# WESTERN SYDNEY PARKLANDS TRUST


# CIVIL ENGINEERING REPORT
# LIGHT HORSE INTERCHANGE BUSINESS HUB, EASTERN CREEK
# STATE SIGNIFICANT DEVELOPMENT APPLICATION (SSD 9667)

## Revision 4 – For SSDA
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# 1. INTRODUCTION

## 1.1. General

Henry & Hymas has been engaged by Western Sydney Parklands Trust (WSPT) to prepare this Civil Engineering Report (Report) to satisfy civil engineering matters in support of the proposed State Significant Development Application to be lodged for the Light Horse Interchange Business Hub.

This Report aims to provide a summary on key civil engineering design elements of the proposed development application:

- General site locality, topography and existing characteristics;
- Proposed and existing infrastructure and services;
- Roads and transportation ;
- Proposed Site Works – earthworks and retaining walls;
- Stormwater management – flooding, water quality and quantity;
- Sediment and Erosion;
- Specific items raised in the Secretary's Environmental Assessment Requirements (SEARs) and authority submissions.

This Report has been prepared in conjunction with a set of Civil Engineering Drawings which show the general proposed infrastructure design for the development.

As the development is deemed a State Significant Development (SSD), the consenting authority is the NSW Department of Planning and Environment. The development is located within the local government area of Blacktown City Council (BCC), and whilst the Council development control plans (DCP) does not apply to the SSDA, the DCP and policy requirements pertaining to the Council were considered in the design. BCC was consulted several times during the early approval design phase of the development, particularly relating to matters regarding stormwater and flooding.

The NSW Department of Planning and Environment has provided Secretary's Environmental Assessment Requirements (SEARs) dated 7th November 2018 (Ref: SSD 9667). In addition to providing a general summary of civil engineering aspects of the project, this report addresses the following relevant SEARs items below. Detailed on how these SEARs items have been addressed can be found in this report:

- Suitability of the Site – Sections 2.5 and 6.3
- Traffic and Transport – Section 4.1 - 4.8
- Flooding – Sections 2.5 and 6.3
- Soils and Water – Sections 6 and 7
- Infrastructure Requirements – Section 3.1 – 3.5
- Bulk Earthworks – Sections 5.1 and 5.2
- Stormwater management (quantity and quality) – Section 6.1 – 6.8.

# 2. SITE CHARACTERISTICS

## 2.1. Location

The site is located on the south east corner of the Light Horse Interchange between the M4 Western Motorway and the M7 Westlink as shown in Figure 2.1. The site forms part of the overall Western Sydney Parklands. The development portion of the site has an area of 29.4 Hectares (Lots 1-7) and is designated for Industrial Development including associated infrastructure, roads, basins, utilities and creek realignment. The remainder of the study area which is not being developed is in the Western Sydney Parklands bushland corridor. The study area is bounded by Motorways to the north and west, Suez treatment plant the south, and Eastern Creek Raceway the east. The study area spans between two lots, Part of Lot 10 DP 1061237 (165 Wallgrove Road, Eastern Creek); and Part of Lot 5 DP 804051 (475 Ferrers Road, Eastern Creek).

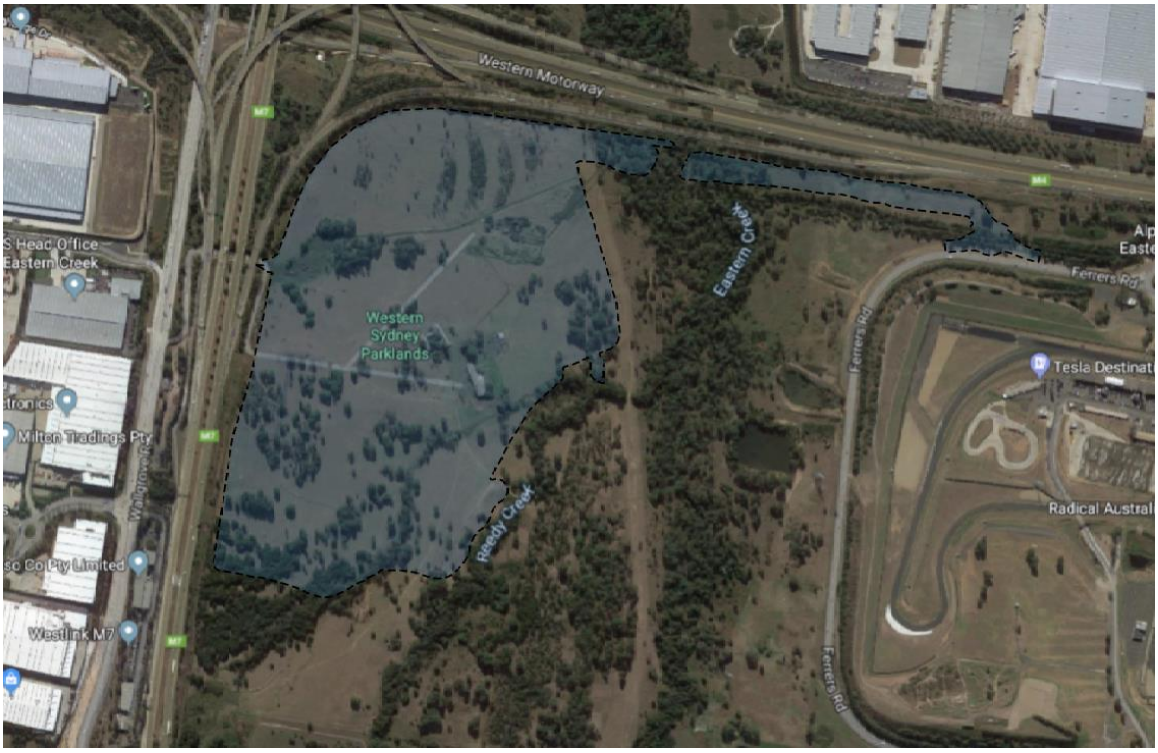


Figure 2.1 – Site Location

## 2.2. Topography

The site is located to the west of Eastern Creek which is an ephemeral creek that drains from south to north. Two smaller ephemeral creeks drains from the west of the site beneath the M7 those being Reedy Creek and Eskdale Creek. These two creeks converge with Eastern Creek to the east of the development portion of the site. The development portion of the site general has moderate falls from west to east.

## 2.3. Existing Site Conditions

The site was previously used by the Australian Army for numerous purposes as well as a waste water treatment plant (WWTP) and as such there are several small buildings located on-site. The majority of the site is vacant sparsely vegetated land with the exception of more densely vegetated riparian vegetation along the lines of the existing creeks particularly Eastern Creek. The site is currently being used as grazing land and has so for over 10 years.

## 2.4. Access

The site is currently accessed via an access road from Wallgrove Road to the west of the site. Wallgrove Road is located west of and parallel to the M7. The access road is an underpass beneath the M7. There are currently no formalised vehicular access points from the north, east or south of the site. Additional paths are present, however these typically for the purpose of maintaining infrastructure onsite, for example Jemena's Gas Line or on-grade creek crossings.

## 2.5. Flooding

Eastern Creek drains through the site and as such, the overall site is affected by the 100 year ARI flood as well as the Probable Maximum Flood (PMF). The development portion of the site is located to the west of Eastern Creek and will be filled to ultimately be positioned above both the 100 year ARI flood and the PMF.

## 2.6. Proposed Development

The proposed industrial development comprises seven (7) industrial lots that will be accessed via a sealed access road connecting through from Ferrers Road located to the east of the site. Ferrers Road is situated between the site and Eastern Creek Raceway. The access from Ferrers Road will require the construction of a new road and bridge crossing over Eastern Creek. Refer Figure 2.2 below for details of the Masterplan development layout by Nettleton Tribe Architects.


Figure 2.2 – Masterplan Site Layout by Nettleton Tribe

# 3. INFRASTRUCTURE

Infrastructure works (Stage 1) for the development aim to provide fully accessible, prepared, and benched Lots, which are fully serviced with essential infrastructure. An overview of existing and proposed infrastructure works to achieve the above are outlined in the following sections. The following services have been considered in the assessment:

- Water (potable)
- Sewer
- Gas
- Electrical and Lighting
- Telecommunications

## 3.1. Water

The site will require a potable water supply from Sydney Water mains. Based on preliminary advice from Rose Atkins Rimmer (RAR), the Sydney Water Servicing Coordinator (WSC), it has been identified that the minimum watermain size requirements for a development of this nature is expected to be a 150mm diameter main.

RAR has identified that the site is able to be serviced adequately by an existing 250mm diameter main located in Wallgrove Road or a 200mm diameter main in Ferrers Road with the 250mm diameter main in Wallgrove Road being the preferred option. Details of the connections to these existing mains would be provided at a later stage, however the site connections would need to either be from Ferrers Road across Eastern Creek or from Wallgrove Road via the underpass beneath the M7.

Typical water demand rates for industrial and commercial land uses are provided in Figure 3.1 below:

| Development Type | Development Sub-type | Key unit | Average Daily Demand | Max Daily Demand |
|---|---|---|---|---|
| **Industrial & Logistics** | Light Industrial | kL/ha/Day (floor Area) | 28.2 | 40 |
| | Medium industrial | kL/ha/Day (floor Area) | 41.25 | 66 |
| | Heavy Industrial & Processing | | As required by end user | As required by end user |
| | Manufacturing | | As required by end user | As required by end user |
| | Transportation/Depot | kL/ha/Day (Site Area) | 9.1 | 15 |

Figure 3.1. Typical Water Demand Rates – Based on; Sydney water reporting and surveys, Water Supply Code of Australia (WSA) 2011.

Assuming the majority of the development will be warehousing, light industrial or “like developments” a rate of 40 kL/Ha/day can be applied to the developable floor area of 16.55ha resulting in a max daily demand of 662kl. Using a similar methodology, the average daily demand is estimated to be 465.3kL

Although rainwater tanks are to be integrated into the developments water balance, under Water Supply Code of Australia (WSA) Guidelines it is currently recommended that no allowance (reduction) in design peak demands, for drinking or non-drinking water supply systems, be made for

the presence of rainwater tanks. This is due to the likelihood that some rainwater tank top-up, or bypass of some rainwater tanks will occur during the peak hour.

To further elaborate on the capacity of the existing water mains ability to service the development a extract of the WSA empirical guide for pipe sizing (2011) is provided in Figure 3.2 below:

| Nominal size of main DN | | Capacity of main (single direction feed only) | | | |
|---|---|---|---|---|---|
| Cast iron outside diameter series | ISO series | Residential (lots) | Rural residential (lots) | General/ light industrial (ha) | High usage industrial (ha) |
| 100 | 125 | 40 | 10 | N/A | N/A |
| 150 | 180 | 160 | 125 | 23 | N/A |
| 200 | 250 | 400 | 290 | 52 | 10 |
| 225 | 280 | 550 | 370 | 66 | 18 |
| 250 | 315 | 650 | 470 | 84 | 24 |

Figure 3.2 – Empirical Guide for Pipe Sizing (Extract from WSA – 2011-3.1)

Using the above Figure, it can be determined the main located in Wallgrove Road has sufficient capacity to service 84Ha of general/light industrial development with the main in Ferrers road capable of servicing 52Ha of similar development. The strategy and detailed design for the development connection/extensions will need to be performed by a Sydney Water Service Coordinator.

Notwithstanding the further investigations and applications required with Sydney Water, it is considered that water supply will be able to be provided to the development site in the required timeframe.

## 3.2. Sewer

The site will require a gravity sewer connection to Sydney Water mains. RAR has advised that an industrial development of this nature would need to be serviced by 225mm diameter reticulation sewers. RAR has also identified that there is a 600mm diameter sewer main that drains from south to north through the site. There is also a 375mm diameter sewer main that drains around the north western corner of the site to the east and connects to the 600mm diameter sewer main at the northern end of the site.

There appears to be limited inlet junctions to the existing sewer main, therefore additional inlets may be required. The proposed internal road layout has been designed taking into account the location of this sewer main such that the existing sewer will remain within the building setbacks of the proposed lots which is the conventional location of gravity sewer mains.

It is proposed to retain the existing sewer mains in their current locations and utilise the mains for the sewer connections for the development. Sewer Maintenance Holes (MH) will be adjusted as required to cater for the change in surface levels.

Notwithstanding the further investigations and applications required with Sydney Water, it is considered that sewer supply will be able to be provided to the development site in the required timeframe.

## 3.3. Gas

A 500mm diameter Jemena high pressure gas main is located within a 20m wide easement that runs through the site in a north-south direction. The gas main generally runs along the western side of the Eastern Creek watercourse. The gas main easement forms the eastern most edge at the northern end of the development site.

Discussions were held with Jemena in relation to the potential impact of the proposed development on the gas main. The main issues related to not building structures within the gas easement and ensuring that access to the gas main would be possible in the future without undermining any structures that are constructed outside the easement. The below sketches (Fig 3.3) shows how the excavation to the gas main would still be possible without affecting adjacent structures.

Note that the proposed access road will cross the gas main in one location and restrictions may be placed on this access road in terms of structural requirements to ensure no significant loads are placed on the gas main. This will be subject to future structural design of the access road and consultation with Jemena.

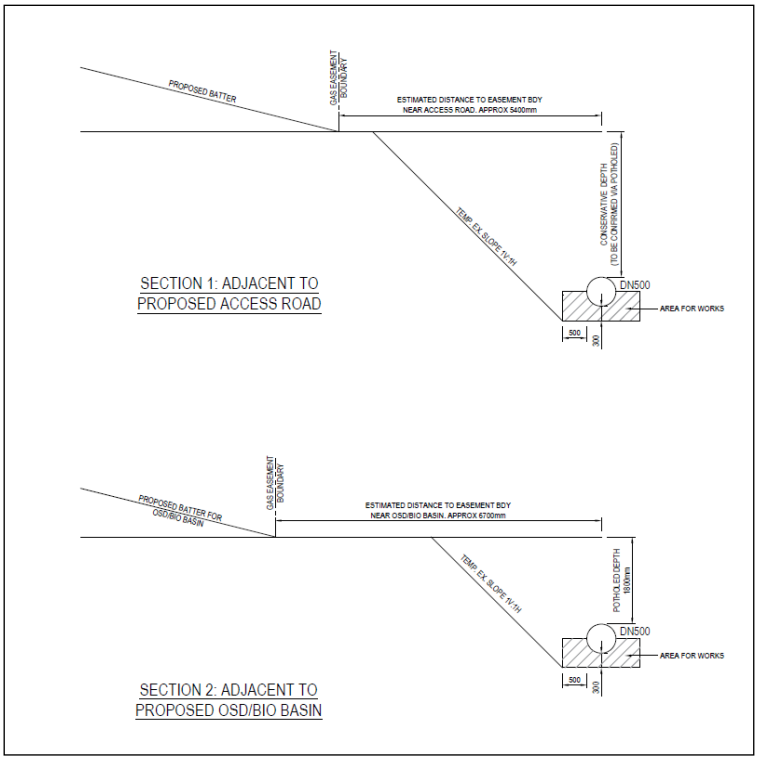


Figure 3.3 – Indicative Sections through Gas Easement

Natural gas supply is usually a low priority for industrial warehouse/distribution type development however this would need to be assessed on an individual needs basis as part of future development applications. Supply of gas is not proposed as part of the current estate infrastructure application.

## 3.4. Power

Endeavour Energy is the servicing authority for energy in the region. The subject site is located in a previous rural residential area with minimal load. There is an existing overhead high voltage feeder on the western side of Wallgrove Road adjacent to the site. An enquiry to the service provider will be necessary to confirm the ability of local cables to service the site. Endeavour Energy will require the engagement of a Level 3 Service Provider to further assess the capacity of the existing system and the requirements for the infrastructure to service the proposed development.

Preliminary advice from Connect Infrastructure suggests that the likely method of supply would be new underground feeder from Northern Eastern Creek Zone Substation. Spare conduits could be available along parts of the route.

Notwithstanding the further investigations and applications required with Endeavour Energy, it is considered that power supply will be able to be provided to the development site from existing power infrastructure.

## 3.5. Street Lighting

Street lighting is proposed to be provided throughout the development as it plays an important role in creating a safe night-time environment for pedestrians and vehicles. In accordance with council policy, lighting should be easily maintained, vandal resistant and have particular regard to the specific environment in which it serves. Street and pedestrian lighting throughout the development should generally be provided in accordance with Council's Street Lighting Policy, Endeavour Energy requirements and relevant sections of Australian Standard AS1158.

To keep an aesthetic consistency throughout the Western Sydney Parklands, street lighting along the access road and shared path external to the estate is proposed to incorporate the principles of WSPT Design Manual, specifically section 11.0 - Lighting. Specific lighting locations, pole type and materials are to be determined by a lighting or electrical consultant in close co-ordination with the Trust. Lighting levels are to be suitably designed to achieve levels of luminosity as specified by WSPT Design Manual and Australian Standard AS1158.3.

## 3.6. Telecommunications

Telecommunications from the National Broadband Network (NBN) are not yet available for the site, but the NBN is available to the east of the site and currently under construction to the west of the site. Telecommunications for the site will be serviced by the local copper or fibre optic supply network until such time as the NBN is available. Note that since the NBN is available in the vicinity of the site, it may be a requirement to install NBN infrastructure within the development but this will be determined at Construction Certificate stage.

# 4. ROADS AND TRANSPORTATION

## 4.1. General Access Layout

As previously stated, it is proposed to provide vehicular access to the site via an access road from Ferrers Road. This access road will be located along the northern end of the development running parallel to the M4 and will cross Eastern Creek via a section of bridge. This access road then bends and runs in a north-south direction. The access road will provide direct access to the seven lots within the development. Since there is no through link from the development site, a cul-de-sac will be provided at the southern end of the access road to cater for turning movements for a B-Double articulated vehicle which is the largest vehicle that will use the access road.

Initial investigations were undertaken to ascertain whether a second access to the site could be provided from Wallgrove Road however it was established that there was no improvement in the level of service as a result of this second access in addition to the access from Ferrers Road and therefore WSPT decided not to pursue a secondary access any further. For additional information regarding site access and levels of service, please refer separate Traffic Report by Ason Group.

The access road has been designed to comply with the requirements of Blacktown City Council both in terms of pavements and geometry as it is the intention of WSPT for the road to be dedicated as a public road at some stage in the near future. A swept path analysis has been conducted on the development's road layout to confirm the layout caters for B- Double articulated vehicle turning movements. Plans of the vehicle swept paths are provided on Henry & Hymas civil engineering drawing 18652_SSDA_C600-C607, found in Appendix A. Refer below for description of road geometry and pavement thicknesses.

## 4.2. Bridge and Access Road from Ferrers Road Intersection

As stated above, a bridge will be required where the access road crosses Eastern Creek. This bridge will be constructed using an RMS type plank system with a concrete topping slab on six rows of piles/columns. The bridge will span 61.5m with individual spans ranging from 10-15m. The bridge has been designed with a full width of the access road carriageway.

This type of construction allows for maximum spans to minimise the potential for blockages in the flow of Eastern Creek. The flood modelling for the development has taken into account the locations of the proposed piles/columns. The bridge has been designed with 500mm freeboard to the underside of the bridge during a 100 year ARI flood which not only caters for potential blockages but also permits access across the bridge even during a 100 year ARI flood if required.

## 4.3. Ferrers Road Intersection

A roundabout is proposed where the access road intersects with Ferrers Road. The roundabout has been designed in accordance with Council's Engineering Guidelines and relevant clauses of Austroads. Traffic studies undertaken by Ason Group take into account future growth to 2030 and have established that the intersection can operate efficiently as a single lane roundabout. However, as part of discussions with Council, intent was expressed by Council Engineers for the design to cater for a two-lane roundabout at some stage into the future. For this reason, the centre of the roundabout was adjusted slightly from the original design to cater for the future two lanes as part of any future road upgrades performed by Council.

The roundabout has been designed to cater for all turning movements for a B-Double articulated vehicle which is the largest vehicle expected to negotiate the roundabout.

A 2.4m x 1.2m box culvert has been designed for where the access road crosses an existing swale to cater for the estimated 3.5$m^3$/s flow derived from Council's hydrographs.

## 4.4. Existing Wallgrove Road Access

As stated above, it is not proposed to use the existing access to the site from Wallgrove Road as a primary access to the site. This existing access will only be used by vehicles for emergency purposes and as such can cater for the turning movements of these vehicles. The existing underpass beneath the M7 will remain and will offer not only emergency access but also cycleway connectivity as described in the design guidelines by Nettleton Tribe. The existing underpass also features drainage infrastructure for conveyance of run-off from upstream catchment, this is further covered in Section 6.3.

## 4.5. Estate Access Road

The proposed site access road has been designed in accordance with Blacktown City Council's standard for industrial roads in regards to widths, cross falls and grades. Due to the minimum amount of fall in the existing terrain in the north-south direction which is the direction that the road is proposed, the longitudinal falls in the roads have been designed at 0.7% which is acceptable in accordance with Council's standards. The road has been designed to incorporate a "saw tooth" pattern with crests and falls, each successive ridge is slightly lower than the adjacent ridge and overall fall is maintained towards the north to an ultimate spill point for the road being low points just west of the proposed bridge

The bend in the road has been designed based on a 60km/h assumed speed limit and the turning movements have been designed to cater for a B-Double articulated vehicle which is the largest vehicle expected to use the access road.

## 4.6. Carriageway Widths

The access road and bridge have been designed with an overall road reserve width of 23m with a carriageway width as per Council's standards. Although the site would be compatible with a 20.5m wide reserve, WSPT have selected the industrial collector option to provide a better design outcome. Refer Figure 4.1 below.

| Road Type | Carriageway (in metres) | Footway each side (in metres) | Total Road Reserve (in metres) | Number of Lanes |
|---|---|---|---|---|
| SUB-ARTERIAL within Zone No. 5(c) | 12.5 separated by 4m median | 4.25 | Generally 25 | 4 travel lanes and no parking |
| INDUSTRIAL<br>Collector<br>within new industrial areas | 15.5 | 3.75 | 23 | 2 travel lanes and 2 parking lanes |
| Other Industrial | 13.5 | 3.5 | 20.5 | 2 travel lanes and 2 parking lanes |

Figure 4.1 – Access Road Width

## 4.7. Road Pavements

The access road pavement has been design as a flexible pavement with an asphaltic concrete wearing course in accordance with Council's requirements. Since the pavement is being designed to Council specifications, a design traffic load of $1x10^7$ ESAs has been adopted as per heavy industrial road types shown in Figure 4.2 below. Based on geotechnical testing, it has been established that the subgrade CBR of the site materials is 3% should be used for the purpose of pavement design.

| Road Type | AADT | N(ESA) | Kerb Type # |
|---|---|---|---|
| SUB-ARTERIAL | Based on Traffic Counts | | 150mm kerb & gutter |
| INDUSTRIAL<br>* Collector & Heavy Duty | - | $1 \times 10^7$ | 150mm kerb & gutter |
| * Light Duty | - | $5 \times 10^6$ | 150mm kerb & gutter |
| COMMERCIAL | - | $2 \times 10^6$ | 150mm kerb & gutter |

Figure 4.2 – Pavement Thickness Design Criteria

## 4.8. Pedestrian Facilities and Transportation

The development can be accessed by pedestrian and bicycle traffic from both Ferrers Road to the east of the site and the M7 cycleway to the west. There will be a continuous shared path link from both these roads to the site which will provide safe amenity for pedestrians and cyclists who will be accessing the site for employment or passing through the parklands for leisure.

Similarly to infrastructure throughout the Study Area, pedestrian facilities adjacent to the estate access road or providing connectivity for the greater Western Sydney Parklands cycleway are proposed to incorporate the design principles of Western Sydney Parklands Design Manual, specifically Section 7 -Tracks. Material options, finish and widths are proposed to be finalised with close co-ordination between the Architect, Blacktown City Council and the Trust. The pedestrian and cyclist connectivity is further elaborated on by the development Architects, Nettleton tribe.

# 5. SITE WORKS

## 5.1. Bulk Earthworks

The development portion of the site is above the 100 year ARI flood level, so it is not necessary to lift the site levels to accommodate for freeboard for flood events. However, a significant amount of fill will be required for the site to accommodate pipe drainage runs from the most disadvantaged points of the development.

It is also a Council requirement to set the OSD outlet to above the 100 year ARI flood level which also drives the site levels up.

The cut and fill quantities for the site result in a shortfall of material of in the order of 905,000$m^3$. Whilst this is a large amount of shortfall, the amount of fill is required to accommodate the development and at the same time, the development does not place a strain on landfill resources as there will be no soil waste generated from the site and the importing of material from external sources further reduces the impacts on local landfill resources as material that would have otherwise been disposed of can be imported to site.

## 5.2. Embankment Stability/ Retaining Walls

Given the large size of the masterplan pad sites, we are not proposing to provide retaining walls between the pad sites at this stage. Retaining walls may be required at a later stage but these will be designed as part of any future Development Applications for each individual lot. In this respect, earthworks batters are provided wherever possible as part of the proposed Stage 1 Works. Earthworks batters will be provided at maximum slopes of 1 in 3 as per geotechnical advice by Dirt Doctors PTY LTD, and where short-term construction batters are implemented, these will be protected from erosion by appropriately installed sediment and erosion control measures.

Whilst earthworks batters will be provided wherever possible, retaining walls will be required in some instances where there are significant level changes including where stormwater structures such as channels and basins are proposed. These walls are predominately located adjacent to the access road, between road and the proposed emergency overland flow path. The locations and heights of these retaining walls are shown on the engineering drawings located in Appendix A.

# 6. STORMWATER MANAGEMENT

## 6.1. Introduction

In general, the engineering objectives of stormwater management systems is to create a system which based on the architectural layout, incorporates the natural topography and site constraints to produce a cost-effective and appropriate drainage system that meets best industry practice and governing water quality and quantity objectives.

The infrastructure works drainage system was designed to accommodate the concept masterplan layout by Nettleton Tribe with grading and drainage of each individual lot to be co-ordinated with the infrastructure works.

In terms of preparation of the infrastructure works package, each individual lot is proposed to be finished with a prepared, and benched pad. Each lot will be graded to intermediate catch drains which direct stormwater runoff in the interim to sediment and erosion control basins. The sediment and erosion control basins will be located at the downstream end of each individual lot. Each basin is proposed to be maintained, flocculated and dewatered in accordance with the publication "Landcom – Managing Urban Stormwater - Soils and Construction, Volume 1, 4th Edition March 2004" and Blacktown City Council requirements.

Stub drainage lines will be provided to the individual lots based on predicted internal grading and stormwater layout of the lot based on the masterplan layout, with each lot having between 2-3 stub drainage lines. In the future, each individual lot will connect the local drainage system to the developments drainage system which will drain to the communal basin. Based on the aforementioned road grading and access requirements, the development's concept masterplan layout is graded to form two major drainage catchments, these catchments can be noted on drawing Henry & Hymas civil engineering drawing 18652_SSDA_C250, found in Appendix A.

The southern most catchment, 23.06 Ha in area, drains via the trunk drainage system beneath the proposed access road to a dual culvert drainage line located between Lots 6 and 7. The line continues to the communal water management basin located at the eastern most extent of the site. Similarly, the northern catchment, 6.61 Ha in area, drains the northern portion of the site via a trunk drainage system that continues beneath the estate access road to enter the water management basin from a northerly direction. Detailed information regarding the design of the aforementioned drainage systems and catchment distributions can be found on drawing Henry & Hymas civil engineering drawing 18652_SSDA_C250 and 18652_SSDA_C101-C109. It is proposed that when the internal access road is dedicated to Council, a right of way easement over the proposed drainage infrastructure that conveys stormwater from the estate road to the communal basin is formed for access.

In terms of water quality and water quantity, the infrastructure works include a communal water management basin. The basin features a combined on-site stormwater detention storage (OSD) and bioretention basin. The basin has been designed generally in accordance with Council's water sensitive urban design standard drawings and best industry practice for water management basins.

The development is subject to both minor and major external overland flows originating form run off from upstream catchments. The magnitude of each instance of overland flow has been matched with the precautionary reaction taking with the design, ranging from the formation of boundary bunding

to in depth and detailed flood modelling. Located within the 100 ARI flood zone of eastern creek, the development has the potential to be subject to major inundation from flooding. The response to major flooding from Eastern Creek has been detailed in a flood analysis report prepared by BMT. A short summary of the results of the flood analysis will be provided in Section 6.4 below.

Overland flow originating from upstream developments and infrastructures is present on site. Currently, the upstream catchment to the west drains beneath the Westlink M7 motorway via catch drains on either side of the Wallgrove Road access underpass. It is proposed that overland flow originating from this catchment is captured and discharge to former Eskdale Creek Line via a pipe network through the development. An emergency overland flow path will be provided, so as in the event of major flooding events or blockages, upstream overland flow be directed around the development to eastern creek. It is proposed a right of access to benefit Council be formed over the pipe network.

## 6.2. Design Criteria

The proposed stormwater system for the development will be designed in accordance and in consideration of the following;

- Institution of Engineers, Australia publication “Australian Rainfall and Runoff” (1987 Edition), Volumes 1 and 2 (AR&R);
- AS 3500.3: National Plumbing and Drainage Code Part 3 – Stormwater Drainage;
- Australian Disaster Resilience Guideline 7-3: Technical flood risk management guideline: Flood hazard, 2014, Australian Institute for Disaster Resilience CC BY-NC;
- Blacktown City Councils relevant planning policies and control plans, specifically;
    - Development Control Plan Part J – Water sensitive urban design and integrated water cycle management;
    - Blacktown City Council’s Engineering Guide for Development 2005;
    - Council’s Water Sensitive Urban Design Standard Drawings.

The site’s stormwater system has been designed in accordance with design recurrence intervals adopted from Council’s engineering guide for development, with minor systems designed to convey flows induced by 20 year average recurrence interval (ARI) storm event. Major system drainage, such as the stormwater line intercepting overland flows originating from Wallgrove road, has be designed to convey the 100-year ARI storm event with a 50% blockage factor applied to all inlet pits/headwalls. The grading of the infrastructure works has been formed in such a manner where overland flows induced by the 100 ARI storm event are safely conveyed towards the proposed access road reserve without negatively impacting any proposed flood levels or access paths.

## 6.3. Drains Modelling Data

For the above-mentioned model, the IFD data used for the rainfall generation is;

| | 2 ARI | 50 ARI | | |
|---|---|---|---|---|
| **1hr** | 30.6(mm/hr) | 56.4(mm/hr) | **G** | 0.01 |
| **12hr** | 6.67(mm/hr) | 12.8(mm/hr) | **F2** | 4.30 |
| **72hr** | 2(mm/hr) | 4.3(mm/hr) | **F50** | 15.81 |

Figure 6.1 – IFD Data Used for Rainfall Generation

The standard parameters used in the DRAINS model are as follows;

| Description | Value |
|---|---|
| **Model for Design and Analysis Run** | Rational Method |
| **Rational Method Procedure** | ARR87 |
| **Soil Type - Normal** | 3.0 |
| **Paved (Impervious) Are Depression Storage** | 1mm |
| **Supplementary Area Depression Storage** | 1mm |
| **Grassed (Pervious) Area Depression Storage** | 5mm (15mm for pre-dev) |
| **Antecedent Moisture Condition (ARI = 1-5 years)** | 2.5 |
| **Antecedent Moisture Condition (ARI = 10-20 years)** | 3.0 |
| **Antecedent Moisture Condition (ARI = 50-100 years)** | 3.5 |
| **Sag Pit Blocking Factor** | 0.5 |
| **On Grade Pit Blocking Factor** | 0.2 |

Figure 6.2 – Standard Parameters for Drains Model

## 6.4. Flooding

As previously discussed, the Study Area is located in a known floodplain area of Eastern Creek, and as such has the potential to be inundated by floodwaters. On this background, a detailed assessment of the surrounding site areas was developed to provide a detailed representation of the local flooding behaviour of the study area as well as the relative impact of the proposed developed in terms of potential changes to existing flood behaviour.

The key outcomes of the detailed assessment provided by BMT Eastern Australia Pty Ltd (BMT) are summarised below:

- All Lot's finished levels are above the peak 1% AEP flood level from local catchment flooding (with a 0.5 m freeboard allowance). The proposed finish levels of the development provide all Lots with flood immunity up to the Extreme Event.
- The detention basin located at the eastern perimeter of the site has flood immunity at the design 1% AEP flood level. However, the detention basin would be subject to inundation at the Extreme Event flood level.
- Flood impacts are typically confined to within the Site boundaries with no significant impacts on adjacent and upstream/downstream property. Based on the impacts being confirmed to within the WSPT land, flood offset investigation was not performed.

- Whilst there are relative increases in peak flood level for the Extreme Event within the M4 Western Motorway corridor, it is important to recognise that under existing conditions there is still significant depth of flow over the road. Flood Hazard mapping for the Extreme Event under existing conditions showing an extended width of the M4 Western Motorway subject to the highest hazard classes (H5 and H6), which was also prevalent in the post developed scenario.
- The development access road provides a minimum 1% AEP flood immunity (up to 0.2% AEP immunity) with a minimum 0.5m to underside of the bridge structure (excluding columns). The service road at the western boundary of the Site linking through to Wallgrove Road provides an alternative emergency flood access route which is flood free up to the Extreme Event.

The effect of flooding on the surrounding ecology have also been investigated by Ecoplanning Pty Ltd. It was concluded that the proposed changes to peak flood levels are unlikely to cause a widespread shift from the existing ecological community which is adapted to periodic flooding to another distinct ecological community. Furthermore, it was generally regarded that the risk to the existing ecology imposed by potential flood offsetting was not outweighed by the possible reduction in flood impacts and associated ecological benefits.

Further investigations were conducted by BMT and Henry and Hymas to determine the impact of the development on the duration of inundation due to flooding. Negligible changes to the overall duration of flood inundation during the major flood event were recorded throughout the flood plain, including heavily vegetated areas. As a result of the investigation it is concluded that the change in the duration of inundation during the 1% AEP event will have minimal impact on the ecology within the 1% AEP floodplain.

## 6.5. Creek Diversion

The proposed development encroaches into the existing creek line of Eskdale Creek. As such a concept creek-realignment plan has been developed with Ecoplanning Pty Ltd to produce a naturalised meadow similar to that of the Eskdale Creek prior to the anthropogenic creek which current operates as an artificial watering point for livestock.

Originally the creek realignment was proposed to span the length of Lot 6, re-connecting at the existing intersection point of Eskdale Creek and Reedy Creek. From further review of the site conditions and topography it was noted better ecological outcomes could be achieved by re-aligning the existing Eskdale Creek by introducing a swampy meadow, and chain of ponds that connect to Reedy Creek, approximately adjacent to the midpoint of Lot 6. The re-alignment aims to incorporate Water Sensitive Urban Design principles whilst improving water quality, regulating creek flow rates, enhancing the surrounding landscape and ecology, and provide a range of aesthetic benefits to the community.

The proposal for the re-alignment was present to the Department of Industry – Lands & Water Engineers with the strategy accepted in ‘principle’. The re-connection location of the proposed alignment was selected carefully to minimise earthworks, match topographically with the existing meanders in Reedy Creek and minimise existing vegetation disturbance.

The re-alignment proposed to introduce the geomorphology of a wide and flat flow path with semi-regular interspersed with deep pools. Shallow marsh is proposed to dominate the re-alignment’s flow path with areas of deep marsh and submerged march confined to the margins of the

interspersed pools. The grading has been formed in such a way to activate the flood plain where possible, whilst minimising impacts to existing vegetation that currently provides shade to protect against possible invasion of invasive species such as Typha.

The general concept of the re-alignment is to confine the flow to the swampy meadow area in low flow events and for larger events to activate the surrounding flood plan similar to the creek conditions prior to existing development on-site. The low flow events are proposed to drain to an elevated water level control structure located in the final pool. The outlet structure connects to an underground pipe which discharges to the pre-determined point in Reedy Creek. The underground pipe and associated creek armouring at the discharge location aims to mitigate bed scour in Reedy Creek.

A concept plan of the creek diversion can be found on Henry & Hymas engineering drawing 18652_SSDA_C101.

## 6.6. Wallgrove Road Overland Flow

It is understood from early consultation with Council's on the 3rd of December 2018 that BCC noted the potential for overland flooding from the upstream catchment west of Wallgrove Road (refer Appendix A, Henry & Hymas engineering drawing 18652_SSDA_EX01). In summary, the proposed strategy below has been prepared to mitigate the risk of flooding from the upstream catchment conveyed to the site by the Wallgrove Road M7 Underpass by providing both an adequately sized drainage line and proposed emergency flow path around the development.

The upstream catchment measures approx. 39.9Ha in area and is highly developed, in addition to the upstream catchment, the downstream systems controlling and retarding run-off from the catchment are likewise, highly developed. The majority of the upstream catchment drains through a trunk drainage system within the catchment to a series of large communal basins. These communal basins discharge via a control structure to the 1050mm diameter stormwater line traversing beneath Wallgrove Road.

The flow from the 1050mm diameter line is then met by several minor flows from the surrounding access areas, controlled flows discharging from M7 retardation basins and further local flows from Wallgrove Road itself. Stormwater is collected in a small sump located immediately downstream of the outlet of the 1050 diameter stormwater line. This small sump connects to, and is drained by a large drainage channel that runs parallel to the existing access road to Wallgrove Road (Refer Figure 6.3 below).

Figure 6.3 – View to Site under M7 Underpass Facing East.

Flow data obtained from hydrographs of Council's XP-RAFTS base model for Eastern Creek place the flow rate at the end of the underpass at 4.4 $m^3/s$ (refer to Appendix E for additional details).

It is proposed to transition the existing drainage channel to a large drainage sump located adjacent to the emergency access point and right of access to the development. The transition channel will be sized to fully accommodate the upstream flow and any flows collected from run-off originating from the underpass itself. The topography in the area will be designed in a way where grading, specifically cross fall across the proposed Wallgrove Road light access road directs any additional flow not wholly contained in the existing channel be directed to the proposed drainage sump. To aid in this, a ridge may need to be formed along the existing boundary in this area. In addition to the major drainage channel, the sump will also collect additional stormwater flows from the surrounding remaining M7 retention basins as well as a small drainage line running beneath the M7 and a small v-drain. The combined flow from the drainage channel and the surrounding minor catchments was $5.2m^3/s$ (obtained from hydrographs of Council's XP-RAFTS base model for Eastern Creek). It is proposed, where possible, that any works required to collect and convey the aforementioned run-off is restricted to WSPT land.

From preliminary pipe sizing analysis, a 1500mm diameter stormwater line will be proposed to convey the overland flow collected in the proposed sump, through the development, to a proposed channel that discharges into the former Eskdale Creek line. The channel discharge location aims to minimise disruption to the natural environment while introducing regular flows to the disconnect creek section. This outlet can be viewed on Henry & Hymas engineering drawing 18652_SSDA_C101-C109.

Whilst contained within the subdivision, the 1500mm diameter stormwater line will be located within a 3.5m right of access easement that runs within Lot 2 to the proposed estate road access road. The stormwater line will follow the proposed estate road before turning east via Lot 8 (dedicated lot for

communal water management basin) to the outlet location. The 1500mm diameter stormwater line, conveyance channel and associated inlet structure will be designed to convey 100-year ARI flow (5.2$m^3$/s) with a 50% blockage at the pipe inlet.

In the event of a severe blockage (50% or more) or extreme storm event (100 year ARI event and above) the overland flow originating for the upstream catchment will overtop a weir in the proposed drainage sump and flow around the site to the north in an emergency drainage channel. The channel will only be 'active' under the aforementioned conditions as the inlet structure to the 1500dia stormwater line will be appropriately sized. The emergency overland flow channel will connect back to the ultimate original discharge location, Eastern Creek, between the proposed bridge and the existing M4 bridges (refer to Henry & Hymas civil engineering drawings 18652_SSDA_C101-C109, Appendix A). The incorporation of the emergency overland flow channel around the perimeter of the development negates the need for external flows to be directed through the development, further protecting the lots from upstream flooding. The emergency overland flow channel is proposed to be approx. 7.6m in width, with a 2m base and 1 in 4 batters. The channel is proposed to be generally grass lined and accessible for regular maintenance.

## 6.7. On-site Stormwater Detention

On-site Stormwater Detention (OSD) will be provided to control the peak stormwater flows from the site by temporarily detaining stormwater from major storms in an underground tank which is then discharged to the downstream drainage system at a controlled rate.

As minuted in the aforementioned Pre-SSDA meeting and noted in the SEARS, the development should comply with the BCC's on-site stormwater detention (OSD) policy. In this case, OSD shall be provided to control the peak flow of stormwater generated from the development in accordance with Development Control Plan (DCP) Part J 2015, and with Blacktown City Council's Deemed to Comply OSD spreadsheet tool. For planning purposes, the catchments draining to the OSD (including the entire OSD area itself) total 31.817Ha with 1.813Ha of area bypassing the OSD (approx. 5.4%).

Using the Deemed to Comply OSD spreadsheet tool, the proposed disturbed areas detailed on drawing 18652_SSDA_C250 yield a required OSD volume of 15,592m$^3$ for the new development. The required OSD volumes are proposed to be detained in an above-ground basin located at the easterly extent of the proposed development, adjacent to the high-pressure gas main. It is proposed that the detention tank be constructed from earth batters and specifically design concrete outlet structures in accordance with best industry practice and Blacktown City Council - Water Sensitive Urban Design (WSUD) standard drawings. As detailed in the Deemed to Comply OSD spreadsheet tool the OSD volume is managed according to ARI discharge (1.5 year and 100 year) with a dual orifice and weir system. Where 10280m$^3$ of OSD storage is detained below the 100-year ARI emergency overflow weir and 10280m$^3$ below the 1.5-year ARI weir. Details regarding the proposed water management basin are provided on drawing 18652_SSDA_C240-C241. The tank's discharge overflow weir will be constructed with a concrete cut of wall and heavy scour protect/armoured embankment, and connected to a specially designed outlet channel which connects to Reedy Creek. The spreadsheet has been adjusted to take into account the downstream water level imposed by the 100 year ARI flood event, with input denoted "RL of obvert of outlet pipe" modified to be 150mm below the 100 year ARI flood level at the discharge area. The impact of applying this flood level increased the OSD storage volume by 1.9%.

Where possible and within site constrains, the design of the on-site detention storage area in water management basins was designed in accordance with, and to fulfil the intent of BCC's Water Sensitive Urban Design (WSUD) Standard Drawings, with particular reference to:

- Surface of bioretention filter system elevated 1m above the basin outlet.
- 1.5-year ARI detention volumes retarded with orifice and weir arrangement which later drains through the 100 year ARI sized orifice (sized with deemed to comply spreadsheet).
- 1.5 year ARI orifices protected by maxi mesh track screen 20 x orifice area.
- 100 year ARI inlet pit protected by custom formed hinged surcharge style grate and trash screening inside the pit.
- Appropriate access path (minimum 4m) provided for maintenance purposes.
- Appropriately sized emergency overflow weir with rip rap scour protection designed in accordance with Landcom – Managing Urban Stormwater - Soils and Construction, Volume 1, 4th Edition March 2004.

## 6.8. Water Quality

### 6.8.1. Targets

Pollution and contamination dislodged or inherent to and in stormwater and stormwater run-off from urban developments have the potential to damage the ecology and health of local creeks and waterways. As such stormwater quality improvement devices (SQIDs) that aim to minimise pollution during construction and operation of the development have been incorporated into the overall stormwater management design. These devices have been sized, specified and designed in accordance with Council's (DCP) Part J 2015, and Council's water sensitive urban design standard drawings. A summary of the implements SQIDs can be seen in later sections.

The performance of the stormwater quality improvement devices (SQIDs) in mitigating pollution from urban development can be assessed by simulating a post developed pollutant reduction rate for the stormwater system as a whole. In accordance with part J (2016) all commercial developments must achieve a minimum percentage reduction of the post developed average annual loads of pollutants in accordance with the Table 6.4 below:

| Pollutant | % Post Development Reduction Target Blacktown City Council |
|---|---|
| **Litter / Gross pollutants** | 90 |
| **Total Suspended Solids** | 85 |
| **Total Phosphorous** | 65 |
| **Total Nitrogen** | 45 |

Table 6.4 – Water Quality Targets

### 6.8.2. SQIDs – Stormwater Quality Improvement Devices

#### 6.8.2.1. Gross Pollutant Traps (GPTs)

As part of an effective treatment train for the site and greater stormwater system as a whole, newly developed hardstand and landscaped areas as well as existing areas will be primarily treated via a gross pollutant trap (GPT). As the development is roughly divided into two catchments, north and south. A GPT is proposed for each of the inlets to the on-site stormwater detention basin prior to the bioretention basin to protect gross pollutants and suspended solids from clogging the filter media.

An appropriate maintenance schedule which details the specific removal method and frequency of gross pollutants from the GPT is provided in Appendix B. The GPT will be fitted with an oil battle to remove hydrocarbons within the stormwater run-off generated by developed site areas.

The GPT has been appropriately located following discussions with Council's Drainage Engineer, Tony Merrilees. To accommodate for the GPTs, the stormwater lines throughout the development have been designed to direct stormwater flows, with minimal bypass to the GPTs. The stormwater lines meet at a diversion pit which will split the treatable flows for treatment by the GPT. In accordance with Council's WSUD standard drawings, the GPTS are opportunely placed to both direct the treatable flow rate to the bioretention and protect gross pollutants and suspended solids from clogging the bioretention.

The GPTs selected are based on commercial availability, treatable flow rates, treatment efficiency, maintainability and respective catchment sizes. The proposed GPTS to primarily treat the stormwater flows are the CDS 3030 for the south catchment and CDS 2028 for the north.

In conjunction with Optimal Stormwater, a signed and dated maintenance schedule specially tailored for the CDS units CDS 3030 and CDS 2028 has been provided in Appendix B.

#### 6.8.2.2. Pit Baskets

As part of an effective treatment train for the site system, selected areas of the development that bypass the OSD system and associated preliminary GPT treatment will be pre-treated via passive screening pit baskets. These will be installed in areas which area highly trafficked and subject to higher instances of pollution and litter, and stand most to benefit from effective pre-treatment. The pit basket proposed to be used is the “Enviropod” pit basket filter by SW360. Pit baskets to be fitted with the “Enviropod” bit basket are noted on drawing Henry & Hymas engineering drawing 18652_SSDA_C200.

#### 6.8.2.3. Bio-retention

Where possible and within site constrains, the design of the bioretention filter system within the water management basins was designed in accordance with, and to fulfil the intent of BCC’s Water Sensitive Urban Design Standard Drawings, with particular reference to:

- Surface of bioretention filter system elevated 1m above outlet level;
- Flows directed to the bioretention limited to the treatable flow rate of the treatment system (aforementioned);
- Partially permanently saturated transition zone to increase the longevity and establishment of biofilm, in addition to ensuring adequate water sources for planted macrophilic plant species;
- Appropriate depth of filter media, transition and drainage layers as outlined in typical bioretention filter detail in Council’s Water Sensitive Urban Design Standard Drawings (refer to Figure 6.5). Filter media is to be tested as Measurement of Hydraulic Conductivity manual in Appendix C;
- Appropriate access and maintenance paths (minimum 4m), refer to standard drawings and maintenance schedule;
- Adequate retarding and distribution systems in the form of perimeter gully drain and up flow pits.

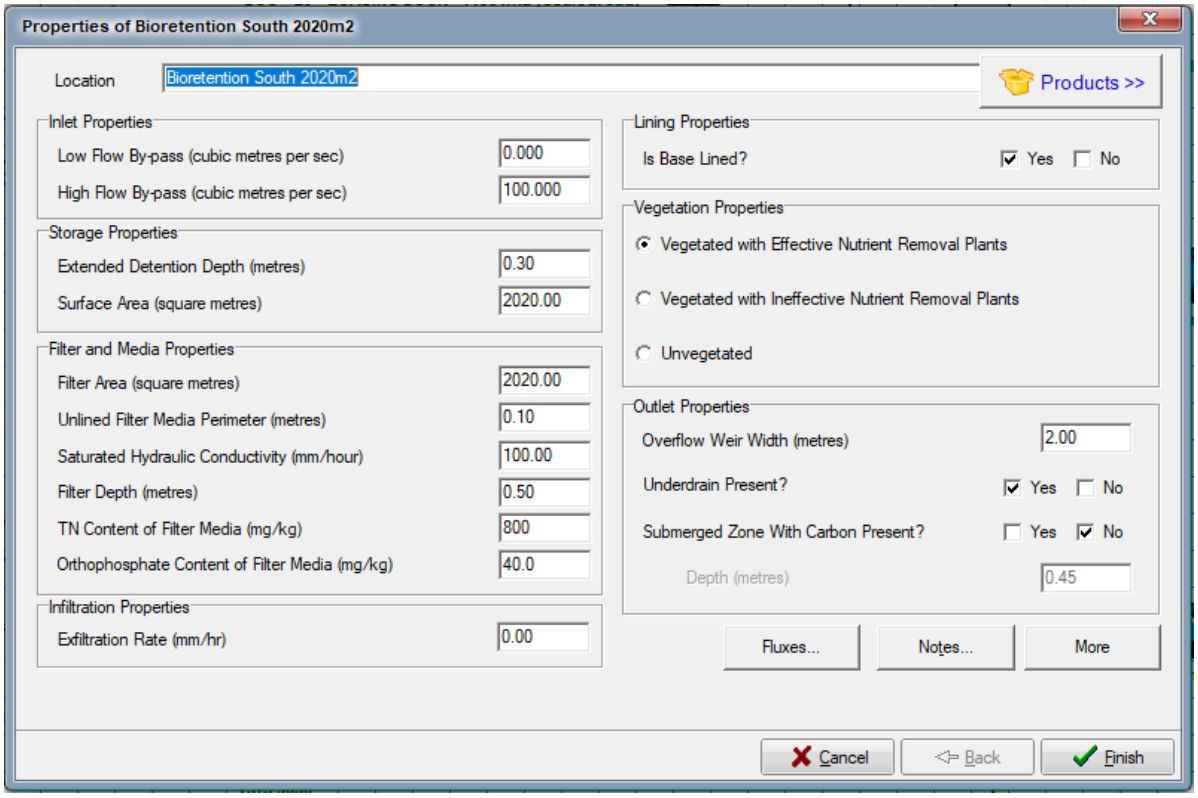

Figure 6.5: Inputs for bioretention in MUSIC

Adequate dispersal and retarding distribution systems in the form of 6m x 3m silt trap and concrete perimeter dispersal drain. Given the hydraulic scenarios for the north and south inlets to the water quality management basin are different the distribution method for each bioretention has been customised to fit the underlining hydraulic conditions. The south bioretention, sustainably larger in area, is proposed to be distributed stormwater using a perimeter gully drain with serrated weir. The north bioretention, limited by pipe grades, is proposed to be distributed stormwater using up flow pits designed in accordance with Council's WSUD standard drawings.

Additional information and details regarding the bioretention systems is detailed on Henry & Hymas engineering drawing 18652_SSDA_C240.

Preliminary sizing using water quality modelling software estimates surface area of bioretention required to fulfil Council's water quality targets is 2,620m$^2$, distributed over 2,020m$^2$ to treat the south catchment and 400m$^2$ to treat the north.

### 6.8.3. Water Quality Modelling - MUSIC

In order to better determine the conceptual design of the water quality treatment trains and to ensure the treatment trains satisfy the reduction parameters outlined in Table 6.4, a Model for Urban Stormwater Improvement Conceptualisation (MUSIC) was developed.

The MUSIC model was set up with the in-built rainfall station, time period data, evapotranspiration data, source node data, treatment node data and run-off parameters provided by the BCC council MUSIC link system. A schematic of the MUSIC model can be viewed above in Figure 6.6. The

schematic illustrates the interrelationship between source nodes (catchments) and treatment nodes (water quality treatment measures) for the catchment.

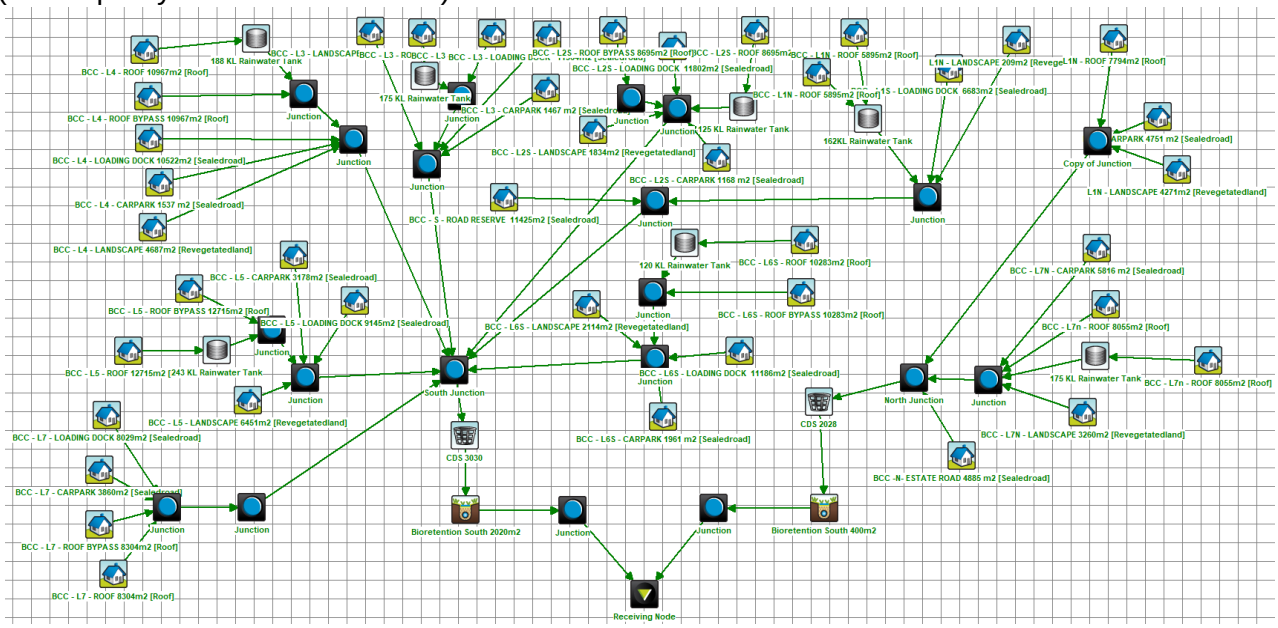


Figure 6.6 Schematic of Music Model.

### 6.8.3.1. Results

The resultant post developed pollutants calculated by the simulation in Table 6.7 below. With the implementation of the aforementioned stormwater quality improvement (SQIDs) devices, the resultant post developed pollutant loads have been reduced below the reduction target for all targeted pollutants.

| Pollutant | % Post Development Reduction Target Blacktown City Council | % Post Development Reduction Reached |
|---|---|---|
| **Litter / Gross pollutants** | 90 | 98.7 |
| **Total Suspended Solids** | 85 | 86.6 |
| **Total Phosphorous** | 65 | 65 |
| **Total Nitrogen** | 45 | 49.5 |

Table 6.7– Resultant post development pollutant reductions

### 6.8.3.2. Rainwater Tanks - Water Reuse

To assist with water conservation, water reuse is generally required for all new developments as outlined in Council's Development Control Plan Part J. The requirements state that for industrial/commercial developments a minimum of 80% of the non-potable water demand on site is to be met through rainwater. Water demand must allow for internal rainwater reuse at the rate of 0.1 KL/day per toilet/urinal and external landscape watering (excluding turf areas) at rate of 0.4 kL/year/$m^2$ as PET-Rain (0.3 kL/year/$m^2$ for drip irrigation).

As water reuse will likely form part of any effective water quality treatment train for the proposed development, rainwater tanks that harvest and store rainwater for re-use were estimated to improve

the accuracy the overall water quality modelling for the site. Using MUSIC water quality modelling software, a rainwater tank size that satisfies 80% of the non-potable water demand of the development was estimated. Several assumptions were made when sizing the rainwater tanks. These assumptions are fundamental for determining the water demand of each building layout concept, and thus the storage volume. These assumptions include;

- Roof catchments and potential irrigation areas are in similar size and arrangement to the concept masterplan by Nettleton Tribe.
- 50% of the roof area of a specific roof catchment will drain to the rainwater tank;
- 100% of landscaped area with a lot boundary will be drip irrigated using harvested water. Remaining landscaped areas throughout the development he remainder are assumed to be turfed, mulched or planted with matured trees that do not required irrigation;
- Approximately 28 toilets/urinals within each newly development lot are proposed to operate with harvested water;
- To allow for anaerobic zones in the rainwater tank, a 20% loss in tank volume is assumed in the water quality model.

A summary of the potential estimated rainwater tank size for each lot can be seen in Figure 6.7 below. Please note the below tank sizes are estimations formed to improve the accuracy of the water quality modelling, and are conceptual in nature.

| Lot number | Estimated Rainwater tank size |
|---|---|
| 1 | 165KL |
| 2 | 170KL |
| 3 | 170KL |
| 4 | 185KL |
| 5 | 243kl |
| 6 | 120kl |
| 7 | 175KL |

Figure 6.6– Estimated rainwater tank size

# 7. SEDIMENT AND EROSION CONTROL

During construction, appropriate sediment and erosion control measures need to be implemented to ensure that downstream receiving waters are not adversely impacted as a result of construction activities. The engineering drawings 18652_SSDA_SE01-SE03 by Henry & Hymas outline appropriately designed and detailed measures to mitigate against this risk. These measures have been designed in accordance with the requirements of the publication “Landcom – Managing Urban Stormwater - Soils and Construction, Volume 1, 4th Edition March 2004” and Blacktown City Council requirements.

# 8. APPENDICES

*APPENDIX A*
*Engineering Drawings*

*APPENDIX B*
*Maintenance Manuals*

- *CDS Unit 3030*
- *CDS Unit 2018*
- *Bioretention (General)*

*APPENDIX C*
*In Situ Measurement of Hydraulic Conductivity for Bioretention*

*APPENDIX D*
*OSD Deemed to Comply Spreadsheet*

*APPENDIX E*
*Hydrographs of BCC XP-RAFTS base model for Eastern Creek*