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Our Ref: DJW: L.T2726.002.docx

23 May 2025
Ben Roose
c/o Hutch Architecture
61-63 Parry St
Newcastle West NSW 2302
Attention: Edward Highton

Dear Ed

RE: FLOOD IMPACT AND RISK ASSESSMENT FOR PROPOSED DEVELOPMENT AT 1 OAKHAMPTON ROAD, MAITLAND NSW

Background

Torrent Consulting was engaged to undertake a Flood Impact Assessment to assist in the approvals process for the proposed development at 1 Oakhampton Road, Maitland, NSW (the Site). The development includes alterations and additions to the existing dwelling, construction of a new garage and shed, and filling of a void at the rear of the Site. It is understood that a flood impact and risk assessment has been requested by Maitland City Council to address Council's flood planning controls in the context of the proposed development.

The Site is located within the Hunter River floodplain, on the right bank of the Hunter River, around 500 m upstream of Belmore Bridge, as presented in Figure 1. The local floodplain is flat and low-lying, with modifications to the local floodplain characterised by raised flood levee and road embankments, drainage lines, and urban development, as presented in Figure 2.

The existing design flood conditions at the Site are detailed in the Hunter River Branxton to Green Rocks Flood Study (WMA Water, 2010) and the Hunter River Floodplain Risk Management Study and Plan (WMA Water, 2015). Information contained within these studies was used to summarise the existing flood conditions and risks in the context of the Site and the proposed development.

The assessment utilises a TUFLOW model of the Lower Hunter River to simulate design flood conditions consistent with those of the existing flood study. This model enables a more detailed understanding of the local flood velocities and hazards under both existing and the proposed post-construction conditions to inform the appropriate flood risk management approach. It also provides a platform to assess the potential flood impacts associated with the proposed filling at the rear of the Site.

Model Development

For this assessment a TUFLOW hydraulic model was utilised that had been previously developed for mound assessments within the Hunter River floodplain. The model covers the entire floodplain of the Lower Hunter River downstream to the river mouth at the Tasman Sea, including upstream to Luskintyre on the Hunter River, Vacy on the Paterson River and Glen Martin on the Williams River, as presented in Figure 3.

The catchment area of the Hunter River covers some 22 000 km^2, with the Paterson and Williams Rivers contributing around 1200 km^2 and 1300 km^2 respectively. The modelled area encompasses some 750 km^2.

The model utilised the NSW Spatial Services LiDAR data product, downloaded via the ELVIS Foundation Spatial Data portal to define the floodplain topography. The model was constructed using a 16 m grid cell resolution, with the sub-grid sampling (SGS) routine enabled to define model elevations from a 4 m resolution LiDAR DEM.

The modelled floodplain contains numerous embankments that function as hydraulic controls and are of too small a scale to be adequately captured by the 16 m grid cell model resolution. Therefore, a network of breaklines was digitised along some 820 km of embankments and the underlying LiDAR data interrogated to populate the breaklines with the elevations of the embankment crests. These were then incorporated into the TUFLOW model using the Z Shape representation, which modifies model cell elevations to match those of the breaklines.

A total of 27 floodplain mound constructions were identified as having been constructed since the LiDAR data was captured in 2012-13, using available aerial imagery in Google Earth. The approximate extent of these mounds was identified from the imagery and incorporated into the TUFLOW model with assumed mound heights being adopted to raise them above the 1% AEP flood level.

The Hunter River Hydrographic Survey (May 2005) was used to provide representative channel cross-section information of the lower Hunter, Paterson and Williams Rivers. An appropriate channel topography was incorporated into the model, with a full 2D representation of both channel and floodplain. Aerial imagery was used to define separate surface materials for areas of cleared floodplain, river channel and remnant vegetation. Modelling of key hydraulic structures within the study area is also included for the Fullerton Cove and Salt Ash floodgates and culverts under Nelson Bay Road.

Many estuarine vegetation communities are not well penetrated, and are subsequently poorly filtered in, the LiDAR data product. These include areas of mangroves, saltmarsh, phragmites, rank grassland, wet heath, and other swampy habitats. The modelled floodplain elevations in these areas have therefore had an elevation correction adjustment applied to the LiDAR data. Vegetation across the Hunter Estuary has been treated in the TUFLOW model, with LiDAR elevations being lowered between 0.2 m and 0.6 m, depending on vegetation cover. The extent of the modified LiDAR elevations is presented in Figure 3.

The upstream model inflow boundaries on the Hunter, Paterson and Williams Rivers were developed using information contained in the Hunter River Branxton to Green Rocks Flood Study (WMA Water, 2010), the Paterson River Flood Study Vacy to Hinton (WMA Water, 2017) and the Williams River Flood Study (BMT WBM, 2009) respectively. Local hydrological inputs for the 750 km^2 of model area were also accounted for, although they are not overly important for the derivation of the design flood conditions. The downstream boundary of the model was configured as a tidal cycle with a peak water level of 1.1 m AHD, which is approximately an annual peak condition.

The model was calibrated to provide consistency with the Hunter River Branxton to Green Rocks Flood Study and the Williamtown – Salt Ash Floodplain Risk Management Study through iterative adjustment of the Manning's 'n' roughness parameters for the digitised land use materials. The adopted Manning's 'n' values are provided in Table 1.

The TUFLOW model produced results at Maitland that closely match those of the Hunter River Branxton to Green Rocks Flood Study. Consistent results at Raymond Terrace were harder to achieve and were found to be significantly influenced by total inflow volumes more-so than peak flow rates alone.

Design flood levels at Oakhampton are driven principally by peak flows (with variations in volume effectively negligible). Flood Frequency Analysis (FFA) undertaken for the Hunter River Branxton to Green Rocks Flood Study and the Singleton Floodplain Risk Management Study (BMT, 2020) provide similar estimates of design flood flows for the Hunter River, which provides a good level of confidence in those estimates. The derivation of design flood flow estimates through FFA at Raymond Terrace is less certain, due to a shorter period of continuous record and a lack of a site rating curve. Using FLIKE to derive probabilistic estimates of design peak flows, the results for the rarer events were found to vary significantly depending on the assumptions made for data entry of historic flood thresholds. This is because there is less than 40 years of continuous record and the largest flood events all occurred before this period.

Table 1 – Adopted Manning's 'n' Values

Surface Material	Manning's 'n'
Cleared floodplain	0.040
Hunter River channel u/s Morpeth	0.030
Hunter River channel Morpeth to Raymond Terrace	0.025
Hunter River channel d/s Raymond Terrace	0.020
Paterson River channel	0.045
Williams River channel	0.025
Remnant vegetation	0.120
Mangroves	0.150

Rainfall-runoff modelling was undertaken for the entire Hunter River catchment using methods outlined in ARR 2019 to assist in establishing suitable design flow conditions at Raymond Terrace, specifically the relationship between modelled peak flow conditions at Oakhampton and Raymond Terrace. With flows on the Hunter River dominating volumes at Raymond Terrace, establishing a relationship between design flows at Oakhampton and expected design flows at Raymond Terrace provides a useful tool for validating design flood levels at Raymond Terrace. The Hunter River catchment rainfall-runoff modelling found the critical duration at Oakhampton to be 48 hours, whereas it was the 72-hour duration at Raymond Terrace – indicative of the additional reliance on overall flood volume to maintain peak flows and levels. Table 2 presents the design flows at Oakhampton and the estimated equivalent design flow condition at Raymond Terrace.

Ultimately, design flow estimates were adopted from the FLIKE FFA for the 20% AEP and 10% AEP events and from the rainfall-runoff modelling analysis for the rarer flood events. A comparison of the adopted design flows at Raymond Terrace with the 90% confidence interval determined using FLIKE is presented in Chart 1.

Table 2 – Hunter River Design Peak Flows (m^3/s)

Design Event	Oakhampton	Raymond Terrace
20% AEP	1700	1400
10% AEP	2600	2300
5% AEP	3800	3200
2% AEP	5800	4700
1% AEP	8000	6300
0.5% AEP	10 300	7900
0.2% AEP	13 500	10 200

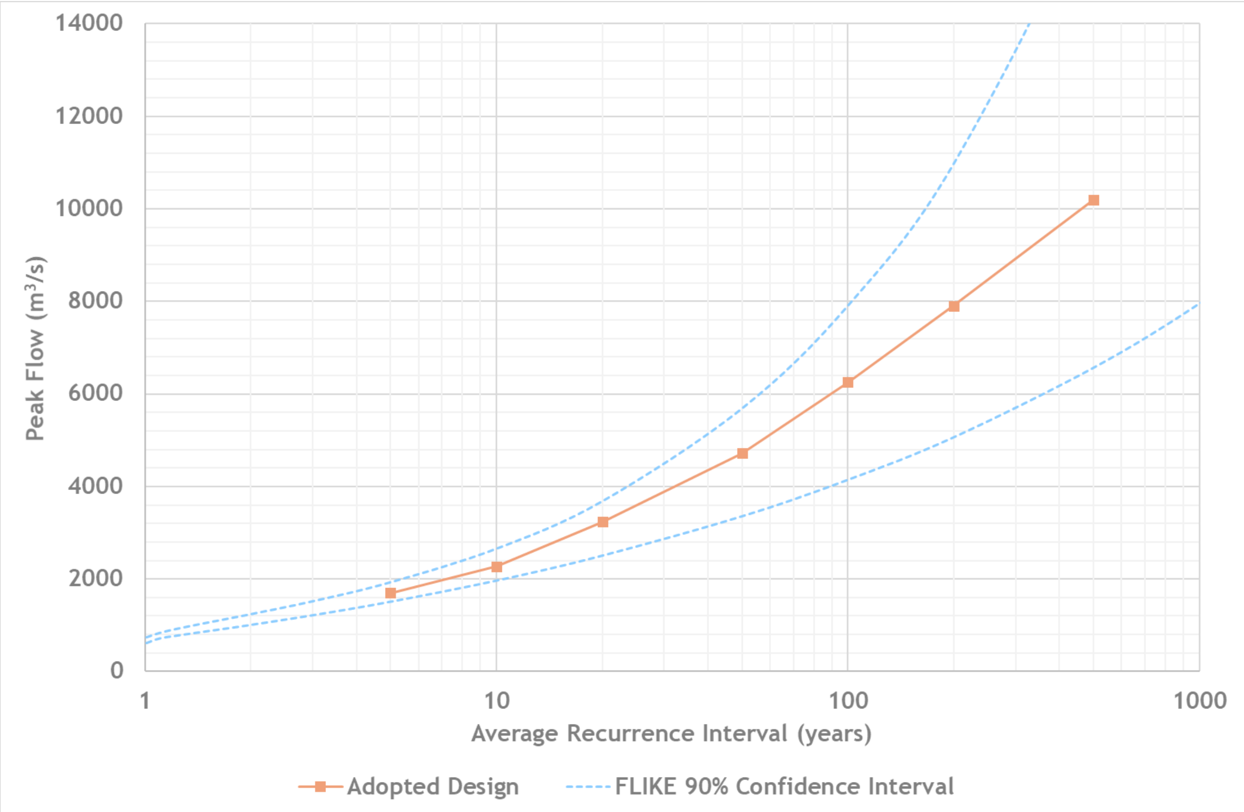


Chart 1 – Adopted Design Flood Flows at Raymond Terrace

Design flood flow hydrographs for the Hunter, Williams and Paterson Rivers were simulated in the TUFLOW model and the volumes of the flood recession were adjusted until the required peak flow conditions at Raymond Terrace were matched. The resultant peak flood levels at the Raymond Terrace gauge are presented in Table 3, together with those established for the Williamtown – Salt Ash Floodplain Risk Management Study. The overall consistency between the two is good and is well within the bounds of uncertainty of the FFA at Raymond Terrace.

Table 3 – Design Flood Levels at Raymond Terrace

Design Event	This Assessment	BMT WBM (2017)
20% AEP	2.6	2.2
10% AEP	3.0	3.0
5% AEP	3.4	3.3
2% AEP	3.9	4.1
1% AEP	4.6	4.8
0.5% AEP	5.2	5.2

Flood Modelling and Mapping

The TUFLOW model was simulated (using the HPC solver) for the 5% AEP, 2% AEP, 1% AEP, 0.5% AEP, and Extreme flood events to define baseline flood conditions for the purposes of assessing flood risk and as the basis for subsequent flood impact assessment. Events more frequent than the 5% AEP do not reach the Site for a Hunter River flood event. The modelled peak flood levels at the Site are summarised in Table ***4***.

The modelled peak flood extents for the 1% AEP, 0.5% AEP and Extreme events are presented in Figure 4, together with the Site lot boundary, proposed mound location, and proposed access road. Figure 5, Figure 6, and Figure 7 are presented for additional flooding context and show the modelled peak flood depths and peak flood level contours for the 1% AEP, 0.5% AEP and Extreme events, respectively.

Table 4 – Modelled Peak Design Flood Levels

Design Event	Flood Level (m AHD)
5% AEP	9.5
2% AEP	10.2
1% AEP	10.8
0.5% AEP	11.6
Extreme	13.7

The Hunter River model utilised for this assessment is generally consistent with the existing flood study, however, the modelled levels on the right bank floodplain of the Hunter River at Oakhampton are lower than those modelled in the Hunter River Branxton to Green Rocks Flood Study. Therefore, the 0.5% AEP conditions modelled for this assessment have been used as a proxy for the adopted 1% AEP conditions to determine flood risk, with mapping from the study indicating a 1% AEP flood level of around 11.5 m AHD at the Site.

At around 13.5 m AHD, the Extreme Flood level presented in the existing study is generally consistent with the Extreme Flood level modelled at the Site for this assessment.

Flood Risk Management

The flood hazard conditions at the Site were assessed to determine the risk to property and risk to life exposure of the proposed development. Appropriate flood risk management measures were identified in accordance with Council's DCP, LEP, and the NSW Floodplain Development Manual.

Figure 8, Figure 9, and Figure 10 present the flood hazard classification at the Site for the 1% AEP, 0.5% AEP and Extreme Flood events, respectively. The flood hazards have been determined in accordance with Guideline 7-3 of the Australian Disaster Resilience Handbook 7 Managing the Floodplain: A Guide to Best Practice in Flood Risk Management in Australia (AIDR, 2017). This produces a six-tier hazard classification, based on modelled flood depths, velocities, and velocity-depth product. The hazard classes relate directly to the potential risk posed to people, vehicles, and buildings, as presented in Chart 2.

The flood hazard mapping is useful for providing context to the nature of the modelled flood risk and to identify potential constraints for the future development of the Site with regards to floodplain risk management. The principal consideration of good practice floodplain risk management is to ensure compatibility of the proposed development with the flood hazard of the land, including the risk to life and risk to property.

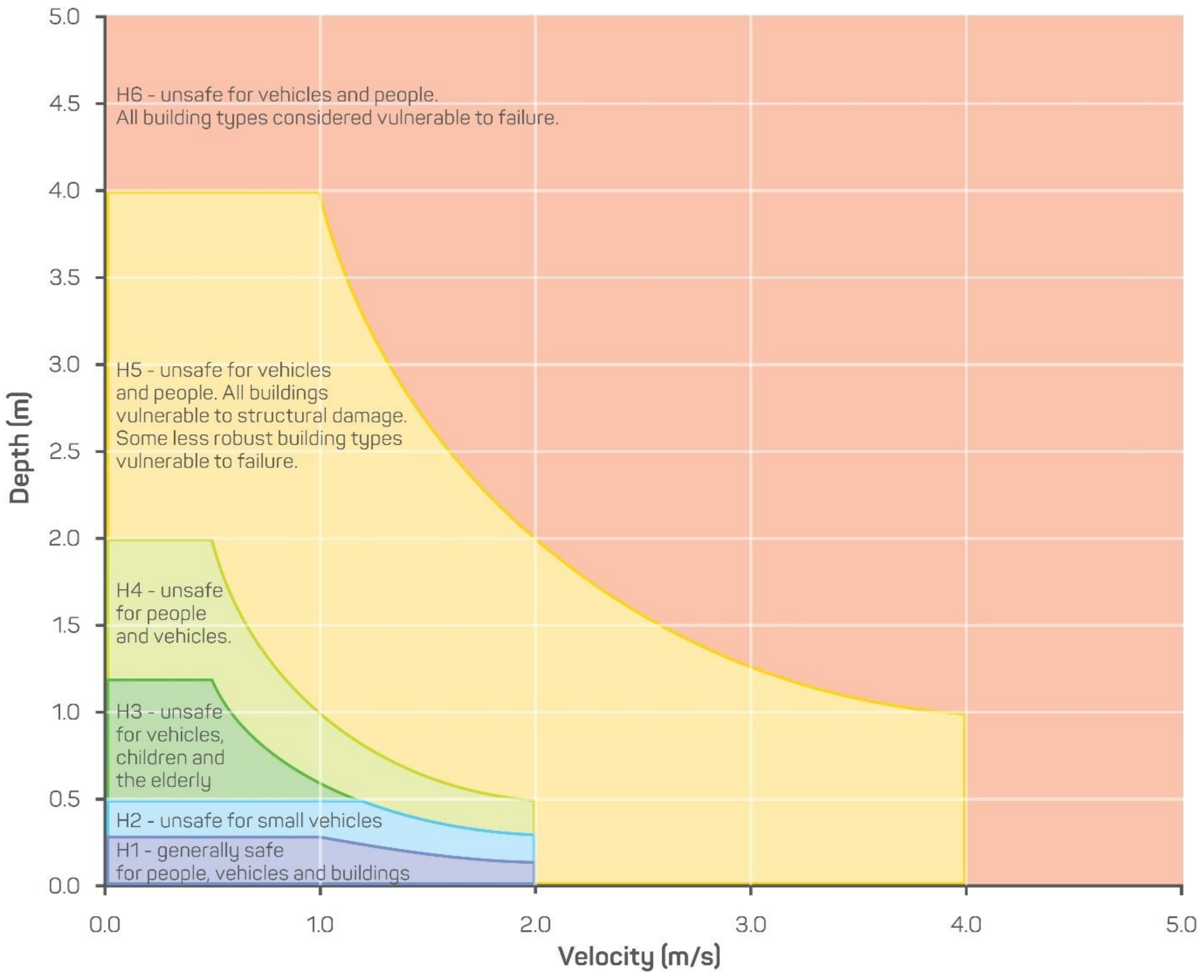


Chart 2 – General Flood Hazard Vulnerability Curves (AIDR, 2017)

The objective of the management of risk to property is to minimise the damages that would be incurred in the event of a flood. This includes potential damage to future building structures and their contents. Risk to property is typically managed to the 1% AEP design flood event, with Council adopting a Flood Planning Level (FPL) of 12.22 m AHD for the Site, being the 1% AEP flood level plus 0.5 m freeboard.

In addition to the fill at the rear of the Site, the development includes a new garage and shed with a loft, and alterations and additions to the existing dwelling, with all proposed development to be below the FPL.

Council make provision for development below the FPL subject to appropriate controls as outlined in the DCP B.3 – Hunter River Floodplain and require adequate information to assess the impact of the proposal on flood behaviour, the environment, flood affectation and risk to life and property before development approval can be granted.

Council requires that development below the FPL must not adversely impact local flooding, with the minor additions to the dwelling, including the garage and shed, not at a scale that will impact Hunter River mainstream flooding. However, filling of the void at the rear of the Site will reduce flood storage, and so the potential for local flood impacts has been investigated in the subsequent flood impact assessment section of this report.

Design of the proposed garage and shed should consider flood hydraulics up to the FPL to ensure the structures will withstand flood conditions. The alterations and additions should consider the existing condition of the dwelling and improve the flood resilience of the building, where feasible, to increase the life span of the dwelling.

Parts of buildings and structures at or below the FPL shall be constructed in accordance with Table 1: Flood Aware Design Requirements for Residential Development on Flood Prone Land as presented in Council's DCP.

Electrical outlets should be located above the FPL in the new buildings, and where possible, be moved above the FPL in the existing dwelling.

The objective of the management of risk to life is to minimise the likelihood of deaths in the event of a flood and is typically considered for rarer flood events than the 1% AEP, up to the PMF (or Extreme Flood). Figure 10 shows that the dwelling is impacted by an H6 hazard at the Extreme event, which would produce high hazard flood conditions on Site. It is therefore essential that occupants are evacuated to flood-free locations prior to an Extreme event occurring.

While the dwelling addition does not increase the enclosed habitable floor space by more than 50%, with no requirement to demonstrate safe evacuation for the development up to a PMF event, the Hunter River flood warning system will provide ample warning time to evacuate prior to life-threatening flood conditions occurring at the Site.

Council does not allow development of buildings in a floodway, however, the mapping in the Hunter River Floodplain Risk Management Study and Plan is not at a scale that readily identifies the hydraulic category at an urban lot scale. The proposed additions, including the shed and garage, are in a heavily urbanised area, aligned with existing buildings, fences and other obstructions that are not characteristic of a floodway, with active floodways likely confined to unobstructed flow paths such as roadways and open fields. As such, the planning controls for development within a floodway are deemed to be not applicable for the Site.

Flood Impact Assessment

The proposed fill at the rear of the Site has the potential to change local flood conditions due to loss of flood storage. As such, the proposed fill design provided by Hutch Architecture (024-005_DA 000_Cover Page & Site Plan_12.pdf) was incorporated into the TUFLOW model, and the design flood events re-simulated for comparison with the baseline flood conditions.

The results of the flood impact assessment are presented in Figure 11 to Figure 16. Flood impact mapping is presented for the modelled peak flood level and modelled peak flood velocity for the 2% AEP, 1% AEP and 0.5% AEP flood events.

The results show that the fill will not result in adverse off-site impacts to flood levels, with a minor reduction in the flood level downstream of the Site due to changes in flow distribution. The modelled impacts to the peak velocity are localised and minor, with off-site impacts not exceeding 0.2 m/s adjacent to the northern boundary of the Site.

Large voids within residential lots, such as that proposed to be filled at the Site, are a unique feature within the local floodplain, and as such, similar development is unlikely to occur, with limited potential for cumulative development impacts. However, given that the proposed fill presents no adverse impact to the local flood levels and only minor and localised impacts to the flood velocity, it is unlikely that similar development over time will present a risk of cumulative development impacts.

Conclusion

The Site at 1 Oakhampton Road, Maitland, NSW requires a flood assessment to accompany the DA for the proposed additions to the existing dwelling, new shed and garage, and filling of an existing void, due to the development being located within the Hunter River floodplain. The flood impact assessment has included use of a TUFLOW hydraulic model to simulate design flood conditions at the Site, whilst maintaining a reasonable consistency with the results of the previous studies.

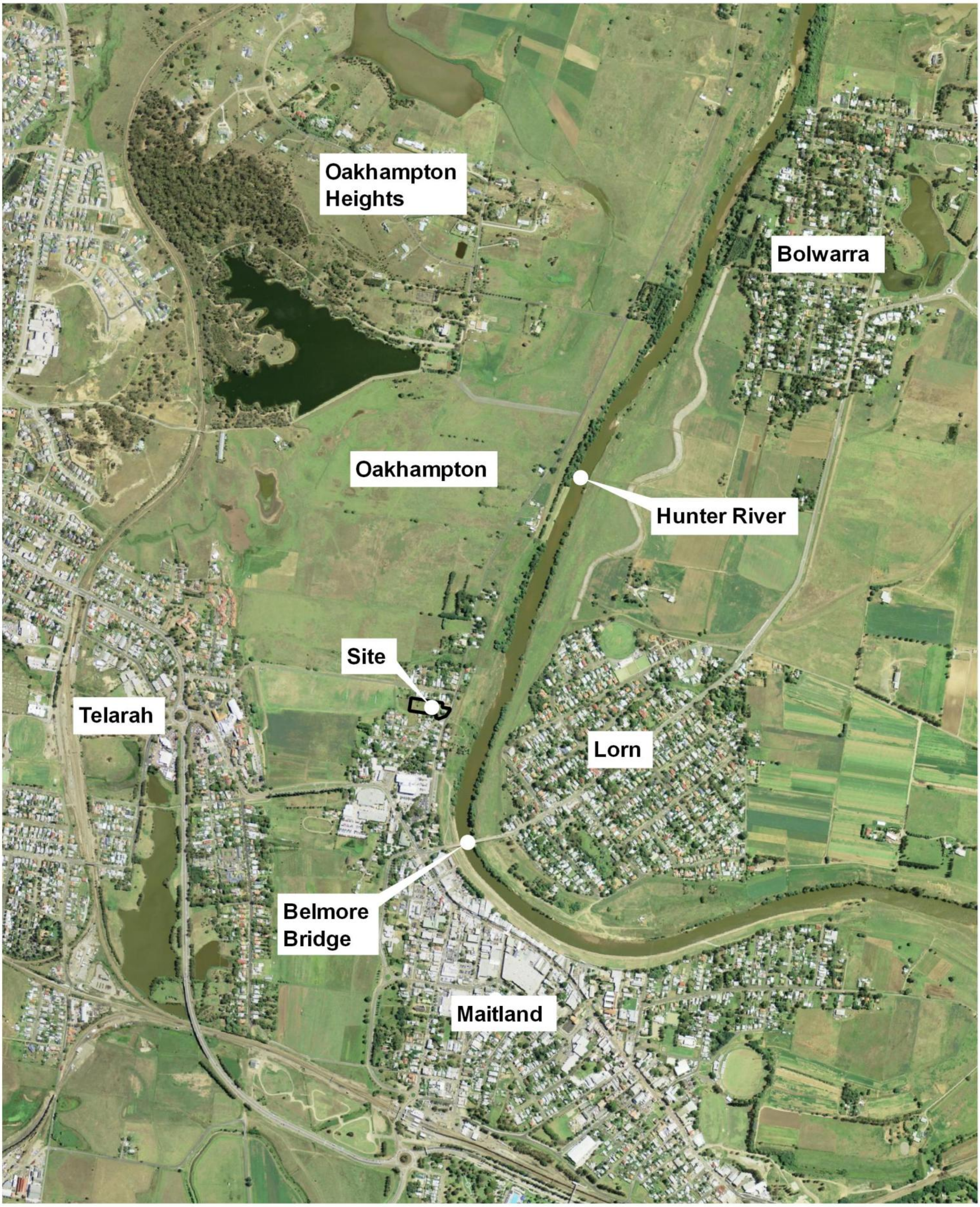
The flood assessment has determined that the proposed development is compatible with the existing flood hazard and does not result in adverse off-site flood impacts.

We trust that this report meets your requirements. For further information or clarification please contact the undersigned.

Yours faithfully

Torrent Consulting

Dan Williams
Director



Title:

Study Locality

0 0.4 0.8 km

approx. scale

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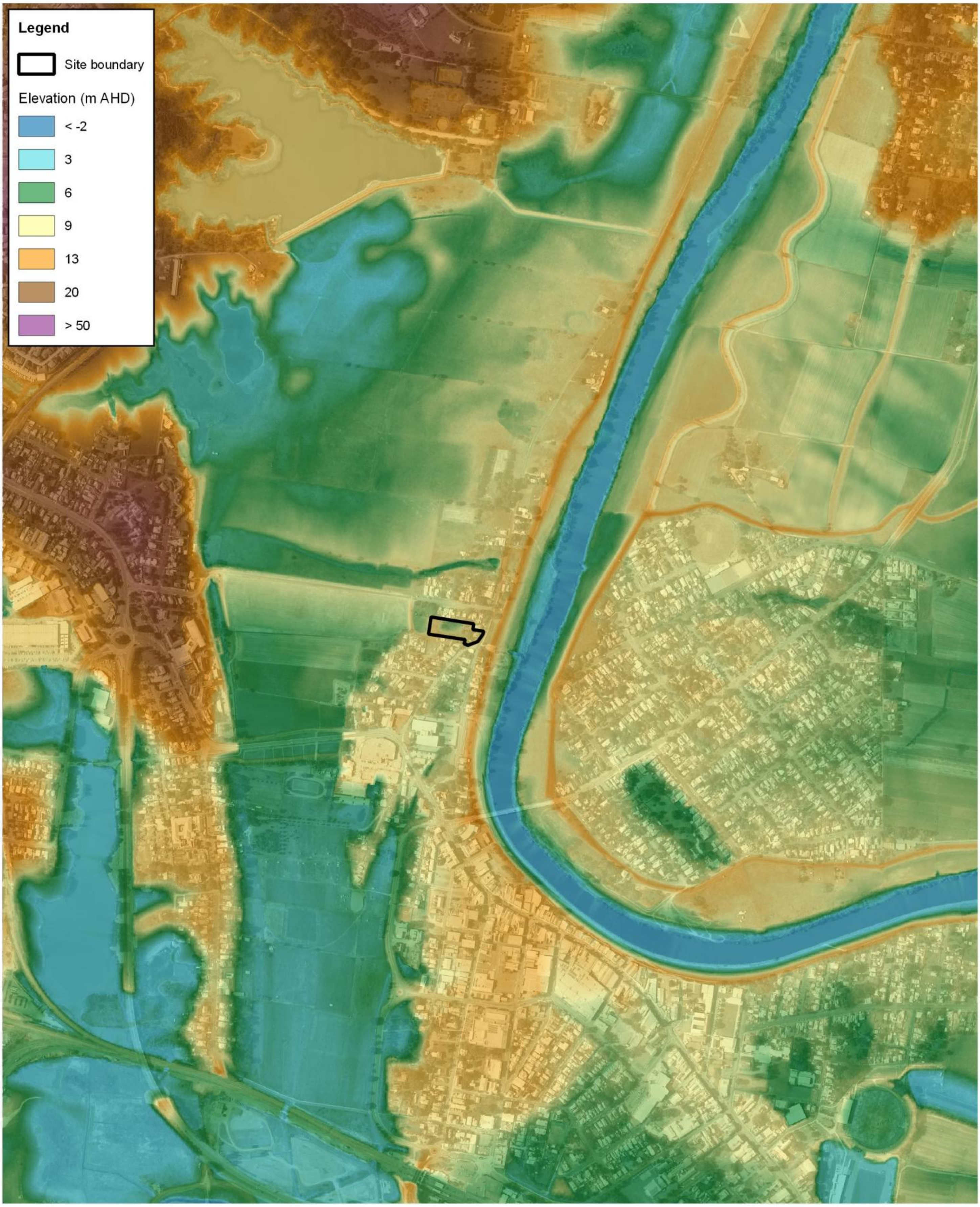

Title:

Local Floodplain Topography

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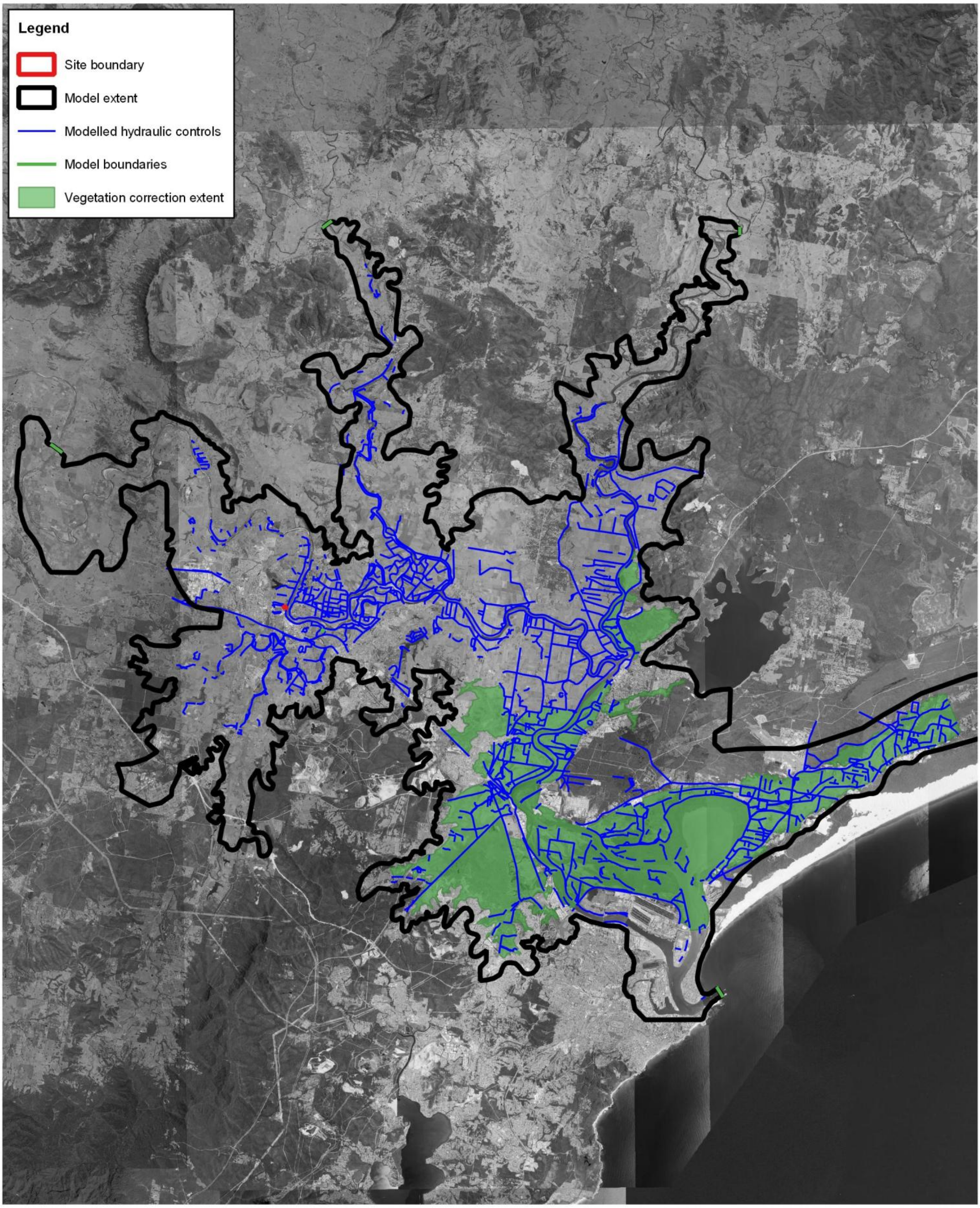

Title:

TUFLOW Model Components

0 7 14 km

approx. scale

Figure: 3

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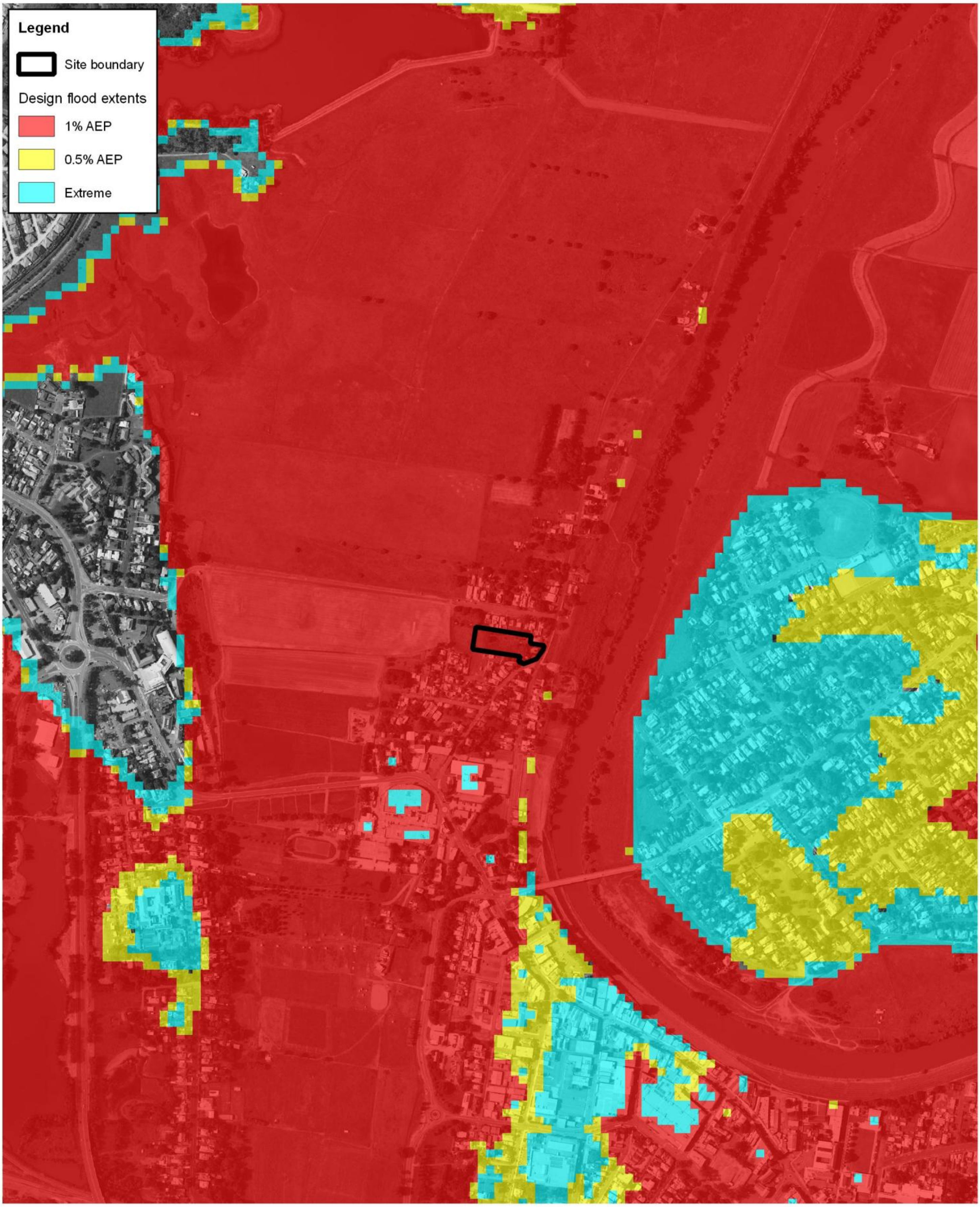

Title:

Modelled Design Flood Extents

Figure: **4**

Revision: **A**

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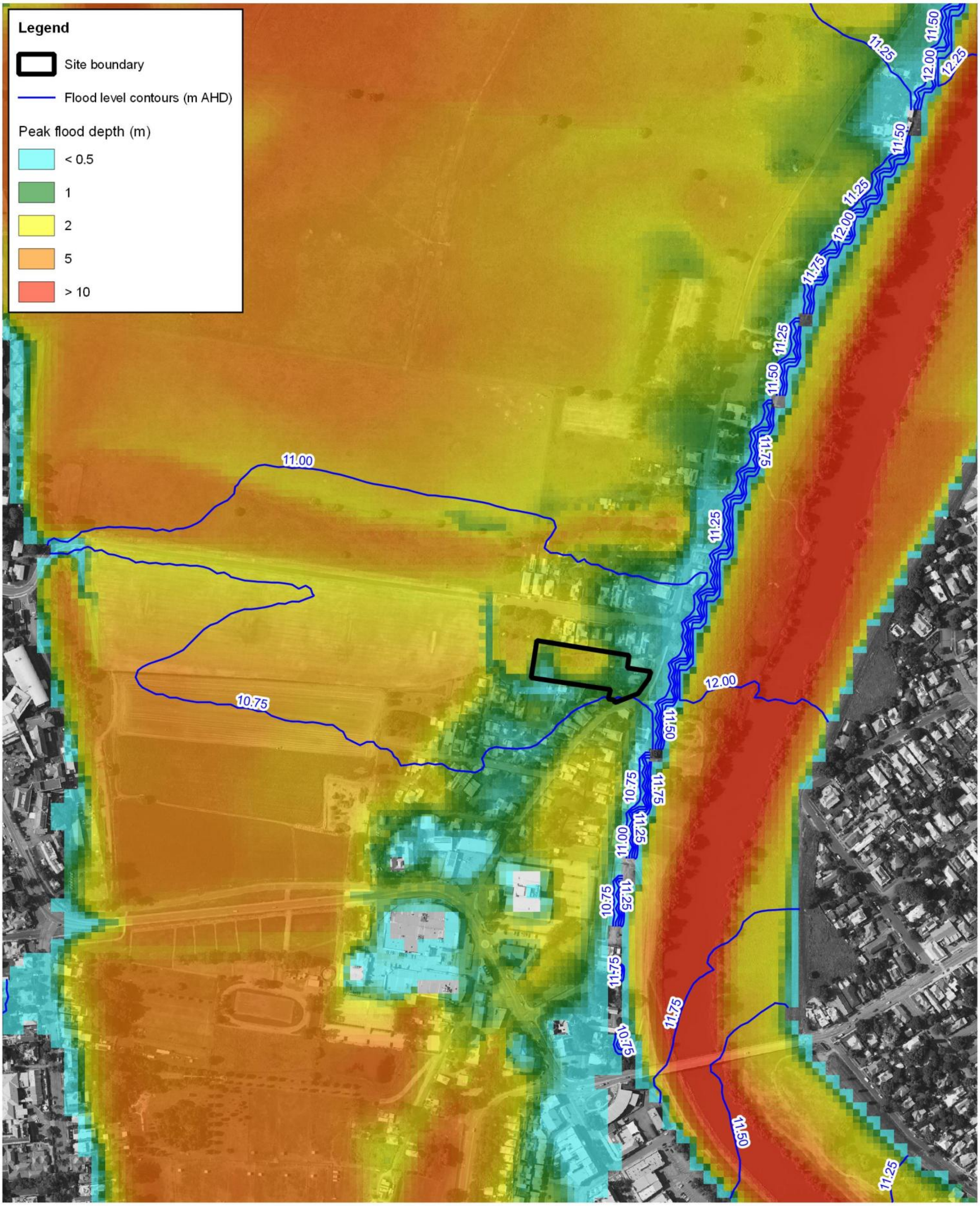

Title:

Modelled 1% AEP Flood Depths and Levels

Figure: **5**

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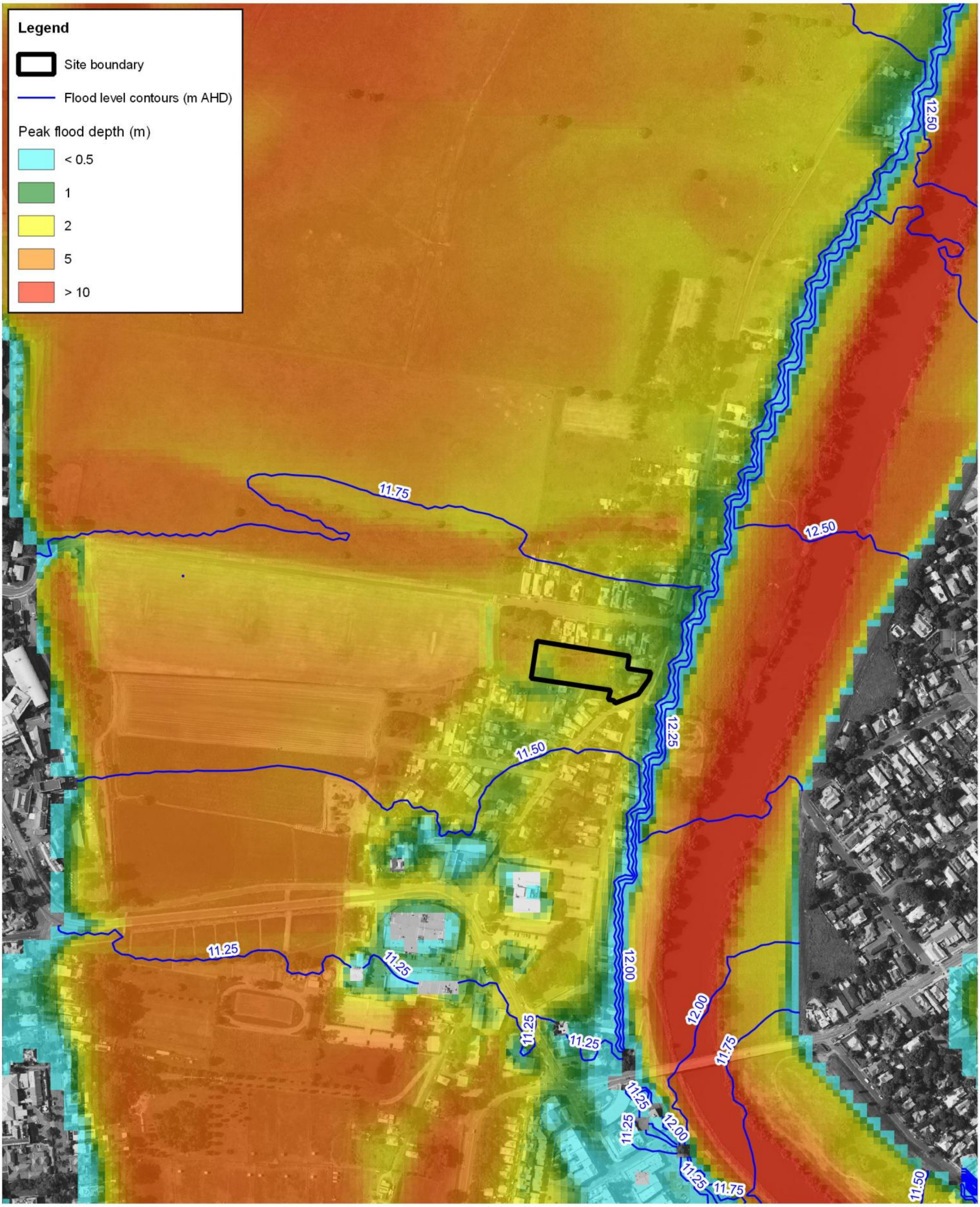

Title:

Modelled 0.5% AEP Flood Depths and Levels

0 100 200 m

approx. scale

Figure: **6**

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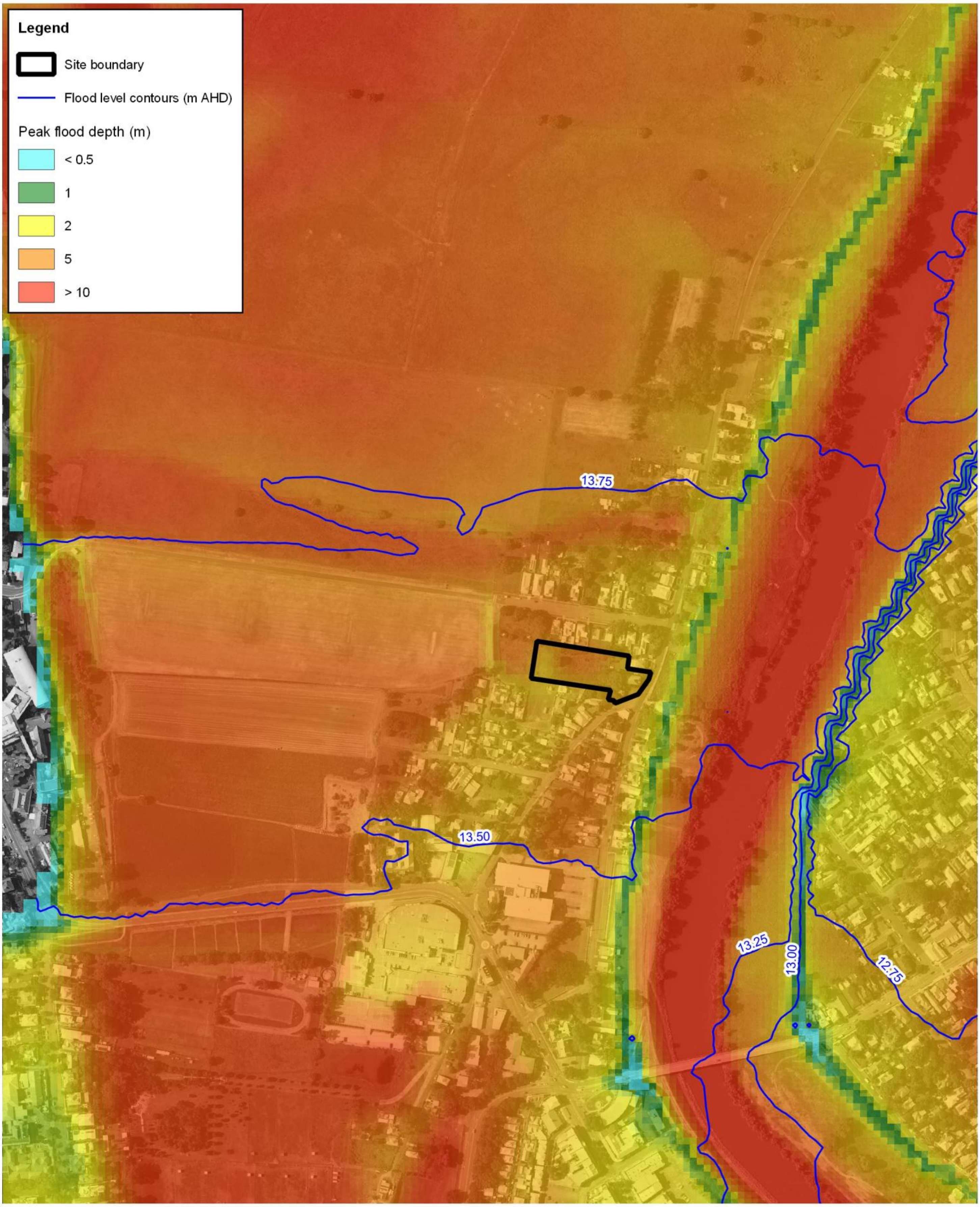

0 100 200 m

approx. scale

Title:

Modelled Extreme Flood Depths and Levels

Figure: **7**

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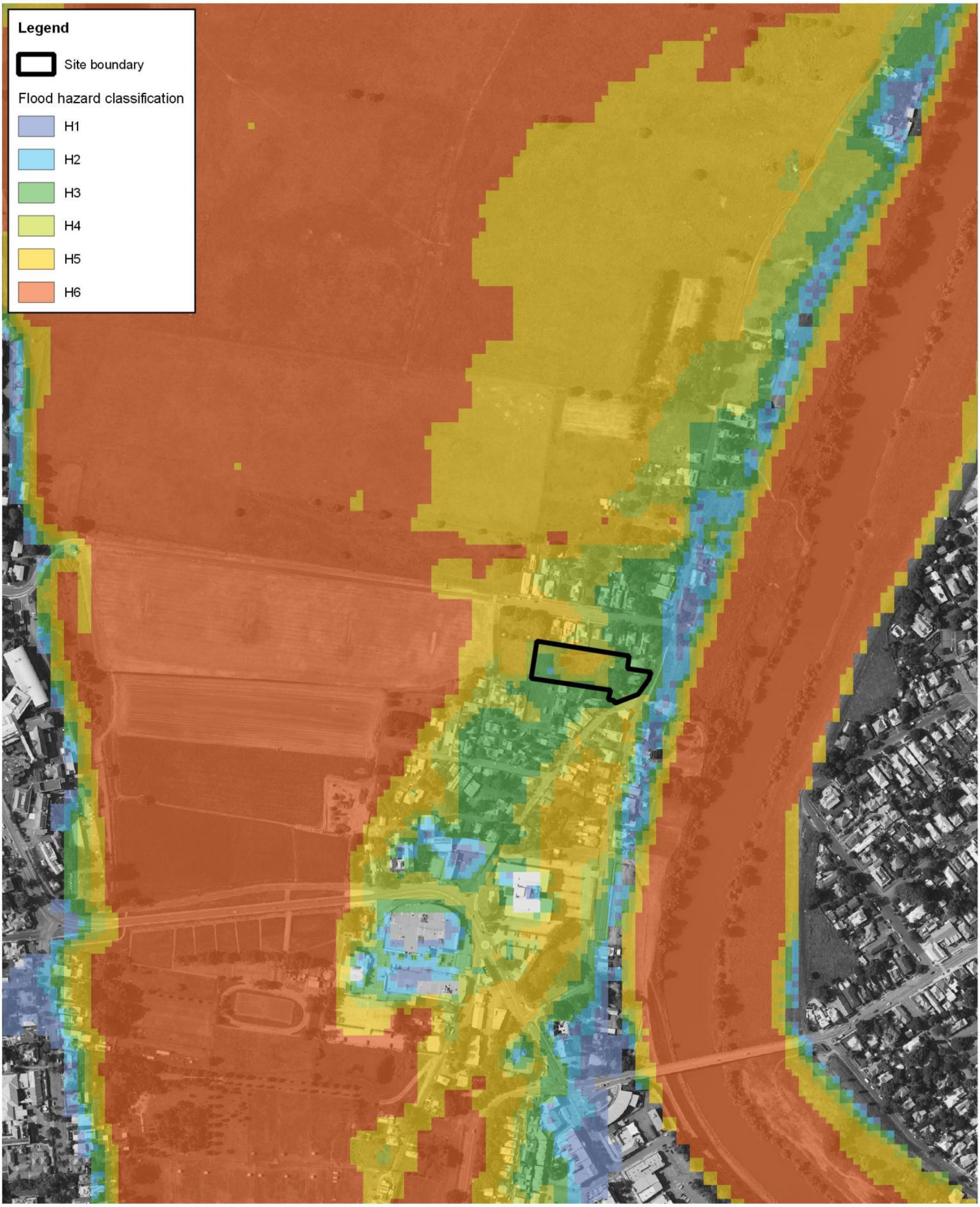

Title:

Modelled 1% AEP Flood Hazard Classification

0 100 200 m

approx. scale

Figure: **8**

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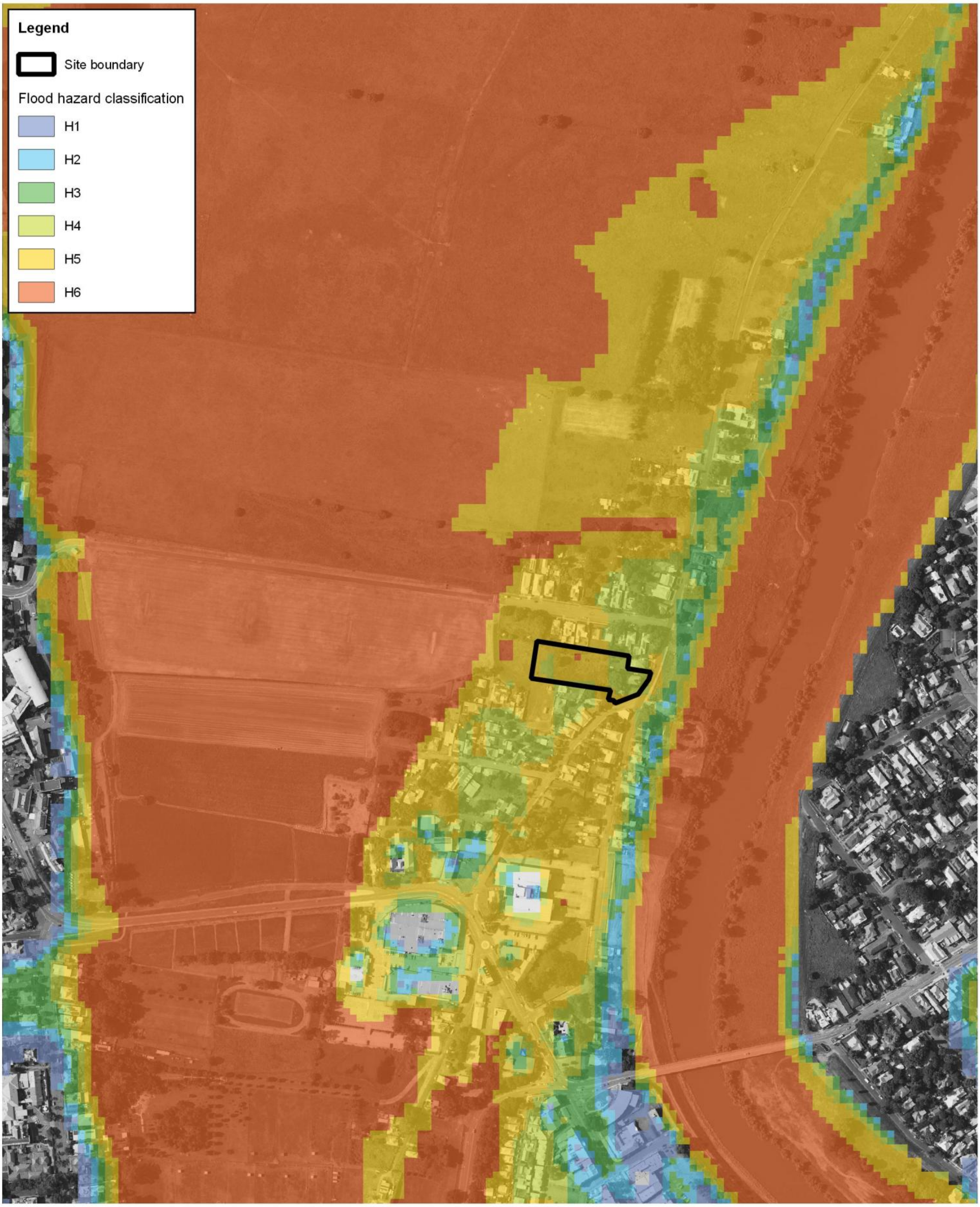

Title:

Modelled 0.5% AEP Flood Hazard Classification

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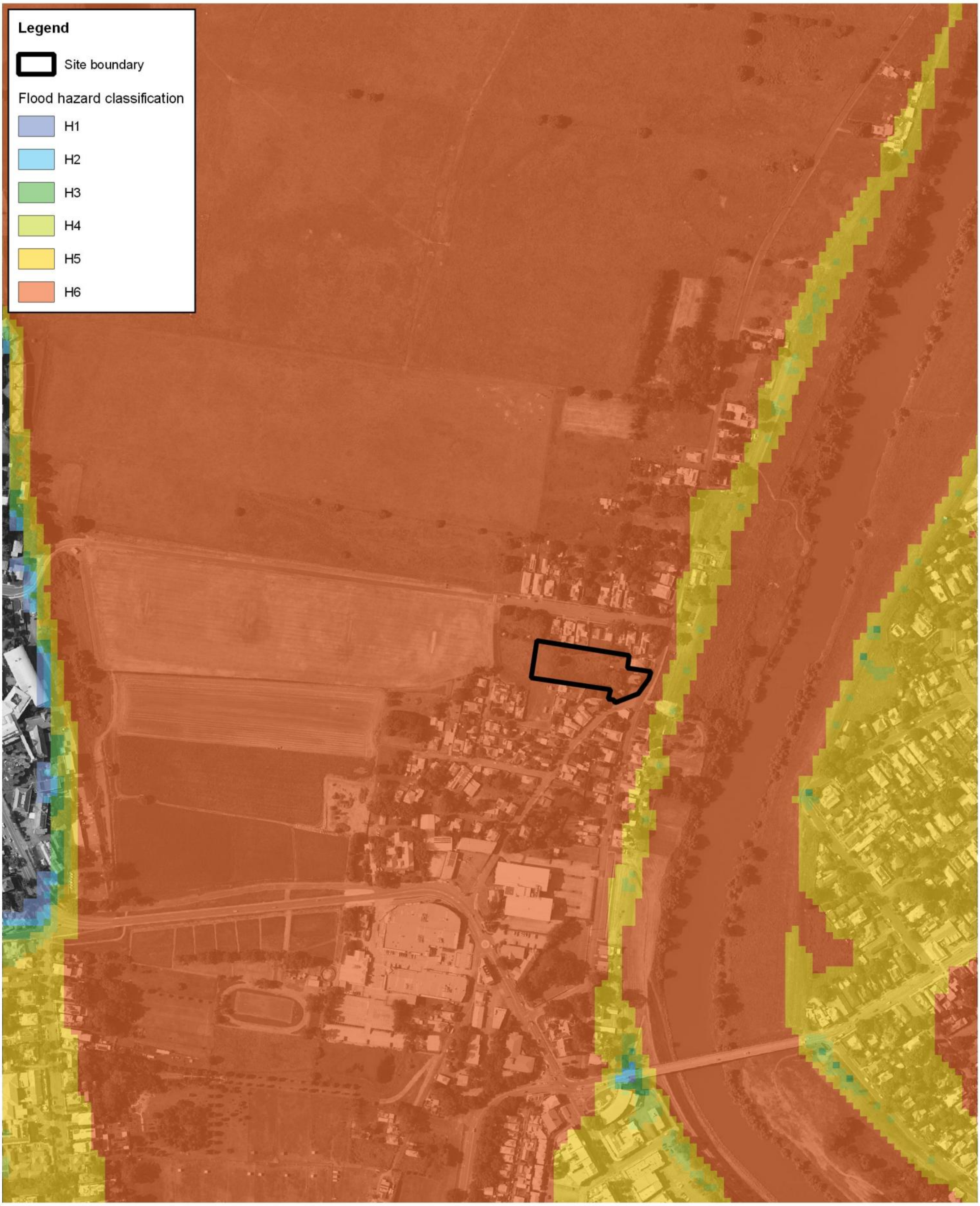

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Modelled Extreme Flood Hazard Classification

0 100 200 m

approx. scale

Figure: **10**

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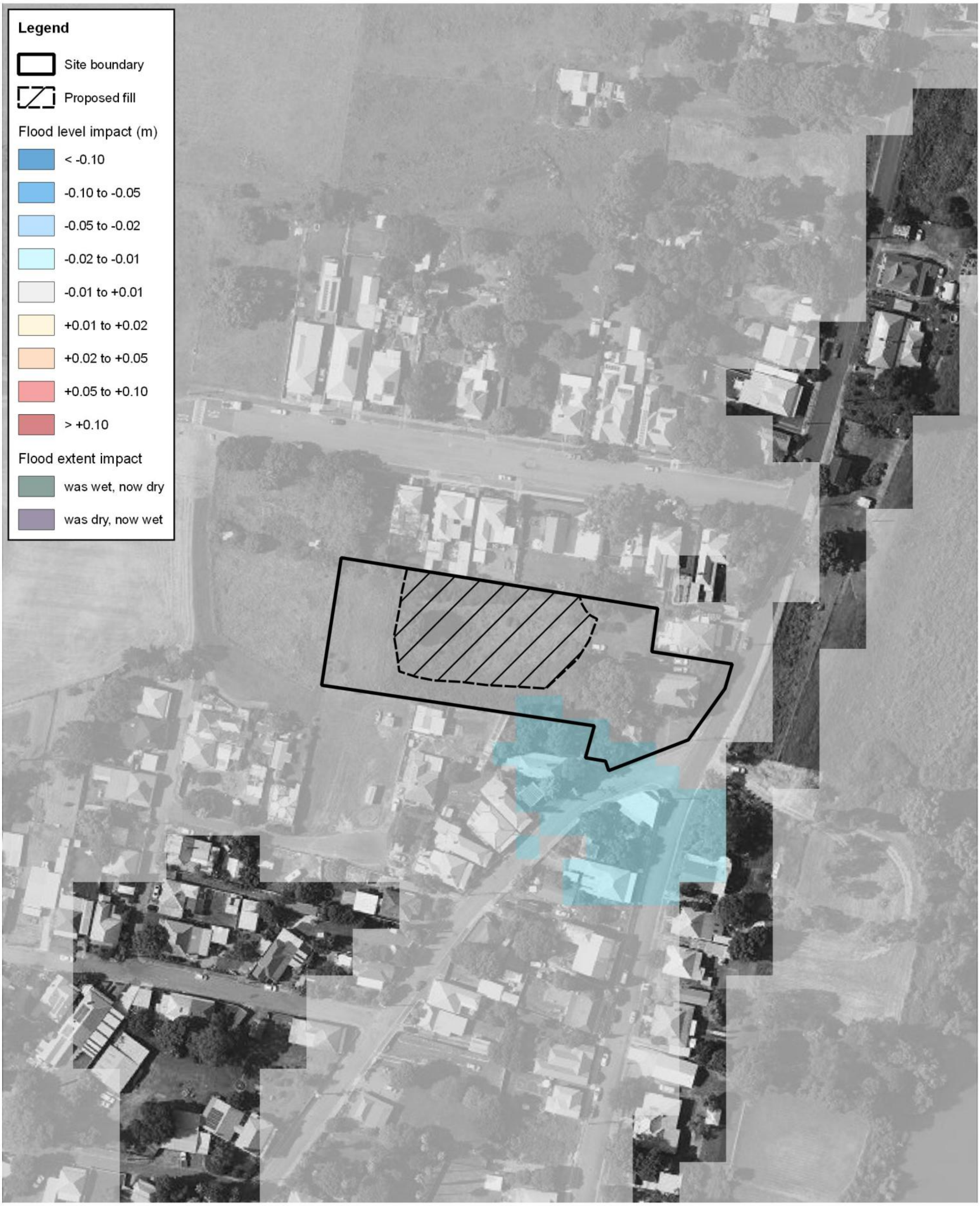

Title:

Modelled 2% AEP Peak Flood Level Impact

0 40 80 m

approx. scale

Figure: **11**

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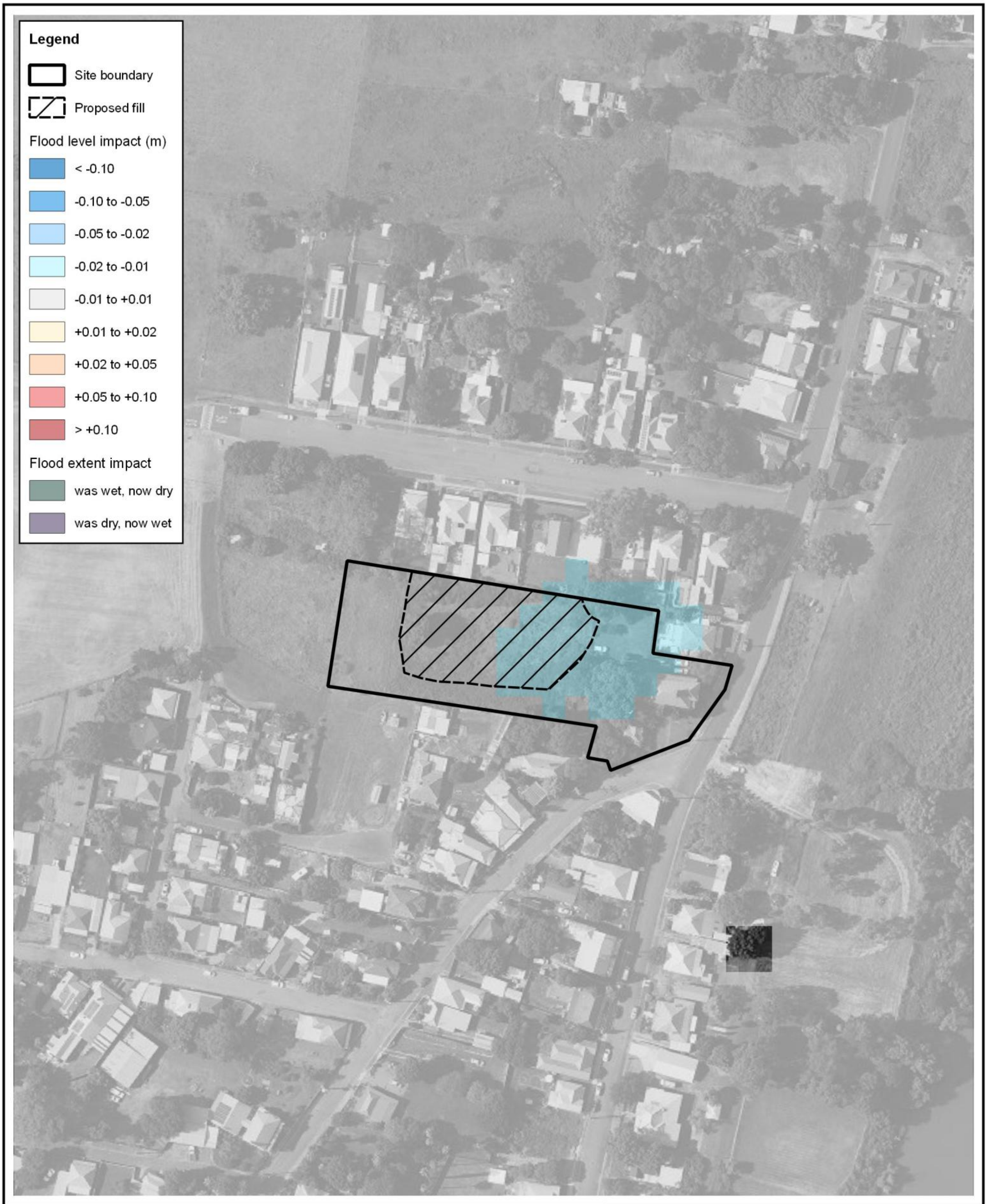

Title:

Modelled 1% AEP Peak Flood Level Impact

Figure: **12**

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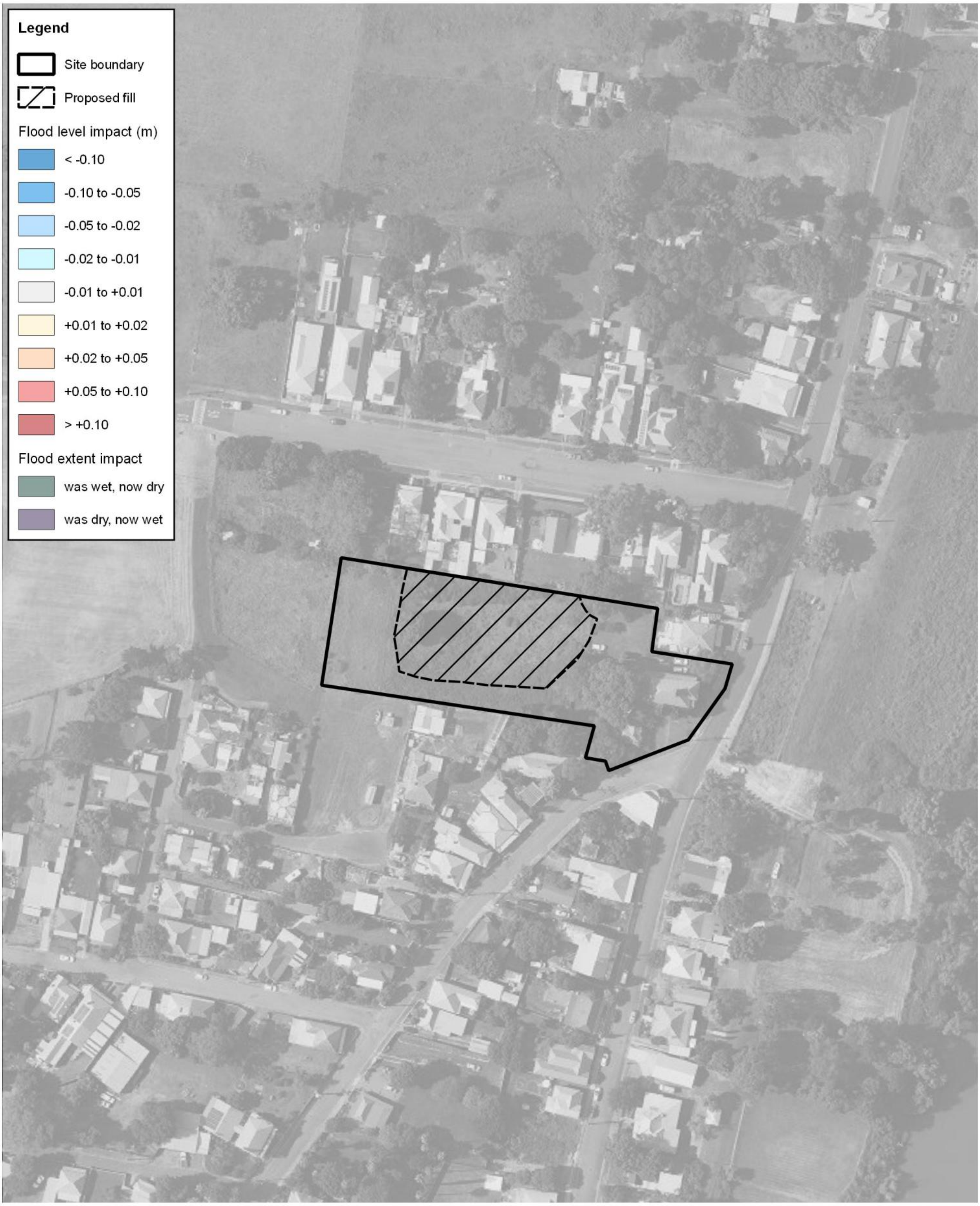

Title:

Modelled 0.5% AEP Peak Flood Level Impact

0 40 80 m

approx. scale

Figure: **13**

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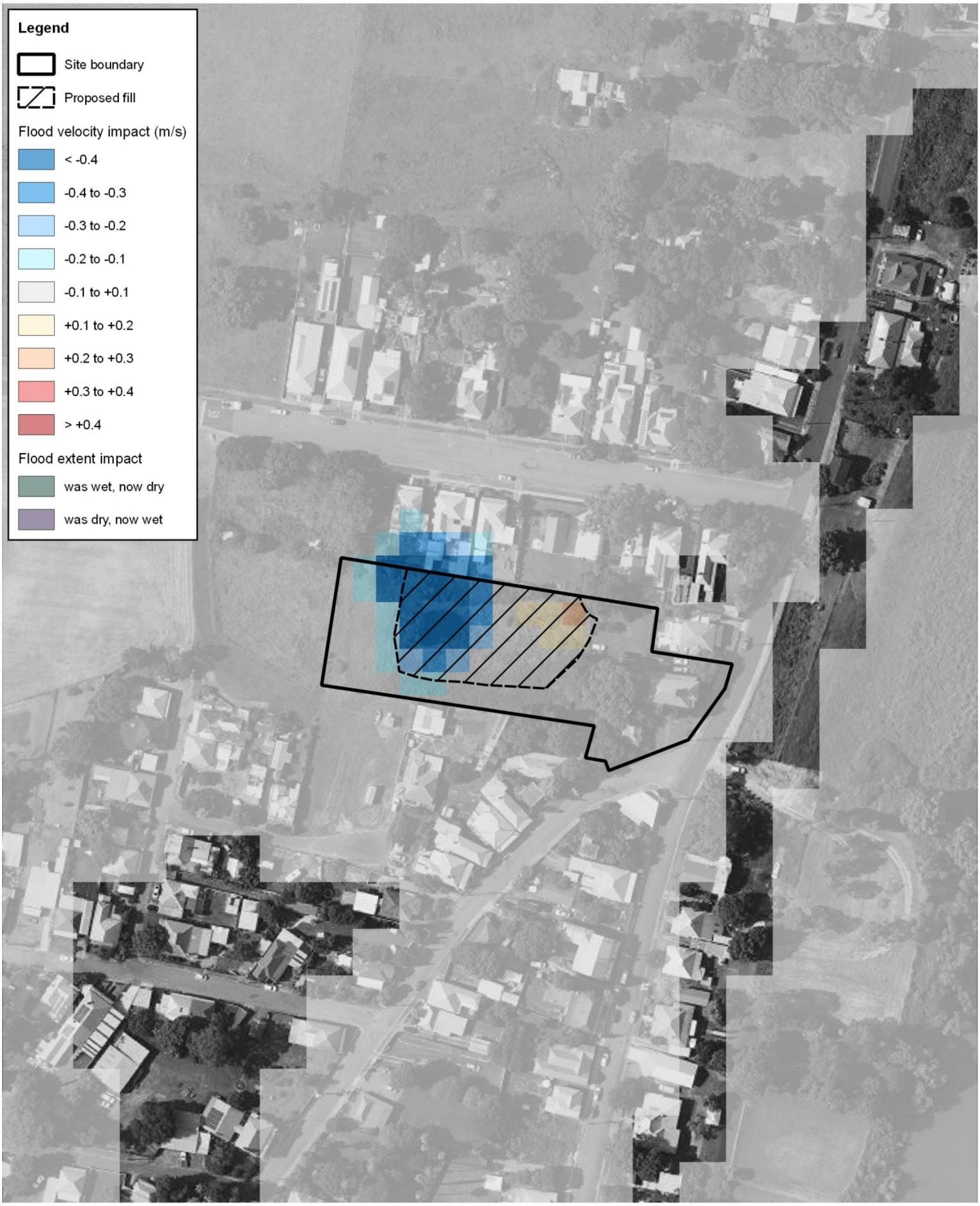

Title:

Modelled 2% AEP Peak Flood Velocity Impact

Figure: **14**

Revision: **A**

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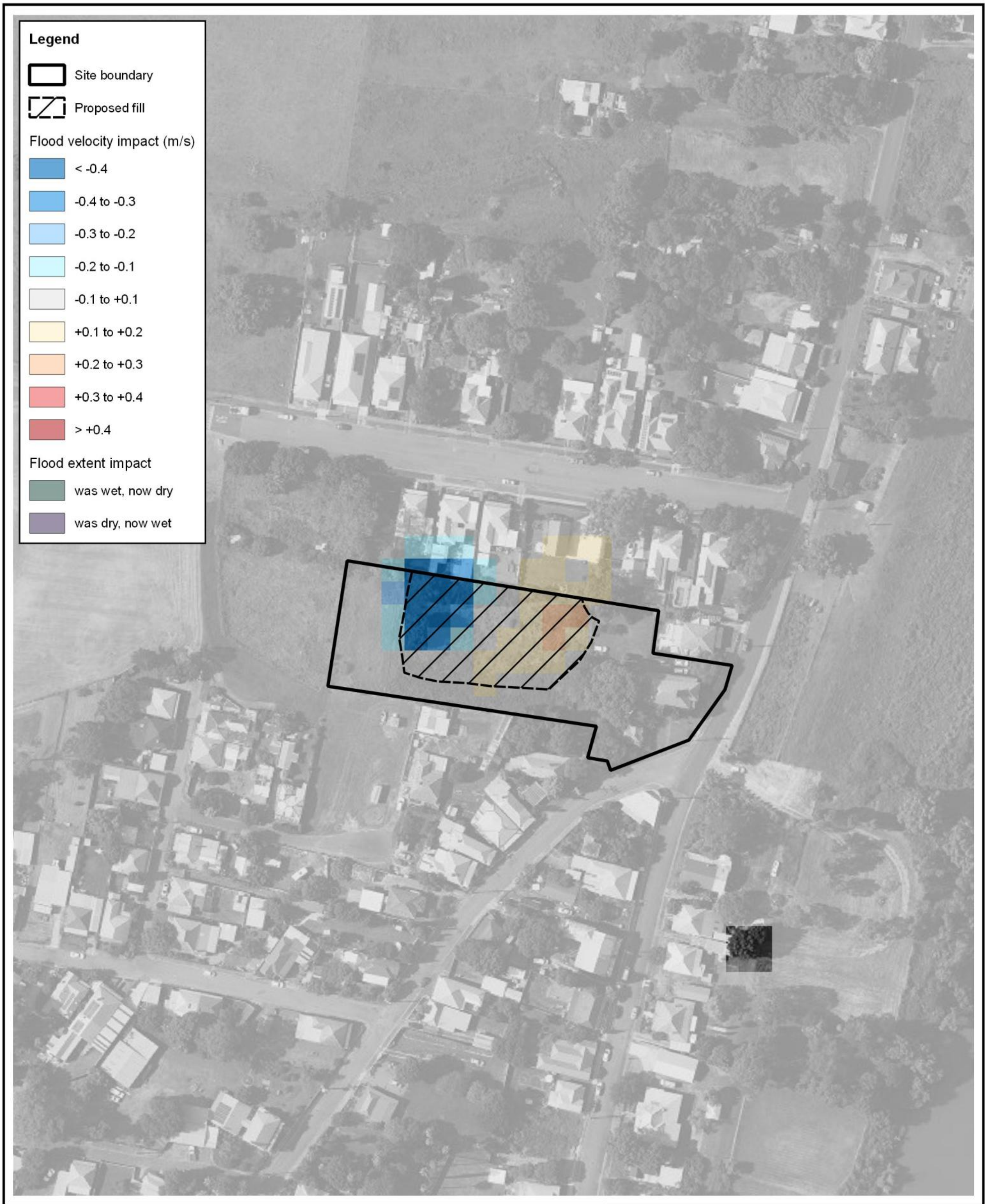

Title:

Modelled 1% AEP Peak Flood Velocity Impact

Figure: **15**

Revision: **A**

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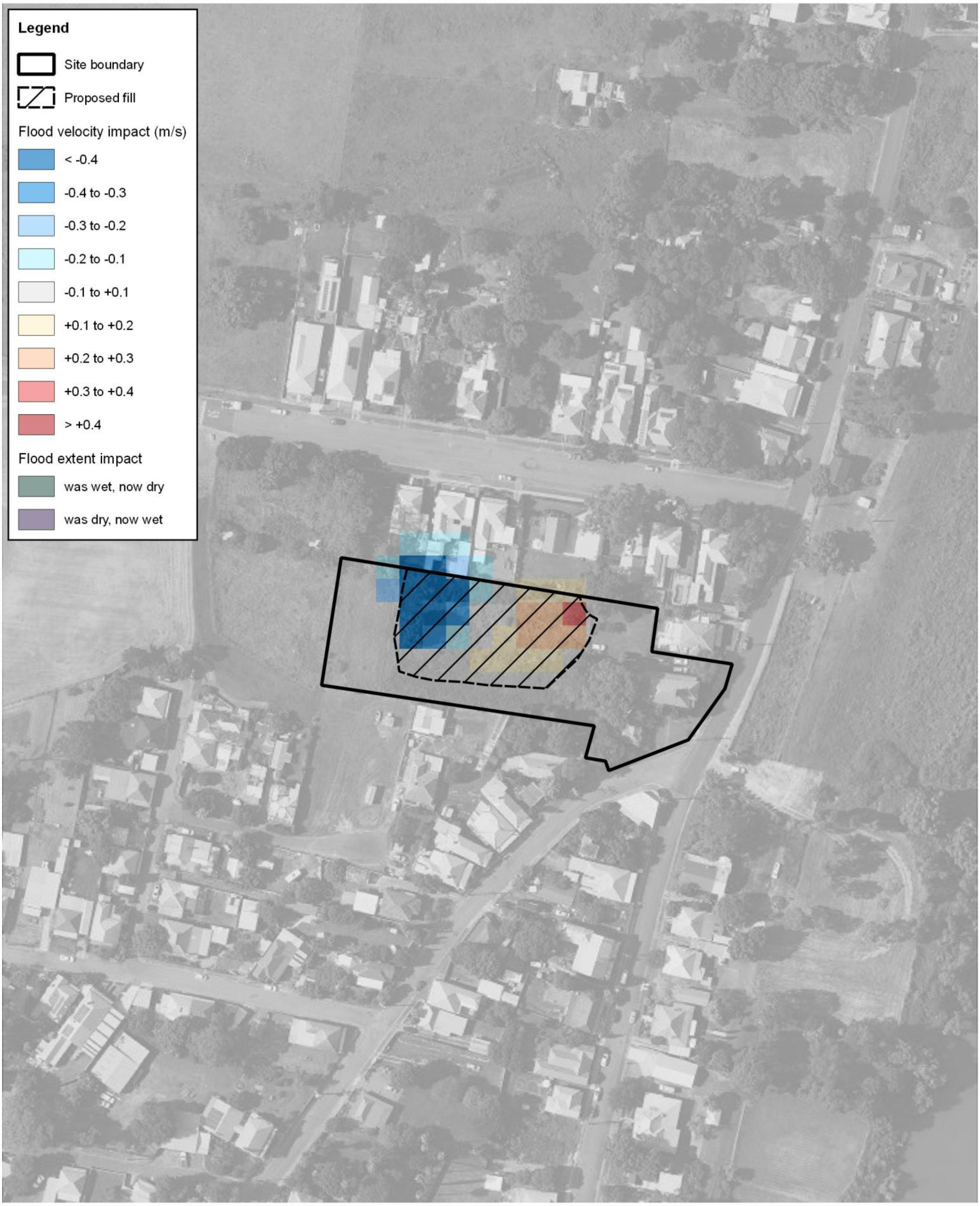

Title:

Modelled 0.5% AEP Peak Flood Velocity Impact

0 40 80 m

approx. scale

Figure: **16**

Revision: **A**

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