# **Appendix B** Assessment of Changes in the Blackbutt Creek Catchment

## Memorandum



## 22 March 2017

То	Greg White, Ku-ring-gai Council		
Copy to			
From	GHD	Tel	0292397100
Subject	Blackbutt Creek FRMS&P TUFLOW Model Update	Job no.	21/25655

## 1 Introduction

Council has asked GHD to update the Flood Study TUFLOW model to include recent developments in the study catchment.

This memo describes the steps GHD undertook to assess the flooding impact of updating the adopted Blackbutt Creek Flood Study TUFLOW model to reflect current catchment conditions. An assessment of the impact on flood levels due to the changes to the model was undertaken.

## 2 Update of Model

As part of the Blackbutt Creek Floodplain Risk Management Study and Plan (FRMS&P), a number of recent developments within the catchment have been identified which were not included in the modelling carried out as part of the Flood Study. GHD was requested to include these developments in the original Flood Study model that has been provided for use as part of the FRMS&P and assess the flood impacts of these changes on results. As part of the assessment, it was agreed the model would be simulated for the 100 year Average Recurrence Interval (ARI) and Probable Maximum Flood (PMF) storms. Details of the changes to the model include:

- the inclusion of the building footprints at a number of new properties throughout the catchment that have been developed since the Flood Study was finalised (refer to Figure 1)
- a new road (Beans Farm Road) that intercepts an overland flow path
- new stormwater drainage infrastructure and modifications to existing infrastructure.

Council has supplied the as-built design topographic information for the road crossing, as well as stormwater drainage details and the building footprints. These have all been incorporated into the updated model.

No changes were made to the model hydrology. It is noted that the Flood Study adopted hydrology from a DRAINS model that was developed in an earlier study (*Local Catchment Plan – Lane Cove River Southern Region Catchments*, prepared for Ku-Ring-Gai Council by URS, 2005). The underlying input information for the DRAINS model, such as sub-catchment boundaries, does not appear to have been available for the Flood Study and hence, was not available for this model update. Therefore, the key limitation of this model update was that it was not possible to assess impacts on hydrology of the new developments nor to update the hydrology model inputs. The hydrology could reasonably be assumed to

remain largely the same as new developments since the Flood Study should have incorporated On-Site Detention (OSD) sufficient to create no increase in peak flows, at least up to a 100 year ARI event.

A second limitation is the manner in which the hydrology is input into the TUFLOW model. The inflows are calculated at discrete sub-catchment boundaries with the effect that flows are correct at the catchment downstream boundary but are not necessarily distributed strictly in a cumulative manner through the sub-catchment reach. This approach has limitations for this model update where a new development is located within a sub-catchment reach. For example, at Beans Farm Road, the Road is located within a sub-catchment reach and flows for that sub-catchment are input into the model at the sub-catchment outlet (downstream of the Road) potentially underrepresenting flows through the Road ross drainage. The methodology used is, however, a typical approach to catchment scale flood modelling and a common limitation.

Further, detailed information regarding changes the terrain around the new building footprints on Merriwa Street were not available.

## 3 Existing Flooding

The existing TUFLOW flooding model for the Blackbutt Creek catchment area was provided to GHD by Council. This included the detailed modelling results, which were processed to carry out the comparison. To do this, the 100 year ARI and PMF storm results were utilised and flood level comparisons made.

## 4 Change in Flood Behaviour

The Flood Study model was adjusted to reflect the changes as described above. A review of the Flood Study results indicated that it was not possible to identify a single storm duration critical to the locations of the new development. The 100 year ARI and PMF storm events were assessed for the range of storms that were used previously in the Flood Study (15, 25, 60, 90 and 120 minutes for the 100 year ARI and 15, 30, 45, 60, 90 and 120 minutes for the PMF). All these models were simulated for the following two scenarios:

- 1. No blockage (All-clear): All stormwater drainage infrastructure elements are assumed to be fully functioning and have no blockage of waterway area.
- 2. Partially-blocked: All stormwater drainage infrastructure elements are assumed to have a level of blockage consistent with that assumed in the Flood Study.

Mapping of the modelling results is shown in Figure 2 to Figure 5. The flood level afflux is illustrated in coloured shading and areas either "Now Dry" or "Now Flooded" are shown in cross hatching. Most of the cross hatched areas reflect the building footprints of previous and new development.

#### Flood level impact

Changes in flood level, where level is measured with reference to a height datum (in this case, Australian Height Datum), are important because they could affect the adopted flood planning levels and flood planning extents, as well as influence risks to adjacent and surrounding development.

Generally, the effect of the change resulted in negligible localised increases in flood level around areas where new property footprints encroach on flowpaths within the catchments, as shown on the figures at

the end of this memorandum. At Beans Farm Road and the nearby new developments however, some impact is evident as indicated in Table 1.

Around 16-24 Merriwa Street, the model shows the overland flowpath is affected with resulting changes in level at this location and as far as the neighbouring property at 33 McIntyre Street.

Increased levels are also shown on Beans Farm Road, and these are largely due to the change in surface levels from the original terrain to the new road levels resulting in an increase in flood levels.

#### Flood depth impact

Changes in flood depth, which are measured relative to the ground level and indicate actual depth of flooding at a particular location, are important because they inform assessment of flood hazard and risk at any given location.

Previous flood depths on the north side of the new residential blocks on Merriwa Street were up to around 200 mm in the 100 year event and 400 mm in the PMF as estimated in the flood study.

Initially, the overland flow path was considered to be blocked by the new development as details of the new development drainage and final finished surface levels around the building footprints were not available. That results in flood depth increases of greater than one (1) metre in the 100 year event and greater than two (2) metres in the PMF.

However, information only recently obtained from the WAE for the new development's stormwater management system, indicates that:

- A 600 mm RC drainage line was installed on a new easement running through the basement to replace the old 525 mm pipe;
- A grated trench 1.5 m by 0.5 m runs along the driveway above the pipe to convey overland flow along the new easement, through the basement and out of the building at the rear.
- The trench was designed to take a flow of 1.59 m<sup>3</sup>/s (as requested by Council), which is in excess of the overland flow estimated by the original Blackbutt Creek flood study for a partially blocked scenario of 1.1 m<sup>3</sup>/s in this location (Total flow is estimated at 1.4 m<sup>3</sup>/s in this area for a partially blocked scenario).

Hence, it is anticipated that no significant flood depth impacts will occur at the Merriwa Street frontage.

Depths of flooding at the location of Beans Farm Road were generally less than 50 mm in the 100 year event and up to around 150 mm in the PMF. Flood depths remain mostly similar to the original depths in a 100 year event, with isolated locations of increase. In the PMF, isolated increases of 220 mm were estimated (Table 2).

Increases in flood depths elsewhere (Table 2) were limited to the vicinity of new building footprints.

#### Velocity impacts

Flood velocities on Merriwa Street were previously up to around 1.8 m/s in a 100 year event and 3.2 m/s in the PMF with isolated areas of higher velocity. Velocities have generally decreased on Merriwa Street. However, the increases shown to the west of the new development (Table 3) are due to the formation of the new flow path in this location.

Elsewhere, as shown in Table 3, velocity increases were generally limited to those areas which were previously not flooded. This was due to the presence of buildings, which have since been removed, and localised areas around new building footprints.

<image>

## Table 1 Estimated changes in flood level

100 yr ARI Flood Level Afflux (All Clear)

100 yr ARI Flood Level Afflux (Partially Blocked)



Note: results do not include the newly implemented drainage.



## Table 2 Estimated changes in flood depth

100 yr ARI Flood Depth Afflux (All Clear)

100 yr ARI Flood Depth Afflux (Partially Blocked)



PMF Flood Depth Afflux (All Clear)



PMF Flood Depth Afflux (Partially Blocked)

Note: results do not include the newly implemented drainage.

## Table 3 Estimated changes in flood velocity



100 yr ARI Flood Velocity Afflux (All Clear)

100 yr ARI Flood Velocity Afflux (Partially Blocked)



PMF Flood Velocity Afflux (All Clear)



PMF Flood Velocity Afflux (Partially Blocked)

LEGEND ≤ <-0.2 m/s +0.05 m/s - +0.1 m/s ≤ +0.4 m/s - +0.5 m/s ⇒ -0.2 m/s - -0.1 m/s ≤ +0.1 m/s ≤ +0.4 m/s - +0.5 m/s ⇒ +0.1 m/s - +0.2 m/s ≤ +0.5 m/s - +0.75 m/s ⇒ +0.1 m/s - +0.25 m/s ≤ +0.2 m/s +0.3 m/s ⇒ +0.75 m/s - +1 m/s ⇒ +1.5 m/s ⇒ +1.5 m/s

Note: results do not include the newly implemented drainage.

#### Discussion

#### Beans Farm Road

The model results indicated that there were significant changes in flood levels around Beans Farm Road. This was considered largely due to the change in surface levels from the original terrain to the new road levels. This was confirmed by review of changes in flood depths, which were found to be minimal. In the original Blackbutt Creek Flood Study report, it was indicated that depths of flooding along Beans farm Road were generally less than 50mm in the 1% AEP flow and up to around 150 mm in the PMF. It is estimated that flood depths remain similar to the original depths in the 1% AEP with isolated locations of increase. In the PMF, isolated increases of up to 220 mm were estimated and are generally similar to the original study. It is therefore considered that the infill development has not significantly changed flood conditions outside the roadway.

#### 16-24 Merriwa Street/33 Macintyre Road

The modelling undertaken indicated that an overland flowpath has been truncated by the new development at 16-24 Merriwa Street. Consequently, flow is being concentrated upstream and near the neighbouring property at 33 Macintyre Road resulting in localised increases in flood depth and velocity. The Blackbutt Creek Flood Study indicated that flood depths on the north (upstream) side of the new residential block were up to 200mm in the 1% AEP event and 400mm in the PMF. The modelling documented in this memorandum indicated flood depth increases of greater than 1m in the 1% AEP and 2m in the PMF could be expected. It was initially thought that this area would require further consideration in the Floodplain Risk Management Study.

However, the infill developments were modelled as opaque objects consistent with the approach in the Flood Study. The 525 mm drainage line running through the development was also considered at capacity in a 1% AEP event in this area. Information only recently obtained from the Works As Executed drawings for the new development's stormwater management system indicates that a 600 mm RC drainage line was installed on a new easement running through the basement to replace the old 525 mm pipe. In addition, a grated trench 1.5 m by 0.5 m runs along the driveway above the pipe to convey overland flow along the new easement, through the basement and out of the building at the rear. The trench was designed to take a flow of 1.59 m<sup>3</sup>/s (supplied by Council to the Developer), which is in excess of the overland flow estimated by the original Blackbutt Creek Flood Study for a partially blocked scenario of 1.1 m<sup>3</sup>/s in this location (total flow is estimated at 1.4 m<sup>3</sup>/s in this area for a partially blocked scenario). Consequently, if the built scenario were to be remodelled it is more than likely that no significant flood impacts would occur in this area as the building is not opaque to overland flows. The 1% AEP flow can pass through the building and would not pond on the north side based on information provided by Council.

#### **Model limitations**

As noted previously, the location of inflows in the model around the Beans Farm Road development from its sub-catchment. The modelling undertaken for the Flood Study, located the inflow for the sub-catchment at a point downstream of this development as noted earlier in this memorandum, at the confluence of the stream defined as Amaroo Gully. This results in the catchment flows entering the

model downstream of the road drainage culverts. Due to this, assessing the impact of the new culverts in detail is not possible in the current model as an adequate base case to do the assessment is not available. The stormwater drainage from Merriwa Street to McIntyre Street was assumed to remain as per the original modelling.

## 5 Conclusion

An assessment was carried out on the flooding impact of the new developments identified within the Blackbutt Creek catchment, as well as, the inclusion of a new Beans Farm Road pavement and drainage infrastructure.

This assessment showed there was a negligible flood impact across most of the catchment due to the new infill developments. The model results indicated impacts at a new development on Merriwa Street, however further investigation identified the presence of upgraded stormwater drainage as part of the development. The new drainage was determined by Council to have capacity such that the modelled impacts would not, in reality, be expected.

The increases shown in the mapping on Beans Farm Road are predominantly due to the change in surface levels in the original terrain to the new road levels with minor changes in actual flood depth.

Also, the configuration of the Flood Study model does not allow for the assessment of the impact of the cross drainage culvert in Beans Farm Road. It was assumed that Council reviewed other hydraulic modelling to approve the design of this culvert and hence, won't have an adverse impact on flood behaviour.

The findings of the modelling and subsequent information provided by Council indicate that, based on the information available, development in the catchment subsequent to the Flood Study release would not result in significant changes to the results of the Flood Study. It is therefore proposed that the original flood study models and results be used as the basis for proceeding with the floodplain risk management study and plan. The results of the analysis documented in this memorandum would be incorporated into the Floodplain Risk Management Study and Plan.

Yours sincerely

GHD Pty Ltd



Figure 1

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