Campus Infrastructure & Services
The University of Sydney
Services Building G12
22 Codrington Street
DARLINGTON NSW 2008

L121017_AIN_FS_rev3.docx

17 October 2012

Attention: Seamus O'Connell

Dear Seamus,

Re: Australian Institute of Nanoscience Project Flood Study

Development is proposed behind the existing Physics Building located on the main campus of the University of Sydney near Physics Road as part of the Australian Institute of Nanoscience construction project. Currently, the existing Physics Building experiences drainage issues under certain rainfall conditions whereby floodwaters enter into the building and its basement area specifically, resulting in serviceability issues. The problem is caused primarily due to its location on a minor flow path compounded by the lack of pits to feed the local trunk drainage as well as the possibility of backflow of floodwaters from the field to the north of the Physics Building.

As part of the flood study for the aforementioned development, WMAwater have conducted the following:

- Modelled and examined existing flood mechanisms at the Physics Building and proposed development site;
- Conducted a flood impact assessment of the development and proposed mitigation works;
- Modelled and evaluated the mitigation design to prevent inundation of the existing Physics Building and the new AIN building;
- Investigated the development contribution to flows in the main trunk drainage pipes;
- Examined the scenario whereby the trunk drainage downstream of the proposed development site is crushed/fully blocked and identified consequences to the upstream pits (potential for surcharge); and
- Proposed and modelled a high flow diversion outlet in order to achieve suitable flood impacts off the University of Sydney campus.

The findings are detailed as follows.

BACKGROUND

The proposed development includes the construction of a new Australian Institute of Nanoscience (AIN) building behind the existing Physics Building located on the main campus of the University of Sydney near Physics Road. The site is flood liable during the 1% AEP design flood event, as defined by the *Johnstons Creek Catchment Flood Study* (WMAwater, 2012). As part of their Development Application submission the University of Sydney are obliged to address the impact of the proposed development on adjoining flood levels and also to demonstrate compliance with City of Sydney (CoS) flood policy in regards to the new development.

PROPOSED DEVELOPMENT

In addition to the construction of the new building (with footprint approximately 4,800 m^2), the proposed development also involves the demolition of the existing Physics Annexe building, realignment of the existing site drainage infrastructure, construction of a new footpath, bund and retaining wall along the southern boundary of the site and the associated earthworks for the new development. It is also proposed to raise the level of the road entrance to the loading dock behind the Physics Building, build a flood wall adjacent to the Edward Ford Building to seal off the overland flow path for runoff from Fisher Road and raise the kerbs adjacent to the Madsen Building to keep out floodwaters from its basement. These are necessary to alleviate the existing drainage issues as well as to reduce the flood liability of the proposed development. This is shown in Figure 2.

EXISTING FLOOD MECHANISMS/ISSUES

Flood behaviour for existing conditions at the site has been defined by the *Johnstons Creek Catchment Flood Study* (WMAwater, 2012). Based on the study, flooding is found to occur at the site when runoff from St Paul's Oval/College to the south and a number of buildings to the east (Edward Ford Building etc.) converge in the region. As the existing Physics Building poses an obstruction to the overland flow paths, rainfall events as small as a 5 year ARI event are shown to create inundation depths in excess of one metre behind/south of the Physics Building. This is relieved primarily by the local drainage system (900 mm diameter pipe on the west end of the building and 525 mm diameter pipe on the east) and the gap between the Physics Building and the adjacent Edward Ford Building. For the 1% AEP design flood event, a peak flood level of 26.4 mAHD can be expected behind/south of the Physics Building (at the loading dock). As the current floor level of the Physics Building is at 25.0 mAHD (which will also be the floor level of the proposed AIN building), the building and its basement are susceptible to over-floor flooding with flows expected to enter the building from the south. It is also possible for floodwaters to backflow from the field to the north of the Physics Building via local pipes that are connected to the basement of the Physics Building as the peak flood level at the field is around 23-24 mAHD for the 1% AEP design flood event compared to the basement level of about 22.0 mAHD or lower. Figure 1 shows the peak flood depths for existing conditions at the site.

Photograph 1: Landform behind existing Physics Building

Photograph 2: View of the proposed development site (south of Physics Building)

METHODOLOGY

For this study, WMAwater utilised the 1D/2D TUFLOW model developed for the *Johnstons Creek Catchment Flood Study* (WMAwater, 2012) and modelled the 1% AEP design flood event for the following scenarios:

- Existing conditions prior to any development;
- Proposed development conditions with the new AIN building, retaining wall, elevated footpath, bund, flood wall, raised kerbs, associated earthworks and realigned trunk drainage system in place; and
- Proposed development conditions as per above plus a high flow diversion outlet for the trunk drainage system on Western Ave to divert outflows from the development site into Uni Oval 1 (location shown in Figure 4).

WMAwater have been provided with the civil works drawings dated 20 April 2012 and the site plans which form part of the environmental assessment documentation dated 15 August 2012.

For the proposed development modelling scenario, the new building was represented by nulling the corresponding grid cells which is consistent with the approach undertaken for the Flood Study. The realigned pit and pipe network for the site was incorporated and the digital terrain model was modified to account for the earthworks proposed for the development site. These are shown in Figure 2.

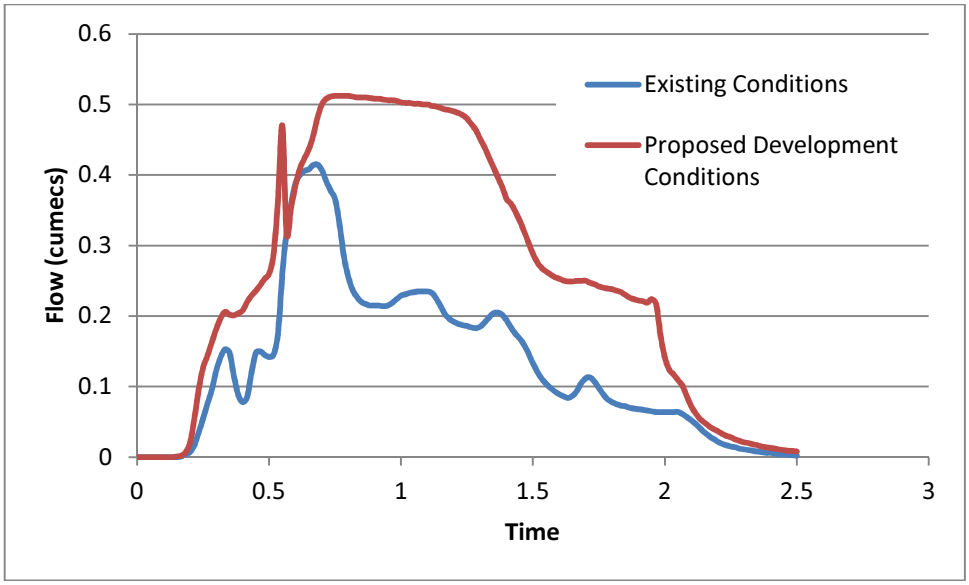
RESULTS

An impact map was generated by determining the differences of the peak flood levels between the existing and proposed development conditions. The results are presented in Figure 3. It can be seen from the figure that flood impacts are found generally in the vicinity of the development site. The impacts are caused by the displaced flood storage due to the development (estimated to be around 542 m^3 for the 1% AEP design flood event). The only adverse impacts (>10 mm) experienced off-site of the University of Sydney campus are found in the Larkin/Sparkes St area with a peak flood level increase of up to 30 mm for the 1% AEP design flood event. This is largely due to the increased peak flows (by 23%) and flood volume (by 96%) discharged from the proposed development site via the 900 mm diameter pipe on the west end of the Physics building, as shown in Chart 1. Under existing conditions, this pipe does not flow at capacity in the 1% AEP design flood event and thus has the capacity to accommodate more flows if additional pits are to be installed. Whilst in existing conditions floodwaters from upstream catchments are collected by the pits located in the pseudo-basin (shown in Photograph 1 and Figure 1) and discharged downstream, for the proposed development a series of new pits will be installed just upstream of a proposed elevated footpath/bund (shown in Figure 2). This new footpath/bund will impede the existing overland flow paths leading to the "build-up" of floodwaters in excess of 1 m deep behind the embankment. The increased head causes more floodwaters to be discharged through these pits which are connected to the realigned major trunk drainage system. As such, in order to address the adverse downstream flood impacts, it is necessary either to reduce the capacity of these inlet pits (identified as PRC_1 to PRC_4 in Figure 2) or to implement the necessary mitigation works (such as diverting some of the major storm flows to the nearby University Oval) to meet the requirements of Council's flood policies.

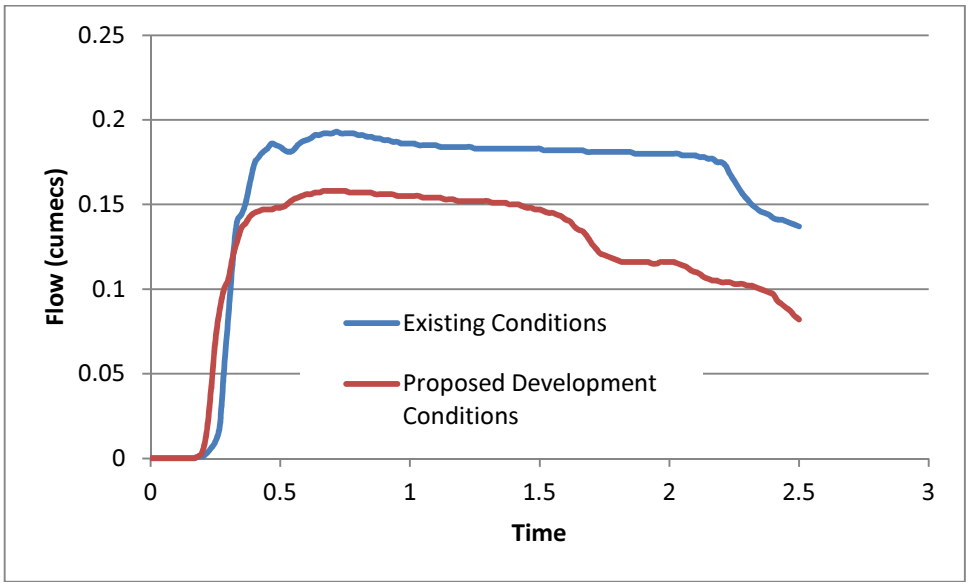
After consultation with the University of Sydney, it was decided that some of the outflows from the development site be diverted into Uni Oval 1 located west of Western Ave and the Physics Building, which currently acts as a flood storage area. A high flow diversion outlet is proposed which is connected to the existing 900 mm trunk drainage pipe. This outlet consists of two 450 mm diameter pipes with a surcharge pit at the end that allows major storm flows to be diverted into the University Oval instead of downstream, thus ensuring minimal impact on the flows currently conveyed by the existing stormwater infrastructure. Figure 4 shows the revised flood impact map and it can be seen that there is no longer any off-site impact as a result of the proposed new outlet installation. This is due to the fact that the peak flows and flood volume discharged from the proposed development site are significantly reduced when compared to the scenario without flow diversion as illustrated in Chart 2. With the peak flows now comparable to those of existing conditions, the level of impact on the existing stormwater infrastructure as a result of the development is deemed minimal.

With the revised civil works arrangement, flows are not expected to enter the proposed new building from the south as the elevated footpath/bund and retaining wall levels are designed to be above the 1% AEP design flood levels (as shown in Figure 2). Further, with the overland flows now directed along Fisher Road and subsequently onto Physics Road in lieu of going through the loading dock area, the new AIN building, the Physics Building and its basement no longer remain liable to over-floor flooding in the 1% AEP design flood event though attention must be given to the detailed design of the local drainage to address any potential remaining stormwater issues. It is also recommended that uni-directional flow valves be installed for the pipes connecting the basement of the Physics Building and the field to the north to prevent backflows from entering the basement area.

In the event that the trunk drainage downstream of the proposed development site is crushed/fully blocked, it was found that the pit identified as PRB_1 (refer to Figure 2) will be surcharged.



(a)



(b)

Chart 1: Pipe outflows (a) west and (b) east of Physics Building

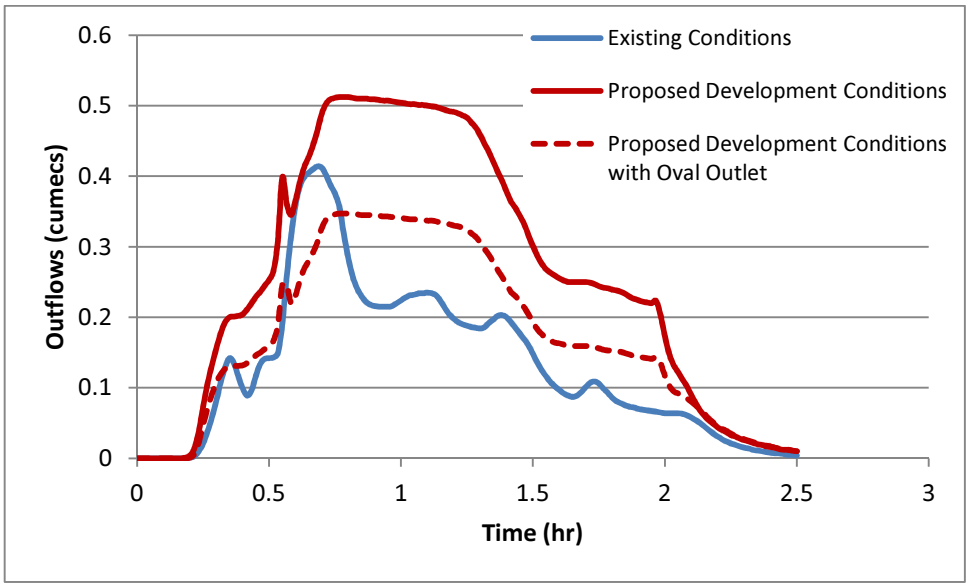


Chart 2: Comparison of trunk drainage outflows discharged from the development site

CITY OF SYDNEY POLICY RELATED TO FLOOD PLANNING

The following documents were reviewed as part of this Flood Study related to flood planning within the City of Sydney Local Government Area (LGA):

- NSW Government's Floodplain Development Manual (FDM) 2005;
- Draft Sydney Local Environmental Plan (LEP) 2011; and
- Draft Sydney Development Control Plan (DCP) 2010.

NSW GOVERNMENT'S FLOODPLAIN DEVELOPMENT MANUAL (FDM) 2005

The FDM provides guidance to Council on managing the development of flood liable land. The Manual requires the preservation of those parts of the floodplain that are important for the conveyance and temporary storage of floodwaters. Appendix L of the Manual provides a method to categorise the floodplain into:

- Floodway,
- Flood storage, and
- Flood fringe.

The Manual defines floodways, flood storage and flood fringe as:

"Floodways are those areas where a significant volume of water flows during floods and are often aligned with obvious natural channels. They are areas that, even if only partially blocked, would cause a significant increase in flood levels and/or a significant redistribution of flood flow, which may in turn adversely affect other areas. They are often, but not necessarily, areas with deeper flow or areas where higher velocities occur."

"Flood storage areas are those parts of the floodplain that are important for the temporary storage of floodwaters during the passage of a flood. If the capacity of a flood storage area is substantially reduced by, for example, the construction of levees or by landfill, flood levels in nearby areas may rise and the peak discharge downstream may be increased. Substantial reduction of the capacity of a flood storage area can also cause a significant redistribution of flood flows."

"Flood fringe is the remaining area of land affected by flooding, after floodway and flood storage areas have been defined. Development in flood fringe areas would not have any significant effect on the pattern of flood flows and/or flood levels."

Under the provisional hydraulic categories as defined in the *Johnstons Creek Catchment Flood Study* (WMAwater, 2012), the majority of the proposed development site is categorised as a flood storage area.

DRAFT SYDNEY LOCAL ENVIRONMENTAL PLAN (LEP) 2011

The draft LEP applies to most of the City of Sydney Local Government Area (LGA) including the proposed development site and is the principal document for controlling development and guiding planning decisions made by Council. This document provides overall objectives, zones and core development standards, including the following provisions related to "Flood Planning". The draft LEP has been on public exhibition and was approved by the Council and referred to the Department of Planning and Infrastructure in March 2012.

Clause 7.17 of the draft Sydney LEP 2011 (Flood Planning) states that:

" Development consent must not be granted to development on land to which this clause applies unless the consent authority is satisfied that the development:

(a) is compatible with the flood hazard of the land, and
(b) will not significantly adversely affect flood behaviour resulting in detrimental increases in the potential flood affectation of other development or properties, and
(c) incorporates appropriate measures to manage risk to life from flood, and
(d) will not significantly adversely affect the environment or cause avoidable erosion, siltation, destruction of riparian vegetation or a reduction in the stability of river banks or watercourses, and
(e) is not likely to result in unsustainable social and economic costs to the community as a consequence of flooding."

DRAFT SYDNEY DEVELOPMENT CONTROL PLAN (DCP) 2010

The draft DCP supports the LEP by providing additional objectives and development standards to enhance the function, appearance, and amenity of development in the City of Sydney LGA. The draft DCP was adopted by the Council in May 2012 and will come into effect once the draft LEP is made.

Section 2.6 of the draft Sydney DCP 2010 includes provisions that assist in the management of stormwater to minimise flooding and ensure that development is not subjected to undue flood risk, nor exacerbate the potential for flood damage or hazard to existing development and to the public domain. Among the requirements applicable to this development include:

" A local drainage management plan is required for development on sites of:

(a) 1,000sqm or more in the Fowler's Creek catchment area (draining to Johnston's Creek) (Stormwater Management Map); or
(b) 1,800sqm or more in other catchments."

" The Local Drainage Management Plan is to address:

(a) the hydrology of the locality and its relationship to the drainage system;
(b) the distribution of soil types and the scope for on-site infiltration;
(c) any expected rise in ground water level due to development;
(d) the role of the principal landscape components on the site for water conservation and on-site detention;
(e) the scope for on-site stormwater detention and retention, including the collection of water for re-use;
(f) how any detrimental impacts on the existing natural hydrology and water quality are proposed to be minimised;
(g) how pedestrian safety is to be ensured; and
(h) integration of drainage management responses and open space areas."

" Where a connection is proposed to the existing stormwater infrastructure, there must be minimal impact (less than 10%) on the capacity of the infrastructure. The development proposal is to show the level of impact on the existing stormwater infrastructure as a result of the proposed new connection."

" The post development run-off from impermeable surfaces (such as roofs, driveways and paved areas) is to be managed by stormwater source measures that:

(a) contain frequent low-magnitude flows;
(b) maintain the natural balance between run-off and infiltration;
(c) remove some pollutants prior to discharge into receiving waters;
(d) prevent nuisance flows from affecting adjacent properties; and
(e) enable appropriate use of rainwater and stormwater."

CONCLUSIONS AND RECOMMENDATIONS

It can be concluded based on the results generated using the TUFLOW model developed for the *Johnstons Creek Catchment Flood Study* (WMAwater, 2012) that the proposed AIN development behind the existing Physics Building located on the main campus of the University of Sydney near Physics Road has no off-site detrimental impacts on the 1% AEP peak flood levels subject to the construction of a high flow diversion outlet that will divert some of the major storm outflows from the development site to the nearby University Oval. This will also ensure minimal impact on the flows currently conveyed by the existing stormwater infrastructure and the requirements of Council's flood policies are met. It is also recommended that uni-directional flow valves be installed for the pipes connecting the basement of the Physics Building and the field to the north to prevent backflows from entering the basement area.

Yours Sincerely,
WMAwater

Steve Gray
ASSOCIATE

FIGURE 1

PEAK FLOOD DEPTH AND LEVEL
EXISTING CONDITIONS
1% AEP DESIGN FLOOD EVENT

600mm
525mm
900mm
300mm
900mm
525mm
900mm
525mm
450mm
300mm
300mm

WESTERN AVE
PHYSICS RD
Physics Building
Edward Ford Building
FISHER RD
St Paul's Oval

N

Pits
Pipes
Peak Flood Level (1mAHD Interval)

Peak Flood Depth (m)
0 - 0.1
0.1 - 0.25
0.25 - 0.5
0.5 - 1
> 1

0 50 100 m

Disclaimer:
Inundation patterns and/or peak flood levels shown for design events are based on best available estimates of flood behaviour within the Catchment. Inundation from local overland flow may vary slightly to the displayed design rainfall inundation patterns .Council should be consulted to confirm flood affectation at individual allotments.

J:\Jobs\112065\ArcGIS\ArcMaps\VariationFigs\Figure01_PeakFloodDepthLvl_Exist_100y.mxd

FIGURE 2

PEAK FLOOD DEPTH AND LEVEL
PROPOSED DEVELOPMENT CONDITIONS
1% AEP DESIGN FLOOD EVENT

600mm
525mm
375mm
900mm
525mm
900mm
375mm
300mm
900mm
375mm

WESTERN AVE
PHYSICS RD
Physics Building
Edward Ford Building
FISHER RD
St Paul's Oval
PRC_1
PRC_2
PRC_3
PRC_4
PRB_1

N

AIN Building
Retaining Wall/Raised Kerb
Fill/Bund
Resurfaced Loading Dock
Pits
Pipes
Peak Flood Level (1mAHD Interval)

Peak Flood Depth (m)
0 - 0.1
0.1 - 0.25
0.25 - 0.5
0.5 - 1
> 1

0 50 100 m

Disclaimer:
Inundation patterns and/or peak flood levels shown for design events are based on best available estimates of flood behaviour within the Catchment. Inundation from local overland flow may vary slightly to the displayed design rainfall inundation patterns .Council should be consulted to confirm flood affectation at individual allotments.

J:\Jobs\112065\ArcGIS\ArcMaps\VariationFigs\Figure02_PeakFloodDepthLvl_Prop_100y.mxd

FIGURE 3

FLOOD IMPACT MAP
PROPOSED DEVELOPMENT CONDITIONS
1% AEP DESIGN FLOOD EVENT

LARKIN ST
SPARKES ST
PARRAMATTA RD
Uni Oval 1
WESTERN AVE
PHYSICS RD
Physics Building
FISHER RD
St Paul's Oval

N

AIN Building
Retaining Wall/Raised Kerb
Fill/Bund
Pits
Pipes

Impact (m)
No Longer Flooded
< -0.01
No Impact
0.01 - 0.05
0.05 - 0.1
> 0.1
Newly Flooded

0 100 200 m

J:\Jobs\112065\ArcGIS\ArcMaps\VariationFigs\Figure03_ImpactMap_100y.mxd

FIGURE 4

FLOOD IMPACT MAP
PROPOSED DEVELOPMENT CONDITIONS WITH UNI OVAL OUTLET
1% AEP DESIGN FLOOD EVENT

LARKIN ST
SPARKES ST
PARRAMATTA RD
WESTERN AVE
PHYSICS RD
Physics Building
FISHER RD
Uni Oval 1
St Paul's Oval

N

- Proposed Surcharge Pit
- Proposed High Flow Outlet
- AIN Building
- Retaining Wall/Raised Kerb
- Fill/Bund
- Pits
- Pipes

Impact (m)

- No Longer Flooded
- < -0.01
- No Impact
- 0.01 - 0.05
- 0.05 - 0.1
- > 0.1
- Newly Flooded

0 100 200 m

J:\Jobs\112065\ArcGIS\ArcMaps\VariationFigs\Figure04_ImpactMap_OvalOut_100y.mxd