WALLACE INFRASTRUCTURE DESIGN PTY LTD

Prepared for

Commercial 7 Pty Ltd
ATF Commercial 7 Unit Trust

34 Wyndella Road LOCHINVAR NSW 2321

DA Stormwater Management Strategy

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List of Acronyms

AEP	Annual Exceedance Probability
AHD	Australian Height Datum
AR&R	Australian Rainfall and Runoff, Commonwealth of Australia, 2019
BASIX	Building Sustainability Index
BOM	Bureau of Meteorology
CC	Construction Certificate
DA	Development Application
EY	Exceedance per Year
FFL	Finished Floor Level
GPT	Gross Pollutant Trap
IFD	Intensity Frequency Duration
I.L	Invert Level
LGA	Local Government Area
MCC	Maitland City Council
NRAR	National Resources Access Regulator
PET	Potential Evapotranspiration
PSD	Permissible Site Discharge
R.L	Reduced Level
TWL	Top Water Level
WDG	Wallace Design Group

1. INTRODUCTION

1.1. Background

Wallace Design Group has been engaged by Commercial 7 Pty Ltd ATF Commercial 7 Unit Trust to formulate a Stormwater Management Strategy to support the Development Application for a 209 site Manufactured Home Estate located at 34 Wyndella Road, Lochinvar NSW 2321. The site is situated within the Maitland City Council Local Government Area. The stormwater drainage strategy will address both stormwater quantity and quality requirements for the proposed development in accordance with ARR 2019, *Maitland City Council Development Control Plan* and *Manual of Engineering Standards (MOES)*.

A locality plan is shown in Figure 1.

Figure 1: Site Locality Plan

1.2. Site Description

The site is 10.74 ha of land located at 34 Wyndella Road, Lochinvar NSW and is generally bound by rural residential land to the north, south and east and residential land to the west. The development land is zoned as rural residential and is suitable for the proposed land use.

Two existing tributaries, both unnamed, pass through the site however they are not defined beds or banks within the mapped hydro lines and this will be confirmed through a riparian corridor assessment by Anderson Environment & Planning, being an appropriately qualified consultant. The tributaries pass through from the Northeast to the Southwest and the application proposes to infill these areas and bypass the flows through the site.

1.3. Proposed Development

The development proposes a new 209 site Manufactured Home Estate with additional community amenities including a central community centre, bowling lawn, pool and pickleball courts. A copy of the development layout plan is shown in Appendix A.

Access to the development will be off the existing Wyndella Road to the West. The proposed primary road corridor will consist of a concrete drive, 6m in width, within a variable width road corridors. The main entry will main a divided road with the engress and egress both maintaining 5m in width. The internal road network consists of an internal loop road with multiple cross-road set up in a grid formation as can be seen on the overall development plan. The road network is further detailed in the Civil and Stormwater Management Plan (refer to Appendix B).

The upstream stormwater catchment, currently bisecting the site within the existing stormwater crossings with be redirected through the site. The redirected network is further detailed in the Stormwater Management Plan.

The stormwater from the proposed development will be controlled for both quality and quantity through a stormwater pit and pipe network, GPT's and Stormwater Filters, and on-site detention basins. Rainwater reuse tanks, although not specifically modelled in MUSIC or DRAINs, will be provided for all residential lots in accordance with BASIX and Council guidelines at the time of construction and as part of the Construction Certificate stage of development.

Stormwater quality controls are to comply with *Maitland City Council – Manual of Engineering Standards.* Review of Council's guidelines indicate that stormwater quality controls are to have a target percentage reduction over the post-developed water quality outputs. To assess the development for water quality, a MUSIC water quality model with the proposed development being cleansed by Atlan stormwater Filters is required. These are further detailed in Section 3.1.

Stormwater quantity controls are to comply with Maitland City Council – Manual of Engineering Standards and Maitland City Council's DCP. Design is to be in accordance with current ARR 2019 methodologies (ref. ARR 2019 Guidelines, online version). The design presented within this report has assessed all required output nodes for each type of use in a manner that maintain developed flow rates to the existing stormwater flow regimes.

1.4. Scope of Work

This Strategy has been undertaken to provide the following information in support of the Development Application:

- Identification of stormwater quality and quantity control requirements within Maitland City Council.
- Identify the impacts of the proposed development on existing waterways.

- Develop a strategy to minimise the stormwater discharge effects of the development on downstream properties/waterways.
- Provide concept design of the proposed stormwater management facilities in accordance with the adopted strategy.

1.5. Available Data

The following available information was utilised in the preparation of this report:

- A development masterplan supplied by BDA Architecture. A copy of the development layout plan is shown in Appendix A.
- Detailed Survey supplied by Commercial 7 Pty Ltd ATF Commercial 7 Unit Trust, as prepared by de Witt Consulting Surveyors, dated August 2023, Ref 14576.

1.6. Strategy Objectives / Criteria

1.6.1. Stormwater Runoff Quality Criteria

Stormwater runoff from the development should be treated prior to discharge, consistent with normal practice for new developments, and with consideration to opportunities for integration with existing site features and topography.

The methodology for Stormwater Runoff Quality typically involves selection of stormwater quality treatment devices based on identified opportunities for stormwater quality management referencing the development site and catchment conditions, and normal best practice.

Stormwater quality management for the subject site could comprise of a series of treatment train measures consisting of:

- Rainwater harvesting / reuse for reducing runoff volumes;
- Biofiltration, bioretention, sedimentation, or filtration basins
- Grassed swales;
- Water quality control ponds; and/or
- Gross pollutant traps (GPT's), or Proprietary water quality improvement devices for primary, secondary and/or tertiary treatment.

1.6.2. Stormwater Runoff Quantity Criteria

The development shall consider stormwater quantity controls in accordance with Council's DCP and *Manual of Engineering Standards* which stipulates that developed stormwater flowrates shall not exceed the pre-developed flow rates for all storms up to and including the 1% Annual Exceedance Probabilities (AEP). The stormwater quantity controls will be conceptually sized and designed using DRAINs stormwater modelling software, the Initial-Loss Continuing Loss (IL-CL) design methodology, the guidelines and methodologies set out in Book 9 of *Australia Rainfall and Runoff: A Guide to Flood Estimation, 2019* (see references).

Stormwater flow management criteria includes:

- The adoption of a minor and major flow considerations to the design of the stormwater flow management system in accordance with Council's stormwater drainage design guidelines.
- Conveyance of major flows through the site in a safe manner.
- Limiting the post-development discharge rates from the subject site to the pre-development discharge rates for all storm events up to and including the 1%AEP.

1.6.3. Flooding Criteria

Developable lot areas should have sufficient buildable area for a dwelling to be located at or above the flood planning level, which is the 1% AEP flood level plus 500mm freeboard for residential developments.

Review of the Maitland City Council's Public GIS Online Mapping System indicates the development is not within a flood studied area and therefore has no defined Flood Planning Level or PMF level.

2. STORMWATER MANAGEMENT STRATEGY

The proposed stormwater management strategy involves:

- The capture roof stormwater runoff, prior to discharge into the stormwater network, in a rainwater reuse tank in accordance with BASIX requirements for each building (expected to be 2500 to 3000L reuse tank). The reuse tanks have not been modelled as part of the development application; however, they are expected to contribute to the overall Stormwater Management Strategy.
- No additional provision for storage volume within the reuse tanks have been considered to offset on-site detention storage volume.
- Outlet controls designed to control stormwater flows for the minor and major AEP storm events in accordance with Council guidelines.
- Capture of stormwater from lots and road areas by a conventional pit and pipe drainage network located in the street and inter-allotment drainage easements.
- Diversion of the 4EY storm event through Atlan StormFilters for primary treatment of stormwater flows for reduction of TSS, TP and TN loadings to meet stormwater Council's stormwater quality targets.
- Diversion of all stormwater flows to on-site detention basins for control of post-developed stormwater flows to pre-developed stormwater flow conditions in accordance with Council guidelines.

The modelling for the conceptual plan provided with the Development Application considers a holistic approach and looks at single source nodes for stormwater quality and quantity (e.g single nodes representing larger catchment areas). *The stormwater quality and quantity plan detailed in the Civil and Stormwater Plans as part of the DA Package is considered conceptual in nature and subject to change with the detailed design to be undertaken at Construction Certificate Stage, and as such, an updated model and report will be provided with the design at the time of Construction Certificate application*.

3. METHODOLOGY

3.1. Stormwater Runoff Quality

The methodology for Stormwater Runoff Quality typically involves selection of stormwater quality treatment devices based on identified opportunities for stormwater quality management referencing the development site and catchment conditions, and normal best practice.

The performance of the stormwater management plan was undertaken using the MUSIC-X stormwater water quality modelling software. MUSIC X is a continuous simulation water quality model. The pollutants considered in the water quality modelling were total suspended solids (TSS), total phosphorus (TP), total nitrogen (TN), and Gross Pollutants (GP) which are typical components of stormwater runoff.

MUSIC input parameters include:

- Rainfall and potential evapotranspiration data.
- Catchment area and percentage impervious.
- Hydrologic parameters.
- Statistical pollutant generation parameters

MUSIC outputs include:

- Average annual pollutant export loads.
- Treatment train effectiveness, expressed in terms of pollutant reduction.

Input parameters used for modelling were derived from local data taken from Maitland Airport (Bureau of Meteorology Station Number: 61428),eWater's BOM Climate Dataset, parameter values in the *MUSIC User Manual* (version 6.1), and *Using MUSIC in Sydney's Drinking Water Catchment, A Sydney Catchment Authority Standard* (Published by Sydney Catchment Authority, Penrith, December 2012).

3.1.1. MUSIC Parameters

Land Use Types

The post-developed land use was modelled using the following MUSIC source nodes:

- Urban Residential (Combined Roof & Lots, 85% impervious)
- Urban Mixed Use (Communal Facility, 100% impervious)
- Urban – Sealed Road (Paved, 100% Impervious)
- Urban – Revegetated Land (Grass, 100% Pervious)

The pollutant generation characteristics of the surface types are shown in Table 2 below.

Rainfall and Evapotranspiration

The rainfall data and monthly average areal potential evapotranspiration (PET) values used for the modelling were obtained from data sourced from the Bureau of Meteorology Station Number: 61428 (Maitland Airport AWS) templated meteorological MUSIC file.

Time Step

The MUSIC model was run with a time step of 6 minutes, as contained within the Maitland Airport Rainfall datasets.

Hydrology

The MUSIC hydrology parameters for each land use type are summarised in Table 1. The individual land use nodes, rainfall thresholds, pervious area properties, and groundwater parameters were determined using Clay Loam *Using MUSIC in the Sydney Drinking Water Catchment, 2019*.

Table 1: MUSIC Rainfall-Runoff Parameters

Parameter	Site Land Use			
	Commercial	Revegetated Lands	Roof/Lots	Sealed Roads
Impervious Area Properties				
Rainfall Threshold (mm/day)	1.5	1.0	1.0	1.5
Pervious Area Properties				
Soil Storage Capacity (mm)	119	119	119	119
Initial Storage (% of Capacity)	25	25	25	25
Field Capacity (mm)	99	99	99	99
Infiltration Capac. Coeff. – a	180	180	180	180
Infiltration Capac. Exp. – b	3.0	3.0	3.0	3.0
Groundwater Properties				
Initial Depth (mm)	10	10	10	10
Daily Recharge Rate (%)	25	25	25	25
Daily Baseflow Rate (%)	25	25	25	25
Daily Deep Seepage Rate (%)	0	0	0	0

Event Mean Concentrations

The pollutant baseflow and stormflow concentration parameters for the existing state and proposed land use types were determined from *Using MUSIC in Sydney's Drinking Water Catchment, Tables 4.6 and 4.7 (See references*) based on Rural Residential and Forest land uses. The adopted pollutant parameters for the specified land use types are provided in Table 2.

Table 2: Adopted Land Use Baseflow and Stormflow Concentration Parameters

Land Use and Flow Type	Total Suspended Solids (TSS) ($\log_{10}$ mg/L)		Total Phosphorus (TP) ($\log_{10}$ mg/L)		Total Nitrogen (TN) ($\log_{10}$ mg/L)	
	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev
Baseflow						
Lot	1.2	0.17	-0.85	0.19	0.11	0.12
Commercial	1.2	0.17	-0.85	0.19	0.11	0.12
Road	1.20	0.17	-0.85	0.19	-0.11	0.12
Revegetated	1.15	0.17	-1.22	0.19	-0.05	0.12
Forest	0.9	0.13	-1.50	0.13	-0.14	0.13
Stormflow						
Residential	2.15	0.32	-0.60	0.25	0.30	0.19
Road	2.43	0.32	-0.30	0.25	0.34	0.19
Revegetated	1.95	0.32	-0.66	0.25	0.30	0.19
Commercial	2.15	0.32	-0.60	0.25	0.30	0.19

NOTE: Roofs have no base flow value, per *Using MUSIC in the Sydney Drinking Water Catchment,* 2019

3.2. Stormwater Runoff Quantity

Pre- and post-development stormwater flowrates are estimated using hydrological computer modelling software to demonstrate the magnitude of the local catchment flowrates in accordance with ARR 2019 and Council guidelines.

The post-development discharge is compared to the post-developed discharge without water quality controls, and if higher, detention is warranted in accordance with Council's standard requirements.

3.2.1. Stormwater Flow Model

A stormwater flow model was prepared for the purpose of estimating pre- and post-development flowrates for the concept plan to demonstrate the magnitude of stormwater flows of the local catchments for the 20% (minor) and 1% AEP (major) using both the ensemble and individual storm methodologies as outlined in ARR 2019.

3.2.1.1. Catchment Plan and Model Data

The surface runoff flowrates from the development were modelled using DRAINS hydrological modelling software for the pre- and post-developed state. The Initial Loss/Continuing Loss (IL/CL) Methodology for analysing stormwater flows was utilised to estimate the stormwater flowrates with the IL and CL values being determined based on the hierarchal approach as provided in ARR 2019 for developments in NSW.

The pre- and post- developed stormwater flowrates were analysed at the point of discharge to the site which is located at the south east and southwest corner of the development where the existing tributaries discharge from the site.

The internal catchments were subdivided in two main sub-catchment areas. These areas consist of developed areas draining to the Atlan Filter System and on-site detention basin to the south west (catchments 1 to 4), and the remaining developed areas draining to the secondary Atlan Filter System and on-site detention basin (catchment 5), refer to Appendix B.

On-site detention was analysed using two potential on-site detention areas. A more detailed catchment plan and stormwater system analysis for the subdivision improvements will be completed at the time of Construction Certificate application to further detail the stormwater pit and pipe network, rainwater reuse tanks, and on-site detention basins associated with each stage of development. The conceptual DRAINs node layout is shown in Figure 2.

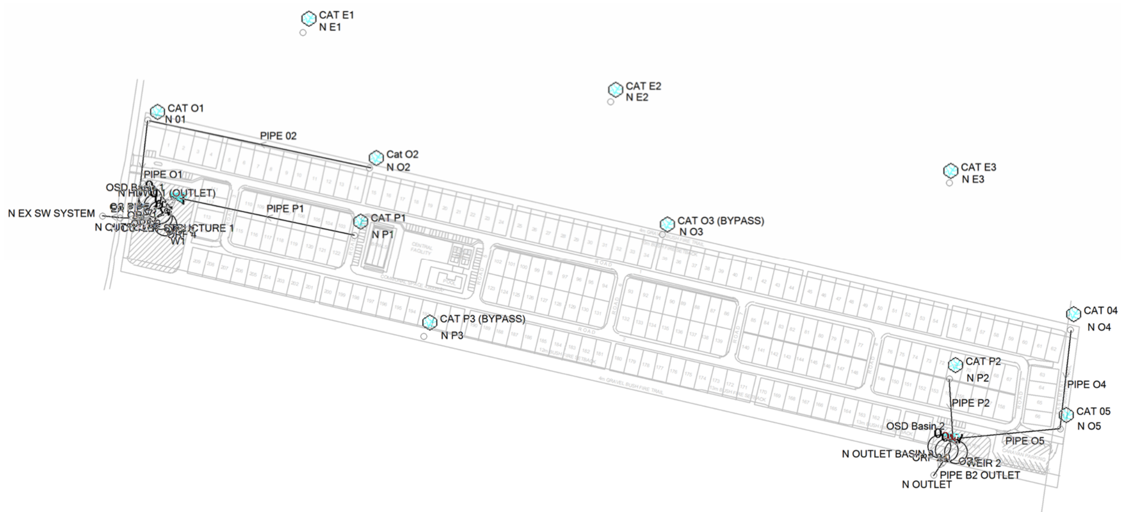


Figure 2: DRAINs Node Layout

The catchments and stormwater network were modelled using the following base assumptions obtained from our research, Council information, and other on-line data (e.g. BOM website, ARR website, etc.):

- Model based on overall concept catchment areas and does not consider individual catchment areas for each stage of development or its pit and pipe network.
- Per above point, the model excluded the 50% blockage factor on all sag pits, and 20% blockage factor on all on-grade pits for major storm events. The model will be amended at Construction Certificate stage to include this criteria.
- A Rainwater Reuse Tank (RWT's) will be provided for each house as required by BASIX. An additional storage volume within the RWT's may be considered at the time of Construction Certificate application; however, *for the conceptual design, separate storage within the rainwater reuse tank was not considered*.
- On-site detention control for the minor and major storm events in accordance with Council Guidelines.

The methodology for stormwater quantity comprised quantitative analysis of available data to estimate pre- and post-developed stormwater flow behaviours from the development site. The analysis involved examination of surface hydrology to assess runoff characteristics from the site and sizing of stormwater mitigation devices to negate the impact of the development on existing flowrates.

This involved the following steps:

- Estimation of pre- and post-developed peak stormwater flowrates at the downstream drainage outlets of the site using the DRAINs software modelling package.
- The critical storm was then selected for each AEP from the 20% to 1% AEP, based on the peak discharge from the site for each storm event. The hydrographs of these 'critical' storms were plotted to determine the approximate volume of storage required.
- Identification of potential locations for on-site stormwater detention structures to reduce post-development discharge flowrates and revise the developed model in DRAINs to include the detention and outlet structures required to reduce post-development discharge flowrates.

3.2.1.2. Rainfall Data

Rainfall data for the 12EY to 1% AEP storm events were obtained through the BOM website (e.g. ARR Data HUB) for storm durations of 10 minutes to 2 hours for downloading directly into the DRAINS modelling software. These data sets were produced using the following geographical data points:

Location	Lochinvar, NSW
Latitude	= 32.696 S
Longitude	= 151.465 E

3.2.1.3. DRAINS IL/CL Model Parameters

Table 3 summarises the initial loss and continuing loss data sets adopted for use in DRAINs. These values were assessed utilising the 5-step hierarchal approach as outlined in ARR 2019. Based on our research regarding steps 1 through 4 of this process, no data existing that would appropriately represent this site; therefore, Step 5 was assumed appropriate for this development. In NSW the adopted CL value is to be multiplied by 0.4; therefore the adopted CL value has been modified from the value provided on the BOM website. This reduction provides an additional factor of safety for the design values adopted.

Table 3: Adopted Initial Loss-Continuing Loss Values

Parameter	Adopted Values
Impervious Area Initial Loss (mm)	1
Impervious Area Continuing Loss (mm)	0
Pervious Area Initial Loss (mm)	18
Pervious Area Continuing Loss (mm)	2.0 (0.8 adopted)

NOTE: Value for CL multiplied by 0.4 in accordance with ARR 2019.

3.2.1.4. Model Sub-Catchment Data

Surface roughness values, n*, used in the DRAINS models are summarised in Table 4.

Table 4: Roughness parameter values, n*, adopted in the DRAINS models

Model - surface type	Surface roughness 'n*' value
Forest Channel	0.15
Short prairie grass	0.10 to 0.21
Pervious (grassed) areas	0.21
Impervious (paved) areas	0.011

Sub-catchment pervious and impervious area percentage values used in the DRAINS modelling are summarised in Table 5 below.

Table 5: Area Percentage values adopted in the DRAINS models

Model - type	Area Percentage
Existing Off-site (Cat 01, 02, 03, 04, and 05), by-pass flows	
– impervious	0
– pervious	100
Proposed Cat P1	
– impervious	65
– pervious	35
Proposed Cat P2	
– impervious	65
– pervious	35
Proposed Cat P3	
– impervious	0
– pervious	100

4. MODEL RESULTS

4.1. Stormwater Runoff Quality

4.1.1. MUSIC Results – Post Development Land Use (No Treatment)

The modelled average annual pollutant loads leaving the site in its post development land use state, without any treatment measures, is shown in Table 6. Pollutant load estimates are provided for total suspended solids (TSS), total phosphorus (TP) and total nitrogen (TN). Figure 3 shows the node layout used in the MUSIC modelling.

Table 6: MUSIC Results for the Site's Post Development Land Use (No Treatment)

Land Use	Average Annual Pollutant Load (kg/yr)		
	Total Suspended Solids (TSS)	Total Phosphorus (TP)	Total Nitrogen (TN)
Post Development	10,620	17.48	112.4

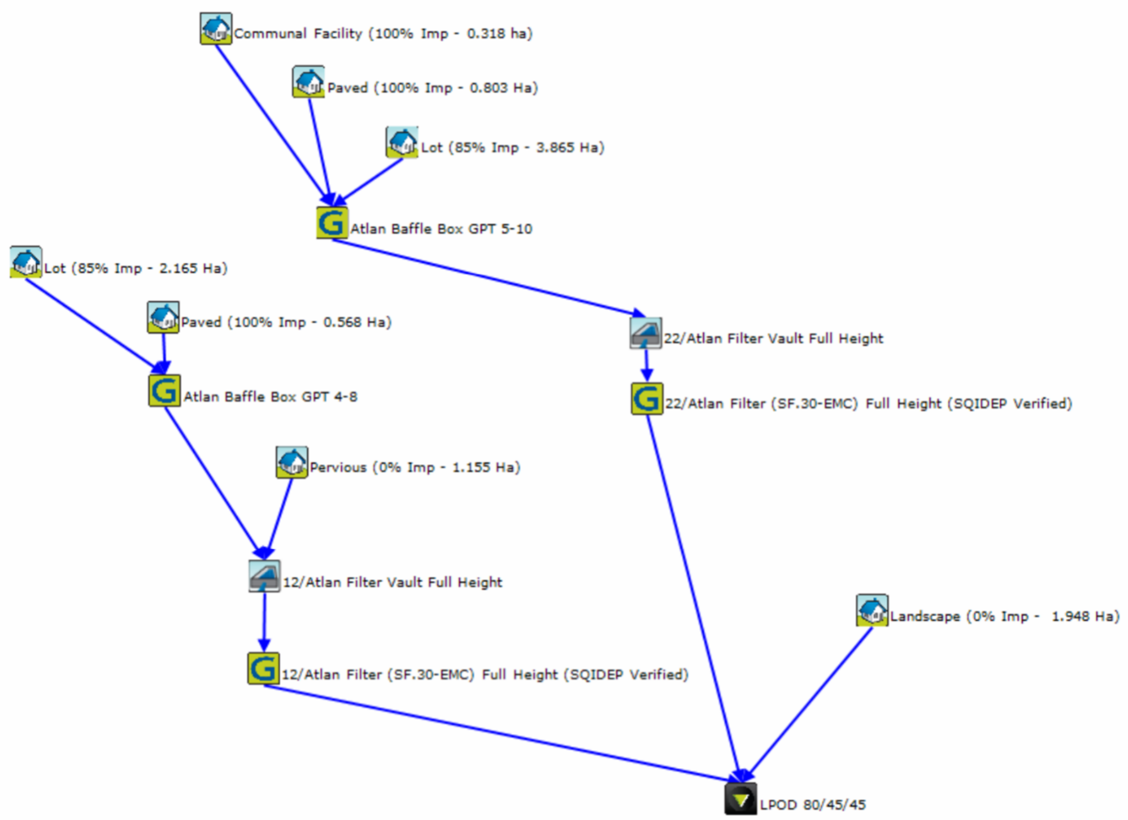


Figure 3: MUSIC Node Layout

4.1.2. MUSIC Results – Post Development Land Use (with Treatment)

The MUSIC model results for the post development land use, with treatment measures, is documented below, enabling the evaluation of the treatment train effectiveness. In assessing treatment devices used for the development, we assessed a series of treatment train measures to minimise the environmental impact of the development. The assessment included the following measures:

- Rainwater harvesting / reuse for reducing runoff volumes;
- Biofiltration, bioretention, sedimentation, or filtration basins
- Water quality control ponds; and/or
- Gross pollutant traps (GPT's), or Proprietary water quality improvement devices for primary, secondary and/or tertiary treatment:

The measures chosen will minimise the impact of the development on the adjacent waterways.

4.1.2.1. Treatment Devices

Treatment devices modelled in MUSIC for the treatment of runoff from the developments impervious surface areas include:

- Rainwater Tanks (considered, but not included in the modelling)
- Atlan Storm Filter System; and,
- GPT's.

4.1.2.1.1. Rainwater Tanks

The rainwater tank node, although not specifically modelled will form a part of the Stormwater Management Strategy. The MUSIC model will be updated at Construction Certificate Stage as part of the overall design strategy to include a RWT node immediately downstream of the roof area node, using the default rainwater tank treatment node parameters within MUSIC. The rainwater tank node will generally include the following node data for each lot:

- Rainwater tank volume of 2.2kL, or as required by BASIX, per each residential lot.
- Daily and annual water usage demand based on Section 4.6.7, Non-potable water demands for rainwater tanks, *Using MUSIC in Sydney's Drinking Water Catchment, 2019*.

4.1.2.1.2. Atlan Baffle Box GPT

The initial treatment device are two Atlan Baffle Box GPT structures. The GPT is a proprietary structure for the removal of Gross Pollutants and the GPT nodes were included as the first node in the treatment train immediately upstream of the Atlan StormFilter System. There are two GPT's for the development which are summarised in Table 7 below.

Table 7: Atlan Baffle Box Parameters

Parameter	GPT Structure	
Inlet Properties	GPT 4-8	GPT 5-10
Low Flow By-pass (m^3/s)	0.0	0.0
High Flow Bypass (m^3/s), (4EY Peak Storm)	0.140	0.274

Target Pollutant Removal Properties		
TSS	80	80
TP	30	30
TN	10	10
Gross Pollutants	100	100

4.1.2.1.3. Atlan StormFilter System

The secondary treatment for the development is the Atlan StormFilter system. The Atlan StormFilter System is a proprietary structure for the primary removal of TSS, TP and TN and is included as the second treatment node in the treatment train prior to discharge into on-site detention basins. There are two node inputs required to analyse the Atlan StormFilter System which are the Filter Vault (Full Height) and the SF.30 EMC Filters. These parameters are provided in Table 8 and Table 9.

Table 8: Atlan Filter Vault Full Height Treatment Parameters

Parameter	Filter Vaults	
Inlet Properties	12/Atlan	22/Atlan
Low Flow By-pass (m^3/s)	0	0.0
High Flow Bypass (m^3/s)	100	100
Storage Properties		
Extended Detention Depth (m)	12	22
Surface Area (m^2)	0.85	0.85
Exfiltration Rate (mm/hr)	0	0
Evaporative Loss as % of PET (%)	0	0
Outlet Properties		
Low Flow Pipe Diameter (mm)	137	185
Overflow Weir Width (m)	4	6
Submerged Zone with Carbon Present	0.07	0.071

Table 9: Atlan Filter (SF.30-EMC) Parameters

Parameter	Filter (SF.30-EMC)	
Inlet Properties	12/Atlan	22/Atlan
Low Flow By-pass (m^3/s)	0.0	0.0
High Flow Bypass (m^3/s)	0.036	0.274
Target Pollutant Removal Properties		
TSS	85	85
TP	74	74
TN	59	59
Gross Pollutants	0	0

4.1.2.2. Modelling Results

The modelled average annual pollutant loads leaving the site in its post development land use, utilising treatment measures, is shown in Table 10. Pollutant load estimates are provided for total suspended solids (TSS), total phosphorus (TP) and total nitrogen (TN). Figure 3 shows the node layout used in the MUSIC modelling.

Table 10: MUSIC Results for the Site's Post Development Land Use (with Treatment)

Land Use	Average Annual Pollutant Load (kg/yr)		
	Total Suspended Solids (TSS)	Total Phosphorus (TP)	Total Nitrogen (TN)
Post Development	501	3.6	43.6

A direct comparison between the existing state and post development pollutant loads with treatment generated by the modelled sources, is summarised in Table 11.

Table 11: MUSIC Model Treatment Train Effectiveness Results

Pollutant	Export Value		Treatment Train Effectiveness (% Reduction)
	Pre Development	Post Development with treatment measures	
TSS (kg/yr)	1051	501	95%
TP (kg/yr)	17.6	3.6	79.8%
TN (kg/yr)	111.1	43.6	60.7%
Gross Pollutants	1401	0	100%

The treatment train effectiveness results above indicate that the pollutant reduction performance provides for a Neutral or Beneficial Effect in accordance with the requirements of *MidCoast Council's WSD Guidelines*, Oct. 2019 and as requested in the pre-development application minutes.

4.2. Stormwater Runoff Quantity

4.2.1. DRAINS Model Results

Following determination of the pre-developed peak flow rates, the post-developed DRAINs model was run for various design storm durations and stormwater drainage configurations to assess the preliminary conveyance sizing required to convey the 20% to 1% AEP through the site and for assessment of stormwater detention requirements.

The model-predicted stormwater flowrates for the pre- and post-development conditions were assessed using both the ensemble and individual storm methodologies. Within the DRAINs modelling software, the peak ensemble storm for the pre- and post-development storm was initially assessed to determine the peak median storm for each design storm event. Using output generated from this assessment preliminary sizing of the on-site detention basins was undertaken. The model-predicted stormwater flowrates were further assessed using the preliminary basin sizing for the pre- and post-development conditions.

The on-site detention basin's model predicted flowrates for the pre- and post-developed state with detention using the ensemble peak flow storms and storm bursts for Basin's 1 and 2 are compared and summarised in Table 12 and Table 13, respectively.

Table 12: DRAINS Ensemble Peak Flow Results with Detention Basin 1

AEP (%)	Existing State		Developed State		% Change
	Peak Flowrate (m^3/s)	Critical Storm Duration/Burst (mins, burst)	Peak Flowrate (m^3/s)	Critical Storm Duration/Burst (mins, burst)	
20	1.447	45, 3	1.440	45, 10	-0.5
1	3.563	25, 1	3.389	45, 6	-4.9

Table 13: DRAINS Ensemble Peak Flow Results with Detention Basin 2

AEP (%)	Existing State		Developed State		% Change
	Peak Flowrate (m^3/s)	Critical Storm Duration/Burst (mins, burst)	Peak Flowrate (m^3/s)	Critical Storm Duration/Burst (mins, burst)	
20	1.104	30, 8	0.921	25, 8	-16.6
1	2.887	20, 10	1.92	20, 6	-33.5

4.2.2. DRAINS Modelled Detention Basin and Outlet Controls

The conceptual design considers two (2) on-site detention basins with pre-treatment measures undertaken before stormwater enters the Basin 1 or 2. Table 14 shows a summary of the concept outlet control(s) used in the DRAINs modelling for the proposed development. The values are subject to change with the detailed Construction Certificate Design.

Table 14: Summary of Basin and Outlet Structures

Basin	Parameter	Description
1	Basin Volume	3320m^3
	Outlet Structure, Low Flow Bypass	2-150mm Orifice
	Outlet Structure, Mid Flow Bypass	2-150mm Orifice
	Outlet Structure, High Flow Bypass	2.4m Weir
	Outlet Pipe to Basin 2	750mm RCP
2	Basin Volume	875m^3
	Outlet Structure, Low Flow Bypass	2-150mm Orifice
	Outlet Structure, High Flow Bypass	1.6m Weir
	Outlet Pipe to Tributary to Moor Creek	600mm RCP

NOTE: The Stormwater Management Strategy does not include any individual lot on-site OSD tanks to ensure the development can maintain controls without individual lot development controls

5. SOIL AND WATER MANAGEMENT DURING CONSTRUCTION

Soil and water management devices to minimise land disturbance during the subdivision construction phase are to be provided in accordance with the publication *Managing Urban Stormwater: Soils and Construction* (Landcom, 2004).

A detailed erosion and sedimentation control plan is to be undertaken during the detailed design stage of the proposed development. The erosion and sedimentation control plan should generally contain the following range of management practices for effective soil and water management during a land disturbance phase:

- Minimise the area of soil disturbed and exposed to erosion by phasing works so that land disturbance is confined to minimum areas.
- Erect barrier fencing to minimise disturbance by preventing vehicular and pedestrian access to restricted areas.
- Limit access for plant etc. to current construction area to limit amount of disturbed area.
- Conserve topsoil for site rehabilitation/revegetation when site works are complete.
- Installation of sediment filters, such as silt fences, straw bales, or turf strips downstream of disturbed areas.
- Control water flow from the top of, and through the development area. In particular, divert upslope runoff around works and limit slope length to 80 metres on disturbed lands if rainfall is expected.
- Where appropriate, reduce the effects of wind erosion by controlling on-site traffic movement and watering bare soil areas.
- Provision of shaker humps / pads near construction entry and exit locations to remove excess soil materials from vehicle tyres and underbodies.
- Rehabilitate disturbed lands quickly.
- Ensure that all erosion and sediment control measures are kept in a properly functioning condition until all site disturbance works are completed and the site is rehabilitated.

6. SUMMARY AND CONCLUSIONS

At Source Management

Although a BASIX's requirements review is not a specific requirement of this stormwater management strategy, it is anticipated that BASIX's requirements would require all individual dwellings to provide rainwater tanks for re-use in conjunction with other BASIX's requirements and Council guidelines. Where installed, rainwater tanks provide at-source stormwater management benefits.

Stormwater Flow Management (stormwater runoff conveyance and quality)

The strategy for management of stormwater runoff from the development is depicted Appendix B, and comprises:

- Capture of stormwater from lot and road reserve areas by a conventional pit and pipe drainage network located in the street or in inter-allotment drainage easements, where required.
- Conveyance of captured stormwater within the pit and pipe network to a GPT for primary treatment, Atlan StormFilter system for secondary treatment, and to the on-site detention basin(s) for tertiary controls.

MUSIC modelling has demonstrated that the proposed treatment devices will treat developed stormwater runoff to meet the requirements of Council's DCP, and on this basis, it is considered that no further water quality controls will be required within the proposed development. The individual lots will be required to provide Reuse Tanks in accordance with BASIXs and Council Guidelines; however, they do not form a part of the water quality modelling for the purpose of approvals.

Details of the proposed local drainage pipe, pit, water quality and on-site detention network will be detailed at the time of Construction Certificate application to Council's standard and specifications.

As illustrated by Appendix B there is sufficient area within the developments footprint to provide stormwater drainage management measures to negate the impact of the proposed development.

7. REFERENCES

- Maitland City Council Development Control Plan
- Maitland City Council *Manual of Engineering Standard (MOES)*.
- Ball J, Babister M, Nathan R, Weeks W, Weinmann E, Retallick M, Testoni I, (Editors) *Australian Rainfall and Runoff: A Guide to Flood Estimation*, ©Commonwelath of Australia (Geoscience Australia), 2019 (available online through arr.ga.gov.au).
- Coombes, P., and Roso, S (Editors), *2019 Runoff in Urban Areas, Book 9 in Australian Rainfall and Runoff – A Guide to Flood Estimation*, © Commonwealth of Australia (Geoscience Australia), 2019 (available online through arr.ga.gov.au).
- Australian Rainfall and Runoff Data Hub (data.arr-software.org)
- Australian Runoff Quality, Engineers Australia, 2006.
- *Using MUSIC in Sydney's Drinking Water Catchment*, Published by WaterNSW, Parramatta, June 2019

Appendix A

Development Layout Plan

LEGEND

Site Area	10.75ha
Bushfire Buffer (10m - 13m)	1.75ha
Home Sites	6.24ha
Private Roads	1.11ha
Communal Landscape Areas	2.71ha
Caravan Parking	17 Bays
Visitor Parking	47 Bays
Storm water	0.43 ha
HYD — HYDRANT	

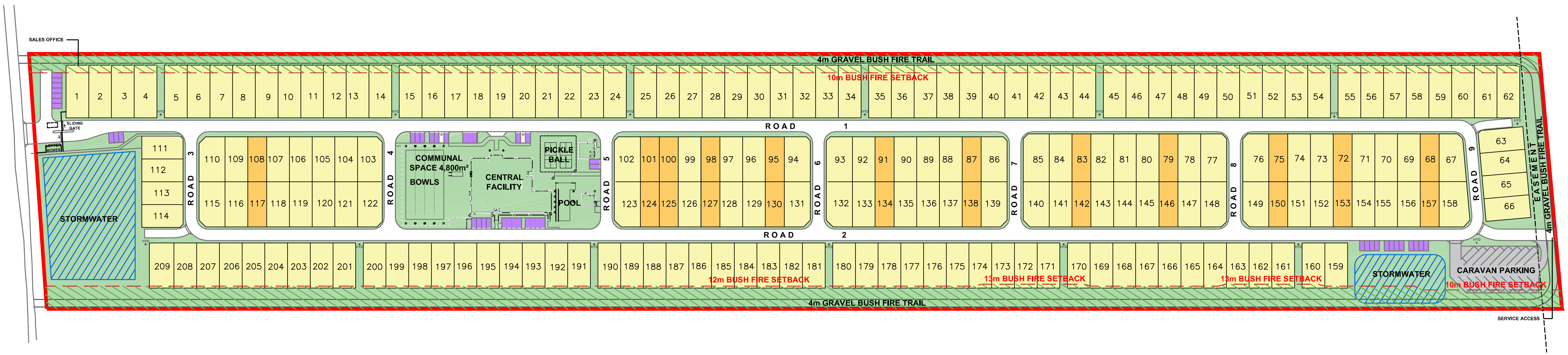
DEVELOPMENT SUMMARY

Home Type		
10 x 23.75/27.75m	24	11%
12 x 23.75/27.75m	185	89%
TOTAL	**209**	

Note:

Corner lots are 1m wider to accommodate an additional side setback.

Communal Landscape Area = Area shown in green minus stormwater and approximate driveway area for each lot.



CLIENT
COMMERCIAL 7 PTY LTD

PROJECT NAME
34 WYNDELLA ROAD, LOCHINVAR

DRAWING
MASTERPLAN

PROJECT NO.	DRAWING NO.	SCALE	ISSUE	DATE
545000	SK.01	1: 2000 @ A3	L	19/12/2023

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Phone: 07 5555 2600
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bda architecture

Appendix B

Civil and Stormwater Management Plan

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CIVIL WORKS for
LOT 34, DP 246447
WYNDELLA ROAD
LOCHINVAR, NSW 2321

DRAWING TITLE:
CIVIL SERVICES
ROAD & STORMWATER MANAGEMENT PLAN (1 OF 3)

DRAWING STATUS	PRELIMINARY				
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DRAWING TITLE:
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ROAD & STORMWATER MANAGEMENT PLAN (2 OF 3)

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ROAD & STORMWATER MANAGEMENT PLAN (3 OF 3)

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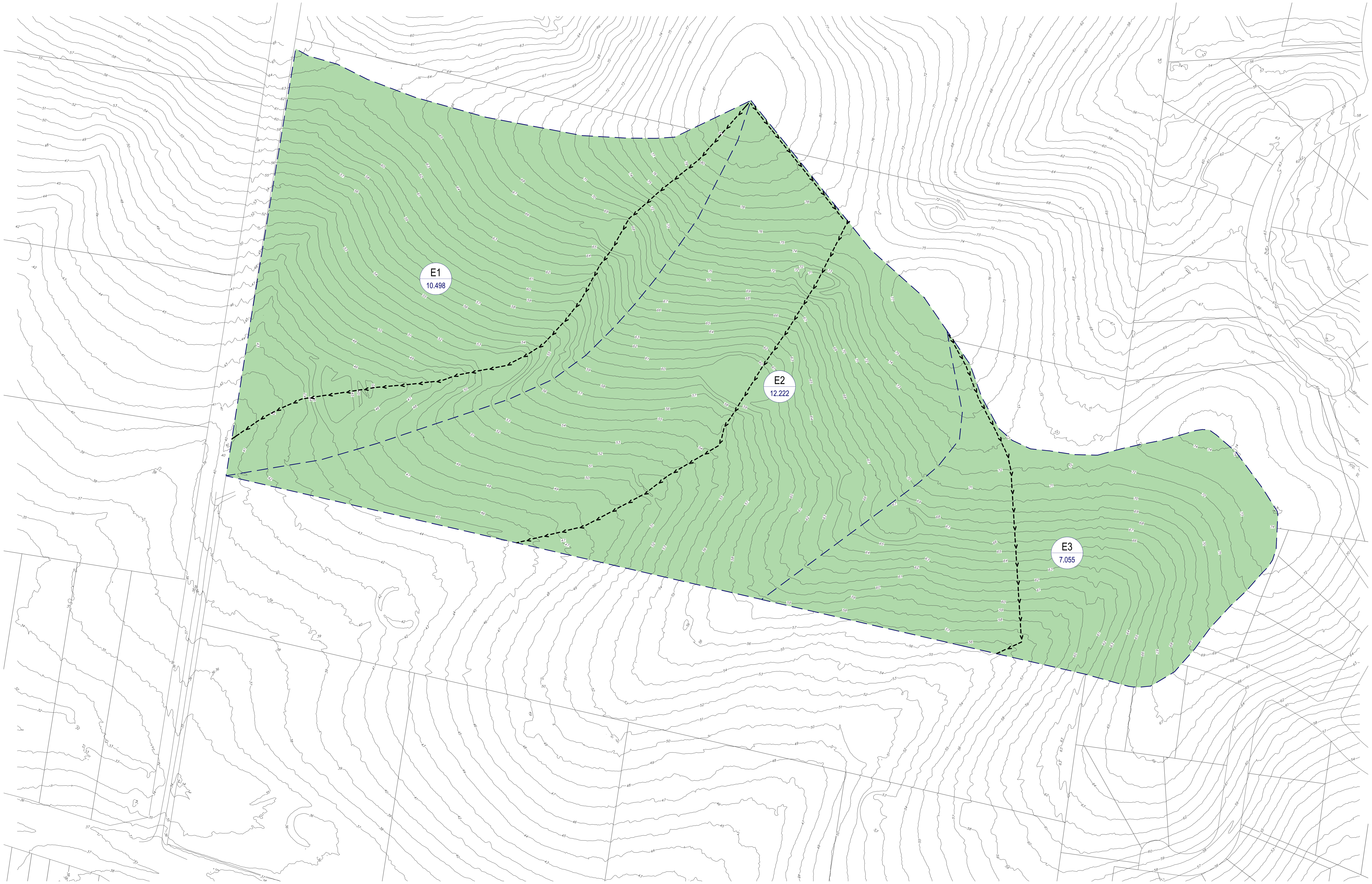

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DRAWING TITLE:
CIVIL SERVICES
EXISTING STORMWATER CATCHMENT PLAN

DRAWING STATUS: **PRELIMINARY**

SCALE: 1:2000 | ORIG. SIZE: A1

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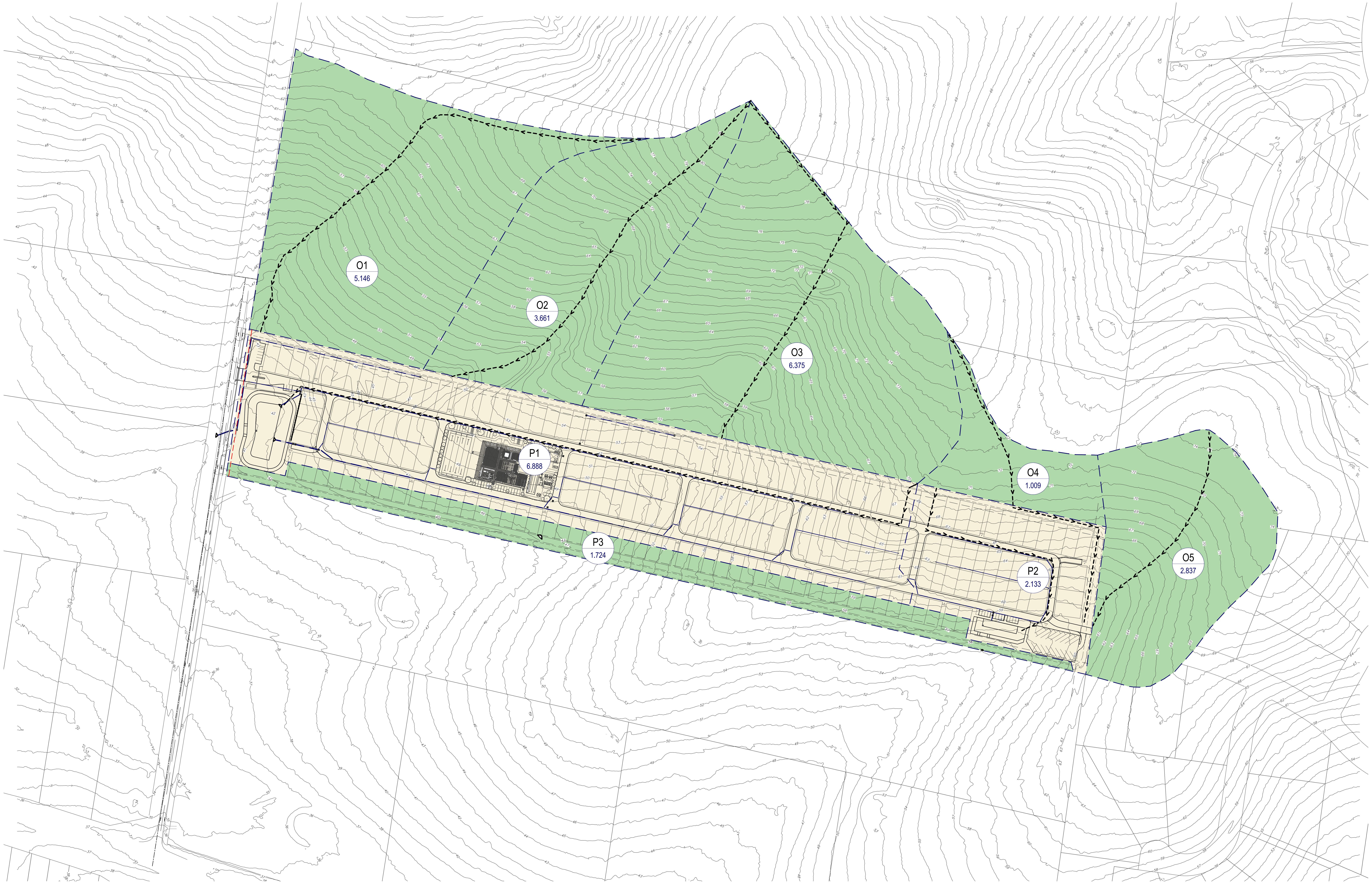

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DEVELOPED STORMWATER CATCHMENT PLAN

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ON-SITE STORMWATER DETENTION BASIN No. 1

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