Our Ref: 82017208-02:Letter007
Contact: Dean Nealon

16 August 2019

University of Wollongong
Facilities Management Division - Building 31
University of Wollongong
Keiraville NSW 2522

Attention: Maree Neary

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Dear Maree,

UOW FLOOD TRAINING WALL HYDRAULIC ASSESSMENT - SECTION 4.55(1A) MODIFICATION TO SSD 8569

1 Introduction

Cardno have been engaged by the University of Wollongong (UOW) as engineering consultants to undertake a flood study for the proposed flood mitigation works associated with a State Significant Development (SSD) application for the proposed Arts and Social Sciences Building (ASSB).

Consent for the ASSB has been granted (SSD 8596) with the required flood mitigation works consisting of the upgrade of the existing 1.8m diameter reinforced concrete pipe (RCP) culvert under O'Leary Road to a 3.6m x 1.8m reinforced concrete box culvert (RCBC) with upstream gabion wall and required downstream tie-in works. The purpose of the proposed culvert upgrade and associated works was to:

- Reduce the extent of the medium flood risk precinct (as defined in Wollongong City Council (WCC) Development Control Plan (DCP 2009) Chapter E13 – Floodplain Management) such that the ASSB is in a low or no flow risk precinct;

The proposed works were designed to achieve the above outcome while:

- Ensuring no detrimental impacts to adjacent properties; and
- Ensuring no increase in risk to life or property resulting from the proposed works.

Due to significant services (including a 500mm diameter water main) running underneath O'Leary Road, the upgrade of the existing culvert was not found to be a desirable solution due to significant cost and service disruption resulting from construction activities.

An alternative flood training wall at the western end of UOW's Western Carpark has been proposed as a suitable alternative to the initial culvert upgrade works. UOW is seeking to submit a Section 4.55(1A) modification to SSD 8596 with regards to this alternative design.

The purpose of this letter is to provide details of the hydraulic assessment conducted on the proposed flood training wall and demonstrate qualitative and quantitative compliance with the objectives of flood mitigations required in the consent conditions of SSD 8596. The contents of this letter demonstrates that the modified development is substantially the same as that approved under SSD 8596. This letter is an addendum to the approved Flood Report: UOW – Arts and Social Sciences Building (Cardno, February 2018) submitted as part of SSD 8596.

2 Hydraulic Assessment

2.1 Flood Modelling

Additional flood modelling has conducted as per the original submission. Please refer to Flood Report: UOW – Arts and Social Sciences Building (Cardno, February 2018) for details of:

- Methodology;
- Data and assumptions; and
- Existing case model outputs.

A post-development case assessment has been set up to include the proposed flood training wall and the ASSB footprint. For details of the proposed flood training wall design, refer to the enclosed design plans.

2.2 Floodplain Management

2.2.1 Flood Risk Precincts

WCC's DCP (2009) - Chapter E13 requires that flood prone land should be divided into three flood risk areas (refer **Table 2-1**) to determine flood planning requirements for proposed development. An updated flood risk precinct map for the flood training wall modification has been enclosed with this letter.

Results demonstrate that the proposed flood training wall is sufficient to remove the ASSB from the medium risk flood precinct and therefore the flood planning requirements for the ASSB are identical to those approve with the initial concept.

Table 2-1 Flood Risk Precincts – WCC DCP (2009)

Risk Precinct	Definition
High	The area within the envelope of land subject to a high provisional hydraulic hazard in a 100 year flood event plus all land within 10m from the top of the creek bank.
Medium	Land below the 100 year flood level (plus 500mm freeboard) that is not within the High Flood Risk precinct.
Low	All other land within the floodplain (i.e. the extent of the PMF) but not defined within either the High or Medium Flood Risk precincts.

2.2.2 Flood Affectation

Changes in flood elevations in the 100 year ARI and PMF storm events as a result of the proposed works were assessed and flood impacts maps have been enclosed with this letter.

Results demonstrate no detrimental impacts in the 100 year ARI or PMF Events. In consideration that there are no meaningful effects to floodplain behaviour as the result of the proposed development, it can also be concluded that there are no increase in risk to life or property as a result of this proposal.

3 Compliance with SSD 8596

3.1 Demonstration of Qualitative and Quantitative Compliance

A Section 4.55(1A) modification to a SSD requires that qualitative and quantitative compliance with the objectives and outcomes of the approved SSD. The outcomes of the proposed flood training wall are assessed against the objectives and outcomes of the initial culvert design in **Table 3-1** below. It is clear that the replacement of the culvert upgrade with the proposed flood training wall meets all of the objectives and outcomes of SSD 8596 both qualitatively and quantitatively.

It is also noted that modification from the culvert upgrade option to the proposed flood training wall results in the removal of works from public land (i.e. O'Leary Road road reserve) and no longer impacts upon major service provision including the 500mm raw water main under O'Leary Road.

Table 3-1 Comparison of the Approved Culvert Upgrade Works and the Proposed Flood Training Wall

Objective/Outcome	Culvert Upgrade	Proposed Flood Training Wall	Qualitative and Quantitative Compliance
Remove the ASSB from the medium risk flood precinct	Achieved	Achieved	Yes
No detrimental impacts	Achieved	Achieved	Yes
No increase in risk to life or property	Achieved	Achieved	Yes

3.2 Recommendations Regarding Consent Conditions of SSD 8596

The following recommendation are made with regarding the stormwater and flooding related consent conditions of SSD 8596:

Table 3-2 Recommendation Regarding the Consent Conditions of SSD 8596

No.	Condition	Recommendation
A2.d)	The development may only be carried out in accordance with the approved plans […] below: • 8201720801-001 SK005 Rev2 – Culvert Layout Plan (05.02.18) • 8201720801-001 SK006 Rev1 – Long Section (15.01.18) • 8201720801-001 SK007 Rev1 – Cross Section (15.01.18) • 8201720801-001 SK008 Rev1 – Typical Details (15.01.18)	Cardno recommends that this condition be changed to reference the enclosed plans.
B17	Final drainage design plans of the stormwater drainage management system must be prepared by a suitably qualified engineer generally in accordance with the requirements of Chapter E14 of Council's Development Control Plan 2009. The drainage design plans must be submitted to the certifying authority prior to the commencement of works. The design of the development is to ensure there are no adverse effects adjoining properties or upon the land as a result of flood or stormwater run-off.	Cardno recommends that this condition be retained. The assessment conducted as part of the proposed modification demonstrates that there are no adverse effects adjoining properties or upon the land as a result of flood or stormwater run-off.
B18	Overflow paths must be provided to allow for flows of water in excess of the capacity of the pipe/drainage system draining the land, as well as from any detention storage on the land. Blocked pipe situations	Cardno recommends that this condition be retained.

No.	Condition	Recommendation
	with 1 in 100 year ARI events should be incorporated into the design (in accordance with Wollongong City Council – Review of Conduit Blockage Policy Summary Report, June 2016). Overflow paths should also be provided in low points and depressions. This requirement is to be reflected on final plans submitted to the certifying authority prior to commencement of works.	Pipe blockages on the proposed culvert have been included in the hydraulic assessment in accordance with Wollongong City Council – Review of Conduit Blockage Policy Summary Report, June 2016. A dish-drain has been provided on the upstream side of the flood training wall to ensure all flows upstream of the wall are returned to the watercourse and flood modelling has confirmed that the flood training wall is sufficient to return all flows to the watercourse in all events up to and including the 100 year ARI.
B19	Habitable flood levels of the education building should be constructed at a minimum of the adjacent 100 year flood level as determined by a suitable qualified civil engineer plus 0.5m freeboard. This requirement is to be reflected on final plans submitted to the certifying authority prior to the commencement of works	Cardno recommends that this condition be retained. The proposed Arts and Social Sciences Building is outside of the medium risk flood precinct extents (100 year ARI + 500mm freeboard) and as a result minimum flood levels are not required.
B20	Any portion of the building or structure below the adjacent 100-year flood level as determined by a suitably qualified civil engineer plus 0.5 m freeboard should be built from flood compatible materials. Where materials are proposed and not listed in Appendix B of Chapter E13 of the Wollongong DCP 2009, relevant documentation from the manufacturer should be provided demonstrating that the materials satisfy the definition of 'flood compatible materials' as stated in Chapter E13 of the Wollongong DCP 2009. These requirements are to be reflected on final plans submitted to the certifying authority prior to commencement of works.	Cardno recommends that this condition be retained. The proposed Arts and Social Sciences Building is outside of the medium risk flood precinct extents (100 year ARI + 500mm freeboard) and as a result flood compatible materials are not required.
B21	A design report from a suitably qualified and experienced structural engineer is to be submitted to the certifying authority prior to commencement of works. This design report is to explain the design features to be adopted in the construction of the proposed development such that a structural certification can be issued by the engineer at the completion of the works, in accordance with this consent. The structural certification is required to verify that the development can withstand the forces of floodwater, debris and buoyancy up to and including the adjacent 100 year flood level as determined by a suitably qualified civil engineer plus 0.5m freeboard,	Cardno recommends that this condition be retained. The proposed Arts and Social Sciences Building is outside of the medium risk flood precinct extents (100 year ARI + 500mm freeboard) and as a result structural certification for ability to withstand the forces of floodwater, debris and buoyancy are not required.

Yours sincerely,

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Reviewed by,

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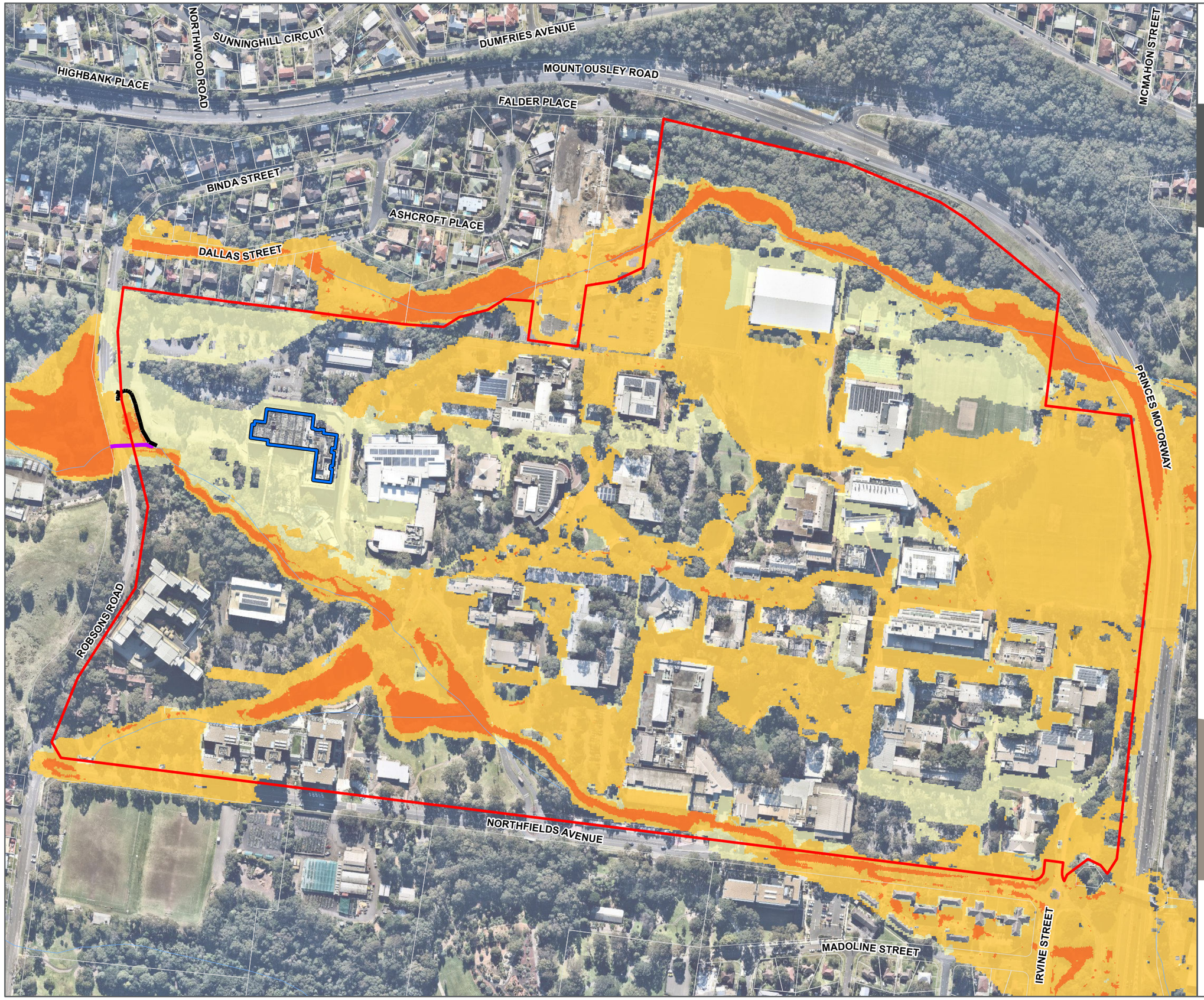
Enc: Flood Maps
Flood Training Wall Design Plans



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Flood Risk Precinct Developed (Flood Training Wall)

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Legend

- Site Boundary
- Existing Culvert
- Watercourse (LPI)
- Proposed Flood Training Wall
- ASSB Footprint
- Cadastre (DFSI-SS, 2017)

Flood Risk Precinct

- Low
- Medium
- High

1:3,500 Scale at A3

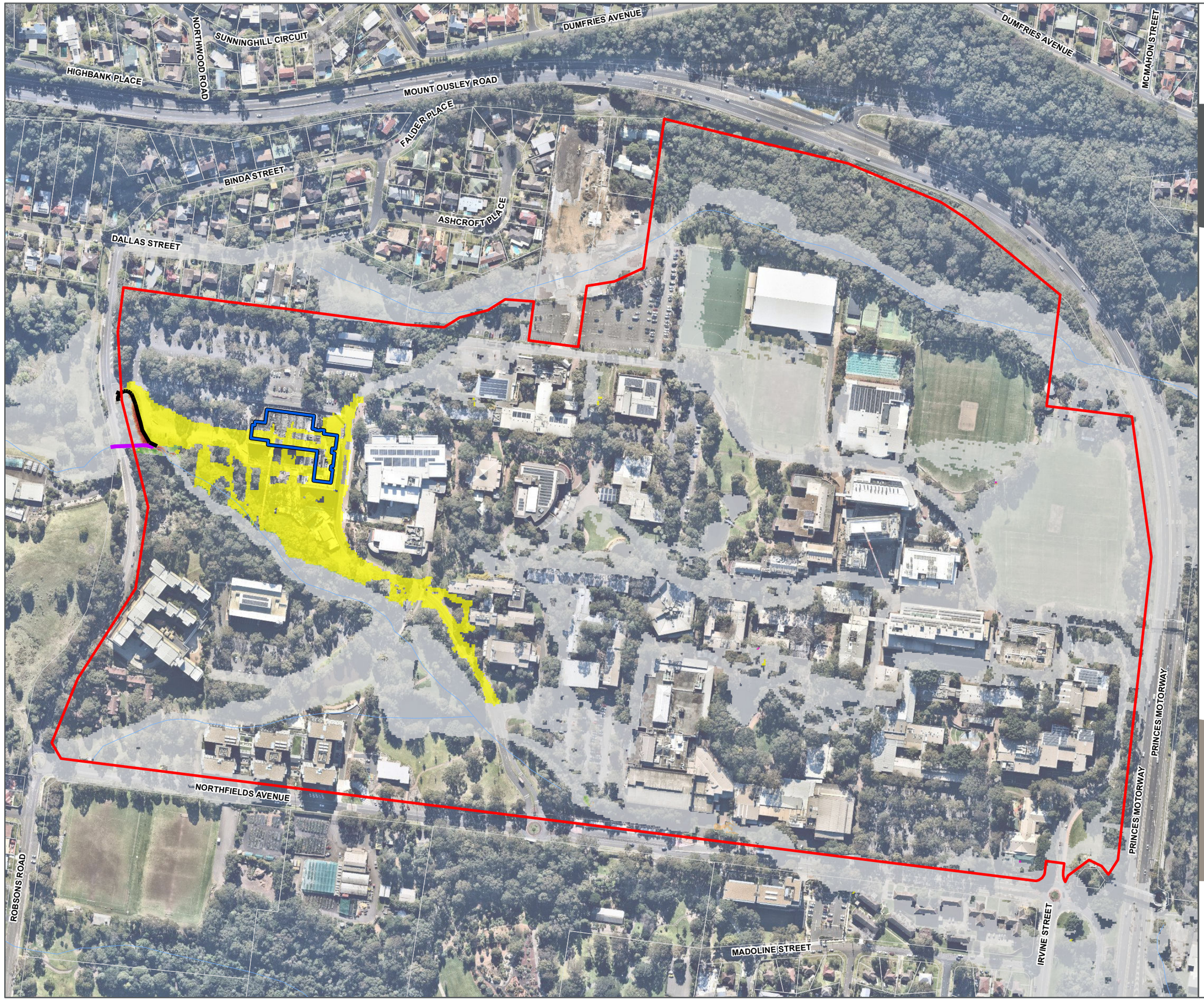
Metres

0 50 100 150 200

N

Cardno

Map Produced by Cardno NSW/ACT Pty Ltd (WOL)
Date: 2019-08-16 | Project: 82017208_01
Coordinate System: GDA 1994 MGA Zone 56
Map: 82017208-01-GS-018-DevFRP_TrainingWall.mxd 01
Aerial imagery supplied by Nearmap (July, 2019)



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Flood Impacts 100 Year ARI (Flood Training Wall)

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Legend

- Site Boundary
- Existing Culvert
- Watercourse (LPI)
- Proposed Flood Training Wall
- ASSB Footprint
- Cadastre (DFSI-SS, 2017)

Change in Flood Levels (m)

- Was Wet Now Dry
- < -0.5
- -0.5 to -0.2
- -0.2 to -0.1
- -0.1 to -0.05
- -0.05 to -0.02
- -0.02 to 0.02
- 0.02 to 0.05
- 0.05 to 0.1
- 0.1 to 0.2
- 0.2 to 0.5
- > 0.5
- Was Dry Now Wet

1:3,500 Scale at A3

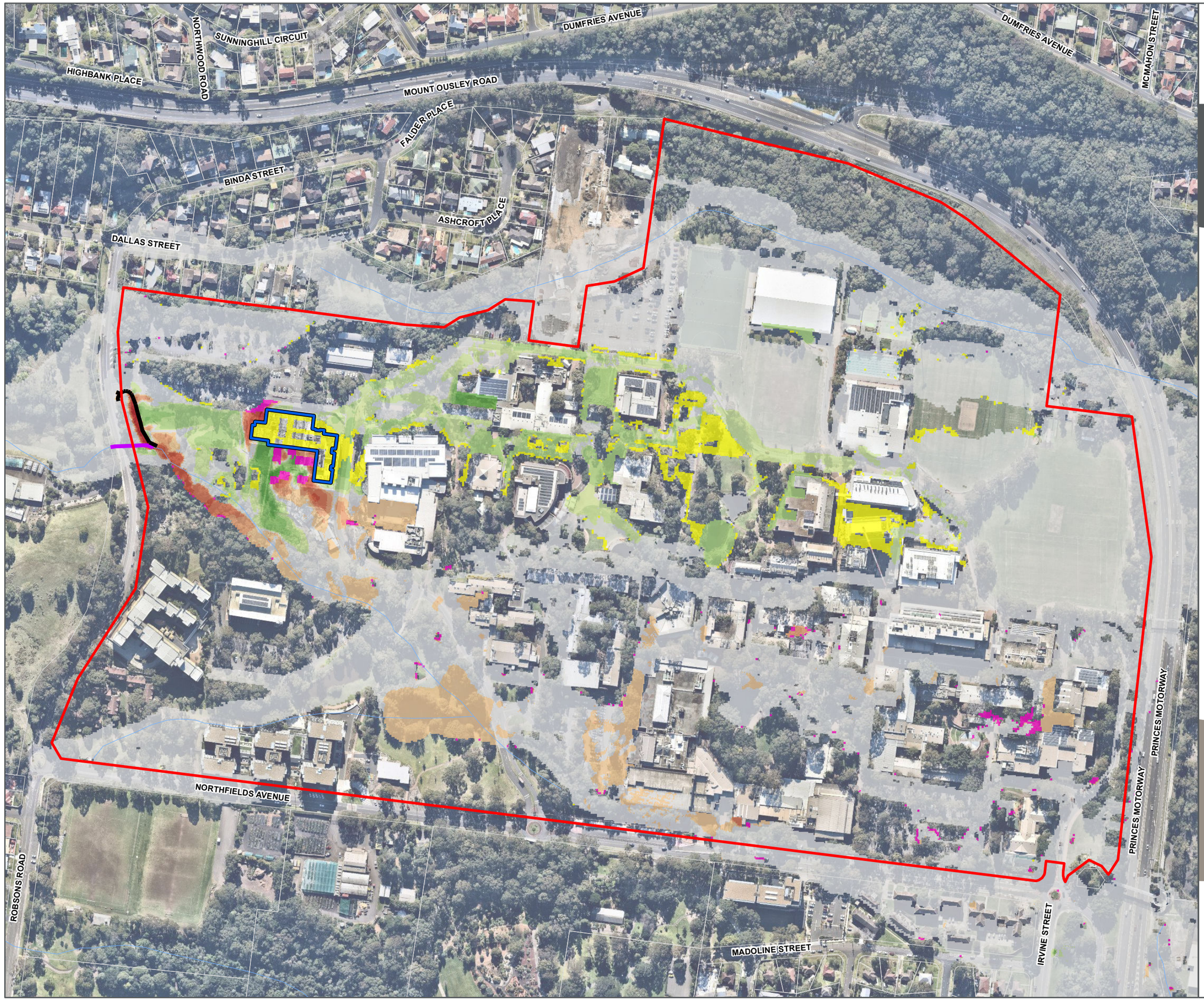
Metres

0 50 100 150 200

N

Cardno

Map Produced by Cardno NSW/ACT Pty Ltd (WOL)
Date: 2019-08-16 | Project: 82017208-01
Coordinate System: GDA 1994 MGA Zone 56
Map: 82017208-01-GS-019-Impacts100y_TrainingWall.mxd 01
Aerial imagery supplied by nearmap (July, 2019)



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Flood Impacts PMF (Flood Training Wall)

UNIVERSITY OF WOLLONGONG

Legend

- Site Boundary
- Existing Culvert
- Watercourse (LPI)
- Proposed Flood Training Wall
- ASSB Footprint
- Cadastre (DFSI-SS, 2017)

Change in Flood Levels (m)

- Was Wet Now Dry
- < -0.5
- -0.5 to -0.2
- -0.2 to -0.1
- -0.1 to -0.05
- -0.05 to -0.02
- -0.02 to 0.02
- 0.02 to 0.05
- 0.05 to 0.1
- 0.1 to 0.2
- 0.2 to 0.5
- > 0.5
- Was Dry Now Wet

1:3,500 Scale at A3

Metres

0 50 100 150 200

N

Cardno

Map Produced by Cardno NSW/ACT Pty Ltd (WOL)
Date: 2019-08-16 | Project: 82017208-01
Coordinate System: GDA 1994 MGA Zone 56
Map: 82017208-01-GS-020-ImpactsPMF_TrainingWall.mxd 01
Aerial imagery supplied by nearmap (July, 2019)