WATER CYCLE AND STORMWATER MANAGEMENT STRATEGY

FOR

20-24 LOCKYER STREET, GOULBURN

INDUSTRIAL REZONING OF THE LAND

REPORT NO. R02714-WCSMS
REVISION C

OCTOBER 2023

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PROJECT DETAILS

Property Address: 20-24 Lockyer Street, Goulburn

Development Proposal: Industrial Rezoning of the Land

REPORT CERTIFICATION

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DOCUMENT CONTROL

REVISION	ISSUE DATE	ISSUED TO	ISSUED FOR
A	24 AUGUST 2023	CLIENT	INFORMATION
B	30 AUGUST 2023	CLIENT	INFORMATION
C	18 OCTOBER 2023	CLIENT	INFORMATION

EXECUTIVE SUMMARY

This Water Cycle and Stormwater Management Strategy has been prepared to support the application for rezoning of the subject site.

In summary, the stormwater management works required for the proposed development will generally comprise the following:

1. A pipe network system to collect minor storm runoff from surface areas which will minimise nuisance flooding;

2. On-site stormwater detention system(s) to detain storm flows so that they can be slowly released over time. The On-site Stormwater Detention system was designed to satisfy Site Storage Requirements (SSR) & Permitted Site Discharge (PSD) rates provided by Council. This will assist with maintaining environmental flows and reduce the likelihood of scouring and instability within downstream waterways;

3. Bio-retention basin(s) to provide significant water quality treatment to runoff from impervious areas while at the same time providing some stormwater detention;

4. OceanGuards (OceanProtect) installed in all surface inlet pits (109) to form part of the water quality treatment train, removing pollutants and nutrients that are detrimental to downstream waterways;

5. 1 x Ocean Protect ‘Jellyfish’ JF3250-28-5 and 1 x JF2250-6-1 to further treat stormwater.

6. Overland flow paths (such as roads and swales) to carry major storms through the site without causing damage to property from flooding.

The results from the investigations and modelling for this project that have been summarised in this report, indicate that the proposed works with the proposed WSUD Neutral or Beneficial Effect (NorBE) strategy and management can help provide a safe and ecologically sustainable environment.

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1. INTRODUCTION

1.1 Background

This water cycle and stormwater management strategy (the strategy) has been prepared to support a planning proposal for the subject site known as 20-24 Lockyer Street, Goulburn. The planning proposal seeks to rezone the land to E4 General Industrial under the Goulburn Mulwaree Local Environmental Plan 2009 and to introduce a new minimum 1-hectare lot size requirement.

The scope of this report includes a comprehensive assessment of the likely stormwater management requirements for any future proposed development. Accordingly, this report includes findings of the assessment and proposes a best practice stormwater management strategy.

The report describes the principles and operation of the proposed stormwater systems as well as the primary components of the drainage system.

The following information and documents were utilised in this report:

- Preliminary Civil Engineering Drawings for the Development Application submission prepared by C&M Consulting Engineers;
- Architectural concept sketch by ReidCampbell Architecture, Interiors, Project Management;
- WaterNSW – Using MUSIC in Sydney Drinking Water Catchment, 2019
- Goulburn Mulwaree Council – Stormwater Drainage & Rainwater Collection Systems Policy;
- Goulburn Mulwaree Council – Stormwater Drainage Design Handbook (2020) Section 7 – Onsite Stormwater Detention;
- “Australian Runoff Quality – A Guide to Water Sensitive Urban Design”, Engineers Australia (2006);
- “Australian Rainfall and Runoff – A Guide to Flood Estimation”, Institute of Engineers, Australia (1987).

The increase in impervious areas and alteration of the natural topography due to land development has the potential to increase and concentrate peak storm flows. This has the potential to impact on flow regimes and cause erosion of the downstream drainage network and associated waterways.

To avoid any adverse impact on the downstream drainage systems, the site stormwater management system must be designed to achieve NorBE, ensure the safe conveyance of flows through the site and within the capacity of the downstream trunk drainage systems in a healthy environmental state for Ecological Sustainable Development.

1.2 The Site

The site is located at 20-24 Lockyer Street, Goulburn. It is bound by Lockyer Street to the North-West, and by undeveloped Greenland in all other directions. The site currently comprises of vacant land (Refer to **Figure 1**).

Figure 1 - Aerial Photo of Existing Site
(Source: sixmaps)

The generally slopes to the south-east towards the existing creek. The indicative concept scheme involves the rezoning of the existing property for industrial purposes including earthworks, driveways, carparking and drainage.

1.3 Key Issues

The key issues to be addressed in this report include:

- **Water Quantity** – Increases in impervious areas as a result of development (such as roofs, driveways, etc) has the potential to increase stormwater flows from the site during storm events. To avoid impacting on the site and downstream properties, the site stormwater system must be designed to safely convey flows through the site and within the capacity of the downstream drainage system.

- **Water Quality** – Urban developments have the potential to increase gross pollutants, sediments and nutrient concentrations in storm water runoff. To limit the impact on the downstream water quality, pollution control measures to achieve NorBE will be provided within the sites

stormwater management system prior to discharging into the drainage network.

2. RELEVANT GUIDELINES

2.1 Design Guidelines

The site-based stormwater management and planning elements are to be designed and constructed in accordance with the following:

Water Quantity

Guidelines: Goulburn Mulwaree Council – Stormwater Drainage Design Handbook (2020) Section 7 – Onsite Stormwater Detention

The proposed development increases the total impervious area of the existing site and therefore will increase the discharge rate to the downstream drainage network and waterways. The main objective is to achieve a natural water balance using rates nominated by the local authority – Goulburn Mulwaree Council as well as controlling erosion and sediment removal. Therefore, stormwater detention is required as part of the development on this site.

Water Quality

Guidelines: Goulburn Mulwaree Council – Stormwater Drainage & Rainwater Collection Systems Policy

The main objective for stormwater quality is to minimise the impacts on downstream water bodies. Goulburn Mulwaree Council has adopted a stormwater management policy that incorporates “best practice” principles of Water Sensitive Urban Design. As nearly all the council land is within the Sydney Drinking Water Catchment, any development must achieve a Neutral or Beneficial Effect (NorBE) on water quality.

2.2 Objectives and Targets

Compatible with the legislation, policy and requirements, the objectives and targets for stormwater management are as provided in Table 1.

Table 1 - Stormwater Management Objectives

STORMWATER MANAGEMENT	OBJECTIVES	TARGET
Quantity	▪ The existing runoff flow regimes for the full storm events should be maintained and provide safe conveyance system for the major storm events. ▪ The existing runoff from the external catchment be safely mitigated through the site.	▪ Maintain/ Improve existing runoff from development: – Provide safe flood mitigation measures to minimise any impact on the site, and – No adverse impact on downstream properties. – Limit post development stormwater flows discharging from the site to that of the pre developed site and/or at a rate nominated to be acceptable by the local Authority.
Quality	▪ The full range of typical urban stormwater pollutants shall meet Council requirements.	▪ Runoff from site is to achieve a Neutral or Beneficial Effect (NorBE) when comparing pre and post development annual pollutant loads for stormwater runoff quality

2.3 Overall Strategies

The proposed stormwater management strategies to manage runoff and ensure no detriment to the receiving environments have been divided into both short and long term strategies are summarised in Table 2.

Table 2 - Stormwater Management Strategies

STRATEGY	DESCRIPTION
Short Term Strategies	Short term strategies generally refer to control of soil and water erosion during the construction phase. The primary risk occurs while soils are exposed during construction works when suspended sediment and associated pollutants can be washed into downstream waterways. The strategies to prevent this potential degradation include adequate provision of sediment and erosion control measures that should be documented prior to commencement of the works in a Soil and Water Management Plan (SWMP). The controls will limit movement of sediment in disturbed areas and will be designed to remove sediment from runoff prior to discharge from site.
Long Term Strategies	Long term strategies to maintain stormwater quality discharged from the site include utilisation of a number of permanent treatment measures to remove litter, suspended solids, and nutrients effectively. The main measures to be implemented are Rainwater Reuse, Bioretention, OceanGuards and 2 x JellyFish devices to further remove the TSS, nitrogen and phosphate nutrients removal.

This report addresses the long term impacts of the indicative concept scheme. For short term effects (i.e. during the construction phase) water quality control is achieved by implementing the measures in the Sedimentation & Erosion Control Plans.

3. STORMWATER QUANTITY CONTROL

3.1 Introduction

The main criteria for the stormwater quantity control are to ensure that the post-developed peak flows do not cause detriment to the downstream waterways and Council's existing drainage network.

3.2 Proposed Drainage System

The drainage system for the proposed development will be designed to collect the majority of concentrated flows from impermeable surfaces such as access ways, parking areas and buildings. Where possible (and practical), runoff from pervious areas will also be collected.

The proposed stormwater management system for the indicative concept scheme includes:

- A pit and pipe network to collect minor storm runoff from areas;
- Overland flow paths to carry major storms through the site and;
- Rainwater reuse tanks to collect roof drainage;
- An on-site stormwater detention system.

3.2.1 Stormwater Detention Requirements

The OSD requirement for the development was calculated using the Goulburn Mulwaree Council Stormwater Drainage Handbook – Section 7.

As per Section 7, the On-site Stormwater Detention system is to be designed to satisfy Site Storage Requirements (SSR) & Permitted Site Discharge (PSD). As 95% of the site will drain to the OSD and with 90% of the site being impervious, the SSR and PSD are 162m3/s/ha and 205L/s/ha respectively. The total site area is 12.3566ha. Therefore:

- SSR = 2001m3
- PSD = 2396L/s

For the proposed development, it is recommended that OSD be provided in the form of an above ground basin with a discharge control pit, orifice and weir control. The basin will have a minimum storage volume of 2001m^3.

A concept design for the OSD basin is shown on the concept civil engineering drawings submitted with the Planning Proposal.

3.2.2 Rainwater Harvesting & Reuse (Water Balance)

The indicative concept scheme adopts a WSUD strategy to reduce the loading placed on water and wastewater infrastructure. This strategy will give opportunities to reduce demand on potable water and to reduce wastewater discharged from the site.

As required by Goulburn Mulwaree Council, a rainwater harvest and reuse strategy has been provided for the indicative concept scheme. For new industrial developments the entire roof area is to be connected to rain water tanks. The size of the tanks is based on the rate 1kL per 10m2 of roof area. Therefore, the total rainwater tank volume required for the site is 5022kL. To achieve this, there will be several rainwater tanks dispersed throughout the site.

As per Councils Stormwater Drainage & Rainwater Collection Systems Policy, rainwater reuse is required for:

- Landscape irrigation;
- Toilet flushing;
- General wash down;
- Laundry washing.

A MUSIC model for the proposed development was created in accordance with Goulburn Mulwaree Council's MUSIC modelling requirements.

The following demands were input into the model:

- Landscape irrigation – This will be provided for the ground landscape area of 15899m2. Using the rate of 1.5mm/day/m2, we get 8704kL/yr.

- Toilet Flushing – It is assumed that 9 toilets will be provided in each warehouse. Therefore to conservatively allow 92 toilets at a usage of 0.05kl/day/toilet = 4.6kl/day (Distribution: Uniform);

- General washdown – 30 taps x 0.005kL/d = 0.15kL/d;

- Laundry washing – It is assumed that laundry washing will be 0.5kL/d.

4. WATER QUALITY CONTROL

4.1 Introduction

The quality of runoff from a catchment depends upon many factors such as land use, degree of urbanisation, population density, sanitation, waste disposal practices, landform, soil types, and climate. Pollutants typically transported by runoff include litter, sediment, nutrients, oil, grease, and heavy metals. Whilst these pollutants have a deterious impact on the receiving water quality, suspended solids and nutrients cause the highest detrimental impact to the environment. Litter, oils, and other surfactants have an aesthetic impact.

Activity within a catchment during urbanisation includes the disturbance of vegetation, removal of topsoil, land shaping, road construction, installation of services, and building works. It is during this phase that the sediment movement is greatest and is estimated that the sediment production levels may be up to 6 times higher than under the existing conditions. However, once development is completed, the sediment loading may return to the existing level or remain at a higher level depending on land management practices.

As with all development projects, soil erosion during the construction phase presents a potential risk to water quality. The primary risk occurs while soils are exposed during earthworks when suspended sediment and associated pollutants can be washed into downstream watercourses.

This section of the report addresses the long term impacts of the development on water quality. For short term effects (i.e. during the construction phase) water quality control is achieved by implementing the measures in the Sedimentation & Erosion Control Plans.

4.2 Water Quality Control Measures

There are a number of measures that can reduce pollutant loadings, varying in effectiveness depending on land use type, topography and the control target.

The measures proposed for the redevelopment are summarised in Table 3.

Table 3 - Water Quality Control Measures

MEASURES	DESCRIPTIONS
Rainwater Tanks	▪ Rainwater tanks are effective in the removal of pollutant loads at source. The pollutant removal process occurs by harvesting runoff for reuse, thereby limiting the nutrients that are discharged into the waterways. ▪ It is proposed to provide a total of at least 5022kL of rainwater tank storage apportioned over each of the proposed lots based on site area. The harvested water will be plumbed for toilet flushing, external landscape irrigation, general wash down and laundry washing.
Jellyfish	▪ The Jellyfish uses gravity, flow rotation and up flow membrane filtration to provide stormwater treatment. ▪ The Jellyfish utilises filtration cartridges that have a large membrane surface area, resulting in high pollutant removal capacities and high flow rates. ▪ The models selected for this study are the JF3250-28-5 and 2 x JF2250-6-1.
Bio-retention Basins	▪ A bio-retention system is a vertical filtration system that filters stormwater through a prescribed media (e.g. sandy loam) before being collected by an underlying perforated pipe for subsequent discharge to the receiving water. ▪ The filtration media should have a permeability of at least one order of magnitude higher than the surrounding soils to ensure that the pathways of stormwater through the system is well-defined and directed at the perforated pipe underlain. ▪ The basins selected for this study will have a detention depth of 0.5m and the filter media depth of 0.6m.

4.3 Strategy Effectiveness

The effectiveness of the proposed water quality measures have been assessed using numerical modelling. The results were compared against the Council requirements to determine the effectiveness of the proposed strategy.

4.4 Water Quality Modelling

4.4.1 *MUSIC Program*

The water quality model adopted for this project is the MUSIC (Model for Urban Stormwater Improvement Conceptualisation version 6) water quality numerical model developed by the MUSIC Development Team of the Cooperative Research Centre for Catchment Hydrology (CRCCH). MUSIC is an event basis model, simulating the performance of a group of stormwater management measures, configured in series or in parallel to form a “treatment train”.

The MUSIC User Manual suggests that the time-step should not be greater than the time of concentration of the smallest sub-catchment, but consideration should also be given to the smallest Detention time of treatment nodes in the system. To accurately model the performance of the treatment nodes, a 6-minute time step was chosen.

The MUSIC model was generated using the site-specific rainfall data. The historical 6-minute rainfall and monthly evapotranspiration data for Zone_A_6min_BUNGONIA_WINDTHORPE for a period of 5 years from 1995 to 1999 was utilised.

Catchment characteristics were defined using a combination of roof areas and non-roof catchments with varying imperviousness ratios to replicate the catchment for the development condition. The MUSIC model layout is shown in Appendix B of this report. The model will be provided upon request.

4.4.2 *Event Mean Concentration*

MUSIC uses different event mean concentrations (EMC) to determine the pollutant loads generated by different land uses. The standard EMCs adopted within MUSIC were based on research undertaken by Duncan (1999) through the CRCCH and the results are reproduced in Australian Runoff Quality – A Guide to Water Sensitive Urban Design (ARQ). Table 5 summarises the parameters used for the development site.

Table 4 - EMC Parameters

LAND USE	MEAN BASE FLOW CONCENTRATION PARAMETERS Log_{10} (mg/L)			MEAN STORM FLOW CONCENTRATION PARAMETERS Log_{10} (mg/L)		
	TSS	TP	TN	TSS	TP	TN
Roof Areas	Not Applicable*Note 1			1.300	-0.890	0.300
Road Areas	Not Applicable*Note 1			2.430	-0.300	0.340
Pervious	1.150	-1.220	-0.050	1.950	-0.660	0.190

*Note 1 – Roof and Roadway areas consists of 100% impervious area so there is no base flow generated from this area.

4.4.3 *Configuration*

Table 6 and Table 7 provide the treatment configurations used in the MUSIC model:

For the predevelopment land use model, images were obtained for the site from Nearmaps.

Figure 2 shows that the site is generally grassland with unvegetated areas, multiple unsealed roads (or tracks), one house and 4 dams of varying sizes. The estimated predevelopment areas are included in table 6.

The large dam at the bottom of the site has been included in the pre developed MUSIC model as a wetland as per the WaterNSW – Using MUSIC in Sydney Drinking Water Catchment document.

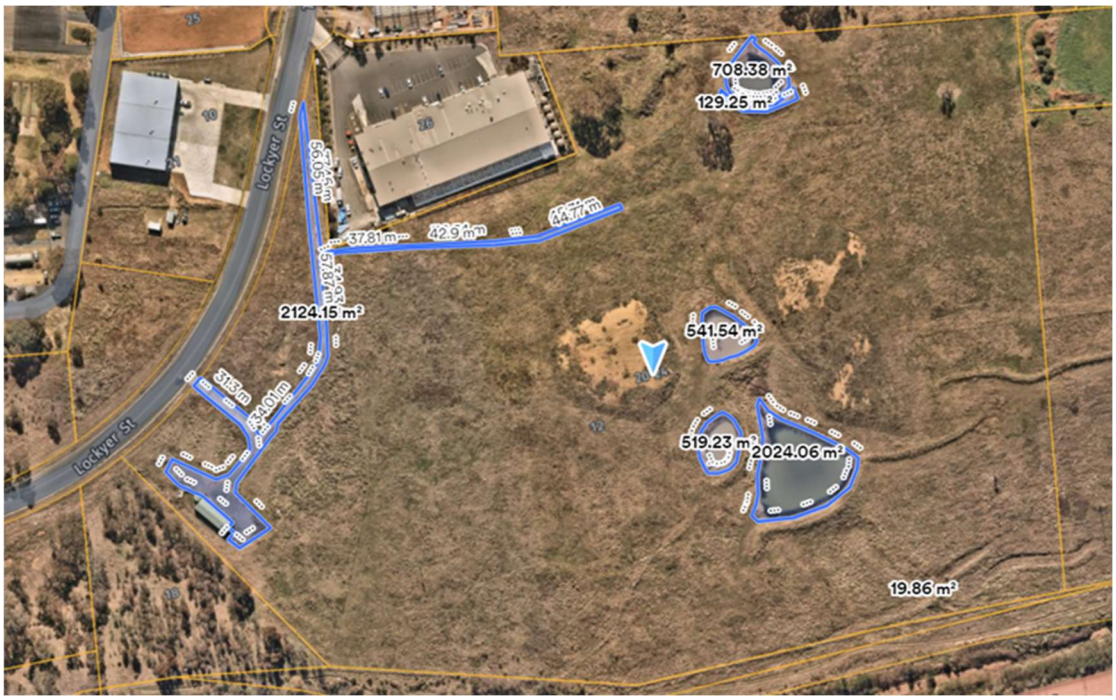

Figure 2 - Image of the Site from 2023
(Source: Nearmaps)

Table 5 - Catchment Areas

LAND USE	DEVELOPED CONDITIONS		LAND USE CATCHMENTS (%)
	AREA (m^2)	IMPERVIOUSNESS (%)	
PRE-DEVELOPMENT			
Roof Area	202	100	<1
Pervious Area	62223	5	50
Other Impervious Area	2123	100	2
PRE-DEVELOPMENT PASSING THROUGH DAM			
Other Impervious Area	3922	100	3
Pervious Area	53096	5	43
Pond Area	2000	100	2
Pre Dev Total	123566	11	100
POST-DEVELOPMENT			
AREA 1			
Roof Area	55067	100	45
Other Impervious Areas	37727	100	30
Pervious Areas	17201	0	14
Road Area	6884	95	6
AREA 2			
Roof Area	1330	100	1
Other Impervious Areas	2249	100	2
Pervious Areas	318	0	<1
AREA 3			
Other Impervious Areas	1262	100	1
Pervious Areas	1528	0	1
Post Dev Total	123566	84	100

Table 6 - Stormwater Quality Improvement Devices (SQID)

STORMWATER QUALITY IMPROVEMENT DEVICE (SQID)	QUANTITY OF SQID
Ocean Protect 'Jellyfish'	1 x JF3250-28-5 2 x JF2250-6-1
Several Rainwater Reuse Tanks	5022kL (Total Volume)
Bioretention	1 x 6000m2 1 x 200m2

4.4.4 *Results*

The results of the MUSIC modelling are summarised in Table 7. The total pollutant loads from the development are expressed in kilograms per year. The reduction rate is expressed as a percentage and compares the pollution from the post developed site to that of the existing developed state of the site. The existing drainage channel area within the site has not been included in the MUSIC Model.

Table 7 - Summary of Music Model Results

PARAMETER	PRE-DEVELOPMENT SITE LOADS (KG/YR)	POST DEVELOPMENT SITE LOADS WITH TREATMENT (KG/YR)	PRE VS POST REDUCTION (%)	NorBE ACHIEVED
GP	**106**	**0**	**100**	**Yes**
TSS	**2190**	**108**	**95.1**	**Yes**
TP	**2.26**	**2.2**	**2.7**	**Yes**
TN	**20.9**	**20.3**	**2.9**	**Yes**

GP = Gross Pollutants TSS = Total Suspended Solids
TP = Total Phosphorus TN = Total Nitrogen

In all instances, the proposed water quality control measures enabled the reduction targets to be achieved for all key stormwater pollutants. Therefore, by implementing the proposed treatment train measures within the proposed development, NorBE will be achieved.

5. RECOMMENDATIONS

Stormwater management practices must now also consider water quality, aquatic habitats, riparian vegetation, recreation, aesthetic and economic issues.

The key strategies to be adopted include the following:

Water Quantity

- A pit and pipe network to collect minor storm runoff from surface areas which will minimise nuisance flooding;
- Overland flow paths along roads to carry major storms through and around the site without causing damage to property from flooding;
- On-site stormwater detention system(s) to detain storm flows so that they can be slowly released over time. The On-site Stormwater Detention system was designed to satisfy Site Storage Requirements (SSR) & Permitted Site Discharge (PSD) rates provided by Council. The minimum storage capacity of 2001m3 for the site was determined. This will assist with maintaining environmental flows and reduce the likelihood of scouring and instability within downstream waterways;
- Several rainwater reuse tanks totalling a volume of 5022kL while at the same time providing improvement to the quality of stormwater runoff from the site and providing some level of stormwater detention. Harvested rainwater shall be used for irrigation, toilet flushing, general washdown and laundry washing.

Water Quality

- 109 x OceanGuards (OceanProtect) installed in all surface inlet pits to form part of the water quality treatment train, removing pollutants and nutrients that are detrimental to downstream waterways.
- 1 x Ocean Protect ‘Jellyfish’ JF3250-28-5 and 2 x JF2250-6-1 to further treat stormwater.
- 2 x Bioretention basins with a combined bio area of 6200m2 to further treat stormwater.

The results from the investigations and modelling for this project that have been summarised in this report, indicate that the proposed works with the proposed WSUD Neutral or Beneficial Effect (NorBE) strategy and management can help provide a safe and ecologically sustainable environment.

6. REFERENCES

- Concept Civil Engineering Drawings for the Development Application submission prepared by C&M Consulting Engineers;
- Architectural concept sketch by ReidCampbell Architecture, Interiors, Project Management;
- WaterNSW – Using MUSIC in Sydney Drinking Water Catchment, 2019
- Goulburn Mulwaree Council – Stormwater Drainage & Rainwater Collection Systems Policy;
- Goulburn Mulwaree Council – Stormwater Drainage Design Handbook (2020) Section 7 – Onsite Stormwater Detention;
- "Australian Runoff Quality – A Guide to Water Sensitive Urban Design", Engineers Australia (2006)
- "Australian Rainfall and Runoff – A Guide to Flood Estimation", Institute of Engineers, Australia (1987)
- eWater – *MUSIC Version 6.2 (Build 1.1592).*

APPENDIX A

STORMWATER DRAINAGE MASTERPLAN

A1

EXISTING SUBSTATION

NEIGHBOURING INDUSTRIAL BUILDING
METAL BUILDING
METAL ROOF
No. 20-24

STREET

LOCKYER

ROAD No.1

BIO-RETENTION
AREA = 200m²

S1 351
S2 351
S3 351
S4 351
S5 351

OFFICE UNITS 4A
SITE AREA
14,662 m²
WAREHOUSE UNITS 4
OFFICE UNITS 4B
OFFICE UNITS 4C
SITE AREA
27,732 m²
WAREHOUSE 5
OFFICE 5A
OFFICE 5B
OFFICE UNITS 3
WAREHOUSE UNITS 3
SITE AREA
10,402 m²
WAREHOUSE 6
CAR PARKING (39)
OFFICE UNITS 1
WAREHOUSE UNITS 1
SITE AREA
7,067 m²
WAREHOUSE UNITS 2
OFFICE UNITS 2
OFFICE 1
WAREHOUSE 1
SITE AREA
14,295 m²
OFFICE 2
WAREHOUSE 2
SITE AREA
15,283 m²
OFFICE
WAREHOUSE 3 / 4

DN525
DN600
DN450
DN750
DN1350

BASIN DISCHARGE
CONTROL PIT

OSD BASIN
APPROX. VOLUME REQUIRED = 2000m³
APPROX. BIO-RETENTION AREA = 6000m²
APPROX. BASIN DEPTH = 0.6m

OUTLET HEADWALL DISCHARGE
TO EXISTING CREEK

Top of Bank

LEGEND

- STORMWATER DRAINAGE PIPE & PIT
- 660 FINISHED SURFACE LEVEL CONTOUR
- 660 EXISTING SURFACE LEVEL CONTOUR
- RL665.34 FINISHED SURFACE SPOT LEVEL
- OVERLAND FLOW PATH

PRELIMINARY

0 15 30 45 60 75m
15 10 5
SCALE 1:750

CAD FILENAME: T:\02701-02800\PN-02714 - LOCKYER STREET 20-24, GOULBURN\ACAD\02714_201.dwg

REV.	DES.	DATE	VER.	DESCRIPTION
P5	W.M.		A.M.	PRELIMINARY
P4	W.M.		A.M.	PRELIMINARY
P3	W.M.		A.M.	PRELIMINARY
P2	W.M.		A.M.	PRELIMINARY
P1	W.M.		A.M.	PRELIMINARY

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ENGINEER	P.O.	LGA	GOULBURN MULWAREE
VERIFIER	A.M.	SCALE @ A1	1:750

20-24 LOCKYER STREET, GOULBURN

GENERAL ARRANGEMENT PLAN

STATUS	DRAWING No.	REVISION
PRELIMINARY	02714__201	P5

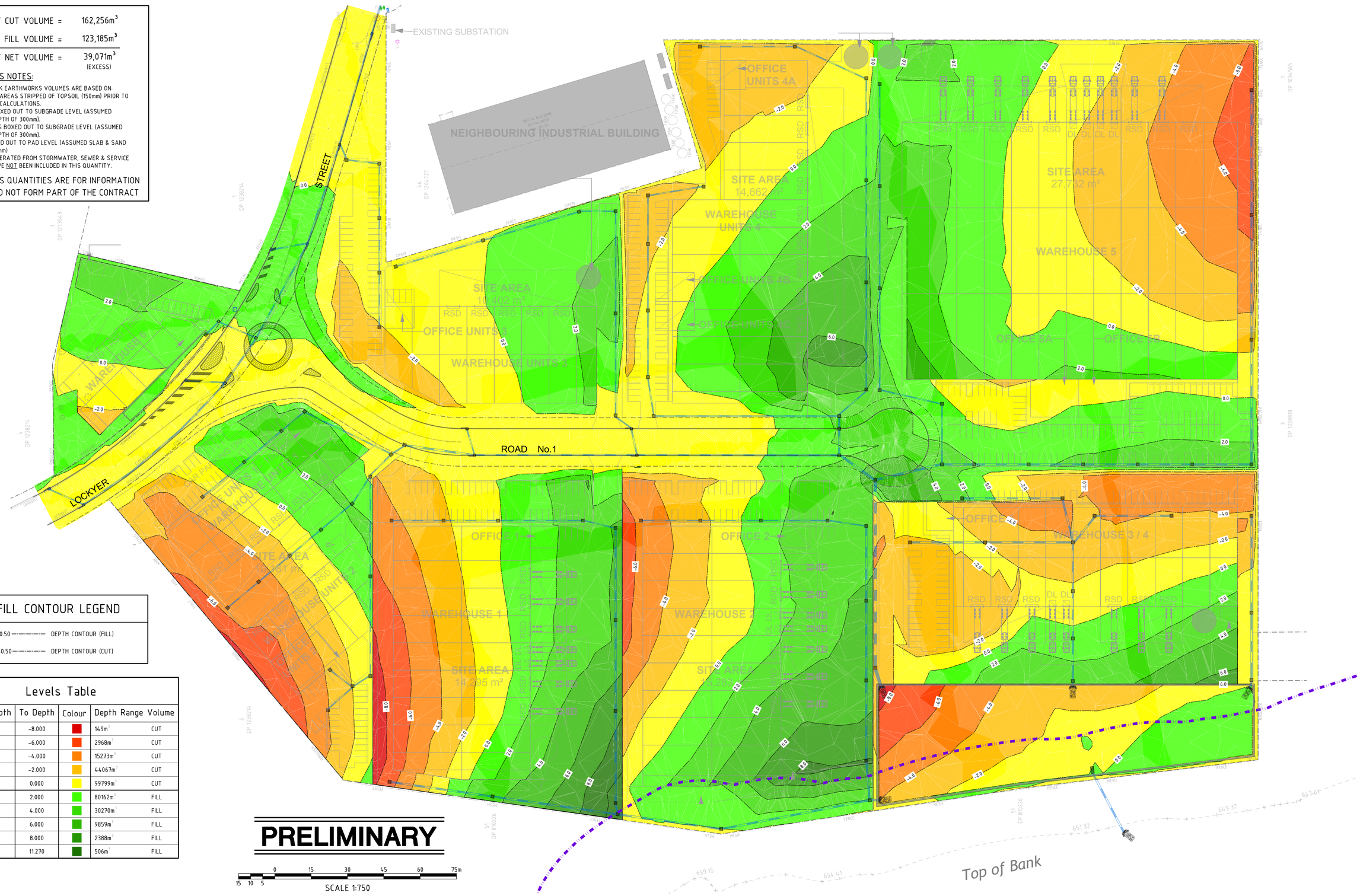
A1

PRELIMINARY CUT VOLUME =	162,256m³
PRELIMINARY FILL VOLUME =	123,185m³
PRELIMINARY NET VOLUME =	39,071m³ (EXCESS)

EARTHWORKS NOTES:

PRELIMINARY BULK EARTHWORKS VOLUMES ARE BASED ON:
- EARTHWORKS AREAS STRIPPED OF TOPSOIL (150mm) PRIOR TO EARTHWORKS CALCULATIONS.
- ALL ROADS BOXED OUT TO SUBGRADE LEVEL (ASSUMED PAVEMENT DEPTH OF 300mm).
- ALL CARPARKS BOXED OUT TO SUBGRADE LEVEL (ASSUMED PAVEMENT DEPTH OF 300mm).
- BUILDING BOXED OUT TO PAD LEVEL (ASSUMED SLAB & SAND DEPTH OF 300mm).
- MATERIAL GENERATED FROM STORMWATER, SEWER & SERVICE TRENCHES HAVE NOT BEEN INCLUDED IN THIS QUANTITY.

EARTHWORKS QUANTITIES ARE FOR INFORMATION ONLY AND DO NOT FORM PART OF THE CONTRACT



CUT FILL CONTOUR LEGEND

0.50	DEPTH CONTOUR (FILL)
-0.50	DEPTH CONTOUR (CUT)

Levels Table

No.	From Depth	To Depth	Colour	Depth Range Volume	
1	-9.334	-8.000		149m³	CUT
2	-8.000	-6.000		2968m³	CUT
3	-6.000	-4.000		15273m³	CUT
4	-4.000	-2.000		44067m³	CUT
5	-2.000	0.000		99799m³	CUT
6	0.000	2.000		80162m³	FILL
7	2.000	4.000		30270m³	FILL
8	4.000	6.000		9859m³	FILL
9	6.000	8.000		2388m³	FILL
10	8.000	11.270		506m³	FILL

PRELIMINARY

0 15 30 45 60 75m
15 10 5
SCALE 1:750

CAD FILENAME: T:\02701-02800\PN-02714 - LOCKYER STREET 20-24, GOULBURN\ACAD\02714_231.dwg

REV.	DES.	DATE	VER.	DESCRIPTION
P2	W.M.		A.M.	PRELIMINARY
P1	W.M.		A.M.	PRELIMINARY

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ABN 21 118 134 240

DESIGNER	W.M.	DATE	MAY 2023
ENGINEER	P.O.	LGA	GOULBURN MULWAREE
VERIFIER	A.M.	SCALE @ A1	1:750

20-24 LOCKYER STREET, GOULBURN

BULK EARTHWORKS CUT/FILL PLAN

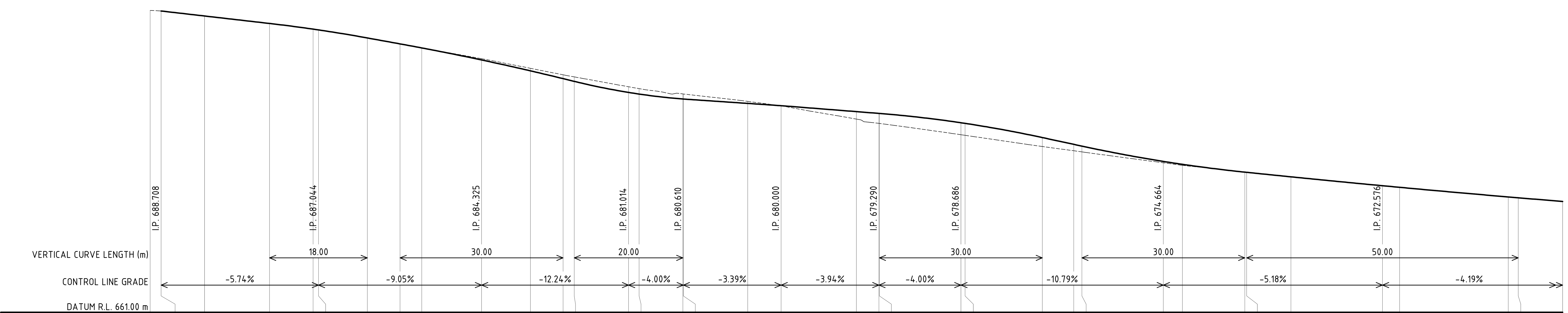
STATUS	DRAWING No.	REVISION
PRELIMINARY	02714_231	P2

A1

PRELIMINARY

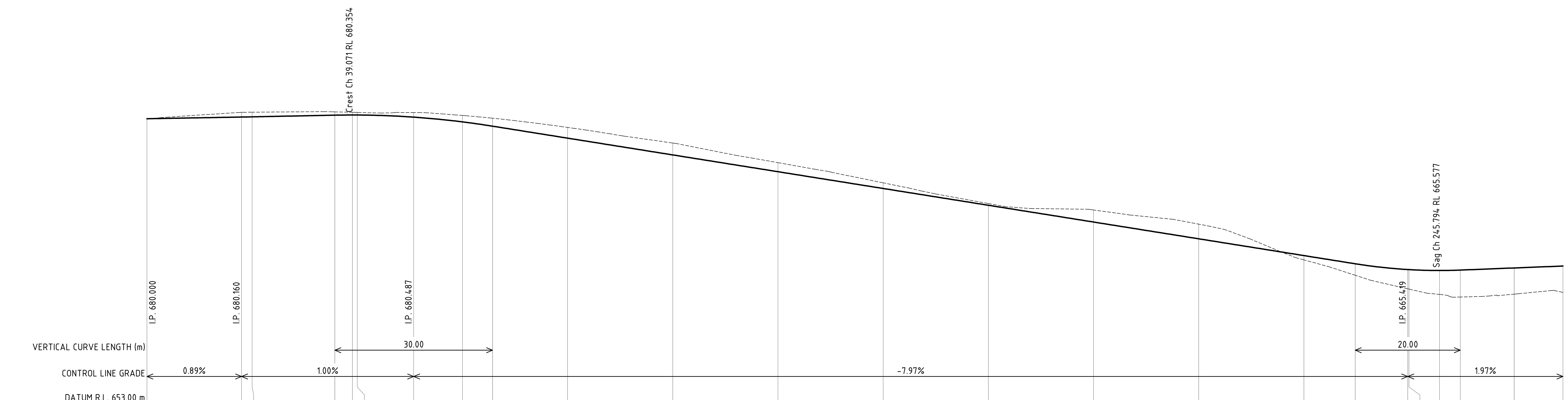
SCALE 1:250

SCALE 1:500



CHAINAGE ALONG CONTROL LINE	CUT / FILL DEPTHS ALONG CONTROL LINE	DESIGN SURFACE LEVEL ALONG CONTROL LINE	EXISTING SURFACE LEVEL ALONG CONTROL LINE
110.000			688.760
112.000	+0.000	688.708	688.708
120.000	+0.000	688.249	688.249
131.976	+0.000	687.561	687.561
140.000	+0.013	687.041	687.028
140.976	+0.013	686.969	686.956
149.976	-0.004	686.229	686.233
156.000	-0.003	685.683	685.686
160.000	-0.010	685.313	685.323
171.000	-0.119	684.206	684.325
180.000	-0.233	683.204	683.437
186.000	-0.351	682.489	682.840
188.054	-0.410	682.238	682.648
198.054	-0.522	681.220	681.742
200.000	-0.500	681.069	681.569
208.054	-0.468	680.614	681.082
208.142	-0.467	680.610	681.077
220.000	-0.189	680.208	680.397
226.142	+0.008	680.000	679.992
240.000	+0.686	679.453	678.767
244.142	+0.919	679.290	678.371
244.233	+0.921	679.286	678.365
259.233	+1.102	678.432	677.330
260.000	+1.099	678.374	677.275
274.233	+0.822	677.068	676.246
280.000	+0.593	676.445	675.852
281.504	+0.533	676.283	675.750
296.504	+0.126	674.875	674.749
300.000	+0.093	674.607	674.514
311.504	+0.000	673.888	673.888
311.841	+0.000	673.870	673.870
320.000	+0.025	673.454	673.429
336.841	-0.004	672.638	672.642
340.000	-0.008	672.491	672.499
360.000	+0.001	671.606	671.605
361.841	+0.000	671.528	671.528
370.000	+0.000	671.186	671.186

LONGITUDINAL SECTION ALONG LOCKYER STREET
SCALE: H 1 in 500 V 1 in 250



CHAINAGE ALONG CONTROL LINE	CUT / FILL DEPTHS ALONG CONTROL LINE	DESIGN SURFACE LEVEL ALONG CONTROL LINE	EXISTING SURFACE LEVEL ALONG CONTROL LINE
0.000	+0.008	680.000	679.992
18.000	-0.446	680.160	680.606
20.000	-0.439	680.180	680.619
35.727	-0.315	680.337	680.652
39.071	-0.254	680.354	680.608
40.000	-0.243	680.353	680.596
50.727	-0.436	680.151	680.587
60.000	-0.612	679.699	680.311
65.727	-0.760	679.292	680.052
80.000	-1.019	678.154	679.173
100.000	-1.131	676.559	677.690
120.000	-0.860	674.965	675.825
140.000	-0.538	673.371	673.909
160.000	-0.162	671.777	671.939
180.000	-1.148	670.182	671.330
200.000	-1.392	668.588	669.980
220.000	+0.409	666.994	666.585
229.757	+1.094	666.216	665.122
239.757	+1.831	665.667	663.836
240.000	+1.852	665.660	663.808
245.794	+2.271	665.577	663.306
249.757	+2.561	665.616	663.055
260.000	+2.488	665.817	663.329
269.268	+2.509	666.000	663.491

LONGITUDINAL SECTION ALONG ROAD No.1
SCALE: H 1 in 500 V 1 in 250

REV.	DES.	DATE	VER.	DESCRIPTION
P1	W.M.		A.M.	PRELIMINARY

CLIENT

C&M CONSULTING ENGINEERS
CIVIL AND HYDRAULIC ENGINEERING DESIGN AND PROJECT MANAGEMENT
SUITE 26
11 - 13 BROOKHOLLOW AVE
NORWEST NSW 2153
PHONE: (02) 9680 3100
FAX: (02) 9634 6989
ABN 21 118 134 240

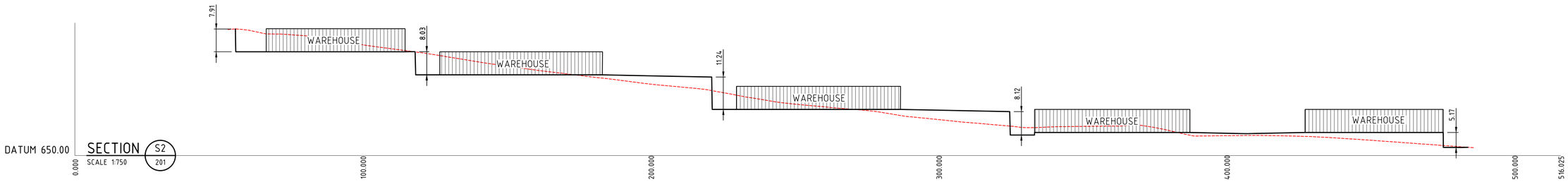
DESIGNER	W.M.	DATE	MAY 2023
ENGINEER	P.O.	LGA	GOULBURN MULWAREE
VERIFIER	A.M.	SCALE @ A1	AS NOTED

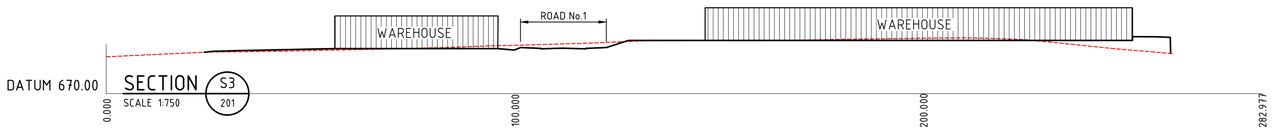
20-24 LOCKYER STREET, GOULBURN

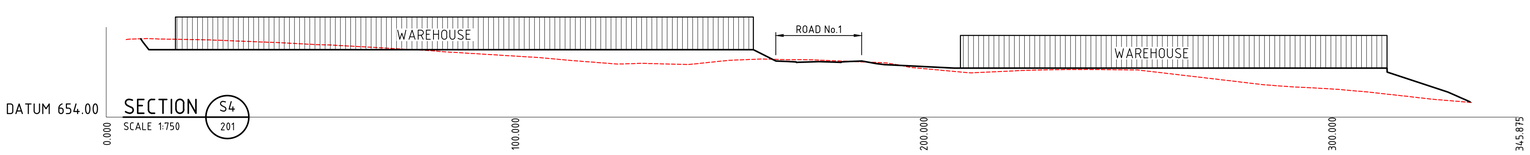
ROAD LONGITUDINAL SECTIONS

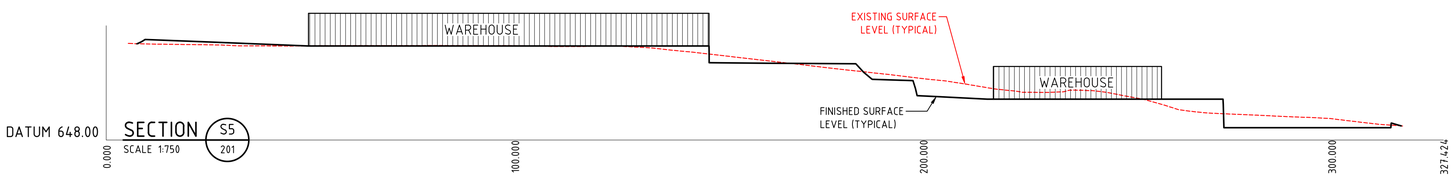
STATUS	DRAWING No.	REVISION
PRELIMINARY	02714_301	P1

A1









PRELIMINARY

15 10 5 0 15 30 45 60 75m

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REV.	DES.	DATE	VER.	DESCRIPTION
P2	W.M.		A.M.	PRELIMINARY
P1	W.M.		A.M.	PRELIMINARY

CLIENT

CIVIL AND HYDRAULIC ENGINEERING DESIGN AND PROJECT MANAGEMENT

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NORWEST NSW 2153

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FAX: (02) 9634 6989

ABN 21 118 134 240

C&M CONSULTING ENGINEERS

DESIGNER	W.M.	DATE	MAY 2023
ENGINEER	P.O.	LGA	GOULBURN MULWAREE
VERIFIER	A.M.	SCALE @ A1	1:750

20-24 LOCKYER STREET, GOULBURN

SITE SECTIONS

STATUS	DRAWING No.	REVISION
PRELIMINARY	02714_351	P2

A1

REV.	DES.	DATE	VER.	DESCRIPTION
P2	W.M.		A.M.	PRELIMINARY
P1	W.M.		A.M.	PRELIMINARY

CLIENT

C&M CONSULTING ENGINEERS

CIVIL AND HYDRAULIC ENGINEERING DESIGN AND PROJECT MANAGEMENT

SUITE 26
11 - 13 BROOKHOLLOW AVE
NORWEST NSW 2153

PHONE: (02) 9680 3100
FAX: (02) 9634 6989
ABN 21 118 134 240

DESIGNER	W.M.	DATE	MAY 2023
ENGINEER	P.O.	LGA	GOULBURN MULWAREE
VERIFIER	A.M.	SCALE @ A1	1:750

20-24 LOCKYER STREET, GOULBURN

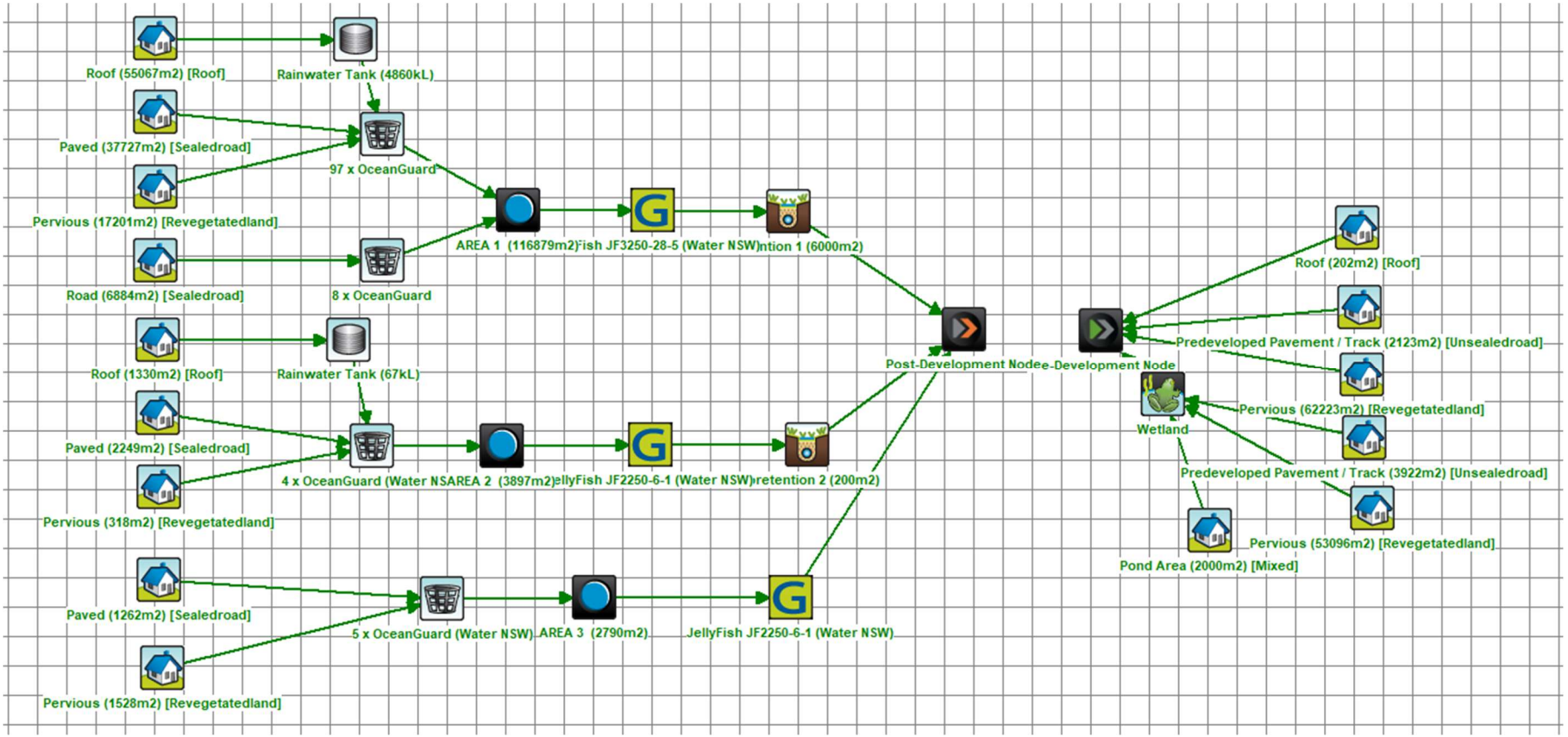
CATCHMENT PLAN

STATUS: PRELIMINARY | DRAWING No. 02714_601 | REVISION P2

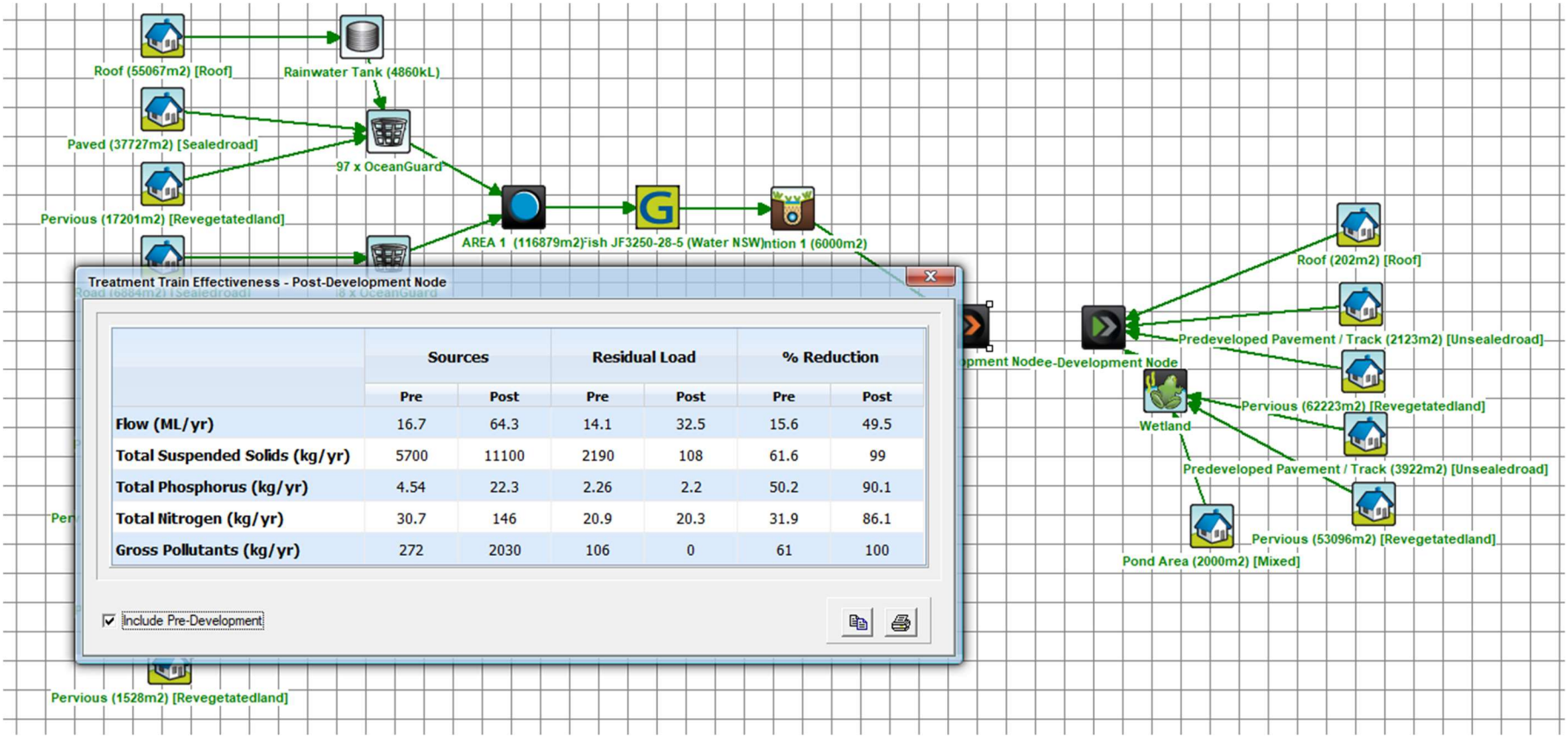
APPENDIX B

MUSIC MODEL LAYOUT AND RESULTS

MUSIC MODEL LAYOUT



MUSIC MODEL RESULTS



	Sources		Residual Load		% Reduction	
	Pre	Post	Pre	Post	Pre	Post
Flow (ML/yr)	16.7	64.3	14.1	32.5	15.6	49.5
Total Suspended Solids (kg/yr)	5700	11100	2190	108	61.6	99
Total Phosphorus (kg/yr)	4.54	22.3	2.26	2.2	50.2	90.1
Total Nitrogen (kg/yr)	30.7	146	20.9	20.3	31.9	86.1
Gross Pollutants (kg/yr)	272	2030	106	0	61	100