X- Travigant C/- Precise Planning

# Concept Stormwater Management Plan: Proposed Subdivision - 30 Greenacre Drive, Tahmoor, NSW

P1706329JR04V01
April 2018

ENVIRONMENTAL

WATER

WASTEWATER

GEOTECHNICAL

CIVIL

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**Document and Distribution Status**

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| Revision No. | Description | Status | Release Date | Document Location | | | |
|---|---|---|---|---|---|---|---|
| | | | | File Copy | Precise Planning | | |
| 1 | Initial Release | Draft | 06/06/2018 | 1E,1P,1H | 1E | | |
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**All enquiries regarding this project are to be directed to the Project Manager.**

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# Tables

# 1 Introduction

## 1.1 Overview

This report has been prepared to support a development application (DA) for subdivision of land at 30 Greenacre Drive, Tahmoor, NSW. It provides an assessment of the proposed development with respect to stormwater quantity and quality management.

This report is to be read in conjunction with the drawings by Martens and Associates (MA) (MA planset P1706329PS02-R01).

## 1.2 Proposed Development

The subdivision works designed by MA for the site will result in the creation of:

- 34 residential lots.
- Internal roads and the stormwater drainage network.

## 1.3 Scope

This report outlines the following:

- Documentation of results of a water quality assessment for the site.
- Treatment train specification to achieve nominated water quality objectives.
- Assessment of on-site detention (OSD) requirements for the site.

## 1.4 Relevant Planning Controls and Design Principles

The following planning and engineering controls and design principles have been used:

- Wollondilly Shire Council (WSC) (2016) Development Control Plan (DCP).
- WSC (2016) Design Specification D5 – Stormwater Drainage Design.
- BMT WBM (2015) - NSW MUSIC Modelling Guidelines.

# 2 Site Description

Site description summary is provided in Table 1.

**Table 1:** Site description summary.

| Element | **Site Details** |
|---|---|
| Site address (Lot/DP) | Lot 7 DP 263172 |
| Local Government Area (LGA) | Wollondilly Shire Council (WSC) |
| Site area | 2.20 ha |
| Proposed land use | Low density residential subdivision |
| Topography | Located within moderately undulating terrain |
| Typical slopes, aspect | Located within moderately undulating terrain (site slopes generally < 10%) with an easterly aspect. |
| Elevation | Site elevation ranges from approximately 265 mAHD in a drainage depression near the north eastern boundary to 279 mAHD near the south western boundary (Google Earth, 2017). |
| Site description | Rural residential block consisting of a dwelling and sheds in the centre of the site, some scattered trees to the north of the dwelling. Grassed, managed paddocks to both east and west of dwelling. |
| Drainage | Site drainage is via overland flow to the south east towards a tributary of the Bargo River (approximately 450 m east); the Bargo River is located approximately 350 m south of the site. |

# 3 Stormwater Quality Assessment

## 3.1 Water Quality Objectives

WSC has provided the treatment objectives for pollutants in Council's Design Specifications. The following water quality objectives are to be achieved by the development when comparing the developed site with and without integration of water quality treatment measures:

- 70% reduction in total gross pollutants (GP).
- 80% reduction in total suspended solids (TSS).
- 45% reduction in total phosphorus (TP).
- 45% reduction in total nitrogen (TN).

## 3.2 Modelling Methodology

### 3.2.1 Overview

The Model for Urban Stormwater Improvement Conceptualisation (*MUSIC*, Version 6.2) developed by the CRC for Catchment Hydrology was utilised to evaluate treatment train effectiveness (TTE) and post development pollutant generation from the site.

Modelling has been undertaken in accordance with BMT WBM (2015) guidelines with the developed site based on conceptual lot layout with water quality treatment devices included to achieve adopted objectives.

The MUSIC model layout is provided in MA drawing No.PS02-E700.

### 3.2.2 Approach

To achieve adopted objectives, an iterative approach was used for post-development modelling to determine appropriate types, sizes and locations of stormwater treatment devices.

The following modelling scenarios were considered:

- Post-development (untreated) – the developed site without any water quality improvement devices included.
- Post-development (treated) – the developed site with water quality improvement devices included to achieve stormwater quality objectives.

Individual lot treatment and end-of-line treatment structures were assessed to determine the most effective treatment option.

### 3.2.3 Climate Data

Rainfall climate data was sourced from the Bureau of Meteorology (BOM) weather station located in Bowral (Station No. 068102). The data was run on a 6 minute time-step from 1/10/2001 – 31/12/2007.

### 3.2.4 Input Parameters

Input parameters for source and treatment nodes are consistent with BMT WBM (2015) guidelines, a summary of input parameters is provided in Attachment A.

### 3.2.5 Catchment Areas

Post development catchment areas and pervious/impervious areas of each catchment are provided in MA drawing No.PS02-E700.

### 3.2.6 Model Parameters

Base and storm flow concentration inputs were adopted from BMT WBM (2015) guidelines. The values used are displayed below in Table 2.

**Table 2:** Adopted EMCs for source nodes.

| Land Use | Parameter | Base Flow (mg/L) | | Storm Flow (mg/L) | |
|---|---|---|---|---|---|
| | | Log (mean) | Log (stdev) | Log (mean) | Log (stdev) |
| Roads | TN | 0.110 | 0.120 | 0.340 | 0.190 |
| | TP | -0.850 | 0.190 | -0.300 | 0.250 |
| | SS | 1.200 | 0.170 | 2.430 | 0.320 |
| Roof | TN | N/A | N/A | 0.300 | 0.190 |
| | TP | N/A | N/A | -0.890 | 0.250 |
| | SS | N/A | N/A | 1.300 | 0.320 |
| Residential | TN | 0.110 | 0.120 | 0.300 | 0.190 |
| | TP | -0.850 | 0.190 | -0.600 | 0.250 |
| | SS | 1.200 | 0.170 | 2.150 | 0.320 |

The adopted node types for individual catchments are provided in MA drawing No. PS02-E700.

## 3.3 Treatment Train Philosophy

The preferred stormwater treatment strategy for the site aims to provide stormwater reuse and end of line controls, in accordance with the principles of WSUD, to satisfy treatment objectives. Major treatment components include:

- Rainwater tanks.
- Bio-retention structures.

Individual stormwater quality improvement devices (SQIDs) included in conceptual modelling are outlined in the following sub-sections.

### 3.3.1 Rainwater Tanks

Individual rainwater tanks shall be included on each lot to capture roof water for external reuse.

Preliminary MUSIC modelling indicated a minimum 2 kL rainwater tank for each lot is required, with the captured water being used for external non-potable water demands. Final sizing of rainwater tank for individual lots will be subject to the future building size which shall be confirmed at detailed design stage.

### 3.3.2 Bio-retention Basins

A communal bio-retention basin has been proposed (approx. 105 $m^2$) as an end of line treatment structure. Runoff from the site will be collected by the road drainage network and inter-allotment drainage and directed to the basin. Final bio-retention structure details are subject to the ultimate site drainage and earthwork design which will be confirmed at detailed design stage. Indicative locations and details are provided in MA drawing No.PS02-E100 and PS02-E200.

## 3.4 MUSIC Results

The results of the assessment of the proposed site development are provided below, in Table 3.

**Table 3:** Site development MUSIC results.

| Parameter | Sources | Residual Load | Achieved Reduction | Required Reduction | Complies (Y/N) |
|---|---|---|---|---|---|
| TSS (kg/year) | 1020.00 | 185.00 | 81.90 | 80.00 | Y |
| TP (kg/year) | 2.26 | 1.14 | 49.70 | 45.00 | Y |
| TN (kg/year) | 17.80 | 7.59 | 57.30 | 45.00 | Y |
| Gross Pollutants (kg/year) | 279.00 | 0.00 | 100.00 | 70.00 | Y |

MUSIC results show that the required reduction criteria are achieved for the site with the implementation of the proposed treatment train.

## 3.5 Conclusions

Results indicate that post development water quality objectives will be met by the proposed stormwater treatment train, which includes rainwater tanks (with outdoor and indoor reuse) and a communal end of line bio-retention structure.

Further refinement of the model at detailed design stage may alter the sizes and locations of proposed treatment structures; however, performance outcomes of final design are to achieve specification provided in this report.

# 4 Stormwater Quantity Assessment

## 4.1 Water Quantity Objectives

Site stormwater quantity performance objectives are consistent with WSC Engineering Design Specifications (2016). Objectives are outlined below:

- OSD is to be provided to ensure post development discharge rate does not exceed the rate of runoff for existing conditions up to the 1 in 100 year ARI storm event.
- System to be designed to carry all flow during minor storm events, up to and including the 1 in 10 year ARI, by way of a pit and pipe network.
- System to be designed to carry all flows during major storm events, up to and including the 1 in 100 year ARI, by way of overland flow paths.

## 4.2 OSD Modelling Methodology

### 4.2.1 Overview

DRAINS hydrological and hydraulic modelling package was used with the ILSAX engine to determine preliminary site storage requirements to ensure post development discharge is less than or equal to pre-development discharge for the site.

### 4.2.2 Approach

Preliminary sizing of the OSD was completed through iterative modelling to achieve compliance with site objectives. Modelling was undertaken for all durations of the following storms:

- 1 in 1 year ARI.
- 1 in 2 year ARI.
- 1 in 5 year ARI.
- 1 in 10 year ARI.
- 1 in 20 year ARI.
- 1 in 50 year ARI.
- 1 in 100 year ARI.

### 4.2.3 IFD Data

Intensity Frequency Duration (IFD) parameters were based on the coefficients provided in D5.04 of Wollondilly's Design Specifications (2016).

### 4.2.4 Catchment Areas

Catchment delineation was developed using site LIDAR data and based on the conceptual subdivision layout. Refer to MA drawing No. PS02-E600 for catchment plan. Impervious fractions were based on aerial photography for existing condition model and consistent with the WSC recommended impervious fractions for the post development model.

## 4.3 DRAINS results

OSD storage has been provided to limit post development peak discharge to existing rates for all durations for the 1, 2, 5, 10, 20, 50 and 100 year ARI storms. Table 4 displays the peak results for each storm event, refer to the drawing PS02-E600 in Attachment B for further information.

**Table 4:** DRAINS results

| Storm Event (ARI) | Critical Duration (hour) | Existing Peak Discharge ($m^3/s$) | Post Development Peak Discharge ($m^3/s$) | Change ($m^3/s$) | Complies with council's requirement |
|---|---|---|---|---|---|
| 1 | 2 | 0.081 | 0.079 | - 0.002 | Y |
| 2 | 2 | 0.222 | 0.202 | - 0.020 | Y |
| 5 | 2 | 0.401 | 0.361 | -0.040 | Y |
| 10 | 2 | 0.473 | 0.432 | -0.041 | Y |
| 20 | 2 | 0.565 | 0.509 | -0.056 | Y |
| 50 | 2 | 0.645 | 0.600 | -0.045 | Y |
| 100 | 2 | 0.733 | 0.728 | - 0.005 | Y |

DRAINS modelling indicated that the site OSD basin requires an approximate storage volume of 480 $m^3$ with multi-stage orifice for low flows and a 1.8 m weir for high flows. The basin is to be connected to the proposed kerb inlet pit on Greenacre Drive.

## 4.4 Concept Site Drainage Network

### 4.4.1 Road Drainage

A concept pit and pipe layout with preliminary sizing for the roads is provided in MA planset P1706329PS02, drawing No. PS02-E100. Hydraulic modelling is to support the proposed design and be completed in accordance with WSC policy at detailed design stage. Modelling is to ensure the system has been designed to cater for the minor storm event (i.e. the 1 in 10 year event) and overland flows for the major storm event (up to the 1 in 100 year event).

### 4.4.2 Inter-allotment Drainage

Lots which are unable to discharge run-off directly into proposed street drainage shall be serviced by inter-allotment drainage, which will convey run-off through adjacent lots in order to reach an appropriate discharge point.

These systems are to be confirmed at detailed design stage, once site grading and earthworks analysis has been completed.

## 4.5 Conclusion

Preliminary hydraulic modelling indicates that provision of OSD achieves site objectives for water quantity. Detailed design of the site drainage system and OSD basin including size, position, dimensions, outlet control, overflow weir and final volume will need to be undertaken during the detailed design stage of the development.

# 5 References

BMT WBM (2015) NSW MUSIC Modelling Guidelines.

FAWB (2009) Adoption Guidelines for Stormwater Biofiltration Systems, Facility for Advancing Water Biofiltration, Monash University.

Wollondilly Shire Council (2016) Engineering Design Specification D5 – Stormwater Drainage Design.

Wollondilly Shire Council (2016) Development Control Plan (DCP).

# 6 Attachment A – MUSIC Model Inputs

**Table 5:** Treatment node inputs.

| Element | Factor | Input | Source |
|---|---|---|---|
| Setup | Climate File | Climate mlb file from Bowral (Parry Drive) | eWater |
| Source Nodes | Rainfall Threshold | Based on surface type specified in Table 5-4 | BMT WBM (2015) |
| | Base & Stormflow Properties | As per Table 5-6 & 5-7 | BMT WBM (2015) |
| | Estimation Method | Stochastically generated | BMT WBM (2015) |
| Rainwater Tank | Low Flow By-Pass | 0 $m^3/s$ | BMT WBM (2015) |
| | High Flow By-Pass | 0.005 $m^3/s$ per dwelling | BMT WBM (2015) |
| | Volume Below Overflow | 2.0 kL per dwelling (modelled only 80% of tank volume) | By design |
| | Surface Area | 0.8 $m^2$ per tank | By design |
| | Overflow Pipe Diameter | 90 mm pipes for each tank | By design |
| | Re-use | Annual demand of 0.151 kL/dwelling/day for outdoor water purposes.<br>Daily demand of 82 L/dwelling/day for indoor toilet use. | BMT WBM (2015) |
| Bioretention Structure | Low Flow By-Pass | 0 $m^3/s$ | BMT WBM (2015) |
| | High Flow By-Pass | 100 $m^3/s$ | Set to ensure all flows drain to bioretention |
| | Extended Detention Depth | 0.3 m | By design, within FAWB recommended range |
| | Surface Area | 105 $m^2$ | By design |
| | Filter Area | 105 $m^2$ | By design |
| | Unlined filer media | 0.01 m, nominally 0 m | Structure is lined |
| | Saturated Hydraulic Conductivity | 100 mm/hr | FAWB (2009) |
| | Filter Depth | 0.4 m | By design, within FAWB (2009) standard range |
| | TN content of filter media | 400 mg/kg | BMT WBM (2015) default |
| | Orthophosphate content of filter media | 40 mg/kg | BMT WBM (2015) default |
| | Exfiltration rate | 0 mm/hr | Base is lined |
| | Lined base | Yes | By design, all water is treated |
| | Vegetation properties | With effective nutrient removal plants | By design |
| | Overflow weir width | 1.8 m | By design |
| | Underdrain present | Yes | By design |
| | Submerged zone | Yes | By design |