224-398 Burley Road, Horsley Park Flood Impact Assessment

Reference: R.M21161.001.01.Final.docx
Date: March 2019
Confidential

Document Control Sheet

BMT Eastern Australia Pty Ltd
Level 5, 99 King Street
Melbourne Vic 3000
Australia

Tel: +61 3 8620 6100
Fax: +61 3 8620 6105

ABN 54 010 830 421

www.bmt.org

Document:	R.M21161.001.01.Final.docx
Title:	224-398 Burley Road, Horsley Park Flood Impact Assessment
Project Manager:	Joel Leister
Author:	Joel Leister
Client:	Goodman Property Services (Aust) Pty Ltd
Client Contact:	Luke Ridley
Client Reference:	

Synopsis:

REVISION/CHECKING HISTORY

Revision Number	Date	Checked by		Issued by	
1	7/3/2019	AG	[redacted]	JL	[redacted]

DISTRIBUTION

Destination	Revision										
	0	1	2	3	4	5	6	7	8	9	10
Goodman Property Services (Aust) Pty Ltd	1										
BMT File	1										
BMT Library	1										

Contents

List of Figures

List of Tables

1 Introduction

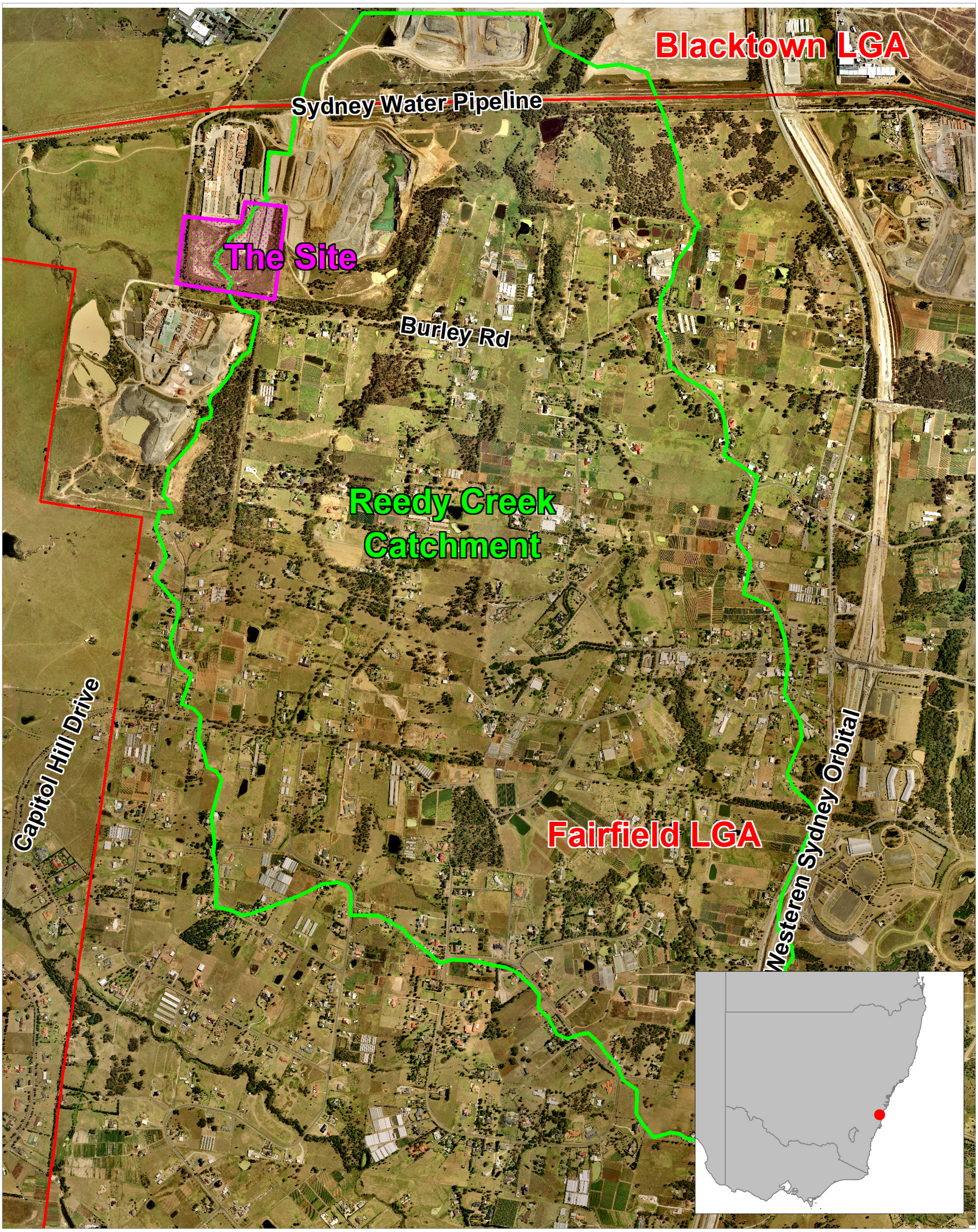
Goodman Property Services (Aust) Pty Ltd (GPSA) is seeking approval for a proposed industrial park development in Horsley Park, a suburb approximately 38 km east of the Sydney CBD. The location of the proposed development is 224-398 Burley Road, Horsley Park (the site). The site is bounded to the west by Old Wallgrove Road, Burley Road to the South and the Austral Brick (Plant 3) site to the north and east, as shown in Figure 1-1. The site is located within the Reedy Creek floodplain, with Reedy Creek itself located along the eastern boundary of the Austral Brick (Plant 3) site. BMT (formerly BMT WBM) previously prepared flood studies for both the Reedy Creek catchment as part of the Rural Area Flood Study on behalf of Fairfield City Council (BMT WBM, 2013).

The current study involved updating the Reedy Creek catchment flood model to include the neighbouring quarries. The proposed development will drain via underground pipe to the east to discharge into Reedy Creek. In order to demonstrate that the development does not adversely impact flood levels on the surrounding properties, BMT WBM has adopted and updated the modelling used in BMT WBM (2013) as follows:

- Extend the regional Reedy Creek catchment two-dimensional (2D) TUFLOW flood model of the existing floodplain include the full extent of the proposed development (to ensure accurate representation of local rainfall on the Site);
- Update the underlying terrain data to include the floodplain storage associated with the neighbouring quarries. BMT WBM (2013) used a ‘post quarry’ surface to represent the floodplain once the quarry sites had been closed and rehabilitated.
- Update the developed case model to include the proposed development fill platform and associated stormwater drainage; and
- Assess the impacts of the proposed development upstream and downstream of the development site for the 100, 50 and 20 year ARI events as well as the Probable Maximum Precipitation (PMP) flood event

This report presents the final modelling results (including flood maps) using the latest provided design.

Although this report is intended to provide sufficient detail on the methodologies of the modelling, this report contains only a summary of the Reedy Creek model development. For further details on the base case model development are document in the Rural Area Flood Study Report (BMT WBM, 2013).



Title:

Fairfield Rural Area Flood Study
Locality Map

Figure: **1 - 1**

Rev: **A**

N

0 375 750m
Approx. Scale

BMT
www.bmt.org

Filepath : T:\M20101.JL.WallgroveRd_FIA\MapInfo\Drawings\R.M20101.001.02.ModellingReport\OE_Fig1-1_Locality_RevA.WOR

2 Data Sets

The study drew upon data sets provided by Council and GPSA. The key data sets included:

- Digital aerial photography and cadastral property boundaries provided by Fairfield City Council;
- A catchment digital terrain model (DTM) developed from LiDAR and field survey by Fairfield City Council;
- Detailed feature survey of the existing topography provided by at&l (5 Feb 2019); and
- A design surface and proposed drainage network for the proposed development supplied by at&l (5 Feb 2019 and 7 Feb 2019).

3 Hydraulic Model Selection

Fairfield City Council (FCC) commissioned BMT WBM Pty Ltd (BMT WBM) to undertake a flood study of three distinct yet adjoining catchments (Reedy Creek, Ropes Creek and Eastern Creek) as part of the Rural Area Flood Study. The study was undertaken in a manner consistent with the requirements of the NSW Flood Prone Land Policy and the process described in the NSW Government's Floodplain Development Manual (NSW Government, 2005). The findings and models created for these flood study was completed and provided to Council in 2013.

The flood impact assessment of the site has been carried out with an extended version of the Reedy Creek model developed as part of the aforementioned flood study commissioned by FCC.

4 Model Development – Existing Case

This section summarises the development of the Reedy Creek 2D TUFLOW hydraulic model. For further details refer to the final report issued to FCC as part of the Rural Area Flood Study (BMT WBM, 2013).

4.1 Hydrology Inputs

The modelling approach adopted for this study was to apply the rainfall directly to the hydraulic model. Consequently, there is no hydrologic model to provide inflow boundaries for the hydraulic model. With the direct rainfall modelling approach, all the rainfall losses were processed by TUFLOW prior to application of the boundaries to the hydraulic model, and routing was undertaken by the hydraulic model.

Direct rainfall modelling was adopted for the Rural Area Flood study as it would provide detailed flood modelling and flood behaviour mapping for not only the main creeks within the catchment, but also all the tributaries within the study area, including those located in the vicinity of the Site.

Rainfall inputs were determined for the 20, 50, 100, 500 and 2000 year Average Recurrence Interval (ARI) flood events and the Probable Maximum Precipitation (PMP) flood event as modelled for the Rural Area Flood Study (BMT WBM, 2013). Full details of the derivation of the rainfall inputs are provided in BMT WBM (2013).

4.2 Hydraulic Model Layout and Coverage

A base case hydraulic model of the existing site and surrounds was developed to establish the existing flood behaviour of the study area. The TUFLOW model boundary was extended sufficiently of the site to ensure that the complex distributions of flow in the floodplain upstream of the development were reliably modelled, and also to ensure that any flood impacts resulting from the development could be simulated within the model domain. The model was also extended to include the extent of the proposed development to assess impacts of the proposed development on downstream flooding.

The proposed development site and TUFLOW model domains are shown in Figure 4-1.

4.3 Base Case Model Development

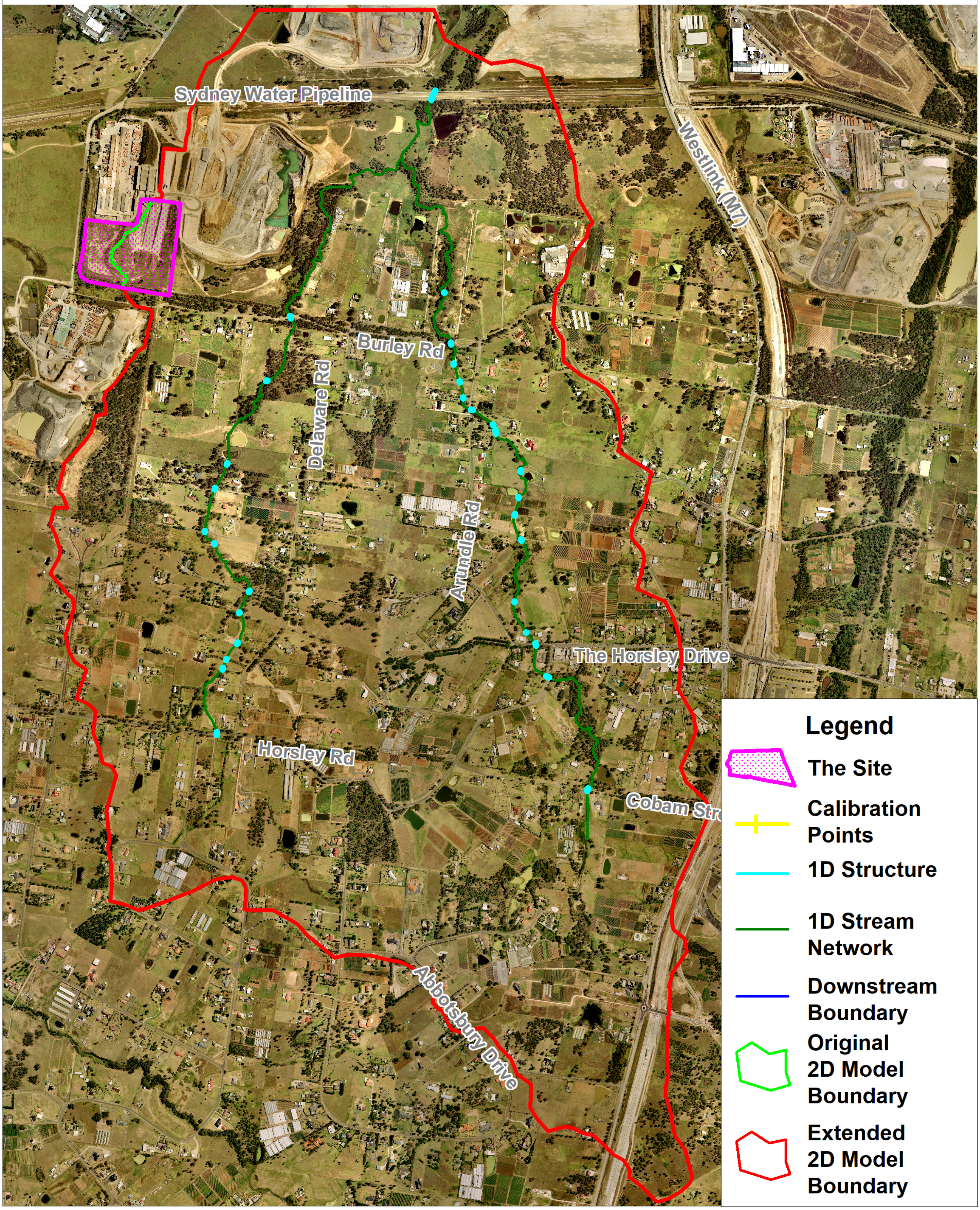
The base case TUFLOW model was developed with a 5 m grid across the study area. The broader floodplain geometry was defined within the model by extracting ground surface elevations from a DTM provided by FCC at each TUFLOW grid point.

1D elements were 'carved' through the 2D domain to represent the geometry of open channels and culverts. This process overcomes the limitation of modelling fine detail features with a 5 m fixed grid. Channel geometry was defined by detailed cross section survey of the major creeks alignments, including top of bank survey. Structures within the floodplain mainly comprised culverts and road crossing embankments. Culvert details of were included based upon survey provided by FCC. The 1D elements were dynamically nested within the 2D domain allowing for the interchange of water between the two model domains at every time step.

The direct rainfall modelling approach does not require individual inflow boundaries to be applied at discreet locations throughout the hydraulic model. Rather, a rainfall hyetograph is applied across the entire model domain. The direct rainfall modelling approach allows for different initial loss and continuing loss values to be applied to each different land use type within the hydraulic model. The adopted initial loss and continuing loss values were adjusted as part of the comparison process to ensure that the direct rainfall model was able to replicate the performance of the traditional modelling approach (refer to BMT WBM (2013) for details).

Stage-discharge boundaries (or rating curves) were used as the downstream boundaries for the TUFLOW model. TUFLOW automatically generated the stage-discharge relationship based upon a user defined slope. This calculation is based upon a Manning's flow calculation which uses the underlying model roughness in conjunction with the elevations of the hydraulic model at the location of the downstream boundary to determine the stage-discharge relationship for the defined slope at the boundary location. The adopted slopes were consistent with the ground slopes at the downstream extent of the model.

Boundary condition locations and types are shown in Figure 4-1.



Title:

Base Case Hydraulic Model
Domain Extension and Significant Hydraulic Features

Figure: **4-1**

Rev: **A**

N

0 400 800m
Approx. Scale

BMT
www.bmt.org

Filepath : T:\M20101.JL.WallgroveRd_FIA\MapInfo\Drawings\R.M20101.001.02.ModellingReport\OE_Fig4-1_Reedy_TUFLOW_RevA.WOR

4.4 Manning's Roughness Values

The Manning's roughness values are defined for each land use within the hydraulic model. Due to the nature of a direct rainfall model it is important to vary the Manning's roughness with water depth. Typically in a rural environment the initial roughness is higher for shallow floodwaters and decreases as the depth increases. For instance, low flood depths through grass are rough, however once flood depths are at a greater height than the grass the roughness drops until the grass is pushed over by the flood waters and the roughness drops even further. The adopted parameters based on the results of the model calibration (BMT WBM, 2013) are listed in Table 4-1.

Table 4-1 Adopted Manning's 'n' Coefficients and Hydrological Loss Values

Land use	Lower Depth (m)	Lower 'n'	Upper Depth (m)	Upper 'n'	Initial Loss (mm)	Continuing Loss (mm/hr)
Agriculture	0.1	0.300	0.2	0.050	11.5	2.5
Forest / High Density Veg	0.1	0.300	0.2	0.160	11.5	2.5
Forest and Grassland / Medium Veg	0.1	0.300	0.2	0.110	11.5	2.5
Grassland / No Veg	0.1	0.300	0.2	0.050	10.0	2.0
Grazing / Low Veg	0.1	0.300	0.2	0.035	11.5	2.5
Transport	0.1	0.030	0.2	0.025	2.0	0.5
Commercial	0.1	0.075	0.2	0.250	2.0	0.5
Natural Waterway / Lake	0.1	0.025	0.2	0.045	12.0	2.5
Quarry	0.1	0.030	0.2	0.050	5.0	2.5
Waterway – No/Low Veg	0.1	0.300	0.2	0.045	11.5	2.5
Waterway – Med. Veg	0.1	0.300	0.2	0.055	11.5	2.5
Waterway – High Veg	0.1	0.300	0.2	0.080	11.5	2.5
Farm land including farm houses, roads and associated infrastructure (Tag Key from LEP = 1(a))	0.1	0.300	0.2	0.085	11.5	2.5
Quarry (Tag Key from LEP = 1(b))	0.1	0.030	0.2	0.050	5.0	2.5
Commercial (Tag Key from LEP = 1(v))	0.1	0.075	0.2	0.200	2.0	1.0
Pipeline easement and associated infrastructure (Tag Key from LEP = 5(a))	0.1	0.300	0.2	0.050	11.5	2.5
Sealed road and verge (Tag Key from LEP = 5(b), 5(c))	0.1	0.030	0.2	0.025	2.0	0.5
Sports ground (Tag Key from LEP = 6(a))	0.1	0.300	0.2	0.050	11.5	2.5

Land use	Lower Depth (m)	Lower 'n'	Upper Depth (m)	Upper 'n'	Initial Loss (mm)	Continuing Loss (mm/hr)
Farm land including farm houses, roads and associated infrastructure (Tag Key from LEP = 6(d))	0.1	0.300	0.2	0.080	11.5	2.5
Farm land including farm houses, roads and associated infrastructure (Tag Key from LEP = SREP 31)	0.1	0.300	0.2	0.080	11.5	2.5

4.5 Design Event Modelling

The 20, 50 and 100 year ARI design storm events were modelled in TUFLOW for a number of storm durations: 2 hour, 3 hour, 6 hour, 9 hour, 12 hour and 18 hour. The critical storm duration varied across the catchment and hence a variety of storm durations were modelled to ensure the maximum flood heights across the entire catchment are captured. Generally, the 9 hour storm duration was critical across the majority of the Reedy Creek catchment.

A peak flood height envelope was developed from the durations modelled and the peak envelope of flood levels mapped.

4.6 Hydraulic Structures

The collected survey information was used to include various structures (bridges and culverts) in the hydraulic model.

Bridges and culverts were always modelled as 1D elements, and where a roadway was present over the structure, a weir was used representing the flow over the road. The weir was represented using either the available survey information or road levels derived from the DEM. Where bridge railings (either as guard rails or pedestrian hand rails) were present, they included in the representation of the structure within the 1D model. These railing were modelled as a 50% blockage to the flow (based upon the available survey information for a number of the structures throughout the catchment).

4.7 Modifications to the Base Case from Previous Modelling

The proposed development is located on the western boundary of the Reedy Creek catchment, with a portion of the proposed development extending into the neighbouring catchment to the west. It was therefore necessary to extend the catchment to the west to include the full extent of the development in the hydraulic model. In addition, the following enhancements were incorporated into the base case model:

- Feature survey information of the site was incorporated into the base case model covering the site and the near surrounds. This survey included details of the quarry which had been excluded from the original 2013 flood study (see BMT WBM, 2013 for details).

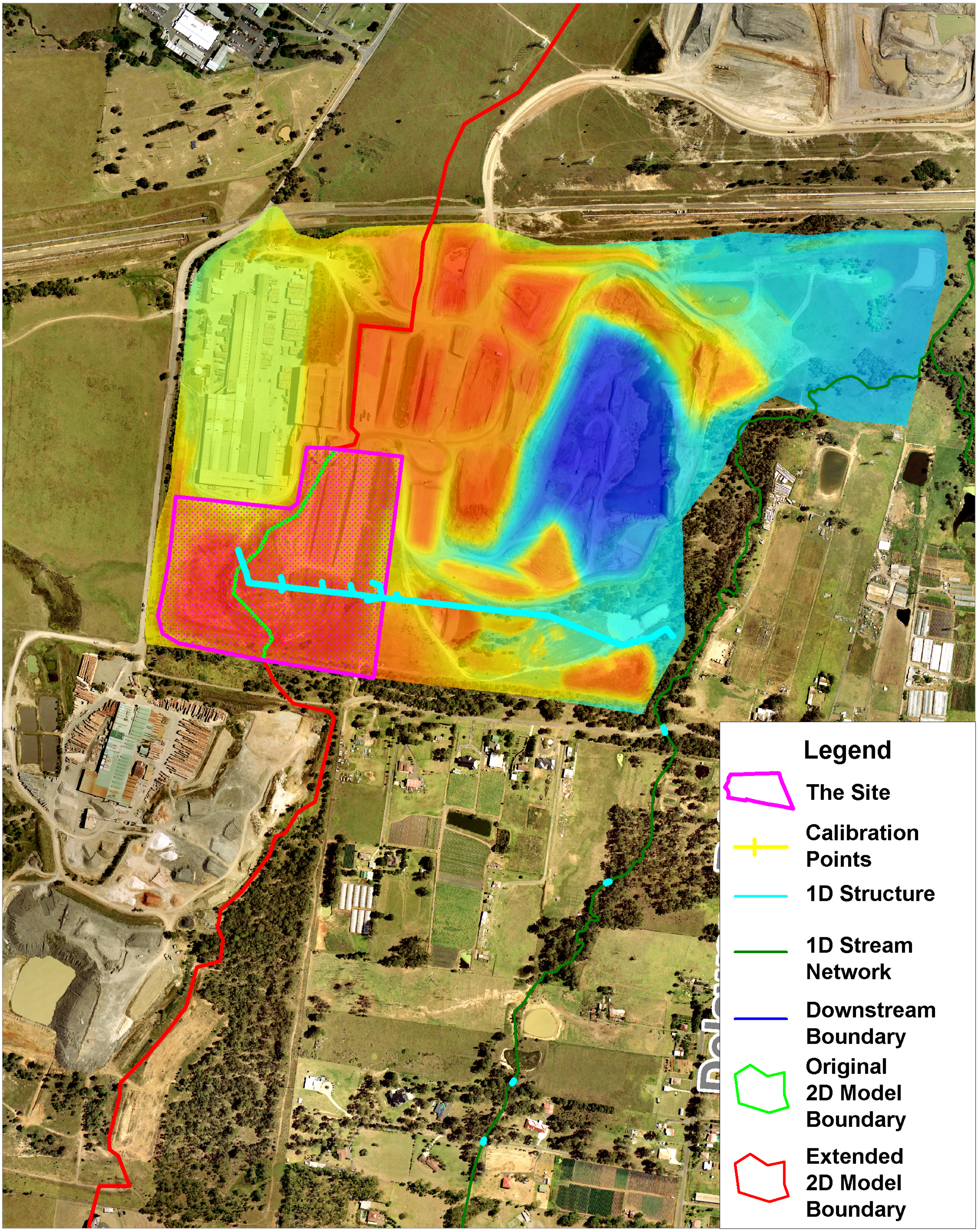
5 Model Development – Developed Case

The base case TUFLOW model was modified to incorporate the proposed development. The design surface for the proposed development (provided by at&l) was included in the hydraulic model. Internal drainage has been designed by at&l, and the resultant DRAINS models was provided by BMT for inclusion in the hydraulic model.

The rainfall was not modified as part of the developed case model. The underlying roughness parameters were adjusted to reflect the change land use due to the proposed development.

The design surface and drainage network of the proposed development are illustrated in Figure 5-1.

.



Title:

Developed Case Terrain Modification

Figure: **5-1**

Rev: **A**

N

0 125 250m
Approx. Scale

BMT
www.bmt.org

Filepath : T:\M20101.JL.WallgroveRd_FIA\MapInfo\Drawings\R.M21161.001.01.Final\OE_Fig5-1_DevCaseModel_RevA.WOR

6 Flood Mapping

TUFLOW produces a geo-referenced data set defining peak water levels throughout the model domain at the corners of its computational cells. For the peak flood level from all of the storm durations was selected for each computational cell to generate an envelope of peak flood level. This data were imported into GIS to generate a digital model of the flood surface.

The flood mapping in the enclosed maps was not shown where the flood depth is less than 0.15 metres. This is consistent with the approach adopted in BMT WBM (2013) and is based on advice provided by Council during the Rural Areas Flood Study.

6.1 Flood Depth and Extent Mapping

The TUFLOW flood model was initially used to determine the flood depths for the 100 year ARI flood events for the base case and developed case. These flood extent maps are presented in Figure 6-1 and Figure 6-2 respectively.

6.1.1 Discussion of Flood Depth Mapping

The developed case flood depth modelling (shown in Figure 6-2), shows minimal change in flooding patterns when compared to the existing condition (Figure 6-1).

Beyond the immediate site there is minimal, if any, change to the flood depths.

6.2 Flood Impact Mapping

Digital flood surfaces were created for the base case and developed case, and the changes in peak flood height were calculated by subtracting the base case model peak flood heights from the developed case model flood heights at each TUFLOW grid cell. The change in peak flood height for the 20, 50 and 100 year ARI flood events and the PMP flood event colour contoured and mapped in Figure 6-3 through Figure 6-6.

6.2.1 Discussion of Flood Impact Mapping

The results from the flood model indicate that the proposed development will not significantly increases in flood levels external to the site. The maps demonstrate there will be some increased flood levels along Reedy Creek downstream of the discharge of the outlet pipe. These impacts are generally confined to the waterway and do not result in an increased flood extent.

6.3 Flood Velocity Mapping

Digital flood velocity layers were created for the base case and developed case, and the changes in peak flood velocity were calculated by subtracting the base case model peak flood velocity from the developed case model flood velocity at each TUFLOW grid cell. The change in peak flood velocity for the 20, 50 and 100 year ARI flood events colour contoured and mapped in Figure 6-7, Figure 6-8 and Figure 6-9 respectively.

6.3.1 Discussion of Flood Velocity Mapping

The results from the flood model indicate that the proposed development will result in some higher velocities near the pipe outlet to Reedy Creek. In these locations, velocity increases of up to 0.1 metres per second are observed. Such increases may require erosion control measures to be implemented depending on the nature of the underlying soil and its susceptibility to scour.

6.4 Duration of Flood Inundation

The results from the flood impact mapping generally shows no significant increases in flood level. Consequently, as there is no noticeable change in flood level, it is unlikely that there will be any significant change in flood duration.