B | B | C
CONSULTING PLANNERS

18 December 2018 Our ref: DB/16-090

General Manager
Parramatta City Council
PO Box 32
PARRAMATTA NSW 2124

Attention: Shaylin Moodliar

Dear Shaylin,

Re: DA/1281/2016 for a residential care facility at 12 Station Street Toongabbie

Please find attached an addendum to Appendices 13 and 14 to the Statement of Environmental Effects submitted with the development application addressing paragraph 2 of Schedule 2 of the Site Compatibility Certificate issued on 23 November 2018 which requires:

> *The development application is to be supported by appropriate documentation that demonstrates how residents will be made safe in a flood event and how the proposal will be appropriately designed to mitigate any risk to life.*

Appendix 13 and **Appendix 14** submitted with the application provide the appropriate documentation demonstrating how residents will be made safe in a flood event and how the proposal will be appropriately designed to mitigate any risk to life. In particular:

- Section 5 of the Martens & Associates report at Appendix 13 to the Statement of Environmental Effects presents a detailed risk assessment of flood events;
- Section 6.2 of the Martens & Associates report outlines how the proposal has been designed to mitigate risk from a flood event;
- Section 6.3 of the Martens & Associates report outlines risk mitigation measures to be implemented to reduce the risk of floods to people, structures, services, and vehicles;
- Section 6.6 of the Martens & Associates report contains a preliminary flood emergency response plan and outlines actions to be taken by staff to prepare for, and respond to, a flood event;
- Appendix 14 is a Flood Emergency Response Plan prepared by Opal which outlines further procedures by the operator demonstrating how residents will be made safe in a flood event.

55 MOUNTAIN STREET BROADWAY NSW ~ PO BOX 438 BROADWAY NSW 2007 ~ TELEPHONE [02] 9211 4099 FAX [02] 9211 2740
EMAIL: bbc@bbcplanners.com.au ~ WEB SITE: www.bbcplanners.com.au

ABN 24 061 868 942

Similar measures to those above have been identified and described in reports prepared by Molino and Stewart submitted during the development application assessment process and in the final report of Bewsher Consulting dated 5 July 2018 prepared for the Sydney Central City Planning Panel.

All the reports appended to the attachment has been previously provided to Council.

Finally, the applicant, in response to draft without prejudice conditions of consent prepared by Parramatta City Council suggests a replacement operational condition of consent:

> *a) A final Flood Emergency Response Plan for the residential care facility shall be prepared prior to commencement of operations. This Flood Emergency Response Plan is to be independently reviewed by an experienced flood engineer prior to an occupation certificate being issued.*

In this manner, the requirements of Paragraph 2 of Schedule 2 of the Site Compatibility Certificate dated 23 November 2018 have been addressed in the development application.

If further information is required, we are happy to assist.

Yours sincerely
BBC Consulting Planners

Dan Brindle
Director

BBC
CONSULTING PLANNERS

ATTACHMENT PREPARED BY MARTENS & ASSOCIATES

martens
consulting engineers since 1989

Posted	☐	
Faxed	☐	
Emailed	X	Suzie Jattan
Courier	☐	
By Hand	☐	
Contact:		Terry Harvey
Our Ref:		P1605655JC03V01
Pages:		3 + Attachments
cc.		Corey Taylor, Dan Brindle, Steven Molino

December 18, 2018

Suzie Jattan
Department of Planning & Environment
Level 24, 320 Pitt Street
Sydney NSW 2000
By Email

Dear Suzie,

RE: ADDENDUM TO APPENDICES 13 AND 14 OF SEE IN RESPONSE TO PARAGRAPH 2, SCHEDULE 2 OF CERTIFICATE OF SITE COMPATIBILITY – 12 STATION ROAD & 4-10 WENTWORTH AVENUE, TOONGABBIE, NSW

1.0 INTRODUCTION

Martens & Associates (MA) have prepared this response to Paragraph 2, Schedule 2 of the Site Compatibility Certificate (SCC).

The Statement of Environmental Effects (SEE) prepared by BBC Consulting Planners accompanying the development application (DA) made reference to the SCC issued by the Executive Director Regions of the Department of Planning and Environment dated 16 August 2016. A new SCC for the site was issued on 23 November 2018. Paragraph 2 of Schedule 2 of the new SCC requires:

> *The development application is to be supported by appropriate documentation that demonstrates how residents will be made safe in a flood event and how the proposal will be appropriately designed to mitigate any risk to life.*

This response summarises the flood emergency response documentation already provided in order to address the above requirement.

2.0 FLOOD EMERGERGENCY RESPONSE PLAN DOCUMENTS

The documents listed below and attached to this response address the SCC requirements:

1. Attachment A – Martens & Associates (14 December 2016), *Flood Impact Report and Draft Flood Risk and Emergency Response Plan: 12 Station Road, Toongabbie, NSW* (REF: P1605655JR01V04).
    a. We note this report was included as Appendix 13 of the SEE.
    b. This report included:
        i. A detailed flood risk assessment (Section 5).
        ii. Details of flood risk mitigation measures (Sections 6.2 and 6.3).
        iii. On-site flood warning system details (Section 6.5).

iv. A preliminary flood emergency response plan (Section 6.6).

2. Attachment B – Opal Specialist Aged Care (16 December 2016), *Flood Emergency Response Plan*.

    a. We note this report was included as Appendix 14 of the SEE.

    b. This plan included detailed operational procedures demonstrating how residents will be made safe in a flood event.

3. Attachment C – Martens & Associates (31 May 2018), *Flood Assessment for Proposed Aged Care Facility – 12 Station Road & 4-10 Wentworth Avenue, Toongabbie, NSW* (REF: P1605655JC01V05).

    a. This report detailed hydrologic and hydraulic modelling of the site in existing and proposed conditions to better inform the flood assessment.

4. Attachment D – Molino Stewart (May 2018), *Opal Aged Care Toongabbie – Flood Issues Summary.*

    a. This report addressed site flood risk issues and responded to City of Parramatta Council (CoPC) comments.

5. Attachment E – Bewsher Consulting (5 July 2018), *Proposed Residential Care Facility (RCF) – Opal Aged Care, Toongabbie Sports and Recreation Club & Adjacent Lots, City of Parramatta Council DA/1281/2016, Independent Review of Flood Risks* (REF: J2266L_2).

    a. This report represented an independent review of the flood risk at the site and was commissioned by the applicant and CoPC.

    b. The review confirmed the MA and Molino Stewart assessments appropriately addressed flood risks.

In summary, the documents provide the following flood risk mitigation measures:

1. The development footprint is flood free for the 1 in 100 year average recurrence interval (ARI) flood event.

2. The development footprint remains flood free in the 1000 year ARI flood event, and is only adjacent to shallow low hazard flood waters in the 2000 year ARI flood event.

3. All floor levels are above the probable maximum flood (PMF) level such that no resident or structure is at risk of flood inundation.

4. Risk management devices have been included in the design, such as an on-site flood warning device, backup power generator and supply of essential services in case of flooding.

5. Because of the above, there is no requirement to evacuate the site during a flood because suitable shelter-in-place is available.

6. The risk to life with these measures has been assessed by MA as well as two highly regarded flood risk experts, one of whom was completely independent. All three flood experts agree that the flooding risk is very low and acceptable.

3.0 SUMMARY

The documentation provided appropriately demonstrates how residents will be made safe in a flood event, and how the proposal has been designed to mitigate flooding risks to life.

Finally, in response to the draft without prejudice conditions of consent prepared by CoPC, we suggest a replacement operational condition of consent:

> *A final Flood Emergency Response Plan for the residential care facility shall be prepared prior to commencement of operations. This Flood Emergency Response Plan is to be independently reviewed and approved as being acceptable by an experienced flood engineer prior to an occupation certificate being issued.*

In this manner, the requirements of Paragraph 2 of Schedule 2 of the Site Compatibility Certificate dated 23 November 2018 have been addressed in the DA.

If you have any queries, please do not hesitate to contact our offices.

For and on behalf of

MARTENS & ASSOCIATES PTY LTD

DANIEL DHIACOU
Civil & Environmental Engineer

TERRY HARVEY
Senior Engineer / Project Manager

ATTACHMENT A – FLOOD IMPACT REPORT AND DRAFT FLOOD RISK AND EMERGENCY RESPONSE PLAN, MARTENS & ASSOCIATES (14 DECEMBER 2016)

Opal Aged Care

Flood Impact Report and Draft Flood Risk and Emergency Response Plan: 12 Station Road, Toongabbie, NSW

martens consulting engineers

ENVIRONMENTAL

WATER

WASTEWATER

GEOTECHNICAL

CIVIL

PROJECT MANAGEMENT

P1605655JR01V04
December 2016

Copyright Statement

Limitations Statement

The sole purpose of this report and the associated services performed by Martens & Associates Pty Ltd is to prepare a Draft Flood Risk Emergency Response Plan in accordance with the scope of services set out in the contract / quotation between Martens & Associates Pty Ltd and Opal Aged Care (hereafter known as the Client). That scope of works and services were defined by the requests of the Client, by the time and budgetary constraints imposed by the Client, and by the availability of access to the site.

Martens & Associates Pty Ltd derived the data in this report primarily from a number of sources which may include for example site inspections, correspondence regarding the proposal, examination of records in the public domain, interviews with individuals with information about the site or the project, and field explorations conducted on the dates indicated. The passage of time, manifestation of latent conditions or impacts of future events may require further examination / exploration of the site and subsequent data analyses, together with a re-evaluation of the findings, observations and conclusions expressed in this report.

In preparing this report, Martens & Associates Pty Ltd may have relied upon and presumed accurate certain information (or absence thereof) relative to the site. Except as otherwise stated in the report, Martens & Associates Pty Ltd has not attempted to verify the accuracy of completeness of any such information (including for example survey data supplied by others).

The findings, observations and conclusions expressed by Martens & Associates Pty Ltd in this report are not, and should not be considered an opinion concerning the completeness and accuracy of information supplied by others. No warranty or guarantee, whether express or implied, is made with respect to the data reported or to the findings, observations and conclusions expressed in this report. Further, such data, findings and conclusions are based solely upon site conditions, information and drawings supplied by the Client *etc.* in existence at the time of the investigation.

This report has been prepared on behalf of and for the exclusive use of the Client, and is subject to and issued in connection with the provisions of the agreement between Martens & Associates Pty Ltd and the Client. Martens & Associates Pty Ltd accepts no liability or responsibility whatsoever for or in respect of any use of or reliance upon this report by any third party.

Head Office
Suite 201, 20 George St
Hornsby, NSW 2077, Australia
ACN 070 240 890 ABN 85 070 240 890
Phone: +61-2-9476-9999
Fax: +61-2-9476-8767
Email: mail@martens.com.au
Web: www.martens.com.au

Document and Distribution Status

Author(s)	Reviewer(s)	Project Manager	Signature
Jonathan Frecker / Michael Huan	Terry Harvey	Terry Harvey	

Revision No.	Description	Status	Release Date	Document Location			
				File Copy	MA Library	Client	Void
4	Amended for DA submission	Final	14/12/2016	1P	1P	1P	
3	Amended for DA submission	Draft	23/11/2016	1P	1P	1P	
2	Council Submission	Draft	02/11/2016	1P	1P	1P	
1	Client Review	Draft	21/10/2016	1P	1P	1P	

Distribution Types: F = Fax, H = hard copy, P = PDF document, E = Other electronic format. Digits indicate number of document copies.

All enquiries regarding this project are to be directed to the Project Manager.

Executive Summary

This report has been prepared to assess the impact of the proposed development at 12 Station Road, Toongabbie on flooding behaviour, prepare a risk assessment and a flood emergency response plan for the development.

Flooding behaviour was analysed using a DRAINS hydrological model and 20 year ARI, 100 year ARI and PMF flood levels from flood maps provided by council. Risk assessments for the 100 year ARI event and PMF event were undertaken to identify the potential hazards affecting the development due to flooding.

Results indicate that the site grounds are generally unaffected by flooding up to the 100 year ARI event. Site grounds are inundated in PMF events, however all habitable levels are located at or above the PMF event flood level. Risk assessments indicate that the risk levels caused by hazards to persons, structures, services and vehicles up to the PMF event are generally low to very low.

Based on the expected flooding behaviour and risk levels, this report provides and describes several flood risk mitigation measures, including:

- Features incorporated into design of the proposed development.
- A proposed on-site flood warning system.
- Preliminary flood emergency response plan which will form part of the development's overall emergency management plan.

Contents

1 Introduction

1.1 Overview

Martens & Associates have been engaged to provide a Flood Impact Report and Draft Flood Risk and Emergency Response Plan for the proposed development at 12 Station Road, Toongabbie, NSW (the "site").

1.2 Site Details

Table 1 summarises general site details.

Table 1: Site details.

Element	Site Details
Site Address	12 Station Road, Toongabbie, NSW
Lot/DP	Lots 7, 8, 9, DP22506, and Lot 30 DP 1106209. Proposed to subdivide to form Lot 502
Site Area	4,887 m^2
Neighbouring Environment	The site is bounded by Girraween Creek to the west, Toongabbie Sports and Bowling Club to the north, Wentworth Avenue to the east and residential apartment buildings to the south
Site Elevation	Approximately 29.3 mAHD
LGA	Parramatta City Council

1.3 Relevant Guidelines

This report has been prepared with reference to the following guidelines:

- Department of Infrastructure, Planning and Natural Resources (2005) *Floodplain Development Manual: The management of flood liable land.*
- Parramatta Local Emergency Management Committee (2009) *Parramatta Local Disaster Plan (DISPLAN).*
- Parramatta City Council (2006) *Local Floodplain Risk Management Policy.*
- Parramatta City Council (2011) *Parramatta Development Control Plan.*

2 Proposed Development

2.1 Overview

This section provides a description of the proposed development.

2.2 Proposed Development Details

The proposed development comprises a 128 bed residential care facility providing 24-hour nursing and personal care for seniors who are less independent or frail and have been assessed by the Aged Care Assessment Service. The facility will provide four habitable levels in total, and will be owned and operated by the Client. The facility also incorporates several design features which act as flood risk mitigation measures, which are described in Section 6. Proposed uses for each level of the site are summarised in Table 2.

Table 2: Proposed uses.

Level	Proposed Uses
Ground Floor	• 18 single-bed rooms (dementia units) with ensuite bathrooms; • staff amenities, staff lockers; staff lounge, staff offices; • utility rooms and bulk store rooms; • lounge/activities room and multi-purpose room; • nurses stations; • dining area and servery; • hair salon; • cafe and seating; • reception and office; • hot desk; • lift access; • laundry facilities and garbage rooms; • an external courtyard and outdoor seating; and • at grade parking
Level 1	• 40 single-bed rooms with ensuite bathrooms; • Lounge rooms and terrace areas, • dining area and servery; • nurses station; • staff amenities, • treatment room; • linen cupboards and store rooms; • garbage rooms; and • lift access
Level 2	• 40 single-bed rooms with ensuite bathrooms; • Lounge rooms and terrace areas, • dining area and servery;

Level	Proposed Uses
	• nurses station; • staff amenities, • treatment room; • quiet room; • linen cupboards and store rooms; • garbage rooms; and • lift access
Level 3	• 30 single-bed rooms with ensuite bathrooms; • lounge/activity rooms; • terrace areas including one large landscaped terrace area; • dining area and servery; • nurses station; • staff amenities, • treatment room; • quiet room; • linen cupboards and store rooms; • garbage rooms; and • lift access
Roof Level	• Hydraulic plant room; and • Mechanical plant room

3 Flooding Behaviour

3.1 Overview

This section describes existing flood behaviour in the vicinity of the site and compares flood levels to proposed habitable floor levels of the proposed development.

3.2 Flooding Behaviour

The dominant feature controlling flood behaviour on the site is Girraween Creek located directly adjacent and to the West of the site. Girraween Creek is a heavily vegetated channel with a catchment area of over 900 hectares. The *Parramatta City Council Flood Map* (refer to Attachment A) and the survey plan (RPS Australia East Pty Ltd, March 2016, refer to Attachment B) were used to approximate the flood behaviour at the site.

Flooding is contained within the Girraween Creek channel adjacent to site up to the 20 year ARI event. North of the site on Station road, flood waters begin to back up although access to site via Cornelia Road is unimpeded.

Flooding is generally contained in the Girraween Creek channel adjacent to the site between the 20 and 100 year ARI event. North of the site on Station Road, flood water continues to back up however access to site is still not impeded via Cornelia Road.

Flood water overtops the creek banks and rises to a depth on site of approximately 0.9 m from the 100 year ARI to the PMF event. The *Parramatta City Council Flood Hazard Map* (refer to Attachment A) indicates that the hydraulic hazard (velocity and depth product) for this site is classified as low.

3.3 Flood Hydrographs

Approximate creek hydrographs at the site were produced using preliminary DRAINS hydrological modelling of the upslope catchment. The 20 and 100 year ARI and PMF events of varying durations were modelled. The peak flow hydrographs are presented in Figure 1.

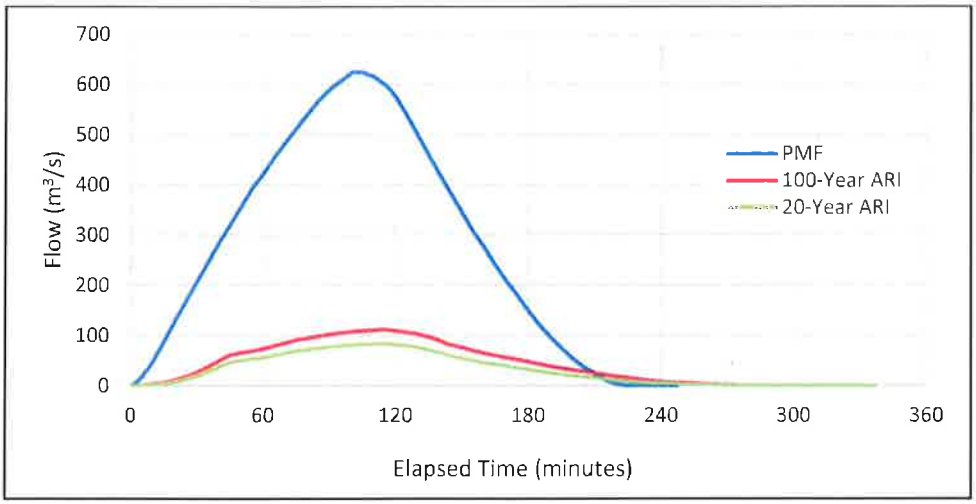


Figure 1: Approximate flood hydrographs for the 20 and 100 year ARI and PMF storm events.

The initial water level adjacent to the site was inferred to be 26.50 mAHD, and flood levels for the 20 and 100 year ARI and the peak PMF event are approximately 28.38 mAHD, 28.61 mAHD and 30.17 mAHD respectively based on *Parramatta City Council Flood Map*. Resulting flood level hydrographs were then created based on these levels and peak flows obtained from DRAINS, and are shown on Figure 2. Various duration PMF events have been included to assess different flooding scenarios.

Figure 2 indicates that the egress road is not inundated in the 20 year ARI and 100 year ARI event. The egress road is inundated in all PMF events; however the ground floor FFL is higher than the PMF flood level which indicates that all residents and staff will be able to shelter in place in the facility for the duration of the storm. For the shorter duration PMF events (1.5 hour to 3 hour), the flood level is expected to rise to the egress road level in 30 to 45 minutes, and will take between 2 hours and 3 hours for the flood level to fall below the egress road level. For the longer duration PMF event (6 hour), the flood level is expected to rise to the egress road level in 70 minutes, and will take 4 hours for the flood level to fall below the egress road level. As a result all persons in the site could have only 30 minutes to evacuate the site in a PMF event. In contrast, all persons would need to shelter in place for up to 5 hours in a longer duration PMF event.

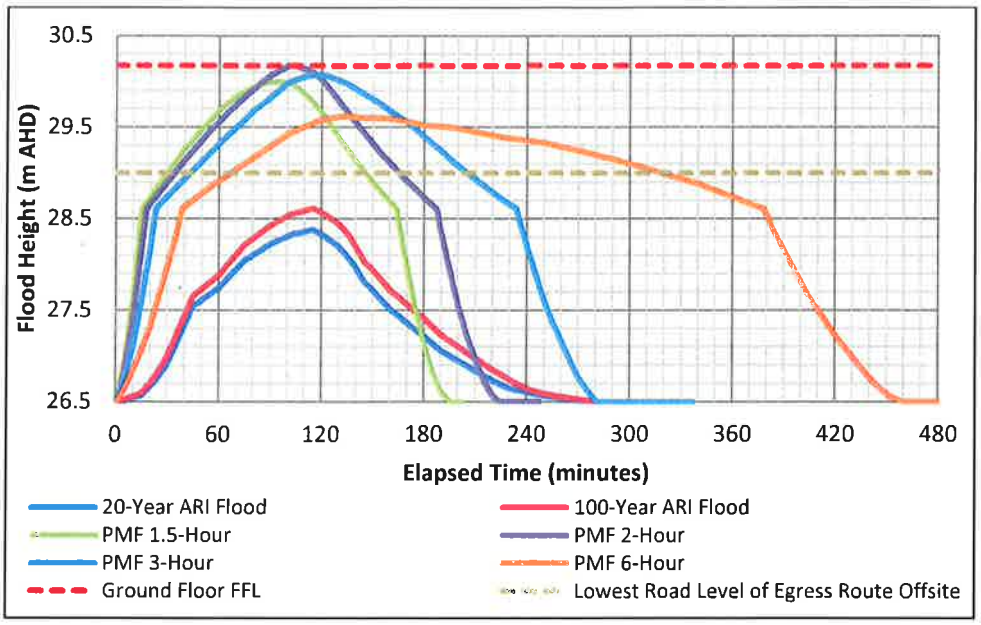


Figure 2: Approximate flood level hydrographs for the 20 and 100 year ARI and PMF events.

3.4 Minimum ARI for Inundation

As the ground floor level is at the PMF event flood level, no habitable levels will be inundated in any storm event. The probability of the flood level reaching the ground floor level has been estimated from Figure 3 at approximately 1 in 1,000,000 years.

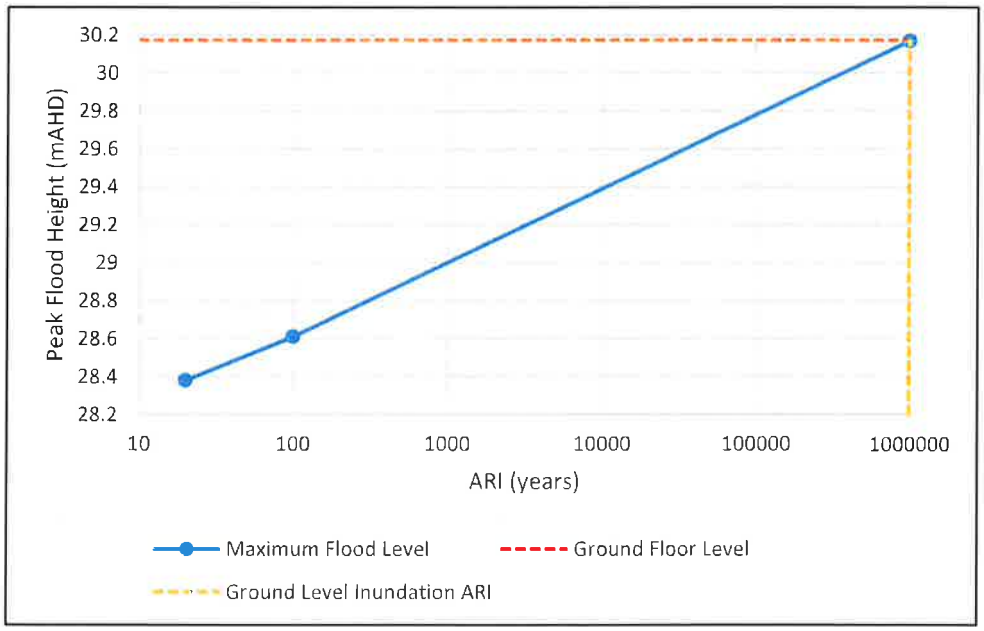


Figure 3: Approximate flood levels for 20 year ARI to PMF storm events.

4 Planning Considerations

4.1 Overview

This section will address the controls and objectives set out in *Parramatta Development Control Plan* (2011) in the context of the site and proposed development.

4.2 Site Compatibility Certificate

A *Certificate of Site Compatibility* (May 2016) issued by the Department of Planning and Environment (refer to Attachment C) has certified that the site is suitable for a residential care facility, subject to a flood evacuation plan being prepared to "demonstrate how people dependent on care can be evacuated in case of an emergency". In compliance with the certificate, this report provides flood risk mitigation measures and a shelter in place evacuation strategy in Section 6, which addresses measures such as flood warning systems, educating staff and residents about flood risks and training staff to perform evacuations.

In this regard it is noted that all habitable floor levels are at or above the PMF event. As outlined in this report, it is safer for residents to shelter in the building during the PMF event compared to evacuating to another place or walking to the streets.

4.3 Flooding Objectives

The proposed development is located in flood liable land and is categorized as a "Low Flood Risk" precinct (low hydraulic hazard and affected by storm events between the 100 year ARI event and PMF event). The proposed development is also classified as "Sensitive Uses and Facilities". Therefore under the Floodplain Matrix or Table 2.7 in *Parramatta Development Control Plan* (2011), the proposed development is classified as an unsuitable land use. A review of the flooding objectives in Section 2.4.2 of *Parramatta Development Control Plan* is provided in Table 3, and is further elaborated upon in the following sections.

Table 3: *Parramatta Development Control Plan* (2011) objectives.

Objective	Description	Response
1	Developers and community are aware of the potential flood hazard and risk	Education and training of staff and residents
2	Manage flood liable land in an economically, environmentally and socially sustainable manner	NA/OS

Objective	Description	Response
3	High flood sensitivity developments are sited and designed to provide reliable access and minimise risk of flooding	Residential levels are situated above the PMF event flood level to eliminate risk of flooding
4	Allow development with a lower sensitivity to flood risk to be located in the flood plain	NA/OS
5	Prevent intensification of the development and use of High Flood Risk Precincts	NA/OS
6	Ensure the proposed development does not expose existing development to increased flood risks	NA/OS
7	Ensure building design and location address flood hazard without having an adverse flood impact on the amenity or ecology of an area	NA/OS
8	Minimise the risk to life by ensuring provision of appropriate access from areas affected by flooding	Flood warning system to be installed and shelter in place evacuation strategy to be implemented, refer to Section 6.
9	Minimise damage to property, including motor vehicles from flooding	Flood resistant materials to be used, adequate warning time given to move vehicles, refer to Section 6.
10	Incorporate the principles of Ecologically Sustainable Development	NA/OS

Notes:

1. NA = Not Applicable.
2. OS = Outside the scope of this report.

4.4 Other Permissible Uses

Based on the Floodplain Matrix or Table 2.7 in *Parramatta Development Control Plan*, other development types permissible with consent in a "Low Flood Risk" precinct are described in Table 4.

Table 4: Development permissible with consent

Land Use Type	Development permissible with consent
Critical Uses and Facilities	Telecommunication facilities; waste management facilities
Residential	Health consulting rooms; home based child care
Commercial and Industrial	Function centres; medical centres

Other development types such as telecommunication facilities are critical for the entire LGA are permissible with consent in "Low Flood Risk" precincts. Similar development types which accommodate a large number of people, such as function centres, or developments which accommodate less mobile people or children are also permissible with consent. These development types carry a comparable risk profile with the proposed development.

4.5 Preliminary Flood Impact Analysis

The site has a minimum elevation of 29 mAHD, approximately 400 mm above the 100 year ARI event flood level. Therefore, the proposed development will not impact the behaviour of floods up to and including the 100 year ARI event.

The proposed development has the potential to marginally impact flood levels (subject to flood modelling) once flood levels reach 29.4 mAHD which correlates to the 1 in 10,000 year event. However, these impacts, which are well above the flood planning level, are not considered significant and are not expected to materially affect flood risk on adjoining properties.

5 Risk Assessment

5.1 Overview

This section describes the method used to assess the risk of various hazards identified that could occur due to a flood event, and the subsequent level of risk that each hazard poses.

5.2 Risk Assessment Method

Table 5 provides risk scores based on the combination of the likelihood and consequence of an event occurring. The definitions used to assess likelihood and consequence are described below.

5.2.1 Likelihood of Occurrence

Broad definitions adopted for each of the likelihood terms are based on the following:

1. Almost certain – Expected to occur regularly.
2. Likely – Will probably occur regularly.
3. Possible – Could occur under adverse circumstances.
4. Unlikely – May occur under very adverse circumstances.
5. Rare – Conceivably could occur under exceptional circumstances.
6. Barely Credible – The event is inconceivable or fanciful.

5.2.2 Consequence

Broad definitions adopted for the consequence terms are based on the following:

1. Consequences to person

   Broadly, consequences to person are rated according to the range of injury that would be expected should exposure to the hazard occur. These range from situations where no injury is expected (insignificant consequence) to possible death or major trauma (major consequence) or likely death (severe consequence).

2. Consequence to chattels and property

Broadly, consequence to chattels and property are rated according to the range of damage that would be expected should exposure to the hazard occur. These range from situations where no damage is expected (insignificant consequence) to substantive damage (major consequence) or complete destruction (severe consequence).

Table 5: Risk Scores Matrix.

		Consequence				
		Insignificant	**Minor**	**Moderate**	**Major**	**Severe**
Likelihood	**Almost certain**	Moderate	Moderate	High	High	High
	Likely	Low	Moderate	Moderate	High	High
	Possible	Very Low	Low	Moderate	High	High
	Unlikely	Very Low	Very Low	Low	Moderate	High
	Rare	Very Low	Very Low	Low	Moderate	Moderate
	Barely Credible	Very Low	Very Low	Very Low	Very Low	Very Low

5.3 Potential Hazards due to Flooding

5.3.1 Hazards to Persons

There are several ways for persons to become exposed to flood hazards, including:

1. Residents exposed to flood waters within site grounds – this is considered rare to barely credible because the site has a minimum level of 29 mAHD which is higher than the 100 year ARI event flood level of 28.61 mAHD; residents will need to be outside during an event approaching the PMF event for this to occur.

2. Residents exposed to flood waters within building – this is considered rare to barely credible because all habitable floor levels are at or above the PMF event flood level.

3. Residents exposed to flood waters while accessing or leaving the site – this is considered rare because the level of the roundabout on Cornelia Road (approximately 29.0 – 29.5 mAHD) is greater than the 100 year ARI event (28.61 mAHD); residents would need to be trying to access the site during an event approaching the PMF event for this to occur.

Residents in the building may also experience concern during the course of a major flooding event, as vehicular access to and from the site and services may be impacted for approximately 3 to 5 hours in a PMF event. However through the implementation of flood risk mitigation measures, such as educating residents on flood risks and evacuation strategy and having trained staff to assist, resident concerns can be adequately mitigated.

5.3.2 Hazards to Structures

We expect the building to be designed to be resistant to flood forces and make the following assessment:

1. During the 100 year ARI event, all habitable floor levels are not impacted by flood water and therefore the risk is very low.

2. During the PMF event, all habitable floor levels are not impacted by flood water and therefore the risk is very low.

5.3.3 Hazards to Services

Flood waters have the potential to affect services when above the 100 year ARI event flood level and approaching the PMF level. Potential impacts are:

1. Building utilities disrupted.

2. Building lifts disrupted.

3. Medical services disrupted.

4. Food supply disrupted.

The duration of services disruption may be in the order of 3 to 5 hours in a PMF event.

5.3.4 Hazards to Vehicles

Floods can damage cars by: water entering the car components and interior; damage by floating debris; or cars being floated and carried away. The following assessment is made:

1. During the 100 year ARI event, the carpark and the road accessing the site is not affected and therefore the risk is very low.

2. During the PMF event, water depths in the carpark are in the order of 0.5 m and will affect vehicle trafficablity, however the

velocity is expected to be low and therefore the hydraulic hazard and associated risk is low.

5.3.5 Summary

Table 6 and Table 7 summarise the likelihood, consequence and resulting risk score for each hazard described above, for the 100 year ARI and PMF events. It was determined that for all hazards, without implementation of risk mitigation measures, the risk was either low or very low.

Table 6: Risk assessment for the 100 year ARI event.

Hazard	Likelihood	Consequence	Risk Level
Risk to Persons	Barely credible	Insignificant	Very low
Risks to Structure	Barely credible	Insignificant	Very low
Risk to Services	Barely credible	Insignificant	Very low
Risk to Vehicles	Barely credible	Insignificant	Very low

Table 7: Risk assessment for the PMF event.

Hazard	Likelihood	Consequence	Risk Level
Risk to Persons	Rare – Barely credible	Minor	Very low
Risks to Structure	Rare – Barely credible	Minor	Very low
Risk to Services	Rare	Minor	Very low
Risk to Vehicles	Rare – Barely credible	Moderate	Low - very low

6 Flood Risk Mitigation Measures

6.1 Overview

The following section outlines various measures that have been, to be, or are implemented in order to reduce the risk of a flood event to people, structures, services and vehicles. Where applicable, these have been devised with reference to *Parramatta Development Control Plan* (2011) design standards for flood affected developments and the *Parramatta Local Disaster Plan* (DISPLAN) (Parramatta Local Emergency Management Committee, 2009).

6.2 Currently Designed Mitigation Measures

The proposed development is designed to manage evacuation onsite, specifically through a shelter in place evacuation strategy. This strategy is considered to be more effective than evacuating from the site due to the following flood risk mitigation measures:

1. Ground floor level of 30.17 mAHD is at the PMF event flood level. This indicates that all habitable floor levels will not be inundated in any storm event.

2. Switch room, communications room equipment, genset electricity generator and electricity substation are to be installed above the level of the PMF to minimise the disruption to services during any storm event.

3. Buildings are to be constructed using flood-compatible materials up to the PMF event flood level.

4. Flood warning system to be implemented.

All residents, visitors and staff can shelter in place on the ground floor or higher floors during flooding events. As noted in Section 5.3, there will likely be disruption to vehicular access and some services for between 3 and 5 hours in the PMF event, however these risks can be mitigated through the recommended measures in Section 6.3.

In contrast, evacuating from the site in storm events between the 100 year and PMF event will carry a larger risk as people could only have 30 minutes to evacuate from the site in a PMF event before the access roads surrounding the site are inundated, as discussed in Section 2.2. This report recommends shelter in place as the primary evacuation strategy, with site evacuation only occurring following orders received from the NSW State Emergency Service (SES).

6.3 Risk Mitigation Measures

Table 8 summarises risk mitigation measures to be implemented to reduce the risk of floods to people, structures, services, and vehicles. It is noted that several risk mitigation measures have been incorporated into the design of the facility.

Table 8: Risk mitigation measures.

Risk	Mitigation Measure
To persons	• Shelter in place evacuation strategy for all residents to remain on ground floor or higher levels. • Flood evacuation information to be provided in suitable locations. • Staff training in flood hazards and evacuation plans. • Education of residents of the risk of floods and the evacuation plan. • On-site flood warning system. • Flood depth indicator to be installed at the lowest point on Cornelia Road access route.
To structures	• Ground floor to be located above the PMF event flood level to ensure facility is not flooded in any storm event. [1] • Flood resistant materials to be installed in areas affected by the PMF event. [1] • Structural elements to be designed to withstand likely forces from flood water, debris and buoyancy. [1]
To services	• Critical service infrastructure and equipment to be installed above the PMF level. [1] • Genset electricity generator to be located above the PMF level and to be capable of providing emergency electricity supply to the facility in the event that electricity is cut off during a flood or as a result of any other disruption to electricity supply. [1] • Electricity substation to be constructed above the PMF storm event. [1] • Ground floor electrical circuits below the PMF to be isolated during a flood event. • Lifts to be parked above ground level and isolated during a flood event which inundates the building. • Adequate medical equipment to be on level 1 and higher at all times to cater for the facility for up to 4-6 hours of isolation. • Adequate numbers of medical staff to be on site at all times to manage the facility for up to 4-6 hours of isolation. • Adequate food and water to be kept on level 1 and higher to cater for the facility for up to 4-6 hours of isolation.
To vehicles	• Vehicles to be moved off-site to higher ground when flood warning received.

Notes:

1. Incorporated into design of facility.

6.5 On-Site Flood Warning System

An on-site flood warning system is proposed to warn facility management of a flood emergency. This is to be installed in a pit on-site, hydraulically connected to Girraween Creek (refer to Figure 4). Proposed trigger conditions are summarised in Table 9, to be formalised with further analysis at Construction Certificate phase.

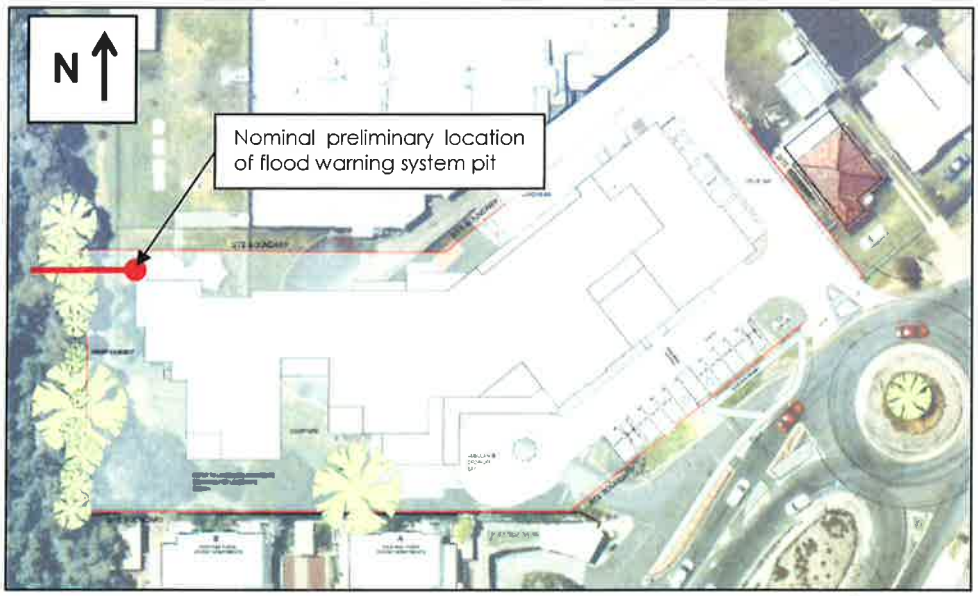


Figure 4: Nominal proposed location of flood warning system pit.

Table 9: Flood warning system trigger levels.

Alarm	Condition	Response
1	Creek rises from natural state to 27.5mAHD in less than 30 minutes	Audible and visual alarm to notify residents to evacuate from ground floor to higher floors.
2	Creek rises to 29.6m AHD	Audible and visual alarm to notify residents that inundation of ground level is imminent or possible

6.6 Preliminary Flood Emergency Response Plan

Table 10 describes the actions to be taken by staff to prepare for, and respond to, a flood event. Note that the primary response is to shelter in place; evacuating from the site should only be undertaken if the NSW SES issues the order to evacuate from the site. These measures are to form part of the Client's Emergency Management Plan for the facility.

Table 10: Flood emergency response plan.

PREPARE PHASE
• Staff to be alert to the threat posed by flooding. • Duty Manager to monitor weather warning services: Bureau of Meteorology, NSW SES, Local Emergency Operations Controller (LEOCon). • Staff to be trained in evacuation procedure, and refreshed annually. • Local SES and LEOCon to be advised of shelter in place evacuation strategy. • Install permanent signage in appropriate locations describing flood risk and evacuation route. • Residents to be educated of the hazard posed by floods and the shelter in place evacuation strategy and procedure. • Regular maintenance and testing of flood warning system to be carried out.
RESPOND PHASE
Weather Warning Received: • Staff, visitors and residents to be notified of a potential risk of flood. • Any residents, visitors or staff in external areas to be brought inside. • Duty manager to stay in contact with LEOCon and NSW SES to monitor the situation. • Non-essential electrical equipment on ground floor to be unplugged. Evacuation Alarm Signalled: • All residents and visitors to shelter at ground floor or higher floors by staff. • Duty Manager to inform NSW SES and LEOCon of shelter in place. • Vehicles to be moved to higher ground if practicable. • Lifts to be parked on level 1 or higher and isolated to prevent accidental use or persons becoming trapped. • All ground-floor electrical circuits to be isolated. • All ground floor electrical equipment to be unplugged. • Staff to reassure residents and visitors to stay calm and prevent any persons from moving out of the building. If Evacuate from Site Order Issued by NSW SES: • If NSW SES issues the order to evacuate from the site, Duty Manager to remain in communication with NSW SES. • Duty Manager to confirm location of evacuation site, method of evacuation and safest evacuation route with NSW SES, and then inform staff of details. • Staff to lead organised groups of residents, visitors and other staff (all persons) to the evacuation site following the selected evacuation route. • After moving to evacuation site, staff to perform headcount to account for all persons. • Staff to remain with all persons until the NSW SES advises the situation is all clear.
RECOVER PHASE
• Residents to be moved off-site if necessary in consultation with NSW SES and LEOCon. • Required cleaning and repairs to be carried out. • Testing of services and equipment to be conducted by qualified tradesmen before being re-instated. • Review effectiveness of flood response and update response plan if required.

7 Conclusion

This report has found that the site is generally unaffected by flooding up to the 100 year ARI event, however the site is inundated in PMF events. All habitable levels are located at or above the PMF event flood level.

Risk assessments conducted for the development indicate that flooding impact as a result of the development and the risks posed by flooding to the proposed development are very low, with the exception of the risk to vehicles in the PMF event which is considered to be low to very low.

The risks can be further reduced through implementation of the flood risk mitigation measures provided in this report.

8 References

Department of Infrastructure, Planning and Natural Resources (2005) *Floodplain Development Manual: The management of flood liable land.*

Parramatta City Council (2006) *Local Floodplain Risk Management Policy.*

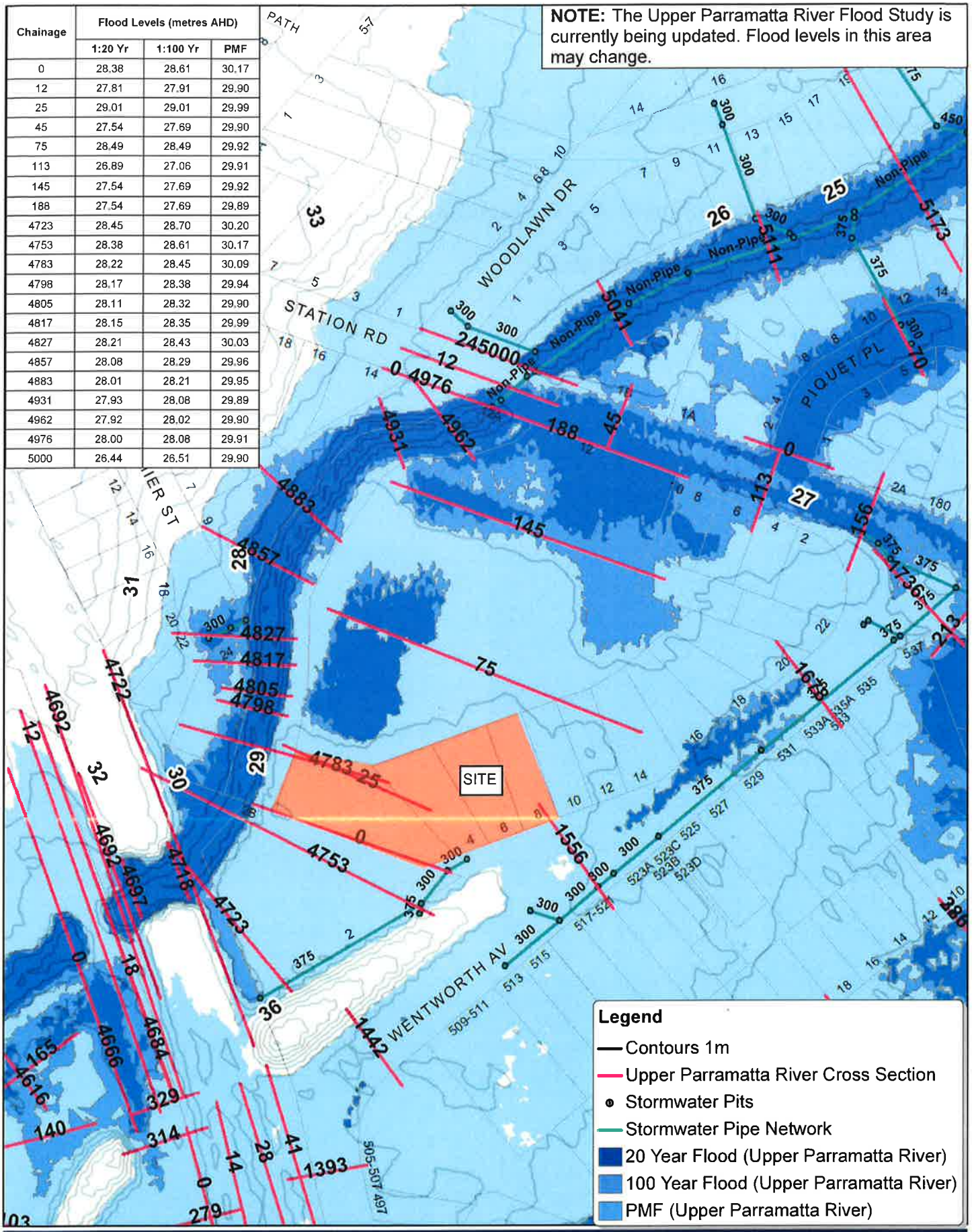
Parramatta City Council (2011) *Parramatta Development Control Plan.*

Parramatta Local Emergency Management Committee (2009) *Parramatta Local Disaster Plan (DISPLAN).*

9 Attachment A – Parramatta City Council Flood Map and Flood Hazard Map

Chainage	Flood Levels (metres AHD)		
	1:20 Yr	1:100 Yr	PMF
0	28.38	28.61	30.17
12	27.81	27.91	29.90
25	29.01	29.01	29.99
45	27.54	27.69	29.90
75	28.49	28.49	29.92
113	26.89	27.06	29.91
145	27.54	27.69	29.92
188	27.54	27.69	29.89
4723	28.45	28.70	30.20
4753	28.38	28.61	30.17
4783	28.22	28.45	30.09
4798	28.17	28.38	29.94
4805	28.11	28.32	29.90
4817	28.15	28.35	29.99
4827	28.21	28.43	30.03
4857	28.08	28.29	29.96
4883	28.01	28.21	29.95
4931	27.93	28.08	29.89
4962	27.92	28.02	29.90
4976	28.00	28.08	29.91
5000	26.44	26.51	29.90

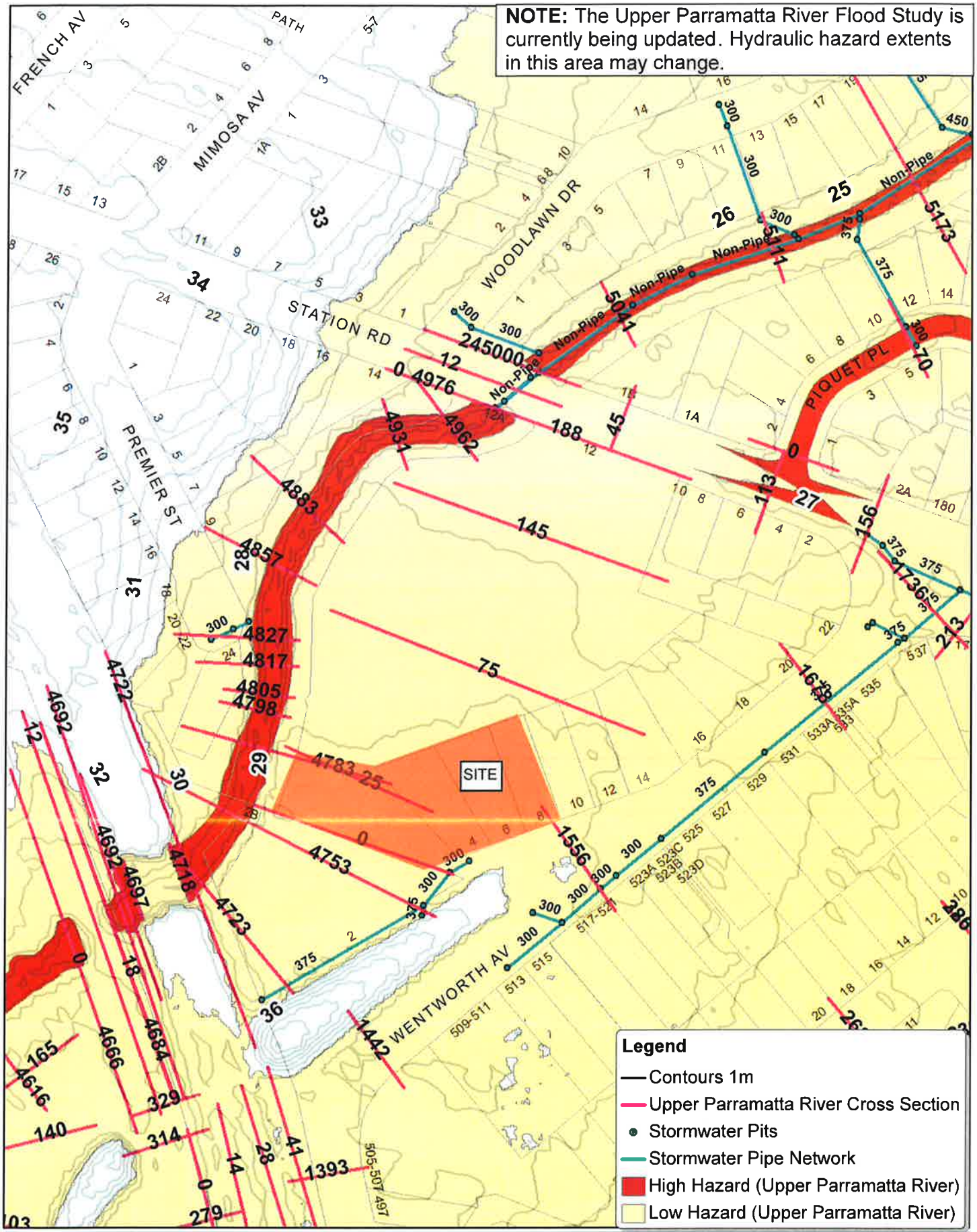
NOTE: The Upper Parramatta River Flood Study is currently being updated. Flood levels in this area may change.



Parramatta City Council Flood Map

1:2,000

Printed 28/07/2014



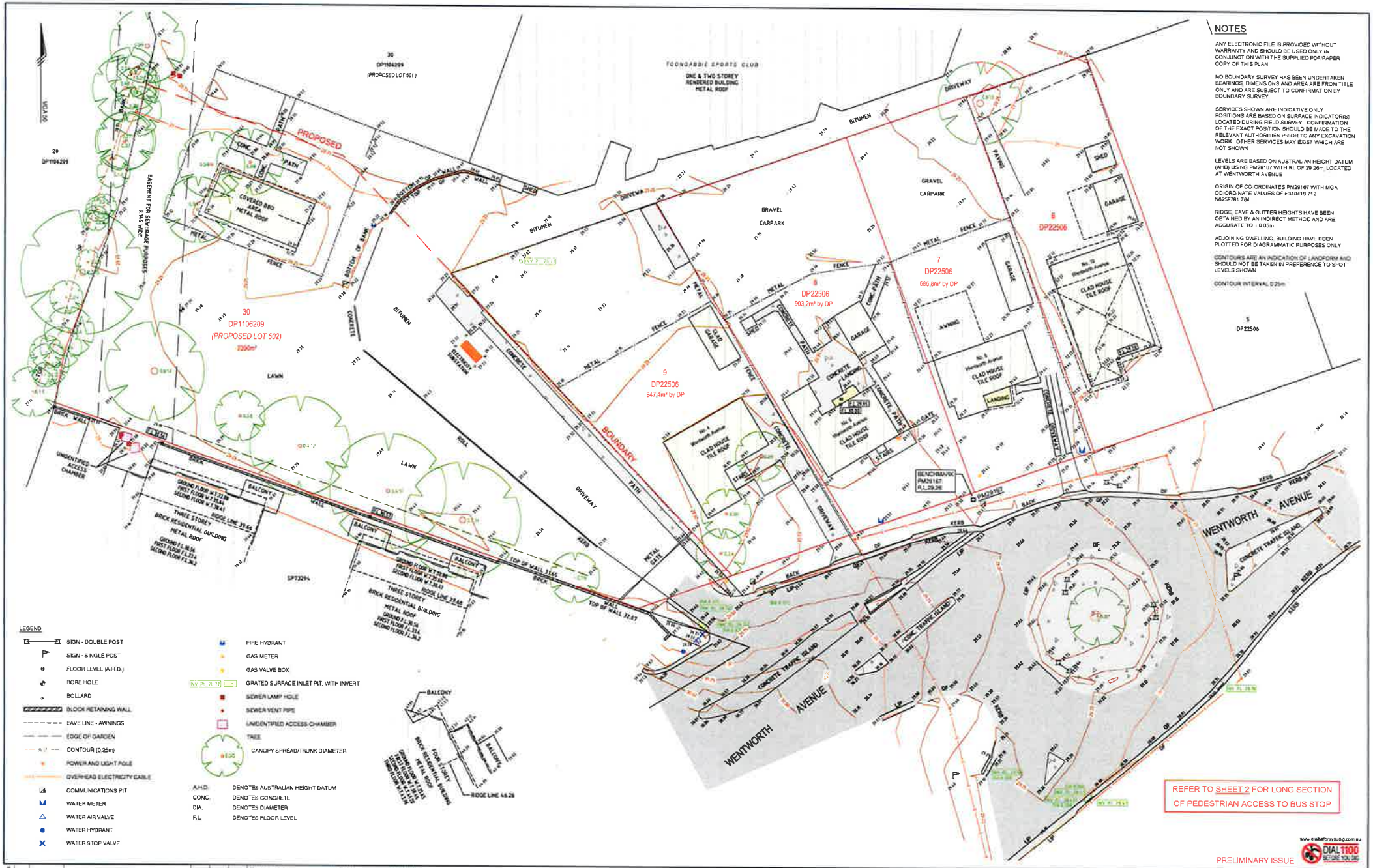
Parramatta City Council Flood Hazard Map

1:2,000

N

Printed 28/07/2014

10 Attachment B – Survey Plan (prepared by RPS Australia East Pty Ltd, March 2016)



1:200	N/A @ A1	VIDE PLAN SHEET	Align Projects	Detail Survey Lots 6-9 DP22506 and Part Lot 30 DP1106209 Wentworth Avenue, Toongabbie	PR127201SU DS01 B
COORDINATES MGA	DATUM AHD		DRAWN CDS	DATE OF SURVEY 23.02.2016	
BENCH PM29157	SHEET PM29157		DESIGN CFW	DATE OF PLAN 02.03.2016	
			CHECKED GDS		
			APPROVED -		

RPS

J:\PR127201 Opal Toongabbie Concept\10 - Drafting\Survey\2. Detail\PR127201SU-DS01b.dwg 09.03.2016 9:26 AM

11 Attachment C – Site Capability Statement

COPY

State Environmental Planning Policy (Housing for Seniors or People with a Disability) 2004
Certificate of Site Compatibility

I, the Executive Director, Regions as delegate of the Secretary of the Department of Planning and Environment determine the application made by BBC Consulting Planners on behalf of Toongabbie Sports Club on 5 May 2016, by issuing this certificate under clause 25(4)(a) of the *State Environmental Planning Policy (Housing for Seniors or People with a Disability) 2004*.

I certify that in my opinion:

- the site described in Schedule 1 is suitable for more intensive development;
- the development described in Schedule 1 is compatible with the surrounding environment having had regard to the criteria specified in clause 25(5)(b); and
- that development for the purposes of seniors housing of the kind proposed in the development application is compatible with the surrounding land uses only if it satisfies certain requirements specified in Schedule 2 of this certificate.

Stephen Murray
Executive Director, Regions

Date certificate issued: 16 August 2016

Please note: This certificate will remain current for 24 months from the date of this certificate (clause 25(9)).

SCHEDULE 1

Site description: Part Lot 30 in DP 1106209, 12 Station Road, Toongabbie.

Local Government Area: City of Parramatta

Project description: Toongabbie Sports Club - Demolition of existing buildings on the site and the construction of a residential care facility.

SCHEDULE 2

Application made by: BBC Consulting Planners on behalf of Toongabbie Sports Club.

Requirements imposed on determination:

1. The final development layout and number of beds in the residential care facility will be subject to the consent authority being satisfied with the form, height, bulk, scale and setbacks and shall be determined through the assessment of the development application under section 79C of the *Environmental Planning and Assessment Act 1979*; and
2. A flood evacuation plan is to be prepared with the development application to demonstrate how people dependent on care can be evacuated in case of an emergency.

NSW GOVERNMENT | Planning & Environment

COPY

Mr Dan Brindle
Director
BBC Consulting Planners
PO BOX 438
Broadway NSW 2007

Our Ref: 16/08265

Dear Mr Brindle

Determination of application for a site compatibility certificate for Part Lot 30, DP 1106209, No.12 Station Road, Toongabbie

I refer to your application for a site compatibility certificate under clause 25(1) of *State Environmental Planning Policy (Housing for Seniors or People with a Disability) 2004* (the SEPP) in relation to the proposed seniors housing development over part Lot 30, DP 1106209 (Toongabbie Sports Club).

As the Secretary's delegate, I have determined the application for a site compatibility certificate under clause 25(4)(a) of the SEPP by issuing a site compatibility certificate subject to satisfaction of certain requirements specified in the certificate (clause 25(7)). I have attached the Certificate of Site Compatibility.

The final development layout and number of beds in the residential care facility shall be determined by Council through the assessment of the development application under section 79C of the *Environmental Planning and Assessment Act 1979*.

The City of Parramatta Council has made various comments about the suitability of the site for a residential care facility, including flooding and evacuation, stormwater disposal, water sensitive urban design and traffic impacts. In the circumstances, I encourage you to contact Council to discuss the development design and what additional studies are required, prior to the lodgement of the development application.

If you have any questions in relation to this matter, please contact Mr Martin Cooper, Acting Team Leader, Sydney East Region of the Department of Planning and Environment on (02) 9228 6582.

Yours sincerely

16 August 2016

Stephen Murray
Executive Director, Regions
Department of Planning and Environment

Encl: Certificate of Site Compatibility

ATTACHMENT B – FLOOD EMERGENCY RESPONSE PLAN, OPAL SPECIALIST AGED CARE (16 DECEMBER 2016)

Opal specialist aged care		Version:	1.00
		Date:	16 December 2016
		Author:	Opal / H&H
		Approved:	
		December 2016	

FLOOD EMERGENCY RESPONSE PLAN	
Issue:	In the event of an extreme flood, evacuation from the site may not be possible, and all residents, staff and visitors (the occupants) may be required to remain on site until such stage as the flood recedes, or until directed to leave the site by emergency services personnel. The reason that evacuation from site may not be possible is because the roads surrounding the site will also be flooded. For this reason, the Flood Emergency Response Plan for the site will be to Shelter in Place, whereby the occupants can remain in the building and be safe from rising flood waters. The site is only affected by flooding in extremely rare storm events. Flooding will generally be caused by rising flood waters from Girraween Creek located along the western boundary of the site. To put this in perspective, the flood level for a 1 in 100 year storm will be 1.56m below the ground floor level and will be largely contained within the banks of Girraween Creek. For the Probable Maximum Flood (PMF) which is the largest flood possible, the flood level will be at the floor level. The likelihood of this flood occurring is estimated to be 1 in 1 million years. Despite the unlikelihood of this flood occurring, for the safety of the occupants, procedures and actions must be put in place for managing such a flood. These will include preparation prior to flooding, during flooding and after the flood recedes. The following are identified issues in which occupants become exposed to flood hazards: 1. Occupants exposed to flood waters within site grounds (outside building); 2. Occupants exposed to flood waters within building which is unlikely given that the floor level has been set at the PMF; 3. Occupants exposed to flood waters while accessing or leaving site. Whilst the above present issues in which occupants are exposed to flood hazards, they are considered low risk and as such do not pose a significant risk. Prior to the flood reaching its peak, procedures and actions should have already been implemented to prevent further exposure to occupants within the site.

FLOOD EMERGENCY RESPONSE PLAN continued	
Documentation / Forms	All events and actions to be documented. Mandatory Forms: Riskman/Riskman Incident Register (IT system down) Optional Forms: Injury Report Property Damage Report Media Contact Report Fatality Report

Where there is a possibility that the building may be exposed to a flood, staff members should consider the following action:

(a) Immediately advise the Duty Manager, their workplace manager, immediate Supervisor or warden who will notify the Emergency Coordinator;

(b) Ensure that they do not use any property services such as lifts; the operation of which may be affect by the flood.

(c) Remain in their normal area unless it is unsafe to do so as leaving may expose them to possible risk. If individual residents do depart it may also create difficulties in accounting for them;

(d) Follow the directions of Wardens if there is a need to evacuate the building;

(e) Move to a designated assembly area or such other location as directed; and

(f) Remain at the evacuation assembly area until it is unsafe to do so or directed to return by the Emergency Coordinator or the officer in charge of the responding Emergency Service.

FLOOD EMERGENCY RESPONSE PLAN		
1.1 Preparation Phase:	**Action**	**Time**
Staff to be made aware of the threat posed by flooding - New staff to be made aware of the risk of flooding. - New staff to be trained in the procedures and actions to implement in the event of a flood. - Existing staff to undergo refresher training on an annual basis.		
During heavy rainfall events, Duty Manager to monitor weather warning services: Bureau of Meteorology, NSW SES, Local Emergency Operations Controller (LEOCon). The following web sites should be monitored:		

http://www.bom.gov.au/australia/warnings/ http://www.ses.nsw.gov.au/ https://www.emergency.nsw.gov.au/		
All staff to be trained in shelter in place evacuation procedures and refreshed annually.		
Local SES and LEOCon to be advised of shelter in place flood evacuation strategy. The Emergency Coordinator is to ensure that the details of the relevant contacts (SES and LEOCon) are located in a prominent location in the Duty Manager's office. The SES contact number is 132 500.		
Install permanent signage in appropriate locations describing flood risk and evacuation routes within the building and assembly point.		
Residents to be educated of the hazard posed by floods and the shelter in place evacuation strategy and procedure. This should be undertaken for all new residents and on an ongoing basis thereafter.		
Regular maintenance and testing of flood warning system and emergency power supply to be carried out. Maintenance and testing should be made in accordance with the manufacturer's, supplier's and legislative requirements.		
Visitor books and staff and resident list should be maintained at all times to ensure that all occupants are able to be accounted for.		
1.2 Respond Phase	**Action**	**Time**
1.2.1 Respond Phase - Weather Warning Received		
Upon receipt of a severe weather warning, the Emergency Coordinator shall notify all staff, visitors and residents of a potential risk of flood. The warning should be broadcast through the PA system and via door knocking of resident's rooms. A role call/ head count should be taken to ensure all residents and staff are accounted for. The visitor book should also be checked to ensure all visitors are accounted for. More specifically:		

Emergency Coordinator: - Responsible for all other Supervisors and Duty Manager. - Make initial contact with all Supervisors and Duty Manager. - Stay in regular contact with Supervisors and Duty Manager during flood event. Duty Manager - Make initial contact with relevant emergency services and maintain contact during flood event. - Liaise with Emergency Coordinator and act on their instructions. Kitchen/Catering Supervisor: - Responsible for remaining in contact with Emergency Coordinator and acting on their instructions. - Undertake head count of kitchen and catering staff. - Ensure kitchen and catering staff are accounted for. - Advise Nursing Supervisor of residents that are currently using kitchen facilities and ensure that they are returned to the Nursing Supervisor. - Begin preparation of food and water supply for a six hour meal cycle. The specific menu requirements will depend on the time of the day that the flood occurs. Nursing Supervisor: - Responsible for remaining in contact with Emergency Coordinator and acting on their instructions. - Undertake head count of residents and nursing staff. - Ensure residents and nursing staff are accounted for. - Begin preparation of medical and first aid supplies for a six hour cycle. The specific medical requirements will depend on the time of the day that the flood occurs. Maintenance Supervisor: - Responsible for remaining in contact with Emergency Coordinator and acting on their instructions. - Undertake head count of maintenance staff. - Ensure maintenance staff are accounted for. - Undertake a patrol of the grounds external to the building with a member of the nursing staff and ensure all residents, staff and visitors are returned to the building. - Begin preparation of maintenance equipment to ensure the building can operate for six hours.		
Any residents, visitors or staff in external areas are to be brought inside (see above).		

Duty Manager to stay in contact with LEOCon and NSW SES to monitor the situation. The SES contact number is 132 500.		
Non-essential electrical equipment on ground floor to be unplugged by Maintenance Supervisor and team.		
In the event of a blackout or loss of power, power supply will automatically switch to the emergency power supply (Genset) for shelter in place requirements. Maintenance staff should monitor the power supply to ensure that it is remains operational. The Genset (diesel generator) has a 600L fuel tank that should have capacity to operate for eight hours) so there should be no need for the tank to be refilled during the PMF.		
Staff responsible for medical equipment shall prepare the equipment and ensure it is functional and connected to the emergency power supply if required.		
1.2.2 Respond Phase - Evacuation Alarm Signalled		
All residents and visitors to shelter at ground floor or on higher floors or designated assembly point.		
Duty Manager to inform NSW SES and LEOCon that shelter in place flood evacuation strategy has been implemented.		
If possible, vehicles parked on site shall be moved to the Porte Cochere which is the highest vehicular trafficable location.		
Lifts to be parked on level 1 or higher and isolated to prevent accidental use or persons becoming trapped. Barriers placed across lift doors at ground level.		
All ground-floor electrical circuits to be isolated.		
All ground floor electrical equipment to be unplugged.		

Staff to reassure residents and visitors to stay calm and prevent any persons from moving out of the building by reminding them that the floor level is higher than the highest possible flood level.		
Staff to remain with all persons until the flood level recedes and NSW SES advises the situation is all clear.		
1.2.3 Respond Phase - Issued by SES to evacuate site		
If NSW SES issues the order to evacuate from the site, Duty Manager to remain in constant communication with NSW SES. The Duty Manager shall convey all information and instructions to the Emergency Coordinator. The Emergency Coordinator in consultation with the Duty Manager to confirm location of evacuation site, method of evacuation and safest evacuation route with NSW SES, and then inform Supervisors of details.		
Supervisors to lead organised groups of residents, visitors and other staff (all persons) to the evacuation site following the selected evacuation route.		
Prior to moving to evacuation site, Supervisors to perform role call/ headcount to account for all persons. This role call/ headcount should be undertaken again upon the arrival of the evacuated site.		
Staff to remain with all persons until the NSW SES advises the situation is all clear.		
1.3 Recover Phase	**Action**	**Time**
In the event that the building is damaged by the flood and the building is unable to be resided in, residents are to be moved off-site to another OPAL facility if necessary in consultation with NSW SES and LEOCon.		
Cleaning and repairs to be carried out as required depending on the extent of flood damage. This may include property within the building or outside including services. This process should be managed by the relevant OPAL maintenance team.		

The Genset shall be tested and refuelled as required to ensure that it is able to be used in the event of the next blackout or loss of power. Testing of services and equipment to be conducted by qualified tradesmen before being re-instated.		
Review effectiveness of flood evacuation plan and update if required. If flood evacuation plan is update, inform NSW SES and LEOCon of amendments to the plan.		
All staff are to be informed of updated flood evacuation plan and retrained as required.		

ATTACHMENT C – FLOOD ASSESSMENT FOR PROPOSED AGED CARE FACILITY, MARTENS & ASSOCIATES (31 MAY 2018)

martens
consulting engineers since 1989

Posted		
Faxed		
Emailed	X	Corey Taylor
Courier		
By Hand		
Contact:		Terry Harvey
Our Ref:		P1605655JC01V05
Pages:		42
cc.		Dan Brindle, Steven Molino

May 31, 2018

DPG Services Pty Ltd (Opal Aged Care)
C/- Mr Corey Taylor
PactPM
L14, 5 Martin Place Sydney NSW 2000
By Email

Dear Corey,

RE: FLOOD ASSESSMENT FOR PROPOSED AGED CARE FACILITY – 12 STATION ROAD & 4-10 WENTWORTH AVENUE, TOONGABBIE, NSW

1.0 INTRODUCTION

1.1 Overview

Martens & Associates Pty Ltd (MA) have prepared this flood assessment to support a development application (DA/1281/2016) for a proposed aged care facility at the above address. This assessment provides updated results of the flood model previously prepared by MA and presented to the Joint Regional Planning Panel (JRPP) on December 6, 2017. In particular this report looks at the impacts of the development on flood conditions off site. This has been undertaken to address issues raised by the SES in relation to off-site impacts and similar issues expressed by Council catchment engineers.

According to flood information provided by City of Parramatta Council (CoPC) (Attachment A), flood waters in events up to and including the 100 year average recurrence interval (ARI) are generally contained within the Girraween Creek top of banks and do not extend to the site. The ground floor level of the proposed development has been set above the probable maximum flood (PMF) level provided by CoPC. This report documents the existing flood conditions in the 100 year ARI flood and PMF and provides flood characteristics and a flood impact assessment for very rare floods beyond the 100 year ARI.

1.2 Scope of Works

1. Estimate rainfall intensities for 100, 1000 and 2000 year ARI and PMF events.
2. Establish a 2D TUFLOW hydraulic model for the Girraween Creek Catchment upstream of the site using flood information provided by CoPC.
3. Increase the TUFLOW model resolution to allow detailed hydraulic modelling of the site in existing and proposed conditions.
4. Prepare relevant flood maps including flood extents, depths, water levels, velocities, hazards and impacts.
5. Comment on flood characteristics and model outcomes in existing and proposed conditions.

Head Office
Suite 201, 20 George St
Hornsby NSW 2077, Australia
Ph 02 9476 9999 **Fax** 02 9476 8767

> mail@martens.com.au
www.martens.com.au
MARTENS & ASSOCIATES P/L
ABN 85 070 240 890 ACN 070 240 890

2.0 HYDROLOGY ANALYSIS

2.1 Rainfall

Intensity Frequency Duration (IFD) data and rainfall temporal patterns were based on the Bureau of Meteorology (BOM 2017) *Rainfall IFD Data System* and *Australian Rainfall & Runoff* (ARR 1987). Probable maximum precipitation (PMP) intensities and temporal distributions were determined using the BOM (2003) *Generalised Short-Duration Method*.

Rainfall depths for very rare short duration flood events were estimated by multiplying the 100 year ARI rainfall depth by a factor as per the procedure in *Jordan et al 2005*. This method is also recommended in Chapter 3.6.3 of *Australian Rainfall and Runoff* (ARR, 2016).

2.2 Critical Duration

A preliminary DRAINS (ILSAX) hydrology model was produced to determine critical duration events. It was found that the critical duration for all events modelled is 1.5 hours at the site. Total rainfall depths for the critical duration are provided in Table 1.

Table 1: Multiplication factors and estimated rainfall depths for very rare rainfall events (adapted from ARR 2016).

ARI (years)	100	200	500	1000	2000
Multiplication factors	N/A	1.140	1.344	1.513	1.698
Critical Duration Raintall Depth (mm)	79.5	90.6	106.8	120.3	134.9

3.0 HYDRAULIC MODELLING

3.1 Overview

The TUFLOW hydraulic model was used to determine flood characteristics including flood extents, levels, depths, velocities and hydraulic hazard for the existing condition critical 100 year ARI and PMF events, as well as the existing and proposed condition during critical 1000 and 2000 year ARI events. Initially a coarse model was established to estimate flood to the site, and based on this model a detailed site model was established.

3.2 Terrain Data

Catchment LIDAR data provided by LPI (2013) was merged with site survey data (Attachment B) provided by RPS (2016) to create a 3D surface for the existing conditions site and the local area used in the TUFLOW model. The proposed conditions surface also included site grading design provided by Henry & Hymas (2016) as shown in Attachment C.

3.3 Model Setup

3.3.1 Existing Conditions – Coarse Model

TUFLOW model construction for the Girraween Creek Catchment upstream of the site in existing conditions consisted of:

1. A 5.0 m topographic grid based on the available survey and LIDAR data.

2. The model domain was defined as the entire catchment area upstream of the confluence of Girraween Creek and Pendle Creek, approximately 500 m downstream of the site. Model boundary extents were generally placed along

catchment ridgelines and / or connecting catchment high points surrounding the study area.

3. A direct rainfall boundary condition based on the critical duration hyetographs.

4. Computed water slope for the downstream model extents boundary condition based on the water surface slopes interpolated from the CoPC flood map (Attachment A).

5. Manning's zones based on Nearmap (2018) aerial photography of the study area with roughness coefficients adopted as per Table 2.

6. Hydrologic loss coefficients for each catchment material were adopted as per Table 2.

Table 2: Manning's roughness and hydrologic loss values for coarse TUFLOW modelling.

Catchment Material Type	Manning's Roughness Coefficient [1]	Initial Loss (mm) [1]	Continuing Loss (mm/hr) [1]
Industrial	0.080	2.4	0.5
Park	0.035	9.5	4.7
Urban	0.060	6.6	3.0

Notes

1. Based on the weighted average land use (impervious percentage) of representative areas and typical values from similar catchments.

3.3.2 Model Validation

Comparison between the CoPC flood map and the MA coarse model for the 100 year ARI flood and PMF events is given in Table 5. Comparison is made for changes the peak flood levels at locations indicated on CoPC flood map.

Table 5: Comparison between CoPC flood map and MA modelled peak water levels.

	100 year ARI				PMF			
	Peak Flood Level (mAHD)		Difference		Peak Flood Level (mAHD)		Difference	
Chainage [1]	CoPC	MA	(m)	(%)	CoPC	MA	(m)	(%)
4783	28.45	28.61	0.16	0.6%	30.09	29.95	-0.14	-0.5%
4798	28.38	28.38	0.00	0.0%	29.94	29.86	-0.08	-0.3%
4805	28.32	28.38	0.06	0.2%	29.90	29.93	0.03	0.1%
4817	28.35	28.42	0.07	0.2%	29.99	29.97	-0.02	-0.1%
4827	28.43	28.43	0.00	0.0%	30.03	29.97	-0.06	-0.2%
4857	28.29	28.25	-0.04	-0.1%	29.96	29.95	-0.01	0.0%
4883	28.21	28.17	-0.04	-0.1%	29.95	30.05	0.10	0.3%
4931	28.08	28.08	0.00	0.0%	29.89	29.98	0.09	0.3%
4962	28.02	28.04	0.02	0.1%	29.90	29.97	0.07	0.2%

Notes

1. Calibration locations provided on CoPC flood map (Attachment A).

The comparison shows flood levels as modelled by MA agree well with the CoPC flood map, and differences are ≤ ± 150 mm. The differences between flood levels are likely due to the different modelling approaches and solution schemes between CoPC's Mike 11 and MA's TUFLOW model.

Further, flood extents throughout the area covered by the CoPC flood map were compared and were found to have close agreement. We therefore consider the MA model closely matches the CoPC adopted flood characteristics and is considered adequate to be used as the basis for detailed site modelling.

3.3.3 Existing Conditions – Detailed Model

The coarse model was used to inform a detailed site model. The model construction for existing conditions consisted of:

1. A 1.0 m topographic grid based on the available survey and LIDAR data.

2. Establishment of reduced model boundary extents approximately 70 m upstream of the site under the railway bridge over Girraween Creek and 150 m downstream of the site. The upstream boundary was selected as it acted as a control for site flooding.

3. Inclusion of flow rates at upstream model extents extracted from the coarse model to ensure replication of flood water delivery to the detailed site model. Hydrographs extracted from the coarse model are shown in Figure 1.

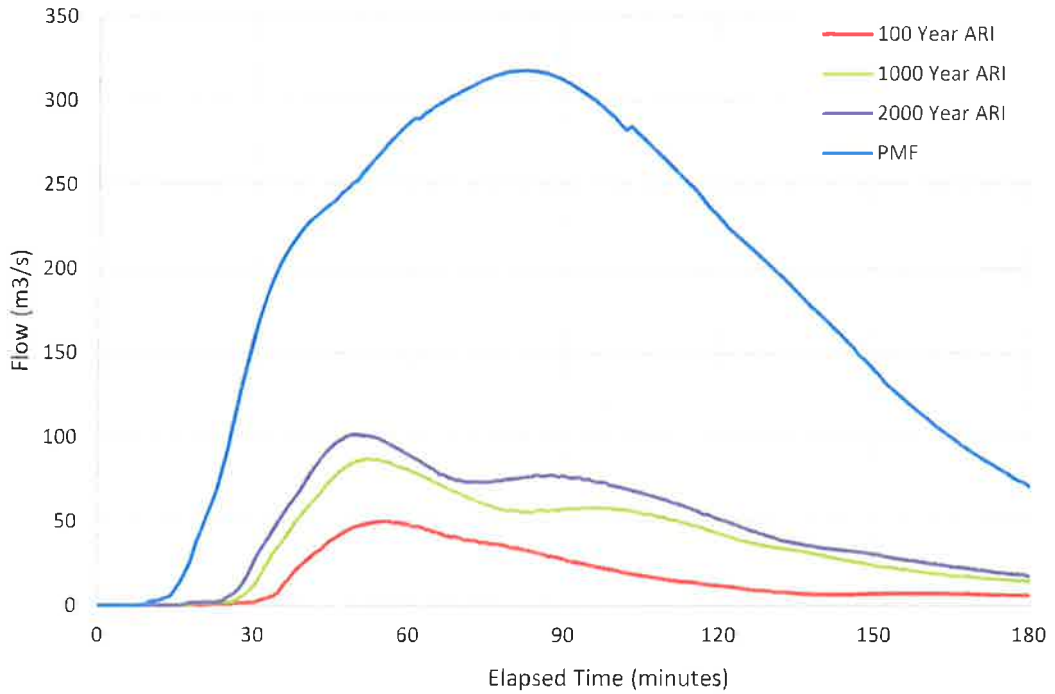


Figure 1: Extracted flood hydrographs at the railway bridge over Girraween Creek for the 100, 1000, 2000 year ARI and PMF events.

4. Inclusion of staged water level hydrographs at the downstream model extents extracted from the coarse model to ensure replication of tailwater conditions in the detailed site model.

5. Existing buildings were assigned elevations above ground to model flow obstructions.

6. Site manning's zones were updated to represent existing surfaces as per Table 3.

Table 3: Manning's roughness for detailed TUFLOW modelling.

Catchment Material Type	Manning's Roughness Coefficient [1]
Paved Surface	0.012
Grass	0.032
Riparian land	0.040

Notes

1. Based on typical values from similar catchments.

3.3.3 Proposed Conditions – Detailed Model

The detailed existing conditions model was modified as follows to simulate proposed conditions:

1. A 1.0 m topographic grid based on the available survey, LIDAR data and proposed site grading.

2. Site manning's zones were updated to represent design surfaces.

3. Site buildings were removed and replaced with proposed buildings to model as flow obstructions.

All other model construction elements remained consistent with the detailed existing model.

3.4 Results

Flood mapping results (flood levels, depths, velocities and velocity depth (VD) product) for the coarse and detailed model for various flood events are provided in Attachment D, with drawing references summarised in Table 4.

Table 4: Flood map drawing references in Attachment D (MA planset P1605655PS01).

Flood Condition Scenario	Critical Duration Flood Event	Water Level & Depth	Water Velocity	Hazard (VD product) [1]	Water Level Impact
Existing Conditions (Catchment Model)	100 year ARI	K110	K111	K112	–
	1000 year ARI	K120	K121	K122	–
	2000 year ARI	K130	K131	K132	–
	PMF	K150	K151	K152	–
Existing Conditions (Detailed Model)	1000 year ARI	K160	K161	K162	–
	2000 year ARI	K170	K171	K172	–
Proposed Conditions (Detailed Model)	1000 year ARI	K260	K261	K262	K360
	2000 year ARI	K270	K271	K272	K370

Notes

1. Hydraulic hazard is provided as VD product (velocity x depth). On these maps, green areas denote low hydraulic hazard (VD product < 0.4 m^2/s), yellow areas denote moderate hydraulic hazard (0.4 m^2/s < VD product < 0.6 m^2/s), and red areas denote high hydraulic hazard (VD product > 0.6 m^2/s).

4.0 DISCUSSION

We note the following regarding modelled flood behaviour in existing conditions:

1. The site for the proposed residential care facility is flood free for events up to and including the 500 year ARI flood event. In larger flood events, floodwaters enter the site from the southwestern boundary and flow across the site in the flow direction of Girraween Creek.

2. For the 1000 year ARI event, flood extents are limited to the western corner of the site with flood depths < 0.25 m. Water depths in Girraween Creek adjacent to the site are up to 3.1 m.

3. For the 2000 year ARI event, site flood depths are generally < 0.6 m. Water depths in Girraween Creek adjacent to the site are up to 3.3 m.

4. Flood velocities across the site are generally low (< 1.0 m/s) up to and including the 1 in 2000 year ARI event.

5. Hydraulic hazard (VD product) across the site is low (< 0.4 m^2/s) up to and including the 2000 year ARI event.

6. Based on the coarse model, PMF site flood depth are generally < 1.2 m. Water depths in Girraween Creek adjacent to the site are up to 4.2 m. VD products are low along the southern and eastern boundary and generally high in the western portion of the site.

We note the following regarding modelled flood behaviour in the proposed conditions:

1. The proposed flooding conditions are largely unchanged from existing conditions, and the proposed fill pad does not materially affect local flood characteristics.

2. For the 1000 year ARI event, site flood inundated areas are generally in and around proposed basins, and do not extend to the proposed building.

3. For the 1 in 2000 year ARI event, the flood level is 29.52 mAHD. The proposed finished floor level (30.17 mAHD) is 650 mm above this flood level.

4. Site velocities and hazards in events up to and including the 2000 year ARI flood are low and are largely unchanged by the proposed development.

The impact analysis indicates:

1. For flood events up to and including the 1000 year ARI event, the proposed development has negligible offsite impacts.

2. For the 2000 year ARI event, there are minor upstream offsite impacts (up to 50 mm) adjacent to the site's southwestern boundary.

3. We note flood impacts are generally assessed for events up to and including the 100 year ARI flood, the site is unaffected by this event hence there would be no impacts.

4. Given offsite impacts only occur for flood events larger than 1000 year ARI, the proposed development is considered to have an acceptable impact on local flooding.

5.0 SUMMARY

A catchment scale TUFLOW hydraulic model has been developed to replicate CoPC adopted flood characteristics. The model was refined around the site to determine the existing and proposed flood conditions in the 1000 and 2000 year ARI events. Modelling concluded that:

1. Proposed flood characteristics are largely consistent with existing conditions for flood events up to and including the 2000 year ARI event.

2. The proposed development area of the site is generally flood free in flood events up to and including the 1000 year ARI event.

3. The proposed finished ground floor level and evacuation route are set according to CoPC's PMF level, therefore the proposed onsite development flood risk is minimised.

4. The proposed development would have negligible onsite and offsite flood impacts for flood events up to and including the 1000 year ARI events and minimal impacts in the 2000 year ARI event. This is considered an acceptable outcome for the local catchment and does not have a significant impact on both onsite and offsite flood risks.

If you have any queries, please do not hesitate to contact our offices.

For and on behalf of

MARTENS & ASSOCIATES PTY LTD

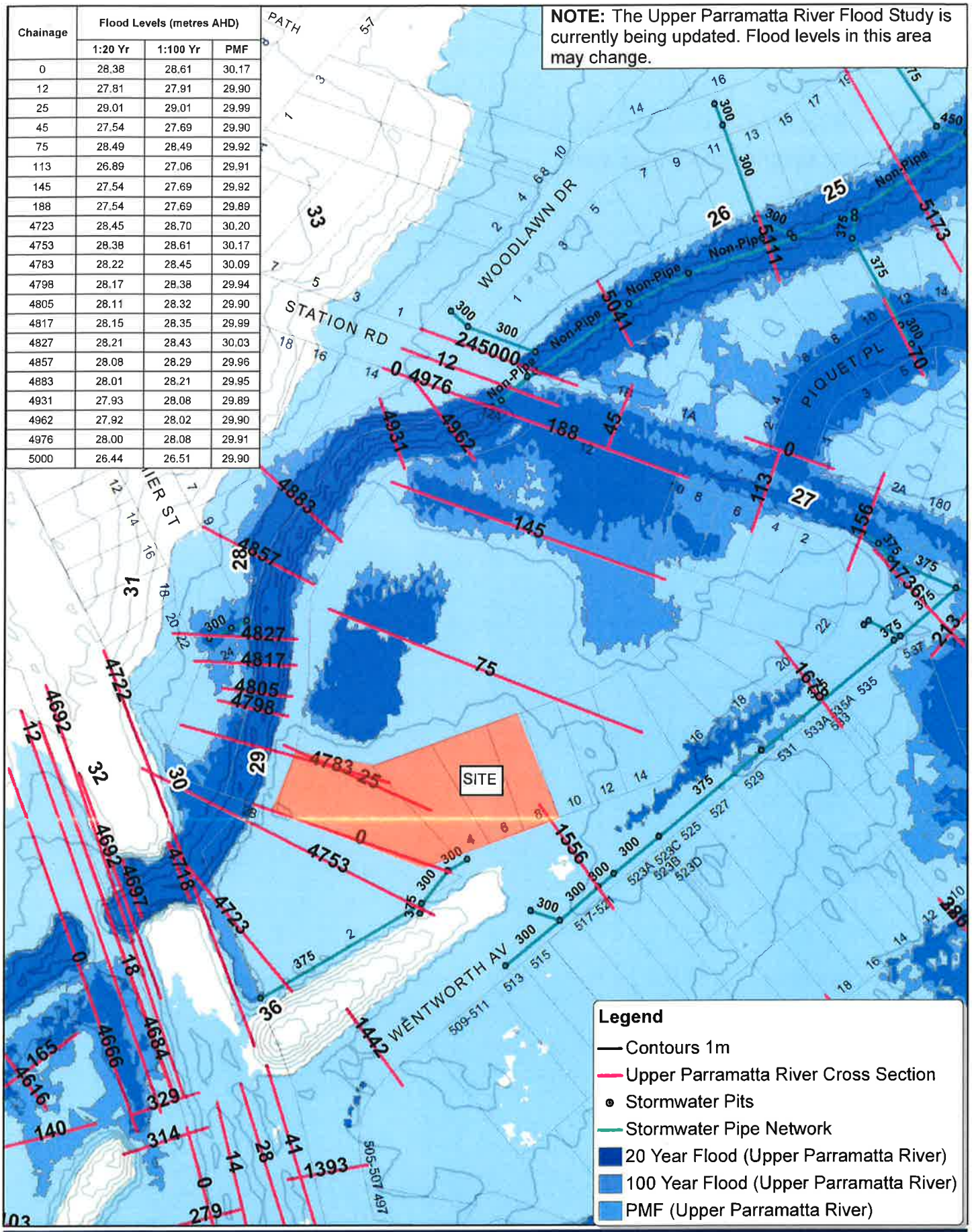
TERRY HARVEY

Senior Engineer / Project Manager

ATTACHMENT A – COPC FLOOD MAPS

Chainage	Flood Levels (metres AHD)		
	1:20 Yr	1:100 Yr	PMF
0	28.38	28.61	30.17
12	27.81	27.91	29.90
25	29.01	29.01	29.99
45	27.54	27.69	29.90
75	28.49	28.49	29.92
113	26.89	27.06	29.91
145	27.54	27.69	29.92
188	27.54	27.69	29.89
4723	28.45	28.70	30.20
4753	28.38	28.61	30.17
4783	28.22	28.45	30.09
4798	28.17	28.38	29.94
4805	28.11	28.32	29.90
4817	28.15	28.35	29.99
4827	28.21	28.43	30.03
4857	28.08	28.29	29.96
4883	28.01	28.21	29.95
4931	27.93	28.08	29.89
4962	27.92	28.02	29.90
4976	28.00	28.08	29.91
5000	26.44	26.51	29.90

NOTE: The Upper Parramatta River Flood Study is currently being updated. Flood levels in this area may change.

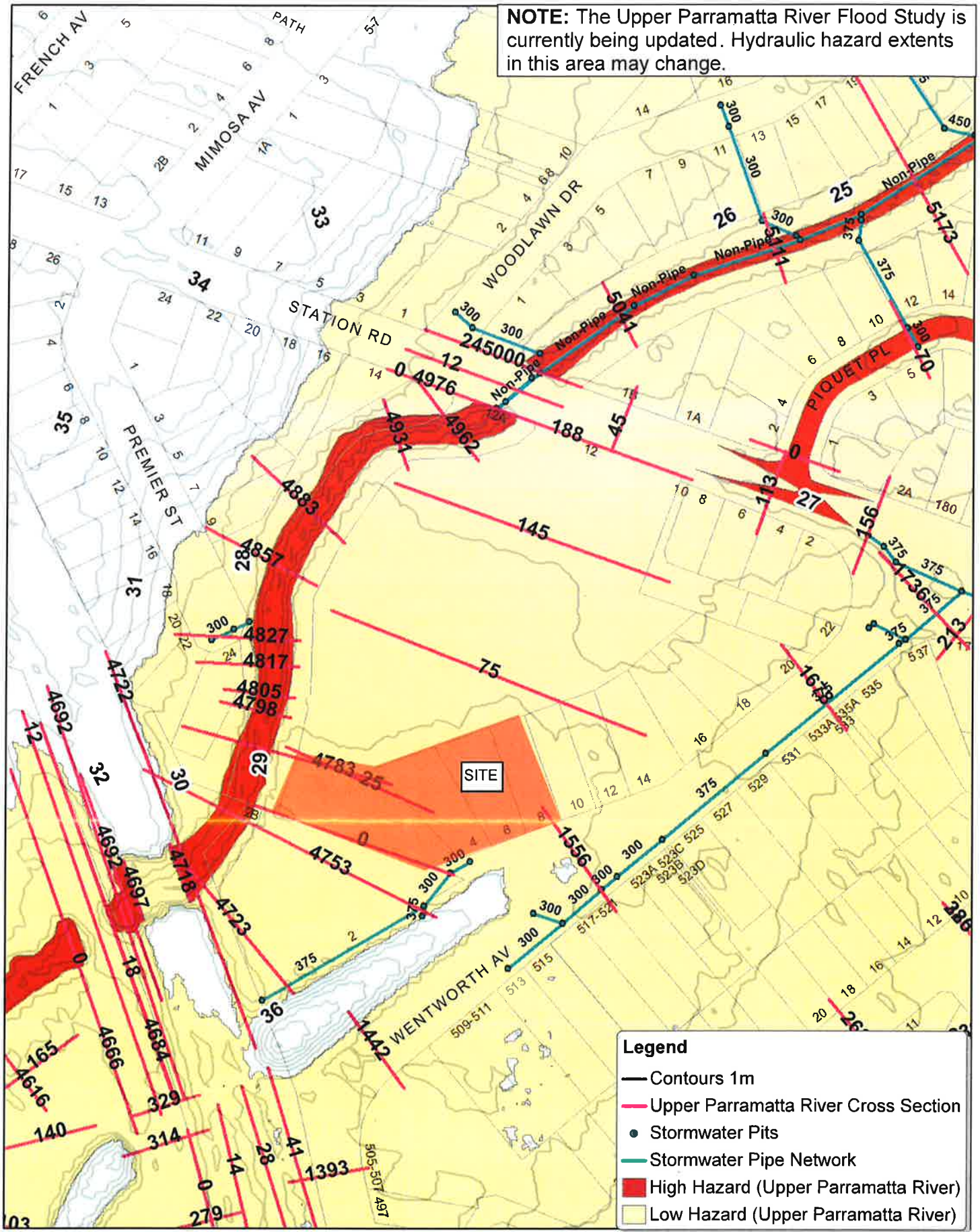


Parramatta City Council Flood Map

1:2,000

N

Printed 28/07/2014



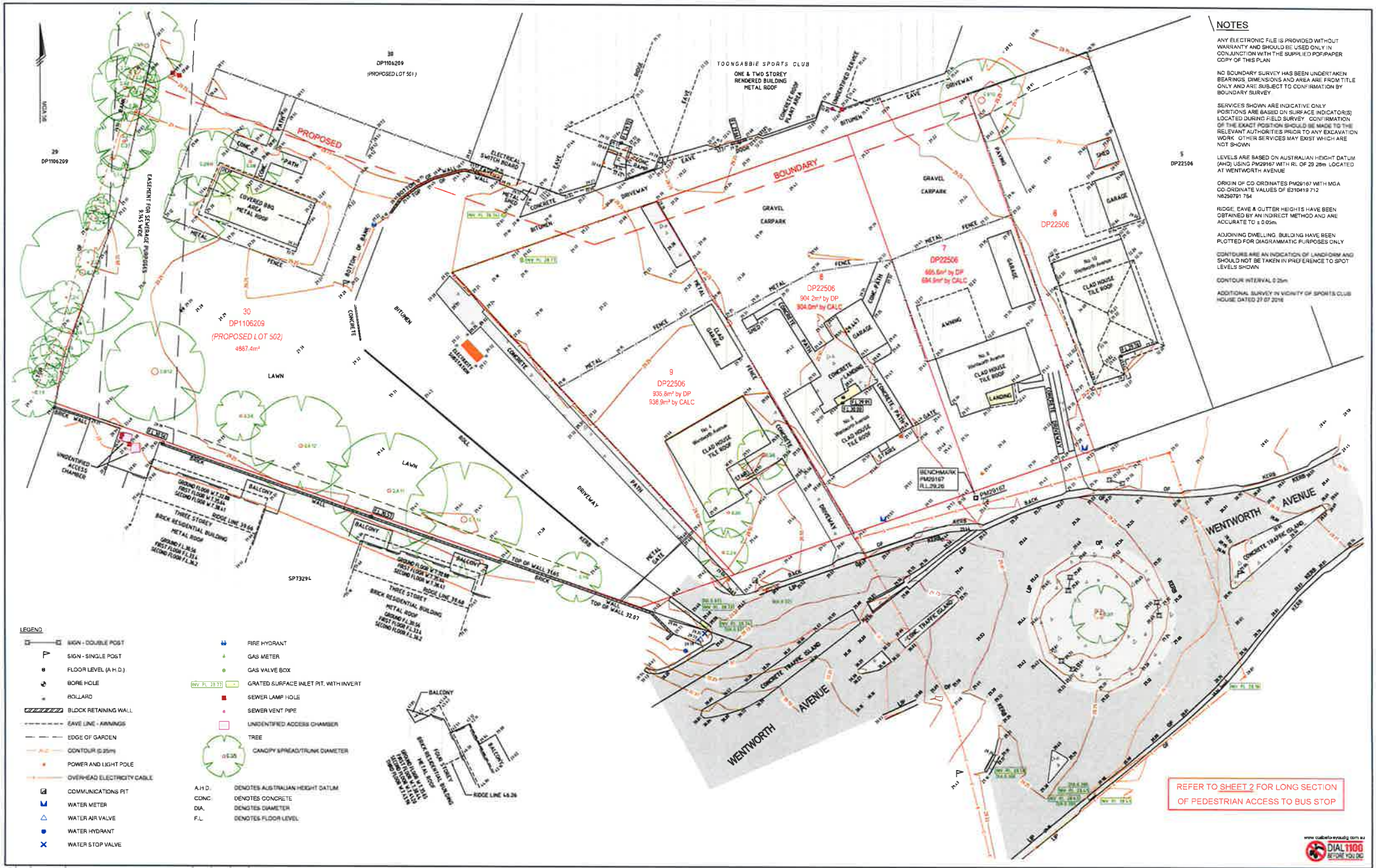
Parramatta City Council Flood Hazard Map

1:2,000

N

Printed 28/07/2014

ATTACHMENT B – SITE SURVEY



D	15.12.2016	EXISTING SERVICES LOCATIONS AMENDED	LMS	LMS
C	29.07.2016	ADDITIONAL DETAIL IN VICINITY OF SPORTS CLUB BUILDING ADDED	GDS	LMS
B	02.03.2016	CONSTRAINING SECTION DETAILS ADDED - DRAFT ISSUE	CFW	-
A	03.02.2016	PRELIMINARY ISSUE	CFW	GDS
No.	DATE	REVISION DETAILS	DRN	CHK

SURVEY SCALE	1:200
PAPER SIZE	N/A @ A1
COORDINATES	MGA
DATUM	AHD
LEVELS	PM29167
LEVELS	PM29167

SCALE IN METRES AT ORIGINAL REDUCTION RATIO

VIDE PLAN SHEET

Align Projects

SURVEY	CDS
DRAWN	CFW
CHECKED	GDS
APPROVED	LMS
DATE OF SURVEY	23.02.2016
DATE OF PLAN	02.03.2016
DATE LAST AMEND	15.12.2016
DATE APPROVED	29.07.2016

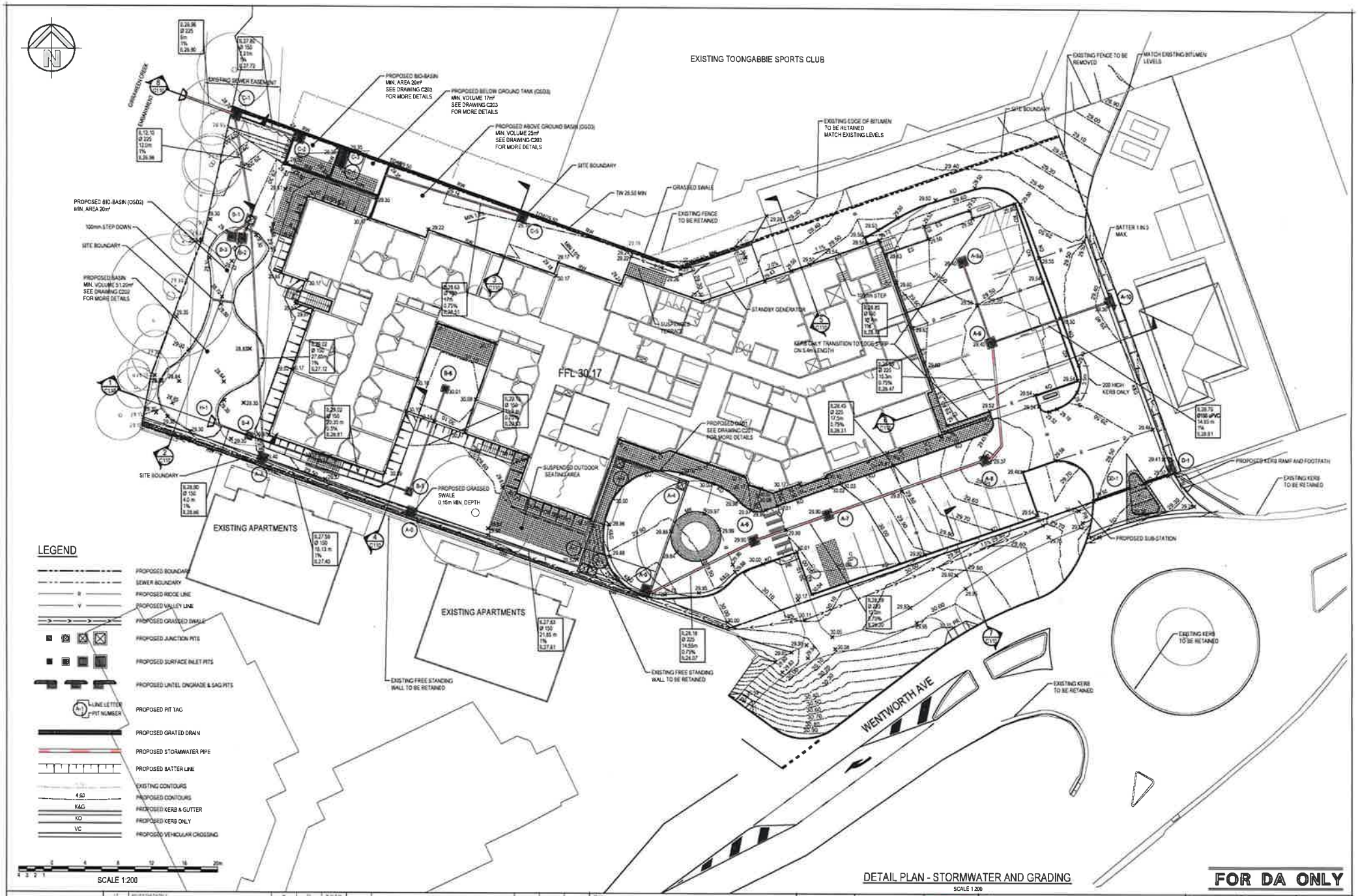
Detail Survey
Lots 6-9 DP22506 and Part Lot 30 DP1106209
Wentworth Avenue, Toongabbie

JOB No.	PR127201SU
DRG No.	DS01
REV	D
SHEET SIZE	A1

RPS

J:\PR127201 Opal Toongabbie Concept\10 - Drafting\Survey\2. Details\PR127201SU-DS01d.dwg 16.12.2016 12:12 PM

ATTACHMENT C – SITE GRADING PLAN



DETAIL PLAN - STORMWATER AND GRADING

SCALE 1:200

FOR DA ONLY

SURVEY INFORMATION
SURVEYED BY: RPS AUSTRALIA EAST
DATUM AHD
ORIGIN OF LEVELS: PM8197

OPAL SPECIALIST AGED CARE

CALDER FLOWER ARCHITECTS

Level 5, 79 Victoria Avenue, Chatswood NSW 2067
Telephone +61 2 9417 6400
Facsimile +61 2 9417 6557
Email email@hymas.com.au
Web www.henryandhymas.com.au
henry&hymas

OPAL SPECIALIST AGED CARE
WENTWORTH AVE., TOONGABBIE, NSW

DETAIL PLAN - STORMWATER AND GRADING

Drawn	Designed	Date
T.Zaha	L.Cama	MAY 2018
Checked	Approved	Scale
T.Chan	A.Francis	1:200 @ A1

Drawing No. 15B96_DA_C100 | Revision 08

ATTACHMENT D – MA PLANSET P1605655PS01

PROJECT: AGED CARE FACILITY

PLANSET: FLOOD ASSESSMENT

CLIENT: DPG SERVICES PTY LTD (OPAL AGED CARE)

LOCALITY PLAN
N.T.S.

CITY OF PARRAMATTA COUNCIL

12 STATION ROAD & 4-10 WENTWORTH AVENUE, TOONGABBIE, NSW

LOT 30 DP 1106209 AND LOTS 6, 7, 8 & 9 DP 22506

DRAWING LIST

DWG NO.	REV	DWG TITLE
GENERAL		
PS01-A000	F	COVERSHEET
FLOODING		
PS01-K110	D	1 IN 100 YEAR ARI CRITICAL STORM DURATION EXISTING CONDITION - CATCHMENT WATER LEVEL (mAHD) & WATER DEPTH (m)
PS01-K111	D	1 IN 100 YEAR ARI CRITICAL STORM DURATION EXISTING CONDITION - CATCHMENT WATER VELOCITY (m/s)
PS01-K112	D	1 IN 100 YEAR ARI CRITICAL STORM DURATION EXISTING CONDITION - CATCHMENT VXD HYDRAULIC HAZARD (m2/s)
PS01-K120	D	1 IN 1000 YEAR ARI CRITICAL STORM DURATION EXISTING CONDITION - CATCHMENT WATER LEVEL (mAHD) & WATER DEPTH (m)
PS01-K121	B	1 IN 1000 YEAR ARI CRITICAL STORM DURATION EXISTING CONDITION - CATCHMENT WATER VELOCITY (m/s)
PS01-K122	B	1 IN 1000 YEAR ARI CRITICAL STORM DURATION EXISTING CONDITION - CATCHMENT VXD HYDRAULIC HAZARD (m2/s)
PS01-K130	E	1 IN 2000 YEAR ARI CRITICAL STORM DURATION EXISTING CONDITION - CATCHMENT WATER LEVEL (mAHD) & WATER DEPTH (m)
PS01-K131	B	1 IN 2000 YEAR ARI CRITICAL STORM DURATION EXISTING CONDITION - CATCHMENT WATER VELOCITY (m/s)
PS01-K132	B	1 IN 2000 YEAR ARI CRITICAL STORM DURATION EXISTING CONDITION - CATCHMENT VXD HYDRAULIC HAZARD (m2/s)
PS01-K150	C	PMF CRITICAL DURATION STORM EXISTING CONDITION - CATCHMENT WATER LEVEL (mAHD) & WATER DEPTH (m)
PS01-K151	C	PMF CRITICAL DURATION STORM EXISTING CONDITION - CATCHMENT WATER VELOCITY (m/s)
PS01-K152	C	PMF CRITICAL DURATION STORM EXISTING CONDITION - CATCHMENT VXD HYDRAULIC HAZARD (m2/s)
PS01-K160	A	1 IN 1000 YEAR ARI CRITICAL STORM DURATION EXISTING CONDITION WATER LEVEL (mAHD) & WATER DEPTH (m)
PS01-K161	A	1 IN 1000 YEAR ARI CRITICAL STORM DURATION EXISTING CONDITION WATER VELOCITY (m/s)
PS01-K162	A	1 IN 1000 YEAR ARI CRITICAL STORM DURATION EXISTING CONDITION VXD HYDRAULIC HAZARD (m2/s)
PS01-K170	B	1 IN 2000 YEAR ARI CRITICAL STORM DURATION EXISTING CONDITION WATER LEVEL (mAHD) & WATER DEPTH (m)
PS01-K171	B	1 IN 2000 YEAR ARI CRITICAL STORM DURATION EXISTING CONDITION WATER VELOCITY (m/s)
PS01-K172	B	1 IN 2000 YEAR ARI CRITICAL STORM DURATION EXISTING CONDITION VXD HYDRAULIC HAZARD (m2/s)
PS01-K260	C	1 IN 1000 YEAR ARI CRITICAL STORM DURATION PROPOSED CONDITION WATER LEVEL (mAHD) & WATER DEPTH (m)
PS01-K261	C	1 IN 1000 YEAR ARI CRITICAL STORM DURATION PROPOSED CONDITION WATER VELOCITY (m/s)
PS01-K262	C	1 IN 1000 YEAR ARI CRITICAL STORM DURATION PROPOSED CONDITION VXD HYDRAULE HAZARD (m2/s)
PS01-K270	C	1 IN 2000 YEAR ARI CRITICAL STORM DURATION PROPOSED CONDITION WATER LEVEL (mAHD) & WATER DEPTH (m)
PS01-K271	C	1 IN 2000 YEAR ARI CRITICAL STORM DURATION PROPOSED CONDITION WATER VELOCITY (m/s)
PS01-K272	C	1 IN 2000 YEAR ARI CRITICAL STORM DURATION PROPOSED CONDITION VXD HYDRAULIC HAZARD (m2/s)
PS01-K360	C	1 IN 1000 YEAR ARI CRITICAL STORM DURATION PROPOSED CONDITION WATER LEVEL IMPACT (m)
PS01-K370	C	1 IN 2000 YEAR ARI CRITICAL STORM DURATION PROPOSED CONDITION WATER LEVEL IMPACT (m)

REV	DESCRIPTION	DATE	DRAWN	DESIGNED	CHECKED	APPRVD
F	AMENDED	14/06/2018	RK	CL	DD	TH
E	UPDATED AS PER CLIENT REQUEST	31/05/2018	RK	CL	DD	TH
D	UPDATED AS PER CLIENT REQUEST	29/05/2018	RK	CL	DD	TH
C	GENERAL REVISION	25/05/2018	KW	CL	TH	TH
B	UPDATED DESIGN PAD	11/05/2018	KW	CL	DD / TH	
A	INITIAL RELEASE	17/04/2018	KW	CL	DD / TH	

SCALE

GRID: ---
DATUM: ---
PROJECT MANAGER: TH

CLIENT: DPG SERVICES (OPAL AGED CARE)

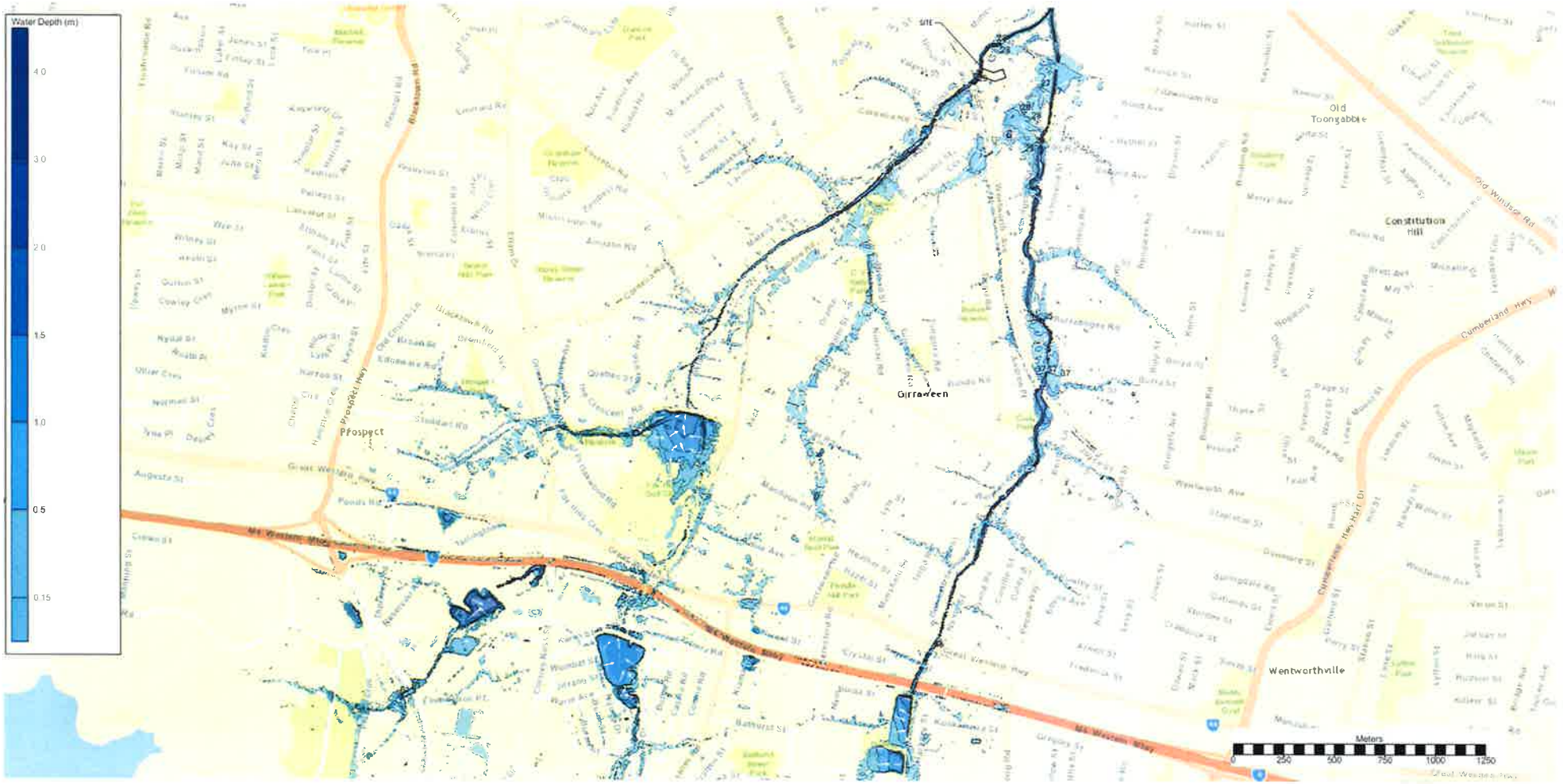
PROJECT NAME/PLANSET TITLE
AGED CARE FACILITY
FLOOD ASSESSMENT
12 STATION ROAD & 4-10 WENTWORTH AVENUE, TOONGABBIE, NSW
LOT 30 DP 1106209 AND LOTS 6, 7, 8 & 9 DP 22506

martens & Associates Pty Ltd
Consulting Engineers
Environment
Water
Geotechnical
Civil
Suite 201, 20 George St, Hornsby, NSW 2077 Australia Phone (02) 9476 9999 Fax (02) 9476 8767
Email mail@martens.com.au Internet www.martens.com.au

DEVELOPMENT APPLICATION - NOT FOR CONSTRUCTION

DRAWING TITLE: COVERSHEET

PROJECT NO	PLANSET NO	RELEASE NO	DRAWING NO	REVISION
P1605655	PS01	R06	PS01-A000	F



KEY

SITE BOUNDARY

DEVELOPMENT APPLICATION - NOT FOR CONSTRUCTION

REV	DESCRIPTION	DATE	DRAWN	DESIGNED	CHECKED	APPROVED
D	UPDATED AS PER CLIENT REQUEST	31/05/2018	RK	CL	DD	TH
C	UPDATED AS PER CLIENT REQUEST	29/05/2018	RK	CL	DD	TH
B	GENERAL REVISION	25/05/2018	KM	CL	TH	TH
A	INITIAL RELEASE	17/04/2018	KM	CL	DD / TH	

SCALE: A1 (A3) 1:10,000 (1:20,000) — KILOMETRES

GRID	DATUM	PROJECT MANAGER
MGA	mAHD	TH

CLIENT: DPG SERVICES (OPAL AGED CARE)

PROJECT NAME/PLANSET TITLE: AGED CARE FACILITY
FLOOD ASSESSMENT
12 STATION ROAD & 4-10 WENTWORTH AVENUE, TOONGABBIE, NSW
LOT 30 DP 1106209 AND LOTS 6, 7, 8 & 9 DP 22506

DISCLAIMER & COPYRIGHT

This plan must not be used for construction unless agreed or approved by prescribed certifying authority.

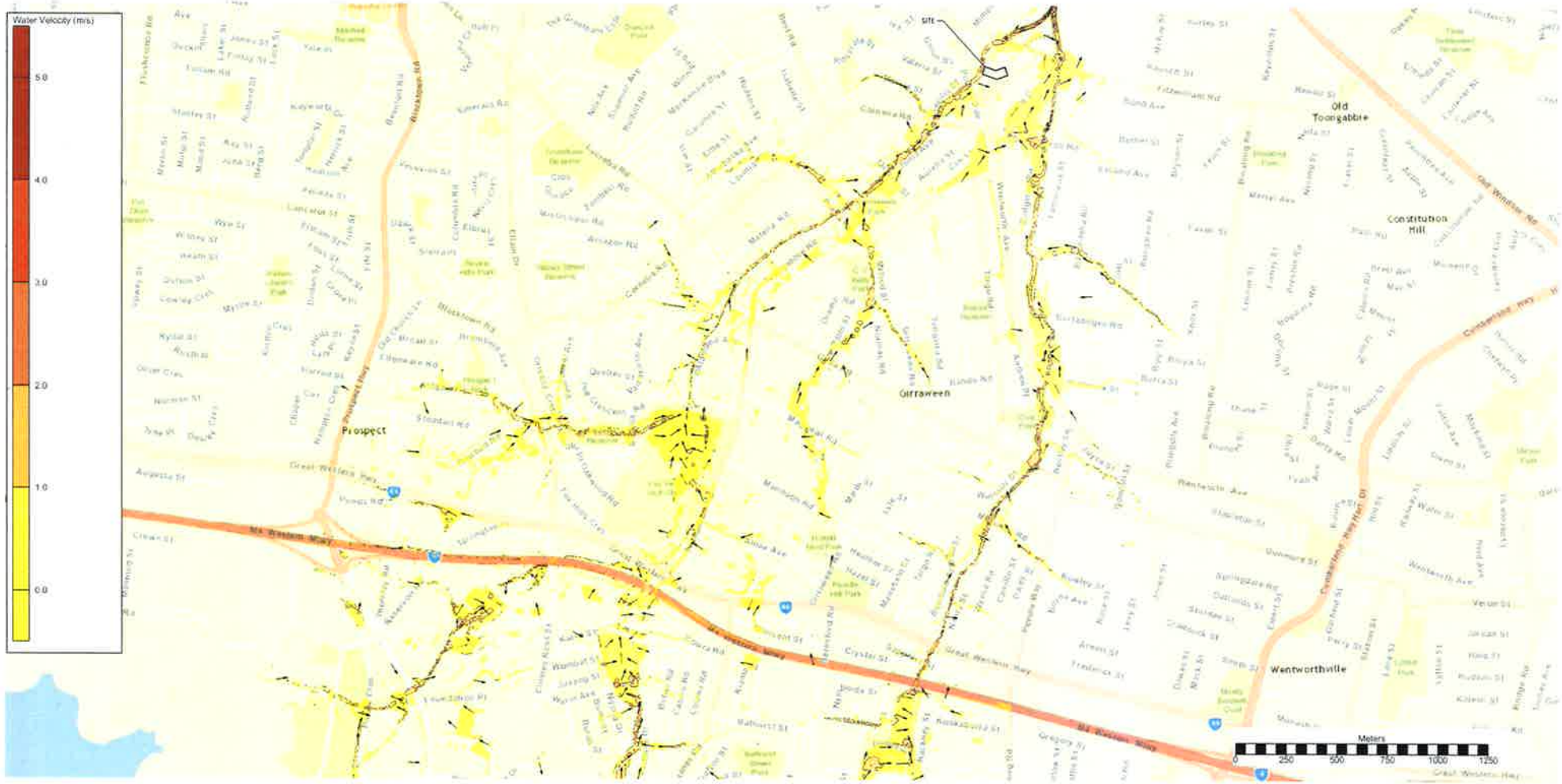
All measurements in millimetres unless otherwise specified.

The drawing must not be reproduced in whole or part without prior written consent of Martens & Associates Pty Ltd.

martens & Associates Pty Ltd
Consulting Engineers
Environment
Water
Geotechnical
Civil
Suite 201, 20 George St, Hornsby, NSW 2077 Australia. Phone: (02) 9476 9999 Fax: (02) 9476 8767
Email: mail@martens.com.au Internet: www.martens.com.au

DRAWING TITLE: 1 IN 100 YEAR ARI CRITICAL STORM DURATION
EXISTING CONDITION
WATER LEVEL (mAHD) & WATER DEPTH (m)

PROJECT NO.	PLANSET NO.	RELEASE NO.	DRAWING NO.	REVISION
P1605655	PS01	R06	PS01-K110	D



KEY

SITE BOUNDARY

DEVELOPMENT APPLICATION - NOT FOR CONSTRUCTION

REV	DESCRIPTION	DATE	DRAWN	DESIGNED	CHECKED	APPRVD
D	UPDATED AS PER CLIENT REQUEST	31/05/2018	RK	CL	DD	TH
C	UPDATED AS PER CLIENT REQUEST	29/05/2018	RK	CL	DD	TH
B	GENERAL REVISION	25/05/2018	KW	CL	TH	TH
A	INITIAL RELEASE	17/04/2018	KW	CL	DD / TH	

SCALE
A1 (A3) 1:10,000 (1:20,000)
KILOMETRES

GRID	DATUM	PROJECT MANAGER
MGA	mAHD	TH

DISCLAIMER & COPYRIGHT
This plan must not be used for construction unless signed as approved by relevant authority.
All measurements in millimetres unless otherwise specified.
This drawing must not be reproduced in whole or part without prior written consent of Martens & Associates Pty Ltd.
(C) Copyright Martens & Associates Pty Ltd

CLIENT
DPG SERVICES (OPAL AGED CARE)

PROJECT NAME/PLANSET TITLE
AGED CARE FACILITY
FLOOD ASSESSMENT
12 STATION ROAD & 4-10 WENTWORTH AVENUE, TOONGABBIE, NSW
LOT 30 DP 1106209 AND LOTS 6, 7, 8 & 9 DP 22506

martens & Associates Pty Ltd
Consulting Engineers
Environment
Water
Geotechnical
Civil
Suite 201, 20 George St, Hornsby, NSW 2077 Australia. Phone (02) 8476 9999 Fax (02) 9476 6757
Email mail@martens.com.au Internet www.martens.com.au

DRAWING TITLE
1 IN 100 YEAR ARI CRITICAL STORM DURATION
EXISTING CONDITION
WATER VELOCITY (m/s)

PROJECT NO	PLANSET NO	RELEASE NO	DRAWING NO	REVISION
P1605655	PS01	R06	PS01-K111	D

KEY

SITE BOUNDARY

NOTES:
HYDRAULIC HAZARD IS PROVIDED AS VD PRODUCT (VELOCITY X DEPTH) ON THESE MAPS.
GREEN AREAS DENOTE LOW HYDRAULIC HAZARD (VD PRODUCT - 0.4 m^2/s), YELLOW
AREAS DENOTE MODERATE HYDRAULIC HAZARD (0.4 m^2/s < VD PRODUCT < 0.6 m^2/s), AND
RED AREAS DENOTE HIGH HYDRAULIC HAZARD (VD PRODUCT > 0.6 m^2/s)

DEVELOPMENT APPLICATION - NOT FOR CONSTRUCTION

REV	DESCRIPTION	DATE	DRAWN	DESIGNED	CHECKED	APPRVD
D	UPDATED AS PER CLIENT REQUEST	31/05/2018	RK	CL	DD	TH
C	UPDATED AS PER CLIENT REQUEST	29/05/2018	RK	CL	DD	TH
B	GENERAL REVISION	25/05/2018	KW	CL	TH	TH
A	INITIAL RELEASE	17/04/2018	KW	EL	DD / TH	

SCALE: A1 (A3) 1:10,000 (1:20,000) METRES

GRID	DATUM	PROJECT MANAGER
MGA	mAHD	TH

DISCLAIMER & COPYRIGHT
This plan must not be used for construction unless signed as approved by principal certifying authority.
All measurements in millimetres unless otherwise specified.
This drawing must not be reproduced in whole or part without prior written consent of Martens & Associates Pty Ltd.

CLIENT: DPG SERVICES (OPAL AGED CARE)

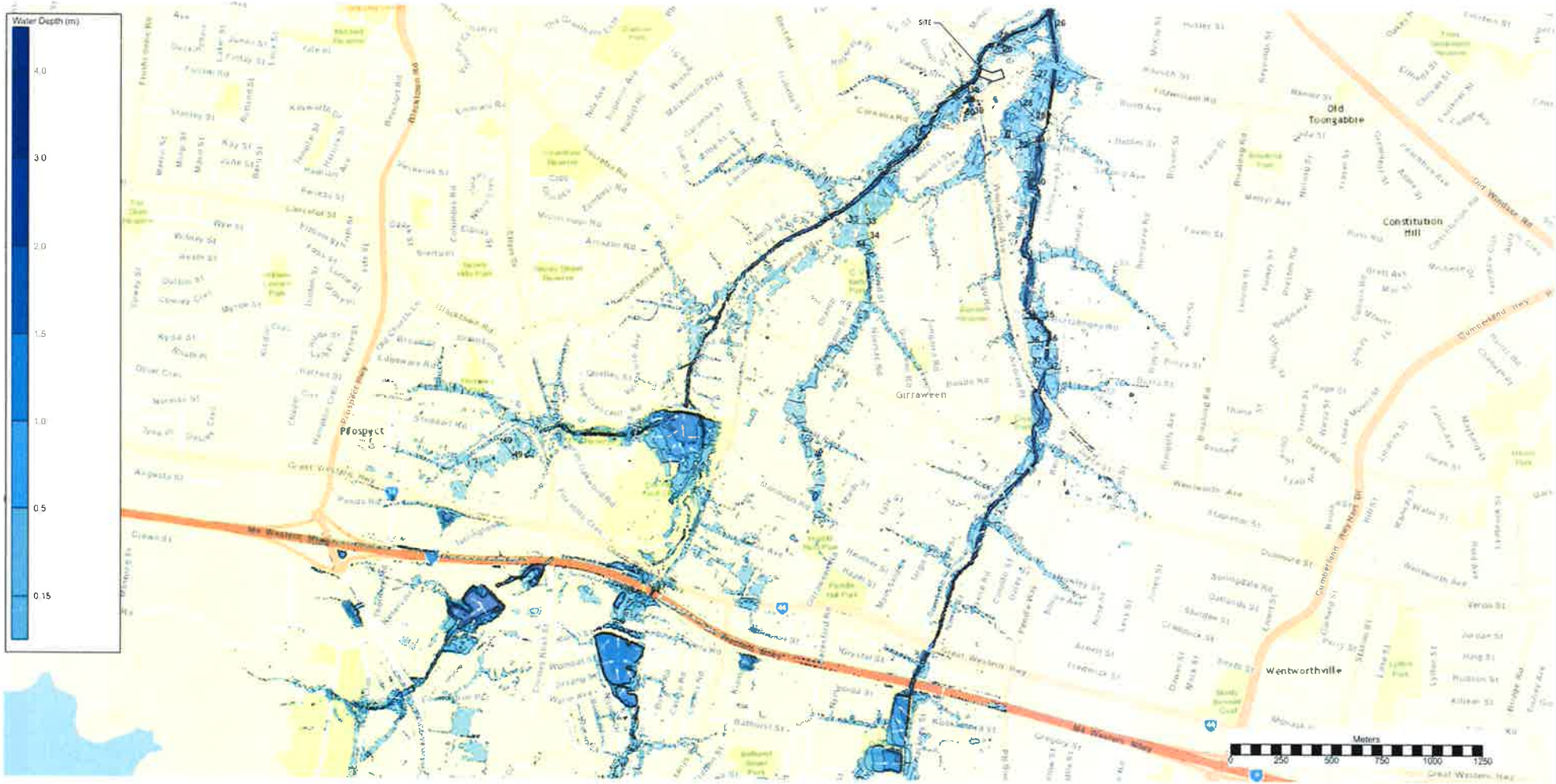
PROJECT NAME/PLANSET TITLE:
AGED CARE FACILITY
FLOOD ASSESSMENT

12 STATION ROAD & 4-10 WENTWORTH AVENUE, TOONGABBIE, NSW
LOT 30 DP 1166209 AND LOTS 6, 7, 8 & 9 DP 22506

martens & Associates Pty Ltd
Consulting Engineers
Environment
Water
Geotechnical
Civil
Suite 201, 20 George St, Hornsby, NSW 2077 Australia Phone: (02) 9476 9999 Fax: (02) 9476 8767
Email: mail@martens.com.au Internet: www.martens.com.au

DRAWING TITLE:
1 IN 100 YEAR ARI CRITICAL STORM DURATION
EXISTING CONDITION
VXD HYDRAULIC HAZARD (m2/s)

PROJECT NO	PLANSET NO	RELEASE NO	DRAWING NO	REVISION
P1605655	PS01	R06	PS01-K112	D



KEY

SITE BOUNDARY

DEVELOPMENT APPLICATION - NOT FOR CONSTRUCTION

REV	DESCRIPTION	DATE	DRAWN	DESIGNED	CHECKED	APPROVED
D	UPDATED AS PER CLIENT REQUEST	31/05/2019	RK	CL	DD	TH
C	UPDATED AS PER CLIENT REQUEST	29/05/2019	RK	CL	DD	TH
B	GENERAL REVISION	25/05/2019	KW	CL	TH	TH
A	INITIAL RELEASE	17/04/2019	KW	CL	DD / TH	

SCALE
A1 (A3) 1:10,000 (1:20,000)
METRES

GRID	DATUM	PROJECT MANAGER
MGA	mAHD	TH

DISCLAIMER & COPYRIGHT
This plan must not be used for construction unless signed as approved by council or relevant authority.
All measurements in millimetres unless otherwise specified.
The drawing must not be reproduced in whole or part without prior written consent of Martens & Associates Pty Ltd.
(C) Copyright Martens & Associates Pty Ltd

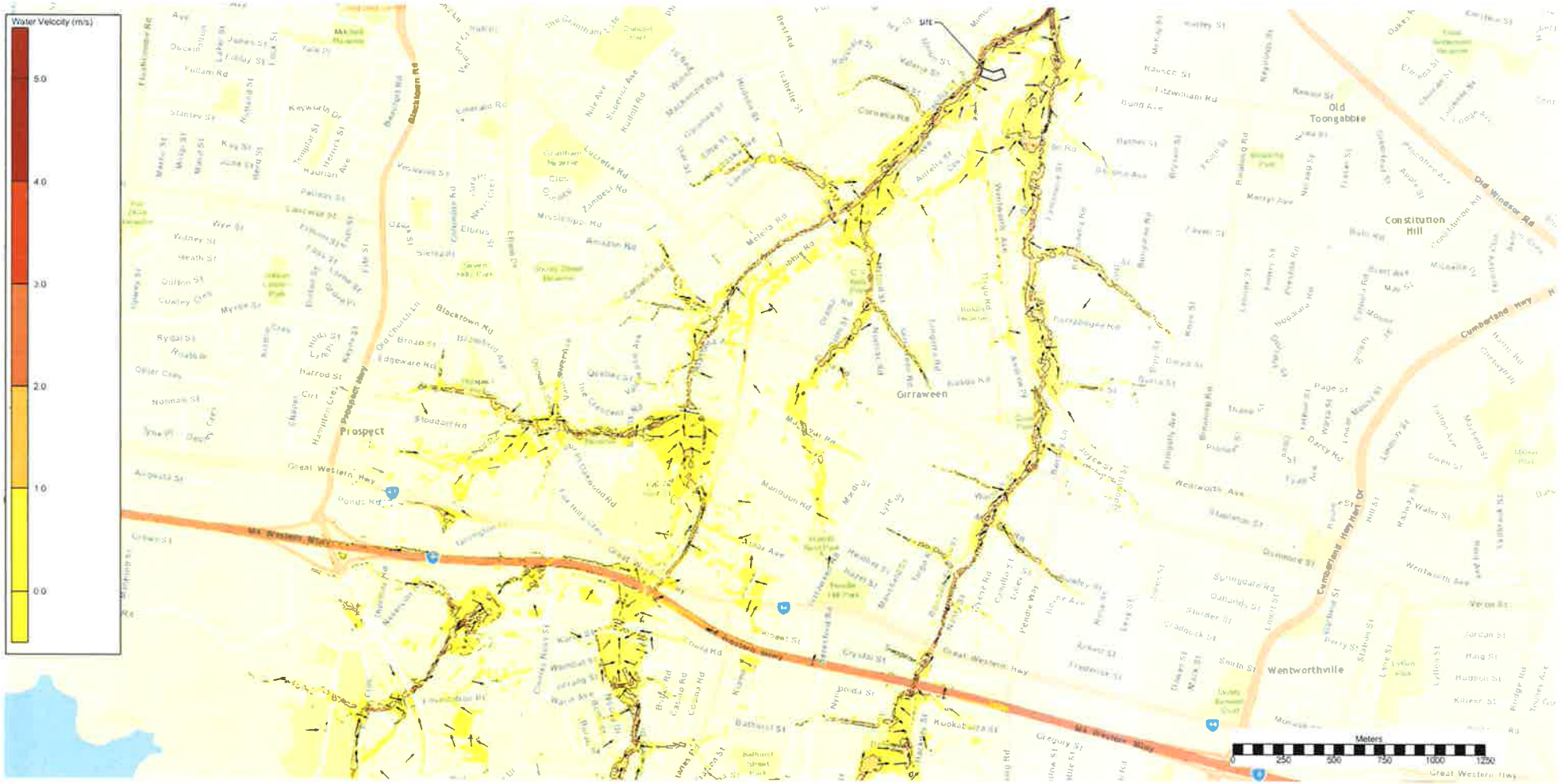
CLIENT
DPG SERVICES (OPAL AGED CARE)

PROJECT NAME/PLANSET TITLE
AGED CARE FACILITY
FLOOD ASSESSMENT
12 STATION ROAD & 4-10 WENTWORTH AVENUE, TOONGABBIE, NSW
LOT 30 DP 1106209 AND LOTS 6, 7, 8 & 9 DP 22506

martens & Associates Pty Ltd
Consulting Engineers
Environment
Water
Geotechnical
Civil
Suite 201, 20 George St, Hornsby, NSW 2077 Australia Phone (02) 9476 9999 Fax (02) 9476 8767
Email mail@martens.com.au Internet www.martens.com.au

DRAWING TITLE
1 IN 1000 YEAR ARI CRITICAL STORM DURATION
EXISTING CONDITION - CATCHMENT
WATER LEVEL (mAHD) & WATER DEPTH (m)

PROJECT NO	PLANSET NO	RELEASE NO	DRAWING NO	REVISION
P1605655	PS01	R06	PS01-K120	D



KEY

SITE BOUNDARY

DEVELOPMENT APPLICATION - NOT FOR CONSTRUCTION

REV	DESCRIPTION	DATE	DRAWN	DESIGNED	CHECKED	APPRVD
B	UPDATED AS PER CLIENT REQUEST	31/05/2016	RK	DL	DD	TH
A	UPDATED AS PER CLIENT REQUEST	29/05/2016	RK	DL	DD	TH

SCALE: A1 (A3) 1:10,000 (1:20,000) KILOMETRES

GRID	DATUM	PROJECT MANAGER
MGA	mAHD	TH

CLIENT: DPG SERVICES (OPAL AGED CARE)

PROJECT NAME/PLANSET TITLE: AGED CARE FACILITY
FLOOD ASSESSMENT

12 STATION ROAD & 4-10 WENTWORTH AVENUE, TOONGABBIE, NSW
LOT 30 DP 1126299 AND LOTS 6, 7 & 9 DP 22506

martens & Associates Pty Ltd
Consulting Engineers
Environment
Water
Geotechnical
Civil
Suite 201, 20 George St, Hornsby, NSW 2077 Australia. Phone: (02) 9476 9999 Fax: (02) 9476 8767
Email: mail@martens.com.au Internet: www.martens.com.au

DRAWING TITLE:
1 IN 1000 YEAR ARI CRITICAL STORM DURATION
EXISTING CONDITION - CATCHMENT
WATER VELOCITY (m/s)

PROJECT NO	PLANSET NO	RELEASE NO	DRAWING NO	REVISION
P1605655	PS01	R06	PS01-K121	B

KEY

SITE BOUNDARY

NOTES:
HYDRAULIC HAZARD IS PROVIDED AS VD PRODUCT (VELOCITY X DEPTH) ON THESE MAPS.
GREEN AREAS DENOTE LOW HYDRAULIC HAZARD (VD PRODUCT < 0.4 m²/s), YELLOW AREAS DENOTE MODERATE HYDRAULIC HAZARD (0.4 m²/s < VD PRODUCT < 0.6 m²/s), AND RED AREAS DENOTE HIGH HYDRAULIC HAZARD (VD PRODUCT > 0.6 m²/s)

DEVELOPMENT APPLICATION - NOT FOR CONSTRUCTION

REV	DESCRIPTION	DATE	DRAWN	DESIGNED	CHECKED	APPRVD
B	UPDATED AS PER CLIENT REQUEST	31/05/2018	RK	CL	DD	TH
A	UPDATED AS PER CLIENT REQUEST	29/05/2018	RK	CL	DD	TH

SCALE: A1 (A3) 1:10,000 (1:20,000) — KILOMETRES

GRID	DATUM	PROJECT MANAGER
MGA	mAHD	TH

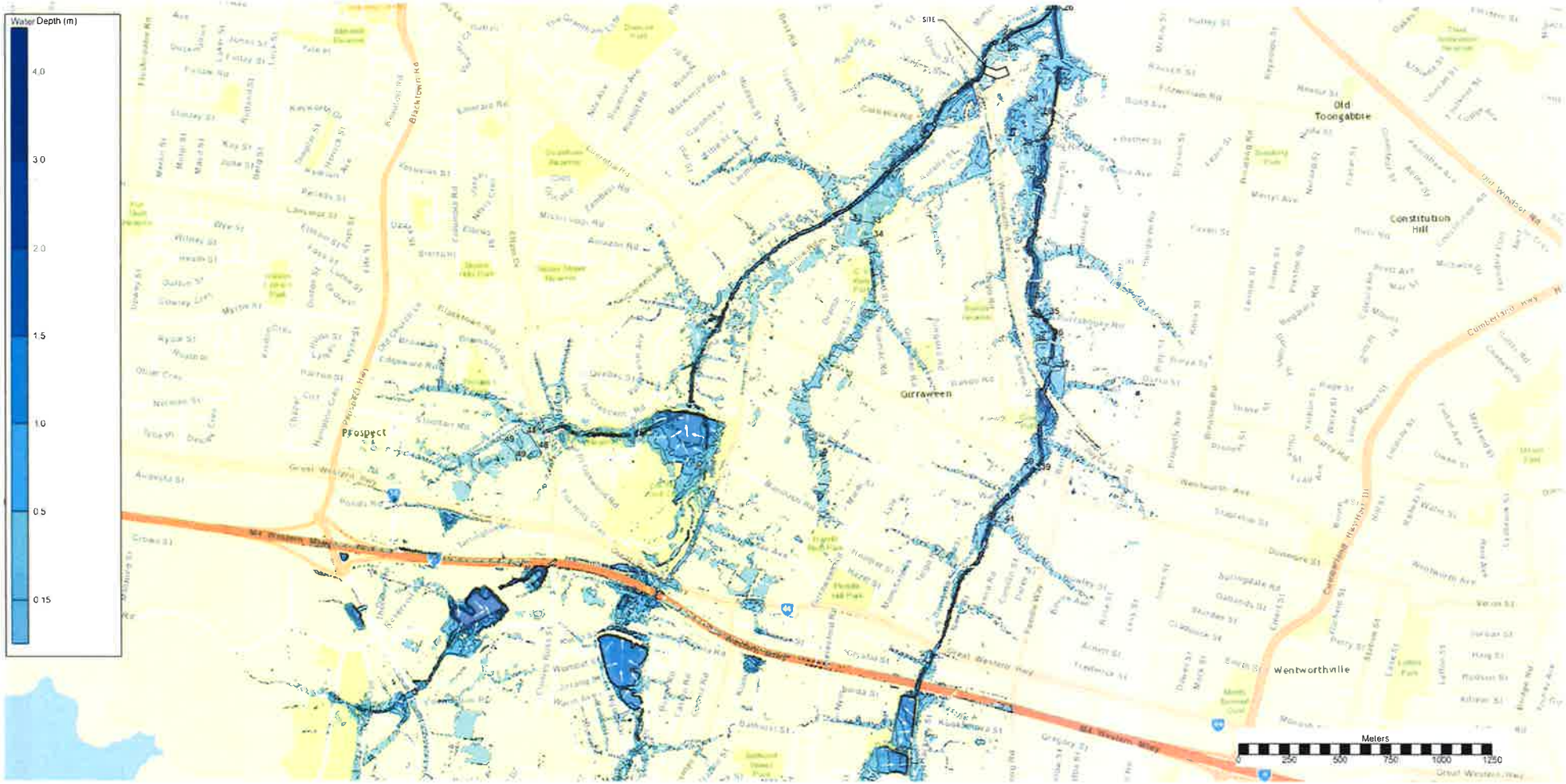
CLIENT: DPG SERVICES (OPAL AGED CARE)

PROJECT NAME/PLANSET TITLE: AGED CARE FACILITY
FLOOD ASSESSMENT
12 STATION ROAD & 4-10 WENTWORTH AVENUE, TOONGABBIE, NSW
LOT 30 DP 1064299 AND LOTS 6, 7, 8 & 9 DP 22506

martens & Associates Pty Ltd
Consulting Engineers
Environment
Water
Geotechnical
Civil
Suite 201, 20 George St, Hornsby, NSW 2077 Australia Phone: (02) 9476 9999 Fax (02) 9476 8767
Email mail@martens.com.au Internet www.martens.com.au

DRAWING TITLE
1 IN 1000 YEAR ARI CRITICAL STORM DURATION
EXISTING CONDITION - CATCHMENT
VXD HYDRAULIC HAZARD (m2/s)

PROJECT NO	PLANSET NO	RELEASE NO	DRAWING NO	REVISION
P1605655	PS01	R06	PS01-K122	B



KEY

SITE BOUNDARY

DEVELOPMENT APPLICATION - NOT FOR CONSTRUCTION

REV	DESCRIPTION	DATE	DRAWN	DESIGNED	CHECKED	APPRVD
E	UPDATED AS PER CLIENT REQUEST	31/05/2018	RK	CL	DD	TH
D	UPDATED AS PER CLIENT REQUEST	29/05/2018	RK	CL	DD	TH
C	GENERAL REVISION	25/05/2018	KW	CL	TH	TH
B	UPDATED DESIGN PAD	11/05/2018	KW	CL	DD / TH	
A	INITIAL RELEASE	17/04/2018	KW	CL	DD / TH	

SCALE: A1 (A3) 1:10,000 1:20,000

GRID	DATUM	PROJECT MANAGER
MGA	mAHD	TH

DISCLAIMER & COPYRIGHT

CLIENT: DPG SERVICES (OPAL AGED CARE)

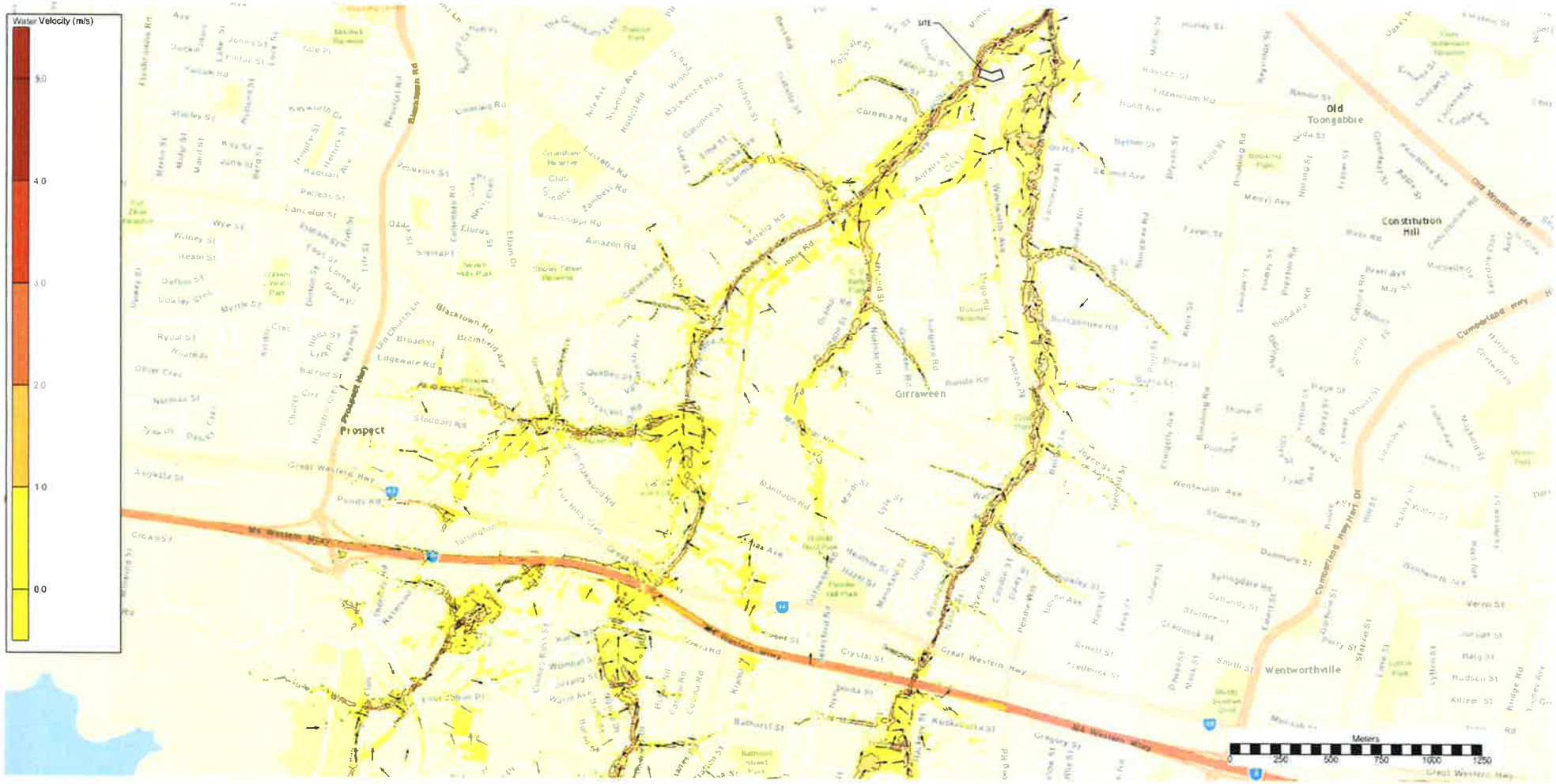
PROJECT NAME/PLANSET TITLE: AGED CARE FACILITY
FLOOD ASSESSMENT

12 STATION ROAD & 4-16 WENTWORTH AVENUE, TOONGABBIE, NSW
LOT 30 DP 1186209 AND LOTS 4, 7, 8 & 9 DP 22566

martens & Associates Pty Ltd
Consulting Engineers
Environment
Water
Geotechnical
Civil
Suite 201, 20 George St, Hornsby, NSW 2077 Australia Phone: (02) 9476 9999 Fax: (02) 9476 8767
Email: mail@martens.com.au Internet: www.martens.com.au

DRAWING TITLE: 1 IN 2000 YEAR ARI CRITICAL STORM DURATION
EXISTING CONDITION - CATCHMENT
WATER LEVEL (mAHD) & WATER DEPTH (m)

PROJECT NO.	PLANSET NO	RELEASE NO	DRAWING NO	REVISION
P1605655	PS01	R06	PS01-K130	E



KEY

SITE BOUNDARY

DEVELOPMENT APPLICATION - NOT FOR CONSTRUCTION

REV	DESCRIPTION	DATE	DRAWN	DESIGNED	CHECKED	APPROVED
B	UPDATED AS PER CLIENT REQUEST	30/05/2018	RK	CL	DD	TH
A	UPDATED AS PER CLIENT REQUEST	29/05/2018	RK	CL	DD	TH

SCALE: A1(A3) 1:10,000 (1:20,000) KILOMETRES

GRID	DATUM	PROJECT MANAGER
MGA	mAHD	TH

CLIENT: DPG SERVICES (OPAL AGED CARE)

PROJECT NAME/PLANSET TITLE: AGED CARE FACILITY
FLOOD ASSESSMENT
12 STATION ROAD & 4-16 WENTWORTH AVENUE, TOONGABBIE, NSW
LOT 30 DP 1106299 AND LOTS 6, 7, 8 & 9 DP 22586

martens & Associates Pty Ltd
Consulting Engineers
Environment
Water
Geotechnical
Civil
Suite 201, 20 George St, Hornsby, NSW 2077 Australia Phone: (02) 9476 9999 Fax: (02) 9476 9767
Email: mail@martens.com.au Internet: www.martens.com.au

DRAWING TITLE: 1 IN 2000 YEAR ARI CRITICAL STORM DURATION
EXISTING CONDITION - CATCHMENT
WATER VELOCITY (m/s)

PROJECT NO	PLANSET NO	RELEASE NO	DRAWING NO	REVISION
P1605655	PS01	R06	PS01-K131	B

KEY

SITE BOUNDARY

NOTES:
HYDRAULIC HAZARD IS PROVIDED AS VD PRODUCT (VELOCITY X DEPTH) ON THESE MAPS.
GREEN AREAS DENOTE LOW HYDRAULIC HAZARD (VD PRODUCT = 0.4 m^2/s), YELLOW AREAS DENOTE MODERATE HYDRAULIC HAZARD (0.4 m^2/s < VD PRODUCT < 0.6 m^2/s), AND RED AREAS DENOTE HIGH HYDRAULIC HAZARD (VD PRODUCT > 0.6 m^2/s)

DEVELOPMENT APPLICATION - NOT FOR CONSTRUCTION

REV	DESCRIPTION	DATE	DRAWN	DESIGNED	CHECKED	APPROVED
B	UPDATED AS PER CLIENT REQUEST	25/05/2018	RK	CL	DD	TH
A	UPDATED AS PER CLIENT REQUEST	21/05/2018	RK	CL	DD	TH

SCALE: A1 (A3) 1:10,000 (1:20,000) — KILOMETRES

GRID	DATUM	PROJECT MANAGER
MGA	mAHD	TH

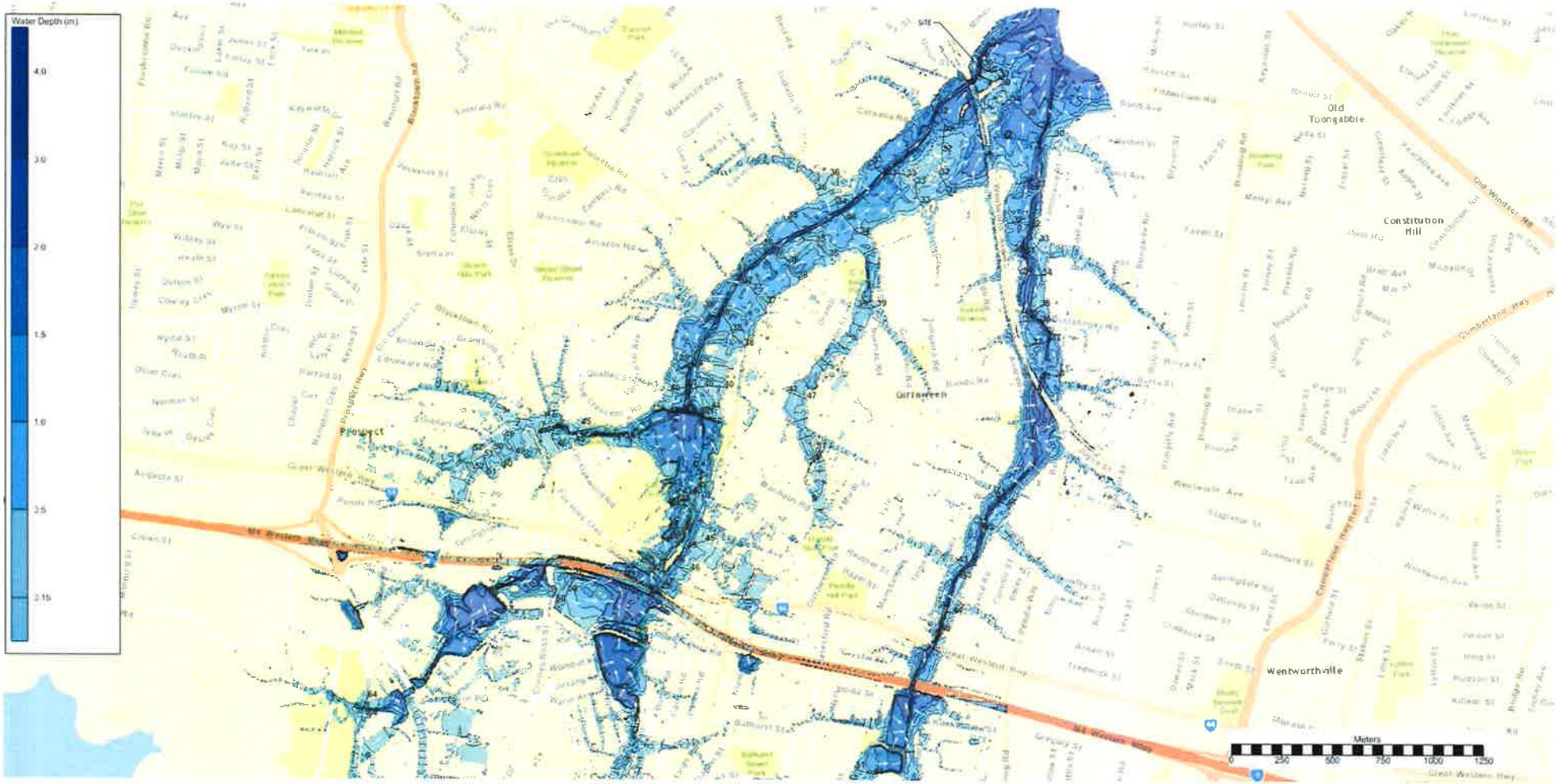
CLIENT: DPG SERVICES (OPAL AGED CARE)

PROJECT NAME/PLANSET TITLE: AGED CARE FACILITY
FLOOD ASSESSMENT
12 STATION ROAD & 4-10 WENTWORTH AVENUE, TOONGABBIE, NSW
LOT 30 DP 1106209 AND LOTS 6, 7, 8 & 9 DP 32506

martens & Associates Pty Ltd
Consulting Engineers
Environment
Water
Geotechnical
Civil
Suite 201, 20 George St, Hornsby, NSW 2077 Australia. Phone: (02) 9476 9999 Fax: (02) 9476 9767
Email: mail@martens.com.au Internet: www.martens.com.au

DRAWING TITLE
1 IN 2000 YEAR ARI CRITICAL STORM DURATION
EXISTING CONDITION - CATCHMENT
VXD HYDRAULIC HAZARD (m2/s)

PROJECT NO	PLANSET NO	RELEASE NO	DRAWING NO	REVISION
P1605655	PS01	R06	PS01-K132	B



KEY

SITE BOUNDARY

DEVELOPMENT APPLICATION - NOT FOR CONSTRUCTION

REV	DESCRIPTION	DATE	DRAWN	DESIGNED	CHECKED	APPRVD
C	UPDATED AS PER CLIENT REQUEST	31/05/2019	RK	CL	DD	TH
B	UPDATED AS PER CLIENT REQUEST	29/05/2019	RK	CL	DD	TH
A	GENERAL REVISION	25/05/2019	KW	CL	TH	TH

SCALES: A1 (A3) 1:10,000 (1:20,000)

GRID	DATUM	PROJECT MANAGER
MGA	mAHD	TH

DISCLAIMER & COPYRIGHT

This plan must not be used for construction unless signed as approved by principal certifying authority.

All measurements in millimetres unless otherwise specified.

This drawing must not be reproduced in whole or part without prior written consent of Martens & Associates Pty Ltd.

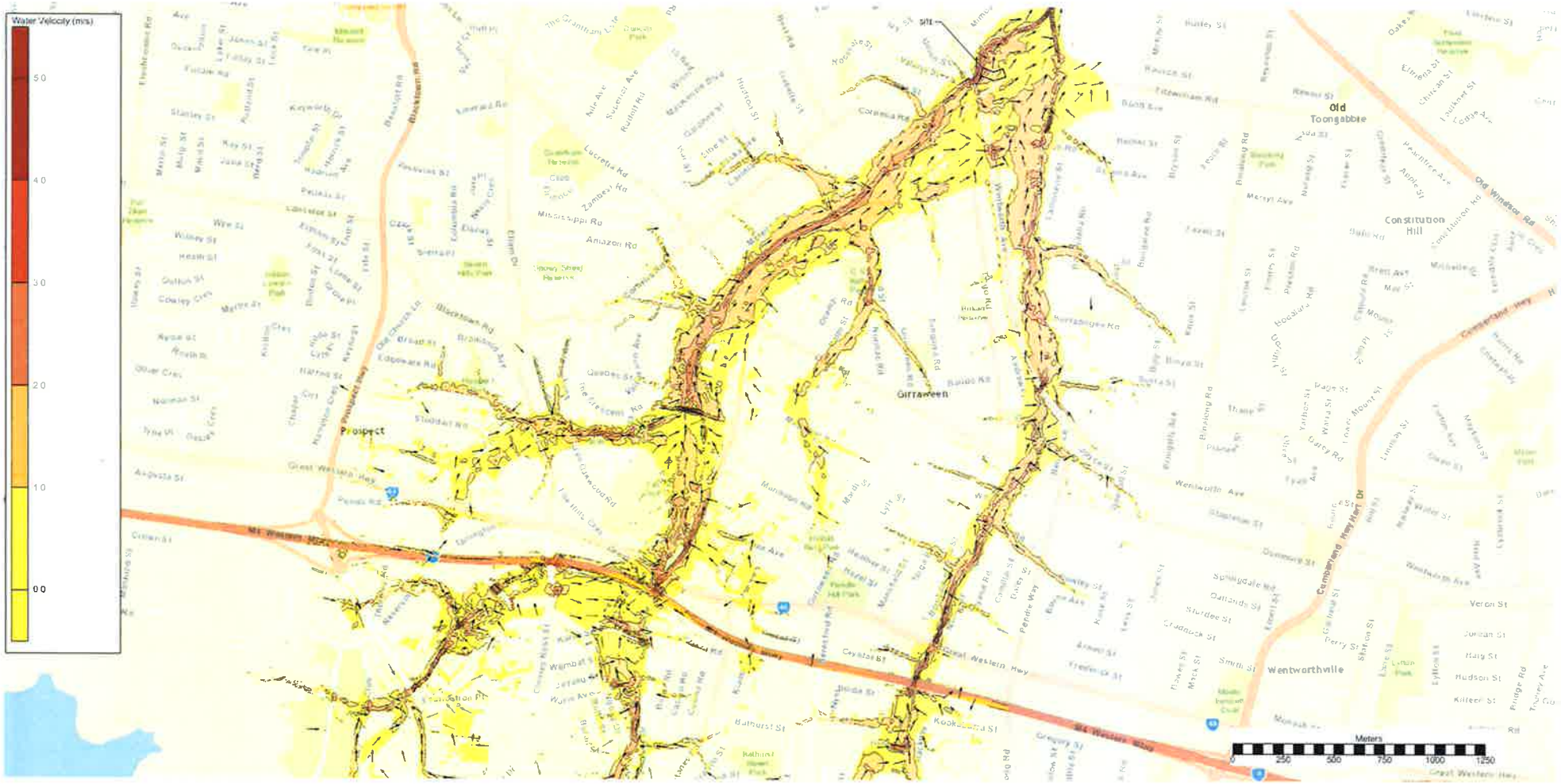
CLIENT: DPG SERVICES (OPA_ AGED CARE)

PROJECT NAME/PLANSET TITLE: AGED CARE FACILITY
FLOOD ASSESSMENT
10 STATION ROAD & 4-16 WENTWORTH AVENUE, TOONGABBIE, NSW
LOT 30 DP 1196209 AND LOTS 6, 7, 8 & 9 DP 22505

martens & Associates Pty Ltd
Consulting Engineers
Environment
Water
Geotechnical
Civil
Suite 201, 20 George St, Hornsby, NSW 2077 Australia Phone: (02) 9476 9999 Fax: (02) 9476 6767
Email: mail@martens.com.au Internet: www.martens.com.au

DRAWING TITLE: PMF CRITICAL DURATION STORM
EXISTING CONDITION
WATER LEVEL (mAHD) & WATER DEPTH (m)

PROJECT NO	PLANSET NO	RELEASE NO	DRAWING NO	REVISION
P1605655	PS01	R06	PS01-K150	C



KEY

SITE BOUNDARY

DEVELOPMENT APPLICATION - NOT FOR CONSTRUCTION

REV	DESCRIPTION	DATE	DRAWN	DESIGNED	CHECKED	APPRVD
C	UPDATED AS PER CLIENT REQUEST	31/05/2018	RK	CL	DD	TH
B	UPDATED AS PER CLIENT REQUEST	29/05/2018	RK	CL	DD	TH
A	GENERAL REVISION	25/05/2018	RK	CL	TH	TH

SCALE: A1 (A3) 1:10,000 (1:20,000) KILOMETRES

GRID	DATUM	PROJECT MANAGER
MGA	mAHD	TH

CLIENT: DPG SERVICES (OPAL AGED CARE)

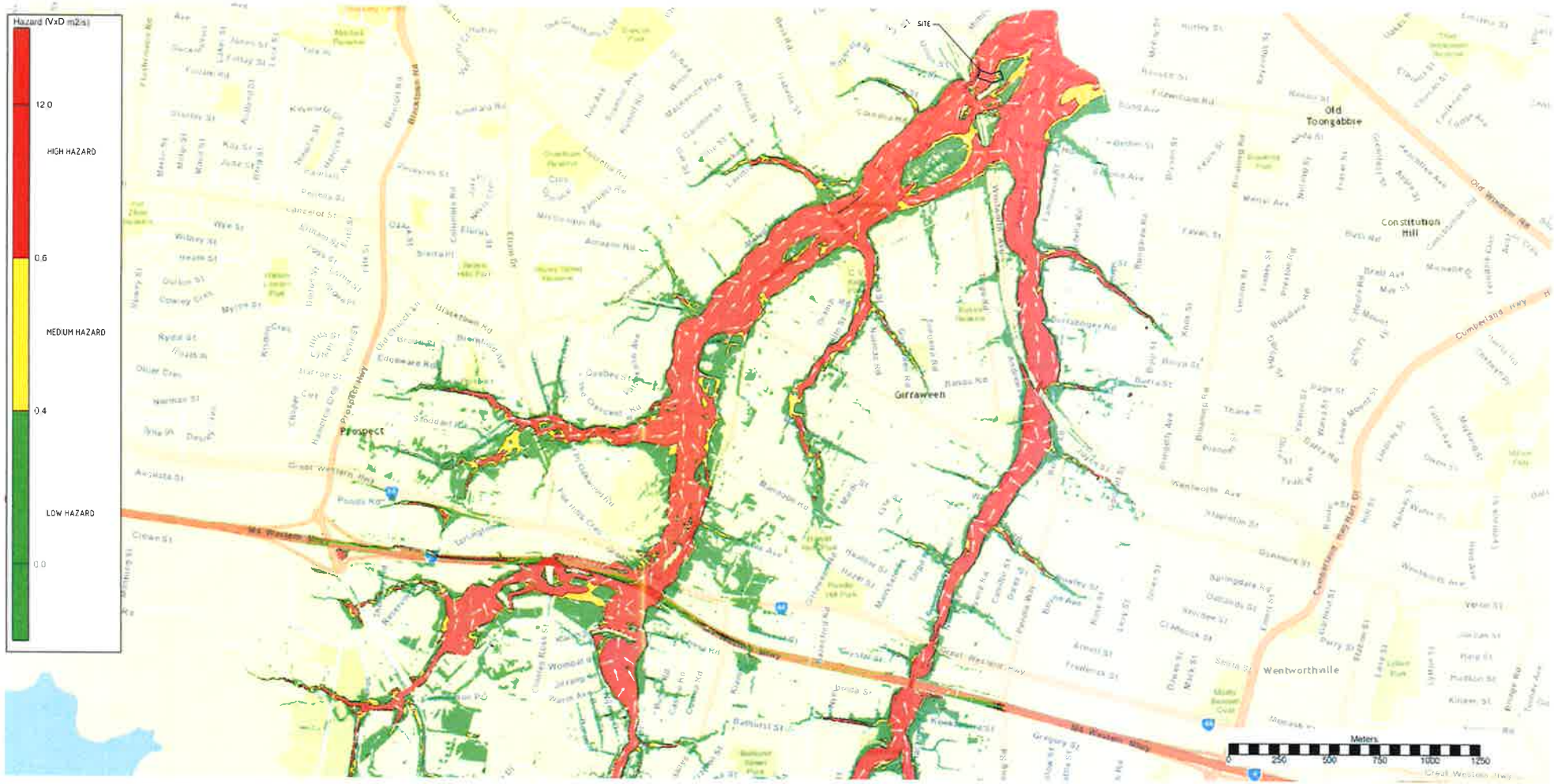
PROJECT NAME/PLANSET TITLE: AGED CARE FACILITY
FLOOD ASSESSMENT

12 STATION ROAD & 4-10 WENTWORTH AVENUE, TOONGABBIE, NSW
LOT 30 DP 1062299 AND LOTS 6, 7 & 9 DP 22586

martens & Associates Pty Ltd
Consulting Engineers
Environment
Water
Geotechnical
Civil
Suite 201, 20 George St, Hornsby, NSW 2077 Australia Phone: (02) 9476 9999 Fax (02) 9476 8767
Email mail@martens.com.au Internet: www.martens.com.au

DRAWING TITLE: PMF CRITICAL DURATION STORM
EXISTING CONDITION
WATER VELOCITY (m/s)

PROJECT NO	PLANSET NO	RELEASE NO.	DRAWING NO	REVISION
P1605655	PS01	R06	PS01-K151	C



KEY

SITE BOUNDARY

NOTES:
HYDRAULIC HAZARD IS PROVIDED AS VD PRODUCT (VELOCITY X DEPTH) ON THESE MAPS.
GREEN AREAS DENOTE LOW HYDRAULIC HAZARD (VD PRODUCT < 0.4 m^2/s), YELLOW AREAS DENOTE MODERATE HYDRAULIC HAZARD (0.4 m^2/s < VD PRODUCT < 0.6 m^2/s), AND RED AREAS DENOTE HIGH HYDRAULIC HAZARD (VD PRODUCT > 0.6 m^2/s)

DEVELOPMENT APPLICATION - NOT FOR CONSTRUCTION

REV	DESCRIPTION	DATE	DRAWN	DESIGNED	CHECKED	APPROVED
C	UPDATED AS PER CLIENT REQUEST	31/05/2018	RK	CL	DD	TH
B	UPDATED AS PER CLIENT REQUEST	29/05/2018	RK	CL	DD	TH
A	GENERAL REVISION	25/05/2018	KW	CL	TH	TH

SCALE: A1 (A3) 1:10,000 (1:20,000)

GRID	DATUM	PROJECT MANAGER
MGA	mAHD	TH

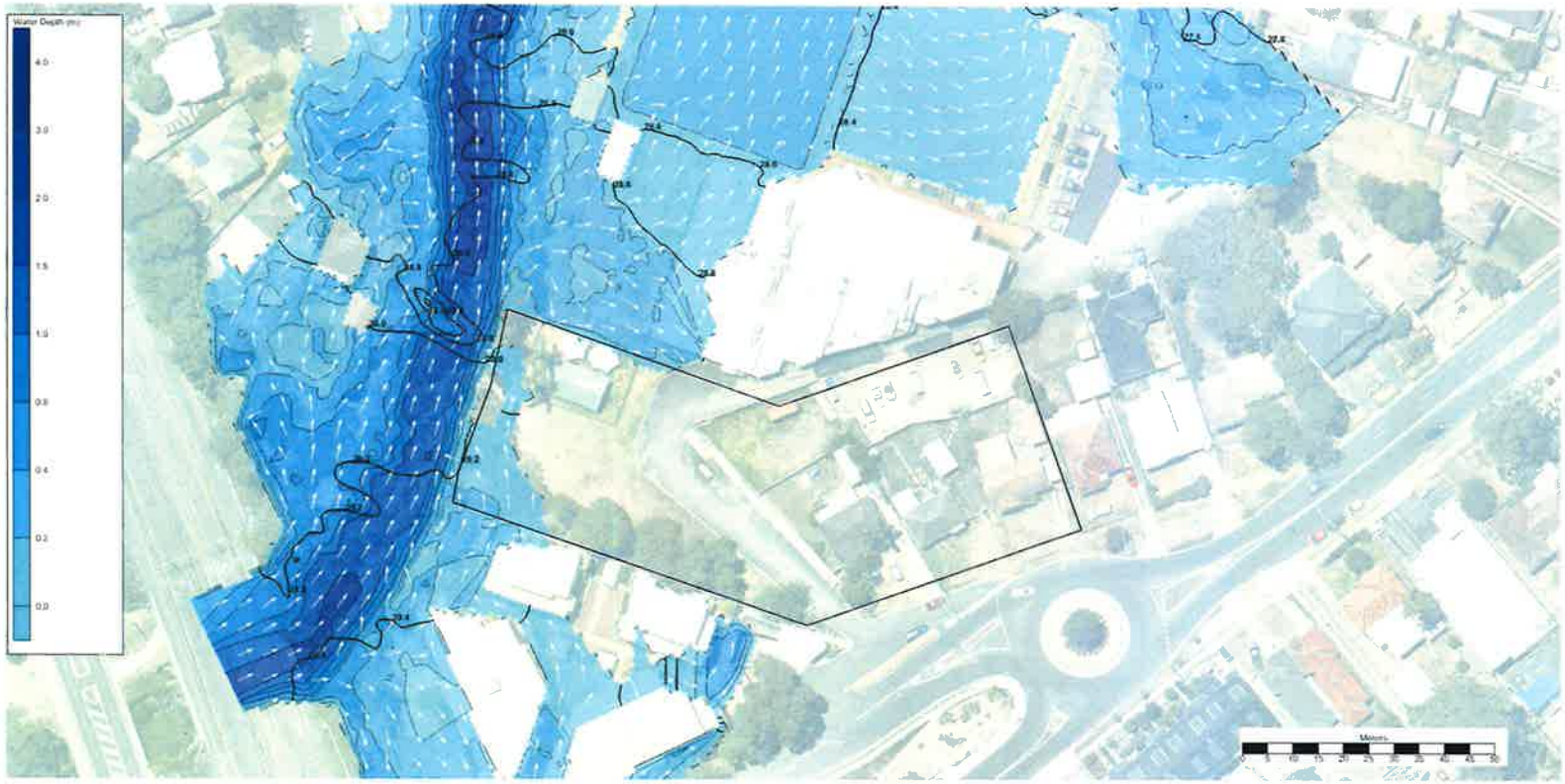
CLIENT: DPG SERVICES (OPAL AGED CARE)

PROJECT NAME/PLANSET TITLE: AGED CARE FACILITY
FLOOD ASSESSMENT
12 STATION ROAD & 4-10 WENTWORTH AVENUE, TOONGABBIE, NSW
LOT 30 DP 1186209 AND LOTS 6, 7, 8 & 9 DP 22506

martens & Associates Pty Ltd
Consulting Engineers
Environment
Water
Geotechnical
Civil
Suite 201, 20 George St, Hornsby, NSW 2077 Australia Phone: (02) 9476 9999 Fax: (02) 9476 6767
Email: mail@martens.com.au Internet: www.martens.com.au

DRAWING TITLE
PMF CRITICAL DURATION STORM
EXISTING CONDITION
VXD HYDRAULIC HAZARD (m2/s)

PROJECT NO	PLANSET NO	RELEASE NO	DRAWING NO	REVISION
P1605655	PS01	R06	PS01-K152	C



KEY

SITE BOUNDARY

DEVELOPMENT APPLICATION - NOT FOR CONSTRUCTION

REV	DESCRIPTION	DATE	DRAWN	DESIGNED	CHECKED	APPRVD
A	UPDATED AS PER CLIENT REQUEST	24/05/2018	RK	CL	DD	TH

SCALE: A1 (A3) 1:500 (1:1000) METRES

GRID	DATUM	PROJECT MANAGER
MGA	mAHD	TH

DISCLAIMER & COPYRIGHT

The plan must not be used for construction unless agreed as approved by principal certifying authority.

All measurements in millimetres unless otherwise specified.

This drawing must not be reproduced in whole or part without prior written consent of Martens & Associates Pty Ltd.

CLIENT: DPG SERVICES (OPAL AGED CARE)

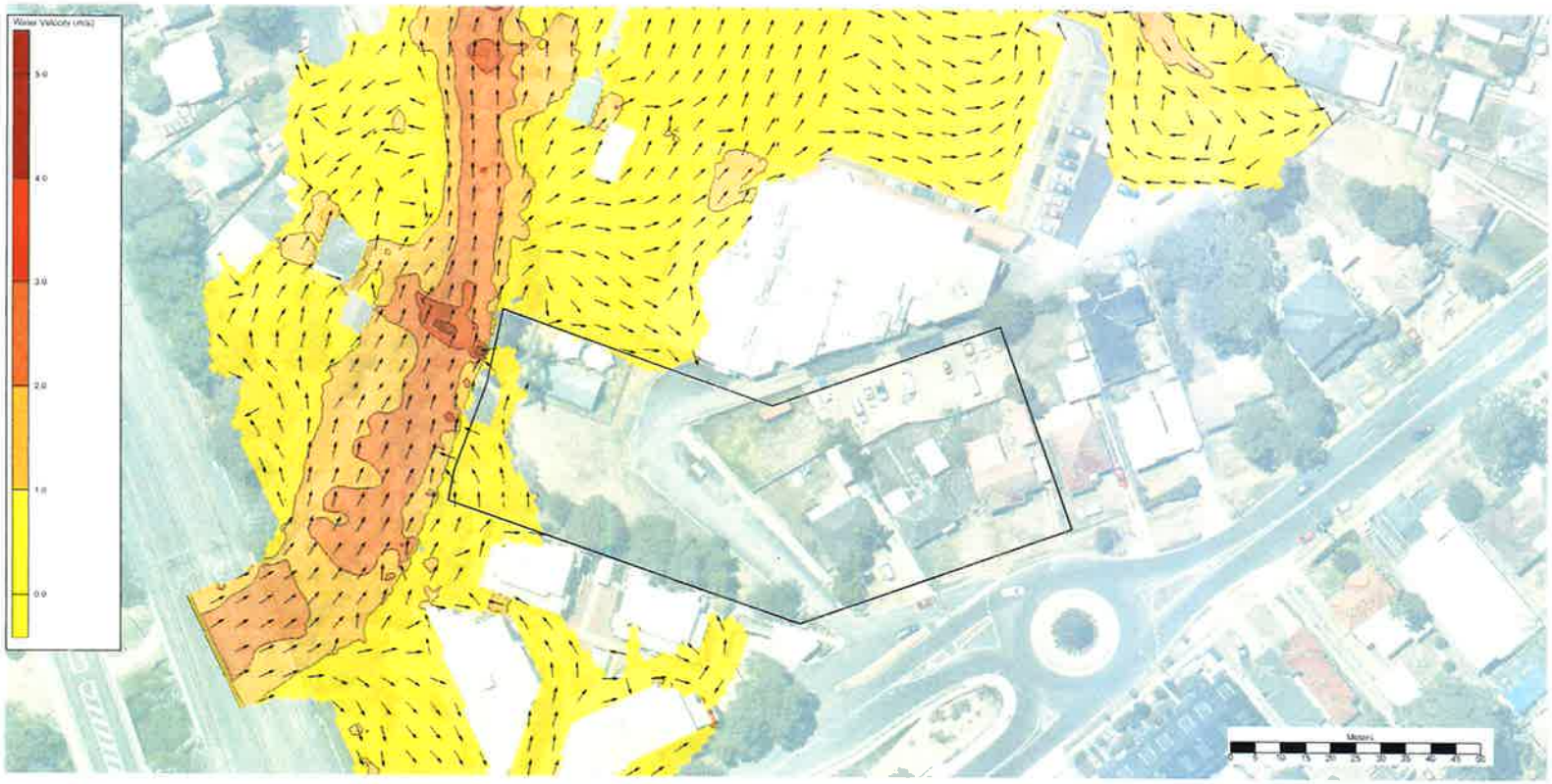
PROJECT NAME/PLANSET TITLE: AGED CARE FACILITY
FLOOD ASSESSMENT

12 STATION ROAD & 4-10 WENTWORTH AVENUE, TOONGABBIE, NSW
LOT 33 DP 1186209 AND LOTS 6, 7 & 9 DP 22504

martens & Associates Pty Ltd
Consulting Engineers
Environment
Water
Geotechnical
Civil
Suite 101, 20 George St, Hornsby, NSW 2077 Australia. Phone: (02) 9476 2888 Fax: (02) 9476 2767
Email: mail@martens.com.au Internet: www.martens.com.au

DRAWING TITLE:
1 IN 1000 YEAR ARI CRITICAL STORM DURATION
EXISTING CONDITION
WATER LEVEL (mAHD) & WATER DEPTH (m)

PROJECT NO.	PLANSET NO.	RELEASE NO.	DRAWING NO.	REVISION
P1605655	PS01	R06	PS01-K160	A



KEY

SITE BOUNDARY

DEVELOPMENT APPLICATION - NOT FOR CONSTRUCTION

REV	DESCRIPTION	DATE	DRAWN	DESIGNED	CHECKED	APPRVD
A	UPDATED AS PER CLIENT REQUEST	29/05/2018	RK	CL	DD	TH

SCALE: A1 (A3) 1:500 (1:1,000) METRES

GRID: MGA | DATUM: mAHD | PROJECT MANAGER: TH

DISCLAIMER & COPYRIGHT

The plan must not be used for construction unless signed as approved by principal or relevant authority.

All measurements in millimetres unless otherwise specified.

The drawing must not be reproduced in whole or part without prior written consent of Martens & Associates Pty Ltd.

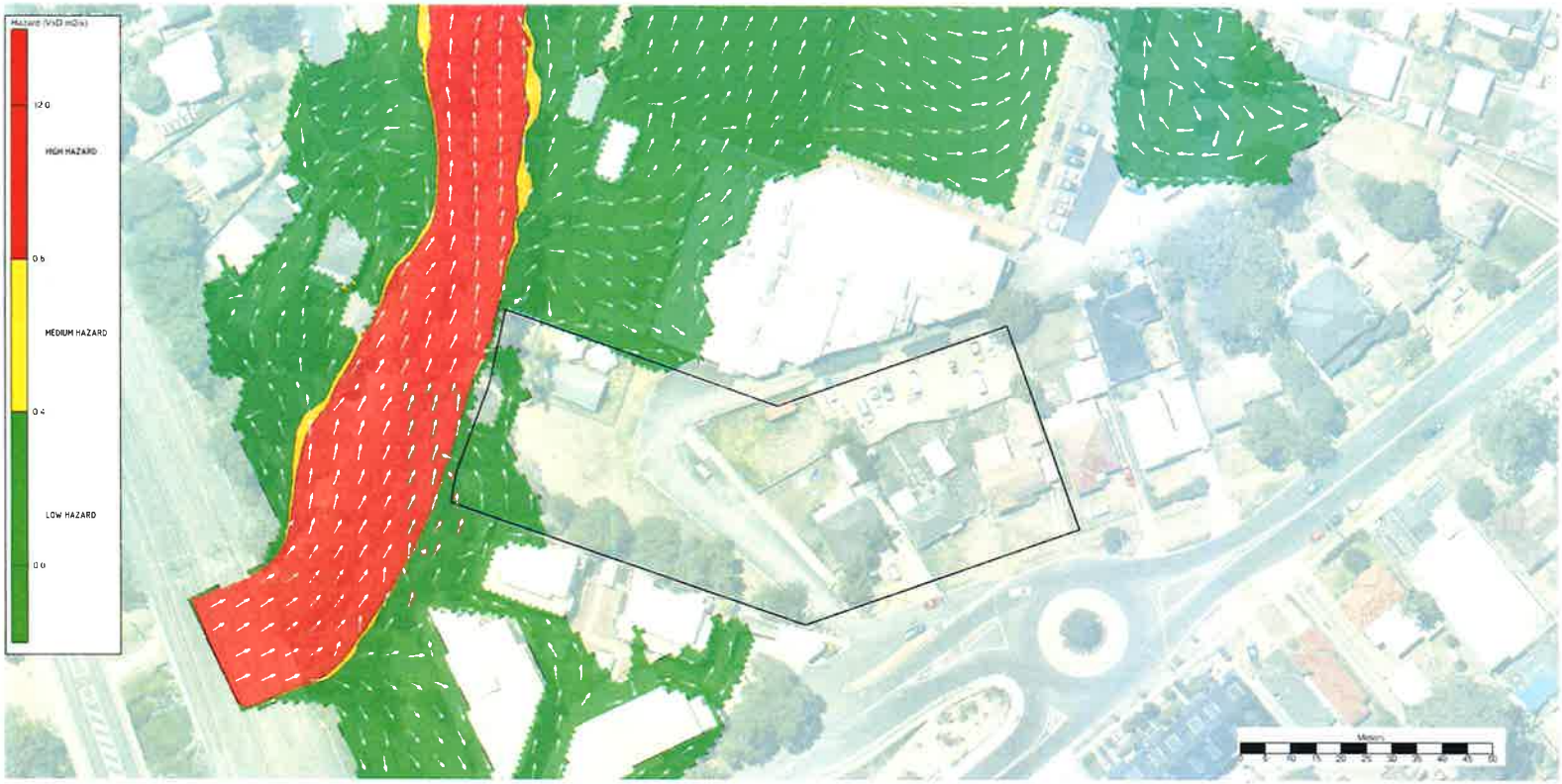
CLIENT: DPG SERVICES (OPAL AGED CARE)

PROJECT NAME/PLANSET TITLE: AGED CARE FACILITY
FLOOD ASSESSMENT
12 STATION ROAD & 4-10 WENTWORTH AVENUE, TOONGABBIE, NSW
LOT 30 DP 1105289 AND LOTS 6, 7, 8 & 9 DP 22506

martens & Associates Pty Ltd
Consulting Engineers
Environment
Water
Geotechnical
Civil
Suite 201, 20 George St, Hornsby, NSW 2077 Australia Phone: (02) 9476 9999 Fax: (02) 9476 8767
Email: mail@martens.com.au Internet: www.martens.com.au

DRAWING TITLE: 1 IN 1000 YEAR ARI CRITICAL STORM DURATION
EXISTING CONDITION
WATER VELOCITY (m/s)

PROJECT NO	PLANSET NO	RELEASE NO	DRAWING NO	REVISION
P1605655	PS01	R06	PS01-K161	A



KEY

SITE BOUNDARY

NOTES:
HYDRAULIC HAZARD IS PROVIDED AS VD PRODUCT (VELOCITY X DEPTH) ON THESE MAPS.
GREEN AREAS DENOTE LOW HYDRAULIC HAZARD (VD PRODUCT < 0.4 m^2/s), YELLOW
AREAS DENOTE MODERATE HYDRAULIC HAZARD (0.4 m^2/s < VD PRODUCT < 0.6 m^2/s), AND
RED AREAS DENOTE HIGH HYDRAULIC HAZARD (VD PRODUCT > 0.6 m^2/s)

DEVELOPMENT APPLICATION - NOT FOR CONSTRUCTION

REV	DESCRIPTION	DATE	DRAWN	DESIGNED	CHECKED	APPRVD
A	UPDATED AS PER CLIENT REQUEST	29/05/2019	RK	CL	DD	TH

SCALE: A1 (A3) 1:500 (1:1000) METRES

GRID	DATUM	PROJECT MANAGER
MGA	mAHD	TH

DISCLAIMER & COPYRIGHT
This plan must not be used for construction unless signed as approved by principal certifying authority.
All measurements in millimetres unless otherwise specified.
This drawing must not be reproduced in whole or part without prior written consent of Martens & Associates Pty Ltd.
(C) Copyright Martens & Associates Pty Ltd

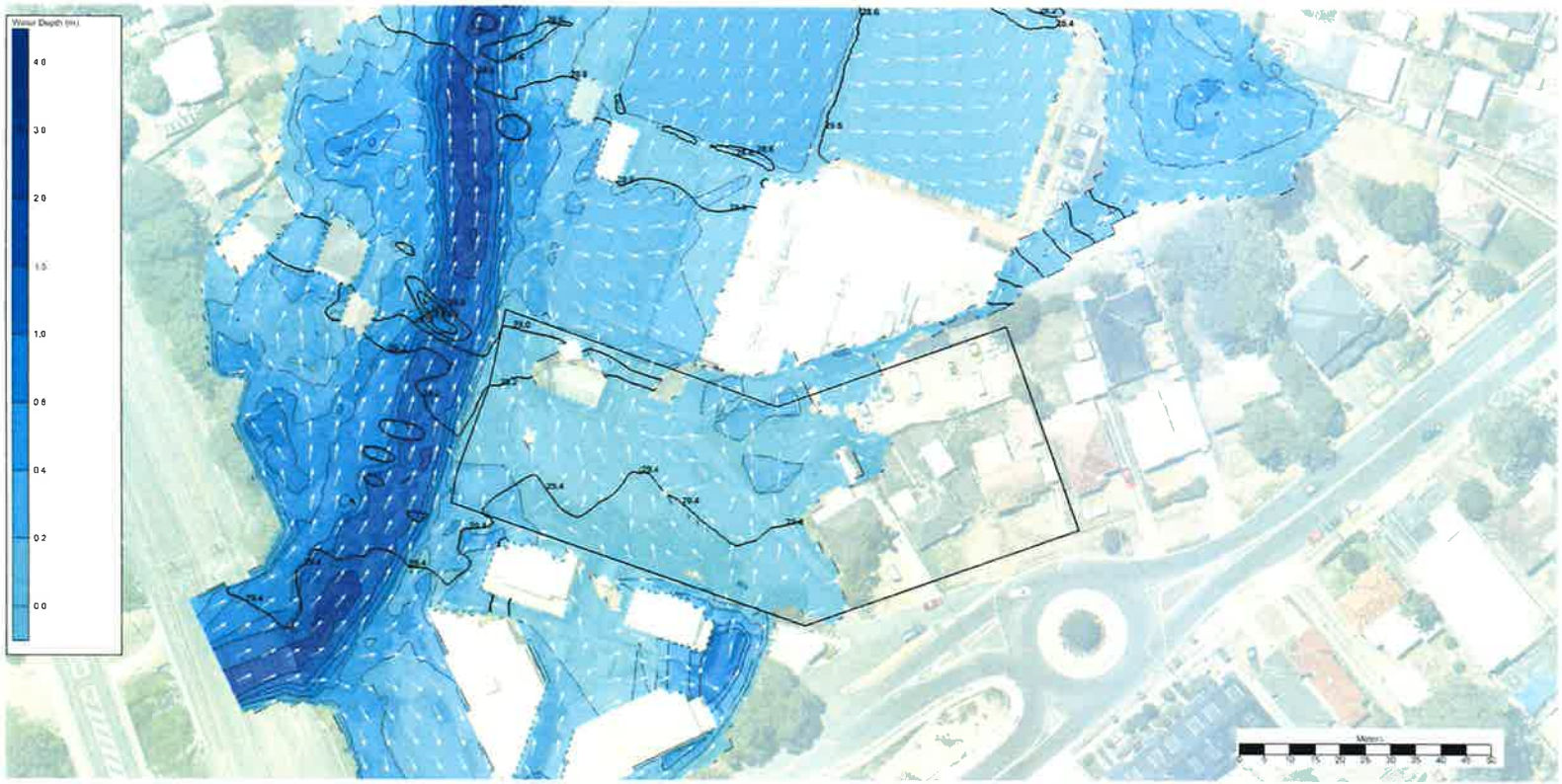
CLIENT: DPG SERVICES (OPAL AGED CARE)

PROJECT NAME/PLANSET TITLE
AGED CARE FACILITY
FLOOD ASSESSMENT
12 STATION ROAD & 4-10 WENTWORTH AVENUE, TOONGABBIE, NSW
LOT 30 DP 1106209 AND LOTS 6, 7, 8 & 9 DP 22506

martens & Associates Pty Ltd
Consulting Engineers
Environment
Water
Geotechnical
Civil
Suite 201, 20 George St, Hornsby, NSW 2077 Australia Phone: (02) 9476 9999 Fax: (02) 9476 8767
Email: mail@martens.com.au Internet: www.martens.com.au

DRAWING TITLE
1 IN 1000 YEAR ARI CRITICAL STORM DURATION
EXISTING CONDITION
VXD HYDRAULIC HAZARD (m2/s)

PROJECT NO	PLANSET NO	RELEASE NO	DRAWING NO	REVISION
P1605655	PS01	R06	PS01-K162	A



KEY

SITE BOUNDARY

DEVELOPMENT APPLICATION - NOT FOR CONSTRUCTION

REV	DESCRIPTION	DATE	DRAWN	DESIGNED	CHECKED	APPRVD
B	AMENDED	16/08/2018	RK	CL	DO	TH
A	UPDATED AS PER CLIENT REQUEST	29/05/2018	RK	CL	DO	TH

SCALE: A1 [A3] 1:500 [1:1,000] METRES

GRID	DATUM	PROJECT MANAGER
MGA	mAHD	TH

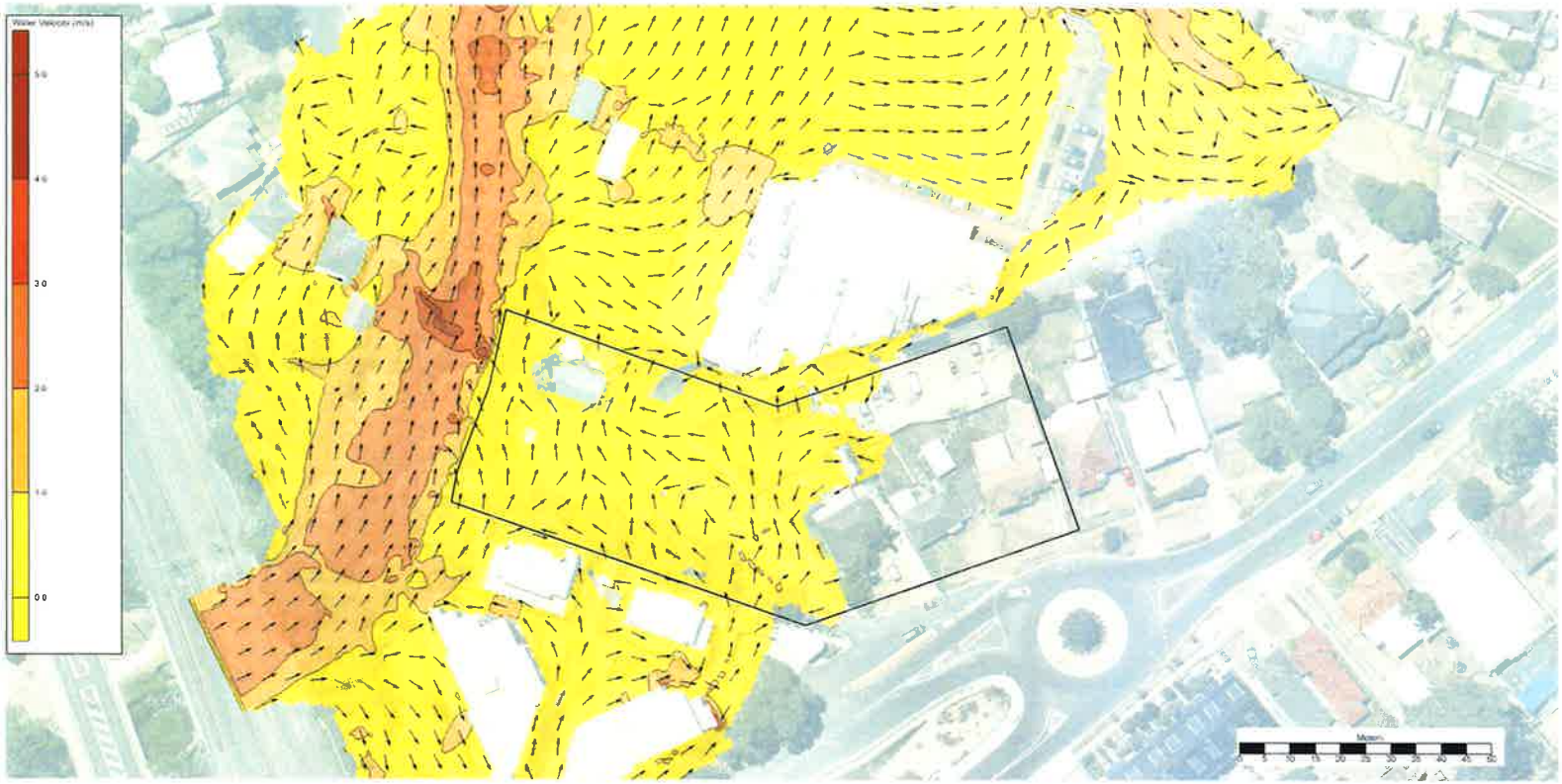
CLIENT: DPG SERVICES (OPAL AGED CARE)

PROJECT NAME/PLANSET TITLE: AGED CARE FACILITY
FLOOD ASSESSMENT
12 STATION ROAD & 4-10 WENTWORTH AVENUE, TOONGABBIE, NSW
LOT 30 DP 1106209 AND LOTS 6, 7, 8 & 9 DP 22504

martens & Associates Pty Ltd
Consulting Engineers
Environment
Water
Geotechnical
Civil
Suite 201, 20 George St, Hornsby, NSW 2077 Australia Phone: (02) 9476 9999 Fax: (02) 9476 8767
Email: mail@martens.com.au Internet: www.martens.com.au

DRAWING TITLE: 1 IN 2000 YEAR ARI CRITICAL STORM DURATION
EXISTING CONDITION
WATER LEVEL (mAHD) & WATER DEPTH (m)

PROJECT NO.	PLANSET NO.	RELEASE NO.	DRAWING NO.	REVISION
P1605655	PS01	R06	PS01-K170	B



N

KEY

SITE BOUNDARY

DEVELOPMENT APPLICATION - NOT FOR CONSTRUCTION

REV	DESCRIPTION	DATE	DRAWN	DESIGNED	CHECKED	APPROVED
B	AMENDED	16/06/2016	RK	CL	OD	TH
A	UPDATED AS PER CLIENT REQUEST	24/05/2016	RK	CL	OD	TH

SCALE: 0 5 10 15 20 25 30 35 40 45 50 METRES
AT (A3) 1:500 (1:1000)

GRID	DATUM	PROJECT MANAGER
MGA	mAHD	TH

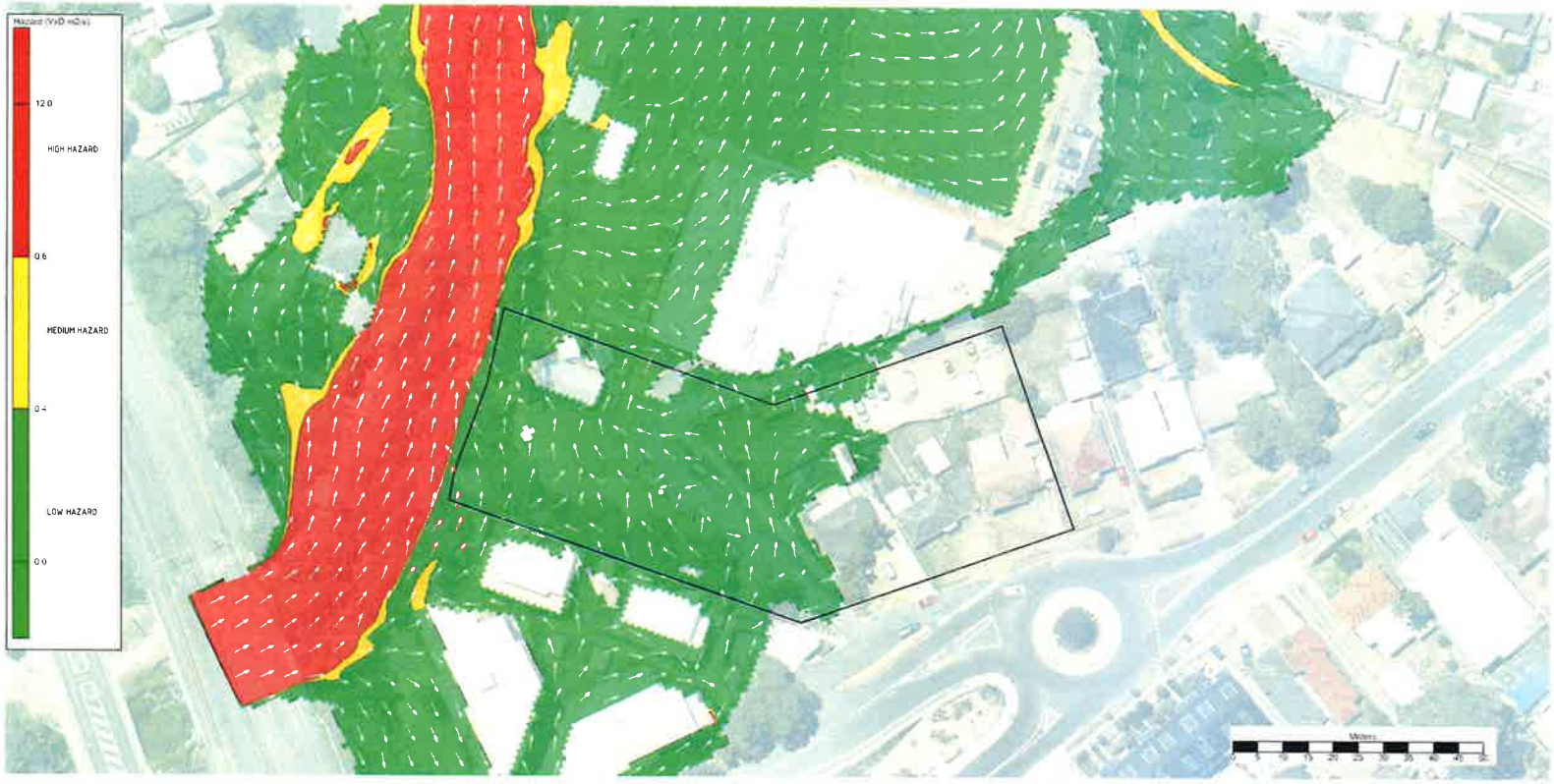
CLIENT: DPG SERVICES (OPAL AGED CARE)

PROJECT NAME/PLANSET TITLE: AGED CARE FACILITY
FLOOD ASSESSMENT
12 STATION ROAD & 4-10 WENTWORTH AVENUE, TOONGABBIE, NSW
LOT 30 DP 116299 AND LOTS 6, 7, 8 & 9 DP 22506

martens & Associates Pty Ltd
Consulting Engineers
Environment
Water
Geotechnical
Civil
Suite 201, 20 George St, Hornsby, NSW 2077 Australia Phone (02) 8476 9999 Fax (02) 8476 9767
Email mail@martens.com.au Internet www.martens.com.au

DRAWING TITLE: 1 IN 2000 YEAR ARI CRITICAL STORM DURATION
EXISTING CONDITION
WATER VELOCITY (m/s)

PROJECT NO	PLANSET NO	RELEASE NO	DRAWING NO	REVISION
P1605655	PS01	R06	PS01-K171	B



KEY

SITE BOUNDARY

NOTES:
HYDRAULIC HAZARD IS PROVIDED AS VD PRODUCT (VELOCITY X DEPTH) ON THESE MAPS.
GREEN AREAS DENOTE LOW HYDRAULIC HAZARD (VD PRODUCT - 0.4 m^2/s); YELLOW AREAS DENOTE MODERATE HYDRAULIC HAZARD (0.4 m^2/s - VD PRODUCT - 0.6 m^2/s); AND RED AREAS DENOTE HIGH HYDRAULIC HAZARD (VD PRODUCT - 0.6 m^2/s)

DEVELOPMENT APPLICATION - NOT FOR CONSTRUCTION

REV	DESCRIPTION	DATE	DRAWN	DESIGNED	CHECKED	APPRVD
B	AMENDED	14/06/2018	RK	EL	DD	TH
A	UPDATED AS PER CLIENT REQUEST	29/05/2018	RK	EL	DD	TH

SCALE
A1 (A3) 1:500 (1:1,000)
METRES

GRID	DATUM	PROJECT MANAGER
MGA	mAHD	TH

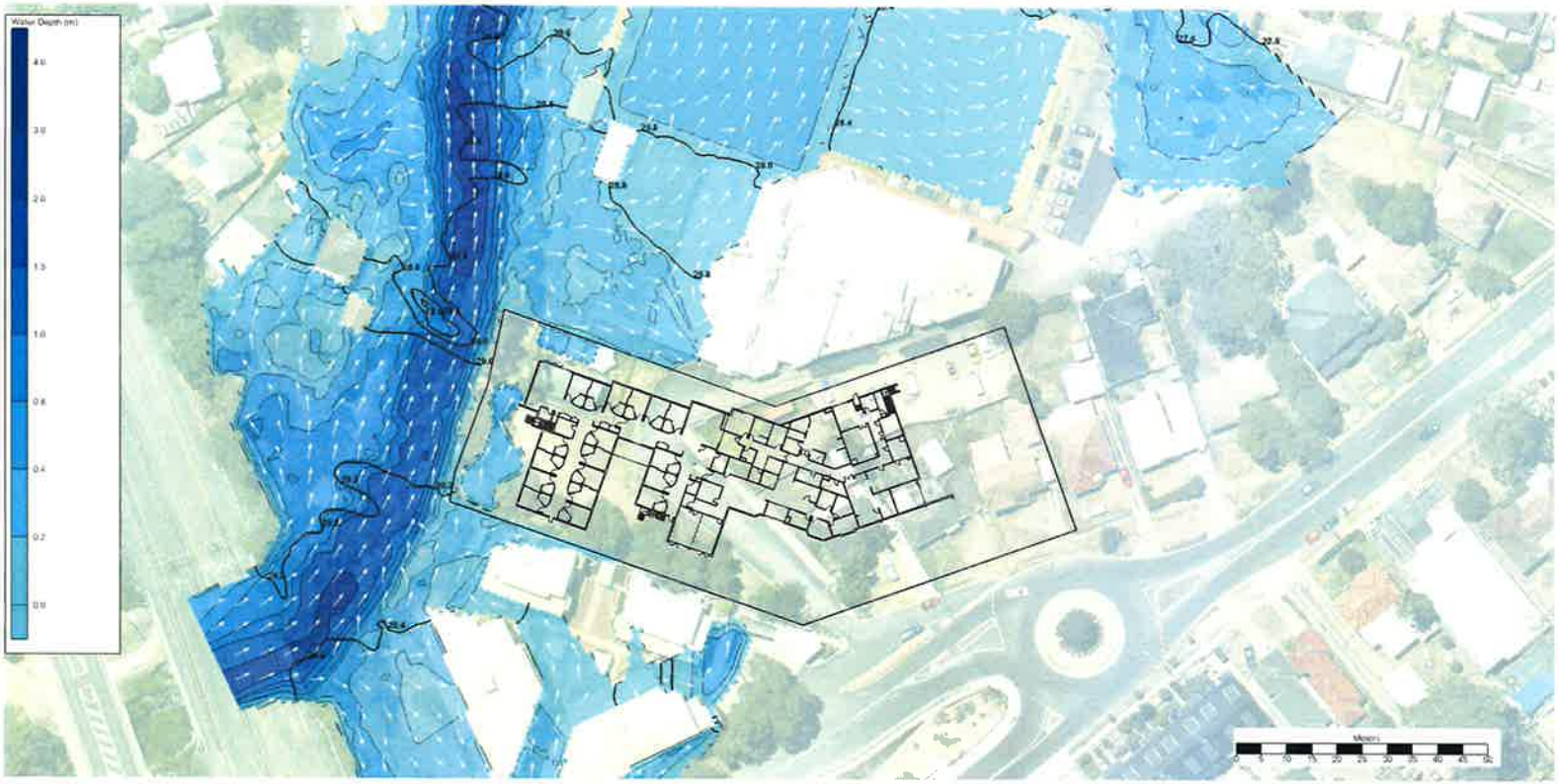
CLIENT
DPG SERVICES (OPAL AGED CARE)

PROJECT NAME/PLANSET TITLE
AGED CARE FACILITY
FLOOD ASSESSMENT
12 STATION ROAD & 4-10 WENTWORTH AVENUE, TOONGABBIE, NSW
LOT 30 DP 1186209 AND LOTS 6, 7, 8 & 9 DP 22505

martens & Associates Pty Ltd
Consulting Engineers
Environment
Water
Geotechnical
Civil
Suite 201, 20 George St, Hornsby, NSW 2077 Australia Phone: (02) 9476 9999 Fax: (02) 9476 8767
Email: mail@martens.com.au Internet: www.martens.com.au

DRAWING TITLE
1 IN 2000 YEAR ARI CRITICAL STORM DURATION
EXISTING CONDITION
VXD HYDRAULIC HAZARD (m2/s)

PROJECT NO	PLANSET NO	RELEASE NO	DRAWING NO	REVISION
P1605655	PS01	R06	PS01-K172	B



KEY

SITE BOUNDARY

PROPOSED BUILDING LAYOUT

DEVELOPMENT APPLICATION - NOT FOR CONSTRUCTION

REV	DESCRIPTION	DATE	DRAWN	DESIGNED	CHECKED	APPRVD
A	UPDATED AS PER CLIENT REQUEST	29/05/2019	RK	CL	OD	TH

SCALE: A1(A3) 1:500 (1:1,000) METRES

GRID	DATUM	PROJECT MANAGER
MGA	mAHD	TH

DISCLAIMER & COPYRIGHT

The plan must not be used for construction unless signed as approved by principal consulting authority.

All measurements in millimetres unless otherwise specified.

This drawing must not be reproduced in whole or part without prior written consent of Martens & Associates Pty Ltd.

CLIENT: DPG SERVICES (OPAL AGED CARE)

PROJECT NAME/PLANSET TITLE: AGED CARE FACILITY
FLOOD ASSESSMENT
12 STATION ROAD & 4-10 WENTWORTH AVENUE, TOONGABBIE, NSW
LOT 30 DP 1194209 AND LOTS 6, 7, 8 & 9 DP 22586

martens & Associates Pty Ltd
Consulting Engineers
Environment
Water
Geotechnical
Civil
Suite 201, 20 George St, Hornsby, NSW 2077 Australia Phone (02) 9476 9999 Fax (02) 9476 8767
Email mail@martens.com.au Internet www.martens.com.au

DRAWING TITLE: 1 IN 1000 YEAR ARI CRITICAL STORM DURATION
PROPOSED CONDITION
WATER LEVEL (mAHD) & WATER DEPTH (m)

PROJECT NO.	PLANSET NO.	RELEASE NO.	DRAWING NO.	REVISION
P1605655	PS01	R06	PS01-K260	A

KEY

SITE BOUNDARY

PROPOSED BUILDING LAYOUT

DEVELOPMENT APPLICATION - NOT FOR CONSTRUCTION

REV	DESCRIPTION	DATE	DRAWN	DESIGNED	CHECKED	APPRVD
A	UPDATED AS PER CLIENT REQUEST	29/05/2018	RK	CL	DD	TH

SCALE: A1 (A3) 1:500 (1:1000)

GRID	DATUM	PROJECT MANAGER
MGA	mAHD	TH

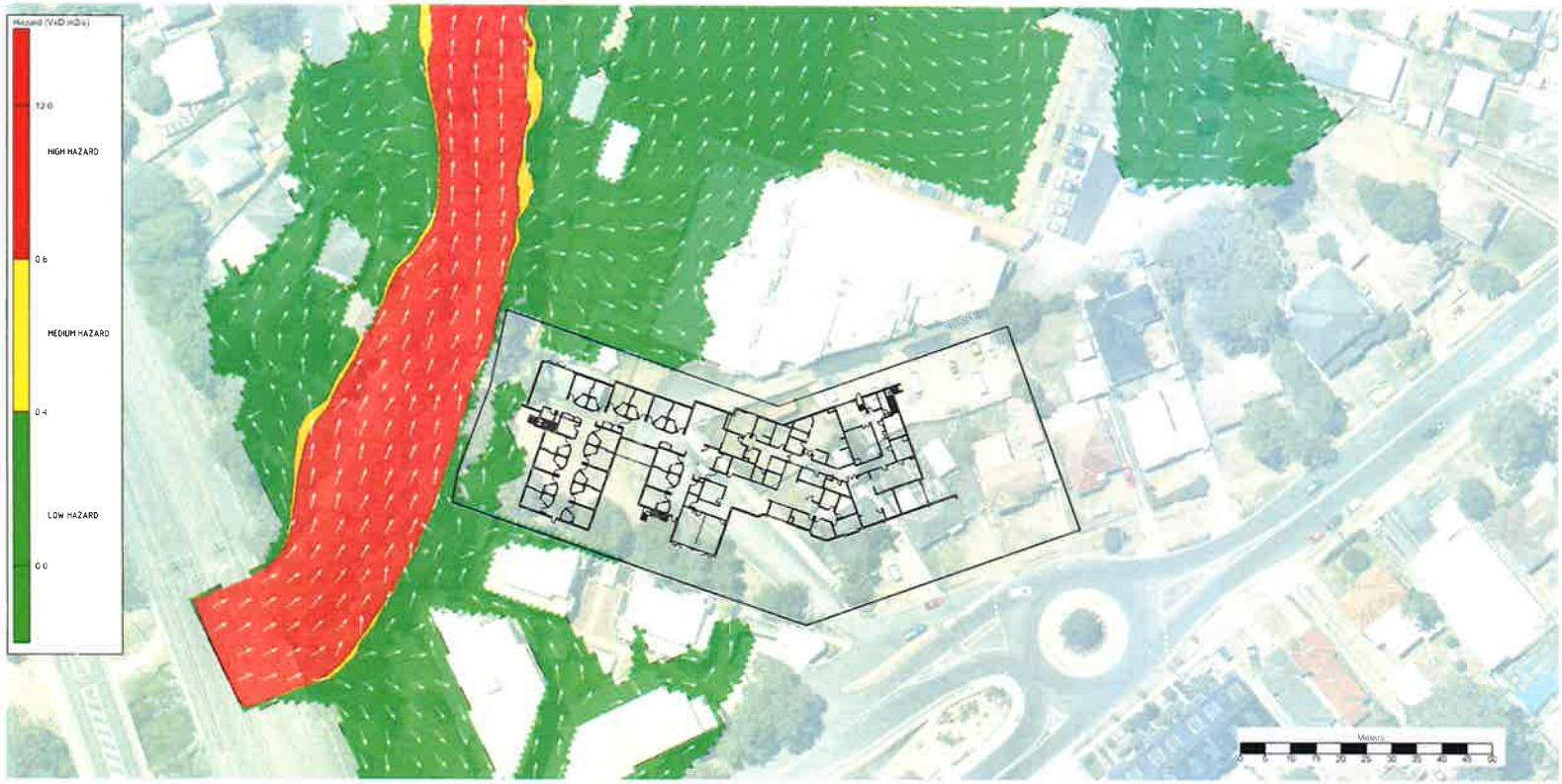
CLIENT: DPG SERVICES (OPAL AGED CARE)

PROJECT NAME/PLANSET TITLE: AGED CARE FACILITY
FLOOD ASSESSMENT
12 STATION ROAD & 4-10 WENTWORTH AVENUE, TOONGABBIE, NSW
LOT 30 DP 1106299 AND LOTS 6, 7, 8 & 9 DP 32566

martens & Associates Pty Ltd
Consulting Engineers
Environment
Water
Geotechnical
Civil
Suite 201, 20 George St, Hornsby, NSW 2077 Australia Phone: (02) 9476 9999 Fax: (02) 9476 9767
Email: mail@martens.com.au Internet: www.martens.com.au

DRAWING TITLE: 1 IN 1000 YEAR ARI CRITICAL STORM DURATION
PROPOSED CONDITION
WATER VELOCITY (m/s)

PROJECT NO	PLANSET NO	RELEASE NO	DRAWING NO	REVISION
P1605655	PS01	R06	PS01-K261	A



KEY

SITE BOUNDARY

PROPOSED BUILDING LAYOUT

NOTES:
HYDRAULIC HAZARD IS PROVIDED AS VD PRODUCT (VELOCITY X DEPTH) ON THESE MAPS.
GREEN AREAS DENOTE LOW HYDRAULIC HAZARD (VD PRODUCT = 0.4 m^2/s), YELLOW AREAS DENOTE MODERATE HYDRAULIC HAZARD (0.4 m^2/s < VD PRODUCT < 0.6 m^2/s), AND RED AREAS DENOTE HIGH HYDRAULIC HAZARD (VD PRODUCT > 0.6 m^2/s)

DEVELOPMENT APPLICATION - NOT FOR CONSTRUCTION

REV	DESCRIPTION	DATE	DRAWN	DESIGNED	CHECKED	APPRVD
A	UPDATED AS PER CLIENT REQUEST	29/05/2018	RK	CL	DD	TH

SCALE: A1(A3) 1:500 (1:1000)

GRID	DATUM	PROJECT MANAGER
MGA	mAHD	TH

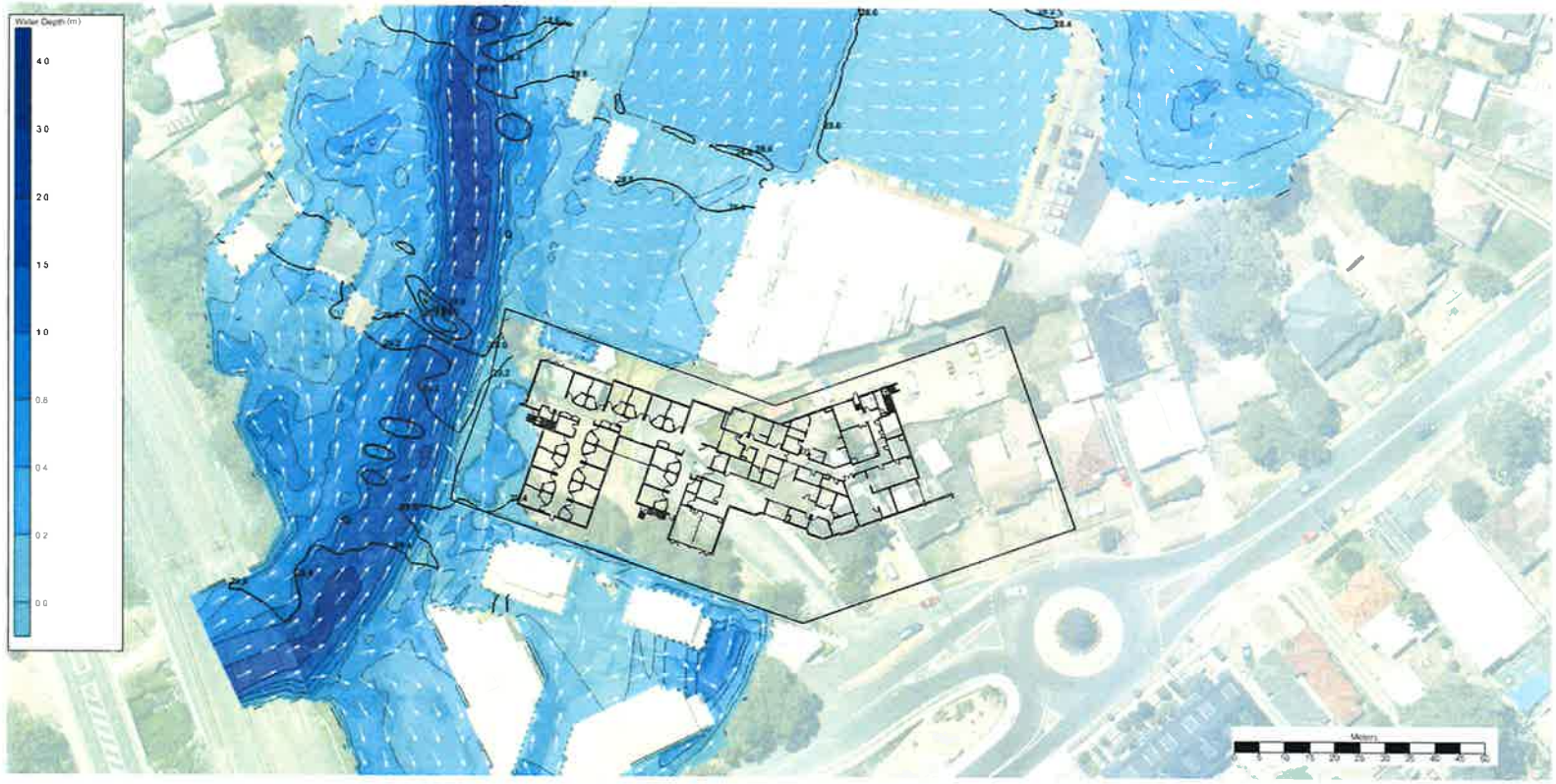
CLIENT: DPG SERVICES (OPAL AGED CARE)

PROJECT NAME/PLANSET TITLE: AGED CARE FACILITY
FLOOD ASSESSMENT
12 STATION ROAD & 4-10 WENTWORTH AVENUE, TOONGABBIE, NSW
LOT 30 DP 1106209 AND LOTS 6, 7, 8 & 9 DP 22506

martens & Associates Pty Ltd
Consulting Engineers
Environment
Water
Geotechnical
Civil
Suite 201, 20 George St, Hornsby, NSW 2077 Australia Phone (02) 8476 9999 Fax (02) 8476 8767
Email mail@martens.com.au Internet www.martens.com.au

DRAWING TITLE
1 IN 1000 YEAR ARI CRITICAL STORM DURATION
PROPOSED CONDITION
VXD HYDRAULIC HAZARD (m2/s)

PROJECT NO	PLANSET NO	RELEASE NO	DRAWING NO	REVISION
P1605655	PS01	R06	PS01-K262	A



KEY

SITE BOUNDARY

PROPOSED BUILDING LAYOUT

DEVELOPMENT APPLICATION - NOT FOR CONSTRUCTION

REV	DESCRIPTION	DATE	DRAWN	DESIGNED	CHECKED	APPRVD
A	UPDATED AS PER CLIENT REQUEST	29/05/2018	RK	CL	OD	TH

SCALE: A1 (A3) 1:500 (1:1000) METRES

GRID	DATUM	PROJECT MANAGER
MGA	mAHD	TH

CLIENT: DPG SERVICES (OPAL AGED CARE)

PROJECT NAME/PLANSET TITLE: AGED CARE FACILITY
FLOOD ASSESSMENT
12 STATION ROAD & 4-10 WENTWORTH AVENUE, TOONGABBIE, NSW
LOT 30 DP 1106209 AND LOTS 6, 7, 8 & 9 DP 22506

martens & Associates Pty Ltd
Consulting Engineers
Environment
Water
Geotechnical
Civil
Suite 201, 20 George St, Hornsby, NSW 2077 Australia Phone: (02) 9476 9999 Fax: (02) 9476 8767
Email: mail@martens.com.au Internet: www.martens.com.au

DRAWING TITLE: 1 IN 2000 YEAR ARI CRITICAL STORM DURATION
PROPOSED CONDITION
WATER LEVEL (mAHD) & WATER DEPTH (m)

PROJECT NO	PLANSET NO	RELEASE NO	DRAWING NO	REVISION
P1605655	PS01	R06	PS01-K270	A

KEY

SITE BOUNDARY

PROPOSED BUILDING LAYOUT

DEVELOPMENT APPLICATION - NOT FOR CONSTRUCTION

REV	DESCRIPTION	DATE	DRAWN	DESIGNED	CHECKED	APPRVD
A	UPDATED AS PER CLIENT REQUEST	29/05/2018	RK	CL	DD	TH

SCALE: A1(A3) 1:500 (1:1000) METRES

GRID	DATUM	PROJECT MANAGER
MGA	mAHD	TH

CLIENT: DPG SERVICES (OPAL AGED CARE)

PROJECT NAME/PLANSET TITLE: AGED CARE FACILITY
FLOOD ASSESSMENT
12 STATION ROAD & 4-18 WENTWORTH AVENUE, TOONGABBIE, NSW
LOT 30 DP 784209 AND LOTS 6, 7, 8 & 9 DP 22506

martens & Associates Pty Ltd
Consulting Engineers
Environment
Water
Geotechnical
Civil
Suite 201, 20 George St, Hornsby, NSW 2077 Australia Phone: (02) 9476 9999 Fax: (02) 9476 8767
Email: mail@martens.com.au Internet: www.martens.com.au

DRAWING TITLE: 1 IN 2000 YEAR ARI CRITICAL STORM DURATION
PROPOSED CONDITION
WATER VELOCITY (m/s)

PROJECT NO	PLANSET NO	RELEASE NO	DRAWING NO	REVISION
P1605655	PS01	R06	PS01-K271	A

KEY

SITE BOUNDARY

PROPOSED BUILDING LAYOUT

NOTES:
HYDRAULIC HAZARD IS PROVIDED AS VD PRODUCT (VELOCITY X DEPTH) ON THESE MAPS.
GREEN AREAS DENOTE LOW HYDRAULIC HAZARD (VD PRODUCT < 0.4 m^2/s), YELLOW AREAS DENOTE MODERATE HYDRAULIC HAZARD (0.4 m^2/s < VD PRODUCT < 0.6 m^2/s), AND RED AREAS DENOTE HIGH HYDRAULIC HAZARD (VD PRODUCT > 0.6 m^2/s).

DEVELOPMENT APPLICATION - NOT FOR CONSTRUCTION

REV	DESCRIPTION	DATE	DRAWN	DESIGNED	CHECKED	APPRVD
A	UPDATED AS PER CLIENT REQUEST	29/05/2018	RK	CL	DD	TH

SCALE: A1 (A3) 1:500 (1:1000) METRES

GRID: MGA | DATUM: mAHD | PROJECT MANAGER: TH

CLIENT: DPG SERVICES (OPAL AGED CARE)

PROJECT NAME/PLANSET TITLE: AGED CARE FACILITY
FLOOD ASSESSMENT
12 STATION ROAD & 4-10 WENTWORTH AVENUE, TOONGABBIE, NSW
LOT 30 DP 1196209 AND LOTS 6, 7, 8 & 9 DP 22505

martens & Associates Pty Ltd
Consulting Engineers
Environment
Water
Geotechnical
Civil
Suite 201, 20 George St, Hornsby, NSW 2077 Australia Phone: (02) 9476 9999 Fax: (02) 9476 8767
Email: mail@martens.com.au Internet: www.martens.com.au

DRAWING TITLE: 1 IN 2000 YEAR ARI CRITICAL STORM DURATION
PROPOSED CONDITION
VXD HYDRAULIC HAZARD (m2/s)

PROJECT NO	PLANSET NO	RELEASE NO	DRAWING NO	REVISION
P1605655	PS01	R06	PS01-K272	A

KEY

SITE BOUNDARY

PROPOSED BUILDING LAYOUT

NOTES:
- AREAS COLOURED WHITE REPRESENT NEGLIGIBLE CHANGE
- AREAS COLOURED YELLOW / RED REPRESENT WATER LEVEL INCREASE

DEVELOPMENT APPLICATION - NOT FOR CONSTRUCTION

REV	DESCRIPTION	DATE	DRAWN	DESIGNED	CHECKED	APPRVD
A	UPDATED AS PER CLIENT REQUEST	29/05/2018	RK	CL	DD	TH

SCALE: A1 (A3) 1:500 (1:1,000)

GRID	DATUM	PROJECT MANAGER
MGA	mAHD	TH

DISCLAIMER & COPYRIGHT

This plan must not be used for construction unless signed as approved by principal certifying authority.

All measurements in millimetres unless otherwise specified.

This drawing must not be reproduced in whole or part without prior written consent of Martens & Associates Pty Ltd.

CLIENT: DPG SERVICES (OPAL AGED CARE)

PROJECT NAME/PLANSET TITLE: AGED CARE FACILITY
FLOOD ASSESSMENT
12 STATION ROAD & 4-10 WENTWORTH AVENUE, TOONGABBIE, NSW
LOT 30 DP 1106209 AND LOTS 6, 7, 8 & 9 DP 22506

martens & Associates Pty Ltd
Consulting Engineers
Environment
Water
Geotechnical
Civil
Suite 201, 20 George St, Hornsby, NSW 2077 Australia Phone: (02) 9476 9999 Fax: (02) 9476 8767
Email: mail@martens.com.au Internet: www.martens.com.au

DRAWING TITLE: 1 IN 1000 YEAR ARI CRITICAL STORM DURATION
PROPOSED CONDITION
WATER LEVEL IMPACT (m)

PROJECT NO	PLANSET NO	RELEASE NO	DRAWING NO	REVISION
P1605655	PS01	R06	PS01-K360	A

KEY

SITE BOUNDARY

PROPOSED BUILDING LAYOUT

NOTES:
- AREAS COLOURED WHITE REPRESENT NEGLIGIBLE CHANGE
- AREAS COLOURED YELLOW / RED REPRESENT WATER LEVEL INCREASE

DEVELOPMENT APPLICATION - NOT FOR CONSTRUCTION

REV	DESCRIPTION	DATE	DRAWN	DESIGNED	CHECKED	APPRVD
A	UPDATED AS PER CLIENT REQUEST	29/05/2018	RK	CL	DD	TH

SCALE: A1 (A3) 1:500 (1:1,000) METRES

GRID	DATUM	PROJECT MANAGER
MGA	mAHD	TH

CLIENT: DPG SERVICES (OPAL AGED CARE)

PROJECT NAME/PLANSET TITLE: AGED CARE FACILITY
FLOOD ASSESSMENT

12 STATION ROAD & L-16 WENTWORTH AVENUE, TOONGABBIE, NSW
LOT 30 DP 1196209 AND LOTS 6, 7, 8 & 9 DP 22506

martens & Associates Pty Ltd
Consulting Engineers
Environment
Water
Geotechnical
Civil
Suite 201, 20 George St, Hornsby, NSW 2077 Australia Phone: (02) 9476 9999 Fax: (02) 9476 8767
Email: mail@martens.com.au Internet: www.martens.com.au

DRAWING TITLE: 1 IN 2000 YEAR ARI CRITICAL STORM DURATION
PROPOSED CONDITION
WATER LEVEL IMPACT (m)

PROJECT NO	PLANSET NO	RELEASE NO	DRAWING NO	REVISION
P1605655	PS01	R06	PS01-K370	A

ATTACHMENT D – FLOOD ISSUES SUMMARY, MOLINO STEWART (MAY 2018)

Opal Aged Care Toongabbie – Flood Issues Summary

This document summarises the flood issues associated with the proposed development of an aged care facility at 12 Station Road & 4-10 Wentworth Avenue Toongabbie.

1. Flood Affectation

1% AEP Flood - The site is beyond the reach of the 1% AEP flood extent according to flood modelling provided by City of Parramatta Council (CoPC) (Figure 1) and confirmed by two dimensional flood modelling (TUFLOW) undertaken by Martens Associates (Figure 2). The local 1% AEP flood level is 28.5m AHD.

Probable Maximum Flood – According to CoPC, the Probable Maximum Flood (PMF) reaches a level of 30.1m AHD across the site (Figure 1). This has been modelled by Martens Associates' TUFLOW model which shows flood depths of up to 1.5m on site (Figure 3) for a PMF level 0.2m higher than Council's. However, this is measured using the existing levels on site and does not fully account for the attenuating effects of adjacent buildings. The proposed development will involve bulk earthworks and civil works which will change the existing site levels. Figure 4 is the proposed ground floor plan. Key reference levels in the plan are:

- Loading Bay 29.5m AHD
- Standby Generator 30.27m AHD
- Ground Floor 30.17m AHD

Figure 5 shows the proposed finished pavement levels at the front of the building. The key levels here are:

- Drainage low points in Car Park 29.4m AHD
- Car Park entry 29.5m AHD
- Onsite Pedestrian Crossing outside Building Main Entry 30.0m AHD
- Low point on public footpath outside main entry to site 29.83m AHD

Comparing these depths to Council's adopted PMF peak level, the peak depths on site would be:

- Car Park – 0.1m-0.7m
- Onsite pedestrian crossing – 0.1m
- External footpath – less than 0.3m and flood free ground on the path is within a metre of this low point and the low point can be avoided by walking on the adjacent grass which is no lower than the onsite pedestrian crossing
- Ground Floor – This is 0.07m above the PMF peak
- Generator – this is 0.17m above the PMF peak.

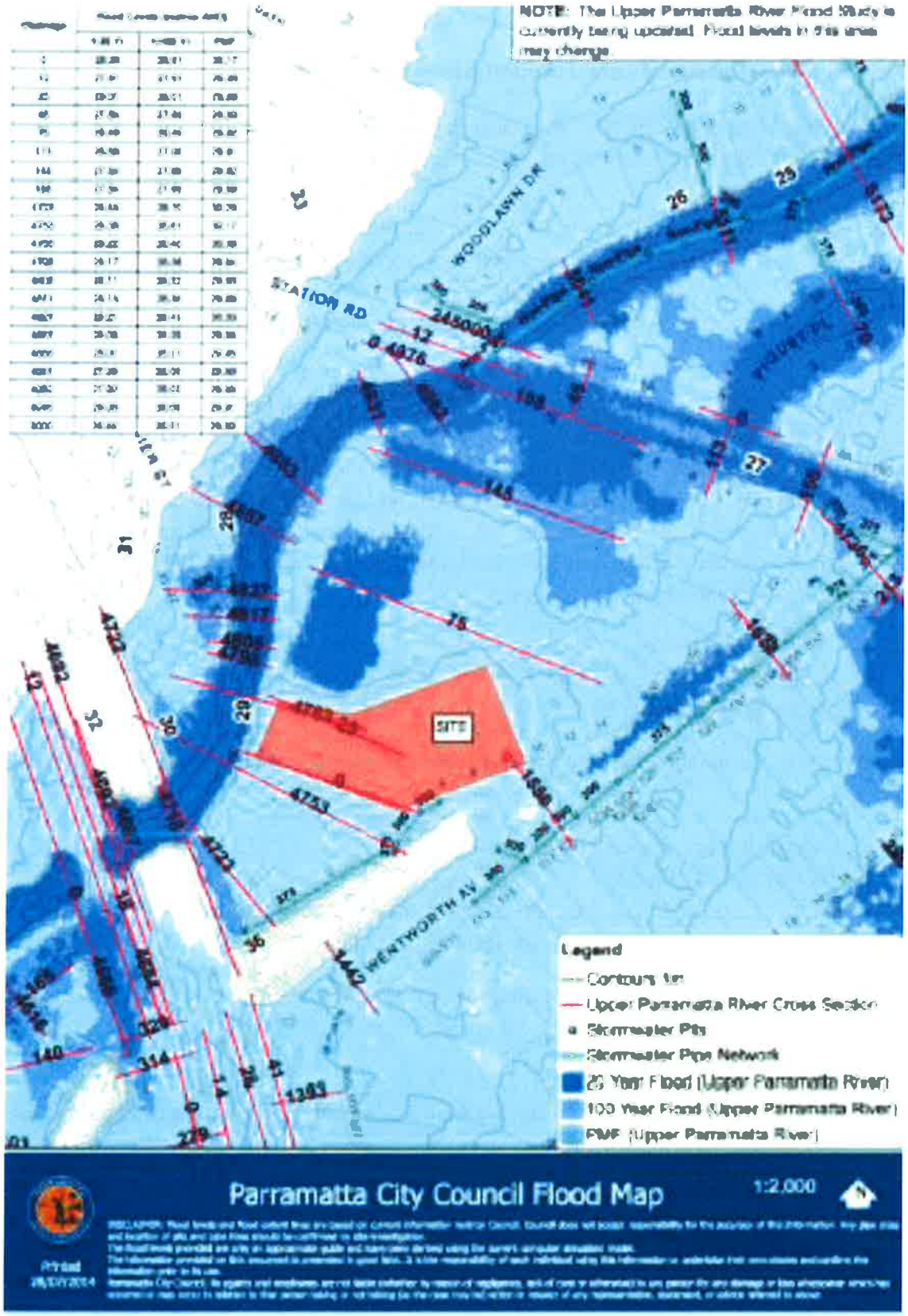


Figure 1: CoPC Flood Mapping

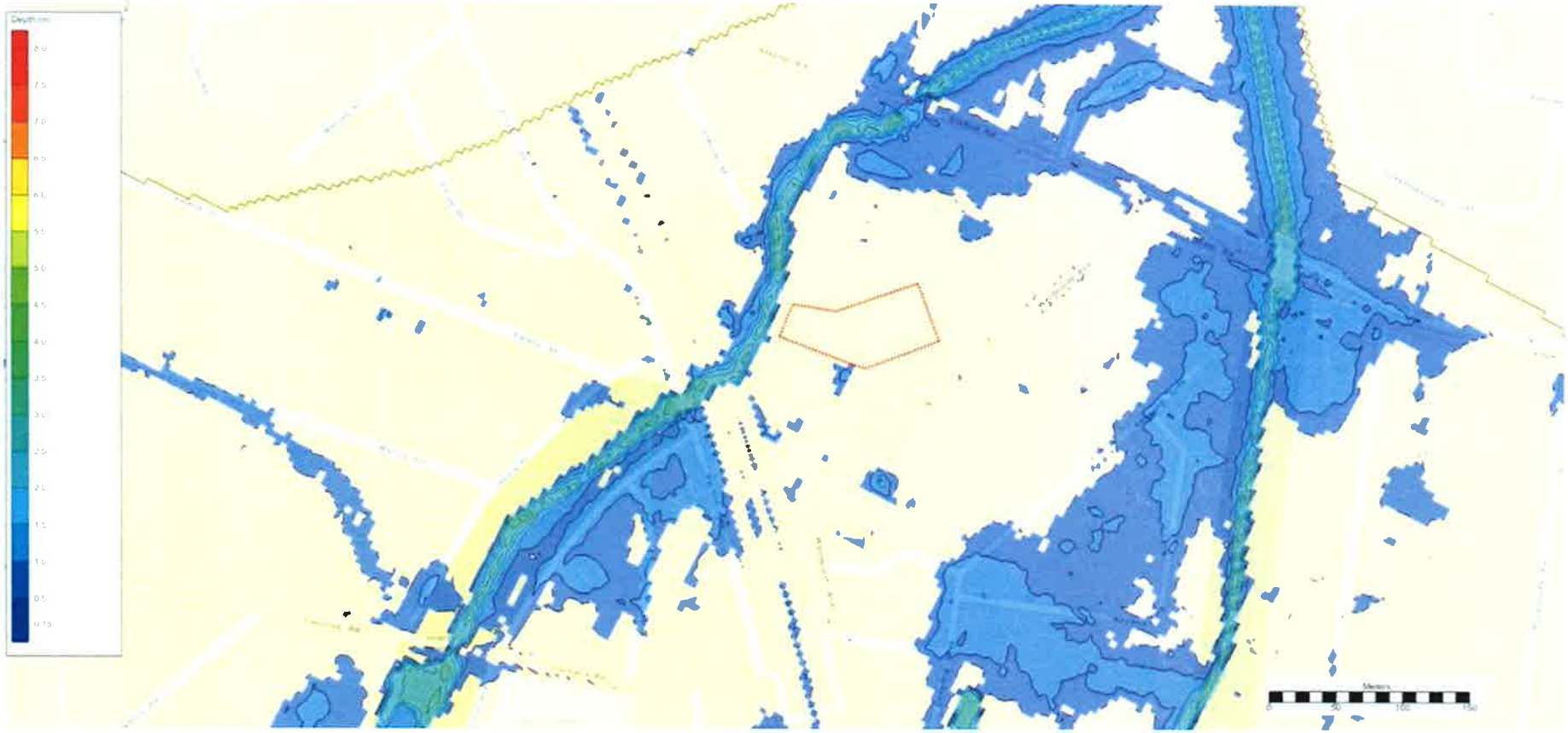


Figure 2: Martens Associates 1% AEP Flood Mapping

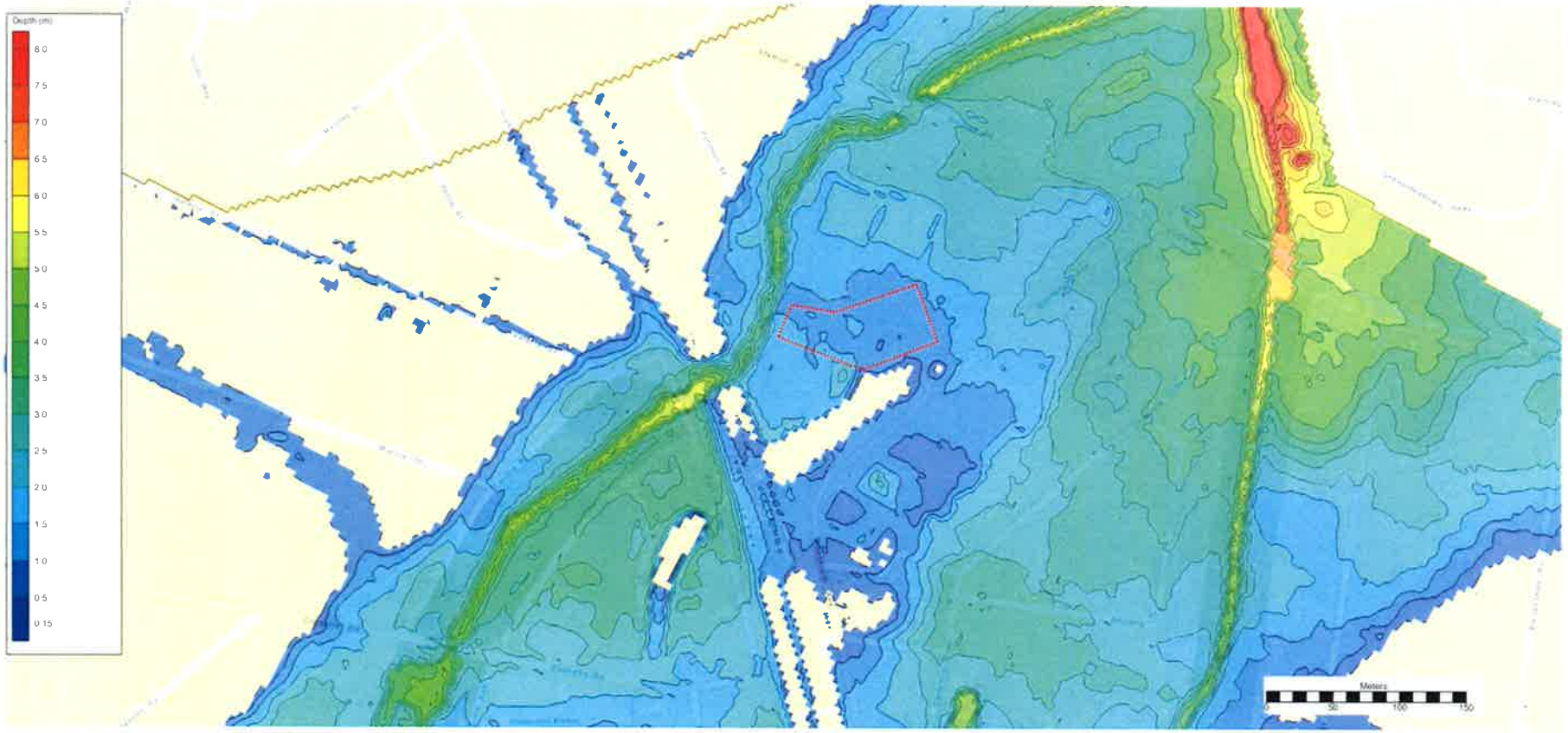


Figure 3: Martens Associates PMF Flood Depths

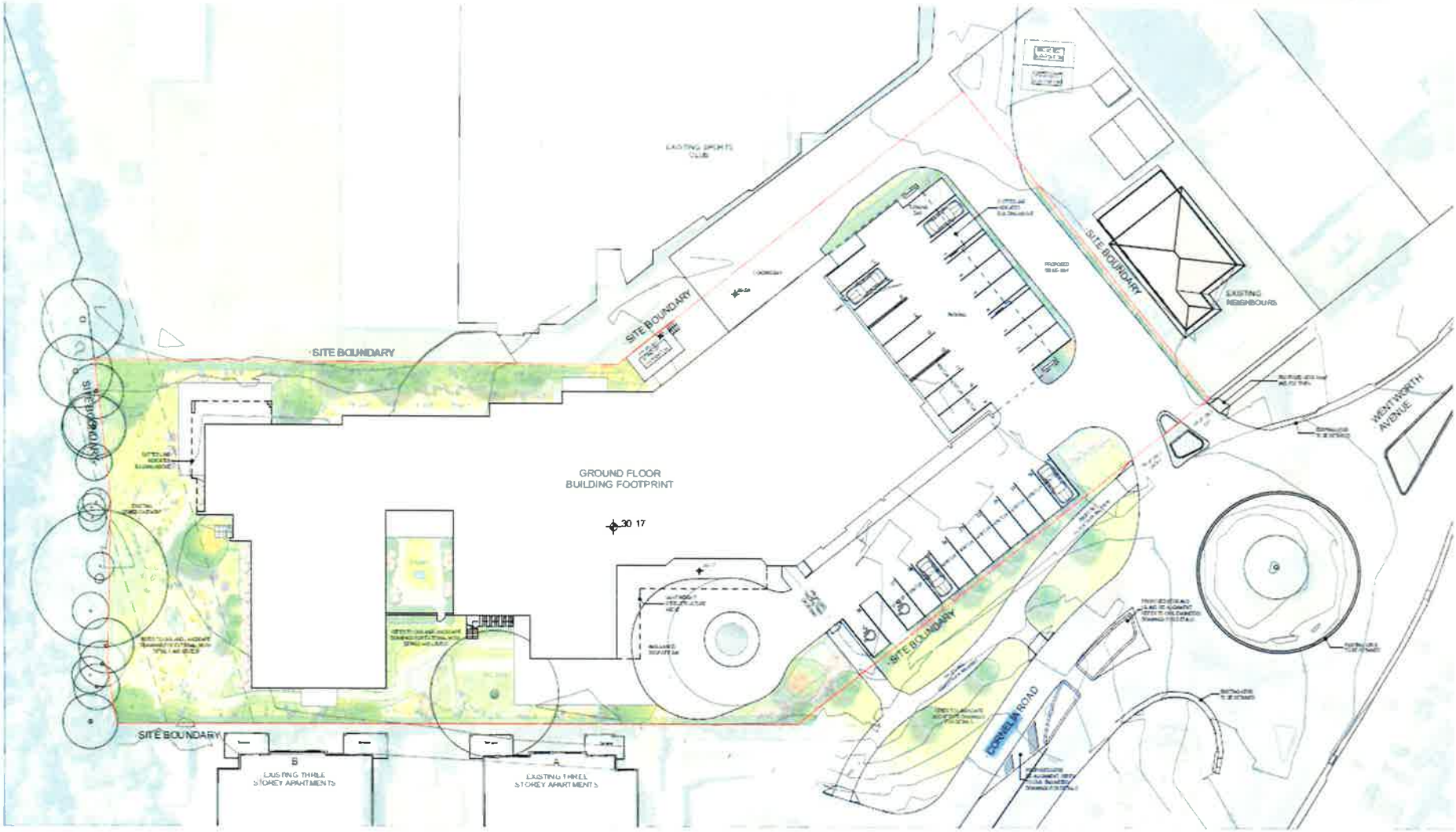


Figure 4: Ground Floor Plan

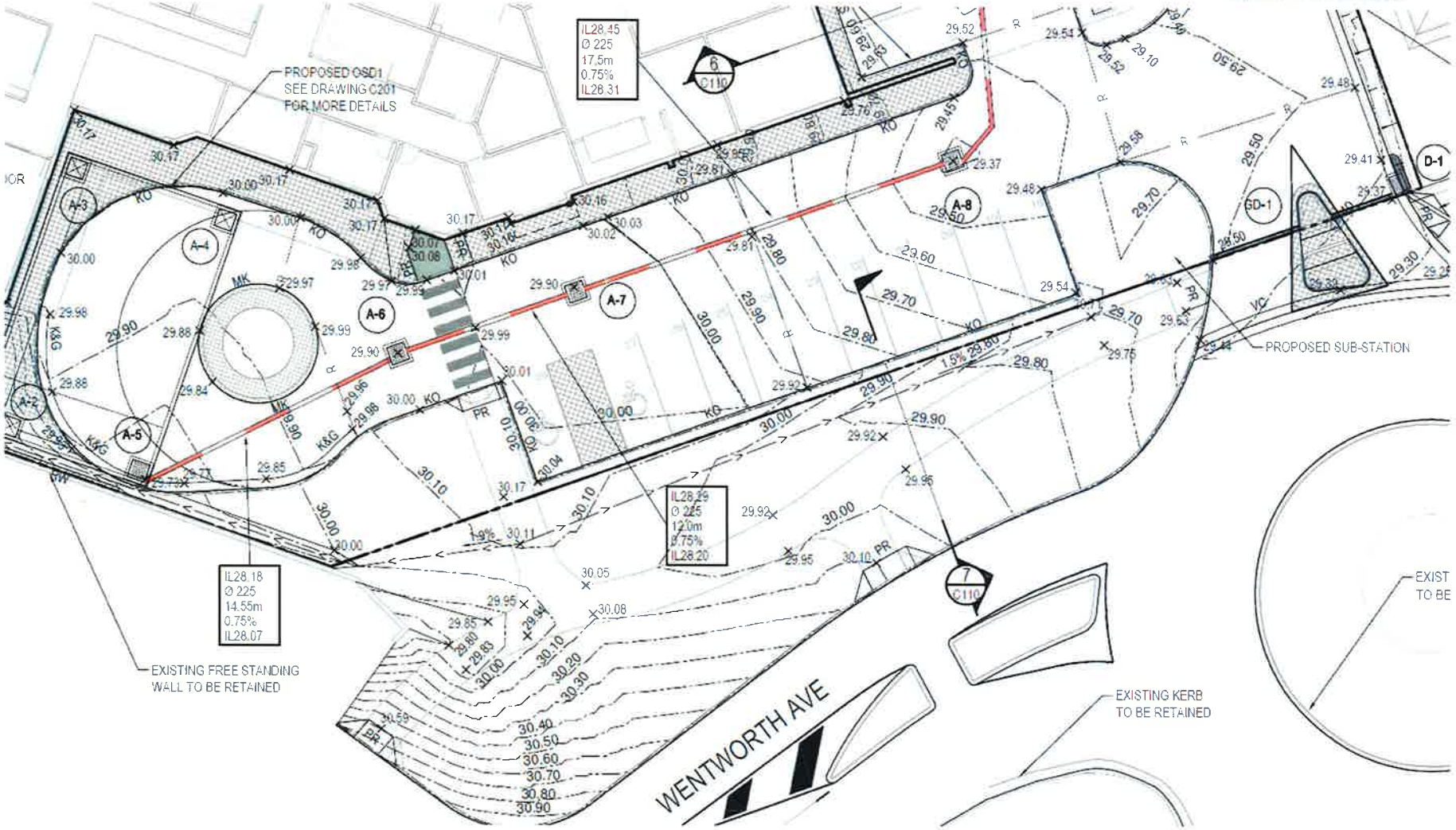


Figure 5: Finished Ground Levels

2. Blockage Considerations

At the Joint Regional Planning Panel (JRPP) presentation, CoPC's engineer raised the need to consider the potential impacts of blockage on flood levels.

Neither the model upon which the Council mapping is based, nor the Martens Associates' TUFLOW model accounts for the potential impacts of culvert blockage on flood levels on site. When considered qualitatively the following observations can be made:

- The site is about 50m downstream of the rail embankment which is immediately downstream of Portico Parade.
- The culverts under Portico Parade are particularly small and there is fencing across the top of the road crossing on both sides (Figure 6)
- It is likely that any debris from upstream of Portico Parade which can cause significant blockage would get trapped at this point by either the culverts or fencing
- Blockage at this location is likely to reduce flood levels downstream, potentially as far downstream as the site
- The next opportunity for significant blockage of culverts is where Girraween Creek passes under Station Road about 170m downstream of the site.
- Flood modelling shows that, up to the 1% AEP flood at least, the creek is mostly within bank along this reach (Figure 1) so there is little opportunity for large items to be washed in from the catchment (cars, bins etc) to cause blockage.
- Vegetation in the creek might become detached and cause blockage
- In the 1% flood, the flood level at Station Street is 27.7m AHD (Figure 1) therefore blockage at this location would have to create a 1.7m afflux at site before floodwaters started to enter the car park on site.
- Even in the 5% flood there is significant flow over the road at Station Street across a wide flow path (Figure 1) which increases considerably in extent in the 1% event. Were the culverts under Station Street to be completely blocked any afflux would be spread across a wide area and is unlikely to reach the site.

Figure 6: Portico Parade Creek Crossing

3. Potential Afflux Caused by Proposed Development

CoPC also raised within the JRPP meeting the potential for the proposed building to block flow paths and cause afflux on adjoining properties. Again this has been considered qualitatively here:

- The building is beyond the reach of the 1% flood level and therefore would not create afflux in events up to this size.
- Figure 7 shows velocity vectors for the PMF on the site and surrounding areas with the arrows providing an indication of the relative speed and direction of flows as estimated by the TUFLOW model in the absence of the proposed building.
- This shows that there is comparatively little flow through most of the site as out of channel flows through this area are strongly influenced by the close proximity of the rail and road embankments which block such flows. It is principally the western wing of the building which may affect flow patterns in the more extreme floods. More detailed flood modelling of the building and the surrounding features would be required to determine if this is likely to be significant.
- When one considers the scale of the building and the depth of flooding at that location compared to the extent of the floodplain and the depths in surrounding areas, the placement of the building in this location is unlikely to make a significant difference to flood storage in the PMF and therefore is not expected to cause significant afflux in this event through loss of flood storage. This supports the conclusion of Martens in its *Flood Impact Report* accompanying the development application (Section 4.5 of Appendix 13 to the Statement of Environmental Effects).

4. Building stability

As sheltering in place is the proposed flood response strategy it is important that the building remains structurally stable in the full range of floods. Figure 8 is the current hazard stability class diagram from Australian Rainfall and Runoff (Engineers Australia, 2017) and shows that standard buildings can be expected to be structurally stable through to hazard Category 4 and engineered buildings can tolerate flooding in hazard Category 5.

Figure 9 is a map of the product of depth and velocity for the site in a PMF, noting that the PMF levels in this model are 0.2m higher than the values adopted by Council. This shows that the depth velocity product ranges between 0.4 and 3.0 on the currently undeveloped site. This would place most of the building in hazard category 4. The highest depth velocity product occurs at the western end of the building where hazard category 5 flooding is likely.

This means that a standard house construction would remain structurally stable in the eastern part of the site but that part of the building on the western part of the site would need to be designed to withstand flood forces including hydrostatic, buoyancy and scouring from water and static and impact loads from debris.

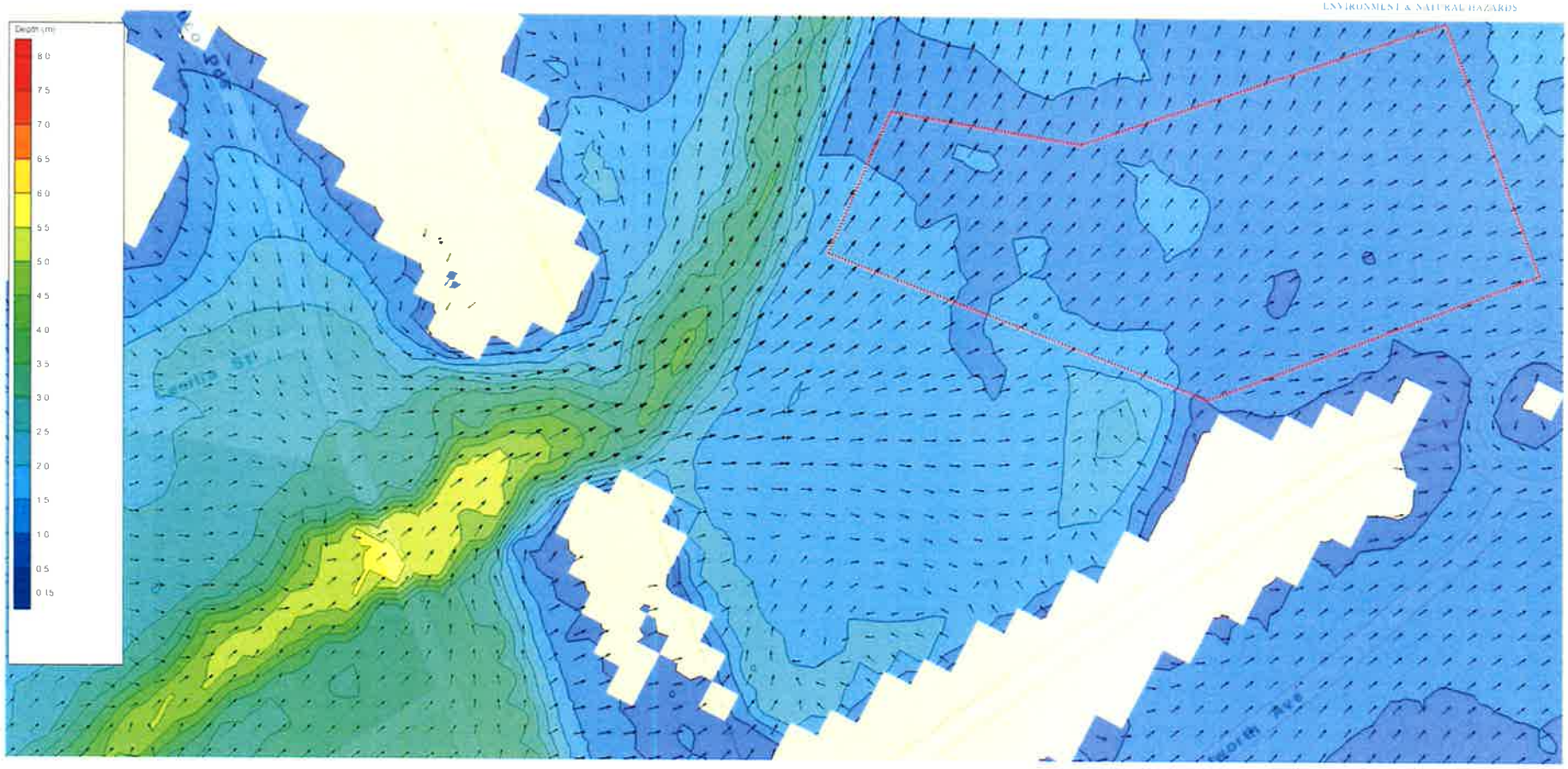


Figure 7: PMF Depth and Velocity Mapping

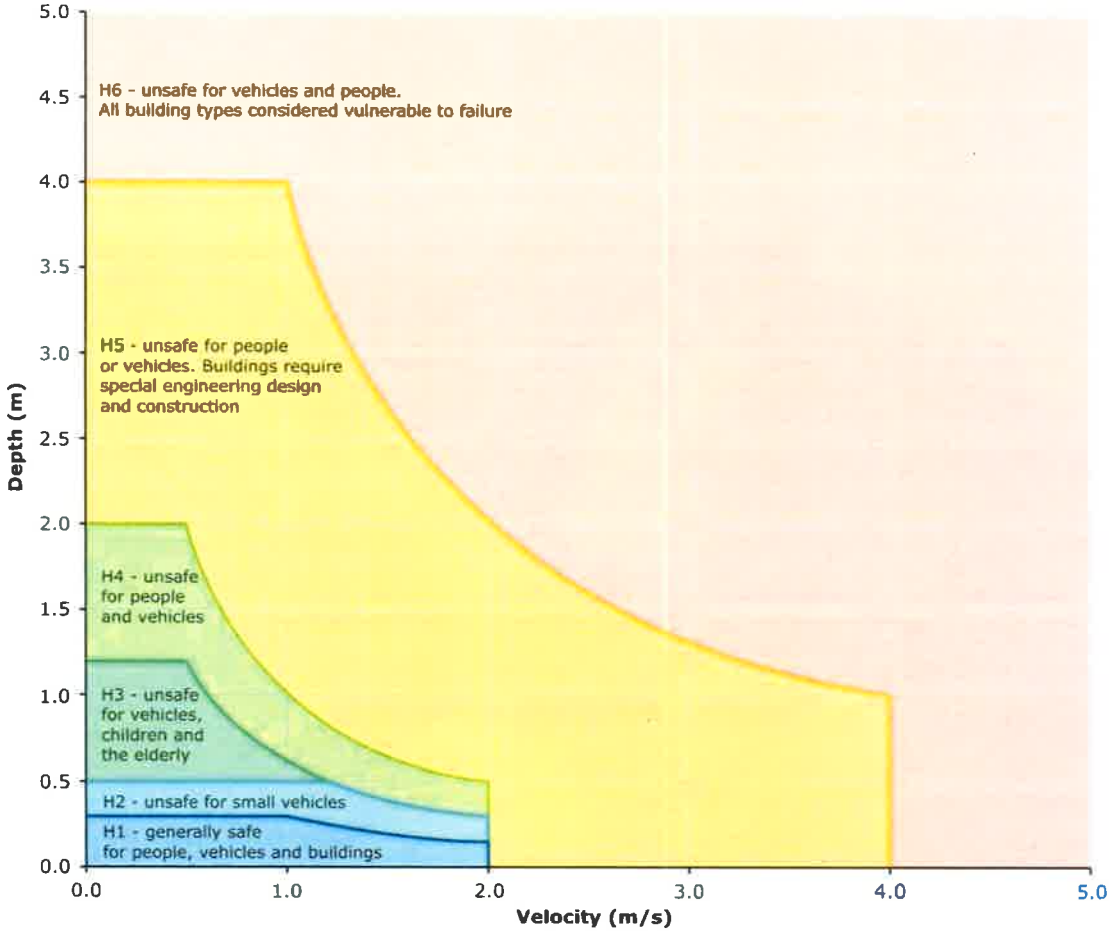


Figure 8: ARR Flood Hazard Categories (Smith et al. 2015)

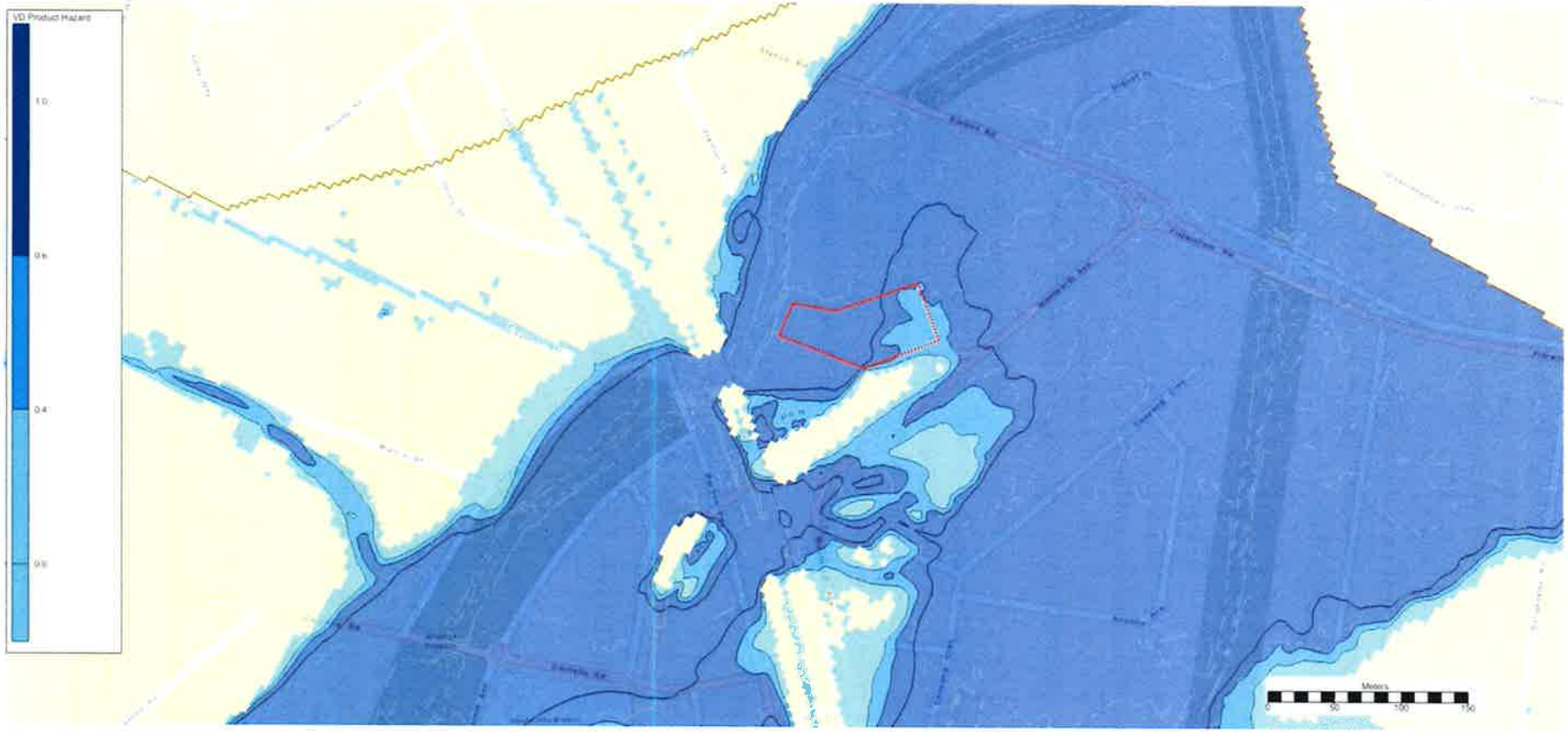


Figure 9: PMF Depth Velocity Product Mapping

The proposed development will be of concrete, steel and masonry construction with that part of the building below the PMF level being a mass concrete slab on compacted earth. There is a low probability of debris loads and impacts on the building because there is a low probability of high debris loads in this part of the floodplain.

The building itself will change flood depths and velocities in a PMF and detailed modelling will be needed to determine these, however, it is expected that the building can be designed to remain structurally stable in the full range of flood events.

5. Isolation Risks

5.1 Isolation Durations

The development sits in a very wide floodplain and would be surrounded by water in a PMF. Figure 10 shows the extent of hazardous floodwater in the 1% AEP flood. There are flood free vehicular routes from the site via the Cornelia Road overpass. This includes to the Great Western Highway via Aurelia St and to Blacktown via Cornelia Road where it crosses Girraween Creek.

The latter route provides access to and from the Seven Hills Fire Station, Blacktown Ambulance Station and Blacktown Hospital (Figure 11). The Cornelia Road crossing of Girraween Creek is the low point on this route and the TUFLOW modelling suggests that it would be cut for up to 2.5 hours in a PMF. It would be cut for less time in smaller events and not at all in the 1% AEP flood. Even when the road access is cut by flooding it is possible to walk from the building along a continuously rising route onto the Cornelia Road overpass which is flood free just several metres away from the proposed pedestrian entrance to the site.

The lowest point on this pedestrian route is the pedestrian crossing within the development's car park which would sit at RL 30.0 just 0.1m below the peak level of the PMF. It would be flooded for less than 1hr in the PMF and, as shown in Figure 8, this depth of floodwater would be safe to traverse if absolutely necessary. In other words in all levels of flooding it would be possible to safely walk from the building to a large area away from the building which is well above the reach of floodwaters.

Figure 12 shows the extent of hazardous flooding across the floodplain in the PMF. It is observed from that map that large parts of Girraween which lie between Girraween Creek and Pendle Creek but which are above the PMF level are isolated from access to emergency services in exactly the same way that the proposed development is. In other words, an aged care facility constructed above the PMF level in that part of Girraween would have exactly the same risk of isolation as the proposed development but the DCP does not require it to consider that isolation risk.

5.2 Proposed Isolation Responses

Should there be a flood then the proposed response at the facility is business as usual because:

- The lowest parts of the car park are 0.9m above the 1% flood level and 0.7m below the PMF level
- The PMF would result in water on the ground in the car park for less than 1.5hrs
- PMF hazardous flooding in the lowest levels of car park would occur for about 0.5hrs

Figure 10: 1% AEP Catchment Wide Flooding