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14 April 2023

SY200410_B01_[E]

Cambridge Unit Developments
C/- Chris Ryan
Ionic Management Pty Ltd
PO Box 165
Cronulla, NSW, 2230

Dear Chris,

Re: 143 Stoney Creek Road, Beverly Hills – Flood Risk Impact Assessment for Planning Proposal submission.

Northrop Consulting Engineers have prepared a Flood Risk Impact Assessment, on behalf of their client, Cambridge Unit Developments, care of Ionic Management Pty Ltd. Cambridge Unit Developments is seeking to rezone 143 Stoney Creek Road, Beverly Hills, herein referred to as the "subject site".

The purpose of this letter is to support the Planning Proposal submission prepared by Sutherland and Associates Planning and dated March 2022. In doing so, this correspondence will assess the flooding related risks of the planning proposal submission and compliance with relevant planning controls.

The following provides an outline of the subject site locality, a summary of the proposed rezoning, some background of previous flood assessments performed for the subject site as well as the proposal's compliance with the relevant planning controls.

Subject Site Description

The subject site is located on the southwestern corner of the intersection of Stoney Creek Road and Cambridge Street, Beverly Hills. It includes the parcel of land at 143 Stoney Creek Road, otherwise known as Lots 2 and 3 of DP1205598. The subject site is located within the Hurstville portion of the Georges River Council (GRC) Local Government Area (LGA).

The subject site former use was a Roads and Traffic Authority (RTA) training facility which was sold by the NSW State Government in 2018. Infrastructure on the subject site includes an existing training facility located in the north-eastern portion of the property with the remainder of the site largely made up of the associated carpark and landscaping. Detailed survey suggests the ground surface is relatively flat across the site with elevations generally ranging from 29.90m AHD to 30.25m AHD.

An existing Sydney Water 1.981m wide by 1.219m high Reinforced Concrete Box Culvert (RCBC) and associated easement traverses the site. The easement extends from the southern boundary (in a north-easterly direction across the subject site), which then continues beneath Stoney Creek Road to the north.

The subject site is predominately zoned SP2 (Infrastructure) with a portion also zoned R2 (Low Density Residential). The SP2 (Infrastructure) zoning generally limits the existing facility for use for Public Administration purposes only, significantly limiting the occupation capacity and use of the existing facility. As a result, the site largely remains un-occupied.

The Proposal

The proposal seeks to rezone the property from R2 (Low Density Residential) and SP2 (Infrastructure) to R4 (High Density Residential). The change in zoning is generally consistent with other zoning boundaries observed in the area with R4 (High Density Residential) zoning and land use already observed on the northern side of Stoney Creek Road.

The proposal is intended to enable the interim use of the existing facility for commercial purposes and ultimately facilitate the introduction of a new residential flat development on the subject site. A concept plan of the ultimate proposed development has been prepared by Ionic Management and has been included as part of the submission package prepared by Sutherland and Associates Planning (March 2022).

Background

Flooding across the subject site has been assessed as part of the Overland Flow Flood Study for Hurstville, Mortdale and Peakhurst Wards, prepared by SMEC in 2016, herein referred to as the "HMPW Overland Flow Flood Study (SMEC, 2016)".

In addition to the above, a Flood Impact Assessment has also been prepared for the subject site, dated the 17th of December 2020, herein referred to as the "Flood Impact Assessment (Northrop, 2020)".

The Flood Impact Assessment (Northrop, 2020) was submitted to Georges River Council to support the Development Application for the construction of a Health Services Facility which was approved by Georges River Council in 2021. The Flood Impact Assessment (Northrop, 2020) built on the original HWPW Overland Flow Flood Study (SMEC, 2016) and included site specific data such as detailed survey and the proposed development.

In addition to the Flood Impact Assessment (Northrop, 2021) an additional letter was prepared for the proposed Health Services Facility which provided a response to the Georges River Council Request for Additional Information (RFI). The letter was dated the 18th of December 2020 and is herein referred to as the "RFI Letter (Northrop, 2020)".

Both the Flood Impact Assessment (Northrop, 2020) and the RFI Letter (Northrop, 2020) have been included as Attachments 1 and 2 respectively.

Flood Behaviour

During the existing case, overland flow derived from the upstream catchment enters the subject site from the southern and western boundaries, before continuing towards Cambridge Street via the driveway entrance and finally onto Stoney Creek Road as flows pass across the northern boundary. Overland flow continues in a north-easterly direction across Stoney Creek Road, exceeding the capacity of the road network and into the properties to the north.

Figures C1 and C3 of Attachment 1 presents the existing case flood depth for the 1% AEP and PMF design storm events respectively. Flood depths for the 1% AEP range across the subject site between 100-500mm while, depths in the order of 600-1000mm are observed in the PMF.

Additional return intervals have been included as part of this correspondence as presented in Attachment 3. Figure C5 of Attachment 3 suggests there is the potential for flood depths to range in the order of 100-300mm during the 50% AEP design storm event.

The following Table 3 presents the corresponding existing flood elevations at each corner of the site for events ranging from the 50% AEP to PMF design storm event.

Table 1 - Subject Site Existing Case Flood Levels

Reporting Point	50% AEP Flood Elevation (mAHD) (Refer to Figure C5 of Attachment 3)	1% AEP Flood Elevation (mAHD) (Refer to Figure C1 of Attachment 1)	PMF Flood Elevation (mAHD) (Refer to Figure C3 of Attachment 1)
North-Eastern Corner	29.92	29.93	30.38
North-Western Corner	30.17	30.38	30.87
South-Eastern Corner	30.14	30.37	30.78
South-Western Corner	30.28	30.47	30.90

Flood hazard has been assessed using the latest Australian Rainfall and Runoff 2019 guidelines. The ARR 2019 flood hazard categories across the subject site and vicinity during the 1% AEP and PMF design storm events are presented in **Figure C2 and C4** of Attachment 1 respectively.

Figure C2 of Attachment 1 suggests flood hazard categories across the subject site during the 1% AEP design storm event are generally less than H2 with the exception of a portion of H3 observed along the northern boundary. During the PMF, **Figure C4** shows flood hazard varies between H2 to H5 across the subject site.

External to the subject site, patches of H5 hazard flow are observed in Cambridge Street and Stoney Creek Road during the 1% AEP. A patch of H3 and H4 hazard flow is observed at the driveway entrance to the subject site off Cambridge Street, suggesting evacuation from the site may not be safe during a major event during the existing conditions. During the PMF, hazard conditions throughout the upstream properties and road network are largely H5.

The NSW Floodplain Development Manual (FPDM) (2005) hazard categories during the 1% AEP design storm event are also presented in **Figure 2** of the RFI Letter (Northrop, 2020) (Attachment 2). Small, discontinuous patches of high hazard are observed across the subject site during the 1% AEP design storm event, with the majority (i.e. 99.6%) of the site shown as low hazard. As discussed in the RFI Letter (Northrop, 2020), although small patches of high hazard are observed during the 1% AEP, the site is characterised by low flood hazard.

Additional information with respect to the existing flood behaviour is presented in the Flood Impact Assessment (Northrop, 2020) and the RFI Letter (Northrop, 2020) presented in Attachments 1 and 2 respectively.

Ministerial Direction 4.1 - Flooding

Objectives

The objectives of Ministerial Direction 4.1 are summarised in italics below. A response to the objectives is also provided.

a. *Ensure that development of flood prone land is consistent with the NSW Government's Flood Prone Land Policy and the principles of the Floodplain Development Manual 2005"*

Response

The Floodplain Development Manual (2005), and the NSW Government Flood Prone Land Policy (NSW FPDM, 2005; pp i):

> *"promotes the use of a merit approach which balances social, economic, environmental and flood risk parameters….", thus "… avoids the unnecessary sterilisation of flood prone land"*

More-over, the Floodplain Development Manual also highlights that the NSW Flood Prone Land Policy (NSW FPDM, 2005; pp J-2)

> *"…does not support the use of zoning to unjustifiably restrict development simply because land is flood prone. Zoning of flood prone land should be based on objective assessment of land suitability and capability, flood risk, environmental or other factors"*

A merits-based assessment is sought for the proposed rezoning, with the previous approval for the subject site, presented in the Flood Impact Assessment (Northrop, 2020) demonstrating a feasible solution exists to make the site suitable for use.

Consistency of the proposal with the principles of the NSW Floodplain Development Manual is further summarised in the "Floodplain Development Manual" section of this report.

b. *ensure that the provisions of an LEP that apply to flood prone land are commensurate with flood behaviour and includes consideration of the potential flood impacts both on and off the subject land*

Response

The flood related provisions of the Georges River Local Environmental Plan (LEP) (2021), in particular Section 5.21 – Flood Planning, are summarised in the following Table 2 along with a response.

Table 2 - Georges River Council LEP (2021) provisions

Reference	Local Environmental Plan Item	Response
5.21 (1)	**The objectives of this clause are as follows:**	
(a)	to minimise the flood risk to life and property associated with the use of land	The Flood Impact Assessment (Northrop, 2020) demonstrates the capacity to incorporate flood mitigation and adaption measures in accordance with the Georges River Stormwater Management Policy (2020). Incorporation of these measures minimise the flood risk to life and property on the subject site. With potential difficulty for off-site evacuation due to the compromised road network, additional Flood Emergency Response

Reference	Local Environmental Plan Item	Response
		measures can be introduced to manage the residual site risk during an extreme event. This includes the incorporation of on-site refuge (evacuation to upper levels) and the preparation of a Flood Emergency Response Plan to define evacuation / refuge procedures, enhance site preparation and introduce education and awareness programs.
(b)	to allow development on land that is compatible with the flood function and behaviour on the land, taking into account projected changes as a result of climate change	The Flood Impact Assessment (Northrop, 2020) demonstrates the capacity to incorporate flood mitigation and adaption measures in accordance with the Georges River Stormwater Management Policy (2020). The strategy presented in the Flood Impact Assessment (Northrop, 2020) incorporates a worst case (i.e. PMF) Flood Planning Level. If lower Flood Planning Levels are considered for future development, the effect of climate change can be reviewed.
(c)	to avoid adverse or cumulative impacts on flood behaviour and the environment	The Flood Impact Assessment (Northrop, 2020) demonstrates the capacity to modify the existing site to manage flood impacts derived by development.
(d)	to enable the safe occupation and efficient evacuation of people in the event of a flood	Development of the subject site has the capacity to enhance evacuation / refuge opportunities for the subject site and neighbouring properties by providing flood refuge to a level above the worst case, Probable Maximum Flood event.
5.21 (2)	**Development consent must not be granted to development on land the consent authority considers to be within the flood planning area unless the consent authority is satisfied the development**	
(a)	is compatible with the flood function and behaviour on the land	The Flood Impact Assessment (Northrop, 2020) demonstrates the capacity to incorporate flood mitigation and adaption measures in accordance with the Georges River Stormwater Management Policy (2020).
(b)	will not adversely affect flood behaviour in a way that results in detrimental increases in the potential flood affectation of other development or properties	The Flood Impact Assessment (Northrop, 2020) demonstrates the capacity to modify the existing site to manage flood impacts derived by development.

Reference	Local Environmental Plan Item	Response
(c)	will not adversely affect the safe occupation and efficient evacuation of people or exceed the capacity of existing evacuation routes for the surrounding area in the event of a flood	Development of the subject site has the capacity to enhance evacuation / refuge opportunities for the subject site and neighbouring properties by providing flood refuge to a level above the worst case, Probable Maximum Flood event.
(d)	incorporates appropriate measures to manage risk to life in the event of a flood,	The Flood Impact Assessment (Northrop, 2020) demonstrates the capacity to incorporate flood mitigation and adaption measures in accordance with the Georges River Stormwater Management Policy (2020). Additional Flood Emergency Response measures can also be introduced to manage the residual site risk during an extreme event. This includes the incorporation of on-site refuge, definition of evacuation / refuge procedures, site preparation as well as education and awareness programs.
(e)	will not adversely affect the environment or cause avoidable erosion, siltation, destruction of riparian vegetation or a reduction in the stability of riverbanks or watercourses.	The Flood Impact Assessment (Northrop, 2020) demonstrates the capacity to modify the existing site to manage flood impacts derived by development.
5.21 (3)	**In deciding whether to grant development consent on land to which this clause applies, the consent authority must consider the following matters**	
(a)	the impact of the development on projected changes to flood behaviour as a result of climate change	The Flood Impact Assessment (Northrop, 2020) demonstrates the capacity to modify the existing site to manage flood impacts derived by development. The strategy presented in the Flood Impact Assessment (Northrop, 2020) incorporates a worst case (i.e. PMF) Flood Planning Level. If lower Flood Planning Levels are considered for future development, the effect of climate change can be reviewed.
(b)	the intended design and scale of buildings resulting from the development	The Flood Impact Assessment (Northrop, 2020) demonstrates the potential to modify the existing site to manage flood impacts derived by development.
(c)	whether the development incorporates measures to minimise the risk to life and ensure the safe evacuation of people in the event of a flood	The Flood Impact Assessment (Northrop, 2020) demonstrates the capacity to incorporate flood mitigation and adaption measures in accordance with the Georges River Stormwater Management Policy (2020).

Reference	Local Environmental Plan Item	Response
		Additional Flood Emergency Response measures can also be introduced to manage the residual site risk during an extreme event. This includes the incorporation of on-site refuge, definition of evacuation / refuge procedures, site preparation as well as education and awareness programs.
(d)	the potential to modify, relocate or remove buildings resulting from development if the surrounding area is impacted by flooding or coastal erosion	The Flood Impact Assessment (Northrop, 2020) demonstrates the potential to modify the existing site to manage the existing flood risk on the subject site. As the subject site is not directly exposed to the ocean, it is not expected to be impacted by coastal erosion.

Ministerial Directions

The following Table 3 demonstrates how the flood related Ministerial Directions can be addressed for the subject site.

Table 3 - NSW Ministerial Direction 4.1 (Flooding) Controls

Item	Development Control	Response
4.1.1	**A planning proposal must include provisions that give effect to and are consistent with:**	
(a)	The NSW Flood Prone Land Policy	As mentioned above, the NSW Flood Prone Land Policy promotes a merits-based approach and supports rezoning of flood prone land provided an objective assessment can demonstrate development suitability. The Flood Impact Assessment (Northrop, 2020) and RFI Letter (Northrop, 2020) provided in Attachments 1 and 2 demonstrate that flood impacts, the liability of owners and occupiers, and losses during a flood event can be minimised through appropriate flood mitigation and adaption measures.
(b)	The principles of the Floodplain Development Manual 2005.	The principles of the Floodplain Development Manual 2005 are discussed above and in the Floodplain Development Manual Section of this letter.
(c)	The Considering Flooding in Land Use Planning Guideline 2021	The full range of flood events, up to and including the PMF have been presented in the Flood Impact Assessment (Northrop, 2020). Additional Special Flood Considerations outlined in the Considering Flooding in Land use Planning Guideline 2021 have not been

Item	Development Control	Response
		adopted in the Georges River Local Environmental Plan (2021).
(d)	Any adopted flood study and/or floodplain risk management plan prepared in accordance with the principles of the Floodplain Development Manual 2005 and adopted by the relevant council	The Flood Impact Assessment (Northrop, 2020) was prepared using Council's Adopted HMPW Overland Flow Flood Study (SMEC, 2016). The HMPW Overland Flow Flood Study (SMEC, 2016) discusses Flood Planning Levels (FPL) of the 1% AEP + 500mm for residential and 1% AEP + 300mm for commercial / industrial. The Flood Impact Assessment (Northrop, 2020) demonstrates a FPL of the PMF is feasible for the subject site, exceeding the recommendations presented in Council's adopted flood study.
4.1.2	A planning proposal must not rezone land within the flood planning area from Recreation, Rural, Special Purpose or Conservation Zones to a Residential, Business, Industrial or Special Purpose Zones.	The Flood Impact Assessment (Northrop, 2020) and RFI Letter (Northrop, 2020) provided in Attachments 1 and 2 demonstrate that development of the subject site is feasible and that flood impacts, the liability of owners and occupiers, and losses during a flood event can be minimised through appropriate flood mitigation and adaption measures. The Flood Impact Assessment (Northrop, 2020) also demonstrates the capacity to incorporate flood mitigation and adaption measures in accordance with the Georges River Stormwater Management Policy (2020). Additional Flood Emergency Response measures can also be introduced to manage the residual site risk during an extreme event. This includes the incorporation of on-site refuge, definition of evacuation / refuge procedures, site preparation as well as education and awareness programs.
4.1.3	**A planning proposal must not contain provisions that apply to the flood planning area which:**	
(a)	Permit development in floodway areas	The approved development footprint presented in the Flood Impact Assessment (Northrop, 2020) demonstrates no significant impact compared to the existing case. No amendment to this footprint is proposed through the rezoning.

Item	Development Control	Response
(b)	Permit development that will result in significant flood impacts to other properties,	As demonstrated by the Flood Impact Assessment (Northrop, 2020), flood impacts created by the development of the subject site can be managed using appropriate on-site flood mitigation measures.
(c)	Permit development for the purposes of residential accommodation in high hazard areas	As discussed in the RFI Letter (Northrop, 2020), the majority (99.6%) of the subject site is low hazard during the 1% AEP design storm event with no continuous path of high hazard observed. As such, the subject site is characterised by low hazard. In addition, the Flood Impact Assessment (Northrop, 2020) demonstrates appropriate flood mitigation measures can be introduced to make the site suitable for future use and to manage any remaining residual flood risk on site.
(d)	Permit a significant increase in the development and/or dwelling density of that land	Rezoning has the potential to increase the dwelling density of the land however, as demonstrated by the Flood Impact Assessment (Northrop, 2020) the subject site can be made suitable for use through adoption of necessary flood mitigation measures. The proposed residential flat development is also expected to improve Flood Risk Management for the subject site and neighbouring properties through the introduction of available flood refuge in the upper levels and public awareness (through the preparation of a Flood Emergency Response Plan).
(e)	Permit development for the purpose of centre-based childcare facilities, hostels, boarding houses, group homes, hospitals, residential care facilities, respite day care centres and seniors housing in areas where the occupants of the development cannot effectively evacuate.	Rezoning of the land is not expected to enable development of the subject site for these purposes during the interim case. It is anticipated, any future change in use will be reviewed at Development Application phase as discussed in the below “Interim Case” section of this letter.
(f)	Permit development to be carried out without development consent except for the purposes of exempt development or agriculture. Dams, drainage canals, levees, still require development consent	Rezoning of the land is not expected to enable development to be carried out on the land without development consent. This is discussed further in the “Interim Case” section of this letter.
(g)	Are likely to result in a significantly increased requirement for government spending on emergency management	Rezoning and future development of the subject site is not expected to result in a significant increase in government spending.

Item	Development Control	Response
	services, flood mitigation and emergency response measures, which can include but are not limited to the provision of road infrastructure, flood mitigation infrastructure and utilities	Future development of the subject site has the potential to enhance existing emergency management procedures for the area by providing a common place for flood refuge if required. In addition, on-site Flood Emergency Response policies and procedures can be introduced to manage residual site risk during an extreme event. This includes the incorporation of on-site refuge, definition of evacuation / refuge procedures, site preparation as well as education and awareness programs.
(h)	Permit hazardous industries or hazardous storage establishments where hazardous materials cannot be effectively contained during the occurrence of a flood event	Placement of hazardous materials in accordance with the Georges River Stormwater Policy (2020) is not expected to be a site limitation.

Floodplain Development Manual

Part I6.3.7 of the NSW Floodplain Development Manual (2005) highlights specific flood risk management measures that should be considered when rezoning land. These criteria as well as a response are summarised in the following Table 4.

Table 4 - NSW Floodplain Development Manual (2005) Rezoning Criteria

Criteria	Response
It will not increase the flood risk experienced by other current floodplain occupants. This includes no altering the danger to personal safety of existing floodplain inhabitants or flood damage to other properties, or adversely affect them in any way (such as elongation of inundation times) during flooding.	The Flood Impact Assessment (Northrop, 2020) and RFI Letter (Northrop, 2020) provided in Attachments 1 and 2 demonstrate that development of the subject site is feasible and that flood impacts, the liability of owners and occupiers, and losses during a flood event can be minimised through appropriate flood mitigation and adaption measures. The proposed residential flat development is also expected to improve Flood Risk Management for the subject site and neighbouring properties through the introduction of available flood refuge in the upper levels and public awareness (through the preparation of a Flood Emergency Response Plan).
It has been designed and constructed in such a manner as to ensure that potential loss of life in an extreme flood event is minimal. The development does not significantly adversely impact on emergency response management of other sites or areas.	As demonstrated by the Flood Impact Assessment (Northrop, 2020), flood impacts created by the development of the subject site can be managed using appropriate on-site flood mitigation measures.

Criteria	Response
This may involve incorporation of permanent fail-safe, maintenance free measures into the development to ensure the timely, orderly and safe evacuation of people from that area, should a flood occur. In addition, it should also be demonstrated that the displacement of these people during times of flood will not significantly add to the overall cost and community disruption caused by the flood.	Rezoning and future development of the subject site is not expected to result in a significant increase in government spending. Future development of the subject site has the potential to enhance existing emergency management procedures for the area by providing a common place for flood refuge if required.
It has to be undertaken, designed and constructed in such a manner as to hold potential financial losses from flooding at an acceptably low level.	The Flood Impact Assessment (Northrop, 2020) and RFI Letter (Northrop, 2020) provided in Attachments 1 and 2 demonstrate that development of the subject site is feasible and that flood impacts, the liability of owners and occupiers, and losses during a flood event can be minimised through appropriate flood mitigation and adaption measures. Rezoning and future development of the subject site is not expected to result in a significant increase in government spending.
It will also not adversely impact on the social, economic, cultural or environmental requirements of the floodplain.	The Flood Impact Assessment (Northrop, 2020) and RFI Letter (Northrop, 2020) provided in Attachments 1 and 2 demonstrate that development of the subject site is feasible and that flood impacts, the liability of owners and occupiers, and losses during a flood event can be minimised through appropriate flood mitigation and adaption measures.

Gateway Determination Conditions

Following submission of the Planning Proposal, Gateway Determination was received on the 2nd of March 2023. The Gateway Determination included several flooding related conditions as outlined in Item 4 of the Determination (REF: PP-2021-6630). These conditions are outlined in the following Table 5 along with a summary of how this correspondence is considered to satisfy each condition.

Table 5 - Gateway Determination Conditions

Condition		How addressed?
4. Prior to any finalisation, the proposal and relevant technical studies must be updated (as required and in consideration of agency comments received during consultation) to address the following flood matters in the context of potential high density residential development and the land uses permitted in the R4 High Density Residential Zone:		
i.	Consistency and/or justification with all applicable Direction 4.1 Flooding requirements	Consistency, and justification of any deviation from the Ministerial Direction is presented in the Ministerial Direction 4.1 – Flooding section of this report.

Condition		How addressed?
ii.	The full range of flood events on the site, up to a Probable Maximum Flood (PMF) event;	The 1% AEP and PMF design storm events were considered as part of the original Flood Impact Assessment (Northrop, 2020) and RFI Letter (Northrop, 2020). These are provided in Attachments 1 and 2 respectively. Additional, return intervals ranging from the 50% AEP to 5% AEP have been included in Attachment 3.
iii.	Identify and map all flooding hazards associated with the full range of flooding events up to the PMF;	The 1% AEP and PMF design storm events were considered as part of the original Flood Impact Assessment (Northrop, 2020) and RFI Letter (Northrop, 2020). These are provided in Attachments 1 and 2 respectively. Additional, return intervals ranging from the 50% AEP to 5% AEP have been included in Attachment 3.
iv.	Any flooding impacts which may arise from cut and fill on the site;	Flood impact for the 1% AEP and PMF design storm events were considered as part of the Flood Impact Assessment (Northrop, 2020), and are presented in Attachment 1.
v.	Any flooding impacts (on and off-site) which may arise from development which may occur within a 1% AEP and PMF impacted area of the site	Flood impacts, both on and off the subject site, for the 1% AEP and PMF design storm events were considered as part of the Flood Impact Assessment (Northrop, 2020), and are presented in Attachment 1.
vi.	Climate Change Impacts;	Climate change flood depth and elevation during the 1% AEP are presented in Figure D6 of Attachment 3. Review of Figure D6 suggests flood elevations across the subject site have the potential to increase by approximately 30-110mm. These levels remain below the proposed recommended minimum habitable floor level of the 1% AEP + 500mm or the PMF (whichever is higher).
vii.	Evacuation management for the site	A Flood Emergency Response Summary is presented in the Flood Impact Assessment (Northrop, 2020). It is expected this strategy will be updated for any future Development Applications for the subject site.

Guiding Principles for Flood Management for Future Development of the Site

It is important to recognise that rezoning the land does not permit immediate development of the site. Rezoning is a gateway for further consideration of the suitability of use. It is anticipated that the subject site will require further review during future development phases, either through submission of a Complying Development Certificate or a Development Application.

As the subject site is burdened by a "flow path", Complying Development in accordance with SEPP (Exempt and Complying Codes, 2008) is not expected to be an acceptable approval pathway for the subject site in accordance with Section 3.5 (1) (c). As such, submission of a Development Application is expected to be the most likely approval pathway, post rezoning phase.

As a result, it is anticipated Georges River Council will have the opportunity to review any future proposals during the Development Application phase and enforce appropriate flood mitigation and flood risk management measures to enable safe occupation of the facility.

As discussed in the RFI Letter (Northrop, 2020), development of the subject site has been shown to have the capacity to improve the existing conditions and make the subject site suitable for use from a Floodplain Risk Management perspective by:

- Providing a point of refuge above the 1% AEP and PMF design storm events.
- The residual flood risk on site can be appropriately managed through the preparation of a Flood Emergency Response Plan prior to occupation of the building. A Flood Emergency Response Summary has been provided in the Flood Impact Assessment (Northrop, 2020) which demonstrates the residual flood risk on site can be managed appropriately.
- The proposed development is not expected to result in any unacceptable impacts in adjacent properties during both the 1% AEP and PMF design storm events.

To ensure future development remains generally consistent with the previous approval, the following flood management measures are expected to be required:

- Diversion of the existing Sydney Water 1.981m wide by 1.219m high Reinforced Concrete Box Culvert (RCBC) where a building is proposed above the existing culvert (or as required by Sydney Water).
- Construction of a flood storage chamber with sufficient capacity to limit off-site impacts and improve site flood behaviour as confirmed via detailed flood modelling
- Habitable floors are to be sited at a minimum of the 1% AEP + 500mm or the PMF flood level, whichever is higher.
- Flood impacts in adjacent properties are to be generally consistent with those presented in the Flood Impact Assessment (Northrop, 2020).
- A point of refuge is to be provided within the facility above the PMF event and with enough capacity to support all occupants / tenants reasonably expected to be on-site during a major flood event.
- The basement carpark entry threshold is to be set at a minimum of the 1% AEP level plus a freeboard of 300mm. All other openings to the basement including the carpark intake and exhaust, basement carpark stairwells and lift shafts are to be positioned at or above the PMF flood level.
- The building shall be of robust construction and all structural components below the Flood Planning Level (i.e. the 1% AEP + 500mm) shall be flood compatible. Any building elements sited below the Flood Planning Level shall be constructed using elements that maintain

strength and durability when wet, facilitate easy cleaning after inundation and are capable of resisting the forces of floodwater, debris and buoyancy during an event.

- Any structures to be used for the purposes of on-site refuge shall be designed to withstand PMF flood behaviour.
- A maximum of H2 hazard conditions (See ARR 2019 / AIDR) are to be observed in the driveway and carpark during the 1% AEP design storm event to reduce the risk of vehicles becoming buoyant during a major event. If this is not possible, bollards (or similar) are to be installed to ensure vehicles are not washed downstream.
- Preparation of a Flood Emergency Response Plan is required prior to Construction Certificate to manage residual flood risk on site.
- Vertical evacuation from the basement garage into the upper levels is required to ensure evacuation from areas below the PMF is achievable.

It is anticipated an updated Flood Impact Assessment will be required at Development Application Stage for any modifications to the originally approved layout. In addition, it is anticipated that any deviation from the above flood management measures will need to be assessed based on their merit and documented as part of a Development Application.

Conclusion

A Flood Risk Impact Assessment has been undertaken for the property located at 143 Stoney Creek Road, Beverly Hills.

A summary of the subject site, proposed rezoning, existing site flood behaviour and consistency with the NSW Ministerial Direction, NSW Floodplain Development Manual and Georges River Local Environmental Plan has been presented.

Rezoning of the subject site is considered acceptable noting that flood risks are expected to be further reviewed at Development Application phase.

Should you have any queries regarding this correspondence, please feel free to contact the undersigned on (02) 4943 1777.

Prepared by:

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Reviewed by:

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Limitation Statement

Northrop Consulting Engineers Pty Ltd (Northrop) has been retained to prepare this report based on specific instructions, scope of work and purpose pursuant to a contract with its client. It has been prepared in accordance with the usual care and thoroughness of the consulting profession for the use by Cambridge Unit Developments.

The report is based on generally accepted practices and standards applicable to the scope of work at the time it was prepared. No other warranty, express or implied, is made as to the professional advice included in this report except where expressly permitted in writing or required by law, no third party may use or rely on this report unless otherwise agreed in writing by Northrop.

Where this report indicates that information has been provided to Northrop by third parties, Northrop has made no independent verification of this information except as expressly stated in the report. Northrop is not liable for any inaccuracies in or omissions to that information.

The report was prepared on the dates shown and is based on the conditions and information received at the time of preparation.

This report should be read in full, with reference made to all sources. No responsibility is accepted for use of any part of this report in any other context or for any other purpose. Northrop does not purport to give legal advice or financial advice. Appropriate specialist advice should be obtained where required. To the extent permitted by law, Northrop expressly excludes any liability for any loss, damage, cost or expenses suffered by any third party relating to or resulting from the use of, or reliance on, any information contained in this report.

Attachment 1 – Flood Impact Assessment (Northrop, 2020)

NORTHROP

CIVIL

Flood Impact Assessment

for

143a Stoney Creek Road, Beverly Hills

for Cambridge Unit Developments

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Table 4 - Developed Case Flood Levels 14

Acronyms

AEP	Annual Exceedance Probability
AHD	Australian Height Datum
ALS	Airborne Laser Survey (LiDAR)
DCP	Development Control Plan
FERP	Flood Emergency Response Plan
FPL	Flood Planning Level
GRC	Georges River Council
LGA	Local Government Area
LiDAR	Light Detection and Ranging (also see ALS)
m	Measure of length / height / distance (metres)
m AHD	Meters above Australian High Datum
m^3/s	Measure of flow rate (cubic metres per second)
NSW	New South Wales
PMF	Probable Maximum Flood
PMP	Probable Maximum Precipitation
RoG	Rainfall on Grid
TUFLOW	A 1D and 2D hydraulic modelling software

Introduction

Northrop Consulting Engineers Pty Ltd (Northrop) have been engaged by Cambridge Unit Developments to prepare a Flood Impact Assessment for the proposed Health Services Facility located at 143a Stoney Creek Road, Beverly Hills, herein referred to as the subject site.

The Overland Flow Flood Study for Hurstville, Mortdale and Peakhurst Wards (SMEC, 2016) has identified the site to be impacted by flooding during both the 1% AEP and PMF design storm events. Initial liaison with Council confirmed that the subject site is flood prone, and that a Flood Impact Assessment will be required.

This Flood Impact Assessment aims to review the impact the proposed facility has on the existing flood behaviour within the subject site and adjacent properties.

Legislation, Policies and Guidelines

This assessment has been prepared with consideration to the following legislation, policies and guidelines.

- Hurstville Local Environmental Plan (2012).
- Hurstville Development Control Plan (2018).
- Australian Rainfall and Runoff 2016 (AR&R 2016).
- Australian Rainfall and Runoff 1987 (ARR1987) and subsequent updates.
- NSW Flood Prone Land Policy.
- NSW Government Floodplain Development Manual (NSW Government, 2005).
- Water Management Act 2000 (NSW Government, 2016).

Relevant Reports and Documents

This report is to be read in conjunction with the following reports and documents:

1. Detailed survey drawings prepared by LTS Lockley – Further stormwater details added from laser scan issue dated the 5 of April 2020.
2. Civil engineering drawings prepared by Northrop Consulting Engineers – DA revision dated 9 of December 2020 (ref 200410 DAC01.01 to DAC07.01).
3. Architectural drawings prepared by Rothelowman – DA Amendments issue dated 23 of November 2020.

The flood information discussed herein has been prepared based on the following study and model, used under a licence agreement for this project:

4. Overland Flow Flood Study for Hurstville, Mortdale and Peakhurst Wards, prepared by SMEC in 2016 herein referred to as the “HMPW Overland Flow Flood Study (SMEC, 2016)” or the “original model (SMEC, 2016)”.

Contained herein is a description of the subject site and proposed development, a summary of the modelling methodology and a discussion of the results.

Locality and Proposed Development

Subject Site

The subject site is located on the south western corner of the intersection of Stoney Creek Road and Cambridge Street, Beverly Hills. It includes the parcel of land at 143a Stoney Creek Road, otherwise known as Lot 3, DP1205598. The subject site is located within the Hurstville portion of the Georges River Council (GRC) Local Government Area (LGA). The location of the subject site and general vicinity is presented in **Figure 1** shown overleaf.

The current land-use is a single storey commercial facility and its associated carparking and landscaping. Detailed survey suggests the ground surface is relatively flat across the site with elevations generally ranging from 29.9m AHD to 30.25m AHD.

In its current state, the site is bordered by a series of brick landscaped walls around the northern and eastern boundaries, which detailed survey suggests has a variable top of wall height ranging from approximately 30.1-30.31m AHD. A green palisade fence sits on top of the brick landscaped wall and extends in excess of 1.5m above the brick wall.

Around the southern and western boundaries, a kerb and landscaped brick wall is observed with a 1.8m high Colourbond metal fence sited on top. Detailed survey suggests top of wall elevations range from 30.30m AHD to 30.45m AHD. There are two high landscaped brick walls around the site boundary; one located in the south-eastern corner of the subject site and the second extending approximately half-way along the western boundary. Detailed survey suggests that these two walls have a top elevation of 32.07m AHD and 32.01m AHD respectively.

Access to the existing facility is via the driveway off Cambridge Street, located in the south-eastern corner of the subject site.

An existing Sydney Water 1.981m wide by 1.219m high Reinforced Concrete Box Culvert (RCBC) and associated easement traverses the site. It extends from the southern boundary (in a north-easterly direction across the subject site), which then continues beneath Stoney Creek road to the north.

Legend

Subject Site

Cadastre

0 62.5 125 250 Meters 1:5,000

Figure 1 [A]

Subject Site Locality

Data Source: LPI

143 Stoney Creek Road, Beverly Hills

NORTHROP

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The Proposed Development

The proposed development is shown below in **Figure 2.** It includes a three storey Health Services Facility and its associated basement carpark and landscaping. Similar to the existing case, vehicular access is proposed in the south-eastern corner of the site, off Cambridge Street. The internal driveway extends parallel with the southern boundary before ramping down into three levels of basement carparking below.

It is proposed to re-direct the existing Sydney Water 1.981x1.219m RCBC and easement around the eastern boundary of the subject site, to avoid the proposed development. A new 2.1m wide by 1.29m high RCBC is proposed, with a maximum bend radius of 6m (as per initial advice provided by Sydney Water).

A flood storage chamber is also proposed beneath the ground floor level and western portion of the driveway which is intended to increase the available flood storage on the subject site. The flood storage chamber is sandwiched between the Ground Floor Level and Basement Level 1. The storage chamber has an invert level of 28.7m AHD and a maximum height of approximately 2.2 meters.

The inclusion of the flood storage chamber provides in excess of 2000m^3 of flood storage beneath the building before flows begin to overtop the landscaped walls along the northern and eastern boundaries. Low flows and flood water captured within the flood chamber is to discharge into the Sydney Water culvert through a series of Floor Waste pits and dual 225mm uPVC pipes. The chamber is intended to capture flood water before it continues onto Cambridge and Stoney Creek Road to the east and north respectively.

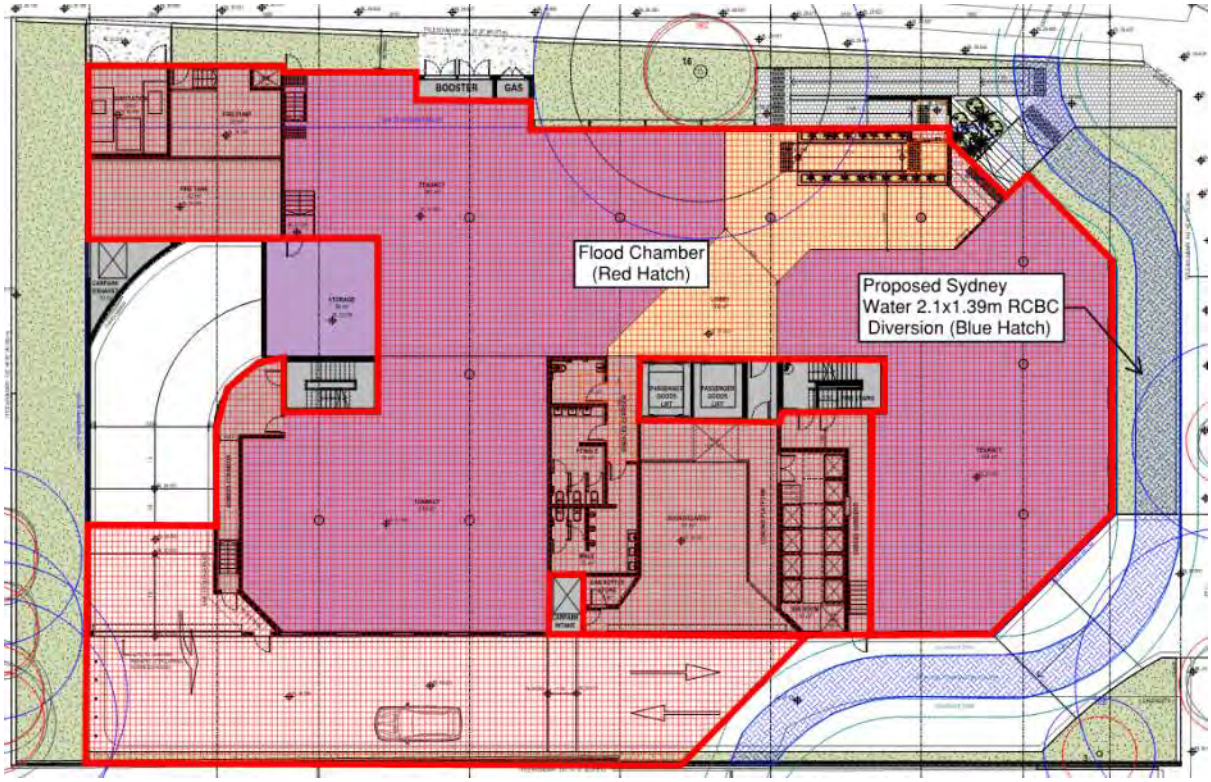


Figure 2 - Proposed Ground Floor Plan of the Health Services Facility (refer to Architectural Drawings for Details)

Methodology

This flood impact assessment was undertaken using the following procedure:

- Desktop review of previous investigations including the HMPW Overland Flow Flood Study (SMEC, 2016).
- Desktop review of available information including design plans, survey data, stormwater infrastructure and latest aerial imagery.
- Liaison with Georges River Council officers to obtain a copy of HMPW Overland Flow Flood Study (SMEC, 2016) model files.
- Create an “Existing Case” flood model by updating the HMPW Overland Flow Flood Model (SMEC, 2016) to include detailed survey and recent aerial imagery.
- Modify the Existing Case flood model to include the proposed development and create the “Developed Case” flood model.
- Compare the results of the Existing and Developed case flood models to review the impact the proposed development has on the existing flood behaviour on-site and in adjacent properties.

The results of the assessment have been reported herein.

Regional Flood Model Updates

The HMPW Overland Flow Flood Model (SMEC, 2016) has been provided by GRC under a license agreement for use in this study. The HMPW Overland Flow Flood Study (SMEC, 2016) covers the catchments of Hurstville, Mortdale and Peakhurst Wards and is a two-dimensional combined hydrological and hydraulic TUFLOW model. The hydrological model is Rainfall on Grid (RoG) with initial and continuing rainfall losses accounted for at the model surface through variable land-use types.

The HMPW Overland Flow Flood Model (SMEC, 2016) has been updated to include information captured on site through detailed survey, review of aerial imagery and by site photos to create the latest Existing Case model. The updated Existing Case model was then modified to include the proposed development. The following section identifies the changes made to the original model (SMEC, 2016).

Two-Dimensional Grid Extent and Size

A grid size of 2m has been adopted for the study which remains un-changed from what was used in the original model (SMEC, 2016). The 2m grid size was considered appropriate for the purposes of the study and is typically used for urban areas. Similarly, a timestep of 0.5 seconds has been adopted which also remains un-changed from what was used in the original model (SMEC, 2016). In addition, no changes were made to the model extent for the purposes of this study.

Terrain

Existing Case

Figure A1 of Appendix A presents the updated existing case topography. The original model terrain was updated to include the latest detailed survey. Landscaped walls have been excluded from the model following feedback received from Council.

The terrain around the upstream side of existing building has been raised to represent the flow obstruction generated by the walls around the building while, the downstream walls have been removed to enable storage within the building. This is consistent with the methodology used to model buildings both onsite and elsewhere in the original model (SMEC, 2016). Similarly, the terrain beneath the existing building was raised to a level of 30.26m AHD to match the existing case finished floor level presented in the detailed survey.

Developed Case

Figure A2 of Appendix A presents the modelled developed case topography. During the developed case scenario, a model surface (which includes the flood chamber) was created using the 12d software and overlayed the detailed survey. Openings into the basement, such as the stairwells, exhaust vents and the basement driveway ramp were raised above the flood level to represent exclusion of flow into these areas.

Land-use and Losses

Existing Case

The updated land-use and surface roughness for the existing case model is presented in **Figure A3** of Appendix A. For the existing case, surface roughness has been updated based on observations from the detailed survey and aerial imagery. Hardstand areas across the subject site have been modelled using a variable roughness as shown in the following Table 1. Landscaped areas across the subject site have also been modelled using the variable roughness presented in Table 2. Similarly, the existing case building has been modelled with a roughness of 0.025. All of the values are consistent with those modelled for Roads, Shrubs and Buildings in the original model (SMEC, 2016) respectively.

Table 1 - Hardstand Surface Roughness

Flow Depth (m)	Manning's Roughness (*n*)
0.00	0.017
0.04	0.017
0.10	0.021
0.15	0.018
100	0.018

Table 2 - Landscaped Surface Roughness

Flow Depth (m)	Manning's Roughness (*n*)
0.00	0.137
0.30	0.137
1.00	0.077
1.50	0.047
100	0.047

Fences sited on top of landscaped walls around the boundary have been entered into the model manually through a series of flow constriction polylines. A blockage factor of 50% was applied to fences, which is consistent with the assumptions made in the original model (SMEC, 2016), both on the subject site and around lot boundaries elsewhere in the model.

Developed Case

Figure A4 of Appendix A presents the developed case land-use and surface roughness. During the developed case scenario, hardstand areas, including the flood storage chamber and driveway, have been modelled in a similar manner to roads elsewhere in the model. Similarly, landscaped areas were modelled as shrubs.

Similar to the existing case, boundary fences around the southern and eastern sides of the subject site where modelled with 50% blockage during the developed case which is consistent with the assumptions made in the original HMPW Overland Flow Flood Study (SMEC, 2016).

Rainfall losses remain un-changed to those used in the HMPW Overland Flow Flood Study (SMEC, 2016) with an initial and continuing loss of 1.0mm and 0mm/hr for Roads and 10mm and 2.5mm/hr for Shrubs respectively. All remaining land-use and surface roughness external to the subject site have been maintained as per the original HMPW Overland Flow Flood Study (SMEC, 2016)

Below Ground Stormwater Infrastructure

The existing Sydney Water 1.981x1.219m RCBC and inverts were updated in the existing case model based on detailed survey. It is noted a larger culvert cross section was assumed across the subject site in the original model (SMEC, 2016) when compared to what has been picked up by detailed survey. As such, the model cross section has been updated based on the detailed survey. A 50% blockage factor was included at the headwall upstream of the subject site by reducing the size of the culvert cross section.

Nearby pits and pipes were also updated in the existing case to match the detailed survey and observations made using aerial imagery and Google Street View.

The proposed diversion has been included in the model as a 2.1x1.29m RCBC. Additional form losses have been applied to the proposed culvert to represent head loss due to the bends.

Flood Chamber

The flood chamber has been represented in the model through the inclusion of a series of flow constrictions. **Figure A2** of Appendix A presents the flow constrictions, including polygons for the majority of the under-croft area and more perimeter polylines to allow for additional blockage where louvres (or similar) are proposed. A blockage factor of 10% has been applied beneath the building whereas, an increased factor of 20% has been considered where the chamber extends beneath the driveway, ramp and substation. Blockage in these areas has been included to represent supporting columns with additional supports expected for the driveway.

A slab thickness of 250mm with 150mm high kerb has been assumed for the driveway slab while a thickness of 300mm has been assumed for the building floor slab. A blockage factor of 100% has been applied to these elements representing a total obstruction to flow where flood water contacts the suspended slabs. Similarly, flows above the building floor level are also assumed 100% blocked, while flows above the driveway slab are assumed to pass over un-obstructed. An additional allowance for form loss has been applied to the flow constrictions within the flood chamber to allow for losses in momentum due to the columns within the flood chamber.

Blockage for louvres are shown in **Figure A2** to vary with generally 20% along the southern and western extent of the building and 50-70% along the northern and eastern extents. Similarly, **Figure A2** also shows a façade wall is proposed around the northern face of the building in an attempt to maintain the existing flow distribution across the boundary, post development. These will be designed during the detailed design and require a structural engineer to confirm they have the capacity to withstand flood forces and debris impact loads.

A total of twelve 150mm circular floor waste pits are proposed in the base of the flood chamber in order to drain stored flood water from the chamber. The inlet capacity rating curves for these floor waste pits suggest that only two would be sufficient to convey the required capacity through the proposed dual 225mm uPVC pipes due to the available head over the floor waste pits. This is equivalent to a blockage factor of approximately 85%.

The dual 225mm uPVC pipes are proposed from the floor wastes, connecting into the Sydney Water culvert. A one-way flap is also proposed at the connection to the Sydney Water Culvert to prevent back-flow into the chamber. Refer to the previously referenced Civil Engineering Drawings for additional details.

Results

Critical Duration

The critical duration for the subject site has been based on the information provided in the HMPW Overland Flow Flood Study report (SMEC, 2016). This suggests the 120-minute duration is critical for the 1% AEP, and the 60-minute duration is critical for the PMF.

Comparison with Regional Study

A comparison between the results from the original HMPW Overland Flow Flood Study (SMEC, 2016) and the updated Existing Case scenario has been prepared for the 1% AEP. The results are presented in the attached **Figure B1** of Appendix A.

Figure B1 of Appendix A shows a decrease in the properties west of the subject site which is expected to be due to the removal of a building that was modelled on the western portion of the site in the original model (SMEC, 2016). Similarly, an increase is observed upstream due to the updated culvert size and inclusion of blockage.

As a result, additional flow enters the subject site which leads to an increase in flood depths across the site when compared to the original HMPW Overland Flow Flood Study (SMEC, 2016). An increase is also observed downstream of the subject site which is expected to be commensurate with the decrease in the properties to the west and the increases observed upstream.

Existing Flood Behaviour

During the existing case, overland flow derived from the upstream catchment enters the subject site from the southern and western boundaries before continuing towards Cambridge Street via the driveway entrance and finally onto Stoney Creek Road as flows passes across the northern boundary. Overland flow continues in a north-easterly direction across Stoney Creek Road, and through the road network and the properties to the north.

Figure C1 and C3 of Appendix A presents the existing flood depths for the 1% AEP and PMF design storm events respectively. Flood depths for the 1% AEP range across the subject site between 100-500mm while, depths in the order of 600-1000mm are observed in the PMF. Similarly, the below Table 3 presents the corresponding existing flood elevations at each corner of the site.

Table 3 – Subject Site Existing Case 1% AEP Flood Levels

Reporting Point	1% AEP Flood Elevation (mAHD) (Refer to Figure C1 of Appendix A)	PMFFlood Elevation (mAHD) (Refer to Figure C3 of Appendix A)
North-Eastern Corner	29.93	30.38
North-Western Corner	30.38	30.87
South-Eastern Corner	30.37	30.78
South-Western Corner	30.47	30.90

Flood hazard has been assessed using the latest Australian Rainfall and Runoff 2019 guidelines, in particular **Figure 6.7.9** of Book 6 – Chapter 7, reproduced below as **Figure 3**. The flood hazard categories across the subject site and vicinity during the 1% AEP and PMF design storm events are presented in **Figure C2 and C4** of Appendix A respectively.

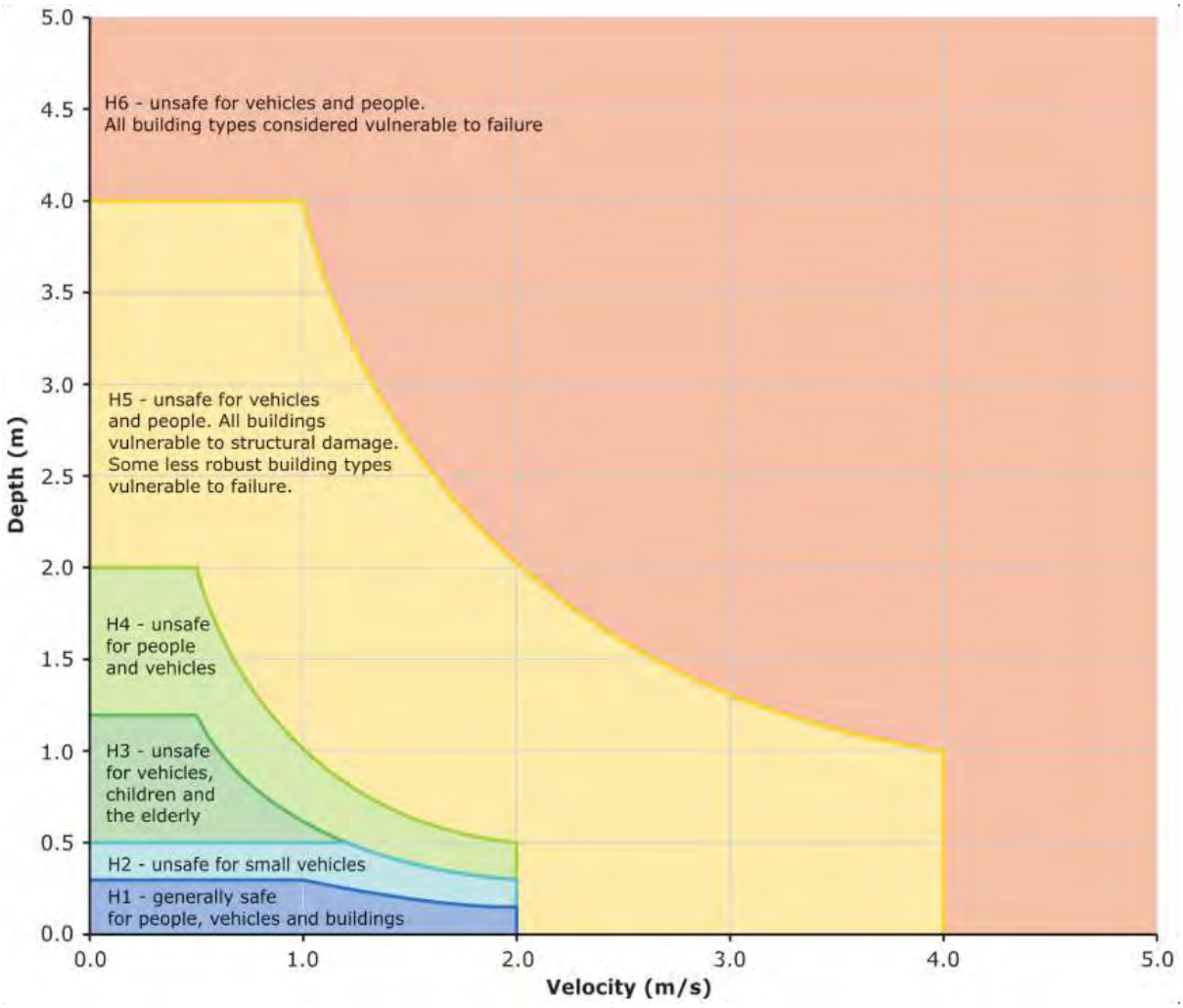


Figure 3 - Australian Rainfall and Runoff 2019 Flood Hazard Categories (Figure 6.7.9)

Figure C2 of Appendix A suggests flood hazard categories across the subject site during the 1% AEP design storm event are generally less than H2 with the exception of a portion of H3 observed along the northern boundary. During the PMF, Figure C4 shows flood hazard varies between H2 to H5 across the subject site.

External to the subject site, patches of H5 hazard flow are observed in Cambridge Street and Stoney Creek Road during the 1% AEP. A patch of H3 and H4 hazard flow is observed at the driveway entrance to the subject site off Cambridge Street, suggesting evacuation from the site may not be safe during a major event under existing conditions. During the PMF, hazard conditions throughout the upstream properties and road network are largely H5.

Developed Flood Behaviour

Flow behaviour during the developed case is similar to that of the existing case. Stormwater derived from the upstream catchment enter the subject site from the western and southern boundaries. Overland flow that enters the site then spills into the proposed flood chamber beneath the building. Flood water stored in the chamber is proposed to be drained out via the proposed floor waste pits and the dual 225mm uPVC pipes. Similar to the existing case, flows that spill across the southern and western boundaries also travels in an easterly direction along the proposed driveway and towards Cambridge Street.

When full, overflow from the flood chamber spills into the landscaped areas along the northern and eastern boundaries. Flows then continue onto Cambridge Street and Stoney Creek Road.

Figure D1 and D3 of Appendix A presents the flood depths and elevations across the subject site during the developed case. Similarly, the below Table 4 presents the 1% AEP and PMF flood elevations at each corner of the subject site.

Table 4 - Developed Case Flood Levels

Reporting Point	1% AEP Flood Elevation (mAHD) (Refer to Figure D1 of Appendix A)	PMF Flood Elevation (mAHD) (Refer to Figure D3 of Appendix A)
North-Eastern Corner	29.92	30.40
North-Western Corner	30.25	30.66
South-Eastern Corner	30.22	30.73
South-Western Corner	30.38	30.94

Flood hazard during the developed case has also been considered with respect to the above **Figure 3, Figures D2 and D4** of Appendix A present the developed case flood hazard conditions during the 1% AEP and PMF design storm events respectively. During the 1% AEP, flood hazard within the driveway is limited to a maximum of H2 which **Figure 3** suggests is safe for large vehicles and pedestrians.

Flood hazard within the chamber is generally H4 with some patches of H5 during the 1% AEP and H5 with patches of H6 during the PMF design storm event. The chamber is proposed to exclude pedestrian access under normal operation with access permitted only for maintenance purposes. Under no circumstances should anyone attempt to enter the flood chamber during a flood event. Louvres (or similar) restrict access into the flood chamber around the building and are proposed to reduce the risk of someone entering and / or becoming trapped beneath the building during a flood event.

Development Impact

Figures E1 and E2 of Appendix A presents the impact of the proposed development during the 1% AEP **and PMF** design storm events respectively. With the introduction of the flood chamber beneath the building, an increase in the available flood storage on site is provided for the regional catchment. Under existing conditions, approximately 600m^3 of flood storage is available across the subject site while, during the developed scenario, in excess of 2000m^3 is provided. As a result, Figure E1 of Attachment 1 shows that during the 1% AEP design storm event, flood levels typically decrease across the subject site and within the adjacent properties.

A minor increase of up to approximately 68mm is observed in Stoney Creek Road during the 1% AEP design storm event which is expected to be due to a slight change in flow behaviour in this area when compared to the existing case. Similarly, an increase of up to approximately 46mm is observed in Cambridge Street which is also expected due to a minor change of flow behaviour across the subject site. These increases are generally contained in the road reserves and are not considered to adversely impact trafficability of these roads when compared to the existing conditions.

Figure E1 also shows an increase in the properties on the eastern side of Cambridge Street during the 1% AEP design storm event. This increase in less than 20mm and is located on the lowest side of these properties and is therefore not considered to create a significant adverse impact within these properties.

During the PMF, Figure E2 of Attachment 1 shows a decrease for the majority of the subject site and the surrounding properties. Similar to the 1% AEP, a minor localised increase of up to 63mm and 82mm is observed in Stoney Creek Road and Cambridge Street respectively which is expected to be due to a slight change in flow behaviour across the site.

In addition, increases are observed in the properties adjacent to the western boundary of the subject site and on the opposite side of Cambridge Street to the east. Generally, consideration to the PMF is given when reviewing risk to life and as such, a review of the change in hazard conditions in these areas has been considered. A comparison between the results presented in Figures C4 and D4 of Attachment 1 shows minimal change in the extent of the existing hazard conditions already observed in these properties under existing conditions. Furthermore, there is no escalation in hazard conditions that are already observed in these properties (i.e. H5 to H6). As such, the increased flood levels observed in these areas during the PMF are not considered to create a significant adverse impact to these properties.

Discussion

Flood Planning Levels

A minimum of the 1% AEP + 500mm or the PMF flood level is proposed as the Flood Planning Level for the proposed development. This is considered to provide a suitable level of protection to the development and is consistent with the requirements set out by the NSW Floodplain Development Manual (2005) for emergency response facilities and critical infrastructure. In this case, the PMF is the governing requirement with a maximum level in the south-western corner of the site of approximately 30.94m AHD. The ground floor is above this level with a Finished Floor Level of 31.2m AHD.

It is noted that the delivery dock area is sited below the 1% AEP flood level. This was required to enable vehicular access into the building while limiting flood impact to adjacent properties and has been raised to a minimum RL of 30.22m AHD following discussion with GRC. Positioning this area below the 1% AEP flood level is not considered to create in an increased risk to life within the facility as a step in the loading dock is proposed that will enable pedestrian access above the PMF flood level. Similarly, as recommended below, building elements located below the Flood Planning Level shall be structurally capable to withstand flood forces and facilitate easy cleaning.

Following initial liaison with Council, the basement carpark entry threshold is proposed to be set at a minimum of the 1% AEP level plus a freeboard of 300mm. This corresponds to a level of approximately 30.8m AHD. All other openings including the carpark intake and exhaust, basement carpark stairwells and lift shafts are positioned at or above the PMF flood level.

Building Components

The building shall be of robust construction and all structural components below the Flood Planning Level shall be flood compatible. Any building elements sited below the Flood Planning Level shall be constructed using elements that maintain strength and durability when wet, facilitate easy cleaning after inundation and capable of resisting the forces of floodwater, debris and buoyancy during an event.

The proposed louvers (or equivalent) surrounding the flood chamber are to be designed to withstand flood forces to prevent vehicles and pedestrians being washed into the flood chamber during a flood event. It is recommended certification of structural adequacy (by a qualified structural engineer) be required prior to issue of a Construction Certificate for this work.

Due to the type of building proposed, it is expected flood forces, debris impact loading and buoyancy will not be limiting in the design. This will need to be confirmed by structural engineers prior to Construction Certificate.

Safety and Evacuation

The proposed driveway has been raised to a level that minimises risk to life during a 1% AEP design storm event. Maximum of H2 hazard conditions have been achieved in the driveway and will reduce the risk of vehicles becoming buoyant and the risk to life within the subject site during a major event.

In addition, the proposed development provides refuge above the PMF level. This will facilitate vertical evacuation in the event of a rare or extreme flood event. As mentioned above, the building is to be designed to withstand flood forces and debris impact loads during a PMF event, which facilitates this approach. The provision for refuge above the 1% AEP and PMF is considered an improvement to the current conditions on site as there is limited opportunity for refuge during these events under existing flood scenarios.

The basement carpark entrance threshold level has been positioned in accordance with Council's requirements. All remaining building openings or penetrations leading to the basement are positioned at the PMF level. This will provide anyone that becomes trapped within the basement, during an event greater than the 1% AEP + 300mm, the opportunity for vertical evacuation (e.g. using emergency access stairs).

Access and egress to and from the subject site should not be attempted during the 1% AEP or less frequent events, as flood hazard conditions in excess of H2 are observed in Cambridge Street and Stoney Creek Road. During these events, vertical evacuation and refuge onsite should be sought following commencement of rainfall. With a critical duration of 2 hours during the 1% AEP and 60 minutes during the PMF design storm events, flood water is expected to rise and fall quickly over a period of a few hours. As such, the subject site is not expected to be cut off for a prolonged period of time.

It is recommended a Flood Emergency Response Plan (FERP) be prepared to assist in reducing the risk to life. This is intended to educate building occupants on the existing flood risk prior to the onset of rare to extreme rainfall. The FERP should outline the necessary response procedures and available areas of refuge within the building. This should be provided prior to Occupation Certificate. A Flood Emergency Response summary has been prepared for the subject site and is included as Appendix B.

Monitoring and Maintenance

Access to the flood chamber is to be provided with a minimum access opening of 600x900mm as per the requirements set out in AS3500.3. It is anticipated this can be achieved a number of ways such as access hatches from the suspended driveway, access hatches or grates through the louvres around the perimeter of the building or even through the temporary removal of the louvres. There are numerous opportunities to gain access to the flood chamber and it is anticipated this will be resolved during detailed design.

Some areas of the chamber are in excess of 1.2m deep and as such, step irons or a ladder will be required at access openings in accordance with the requirements set out by AS3500.3.

It is recommended that an operation and maintenance manual be developed for the flood chamber with scheduled inspections and cleaning performed to reduce the risk of blockage.

Conclusion

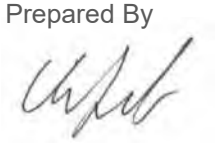
Northrop Consulting Engineers were engaged by Cambridge Unit Developments to prepare a Flood Impact Assessment for the proposed Health Services Facility located at 143a Stoney Creek Road, Beverly Hills.

It was found that the proposed development has no significant impacts on flood behaviour and affectation in the vicinity of the subject site. As a result, the proposed development is not considered to increase the existing level of hazard to persons or property within the subject site or in adjacent properties.

With the introduction of the proposed mitigation measures, (including the flood chamber and preparation of a Flood Emergency Response Plan), the proposed development is considered to improve the existing flood risk on site and make the site suitable for use.

We commend our findings to Council for their review. Should you have any queries regarding this correspondence, please feel free to contact the undersigned on (02) 4943 1777.

Prepared By



Laurence Gitzel
Civil Engineer
BEng (Civil)

Reviewed By

Matt Richards
Principal | Civil Section Manager

Limitation Statement

Northrop Consulting Engineers Pty Ltd (Northrop) has been retained to prepare this report based on specific instructions, scope of work and purpose pursuant to a contract with its client. It has been prepared in accordance with the usual care and thoroughness of the consulting profession for the use by Cambridge Unit Developments. The report is based on generally accepted practices and standards applicable to the scope of work at the time it was prepared. No other warranty, express or implied, is made as to the professional advice included in this report.

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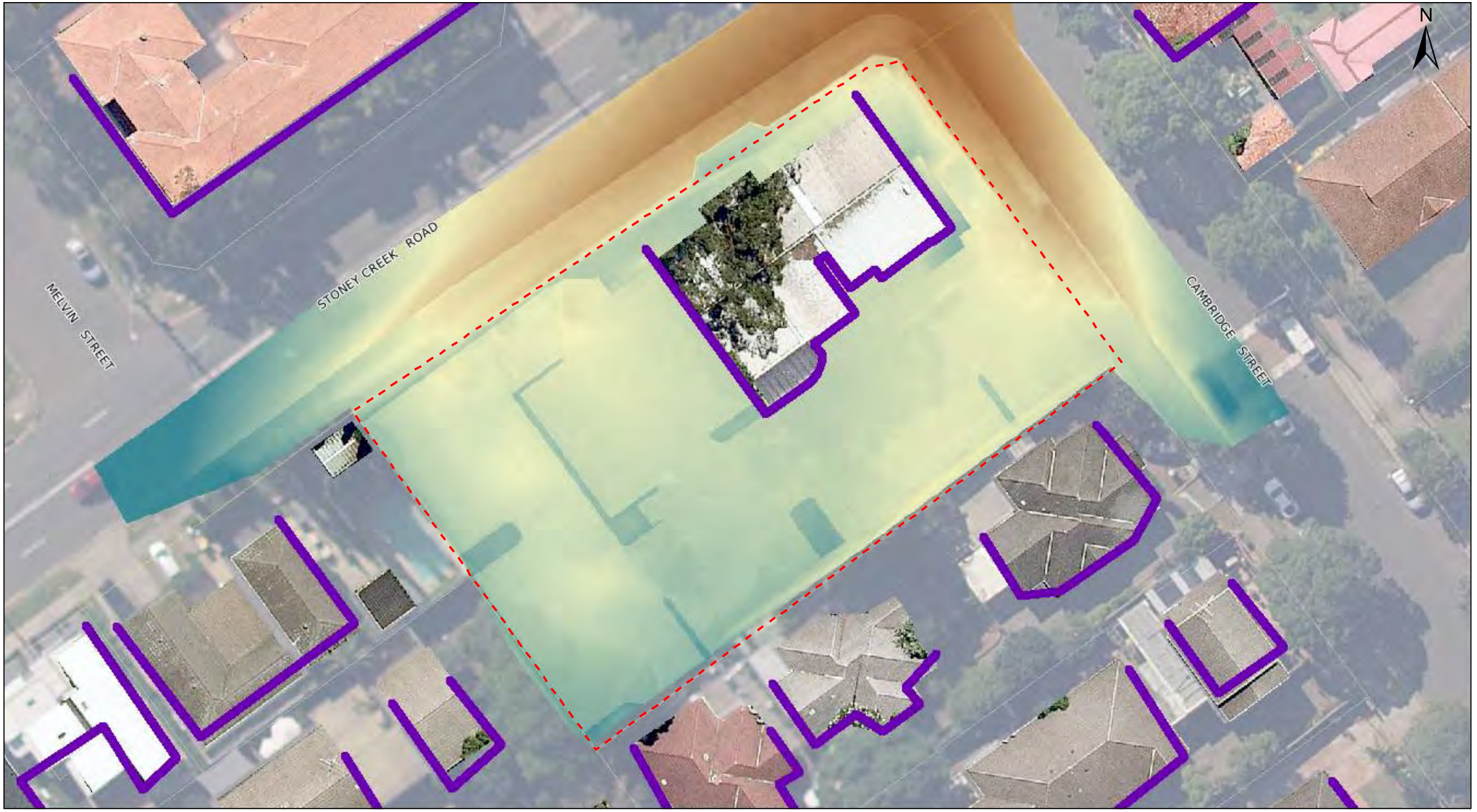
Document Register

Rev	Status	Prepared	Approved	Date
1	Draft for Client Review	LG	MR	27 May 2020
A	For Approval	LG	MR	28 May 2020
B	Re-Issued for Approval	LG	GB	16 December 2020

Appendix A – Figures



Legend

- Subject Site
- Building Walls
- Cadastre

Detailed Survey (mAHD)

- High : 30.71
- Low : 29.20

0 5 10 20 Meters 1:500

Figure A1 [C]

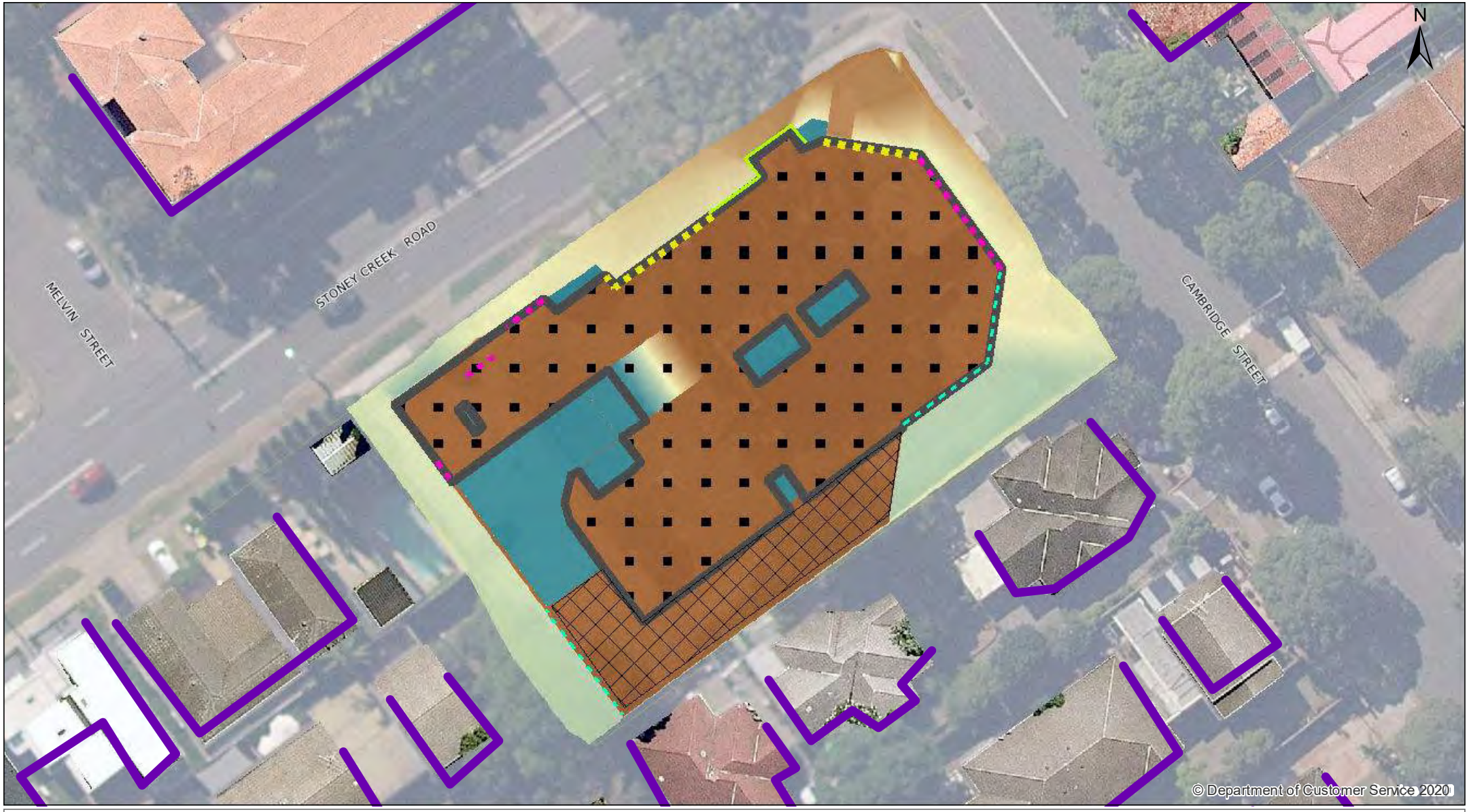
Existing Case Terrain

143 Stoney Creek Road, Beverly Hills

NORTHROP

Data Source: LPI

4/11/2020 X:\PROJECTS\SYDNEY\2020 Jobs\BeverlyHills\TUFLOW\Figures\ArcMap\SY200410__A1[C].mxd



Legend

- Building Walls
- Facade Wall
- Suspended Ramp

Flood Chamber Louvers

- 20% Blocked
- 50% Blocked
- 70% Blocked
- Building Flow Constriction(Ground Level)

Design Surface (mAHD)

- High : 32
- Low : 28.7

0 5 10 20 Meters 1:500

Figure A2 [D]

Developed Case Terrain

143 Stoney Creek Road, Beverly Hills

NORTHROP

Data Source: LPI

11/11/2020 X:\PROJECTS\SYDNEY\2020 Jobs\BeverlyHills\TUFLOW\Figures\ArcMap\SY200410__A2[D].mxd

Legend

- Subject Site
- Fences (50% Blocked)
- Cadastre

Land Use

- Building
- Concrete
- Vegetation

0 5 10 20 Meters 1:500

Figure A3 [B]

Existing Case Land use

143 Stoney Creek Road, Beverly Hills

NORTHROP

Data Source: LPI

4/11/2020 X:\PROJECTS\SYDNEY\2020 Jobs\BeverlyHills\TUFLOW\Figures\ArcMap\SY200410__A3[A].mxd

Legend

- Fences (50% Blocked)
- Cadastre
- Suspended Ramp
- Building Flow Constriction(Ground Level)

Land Use

- Concrete
- Vegetation

0 5 10 20 Meters 1:500

Figure A4 [C]

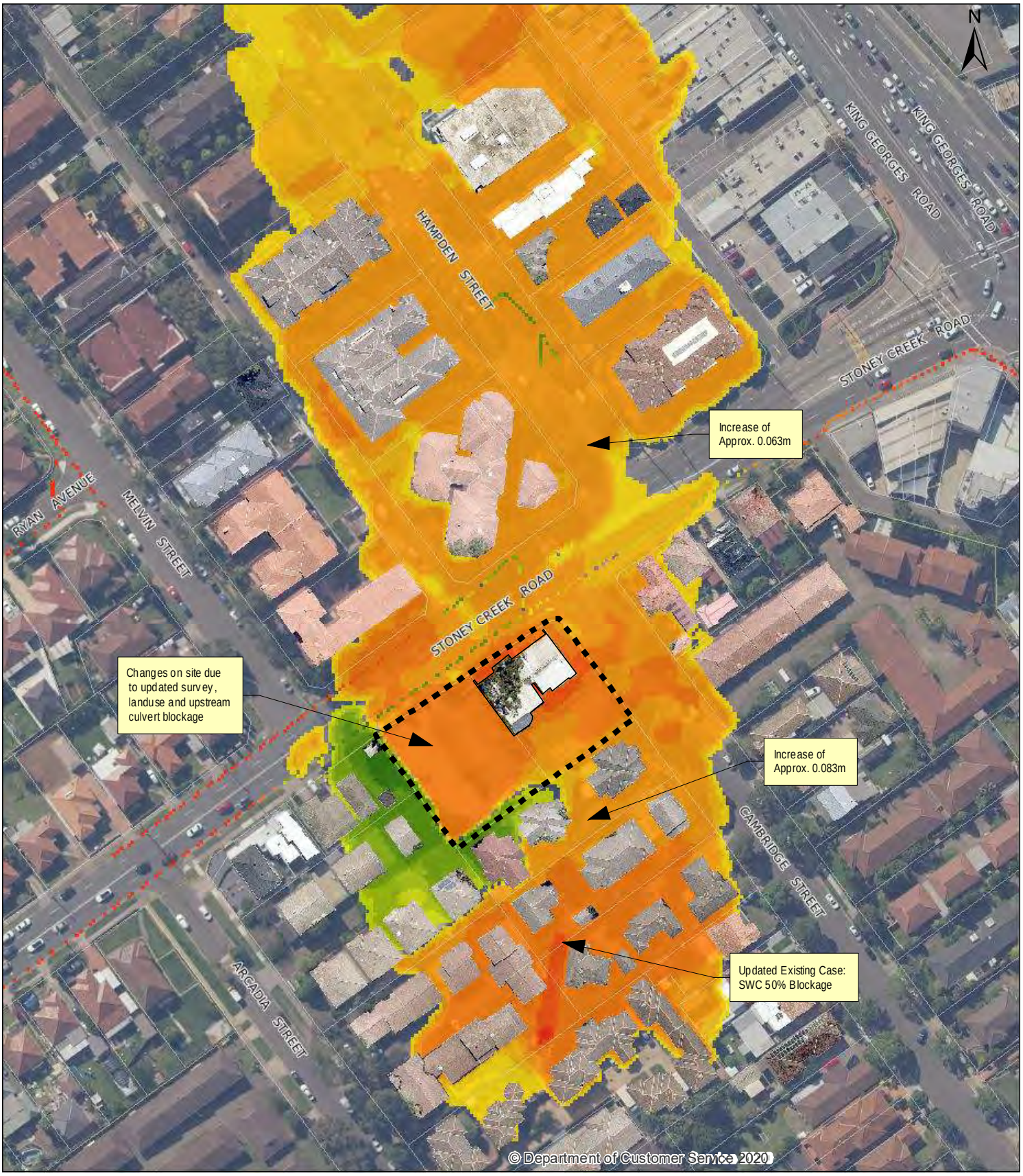
Developed Case Land use

Data Source: LPI

11/11/2020 X:\PROJECTS\SYDNEY\2020 Jobs\BeverlyHills\TUFLOW\Figures\ArcMap\SY200410__A4[C].mxd

143 Stoney Creek Road, Beverly Hills

NORTHROP



Legend

- Subject Site
- Existing Building
- Cadastre

Water Elevation Difference(m)

- <-0.499
- -0.499 - -0.300
- -0.299 - -0.100
- -0.099 - -0.050
- -0.049 - -0.030
- -0.029 - -0.010
- Less than +/- 10mm
- 0.011 - 0.030
- 0.031 - 0.050
- 0.051 - 0.100
- 0.101 - 0.300
- 0.301 - 0.500
- >0.500

0 15 30 60 Meters 1:1,500

Figure B1 [B]

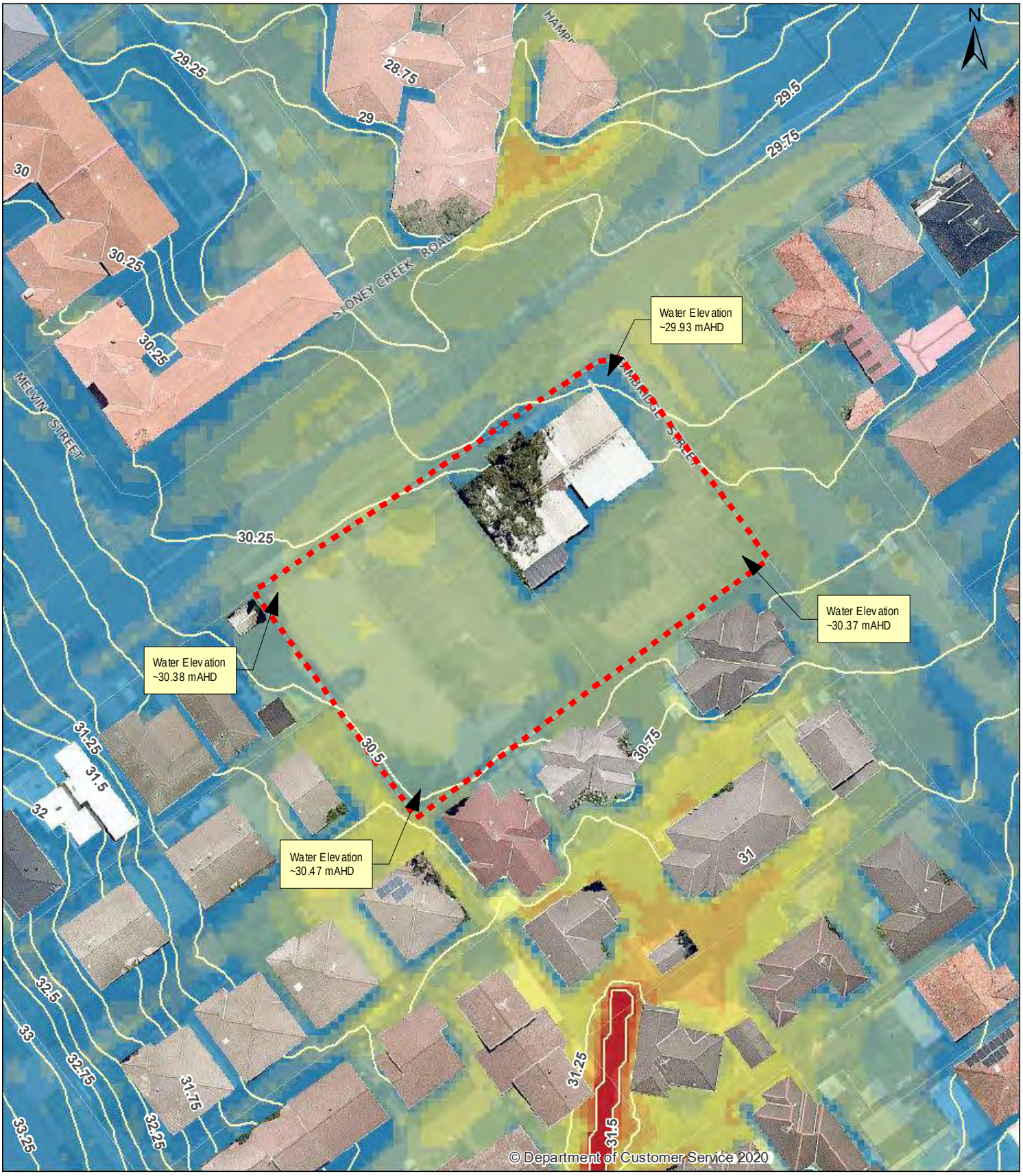
Updated Existing Case minus Original 1% AEP Flood Elevation Difference

Data Source: LPI

143 Stoney Creek Road, Beverly Hills

NORTHROP

10/11/2020 X:\PROJECTS\SYDNEY\2020 Jobs\Beverly Hills\TUFLOW\Figures\ArcMap\SY200410__B1[B]_v2.mxd



Legend

- Subject Site
- Water Levels
- Cadastre

Depth(m)

- 0.00 - 0.05
- 0.05 - 0.1
- 0.1 - 0.3
- 0.3 - 0.5
- 0.5 - 0.7
- 0.7 - 0.9
- 0.9 - 1.1
- 1.1 - 1.3
- 1.3 - 1.5
- 1.5 - 1.7
- 1.7 - 2

0 5 10 20 Meters 1:750

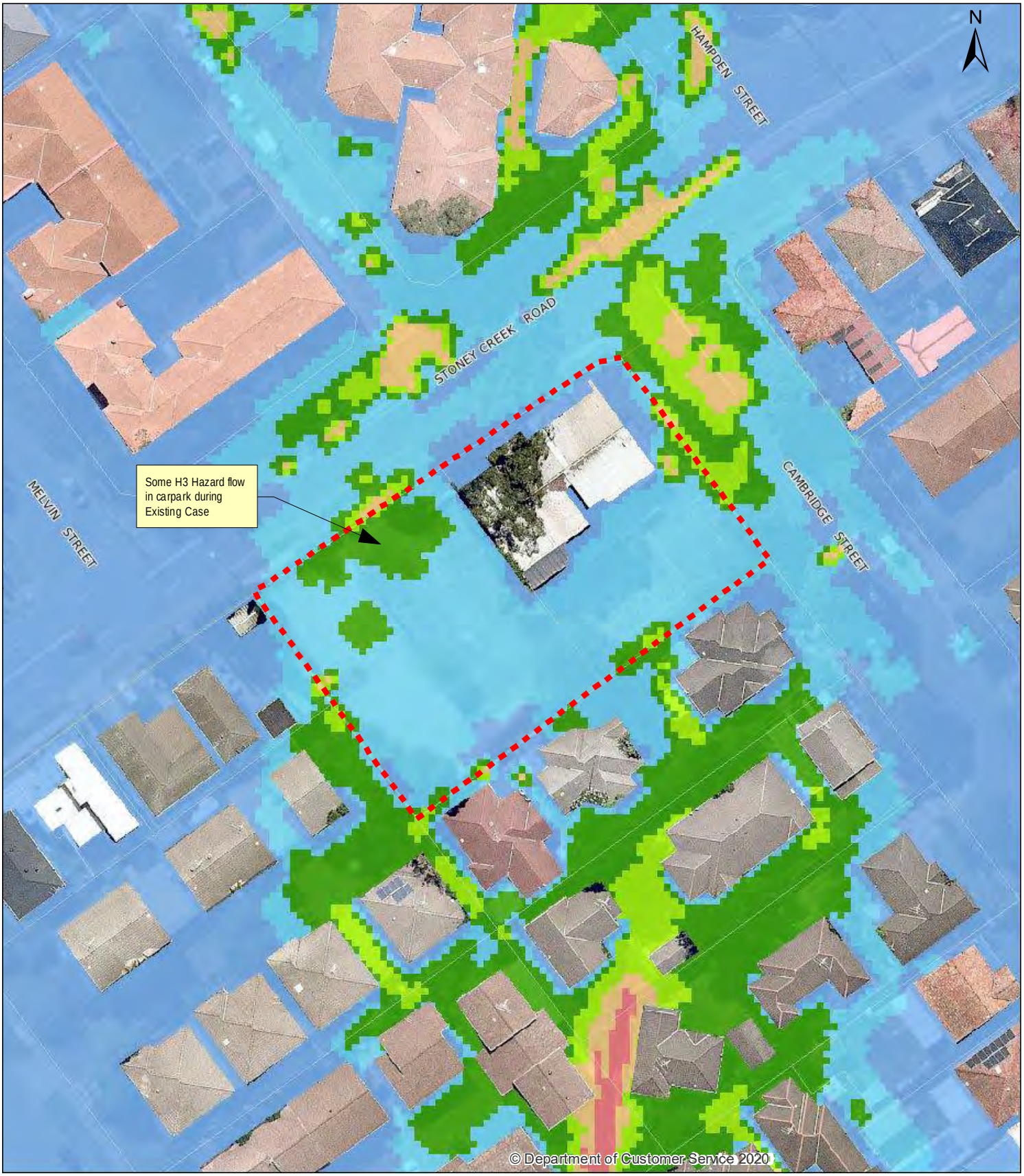
Figure C1 [B]

Existing Case 1%AEP Depth and Elevation Contours

Data Source: LPI

143 Stoney Creek Road, Beverly Hills

NORTHROP



Legend

Subject Site

Cadastre

Hazard

H1
H2
H3
H4
H5
H6

0 5 10 20

Meters 1:750

Figure C2 [B]

Existing Case
1% AEP Flood Hazard
(ARR 2019)

Data Source: LPI

143 Stoney Creek Road, Beverly Hills

NORTHROP

Legend

- Subject Site
- Water Levels
- Cadastre

Depth(m)

- 0.00 - 0.05
- 0.05 - 0.1
- 0.1 - 0.3
- 0.3 - 0.5
- 0.5 - 0.7
- 0.7 - 0.9
- 0.9 - 1.1
- 1.1 - 1.3
- 1.3 - 1.5
- 1.5 - 1.7
- 1.7 - 2

0 5 10 20
Meters 1:750

Figure C3 [B]

Existing Case
PMF Depth and
Elevation Contours

Data Source: LPI

143 Stoney Creek Road, Beverly Hills

NORTHROP

Legend

Subject Site

Cadastre

Hazard

H1

H2

H3

H4

H5

H6

0 5 10 20

Meters 1:750

Figure C4 [B]

Existing Case
PMF Flood Hazard
(ARR 2019)

Data Source: LPI

143 Stoney Creek Road, Beverly Hills

NORTHROP

10/11/2020 \\ncl-nas3\FLOODING\PROJECTS\SYDNEY\2020 Jobs\BeverlyHills\TUFLOW\Figures\ArcMap\SY200410__C4[B].mxd

Legend

- Subject Site
- Water Levels
- Ramp
- Building Flow Constriction
- Cadastre

Depth(m)

- 0.00 - 0.05
- 0.05 - 0.1
- 0.1 - 0.3
- 0.3 - 0.5
- 0.5 - 0.7
- 0.7 - 0.9
- 0.9 - 1.1
- 1.1 - 1.3
- 1.3 - 1.5
- 1.5 - 1.7
- 1.7 - 2

Design Surface (mAHD)

High : 32.0

Low : 28.7

0 5 10 20

Meters 1:750

Figure D1 [D]

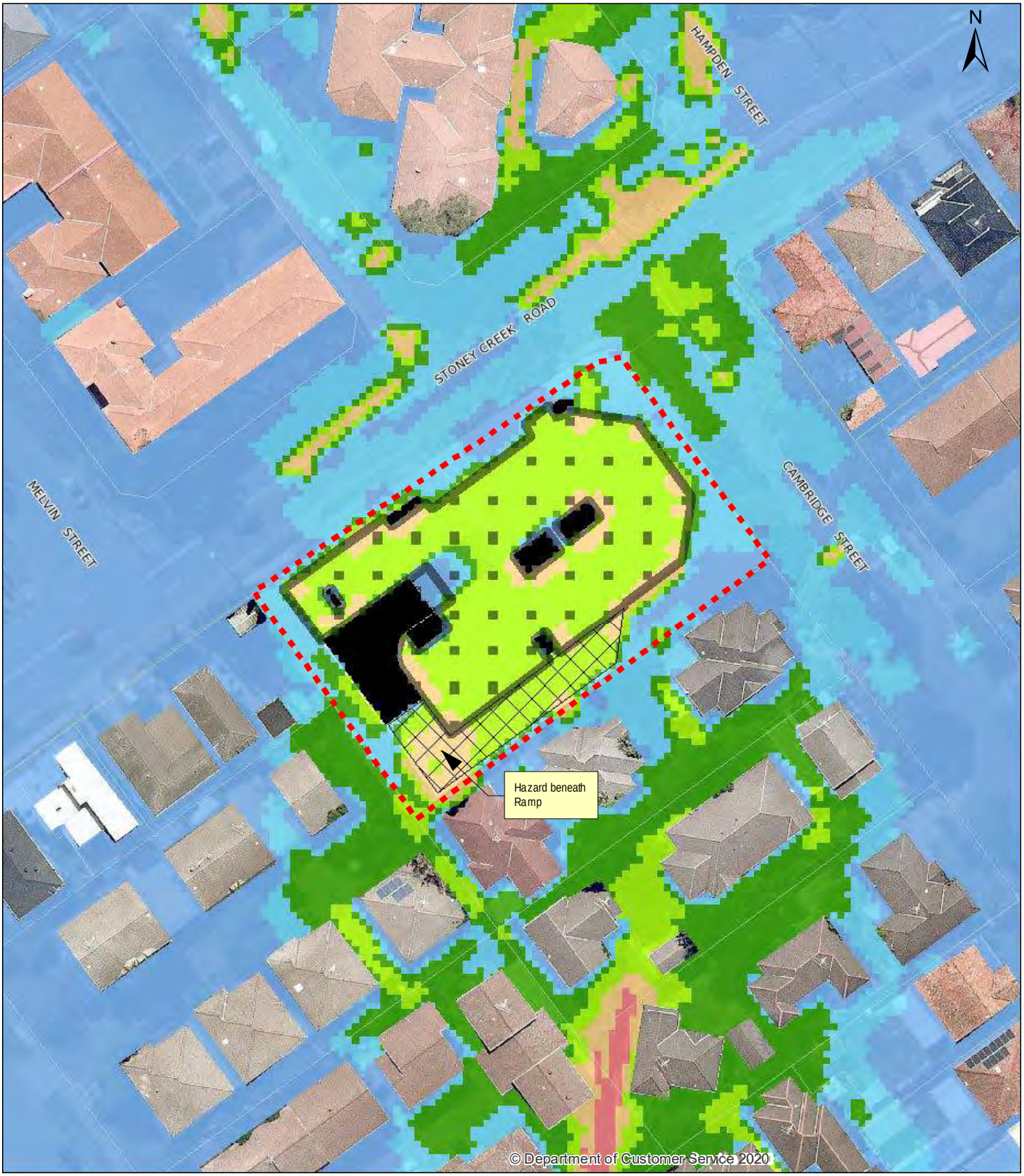
Developed Case
1% AEP Depth and
Elevation Contours

Data Source: LPI

143 Stoney Creek Road, Beverly Hills

NORTHROP

10/11/2020 X:\PROJECTS\SYDNEY\2020 Jobs\Beverly Hills\TUFLOW\Figures\ArcMap\SY200410__D1[D].mxd



Legend

- Subject Site
- Building Flow Constriction
- Ramp
- Cadastre

Hazard

- H1
- H2
- H3
- H4
- H5
- H6

Design Surface (mAHD)

High : 32.0

Low : 28.7

0 5 10 20 Meters 1:750

Figure D2 [D]

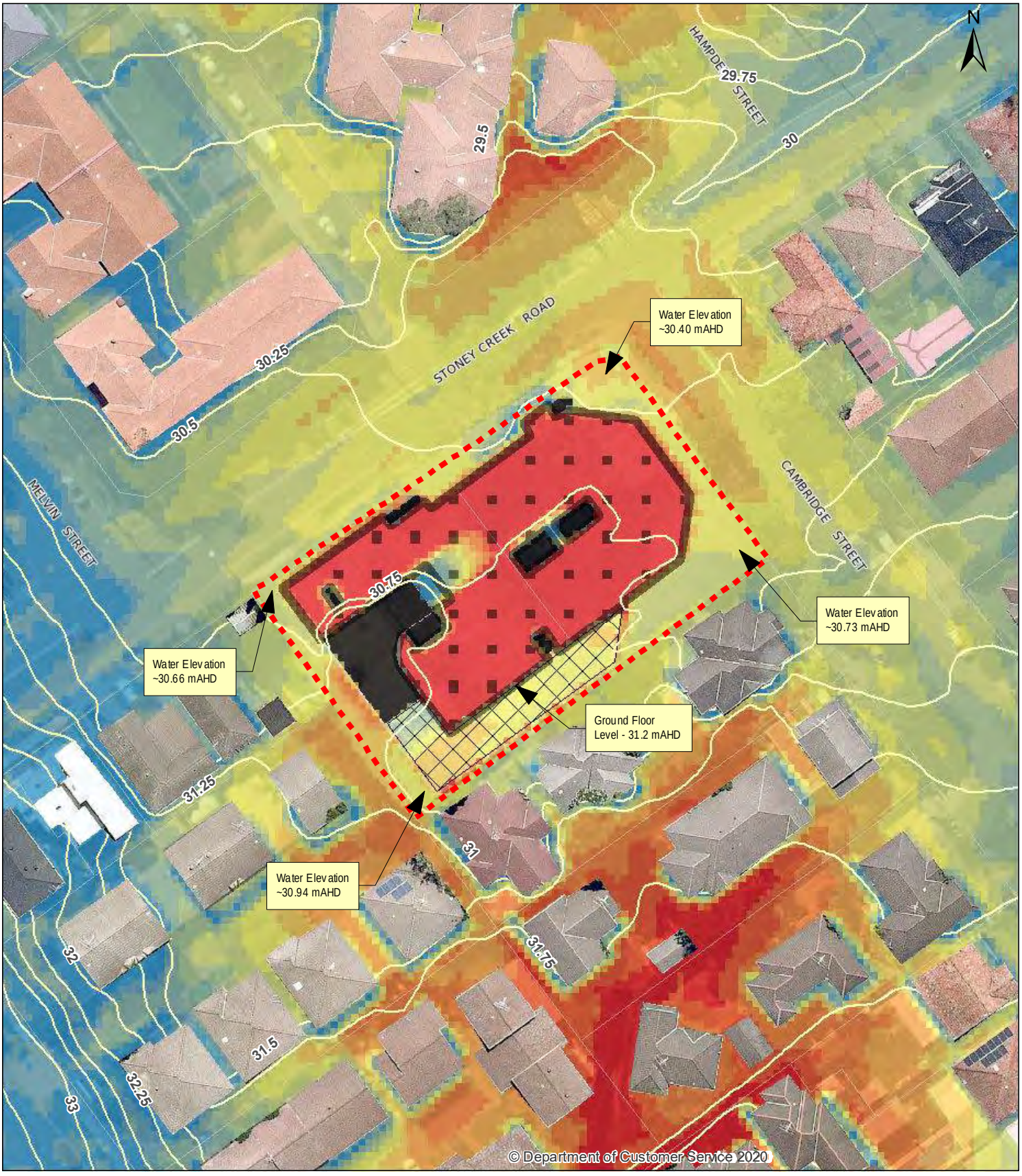
Developed Case
1% AEP Flood Hazard
(ARR 2019)

Data Source: LPI

143 Stoney Creek Road, Beverly Hills

NORTHROP

10/11/2020 \\ncl-nas3\FLOODING\PROJECTS\SYDNEY\2020 Jobs\BeverlyHills\TUFLOW\Figures\ArcMap\SY200410__D2[D].mxd



Legend

- Subject Site
- Water Levels
- Ramp
- Building Flow Constriction
- Cadastre

Depth(m)

- 0.00 - 0.05
- 0.05 - 0.1
- 0.1 - 0.3
- 0.3 - 0.5
- 0.5 - 0.7
- 0.7 - 0.9
- 0.9 - 1.1
- 1.1 - 1.3
- 1.3 - 1.5
- 1.5 - 1.7
- 1.7 - 2

Design Surface (mAHD)

High : 32.0

Low : 28.7

0 5 10 20

Meters 1:750

Figure D3 [D]

Developed Case PMF Depth and Elevation Contours

Data Source: LPI

143 Stoney Creek Road, Beverly Hills

NORTHROP

10/11/2020 X:\PROJECTS\SYDNEY\2020 Jobs\Beverly Hills\TUFLOW\Figures\ArcMap\SY200410__D3[D].mxd

Legend

- Subject Site
- Building Flow Constriction
- Ramp
- Cadastre

Hazard

- H1
- H2
- H3
- H4
- H5
- H6

Design Surface (mAHD)

High : 32.0

Low : 28.7

0 5 10 20 Meters 1:750

Figure D4 [D]

Developed Case
PMF Flood Hazard
(ARR 2019)

Data Source: LPI

143 Stoney Creek Road, Beverly Hills

NORTHROP

10/11/2020 \\ncl-nas3\FLOODING\PROJECTS\SYDNEY\2020 Jobs\BeverlyHills\TUFLOW\Figures\ArcMap\SY200410__D4[D].mxd

Legend

- Subject Site
- Existing Building
- Cadastre

Water Elevation Difference(m)

- <-0.499
- -0.499 - -0.300
- -0.299 - -0.100
- -0.099 - -0.050
- -0.049 - -0.030
- -0.029 - -0.010
- Less than +/- 10mm
- 0.011 - 0.030
- 0.031 - 0.050
- 0.051 - 0.100
- 0.101 - 0.300
- 0.301 - 0.500
- >0.500

0 12.5 25 50 Meters 1:1,000

Figure E1 [E]

Pre to Post Comparison
1% AEP Flood Elevation

Data Source: LPI

143 Stoney Creek Road, Beverly Hills

NORTHROP

6/11/2020 X:\PROJECTS\SYDNEY\2020 Jobs\BeverlyHills\TUFLOW\Figures\ArcMap\SY200410__E1[E].mxd

Legend

- Subject Site
- Existing Building
- Cadastre

Water Elevation Difference(m)

- <-0.499
- -0.499 - -0.300
- -0.299 - -0.100
- -0.099 - -0.050
- -0.049 - -0.030
- -0.029 - -0.010
- Less than +/- 10mm
- 0.011 - 0.030
- 0.031 - 0.050
- 0.051 - 0.100
- 0.101 - 0.300
- 0.301 - 0.500
- >0.500

0 12.5 25 50 Meters 1:1,000

Figure E2 [E]

Pre to Post Comparison
PMF Flood Elevation

Data Source: LPI

143 Stoney Creek Road, Beverly Hills

NORTHROP

6/11/2020 X:\PROJECTS\SYDNEY\2020 Jobs\BeverlyHills\TUFLOW\Figures\ArcMap\SY200410__E2[E].mxd

Appendix B – Flood Emergency Response Summary

The following provides as summary of the expected flood behaviour and the anticipated Flood Emergency Response including:

- A summary of the anticipated developed case flood depth and elevation at each corner of the subject site during both the 1% AEP and PMF design storm events. Flood depths and elevations are presented to provide an understanding of the expected flood behaviour across the subject site (refer to Table 1).
- A comparison of the proposed floor levels with respect to the anticipated maximum flood levels which are provided to highlight opportunities for on-site flood refuge (refer to Table 2).
- A summary of the potentially hazardous rainfall depths that are expected to trigger evacuation/ on-site refuge and are expected to result in flooding across the subject site (refer to Table 3).
- The recommended flood emergency response measures, prior to, during and after a flood event including those responsible to managing each response measure (refer to Table 4).
- Example signage is provided to highlight the on-site refuge points and the procedure for facility users to follow in the event of a flood emergency (refer to the "Example Flood Signage Section below").

Table 1 - Summary of Flood Behaviour

Event	North-Eastern Corner	North-Western Corner	South-Eastern Corner	South-Western Corner
1% AEP Flood Level (mAHD)	29.92	30.25	30.22	30.38
1% AEP Flood Depth (m)	0.42	0.25	0.32	0.28
PMF Flood Level (mAHD)	30.40	30.66	30.73	30.94
PMF Flood Depth (m)	0.90	0.66	0.83	0.84

Table 2 - Internal Floor Levels

Floor	Level (m AHD)	Relationship to Flood Levels
Basement Level 3	19.50	Below 1% AEP, below PMF
Basement Level 2	22.50	Below 1% AEP, below PMF
Basement Level 1	25.50	Below 1% AEP, below PMF
Ground Level	31.20	**Above 1% AEP and PMF**
Upper Level 1	35.22	**Above 1% AEP and PMF**
Upper Level 2	38.82	**Above 1% AEP and PMF**

Table 3 - Potentially Hazardous Rainfall Depths

Depth	Timescale	Depth	Timescale	Depth	Timescale	Depth	Timescale
62.5mm	30-mins	86.7mm	1-hour	113.8mm	2-hours	166.2mm	6-hours

Table 4 - Flood Response Actions Summary

WHEN	WHAT	BY WHO
Prior to Flooding	**Nominate Flood Wardens and First Aid Officer** (at least one of each per Tenancy).	Chief Flood Warden (e.g. Building Manager)
	Assemble **Emergency Kit.**	First Aid Officer
	Check **Floodsafe Kit** every three months (one kit per Tenancy).	First Aid Officer
	Perform induction training for new staff.	Chief Flood Warden / Flood Wardens
	Coordinate drills twice per year (minimum).	Chief Flood Warden
	Sign up to the Early Warning Network and monitor weather situation at 4pm daily.	Chief Flood Warden
	Install and Maintain Flood Signage.	Chief Flood Warden / Flood Wardens
On-site Refuge	**Text / Email from the Early Warning Network** with rainfall predicted to be greater than; **62.5mm** in 30 minutes **86.7mm** in 1-hour **113.8mm** in 2-hours **166.2mm** in 6-hours	Chief Flood Warden
	If rainfall is predicted for the following day, **close the facility, and cancel all procedures / appointments.** **Notify the SES / Police** of the decision to close the facility.	Chief Flood Warden
	If rainfall is predicted for the same day, **make decision to seek refuge on-site and wait it out.** **Notify SES / Police** of the decision to seek refuge on-site and wait it out.	Chief Flood Warden
	Communicate decision to remain on-site with facility users and organise seating and lighting as required.	Chief Flood Warden and Flood Wardens
	Wait it out on Ground Floor and Upper Levels	All
	Maintain regular communication with staff and facility users.	Chief Flood Warden & Flood Wardens
	Do not attempt to access the basement levels or the flood chamber during a flood event.	All
	Do not attempt to drive or walk through floodwaters. If in a life-threatening situation, call 000 immediately.	All
Once Risk has Passed / After a Flood	Check all services and structural stability of building.	Qualified persons
	Return to occupation.	Chief Flood Warden

Example Signage and Refuge

Route to On-site Flood Refuge (Basement Level 3)

This property is flood prone with predicted depths surrounding the property of up to approximately 0.9 meters. **Refuge above predicted flood levels is available** on the Ground Floor level and above. In the event of a predicted flood event **proceed to the upper levels of the facility and remain in place to receive advice from the nominated Flood Wardens**.

No attempt should be made to evacuate elsewhere through floodwater by foot or vehicle. Access to the basement carpark should not be attempted during a flood event and lifts should not be used.

During a flood event, and following commencement of the flood emergency alarm, please proceed to the ground floor and upper levels and await instruction from the Flood Wardens.

If assistance is required, please call the following emergency numbers:

Table 5 – Emergency Numbers

Person Organisation	Name	Number
Chief Flood Warden		
Deputy Flood Warden		
First Aid Officer		
SES	-	132 500
Police / Fire / Ambulance	-	000

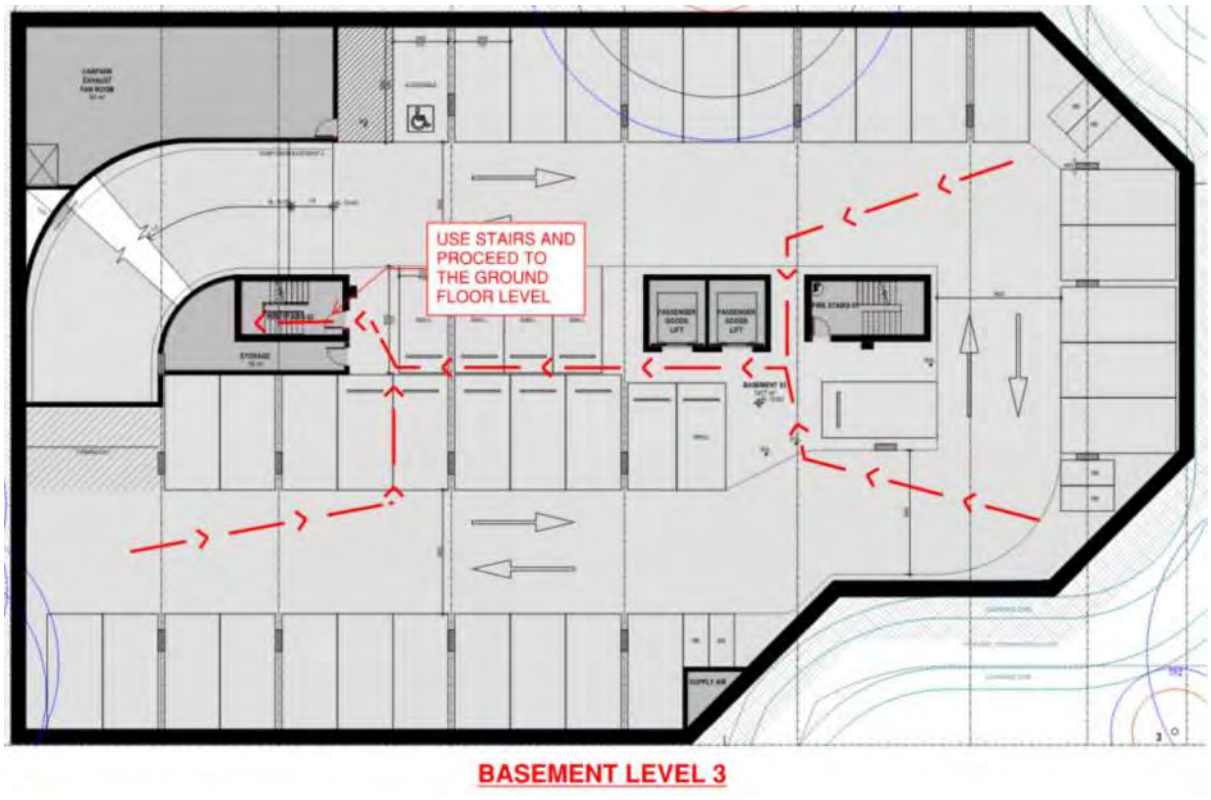


Figure 1 – Basement Level 3 Refuge

Route to On-site Flood Refuge (Basement Level 2)

This property is flood prone with predicted depths surrounding the property of up to approximately 0.9 meters. **Refuge above predicted flood levels is available** on the Ground Floor level and above. In the event of a predicted flood event **proceed to the upper levels of the facility and remain in place to receive advice from the nominated Flood Wardens**.

No attempt should be made to evacuate elsewhere through floodwater by foot or vehicle. Access to the basement carpark should not be attempted during a flood event and lifts should not be used.

During a flood event, and following commencement of the flood emergency alarm, please proceed to the ground floor and upper levels and await instruction from the Flood Wardens.

If assistance is required, please call the following emergency numbers:

Table 6 – Emergency Numbers

Person Organisation	Name	Number
Chief Flood Warden		
Deputy Flood Warden		
First Aid Officer		
SES	-	132 500
Police / Fire / Ambulance	-	000

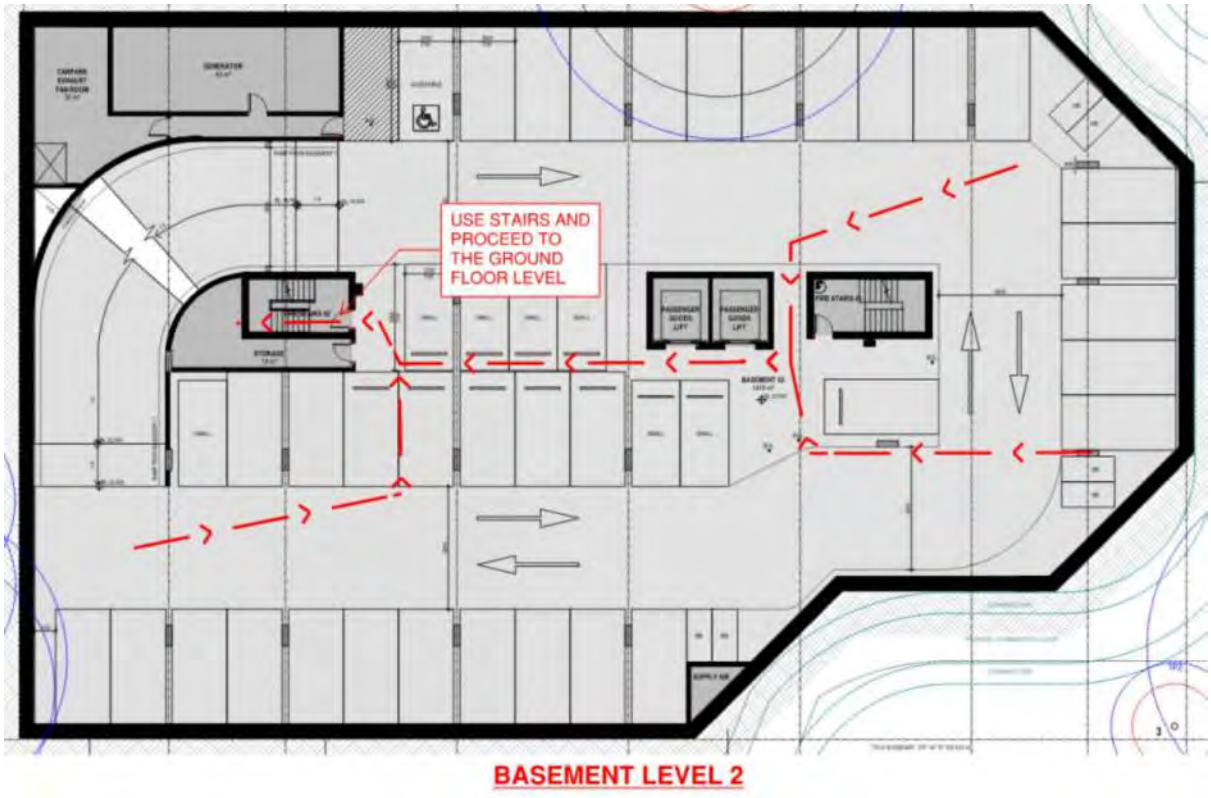


Figure 2 - Basement Level 2 Refuge

Route to On-site Flood Refuge (Basement Level 1)

This property is flood prone with predicted depths surrounding the property of up to approximately 0.9 meters. **Refuge above predicted flood levels is available** on the Ground Floor level and above. In the event of a predicted flood event **proceed to the upper levels of the facility and remain in place to receive advice from the nominated Flood Wardens**.

No attempt should be made to evacuate elsewhere through floodwater by foot or vehicle. Access to the basement carpark should not be attempted during a flood event and lifts should not be used.

During a flood event, and following commencement of the flood emergency alarm, please proceed to the ground floor and upper levels and await instruction from the Flood Wardens.

If assistance is required, please call the following emergency numbers:

Table 7 – Emergency Numbers

Person Organisation	Name	Number
Chief Flood Warden		
Deputy Flood Warden		
First Aid Officer		
SES	-	132 500
Police / Fire / Ambulance	-	000

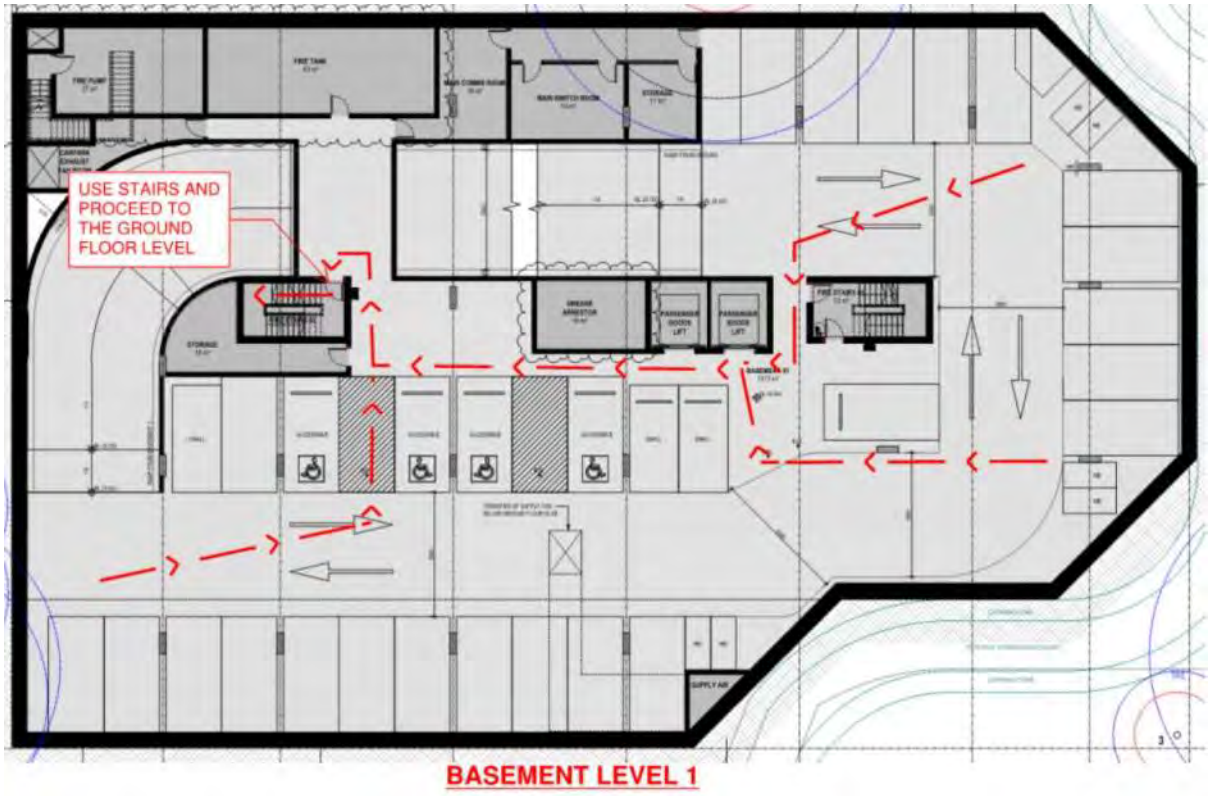


Figure 3 – Basement Level 1 Refuge

Route to On-site Flood Refuge (Ground Floor Level)

This property is flood prone with predicted depths surrounding the property of up to approximately 0.9 meters. **Refuge above predicted flood levels is available** on the Ground Floor level and above. In the event of a predicted flood event **proceed to the upper levels of the facility and remain in place to receive advice from the nominated Flood Wardens**.

No attempt should be made to evacuate elsewhere through floodwater by foot or vehicle. Access to the basement carpark should not be attempted during a flood event and lifts should not be used.

During a flood event, and following commencement of the flood emergency alarm, please proceed to the ground floor and upper levels and await instruction from the Flood Wardens.

If assistance is required, please call the following emergency numbers:

Table 8 – Emergency Numbers

Person Organisation	Name	Number
Chief Flood Warden		
Deputy Flood Warden		
First Aid Officer		
SES	-	132 500
Police / Fire / Ambulance	-	000

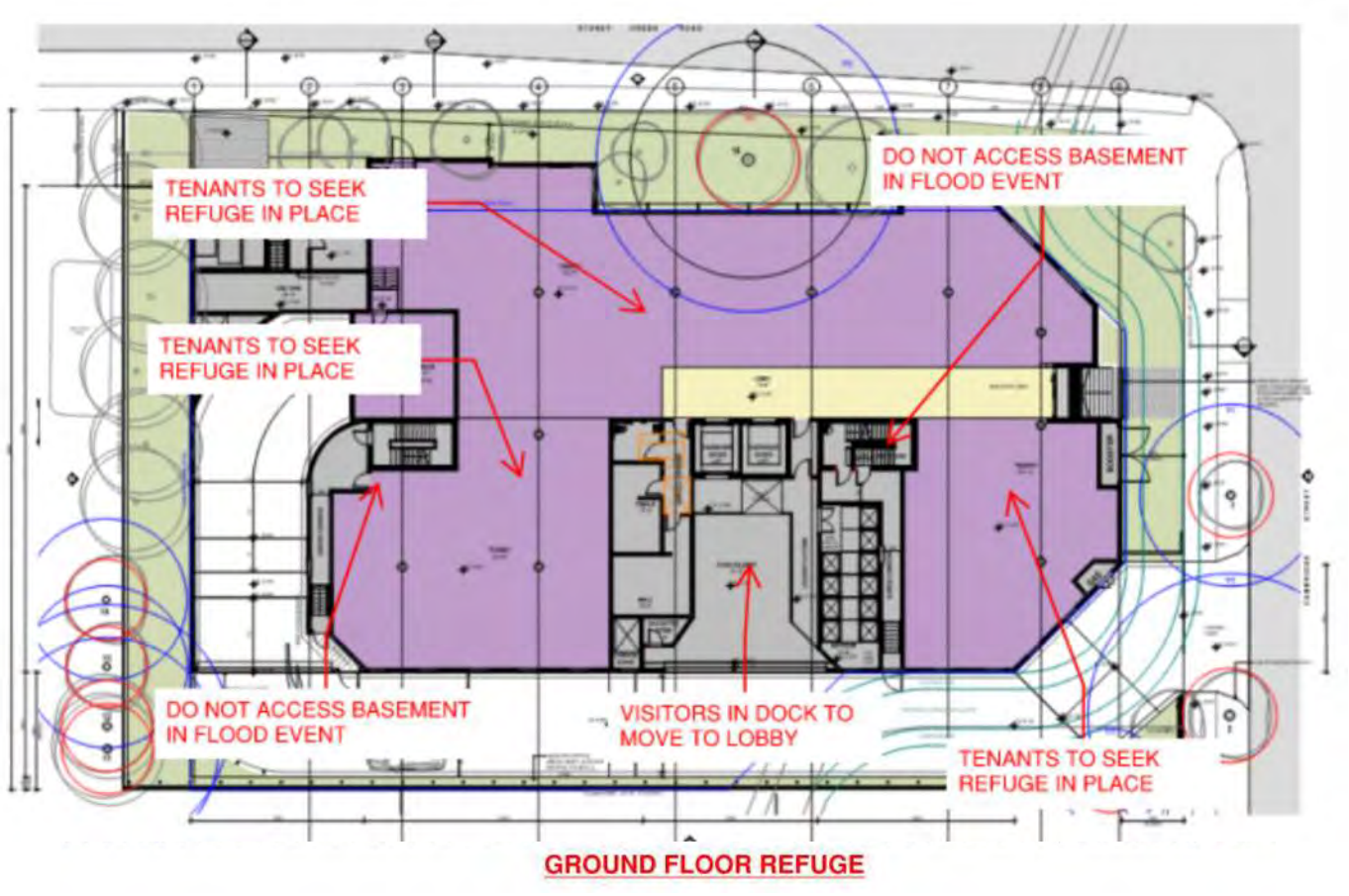


Figure 4 – Ground Floor Level Refuge

Route to On-site Flood Refuge (Upper Level 1)

This property is flood prone with predicted depths surrounding the property of up to approximately 0.9 meters. **Refuge above predicted flood levels is available** on the Ground Floor level and above. In the event of a predicted flood event **proceed to the upper levels of the facility and remain in place to receive advice from the nominated Flood Wardens**.

No attempt should be made to evacuate elsewhere through floodwater by foot or vehicle. Access to the basement carpark should not be attempted during a flood event and lifts should not be used.

During a flood event, and following commencement of the flood emergency alarm, please proceed to the ground floor and upper levels and await instruction from the Flood Wardens.

If assistance is required, please call the following emergency numbers:

Table 9 – Emergency Numbers

Person Organisation	Name	Number
Chief Flood Warden		
Deputy Flood Warden		
First Aid Officer		
SES	-	132 500
Police / Fire / Ambulance	-	000

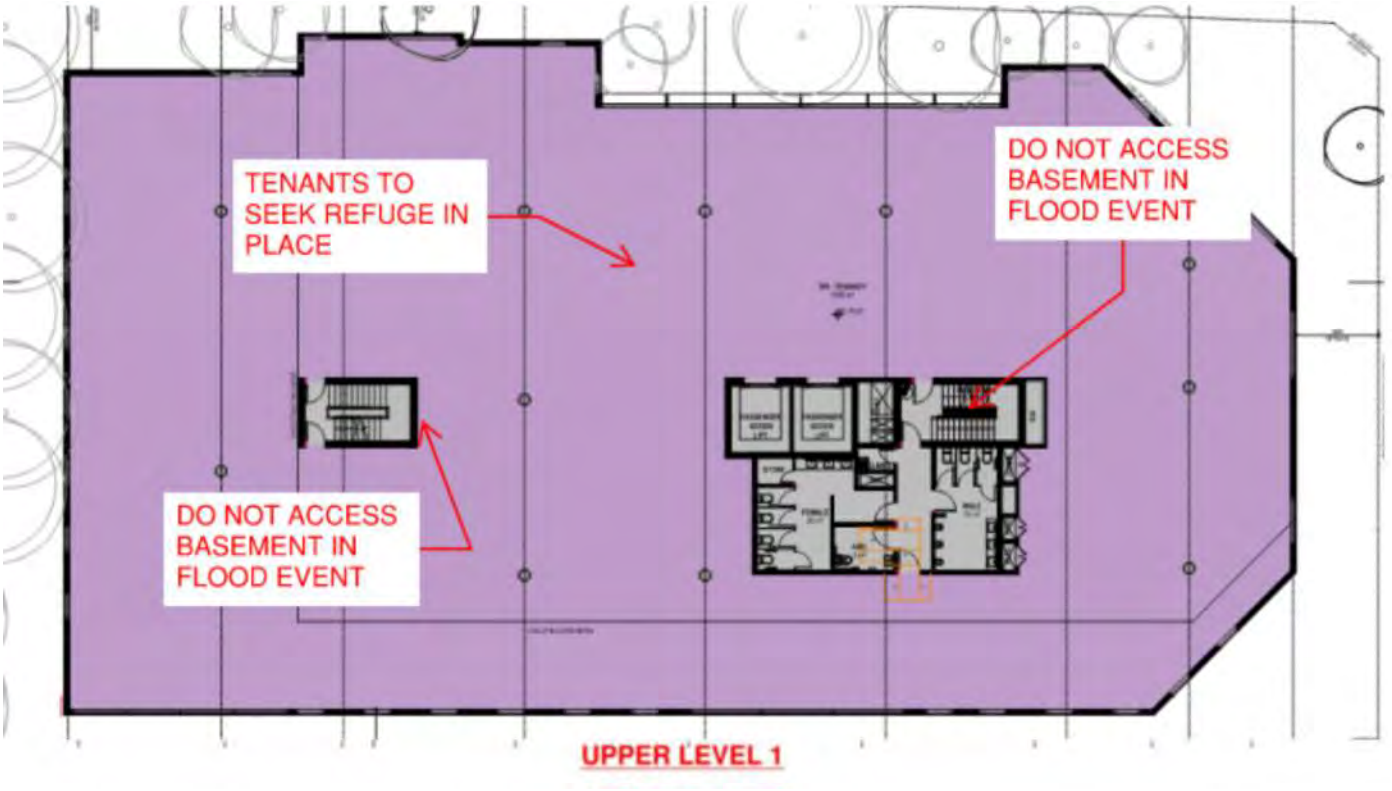


Figure 5 – Upper Level 1 Refuge

Route to On-site Flood Refuge (Upper Level 2)

This property is flood prone with predicted depths surrounding the property of up to approximately 0.9 meters. **Refuge above predicted flood levels is available** on the Ground Floor level and above. In the event of a predicted flood event **proceed to the upper levels of the facility and remain in place to receive advice from the nominated Flood Wardens**.

No attempt should be made to evacuate elsewhere through floodwater by foot or vehicle. Access to the basement carpark should not be attempted during a flood event and lifts should not be used.

During a flood event, and following commencement of the flood emergency alarm, please proceed to the ground floor and upper levels and await instruction from the Flood Wardens.

If assistance is required, please call the following emergency numbers:

Table 10 – Emergency Numbers

Person Organisation	Name	Number
Chief Flood Warden		
Deputy Flood Warden		
First Aid Officer		
SES	-	132 500
Police / Fire / Ambulance	-	000

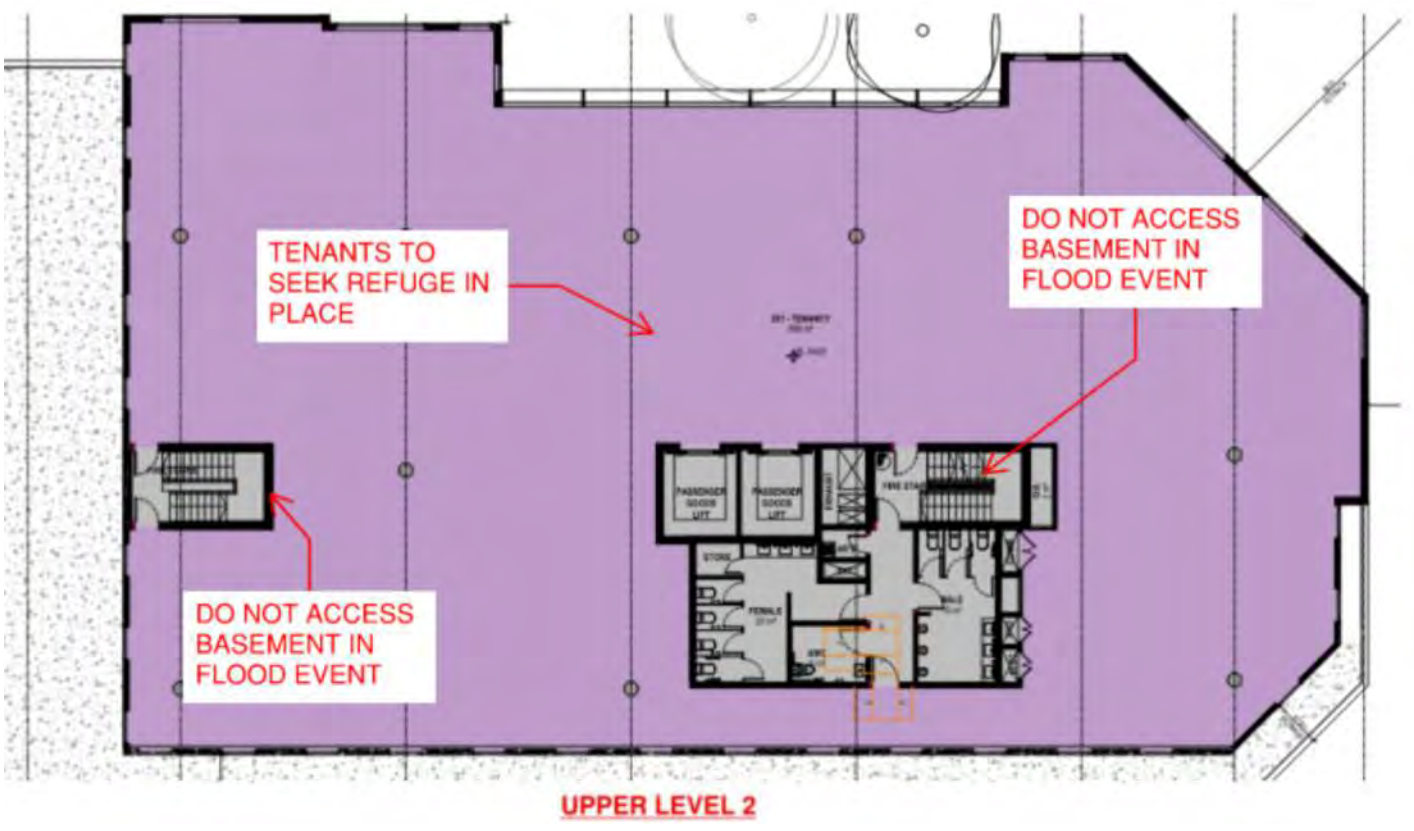


Figure 6 – Upper Level 2 Refuge

Attachment 2 – RFI Letter (Northrop, 2020)

Level 1, 215 Pacific Highway
Charlestown NSW 2290
02 4943 1777
newcastle@northrop.com.au
ABN 81 094 433 100

18 December 2020

SY200410_B02

Cambridge Unit Developments
C/- Chris Ryan
Ionic Management Pty Ltd.
PO Box 165
Cronulla, NSW, 2230

Dear Chris,

Re: 143a Stoney Creek Road, Beverly Hills – Response to Council Request for Information

Northrop Consulting Engineers have undertaken a flood investigation on behalf of Cambridge Unit Developments, care of Ionic Management Pty Ltd. to assess the flood conditions and the flood impact of the proposed development of 143a Stoney Creek Road, Beverly Hills, herein referred as "the subject site" or "the site".

The following correspondence has been prepared in response to a Request for Information (RFI) received from Georges River Council (GRC) on the 7 December 2020 and subsequent meeting held on the 10 of December 2020.

A previous response to Council's RFI has been prepared for the subject site and is dated the 11 November 2020.

A summary of Council's RFI is provided below along with a response to each query.

GRC Comment #1

In order to ascertain the category of the development as per the flood matrix in Part 6 of Council's Stormwater Management Policy 2020, we require the velocity of flow throughout the site. The figure is important in order to numerically demonstrate that the site is not in a high hazard zone.

Response to Comment #1

We have examined the existing case flood velocity for the 1% AEP, which demonstrates a positive result. Figure 1 of Attachment 1 presents the existing case flood velocity for the 1% AEP including spot elevations as requested during the meeting by GRC on the 10 December. In addition, we have also provided an existing case flood hazard figure (refer to Figure 2 of Attachment 1) that presents the hazard conditions defined by the NSW Floodplain Development Manual (2005) and used as a reference for the definition of Flood Precincts as per Councils latest Stormwater Management Policy (July 2020).

The attached Figures 1 and 2 of Attachment 1 show the vast majority, being approximately 99.6% of the subject site, is expected to experience flow velocities generally less than 2.0m/s and therefore the site is reasonably characterised as low flood hazard under the existing conditions, due to the following reasons:

		Date
Prepared by	LG/DL	18/12/2020
Checked by	GB/MR	18/12/2020
Admin	BBR	18/12/2020

- The majority of the subject site (99.6%) experiences low flood hazard and velocities less than 2.0m/s. Spot elevations presented in Figure 1 of Attachment 1 suggests velocities range from approximately 0.13m/s to 1.53m/s with an isolated spike of up to 2.33m/s.
- The extent of velocities in excess of 2.0m/s and the extent of high hazard (being only 0.4%) is an isolated occurrence due to increased velocities as flows travel around the existing building, and is therefore an anomaly and not representative of the overwhelming majority of the site which is low hazard.

In addition, during our meeting on the 10 December, GRC requested a comparison of the updated 1% AEP flood velocities presented in Figure 1 with the velocities observed in the original HMPW Overland Flow Flood Study (SMEC, 2016). As such, a similar velocity figure presenting the original results from the HWPW Overland Flow Flood Study (SMEC, 2016) is presented in the attached figure 3.

A comparison between the results presented in Figures 1 and 3 of Attachment 1 demonstrates velocities across the subject site are generally less than 1.5m/s for both Figures 1 and 3. Some isolated spikes above 1.5m/s are observed in both sets of results, with a maximum of approximately 2.33m/s and 2.14m/s shown in Figures 1 and 3 respectively.

It is noted that the flow behaviour shown in Figures 1 and 3 are slightly different across the subject site which is expected to be due to the inclusion of the detailed survey, updates to surface roughness, modified culvert and blockage upstream and the removal of a building that was modelled in the original HMPW Overland Flow Flood Study (SMEC, 2016) which is not observed under current conditions.

The proposed development is considered to improve the existing conditions and make the subject site suitable for use from a Floodplain Risk Management perspective by:

- Providing a point of refuge above the 1% AEP and PMF design storm events.
- The flood risk on site can be appropriately managed through the preparation of a Flood Emergency Response Plan prior to occupation of the building. A Flood Emergency Response Summary is provided in Attachment 3 which demonstrates the flood risk on site can be managed appropriately.
- A reduction in the extent of flood hazard conditions in both Cambridge and Stoney Creek Roads is achieved during both the 1% AEP and PMF design storm events as a result of the proposed development.
- The proposed development is not expected to result in any unacceptable impacts in adjacent properties during both the 1% AEP and PMF design storm events.

GRC Comment #2

The loading dock has not been designed to the 1:100 required level. Council's engineer requires that the loading dock be raised to be at the level required by the amended flood report (without walls- 50% blockage scenario). Essentially, this would require that the loading dock be raised by another 250mm.

Notwithstanding the above, Council's engineer stated that he will be satisfied if the current level is raised by another 100mm (to become at RL 30.22).

Response to Comment #2

The loading dock has been raised to 30.22m AHD as per Council's request. Please refer to the latest Architectural Drawings for details.

GRC Comment #3

The proposed pedestrian entrance at the corner of Stoney Creek Road and Cambridge Street is to be relocated to be at a location that is higher within the site. This will aid in reducing the flood risk.

Response to Comment #3

The proposed pedestrian entrance has been moved to the south, fronting Cambridge Street as per Council's request. Please refer to the latest Architectural Drawings for details.

In addition, it is noted that there are two additional access/egress points from the building; one located adjacent to the proposed Bin Room on the southern side of the building, enabling pedestrian access to Cambridge Street via the proposed driveway and; a second, located adjacent to the Cold Water Pump Room which provides access to Stoney Creek Road.

During the 1% AEP, Figure D1 presented in the previous response to Council's RFI (dated the 11th of November 2020) demonstrates a clear path of H2 (which is considered safe for pedestrians) is available in Stoney Creek Road, the proposed driveway and in Cambridge Street adjacent to these additional access/egress points. These access/egress points may be used by emergency services in the unlikely event of an emergency during the expected short peak of the flood event.

GRC Comment #4

The proposed culvert diversion within the site shall be 2.5m wide to provide additional flow capacity and minimise the top of water level from the upstream catchment. In addition to the above, and in order to provide more clarity with regards to the culvert location, please show a section plan of the culvert showing its location within the site (particularly in relation to its depth).

Response to Comment #4

We note that the proposed culvert is currently 2.1m wide being an increase of 100mm from the existing culvert width. An additional 300mm height has been provided to allow additional flood storage. Civil drawings have been updated to include a cross-section and long-section of the proposed culvert diversion. The implications of increasing the culvert to 2.5m will result in a shifting of the centreline which in turn pushes the culvert 0.5m outside the site boundary impacting on nearby trees. The reason for this is that Sydney water require a 1m easement from the edge of the culvert; and this line runs directly along the basement.

Additional Civil Plans included as Attachment 2

GRC Comment #5

Provide a chamber (approximately 2.0 x 2.0 x 2.0m) within the culvert opposite the stormwater discharge connection point of the (2x225mm) pipes draining the flood chamber to minimise a conflict in the flow and avoid a backflow in this location.

Response to Comment #5

We note that the discharge pipes from the culvert are intended to drain the chamber and not be the main discharge avenue. The main discharge avenue would be via the proposed louvers in the larger storms. Non-return flap valves are provided to prevent backflow of water from the culvert back through the internal drainage system and flood chamber. We have maintained the original alignment which was discussed with Ellie; we have demonstrated the pipes to be on an angle in the direction of flow.

GRC Comment #6

The flood impact report did not provide an evacuation plan for pedestrian with warning signs and instruction and it did not provide a Flood Emergency Response Plan.

Response to Comment #5

A Flood Emergency Response summary has been prepared for the subject site and is included as Attachment 3. It is anticipated that a Flood Emergency Response Plan will be prepared in consultation with both GRC and the State Emergency Service prior to Occupation of the facility.

GRC Comment #7

The head clearance of the flood chamber as shown on the Section Plan TP03.02(A) dated 5.11.20 (particularly below substation) is not sufficient to be accessed and cleaned. It is required that this detail be revisited to allow for maintenance crew to access and maintain the flood chamber area.

Considering the above, and in order to provide more clarity with regards to the flood chamber area, please submit a floor plan of the flood chamber area.

Response to Comment #7

Considered by others. Please refer to the latest Architectural Drawings for Details.

GRC Comment #8

Indicate and show where the dedicated pedestrian refuge area above the PMF within the building is. This area is not to be located behind locked doors and is to be accessible by all people including people with a disability.

Response to Comment #8

Please refer to the Flood Emergency Response summary provided as Attachment 3 which includes a plan showing the location of and proposed strategy for refuge within the facility.

It is expected that given the proposed tenancies are located above the predicted PMF flood level, anyone unable to evacuate prior to commencement of a flood event can seek refuge within each tenancy. Similarly, adequate space is available in the tenancies and common areas for anyone located in the access corridors and non-habitable floors elsewhere within the subject site.

Furthermore, it is anticipated that during the normal operation hours of the facility, internal and external doors to the facility will remain unlocked to allow users of the facility and emergency services to enter. The requirement to ensure doors remain un-locked during a flood event can be addressed as part of the Flood Emergency Response Plan, to be provided prior to occupation of the facility.

In addition, a critical duration of two hours as defined by the HWPW Overland Flow Flood Study (SMEC, 2016) flooding across the subject site is expected occur over a short period of time. As such, inundation and refuge within the subject site is not expected to occur for a prolonged period.

Conclusion

Northrop Consulting Engineers were engaged by Cambridge Unit Developments to assess the flood conditions and the flood impact of the proposed development of 143a Stoney Creek Road, Beverly Hills.

This assessment demonstrates Council's comments have been address and accommodated in the revised design.

We trust this is what you require. Should you have any queries please feel free to call the undersigned on (02) 4943 1777.

Prepared by:

Laurence Gitzel
Flood Engineer

Reviewed by:

Angus Brien
Principal Flood Engineer

Limitation Statement

Northrop Consulting Engineers Pty Ltd (Northrop) has been retained to prepare this report based on specific instructions, scope of work and purpose pursuant to a contract with its client. It has been prepared in accordance with the usual care and thoroughness of the consulting profession for the use by Cambridge Unit Developments Pty. Ltd.

The report is based on generally accepted practices and standards applicable to the scope of work at the time it was prepared. No other warranty, express or implied, is made as to the professional advice included in this report except where expressly permitted in writing or required by law, no third party may use or rely on this report unless otherwise agreed in writing by Northrop.

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The report was prepared on the dates shown and is based on the conditions and information received at the time of preparation.

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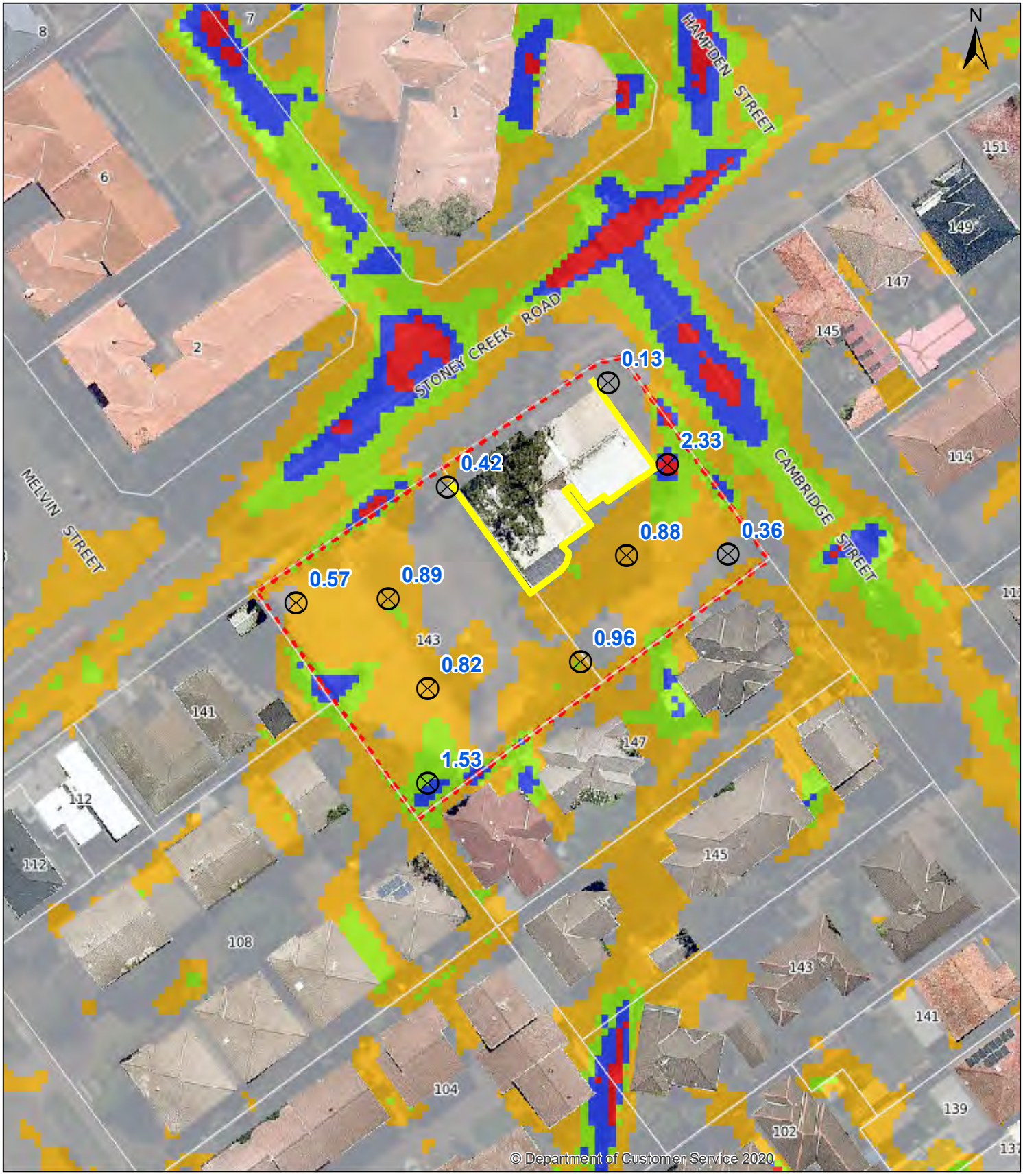
Attachment 1 – Existing Case Flood Figures



Legend

- Spot Velocities (m/s)
- Updated Buildings
- Subject Site

Velocity (m/s)

- 0.0 - 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- >2.0

0 5 10 20 Meters 1:750

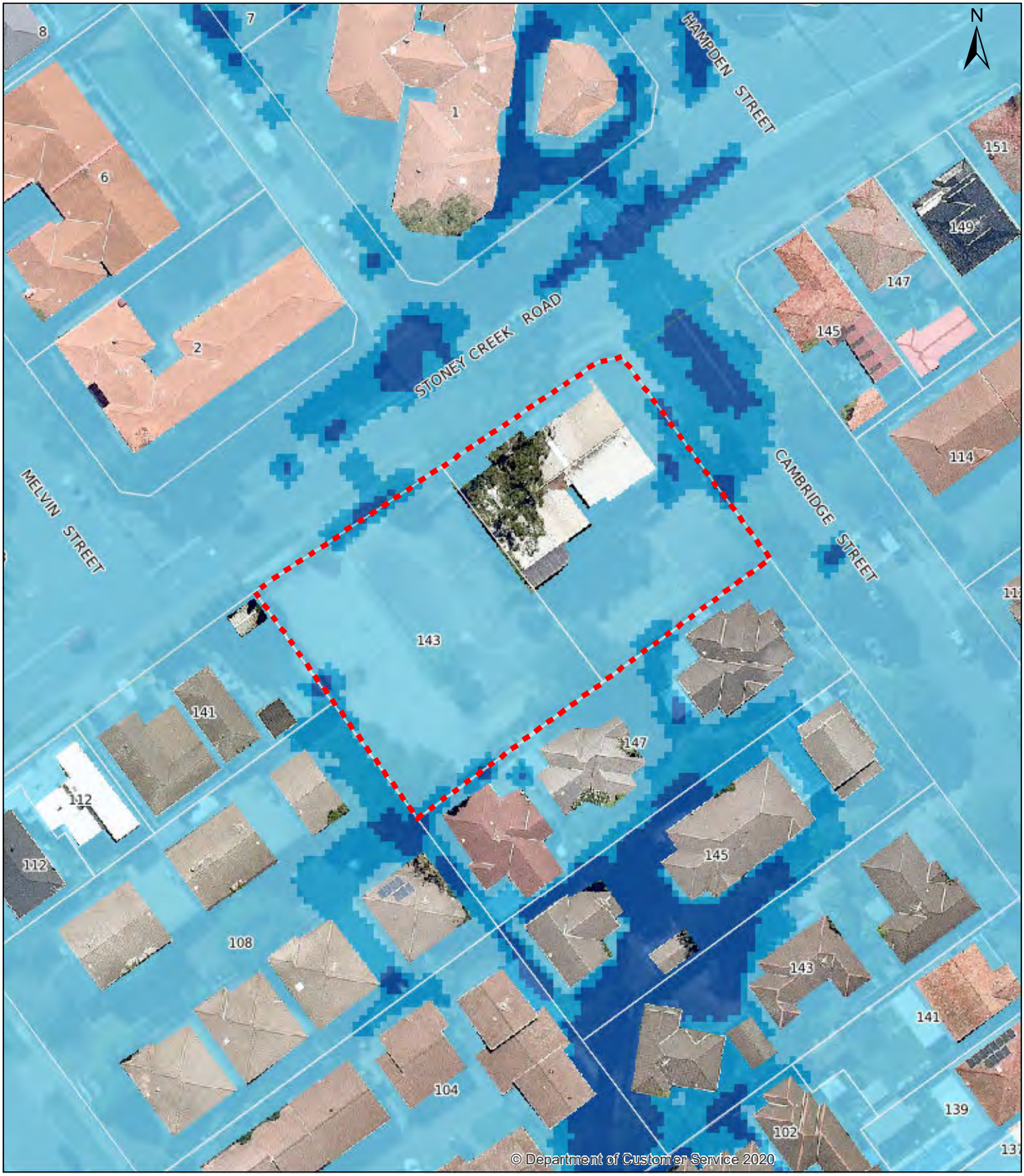
Figure 1 [B]

Existing Case
1% AEP Flood Velocity

Data Source: LPI
16/12/2020 X:\PROJECTS\SYDNEY\2020 Jobs\BeverlyHills\TUFLOW\Figures\ArcMap\SY200410_Figure_1_1AEP_Velocity_[B].mxd

143 Stoney Creek Road, Beverly Hills

NORTHROP

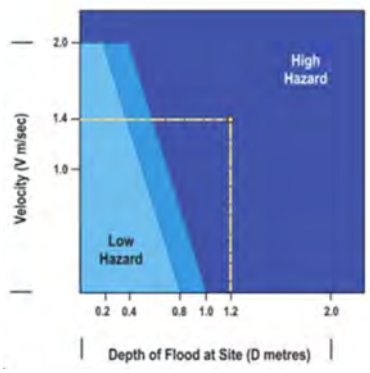


Legend

- Subject Site
- Cadastre

Flood Hazard (FDM, 2005)

- Low
- Intermediate
- High



0 5 10 20
Meters 1:750

Figure 2 [A]

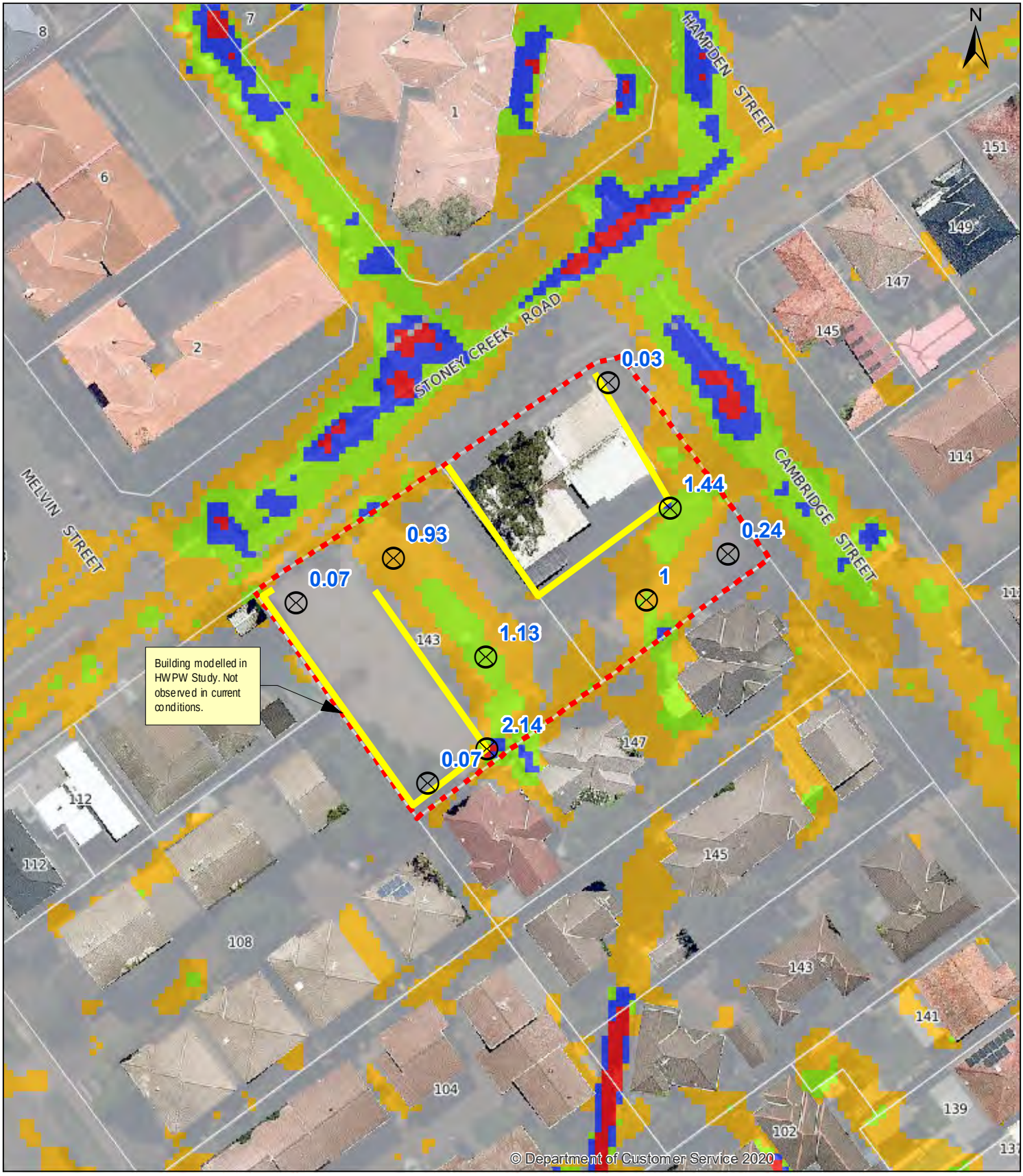
Existing Case
1% AEP Flood Hazard
FDM (2005)

Data Source: LPI

143 Stoney Creek Road, Beverly Hills

NORTHROP

8/12/2020 X:\PROJECTS\SYDNEY\2020 Jobs\BeverlyHills\TUFLOW\Figures\ArcMap\SY200410__Figure_2_1AEP_Hazard.mxd



Legend

- Spot Velocities (m/s)
- HMPW Buildings
- Subject Site

Velocity (m/s)

- 0.0 - 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- >2.0

0 5 10 20 Meters 1:750

Figure 3 [A]

HMPW Flood Study (SMEC, 2016)
1% AEP Flood Velocity

Data Source: LPI

16/12/2020 X:\PROJECTS\SYDNEY\2020 Jobs\BeverlyHills\TUFLOW\Figures\ArcMap\SY200410__Figure_3_1AEP_Velocit.mxd

143 Stoney Creek Road, Beverly Hills

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Attachment 2 – Civil Drawings

Attachment 3 – Flood Emergency Response Summary

The following provides as summary of the expected flood behaviour and the anticipated Flood Emergency Response including:

- A summary of the anticipated developed case flood depth and elevation at each corner of the subject site during both the 1% AEP and PMF design storm events. Flood depths and elevations are presented to provide an understanding of the expected flood behaviour across the subject site (refer to Table 1).
- A comparison of the proposed floor levels with respect to the anticipated maximum flood levels which are provided to highlight opportunities for on-site flood refuge (refer to Table 2).
- A summary of the potentially hazardous rainfall depths that are expected to trigger evacuation/ on-site refuge and are expected to result in flooding across the subject site (refer to Table 3).
- The recommended flood emergency response measures, prior to, during and after a flood event including those responsible to managing each response measure (refer to Table 4).
- Example signage is provided to highlight the on-site refuge points and the procedure for facility users to follow in the event of a flood emergency (refer to the "Example Flood Signage Section below").

Table 1 - Summary of Flood Behaviour

Event	North-Eastern Corner	North-Western Corner	South-Eastern Corner	South-Western Corner
1% AEP Flood Level (mAHD)	29.92	30.25	30.22	30.38
1% AEP Flood Depth (m)	0.42	0.25	0.32	0.28
PMF Flood Level (mAHD)	30.40	30.66	30.73	30.94
PMF Flood Depth (m)	0.90	0.66	0.83	0.84

Table 2 - Internal Floor Levels

Floor	Level (m AHD)	Relationship to Flood Levels
Basement Level 3	19.50	Below 1% AEP, below PMF
Basement Level 2	22.50	Below 1% AEP, below PMF
Basement Level 1	25.50	Below 1% AEP, below PMF
Ground Level	31.20	**Above 1% AEP and PMF**
Upper Level 1	35.22	**Above 1% AEP and PMF**
Upper Level 2	38.82	**Above 1% AEP and PMF**

Table 3 - Potentially Hazardous Rainfall Depths

Depth	Timescale	Depth	Timescale	Depth	Timescale	Depth	Timescale
62.5mm	30-mins	86.7mm	1-hour	113.8mm	2-hours	166.2mm	6-hours

Table 4 - Flood Response Actions Summary

WHEN	WHAT	BY WHO
Prior to Flooding	**Nominate Flood Wardens and First Aid Officer** (at least one of each per Tenancy).	Chief Flood Warden (e.g. Building Manager)
	Assemble **Emergency Kit.**	First Aid Officer
	Check **Floodsafe Kit** every three months (one kit per Tenancy).	First Aid Officer
	Perform induction training for new staff.	Chief Flood Warden / Flood Wardens
	Coordinate drills twice per year (minimum).	Chief Flood Warden
	Sign up to the Early Warning Network and monitor weather situation at 4pm daily.	Chief Flood Warden
	Install and Maintain Flood Signage.	Chief Flood Warden / Flood Wardens
On-site Refuge	**Text / Email from the Early Warning Network** with rainfall predicted to be greater than; **62.5mm** in 30 minutes **86.7mm** in 1-hour **113.8mm** in 2-hours **166.2mm** in 6-hours	Chief Flood Warden
	If rainfall is predicted for the following day, **close the facility, and cancel all procedures / appointments.** **Notify the SES / Police** of the decision to close the facility.	Chief Flood Warden
	If rainfall is predicted for the same day, **make decision to seek refuge on-site and wait it out.** **Notify SES / Police** of the decision to seek refuge on-site and wait it out.	Chief Flood Warden
	Communicate decision to remain on-site with facility users and organise seating and lighting as required.	Chief Flood Warden and Flood Wardens
	Wait it out on Ground Floor and Upper Levels	All
	Maintain regular communication with staff and facility users.	Chief Flood Warden & Flood Wardens
	Do not attempt to access the basement levels or the flood chamber during a flood event.	All
	Do not attempt to drive or walk through floodwaters. If in a life-threatening situation, call 000 immediately.	All
Once Risk has Passed / After a Flood	Check all services and structural stability of building.	Qualified persons
	Return to occupation.	Chief Flood Warden

Example Signage and Refuge

Route to On-site Flood Refuge (Basement Level 3)

This property is flood prone with predicted depths surrounding the property of up to approximately 0.9 meters. **Refuge above predicted flood levels is available** on the Ground Floor level and above. In the event of a predicted flood event **proceed to the upper levels of the facility and remain in place to receive advice from the nominated Flood Wardens**.

No attempt should be made to evacuate elsewhere through floodwater by foot or vehicle. Access to the basement carpark should not be attempted during a flood event and lifts should not be used.

During a flood event, and following commencement of the flood emergency alarm, please proceed to the ground floor and upper levels and await instruction from the Flood Wardens.

If assistance is required, please call the following emergency numbers:

Table 5 – Emergency Numbers

Person Organisation	Name	Number
Chief Flood Warden		
Deputy Flood Warden		
First Aid Officer		
SES	-	132 500
Police / Fire / Ambulance	-	000

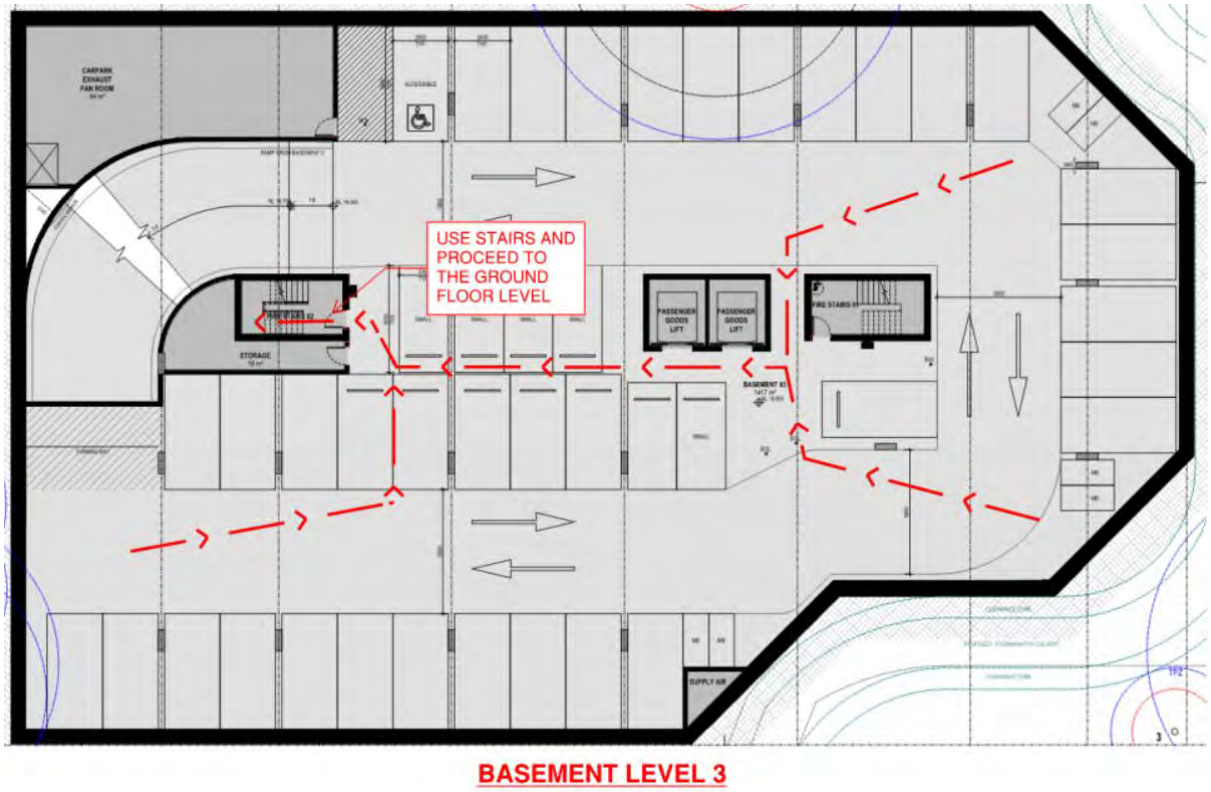

Figure 1 – Basement Level 3 Refuge

Route to On-site Flood Refuge (Basement Level 2)

This property is flood prone with predicted depths surrounding the property of up to approximately 0.9 meters. **Refuge above predicted flood levels is available** on the Ground Floor level and above. In the event of a predicted flood event **proceed to the upper levels of the facility and remain in place to receive advice from the nominated Flood Wardens**.

No attempt should be made to evacuate elsewhere through floodwater by foot or vehicle. Access to the basement carpark should not be attempted during a flood event and lifts should not be used.

During a flood event, and following commencement of the flood emergency alarm, please proceed to the ground floor and upper levels and await instruction from the Flood Wardens.

If assistance is required, please call the following emergency numbers:

Table 6 – Emergency Numbers

Person Organisation	Name	Number
Chief Flood Warden		
Deputy Flood Warden		
First Aid Officer		
SES	-	132 500
Police / Fire / Ambulance	-	000

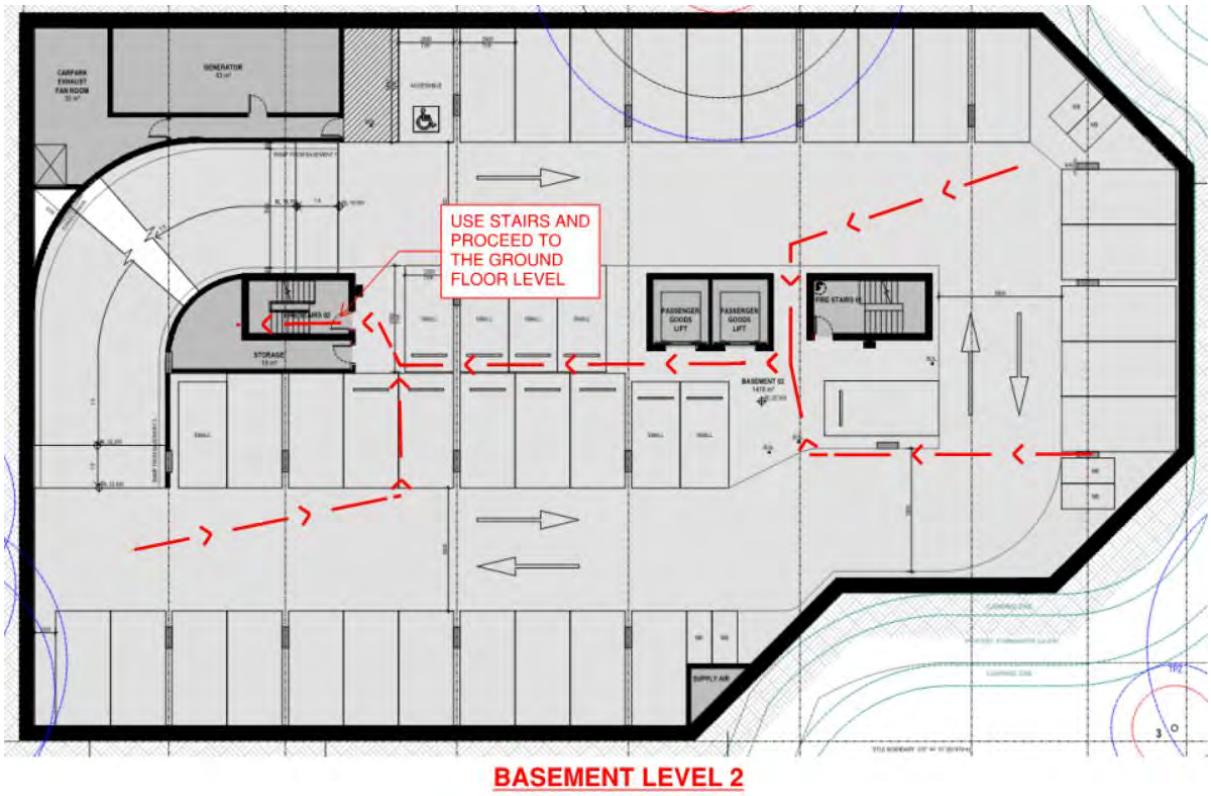

Figure 2 - Basement Level 2 Refuge

Route to On-site Flood Refuge (Basement Level 1)

This property is flood prone with predicted depths surrounding the property of up to approximately 0.9 meters. **Refuge above predicted flood levels is available** on the Ground Floor level and above. In the event of a predicted flood event **proceed to the upper levels of the facility and remain in place to receive advice from the nominated Flood Wardens**.

No attempt should be made to evacuate elsewhere through floodwater by foot or vehicle. Access to the basement carpark should not be attempted during a flood event and lifts should not be used.

During a flood event, and following commencement of the flood emergency alarm, please proceed to the ground floor and upper levels and await instruction from the Flood Wardens.

If assistance is required, please call the following emergency numbers:

Table 7 – Emergency Numbers

Person Organisation	Name	Number
Chief Flood Warden		
Deputy Flood Warden		
First Aid Officer		
SES	-	132 500
Police / Fire / Ambulance	-	000

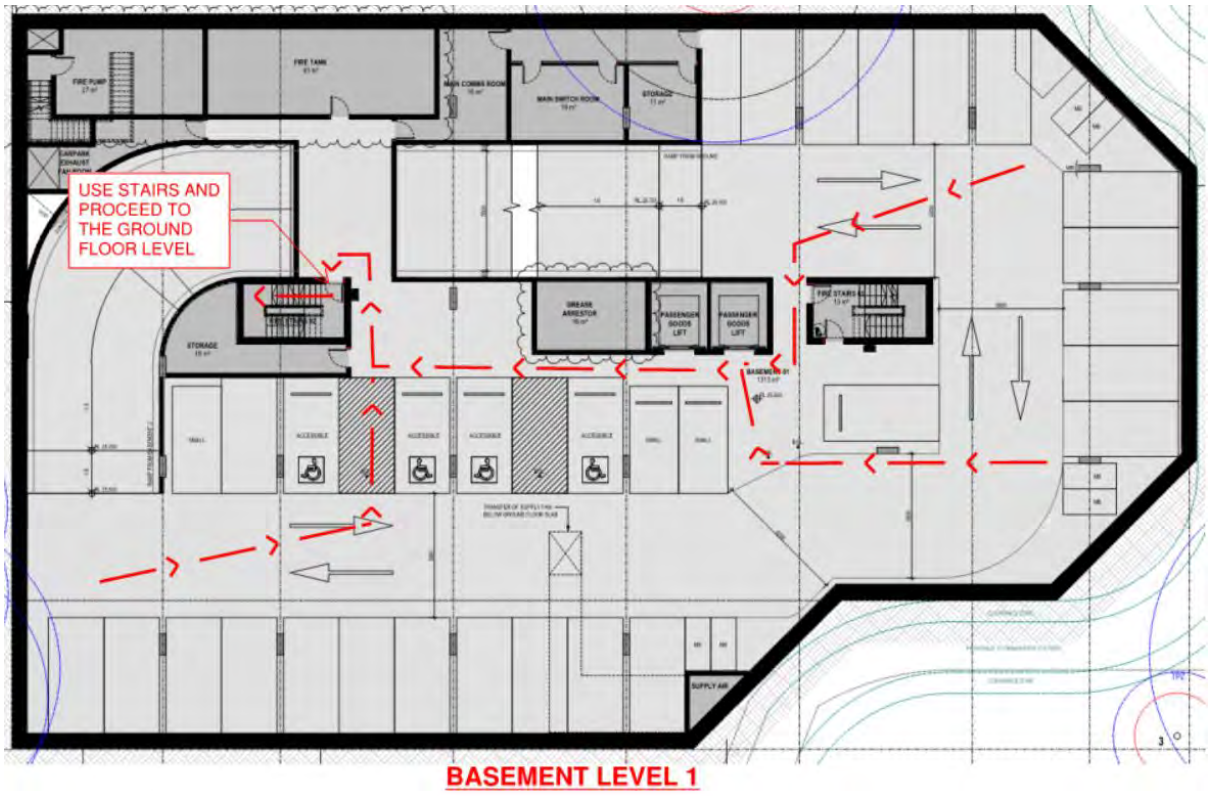

Figure 3 – Basement Level 1 Refuge

Route to On-site Flood Refuge (Ground Floor Level)

This property is flood prone with predicted depths surrounding the property of up to approximately 0.9 meters. **Refuge above predicted flood levels is available** on the Ground Floor level and above. In the event of a predicted flood event **proceed to the upper levels of the facility and remain in place to receive advice from the nominated Flood Wardens**.

No attempt should be made to evacuate elsewhere through floodwater by foot or vehicle. Access to the basement carpark should not be attempted during a flood event and lifts should not be used.

During a flood event, and following commencement of the flood emergency alarm, please proceed to the ground floor and upper levels and await instruction from the Flood Wardens.

If assistance is required, please call the following emergency numbers:

Table 8 – Emergency Numbers

Person Organisation	Name	Number
Chief Flood Warden		
Deputy Flood Warden		
First Aid Officer		
SES	-	132 500
Police / Fire / Ambulance	-	000

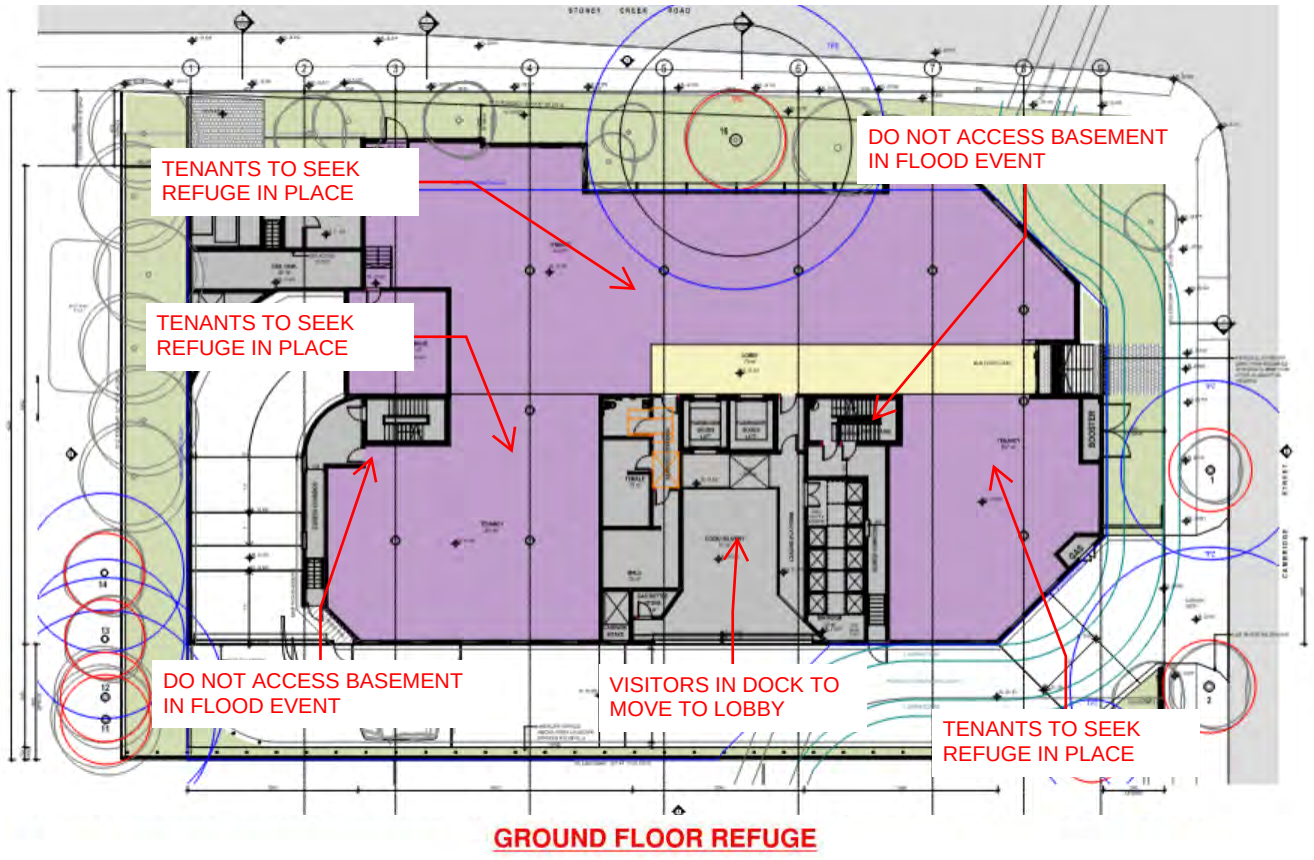

Figure 4 – Ground Floor Level Refuge

Route to On-site Flood Refuge (Upper Level 1)

This property is flood prone with predicted depths surrounding the property of up to approximately 0.9 meters. **Refuge above predicted flood levels is available** on the Ground Floor level and above. In the event of a predicted flood event **proceed to the upper levels of the facility and remain in place to receive advice from the nominated Flood Wardens**.

No attempt should be made to evacuate elsewhere through floodwater by foot or vehicle. Access to the basement carpark should not be attempted during a flood event and lifts should not be used.

During a flood event, and following commencement of the flood emergency alarm, please proceed to the ground floor and upper levels and await instruction from the Flood Wardens.

If assistance is required, please call the following emergency numbers:

Table 9 – Emergency Numbers

Person Organisation	Name	Number
Chief Flood Warden		
Deputy Flood Warden		
First Aid Officer		
SES	-	132 500
Police / Fire / Ambulance	-	000

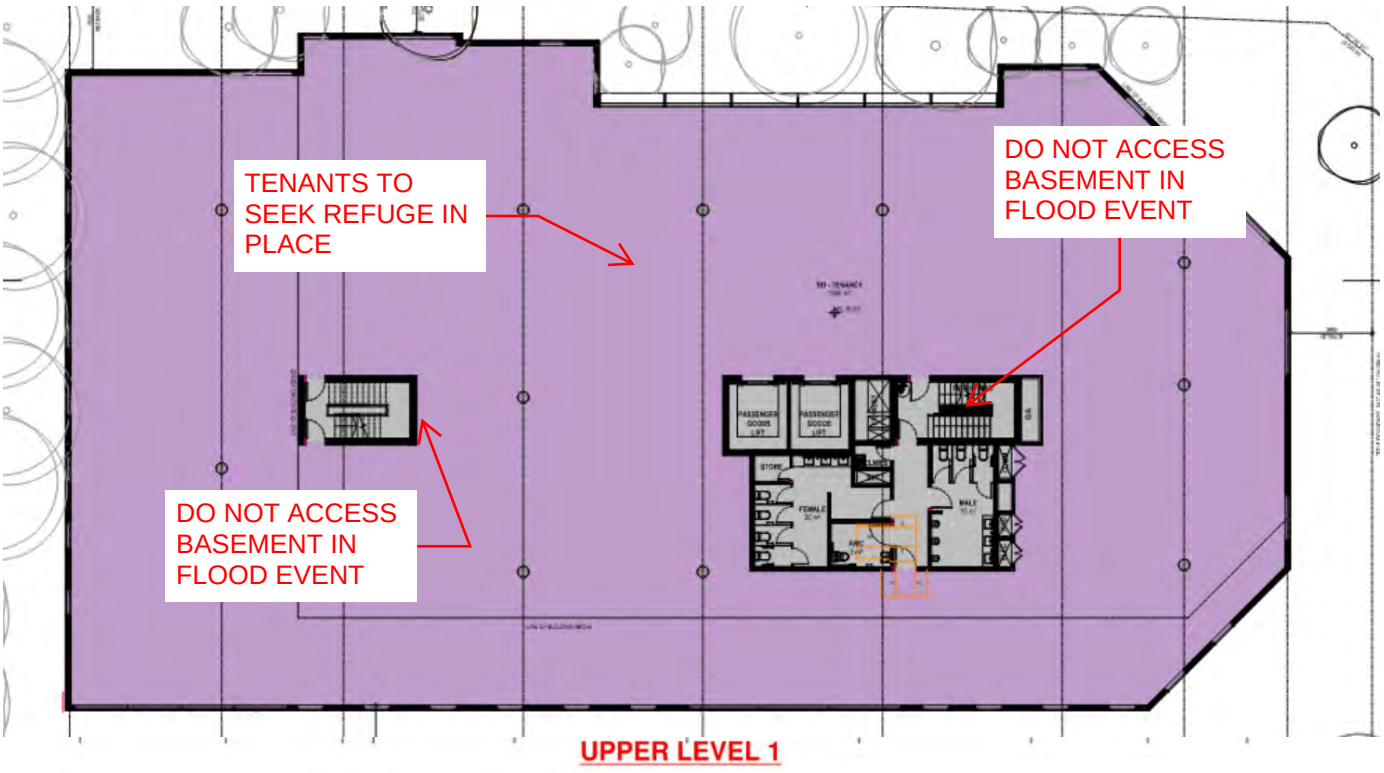

Figure 5 – Upper Level 1 Refuge

Route to On-site Flood Refuge (Upper Level 2)

This property is flood prone with predicted depths surrounding the property of up to approximately 0.9 meters. **Refuge above predicted flood levels is available** on the Ground Floor level and above. In the event of a predicted flood event **proceed to the upper levels of the facility and remain in place to receive advice from the nominated Flood Wardens**.

No attempt should be made to evacuate elsewhere through floodwater by foot or vehicle. Access to the basement carpark should not be attempted during a flood event and lifts should not be used.

During a flood event, and following commencement of the flood emergency alarm, please proceed to the ground floor and upper levels and await instruction from the Flood Wardens.

If assistance is required, please call the following emergency numbers:

Table 10 – Emergency Numbers

Person Organisation	Name	Number
Chief Flood Warden		
Deputy Flood Warden		
First Aid Officer		
SES	-	132 500
Police / Fire / Ambulance	-	000

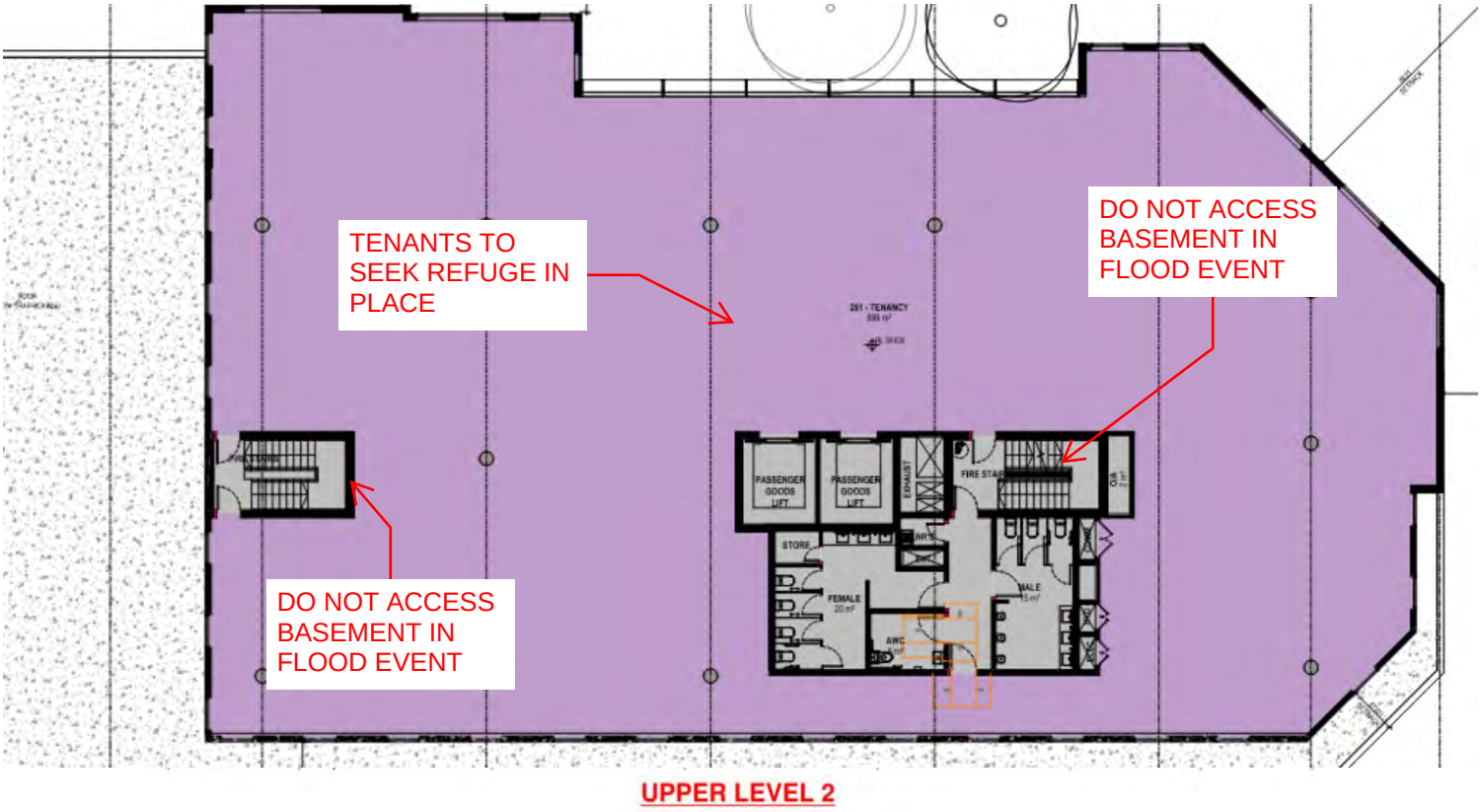

Figure 6 – Upper Level 2 Refuge

Attachment 3 – Additional Design Events

Legend

- Subject Site
- Cadastre
- Spot Levels (mAHD)
- 0.25m Water Contours

Depth(m)

- < 0.01
- 0.01 - 0.10
- 0.10 - 0.30
- 0.30 - 0.50
- 0.50 - 0.70
- 0.70 - 1.00
- 1.00 - 1.50
- 1.50 >

0 10 20 Metres

1:750

Figure C1[A]

1% AEP Flood Depth and Elevation Existing Case

143 Stoney Creek Road, Beverly Hills

NORTHROP

Data Source: NSW LPI - Cadastre, NSW Imagery - Aerial

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Legend

- Subject Site
- Cadastre
- Spot Levels (mAHD)
- 0.25m Water Contours

Depth(m)

- < 0.01
- 0.01 - 0.10
- 0.10 - 0.30
- 0.30 - 0.50
- 0.50 - 0.70
- 0.70 - 1.00
- 1.00 - 1.50
- 1.50 >

0 10 20 Metres

1:750

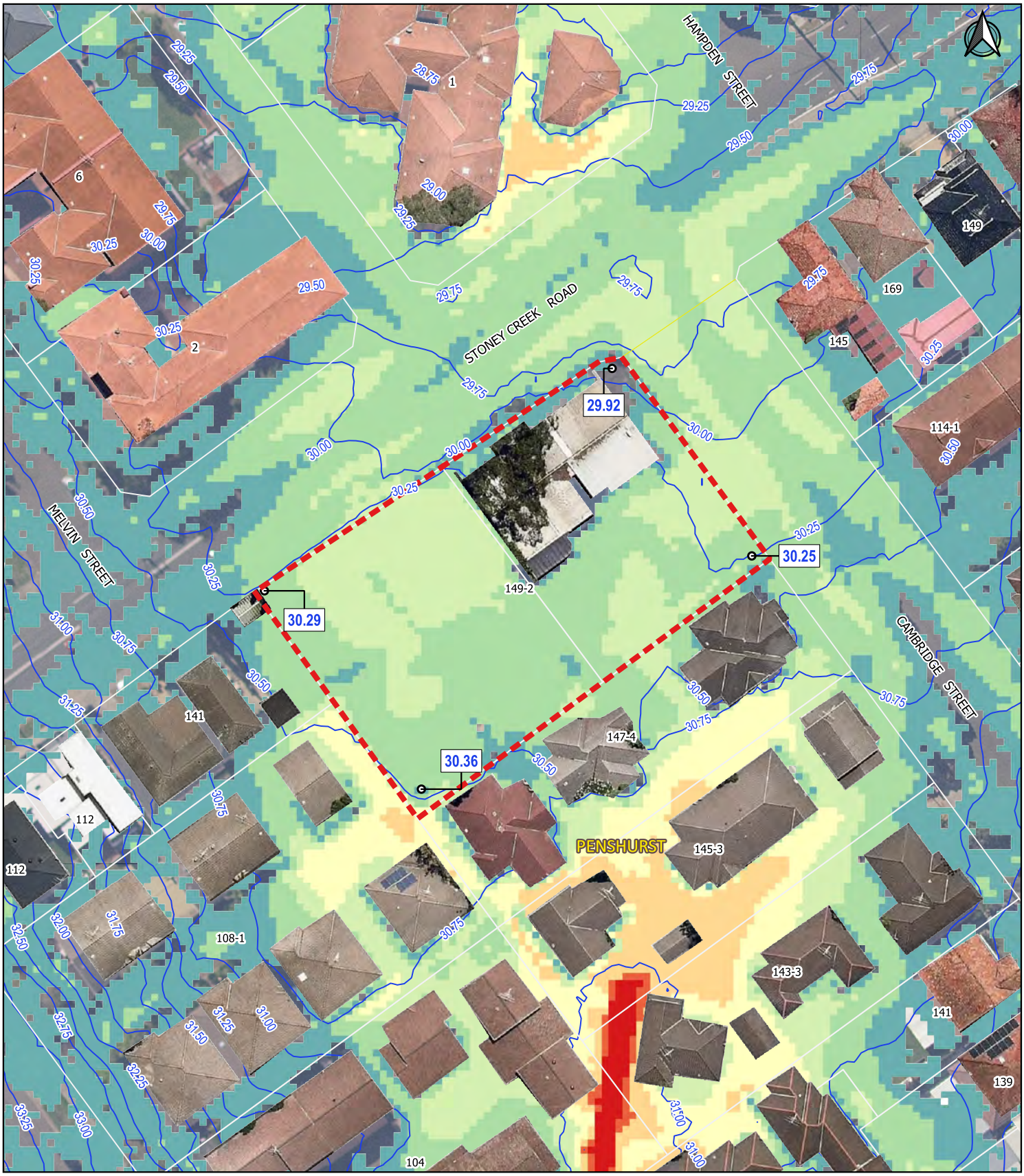
Figure C2[A]

5% AEP Flood Depth and Elevation Existing Case

143 Stoney Creek Road, Beverly Hills

NORTHROP

Data Source: NSW LPI - Cadastre, NSW Imagery - Aerial



Legend

- Subject Site
- Cadastre
- Spot Levels (mAHD)
- 0.25m Water Contours

Depth(m)

- < 0.01
- 0.01 - 0.10
- 0.10 - 0.30
- 0.30 - 0.50
- 0.50 - 0.70
- 0.70 - 1.00
- 1.00 - 1.50
- 1.50 >

0 10 20 Metres

1:750

Figure C3[A]

10% AEP Flood Depth and Elevation Existing Case

143 Stoney Creek Road, Beverly Hills

NORTHROP

Data Source: NSW LPI - Cadastre, NSW Imagery - Aerial

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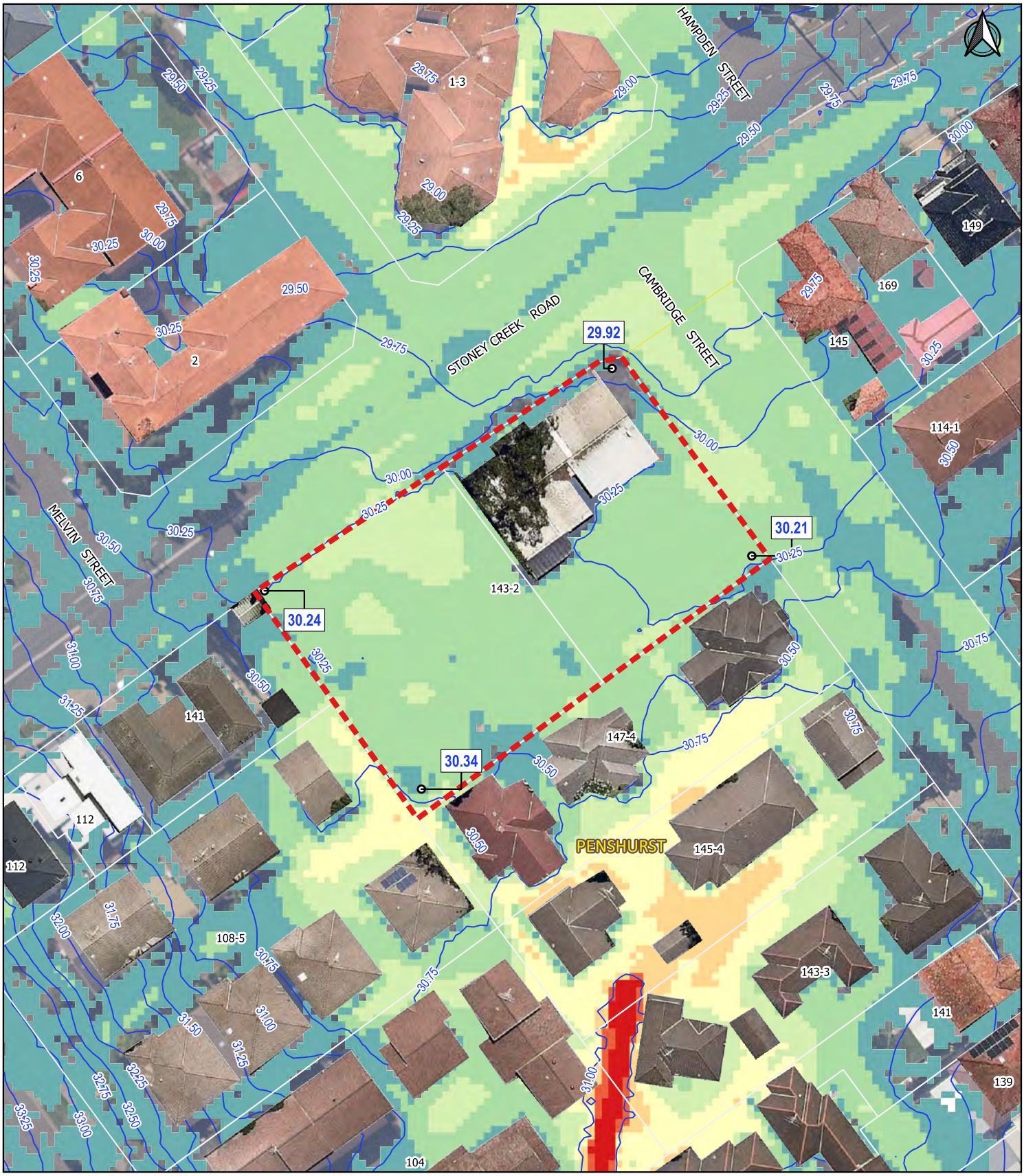

Legend

- Subject Site
- Cadastre
- Spot Levels (mAHD)
- 0.25m Water Contours

Depth(m)

- < 0.01
- 0.01 - 0.10
- 0.10 - 0.30
- 0.30 - 0.50
- 0.50 - 0.70
- 0.70 - 1.00
- 1.00 - 1.50
- 1.50 >

0 10 20 Metres

1:750

Figure C4[A]

20% AEP Flood Depth and Elevation Existing Case

143 Stoney Creek Road, Beverly Hills

NORTHROP

Data Source: NSW LPI - Cadastre, NSW Imagery - Aerial

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Legend

- Subject Site
- Cadastre
- Spot Levels (mAHD)
- 0.25m Water Contours

Depth(m)

- < 0.01
- 0.01 - 0.10
- 0.10 - 0.30
- 0.30 - 0.50
- 0.50 - 0.70
- 0.70 - 1.00
- 1.00 - 1.50
- 1.50 >

0 10 20 Metres

1:750

Figure C5[A]

50% AEP Flood Depth and Elevation Existing Case

143 Stoney Creek Road, Beverly Hills

NORTHROP

Data Source: NSW LPI - Cadastre, NSW Imagery - Aerial

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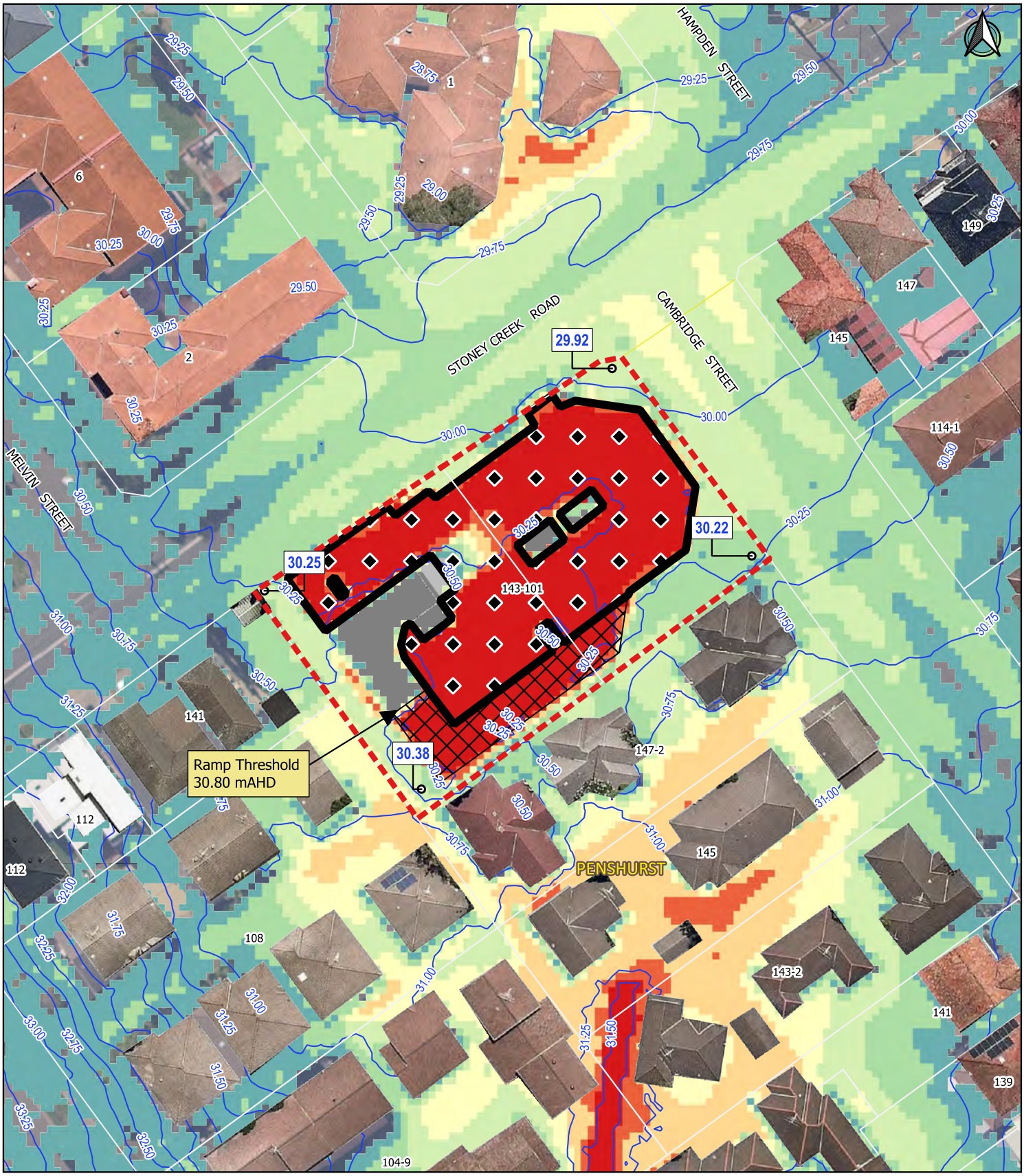

Legend

- Subject Site
- Cadastre
- Spot Levels (mAHD)
- 0.25m Water Contours
- Ramp
- Building Flow Constriction

Depth(m)

- < 0.01
- 0.01 - 0.10
- 0.10 - 0.30
- 0.30 - 0.50
- 0.50 - 0.70
- 0.70 - 1.00
- 1.00 - 1.50
- 1.50 >

Design Surface (mAHD)

- <= 29.9
- 29.9 - 31.1
- 31.1 - 32.3
- 32.3 - 33.5
- > 33.5

0 10 20 Metres

1:750

Figure D1[A]

1% AEP Flood Depth and Elevation Developed Case

143 Stoney Creek Road, Beverly Hills

NORTHROP

Data Source: NSW LPI - Cadastre, NSW Imagery - Aerial

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Legend

- Subject Site
- Cadastre
- Spot Levels (mAHD)
- 0.25m Water Contours
- Ramp
- Building Flow Constriction

Depth(m)

- < 0.01
- 0.01 - 0.10
- 0.10 - 0.30
- 0.30 - 0.50
- 0.50 - 0.70
- 0.70 - 1.00
- 1.00 - 1.50
- 1.50 >

Design Surface (mAHD)

- <= 29.9
- 29.9 - 31.1
- 31.1 - 32.3
- 32.3 - 33.5
- > 33.5

0 10 20 Metres

1:750

Figure D2[A]

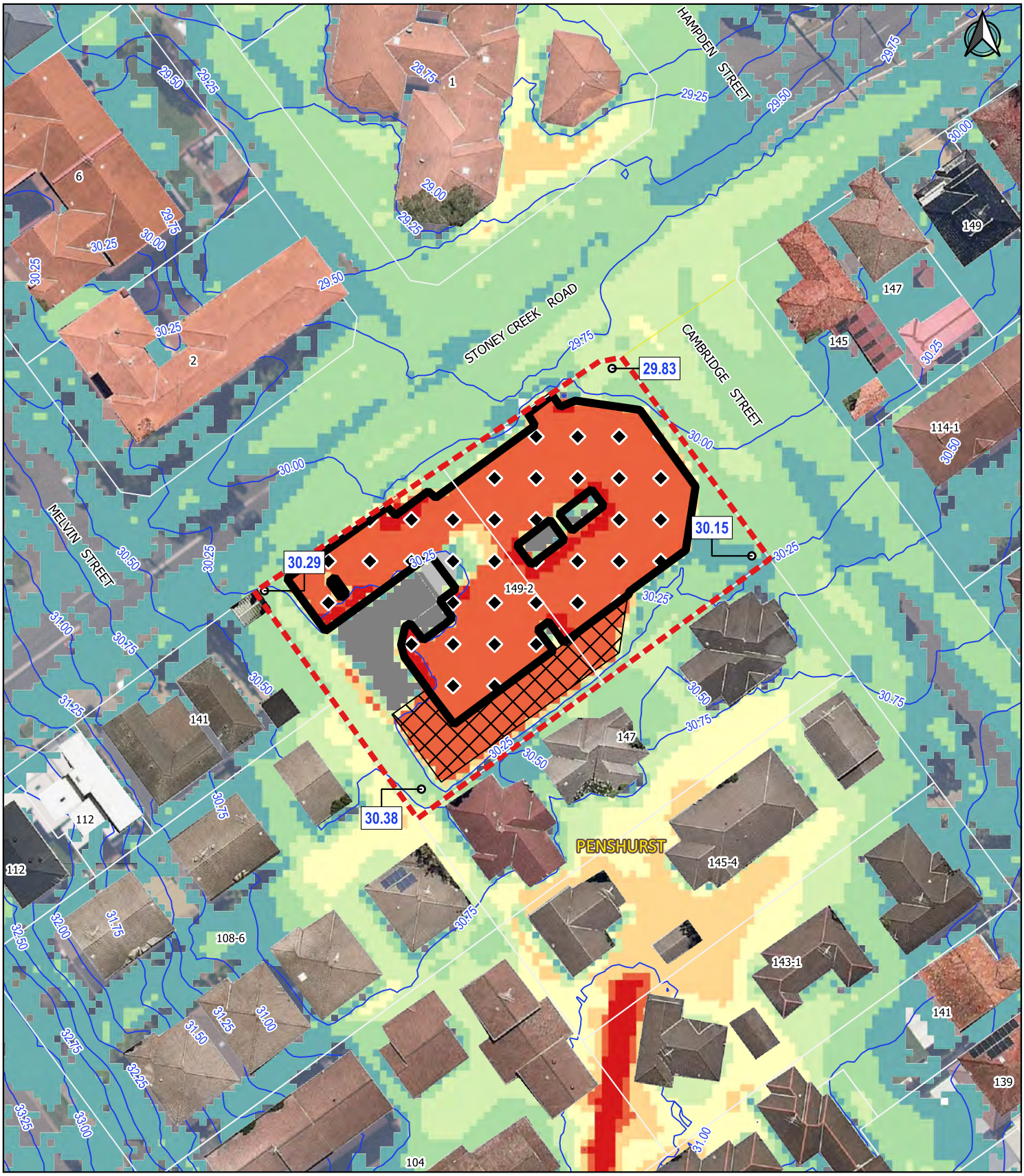
5% AEP Flood Depth and Elevation Developed Case

143 Stoney Creek Road, Beverly Hills

NORTHROP

Data Source: NSW LPI - Cadastre, NSW Imagery - Aerial

13/4/2023 X:\PROJECTS\SYDNEY\2020 Jobs\BeverlyHills\TUFLOW\Figures_2023_Mod\Figures.qgz



Legend

- Subject Site
- Cadastre
- Spot Levels (mAHD)
- 0.25m Water Contours
- Ramp
- Building Flow Constriction

Depth(m)

- < 0.01
- 0.01 - 0.10
- 0.10 - 0.30
- 0.30 - 0.50
- 0.50 - 0.70
- 0.70 - 1.00
- 1.00 - 1.50
- 1.50 >

Design Surface (mAHD)

- <= 29.9
- 29.9 - 31.1
- 31.1 - 32.3
- 32.3 - 33.5
- > 33.5

0 10 20 Metres

1:750

Figure D3[A]

10% AEP Flood Depth and Elevation Developed Case

143 Stoney Creek Road, Beverly Hills

NORTHROP

Data Source: NSW LPI - Cadastre, NSW Imagery - Aerial

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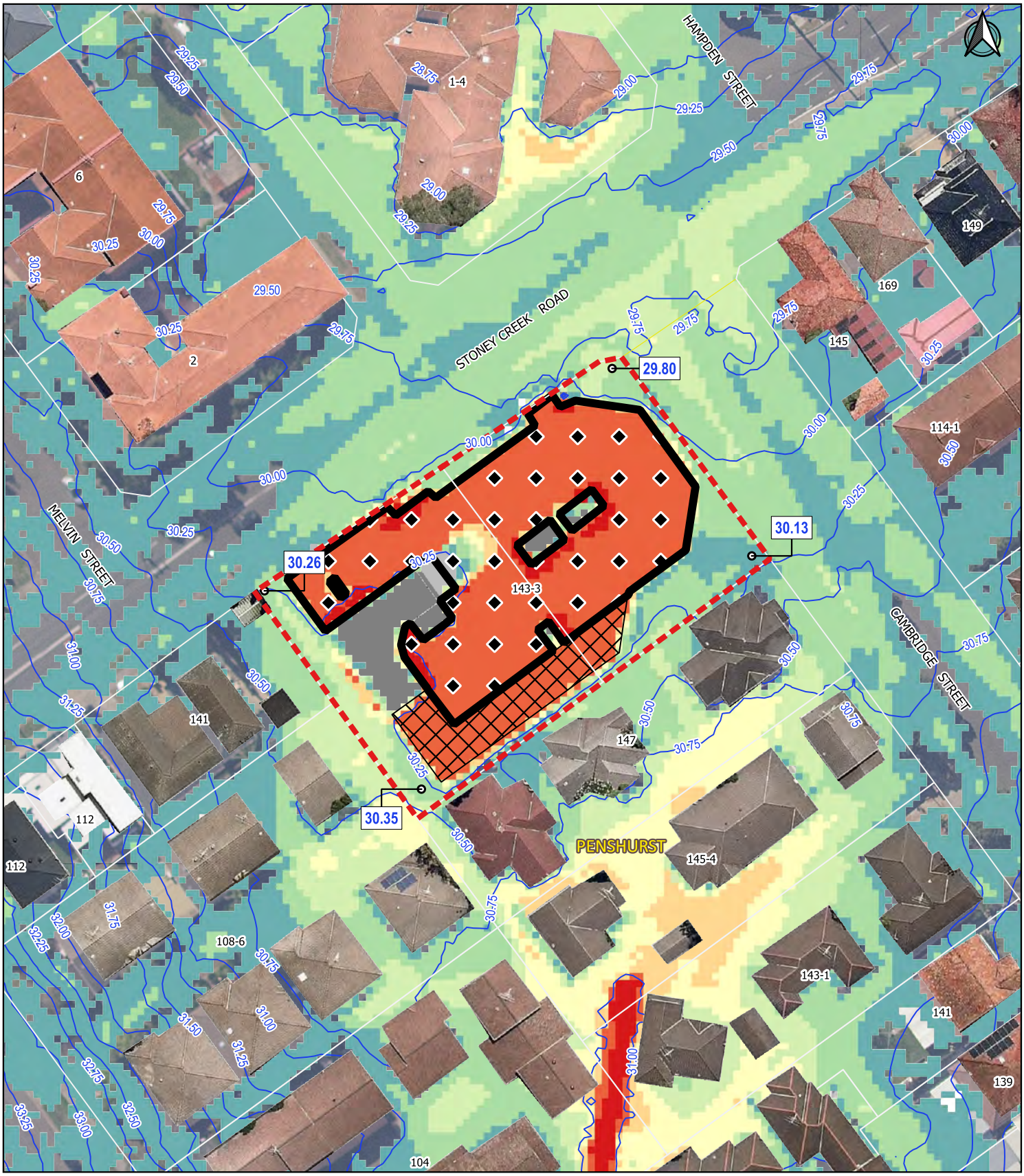

Legend

- Subject Site
- Cadastre
- Spot Levels (mAHD)
- 0.25m Water Contours
- Ramp
- Building Flow Constriction

Depth(m)

- < 0.01
- 0.01 - 0.10
- 0.10 - 0.30
- 0.30 - 0.50
- 0.50 - 0.70
- 0.70 - 1.00
- 1.00 - 1.50
- 1.50 >

Design Surface (mAHD)

- <= 29.9
- 29.9 - 31.1
- 31.1 - 32.3
- 32.3 - 33.5
- > 33.5

0 10 20 Metres

1:750

Figure D4[A]

20% AEP Flood Depth and Elevation Developed Case

143 Stoney Creek Road, Beverly Hills

NORTHROP

Data Source: NSW LPI - Cadastre, NSW Imagery - Aerial

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Legend

- Subject Site
- Cadastre
- Spot Levels (mAHD)
- 0.25m Water Contours
- Ramp
- Building Flow Constriction

Depth(m)

- < 0.01
- 0.01 - 0.10
- 0.10 - 0.30
- 0.30 - 0.50
- 0.50 - 0.70
- 0.70 - 1.00
- 1.00 - 1.50
- 1.50 >

Design Surface (mAHD)

- <= 29.9
- 29.9 - 31.1
- 31.1 - 32.3
- 32.3 - 33.5
- > 33.5

0 10 20 Metres

1:750

Figure D5[A]

50% AEP Flood Depth and Elevation Developed Case

143 Stoney Creek Road, Beverly Hills

NORTHROP

Data Source: NSW LPI - Cadastre, NSW Imagery - Aerial

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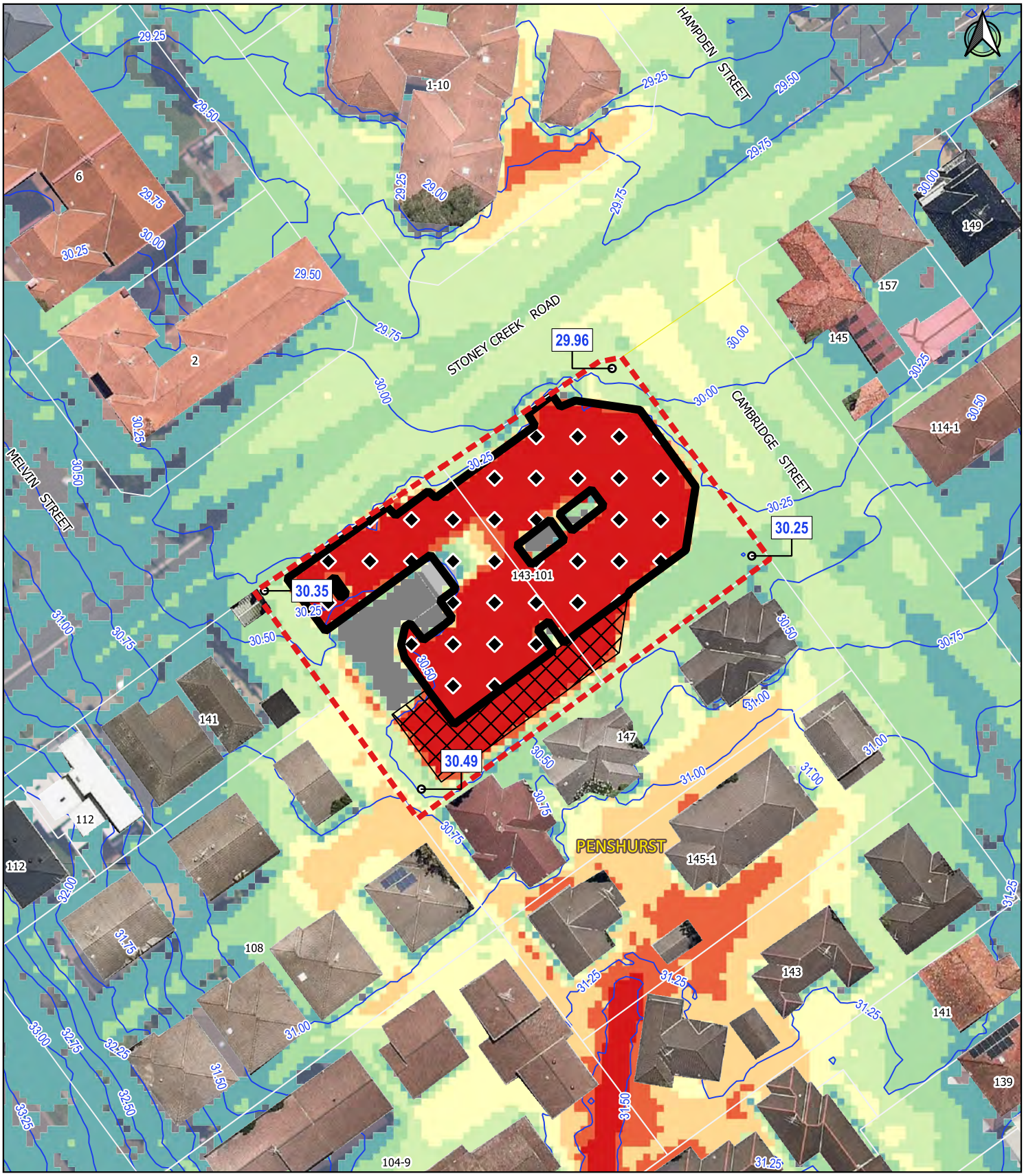

Legend

- Subject Site
- Cadastre
- Spot Levels (mAHD)
- 0.25m Water Contours
- Ramp
- Building Flow Constriction

Depth(m)

- < 0.01
- 0.01 - 0.10
- 0.10 - 0.30
- 0.30 - 0.50
- 0.50 - 0.70
- 0.70 - 1.00
- 1.00 - 1.50
- 1.50 >

Design Surface (mAHD)

- <= 29.9
- 29.9 - 31.1
- 31.1 - 32.3
- 32.3 - 33.5
- > 33.5

0 10 20 Metres

1:750

Figure D6[A]

1% AEP Flood Depth and Elevation Developed Case Climate Change 2100

143 Stoney Creek Road, Beverly Hills

NORTHROP

Data Source: NSW LPI - Cadastre, NSW Imagery - Aerial

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