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CIVIL ENGINEERING REPORT:
S75W INFRASTRUCTURE DEVELOPMENT APPLICATION (SSD 06_0225)

PROPOSED DEVELOPMENT:
HANSON LAND, LOT 5 DP 1145808
EASTERN CREEK NSW

Prepared For:
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1 INTRODUCTION

1.1 Introduction

Frasers Property Australia (Frasers) propose to subdivide and perform infrastructure works to enable future industrial development of a parcel of land, Lot 5 DP1145808, at Honeycomb Drive, Eastern Creek, NSW. The land comprises an area of approximately 27 Ha and is located on the southern extent of the Sydney Business Park industrial area. The current site is currently utilised as mixed industrial operations including asphalt and concrete plants operated by Hanson Australia and several areas for stockpiling and material.

Previous applications for development have been granted over the land under NSW Department of Planning and Infrastructure SSD 06_0225 (3 June 2010) and SSD 06_0225 MOD1 (24 October 2013). This application includes for an amended Masterplan Layout, to suit larger lot sizes which are more consistent with current market development demands.

1.2 Scope

Costin Roe Consulting Pty Ltd has been commissioned by Frasers to prepare this Engineering Report in support of the proposed S75w Development Application for infrastructure works on the site. This report follows from a previous

This report provides a summary of the design principles and planning objectives for the following civil engineering components of the project:

- Roads and Transportation;
- Earthworks & Retaining Walls;
- Stormwater Management; and
- Erosion Control.

The engineering objectives for the development are to create a site which responds to the existing site topography and site constraints, and to provide an appropriate and economical stormwater management system which incorporates best practice in water sensitive urban design and is consistent with the requirements of council's water quality objectives.

A set of drawings have been prepared to show the proposed infrastructure works including bulk earthworks for future development of each lot based on flat platforms, retaining walls, road works and stormwater drainage. The sediment and control measures detailed are also based on the proposed bulk earthwork levels which consist of flat pads with minimal fall to control drainage and minimise future bulk earthworks on the sites.

1.3 Authority Jurisdiction

The consent authority is Blacktown City Council. The requirements of the Blacktown City Council *Engineering Guide for Development* and *Part J* of the *Development Control Plan 2015* apply.

1.4 Differences Between The Current Application and SSD 06_0225 Mod1

This application is for an amendment to SSD 06_0225 Mod1. The main component of the amendment is for an adjustment to the approved lot layout and earthworks levels completed by Martins Consulting Engineers during 2013. Some minor amendments to other components of the design will be apparent due to this change. This section of the report provides a summary of the engineering components of the development which will change from, or remain consistent with, the approved SSD 06_0225 Mod1 development.

Summary of design elements as follows:

- Development Layout
  The development layout differs from the previous development application in that the development lot sizes on the western side of the main estate access road have been increased to suit large format warehouse and distribution centre type development. The lot layouts to the east and south of the estate road are generally consistent with the approved SSD 06_0225 Mod1 approval.
  Some minor realignment to the estate access road have also been made to suit the current Masterplan Site Layout and to tie into the known alignments road from the adjacent proposed development to the west by Dial-A-Dump.
- Stormwater Management
  The Stormwater Management Strategy for the site will remain generally consistent with the approved configuration produced by Martins Consulting in SSD 06_0225 Mod1. This will include for the provision of an estate level detention basin, wetland and bio-retention, water quality system in the south-west corner of the development site. The design will incorporate some additional measures to the wetland system which were requested by Blacktown Council during the Mod1 approval during August 2012. These improvements to the design include the introduction of deep water zones, marsh zones, deep marsh zones, consideration to overflow during 1:100 ARI storm events and the PMF event, rip-rap/ energy dissipater allowances and other detailed information relating to the wetland.
  The combined detention basin, wetland and associated structures will be located clear of the adjacent Ropes Creek riparian corridor and proposed reuse by the Hanson Facility also remains consistent with the Mod1 approval.
  The site allows to drain the 1 in 100 ARI storm flows from the adjacent Eastern Creek Business Park (Stage 3) catchment which currently discharges onto the property. Site discharge to Ropes Creek riparian corridor also remains consistent with the Mod1 Approval.
- Earthworks
  There are some adjustments proposed to the earthworks design to suit the revised Masterplan Layout for the estate. The proposed earthworks levels are shown on drawings **Co10726.13-DA31, DA32 and DA35**.
- Conservation Areas
  There are adjustments proposed to the conservation of Cumberland Woodplain between the current and Mod 1 Approval. It is proposed that the conservation zone will be located on the western boundary of the site, adjacent to the Fulton Hogan eastern property boundary. Reference to the Masterplan Layout confirms the location.

2 DEVELOPMENT SITE

2.1 Existing Site

The existing site is currently utilised as mixed industrial operations including asphalt and concrete plants operated by Hanson Australia and several areas for stockpiling and material.

The supplied survey data indicates the site is a regraded side slope within the Ropes Creek catchment. The highest elevation on the property is approximately RL 92.5m (AHD) and the lowest at RL 59.0m. Grades over the site vary generally between 0.5% to 5%. The site is comprised of gravel roads and a number of large fill stockpiles. Concrete and other building waste is also present on the site, along with Hanson asphalt recycling plant. There are also two earth embankment dams located in the south-west corner of the site.

Note that quoted areas are shown to 2 significant figures in this report. Minor variations to quoted areas may be apparent between figures quoted in the report and detailed architectural, engineering and surveying plans.

2.2 Proposed Development

The proposed application is for infrastructure works associated with a subdivision of the property as an industrial estate. The site works incorporates the following elements:

- Earthworks and retaining walls to facilitate flat building pads;
- A local subdivision access road;
- Extension of Honeycomb Drive, consistent with council precinct plans and known future development to the west of the site;
- Infrastructure works including stormwater, energy, telecommunications and sewer;
- Provision of area for the Hanson Asphalt plant to continue operations within the overall envelope of the property; and
- Provision of drainage connections and servicing of individual development lots.

This development covers subdivision and infrastructure works only. Future separate development applications will be made for individual development lots which would include for improvements to the lots.

3 ROADS AND TRANSPORTATION

3.1 General

The proposed road has been designed with the following allowances:

- Geometric design completed in accordance with Austroads Guide to Road Design 2010, Austroads – Pavement Design, A guide to Structural Design of Road Pavements and Blacktown City Council Engineering Guide for Development, 2005;
- Design Vehicle – Estate Road, B-Double;
- Design Speed – 60kM/hr (50kM/hr posted);
- Estate Road Type – Industrial; and
- Traffic Loading – $1x10^7$ Equivalent Standard Axles.

3.2 Road Widths

The proposed estate and collector roads are required of Blacktown Council to be designed as an industrial and collector road as defined in Blacktown Engineer Guide for Development.

Road Type & Traffic Volume	Carriageway	Verge (Footpath Pedestrian)	Verge (Pedestrian & Cycleway)	Total Road Reserve	Number of lanes
Industrial (Up to 4,000vpd)	13.5m (2 x 6.75m)	3.5m	4.5m	21.50m	2 travel/ 1 parking lane
Collector Road	15.5m	3.75	3.75	23.0	2 travel/ 2 parking

Table 3.1. Proposed Road Cross Sections

The roads will have concrete kerb and gutter and a carriageway surface finished with asphaltic concrete as per the requirements of Blacktown City Council.

Collector Road A extends from the intersection of Honeycomb and Kangaroo Avenue, around the northern portion to the western estate boundary, and eastern boundary of the Fulton Hogan development. This section of roadway will be designed and constructed by Frasers. An indicative layout and alignment of the collector road (Collector Road B), as it extends past the Fulton Hogan property to the west, has also been shown. This section of road will be completed by Blacktown Council as part of S94 Contributions and is shown for information purposes only. Stormwater drainage for Collector Road B is through the Fulton Hogan property to the south west and forms part of the current application and documentation.

The dimensions of the adopted design cross section are shown on Drawing No.'s **Co10726.13-DA51, DA52** and **DA53** in **Appendix A**.

3.3 Road Alignments

The proposed road alignments have been designed to meet Council and Austroads requirements. The proposed road layout incorporates best practice for both horizontal and vertical alignments with empathy to the landform. Priority has been given in the design for the safety of vehicles and pedestrians.

The horizontal alignments generally meet Council standards. Minimum horizontal radii in accordance with Section 3.11 of Council's Engineering Guide for Development, 2005, have been provided.

In accordance with the Council standards, a minimum longitudinal grade of 1% and a maximum of 7.5% have been designed. The maximum grade of the industrial access road is slightly higher than councils desirable grade limit (Table 3.6 of Blacktown Council Engineering Guide for Development 21005) of 6% however less than the absolute maximum of 10%. The steeper than desirable grade is required to facilitate access to the development lots and given the short extent of travel within the cul-de-sac the 7.5% grade is considered acceptable.

Where a change of grade is in excess of 0.6%, a vertical curve in accordance with the RTA Road Design Guide for a design speed of 60 km/h has been provided.

3.4 Pedestrian Facilities

Pedestrian paths have been located on both sides of the estate and collector roads.

4 SITE WORKS

4.1 Bulk Earthworks

The proposed development will be sympathetic to the site topography and the environment with building pads being sited to the contours of the land. As the proposed development is for industrial use, and the level difference over the existing site are reasonably large, it is inevitable that some areas will be in substantial cut, and others in fill. This will be required in order to provide large flat pads for the future buildings.

The existing surface levels and proposed pad levels are shown on Drawings **Co10726.13-DA31, DA32 & DA35 in Appendix A.**

The Bulk Earthwork Levels (B.E.L) shown on above plans are based on creating a balance of the earthwork cut and fill volumes. This will require neither importation nor exportation of material other than stripped topsoil and any other vegetation or deleterious material.

The Bulk Earthwork Levels have been selected based on the proposed estate lot layout while attempting to follow the surrounding levels, to allow for access, to drain the site by gravity and minimise retaining walls. The proposed bulk earthworks layout comprises a number of level pads with falls away from nominal building pad locations to the new estate road and proposed boundaries.

We note that levels nominated on the provided concept design drawings are within plus or minus 500mm of the final levels subject to the final geotechnical requirements, site layouts, service excavation volumes and final volumes on site.

Soil Erosion and Sediment Control measures including sedimentation basins are to be placed in accordance with submitted drawings and the Soil and Water Management Plan in **Section 8** of this report.

4.2 Embankment Stability

To assist in maintaining embankment stability permanent batters slopes will be no steeper than 3 horizontal to 1 vertical, while temporary batters will be no steeper than 2 horizontal to 1 vertical.

Stability of batters and reinstatement of vegetation shall be in accordance with the submitted drawings and the Soil and Water Management Plan.

4.3 Supervision of Earthworks

All geotechnical testing and inspections performed during the earthworks operations will be undertaken to Level 1 geotechnical control, in accordance with AS3798-1996.

4.4 Retaining Walls

Due to the existing topography and the nature of the proposed development, retaining walls will be required over the site. The proposed layout and configuration of retaining walls is shown on drawing **Co10726.13-DA60**. Typical retaining wall details are shown on drawings **DA60**.

Walls greater than 3m in height, where aligned along public roads, will be terraced in accordance with BCC requirements. Where walls are located outside of public view (ie behind buildings or future development sites on adjoining properties) then terraces will not be included in the design.

5 STORMWATER DRAINAGE

5.1 Site Drainage

5.1.1 Existing Site Drainage

As discussed in previous sections the property currently comprises a facility for Hanson. The stormwater management on the site is performed by a series of dams and sediment ponds.

Two irregular natural watercourses are present on the site. The first water course is an upper tributary of Ropes Creek which starts from a catchment south of the site and flows from the property immediately to the south of the site and passes the south west corner of the site. This forms the site discharge point and is also part of a conservation zone. The second watercourse is a local stormwater depression which conveys flows from the Stage 3 of the Eastern Creek Business Park. This currently conveys flows across the eastern portion of the site, into the south eastern corner of the site and one of the site's sedimentation ponds. Flows from the upper portion of the site also flow into this water course and pond.

Management is made via a series of dams which act as sediment ponds. A top dam is located near the crusher plant, several middle dams receive flows from the top dam via an open channel. A larger sedimentation dam is located in the south western portion of the site which receives combined pit, process effluent and stormwater runoff. Water is released from the site into the ropes creek tributary following overflow from the major sediment dam via a series of small sediment and detention ponds. A more detailed description of the existing dam arrangement and management can be found in the original and Mod1 application documents completed by Martins.

5.1.2 Proposed Site Drainage

As per general engineering practice and the guidelines of BCC, the proposed stormwater drainage system for the development will comprise a minor and major system to safely and efficiently convey collected stormwater run-off from the development.

The minor system is to consist of a piped drainage system which has been designed to accommodate the 1 in 20-year ARI storm event (Q20). This results in the piped system being able to convey all stormwater runoff up to and including the Q20 event. The major system through new paved areas has been designed to cater for storms up to and including the 1 in 100-year ARI storm event (Q100). The major system employs the use of defined overland flow paths to safely convey excess run-off from the site.

The design of the stormwater system for this site will be based on relevant national design guidelines, Australian Standard Codes of Practice, the standards of BCC and accepted engineering practice and as defined in the Sydney Business Park Stormwater Management Strategy. Runoff from buildings will generally be designed in accordance with AS 3500.3 National Plumbing and Drainage Code Part 3 – Stormwater Drainage. Overall site runoff and stormwater management will generally be designed in accordance with the Institution of Engineers, Australia publication "Australian Rainfall and Runoff" (1988 Edition), Volumes 1 and 2 (AR&R).

Water quality and re-use are to be considered in the design to ensure that any increase in the detrimental effects of pollution are mitigated, BCC Water Quality Objectives are met and that the demand on potable water resources are reduced. This document confirms the requirements for future development lots based on a whole of catchment approach, allowing for partial treatment of the road.

Following earthworks and prior to development of individual lots, stormwater management will be performed as per Blacktown Council Guidelines and recommendations of the Landcom Blue Book.

The drainage system has been designed to convey stormwater from the northern collector road (Honeycomb Drive extension), from a ridge line at the estate/ Fulton Hogan property boundary to the east and the estate access road. The drainage line then travels south along the alignment of the estate access road, to the cul-de-sac at the south end of the road. From here the drainage follows a route to the west, toward the wetland, detention basin and water quality treatment system. The low flow event (up to 1 in 1 year ARI) is routed to and pre-treated by a vortech type GPT and bio-retention system, the high flow is diverted directly to the wetland and detention basin.

The estate drainage system caters for the stormwater flows from the Fulton Hogan Property, with the water quality management based on Fulton Hogan providing a vortech style GPT (or equivalent approved Blacktown Council measure) prior to discharge into the estate drainage system.

Falls and drainage of the northern collector road (Collector Road B), to the west of the ridge in the road and to the north of the Fulton Hogan property, will be conveyed to the south west. The drainage system has been designed to convey stormwater from the northern collector road (Collector Road B), from a ridge line at the estate/ Fulton Hogan property boundary to the west. The drainage line then travels south within the Fulton Hogan property toward the wetland, detention basin and water quality treatment system. The water quality management is based on providing a vortech style GPT (or equivalent approved Blacktown Council measure) prior to discharge into the estate drainage system.

5.1.3 Site Discharge

The proposed legal point of discharge for the development is the riparian zone of the Ropes Creek Tributary located at the south-western corner of the estate. The outlet arrangement provides for a staged discharge between the 2 year, 20 year, 100 year and larger ARI storm events. The location of the discharge point is shown on drawing **Co10726.13-DA42**.

5.2 Hydrologic Modelling and Analysis

5.2.1 General Design Principles

The design of the stormwater system for this site will be based on relevant national design guidelines, Australian Standard Codes of Practice, Blacktown City Council and accepted engineering practice.

Specifically the design will be based on:

- Runoff from buildings will generally be designed in accordance with AS 3500.3 National Plumbing and Drainage Code Part 3 – Stormwater Drainage;
- Overall site runoff and stormwater management will generally be designed in accordance with the Institution of Engineers, Australia publication "Australian Rainfall and Runoff" (1987 Edition), Volumes 1 and 2 (AR&R);
- Blacktown City Council's *Engineering Guidelines for Development 2005;*
- Storm events for the 2 to 100 Year ARI event have been assessed.

5.2.2 Minor/ Major System Design

The piped stormwater drainage (minor) system has been designed to accommodate the 20-year ARI storm event (Q20). Overland flow paths (major) which will convey all stormwater runoff up to and including the Q100 event have also been provided which will limit major property damage and any risk to the public in the event of a piped system failure.

5.2.3 Rainfall Data

Rainfall intensity Frequency Duration (IFD) data used as a basis for ILSAX and RAFTS modelling for the 2 to 100 Year ARI events, was taken from Blacktown City Council's *Engineering Guidelines for Development 2005*.

5.2.4 Runoff Models

In accordance with the recommendations and standards of Blacktown City Council, the calculation of the runoff from storms of the design ARI will be calculated with the catchment modelling software DRAINS. The ILSAX hydrological model component will be utilised for the post-development site and the RAFTS model component for broad scale catchments. This will be in accordance with previous studies and approvals for land in the area.

The design parameters for the ILSAX model are to be based on the recommendations as defined by BCC and parameters for the area and are as follows:

Model	Model for Design and analysis run	Rational method	
	Rational Method Procedure	ARR87	
	Soil Type-Normal	3.0	
	Paved (Impervious) Area Depression Storage	1	mm
	Supplementary Area Depression Storage	1	mm
	Grassed (Pervious) Area Depression Storage	5	mm
AMC	Antecedent Moisture Condition (ARI=1-5 years)	2.5	
AMC	Antecedent Moisture Condition (ARI=10-20 years)	3.0	
AMC	Antecedent Moisture Condition (ARI=50-100 years)	3.5	
	Sag Pit Blocking Factor (Minor Systems)	0	
	On Grade Pit Blocking Factor (Minor Systems)	0	
	Sag Pit Blocking Factor (Major Systems)	0.5	
	On Grade Pit Blocking Factor (Major Systems)	0.2	
	Inlet Pit Capacity		

Table 5.1. DRAINS ILSAX Parameters

5.3 Hydraulics

5.3.1 General Requirements

Hydraulic calculations will be carried out utilising DRAINS modelling software during the detail design stage to ensure that all surface and subsurface drainage systems perform to or exceed the required standard.

5.3.2 Freeboard

The calculated water surface level in open junctions of the piped stormwater system will not exceed a freeboard level of 150mm below the finished ground level, for the peak runoff from the Minor System runoff. Where the pipes and junctions are sealed, this freeboard would not be required.

Freeboard of 300mm has been achieved to building levels during the Major Storm Event.

5.3.3 Public Safety

For all areas subject to pedestrian traffic, the product (dV) of the depth of flow d (in metres) and the velocity of flow V (in metres per second) will be limited to 0.4, for all storms up to the 100-year ARI.

For other areas, the dV product will be limited to 0.6 for stability of vehicular traffic (whether parked or in motion) for all storms up to the 100-year ARI.

5.3.4 Inlet Pit Spacing

The spacing of inlets throughout the site will be such that the depth of flow, for the Major System design storm runoff, will not exceed the top of the kerb (150mm above gutter invert).

5.3.5 Overland Flow

Dedicated flow paths have been designed to convey all storms up to and including the 100-year ARI. These flow paths will convey stormwater from the site to the estate road system.

5.4 External Catchments and Flooding

The site is affected by overland flow from the Eastern Creek Business Park Stage 3 Estate. Stormwater from this catchment enters the site on the southern portion of the eastern boundary and, based on the estate infrastructure design documents by Henry & Hymas, a peak flow of 5.4m3/s (Q100 ARI) is required to be conveyed through the development site. This flow is proposed to be conveyed south adjacent to the eastern boundary via an open drainage swale. Once it reaches the southern boundary it will head west, adjacent to the southern site boundary, to its discharge point at the Ropes Creek tributary at the south-western corner of the development. The stormwater quantity and quality from the Eastern Creek Business Park Estate has been managed in prior to entering the Hanson property and will bypass all proposed stormwater measures on this site.

There are no known flooding issues and the site has not been flagged by Blacktown City Council or within Blacktown City Council flood maps.

5.5 Stormwater Management

The proposed stormwater management will be consistent with Blacktown City Council DCP2015 Part J and generally in accordance with the approved Mod1 arrangement. Some minor modifications have been made to address current council policy and industry best practice.

Sections 6 and **7** of this report describe the general arrangement for the Stormwater Management and objectives which will be required for development lots.

6 STORMWATER QUANTITY MANAGEMENT

Blacktown City Council requires water quantity to be managed to limit the runoff discharged from private property into the underground piped drainage system to pre-developed flow and to assist in mitigating the increased stormwater runoff generated by development. Water quantity management is sometimes referred to as stormwater detention, or on-site detention (OSD).

As per councils engineering requirements, stormwater detention has been provided for the development and is proposed for to be provided in the form of a combined water quantity and quality basin in the south-west corner of the site.

Storm events in the range of 1 to 100 Year ARI were modelled to determine storage requirements, based on attenuating stormwater to pre-developed flow rates at the peak of the event. Consideration to the PMF event has also been made in the sizing of the emergency overflow to the basin.

Pre and post-development flows were calculated using DRAINS/ILSAX model which includes road network and development lot catchments. **Table 6.1** shows the pre and post development flows over the catchment and the associated storage capacity for the different events.

ARI (yrs)	Storm Duration (hrs)	Flow (m^3/s)			Water Level (m)	Storage (m^3)
		Pre-Devel.	Post Devel. (un-attenuated)	Post Devel. (with attenuation)		
1	2	0.464	2.60	0.435	62.27	5,000
2	2	1.31	3.37	0.889	62.52	6,170
20	2	3.68	5.73	3.23	62.92	8,060
100	2	5.19	7.10	5.17	63.10	8,960
PMF	2	21.7	23.0	22.9	63.42	10,660

Table 6.1. Pre and Post Development Flows and OSD Storage Requirements

In order to maintain the above flow attenuation, in the range of 1 to 100 Year ARI, a total of 8,960m^3 of active storage will be provided with a maximum depth of 2.10m during the Q100 ARI storm event.

An active storage of 10,660m³ will be provided with a maximum depth of 2.42m during the PMF storm event.

7 STORMWATER QUALITY CONTROLS

7.1 Stormwater Management Objectives

There is a need to provide design which incorporates the principles of Water Sensitive Urban Design (WSUD) and to target pollutants that are present in the stormwater so as to minimise the adverse impact these pollutants could have on receiving waters and to also meet the requirements specified by the Blacktown City Council.

Stormwater quality will comprise a treatment train which meets the percentage based pollution reduction objectives of Blacktown Council Policy DCP2015 Part J.

The water quality objectives for the entire development are presented in terms of annual percentage pollutant reductions on a developed catchment:

Gross Pollutants	90%
Total Suspended Solids	85%
Total Phosphorus	65%
Total Nitrogen	45%
Total Hydrocarbons	90%

The water quality management will be provided at an estate level. This will be achieved by the implementation of the following measures:

- Pre-treatment via vortech type GPT;
- Tertiary treatment via bio-retention basin; and
- Final polishing via a constructed wetland system (which also forms the combined detention basin system).

Treatment measures on the development lots will not be required as all management measures will be achieved by the estate level measures described above. The treatment measure will target Total Suspended Solids (TSS), Total Phosphorous (TP), Total Nitrogen (TN), Gross Pollutants (GP) and Hydrocarbons (H) in accordance with Council Policy.

A MUSIC analysis has been completed to confirm the effectiveness of the water quality treatment train.

7.2 Stormwater Quality Modelling

7.2.1 Introduction

The MUSIC model was chosen to model water quality. This model has been released by the Cooperative Research Centre for Catchment Hydrology (CRCCH) and is a standard industry model for this purpose. MUSIC (the Model for Urban Stormwater Improvement Conceptualisation) is suitable for simulating catchment areas of up to 100 km2 and utilises a continuous simulation approach to model water quality.

By simulating the performance of stormwater management systems, MUSIC can be used to determine if these proposed systems and changes to land use are appropriate for their catchments and are capable of meeting specified water quality objectives (CRC

2002). The water quality constituents modelled in MUSIC and of relevance to this report include Total Suspended Solids (TSS), Total Phosphorus (TP) and Total Nitrogen (TN).

The pollutant retention criteria set out in Part J of BCC's DCP2015 and nominated in Section 7.1 of this report were used as a basis for assessing the effectiveness of the selected treatment trains.

The MUSIC model "10726.13_DA Rev2.sqz" was set up to examine the effectiveness of the water quality treatment train and to determine pollution reduction requirements. The layout of the MUSIC model is presented in **Appendix B**.

7.2.2 Rainfall Data

Six minute pluviographic data was provided by BCC which has been sourced from the Bureau of Meteorology (BOM) as nominated below. Evapo-transpiration data for the period was sourced from the Sydney Monthly Areal PET data set supplied with the MUSIC software.

Input	**Data Used**
Rainfall Station	67035 Liverpool (Whitlam)
Rainfall Period	1 January 1967 – 31 December 1976 (10 years)
Mean Annual Rainfall (mm)	857
Evapotanspiration	Sydney Monthly Areal PET
Model Timestep	6 minutes

7.2.3 Rainfall Runoff Parameters

Parameter	**Value**
Rainfall Threshold	1.40
Soil Storage Capacity (mm)	170
Initial Storage (% capacity)	30
Field Capacity (mm)	70
Infiltration Capacity Coefficient a	210
Infiltration Capacity exponent b	4.7
Initial Depth (mm)	10
Daily Recharge Rate (%)	50
Daily Baseflow Rate (%)	4
Daily Seepage Rate (%)	0

7.2.4 Pollutant Concentrations

Pollutant concentrations for source nodes are based on BCC land use parameters as per the **Table 7.2**.:

Flow Type	Surface Type	TSS (log_{10} values)		TP (log_{10} values)		TN (log_{10} values)	
		Mean	Std Dev.	Mean	Std Dev.	Mean	Std Dev.
Baseflow	Roof	1.20	0.17	-0.85	0.19	0.11	0.12
	Roads	1.20	0.17	-1.11	0.48	0.14	0.12
Stormflow	Roof	1.30	0.32	-0.89	0.25	0.30	0.19
	Roads	2.43	0.32	-0.30	0.25	0.34	0.19

Table 7.2. Pollutant Concentrations

7.2.5 Source Nodes

The MUSIC model has been setup with a treatment train approach based on the pollutant concentrations in **Table 7.2** As the layouts for the future developments are not know at this time, an allowance of 40% hardstand and 60% roofed areas has been allowed for over the site. The hardstand catchments include an allowance for the estate road.

7.2.6 Treatment Nodes

GPT, bio-retention, rainwater and constructed wetland nodes have been used in the modelling of the development. Input values can be observed in the MUSIC Link output provided in **Appendix B** of the report.

7.2.7 Analysis and Results

Tables 7.3 show the results of the MUSIC analysis with the reduction rates expressed as a percentage, comparing the post-development pollutant loads without treatment to the post-development loads with treatment.
In order to define reduction rates which would be used for individual development lots in future development applications the standard council removal objectives were adjusted to ensure the overall development achieved the stand Part J reduction objectives.

Pollutant	**Source**	**Residual Load**	**% Reduction**
Total Suspended Solids (kg/yr)	33,600	**4,950**	**85.3 %**
Total Phosphorus (kg/yr)	65.5	**21.6**	**67.0 %**
Total Nitrogen (kg/yr)	393	**210**	**46.5 %**
Gross Pollutants (kg/yr)	4,330	**22.6**	**99.5 %**

Table 7.3. MUSIC analysis results

7.3 Stormwater Harvesting

Stormwater harvesting refers to the collection of stormwater from the developments internal stormwater drainage system for re-use in non-potable applications. Stormwater from the stormwater drainage system can be classified as either rainwater where the flow is from roof areas only, or stormwater where the flow is from all areas of the development.

For the purposes of this development, we refer to a rainwater harvesting system, where benefits of collected stormwater from roof areas over a stormwater harvesting system can be made as rainwater is generally less polluted than stormwater drainage.

Rainwater harvesting is proposed for future lots within this development with re-use for non-potable applications. Internal uses include such applications as toilet flushing while external applications will be used for irrigation. The aim is to reduce the water demand for the development by a minimum of 80% and to satisfy *Part J of Blacktown Council DCP2015*.

In general terms the rainwater harvesting systems will be in-line tanks for the collection and storage of rainwater. At times when the rainwater storage tank is full rainwater can pass through the tank and continue to be discharged via gravity into the stormwater drainage system. Rainwater from the storage tank will be pumped for distribution throughout the development in a dedicated non-potable water reticulation system.

Rainwater falling on roofs is soft, clear and generally low in microbial and chemical contamination. Any contamination of rainwater generally occurs during collection and storage. The use of simple and cost effective rainwater collection and treatment systems ensures reliable operation and water quality for non-potable use. The proposed rainwater treatment will be a first flush diverter in accordance with council engineering guidelines.

Indoor and outdoor water demand and rainwater tanks sizing will be based on individual site requirements and form part of separate future development applications over these development lots.

Allowance for the reuse required by the Hanson facility has been included in the MUSIC modelling for the site. This is based on values contained in the Mod1 Application documentation which require 127 kL/day to be reused from the constructed wetland. Allowances for reuse of rainwater from development lots was also made in the model with nominal rates being adopted and a 25% of expected roof area being drained to the rainwater tanks.

7.4 Maintenance and Monitoring

It is important that each component of the water quality treatment train is properly operated and maintained. In order to achieve the design treatment objectives, an indicative maintenance schedule has been prepared (refer to **Table 7.4** and **Table 7.5** below) to assist in the effective operation and maintenance of the various water quality components.

Note that inspection frequency may vary depending on site specific attributes and rainfall patterns in the area. In addition to the below nominated frequency it is recommended that inspections are made following large storm events.

Table 7.4. Indicative Maintenance Schedule

MAINTENANCE ACTION	FREQUENCY	RESPONSIBILITY	PROCEDURE
SWALES/ LANDSCAPED AREAS			
Check density of vegetation and ensure minimum height of 150mm is maintained. Check for any evidence of weed infestation	Six monthly	Maintenance Contractor	Replant and/or fertilise, weed and water in accordance with landscape consultant specifications
Inspect swale for excessive litter and sediment build up	Six monthly	Maintenance Contractor	Remove sediment and litter and dispose in accordance with local authorities' requirements.
Check for any evidence of channelisation and erosion	Six monthly/ After Major Storm	Maintenance Contractor	Reinstate eroded areas so that original, designed swale profile is maintained
Weed Infestation	Three Monthly	Maintenance Contractor	Remove any weed infestation ensuring all root ball of weed is removed. Replace with vegetation where required.
Inspect swale surface for erosion	Six Monthly	Maintenance Contractor	Replace top soil in eroded area and cover and secure with biodegradable fabric. Cut hole in fabric and revegetate.
WETLAND AND OSD BASIN			
Landscape & Vegetation	Refer to Above	Refer to Above	Refer to Above
Inspect and remove any blockage from orifice	Six Monthly	Maintenance Contractor/ Owner	Remove grate and screen to inspect orifice.
Inspect trash screen and clean	Six Monthly	Maintenance Contractor/ Owner	Remove grate and screen if required to clean it.

MAINTENANCE ACTION	FREQUENCY	RESPONSIBILITY	PROCEDURE
Inspect flap valve and remove any blockage.	Six Monthly	Maintenance Contractor/ Owner	Remove grate. Ensure flap valve moves freely and remove any blockages or debris.
Inspect pit sump for damage or blockage.	Six Monthly	Maintenance Contractor/ Owner	Remove grate & screen. Remove sediment/ sludge build up and check orifice and flap valve is clear.
Inspect storage areas and remove debris/ mulch/ litter etc likely to block screens/ grates.	Six Monthly	Maintenance Contractor/ Owner	Remove debris and floatable materials.
Check attachment of orifice plate and screen to wall of pit	Annually	Maintenance Contractor	Remove grate and screen. Ensure plate or screen mounted securely, tighten fixings if required. Seal gaps if required.
Check orifice diameter is correct and retains sharp edge.	Five yearly	Maintenance Contractor	Compare diameter to design (see Work-as-Executed) and ensure edge is not pitted or damaged.
Check screen for corrosion	Annually	Maintenance Contractor	Remove grate and screen and examine for rust or corrosion, especially at corners or welds.
Inspect overflow weir and remove any blockage	Six monthly	Maintenance Contractor/ Owner	Ensure weir is free of blockage.
Inspect walls for cracks or spalling	Annually	Maintenance Contractor	Remove grate to inspect internal walls, repair as necessary.
Check step irons	Annually	Maintenance Contractor	Ensure fixings are secure and irons are free from corrosion.
RAINWATER TANKS			
Check for any clogging and blockage of the first flush device	Monthly	Maintenance Contractor	First flush device to be cleaned out

MAINTENANCE ACTION	FREQUENCY	RESPONSIBILITY	PROCEDURE
Check for any clogging and blockage of the tank inlet - leaf/litter screen	Six monthly	Maintenance Contractor	Leaves and debris to be removed from the inlet leaf/litter screen
Check the level of sediment within the tank	Every two years	Maintenance Contractor	Sediment and debris to be removed from rainwater tank floor if sediment level is greater than the maximum allowable depth as specified by the hydraulic consultant
INLET & JUNCTION PITS			
Inside Pit	Six Monthly	Maintenance Contractor	Remove grate and inspect internal walls and base, repair where required. Remove any collected sediment, debris, litter.
Outside of Pit	Four Monthly/ After Major Storm	Maintenance Contractor	Clean grate of collected sediment, debris, litter and vegetation.
GROSS POLLUTANT TRAPS – VORTECH/ CDS			
General inspection	3 monthly & after major storm event	Maintenance Contractor	Refer to manufacturer's O&M manual
Removal of Pollutants & general maintenance requirements as per manufacturer's O&M manual	Bi-annually Asper manufacturer's O&M manual	Maintenance Contractor	As per manufacturer's O&M manual
STORMWATER SYSTEM			
General Inspection of complete stormwater drainage system	Bi-annually	Maintenance Contractor	Inspect all drainage structures noting any dilapidation in structures and carry out required repairs.

Due to the complex makeup of the bio-retention system a specific maintenance schedule has been prepared for this component of the treatment train as shown below in **Table 7.5**.

Table 7.5. Indicative Maintenance Schedule – bio-retention basin

ITEM	WHAT TO CHECK FOR	ACTION	FREQUENCY
Civil Components			
Inlet	No evidence of erosion, blockage, damage or standing water.	Clear inlet of accumulated sediment or debris. Eroded areas should be locally re-profiled or reinforced, and re-planted if necessary.	Storm events 3 months
Outlet	No evidence of erosion, blockage, damage or standing water Outlet freely draining.	Clear outlet of accumulated sediment or debris. Seek specialist advice if standing (backwatering into the raingarden) is present.	Storm events 3 months
Other Structures	No evidence of erosion and damage to other structures, e.g. pits, pipes, access ramps, walls and rock protection.	Repair minor damage to structures. Eroded areas should be repaired (reinforced). This may involve minor re-profiling or re-planting works. For severe damage, i.e. where flows have scoured down the side of a structure seek specialist advice.	3 months
Batter & Bunds	No evidence of erosion	Eroded areas should be locally re-profiled or reinforced, and re-planted if necessary.	Annually
Hydraulic Conductivity	Filter media is draining freely. No water ponded on the surface of the raingarden for more than 12 hours after rainfall.	If water is ponded on the surface of the raingarden for more than 12 hours after rainfall, seek specialist advice. Note: the disposal of raingarden filter material must comply with EPA guidelines for the disposal of contaminated soil.	Storm events
Sediment Accumulation	Sediment forebay less than 75% full. No major sediment accumulation on surface of the raingarden.	Clean out accumulated sediment from the sediment forebay. Accumulated sediment to be removed from the surface of the raingarden and the system replanted as required.	Annually

ITEM	WHAT TO CHECK FOR	ACTION	FREQUENCY
Filter Media Surface	No surface scour, depressions	Filter surface to be repaired. This may involve evening out the surface, importing additional filter media and replanting.	3 months
Fine Sediment Surface Crust	No impermeable or clayey surface on the filter media. No major surface crusting (<3mm depth across less than 10% of the filter area is permissible)	Repair surface layer by scarify filter media surface, re-profiling and re-establishing vegetation, if required. If the problem persists refer to seek specialist advice.	3 months
Mulch Layer	Even depth and distribution of the mulch layer. Surface of the mulch layer is at least 100 mm below the top of the outflow pit. Mulch is not touching the plant stems	Re-distribute or replace mulch that has been washed out or displaced. This may involve retaining mulch using jute mats or nets. Remove mulch that is touching plant stems.	3 months
Algal or Moss Growth	No major algal growth (less than 10% of raingarden area is permissible). No moss growth.	If significant patches of algal growth or moss persist across the surface of the raingarden (i.e. greater than 10% of the surface) then seek specialist advice.	3 months
Inspection Opening	Water level is below filter media layer. No sediment accumulation in underdrain system.	Seek specialist advice if standing water is present in the filter media layer. Flush the underdrain system using low pressure water jet to remove accumulated sediment.	Annually
Landscape Components			
Vegetation Cover – Filter Media	Greater than 90% vegetation cover. Plants healthy, free from disease and vigorously growing.	Remove any dead or diseased vegetation. Replant individual bare patches (greater than 5% of the area) using either new plants or by dividing and translocating existing plants. If bare areas represent greater than 30% of the raingarden area, seek specialist advice.	3 months
Vegetation Cover – Batters	Continuous vegetation cover along the lower batter. Greater than 90% vegetation	Remove any dead or diseased vegetation. Replant individual bare patches	3 months

ITEM	WHAT TO CHECK FOR	ACTION	FREQUENCY
	cover. Plants healthy, free from disease and vigorously growing.	(greater than 5% of the area) using either new plants or by dividing and translocating existing plants.	
Weeds -filter media - batters	Less than 10% of the filter media surface area and batters covered in weeds.	Physically remove weeds from filter media surface and batters. Do not use herbicides as these may harm the desirable raingarden vegetation and contaminate the filter media. Seek specialist advice if weed ingress is a persistent problem (i.e. weed coverage is persistently greater than 30%).	3 months
Litter	Filter media surface and batters free of litter (i.e. less than 1 piece litter per 4m2).	Remove all litter and excessive debris	3 months
Pests	No damage by pest animals and insects.	Seek specialist advice if persistent insect damage is observed.	3 months

8 EROSION & SEDIMENT CONTROL PLAN

An erosion and sediment control plan (ESCP) is shown on drawings **Co10726.13-DA20** and **DA25**. These are conceptual plans only providing sufficient detail to clearly show that the works can proceed without undue pollution to receiving waters. A detailed plan will be prepared once consent is given and before works start.

8.1 General Conditions

1. The ESCP will be read in conjunction with the engineering plans, and any other plans or written instructions that may be issued in relation to development at the subject site.
2. Contractors will ensure that all soil and water management works are undertaken as instructed in this specification and constructed following the guidelines stated in Managing Urban Stormwater, Soils and Construction (1998) and BCC specifications.
3. All subcontractors will be informed of their responsibilities in minimising the potential for soil erosion and pollution to down slope areas.

8.2 Land Disturbance

1. Where practicable, the soil erosion hazard on the site will be kept as low as possible and as recommended in **Table 8.1**.

Land Use	Limitation	Comments
Construction areas	Limited to 5 (preferably 2) metres from the edge of any essential construction activity as shown on the engineering plans.	All site workers will clearly recognise these areas that, where appropriate, are identified with barrier fencing (upslope) and sediment fencing (downslope), or similar materials.
Access areas	Limited to a maximum width of 5 metres	The site manager will determine and mark the location of these zones onsite. They can vary in position so as to best conserve existing vegetation and protect downstream areas while being considerate of the needs of efficient works activities. All site workers will clearly recognise these boundaries.
Remaining lands	Entry prohibited except for essential management works	

Table 8.1 Limitations to access

8.3 Erosion Control Conditions

1. Clearly visible barrier fencing shall be installed as shown on the plan and elsewhere at the discretion of the site superintendent to ensure traffic control and prohibit unnecessary site disturbance. Vehicular access to the site shall be limited to only those essential for construction work and they shall enter the site only through the stabilised access points.
2. Soil materials will be replaced in the same order they are removed from the ground. It is particularly important that all subsoils are buried and topsoils remain on the surface at the completion of works.
3. Where practicable, schedule the construction program so that the time from starting land disturbance to stabilisation has a duration of less than six months.
4. Notwithstanding this, schedule works so that the duration from the conclusion of land shaping to completion of final stabilisation is less than 20 working days.
5. Land recently established with grass species will be watered regularly until an effective cover has properly established and plants are growing vigorously. Further application of seed might be necessary later in areas of inadequate vegetation establishment.
6. Where practical, foot and vehicular traffic will be kept away from all recently established areas
7. Earth batters shall be constructed in accordance with the Geotechnical Engineers Report or with as law a gradient as practical but not steeper than:
   - 2H:1V where slope length is less than 7 meters
   - 2.5H:1V where slope length is between 7 and 10 meters
   - 3H:1V where slope length is between 10 and 12 meters
   - 4H:1V where slope length is between 12 and 18 meters
   - 5H:1V where slope length is between 18 and 27 meters
   - 6H:1V where slope length is greater than 27 meters
8. All earthworks, including waterways/drains/spillways and their outlets, will be constructed to be stable in at least the design storm event.
9. During windy weather, large, unprotected areas will be kept moist (not wet) by sprinkling with water to keep dust under control. In the event water is not available in sufficient quantities, soil binders and/or dust retardants will be used or the surface will be left in a cloddy state that resists removal by wind.

8.4 Pollution Control Conditions

1. Stockpiles will not be located within 5 meters of hazard areas, including likely areas of high velocity flows such as waterways, paved areas and driveways.
2. Sediment fences will:
   a) Be installed where shown on the drawings, and elsewhere at the discretion of the site superintendent to contain the coarser sediment fraction (including aggregated fines) as near as possible to their source.

b) Have a catchment area not exceeding 720 square meters, a storage depth (including both settling and settled zones) of at least 0.6 meters, and internal dimensions that provide maximum surface area for settling, and

c) Provide a return of 1 meter upslope at intervals along the fence where catchment area exceeds 720 square meters, to limit discharge reaching each section to 10 litres/second in a maximum 20 year t_c discharge.

3. Sediment removed from any trapping device will be disposed in locations where further erosion and consequent pollution to down slope lands and waterways will not occur.
4. Water will be prevented from directly entering the permanent drainage system unless it is relatively sediment free (i.e. the catchment area has been permanently landscaped and/or likely sediment has been treated in an approved device). Nevertheless, stormwater inlets will be protected.
5. Temporary soil and water management structures will be removed only after the lands they are protecting are stabilised.

8.5 Waste Management Conditions

Acceptable bind will be provided for any concrete and mortar slurries, paints, acid washings, lightweight waste materials and litter. Clearance service will be provided at least weekly.

8.6 Site Inspection and Maintenance

1. A self-auditing program will be established based on a Check Sheet. A site inspection using the Check Sheet will be made by the site manager:
   - At least weekly.
   - Immediately before site closure.
   - Immediately following rainfall events in excess of 5mm in any 24 hour period.

   The self audit will include:
   - Recording the condition of every sediment control device
   - Recording maintenance requirements (if any) for each sediment control device
   - Recording the volumes of sediment removed from sediment retention systems, where applicable
   - Recording the site where sediment is disposed
   - Forwarding a signed duplicate of the completed Check Sheet to the project manager/developer for their information
2. In addition, a suitably qualified person will be required to oversee the installation and maintenance of all soil and water management works on the site. The person shall be required to provide a short monthly written report. The responsible person will ensure that:
   - The plan is being implemented correctly
   - Repairs are undertaken as required

- Essential modifications are made to the plan if and when necessary

The report shall carry a certificate that works have been carried out in accordance with the plan.

3. Waste bins will be emptied as necessary. Disposal of waste will be in a manner approved by the Site Superintendent.
4. Proper drainage will be maintained. To this end drains (including inlet and outlet works) will be checked to ensure that they are operating as intended, especially that,
   - No low points exist that can overtop in a large storm event
   - Areas of erosion are repaired (e.g. lined with a suitable material) and/or velocity of flow is reduced appropriately through construction of small check dams of installing additional diversion upslope.
   - Blockages are cleared (these night occur because of sediment pollution, sand/soil/spoil being deposited in or too close to them, breached by vehicle wheels, etc.).
5. Sand/soil/spoil materials placed closer than 2 meters from hazard areas will be removed. Such hazard areas include and areas of high velocity water flows (e.g. waterways and gutters), paved areas and driveways.
6. Recently stabilised lands will be checked to ensure that erosion hazard has been effectively reduced. Any repairs will be initiated as appropriate.
7. Excessive vegetation growth will be controlled through mowing or slashing.
8. All sediment detention systems will be kept in good, working condition. In particular, attention will be given to:
   a) Recent works to ensure they have not resulted in diversion of sediment laden water away from them
   b) Degradable products to ensure they are replaced as required, and
   c) Sediment removal, to ensure the design capacity or less remains in the settling zone.
9. Any pollutants removed from sediment basins or litter traps will be disposed of in areas where further pollution to down slope lands and waterways should not occur.
10. Additional erosion and/or sediment control works will be constructed as necessary to ensure the desired protection is given to down slope lands and waterways, i.e. make ongoing changes to the plan where it proves inadequate in practice or is subjected to changes in conditions at the work site or elsewhere in the catchment.
11. Erosion and sediment control measures will be maintained in a functioning condition until all earthwork activities are completed and the site stabilised
12. Litter, debris and sediment will be removed from the gross pollutant traps and trash racks as required.

9 CONCLUSION

This Civil Engineering Details Report has been prepared in support of the Infrastructure Development Application associated with the subdivision and development of the land surrounding the Hanson Australia asphalt and concrete facility at Honeycomb Avenue, Eastern Creek, NSW. The report is provided as an adjustment to the currently approved development under SSD 06_0225 Mod1.

A civil engineering strategy for the site has been developed which provides a best practice solution within the constraints of the existing landform and proposed subdivision layout. Within this design a stormwater quantity and quality management strategy has been developed to reduce peak flows and pollutant loads in stormwater leaving this site. The stormwater management strategy for the development has been designed in accordance with Blacktown City Council's Part J of DCP2015 and the remains consistent with the strategy defined by Martins Consulting as part of the SSD 06_0225 Mod1 application.

During the construction phase, a Sediment and Erosion Control Plan will be in place to ensure the downstream drainage system and receiving waters are protected from sediment laden runoff.

Stormwater Quality pollution reduction objectives have been defined for the development lots during the operational phase of the development, allowing for the partially treated cul-de-sac catchment. A treatment train of water quality measures will be required to achieve the required objectives and Councils DCP2015 Part J Stormwater Treatment objectives.

The detail contained in this report provides sufficient information to demonstrate to the consent authority that legal discharge points and a stormwater management strategy is available for the development, and that the requirements associated with the strategy can be met. It is recommended the management strategies in this report be approved and incorporated into the future detailed design and individual lot development applications.