Lake Illawarra, Mt Warrigal and Oak Flats Flood Study

Reference: R.S20103.001.04.Shellharbour.docx
Date: February 2019
FINAL DRAFT

Document Control Sheet

BMT Eastern Australia Pty Ltd
Suite G2, 13-15 Smail Street
Ultimo, Sydney, NSW, 2007
Australia
PO Box 1181, Broadway NSW 2007

Tel: +61 2 8960 7755
Fax: +61 2 8960 7745

ABN 54 010 830 421

www.bmt.org

Document:	R.S20103.001.04.Shellharbour.docx
Title:	Lake Illawarra, Mt Warrigal and Oak Flats Flood Study
Project Manager:	Sebastian Froude
Author:	Sebastian Froude, Darren Lyons
Client:	Shellharbour City Council
Client Contact:	Adam De Clouett
Client Reference:	S20103

Synopsis: **Final draft report for the Lake Illawarra, Mt Warrigal and Oak Flats Flood Study. The report covers the data collection process, community consultation, development of computer models, establishment of design flood behaviour and flood mapping.**

REVISION/CHECKING HISTORY

Revision Number	Date	Checked by		Issued by	
01	27/07/2016	DL		SF	
02	13/10/2017	DL		SF	
03	25/01/2019	DL		SF	
04	28/02/2019	DL		SF	

DISTRIBUTION

Destination	Revision										
	0	1	2	3	4	5	6	7	8	9	10
Shellharbour City Council	0	1	1	1	1						
BMT File	0	1	1	1	1						
BMT Library	0	0	0	0	1						

Executive Summary

Introduction

The Oak Flats, Mt Warrigal and Lake Illawarra Flood Study has been prepared for Shellharbour City Council (Council) to define the existing flood behaviour in the study catchments and establish the basis for subsequent floodplain management activities.

The primary objective of the Flood Study is to define the flood behaviour within the study area through the establishment of appropriate numerical models. The study has produced information on flood flows, velocities, levels and extents for a range of flood event magnitudes under existing catchment and floodplain conditions. Specifically, the study incorporates:

- Compilation and review of existing information pertinent to the study;
- Development and calibration of appropriate hydrologic and hydraulic models;
- Determination of design flood conditions for a range of design event including the 50% AEP, 20% AEP, 10% AEP, 5% AEP, 2% AEP, 1% AEP, 0.5% AEP and PMF event; and
- Presentation of study methodology, results and findings in a comprehensive report incorporating appropriate flood mapping.

Catchment Description

The catchment is fully developed and comprises predominantly low-density housing with pockets of commercial development. There are large open spaces within the catchment including Shane Lee Field, Oak Park and the Howard Fowles Sports Oval.

The catchment covers an area of approximately 7km^2 and drains into Lake Illawarra at various locations via the trunk drainage system, the largest of which discharges to Oak Park downstream of the Shellharbour City Centre. The trunk drainage network is connected to Council's minor stormwater drainage system which comprises; pipes, culverts and pits. There are a number of natural creeks and engineered swales which act as receiving waterways prior to entering Lake Illawarra.

The topography within the Lake Illawarra, Mt Warrigal and Oak Flats catchments varies from steep surface slopes in excess of 20% at Mt Warrigal to the near flat areas of Lake Illawarra and other shoreline locations. The catchment therefore has regions where surface water runoff within the road network has high velocity with shallow depths, whilst in the lower catchment surface water is more likely to pond in sag points and flow velocities will be lower. The lower reaches of the catchment are potentially affected by elevated water levels within Lake Illawarra, in particular the suburb of Lake Illawarra.

Historical Flooding

There is no surveyed data of historic flood levels available for this study area. Model calibration and validation primarily relied upon anecdotal reports of flooding from the community, Council records and photographs of flood behaviour. Photographs cannot be assumed to record the peak flood behaviour, however, they are important for identifying flooding hotspots.

Model Development

Development of hydrologic and hydraulic models has been undertaken to simulate flood conditions in the catchments. The hydrological and hydraulic model was developed using TUFLOW two-dimensional (2D) software developed by BMT. The hydrological model provides for the simulation of the rainfall-runoff process using the catchment characteristics of the study area and historical and design rainfall data. The hydraulic model, simulates flood depths, extents and velocities in the study area. The 2D modelling approach is suited to model the complex interaction between channels and floodplains and converging and diverging of flows through structures and urban environments.

The floodplain topography is defined using a digital elevation model (DEM) derived from topographic, bathymetric and topographic survey data provided by Council.

Model Calibration and Validation

The selection of suitable historical events for calibration of computer models is largely dependent on available historical flood information. Ideally the calibration and validation process should cover a range of flood magnitudes to demonstrate the suitability of a model for the range of design event magnitudes to be considered.

Through consultation with Council a set of flood events were identified as being suitable for use in the model calibration and validation process. These are events of a reasonable flood magnitude, for which there are observed flood data available for comparison with the model performance. The principal event selected for model calibration was the March 2011 event, as this is the flood event with the most intense rainfall of recent years.

The November 2013 and March 2014 flood events have been selected for model validation. The November 2013 event was almost as intense as the March 2011 storm, but the March 2011 event had a greater total rainfall. It is therefore the largest recent flood event in the study area catchments in recent memory. The November 2013 and March 2014 flood events were used in model validation.

To validate the use of the rainfall-on-grid methodology, Watershed Boundary Network Modelling (WBNM) was undertaken on the Oakey Creek catchment, producing a favourable comparison.

Design Event Modelling and Output

The developed models have been applied to derive design flood conditions within the study catchments. A range of storm durations using the 2016 AR&R guidelines, were modelled in order to identify the critical storm duration for design event flooding in the catchment.

A range of design flood conditions were modelled. The simulated design events included the 50% AEP, 20% AEP, 10% AEP, 5% AEP, 2% AEP, 1% AEP, 0.5% AEP and PMF event. The model results for the design events considered have been presented in Appendix A. The flood data presented includes design flood inundation, peak flood water levels and depths.

Hydraulic categories (floodway, flood fringe and flood storage) and provisional flood hazard categories have been mapped for flood affected areas within the catchment.

Sensitivity Testing

A number of sensitivity tests have been undertaken to identify the impacts of the adopted model parameters on the design flood levels. Sensitivity tests included:

- Hydraulic roughness;
- Stormwater drainage blockages;
- Rainfall losses;
- Downstream boundary

Climate Change

The potential for climate change impacts is now a key consideration for floodplain management. The NSW Floodplain Development Manual (DIPNR, 2005) requires consideration of climate change in the preparation of Floodplain Risk Management Studies and Plans, with further guidance provided in:

- Floodplain Risk Management Guideline – Practical Consideration of Climate Change (DECC, 2007);
- Flood Risk Management Guide – Incorporating Sea Level Rise Benchmarks in Flood Risk Assessments (DECCW, 2010); and
- Australian Rainfall and Runoff: A Guide to Flood Estimation (Ball et al, 2016)

Key elements of future climate change (e.g. sea level rise, rainfall intensity) are therefore important considerations in the ongoing floodplain risk management.

In line with the guidance above, and several more recent revelations, additional tests were undertaken incorporating a 10% and a 20% increase to design rainfall in addition to an elevated tailwater condition in Lake Illawarra of 0.4 m and 0.9 m.

Flood Risks

Flooding problem areas across the study area can be isolated to three main regions, being Oakey Creek, the Lake Illawarra foreshore and the suburb of Lake Illawarra. These regions are summarised below, with specific flood areas listed beneath:

Oakey Creek:

- Properties located at the upstream side of the intersection of The Esplanade and Oakey Creek;
- Properties located on the eastern side of Leamington Road from Link Road to The Esplanade;
- Properties located upstream of the Oak Flats Bowling and Recreation Club between Kingston Street, Lake Entrance Road and New Lake Entrance Road;
- Properties located on an overland flow path running from the corner of Gordon Avenue and Marlin Road via Devonshire Crescent;
- The rear of properties located along Timbs Road and Devonshire Crescent adjacent the main tributary of Oakey Creek;
- Properties located along Birra Drive and Jilba Place; and
- Commercial properties located downstream of the Shellharbour City Centre Basin adjacent the low-point in New Lake Entrance Road.

Lake Foreshore Areas

- The lake frontage properties along Horsley Road, Newton Crescent, The Boulevarde, The Esplanade and Reddall Parade;

Lake Illawarra (suburb):

- The properties east of Shellharbour Road, bound by Peterborough Avenue to the south, View Street to the east, and Pur Pur Avenue to the north;
- The properties east of Shellharbour Road, bound by Reddall Parade and Pur Pur Avenue;
- The properties either side of Addison Avenue and Pur Pur Avenue located to the west of Shellharbour Road;
- The properties located at the low-point in Girraween Avenue adjacent Howard Fowls Oval reserve; and
- The properties either side of Kotari Parade and Corona Avenue.

Conclusions

The primary objective of the study was to undertake a detailed flood study of the Oak Flats, Mt Warrigal and Lake Illawarra catchments and to establish models as necessary for design flood level prediction

In completing the flood study, the following activities were undertaken:

- Compilation and review of existing information pertinent to the study;
- Development and calibration of appropriate hydrologic and hydraulic models;
- Calibration of the developed models using the available flood data, including the recent events of 2011, 2013 and 2014; and
- Prediction of design flood conditions in the study area and production of design flood mapping series.

The principal outcome of the flood study is the understanding of flood behaviour in the study area and in particular design flood level information. The study provides updated and more detailed flooding information than the previous studies, to be used to inform floodplain risk management within the study area.

The modelled flood conditions sensitivity to hydraulic roughness, stormwater drainage blockage and rainfall losses were limited. However, the model results show that the suburb of Lake Illawarra and the foreshore areas of Lake Illawarra, Mt Warrigal and Oak Flats are highly susceptible to rising sea levels and downstream boundary condition. Given the significant increase in flood risk across these areas sensitive to an elevated tailwater (Lake Illawarra), the incorporation of Lake Illawarra flooding within the design flood levels should be considered for flood planning purposes, particularly for the suburb of Lake Illawarra and lake foreshore areas. It is expected that management of food risk within these areas will be one of the key focuses of future floodplain risk management activities.