Milperra Village – Anglican Community Services
Stormwater Management, Flood Study, Flood Risk Management Study
16116 – January 2019

siteplus

planning . engineering . landscape . design . management

MILPERRA VILLAGE FLOOD STUDY, RISK MANAGEMENT STUDY
BULLECOURT AVE, MILPERRA

PREPARED FOR

Anglican Community Services

PREPARED BY

Site Plus Pty Ltd
(Siteplus)

Head Office: **345 Keira Street WOLLONGONG NSW 2500**
Telephone: (02) 4227 4233
Fax: (02) 4227 4133
E-mail: info@siteplus.com.au

Camden Office: **12 View Street, CAMDEN NSW 2570**
Telephone: (02) 4655 5877
Fax: (02) 4655 5024
E-mail: camden@siteplus.com.au

Site Plus Pty. Ltd.
(Incorporated in NSW)
ACN 104 315 095

Document Tracking

Document Status		Report					
File Location		T:\Projects\16116 Milperra Village\16116_Flood Study & Flood Risk Management Study_2.doc					
Project No.		16116			Date	January 2019	
Rev No	Issue	Author			Approved		
		Name	Signature	Date	Name	Signature	Date
1	Draft	Andrew Craddock		Sep 2016	Ken Rootsey		March 2017
2	CPM Review	Andrew Craddock		Aug 2017	Ken Rootsey		Aug 2017
3	DFP Review	Andrew Craddock		Oct 2017	Ken Rootsey		Oct 2017
4	DFP Review	Andrew Craddock		Oct 2017	Ken Rootsey		Oct 2017
5	DFP Review	Andrew Craddock		Dec 2017	Ken Rootsey		Dec 2017
6	Revised Layout	Andrew Craddock		Dec 2018	Dane Nethery		Dec 2018
7	DFP Review	Andrew Craddock		Jan 2019	Dane Nethery		Jan 2019
8	Flood Emergency Response Plan Review	Andrew Craddock		Jan 2019	Dane Nethery		Jan 2019

TABLE OF CONTENTS **Page No.**

APPENDICES

LIST OF FIGURES

LIST OF TABLES

EXECUTIVE SUMMARY

On behalf of Anglican Community Services (ACS), Site Plus has prepared a Flood study and Floodplain Risk Management Report for the proposed Milperra Village which fronts onto Bullecourt Avenue and Bullecourt Lane, Milperra. The site is located the between the flood storage area of the Georges River and active flow from the upstream urban catchment.

This report reviews and responds to the requirements of the NSW Floodplain development Manual 2005 and Bankstown's Development Control Plan (DCP) 2015 Part B12 Flood Risk Management. The NSW Floodplain Development Manual sets out the NSW flood prone land policy and recognises that flood-prone land is a valuable resource that should not be sterilised by unnecessarily precluding development.

The proposal consists of three main buildings, two with predominately retirement living units, and one residential care facility. Also, green space is proposed between the buildings with at grade parking is proposed for visitors.

This report considers the development's impact on Downstream Drainage and Flooding, along with addressing the requirements of Flood Risk Management.

Due to the site's location at the downstream end of the local urban drainage catchment and close proximity to the flood storage, on the adjoining Bankstown Golf Club, On Site Detention (OSD) was found to not be required due to the timing of peak hydrographs when modelling the total upstream catchment. Also, considering the Georges River is the receiving water body which in flood situations is immediately downstream of the site, it was found that not providing OSD would not have an adverse impact of flood levels downstream of the site.

Siteplus attained Bankstown Council's Flood TUFLOW Model conducted by BMT WBM dated October 2015 for the Local Milperra Catchment. The proposed development was input into the model to assess the flooding impacts. The results indicated that critical areas within the site needed to have buildings suspended above the flood waters to not adversely affect the flow of floodwaters through the site.

To meet the requirements of Bankstown Council's DCP part B12 Flood Risk Management, the results from the Milperra Catchment Flood Study conducted by BMT WBM dated October 2015 have been adopted. Using the results from the local flood study all habitable ground floor levels are proposed above the 100yr with 500mm freeboard and the PMF flood level. The flood study results indicate that in the 100yr storm event the development has no adverse impacts on adjoining

private properties with only slight increases in Bullecourt Lane due to the proposed Bullecourt Lane upgrades.

In summary, the proposed development can be supported for the following reasons:

- Developing the site as proposed manages the flood constraints and reduces flood impacts on the nearby private properties.
- The proposal includes suspending parts of the buildings Habitable floors levels above the 100yr ARI and PMF flood levels to ensure the free flow of floodwater through the site.
- All of the proposed Habitable Floor levels are above the 100yr ARI plus freeboard, and are above the PMF flood levels.
- Basement carpark entry levels are also a minimum of 500mm above the 100 year and PMF flood level.

Each point has been discussed at length within the body of the report.

1. INTRODUCTION

1.1. Preliminary

1.1.1. Site Plus Engagement

Siteplus, has been commissioned by Anglican Community Services (ACS) to prepare a Stormwater Management, Flood Study, Flood Risk Management Report to address the requirements of the NSW Floodplain development Manual 2005 and Canterbury Bankstown City Councils requirements in relation to the proposed Milperra Retirement Village.

1.1.2. Scope of Work

To meet the requirements of Canterbury Bankstown City Council and the NSW floodplain development Manual 2005, Site Plus has determined that the report needs to address the following:

- Discuss the site location and negligible impact of the development on the surrounding drainage infrastructure.
- Run the local Milperra Catchment Council TUFLOW model to assess the current flooding impacts on the site
- Integrate the proposed development into the 2D TUFLOW model to assess the developments impact on future flood behaviour surrounding the site;
- Evaluate the site in terms of Bankstown City Council's Floodplain Risk Requirements; and the NSW Floodplain Development Manual 2005; and
- Prepare a report that summarises the findings of our analysis.

1.2. Liaison with Council

Siteplus engineers have received from Council the Milperra Catchment Council TUFLOW model to form a baseline for the flood modelling. The TUFLOW model was adopted by Council and was prepared by BMT WBM in October 2015.

1.3. Subject Land

The subject site is a vacant parcel of land which has been recently sold off from the grounds of Bankstown Golf Course. The Site has frontage to Bullecourt Avenue and Bullecourt Lane. It is currently used as a driving range and golf practice facility. The site is a large slightly sloping flat grassed area with an existing storage shed onsite.

Figure 1-1 Locality Map

1.4. Site Features

The subject site is a 2.5ha parcel of land with a large grass area. There is a large overgrown earth mound in the rear north western corner of the site and an open channel which straddles the northern boundary to the golf course. There is also an existing steel storage shed in the north eastern corner used by the golf course.

2. STORMWATER MANAGEMENT

Once the TUFLOW flood modelling for the site was conducted the major storms events were analysed. The minor storms were also run to determine the impact of providing higher amounts of impervious areas within the local catchment.

Council's Milperra Catchment 2D TUFLOW model was used for minor storm impact assessment as the majority of the flow enters the site from Bullecourt Avenue. Bullecourt Ave cannot contain the flow which overtops the road reserve parallel to the site.

Modelling the location and direction of this overtopping flow in a 1D model is inaccurate as all the flow would need to enter the system at a single point, inaccurately representing the sheet flow entering the site from the Bullecourt Avenue road reserve and into the northern open channel onto the golf course.

2.1. TUFLOW Model

In same way as a 1D model, TUFLOW uses rainfall, and routes the resulting flows through the model area. Greater impervious areas change the hydrograph shape and catchment response time.

A land use patch was developed shown in Figure 4-1 within the TUFLOW model to represent the increased impervious surfaces proposed by the development. The same parameters as contained in the original council flood study have been used in the land use patch.

Due to the location of the development being at the lower end of the catchment and the proximity of backwater from the Georges River being on the northern boundary of the site, all minor storm results indicate no increase flood levels downstream of the site.

2.2. 10yr and 5yr ARI Model Results

Appendix B and Appendix C illustrates the existing and proposed flood mapping during the 5yr and 10yr ARI storm. The results indicate that majority of the flow even in the minor events enter the site perpendicular to the intersections of Dernancourt Parade and Armentieres Avenue, from Bullecourt Avenue. The Roadway and stormwater drainage system are not able to contain the flow, forcing stormwater onto the site and out into the northern open channel.

The impact assessment within Appendix D illustrates that all surrounding properties experience no change or slightly reduced flood levels during the 5yr and 10yr ARI storm events as a result of the development. This is primarily due to the proposed Bullecourt Lane upgraded drainage system which efficiently conveys stormwater to the rear open channel.

3. PREVIOUS FLOOD REPORTS

3.1. Brewsher Consulting Pty Ltd, Georges River, Floodplain Risk Management Study and Plan, 2004

The Brewsher study conducted in 2004 covers the entire Georges River Catchment being 960km^2. Covering the top of the catchment in Southern Campbelltown through to Botany Bay. The study is a board bush approach using a 1D MIKE 11 model with cross sections at approximately every 300m.

The study also assumes that the entire catchment receives the same rainfall intensity in a given storm event, coupled with extreme wave run-up and very high tides. This is highly unlikely to occur across such a large catchment and makes the results extremely conservative.

Section 6.1.3 of the flood study reiterates the conservative nature of the flood study as it states *"the MIKE-11 results are appropriate for use with flood damage estimates, but should not be used when specifying minimum floor levels or related development controls. Reference should always be made to the flood level results in the adopted flood study reports"*.

Based on this statement above the Council commissioned BMT WBM Pty Ltd flood study conducted in 2015 has been the basis of the flooding analysis for the site.

3.2. BMT WBM Pty Ltd, Milperra Catchment, Flood Study Update 2015

A 2D TUFLOW model was developed for Council for the Milperra Catchment. The model has been commissioned by Council in 2015 and the results show the site as being flood affected by overland flow and backwater from the Georges River.

This model has been given to Siteplus on a data share arrangement and forms the basis for all of the flood modelling for the site. Siteplus has integrated the development into the council model to form an impact assessment for the site and surrounding catchment. The changes made to the council model are only the proposed materials, proposed pit and pipe network, proposed channels and topography for the site.

The Milperra Catchment BMT WBM study identifies the site as being within the low and medium risk flood precinct. This differs from the flood risk areas shown in Map 1 of Part B12 of the Bankstown DCP 2015, which is based on the Georges River Floodplain Risk Management Study and Plan 2004. The BMT WBM is an update of the previous studies and therefore has been referenced for the development assessment.

Figure 3-1 BMT WBM Milperra Catchment 2015 Provisional Flood Risk Precinct map

3.3. J.Wydham Prince, Bankstown Golf Club, Flood Impact Assessment, 2014

As part of the site rezoning, Bankstown Golf Club engaged J. Wyndham Prince to carry out a flood impact assessment for the site to ascertain if the site could be developed for residential use.

The study found that with the now completed compensatory adjoining earthworks in the form of making a dam larger within the golf course the site could be developed for residential purposes.

The adjoining compensatory earthworks has been incorporated into the flood model, based on the work-as executed plans.

4. HYDRAULIC ANALYSIS

4.1. Existing Site Hydraulic Features and TUFLOW Model

Once the Council TUFLOW model was received a model run of all the existing site conditions was undertaken to form a baseline for the flood assessment of the proposed development. None of Councils TUFLOW model parameters have been changed to assess the development.

The only modifications to the model were topographical and land uses as shown in Figure 4-1 and proposed structures and terrain shown in Figure 4-2.

The existing model contains all the of the existing site features including the northern open channel, existing earth mound and storage shed. The remaining parts of the site are large flat grass area currently being used as golf practice facility.

The 50% pit blockage scenario was used for the flood assessment as discussed within Section 4.4 of the BMT WBM Milperra Catchment Flood Modelling Report.

4.2. Proposed Site Hydraulic Features

To better manage the flow of floodwaters through the site, the proposal needed to minimise flow obstructions and regrade the site to remove a trapped low point which was occurring behind an existing earth mound in the north western corner of the site.

It was found that portions of the proposed buildings needed to be suspended above the flood levels to allow floodwater flow under critical portions of the proposed buildings. The location of the suspended buildings are shown in Appendix C and Figure 4-2.

4.2.1. Hydraulic Roughness

The proposed development land uses were input into the TUFLOW model to model the proposed site. The hydraulic roughness file from the council study was adopted with a patch on the subject site for the development scenario. The patch is shown within Figure 4-1.

4.2.2. Proposed Sub-floor Screens

The suspended building sections will contain screens across the openings between columns to prevent access. The suspended floor sections have been modelled within TUFLOW as a variable height flow constriction, to model the suspended floor and the building above.

The suspended building have the flowing variables:

- 25% blocked openings
- Obverts set 0.3m below proposed Finished Floor Levels.
- 0.02 roughness co-efficient under the building
- Form loss co-efficient suspended section 0.02
- Form loss co-efficient of the building above 0.13

4.2.3. Proposed Pit and Pipe Network

To remove site ponding and better management minor event stormwater flow. The proposed pit and pipe network was input into the TUFLOW model as per Figure 4-2 and the Siteplus civil engineering details found in Appendix E.

4.2.4. Proposed 1D Channels

Two proposed 1D channels were input into the TUFLOW model and the rear northern channel increased in size to increase its capacity. These channels were use and proposed, as channels have a higher capacity than a pipe system and accept overland flow continuously along the channel edge. The location and details on of the channels can be found in Figure 4-2 and the Siteplus civil engineering details in Appendix E.

Figure 4-1 Land use Patch

Figure 4-2 Proposed Site Topography and structures

4.3. Flood Modelling Results

4.3.1. Existing

Modelling the current existing site illustrates that Bullecourt Ave in front of the subject site is at the convergence of a number of overland flow routes from the upstream catchments. The convergence of flows from Bullecourt Avenue flowing west, Dernancourt Parade flowing north and Armentieres Avenue flowing north. The existing results are shown in Appendix B.

The convergence of flows and momentum from the perpendicular flow from Armentieres Ave and Dernancourt Pde forces floodwater over the Bullecourt Ave road reserve into the site.

Floodwaters flow in sheet form flows from Bullecourt Avenue to the northern open channel adjoining the golf course. An existing earth mound in the north western corner traps flow, forcing water either side and into the open channel.

All results indicate that the flood water is low hazard as per the NSW Floodplain Development Manual, apart from a small number of cells within the open channel along the northern boundary. The medium risk cells straddle the boundary as shown in Appendix B.

There is also a small catchment which enters the site via Bullecourt Lane which joins the main flow within the site prior to entering the northern drainage channel.

4.3.2. Proposed

Modelling the proposed development shows floodwaters enter the site from both Bullecourt Avenue and Bullecourt Lane, pass under and between the buildings through the graded site and then into the northern drainage channel as shown in Appendix C.

The existing earth mound has been removed and site re-graded to give the channels and pipe network adequate cover to fall into the northern open channel. Portions of buildings have been suspended to allow for flow from Bullecourt Ave and Bullecourt Lane to pass underneath them.

The impact assessment in Appendix D shows that the proposed development results in no impacts to private property with regard to increasing flood levels. Minor level impacts of 0.3m increases in depth occur in Bullecourt Lane. This is due to the re-grading of Bullecourt lane to accommodate the new low point adjacent to the Northern Boundary Channel.

5. FLOODPLAIN RISK MANAGEMENT

The following section of the report address the requirements of Part B12 Flood Risk Management in the Bankstown Development Control Plan 2015.

Seniors Housing is classed as a sensitive use under the DCP which for flood affected sites is potentially classed as an unsuitable' land use.

The proposed nursing home or Residential Care Facility (RC building) is classed as a critical use facility under council's DCP, also being a potentially unsuitable' land use.

However, as demonstrated below the proposed development is suitable as it complies with the objects and performance criteria of the Part B12 of Council's DCP. All the proposed flood controls reduce the flood risk to a manageable level.

5.1. DCP Objective Assessment

Objective (a)

"To reduce the risk to human life and damage to property caused by flooding through controlling development on land affected by potential floods."

The proposed development will not increase the risk to human life and property damage by the following:

- The proposed habitable floor levels are above both the 100yr ARI plus freeboard and the PMF flood event.
- All structures below the PMF flood level are flood compatible and will be able to withstand the forces of floodwaters. This ensure that occupants will be safe during all flood events and the buildings will not incur structural damage during major storm events.

Objective (b)

"To apply a "merit–based approach" to all development decisions which takes account of social, economic and environmental as well as flooding considerations in accordance with the principles contained in the NSW Floodplain Development Manual (FDM)."

The merit based approach within this assessment considers social, economic and environmental considerations. The NSW floodplain development manual is to ensure that floodplains are developed in a safe manner and not sterilise floodplains for development.

The development will provide seniors housing for the local area in a location that contains the facilities required for an aging population and has close proximity to arterial road and transport facilities.

The site is currently vacant surrounded by development on three sides. Development will occur on the subject site at some stage and the proposal ensures that the proposed grading of the land and drainage infrastructure will improve the flooding outcome for the site and surrounds.

Objective (c)

"To control development and other activity within each of the individual floodplains within the City of Bankstown having regard to the characteristics and level of information available for each of the floodplains."

The information available for the flood assessment of this development are up to date and based on a council approved flood study conducted in 2015. The Council and this impact assessment use the latest modelling techniques and best information available. Ensuring that the best information is available for decision making.

Objective (d)

"To assess applications for development on land that could be flood affected in accordance with the principles included in the FDM, issued by the State Government."

This report uses the Floodplain Development Manual (FDM), principles and techniques to assess the development in terms of flooding. Section 5 of this report addresses all the required parameters as per the FDM.

5.2. Land Use Category

Senior housing is classed as a sensitive use and the nursing home is classed as a critical use as per Schedule 2 of Council's DCP Part B12. However, the proposed developments meets the objectives of the DCP by:

- Providing floor levels 0.5m above the 100yr and PMF flood levels.
- Constructing buildings able to withstand the forces of floodwaters and debris.
- Not impacting the surrounding floodwaters by provision of site re-grading and subfloor screens.
- Having a safe low flood hazard vehicular evacuation route east along Bullecourt Lane with a maximum depth of 0.215m during the 100yr flood event and 0.39m maximum depth in the PMF event.
- Development of a detailed site evacuation plan where trained 24hr onsite staff can implement the plan, to

ensure occupants remain safe during all flood event including the PMF.

The Site has been assessed under a residential a land use category under Schedule 3 of Council's DCP Part B12 to confirm that the proposal meets all of Council's flooding concerns.

5.3. Flood Risk Precinct

The site is mapped as being within the low, medium and high flood risk precincts in map of Part B12 of the DCP. However, Appendix F of Council's Milperra Catchment flood study shows the site contains both medium and low flood risk precincts. Due to the site containing floodwaters during the 100yr flood event the site has been assessed as medium flood risk for a Residential Land use. The following assessment is a criteria based assessment as outlined in Section 2 and Section 3 of Part B12 of Councils DCP.

5.4. DCP Section 3 Controls - Objectives

Objective (a)

"To require developments with high sensitivity to flood risk to be designed so that they are subject to minimal risk."

Details outlined within this report reduce flood risk to an acceptable level by:

- Providing floor levels 0.5m above the 100yr and PMF flood levels.
- Constructing buildings able to withstand the forces of floodwaters and debris.
- Not impacting the surrounding floodwaters by provision of site re-grading and subfloor screens.
- Having a safe low flood hazard vehicular evacuation route. As shown in the flood mapping, Appendix C of this report.

Objective (b)

"To allow development with a lower sensitivity to the flood hazard to be located within the floodplain, provided the risk of harm and damage to property is minimised."

The seniors living development proposal will have a strict onsite management system and specially designed buildings to ensure that both risk of harm to occupants and damage to property in negligible in terms of flooding. The applicant intends to both develop and manage the site during operation ensuring that high standards of safety and building maintenance are maintained for the life of the development.

Objective (c)

"To minimise the intensification of the High Flood Risk Precinct or floodway, and if possible, allow for their conversion to natural waterway corridors."

The subject site is located on the outer edge of the Georges River floodplain and is subject to overland flooding in the 100yr and storage from the Georges River in the PMF event. The development has no egress into the high risk flood precinct and is totally suspended above all high risk areas. The site is not in a floodway and no natural waterways exist within the site.

Objective (d)

"To ensure design and siting controls required to address the flood hazard do not result in unreasonable social, economic or environmental impacts upon the amenity or ecology of an area."

This report illustrates that no adverse impacts in terms of flooding will occur surround the site (see section 5.10 and Appendix D). The buildings are designed to allow free flow of floodwaters through the site and under the buildings. Thereby minimising economic impacts such as damage to buildings and social impacts by locating habitable levels above the PMF flood level. No environmental impact will result from the development as it's located outside of any water course or riparian zone.

Objective (e)

"To minimise the risk to life by ensuring the provision of reliable access from areas affected by flooding."

Safe vehicle evacuation is achievable from the development east to Bullecourt Avenue during the 100yr ARI (maximum depth 0.215m) and PMF flood event (maximum depth 0.39m). This allows evacuation in emergencies away from flood waters.
Please refer to the Site specific Flood Emergency Response Plan by Molino Stewart for further evacuation information supporting this development.

Objective (f)

"To minimise the damage to property (including motor vehicles) arising from flooding."

Sections 5.8, 5.9 and 5.11 of this report illustrate how any damage to both buildings and private vehicles within the carparks will not be impacted by floodwaters.

Objective (g)

"To ensure the proposed development does not expose existing development to increased risks associated with flooding."

The impact assessment within Appendix D of this report illustrates no impacts to the surrounding development with only minor impacts within Council's road reserves from the regrading of Bullecourt lane. The regarding of Bullecourt lane is require to meet grading requirements as outline within Council's Engineering Standards.

5.5. DCP Section 3 Controls – Performance Criteria

Performance Criteria (a)

"The proposed development should not result in any significant increase in risk to human life, or in a significant increase in economic or social costs as a result of flooding."

The proposed development reduces risk to human life and economic and social costs by:

- Providing floor levels 0.5m above the 100yr and PMF flood levels.
- Constructing buildings able to withstand the forces of floodwaters and debris.
- Not impacting the surrounding floodwaters by provision of site re-grading and subfloor screens.
- Having a safe low flood hazard vehicular evacuation route.
- Development of a detailed site flood evacuation plan.

Performance Criteria (b)

"The proposal should only be permitted where effective warning time and reliable access is available to an area free of risk from flooding, consistent with any relevant Flood Plan or flood evacuation strategy."

The Georges River Floodplain Risk Management Study and Plan, 2004 (being the regional flood study) states that the MIKE-11 results should not be used for specifying minimum floor levels or related development controls and reference should always be made to the flood level results in the adopted flood study reports. We have therefore focused our analysis a on the local flooding modelling from BMT WBM Milperra Catchment Flood Study 2015 which is the model issued to Siteplus for development assessment by Council.

Refer to the Site specific Flood Emergency Response Plan by Molino Stewart for further details.

Performance Criteria (c)

"Development should not significantly increase the potential for damage or risk other properties either individually or in combination with the cumulative impact of development that is likely to occur in the same floodplain."

Appendix D illustrates the impacts as a result of the development. All impacts occur within the subject site or within the upstream road reserves due to regrading and formalisation of Bullecourt Lane. Reductions also occur within the upstream residential areas as the drainage infrastructure increases flow conveyance through the site. As a result the development has a positive impact on flooding and can be supported in terms of flooding affects.

Performance Criteria (d)

"Motor vehicles are able to be relocated, undamaged, to an area with substantially less risk from flooding, within effective warning time."

Section 5.11 of this report addresses this performance criteria. The low hazard flood waters and low depth does not adversely impact the car parking areas and vehicles are able to relocate away from the site during all flood events. Due to the low depth of flooding vehicles will be able to safely travel along Bullecourt Lane to relocate their vehicles offsite during either the 1:100 or PMF local storm event. Residents and staff will have basement carparks which have berm heights above the PMF level.

Performance Criteria (e)

"Procedures would be in place, if necessary, (such as warning systems, signage or evacuation drills) so that people are aware of the need to evacuate and relocate motor vehicles during a flood and are capable of identifying the appropriate evacuation route."

As discussed above all visitor at grade vehicles can safely leave the site during the PMF event. Occupants have basement car parking where the entry level (berm) is above the PMF level.

Please refer to the detailed Flood Emergency Response Plan prepared by Molino Stewart for further details.

Performance Criteria (f)

"To minimise the damage to property, including motor vehicles arising from flooding."

Sections 5.8, 5.9 and 5.11 of this report illustrate how any damage to both buildings and private vehicles within the carparks will not be impacted by floodwaters. Low hazard flood waters cover the building areas and car parking areas during the PMF which means that building have less risk of being damaged and vehicles will not become buoyant.

Performance Criteria (g)

"Development should not result in significant impacts upon the amenity of an area by way of unacceptable overshadowing of adjoining properties, privacy impacts (e.g. by unsympathetic house–raising) or by being incompatible with the streetscape or character of the locality."

The SEE prepared by DFP planning has addressed amenity and streetscape character.

5.6. Site Fencing Requirements

Open pool type site fences are to be located within the 100yr flood level plus 500mm freeboard. All subfloor screens are to be 75% open to allow for the free flow of water.

5.7. Floor Level

All of the proposed buildings across the site have a floor level above 100year flood level plus 500mm freeboard. All Habitable floor levels are also above the PMF flood level.

All minimum floor levels are shown within Table 5-1 which summaries the proposed floor levels and the flood levels impacting the development.

Table 5-1 Flood and Floor Level Summary

Milperra Village Floor Level Summary Table			
Building	**Ground Floor Level**	**100yr Flood Level**	**PMF Flood Level**
RC Building	7.10	6.58	6.73
Building A and Community	6.90	6.35	6.46
Building B	6.00	5.47	5.86
Building C	6.90	6.14	6.37
Building D	6.90	6.14	6.37

5.8. Building Components

All building components of the proposed buildings are to be flood compatible up to the PMF level. The proposed buildings are to be made with masonry or steel that is unaffected by submersion in flood waters.

5.9. Structural Soundness

All building components up to the PMF flood level are to be able to withstand the forces of floodwaters. This is to be factored into the structural design of the buildings at construction detailing stage.

5.10. Flood Effects

The proposed suspended buildings, proposed pit and pipe network and with the removal of the existing earth mound, are to ensure that the proposed development does not adversely impact the rest of the floodplain and surrounding development. Refer to the impact assessment in Appendix D which confirms no adverse impact.

5.11. Carparking and Driveway Access

All proposed staff and resident carparking areas are located within basement carparks with a berm height at the 100yr ARI level plus 500mmm freeboard. Only visitor parking is on grade and potentially flood affected. The results attained within this flood study show that the maximum depth of floodwaters in the visitor car parking low point adjacent to Bullecourt Lane is 0.27m deep with a velocity of 0.177m/s in the 100yr ARI. This results in vehicle not becoming buoyant during the 100yr flood event. This is based on Flood hazard category as outlined by Australian Emergency Management Institute in 2014.

The maximum depth of floodwaters in Bullecourt Lane along the access route is 0.215m during the 100yr flood event and 0.39m maximum depth in the PMF event. This allows vehicles to safely travel along Bullecourt Lane during both events to evacuate to higher ground.

5.12. Flood Evacuation

A detailed flood evacuation plan has be developed for the site The flood evacuation plan has been developed in conjunction with Anglican Community Services and Molino Stewart. Refer to the Molino Stewart Flood Emergency Response Plan for further details.

5.13. Management and Design

This report indicates that no additional flood risk will occur as a result of the development. Measures are proposed to reduce the impact of flooding on and surrounding the site and reduce the flood risk to a low risk flood precinct.

6. CONCLUSION

In terms of Stormwater Management, the smaller 5yr and 10yr storm events are not impacted by the proposed development. The smaller events modelled result in no adverse impacts to the surrounding properties as shown in Appendix D. This is primarily due to the location of the development in the lower reaches of the catchment adjacent to receiving Georges River Flood waters. Peak flow from the development has travelled downstream and passed before the peak catchment flow runs through the site.

The proposed village can be supported in terms of flood risk management for the following reasons:

- The proposed development will provide floor levels above the 100yr flood level plus freeboard and the PMF flood level.
- Parts of the proposed buildings are suspended above the 100yr ARI flood level plus 500mm freeboard and PMF to ensure that no adverse impacts occur surrounding the site.
- The site is located within the lower reaches of the Milperra Catchment and the proposed upgraded drainage system on Bullecourt Lane shows to have a positive impact of flood levels surrounding the site.

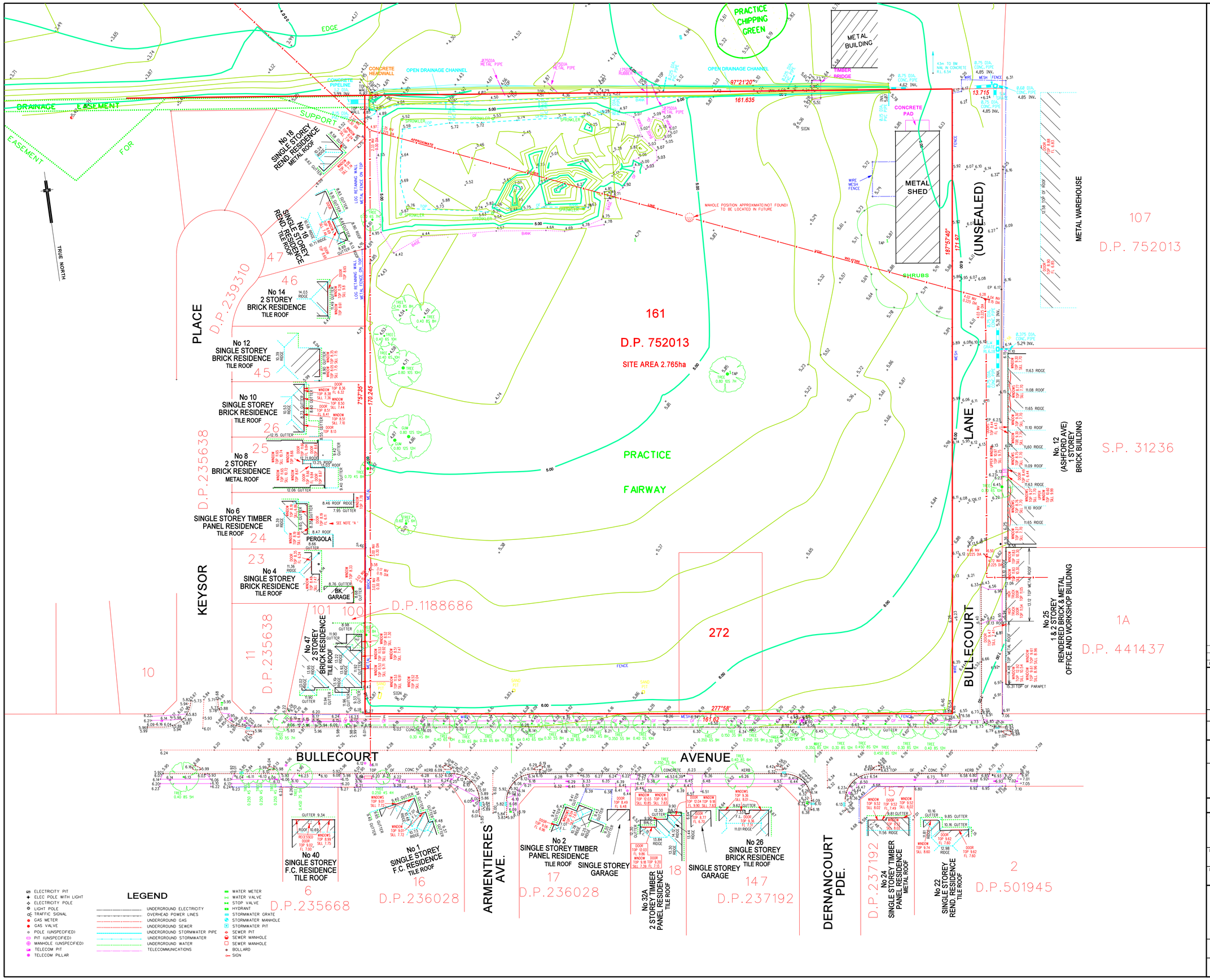
The following recommendation should be implemented to reduce the flood risk and flood impacts to an acceptable level:

- Provide suspended sections of the buildings to ensure the free flow of floodwaters through the site.
- Provide flood compatible materials for every building proposed up to the PMF levels across the site. Structural masonry or concrete components should be provided to withstand the forces of floodwaters up to the PMF levels.
- Developing a site flood and evacuation plan as part of the emergency management plan which is owned, practiced and implemented by the site's manager. The plan should focus on flood warning, evacuation notification and emergency response procedures for the site.

The depths of the floodwater onsite are shown on the within Appendences C and D.

APPENDIX A

Site Survey



NOTES:

IF ANY CONSTRUCTION IS INTENDED IN THE PROXIMITY OF THE BOUNDARIES IT IS RECOMMENDED THAT A FURTHER SURVEY BE REQUESTED FOR THE MARKING OF THE RELEVANT BOUNDARIES.

TREE SPREADS & TRUNK DIAMETERS SHOWN ARE DIAGRAMMATIC ONLY AND TREE HEIGHTS ARE ESTIMATED. IF ANY OF THESE ELEMENTS ARE CRITICAL TO DESIGN (IN PARTICULAR DRIPLINES) MORE SPECIFIC DETAILS SHOULD BE REQUESTED FOR ACCURATE LOCATION.

SYMBOLS REPRESENTING SERVICE PITS, POLES AND STREET FURNITURE ARE NOT TO SCALE.

PIT SIZE IS SHOWN AT GROUND LEVEL. PITS MAY BE LARGER BELOW THE SURFACE.

SERVICE LINES SHOWN ARE DIAGRAMMATIC ONLY AND DO NOT REPRESENT THE WIDTH AND NUMBER OF CABLES OR PIPES IN THE GROUND.

POSITION OF UNDERGROUND SERVICES PLOTTED FROM INFORMATION SUPPLIED BY THE RELEVANT AUTHORITIES AND MAY BE APPROXIMATE ONLY.

BEARING SHOWN RELATE TO TRUE NORTH

IT IS THE RESPONSIBILITY OF EACH CONTRACTOR AND/OR CONSULTANT TO CONTACT THE RELEVANT AUTHORITY AND/OR "Dial Before You Dig" (Phone 1100 Fax 1300 652 077) BEFORE COMMENCING ANY EXCAVATION.

THIS PLAN HAS BEEN CREATED AT A SCALE OF 1:400 AND MAY NOT BE SATISFACTORY FOR OTHER PURPOSES. THE ACCURACY OF ANY ENLARGEMENT OR OTHER REPRODUCTION MAY BE LESS THAN THAT OF THE ORIGINAL.

ADJOINING LOT BOUNDARIES ARE APPROXIMATE ONLY.

" A " WINDOWS & DOORS FOR LOT 24 D.P.2356 ADDED BY PHOTO SCALING

BOUNDARIES SHOWN HEREON ARE PROVISIONAL ON REGISTRATION OF A PLAN OF REDEFINITION AND CONSOLIDATION BEING REGISTERED BY LAND AND PROPERTY INFORMATION

LEGEND

- ELECTRICITY PIT
- ELEC POLE WITH LIGHT
- ELECTRICITY POLE
- LIGHT POLE
- TRAFFIC SIGNAL
- GAS METER
- GAS VALVE
- POLE (UNSPECIFIED)
- PIT (UNSPECIFIED)
- MANHOLE (UNSPECIFIED)
- TELECOM PIT
- TELECOM PILLAR
- UNDERGROUND ELECTRICITY
- OVERHEAD POWER LINES
- UNDERGROUND GAS
- UNDERGROUND SEWER
- UNDERGROUND STORMWATER PIPE
- UNDERGROUND STORMWATER
- UNDERGROUND WATER
- TELECOMMUNICATIONS
- WATER METER
- WATER VALVE
- STOP VALVE
- HYDRANT
- STORMWATER GRATE
- STORMWATER MANHOLE
- STORMWATER PIT
- SEWER PIT
- SEWER MANHOLE
- SEWER MANHOLE
- BOLLARD
- SIGN

REV.	DATE	AMENDMENTS
A	26/02/2015	ADDITIONAL DETAIL & LEVELS ADDED (76775)

RYGATE SURVEYORS
SURVEYING SINCE 1893
Rygate & Company Pty Limited
P.W. Rygate & West
ABN 61 001 204 897
a Suite 904 Level 9, 89 York St Sydney NSW 2000
p +61 2 8262 6800
f +61 2 8262 6843
e surveyors@rygate.com.au
w rygate.com.au

SUBDIVISION | STRATA PLANS | STRATUM SUBDIVISION | LEASE PLANS | TOPOGRAPHIC SURVEYS | GPS SURVEYS | 3D MODELLING | RACECOURSE DESIGN | PROJECT MANAGEMENT | SUN SHADOW DIAGRAMS

SURVEYOR	DRAWN	CHECKED	APPROVED
M.T.	M.T.		

0 — REDUCTION RATIO 1:400 @ B1 — 40

DATUM : AUSTRALIAN HEIGHT DATUM
CONTOUR INTERVAL : 0.25 METRE
ORIGIN OF LEVELS : SSM 48784 RL 11.109 (AHD)

THIS TITLE BLOCK AND NOTES FORM AN INTEGRAL PART OF THE PLAN AND MUST BE REPRODUCED IN ANY USE, DUPLICATION OR AMENDMENT.

CLIENT: BANKSTOWN GOLF CLUB

LOCALITY: BANKSTOWN

L.G.A.: CITY OF BANKSTOWN

PLAN

SHOWING DETAIL AND LEVELS
BANKSTOWN GOLF CLUB

CAD REFERENCE: 74578_Rev_A.DGN

REFERENCE No.	PLAN No.	DATE	SHEET No.
74578	76775.dgn	18/2/2011	1 OF 2 SHEETS

APPENDIX B

Existing Flood Model Results

Title:

Peak Flood Depths - Existing 5yr ARI Event

N

25 0 25 50 75 100 m

Ref No: **16116**

Date: **20/10/17**

Rev: **A**

siteplus

Title:

Peak Flood Depths - Existing 10yr ARI Event

N

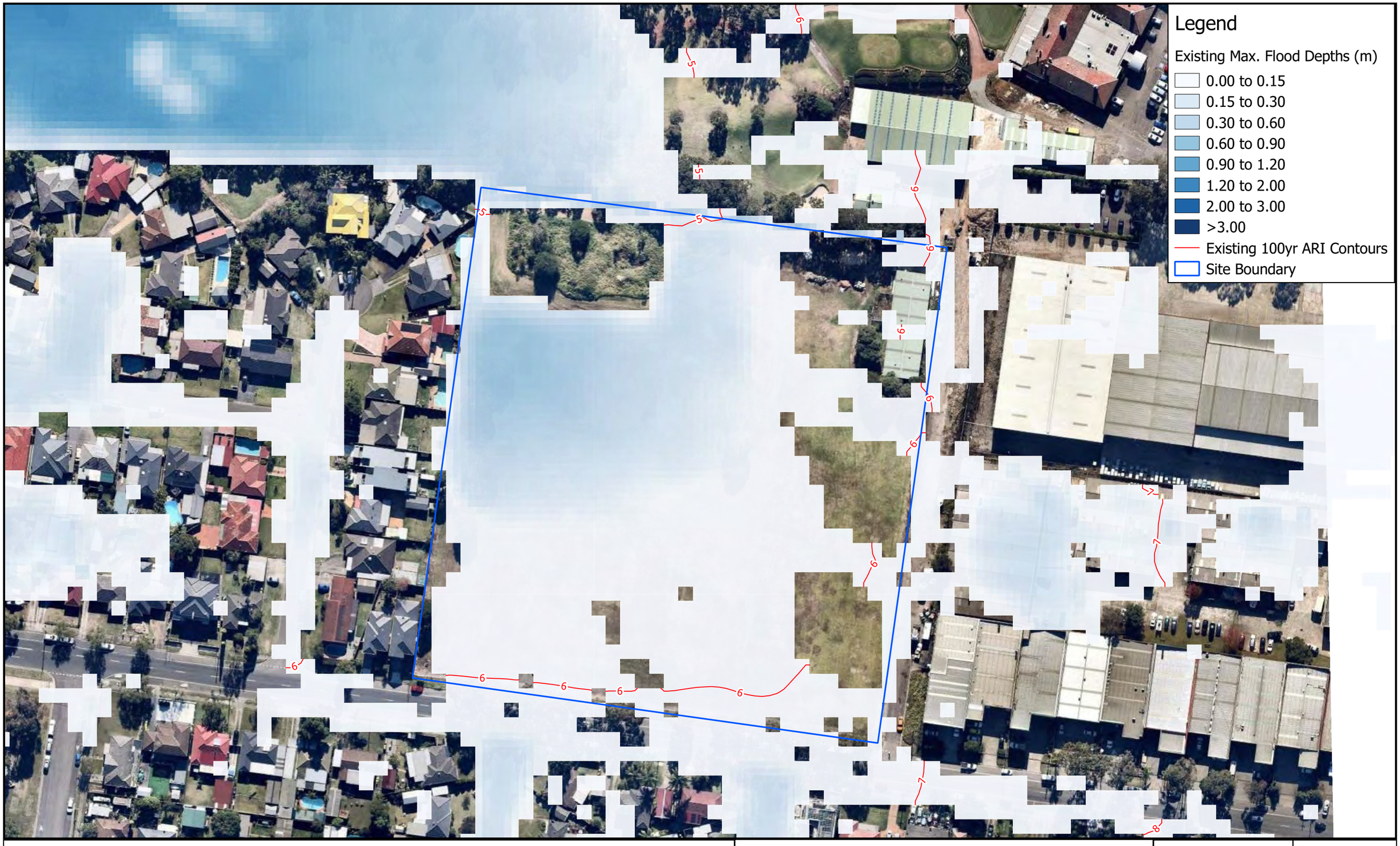
25 0 25 50 75 100 m

Ref No: **16116**

Rev: **A**

Date: **20/10/17**

siteplus



Title:

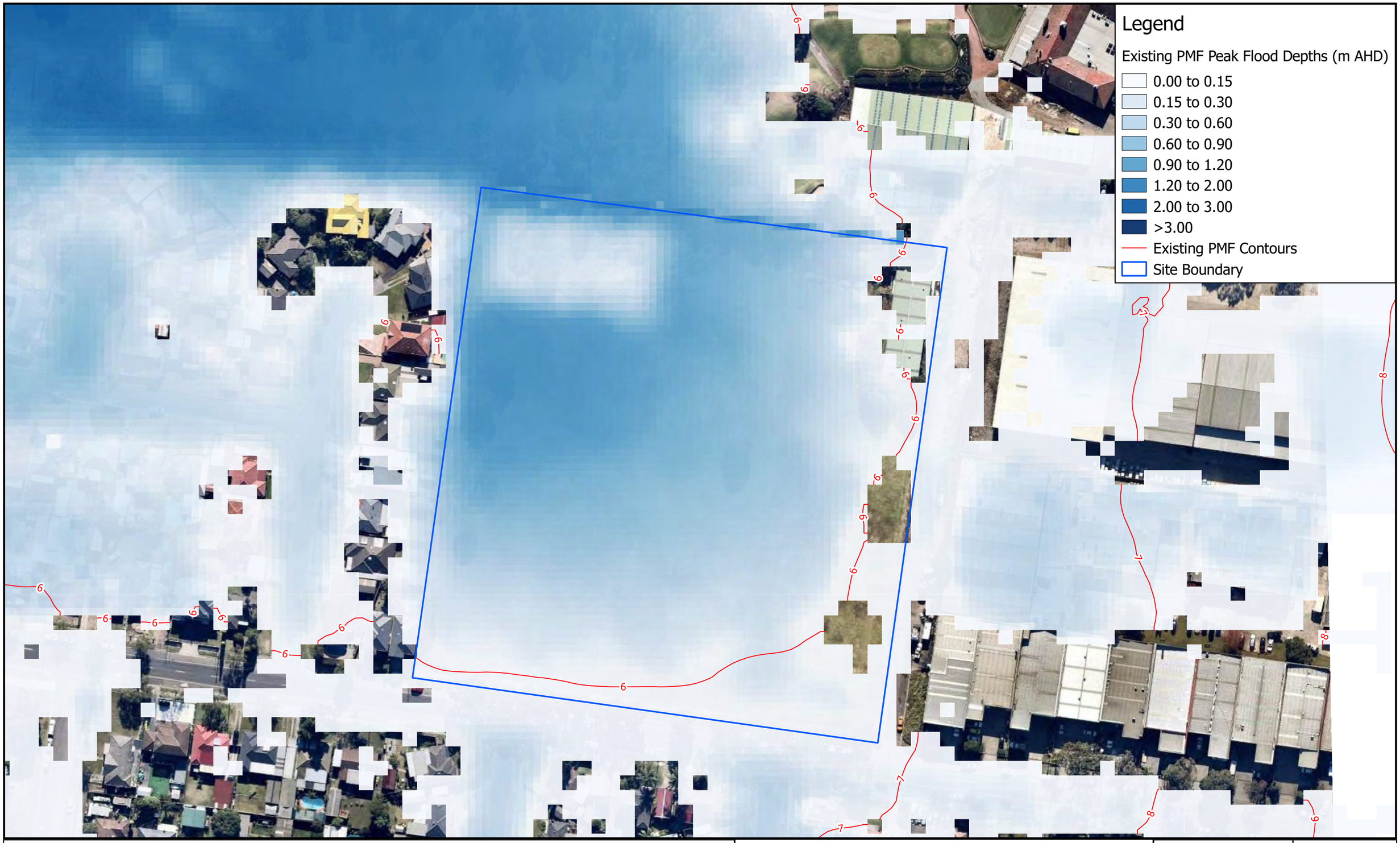
Peak Flood Depths - Existing 100Yr ARI Event

Ref No: **16116**

Rev: **A**

Date: **05/09/16**

siteplus



Title:

Peak Flood Depths - Existing PMF Event

N

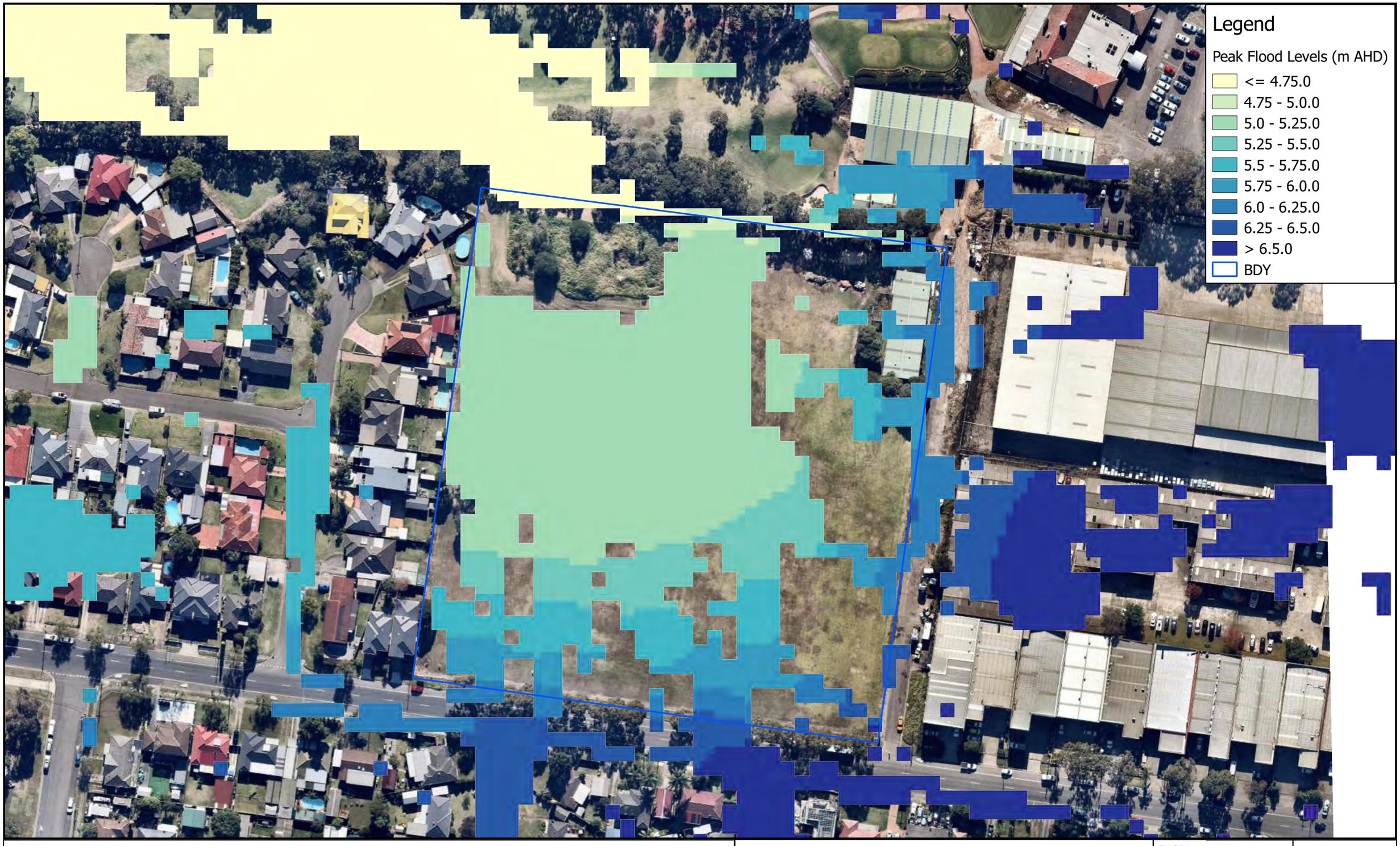
25 0 25 50 75 100 m

Ref No: **16116**

Date: **05/09/16**

Rev: **A**

siteplus



Title:

Peak Flood Levels - Existing 5yr ARI Event

N

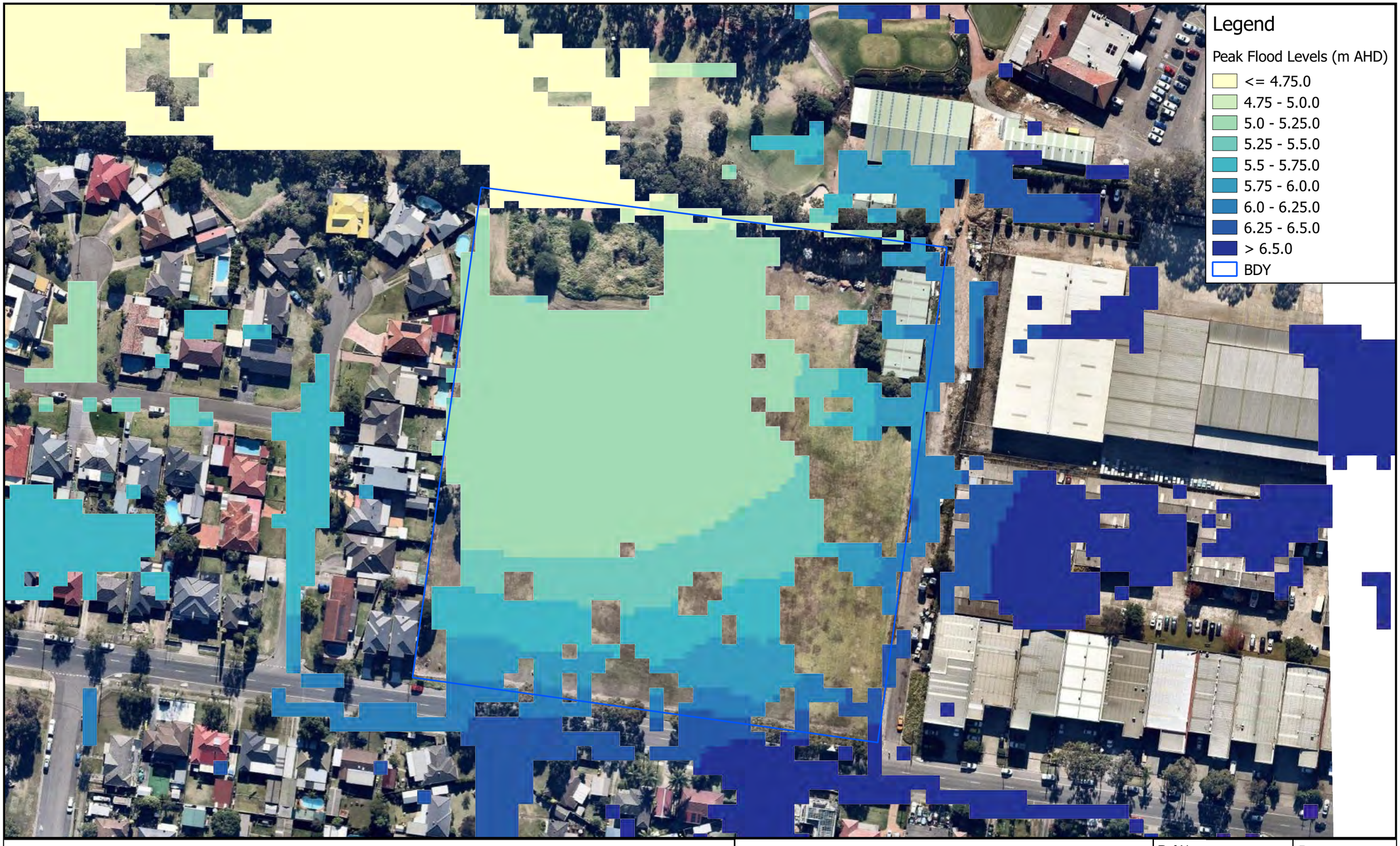
25 0 25 50 75 100 m

Ref No: 16116

Date: 20/10/17

Rev: A

siteplus



Title:

Peak Flood Levels - Existing 10yr ARI Event

N

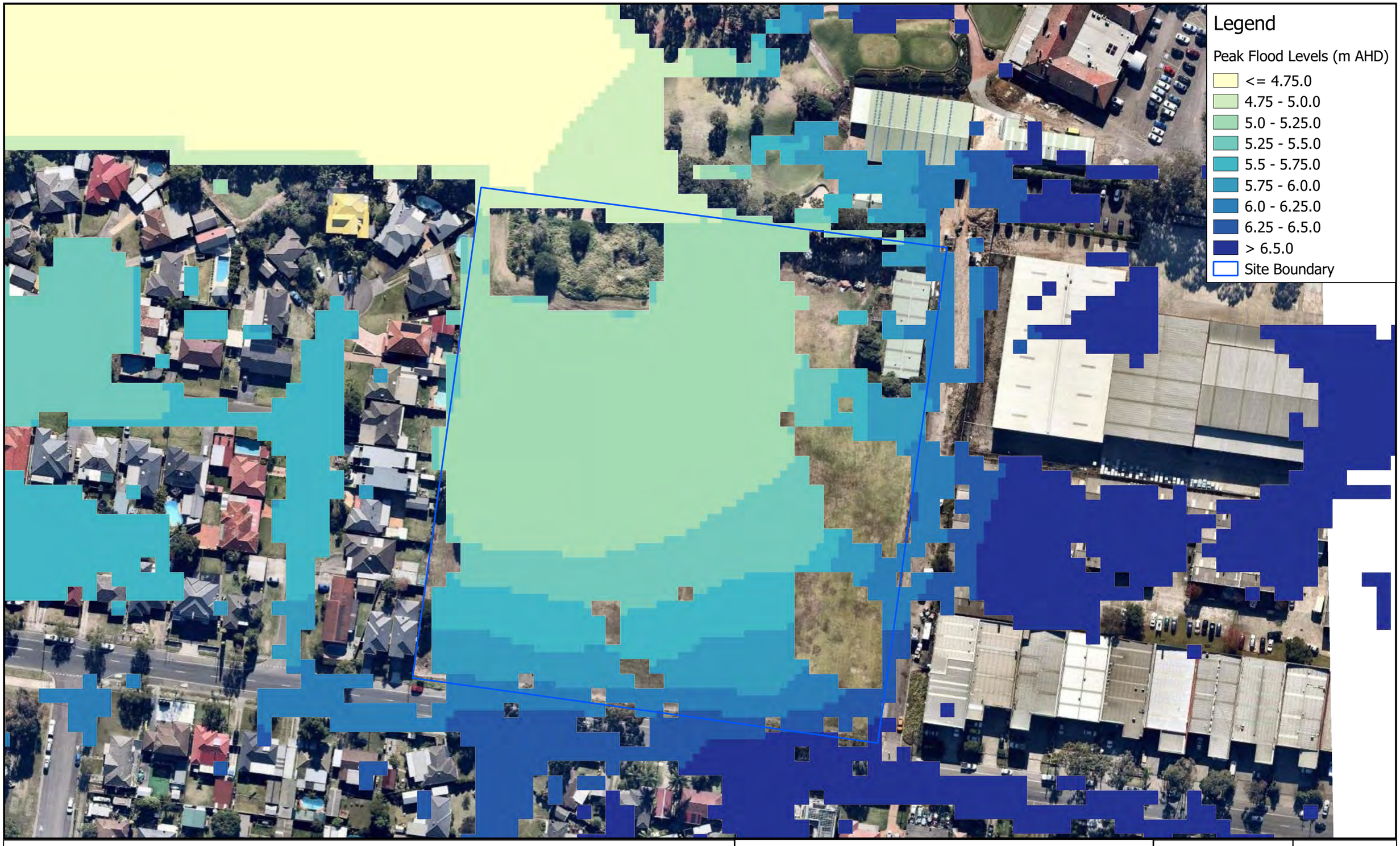
25 0 25 50 75 100 m

Ref No: 16116

Date: 20/10/17

Rev: A

siteplus



Title:

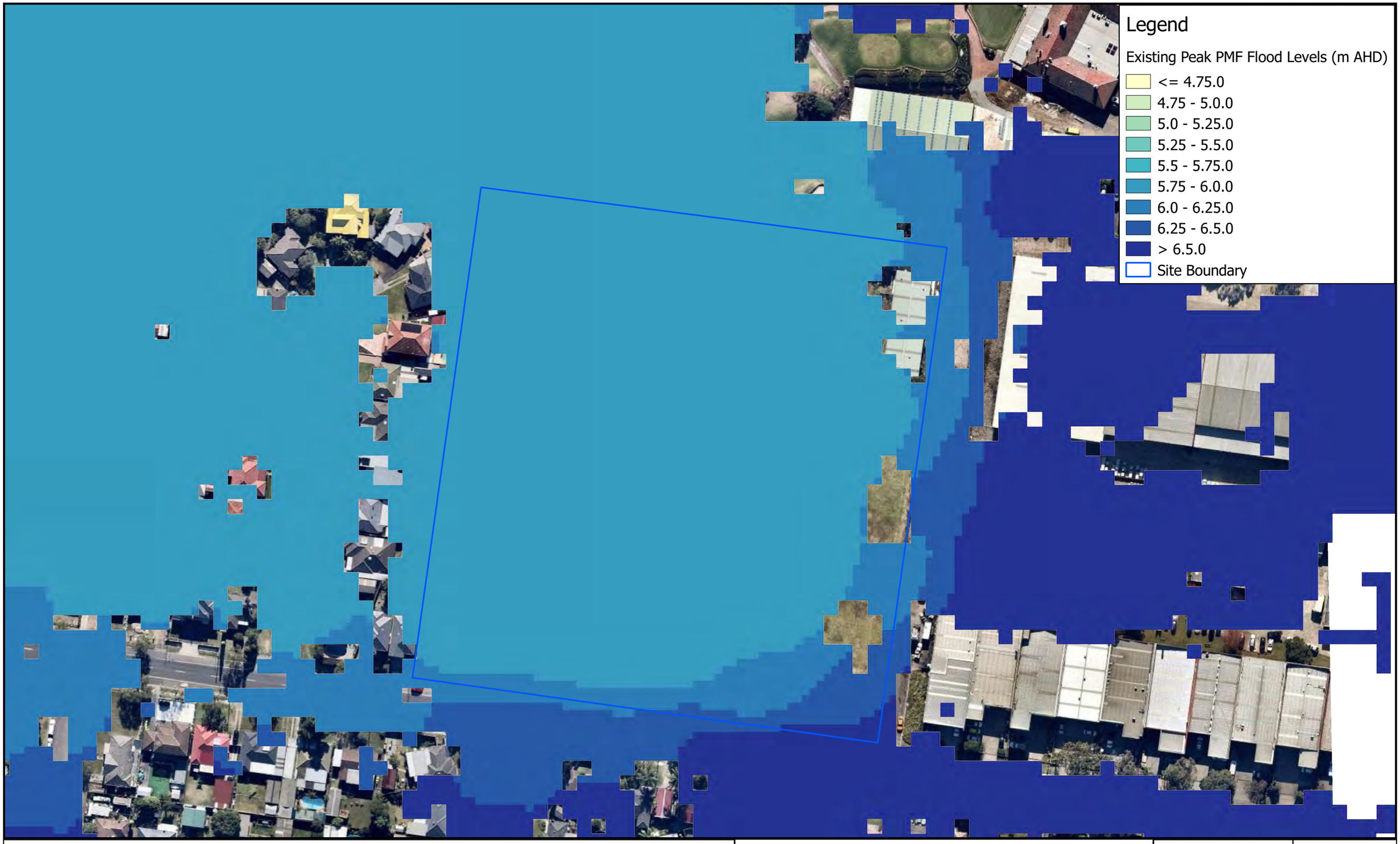
Peak Flood Levels - Existing 100Yr ARI Event

Ref No: **16116**

Rev: **A**

Date: **05/09/16**

siteplus



Title:

Peak Flood Levels - Existing PMF Event

N

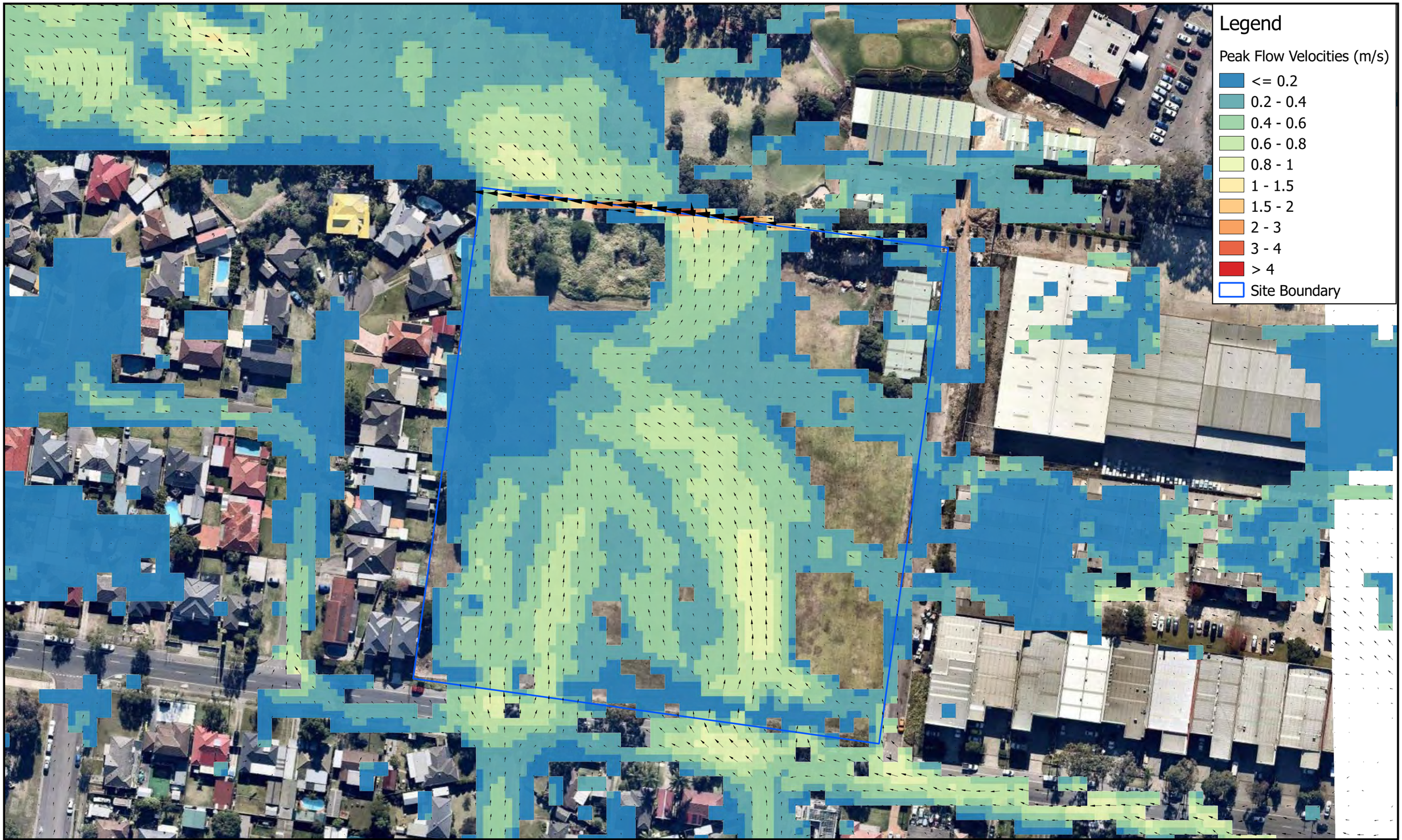
25 0 25 50 75 100 m

Ref No: **16116**

Date: **05/09/16**

Rev: **A**

siteplus



Title:

Peak Flow Velocities - Existing 100Yr ARI Event

N

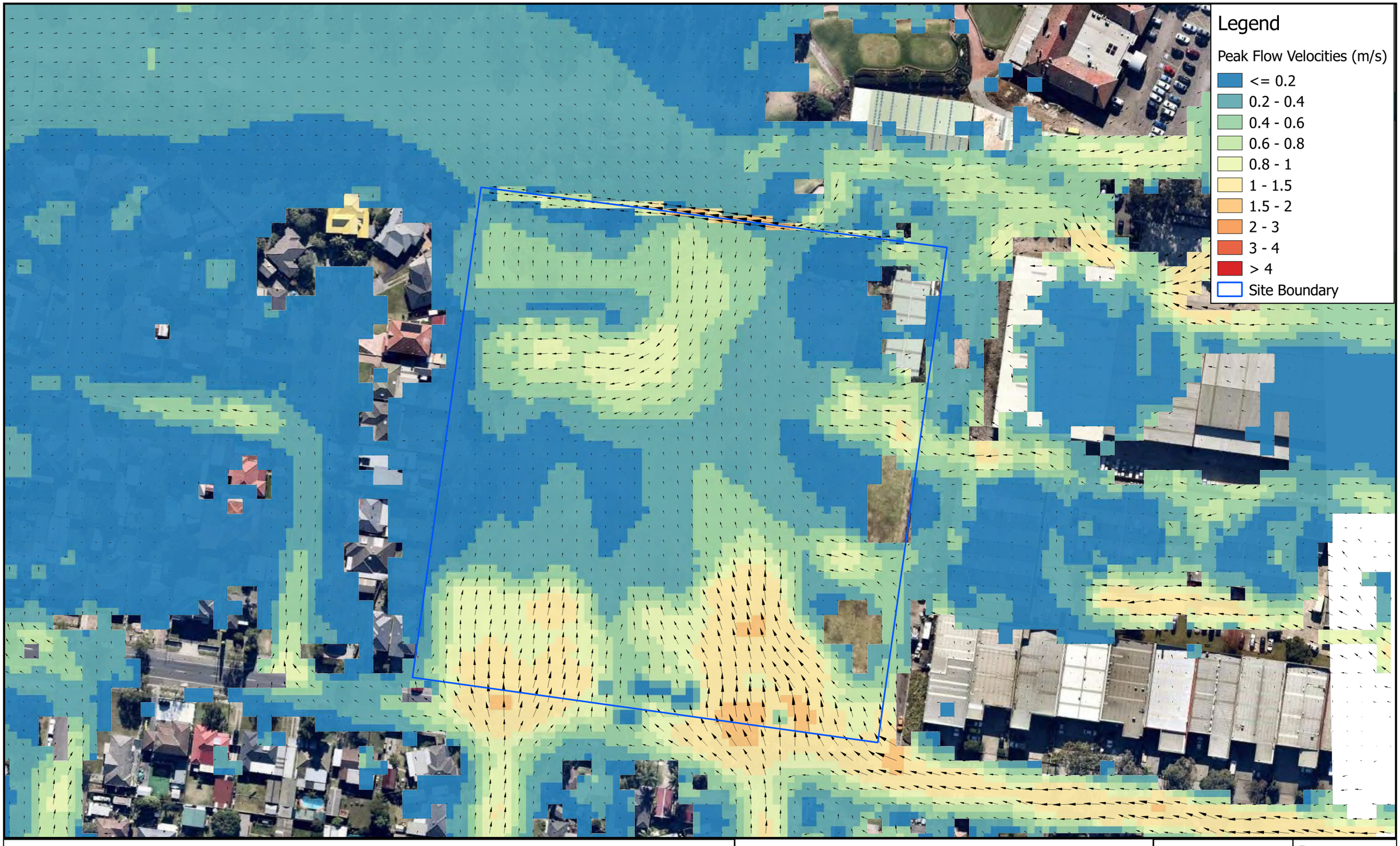
25 0 25 50 75 100 m

Ref No: **16116**

Date: **07/09/16**

Rev: **A**

siteplus



Title:

Peak Flow Velocities - Existing PMF Event

N

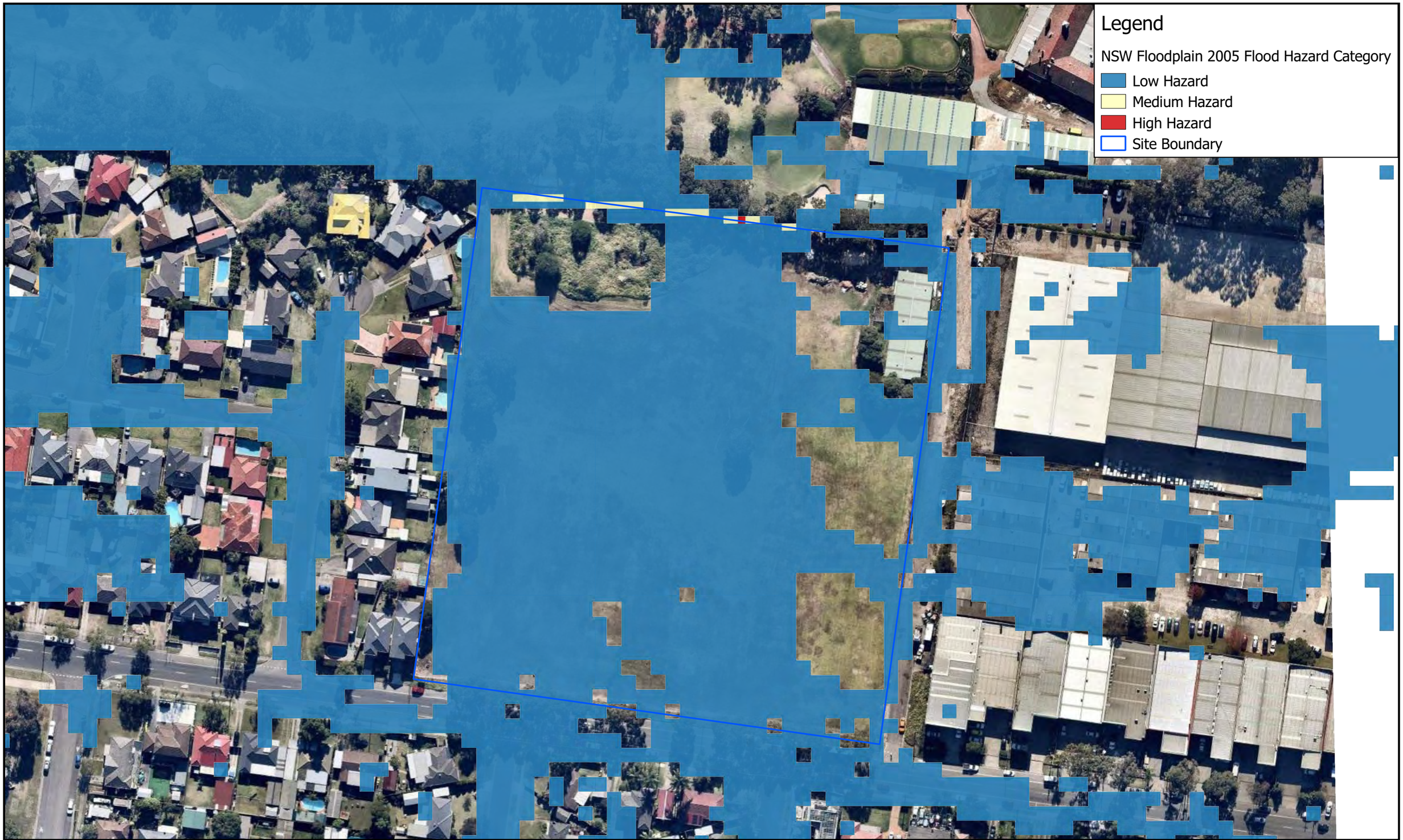
25 0 25 50 75 100 m

Ref No: **16116**

Date: **07/09/16**

Rev: **A**

siteplus



Title:

Flood Hazard Category - Existing 100yr Event

N

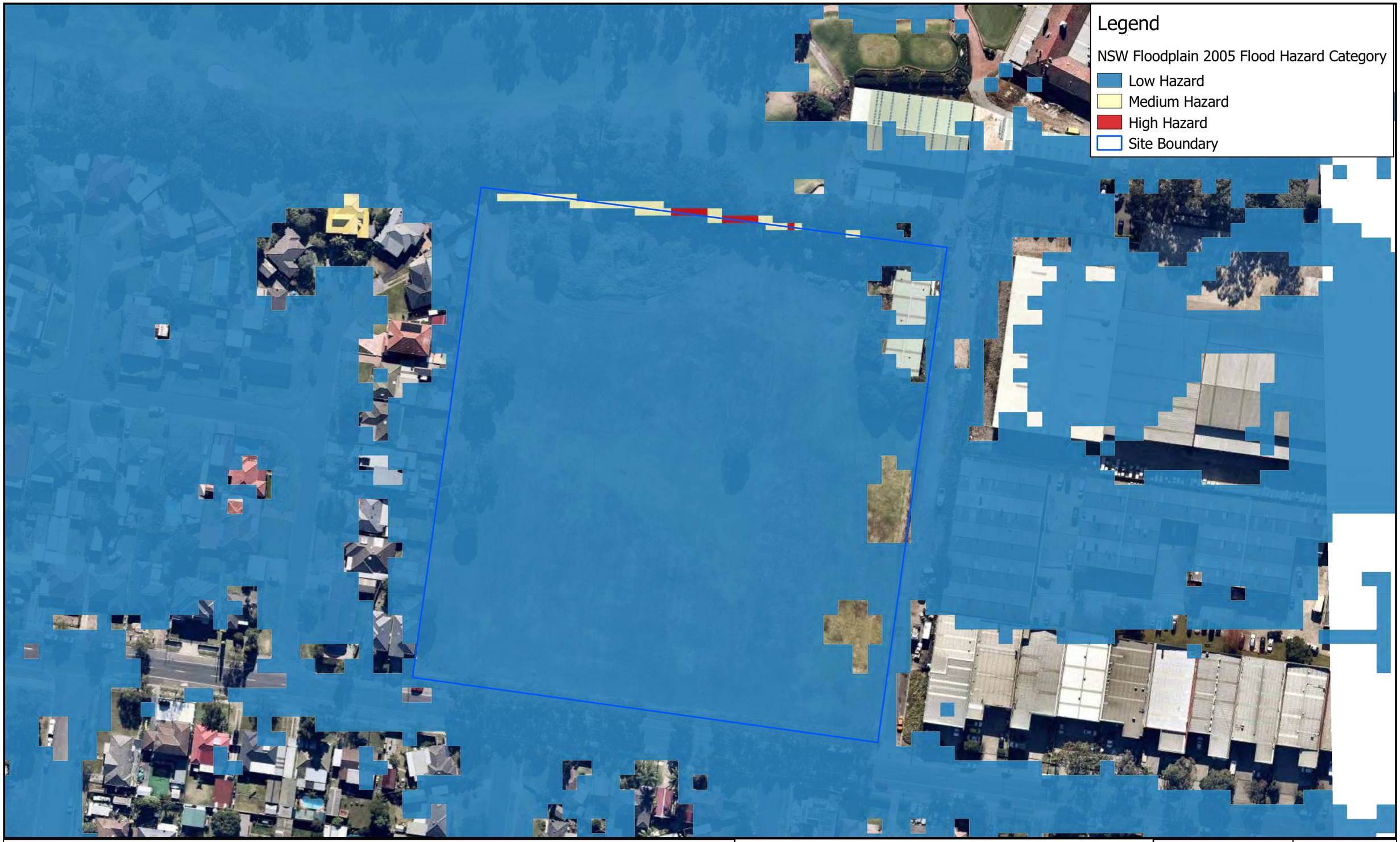
25 0 25 50 75 100 m

Ref No: **16116**

Date: **07/09/16**

Rev: **A**

siteplus



Title:

Flood Hazard Category - Existing PMF Event

Ref No: **16116**

Rev: **A**

Date: **07/09/16**

siteplus

APPENDIX C

Proposed Flood Model Results

Title:

Peak Flood Depths - Development 5yr ARI Event

N

25 0 25 50 75 100 m

Ref No: 16116

Rev: C

Date: 21/12/18

siteplus

Title:

Peak Flood Depths - Development 10yr ARI Event

N

25 0 25 50 75 100 m

Ref No: 16116

Rev: C

Date: 21/12/19

siteplus

Title:

Peak Flood Depths - Development 100yr ARI Event

N

25 0 25 50 75 100 m

Ref No: 16116

Rev: C

Date: 21/12/18

siteplus

Title:

Peak Flood Depths - Development PMF Event

N

25 0 25 50 75 100 m

Ref No: 16116

Rev: C

Date: 21/12/19

siteplus

Title:

Peak Flood Levels - Development 5yr ARI Event

N

25 0 25 50 75 100 m

Ref No: **16116**

Rev: **C**

Date: **21/12/19**

siteplus

Title:

Peak Flood Levels - Development 10yr ARI Event

N

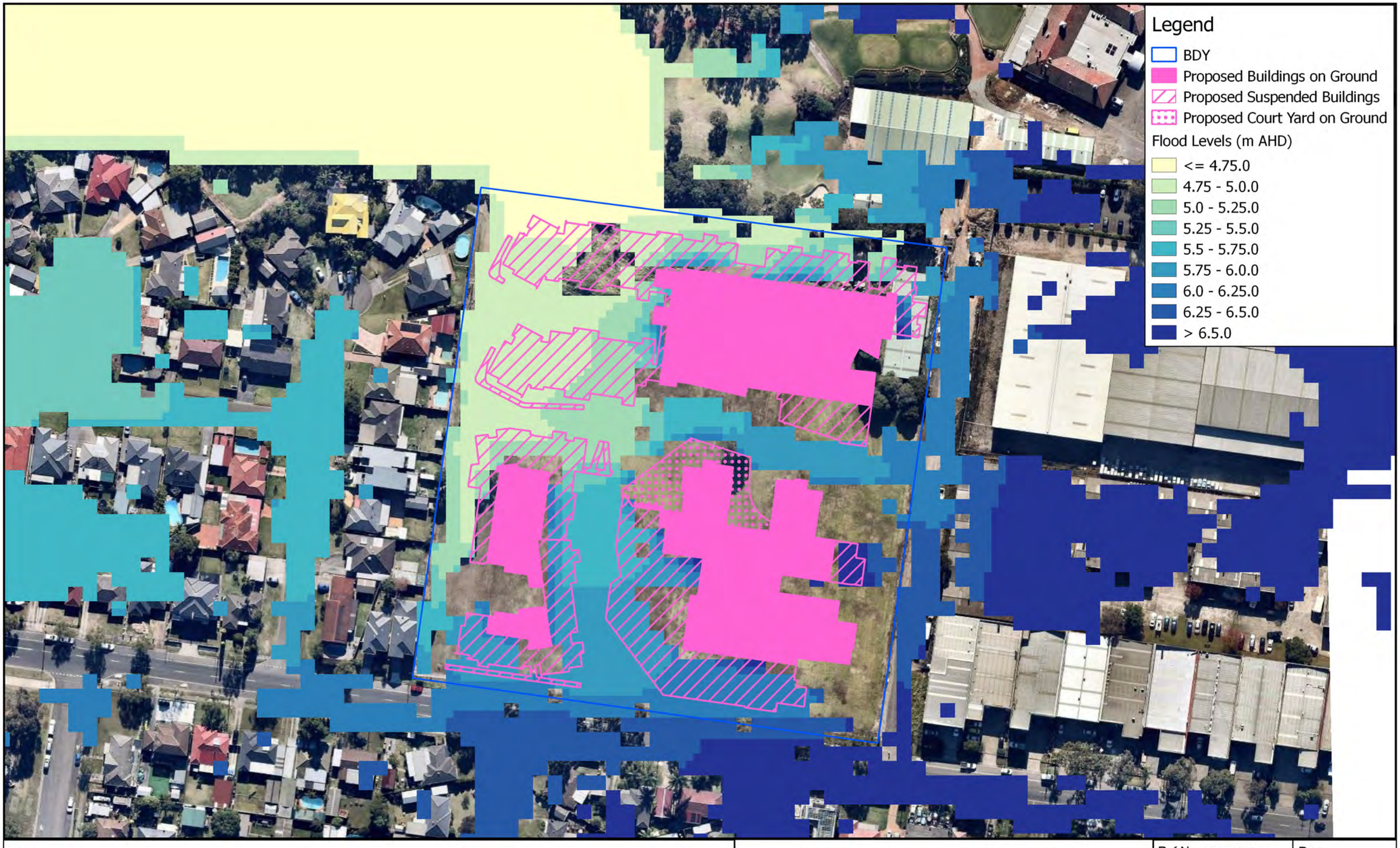
25 0 25 50 75 100 m

Ref No: **16116**

Rev: **C**

Date: **21/12/19**

siteplus



Title:

Peak Flood Levels - Development 100yr ARI Event

N

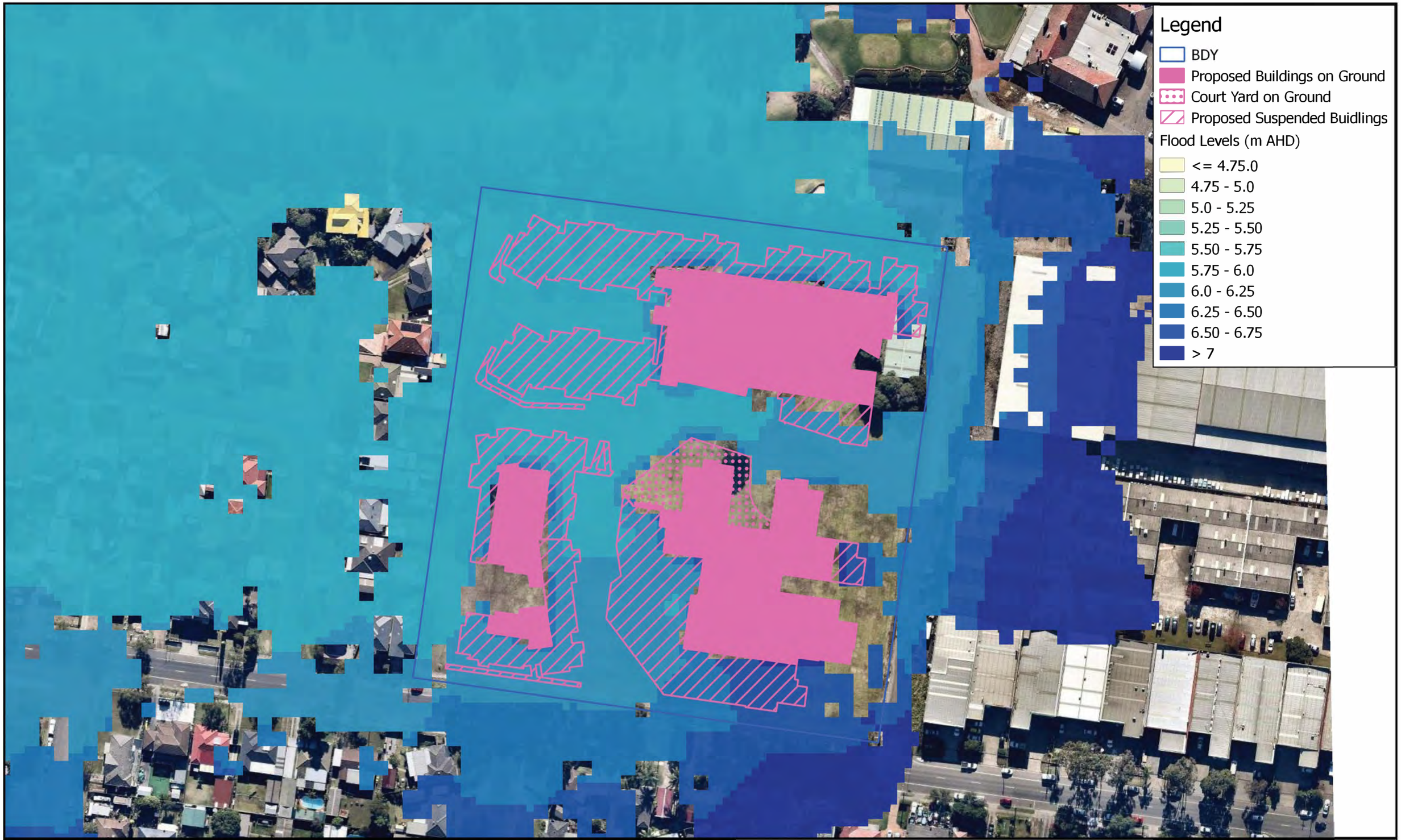
25 0 25 50 75 100 m

Ref No: **16116**

Rev: **C**

Date: **21/12/18**

siteplus



Title:

Peak Flood Levels - Development PMF Event

N

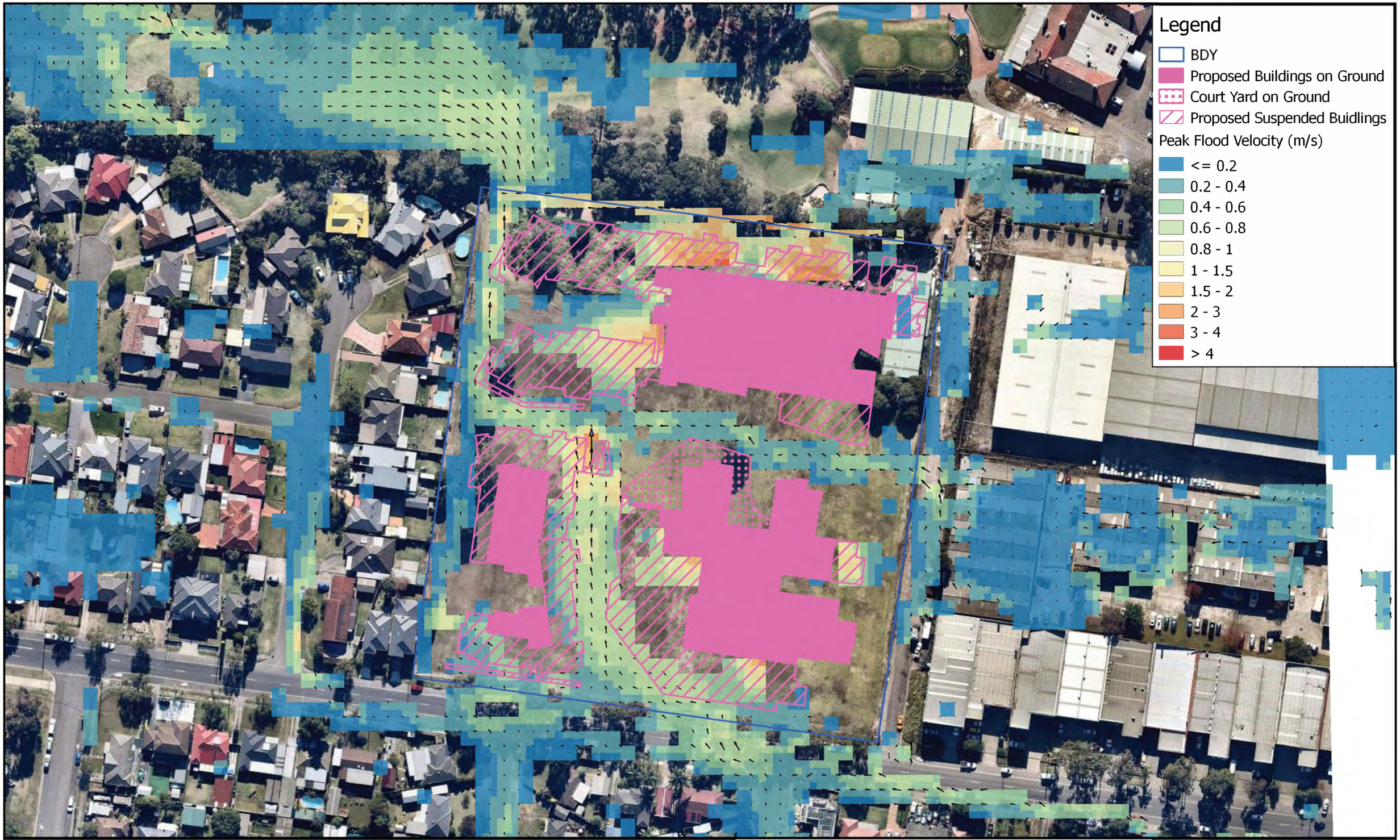
25 0 25 50 75 100 m

Ref No: 16116

Date: 21/12/19

Rev: C

siteplus



Title:

Peak Flood Velocity - Development 5yr ARI Event

N

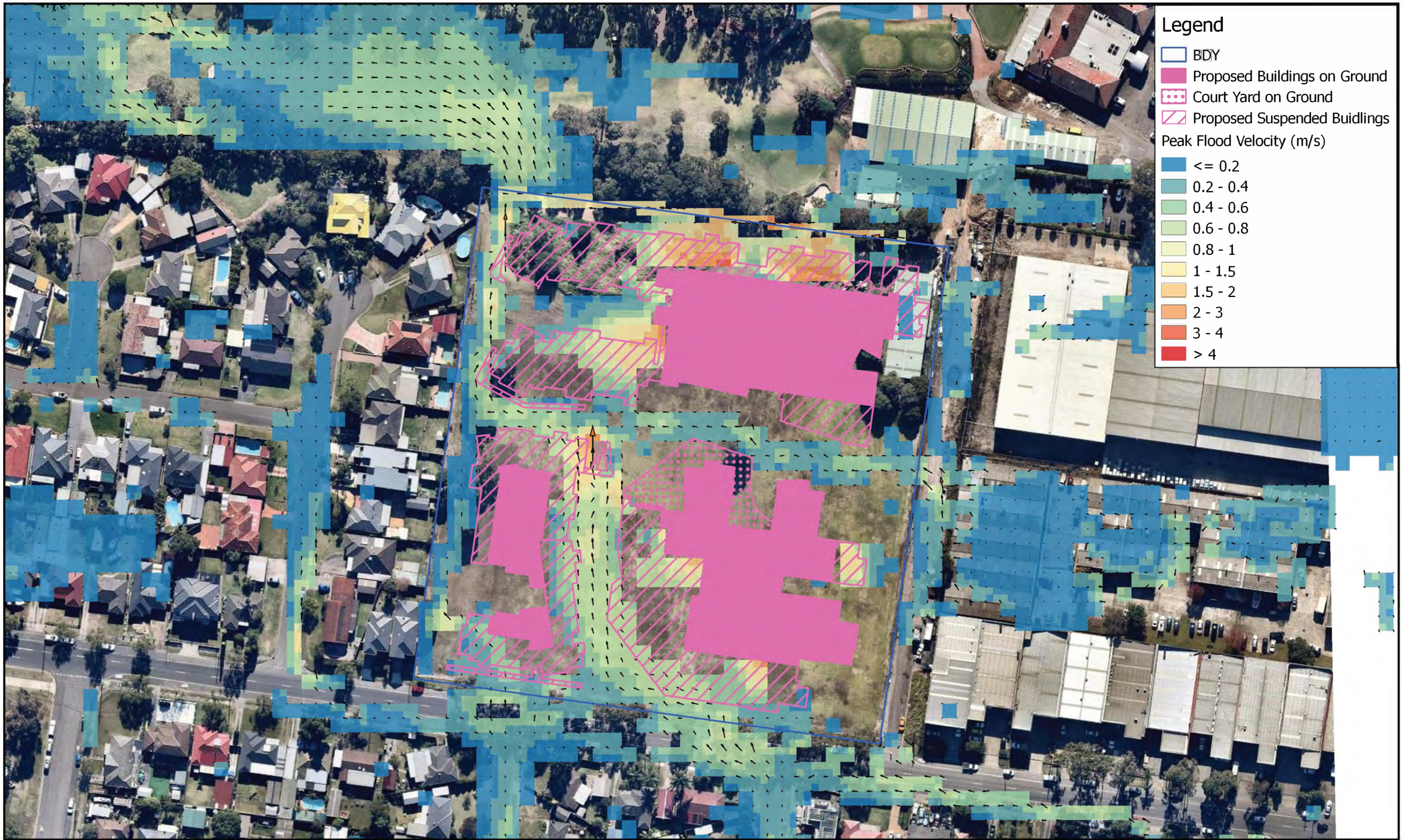
25 0 25 50 75 100 m

Ref No: 16116

Date: 21/12/18

Rev: C

siteplus



Title:

Peak Flood Velocity - Development 10yr ARI Event

N

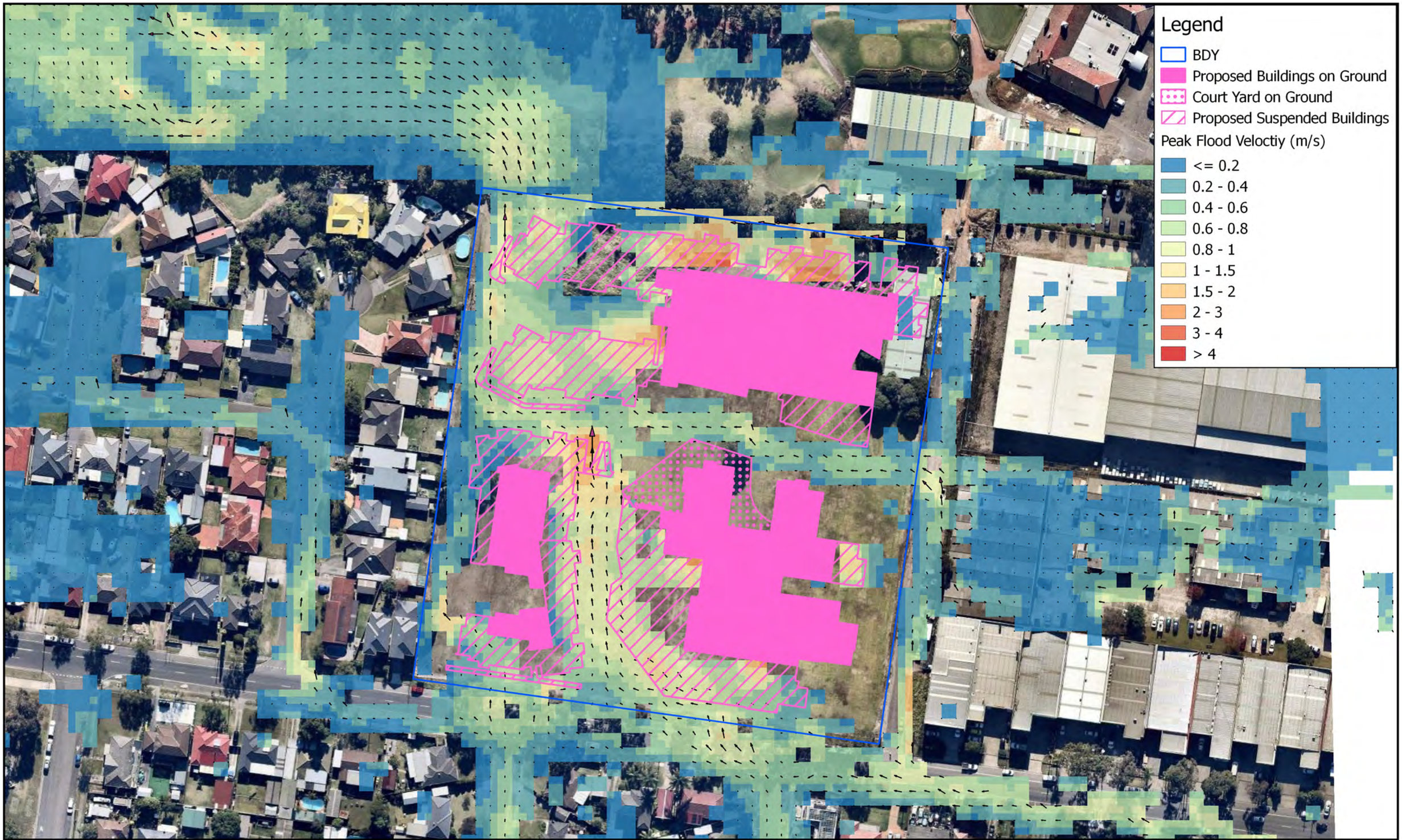
25 0 25 50 75 100 m

Ref No: 16116

Date: 21/12/18

Rev: C

siteplus



Title:

Peak Flow Velocities - Development 100yr ARI Event

N

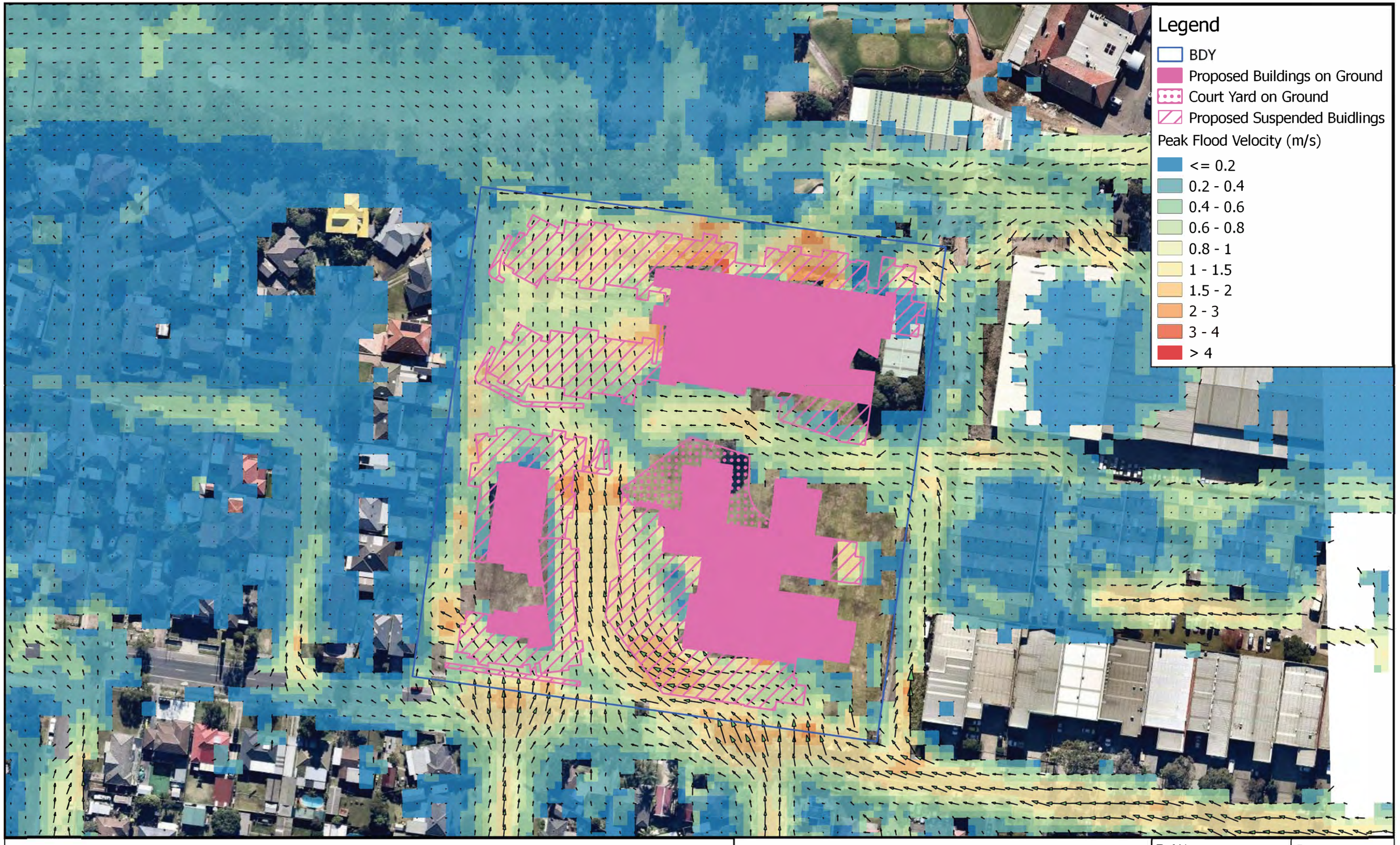
25 0 25 50 75 100 m

Ref No: 16116

Date: 21/12/18

Rev: C

siteplus



Title:

Peak Flood Velocity - Development PMF Event

N

25 0 25 50 75 100 m

Ref No: 16116

Rev: C

Date: 21/12/18

siteplus

Title:

Peak Flood Hazard - Development 5yr ARI Event

N

25 0 25 50 75 100 m

Ref No: **16116**

Date: **21/12/19**

Rev: **C**

siteplus

Title:

Peak Flood Hazard - Development 10yr ARI Event

N

25 0 25 50 75 100 m

Ref No: **16116**

Rev: **C**

Date: **21/12/19**

siteplus

Title:

Peak Flood Hazards - Development 100yr ARI Event

N

25 0 25 50 75 100 m

Ref No: **16116**

Date: **21/12/18**

Rev: **C**

siteplus

Legend

BDY

Proposed Buildings on Ground

Proposed Suspended Buildings/Walkways

Proposed Court Yard

Flood Hazard

Low Hazard

Medium Hazard

High Hazard

Title:

Peak Flood Hazard - Development PMF Event

N

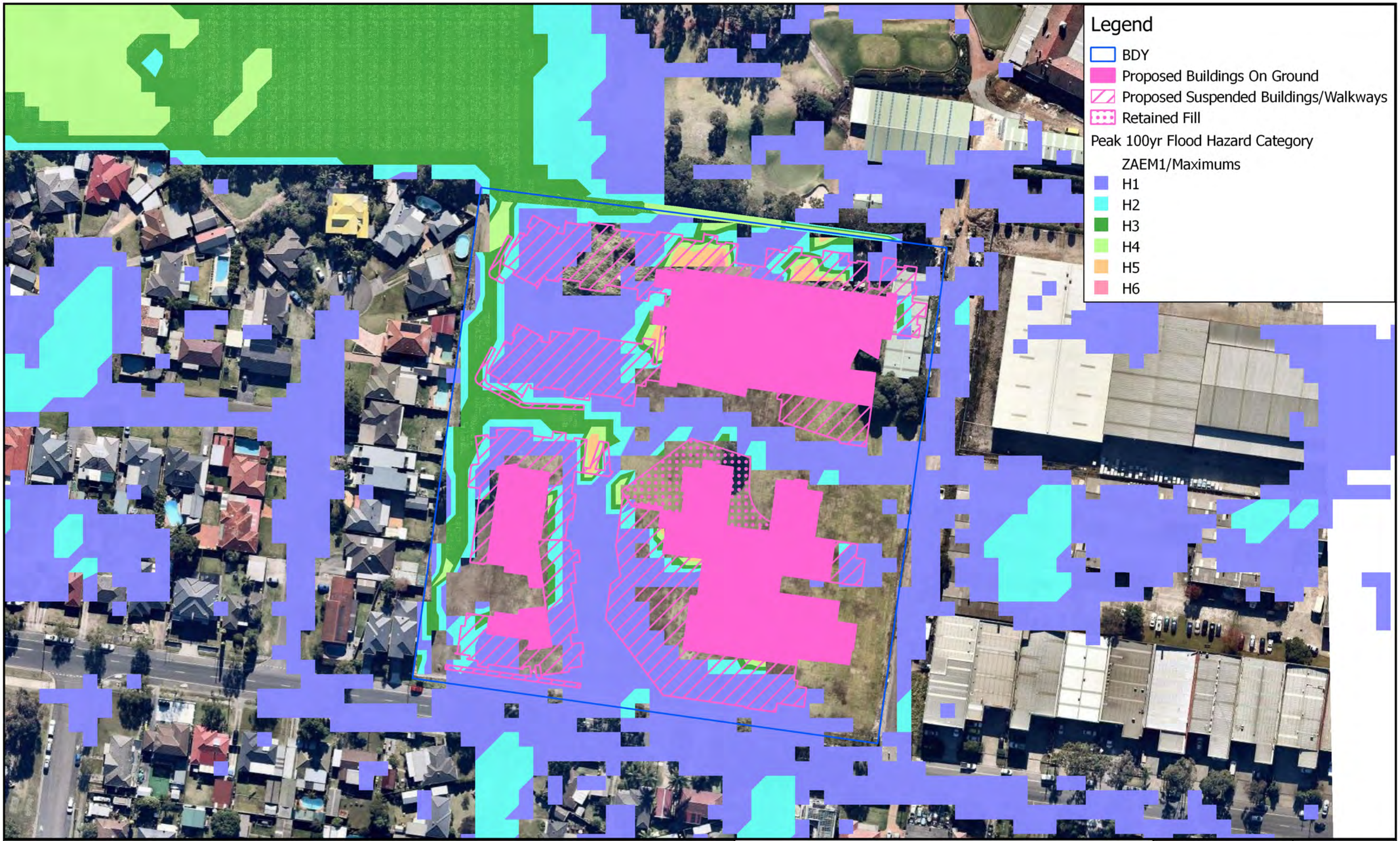
25 0 25 50 75 100 m

Ref No: 16116

Date: 21/12/18

Rev: C

siteplus



Title:

Flood Hazard Category - Development 100yr Event

N

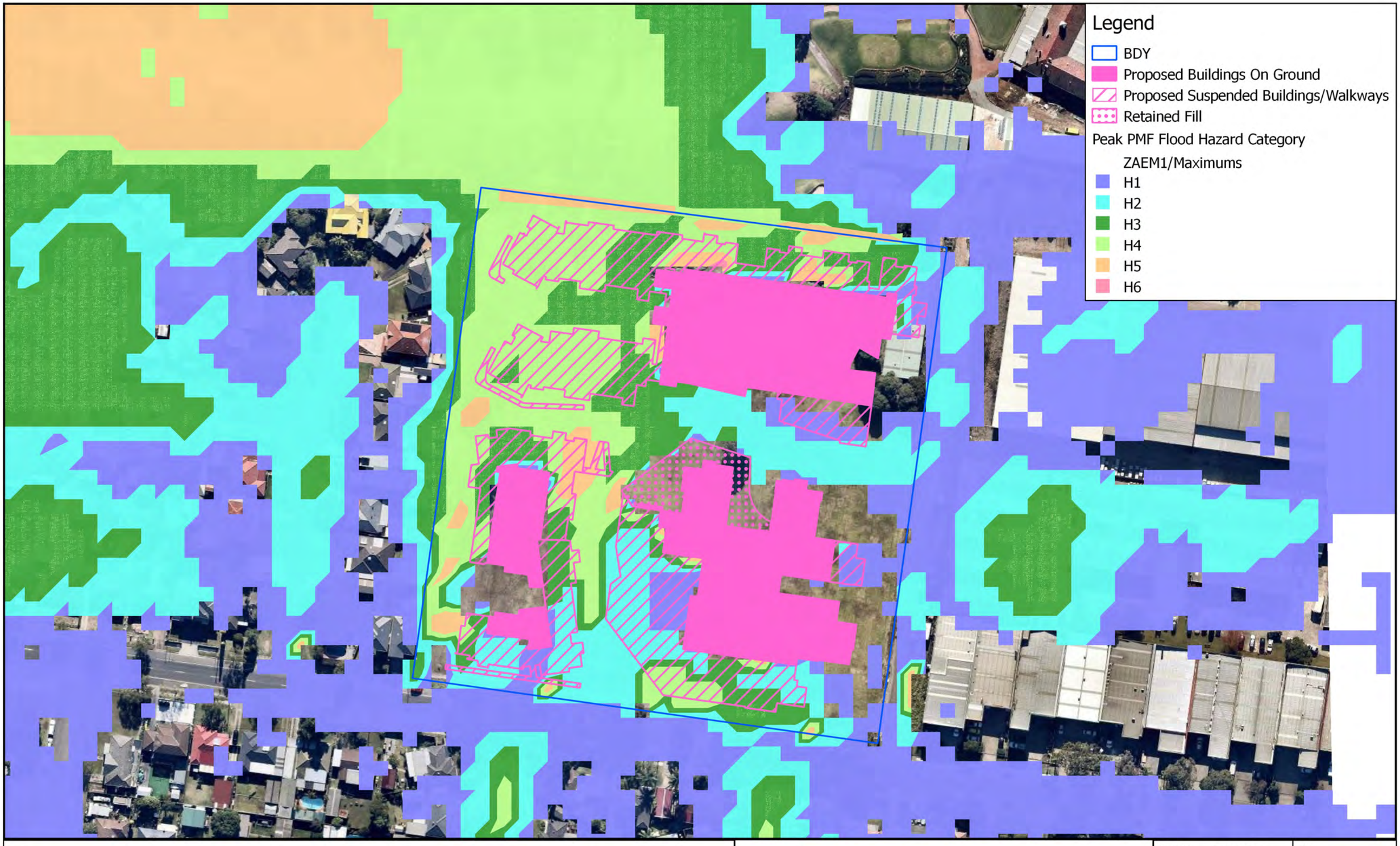
25 0 25 50 75 100 m

Ref No: **16116**

Date: **21/12/18**

Rev: **C**

siteplus



Title:

Flood Hazard Category - Development PMF Event

N

25 0 25 50 75 100 m

Ref No: **16116**

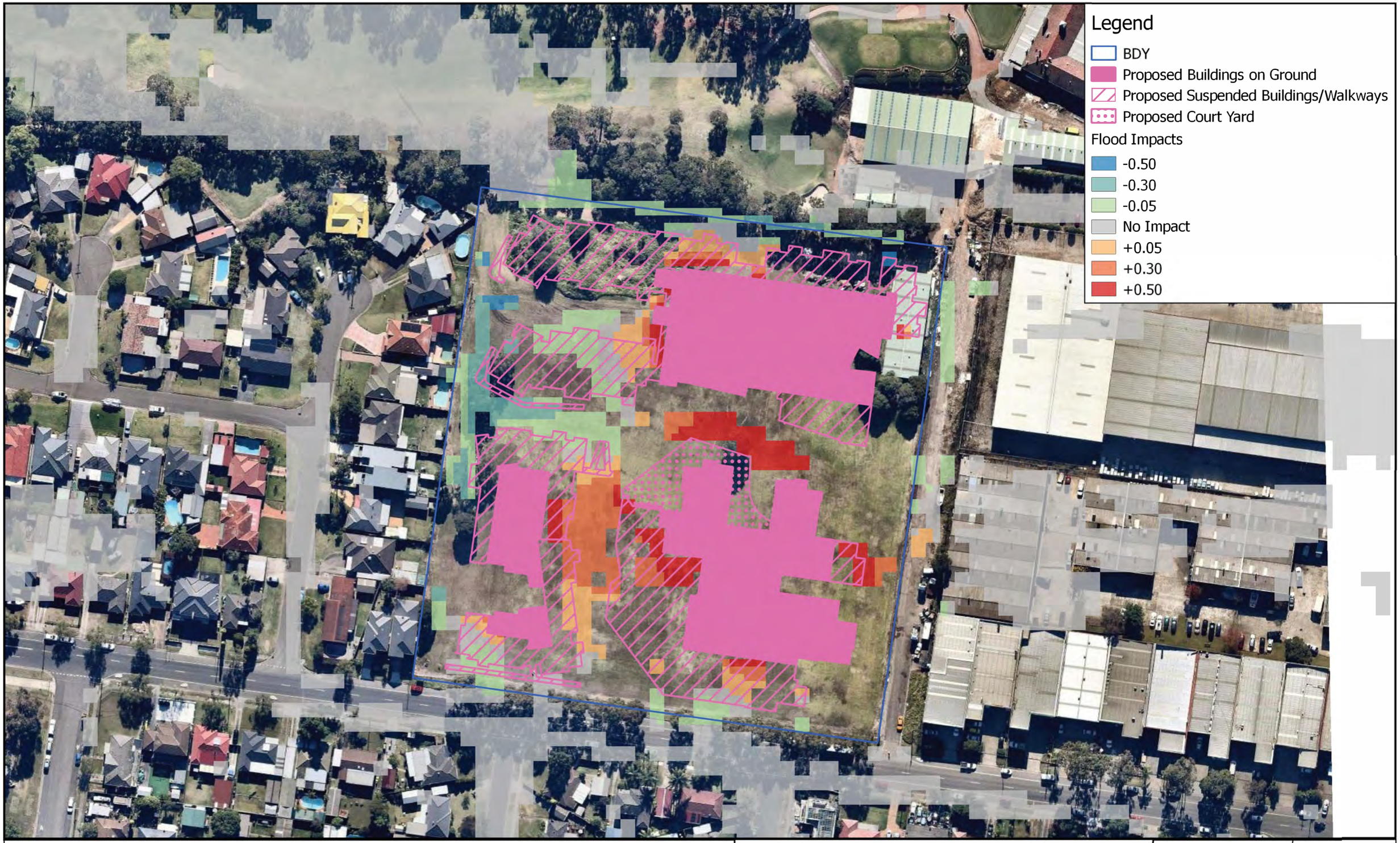
Rev: **C**

Date: **21/12/18**

siteplus

APPENDIX D

Flood Impact Assessment



Title:

Flood Impacts - Development 5yr ARI Event

N

25 0 25 50 75 100 m

Ref No: 16116

Date: 21/12/18

Rev: C

siteplus

Title:

Flood Impacts - Development 10yr ARI Event

N

25 0 25 50 75 100 m

Ref No: **16116**

Date: **21/12/18**

Rev: **C**

siteplus

Title:

Peak Flood Impacts - Development 100yr ARI Event

N

25 0 25 50 75 100 m

Ref No: 16116

Date: 21/12/18

Rev: C

siteplus

Title:

Flood Impacts - Development PMF Event

N

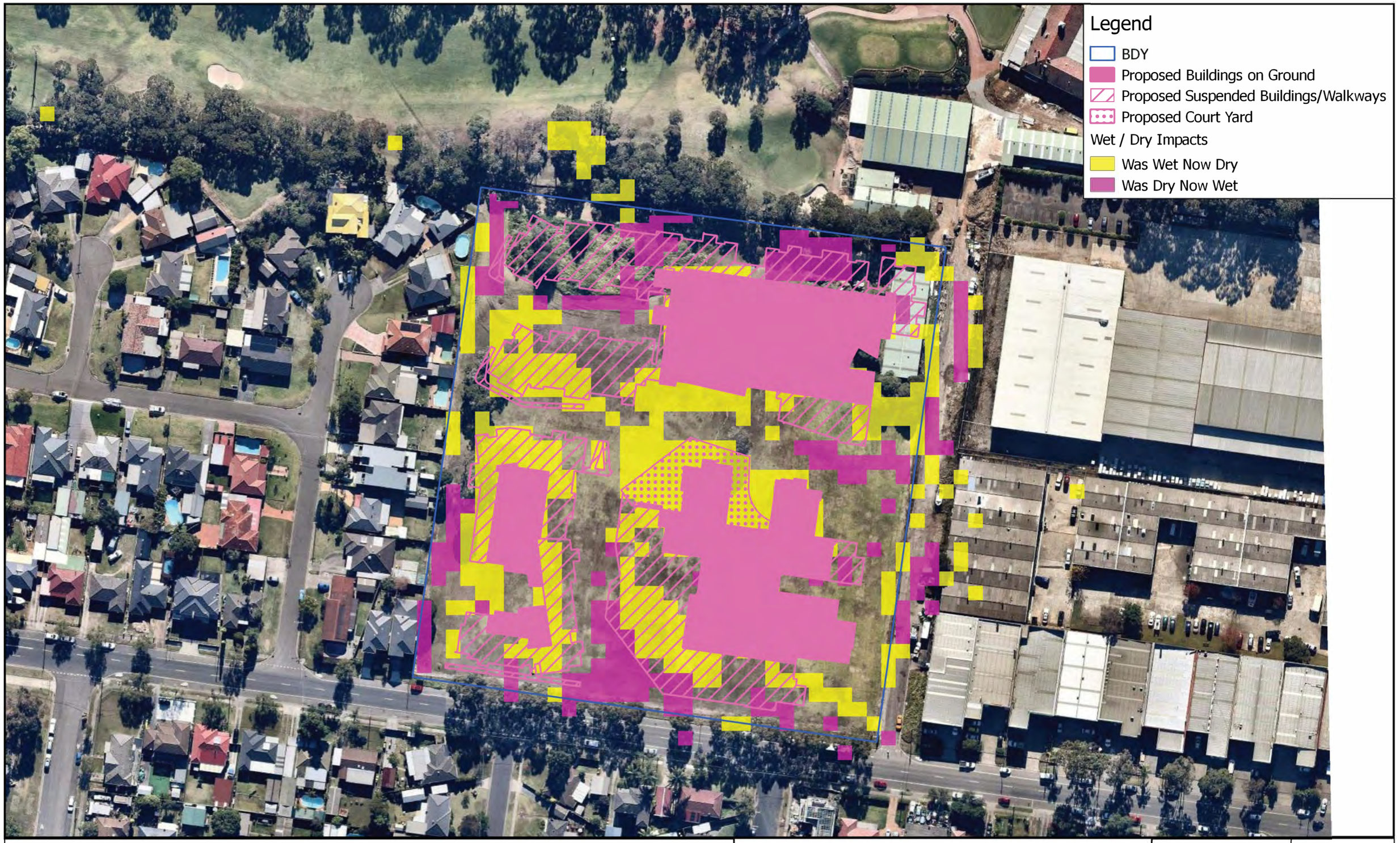
25 0 25 50 75 100 m

Ref No: **16116**

Rev: **C**

Date: **21/12/18**

siteplus



Title:

Wet Dry Impact - Development 5yr ARI Event

N

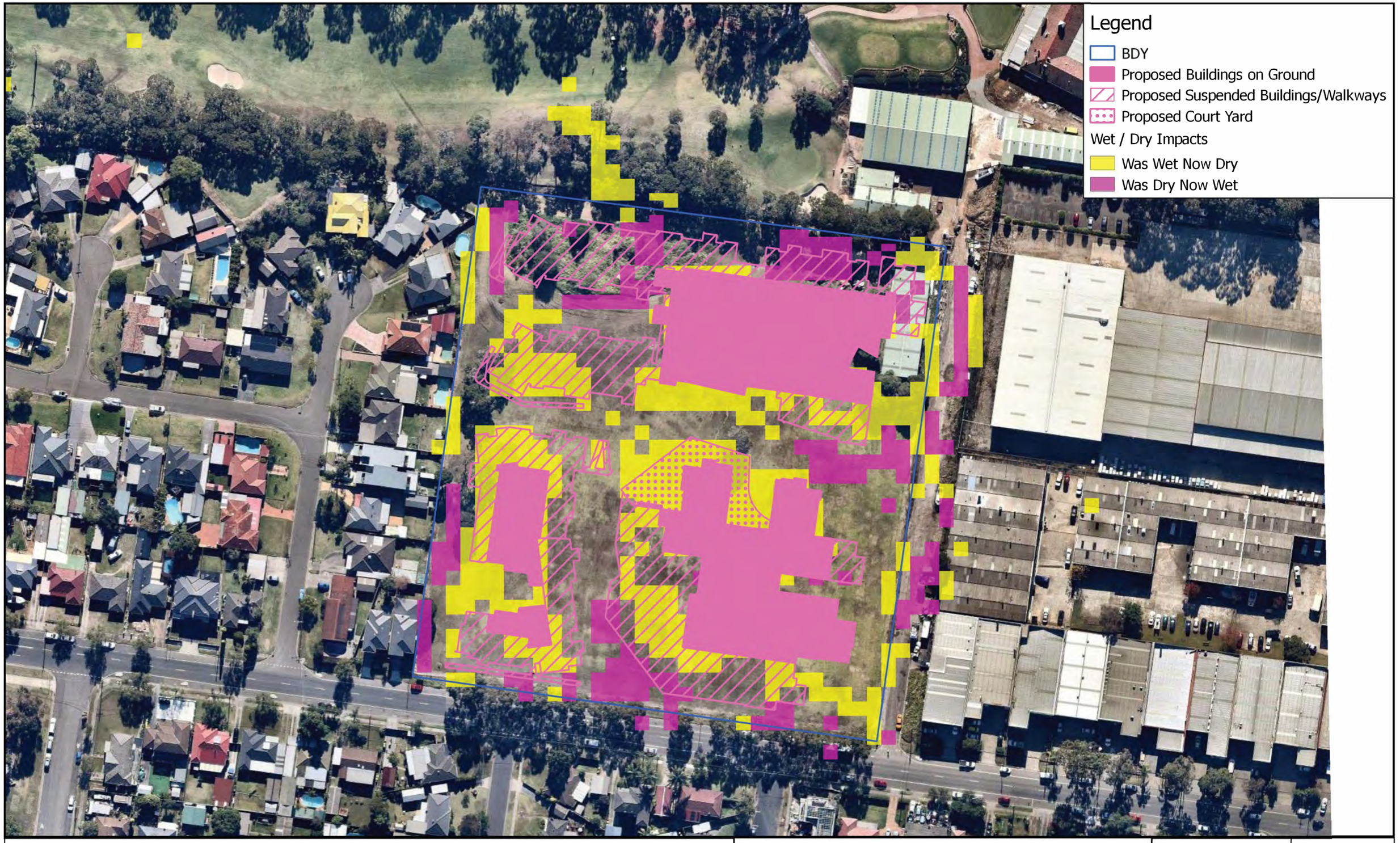
25 0 25 50 75 100 m

Ref No: 16116

Rev: C

Date: 21/12/18

siteplus



Title:

Wet Dry Impact - Development 10yr ARI Event

N

25 0 25 50 75 100 m

Ref No: **16116**

Rev: **C**

Date: **21/12/18**

siteplus

Title:

Wet Dry Impacts - Development 100yr ARI Event

N

25 0 25 50 75 100 m

Ref No: 16116

Rev: C

Date: 21/12/18

siteplus

Title:

Wet Dry Impact - Development PMF Event

N

25 0 25 50 75 100 m

Ref No: 16116

Date: 21/12/18

Rev: C

siteplus