

Expert Witness Statement



Expert statement regarding Amendment C384 and the properties at 62-70 Gracie Street, and at 49-51 Henderson Street, North Melbourne

Date: Thursday 6 October 2022

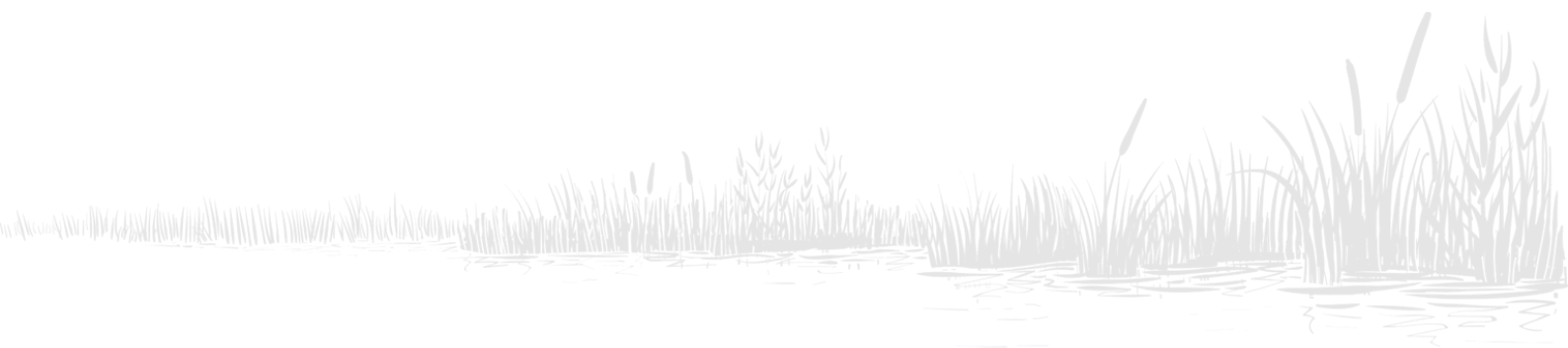
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1. Report Author:

Christopher Mitchell Beardshaw

Principal Engineer

Afflux Consulting Pty Ltd

Emerald, VIC 3178

Qualifications:

BEnvEng (Hons), Monash University, 2002

MEngSci, UNSW, 2006

Graduate Certificate River Health Management, University of Melbourne, 2009

River Styles TM, 2019

Affiliations:

Member, Institution of Engineers Australia

Former President, Stormwater Victoria Industry Association (2016-2019)

Area of Expertise:

Key areas of expertise relevant to this report are summarised below:

- Assessment of flooding, water quality and waterway protection
- Drainage and WSUD industry expert
- Urban and rural river design and management
- Data collection, processing and analysis
- Application of GIS
- 1- and 2- Dimensional Flood modelling

Statement of Expertise

With my qualifications and experience, I believe that I am well qualified to provide an expert opinion of the flood modelling and flood overlay proposal for the properties at 49-51 Henderson Street, North Melbourne and 62-70 Gracie Street, North Melbourne.

More generally, I have specific expertise in contemporary flood modelling practice that may be of interest to the Panel as it considers the proposed Planning scheme amendment as it relates to the wider area consequential implications for implementation of overlays in other parts of Melbourne.

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Scope of this Statement and associated Report

I have been instructed by HWL Ebsworth Lawyers to:

- Prepare this attached expert statement
- Provide expert evidence as per the attached investigation report
- Prepare evidence to appear at the City of Melbourne C384 Planning Scheme Amendment Hearing
- Attend any Expert Conclave dealing with drainage matters as determined by the Planning Panel.

Report Contributors

In preparing our report I was assisted by fellow engineering professionals with experience in flood modelling and development approvals.

- Andrew Allan B. Eng (Env)

Qualifications:

Bachelor of Engineering (Environmental)

Affiliations:

Member Stormwater Victoria

Member Engineers Australia

Former President Stormwater Australia (National), Stormwater Victoria (State)

Area of Expertise:

- 2-dimensional flood modelling
- Assessing and preparing flood studies for private and municipal clients
- Assessment of flood and stormwater management plans
- Developing of specifications relating to flood modelling and stormwater management more generally
- Data collection, processing and analysis
- Application of GIS

Scope of contribution:

Andrew Allan has assisted in the preparation of the report, including preparing and running flood models, data review and figure preparation and report preparation under my instruction and supervision.



2. Basis of Statement and Report

In preparing my evidence the following documents have been reviewed:

- Report to the Future Melbourne Committee- Inundation Overlays and the Good Design Guide- Amendment C384 (2 August 2022)
- Melbourne Planning Scheme Amendment C384 Explanatory Report
- Online Submission to C384 Planning Scheme Amendment in relation to 62- 70 Gracie Street, North Melbourne
- Online Submission to C384 Planning Scheme Amendment in relation to 49- 51 Henderson Street, North Melbourne
- Good Design Guide for Buildings in Flood Affected Areas in Fishermans Bend, Arden Macaulay (downloaded from <https://participate.melbourne.vic.gov.au/amendment-c384/good-design-guide-flood-affected-areas> June 2021)¹
- Schedule 3 to Clause 44.05 Land Subject to Inundation Overlay (proposed)
- Arden Macaulay Precinct & Moonee Ponds Creek Flood Modelling Model Build Report (Engeny August 202- V3000_080-REP-001-1)
- Various documents relating to Panel process including correspondence issued to submitters, key date etc
- Expert Evidence Amendment C384 to the Melbourne Planning Scheme Hydrology and Hydraulics (prepared for the City of Melbourne by Luke Cunningham, Rain Consulting- October 2022)
- Expert Opinion Amendment C384 to the Melbourne Planning Scheme (prepared for Melbourne Water by Warwick Bishop, Water Technology- October 2022)

In addition to these documents, Afflux Consulting has access to a bespoke TUFLOW model of the area that was commissioned as part of a previous flood mitigation review by the two property owners via a third party and was relied upon to inform Expert Evidence in relation to City of Melbourne Planning Scheme Amendment C407

In relation to this Afflux staff have also assisted in the preparation of various reports as follows:

- The Appropriateness of the drainage strategy which underpins the Arden Structure Plan at 49-51 Henderson Street & 62-70 Gracie Street, North Melbourne (Professor Perter Coombes, Urban Water Cycle Solutions- February 2022)
- Expert Conclave Joint Report on Flooding and Drainage (Planning Scheme Amendment C407melb)²

In preparing this opinion I have relied on previous work undertaken by Afflux in the area to which involved the construction of a 2-dimensional flood model for the area to assist in developing an

¹ There are various versions of the Good Design Guide that have been made available on various websites and sets of documents provided. In essence these are very similar in the issues they canvas and solutions offered (esp. from a built form and pedestrian access perspective)

² Andrew Allan of Afflux Consulting was engaged as a note taker to assist in the preparation of the Conclave report authored by Robert Swan, Peter Coombes, Paul Clemson and Warwick Bishop

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understanding of flood behaviour through the area. Afflux Consulting was commissioned through Urban Water Cycle Solutions as specialised sub consultants to provide flood modelling services.

I understand that the details of the model, including assumptions and results have been provided as part of the submission process to the C384 process.

Review comments contained in this expert evidence are provided to cover 'theme' areas as follows:

- The construction of the proposed LSIO3 as it relates to specific properties in question, including key assumptions, transparency of information and representativeness of overlay extents
- The application of the proposed overlays to inform future development, including supporting information in the form of guidelines and their application
- Response to Expert Evidence provided on behalf of Melbourne Water and the City of Melbourne
- Best practice flood modelling to incorporate contemporary practice and methodologies to inform Planning scheme amendments including examples of unintended, misleading or process intensive outcomes

Evidence.

Preliminary

At the outset it is important to establish that in my opinion parts of the Arden and Macaulay Street areas are flood affected. From modelling Afflux has undertaken previously this flooding can be of a significant depth, however when analysis includes high resolution terrain and buildings the likely extent is largely contained in road areas (assuming some level of building imperviousness). The following points are pertinent to the discussion:

- From visual inspection throughout the area, it is apparent that many of the properties that currently exist are located on land that is elevated from the surrounding road network. This includes the properties at 49-51 Henderson Street and 62-70 Gracie Street.
- For properties located closer to Moonee Ponds Creek, the modelled flooding extent and depth is impacted by various assumptions around flow in the Moonee Ponds Creek, the protection provided by levees constructed to contain the creek flow³ and the operation of various flood mitigation infrastructure (i.e., pumps).
- The properties at 49-51 Henderson Street and 62-70 Gracie Street are expected to be impacted by flow emanating from the Moonee Ponds Creek and should normally expect to benefit from flood defences provided.
- Tailwater conditions (i.e., the level at which runoff enters a receiving body such as Port Phillip Bay) can have an impact on flood extent which diminishes, and land becomes more elevated above 'sea level'.
- The interactions of runoff from the local catchment (i.e., surrounding urban areas) and regional flow (Moonee Pond Creek) are unlikely to coincide due to the time it takes for runoff to manifest at different scales.
- Our previous work undertaken as part of C407 was focussed on various flood mitigation measures for the area and as such questioned various assumptions that were included in the modelling that

³ an embankment built to prevent the overflow of a river. Along the Moonee Ponds Creek these are elevated walls running parallel to the creek and locate between the creek and the railway line generally to the eastern side of the creek. Levees should be continuous and set at a level higher than the expected level within the creek or waterbody

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has ultimately been relied upon for the C384 amendment in this area (i.e. Engeny Report Arden Macaulay Precinct & Moonee Ponds Creek Flood Modelling Model Build Report).

- Ultimately it was agreed at the C407 Expert Conclave that various assumptions used to underpin flood modelling of the area likely overestimated flood risk, and that “*policy factors that may not be aligned with the best hydrological outcomes*” were driving assumptions require for adoption by Melbourne Water.
- At this same conclave there was disagreement on the significance of assumptions in arriving at an outcome.

Many of these same issues are expected to arise in this hearing process.

Construction of the Overlay Control

There are a number of steps involved in constructing a flood overlay. These ultimately rely on a range of computer assisted processes to undertake modelling, interpret the results and then construct ‘layers’ which identify land parcels.

It is a matter of judgement as to how the final overlays are represented over a set of properties.

I note that from the modelling undertaken it is apparent that the modelling did not explicitly take into account the effect of buildings in the area. Many of these are constructed in an ‘abutting’ style, on raised land and/ or with raised floor. This detail has the potential to alter the flood extent.

Two examples are provided from modelling work previously undertaken for the area:

Figure 1 shows in hatched format the extent of flooding estimated in Afflux modelling and the overlay extent proposed. It is suggested that a ‘stylised’ representation of flood extent has been created through aggregation to ensure entire land parcels are included.



Figure 1. Orange dotted line showing possible example of how flood overlay extent could be constructed by joining other flood affected areas through filtering/ processing of flood results

In our day-to-day practice we see examples of this either as a deliberate process of design or artefact of the computer processing methods.

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Figure 2 shows a cross section of the terrain through the area. It is evident that the flooding is closely aligned with the roads.

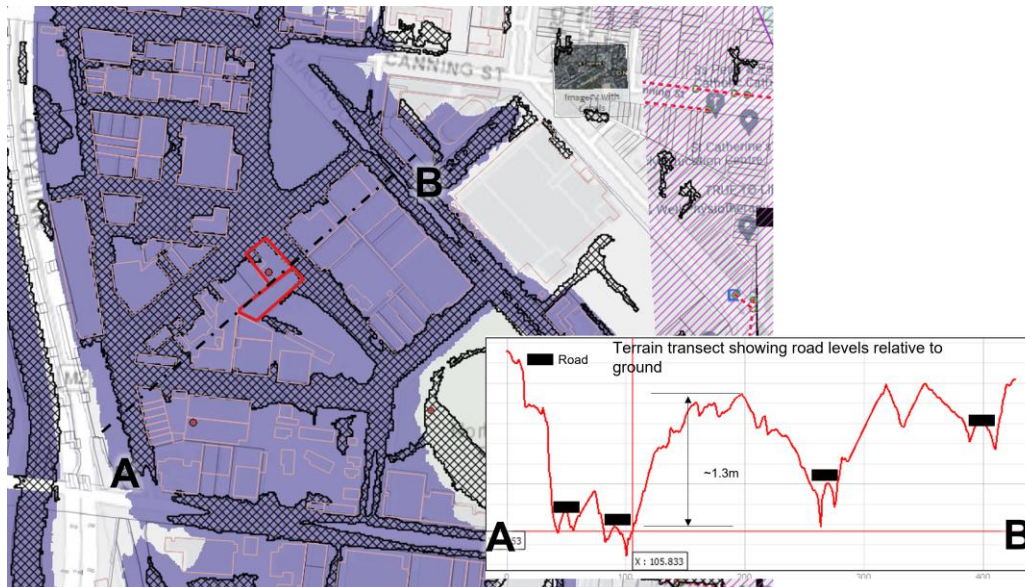


Figure 2. Cross section showing terrain cross section and roads relative to this. Purple indicates flood overlay extent proposed through C384 amendment. Hatched areas were determined as flood impacted through Afflux modelling

It is possible that the broad extent of flooding near the Moonee Ponds Creek is influenced by escaping flows that overtop the levees. It is possible to 'increase' the flow in the creek to achieve any depth of flooding, as once the water has left the creek channel those same levees prevent it returning. As such the operation of pumps (or not) and the calculations underpinning assumptions for creek flow are critical.

It is understood that the hydrological models underpinning the Moonee Valley Creek have been requested but not provided. This is a disappointing outcome as any 'obscured' assumptions can have significant ramifications for flood planning throughout the catchment. Indeed, consideration be given that this information be made publicly available was another aspect that the C407 Expert conclave was in agreement on.

As an aside, this lack of transparency (by Melbourne Water) in making underlying technical reports available is not an isolated incidence. Not allowing proper scrutiny of technical assumptions and documentation could be argued to hinder relevant bodies (such as a Planning Panel) from making properly informed decisions.

The assumptions around operation of pumping infrastructure is one that is questioned as a Policy position (i.e. Should infrastructure provided for the purposes of flood protection be relied upon if an event occurs for which it has been designed?)

Ultimately the flood extents are likely to be described as 'conservative' in that they overestimate the extent of area directly affected by flood, but in so doing ensure that referral triggers are provided for each impacted property.

I now address the practical implications of a Planning referral being triggered, including the suitability of ordinance and the need for information and administrative support to ensure advice is processed in a timely manner.

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The LSIO planning scheme controls that apply to land affected by flooding associated with waterways and open drainage systems and these areas are commonly known as floodplains. Overlays of this nature require a planning permit for buildings and works.

Although protected by a levee, the area in North Melbourne is almost certainly part of a floodplain, although the exact extent is obscured by the many changes in land and use over the time.

The area is 'flat' and located close to the confluence with Port Phillip Bay. The types of industrial uses that have been historically associated with the North Melbourne area are typically seen in other low-lying areas, and there is a history of flooding through the area.

It was suggested in our previous work in the area that the Moonee Ponds Creek likely had various 'transitions' in grade as it flowed toward Port Phillip and lower lying land. In examining possible flood mechanisms (i.e., how the creek overtopped the levee) it was postulated that this information might be useful in developing mitigation solutions.

In contemporary practice, areas that are expected to be flood prone can benefit from various engineering works to divert or contain flood events away from developable areas. Indeed, this is a fundamental principle underlying Development Services Schemes that operate in many parts of Melbourne.

As such I agree that the LSIO is an appropriate control for the area if provided flood defences are not operational.

The operation of the LSIO triggers a referral response by Council to Melbourne Water as the relevant authority. Under the current legislative process Melbourne Water is designated as a 'determining authority'. Any referral advice provided by Melbourne Water must be explicitly included as part of Permit conditions.

Under the proposed Schedule 3 to Clause 44.04 Land Subject to inundation Overlay there are several subsections which include

- Flood management objectives to be achieved (Objectives)
- Statement of risk
- Permit requirement
- Application requirements and
- Decision guidelines

I agree with the Objectives to be achieved, and the general intent of the Statement of Risk.

The Statement of Risk includes high level details of the modelling assumptions used in the modelling, however, provides no specific context on the nature of flows within the Moonee Ponds Creek. As identified above this is a considerable assumption that affects both the extent and significance of the overlay and to date has not been provided for evaluation.

Under the Permit requirement there are certain circumstances in which a permit is not required. Of most relevance is the following which states:

- Earthworks that do not change the rate of flow or the discharge point of water across a property boundary.

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As the construction of the overlay implies that water is flowing across the property boundary, it is my opinion that it will be difficult to demonstrate this requirement. This will be compounded if recent concerns across industry on Melbourne Water's move to require 'zero afflux'⁴ become entrained in practice.

It is also interesting to note that exemptions are also granted for 'bus and tram' shelters which are likely to be located in roads (which will exhibit elevated flood levels) and potentially expose flood plain users to heightened risk.

Application requirements for development appear reasonable and request information that is appropriate for the intended assessment, however again the 'devil is in the detail'.

A typical application process involves seeking pre-application advice from Melbourne Water, and ultimately conditions imposed as part of the referrals process on permit.

I have noticed in recent times that the information and assessment service provided by Melbourne Water is becoming increasingly administrative in nature. Often levels provided are blanket levels across an entire block and do not take into account site topography, particularly where it varies from one side of the allotment to the other and can become an 'explicit' requirement.

From experience in other circumstances, additional modelling advice is often requested for the site, a process that can be expensive, susceptible to long delays with no guarantee of robust technical assessment.

This then raises another concern about the operation of the overlay and implications for landholders.

I have reviewed the Good Design Guide that has been prepared for the Fishermans Bend and Arden Macaulay area. It sets out some good principles for redevelopment and is realistic in its interpretation that new development should respond to flood risk (i.e., that flooding can't be avoided entirely).

The Guidelines are focussed on the built form and various building interfaces. They do not cover situations where, if flooding were to occur warnings would be appropriate, or evacuation should be considered.

It is my understanding that these guidelines have been produced to support redevelopment of areas that are being 'repurposed.' This is acknowledged as a reason for why the C384 Amendment is required in Council's explanatory report.

The Amendment is required to ensure the precinct planning for the urban renewal areas of Arden, Macaulay and Fishermans Bend appropriately consider and plan for flood risk in the public and private realm. At the time of drafting this Amendment, the structure plans and associated planning scheme

While land valuation is an area beyond my specific expertise, I consider it appropriate to question the veracity of the overlay extent and the absence of key assumptions if this affects the viability and value of existing land tenure in the area.

⁴ Afflux is a term that relates to the flow of water. In assessing the impact of a development in an area that is flood affected authorities have regard to whether the development changes the nature of flow and increases flood depth on surrounding properties. For many years there was a tolerance on what was reasonable to expect but recently Melbourne Water has indicated that their standards may become more stringent and require zero change in flood levels

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It also raises the question as to how other properties outside the immediate renewal area which are deemed as flooded based on the same modelling assumptions are affected, and what interim protections they may be afforded for flood protection.

Response to Experts

The flood overlays across the entire City of Melbourne have been prepared based on modelling input from various consultancy firms over a number of years.

It is generally considered that studies of this nature take considerable time to complete and that it is not unreasonable to expect that in some aspect's information can become dated.

For instance, modelling completed by Afflux Consulting in February this year benefitted from terrain information that was collected in 2017. Flood investigations that were well underway prior to this information becoming available may not have been updated.

Both the experts for the City of Melbourne and Melbourne Water acknowledge the complexities of undertaking studies of this nature, and to varying degrees have ongoing involvement with the organisations for which they have provided expertise.

All the flood studies have been completed in 2-dimensional flood modelling software (TUFLOW) and variances in the way water has been applied in each instance is a major difference.

Mr Bishop opines that since 2010 there have been no 'step changes' in technology or methods that would underpin flood modelling, and given the right context is something I agree with. However, the methods in which water is applied into a flood modelling program is a major difference in this case and is continually advancing. Similarly, the inclusion of buildings as potential obstructions to flow is something that is increasingly commonplace in other jurisdictions and private practice, and more recently is supported by available datasets. This is all possible due the gradual increase in modelling speed and calculation method that has incrementally increased since 2010.

It is known that Mr Cunningham has produced flood mapping specifications for the City of Melbourne in late 2020 (pers communication). These have not been referenced in evidence provided and is expected if flood mapping was substantially underway prior to these being developed (i.e., these guidelines were too late to influence modelling). It is of interest to note however that these include discussion about the use of buildings to modify flow in areas where the *'building is completely blocked off from the surface and there is no potential for water to move through the building.'*

It may be a moot point as to whether these advancements occurred in a timeframe that could influence the various modelling exercises, however, as is noted, many of these studies did take advantage of Direct Rainfall⁵ methods for applying water into the model.

The predominant justification for the methods used in the various studies is that they were all *'built to the flood mapping guidelines of the time,'* and as is general industry practice would have been reliant on Melbourne Water technical specifications.

The methods described in Melbourne Water specifications have a long basis for determining reasonable flood extents in areas near waterways where Melbourne Water has an overwhelming jurisdiction.

They become less reliable in upper reaches of catchments where the influence of terrain, buildings and method of introducing water become increasingly important.

⁵ Direct Rainfall (also known as Rainfall on Grid) is a technique that allows 'rainfall' to be applied in a computer modelling software package directly onto the underlying ground surface. These models more closely replicate real world physical processes in that the computer is able to calculate where water will flow rather than rely on arbitrary assumptions being made

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For the Arden Macaulay area the terrain is generally flat, however it is evident from the flood results that water has been applied in discrete locations and allowed to find its own level via calculations performed by the computer

The implications of how water is introduced into the models and the implication of excluding buildings is concerning. I have found in work for other municipal and private clients that these inclusions are important to gain a full appreciation of flood extent and impact.

Based on this I feel it is important that the Panel understands that there have been considerable changes in practice, albeit not necessarily well recognised in Melbourne Water specifications.

Finally, I note that Mr Cunningham has prepared a specific response for various submissions, none of which include this client sites. Indeed Mr Cunningham's evidence pertains mainly to Council flooded areas and relate to the construction of a Special Building Overlay (SBO).



3. Conclusions

The following points can be made from this review of the presented evidence:

- The proposed overlay covers areas of a significant historical floodplain, however that floodplain is largely cut-off from Moonee Ponds Creek/tailwater interactions due to the constructed levees.
- The overlay is extensive and relies on a failure of the levees to produce the flood extent. The failure of levee mechanism could take many forms and as such the extent is largely theoretical
- If the levees don't fail, or there is significant mitigation infrastructure (pumps or other), the likely actual flood extent is probably limited to the road network. Nuances in flood modelling techniques would likely produce some minor effects on the flow paths associated with this non-levee effected flooding.
- If the extent is considered as a development or planning "flag" only, then this is an appropriate floodplain management tool. There is some concern that implementing the overlay without appropriate care may result in other floodplain requirements that are not appropriate for this area (such as afflux provisions, or overland flow requirements). It may be important to specifically reference the "Good Design Guidelines" for this area to ensure that the context of this flooding is appreciated.
- The sites reviewed for this evidence are unlikely to be directly affected by flood waters on property but will be restricted by floodwaters within the road network (unless levee assumptions fail). As such there should be an acknowledgement of development requirements including minimum floor levels, with an appreciation of the context. The "Good Design Guidelines" may aid in this result.
- If indeed these areas are to remain flood prone after being redeveloped, there will still be a need to provide a range of flood responses to benefit those who occupy and could include flood warning, evacuation and provision for post flood recovery.

Declaration

I have made all enquiries that I believe are desirable and appropriate. No matters of significance which I regard as relevant have to my knowledge been withheld from the Tribunal. Accordingly, I believe that the report is a complete and accurate statement of the hydraulic and water quality matters.



Chris M Beardshaw

BEnvEng (Hons), MEngSci, Grad Cert River Health

06 October 2022