PREPARED FOR MIRVAC HOMES (NSW) PTY LTD
17-003293
ORIGINAL
WATER & ENVIRONMENT

Station Street, Menangle
Stage 1 BEW Stormwater Concept Plan

COMMERCIAL IN CONFIDENCE

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DOCUMENT CONTROL

17-003293

Issue	Date	Issue Details	Author	Checked	Approved
1	23/05/18	Client Review	TE		

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1 INTRODUCTION

This report has been prepared by Calibre Consulting to support the Development Application for the Stage 1 Bulk Earth Works at Station Street, Menangle.

This report details a stormwater management strategy based on water sensitive urban design (WSUD) principles. The key objectives of the strategy are to:

- Link water infrastructure effectively to minimise the impact of the development upon the watercycle.
- Protect the subdivision and downstream development from flooding.
- Protect receiving water quality.
- Provide a design consistent with requirements specified in this report at Section 2 – Relevant Policies and Guidelines.

1.1 SITE DESCRIPTION

The site locality of the site is shown in Figure 1.

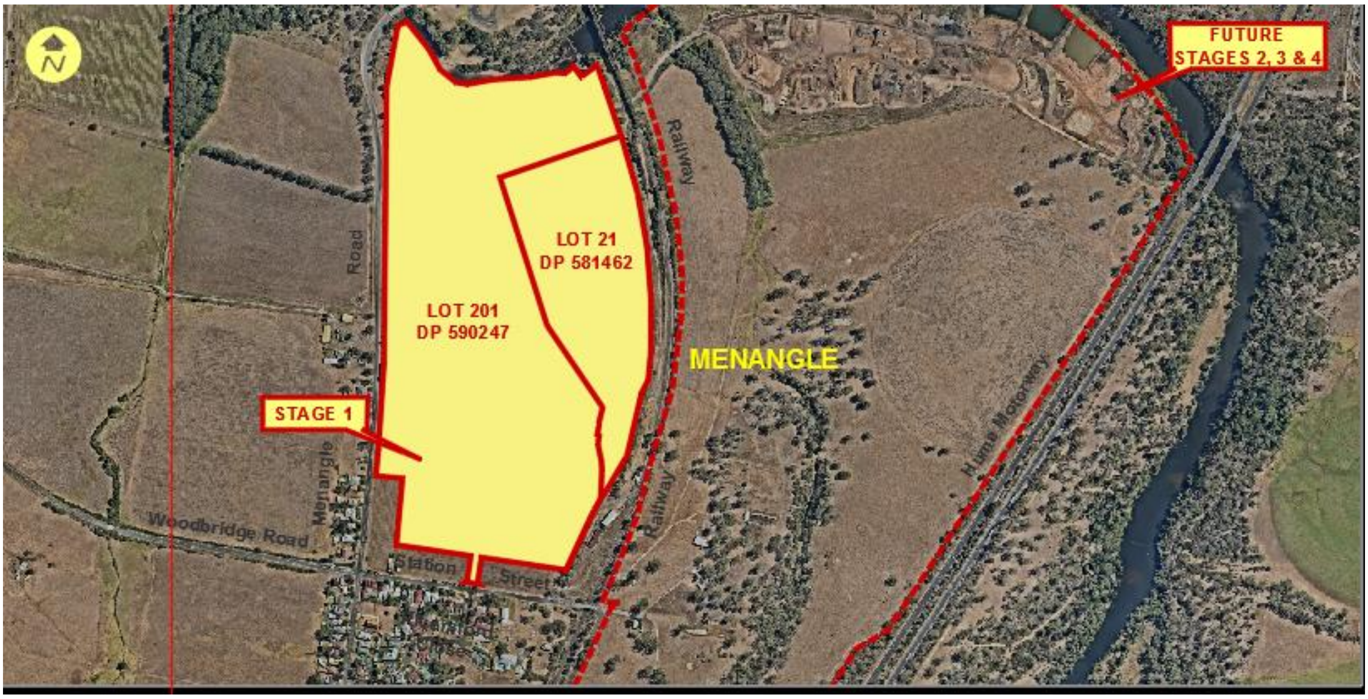

Figure 1 – Locality Plan

This proposed development is on Lot 201 DP 590247 located on station street, Menangle. The site is bounded to the East by the Railway, West by Menangle Road and South by Station Street. The drains to the Nepean River with grades typically of 3-7%.

A general layout plan of the proposed development is shown in Figure 2.

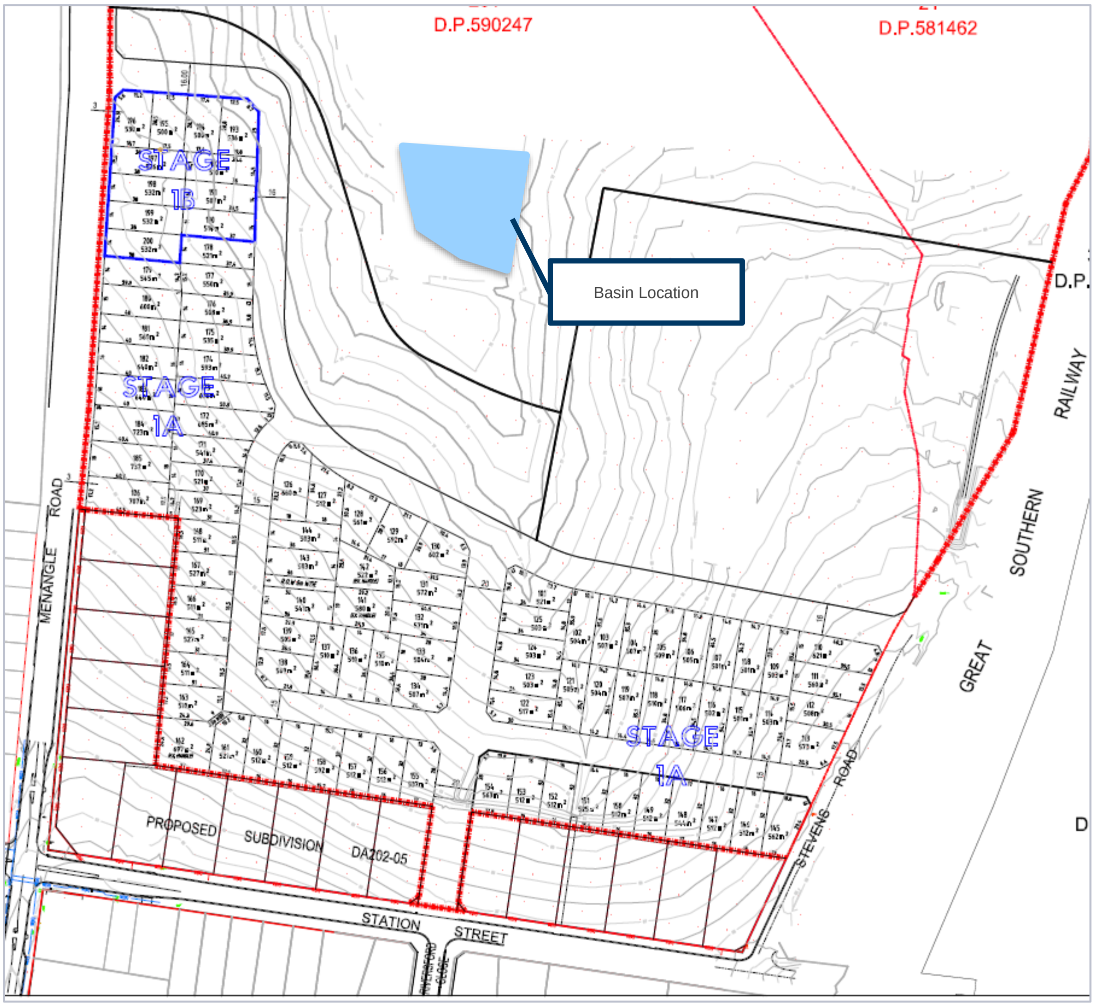

Figure 2 – Station Street, Menangle General Layout Plan

1.2 BACKGROUND

1.2.1 PLANNING PROPSAL STATION STREET MENANGLE GATEWAY DETERMINATION INFORMATION – FLOOD, HYDROLOGY, RIPARIAN AND WSUD ASSESSMENT (NPC 2014)

This report presented the flooding, hydrology, riparian and WSUD assessment for the agricultural land north and north east of the Menangle Township, comprising of Lot 201 DP 590247, Lot 21 DP 581462 and Part Lot 202 DP 590247.

The report identified the flood levels from the Upper Nepean River Flood Study with the 100yr Flood levels as 77.7m AHD at Menangle Road and 77.8m AHD upstream of the railway. The study identified the site was within the flood storage and flood fringe. The study assessed the potential flood impacts as a result of filling the development above the flood level and identified that the filling will have no significant impact because any loss of flood storage was offset by the soil extraction on the Southern bank of the River. The extraction rate to continue you beyond 2020 is 160,000 m^3/yr.

The study identified that the development will be filled above the regional 100 year flood level with the option to evacuate to areas above the PMF.

The study identified a WSUD strategy that included provisions for detention storages to manage peak flows, raingardens for water quality and design of discharges into riparian corridors to conform to best practices.

2 RELEVANT POLICIES AND GUIDELINES

2.1 COUNCIL REQUIREMENTS

2.1.1 *ENGINEERING DESIGN SPECIFICATION (WOLLONDILLY COUNCIL 2016)*

This specification contains technical design data for the calculation of flows, flood elevations and velocities along with technical standards for the design of drainage infrastructure. The hydrologic parameters include rainfall intensity charts and runoff parameters for flow estimation. The document also outlines hydraulic parameters and design requirements for pits, culverts and pipes.

2.2 *WATER MANAGEMENT ACT 2000*

The key NSW legislation governing the management of the state's water resources are the *Water Management Act 2000* and the *Water Act 1912*. The *Water Management Act 2000* is progressively replacing the *Water Act 1912* which represented outdated principles in water management.

The objective of the *Water Management Act 2000* is to provide sustainable and integrated management of water resources for the benefit of both present and future generations (NSW Office of Water, 2014). The NSW Office of Water administers the *Water Management Act 2000* and regulates controlled activities carried out around and on waterfront land.

Amendments have been made to the legislation since it was passed by NSW parliament in December 2000. In 2012, the *Guidelines for Riparian Corridors on Waterfront Land* (NSW Office of Water, 2012) allowed construction of online detention basins in riparian corridors. The revision also streamlined the categorisation of streams and permitted activities around the riparian corridors.

2.3 *OTHER RELEVANT SPECIFICATIONS*

- AS/NZ3500.3 Plumbing and Drainage - Stormwater Drainage
- Australian Rainfall & Runoff (Engineers Australia)
- Australian Runoff Quality (Engineers Australia)
- Technical Note: Interim Recommended Parameters for Stormwater Modelling – North-West and South-West Growth Centres
- Building Code of Australia Housing Provisions (current edition)
- Managing Urban Stormwater - Soils and Construction (current edition)
- Water Sensitive Urban Design in the Sydney Region Resource Kit (2003)
- Water Sensitive Urban Design Technical Guidelines for Western Sydney (2004)
- Map of Salinity Potential in Western Sydney (2002)
- WSROC Western Sydney Salinity Code of Practice (2004)

- DNR Local Government Salinity Initiative Publications (various)
- NSW Floodplain Development Manual (2005)
- *MUSIC* Manual (Version 5)
- *DRAINS* Manual.

3 STORMWATER QUANTITY MANAGEMENT

Urbanisation has the potential to impact the hydrology and hydraulics within the development site, downstream areas and watercourses. Urban stormwater is predominantly runoff from impervious areas such as roads, roofs, footpaths and car parks. Runoff from pervious areas such as gardens, lawns and vegetated open spaces contribute additional stormwater runoff during high intensity rainfall events.

Urbanised catchments are characterised with increased impervious areas which are smoother and allow stormwater to flow and concentrate faster. As a result, post-development catchments discharge greater stormwater volumes at higher flow rates leading to more frequent high flow events when stormwater runoff is not managed. The potential impacts of increased stormwater runoff quantity include:

- Increases in channel forming flows. The increased frequency of high flow events changes the channel forming flow and affects channel shape. This may damage or destroy important in-stream and bank habitats
- Increases in peak flows. Increased peak flows increase downstream flood risks and place greater pressure on downstream drainage infrastructure
- Increases in flood levels. Higher flood levels may pose risks to public safety and subdivision assets

As a result, a stormwater quantity management strategy is required to mitigate the risks and consequences of urbanisation on the existing catchments.

3.1 STORMWATER QUANTITY MANAGEMENT STRATEGY

The stormwater quantity management strategy aims to match post-development peak runoff to the permissible site discharge (PSD) in all storm events up to and including the 100 year storm event in accordance to Council's requirement for stormwater quantity. This will mitigate large scale flooding while maintaining the smaller channel forming flows and in-stream environments.

Stormwater quantity will be managed by detention components within the basin until such time as the regional basin is constructed. The locations of the detention basin is shown in Figure 2 and presented in the Bulk Earthworks plans.

3.2 HYDROLOGICAL MODELLING

The DRAINS model was used for the hydrological analysis of the Stage 1 Basin, including the future development within the catchment and the associated stormwater detention strategy. The modelling methodology is discussed in the following sections.

1.1.1 Hydrological Models

The DRAINS hydrological modelling used in the analysis using the ILSAX hydrological models.

i) ILSAX Hydrological Model Assumptions

Antecedent rainfall is that falling prior to the start of a storm event. It increases soil moisture levels and affects rates of infiltration. The Antecedent Moisture Condition is a parameter used in the loss calculations of the ILSAX hydrological model to specify the wetness or dryness of soils in a catchment at the start of a storm. The AMC number represents the starting point on an infiltration curve, as shown in the figure below. The curve defines the rate at which rainwater can penetrate into the soil. During a storm event, this will decrease, due to the soil becoming wetter and available storage in the soil decreasing.

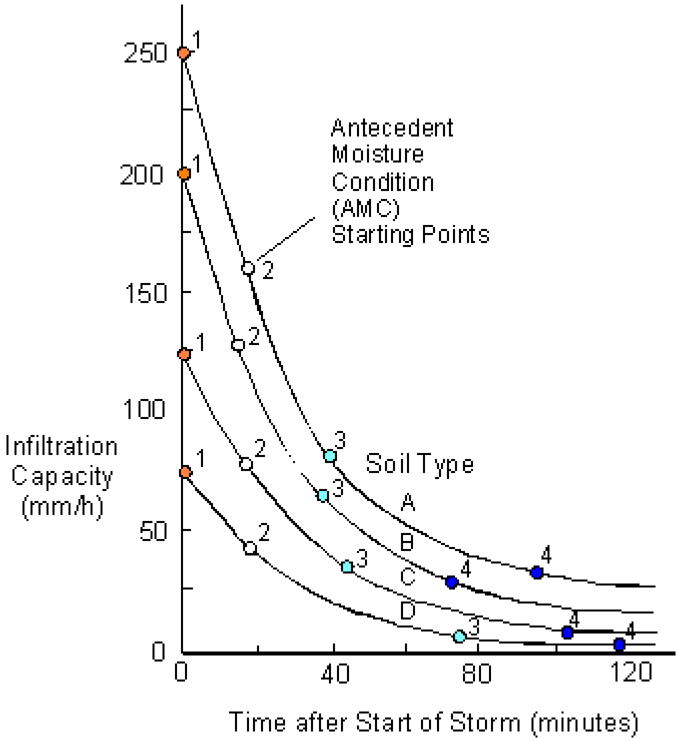

Figure 3 DRAINS Infiltration Curve

It has proved to be reasonably accurate to relate the AMC value of 1 to 4 to the rainfall in the previous 5 days, as shown in Table 1. The ILSAX model used in the analysis adopted a Soil Type 3 and antecedent moisture condition 3.

Table 1 DRAINS Antecedent Moisture Condition Values

Number	Description	Total Rainfall in 5 days (mm)
1	Completely Dry	0
2	Rather Dry	0 to 12.5
3	Rather Wet	12.5 to 25

The DRAINS model sub-catchment properties adopted for the hydrological modelling included:

- Paved area depression storage (impervious) 1 mm
- Supplementary area depression storage 0 mm
- Grassed area depression storage (pervious) 5 mm

Impervious areas used in the DRAINS modelling were 75% for the developed catchments. For external catchments, the impervious was based on the measure % of the existing development.

1.1.2 Rainfall Data

The rainfall intensities taken from the Wollondilly Shire Council Engineering Design Specifications were used for the modelling. Storm durations from 10 minutes to 9 hours were analysed.

1.1.3 Hydrological Model Catchments

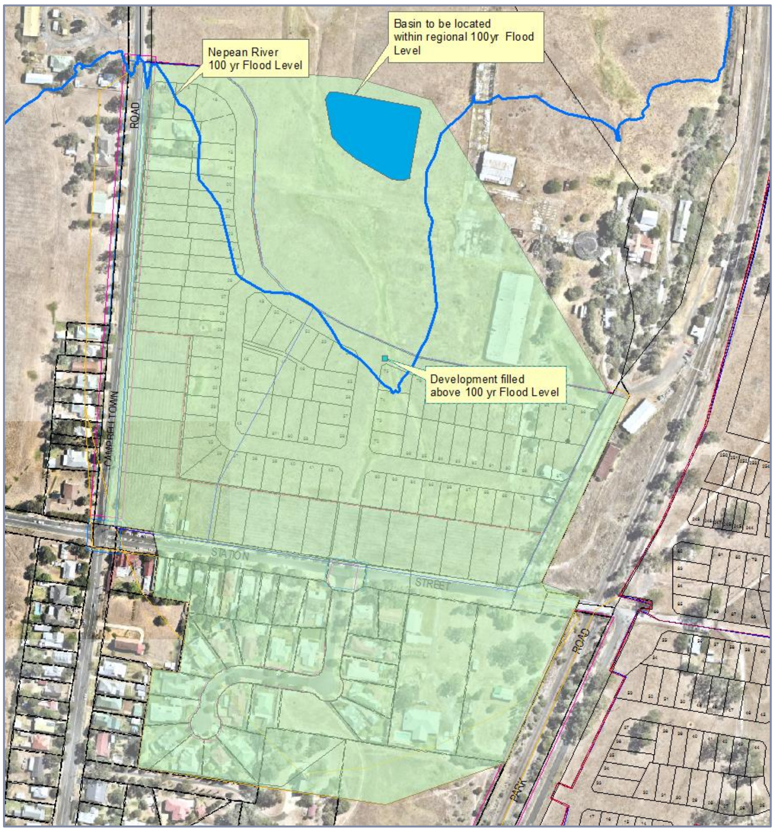

Figure 4 Basin Catchments

3.3 DEVELOPED CATCHMENTS

The existing catchments was determined from the topology of the land taken from both land survey and contour maps. These areas were then broken up, taking into consideration the locations of the proposed trunk drainage infrastructure. Existing catchment parameters were then applied to these sub-catchments.

The post-development catchments were then delineated based on the proposed street and lot layouts of the subdivisions and follow the designed pipe and overland flow path routes.

The catchments are shown in Figure 4.

The existing and post-development peak flows at the outlet of the catchments were calculated by the *DRAINS* model and are presented in Table 2. The existing or 'pre-development' peak flows are adopted as the PSD for the post-development scenario in accordance with Council requirements.

Table 2 – Existing and post-development (no detention) peak flows at catchment outlet

ARI (Years)	Permissible Site Discharge (m^3/s)	Post-development Peak Flow (m^3/s)
Basin 1		
2	2.15	3.6
20	5.5	6.5
100	6.8	7.9

The post-development peak flows without detention are higher than the pre-development peak flows for the storm events modelled. Detention of flows is required in order to reduce the peak post-development outflows to the PSD.

3.4 ATTENUATED POST-DEVELOPMENT MODELLING

The detention basin incorporated into the post-development *DRAINS* model for the development. The model incorporates the impact of the external catchments.

The post-development peak flows were then modelled incorporating the stage volume relationships of these detention basins. The storage utilised to attenuate the 100 year storm event is 3,500 m^3. The proposed sediment basin has a capacity of 6,500m^3 and could cater for all storm events up to and including the 100 year event.

The *DRAINS* model with attenuation was used to confirm that the stormwater management provided by the basins met requirements. The results are shown in Table 4. The discharge results for the basin/catchment are inclusive of the external catchments.

Table 4 –Catchment Modelling Results for Critical Storm Event

ARI (Years)	Permissible Site Discharge (m^3/s)	Attenuated Site/Basin Discharge (m^3/s)	Storage Utilised (m^3)
Basin 1			
2	2.7	2.0	600
20	5.5	4.1	2200
100	6.8	4.8	3500

The results of the modelling presented in Table 4 indicate that the post-development peak discharges do not exceed the PSD for all storm events.

3.5 EXEMPTION FROM DETENTION

The water quantity assessment has been undertaken on a site basis, the detention volumes specified in table manage the flow off the local site.

However the site is situated on the lower reaches of the tributary and a close proximity to the Nepean River. The Tributary has a significant catchment upstream of the site; it is considered best practice to not provide stormwater detention on the lower reaches of the catchment of major waterways to avoid aligning peaks. The understanding is that the lower catchment should drain at a shorter time of concentration and be through to the River before the peak of the upstream catchment arrives at the River. Typically providing detention and limiting the outflow also increases the duration of peak and will result in an increase in the existing peak flows of the overall catchment.

To avoid aggravating the existing regional stormwater flows it is recommended that the future basins be utilised for water quality treatment and allowed to drain freely without detention.

The reduced volumes will also reduce the maintenance burden of such basins.

4 STORMWATER QUALITY MANAGEMENT

The stormwater quality objectives established by Council will be achieved by treating frequent stormwater runoff flows. The catchments will drain to a bioretention basin for treatment prior to leaving the site.

4.1 TREATMENT MEASURES

4.1.1 BIORETENTION BASINS

Bioretention basins will be utilised as part of the water quality treatment strategy for the site and to receive flows from the minor drainage system. Bioretention basins remove sediments and attached pollutants through filtration via an engineered filter media and nutrient uptake via plant and vegetation root areas. The proposed bioretention basins will be located clear of the core riparian zones.

The bioretention basins incorporate an extended detention storage above the filter media. The filter depths and extended detention depths for each basin are nominated in Table 7.

Plantings within bioretention basins must be complementary to the adjacent local native plant communities of the riparian corridor and be able to withstand periods of inundation and some long dry periods between rain events. Suitable littoral or transitional plant species (DLWC, 1998) for the bioretention basins could include species such as: *Baumea juncea, Carex appressa, Carex fascicularis, Cyperus exaltatus, Carex polystachyus, Gahnia sieberana, Juncus prismatocarpus, Juncus usitatus, Lomandra longifolia, Paspalum distichum, and Schoenus brevifolius*.

Sediment must be controlled during construction at the source to prevent the filter from being clogged prematurely from construction run-off. Prior to installation of the filter media, the bioretention basin will typically be used as a sediment control basin and be turfed.

4.2 WATER QUALITY MODELLING

The performance of the proposed water quality treatment strategy has been modelled using the *MUSIC* water quality program (Version 6). Wollondilly Council do not specify *MUSIC* modelling parameters. As a result, the *MUSIC* modelling was undertaken based on parameters and land use types specified in the *Developer Handbook for Water Sensitive Urban Design* (Blacktown City Council, 2013).

The water quality objectives applicable to the development site are outlined in the in Table 5.

Table 5 – Water Quality Objectives

Pollutant	Reduction Target
Gross Pollutants	90 %
Total Suspended Solids (TSS)	85 %
Total Phosphorus	65 %
Total Nitrogen	45 %

4.3 WATER QUALITY TREATMENT

The bioretention configurations are summarised in Table . The locations of the basins are shown in Figure 4. The nominated bioretention filter areas are the minimum required to achieve the stormwater quality objectives.

Table 6 – Bioretention Basin Summary

Bioretention Basin	Filter Area (m^2)	Extended Detention Depth (mm)	Filter Media Depth (mm)
Basin 1	1000	300	600

The configuration of the proposed basin was determined through iterations using the *MUSIC* model to meet the required pollution reduction targets established. The results of modelling the water quality treatment system are shown in Table 7.

Table 7 – Pollutant Removal Rates – *MUSIC* Modelling Results

Pollutant	Water Quality Targets (% removal)	Pre-Treatment Pollutant Load (kg/year)	Post-Treatment Pollutant Load (kg/year)	Removal Rate Achieved (%)
Total Suspended Solids	85	3760	190	94.9
Total Phosphorous	65	8.03	1.97	75.5
Total Nitrogen	45	65	21	67.7
Gross Pollutants	90	789	0	100

The results of the *MUSIC* modelling outlined in this report demonstrate that the designed treatment train has been designed in accordance with the water quality objectives outlined in Table 5.

4.4 CONSTRUCTION STAGING

4.4.1 PHASE 1: CONSTRUCTION OF BULK EARTHWORKS

The earthworks will utilise swales to direct flows to the bulk earthworks basins in accordance to *Managing Urban Stormwater – Soils and Construction* (Landcom, 2004) which is also commonly known as the Landcom 'Blue Book'. Sedimentation control during construction is critical to protect the downstream environment of the creek system.

4.4.2 PHASE 2: CIVIL WORKS PHASE

Initially the proposed bulk earthworks basins will be used as sediment basins during the construction of the civil works within the developments. Silt fences are to be erected around the outside of the disturbed areas to exclude silt and fencing around the basins to ensure access is restricted. It is proposed that the swales and sediment basins will manage sediments and pollutants off the site during the construction process.

Protective erosion and sediment control measures are to remain in place and function as temporary sediment basins for the duration of the construction phase, or until sufficient upstream sediment controls have been installed. Access to the sediment basins is to be restricted throughout construction.

4.4.3 PHASE 3: BUILDING CONSTRUCTION PHASE

Road and drainage construction has been completed and the upstream construction work is deemed to be at a suitably advanced stage. Earthworks and shaping to create the layout and functional elements of the sediment basins will be undertaken. The basin batters and base will be turfed and outlet configuration altered to provide dry sedimentation basins and detention volume to support the roads.

4.4.4 PHASE 4: OPERATIONAL PHASE

When all upstream building activities have been substantially completed (approximately 80%) the bioretention basins are to be commissioned. The following works are to be undertaken:

- Remove from site any silt and sediment, temporary turf and underlay (if installed during interim basin construction phase), install subsoil drainage, outlet structures and filter media.
- Supply, replacement and shape sandy-loam media for infiltration bed to establish final media bed level.
- Undertake final planting of media bed with nominated emergent aquatic species.

Following construction activities regular inspections of the bioretention basins are required to ensure that the vegetation establishes and the properties of the filter media remain effective.

5 FLOOD LEVELS

The flood assessment for the planning proposal for Station Street prepared by NPC (2014) identified the Nepean River regional flood levels as 77.7m AHD at Menangle Road and 77.8m AHD upstream of the railway for the 100 yr storm event. The flood study of the Nepean River prepared by Worley Parson (2015) provided 100 year flood levels of 78.1m at the Railway. An updated flood study by NPC (2016) identified a 100 year flood level of 78.0m AHD west of the railway line.

The proposal has allowed for the filling of the development to ensure that the floor levels are 500mm above the regional flood level. This will require fill greater than 1m along the areas affected by the regional flood. To reduce the fill required, the basin has been located within the regional flood level. The peak storm event for the local catchments (including upstream external catchments) is typical 45min – 1 hour, the regional storm event for the Nepean River is typically several hours to days. The intention is to design the detention/water quality basins to detain and treat the local storm event and ensure the existing flow rates are not aggravated as a result of the proposed development. The basin will be in operation well before the regional flood level is at its peak flood level.

The site is within the Nepean River flood storage and flood fringe areas. The potential flood impacts as a result of filling the development above the flood level will have no significant impact because any loss of flood storage was offset by the soil extraction on the Southern bank of the River.

6 CONCLUSION

Hydrological modelling has shown the need to implement water quantity measures in the development to meet Wollondilly Council requirements. However it is suggested that the site be considered exempt from, detention due to the close proximity to the Nepean River. A stormwater management strategy has been designed to protect the receiving waters from water quality impacts in support of future Development Applications.

The strategy meets the requirements detailed in Section 2 – Relevant Policies and Guidelines. The strategy incorporates:

- Protecting downstream receiving waters and the subdivision from flooding.
- Treating post-development stormwater runoff quality with water sensitive urban design features such as rainwater tanks, gross pollutant traps and bioretention basins. The *MUSIC* modelling demonstrates that the designed treatment train will achieve the water quality targets.