

PITTWATER COUNCIL'S APPROACH TO OVERLAND FLOW MANAGEMENT

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Abstract

Overland flooding is a common problem across most Local Government Areas (LGA), so Pittwater is not alone. With its LGA characterised by many, small, steep catchments, Pittwater is highly susceptible to flash flooding from overland flows, with very little warning time. For that reason Pittwater Council engaged consultant Cardno to identify the risk from overland flow paths throughout the entire LGA.

In order to ensure that the community was well informed on the location of overland flow paths a variety of community engagement activities were organised including: webpage, Frequently Asked Questions brochure, one-on-one face-to-face information sessions, community phone call back service and a review of resident submissions during the public exhibition phase.

The significant outputs of the Study are maps illustrating flood extents, depths, hazards, velocities and location of floodways; property-based maps of land potentially affected by overland flow paths to inform Council's DCP and section 149 notifications and prioritised sub-catchments for future detailed overland flow flood studies.

This paper draws upon and outlines the key lessons learnt including overland flow paths being separated into two different categories based on the depth, freeboards, and the assumptions within the modelling used, for example the impact of blockage.

Background

Prior to the commencement of the Overland Flow Mapping and Flood Study, Council did not have a flood extent map of the location of Overland Flow Affected Properties (known as Category 3 Properties in Pittwater's DCP). Without a map, there has always been a degree of subjectivity and uncertainty as to whether flood-related development controls should be applied to a particular property. Therefore all properties not identified in primary floodplains, were assigned a Category 3 (Overland Flow) flood classification in the Pittwater 21 DCP and on their section 149 (5) planning certificate.

Prior to the undertaking of this study, preliminary investigations had estimated that more than 3,000 properties would be potentially affected by 'overland flooding'. With these properties spread across all catchments in Pittwater, it had always been cost and time prohibitive to undertake formal Flood Studies of every catchment to map the locations of these properties.

In addition to the Draft Pittwater Overland Flow Mapping and Flood Study, which was done for the entire Pittwater LGA, further more detailed catchment based Overland Flow Flood Studies and Flood Risk Management Studies and Plans (in accordance with the NSW Governments Floodplain Development Manual) (NSW Government,

2005) will be conducted over the next 10 years (subject to grant funds), based on the prioritisation of overland flow catchments.

Categories of flooding in Pittwater

There are three flood categories in Pittwater (Pittwater Council, 2009):

- *Category 1 Flood Classification (Low Hazard and High Hazard)* — where the lowest point of the property is affected by the Flood Planning Level (FPL) (1% AEP + 0.5m vertical freeboard).
- *Category 2 Flood Classification* — where the lowest point of the property lies above the FPL but below the level of the Probable Maximum Flood.
- *Category 3 Flood Classification* refers to properties generally located outside the Primary Floodplain Areas that are affected by flooding hazards associated with major stormwater drainage systems, overland flow paths or drainage easements

A property with a Category 3 Flood Classification may also have a Category 1, Category 2 Flood Classification or a tidal/estuarine inundation risk classification.

Stages of the overland flow flood study

The Overland Flow Flood Study has been an evolving and staged process over the past 6 years, to ensure that the overland flow paths within the Pittwater LGA are identified using the best available information.

Stage 1 of flood study — desktop analysis and preliminary mapping

Stage 1 was undertaken in 2007 utilising the best available method at the time given the available resources (Cardno Lawson Treloar, 2007a and 2007b). At the time the purpose of Stage 1 (and Stage 2 - groundtruthing) was to use the results to identify properties at risk of being potentially affected by overland flow paths.

Stage 1 of the project involved a GIS-based desktop analysis based on well-defined and consistent criteria to produce a 'Preliminary Map of Category 3 Properties', using the following information:

- aerial photography and cadastral information;
- best available topographical information at the time (the best available topographical information at the time consisted of 2m ground contours);
- GIS-based location of stormwater pits, pipes, easements, watercourses and other drainage lines.

The following key assumptions were made to determine whether a property may be affected by overland flooding:

- the underground stormwater system has insufficient capacity to carry a 1% AEP flow and so there would be overland flow in such a flood.
- any part of the stormwater system in a road reserve was excluded because it was assumed the road and/or road reserve would act as the overland flow path once the capacity of the underground system had been exceeded.

- a 'depression', 'water course' or 'open drainage line' was defined as where the depth of overland flow or surface water ponding was greater than 0.15m in a 1% AEP flood.

Applying these assumptions, the following four criteria were used to determine whether a property would be potentially affected by overland flooding and therefore be included on the Preliminary Map of Category 3 Properties. A property could be included in one or more of the four Criteria:

- **Criteria 1** — the property was shown to have a piped or open drainage line through any part of the property as shown on the 'pit and pipe layer';
- **Criteria 2** — the property was shown to have a 'depression', 'water course' or 'open drainage' line through any part of the property based on modelling with a simplistic two-dimensional hydraulic model using the 2m contour information;
- **Criteria 3** — any part of the property was located within 10 metres of a piped or open drainage line identified on the 'pit and pipe layer' from Criteria 1;
- **Criteria 4** — any part of the property was located within 10 metres of a 'depression', 'water course' or 'open drainage line' identified from Criteria 2.

As a result of Stage 1, 4101 properties were identified as Category 3 properties on the Preliminary Map.

Stage 2 of flood study — detailed site inspections and final mapping

Stage 2 involved detailed site inspections (ground truthing) based on the properties identified in the Stage 1 Preliminary Mapping (Cardno Lawson Treloar, 2007c and 2007d). Stage 1 significantly narrowed the field of investigations in the ground truthing exercise so that only key locations were targeted during the detailed site inspections.

As a result of Stage 2 groundtruthing, 3807 properties were identified as being potentially affected by overland flooding (a reduction of 294 properties from Stage 1).

At the completion of Stage 2, the project was put on hold in order to assess the methodology used in Stage 1.

Stage 3 of flood study — peer review and expert panel workshop

Due to the number of properties identified in Stage 2 as being potentially affected by overland flow paths, and the knowledge that Pittwater Council would soon be getting LiDar data, a peer review of the methodology used in Stages 1 and 2 was conducted.

Stage 3 involved a peer review and expert panel workshop which included representatives from Pittwater Council, Department of Environment Climate Change and Water (DECCW) (now Office of Environment and Heritage (OEH)), Cardno and six councils with similar overland flow issues (Cardno, 2010). One of the key recommendations from the peer review process was that some refinement to Stage 2 mapping should be undertaken prior to the release of a Overland Flow Mapping and Flood Study.

At the completion of Stage 3, the project was further put on hold until grant funding (through the Natural Disaster Resilience Grants Scheme) was available to enable more refined modelling.

Stage 4 of flood study — detailed mapping and additional ground truthing

Stage 4 (current stage) is a direct outcome of Stages 1, 2 and 3, and incorporates some of the key recommendations of Stage 3, including:

- use of LiDAR data which was previously not available in Stage 1 and 2;
- modelling of a range of design storms, up to the PMF, and
- sensitivity testing of climate change impacts.

The aim of Stage 4 was to identify overland flow risk and prepare maps of all properties potentially affected by overland flooding for the entire Pittwater LGA (Cardno, 2012).

With the overarching aim of increasing safety for residents and businesses by decreasing future damages during floods, this mapping will be used as an invaluable resource for:

- identification of properties that are subject to development controls related to overland flooding;
- identification of properties that are subject to flood notations on Section 149 Certificates; and
- prioritising catchments for future detailed flood studies and floodplain risk management studies and plans.

As a result of the flood modelling completed in Stage 4, 1833 properties are now identified as being affected by overland flooding in the 1% AEP – with a Category 3 flood classification. This is a reduction of 1974 properties from Stage 2, and 2218 from Stage 1.

Lessons learnt from Pittwater’s overland flow flood study

Mapping of vertical freeboard versus horizontal freeboard

A freeboard was added to flowpaths identified as Overland Flow Path – Major. No freeboard was placed on the 1% AEP extent for Overland Flow Path – Minor. A freeboard was added to the Overland Flow Path – Major flowpaths due to the increased risk to property and life posed by these flowpaths and the need for suitable development controls to apply to these properties.

The flood extents for the Overland Flow Path – Major were defined using the 1% AEP Overland Flow Path – Major extent plus 0.5m vertical freeboard, as stated in the NSW Governments Floodplain Development Manual (NSW Government, 2005).

During public exhibition it was noted that the 0.5m (vertical) freeboard for the Overland Flow Path – Major category had included 112 properties that were only identified as flood affected because the property was within the freeboard extent.

As a result of the above issues encountered with the 0.5m vertical freeboard on overland flow flood maps, a pilot study was conducted by Cardno to test whether a 5m horizontal freeboard was more appropriate for overland flow paths with a depth greater than 0.3m.

The impact of applying the 5m horizontal freeboard instead of the 0.5m vertical freeboard for all overland flow paths with a depth greater than 0.3m in the pilot model catchment resulted in the following (see Figure 1):

- A 37% reduction in area identified as Overland Flow Path – Major;
- 26 properties removed from the Overland Flow Path – Major classification;
 - 9 of the 26 properties reclassified as Overland Flow Path – Minor;
 - 17 of the properties no longer classified as flood affected (this is primarily because the properties were affected by the 0.5m vertical freeboard extent and not actually within the 1% AEP extent)

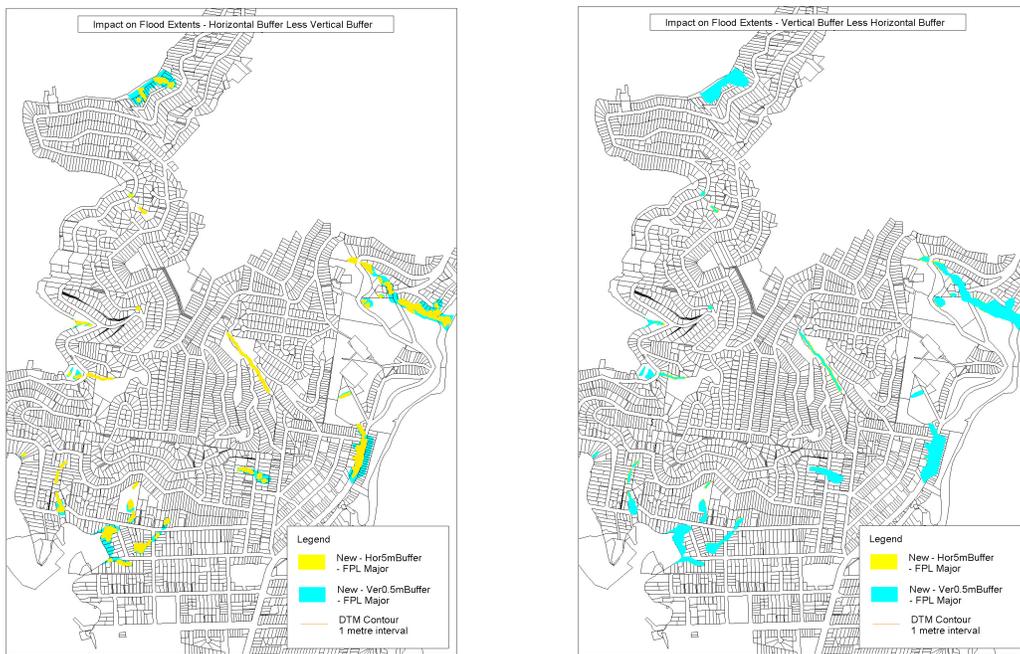


Figure 1 - Difference between 5m horizontal freeboard and the 0.5m vertical freeboard

Replacing the 0.5m vertical freeboard with the 5m horizontal freeboard for overland flow paths with a depth greater than 0.3m provides consistency in the freeboard mapping approach. Where the 0.5m vertical freeboard was applied to ‘ponding’ in relatively flat areas, the Overland Flow Path – Major extent was overestimated. The application of a 5m horizontal freeboard significantly reduces the flood extent in these locations.

The disadvantage of the 5m horizontal freeboard is when side slopes are greater than 10 percent. In these cases the 5m horizontal freeboard is more conservative than the 0.5m vertical freeboard. This tends to occur in the ‘channel flow’ areas where channel side slopes are well defined and the flowpath is well contained within the channel. However, within the pilot model catchment the difference in the flood extent widths in these ‘channel flow’ areas is not significant, primarily due to the side slopes not typically exceeding 1V:2H (which results in the 5m horizontal freeboard in these ‘channel flow’ areas being on average 2.5m wider than the 0.5m vertical freeboard extent).

As a result of the pilot study, it was decided (through consultation between Council and OEH) that the 5m horizontal freeboard would be more appropriate for the Pittwater LGA overland flow paths with a depth greater than 0.3m.

The overland flow paths with a depth greater than 0.3m (defined as Overland Flow Path – Major) would therefore have a 5m horizontal freeboard. Those flowpaths (defined as Overland Flow Path – Minor) identified with a depth less than 0.3m have no freeboard. It is also proposed that the two overland flow path groups (Major and Minor) would have different minimum floor level height freeboard controls: 0.5m for Major and 0.3m for Minor.

It should be noted that the 0.5m vertical freeboard will still be used to map the flood planning level in the Pittwater LGA for all primary floodplain areas.

Defining overland flow

Pittwater Council split the definition of overland flow into two groups, due to the level of risk to properties and implications for development controls. At the commencement of the public exhibition phase the groups were defined as follows:

Overland Flow Path - Major is any land that has a depth of overland flow greater than 0.3m, or any land that is affected by high hazard with a depth of overland flow greater than 0.15m. The inclusion of high hazard is reflective of the risk to personal safety and significant damage to property, as identified in the NSW Governments Floodplain Development Manual (NSW Government, 2005).

Overland Flow Path - Minor is any land that has a depth of overland flow greater than 0.15m and less than 0.3m and is not within a high hazard area. A 0.15m filter was selected as this is generally the standard height of most kerb and gutters within the Pittwater LGA. Depths in excess of this are likely to represent a reasonable proportion of flow, particularly within the steep terrain of the Pittwater LGA.

The above definitions were used to map the properties impacted by overland flow paths in Pittwater.

However, as a result of the public exhibition period (where the community found the definitions confusing and caused many issues related to freeboards and development controls), consultation with OEH, and investigating a more streamline method for identifying properties affected by overland flow flood risk, the definitions were revised to:

Overland Flow Path – Major is land that has a depth of overland flow greater than 0.3m

Overland Flow Path – Minor is land that has a depth of overland flow greater than 0.15m and less than 0.3m

The categories relating to high and low hazard will only be used for land use planning purposes.

A pilot model catchment was utilised by Cardno to test the revised overland flow definition (removing the hazard classification from the definition). The model catchment contained 4,232 properties, and experiences the 3 different types of overland flow paths identified throughout the Pittwater LGA, namely:

- Sheet Flow: typified by steep flowpaths with poorly defined channels, resulting in shallow flow at high velocity;
- Ponding: flat areas within flowpaths, typically on the downstream side of a catchment, results in low velocity and greater depth; and
- Channel Flow: well defined channels, resulting in both deep and high velocity flow.

The result of removing the high hazard classification from Overland Flow– Major from the pilot model catchment was:

- an 11 % reduction in area identified as Overland Flow Path – Major;
- 17 properties removed from the Overland Flow Path – Major classification;
 - 15 of the 17 properties reclassified as Overland Flow Path – Minor; and
 - 2 properties no longer classified as flood affected (this is primarily because these properties were affected by the 0.5m vertical freeboard extent and not actually within the 1% AEP extent)

The removal of high hazard from the overland flow paths with a depth less than 0.3m may also remove some of the properties originally identified as Overland Flow Path – Major. These properties were only included as they have high velocity/low depth 'sheet flow' which would normally correspond to poorly defined flowpaths, with very minimal depth likely observed during more frequent design flood events.

Blocked versus unblocked

The Pittwater Overland Flow Flood Study analysed the impact of pipe blockages within a pilot catchment and the impacts on flood levels. This review was also used to identify an appropriate alternate modelling methodology to represent the pits and pipes within the model.

Pilot models were developed with and without blockage for the 1%, 5% and 20% AEP under a representative critical duration of 1 hour using a 3 m grid cell size. All available pit and pipe data was incorporated into the model for this analysis. The results of the pilot modelling identified that:

- The blockage of the pits and pipes resulted in a average difference in flood levels of 0.05m to unblocked pits and pipes and a maximum difference of 0.12m for the 1% AEP flood event.
- The 1% AEP flood event overland flow flood behaviour with unblocked pipes was similar to the overland flow behaviour for the 5% AEP event with all pipes assumed to be fully blocked.
- There was an average difference of 0.01m and a maximum difference of 0.08m between the 5% AEP blocked scenario and the 1% AEP unblocked scenario (Figure 2).

As a result of the findings of the blockage analysis and the outcomes of the lessons learnt from other Councils' overland flow studies, it was decided that the 5% AEP with blockage scenario was considered a suitable representation of the 1% AEP without blockage scenario.

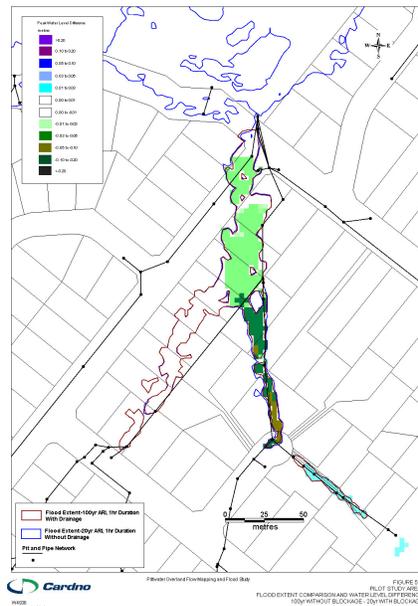


Figure 2 - Flood extent comparison – 100 year without blockage versus 20 years with blockage

Therefore the overland flow models for the Pittwater LGA were run with the 5% AEP blockage scenario to represent the 1% AEP flood extents without blockage. This considerably reduced the model set up and run times and was considered to provide an adequate representation of overland flow behaviour for the purposes of the study.

This assumption of unblocked pits and pipes however, differs from Council's primary floodplain areas which still assumes some level of blockage in the 1% AEP design flood events.

The notion of blocked and unblocked pipes seemed to be poorly understood by the community. This was made clear through the submissions received during the public exhibition period, from property owners and in some cases the 'experts' that they engaged.

Property based maps versus extent based maps

Pittwater Council currently uses property based maps for its Development Control Plan (Pittwater 21 DCP) (Pittwater Council, 2009). As a result, property based maps are prepared for public exhibition illustrating if a property is impacted by overland flow paths.

This form of mapping has not caused Council any issues in the past, and Council's online Flood and Estuary Tool utilises these property based maps to illustrate if a property is impacted by flooding.

The property based map however did encounter a number of issues during the public exhibition of the Draft Overland Flow Flood Study and Mapping. The issues/concerns outlined by property owners included:

- 'scaring' property owners who thought the overland flow path occurred across their entire property;

- not knowing the difference between a property based map and a flood extent based map;
- confusion on how flooding is likely to occur; and
- misconception about the purpose of section 149 planning certificates.

These concerns were addressed and where possible reduced during the public exhibition community information sessions, where property owners were provided property specific extent based maps (Figure 3) which illustrate where on the property the overland flow path was predicted to occur.

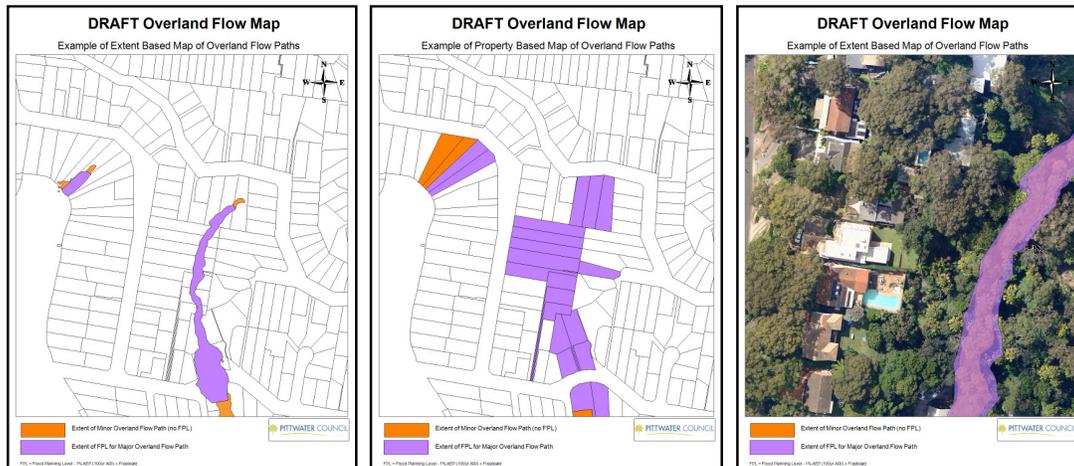


Figure 3 - Example of property based maps versus the extent based and the property specific extent map given/sent to property owners

Submissions received during the public exhibition period requested that extent based maps be provided online instead of the property based maps.

Whilst there is still a need in Pittwater Council for the property based maps for land use planning, future flood studies will present the maps in the extent based format. Although it should be noted that development controls and section 149 planning certificates will still apply to the whole property.

Community consultation

It has been Pittwater Council's experience that even the most rigorous and well established flood models cause contention and even threats of litigation from members of the community. On the other hand there will also be others who are grateful for being more informed about flood risks – both of which were experienced during the public exhibition period.

Community consultation is a necessary, but very time consuming and costly task, contributing to 40% of the total project cost. There is also the need to consider how staff and consultant time should be placed towards the consultation phases, and whether 'drip feeding' information to the community over a longer time frame would be more beneficial to the community.

In total 2,050 properties (including strata titled properties) were identified as part of the Pittwater's Overland Flow Flood Study. Each of the property owners received written correspondence from Council advising them that their property had been identified as potentially affected by flooding from overland flows. They were also notified that

changes to the properties s149 planning certificates would be made advising that 'the land in question is subject to flood-related development controls'.

This change to the s149 planning certificates and introduction of 'overland flow paths' concepts to the Pittwater community raised a lot of interest and questions from concerned property owners, with a 6% response rate.

Due to the property specific nature of overland flow paths in Pittwater it was decided by Council that a large community forum/meeting would not be of benefit, as many property owners had site specific concerns. Therefore, community information one-on-one sessions were held during the public exhibition period.

The information sessions were in two formats:

- Face-to-Face sessions were held at two locations within the Pittwater LGA – Avalon Recreation Centre and Mona Vale Customer Service. The face-to-face sessions allowed the property owner to book in for a 15 minute session with a staff member from Council and the consultant (Cardno) to discuss their concerns and have any questions answered. Property owners were also given their property specific extent maps at these sessions.
 - The face-to-face sessions were held over 6 days from 1pm to 7pm during the public exhibition period.
 - In total 220 property owners attended the face-to-face sessions.
- Phone sessions allowed the property owner to book a 15 minute session, where a staff member of council would call them to discuss their concerns relating to the study and specifically to their property. A property specific extent based map was also posted/emailed to participants prior to their session. The reason behind adding phone sessions was to allow those not able to attend the face-to-face sessions, the elderly and the less mobile, to still have an opportunity to discuss their concerns with a Council staff member.
 - Phone sessions were held over 3 days from 9am to 5pm during the public exhibition period.
 - In total 50 property owners were engaged through the phone sessions over the public exhibition period

Along with the community information sessions, property owners were sent an information brochure, a 'How to read the Overland Flow Maps' and a Frequently Asked Questions brochure (Figure 6). A webpage was also set up outlining information about the study and the public exhibition, with a direct link from Council's homepage.

The community engagement strategy for the Pittwater Overland Flow Flood Study was developed as one-on-one sessions, as most people who are affected by flooding are primarily interested in their own property or their neighbours, and this was found to be a suitable and effective method of communicating draft maps to the affected residents.

During the public exhibition period Council staff received approximately 130 calls from property owners with further questions relating to the Draft Overland Flow Flood Study. The public exhibition period was originally planned for 8 weeks but extended by two more weeks due to public feedback.

The key matters raised in the 120 submissions received by Council during the public exhibition period included:

- Concerns about the validity of the study results.
- Concerns about changes to their planning certificate notations.
- Questions why Council undertook floodplain management at all.
- Concerns about impacts on insurances, mortgages, property values.

- Requesting reduced rates due to the classification.
- Wanting to know how is Council going to fix the problem/stop the flooding.
- Concerns that Council will pass the risk to the property owner.
- Identifying that Council should then increase its drainage system to cope with the 1% AEP flood event.
- Concerns about lack of historical evidence of the 1% AEP flood event and therefore the validity of the results.
- Confusion over what overland flow is (i.e. statements like – ‘it can’t flood on hills’).
- Concerns about potentially onerous and additional costs of developing the site in the future.
- Identifying private drainage systems already on properties so disbelief that overland flow could occur.
- Perceived unfairness of identifying the whole property (cadastral) as flood affected given that only a portion of the property is affected by the flood extents.

The collage consists of several informational materials from Pittwater Council:

- Top Left:** A brochure titled "What development controls affect my property?" explaining that if a property is within an overland flow path, a Flood Risk Management Report may be required. It lists controls like increasing flood levels, ensuring no increase in flooding hazards, and ensuring no adverse flood impacts on neighboring properties.
- Top Middle:** A large blue graphic titled "What you should know about Overland Flow in Pittwater" with a background image of a flooded area.
- Top Right:** A section titled "Your questions answered" with sub-sections: "What is overland flow?" (surface runoff before entering a waterway), "Why is it an issue?" (caused by rainfall, flooding causes damage), "How is mainstream flooding different from overland flow?" (mainstream flooding is associated with water which overtops the banks of creeks, waterways and lagoons), and "How is Pittwater Council managing overland flow?" (Council has a Flood Policy, Flood Study, and Flood Maps).
- Middle Left:** A brochure titled "How do I find out more about the risk on my property?" providing contact information for the Catchment Management & Climate Change Team.
- Middle Right:** A brochure titled "How is Pittwater Council managing overland flow?" detailing the Flood Policy, Flood Study, and Flood Maps.
- Bottom Left:** A map titled "Properties that may be affected by Overland Flow and Mainstream Flooding" showing various colored zones across the council's area.
- Bottom Middle:** A brochure titled "How to read the Overland Flow Maps" explaining the color coding: Purple for Mainstream Flooding, Orange for Overland Flow, and Blue for Mainstream Flooding.
- Bottom Right:** A brochure titled "Information Sessions" providing details on when and where to attend sessions to discuss property-specific concerns.

Figure 4: Example of the community engagement material used during the project

Additional lessons learnt

In addition to the above key lessons learnt the following was also ascertained:

- Section 149 planning certificates seem to be poorly understood by the community – both what the certificate contains and why Council places information on it;

- A clear community engagement strategy needs to be developed from the commencement of the project, to ensure that each step of the project is effectively conveyed to the community;
- Council understands that the report is still a highly technical document, however its intent was even misinterpreted by some 'experts' acting on behalf of property owners;
- Community groups will try to circumvent the community engagement process by directly appealing to Councilors and General Manager for separate meetings;
- A working group was not established at the commencement of the Flood Study, due to the study being LGA wide, and it was believed there would be minimum interested residents. However, as a result of the public exhibition a working group has now been established to work through any further concerns from property owners. In addition the working group will allow greater involvement of agencies such as OEH and NSW SES;
- Having a clear idea about what the information will be used for and ensuring this is understood by the community. Pittwater Council's consultation revealed that the community expected the study to be a rectification works plan and did not appreciate that Council had no specific plan to install larger pits and pipes or that the information would be used to inform development controls;
- Ensure Councilors are kept informed throughout the project; and
- In the absence of rainfall calibration events, make sure that there is adequate sensitivity investigations, keeping in mind the purpose of the study.

Summary

Of the 1,883 properties (2,050, once strata titles were included) that were notified and the subsequent changes to s149(2) and s149(5) planning certificates, there was 120 submissions received to date (a 6% response rate).

The majority of the submissions relate to the flood notification being placed on their property and the perceived 'knock on' affects of increased insurance premiums and decreased property prices (both of which are outside Councils control).

Pittwater Council has learnt a great deal from the Overland Flow Flood Study that will be used for future flood studies throughout Pittwater.

However, councils still need to know what they want the information for, have a clear communicable plan on what they intend to do with the information, and ensure the methodology undertaken is fit for purpose.

The key take home messages from Council's key lessons learnt are:

- Identify a suitable definition for overland flow paths - choose a definition that can be well understood and easily set out in development controls.
- Choose the correct freeboard: 5m horizontal freeboard of overland flow paths with a depth greater than 0.3m instead of the 0.5 vertical freeboard. Councils need to thoroughly consider how the freeboard is selected, depending on the nature of the study and study area characteristics.
- Assume pipes are running at full capacity and are not blocked. It was more worthwhile to make sure that drainage was taken in account, in order to appease a portion of the community, however this concept needs to be clearly explained in the flood study report.

- Use the 5% AEP blockage scenario to represent the 1% AEP unblocked scenario. It was possible to use this concept base on pilot testing, knowing that the output would fit for the purpose of identifying properties for development controls.
- Develop a clear community engagement strategy and ensure appropriate resourcing using targeted techniques in engagement (one on one/ phone sessions), and if possible report to community group representatives through other group meeting avenues (e.g. Floodplain Committee), and
- Use extent maps instead of property based maps when providing the information to the public.

References

Cardno Lawson Treloar., 2007a. *Mapping of Properties Affected by Overland Flooding (Interim Category 3 properties). Stage 1 Report: Preliminary Mapping – Volume 1: Report (7 March 2007)*. Cardno Lawson Treloar, Gordon. NSW

Cardno Lawson Treloar., 2007b. *Mapping of Properties Affected by Overland Flooding (Interim Category 3 properties). Stage 1 Report: Preliminary Mapping – Volume 2: Figures (7 March 2007)*. Cardno Lawson Treloar, Gordon. NSW

Cardno Lawson Treloar., 2007c. *Mapping of Properties Affected by Overland Flooding (Category 3 properties). Stage 2 Report: Groundtruthing – Volume 1: Report (6 September 2007)*. Cardno Lawson Treloar, Gordon. NSW

Cardno Lawson Treloar., 2007d. *Mapping of Properties Affected by Overland Flooding (Category 3 properties). Stage 2 Report: Groundtruthing – Volume 2 (6 September 2007)*. Cardno Lawson Treloar, Gordon. NSW

Cardno., 2010. *Overland Flow Workshop – Outcomes Report – 3 August 2010*. Cardno, Gordon. NSW

Cardno., 2012. *Pittwater Overland Flow Mapping and Flood Study – Draft for Public Exhibition – 4 September 2012*. Cardno, St Leonards. NSW

New South Wales Government., 2005. *Floodplain Development Manual – the management of flood liable land – April 2005*. Department of Infrastructure, Planning and Natural Resources, Sydney. NSW

Pittwater Council., 2009. *Pittwater 21 DCP – 12 October 2009*. Pittwater Council, Mona Vale. NSW