Bonacci Group Pty Ltd
Level 6, 37 York Street
SYDNEY NSW 2000

18/12/2017

Dear Mr John Williams,

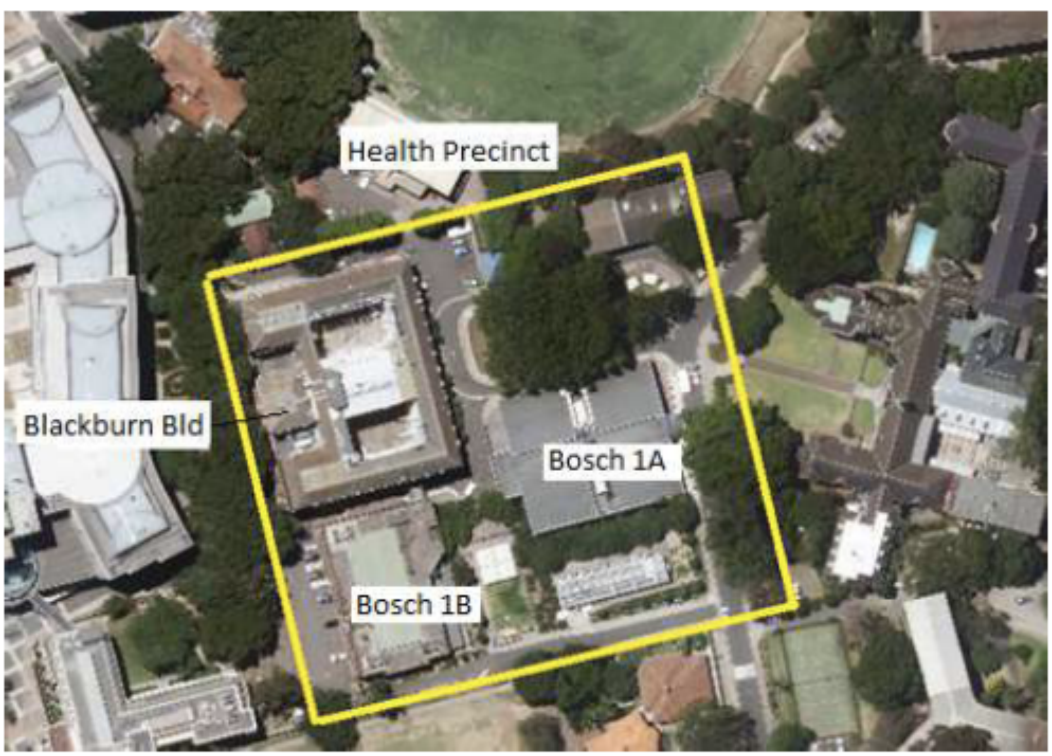
Re: Stage 1 Development – University of Sydney Health Precinct

This letter provides advice, supported by hydraulic flood modelling results, on how the proposed Stage 1 works at the above referenced location, impact on existing flood risk.

BACKGROUND

The proposed Stage 1 works are defined in Bonacci's report of 21 September 2017. Broadly they consist of demolishing the existing Blackburn Building and the construction of a new structure. Image 1 below, taken from Bonacci's 2017 report, defines the subject site.

Image 1: Study Area



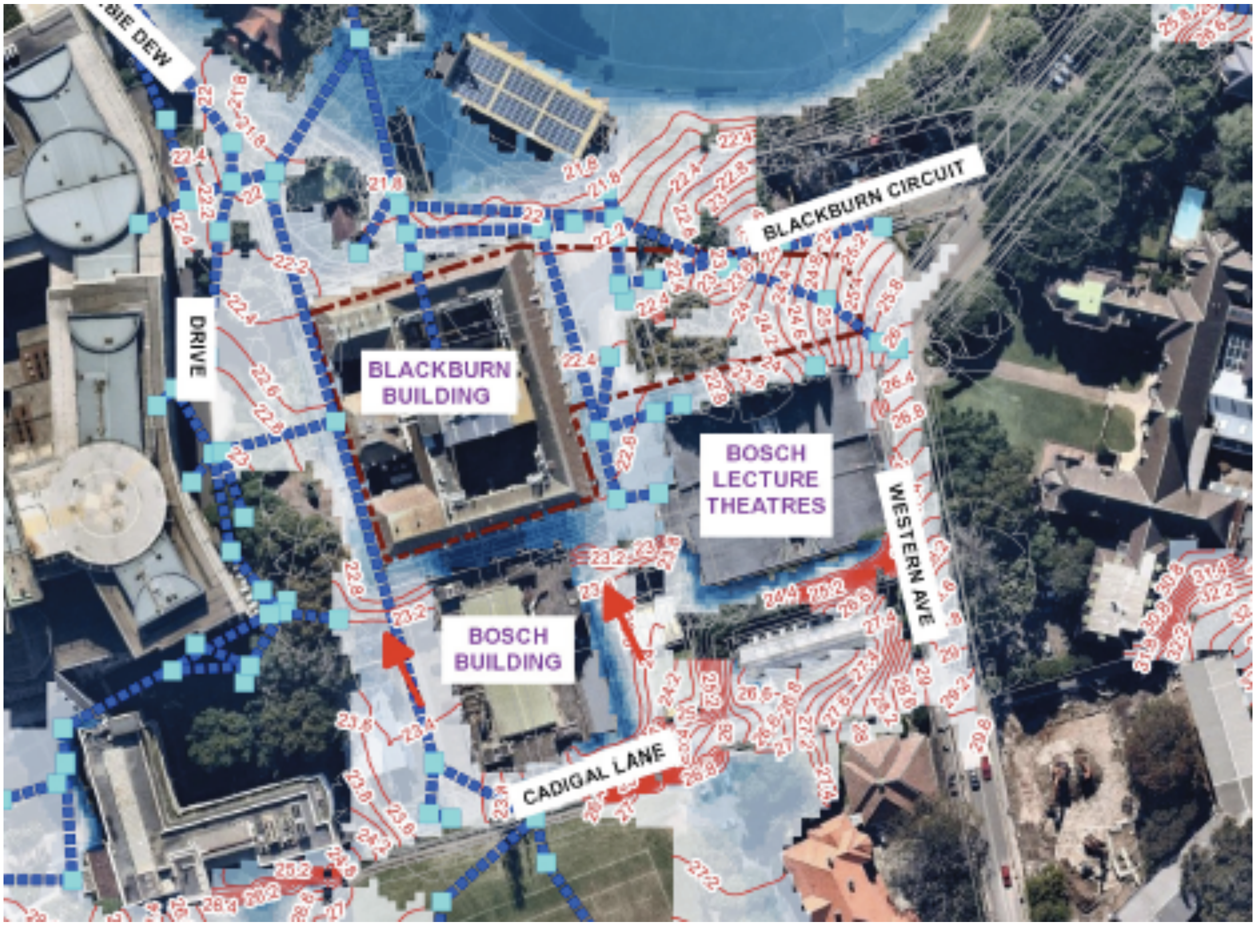
Stephen Gray
Director
gray@grchydro.com.au
0413 631 447

Zac Richards
Director
richards@grchydro.com.au
0432 477 036

GRC Hydro
ABN: 71 617 368 331
www.grchydro.com.au

Image 2 below describes the existing flood affectation at the site and also indicates the extent of the proposed building (see maroon dashed extent).

Image 2: Excerpt from Figure 1 of Bonacci (2017) – Existing flood levels for the 1% AEP event plus proposed development extent outline.



Significant previous flood work has been carried out at the site. Issues this work identified which provide context for reporting herein are:

- Overall Health Precinct is impacted by flow of ~ 7 m^3/s (combined) in the 1% AEP event;
- This flow runs to the north through the site and runs onto the area adjacent and west of the subject site which is land owned by the adjacent RPA;
- Development in the area, unless sensitive to flooding issues or incorporating significant flood mitigation works, will tend to cause flood impacts;
- Both Oval 1 and downstream locations off campus (Sparkes Street) will tend to be impacted as these are both volume sensitive locations; and finally
- Previously CIS put a Masterplan together for the overall Campus Improvement Program (CIP). The Masterplan sought to make the provision of OSD communal rather than making it building specific. This Masterplan was endorsed by consent authorities (City of Sydney and Sydney Water). A part of this Masterplan was the provision of storage at Hockey Square in order to offset impacts associated with Health Precinct development.

Bonacci's 21 September 2017 report put forward a proposed design of flood mitigation works that would work with the Stage 1 development to achieve compliance with consent authority flood requirements. The chief feature of the proposal is a 1,600 m^3 storage (at grade), that is integrated into the proposed new building.

Bonacci's report (2017) was reviewed by CIS at a meeting that occurred on October 12th 2017. At this meeting various suggestions were made regarding required amendments. Following on from this meeting GRC Hydro were engaged by Bonacci to carry out several of the required amendments.

Following this work, on December 11th a further meeting was held at which those issues raised in the meeting of October 12th but not yet addressed were discussed. At this meeting several key items of flood risk for the University were identified by CIS. Also a deadline for provision of information in regard to these risk items was specified, this being December 18th.

Subsequently GRC Hydro were engaged to address specific flood risk items as follows:

- Flood impact for downstream volume sensitive locations;
- Flood storage calculations (net loss/gain);
- Flood hazard mapping;
- Blockage scenarios to investigate worst case hazard; and
- Feedback for CIS on design freeboard for the storage obvert (which is the underside of the ground floor of the proposed building).

INTRODUCTION

The work scope then is as follows:

- Assess impact for the 1% AEP nine hour event and examine downstream impact off campus (ensures consistency of development with Masterplan);
- Assess net floodplain storage change (ensures consistency with Masterplan);
- Carry out an assessment of the impact of proposed storage inlet/outlet blockage on design flood levels at the site – compare design levels to structure obvert to ensure preservation of required freeboards; and
- Carry out hazard mapping, particularly for blockage scenarios and assess flood risk.

RESULTS

Off-site Impacts

In order that the impact assessment be consistent with Masterplan work, a nine hour volume centric event was examined for flood impact purposes. The specific focus was on potential impacts at Oval #1 and downstream and off-campus, in Sparkes Street (upstream of Pyrmont Bridge Road).

Results are presented in Appendix A as Figure 1. As indicated in the plot there are no downstream impacts in the volume centric nine hour event modelled. This indicates then an adherence to Masterplan requirements.

Net Floodplain Storage Change

A key issue for adherence to Masterplan requirements relates to the proposed developments impact on floodplain storage. As per basic hydrologic theory, any loss of flood storage will tend to lead to:

- An increase in the peak flow at downstream locations;
- A reduction in the time to peak at downstream locations; and hence
- Overall increased flood risk at downstream locations.

As such the yellow extent shown in Image 1) has been used to delimit an extent for use in assessing any changes to floodplain flood storage caused by the development.

Calculations utilise the 1% AEP proposed design case (2 hour run with 50% inlet/outlet blockage) versus the existing case 1% AEP 2 hour run. Results are presented below.

For the existing case we see 2,638 m^3 in the area indicated as per Image 1 above (yellow extent). This is based on the 1% AEP design case (50% blockage inlet/outlet) and the 2 hour run. In the developed case we see 4,625 m^3 in the same area (inclusive of the storage). This indicates that the proposed development, inclusive of the 1,600 m^3 storage, leads to an increase in storage of 1,987 m^3. This is achieved via the designed 1,600 m^3 of storage as well as the retarding impact of the proposed development as it extends east and blocks flow.

It is clearly this net improvement of floodplain storage which facilitates the proposed developments lack of impact on flood levels both in areas to the immediate downstream and west of the site, as well as those areas off campus and downstream.

Overall then the development, by enhancing flood storage, meets Masterplan requirements and this is demonstrated by the overall lack of flood impact.

Storage Inlet/Outlet Blockage Sensitivity

The proposed storage accommodates 1,600 m^3 of flood water in the 1% AEP 2 hour event. Blockage of the inlet/outlet structure is possible, and as such sensitivity runs have been done and analysis carried out in order to assess the consequences of such blockage on adjacent hazard levels.

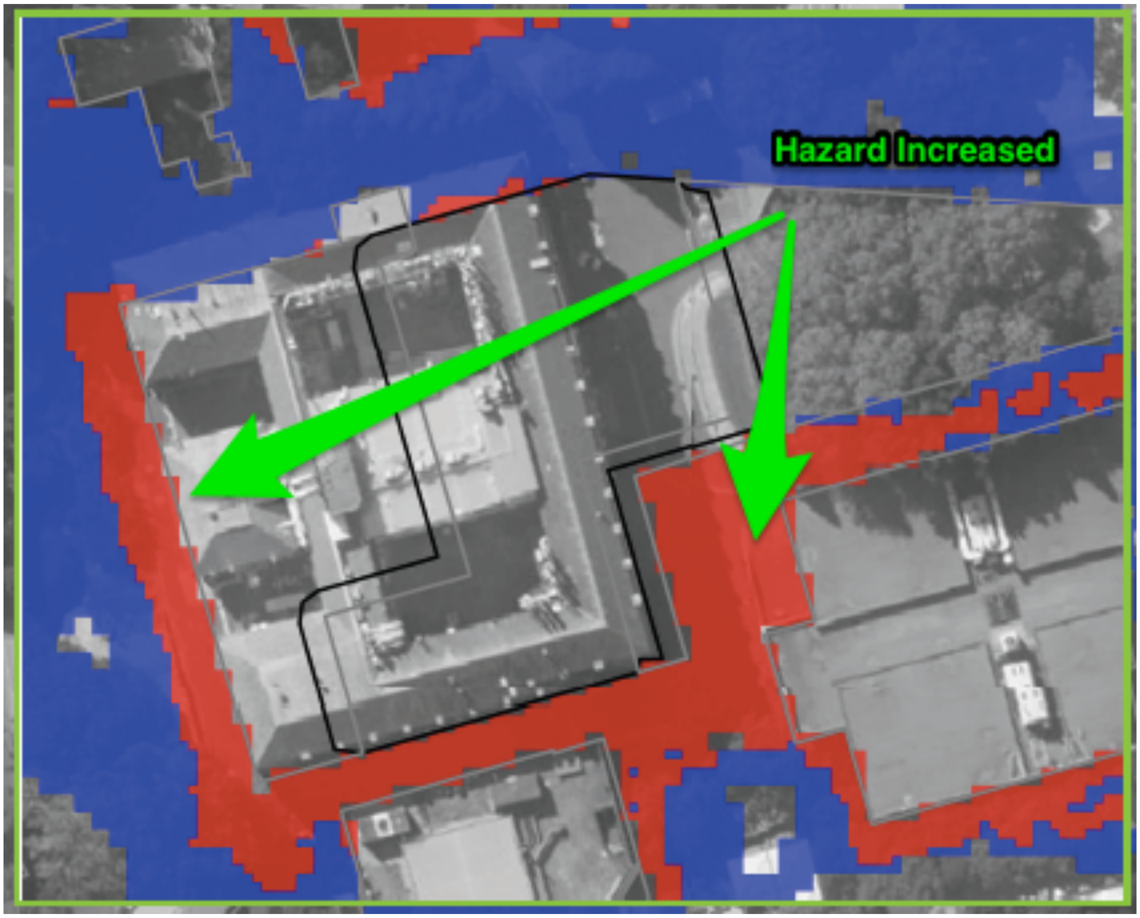
Of the runs executed the 100% inlet/outlet blockage indicates the most conservative results and as such this run has been used for hazard analysis.

Figures 2 and 3 in Appendix A provide mapped hazard as per the NSW Floodplain Development Manual (NSW, 2005). The plots indicate that in the 1% AEP event:

- In the existing case (Figure 2), high hazard occurs adjacent to and to the south of the building. Other areas adjacent to the building are low hazard;
- In the proposed case (Figure 3) with worst case blockage (100% inlet and outlet) we see that areas previously low hazard are now classified as being high hazard. These areas include the area adjacent to the propose building (west) as well as the areas to the east of the building.

The difference between Figures 2 and 3 is highlighted in Image 3 below.

Image 3: Excerpt from Appendix A Figure 3 – Hazard impact of blockage



Overall then in the worst case scenario (100% blockage of inlet and outlet) we do see 1% AEP hazard increase from low to high for areas directly adjacent to the building. These impacts do not however propagate to other areas and remain proximate to the site of the proposed development.

Based on these results I would recommend the following:

- The change in hazard due to 100% blockage as represented in Figure 3 below is localised;
- High hazard flow will occur in conjunction with extremely heavy rainfall and this will tend to mean the number of people at risk will be minimal. Also high hazard flow conditions will be sustained for a relatively short period of time (minutes);
- The hazard results for this worst case analysis substantiate the existing need for overland flow flood warning signs in the Health Precinct. Users of the area need to be informed that at times of heavy rainfall, the site can be flood liable; and further
- These results substantiate the need for a maintenance regime which seeks to avoid blockage of the storage inlet/outlet arrangements. This regime simply consists of visual checks (from exterior) of the inlet/outlet condition and corrective work where blockage is identified (remove debris).

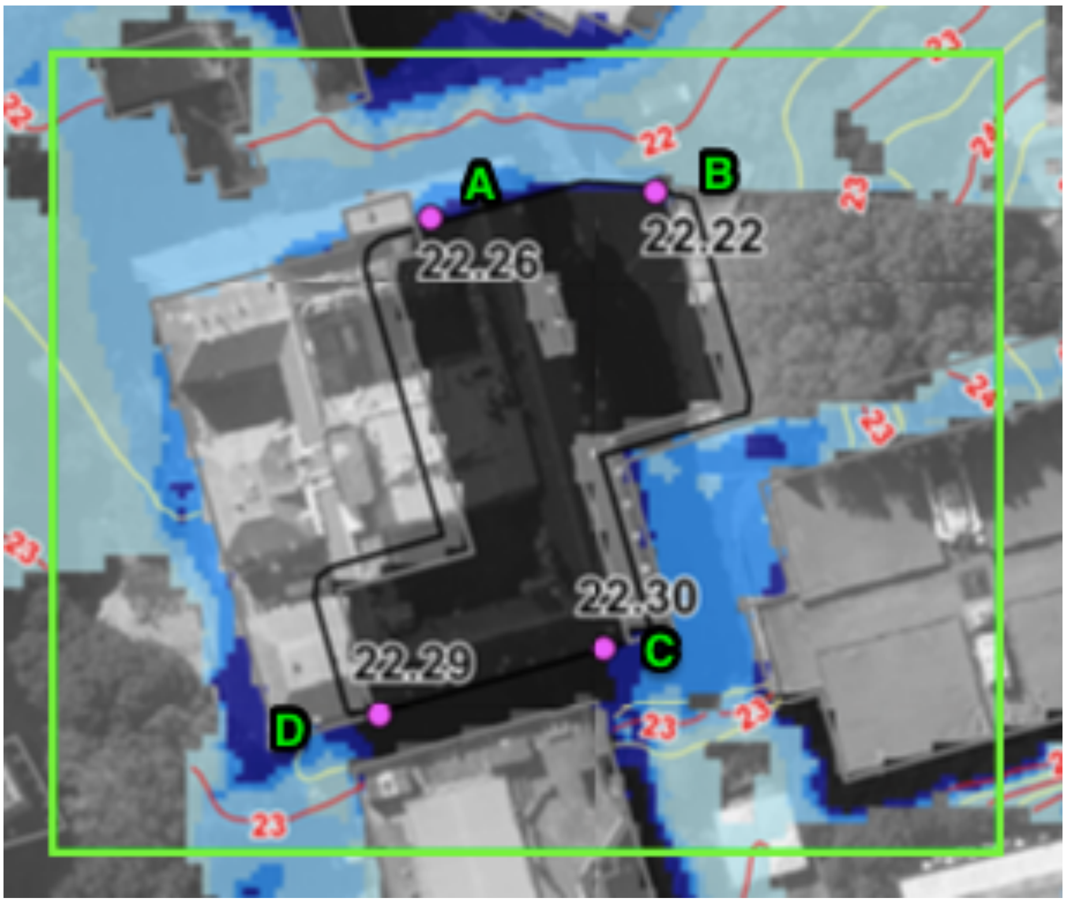
Storage Obvert Flood Liability

An assessment has been carried out of the 1% AEP 2h proposed development flood levels (see Figure 4 of Appendix A) versus storage obvert heights. The assessment's purpose is to identify whether or not the ground floor slab of the building is likely to suffer any wetting of its underside as a result of flooding.

Design 1% AEP levels are provided in Figure 4 of Appendix A. At four locations, "A" through "D" as shown in Image 4 below, the storage obvert level is compared to the 1% AEP design level.

- Location A – Obvert Level = 22.65 mAHD, Flood Level = 22.26 mAHD
- Location B – Obvert Level = 22.65 mAHD, Flood Level = 22.22 mAHD
- Location C – Obvert Level = 22.65 mAHD, Flood Level = 22.30 mAHD
- Location D – Obvert Level = 22.65 mAHD Flood Level = 22.29 mAHD

Image 4: Comparison locations – storage obvert versus design 1% AEP flood levels.

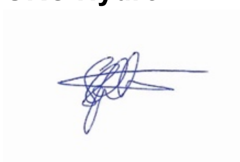


Clear height above the flood surface to the lowest levels of the storage obvert (measured at beam locations, i.e. worst case) does then range from 0.35 to 0.40 m. Note if the height to the actual slab is being examined then clearance ranges from 0.7 to 0.75 m.

These results indicate that the underside of the ground floor (obvert of storage) is not impacted by flood waters in the 1% AEP event. The “freeboard[1]” is less than 0.5 m, but more than 0.3 m. Given that what is being discussed here is not over floor flooding, but simply the wetting of a concrete beam (in an event that will occur on average once every one hundred years) a minimal freeboard is reasonable. As such it seems reasonable to conclude that adequate freeboard exists in the storage structure.

This section

Yours Sincerely
GRC Hydro



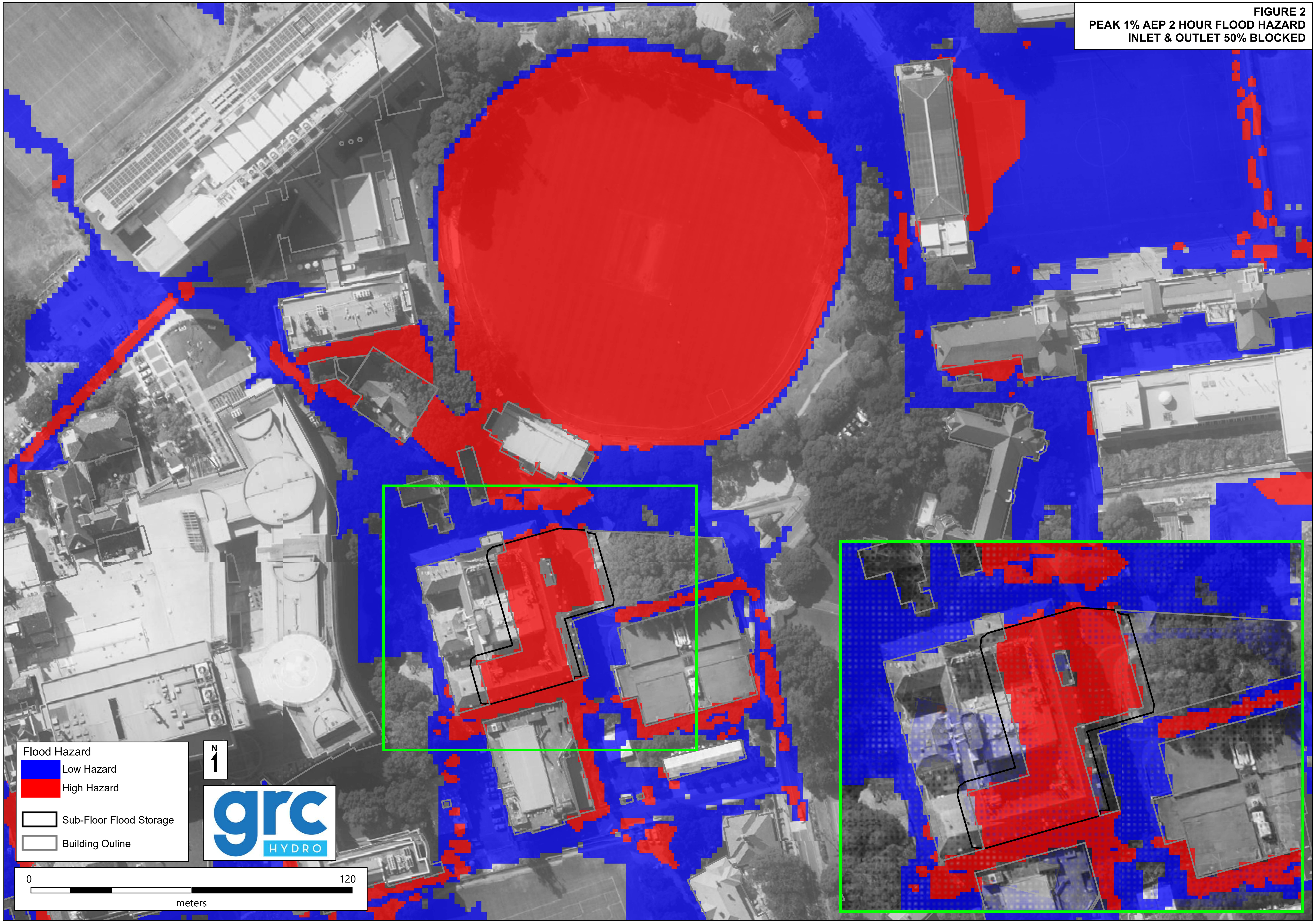
Stephen Gray
Director

[1] Freeboard is the height added to design flood levels in order to ensure that buildings have a factor of safety protecting against over floor flooding. Guidance on freeboard comes from the NSW State Government (NSW, 2005) as well as from various Council DCP’s. Typical freeboards range from 0.3 to 0.5 m.

APPENDIX A - FIGURES


FIGURE 1
PEAK 1% AEP 9 HOUR FLOOD LEVEL IMPACTS
INLET & OUTLET 50% BLOCKED
PYRMONT BRIDGE RD
ROSS ST
SPARKES ST
PARRAMATTA RD
Change in Flood Level (m)
< -0.3
-0.3 to -0.2
-0.2 to -0.1
-0.1 to -0.01
No Impact
0.01 to 0.1
0.1 to 0.2
0.2 to 0.3
> 0.3
Newly Flooded
No Longer Flooded
Sub-Floor Flood Storage
Building Ouline
N
grc HYDRO
0
300
meters

FIGURE 2
PEAK 1% AEP 2 HOUR FLOOD HAZARD
INLET & OUTLET 50% BLOCKED



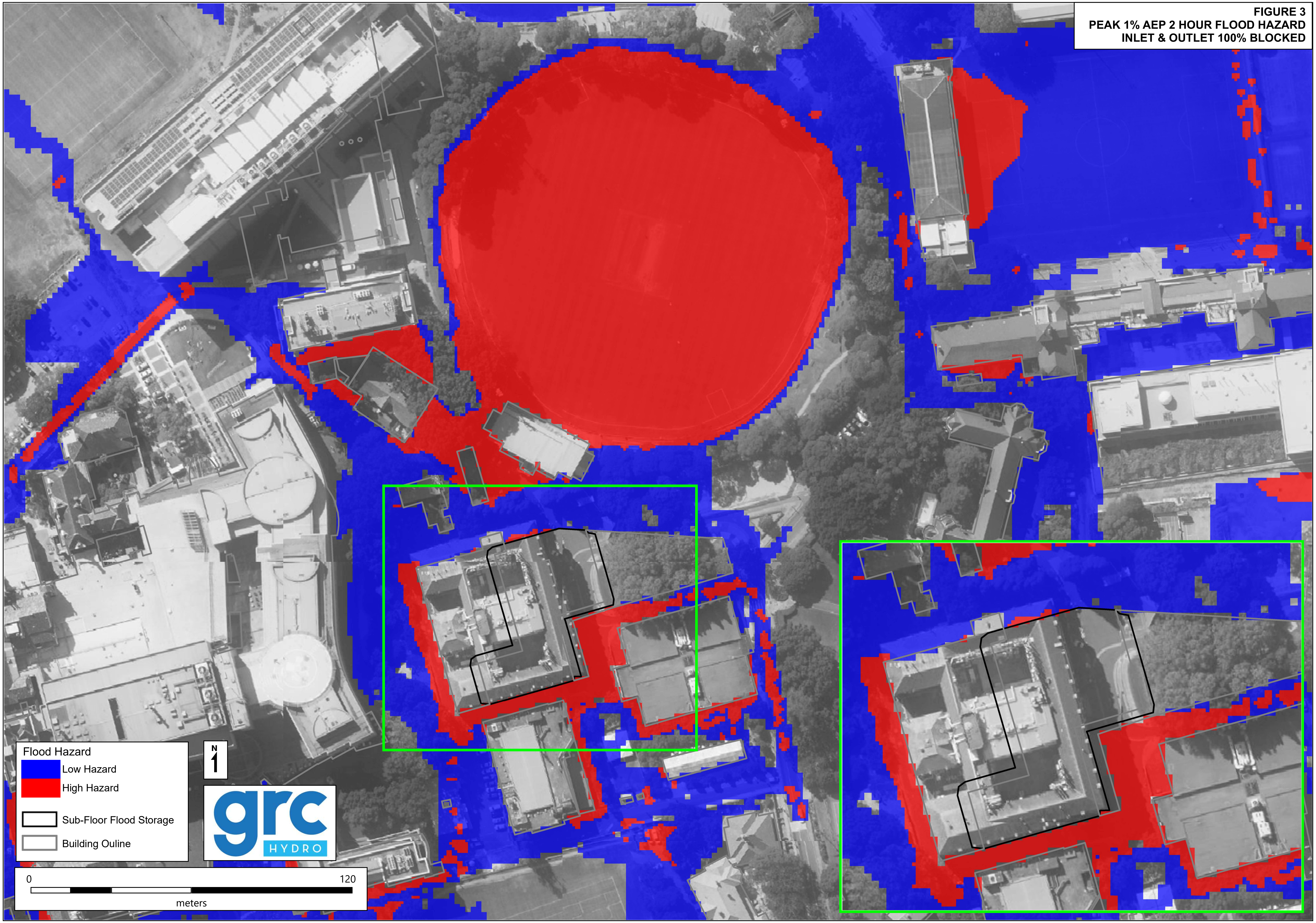


FIGURE 3
PEAK 1% AEP 2 HOUR FLOOD HAZARD
INLET & OUTLET 100% BLOCKED
Flood Hazard
Low Hazard
High Hazard
Sub-Floor Flood Storage
Building Ouline
N
grc
HYDRO
0
120
meters

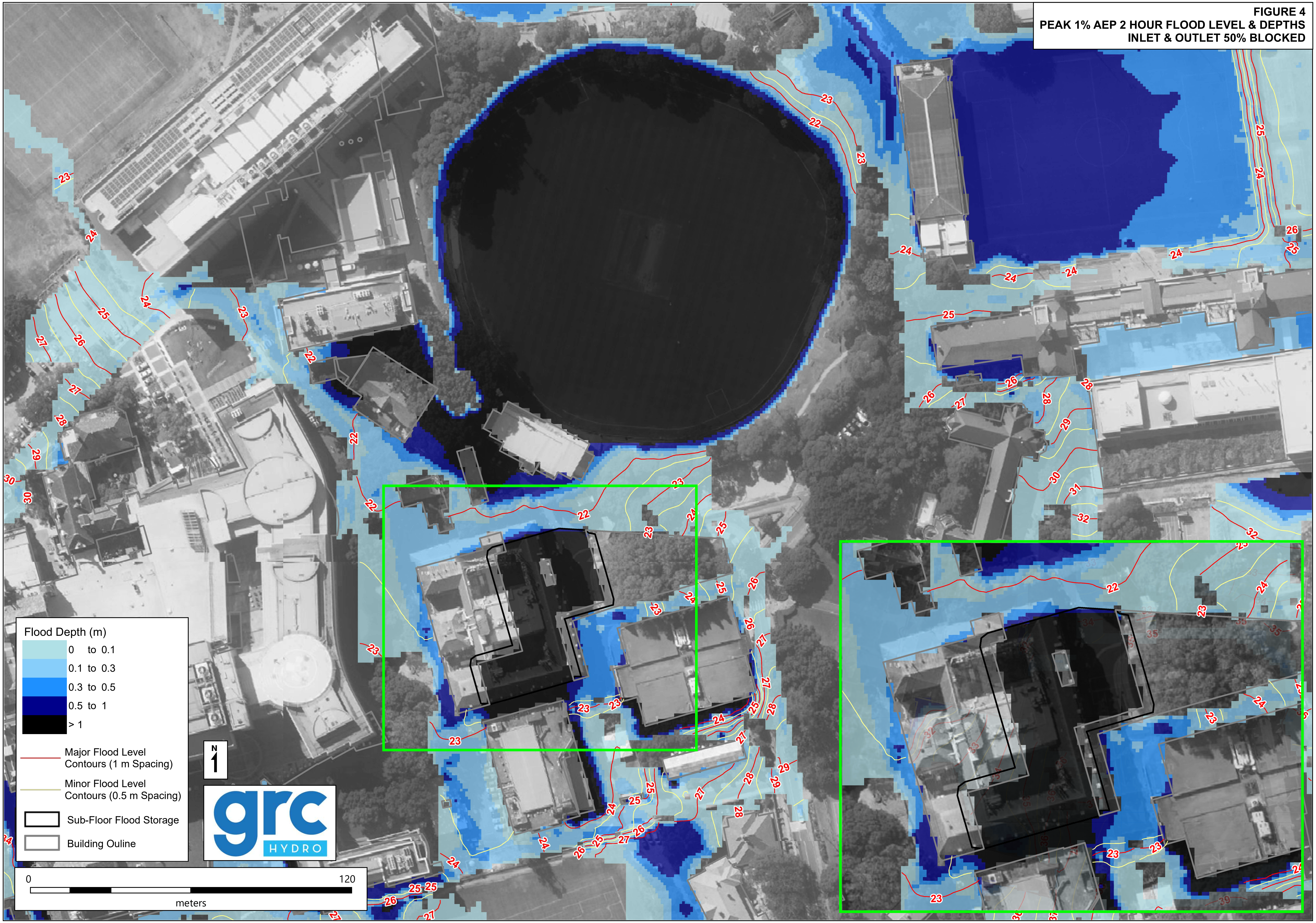


FIGURE 4
PEAK 1% AEP 2 HOUR FLOOD LEVEL & DEPTHS
INLET & OUTLET 50% BLOCKED
Flood Depth (m)
0 to 0.1
0.1 to 0.3
0.3 to 0.5
0.5 to 1
> 1
Major Flood Level Contours (1 m Spacing)
Minor Flood Level Contours (0.5 m Spacing)
Sub-Floor Flood Storage
Building Ouline
N
grc HYDRO
0
120
meters