Blacktown Workers Club, Reservoir Rd,

Flood Assessment

On behalf of Paynter Dixon

MARCH 2018

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BLACKTOWN WORKERS CLUB REDEVELOPMENT FLOOD MODELLING AND ASSESSMENT

FINAL REPORT

MARCH 2018

Project Blacktown Workers Club Redevelopment, Flood Modelling and Impact Assessment	**Project Number** 170059
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Terminology used in this Report

The revision of the Australian Rainfall and Runoff Guidelines (2016) (Reference 3) has resulted in a change in the terminology used to refer to the probability of floods. Most notably, Average Recurrence Interval (ARI) has been replaced with Annual Exceedance Probability (AEP). AEP is expressed using the percentage probability that an event of a certain size or larger will occur in any one year. For example, the 100 year ARI (or 1 in 100 year ARI) flood event is now referred to as the 1% AEP flood event.

The Probable Maximum Flood (PMF), or Probable Maximum Rainfall, is the largest possible rainfall that can occur at a given location. The probability of the event is in the order of 1 in 1 million years, which is 10,000 times more rare than the 1% AEP flood event. The 1% AEP rainfall is in the order of 80 mm (occurring over an hour). The PMF for the site is in the order of 300 mm occurring over the space of 45 minutes.

1. Background

Redevelopment of the playing fields at the Blacktown Workers Club, Reservoir Road (the subject site) is proposed for a seniors living precinct. The subject site is located to the north-west of the intersection of Reservoir Road and Penny Place in Arndell Park, as indicated in Figure 1 (see rear of report for figures).

The site is subject to very limited flooding in the 1% AEP event (see Figure 4 at rear of report). Design 1% AEP flood levels have been assessed with 50% blockage of the stormwater network.

The following work scope has been executed:

- Site Visit;
- Collection of previous studies and review;
- Contacted Blacktown City Council to obtain trunk drainage details;
- Development of detailed hydrologic and hydraulic flood models for the site;
- Provision of relevant flood information for the site inclusive of mapping, levels etc.; and
- Reporting inclusive of relevant flood policy requirements for the proposed development.

The goal of the work was to define the existing flood situation for the subject site in the 1% AEP and PMF flood events for a Site Compatibility Certificate (SCC) application, used as a part of the Seniors Housing SEPP. This work also involved summarising applicable flood provisions from the Floodplain Development Manual and providing recommendations regarding the development and compliance with consent requirements.

2. Relevant Policy

2.1 Floodplain Development Manual

The Floodplain Development Manual 2005 (Reference 2) supports the Flood Prone Land Policy to reduce the impact of flooding, flood liability on owners/occupiers of flood-prone property and reduce public and private losses. The manual outlines various development provisions, most pertinent of which to this assessment are:

- *"Higher FPL's (than the 1% AEP plus 0.5 m freeboard) may be necessary for aged care facilities and other types of developments with particular evacuation or emergency response issues."* (Section K 3.1 FPLs for Development Control)
- *"Access routes do not have to be above the PMF level but be at a level of protection that, in combination with effective warning time, development type and flood duration, provides adequate time of evacuation and reduces risk to acceptable levels."* (Section L 6.8 Effective Flood Access)

3. Methodology

Existing design flood behaviour for the subject site is defined by hydrologic and hydraulic modelling developed as a part of the current study. This modelling is based on the use of a hydrologic model (WBNM) to convert rainfall into runoff and then a hydraulic model (TUFLOW)

to convert applied runoff into flood depths and levels. Both WBNM and TUFOW are commonly used in Australia for flood modelling and can be considered best practice.

The study was conducted in accordance with methodology recommended in Australian Rainfall and Runoff (AR&R, Reference 1).

3.1 Hydrologic Model

A hydrologic model was developed using WBNM to convert rainfall into runoff for input in the TUFLOW hydraulic model. This process involves an analysis on the 44 hectare local catchment upstream of site and the wider upstream catchment (120 hectares) for Bungarribee Creek (shown in Figure 2). The following information was used in this model:

- Percentage impervious for each catchment;
- Bureau of Meteorology 1987 rainfall intensities;
- A lag parameter of 1.6 (default and recommended in the absence of gauged data justifying adoption of other values);
- For the 1% AEP Event:
    - Initial Loss: 10 mm
    - Continuing Loss: 2.5 mm/hr
- For the PMF Event:
    - Initial Loss: 1 mm
    - Continuing Loss: 0 mm/hr

A critical duration analysis was undertaken in the hydrologic model which found that the 2 hour duration was critical in the 1% AEP event and the 45 minute duration in the PMF event.

3.2 TUFLOW Model Build

GRC Hydro have built a modelling system to undertake the following assessment. TUFLOW is a hydraulic modelling tool that can utilise one and two-dimensional model elements.

The hydraulic modelling system is comprised of the following elements:

- LiDAR data has been used to inform a 2 m finite difference grid. This data has a typical accuracy of ±0.15 m (1st confidence interval);
- Pipe elements (shown in Figure 3) are included based on pipe diameter and configuration provided by Council. Design plans with invert levels were supplied by Council for the trunk drainage elements adjacent to the subject site. Where pipe inverts were not available, inverts were informed by an offset from Lidar ground elevations;
- Manning's roughness values were applied as follows (shown in Figure 3):
    - General: 0.04
    - Roads: 0.02
    - Commercial: 0.03
    - Dense Vegetation: 0.07
- A fixed tailwater was adopted at the catchment's downstream boundary, although this does not impact on results within the area of interest.

4. Existing Flood Behaviour

Figure 4 shows the existing flood behaviour in the vicinity of the subject site in the 1% AEP event assuming 50% pipe blockage (a conservative 1% AEP scenario). Flow arrives at the site primarily from the north-east where water flows around the development and into two flow paths (one to the north of the site and another to the south – shown in Figure 1). Both of these flow paths outlet into Bungarribee Creek. In the 1% AEP event, the capacity of the existing drainage system is exceeded and additional flow is conveyed overland

Figure 5 presents the existing flood behaviour for the PMF event with no structure blockage.

5. Flood Egress

Flood egress at the subject site is affected by flood liability. More details are provided in the following sections.

5.1 Flood Hazard

Flood hazard is a measure of the potential harm posed by flooding and considers a number of factors including depth of flooding, velocity of flood waters, access to escape routes and duration of inundation. The preliminary flood hazard for the 1% AEP event is shown in Figure 6. These flood hazard categories (low and high hazard) were defined in accordance with the Floodplain Development Manual (Figure L2) (Reference 2) as indicated in Image 1 (below). The hazard categories shown in Image 1 use the relationship between the depth of flooding and the velocity of flood waters to determine a preliminary hydraulic hazard (low or high) for the subject site.

Image 1: Hydraulic Hazard Categories (Reference 2)

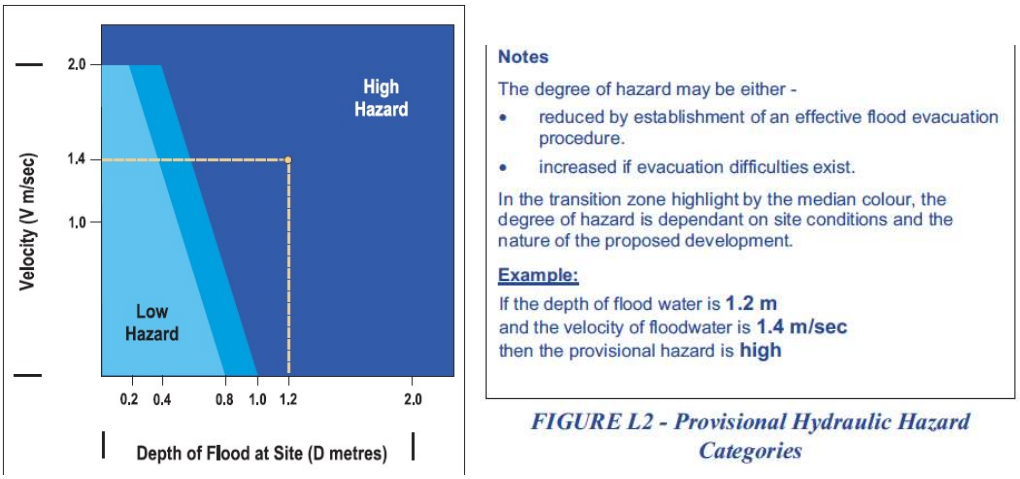

FIGURE L2 - Provisional Hydraulic Hazard Categories

In the 1% AEP event, the subject site is affected by low hazard flooding. There are small areas of high hazard flooding adjacent to the subject site, along the northern flow path, due to large flood depths. It is important to note that these areas of high hazard flooding will not affect flood egress from the site.

The proposed route for flood access along Penny Place and Reservoir Road to the Great Western Highway is affected by low hazard flooding.

5.2 Depth of Inundation

The existing flood behaviour presented in Figure 4 for the 1% AEP event and Figure 5 for the PMF event indicate that flood access is possible for both events. In the 1% AEP, the proposed route for flood access is inundated by a peak depth of 0.02 m. Similarly, in the PMF event the proposed route is inundated by a peak depth of 0.2 m.

Based on Book 6, Section 7.2.4 Vehicle Stability of the 2016 Australian Rainfall and Runoff Guidelines (Reference 3), small vehicles can withstand flood depths of up to 0.3 m before beginning to float. Furthermore, large four-wheeled drive vehicles can withstand flood depths of up to 0.5 m before they float.

As such, it is evident that flood access to/from the subject site will be possible in the 1% AEP and PMF events.

6. Conclusions

The modelling herein has established the existing flood conditions at the subject site for the 1% AEP and PMF events. Flood liability is shown in Figures 4 and 5 for the 1% AEP and PMF events, respectively.

Further, as per the Floodplain Development Manual (FDM), we have assessed the flood risk at the site by examining various aspects of the flooding as recommended by the FDM. Together we are of the view, the various aspects of the subject site's flood affectation reduce risk to acceptable levels. We base our conclusion on the following:

- Overall context of the flooding – the subject site is impacted by runoff from a low density local urban catchment area of 44 hectares only and is adjacent to Bungarribee Creek which has an upstream catchment of 120 hectares. Flooding is overland and not mainstream. Flood waters at the subject site are very shallow (< 0.05 m). Water which is excess of drainage existing system capacity will flow down the northern and southern flow paths. Flooding at the subject site in the 1% AEP event is minor in extent.
- Development Type – the Site Compatibility Certificate is for an integrated seniors' independent living village.
- Evacuation – clearly the subject site, being located in a relatively small urban catchment, has no effective warning time. However, the development, as proposed, will have its lowest habitable floor levels above the PMF level. Evacuation in place is the default response. If egress is required however this is possible even in the PMF event. This can be safely undertaken via Penny Place and Reservoir Road; and finally
- Depth of Flooding – Egress at all times will be available, even for small cars, in the 1% AEP and PMF events.

Based on the above analysis then and the FDM criteria articulated herein, it is clear that the proposed development can be achieved with risks kept at acceptable levels.