Oakdale West Development

State Significant Development Application

Civil, Stormwater and Infrastructure Services Report

Author: Andrew Tweedie

Approver: Anthony McLandsborough

Report no: 15-272-R001 **Revision:** 06 **Date:** June 2017

Document information

Level 7, 153 Walker Street, North Sydney, NSW 2060

Document registration

Document title	Oakdale West Development – State Significant Development Application
Document file name	15-272-R001-06-Oakdale West Civil Report.docx
Section	Civil Engineering
Document author	Andrew Tweedie

Issue	Description	Date
01	Issue for Client Review	22/01/2016
02	Issue for Client Review	12/04/2016
03	Issued for Final Draft	22/04/2016
04	SSD Application	14/03/2017
05	Final Issue	05/06/2017
06	Earthworks figures updated	21/06/2017

Finalisation signatures

The design described in this report is considered to have been finalised.

	Signature	Date
Andrew Tweedie Senior Civil Engineer (Author)		21/06/2017
Mark Marsic Senior Civil Designer		05/06/2017
Anthony McLandsborough Director		21/06/2017

Notes: The finalisation signatures shown above do not provide evidence of approval to the design. Approval signatures are shown on the title sheet of the design plans.

Contents

LIST OF TABLES

LIST OF FIGURES

APPENDIX

Abbreviations

OWE	Oakdale West Estate
OEH	Office of Environment and Heritage
EP	Equivalent Persons
ET	Equivalent Tenancy
IWM	Integrated Water Management
GPS	Goodman Property Services (Aust) Pty Ltd
STP	Sewerage Treatment Plant
SWC	Sydney Water Corporation
WELS	Water Efficiency Labelling
EIS	Environmental Impact Statement
SSDA	State Significant Development Application
RMS	Roads and Martine Service
EPLR	Erskine Park Link Road

Executive Summary

Goodman Property Services (Aust) Pty Ltd is developing the Oakdale West site for the purposes of providing a warehouse and distribution complex. The Oakdale West site is a precinct within the wider 'Oakdale' Estate development and forms part of a progressive development designed to make 'Oakdale' a regional distribution park of warehouses, distribution centres and freight logistics facilities.

Purpose of Report:

This report has been prepared to address the Secretary's Environmental Assessment Requirements (SEARs) for the project relevant to earthworks, stormwater, roadworks and infrastructure servicing. Its outlines the proposed components of the design including, Civil Design and Infrastructure, Road geometry and pavement design and Sedimentation and Erosion Control, Stormwater Management (On Site Detention, Piped and Overland Flows, Water Sensitive Urban Design) and Construction.

The overall development will be constructed over six stages with each construction stage consisting of the construction of the estate road, bio-retention basin, lead-in services and utility reticulation as required to service each civil stage.

The Oakdale West project is a staged development including bulk earthworks, civil works, and services infrastructure and stormwater management.

This Stage Significant Development (SSD) application number SSD 15_7348 includes the following:

- A Concept Proposal for the warehouse and distribution estate comprising of 22 building envelopes, including a development master plan, development control, landscape concept plan and biodiversity offsets; and
- Stage 1 Development Application, including:
    - Staged bulk earthworks across the whole site including stormwater management and basins;
    - Staged trunk infrastructure for the site including lead in services;
    - Staged subdivision;
    - Landscaping and public domain works;
    - Development comprising the construction and operation of three warehouse and distribution facilities in Precinct 1. Refer to Architectural Drawing OAK MP 02 (by SBA Architects) and AT&L Drawing C1003 indicating Precinct 1 extents.
    - Road and infrastructure associated with Stage 1
    - The North South Link Road connecting the site northward to the Erskine Park Link Road

The site is located in the Penrith City Council Local Government area. In order to meet the council requirements for Hydraulic Design and Water Sensitive Urban Design, DRAINs and MUSIC modelling software has been used to calculate the required output results.

The Precinct based bio-retention basins have been designed to both attenuate stormwater flows and treat the nutrients to Penrith City Council treatment rates. The Precinct Site Detention is designed to mitigate post development flows to pre-developed flows for peak Average Reoccurrence Interval (ARI) events and has been sized to ensure that for all storm events up to and including the 1:100 ARI event, the development does not increase stormwater flows in any downstream areas.

The post-development Site Catchment plan is separated into six areas (1-6) and the northern NSLR catchment (7), with all areas draining into bio-retention basins.

This report also identifies the strategy for infrastructure services required to service the site including potable water, sewer, power, telecommunications and gas. The infrastructure to service this development forms part of an overall strategy for infrastructure to the 'Oakdale' Estate which in most cases requires the infrastructure to be extended into Oakdale West to service the required Precinct area based on the staged construction.

This report also details the proposed estate road and pavement construction methodology along with the typical retaining wall details for both cut and fill construction.

This report, the design drawings and the calculations form the response to the relevant Secretary's Environmental Assessment Requirements with respect to the overall Masterplan and the staged construction works as documented in the Staging Plan shown in Appendix A.

Compliance with Secretary's Environmental Assessment Reports (SEARs)

This report responds to the SEAR's issued by the NSW Planning and Environment in November 2015. Table 1 below summaries all key civil / infrastructure issues raised in the SEAR's and how they have been dealt with.

Key Issue	Response
Soils and Water	
A detailed and consolidated site water balance	A Water Balance section has been included in this report. Refer Section 7 for all site water balance details, water supply source, usage calculations and efficiency measures.
Related infrastructure, watercourses, riparian land and measures proposed to reduce and mitigate those impacts	
Describe surface and stormwater management measures designed in accordance with Water Sensitive Urban Design principles, including on-site detention, measures to treat or reuse water, and proposed and uses of potable and non-potable waters	A detailed description of all Stormwater Management including WSUD design principles is included within Section 6 of this report.
Full technical details and data of all surface and groundwater modelling	A detailed description of all surface and is included within Section 6 of this report.
Proposed surface and groundwater monitoring activities and methodologies	Refer to Section 3 for all monitoring activities and methodologies.
Description of proposed erosion and sediment controls during construction and operation	A detailed description of the Erosion and Sediment Control measures is included within Section 3 of this report. Note also a full set of Erosion and Sediment Control plans has been provided. Refer Appendix E of the EIS.
Proposed cut and fill works associated with the development, and measures to minimize the extent of cut and fill	Refer to Section 2 of this report and Appendix E of the EIS.
Flooding	
A comprehensive assessment of the impact of flooding on the development for the full range of flood events up to the probable maximum flood. This assessment should address any relevant provisions of the NSW Floodplain Development Manual (2005) including the potential effects of climate change, sea level rise and an increase in rainfall intensity	Refer to Section 8 for Flood Modelling Report which is a summary of an overall site flood report undertaken by Cardno.
Assessment of the impact of the development on flood behavior (ie levels, velocities and duration of flooding) and on adjacent, downstream and upstream areas	Refer to Section 8 for Flood Modelling Report.
Detail proposed flood levels for all proposed habitable structures on the site having considered the full range of flood events up to the probable maximum flood	Refer to Section 8 for Flood Modelling Report.
Detail an emergency response plan for the site, which includes consideration of a floor-free access to or from the development site in extreme flood events	Refer to Section 8 for Flood Modelling Report.

Infrastructure Requirements	
A detailed written and/or geographical description of infrastructure required on the site	Refer to Section 9 within this report for a description of all proposed infrastructure services to the site.
Identification of any infrastructure upgrades required off-site to facilitate the development, and describe any arrangements to ensure that the upgrades will be implemented in a timely manner and maintained	Refer to Section 9 within this report
An infrastructure delivery and staging plan, including a description of how infrastructure on and off-site will be coordinated and funded to ensure it is in place prior to the commencement of construction	Refer to Section 9 and Appendix E for infrastructure delivery and staging plan
An assessment of the impacts of the development (construction and operation) on existing infrastructure surrounding the site	Refer to Section 9 and Appendix E for infrastructure delivery and staging plan

Table 1 - SEARS Compliance

Agency Consultation

This report summarises all consultation and correspondence undertaken with the relevant authorities during the design phase. The following table summarises these consultations and the relevant correspondence. It should be noted not all authorities were consulted during the initial design phase. The reason for no consolation is summarized below.

Agency Consulted	Correspondence
Penrith City Council	• 08.03.16 - Telephone call to Kate Smith (Penrith Council) to discuss OWE proposal. • 08.03.16 & 09.07.13 – Email to Kate Smith suggesting dates to meet to discuss proposal. • 11.03.16 - Kate Smith responses by telephone stating they didn't have availability at the moment for a meeting to discuss OWE and would prefer we email draft plans and summary of the proposal • 21.07.16 – Guy Smith (Goodman) emailed draft plans and summary of OWE proposal to Robert Craig at Penrith Council. Requested confirmation whether a meeting was required or satisfied to review plans and provide comments. • Council confirmed by email 26.07.16 that they will attend a meeting with GPS following lodgment but before exhibition of the proposal. This will allow a run through of any potential issues and their preparation of their Referral response.
Fairfield City Council	• Emailed Edward Saulig on 22.07.16 inviting comment / meeting • Emailed again 18.08.16 • Further email seeking response sent 30.08.16 • Email received from Edward Saulig on 30.08.16 confirming: "Andrew Mooney, Strategic Planning Coordinator (9725 0214) is following up on the submitted information and hopes to provide a response before the 2 September deadline"
Blacktown City Council	• Emailed Judith Portelli on 22.07.16 inviting comment / meeting • Judith responded on 22.07.16 seeking dates for meeting to discuss proposal. • Email sent to Judith Portelli, 29.08.16 seeking meeting time to discuss OWE. • Meeting scheduled with Judith Portelli to discuss proposal on 06.09.16.
Sydney Water	AT&L has undertaken extensive consultation with Sydney Water during the development of the OWE SSD proposal. As a result of the ongoing development within the Western Sydney Employment Area (WSEA) Precinct No.8 – Area South of Pipeline, Sydney Water requested that a Local Area Servicing Plan (LASP) for both sewer and potable water infrastructure was prepared to ensure that future Sydney Water infrastructure could ultimately service future developments within the WSEA Precinct No.8 – Area South of Pipeline. The LASP for sewer and potable water (GH 2016) identifies the servicing strategy for the WSEA Precinct No.8 – Area South of Pipeline. At the request of Sydney Water, GHD were engaged to prepare the LASP for both sewer and potable water. During preparation of these documents, extensive consultation was undertaken with Sydney Water to ensure compliance with Sydney Water's performance requirements for both sewer and potable water. For further details on the LASP for potable water and sewer refer to Section 9.1. and Appendix F.

Endeavour Energy	Over the past 18 months' numerous meetings have been held with Endeavour Energy (EE) in relation to servicing the proposed development site. Currently EE have indicated that a new Zone Substation will be required to service the development. EE have advised that a new Zone Substation will be provided within Oakdale West in the future. Interim supply to Oakdale South can be made via connection to the Eastern Creek Zone Substation. A copy of this correspondence is attached within Appendix I.
TransGrid	Meeting Held with Tim Cowdroy of Transgrid and AT&L to discuss both OWE and OSE and the impacts of the development on the existing easements. The meeting was held on the 25.11.15. This was a briefing on what was proposed and Tim indicated at the time he was generally happy with the proposal subject to detailed design. Emailed 18.08.16 seeking comment on proposal.
Water NSW	Meeting held with WaterNSW, GM and AT&L on the 16.12.15 to discuss the proposed bridge crossing and design criteria required. Preliminary Design drawings of the bridge crossing were issued to WaterNSW for comment on the 1.6.16. No comments received Follow up email 23.6.16 requesting comments. Email received from WaterNSW 23.6.16 stating comments due the following week. Again follow up email sent 8.7.16 with no reply Further consultation with WaterNSW has been undertaken in August 2016. A brief description of the project along with the masterplan and staging plans was prepared for WaterNSW. A response providing comment on the Civil and Architectural plans was provided by Alison Kniha, Environmental Policy and Planning Manager for Water NSW on the 25th of August 2016. A summary of Water NSW pre-lodgement comments along with AT&L response is included below. • *(WaterNSW)-The Proposed North South Link Road, which will be a new road crossing of the Warragamba Pipelines, is of particular concern to WaterNSW. A review of the preliminary design identified that while adequate from an engineering perspective, the design was unacceptable from a continuing asset maintenance and operations perspective. Ongoing safe and efficient access to the pipelines corridor must be maintained at all times for WaterNSW staff and contractors. It is therefore imperative that WaterNSW is closely consulted on an ongoing basis, including all stages of detailed design and construction.* **AT&L response- The preliminary design prepared to date has already considered the access design criteria supplied by WaterNSW. Through the next phase of the project, the design will need to evolve with the input of the WaterNSW engineers.** • *Owners consent will be required for all road, bridge and associated works on WaterNSW land. Currently I can find no evidence to suggest this has been obtained or requested.* **AT&L response- Noted consent has been requested from WaterNSW.** • *It is noted a large detention basin (Basin 2) on the pipelines corridor boundary is proposed as part of Precinct 1 where a dam currently exists. Outflow from the dam crosses into and across the pipelines corridor near the valve house (the brick structure at the low point of the pipeline) and continues into the drainage depression on the northern boundary of the corridor. The development, including all earthworks, dewatering of the dam and changes in levels and impervious areas due to the development, must not cause the stormwater flows into the pipelines corridor to increase above their current levels. Additionally, the outlet for the basin is not indicated on the preliminary plans – flows from the basin must not exceed the volume of stormwater currently entering the corridor at this point.* **AT&L response- Noted WaterNSW will be consulted during detailed design to ensure all stormwater issues are addressed to WaterNSW's satisfaction. At this stage, the design does not anticipate any water entering the pipeline corridor**

	• *Note the presence of two scour valves on the pipelines, which must not be impacted by any proposed development.* **AT&L response- Noted. The preliminary design considers the valves and there is no intention for there to be any impact to the pipeline.** • *The smaller basin at the NW corner of Precinct 2 (Basin 5) must also not cause an increase in stormwater into the corridor.* **AT&L response- Noted WaterNSW will be consulted during detailed design to ensure all stormwater issues are addressed to WaterNSW's satisfaction. At this stage, the design does not anticipate any water entering the pipeline corridor.** • *A previously supplied Overall Site Plan (November 2015) identified a retaining wall along the boundary of Precinct 2 and the pipelines corridor varying in height from 4.0 to 6.5m in height. WaterNSW's preference is for the retaining wall to be set back from the boundary, similar to Oakdale Central Stage 3, to allow for full safe access to the pipelines at all times for maintenance and operation purposes.* **AT&L response- Noted the wall is current documented to be approx. 5m off the boundary with a smaller wall along the boundary.** • *It is noted the development, including Basins 2 and 5 are located above the underground Austral gas pipeline.* **AT&L response- Noted. It is proposed the private Austral Gas main to either remain or be relocated to suit the proposed design.** • *Access to the pipelines corridor is prohibited without a written access consent, which must be obtained from WaterNSW.* **AT&L response- Noted** • *Security fencing meeting WaterNSW's requirements must be installed along the boundary of the Oakdale West Estate. The North South Link Road bridge fencing must incorporate throw screens.* **AT&L response- Noted security fencing will be incorporated into the detailed design to match the previously installed fencing in Oakdale Central** • *The pipelines have been assessed a having state heritage significance, but are not currently listed on the State Heritage Register. Relevant heritage information on the Pipelines can be provided on request by WaterNSW. The design, construction and operation of structures should prevent, or at least minimise, impacts on the heritage significance of the pipelines.* **AT&L response- Noted.** • *An easement or licence agreement with WaterNSW will need to be established for the road bridge across the pipelines*. **AT&L response- Noted**

Table 2 – Agency Consultation

1 Introduction

This report has been prepared to inform a State Significant Development Application (SSDA) for the staged development of the Oakdale West Estate (OWE). The aim of the report is to assess the potential impacts of the proposed development with respect to the Civil and Infrastructure and has been prepared in accordance with Penrith City Council current design guidelines, the relevant Australian Standards and the relevant Austroad Guidelines. The report responds to the Secretary's Environmental Assessment Requirements (SEARs) as they relate to Civil and Infrastructure, specifically as outlined in the SEAR Compliance Table above. This report supports an Environmental Impact Statement (EIS) prepared in respect of the proposal and should be read in conjunction with the EIS and development plans submitted with the SSDA.

The SSDA for the OWE seeks approval for:

- A Concept Proposal for the warehouse and distribution estate comprising of 22 building envelopes, including a development master plan, development controls
- Landscape concept plan and biodiversity offsets
- Stage 1 Development Application, including:
    - Staged bulk earthworks across the whole site including retaining wall construction
    - Staged trunk infrastructure for the site
    - Staged subdivision
    - Landscaping and public domain works
    - Development comprising the construction and operation of three warehouse and distribution facilities in Precinct 1
    - Road and Stormwater infrastructure associated with Stage 1
    - North South Link Road (NSLR)
    - Lead in services

1.1 Scope of Report

Objective of Report

The objective of this civil, stormwater and infrastructure services report is to outline the design criteria used for the Engineering design of all components of the development and compare to the requirements of the Penrith City Council Development Control Plans (DCP).

This report should be read in conjunction with the AT&L Civil Engineering drawings as indicated within Appendix B.

In respect to the NSLR, and additional design report "15-272-R002 – North South Link Road Design Report" should be referred to. While the design report will outline design parameters in respect the requirements of the RMS Design guidelines, the associated stormwater design forms part of this report.

Summary

This report generally discusses the design philosophy behind the following components of the design for Oakdale West Estate (OWE):

- Earthworks
- Sedimentation and Erosion Control
- Retaining Walls
- Road Design
- Stormwater Management
    - On Site Detention (OSD)
    - Piped and Overland Flows
    - Water Sensitive Urban Design (WSUD)
    - Water Balance across the site
- Flood Modelling
- Servicing
    - Water
    - Sewerage
    - Communications
    - Gas
    - Electrical
- Infrastructure Staging
- Construction
    - Clearing and Grubbing
    - Demolition
    - Earthworks
    - Roadworks and Services
    - Program
    - Plant and Equipment

Supporting documentation that is referenced and commented on within the report include the following sections;

- Flooding (Cardno)
- Geotechnical review (PSM)
- Salinity Management Report (PSM)

The proposed site plan covering the entire Oakdale West development along with all proposed lot layouts are attached within Appendix A.

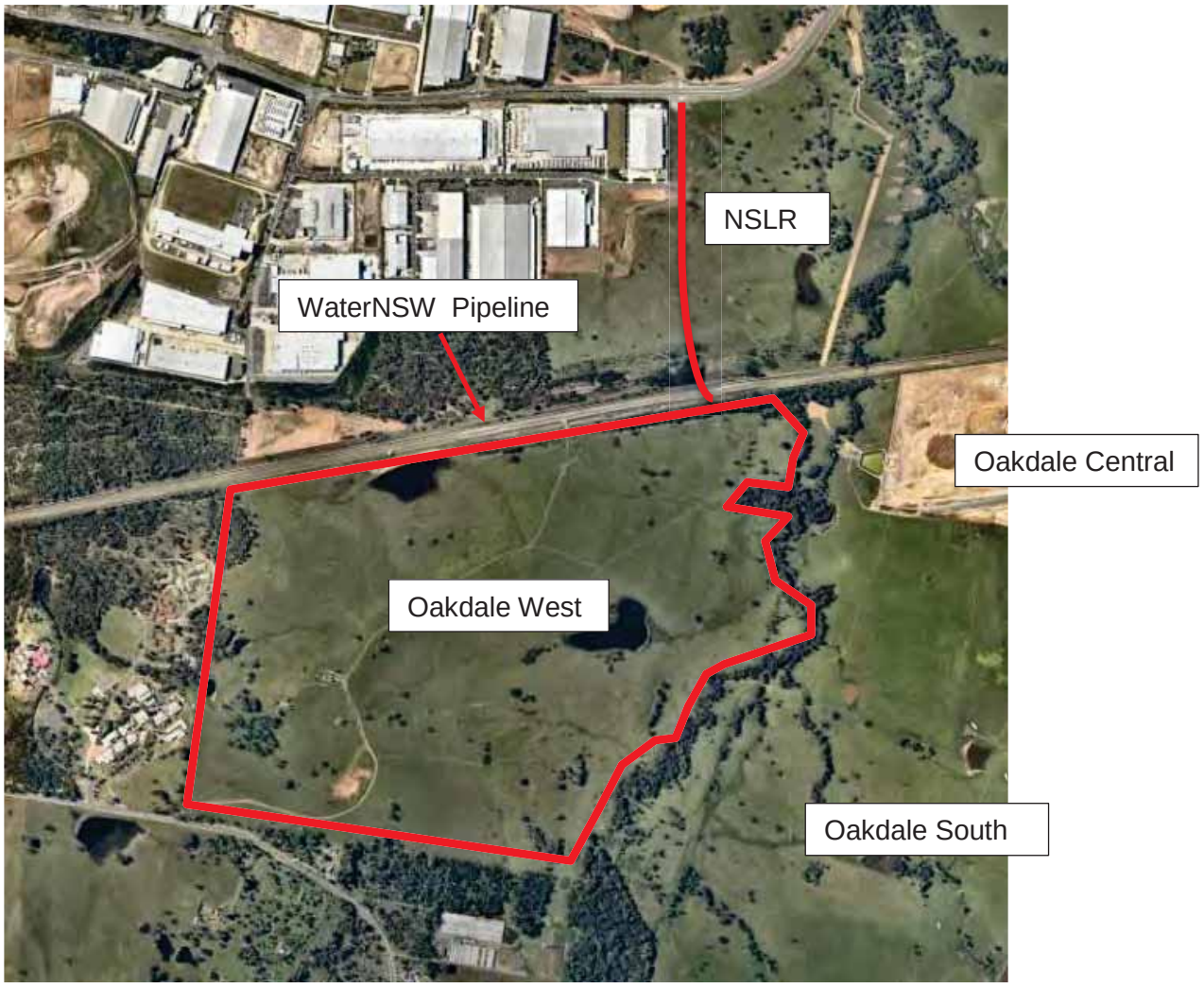


Figure 1 – Locality Plan

2 Earthworks

2.1 Existing Geology

Based on a Geotechnical Report undertaken by Pells Sullivan Meynink (PSM) in November 2015 the following sub surface soils were encountered across the site:

- Topsoil – CLAY with grass roots Depth 0.0 -0.04m
- Natural Soil – CLAY : Depth 0.04 to 0.5m
- Bedrock – SANDSTONE and SHALE: Depth 0.7 to 5.0m

2.2 Cut/Fill Requirements

The site will require bulk and detail earthworks to be carried out across the various precincts due to the significant elevation changes.

It is noted that following an options analysis process was undertaken which included:

- Either maximising cut to fill and minimising import,
- Multiple smaller earthworks pads and minimising both cut / fill and retaining walls
- Maximising import and minimising cut and retaining walls

Ultimately in reviewing the various options and reviewing the cost benefit of each of the options and then taking into consideration the market availability of surplus fill, it was decided to minimise import and maximise cut across the site. By doing so we have maximised site utilisation creating large flat pads. This design limits the height of required retaining to a maximum of 6m for cut walls and generally 6-8m for fill walls. Unlike the neighbouring site Oakdale South Estate, the import has been dramatically reduced as the topography requires significantly more cut than OSE Refer to Drawing C1014 for Bulk Earthworks Cut/Fill Plan within Appendix A.

EARTHWORKS VOLUMES

PRECINCT	EXISTING TOPSOIL STRIPPING VOLUME (cu.m) REFER NOTE No.1	EXCAVATION OF EXISTING CREEKS AND DAMS (cu.m) REFER NOTE No.2	NET CUT (cu.m)	NET FILL (cu.m)	BALANCE (cu.m)
1	30,808	18,844	454,850	473,126	-18,276
2	26,124	3,452	218,955	636,036	-417,081
3	28,854	0	1,045,709	153,821	891,888
4	20,878	24,295	257,586	652,662	-395,076
5	3,347	0	7,231	170,132	-162,901
SLR	8,589	0	112,724	19,585	93,139
TOTAL	118,600	46,591	2,097,055	2,105,362	-8,307

Table 3 - Cut/Fill Summary

Note these volumes are based on the current design, further detailed design may alter these. + balance indicates net cut whilst – balance indicates import required

Any import of material will be classified as either Virgin Excavated Natural Material (VENM) or Excavated Natural Material (ENM) or as specified by in the Geotechnical Engineering Specification for the project.

Topsoil is only proposed to be stripped from cut areas and or areas that have less than 1 metre of filling over. In all other areas, topsoil is to be left insitu with filling to occur directly over. Where topsoil has been stripped, the topsoil will be blended with the either cut material or imported material and used as general fill.

Prior to commencement of works, it envisaged the entire work zone would sprayed to limit grow back of the grasses within the work.

It is not proposed to export any topsoil from the site.

3 Sedimentation and Erosion Control

3.1 Sedimentation and Erosion Control (Construction)

Soil and Water Management Plans (SWMP) has been prepared in accordance with the NSW Department of Housing Publication titled: Managing Urban Stormwater-Soils and Construction (2004) for the whole site. Refer to AT&L Civil drawings within Appendix A.

Suitable erosion and sediment controls shall be provided and maintained throughout all stages of works, including at completion of the bulk earthworks. Design, documentation, installation and maintenance of sediment and erosion controls will be in accordance with the requirements of the *Protection of the Environment Operations Act, Penrith City Council's specifications* and the *Office of Environment and Heritage's 'Managing Urban Stormwater: Soils and Construction. Landcom, (4th Edition) (The "Blue Book") Volume 1 and Volume 2*.

Ultimately the final temporary sediment basin locations and sizes will be provided to suit development staging requirements and will be sized & maintained in accordance with the requirements of the *Protection of the Environment Operations Act, Penrith City Council's specifications* and the *Office of Environment and Heritage's 'Managing Urban Stormwater: Soils and Construction. Landcom, (4th Edition) (The "Blue Book") Volume 1 and Volume 2*.

3.2 Sources of Pollution

The activities and aspects of the works that have potential to lead to erosion, sediment transport, siltation and contamination of natural waters include:

- Earthworks undertaken immediately prior to rainfall periods
- Work areas that have not been stabilised
- Extraction of construction water from waterways during low rainfall periods
- Clearing of vegetation and the methods adopted, particularly in advance of construction works
- Stripping of topsoil, particularly in advance of construction works
- Bulk earthworks and construction of pavements
- Works within drainage paths, including depressions and waterways
- Stockpiling of excavated materials
- Storage and transfer of oils, fuels, fertilisers and chemicals
- Maintenance of plant and equipment
- Ineffective implementation of erosion and sediment control measures
- Inadequate maintenance of environmental control measures
- Time taken for the rehabilitation / revegetation of disturbed areas

3.3 Potential Impacts

The major potential impacts on the riparian environment relate to erosion of distributed areas or stockpiles and sediment transportation. Potential adverse impacts from erosion and sediment transportation can include:

- Loss of topsoil
- Increased water turbidity
- Decreased levels of dissolved oxygen
- Changed salinity levels
- Changed pH levels
- Smothering of stream beds and aquatic vegetation
- Reduction in aquatic habitat diversity
- Increased maintenance costs
- Decrease in waterway capacity leading to increased flood levels and durations

3.4 Construction Methodology

The following construction methodology will be followed to minimise the impact of sedimentation due to construction works:

- Diversion of "clean" water away from the disturbed areas and discharge via suitable scour protection.
- Provision of hay bale type flow diverters to catch drainage and divert to "clean" water drains.
- Diversion of sediment-laden water into temporary sediment control basins to capture the design storm volume and undertake flocculation (if required).
- Provision of construction traffic shaker grids and wash-down to prevent vehicles carrying soils beyond the site.
- Provision of catch drains to carry sediment-laden water to sediment basins.
- Provision of silt fences to filter and retain sediments at source.
- Where future construction and building works are not proposed, the rapid stabilisation of disturbed and exposed ground surfaces with hydro-seeding

Note these sediment and erosion control measures will be in place for each Stage of the works. Upon completion of Stage 1, the control measures will remain in place during construction of future stages until the individual lots are developed on.

3.5 Site Inspection and Maintenance

The inspection and maintenance requirements outlined in this section will need to be carried out as long as either earthworks or quarrying is being conducted and all areas re-established.

The Contractor's site Superintendent will inspect the site after every rainfall event and at least weekly, and will:

- Inspect and assess the effectiveness of the SWMP and identify any inadequacies that may arise during normal work activities or from a revised construction methodology. Construct additional erosion and sediment control works as necessary to ensure the desired protection is given to downstream lands and waterways
- Ensure that drains operate properly and to effect any repairs

- Remove spilled sand or other materials from hazard areas, including lands closer than 5 metres from areas of likely concentrated or high velocity flows especially waterways and paved areas
- Remove trapped sediment whenever less than design capacity remains within the structure
- Ensure rehabilitated lands have affectively reduced the erosion hazard and to initiate upgrading or repair as appropriate
- Maintain erosion and sediment control measures in a fully functioning condition until all construction activity is completed and the site has been rehabilitated
- Remove temporary soil conservation structures as the last activity in the rehabilitation

3.6 Conclusion

The erosion control measures proposed for the site will comply with the requirements of Penrith City Council and The Department of Environment, Climate Change and Water (DECC).

The proposed SWMP will ensure that the best management practice is applied to the development site in controlling and minimising the negative impacts of soil erosion.

4 Retaining Walls

4.1 Retaining Walls

Where possible, batter slopes will be provided to accommodate level changes. Where this is not possible retaining walls will be constructed along the estate road, lots and basins based on the current civil and earthworks design. An Austral product or other similar face block will be adopted for all retaining walls as detailed on the civil drawings.

The proposed retaining walls will be built to the manufacturers design guideline requirements and verified by a structural engineer prior to construction. This practice was adopted on Oakdale Central and South and considered input from the geotechnical engineer, utility coordination as well as entry and exit points from proposed lots.

Retaining is required along the southern boundary where it is required to cut down from existing to create new building pads. Refer to Drawing C1070 for cut wall locations. Retaining walls will be designed and constructed using standard industry practises.

All retaining walls will be constructed on a staged basis and as required to suite the earthworks and stormwater basin works. Where the walls are not constructed a batter of 1 in 4 will be maintained for stability purposes. Any batter steeper than 1 in 5 shall be vegetated.

All retaining walls will be located within private property and not within the road reserve areas unless within the basins or adjacent to the basins.

All retaining walls will have pedestrian and vehicular safety barriers in accordance with Austroads Guidelines.

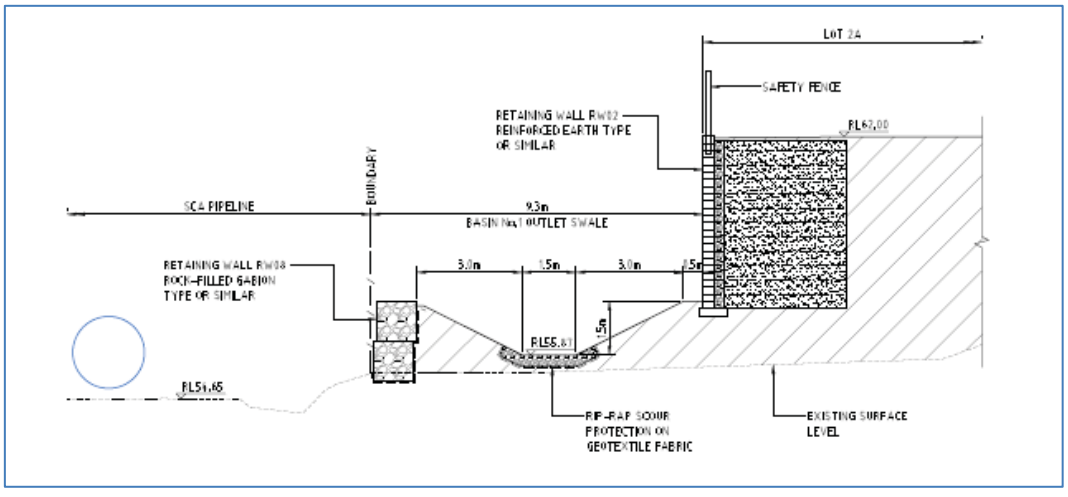


Figure 2 – Typical Section through Retaining Wall – Northern Boundary

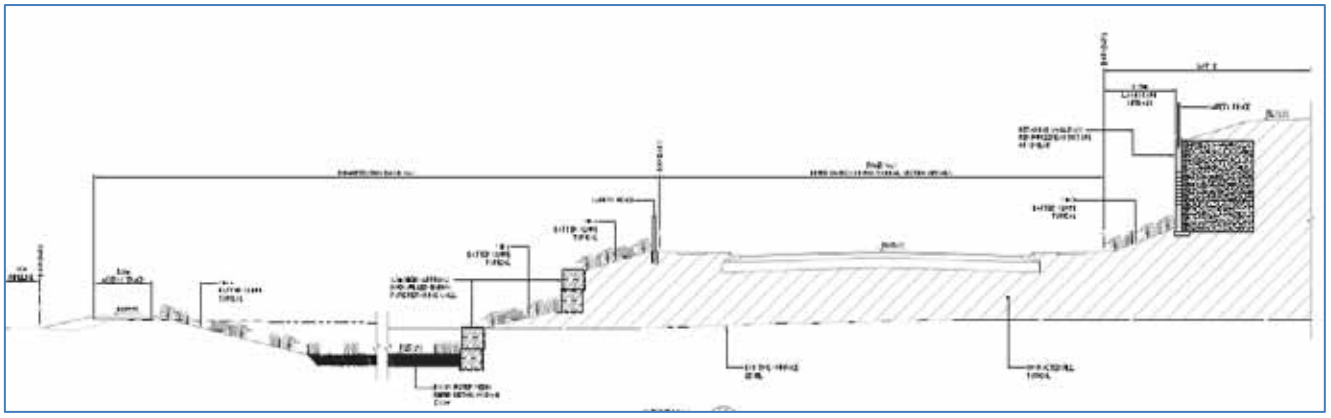


Figure 3 - Typical Section through Retaining Wall - Bio-Retention Basin 1

5 Road Design

5.1 Horizontal and Vertical Geometry

The Estate Roads within Oakdale West Estate have generally been designed to meet Austroads requirements and Australian Standards to accommodate B-Double truck movements where possible.

The estate roads will connect into the proposed Future Southern Link Road which runs through the middle of the site and NSLR in the north east corner of the site adjacent the WaterNSW Pipeline. In the north east corner of OWE the NSLR will cross over the WaterNSW Pipeline via a proposed bridge and connect into the EPLR approximately 1km to the north.

See drawings within Appendix A for proposed Estate Road layout along with connections into Southern Link Road and NSLR.

The proposed road reserve as described below does not conform to Penrith City Council's standard road reserves which requires a minimum 20.6m road reserve. This greater road reserve width has been adopted as it was used on the adjacent Oakdale Central and South development. To ensure consistency between the three developments the Oakdale Central road reserve alignment has been adopted for the design base for the OWE.

For details on the NSLR refer the design report.

The Estate Road is designed as such:

- 23.0m wide Road Reserve
- 15.5m wide Carriageway comprising:
    - 2x 3.5m wide traffic lanes
    - 2x 4.25m wide traffic lanes adjacent kerb
- Verge 3.75m wide
- Cul-De-Sac have been shown at 30m Diameter to accommodate the largest design vehicle
- The largest design vehicle is a B-Double
- Design Speed of Road = 60km/hr
- No guard fences have been shown and these will be assessed at detailed design stage in accordance with Austroads.

Refer to Figure 4 indicating typical road section.

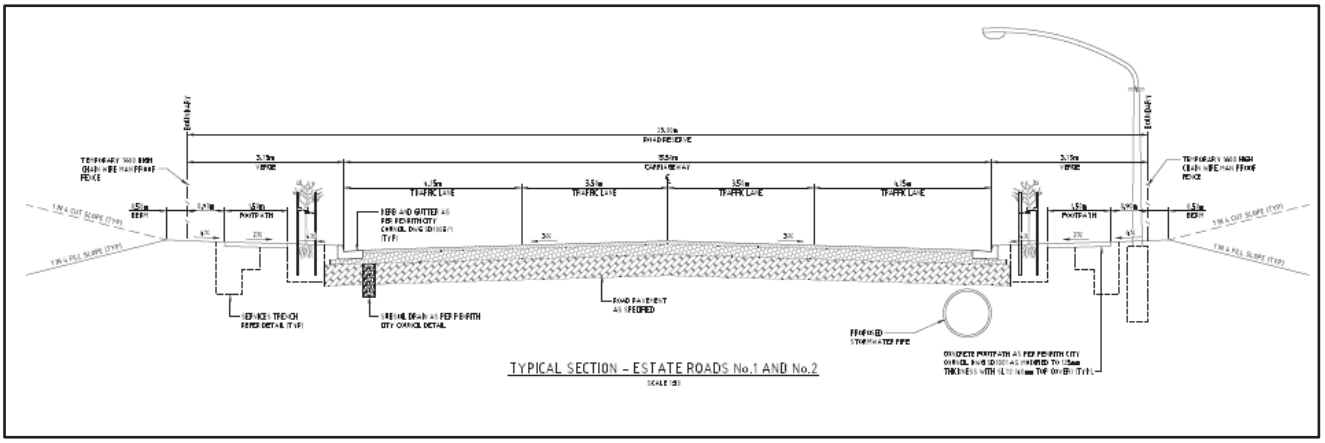


Figure 4 - Typical Estate Road Section for Roads No. 1 and No.2

5.2 Pavement

Pavement will be designed based on the requirements of Austroads Pavement Design Guide – A Guide to the Structural Design of Road Pavements and recommendations provided by Pells Sullivan Meynink (PSM) in report PSM1541-127L dated November 2015.

The basis of this design is:

- Design Traffic Loading : N =1x10^7 ESA
- Design subgrade CBR = 2% with a reduction if the subgrade is CBR 5%

Based on these parameters the pavement design is as follows:

- 35mm AC 14 320 Bitumen
- 35mm AC 14 320 Bitumen
- 7mm Spray Seal
- 250mm DGB 20 (placed in two layers)
- 500mm Select Sandstone Fill with minimum CBR= 35% (placed in three layers)

If the subgrade CBR = 5% the bottom 200mm of select sandstone fill can be replaced with select fill with minimum CBR of 5%.

CBR testing is proposed to the undertaken at the subgrade level to confirm this pavement design.

Polymer modified asphalt will be used within all cu-de-sacs.

5.3 Batter Design

Any batter's steeper than 1 in 5 will be vegetated. All external batters to the development have been limited to 1 in 4 as a minimum generally.

Any temporary batters constructed during the works will be in accordance with the geotechnical report and ongoing advice from the Level 1 supervisor.

5.4 Conclusion

All road design as demonstrated above is in accordance with Austroads Standards and the requirements of Penrith City Council, as a minimum.

A professional geotechnical engineer will be engaged to design the structural pavement. This is also in accordance with Austroads Pavement Design Guide – A Guide to Structural Design of Road Pavements.

6 Stormwater Management

6.1 Existing Site Stormwater Drainage

Currently the site comprises farmland and is classified as a "greenfield" site with an entire coverage of pervious areas and farm dams.

The topography of the site is such that there is a ridge line running roughly north-south through the site. This ridge line is highlighted in Drawing C1065 in Appendix A. Existing overland flows generated to the east of the ridge line flows into farm dams and Ropes Creek to the east of OWE. Overland flows generated to the west of the ridge line flow into farm dams on the western and north west boundaries of the site and ultimately drain into existing creeks at the western boundary of OWE. These flows discharge into existing creeks north of Emmaus Catholic College and the Catholic Healthcare west of OWE.

Refer to Drawing C1065 within Appendix A for a pre-development stormwater catchment plan indicating the location of these catchments.

There are seven existing catchments draining the site via Discharge Points:

- Catchment 1 – area of 13.35 Ha draining to east into Ropes Creek via Discharge Point A.
- Catchment 2 – area of 31.65 Ha draining to north west adjacent WATERNSW pipeline via Discharge Point B.
- Catchment 3 – area of 24.52 Ha draining to the west into existing dams and then over flowing into South Creek via Discharge Point C.
- Catchment 4 – area of 11.90 Ha draining to the south east of the site via Discharge Point D.
- Catchment 5 – area of 7.60 Ha draining to the east into an existing dam and then over flowing into Ropes Creek via Discharge Point E.
- Catchment 6 – area of 28.97 Ha draining to the east into Ropes Creek via Discharge Point F.
- Catchment 7 – area of 3.21 Ha draining to south west corner of the site via Discharge Point H.

6.2 Proposed Site Stormwater Drainage

As discussed in Section 2.2 of this report, due to the existing steep grades across the site extensive cutting and filling is required to ensure level pads are created for proposed roads and on lot pads.

The main objective for the stormwater drainage design of the proposed development is to ensure post-developed catchment areas do not exceed the pre-developed catchment areas. With OSD systems (described in Section 6.3.5) in place to limit discharges to pre-developed rates, this will ensure the downstream catchments will not be inundated with flows and cause adverse flooding affects downstream of the development. This is in line with the Penrith City Council Engineering guidelines.

It is proposed to split the catchments up to generally match pre-developed catchments, with the intent to drain into the same low lying creeks as described in Section 6.1. Refer to Section 6.3.4 for a full description of each proposed catchment.

All stormwater on the lots and within the road reserve is proposed to be collected via pits and pipes and connect into On-Site Detention basins. All basins will have an outlet structure and overflow weir system to drain into the adjacent Ropes Creek to the east or the western creek system eventuating into South Creek. Scour protection will be provided on these outlet structures to minimize the effects of erosion on creeks.

Refer to the Civil Drawings for layout and details for the proposed stormwater network across the site.

6.3 Council Requirements & Recommendations

All estate level stormwater drainage for the OWE development is designed to comply with the following:

- Penrith City Council Design Guidelines for Engineering Works
- Penrith City Council Water Sensitive Urban Design (WSUD) Policy December 2013
- C3 Water Management DCP.

A summary of the design requirements adopted is listed below:

- Precinct based basins will serve the development as detention and bio-retention basins
- All stormwater drainage within the access road and bio-retention basins will be dedicated to Penrith City Council. Maintenance and repair works of the stormwater drainage network outside of the lots will be the responsibility of Penrith City Council. All stormwater drainage within the lots will be the responsibility of the individual property owners.
- OSD to be sized to ensure that for all rainwater events up to and including the 1:100 ARI event, new developments do not increase stormwater peak flows in any downstream areas.
- OSD to mitigate post development flows to pre-developed flows for peak Average Reoccurrence Interval (ARI) events.
- All OSD basins have been designed with a 3.0m wide sprayed seal access road along the berm to ensure maintenance vehicles can access the entire exterior of the basin

- WSUD to achieve target reductions:
    - 85% Total Suspended Solids (TSS)
    - 60% Total Phosphorus (TP)
    - 45% Total Nitrogen (TN)
    - 90% Gross Pollutants (GP)
- Finished Floor Levels (FFL) to have minimum 500mm freeboard to 100 year overland flows.
- A gross pollutant trap (GPT) will be installed within each development lot on the final downstream stormwater pit prior to discharging. As these GPT's will be located on-lot as they will be owned and maintained by the individual property owner.

Rainwater tanks are desirable for re-use for irrigation, toilet and other non-potable water uses. Rainwater tank size is determined in accordance with the Penrith City Council C3 Water Management DCP to meet 80% of non-potable demand for irrigation and toilet flushing. Refer to Section 7 of this report for a more detailed description on rainwater harvest tanks.

6.3.1 Modelling Software

DRAINs modelling software has been used to calculate the Hydraulic Grade Line (HGL) of the estate level stormwater pipes. DRAINs is a computer program used for designing and analyzing urban stormwater drainage systems and catchments. It is widely accepted by Council's across NSW as the basis for stormwater design and has been confirmed by Penrith City Council as the preferred stormwater software analysis package. DRAINs data files and output results are attached in Appendix C.

MUSIC modelling software has been used to evaluate pollutant loads from each developed lot. For a detailed description of the MUSIC modelling refer to Section 6.3.7 of this report. MUSIC data files and output results are attached in Appendix D.

6.3.2 Hydrology

- Pipe drainage shall be designed to accommodate the 20-year ARI storm event.
- The combined piped and overland flow paths shall be designed to accommodate the 100-year ARI storm event.
- Where trapped low points are unavoidable and potential for flooding private property is a concern, an overland flowpath capable of carrying the total 100-year ARI storm event shall be provided. Alternatively, the pipe and inlet system may be upgrade to accommodate the 100 year ARI storm event.
- Rainfall intensities shall be as per the Intensity-Frequency-Duration table in accordance with the Australian Rainfall and Runoff (AR&R) volume 2.
- Times of concentration for each sub catchment shall be determined using the kinematic wave equation.
- Runoff coefficients shall be calculated in accordance with AR&R. The fraction impervious shall be determined from analysis of the sub catchments.

- Flow width in gutter shall not exceed 2.5m for the minor design storm event.
- Velocity depth ratios shall not exceed 0.4 for all storms up to and including the 100 year ARI event.
- Inlet pits to be spaced so that flow width shall not exceed 80l/sec
- Bypass from any pit on grade shall not exceed 15% of the total flow at the pit
- Blockage factors of 20% and 50% shall be adopted for pits on grade and at sags respectively.

6.3.3 Hydraulics

- A hydraulic grade line HGL design method shall be adopted for all road pipe drainage design. The HGL shall be shown on all drainage long sections.
- The minimum pipe size shall be 375mm diameter RCP.
- Maximum spacing between pits shall not exceed 75m.
- The minimum pipe grade shall be 0.5%.
- All pipes shall be Rubber Ring Jointed unless noted otherwise.
- The minimum cover over pipes shall be 450mm in grassed areas and 600mm within carriageways.
- Where minimum cover cannot be achieved due to physical constraints the pipe class shall be suitably increased.
- All trafficable shall be Reinforced Concrete Pipes or Fibre Reinforced Cement equivalent.
- The pipe friction coefficients to adopted shall be:

Materials	Mannings – n	Colebrook-White – k	Min. Pipe Class
RCP	0.012	0.6	3
FRC	0.01	0.15	3

Table 4 - Pipe Details

- All pipes classes shall be designed for the ultimate service loads and where applicable, construction loads will be designed for.
- Pipes discharging to the overland flow path shall adopt a minimum tailwater level equivalent to respective overland flow level.
- Pit Loss coefficients shall be calculated in accordance with Missouri Charts.

- A minimum 150mm freeboard shall be maintained between pit HGL and pit surface levels.
- Overland flowpaths shall maintain a minimum of 300mm freeboard to all habitable floor levels.
- Pits deeper than 1.2m shall contain step irons at 300 mm centres.

6.3.4 Catchments

A Stormwater Catchment Plan for each Catchment and flow paths into the bio-retention basins are shown in Appendix A. As indicated in the Catchment Plan each of the basins are bio-retention basins designed to both attenuate stormwater flows and treat the nutrients to Penrith City Council treatment rates. These treatment rates are from the Penrith City Council C3 Water Management DCP.

A summary of each catchment and the outflow and overflow locations are described below:

Catchment 1

Total Area = 29.12Ha

Includes: Lot1B, 1C, 2A and 2B

Flow path to north-west of catchment into Basin 1

Outlet and overland flow from Basin 1 drain to west, north of Lots 2A and 2C into the existing low lying vegetated area adjacent the north west corner of the site

Catchment 1A

Total Area = 2.62Ha

Includes: Lot 1A

Flow path to north-east of catchment into Basin 1A

Outlet and overland flow from Basin 1A drains to east into Ropes Creek.

Catchment 2

Total Area = 3.26Ha

Includes: Lot 2C

Flow path to north-west of catchment into Basin 2

Outlet and overland flow from Basin 2 drain to west into the existing low lying vegetated area adjacent the north-west corner of the site

Catchment 3

Total Area = 36.63Ha

Includes: Lots 2D, 2E, 2F, 2G, 3A, 3B, 3C and 3D

Flow path to north-west of catchment into Basin 3

Outlet and overland flow from Basin 3 drain to west into the existing creek north of Emmaus Catholic College

Catchment 4

Total Area = 10.46Ha

Includes: Lots 4A and 4E

Flow path to south of catchment into Basin 4

Outlet and overland flow from Basin 4 drains to east along southern boundary into Ropes Creek to the east

Catchment 5

Total Area = 15.05Ha

Includes: Lots 4B, 4C, 4D, 4G and 4F

Flow path to north-east of catchment into Basin 5

Outlet and overland flow from Basin 5 drains to east through proposed Stage 6 into Ropes Creek to the east.

Catchment 6

Total Area = 7.24Ha

Includes: Lot 5A

Over flow path to east of catchment into Basin 6

Outlet and overland flow from Basin 6 drains to east into Ropes Creek to the east.

Catchment 7

Total Area = 2.35Ha

Includes: Southern Catchment of North South Link Road

Flow path to south of catchment into NSRL South Basin

Outlet and overland flow from NSLR South Basin drains to east into Ropes Creek.

Catchment 8

Total Area = 2.89Ha

Includes: Northern Catchment of North South Link Road

Flow path to north of catchment into NSLR North Basin

Outlet and overland flow from NSLR North Basin drains to east into Ropes Creek.

6.3.5 On-Site Detention (OSD)

As discussed in Section 6.1, OSD is required within the development to mitigate post developed flows to pre-developed flow rates for peak Average Recurrence Intervals (ARIs).

Catchments Discharge Points

As discussed within Section 6.2 of this report, the main objective of the stormwater management of the proposed development is to ensure post-developed catchment flows do not exceed pre-developed catchment flows for all storms from the 1 to 100 year ARI event for all existing catchments.

In order to ensure these post-developed flows do not exceed the pre-developed flows it is important to look at the existing catchments and compare the outflows.

Comparing Drawings C1065 and C1066 and reviewing Table 5 below, indicates the pre and post-developed catchment areas do not match. This is due to creation of flat pads, retaining walls and associated roads and having to create formal drainage system to suit the proposed layout.

Whilst these areas do not match, it is important to ensure post developed flows, at the existing stormwater outlets indicated in drawing C0165, do not exceed the pre-developed flows. For simplicity the outlet points for the pre-developed flows are indicated as outlets from A to H within Drawing C1065.

Table 5 indicates the pre development catchment areas flowing to these outlet points with a post developed catchment area draining to these same points in comparison.

Outlet Flow Point	Pre-Developed Catchment Area to Outlet Point (Ha)	Associated Basins	Post-Developed Catchment Area to Outlet Point (Ha)
A	13.35	1A, NSLR 1	5.15
B	31.65	1, 2	32.38
C	24.52	3	36.63
D	11.91	4	10.46
E	7.60	5	15.05
F	28.97	6	7.24
G		NSLR 2	2.98

Table 5 - Outlet Flow Points

To reduce the post-developed flow rates at each of these discharge points to pre-developed flow rates bio-retention/OSD basins with controlled outlet structures within are proposed.

A summary of the OSD requirements for each discharge point and associated pre-develop catchment area are as below:

Discharge Point A

All stormwater runoff into Discharge Point A will comprise outflows from the North South Link Road Basin 1 and Basin 1A. NSLR Basin 1 drains the southern catchment of the North South Link Road and Basin 1A drains Lot 1A.

Refer Table 6 for flow rates for pre and post developed rates to Discharge Point A.

The OSD within the basin has been designed to achieve the following outcomes:

- OSD NSLR Basin 1 volume of 550.8m^3 (capacity of the basin from extended detention RL 63.5 to weir of basin RL 64.50)
- OSD Basin 1A volume of 976m^3 (capacity of the basin from extended detention RL 64.8 to weir of basin RL 65.7)

Duration	Pre Developed Flows (m^3/s)	Post Developed Flows (m^3/s)
1 YR ARI	0.356	0.323
2 YR ARI	1.1	0.702
5 YR ARI	2.16	1.24
10 YR ARI	2.55	1.44
20 YR ARI	3.05	1.69
100 YR ARI	3.98	2.33

Table 6 - Pre-Post Developed Flows to Discharge Point A

Discharge Point B

All stormwater runoff into Discharge Point B will comprise outflows from both Basin No 1 and 2 in the post developed case. Refer Drawing C1066. As both basins discharge to this discharge point both outflows have to be added to determine total peak flows. These are compared to pre-developed rates for all storm events up to the 100 year ARI event. Refer Table 7 for flow rates.

The OSD within the basin has been designed to achieve the following outcomes:

- OSD Basin no 1 volume of 7,901m^3 (capacity of the basin from extended detention RL 58.20 to weir of basin RL 59.75)
- OSD Basin no 2 volume of 1,476m^3 (capacity of the basin from extended detention RL 51.00 to weir of basin RL 52.50)

Duration	Pre Developed Flows (m^3/s)	Post Developed Flows (m^3/s)
1 YR ARI	0.84	0.48
2 YR ARI	2.61	0.85
5 YR ARI	5.13	1.23
10 YR ARI	6.05	1.31
20 YR ARI	7.24	2.34
100 YR ARI	9.43	2.68

Table 7 - Pre-Post Developed Flows to Discharge Point B

Discharge Point C

All stormwater runoff into Discharge Point C will comprise outflows from Basin No 3 in the post developed case. Refer Drawing C1066. Refer Table 8 for flow rates for pre and post developed rates to Discharge Point C.

The OSD within the basin has been designed to achieve the following outcomes:

- OSD volume of 16,783m^3 (capacity of the basin from extended detention RL 58.00 to weir of basin RL 59.7)

Duration	Pre Developed Flows (m^3/s)	Post Developed Flows (m^3/s)
1 YR ARI	0.654	0.478
2 YR ARI	2.02	0.854
5 YR ARI	3.97	1.45
10 YR ARI	4.68	1.83
20 YR ARI	5.61	2.37
100 YR ARI	7.31	3.54

Table 8 - Pre-Post Developed Flows to Discharge Point C

Discharge Point D

All stormwater runoff into Discharge Point D will comprise outflows from Basin No 4 in the post developed case. Refer Drawing C1066. Refer Table 9 for flow rates for pre and post developed rates to Discharge Point D.

The OSD within the basin has been designed to achieve the following outcomes:

- OSD volume of 4943m^3 (capacity of the basin from extended detention RL 73.30 to weir of basin RL 74.70)

Duration	Pre Developed Flows (m^3/s)	Post Developed Flows (m^3/s)
1 YR ARI	0.318	0.171
2 YR ARI	0.982	0.184
5 YR ARI	1.93	0.221

10 YR ARI	2.28	0.341
20 YR ARI	2.27	0.505
100 YR ARI	3.55	0.871

Table 9 - Pre-Post Developed Flows to Discharge Point D

Discharge Point E

All stormwater runoff into Discharge Point E will comprise outflows from Basin No 5 in the post developed case. Refer Drawing C1066. Refer Table 10 for flow rates for pre and post developed rates to Discharge Point E.

The OSD within the basin has been designed to achieve the following outcomes:

- OSD volume of 4,054m^3 (capacity of the basin from extended detention RL 63.30 to weir of basin RL 64.70)

Duration	Pre Developed Flows (m^3/s)	Post Developed Flows (m^3/s)
1 YR ARI	0.203	0.127
2 YR ARI	0.626	0.451
5 YR ARI	1.23	0.895
10 YR ARI	1.45	1.42
20 YR ARI	1.74	1.29
100 YR ARI	2.26	1.36

Table 10 - Pre-Post Developed Flows to Discharge Point E

Discharge Point F

All stormwater runoff into Discharge Point E will comprise outflows from Basin No 6 in the post developed case. Refer Drawing C1066. Refer Table 11 for flow rates for pre and post developed rates to Discharge Point F.

The OSD within the basin has been designed to achieve the following outcomes:

- OSD volume of 2,571m^3 (capacity of the basin from extended detention RL 56.30 to weir of basin RL 57.50)

Duration	Pre Developed Flows (m^3/s)	Post Developed Flows (m^3/s)
1 YR ARI	0.773	0.134
2 YR ARI	2.39	0.225
5 YR ARI	4.7	0.441
10 YR ARI	2.26	0.629
20 YR ARI	6.63	0.88
100 YR ARI	8.63	0.931

Table 11 - Pre-Post Developed Flows to Discharge Point F

Discharge Point G

All stormwater runoff into Discharge Point G will comprise outflows from the North South Link Road northern basin. This basin drains with northern catchment of the North South Link Road. Refer Table 12 for flow rates for pre and post developed rates to Discharge Point G.

The OSD within the basin has been designed to achieve the following outcomes:

- OSD volume of 1,035m^3 (capacity of the basin from extended detention RL 50.70 to weir of basin RL 52.00)

Duration	Pre Developed Flows (m^3/s)	Post Developed Flows (m^3/s)
1 YR ARI	0.571	0.503
2 YR ARI	1.76	1.61
5 YR ARI	3.47	3.16
10 YR ARI	4.09	3.83
20 YR ARI	4.90	4.69
100 YR ARI	6.38	6.04

Table 12 - Pre-Post Developed Flows to Discharge Point G

Discharge Point H

Due to site regrading and the construction of flat pads and stormwater infrastructure, no stormwater from the post developed site will discharge via Discharge Point H. The post developed catchment which previously discharged into Discharge Point H will be diverted to drain via Basins 3 and 4 and out of the site at respective Discharge Points, B and C.

6.3.6 Overland Flows

Overland flows within the access roads, carparks and hardstanding areas have been designed to be safely conveyed within the road carriageway to comply with flow widths and velocities within the Penrith City Council Design Guidelines for Engineering Works.

The 100 year ARI flood level determined by Cardno within Ropes Creek adjacent to the proposed basins have been adopted as the tailwater levels for the hydraulic modelling of the basin and stormwater network for all catchments.

6.3.7 Water Sensitive Urban Design (WSUD)

Water Sensitive Urban Design encompasses all aspects of urban water cycle management, including water supply, wastewater and stormwater management. WSUD is intended to minimise the impacts of development upon the water cycle and achieve more sustainable forms of urban development.

The WSUD strategy, MUSIC Model and subsequent WSUD designs prepared by AT & L are based upon requirements within the Penrith City Council C3 Water Management DCP.

All stormwater runoff from catchments 1, 2, 3, 4, 5 and 6 as mentioned in Section 6.3.4 is proposed to drain into Bio-Retention basins for the water to be treated and discharged at rates acceptable to Penrith City Council. A summary of the Basin parameters is indicated in Table 13 and details and cross sections included on the Civil drawings.

Discharge from the basins will be controlled via a rock lined swale that will intersect the existing creek system. These discharge swales will be design and documented to meet the OoW Guidelines for outlet structures on waterfront land.

Refer to attached Civil Drawings list in Appendix B.

6.3.7.1 WSUD Modelling – MUSIC Model

The MUSIC Model for Urban Stormwater Improvement Conceptualisation (MUSIC, Version 5.00.10) was used to evaluate pollutant loads from each of the proposed lots for Post-development (treated) conditions based on the proposed site development.

A conceptual view of the MUSIC model used in this report can be found in Appendix D.

Pluviograph data (6 minute rainfall intensity and evapotranspiration) for Horsley Park (Station 067119) was used in the MUSIC model.

6.3.7.2 Catchment Areas and MUSIC Parameters

All building lot catchment areas were assumed to 65% roofed. Of the non-roofed areas, 90% of this area was assumed to be impervious. To provide a more accurate model, separate catchment nodes were created to simulate the roofed area and non-roofed areas for each lot.

MUSIC model input parameters for these catchments including rainfall-runoff, base flow concentration and stormflow concentration parameters were selected as per the Penrith City Council Water Sensitive Urban Technical Guidelines June 2015 document. The parameters used for the various catchment areas can be seen in tables 13, 14, 15, 16 and 17.

Parameter	Unit	Figure
Rainfall Threshold	mm/day	1.40
Soil Storage Capacity	Mm	105
Initial Storage	% of Capacity	30
Field Capacity	Mm	70
Infiltration Capacity Coefficient	a	150
Infiltration Capacity Coefficient	b	3.5
Initial Depth (Ground Water)	mm	10
Daily Recharge Rate	%	25
Daily Baseflow Rate	%	10
Daily Seepage Rate	%	0.00

Table 13 - Rainfall-Runoff Parameters - All Catchment Areas

Pollutant	Baseflow Concentration Parameter – Mean (log mg/L)	Baseflow Concentration Parameter – Std Dev (log mg/L)	Stormflow Concentration Parameters – Mean (log mg/L)	Stormflow Concentration Parameters – Std Dev (log mg/L)
TSS	0.000	0.000	1.300	0.320
Phosphorus	0.000	0.000	-0.890	0.250
Nitrogen	0.000	0.000	0.300	0.190

Table 14 - Base Flow/Stormwater Concentration Parameters - Impervious (Roofed) Areas

Pollutant	Baseflow Concentration Parameter – Mean (log mg/L)	Baseflow Concentration Parameter – Std Dev (log mg/L)	Stormflow Concentration Parameters – Mean (log mg/L)	Stormflow Concentration Parameters – Std Dev (log mg/L)
TSS	1.200	0.170	2.150	0.320
Phosphorus	-0.850	0.190	-0.600	0.250
Nitrogen	0.110	0.120	0.300	0.190

Table 15 - Base Flow/ Stormwater Concentration Parameters - Previous Areas

Pollutant	Baseflow Concentration Parameter – Mean (log mg/L)	Baseflow Concentration Parameter – Std Dev (log mg/L)	Stormflow Concentration Parameters – Mean (log mg/L)	Stormflow Concentration Parameters – Std Dev (log mg/L)
TSS	0.000	0.00	2.430	0.320
Phosphorus	0.000	0.000	-0.300	0.250
Nitrogen	0.000	0.000	0.340	0.190

Table 16 - Base Flow/ Stormwater Concentration Parameters - Road

MUSIC model parameters used for the Bio-retention basin were based off guidelines provided by FAWB – Stormwater Biofiltration Systems – Version 1, 2009, and were modified accordingly. Parameters used to model the bio-retention basin are shown in the Table 17 below.

Parameter	Unit	Figure
Extended Detention Depth	m	0.30
Surface Area	m2	Varies
Filter Area	m2	Varies
Unlined Filter Media Perimeter	M	0.01
Saturated Hydraulic Conductivity	mm/hour	125
Filter Depth	m	0.50
TN Content of Filter Media	mg/kg	800
Orthophosphate Content of Filter Media	mg/kg	40.0
Exfiltration Rate	mm/hour	0.00
Base Lined	-	No
Vegetation Properties	-	Vegetated with Effective Nutrient Removal Plants
Overflow Weir Width	m	10.00
Underdrain Present	-	Yes
Submerged Zone	-	No

Table 17 - Bio-Retention Basin Parameters

6.3.7.3 Results

MUSIC modelling results presented as mean annual loads at the receiving node indicate that adopted target reductions are achieved, as shown in Tables 18, 19, 20, 21, 22, 23 and 24.

Pollutant	Sources (Kg/yr)	Residual Load (Kg/yr)	Reduction (%)	Target Reduction (%)
Total Suspended Solids	16,500	2,100	87.3	85
Total Phosphorus	35.9	12.3	65.7	60
Total Nitrogen	333	135	59.4	45
Gross Pollutants	3,990	225	94.4	90

Table 18 - Pollutant Loads - Bioretention Basin 1

Pollutant	Sources (Kg/yr)	Residual Load (Kg/yr)	Reduction (%)	Target Reduction (%)
Total Suspended Solids	2,250	228	89.8	85
Total Phosphorus	4.56	1.30	71.4	60
Total Nitrogen	36.7	13.5	63.2	45
Gross Pollutants	500	25.3	94.9	90

Table 19 - Pollutant Loads - Bioretention Basin 2

Pollutant	Sources (Kg/yr)	Residual Load (Kg/yr)	Reduction (%)	Target Reduction (%)
Total Suspended Solids	19,300	2,420	87.5	85
Total Phosphorus	42.6	14.5	65.9	60
Total Nitrogen	396	157	60.4	45
Gross Pollutants	5,390	331	93.9	90

Table 20 - Pollutant Loads - Bioretention Basin 3

Pollutant	Sources (Kg/yr)	Residual Load (Kg/yr)	Reduction (%)	Target Reduction (%)
Total Suspended Solids	5,110	651	87.2	85
Total Phosphorus	11.6	4.18	64	60
Total Nitrogen	112	45.3	59.5	45
Gross Pollutants	1,540	81.1	94.7	90

Table 21 - Pollutant Loads - Bioretention Basin 4

Pollutant	Sources (Kg/yr)	Residual Load (Kg/yr)	Reduction (%)	Target Reduction (%)
Total Suspended Solids	8,420	1,410	83.3	85
Total Phosphorus	18.0	6.98	61.3	60
Total Nitrogen	163	79.3	51.2	45
Gross Pollutants	2,200	35.7	98.4	90

Table 22 - Pollutant Loads - Bioretention Basin 5

Pollutant	Sources (Kg/yr)	Residual Load (Kg/yr)	Reduction (%)	Target Reduction (%)
Total Suspended Solids	3,780	460	87.8	85
Total Phosphorus	8.60	2.82	67.2	60
Total Nitrogen	78.9	30.7	61.1	45
Gross Pollutants	1,060	60.3	94.3	90

Table 23 - Pollutant Loads - Bioretention Basin 6

Pollutant	Sources (Kg/yr)	Residual Load (Kg/yr)	Reduction (%)	Target Reduction (%)
Total Suspended Solids	55,500	7340	86.8	85
Total Phosphorus	121	42	65.3	60
Total Nitrogen	1130	463	59.0	45
Gross Pollutants	15,300	758	95	90

Table 24 - Pollutant Loads - Overall Development

6.4 Conclusion

As highlighted in the above section all stormwater drainage within the Oakdale West development has been designed in accordance with the Penrith City Council Engineering Guidelines. This includes design of all pipework, On-Site Detention basins and WSUDs infrastructure. To summarise:

- OSD to be sized to ensure that for all rainwater events up to and including the 1:100 ARI event, new developments do not increase stormwater peak flows in any downstream areas.
- OSD to mitigate post development flows to pre-developed flows for peak Average Reoccurrence Interval (ARI) events.
- WSUD to achieve target reductions:
    - 85% Total Suspended Solids (TSS)
    - 60% Total Phosphorus (TP)
    - 45% Total Nitrogen (TN)
    - 90% Gross Pollutants (GP)
- Finished Floor Levels (FFL) to have minimum 500mm freeboard to 100 year overland flows
- The implementation of OSD to mitigate flows and WSUD systems to treat the water runoff prior to discharging into Ropes Creeks and the creek to the west demonstrates a commitment to adhere to the Sydney Regional Environmental Plan (SREP) No 20 – Hawkesbury-Nepean River guidelines.

7 Water Balance

7.1 General

The water balance was simulated using a water cycle management model as part of the MUSIC Model to allow the evaluation of various elements of the water cycle to be assessed at differing stages in the development.

7.2 Water Balance Objective

Potable water supplies in the Sydney area are in recognised short supply with projected population increases, potential climate change and periods of extended drought and any development in sources of the Sydney region places increasing demands on an already reduced water supply. As a result, government bodies, together with Sydney Water have encouraged sustainable development by the implementation of an integrated approach to water cycle management (potable water, sewage, stormwater and rainwater) to minimise demands of potable water supplies.

Whilst opportunities for Water Reuse include such initiatives as regional stormwater harvesting, black water recycling and recycled water, this development is limited to rainwater collection and reuse on an individual lot by lot basis.

As such, we have used MUSIC to establish an estimated tank size for each lot within the development and demonstrated the volume of water reuse possible and provide a more sustainable servicing solution.

7.3 Water Balance End Uses

AT&L has identified the following water demand end uses to be required across the development:

- toilet and urinal flushing, hand basin washing, showering;
- kitchen (food preparation, washing), drinking;
- air conditioning cooling;
- internal cleaning;
- leaking water devices;
- truck/car wash;
- external cleaning; and
- watering (outdoor garden use).

End Use (Water Demand)	Water Demand* (L/day for a total development)	Percentage of Total Water Demand	Assumptions
Toilet and Urinal Flushing	586	12%	Based on '3-star' toilet and urinal fittings. Based on being flushed
Hand Basin Washing	348	7%	Based on 3 uses of the hand basin per person/day for 15 seconds each time using a 3-star tap fitting (8.5 L/min).
Showering	698	14%	20% of staff have showers each day for 8 minutes each time using a 3-star shower head (8L/min)
Kitchen (washing& drinking)	164	3%	3 L / EP/ day
Air Conditioning Cooling	496	10%	10% of total water consumption-of which 88% evaporates.
Leaking Water Devices	Negligible	0%	Traditionally 0.7% of total water consumption in residential dwellings is attributed to leaks (SWC, 2005). However, as the new dwellings will be fitted with efficient, correctly installed and appropriately maintained fittings- the water consumption attributed to leaking water devices was assumed to be negligible.
Unaccounted for Water	499*	10%*	Unaccounted for water accounted for 10% of overall water demand in 2005 (SWC, 2005). *It has been assumed that "unaccounted for water" is equivalent to 10% of pressurised water demands. In reality this will be made up from a portion of both the potable and non-potable demands. This results in an overall "unaccounted for water" demand, except in the case where rainwater tanks are used to supplement end uses. In this case the total "unaccounted for water" demand will be less than 10%.
Truck Wash (Not on all lots)	300	6%	Based on two trucks being washed each day, requiring 150 L per wash.
Internal Cleaning	74	1.5%	Based on the assumption that cleaning involves toilet flushing (8 toilet flushes- 24L) and mopping (5 buckets each 10 L- 50L).

External Cleaning	20	0.4%	Assuming each bucket of water requiring for mopping contains 10 L
Watering (Outdoor Garden use)	1,777	36%	Using subsurface irrigation (and other water efficient watering methods)- the watering required during an 'average' rainfall year was assumed to be 0.88 mm/day (source
Total (L/day/ Generic Warehouse (or per 2.04 net hectares)	4,962	100%	
Total (L/day/ net hectare)	2,432		
Total (L/day/net hectare) for irrigation and toilet flushing (assuming 50% of total water used)	1,216		

Table 25 - Summary of Adopted End Use Assumptions within the Development

Note * the water demand rates indicated in this table are based on the Oakdale Concept Plan Water Balance Options Report prepared by GHD in December 2007. Refer to Appendix J for Water Demands – End Uses section summarising the proposed water usages.

7.4 Total Site Demands

Portion of Proposed Warehouse Facility	**Lot 1A Area (m^2)**	**Lot 1B Area (m^2)**	**Lot 1C Area (m^2)**
Warehouse (including dock office lower level)	21,115	15,190	75,255
Office	1,370	990	4,105
Hardstand (including internal circulation roads, footpaths, car parks)	11,198	8,247	37,801
Garden / Landscape Area (including courtyards)	7,342	14,064	20,660

Total Area of Proposed Warehouse Facility	41,025	38,491	137,821
Daily Non Potable Water Usage for irrigation and toilet flushing (based on 1.216kL/day/ net Hectare) as per Table 25.	**2.73kL/day**	**1.97kL/day**	**9.65kL/day**

Table 26 - Total Site Demands and Daily Usage

7.5 Rainwater Reuse

The use of rain water collected in rainwater tanks from runoff on the roofs of the warehouse roofs provides a valuable alternative to potable water for a variety of non-potable end uses, such as vehicle washing, air conditioning cooling, and toilet flushing and watering.

We have assumed for this development, irrigation and toilet flushing will be plumbed to the rainwater tanks. Other uses such as truck washing maybe considered at the detailed design stage.

A rainwater tank model was constructed to simulate the rainwater tank operations and select the optimal rainwater tank size, in doing so, the following considerations were made:

- Rainfall received;
- Roof area or runoff area;
- Roof Wetting;
- First Flush; and
- Rainwater demands (by end use).

7.6 Rainwater Tank Model Assumptions

The rainwater tank model assumptions built into the scenarios assumed the following:

Rainfall received

The rainfall runoff that could potentially be captured by the rainfall tank from the roof of each building was simulated individually for the 'dry', 'wet' and 'average' rainfall year within each scenario run.

Roof Wetting, First Flush Diversions and Overflow

While it is assumed that rainfall runoff has the potential to runoff 100% of the area of the roof into the rainwater tank, the proportion of rainfall that actually reaches the rainwater tank is affected by four factors:

- It is assumed that the initial 2mm of rainfall that falls on the roof is considered 'wetting', that is, potential rainfall runoff that is not captured by the rainwater tank, but is rather 'lost runoff' as evaporation or other;
- To prevent sediment and other pollutants entering the rainwater tank, a portion of the initial runoff from the roof is transferred to stormwater, this is known as the 'first flush'. The portion of water diverted as part of the first flush

differs for each facility depending on the amount of pollution each roof is susceptible to.

- As the development is located in a predominantly light industrial area, where there may be potential for some roof pollution, a standard first flush volume of 1mm of runoff from across the roof area has been adopted.
- Any roof runoff that exceeds the rainwater tank capacity is 'overflow', and is directed to the stormwater drainage system.

7.7 Rainwater Tank Modelling

7.7.1 General

For the MUSIC analysis the following parameters are assumed:

- An allowance for 20% loss in rainwater tank size volume to allow for anaerobic zones, mains water top up levels and overflow levels
- Approximately 30% of the total roof area can drain into the rainwater harvest tank
- The daily non potable water usage for irrigation and toilet flushing is calculated based on 1.216kL/day/ building area as per the requirements from Table 25.

7.7.2 Rainwater Tank Modelling Results

The use of a rainwater tank was simulated for 'average' rainfall conditions to service three differing combinations of end uses for each Facility being:

Lot Number	Total Roof Area (m^2)	Roof Area draining to tank (m^2)	Size of Tank (kL)	% of total non-potable water used from tank (based on MUSIC modelling)
1A	24,470	7,341	80	**80.1**
1B	17,590	5,277	60	**80.2**
1C	84,210	25,263	275	**80.3**

Table 27 - Percentage of Non-Potable Water Used from Tank

7.8 Conclusion

The use of rainwater harvest tanks and the design basis to size the tanks to ensure as a minimum 80% of all non-potable water on each lot can be sourced from the tank, demonstrates a commitment to water recycling and minimising the usage of mains water.

This is in line with the industry best practise and the NSW Stage Government's objective of reducing the amount of potable (drinking) water consumed for non-potable uses.

8 Flood Modelling

A Flood Impact Assessment of the Proposed Oakdale West Estate was undertaken by Cardno in March 2016.

8.1 Purpose of Flood Report

The purpose of this report is determine the flood impact assessment to the surrounding areas and proposed building pads and roads within the Oakdale West site due to the proposed development. For the basis of the proposed development conditions Cardno used the latest Architectural masterplan and AT&L design siteworks plan. *Both the 100 yr ARI and PMF (Probable Maximum Flood) levels have been identified within this report.*

8.2 Flood Modelling Results

Based on the Cardno flood report the following impacts were discovered when comparing the proposed development flood conditions against the existing flood conditions:

- There will be minor impacts on the 100 yr ARI flooding on the Ropes Creek floodplain which will not adversely impact on any adjoining property subject to the peak target outflows not exceed the designated 2yr ARI and 100 yr ARI peak flows
- Any impacts on the 100 yr ARI and PMF flood levels and velocities are primarily associated with the Oakdale South development and the local impacts of Oakdale West development is primarily created by Lot %a and the incremental impacts are confined within the overall Oakdale precinct.

8.3 Conclusion

The Cardno report concludes that the proposed development will have minor impacts on the 100 yr ARI flooding on the Ropes Creek floodplain however this will not adversely impact on any adjoining property. This is subject to the post-developed peak flows being limited to pre-developed flows which has been discussed in Section 6.3.5 of this report.

9 Services

9.1 Sydney Water

AT&L has undertaken extensive consultation with Sydney Water during the development of OWE. As a result of the ongoing development within the Western Sydney Employment Area (WSEA) Precinct No.8 – Area South of Pipeline, Sydney Water requested that a Local Area Servicing Plan (LASP) for both sewer and potable water infrastructure was prepared. This was to ensure that future Sydney Water infrastructure could ultimately service future developments within the WSEA Precinct No.8 – Area South of Pipeline.

The LASP for sewer and potable water (GHD 2016) identifies the servicing strategy for the WSEA Precinct No.8 – Area South of Pipeline as shown below within Figure 6.

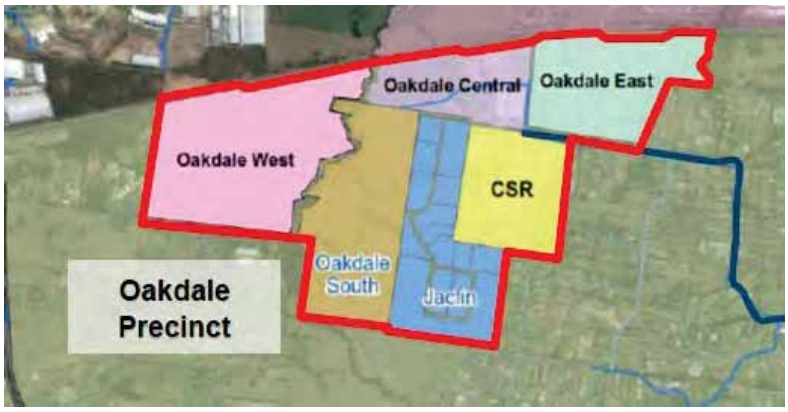


Figure 5 – WSEA Precinct No.8 – Area South of Pipeline.

At the request of Sydney Water, GHD were engaged to prepare the LASP for both sewer and potable water. During preparation of these documents, extensive consultation was undertaken with Sydney Water, Jacfin and CSR to ensure compliance with Sydney Water's performance requirements for both sewer and potable water.

An overview of the sewer and potable water servicing strategy for the WSEA Precinct No.8 – Area South of Pipeline with specific reference to Oakdale South is provided below.

9.1.1 Water Supply

Oakdale West is zoned as IN1 'General Industrial' under the State Environmental Planning Policy (Western Sydney Employment Area) 2009. Water demands were assessed for Oakdale West on this basis within the LASP for potable water (GHD 2016).

Within the LASP for potable water (GHD 2016), an evidence based approach to forecasting future demands in the WSEA Precinct No.8 – Area South of Pipeline, based on observed demands in an adjacent water supply system, was adopted as per the 'Water System Planning Guidelines 2014".

The LASP for potable water (GHD 2016) calculated the potable water daily demands for Oakdale West as follows:

- Average Day Demand (ML/d): 0.83ML/d
- Max Day Demand (ML/d): 1.3ML/d

The LASP for potable water (GHD 2016) states that Oakdale West will be supplied via the proposed DN300 potable water main (Refer Section 7-8 within Figure 2 in Appendix F) which is supplied from the Minchinbury Elevated System.

To improve system reliability, the LASP also requires a proposed DN300 connection (refer section 4-7 within Figure 2 in Appendix F) between the existing DN250 within Millner Avenue (refer section 3-4 within Figure 2 in Appendix E) to the proposed DN300 within Oakdale West (refer section 7-8 within Figure 2 in Appendix F) which ultimately connects to the existing DN300 within Erskine Park Link Road (EPLR). The proposed DN300 connection (refer section 4-7 within Figure 2 in Appendix E) between Millner Avenue and Oakdale West is included within this proposal and will be provided as part of the OSE development.

A DN300 connection between the existing DN450 within Burley Road and the Millner Avenue Roundabout (refer section 2-4 within Figure 2 in Appendix E) is also required as part of the LASP. This proposed DN300 connection will be provided as part of the OWE development subject to Sydney Water Notice of Requirements.

The provision of OSE potable water reticulation (internal and external works) will be undertaken in accordance with the Sydney Water endorsed LASP for potable water (GHD 2016), Sydney Water requirements and procurement process.

9.1.2 Sewerage

Oakdale West is zoned as IN1 'General Industrial' under the State Environmental Planning Policy (Western Sydney Employment Area) 2009. Sewer loads were assessed for Oakdale West on the basis within the LASP for sewer (GHD 2016)

The St Clair Trunk sewer system has recently been completed which connects the wider Oakdale Precinct to the existing St Clair Sewer Carrier approximately 1.6km to the north west of the site. As part of the those works, a connection point was provisioned for OWE in the north east corner.

The LASP for sewer (GHD 2016) calculated the sewer loads for Oakdale South as follows:

- Average Dry Weather Flow (ML/d): 1.34ML/d

The LASP for sewer (GHD 2016) identified the sizing of sewer infrastructure required to service Oakdale West as between DN375 to DN225. For further details on proposed sewer alignments for Oakdale West, refer to Appendix E.

The provision of OWE sewer infrastructure (internal and external works) will be undertaken in accordance with the Sydney Water endorsed LASP for sewer (GHD 2016), Sydney Water requirements and procurement process.

In the event of delays of delivery of sewer infrastructure to service OWE, temporary interim measures may need to be adopted such as provision of sewer rising main

systems between OWE and the East St Clair Carrier, located at Millner Avenue roundabout, subject to PCC and/or Sydney Water approvals.

An overview of the preliminary alignments and sizing of sewer infrastructure within the Sydney Water endorsed LASP for sewer (GHD 2016) is shown within Figure 6 in Appendix E.

The existing school and retirement village may be able to connect to the proposed sewer service in the north west corner of the OWE. When designing the sewer, consideration will be made and provisioned to service the adjacent site.

The school and retirement village currently have no trunk sewer system and utilize a low pressure pump system.

9.2 Communications

Communication conduits will be extended along the proposed NSLR to service Oakdale West, the pit and pipe network will be extended and reticulated through the roadways to service the proposed lots.

Staging of the pit and pipe network will coincide with the civil stages.

Refer Appendix E for concept servicing plans

9.3 Gas

To service Oakdale West, conduits will be extended and reticulated through the roadways to service the proposed lots.

Staging of the reticulation will coincide with the civil stages.

It is not proposed to reticulate gas although provision for it.

Refer Appendix E for concept servicing plans

9.4 Electrical

Over the past 18 months' numerous meetings have been held with Endeavour Energy (EE) in relation to servicing the proposed development site. Currently EE have indicated that a new Zone Substation (ZS) will ultimately be required to service the greater development area. The new ZS will potentially have capacity to also service adjacent developments including the Jacfin, CSR and Oakdale South sites. This is subject to detailed design and investigation by EE.

The Services Lot adjacent to Precinct 4 has been identified as the location for the Zone Substation. This has been determined in consultation with EE and they have verbally agreed to the location.

EE will ultimately construct and own and operate the zone substation and is not subject to this application.

EE has indicated that Stage 1 could be serviced in the interim by connecting to the existing 11kV reticulation within the EPLR and to the existing Erskine Park Zone Substation. Reticulation would be extended along the proposed NSLR.

EE has indicated that in order to service further Stages of development the new Zone Substation will be required on the site subject to future design and evaluation by EE. Stage 1 and all remaining Stages of development would then be serviced by the new Zone Substation upon completion of the ZS.

Whilst Stage 1 could be serviced by the existing Erskine Park Zone Substation, depending on discussion with EE, additional feeders could be pulled to service all subsequent stages although this would not be economically viable option.

The new zone substation would be supplied via the overhead 132kV feeder 93X located approximately 400m east of Old Wallgrove Road. Additional works associated with supplying power to the new Zone Substation will need to be completed as follows:

- Possible augmentation to feeder 93X; and

Refer Appendix E for concept servicing plans

9.5 Conclusion

This section demonstrates that services including sewer, water, power, telecommunications and gas can be made available to the site.

Internal reticulation will be coordinated at the Construction Certificate (CC) stage of works and applications to the relevant authorities.

10 Infrastructure Staging

10.1 Staging

It has been assumed that the development will be constructed over five precincts in accordance with proposed development layouts.

- Precinct 1
- Precinct 2
- Precinct 3
- Precinct 4
- Precinct 5
- Southern Link Road

A summary of the works required for the stages is outlined in the following sections. A copy of the staging plan is provided in Drawing C1003 in **Appendix A.**

10.1.1 Precinct 1

ELEMENT	DESCRIPTION OF WORKS	TIMING/DURATION
Construction Stage 1 Inc. NSLR		
General	Construction of estate roads, bio-retention basins, lead in services, utility reticulation and NSLR	Stage 1 construction is expected to commence May 2017 and would take place over approximately 12 months.
Earthworks	Bulk and detail earthworks with cut to fill across the precinct 1 which includes approx. 450,000m3	
Fill Import and Stockpiling	- Importation of 30,000m^3 of fill material. - Fill to be brought to the OSE within the first 2 months of the works - Average daily import of fill material– 500 - 1000m^3	
Stormwater/OSD	- Construction of Basin No. 1 including the outlet swale to the west adjacent to the Water NSW pipeline and Precinct 2.	
Roads	- Road No. 1 and 2 would be constructed along with the NSLR which would include the bridge crossing of the Water NSW pipeline.	
Landscape	Landscape works would include all future planting along the streets, along with basin planting. Entry signage and planting would also be undertaken with this stage.	
Services	**Water** Water Reticulation generally in accordance with Sydney Water "Oakdale Industrial Development – Planning of Water Related Services – Final Report - Water" Dated July 2016 Prepared by GHD This would generally include trunk water mains and minor reticulation to each road. A trunk main would be constructed along the proposed NSLR along a trunk link to Oakdale South/Central. **Sewer** Sewer Reticulation generally in accordance with Sydney Water "Oakdale Industrial Development – Planning of Water Related	

	Services – Final Report - Wastewater" Dated July 2016 Prepared by GHD This would generally include trunk sewer mains reticulated throughout the site and connected to the already constructed St Clair Carrier (completed as part of the Oakdale Central works) Gas - Provision of conduits in the estate road reserves to allow for future gas services to development sites if required. Electricity Reticulation of HV and LV mains, street lighting and provision for future mains. Lead in services will be reticulated along the proposed NSLR and the existing EPLR to the Erskine Park Zone Sub Station. Lead in connections will also be made to the Oakdale South site. Communications Communication ducts will be reticulated in each road as required by NBNco. Lead in ducts will be located in the proposed NSLR and connected to the existing ducts in the EPLR.	

Table 28 - Precinct Works

10.1.2 Precinct 2

Construction Stage 2		
General	Generally, these works include Bulk earthworks, boundary retaining walls and stormwater / sedimentation control basins only.	Stage 2 construction is expected to commence in January 2018 and would take place over approximately 12 months.
Earthworks	- Bulk and detail earthworks with cut to fill across the precinct 2 which includes approx. 225,000m3 of Cut and fill of 605,000m3	
Fill Import and Stockpiling	- Importation of 230,000m^3 of fill material from Stage 3. Earthworks would be undertaken within stage 3 to win the material for stage 2. - Fill would also be imported off site of 150,000m3 - Fill to be brought to the OSE within the first 5 months of the works - Average daily import of fill material– 500 - 1000m^3	
Stormwater/OSD	- Basin 2 and 3 would be constructed in their final form along with the associated stormwater outlets and scour protection for the purpose of sedimentation control. No filter material would be installed at this stage. It may be required to install precinct drainage in some areas to direct stormwater flows from the final pad as part of the sedimentation and erosions control measures.	
Roads	- No roads are proposed to be constructed at this stage	
Services	No services are proposed to be constructed at this stage No services are proposed to be constructed at this stage	

Table 29 - Precinct 2 Works

10.1.3 Precinct 3

Construction Stage 3		
General	Generally, these works include Bulk earthworks, boundary retaining walls and stormwater / sedimentation control basins only. -	Stage 3 construction is expected to commence in July 18 and would take place over approximately 12 months.
Earthworks	- Bulk and detail earthworks with cut to fill across the precinct 3 which includes approx. 654,000m3 of Cut and fill of 168,000m3	
Fill Import and Stockpiling	- Export of 403,000m^3 of fill material to Stage 4 where is will be placed and compacted. - Export of 80,000m^3 of fill material to Stage 5 where is will be placed and compacted. - No fill would be imported during this stage of works. -	
Stormwater/OSD	- Basin 4,5 and 6 (stages 4 and 5) would be constructed in their final form along with the associated stormwater outlets and scour protection for the purpose of sedimentation control. No filter material would be installed at this stage. It may be required to install precinct drainage in some areas to direct stormwater flows from the final pad as part of the sedimentation and erosions control measures.	
Roads	- No roads are proposed to be constructed at this stage	
Services	No services are proposed to be constructed at this stage	

Table 30 - Precinct 3 Works

10.1.4 Precinct 4

Construction Stage 4		
General	Generally, these works include Bulk earthworks, boundary retaining walls and stormwater / sedimentation control basins only.	Stage 4 construction is expected to commence in January 19 and would take place over approximately 12 months.
Earthworks	- Bulk and detail earthworks with cut to fill across the precinct 4 which includes approx. 270,000m3 of cut to fill	
Fill Import and Stockpiling	- Cut to fill of 270,000m3 - No fill would be imported during this stage of works. -	
Stormwater/OSD	- No stormwater basin works are required as these were completed as part of stage 3 - Sedimentation and erosions control measures.	
Roads	- No roads are proposed to be constructed at this stage	
Services	No services are proposed to be constructed at this stage -	

Table 31 - Precinct 4 Works

10.1.5 Precinct 5

Construction Stage 5 including the SLR corridor		
General	Generally, these works include Bulk earthworks, boundary retaining walls and stormwater / sedimentation control basins only.	Stage 5 construction is expected to commence in July 19 and would take place over approximately 6 months.
Earthworks	- Bulk and detail earthworks with cut to fill across the precinct 5 which includes approx. 80,000m3 of fill	
Fill Import and Stockpiling	- Filling of approx. 80,000m3 - Material would be won from the proposed SLR corridor	
Stormwater/OSD	- No stormwater basin works are required as these were completed as part of stage 3 - Sedimentation and erosions control measures.	
Roads	- No roads are proposed to be constructed at this stage	
Services	No services are proposed to be constructed at this stage -	

Table 32 - Precinct 5 inc. SLR Earthworks

11 Construction

11.1 Clearing and Grubbing

The site is predominantly grassed paddocks with minor pockets of trees. Clearing and Grubbing would generally consist of slashing, tree removal and removal of grass and roots within the top layer of the topsoil where required.

Where trees are to be removed these will be mulched and then reused on site as part of the landscape treatment.

Clearing and grubbing would take place in a staged manner in line with civil and infrastructure works. Where possible existing ground coverings will be left undisturbed until such time it is required to be removed.

All riparian and offset lands would be fenced off and trees to be retained marked to prevent clearing and protected areas.

11.2 Demolition

A number of small structures need to be removed from site including a derelict house, cattle yards and rural fencing. There are no substantial improvements on the site that require demolition.

11.3 Road works and Services

The roads and services to be constructed will be undertaken once the earthworks for the road corridor and adjacent lots are completed.

The performance of the imported sub grade may ultimately determine whether any modifications are required to the pavement design although at the time of tender, the contractors will be required to determine their source of material and the applicable CBR.

If the cut material from the site is better suited for sub grade, it will be separated and utilised for the final layers.

The general sequence of the road and services is as follows;

- Boxing and construction of base pavement layers
- Excavation for stormwater and laying of pipes and construction of pits
- Excavation for combined services trenches
- Where deep sewer is required to cross roads, this will be finalised
- Services road crossings including water
- Kerb and gutter
- Watermain installation
- Final pavement base layer

- First layer of asphalt
- Light poles stood
- Foot paths constructed
- Topsoil and LandWaterNSWpe completed
- Signage and linemarking

Note, final layer of asphalt will not be installed until 12 months after completion of that stage.

Stormwater basin will be established as a matter of priority to control sediment runoff and once the roads are completed these will be finalised in their final configuration.

11.4 Program

The table below outlines the preliminary construction commencement and completion dates for the various stages.

STAGE No.	COMMENCMENT	COMPLETION	DURATION
1 inc. NSLR	May 2017	May 2018	12 months
2	Jan 2018	Jan 2018	12 months
3	July 2018	July 2019	12 months
4	Jan 2019	Jan 2020	12 months
5	July 2019	Jan 2020	6 months

Table 33 - Construction Program

11.5 Construction Plant and Equipment

Throughout the various stages of the project, it is expected that the following construction plant and equipment will be required. This list is including but is not limited to:

- Construction compound
  - Site offices and facilities for staff
  - Car parking
  - Meeting rooms
  - Lay down area for delivery of materials
  - Mechanical bay for plant
- Construction plant
  - Skidsteer loader (Bobcat) 5 of
  - Backhoe (dig depth up to 5 m) 5 of
  - Backhoe + hammer 2 of
  - Dozer 98 to 145 kW (equivalent to Caterpillar D6) 1 of
  - Dozer 145 to 175 kW (equivalent to Caterpillar D7) 1 of
  - Dozer 220 to 305 kW (equivalent to Caterpillar D8) 1 of

- Dozer 305 to 400 kW (equivalent to Caterpillar D9) 1 of
- Grader 3 of
- Loader (up to 90 kW) 5 of
- Roller, multi-tyred 1 of
- Roller, padfoot (various sizes) 3 of
- Roller, smooth drum 1 of
- Scraper, open bowl, 17 to 28 m3 5 of
- Excavator < 10 t + hammer 1 of
- Excavator 12 t + hammer 1 of
- Excavator 20 t + hammer 1 of
- Excavator 30 t + hammer 1 of
- Watercart 15,000 L 1 of
- Truck 13 t payload 1 of
- Truck and dog 30 t payload 5 of
- Road profiler
- Air compressor (without operator) 41 L/s
- Generator 6.8 kVA (without operator)

11.6 Conclusion

The Construction Staging as demonstrated above is based on the development being split into 5 stages.

This section demonstrates the works required within each of these Stages and the likely construction program and plant and equipment to be used to complete these stages.

Appendix A

Proposed Site Plans, Staging and Catchment Plans

LEGEND

- EXISTING BOUNDARY
- EXISTING EASEMENT
- PROPOSED BOUNDARY
- PRECINCT No.1
- PRECINCT No.2
- PRECINCT No.3
- PRECINCT No.4
- PRECINCT No.5
- FUTURE SOUTHERN LINK ROAD
- NORTH-SOUTH LINK ROAD

Bar Scales

0 50 100 150 200 250

1 : 3000 @ A1

Issue	Description	Date
A1	ISSUED FOR SSD APPROVAL	14-03-17

Status: FOR APPROVAL
NOT TO BE USED FOR CONSTRUCTION — A1

Scales	1 : 3000	15-272-C0003.dwg	
		Drawn	MM
		Designed	MM
Height Datum	AHD	Checked	AM
Grid	MGA	Approved	AM

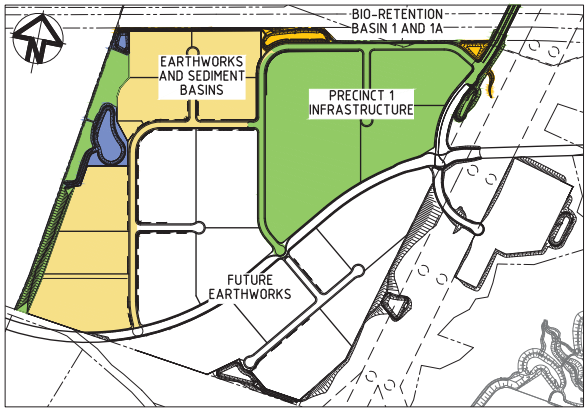
Client: Goodman

Civil Engineers and Project Managers
at&l
Level 7, 153 Walker Street
North Sydney NSW 2060
ABN 96 130 882 405
Tel: 02 9439 1777
Fax: 02 9923 1055
www.atl.net.au
info@atl.net.au

Project
PROPOSED INDUSTRIAL DEVELOPMENT OAKDALE WEST

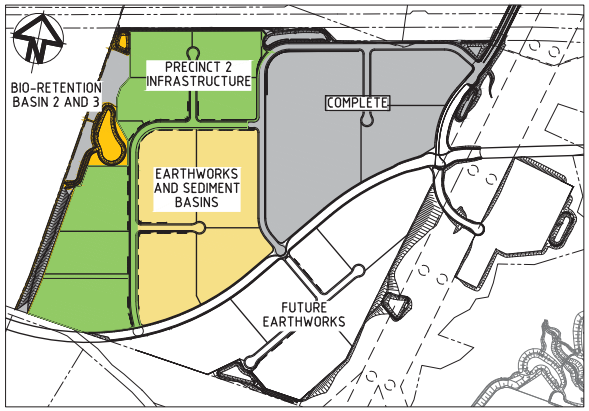
Title
PRECINCT PLAN

Drawing No.	Project No.	Issue
15-272-C0003	15-272	A1



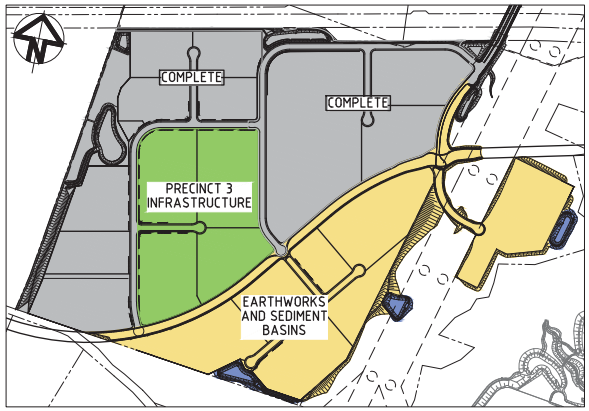
STAGE 1

- BULK EARTHWORKS PRECINCT 1 & 2
- DETAILED EARTHWORKS PRECINCT 1
- SEDIMENT BASINS
- ROAD & LOT RETAINING WALLS
- LEAD IN SERVICES INCLUDING POWER, COMMUNICATIONS, GAS, SEWER & WATER
- ROAD CONSTRUCTION INCLUDING SERVICES RETICULATION
- STORMWATER DRAINAGE
- STORMWATER BIO-RETENTION BASIN 1 & 1A
- OUTLET SWALES FROM BASINS
- LANDSCAPE
- NORTH SOUTH LINK ROAD



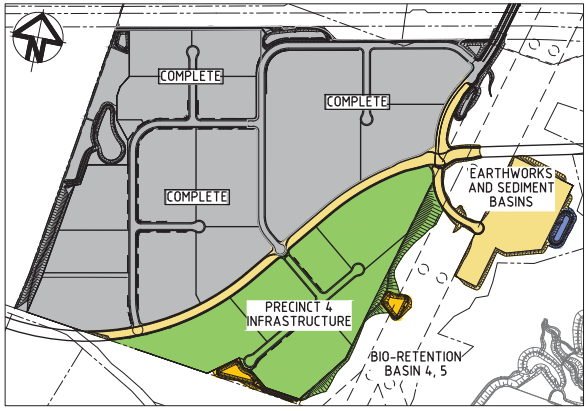
STAGE 2

- BULK EARTHWORKS PRECINCT 3
- DETAILED EARTHWORKS PRECINCT 2
- ROAD & LOT RETAINING WALLS
- LEAD IN SERVICES INCLUDING POWER, COMMUNICATIONS, GAS, SEWER & WATER
- ROAD CONSTRUCTION INCLUDING SERVICES RETICULATION
- STORMWATER DRAINAGE
- STORMWATER BIO-RETENTION BASIN 2 & 3
- OUTLET SWALES FROM BASINS
- LANDSCAPE



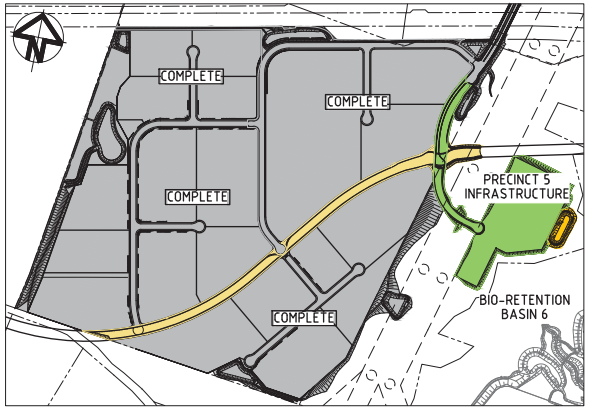
STAGE 3

- BULK EARTHWORKS PRECINCT 4, 5 & SOUTHERN LINK ROAD
- DETAILED EARTHWORKS PRECINCT 3
- SEDIMENT BASINS
- ROAD & LOT RETAINING WALLS
- LEAD IN SERVICES INCLUDING POWER, COMMUNICATIONS, GAS, SEWER & WATER
- ROAD CONSTRUCTION INCLUDING SERVICES RETICULATION
- STORMWATER DRAINAGE
- LANDSCAPE



STAGE 4

- BULK EARTHWORKS PRECINCT 5 & SOUTHERN LINK ROAD
- DETAILED EARTHWORKS PRECINCT 4
- SEDIMENT BASINS
- ROAD & LOT RETAINING WALLS
- LEAD IN SERVICES INCLUDING POWER, COMMUNICATIONS, GAS, SEWER & WATER
- ROAD CONSTRUCTION INCLUDING SERVICES RETICULATION
- STORMWATER DRAINAGE
- STORMWATER BIO-RETENTION BASIN 4 & 5
- OUTLET SWALES FROM BASINS
- LANDSCAPE



STAGE 5

- DETAILED EARTHWORKS PRECINCT 5
- SEDIMENT BASINS
- ROAD & LOT RETAINING WALLS
- LEAD IN SERVICES INCLUDING POWER, COMMUNICATIONS, GAS, SEWER & WATER
- ROAD CONSTRUCTION INCLUDING SERVICES RETICULATION
- STORMWATER DRAINAGE
- STORMWATER BIO-RETENTION BASIN 6
- OUTLET SWALES FROM BASINS
- LANDSCAPE

LEGEND

- EXISTING BOUNDARY
- EXISTING EASEMENT
- PROPOSED BOUNDARY
- DETAILED INFRASTRUCTURE
- GENERAL EARTHWORKS AREAS
- SEDIMENT BASIN
- BIO-RETENTION BASIN
- COMPLETED WORKS
- FUTURE EARTHWORKS

Bar Scales

0 50 100 150 200 250

1 : 3000 @ A1

Issue	Description	Date
A1	ISSUED FOR SSD APPROVAL	14-03-17

Status: FOR APPROVAL — NOT TO BE USED FOR CONSTRUCTION — A1

Scales	1 : 3000	15-272-C0004.dwg	
		Drawn	MM
		Designed	MM
Height Datum	AHD	Checked	AM
Grid	MGA	Approved	AM

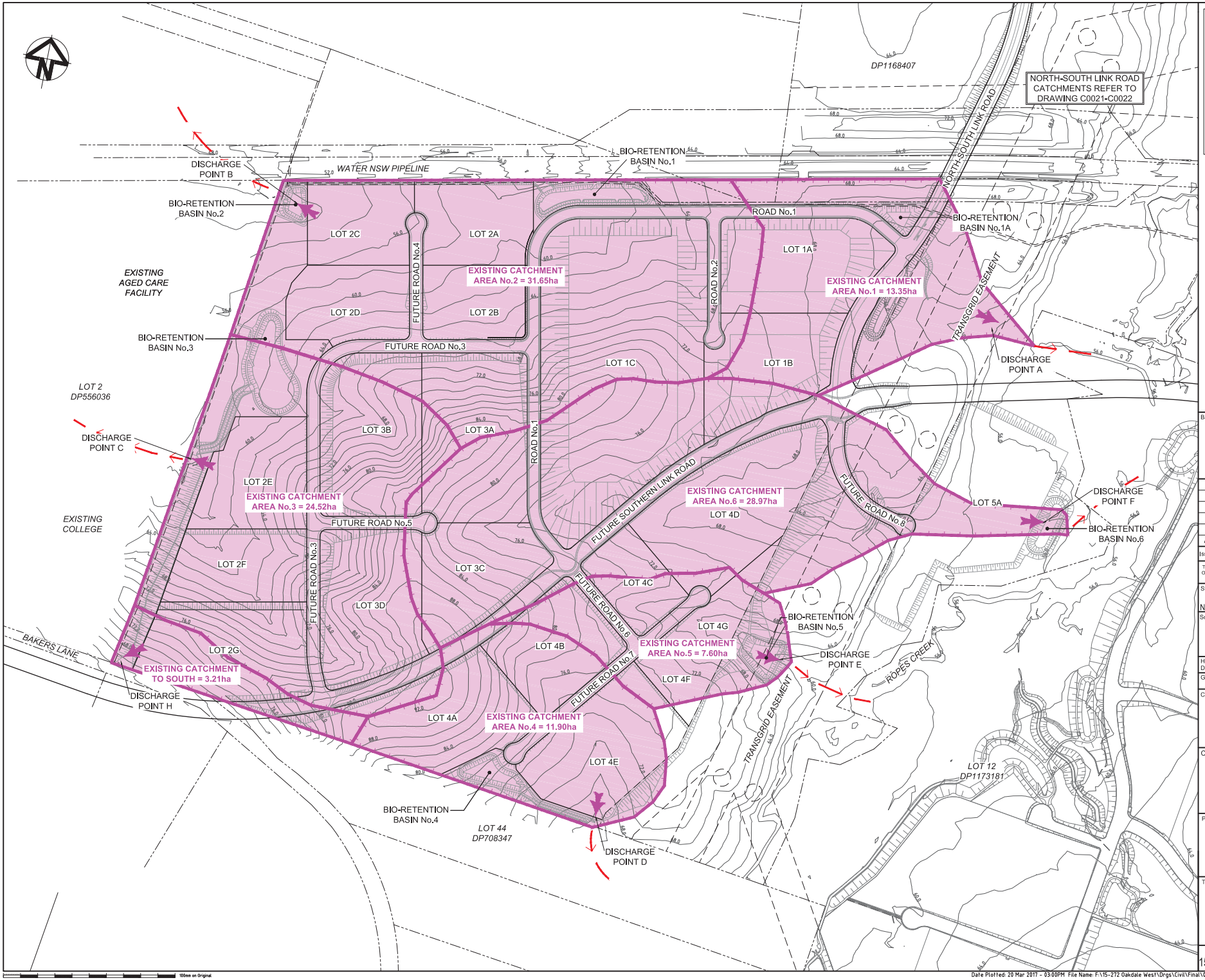
Client: Goodman

Civil Engineers and Project Managers
at&l
Level 7, 153 Walker Street
North Sydney NSW 2060
ABN 96 130 882 405
Tel: 02 9439 1777
Fax: 02 9923 1055
www.atl.net.au
info@atl.net.au

Project: PROPOSED INDUSTRIAL DEVELOPMENT OAKDALE WEST

Title: INDICATIVE INFRASTRUCTURE / EARTHWORKS STAGING PLAN

Drawing No.	Project No.	Issue
15-272-C0004	15-272	A1



Bar Scales

0 50 100 150 200 250

1 : 3000 @ A1

Issue	Description	Date
A1	ISSUED FOR SSD APPROVAL	14-03-17

Status: FOR APPROVAL
NOT TO BE USED FOR CONSTRUCTION — A1

Scales	1 : 3000	15-272-C0006.dwg	
		Drawn	MM
		Designed	MM
Height Datum	AHD	Checked	AM
Grid	MGA	Approved	AM

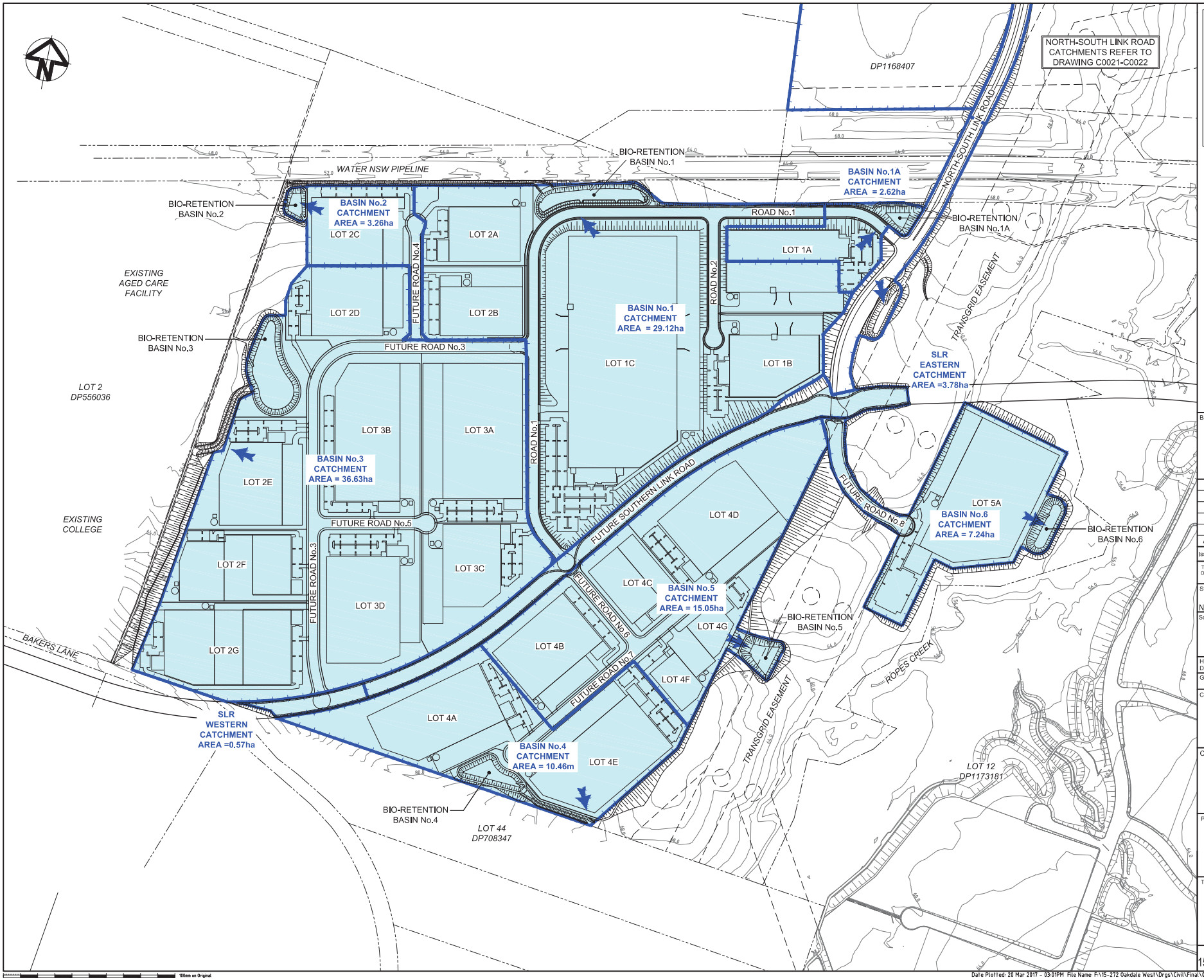
Client: Goodman

Civil Engineers and Project Managers
at&l
Level 7, 153 Walker Street
North Sydney NSW 2060
ABN 96 130 882 405
Tel: 02 9439 1777
Fax: 02 9923 1055
www.atl.net.au
info@atl.net.au

Project: PROPOSED INDUSTRIAL DEVELOPMENT OAKDALE WEST

Title: STORMWATER DRAINAGE CATCHMENT PLAN (PRE-DEVELOPED)

Drawing No.	Project No.	Issue
15-272-C0006	15-272	A1



Bar Scales

0 50 100 150 200 250

1 : 3000 @ A1

Issue	Description	Date
A1	ISSUED FOR SSD APPROVAL	14-03-17

Status: FOR APPROVAL
NOT TO BE USED FOR CONSTRUCTION — A1

Scales	1 : 3000	15-272-C0007.dwg	
		Drawn	MM
		Designed	MM
Height Datum	AHD	Checked	AM
Grid	MGA	Approved	AM

Client: Goodman

Civil Engineers and Project Managers
at&l
Level 7, 153 Walker Street
North Sydney NSW 2060
ABN 96 130 882 405
Tel: 02 9439 1777
Fax: 02 9923 1055
www.atl.net.au
info@atl.net.au

Project: PROPOSED INDUSTRIAL DEVELOPMENT OAKDALE WEST

Title: STORMWATER DRAINAGE CATCHMENT PLAN (DEVELOPED)

Drawing No.	Project No.	Issue
15-272-C0007	15-272	A1

100mm on Original

Date Plotted: 20 Mar 2017 - 03:01PM File Name: F:\15-272 Oakdale West\Drgs\Civil\Final\0000_Master Plan Concept Package\15-272-C0007.dwg V1

LEGEND

- EXISTING BOUNDARY
- EXISTING EASEMENT
- PROPOSED BOUNDARY
- EXISTING STORMWATER FLOW PATH
- EXISTING STORMWATER CATCHMENT BOUNDARY
- FLOW DIRECTION

Bar Scales

0 50 100 150 200 250

1 : 3000 @ A1

Issue	Description	Date
A1	ISSUED FOR SSD APPROVAL	14-03-17

Status: FOR APPROVAL
NOT TO BE USED FOR CONSTRUCTION — A1

Scales	1 : 3000	15-272-C0021.dwg	
		Drawn	MM
		Designed	MM
Height Datum	AHD	Checked	AM
Grid	MGA	Approved	AM

Client: Goodman

Civil Engineers and Project Managers
at&l
Level 7, 153 Walker Street
North Sydney NSW 2060
ABN 96 130 882 405
Tel: 02 9439 1777
Fax: 02 9923 1055
www.atl.net.au
info@atl.net.au

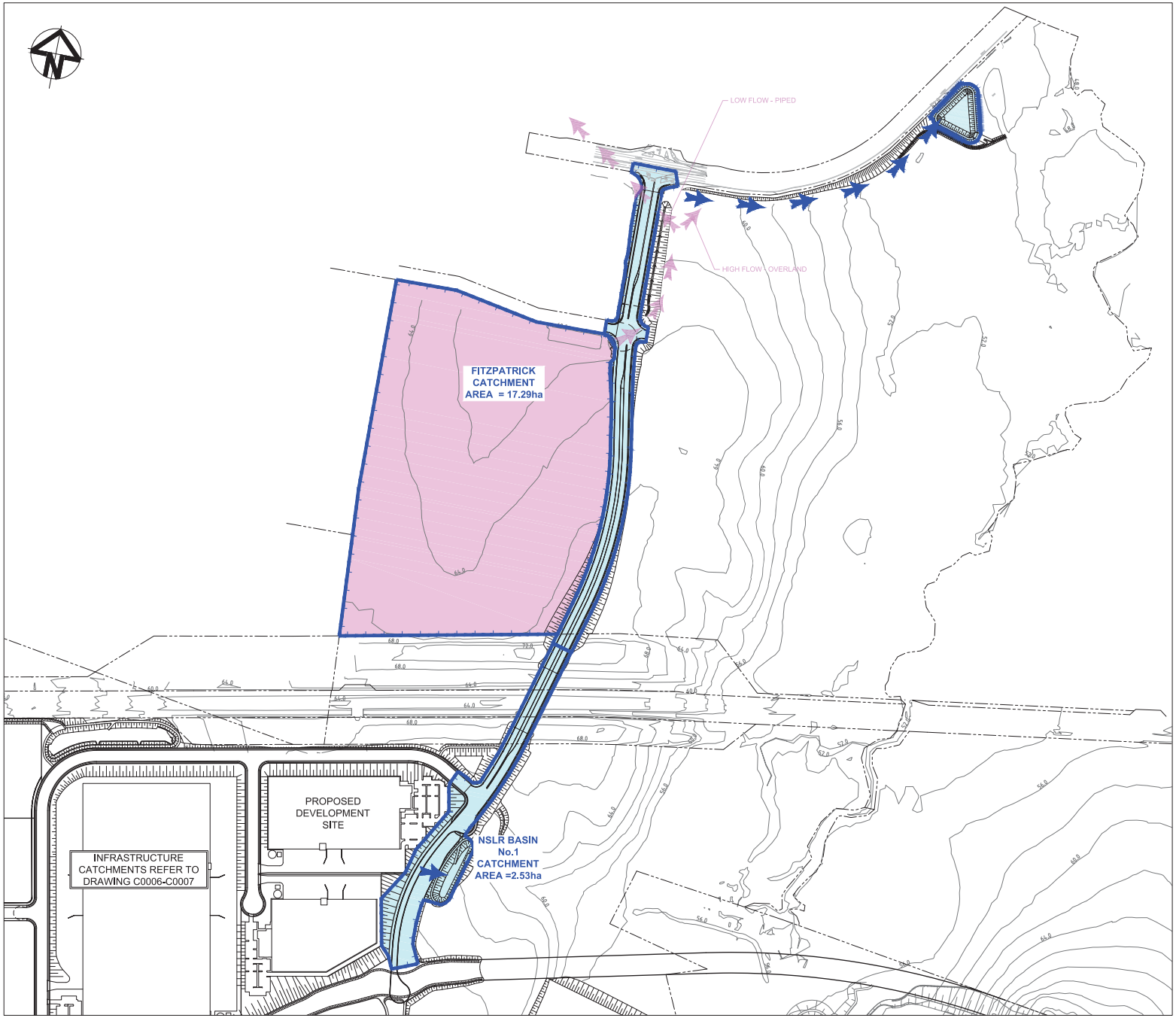
Project
PROPOSED INDUSTRIAL DEVELOPMENT
OAKDALE WEST

Title
NORTH-SOUTH LINK ROAD
STORMWATER DRAINAGE
CATCHMENT PLAN
(PRE-DEVELOPED)

Drawing No.	Project No.	Issue
15-272-C0021	15-272	A1

100mm on Original

Date Plotted: 20 Mar 2017 - 03:03PM File Name: F:\15-272 Oakdale West\Drgs\Civil\Final\0000_Master Plan Concept Package\15-272-C0021.dwg V1



LEGEND

- EXISTING BOUNDARY
- EXISTING EASEMENT
- PROPOSED BOUNDARY
- EXISTING STORMWATER CATCHMENT BOUNDARY
- REDIRECTED FLOW DIRECTION
- STORMWATER CATCHMENT BOUNDARY
- FLOW DIRECTION

Bar Scales

0 50 100 150 200 250

1 : 3000 @ A1

Issue	Description	Date
A1	ISSUED FOR SSD APPROVAL	14-03-17

Status: FOR APPROVAL
NOT TO BE USED FOR CONSTRUCTION — A1

Scales	1 : 3000	15-272-C0022.dwg	
		Drawn	MM
		Designed	MM
Height Datum	AHD	Checked	AM
Grid	MGA	Approved	AM

Client: Goodman

Civil Engineers and Project Managers
at&l
Level 7, 153 Walker Street
North Sydney NSW 2060
ABN 96 130 882 405
Tel: 02 9439 1777
Fax: 02 9923 1055
www.atl.net.au
info@atl.net.au

Project
PROPOSED INDUSTRIAL DEVELOPMENT
OAKDALE WEST

Title
NORTH-SOUTH LINK ROAD
STORMWATER DRAINAGE
CATCHMENT PLAN
(DEVELOPED)

Drawing No.	Project No.	Issue
15-272-C0022	15-272	A1

Appendix B

AT&L – Drawing List of Civil Works

0000 SERIES - MASTER PLAN PACKAGE	
DRAWING No.	DRAWING TITLE
15-272-C0000	COVER SHEET
15-272-C0001	GENERAL ARRANGEMENT MASTER PLAN
15-272-C0002	EXISTING SITE PLAN
15-272-C0003	PRECINCT PLAN
15-272-C0004	INDICATIVE INFRASTRUCTURE / EARTHWORKS STAGING PLAN
15-272-C0005	CUT\FILL PLAN
15-272-C0006	STORMWATER DRAINAGE CATCHMENT PLAN (PRE-DEVELOPED)
15-272-C0007	STORMWATER DRAINAGE CATCHMENT PLAN (DEVELOPED)
15-272-C0008	EROSION AND SEDIMENT CONTROL MASTER PLAN
15-272-C0010	TYPICAL SECTIONS SHEET 1
15-272-C0011	TYPICAL SECTIONS SHEET 2
15-272-C0012	TYPICAL SECTIONS SHEET 3
15-272-C0020	NORTH-SOUTH LINK ROAD GENERAL ARRANGEMENT PLAN
15-272-C0021	NORTH-SOUTH LINK ROAD STORMWATER DRAINAGE CATCHMENT PLAN (PRE-
15-272-C0022	NORTH-SOUTH LINK ROAD STORMWATER DRAINAGE CATCHMENT PLAN
15-272-C0023	NORTH-SOUTH LINK ROAD PROPOSED LAND ACQUISITION PLAN

1000 SERIES - INFRASTRUCTURE PACKAGE	
DRAWING No.	DRAWING TITLE
15-272-C1000	COVER SHEET
15-272-C1001	DRAWING LIST
15-272-C1002	GENERAL NOTES
15-272-C1003	PRECINCT GENERAL ARRANGEMENT PLAN
15-272-C1004	TYPICAL SITE SECTIONS SHEET 1 OF 6
15-272-C1005	TYPICAL SITE SECTIONS SHEET 2 OF 6
15-272-C1006	TYPICAL SITE SECTIONS SHEET 3 OF 6
15-272-C1007	TYPICAL SITE SECTIONS SHEET 4 OF 6
15-272-C1008	TYPICAL SITE SECTIONS SHEET 5 OF 6
15-272-C1009	TYPICAL SITE SECTIONS SHEET 6 OF 6
15-272-C1010	TYPICAL ROAD SECTIONS
15-272-C1011	WESTERN BOUNDARY LAYOUT AND SECTIONS
15-272-C1012	SOUTHERN BOUNDARY LAYOUT AND SECTIONS
15-272-C1014	BULK EARTHWORKS CUT\FILL PLAN
15-272-C1015	EARTHWORKS AND STORMWATER DRAINAGE PLAN SHEET 1 OF 20
15-272-C1016	EARTHWORKS AND STORMWATER DRAINAGE PLAN SHEET 2 OF 20
15-272-C1017	EARTHWORKS AND STORMWATER DRAINAGE PLAN SHEET 3 OF 20
15-272-C1018	EARTHWORKS AND STORMWATER DRAINAGE PLAN SHEET 4 OF 20
15-272-C1019	EARTHWORKS AND STORMWATER DRAINAGE PLAN SHEET 5 OF 20
15-272-C1020	EARTHWORKS AND STORMWATER DRAINAGE PLAN SHEET 6 OF 20
15-272-C1021	EARTHWORKS AND STORMWATER DRAINAGE PLAN SHEET 7 OF 20
15-272-C1022	EARTHWORKS AND STORMWATER DRAINAGE PLAN SHEET 8 OF 20
15-272-C1023	EARTHWORKS AND STORMWATER DRAINAGE PLAN SHEET 9 OF 20
15-272-C1024	EARTHWORKS AND STORMWATER DRAINAGE PLAN SHEET 10 OF 20
15-272-C1025	EARTHWORKS AND STORMWATER DRAINAGE PLAN SHEET 11 OF 20
15-272-C1026	EARTHWORKS AND STORMWATER DRAINAGE PLAN SHEET 12 OF 20

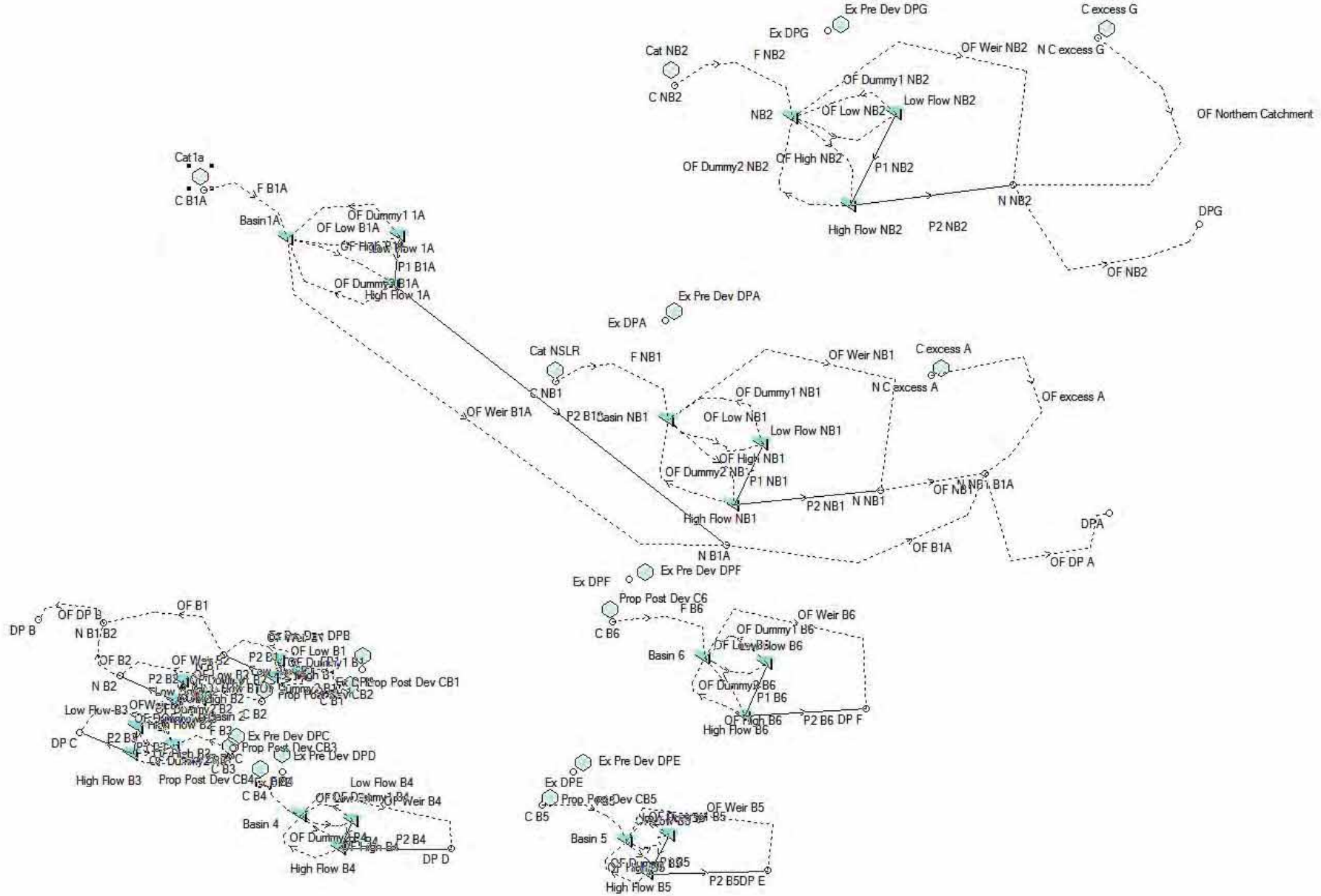
15-272-C1027	EARTHWORKS AND STORMWATER DRAINAGE PLAN SHEET 13 OF 20
15-272-C1028	EARTHWORKS AND STORMWATER DRAINAGE PLAN SHEET 14 OF 20
15-272-C1029	EARTHWORKS AND STORMWATER DRAINAGE PLAN SHEET 15 OF 20
15-272-C1030	EARTHWORKS AND STORMWATER DRAINAGE PLAN SHEET 16 OF 20
15-272-C1031	EARTHWORKS AND STORMWATER DRAINAGE PLAN SHEET 17 OF 20
15-272-C1032	EARTHWORKS AND STORMWATER DRAINAGE PLAN SHEET 18 OF 20
15-272-C1033	EARTHWORKS AND STORMWATER DRAINAGE PLAN SHEET 19 OF 20
15-272-C1034	EARTHWORKS AND STORMWATER DRAINAGE PLAN SHEET 20 OF 20
15-272-C1040	ROADWORKS AND STORMWATER DRAINAGE PLAN SHEET 1 OF 8
15-272-C1041	ROADWORKS AND STORMWATER DRAINAGE PLAN SHEET 2 OF 8
15-272-C1042	ROADWORKS AND STORMWATER DRAINAGE PLAN SHEET 3 OF 8
15-272-C1043	ROADWORKS AND STORMWATER DRAINAGE PLAN SHEET 4 OF 8
15-272-C1044	ROADWORKS AND STORMWATER DRAINAGE PLAN SHEET 5 OF 8
15-272-C1045	ROADWORKS AND STORMWATER DRAINAGE PLAN SHEET 6 OF 8
15-272-C1046	ROADWORKS AND STORMWATER DRAINAGE PLAN SHEET 7 OF 8
15-272-C1047	ROADWORKS AND STORMWATER DRAINAGE PLAN SHEET 8 OF 8
15-272-C1050	ROAD LONGITUDINAL SECTIONS SHEET 1 OF 5
15-272-C1051	ROAD LONGITUDINAL SECTIONS SHEET 2 OF 5
15-272-C1052	ROAD LONGITUDINAL SECTIONS SHEET 3 OF 5
15-272-C1053	ROAD LONGITUDINAL SECTIONS SHEET 4 OF 5
15-272-C1054	ROAD LONGITUDINAL SECTIONS SHEET 5 OF 5
15-272-C1060	BIO-RETENTION BASIN No.1 DETAIL PLAN SHEET 1 OF 2
15-272-C1061	BIO-RETENTION BASIN No.1 DETAIL PLAN SHEET 2 OF 2
15-272-C1062	BIO-RETENTION BASIN No.1A DETAIL PLAN
15-272-C1065	STORMWATER DRAINAGE CATCHMENT PLAN (PRE-DEVELOPED)
15-272-C1066	STORMWATER DRAINAGE CATCHMENT PLAN (POST-DEVELOPED)
15-272-C1070	RETAINING WALL GENERAL ARRANGEMENT PLAN
15-272-C1071	RETAINING WALL PROFILES SHEET 1 OF 6
15-272-C1072	RETAINING WALL PROFILES SHEET 2 OF 6
15-272-C1073	RETAINING WALL PROFILES SHEET 3 OF 6
15-272-C1074	RETAINING WALL PROFILES SHEET 4 OF 6
15-272-C1075	RETAINING WALL PROFILES SHEET 5 OF 6
15-272-C1076	RETAINING WALL PROFILES SHEET 6 OF 6
15-272-C1080	SERVICES AND UTILITIES COORDINATION PLAN SHEET 1 OF 6
15-272-C1081	SERVICES AND UTILITIES COORDINATION PLAN SHEET 2 OF 6
15-272-C1082	SERVICES AND UTILITIES COORDINATION PLAN SHEET 3 OF 6
15-272-C1083	SERVICES AND UTILITIES COORDINATION PLAN SHEET 4 OF 6
15-272-C1084	SERVICES AND UTILITIES COORDINATION PLAN SHEET 5 OF 6
15-272-C1085	SERVICES AND UTILITIES COORDINATION PLAN SHEET 6 OF 6
15-272-C1086	EXISTING TRANSGRID OVERHEAD ELECTRICAL CABLES PLAN
15-272-C1087	EXISTING TRANSGRID OVERHEAD ELECTRICAL CABLES LONGITUDINAL SECTIONS
15-272-C1088	EXISTING TRANSGRID OVERHEAD ELECTRICAL CABLES TYPICAL SECTIONS SHEET 1 OF
15-272-C1089	EXISTING TRANSGRID OVERHEAD ELECTRICAL CABLES TYPICAL SECTIONS SHEET 2 OF
15-272-C1090	EROSION AND SEDIMENT CONTROL PLAN SHEET 1 OF 6
15-272-C1091	EROSION AND SEDIMENT CONTROL PLAN SHEET 2 OF 6
15-272-C1092	EROSION AND SEDIMENT CONTROL PLAN SHEET 3 OF 6
15-272-C1093	EROSION AND SEDIMENT CONTROL PLAN SHEET 4 OF 6
15-272-C1094	EROSION AND SEDIMENT CONTROL PLAN SHEET 5 OF 6

15-272-C1095	EROSION AND SEDIMENT CONTROL PLAN SHEET 6 OF 6
15-272-C1096	EROSION AND SEDIMENT CONTROL DETAILS

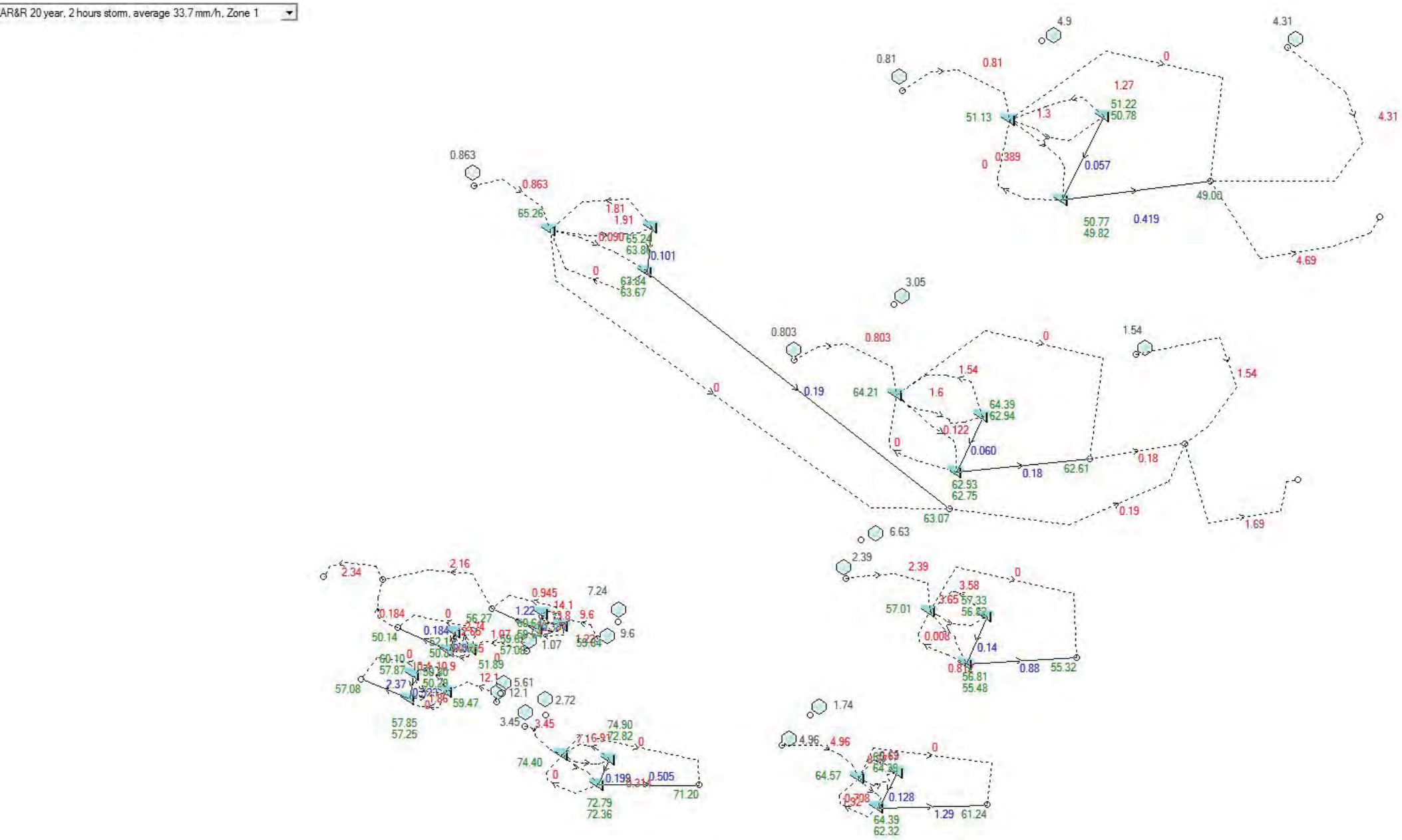
2000 SERIES - STAGE 1 ON-LOT PACKAGE	
DRAWING No.	DRAWING TITLE
15-272-C2000	COVER SHEET
15-272-C2001	DRAWING LIST
15-272-C2002	GENERAL NOTES
15-272-C2003	GENERAL ARRANGEMENT PLAN
15-272-C2010	SITEWORKS AND STORMWATER DRAINAGE PLAN SHEET 1 OF 15
15-272-C2011	SITEWORKS AND STORMWATER DRAINAGE PLAN SHEET 2 OF 15
15-272-C2012	SITEWORKS AND STORMWATER DRAINAGE PLAN SHEET 3 OF 15
15-272-C2013	SITEWORKS AND STORMWATER DRAINAGE PLAN SHEET 4 OF 15
15-272-C2014	SITEWORKS AND STORMWATER DRAINAGE PLAN SHEET 5 OF 15
15-272-C2015	SITEWORKS AND STORMWATER DRAINAGE PLAN SHEET 6 OF 15
15-272-C2016	SITEWORKS AND STORMWATER DRAINAGE PLAN SHEET 7 OF 15
15-272-C2017	SITEWORKS AND STORMWATER DRAINAGE PLAN SHEET 8 OF 15
15-272-C2018	SITEWORKS AND STORMWATER DRAINAGE PLAN SHEET 9 OF 15
15-272-C2019	SITEWORKS AND STORMWATER DRAINAGE PLAN SHEET 10 OF 15
15-272-C2020	SITEWORKS AND STORMWATER DRAINAGE PLAN SHEET 11 OF 15
15-272-C2021	SITEWORKS AND STORMWATER DRAINAGE PLAN SHEET 12 OF 15
15-272-C2022	SITEWORKS AND STORMWATER DRAINAGE PLAN SHEET 13 OF 15
15-272-C2023	SITEWORKS AND STORMWATER DRAINAGE PLAN SHEET 14 OF 15
15-272-C2024	SITEWORKS AND STORMWATER DRAINAGE PLAN SHEET 15 OF 15
15-272-C2030	PAVEMENT PLAN

Appendix C

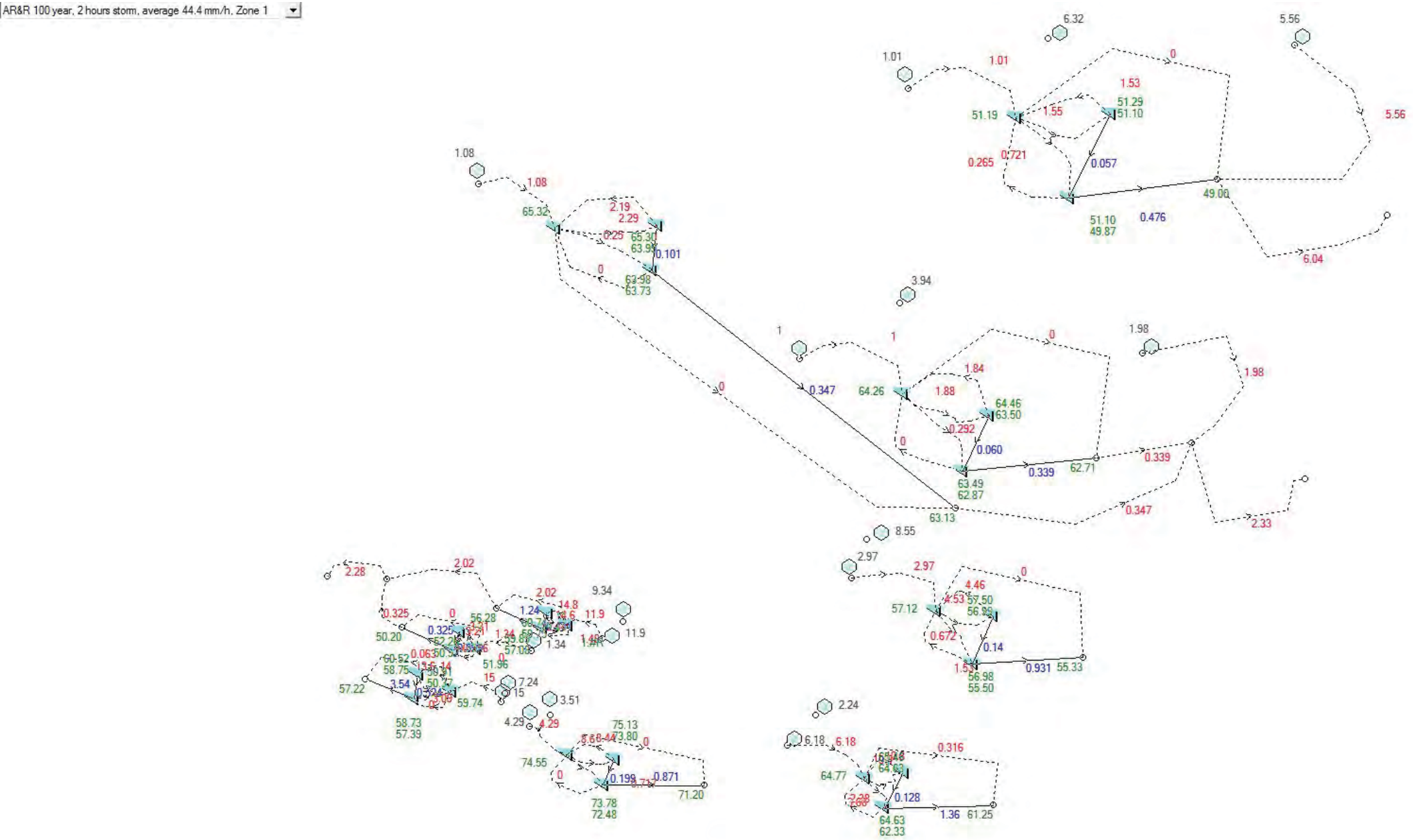
DRAINs Model


Ex Pre Dev DPG
Ex DPG
C excess G
Cat NB2
F NB2
OF Weir NB2
N C excess G
C NB2
OF Dummy1 NB2
Low Flow NB2
OF Low NB2
NB2
OF Northern Catchment
OF Dummy2 NB2
OF High NB2
P1 NB2
N NB2
High Flow NB2
P2 NB2
DPG
OF NB2
Cat 1a
C B1A
F B1A
Basin 1A
OF Dummy1 1A
OF Low B1A
P1 B1A
High Flow 1A
Ex Pre Dev DPA
Ex DPA
Cat NSLR
F NB1
OF Weir NB1
C excess A
C NB1
N C excess A
OF excess A
OF Weir B1A
P2 B1
Basin NB1
OF Dummy1 NB1
OF Low NB1
Low Flow NB1
OF High NB1
OF Dummy2 NB1
P1 NB1
N NB1
OF NB1
N NB1 B1A
P2 NB1
High Flow NB1
DPA
N B1A
OF B1A
OF DP A
Ex DPF
Ex Pre Dev DPF
Prop Post Dev C6
F B6
OF Weir B6
C B6
OF Dummy1 B6
OF Low B6
Low Flow B6
Basin 6
OF Dummy2 B6
P1 B6
OF High B6
P2 B6 DP F
High Flow B6
Ex Pre Dev DPE
Ex DPE
Prop Post Dev CB5
C B5
OF Weir B5
Basin 5
P2 B5
High Flow B5
P2 B5DP E
DP B
OF DP B
OF B1
N B1 B2
OF B2
OF Weir B2
N B2
Low Flow-B3
DP C
P2 B3
High Flow B3
Prop Post Dev CB4
C B3
C B4
Low Flow B4
OF Weir B4
Basin 4
P2 B4
DP D
High Flow B4

AR&R 20 year, 2 hours storm, average 33.7 mm/h, Zone 1

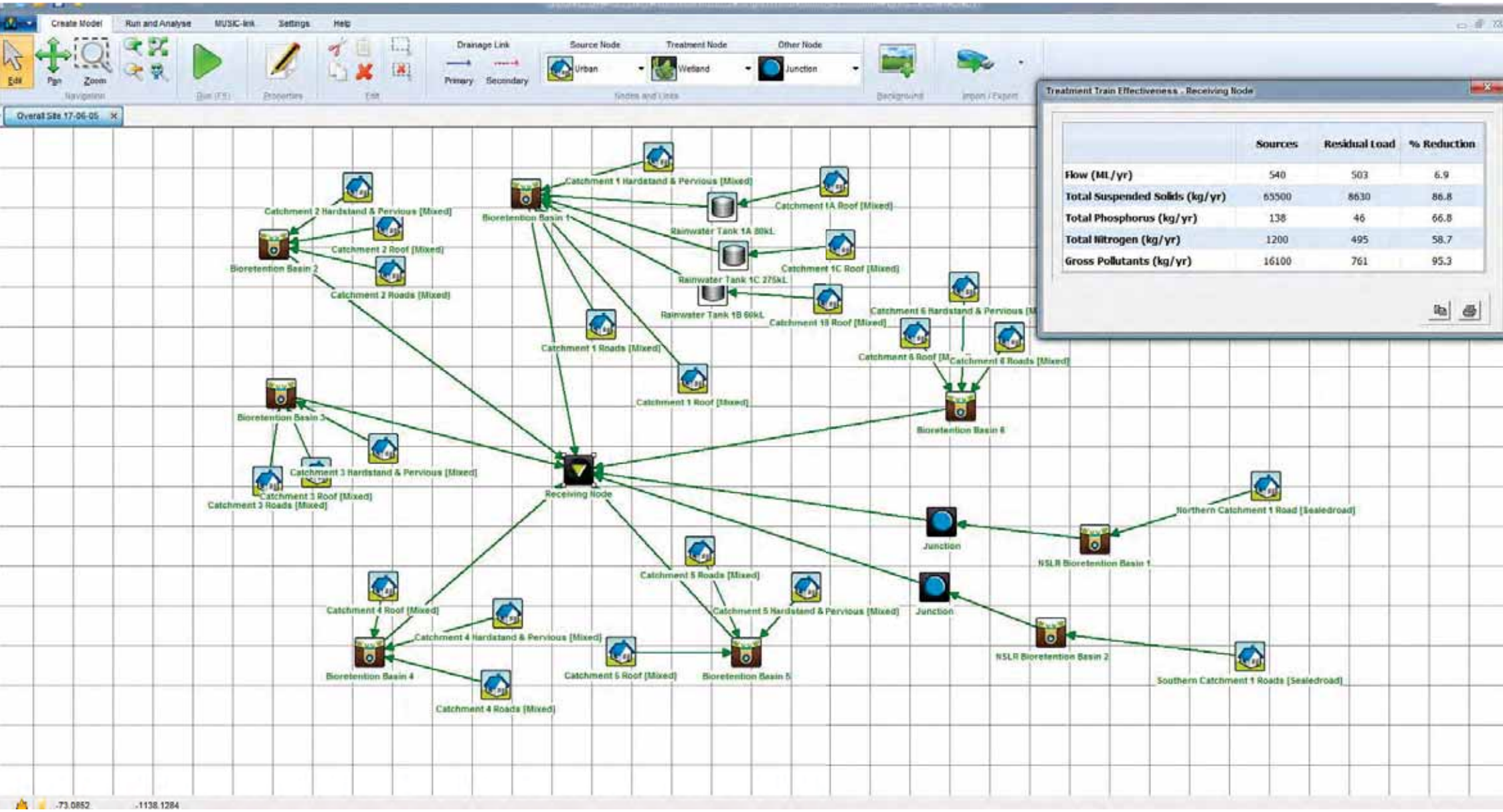


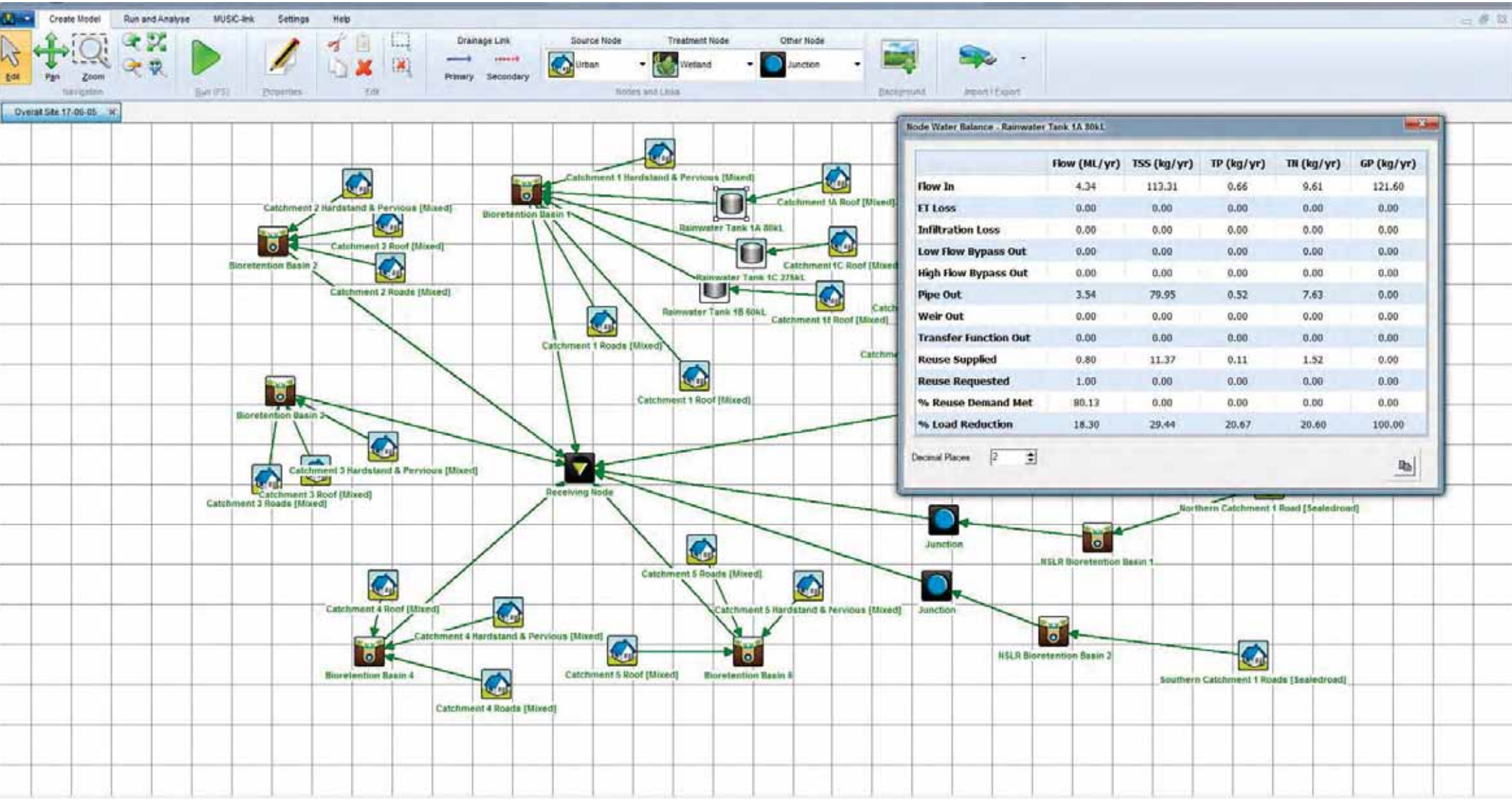
AR&R 100 year, 2 hours storm, average 44.4 mm/h, Zone 1

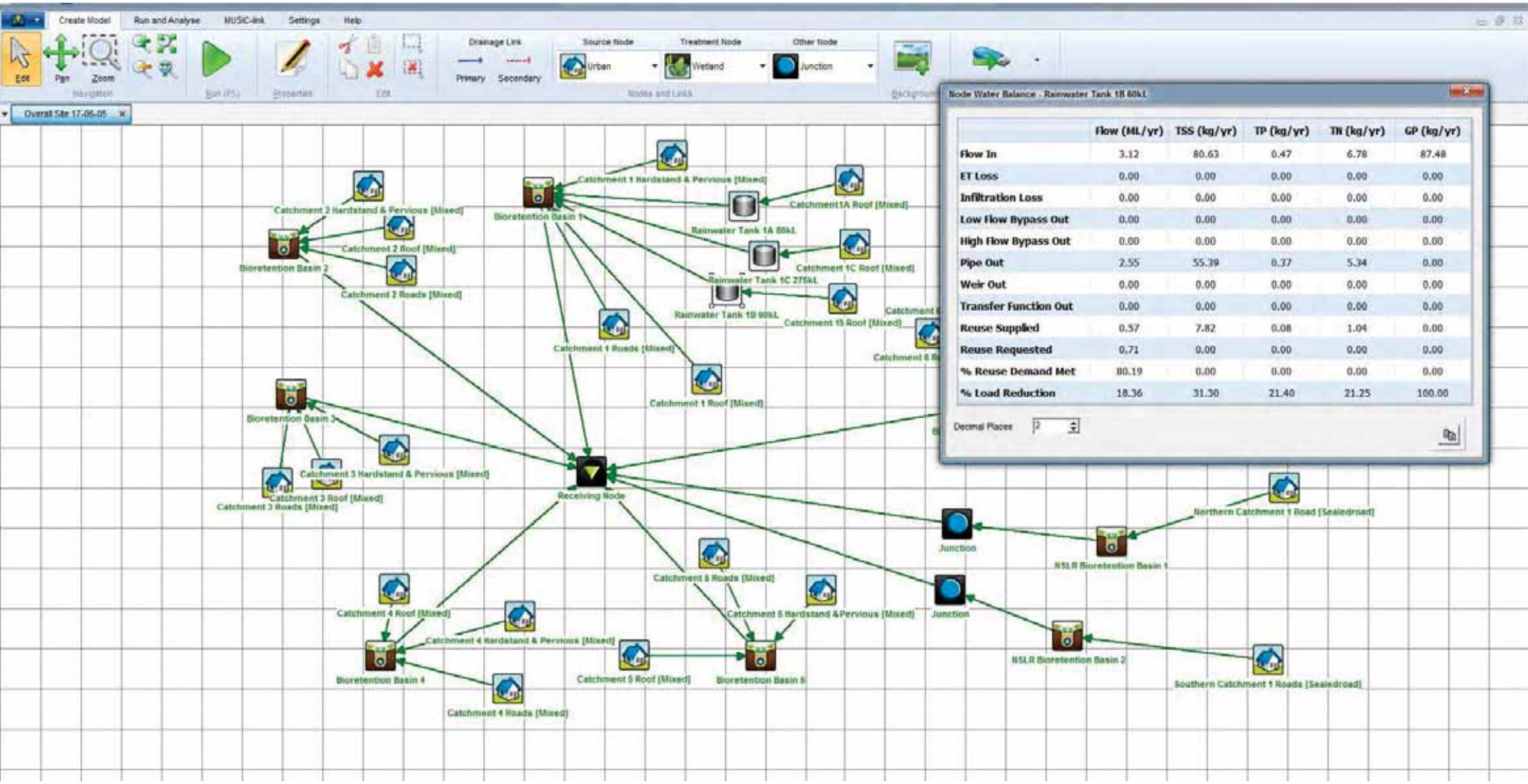


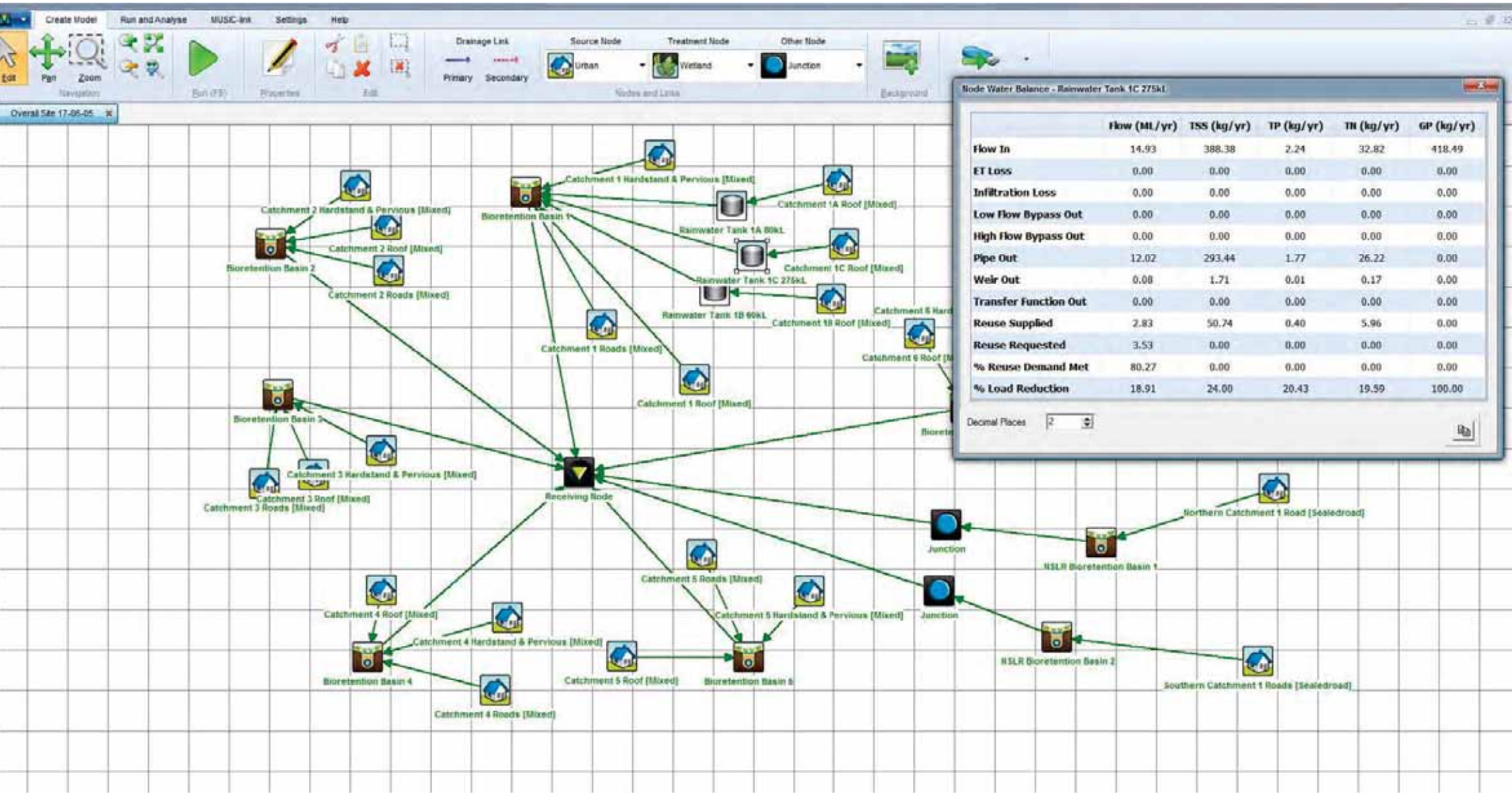
Appendix D

MUSIC Model & Results


Create Model
Run and Analyse
MUSIC-link
Settings
Help
Edit
Pan
Zoom
Navigation
Run (F5)
Properties
Edit
Drainage Link
Primary
Secondary
Source Node
Urban
Treatment Node
Wetland
Other Node
Junction
Nodes and Links
Background
Import / Export
Overall Site 17-06-05
Treatment Train Effectiveness - Receiving Node
Sources
Residual Load
% Reduction
Flow (ML/yr) 540 503 6.9
Total Suspended Solids (kg/yr) 65500 8630 86.8
Total Phosphorus (kg/yr) 138 46 66.8
Total Nitrogen (kg/yr) 1200 495 58.7
Gross Pollutants (kg/yr) 16100 761 95.3
Catchment 1 Hardstand & Pervious [Mixed]
Catchment 1A Roof [Mixed]
Bioretention Basin 1
Rainwater Tank 1A 80kL
Catchment 2 Hardstand & Pervious [Mixed]
Catchment 2 Roof [Mixed]
Bioretention Basin 2
Catchment 2 Roads [Mixed]
Catchment 1C Roof [Mixed]
Rainwater Tank 1C 275kL
Rainwater Tank 1B 60kL
Catchment 1B Roof [Mixed]
Catchment 6 Hardstand & Pervious [M
Catchment 1 Roads [Mixed]
Catchment 6 Roof [M
Catchment 6 Roads [Mixed]
Catchment 1 Roof [Mixed]
Bioretention Basin 6
Bioretention Basin 3
Catchment 3 Hardstand & Pervious [Mixed]
Catchment 3 Roof [Mixed]
Catchment 3 Roads [Mixed]
Receiving Node
Northern Catchment 1 Road [Sealedroad]
Junction
NSLR Bioretention Basin 1
Catchment 5 Roads [Mixed]
Catchment 4 Roof [Mixed]
Catchment 5 Hardstand & Pervious [Mixed]
Junction
Catchment 4 Hardstand & Pervious [Mixed]
NSLR Bioretention Basin 2
Bioretention Basin 4
Catchment 5 Roof [Mixed]
Bioretention Basin 5
Southern Catchment 1 Roads [Sealedroad]
Catchment 4 Roads [Mixed]
-73.0852
-1138.1284


Create Model
Run and Analyse
MUSIC-link
Settings
Help
Drainage Link
Primary
Secondary
Source Node
Urban
Treatment Node
Wetland
Other Node
Junction
Overall Site 17-06-05
Node Water Balance - Rainwater Tank 1A 80kL
Flow (ML/yr) TSS (kg/yr) TP (kg/yr) TN (kg/yr) GP (kg/yr)
Flow In 4.34 113.31 0.66 9.61 121.60
ET Loss 0.00 0.00 0.00 0.00 0.00
Infiltration Loss 0.00 0.00 0.00 0.00 0.00
Low Flow Bypass Out 0.00 0.00 0.00 0.00 0.00
High Flow Bypass Out 0.00 0.00 0.00 0.00 0.00
Pipe Out 3.54 79.95 0.52 7.63 0.00
Weir Out 0.00 0.00 0.00 0.00 0.00
Transfer Function Out 0.00 0.00 0.00 0.00 0.00
Reuse Supplied 0.80 11.37 0.11 1.52 0.00
Reuse Requested 1.00 0.00 0.00 0.00 0.00
% Reuse Demand Met 80.13 0.00 0.00 0.00 0.00
% Load Reduction 18.30 29.44 20.67 20.60 100.00
Decimal Places
Catchment 1 Hardstand & Pervious [Mixed]
Catchment 1A Roof [Mixed]
Bioretention Basin 1
Rainwater Tank 1A 80kL
Catchment 2 Hardstand & Pervious [Mixed]
Catchment 3 Roof [Mixed]
Bioretention Basin 2
Catchment 2 Roads [Mixed]
Catchment 1C Roof [Mixed]
Rainwater Tank 1C 275kL
Rainwater Tank 1B 60kL
Catchment 1B Roof [Mixed]
Catchment 1 Roads [Mixed]
Catchment 1 Roof [Mixed]
Bioretention Basin 3
Catchment 3 Hardstand & Pervious [Mixed]
Catchment 3 Roof [Mixed]
Catchment 3 Roads [Mixed]
Receiving Node
Junction
Northern Catchment 1 Road [Sealedroad]
NSLR Bioretention Basin 1
Catchment 5 Roads [Mixed]
Catchment 4 Roof [Mixed]
Catchment 5 Hardstand & Pervious [Mixed]
Junction
Catchment 4 Hardstand & Pervious [Mixed]
NSLR Bioretention Basin 2
Bioretention Basin 4
Catchment 5 Roof [Mixed]
Bioretention Basin 5
Southern Catchment 1 Roads [Sealedroad]
Catchment 4 Roads [Mixed]


Create Model
Run and Analyse
MUSIC-link
Settings
Help
Edit
Pan
Zoom
Navigation
Run (F5)
Properties
Edit
Drainage Link
Primary
Secondary
Source Node
Urban
Treatment Node
Wetland
Other Node
Junction
Nodes and Links
Background
Overall Site 17-06-05
Node Water Balance - Rainwater Tank 1B 60kL
Flow (ML/yr) TSS (kg/yr) TP (kg/yr) TN (kg/yr) GP (kg/yr)
Flow In 3.12 80.63 0.47 6.78 87.48
ET Loss 0.00 0.00 0.00 0.00 0.00
Infiltration Loss 0.00 0.00 0.00 0.00 0.00
Low Flow Bypass Out 0.00 0.00 0.00 0.00 0.00
High Flow Bypass Out 0.00 0.00 0.00 0.00 0.00
Pipe Out 2.55 55.39 0.37 5.34 0.00
Weir Out 0.00 0.00 0.00 0.00 0.00
Transfer Function Out 0.00 0.00 0.00 0.00 0.00
Reuse Supplied 0.57 7.82 0.08 1.04 0.00
Reuse Requested 0.71 0.00 0.00 0.00 0.00
% Reuse Demand Met 80.19 0.00 0.00 0.00 0.00
% Load Reduction 18.36 31.30 21.40 21.25 100.00
Decimal Places
Catchment 1 Hardstand & Pervious [Mixed]
Catchment 2 Hardstand & Pervious [Mixed]
Bioretention Basin 1
Catchment1A Roof [Mixed]
Rainwater Tank 1A 60kL
Catchment 2 Roof [Mixed]
Bioretention Basin 2
Catchment 1C Roof [Mixed]
Rainwater Tank 1C 275kL
Catchment 2 Roads [Mixed]
Rainwater Tank 1B 60kL
Catchment 1B Roof [Mixed]
Catchment 1 Roads [Mixed]
Catchment 1 Roof [Mixed]
Bioretention Basin 3
Catchment 3 Hardstand & Pervious [Mixed]
Catchment 3 Roof [Mixed]
Catchment 3 Roads [Mixed]
Receiving Node
Junction
Northern Catchment 1 Road [Sealedroad]
NSLR Bioretention Basin 1
Catchment 5 Roads [Mixed]
Catchment 4 Roof [Mixed]
Catchment 5 Hardstand & Pervious [Mixed]
Junction
Catchment 4 Hardstand & Pervious [Mixed]
NSLR Bioretention Basin 2
Bioretention Basin 4
Catchment 5 Roof [Mixed]
Bioretention Basin 5
Southern Catchment 1 Roads [Sealedroad]
Catchment 4 Roads [Mixed]


Create Model
Run and Analyse
MUSIC-link
Settings
Help
Edit
Pan
Zoom
Navigation
Run (F5)
Properties
Edit
Drainage Link
Primary
Secondary
Source Node
Urban
Treatment Node
Wetland
Other Node
Junction
Nodes and Links
Background
Overall Site 17-06-05
Node Water Balance - Rainwater Tank 1C 275kL
Flow (ML/yr) TSS (kg/yr) TP (kg/yr) TN (kg/yr) GP (kg/yr)
Flow In 14.93 388.38 2.24 32.82 418.49
ET Loss 0.00 0.00 0.00 0.00 0.00
Infiltration Loss 0.00 0.00 0.00 0.00 0.00
Low Flow Bypass Out 0.00 0.00 0.00 0.00 0.00
High Flow Bypass Out 0.00 0.00 0.00 0.00 0.00
Pipe Out 12.02 293.44 1.77 26.22 0.00
Weir Out 0.08 1.71 0.01 0.17 0.00
Transfer Function Out 0.00 0.00 0.00 0.00 0.00
Reuse Supplied 2.83 50.74 0.40 5.96 0.00
Reuse Requested 3.53 0.00 0.00 0.00 0.00
% Reuse Demand Met 80.27 0.00 0.00 0.00 0.00
% Load Reduction 18.91 24.00 20.43 19.59 100.00
Decimal Places 2
Catchment 1 Hardstand & Pervious [Mixed]
Catchment 1A Roof [Mixed]
Bioretention Basin 1
Rainwater Tank 1A 60kL
Catchment 2 Hardstand & Pervious [Mixed]
Catchment 2 Roof [Mixed]
Bioretention Basin 2
Catchment 1C Roof [Mixed]
Rainwater Tank 1C 275kL
Catchment 2 Roads [Mixed]
Rainwater Tank 1B 60kL
Catchment 1B Roof [Mixed]
Catchment 1 Roads [Mixed]
Catchment 6 Roof
Catchment 1 Roof [Mixed]
Bioretention Basin 3
Catchment 3 Hardstand & Pervious [Mixed]
Catchment 3 Roof [Mixed]
Catchment 3 Roads [Mixed]
Receiving Node
Junction
Northern Catchment 1 Road [Sealedroad]
NSLR Bioretention Basin 1
Catchment 5 Roads [Mixed]
Catchment 4 Roof [Mixed]
Catchment 5 Hardstand & Pervious [Mixed]
Junction
Catchment 4 Hardstand & Pervious [Mixed]
NSLR Bioretention Basin 2
Bioretention Basin 4
Catchment 5 Roof [Mixed]
Bioretention Basin 5
Southern Catchment 1 Roads [Sealedroad]
Catchment 4 Roads [Mixed]

Appendix E

Proposed Service Strategy Drawings

Section	Description	Delivery Date	Capital Cost ($M)
1-2	4.0 km DN450	Constructed	NA
2-3	0.35 km DN250	Constructed	NA
3-4	1.2 km DN250	Constructed	NA
2-4	1.2 km DN300	2016-2017	$2.21 M
4-5	0.9 km DN250	2016-2017	$1.34 M
5-6	0.85 km DN200	2016-2017	$1.08 M
4-7	0.7 km DN300	2017-2018	$ 1.31 M
7-8	1.2 km DN300	2018-2019	$2.21 M
8-9	1.6 km DN300	2018-2019	$2.93 M

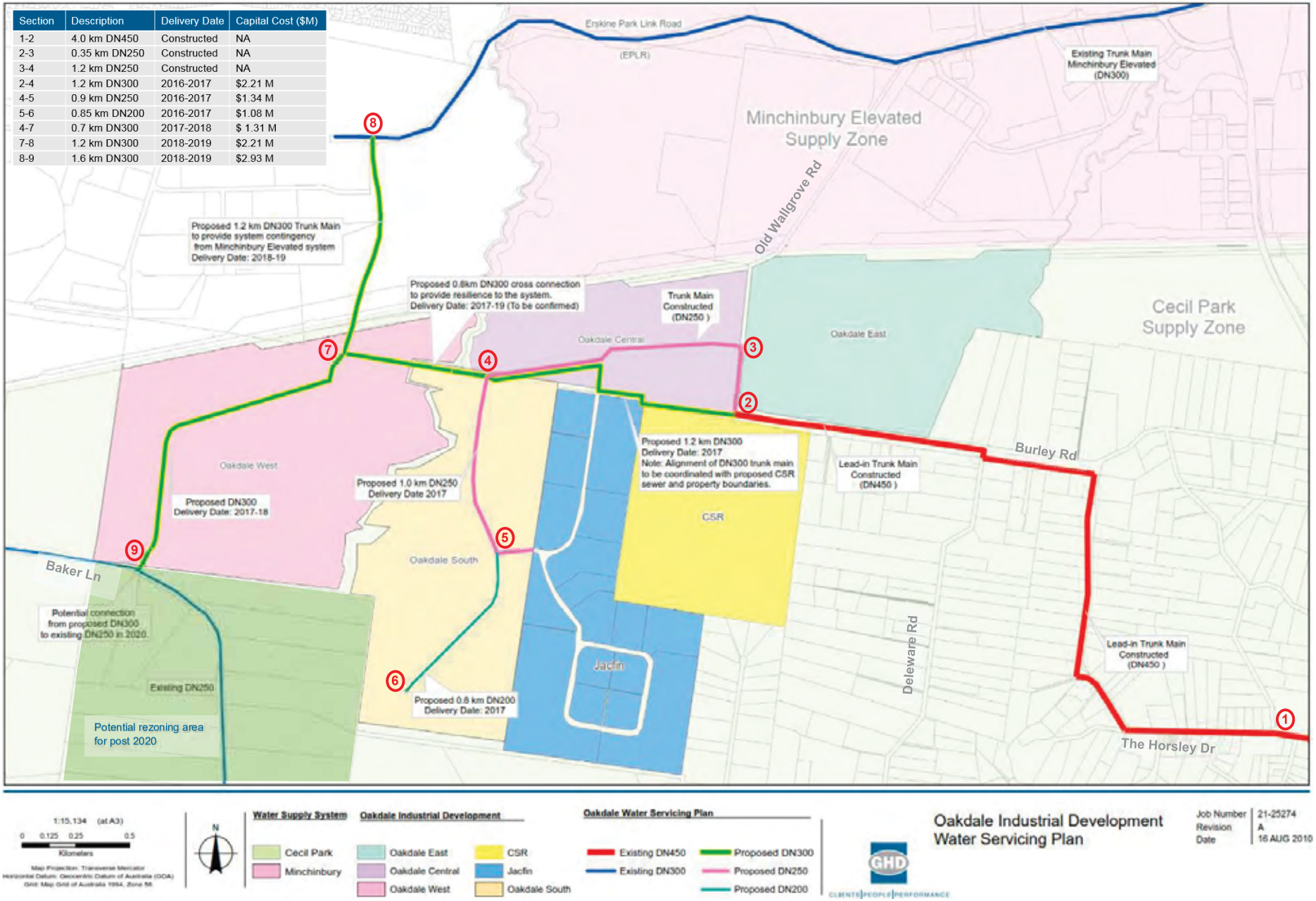


Figure 2- Oakdale Industrial Water Servicing Plan