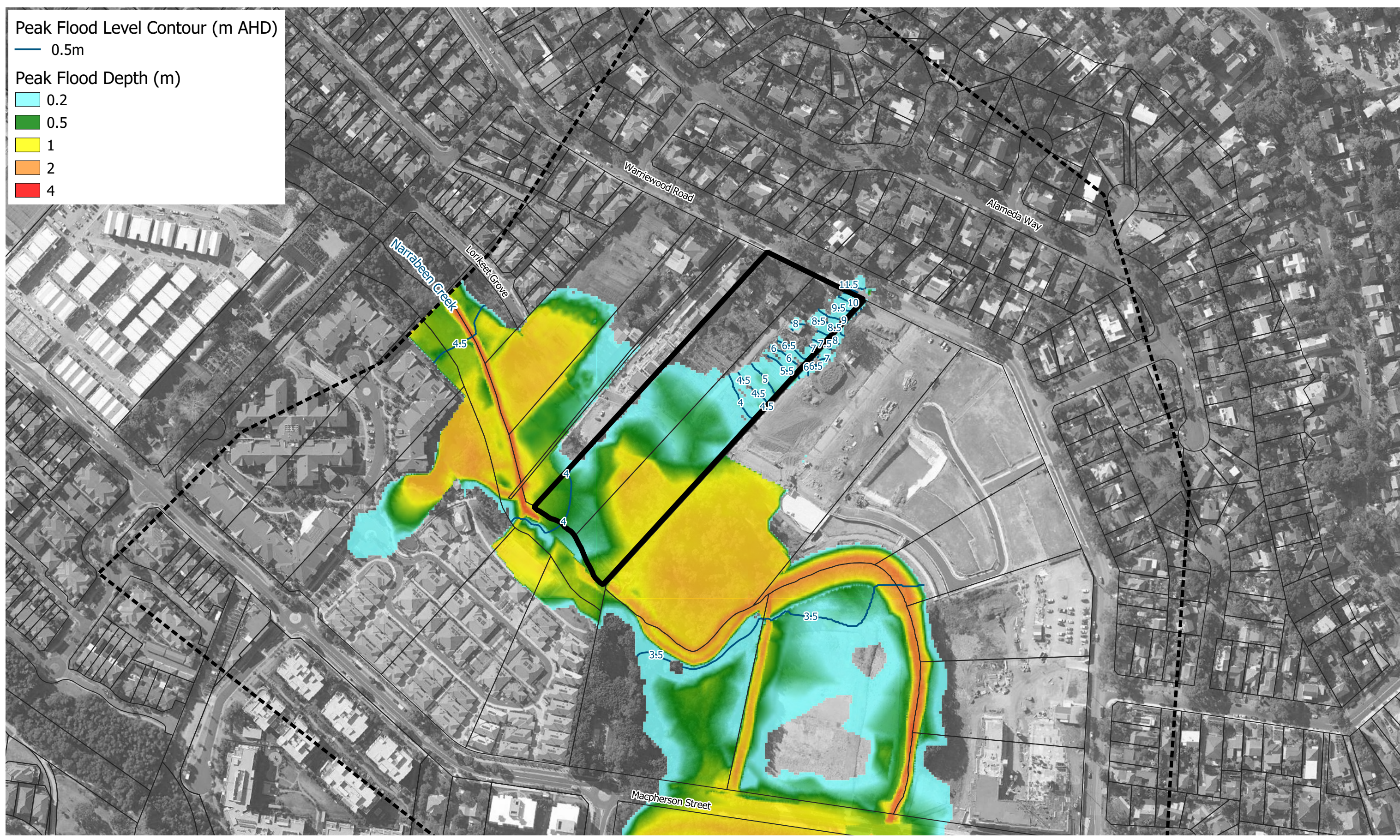
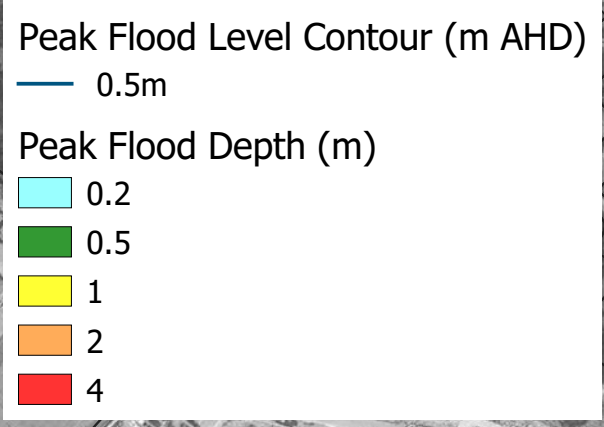
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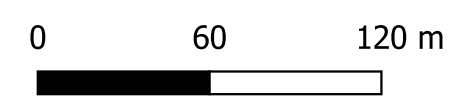
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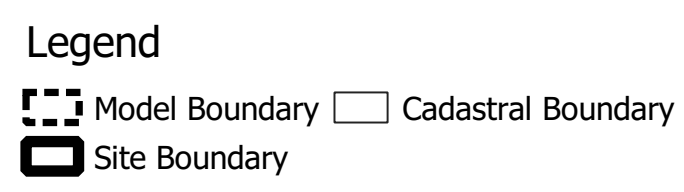
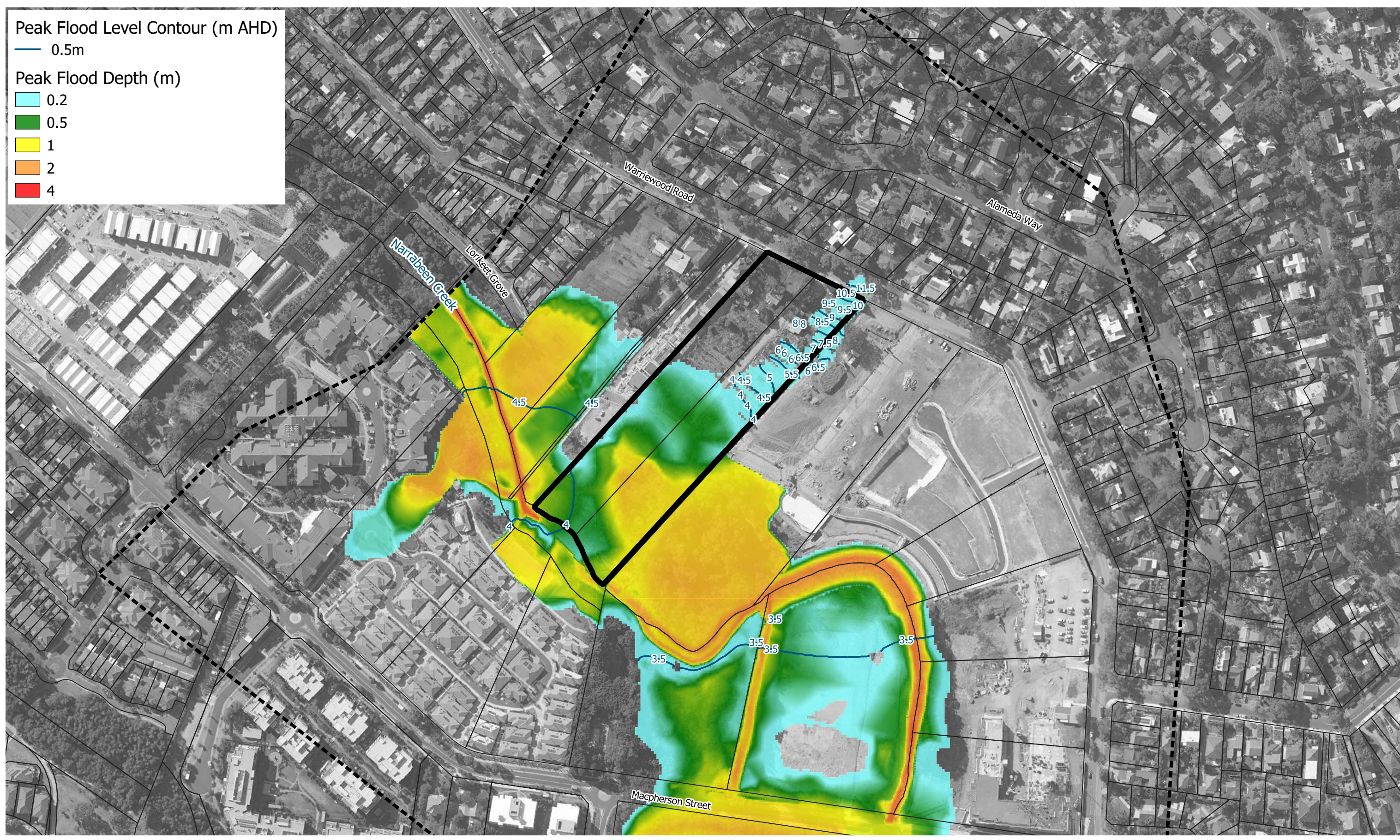
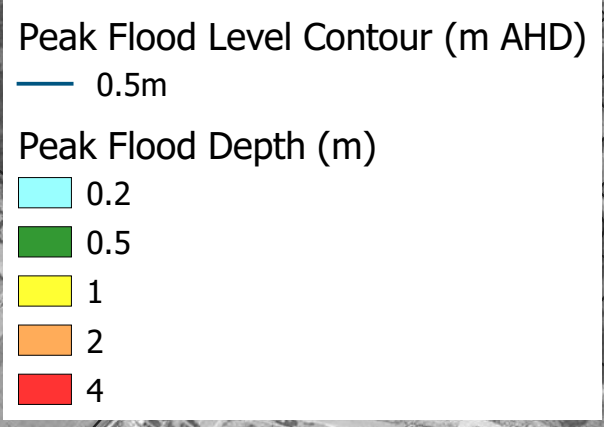
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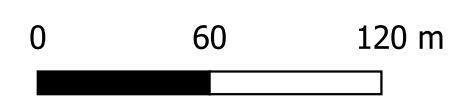
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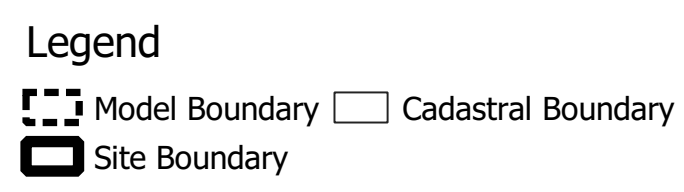
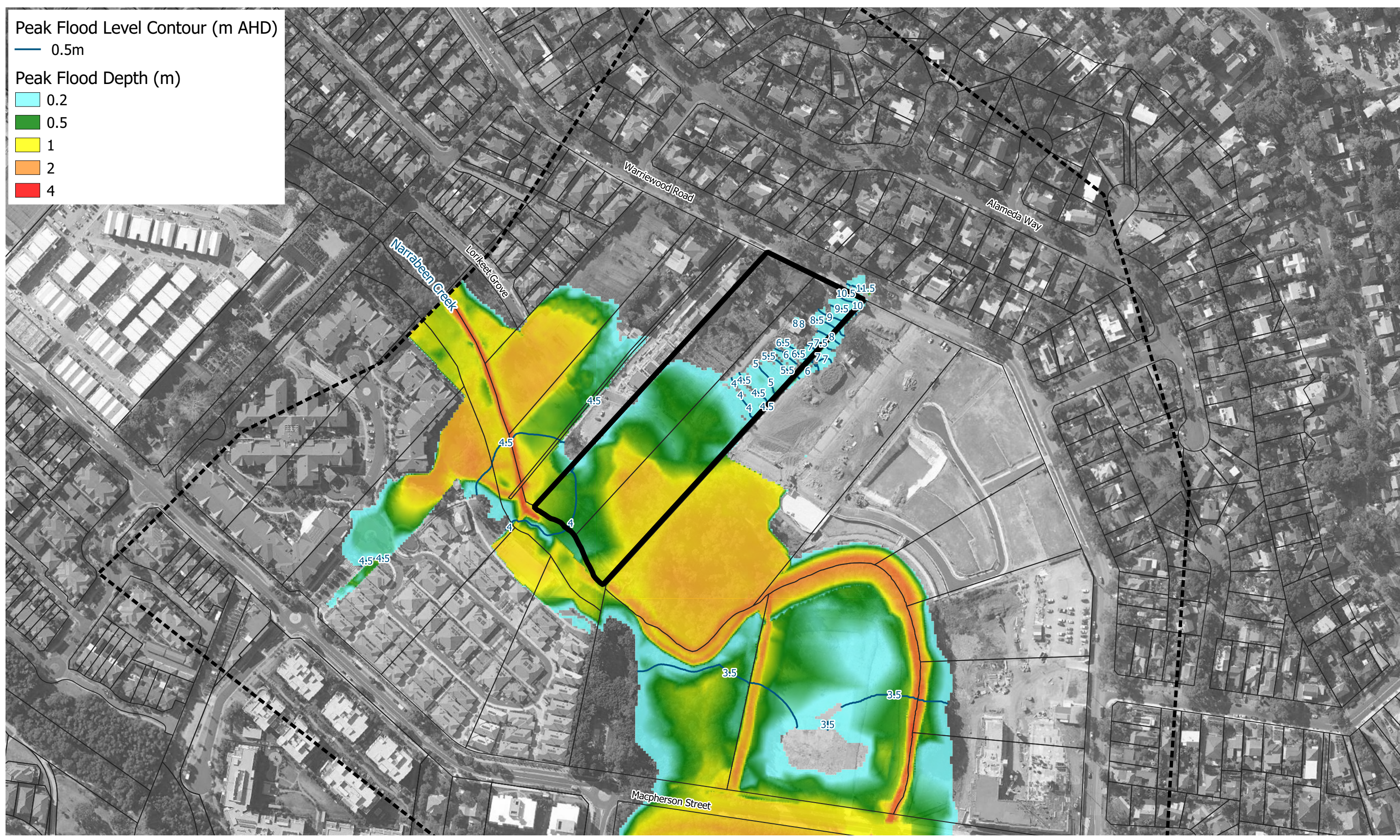
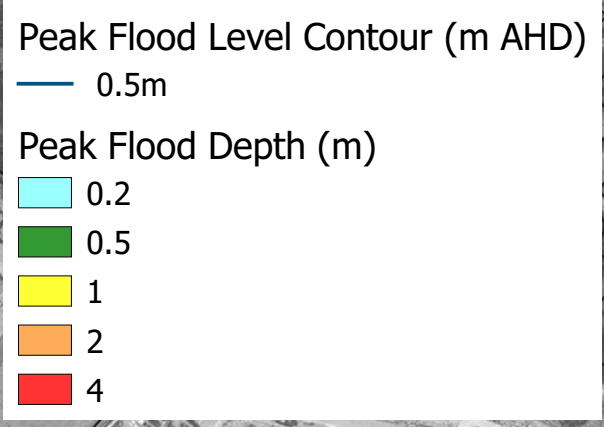
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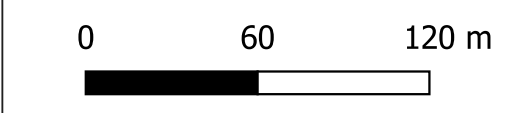
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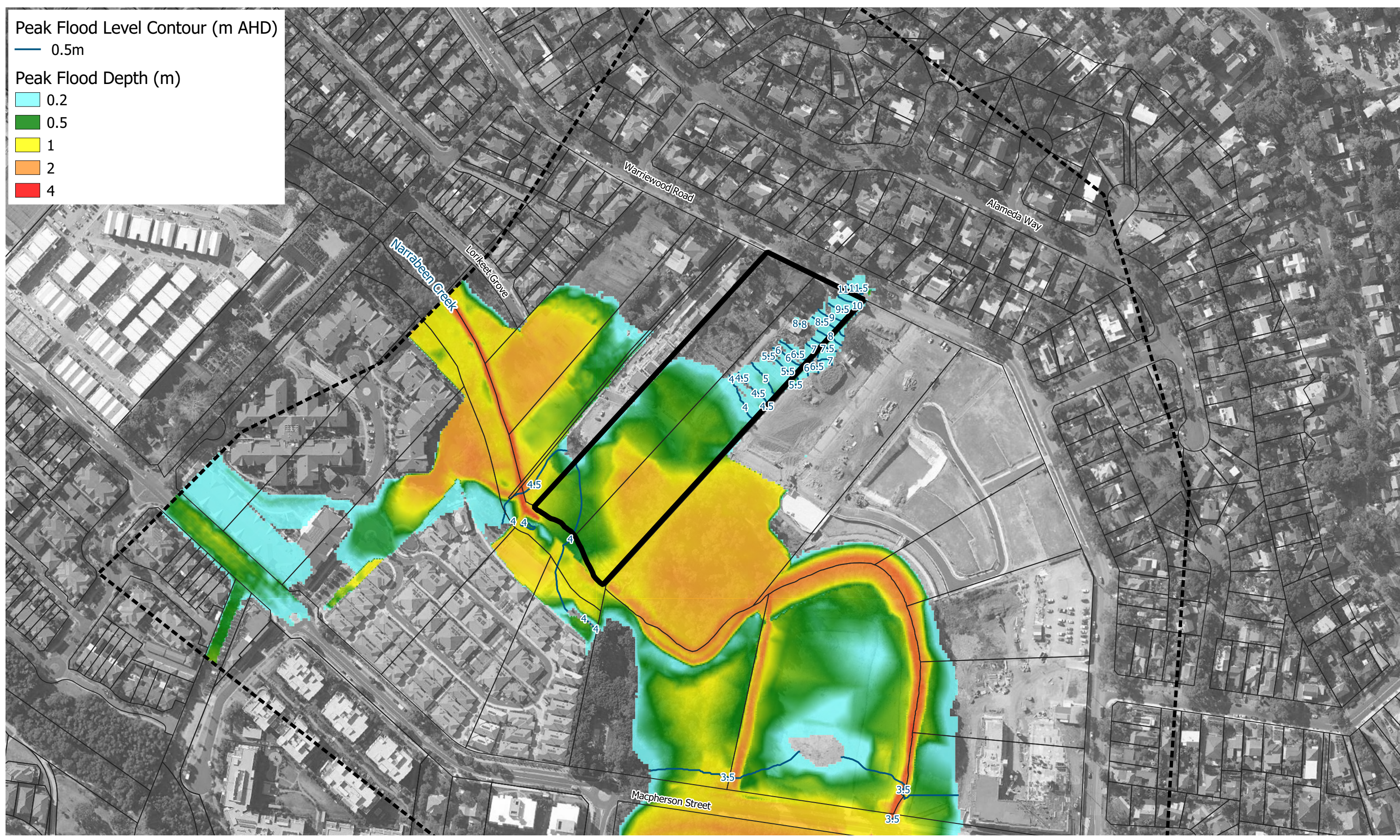
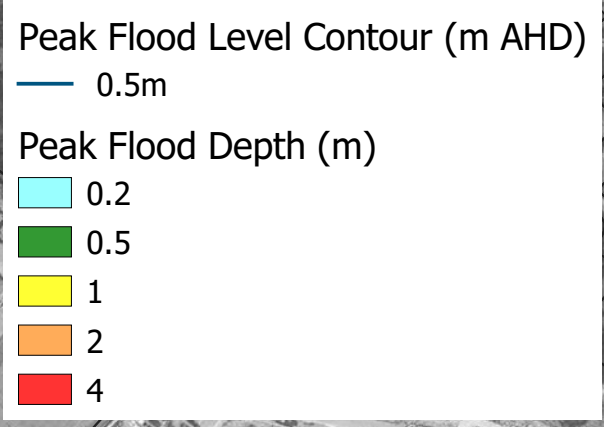
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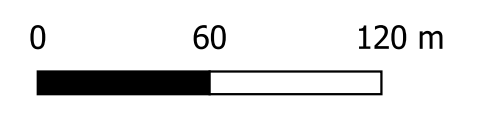
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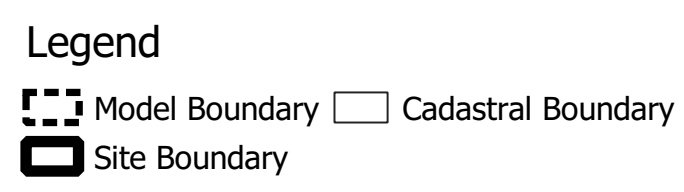
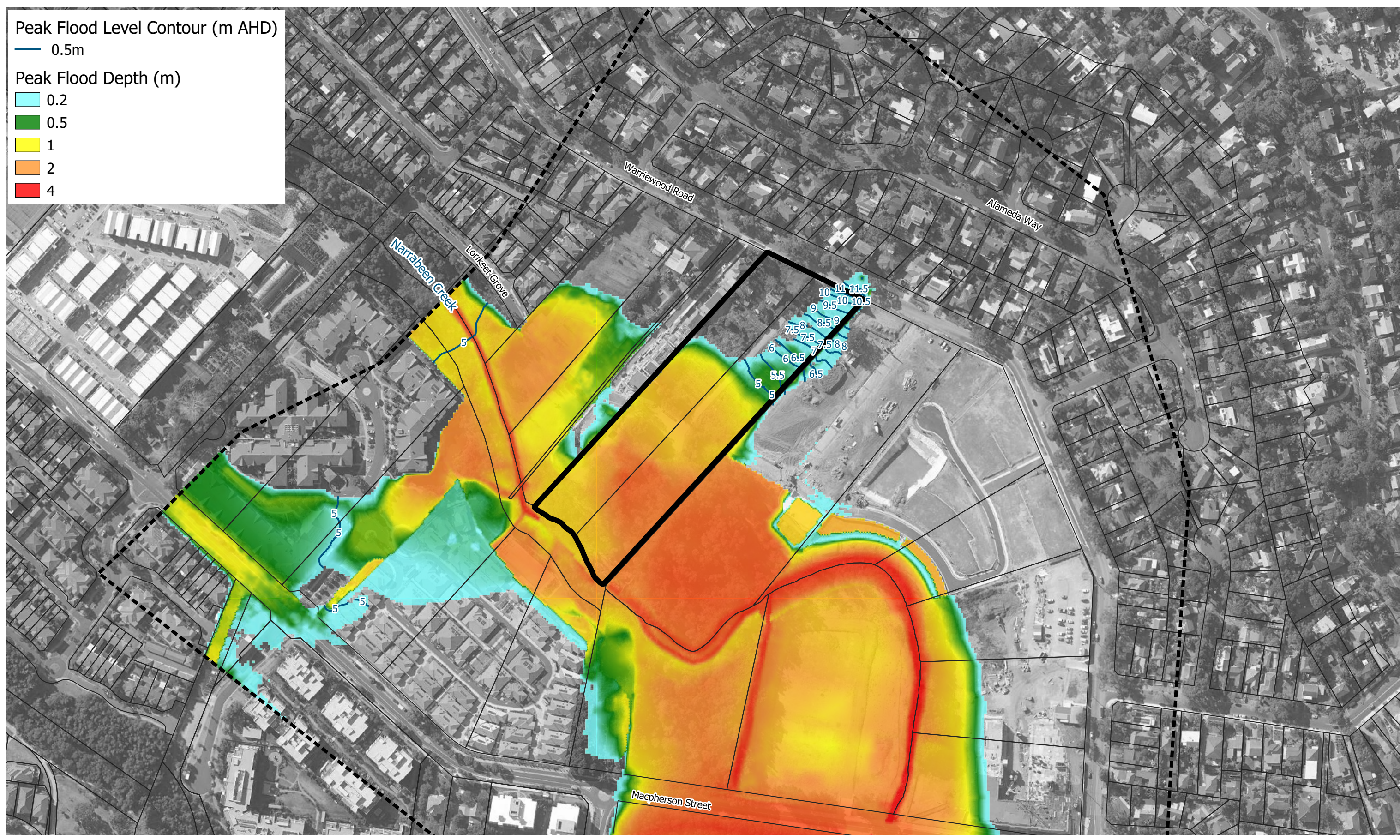
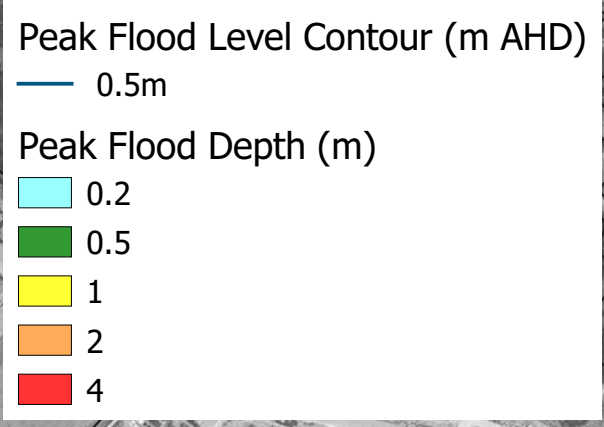
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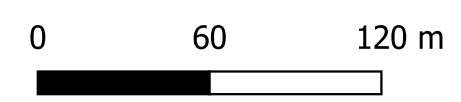
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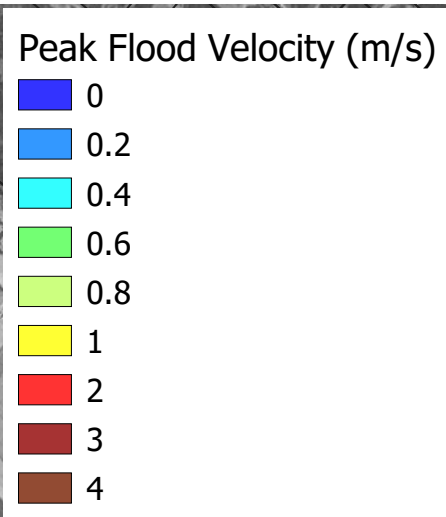
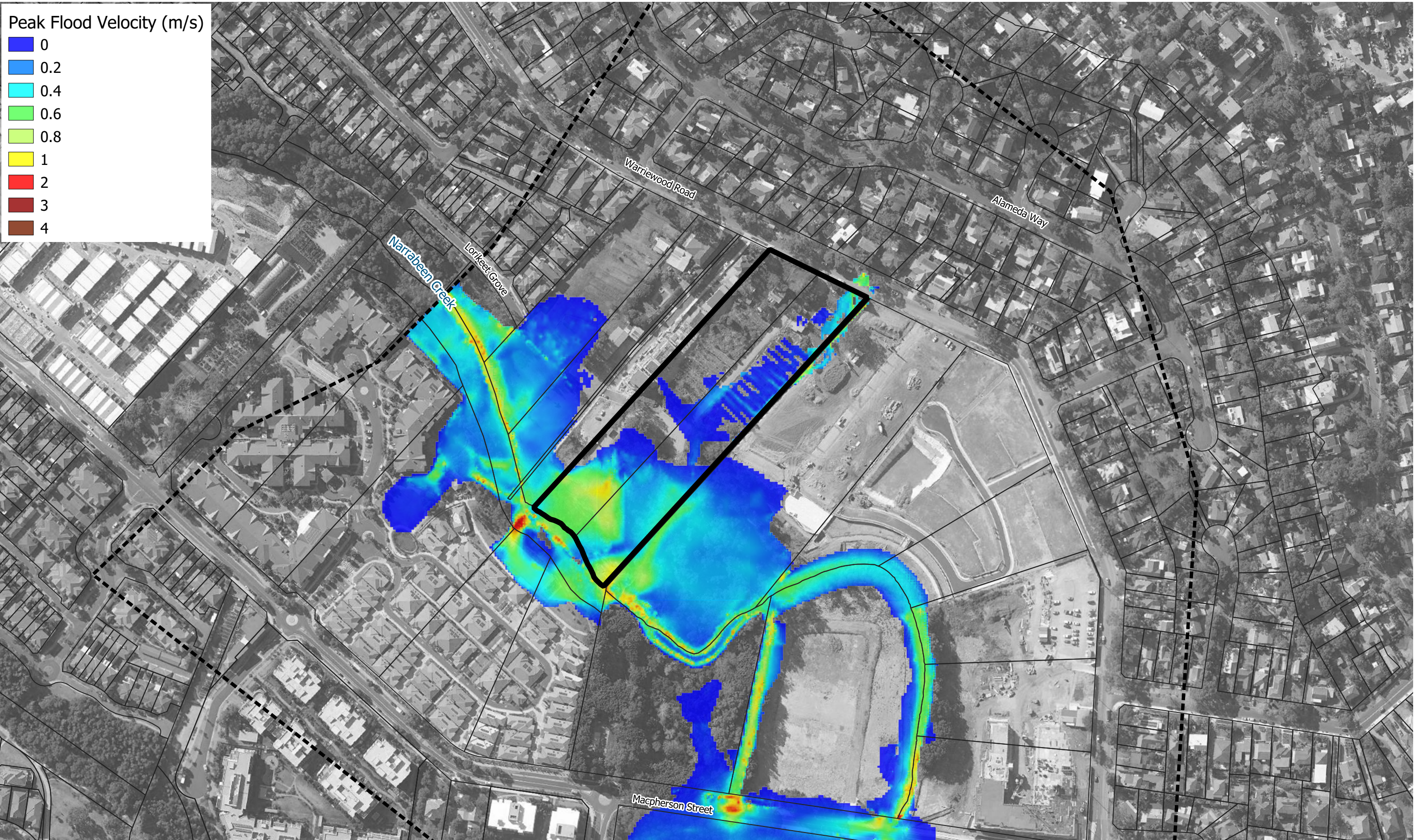
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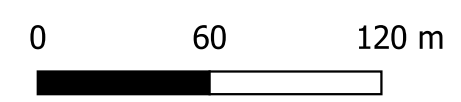
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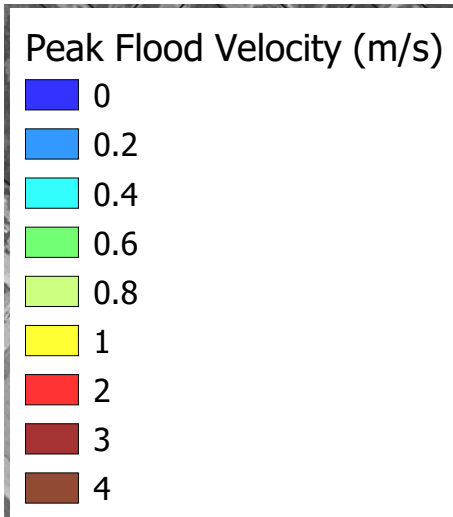
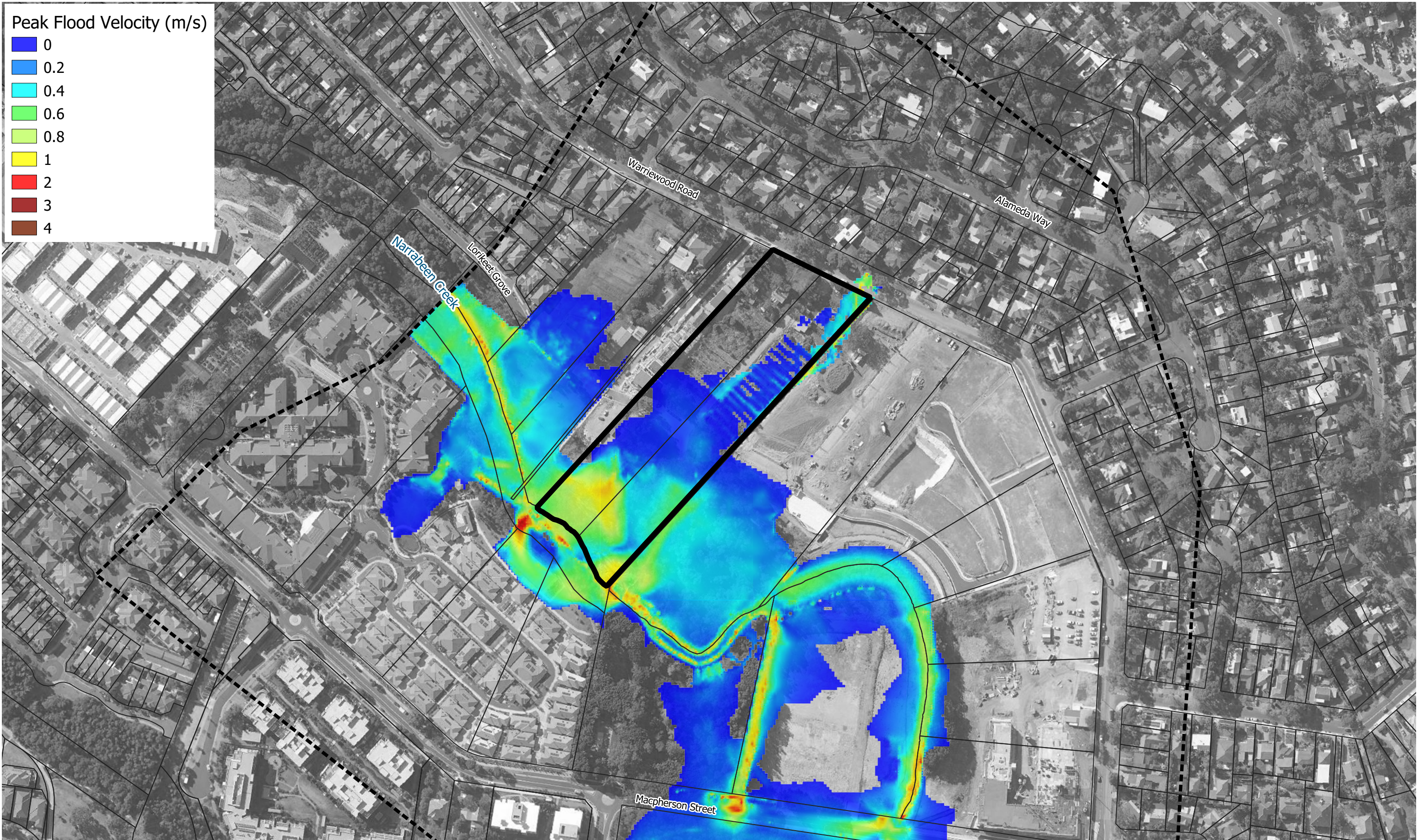
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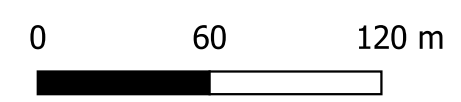
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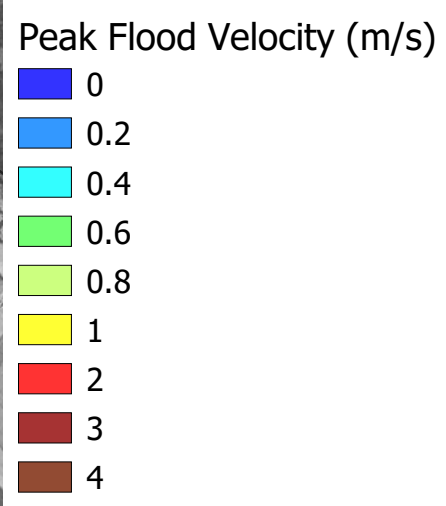
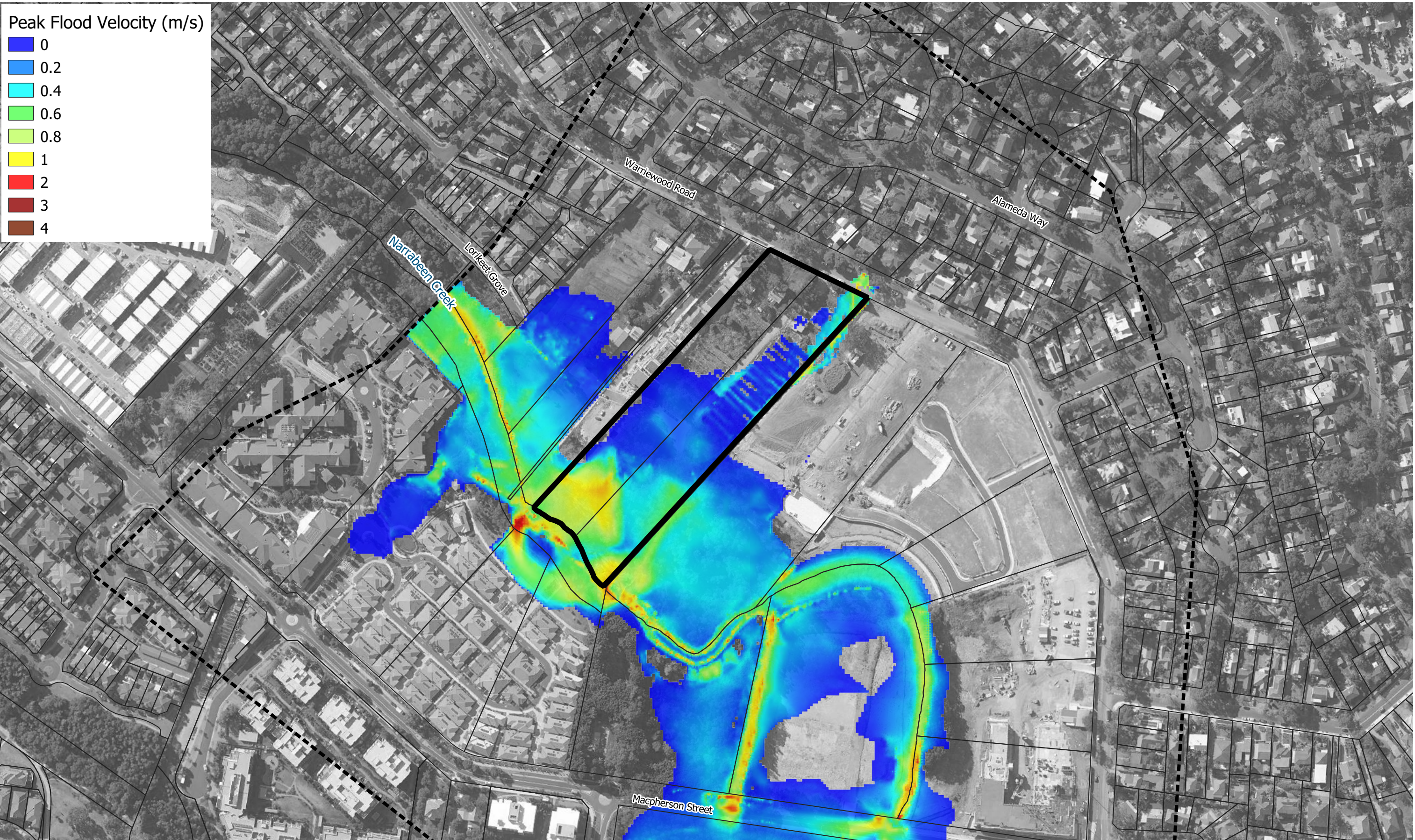
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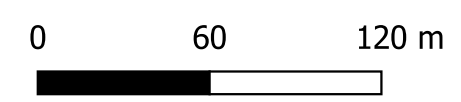
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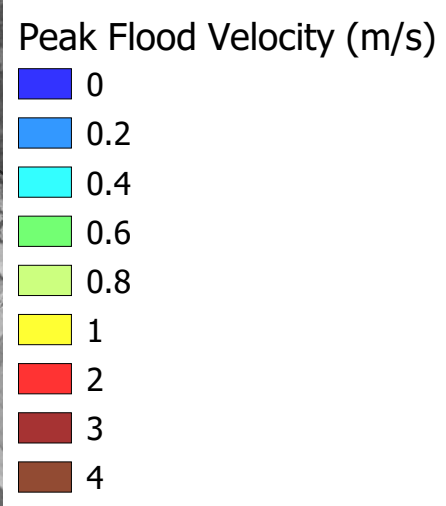
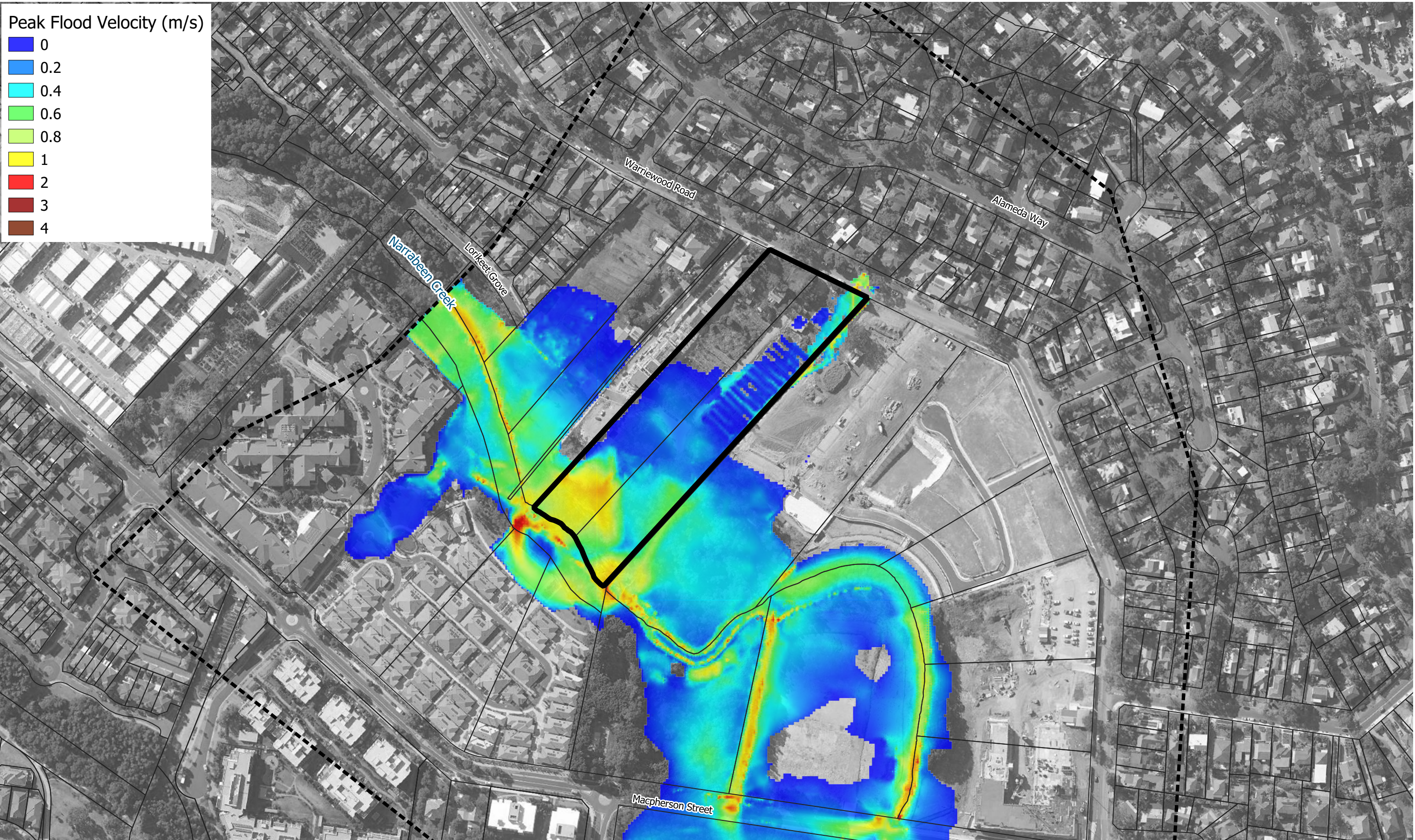
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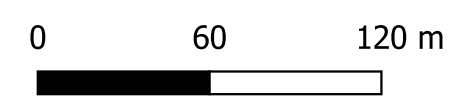
Legend

Model Boundary
 Cadastral Boundary
 Site Boundary

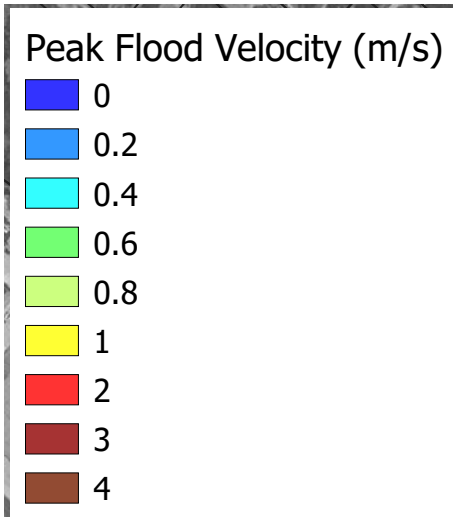
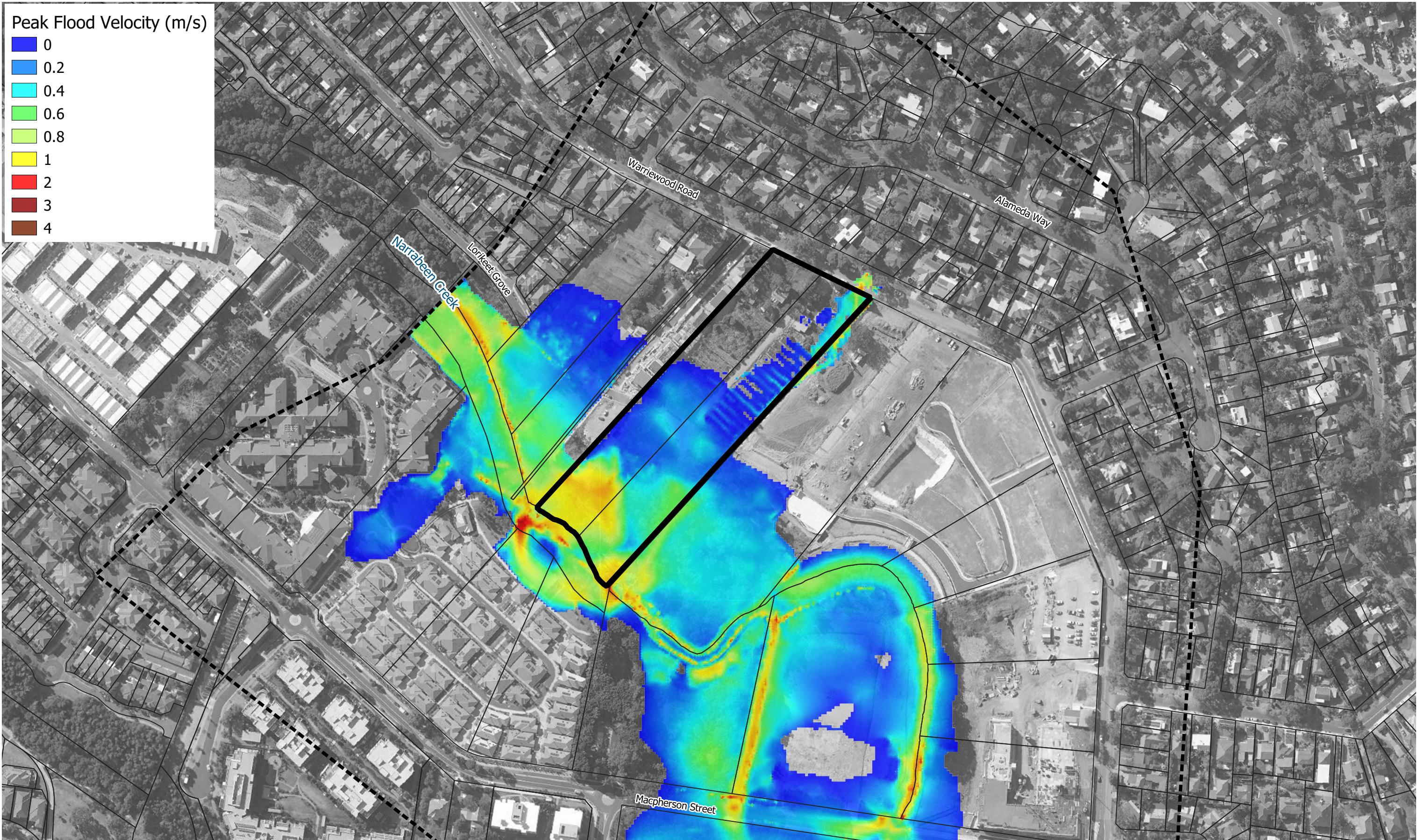
Title:
5% AEP event - Existing Scenario - Peak Flood Velocities for Coincident Local and Creek Flooding

Drawing: **A-12** Rev: **A**

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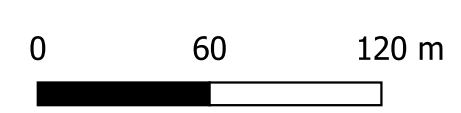
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Model Boundary
 Cadastral Boundary
 Site Boundary

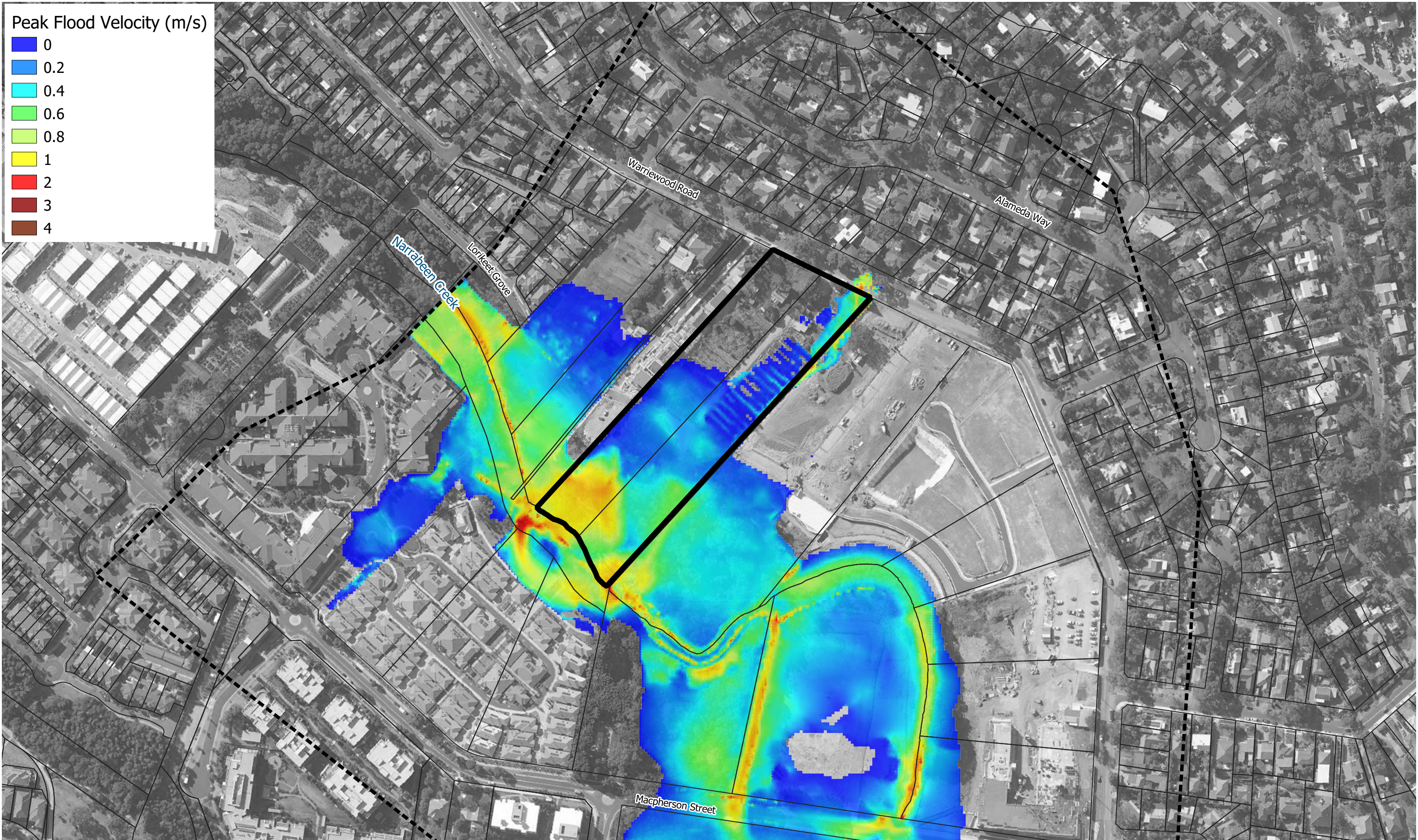
Title:
2% AEP event - Existing Scenario - Peak Flood Velocities for Coincident Local and Creek Flooding

Drawing: **A-13** Rev: **A**

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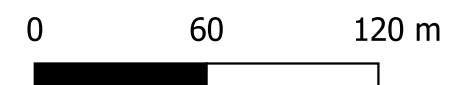
Legend

- Model Boundary Cadastral Boundary
- Site Boundary

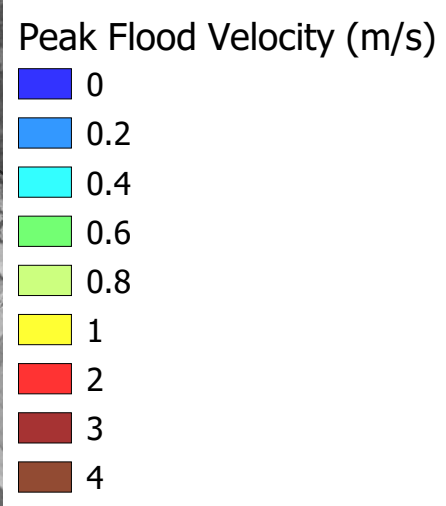
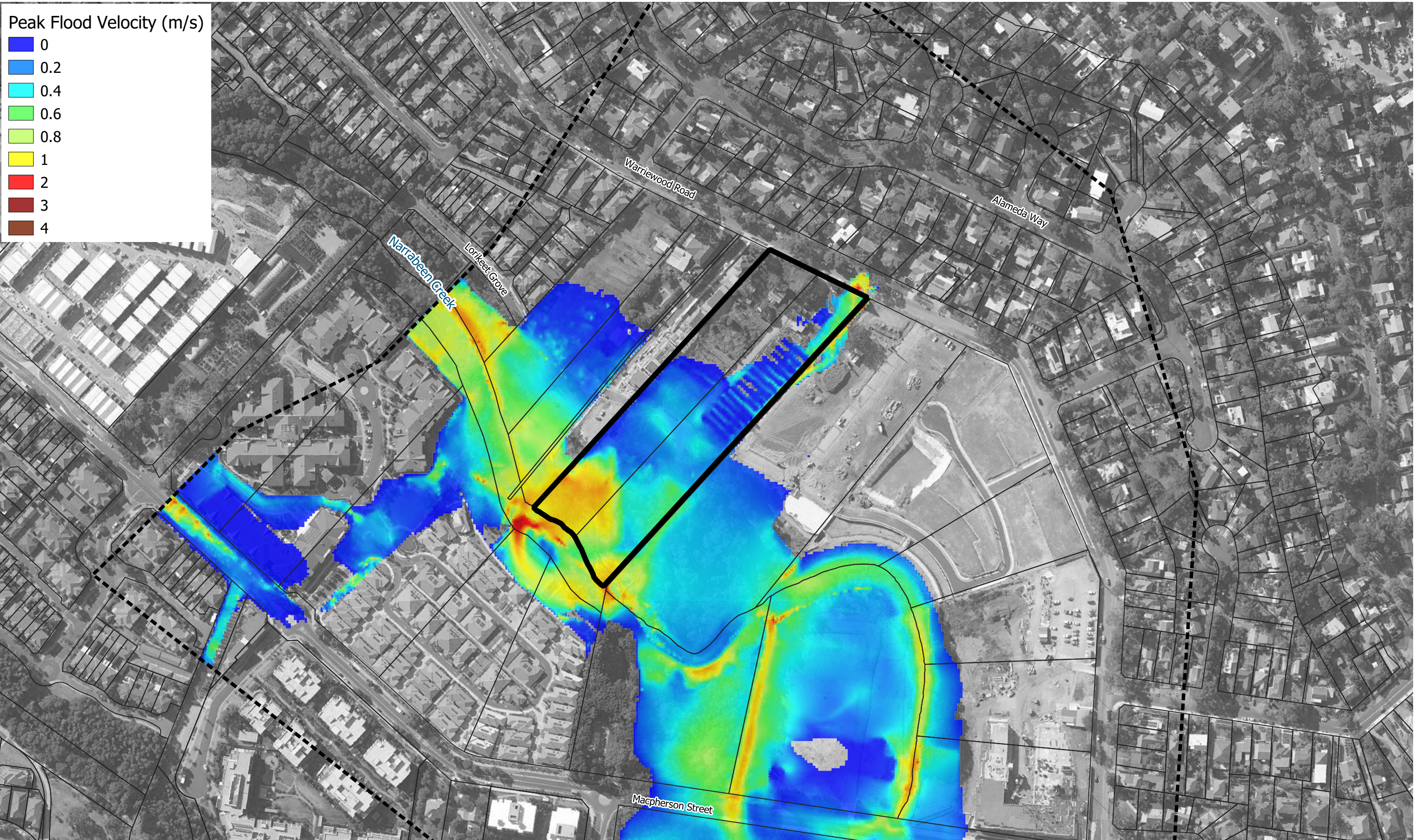
Title:
1 % AEP event - Existing Scenario - Peak Flood Velocities for Coincident Local and Creek Flooding

Drawing: **A-14** Rev: **A**

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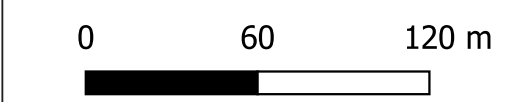
Legend

Model Boundary
 Cadastral Boundary
 Site Boundary

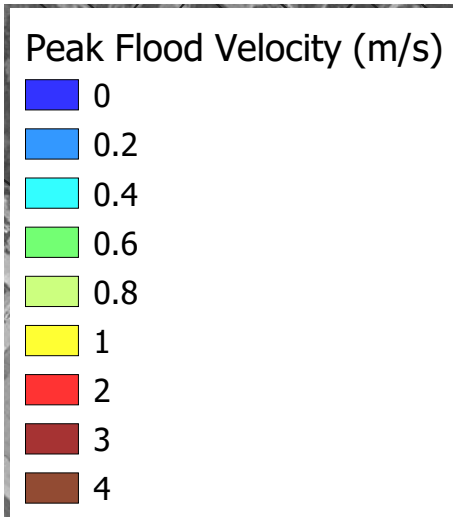
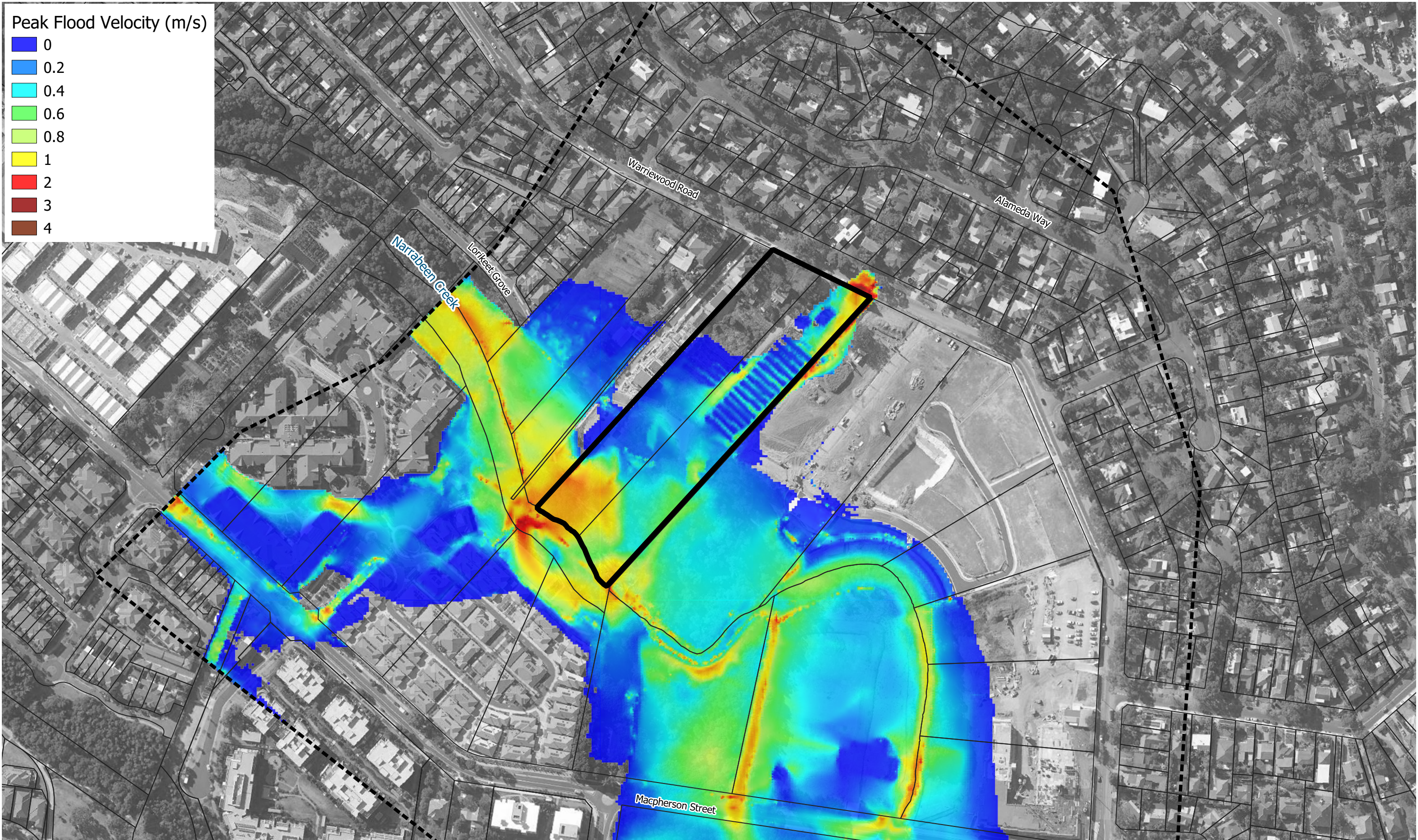
Title: **1% AEP + CC event - Existing Scenario - Peak Flood Velocities for Coincident Local and Creek Flooding**

Drawing: **A-15** Rev: **A**

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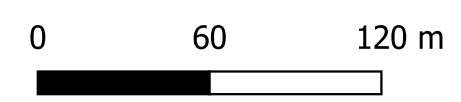
Legend

Model Boundary
 Cadastral Boundary
 Site Boundary

Title: **PMF event - Existing Scenario - Peak Flood Velocities for Coincident Local and Creek Flooding**

Drawing: **A-16** Rev: **A**

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Peak Flood Hazard

- H1
- H2
- H3
- H4
- H5
- H6

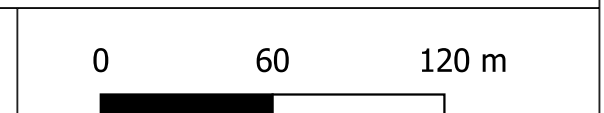
Legend

- Model Boundary
- Cadastral Boundary
- Site Boundary

Title: **1 % AEP event - Existing Scenario - Peak Flood Hazard for Coincident Local and Creek Flooding**

Drawing: **A-17** Rev: **A**

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Peak Flood Hazard

- H1
- H2
- H3
- H4
- H5
- H6

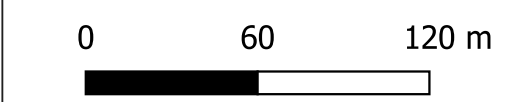
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- Model Boundary
- Cadastral Boundary
- Site Boundary

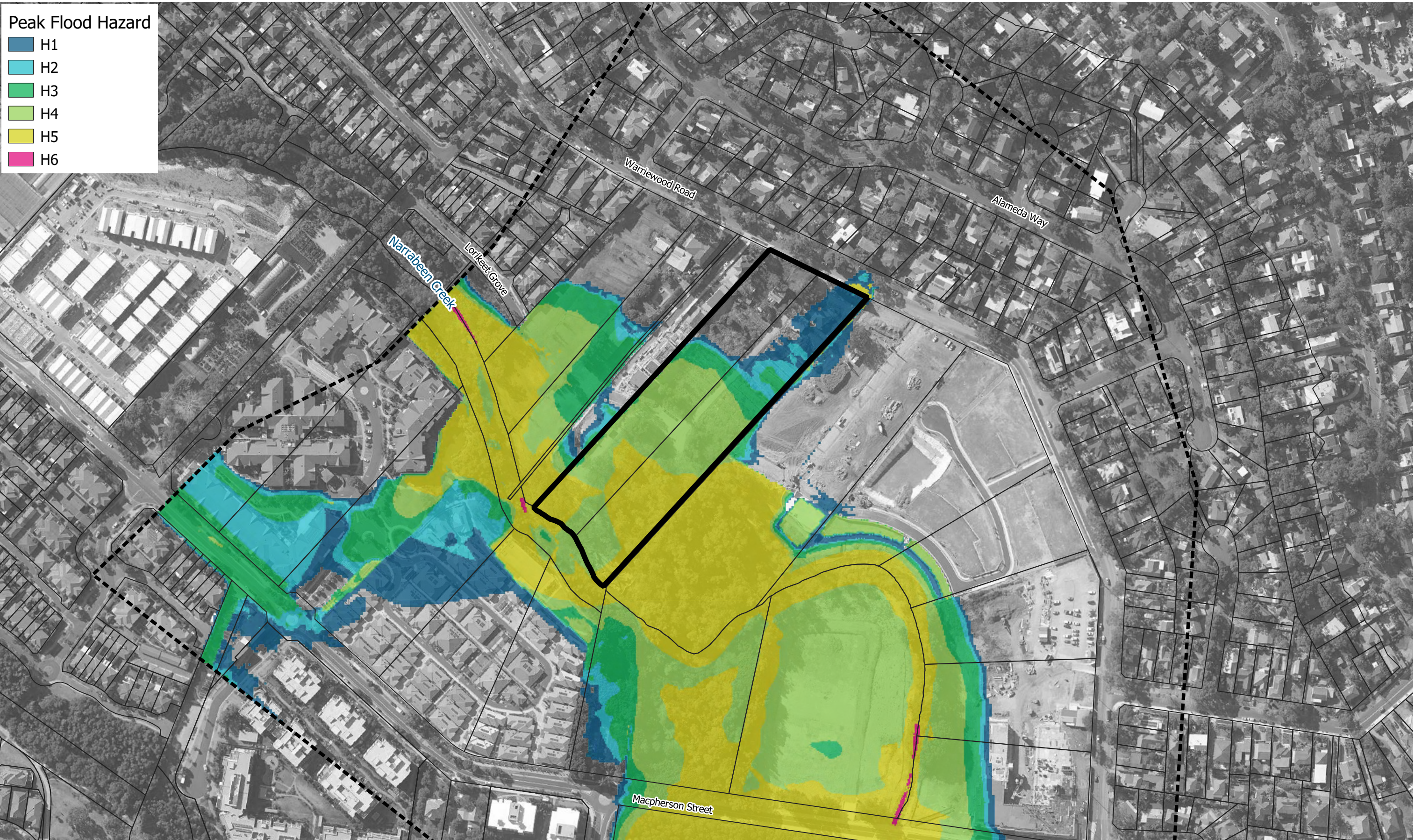
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Drawing: **A-18** Rev: **A**




BMT endeavours to ensure that the information provided in this map is correct at the time of publication. BMT does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.



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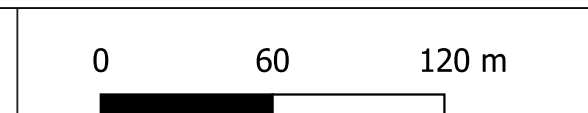
Legend

 Model Boundary
  Cadastral Boundary
 Site Boundary

Title: **PMF event - Existing Scenario - Peak Flood Hazard for Coincident Local and Creek Flooding**

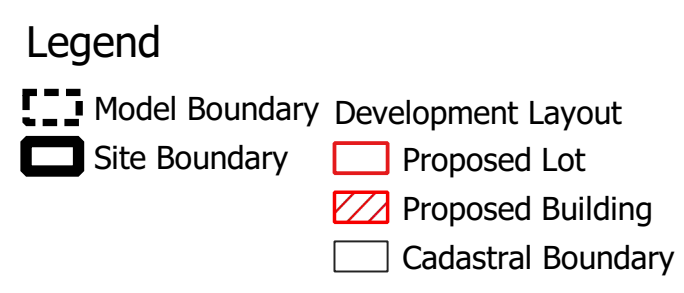
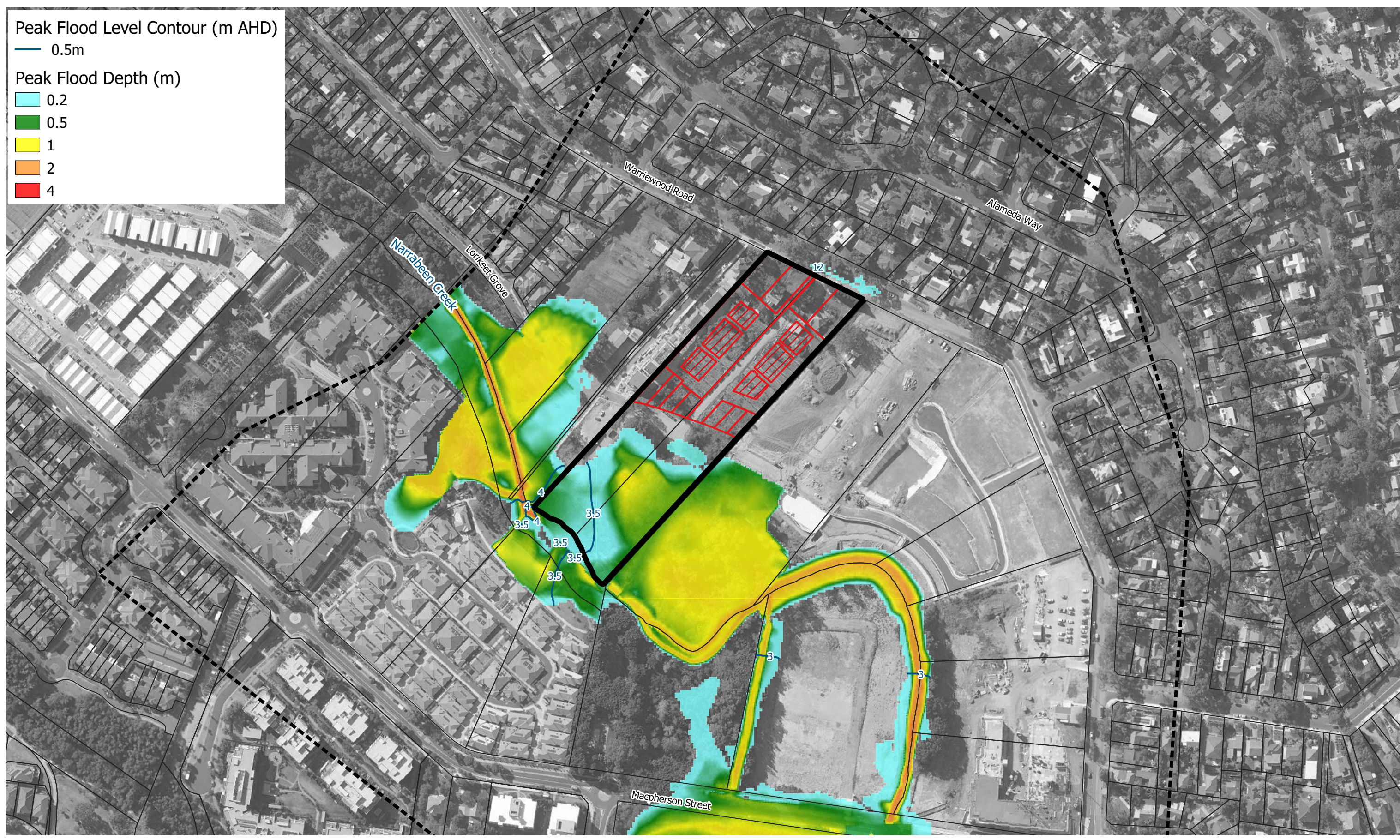
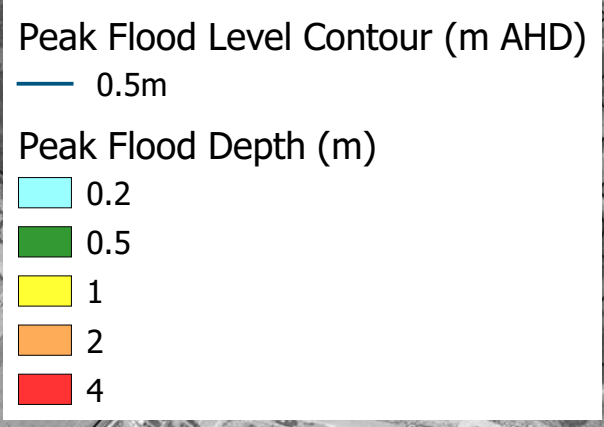
Drawing: **A-19** Rev: **A**

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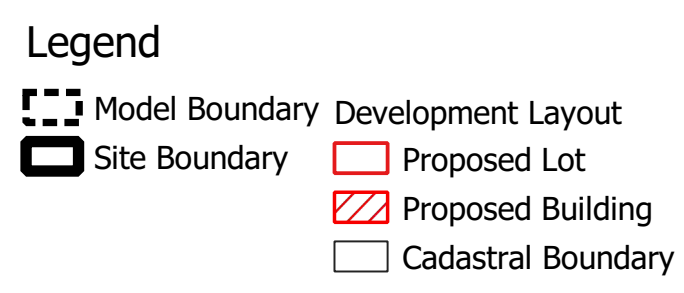
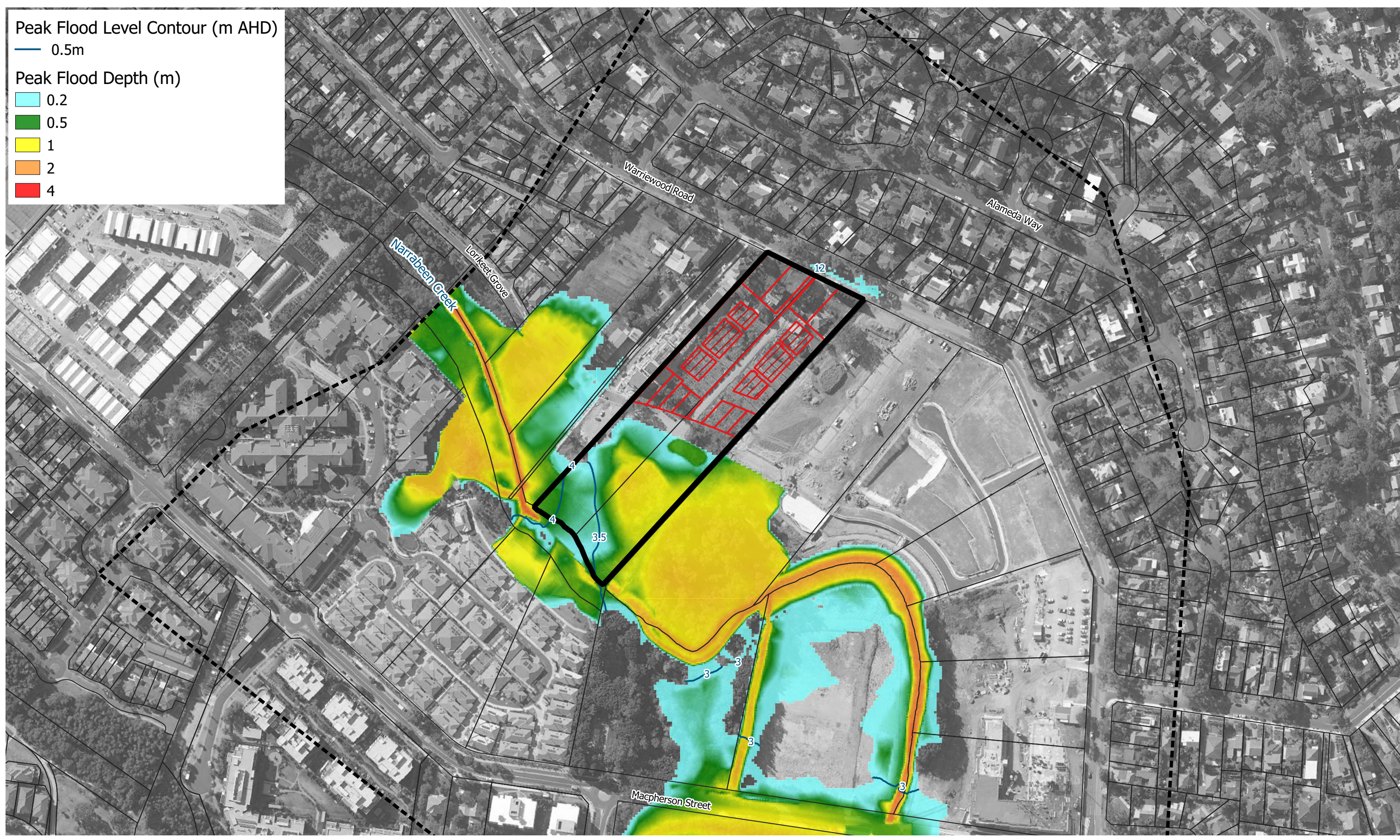
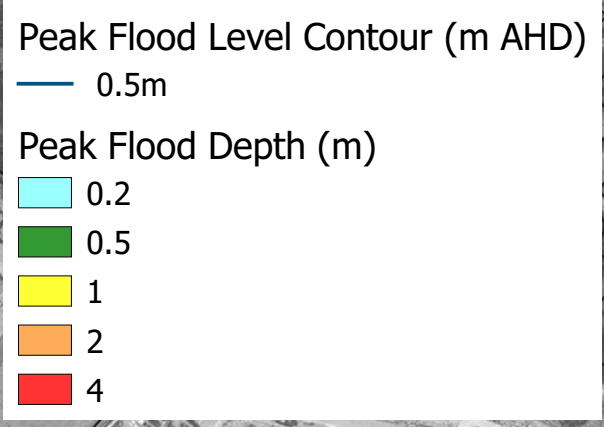


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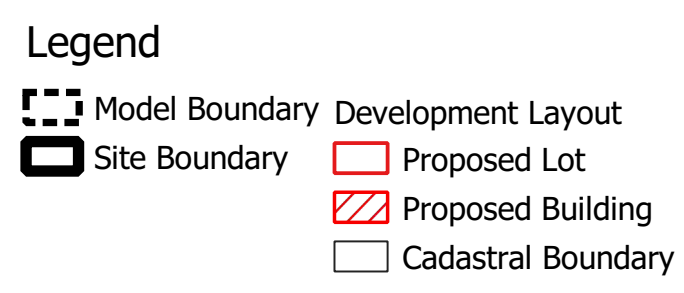
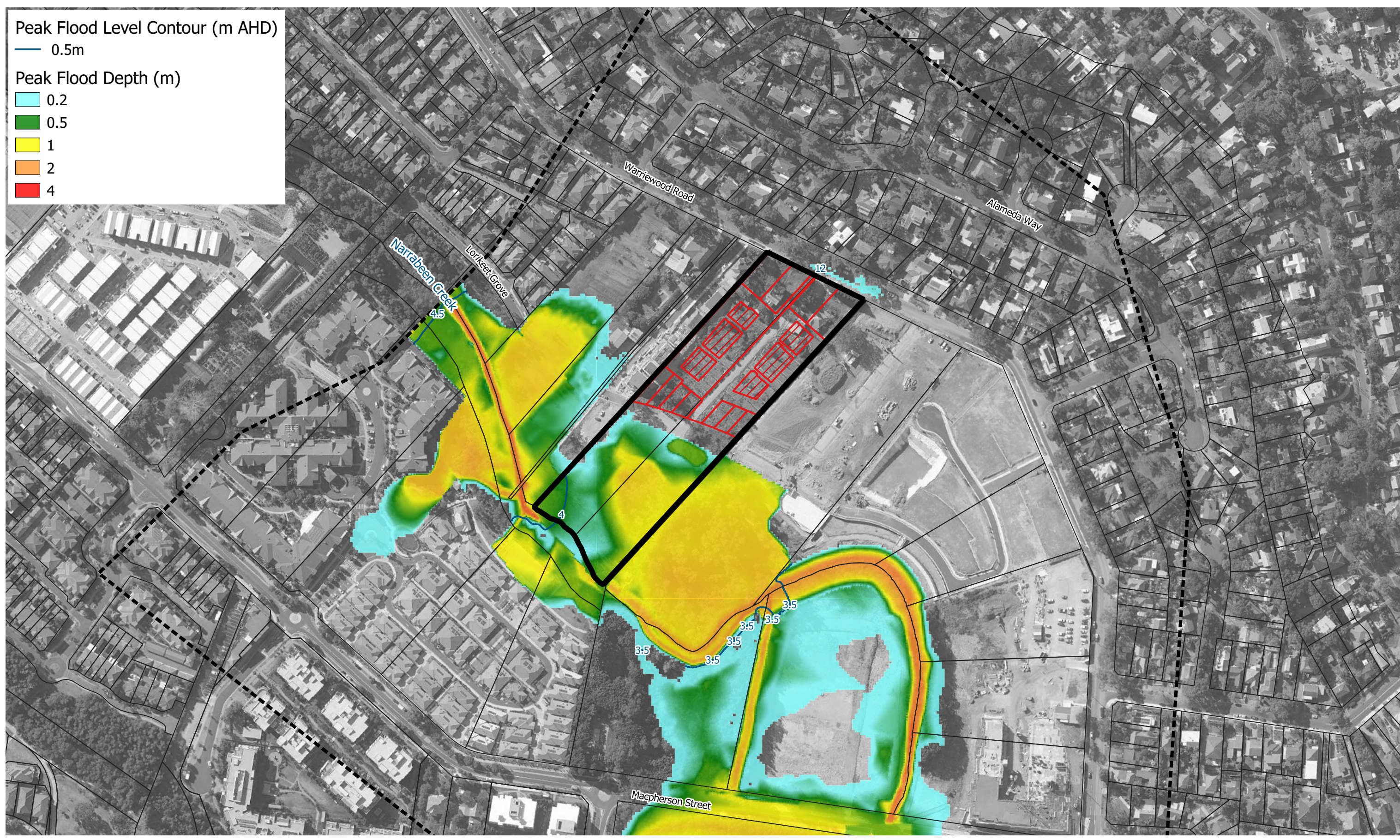
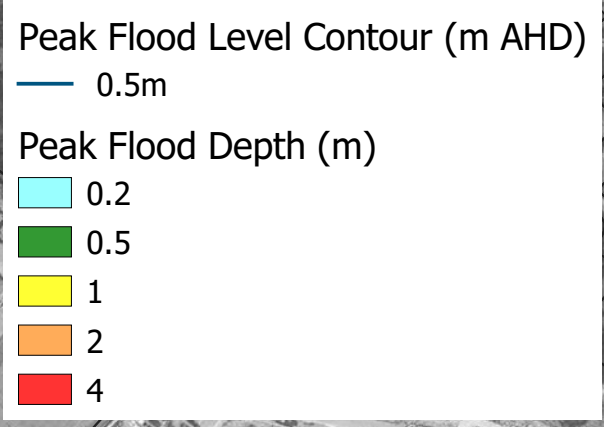
Annex B Flood Mapping for Developed Scenario



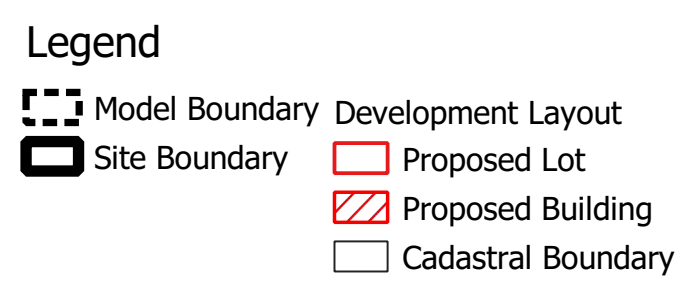
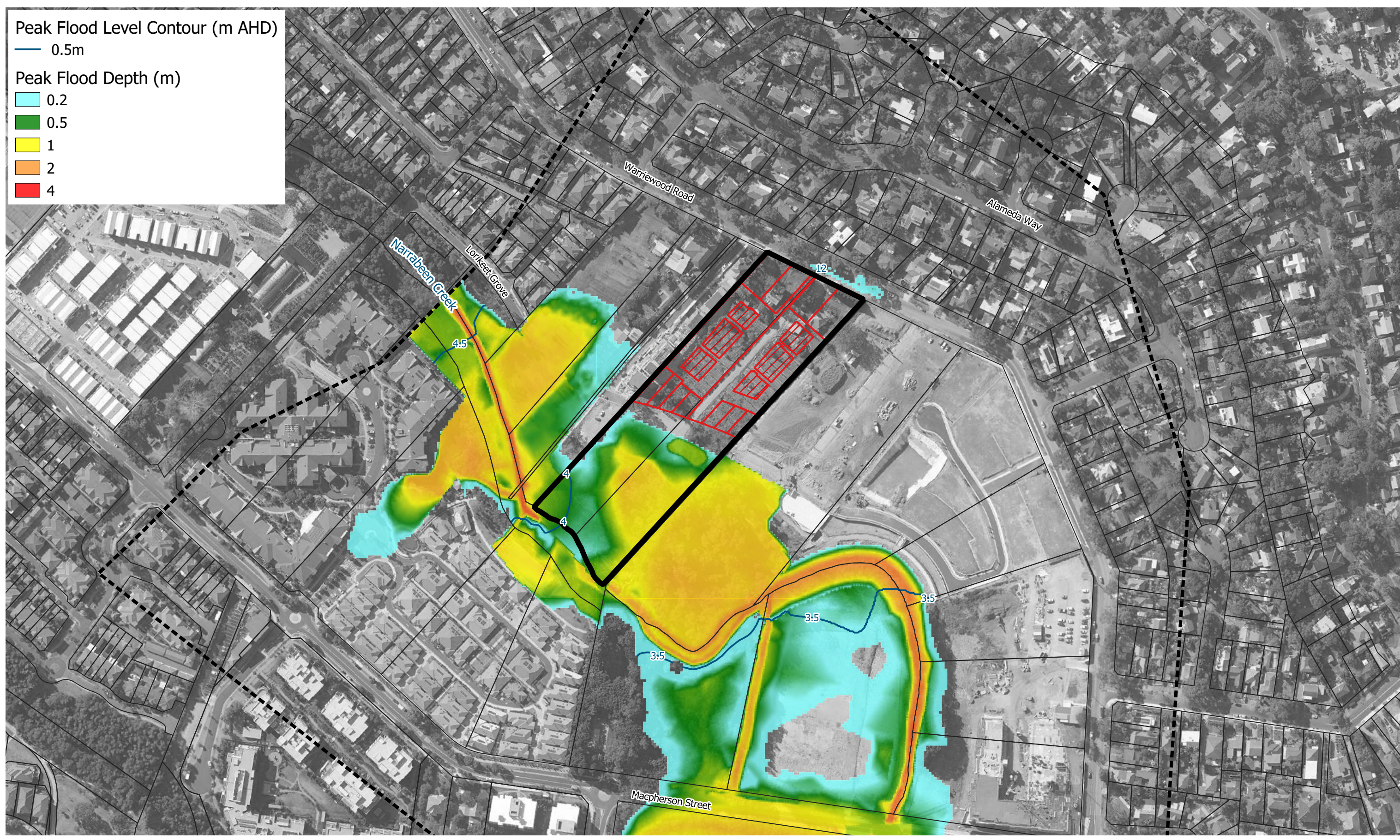
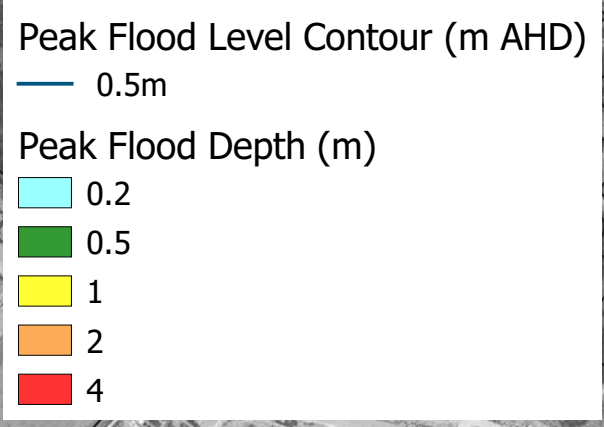
<p>Title:</p> <p>2 year ARI event - Developed Scenario - Peak Flood Depths and Levels for Coincident Local and Creek Flooding</p> <p><small>BMT endeavours to ensure that the information provided in this map is correct at the time of publication. BMT does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.</small></p> <p>Filepath: K:\N20951_45WarriewoodRd_FIA\QGIS\Generator_FIA_Update\AppendixFigure\Mapping_Figure_Generator.gqz</p>	<p>0 60 120 m</p>	<p>Drawing:</p> <p>B-01</p>	<p>Rev:</p> <p>A</p>



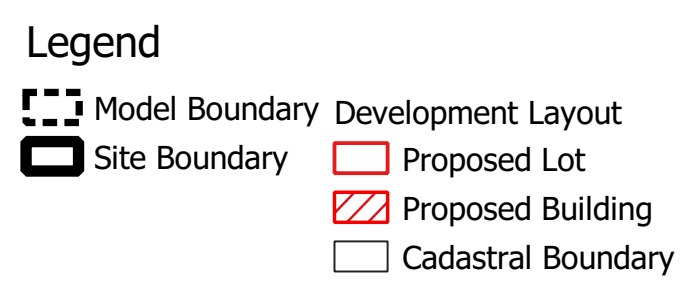
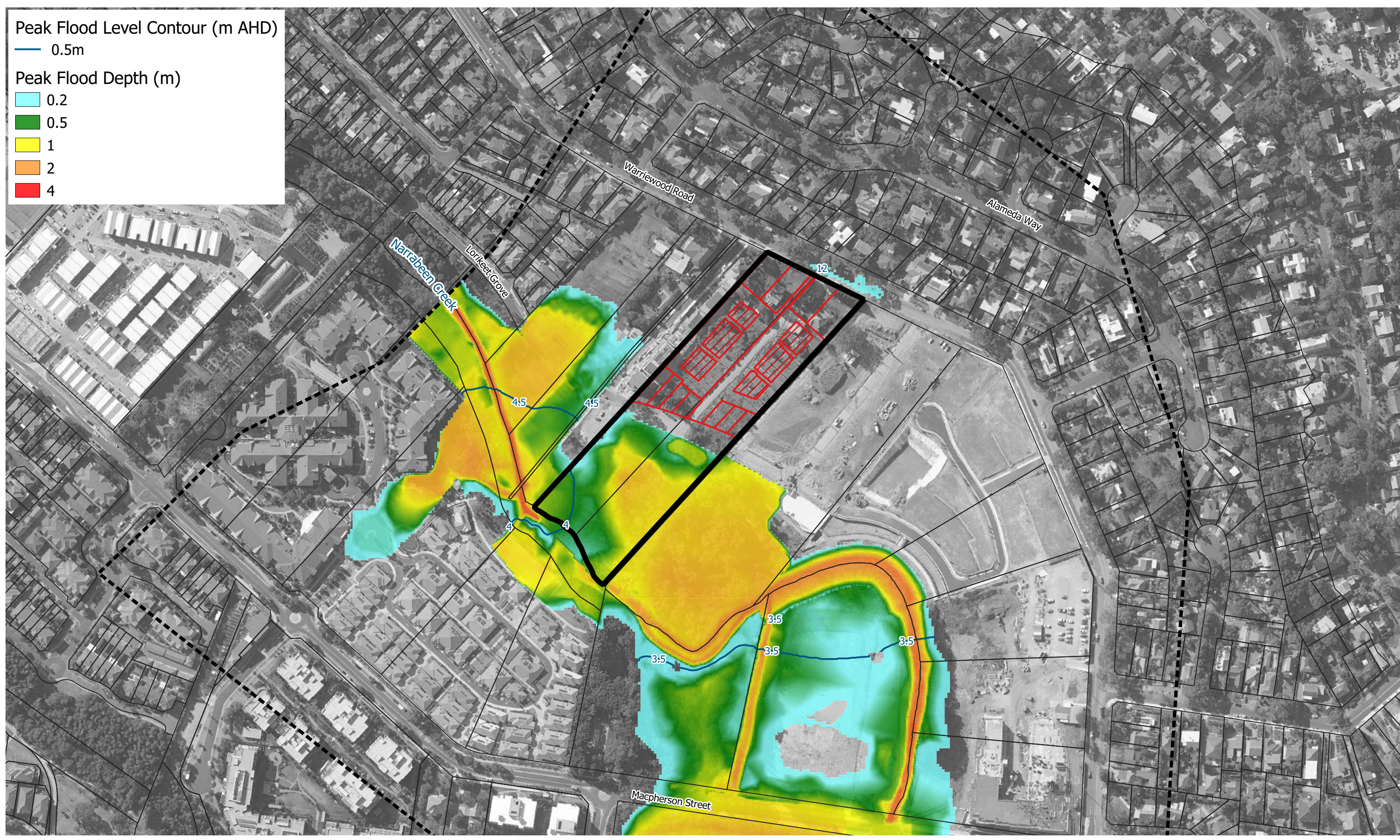
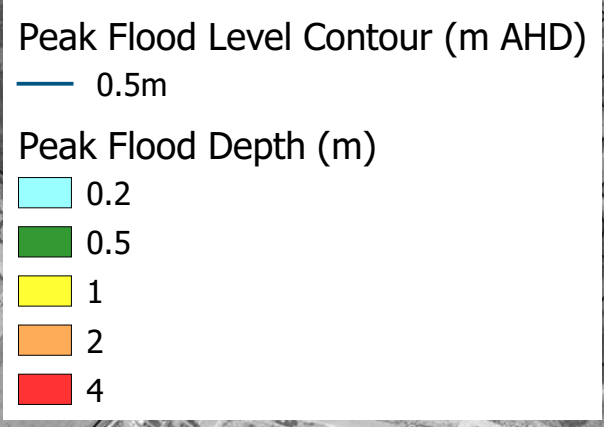
<p>Title:</p> <p>5 year ARI event - Developed Scenario - Peak Flood Depths and Levels for Coincident Local and Creek Flooding</p> <p>BMT endeavours to ensure that the information provided in this map is correct at the time of publication. BMT does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.</p> <p>Filepath: K:\N20951_45WarriewoodRd_FIA\QGIS\Generator_FIA_Update\AppendixFigure\Mapping_Figure_Generator.gqz</p>	<p>0 60 120 m</p>	<p>Drawing:</p> <p>B-02</p>	<p>Rev:</p> <p>A</p>



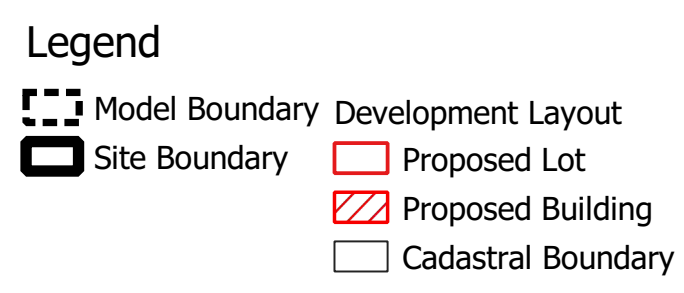
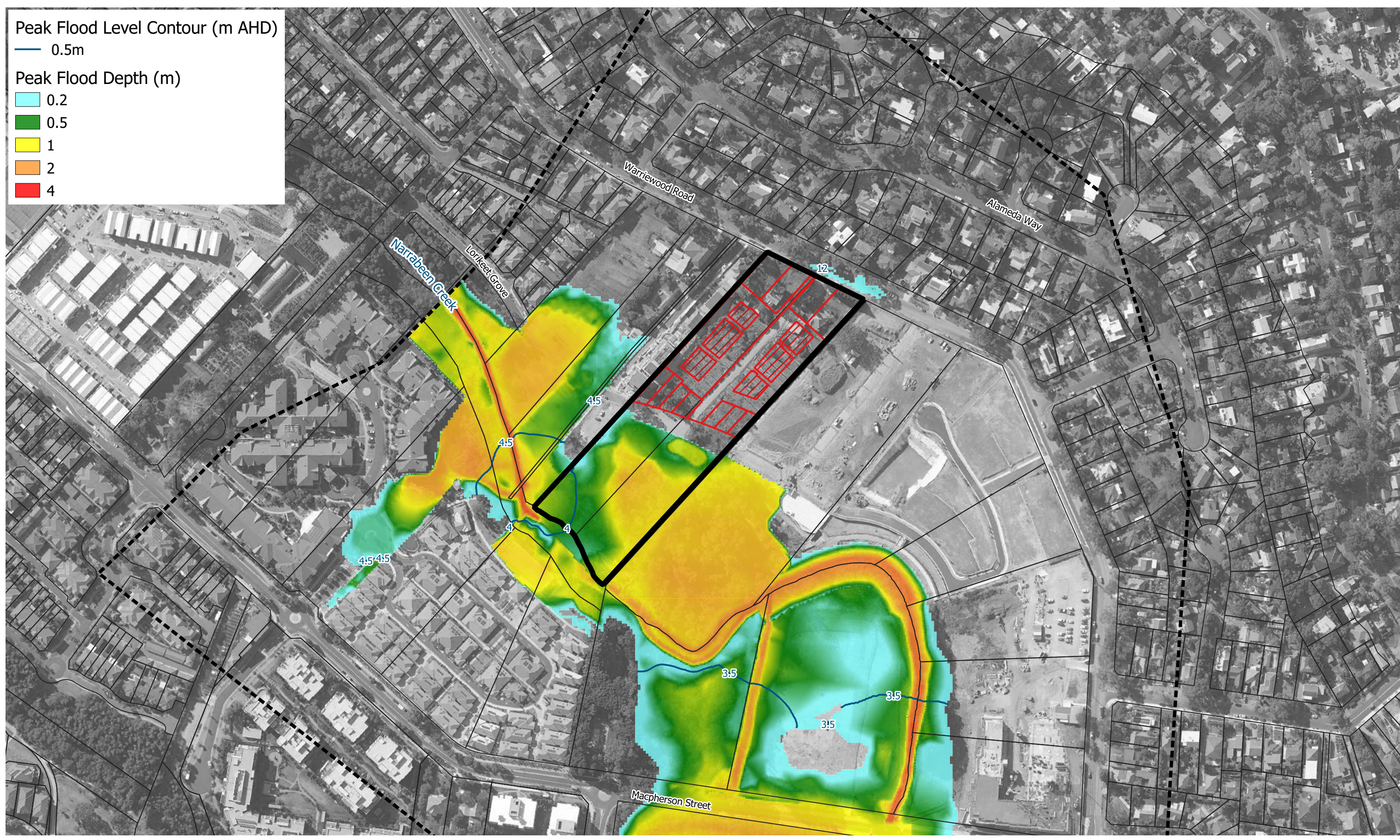
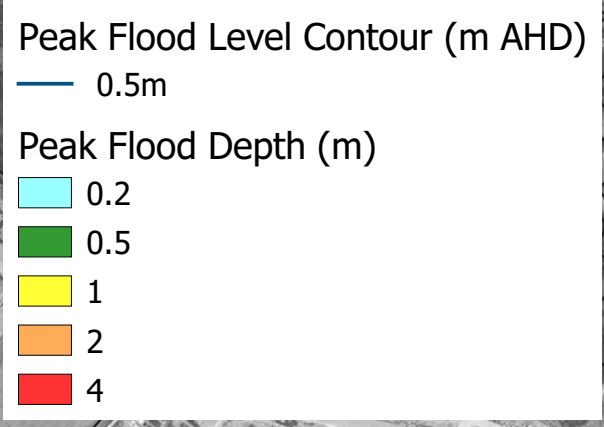
<p>Title:</p> <p>10 % AEP event - Developed Scenario - Peak Flood Depths and Levels for Coincident Local and Creek Flooding</p> <p><small>BMT endeavours to ensure that the information provided in this map is correct at the time of publication. BMT does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.</small></p> <p>Filepath: K:\N20951_45WarriewoodRd_FIA\QGIS\Generator_FIA_Update\AppendixFigure\Mapping_Figure_Generator.gqz</p>	<p>0 60 120 m</p>	<p>Drawing:</p> <p>B-03</p>	<p>Rev:</p> <p>A</p>
<p>BMT www.bmt.org</p>			



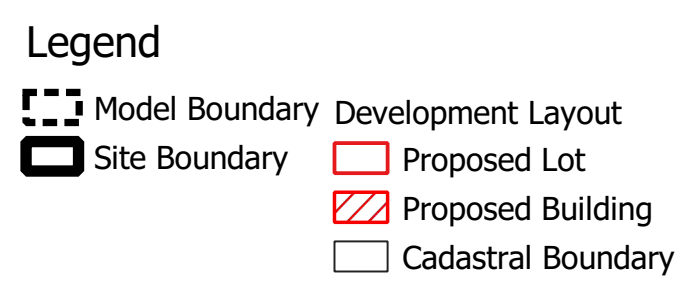
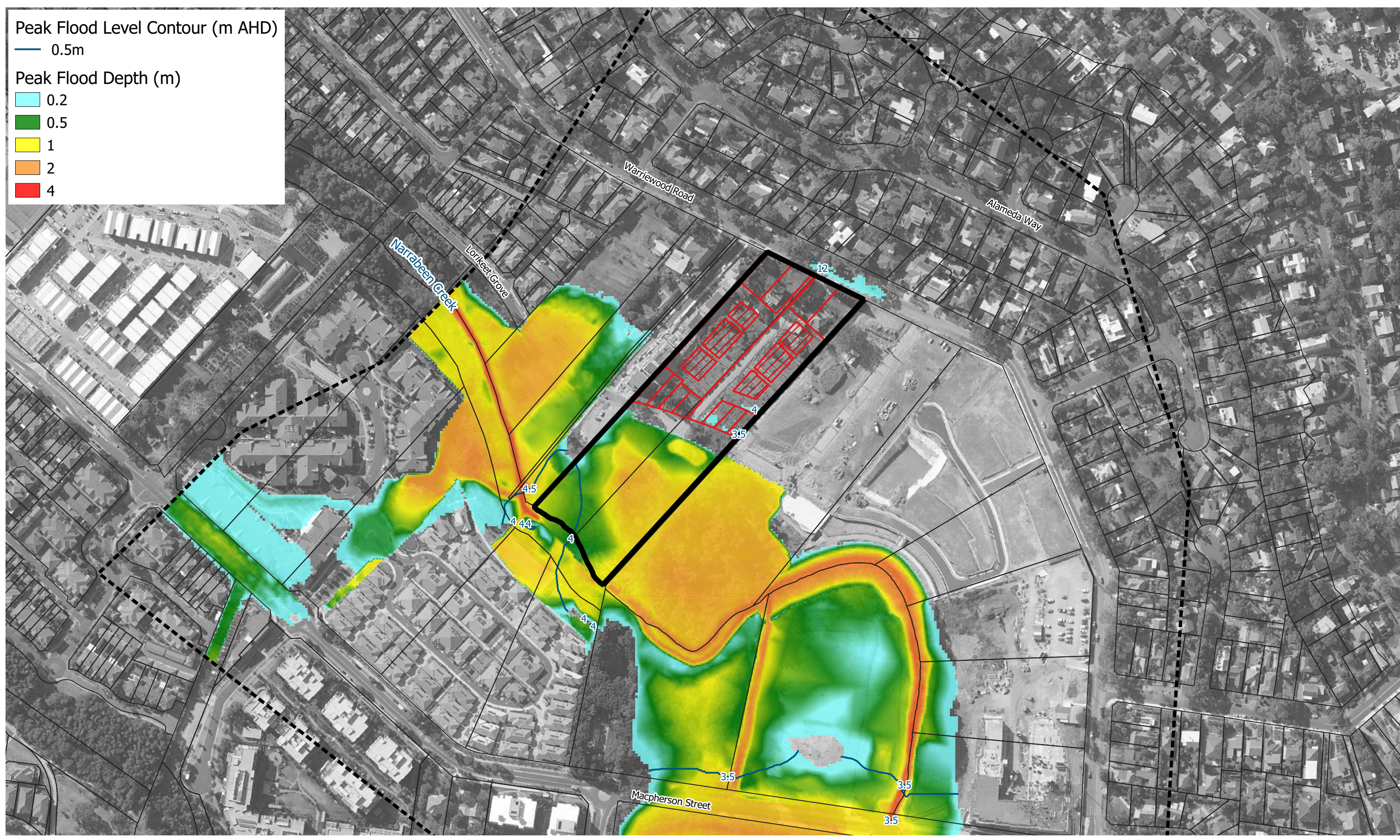
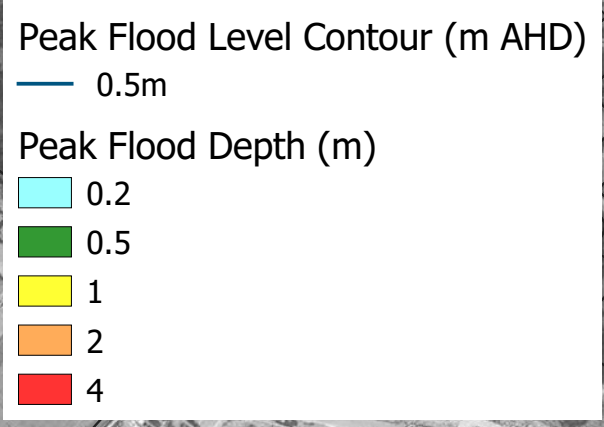
<p>Title:</p> <p>5 % AEP event - Developed Scenario - Peak Flood Depths and Levels for Coincident Local and Creek Flooding</p> <p>BMT endeavours to ensure that the information provided in this map is correct at the time of publication. BMT does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.</p> <p>Filepath: K:\N20951_45WarriewoodRd_FIA\QGIS\Generator_FIA_Update\AppendixFigure\Mapping_Figure_Generator.gqz</p>	<p>Drawing:</p> <p>B-04</p>	<p>Rev:</p> <p>A</p>



<p>Title:</p> <p>2 % AEP event - Developed Scenario - Peak Flood Depths and Levels for Coincident Local and Creek Flooding</p> <p>BMT endeavours to ensure that the information provided in this map is correct at the time of publication. BMT does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.</p> <p>Filepath: K:\N20951_45WarriewoodRd_FIA\QGIS\Generator_FIA_Update\AppendixFigure\Mapping_Figure_Generator.gqz</p>	<p>0 60 120 m</p>	<p>Drawing:</p> <p>B-05</p>	<p>Rev:</p> <p>A</p>

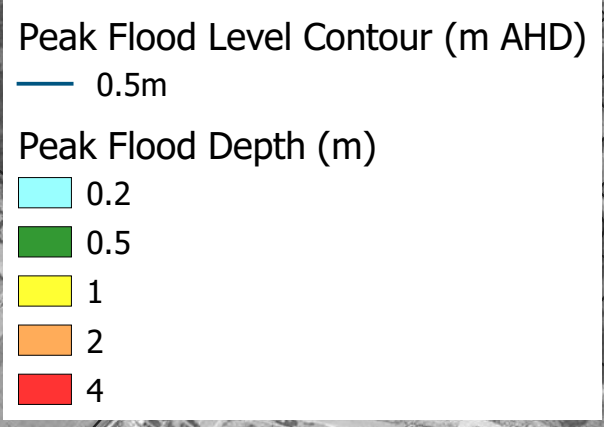
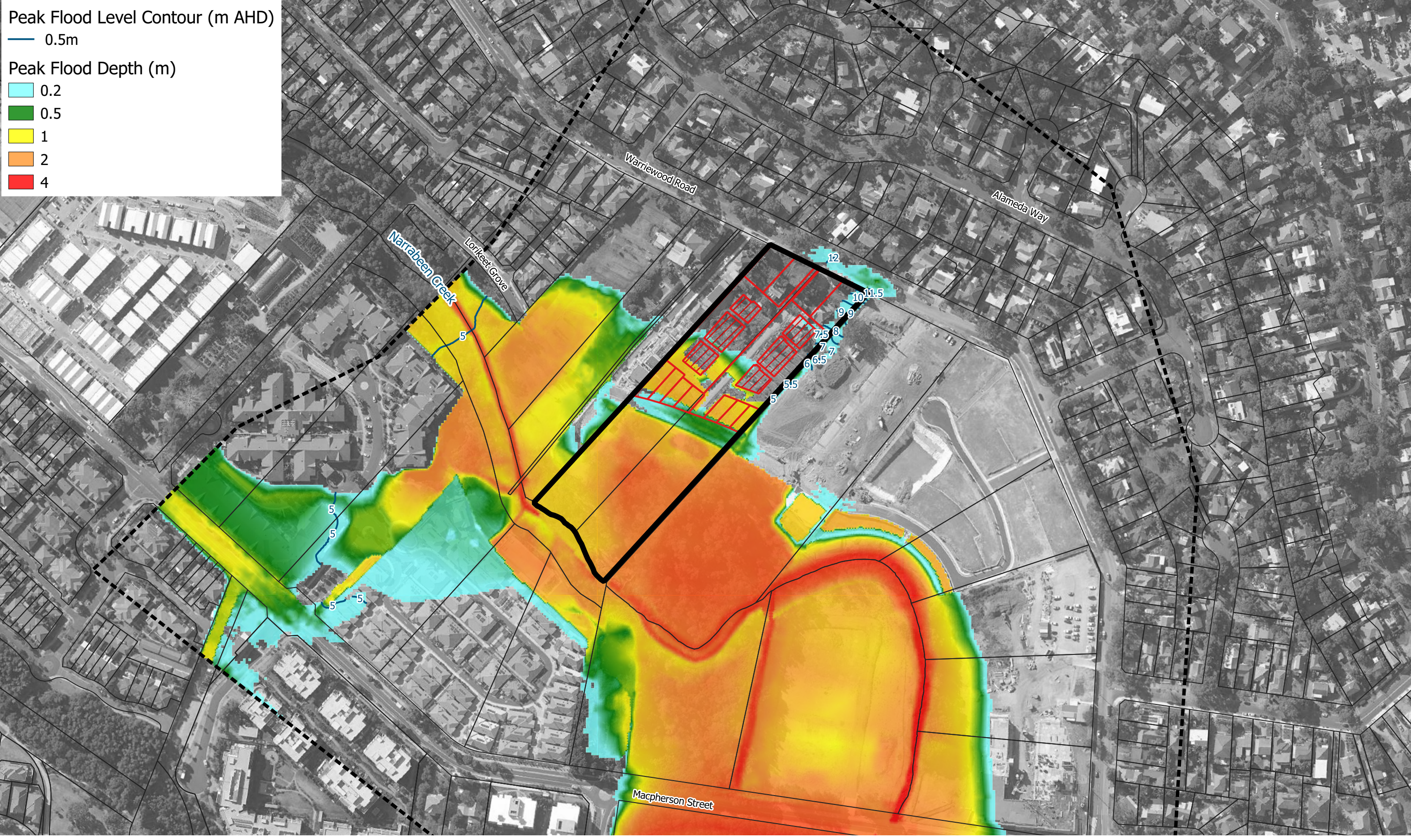


<p>Title:</p> <p>1 % AEP event - Developed Scenario - Peak Flood Depths and Levels for Coincident Local and Creek Flooding</p> <p>BMT endeavours to ensure that the information provided in this map is correct at the time of publication. BMT does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.</p> <p>Filepath: K:\N20951_45WarriewoodRd_FIA\QGIS\Generator_FIA_Update\AppendixFigure\Mapping_Figure_Generator.gqz</p>	<p>0 60 120 m</p>	<p>Drawing:</p> <p>B-06</p>	<p>Rev:</p> <p>A</p>



<p>Title:</p> <p>1% AEP + CC event - Developed Scenario - Peak Flood Depths and Levels for Coincident Local and Creek Flooding</p>		<p>Drawing:</p> <p>B-07</p>	<p>Rev:</p> <p>A</p>
<p>BMT endeavours to ensure that the information provided in this map is correct at the time of publication. BMT does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.</p>		<p>0 60 120 m</p>	
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Legend

- Model Boundary
- Site Boundary
- Development Layout
- Proposed Lot
- Proposed Building
- Cadastral Boundary

Title: **PMF event - Developed Scenario - Peak Flood Depths and Levels for Coincident Local and Creek Flooding**

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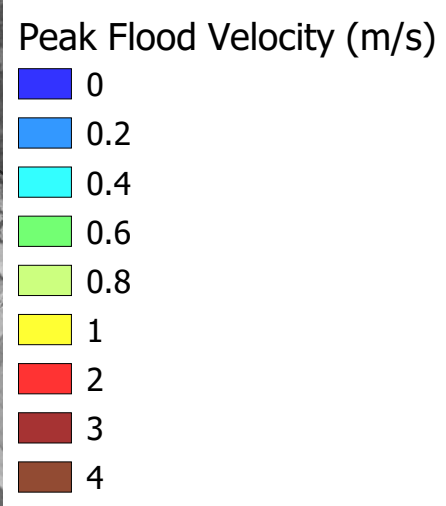
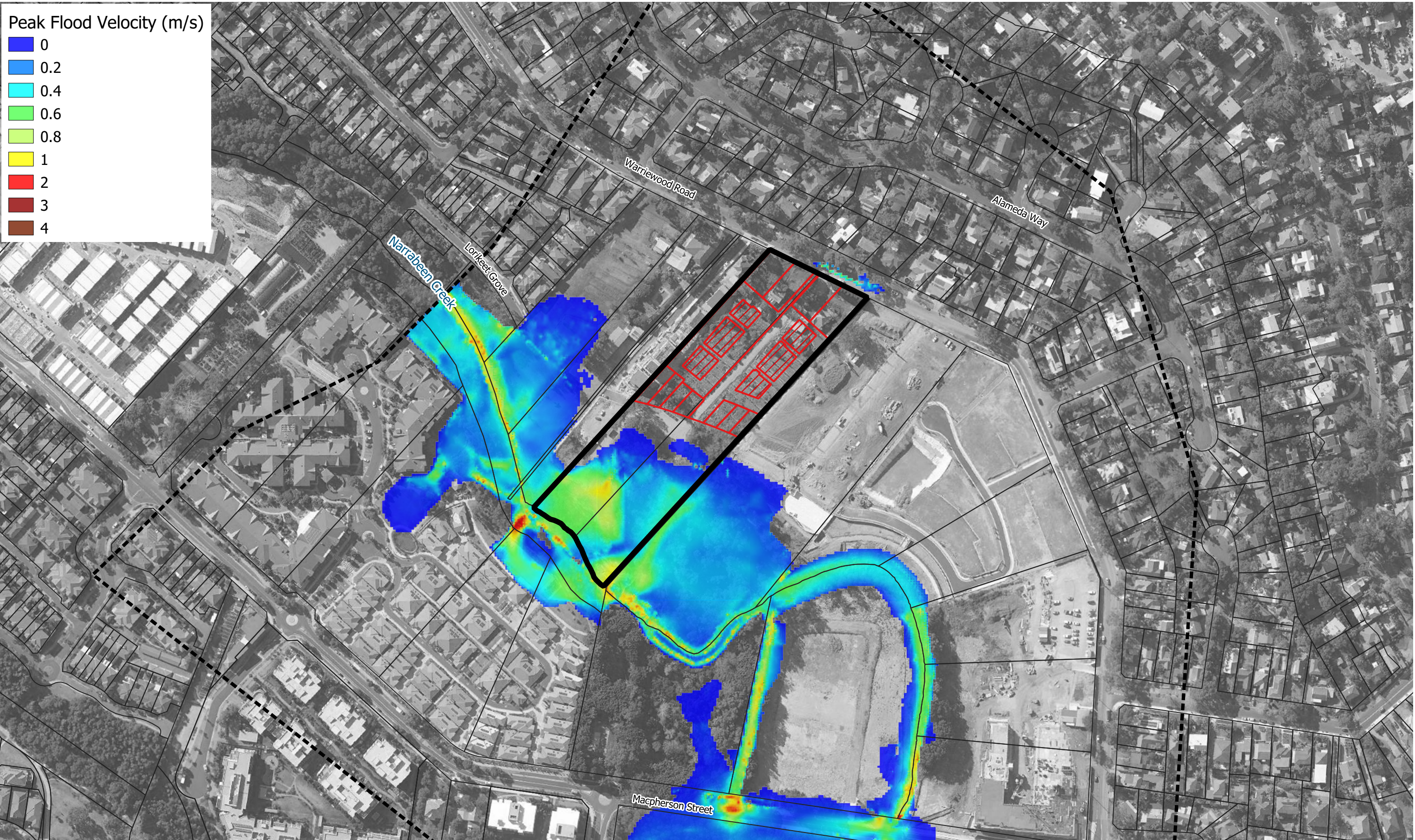
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Drawing: **B-08** Rev: **A**



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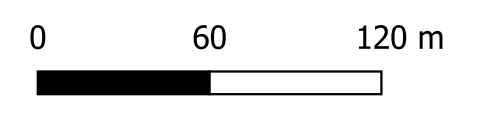
Legend

	Model Boundary		Development Layout
	Site Boundary		Proposed Building
	Proposed Lot		Cadastral Boundary

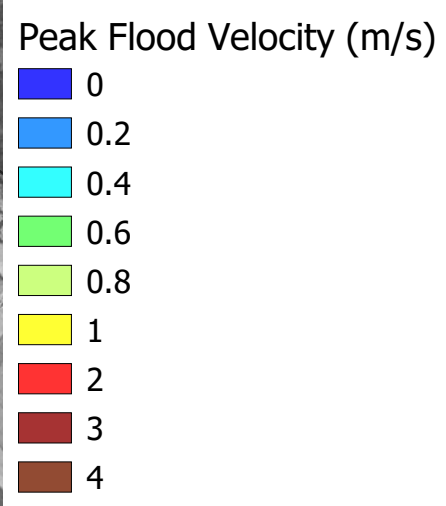
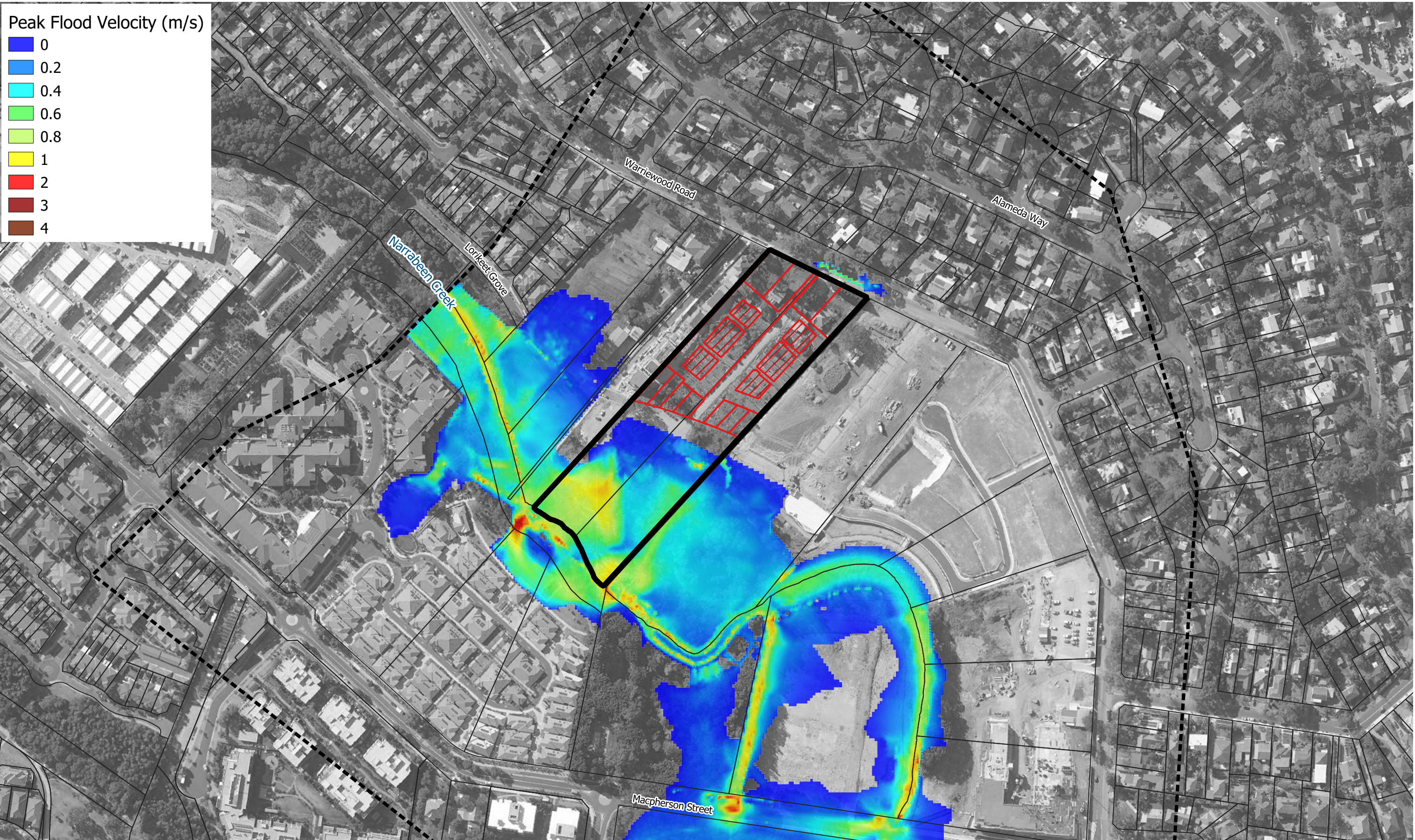
Title: **2 year ARI event - Developed Scenario - Peak Flood Velocities for Coincident Local and Creek Flooding**

Drawing: **B-09** Rev: **A**

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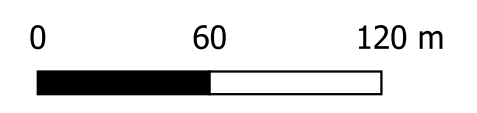
Legend

Model Boundary	Development Layout
Site Boundary	Proposed Lot
	Proposed Building
	Cadastral Boundary

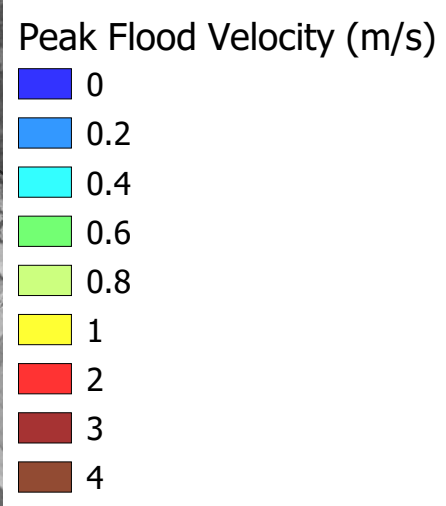
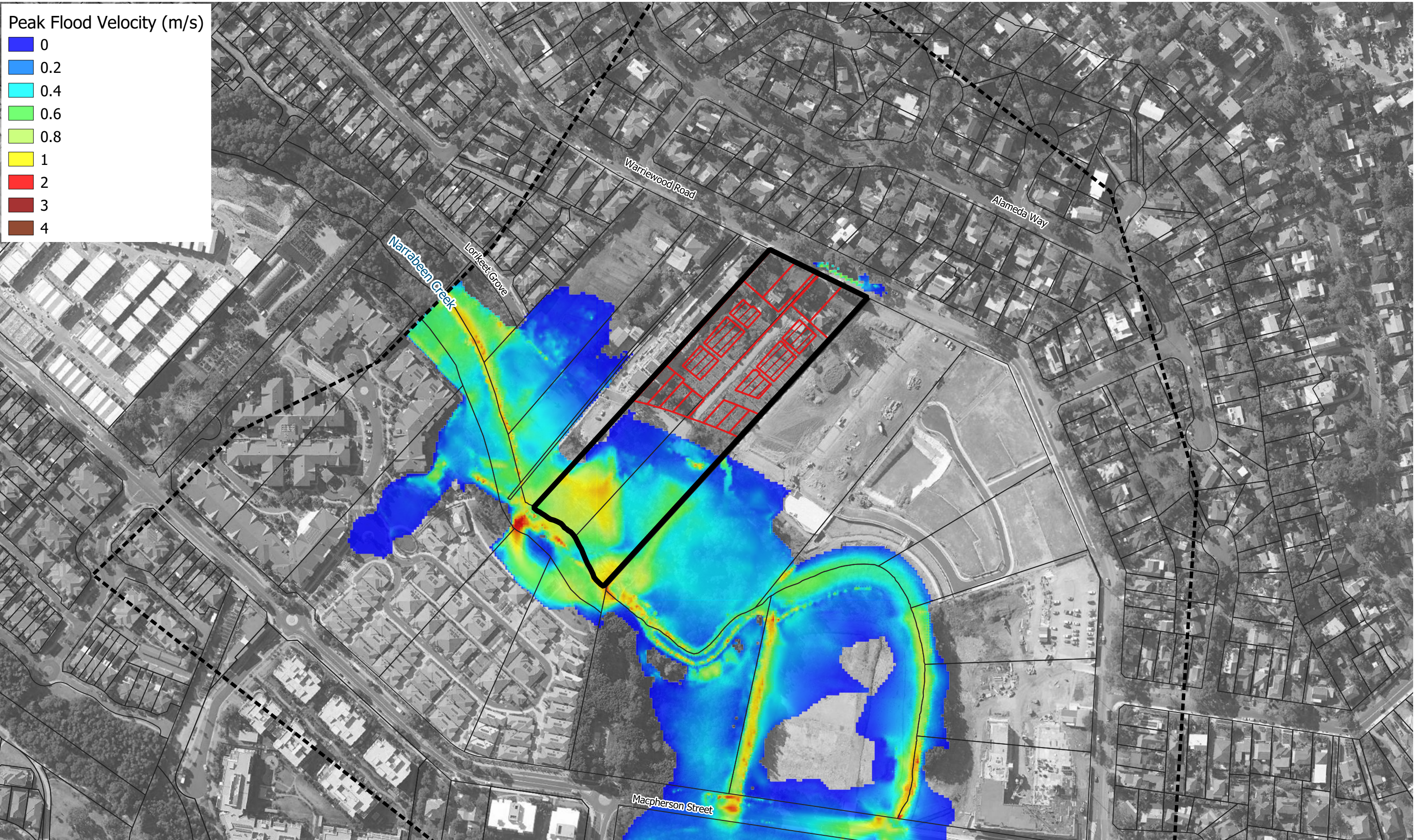
Title: **5 year ARI event - Developed Scenario - Peak Flood Velocities for Coincident Local and Creek Flooding**

Drawing: **B-10** Rev: **A**

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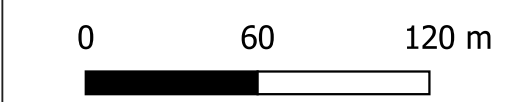
Legend

Model Boundary	Development Layout
Site Boundary	Proposed Lot
	Proposed Building
	Cadastral Boundary

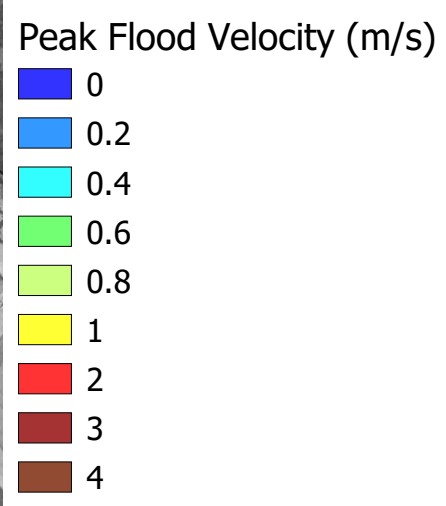
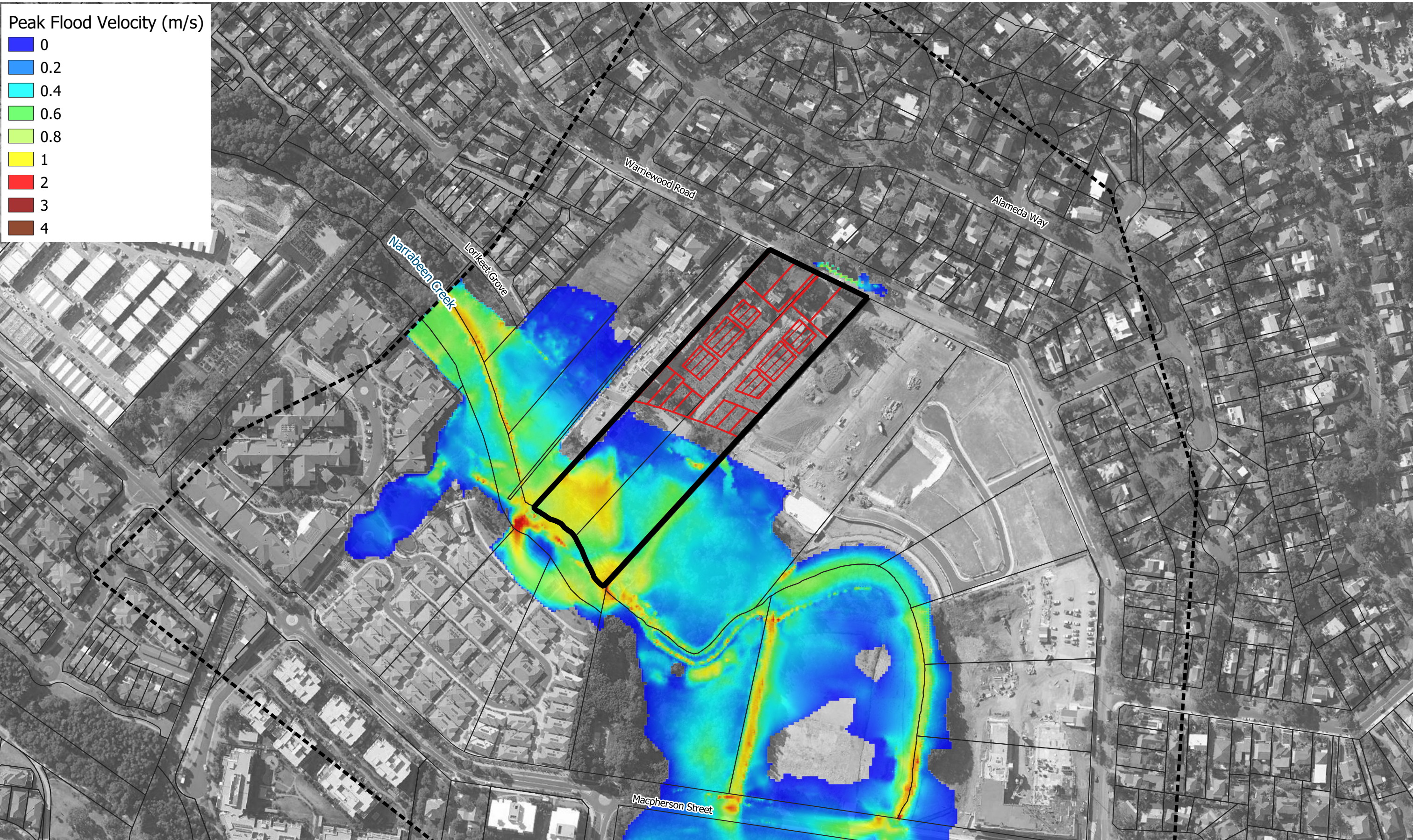
Title: **10% AEP event - Developed Scenario - Peak Flood Velocities for Coincident Local and Creek Flooding**

Drawing: **B-11** Rev: **A**

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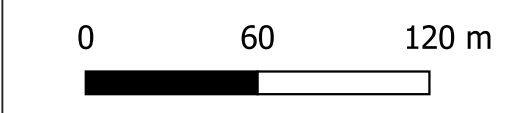
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Model Boundary	Site Boundary	Development Layout	Proposed Lot
		Proposed Building	Cadastral Boundary

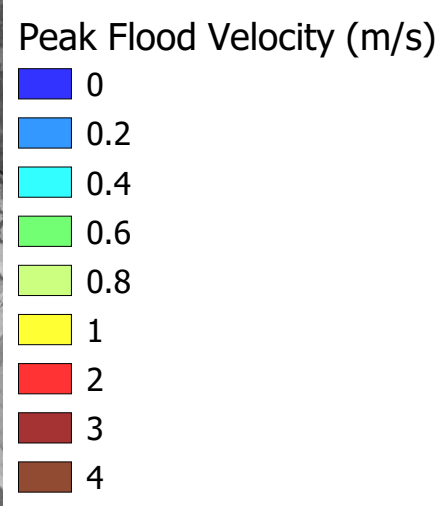
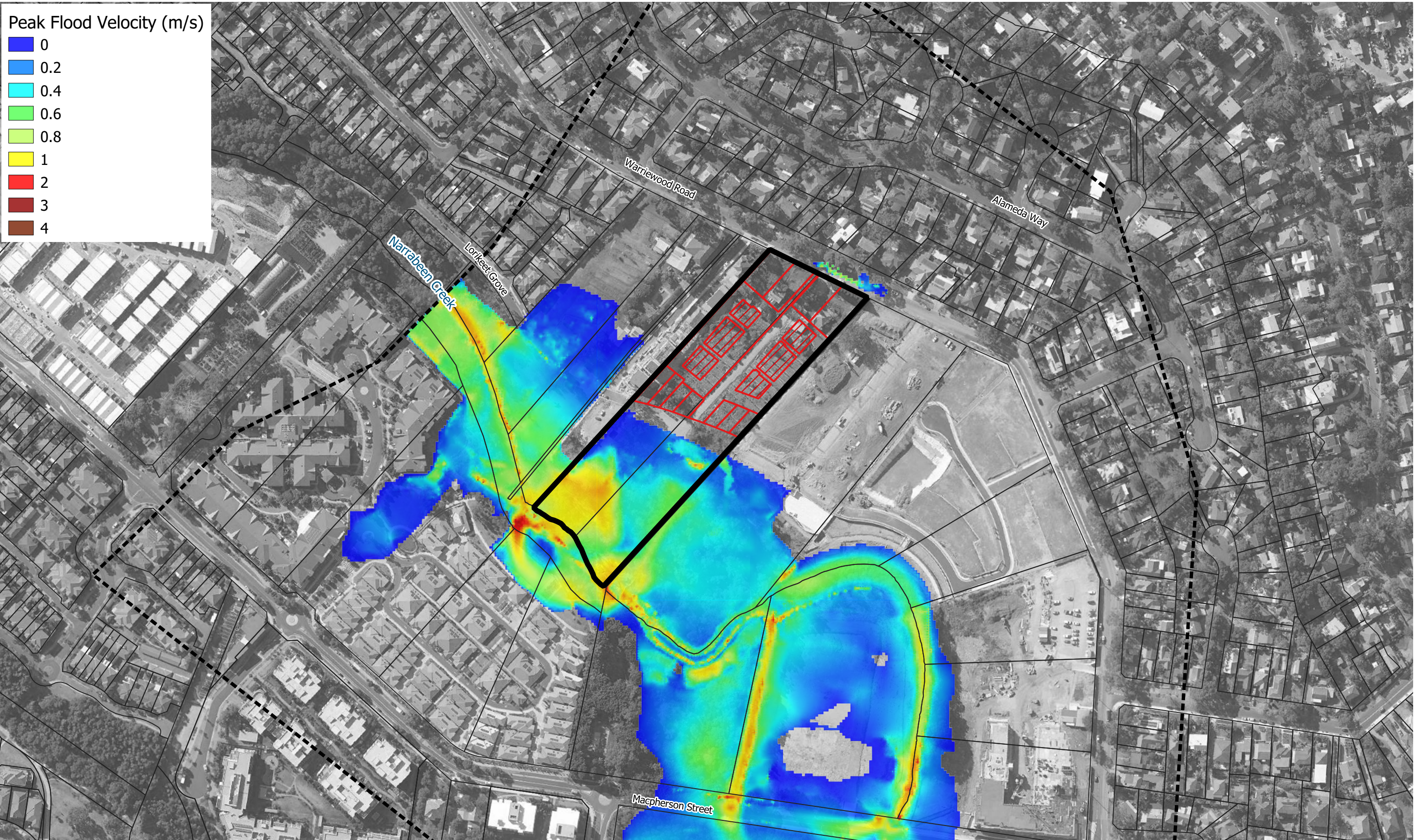
Title: **5% AEP event - Developed Scenario - Peak Flood Velocities for Coincident Local and Creek Flooding**

Drawing: **B-12** Rev: **A**

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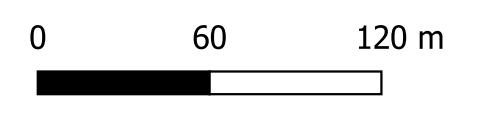


Legend

- Model Boundary
- Site Boundary
- Development Layout
- Proposed Lot
- Proposed Building
- Cadastral Boundary

Title: **2% AEP event - Developed Scenario - Peak Flood Velocities for Coincident Local and Creek Flooding**

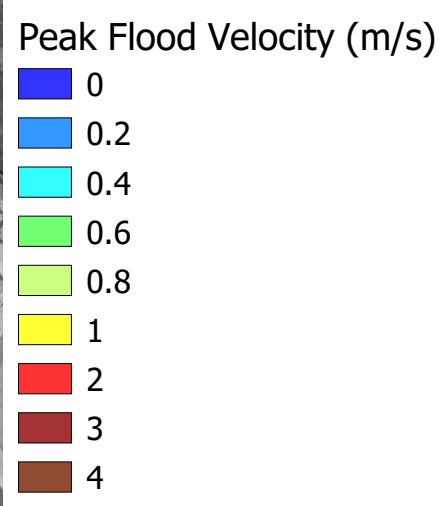
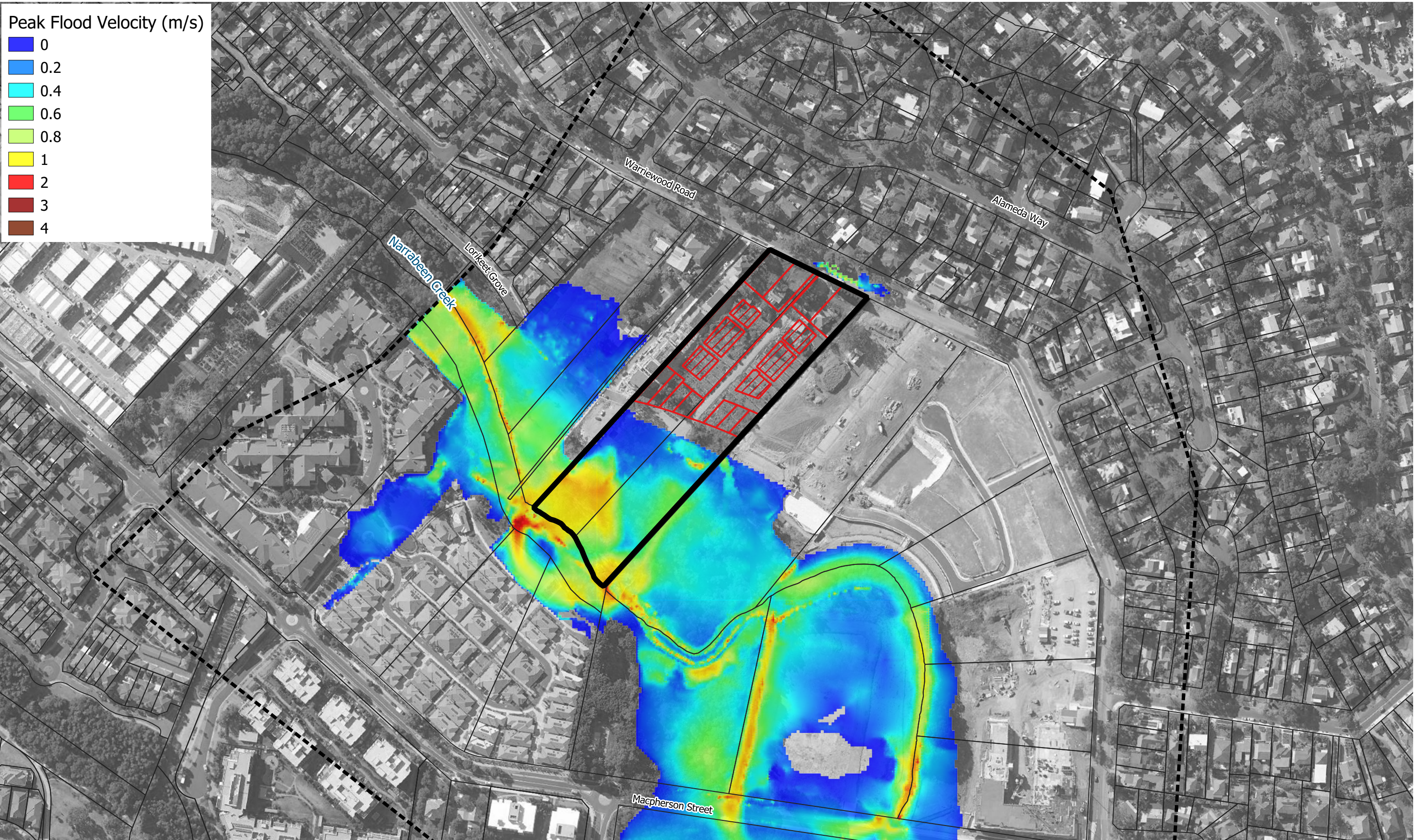
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Drawing: **B-13** Rev: **A**



Filepath: K:\N20951_45WarriewoodRd_FIA\QGIS\Generator_FIA_Update\AppendixFigure\Mapping_Figure_Generator.gqz



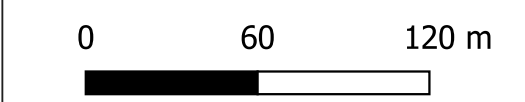
Legend

Model Boundary	Development Layout
Site Boundary	Proposed Lot
	Proposed Building
	Cadastral Boundary

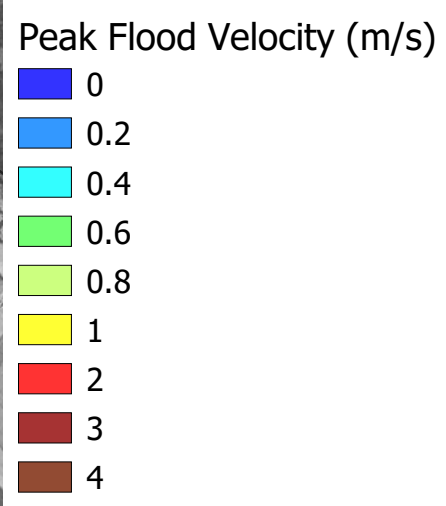
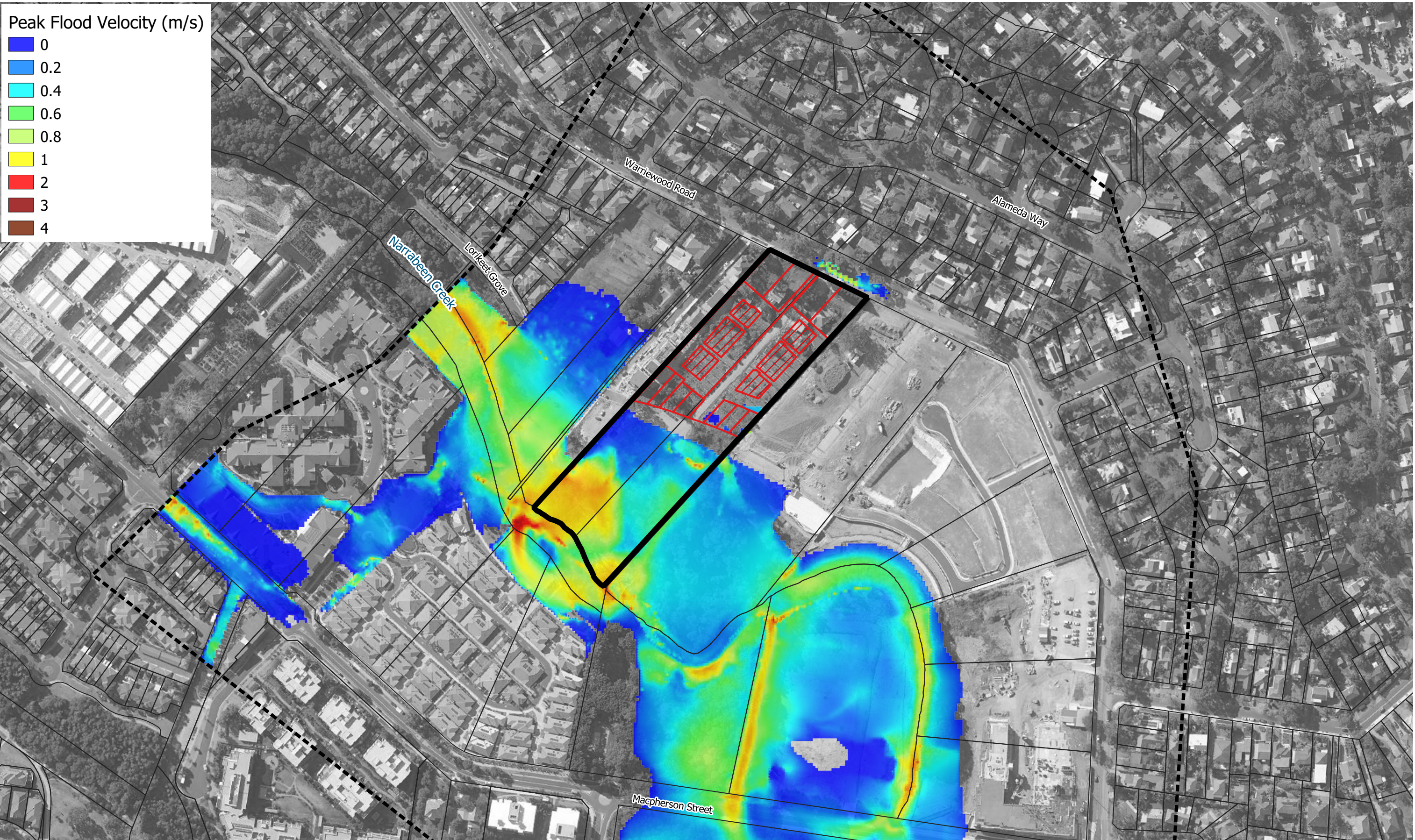
Title: **1 % AEP event - Developed Scenario - Peak Flood Velocities for Coincident Local and Creek Flooding**

Drawing: **B-14** Rev: **A**

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Filepath: K:\N20951_45WarriewoodRd_FIA\QGIS\Generator_FIA_Update\AppendixFigure\Mapping_Figure_Generator.gqz



Legend

Model Boundary	Development Layout
Site Boundary	Proposed Lot
	Proposed Building
	Cadastral Boundary

Title: **1% AEP + CC event - Developed Scenario - Peak Flood Velocities for Coincident Local and Creek Flooding**

BMT endeavours to ensure that the information provided in this map is correct at the time of publication. BMT does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.

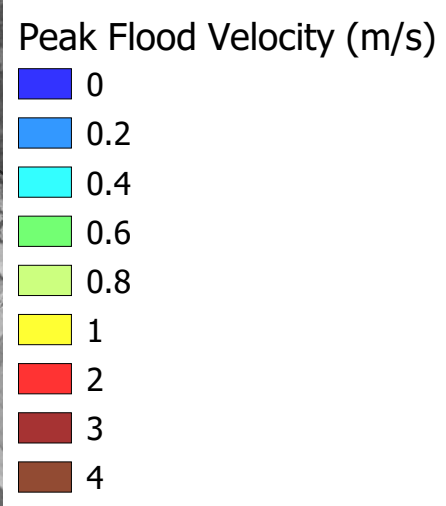
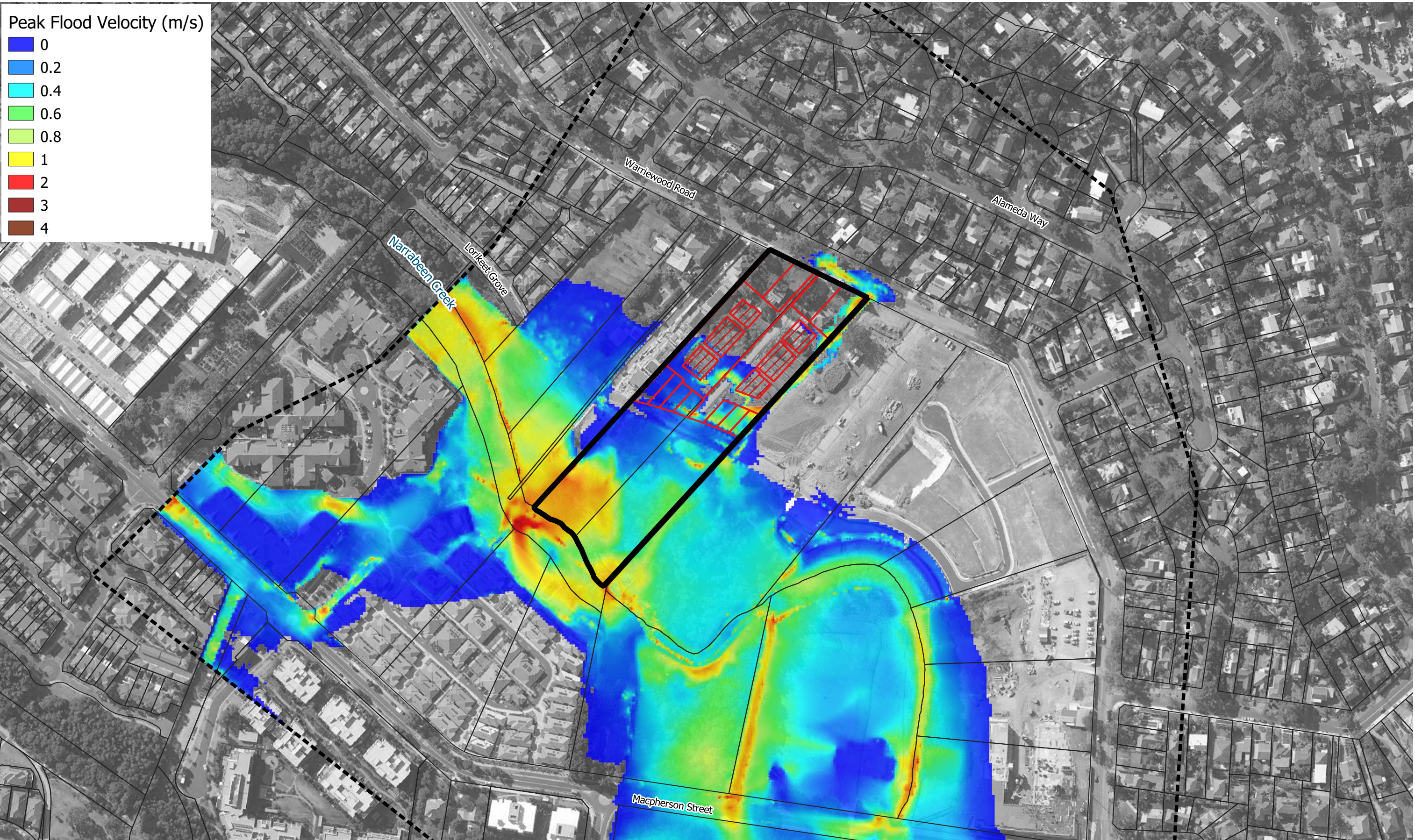
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Filepath: K:\N20951_45WarriewoodRd_FIA\QGIS\Generator_FIA_Update\AppendixFigure\Mapping_Figure_Generator.gqz

Drawing: **B-15**

Rev: **A**

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Legend

Model Boundary	Development Layout
Site Boundary	Proposed Lot
	Proposed Building
	Cadastral Boundary

Title: PMF event - Developed Scenario - Peak Flood Velocities for Coincident Local and Creek Flooding		Drawing: B-16	Rev: A
<p>BMT endeavours to ensure that the information provided in this map is correct at the time of publication. BMT does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.</p>		<p>0 60 120 m</p>	
<p>Filepath: K:\N20951_45WarriewoodRd_FIA\QGIS\Generator_FIA_Update\AppendixFigure\Mapping_Figure_Generator.gqz</p>			





Legend

Model Boundary	Development Layout
Site Boundary	Proposed Lot
Proposed Building	Cadastral Boundary

Title:
1 % AEP event - Developed Scenario - Peak Flood Hazard for Coincident Local and Creek Flooding

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0 60 120 m

Filepath: K:\N20951_45WarriewoodRd_FIA\QGIS\Generator_FIA_Update\AppendixFigure\Mapping_Figure_Generator.gqz

Drawing: **B-17** Rev: **A**

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Legend

Model Boundary	Development Layout
Site Boundary	Proposed Lot
Proposed Building	Cadastral Boundary

Title:
1% AEP + CC event - Developed Scenario - Peak Flood Hazard for Coincident Local and Creek Flooding

BMT endeavours to ensure that the information provided in this map is correct at the time of publication. BMT does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.

0 60 120 m

Filepath: K:\N20951_45WarriewoodRd_FIA\QGIS\Generator_FIA_Update\AppendixFigure\Mapping_Figure_Generator.gqz

Drawing: **B-18** Rev: **A**



Peak Flood Hazard

- H1
- H2
- H3
- H4
- H5
- H6

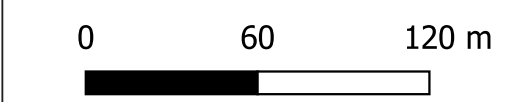
Legend

- Model Boundary
- Site Boundary
- Development Layout
- Proposed Lot
- Proposed Building
- Cadastral Boundary

Title: **PMF event - Developed Scenario - Peak Flood Hazard for Coincident Local and Creek Flooding**

Drawing: **B-19** Rev: **A**

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Filepath: K:\N20951_45WarriewoodRd_FIA\QGIS\Generator_FIA_Update\AppendixFigure\Mapping_Figure_Generator.gqz

Annex C Flood Impact Mapping



Change in Flood Extent

- Was Wet Now Dry
- Was Dry Now Wet

Change in Flood Level (m)

- <= -0.2
- -0.2 - -0.1
- -0.1 - -0.05
- -0.05 - -0.02
- -0.02 - 0.02
- 0.02 - 0.05
- 0.05 - 0.1
- 0.1 - 0.2
- => 0.2

Legend

- Model Boundary
- Site Boundary
- Development Layout
- Proposed Lot
- Proposed Building
- Cadastral Boundary

Title: **2 year ARI event - Developed Scenario - Change in Peak Design Flood Levels**


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0 60 120 m

Filepath: K:\N20951_45WarriewoodRd_FIA\QGIS\Generator_FIA_Update\AppendixFigure\Mapping_Figure_Generator.gqz

Drawing: **C-01**

Rev: **A**



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Change in Flood Extent

- Was Wet Now Dry
- Was Dry Now Wet

Change in Flood Level (m)

- <= -0.2
- -0.2 - -0.1
- -0.1 - -0.05
- -0.05 - -0.02
- -0.02 - 0.02
- 0.02 - 0.05
- 0.05 - 0.1
- 0.1 - 0.2
- => 0.2

Legend

- Model Boundary
- Site Boundary
- Development Layout
- Proposed Lot
- Proposed Building
- Cadastral Boundary

Title: **5 year ARI event - Developed Scenario - Change in Peak Design Flood Levels**

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0 60 120 m

Filepath: K:\N20951_45WarriewoodRd_FIA\QGIS\Generator_FIA_Update\AppendixFigure\Mapping_Figure_Generator.gqz

Drawing: **C-02**

Rev: **A**

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Change in Flood Extent

- Was Wet Now Dry
- Was Dry Now Wet

Change in Flood Level (m)

- <= -0.2
- -0.2 - -0.1
- -0.1 - -0.05
- -0.05 - -0.02
- -0.02 - 0.02
- 0.02 - 0.05
- 0.05 - 0.1
- 0.1 - 0.2
- => 0.2

Legend

- Model Boundary
- Site Boundary
- Development Layout
- Proposed Lot
- Proposed Building
- Cadastral Boundary

Title: **10 % AEP event - Developed Scenario - Change in Peak Design Flood Levels**


BMT endeavours to ensure that the information provided in this map is correct at the time of publication. BMT does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.

0 60 120 m

Filepath: K:\N20951_45WarriewoodRd_FIA\QGIS\Generator_FIA_Update\AppendixFigure\Mapping_Figure_Generator.gqz

Drawing: **C-03**

Rev: **A**



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Change in Flood Extent

- Was Wet Now Dry
- Was Dry Now Wet

Change in Flood Level (m)

- <= -0.2
- -0.2 - -0.1
- -0.1 - -0.05
- -0.05 - -0.02
- -0.02 - 0.02
- 0.02 - 0.05
- 0.05 - 0.1
- 0.1 - 0.2
- => 0.2

Legend

- Model Boundary
- Site Boundary
- Development Layout
- Proposed Lot
- Proposed Building
- Cadastral Boundary

Title: **5 % AEP event - Developed Scenario - Change in Peak Design Flood Levels**


BMT endeavours to ensure that the information provided in this map is correct at the time of publication. BMT does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.

0 60 120 m

Filepath: K:\N20951_45WarriewoodRd_FIA\QGIS\Generator_FIA_Update\AppendixFigure\Mapping_Figure_Generator.gqz

Drawing: **C-04**

Rev: **A**



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Legend

- Model Boundary
- Site Boundary
- Development Layout
- Proposed Lot
- Proposed Building
- Cadastral Boundary

Title:
2 % AEP event - Developed Scenario - Change in Peak Design Flood Levels

BMT endeavours to ensure that the information provided in this map is correct at the time of publication. BMT does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.

0 60 120 m

Filepath: K:\N20951_45WarriewoodRd_FIA\QGIS\Generator_FIA_Update\AppendixFigure\Mapping_Figure_Generator.gqz

Drawing: **C-05**

Rev: **A**



Change in Flood Extent

- Was Wet Now Dry
- Was Dry Now Wet

Change in Flood Level (m)

- <= -0.2
- -0.2 - -0.1
- -0.1 - -0.05
- -0.05 - -0.02
- -0.02 - 0.02
- 0.02 - 0.05
- 0.05 - 0.1
- 0.1 - 0.2
- => 0.2

Legend

- Model Boundary
- Site Boundary
- Development Layout
- Proposed Lot
- Proposed Building
- Cadastral Boundary

Title:
1 % AEP event - Developed Scenario - Change in Peak Design Flood Levels


BMT endeavours to ensure that the information provided in this map is correct at the time of publication. BMT does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.

0 60 120 m

Filepath: K:\N20951_45WarriewoodRd_FIA\QGIS\Generator_FIA_Update\AppendixFigure\Mapping_Figure_Generator.gqz

Drawing: **C-06**

Rev: **A**



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Change in Flood Extent

- Was Wet Now Dry
- Was Dry Now Wet

Change in Flood Level (m)

- <= -0.2
- -0.2 - -0.1
- -0.1 - -0.05
- -0.05 - -0.02
- -0.02 - 0.02
- 0.02 - 0.05
- 0.05 - 0.1
- 0.1 - 0.2
- => 0.2

Legend

- Model Boundary
- Site Boundary
- Development Layout
- Proposed Lot
- Proposed Building
- Cadastral Boundary

Title: **1% AEP event with climate change - Developed Scenario - Change in Peak Design Flood Levels**


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0 60 120 m

Filepath: K:\N20951_45WarriewoodRd_FIA\QGIS\Generator_FIA_Update\AppendixFigure\Mapping_Figure_Generator.gqz

Drawing: **C-07**

Rev: **A**



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Change in Flood Extent

- Was Wet Now Dry
- Was Dry Now Wet

Change in Flood Level (m)

- <= -0.2
- -0.2 - -0.1
- -0.1 - -0.05
- -0.05 - -0.02
- -0.02 - 0.02
- 0.02 - 0.05
- 0.05 - 0.1
- 0.1 - 0.2
- => 0.2

Legend

- Model Boundary
- Site Boundary
- Development Layout
- Proposed Lot
- Proposed Building
- Cadastral Boundary

Title: **PMF event - Developed Scenario - Change in Peak Design Flood Levels**


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0 60 120 m

Filepath: K:\N20951_45WarriewoodRd_FIA\QGIS\Generator_FIA_Update\AppendixFigure\Mapping_Figure_Generator.gqz

Drawing: **C-08**

Rev: **A**



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Change in Flood Velocity (m/s)

- <= -0.2
- 0.2 - -0.1
- 0.1 - -0.05
- 0.05 - -0.02
- 0.02 - 0.02
- 0.02 - 0.05
- 0.05 - 0.1
- 0.1 - 0.2
- => 0.2

Change in Flood Extent

- Was Wet Now Dry
- Was Dry Now Wet

Legend

- Model Boundary
- Site Boundary
- Development Layout
- Proposed Lot
- Proposed Building
- Cadastral Boundary

Title: **2 year ARI event - Developed Scenario - Change in Peak Design Flood Velocities**

BMT endeavours to ensure that the information provided in this map is correct at the time of publication. BMT does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.

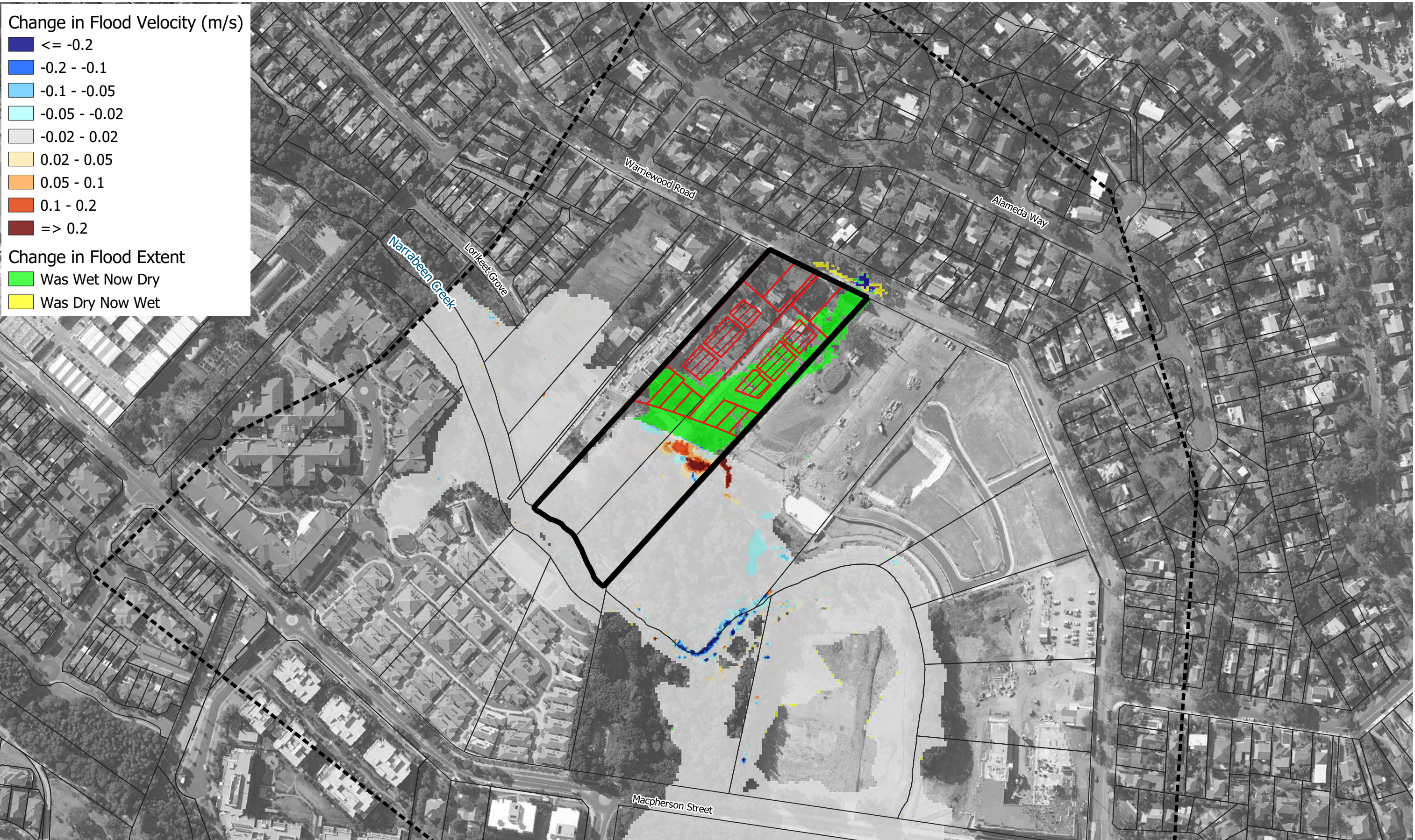
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Drawing: **C-09**

Rev: **A**

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Change in Flood Velocity (m/s)

- <= -0.2
- 0.2 - -0.1
- 0.1 - -0.05
- 0.05 - -0.02
- 0.02 - 0.02
- 0.02 - 0.05
- 0.05 - 0.1
- 0.1 - 0.2
- => 0.2

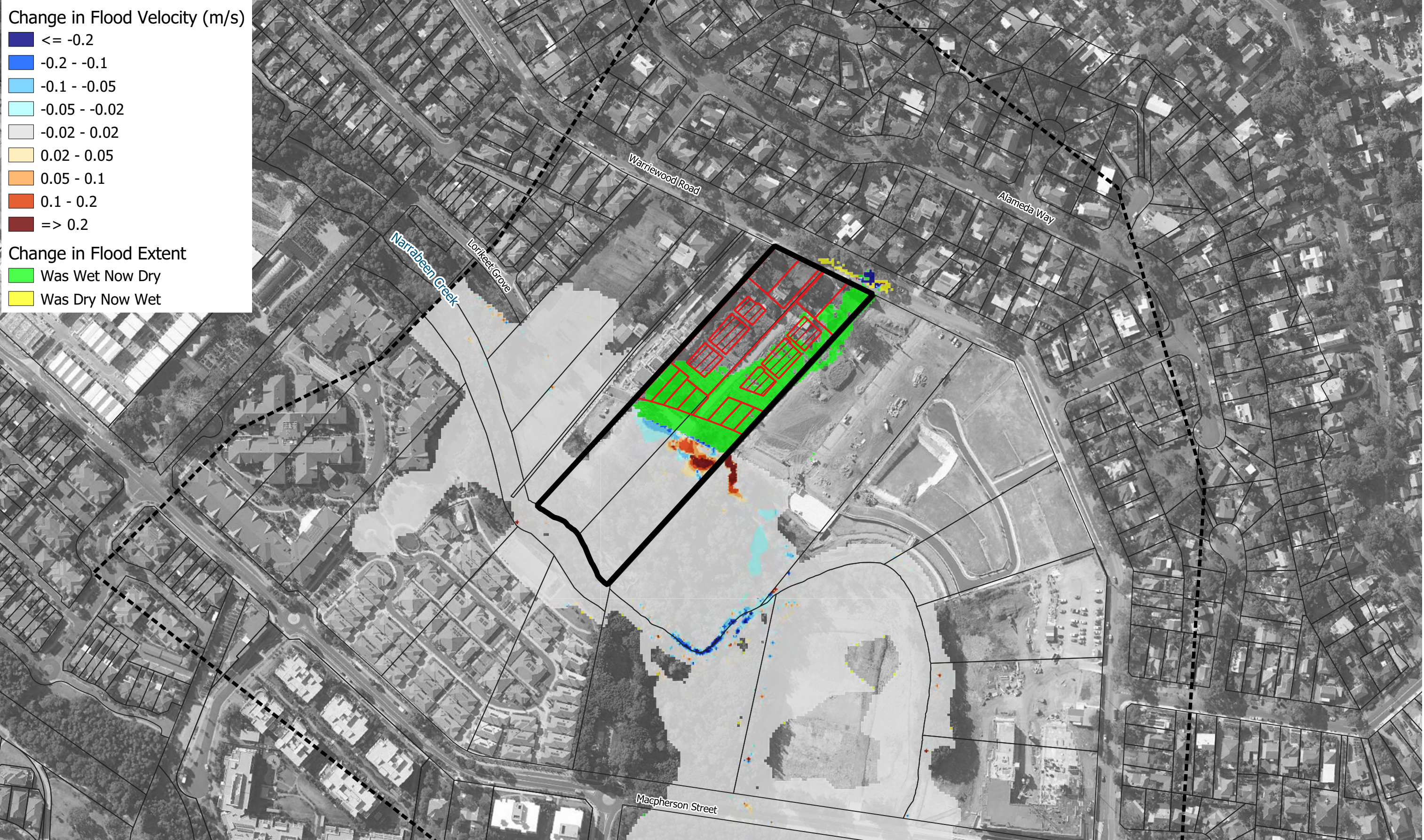
Change in Flood Extent

- Was Wet Now Dry
- Was Dry Now Wet

Legend

- Model Boundary
- Site Boundary
- Development Layout
- Proposed Lot
- Proposed Building
- Cadastral Boundary

<p>Title:</p> <p>5 year ARI event - Developed Scenario - Change in Peak Design Flood Velocities</p> <p><small>BMT endeavours to ensure that the information provided in this map is correct at the time of publication. BMT does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.</small></p> <p>Filepath: K:\N20951_45WarriewoodRd_FIA\QGIS\Generator_FIA_Update\AppendixFigure\Mapping_Figure_Generator.gqz</p>	<p>0 60 120 m</p>	<p>Drawing:</p> <p>C-10</p>	<p>Rev:</p> <p>A</p>
<p>BMT www.bmt.org</p>			



Change in Flood Velocity (m/s)

- <= -0.2
- 0.2 - -0.1
- 0.1 - -0.05
- 0.05 - -0.02
- 0.02 - 0.02
- 0.02 - 0.05
- 0.05 - 0.1
- 0.1 - 0.2
- => 0.2

Change in Flood Extent

- Was Wet Now Dry
- Was Dry Now Wet

Legend

- Model Boundary
- Site Boundary
- Development Layout
- Proposed Lot
- Proposed Building
- Cadastral Boundary

Title: **10 % AEP event - Developed Scenario - Change in Peak Design Flood Velocities**


BMT endeavours to ensure that the information provided in this map is correct at the time of publication. BMT does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.

0 60 120 m

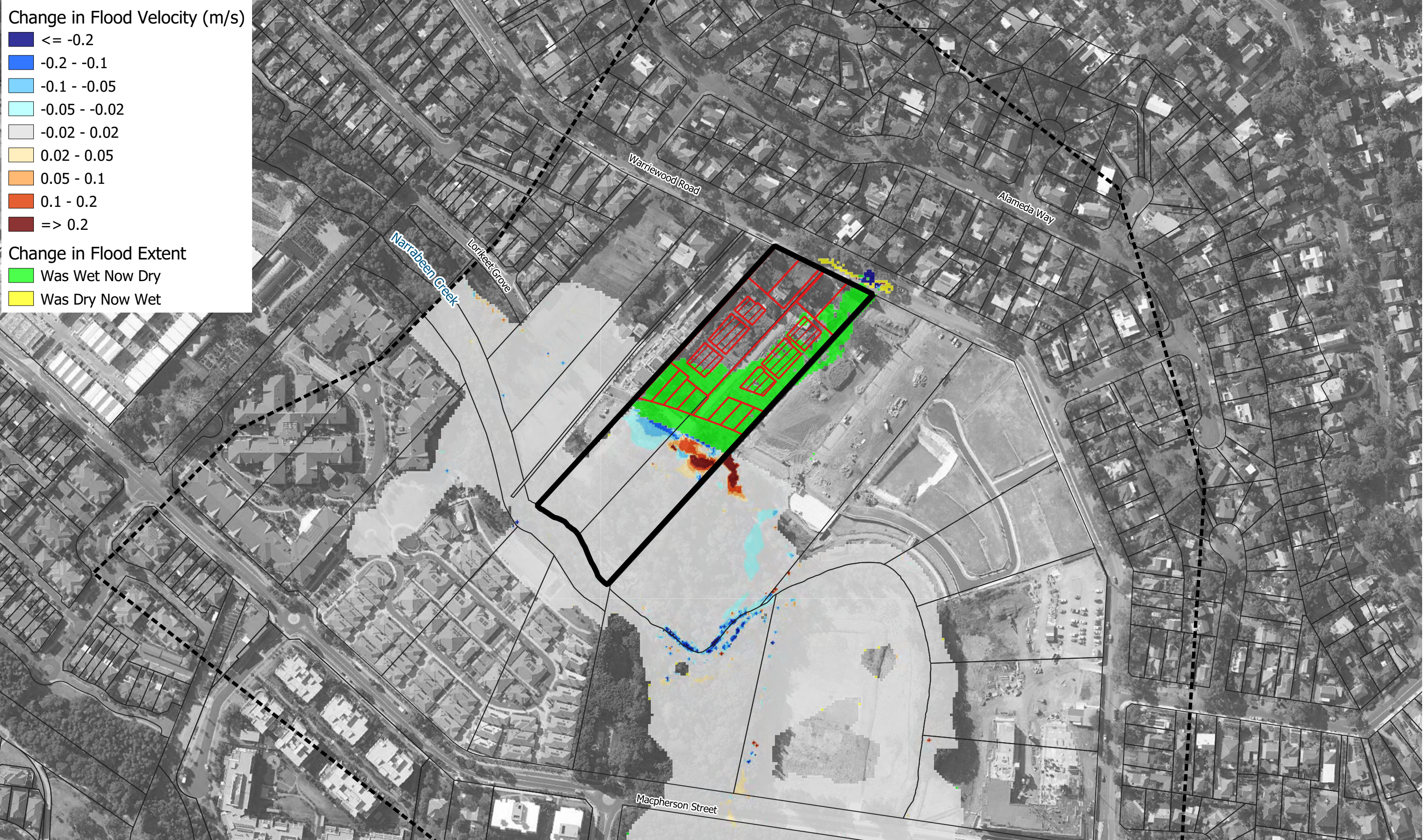
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Drawing: **C-11**

Rev: **A**



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Change in Flood Velocity (m/s)

- <= -0.2
- 0.2 - -0.1
- 0.1 - -0.05
- 0.05 - -0.02
- 0.02 - 0.02
- 0.02 - 0.05
- 0.05 - 0.1
- 0.1 - 0.2
- => 0.2

Change in Flood Extent

- Was Wet Now Dry
- Was Dry Now Wet

Legend

- Model Boundary
- Site Boundary
- Development Layout
- Proposed Lot
- Proposed Building
- Cadastral Boundary

Title: **5 % AEP event - Developed Scenario - Change in Peak Design Flood Velocities**

BMT endeavours to ensure that the information provided in this map is correct at the time of publication. BMT does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.

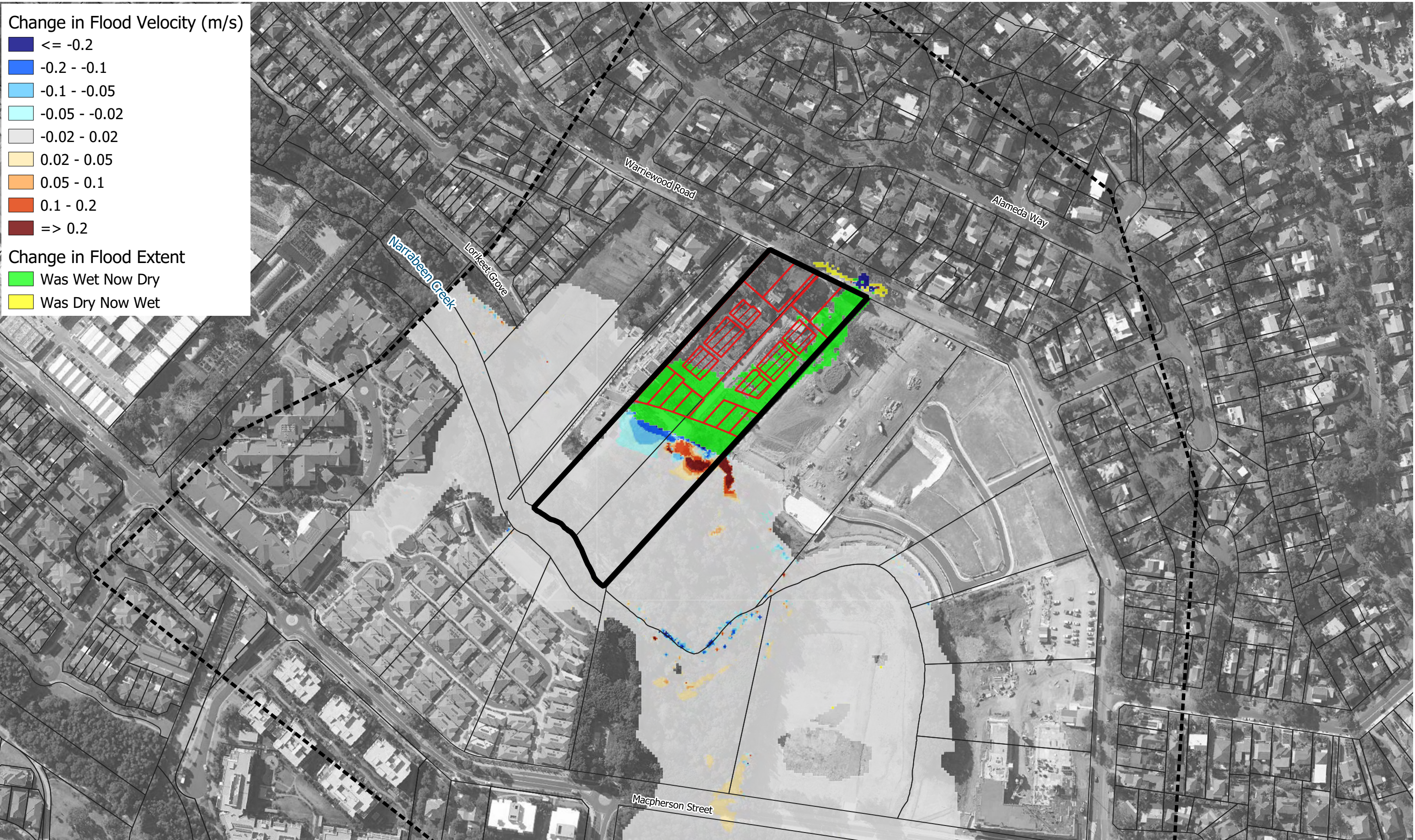
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Drawing: **C-12**

Rev: **A**

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Change in Flood Velocity (m/s)

- ≤ -0.2
- 0.2 - -0.1
- 0.1 - -0.05
- 0.05 - -0.02
- 0.02 - 0.02
- 0.02 - 0.05
- 0.05 - 0.1
- 0.1 - 0.2
- ≥ 0.2

Change in Flood Extent

- Was Wet Now Dry
- Was Dry Now Wet

Legend

- Model Boundary
- Site Boundary
- Development Layout
- Proposed Lot
- Proposed Building
- Cadastral Boundary

Title: **2 % AEP event - Developed Scenario - Change in Peak Design Flood Velocities**


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0 60 120 m

Filepath: K:\N20951_45WarriewoodRd_FIA\QGIS\Generator_FIA_Update\AppendixFigure\Mapping_Figure_Generator.gqz

Drawing: **C-13**

Rev: **A**



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Change in Flood Velocity (m/s)

- <= -0.2
- 0.2 - -0.1
- 0.1 - -0.05
- 0.05 - -0.02
- 0.02 - 0.02
- 0.02 - 0.05
- 0.05 - 0.1
- 0.1 - 0.2
- => 0.2

Change in Flood Extent

- Was Wet Now Dry
- Was Dry Now Wet

Legend

- Model Boundary
- Site Boundary
- Development Layout
- Proposed Lot
- Proposed Building
- Cadastral Boundary

Title: **1 % AEP event - Developed Scenario - Change in Peak Design Flood Velocities**


BMT endeavours to ensure that the information provided in this map is correct at the time of publication. BMT does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.

0 60 120 m

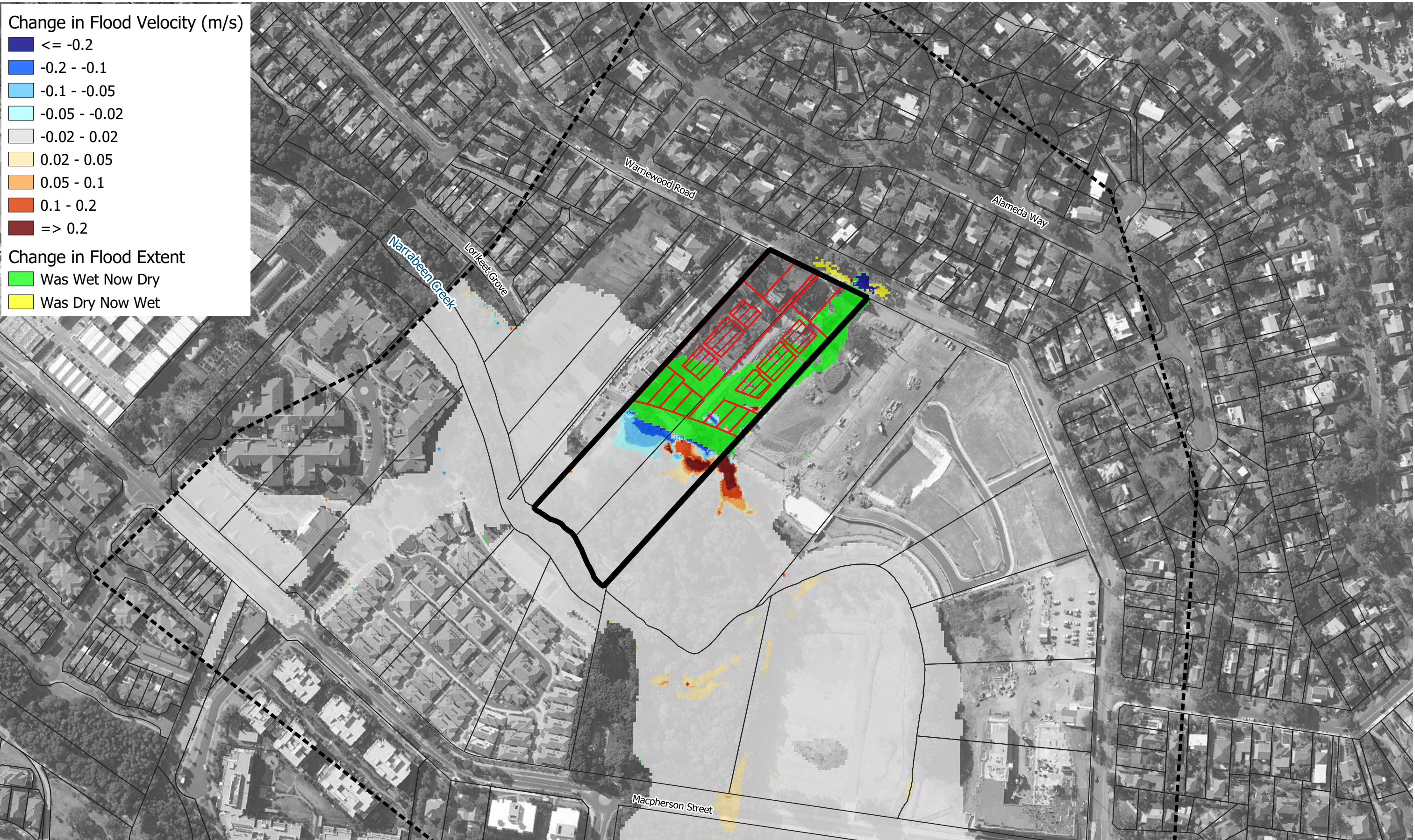
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Drawing: **C-14**

Rev: **A**



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Change in Flood Velocity (m/s)

- <= -0.2
- 0.2 - -0.1
- 0.1 - -0.05
- 0.05 - -0.02
- 0.02 - 0.02
- 0.02 - 0.05
- 0.05 - 0.1
- 0.1 - 0.2
- => 0.2

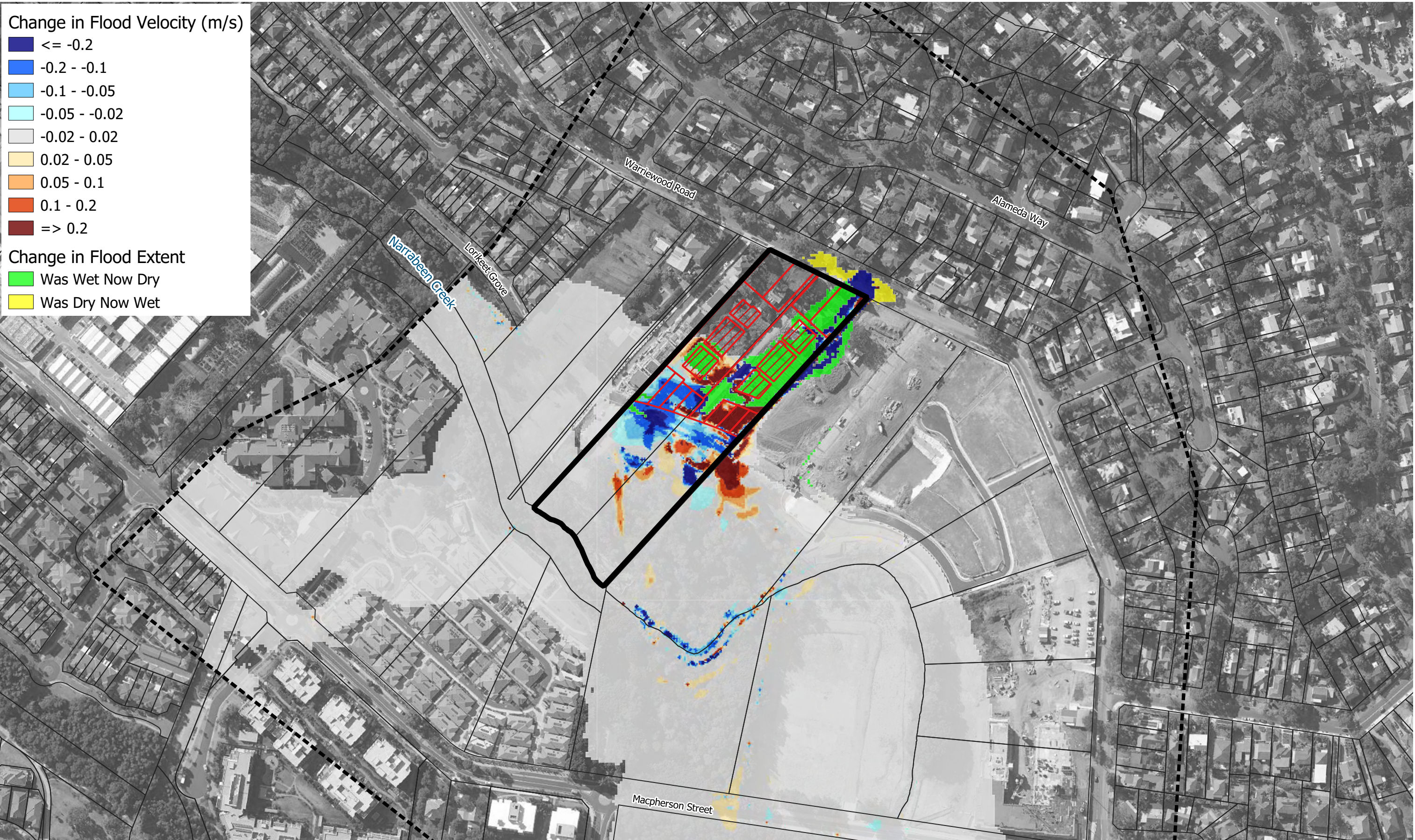
Change in Flood Extent

- Was Wet Now Dry
- Was Dry Now Wet

Legend

- Model Boundary
- Site Boundary
- Development Layout
- Proposed Lot
- Proposed Building
- Cadastral Boundary

<p>Title:</p> <p>1% AEP event with climate change - Developed Scenario - Change in Peak Design Flood Velocities</p> <p><small>BMT endeavours to ensure that the information provided in this map is correct at the time of publication. BMT does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.</small></p> <p>Filepath: K:\N20951_45WarriewoodRd_FIA\QGIS\Generator_FIA_Update\AppendixFigure\Mapping_Figure_Generator.gqz</p>	<p>0 60 120 m</p>	<p>Drawing:</p> <p>C-15</p>	<p>Rev:</p> <p>A</p>



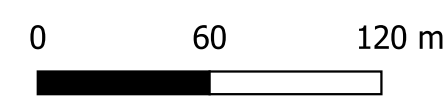
Legend

- Model Boundary
- Site Boundary
- Development Layout
- Proposed Lot
- Proposed Building
- Cadastral Boundary

Title: **PMF event - Developed Scenario - Change in Peak Design Flood Velocities**

Drawing: **C-16** Rev: **A**

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Filepath: K:\N20951_45WarriewoodRd_FIA\QGIS\Generator_FIA_Update\AppendixFigure\Mapping_Figure_Generator.gqz

Annex D Stormwater Drainage Plan
