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ITEM 7 KULLY BAY OVERLAND FLOW STUDY (2019) - WARRAWONG

The Kully Bay Overland Flow Study (2019) was on exhibition from 26 August 2019 through to 23 September 2019 and has now been finalised. It is recommended Council adopt the Kully Bay Overland Flow Study (2019) which will inform land use planning and planning certificates.

This catchment is located in Warrawong, has no actual creek system and drains via overland flow paths to Lake Illawarra. A Council catchment wide flood or overland flow study for the Kully Bay Catchment has not previously been undertaken.

The reports and flood models for the Kully Bay Overland Flow Study (2019) will be placed on the NSW Flood data portal so that they can be publicly accessed. This will lead to a greater understanding of flood behaviour and risk and wiser decision making.

RECOMMENDATION

1 That the Kully Bay Overland Flow Study (2019) be adopted.

REPORT AUTHORISATIONS

Report of: Mike Dowd, Manager Infrastructure Strategy + Planning

Authorised by: Andrew Carfield, Director Infrastructure + Works

ATTACHMENTS

- 1 Kully Bay Overland Flow Study 2019 Executive Summary
- 2 Community engagement report Kully Bay Overland Flow Study 2019

BACKGROUND

The NSW Government's Floodplain Development Manual provides a framework to ensure the sustainable use of floodplain environments and incorporates the NSW Flood Prone Policy. Under the Policy, the management of flood liable land remains the responsibility of Local Government with State Government subsidising flood mitigation works to alleviate existing problems and providing specialist technical advice to assist Councils in performing their floodplain management responsibilities.

The Policy provides for technical and financial support by the State Government through five stages -

- 1 Flood Study Determines the nature and extent of flooding.
- 2 Floodplain Risk Management Study Evaluates risks and management options for the floodplain in respect of both existing and proposed development.
- 3 Floodplain Risk Management Plan Involves formal adoption by Council of a plan of management for the floodplain.
- 4 Implementation of the Plan voluntary house purchase, flood readiness and response plans, construction of flood mitigation works to protect existing development and use of planning controls (LEP, DCP) to ensure new development is compatible with the flood hazard.
- 5 Review reviews are recommended on average every 5 years and are also generally recommended after significant flood events, policy changes, or land use changes and where impediments to floodplain management plan implementation exist that warrant a review.

Kully Bay Overland Flow Study

In 2017, Rhelm Pty Ltd was commissioned by Wollongong City Council (WCC) to complete the Kully Bay Overland Flow Study. The Kully Bay catchment has not previously been studied as part of a Council flood study. There are no creeks or rivers within the catchment, meaning that only overland flow needs to be studied and not creek-based flood behaviour.

Attachment 1 provides an executive summary of the final report recommended for adoption by Council.



PROPOSAL

The Kully Bay Overland Flow Study (2019) be adopted. After adoption, the following actions will be undertaken -

- Update the flood planning levels Planning & Environment
- Update of the relevant Section 10.7 planning certificate Planning & Environment
- Provide flood level information advice in accordance with new study results Infrastructure & Works

CONSULTATION AND COMMUNICATION

On 1 August 2019, the draft Overland Flow Study was presented to the Southern Floodplain Risk Management Committee who recommended public exhibition of the draft report.

The final draft Overland Flow Study went on public exhibition 26 August 2019 to 23 September 2019. A community drop-in session at the Warrawong Community Centre on Saturday 7 September from 9:30 am to 11:00 am and attended by 3 community members including SES volunteers and a floodplain management committee member.

A letter to over 1000 residents, businesses and property owners in flood-affected areas (all properties within the extent of the probable maximum flood) was mailed out to advise of the public exhibition process and seek feedback on the document.

Notices of the public exhibition were published in the local newspaper on 28 August and 4 September 2019. Hard copies of the Flood Study were placed in the Warrawong Library and PDFs were available through Council's "Have Your Say" page. 19 people viewed the Website's project page. 9 people downloaded the documents from the Website. No submissions we received throughout the exhibition period.

A community engagement report is provided in Attachment 2 and outlines in more detail the process and outcomes of the consultation. The committee has been advised of the outcomes of the public exhibition and has not raised any objection to Council adopting the final report.

PLANNING AND POLICY IMPACT

This report contributes to the delivery of Our Wollongong 2028 goal "We value and protect our environment". It specifically delivers on the following:

Community Strategic Plan	Delivery Program 2018-2021	Operational Plan 2019-20	
Strategy	3 Year Action	Operational Plan Actions	
1.1.3 The potential impacts of natural disasters, such as those related to flood and landslips are managed and risks are reduced to protect life, property and the environment	1.1.3.2 Establish effective urban stormwater and floodplain management programs	Develop and implement Floodplain Risk Management Plans	

FINANCIAL IMPLICATIONS

The Kully Bay Overland Flow Study (2019) cost \$87,071 excluding GST. The next stage in the flood planning process for this catchment, being the Floodplain Risk Management Study & Plan, will be funded from existing budget allocations with an application to be made for State Government grant funding.

CONCLUSION

The Kully Bay Overland Flow Study (2019) was prepared with the cooperation, assistance and support of many stakeholders; including community members, State Government representatives, and the Southern Floodplain Risk Management Committee.

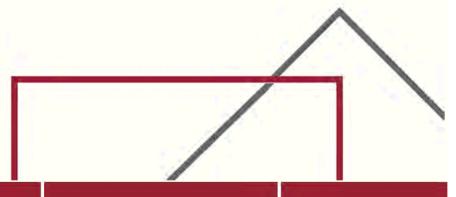
The study provides flood levels and flood behaviour in the Kully Bay catchment. The reports and flood models for the Kully Bay Overland Flow Study (2019) will be placed on the NSW Flood Data Portal so that they can be publicly accessed. This will lead to a greater understanding of flood behaviour and risk and wiser decision making.







Volume 1







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Document Control

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1	15 August 2019	Internal Review	LRE	RST
2	16 August 2019	Issue to Council	LRE	RST / ERM
3	9 October 2019	Executive Summary issued to Council	RST	RST

Prepared For: Wollongong City Council

Project Name: Kully Bay Overland Flow Study

Rhelm Reference: J1098

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Client Reference: Stage 4 Report

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Foreword

The primary objective of the New South Wales (NSW) Government's Flood Prone Land Policy is to reduce the impact of flooding and flood liability on individual owners and occupiers of flood prone property, and to reduce private and public losses resulting from floods, utilising ecologically positive methods wherever possible.

Through the NSW Office of Environment and Heritage (OEH), NSW Department of Planning and Environment (DPE) and the NSW State Emergency Service (SES), the NSW Government provides specialist technical assistance to local government on all flooding, flood risk management, flood emergency management and land-use planning matters.

The Floodplain Development Manual (NSW Government 2005) is provided to assist councils to meet their obligations through the preparation and implementation of floodplain risk management plans, through a staged process. Figure F1, taken from this manual, documents the process for plan preparation, implementation and review.

The Floodplain Development Manual (NSW Government 2005) is consistent with Australian Emergency Management Handbook 7: Managing the floodplain: best practice in flood risk management in Australia (AEM Handbook 7) (AIDR 2017).

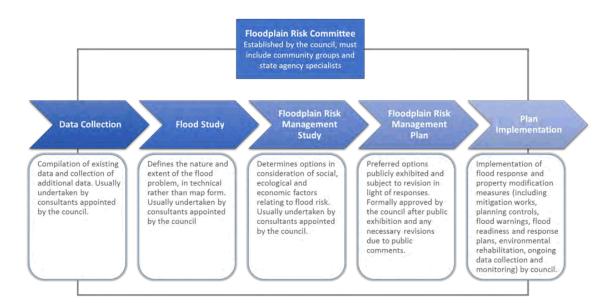


Figure F1 The Floodplain Risk Management Process (source: NSW Government, 2005)

Wollongong City Council is responsible for local land use planning in its service area, including in the Kully Bay catchment and its floodplain. Through its Floodplain Risk Management Committee, Council has committed to prepare a comprehensive floodplain risk management plan for the study area in accordance with the NSW Government's *Floodplain Development Manual* (2005). This document relates to the flood study phase of the process.





Executive Summary

The Kully Bay Overland Flow Study has been prepared for Wollongong City Council (Council) to define the existing flood behaviour in the Kully Bay catchment and to establish the basis for subsequent floodplain management activities.

The Kully Bay catchment is located in the suburb of Warrawong, in the Wollongong City LGA. The catchment covers an area of approximately 150 hectares and extends from the northern shores of Lake Illawarra in the south of the catchment to some 200m south of Wattle Street and Five Islands Road in the north.

The catchment area is largely comprised of residential development (primarily detached dwellings) and commercial development, with a significant commercial centre, Warrawong Plaza, in the downstream reaches of the catchment.

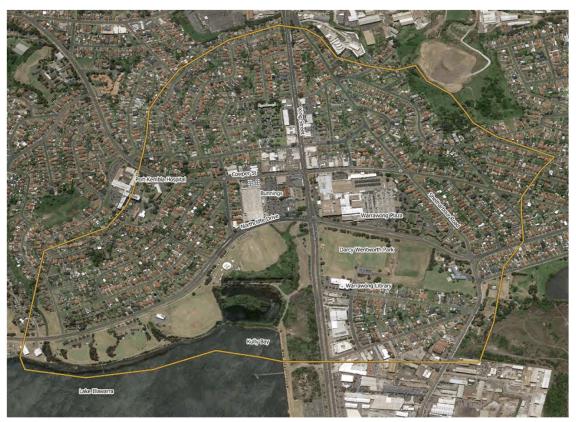


Figure i. Kully Bay Catchment

This project is an overland flow study, which is a comprehensive technical investigation of flood behaviour that provides the main technical foundation for the development of a robust floodplain risk management plan. It aims to provide a better understanding of the full range of flood behaviour and consequences. It involves consideration of the local flood history, available collected flood data, and the development of hydrologic and hydraulic models that are calibrated and verified, where possible, against historic flood events and extended, where appropriate, to determine the full range of flood behaviour.





A comprehensive engagement strategy was undertaken throughout the development of the overland flow study. This involved:

- Engaging agency and industry stakeholder to obtain details of historical flooding, survey data and
 other relevant data sets. Stakeholders have also been invited to provide feedback on the draft
 overland flow study during public exhibition.
- Community engagement has been undertaken through the mail out of an information brochure and brief survey. This was supplemented by door knocking of a number of residential properties to gain information directly from residents. The purpose of the engagement was to raise awareness of the study and flood risk in the catchment, as well and obtain observations of historical flooding to assist in model calibration.
- The Overland Flood Study has been overseen by the Southern Floodplain Risk Management Committee which includes representatives from community and state agencies.
- The Flood Study was placed on public exhibition from 26 August 2019 to 23 September 2019. During the exhibition period, letters were sent to residents and owners to inform them of the study. An information session was also provided on 7 September 2019.

An indirect validation of the hydraulic model has been undertaken utilising historical rainfall intensities, community observations and comparisons to previous hydraulic models. The outcome of this validation identified that the model was suitable for use in defining the design flood event results.

The hydrological and hydraulic models were analysed for the Probable Maximum Flood (PMF), 1% AEP, 2% AEP, 10% AEP and 20% AEP events. The models were analysed for 60, 90, 120, and 360 minute duration storms.

The models represent the catchment conditions at the time of survey, being 2017. This study represents the flood behaviour driven by catchment flooding. In the downstream areas of the study area, this overland flow study should be read in conjunction with the Lake Illawarra Flood Study (Lawson & Treloar, 2001) and the Lake Illawarra Floodplain Risk Management Study and Plan (Cardno Lawson Treloar, 2012).

An overview of the flood behaviour is provided for the PMF, 1% AEP and 20% AEP events in Figures ii to ix.

There are five major overland flowpaths through the catchment area, with varying degrees of flood severity. Three of these are located west of King Street. The first two run from Second Avenue, past First Avenue and into Bent Street. The first is then conveyed along Greene Street, while the second spreads widely through the multi-unit dwellings at Todd Street. Only the first flow path results in flows that cut road access, with depths of greater than 0.3m occurring at First Avenue in the 2% AEP event.

The third flowpath on the west runs from First Avenue in the north, across Bent Street and into King Street near the north of the catchment. Access along Bent Street is lost in events as small as the 20% AEP due to flows from this flowpath by depths of up to 0.5 metres.

On the east side of King Street are the two remaining overland flowpaths. The northernmost flowpath runs adjacent to Storey Street before crossing Robertson Street and then McGowen Street. At Shellharbour Road, the flow disperses, with some passing down Montgomery Avenue, and the rest spilling through residential blocks to Cowper Street. Along this flowpath, access is lost at both Robertson Street (>1% AEP) and Shellharbour Road (5% AEP).

The final overland flowpath conveys flow from the far east of the catchment. Flows commence upstream of Cowper Street, before flowing through residential zones across Forster Street and Shellharbour Road. It then





passes along the northern side of Northcliffe Drive until the plaza, where it combines with the backwater from the lake and wetlands.

There are no creeks or rivers to convey flood water within the catchment area. When the stormwater drainage infrastructure capacity is exceeded, then primary flowpaths conveying water through the catchment are the road reserves, and the previously discussed urban overland flowpaths discharge into road reserves rather than creek channels.

The primary flowpath through the catchment is along King Street, which runs north-south through the centre of the catchment. With the exception of some overland flow from the far eastern and western sides, all flow within the catchment eventually reaches King Street. Other significant flows are conveyed along roads that run perpendicular to King Street – Cowper Street and Greene Street / Montgomery Avenue in particular (which then discharge into King Street). Between them, these three road reserves serve as the major flowpaths through the catchment.

Access along King Street is lost for much of its length during flood events. While the northern section is only affected in events of a 2% or 1% AEP magnitude, the lower sections, in particular around the Cowper Street intersection, are inundated in events as small as the 10% AEP. This serves to largely divide the catchment in half from an access perspective with a limited ability to cross from one side of the catchment to the other in events above a 5% AEP.

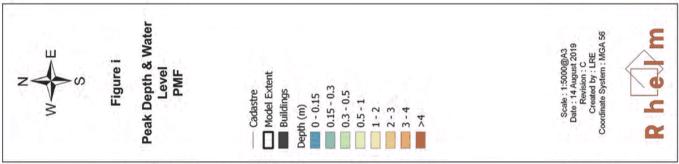
Downstream of Northcliffe Drive, the flooding is largely driven by backwater from Lake Illawarra. Access along Northcliffe Drive is lost at multiple locations within the study area. Aside from the intersection with First Avenue South, all of the intersections along Northcliffe Drive within the study area are inundated in events as small as the 20% AEP. The flooding is most pronounced east and west of the King Street intersection with depths of up to 1 metre in the 1% AEP.

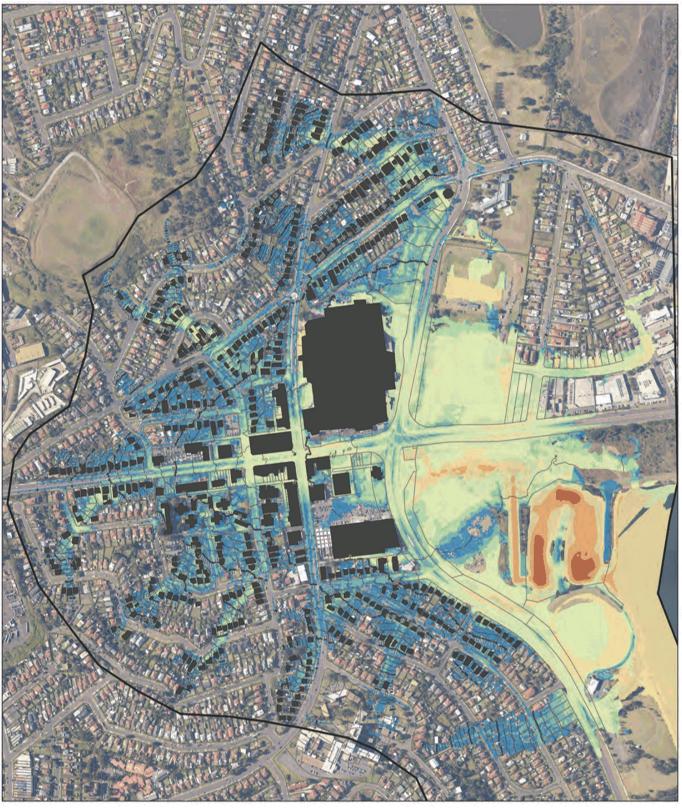
Sensitivity testing was undertaken on model roughness, inflows and blockage. It was found that overall, the model is relatively insensitive to model roughness assumptions, with potential variation in water levels in the order of +/- 0.2 metres arising from +/- 20% changes in roughness values. The model was also relatively insensitive to hydrological assumptions on flows, with levels changing by up to 0.05 metres as a result of a 20% increase in flows in the 1% AEP event.

With respect to blockage, the assessment showed that the impact of blockage in the catchment is generally limited, with the majority of water level changes within +/- 0.05m, and only for very limited areas of the catchment. The 20% AEP event showed a greater change in levels along the western length of Cowper Street than the 1% AEP event. This is likely due to the pipes running full in the 1% AEP event, so that pit capacity has less of an influence over peak flood levels.

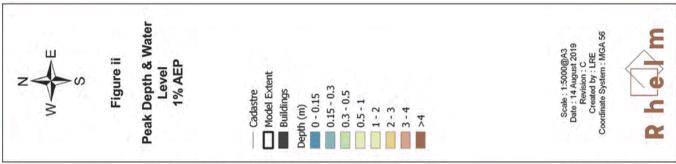
This report provides an understanding of the flood risk within the Kully Bay catchment and provides Council with the tools for planning. This study provides a baseline against which a Floodplain Risk Management Study and Plan can be prepared.





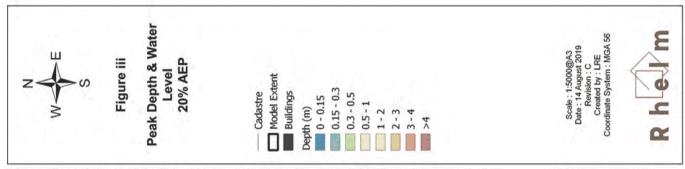






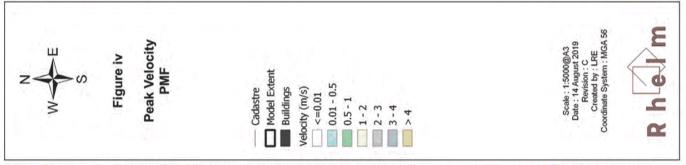






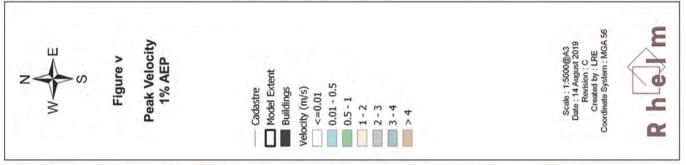


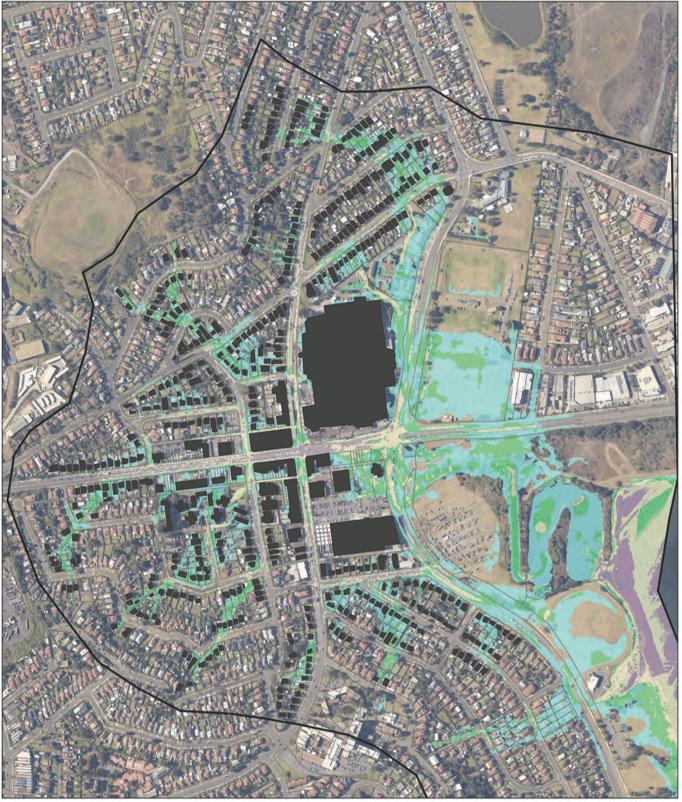




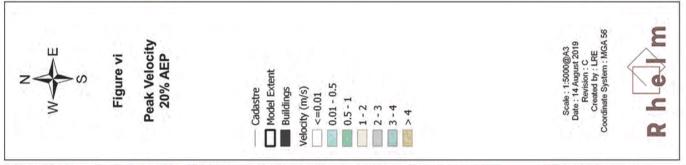






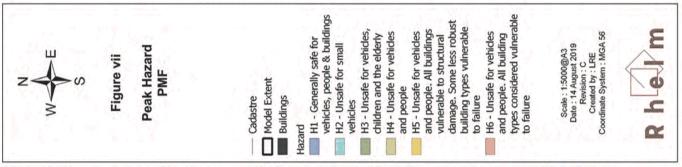


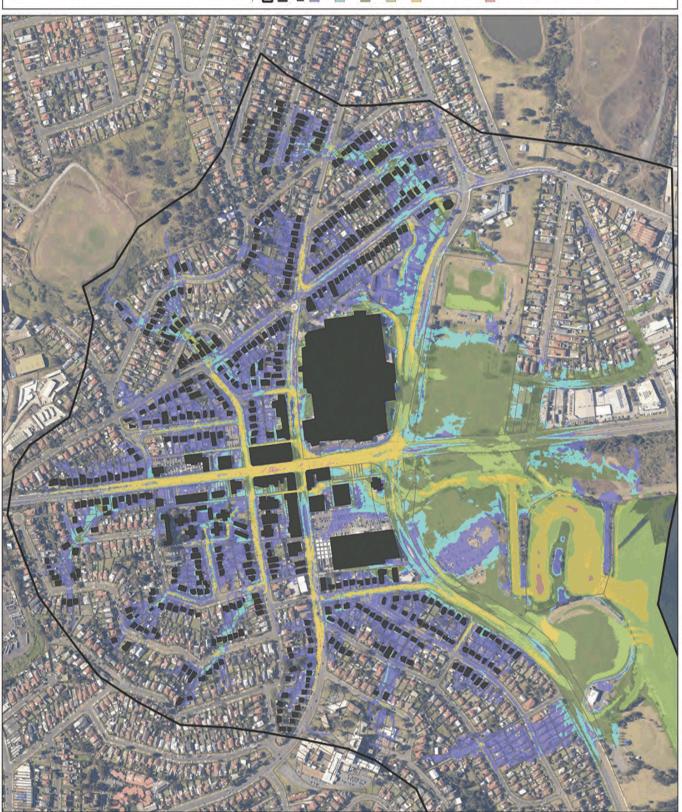




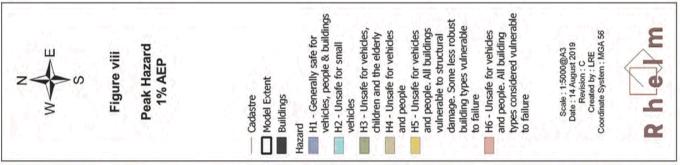


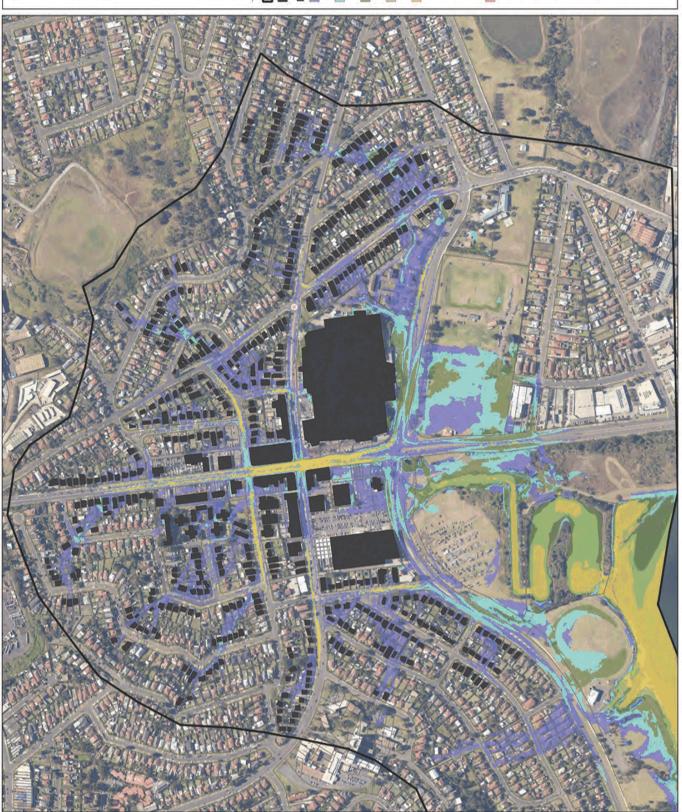
















KULLY BAY OVERLAND FLOW STUDY

ENGAGEMENT REPORT

OCTOBER 2019 Z19/





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The information in this report is based on data collected from community members who chose to be involved in engagement activities and therefore should not be considered representative.

This report is intended to provide a high-level analysis of the most prominent themes and issues. While it's not possible to include all the details of feedback we received, feedback that was relevant to the project has been provided to technical experts for review and consideration.



Executive Summary

Council is responsible for planning and managing flood prone lands in our area and has produced the Kully Bay Overland Flow Study as part of this commitment. A report on the draft Study was prepared, which explains the way flooding happens in the Kully Bay catchment. The Study will form a basis for the ongoing management of flood risk in the catchment.

Council's engagement team worked collaboratively with a technical consultant to share the draft Study with the community and key stakeholders. During the public exhibition period, 26 August to 23 September 2019, Council sent letters to more than 1,000 residents and property owners in the catchment area inviting them to learn more about the Study. Customer service information was included in the three most commonly-spoken languages in this area other than English; Macedonian, Italian and Arabic. The additional information let the community know that Council and the National Relay Service could provide language assistance if needed. Emails with this information were sent to community, education, Register of Interest (flood), business, government and emergency services' stakeholders. The information was also available at Council's Customer Service Centre. Copies of the draft report, a Frequently Asked Questions sheet and Feedback Form were made available at Warrawong Library, and at the information session at Warrawong Community Centre on 7 September 2019. They were also included on the project webpage, which also included a Google Translate feature to assist with online translation. Notices of the exhibition were published in the Advertiser on 28 August and 4 September 2019. The community were invited to provide feedback via Council's website, Customer Service Centre and at the community information session.

There were no submissions, however some comments were provided at the drop-in information session which was attended by a total of 3 community members, including SES volunteers and a floodplain committee member.

Feedback themes related to general interest about flood risk in the catchment. There was also interest in the flood gates at the entrance of Warrawong Mall.



Background

Wollongong City Council is committed to finding solutions to reduce the social and economic damages of flooding. Many homes and businesses in the Kully Bay catchment experience frequent flooding from overland flow. Overland flow is rainfall runoff from homes, driveways and other surfaces. This catchment includes residential and commercial land in Warrawong and Port Kembla.

Figure 1 Kully Bay catchment map



As part of producing the Study, Council's revised Blockage Policy was considered, which helps us work out how blocked stormwater structures might affect flooding. Recent data from land and waterway surveying was used, and the network of drainage pits and pipes was considered. This data was collected and used to create computer models that simulate the flooding in the catchment, and to produce flood maps that provide a visual illustration of the flood risk in the catchment.

At the Southern Floodplain Risk Management Committee meeting on 1 August 2019, the public exhibition of the draft Kully Bay Overland Flow Study was unanimously supported. The outcomes of the exhibition and resulting amendments to the Study will be reported to the Southern Floodplain Risk Management Committee and Council in view of adopting it in 2019.

Results from the study will help us to better understand and plan for future flooding in the catchment.



Methods

Our Stakeholders



Our Methods

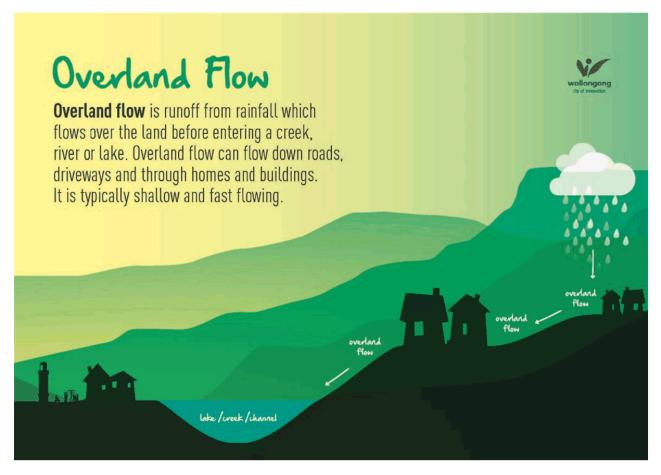
Table 1: Details of Communication and Engagement Methods

Table 11 Betaile	Table 1: Details of Communication and Engagement Methods			
Methods	Details of Methods			
Communication Methods				
Presentation	Information about the proposal was presented at the Floodplain Risk Management Committee (Southern) meeting on 1 August 2019			
The Advertiser	Details of the public exhibition, information sessions and Engagement HQ webpage were included in Council's Community Update pages on 28 August and 4 September 2019			
Email to key stakeholders	An email and FAQ were sent to key stakeholders identified through an analysis process			
Register of Interest	An email was sent to all participants with registered interest in 'Flood'			
Info packs	Frequently asked question sheets and hardcopy feedback forms were made available at Warrawong Library and Customer Service. A hardcopy of the draft report was also made available at Warrawong Library.			
Letter	A letter about the public exhibition, information session and how to submit feedback (via phone, email, in person or post) was mailed to local residents and property owners			
Frequently Asked Questions	Responses to questions about updates to the Study and floodplain risk management were distributed with the letter and emails, published on the project webpage and distributed at the information session			
Posters	Posters were produced to help explain the floodplain risk management			



	process and what overland flow is
Engagement HQ Website	 The project webpage hosted background info and supporting documents: Frequently Asked Questions with information on the Study and flood risk management News Feed for updates on project progress Document Library with the Report Floodplain risk management process and overland flow graphics Flood modelling video Flooding in Wollongong video Online survey tool to capture participant's feedback
Video	The Flooding in Wollongong video was used on the Engagement HQ webpage and a flood modelling video was screened at information sessions and on the Engagement HQ webpage
Engagement HQ Website	An online survey tool was used to capture participant's feedback. The page also hosted background info and supporting documents.
Feedback Form	A hardcopy feedback form was made available at Warrawong Library and at the information session
Community Information Sessions	A drop-in session was held to provide the community with information on the work undertaken to date and findings of the Report. The Report, flood modelling maps and flood modelling video were displayed along with the FAQ and feedback forms. Floodplain management engineers working on the Study were on hand to answer questions.

Figure 2 Overland Flow Poster



Item 7 - Attachment 2 - Community engagement report - Kully Bay Overland Flow Study 2019





8

Results

Flow Study 2019

All stakeholders and the wider community were invited to provide feedback on the draft Study. This section provides details on the participation at engagement activities (Table 2), and the feedback received during the exhibition period.

Item 7 - Attachment 2 - Community engagement report - Kully Bay Overland

Engagement Participation

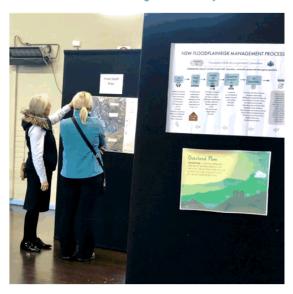
Details of the number of participants for each engagement activity are presented in Table 2.

Table 2: Engagement participation results

Engagement Activities	Participation
Southern Floodplain Risk Management Committee Meeting	8
Drop-in Community Information Session at Warrawong Community Centre	3
Online Participation • Aware – Total number of users who viewed the project page • Informed – Total number of users who clicked a hyperlink, e.g. to download	19
 a document Engaged – Total number of users who actively contributed to the project, e.g. submitted feedback via the online form 	9

Figures 3 and 4 Community Information Session at Warrawong Community Centre





Submission Results

There were no submissions. Feedback themes from discussions at the drop-in session related to general interest about flood risk in the catchment. There was also interest in the flood gates at the entrance of Warrawong Mall.