Planning Proposal 2017 CANAD_005

Lot 1 DP219742, 7 Concord Avenue, Concord West

Response to Submissions Report – Addenda Flooding Report

October 2020

Catchment Simulation Solutions

7 Concord Avenue, Concord West

Response to Submissions Report – Addenda Flooding Report

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REVISION / REVIEW HISTORY

Revision #	Description	Prepared by	Reviewed by
1	Response to Submissions Report	TM	LD
2	Update to Response to Submissions report	TM	LD
3	Jenny Rudolph and Brett Phillips Review	TM	LD
4	Justin Foong and Jenny Rudolph Review	TM	LD
5	Mark Tooker Review	TM	N/A
6	Joe Dagostino Review	TM	N/A

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File Reference: CSS response to DPIE concerns 01Oct2020.docx

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1 BACKGROUND

1.1 DPIE submissions report

The Department of Planning, Industry and Environment (DPIE) provided a Submissions Report to the Sydney Eastern City Planning Panel on the 25th June 2020 regarding the Planning Proposal for 7 Concord Avenue, Concord West in the Canada Bay Local Government Area (LGA).

Section 4.1 of the Submissions report relate to flooding issues. Section 7 of the same report includes the Conclusion and Recommendation. Amongst several points, the conclusion includes the following comment related to flooding:

'The Department considers that flooding raises substantial issues that have not been fully resolved in the planning proposal and that unresolved Council, community and agency concerns remain in relation to flooding.

The Department also considers that the proposal remains inconsistent with Section 9.1 Direction on Flood Prone Land and the information submitted indicates it is unlikely to fall into the category of being a minor inconsistency'.

CSS has been requested to prepare information as part of the reply to the Response to Submissions which was included in a "supplementary information table", which has been previously provided to DPIE. This report is an addenda to the HydroSpatial (2018) Flood Study report and has been prepared to include this supplementary information. DPIE's "Response to Submission" concerns related to flooding, and our initial response to DPIE are included in **Table 2** included in **Appendix A.**

In addition, subsequent discussions with DPIE clarified that their main concerns were now focused on:

- The definition of a floodway, and whether the site was located in a floodway
- The potential impact on neighbouring properties
- The potential impact on government infrastructure, particularly the culverts beneath Homebush Bay Drive downstream of the site

These issues are discussed as part of the supplementary information included in **Table 2,** however DPIE has requested additional and more detailed information since this supplementary report was submitted, which is addressed in **Sections 2.1 to 2.2.2** of this report.

1.2 Flood modelling information

The Draft Concord West Precinct Master Plan Flood Study was prepared by Jacobs on behalf of Canada Bay Council in 2015 (*Concord West Precinct Master Plan Flood Study'* Jacobs, 2015). The report included hydrologic and hydraulic modelling to define the flood behaviour upstream, downstream and through the proposed development site. This Jacobs modelling, as agreed to with Council, has been used as the basis for the flood impact assessment for this proposed development site. A few minor updates were made to this model in 2018 to better reflect existing and proposed conditions on the development site itself. Otherwise no other changes were made and the model was run as per its completion in 2015.

The main flood mitigation structure (a "void" with a flood storage area) has been designed to sit at approximately ground level and convey water through the pace between the podium ground floor level and basement car park. The ground floor of the structure sits elevated above the void (1m above the 1% AEP flood level), sometimes referred to as the "podium", while underground car parking is tanked so that no flooding can enter the basement carpark. The void has been modelled as a one dimensional network in order to allow the 2D model to represent flooding on the podium.

The Jacobs report did not define hydraulic categories through the site, and as such floodways were not defined through the proposed development site. The Jacobs study uses the term "floodway" interchangeably throughout the report, instead of "flow path". A "floodway" should be defined by the processes set out in the NSW Floodplain Development Manual 2005 (particularly Appendix L of the manual and repeated in the following sections of this report), which is typically rigorously delineated in a flood study or through the floodplain risk management study process.

The reference to "floodways" in the Jacobs report is therefore undefined. The Jacobs report has not demonstrated that the "floodways" have been defined in accordance with the Floodplain Development Manual, as outlined in the following section. Our modelling has confirmed that there are no floodways on the subject site.

2 DPIE Concerns with Section 4.3 Direction of EPA&A Act 1979

2.1 Floodway Classification

Floodplain Development Manual definition of floodway

The *'Floodplain Development Manual'* (NSW Government, 2005) defines a floodway as:

> *Those areas where a significant volume of water flows during floods and are often aligned with obvious natural channels. They are areas that even if only partially blocked, would cause a significant increase in flood levels and/or a significant redistribution of flood flow, which may in turn adversely affect other areas. They are often, but not necessarily, areas with deeper flow or areas where higher velocities occur.*

No quantitative criteria is provided by the NSW Governments '*Floodplain Development Manual'* (The Manual) to define a floodway.

The *Floodplain Risk Management Guideline – Floodway Definition';* prepared by NSW Department of Environment & Climate Change (October 2007)' states that the definition of floodway in the *'Floodplain Development Manual'* does not relate to the velocity or depth of flow but to the significance of discharge (significance is relative to the total flow along an individual flowpath rather than the "hazard") and the hydraulic impacts of blockage (the impacts on both the floodplain as a whole and the flowpath in question). The Manual allows for a variable quantitative definition of floodways as to what constitutes a floodway (i.e. the significance of the discharge, or the impacts of blockage) will vary significantly between smaller and larger catchments.

The same Guideline goes on to state that floodways are primarily defined through hydraulic function and their characterisation needs to be along the same lines. Hydraulic function is a method of delineating the floodplain into their primary purpose during a flood (e.g. floodway conveys water, flood storage acts as temporary storage and flood fringe is the remaining area). Hence an obstruction of a floodway areas would be expected to have at least one of the following hydraulic characteristics:

- Divert water to other existing flowpaths
- Have a significant impact upon upstream flood levels in the planning level flood
- Divert significant amounts of water away from existing flowpaths resulting in the development of new flowpaths and associated adverse impacts

Canada Bay Council definition of floodway

Councils Local Environment Plan 2013 and Development Control Plan (DCP) 2019 refer to Flood Planning Area. The DCP 2019 includes definitions for flood risk precincts, however

definitions for hydraulic categorisation is not included in the DCP or LEP. The DCP adopts the definition of a floodway as per the Floodplain Development Manual (2005)

As discussed in Section 1.2 above, in 2015, Council completed the Concord West Precinct Master Plan, with a flood study completed by Jacobs for the study area (*Concord West Precinct Master Plan Flood Study'* (Jacobs, 2015). As part of the development of those documents, it was recommended that council completed a precinct wide floodplain risk management study and plan, which would have included this development site. It is anticipated that this new Council study would have included hydraulic categorisation and therefore delineated floodways and flood flow through this site.

Proponents definition of floodway

The HydroSpatial (2018) study mapped hydraulic categories using the most commonly used methodology in NSW (Howells et al, 2003) for small to medium sized catchments. This delineates the floodplain into three categories which include:

- Floodway
- Flood storage
- Flood Fringe.

The qualitative criteria used to determine the hydraulic categories for the site for included in **Table 1** below.

Table 1 Quantitative Criteria used to define Hydraulic Categories

Hydraulic Category	Adopted Criteria*
Floodway	• V x D > 0.25 m^2/s AND peak velocity > 0.25m/s OR • peak velocity > 1.0m/s.
Flood Storage	• Not floodway and depth ≥1.0 m
Flood Fringe	• Remaining area of land affected by flooding, after floodway and flood storage areas have been defined

NOTES: V = Velocity, D = Depth
Hydraulic categories were only applied to areas subject to inundation (i.e., D > 0.15m)

Proponents Floodway definition mapping

The following **Figure 1** and **Figure 2** outline the mapping of hydraulic categories that was calculated and included in the 2018 Flood Study by HydroSpatial.

Using the methods outlined above, there is no floodway on the site under bother the existing conditions and with the proposed development in place.

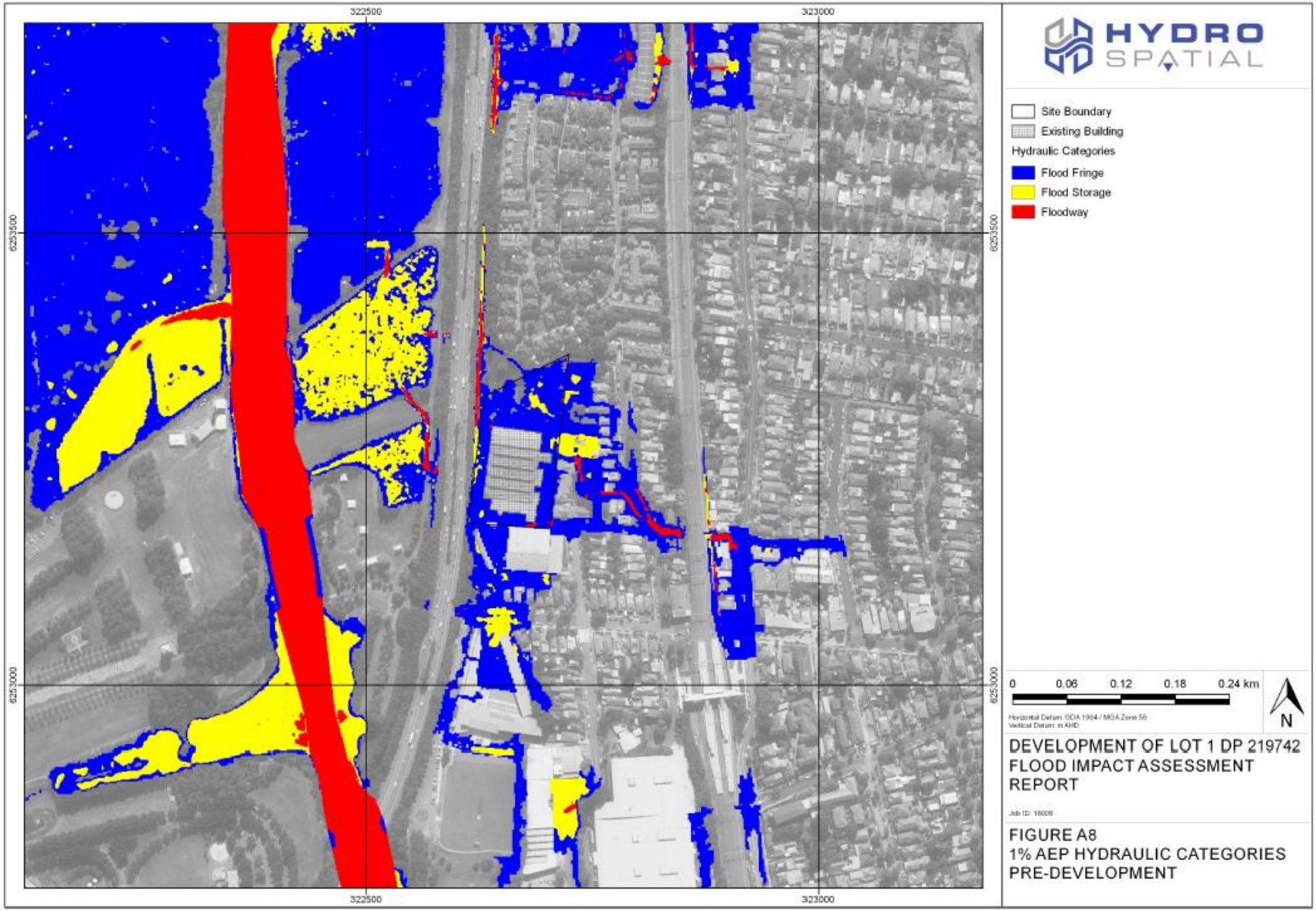

Figure 1- Pre-developed Hydraulic Categories

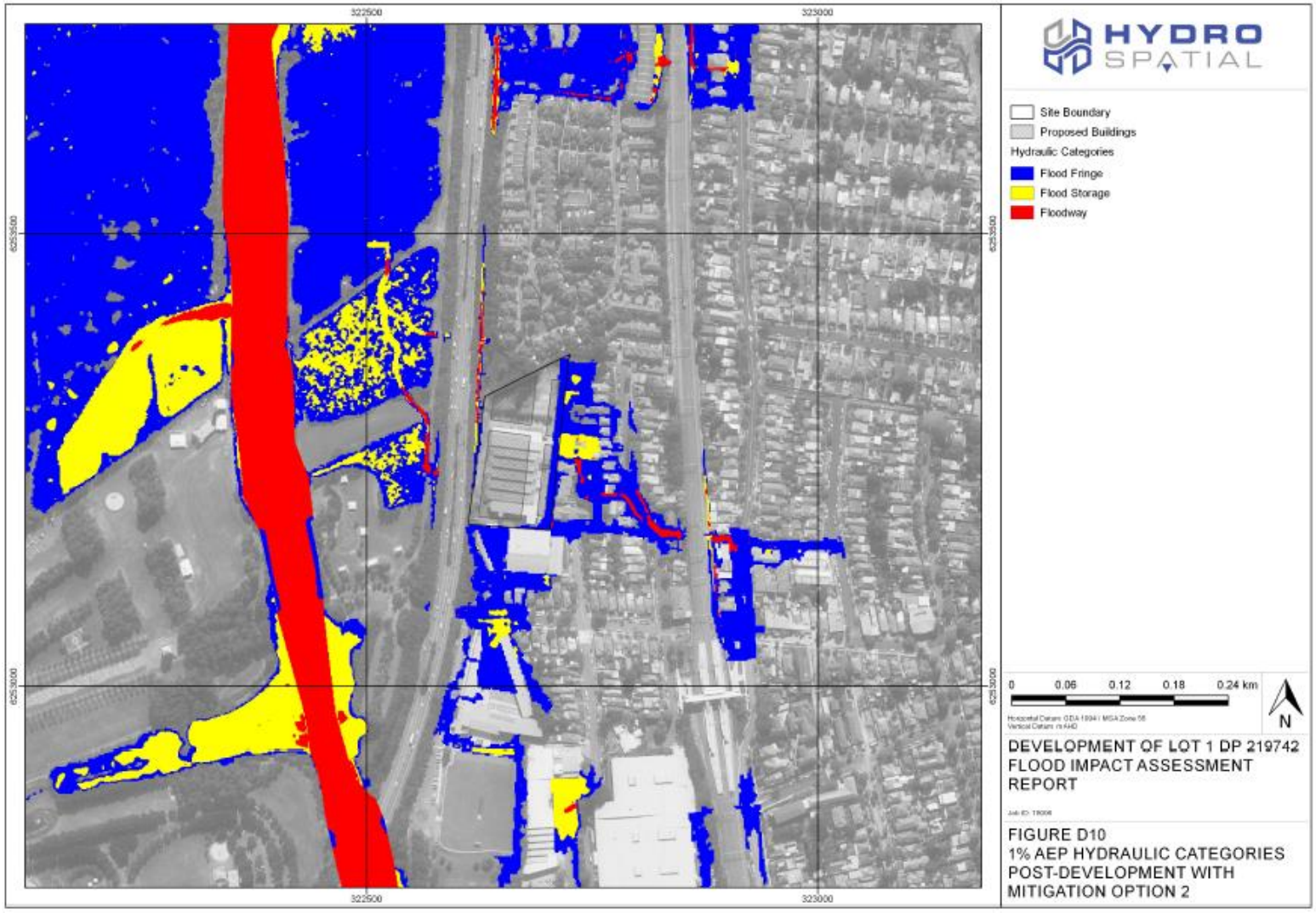

Figure 2 - Post developed (including Option 2) Hydraulic Categories

Note that this figure shows flooding in open areas only, and does not show flooding within the enclosed void.

Floodways as defined in other studies carried out in Canada Bay LGA

In the absence of a "floodway" being defined in any formal council planning document or development control plan, we have reviewed the Draft Exile Bay Flood Study (Draft Flood Study for Public Exhibition, 14 February 2020), this study is being prepared for City of Canada Bay.

At the time of writing, the Draft Exile Bay Flood Study document had not been adopted by Council and was in draft format, however it had been on public exhibition since early 2020. The development of the draft flood study required the review and approval by council officers, and the support of Council officers to proceed to public exhibition. As such, the definitions included in the Exile Bay Flood Study are deemed to be supported by Council, and have been included here for reference purposes.

Section 9.5 of the Draft Exile Bay Flood Study relates to *Flood Function*, which is also known as hydraulic categories. The study breaks the floodplain up into three (3) categories – flow conveyance, flood storage and flood fringe.

The terminology of 'flow conveyance' is used as an alternative to floodway. The definition of flood conveyance is the same as the definition for floodway in the Floodplain Development Manual (2005). The Exile Bay Flood Study defines flow conveyance as:

The areas where a significant proportion of the floodwaters flow and typically align with defined channels. If these areas are blocked or developed, there will be significant redistribution of flow and increased flood levels across the floodplain. Generally, flow conveyance areas have deep and/or fast-moving floodwaters;

The report defined the flood function classifications in accordance with Howells et. al (2003) with the quantitative criteria for flow conveyance classified as those areas where:

the velocity-depth product > 0.25 m2/s and peak velocity >0.25 m/s
or
velocity > 1 m/s

This quantitative criterion used in Council's exhibited Draft Exile Bay Flood study is the same classification that has been used in the HydroSpatial (2018) study and, used as part of this planning proposal to define floodway areas through the site and areas around 7 Concord Avenue, Concord West.

As such, it is inferred that Council officers support the classification of hydraulic categories as:

- Floodway/Flow conveyance
- Flood Storage
- Flood fringe

with the quantitative criterion used to define floodway / flow conveyance areas as proposed by Howells et. al (2003).

Comment on potential floodway through development site

Figure 1 above outlines the existing site conditions and the hydraulic categories, including any floodways, through the site. There are no floodways on the existing site.

The proposed development alters the existing footprint of the built components on the site and includes mitigation option 2, which takes into account a 50% blockage factor through the main flow conveyance systems. **Figure 2** outlines the post developed hydraulic categories, including any floodways, through the developed site. There are no floodways on the post developed site.

Figure 3 outlines the impact during the 1% AEP design flood event of the development when mitigation option 2 is included.

In summary, the resultant impacts and hydraulic categorisation for the site (and adjoining areas upstream) indicate that:

- there would be no significant increase in flood levels or redistribution of flood flows or change in hydraulic categorisation on neighbouring properties as a result of this development. This includes a high blockage factor assigned to the inlet and conveyance structures.
- Using standard methodology (Howells et al, 2003) there is no floodway on site, either pre or post development.

The definition of a floodway, outlined above, asserts that if the development area included a floodway, these works would result in a significant redistribution of flood flows.

In conclusion, defining the floodway/flow conveyance with the Howells definition of floodway/ flood conveyance and consistent with that included in the draft Exile Bay Flood Study, conforms to industry accepted and standard floodplain management practice in defining a Floodway. It also conforms to the NSW Governments Floodplain Development Manual (2005) as well as with the definitions that Council is using in other areas of the LGA in current studies. This methodology concludes that a floodway is not located on any part of this site, and:-

- There are no adverse flood impacts external to the development site as a result of this development.
- There would be no significant increase in flood levels or redistribution of flood flows or change in hydraulic categorization on neighboring properties as a result of this development
- The floodwaters flow align with defined channels along the southern part of the site
- Even with a 50% (conservative) blockage in the model in both inlet and conveyance structures, there will be no significant redistribution of flow and no increased flood levels external to the site

Figure 3 - 1% AEP flood level impact - Post developed including mitigation option 2.

Note that this figure shows flooding in open areas only, and does not represent flooding within the enclosed void. The podium area (essentially ground flood) is no longer flooded while the void underneath is.

2.2 Impact on neighbouring properties

2.2.1 Flooding Impacts on neighbouring properties

The stormwater management design for the site has considered two different options to convey and manage the stormwater from the upstream end of the site to the downstream end, and out to the catchment outlet under Homebush Bay Drive. Mitigation Option 2 has been incorporated into the design of the development.

Mitigation Option 2 includes the provision of a flood area (the void) that allows water to move from the eastern side to the western side of the site, extending beneath the whole of the elevated ground floor. This flood area has a height of 1 metre or more. A significant sized inlet structure is proposed on the eastern side of this flood area, with a width of 22 metres and height of 1 metre. This approach has been used for a number of new developments in the Parramatta CBD, as shown in the HydroSpatial (2018) report e.g. 2 Kendall St, 31 – 37 Hassall St, 37 Cowper St and 32 Hassall St all in Parramatta.

A 50% blockage factor was applied to this inlet structure to reflect that this opening would have a reduced aperture to reduce flow into the conveyance areas. Within the void, additional flood storage areas have been included to the north and the south of the central conveyance area.

The flood impact assessment results of Mitigation Option 2 indicate that the only area impacted by an increase in flood levels as a result of the development is in the south-east of the site and by an amount of less than 0.014 metres (1.4cm) (see Figure 3). This site is located on or close to the driveway and proposed open space area along the boundary fence in this area. 0.014 metres is considered to be a negligible increase and is contained to a very small localised area. It also considered within the acceptable thresholds of error of hydraulic modelling. As such, it is considered that the implementation of Mitigation Option 2 would result in no adverse impacts on neighbouring or other properties in the 1% AEP design flood event as a result of this development.

Section C7.5 of Councils Development Control Plan, includes consideration for flood affectation elsewhere. It states that:
An Engineer's report is required to demonstrate how and certify that the development will not increase flood affectation elsewhere, having regard to:

a) loss of flood storage;
b) changes in flood levels, flows and velocities caused by alterations to flood flows; and
c) the cumulate impact of multiple potential developments in the vicinity

Figure 3 represents the post developed flood level impacts for the 1% AEP design flood event in open areas (note the flooding in the void is not shown), with mitigation option 2 included in the development. This indicates that there is no increase in flood levels caused by the alteration to the flood flows on the development site. Small reduction in flood levels of up to 0.05 metres (5cm) are predicted to occur across the neighbouring properties during the 1% AEP design flood event. In addition, it also indicates that the implementation of Option 2

would not result in the redistribution of flood flow outside of the site, even with 50% blockage of the inlet opening.

Blockage was included in the 2018 HydroSpatial Flood Study. A detailed blockage assessment was undertaken by Cardno as part of this reply to the Response to Submissions. A full copy of these blockage calculations has been included in **Appendix C**. The blockage assessment based on Australian wide guidelines (ARR 2019) showed no significant adverse flooding impacts even with a 50% blockage which is twice as much than the Australian wide guidelines ARR 2019 recommendation

The assessment of potential blockage in the opening of the void, and through the conveyance system itself (referred to as "barrel" in the calculation sheets) includes the blockage potential of a range of different sediment, including:

- clay/silt,
- sane
- gravel
- cobbles
- boulders

The blockage assessment considered two different scenarios for the opening to the culvert - a 22 metre wide and 3 metre wide opening.

The blockage assessment indicates that with an opening width of 3 metres, a blockage of up to 20% could be expected at the opening, and 25% through the barrel of the conveyance system itself in floods greater than a 0.5% AEP design flood event. A blockage allowance of 50% was included in the calculations for the stormwater drainage system design for the proposed development, which is double what was calculated during the blockage assessment and equates to an extreme blockage scenario in an extreme flood.

50% blockage of the inlet structure is considered very conservative, particularly considering the characteristics of the upstream catchment (heavily urbanised therefore prone to small flood debris and not larger debris such as trees and logs). This blockage scenario is in excess of the extreme blockage consequences criteria for a 1% AEP flood that is recommended in Australian Rainfall and Runoff 2019. In addition, the velocity of floodwaters through and around the site is estimated to be relatively low. Therefore, the likelihood of 50% blockage is extremely minor, with a resultant increase in flood levels of less than 0.02 metres more likely.

The clear opening (22m) to the conveyance system (mitigation option 2) can be maintained to allow columns at three (3) metre intervals to support the opening. It is based on installing bar screen with bars spaced 0.15 metres apart, perpendicular to the fence and tied into the building, to preclude access and retention of the existing fence opposite the 22 metre wide opening to the conveyance area. If the boundary fence fails for any reason, then the debris would be transported through the opening with minimal potential for blockage and conveyed through the void or possibly deposited in the void. Either way the impact on flood levels would be minimal. This would also mean that the current 50% blockage scenario also accommodates the *Extreme blockage consequence* case.

Access to the inlet of the conveyance area will be restricted by a number of different treatment options that will be included in the development. Children and adults will not be exposed to these floodwaters except along the edges of the platform. To avoid potential risk that children or adults would step off the platform into hazardous floodwaters a number of treatments are available including:

- Fencing or a dense (prickly) vegetated barrier along those edges of the platform where there is a vertical or steep decline from the platform to a lower surrounding ground level to prevent children or adults approaching the edge; and/or
- A flatter grade on any slope to allow a child or adult to clamber back onto the platform if they inadvertently enter the floodwaters; and/or
- A shallow bench along the edge where any child or adult who inadvertently steps into floodwaters only steps into shallow floodwaters or is able to clamber back onto the platform.

The merits of any or all of these treatment options would be assessed during the detail design stage as part of the DA stage. Consideration of each of these treatment options has been included during the design of the conveyance system and are supportable.

The requirement for appropriate flood compatible fencing and ongoing maintenance will be the responsibility of the strata body. The proposed flood management infrastructure includes an allowance of 50% blockage in the current modelling, which adequately accounts for both the debris load estimated to occur during these design flood events and the flood compatible fencing to be used as part of this design. Integrating the flood management infrastructure into the body corporate rules and by laws will ensure the flood management infrastructure is maintained into perpetuity so that nil flood impacts on neighbouring properties is maintained.

Accordingly, based on the Australian wide ARR 2019 guidelines, the implementation of mitigation option 2 with the proposed development is predicted to lead to no adverse flood impacts external to the development site.

2.2.2 Flood Impacts on Homebush Bay Drive Culverts

The Department (Department of Planning, Industry and Environment) has raised concerns that the development may impact the two existing pipe culverts (that outlet as box culverts) beneath Homebush Bay Drive. Council have also raised concerns around this as they believe the culverts are poorly maintained.

The existing downstream pipe culverts have been included in the flood models and their impacts on flood levels on the subject site are incorporated into the flood assessments. The proposed development will lower the peak flow rates entering the culverts thereby reducing their impact on flood levels. Also, the proposed development minimum floor levels have a 1m freeboard to the 1% AEP flood levels (which is 0.5m above the FDM 2005 requirements) to accommodate variations in flood levels.

Analysis of the Jacobs model suggests that the catchment draining to the culverts is at least 49.7% impervious, although this only includes roads and buildings and not other impervious areas such as driveways and concreted yards. The development will cause an increase in the impermeable area of only 1.1% in the catchment. Therefore, the development will generate an insignificant amount of additional volume that flows into these culverts.

The proposed development also controls the floodwaters that arrive on site and directs them into the proposed void. This has an attenuating affect which reduces the flood peaks through the Homebush Bay Drive culverts downstream, therefore having a net positive impact on the culverts. This is shown in Figure 4 and Figure 5 for the northern and southern culverts respectively, where water levels downstream are reduced form existing levels.

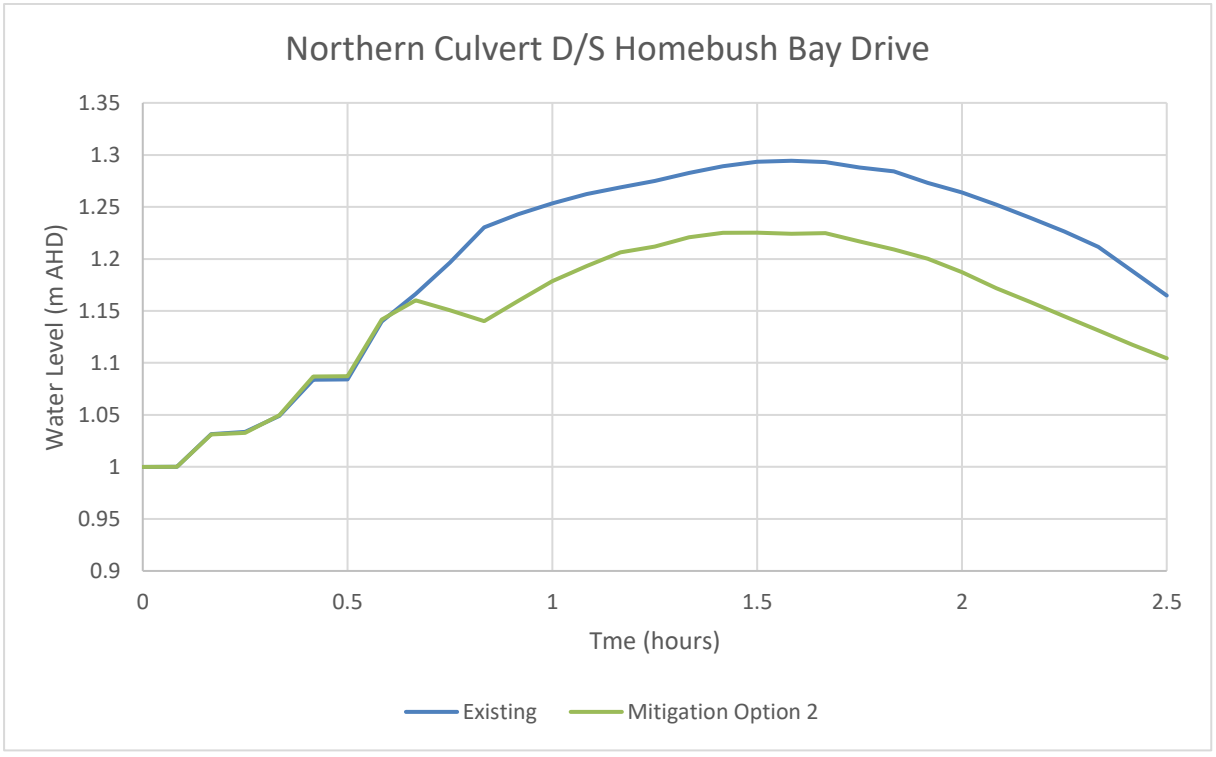

Figure 4 Water Level Hydrograph for the D/S end of the Northern Culvert for the 1% AEP flood

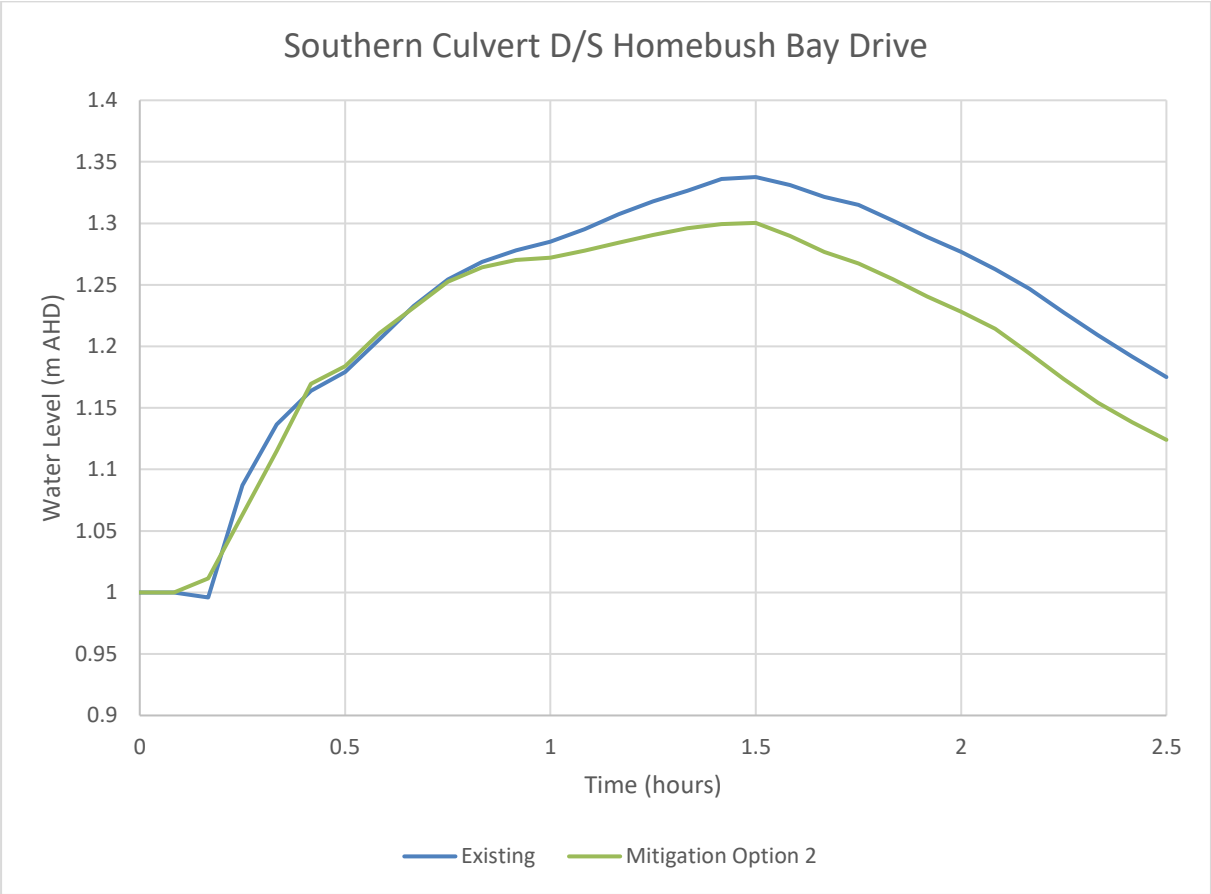

Figure 5 Water Level Hydrograph for the D/S end of the Southern Culvert for the 1% AEP flood

2.2.3 Tidal Inundation Impacts on the Stormwater Infrastructure

Council has raised concerns with regard to the proposed stormwater system and the potential for water to stagnate and remain in the proposed stormwater infrastructure through the site, due to the low grades in the existing stormwater infrastructure upstream and downstream of this site.

The 1% AEP design flood levels for the proposed development site have been calculated with an allowance for sea level rise (increase of 0.9 m by 2100) included in the downstream water level boundary conditions.

The inclusion of a a one-way “flap gate” on the outlet of the stormwater infrastructure from the site to reduce the ingress of the salt water flows from the existing stormwater system. This adequately addresses the concern raised in correspondence from council.

2.2.4 Maintenance of the on-site stormwater drainage network

In addition, council correspondence includes a number of issues and some information related to the existing, and potential future, stormwater infrastructure in the general vicinity of this

site. These are issues primarily associated with the maintenance of the current stormwater drainage system and the existence of sediment and high water levels in this infrastructure.

The planning proposal submitted for this site was based on Councils Concord West Precinct Master Plan (JBA) completed in 2014. This masterplan included the redevelopment of this subject site (amongst several others) into a medium density residential development.

The stormwater drainage design included in the proposal will manage the stormwater around the site, so water is conveyed in a controlled manner around and out of the site. Currently stormwater and overland flows are arriving and discharging from the site in an uncontrolled manner. The developer of this site is not responsible for the conveyance system, and/or its maintenance, upstream or downstream, of this site.

It is proposed to include the on-site stormwater drainage infrastructure and associated documents into the strata title plan and by laws for the proposed development. Most, if not all medium density and high density developments in NSW include by laws with these types of responsibilities, if not for flood but also for fire. This include such things as the internal roadways, gardens, stormwater drainage infrastructure. As such, it is considered that there will be appropriate management of the stormwater drainage infrastructure into perpetuity by way of common by law protection.

2.3 Impact on government spending

2.3.1 Off-site Stormwater infrastructure maintenance spending

The proposed development does not have an impact on the stormwater system (no additional water, can handle blockage and will slow the water into the downstream culverts), as there is minimal change in impermeable area, no changes to the Council network and no increase in peak flows at the Homebush Bay Drive culvert. Therefore there is no cost or requirement for the upgrade to any element of Council's drainage system, either upstream or downstream.

The cost and responsibility of undertaking any maintenance works within the development site itself would be covered under the Strata funding for the development and, as such, would be shared by all future property owners, as legally required by the by laws registered on title. No level of government would be responsible for the maintenance of stormwater infrastructure on this site. Therefore, there is no requirement for additional maintenance to be undertaken by Council, RMS and/or SOPA beyond what these organisations currently undertake in their respective jurisdictions to maintain the functioning and capacity of their respective stormwater drainage assets.

Catchment Sediment Contribution

A thorough site inspection was undertaken by Cardno on 7 August 2020. This site inspection assessed the current condition of the existing stormwater drainage infrastructure upstream and downstream of the site, the outlet from the site, downstream culverts under Homebush Bay Drive and provided comment on the vulnerability of councils stormwater infrastructure to sediment deposition and sea level rise.

A review of aerial imagery, in conjunction with site visits, indicate that there are no substantial sources of sediment in the upstream catchment which are generating extensive deposition on the existing site.

The potential for areas or developments that generate sediment into the stormwater drainage infrastructure to be located within the upstream catchment in future is almost nil, as the area is already developed with primarily low density residential and will likely move towards medium to high density residential in the future, with less open ground surfaces. As the proposed development will not change the generation of sediment within the upstream catchment, with the minimal evidence of sediment deposition issues currently experienced on site, the site improvements to manage potential sediment generation from the developed site will not place any additional requirements on government for maintenance or management of stormwater. The planned development will reduce the potential for sediment generation from within the site itself by redeveloping, paving and landscaping the northern section of the site, which is currently open gravel and partially grassed.

Resident Complaints

One of the main concerns of Council appears to be that the changes in land use will mean additional complaints to Council regarding either the on-site stormwater or the Homebush Bay Drive culverts. As discussed, the strata body will ensure that the on-site works will be maintained, relatively simple actions can be taken to prevent salt water ingress.

2.3.2 Flood Emergency Management Expenditure

The flood management of the site includes a Flood Emergency Management Plan (FEMP). This plan will also be included in the strata by-law plans for the site. Part of this FEMP includes vertical evacuation (for ground floor residents) and shelter in place during times of larger rainfall events. The FEMP would also prevent people from leaving the site in vehicles during a flood event. One of the key actions would be to close the flood gates within the development car park to stop the ingress of flood waters in extreme floods approaching the PMF (if the lip of the car park is not above the PMF in the detailed design). This would also prevent residents and visitors from leaving the development and potentially requiring flood rescue should they get trapped trying to traverse flooded sections of local roads. Flood gates on the entrance to underground carparks are commonly used at many sites around Sydney to mitigate flood flows into the carpark. Alternatively if the lip of the carpark is raised to above the PMF, the standard access gates will be used to prevent vehicles leaving the site.

The building is proposed to be designed to withstand the forces applied by the flooding and constructed using flood compatible materials up to and including the PMF flood level. The detail design of this will be included in the Development Application stage. This resilient building design will enable safe refuge on site for the duration of the flood level event, which is predicted to last less than 4 hours, including during the PMF. The ground floor level is set at 3.2 m AHD which provides 0.8 m – 0.9 m freeboard above the 1% AEP flood under climate change conditions (0.9 m of sea level rise and a 30% increase in rainfall intensity). This is significantly higher than the minimum requirement of the 1% AEP (current conditions) plus

0.5 m freeboard. Therefore, minor inundation of the ground floor is only expected to occur in extreme floods approaching a PMF event in the distant future. The flood which would initiate overfloor flooding on the ground floor is estimated to be a flood with an annual recurrence interval greater than 1 in 400,000 AEP (0.00025% AEP). The implementation of flood mitigation option 2 and the flood emergency management plan have been designed to mitigate the risks to life and property associated with flooding with the proposed development.

The flash flood nature of flooding in the catchment mean that it is unlikely that the NSW SES would not be able to respond in a timely manner to any flood event. The flash flooding on the site would rise and fall within 4 hours. The NSW SES official flood evacuation timeline guideline requires an initial 6 hour mobilisation effort for their personnel in which time the flooding on the subject site has gone. Hence the need for an onsite FEMP. As such, there is no requirement for additional government spending for emergency management requirements as a result of this development, with the implementation of the proposed flood management plans for the site. Through the implementation of these features of the FEMP, there would be no extra requirements for government spending on flood emergency management for the site.

3 CONCLUSION

This report has reviewed and evaluated the issues raised by Council and DPIE and has demonstrated that this development is consistent with the Ministerial Directions 9.1 of the Environmental Planning and Assessment Act 1979. Specifically, we have addressed the DPIE and Council's concerns and shown that:

- The site is not located in a floodway and that the usage of the term in the Jacobs report was done so in error
    1. This has been confirmed with a qualitative and quantitative approach
    2. Using industry accepted approach, the development does not meet the criteria that a floodway would be required to feature
    3. Undertaking flow calculations as defined by the FDM to re-confirm hydraulic categorisation
    4. This confirms the 2018 modelling that demonstrates the perimeter of the site is affected by 'flood fringe' pre-development and the site is further improved post-development
- There will not be any increase or requirement for government spending on the subject site or outside of the site as the development's design is effective and does not require complex actions in order to ensure its operation
    1. The flooding duration is relatively short at 4 hours
    2. Only during the rare event of PMF would ground floor occupants have to relocate to level 1. Vertical evacuation practice is not uncommon and would only necessary for a short period on a very rare occurrence
    3. A simple, procedural maintenance programme is all that is required to ensure the efficient ongoing operation of the mitigation option and one that can be managed within the framework and jurisdiction of an owner's corporation and general maintenance worker/s
- The increase in development of the land is a minor inconsistency as the proposed development manages the flood risk to property and life through design and a simple maintenance programme.
    1. The ground floor levels are set at 1 metre above the 1% AEP design flood level, which is 0.5 metres above the NSW Governments Floodplain Development Manual 2005 and Council requirements.
    2. The mitigation option included in the development has been demonstrated not to create floodway conditions, with flood fringe defined and modelled at eastern boundary only.
- The proposed development has been modelled to not have significant impact on flooding of adjacent properties even when utilising a conservative 50% blockage rate at the inlet and through the conveyance system.

4 REFERENCES

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- Howells L, McLuckie D., Collings G., Lawson N. (2003), Defining the Floodway – Can One Size Fit All?. FMA NSW Annual Conference, Forbes, February 2003
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Appendix A
DPIE Submissions Report - flooding issues and Proponent Response

Table 2 Assessment of Ministerial Direction 4.4 and issues raised by DPIE

Ministerial Direction	DPIE Concern Section 4.1 of DPIE Submissions Report 25 June 2020	Our Response
Part 6 of Direction 4.3 requires that a planning proposal must not contain provisions that apply to flood planning areas which:		
(a) permit development in floodway areas,	The Department considers that more explanation is needed as to why the planning proposal is considered not to be located in a floodway	**There is no floodway on the site. The term 'floodway' is defined in the Floodplain Development Manual (2005). The HydroSpatial (2018) study mapped and defined hydraulic categories at and around the site using the most commonly used and accepted methodology in NSW referencing Howells et al, 2004. The results did not map any floodway on the site in either pre or post development conditions.** The 'Floodplain Development Manual' (NSW Government, 2005) defines a floodway as: *Those areas where a significant volume of water flows during floods and are often aligned with obvious natural channels. They are areas that even if only partially blocked, would cause a significant increase in flood levels and/or a significant redistribution of flood flow, which may in turn adversely affect other areas. They are often, but not necessarily, areas with deeper flow or areas where higher velocities occur.* The 'Floodplain Development Manual' does not give explicit directions on how a floodway is defined. However, there are a number of industry accepted methods that have been developed for defining floodways. The method most widely used on when undertaking flood studies in NSW, floodplain risk management studies and the preparation of floodplain risk management plans is provided in Howells et al (2004) and undertaken in accordance with the requirements of the 2005 Floodplain Development Manual. This method has been adopted for this study to map the hydraulic categories within the site and external to the site. This method applies the following criteria to define three hydraulic categories as follows: Floodways: Velocity x Depth greater than 0.25 m2/s and Velocity greater than 0.25 m/s; or Velocity greater than 1 m/s. Flood Storage

Ministerial Direction	DPIE Concern Section 4.1 of DPIE Submissions Report 25 June 2020	Our Response
		Areas which do not operate as floodways but where the depth of inundation exceeded 1 m. Flood Fringe Remaining area of land affected by flooding, and area not defined as floodway and flood storage. Figure A8 (reproduced as Figure 2 in this report) of the 2018 Flood Study maps the hydraulic categories (i.e., floodway, flood storage and flood fringe) through the site during the 1% AEP design flood under Pre-development Conditions. Figure D10 (reproduced as Figure 3 in this report) of the HydroSpatial (2018) report maps the hydraulic categories under Post-development Conditions (based on mitigation Option 2). These Figures show that there is no floodway mapped within the site in a 1% AEP flood under Pre-development Conditions or under Post-development Conditions. The proposed development (as part of mitigation Option 2) is suspended above ground or raised in order to create a void beneath the development to maintain flood storage volume and the pattern of flood flow through the property in a 1% AEP flood. The Option 2 results reported in the 2018 study included a conservative allowance of a 50% blockage rate of the inlet opening as contingency and good practice. The blockage represents a scenario where access to the void is inaccessible for an extraordinary reason and that significant amounts of particularly sized debris are conveyed from upstream properties into the void opening. This is an unlikely scenario but a modelled scenario that is conservative and includes significant contingency The Options 2 results demonstrate that in a 1% AEP flood the proposed development has negligible impact on flood levels. The modelling also shows that it does not 'redistribute flood flow' even with 50% blockage of the inlet opening. We do note the 'Concord West Precinct Master Plan Flood Study' (Jacobs, 2016) study uses the term "floodway" throughout the document despite the term floodway not being formally defined in the report nor were the hydraulic categories defined. It is our interpretation that the Jacobs study uses the term "floodway" interchangeably without consideration of its criteria, its formal definition and is used in a generic sense. See Section 2.1 in this report that discusses this further and also

Ministerial Direction	DPIE Concern Section 4.1 of DPIE Submissions Report 25 June 2020	Our Response
		includes the evaluation and calculations undertaken to confirm the floodway definition. Despite labelling the mitigation option as a 'floodway' in the 2016 Jacobs report, it would be inconsistent and in error for Jacobs to develop and design a mitigation option that would result in floodway conditions. We have demonstrated that there are no floodway conditions that occur on or around the site (see Section 2.1), The proposed development's mitigation solution and design is largely consistent with the mitigation solution that was developed and included in the 2016 Jacobs report. The Jacobs report refers to the suggested mitigation option for the site as a "floodway" rather than as a naturally occurring floodway through the site (as shown on page 6 of the Submissions Report). It is therefore concluded that the proposed development complies with this requirement because it has been demonstrated that there is no floodway mapped through the site before and after development. In addition, modelling has shown that the development does not significantly redistribute flood flow or significantly increase flood levels even under a simulated (and unlikely) scenario of a 50% blockage rate of the inlet opening.
(b) permit development that will result in significant flood impacts to other properties,	The Department is concerned to ensure that the proposed mitigation works do not adversely affect other properties should a blockage or problem with the mitigation cause the diversion of flow onto neighbouring sites.	**The proposed mitigation structure has been modelled and tested using a conservative 50% blockage rate to simulate the unlikely event of significant blockage and for additional contingency and found there was no adverse impact on neighbouring properties. Cardno have undertaken a blockage assessment in accordance with Australian Rainfall and Runoff (2019) which found that 50% blockage is conservative in all rain events, and assumes that access to the mitigation structure is prevented for safety.** **NSW OEH, who are the recognised flood experts within the State Government have concluded through agency referrals that the HydroSpatial (2018) report adequately addresses the flooding impacts of the proposed development and rezoning of the site.** The proposed development (as part of mitigation Option 2) is suspended above ground or raised in order to create a void beneath the development to maintain existing flood storage volume and the pattern of flood flow through the property in a 1% AEP flood. The Option 2 results demonstrate that in a 1% AEP flood the proposed development has negligible impact on

<table>
<tr><th>Ministerial Direction</th><th>DPIE Concern
Section 4.1 of DPIE Submissions Report
25 June 2020</th><th>Our Response</th></tr>
<tr><td></td><td></td><td>
flood levels nor does it redistribute flood flow even with 50% blockage of the inlet opening.

In fact, small reductions in flood levels of up to 5 cm are predicted across some neighbouring properties during the 1% AEP flood.

An assessment of two blockage scenarios for the inlet opening have been recently undertaken in accordance with the guidance given in Chapter 6 of Book 6 in the 2019 version of Australia Rainfall & Runoff. Two scenarios were assessed as follows:

A 22 m x 1 m high clear opening – which represents the proposed opening; and

A (notional) 3 m x 1 m high clear opening – based on intermediate columns in the opening notionally spaced 3 m apart.

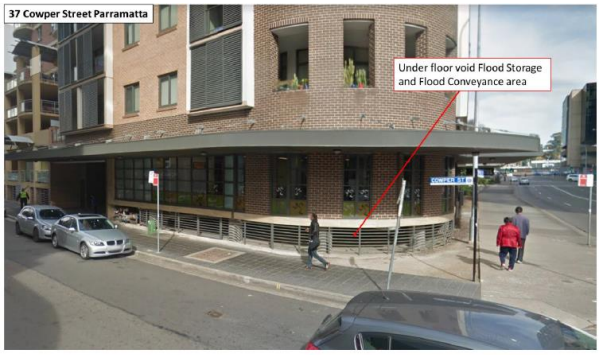
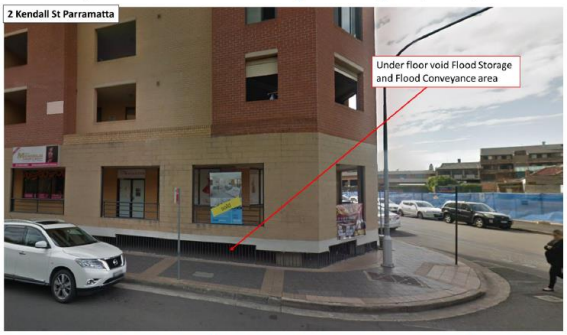
The assessed rates of blockage were:

<table>
<tr><td>Clear Opening Width (m)</td><td>22</td><td>3</td><td>22</td><td>3</td></tr>
<tr><td></td><td colspan="2">Inlet (debris)</td><td colspan="2">Barrel (sediment)</td></tr>
<tr><td>> 5% AEP</td><td>0%</td><td>0%</td><td>0%</td><td>0%</td></tr>
<tr><td>5% - 0.5% AEP</td><td>0%</td><td>10%</td><td>0%</td><td>0%</td></tr>
<tr><td>< 0.5% AEP</td><td>10%</td><td>20%</td><td>25%</td><td>25%</td></tr>
</table>

Section 6.4.4.1 suggests that an extreme blockage consequences assessment can be undertaken using 2*BDES% (S6.4.4.11, Book 6, ARR, 2019).

The assessment of 50% blockage of the opening in a 1% AEP flood exceeds the extreme blockage consequences criterion.

It is noted that the proposed perforated blocks which it has been proposed to install to limit unauthorised access to the void represents a substantial reduction in the available water area.
</td></tr>
</table>

Ministerial Direction	DPIE Concern Section 4.1 of DPIE Submissions Report 25 June 2020	Our Response
		Consideration could be given to achieving the same outcome i.e. deny access using a different approach by installing a bar screen with bars spaced 0.15 m apart perpendicular to the wall (see images below of similar approaches implemented in Parramatta) and tied in to the rear fence to preclude access and retention of the existing fence opposite the 22 m wide opening. If the boundary fence fails for any reason during a flood and the debris of a suitable size to pass through the bar screen, then the debris would be transported through the opening with minimal potential for blockage at the opening and conveyed through the void or possibly deposited in the void. Either way the impact on flood levels would be negligible.  *Plate 6 Example of under floor void flood storage and conveyance (37 Cowper St Parramatta)*  *Plate 9 Example of under floor void flood storage and conveyance (2 Kendall St Parramatta)*
(c) permit a significant increase in the development of that land and	(i) The Department considers that: Despite the site being identified in Council's draft Concord West Master Plan (2014) and the PRCUTS for rezoning to	**This report as well as others to date have demonstrated that flood risk is able to be managed on site. The implementation of the Jacobs mitigation option has also been tested and confirmed to not only result in no significant adverse effects on the site and neighbours but a mild improvement to some surroundings lands. Specifically, the following issues are addressed on site, confirming the management of risk on the site, thereby permitting safe development of the land:**

Ministerial Direction	DPIE Concern Section 4.1 of DPIE Submissions Report 25 June 2020	Our Response
	medium density residential, the subsequent flood study (2016) raises significant and unresolved flooding issues. Council's LSPS recommends implementing the recommendations of the draft Concord West Precinct Master Plan Flood Study which includes introducing LEP and DCP controls. The Jacobs flood study also recommends that Council prepare a revised planning strategy for the site based on its findings.	**1. The ground floor levels are set at 1 metre above the 100 year ARI level, which is 0.5 metres above the FPM 2005 and Council requirements.** **2. The mitigation option has been demonstrated not to create floodway conditions, with flood fringe defined and modelled at eastern boundary only.** The stated objective of the IGS, 2016 assessment was … *to address the following considerations for planned development of the site which are based on contemporary planning requirements in other LGAs which consider the development of land with similar flood affectation as the subject site*: On precedent, developments located on the Parramatta River and Clay Cliff Creek floodplains are subject to similar or more extreme flooding conditions than the proposed development. Furthermore, the proposed development was previously assessed against the requirements of the Parramatta DCP 2011, which detail, more stringent and contemporary planning requirements. The merit assessment contained within the Parramatta DCP 2011 would satisfy the requirements for development in a Medium Flood Risk Precinct except in relation to the very localised adverse impact on 1% AEP flood levels at the western end of Station Avenue, near where a Council drainage asset is located. . Section 2 of the Parramatta DCP 2011 describes site planning considerations including design objectives, design principles and design controls. On the basis that the subject site is subject to low hazard in a 1% AEP flood (refer Maps C-27 and D-5 in Jacobs, 2015 and Map A9 and in 2018 Flood Study) the site would be classified as being located in a Medium Flood Risk Precinct. As a guide to the City of Canada Bay, the development was assessed against the planning and development controls that apply to "Residential" in a Medium Flood Risk Precinct. The ground floor level is set well beyond the minimum habitable floor level at 3.2 m AHD which provides 0.8 m – 0.9 m freeboard above the 1% AEP flood under climate change conditions (0.9 m of sea level rise and a 30% increase in rainfall intensity). Inundation of the ground floor, which only occur in floods greater than a 400,000 yr ARI (0.00025% AEP) means that ground floor occupants can evacuate safely to upper levels on site and is in stark contrast to the far higher risk

Ministerial Direction	DPIE Concern Section 4.1 of DPIE Submissions Report 25 June 2020	Our Response
		of flooding experienced by staff and visitors(up to 100) at the industrial site. The recommendation from the Jacobs study is now at least four years old. Council has not taken any action on preparing any additional studies and the site was subsequently identified in the Parramatta Road Corridor Urban Transformation Strategy (PRCUTS) for renewal. Further, we note that previous panel members also recommended that a precinct wide Flood Plain Risk Management Plan be prepared; this was pursued by the client with the DPIE who offered to contribute financially however, Council were not willing to participate in the study, which is a requirement of the plan being prepared. Therefore, the proponent has proceeded without this council sponsored study in place.
	(ii) The Department is concerned about the highly engineered mitigation option proposed and the ongoing risks to public safety that will be the responsibility of the strata body corporate, Council and the SES to manage.	**While the proposed development does increase the population on the site, the risk to the population has been demonstrated to be able to be managed on site. The risk is also further reduced and improved over the current building/landform through the mitigation measures as envisaged by Jacobs as part of the development.** **The design and the operation in normal conditions or in 1% AEP events is not designed or dependant on external agencies or services such as the NSW SES. The proposed shelter-in-place emergency management is appropriate and commonly accepted in NSW, particular given the relatively short warning time and short duration (4 hours) of flooding.** There is no intention to require or rely on NSW SES during flood events as it has not been modelled to be required. Evacuation of residents and any visitors from only the ground floor to higher levels in the various buildings during extreme floods. It is unclear that the SES could even reach the site during a short duration PMF. In the case of the PMF, the limited time available prior to the peak of the PMF means that the PMF peak is likely to be reached even before the NSW SES could mobilise. The only way that the NSW SES could react in sufficient time would be if it received an accurate warning from the BoM that disclosed a high likelihood of an extreme storm tracking over the local catchment hours ahead of the actual

Ministerial Direction	DPIE Concern Section 4.1 of DPIE Submissions Report 25 June 2020	Our Response
		storm reaching the location and mobilise in anticipation, and possibly also ignore other requests for help. The proposed shelter-in-place strategy for extreme PMF floods is appropriate given the relatively short warning time and short duration of the flooding and is consistent with the emergency response strategy for adjoining areas. This proposed shelter-in-place strategy will be developed and implemented through a Flood Emergency Management Plan (FEMP), typically as part of a Development Application. The FEMP will detail the obligations of future landowners, provisions for strata bylaws, education provisions, specify all necessary wayfinding and signage, devise exact paths and routes, provide backup options and outline the warning/trigger system to commence the shelter-in-place strategy. (Section 7.5.1 of the Revised Flood Impact Assessment, June 2018). As detailed in the Department's report, the Chief Engineer points out, this approach has merit and is consistent with other developments. As part of the strata bylaws, prior to purchasing or renting a property, future ground floor residents will be informed of the FEMP and the strategy in force for PMF or greater events. Residents will need to sign a register saying they have read and understood the FEMP (Refer Table 8 of the 2018 Flood Impact Assessment). The shelter-in-place strategy of the FEMP will be similar to a fire drill. During a flood, the building warden via a Public Announcement system will advise all occupants that the FEMP trigger has been activated and that all occupants should be aware not to attempt to leave the site. It should be noted that other developments in the precinct under PMF events would be experiencing similar behaviour. In the case where the basement car park driveway crest is elevated to just above the PMF level and there is access from the basement to Level 1 above the PMF, then the proposed development does not include any mechanical parts or require maintenance of complex machinery or infrastructure. The requirement would be simply that the entrance to the conveyance area and the void area itself is kept unblocked. As discussed, this is not expected to be an onerous or a large ongoing cost to the strata body and is also a common undertaking for many multi-unit and strata developments throughout NSW. If a flood gate is used to protect the car park entrance, then this will need to be maintained and this responsibility would fall on the strata body. Again, this is

Ministerial Direction	DPIE Concern Section 4.1 of DPIE Submissions Report 25 June 2020	Our Response
		routine maintenance and operation able to be managed independently on site and would not pose any additional maintenance burden on Council.
	(iii) The flood studies highlight risks with the proposed flood storage areas and a floodway which are located close to the building footprints. Both the flood storage areas and the floodway are considered hazardous to children on the basis of depth of the flood behaviour. Considering safety to people, both the flood storage areas and floodway would require flood compatible fencing and ongoing maintenance to avoid blockages and public health concerns.	**The flood studies undertaken in 2016, 2016, 2018 and the work comprising this report have confirmed the ability for the site to support the proposed development. The Jacobs report identified low flood risk and devised a mitigation solution, which comprises a simple void for the conveyance of water. Various modelling undertaken to date has shown that this mitigation solution not only results in no significant adverse effects on properties but minor improvements to flood levels on neighbouring properties. The void is not a floodway and has never been formally or scientifically defined or deemed to be one.** **The void being located within the building is an advantage and ensures that ownership and responsibility of the void remains with the building. It should be noted that the void is inaccessible from above as the proposed building is built over it creating additional security for access unlike any of the open channels you see running through Sydney's urban areas (inner west Sydney, western Sydney, greenfield areas). The void is not dissimilar to any flow path in an urban environment and will be protected from access at the entrance and exit using any number of standard, BCA treatment options that will be implemented to avoid potential risk that children or adults would step off the platform into hazardous floodwaters. The Flood Emergency Response Plan would formalise and incorporate the objectives and strategies to all residents and visitors** As concluded in the discussion under Item (a), there is no floodway mapped through the site and the development does not significantly redistribute flood flow or significantly increase flood levels even under 50% blockage of the inlet opening. The 2016 Jacobs report did not delineate hydraulic categories and used the floodway term in error to label their own proposed mitigation solution, which is clearly inconsistent. To test this, studies undertaken in 2016, 2018 and again now, have confirmed that conditions in the void and around the site do not meet floodway criteria qualitatively or quantitively. The proposed flood management infrastructure and associated flood storage areas will be all located on land that will be

Ministerial Direction	DPIE Concern Section 4.1 of DPIE Submissions Report 25 June 2020	Our Response
		private property and all habitable areas will be elevated well above floodwaters being 1 metre over the 1% AEP flood level, a whole 500mm over and above any general requirement for freeboard. To avoid potential risk that children or adults would step off the platform into catchment flows, under heavy and extreme flooding events, a number of treatments are available including: Fencing or a dense (prickly) vegetated barrier along those edges of the platform where there is a vertical or steep decline from the platform to a lower surrounding ground level to prevent children or adults approaching the edge; and/or A flatter grade on any slope to allow a child or adult to clamber back onto the platform if they inadvertently enter the floodwaters; and/or A shallow bench along the edge where any child or adult who inadvertently steps into floodwaters only steps into shallow floodwaters or is able to clamber back onto the platform. The incorporation of any or all of these treatment options would be assessed during the detail design stage as part of the DA stage. Blockage concerns are addressed under Item (b) above.
(d) are likely to result in a substantially increased requirement for government spending on flood mitigation measures, infrastructure or services.	The HydroSpatial report (2018) considers the proposal consistent as the proposed flood emergency response plan for the site will not require additional assistance from emergency services and no external flood mitigation measures or infrastructure will be required. The Department considers that:	See below.

Ministerial Direction	DPIE Concern Section 4.1 of DPIE Submissions Report 25 June 2020	Our Response
	(i) Council has raised concern that the proposal is likely to result in a substantial increase in the requirement for government spending on infrastructure and drainage upgrades. Council raises that maintenance of drainage by way of removing sediment due to frequent inundation of their site which would comprise several hundreds of cubic metres and there is no clear responsibility that this is accepted by all the parties (including Council, RMS & SOPA).	**It is unclear how the proposed development has any impact whatsoever on Council's infrastructure or drainage system. All proposed drainage measures are located on the site and private property. The proposed development does not result in any need to upgrade any element of Council's drainage system. The proposed development would decrease the sediment load rather than increase it and also see minor benefits to flood levels on neighbouring land. The strata body will be responsible for the routine maintenance of drainage infrastructure within the site including the void, just like any strata-held building or even Torrens title held properties. There is no requirement for additional maintenance to be undertaken by Council, RMS or SOPA beyond what these organisations undertake to maintain the function and capacity of their respective drainage assets** The proposed site location is primarily covered by a substantial building, associated paving with a northern part of the site unpaved and a potential source of sediment. A review of aerial images, tenant statement and site inspections indicate that there are no substantial sources of sediment in the upstream catchment which would generate extensive deposition on the existing site. The proposed development of the site will effectively reduce the potential for sediment generation from within the site by redeveloping and paving the northern section of the site. Given that the proposed development will have no effect or change to the generation of sediment in the upstream catchment, there appears to be little evidence of sediment deposition issues on the existing site. The fact that the proposed development is likely to reduce sediment generation within the site, it is unclear how Council has derived its concern. All proposed drainage works are located on the site and private property. The proposed development does not result in any need to upgrade any element of Council's drainage system. It is fully expected that the strata body will be responsible for the routine maintenance of drainage infrastructure within the site including the void. The cost of undertaking any maintenance works would be covered under the Strata funding for the development and, as such, would be shared by all future property owners. An estimated cost to maintain the void monthly, based on 6 hours at $50p/h would equate to $3,600 over a year which equates $12.40 per unit, per year and is not

Ministerial Direction	DPIE Concern Section 4.1 of DPIE Submissions Report 25 June 2020	Our Response
		considered onerous. Therefore, there is no requirement for additional maintenance to be undertaken by Council, RMS or SOPA beyond what these organisations undertake to maintain the function and capacity of their respective drainage assets.
	(ii) State Emergency Service (SES) has also made a submission it believes the proposal will increase the risk to their operations by increasing demand on and risk to NSW SES volunteers and other emergency services to respond to potentially dangerous situations.	**As outlined above, the design and the operation under normal conditions or in 1% AEP events is not designed or dependant on external agencies or services such as the NSW SES. The proposed shelter-in-place emergency management strategy for PMF floods is appropriate and commonly accepted in NSW, particular given the relatively short warning time and short duration (4 hours) of flooding. No emergency response is sought as the proposed development is able to protect occupants in all flood events and not increase the demand on the NSW SES. As the Chief Engineer points out, this approach has merit and is consistent with other developments. OEH has also provided their support for the proposed development. Only in the most extreme PMF flood would ground floor occupants be required to seek higher ground as a precaution for 4 hours only.** It is unclear that the SES could even reach the site during a short duration PMF. In the case of the PMF, the limited time available prior to the peak of the PMF means that the PMF peak is likely to be reached even before the NSW SES could mobilise. The only way that the NSW SES could react in sufficient time would be if it received an accurate warning from the BoM that disclosed a high likelihood of an extreme storm tracking over the local catchment hours ahead of the actual storm reaching the location and mobilise in anticipation, and possibly also ignore other requests for help. Therefore, NSW SES is not relied upon nor is it factored into for the continued and safe occupation of the site. The proposed shelter-in-place strategy for extereme PMF floods is appropriate given the relatively short warning time and short duration of the flooding and is consistent with the emergency response strategy for adjoining areas. This proposed shelter-in-place strategy will be developed and implemented through a Flood Emergency Management Plan (FEMP), typically as part of a Development Application. The FEMP will detail the obligations of future landowners, provisions for strata bylaws, education provisions, specify all necessary wayfinding and signage, devise exact paths and

Ministerial Direction	DPIE Concern Section 4.1 of DPIE Submissions Report 25 June 2020	Our Response
		routes, provide backup options and outline the warning/trigger system to commence the shelter-in-place strategy. (Section 7.5.1 of the Revised Flood Impact Assessment, June 2018)
	(iii) The Chief Engineer of the Department reviewed the responses from SES and the proponent and generally noted that the proponent's emergency response procedures have merit and are consistent with similar engineering practices elsewhere.	**The view of the Chief Engineer of the Department accords with our conclusion that the proposed development satisfies the planning requirements for urban floodplains in Sydney which are subject to similar or more extreme flooding conditions.** This accords with our conclusion that based on the merit assessment detailed above (refer Item (c)) the proposed development and measures to manage flood risks would satisfy the merit assessment of the Parramatta DCP 2011 for development in a Medium Flood Risk Precinct except in relation to the very localised adverse impact on 1% AEP flood levels at the western end of Station Avenue
	(iv) Whilst the proposal does indicate a shelter in place response, the flood risk assessment found that due to the flash flood nature of the catchment, there would be negligible opportunity for vehicular escape from the site prior to or during the flood. Accordingly, emergency services are still featured in the	**"Vehicular escape" during a heavy flood event is not logical behaviour, however, the proposed development ensures residents and visitors are far safer sheltering-in-place than driving in a flood event and risk being trapped on the local road system which is very likely to be cut off in multiple locations during major storms. The Flood Emergency Response Plan will actively discourage people from entering floodwaters by foot or by vehicle. Therefore, there would be no requirement for the NSW SES to assist stranded evacuees. This would be standard practice and a commonly utilised strategy for similar developments in similar environments.** The intent of the proposed scheme is that there be no "vehicular escape" from the site because any residents or visitors are far safer sheltering-in-place. It is unclear where any persons seeking to "escape from the site" would be going in an extreme flood event and given that no evacuation shelters would be prepared during a flash flood. Roads and local infrastructure in the precinct and Sydney generally would be inundated and this would act as a natural deterrent.

Ministerial Direction	DPIE Concern Section 4.1 of DPIE Submissions Report 25 June 2020	Our Response
	plan and therefore will be required to assist should flooding occur.	As part of the FEMP, one of the key actions would be to close the flood gates within the development car park to stop the ingress of flood waters, otherwise if the crest of the basement car park is elevated above the level of the PMF this would not be required. The entrance to the car park would be closedto prevent residents and visitors from leaving the development and potentially requiring flood rescue should they get stranded in floodwaters out of the site. Flood gates on the entrance to underground carparks are used at many sites around Sydney to mitigate flood flows into the carpark. As discussed above, it would take the NSW SES considerable time to mobilise and respond to a flood of a magnitude such as the PMF, therefore any flash flooding would come and go before they could provide assistance to this site. Similarly, it is more than likely that the SES personnel would struggle to respond to a flood emergency at this site during such a large flood event due to the vulnerability to flooding of the road network in the area and surrounding suburbs. The NSW SES is not needed nor is their presence relied upon given the design and mitigation measures adopted for the proposed development.
	(v) The response relies on the strata committee to provide a flood warden and the occupants be made aware of the roles and responsibilities. There may be the potential for visitors to the site and there is also concerns about the rapid nature of the flood indicated in the assessment.	**Strata committees for multi-storey residential apartment developments on urban floodplains across Sydney are all charged with the same responsibility and accepted by consent authorities in NSW. The Flood Warden and public announcement system approach is similar to the approach taken for Fire Emergencies for many years. Only ground flood occupants would need to seek level 1 areas in the extreme PMF flood. All other occupants would shelter-in-place, like most if not all other developments in a similar environment. Maintenance and upkeep of the stormwater infrastructure is also routine, not complex and able to be incorporated into any standard bylaw maintenance programme along with other assets.** In addition to the design measures and maintenance routines incorporated into the building, the FEMP will ensure that occupants be made aware of the appropriate actions to undertake in a response to a flood. This is no different to current requirements listed in Part 9 of the EP&A Regulation (2000) for fire safety and management. As noted, OEH have concluded their support for the proposed development and provided further that these actions could be further enforced

Ministerial Direction	DPIE Concern Section 4.1 of DPIE Submissions Report 25 June 2020	Our Response
		through the provision of signage as well as a sign in register for visitors, which would include flood response information.

Appendix B
Canada Bay Council Email Response to Queries on Floodway Definition

Tim Morrison

From: Brian Woolley <Brian.Woolley@canadabay.nsw.gov.au>
Sent: Friday, 7 August 2020 3:33 PM
To: Tim Morrison
Cc: Stephen Chow; John Earls; Karen Lettice
Subject: FW: Flood enquiry - FW: 7 Concord Ave, Concord West Queries

Hi Tim,
Stephen has referred your questions to me to answer as I have decades of history observing the catchment, the problems on the subject property and surrounds and I have been involved representing Council wrt the proposed rezoning.
I consider it would be preferable for you to refer to and review the source documents rather than rely on a wide ranging summary prepared by the department and probably not by water specialists. Please ensure you are aware of the contents of Jacobs Reports dated 17/2/2017,

1. Amenity Impacts:-
   The proposal includes a chamber above the car park. The height of the chamber is conducive to easy access for cleaning. Given height, distance, area, tidal time constraints, safety and waste disposal et al considerations, any cleaning regime would be expensive and is unlikely to be maintained. The level of the chamber makes it tidal, which means it will be subject to marine sedimentation and the growth, death and decay of marine organisms. During low tides, exposure of these materials will produce odours. The area will be constantly damp. Marine organisms will provide a source of food. Excessive problems with large populations of mosquitos, cockroaches and other insects are anticipated.
2. Floodway Definition:-
   The Floodplain Development Manual defines floodway as "*those areas of the floodplain where a significant discharge of water occurs during floods. They are often aligned with naturally defined channels. Floodways are areas that, even if only partially blocked, would cause a significant redistribution of flood flow, or a significant increase in flood levels.*"
   The Draft Concord West Flood Study was "*generally in accordance with the floodplain risk management process outlined in State*
   Government's Floodplain Development Manual, April 2005" and so presumably adopted this definition. The Exile Bay Catchment Flood Study seems to adopt the same definition. Council recognises the FDM. If you want comment on a methodology you will need to be more specific.
3. Maintenance:-
   Council owns and maintains the public drainage system up-stream of Homebush Bay Drive except for the section within the rail corridor. RMS is responsible for the drainage under Hombush Bay Drive and probably for the sections downstream of the County Road Corridor that were constructed in conjunction with Homebush Bay Drive. SOPA is responsible beyond that. To my knowledge RMS have not cleaned the system (including culverts and trapezoidal channel) in more than 10 years perhaps 20. Water remains stagnant at about the obvert of the Station Ave culvert outlet due to sedimentation levels in the mangroves. SOPA cleared a flow path in the mangroves some years ago but have indicated they will not do so again. Sedimentation rates within the mangrove have been documented and will gradually reduce the effectiveness of the drainage system not withstanding any worsening influence of Sea Level Rise. Should the rezoning proceed, which Council opposes, the change of use will bring different and higher expectations on drainage system performance by more people and thus more frequent requests and complaints and there is no clear acceptance of responsibilities in this area. There will be problems that will not be in Council's power to reasonably solve.
   Given Council opposes the rezoning the question regarding the role and responsibility of the developer is an hypothetical question. An hypothetical answer then, would be that the Developer be responsible for all drainage issues including maintenance within the development and from the development to disposal at Powells Creek and for up steam problems created, for the life of the development. That if the Developer is a

corporate entity that fails or is closed down, the directors at time of approval be held personally responsible. That such responsibility survives any bankruptcy and devolves to their estate and heirs on their death. While that response may be dismissed as facetious the intended message is very serious.

I am willing to guide you on an inspection of site and surrounds if you wish.

This reply is provided in good faith in an effort to assist you and without prejudice to any future Council decision or approval.

Regards
Brian

Brian Woolley | Drainage, Marine & Floodplain Engineer
City of Canada Bay

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T: 02 9911 6339 | Brian.Woolley@canadabay.nsw.gov.au

From: Stephen Chow
Sent: Tuesday, 4 August 2020 2:46 PM
To: Brian Woolley <Brian.Woolley@canadabay.nsw.gov.au>
Cc: John Earls <John.Earls@canadabay.nsw.gov.au>
Subject: Flood enquiry - FW: 7 Concord Ave, Concord West Queries

Hi Brian,

I hope this email find you well.

I received an enquiry from a flood consultant below regarding a rezoning proposal at 7 Concord Avenue, Concord West and he has some questions from the attached document regarding flooding.

Could you please have a look and provide comment or advice if possible?

If you need anything from me, please let me know.

Regards,

Stephen

Stephen Chow | Development Engineer Coordinator
City of Canada Bay

15-17 Regatta Road Five Dock NSW 2046 | www.canadabay.nsw.gov.au
T: 02 9911 6201 | Stephen.Chow@canadabay.nsw.gov.au

From: Tim Morrison [mailto:tim.morrison@csse.com.au]
Sent: Tuesday, 4 August 2020 12:21 PM
To: Stephen Chow <Stephen.Chow@canadabay.nsw.gov.au>
Subject: 7 Concord Ave, Concord West Queries

Hi Stephen,

Thanks for calling me back and your help with this.

To confirm, we have been asked by our client and DPIE to respond to Council's concerns raised as part of the rezoning of 7 Concord Ave, Concord West by issuing an addenda to the 2018 HydroSpatial study that was undertaken. The addendum will be considered by an independent expert that will be appointed by the Planning Panel in the next week or so, as well as DPIE. We therefore need to have our addendum report complete by then, or very shortly after, so that it can be provided to the expert.

For context I have attached the Department of Planning, Industry and Environment's submission report that went to the Planning Panel, which is publicly available.

As discussed, I would appreciate any clarification or information in relation to extracts from the report (**below in italics**), followed by my specific query (in red).

Page 17 (final bullet point) would create unacceptable amenity impacts for future occupiers of the site due to the proposed flood mitigation measures.

- Can you, or someone at Council please provide further detail as to what the amenity impacts refer to, and outline the nature of the impacts.

Page 20 (a) Council's comments consider the subject site to be located in a floodway in accordance with the Floodplain Development Manual 2005 and considers the blockage of the site would cause diversion of flows and impact on upstream levels. The Jacobs (2016) flood study also reference a floodway on the site.

- Can you please provide me with the definition and how Council defines a floodway so that we can compare this to our methodology. My reading of the Jacobs report is that floodway is used in a fairly loose way and is not explicitly defined and therefore cannot be repeated.

I have reviewed the Draft Exile Bay Flood Study that GRC Hydro Pty Ltd is currently undertaking for Council. Is the proposed definition and methodology in this report acceptable to Council?

Page 21 (first bullet point) Council has raised concern that the proposal is likely to result in a substantial increase in the requirement for government spending on infrastructure and drainage upgrades. Council raises that maintenance of drainage by way of removing sediment due to frequent inundation of their site which would comprise several hundreds of cubic metres and there is no clear responsibility that this is accepted by all the parties (including Council, RMS & SOPA).

- Does Council currently maintain the drainage system in that area, and that it goes under Homebush Drive?
- Is the removing of sediment undertaken annually or more frequent?
- What would the additional sediment loads maintenance include?
- What additional work would Council determine the extra spending requirement and what would Council consider appropriate role/responsibility be for the developer?

Thank you in advance, please feel free to give me a call to discuss this with you.

Regards,

Tim Morrison
Senior Water Resources Engineer

Catchment Simulation Solutions

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Local Government PROCUREMENT APPROVED CONTRACTOR

Appendix C
Cardno Blockage AR&R(2019) Assessment

BLOCKAGE CALCULATIONS - ARR (2016) Book 6 Chapter 6

Project: Lot 1 DP219742 Concord West
Structure/Drawing: Culvert
Location & LGA: Concord West
Designer/Engineer:
Checked by: BCP
Date: 29/06/2020

User Defined Text & Parameters

Side notes: S=Section, T=Table in ARR Bk6 Ch6

STEP 1: Setup Details		
Catchment Area:	15.7	ha or km2
Source Area (&Landuse):	Urban	S6.3.3
Inlet Blockage Data (floating /non-floating debris)		
Description:	Sticks, fallen tree limbs, bins, palings	
How assessed:	Visual assessment	
Inlet Clear Width **(W)**	22	(m)
Inlet Clear Height **(D)**	1	(m)
Check W/D<=3	22.0	(m/m) S6.4.4.8
L_{10}	1.5	(m) S6.4.4.1
Barrel Blockage Data (sediment & bedload)		
Description:	Coarse gravel. Limited sand and silt	
How assessed:	Visual assessment	
D_{50}	1	(mm)
Barrel velocity **(V)**	0.5	(m/s)

STEP 2: Debris Potential at Structure for 1% AEP			
Blockage Location	Inlet (debris)	Barrel (sediment)	
Availability (H,M,L)	H	L	S6.4.4.2 & T6.6.1
Mobility (H,M,L)	M	M	S6.4.4.3 & T6.6.2
Transportability (H,M,L)	M	H	S6.4.4.4 & T6.6.3
Combined Result	HMM	LMH	
1% Debris Potential	MED	MED	S6.4.4.5 & T6.6.4

STEP 3: AEP Adjusted Debris Potential (S6.4.4.6 & T6.6.5)			
Event AEP(%) [1:yr]	HIGH	MED	LOW
>5% [<1:20]	Med	Low	Low
5%-0.5% [1:20 - 1:200]	High	Med	Low
<0.5% [>1:200]	High	High	Med

STEP 4: Inlet Blockage Level (S6.4.4.7 & T6.6.6)			
AEP Adjusted Debris Potential At Structure (Inlet)			
Control Dimension	High	Med	Low
$W < L_{10}$	100%	50%	25%
$L_{10} <= W <= 3*L_{10}$	20%	10%	0%
$W > 3*L_{10}$	10%	0%	0%

STEP 5: Likelihood of Sediment Deposition in Barrel (T6.6.7)					
Sediment (Type & D_{50})	Clay/Silt	Sand	Gravel	Cobbles	Boulders
Structure Velocity (m/s)	<=0.04mm	>0.04-2mm	>2-63mm	>63-200mm	>200mm
>=3.0	*low*	*low*	*low*	*low*	*med*
1.0 to < 3.0	*low*	*low*	*low*	*med*	*med*
0.5 to < 1.0	*low*	*low*	*low*	*med*	*high*
0.1 to < 0.5	*low*	*low*	*med*	*high*	*high*
< 0.1	*low*	*med*	*high*	*high*	*high*

STEP 6: Depositional Blockage Levels (T6.6.8)			
AEP Adjusted Sediment Potential At Structure (barrel)			
Likelihood of Deposition	High	Med	Low
high	100%	60%	25%
med	60%	40%	15%
low	25%	15%	0%

STEP 7: BLK-DES%	**Inlet (Debris)**		**Barrel (Sediment)**	
Event AEP(%) [1:yr]	**MED**	**STEP 4**	**MED**	**STEP 6**
>5% [<1:20]	Low	0%	Low	0%
5%-0.5% [1:20 - 1:200]	Med	0%	Med	15%
<0.5% [>1:200]	High	10%	High	25%

STEP 8: RISK ASSESSMENT & SENSITIVITY ANALYSIS

ASSESS:

1). Extreme blockage consequences using 2*BDES% (S6.4.4.11)
2). Worse case downstream flooding using "All Clear" case (S6.4.5)

If CONSEQUENCES HIGH:

Flood Study: Review blockage parameters. Notify asset owner.
Design: Review blockage parameters. Mitigate Risk. **(see S6.6)**

BLOCKAGE CALCULATIONS - ARR (2016) Book 6 Chapter 6

Project: Lot 1 DP219742 Concord West
Structure/Drawing: Culvert
Location & LGA: Concord West
Designer/Engineer:
Checked by: BCP
Date: 29/06/2020

User Defined Text & Parameters

Side notes: S=Section, T=Table in ARR Bk6 Ch6

STEP 1: Setup Details		
Catchment Area:	15.7	ha or km2
Source Area (&Landuse):	Urban	S6.3.3
Inlet Blockage Data (floating /non-floating debris)		
Description:	Sticks, fallen tree limbs, bins, palings	
How assessed:	Visual assessment	
Inlet Clear Width **(W)**	3	(m)
Inlet Clear Height **(D)**	1	(m)
Check W/D<=3	3.0	(m/m) S6.4.4.8
L_{10}	1.5	(m) S6.4.4.1
Barrel Blockage Data (sediment & bedload)		
Description:	Coarse gravel. Limited sand and silt	
How assessed:	Visual assessment	
D_{50}	1	(mm)
Barrel velocity **(V)**	0.5	(m/s)

STEP 2: Debris Potential at Structure for 1% AEP			
Blockage Location	Inlet (debris)	Barrel (sediment)	
Availability (H,M,L)	H	L	S6.4.4.2 & T6.6.1
Mobility (H,M,L)	M	M	S6.4.4.3 & T6.6.2
Transportability (H,M,L)	M	H	S6.4.4.4 & T6.6.3
Combined Result	HMM	LMH	
1% Debris Potential	MED	MED	S6.4.4.5 & T6.6.4

STEP 3: AEP Adjusted Debris Potential (S6.4.4.6 & T6.6.5)			
Event AEP(%) [1:yr]	HIGH	MED	LOW
>5% [<1:20]	Med	Low	Low
5%-0.5% [1:20 - 1:200]	High	Med	Low
<0.5% [>1:200]	High	High	Med

STEP 4: Inlet Blockage Level (S6.4.4.7 & T6.6.6)			
AEP Adjusted Debris Potential At Structure (Inlet)			
Control Dimension	High	Med	Low
$W < L_{10}$	100%	50%	25%
$L_{10} <= W <= 3*L_{10}$	20%	10%	0%
$W > 3*L_{10}$	10%	0%	0%

STEP 5: Likelihood of Sediment Deposition in Barrel (T6.6.7)					
Sediment (Type & D_{50})	Clay/Silt	Sand	Gravel	Cobbles	Boulders
Structure Velocity (m/s)	<=0.04mm	>0.04-2mm	>2-63mm	>63-200mm	>200mm
>=3.0	*low*	*low*	*low*	*low*	*med*
1.0 to < 3.0	*low*	*low*	*low*	*med*	*med*
0.5 to < 1.0	*low*	*low*	*low*	*med*	*high*
0.1 to < 0.5	*low*	*low*	*med*	*high*	*high*
< 0.1	*low*	*med*	*high*	*high*	*high*

STEP 6: Depositional Blockage Levels (T6.6.8)			
AEP Adjusted Sediment Potential At Structure (barrel)			
Likelihood of Deposition	High	Med	Low
high	100%	60%	25%
med	60%	40%	15%
low	25%	15%	0%

STEP 7: BLK-DES%	**Inlet (Debris)**		**Barrel (Sediment)**	
Event AEP(%) [1:yr]	**MED**	**STEP 4**	**MED**	**STEP 6**
>5% [<1:20]	Low	0%	Low	0%
5%-0.5% [1:20 - 1:200]	Med	10%	Med	15%
<0.5% [>1:200]	High	20%	High	25%

STEP 8: RISK ASSESSMENT & SENSITIVITY ANALYSIS

ASSESS:

1). Extreme blockage consequences using 2*BDES% (S6.4.4.11)
2). Worse case downstream flooding using "All Clear" case (S6.4.5)

If CONSEQUENCES HIGH:

Flood Study: Review blockage parameters. Notify asset owner.
Design: Review blockage parameters. Mitigate Risk. **(see S6.6)**