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STORMWATER MANAGEMENT PLAN

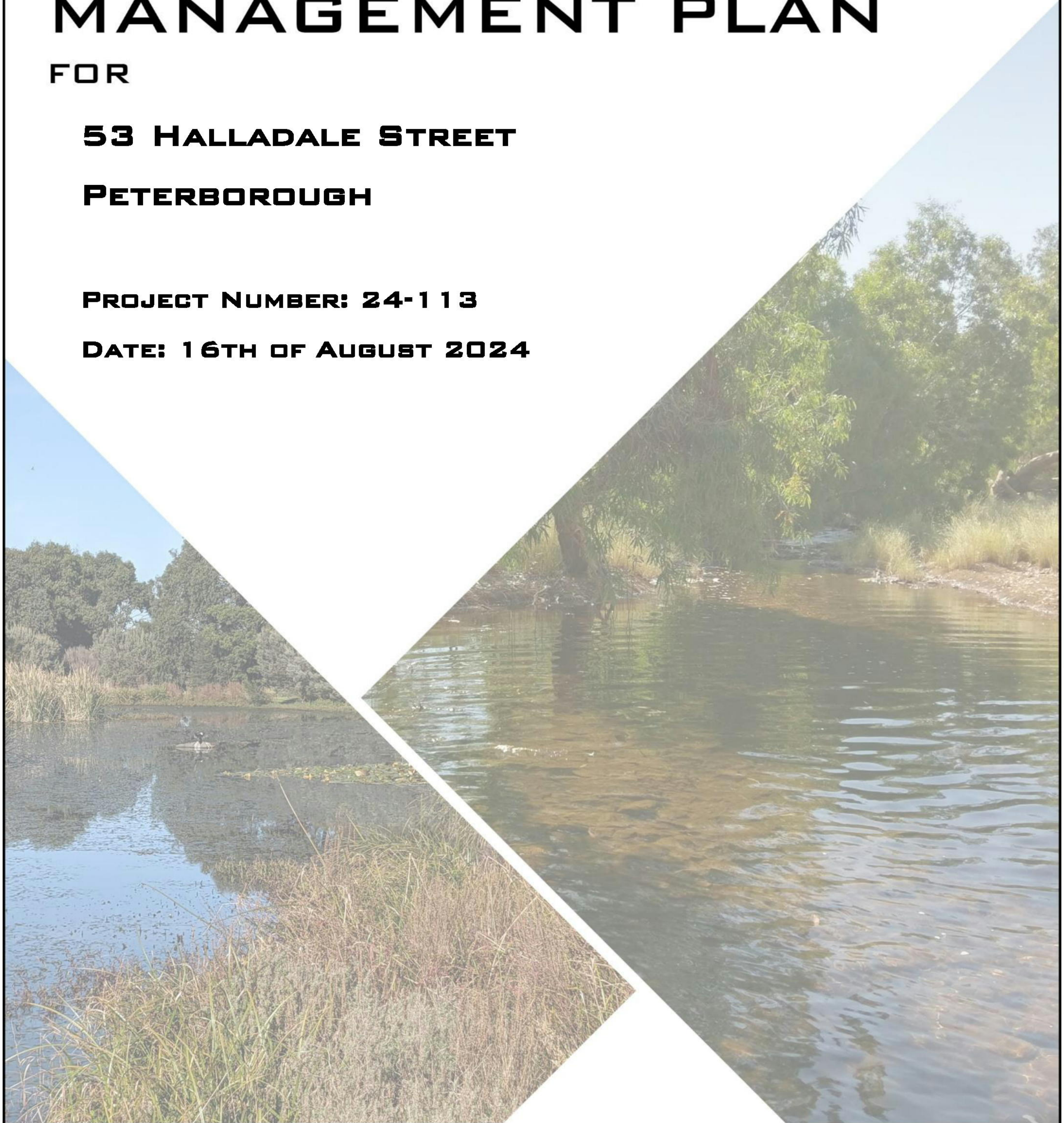
FOR

53 Halladale Street

Peterborough

Project Number: 24-113

Date: 16th of August 2024



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Accreditation

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Reviewer: James Baudinette

Accreditation: BEng (Civil)(Hons), MIEAust

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1.0 Introduction

SITEC has been engaged to compile a Storm Water Management Plan for the 5183m^2 (0.5183ha) site, at 53 Halladale Street, Peterborough on behalf of Dan Pech.

This report is to accompany the planning documents submitted to the Moyne Shire to provide details on how the stormwater will be controlled from the 4-lot subdivision development.

This report provides information about the site and the way in which storm water run-off will be conveyed to the proposed outfall points. It also provides explanation of the storage and treatment methods prior to entry into the existing stormwater network. Figure 1 provides a locality plan and indicates the location of the proposed development.

Figure 1 - Locality Plan

2.0 Site Description

The overall development is made up of an existing residential block that contains an existing dwelling and 2 outbuildings (sheds).

2.1 Proposed Development

Figure 2 below demonstrates the proposed development layout. This consists of a four-lot residential subdivision with frontages of the lots onto Old Peterborough Road and Halladale Street.

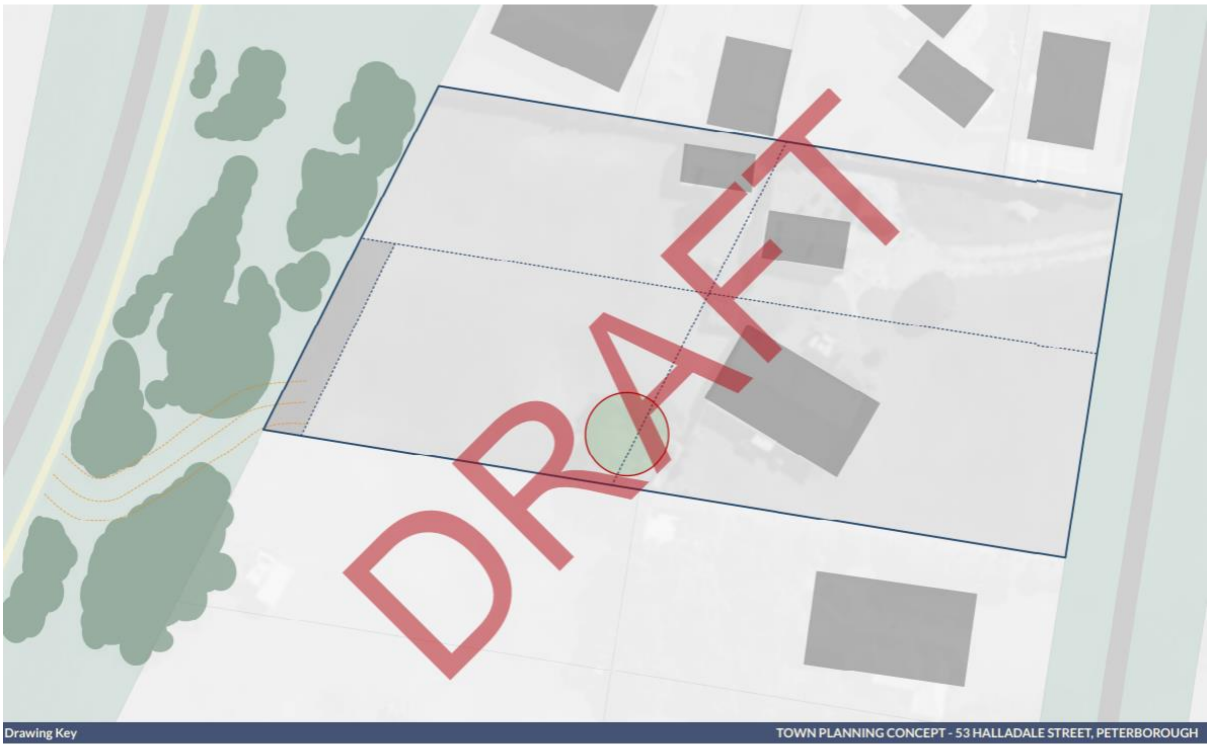


Figure 2 - Development Layout

2.2 Existing Catchment and Outfalls

The site is currently occupied by an existing residence with small to medium trees across the site. The site's high point is located at the Southwest corner of the block with the low point in the middle of the Eastern Perimeter. Hence the site naturally falls to the Eastern side of the site with the overland stormwater flows being directed towards this area. The development site's high and low points to AHD heights are approximately 6.06m and 2.53m respectively.

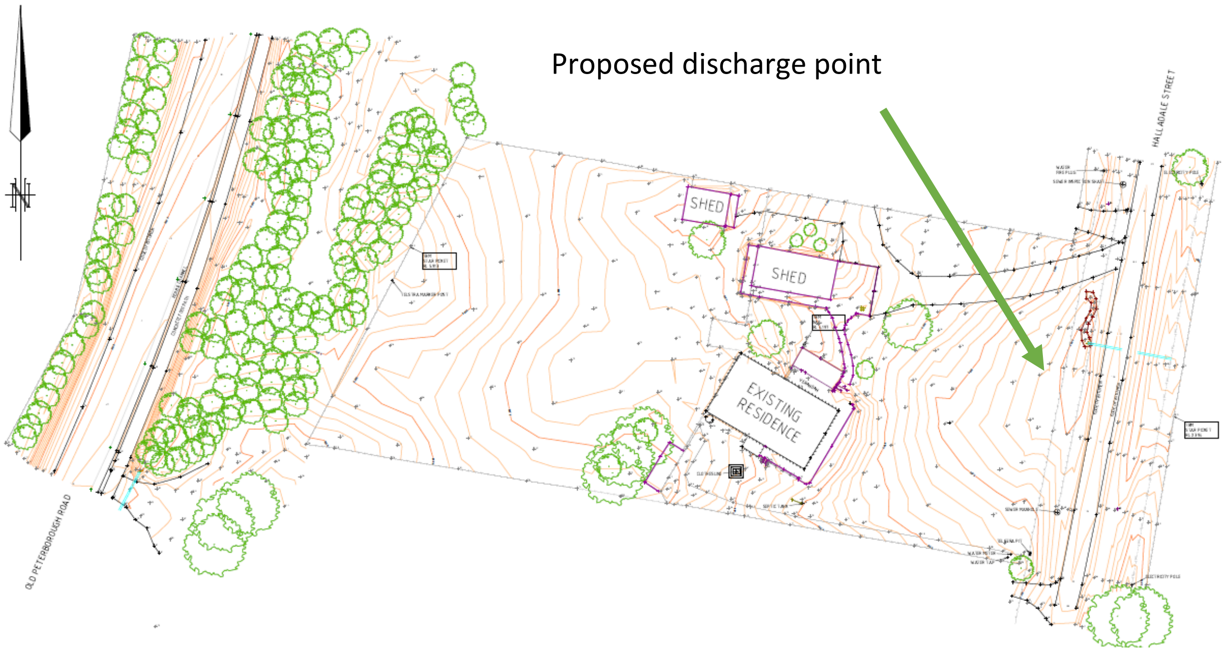


Figure 3 – Development site

Currently, the stormwater generated from the lot runs into the existing stormwater culvert beneath Halladale Street. The land to the west (Old Peterborough Road) has a depression that transitions into a table drain that directs the stormwater generated in the road to the north. Hence there is no upstream catchment affecting this development.

There are several items requiring attention for this proposed development which will be addressed in this report. These items include the storm water retention on site, its location and the treatment of the storm water before it enters the existing storm water network.

3.0 Requirements and Constraints

The assumptions for the proposed subdivision include:

- The storm water discharge from the development will be limited to predevelopment runoff for an 20% AEP storm event.
- If the post development runoff is greater than the predevelopment runoff, on-site stormwater retention (storage) will be required.
- Underground stormwater network and open swales will be required to convey stormwater to LPOD.
- Stormwater generated from the proposed development will not further impede on the existing, neighbouring properties above the existing conditions.
- Measures to enhance stormwater discharge quality from the site to protect downstream waterways will be required.
- Stormwater from a 1% AEP storm event is required to pass through the development via the road reserve or drainage reserves without impeding on facilities or neighbouring properties.

3.1 Flood Storage Requirements

It is assumed that Council will require runoff from the site to be restricted to pre-development levels. This has been taken as assuming 20% AEP post-development outflows from the subject site must be restricted to 20% AEP pre-development flow rates at the designated outfall location.

3.2 Flood Level Requirements

The 1% AEP flood event will be required to be contained in the road reserve and the proposed drainage infrastructure.

3.3 Water Sensitive Urban Design (WSUD) Requirements

Clause 56.07-4 of the Victorian State Planning provisions states that urban stormwater management systems must be designed to meet current best practice management performance objectives for stormwater quality management in the Urban Stormwater – Best Practice Environmental Management Guidelines (CSIRO 1999). The Best Practice Environmental Management Guidelines (BPEMG) objectives for environmental management of stormwater pollutants are:

- Total Suspended Solids (TSS) 80% retention of the typical urban annual load
- Total Phosphorus (TP) 45% retention of the typical urban annual load
- Total Nitrogen (TN) 45% retention of the typical urban annual load
- Gross Pollutants 70% retention of the typical urban annual load

3.4 Asset Ownership and Maintenance

The proposed underground stormwater network and swale will be designed to the IDM standards and to councils satisfaction. As such the pipe and pit infrastructure located in the proposed drainage easement along with the swale will be vested in council. Hence this infrastructure will be councils responsibility to maintain. Whilst the stormwater infrastructure including the stormwater tanks and minor stormwater pipe that connects the stormwater catchments to the council infrastructure will be private and the responsibility of the land owner.

3.5 Applicable Standards

All stormwater treatment elements and overland flow paths will be designed to the following:

- Australian Rainfall and Runoff 2019 (Ball et al. 2019);
- Infrastructure Design Manual (Local Government Infrastructure Design Association, V5.4, 2022);
- WSUD Engineering Procedures: Stormwater Melbourne (Melbourne Water, 2005).

4.0 Proposed Strategy

The SWMP proposed is shown in detail in Appendix B. The sections below provide commentary on key aspects of the strategy.

4.1 Stormwater Treatment Elements

This catchment will incorporate 2 types of stormwater treatment elements:

- A stormwater tank that will capture and store the stormwater collected off the roof will be connected and the overflow will be directed into the existing stormwater network. The collected stormwater will be reused throughout the house for flushing and irrigation purposes.
- A swale drain will be constructed to treat and convey the stormwater prior to it entering the Halladale Street road reserve.

Table 1 below (reproduced from Appendix C) shows that the treatment train below is able to exceed all BPEMG stormwater treatment requirements for the development.

Table 1 - Expected Stormwater Pollutant Retention from the Proposed Systems

Pollutant	***Pollutants generated from Development (kg/yr)***	***Pollutants Retained in Treatment Elements (kg/yr)***	***% Pollutants withheld relative to pollutant generation from development (%)***
Total Suspended Solids	**444**	**51.1**	**88.5%**
Total Phosphorus	**0.894**	**0.233**	**73.9%**
Total Nitrogen	**6.2**	**3.35**	**45.9%**
Gross Pollutants	**105**	**0**	**100%**

4.2 Flood Storage Elements

For the development the post development flows for the 20% AEP storm event (0.043m^3/s) are greater than the predevelopment flows (0.018m^3/s) hence storage is required. The stormwater network has been designed to store the difference between the pre and post development flows from the subject site.

During this 20% AEP event, 21m^3 of storage is required to contain the storm water generated onsite. The calculations that were used to determine the storage requirements are located in Appendix B. This storage will be located in the stormwater tanks that will be required on each of the proposed lots. Each lot will require a 10,000ltr tank minimum to cater for the 20% AEP event. The overflow from these tanks will be directed into the proposed stormwater pipe that will be constructed between the eastern lots.

Detailed storage design will be available as part of the civil detailed design documents.

Table 2 - Pre- and Post-Development Flow Estimates

Location	20% AEP Flow Estimate (m^3/sec)			
	Pre	Critical Duration	Post	Critical Duration
53 Halladale Street	0.018	14-minutes	0.041	15-minutes

Note: All flows rounded to the nearest 0.001 m3/s due to storage modelling detail.

4.3 Flood Impact

4.3.1 Flood Levels

The internal stormwater pipe will be designed to catch the 1% AEP event. This pipe will discharge into the Halladale Street road reserve and into the neighbouring flood zone.

4.3.2 Road Inundation and Road Overland Flow Paths

No inundation of the proposed roads and intersections are expected as stormwater flows will traverse down the internal stormwater pipe and into the neighbouring flood zone to the east.

4.4 Subdivision Drainage Layout

Appendix A demonstrates the indicative location of the drainage infrastructure to service each lot. All lots will drain the stormwater caught into the underground drainage network prior to it entering the swale drain.

4.5 Proposed Easement or Reserve

As the underground stormwater drainage network and swale drain is located within the proposed lots, an easement will need to be created in favour of council as the proposed infrastructure will be vested to council.

5.0 Concluding Remarks and Further Work Required

The SWMP detailed within this report and associated concept design documents, demonstrates the designs of assets required to service the proposed development. To ensure all applicable planning controls are met, the development is to incorporate:

- A stormwater storage tank to service each lot of the subdivision will be 10,000ltr in size which will collect and store the 20% AEP event and release flows at predevelopment levels.
- The stormwater stored will be reused throughout the lot for flushing and irrigation purposes.
- The post development flows will be restricted to predevelopment level by an appropriately sized pipe connected to the stormwater tanks which will act as an orifice so the designated flows can be released.
- Once the stormwater is released from the tanks at predevelopment levels, it will flow through the swale prior to the stormwater entering the Halladale Street road reserve.
- Overland flows will not inundate the development or existing establishments in the 1% AEP storm event and will be able to pass through the proposed drainage easement.

As such, it is requested that Council approve the preliminary SWMP presented herein, allowing the development process to progress.

6.0 References

Melbourne Water (2005). "*WSUD Engineering Procedures: Stormwater Melbourne*", CSIRO Publishing.

Local Government Infrastructure Design Association, *Infrastructure Design Manual V5.4, 2022*

7.0 Abbreviations, Descriptions and Definitions

The following table lists some common abbreviations and drainage system descriptions and their definitions which may be referred to in this report.

Table 3 - Common Abbreviations Associated with Stormwater Management Plans

Abbreviation / Descriptions	**Definition**
AHD - Australian Height Datum	Common base for all survey levels in Australia. Height in metres above mean sea level.
ARI - Average Recurrence Interval.	The average length of time in years between two floods of a given size or larger. A 100 Year ARI event has a 1 in 100 chances of occurring in any one year.
AEP – Annual Exceedance Probability	The chance of a storm (flow) of that magnitude (or larger) occurring in a given year. $\boldsymbol{AEP = 1 - e^{(\frac{-1}{ARI})}}$. i.e. 18.13% AEP = 5 Year ARI
BPEMG	Best Practice Environmental Management Guidelines available from CSIRO (2009).
DSS or DS	Development Services Scheme (DSS) or Drainage Scheme (DS) is a master plan developed my MWC for drainage within a catchment area.
ED	Extended detention. A hight that corresponds to the vertical limit of a volume of water stored for treatment within a treatment element.
EY – Exceedances per year	The amount of times a storm (flow) of that magnitude is expected to be exceeded per year. i.e. 4 EY = 3 Month ARI
Hectare (ha)	10,000 square metres
HECRAS	A hydraulic software package that enables the calculations of flood levels and velocities along a waterway given a specified flow.
LPOD	Legal Point Of Discharge
m^3/s -cubic metre/second	Unit of discharge usually referring to a design flood flow along a stormwater conveyance system
Megalitre (ML) (1000 cubic metres)	1,000,000 litres = 1000 cubic metres. Often a unit of water body (e.g. pond) size
MUSIC	Hydrologic computer program used to calculate stormwater pollutant generation in a catchment and the amount of treatment which can be attributed to the WSUD elements placed in that catchment
MWC	Melbourne Water Corporation
Retarding basin	A flood storage dam which is normally empty. May contain a lake or wetland in its base
NWL - Normal Water Level	Water level of a wetland or pond defined by the lowest invert level of the outlet structure
NSL – Natural Surface Level	The surface level of the natural (existing) surface before works.

RORB	Hydrologic computer program used to calculate the design flood flow (in m^3/s) along a stormwater conveyance system (e.g. waterway)
RCP	Representative Concentration Pathway. A relative greenhouse gas concentration into the future. RCP 8.5 represents no significant reduction in emissions until 2100 resulting in significant global warming.
Sedimentation basin (Sediment pond)	A pond that is used to remove coarse sediments from inflowing water mainly by settlement processes.
Swale	A small shallow drainage line designed to convey stormwater discharge. A complementary function to the flood conveyance task is its WSUD role (where the vegetation in the base acts as a treatment swale).
TSS	Total Suspended Solids – a term for a particular stormwater pollutant parameter
TP	Total Phosphorus – a term for a particular stormwater pollutant parameter
TN	Total Nitrogen – a term for a particular stormwater pollutant parameter
WSUD - Water Sensitive Urban Design	Term used to describe the design of drainage systems used to: ○ Convey stormwater safely ○ Retain stormwater pollutants ○ Enhance local ecology ○ Enhance the local landscape and social amenity of built areas
Wetland	WSUD element, which is used to collect TSS, TP and TN. Usually incorporated at normal water level (NWL) below which the system is designed as shallow marsh, marsh, deep marsh and open water areas.

Appendix A – Concept Drawings

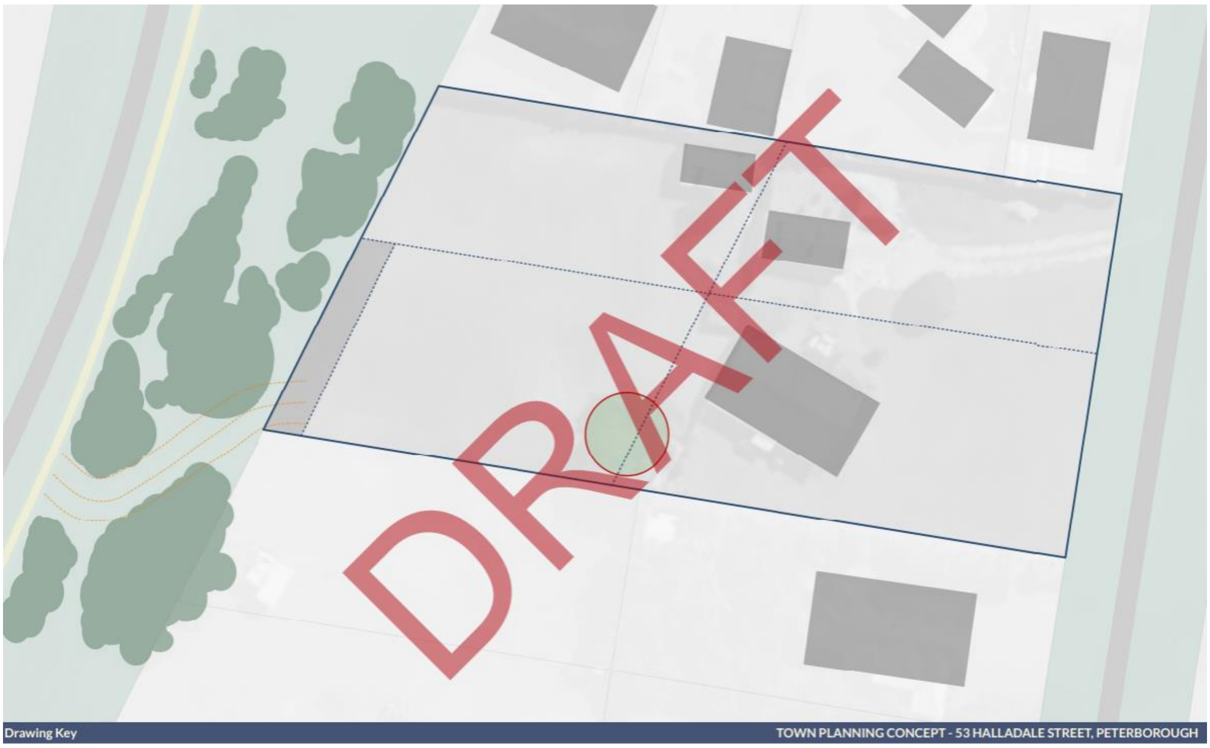


Figure 4 – Concept Layout Plan

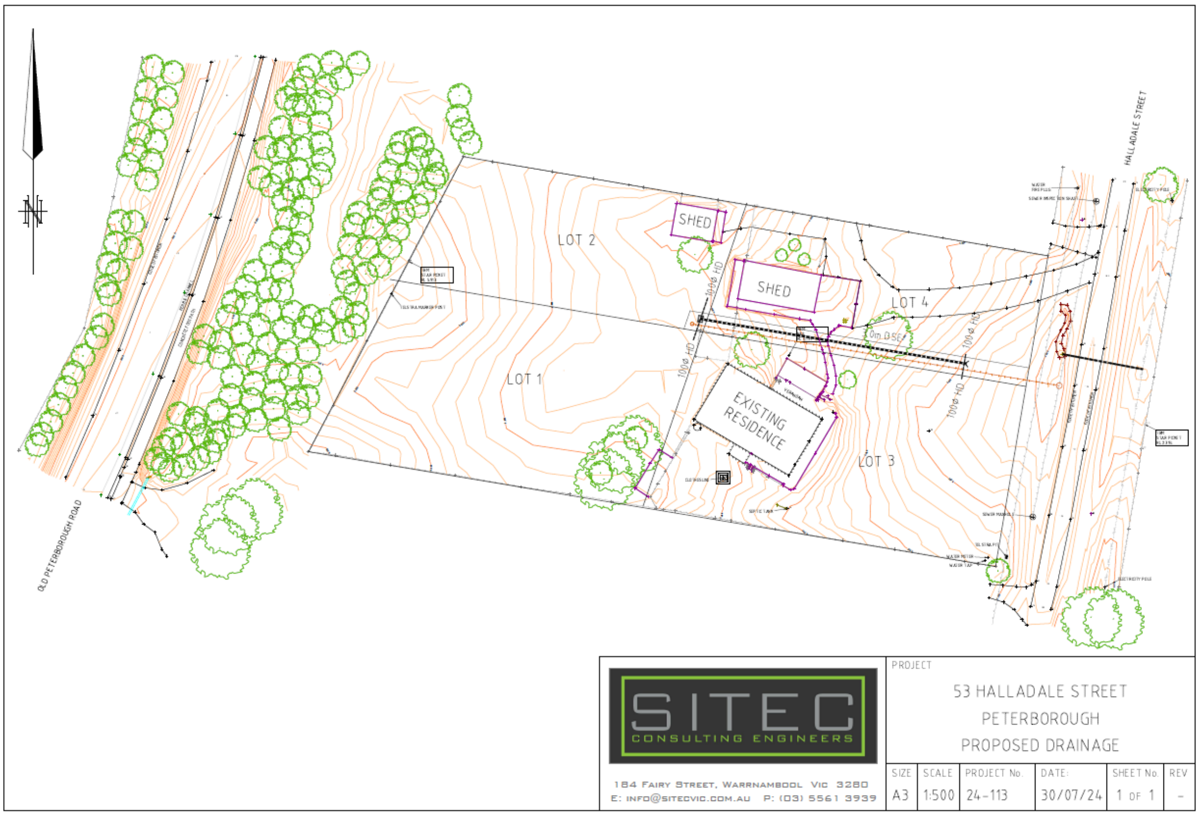


Figure 5 – Concept Storm Water

Appendix B – Hydrologic Modelling

The hydrologic calculations are undertaken below for the proposed 4-lot development.

The is no upstream catchment contributing to the stormwater through this development. Hence this stormwater and the rainfall generated onsite will only need to be included in the calculations. The rational method (with current BoM rainfall intensity) and Boyd's method (or similar) can be used to define flood storage requirements. The storage indicated by these methods suggest storage will be required to fit on site and consideration has been given to how the outlet may be configured.

Predevelopment Flows

Site Catchment

The predevelopment flows for the development site will be calculated using the rational method: $\boldsymbol{Q_{PRE-DEV}} = \frac{CAI_{20\%}}{360}$

Where:

$Q_{PRE-DEV}$	= Pre development discharge (*m^3/s*)
C	= Run off co-efficient = 0.30 (GRZ1)
A	= Total Area (*Ha*) = 5183m^2 (0.5183)Ha
$I_{20\%}$	= 20% AEP Rainfall Intensity (mm/hr)

To calculate the 20% AEP Intensity, the Time of Concentration is calculated using iterations of the Kinetic Wave method:

- $T_c = \frac{6.94\,(L\,F_R)^{0.6}}{I^{0.4}S^{0.3}}$

  Where:

  T_c = Time of concentration

L	= Length of Overland Flow	*= 129m*
F_R	= Retardance Factor (VicRoads Manual)	= 0.05
I	= Rainfall Intensity for 20% AEP(Peterborough)	*= 42.60mm/hr*
S	= Slope of Hydraulic Grade line	*= 0.027 m/m*

T_c = 13.94 minutes

I_{20} = 42.60 mm/hr

$$\boldsymbol{Q_{PRE-DEV}} = \frac{0.3\ \times 0.5183\ \times 42.60}{360} = 0.018m^3/s$$

This yields a total of $\boldsymbol{Q_{PRE-DEV}}$ = **0.018 *m^3/s*** of flow for the overall site which must be catered for in the drainage networks for the subdivision and conveyed to the discharge points.

The allowable predevelopment flow of 0.018*m^3/s* will be sent to the outfall point of the subdivision being the existing culvert under Halladale Street.

Post-development Flows

The post development flows for the site will be calculated using the rational method:

$$\boldsymbol{Q_{Post-DEV}} = \frac{CAI_{10\%}}{360}$$

Where:

$Q_{Post-DEV}$	= Post development discharge (m^3/s)
C	= Run off co-efficient = 0.70 (Residential 600-1,000m^2)
A	= Total Area (*Ha*) = 0.5183Ha
$I_{20\%}$	= 20% AEP Rainfall Intensity (mm/hr)

To calculate the 20% AEP Intensity, the Time of Concentration is calculated using iterations of the Kinetic Wave method:

- $T_c = \frac{6.94\,(L\,F_R)^{0.6}}{I^{0.4}S^{0.3}}$

  Where:

  T_c = Time of concentration

L	= Length of Overland Flow	*= 129m*
F_R	= Retardance Factor (VicRoads Manual)	= 0.05
I	= Rainfall Intensity for 20% AEP(Peterborough)	*= 42.60mm/hr*
S	= Slope of Hydraulic Grade line	*= 0.027 m/m*

T_c = 15 minutes

I_{20} = 40.9 mm/hr

$$\boldsymbol{Q_{PRE-DEV}} = \frac{0.7\ \times 0.5183\ \times 40.9}{360} = 0.041m^3/s$$

This yields a total of $\boldsymbol{Q_{POST-DEV}}$ = **0.041 *m³/s*** of flow for the entire development which must be catered for in the drainage networks for the subdivision and conveyed to the discharge points.

Pre-development flow (20 yr)

Determine Time of concerntration

$$t_c = 6.94(L \times F_R)^{0.6} / I^{0.4} \times S^{0.3}$$

length of flow path (L)=	129	m
Retardence Factor (F_R)=	0.05	(between 0.05-0.2 as per Vicroads drainage design table 7.4.5.3)
Intensity (I) =	42.60	mm/hr
High RL = 6.06 Low RL =	2.53	Fall = 3.53
Slope (S) =	0.027364	(fall/ length)
Time of Concentration (T_c)	13.94	mins

Determine pre-development flow

$$Q = CIA/360$$

Co-efficient of Runoff(C) =	0.3	(pre-development)
Area (A)=	0.5183	Ha
Intensity (I)=	42.60	mm/hr

Pre-development flow $Q_{(20)}$ = 0.018 m^3/sec

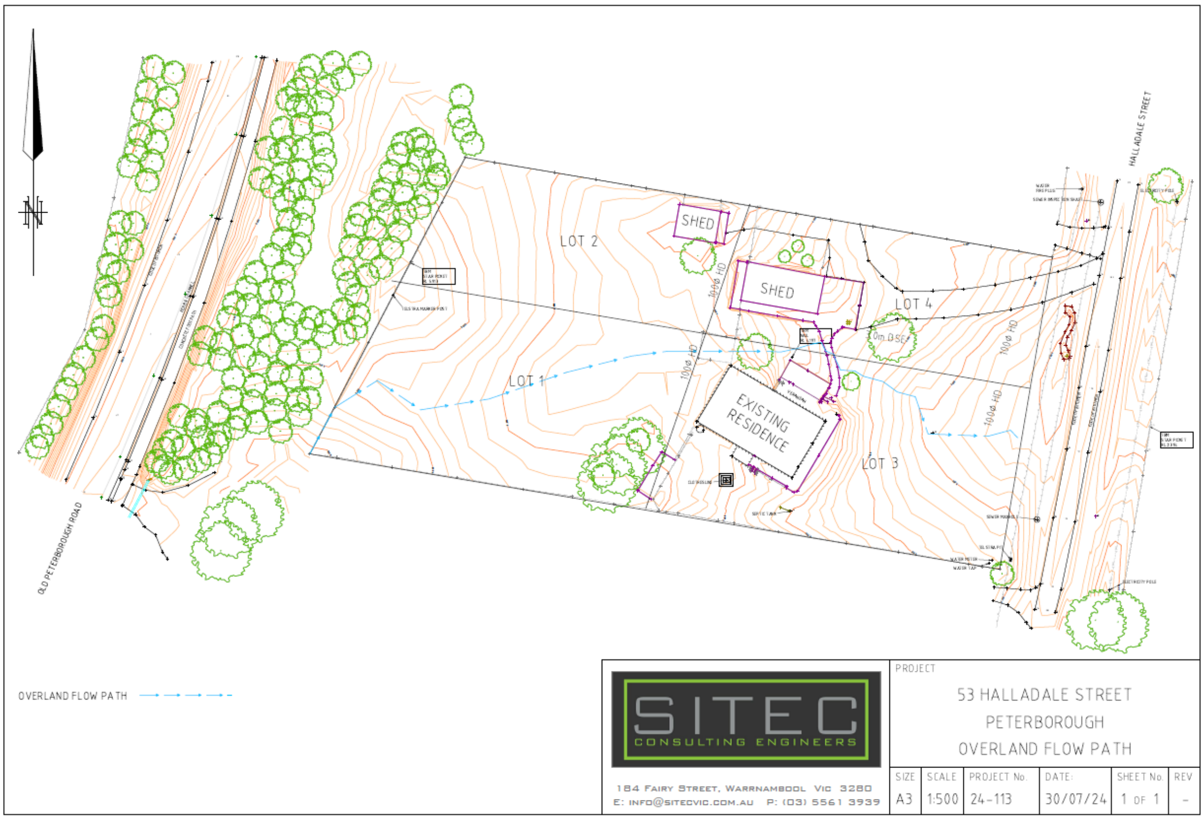
Peterborough

20% AEP

t= (mins)	13.94	13.94
	I =	42.60
a	0.61069393	0.610694
b	0.74714154	1.96854
c	0.077167988	0.535698
d	-0.089914165	-1.64457
e	0.022614026	1.089792
f	-0.002340224	-0.29714
g	8.71E-05	0.029145
	ln I =	2.292157

ABOVE: Figure 6 – Time of concentration

BELOW: Figure 7 – Overland Flow Path



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Stormwater Detention - Boyds Formula (20% AEP)
Boyds Formula (20% AEP)

Project: **53 Halladale Street, Peterborough**
Job No: **24-113**

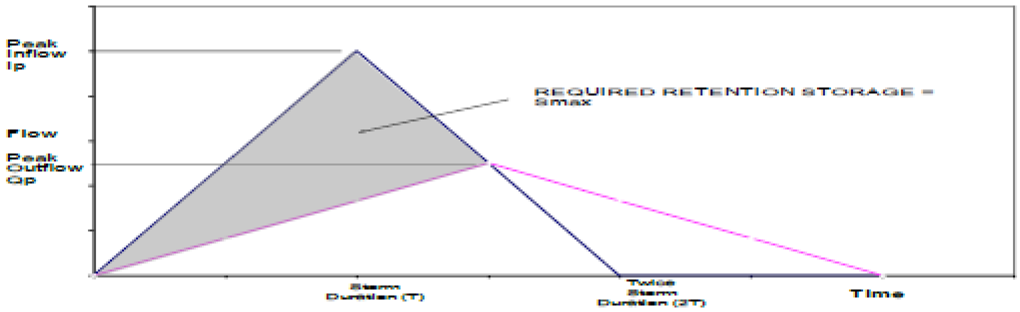
IFD Region= **Peterborough**

Catchment Area (A) =	Residential 600-1000	0.5183	ha
Runoff Coefficient =	Residential 600-1000	0.7	
Effective Catchment Area = ∑CA =		0.363	ha
Restricted outflow requirement =		0.018	m^3/s

Storage requirement is highest value of S_{max} calculated in the table below
Critical storm duration is the storm duration when S_{max} occurs

Continue table until a clear Smax is calculated

Storm Duration (min)	20% AEP Intensity (mm/hr)	I_p (m^3/s)	Q_p (m^3/s)	V_1 (m^3)	S_{max} (m^3)
5	70.2	0.07	0.018	21.224	15.824
10	51	0.05	0.018	30.839	20.039
14	42.5	0.04	0.018	35.979	20.859
15	40.9	0.041219	0.018	37.0973225	20.8973225
16	39.4	0.04	0.018	38.119	20.839
17	38	0.038297	0.018	39.0625433	20.7025433
18	36.8	0.037087	0.018	40.054224	20.614224
19	35.6	0.04	0.018	40.901	20.381



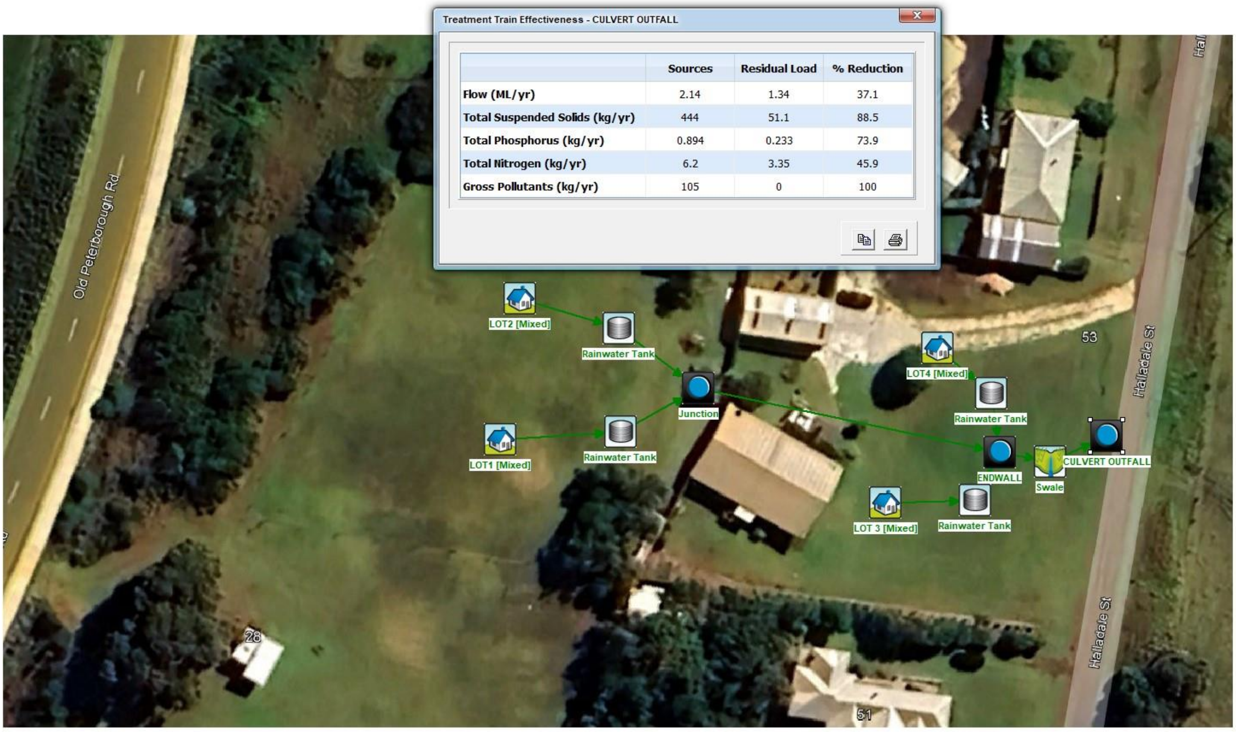
$$S_{max} = V_1 (1 - Q_p/I_p)$$

S_{max} = Maximum Volume of temporary Storage (m^3)
V_1 = Volume of inflow flood (m^3)
I_p = Peak discharge of inflow hydrograph (m^3/s)
Q_p = Peak discharge of outflow hydrograph (m^3/s)

Figure 8 – Storage calculations

Appendix C – Music Modelling

The Music model shown below reflects the figures presented in table 1.



	Sources	Residual Load	% Reduction
Flow (ML/yr)	2.14	1.34	37.1
Total Suspended Solids (kg/yr)	444	51.1	88.5
Total Phosphorus (kg/yr)	0.894	0.233	73.9
Total Nitrogen (kg/yr)	6.2	3.35	45.9
Gross Pollutants (kg/yr)	105	0	100

Figure 9 – Music Modelling and Results