53A & 53B Warriewood Rd, Warriewood

(Lot 2 and 3, DP 1115877)

Flood Impact Assessment

Revision 2
March 2025

Catchment Simulation Solutions

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(Lot 2 and 3, DP 1115877)

Flood Impact Assessment

Client	Client Representative
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1	Report for RFI submission	D. Fedczyna (NER)	D. Tetley
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1 INTRODUCTION

Sekisui House is proposing to subdivide two existing lots (Lot 2 and 3, DP1115877) into 29 residential lots. The site is known as 53A & 53B Warriewood Rd, Warriewood. The location of the site is shown in **Figure 1**, which is enclosed in **Appendix A**.

The sites currently consist of a dwelling on each lot, together with multiple ancillary sheds and an inground swimming pool located on 53B Warriewood Road. The sites are generally clear of any significant vegetation. The sites are located on the northern bank of Narrabeen Creek, with the topography across the sites grading down from the Warriewood Road frontage towards the rear of the lots (Narrabeen Creek).

Due to the proximity of the development sites to Narrabeen Creek, there is potential for flooding of parts of the site during heavy rainfall in the catchment. Furthermore, the future subdivision and development of the land has the potential to increase runoff rates, runoff volumes and peak discharges which may adversely impact on flooding along waterways and properties located downstream of the site.

The outcomes of computer flood modelling completed as part of the '*Ingleside, Elanora and Warriewood Overland Flow Flood Study* (WMAwater, 2019) shows that there is potential for inundation across the southern regions of the sites during flood events as frequent as the 2-year ARI. As a result, Northern Beaches Council requested a flood assessment to be completed to confirm the proposed development complies with the requirements of Section B3.11 of the Pittwater 21 Development Control Plan.

In recognition of the potential for inundation of the site and for the proposed works to impact on existing flood behaviour, Sekisui House engaged Catchment Simulation Solutions to prepare a Flood Impact Assessment (FIA) for the works. This report summarises the outcomes of the investigation, including:

- Existing flood behaviour in the vicinity of the proposed development for a wide range of possible flood events (under future climate conditions)
- Predicted flood behaviour with the proposed works in place for a wide range of possible flood events (under future climate conditions)
- Impact of the proposed works on flood behaviour in the vicinity of the site
- Consistency of the works to Section B3.11 of the Pittwater 21 Development Control Plan

Further detailed information on the outcomes of the flooding investigation are provided in the following sections.

2 EXISTING FLOOD BEHAVIOUR

2.1 General

In order to understand the potential impact of flooding on the proposed development sites, it is first necessary to define flood behaviour for "existing" conditions. Existing flood behaviour was previously defined across the Narrabeen Creek catchment as part of the *'Ingleside, Elanora and Warriewood Overland Flow Flood Study'* (WMA Water, 2019). The flood study included the development of a DRAINS model to simulate rainfall-runoff (i.e., hydrologic) processes as well as a TUFLOW model to simulate flood hydraulics.

The DRAINS and TUFLOW models were provided by Northern Beaches Council for use as part of the assessment. However, before they were used, a review of each model was completed to ensure they provided a suitable representation of flood behaviour in the vicinity of the sites. The outcomes of the model review along with the updates that were completed to each model are detailed in Section 2.2.

Once the models were updated, they were used to simulate flood behaviour for existing topographic and development conditions. The results of the flood simulations are discussed in Section 2.3.

2.2 Model Updates

2.2.1 DRAINS Model

As discussed, a DRAINS model was used to represent hydrologic processes across the wider catchment as part of the *'Ingleside, Elanora and Warriewood Overland Flow Flood Study'* (WMA Water, 2019). The DRAINS model was reviewed as part of the current assessment, and a number of limitations were identified:

- No overflow routes were defined between subcatchments, removing the ability to calculate 'total' flows throughout the catchment, making it impossible to define/confirm peak flows from the DRAINS model at any location within the catchment. This also precludes the ability to effectively apply ARR2019 hydrologic procedures on this assessment (as was desired by Council).
- No definition of the 2-year ARI flood event was contained within the model. As previously discussed, this was requested by Council to define in-bank flows.
- For non-PMF events, a non-standard storm temporal pattern was applied which embedded the 120 minute duration temporal pattern within the 540-minute duration temporal pattern to account for flood behaviour produced by the high intensity of the 120-minute duration event, together with the larger volume produced by the 540-minute duration event. The PMF adopted a 30-minute critical duration.
- Storm events reflecting the required 30% increase in rainfall depths were not defined for all ARI events.

Given these limitations, the following procedure was applied to define flows at the development sites to cover the full range of floods requiring assessment:

- Extraction of the ARR1987 design rainfall depths for the 2-year ARI from the Bureau of Meteorology website for the upstream catchment. As discussed, the limitations of the DRAINS model preludes the ability to effectively apply ARR2019 hydrologic procedures on this assessment.
- Application of the non-standard temporal pattern for < 30-year ARI events (120-minute embedded burst within a 540-minute event) to the 2-year ARI rainfall depths
- Definition of new storms (reflecting the same non-standard temporal pattern) for all ARI events reflecting a 30% increase in rainfall depth associated with potential climate change impacts.
- All other parameters within the DRAINS model were retained as per the *'Ingleside, Elanora and Warriewood Overland Flow Flood Study'* (WMA Water, 2019).

The DRAINS model was then used to generate revised design flows for the 2-year, 5-year, 20-year and 100-year ARI events, as well as the PMF reflecting the impact of climate change.

2.2.2 TUFLOW Model

The TUFLOW hydraulic model was also reviewed within the vicinity of the development site. This review indicated that a number of changes to the model would be necessary to provide enhanced detail for the current study. The updates to the existing model included:

- Topography: The existing TUFLOW model utilises LiDAR collected in 2011 to define the topography across the model extent. To supplement this topographic data, detailed site survey collected by Colliers International Engineering and Design in January 2021 was provided and included within the TUFLOW model to allow the existing topography across the development sites to be represented more precisely. A copy of the survey is included within **Appendix B**.
- Inflows: The inflows described in Section 2.2.1 were applied to the TUFLOW model.
- Land Use polygons were adjusted to better reflect areas of grass and areas of more dense vegetation within the vicinity of the sites.
- Buildings across the site were removed to reflect their demolition which has been approved as part of an approved DA (DA-2024-0586).

The modified existing conditions TUFLOW layout is shown on **Plate 1**.

2.3 Results

The updated TUFLOW model was used to simulate flood behaviour for the 2 year, 5 year, 20 year, 100 year ARI events, as well as the PMF. The 540-minute storm duration, with embedded 120-minute burst was simulated for events up to the 100 year ARI as per the *'Ingleside, Elanora and Warriewood Overland Flow Flood Study'* (WMA Water, 2019). Similarly, the 30-minute storm duration was simulated for the PMF. All storm events included a 30% increase in rainfall intensity associated with climate change.

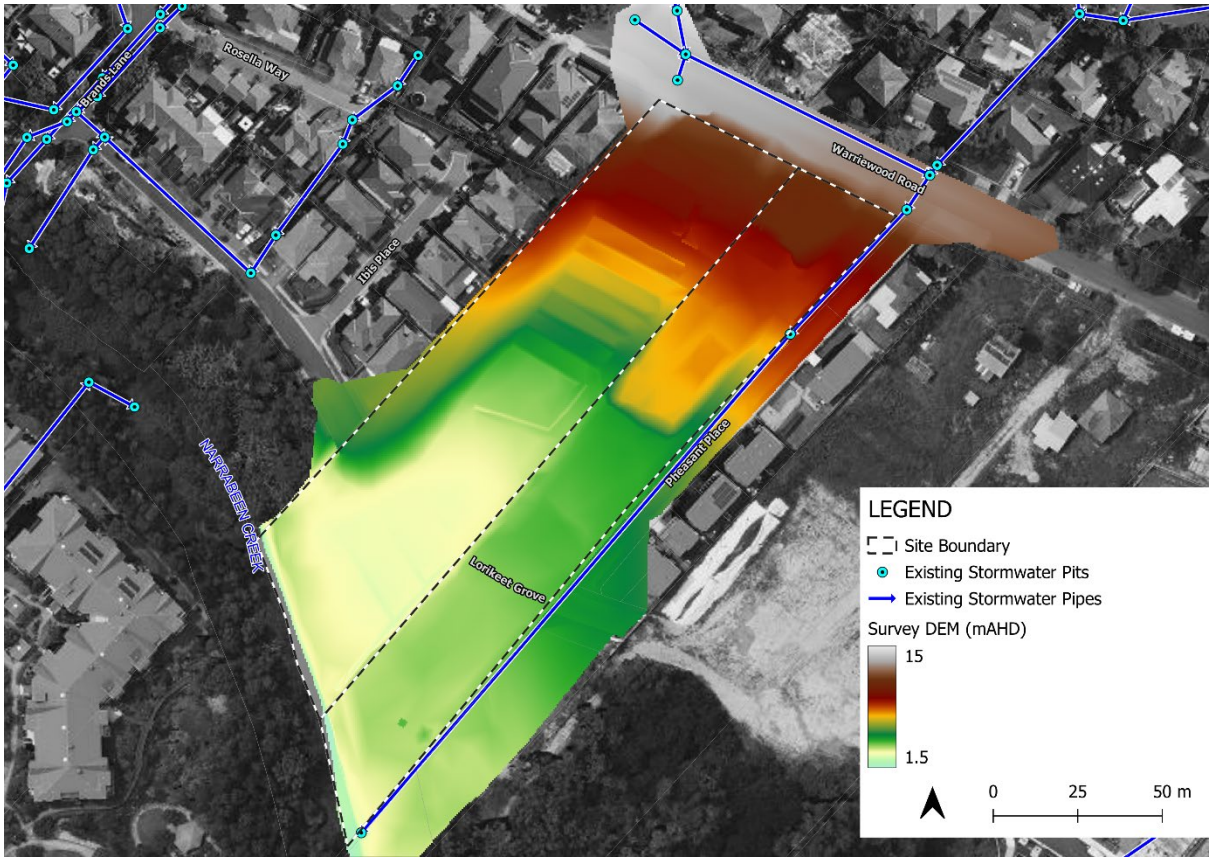


Plate 1 Existing conditions TUFLOW model layout

Flood mapping was prepared for the 2 year, 5 year, 20 year, 100 year ARI events, as well as the PMF, and is presented in **Appendix A** as follows:

- Peak floodwater depths and levels: **Figures 2** to **6**.
- Peak velocity: **Figures 7** to **11**.

Figure 2 through **Figure 6** shows that Narrabeen Creek flows along the rear property boundaries, and that a large area with depths of over 1.3 metres in the 2-year ARI, 1.6 metres in the 100-year ARI, and over 2.5 metres in the PMF is present within the rear of 53A Warriewood Road. The rear of 53B Warriewood Road experiences shallow depths of up to 0.7 metres in the 100-year ARI and 1.5 metres in the PMF. Shallow overland 'sheet' flow of depths generally less than 0.05 metres are predicted to enter the sites from 'spillage' off Warriewood Road which does not have formed kerb and gutter along the site frontage.

Peak Narrabeen Creek flood levels at the upstream (northern side) and downstream (southern side) of the development site are provided in **Table 1** for all flood events considered in the current assessment. This indicates that a variation of 0.35 metres occurs between the 2-year ARI and 100-year ARI event, and a further increase of 0.83 metres increase above the 100-year ARI to the PMF level.

Table 1 Peak existing mainstream (Narrabeen Creek) flood levels within the development sites

Flood Event	Peak Flood Level (m AHD)	
	Upstream (northern) end of sites	Downstream (southern) end of sites
2-year ARI	4.37	4.35
5-year ARI	4.45	4.44
20-year ARI	4.56	4.54
100-year ARI	4.72	4.71
PMF	5.55	5.55

Figures 7 through **Figure 11** indicate that in general, peak velocities within the western portion of the site (mainstream Narrabeen Creek inundated areas) can vary from 0.6m/s in the 2-year ARI event up to 1.5m/s in the PMF, however, within the creek itself, velocities can exceed 1m/s in all events. Within the portion of the sites impacted by overland flooding, peak velocities are generally no greater than 0.7m/s.

2.3.1 Flood Hazard

To confirm the nature and extent of the flood hazard through the site, flood hazard mapping was prepared based upon flood hazard vulnerability curves presented in '*Flood Hazard – Flood risk management guideline FB03*' (NSW Government Department of Planning and Environment, 2023). The hazard curves, which are reproduced in **Plate 2**, assess the potential vulnerability of people, cars and structures to flooding based upon the depth and velocity of floodwaters at a particular location. The maximum flood hazard for each design flood are presented in **Figures 12** to **16**.

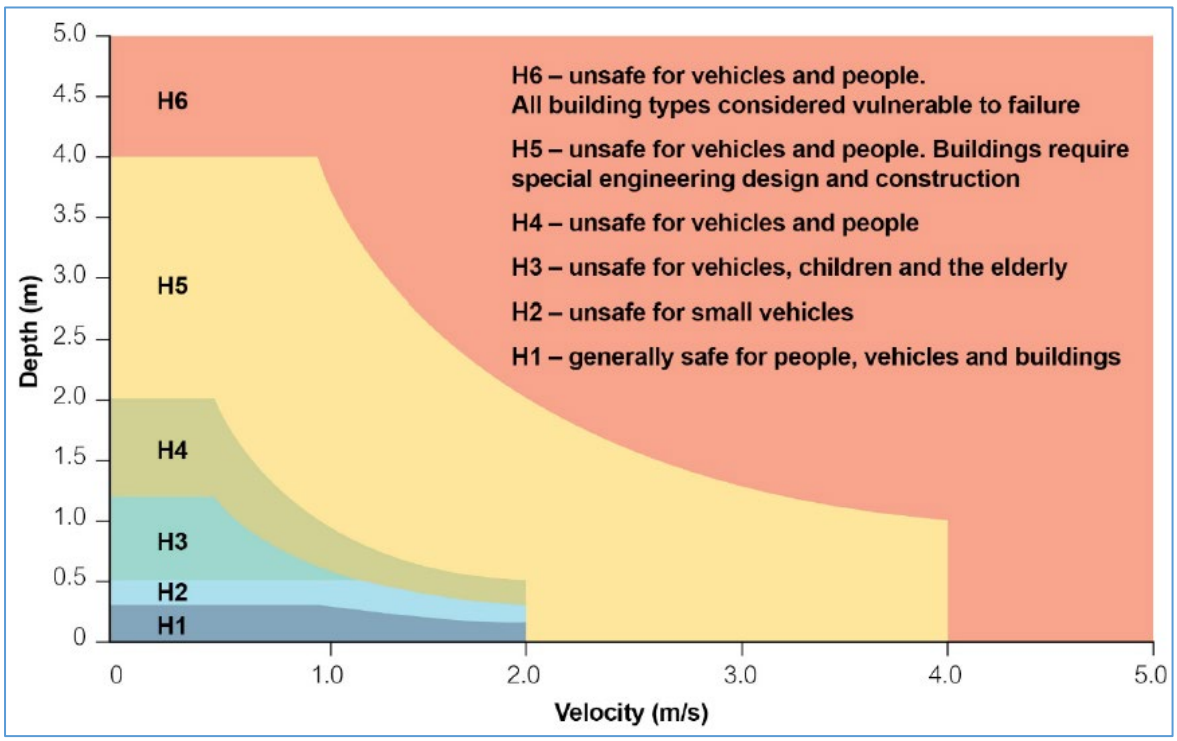


Plate 2 Flood hazard vulnerability curves (NSW Government, 2023)

Figures 12 to **16** show that the flood hazard within the western portion of the site can reach up to H4 in the 2-year ARI event, and as high as H5 within the main creek. In the 100-year ARI and PMF events, a hazard of H4 or H5 is common. Across the portion of the site impacted by overland flooding, a hazard of no greater than H1 is predicted in all flood events.

2.3.2 Hydraulic Categories

Hydraulic Categories for the 100 Year ARI flood were also calculated. This involved subdividing the floodplain into floodway, flood storage and flood fringe categories.

Criteria for defining hydraulic categories were established in *'Ingleside, Elanora and Warriewood Overland Flow Flood Study'* (WMA Water, 2019). This included defining floodways based on criteria corresponding in part to criteria proposed by Howells et al (2004), as follows:

- Velocity x Depth > 0.25m^2/s AND Velocity > 0.25m/s, OR
- Velocity > 1m/s.

Flood storage and flood fringe areas were subsequently defined based on (and consistent with *'Ingleside, Elanora and Warriewood Overland Flow Flood Study'* (WMA Water, 2019)) as per the following:

- Flood Storage: Areas not defined as floodway and depth > 0.2m.
- Flood Fringe: Areas not defined as floodway and depth < 0.2m.

These criteria were applied to the 100 Year ARI results from the updated flood modelling and the resulting hydraulic categories are presented on **Figure 17**.

Figure 17 indicates that in the 100-year ARI event, the areas subject to mainstream Narrabeen Creek inundation are made up of floodway or flood storage classification. The areas subject to overland flooding are classified as flood fringe areas.

3 POST-DEVELOPMENT FLOOD BEHAVIOUR

3.1 Proposed Works

The proposed development will involve subdividing the two existing lots to from 32 new residential lots. Plans of the proposed subdivision are included in **Appendix C**. The proposed works include:

- Cut and fill across the northern two-thirds of the site to form a suitably elevated and graded site to accommodate the proposed roads and residential lots
- The construction of Lorikeet Grove through the southern portion of the site, linking in with the existing Lorikeet Grove pavement on both the eastern and western side of the site.
- Construction of roadways within the site to provide access to the new lots
- Earthworks in the proposed Lot 1 to provide compensatory flood storage adjacent to Narrabeen Creek.
- Replacement of the existing 600mm diameter Council stormwater pipe running within a drainage easement on the eastern site boundary with 2 x 900mm diameter pipes.
- Construction of stormwater pit inlets along the Warriewood Road frontage linking into the 2 x 900mm diameter pipes.
- Construction of an internal stormwater network.

Given the proximity of the site to Narrabeen Creek, and the large flood affectation present within the existing site, the earthworks proposed as part of the subdivision of the land has the potential to impact both local overland flood behaviour and mainstream Narrabeen Creek flood behaviour. The following section describes the assessment that was completed to define "post-development" flood conditions. This includes a discussion on the potential impacts that the proposed works are likely to have on existing flood behaviour.

3.2 Model Updates

The updated DRAINS model described in the previous section was also used to define hydrologic inputs under post-development conditions with no further modifications. However, the TUFLOW model was updated to reflect proposed conditions across the development site. This included:

- Design topography was included across the site based on a digital elevation model provided by Enspire on 14th March 2025. A copy of this information is enclosed with the proposed subdivision development plans in **Appendix C**.
- The proposed stormwater network (pits and pipes) was added to the TUFLOW model, including the upgraded pipe along the eastern site boundary.
- Land use modifications were implemented to reflect the new urban areas, the new paths and roadways (Lorikeet Grove and walking path), as well as Lot 1 defined as

having medium density vegetation. All hydraulic roughness coefficients were adopted as per existing conditions.

The extent of the updates that were completed to the TUFLOW model to reflect the proposed development are shown on **Plate 3**.

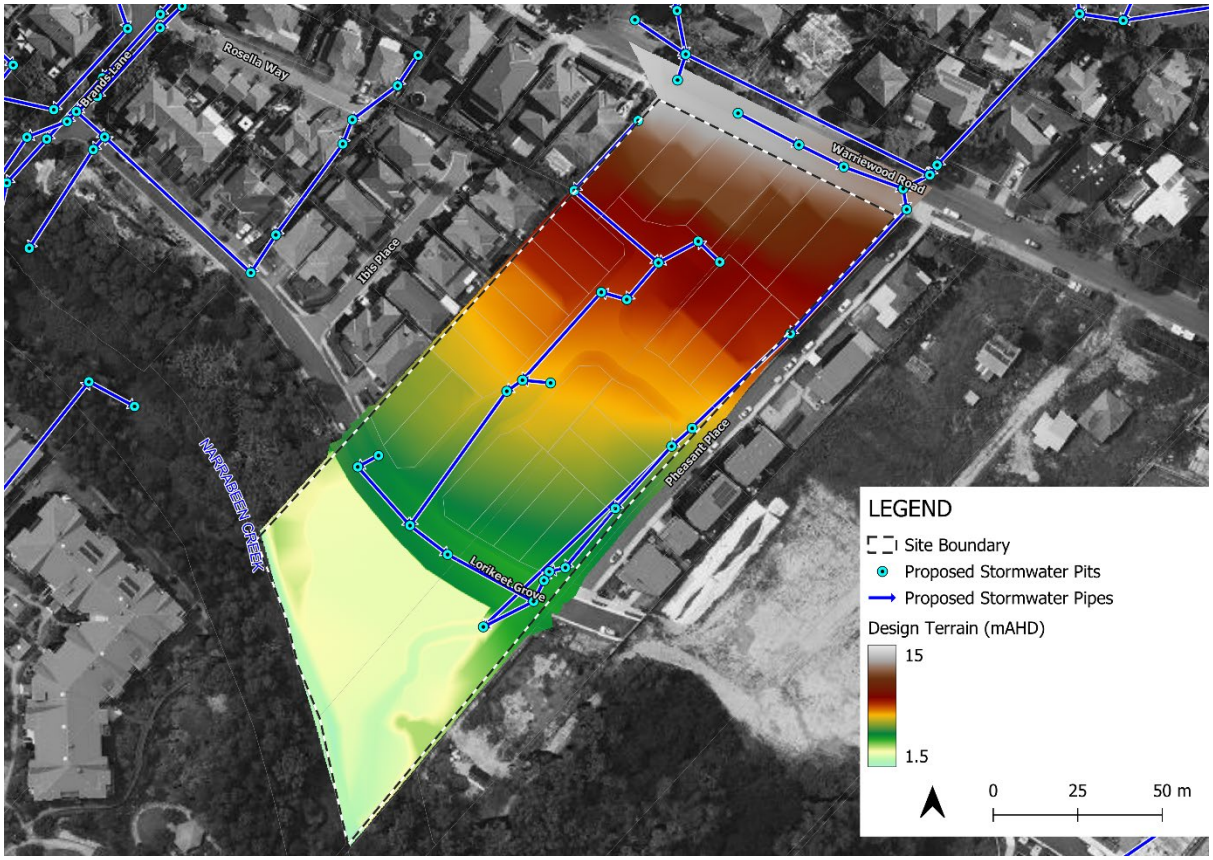


Plate 3 Post-development conditions TUFLOW model layout

3.3 Results

The updated TUFLOW model was used to simulate flood behaviour for the 2 year, 5 year, 20 year, 100 year ARI events, as well as the PMF for post-development conditions. The same storm events were simulated to that under existing conditions.

Flood mapping was prepared for the 2 year, 5 year, 20 year, 100 year ARI events, as well as the PMF, and is presented in **Appendix A** as follows:

- Peak floodwater depths and levels: **Figures 18** to **22**.
- Peak velocity: **Figures 23** to **27**.

Figure 18 through **Figure 22** show that with the proposed works in place, mainstream flooding is contained to the flood storage area within the western portion of the sites, where depths of over 1.3 metres are predicted in the 2-year ARI event, over 1.6 metres in the 100-year ARI event, and over 2.5 metres in the PMF. No inundation of the proposed development lots or Lorikeet Grove is predicted in events up to and including the 100-year ARI. However, in the PMF, inundation of Lorikeet Grove, within the south-eastern portion of the site is predicted

with depths of up to 0.8 metres. Some inundation of up to 0.5 metres is predicted to extend into a number of lots fronting Lorikeet Grove. Overland flooding across the proposed development lots is also predicted in the PMF, however, the depths of inundation are extremely shallow 'sheet' flow (depth of < 0.05 metres).

Peak Narrabeen Creek flood levels at the upstream (northern side) and downstream (southern side) of the development site are provided in **Table 2** for all flood events considered under both existing and proposed conditions. This indicates that peak flood levels under proposed conditions are lower than those under existing conditions.

Table 2 Peak existing and proposed mainstream (Narrabeen Creek) flood levels within the development sites

Flood Event	Peak Flood Level (m AHD)			
	Upstream (northern) end of sites		Downstream (southern) end of sites	
	Existing	Proposed	Existing	Proposed
2-year ARI	4.37	4.32	4.35	4.29
5-year ARI	4.45	4.41	4.44	4.38
20-year ARI	4.56	4.53	4.54	4.49
100-year ARI	4.72	4.70	4.71	4.66
PMF	5.55	5.56	5.55	5.53

Figures 23 through **Figure 27** indicate that peak velocities within the western portion of the site can vary from 0.6m/s in the 2-year ARI to over 0.75m/s in the 100-year ARI event. In the PMF, velocities of over 1.3m/s are common, and in all events, the mainstream creek can experience velocities of over 1m/s. Overland flooded areas of the site in the PMF generally experience a velocity of less than 2m/s (noting that this inundation is shallow 'sheet' flow of depth < 0.05 metres).

3.3.1 Flood Hazard

Flood hazard mapping under post-development conditions was prepared. The maximum flood hazard for each design flood is presented in **Figures 28** to **32**.

Figures 28 to **32** show that a flood hazard of H4 or H5 is common within the western portion of the site in all flood events. In the PMF, a hazard of H3 is predicted across the south-eastern portion of Lorikeet Grove, with this extending into the frontage of some lots. The overland portion of the sites inundated in the PMF are not predicted to experience a hazard of greater than H1 (noting that this inundation is shallow 'sheet' flow of depth < 0.05 metres).

3.3.2 Hydraulic Categories

Hydraulic Categories for the 100 Year ARI flood under post-development conditions were also calculated and are presented on **Figure 33**.

Figure 33 indicates that in the 100-year ARI event, the entire western portion of the site is classified as floodway.

3.3.3 Flood Impact Assessment

Flood level and velocity difference mapping has been prepared to confirm the magnitude and extent of any changes in flood level/extent and velocity associated with the works. The difference mapping was prepared by subtracting peak "existing" water level and velocity results from "post-development" water level and velocity results. The flood level difference mapping is provided in **Figures 34** to **Figure 38**, and the velocity difference mapping is provided in **Figures 39** to **Figure 43** for the 2 year, 5 year, 20 year, 100 year ARI events, as well as the PMF respectively**.**

Figure 34 to **38** show that the proposed works are predicted to result in flood level reductions within the mainstream Narrabeen Creek of up to 0.05 metres in events up to and including the 100-year ARI, with reductions of up to 0.08 metres predicted within the western portion of the site. A small, localised area of flood level increases of up to 0.04 metres is predicted within the very southern portion of the site but is retained within the site boundary/drainage easement. In the PMF, peak flood levels differences within Narrabeen Creek and the western portion of the site are shown to remain less than the +- 0.05 metres threshold. Flood level reductions or areas of 'now dry' are typical within the proposed development lots.

However, **Figure 34** to **38** do show that flood level increases are predicted along the Warriewood Road frontage of the site in all flood events. Maximum increases range from 0.08 metres in the 2-year ARI event, 0.23 metres in the 100-year ARI event and over 0.6 metres in the PMF. These increases are a result of the higher terrain along the site frontage (which largely prevent overland flow entering the site), formation of kerb and gutter, as well as reformation of the southern travel lane of Warriewood Road. Therefore, these increases are attributed to the increase in elevation of the road and frontage rather than increases in depth.

Figures 39 to **Figure 43** indicate that peak velocity within the western portion of the sites are predicted to reduce by up to 0.5m/s in flood events up to and including the 100-year ARI, and 0.65m/s in the PMF, however, an isolated increase is also predicted on the south-eastern lot boundary of up to 0.5m/s in all flood events. Changes (both increases and reductions of typically up to +-0.40m/s) in peak velocity are predicted along the Warriewood Road frontage of the site as a result of the frontage works and roadworks proposed in this location. In all events up to and including the 100-year ARI, these changes in velocity are restrained to the roadway and frontage works area, however, in the PMF, increases in peak flood velocity are predicted to impact adjacent properties to the east of the development sites, however, as shown on **Figure 32**, these increases do not result in a significant increase in the flood hazard within these areas, and therefore do not increase the risk to life or property. Further, the extreme rarity of the PMF (1 in 10,000,000 year frequency) means that the PMF is unlikely to occur within the design life of the development, further decreasing the risk posed by the impacts. It should also be noted that these increases in PMF velocity occur within an area subject to overland flooding rather than mainstream flooding.

Overall, the results shown on **Figures 34** to **Figure 43** show that the proposed works are not predicted to have any significant adverse impact on flood behaviour outside of the development site, apart from along the Warriewood Road frontage, however, these changes are a direct result of alterations to the underlying topography. The flood mitigation works undertaken within the western portion of the site are able to effectively manage the fill placement within the site.

3.3.4 Flood Storage Volume

Under existing conditions, the 100-year ARI peak volume of floodwater within the development sites has been calculated (via summation of peak depths) and recorded as 8677m^3. Under proposed conditions, the same calculation has been made with a volume of 6160m^3 recorded. Therefore, a deficit of 2517m^3 results (excluding on site storage tanks). However, as discussed in the preceding section, this loss of flood storage does not translate into any adverse impact on peak flood levels outside of the development site as the flood storage area provided on the site under proposed conditions allows a more efficient use of active storage volume compared to existing conditions (which has a 'dead' storage component produced by the elevated creek bank).

3.3.5 Comparison to similar developments

It is noted that the proposed works do not fully comply with Councils requirements. Namely,

- Adverse flood level and velocity impacts on Warriewood Road along the site frontage is predicted in all flood events.
- Adverse impacts outside of the development site in the PMF are predicted in which exceed the tolerance set out in DCP.
- Flood storage volumes within the proposed site are reduced relative to existing conditions (i.e.: there is a loss of flood storage).

In response to this limitation, review of flood assessments for surrounding properties has been undertaken. Most notably, a flood assessment completed for development at 49 Warriewood Road (located 2 properties further east on Warriewood Road). The flood impact mapping contained within this assessment indicates that increases in peak flood level in all flood events is also predicted on Warriewood Road. Additionally, increases in peak velocity are also predicted outside of the site and with the adjacent property. Further, the report states that the flood storage volume provided within the site under proposed conditions is less than that provided under existing conditions. The outcome of the assessment was approval through the Land and Environment Court.

It is considered that this has set a precedent within the Warriewood Valley that could be applied to the current assessment and allow some leniency to the DCP controls to be applied where there is no increase in flood hazard and risk to people or property.

3.4 Planning Considerations

The Flood Planning Level (FPL) in the vicinity of the site has been defined as 0.5 metres above the peak 100-year ARI flood level under climate change conditions. This equates to 0.5 metres above the peak 100-year ARI proposed flood levels presented in **Table 2**, resulting in an applicable FPL ranging from 5.20m AHD at the northern extent of the site, to 5.16m AHD at the southern extent. The Flood Planning Area (FPA) has also been defined by extending the FPL out laterally until it intersects higher ground. The FPA is presented on **Figure 44**. Note that the FPA has only been prepared across the development site.

Figure 44 shows that the FPA extends across the majority of Lorikeet Grove, as well as 4 future residential lots in the south-east corner of the site. However, adequate space within these lots is provided for the construction of future dwellings above the FPL. It should be noted

that the levels of Lorikeet Grove are relatively 'fixed' due to the need to tie into the existing roadway on either side of the development.

The outcomes of the current assessment have also demonstrated that the proposed works are such that:

- The location of all lots that are proposed to be developed are such that they are located outside of flood liable areas in all events up to and including the 100-year ARI (with climate change), but that some inundation is predicted to occur in the PMF to 4 lots in the south-east of the site.
- All lots have been designed to be provide adequate space above the FPL under climate change conditions for the construction of future dwellings.
- The proposed works do not produce any adverse impacts to peak flood level or velocity across any adjacent property or within the mainstream flood area of Narrabeen Creek in events up to and including the 100-year ARI (with climate change). However, in the PMF, velocity increases are predicted external to the site, although these do not produce an increase to flood hazard and risk.
- No habitable works are proposed to be undertaken within the floodway area of Narrabeen Creek
- There is a decrease in the flood storage volume provided within the site as a result of the proposed earthworks. However, this reduction in storage volume does not have any adverse impact on simulated peak flood levels or velocities due to better utilisation of the flood storage capacity within the site compared to existing conditions.

3.5 Emergency Response Considerations

As discussed in **Section 3.3**, and shown on **Figures 18** to **21**, no inundation of proposed development lots is proposed in any flood event up to and including the 100-year ARI. In the PMF, inundation is predicted along Lorikeet Grove as well as along the frontage of the lots fronting Lorikeet Grove. The inundation on Lorikeet Grove will pose evacuation difficulties for almost all development lots due to a hazard of H2 present at the intersection of Road 1 with Lorikeet Grove. Furthermore, peak PMF hazard on Brands Lane (in which must be traversed when accessing the site) can reach up to H5, which would further limit safe access/egress at the peak of the PMF. Note that in events up to and including the 100-year ARI, a maximum of H1 hazard is present on Lorikeet Grove, but that some isolated sections of H5 are present on Brands Ln (however these are isolated and generally contained to the gutter).

Plate 4 shows a flood depth and hazard hydrograph at the intersection of Lorikeet Grove and Road 1 in the PMF and shows that the hazard exceeds H1 after ~23 minutes of rainfall and remains above H1 until ~38 minutes of rainfall, meaning access is cut for 15 minutes. Given the rapid onset of flooding in the PMF event, and flood hazard along the access/egress route, the only emergency response option available for the subdivision is to shelter in place for the short duration of isolation in the PMF event. This will typically require future residents of the subdivision to remain within their homes for roughly 15 minutes based on the critical 30-minute duration PMF event. Note that longer PMF durations can occur and may lead to

longer periods of isolation, however, the peak depth (and potentially hazard) would not be as severe.

The duration of isolation of 15 minutes is considered tolerable given the extreme rarity of such an event and very short duration of isolation.

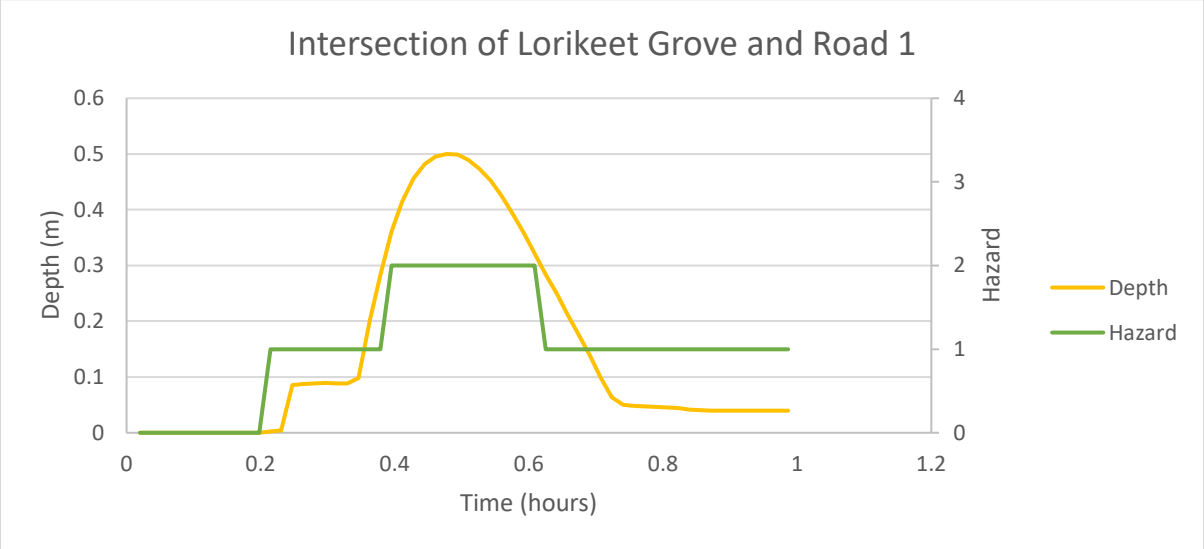


Plate 4 Hazard and depth hydrographs at the intersection of Lorikeet Grove and Road 1

Notwithstanding, it is considered appropriate that a site-specific Flood Emergency Response Plan (FERP) be prepared to raise awareness of the potential impacts of flooding within the site, and suggested actions for residents before, during and after a flood event. In this regard, a FERP has been prepared and is contained in **Appendix D**. The FERP outlines that during flood events, it is safest to remain within the residential lots for the duration of the event, and that the siting of all future residential dwelling will be such that they will not become inundated in any flood event. It also outlines that traversing floodwater is never recommended.

Note that the FERP is not necessarily designed to manage the flood risk, but rather to raise awareness and should complement any flood awareness campaigns the NSW SES undertakes from time to time. The FERP should also be updated once the subdivision has been approved and prior to construction/occupation of any future dwellings.

4 REGULATORY REQUIREMENTS

The subdivision of flood liable land requires that any potential development resulting from it can comply with all local and state government legislation/requirements. These are detailed in the following sections.

4.1 Pittwater Local Environment Plan 2014

The Pittwater Local Environment Plan 2014 (LEP2014) outlines a number of requirements and matters that need consideration when deciding to grant development consent on flood liable land.

Section 5.21(2) and 5.21(3) of LEP2010 primarily deals with ways in which the proposed development will interact and impact on existing flood behaviour, and how the flood risk is managed. Details of how the future development of the site can meet each specific requirement of LEP2014 is summarised in **Table 3**.

Table 3 Pittwater LEP2014 requirements and matters to be considered

Council Requirement	Does Development Meet this Requirement?
Section 5.21(2)	
a) The development is compatible with the flood function and behaviour on the land	The flood function (hydraulic categories) across the site for the 100-year ARI under proposed conditions have been defined (**Figure 33**). This shows that the lots to be used for future development are located clear of flood storage or floodway areas. Therefore, any development leading from the subdivision would be compatible with the flood function in the 100-year ARI event.
b) The development will not adversely affect flood behaviour in a way that results in detrimental increases in the potential flood affectation of other development or properties	**Figure 34-43** demonstrate that the works proposed as part of the subdivision are not predicted to impact flood behaviour or increase the flood affectation of other developments or properties.
c) The development 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	As discussed in **Section 3.5**, no inundation of proposed development lots is proposed in any flood event up to and including the 100-year ARI. In the PMF, inundation is predicted along Lorikeet Grove as well as along the frontage of the lots fronting Lorikeet Grove in the south-east of the site. However, space is available on all lots for a dwelling to be sited such that it will be elevated above all potential floods, as well as the FPL, and evacuation from the site will not be necessary, facilitating safe occupation and ensuring the capacity of existing evacuation routes is not compromised. However, if access/egress is required, evacuation will be

Council Requirement	Does Development Meet this Requirement?
	possible in all flood events up to and including the 100-year ARI. In the PMF, access/egress is cut, however, the duration of isolation of 15 minutes (for the critical PMF duration of 30-minutes) is considered tolerable given the extreme rarity of such an event and the relatively short duration of isolation. Overall, any development resulting from the subdivision is not predicted to adversely affect the safe occupation or efficient evacuation of people from the site.
d) The development incorporates appropriate measures to manage risk to life in the event of a flood	The development is considered to incorporate appropriate measures to manage the risk to life by providing space on all lots for a dwelling to be sited such that it will be elevated above all potential floods, and the FPL. However, if access/egress is required, evacuation will be possible in all flood events up to and including the 100-year ARI. In the PMF, access/egress is cut, however, the duration of isolation of 15 minutes (for the critical PMF duration of 30-minutes) is considered tolerable given the extreme rarity of such an event and the relatively short duration of isolation.
e) The development will not adversely affect the environment or cause avoidable erosion, siltation, destruction of riparian vegetation or a reduction in the stability of river banks or watercourses	As shown on **Figures 34-38**, no adverse impacts to peak flood level are predicted outside of the development site in any flood event. Although **Figures 39-43** indicate that some change to flood velocity is predicted, these are generally isolated to the Warriewood Road frontage dye to frontage works and roadworks, and do not impact riparian vegetation or riverbanks. Therefore, the development is not predicted to adversely impact the environment or cause erosion, siltation, destruction of riparian vegetation or a reduction in the stability of riverbanks or watercourses in all flood events.
Section 5.21(3)	
a) The development needs to consider the impact of the development on projected changes to flood behaviour as a result of climate change	All flood modelling completed as part of the current assessment have considered a 30% increase in rainfall intensity due to climate change, and as such, the assessment has intrinsically considered any changes to flood behaviour as a result of climate change.
b) The development needs to consider the intended design and scale of buildings resulting from the development	This is an application for subdivision, and the design and scale of development (dwellings) within the future subdivision is yet to be completed. However, it is expected that it will be sympathetic to and appropriate for the surrounding natural and built environment, be acceptable to the community and maintain economic feasibility.
c) The development needs to consider whether the development incorporates measures to minimise the risk to life and ensure the safe evacuation of people in the event of a flood	See response to 5.21(2) c) and d)

Council Requirement	Does Development Meet this Requirement?
d) The development needs to consider the potential to modify, relocate or remove buildings resulting from development if the surrounding area is impacted by flooding or coastal erosion	Any future development resulting from this subdivision can be sited to prevent being impacted in any flood event, including under climate change conditions and are not in a location at risk of coastal erosion. Therefore, modifying, relocating, or removing buildings from the site to reduce the flood risk is not considered necessary.
Section 5.22(2)	
a) This clause applies to sensitive and hazardous development—land between the flood planning area and the probable maximum flood	The subdivision is for residential purposes and not for sensitive or hazardous development, thus this clause is not applicable.
b) for development that is not sensitive and hazardous development—land the consent authority considers to be land that, in the event of a flood, may— (i) cause a particular risk to life, and (ii) require the evacuation of people or other safety considerations.	(i) No particular risk to life has been identified as the sections of the site to be used for future residential development are not predicted to be inundated in the 100-year ARI (with climate change) event. (ii) Evacuation from the site is not considered necessary, however, reliable access from all proposed lots is available in all events up to and including the 100-year ARI (with climate change).
Section 5.22(3)	
a) Development on the land will not affect the safe occupation and efficient evacuation of people in the event of a flood	Although Clause 5.22 is not considered to be applicable to the subject land as it is not for a sensitive land use, the response for 5.21(2) c) can be applied.
b) The development incorporates measures to manage risk to life in the event of a flood	Although Clause 5.22 is not considered to be applicable to the subject land, the response for 5.21(2) d) can be applied.
c) The development will not adversely affect the environment in the event of a flood	Although Clause 5.22 is not considered to be applicable to the subject land, the response for 5.21(2) e) can be applied.

4.2 Warriewood Valley Urban Land Release Water Management Specification 2001

Section 4.5 (Flood protection) of the Warriewood Valley Urban Land Release Water Management Specification outlines the requirements of flood assessments undertaken within the Warriewood Valley (in which the site is located). This includes flood planning levels and reporting requirements. The requirements, together with commentary on how this report has addressed these, is included in **Table 4**.

Table 4 Requirements from the Warriewood Valley Urban Land Release area Water Management Specification 2001

Warriewood Valley Urban Land Release Water Management Specification Requirement	Comment
Flood Planning and Design Levels for Development	
50%AEP flow to be carried in-bank	**Figure 2** shows that under existing development conditions, that the mainstream 2yr-ARI flood extent (with climate change) extends into the development site, with significant depths present (>1.2 metres). The inundation within the site is not considered to be carried within the creek 'banks'. **Figure 18** indicates that under proposed conditions, inundation is still present within the site (and not necessarily within the creek 'banks'), however the inundation is much more closely restrained towards the main creek line. Overall, although inundation is not contained within the creek 'banks' (under both existing and proposed development conditions), the proposed case reflects a closer representation of containment to the creek corridor.
The level of walkways and cycleways adjacent to the creeks are to be above the 20%AEP flood level except under special circumstances (and exposed for only short duration's)	The walkway proposed on the western side of Lorikeet Grove is located at a minimum level of 4.70m AHD. The peak 5yr-ARI level (with climate change) varies from 4.3-4.4m AHD within the site. Therefore, the walkway is located above the 5-year ARI (with climate change) level.
Water quality control ponds, filter strips and structures are to be above the 20%AEP flood level, and can be below the 1%AEP flood level but must lie within the private buffer area as outlined in Section 4.3.2.	No water quality control ponds, filter strips or structures are proposed within the extent of the 5yr-ARI or 100yr-ARI (with climate change).
1%AEP flows are to be carried within the public space corridors, and are to be further designed such that floodplain management and hazard management guidelines are accommodated to minimise risk to life	Mainstream flood behaviour within the site is restricted to the area west of Lorikeet Grove (Lot 1 and Lot 2), in which are allocated to be open space with no formal access to pedestrians or vehicles. Therefore, no risk to life is anticipated.
Flood extent to be mapped	Flood extents for all flood events are represented by the extent of results on all figures. **Figure 44** also shows the flood extent of all events considered as part of this assessment (but excludes areas of shallow overland inundation in the PMF).
Floor levels for properties adjacent to the creek are to be set at least 0.5 m above the 1%AEP level	The peak 100-yr ARI flood level (with climate change) within Narrabeen Creek adjacent to the site is 4.70m AHD. The minimum level of lots

	proposed for development is 4.86m AHD. Therefore, any future dwelling will need to be constructed at a maximum of 0.34 metres above ground level to achieve a finished floor level of 5.20m AHD (the FPL) and satisfy this requirement, which is considered feasible.
Obverts of bridge decks of evacuation routes are to be set at least 0.5 m above the 1%AEP level	Not applicable as no bridge is required to be constructed to form an evacuation route from the site.
PMF used for Evacuation Planning	As per Section 3.5 of the current report, the PMF has been considered in evacuation planning and indicates that most lots will only be isolated for 15 minutes (for the critical PMF duration of 30-minutes).
PMF Flood hazards and risk to life	**Figure 32** presents the peak PMF flood hazard and indicates that all lots proposed for development are exposed to a H1 hazard, apart from the very frontage of 4 lots in the south-east corner of the site in which can experience a hazard of H2/H3 in the PMF. Notwithstanding, all dwellings would be constructed at 0.5 metres above the 100-yr ARI level (with climate change) and therefore remain within a H1 hazard area which is safe for refuge in all flood events.
PMF Flood extent to be mapped	Flood extents for all flood events are represented by the extent of results on all figures, as well as on **Figure 44** (but excludes areas of shallow overland inundation in the PMF).
Reporting	
Design flood modelling undertaken including model cross sections and assumptions	Flood modelling has been undertaken utilising a 2d TUFLOW model that was originally developed as part of the *'Ingleside, Elanora and Warriewood Overland Flow Flood Study'* (WMA Water, 2019) with all modification to the base model documented within the current report.
Plans showing design flood levels (as described in Section 4.4)	Design flood levels are provided on the design plans.
The application of any flood planning levels	The flood planning level has been defined as the peak 100-year ARI (with 30% climate change), plus a 0.5 metre freeboard. All future dwelling will be constructed with a minimum floor level at or above this level.
Interim flood protection works	No interim flood protection works are proposed.
A flood evacuation plan.	A flood evacuation plan has been prepared and is discussed in **Section 3.5** and provided in **Appendix D**.

All flooding assessments must extend a sufficient distance upstream and downstream to accommodate all likely hydraulic influences, such as potential overland flow paths from upstream areas, downstream culverts and tidal conditions	The current flood assessment has utilised the TUFLOW model originally developed as part of the *'Ingleside, Elanora and Warriewood Overland Flow Flood Study'* (WMA Water, 2019), with the only modifications made related to the development site, with all hydraulic influences intrinsically accounted for.
Tables of data and sections are to indicate the peak flood levels for various design events of the 50%AEP, 20%AEP, 5%AEP, 1%AEP and the PMF	**Table 1** and **Table 2** presents the peak flood level at the northern and southern site boundaries for all flood events under both existing and proposed conditions.

4.3 Pittwater 21 Development Control Plan 2003

The Pittwater 21 Development Control Plan 2003 (DCP2003) outlines the flood related controls that are applicable within the former Pittwater LGA. The controls, together with commentary on how the subdivision and any future development can satisfy the controls are included in **Table 5**.

Table 5 Flood related development controls from the Pittwater 21 Development Control Plan 2003

DCP 2003 Control	Comment
A1.9 Definitions	
Adverse Impacts (for the purposes of the Flood Prone Land clause only) means, the proposed development:	
Will result in less than 0.02m increase in the 1% AEP	**Figure 37** demonstrates that 100-yr ARI peak flood levels external to the development site (other than where frontage and roadworks are proposed on Warriewood Road) are not predicted to increase by greater than 0.02 metres.
Will result in less than a 0.05m increase in the PMF	**Figure 37** demonstrates that peak PMF levels external to the development site (other than where frontage and roadworks are proposed on Warriewood Road) are not predicted to increase by greater than 0.05 metres.
Will result less than a 10% increase in PMF peak velocity	**Figure 43** demonstrates that peak PMF velocity along the Warriewood Road frontage, and within properties located to the east of the development site is predicted to increase by up to 0.8m/s. This occurs at locations predicted to experience a peak velocity (under existing conditions) of between 0.5 - 1m/s. Therefore, an increase in velocity of up to 100% is predicted, which exceeds the 10% threshold. However, the flood hazard in this area is not predicted to

	significantly increase and therefore does not pose an additional risk to life or property. It is also noted this occurs in an area impacted by overland flooding only, with areas subject to mainstream flooding not predicted to experience any significant increase in velocity.
Will have no loss in flood storage or flood way in the 1% AEP	Comparison of the existing hydraulic categories on **Figure 17** to those under proposed conditions of **Figure 33** indicates that the floodway areas within the site under proposed conditions is generally identical to that under existing conditions. However, a large portion of flood storage area within the existing site has been removed (by way of placement of fill for the proposed residential lots and Lorikeet Grove construction). In this regard, the area functioning as flood storage under existing conditions has been reclassified to floodway under proposed conditions. Notwithstanding, this has not resulted in any increase in flood level or velocity outside of the development site, indicating that the change in flood function has not adversely impacted overall flood behaviour.
B3.11 Flood Prone Land	
Flood Effects Caused by Development	
Control A1: Development shall not be approved unless it can be demonstrated in a Flood Management Report that it has been designed and can be constructed so that in all events up to the 1% AEP event:	
(a) There are no adverse impacts on flood levels or velocities caused by alterations to the flood conveyance; and	Although changes in flood level and velocity do result from the proposed works, they are contained to the development site (other than where frontage and roadworks are proposed on Warriewood Road and an isolated increase off the southern corner of the site) and do not impact the mainstream flood conveyance by way of no adverse impacts to peak flood level or velocity.
(b) There are no adverse impacts on surrounding properties; and	As shown on **Figures 34-38** and **Figures 39-42**, the only adverse impacts to peak flood level or velocity are predicted along the site frontage (Warriewood Road) in flood events up to and including the 100-year ARI (with climate change). These are a direct result of the frontage works and roadworks proposed in this location. An isolated increase of flood velocity off the

	southern corner of the site is also predicted but does not impact adjacent development. **Figure 43** show that increases in peak flood velocity are predicted within properties located to the east of the development site, but that this does not result in an increase in flood hazard and risk.
(c) It is sited to minimise exposure to flood hazard.	The lots proposed for development are all sited away from areas predicted to become significantly inundated and therefore exposure to flood hazard has been minimised.
Major developments and developments likely to have a significant impact on the PMF flood regime will need to demonstrate that there are no adverse impacts in the Probable Maximum Flood.	The subdivision proposed is considered to be a major development. Therefore, the PMF has been considered. As per discussion in **Section 3.3**, impacts to peak PMF flood levels and velocities are predicted along the property frontage, with increased velocity also predicted within properties located to the east of the development site. However, these changes are not predicted to increase the flood hazard or risk to people or property.
Control A2: Development shall not be approved unless it can be demonstrated in a Flood Management Report that in all events up to the 1% AEP event there is no net loss of flood storage. Consideration may be given for exempting the volume of standard piers from flood storage calculations. If Compensatory Works are proposed to balance the loss of flood storage from the development, the Flood Management Report shall include detailed calculations to demonstrate how this is achieved.	**Section 3.3.4** details the calculation that has been undertaken to quantify the flood storage comparison between existing and proposed conditions. It indicates that a deficit of 2517m^3 results (excluding on site storage tanks). However, as discussed in the preceding section, this loss of flood storage does not translate into any adverse impact on peak flood levels outside of the development site as the flood storage area provided on the site under proposed conditions allows a more efficient use of active storage volume compared to existing conditions (which has a 'dead' storage component produced by the elevated creek bank).
Floor Levels	
Control C1: New floor levels within the development shall be at or above the Flood Planning Level.	Although this is an application for subdivision, it is anticipated that any new development within the site can be constructed at or above the flood planning level by being located not more than 0.34 metres above the formed fill within the site (to locate finished floor levels no lower than the FPL), which is considered feasible.
Control C3: All new development must be designed and constructed so as not to impede the floodway or flood conveyance on the site, as well as ensuring no net loss of flood storage in all events up to the 1% AEP event.	No development is proposed within floodway or flood conveyance areas of the site. It is acknowledged that a loss of flood storage is predicted when compared to existing conditions, however, this does not translate into any adverse impact on peak flood levels outside of the development site as the flood storage area

	provided on the site under proposed conditions allows a more efficient use of active storage volume compared to existing conditions (which has a 'dead' storage component produced by the elevated creek bank).
Control C5: The applicant must demonstrate that future development following a subdivision proposal can be undertaken in accordance with this Development Control Plan.	All responses have been prepared with the intent to demonstrate that future development can be undertaken in accordance with the Development Control Plan.
Car Parking	
Control D1: Open carpark areas and carports shall not be located within a floodway.	The developable portion of the site is located outside of any floodway, and therefore no carparking areas or carports would be located in a floodway.
Emergency Response	
Control E1: If the property is affected by a Flood Life Hazard Category of H3 or higher, then Control E1 applies and a Flood Emergency Assessment must be included in the Flood Management Report.	The developable portion of the site is subject to a maximum hazard of H3 in the PMF and therefore a Flood Emergency Assessment has been completed and is discussed in **Section 3.5**.
If the property is affected by a Flood Life Hazard Category of H6, then development is not permitted unless it can be demonstrated to the satisfaction of the consent authority that the risk level on the property is or can be reduced to a level below H6 or its equivalent.	The developable portion of the site is not subject to a hazard of H6 and this control is not applicable.
If the property is flood affected but the Flood Life Hazard Category has not been mapped by Council, then calculations for its determination must be shown in the Flood Management Report, in accordance with the "Technical Flood Risk Management Guideline: Flood Hazard", Australian Institute for Disaster Resilience (2012).	Not applicable
Where flood-free evacuation above the Probable Maximum Flood level is not possible, new development must provide a shelter-in-place refuge where: a) The floor level is at or above the Probable Maximum Flood level; and b) The floor space provides at least 2m2 per person where the flood duration is long (6 or more hours) in the Probable Maximum Flood event, or 1m2 per person for less than 6 hours; c) It is intrinsically accessible to all people on the site, plainly evident, and self-	All development lots may have difficulty evacuating in the PMF (due to inundation of Lorikeet Grove). However, adequate space is available on all lots for the construction of dwellings to be located outside of the PMF extent and therefore provide a safe refuge above the PMF level, with adequate space per person, and accessible to all occupants. Occupants will have access to clean water, a portable radio and batteries and a first aid kit.

directing, with sufficient capacity of access routes for all occupants without reliance on an elevator; and d) It must contain as a minimum: sufficient clean water for all occupants; portable radio with spare batteries; torch with spare batteries; and a first aid kit	
Control E2: If a shelter-in-place refuge is required, it must contain as a minimum: sufficient clean water for all occupants; portable radio with spare batteries; torch with spare batteries; a first aid kit; emergency power; and a practical means of medical evacuation.	
Control E3: It must be demonstrated that evacuation or a shelter-in-place refuge in accordance with the requirements of this DCP will be available for any potential development arising from a Torrens title subdivision.	
Fencing	
Control F1: Fencing, (including pool fencing, boundary fencing, balcony balustrades and accessway balustrades) shall be designed so as not to impede the flow of flood waters and not to increase flood affectation on surrounding land. At least 50% of the fence must be of an open design from the natural ground level up to the 1% AEP flood level. Less than 50% of the perimeter fence would be permitted to be solid. Openings should be a minimum of 75 mm x 75mm.	No inundation across the developable portion of the site is predicted, and therefore no special fencing type is considered necessary.
Pools	
Control H1: Pools located within the 1% AEP flood extent are to be in-ground, with coping flush with natural ground level. Where it is not possible to have pool coping flush with natural ground level, it must be demonstrated that the development will result in no net loss of flood storage and no impact on flood conveyance on or from the site. All electrical equipment associated with the pool (including pool pumps) is to be waterproofed and/or located at or above the Flood Planning Level.	Not applicable as this is an application for subdivision and no pools are proposed.

All chemicals associated with the pool are to be stored at or above the Flood Planning Level.	
B3.12 Climate Change (Sea Level Rise and Increased Rainfall Volume)	
3) Climate Change Assessment for Land Identified within the Warriewood Valley Land Release Area	Applies as the site is located within the Warriewood Valley Land release Area.
The climate change assessment shall include the impacts of climate change on the property over the life of the development and the adaptive measures to be incorporated in the design of the project. The following climate change scenarios shall be considered: • **Scenario 1:** Impacts of sea level rise only • **Scenario 2:** Impacts of sea level rise combined with increased rainfall volume	A climate change factor of 30% (increase in rainfall intensity) has been applied to all simulations as part of the current assessment. The site is located in a position that is not subject to impacts from an increase in sea level, and Scenario 1 has therefore not been assessed, and all results reflect Scenario 2.
C6.1 Integrated Water Cycle Management	
Flooding: The flood levels are to be determined as part of the Water Management Report. The information to be obtained includes:	
the 50% Annual Exceedance Probability (AEP) flood levels with climate change impacts including sea level rise combined with increase rainfall volume;	A climate change factor of 30% (increase in rainfall intensity) has been applied to all simulations (and mapping) as part of the current assessment. The site is located in a position that is not subject to impacts from an increase in sea level.
the 20% AEP flood levels with climate change impacts including sea level rise combined with increase rainfall volume;	
the 1% AEP flood levels with climate change impacts including sea level rise combined with increase rainfall volume;	
the Flood Planning Level (FPL) - equal to the 1% AEP flood level plus freeboard (as defined within clause A1.9 of this DCP) with climate change impacts including sea level rise combined with increase rainfall volume;	
the Probable Maximum Flood (PMF) level with climate change impacts including sea level rise combined with increase rainfall volume;	
the flow velocities for the 1% AEP flood and Probable Maximum Flood with climate change impacts including sea level rise combined with increase rainfall volume; and	
the Flood Category and Flood Hazard Classification as defined in clause A1.9 of this	

DCP with climate change impacts including sea level rise combined with increase rainfall volume.	
Likely flood impacts from the development must also be assessed and where required, mitigated.	As shown on **Figures 34-38** and **Figures 39-42**, the only adverse impacts to peak flood level or velocity are predicted along the site frontage (Warriewood Road) in flood events up to and including the 100-year ARI (with climate change). These are a direct result of the frontage works and roadworks proposed in this location. An isolated increase of flood velocity off the southern corner of the site is also predicted but does not impact adjacent development. **Figure 43** show that increases in peak flood velocity are predicted within properties located to the east of the development site, but that this does not result in a significant increase in flood hazard and risk.
The filling of land will only be permitted where it can be demonstrated within the Water Management Report that:	
there is no net decrease in the floodplain volume of the floodway or flood storage area within the property, for any flood event up to the 1% AEP flood event and the PMF event including climate change considerations for both design events; and/or	As shown on **Figures 34-38** and **Figures 39-42**, the only adverse impacts to peak flood level or velocity are predicted along the site frontage (Warriewood Road) in flood events up to and including the 100-year ARI (with climate change). These are a direct result of the frontage works and roadworks proposed in this location. An isolated increase of flood velocity off the southern corner of the site is also predicted but does not impact adjacent development. **Figure 43** show that increases in peak flood velocity are predicted within properties located to the east of the development site, but that this does not result in an increase in flood hazard and risk. It is acknowledged that a loss of flood storage is predicted when compared to existing conditions, however, this does not translate into any adverse impact on peak flood levels outside of the development site as the flood storage area provided on the site under proposed conditions allows a more efficient use of active storage volume compared to existing conditions (which has a 'dead' storage component produced by the elevated creek bank).
there is no additional adverse flood impact on the subject and surrounding properties and flooding processes for any flood event up to the PMF event including climate change impacts.	
The Water Management Report must identify the minimum floor level requirements for development in accordance with the Flood Hazard and Flood Category applicable to the	As per **Section 3.4**, the Flood Planning Level applicable to the site varies between 5.16 and 5.20m AHD. To achieve this, all future development will need to be located not more

proposed land use specified in Flood Risk Management Policy.	than 0.34 metres above the formed fill within the site, which is considered feasible.
The subdivision of land requires the building platforms for each additional allotment to be created at or above the Flood Planning Level (plus climate change). The Plan of Subdivision is to include the Flood Planning Level (plus climate change) for each new allotment created.	Any future development will be constructed on a fill pad located no lower than the Flood Planning Level of 5.16 and 5.20m AHD (depending on where in the site the lot is located. It is not feasible to locate the entirety of all lots above this level due to the need to tie into the levels on Lorikeet Grove.

4.4 Considering Flooding in Land Use Planning Guideline (2021)

The '*Considering flooding in land use planning guideline'* (DPE, 2021) provides advice to Councils on flood-related land use planning and areas where flood-related development controls should apply. This guideline applies to the current assessment as it is an application for subdivision. As such, it is important to ensure that any future development of the land is consistent with this guideline. The key objectives of the guideline and commentary on how the application intends to comply with these requirements are outlined in **Table 6**.

Table 6 Summary of the guidance provided in the '*Considering flooding in land use planning guideline'* (DPE, 2021).

Requirement	Comment
Considering the full range of flood events up to and including the PMF	The current assessment has examined flood behaviour for the 2 year, 5 year, 20 year, 100 year ARI events, as well as the PMF.
Considering the key constraints that result from flooding on land, namely: flood function, flood hazard, extent and flood behaviour and risk to life	The current assessment has defined the flood function (hydraulic categories), flood hazard, flood extent and behaviour for the full range of events up to the PMF. Dedicated flood storage areas are proposed adjacent to Narrabeen Creek, and all future development lots will be situated such that a dwelling can be erected above the Flood Planning Level. All development lots are located clear of floodways and flood storage areas, ensuring the flood risk is suitably mitigated and the existing flood function through and downstream of the site will be retained.
Definition of the Flood Planning Area (FPA) based on a Defined Flood Event (DFE)	As discussed in Section 3.4, the FPA has been calculated based on the 100-year ARI flood level under climate change conditions.
Adherence to the flood planning clause in the standard instrument (LEP2014)	As per **Section 4.1**, the application adheres to the requirement of Clause 5.21 and 5.22 of LEP2014.

5 SUMMARY

This report has summarised the outcomes of a flood assessment that was completed to quantify the potential impacts that a proposed subdivision at 53A and 53B Warriewood Road, Warriewood may have on existing flood behaviour.

The flood impact assessment was completed using a DRAINS hydrologic and TUFLOW hydraulic computer flood models that was originally developed as part of the '*Ingleside, Elanora and Warriewood Overland Flow Flood Study* (WMAwater, 2019). The DRAINS and TUFLOW models were refined as part of the current study and used to simulate the 2-year, 5-year, 20-year and 100-year ARI events, as well as the PMF design floods for both 'existing' as well as 'post-development' conditions. Climate change has been considered in all flood events by applying a 30% increase in rainfall intensity.

The results of the flood simulations indicate that the proposed development will decrease the flood extent within the development site and provide a suitable subdivision footprint for the future use of residential development. Flood level and velocity increases are predicted along the Warriewood Road frontage of the site as a result of frontage works and roadworks in this area.

The flood planning area has been mapped based on the definition within the '*Ingleside, Elanora and Warriewood Overland Flow Flood Study* (WMAwater, 2019) and confirms that the current design of the proposed subdivision will help to ensure that space on every proposed lot is available for the construction of a dwelling that can be located above the Flood Planning Level, as well as the PMF extent.

A preliminary flood management plan has also been prepared to document the preferred emergency response process to employ during floods larger than the 1% AEP event.

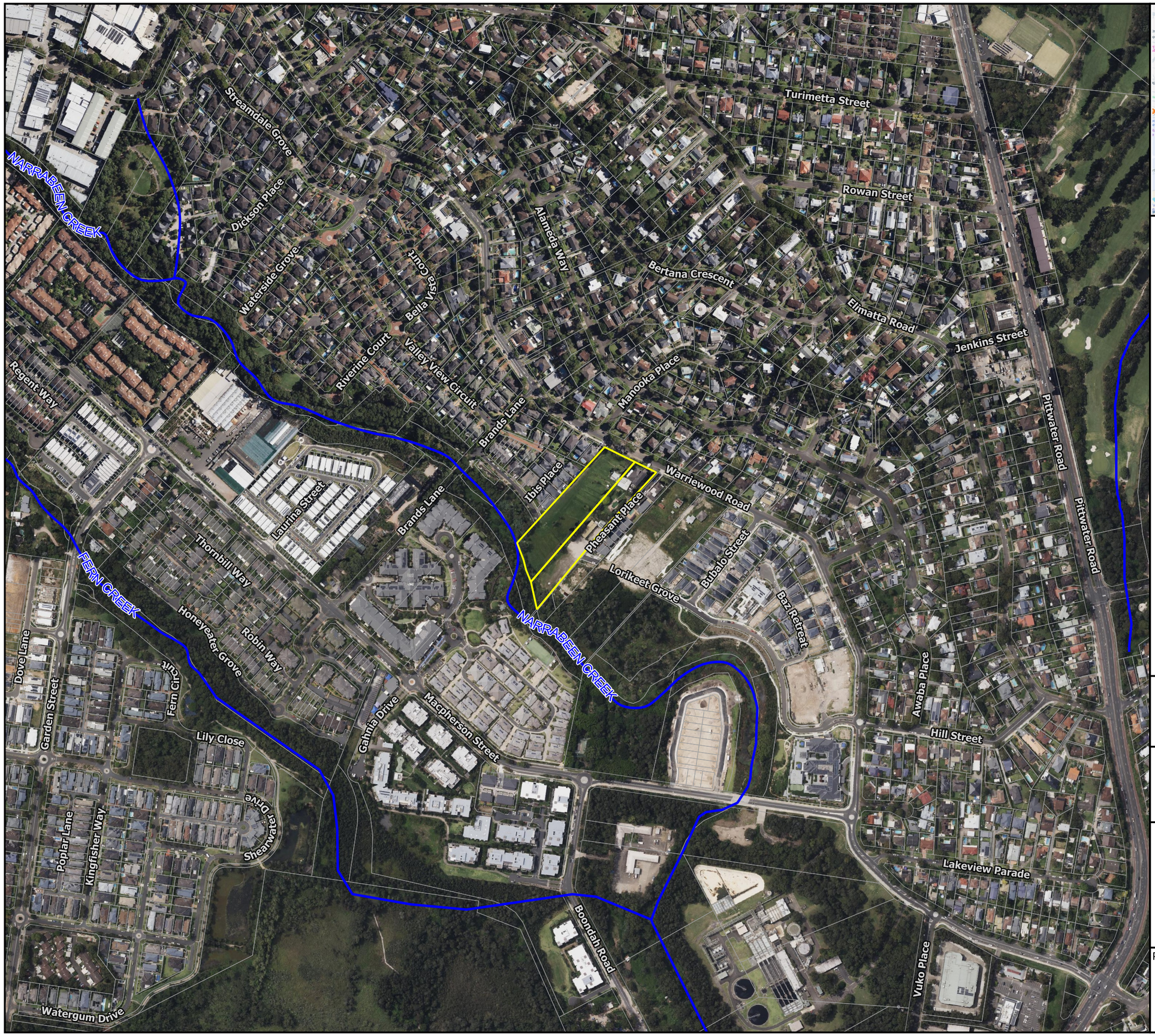
Emergency response has been considered and although evacuation from the site is not considered necessary (i.e., all proposed dwellings can be located above the peak level of the PMF), safe access (no greater than H1 hazard) is available from all lots in all events up to and including the 100-year ARI. In the PMF, the duration of isolation of 15 minutes is considered tolerable given the extreme rarity of such an event and extremely short duration of isolation.

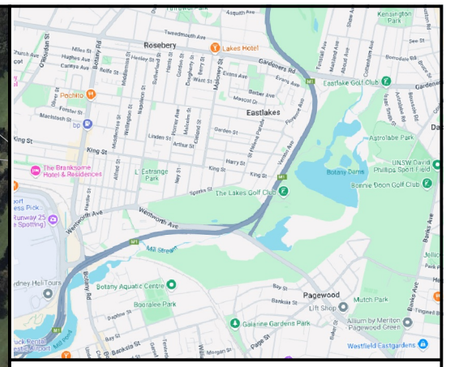
Overall, the proposed subdivision is considered to adhere to the Pittwater Local Environment Plan 2014, Warriewood Valley Urban Land Release Water Management Specification 2001, Pittwater 21 Development Control Plan 2003 and Considering Flooding in Land Use Planning Guideline (2021), with detailed explanation and justification provided for any deviation from these planning instruments.

6 REFERENCES

- Department of Planning and Environment (2021) *Considering flooding in land use planning guideline*
- NSW Government. (2023). *Flood Risk Management Guideline FB03 – Flood Hazard*
- Northern beaches Council (2001) *Warriewood Valley Urban Land Release Water Management Specification*
- Northern beaches Council (2003) *Pittwater 21 Development Control Plan*
- Northern beaches Council (2014) *Pittwater Local Environment Plan*
- WMA Water (2019). *Ingleside, Elanora and Warriewood Overland Flow Flood Study*. Prepared for Northern beaches Council

APPENDIX A
FIGURES





LEGEND

Site Boundary

Notes:
Aerial photograph: NSW SixMap

N

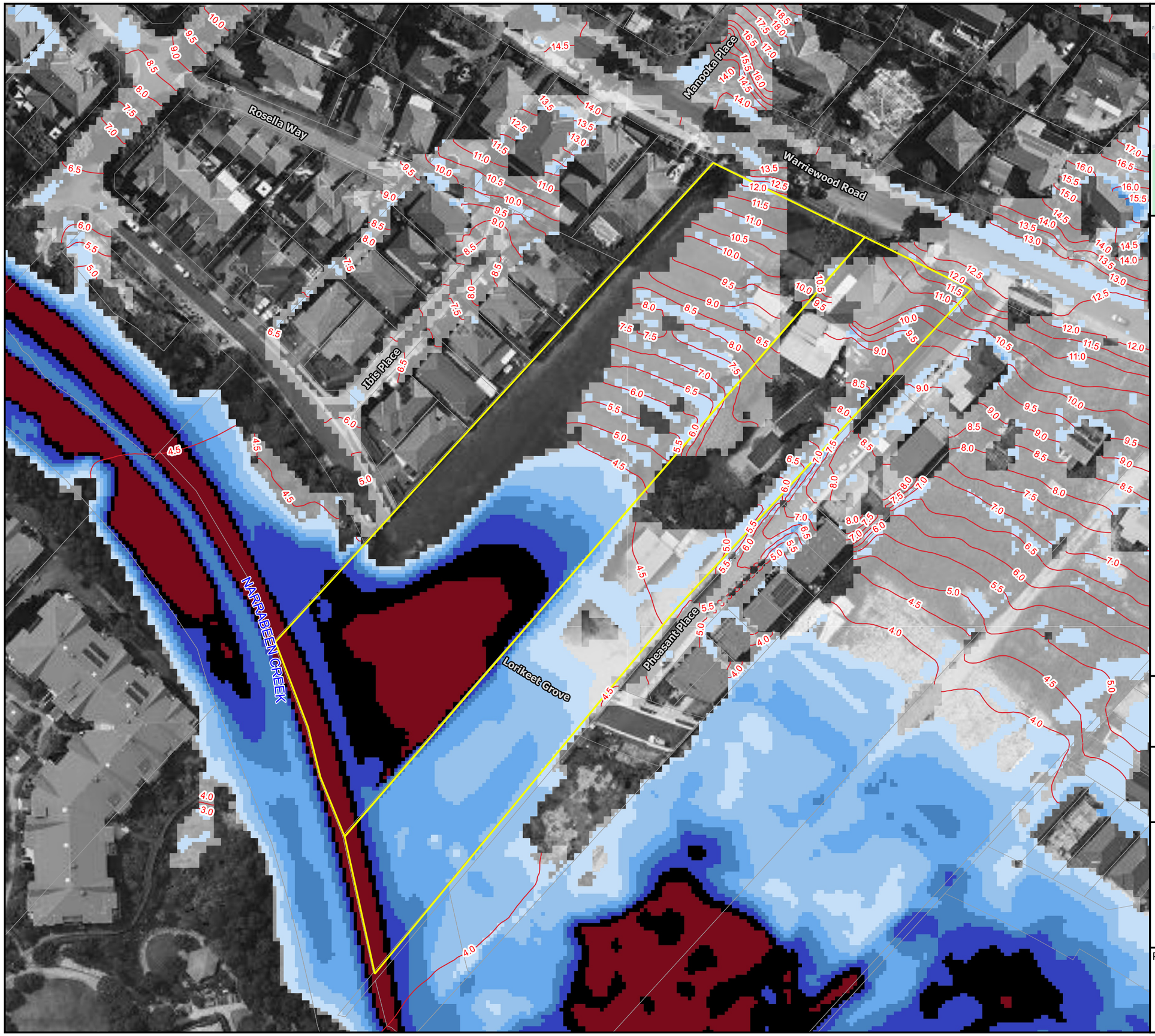
Scale: 1:5000 (at A3)

0 100 200 m

Figure 1 :
Location of Development Sites

Prepared by:
Catchment Simulation Solutions
Suite 1, Level 10, 70 Phillip St
Sydney, NSW, 2000

File Name: J913_Warriewood_Figure.qgz



LEGEND

- Site Boundary
- Flood Level Contours (mAHD) (0.5m intervals)

Depth (m)

- <= 0.05
- 0.05 - 0.20
- 0.20 - 0.40
- 0.40 - 0.60
- 0.60 - 0.80
- 0.80 - 1.00
- 1.00 - 1.20

Notes:
Aerial photograph: NSW SixMap

N

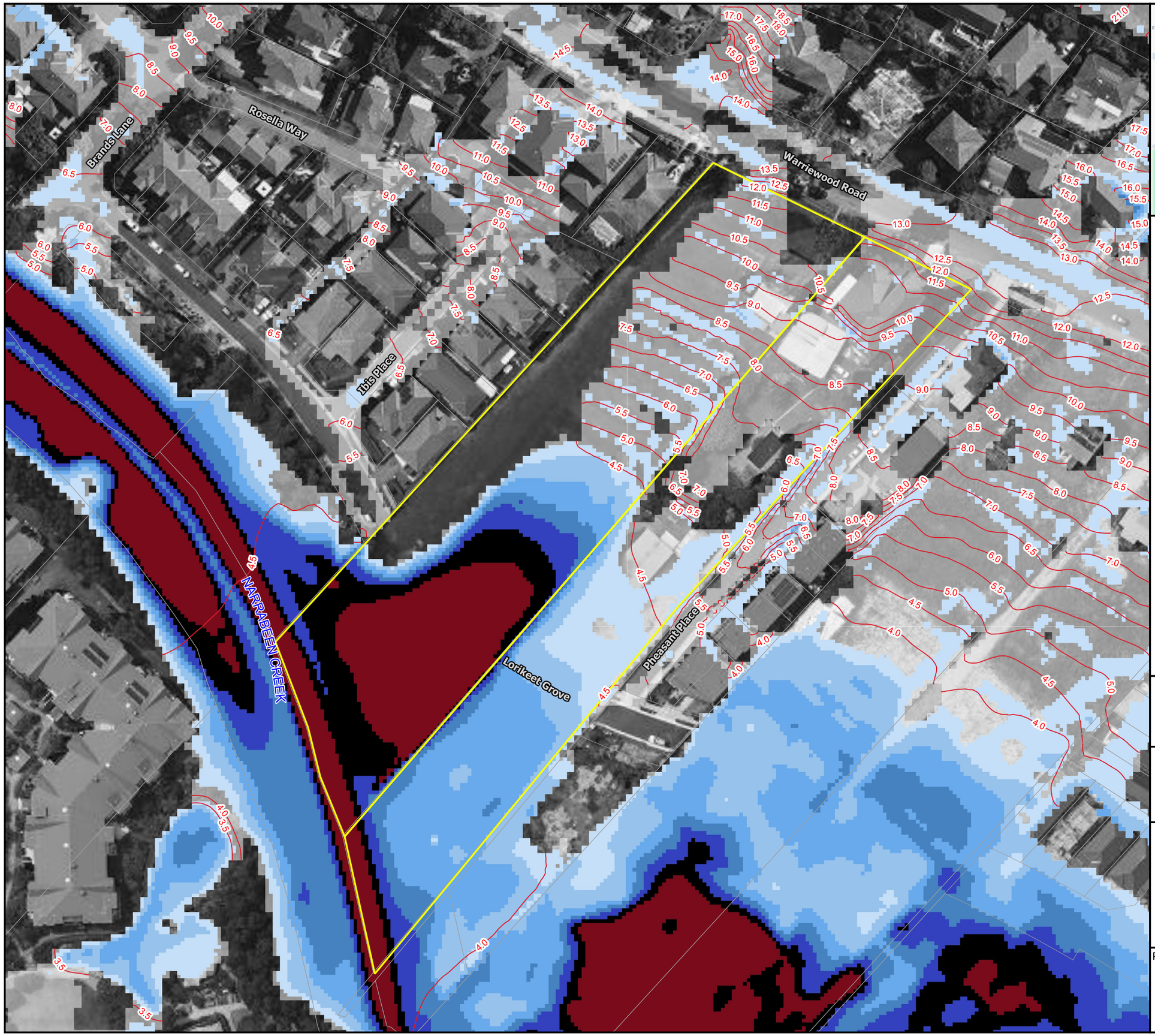
Scale: 1:1000 (at A3)

0 20 40 m

Figure 2 :
Existing Floodwater Depths and Levels for the 2 Year ARI Flood (30% Climate Change Conditions)

Prepared by:
Catchment Simulation Solutions
Suite 1, Level 10, 70 Phillip St
Sydney, NSW, 2000

File Name: J913_Warriewood_Figure.qgz



LEGEND

- Site Boundary
- Flood Level Contours (mAHD) (0.5m intervals)

Depth (m)

- <= 0.05
- 0.05 - 0.20
- 0.20 - 0.40
- 0.40 - 0.60
- 0.60 - 0.80
- 0.80 - 1.00
- 1.00 - 1.20

Notes:
Aerial photograph: NSW SixMap

N

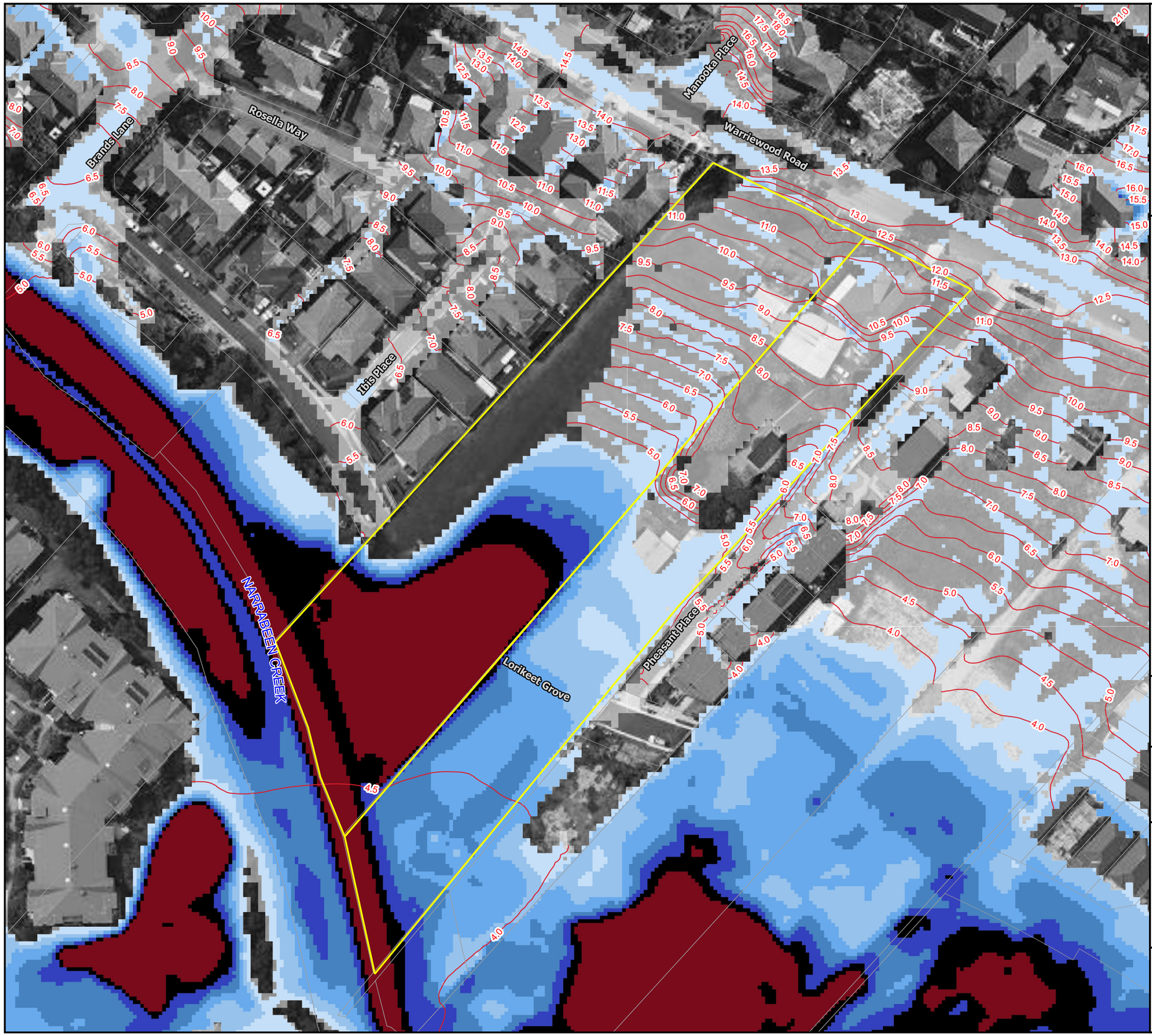
Scale: 1:1000 (at A3)

0 20 40 m

Figure 3 :
Existing Floodwater Depths and Levels for the 5 Year ARI Flood (30% Climate Change Conditions)

Prepared by:
Catchment Simulation Solutions
Suite 1, Level 10, 70 Phillip St
Sydney, NSW, 2000

File Name: J913_Warriewood_Figure.qgz



LEGEND

- Site Boundary
- Flood Level Contours (mAHD) (0.5m intervals)

Depth (m)

- <= 0.05
- 0.05 - 0.20
- 0.20 - 0.40
- 0.40 - 0.60
- 0.60 - 0.80
- 0.80 - 1.00
- 1.00 - 1.20

Notes:
Aerial photograph: NSW SixMap

N

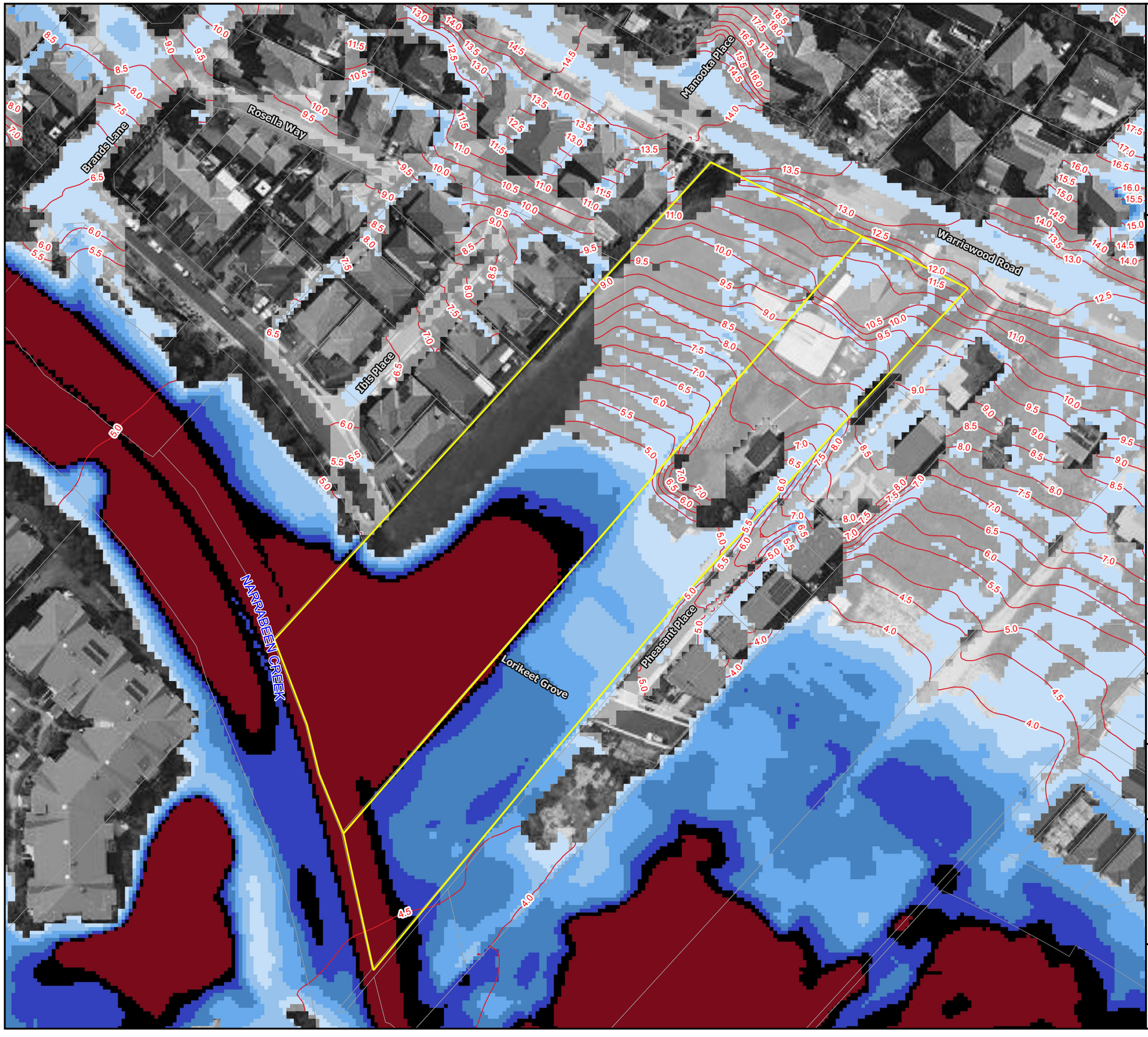
Scale: 1:1000 (at A3)

0 20 40 m

Figure 4 :
Existing Floodwater Depths and Levels for the 20 Year ARI Flood (30% Climate Change Conditions)

Prepared by:
Catchment Simulation Solutions
Suite 1, Level 10, 70 Phillip St
Sydney, NSW, 2000

File Name: J913_Warriewood_Figure.qgz



LEGEND

- Site Boundary
- Flood Level Contours (mAHD) (0.5m intervals)

Depth (m)

- <= 0.05
- 0.05 - 0.20
- 0.20 - 0.40
- 0.40 - 0.60
- 0.60 - 0.80
- 0.80 - 1.00
- 1.00 - 1.20

Notes:
Aerial photograph: NSW SixMap

N

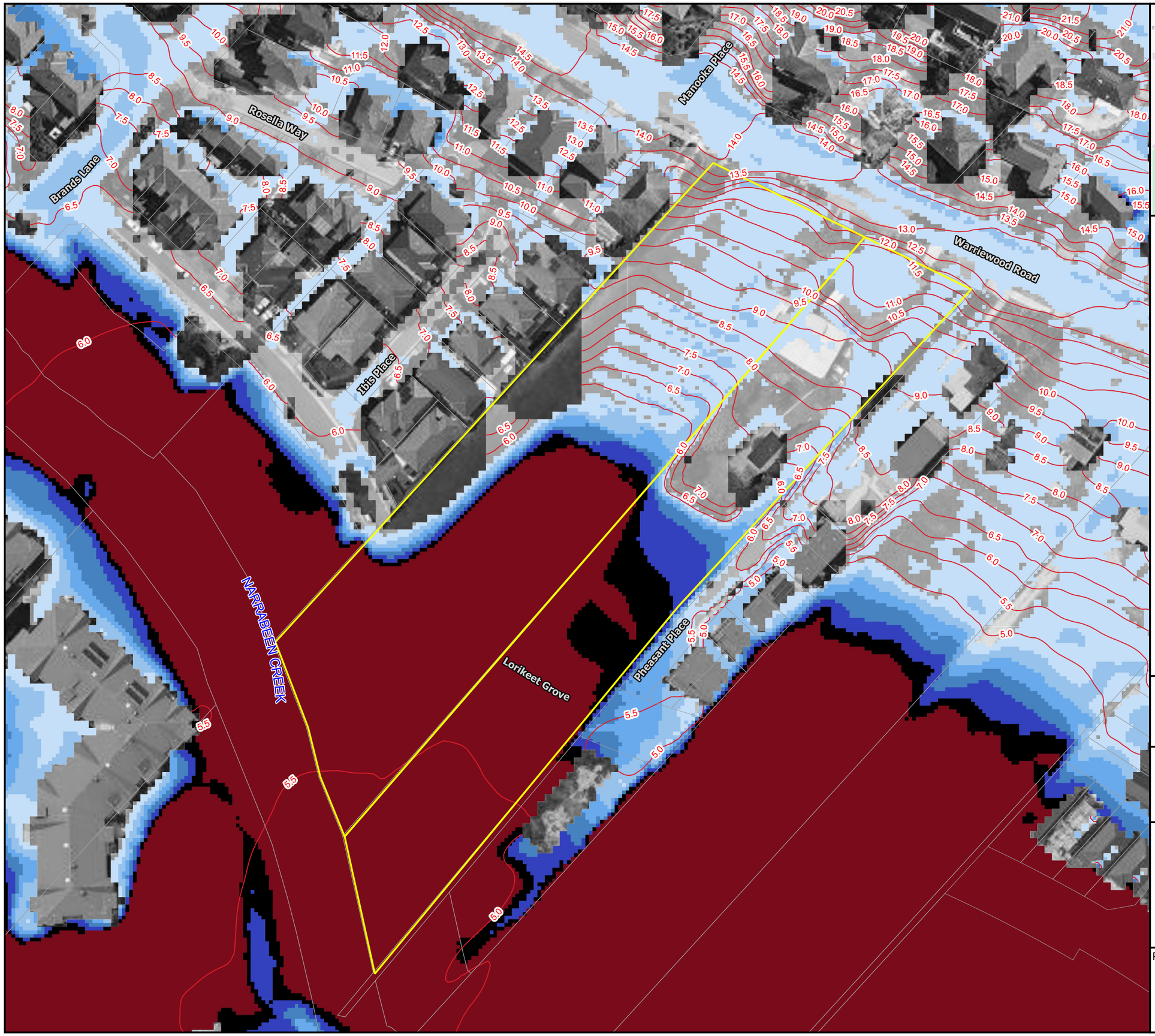
Scale: 1:1000 (at A3)

0 20 40 m

Figure 5 :
Existing Floodwater Depths and Levels for the 100 Year ARI Flood (30% Climate Change Conditions)

Prepared by:
Catchment Simulation Solutions
Suite 1, Level 10, 70 Phillip St
Sydney, NSW, 2000

File Name: J913_Warriewood_Figure.qgz



LEGEND

- Site Boundary
- Flood Level Contours (mAHD) (0.5m intervals)

Depth (m)

- <= 0.05
- 0.05 - 0.20
- 0.20 - 0.40
- 0.40 - 0.60
- 0.60 - 0.80
- 0.80 - 1.00
- 1.00 - 1.20

Notes:
Aerial photograph: NSW SixMap

N

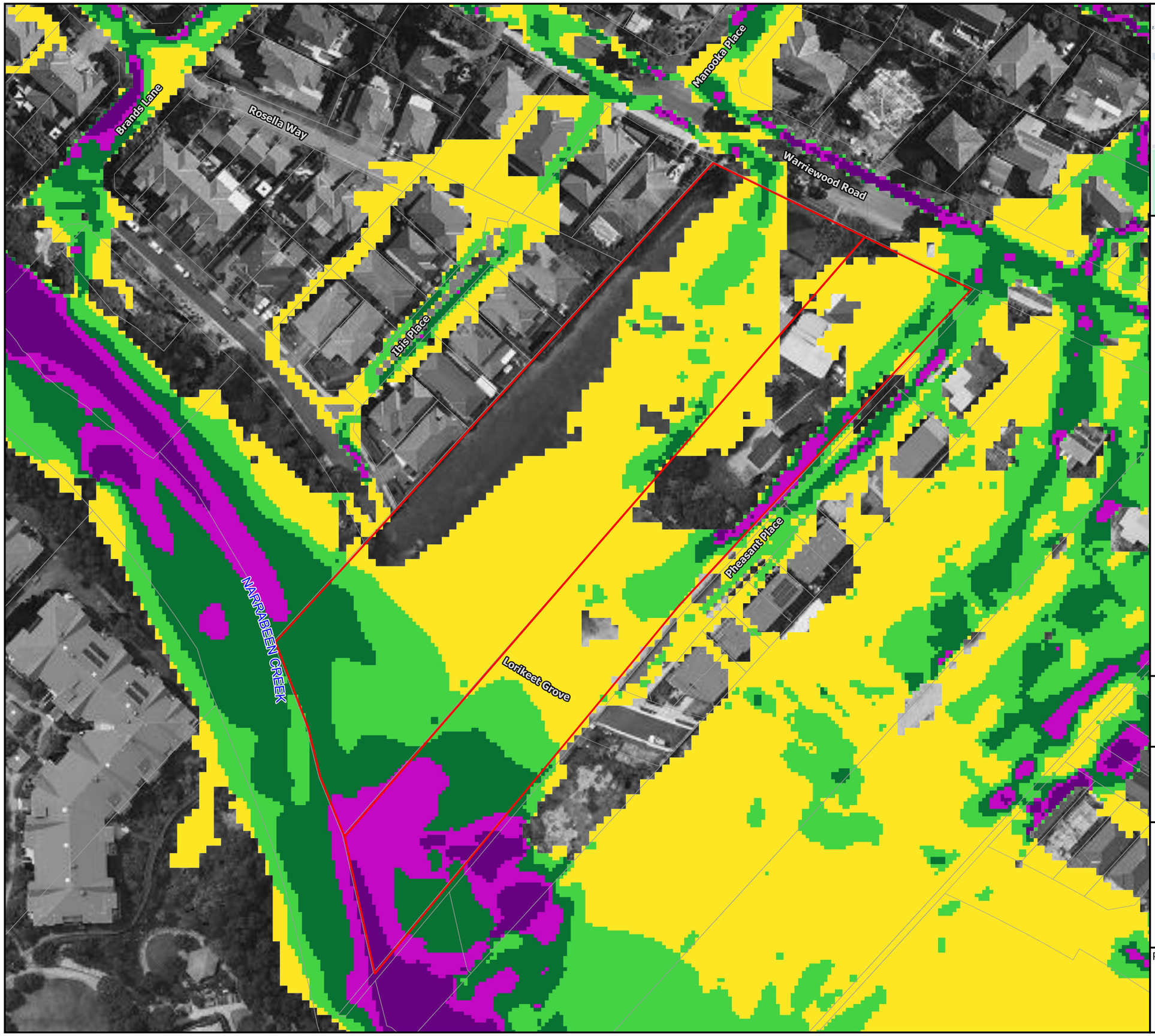
Scale: 1:1000 (at A3)

0 20 40 m

Figure 6 :
Existing Floodwater Depths and Levels for the PMF (30% Climate Change Conditions)

Prepared by:
Catchment Simulation Solutions
Suite 1, Level 10, 70 Phillip St
Sydney, NSW, 2000

File Name: J913_Warriewood_Figure.qgz



LEGEND

- Site Boundary

Velocity (m/s)

- < 0.25
- 0.25 to 0.5
- 0.5 to 0.75
- 0.75 to 1
- > 1

Notes:
Aerial photograph: NSW SixMap

N

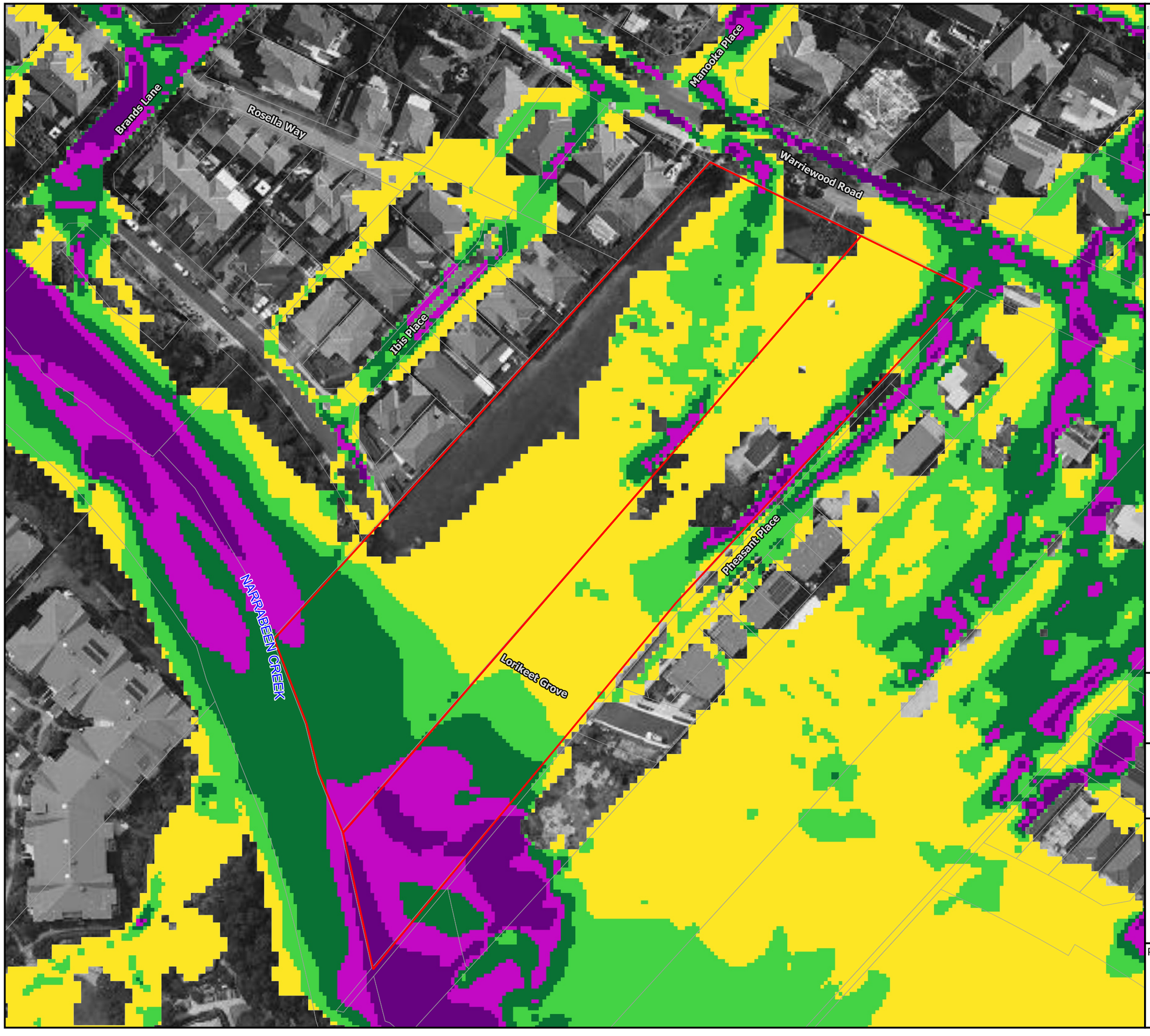
Scale: 1:1000 (at A3)

0 20 40 m

Figure 7 :
Existing Floodwater Velocity for the 2 Year ARI Flood (30% Climate Change Conditions)

Prepared by:
Catchment Simulation Solutions
Suite 1, Level 10, 70 Phillip St
Sydney, NSW, 2000

File Name: J913_Warriewood_Figure.qgz



LEGEND

- Site Boundary

Velocity (m/s)

- < 0.25
- 0.25 to 0.5
- 0.5 to 0.75
- 0.75 to 1
- > 1

Notes:
Aerial photograph: NSW SixMap

N

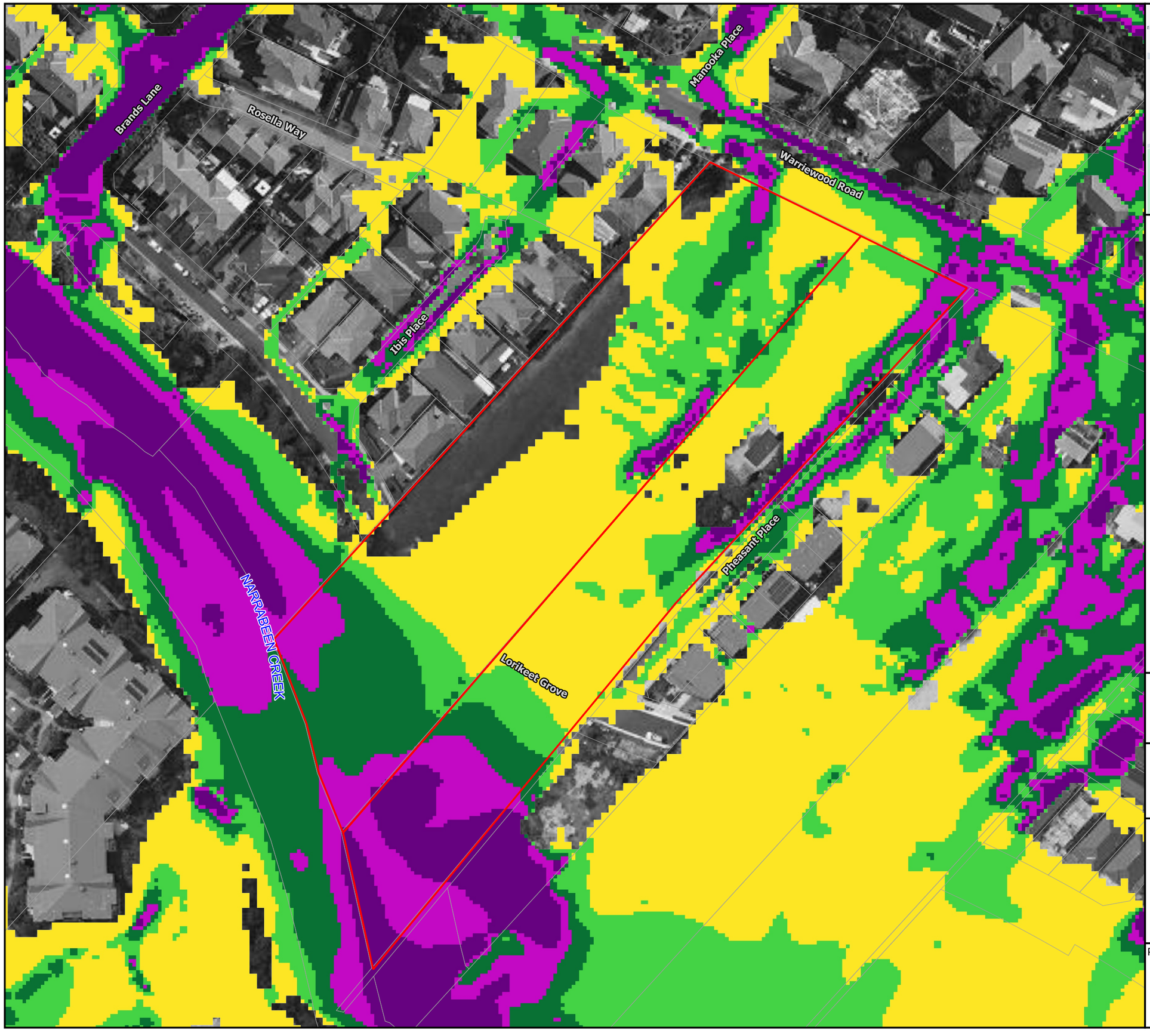
Scale: 1:1000 (at A3)

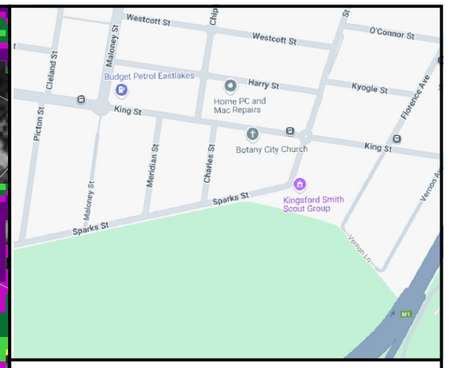
0 20 40 m

Figure 8 :
Existing Floodwater Velocity for the 5 Year ARI Flood (30% Climate Change Conditions)

Prepared by:
Catchment Simulation Solutions
Suite 1, Level 10, 70 Phillip St
Sydney, NSW, 2000

File Name: J913_Warriewood_Figure.ggz





LEGEND

- Site Boundary

Velocity (m/s)

- < 0.25
- 0.25 to 0.5
- 0.5 to 0.75
- 0.75 to 1
- > 1

Notes:
Aerial photograph: NSW SixMap

N

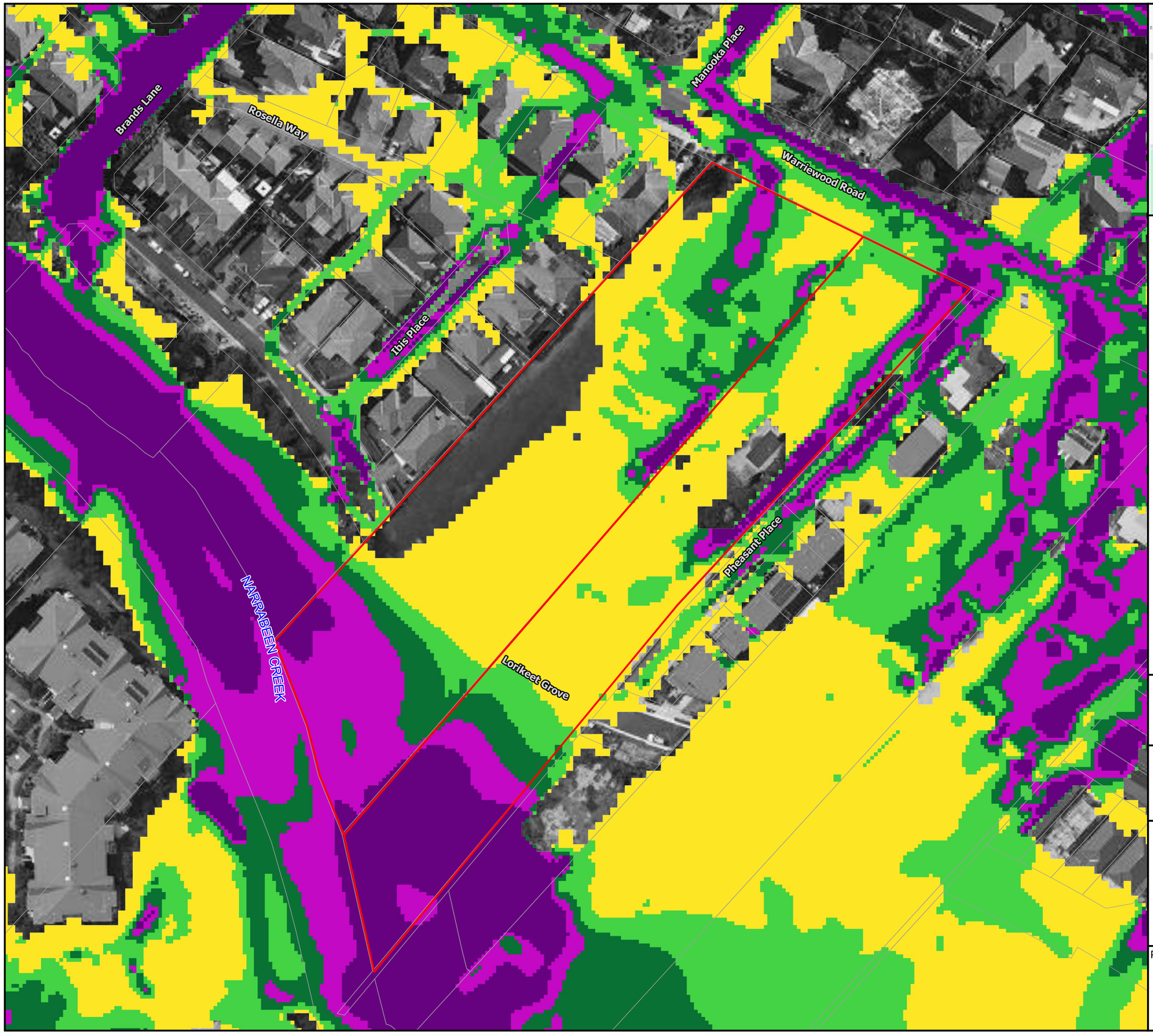
Scale: 1:1000 (at A3)

0 20 40 m

Figure 9 :
Existing Floodwater Velocity for the 20 Year ARI Flood (30% Climate Change Conditions)

Prepared by:
Catchment Simulation Solutions
Suite 1, Level 10, 70 Phillip St
Sydney, NSW, 2000

File Name: J913_Warriewood_Figure.qgz



LEGEND

- Site Boundary

Velocity (m/s)

- < 0.25
- 0.25 to 0.5
- 0.5 to 0.75
- 0.75 to 1
- > 1

Notes:
Aerial photograph: NSW SixMap

N

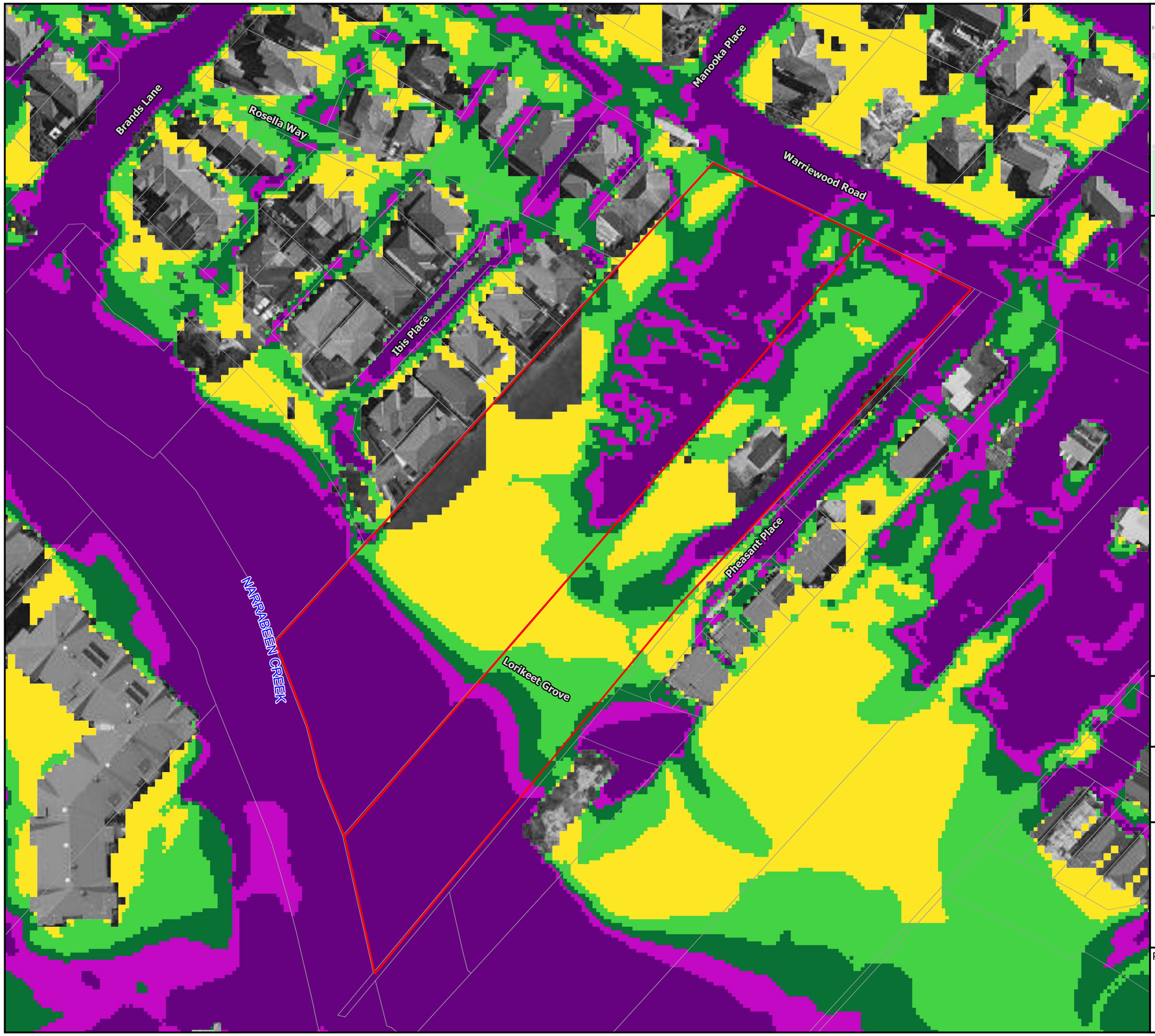
Scale: 1:1000 (at A3)

0 20 40 m

Figure 10 :
Existing Floodwater Velocity for the 100 Year ARI Flood (30% Climate Change Conditions)

Prepared by:
Catchment Simulation Solutions
Suite 1, Level 10, 70 Phillip St
Sydney, NSW, 2000

File Name: J913_Warriewood_Figure.qgz



LEGEND

- Site Boundary

Velocity (m/s)

- < 0.25
- 0.25 to 0.5
- 0.5 to 0.75
- 0.75 to 1
- > 1

Notes:
Aerial photograph: NSW SixMap

N

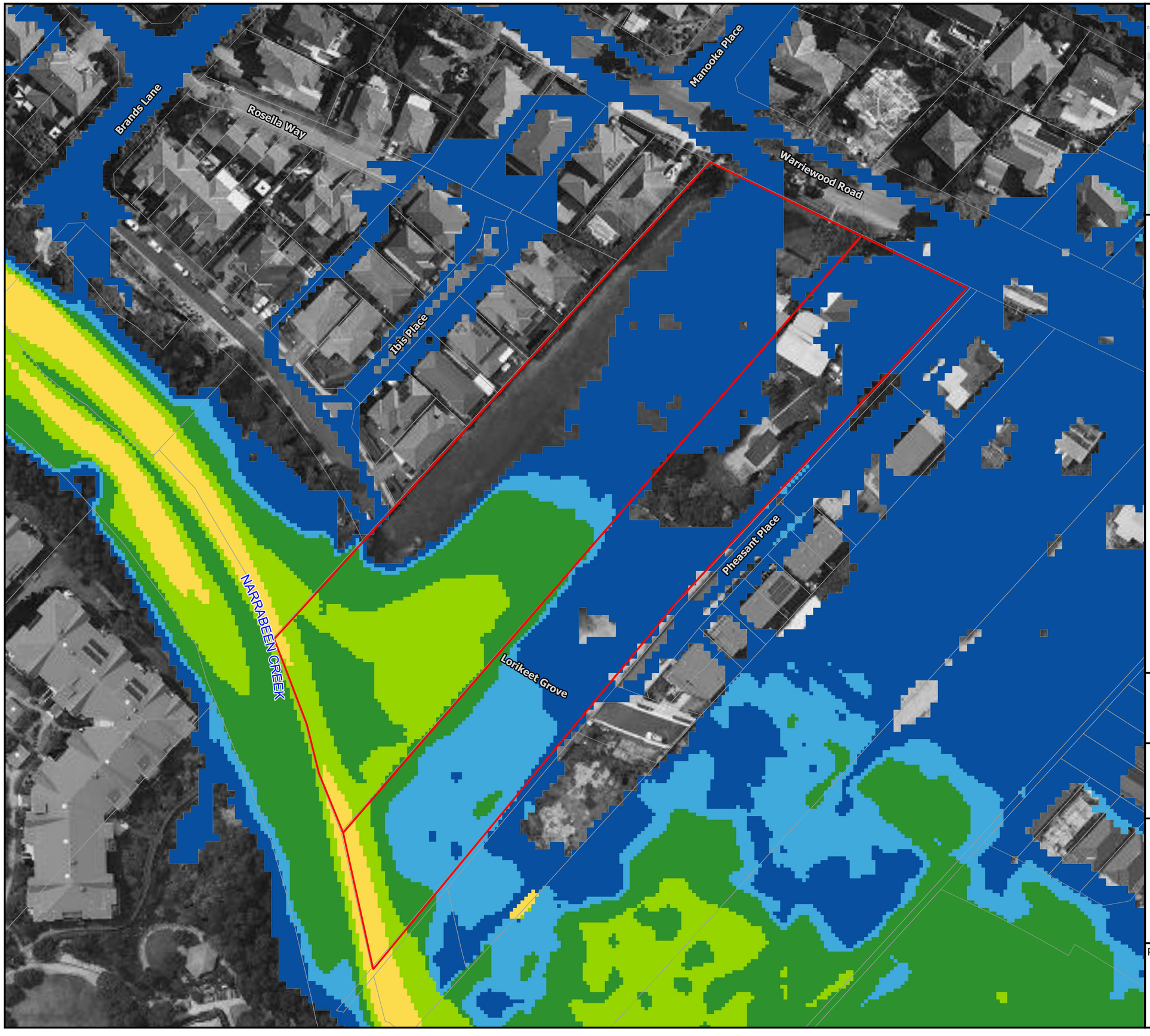
Scale: 1:1000 (at A3)

0 20 40 m

Figure 11 :
Existing Floodwater Velocity for the PMF (30% Climate Change Conditions)

Prepared by:
Catchment Simulation Solutions
Suite 1, Level 10, 70 Phillip St
Sydney, NSW, 2000

File Name: J913_Warriewood_Figure.qgz



LEGEND

- Site Boundary

Hazard Categories

- H1 - Generally safe
- H2 - Unsafe for small vehicles
- H3 - Unsafe for vehicles, children and elderly
- H4 - Unsafe for people and vehicles
- H5 - Unsafe for people and vehicles Buildings require special design
- H6 - Unsafe for people and vehicles All buildings vulnerable to failure

Notes:
Aerial photograph: NSW SixMap

N

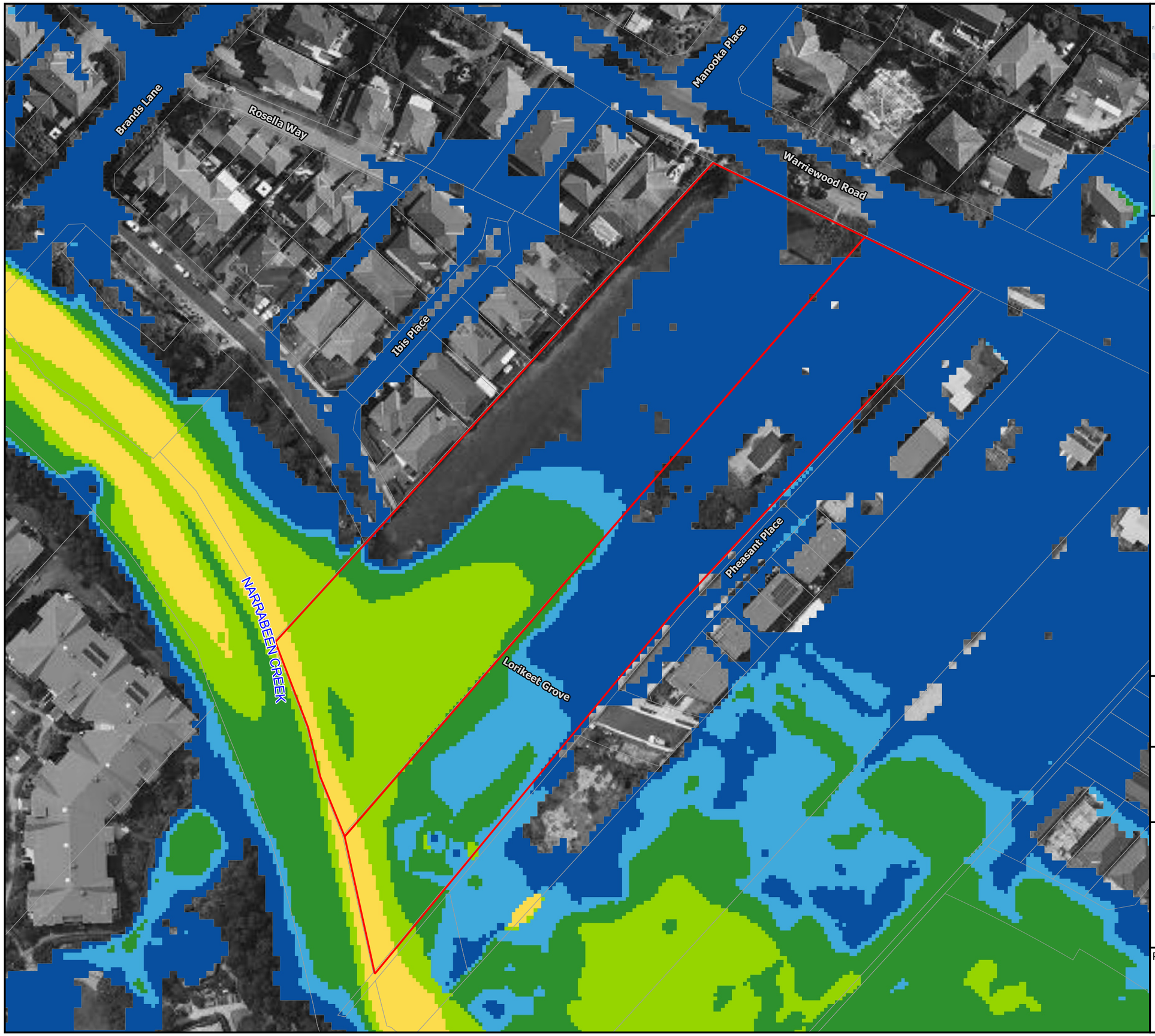
Scale: 1:1000 (at A3)

0 20 40 m

Figure 12 :
Existing Flood Hazard for the 2 Year ARI Flood (30% Climate Change Conditions)

Prepared by:
Catchment Simulation Solutions
Suite 1, Level 10, 70 Phillip St
Sydney, NSW, 2000

File Name: J913_Warriewood_Figure.qgz



LEGEND

- Site Boundary

Hazard Categories

- H1 - Generally safe
- H2 - Unsafe for small vehicles
- H3 - Unsafe for vehicles, children and elderly
- H4 - Unsafe for people and vehicles
- H5 - Unsafe for people and vehicles Buildings require special design
- H6 - Unsafe for people and vehicles All buildings vulnerable to failure

Notes:
Aerial photograph: NSW SixMap

N

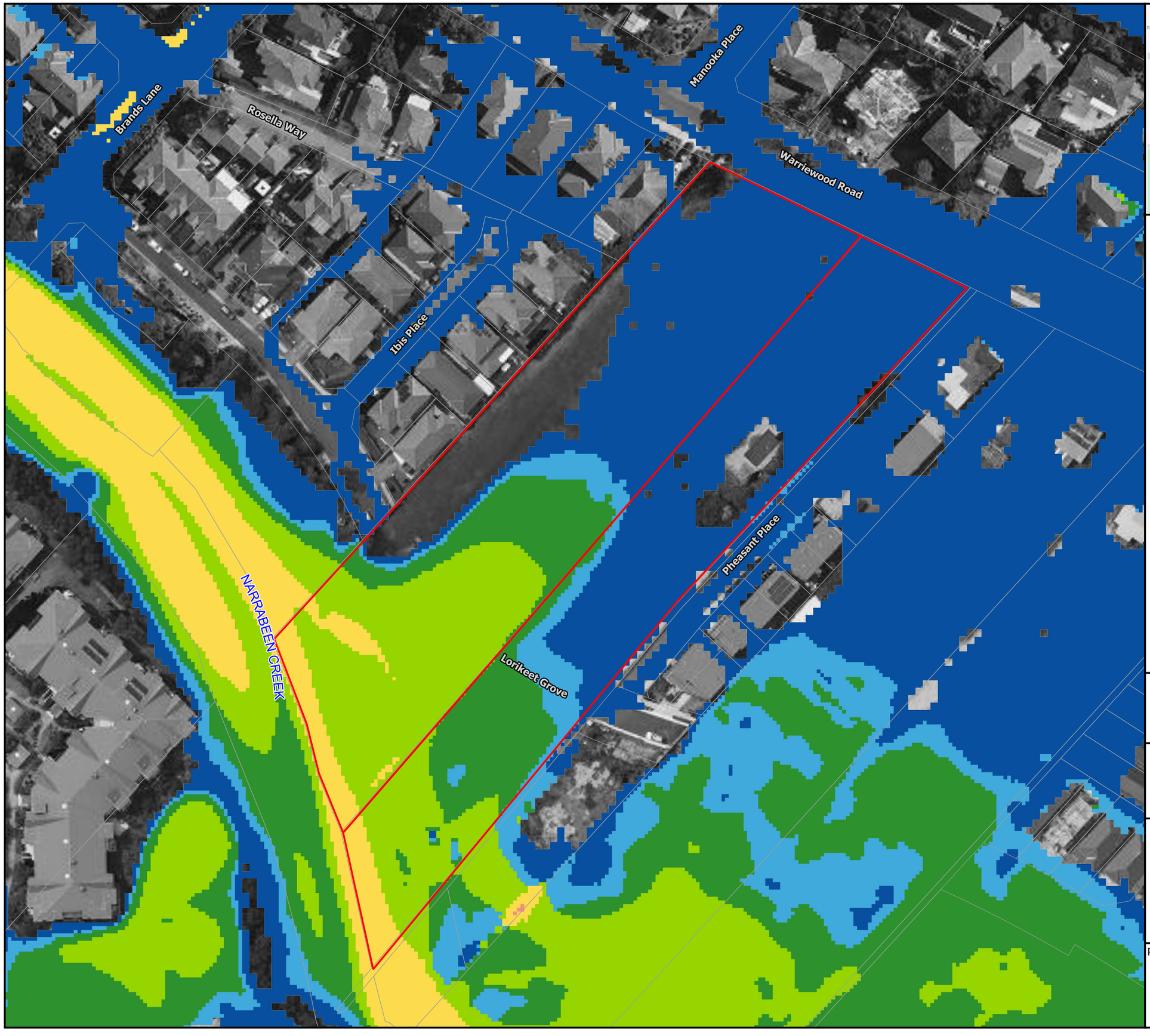
Scale: 1:1000 (at A3)

0 20 40 m

Figure 13 :
Existing Flood Hazard for the 5 Year ARI Flood (30% Climate Change Conditions)

Prepared by:
Catchment Simulation Solutions
Suite 1, Level 10, 70 Phillip St
Sydney, NSW, 2000

File Name: J913_Warriewood_Figure.qgz



LEGEND

- Site Boundary

Hazard Categories

- H1 - Generally safe
- H2 - Unsafe for small vehicles
- H3 - Unsafe for vehicles, children and elderly
- H4 - Unsafe for people and vehicles
- H5 - Unsafe for people and vehicles Buildings require special design
- H6 - Unsafe for people and vehicles All buildings vulnerable to failure

Notes:
Aerial photograph: NSW SixMap

N

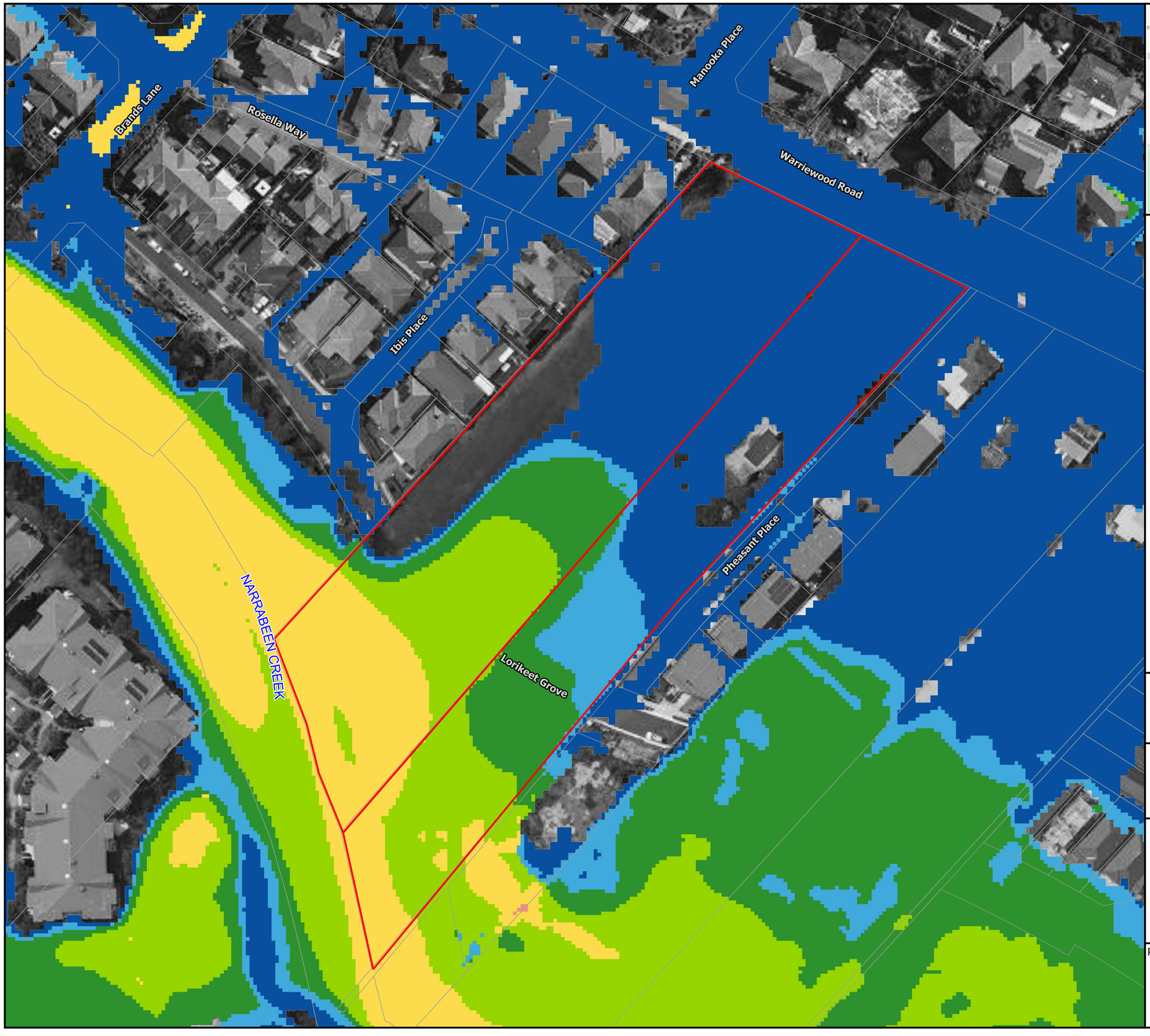
Scale: 1:1000 (at A3)

0 20 40 m

Figure 14 :
Existing Flood Hazard for the 20 Year ARI Flood (30% Climate Change Conditions)

Prepared by:
Catchment Simulation Solutions
Suite 1, Level 10, 70 Phillip St
Sydney, NSW, 2000

File Name: J913_Warriewood_Figure.qgz



LEGEND

- Site Boundary

Hazard Categories

- H1 - Generally safe
- H2 - Unsafe for small vehicles
- H3 - Unsafe for vehicles, children and elderly
- H4 - Unsafe for people and vehicles
- H5 - Unsafe for people and vehicles Buildings require special design
- H6 - Unsafe for people and vehicles All buildings vulnerable to failure

Notes:
Aerial photograph: NSW SixMap

N

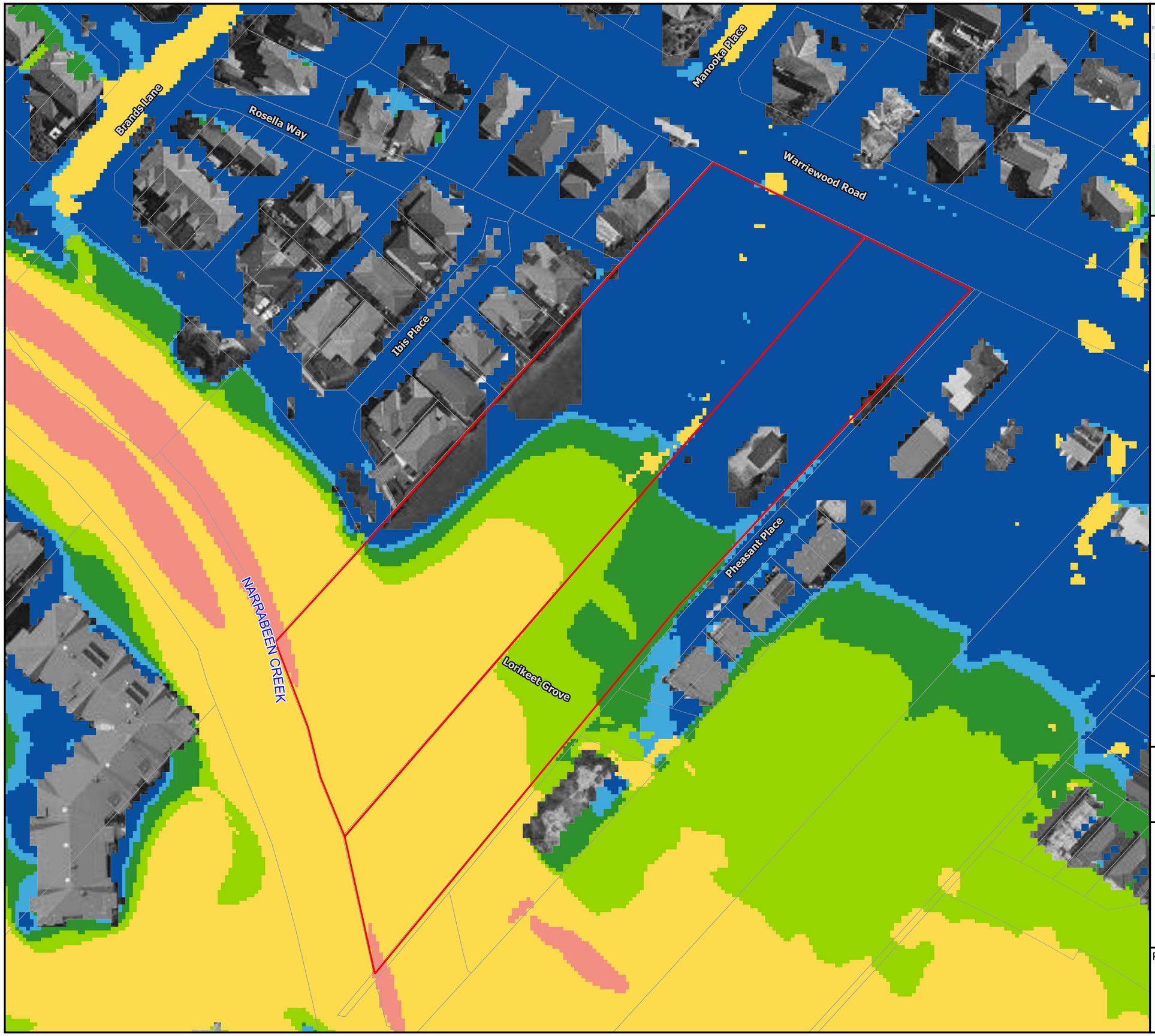
Scale: 1:1000 (at A3)

0 20 40 m

Figure 15 :
Existing Flood Hazard for the 100 Year ARI Flood (30% Climate Change Conditions)

Prepared by:
Catchment Simulation Solutions
Suite 1, Level 10, 70 Phillip St
Sydney, NSW, 2000

File Name: J913_Warriewood_Figure.qgz



LEGEND

- Site Boundary

Hazard Categories

- H1 - Generally safe
- H2 - Unsafe for small vehicles
- H3 - Unsafe for vehicles, children and elderly
- H4 - Unsafe for people and vehicles
- H5 - Unsafe for people and vehicles Buildings require special design
- H6 - Unsafe for people and vehicles All buildings vulnerable to failure

Notes:
Aerial photograph: NSW SixMap

N

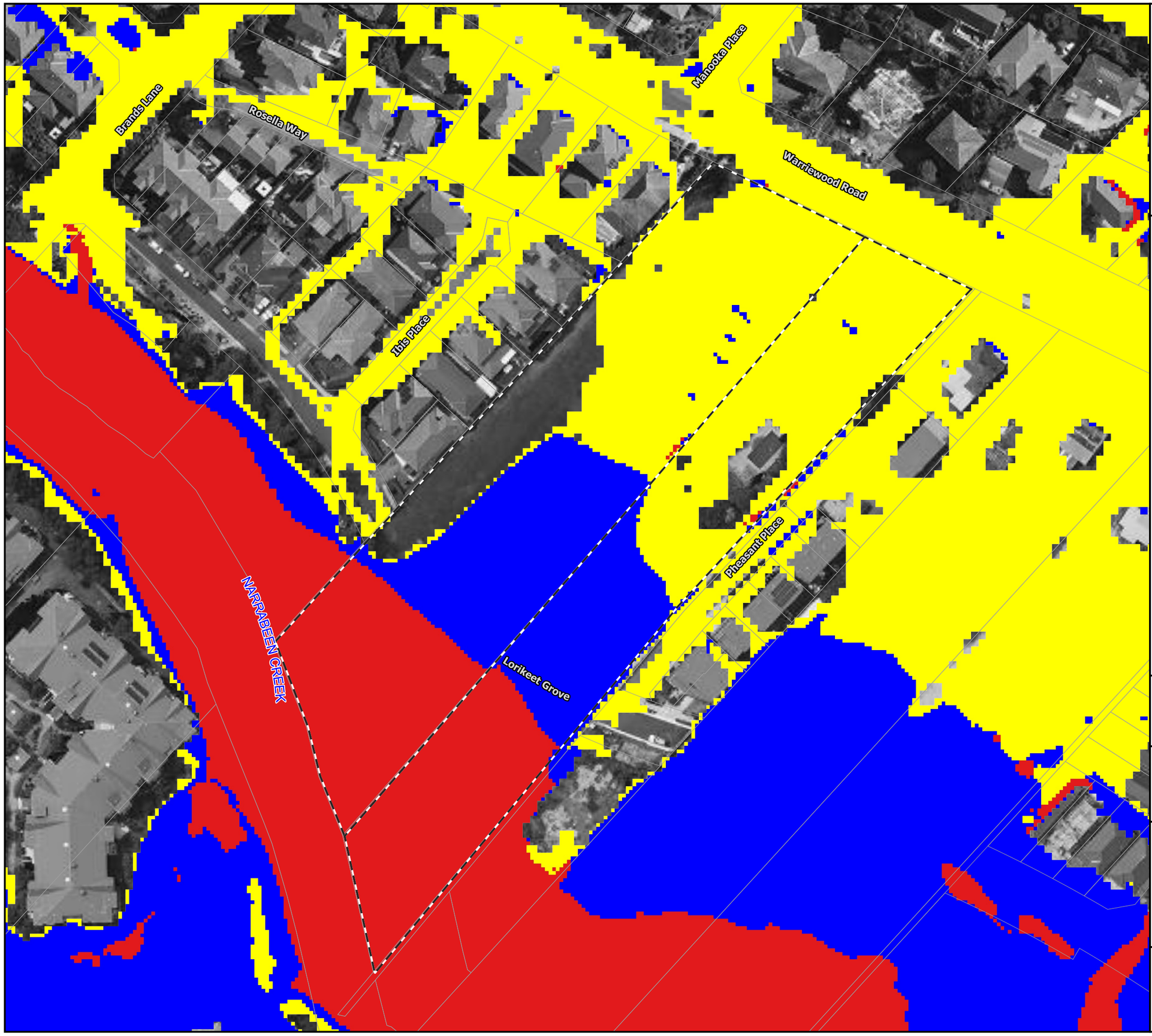
Scale: 1:1000 (at A3)

0 20 40 m

Figure 16 :
Existing Flood Hazard for the PMF (30% Climate Change Conditions)

Prepared by:
Catchment Simulation Solutions
Suite 1, Level 10, 70 Phillip St
Sydney, NSW, 2000

File Name: J913_Warriewood_Figure.qgz



LEGEND

Site Boundary

Hydraulic Categories

- Floodway
- Flood Storage
- Flood Fringe

Notes:
Aerial photograph: NSW SixMap

N

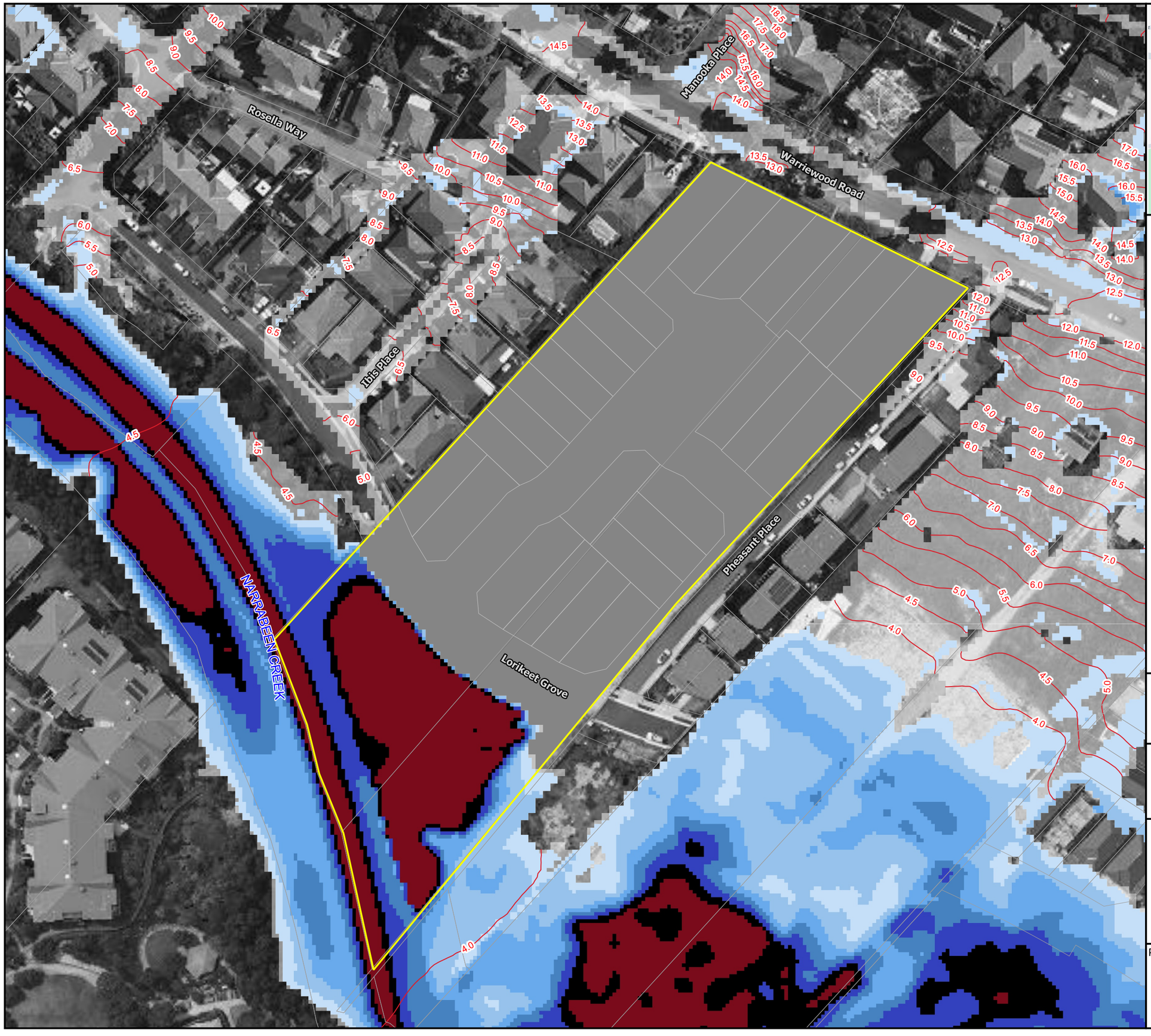
Scale: 1:1000 (at A3)

0 20 40 m

Figure 17 :
Existing Hydraulic Categories for the 100 Year ARI Flood (30% Climate Change Conditions)

Prepared by:
Catchment Simulation Solutions
Suite 1, Level 10, 70 Phillip St
Sydney, NSW, 2000

File Name: J913_Warriewood_Figure.ggz



LEGEND

- Site Boundary
- Flood Level Contours (mAHD) (0.5m intervals)

Depth (m)

- <= 0.05
- 0.05 - 0.20
- 0.20 - 0.40
- 0.40 - 0.60
- 0.60 - 0.80
- 0.80 - 1.00
- 1.00 - 1.20

Notes:
Aerial photograph: NSW SixMap

N

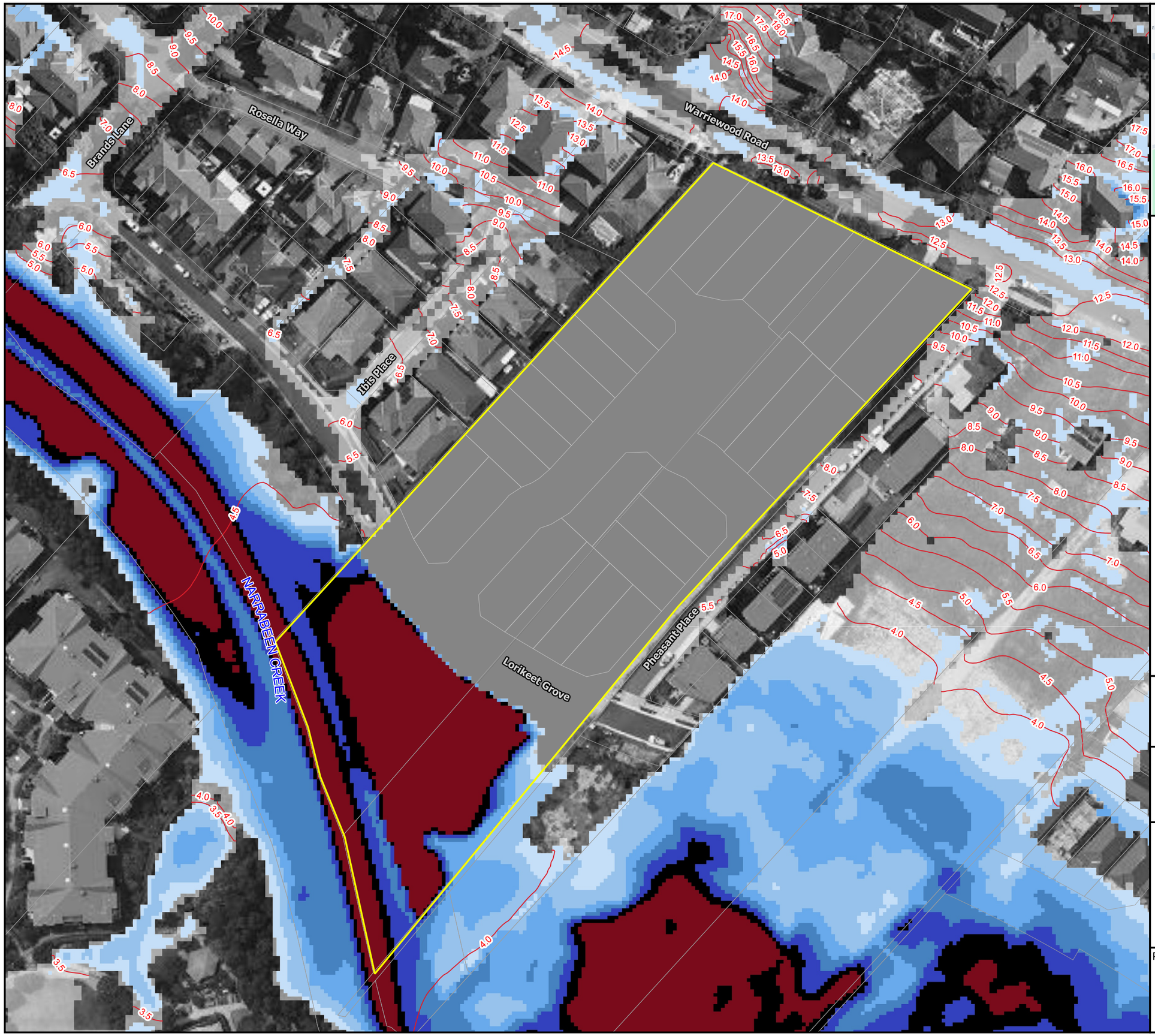
Scale: 1:1000 (at A3)

0 20 40 m

Figure 18 :
Proposed Floodwater Depths and Levels for the 2 Year ARI Flood (30% Climate Change Conditions)

Prepared by:
Catchment Simulation Solutions
Suite 1, Level 10, 70 Phillip St
Sydney, NSW, 2000

File Name: J913_Warriewood_Figure.qgz



LEGEND

- Site Boundary
- Flood Level Contours (mAHD) (0.5m intervals)

Depth (m)

- <= 0.05
- 0.05 - 0.20
- 0.20 - 0.40
- 0.40 - 0.60
- 0.60 - 0.80
- 0.80 - 1.00
- 1.00 - 1.20

Notes:
Aerial photograph: NSW SixMap

N

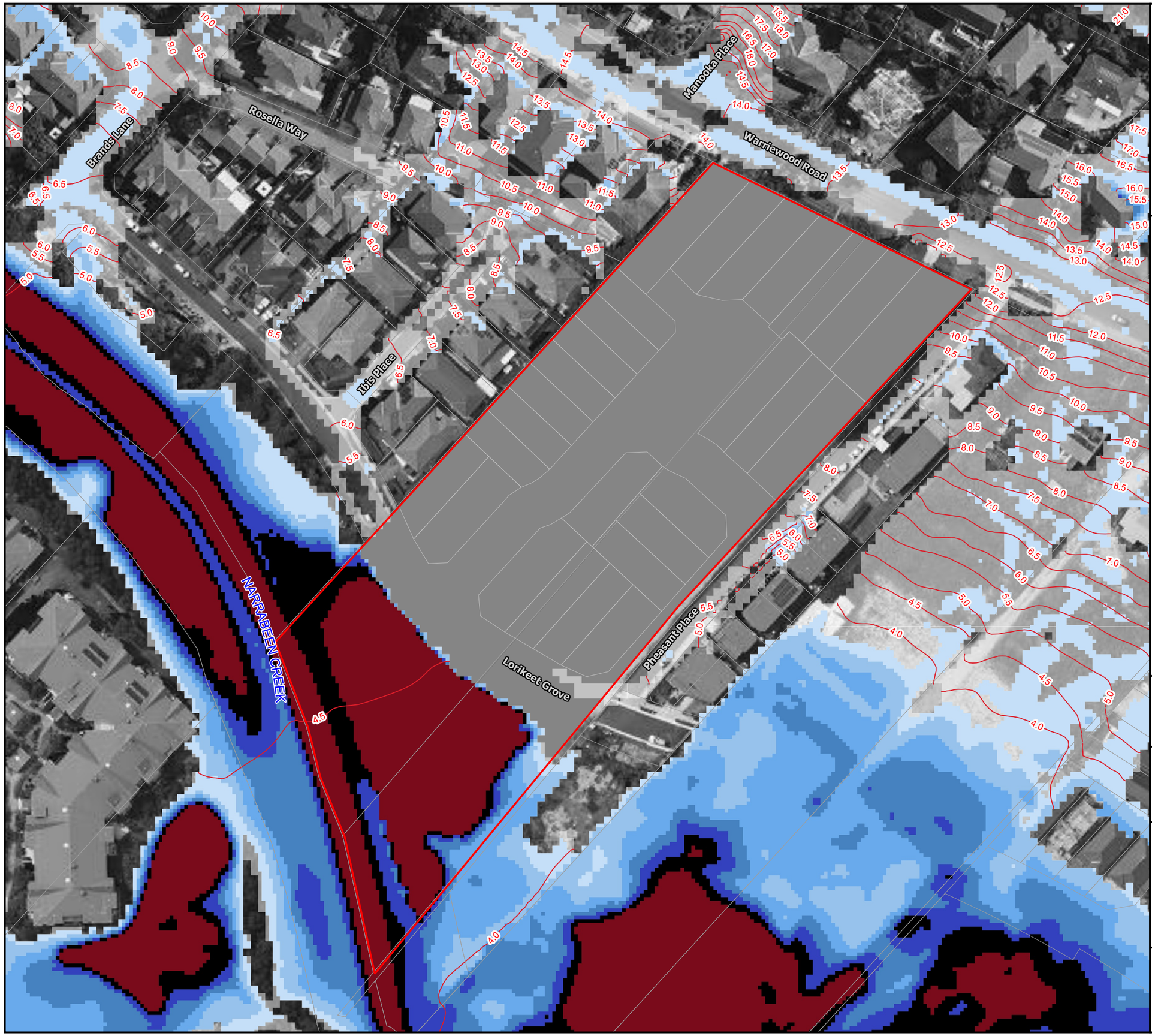
Scale: 1:1000 (at A3)

0 20 40 m

Figure 19 :
Proposed Floodwater Depths and Levels for the 5 Year ARI Flood (30% Climate Change Conditions)

Prepared by:
Catchment Simulation Solutions
Suite 1, Level 10, 70 Phillip St
Sydney, NSW, 2000

File Name: J913_Warriewood_Figure.qgz



LEGEND

- Site Boundary
- Flood Level Contours (mAHD) (0.5m intervals)

Depth (m)

- <= 0.05
- 0.05 - 0.20
- 0.20 - 0.40
- 0.40 - 0.60
- 0.60 - 0.80
- 0.80 - 1.00
- 1.00 - 1.20

Notes:
Aerial photograph: NSW SixMap

N

Scale: 1:1000 (at A3)

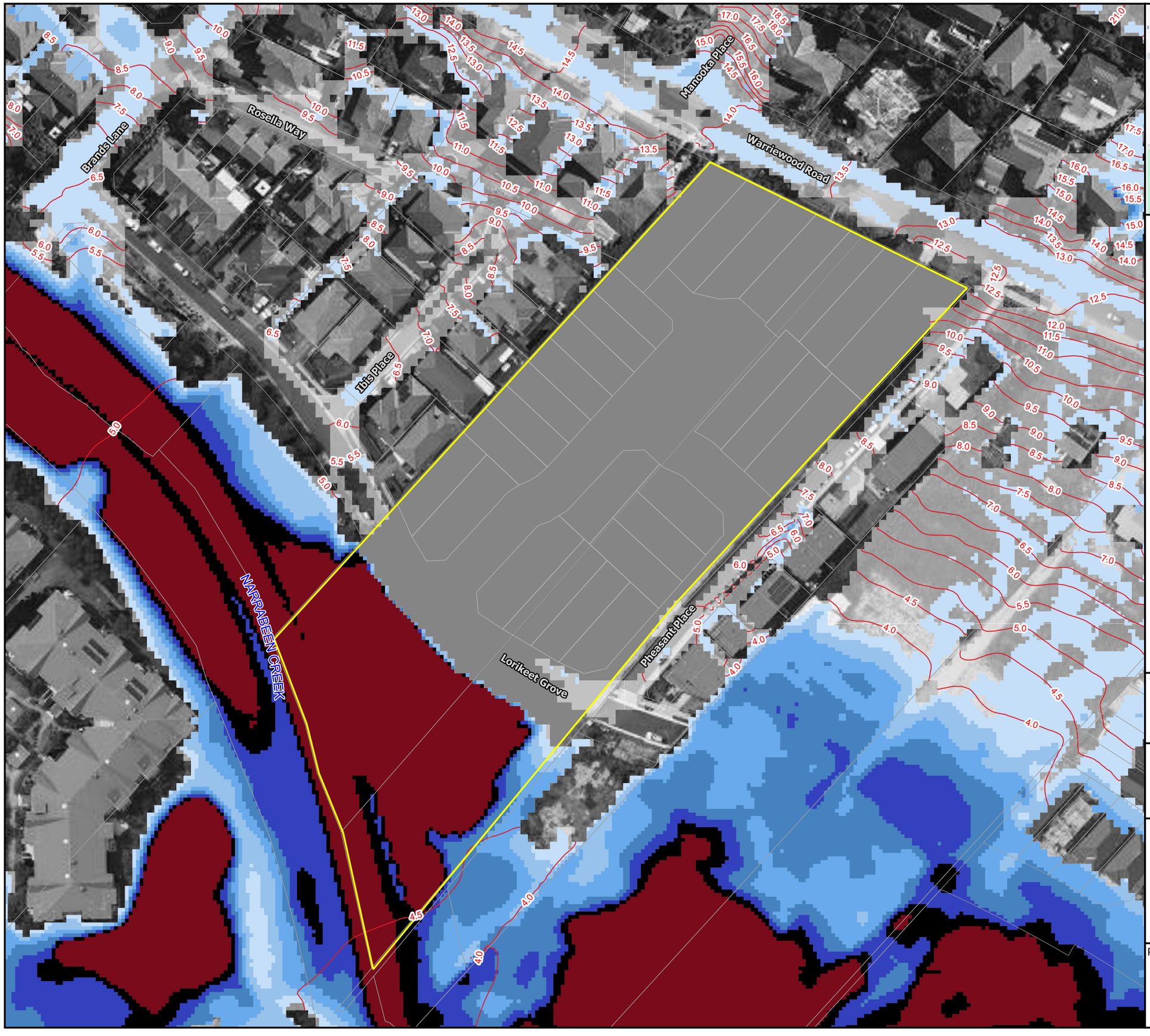
0 20 40 m

Figure 20 :
Proposed Floodwater Depths and Levels for the 20 Year ARI Flood (30% Climate Change Conditions)

Prepared by:

Catchment Simulation Solutions
Suite 1, Level 10, 70 Phillip St
Sydney, NSW, 2000

File Name: J913_Warriewood_Figure.qgz



LEGEND

- Site Boundary
- Flood Level Contours (mAHD) (0.5m intervals)

Depth (m)

- <= 0.05
- 0.05 - 0.20
- 0.20 - 0.40
- 0.40 - 0.60
- 0.60 - 0.80
- 0.80 - 1.00
- 1.00 - 1.20

Notes:
Aerial photograph: NSW SixMap

N

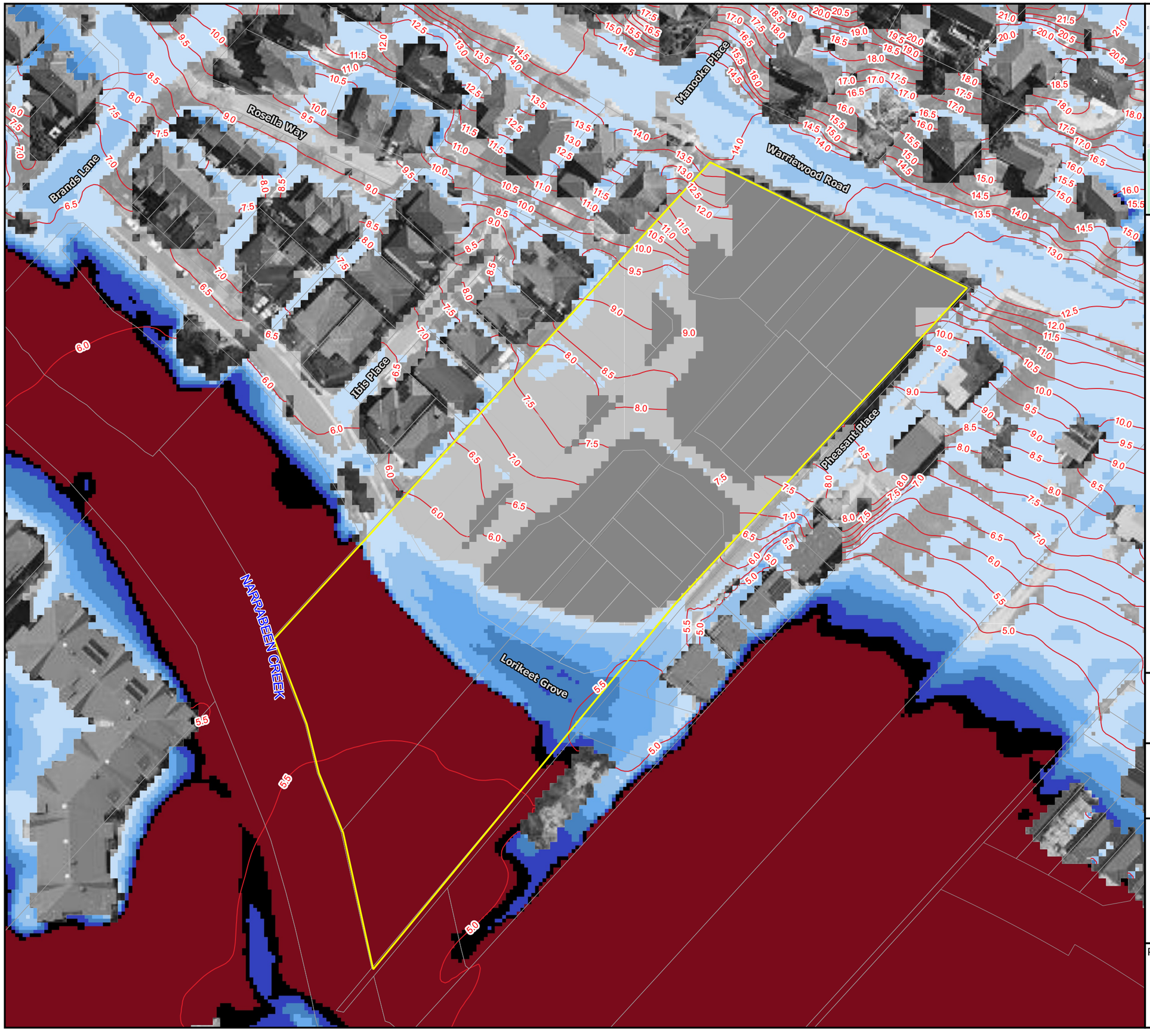
Scale: 1:1000 (at A3)

0 20 40 m

Figure 21 :
Proposed Floodwater Depths and Levels for the 100 Year ARI Flood (30% Climate Change Conditions)

Prepared by:
Catchment Simulation Solutions
Suite 1, Level 10, 70 Phillip St
Sydney, NSW, 2000

File Name: J913_Warriewood_Figure.qgz



LEGEND

- Site Boundary
- Flood Level Contours (mAHD) (0.5m intervals)

Depth (m)

- <= 0.05
- 0.05 - 0.20
- 0.20 - 0.40
- 0.40 - 0.60
- 0.60 - 0.80
- 0.80 - 1.00
- 1.00 - 1.20

Notes:
Aerial photograph: NSW SixMap

N

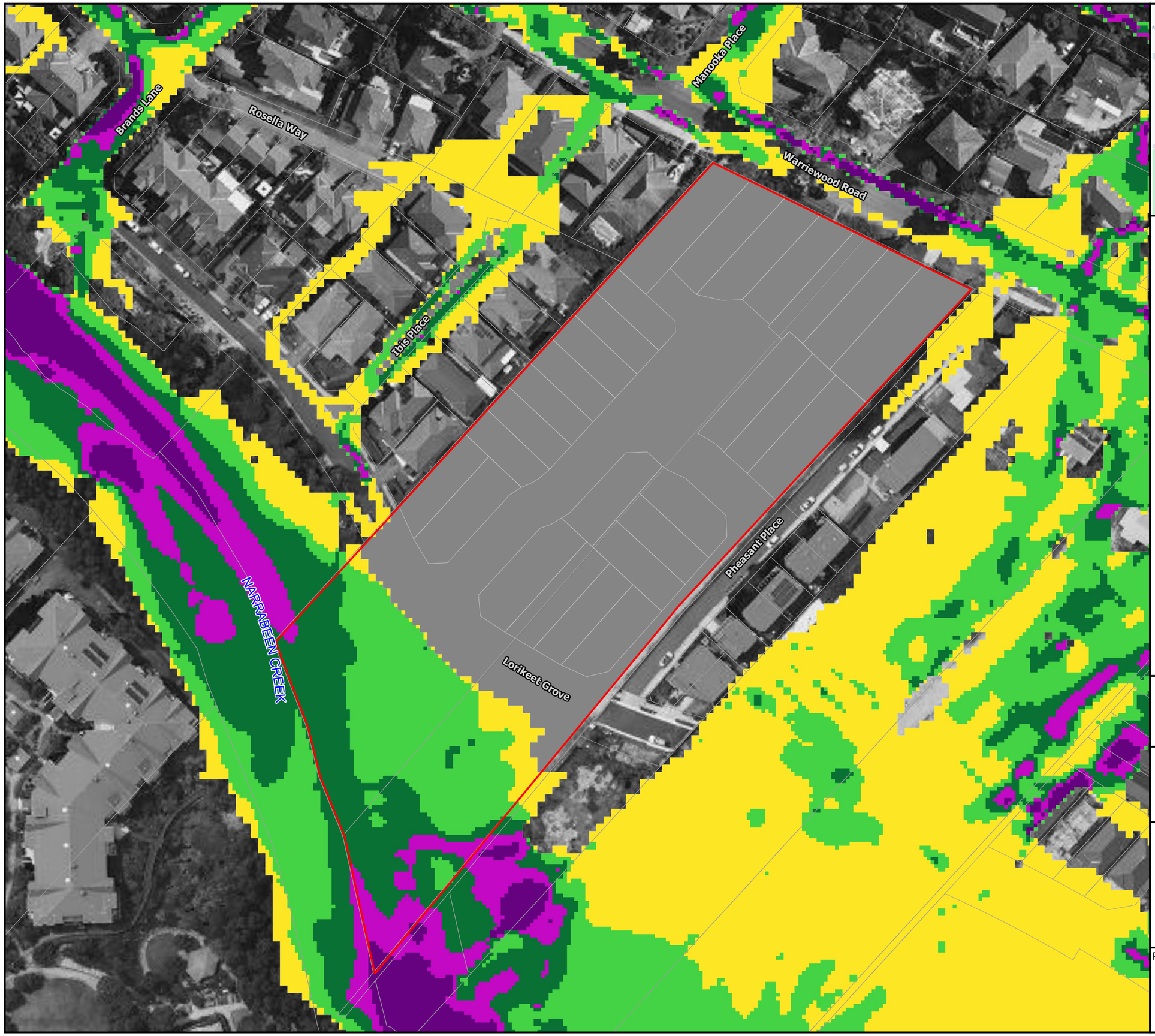
Scale: 1:1000 (at A3)

0 20 40 m

Figure 22 :
Proposed Floodwater Depths and Levels for the PMF (30% Climate Change Conditions)

Prepared by:
Catchment Simulation Solutions
Suite 1, Level 10, 70 Phillip St
Sydney, NSW, 2000

File Name: J913_Warriewood_Figure.qgz



LEGEND

- Site Boundary

Velocity (m/s)

- < 0.25
- 0.25 to 0.5
- 0.5 to 0.75
- 0.75 to 1
- > 1

Notes:
Aerial photograph: NSW SixMap

N

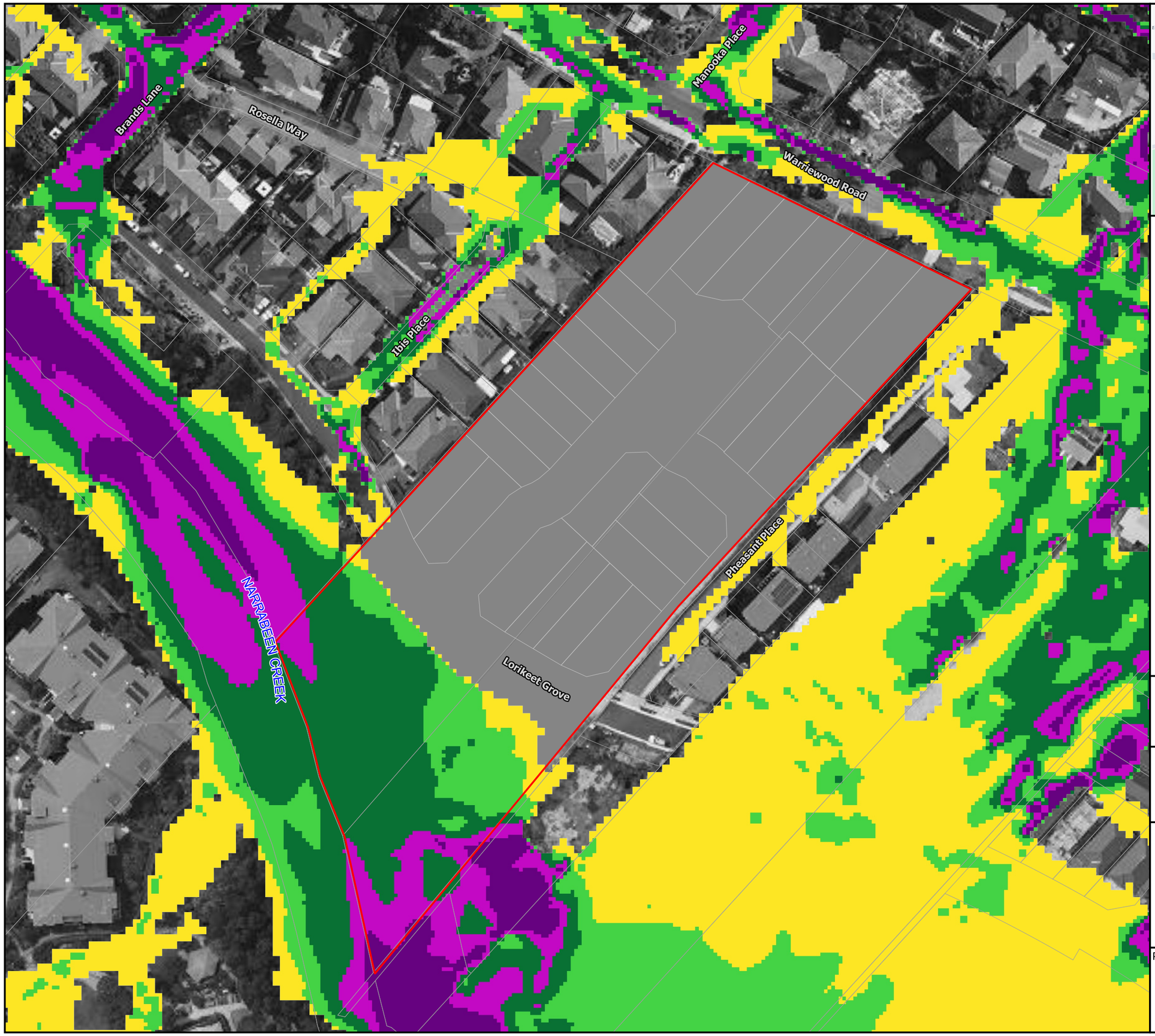
Scale: 1:1000 (at A3)

0 20 40 m

Figure 23 :
Proposed Floodwater Velocity for the 2 Year ARI Flood (30% Climate Change Conditions)

Prepared by:
Catchment Simulation Solutions
Suite 1, Level 10, 70 Phillip St
Sydney, NSW, 2000

File Name: J913_Warriewood_Figure.qgz



LEGEND

- Site Boundary

Velocity (m/s)

- < 0.25
- 0.25 to 0.5
- 0.5 to 0.75
- 0.75 to 1
- > 1

Notes:
Aerial photograph: NSW SixMap

N

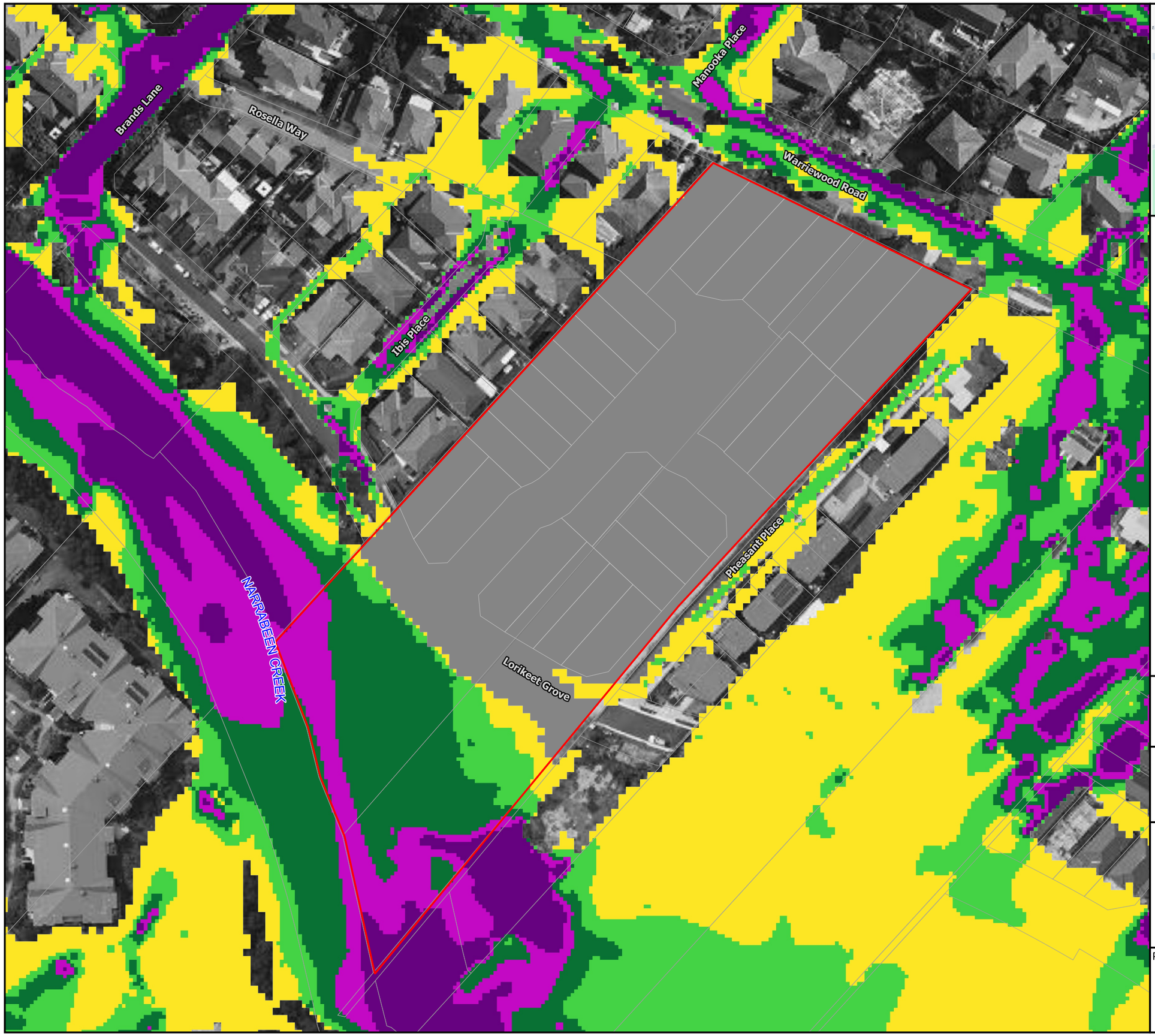
Scale: 1:1000 (at A3)

0 20 40 m

Figure 24 :
Proposed Floodwater Velocity for the 5 Year ARI Flood (30% Climate Change Conditions)

Prepared by:
Catchment Simulation Solutions
Suite 1, Level 10, 70 Phillip St
Sydney, NSW, 2000

File Name: J913_Warriewood_Figure.ggz



LEGEND

- Site Boundary

Velocity (m/s)

- < 0.25
- 0.25 to 0.5
- 0.5 to 0.75
- 0.75 to 1
- > 1

Notes:
Aerial photograph: NSW SixMap

N

Scale: 1:1000 (at A3)

0 20 40 m

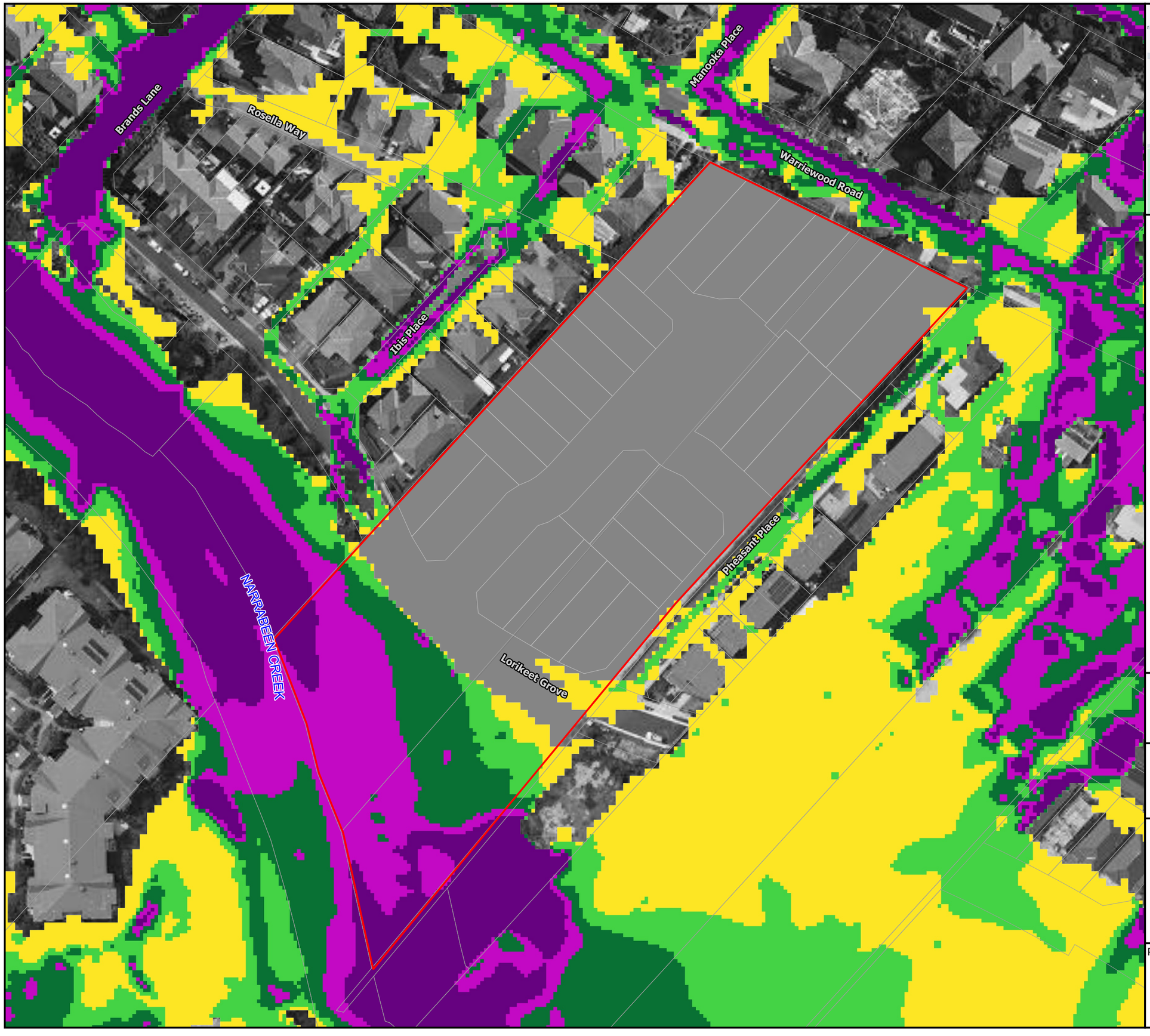
Figure 25 :
Proposed Floodwater Velocity for the 20 Year ARI Flood (30% Climate Change Conditions)

Prepared by:

Catchment Simulation Solutions

Suite 1, Level 10, 70 Phillip St
Sydney, NSW, 2000

File Name: J913_Warriewood_Figure.ggz



LEGEND

- Site Boundary

Velocity (m/s)

- < 0.25
- 0.25 to 0.5
- 0.5 to 0.75
- 0.75 to 1
- > 1

Notes:
Aerial photograph: NSW SixMap

N

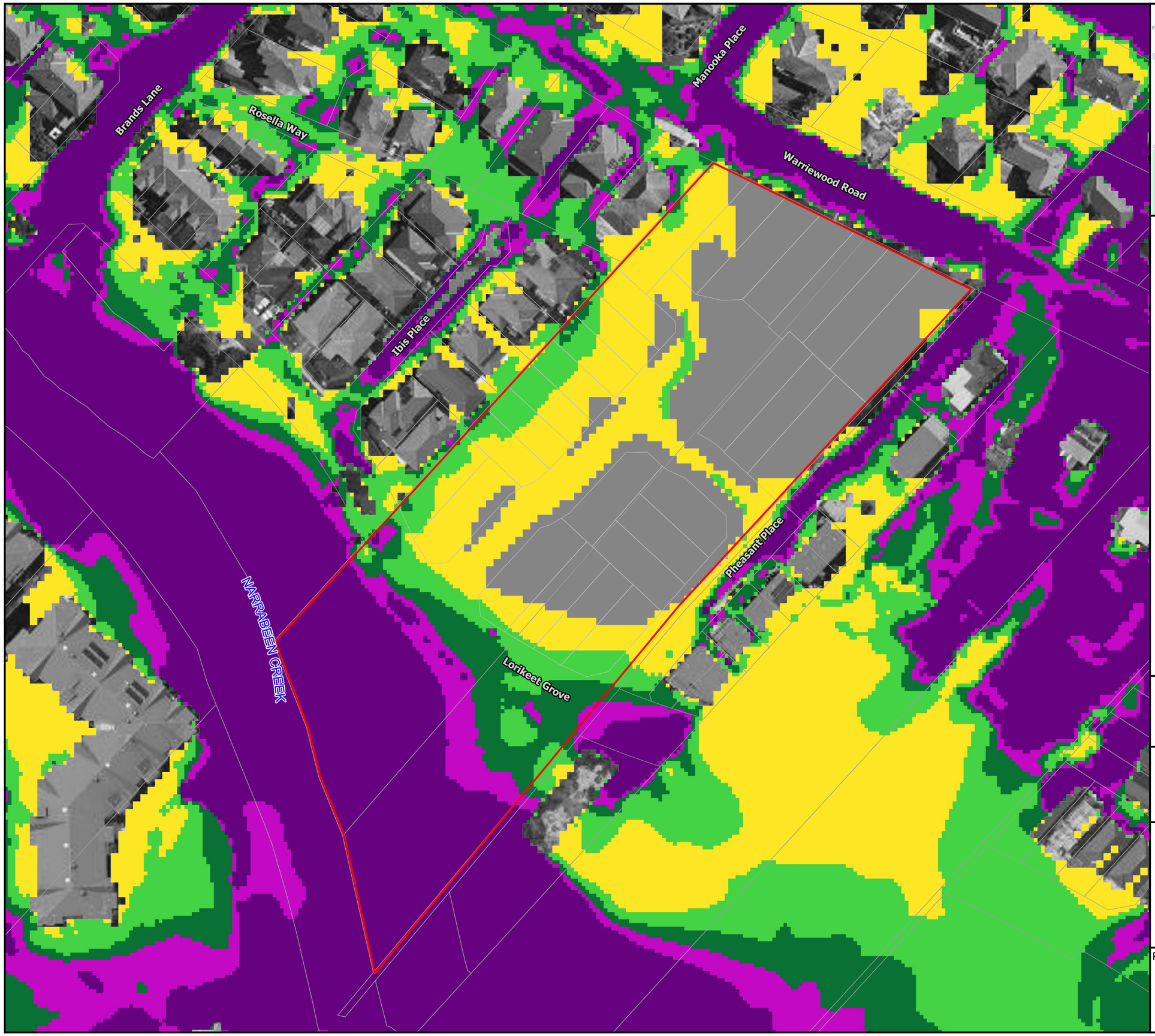
Scale: 1:1000 (at A3)

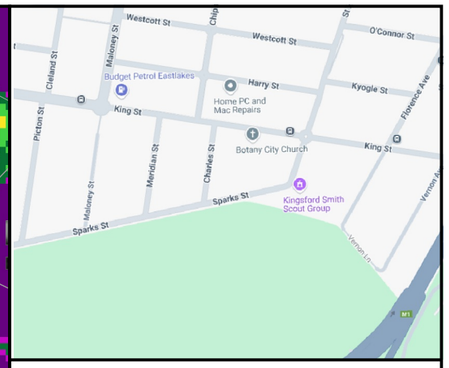
0 20 40 m

Figure 26 :
Proposed Floodwater Velocity for the 100 Year ARI Flood (30% Climate Change Conditions)

Prepared by:
Catchment Simulation Solutions
Suite 1, Level 10, 70 Phillip St
Sydney, NSW, 2000

File Name: J913_Warriewood_Figure.qgz





LEGEND

- Site Boundary

Velocity (m/s)

- < 0.25
- 0.25 to 0.5
- 0.5 to 0.75
- 0.75 to 1
- > 1

Notes:
Aerial photograph: NSW SixMap

N

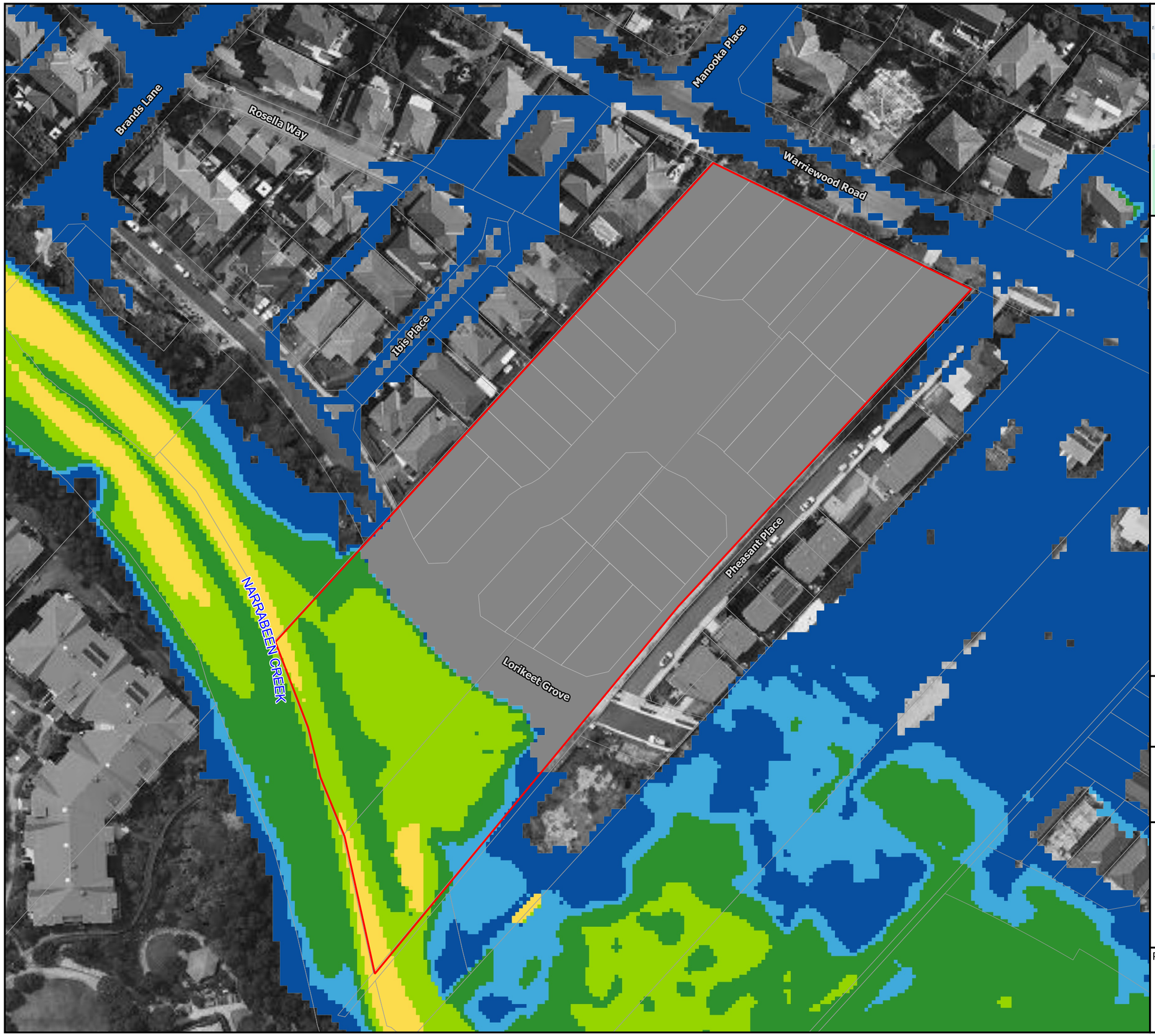
Scale: 1:1000 (at A3)

0 20 40 m

Figure 27 :
Proposed Floodwater Velocity for the PMF (30% Climate Change Conditions)

Prepared by:
Catchment Simulation Solutions
Suite 1, Level 10, 70 Phillip St
Sydney, NSW, 2000

File Name: J913_Warriewood_Figure.qgz



LEGEND

- Site Boundary

Hazard Categories

- H1 - Generally safe
- H2 - Unsafe for small vehicles
- H3 - Unsafe for vehicles, children and elderly
- H4 - Unsafe for people and vehicles
- H5 - Unsafe for people and vehicles Buildings require special design
- H6 - Unsafe for people and vehicles All buildings vulnerable to failure

Notes:
Aerial photograph: NSW SixMap

N

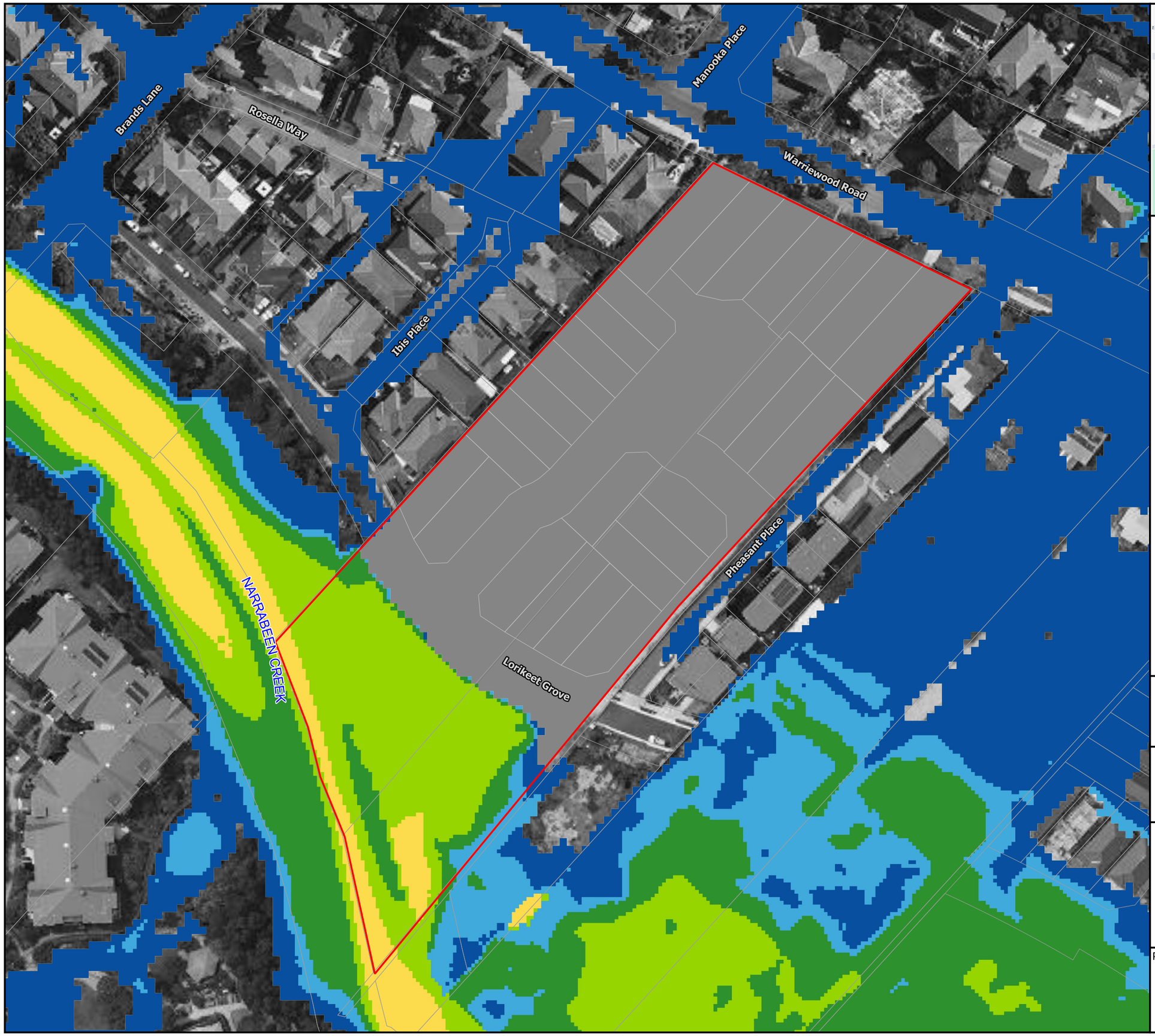
Scale: 1:1000 (at A3)

0 20 40 m

Figure 28 :
Proposed Flood Hazard for the 2 Year ARI Flood (30% Climate Change Conditions)

Prepared by:
Catchment Simulation Solutions
Suite 1, Level 10, 70 Phillip St
Sydney, NSW, 2000

File Name: J913_Warriewood_Figure.ggz



LEGEND

- Site Boundary

Hazard Categories

- H1 - Generally safe
- H2 - Unsafe for small vehicles
- H3 - Unsafe for vehicles, children and elderly
- H4 - Unsafe for people and vehicles
- H5 - Unsafe for people and vehicles Buildings require special design
- H6 - Unsafe for people and vehicles All buildings vulnerable to failure

Notes:
Aerial photograph: NSW SixMap

N

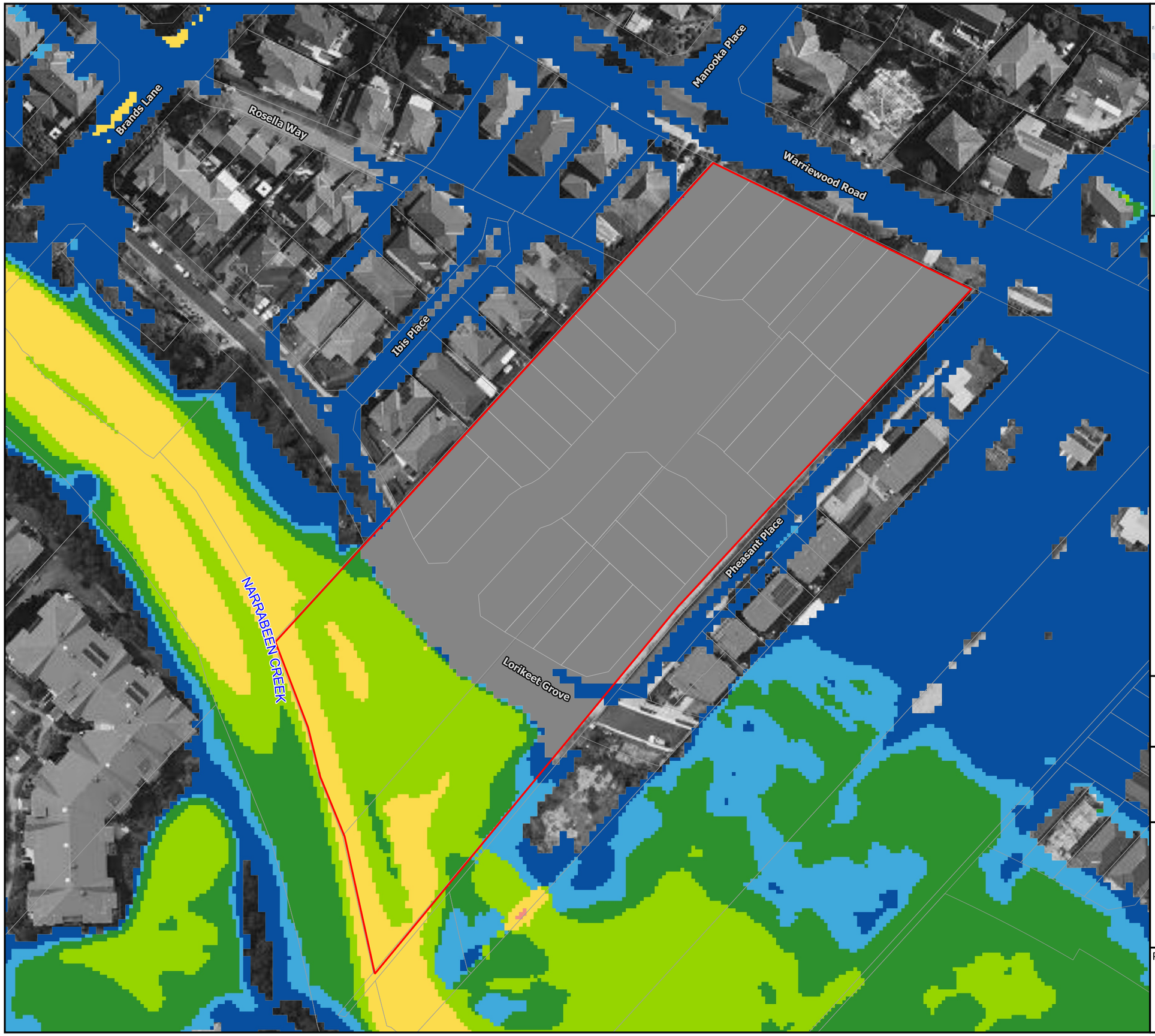
Scale: 1:1000 (at A3)

0 20 40 m

Figure 29 :
Proposed Flood Hazard for the 5 Year ARI Flood (30% Climate Change Conditions)

Prepared by:
Catchment Simulation Solutions
Suite 1, Level 10, 70 Phillip St
Sydney, NSW, 2000

File Name: J913_Warriewood_Figure.qgz



LEGEND

- Site Boundary

Hazard Categories

- H1 - Generally safe
- H2 - Unsafe for small vehicles
- H3 - Unsafe for vehicles, children and elderly
- H4 - Unsafe for people and vehicles
- H5 - Unsafe for people and vehicles Buildings require special design
- H6 - Unsafe for people and vehicles All buildings vulnerable to failure

Notes:
Aerial photograph: NSW SixMap

N

Scale: 1:1000 (at A3)

0 20 40 m

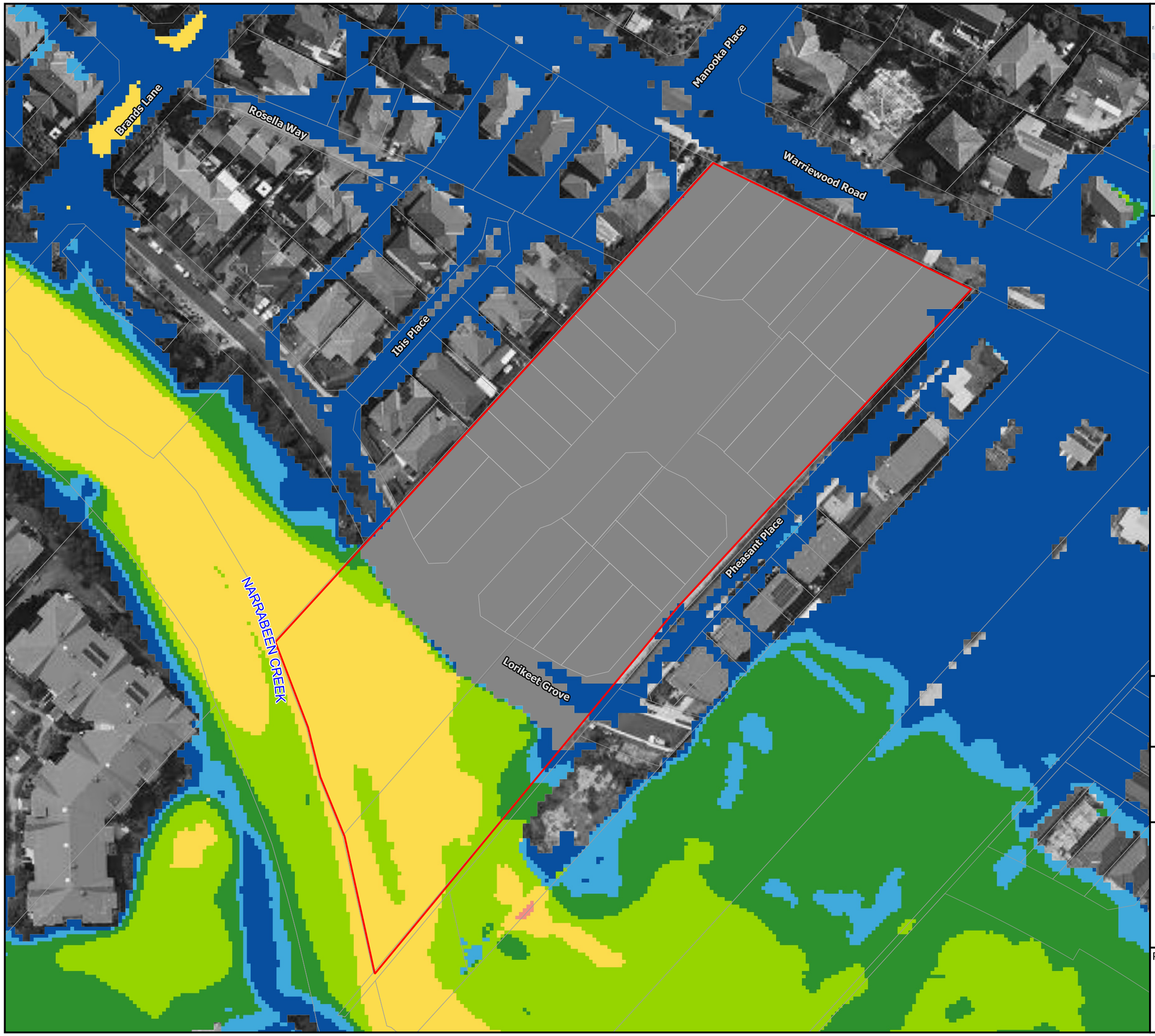
Figure 30 :
Proposed Flood Hazard for the 20 Year ARI Flood (30% Climate Change Conditions)

Prepared by:

Catchment Simulation Solutions

Suite 1, Level 10, 70 Phillip St
Sydney, NSW, 2000

File Name: J913_Warriewood_Figure.qgz



LEGEND

- Site Boundary

Hazard Categories

- H1 - Generally safe
- H2 - Unsafe for small vehicles
- H3 - Unsafe for vehicles, children and elderly
- H4 - Unsafe for people and vehicles
- H5 - Unsafe for people and vehicles Buildings require special design
- H6 - Unsafe for people and vehicles All buildings vulnerable to failure

Notes:
Aerial photograph: NSW SixMap

N

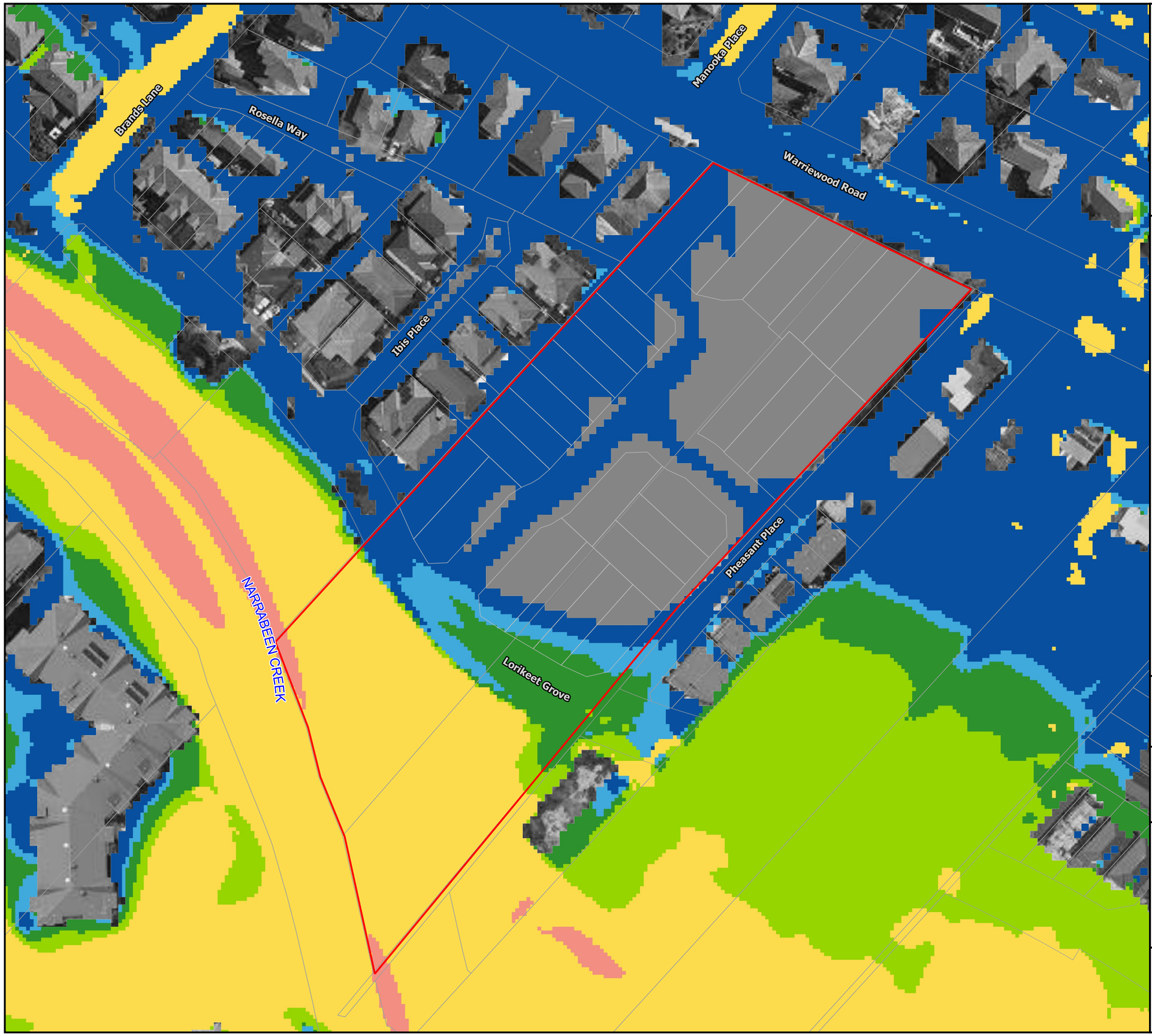
Scale: 1:1000 (at A3)

0 20 40 m

Figure 31 :
Proposed Flood Hazard for the 100 Year ARI Flood (30% Climate Change Conditions)

Prepared by:
Catchment Simulation Solutions
Suite 1, Level 10, 70 Phillip St
Sydney, NSW, 2000

File Name: J913_Warriewood_Figure.qgz



LEGEND

- Site Boundary

Hazard Categories

- H1 - Generally safe
- H2 - Unsafe for small vehicles
- H3 - Unsafe for vehicles, children and elderly
- H4 - Unsafe for people and vehicles
- H5 - Unsafe for people and vehicles Buildings require special design
- H6 - Unsafe for people and vehicles All buildings vulnerable to failure

Notes:
Aerial photograph: NSW SixMap

N

Scale: 1:1000 (at A3)

0 20 40 m

Figure 32 :
Proposed Flood Hazard for the PMF (30% Climate Change Conditions)

Prepared by:
Catchment Simulation Solutions
Suite 1, Level 10, 70 Phillip St
Sydney, NSW, 2000

File Name: J913_Warriewood_Figure.qgz

Brands Lane
Rosella Way
Mamooka Place
Warriewood Road
Ibis Place
Pheasant Place
Lorikeet Grove
NARRABEEN CREEK

LEGEND

Site Boundary

Hydraulic Categories

- Floodway
- Flood Storage
- Flood Fringe

Notes:
Aerial photograph: NSW SixMap

N

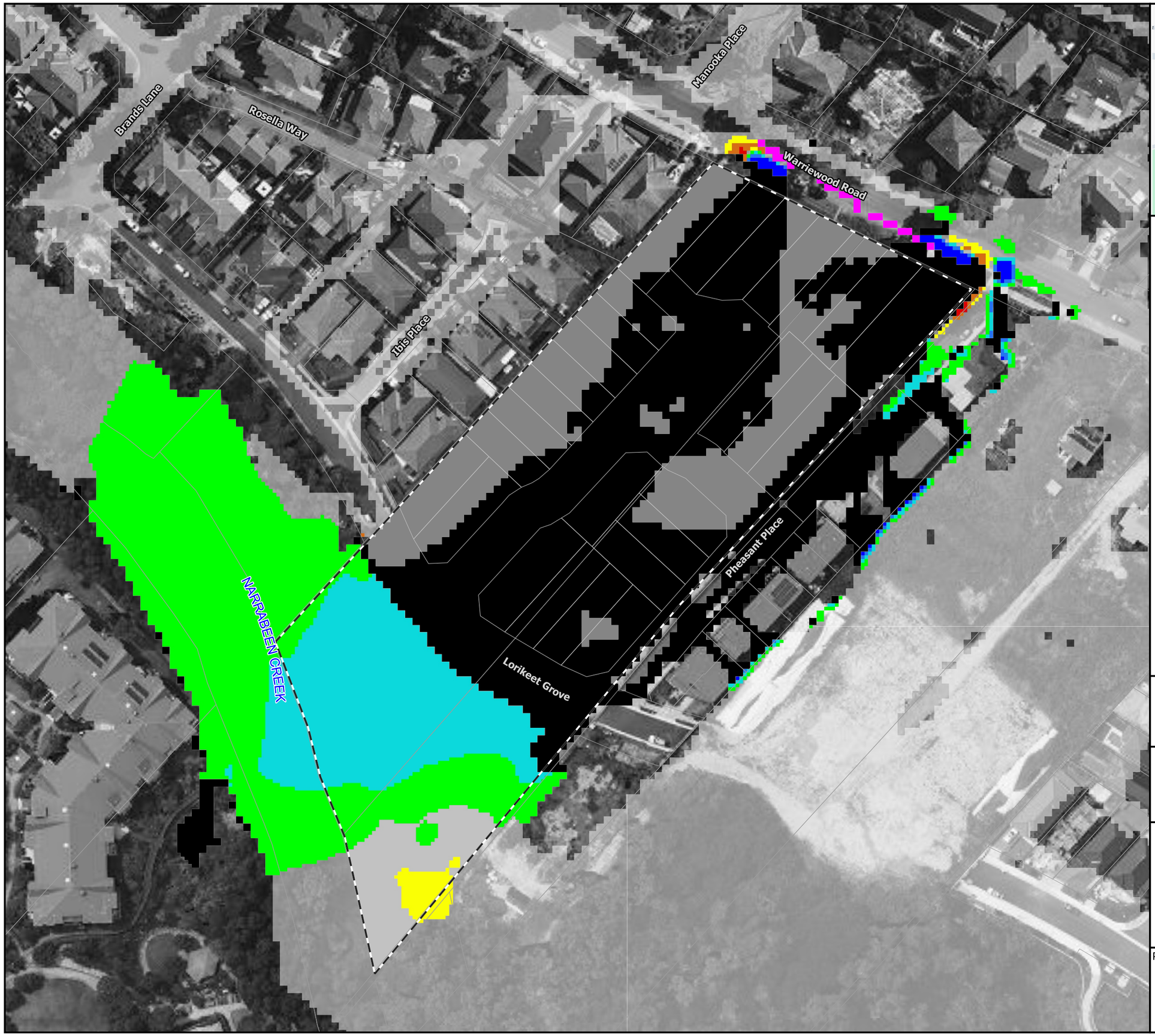
Scale: 1:1000 (at A3)

0 20 40 m

Figure 33 :
Proposed Hydraulic Categories for the 100 Year ARI Flood (30% Climate Change Conditions)

Prepared by:
Catchment Simulation Solutions
Suite 1, Level 10, 70 Phillip St
Sydney, NSW, 2000

File Name: J913_Warriewood_Figure.qgz



LEGEND

- Site Boundary

Flood Level Differences (mAHD)

- < -0.20
- -0.10 to -0.20
- -0.05 to -0.10
- -0.01 to -0.05
- < +- 0.01
- 0.01 to 0.05
- 0.05 to 0.10
- 0.10 to 0.20
- > 0.20
- Was wet, now dry
- Was dry, now wet

Notes:
Aerial photograph: NSW SixMap

N

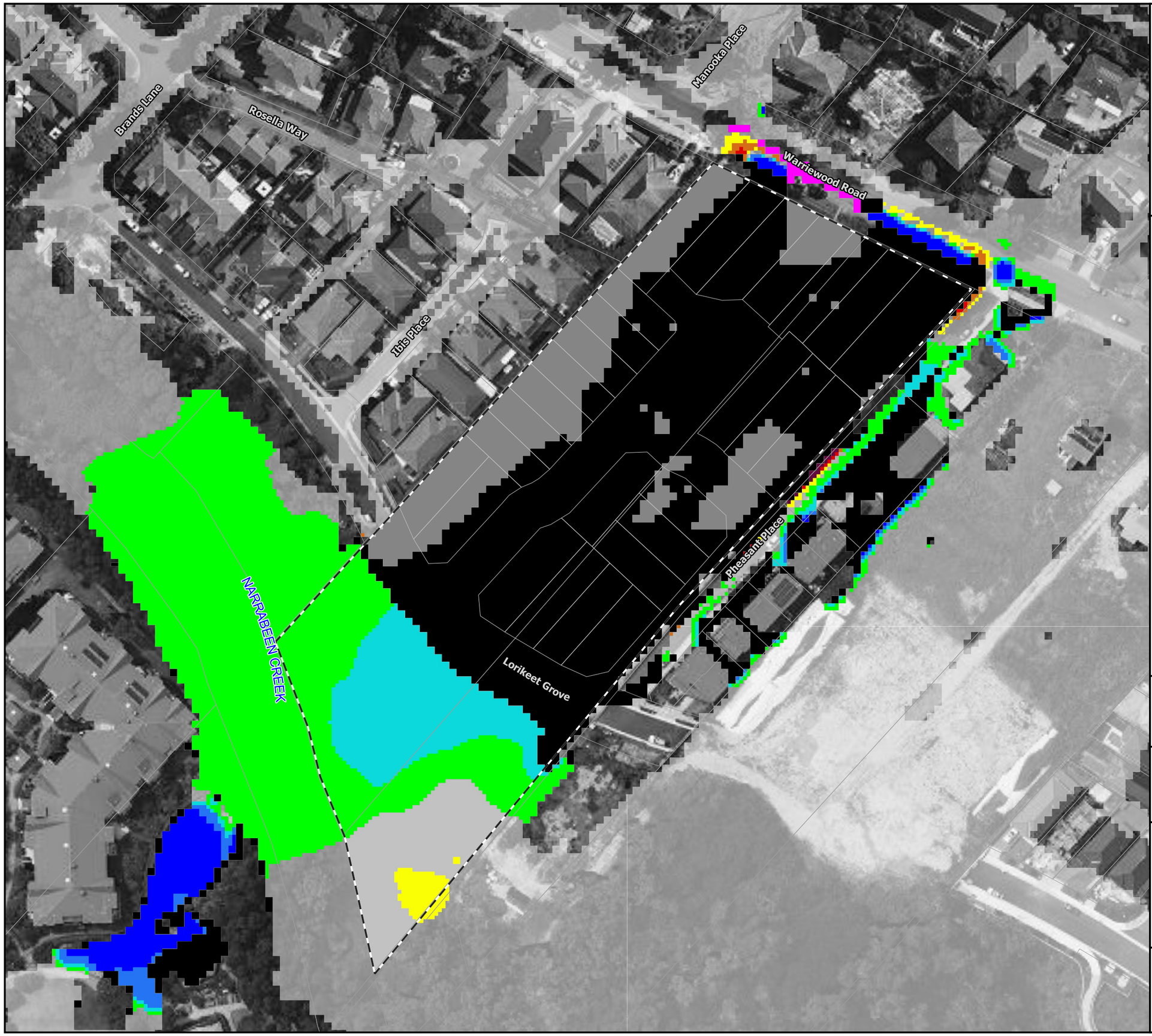
Scale: 1:1000 (at A3)

0 20 40 m

Figure 34 :
Flood Level Differences for the 2 Year ARI Flood (30% Climate Change Conditions)

Prepared by:
Catchment Simulation Solutions
Suite 1, Level 10, 70 Phillip St
Sydney, NSW, 2000

File Name: J913_Warriewood_Figure.qgz



LEGEND

- Site Boundary

Flood Level Differences (mAHD)

- < -0.20
- -0.10 to -0.20
- -0.05 to -0.10
- -0.01 to -0.05
- < +- 0.01
- 0.01 to 0.05
- 0.05 to 0.10
- 0.10 to 0.20
- > 0.20
- Was wet, now dry
- Was dry, now wet

Notes:
Aerial photograph: NSW SixMap

N

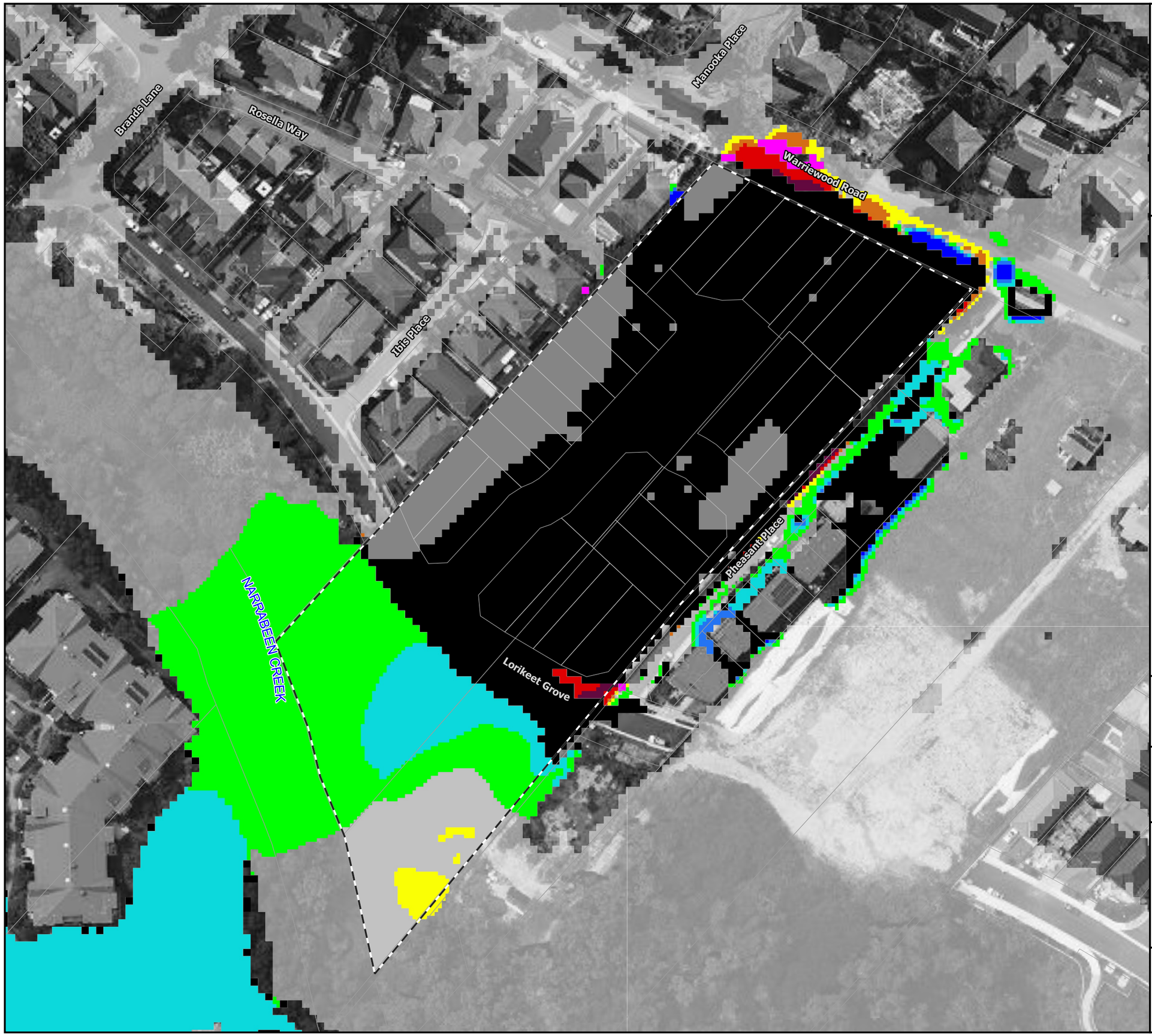
Scale: 1:1000 (at A3)

0 20 40 m

Figure 35 :
Flood Level Differences for the 5 Year ARI Flood (30% Climate Change Conditions)

Prepared by:
Catchment Simulation Solutions
Suite 1, Level 10, 70 Phillip St
Sydney, NSW, 2000

File Name: J913_Warriewood_Figure.ggz



LEGEND

- Site Boundary

Flood Level Differences (mAHD)

- < -0.20
- -0.10 to -0.20
- -0.05 to -0.10
- -0.01 to -0.05
- < +- 0.01
- 0.01 to 0.05
- 0.05 to 0.10
- 0.10 to 0.20
- > 0.20
- Was wet, now dry
- Was dry, now wet

Notes:
Aerial photograph: NSW SixMap

N

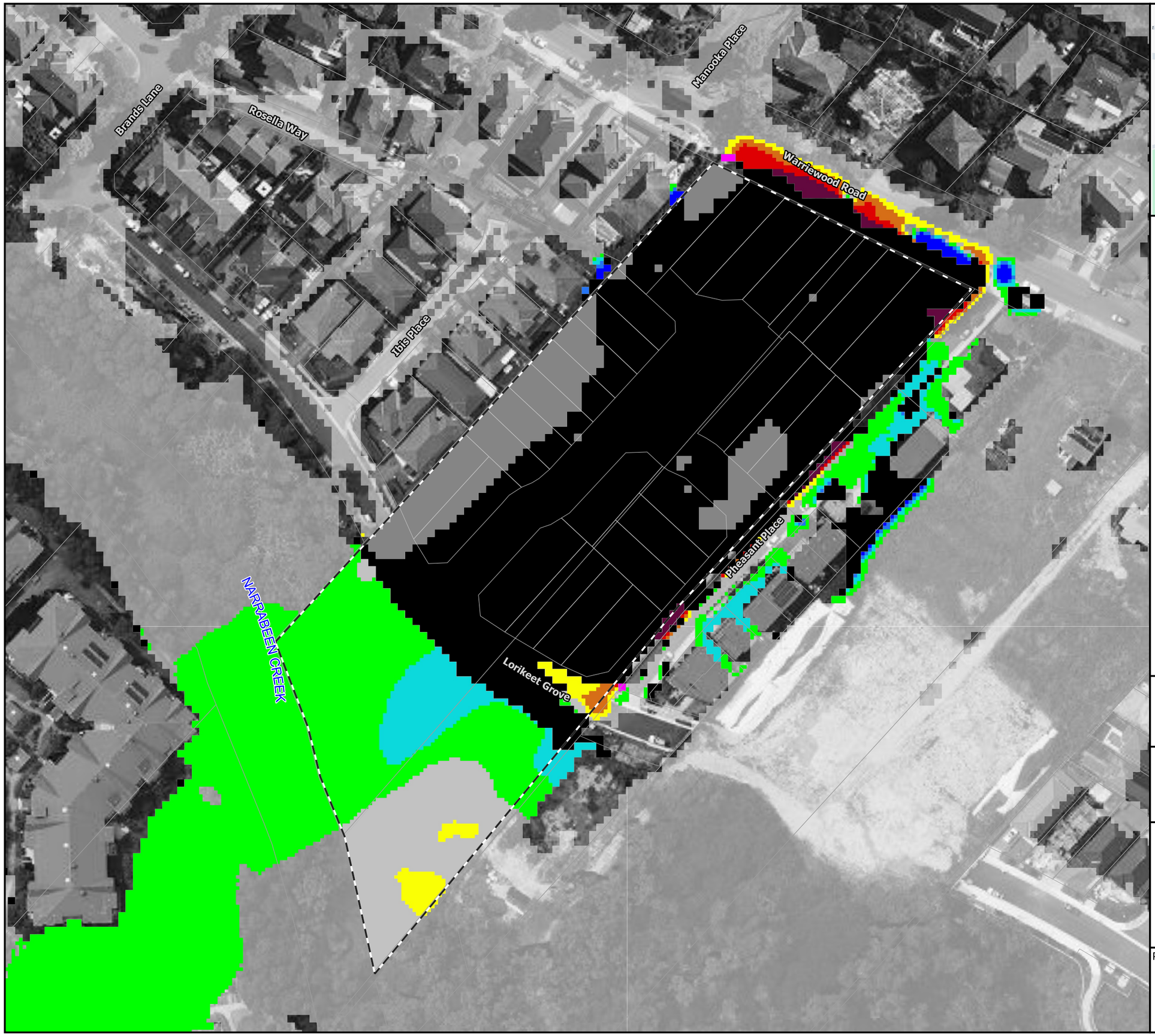
Scale: 1:1000 (at A3)

0 20 40 m

Figure 36 :
Flood Level Differences for the 20 Year ARI Flood (30% Climate Change Conditions)

Prepared by:
Catchment Simulation Solutions
Suite 1, Level 10, 70 Phillip St
Sydney, NSW, 2000

File Name: J913_Warriewood_Figure.qgz



LEGEND

- Site Boundary

Flood Level Differences (mAHD)

- < -0.20
- -0.10 to -0.20
- -0.05 to -0.10
- -0.01 to -0.05
- < +- 0.01
- 0.01 to 0.05
- 0.05 to 0.10
- 0.10 to 0.20
- > 0.20
- Was wet, now dry
- Was dry, now wet

Notes:
Aerial photograph: NSW SixMap

N

Scale: 1:1000 (at A3)

0 20 40 m

Figure 37 :
Flood Level Differences for the 100 Year ARI Flood (30% Climate Change Conditions)

Prepared by:
Catchment Simulation Solutions
Suite 1, Level 10, 70 Phillip St
Sydney, NSW, 2000

File Name: J913_Warriewood_Figure.qgz

LEGEND

- Site Boundary

Flood Level Differences (mAHD)

- < -0.30
- -0.20 to -0.30
- -0.10 to -0.20
- -0.05 to -0.10
- < +- 0.05
- 0.05 to 0.10
- 0.10 to 0.20
- 0.20 to 0.30
- > 0.30
- Was wet, now dry
- Was dry, now wet

Notes:
Aerial photograph: NSW SixMap

N

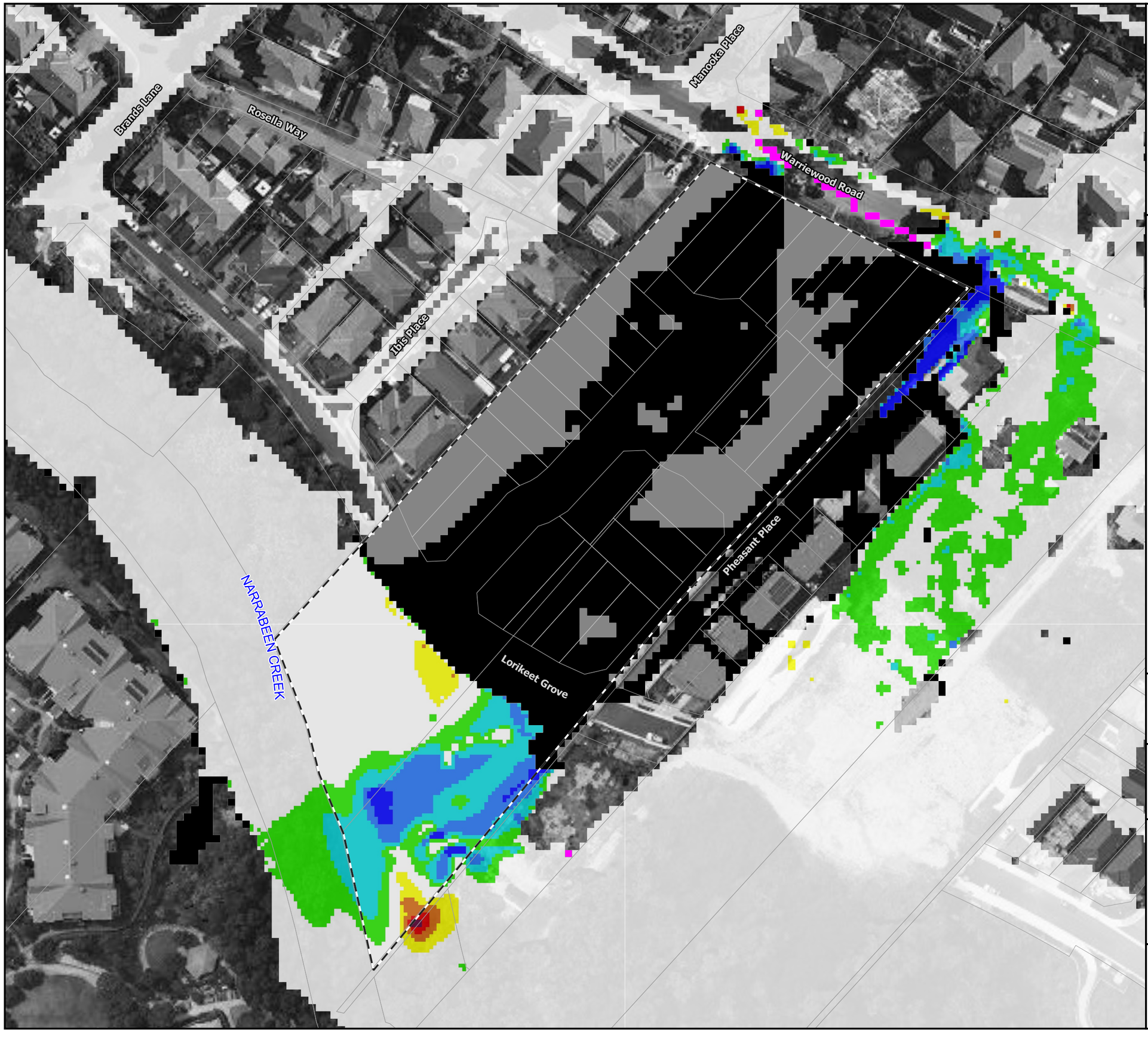
Scale: 1:1000 (at A3)

0 20 40 m

Figure 38 :
Flood Level Differences for the PMF (30% Climate Change Conditions)

Prepared by:
Catchment Simulation Solutions
Suite 1, Level 10, 70 Phillip St
Sydney, NSW, 2000

File Name: J913_Warriewood_Figure.qgz



LEGEND

- Site Boundary

Velocity Differences (m/s)

- < -0.4
- -0.3 to -0.4
- -0.2 to -0.3
- -0.1 to -0.2
- < +- 0.05
- 0.1 to 0.2
- 0.2 to 0.3
- 0.3 to 0.4
- > 0.4
- Was wet, now dry
- Was dry, now wet

Notes:
Aerial photograph: NSW SixMap

N

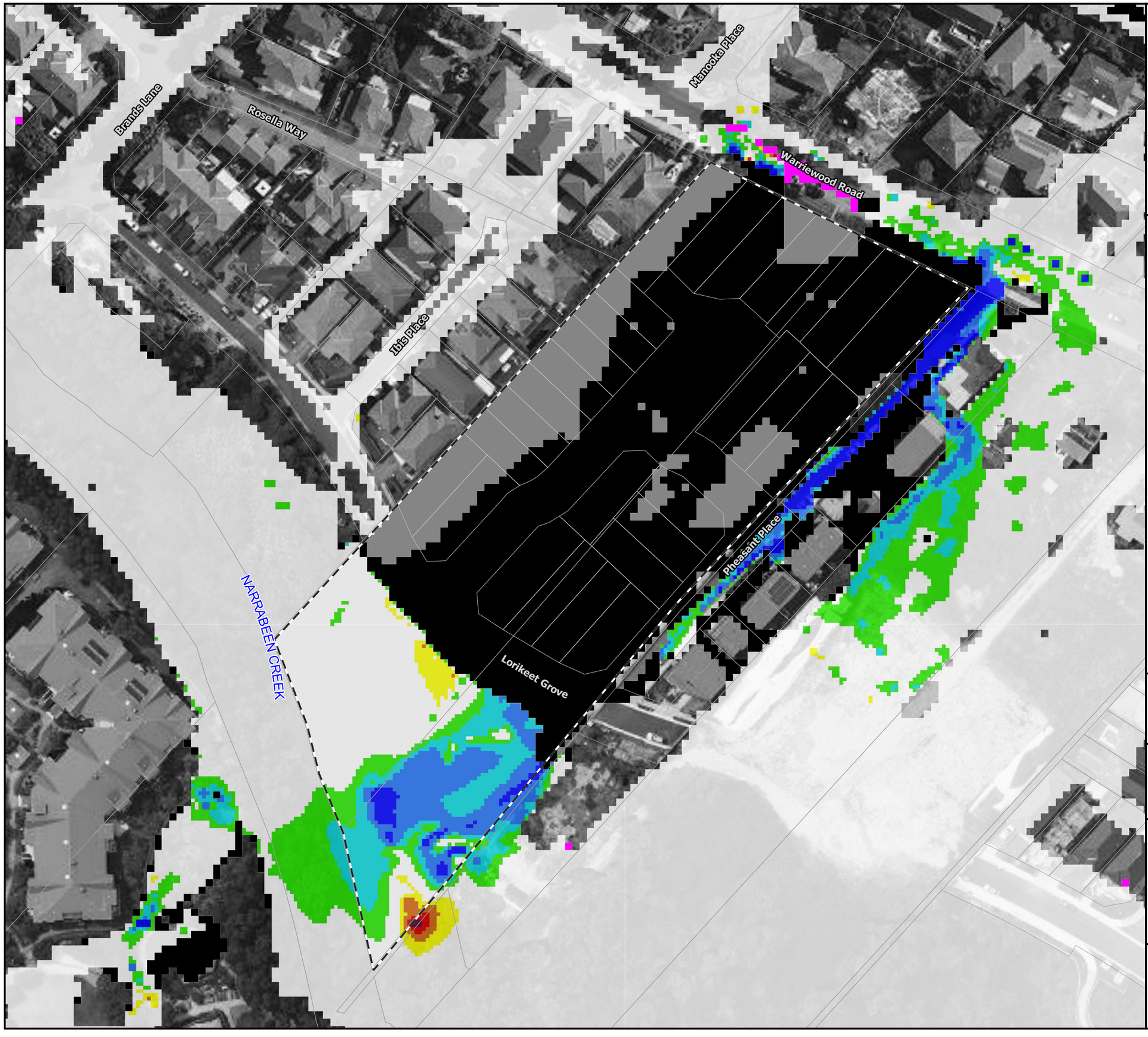
Scale: 1:1000 (at A3)

0 20 40 m

Figure 39 :
Velocity Differences for the 2 Year ARI Flood (30% Climate Change Conditions)

Prepared by:
Catchment Simulation Solutions
Suite 1, Level 10, 70 Phillip St
Sydney, NSW, 2000

File Name: J913_Warriewood_Figure.qgz



LEGEND

- Site Boundary

Velocity Differences (m/s)

- < -0.4
- -0.3 to -0.4
- -0.2 to -0.3
- -0.1 to -0.2
- < +- 0.05
- 0.1 to 0.2
- 0.2 to 0.3
- 0.3 to 0.4
- > 0.4
- Was wet, now dry
- Was dry, now wet

Notes:
Aerial photograph: NSW SixMap

N

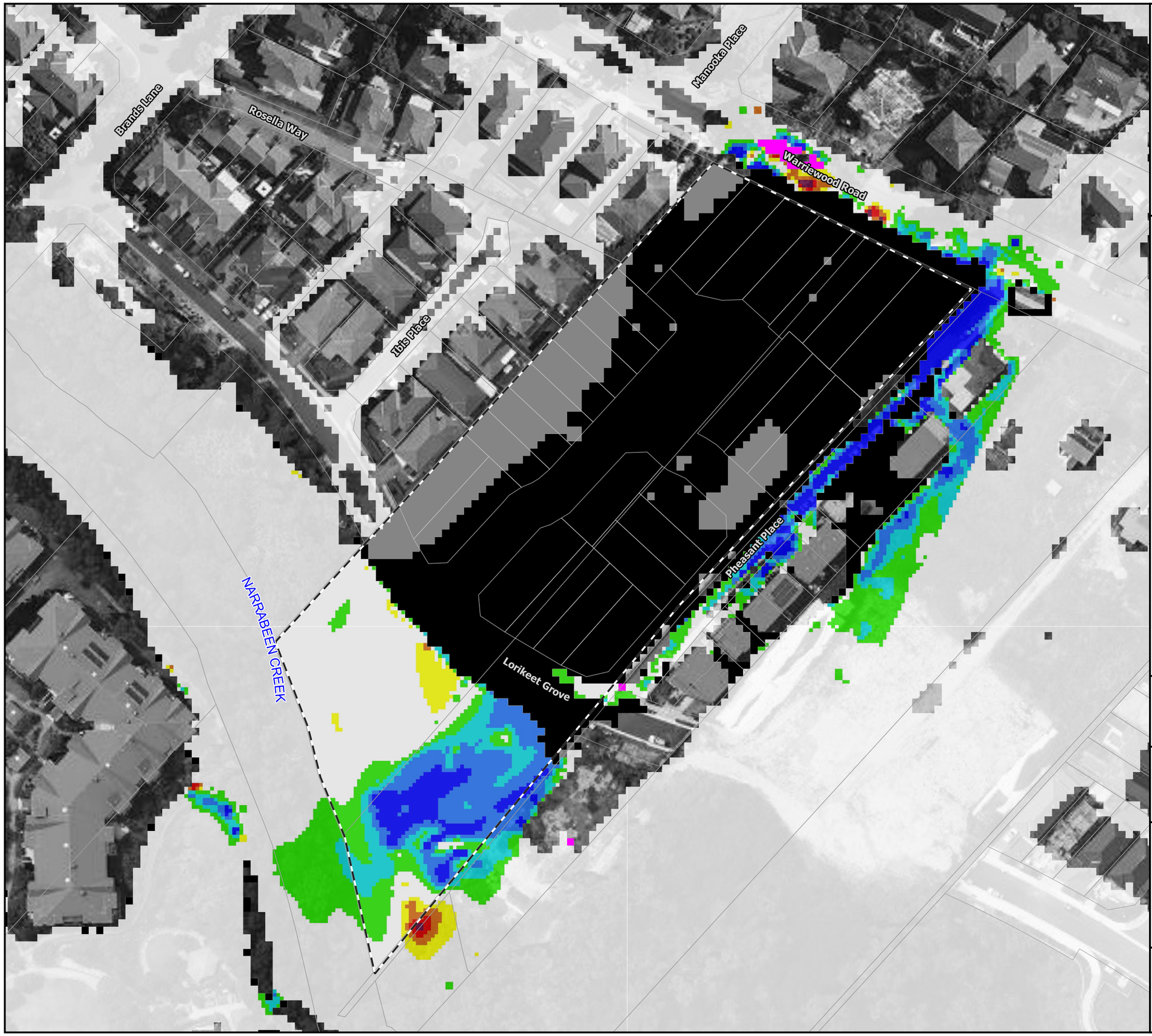
Scale: 1:1000 (at A3)

0 20 40 m

Figure 40 :
Velocity Differences for the 5 Year ARI Flood (30% Climate Change Conditions)

Prepared by:
Catchment Simulation Solutions
Suite 1, Level 10, 70 Phillip St
Sydney, NSW, 2000

File Name: J913_Warriewood_Figure.qgz



LEGEND

- Site Boundary

Velocity Differences (m/s)

- < -0.4
- -0.3 to -0.4
- -0.2 to -0.3
- -0.1 to -0.2
- < +- 0.05
- 0.1 to 0.2
- 0.2 to 0.3
- 0.3 to 0.4
- > 0.4
- Was wet, now dry
- Was dry, now wet

Notes:
Aerial photograph: NSW SixMap

N

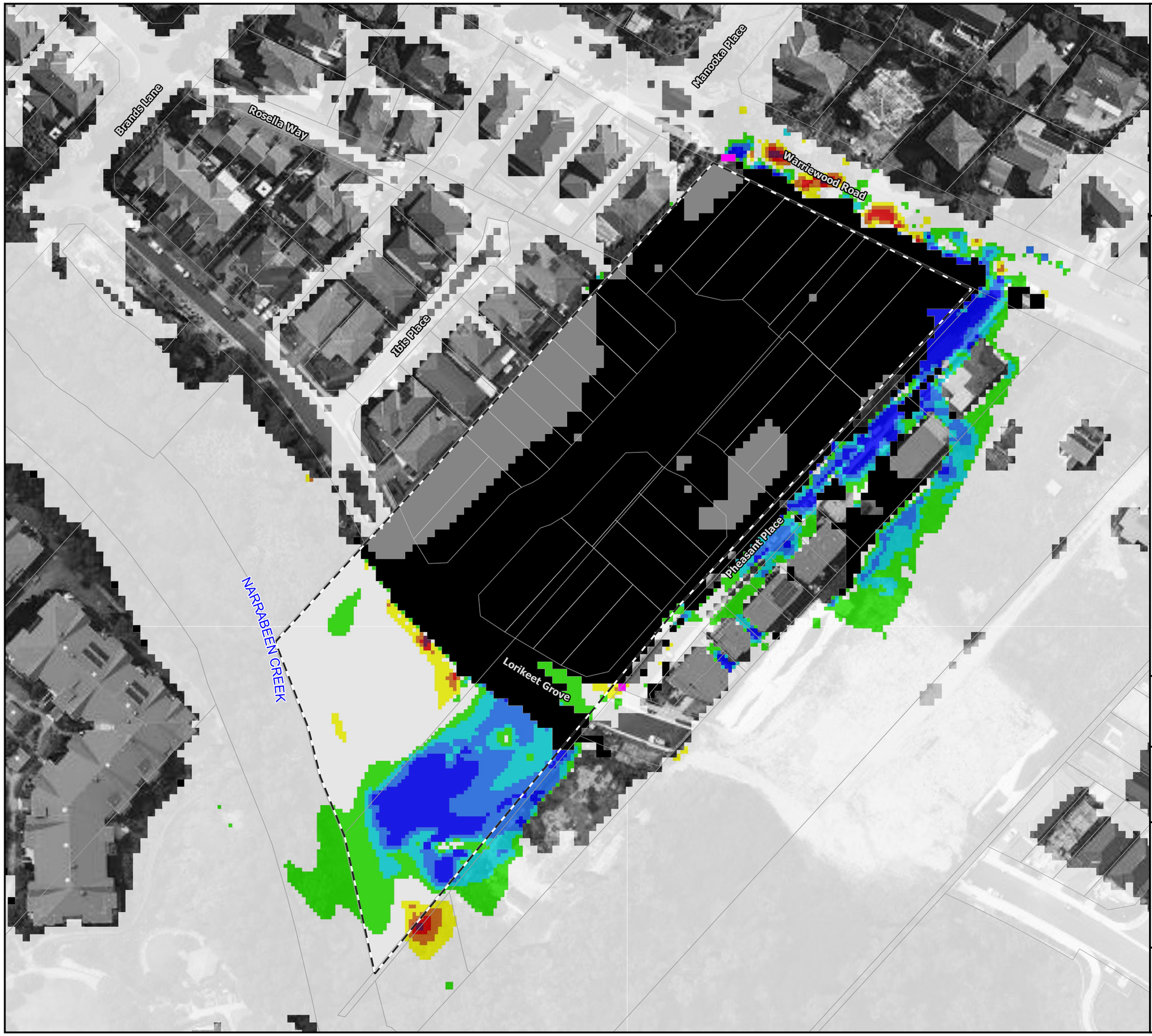
Scale: 1:1000 (at A3)

0 20 40 m

Figure 41 :
Velocity Differences for the 20 Year ARI Flood (30% Climate Change Conditions)

Prepared by:
Catchment Simulation Solutions
Suite 1, Level 10, 70 Phillip St
Sydney, NSW, 2000

File Name: J913_Warriewood_Figure.qgz



LEGEND

- Site Boundary

Velocity Differences (m/s)

- < -0.4
- -0.3 to -0.4
- -0.2 to -0.3
- -0.1 to -0.2
- < +- 0.05
- 0.1 to 0.2
- 0.2 to 0.3
- 0.3 to 0.4
- > 0.4
- Was wet, now dry
- Was dry, now wet

Notes:
Aerial photograph: NSW SixMap

N

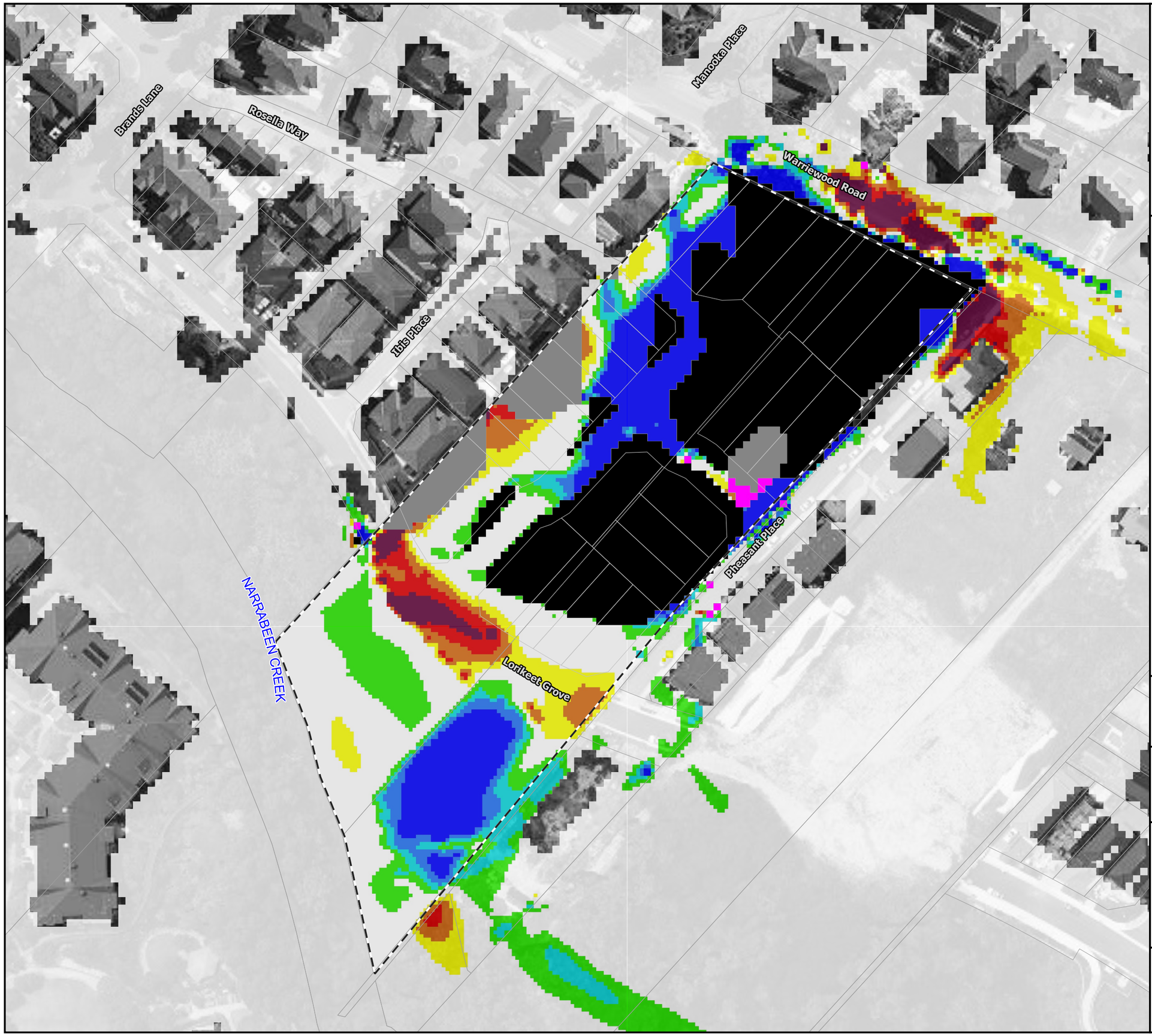
Scale: 1:1000 (at A3)

0 20 40 m

Figure 42 :
Velocity Differences for the 100 Year ARI Flood (30% Climate Change Conditions)

Prepared by:
Catchment Simulation Solutions
Suite 1, Level 10, 70 Phillip St
Sydney, NSW, 2000

File Name: J913_Warriewood_Figure.qgz



LEGEND

- Site Boundary

Velocity Differences (m/s)

- < -0.4
- -0.3 to -0.4
- -0.2 to -0.3
- -0.1 to -0.2
- < +- 0.05
- 0.1 to 0.2
- 0.2 to 0.3
- 0.3 to 0.4
- > 0.4
- Was wet, now dry
- Was dry, now wet

Notes:
Aerial photograph: NSW SixMap

N

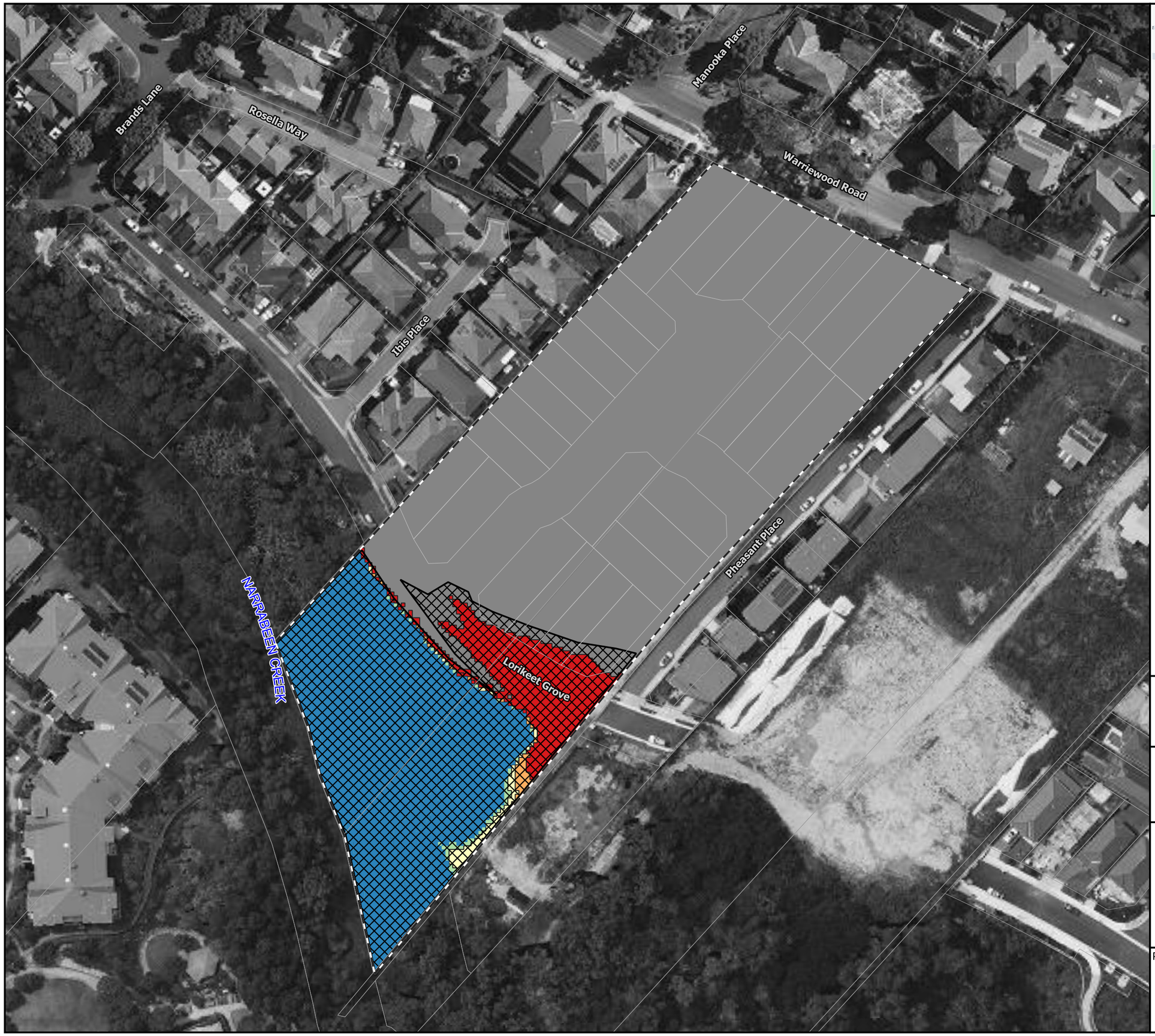
Scale: 1:1000 (at A3)

0 20 40 m

Figure 43 :
Velocity Differences for the PMF (30% Climate Change Conditions)

Prepared by:
Catchment Simulation Solutions
Suite 1, Level 10, 70 Phillip St
Sydney, NSW, 2000

File Name: J913_Warriewood_Figure.qgz



LEGEND

- Site Boundary
- Mainstream Flood Planning Area

Flood Extent

- PMF
- 100 Year ARI
- 20 Year ARI
- 5 Year ARI
- 2 Year ARI

Notes:
Aerial photograph: NSW SixMap

N

Scale: 1:1000 (at A3)

0 20 40 m

Figure 44 :
Flood Extents, Flood Planning Area and Creek Corridor

Prepared by:
Catchment Simulation Solutions
Suite 1, Level 10, 70 Phillip St
Sydney, NSW, 2000

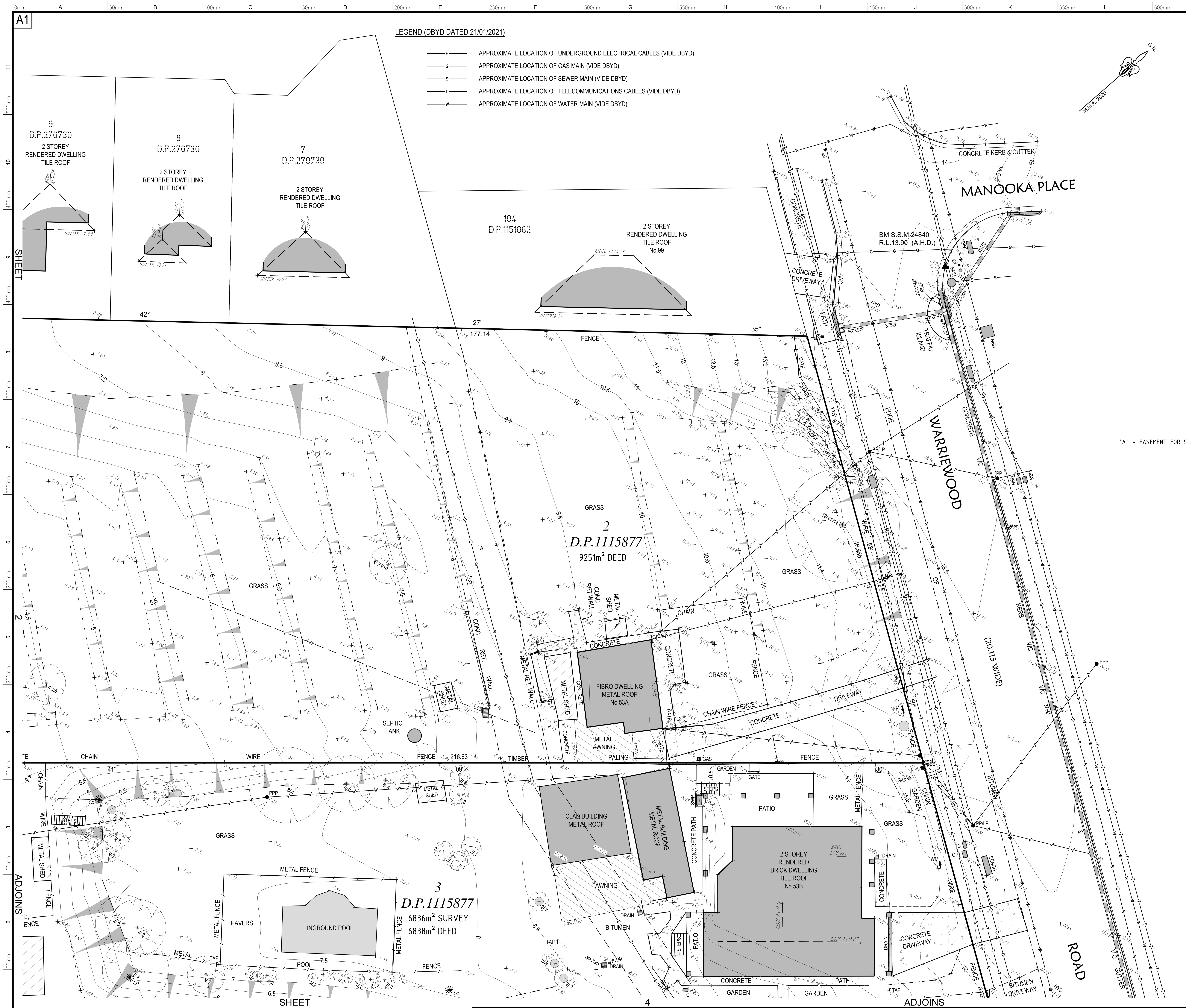
File Name: J913_Warriewood_Figure.qgz

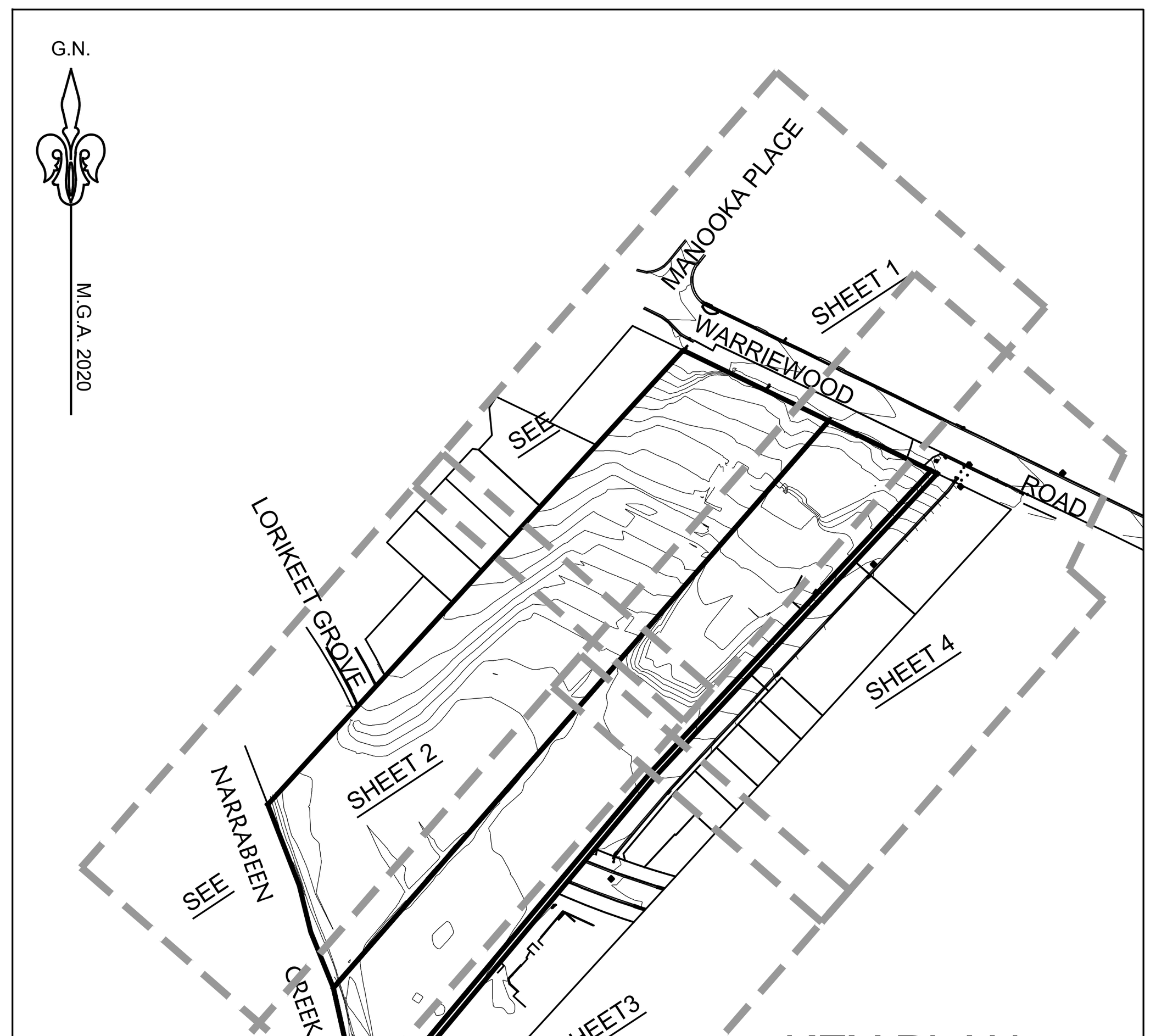
APPENDIX B
SITE SURVEY

A1

LEGEND (DBYD DATED 21/01/2021)

- E — APPROXIMATE LOCATION OF UNDERGROUND ELECTRICAL CABLES (VIDE DBYD)
- G — APPROXIMATE LOCATION OF GAS MAIN (VIDE DBYD)
- S — APPROXIMATE LOCATION OF SEWER MAIN (VIDE DBYD)
- T — APPROXIMATE LOCATION OF TELECOMMUNICATIONS CABLES (VIDE DBYD)
- W — APPROXIMATE LOCATION OF WATER MAIN (VIDE DBYD)





KEY PLAN

SCALE 1:2000

PETER STEWART
REGISTERED LAND SURVEYOR
No.SU008598

LEGEND

- REDUCED LEVEL
- A.H.D. — AUSTRALIAN HEIGHT DATUM
- BM — BENCH MARK
- DRAIN — STORM WATER DRAIN
- EPIL — ELECTRICAL PILLAR
- EPIT — ELECTRICAL PIT
- GAS — GAS METER
- GC — GAS COCK
- WC — WATER COCK
- GATE — GATE
- GP — GULLY PIT
- GULLY PIT WITH LINTEL
- HYD — HYDRANT
- LP — LIGHT POLE
- NBN — NBN PIT
- OPT — OPTUS PIT
- PIT — PIT (SERVICES)
- PP/LP — POWER & LIGHT POLE
- PPP — PRIVATE POWER POLE
- IE — SEWER INSPECTION EYE
- SMH — SEWER MAINTENANCE HOLE
- MS — SEWER MAINTENANCE SHAFT
- S VENT — SEWER VENT
- SV — WATER STOP VALVE
- SWP — STORM WATER PIT
- SS — STREET SIGN
- TAP — TAP (POTABLE WATER)
- TC — TELECOMMUNICATION PIT
- TP — TELSTRA PILLAR
- OVERHEAD POWERLINE
- RAILING
- TOP OF BANK / BOTTOM OF BANK — BATTER
- TREE (SPREAD DIA./TRUNK DIA.)
- V/C — VEHICLE CROSSING
- WM — WATER METER
- CONCRETE

Survey Notes:-

Location of structures approximate only.

The levels and details on this plan have been determined by stadia methods and are within the general accepted accuracies for such surveys. All set out levels must be referred to the bench mark.

Bearings and Distances are by deed only and are subject to Final Survey. Except where shown by dimension, the relationship of improvements to boundaries is diagrammatic only. The true positions are subject to Final Survey.

Tree sizes are estimates and indicative only.

Services and utilities shown have been located by physical evidence and/or by reference to service plans from the relevant authorities. Subsurface utility information shown in accordance with AS5488-2013 QL-D. Pits may not have been opened to verify the type of utility. Excavation has not been carried out to confirm underground location. Service details should be confirmed with the relevant service authority during design and prior to commencement of construction.

As part of your duty of care, please contact the following where necessary :-

Ausgrid	Ph. 131535
Dial Before You Dig	Ph. 1100
Endeavour Energy	Ph. 131081
Jemena Gas Company	Ph. 131245
NBN	Ph. 1800 881 816
Optus Communications	Ph. 1800 505 777
Sydney Water	Ph. 132092
Telstra Corporation	Ph. 132203

This plan has been prepared for the exclusive use of the principal as listed in the title block.

Any construction on or near the boundaries will require further survey so that marks defining boundaries can be placed.

All set out levels must be referred to the bench mark.

1:2000 @ A1

1:200 @ A1

ORIGIN OF LEVELS: S.S.M.24840 R.L.13.902 A.H.D. VIDE SCIMS DATED 17/04/2024
ORIGIN OF COORDINATES: S.S.M.24840 - MGA2020 - EAST 342192.285 , NORTH 6271411.249

AMEND. No.:	DATE:	DETAILS:
02	7/05/2024	LOT 3 D.P.1115877 DETAIL AND ADDITIONAL DETAIL ADDED
01	17/04/2024	SITE AUDIT & UPDATED TO MGA2020
00	02/01/2021	ORIGINAL ISSUE

BEFORE YOU DIG www.byda.com.au — APPROVED COMPANY AS/NZS 4801 — APPROVED COMPANY ISO 14001 — APPROVED COMPANY ISO 9001 — QMS Certification Services

Project: DETAIL SURVEY OVER LOTS 2 & 3 D.P.1115877
No.53A WARRIEWOOD ROAD, WARRIEWOOD

Principal: SEKISUI HOUSE SERVICES (NSW) PTY LIMITED

Scale: 1:200	Date: 02/01/2021	Council Ref.	
	Datum: A.H.D.	L.G.A.: NORTHEN BEACHES	
Calc's: LH	Drawn.: GA	Proj.Man.: BM	Client Ref:

Colliers International Engineering & Design NSW PTY LTD
ABN 77 050 209 991 ACN 050 209 991
Suite 701, Level 7, 3 Rider Boulevard, Rhodes, NSW, 2138
PO Box 3220, Rhodes NSW 2138
Tel. 9869-1855
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www.colliers.com.au

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Our Ref. 434-20

Dwg File Ref. [Rev] - Sheet Ref.
434-20G T01 [02]
- SHEET 01 OF 04

ORIGIN OF LEVELS: S.S.M.24840 R.L.13.902 A.H.D. VIDE SCIMS DATED 17/04/2024

ORIGIN OF COORDINATES: S.S.M.24840 - MGA2020 - EAST 342192.285 , NORTH 6271411.249

5 4 3 2 1 0 5 10

1:200 @ A1

AMEND. No.	DATE	DETAILS
02	7/05/2024	LOT 3 D.P.1115877 DETAIL AND ADDITIONAL DETAIL ADDED
01	17/04/2024	SITE AUDIT & UPDATED TO MGA2020
00	02/01/2021	ORIGINAL ISSUE

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APPROVED COMPANY AS/NZS 4801 — QMS Certification Services

APPROVED COMPANY ISO 14001 — QMS Certification Services

APPROVED COMPANY ISO 9001 — QMS Certification Services

Project:
DETAIL SURVEY OVER LOTS 2 & 3 D.P.1115877
No.53A WARRIEWOOD ROAD, WARRIEWOOD

Principal: SEKISUI HOUSE SERVICES (NSW) PTY LIMITED

Scale: 1:200 | Date: 02/01/2021 | Council Ref.:
Datum: A.H.D. | L.G.A.: NORTHEN BEACHES
Calc's: LH | Drawn.: GA | Proj.Man.: BM | Client Ref.:

Colliers

Colliers International Engineering & Design NSW PTY LTD
ABN 77 050 209 991 ACN 050 209 991
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PO Box 3220, Rhodes NSW 2138
Tel. 9869-1855
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Our Ref.: 434-20

Dwg File Ref. [Rev] - Sheet Ref.: 434-20G T01 [02] - SHEET 02 OF 04

ORIGIN OF LEVELS: S.S.M.24840 R.L.13.902 A.H.D. VIDE SCIMS DATED 17/04/2024
ORIGIN OF COORDINATES: S.S.M.24840 - MGA2020 - EAST 342192.285 , NORTH 6271411.249

1:200 @ A1

AMEND. No.:	DATE:	DETAILS:
02	7/05/2024	LOT 3 D.P.1115877 DETAIL AND ADDITIONAL DETAIL ADDED
01	17/04/2024	SITE AUDIT & UPDATED TO MGA2020
00	02/01/2021	ORIGINAL ISSUE

BEFORE YOU DIG www.byda.com.au

APPROVED COMPANY AS/NZS 4801 — QMS Certification Services
APPROVED COMPANY ISO 14001 — QMS Certification Services
APPROVED COMPANY ISO 9001 — QMS Certification Services

Project:
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- SHEET 03 OF 04

A1

SHEET

ADJOINS

REFER TO SHEET 1 FOR LEGENDS

M.G.A. 2020

WARRIEWOOD ROAD

FIBRO DWELLING METAL ROOF No.53A

CLAD BUILDING METAL ROOF

METAL BUILDING METAL ROOF

2 STOREY RENDERED BRICK DWELLING TILE ROOF No.53B

3 D.P.1115877
6836m² SURVEY
6838m² DEED

D.P.942319

1 D.P.270946
OPEN ACCESSWAY + KNOWN AS "PHEASANT PLACE"

2 D.P.270946

3 D.P.270946

4 D.P.270946

5 D.P.270946

6 D.P.270946

7 D.P.270946

1 D.P.1214859

BM D.H.&W. IN TOP KERB R.L.12.76 (A.H.D.)

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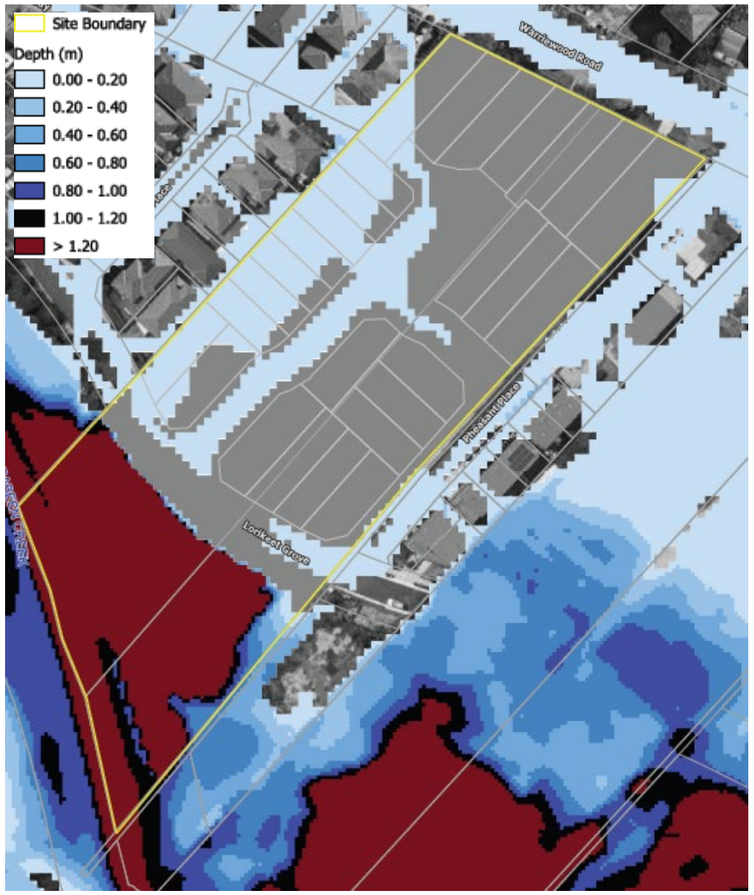
APPENDIX C
DESIGN PLANS

APPENDIX D
FLOOD EMERGENCY RESPONSE PLAN

Flood Emergency Response Plan – 53A 53B Warriewood Rd, Warriewood

Is this area at risk of flooding?

During heavy rainfall, floodwaters from Narrabeen Creek can move past the site. As shown in the 1 in 100 year floodwater depth map below, this floodwater completely inundates the area west of Lorikeet Grove, but Lorikeet Grove and residential lots within the site remain flood free. Roadways surrounding the site may be impacted by floodwater.



The flood characteristics within the western portion of the site during the 1 in 100 year event are characterised by moderate flow velocities of 1m/s and depths exceeding 1.6 metres. Depths of up to 0.15 m on Brooklyn Lane and velocities of up to 3m/s

Flood Emergency Response Plan

Flood characteristics of this nature can be hazardous, and many of the local roads may also be cut by floodwaters. Avoid entering the floodwaters by remaining within the residential lots to ensure that you remain safe.

All siting of buildings within residential lots are located above the peak flood level of all possible floods.

Before a Flood Occurs

It is important to have an understanding of the flood risk within the local area and be familiar with the contents of this plan to aid in taking appropriate action when a flood does occur.

When Heavy Rainfall or Storms Occur

- Occupants should remain within the residential lots to avoid any risk posed by heavy rainfall and storms such as flash flooding.
- All siting of buildings within residential lots are located above the peak flood level of all possible floods.
- Remain within the residential lots until the floodwater has receded.
- Monitor the latest weather forecasts, local media/SES for information, updates, and advice

Evacuation

- Evacuation from the site is not recommended due to the potentially hazardous flooding conditions unless there is a medical emergency. All siting of buildings within residential lots are located above the peak flood level of all possible floods and will be safe to reside in for the duration of the flood event.

After a flood

- Never walk or drive through floodwater.
- Keep active with local media/SES for information, updates, and advice to ensure the flood is over
- Ensure critical services within the building are operational (e.g., water, toilets)
- Have any areas of inundation and utilities professionally cleaned/checked
- Review and update your FloodSafe Plan – could it be improved?

Your FloodSafe Plan:

An emergency plan for each residential lot can be prepared online at: https://www.ses.nsw.gov.au/emergency-planning-tool

However, a "hard copy" should also be maintained and include information on where to find the latest weather forecasts, Flood Watches, Flood Warnings and SES Flood Bulletins.

Site Key Personnel Emergency Contact

Name	Position	Phone Number

For Emergency Help in Floods and Storms Call the SES on

132 500

For life-threatening emergencies call:

000

Northern Beaches Council	**(02) 9470 5900**
SES Website	**http://www.ses.nsw.gov.au/**
BOM Website	**http://www.bom.gov.au/**
RMS Website	**http://www.rms.nsw.gov.au/**

This Flood Emergency Response Plan prepared by:

Catchment Simulation Solutions

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