South Werrington Urban Village Precinct

Stormwater Management Strategy

Universal Property Group

9 March 2017
Revision: 5
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1 Introduction

This report is prepared in support of the proposed development of Lot 102 DP 1140594 in accordance with the Penrith Local Environmental Plan (South Werrington Urban Village) 2009 planning provisions.

The Report provides conceptual proposals for the provision of onsite detention (OSD) and water quality for stage 1 and stage 2 of the proposed development for the subdivision layout proposed for the site. The design of the OSD and water quality treatments are in accordance with the overall master planning for the Werrington precinct and maintains key features such as watercourses, road layout and permeability for pedestrians.

1.1 The Site

The site (Lot 102) is located in Werrington and is part of Penrith LGA. The land is contained within existing housing and light industrial sites to the north and east, a remand centre and college on the southern boundary and the University of Western Sydney on the western boundary.

The LEP provides the zoning within the site as indicated in the figure below:

Figure 1: Site Zoning

Zone Identification		Zone Description	Zone Area (ha)
E2		Environmental conservation	1.39
R1		General residential	6.68
R3-1		Medium density residential	2.07
R3-2		Medium density residential	0.49
IN2		Light industrial	9.03
RE1-1		Public recreation	1.30
RE1-2	Public recreation	6.97	
	Total Site Area	27.97	

2 Werrington Masterplan

2.1 Drainage

Existing watercourse information has been obtained from the Dept. of Planning. This includes minor and major watercourses identified by the Department, representing the primary overland flow paths for the Werrington precinct.

Primary drainage routes identified around the site are Claremont Creek to the south-east of the site and an unnamed watercourse to the west. These major watercourses are characterised by defined overland flow paths, existing farm dams and well defined gulleys and are shown on drawing CIV-002 rev A below. Neither of these watercourses cross the subject site.

Minor watercourses are identified from contours and represent overland flow routes during storm events. The mapping for these routes as shown below is obtained from contours and does not include the effects of existing roads and other structures that could divert flows. These minor watercourses do not affect the site. Overland drainage routes will be accommodated by the proposed development of the site through the strategic location of open space with drainage channels.

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TITLE: EXISTING OVERLAND FLOW PATHS
DRAWING No.: 241636 – 0000 – DRG – CIV – 0002 – A

2.2 Roads

The Dept. of Planning data and previous Master planning reports includes major roads within the site. Existing roads are cut off from the north of the site by the existing railway, while the large private developments on the University site to the west and the Remand Centre to the south have precluded roads through these developments into the site.

The site boundaries, zoning and natural contours lead to a north/south east/west road grid, as this orientation follows the natural ground contours and facilitates drainage on the roadways. It is anticipated that a north-south access road will be required to supplement Werrington Road with an east-west connection through the University site, as shown on the Masterplan.

Primary access to the site will be obtained from Werrington Avenue in the long term. This would intersect Werrington road at the existing Kingsway intersection. Upgrades will be required to the intersection to accommodate the volumes of traffic generated by the proposed subdivision. Immediate road access is available from Chapman Street, via Rance Road. This access would be suitable for a maximum of 414 additional dwellings and would require a roundabout to be provided on the intersection of Rance Road and Werrington Avenue.

2.3 Guidelines used and Background information

Documentation and information gathered and analysed to support the Stormwater Strategy for the proposed development.

- "*South Werrington sub-precinct Masterplan Servicing and Stormwater Management* " Issue 4 August 2007 Patterson Britton and Partners
- Penrith Development Control Plan 2014
- Stormwater Drainage For Building Developments (Working Draft) Penrith Council 14th October 2013
- Site walkover 28/07/15
- Site Survey completed by SDG Land Development Solutions 27/02/13
- Regional contours obtained via an aerial survey

3 Development staging

The development within in the South Werrington Urban Village precinct to be undertaken by Universal Property Group is to be constructed in multiple stages, commencing with stage 1 and stage 2 in the short term.

The first stage of the development 8.3ha is located in the north-western area of the site, adjacent to the western rail line and the University Site (refer to figure 1 below). Stage 1 is proposed to include 85 lots, roads and an environmental conservation reserve. The stage 1 development will be accessed from the Chapman Street.

Stage 2 of the development, approximately 2ha will be located to the east of stage 1 and will comprise an additional 102 dwellings with private roads. The public reserve space will be provided in this stage (zone RE1-1).

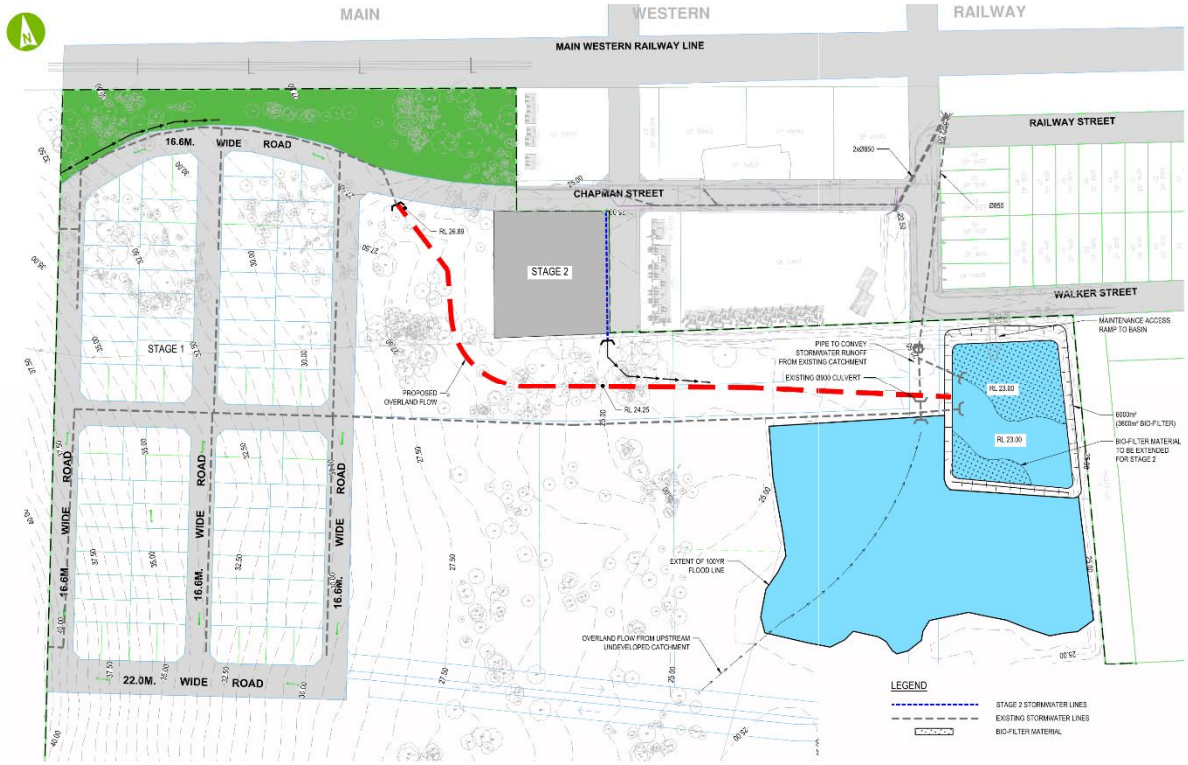


Figure 1 Masterplan layout of stage 1 and 2

3.1 Existing Site Drainage

The nature and extent of existing site drainage required for the final development of the site has been assessed and recommendations provided in the "*South Werrington sub-precinct Masterplan Servicing and Stormwater Management*" report by Patterson Britton and Partners (PB Report).

The majority of the development site (approximately 33.6ha) and external catchments running through the site (approximately 19.3ha) fall to the north where runoff is collected and discharged via an 825mm diameter concrete pipe. The remaining development area falls to the east of the east of the site and is collected in Claremont Creek. Both Claremont Creek and Warrington Creek drain into South Creek.

Refer to drawing CIV-0025 in appendix A for existing catchment layout (existing catchments based on PBP report and Regional contours)

3.1.1 North Catchment

The inlet to the 825 mm diameter pipe draining the north catchment is located within a 2m high earth bank and the pipe discharges to an open channel on the corner of Landers and Railways street. The open channel routes flows to two culverts which carry the runoff under the existing railway line. The first culvert is located to the north west of Landers Street and the second to east of Landers Street, adjacent to Werrington Station. The culverts are 1150mm diameter and 1200mm diameter pipes and their ultimate discharge point is Werrington Creek. The open channel and pipes also collect drainage from the surrounding dwellings and roads within Chapman and Walker Street.

A small detention basin is located to the east of Lander Street and to the north of the developments inlet. From site inspections, the basin appears to be an offline surcharge basin, designed to store excess runoff when the two railway culverts reach capacity.

The proposed stages 1 and 2 of the development are located in the northern catchment draining into Werrington Creek.

3.1.2 South Catchment

Later stages of the development will drain to the south catchment after stages 1 and 2 have been completed. This report includes the effects of stages 1 and 2 only and does not address the recommendations for the south catchment provided in the PB report.

3.1.3 Existing Stormwater Quantity

The Northern catchment (O1 to O3 and E to G) as aforementioned discharges via 825mm diameter inlet that is constructed into a 2m high bank within a low lying area. The bank surrounding the inlet is constructed for 240m along the northern boundary. Its location, shape and height indicates that the bank was constructed to detain flows leaving the site. This is confirmed by the PB report, with the 825mm outlet restricting outflows and leading to the ponding of surplus runoff during severe storms. The existing basin has been included in the modelling of the drainage system of the existing development. It is noted that the small detention basin adjacent to Landers Street has not been included in the stormwater quantity calculations as this lies downstream of the site and will not have a significant effect on the site drainage.

3.1.3.1 Modelling

Stormwater modelling of the existing development catchments has been undertaken using DRAINS version 2015.07, utilizing the PB report's predevelopment catchment characteristics, the site survey and inspection and regional contours.

The DRAINS inputs referenced from the PB report are:

Table 3-1 Catchment characteristics

Node	Total Area(ha)	% impervious	Vectored Average Slope	Mannings n Pervious	Mannings n Impervious
E	6.31	5	4.0	0.04	0.018
F	15.24	0	3.4	0.04	0.018
G	12.07	5	1.7	0.04	0.018
O1	3.57	0	10.7	0.04	0.018
O2	2.26	0	9.0	0.04	0.018
O3	11.22	25	1.0	0.04	0.018

Additional DRAINS Inputs

Table 3-2 flow path lengths

Node	Flow path length (m)
E	330
F	690
G	590
O1	197
O2	177
O3	685

Rainfall losses input to drains has been selected to match the RAFTS modelling undertaken by Patterson Britton Partners for the required detention basin at completion of the Masterplan. These values require refinement for the detailed design of the detention facilities:

Paved area depression storage = 5mm*

Grassed area depression storage= 20mm*

Penrith Councils IFD table was used from Stormwater Drainage for Building Developments (Working Draft) Penrith Council 14th October 2013. A copy of the IFD table is located in appendix B.

The results of the drains model in Table 3-3 represent the existing catchment without the existing detention basin modelled. Three ARI events have been modelled, the 100yr, 20yr and the 1yr for the critical storm.

Table 3-3 DRAINS results for existing development-without the existing basin

Node	1 Year (60min)	20 Year (90min)	100year (120 min)
Northern Outlet	0.371(m³/s)	3.92(m³/s)	7.9 (m³/s)

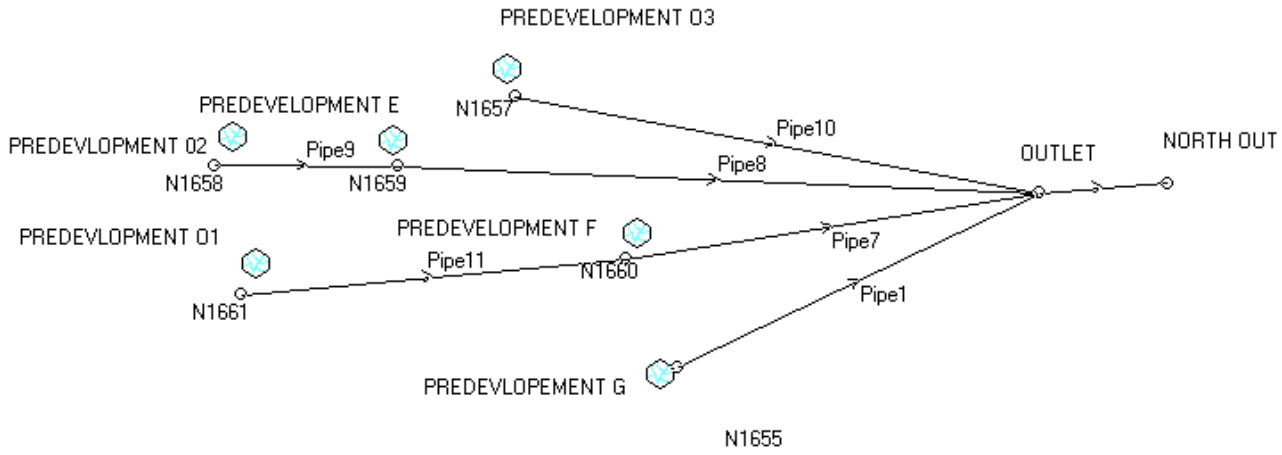


Figure 3-2 DRAINS model 1- no existing basin modelled

The site inspection and the previous PB report indicate that the presence of an earth bank at the inlet discharging flows from the site is acting as an existing basin. The PB report acknowledge the existence of the basin but does not include modelling of the basin in their RAFTS model.

DRAINS modelling undertaken for this report includes the existing storage at the inlet due to its importance for reducing the predevelopment flows exiting through the 825mm diameter inlet and to calculate the existing flood levels for the 100yr and 20yr ARI events around the inlet. Drainage model's parameters and characteristics used match the previous PB report drainage model with the exception of the basin (which has been added). Height and volumes of the existing basin were calculated from the existing survey and using 12D software. The results from the models are represented in the table below:

Table 3-4 DRAINS results for predevelopment basin with existing basin

Node	1 Year (60min)	20 Year (90min)	100year (120 min)
Northern Outlet	0.352 (m³/s)	2.19 (m³/s)	3.23 (m³/s)
Outlet from existing basin	0.322 (m³/s)	1.48 (m³/s)	1.67 (m³/s)

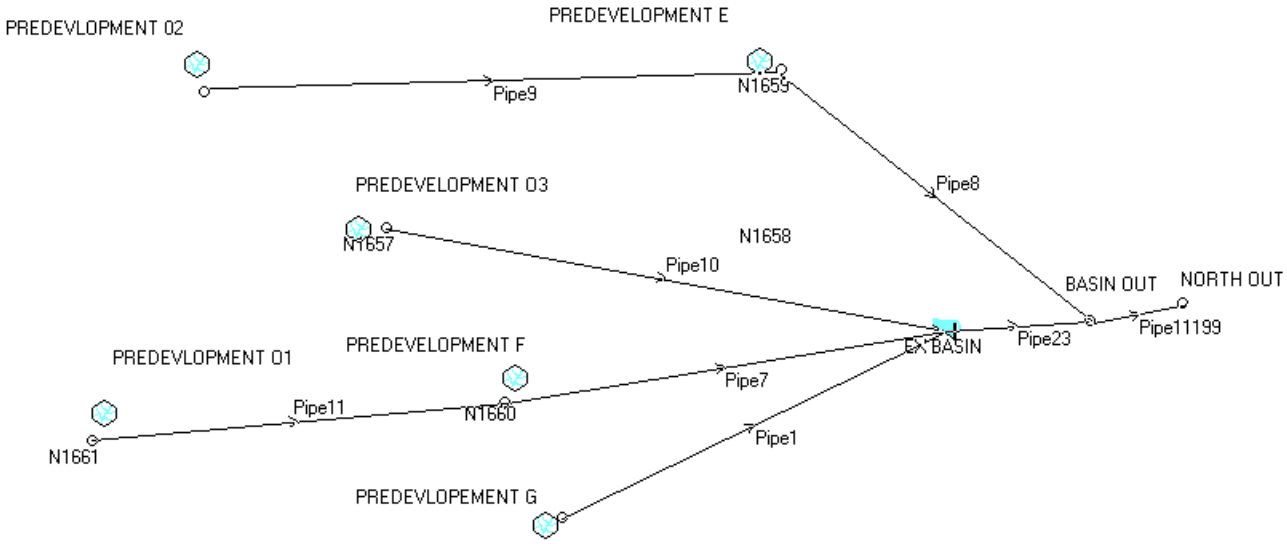


Figure 3-3 DRAINS model 2 with existing detention basin

The predevelopment 100yr ARI flood level for the existing basin has been calculated within drains, the RL of the flood level is 24.2m (AHD). See figure 3-2 below indicting the extent of the 100yr flood level for the existing basin.

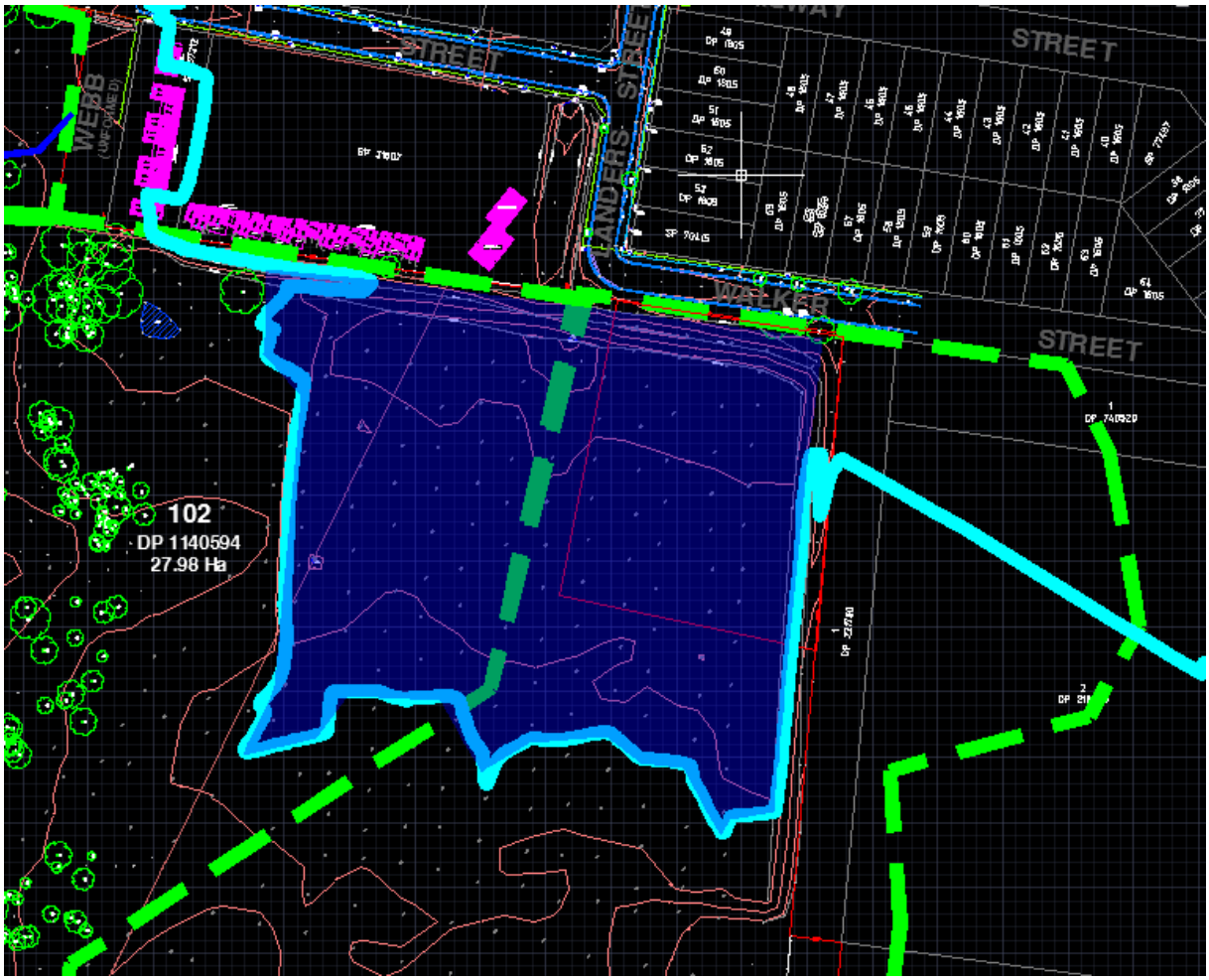


Figure 3-4 100yr flood extent around site inlet

The completed DRAINS modelling with the existing basin indicates that the site discharge for the northern catchment is 3.23m³/s for the 120min duration 100yr ARI. 3.23m³/s peak flow for the existing catchments will form the target peak flow rates in which the new development will either meet or reduce. The peak flows discharging from the site calculated by including the existing basin are less than those provided by the PB report. Both models used to date are conceptual and 2-dimensional modelling should be undertaken at the detailed design stage to confirm the permissible site discharge more accurately.

The use of the reduced peak flows calculated for the undeveloped site limits the maximum permissible discharge allowed after development and results in a conservative estimate for the detention facilities required.

3.1.4 Existing Stormwater Quality

The existing site and external catchments are predominantly covered in light vegetation and grasses. There is currently no known treatment of the existing runoff from the site.

3.2 Stage 1

The proposed stage 1 of the development includes 85 lots, associated roads and an environmental conservation reserve to the north east of the development. Access to Stage 1 will be off the existing end of Chapman Street.

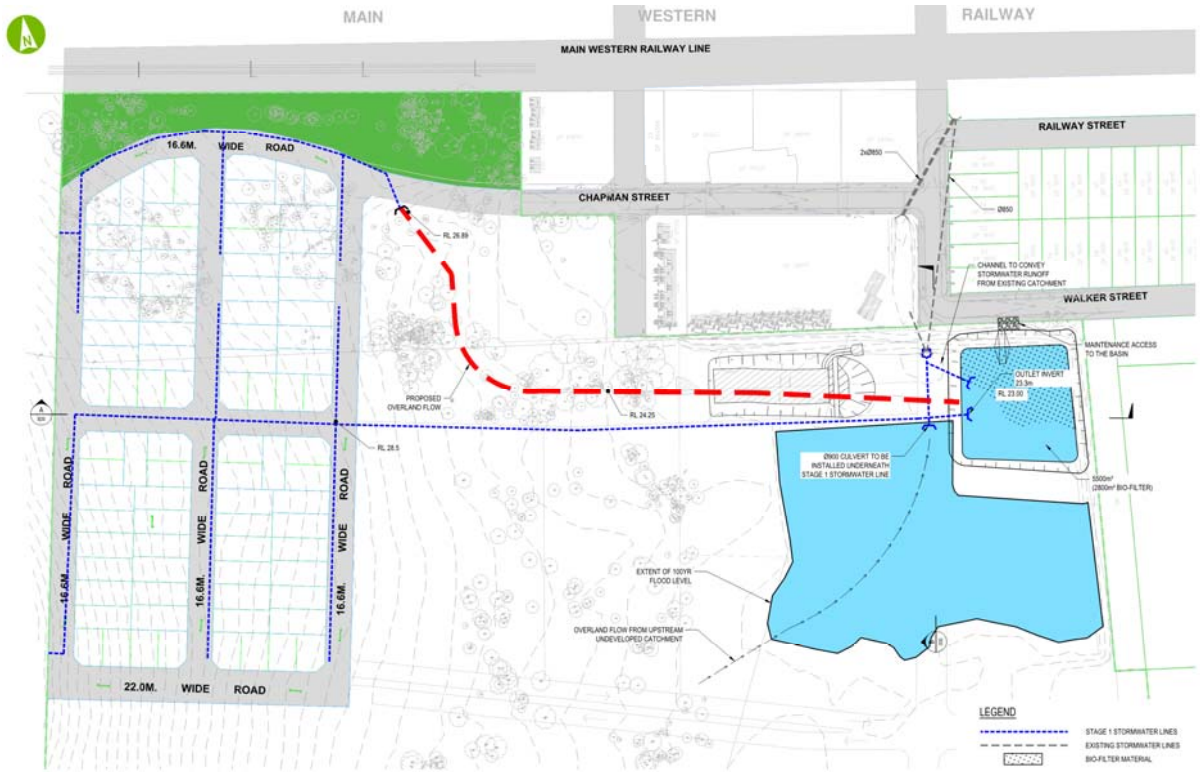


Figure 3-5 Stage 1 development masterplan

3.2.1 Stage 1 Erosion and Sediment control

Erosion and sediment control measures will be implemented during construction. These measures will be in accordance with the “Managing Urban Storm Water” guidelines provided by Landcom and will be agreed with Council prior to commencement of work on site.

The erosion and sediment control measures proposed have been designed to minimise the effect on of the proposed earthworks on the receiving environment. The proposed earthworks generally involve:

- Stripping of topsoil;
- Bulk earthworks to establish building platform levels;
- Relaying of topsoil;
- Installation of services and pipelines;
- Construction of roads;
- Landscaping

3.2.1.1 Stage 1 Sediment sources during construction

The following sediment sources will be present during the construction works:

- Erosion from disturbed ground created by bulk earthworks;
- Erosion from installation of services and construction of road;
- Truck movements;
- Stockpiled material;
- Dust from the site.

3.2.1.2 Basis of Design

The preparation of this Erosion and Sediment Control Management Plan (ESCMP) has been undertaken in accordance with the "Managing Urban Storm Water" guidelines provided by Landcom. This document is referred to as blue book Guidelines in this document.

3.2.1.3 Control measures

Stabilised construction entrances

There is one proposed stabilised construction entrances for the Stage 1 works area. The stabilized entrance is proposed to the north east of the stage 1 works area at the end of Chapman Street. The construction entrance will shake off any dirt from construction vehicles leaving the site. This then prevents sediment being tracked onto the existing roadways. The site stabilised entrance will be constructed and maintained in accordance with the blue book Guidelines (SD 6-14).

Silt fencing

Silt fences will be used during various stages of construction and are not to be limited to the areas shown in the proposed Erosion and Sediment Control Plan (drawing 241636-0000-SK-CIV-0010). Silt fences will also be installed around stockpiles and at the toe of batter slopes to treat sediment laden runoff from exposed areas.

All silt fences will be installed and maintained as outlined in the blue book Guidelines (SD 6-8).

Runoff diversion channels

Runoff diversion channels will be constructed around the perimeter of proposed roadways. The channels will intercept sediment laden water and divert flows to the proposed sediment treatment devices. An overland flow path will be provided through the public open space for drainage from the extension of Chapman Street.

Clean water diversion channels will also be constructed on the upstream perimeter of the development stage to the west of the works area. The channels will divert clean water away from the site and disperse flows into the existing catchment area. The separation bund between the sediment laden and clean water diversion channels will prevent clean water from becoming contaminated with sediment. All diversion channels will be constructed and maintained as outlined in the blue book Guidelines (SD 5-5).

Sediment retention pond

The sediment pond is located to the north east of the works area, adjacent to northern inlet of the site beside Landers Street on the northern boundary of the site.

The pond has been calculated using the method and calculations specified in the Blue book guidelines. The underlying soils of the site have been classified as Luddenham Soil which correlates to sediment type D for sediment pond sizing calculations. The duration for stage 1 of the development will be over 6 months and the site being located in close proximity to the railway corridor and downstream water courses makes the site particularly sensitive. Therefore the storm depth of the 5 day 85th percentile has been used (35.0mm) as a more conservative approach.

Using the calculation Spreadsheet from the blue book the sizing for the pond is presented in the table below

Table 3-5 Sediment basin storage stage 1

Sediment Basin	Sediment Basin Storage (soil) volume	Sediment Basin Settling (water) Volume	Sediment basin total Volume
Stage 1	125m³	1485m³	1610m³

Refer to Appendix D for calculations.

3.2.1.3.1 Dust control

Dust will be managed onsite by the use of water trucks to damp exposed areas, and covering of any stockpiled materials.

3.2.1.3.2 Inlet protection

Existing gully pits in close proximity to the proposed works will be fitted with inlet protection to prevent sediment entering the piping network. Inlet protection will be constructed and maintained in accordance with the blue book Guidelines (SD 6-11).

3.2.2 Stage 1 Stormwater Quantity

3.2.2.1 Site levels

The natural slope of the site is from the south-west to the north-east. Existing ground levels range from RL40 on the south-west corner to RL25.0 on the north–east. The on-site detention basin has been located in the lowest north-eastern corner of the site and the drainage concept report envisaged all runoff from the roads to be piped to this basin.

The detention basin levels have been calculated to provide the minimum bio-filtration and storage depths feasible for the site, with outlet pipes connecting to existing infrastructure under Chapman Street and the adjacent railway line. It is not possible to lower the invert of this basin due to the flat gradients of the outlet system, a storage depth of 1.0 metres has been allowed for.

It is desirable to avoid filling on the public open space areas on the northern boundary of the site and the required gradients for the roads and storm water pipelines have been assessed with a view to retaining the natural levels and vegetation within these areas. Due to the size of the site it has been necessary to assess three options for the proposed levels and drainage of the northern portion of stage 1 of the proposed development:

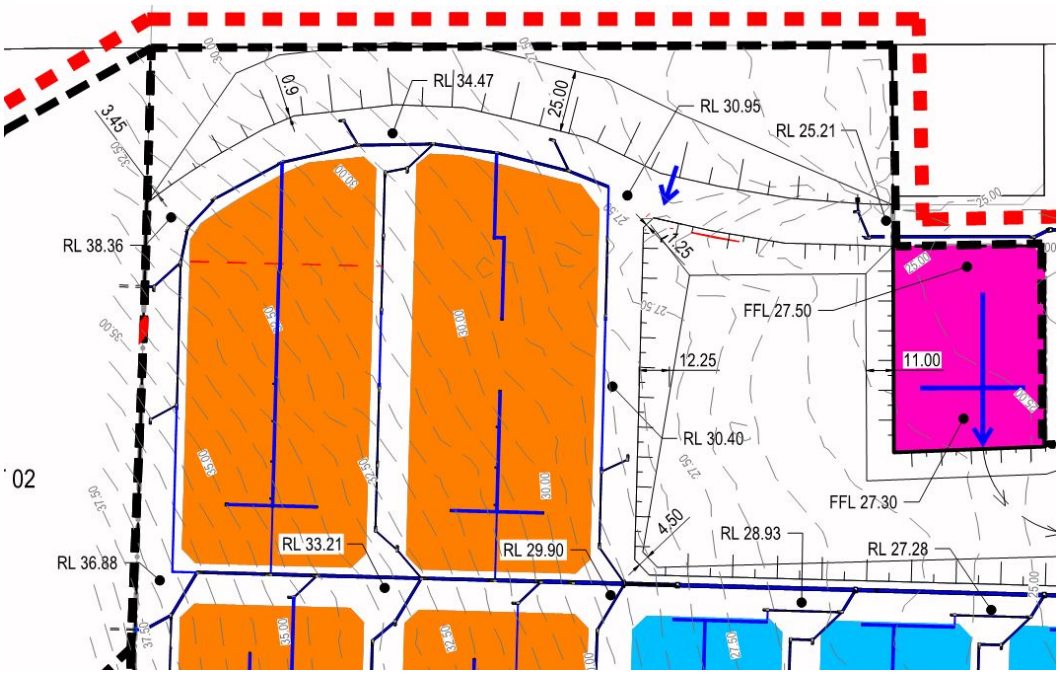
- Option 1 – Fill site to facilitate gravity drainage at minimum grades
- Option 2 – Avoid fill and connect norther portion of Stage 1 drainage to Chapman Street
- Option 3 – Avoid fill and route northern portion of the site through the public open space

3.2.2.2 Option 1 – Fill on northern portion of stage 1

Road levels have been calculated based on Council's minimum requirements for road and drainage grades of 0.7%. All drainage for the roads is routed in underground pipes for storms up to the 20 year ARI and overland on the roads for more intense storms. Final constructions levels for the roads for this option are provide in the sketch below.

The levels required to facilitate surface drainage of the full catchment as defined in the Patterson Britton Masterplan result in road levels on the Chapman Street extension to the north of stage 1 of approximately RL34.47. This is 5.5 metres above the existing ground level at this point. Filling the site to this level would require batters to extend 25 metres into the public open space to the north, affecting the existing vegetation and amenity of the space.

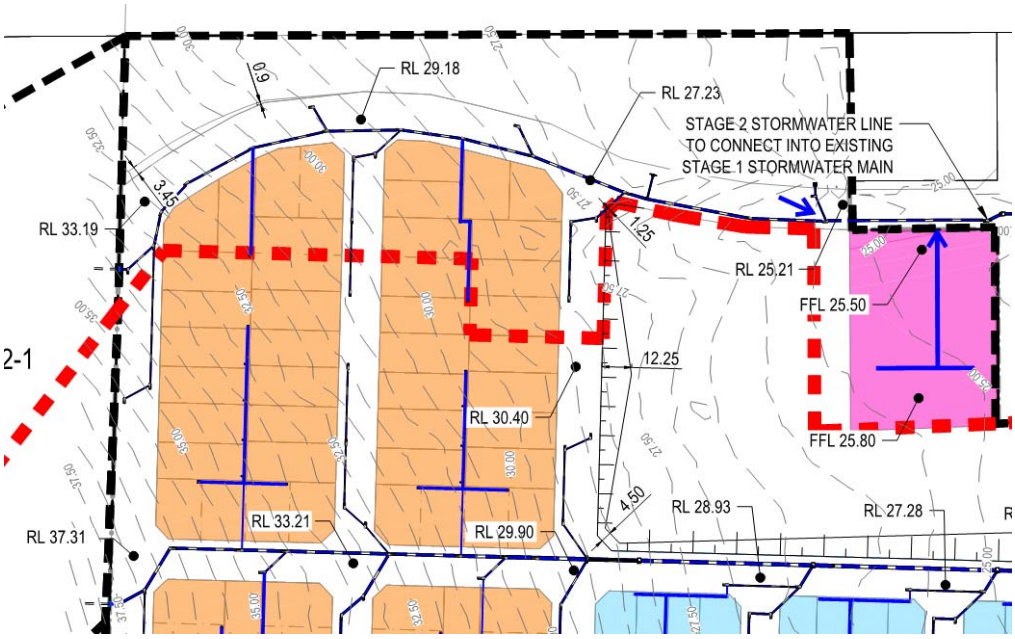
Drainage and water quality modelling has been undertaken for this option and is presented in this report



3.2.2.3 Option 2 – Avoid fill and connect norther portion of Stage 1 drainage to Chapman Street

It was considered unfeasible to fill the site and the Chapman Street extension by 5.5 metres and a Section 96 application was submitted to Council to route the northern portion of stage 1 into Chapman Street. The area routed into Chapman Street would by-pass the OSD a basin and calculation have been undertaken to ensure that the runoff and water quality from the entire site is within Council's standard requirements.

Final constructions levels for the roads for this option are provide in the sketch below.

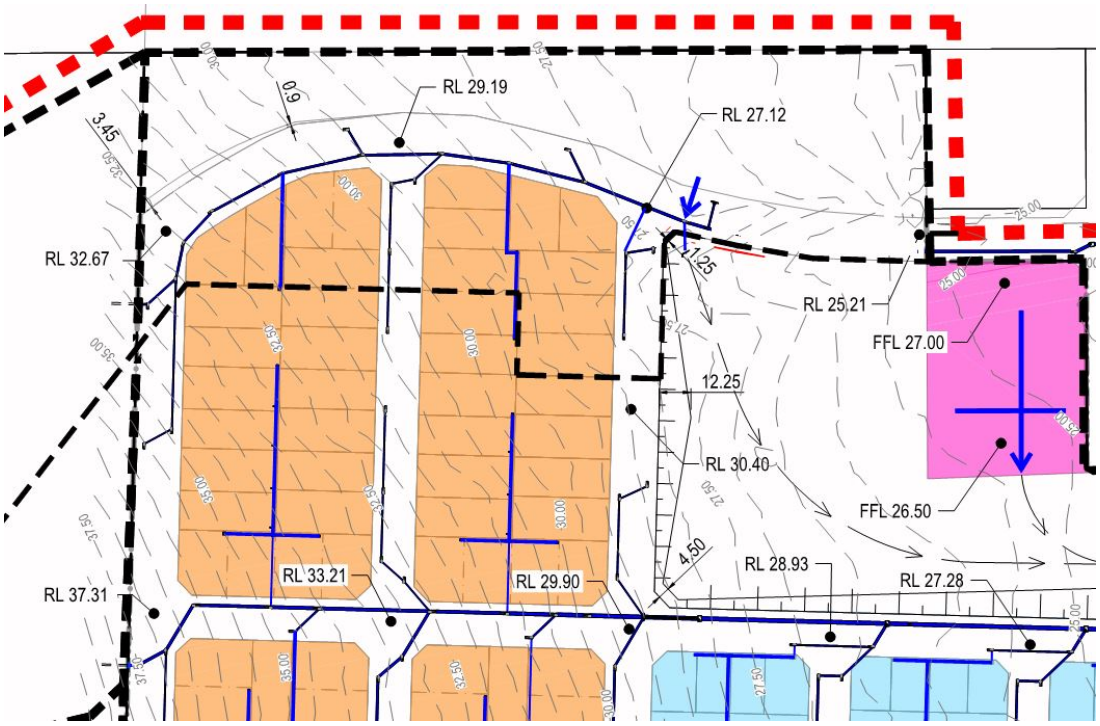


This option reduce the fill at the chapman Street extension, with the majority of the road being constructed at the existing ground levels.

Option 2 is not preferred as it is inconsistent with the adopted PB Report (the adopted PB Report for the precinct does not involve any diversion of stormwater directly to Chapman Street away from the identified detention basin and seeks to drain the whole development to the detention basin) not accepted by Council and no further drainage or water quality modelling are provided.

3.2.2.4 Option 3 – Avoid fill and route northern portion of the site through the public open space

Council have indicated that the routing of the drainage of the northern section to Chapman Street is not acceptable. A third option has thus been proposed which routes this flow through the open space. This avoids excessive fill on the Chapman Street extension and retains the catchments approved in the Patterson Britton Masterplan.



Runoff from the extension of Chapman Street and the public open spaces is routed overland to the on-site detention basin on the north-eastern corner of the site and landscape plans have been prepared which illustrate the flow path and other amenities within these spaces.

This option provides an accessible and convenient interface with the public open spaces to the north and east of stage 1 and avoids the construction of fill or batters within the open spaces. Natural vegetation can be retained and incorporated into the areas.

Further, it is noted that the adopted PB Stormwater Strategy and the Western Local Park Concept Plan shown in Figure E12.18a under the South Werrington Urban Village Penrith DCP has a dual open space and drainage function for the open space corridor through the site with an identified drainage swale running for the full length of both the northern and central open space reserves. In this regard, a Landscape Masterplan prepared by Place Design Group, dated 28 October 2016, accompanies the Section 96 submission demonstrating the intended open space layout, which retains and enhances significant existing vegetation through a central corridor and provides excellent accessibility and connectivity to both passive and active open space areas as envisaged with the

SWUV DCP local park concept shown in Figure E12.18a. Option 3 allows a workable stormwater drainage solution on both an interim basis and ultimate basis (subject to separate DA) with minimal cut and fill for stage 1 and a vegetated drainage swale through the site generally in accordance with the DCP.

This is the proposed preferred option and has been submitted for Council's consideration under a Section 96 submission. Catchments, areas and storm water routing remain substantially similar to option 1 and the drainage and water quality modelling provided in this report for stage 1 is considered applicable to option 3. Minor flow attenuation caused by the overland flow path would reduce the OSD requirements and the flow through the vegetated swales would assist in further improving water quality.

3.2.2.5 Pipe system

A site drainage system will be provided in accordance with Penrith Council standard requirements, with an underground piped system capable of collecting and carrying all storms up to the ARI 20-year event. Pipes will be concrete with spigot and socket joints to a class sufficient for the traffic loading expected.

Storm water inlet pits will be provided on all roads to collect the ARI 20-year flow and these pits will serve as junction pits at changes of direction of the pipes. Further manholes will be provided at junctions not located where storm water inflow is required.

3.2.2.6 Onsite detention

On site detention basins will be provided for the stage 1 development within the open spaces located to the north of to the development. The detention basin will collect and detain peak floods and reduce outflow to pre-development levels for all storms up to the ARI 100-year storm. The detention basin will be constructed with side slopes suitable for public egress.

A DRAINS model has been set up for Option 1 using the same parameters and catchment characteristics for the existing catchments to determine the size of the OSD basin for the stage 1 development and to limit post-development flows to below calculated pre-development flows rates. This model is considered to be conservative for the assessment of the Option 3 proposal submitted for S96 approval and no further modelling has been done on Option 3.

The characteristics of the stage 1 development catchments are:

Table 3-6 Catchment characteristics stage 1

Node	Total Area(ha)	% impervious	Vectored Average Slope	Mannings n Pervious	Mannings n Impervious	Flow path Length
E	1.6	5	4.0	0.04	0.018	182
F	11.23	0	3.4	0.04	0.018	690
G	12.07	5	1.7	0.04	0.018	590
O1	3.57	0	10.7	0.04	0.018	197
O2	2.26	0	9.0	0.04	0.018	177
O3	11.22	25	1.0	0.04	0.018	685
STAGE 1 RESERVE	1.15	0	3.0	0.04	0.018	308
STAGE 1 ROAD	0.22	100	3.0	0.04	0.018	83

STAGE 1 HOUSING AND ROADS	7.0	85*	3.0	0.04	0.018	335

- Fraction of impervious for runoff coefficients in accordance with Penrith City Council Design Guidelines for Engineering Works for Subdivision and developments.

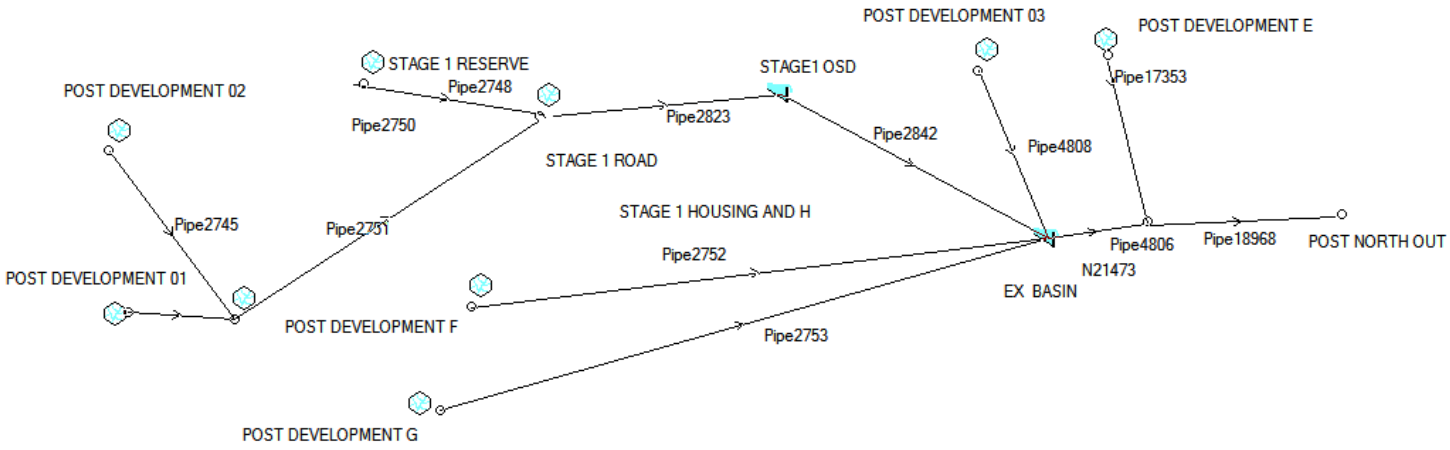


Figure 3-6 DRAINS model 3 –stage 1 development

3.2.2.7 Overland flow

The Stage 1 development will convey the 100yr ARI event through pipe systems and through overland flow paths where it will be discharged into the stage 1 OSD basin. Overland flow on the roads will be limited to a velocity depth product of 0.6 and a depth less than the top of kerbs in accordance with Penrith City Councils Guidelines. The basin will contain flows for all events up until the 100yr ARI, where it will safely discharge via an emergency spillway into the existing basin to the north of the site.

3.2.2.8 Results

Table 3-7 DRAINS results for stage 1

Node	1 Year (60min)	20 Year (90min)	100year (120 min)
Pre development Northern Outlet	0.352 (m³/s)	2.19 (m³/s)	3.23 (m³/s)
Pre development Outlet from existing basin	0.322 (m³/s)	1.48 (m³/s)	1.67 (m³/s)
Post development Stage 1 OSD	0.166(m³/s)	0.595 (m³/s)	0.694 (m³/s)
Post development	0.375(m³/s)	1.75 (m³/s)	1.95 (m³/s)

Stage 1 Northern outlet			

The results from the drains model in table 3-7 above indicate that the Stage 1 basin reduces peak flow from the site significantly in both the 100-yr and 20-yr ARI.

The 1-yr ARI peak runoff has slightly increased by 20l/s. It is noted that this increase in flow is negligible and would be reduced if rainwater tanks or bio filtration storage is included in the DRAINS model. The marginal increase is thus considered acceptable for the 1-yr ARI storm.

The Stage 1 detention basin is proposed to hold a volume of 5,500m³, with an average depth of 1.1m. The basin will include a bio-retention filter to treat runoff from the development and upstream catchments. The outlet from the basin is proposed to be an 800mm diameter orifice with a 900mm outlet pipe discharging into the existing basin in the low lying area beside the northern outlet.

The proposed basin for stage 1 would need to be elevated above the existing ground levels around the basin. The elevation would be required to allow for the depth of filtration media for the bio-retention basin and to provide the basin with fall to drain the basin into the existing catchment.

Flood levels of the 100-yr ARI of the existing basin have been assessed again using 12D software. The height of the 100-yr flood zone is still RL24.2. The stage 1 development is proposed to be constructed at least 500mm higher than the existing basins 100yr ARI flood level.

The discharge from the basin is less than the PB report's recommended permissible site discharge value in their report of 1.55m³/s.

3.2.3 Stage 1 Stormwater Quality

3.2.3.1 MUSIC Modelling

The stormwater quality treatment analysis has been undertaken for Option 1 using (Model for Urban Stormwater Improvement Conceptualization) MUSIC software. The software simulates pollutant wash-off and determines the treatment removal potential from a range of stormwater treatment devices. The results are compared with the reduction targets in pollutant loadings and annual average volume of stormwater runoff. This model is considered to be conservative for the assessment of the Option 3 proposal submitted for S96 approval and no further modelling has been done on Option 3.

The basic inputs into MUSIC for this project included:

- Lot catchment areas
- Road catchment areas
- Open Space Reserved areas
- Detention basin sizes
- Estimated roof areas

Catchment area fraction impervious values have been obtained from the Penrith City Council Design Guidelines for Engineering Works for Subdivisions and Developments, and are as follows:

- Normal Residential (Lots and Residue Lots) = 0.75
- Public Recreation Areas (Open Space Reserved) = 0.5
- Roof Area =1.0

Road catchment areas were modelled as 100% impervious.

Rainfall data and was obtained from weather station Penrith Lakes (Station 67113) 1999 to 2008 in accordance with the Penrith City Councils WSUD Technical Guidelines. Monthly Evapotranspiration values for PET were used from the Penrith technical guidelines.

Stage 1 is proposing to install a CDS gross pollutant trap (GPT) and construct a bio-retention basin to treat the runoff from the stage1 development and the upstream catchments. The GPT and the bio-retention basin parameters were input from the Penrith City WSUD technical guidelines. The parameters input are:

Table 3-8 MUSIC node inputs

Stage 1 Bio-retention basin	
High flow bypass	3- monthly ARI flow (1 year)
Extended detention depth	0.2m
Saturated Hydraulic conductivity	125mm/hr
Filter Depth	0.5
TN content of filter media	800mg/kg
Orthophosphate content of filter media	40mg/kg
Exfiltration rate	0mm/hr
Gross pollutant trap (CDS)*	
High flow bypass	3-monthly ARI flow
TN removal	0
TP removal	0
TSS	70% for inflow concentrations higher than 75mg/l
Rainwater Tank	
Catchment area draining to tank	50%
Annual Demand	50kl/yr as PET
Daily Demand	0.10 kl/day
Tank size per lot	1.5KL

*The MUSIC node used for the CDS GPT was sourced from the supplier Rocla and adjusted to council requirements.

The area for the roof nodes input into the music model are based on the assumption that 20% of the overall developable area for stage 1 equates to 50% of the roof area likely to be drained to the rainwater tanks.

Using the MUSIC software we were able to determine the area of filter media required to meet the Penrith City council reduction targets. The area required to meet the pollution reduction targets is 2800m²

For a summary of Treatment Train Effectiveness refer section the table below.

3.2.3.2 Results

Table 3-9 MUSIC pollutant reductions stage 1

Pollutant	% post development average annual load reduction required	% reduction achieved
Gross Pollutants	90	95.0
Total Suspended Solids	85	86.2
Total Phosphorous	65	70.8
Total Nitrogen	45	60.9

The MUSIC results shows that the proposed gross pollutant trap and bio-retention basin meet Penrith City council's pollutant reduction targets. Refer to Appendix C for a detailed report extracted from MUSIC using the Penrith Council MUSIC link.

A comment is included in the link report relating to the removal of suspended solids through the GPT. CDS units have been specified which are suitable for the sediment removal achieved.

3.3 Stage 2

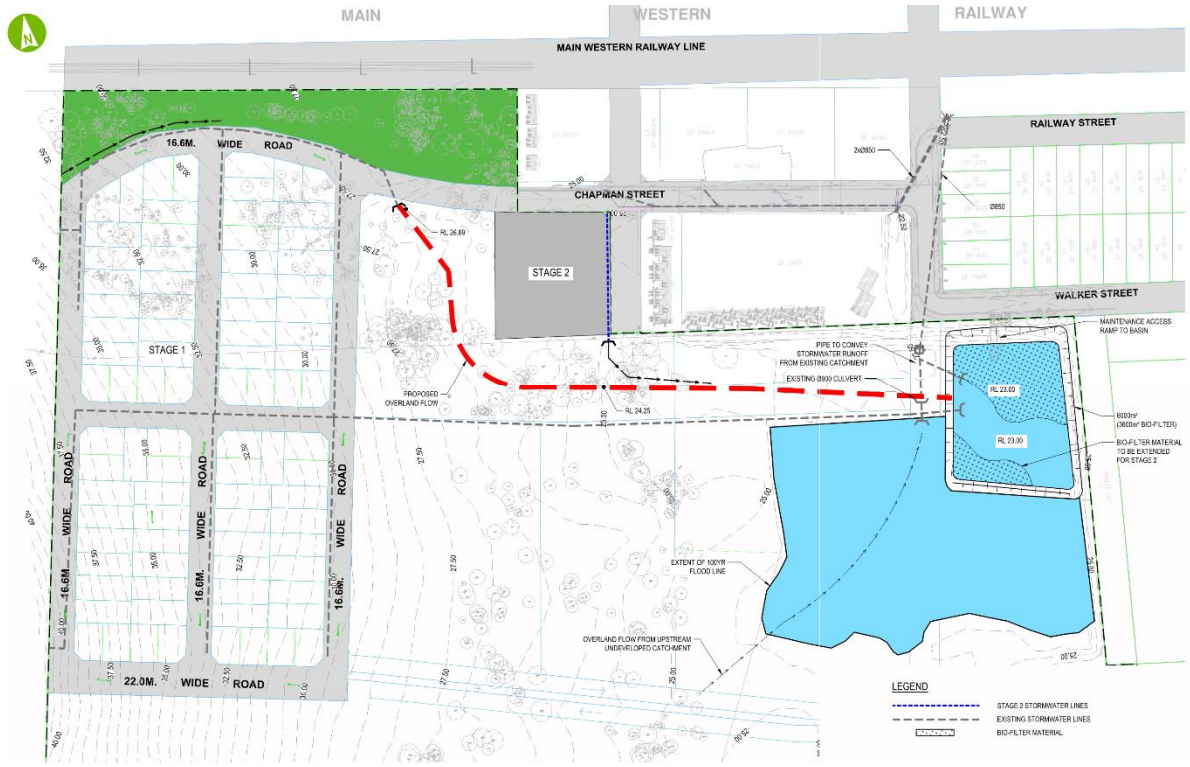


Figure 7 Development layouts- Stages 1 and 2

3.3.1 Stage 2 Erosion and Sediment Control

Erosion and sediment control will be implemented in a similar way to the Stage 1 development. The sediment pond from stage 1 will be utilised as the sediment pond for stage 2. The perimeter of the stage 2 development will contain sediment fences at the low sides of the site to filter sediment laden water leaving the site and the high side of the site will contain a safety fence to prevent residents of stage 1 entering the construction site. Diversion channels will be constructed within the development to intercept and convey the sediment laden water into the existing sediment basin for treatment. The table below indicates the area required for the sediment basin for the stage 2 development.

Table 3-10 Sediment basin storage stage 2

Sediment Basin	Sediment Basin Storage (soil) volume	Sediment Basin Settling (water) Volume	Sediment basin total Volume
Stage 2	69m³	714m³	783m³

3.3.2 Stage 2 Stormwater quantity

3.3.2.1 Pipe system

A site drainage system will be provided in accordance with Penrith Council standard requirements, with an underground piped system capable of collecting and carrying all storms up to the ARI 20-year event. The stormwater system will connect into the existing stage 1 developments pipe network. The Pipes will be concrete with spigot and socket joints to a class sufficient for the traffic loading expected.

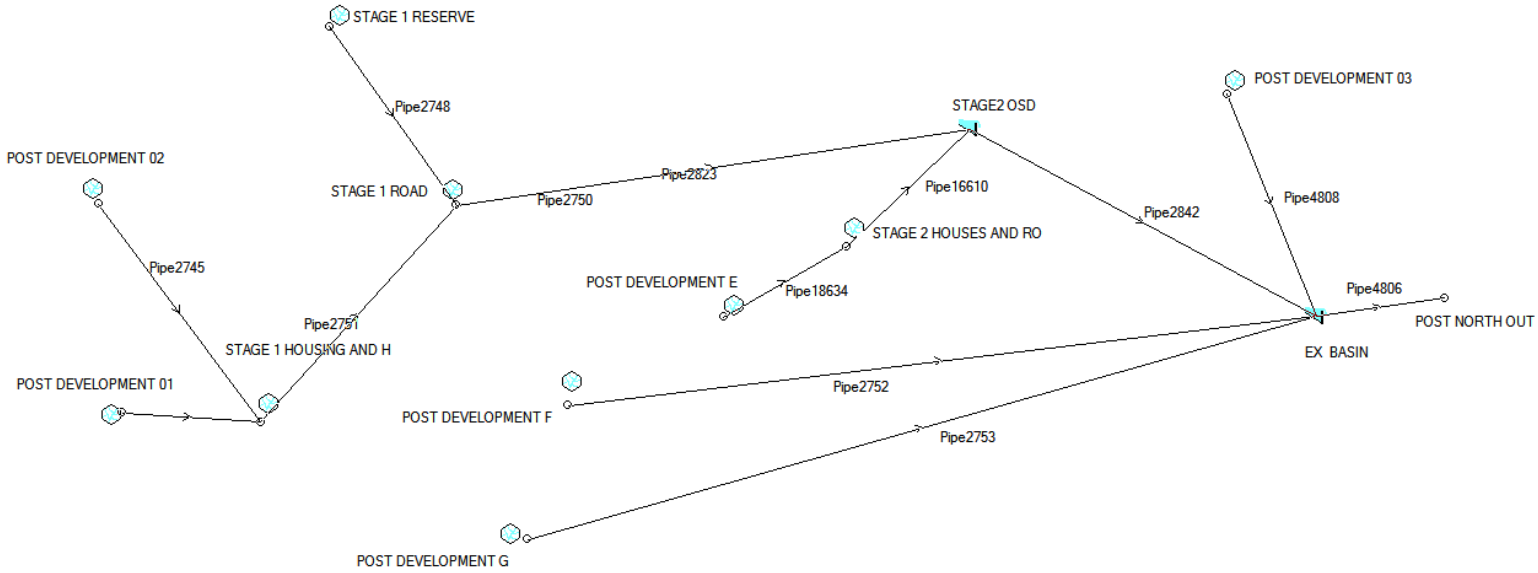
Storm water inlet pits will be provided on all roads to collect the ARI 20-year flow and these pits will serve as junction pits at changes of direction of the pipes. Further manholes will be provided at junctions not located where storm water inflow is required.

3.3.2.2 Onsite detention

Onsite detention will be required for the stage 2 development to limit outgoing flows from the catchment to either equal to or less than predevelopment flows. The onsite detention will be located within the existing stage 1 detention basin. The basin will also provide water quality treatment for the runoff from the new stage. To determine the amount of detention required for the new stage of the development a fourth DRAINS model was set up and completed. The same catchment characteristics from stage 1 were used for the new model except catchments F and E were the areas were being reduced. A table of the new catchments and altered catchments are provided below:

Table 3-11 Catchment characteristics stage 2

Node	Total Area(ha)	% impervious	Vectored Average Slope	Mannings n Pervious	Mannings n Impervious	Flow path Length
E	1.2	5	4.0	0.04	0.018	182
F	11.7	0	3.4	0.04	0.018	690
Stage 2 housing and road	0.619	85	3.0	0.04	0.018	88



3.3.2.3 Overland flow

The Stage 1 development will convey the 100yr ARI event through pipe systems and through overland flow paths where it will be conveyed into the stage 1 OSD basin. Overland flow on the roads

will be limited to a velocity depth product of 0.6 and a depth less than the top of kerbs in accordance with Penrith City Councils Guidelines. The basin will contain flows for all events up until the 100yr ARI, where it will safely discharge via an emergency spillway into the existing basin to the north of the site.

3.3.2.4 Results

Table 3-12 DRAINS results stage 2

Node	1 Year (60min)	20 Year (90min)	100year (120 min)
Predevelopment Northern Outlet	0.352 (m^3/s)	2.19 (m^3/s)	3.23 (m^3/s)
Predevelopment Outlet from existing basin	0.322 (m^3/s)	1.48 (m^3/s)	1.67 (m^3/s)
Post development Stage 2 OSD	0.173(m^3/s)	0.638(m^3/s)	0.661 (m^3/s)
Post development Stage 2 Northern outlet	0.395(m^3/s)	1.69(m^3/s)	1.90(m^3/s)

The results from the drains model in table 3-12 above indicate that the Stage 2 basin reduces flows from the site significantly in both the 100-yr and 20-yr ARI.

The 1-yr ARI post development have slightly increased by 40l/s. It is noted that this increase in flow is negligible and would be reduced if rainwater tanks or bio filtration storage is included in the DRAINS model. The marginal increase is thus considered acceptable for the 1-yr ARI storm.

Flood levels of the 100-yr ARI of the existing basin have been assessed again using 12D software. The height of the 100-yr flood zone is still RL24.2. The stage 2 development is proposed to be constructed at least 500mm higher than the existing basins 100yr ARI flood level.

The Stage 2 detention basin is proposed to hold a volume of 7,000m^3, with an average depth of 1m. The outlet from the basin will not change in size from the stage 1 outlet (800mm orifice plate and a 900mm diameter pipe) and will discharge into the existing basin in the low lying area beside the northern outlet.

3.3.3 Stage 2 Stormwater Quality

3.3.3.1 Music modelling

A second music model was created using the same parameters as the stage one development except with the inclusion of the new stage 2 roads and housing catchments. The results from the music model using a bio filtration media area of 3200m^2 is provided in the table below:

3.3.3.2 Results

Table 3-13 MUSIC results Stage 2

Pollutant	% post development average annual load reduction required	% reduction achieved
Gross Pollutants	90	95.5
Total Suspended Solids	85	87
Total Phosphorous	65	71.6
Total Nitrogen	45	61.5

The MUSIC results shows that the proposed gross pollutant trap and bio-retention basin meet Penrith City council's pollutant reduction targets. Refer to Appendix C for a detailed report extracted from MUSIC using the Penrith Council MUSIC link.

A comment is included in the link report relating to the removal of suspended solids through the GPT. CDS units have been specified which are suitable for the sediment removal achieved.

3.4 FINAL DEVELOPMENT

3.4.1 Final development Stormwater quantity

Full development of the site will require the removal of the existing berm and ponding upstream of the berm, with a consequential reduction in total on-site detention. This is compensated by the routing of the southern catchment away from the northern pipe system, reducing the site runoff.

Drawing CIV-0028 illustrates the final catchment with portions of the pre-development catchments 03, F and G no longer routed to the north pipe system.

3.4.1.1 Pipe system

A site drainage system will be provided in accordance with Penrith Council standard requirements, with an underground piped system capable of collecting and carrying all storms up to the ARI 20-year event. The stormwater system will connect into the previously established developments pipe network. The Pipes will be concrete with spigot and socket joints to a class sufficient for the traffic loading expected.

Storm water inlet pits will be provided on all roads to collect the ARI 20-year flow and these pits will serve as junction pits at changes of direction of the pipes. Further manholes will be provided at junctions not located where storm water inflow is required.

3.4.1.2 Onsite detention

Onsite detention will be provided to flow equal or below flow rates predetermined by the PB report. . To determine the size of detention basin required to meet PB predetermined flow rates a five drains model was created. A table of the catchments are provided below (extracted from PB report):

Table 3-14 Final developments catchment characteristics

Node	Total Area(ha)	% impervious	Vectored Average Slope	Mannings n Pervious	Mannings n Impervious	Flow path Length
P-A	21.85	55	2.0	0.04	0.018	700
O1	3.57	0	10.7	0.04	0.018	197
O2	2.26	0	9.0	0.04	0.018	177
O3	11.22	25	1.0	0.04	0.018	685

3.4.1.3 Results

Table 3-15 DRAINS Results final development

Node	1 Year (60min)	20 Year (90min)	100year (120 min)
Predevelopment Northern Outlet	0.352 (m^3/s)	2.19 (m^3/s)	3.23 (m^3/s)
Predevelopment Outlet from existing basin	0.322 (m^3/s)	1.46 (m^3/s)	1.66 (m^3/s)
Final development OSD	0.247(m^3/s)	1.11 (m^3/s)	1.45(m^3/s)
Final development Northern outlet	0.3336(m^3/s)	1.90(m^3/s)	2.9(m^3/s)

The results from the drains model in table 15 above indicate that the basin reduces flows from the site significantly in both the 100-yr, 20-yr ARI and 1-yr. The outflows from the basin also meet the suggested permissible site discharge rate of 1.55m^3/s in the PB report further illustrating the successful results from the drains model.

The detention basin in the final development is proposed to hold a volume of 10,450m^3, with an average depth of 1.1m. The outlet from the basin will not change in size from the previous stages outlet size (800mm orifice plate and a 900mm diameter pipe) and will connect into the existing culvert underneath Landers Street.

3.4.2 Final Development Stormwater Quality

3.4.2.1 Music modelling

It is proposed that further stages of the project will be designed similarly to stages 1 and 2 above, with separate GPT units as dictated by the future staging. Analysis of the final development has included a single CDS GPT which will be utilised for sediment removal in accordance with Council's guidelines.

A MUSIC model was created to simulate the whole completed development. The parameters used in this stage of development have been altered from the previous two models to accord with the '*Draft Music Modelling Guidelines for New South Wales*' for large scale catchments. The catchment

characteristics for the final development were used from the PB report for the catchment P-A. The characteristics in the music model matched the data displayed in the previous table 3-13 with the following parameter adjustments:

Table 3-16 Default EIA proportions for MUSIC models in NSW

Land Use Type	EIA Factor
Residential	0.55 x TIA
Commercial	0.80 x TIA
Rural residential	0.05 x SCA
Industrial	0.90 x TIA
Agricultural / grazing	0.00 x SCA
Native/plantation forest	0.00 x SCA

TIA=Total Impervious Area

Table 3-17 Pervious Area Parameters – For Source Nodes >10ha

	URBAN
Parameter	All MAR
Pervious Area Parameters	
Soil Storage capacity (mm)	170
Initial Storage (% of capacity)	30
Field Capacity (mm)	70
Infiltration Capacity Coefficient – a	210
Infiltration Capacity Exponent - b	4.7
Groundwater Properties	
Initial depth (mm)	10
Daily Recharge Rate (%)	50
Daily Baseflow Rate (%)	5
Daily Deep Seepage Rate (%)*	0

The results from the music model using the CDS type gross pollutant trap from Rocla and a bio filtration media area of 5000m² is provided in the table below:

3.4.2.2 Results

Table 3-18 MUSIC results final development

Pollutant	% post development average annual load reduction required	% reduction achieved
Gross Pollutants	90	96

Total Suspended Solids	85	85
Total Phosphorous	65	66.8
Total Nitrogen	45	62

The MUSIC results shows that the proposed gross pollutant trap and bio-retention basin meet Penrith City council's pollutant reduction targets. Refer to Appendix C for a detailed report extracted from MUSIC using the Penrith Council MUSIC link.

A comment is included in the link report relating to the removal of suspended solids through the GPT. CDS units have been specified which are suitable for the sediment removal achieved.

4 Indicative Stormwater Infrastructure time line

Stage 1 Development starts (0 years)

- Erosion and sediment basin for stage 1 is constructed
- All flows from stage 1 development diverted into the sediment basin. sediment basin size 1610m³ minimum.

Stage 1 complete (2 years)

- Bio-retention basin constructed for stage 1 alll flows from stage 1 to discharge to the new basin. Basin storage volume 5,500m³ and biofiltration media surface area 2800m²

Stage 2 development starts (2.5 Years)

- Erosion sediment controls installed, all runoff diverted to the Stage 1 erosion and sediment basin. Sediment basin size 1610m³ minimum.

Stage 2 development is completed

- Erosion and sediment basin is either decomissioned or retained for future development
- Bio-retention basin is increased to store 7,000m³ and to biofiltration media surface area of 3200m².

Final development

- No erosion and sediment control. site fully stabilised
- Bio-retention Basin increased to store 10,450m³ and 5000m² of bio filter media at 0.5m depth.

5 Inspections and Maintenance

Maintenance and inspections will be required for the gross pollutant trap and the bio-retention basin. If maintenance is not undertaken, the treatment devices will not function satisfactory and additional maintenance to rectify the issues can become more expensive. This section of the report will give an overview of the likely maintenance programme that would be incorporated for the water treatment controls and devices.

5.1.1 Stormwater Inspections:

- When inspecting the water quality treatment controls and devices all relevant health and safety requirements shall be incorporated, this includes and is not limited to, PPE, specific training (confined space, manual lifting) and safety harnesses.
- Inspections for the Gross Pollutant trap (GPT) should be conducted quarterly (3 months) to ensure the gross pollutant is operating to a satisfactory standard. The inspection should involve:
    - Checking to see if debris are visible from lifting the GPT's cover
    - Using a dipstick or measuring device to determine the depth of the collected sediment. Generally a depth of over 400mm (depending on the GPT unit) would require cleaning.
- Inspection of the bio-retention basin should be undertaken every 2-3 months or after a major storm event during the first 2 years of the basin operation. This enables the observer to :
    - observe the vegetation growth in the bio filtration area
    - monitor ponding clogging or any blockages of the filter material
    - outlet blockages
    - inlet erosion
- Inspection of the overland flow path through the public open space should be undertaken every 2-3 months or after a major storm event during the first 2 years of the basin operation. This enables the observer to :
    - observe the vegetation growth in the flow path
    - monitor ponding, erosion or any obstructions
    - inlet erosion into OSD

5.1.2 Stormwater Maintenance

The Bio-retention basin will require:

- Cleaning debris clear of the surface, inlet and outlet
- Vegetation conditioning, trimming

- Erosion protection , should erosion be visible
- Removal of weeds and other vegetation
- Removal of accumulated sediment

The basin can be maintained without the need for any specialised equipment or training. The maintenance cycle would be based around the observer's inspection results of the bio-retention system. Sediments, debris and trimming would be disposed of offsite at an approved disposal yard.

The gross pollutant trap will require:

- A vacuum truck. The vacuum is lowered into the GPT and is used to remove debris and sediment from the base of the unit. Some debris can become stuck to the GPT screens and will require removal either manually (brush or broom) or by a water jet.
- Once the debris and sediment is all removed the interior of the pit is usually cleaned thoroughly with a water jet.

Again, the basin will be maintained on the recommendation of the inspector. All sediments, debris removed the GPT would be disposed of offsite at an approved disposal yard.

The overland flow path will require:

- Removal of weeds and excessive vegetation to retain free flow through the overland flow path
- Clearing debris deposited by trees. This would generally form part of routine park maintenance procedures

5.1.3 Erosion and sediment control Inspection and Maintenance Schedule

The following are the inspection and maintenance schedules that will be used to maintain the erosion and sediment controls:

- The Contractor shall inspect all control measures at the end of each day
- Thorough inspections shall be undertaken prior to any forecast rain and immediately following rainfall.
- During severe rainfall the contractor shall arrange for a representative to inspect the works and ensure that all erosion and sediment control devices are working as expected and to undertake any remedial works required.
- All measures will be maintained in good working order.
- Sediment shall be removed from sumps, basins and soakpits as required during and after construction.
- Any visible sediment shall immediately be removed from the upstream part of inlet barriers.
- Silt fences will be inspected for depth of sediment and tears, to see if the fabric is securely attached to the fence posts, and to see that the fence posts are firmly in the ground.
- Diversion channels will be inspected after each rainfall event and any breaches will be promptly repaired.
- Temporary and permanent seeding and planting will be inspected for bare spots, washouts, and healthy growth. Any defects shall be repaired/resown as necessary.
- The Engineer or his representative shall be notified of any maintenance or remedial works undertaken, or any changes required to the ESCP or the work programme.
- Any changes in the work programme requiring a significant change in the ESCP shall be approved by the Engineer before being implemented.

Appendix A
Drawings

MAIN WESTERN RAILWAY LINE

16.6M. WIDE ROAD

CONSTRUCTION ENTRANCE INSTALLED TO PREVENT VEHICLES TRACKING SEDIMENT ONTO THE EXISTING ROADS.

CHAPMAN STREET

RAILWAY STREET

EXISTING DETENTION PROVIDED IN CHANNEL

EXISTING DETENTION

WALKER STREET

RL 26.89

INLET PIT PROTECTION TO BE INSTALLED ON EXISTING PITS TO PREVENT SEDIMENT ENTERING THE EXISTING STORMWATER NETWORK

PROPOSED OVERLAND FLOW

EXISTING OVERLAND FLOW

SPILLWAY

RL 24.20

RL 23.75

RIPRAP TO PROTECT EROSION DOWNSTREAM

WALL RL 25.25

TEMPORARY WATER CROSSING REFER TO SD S-1

RL 24.25

1:150

RL 28.5

RL 25.5

TEMPORARY SEDIMENT BASIN WET (TYPE D & F SOILS ONLY) SEE BASIN DETAILS (1950m³, 25m x 78m x 1m DEEP) REFER TO SD 6-4

CHANNEL TO BE LOCATED ON SITE TO AVOID EXISTING TREES

16.6M. WIDE ROAD

16.6M. WIDE ROAD

16.6M. WIDE ROAD

22.0M. WIDE ROAD

OVERLAND FLOW FROM UPSTREAM UNDEVELOPED CATCHMENT

SEDIMENT FENCE TO TREAT STORMWATER RUNOFF LEAVING THE SITE. SEDIMENT FENCE TO BE CONSTRUCTED IN ACCORDANCE WITH THE BLUE BOOK,

LEGEND

- SEDIMENT FENCE
- RUNOFF DIVERSION CHANNEL WITH EARTH BUND
- RUNOFF DIVERSION CHANNEL
- STABILISED CONSTRUCTION ENTRANCE
- INLET PIT PROTECTION

aurecon
www.aurecongroup.com

CLIENT

Universal Property Group Pty Ltd

REV	DATE	REVISION DETAILS	APPROVED
A	07.09.15	ISSUED FOR INFORMATION	R.DEKKER
B	14.01.16	LAYOUT UPDATED	R.DEKKER
C	24.10.16	ISSUED FOR SECTION 96 APPLICATION	R.DEKKER
D	09.03.16	ISSUED FOR INFORMATION	R.DEKKER

SCALE	SIZE
1:1000	A1

DRAWN: B.LOLLBACK
DESIGNED: R.GRANT
VERIFIED: R.DEKKER

PRELIMINARY
NOT FOR CONSTRUCTION

APPROVED
PROJECT DIRECTOR DATE

PROJECT: 16 CHAPMAN STREET, WERRINGTON, NSW
SOUTH WERRINGTON URBAN VILLAGE PRECINCT

TITLE: STORMWATER DRAINAGE STRATEGY
STAGE 1 - CONSTRUCTION PHASE
EROSION AND SEDIMENT CONTROL

DRAWING No. 241636 – 0000 – SKT – CC – 0020 – D

PROJECT No.	WBS	TYPE	DISC	NUMBER	REV
241636	0000	SKT	CC	0020	D

MAIN WESTERN RAILWAY

MAIN WESTERN RAILWAY LINE

16.6M. WIDE ROAD

CHAPMAN STREET

RAILWAY STREET

WALKER STREET

2xØ850

Ø850

RL 26.89

RL 24.25

RL 28.5

PROPOSED OVERLAND FLOW

CHANNEL TO CONVEY STORMWATER RUNOFF FROM EXISTING CATCHMENT

MAINTENANCE ACCESS TO THE BASIN

OUTLET INVERT 23.3m

RL 23.00

Ø900 CULVERT TO BE INSTALLED UNDERNEATH STAGE 1 STORMWATER LINE

5500m³ (2800m² BIO-FILTER)

EXTENT OF 100YR FLOOD LEVEL

OVERLAND FLOW FROM UPSTREAM UNDEVELOPED CATCHMENT

16.6M. WIDE ROAD

16.6M. WIDE ROAD

16.6M. WIDE ROAD

22.0M. WIDE ROAD

A 0030

B 0030

LEGEND

STAGE 1 STORMWATER LINES

EXISTING STORMWATER LINES

BIO-FILTER MATERIAL

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CLIENT

Universal Property Group Pty Ltd

REV	DATE	REVISION DETAILS	APPROVED
A	07.09.15	ISSUED FOR INFORMATION	R.DEKKER
B	14.01.16	LAYOUT UPDATED	R.DEKKER
C	24.10.16	ISSUED FOR SECTION 96 APPLICATION	R.DEKKER
D	09.03.16	ISSUED FOR INFORMATION	R.DEKKER

SCALE	SIZE
1:1000	A1

DRAWN: B.LOLLBACK
DESIGNED: R.GRANT
VERIFIED: R.DEKKER

PRELIMINARY
NOT FOR CONSTRUCTION

APPROVED
PROJECT DIRECTOR DATE

PROJECT: 16 CHAPMAN STREET, WERRINGTON, NSW SOUTH WERRINGTON URBAN VILLAGE PRECINCT

TITLE: STORMWATER DRAINAGE STRATEGY STAGE 1 - COMPLETION

DRAWING No. 241636 – 0000 – SKT – CC – 0021 – D

MAIN WESTERN RAILWAY

MAIN WESTERN RAILWAY LINE

RAILWAY STREET

CHAPMAN STREET

WALKER STREET

16.6M. WIDE ROAD

22.0M. WIDE ROAD

STAGE 1

STAGE 2

CONSTRUCTION ENTRANCE INSTALLED TO PREVENT VEHICLES TRACKING SEDIMENT ONTO THE EXISTING ROADS.

INLET PIT PROTECTION TO BE INSTALLED ON EXISTING PITS TO PREVENT SEDIMENT ENTERING THE EXISTING STORMWATER NETWORK

SEDIMENT FENCE TO TREAT STORMWATER RUNOFF LEAVING THE SITE. SEDIMENT FENCE TO BE CONSTRUCTED IN ACCORDANCE WITH THE BLUE BOOK,

RIPRAP TO PROTECT EROSION DOWNSTREAM

RL 26.89

PROPOSED OVERLAND FLOW

RL 24.25

RL 24.20

SPILLWAY

RL 23.75

WALL RL 25.25

CHANNEL TO CONVEY STORMWATER RUNOFF FROM EXISTING CATCHMENT

TEMPORARY SEDIMENT BASIN WET (TYPE D & F SOILS ONLY) SEE BASIN DETAILS (1950m³, 25m x 78m x 1m DEEP) REFER TO SD 6-4

EXISTING Ø900 INLET UNDERNEATH EXISTING STAGE 1 STORMWATER SYSTEM.

OVERLAND FLOW FROM UPSTREAM UNDEVELOPED CATCHMENT

LEGEND

- SEDIMENT FENCE
- RUNOFF DIVERSION CHANNEL WITH EARTH BUND
- RUNOFF DIVERSION CHANNEL
- STABILISED CONSTRUCTION ENTRANCE
- INLET PIT PROTECTION
- EXISTING STORMWATER INFRASTRUCTURE

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REV	DATE	REVISION DETAILS	APPROVED
A	07.09.15	ISSUED FOR INFORMATION	R.DEKKER
B	14.01.16	LAYOUT UPDATED	R.DEKKER
C	17.10.16	ISSUED FOR APPROVAL	R.DEKKER
D	24.10.16	ISSUED FOR SECTION 96 APPLICATION	R.DEKKER
E	09.03.16	ISSUED FOR INFORMATION	R.DEKKER

SCALE	SIZE
1:1000	A1

DRAWN: B.LOLLBACK
DESIGNED: R.GRANT
VERIFIED: R.DEKKER

PRELIMINARY
NOT FOR CONSTRUCTION

APPROVED
PROJECT DIRECTOR DATE

PROJECT: 16 CHAPMAN STREET, WERRINGTON, NSW SOUTH WERRINGTON URBAN VILLAGE PRECINCT

TITLE: STORMWATER DRAINAGE STRATEGY STAGE 2 - CONSTRUCTION PHASE EROSION AND SEDIMENT CONTROL

DRAWING No. 241636 – 0000 – SKT – CC – 0022 – E

Document Set ID: 7892191
Version: 1, Version Date: 24/10/2017

MAIN WESTERN RAILWAY

MAIN WESTERN RAILWAY LINE

RAILWAY STREET

WALKER STREET

CHAPMAN STREET

16.6M. WIDE ROAD

22.0M. WIDE ROAD

STAGE 1

STAGE 2

RL 26.89

RL 24.25

RL 23.00

RL 23.00

2xØ850

Ø850

PROPOSED OVERLAND FLOW

PIPE TO CONVEY STORMWATER RUNOFF FROM EXISTING CATCHMENT

EXISTING Ø900 CULVERT

MAINTENANCE ACCESS RAMP TO BASIN

6000m²
(3600m² BIO-FILTER)

BIO-FILTER MATERIAL TO BE EXTENDED FOR STAGE 2

EXTENT OF 100YR FLOOD LINE

OVERLAND FLOW FROM UPSTREAM UNDEVELOPED CATCHMENT

LEGEND

- STAGE 2 STORMWATER LINES
- EXISTING STORMWATER LINES
- BIO-FILTER MATERIAL

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REV	DATE	REVISION DETAILS	APPROVED
A	07.09.15	ISSUED FOR INFORMATION	R.DEKKER
B	14.01.16	LAYOUT UPDATED	R.DEKKER
C	17.10.16	ISSUED FOR APPROVAL	R.DEKKER
D	24.10.16	ISSUED FOR SECTION 96 APPLICATION	R.DEKKER
E	09.03.16	ISSUED FOR INFORMATION	R.DEKKER

SCALE	SIZE
1:1000	A1

DRAWN: B.LOLLBACK
DESIGNED: R.GRANT
VERIFIED: R.DEKKER

PRELIMINARY
NOT FOR CONSTRUCTION

APPROVED
PROJECT DIRECTOR DATE

PROJECT: 16 CHAPMAN STREET, WERRINGTON, NSW
SOUTH WERRINGTON URBAN VILLAGE PRECINCT

TITLE: STORMWATER DRAINAGE STRATEGY
STAGE 2 - COMPLETION

DRAWING No. PROJECT No. 241636 – WBS 0000 – TYPE SKT – DISC CC – NUMBER 0023 – REV E

MAIN WESTERN RAILWAY LINE

STAGE 1 RESERVE

16.6M. WIDE ROAD

STAGE 1 LOTS1

STAGE 1 ROAD

CHAPMAN STREET

RAILWAY STREET

RANCE ROAD

WALKER STREET

2 x Ø850

Ø850

RL 26.89

NEW CHANNELS TO BE CONSTRUCTED TO FEED INTO EXISTING CULVERT

CATCHMENT 02

CATCHMENT E

RL 23.00

STAGE 1 LOTS2

RL 28.5

ROAD WIDE 16.6M.

PROPOSED OVERLAND FLOW

CATCHMENT 01

CATCHMENT F

RL 24.25

SYDNEY WATER

22.0M. WIDE ROAD

CATCHMENT G

WOLLEMI SCHOOL

CATCHMENT 03

(A)(B)

LEGEND

- STAGE 1 STORMWATER LINES
- EXISTING STORMWATER LINES
- STAGE 1 CATCHMENT BOUNDARIES
- STAGE 1 CATCHMENT BOUNDARY TO BASIN
- BIO-FILTER MATERIAL
- DETENTION BASIN

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REV	DATE	REVISION DETAILS	APPROVED
A	07.09.15	ISSUED FOR INFORMATION	R.DEKKER
B	14.01.16	LAYOUT UPDATED	R.DEKKER
C	24.10.16	ISSUED FOR SECTION 96 APPLICATION	R.DEKKER
D	09.03.16	ISSUED FOR INFORMATION	R.DEKKER

SCALE	SIZE
NOT TO SCALE	A1

DRAWN: B.HAUSFELD
DESIGNED: R.GRANT
VERIFIED: R.DEKKER

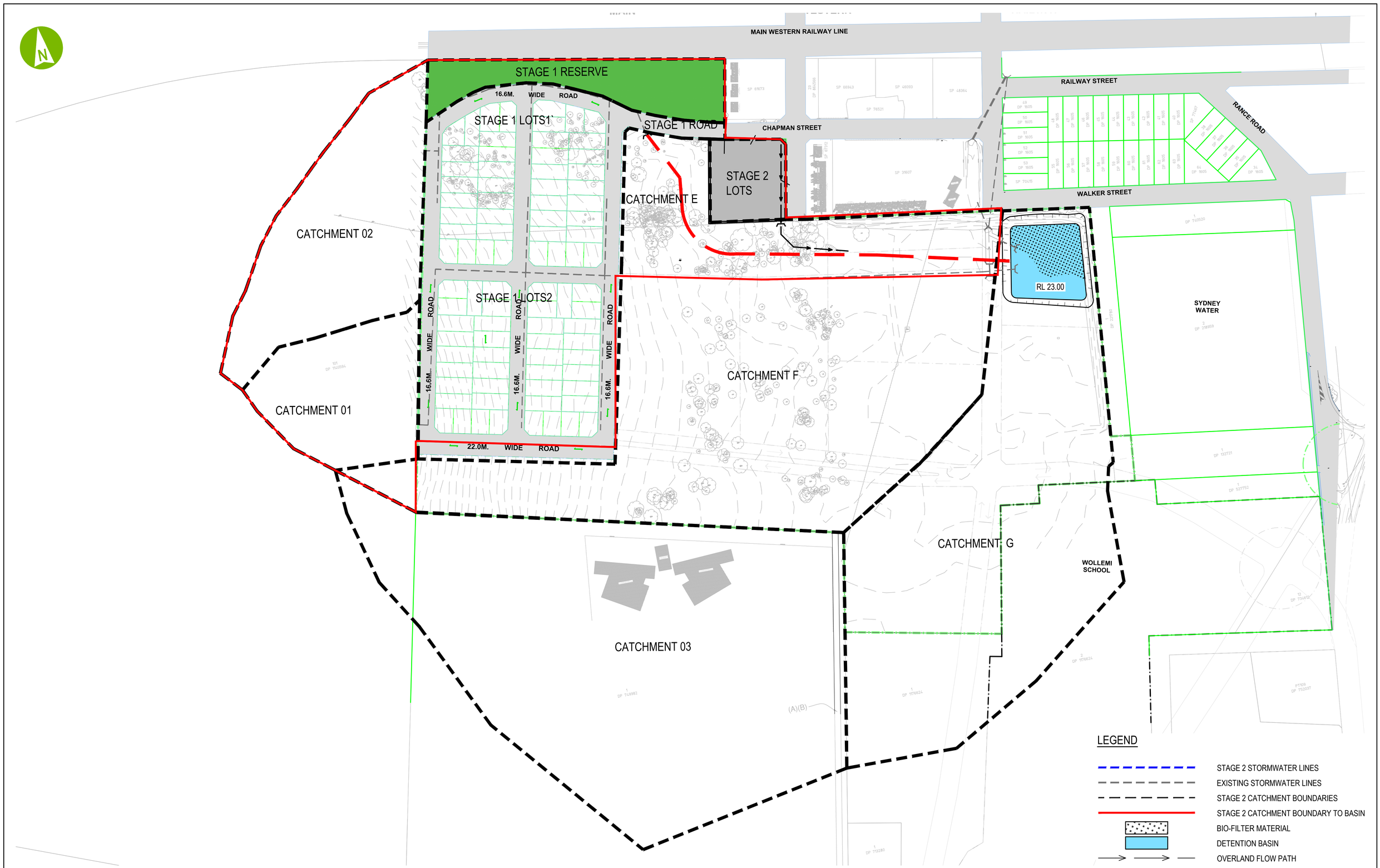
PRELIMINARY
NOT FOR CONSTRUCTION

APPROVED
PROJECT DIRECTOR DATE

PROJECT: 16 CHAPMAN STREET, WERRINGTON, NSW
SOUTH WERRINGTON URBAN VILLAGE PRECINCT

TITLE: CATCHMENT PLAN
STAGE 1

DRAWING No. 241636 – 0000 – SKT – CC – 0026 – D



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REV	DATE	REVISION DETAILS	APPROVED
A	07.09.15	ISSUED FOR INFORMATION	R.DEKKER
B	14.01.16	LAYOUT UPDATED	R.DEKKER
C	24.10.16	ISSUED FOR SECTION 96 APPLICATION	R.DEKKER
D	09.03.16	ISSUED FOR INFORMATION	R.DEKKER

SCALE	SIZE
NTS	A1

DRAWN: B.HAUSFELD
DESIGNED: R. GRANT
VERIFIED: R.DEKKER

PRELIMINARY
NOT FOR CONSTRUCTION

APPROVED
PROJECT DIRECTOR DATE

PROJECT: 16 CHAPMAN STREET, WERRINGTON, NSW
SOUTH WERRINGTON URBAN VILLAGE PRECINCT

TITLE: CATCHMENT PLAN
STAGE 2

DRAWING No.: PROJECT No. 241636 – WBS 0000 – TYPE SKT – DISC CC – NUMBER 0027 – REV D

MAIN WESTERN RAILWAY LINE

RAILWAY STREET

RANCE ROAD

CHAPMAN STREET

WALKER STREET

16.6M. WIDE ROAD

CATCHMENT 01

CATCHMENT 02-2

CATCHMENT 03

P-O

ROAD WIDE 16.6M.

22.0M. WIDE ROAD

EXISTING PIPE TO BE RE-LAID TO CONNECT TO NEW JUNCTION PIT

RL 23.00

SYDNEY WATER

WOLLEMI SCHOOL

LEGEND

- FINAL DEVELOPMENT STORMWATER LINES
- EXISTING STORMWATER LINES
- FINAL CATCHMENT BOUNDARIES
- FINAL CATCHMENT BOUNDARY TO BASIN
- BIO-FILTER MATERIAL
- DETENTION BASIN

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REV	DATE	REVISION DETAILS	APPROVED
A	07.09.15	ISSUED FOR INFORMATION	R.DEKKER
B	24.10.16	ISSUED FOR SECTION 96 APPLICATION	R.DEKKER
C	17.02.17	FINAL CATCHMENT BOUNDARY UPDATED	R.DEKKER
D	09.03.16	ISSUED FOR INFORMATION	R.DEKKER

SCALE	SIZE
NTS	A1

DRAWN: B.HAUSFELD
DESIGNED: R. GRANT
VERIFIED: R.DEKKER

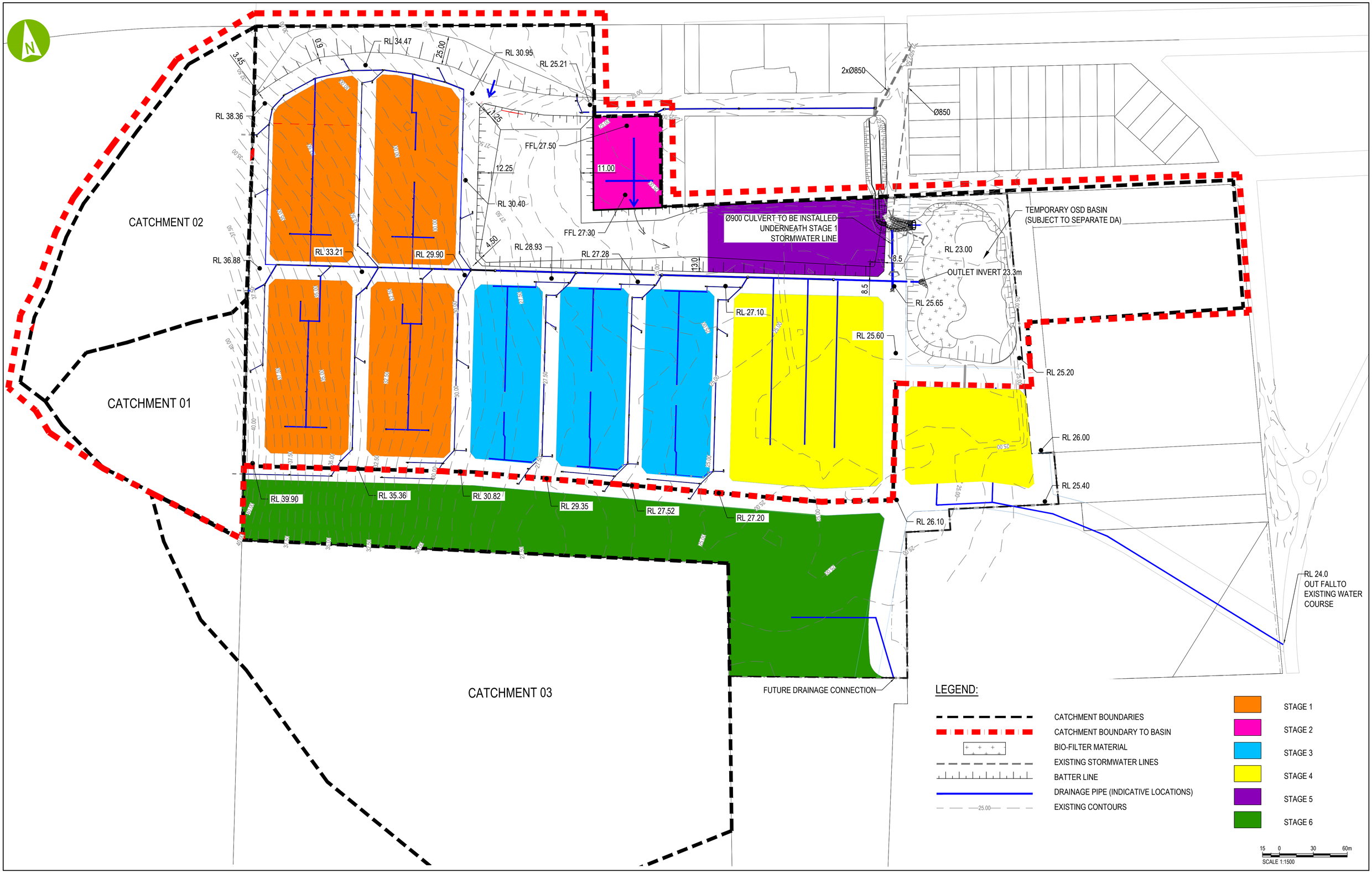
PRELIMINARY
NOT FOR CONSTRUCTION

APPROVED
PROJECT DIRECTOR DATE

PROJECT: 16 CHAPMAN STREET, WERRINGTON, NSW
SOUTH WERRINGTON URBAN VILLAGE PRECINCT

TITLE: CATCHMENT PLAN
FINAL DEVELOPMENT

DRAWING No.	PROJECT No.	WBS	TYPE	DISC	NUMBER	REV
	241636	0000	SKT	CC	0028	D



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REV	DATE	REVISION DETAILS	APPROVED
A	09.03.16	ISSUED FOR INFORMATION	R.DEKKER

SCALE	SIZE
1:1500	A1

DRAWN: B.HAUSFELD
DESIGNED: R.DEKKER
VERIFIED:

PRELIMINARY
NOT FOR CONSTRUCTION

APPROVED
PROJECT DIRECTOR DATE

PROJECT: 16 CHAPMAN STREET, WERRINGTON, NSW
SOUTH WERRINGTON URBAN VILLAGE PRECINCT

TITLE: ESTATE DRAINAGE PLAN NO. 02

DRAWING No.	PROJECT No.		WBS		TYPE		DISC		NUMBER		REV
	241636	–	0000	–	SKT	–	CC	–	0048	–	A

Appendix B
IFD Table

RETURN PERIOD (YEARS)							
Time Hr Min	1	2	5	10	20	50	100
0 6	69.5	90.0	117.7	134.2	155.6	184.2	206.1
0 7	65.6	84.9	111.1	126.6	146.9	173.8	194.5
0 8	62.3	80.6	105.4	120.1	139.3	164.9	184.5
0 9	59.4	76.9	100.5	114.5	132.8	157.1	175.8
0 10	56.9	73.6	96.1	109.5	127.0	150.2	168.0
0 11	54.6	70.7	92.3	105.1	121.9	144.1	161.2
0 12	52.6	68.1	88.8	101.1	117.2	138.6	155.0
0 13	50.7	65.7	85.6	97.5	113.1	133.6	149.4
0 14	49.1	63.5	82.8	94.2	109.3	129.1	144.4
0 15	47.5	61.5	80.2	91.2	105.8	125.0	139.7
0 16	46.1	59.7	77.7	88.5	102.6	121.2	135.5
0 17	44.8	58.0	75.5	85.9	99.6	117.7	131.6
0 18	43.6	56.4	73.4	83.6	96.9	114.4	128.0
0 19	42.4	54.9	71.5	81.4	94.3	111.4	124.6
0 20	41.4	53.5	69.7	79.3	92.0	108.6	121.4
0 22	39.4	51.0	66.4	75.6	87.6	103.5	115.7
0 24	37.7	48.8	63.6	72.3	83.8	99.0	110.7
0 26	36.2	46.8	61.0	69.4	80.4	95.0	106.2
0 28	34.8	45.0	58.6	66.7	77.3	91.3	102.1
0 30	33.5	43.4	56.5	64.3	74.6	88.0	98.4
0 35	30.8	39.9	52.0	59.2	68.6	81.0	90.6
0 40	28.6	37.1	48.3	55.0	63.7	75.3	94.2
0 45	26.8	34.7	45.2	51.5	59.7	70.5	78.8
0 50	25.2	32.7	42.6	48.5	56.2	66.4	74.2
0 55	23.9	30.9	40.3	45.9	53.2	62.9	70.3
1 00	22.7	29.4	38.4	43.7	50.6	59.8	66.8
1 30	17.9	23.2	30.2	34.4	39.9	47.1	52.6
2 00	15.1	19.6	25.4	28.9	33.5	39.6	44.2
2 30	13.2	17.1	22.2	25.3	29.3	34.5	38.6
3 00	11.9	15.3	19.9	22.6	26.2	30.9	34.5

RETURN PERIOD (YEARS)							
Time Hr Min	1	2	5	10	20	50	100
3 30	10.8	14.0	18.1	20.6	23.8	28.1	31.4
4 00	10.0	12.9	16.7	19.0	22.0	25.9	28.9
4 30	9.3	12.0	15.6	17.7	20.4	24.1	26.9
5 00	8.7	11.3	14.6	16.6	19.2	22.6	25.2
5 30	8.2	10.7	13.8	15.6	18.1	21.3	23.8
6 00	7.8	10.1	13.1	14.8	17.2	20.2	22.5
8 00	6.6	8.5	10.9	12.3	14.1	16.5	18.3
10 00	5.7	7.4	9.5	10.7	12.3	14.4	15.9
12 00	5.1	6.6	8.5	9.5	11.0	12.8	14.2
18 00	3.9	5.1	6.6	7.5	8.6	10.2	11.4
24 00	3.2	4.2	5.5	6.3	7.3	8.6	9.6
36 00	2.4	3.2	4.2	4.9	5.7	6.8	7.6
48 00	2.0	2.6	3.5	4.0	4.7	5.7	6.4
60 00	1.7	2.2	3.0	3.4	4.1	4.9	5.5
72 00	1.4	1.9	2.6	3.0	3.6	4.3	4.9

Appendix C
MUSIC Reports

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MUSIC-*link* Report

Project Details		Company Details	
Project:	South Werrignton Stage 1 rev 3	**Company:**	Aurecon
Report Export Date:	14/01/2016	**Contact:**	Ryan Grant
Catchment Name:	South Werrington Rev 3 stage 1	**Address:**	
Catchment Area:	14.2ha	**Phone:**	
Impervious Area*:	68.77%	**Email:**	ryan.grant@aurecongroup.com
Rainfall Station:	67113 PENRITH		
Modelling Time-step:	6 Minutes		
Modelling Period:	1/01/1999 - 31/12/2008 11:54:00 PM		
Mean Annual Rainfall:	691mm		
Evapotranspiration:	1158mm		
MUSIC Version:	6.1.0		
MUSIC-link data Version:	5.9		
Study Area:	Penrith		
Scenario:	Penrith Development		

* takes into account area from all source nodes that link to the chosen reporting node, excluding Import Data Nodes

Treatment Train Effectiveness		Treatment Nodes		Source Nodes	
Node: Receiving Node	**Reduction**	**Node Type**	**Number**	**Node Type**	**Number**
Flow	8.75%	Bio Retention Node	1	Urban Source Node	6
TSS	86.2%	Rain Water Tank Node	1		
TP	70.8%	GPT Node	1		
TN	60.9%				
GP	95%				

Comments

CDS GPT Unit used for the treatment node. TSS removal is 70% for inflow concentrations greater than 75mg/l

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Passing Parameters

Node Type	Node Name	Parameter	Min	Max	Actual
Bio	Bioretention 2	Hi-flow bypass rate (cum/sec)	None	99	0.37
Bio	Bioretention 2	PET Scaling Factor	2.1	2.1	2.1
GPT	CDS 1015	Hi-flow bypass rate (cum/sec)	None	99	0.36
Receiving	Receiving Node	% Load Reduction	None	None	8.75
Receiving	Receiving Node	GP % Load Reduction	90	None	95
Receiving	Receiving Node	TN % Load Reduction	45	None	60.9
Receiving	Receiving Node	TP % Load Reduction	60	None	70.8
Receiving	Receiving Node	TSS % Load Reduction	85	None	86.2
Urban	O1	Area Impervious (ha)	None	None	1.769
Urban	O1	Area Pervious (ha)	None	None	1.800
Urban	O1	Total Area (ha)	None	None	3.57
Urban	O2	Area Impervious (ha)	None	None	1.120
Urban	O2	Area Pervious (ha)	None	None	1.139
Urban	O2	Total Area (ha)	None	None	2.26
Urban	OPEN RESERVE	Area Impervious (ha)	None	None	0.579
Urban	OPEN RESERVE	Area Pervious (ha)	None	None	0.590
Urban	OPEN RESERVE	Total Area (ha)	None	None	1.17
Urban	ROAD	Area Impervious (ha)	None	None	2.648
Urban	ROAD	Area Pervious (ha)	None	None	0
Urban	ROAD	Total Area (ha)	None	None	2.648
Urban	STAGE 1 LOTS	Area Impervious (ha)	None	None	2.738
Urban	STAGE 1 LOTS	Area Pervious (ha)	None	None	0.903
Urban	STAGE 1 LOTS	Total Area (ha)	None	None	3.642
Urban	STAGE 1 ROOF AREA 50% TO RAIN WATER TANK (20% OF DEVELOPMENT AREA)	Area Impervious (ha)	None	None	0.91
Urban	STAGE 1 ROOF AREA 50% TO RAIN WATER TANK (20% OF DEVELOPMENT AREA)	Area Pervious (ha)	None	None	0
Urban	STAGE 1 ROOF AREA 50% TO RAIN WATER TANK (20% OF DEVELOPMENT AREA)	Total Area (ha)	None	None	0.91

Only certain parameters are reported when they pass validation

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Failing Parameters

Node Type	Node Name	Parameter	Min	Max	Actual
GPT	CDS 1015	TN % Load Reduction	0	0	-0.03
GPT	CDS 1015	TP % Load Reduction	0	0	-0.0070711
GPT	CDS 1015	TSS % Load Reduction	0	0	41.26

Only certain parameters are reported when they pass validation

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MUSIC-*link* Report

Project Details		Company Details	
Project:	South Werrington Stage 2 Rev3	**Company:**	Aurecon
Report Export Date:	14/01/2016	**Contact:**	Ryan Grant
Catchment Name:	South Werrington Rev stage 2 rev 3	**Address:**	
Catchment Area:	15.981ha	**Phone:**	
Impervious Area*:	67.81%	**Email:**	ryan.grant@aurecongroup.com
Rainfall Station:	67113 PENRITH		
Modelling Time-step:	6 Minutes		
Modelling Period:	1/01/1999 - 31/12/2008 11:54:00 PM		
Mean Annual Rainfall:	691mm		
Evapotranspiration:	1158mm		
MUSIC Version:	6.1.0		
MUSIC-link data Version:	5.9		
Study Area:	Penrith		
Scenario:	Penrith Development		

* takes into account area from all source nodes that link to the chosen reporting node, excluding Import Data Nodes

Treatment Train Effectiveness

Node: Receiving Node	Reduction
Flow	9.07%
TSS	87%
TP	71.6%
TN	61.5%
GP	95.5%

Treatment Nodes

Node Type	Number
Bio Retention Node	1
Rain Water Tank Node	2
GPT Node	1

Source Nodes

Node Type	Number
Urban Source Node	9

Comments

CDS GPT Unit used for the treatment node. TSS removal is 70% for inflow concentrations greater than 75mg/l

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Passing Parameters

Node Type	Node Name	Parameter	Min	Max	Actual
Bio	Bioretention 2	Hi-flow bypass rate (cum/sec)	None	99	0.435
Bio	Bioretention 2	PET Scaling Factor	2.1	2.1	2.1
GPT	CDS 1015	Hi-flow bypass rate (cum/sec)	None	99	0.435
Receiving	Receiving Node	% Load Reduction	None	None	9.07
Receiving	Receiving Node	GP % Load Reduction	90	None	95.5
Receiving	Receiving Node	TN % Load Reduction	45	None	61.5
Receiving	Receiving Node	TP % Load Reduction	60	None	71.6
Receiving	Receiving Node	TSS % Load Reduction	85	None	87
Urban	O1	Area Impervious (ha)	None	None	1.769
Urban	O1	Area Pervious (ha)	None	None	1.800
Urban	O1	Total Area (ha)	None	None	3.57
Urban	O2	Area Impervious (ha)	None	None	1.120
Urban	O2	Area Pervious (ha)	None	None	1.139
Urban	O2	Total Area (ha)	None	None	2.26
Urban	STAGE 1 LOTS	Area Impervious (ha)	None	None	2.738
Urban	STAGE 1 LOTS	Area Pervious (ha)	None	None	0.903
Urban	STAGE 1 LOTS	Total Area (ha)	None	None	3.642
Urban	STAGE 1 OPEN RESERVE	Area Impervious (ha)	None	None	0.579
Urban	STAGE 1 OPEN RESERVE	Area Pervious (ha)	None	None	0.590
Urban	STAGE 1 OPEN RESERVE	Total Area (ha)	None	None	1.17
Urban	STAGE 1 ROAD	Area Impervious (ha)	None	None	2.648
Urban	STAGE 1 ROAD	Area Pervious (ha)	None	None	0
Urban	STAGE 1 ROAD	Total Area (ha)	None	None	2.648
Urban	STAGE 1 ROOF AREA 50% TO RAIN WATER TANK (20% OF DEVELOPMENT AREA)	Area Impervious (ha)	None	None	0.91
Urban	STAGE 1 ROOF AREA 50% TO RAIN WATER TANK (20% OF DEVELOPMENT AREA)	Area Pervious (ha)	None	None	0
Urban	STAGE 1 ROOF AREA 50% TO RAIN WATER TANK (20% OF DEVELOPMENT AREA)	Total Area (ha)	None	None	0.91
Urban	STAGE 2 LOTS	Area Impervious (ha)	None	None	0.372
Urban	STAGE 2 LOTS	Area Pervious (ha)	None	None	0.122
Urban	STAGE 2 LOTS	Total Area (ha)	None	None	0.495
Urban	STAGE 2 OPEN RESERVE	Area Impervious (ha)	None	None	0.575
Urban	STAGE 2 OPEN RESERVE	Area Pervious (ha)	None	None	0.586
Urban	STAGE 2 OPEN RESERVE	Total Area (ha)	None	None	1.162
Urban	STAGE 2 ROOF AREA 50% TO RAIN WATER TANK (20% OF DEVELOPMENT AREA)	Area Impervious (ha)	None	None	0.124
Urban	STAGE 2 ROOF AREA 50% TO RAIN WATER TANK (20% OF DEVELOPMENT AREA)	Area Pervious (ha)	None	None	0
Urban	STAGE 2 ROOF AREA 50% TO RAIN WATER TANK (20% OF DEVELOPMENT AREA)	Total Area (ha)	None	None	0.124

Only certain parameters are reported when they pass validation

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Failing Parameters

Node Type	Node Name	Parameter	Min	Max	Actual
GPT	CDS 1015	TN % Load Reduction	0	0	-0.02
GPT	CDS 1015	TP % Load Reduction	0	0	-0.00
GPT	CDS 1015	TSS % Load Reduction	0	0	41.4446

Only certain parameters are reported when they pass validation

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MUSIC-*link* Report

Project Details		Company Details	
Project:	South Werrington Final Development	**Company:**	Aurecon
Report Export Date:	19/11/2015	**Contact:**	Ryan Grant
Catchment Name:	South Werrington Rev FINAL DEV REV 2	**Address:**	
Catchment Area:	27.68ha	**Phone:**	
Impervious Area*:	42.13%	**Email:**	ryan.grant@aurecongroup.com
Rainfall Station:	67113 PENRITH		
Modelling Time-step:	6 Minutes		
Modelling Period:	1/01/1999 - 31/12/2008 11:54:00 PM		
Mean Annual Rainfall:	691mm		
Evapotranspiration:	1158mm		
MUSIC Version:	6.1.0		
MUSIC-link data Version:	5.8		
Study Area:	Penrith		
Scenario:	Penrith Development		

* takes into account area from all source nodes that link to the chosen reporting node, excluding Import Data Nodes

Treatment Train Effectiveness		Treatment Nodes		Source Nodes	
Node: Receiving Node	**Reduction**	**Node Type**	**Number**	**Node Type**	**Number**
Flow	11.4%	Bio Retention Node	1	Urban Source Node	4
TSS	85%	Rain Water Tank Node	1		
TP	66.8%	GPT Node	1		
TN	62%				
GP	96%				

Comments

CDS GPT Unit used for the treatment node.TSS removal is 70% for inflow concentrations greater than 75mg/l

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Passing Parameters

Node Type	Node Name	Parameter	Min	Max	Actual
Bio	Bioretention 2	Hi-flow bypass rate (cum/sec)	None	99	0.51
Bio	Bioretention 2	PET Scaling Factor	2.1	2.1	2.1
GPT	CDS 2028	Hi-flow bypass rate (cum/sec)	None	99	0.51
Receiving	Receiving Node	% Load Reduction	None	None	11.4
Receiving	Receiving Node	GP % Load Reduction	90	None	96
Receiving	Receiving Node	TN % Load Reduction	45	None	62
Receiving	Receiving Node	TP % Load Reduction	60	None	66.8
Receiving	Receiving Node	TSS % Load Reduction	85	None	85
Urban	O1	Area Impervious (ha)	None	None	1.769
Urban	O1	Area Pervious (ha)	None	None	1.800
Urban	O1	Total Area (ha)	None	None	3.57
Urban	O2	Area Impervious (ha)	None	None	1.120
Urban	O2	Area Pervious (ha)	None	None	1.139
Urban	O2	Total Area (ha)	None	None	2.26
Urban	P-A (MINUS 50% ROOF AREA)	Area Impervious (ha)	None	None	5.494
Urban	P-A (MINUS 50% ROOF AREA)	Area Pervious (ha)	None	None	13.07
Urban	P-A (MINUS 50% ROOF AREA)	Total Area (ha)	None	None	18.57
Urban	P-A ROOF AREA 50% TO RAIN WATER TANK (15% OF DEVELOPMENT AREA)	Area Impervious (ha)	None	None	3.28
Urban	P-A ROOF AREA 50% TO RAIN WATER TANK (15% OF DEVELOPMENT AREA)	Area Pervious (ha)	None	None	0
Urban	P-A ROOF AREA 50% TO RAIN WATER TANK (15% OF DEVELOPMENT AREA)	Total Area (ha)	None	None	3.28

Only certain parameters are reported when they pass validation

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Failing Parameters

Node Type	Node Name	Parameter	Min	Max	Actual
GPT	CDS 2028	TN % Load Reduction	0	0	-0.01
GPT	CDS 2028	TP % Load Reduction	0	0	-0.01
GPT	CDS 2028	TSS % Load Reduction	0	0	30.0227
Urban	P-A (MINUS 50% ROOF AREA)	Groundwater Daily Baseflow Rate (%)	10	10	5
Urban	P-A (MINUS 50% ROOF AREA)	Groundwater Daily Recharge Rate (%)	25	25	50
Urban	P-A (MINUS 50% ROOF AREA)	Pervious Area Infiltration Capacity coefficient - a	150	150	210
Urban	P-A (MINUS 50% ROOF AREA)	Pervious Area Infiltration Capacity exponent - b	3.5	3.5	4.7
Urban	P-A (MINUS 50% ROOF AREA)	Pervious Area Soil Storage Capacity (mm)	105	105	170

Only certain parameters are reported when they pass validation

Appendix D
Erosion and sediment control calculations

1. Erosion Hazard and Sediment Basins

Site Name: **South Werrington Urban Village**

Site Location: **Werrington**

Precinct/Stage: STAGE 1 **1**

Other Details: **Stormwater Stratergy**

Site area	Sub-catchment or Name of Structure						Notes
Total catchment area (ha)	8.32						
Disturbed catchment area (ha)	7.22						

Soil analysis (enter sediment type if known, or laboratory particle size data)

Sediment Type (C, F or D) if known:	D						From Appendix C (if known)
% sand (fraction 0.02 to 2.00 mm)	30						Enter the percentage of each soil fraction. E.g. enter 10 for 10%
% silt (fraction 0.002 to 0.02 mm)	10						
% clay (fraction finer than 0.002 mm)	60						
Dispersion percentage	15.0						E.g. enter 10 for dispersion of 10%
% of whole soil dispersible	9.75						See Section 6.3.3(e). Auto-calculated
Soil Texture Group	D						Automatic calculation from above

Rainfall data

Design rainfall depth (no of days)	5						See Section 6.3.4 and, particularly, Table 6.3 on pages 6-24 and 6-25.
Design rainfall depth (percentile)	85						
x-day, y-percentile rainfall event (mm)	35						
Rainfall R-factor (if known)							Only need to enter one or the other here
IFD: 2-year, 6-hour storm (if known)	10.1						

RUSLE Factors

Rainfall erosivity (*R* -factor)	2250						Auto-filled from above
Soil erodibility (*K* -factor)	0.038						RUSLE LS factor calculated for a high rill/interrill ratio.
Slope length (m)	300						
Slope gradient (%)	3						
Length/gradient (*LS* -factor)	1.22						
Erosion control practice (*P* -factor)	1.3	1.3	1.3	1.3	1.3	1.3	
Ground cover (*C* -factor)	1	1	1	1	1	1	

Sediment Basin Design Criteria (for Type D/F basins only. Leave blank for Type C basins)

Storage (soil) zone design (no of months)	2	2	2	2	2	2	Minimum is generally 2 months
Cv (Volumetric runoff coefficient)	0.51						See Table F2, page F-4 in Appendix F

Calculations and Type D/F Sediment Basin Volumes

Soil loss (t/ha/yr)	135						
Soil Loss Class	1						See Table 4.2, page 4-13
Soil loss (m^3/ha/yr)	104						Conversion to cubic metres
Sediment basin storage (soil) volume (m^3)	125						See Sections 6.3.4(i) for calculations
Sediment basin settling (water) volume (m^3)	1485						See Sections 6.3.4(i) for calculations
Sediment basin total volume (m^3)	1610						

NB for sizing of Type C (coarse) sediment basins, see Worksheet 3 (if required).

1. Erosion Hazard and Sediment Basins

Site Name: **South Werrington Urban Village**

Site Location: **Werrington**

Precinct/Stage: STAGE 2 **1**

Other Details: **Stormwater Stratergy**

Site area	Sub-catchment or Name of Structure						Notes
Total catchment area (ha)	4						
Disturbed catchment area (ha)	4						

Soil analysis (enter sediment type if known, or laboratory particle size data)

Sediment Type (C, F or D) if known:	D						From Appendix C (if known)
% sand (fraction 0.02 to 2.00 mm)	30						Enter the percentage of each soil fraction. E.g. enter 10 for 10%
% silt (fraction 0.002 to 0.02 mm)	10						
% clay (fraction finer than 0.002 mm)	60						
Dispersion percentage	15.0						E.g. enter 10 for dispersion of 10%
% of whole soil dispersible	9.75						See Section 6.3.3(e). Auto-calculated
Soil Texture Group	D						Automatic calculation from above

Rainfall data

Design rainfall depth (no of days)	5						See Section 6.3.4 and, particularly, Table 6.3 on pages 6-24 and 6-25.
Design rainfall depth (percentile)	85						
x-day, y-percentile rainfall event (mm)	35						
Rainfall R-factor (if known)							Only need to enter one or the other here
IFD: 2-year, 6-hour storm (if known)	10.1						

RUSLE Factors

Rainfall erosivity (*R* -factor)	2250						Auto-filled from above
Soil erodibility (*K* -factor)	0.038						RUSLE LS factor calculated for a high rill/interrill ratio.
Slope length (m)	300						
Slope gradient (%)	3						
Length/gradient (*LS* -factor)	1.22						
Erosion control practice (*P* -factor)	1.3	1.3	1.3	1.3	1.3	1.3	
Ground cover (*C* -factor)	1	1	1	1	1	1	

Sediment Basin Design Criteria (for Type D/F basins only. Leave blank for Type C basins)

Storage (soil) zone design (no of months)	2	2	2	2	2	2	Minimum is generally 2 months
Cv (Volumetric runoff coefficient)	0.51						See Table F2, page F-4 in Appendix F

Calculations and Type D/F Sediment Basin Volumes

Soil loss (t/ha/yr)	135						
Soil Loss Class	1						See Table 4.2, page 4-13
Soil loss (m^3/ha/yr)	104						Conversion to cubic metres
Sediment basin storage (soil) volume (m^3)	69						See Sections 6.3.4(i) for calculations
Sediment basin settling (water) volume (m^3)	714						See Sections 6.3.4(i) for calculations
Sediment basin total volume (m^3)	783						

NB for sizing of Type C (coarse) sediment basins, see Worksheet 3 (if required).

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