BMT WBM Pty Ltd
Level 8, 200 Creek Street
Brisbane Qld 4000
Australia
PO Box 203, Spring Hill 4004

Tel: +61 7 3831 6744
Fax: + 61 7 3832 3627

ABN 54 010 830 421

www.bmtwbm.com.au

Our Ref: L.B22559.001.00.pdf

12 May 2017

Byron Shire Council
PO Box 219
Mullumbimby
NSW 2482

Attention: James Flockton

RE: DEVELOPMENT YIELD ASSESSMENT OF MULLUMBIMBY LOT 22/1073165.

This letter report outlines the background, methodology and results for the flood impact assessment for the proposed development configuration in South Mullumbimby, south and east of the Mullumbimby Community Garden. The objective of the assessment was to quantify the impact of the proposed development on peak flood levels.

1 Introduction

1.1 Background

The modelling undertaken in this assessment is based on the existing North Byron Shire Flood Study[1] (NBSFS) model, delivered to the Byron Shire Council (BSC) in April 2016 by BMT WBM. The NBSFS hydraulic model comprises a nested 5m by 5m resolution two-dimensional (2D) computational grid domain surrounding the township of Mullumbimby. Beyond the nested domain is a coarser 12.5m by 12.5m resolution 2D computational grid domain. The proposed development falls within the coarser resolution domain in close proximity to the boundary of the finer resolution domain.

This regional TUFLOW model was used to simulate the 10% and 1% Annual Exceedance Probability (AEP) (or 10 year and 100 year ARI) design flood events under current climate conditions. While Council's planning policy requires investigation of the 1% AEP flood level including climate change, the 1% AEP design flood event under 2100 climate change conditions is not required for this study. This is due to the NBSFS model results indicating that flood levels in Mullumbimby are not sensitive to the 800mm sea level rise associated with climate change.

In total, six model scenarios were tested: two design flood events for each of the three post-development scenarios investigated.

Stormwater flooding (i.e. from localised short-duration, high-intensity storm events) was not assessed as part of this assessment.

[1] North Byron Shire Flood Study Report, BMT WBM, April 2016

1.2 Site Description

The proposed development is located on Lot 22/1073165. The Lot is approximately 0.286 km^2 and is located to the south and east of the Mullumbimby Community Garden. The development site is located on the western side of the railway line. However, the Lot boundary includes a smaller portion of land to the east of the railway. The proposed assessment does not include filling in the smaller portion of land to the east of the railway (see Figure 1).

Figure 1 Location of Lot 22/1073165 (Showing 100 Year ARI Flood Inundation Extent)

2 Flood Modelling

2.1 Base Case Model Verification

The NBFS TUFLOW model was adopted with refinement (see Section 2.2) for the Base Case scenario used in the flood impact mapping. The original (unrefined) NBFS model was re-simulated using the same 2013 TUFLOW executable to ensure that the NBSFS results were reproducible. Comparison of the reproduced peak flood level against the existing peak flood levels showed that for the entire model extent, peak flood levels are within 0.005m of existing levels.

2.2 Flood Model Refinement

Due to the proximity of the proposed development to the boundary of the finer resolution and coarser resolution model domains, it was necessary to improve the resolution of the 2D-2D boundary link. This improved the simulation of flow across the boundary thus improving reliability of results. The base case model and all design options were simulated using this refinement. While not shown in this letter, the peak water level results for the original and refined model were compared for the 10% and 1% AEP flood events. The results were comparable with small changes in flood levels in close proximity to the refinement. All results presented in this letter are for the refined version of the model.

2.3 Design Flood Events

The base case and proposed developed case options have both been simulated for the 10% and 1% AEP event. The NBSFS considered design events dominated by two separate processes: catchment rainfall and tidal storm surge. Interrogation of the flood model results indicates that the 1% AEP catchment rainfall dominated event governs the flood risk in the location of the proposed development; the catchment rainfall dominated event results in much higher flood levels than the tidal storm surge event across the property (0.9m higher for the 1% AEP event) and inundates a broader area of the property and its surroundings. Therefore, only the catchment rainfall dominated event has been included in this assessment.

Australian Rainfall and Runoff (1987) was used in the NBSFS to derive the design storm events. The same design storm events have been inherited for this flood impact assessment. The events have been simulated for a 24 hour storm duration, which was identified as the critical duration for the Mullumbimby area based on the NBSFS report.

2.4 Design Option Modelling

The base case flood model was used as a basis for simulating the design options. In total, three potential fill configurations within the property were modelled. The topography in the design option TUFLOW models was adjusted to represent the higher elevation associated with fill areas. The elevation in the fill areas was set to an elevation above the 1% AEP flood level. It is noted that there is land in the western portion of the property that is naturally high, and will not require further filling. However, this high ground is mapped as part of the fill areas in this report. This has been done for simplicity to depict the development footprint in the figures. The design options and the influence on flood levels is discussed further in Section 3. These layouts were developed in collaboration with Council.

2.5 Flood Model Results

Peak water level and unit flow (depth x velocity) results are shown in Figure 8 to Figure 23 for the base case and the three design options investigated. Flood impact results are discussed in the section below.

The results show that there is a flow path across the western side of the property in close proximity to the property boundary. Adjacent to this flow path is higher ground that is flood immune in the 1% AEP flood event. The eastern part of the property is flooded in both the 10% and 1% AEP flood event. Floodwater flows southwards across the property. The proposed options utilised fill to provide flood immunity to the proposed development.

3 Design Options and Flood Impacts

3.1.1 Design Option 1

This configuration was the most ambitious in terms of proposed fill area. Most of the property was modelled as being filled (see Figure 2). The resulting change in peak flood level indicated a significant impact north, west and east of the site, due to the fill blocking the natural floodplain flow across the site. See Figure 2 for the 10% AEP flood impact and Figure 5 for the 1% AEP flood impact. This flood impact outcome is not acceptable due to the significant increases in peak flood levels on surrounding property.

3.1.2 Design Option 2

In this configuration, a 25m (two grid cells) wide central drainage reserve was included that bisected the site (see Figure 3). This drainage reserve was included to reinstate part of the natural floodwater flow path across the site. The central drainage reserve was graded to create an even slope from the north to south (2.5mAHD at northern property boundary to 1.5mAHD at southern property boundary).

Another 25m wide drainage reserve was created along the northern perimeter of the property boundary west of the central drainage reserve. This northern drainage reserve was graded from 3.5mAHD at the western corner of the fill to 2.3mAHD at the intersection with the central drainage reserve. This northern drainage reserve was created to assist with catching and directing floodwaters entering the site from the north towards the central drainage reserve.

The flood impacts, which were significantly improved compared to Design Option 1, are shown in Figure 3 for the 10% AEP flood event and Figure 6 for the 1% AEP flood event. In comparison to Design Option 1, the magnitude and areal coverage of the flood impact was reduced. The model results indicated that flood levels increased by 20mm for the 10% AEP flood event and 50mm for the 1% AEP flood level immediately south of the property boundary and central drainage reserve. This area is undeveloped land used for farming activities.

The flood level impact immediately north of the property boundary and northern drainage reserve is more pronounced for the 1% AEP flood event (approximately 120mm). This area is the Mullumbimby Community Gardens, and there are a number of small sheds that are affected. There is also a small flood level impact (20mm) on a sports field and tennis courts which are located 160m north of the property boundary. These impacts are not present in the 10% AEP flood event.

Flood levels have decreased by 20mm to 50mm along the eastern perimeter of the property in the vicinity of the railway for the 1% AEP flood event. For the 10% AEP flood event, flood levels north and east of the property have decreased by up to 50mm in places.

3.1.3 Design Option 3

Design Option 3 built upon Design Option 2 by widening the central drainage reserve (to 50m wide at the southern end) and extending the northern drainage reserve eastwards to split the eastern portion of fill. Thereby, dissecting the fill area into three discrete parts (see Figure 4). The central drainage reserve was tapered to broaden at the intersection with the northern drainage reserve. The fill at the south-eastern side of the property was also pulled back a further 10m from the property boundary. The aim of these measures was to enhance the floodwater flow capacity across the site.

The results show a decrease in flood levels north of the site for both the 10% AEP and 1% AEP events. The only remaining area where flood levels increase is to the south of the property, where the flood impact is 20mm to 30mm for the 10% AEP flood event and 10mm to 20mm for the 1% AEP flood event. The impacted area is confined to rural undeveloped land.

4 Conclusion

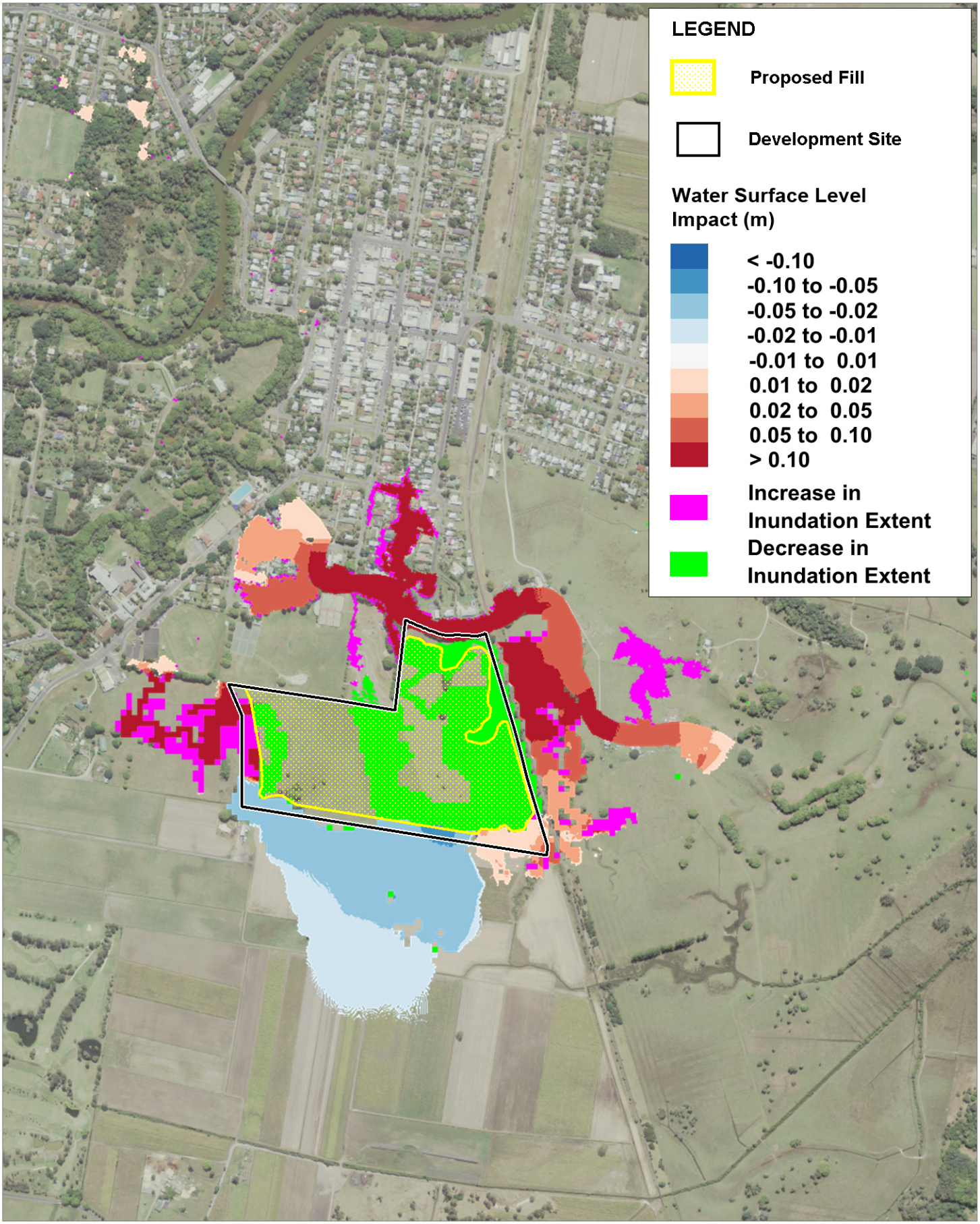
A high-level flooding assessment has been undertaken, in which conceptual fill footprints have been assessed for the proposed development at the subject property. It is expected that this assessment will be used to inform the feasibility of the development in terms of flood impact constraints and for early stage conceptual design of the proposed development. A more detailed flooding assessment will be required to confirm that the proposed development does not cause adverse impacts to neighbouring property prior to seeking development approvals.

Flood impacts, in terms of changes to peak flood level, for three design configurations have been assessed for the 10% and 1% AEP flood event. The results indicate that excessive fill on the site will result in unacceptable flood impacts. Reducing the fill area coverage and maintaining drainage reserves across the property, as per Design Option 3, reduces the impact to a potentially acceptable outcome. For Design Option 3, small flood impacts are predicted to occur south of the property on rural land. Such impacts on rural land may be acceptable, although these would need further assessment at a future detailed assessment stage. It is recommended that additional design events are simulated at this stage to ensure impacts are acceptable across all design event magnitudes. In addition, it may be necessary to consider scour within the drainage reserves and potential changes to duration of inundation in the detailed assessment phase. However, in summary, this assessment suggests that in terms of impact on peak flood levels for the events simulated, a feasible development may be achieved on the subject site.

Should you wish to discuss the contents of the letter further please do not hesitate to contact Richard Sharpe on 07 3831 6744.

Yours Faithfully
BMT WBM

Richard Sharpe
Senior Flood Engineer



Title:

10% AEP Flood Impact Map
Design Option 1

Figure: 2

Rev: A

N

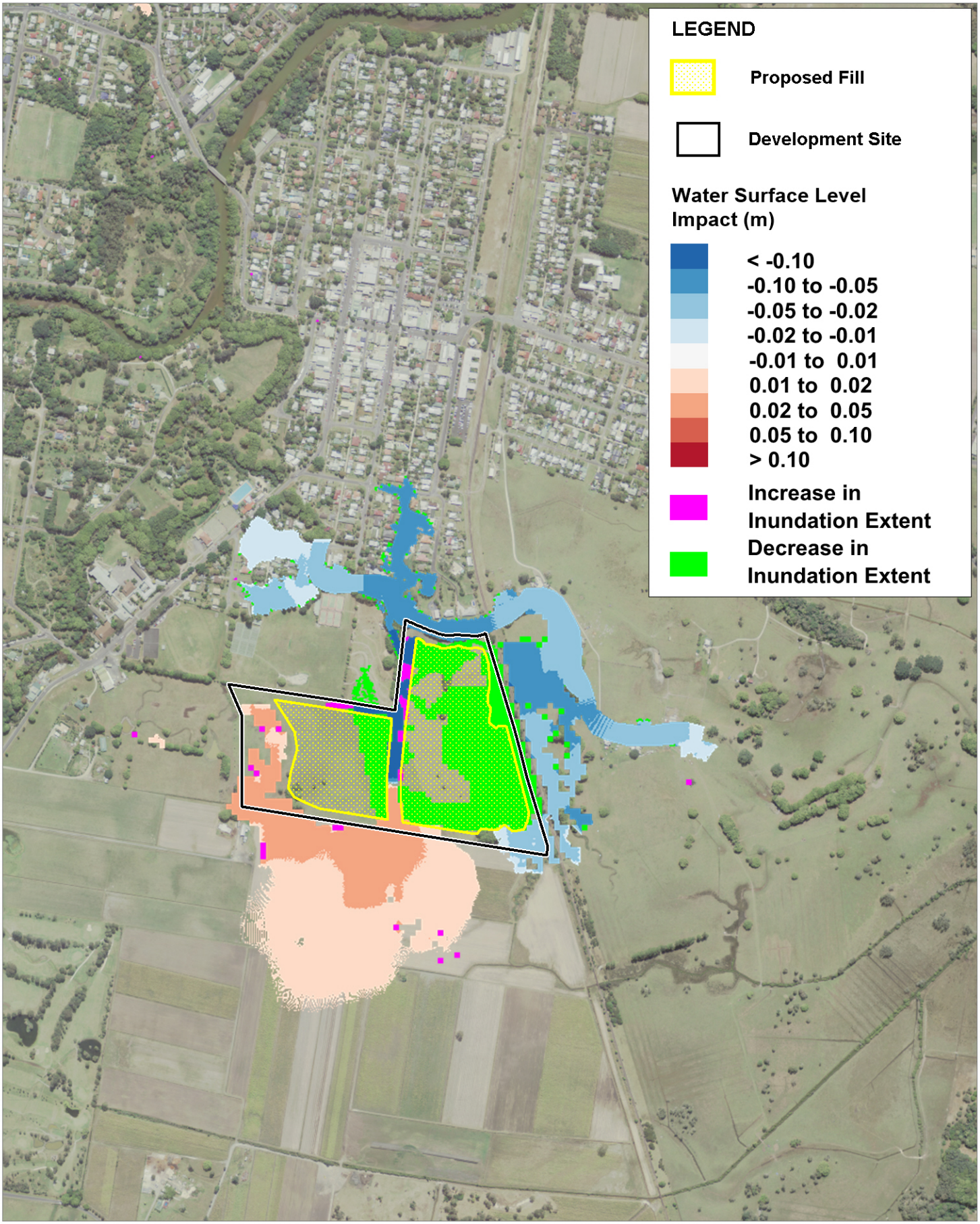
0 250 500m

Approx. Scale

BMT WBM

www.bmtwbm.com.au

Filepath: "I:\B22559.k.rs.Mullum_FIA\DRG\FLD_017_170510_MUL_DES01_Q010_dH.WOR"



Title:

10% AEP Flood Impact Map
Design Option 2

Figure: 3

Rev: A

N

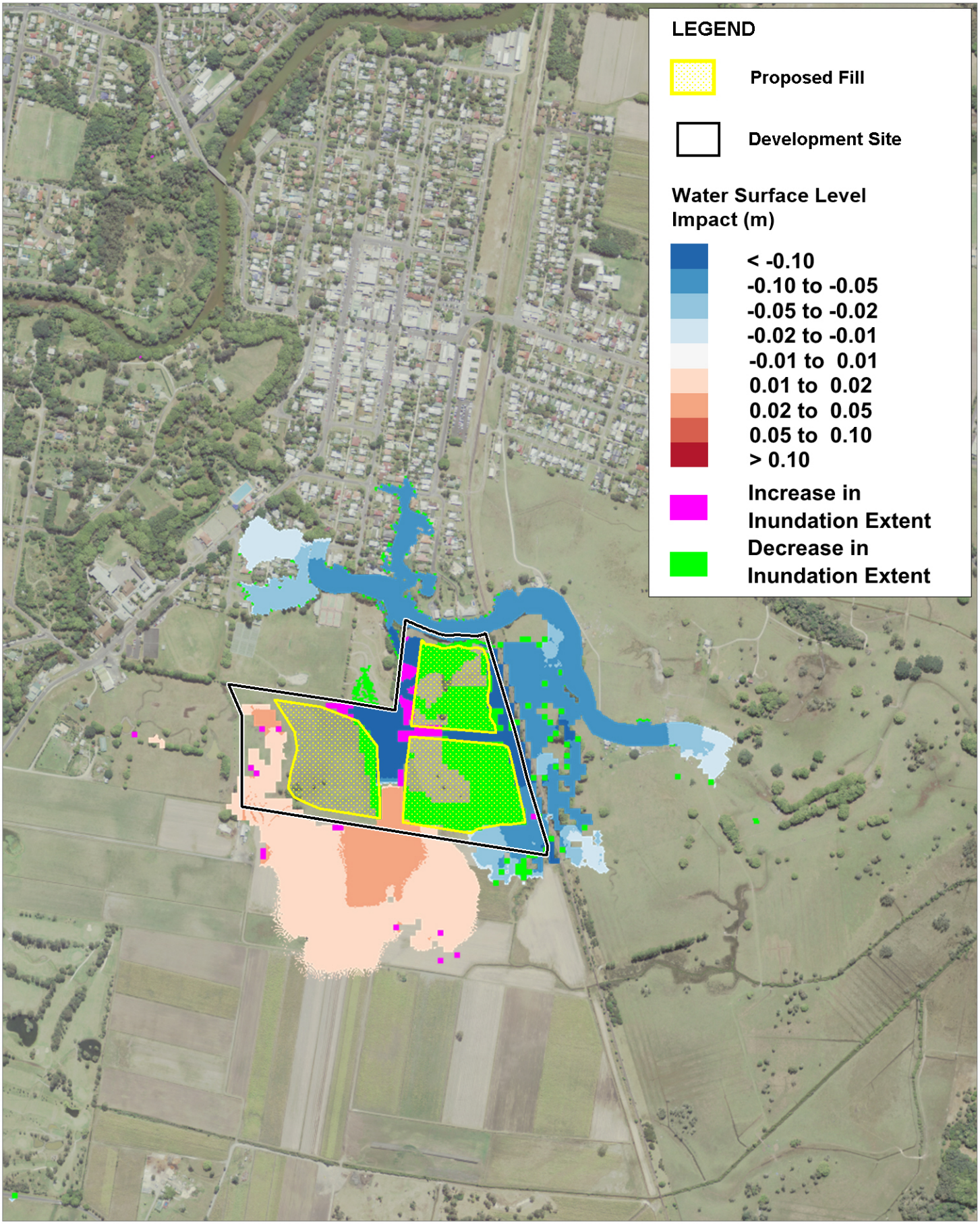
0 250 500m

Approx. Scale

BMT WBM

www.bmtwbm.com.au

Filepath: "I:\B22559.k.rs.Mullum_FIA\DRG\FLD_018_170510_MUL_DES02_Q010_dH.wor"



Title:

10% AEP Flood Impact Map
Design Option 3

Figure: 4

Rev: A

N

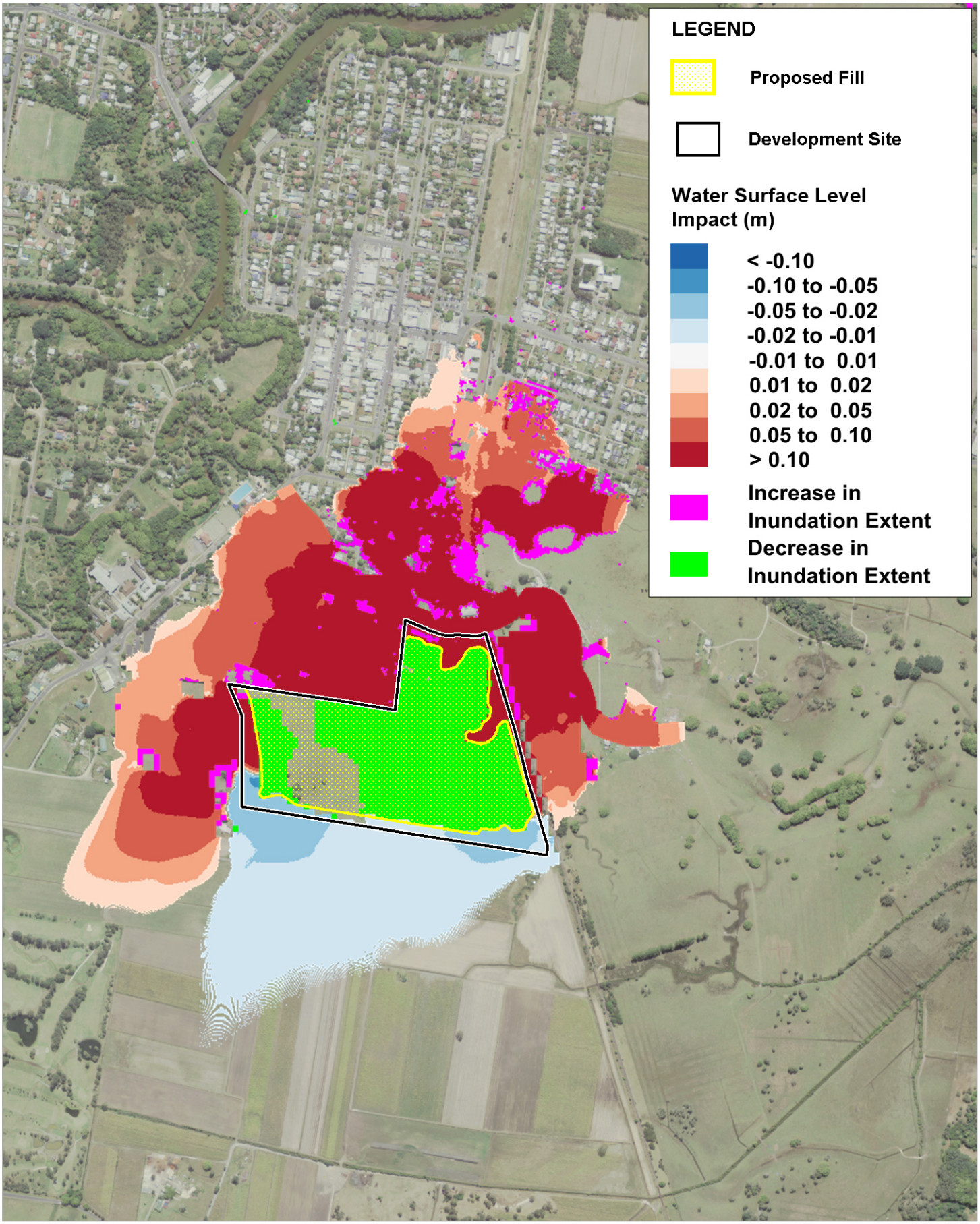
0 250 500m

Approx. Scale

BMT WBM

www.bmtwbm.com.au

Filepath: "I:\B22559.k.rs.Mullum_FIA\DRG\FLD_019_170510_MUL_DES04_Q010_dH.wor"



Title:

1% AEP Flood Impact Map
Design Option 1

Figure: 5

Rev: A

N

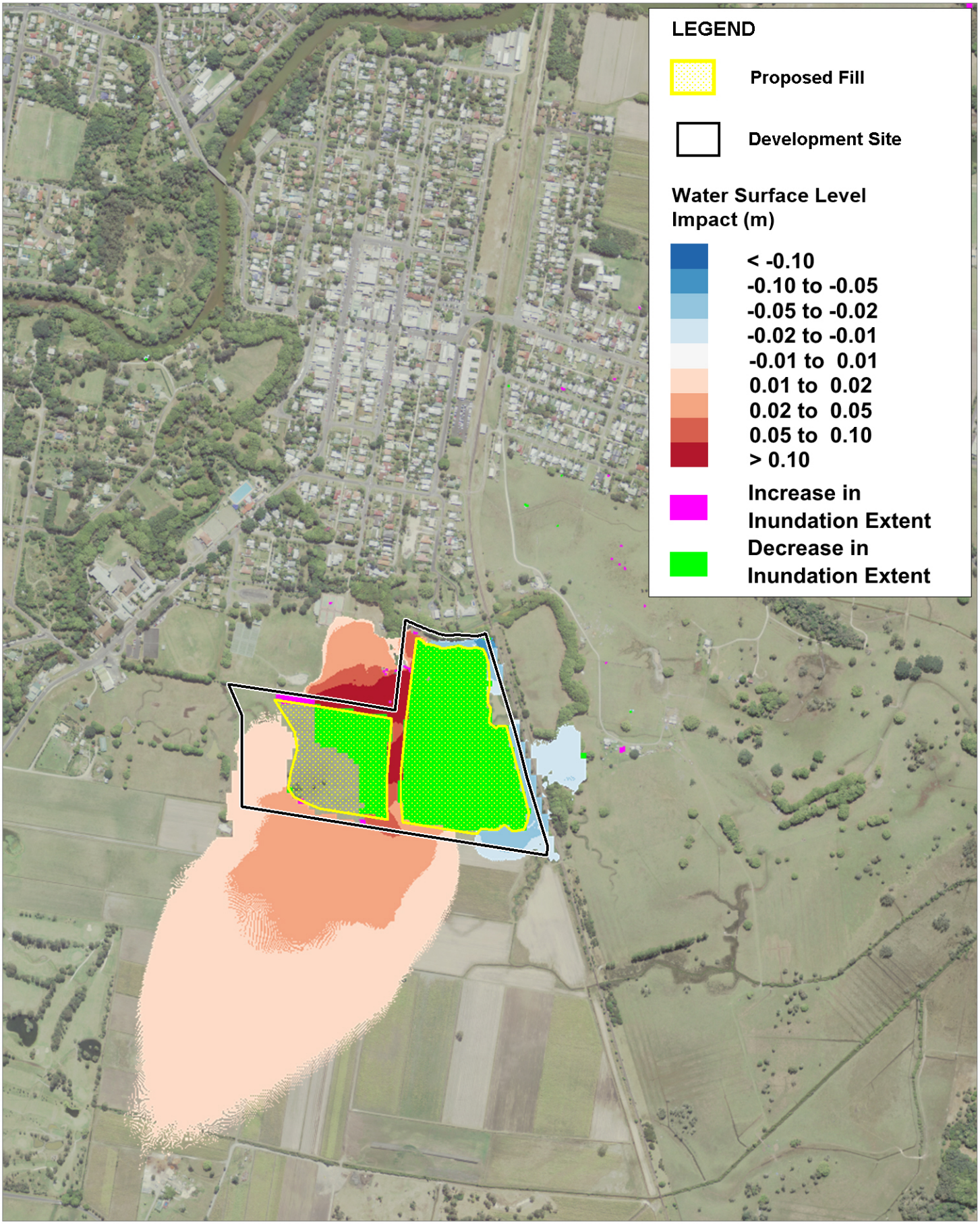
0 250 500m

Approx. Scale

BMT WBM

www.bmtwbm.com.au

Filepath: "I:\B22559.k.rs.Mullum_FIA\DRG\FLD_020_170510_MUL_DES01_Q100_dH.wor"



Title:

1% AEP Flood Impact Map
Design Option 2

Figure: 6

Rev: A

N

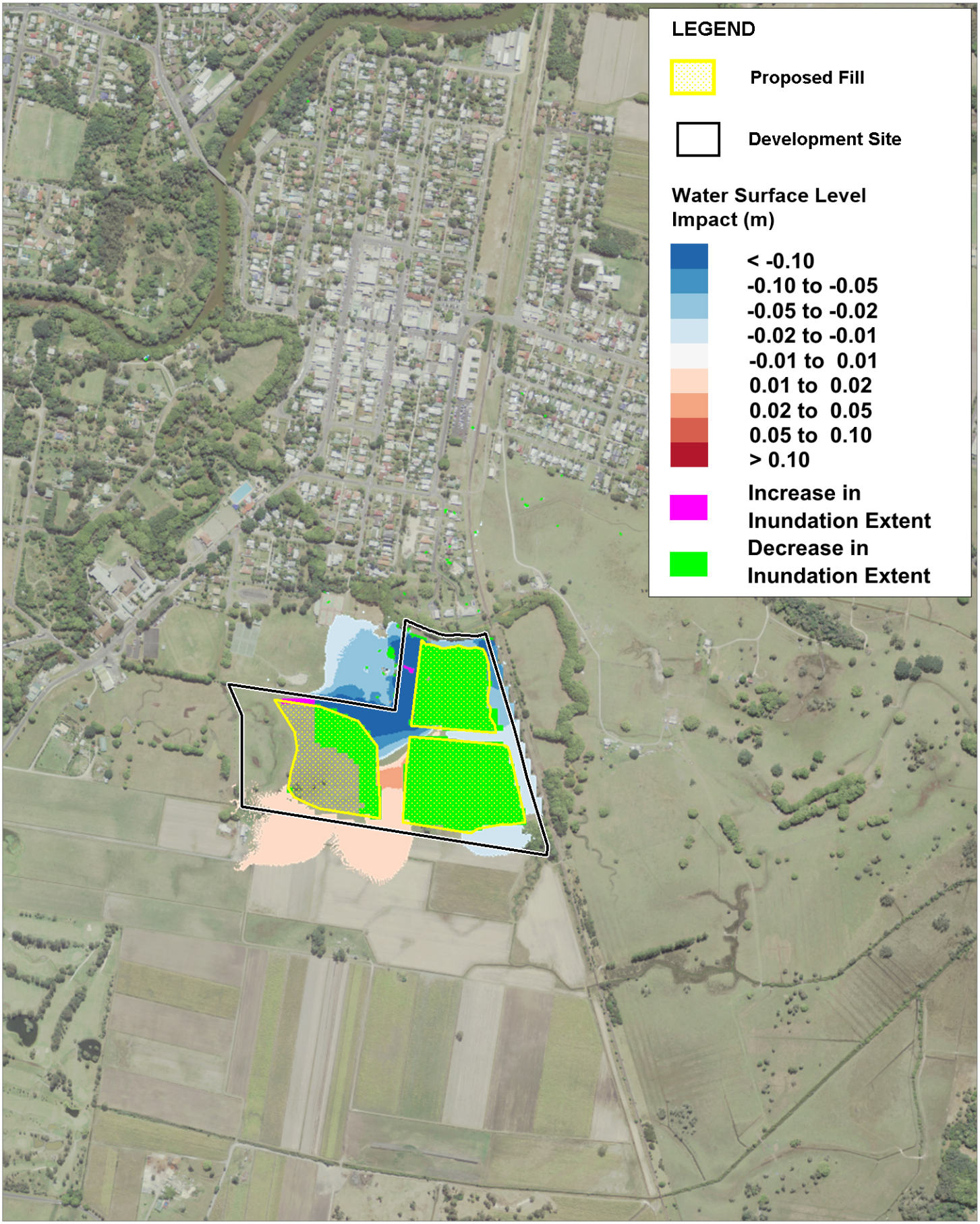
0 250 500m

Approx. Scale

BMT WBM

www.bmtwbm.com.au

Filepath: "I:\B22559.k.rs.Mullum_FIA\DRG\FLD_021_170510_MUL_DES02_Q100_dH.wor"



Title:

1% AEP Flood Impact Map
Design Option 3

Figure: 7

Rev: A

N

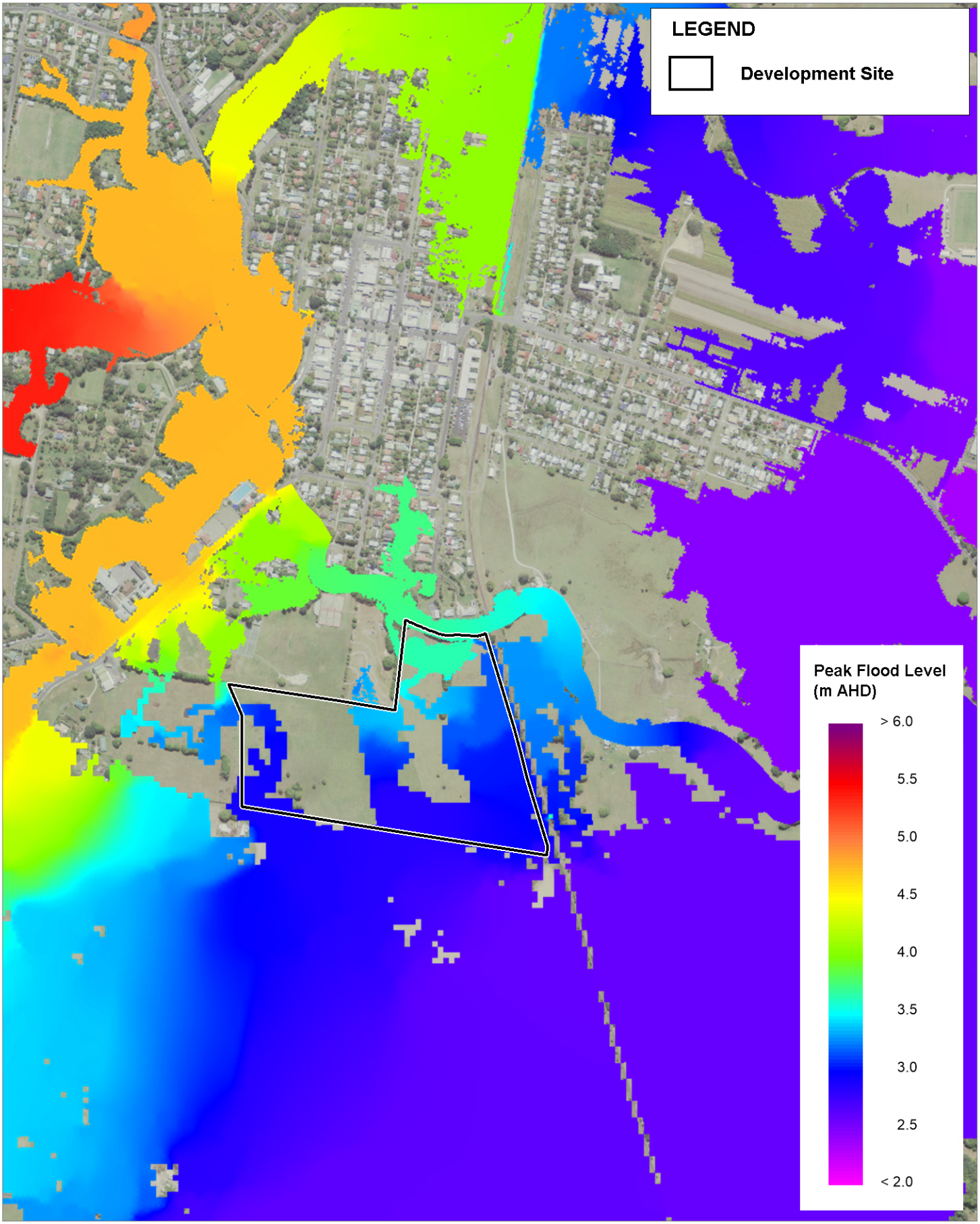
0 250 500m

Approx. Scale

BMT WBM

www.bmtwbm.com.au

Filepath: "I:\B22559.k.rs.Mullum_FIA\DRG\FLD_022_170510_MUL_DES04_Q100_dH.wor"



Title:

10% AEP Peak Flood Level
Base Case

Figure: 8

Rev: A

N

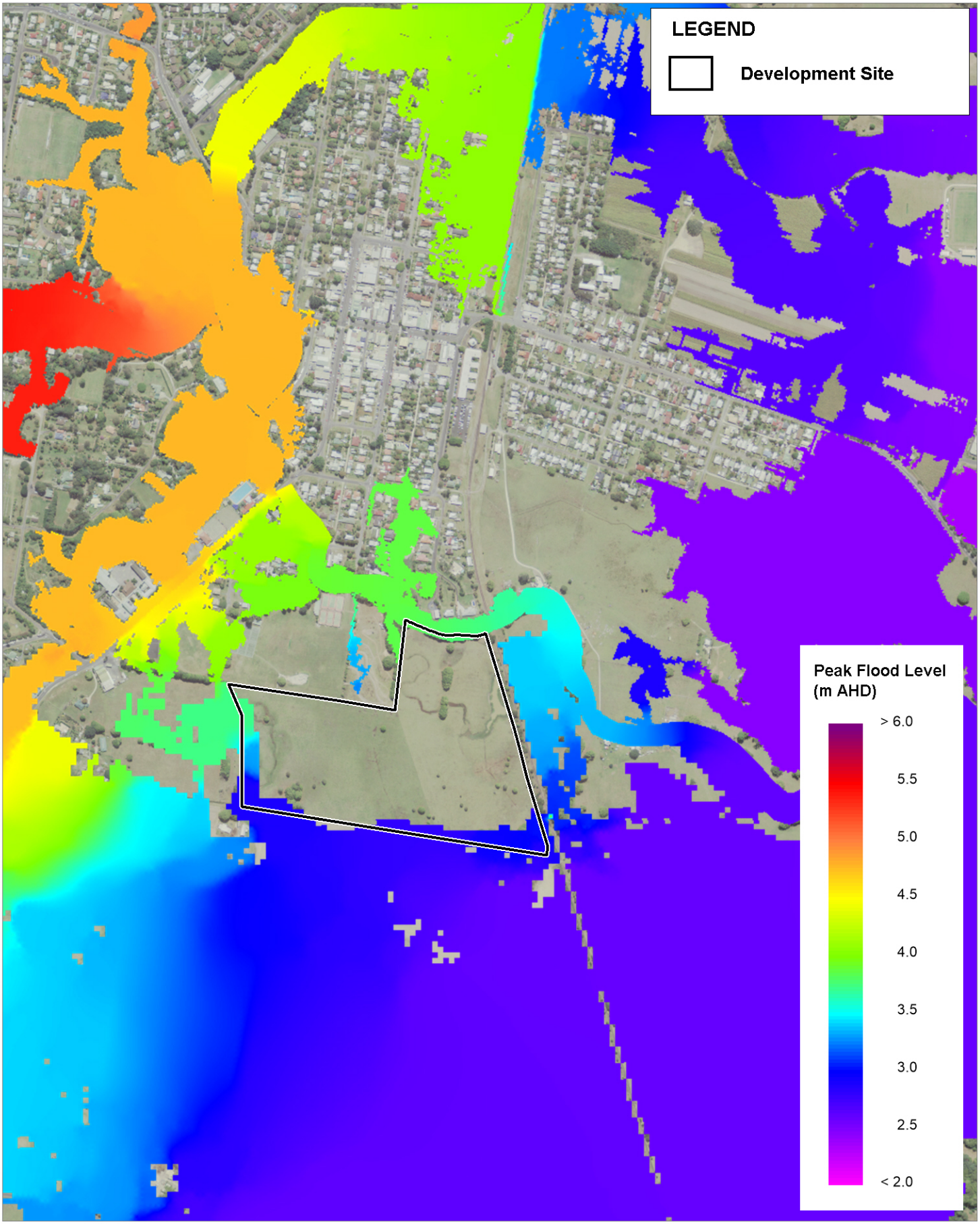
0 250 500m

Approx. Scale

BMT WBM

www.bmtwbm.com.au

Filepath: "I:\B22559.k.rs.Mullum_FIA\DRG\FLD_001_170510_MUL_BASE_Q010_H.WOR"



Title:

10% AEP Peak Flood Level
Design Option 1

Figure: 9

Rev: A

N

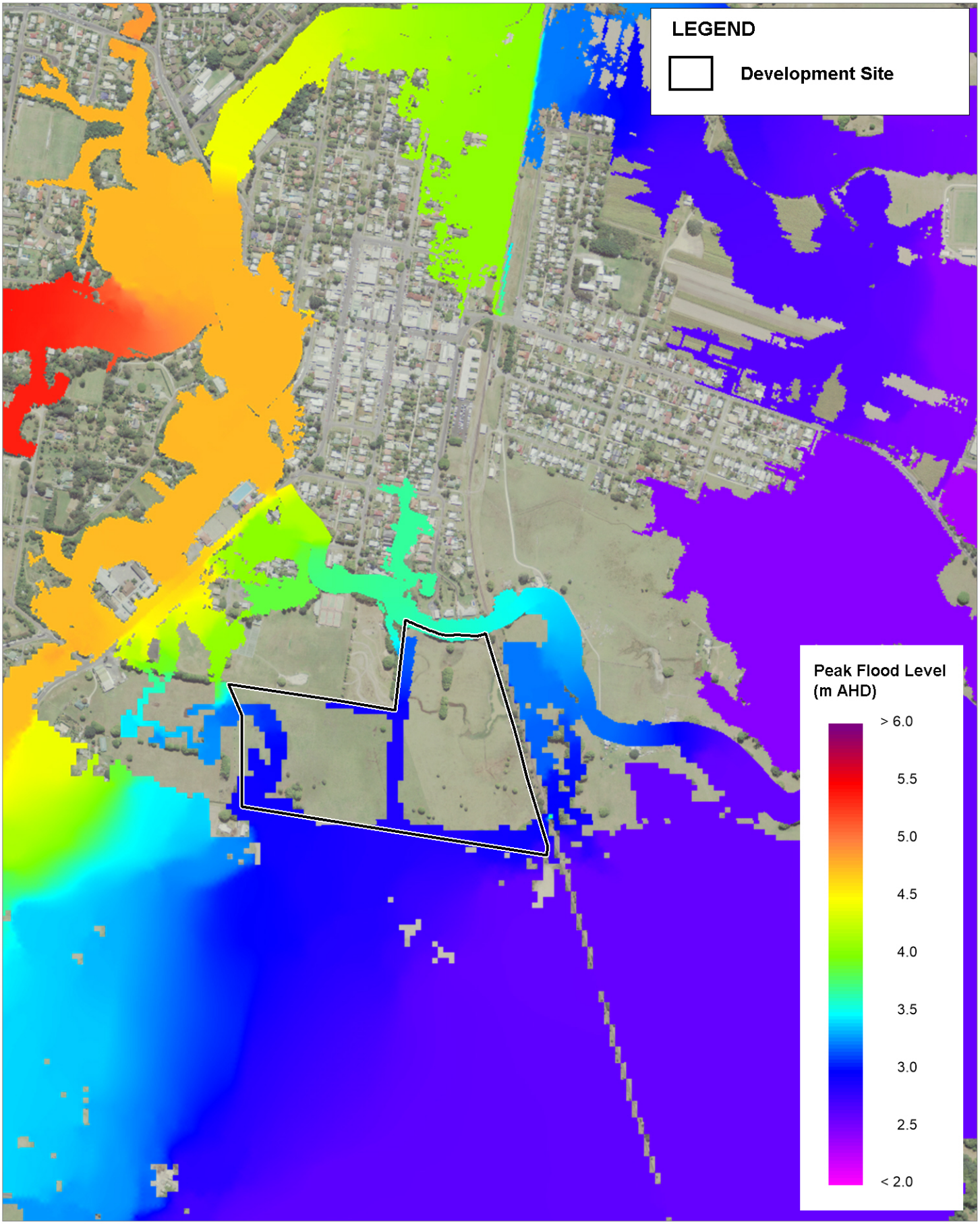
0 250 500m

Approx. Scale

BMT WBM

www.bmtwbm.com.au

Filepath: "I:\B22559.k.rs.Mullum_FIA\DRG\FLD_002_170510_MUL_DES01_Q010_H.wor"



Title:

10% AEP Peak Flood Level
Design Option 2

Figure: 10

Rev: A

N

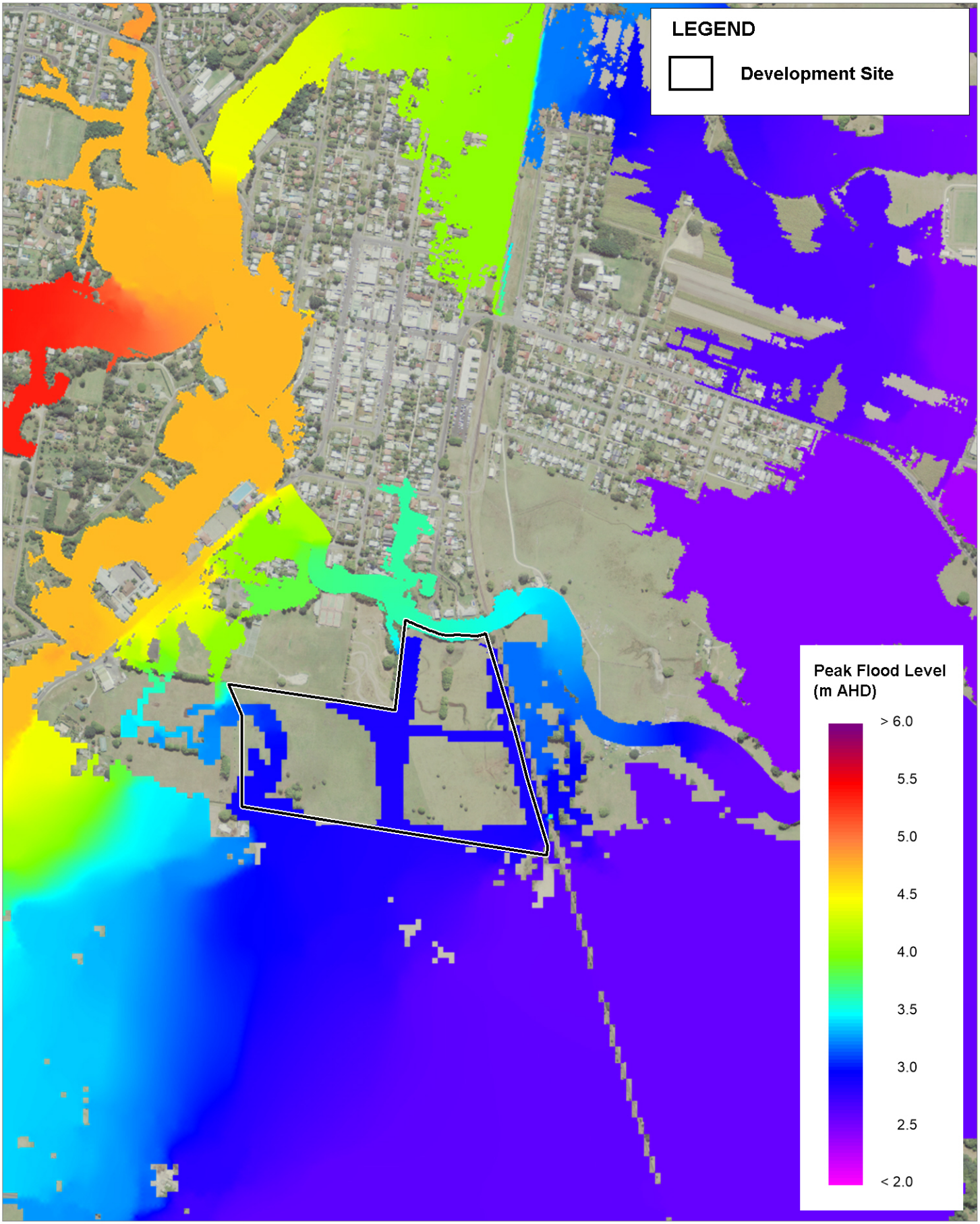
0 250 500m

Approx. Scale

BMT WBM

www.bmtwbm.com.au

Filepath: "I:\B22559.k.rs.Mullum_FIA\DRG\FLD_003_170510_MUL_DES02_Q010_H.wor"



Title:
10% AEP Peak Flood Level
Design Option 3

Figure: 11

Rev: A

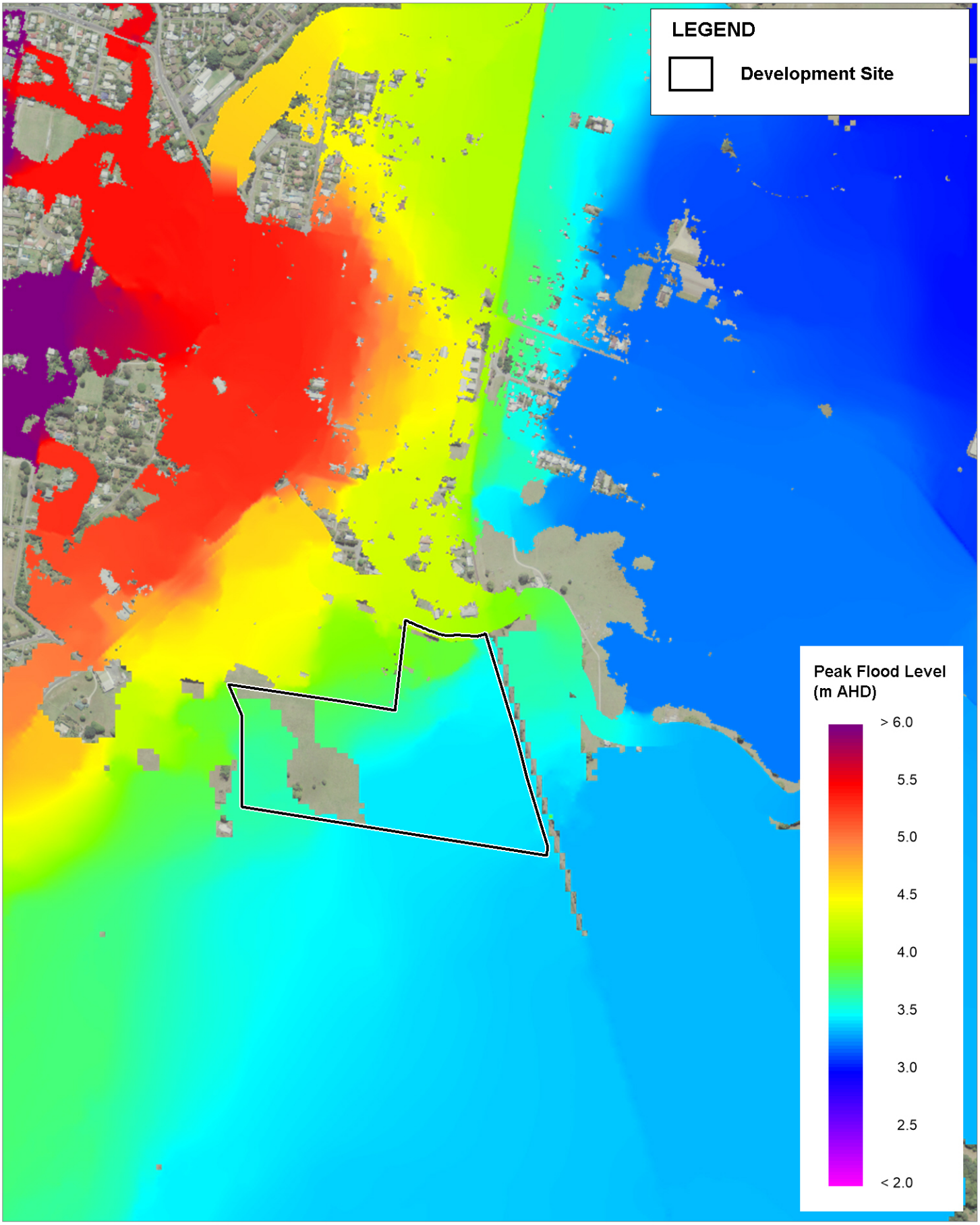
N

0 250 500m

Approx. Scale

BMT WBM
www.bmtwbm.com.au

Filepath: "I:\B22559.k.rs.Mullum_FIA\DRG\FLD_004_170510_MUL_DES04_Q010_H.wor"



Title:

1% AEP Peak Flood Level Base Case

Figure: 12

Rev: A

N

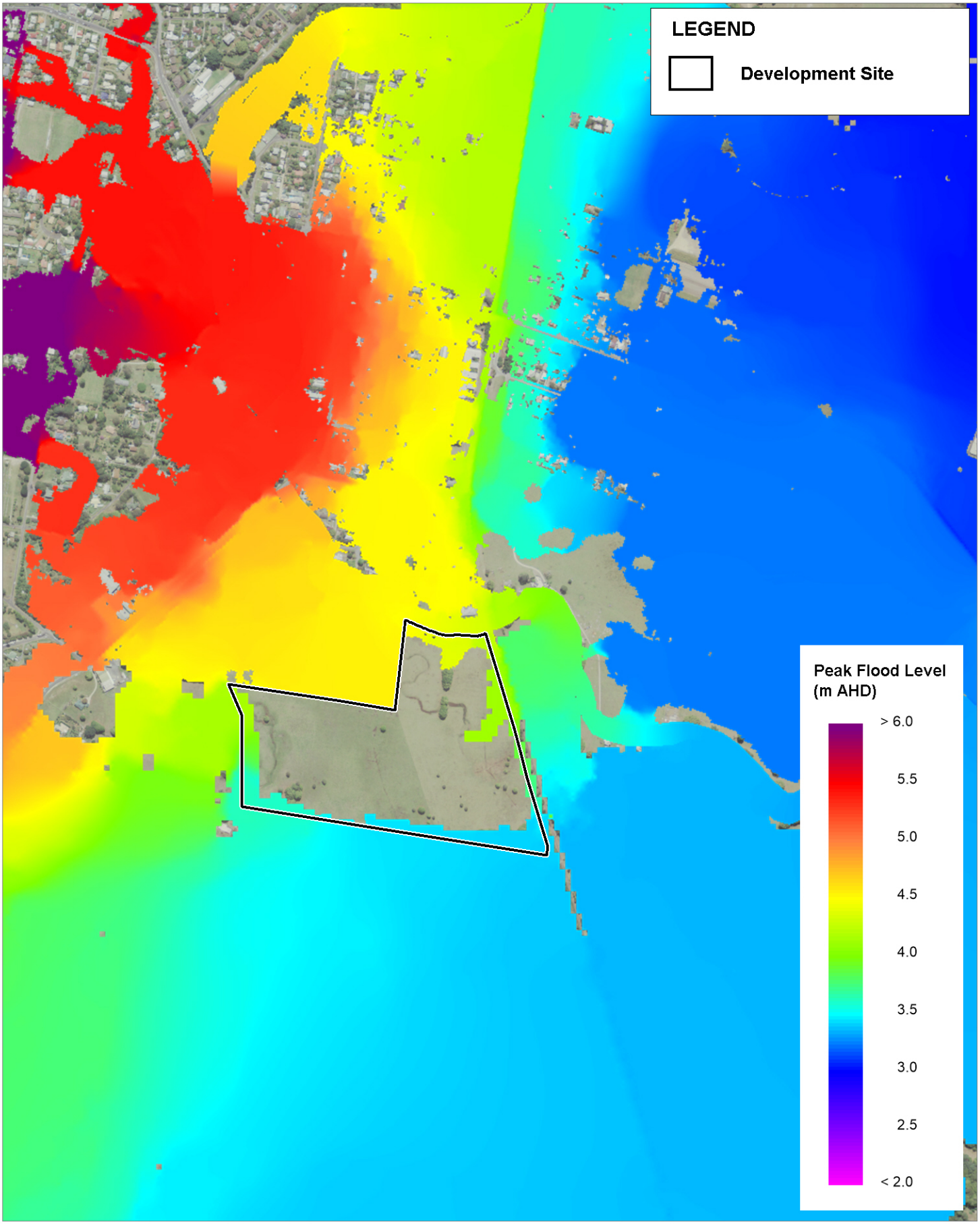
0 250 500m

Approx. Scale

BMT WBM

www.bmtwbm.com.au

Filepath: "I:\B22559.k.rs.Mullum_FIA\DRG\FLD_005_170510_MUL_BASE_Q100_H.wor"



Title:
1% AEP Peak Flood Level Design Option 1

Figure: 13

Rev: A

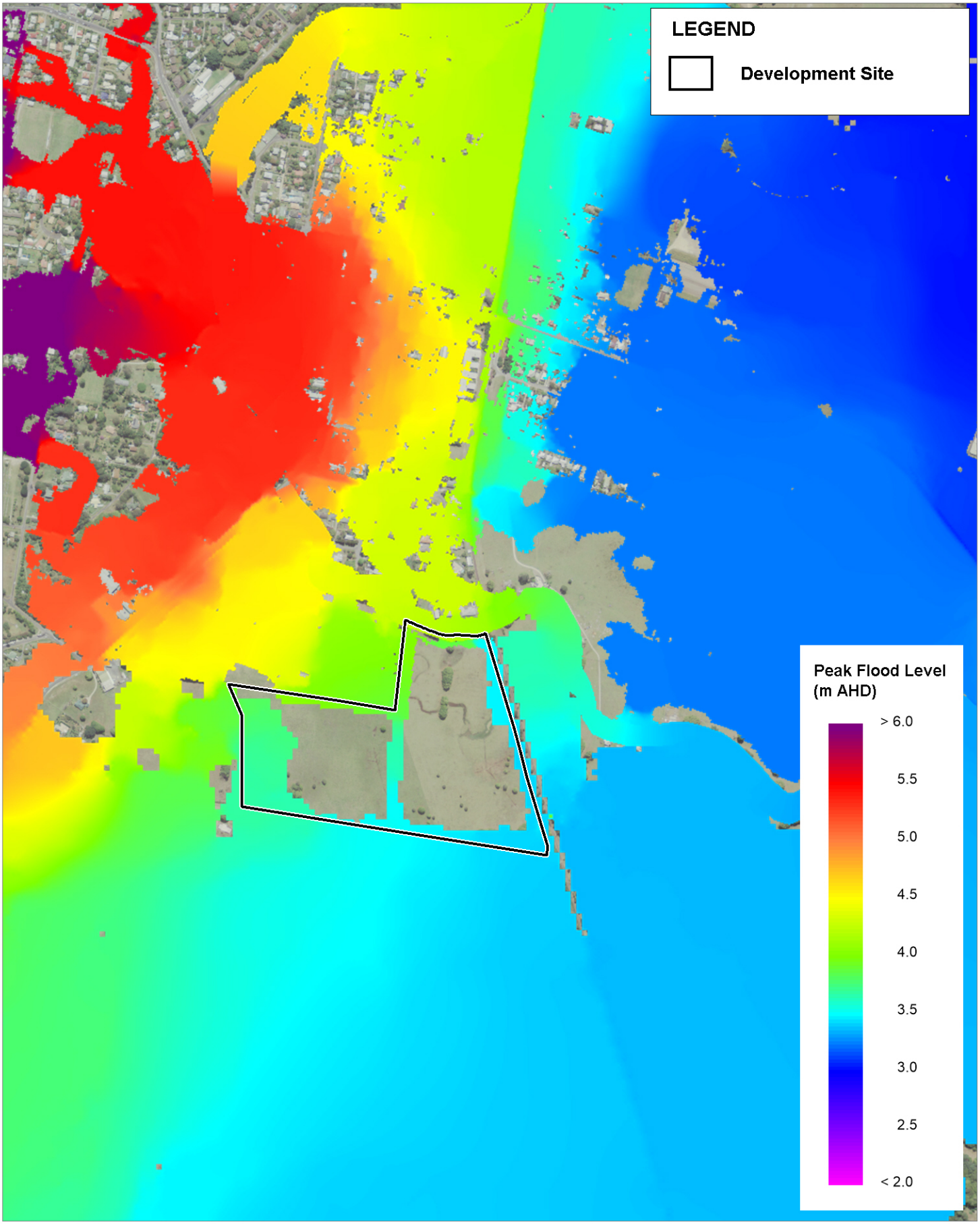
N

0 250 500m

Approx. Scale

BMT WBM
www.bmtwbm.com.au

Filepath: "I:\B22559.k.rs.Mullum_FIA\DRG\FLD_006_170510_MUL_DES01_Q100_H.wor"



Title:
1% AEP Peak Flood Level Design Option 2

Figure: 14

Rev: A

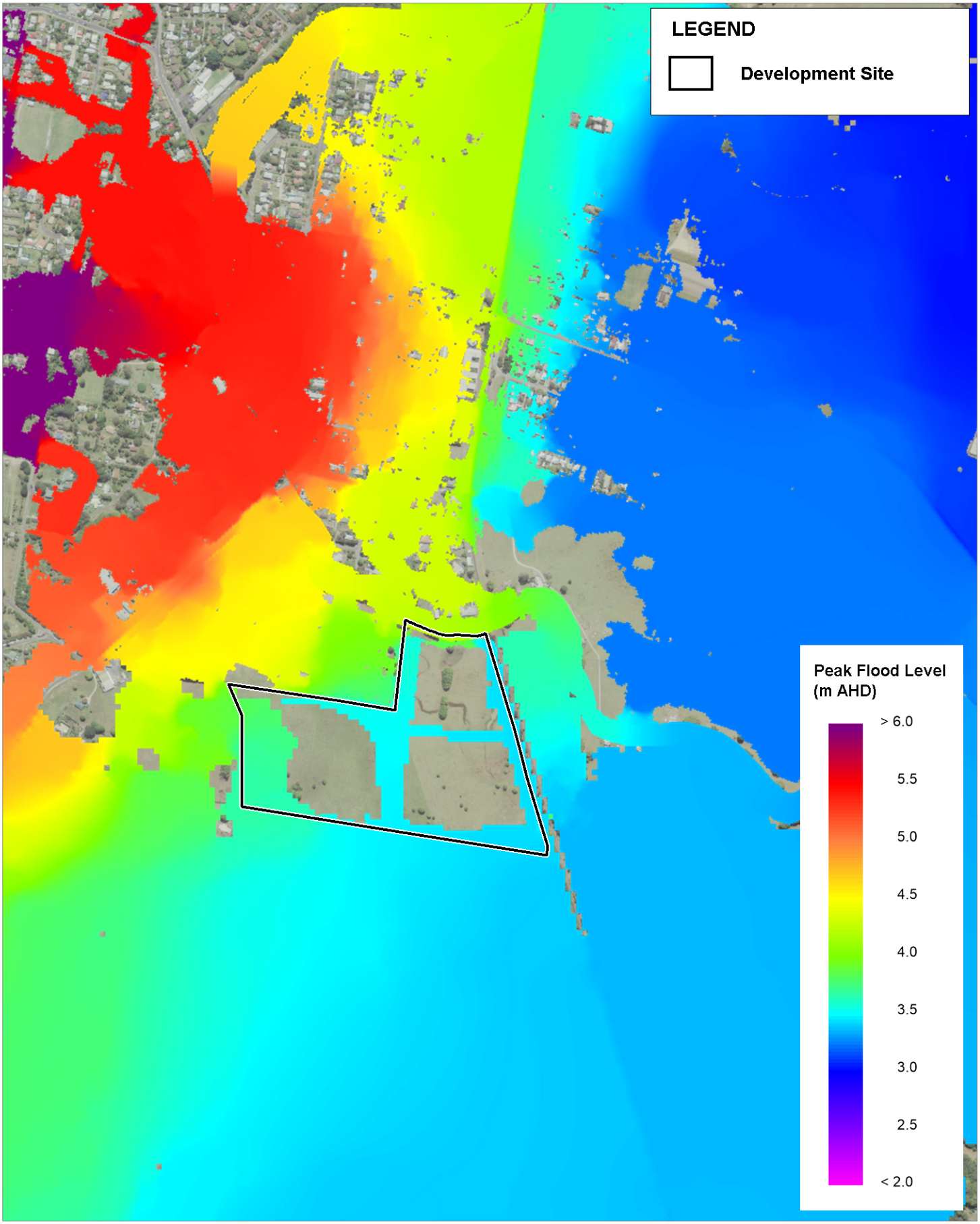
N

0 250 500m

Approx. Scale

BMT WBM
www.bmtwbm.com.au

Filepath: "I:\B22559.k.rs.Mullum_FIA\DRG\FLD_007_170510_MUL_DES02_Q100_H.wor"



Title:
1% AEP Peak Flood Level Design Option 3

Figure: 15

Rev: A

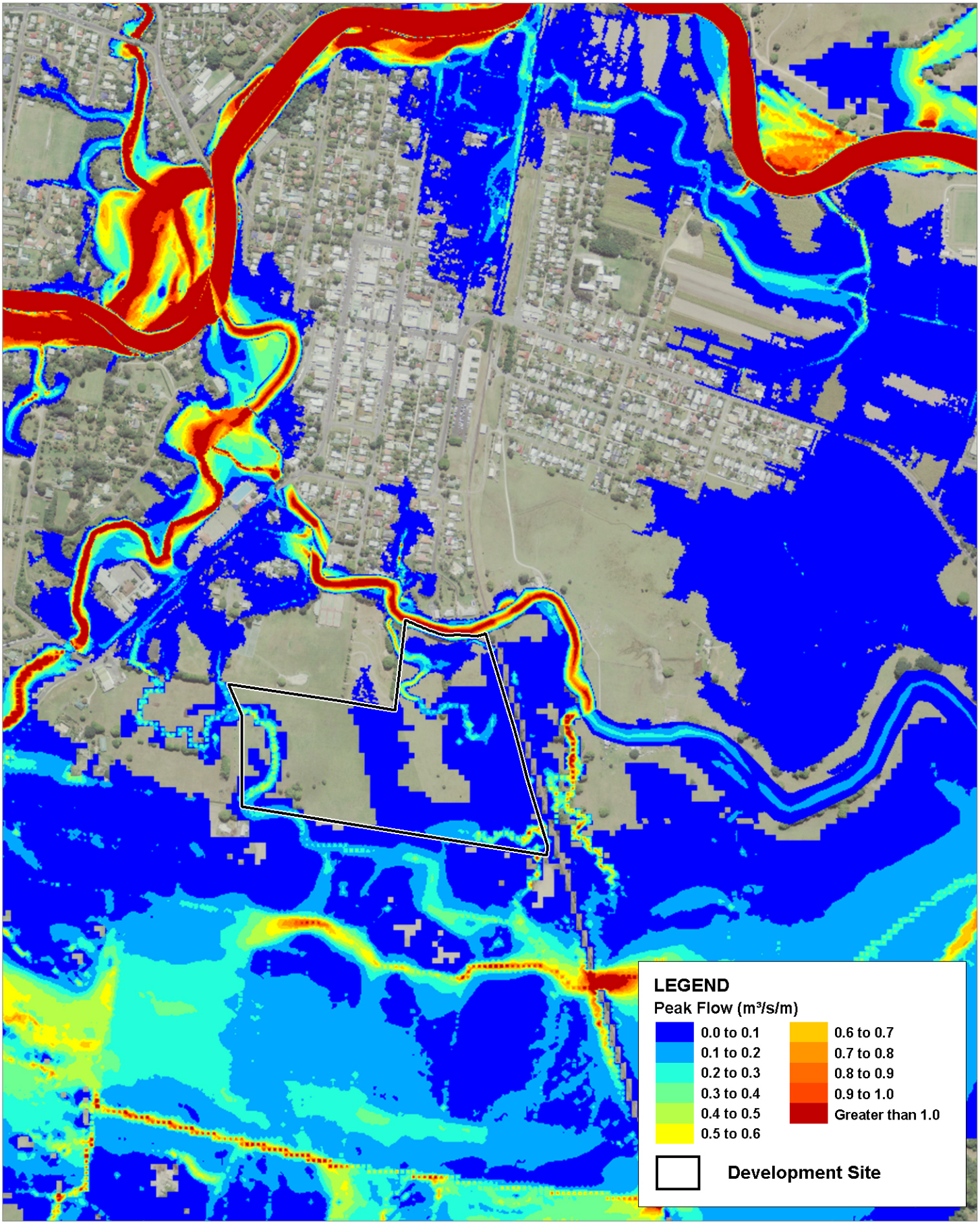
N

0 250 500m

Approx. Scale

BMT WBM
www.bmtwbm.com.au

Filepath: "I:\B22559.k.rs.Mullum_FIA\DRG\FLD_008_170510_MUL_DES04_Q100_H.wor"



Title:

10% AEP Peak Unit Flow Base Case

Figure: 16

Rev: A

N

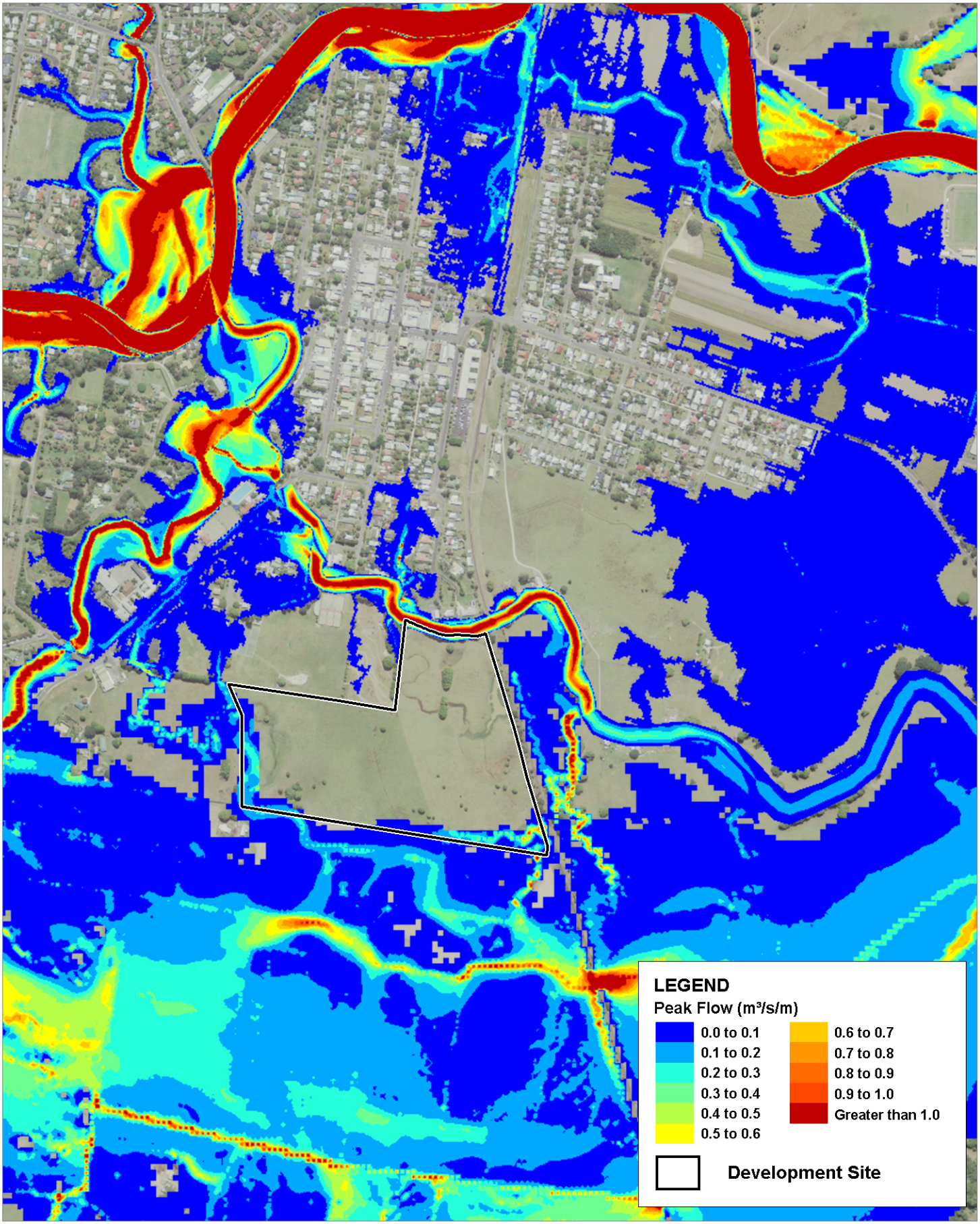
0 250 500m

Approx. Scale

BMT WBM

www.bmtwbm.com.au

Filepath: "I:\B22559.k.rs.Mullum_FIA\DRG\FLD_009_170510_MUL_BASE_Q010_Q.WOR"



Title:

10% AEP Peak Unit Flow
Design Option 1

Figure: 17

Rev: A

N

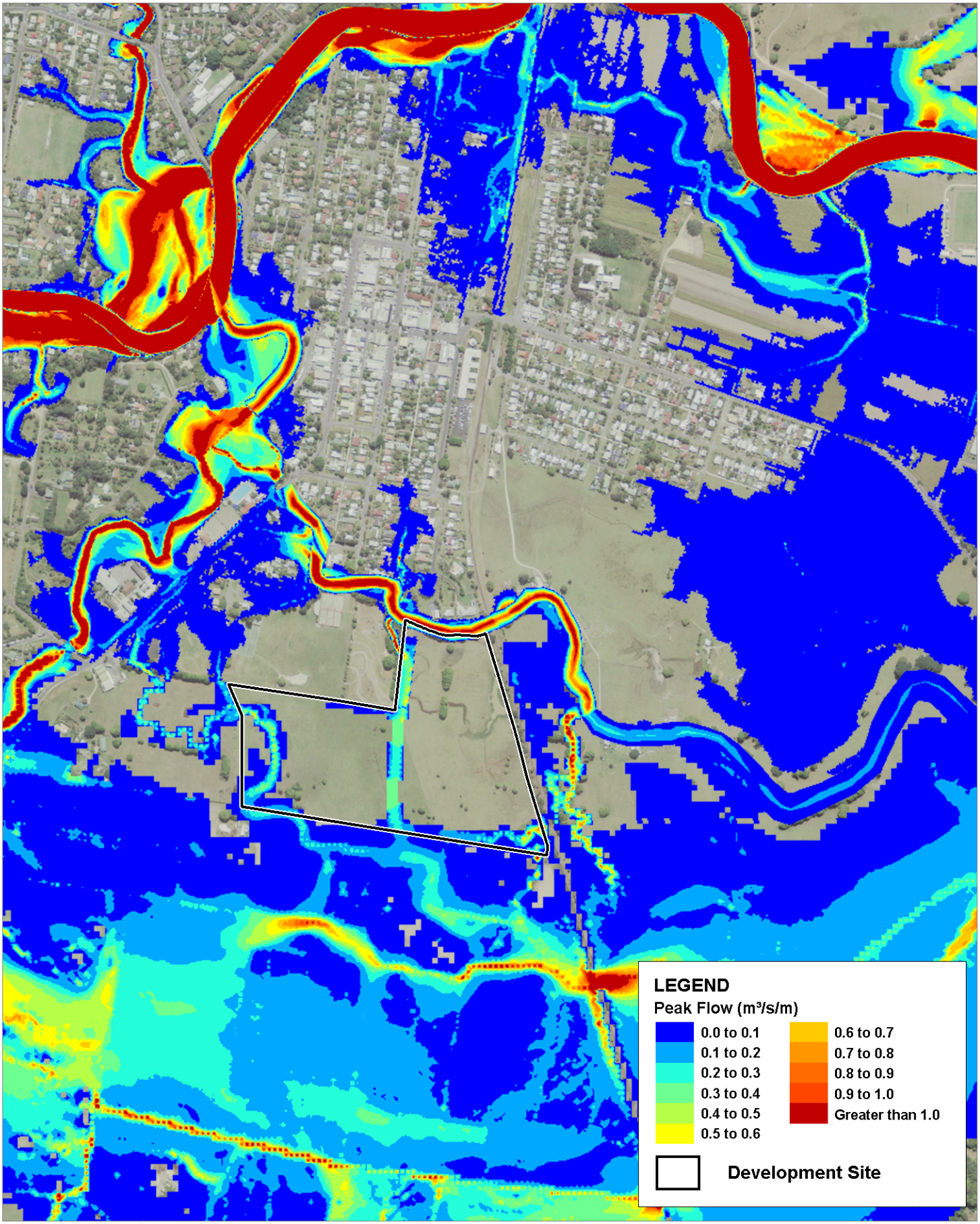
0 250 500m

Approx. Scale

BMT WBM

www.bmtwbm.com.au

Filepath: "I:\B22559.k.rs.Mullum_FIA\DRG\FLD_010_170510_MUL_DES01_Q010_Q.wor"



Title:

10% AEP Peak Unit Flow
Design Option 2

Figure: 18

Rev: A

N

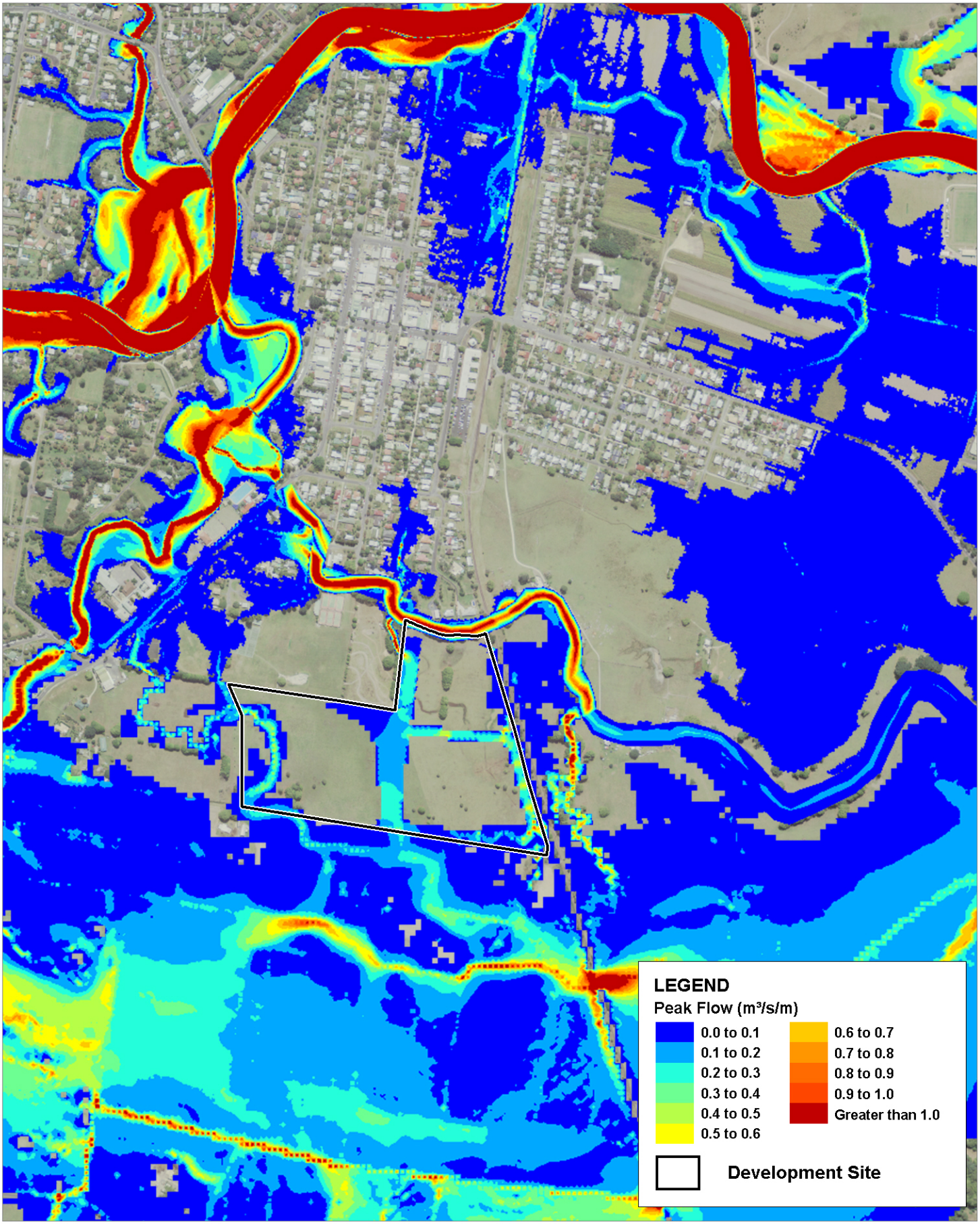
0 250 500m

Approx. Scale

BMT WBM

www.bmtwbm.com.au

Filepath: "I:\B22559.k.rs.Mullum_FIA\DRG\FLD_011_170510_MUL_DES02_Q010_Q.wor"



Title:

10% AEP Peak Unit Flow
Design Option 3

Figure: 19

Rev: A

N

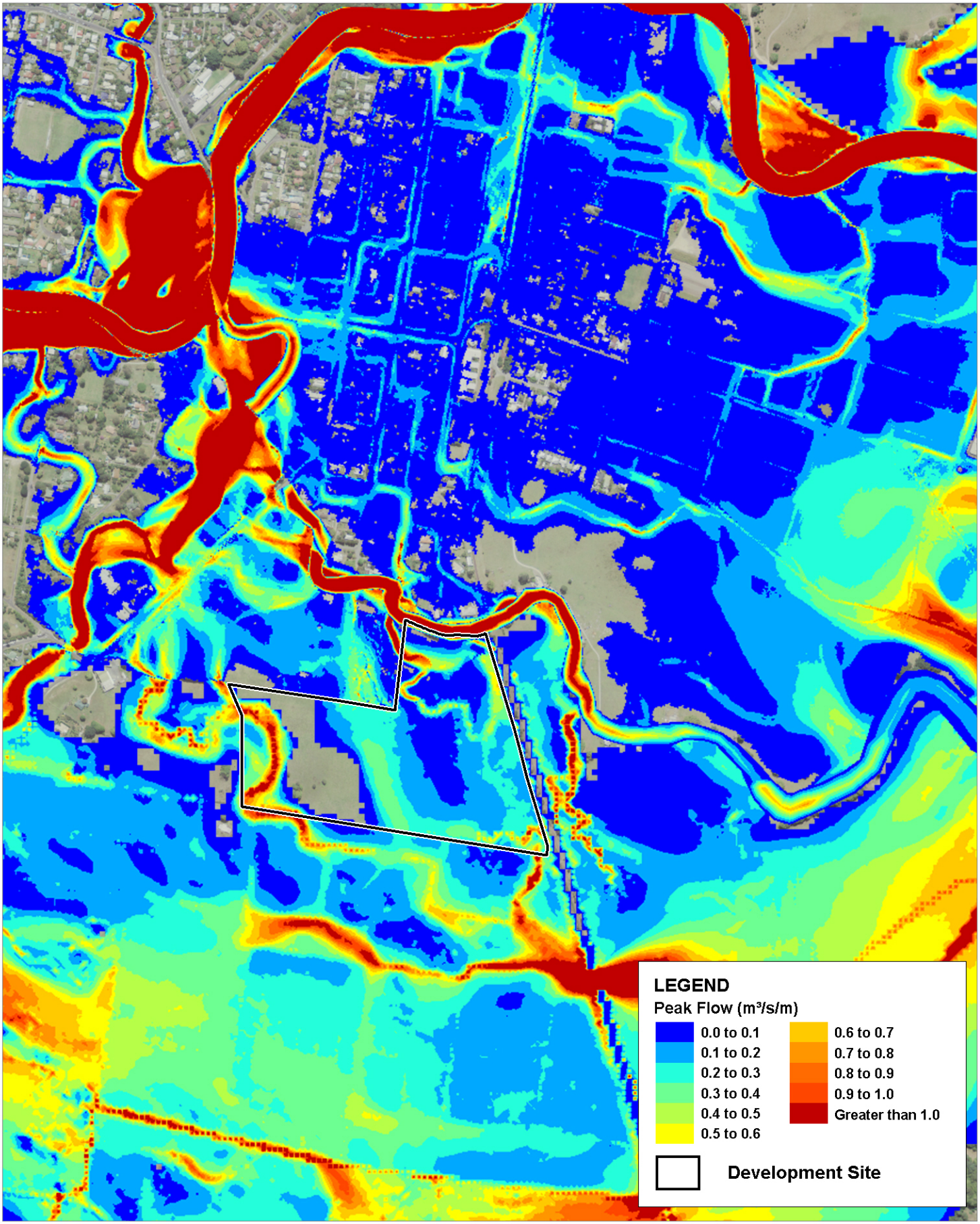
0 250 500m

Approx. Scale

BMT WBM

www.bmtwbm.com.au

Filepath: "I:\B22559.k.rs.Mullum_FIA\DRG\FLD_012_170510_MUL_DES04_Q010_Q.wor"



Title:

1% AEP Peak Unit Flow Base Case

Figure: 20

Rev: A

N

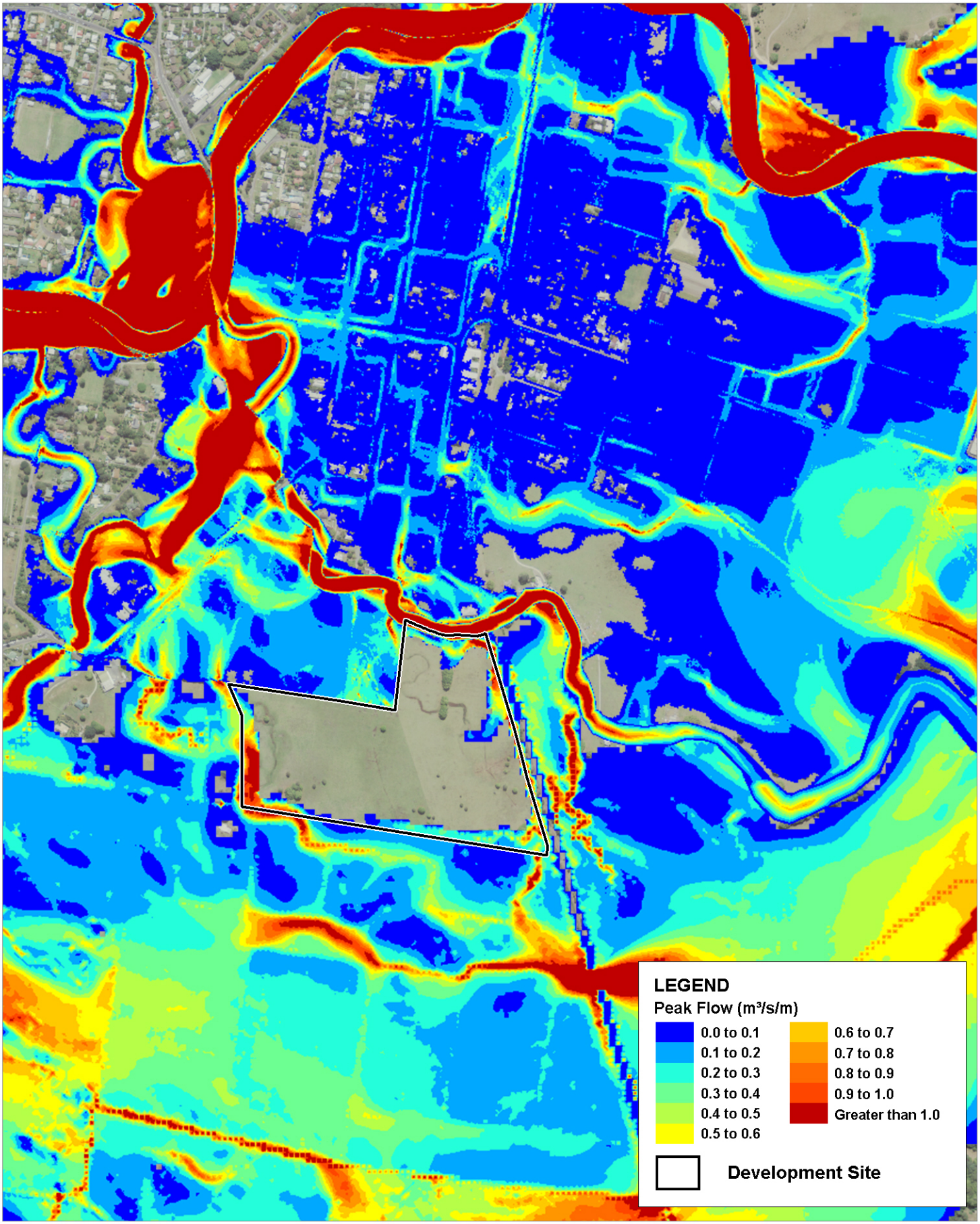
0 250 500m

Approx. Scale

BMT WBM

www.bmtwbm.com.au

Filepath: "I:\B22559.k.rs.Mullum_FIA\DRG\FLD_013_170510_MUL_BASE_Q100_Q.wor"



Title:

1% AEP Peak Unit Flow
Design Option 1

Figure: 21

Rev: A

N

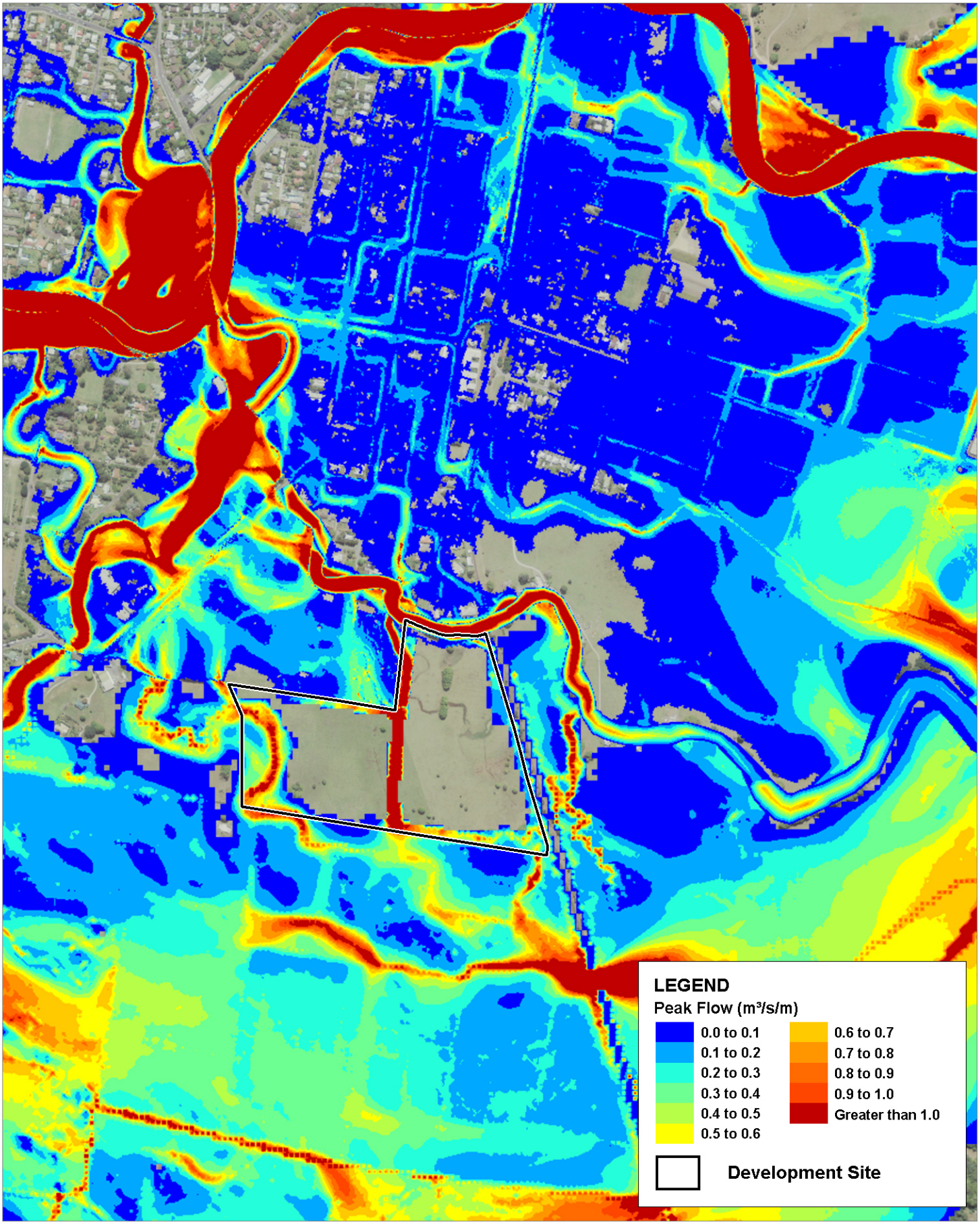
0 250 500m

Approx. Scale

BMT WBM

www.bmtwbm.com.au

Filepath: "I:\B22559.k.rs.Mullum_FIA\DRG\FLD_014_170510_MUL_DES01_Q100_Q.wor"



Title:

1% AEP Peak Unit Flow
Design Option 2

Figure: 22

Rev: A

N

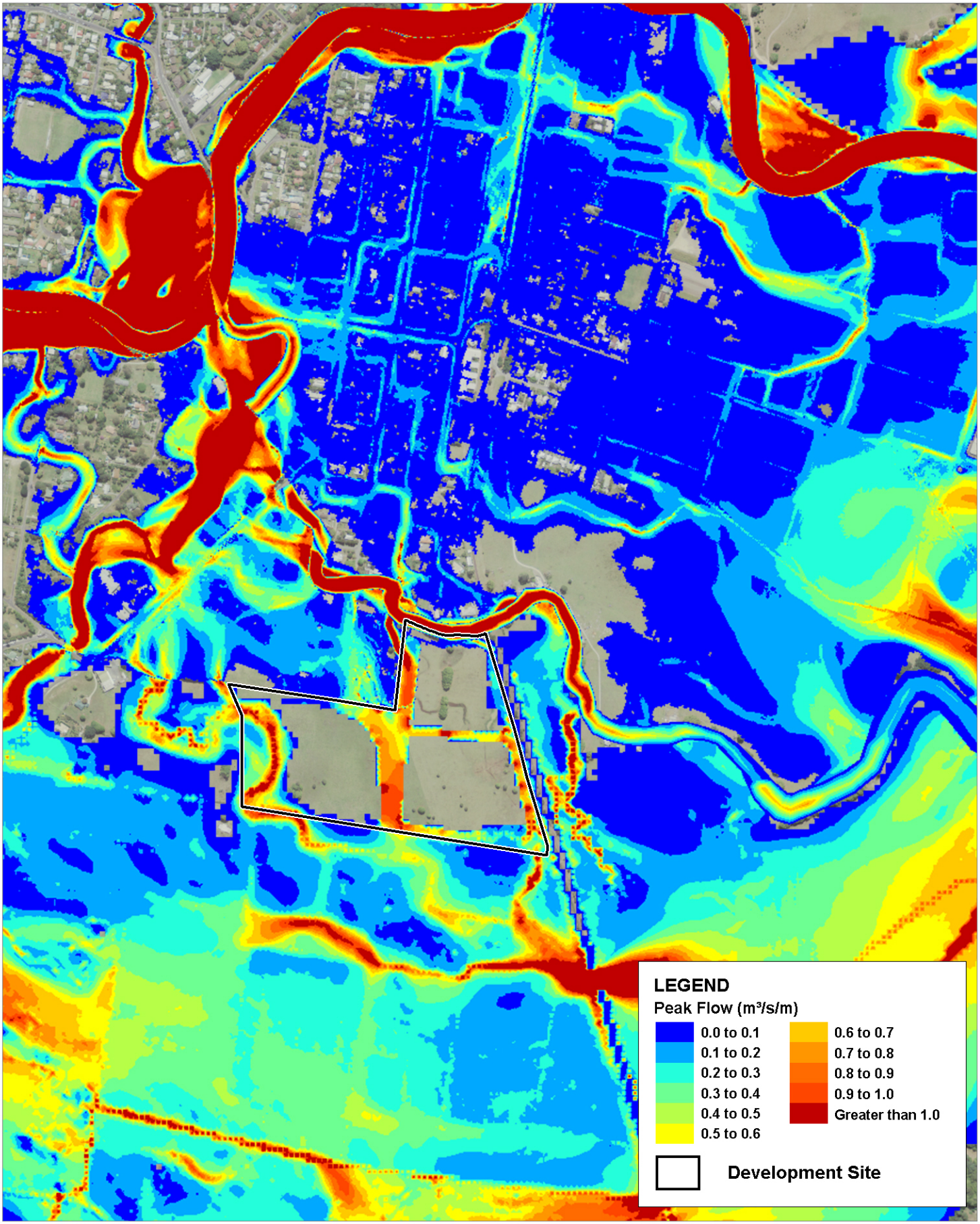
0 250 500m

Approx. Scale

BMT WBM

www.bmtwbm.com.au

Filepath: "I:\B22559.k.rs.Mullum_FIA\DRG\FLD_015_170510_MUL_DES02_Q100_Q.wor"



Title:

1% AEP Peak Unit Flow
Design Option 3

Figure: 23

Rev: A

N

0 250 500m

Approx. Scale

BMT WBM

www.bmtwbm.com.au

Filepath: "I:\B22559.k.rs.Mullum_FIA\DRG\FLD_016_170510_MUL_DES04_Q100_Q.wor"