Our Ref: CLA: 240380(2)

29th April 2025

NSW Land and Housing Corporation
Department of planning and Environment
Locked Bag 5022
Parramatta NSW 2124

RE: STORMWATER MANAGEMENT PLAN, PROPOSED RESIDENTIAL SUBDIVISION, FARNELL ST, FORBES

1. INTRODUCTION

ADW Johnson has been engaged by NSW Land and Housing Corporation (LAHC) to prepare a Stormwater Management Plan (SWMP) addressing stormwater management requirements for the proposed residential subdivision of Lot 7332 DP1166365, Lot 7025 DP1020631 and Lot 7317 DP1166614, located along Farnell Street and Dawson Street within the Forbes Local Government Area (LGA).

Stormwater detention to support the proposed development will be located directly adjacent to the proposed development on land owned by Forbes Shire Council (Council), being part of Lot 1 in DP1077961. It's noted that subdivision of this lot is not proposed as part of the development.

LAHC is a public authority and the proposed development will be assessed under Part 5 of the Environmental Planning & Assessment Act 1979 (EP&A Act). Accordingly, this SWMP has been prepared to determine requirements to capture, convey and treat stormwater flows from the proposed development, along with assessing the environmental impacts, from a stormwater perspective.

This report should be read in conjunction with concept engineering plans *240380(2)-CENG* prepared by ADW Johnson.

2. ADWJ TEAM

ADW Johnson has over 40 years experience working in the land development industry and employs around 125 staff, around 50% of which are in our engineering team. Our team working on this project have extensive experience in the preparation of SWMP's, along with practical experience gained through being involved in the construction and ongoing operation of many Stormwater Management Facilities (SMFs) over the years. As such, we believe that we are suitably qualified to undertake these works and also assess the impacts of the proposed SMF on the environment.

Our team who prepared this SWMP are shown in Table 1 overleaf.

Table 1: ADWJ Team

Name	Position	Qualification/Experience
Nathan Delaney	Senior Civil Engineer	Bachelor of Engineering (Civil) - Hons. Class 1 Bachelor of Surveying - Hons. Class 1 MIEAust, CPEng, NER 20+ Years Experience
George Allan	Senior Civil Engineer	Bachelor of Engineering (Civil) - Hons. Class 1 14 Years
Mitch Knox	Civil Engineer	Bachelor of Engineering (Civil) – Hons. Class 1 7 Years Experience
Christian Langley	Civil Engineer	Bachelor of Engineering (Civil) - Hons. Class 1 Bachelor of Surveying - Hons. Class 1 4 Years Experience

3. SITE DESCRIPTION

The subject site is bounded by Primary Production (RU1) land to the west and north-west, and existing residential development to the north, east and south.

The part of the site to be subdivided comprises of approximately 12.77 ha of General Residential (R1), with the proposed Stormwater Management Facility (SMF) to be located within part of an existing Council owned lot zoned Primary Production (RU1) along the western boundary.

The site largely comprised of small gatherings of scattered trees, maintained grassland, dirt access tracks and parts of existing roads. The site can currently be accessed from the existing road network at multiple points including Watson Close, Farnell Street, Belah Street and Dawson Street / York Street.

Existing site topography is gentle with grades up to five percent. There is an existing ridgeline running north/south which directs the majority of the catchment to the south-west and a small catchment to the south-east. Under existing conditions, the western catchment drains to an existing drainage swale located at the southern end of the site.

The swale flows in a westerly direction towards a mapped first order watercourse, which itself flows south towards Lake Forbes. Although mapped as a first order watercourse within the NSW Hydro Line dataset, this drainage line does not convey regular stream flow. Furthermore, this line has no defined banks or distinct riparian vegetation, consisting only of managed grassland cover. Therefore, it has been concluded that this existing feature functions as a drainage line and not a watercourse.

The north-east portion of the site drains in a south-easterly direction toward the site boundary. Runoff from this catchment generally accumulates in a localised depression in the south-east corner of the site and discharges via a headwall inlet and DN375 pipe to the drainage network located within Farnell St.

Site locality is presented in Figure 1 (*240380(2)-ESK-003[A]*) overleaf.

4. PROPOSED DEVELOPMENT

The proposed development includes 100 residential lots ranging in size from 599 m^2 – 2,499 m^2, public roads, services/infrastructure and stormwater management facilities.

The proposed development is shown in Figure 2 (*240380(2)-ESK-004[B]*) overleaf.

Environmental impacts, from a biodiversity (flora and fauna) perspective, associated with the proposed development have been assessed by OzArk in their Biodiversity Assessment Report (BAR), dated January 2024.

4.1 Stormwater Characteristics of Proposed Development

A ridgeline is maintained within the northern portion of the site, running north/south along proposed road MC04. The majority of the proposed development will drain in a south-westerly direction to the proposed SMF, where water will be treated and detained, prior to discharge into an existing drainage swale which conveys the flow to an existing drainage line (mapped first order watercourse) that heads in a southerly direction towards Lake Forbes.

Within the proposed development, a smaller catchment exists at the site's southwest boundary and drains directly to this formalised swale.

A catchment in the site's northeast drains to the southeast and will discharge into the upgraded DN525 pipe located in the south-east corner of the site. This pipe will convey flows within a drainage easement to the drainage network located within Farnell St.

The stormwater characteristics of the proposed development are shown in Figure 3 (*240380(2)-ESK-005[B]*) overleaf.

5. STORMWATER DISCHARGE QUANTITY

In the absence of stormwater discharge quantity requirements for subdivisions within the Forbes Shire Council DCP, industry-standard requirements were adopted. Peak site discharges under developed conditions should not exceed their pre-developed magnitudes for a range of design storms up to and including the 100-year ARI design storm (*ARR 2019 Book 9, Section 4.2*). This practice is to mitigate the risk of downstream property flood damage and ensure that receiving environments of the development are not impacted from an increase in peak flood discharges. Best practice is for this criterion to be met at each legal point of discharge.

The stormwater catchments associated with the pre and post development scenarios are defined in the following sections.

5.1 Pre-Development Stormwater Catchments

Pre-Development stormwater catchments were delineated by site inspection, analysis of field survey undertaken as well as topographical survey information (LiDAR) and aerial imagery.

Pre-developed catchments largely comprised of small gatherings of scattered trees, maintained grassland, dirt access tracks and parts of existing roads. For modelling purposes, pre-development catchments were adopted as being largely pervious, with an impervious area of 8% adopted (based upon high-level measurement of impervious areas from NearMap imagery).

The pre-development stormwater catchments, along with adopted catchment parameters are shown in Figure 4 and Table 2 overleaf.

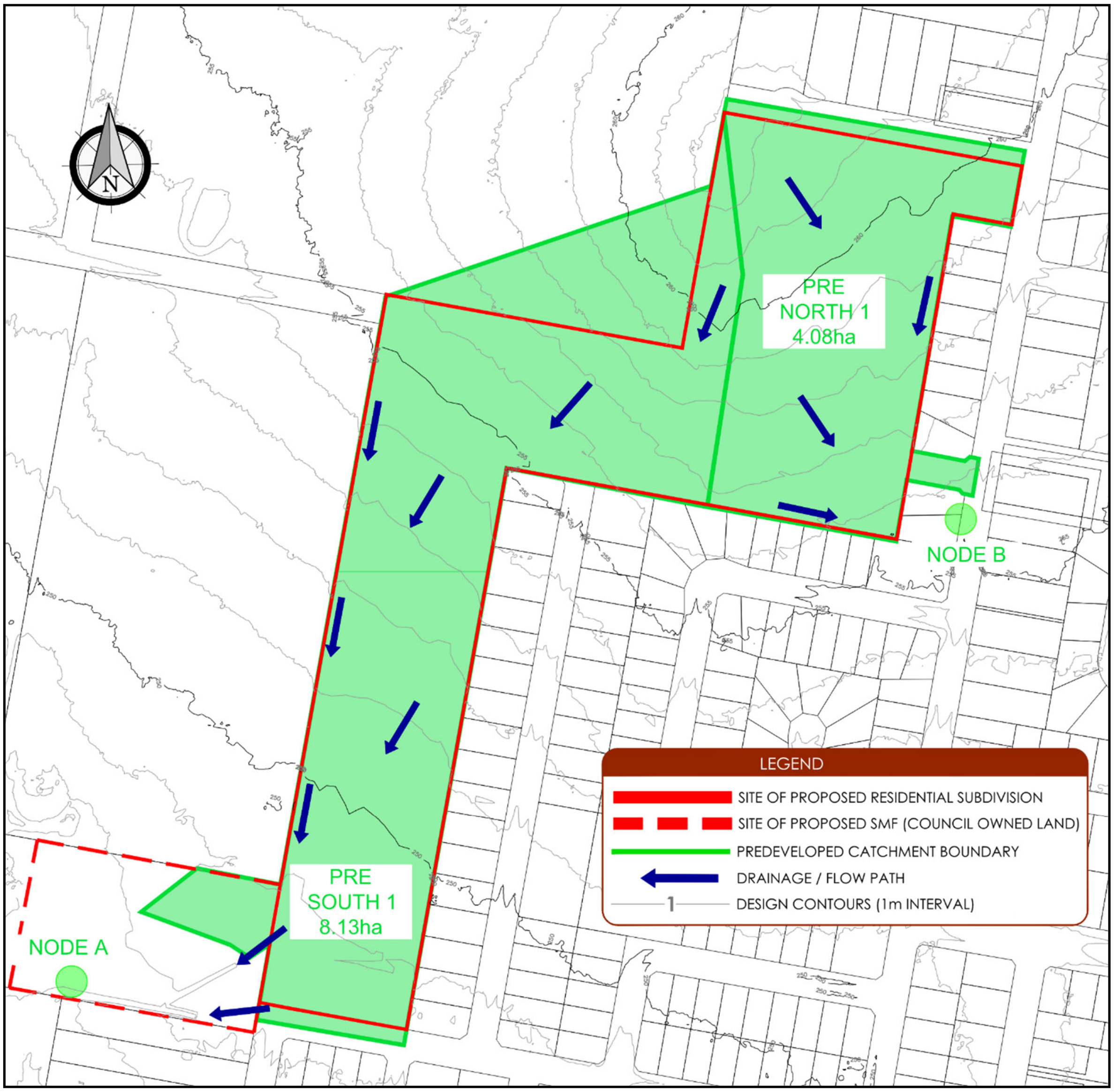

Figure 4: Pre-Development Stormwater Catchments

Table 2: Predeveloped Catchment Areas

Catchment	Area (ha)	% Impervious
Pre South 1	8.13	8%
Pre North 1	4.08	8%
TOTAL	**12.21**	**8%**

6.3 Post-Development Stormwater Catchments

Post-Development stormwater catchments and subcatchments were defined by concept engineering design works completed as part of the wider development, including: site regrading works; proposed road alignments and levels; proposed SMF; existing road and drainage network; etc.

In the absence of standard impervious fractions for land uses within the Forbes Shire Council DCP, impervious fractions were adopted for the proposed development in line with industry best practice.

Two larger lots within Development South 1 catchment have intended uses other than private residential lots. It has been assumed that the larger lots will have an impervious fraction consistent with the proposed development.

The post-development stormwater catchments, along with adopted catchment parameters are shown in Figure 5 and Table 3 overleaf.

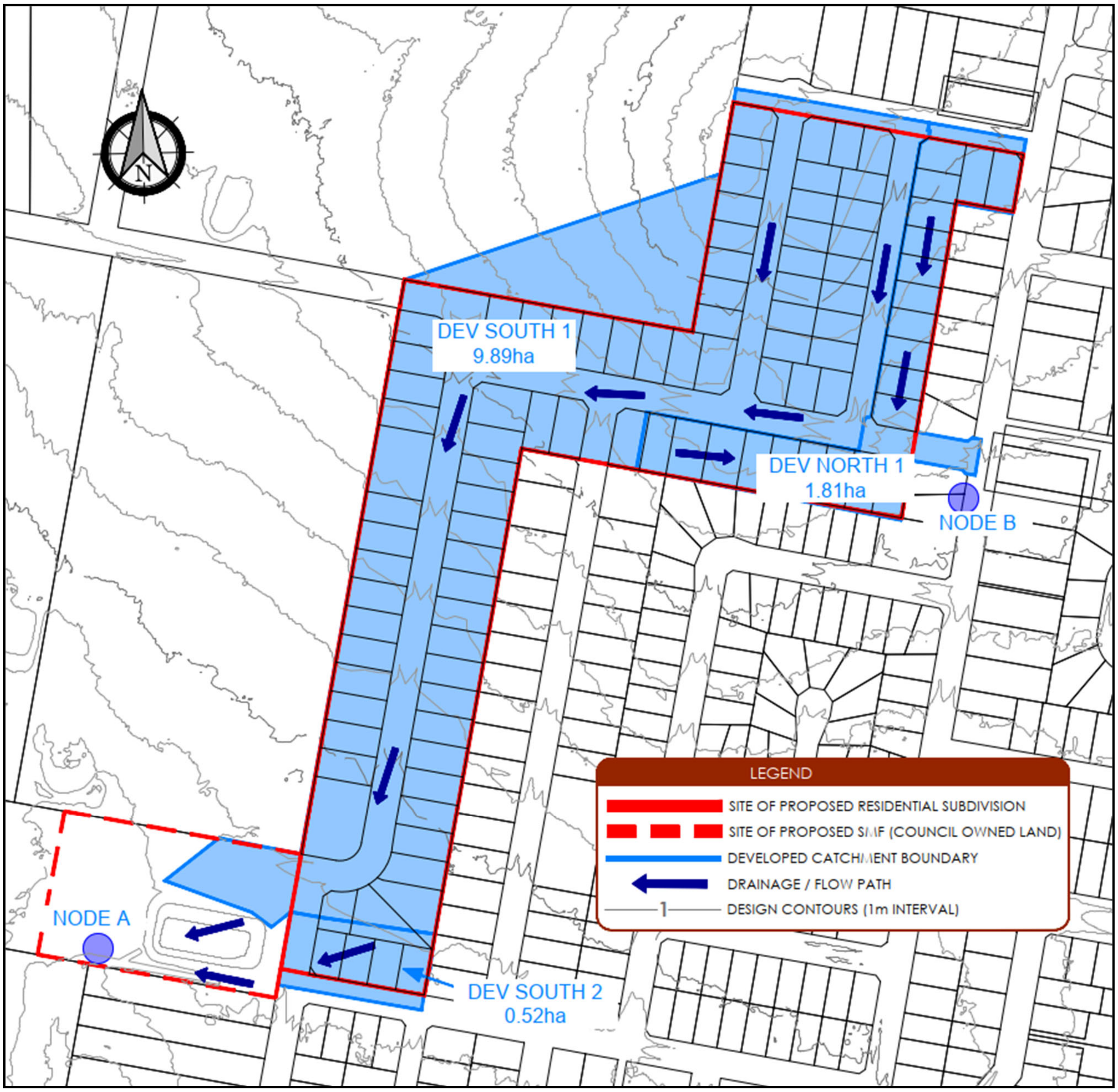

Figure 5: Post-Development Catchments

Table 3: Developed Catchment Areas

Catchment	Subcatchment	Area (ha)	% Impervious
Southern Catchment	Dev South 1	9.89	60%
	Dev South 2	0.52	60%
Northern Catchment	Dev North 1	1.81	60%
TOTAL	**-**	**12.22**	**60%**

6.3 Stormwater Detention Modelling Results

The pre-developed and post-developed peak flows were estimated using XPRAFTS for the 1, 10 and 100-year ARI design storms. Peak flows were investigated at Node A (southern catchment discharge point) and Node B (northern catchment discharge point) – refer to Figures 4 & 5 for node locations.

The post-developed peak flows of the southern catchment (Node A) far exceeded the pre-developed peak flows, therefore warranting a stormwater detention basin in order to maintain existing peak flows into the downstream environment and mitigate impacts on the environment from the proposed development.

Modelling assumed that basin outflows are controlled by a riser pit with a series of cutouts of varying sizes and levels, details of which are shown in Table 4 below. A spillway weir is to be provided to safely convey rare and extreme rainfall events. It is noted that as more detailed design work is undertaken as part of future stages of the development, alternate outlet configurations may be adopted, provided that peak flow attenuation objectives are still met.

Table 4: Basin Details

Basin Parameter	Detail
Basin Description	Detention Basin
Levels	246.5m AHD – Basin Floor Level
	248.3m AHD – Top of Bank Level
Batters	1:5 Internal Batters on South/West Sides 1:10 Internal Batters on North/East Sides
	Variable External Batters
Outlet Controls	Pit – 0.9x0.9m – Pit RL 247.78m Circular Cutout – Ø 175mm – IL 246.5m Circular Cutout – Ø 600mm – IL 247.0m Pit Outlet Pipe – Ø 600mm – IL 246.5m
	Weir – 4m Length – RL 247.9m
Detention Volume at Weir	2,070 m^3

Peak flows for the southern catchment were compared at the location of the formalised drainage swale (Node A) to model the combined peak flow of the basin discharge and the discharge from the small uncontained southern catchment. A comparison of pre-developed and post-developed peak flows at Node A is presented in Table 5 below.

Table 5: Predeveloped and Developed Peak Flows at Node A

Node	Storm Event (ARI)	Peak Discharge (m^3/s)			Difference (Detained Post-Developed minus Pre-Developed)
		Pre-developed	Post-Developed (Undetained)	Post-Developed (Detained)	
Node A	1yr	0.105	0.674	0.080	**-0.025**
	10yr	0.468	1.437	0.403	**-0.065**
	100yr	1.200	2.393	1.096	**-0.004**

Table 5 above shows that the proposed detention basin successfully attenuates peak flows to pre-developed rates in all storm events.

Peak flows for the northern catchment were compared at the location where the catchment discharges from the site into the existing drainage network in Farnell St (Node B). A comparison of predeveloped and developed peak flows at Node B is presented in Table 6 below.

Table 6: Predeveloped and Developed Peak Flows at Node B

Node	Storm Event (ARI)	Peak Discharge (m^3/s)		Difference (Undetained Post-Developed minus Pre-Developed)
		Predeveloped	Undetained Developed	
Node B	1yr	0.034	0.118*	**+0.084**
	10yr	0.273	0.260	**-0.013**
	100yr	0.678	0.476	**-0.202**

Table 6 above shows a minor increase in peak flowrate at Node B was modelled for the 1-year ARI design storm. It is noted that rainwater tanks are proposed on each lot within the catchment with a 'leaky' storage component as per Forbes Shire Council Rainwater Tank Requirements standard drawing *FSC-SD-771* (*Appendix A*) . Whilst not allowed for in the XPRAFTS model, provision of leaky tanks will have an attenuating effect on routine design storms such as the 1-year ARI and therefore it's considered that the modelling results over estimate the post-developed peak flow rates in this storm event.

Overall, it's considered that the peak flow rates associated with stormwater runoff from the proposed development have been attenuated sufficiently to mitigate impacts on the downstream environment. This confirms that there will be no affectation to the flooding behaviour of Lower Morton St at the location of the existing crossing of the mapped watercourse. It should be noted that residential access can be maintained via Edward St regardless of inundation of this crossing.

6. STORMWATER QUALITY

The proposed development is to include water quality treatment devices within the site to reduce pollutant loads prior to discharging downstream. The treatment train was designed to be consistent with the land use requirements from Council, whilst still having the capacity to capture pollutants ranging from gross pollutants and coarse sediment through to nutrients.

The quality of the stormwater discharging from the development was determined using the Model for Urban Stormwater Improvement Conceptualisation (MUSIC). The MUSIC model was used to simulate pollutant source elements for the proposed development and the treatment of the pollutant loading using treatment devices. The treatment train for each subcatchment is outlined in Table 7 below.

Table 7: Treatment Trains

Catchment	Subcatchment	Treatment Train
Southern Catchment	Dev South 1	Rainwater Tanks, GPT, Sediment Basin
	Dev South 2	Rainwater Tanks, Swale
Northern Catchment	Dev North 1	Rainwater Tanks

The developed catchments were delineated according to their treatment trains and points of discharge, identical to the catchments discussed in Section 5. Each catchment was broken down according to surface type as identified from the site masterplan. The MUSIC model incorporated the following surface types:

- Roof (Urban) – This land use defines the impervious roof area. Rooves were assumed to account for 200 m^2 of each lot area and are 100% impervious;

- Lots (Urban) – This land use defines the lot area after the removal of the roof area. Lots were modelled in MUSIC using residential sources nodes. An impervious area was adopted for the lots (without rooves) such that the total area for the lots (including rooves) was modelled as 60% impervious; and

- Road (Urban) – This land use defines the road reserve area. Roads were assumed to be 65% impervious from the typical cross section of each road.

Table 8 below summarises the area and composition of each MUSIC subcatchment adopted.

Table 8: MUSIC Catchment Areas Adopted

Catchment	Subcatchment	Total Area (ha)	Lot (Ha)	Roof (Ha)	Road (Ha)
Southern Catchment	Dev South 1	9.89	5.85	1.52	2.52
	Dev South 2	0.52	0.25	0.08	0.19
Northern Catchment	Dev North 1	1.81	1.12	0.44	0.25

6.1 Rainwater Tanks

Rainwater tanks are at-source controls which harvest roof water and store it for on-site reuse. Modelling was based on the Forbes Shire Council Rainwater Tank Requirements standard drawing *FSC-SD-771* (*Appendix A*). Table 9 below outlines the rainwater tank parameters adopted.

Table 9: Rainwater Tank Parameters Adopted

Parameter	Value
Volume Below Overflow Pipe (L)	5000
Daily Reuse (kL/day/dwelling)	0.324
Number of Tanks	75 (South 1)
	4 (South 2)
	21 (North 1)

The daily reuse was estimated from the NSW MUSIC Modelling Guidelines (BMT WBM, 2015). Allowance has been made for an average household of three people utilising harvested rainwater for toilets, laundry and outdoor use. This conservatively neglects the proposed senior housing and dual occupancy lots.

It should be noted that the 'leaky' storage component of the water tanks was excluded from the modelling.

6.2 Gross Pollutant Traps

Gross Pollutant Traps (GPTs) are utilised as conveyance controls of litter and heavy settlement. Modelling was based on the Humes 'Humegard' which has been implemented successfully throughout developedmene4ts of similar scale. Pollutant removal efficiencies were obtained from Hume's website and are presented in Table 10.

Table 10: GPT Pollutant Removal Efficiencies

Pollutant	% Removal Efficiency
Total Suspended Solids	49
Total Phosphorus	40
Total Nitrogen	26
Gross Pollutants	90

Source: Humes 2024

6.3 Sediment Basin

Sediment Basins are used as end-of-line controls of coarse and medium sediment. The proposed detention basin has been modelled as a sediment basin for purpose of this water quality analysis. Table 11 below summarises the modelled parameters for the basin.

Table 11: Sediment Basin Parameters

Parameter	Value
Surface Area (m^2)	1600
Extended Detention Depth (m)	0.5
Permanent Pool Volume (m^3)	0
Exfiltration Rate (mm/hr)	0
Evaporative Loss as % of PET	100

The sediment basin is assumed to be ineffective in settling sediment for depths above the invert of the DN600 cutout within the outlet pit. Therefore, the invert of this cutout was adopted as the top of extended detention depth.

6.4 Vegetated Swales

Vegetated Swales are used as conveyance controls of coarse sediment and total suspended solids. The existing formalised drainage swale at the southwest boundary of the development site was modelled as a vegetated swale. Table 12 below summarises the modelled parameters for the swale.

Table 12: Vegetated Swale Parameters

Parameter	Value
Length (m)	100
Bed Slope (%)	0.5
Base Width (m)	3
Top Width (m)	5.5
Depth (m)	1.3
Vegetation Height (m)	0.5
Exfiltration Rate (mm/hr)	0

6.5 MUSIC Modelling Results

A network diagram of the MUSIC model, showing catchment links and treatment devices for the northern and southern catchments, is provided as an appendix to this report (*Appendix B*). The average annual pollutant loads from the overall development and the associated pollutant reductions are provided in Table 13 below.

Table 13: Treatment Train Effectiveness (Overall Development)

Pollutant	Developed Untreated Load (kg/yr)	Developed Treated Load (kg/yr)	Modelled Reduction (%)
Total Suspended Solids (TSS)	7260	1510	79.1%
Total Phosphorous (TP)	13.4	5.45	59.4%
Total Nitrogen (TN)	92.2	55.0	40.3%
Gross Pollutants (GP)	1550	151	90.3%

Table 13 above shows the treatment train successfully reduces the pollutant loadings from the development to a satisfactory level, in-turn mitigating impacts on the environment associated with the quality of stormwater runoff from the proposed development.

7. SOIL AND WATER MANAGEMENT

All erosion and sediment controls and practices are to be in accordance with Landcom's Managing Urban Stormwater: Soils and Construction (2004) ('the Blue Book'). No additional requirements are prescribed by Forbes Shire Council.

Treatment devices will be utilised to contain the generated pollutants from the site during construction. These include but are not limited to:

- Silt Fencing;
- Strawbale and Geotextile Fencing;
- Kerb Inlet Controls;
- Sandbag Kerb Inlet Sediment Traps;
- Shaker Ramps; and
- Diversion Drains.

Any clean water entering the site from upstream catchments is to be diverted around the construction site where possible hence remaining clean. Runoff generated from within the site is to be treated and managed using a combination of the above stated treatment devices.

Construction is likely to be staged to minimise the area of disturbed soil at any given time. Consideration will be given to the construction of temporary sediment basins which would be sized and configured during detailed design. The location of the proposed SMF would be a suitable location for a temporary sediment basin during construction.

A preliminary Soil and Water Management Plan is presented within the associated concept engineering plans (*240380(2)-CENG*) by ADW Johnson. The Soil and Water Management Plan is indicative only as another Soil and Water Management Plan will be provided as part of the construction certificate drawings and a further plan will be provided by the contractor to evolve during construction.

The development requires works in close proximity to the mapped watercourse at the south-western corner of the site. The scope of works is outside the footprint of the mapped watercourse. All works would be subject to detailed design and the contractor's Safe Work Method Statement (SWMS), however, probable construction methodology for key work components are provided below.

The project will require relocation of an existing watermain located near the southern boundary of the site. Construction methodology is likely to contain the following:

- Establishment of erosion and sediment controls, including sediment fences, construction access, gravel bags;
- Delineate No-Go areas, including the watercourse;
- Trenching, laying of watermain pipe and backfilling along new designed alignment;
- Location, trenching and removal of existing watermain as required by design;
- Site restoration and stabilisation of disturbed areas.

The project will require realignment of an existing road (Lower Morton St) near the southern boundary of the site. Construction methodology is likely to contain the following:

- Establishment of erosion and sediment controls, including sediment fences, construction access, gravel bags;
- Delineate No-Go areas, including the watercourse;
- Establishment of a Traffic Management Plan, maintaining access for residents along Lower Morton St;
- Stripping and stockpiling of topsoil;
- Minor earthworks;
- Import and placement of pavement materials;
- Removal of existing pavement as required by design;
- Site restoration and stabilisation of disturbed areas.

The project will require construction of the detention basin and the formalisation of the existing drainage swale in the south-western corner of the site. Construction methodology is likely to contain the following:

- Establishment of erosion and sediment controls, including sediment fences, construction access, gravel bags;
- Construction of temporary sediment basin off-line from proposed detention basin;
- Delineate No-Go areas, including the watercourse;
- Construction of temporary stormwater diversion drains to direct runoff away from work area;
- Stripping and stockpiling of topsoil;
- Minor earthworks;
- Trench basin key;
- Construct clay core embankment using imported material;
- Construct stormwater inlet and outlet structures, including weir;
- Excavation of drainage swale;
- Installation of rock scour protection;
- Site restoration and stabilisation of disturbed areas.

To protect receiving channels from erosion, all piped outlets will have scour protection comprising of rock rip-rap and geofabric. Rock scour protection plays an important role in reducing velocities and dissipating energy of stormwater outflows. Rock size and mattress dimensions would be subject to detailed design and will be based on best-practice guidelines by Catchment and Creeks. Scour protection will be neatly placed to interface between existing and design surface levels.

The formalised drainage swale to the south of the basin will be grass-lined, consistent with the existing drainage swale, ensuring a natural transition.

8. ONGOING OWNERSHIP & MAINTENANCE

Upon completion of the development, all internal roads and associated stormwater infrastructure within them, along with the proposed SMF, will be dedicated to Council. Council will in-turn be responsible for the ongoing maintenance and performance of the system.

Having this ownership and ongoing maintenance pathway in place further mitigates any potential long-term impacts on the environment through neglect of the stormwater network and SMF.

9. CONCLUSION

ADW Johnson has been engaged by LAHC to prepare a Stormwater Management Plan (SWMP) addressing stormwater management requirements for the proposed residential subdivision of Lot 7332 DP1166365, Lot 7025 DP1020631 and Lot 7317 DP1166614.

The results of this report confirm that the stormwater management objectives in relation to stormwater detention and water quality can be upheld. Peak stormwater discharges will be managed by a detention basin located adjoining land owned by Council (part of Lot 1 DP1077961), in addition to 'leaky' rainwater tanks provided on each lot, thereby generally limiting peak development flow rates to below pre-developed flow rates. It's considered that this system mitigates impacts on the environment associated with peak flow rates of stormwater runoff from the proposed development.

A Stormwater quality model, comprising of rainwater tanks, gross pollutant traps, a sediment basin and a drainage swale was developed and assessed through nutrient control modelling. The proposed treatment train approach achieved satisfactory reductions in pollutant loads, thereby mitigating impacts on the downstream environment associated with the quality of stormwater runoff from the proposed development.

To ensure downstream waters and adjacent properties are protected, appropriate erosion and sediment controls are to be undertaken during construction. Controls are to be implemented and monitored in accordance with Landcom's 'Blue Book' and Council's Manual of Engineering Standards.

Council's ownership and ongoing maintenance obligations for the stormwater network within the proposed public roads, along with the proposed SMF, ensures that long-term impacts on the environment as a result of stormwater runoff from the development can be mitigated.

Should you have any questions or require any further advice please do not hesitate to contact the undersigned on (02) 4978 5100 or email christianl@adwjohnson.com.au.

Yours sincerely,

Christian Langley

CHRISTIAN LANGLEY
CIVIL ENGINEER
ADW JOHNSON PTY LTD
HUNTER OFFICE

Appendix A

FORBES SHIRE COUNCIL STANDARD DRAWING FSC-SD-771 – NEW DEVELOPMENTS – RAINWATER TANK REQUIREMENTS

Appendix B

MUSIC MODEL

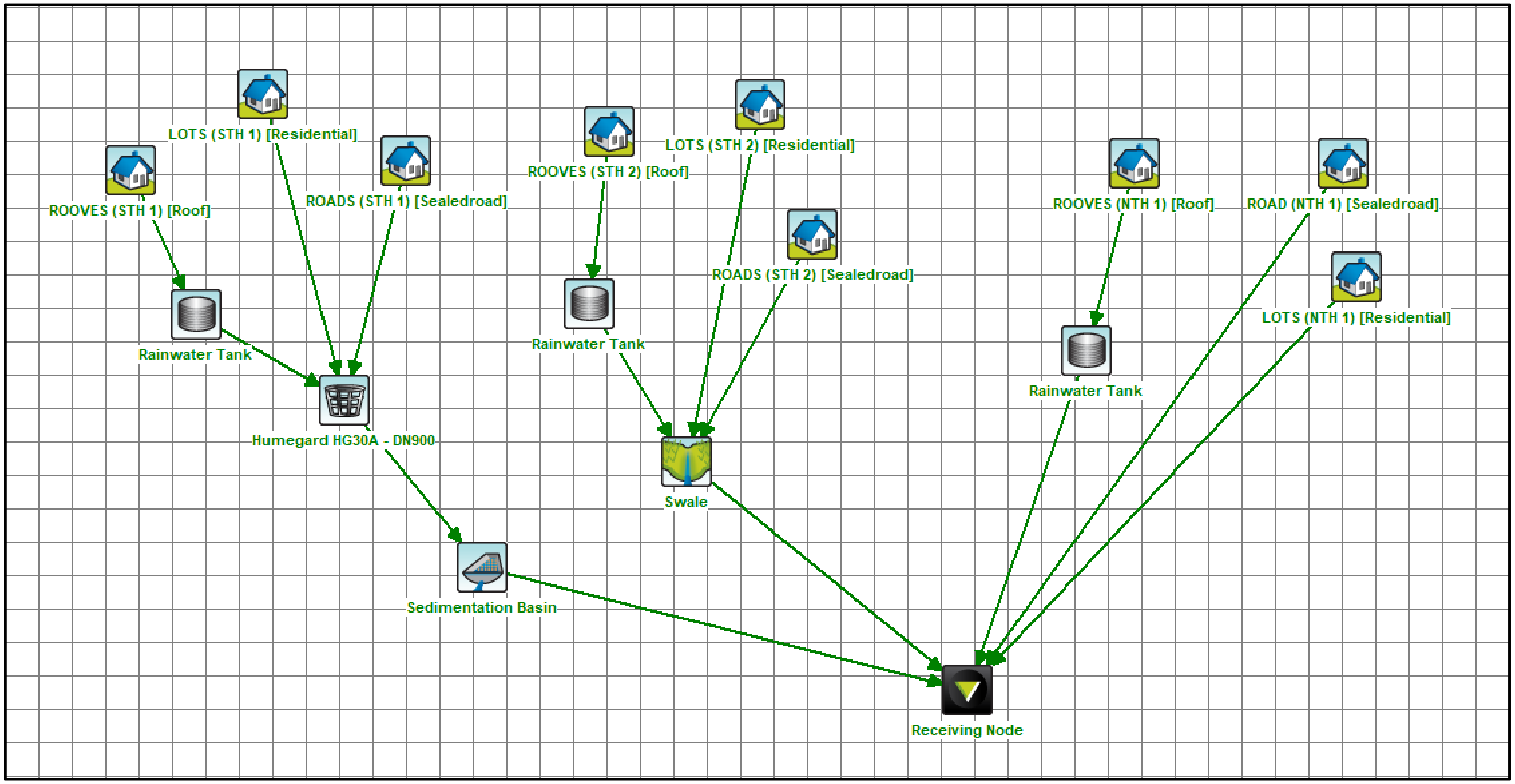

Figure B-1: MUSIC Model.