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Our Reference: 210078_Flood (REV B)

"MARSDEN NETBALL FACILITY"

Lot 1, No.22-42 Winbourne Street, West Ryde

Flood Study Report

Dated: ***1st October 2021***

Prepared by: ***Jason Li*** ***BE (Civil) MSE (Civil) MIEAust***

Checked by: ***Robert Eltobbagi*** ***BE(Civil) MIE Aust CPEng NER (1052208) RPEQ (25464)***

Contents

1 EXECUTIVE SUMMARY

This Report analyses the Local Overland Flooding for the proposed development at ***No.22-42 Winbourne Street, West Ryde***.

The Clients Representative, 'NSW School Infrastructure', is proposing a rezoning of existing Marsden High School site from SP2 Educational Establishment to RE1 Public Recreation. The Site Plan for the proposed development is presented in ***Figure 1.1*** below as prepared by 'COX Architects'.

Figure 1.1: Proposed Site Plan

The **Overland Flow 'Flood' Study** incorporates the following:

- ***Addressing the section 9.1 of the Environmental Planning and Assessment Act 1979, (4.3 Flooding);***
- ***Addressing the 'flood planning controls' per City of Ryde Councils LEP & DCP;***
- ***Design considerations pursuant to 'NSW Floodplain Development Manual 2005' for the purposes of Section 733 Local government Act 1993;***
- ***An assessment of the overland flooding from local upstream catchment affecting the subject site;***
- ***Modelling of overland flow flood behaviours comparing pre & post flood impact on the subject site utilising 2D 'TUFLOW' Flood Model.***

This analysis, modelling & Report outlines the procedures and findings of the hydraulic modelling relative to the subject site for both the pre & post development scenario conditions.

In 'summary', our assessment concluded:

1. ***Off-site flood conditions relative to the proposed rezoning are largely unchanged from the pre-development existing conditions;***

2. ***Proposal for rezoning the existing Marsden High School site from SP2 Educational Establishment to RE1 Public Recreation does not materially affect local flood characteristics;***

3. ***Flood Impact caused by the proposal is negligible (less than 40mm) and is retained within Councils road corridor along Brush Road. Refer to Appendix A Figure A.17 for Flood Impact Map;***

4. ***Proposed indoor court building is not directly impacted by 1%AEP nor PMF Flood extent. Building (indoor courts) floor level RL36.20mAHD is elevated to above PMF Flood Level and provides genuine safety refuge for user of facility;***

5. ***Comprehensive Assessment of 'Council Flood Controls' indicates the proposed rezoning generally complies with 9.1 of the Environmental Planning and Assessment Act 1979, (4.3 Flooding) & Council general 'design intent' requirements.***

2 REFERENCE DOCUMENTS

1. *Site Survey Plan prepared by 'LTS', dated 20th November 2020*
2. *Architectural Plans prepared by 'COX Architects'*
3. *General Arrangement Plan prepared by Henry & Hymas, dated March 2021*
4. *NSW Government Floodplain Development Manual – Management of Flood Liable Land (2005)*
5. *City of Ryde Council DCP 2014*
6. *City of Ryde Council DCP-2014-8.2-stormwater-management-technical-manual*
7. *Flood Information prepared by City of Ryde Council dated 17/05/2021*
8. *Section 9.1(2) Environmental Planning and Assessment Act 1979*

3 LOCAL CATCHMENT

The site is affected by overland flooding from the local upstream catchment. The runoff from the localised upstream catchment traverses' overland through the low-lying areas of the catchment until it reaches subject site.

As the upstream catchment runoff exceeds the capacity of the existing inground drainage infrastructure, overland flooding enters and traverses the subject site mainly from the northern boundary via the upstream properties and western boundary (from Winbourne Street). The overland flow is then be conveyed via a contained gully through the subject site before exiting onto Brush Road.

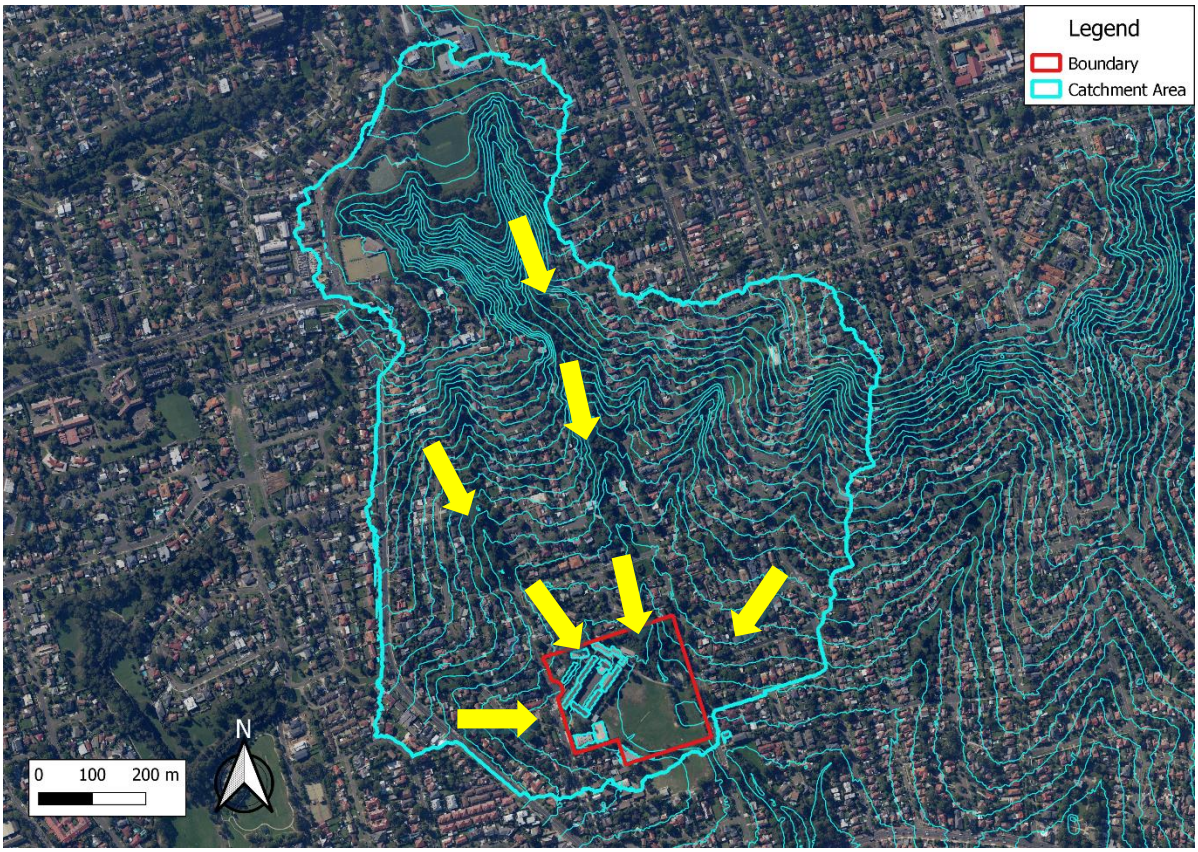

Figure 3 Catchment Plan

4 GLOSSARY

Annual Exceedance Probability (AEP)

The chance of a flood of a given or a larger size occurring in any one year, usually expressed as a percentage i.e. 1%AEP is equivalent to 100 Year ARI

Australian Height Datum (AHD)

A common national surface level datum approximately corresponding to mean sea level.

Catchment

The land area draining through the main stream, as well as tributary streams, to a particular site. It always relates to an area above a specific location.

Flood

Relatively high stream flow which overtops the natural or artificial banks in any part of a stream, river, estuary, lake or dam, and/or local overland flooding associated with major drainage before entering a watercourse.

Flood Planning Levels (FPLs)

Are the combinations of 1% AEP (100YR ARI) flood levels and freeboards selected for floodplain risk management purpose.

Freeboard

Is a factor of safety typically used in relation to the setting of floor levels.

Peak Discharge

The maximum discharge occurring during a flood event.

Probable Maximum Flood

PMF is the largest flood that could conceivably occur at a location, usually estimated from probable maximum precipitation.

High Flood Risk Precinct

Land below the 1% AEP (100-year) flood that is either subject to a high hydraulic hazard or where there are significant evacuation difficulties.

Medium Flood Risk Precinct

Land below the 1% AEP (100-year) flood that is not subject to a high hydraulic hazard and where there may be some evacuation difficulties.

Low Flood Risk Precinct

All other land within the floodplain (i.e. within the extent of the probable maximum flood) but not identified within either the High Flood Risk or the Medium Flood Risk Precinct.

Hazard

Is a source of potential harm or a situation with a potential to cause loss. In relation to this plan, the hazard is flooding which has the potential to cause harm or loss to the community.

Hydraulic Hazard

Is the hazard as determined by the provisional criteria outlined in the FMM in a 1% Annual Exceedance Probability (AEP) flood event.

Local Overland Flooding

Local overland flooding means inundation by local runoff rather than overbank discharge from a stream, river, estuary, lake or dam.

5 AUTHORITIES REQUIREMENTS

Section 9.1(2) of the Environmental Planning and Assessment Act 1979 (4.3 Flooding)

The objective of direction:

a) *to ensure that development of flood prone land is consistent with the NSW Government's Flood Prone Land Policy and the principles of the Floodplain Development Manual 2005.*
b) *to ensure that the provisions of a local environmental plan that apply to flood prone land are commensurate with flood behaviour and include consideration of the potential flood impacts on and off the subject land.*

A planning proposal must include provisions that give effect to and are consistent with:

a) *the NSW Flood Prone Land Policy,*
b) *the principles of the Floodplain Development Manual 2005,*
c) *the Considering flooding in land use planning guideline 2021, and*
d) *any adopted flood study and/or floodplain risk management plan prepared in accordance with the principles of the Floodplain Development Manual 2005 and adopted by the relevant council.*

A planning proposal must not rezone land within the flood planning area from Recreation, Rural, Special Purpose or Environmental Protection Zones to a Residential, Business, Industrial or Special Purpose Zones

A planning proposal must not contain provisions that apply to the flood planning area which:

a) *permit development in floodway areas,*
b) *permit development that will result in significant flood impacts to other properties,*
c) *permit development for the purposes of residential accommodation in high hazard areas,*
d) *permit a significant increase in the development and/or dwelling density of that land,*
e) *permit development for the purpose of centre-based childcare facilities, hostels, boarding houses, group homes, hospitals, residential care facilities, respite day care centres and seniors housing in areas where the occupants of the development cannot effectively evacuate,*
f) *permit development to be carried out without development consent except for the purposes of exempt development or agriculture. Dams, drainage canals, levees, still require development consent,*

g) *are likely to result in a significantly increased requirement for government spending on emergency management services, flood mitigation and emergency response measures, which can include but are not limited to the provision of road infrastructure, flood mitigation infrastructure and utilities, or (h) permit hazardous industries or hazardous storage establishments where hazardous materials cannot be effectively contained during the occurrence of a flood event..*

A planning proposal must not contain provisions that apply to areas between the flood planning area and probable maximum flood to which Special Flood Considerations apply which:

a) *permit development in floodway areas,*
b) *permit development that will result in significant flood impacts to other properties,*
c) *permit a significant increase in the dwelling density of that land,*
d) *permit the development of centre-based childcare facilities, hostels, boarding houses, group homes, hospitals, residential care facilities, respite day care centres and seniors housing in areas where the occupants of the development cannot effectively evacuate,*
e) *are likely to affect the safe occupation of and efficient evacuation of the lot, or*
f) *are likely to result in a significantly increased requirement for government spending on emergency management services, and flood mitigation and emergency response measures, which can include but not limited to road infrastructure, flood mitigation infrastructure and utilities.*
g) *For the purposes of preparing a planning proposal, the flood planning area must be consistent with the principles of the Floodplain Development Manual 2005 or as otherwise determined by a Floodplain Risk Management Study or Plan adopted by the relevant council.*

6 HYDROLOGY

A hydrologic model combines rainfall information with local catchment characteristics to estimate a runoff hydrograph. For this study, all hydrological data sets were obtained from Councils 'TUFLOW' model - *Parramatta River Ryde Sub Catchments.*

Based on the Councils 'TUFLOW' model simulation results, the 1% AEP (100YR ARI) and PMF critical storm duration adopted for this study is 90min duration. The critical storm event is predefined in the 'TUFLOW' model for Design Run. The TUFLOW modelling results adopted this default set in the Councils model and deemed satisfactory for the purpose of this report.

7 HYDRAULIC

7.1 Definition

A hydraulic model converts runoff (traditionally from a hydrological model) into water levels and velocities throughout the major drainage/creek systems in the study area (known as the model 'domain', which includes the definition of both terrain and roughness).

The model simulates the hydraulic behaviour of the water within the study area as potential overland flow paths, which develops when the capacity of the channel(s) is exceeded. The model is established in conjunction with boundary conditions, which include upstream runoff hydrographs generated by 'TUFLOW' model and appropriate downstream boundary.

7.2 Model Topographic Surface

The DEM data included in the model was extrapolated from the ALS datasets. The data sets were obtained from councils 'TUFLOW' model - Parramatta River Ryde Sub Catchments

7.3 '2D' Model Set-up

'TUFLOW' hydraulic modelling was then carried out to determine the flood behaviour within the catchment area. Grid spacing of **3m x 3m** was adopted for the 'TUFLOW' flood model and deemed satisfactory to define the flood extent through the developed areas in the vicinity of the subject property.

7.4 Model '2D' Roughness

ID	Manning Roughness n	Land Type
1	0.02	Road
2	0.1	Urban Residential
3	0.025	Urban- units, commercial, inductrual
4	0.04	Special Use and Misc
5	0.04	Train corridor
6	0.03	Grass
7	0.05	Vegetated
8	0.07	Vegetated Thick
9	0.03	Water
10	0.05	dummy roughness

Table 7.4: Manning's Roughness Coefficient
(Parramatta River Ryde Sub Catchments)

7.5 Upstream & Downstream Boundary Condition

The upstream and downstream boundary conditions were defined by the Council 'TUFLOW' model.

7.6 Adopted Drainage Network

For this study, all in-ground stormwater drainage pits & pipes located within the study area has been incorporated into the Council 'TUFLOW' model. Quantum Engineers have set the in-ground drainage system to **50% Blockage** for this assessment.

7.7 'TUFLOW' Post Development Model Terrain

In the post development state, future building footprints was incorporated and modelled within the 'TUFLOW' model as elevated structures on ground. In the post development scenario 'TUFLOW' input, the existing site terrain is replaced by the Civil Site Grading terrain prepared by 'Henry & Hymas' to assess the impact of the proposed development.

The Netball Court levels and site benching are incorporated to the post development terrain model which overlay the existing terrain on site. Flood mitigation measures such as proposed Grass Swell locations are indicated in the Figure 7.7. The proposed Grass Swell and Bioretention Basin was incorporated to the post development terrain data to perform the runoff diversion.

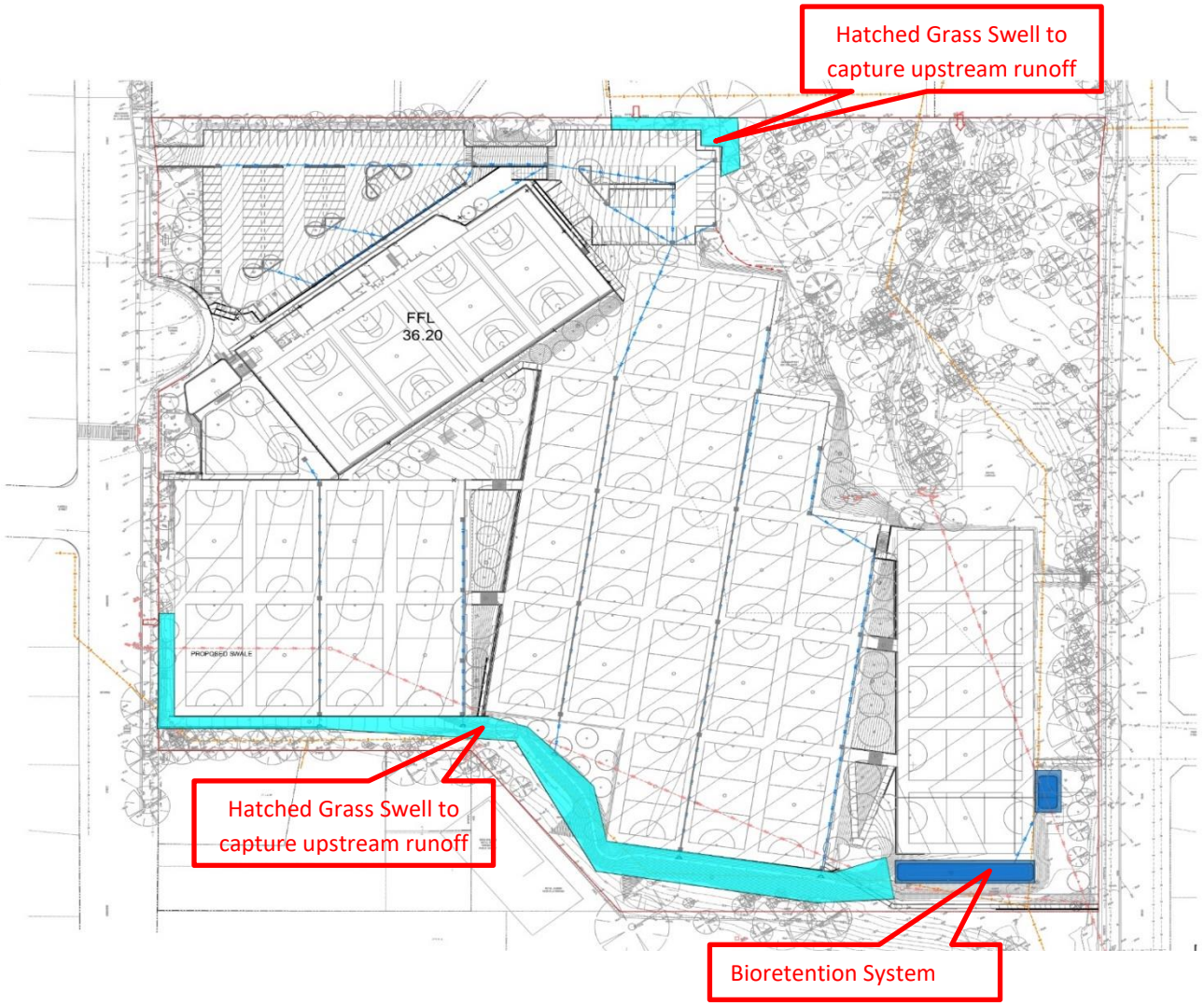

Figure 7.7 Flood Mitigation Measures

8 FLOOD HAZARD CLASSIFICATION

Hazard categories are defined as either **high, intermediate or low hazard** and are based on the guidelines outlined in the **Floodplain Development Manual 2005 (NSW DIPNR 2005)**.

Safety of people in floods is of major concern. As such, an assessment of the **1%AEP Provisional Flood Hazard** (*Velocity & Depth product at 0.2 m^2/s interval*) is presented in ***Appendix A - Figures A.3 & A.7***

Based on the Hazard criteria outlined in ***Figures 8***, the **Provisional Flood Hazard Maps** have been generated for both the pre-development and post development scenario's to assist in understanding the potential relevant flood hazard.

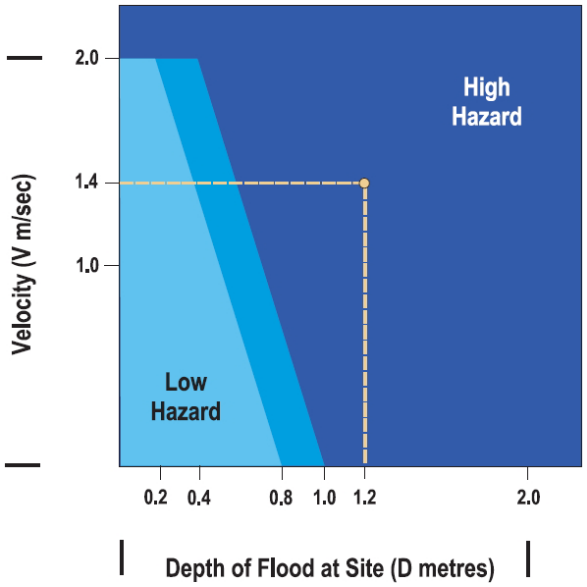

Figure 8 Provisional Flood Hazard Classification (NSW DIPNR 2005)

Pre Development Hazard:

The existing Marsden High School main buildings are impacted by High Flood Risk flooding during 1%AEP event **(Refer to Appendix A Figure A.3**). The building structure located at the southwestern corner was constructed within the major overland flowpath and impeding the existing floodway. This may result in life danger for any occupants who use the educational facility. According to City of Ryde Council DCP, building structure should not be permitted in High Flood Risk area.

Post Development Hazard:

The modelling revealed that for the **1%AEP Post-development Flood Hazard Classification Map (*Refer to Appendix A – Figure A.7*)**, the proposed indoor court building is located outside of the 1%AEP flood extent, the resulting Hazard Category's were confirmed:

- ***Netball Courts (except for Lower Court Terrace) and Carpark – Low Hazard***
- **Lower Court Terrace – Low to High Hazard**
- **Grass Swell – Low to High Hazard -**

The Grass Swell as proposed will capture & drain most of the upstream overland flow to the proposed bioretention system. Majority of Netball Courts are under Low Hazard or not impacted by flooding. A portion of the lower carparking is affected by Low Hazard flooding, but the water depth is less than 300mm which is considered safe for vehicle access. The lower terrace Netball Courts are subject to High Hazard Category during both the 1%AEP and PMF storm events. Access is provided to higher level above PMF for the Lower Court Terrace. Evacuation warning system and flood signage must be in place to mitigate potential flood risk.

As such, during the 1%AEP storm event, it can be concluded that the Hazard Category for egress off-site evacuation from the proposed building and netball courts are generally **safe** for people and vehicles.
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9 COUNCIL REQUIREMENT

This section of the Report demonstrates how the Proposed Rezone will achieve Council's requirements as outlined in City of Ryde Council DCP.

Land Use Category: **Recreation and Non-Urban**

9.1 Floor Level

Proposed building (indoor courts) is positioned outside of 1%AEP Flood extent. Most net ball courts are elevated to above 1%AEP Flood Level or slightly inundated by flood water except for the lower courts adjacent to Brush Road. Evacuation strategy will be implemented and flood signage will be installed to provide sufficient warning to future users.

Car Park level is significantly above 1% AEP (100YR ARI) flood level with over 500mm freeboard except for the eastern portion of the lower parking area is subject to flood water inundation. It is deemed safe for vehicular access provided that the Flood Hazard is classified as Low (NSW DIPNR 2005).

9.2 Building Component & Structural Soundness

New structures including netball courts and carparking subject to flooding and overland flow must be designed & constructed to withstand the anticipated hydrostatic forces.

For all parts of the development potentially exposed to floodwater, the development structure must:

i) All structures to have flood compatible building components below or at the 1%AEP Flood Level

ii) A structural engineer must certify that the completed works are designed and capable of withstanding forces subject to forces of floodwater, debris, buoyancy forces anticipated by the 1%AEP flood event.

9.3 Flood Affectation

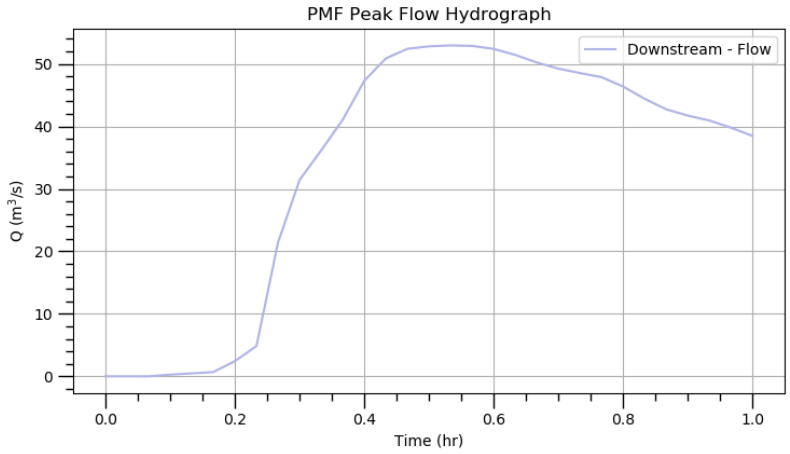
The modelling results undertaken for this Overland Flow Flood Study indicates that the proposed development will have **negligible overall difference in flood depth & flood velocity (*pre to post*)** immediately upstream or downstream during the 1% AEP (100YR ARI) flood event. The flood increase

is contained within the site alone and Council road infrastructure (Brush Road). Water level difference within Brush Road is up to 40mm which is considered insignificant. As such, it can be safely concluded that there is no adverse impact on neighbouring properties ***(Refer to Appendix A Figure A.17)***

10 FLOOD EVACUATION STRATEGY

To minimise risk to personal safety of personal on the subject premises, evacuation strategies shall be prepared and implemented in order to mitigate the flood water impacts due to the land use nature of the proposed rezoning.

The proposed lower terrace Netball Courts adjacent Brush Road will be exposed to High Hazard during 1%AEP and PMF storm events. In reference to the site-specific flood modelling undertaken, the peak runoff will occur at 0.5Hr (30min) during PMF storm event (refer to PMF Peak Flow Hydrograph generated at the downstream boundary location).



The evacuation time of people on site during the PMF storm event flood conditions will be less than 5mins. It has been calculated that this will provide sufficient time to evacuate to higher ground even for the furthest point of the site which is the lower terrace Netball Courts.

The State Emergency Service of New South Wales (NSW SES) is responsible for providing flood updates and issuing Flood Evacuation Warnings and Flood Evacuation Orders. Flood information issued by the NSW SES may be received by local, radio and television news, SMS messaging, Facebook and doorknocking in affected communities.

The Evacuation Route is prepared as below:

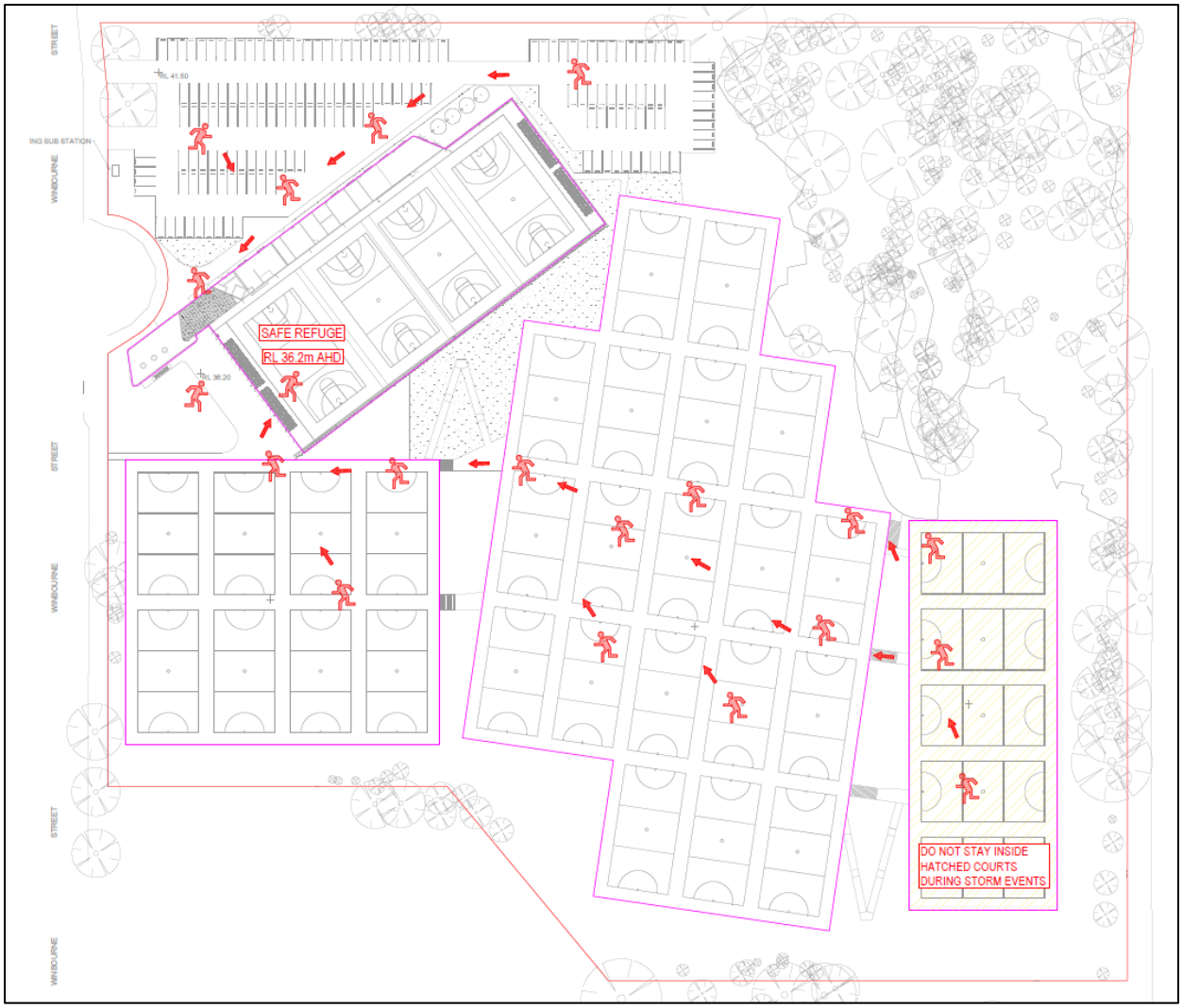
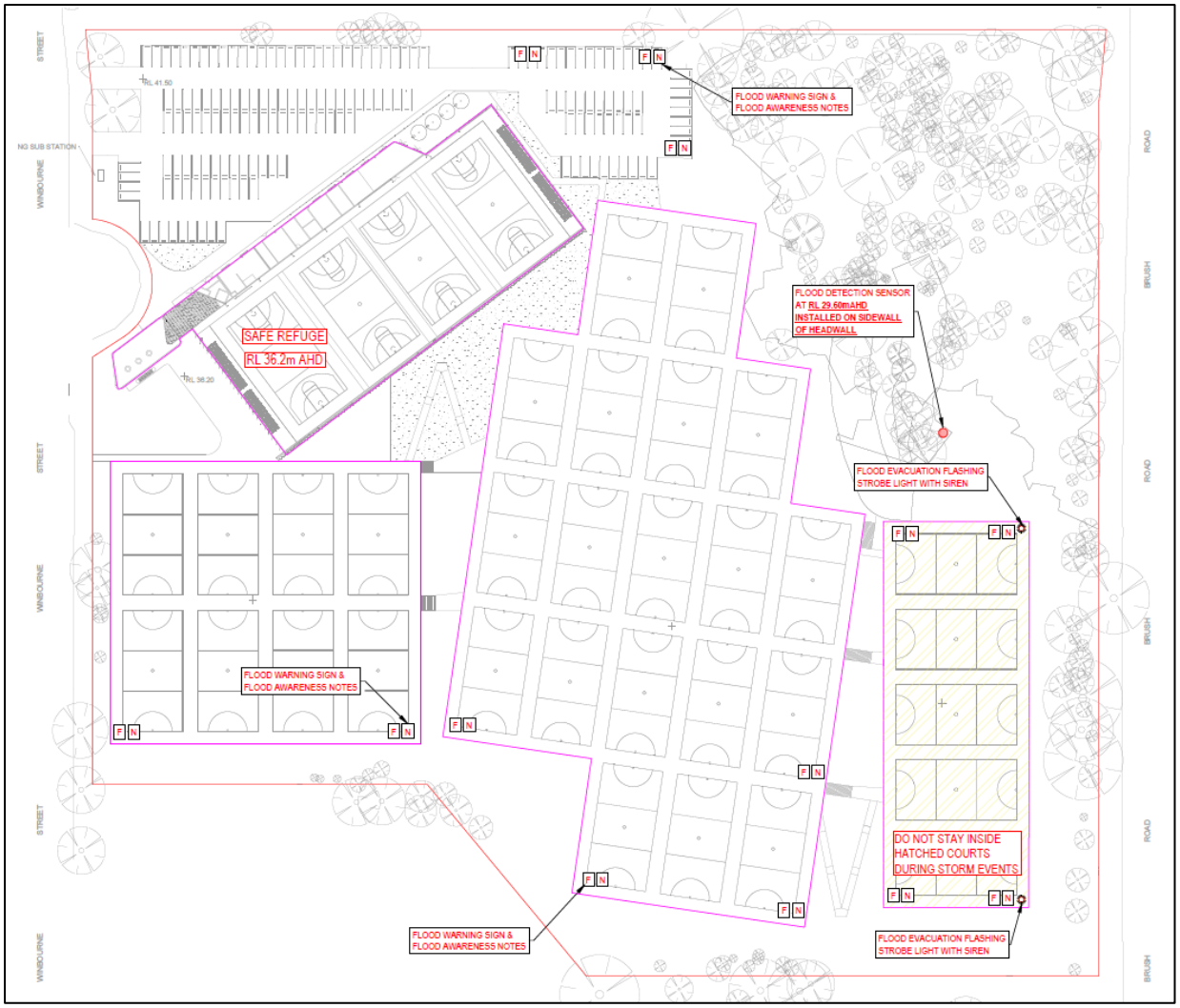


Figure 10.1 Evacuation Route

Flood Signage is to be installed on site to increase flood awareness for all users. A warning system is to be installed which will sound an audible and visual alarm in the event that floodwaters approach the top of the inground pipe system under the lower terrace Netball Courts. The trigger for the alarm system will be set to RL29.60mAHD which is 50% pipe capacity.

The purpose of the alarm is to provide clear warning to all users of the imminent threat of flooding and provide sufficient time for evacuation.



F FLOOD WARNING SIGN

N FLOOD AWARENESS NOTES

FLOOD AWARENESS NOTE:

1. For people remain on site, continually monitor the surface flow through the courts, especially from the lower terrace.
2. Do not stay inside the lower outdoor courts during wet weather. no attempt should be made to travel through water on foot under any circumstances
3. If it is necessary to travel during in storm events, observe the flow in winbourne street before entering the site.
4. If flood water build up in the lower terrace, all users should move higher ground near the indoor courts building.

FLOOD WARNING SIGNAGE
NTS

Figure 10.2 Flood Signage and Alarm Location

11 CONCLUSION & RECOMMENDATION

This Report has been undertaken on the subject site (No.22-42 Winbourne Street, West Ryde) and the proposal for rezoning the existing Marsden High School site from SP2 Educational Establishment to RE1 Public Recreation.

A two-dimensional hydraulic model ('TUFLOW') was constructed for this study which modelled the overland flow from the local upstream catchment with a cell size of 3m x 3m (entire model). The 'TUFLOW' model was undertaken to simulate the overland flood contributing the subject site. The flood model was obtained from City of Ryde Council to ensure consistency with Councils Overland Flood Study (Parramatta River Ryde Sub Catchments).

Utilising the 2D 'TUFLOW' hydraulic model, the flood behaviour during 1% AEP (100YR ARI) & PMF storm events was determined. The flood water depth, flood levels, provisional hydraulic hazard and velocities generated by the 'TUFLOW' model were assessed in this study. Our assessment has revealed 'negligible' increase in off-site floodwater depth from pre to post development scenarios.

It is note that the proposed building is not directly impacted by both the 1%AEP and PMF flood extent (Refer to Appendix A Figure A.5 and Figure A.13)

Flood Warning System & Flood Warning Signage to be installed in an appropriate location to inform occupants of the danger of imminent flooding;

The proposed Grass Swell along the southern boundary and northern boundary has been designed to collect & direct significant overland flow runoff from the impeding major storm events. Refer to Figure 7.7. The Grass Swell will be enclosed by open style fencing to restrict access to such areas affected by hazardous overland flows.

Any boundary fence/wall over the estimated flood extent must be replaced with open type in order to allow unimpeded passage of overland floodwater.

All Proposed Netball Courts are in Low Flood Risk Precinct except for the lower terrace Netball Courts which is within the High Hazard Category precinct as shown in Appendix A Figure A.3 and Figure A.7. Evacuation Access is available to higher ground on the subject site or to safe locations along Brush Road. Provided the evacuation route is less than 5minutes, these areas will not post any significant risk to future users. To alert users to an impeding flood event, a 'warning system' is to be installed which will sound an audible and visual alarm.

A 'Flood Impact Assessment' was also undertaken to determine the impact of the proposed development on the behaviour of 1% AEP floodwaters. The off-site flood water level increase is contained within Councils road infrastructure along Brush road which is able to satisfactorily convey major overland flow runoff. Most importantly, there is no significant impact to any upstream and downstream private properties (Refer to Appendix A Figure A.17)

The outcome of the Flood Study revealed the proposed rezoning generally complies with the objectives outlined in Section 4.3 Flood under Section 9.1 of the Environmental Planning and Assessment Act 1979. The preparation of the report is consistent with the NSW Governments Flood Prone Land Policy, Local Government Flood Policy and generally meet the principles of the Floodplain Development Manual 2005 except for Item (6) (a) – 'A planning proposal must not contain provisions that apply to the flood planning area

which permit development in floodway areas.' The lower netball courts terrace is located within Floodway Area.

Given the planning proposal is to seek rezoning from SP2 Educational Establishment to RE1 Public Recreation, we are of the view that this rezoning will reduce the overall population density of that land and will reduce flood liability on the owner of this flood prone property. Additionally, the flood study will incorporate evacuation strategy and mitigation measures to address the potential flood risk to future users.

We expect Council/Planning Panel considers on merit basis the non-compliant item, having due regard for the proposed flood protection measures detailed in the flood study.

APPENDIX A

'TUFLOW' Flood Modelling Flood Results

(Prepared by Quantum Engineers)

Flood Mapping:

Flood Impact:

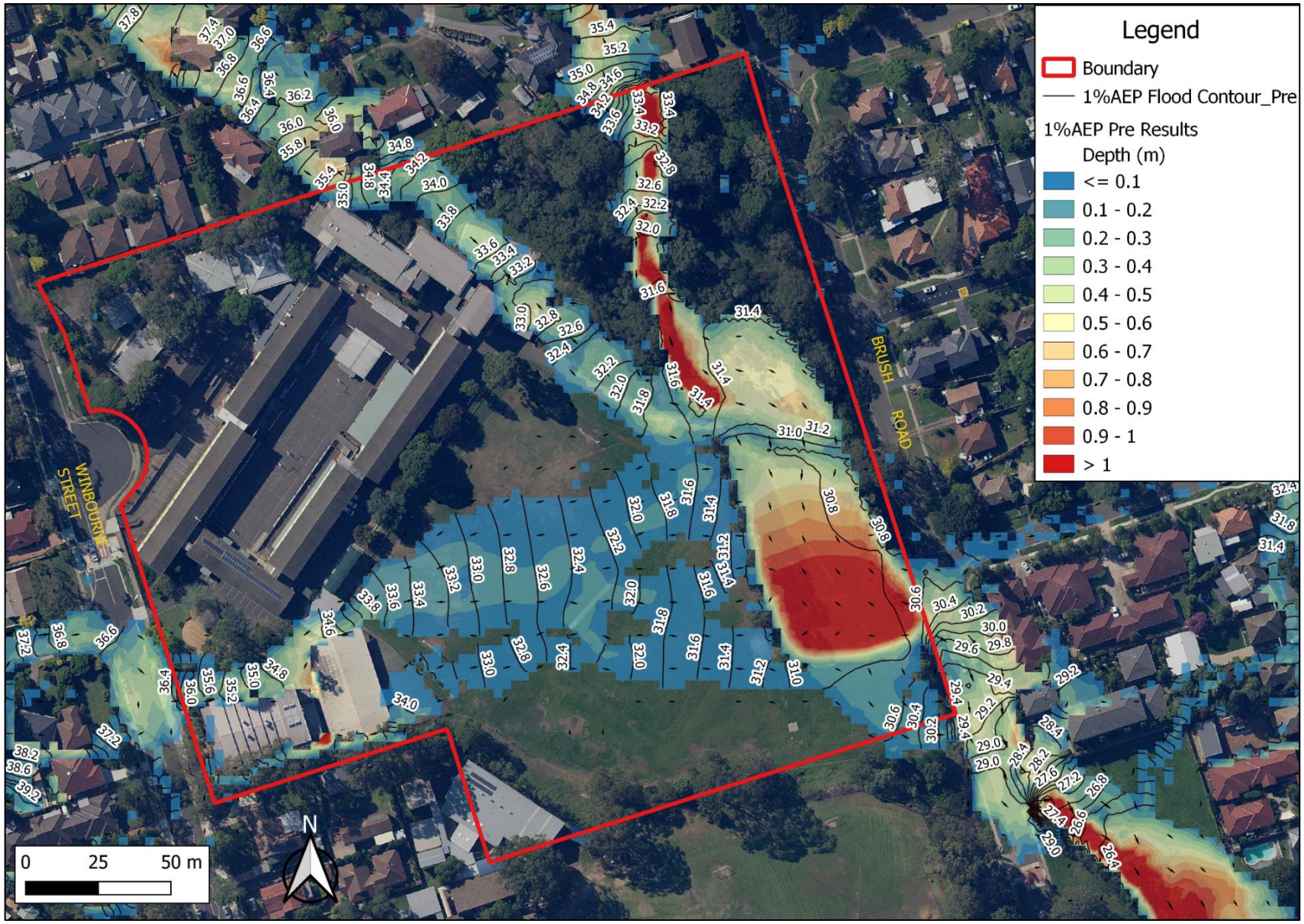


Figure A.1 1% AEP Flood Depth & Contours – Pre Development

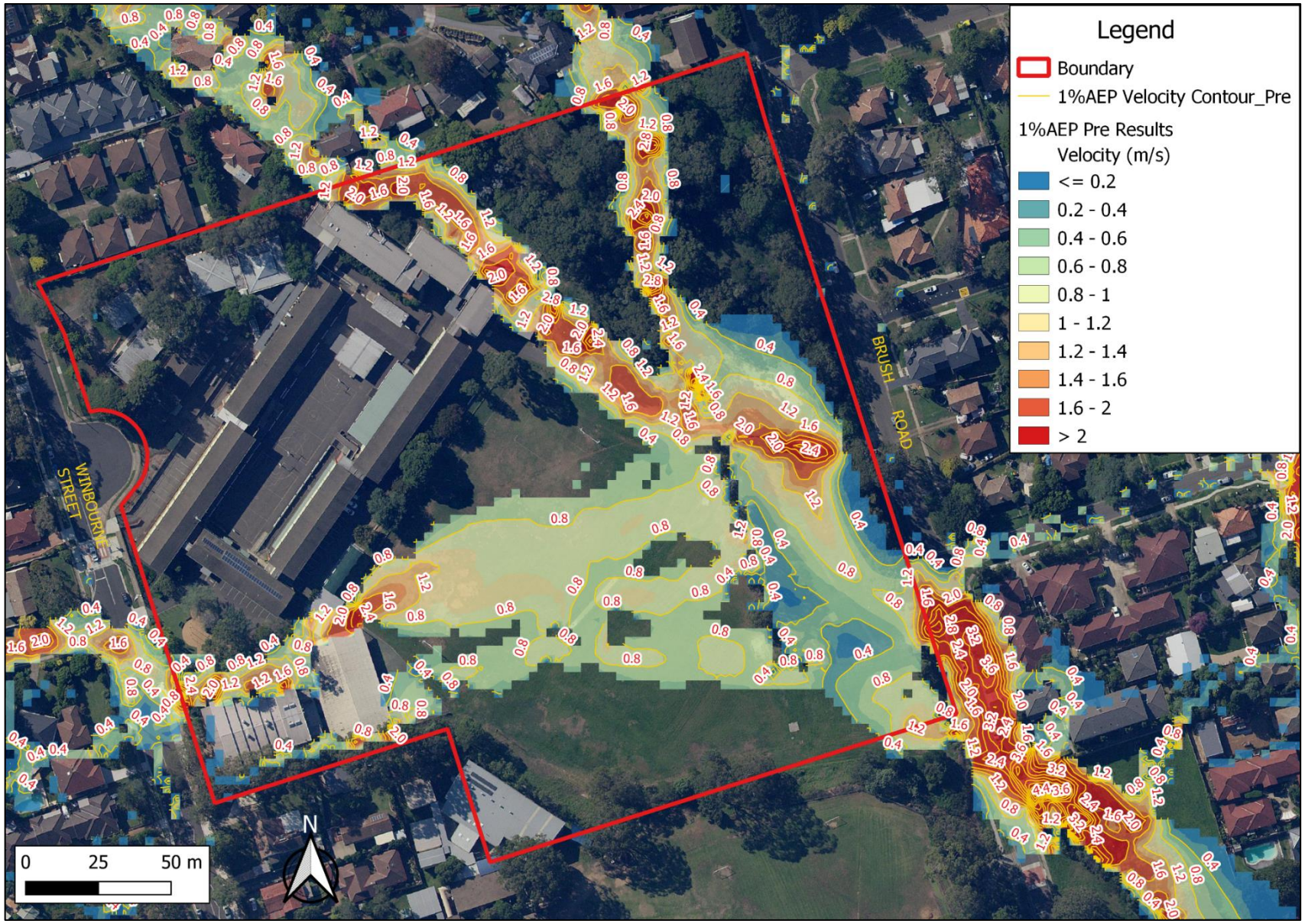


Figure A.2 1% AEP Flood Velocity – Pre Development

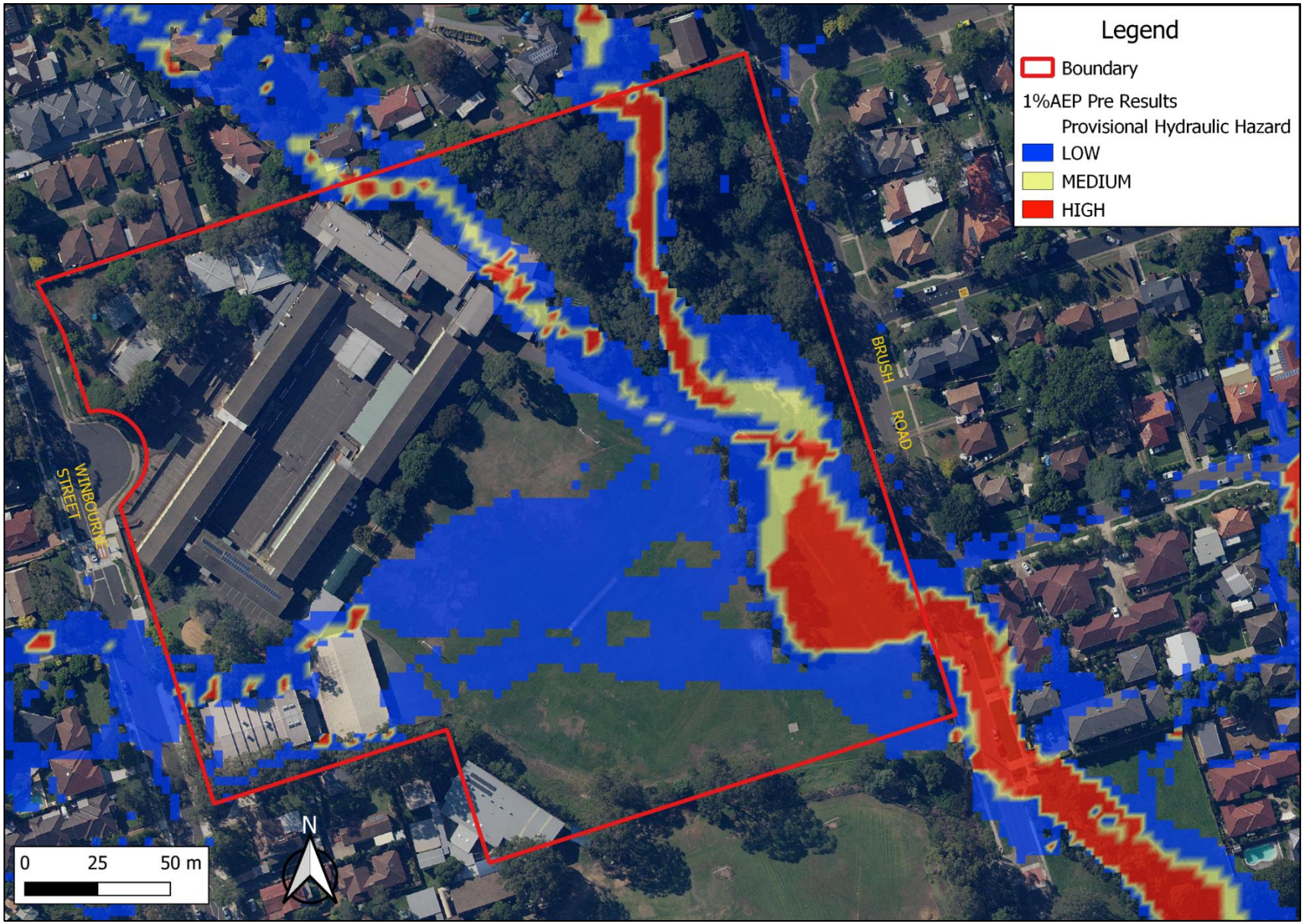


Figure A.3 1% AEP Flood Risk Precincts – Pre Development

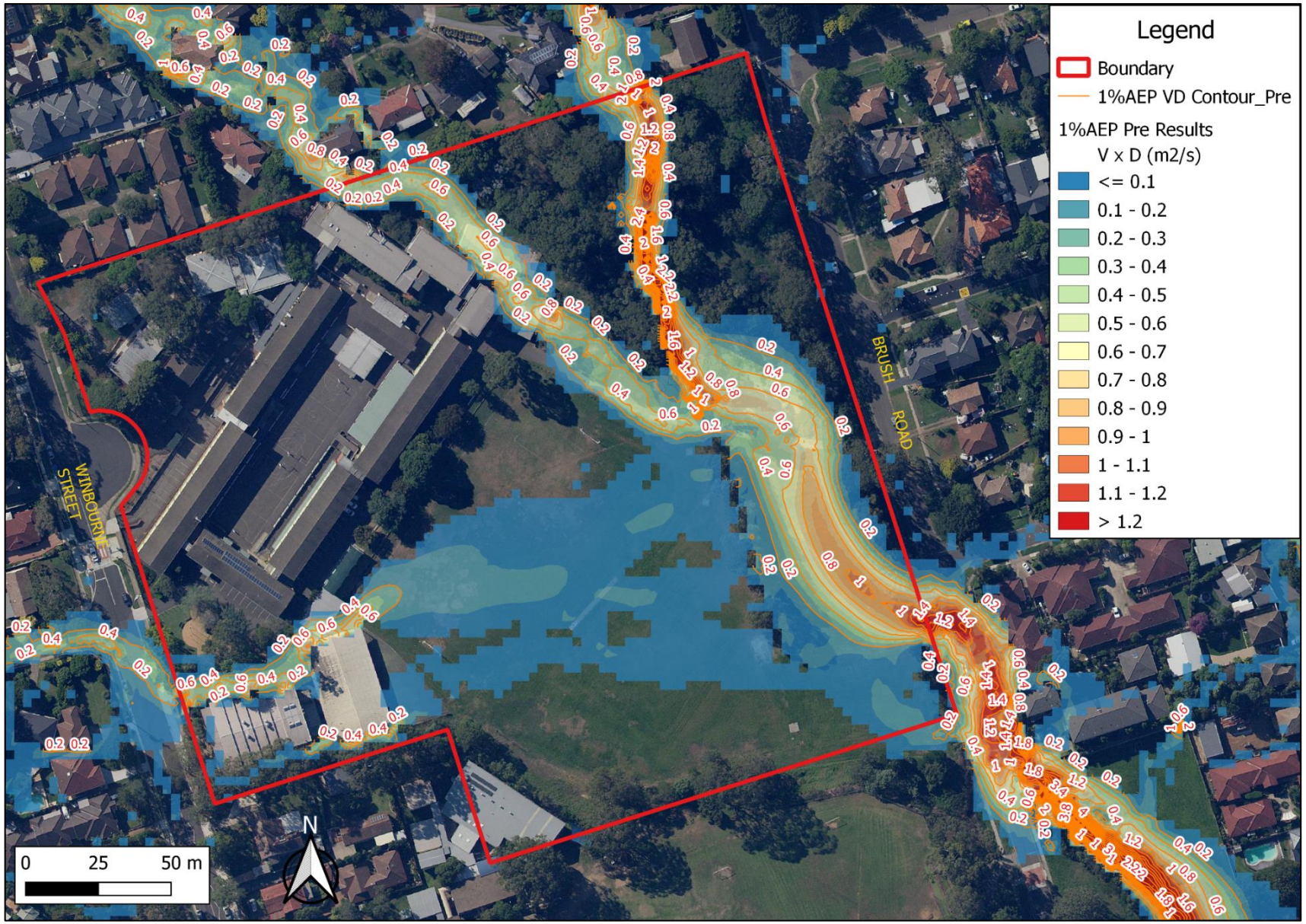


Figure A.4 1% AEP Velocity Depth Product– Pre Development

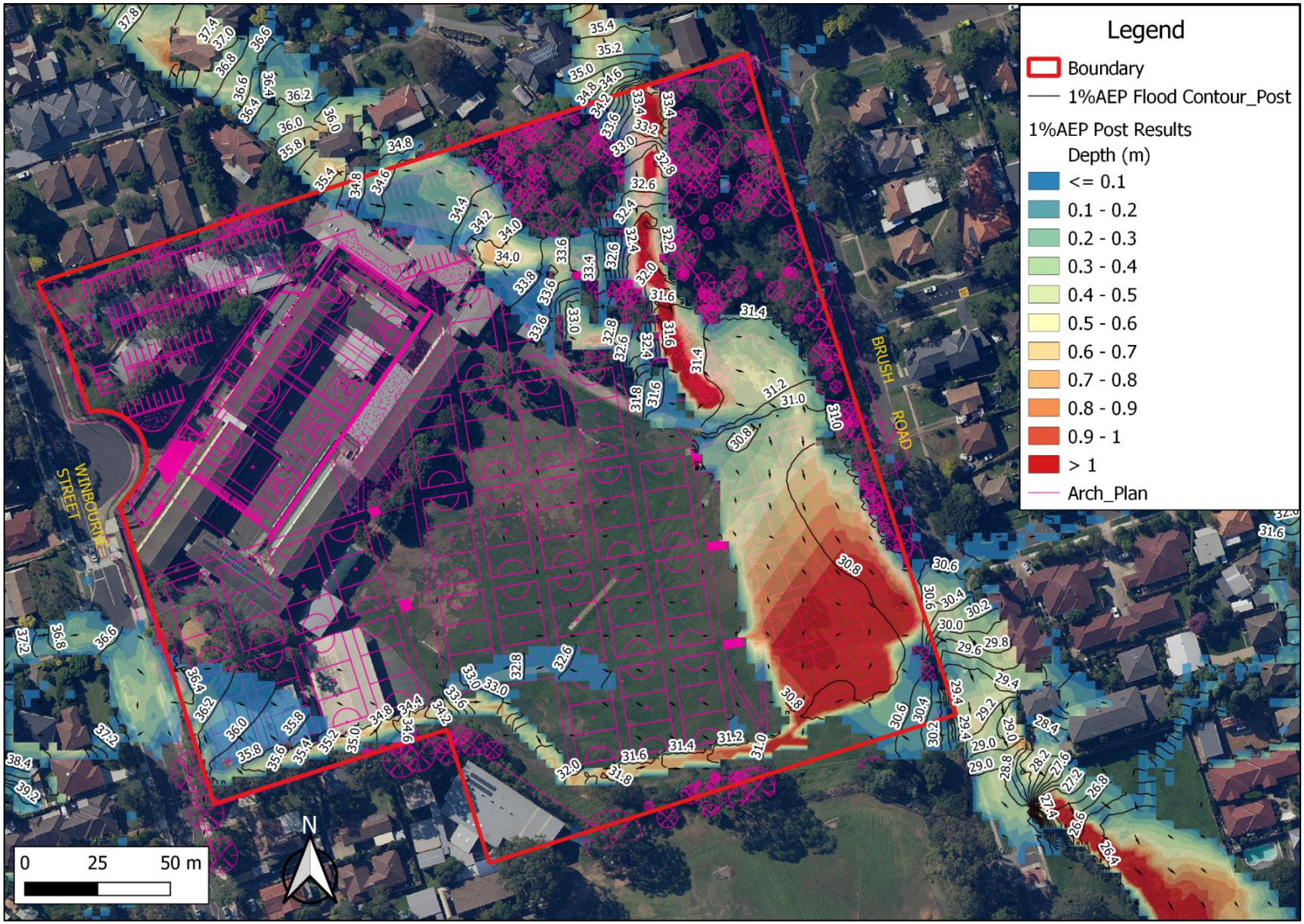


Figure A.5 1% AEP Flood Depth & Contours – Post Development

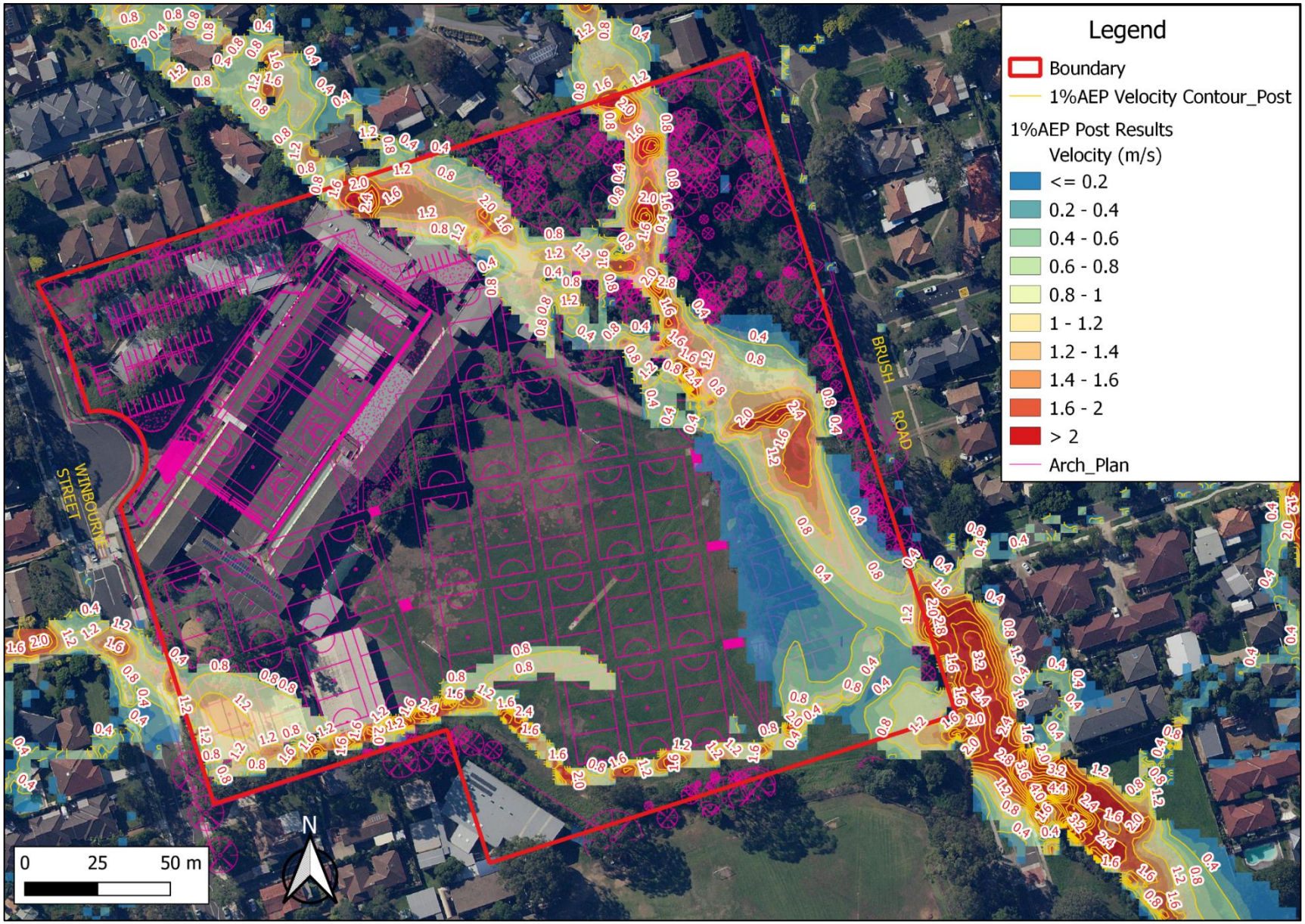


Figure A.6 1% AEP Flood Velocity – Post Development

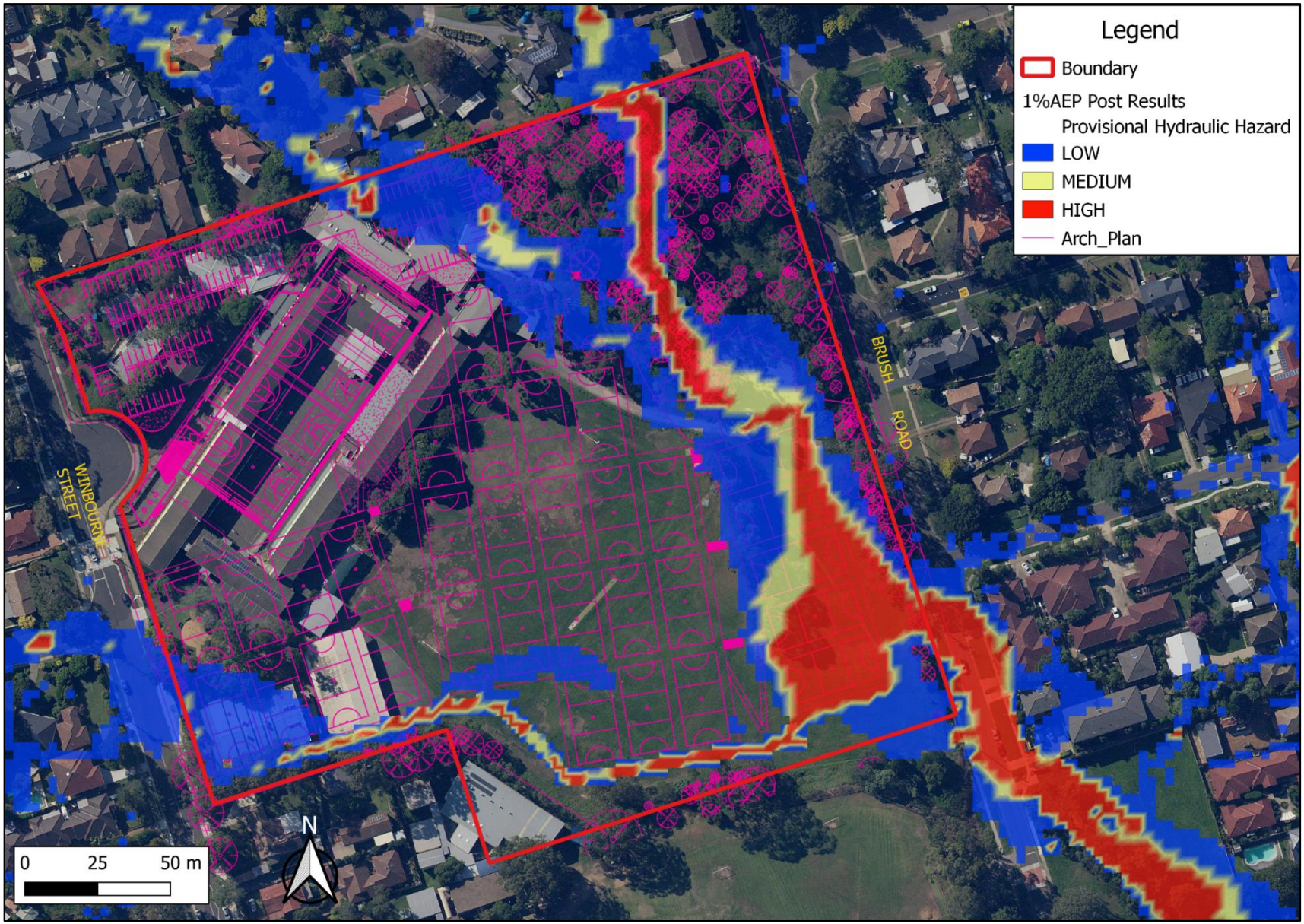


Figure A.7 1% AEP Flood Risk Precincts – Post Development

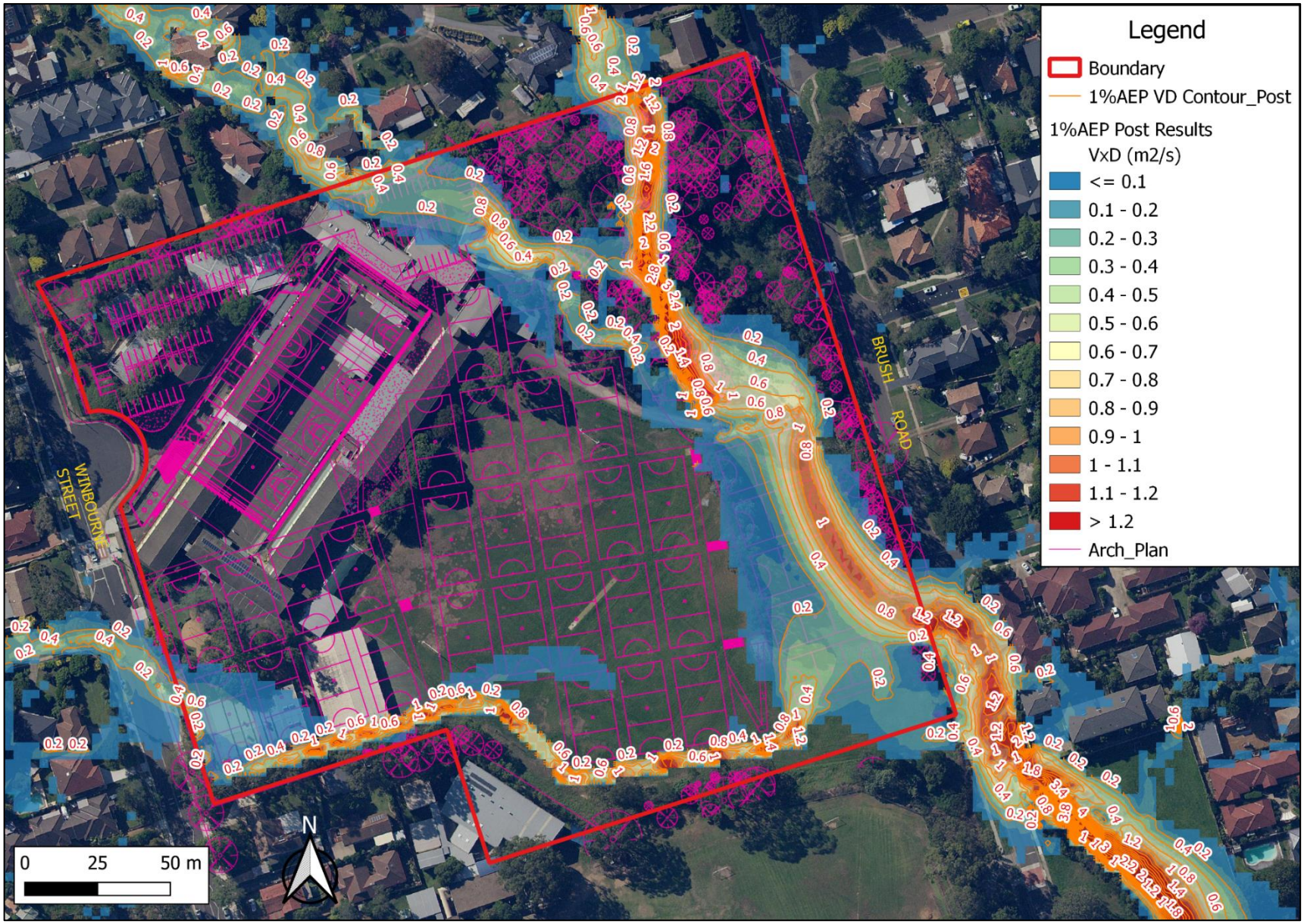


Figure A.8 1% AEP Velocity Depth Product– Post Development

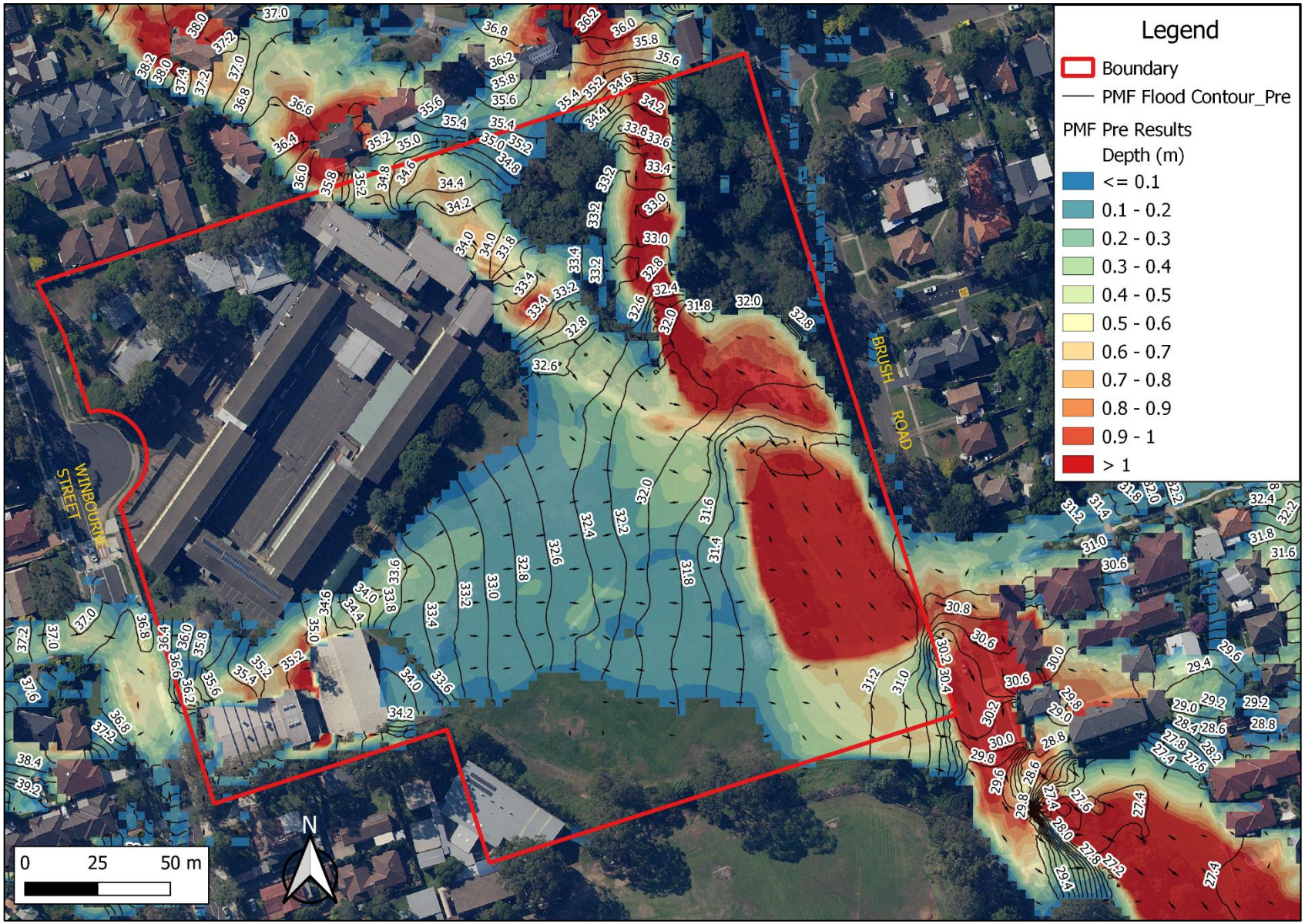


Figure A.9 PMF Flood Depth & Contours – Pre Development

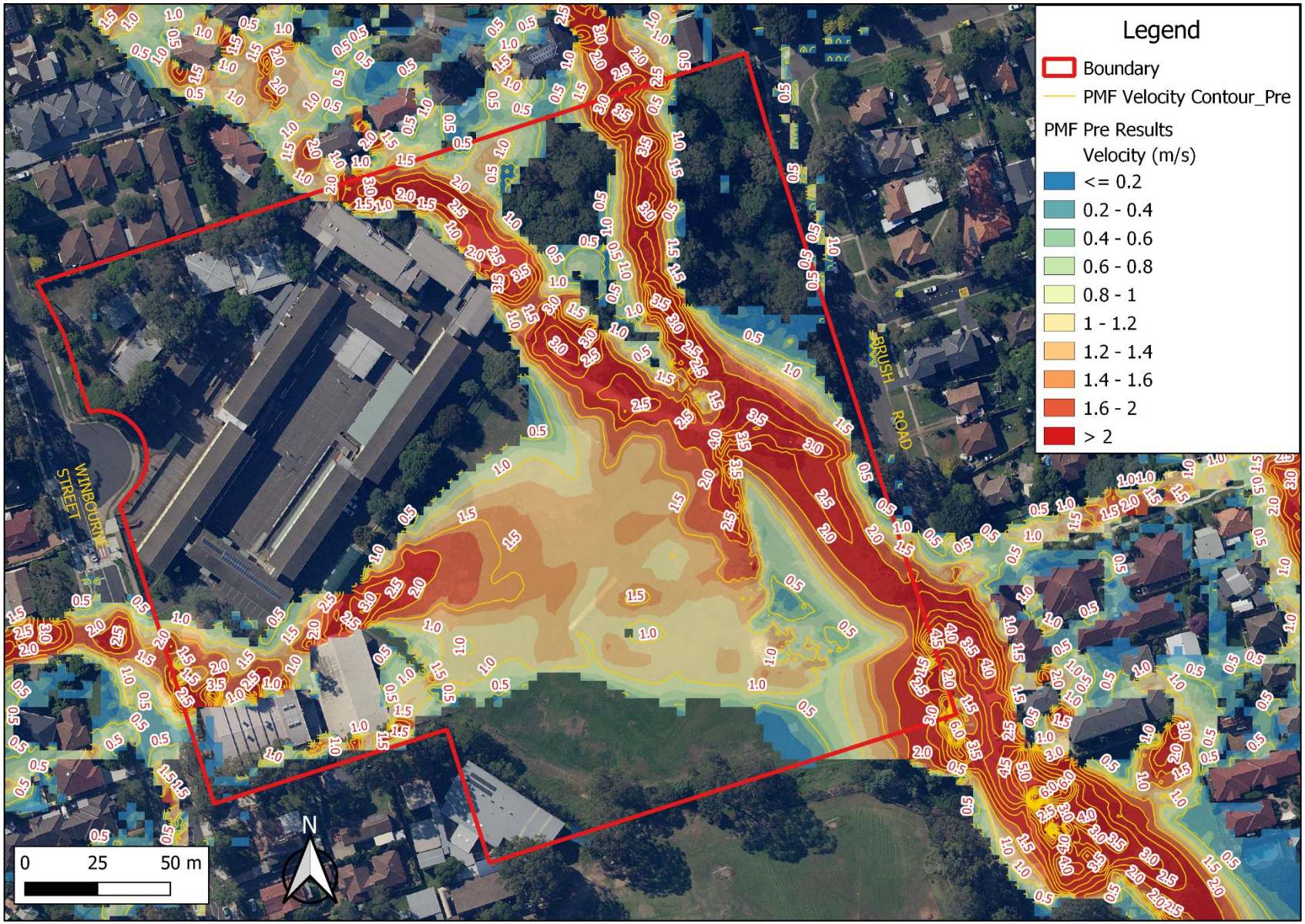


Figure A.10 PMF Flood Velocity – Pre Development

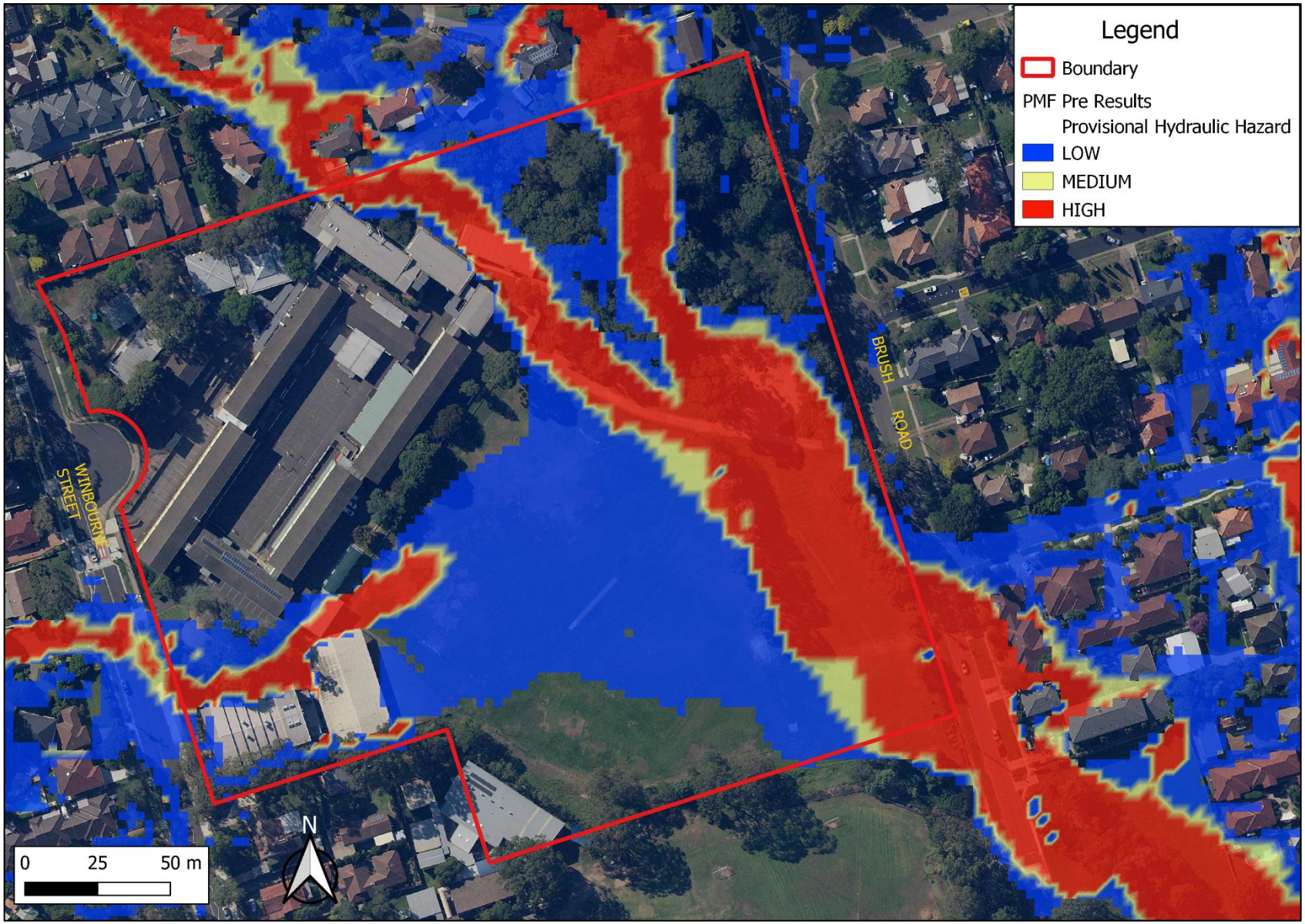


Figure A.11 PMF Flood Hazard Classification – Pre Development

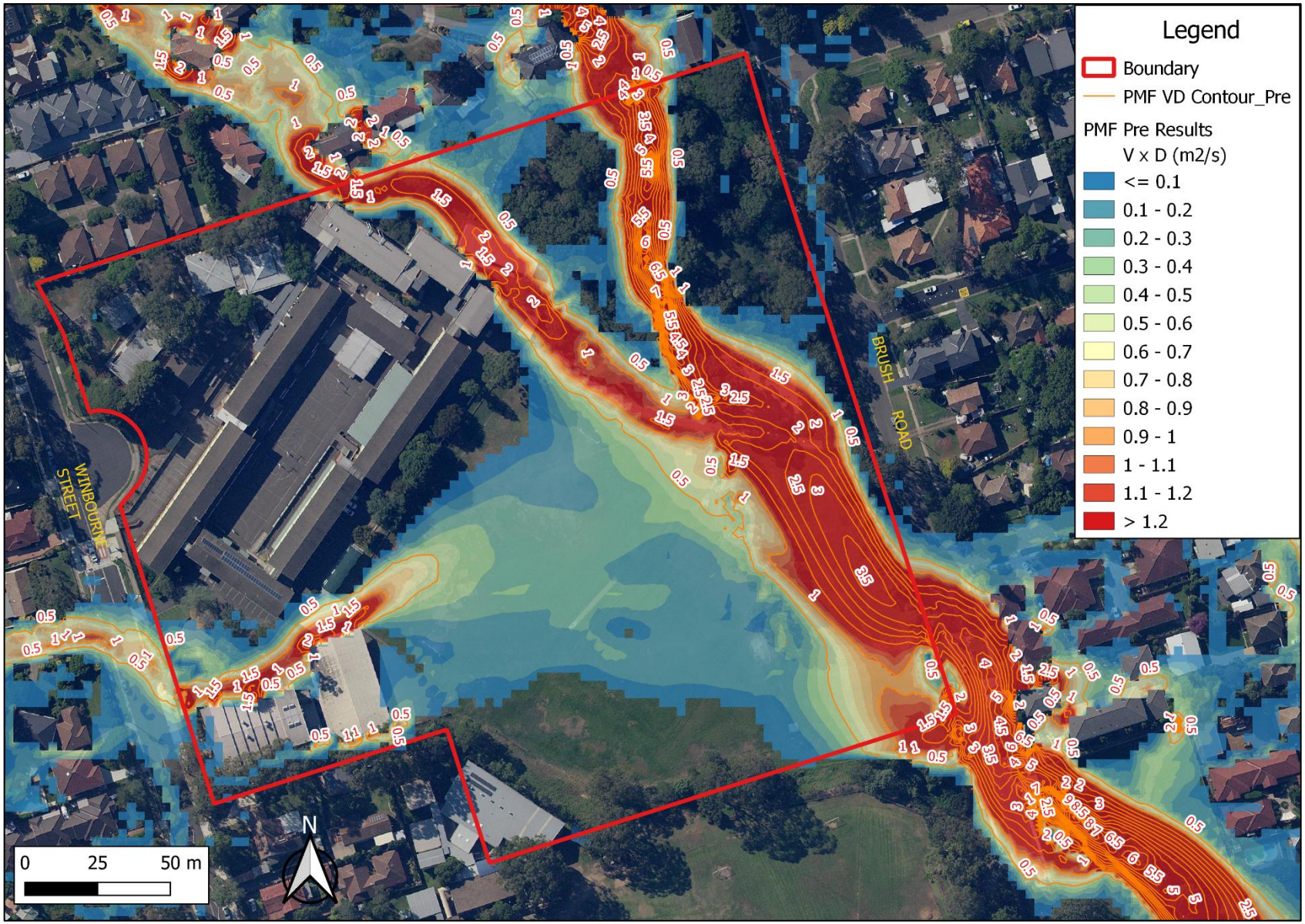


Figure A.12 PMF Velocity Depth Product– Pre Development

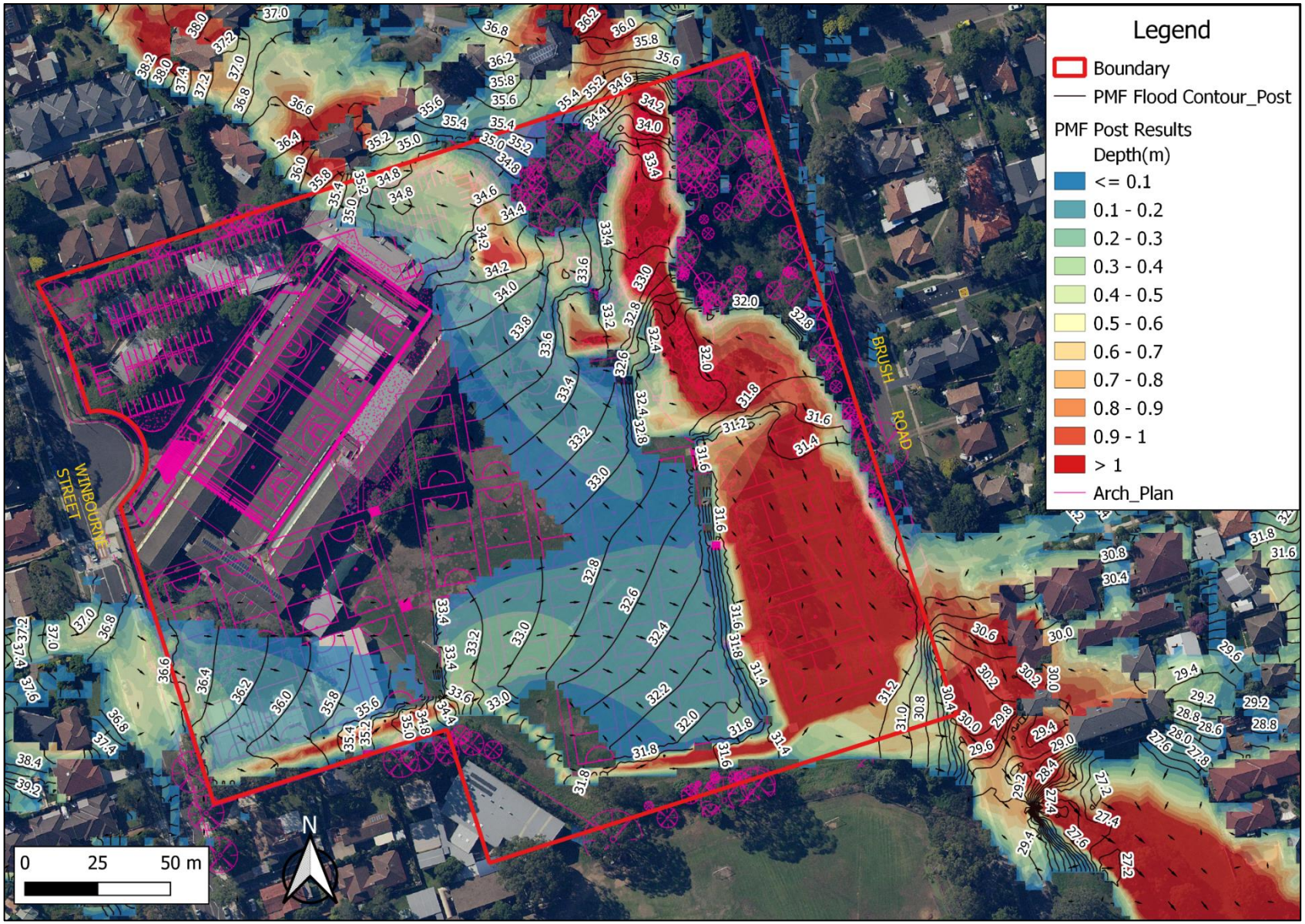


Figure A.13 PMF Flood Depth & Contours – Post Development

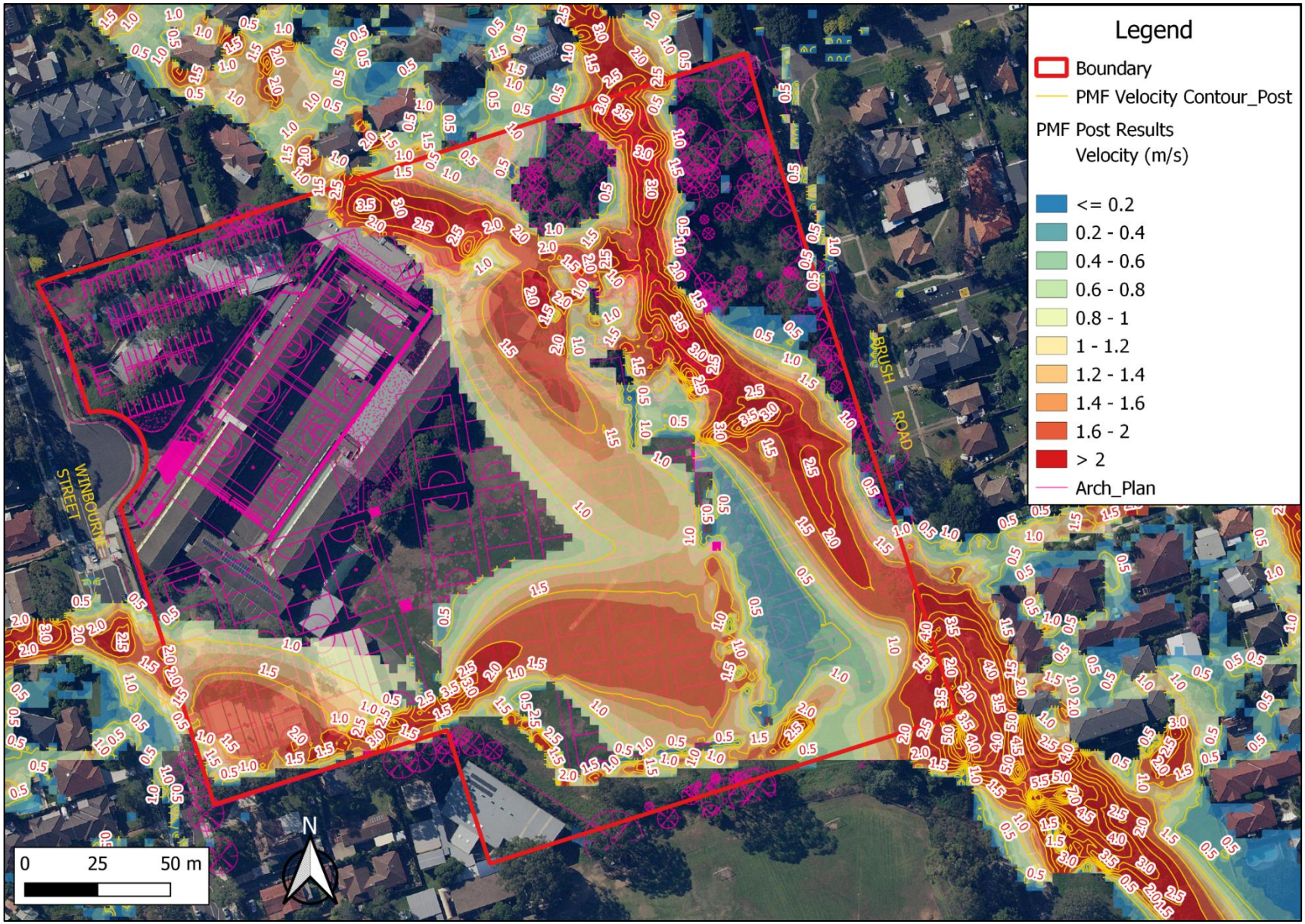


Figure A.14 PMF Flood Velocity – Post Development

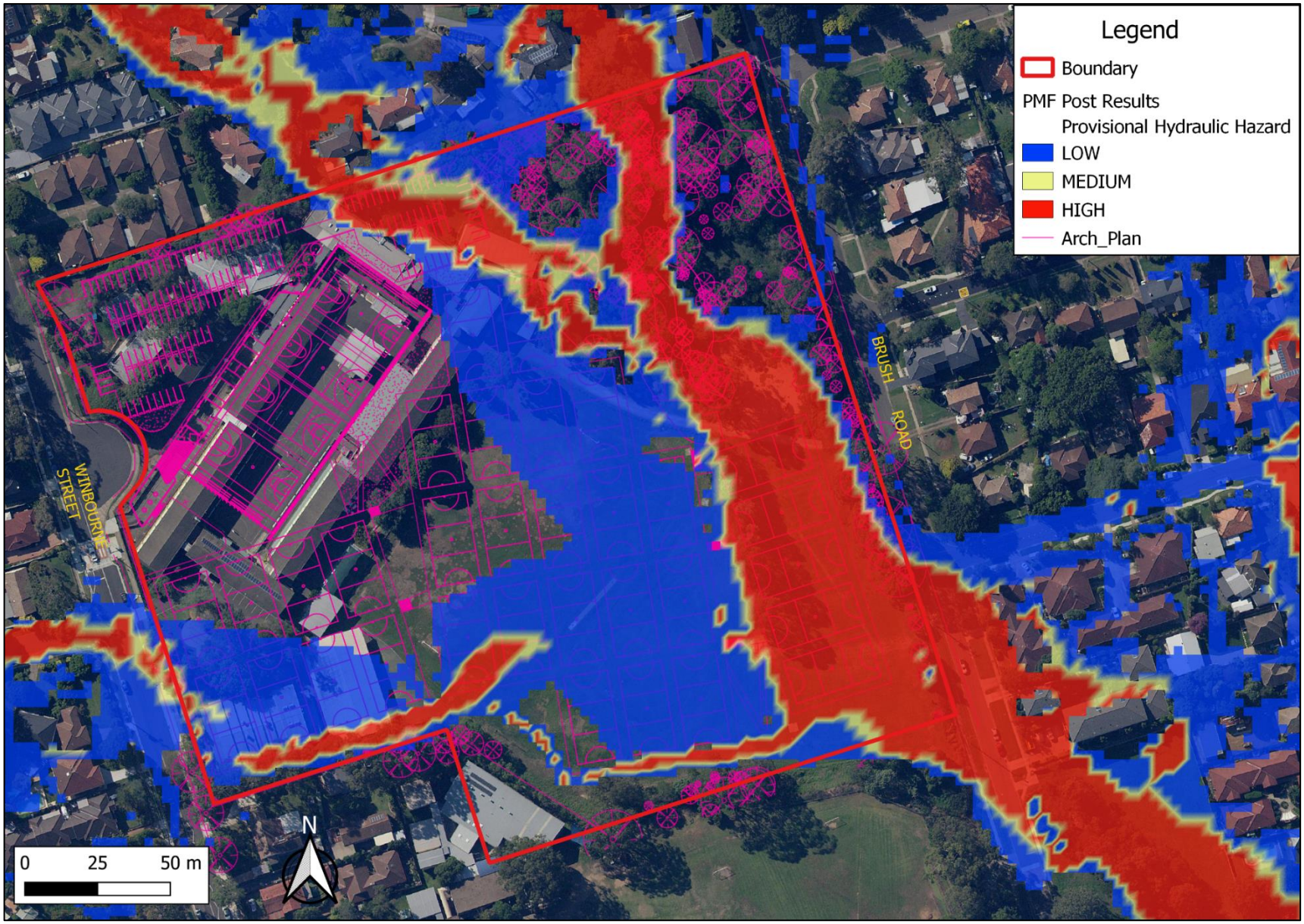


Figure A.15 PMF Flood Hazard Classification – Post Development

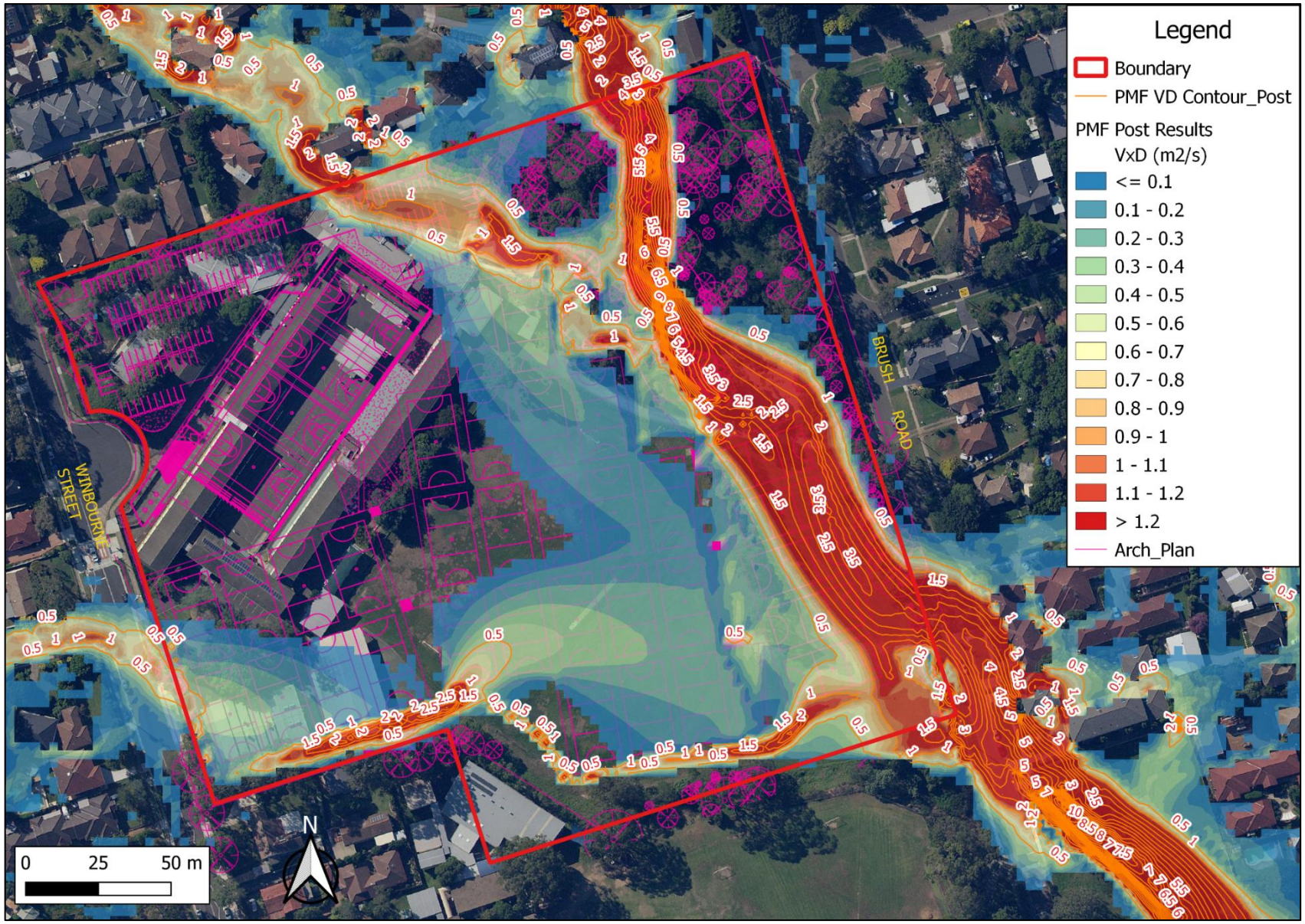


Figure A.16 PMF Velocity Depth Product– Post Development

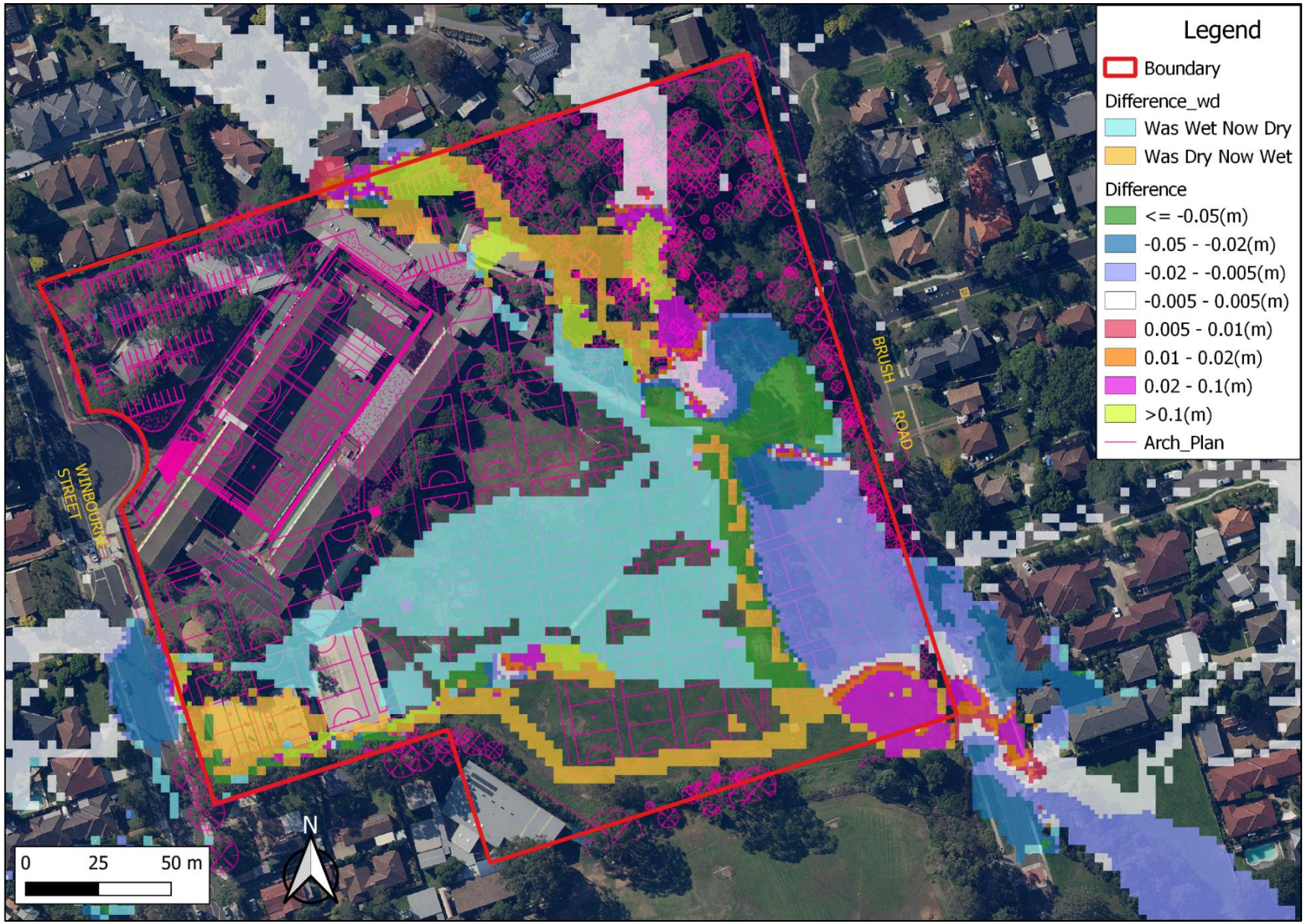


Figure A.13 1% AEP Flood Impact Map

APPENDIX B

Figure B.1 Architectural Plan – 'Site Plan'
Figure B.2 General Arrangement Plan prepared by Henry & Hymas dated March 2021
Figure B.3 Survey Plan

Figure B.1 Architectural Plan – 'Site Plan'

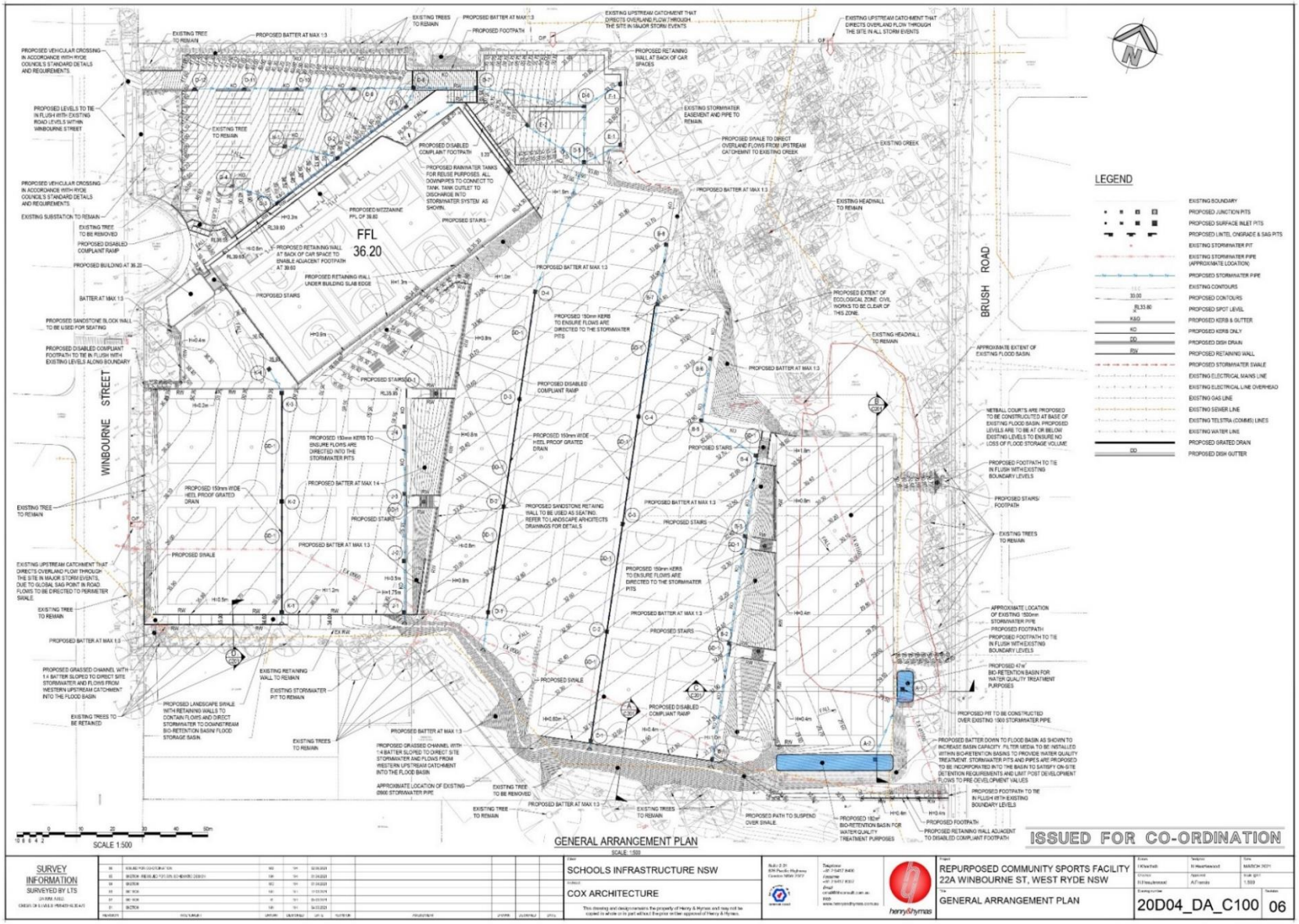


Figure B.2 Civil Plan

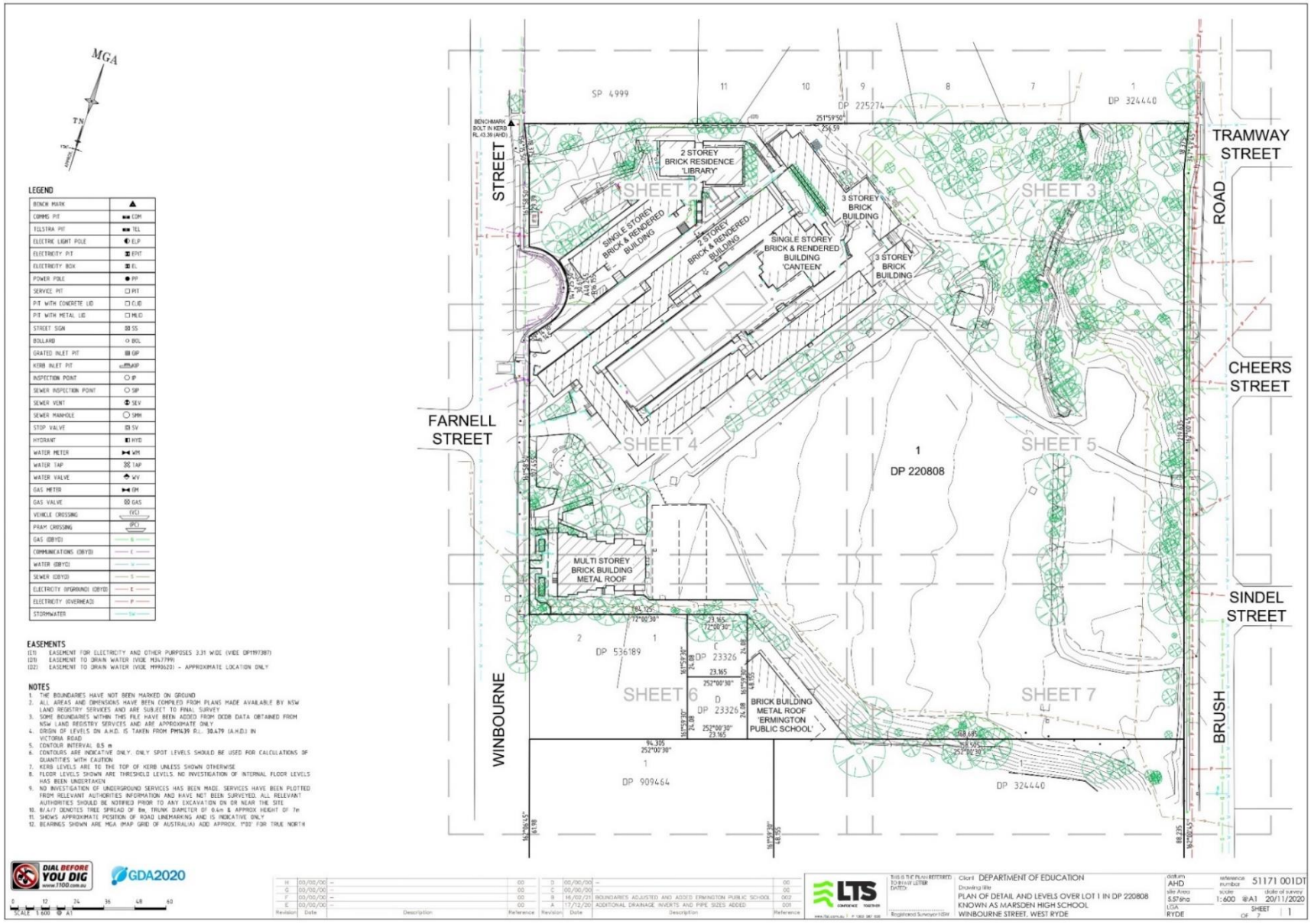


Figure B.3 Survey Plan