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18 September 2018

Catholic Diocese of Maitland Newcastle
c/o Webber Architects
Suite 3, L1, 426 Hunter St
Newcastle
NSW 2300

Attention: Sandra Hinchey

RE: CATHERINE MCAULEY CATHOLIC COLLEGE FLOOD RISK AND IMPACT ASSESSMENT

In November 2017 BMT provided a brief Flood Risk Assessment for the site of the proposed Catholic Collage at 507 Medowie Road / 2 Kingfisher Close, Medowie. The principal objective of the assessment was to clarify the required Flood Planning Level for the development, given that there was significant ambiguity within the Flood Certificate provided by Council.

Development approval for the project is being sought under a State Significant Development pathway, and as such SEARs have been issued for the project. Subsequently, BMT was requested to undertake a more detailed Flood Risk and Flood Impact Assessment to address the requirements of the SEARs. Specifically, this assessment:

- documents the flood prone land, flood planning area and hydraulic categorisations
- identifies the effect the proposed development will have on flood behaviour and discusses the suitability of the development regarding flooding
- assesses the impacts the proposed development will have on other areas (i.e. compatibility with Council floodplain plans, social and economic costs, environmental implications etc)
- outlines appropriate flood emergency management/responses for the proposed development.

The following sections document the Flood Risk and Flood Impact Assessment for the Project.

Flood Behaviour and Development Suitability

The site is located at the southern side of Medowie, on high ground bordering the eastern fringe of Campvale Swamp. There are also two local catchments that drain to Campvale Swamp near the site – one to the north and one to the south of the proposed school. Flood behaviour at the site has been recently modelled for Port Stephens Council and is documented within the Medowie Drainage and Flood Study (WMAwater, 2012) and the Medowie Floodplain Risk Management Study and Plan (WMAwater, 2016). Council has issued a Flood Certificate for the site, the details of which are reproduced in Figure 1.

The Flood Certificate provides a range of flood levels, which makes interpretation of the information potentially confusing and can have a significant impact on the measures required to satisfy the specified levels within the proposed development.

Flood Planning Level	**11.0 metres AHD**	(This level defines the minimum floor level for habitable rooms and land that is subject to flood-related development controls (refer to Port Stephens LEP Section 7.3, Port Stephens DCP Section B5).
Highest Hazard Category	**High Hazard Floodway**	
Flood levels that may be useful are:		
Probable maximum flood level	9.2m – 11.0m AHD	(The highest flood level that could conceivably occur at this location. If required, onsite flood refuges are built at or above this level, refer to the Port Stephens Development Control Plan B5.2)
Surveyed floor level	14.34 metres AHD	(Council may have a floor level at the entrance to the residence on this site that was surveyed June 2012 as part of the preparation of a Floodplain Risk Management Study for this area.)
Current day 1% AEP flood level	8.0m – 10.0m AHD	(This level is useful for insurance purposes, refer to your insurance policy and the Insurance Contracts Regulation 1985 (Cwealth).)
Adaptable minimum floor level	10.8 metres AHD	(The 1% AEP flood level plus 0.5m, 50 years from now, refer to the Port Stephens Development Control Plan B5.2.)
Minimum onsite wastewater level	8.0m – 10.3m AHD	(The 5% AEP level 50 years from now, refer to the Port Stephens On-site Sewage Management Development Assessment Framework and AS/NZS 1547:2012 5.5 land application system design.)

Figure 1 – Key flood levels in the 507 Medowie Road Medowie Flood Certificate

BMT has reviewed the available studies and Flood Certificate to provide appropriate interpretation for the proposed development. Interpretation of the local topography from the available LPI LiDAR data suggests that the nature of flooding to the west of Medowie Road would be dominated by the flood conditions in Campvale Swamp. The local catchment to the north of the site is only some 30 ha in size and is not expected to generate a significant flood risk to the proposed school.

The local catchment within the southern section of the site is around 80 ha in size and principally drains the Pacific Dunes golf course. The nature of the catchment is relatively broad and flat and the topography suggests that downstream of Medowie Road, the flood levels within the local catchment would be determined by the flood level in Campvale Swamp.

The range of flood levels provided within the Flood Certificate is likely a function of localised influences from these local catchments draining to Campvale Swamp. It is also noted that the hydrological approach adopted within the Flood Study modelling is the direct rainfall method. The direct rainfall method can complicate the derivation of flood levels from the model results, due to all cells within the model being wet. Model results are typically filtered (often through application of a minimum depth), but flood levels can still be elevated at the flood fringes where local sheet flow interacts with the broader mainstream flood surface. It is expected that the flood risk for the site should be dominated by the flood conditions in Campvale Swamp.

Figure 2 presents the proposed school site plan (Sheet Number 2544_02_0002_BB, provided by Webber Architects) together with key flood extents for Campvale Swamp provided within the Medowie Drainage and Flood Study, mapped onto the available LPI LiDAR elevation data. The mapped flood extents include:

- The 1% AEP design flood level of 8.1 m AHD
- The Flood Planning Level (FPL) of 8.6 m AHD (1% AEP plus 0.5 m freeboard)
- The Probable Maximum Flood level of 9.2 m AHD.

Title:

Proposed Site Plan and Peak Flood Level Contours for Campvale Swamp

Figure: 1

Rev: A

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Approx. Scale

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It can be seen from Figure 2 that the proposed school buildings, car parking and playing fields are situated outside of the 1% AEP flood extent and that most of the site is situated above the FPL. However, it should be noted that the land at the north of the site (marked for future sub-division) is affected to some degree by the 1% AEP and FPL.

At the PMF event several the proposed school buildings are affected.

The finished floor levels of the proposed buildings as marked on the detailed site plan (provided by Webber Architects) are generally at or above 9.3 m AHD, which means the finished floor levels are situated above the PMF level of Campvale Swamp. The buildings located in the southern most section of the proposed development (Primary School and Early Learning Centre) are located on land below the FPL (8.6 m AHD) however the buildings are designed with finished floor levels set at 9.3 m AHD. Not only does this level raise the buildings above the required FPL, it also situates them above the PMF level (9.2 m AHD) which considerably minimises any risk to life from a flood emergency perspective.

It is noted that the proposed access road into the school site traverses the overland flow path alignment on the southern side of the site. It is understood that this configuration is required to satisfy traffic constraints. The level of flood immunity afforded by the proposed access road will need to be assessed at a later stage when the design details of the road are being developed.

Flood Impacts

From a potential flood impact perspective, the nature of flooding from Campvale Swamp would be non-convective back water inundation. This is supported by Council's mapping which shows most of the site as being low hazard flood fringe. The impact of earthworks and the construction of buildings would have a negligible impact on the broader flood level in Campvale Swamp.

It is understood that Council would not require a Flood Impact Assessment for works within the Low Hazard Flood Fringe areas, which applies to most of the proposed development footprint. The only flood-affected proposed development that is not situated within Low Hazard Flood Fringe is a section of the southern car parking area. Car Park 2, some of Car Park 1 and a short length of the Primary School drop off and loading zone is situated within Low Hazard Flood Storage. This area can be seen in Figure 3, which shows the proposed site plan and flood hazard categories.

Potential flood impacts of the southern car parking area can be minimised by retaining current surface elevations and/or limiting cut and fill of any required earthworks.

If only minor alterations to the topography and surface elevations of the small area in question within the Low Hazard Flood Storage (less than 0.4 ha) occur, the Project is expected to have a negligible impact on the flood levels at the site and surrounding area, or on the broader flood behaviour. A detailed modelling-based impact assessment is therefore deemed unnecessary. However, the proposed access road into the school site traverses the overland flow path alignment (High Hazard Floodway area) on the southern side of the site. The potential for flood impacts associated with the proposed access road has therefore been assessed through a modelling-based Flood Impact Assessment.

Title:

Proposed Site Plan and Flood Hazard Categories

Figure: **2**

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Model Development

The critical flood condition with regards to potential flood impacts and flood immunity of the proposed site access road is driven by the local catchment upstream of Medowie Road. The local catchment drains an area of some 87 ha, principally occupied by the Pacific Dunes Golf Course, as presented in Figure 3. The catchment drains to Campvale Swamp via culverts under Medowie Road and the along a drainage channel that traverses the site. The drainage structures beneath Medowie Road include twin box culverts of around 1.5 m by 0.6 m and a low flow pipe of 0.3 m diameter. There is also an existing bridge structure crossing the drainage channel within the site, consistent with the proposed access road alignment. It is currently a twin 0.9 m pipe arrangement.

Determining an accurate estimate of the Pacific Dunes catchment flood hydrology comprises considerable uncertainty. The catchment hydrology is expected to be more significantly driven by long-term rainfall and groundwater interaction than it is by surface water runoff. The golf course contains significant flood storage and potential for flood attenuation and the soils are likely sandy, with a high capacity for rainfall infiltration. Nonetheless, a XP-RAFTS hydrological model was developed for the catchment to determine an estimate of flood flow conditions from which to assess the proposed access road. The key model parameters include:

- Catchment area of 87 ha and slope of 0.1%
- Impervious portion of 15% to represent areas of hardstand and permanent water bodies
- PERN value of 0.06 for pervious and 0.02 for impervious surfaces
- Initial rainfall loss of 35 mm for pervious and 2 mm for impervious surfaces
- Continuing rainfall loss of 3 mm/h for pervious and 0 mm/h for impervious surfaces
- Incorporation of catchment storage to model attenuation.

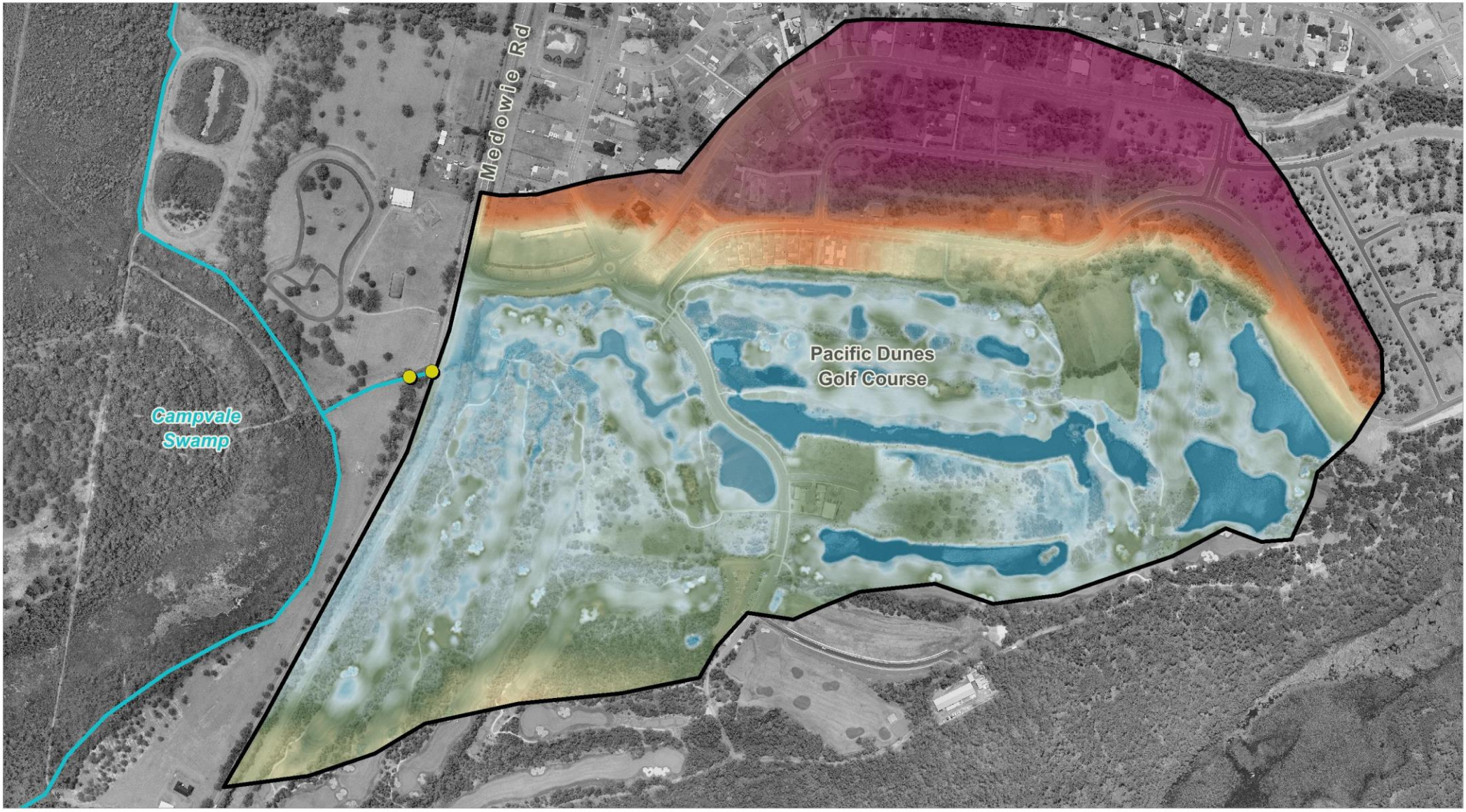
The critical duration for peak discharge under Medowie Road was found to be the 36-hour storm event. This corresponds to a 1% AEP design rainfall depth of 343 mm, resulting in a peak flow of around 3.4 m^3/s. Using the GSDM, the critical duration for the PMF was found to be the 6-hour storm event, with a design rainfall depth of 920 mm and a peak flow of around 16.6 m^3/s.

A local TUFLOW model was developed to simulate the flood hydraulic between Medowie Road and Campvale Swamp, incorporating the drainage channel and existing hydraulic structures. The upstream design inflows were applied, coincident with a 1% AEP tailwater level in Campvale Swamp.

Model Results

Under existing conditions, the 1% AEP event is contained upstream of Medowie Road, but overtops the access bridge downstream, albeit to a depth of < 0.1 m. For the developed condition a road design has been assumed that is 0.2 m higher than the existing bridge, at around 8.8 m AHD, which then grades down after crossing the channel, as presented in Figure 4. The existing twin 0.9 m diameter pipes have been replaced with a twin 1.5 m x 0.9 m box culvert, consistent with the available design drawings.

The resultant 1% AEP flood condition from the local catchment for the developed scenario is contained upstream of the site access road and does not overtop. The impacts of the concept design for the site access road are minimal, being around a 0.02 m decrease in modelled peak flood level in the area between the site access and Medowie Road. The flood levels upstream of Medowie Road are unaffected.



LEGEND

- Catchment boundary
- Swamp extent
- Culvert location

Elevation (m AHD)

8
9
10
12
15
20
30

Title:

Pacific Dunes Catchment

Figure: 3

Rev: A

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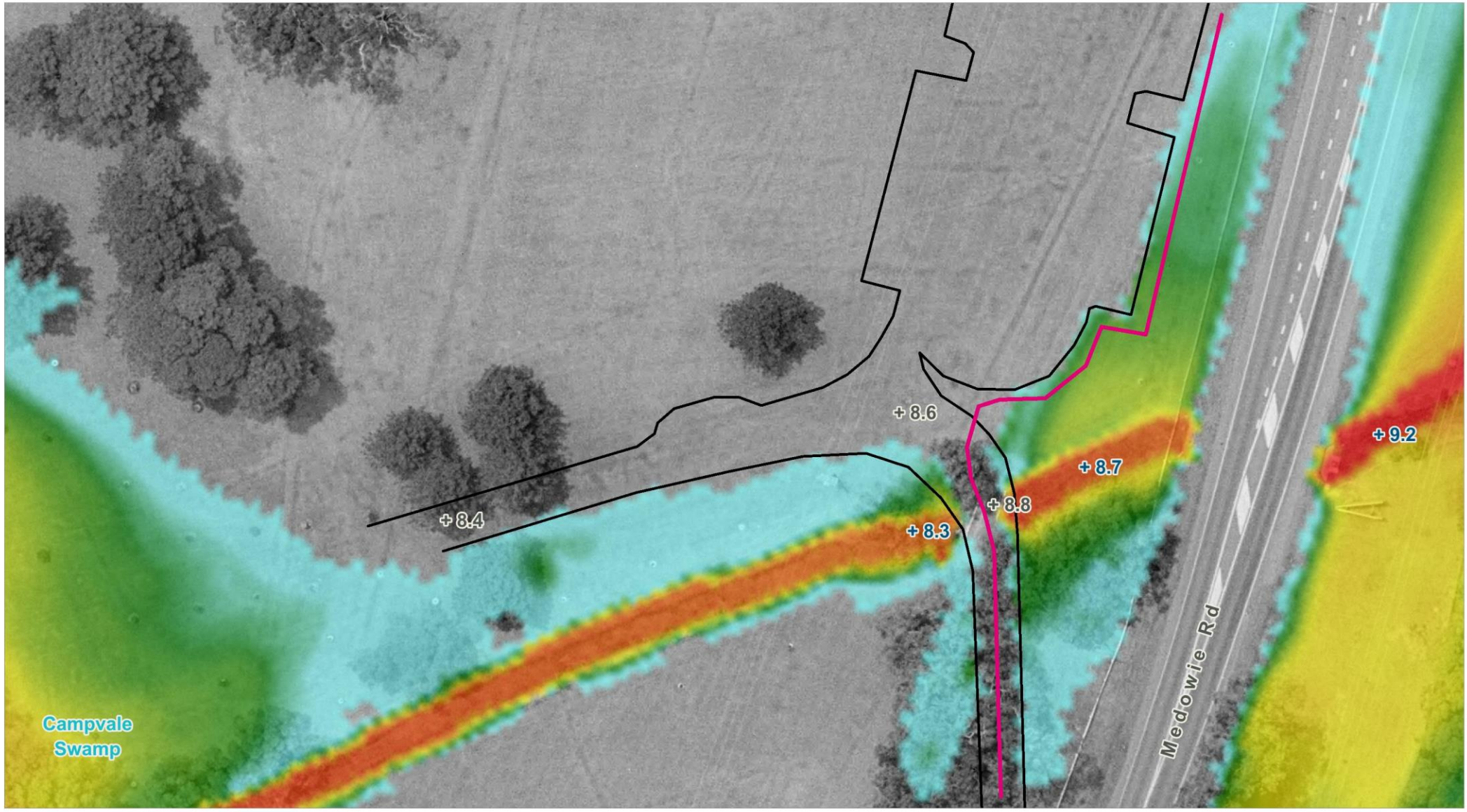

LEGEND

- Road edges
- + 8.8 Modelled road level (m AHD)
- + 8.7 Modelled flood level (m AHD)
- Required FSL of 8.8 m AHD

Peak Flood Depth (m)

0.1 lower depths mapped as same colour
0.2
0.5
1.0
1.5 higher depths mapped as same colour

Title:

CMCC Site Access

Figure: 4

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Other Flooding Implications of the Project

As previously outlined, developed scenario modelling of the entire site has not been undertaken as most of the site is not affected by flooding or is in the low hazard flood fringe category, for which Council does not require an impact assessment. The only development proposed outside of these categories (excluding the proposed site access road) is a small section of the southern car parking which is located on low flood hazard flood storage. However, if there is minimal alteration to surface elevations it is not expected to have any noteworthy impact on the flood behaviour on or around the site. The project is also not expected to have any flood impacts which would affect any property, assets or infrastructure.

To maintain the 1% AEP flood immunity of the proposed site access road the surface levels of the road and southern car park have been modelled at a level of 8.8 m AHD. The finished surface levels of the proposed development should provide a continuous elevation of at least 8.8 m AHD, as indicated on Figure 4. This should be readily accommodated through the crest level of the site access road between Medowie Road and the bridge. North of the bridge, the level can be continued through the top of kerb level around the eastern edge of the southern car park, if possible. Alternatively, minor earth landscaping running between the car park and Medowie Road would achieve the desired flood risk management outcome.

It is noted that the Medowie Floodplain Risk Management Study and Plan was recently completed for Council by WMAwater (2016). The information documented in this assessment is consistent with said Council adopted study. The Medowie Floodplain Risk Management Study and Plan identified that a Local Flood Plan (LFP) has been prepared by the NSW SES for the Port Stephens LGA. The LFP is used by the SES on an LGA-wide basis to manage emergency response to flooding. The LFP for the Port Stephens LGA does not include details for the Medowie community, due to the low flood affectation in Medowie, as reported by WMAwater (2016). The flood emergency management of the site is outlined in the following section. However, with all Project buildings proposed to have floor levels above the existing PMF level, no additional burden will be created with regards to flood emergency response management.

The Project should not change the overall inundation extent within the floodplain and so no impacts with regards to environmentally beneficial flooding are expected. Flood inundation frequency and duration will remain consistent with the existing conditions as will the flood velocities. Therefore, no changes to the geomorphological regime will result from the project, such as siltation, erosion, bank stability or the resultant implications for riparian vegetation.

The flood impacts associated with the proposed development are negligible in terms of affecting property, assets and infrastructure and therefore result in no detriment to the overall social or economic status of the community.

Flood Emergency Management

Whilst much of the site has either no or low flood hazard categorisation (based on Council mapping), due to the intended use of the development it is acknowledged that many students ranging in ages will be present on the site for extended periods. As such, flood emergency management has been considered to minimise the risk to life on-site in advance of a potential major flood event.

Given the nature of the local topography, the elevation of the proposed floor levels and the long duration nature of Campvale Swamp flooding, an appropriate flood emergency response should be readily achieved through evacuation of the site. The key evacuation route from the Project site would be driving north to the township of Medowie via Medowie Road (if unaffected by floodwaters).

Flooding in Medowie causes several main routes to become inundated. The Medowie Floodplain Risk Management Study and Plan (WMAwater, 2016) identified 12 main road crossings were inundation occurs with two locations identified on Medowie Road between the project site and Medowie. The location, depth and velocity of Medowie Road inundation is outlined in Table 1.

As outlined in Table 1, Medowie Road is flooded in two locations in both the 1% AEP and PMF design flood events. However, the depths and velocities present at both locations during the 1% AEP design event are low and would not result in any restrictions to the use of the road (by vehicles or pedestrians).

Under PMF conditions, the depth of water across the road at both locations is not substantial (less than 0.2 m) however the high velocities would result in Medowie Road being unsafe for people and vehicles.

According to the information provided in the Medowie Floodplain Risk Management Study and Plan (WMAwater, 2016), flood emergency evacuation from the site in all events up to the 1% AEP design event can occur via Medowie Road. Under PMF conditions flood emergency evacuation from the site to Medowie may be possible via Brocklesby Road. However, it is noted that most of the site is not affected by flooding and if required people could remain on site with no risk to life from flooding. The Medowie Road inundation locations and possible emergency evacuation routes are shown in Figure 5.

It is important to note that the flood mechanisms affecting the access along Medowie Road are driven by local catchment runoff from shorter duration, intense rainfall. This is significantly different to the flood mechanism affecting the Project site, which is long-duration, large volume, whole of catchment event based. Therefore, it is unlikely that both the Project site and the flood evacuation access along Medowie Road would be affected at the same time. Nevertheless, a Flood Emergency Response Plan for the site would be beneficial, detailing what to do prior to, during and after a major flood event. This will ensure appropriate personnel on site are aware of the local flood risks and what to do in the event of a major flood occurring.

Table 1 – Inundation of Medowie Road Evacuation Route (WMAwater, 2016)

Road Location	Medowie Road, north of intersection with Brocklesby Road	Medowie Road, south of intersection with Blueberry Road and north of intersection with South Street
Event First Flooded Over Road	PMF	PMF
Depth Road Flooded in First Flooded Event (m)	0.16	0.13
Velocity over Road in First Flooded Event (m/s)	4.64	2.95
Depth over Road in 1% AEP Event (m)	0.03	0.07
Velocity over Road in 1% AEP Event (m/s)	0.88	1.24
Alternative Access Available?	Possible alternative access via Brocklesby Road	

*Note: Roads are considered inundated when depths exceed 100 mm.

Subsequent evacuation from Medowie, or directly from the school, may be possible along Medowie Road towards Williamtown and Richardson Road towards Salt Ash or Raymond Terrace. However, insufficient information is available to confirm the broader extent of potential evacuation and this would be dependent on individual road conditions during a particular flood event scenario.

Title:

Flood Emergency Evacuation Constraints and Possible Routes

Figure: 5

Rev: A

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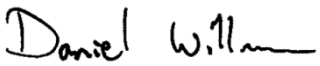
The modelling of the proposed site access road has shown that the road does not overtop at the 1% AEP event. Under the extreme PMF conditions, the local catchment flows overtop the road by 0.16 m, with a peak velocity of around 0.9 m/s.

Conclusion

This assessment has found that the proposed development is compatible with the flood risk at the site. The potential for flood impacts associated with the proposed development are also minimal. Evacuation from the site is readily achievable at the 1% AEP event and a continuous finished surface level along the site access road and southern car park should be implemented to achieve this. At the PMF event, site evacuation becomes compromised, but would likely be for a short duration when concerning local catchment flooding over Medowie Road. Flood-free refuge above the PMF level is also readily available on site.

We trust that this report satisfies your requirements. If you have any further questions regarding any aspect of this report then please do not hesitate to contact the undersigned.

Yours Faithfully
BMT



Daniel Williams
NSW Flood Lead