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Eastwood Shopping Centre Redevelopment

Stormwater Management Report

COMMERCIAL IN CONFIDENCE

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REFERENCES

Calibre Consulting (NSW) Pty Ltd [2016]: Eastwood Town Centre Redevelopment – Flood Study, July 2016

Jeffery and Katauskas Pty Ltd [2007]: Geotechnical Investigation for Proposed Redevelopment of Shopping Centre at Corner Rutledge and Trelawney Streets, Eastwood NSW, 1 November 2007

City of Ryde Council [2015]: Development Control Plan 2014 Part 8.2 Stormwater and Floodplain Management

City of Ryde Council [2015]: Development Control Plan 2014 Part 8.2 Stormwater Management Technical Manual

City of Ryde Council [2015]: Development Control Plan 2014 Part 8.2 WSUD Guidelines

Landcom [2004]: *Managing Urban Stormwater – Soils and Construction*, 4th Edition, March 2004

Institution of Engineers Australia [1987]: *Australian Rainfall and Runoff*

1 INTRODUCTION

It is proposed to redevelop the Eastwood Shopping Centre at 144-186 Rowe Street, Eastwood in NSW. The site is currently occupied by a several commercial & retail buildings. A mixed-use development is being proposed consisting of 4 levels of basement car parking, 2 levels of retail / commercial, and up to 13 levels of residential apartments, with associated vehicular access and goods loading/unloading facilities, landscaping and services.

Calibre Consulting has been engaged to prepare concept plans and report on stormwater management for the site in support of a Development Application to City of Ryde Council. This report addresses potential soil and water management issues for the proposed site including:

- Erosion and sediment controls during construction
- Site stormwater drainage, and
- Water Quality controls.

Copies of the concept plans have been provided in Appendix B.

2 SITE DESCRIPTION

The real property description of the site consists of multiple properties as shown on the survey plans and includes:

Lot 201 on DP 1134152
Lot 1 on DP 331280
Lot 8 on DP 1098697
Lot A on DP 317789
Lot 1 on DP 173607
Lot 7 on DP 656027
Lot 1 on DP 211809
Lot 1 DP 105344
Lots 1 and 2 on DP 583398
Lot 1 on DP 315919
Lot A on DP 342118
Lot Pt25 on DP 4321
Lot A on DP 374497
Lots 1, 2 and 3 on DP 1082714
Lots 1 and 2 on DP 15579

The total area of the site is approximately 12,551 sq. metres (1.255 hectares).

The site is bounded by Rutledge Street to the south, Rowe Street to the north, West Parade to the east, and other properties to the west. Several right-of-way easements through properties west of the site provide access from Trelawney Street to the west. Rutledge Street falls to the east at an average slope of approximately 0.8%. West Parade falls towards the north with an average slope of approximately 8.1%. The western end of Rowe Street falls at approximately 0.9% to the east to a bend in the road and then continues to fall to the north. The eastern extension of Rowe Street is a mall with very flat gradients and no apparent overland flow paths.

The existing site is currently fully developed.

A locality map of the site is shown in Figure 2-1 below.

Figure 2-1: Site Locality Map (Image Source: Google©)

3 CONSTRUCTION PHASE SOIL AND WATER MANAGEMENT

During construction, soil erosion and sedimentation control measures will be installed in all areas disturbed and affected by construction activities to prevent silt and sediment from leaving the construction site. A concept plan for Erosion and Sediment Control for the site has been prepared and is included in Appendix B. Further details of these measures will be prepared and provided as part of the Civil Design Drawings for Construction Certificate.

All construction phase erosion and sediment control measures will be provided and installed in accordance with Hornsby Shire Council's guidelines and Landcom's "Managing Urban Stormwater - Soils and Construction" [2004].

3.1 SITE ACCESS FOR CONSTRUCTION

Construction vehicles can access the site from Rutledge Street or West Parade, using existing vehicle crossings.

Soil adhering to truck wheels will be prevented from leaving the site by the use of truck shaker grids. These will be located at the construction exits so that all trucks leaving the site may be inspected and cleaned before leaving the site. Sediment will be scraped off the shaker grid on a regular basis. The frequency of sediment removal will depend on the rate at which it collects. Typically, the shaker grid would be scraped off daily during bulk earthworks activities and weekly once construction starts.

3.2 PERIMETER PROTECTION

Until all disturbed surfaces are stabilised, the transport of sediment will be minimised by the installation of sediment fences along the three down-slope boundaries. Sediment collected by the fences will be removed regularly to prevent the fence from collapsing.

3.3 GUTTER AND OUTLET PROTECTION

One or more temporary portable sediment tanks or settling pits will be utilised at the lowest point of the site. The captured water will typically contain silt and suspended soil particles, which must be removed before discharge from the site. The portable tank has two chambers. Stormwater runoff within the site will be pumped into the main collection chamber where the sediment settles. Settlement of finer particles will be accelerated by the addition of a flocculating agent such as alum. The water will then pass through a filter medium into a pump chamber. The pump located in the pump chamber will then discharge the water into the nearest stormwater pit in Rowe Street or West Parade.

Sandbag filters will be provided in the gutter in frontage streets upstream of each existing street gully pit as additional protection against silt from the site being washed downstream.

3.4 DUST CONTROL

Dust control measures are to be implemented during all periods of earth works, demolition, excavation and construction in accordance with the requirements of the NSW Department of Environment and Conservation (DEC).

Airborne dust particles are generated in a construction site as a result of construction activity, vehicular and pedestrian traffic movements, or strong wind across bare earth or dusty surfaces. It is ultimately controlled by the completion of construction work, stabilisation of exposed earth surfaces (by paving, landscaping, etc.) and after final site clean-up.

During construction, dust generation can be minimised by applying the following dust control measures:

3.4.1 BARE EARTH SURFACES

Bare earth surfaces will be kept damp during construction activity by spraying water from water trucks or hand-held hoses. Water for this purpose will be obtained under licence from street hydrants or from internal water supply.

Nominated site personnel will be assigned the task of monitoring the environmental conditions to determine the frequency of water application. Water is to be applied sufficiently to prevent dust particles becoming airborne but not enough to make the site muddy or to hamper free movement of vehicles.

At the end of each working day in dry conditions, a final application of water will be sprayed over bare earth surfaces to reduce dust transmission during the night.

3.4.2 CONSTRUCTED SURFACES

Workplace Health and Safety regulations stipulate the regular collection of rubbish from site into skips for disposal to approved waste depots. As part of this operation, construction surfaces will be swept regularly (typically weekly, but as site conditions dictate).

Skips for the collection of rubbish will be located in areas with suitable truck access. If these areas are exposed to the wind, they will be kept covered to prevent dust (and other rubbish) from being picked up and conveyed by wind.

3.4.3 TRANSPORTED MATERIALS

Materials likely to generate dust will be transported to or from site under cover and dampened to prevent dust from being picked up and transported by wind.

4 GROUNDWATER AND SEEPAGE CONTROL

A preliminary geotechnical investigation has been carried out by Jeffery and Katauskas [Jeffery & Katauskas 2007] for the proposed development site. According to the geotechnical report, subsurface conditions will consist of clay and silty clay over weathered shale and siltstone. The report states: "… the subsurface profile as a whole is comprised of relatively low permeability strata…." and that groundwater seepage will occur at the soil/rock interface and through joints and bedding partings within the rock, which may increase during and following rainfall. They recommend to manage the seepage during construction using a combination of gravity drainage and conventional sump and pump techniques. A sump and pump will be used to periodically remove seepage water from the basement excavation. Water that is pumped out during construction will be treated in a similar fashion to site stormwater runoff, as described in Section 3.3, before discharge from site.

After construction, a pumped drainage system will be provided under the lowest basement floor to collect and pump out ongoing seepage which would otherwise result in unacceptable damp conditions within the basement. Drainage points along the basement wall perimeter will be installed to direct seepage into a collection point for pumping out into the Council stormwater drainage system. Inflow rates are expected to be low, given the relatively impervious nature of the soils.

Given the low permeability of the clay and weathered rock, the report concludes that the effect on the regional groundwater table will be minimal. Seepage rates will be more accurately estimated by borehole drilling following demolition, and confirmed on site during excavation. Given the anticipated low inflow rates, it is anticipated that a licence for groundwater extraction from the Office of Water will not be required.

5 FLOOD AFFECTATION

For detailed information on existing flooding and impacts of the proposed development on flooding around the site, reference should be made to the separate Flood Study that has been prepared in support of this Development Application [Calibre 2016].

The report shows that the site is currently unaffected by flooding on any of its street frontages, and the proposed development would have no impact on flood levels in the area.

As discussed in Section 6.3, City of Ryde Council requested that as much as possible of the catchment currently draining towards Rowe Street Mall should be redirected to West Parade to alleviate flooding in Rowe Street Mall. This scenario has also been modelled in the flood report.

The flood report makes recommendations for floor levels to provide freeboard above the 100-year ARI flood levels in accordance with Part 8.2 of City of Ryde Council's Development Control Plan 2014.

6 STORMWATER DRAINAGE

6.1 RAINFALL TERMINOLOGY

Throughout this report, several terms are used to describe rainfall statistical data.

Rainfall intensities have been measured and collated by the Bureau of Meteorology over many years in order to determine the statistical relationship between rainfall of a particular intensity and the frequency of its occurrence. The probability that a particular intensity might be exceeded in a storm in any one year is denoted as its *Annual Exceedance Probability (AEP)*. Thus an intensity which has an AEP of 1% has a probability of 0.01 of being exceeded in any one year. This may also be considered as the intensity that might be exceeded on average once every 100 years (the inverse of 0.01). This intensity can thus be termed as the 100-year *Average Recurrence Interval (ARI)* intensity, and the greatest rate of runoff generated from this rainfall would be termed the Q100 peak runoff.

The absolute worst case flood risk does not rely on extrapolation of rainfall records, but on the physical capacity to generate rainfall based on climatic considerations. The *Probable Maximum Precipitation (PMP)* is defined by the Bureau of Meteorology as the greatest depth of rainfall that is physically possible according to meteorological constraints for a given duration for a given size storm area at a particular location at a particular time of year, with no allowance for long-term climatic trends. The most extreme flood generated by any storm duration at a particular site is called the *Probable Maximum Flood (PMF)*. The PMF is commonly considered to be approximately 10,000 years ARI.

This report does not consider PMP rainfall on the site.

6.2 GENERAL DESIGN PRINCIPLES

Stormwater drainage for the site will be designed in accordance with:

- The Institution of Engineers, Australia publication “Australian Rainfall and Runoff” (1987 Edition), Volumes 1 and 2 [AR&R 1987];
- The relevant Australian Standards and Codes of Practice;
- City of Ryde Council’s Development Control Plan 2014 Part 8.2 Stormwater and Floodplain Management incorporating a Stormwater Management Technical Manual and WSUD Guidelines; and
- Accepted engineering practice.

Council’s DCP requires the attenuation of peak runoff from the site using On-Site Detention (OSD), the capture and on-site use of roofwater in tanks, and the improvement of the quality of stormwater discharge using Water Sensitive Urban Design principles.

The piped drainage system through the buildings and outside will be designed to convey the 100yr ARI storm runoff. The On-Site Stormwater Detention (OSD) tanks will be designed to have sufficient capacity to attenuate runoff from the 100yr ARI storm so that the peak discharge does not exceed the 5-year ARI runoff from the developed catchment. Overland flow paths will be provided with sufficient capacity to convey the full 100yr ARI storm runoff.

6.3 SITE STORMWATER DRAINAGE CONCEPT

The site, while large, is broken down into a number of separate catchments due to the articulation of the buildings. Accordingly, it cannot be considered as a single site for the purpose of OSD or WSUD modelling.

The site is broken up into 5 catchments numbered A to F, as shown on drawing C4-60 in Appendix C. Catchment A is below ground, and it will therefore require a pumped solution. Catchment B consists of a basement driveway, loading dock and a trapped uncovered catchment for which an on-site detention tank is not feasible, due to architectural constraints. Accordingly, this catchment will also require a pumped solution. Catchments C, D and E will have conventional OSD tanks with gravity discharge for the attenuated flow and also for emergency overflow. Catchment F is an elevated park, for which surface OSD storage will be feasible.

Stormwater runoff from the roofs will be drained into rainwater tanks located next to OSD tanks C, D and E for storage and re-use with their overflow draining into the adjoining OSD tanks. The runoff from landscaped and vegetated garden rooftops will be drained into bio-retention systems for initial treatment before draining into the OSD tank. Flows discharging from the OSD will pass through a cartridge-type water treatment unit for further treatment before discharging to Council's road drainage system. This is discussed further in Section 7.2.

The OSD concept drawings were submitted to City of Ryde Council for initial review and comment on 20 May 2016. Council responded on 24 June, and a copy of that correspondence is included in Appendix C. Council pointed out that basement detention systems should only be a last resort. In addition, Council asked that all site stormwater currently draining to the Rowe Street Mall be directed to West Parade instead. This is because there is flooding in the Mall under existing conditions, which cannot be readily resolved by drainage upgrades because the current drainage outlet passes beneath a building.

Catchment A draining to a basement tank cannot be reduced because of open space planning and a small area of basement ramp that is exposed to rainfall. However, catchment B draining to a second basement tank has been reduced by 40% to address Council's concerns. Further reduction will be targeted with detailed design.

All OSD and basement pumpout systems will discharge to Rowe Street and West Parade, with 62% of the site's discharge being directed towards West Parade and virtually no runoff being directed to the Rowe Street Mall. This is a significant change from the current situation, where 54% of the site catchment drains to the Rowe Street Mall and only 13% of the site catchment drains to West Parade. This improvement is only possible because of the linking together of separate tower buildings using bridges over walkways. This allows roofwater from buildings that would otherwise drain to Rowe Street Mall to be conveyed at a high level to buildings on the other side of walkways and from those buildings it is feasible to drain to West Parade. Without the bridges between buildings, the roofwater drainage would need to be conveyed in pipes below ground level, and there is insufficient fall across the site to grade those pipes to West Parade.

Concept plans showing the proposed site stormwater drainage systems are enclosed in Appendix C. Stormwater drainage from the roof and through the building including all connections into the rainwater tanks will be designed by the building hydraulic engineer. Detailed design drawings of the building hydraulics will be made available during submission of documents for Construction Certificate approval.

6.4 ON-SITE DETENTION

City of Ryde Council requires OSD systems to be installed to all redevelopment sites within the council area. According to their design guidelines the OSD is to be designed to store and release stormwater runoff so that the 100yr ARI post-development flow is no greater than the 5yr ARI flow from the developed site.

The catchment and drainage system including the OSD were modelled using the Drains software, which determines both the peak runoff generated by the site and the peak discharge from the OSD tank.

The Drains data files have been provided separately to Council in electronic form, as requested by Council.

Catchments:

The developed catchments are shown on the catchment plan C4-60 in Appendix C. The areas and their break-up in terms of surface type for each catchment are given in the following Table 6-1.

Table 6-1: Catchment Areas (in sq.m.)

CATCHMENT	ROOF	OTHER IMPERVIOUS	PERVIOUS	TOTAL
A		1040		**1040**
B		832		**832**
C	1542	913	75	**2530**
D	1570	2420	473	**4463**
E	1733	200	488	**2421**
F		460	460	**920**
SURFACE BYPASS		344		**344**
TOTALS	**4,845**	**6,209**	**1,496**	**12550**

Surface bypass represents only 2.7% of the gross site area and pervious landscaped area represents 12% of the gross site area.

Permissible Site Discharge (PSD):

Using the 'Drains' stormwater drainage modelling software in accordance with Council requirements, the 5yr ARI runoff from the developed catchment has been calculated and tabulated in Table 6-2 below.

Table 6-2: Permissible Discharge per catchment

CATCHMENT	AREA (sq.m.) TO TANK	AREA (sq.m.) BYPASSING TANK	DEVELOPED FLOW 5-YEAR ARI (l/sec)
A	1040	0	41
B	832	0	32
C	2530	0	99
D	4463	99	175
E	2421	15	82
F	920	230	42
TOTALS	**12,206**	**344**	**471**

Site Storage Requirement (SSR):

Applying the discharge rates above to the Drains model, the minimum OSD storage required for each catchment was calculated and summarised in the following Table 6-3. Where applicable, the size of the orifice that will control the discharge to limit the peak discharge to the PSD has also been indicated in the table.

Table 6-3: Site Storage Requirement per Catchment

CATCHMENT	STORAGE VOLUME (cu.m.)	ORIFICE DIAMETER (mm)
C	30.6	225
D	52.2	310
E	27.6	240
F	27.2	N/A

Note that an orifice size is not specified for catchment F. The flow will be divided between 4 outlets, and discharge will controlled by the outlet pipe size which is smaller than the required orifice diameter.

The position and shape of OSD tank E is not efficient. As part of detailed design of the layouts on ground floor prior to Construction Certificate, there may be scope for relocation which will possibly include part of catchment B (to reduce the required volume in basement storage) and would provide scope for improved efficiency in tank shape.

Basement OSD System:

The sizes of basement pumpout tanks are set not by OSD requirements, but by Council's requirement that such tanks have the capacity to store the full runoff from a 3-hour 100-year ARI design storm event. This equates to a total runoff of 121.5mm over the contributing catchment, as summarised in Table 6-4 below.

Table 6-4: Volumes of Basement Tanks

CATCHMENT	STORAGE VOLUME (cu.m.)
A	126.1
B	101.1

All basement pumpout pits will be fitted with dual pumps, each rated to the Permitted Site Discharge. Only one pump would normally be in operation, with the second pump on standby. In the event that water levels in the tanks rise above the specified volume, both pumps will operate together. If water levels continue to rise above an emergency level, a third pump rated to the 100-year ARI discharge will operate, discharging through a separate discharge line.

In the event of failure of power supply to the development, emergency power will be available to all pumps from diesel fuelled generators as part of the development's backup power system.

As discussed in Section 6.3, the size of basement tank A is predicated by open space requirements. For basement tank B, however, there may be a potential for reduction in size following detailed design of ground floor areas in conjunction with detailed design of OSD tank E.

7 WATER SENSITIVE URBAN DESIGN (WSUD)

Water Sensitive Urban Design aims to minimise the impact of urbanisation on the environment and ecology around and downstream of developments. Its main objectives are to reduce demands on potable water, reduce stormwater runoff volume and peak flows whilst improving its quality and maximising re-use before it leaves the site.

The extent of structures and hard pavements over the site limits the type of WSUD measures that would be suitable for this site. However, it is proposed that WSUD measures be incorporated wherever possible. These initiatives are in addition to other Environmentally Sustainable Design (ESD) initiatives that are being investigated as part of the proposed development.

WSUD initiatives being implemented include:

- Reduction to the peak stormwater discharge flows out of the site by means of an OSD system;
- Reduction to site runoff volume through rainwater harvesting and re-use;
- Treatment of stormwater runoff prior to discharge into Council's stormwater drainage system; and
- Reduction in potable water usage through the use of water saving taps, plumbing fixtures and rainwater re-use.

7.1 RAINWATER RE-USE

As previously mentioned the site will have three rainwater tanks with first flush systems to collect runoff from roof areas for reuse and to irrigate landscaped areas, therefore reducing consumption of reticulated potable water. The stored water will be pumped out using a separate reticulation system from the potable water reticulation system. All water will pass through a filtration system before pumping, to prevent blockage by litter or accumulation of sediment.

In times of dry periods where there is no rainfall, the tanks will switch to potable water main once the volume reduces below 10% of the storage capacity. During these times the RWTs will have up to 90% of their capacity available for additional detention storage in the next storm event.

The sizes of these rainwater tanks are summarised in the following table 7-1.

Table 7-1: Rainwater Tanks

LOCATION	TANK VOLUME (cu.m.)
Catchment C	28.1 to 73.5
Catchment D	30.0 to 81.8
Catchment E	25.8 to 71.2
TOTAL	**83.9 to 226.5**

The minimum figures listed in the above table are the volumes assumed for the MUSIC modelling described in the following sections. The minimum BASIX requirement is 100 cu.m. There is potential to increase the volume to the upper figures in the current space allocation. Actual final volumes would be determined based on landscaping irrigation demand as calculated by the landscaping consultant.

7.2 STORMWATER QUALITY MANAGEMENT

City of Ryde Council's DCP requires any stormwater drainage discharging directly to its drainage network or natural water courses to be treated sufficiently to achieve the treatment targets specified in their WSUD Guidelines.

Below is a summary of Council's treatment targets to be met.

Table 7-2: Stormwater Pollutant Reduction Targets

Stormwater Pollutant	Multi-unit dwellings and Commercial developments
Gross Pollutants	90%
Total Suspended Solids [TSS]	85%
Total Phosphorous [TP]	60%
Total Nitrogen [TN]	45%

To achieve these treatment targets, a combination of water quality improvement measures are proposed for the development. This includes rainwater tanks with first flush systems, bio-retention/rain garden systems, and OSD tanks fitted with an inlet trash basket, a trash screen at the outlet and cartridge type filtration units.

The following outlines a brief methodology on how Council's pollutant reduction targets will be achieved:

1. Three of the residential tower roofs drain into proposed rainwater tanks with a first flush system which will capture nutrients and sediment. Overflows from the rainwater tank will drain into the adjoining OSD tank.
2. Drainage from the roof gardens and landscaping, where possible, will be directed into bio-retention rain gardens at rooftop level. For the elevated garden above the main courtyard, the OSD storage will be on the surface, directed to non-trafficable edges.
3. Rainwater from other areas will drain directly to basement OSD tanks after filtration using enviropod type point source filters.
4. Within each of the above-ground OSD tanks will be a chamber containing a cartridge-type fines filtration system which removes the most challenging pollutants, including fine solids, soluble heavy metals, oil and total nutrients.
5. Treated water is then discharged into the nearest Council road drainage pit.

Cartridge-type filters have not been proposed for the basement pumpout tanks in the MUSIC modelling, but could be fitted if required.

The following Table 7-3 summarises the treatment methods assumed for each catchment.

Table 7-3: Treatment Methodologies assumed in MUSIC model

CATCHMENT	SURFACE AREAS (NOT ROOF)	ROOF AREAS	TERTIARY TREATMENT
A	Enviropod 200 micron filters		
B	Enviropod 200 micron filters		
C	Enviropod 200 micron filters	28.1 cu.m. RWT	10 Stormfilter 360 units (700mm head)
D	Enviropod 200 micron filters	30.0 cu.m. RWT	15 Stormfilter 360 units (700mm head)
E	Enviropod 200 micron filters	25.8m RWT	10 Stormfilter 360 units (700mm head)
F	Bio-retention 30 sq.m. 0.2m extended detention		1 Stormfilter 360 unit

With detailed design, bio-retention will be added to rooftop gardens to reduce the number of Stormfilter units required. This will require coordinated design with architect, landscape architect and structural design for slab setdowns. The current landscaping concept has included a 3m buffer zone between the public paths and the edge of the roof, for safety purposes. This allows wetlands planting, which is most beneficial for rain gardens, to be used without impacting on the amenity of the area.

For preliminary design purposes, the landscape design currently assumes 450mm depth of soil. For the modelling undertaken in MUSIC, it has been assumed that there will be 300mm of loam filter. Ideally, this should be increased to 400mm thickness of loam with 100mm interface layer over a 150mm thick drainage layer incorporating geotextile-sleeved subsoil drains. It is anticipated that setdowns between structural beams at the perimeters of the rooftop gardens will accommodate these bio-retention areas.

With detailed design including these bio-retention areas, it is expected that the number of Stormfilter 360 units will be significantly reduced, with consequent savings in capital and maintenance cost.

Additional information for the proposed treatment devices have been shown on the OSD details in Appendix C.

7.3 *MUSIC* MODELLING

A stormwater hydrology and pollution impact model was prepared for the proposed development using the Model for Urban Stormwater Improvement Conceptualisation (MUSIC) software. City of Ryde Council has not specified MUSIC analysis parameters in their DCP. Accordingly, the parameters set by Blacktown City Council, which are considered to be conservative, have been applied.

The catchment has therefore been modelled in MUSIC in accordance with the following guidelines and parameters:

a. Music version 6.1

b. Rainfall Station 66062 Sydney, 6 minute time step.

c. Sydney CMA Source Node(s) utilizing modified % impervious area, rainfall threshold, soil properties & pollutant concentrations.

d. Blacktown City Council approved Treatment Nodes.

e. No drainage routing between nodes.

The results from the MUSIC model are provided in Table 7-4 below.

Table 7-4: Stormwater Pollutant Reduction Results

Stormwater Pollutant	% Post Development Average Annual Load Reduction
Gross Pollutants	96.3%
Total Suspended Solids [TSS]	84.9%
Total Phosphorous [TP]	69.7%
Total Nitrogen [TN]	47.8%

As demonstrated in Table 7-4, the proposed water quality treatment system exceeds the water quality objectives required by City of Ryde for discharge into their drainage systems, summarised in Table 7-2. Details of the MUSIC model and stormwater treatment system can be found in Appendix A.

The computer file for the MUSIC analysis have been provided separately to Council in electronic format, as required under Council's guidelines.

8 SUMMARY

This report addresses the issues relating to soil and water management for the proposed development site as detailed in the Introduction. These are summarised as follows.

a) Soil erosion, sedimentation and dust controls will be implemented during construction in accordance with Council's guidelines and Landcom's "Managing Urban Stormwater - Soils and Construction" [2004]

b) The concept stormwater drainage design has been presented in the drawings enclosed in Appendix C for reference. The overall concept aims to reduce and control the site's runoff discharging into Council's stormwater drainage system in accordance with Council standards.

c) On-Site Detention is required for this site in accordance with City of Ryde Council guidelines, and excerpts from the relevant standards are included in Appendix A.

d) Correspondence with Council, which is included in Appendix B, has been taken into consideration in the developed concepts. Virtually all the stormwater discharge that used to flow towards Rowe Street Mall has been diverted towards West Parade to alleviate flooding in the Mall. This has been made possible by the high-level bridges between buildings.

e) The concept stormwater drainage design has been presented in the drawings enclosed in Appendix C for reference. The overall concept aims to discharge the attenuated flow from the OSD tanks to stormwater gully pits in Rowe Street and West Parade in accordance with Council guidelines. In an emergency, overflow would also be directed to the same street gullies. The peak runoff from the 100-year ARI storm event has been reduced to the developed 5-year ARI runoff from the site.

f) Council's stormwater quality treatment targets were achieved using a combination of point source filtration, bio-retention systems, trash baskets and cartridge type filtration systems. Minor adjustments to improve efficiencies will be made for Construction Certificate documentation.

APPENDICES

APPENDIX A REFERENCES AND RESULTS

Excerpts from City of Ryde Council standards

MUSIC Model Results

e. Where a multi dwelling housing development is proposed on a site that consolidates two or more lots and any adjoining upslope properties do not have the benefit of a drainage easement, the development must be designed to potentially accommodate a new drainage easement benefitting upstream properties.

f. The design and location of all drainage components must be visually unobtrusive and integrated with site landscaping to ensure they do not detract from the streetscape appearance of the development.

NOTE: Information to be submitted with a Development Application

- All development which affects the impervious footprint of the site or changes to landform, must demonstrate by way of a conceptual plan prepared in accordance with Section 3 of the Stormwater and Floodplain Management Technical Manual, the proposed means of the collection and conveyance of stormwater from the site, so as to demonstrate that stormwater management satisfies this Part.
- Development which is intended to utilise the existing drainage system, must submit documentation prepared by a suitably qualified person, demonstrating that the existing system is compliant with the Ryde DCP controls or otherwise detail the means to rectify the system to make it comply.

2.3 Stormwater Discharge from Property

Property drainage systems should ideally implement a gravity fed stormwater management system, which will eventually direct stormwater runoff to the lowest point of the site. Ideally the property drainage system should then seek to discharge to the public drainage network, comprised of either public drainage infrastructure (kerb and gutter, stormwater channels) or natural watercourses (streams and creeks).

OBJECTIVE

1. To ensure that the discharge of a stormwater runoff from property is undertaken in a controlled and sustainable manner that is not detrimental to downstream areas.

NOTE: *Schedule 1 Overview of Discharge points* provides guidance as to selecting an appropriate stormwater discharge point.

2.3.1 Preferred Discharge Point – Public Drainage Network or Natural Watercourse

The following controls only apply to property drainage systems which are to discharge to the public drainage network or natural watercourse.

CONTROLS

a. Stormwater runoff from property must be directed to either public drainage infrastructure, a natural watercourse or public reserve under gravity feed wherever possible, with the point of connection designed in accordance with Section 1.4.1 of the *Stormwater Technical Manual*.
b. Stormwater discharge from multi-residential dwellings, commercial, retail and industrial development on sites greater than 1000m^2 and within 30 metres of in-ground public drainage infrastructure, must extend this drainage infrastructure to the site, so as to enable a direct connection be made to this infrastructure.

This will generally require a report prepared by a suitably qualified and experienced engineer, of the existing stormwater management system and its capacity to handle the total (existing and proposed development) runoff from storm events up to the 100yr ARI storm event.

In the case of connecting to an existing on-site absorption system the design is to be accompanied with a report by a geotechnical engineer attesting to the absorption capacity of the system (including any necessary information such as an assessment of the infiltration of the soil profile, consideration of antecedent moisture conditions and performance over a variety of rainfall events) and demonstrating that the proposal will not have an adverse impact upon adjoining and/or downstream properties by the direction or concentration of stormwater on those properties.

The location of the existing stormwater drainage system must be shown on the drainage plans to be submitted in conjunction with the development application.

1.4 Onsite Stormwater Detention (OSD) Systems

An onsite detention (OSD) system seeks to mitigate the increasing rate of stormwater runoff generated by ongoing development in the City of Ryde catchment area.

OSD systems are designed to counteract the effect of each development within a catchment by restricting the rate of stormwater runoff discharged during large storm events. This restricted discharge rate requires a "buffer" storage tank/ basin to detain stormwater before slowly releasing it to the public drainage system. Typical OSD systems are shown in Figure 1-6 and Figure 1-7.

Refer to Section 2.4 (*Community Stormwater Management*) of the DCP - Part 7.3 (*Stormwater and Floodplain Management*) in relation as to when onsite detention is required in development.

1.4.1 Exemption from having to provide an OSD system.

Provision of an OSD system may be waived where:

a) The proposal is for a single dwelling or dual-occupancy and less than 35% of the site will be covered by impervious / hardened surfaces
b) The proposal is a one-off extension involving impervious surfaces (roof, driveway, paving, etc) totalling less than 80m^2.
c) The site is within the designated **possible** exclusion zone (marked on Council's mapping system) along the Parramatta and Lane Cove River foreshore subject to there being no known drainage problems in downstream properties.
d) The applicant can demonstrate to Council's satisfaction that if the total catchment containing the site were developed to its full potential, stormwater detention on the subject site would not be of benefit in reducing adverse flooding impacts on downstream roads, properties and open watercourses. This may be the case at the lower end of major catchments.
e) The downstream public drainage network has been upgraded to cater for the storm flows up to 100yr ARI being directed to it.
f) It is demonstrated that the property is subject to significant inundation (say over 50% inundation of the site due to a 100yr ARI storm event) or that it is impractical to provide an OSD storage facility out of or above this flow when the site is partially inundated OR OSD will not be required where the site of the development is located within a Council established 1 in 100 year ARI floodplain and that it can be demonstrated that lesser storm events will also flood the site. Otherwise it will be necessary to provide OSD to control the runoff for the minor storm events.
g) The implementation of OSD on the site cannot be achieved without adverse outcomes, in terms of planning, impracticality and amenity to occupants, upon consideration of all feasible options. Exemption from OSD in cases is required to be confirmed by Council.

1.4.2 General OSD Design Requirements

The following general requirements apply in the design of OSD systems.

a) The OSD system should be located prior to the point of discharge, generally in the lowest point of the site and located in a common area to facilitate access. This can possibly include a car park, open space area or even roof top areas where no underground storage is possible.
b) As much as possible of the site area is to drain through to the OSD system(s). A portion of the impervious area may discharge directly to Council's system if it cannot be drained to the storage facility, provided the PSD is reduced and SRR increased to compensate for the smaller catchment.
c) The maximum desirable extent of impervious surfaces bypassing the OSD system is 25% of the total impervious site area.
d) Where is it proposed for the site to discharge to the kerb and gutter, the PSD shall be restricted to 30L/s.
e) A positive covenant must be executed and registered against the title of the lots containing OSD systems to require maintenance of the system. This positive covenant must be on any linen plans for subdivision of the development. If no subdivision is proposed, the covenant shall be prepared prior to finalisation of the development.

Wherever the PSD shall be reduced (say restricted to 30L/s if discharging to kerb and gutter) the SSR must be increased accordingly.The following formula may be used to calculate the adjusted storage volume:

$$ModSSR = 1.55Ix\left(PSDperm^2x10\right)^{-0.731}x1.2x10^{-4}$$

Where;

I = Intensity of the 100yr – 2hr ARI storm event

= 56 mm/hr in Zone 1

= 51mm/hr in Zone 2 & Eastwood Catchment

Using the appropriate PSD rate and SSR rate based on the OSD catchment area, the OSD volume and orifice outlet size for the site can be determined by following the steps outlined in the On-site Detention Calculation Sheet contained in Appendix 3.

1.4.4 OSD Design - Detailed Method

The detailed method must be used in the following circumstances;

- Where the development does not satisfy the requirements for the simplified method above.
- Where Council considers the nature of the receiving system is too sensitive to warrant the simplified approach.
- Where the site conditions vary from those given in the simplified method.

The OSD must be designed to ensure the level of stormwater runoff discharged from the area of development must not to exceed the peak stormwater discharge arising from the post-developed works, during a 5 year ARI storm event.

To restrict post development flows to pre-development levels a detention basin for the design storms will be required to be modelled. Computational methods based on the approximate triangular method or the rational methods are not acceptable. It is recommended that a program in accordance with Section 3.1 is used.

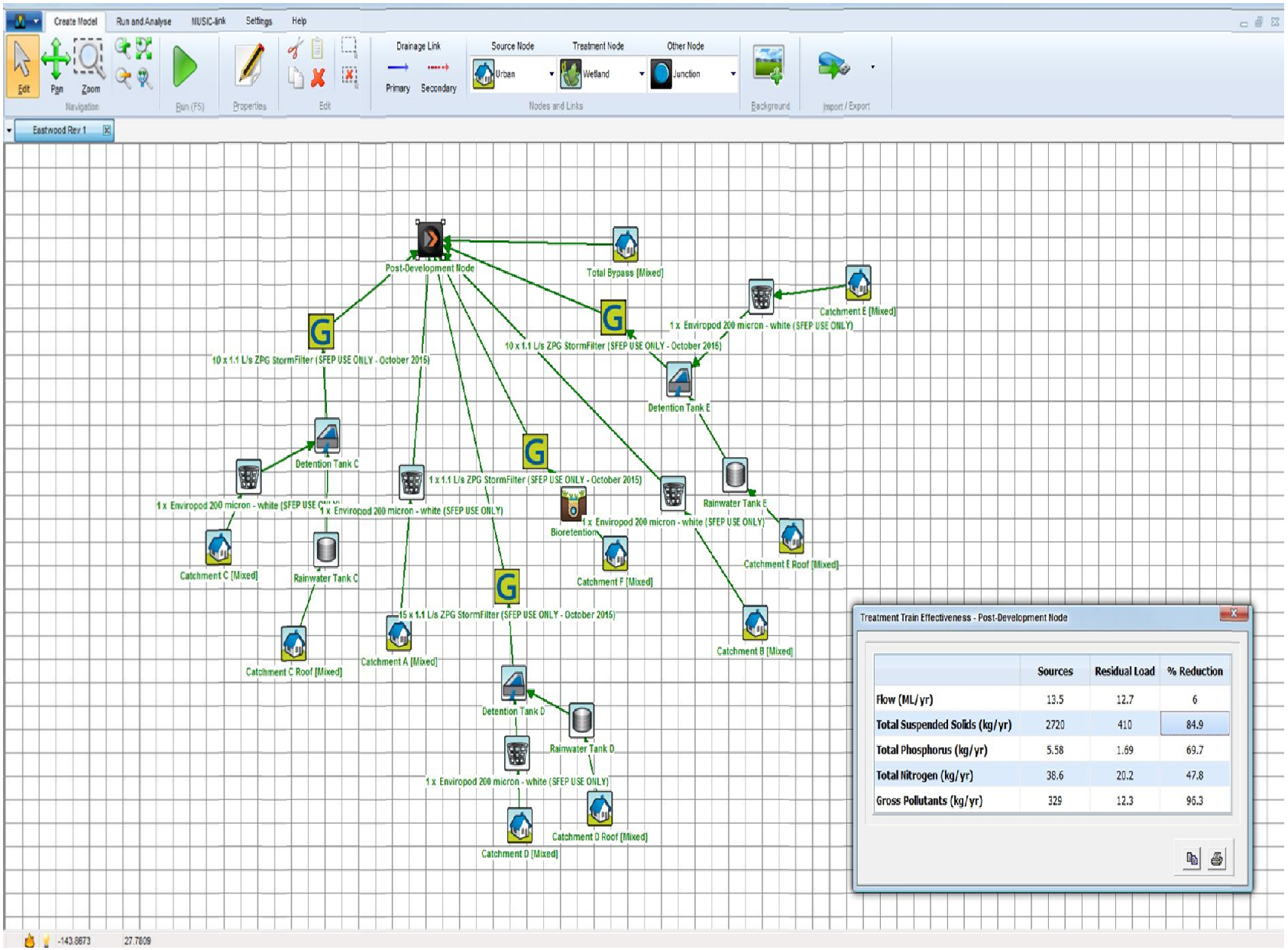
In cases where the site proposes discharge to the kerb and gutter, the point of discharge is to be limited to 30L/s in accordance with Section 1.3.1.

If the rate of discharge from the outlet of the OSD system is affected by tail water conditions from the receiving system, for example where the invert level of the orifice is lower than the surface level at the point of connection into the existing drainage system, then full hydraulic calculations will be required in accordance with Section 5 of this Manual.

1.4.5 Rainwater Tank Offsets

Rainwater tanks do not generally substitute for the storage capacity required for on-site detention. However, where a rainwater storage tank for water efficiency is incorporated into a stormwater drainage system for a single occupancy development and the tank is connected to an internal re-use system, the volume of the required on-site detention may be reduced by an equal amount up to a volume of 5,000 litres for sites less than 3000m^2. This provision will be in addition to any BASIX requirements.

If a rainwater storage system is proposed for a larger development, some on-site stormwater detention offset may be given. The amount of offset shall be calculated from a water balance model


Create Model
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Navigation
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Drainage Link
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Secondary
Source Node
Urban
Treatment Node
Wetland
Other Node
Junction
Nodes and Links
Background
Import / Export
Eastwood Rev 1
Post-Development Node
Total Bypass [Mixed]
Catchment E [Mixed]
1 x Enviropod 200 micron - white (SFEP USE ONLY)
10 x 1.1 L/s ZPG StormFilter (SFEP USE ONLY - October 2015)
10 x 1.1 L/s ZPG StormFilter (SFEP USE ONLY - October 2015)
Detention Tank E
Detention Tank C
1 x 1.1 L/s ZPG StormFilter (SFEP USE ONLY - October 2015)
1 x Enviropod 200 micron - white (SFEP USE ONLY)
Rainwater Tank E
Bioretention
1 x Enviropod 200 micron - white (SFEP USE ONLY)
Catchment E Roof [Mixed]
Catchment C [Mixed]
Rainwater Tank C
Catchment F [Mixed]
15 x 1.1 L/s ZPG StormFilter (SFEP USE ONLY - October 2015)
Catchment B [Mixed]
Catchment C Roof [Mixed]
Catchment A [Mixed]
Detention Tank D
Rainwater Tank D
1 x Enviropod 200 micron - white (SFEP USE ONLY)
Catchment D Roof [Mixed]
Catchment D [Mixed]
Treatment Train Effectiveness - Post-Development Node
Sources
Residual Load
% Reduction
Flow (ML/yr) 13.5 12.7 6
Total Suspended Solids (kg/yr) 2720 410 84.9
Total Phosphorus (kg/yr) 5.58 1.69 69.7
Total Nitrogen (kg/yr) 38.6 20.2 47.8
Gross Pollutants (kg/yr) 329 12.3 96.3
-143.8673
27.7809

APPENDIX B COUNCIL CORRESPONDENCE

Email dated 24 June 2016.

Con Vink

From: Daniel Pearse <DPearse@ryde.nsw.gov.au>
Sent: Friday, 24 June 2016 6:39 PM
To: Con Vink
Cc: Guna Veerasingham; Tilak Goonetilleke
Subject: Proposed Eastwood Centre - Council review of drainage scheme
Attachments: Eastwood Centre - Drainage and flood map.pdf

Con,

Firstly, I much apologise for the delay in getting back to you. We have been quite busy with development in the Ryde area, court cases and so on.

I have reviewed the plans and obtained comments from the Public Works section in regards to the conceptual system. Attached is also output from our mapping system showing an indicative layout of the public drainage system as well as the flood risk layer depicting areas of affectation. The flood risk mapping layer is produced from a combination of flood events up to the PMF, with light blue representing low risk, medium blue equal to medium risk and dark blue representing high risk areas. Broadly the medium blue areas are the extent of 100yr event. I have had some familiarity with the project with discussions from our client managers and discussed the information with our City Works & Infrastructure (CW&I) stormwater assets section.

Below is a figure of the proposed catchment and mapped inground drainage infrastructure surrounding the property.

The following general points are to be noted;

- The proposal should seek to discharge to public drainage infrastructure located in West Parade (highly preferable and where ever possible) and the drainage line continuing down the “The Avenue” - given that this infrastructure presents an easier upgrade path if required.
- The drainage line in Trelawney Street as well as the line draining Eastwood Mall (northeast of your catchment “E”) should be avoided given both lines traverse private property, are constructed over and therefore have a very limited level of service and ability to be upgraded.

- In accordance with the DCP, the OSD must be designed in accordance with the detailed design method which requires that the detention system limit the site discharge to be no greater than the 5yr ARI post-developed discharge rate. Accordingly this will require full DRAINS modelling of the development and the data and input files to be provided with the application.
- You should be aware that the surrounding area is significantly affected by flooding and overland flow. It is therefore warranted that the drainage system and development have a comprehension of these flows to address in the drainage design (potential submerged discharge points) as well as flood protection. I note that our flood mapping system indicates some flood/ overland flow in West Parade in the region of the loading dock access and therefore the potential for a threshold crest before descent may be warranted in this location. Detailed flood information can be obtained from Council on application and it is warranted that this be investigated. Note that driveways leading into basement levels warrant the crest threshold to be at the PMF level.

In regards to the proposed drainage system, the following comments are made;

- The multitude of OSD tanks is not preferred as it can exacerbate maintenance of the system.
- Given the propensity of flooding in the area, it is crucial that the final design consider the potential for submerged outlets at the point of discharge.
- The Council DCP is very particular about the use of pump systems. Specifically the controls limit the use of such systems to for drainage of basement garage ramps only. Generally the use of such systems is a measure of last resort. In this case, drainage of the loading dock access ramp is permissible however areas above the point of discharge (which could feasibly drain under gravity) should not be directed to a pump system. Similarly the ground level of the centre courtyard must drain via a gravity.
- In regards to the use of the pump system for the central courtyard, the arrangement will be considered if there is a corresponding planning benefit, which will be considered in the merits of the development application. It is essential though that the application provide a thorough justification for this non-compliance and it would be warranted that a risk assessment of the arrangement, together with maintenance and backup power details, be provided in the development documentation. The plans are also to provide surface level details of the courtyard demonstrating there are satisfactory freeboards above the access points to lower levels.
- It is crucial that the location of OSD storage units have provision for a failure mode, ideally providing a defined overland flow path to public drainage infrastructure. As such OSD tank “F” should ideally have a clear flowpath through the courtyard to Rowe Street. OSD “D” should be located in proximity to West Parade.
- The development will require the implementation of a WSUD elements. Refer to Section 3 of the DCP Part 8.2 (Stormwater and Floodplain Management).

Please feel free to contact me should you have any further questions to these matters.

Daniel Pearse | Senior Development Engineer – Major Development
City Strategy and Planning.
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On Friday 13 May | Civic Centre closed to the public and Customer Service operating from 1 Pope Street, Ryde
From Monday 16 May – End of June | Customer Service and the Ryde Planning and Business

APPENDIX C DRAWINGS

15-003643-C0-00	COVER SHEET, LOCALITY PLAN AND DRAWING LIST
15-003643-C0-01	SITE PLAN
15-003643-C0-02	GENERAL NOTES AND LEGEND
15-003643-C1-10	SEDIMENTATION AND EROSION CONTROL PLAN
15-003643-C1-15	EROSION AND SEDIMENT CONTROL DETAILS
15-003643-C2-00	GENERAL ARRANGEMENT PLAN SHEET 1 OF 3
15-003643-C2-01	GENERAL ARRANGEMENT PLAN SHEET 2 OF 3
15-003643-C2-02	GENERAL ARRANGEMENT PLAN SHEET 3 OF 3
15-003643-C3-80	CIVIL WORKS DETAILS
15-003643-C4-20	STORMWATER DRAINAGE DETAILS
15-003643-C4-30	OSD STORMWATER GENERAL NOTES AND DETAILS
15-003643-C4-31	OSD STORMWATER TANKS A & B – PLAN & SECTION
15-003643-C4-32	OSD STORMWATER TANKS C & D – PLAN & SECTION
15-003643-C4-33	OSD STORMWATER TANKS E & F – PLAN & SECTION
15-003643-C4-60	STORMWATER DRAINAGE CATCHMENT PLAN