KYNETON COMMERCIAL ESTATE STORMWATER MANAGEMENT PLAN

MAY 2020

MACEDON RANGES SHIRE COUNCIL
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PREPARED FOR

Select Architects

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Revision Status

Revision	Description
A	Draft
B	Draft
C	
D	

TABLE OF CONTENTS

APPENDICES

LIST OF TABLES

LIST OF FIGURES

1 INTRODUCTION

Select Architects have engaged Water Modelling Solutions to prepare a stormwater management plan for the proposed Kyneton Commercial Estate. As part of the approval process with Macedon Ranges Shire Council, a request for information has been requested which detailed a number of specific requirements which needed to be addressed to comply with Clause 53.18 of the Planning Scheme. The following are the key requirements set in out in the request for information response from Macedon Ranges Shire Council and how they have been addressed in this stormwater management plan:

- "The proposed drainage reserve for the commercial component of the subdivision is to be relocated so that gravity drainage is available" – **two detention basins have been designed at a concept level which will drain the commercial portions of the proposed development under gravity.**
- "A suitably sized retarding basin/detention system must be provided to cater for the 1 in 100 year storm event" – **basins have been sized to cater for the 1% AEP event with the full range of durations and temporal patterns tested.**
- "Detention basin outlets are not subject to backwater effect from Post Office Creek" – **the basins are located outside of the 1% AEP flood extent and not subject to backwater effects.**
- "All stormwater must be managed in accordance with the requirements of the Responsible Authority" (Goulburn Murray Water requirement) **– stormwater treatment has been designed in line with best practice, and ensures compliance with treatment targets set out in Macedon Ranges Shire guidelines and the Infrastructure Design Manual (2020)**

2 SITE OVERVIEW

The stormwater management plan is for the proposed commerical estate located in Kyneton to the north of the Calder Freeway. The site, shown in Figure 2-1 is bordered by Edgecombe Road to the west and Baynton Road to the south. The site currently consists predominantly of pastured and agricultural land. It is noted that Post Office Creek traverses the southern end of the site with an approximate upstream catchment area of 8.7 km^2.

The proposed Kyneton Commercial Estate consists of mixed use with 27 commercial and 18 residential lots. The Estate includes a proposed service station, hardware store and subdivision of rural residential lots. The majority of the proposed site is situated on the northern side of Post Office Creek with three lots located on the southern side. Pipers Creek divides the proposed site into two main precincts. The precinct to the south of Pipers Creek Road consists of commercial use including the petrol station and the northern precinct is split between commercial and rural residential uses.

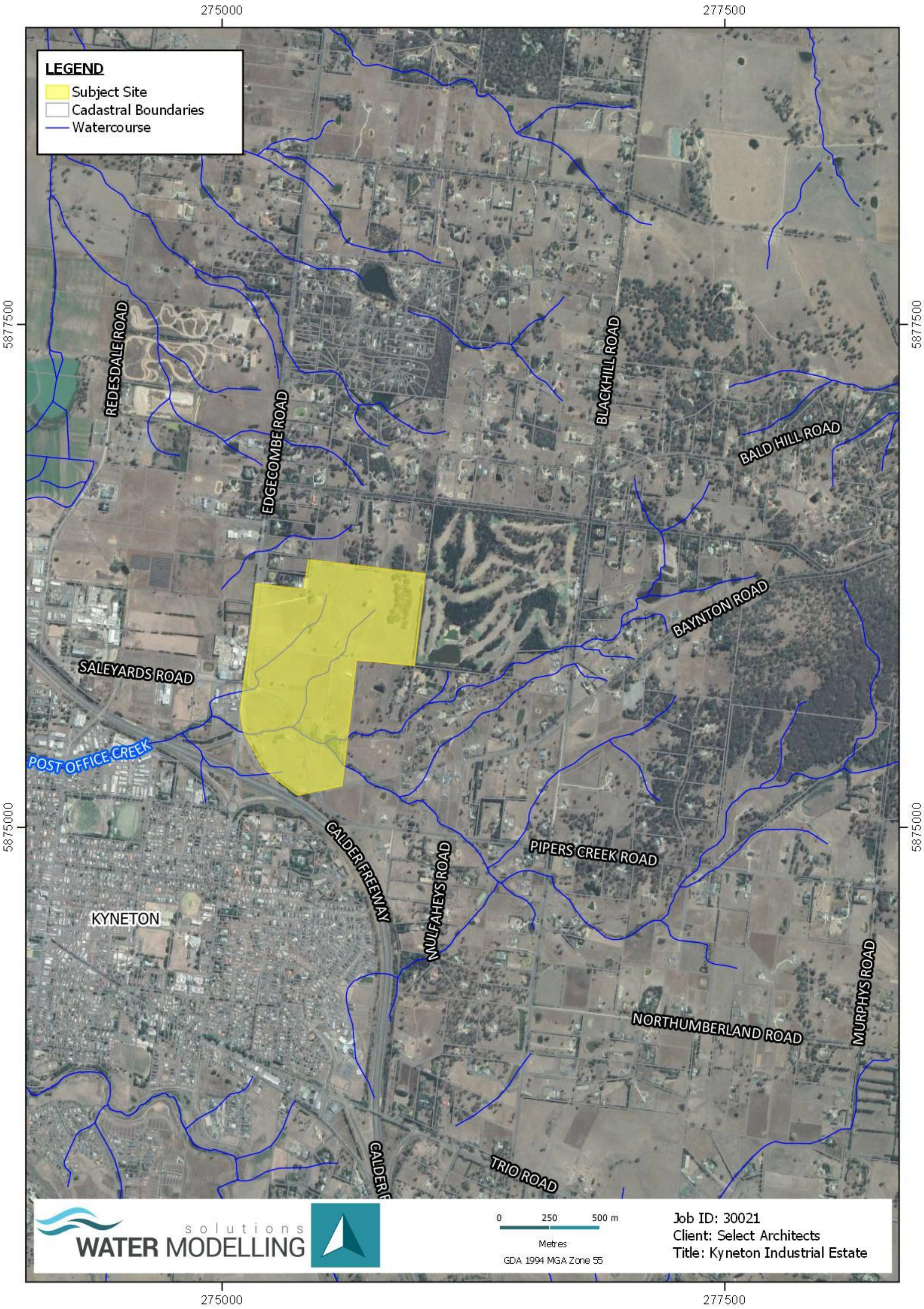

Figure 2-1 Study Area

3 SITE ASSESSMENT

3.1 HYDROLOGY

A hydrological RORB model of the site has been constructed to determine site runoff. The critical temporal pattern and duration for the 1% AEP storm event were adopted from the Post Office Creek catchment RORB model developed for the flood impact assessment. Key RORB parameters used in the site model, scaled based on the Post Office Creek catchment RORB model are summarised below in Table 3-1.

The site catchment delineation shown in was undertaken using CatchmentSIM GIS software and QGIS, using the proposed lots as a guide. Detailed 1m LiDAR was used as the topographic data to delineate and sub-divide within the Kyneton Commercial Estate proposed site. Sub-catchment delineation is shown in Figure 3-1 below for the existing case and in Figure 3-3 for the developed scenario. 'Print' nodes were inserted at the site outlet and downstream of the three main tributaries of the site at sub-catchments 21b, 25m and 13c. This enabled peak flows to be determined at these locations to determine local site runoff and required detention base sizing.

IFD data was sourced from the Bureau of Meteorology (BoM) IFD generation tool for Australian Rainfall and Runoff (ARR) 2016, and was based on the Post Office Creek site coordinates upstream catchment centroid (37.2441S, 144.4812E). Spatial variation of IFD data was not investigated due to the small catchment size.

Table 3-1 Key Site RORB Parameters

Parameter	Existing Value	Design Value	Derivation
Fraction Impervious	Varying	Varying, increased fraction impervious on proposed roads, commercial lots and rural residential lots.	Determined using land use planning zones and aerial imagery. Values consistent with Melbourne Water Music Guidelines.
Initial Loss	23 mm	23 mm	Adopted from Kyneton Flood Study completed in 2019 (North Central CMA, 2019) which was based on 3 calibration events.
Continuing Loss	1 mm/hr	1 mm/hr	Adopted from Kyneton Flood Study completed in 2019 (North Central CMA, 2019) which was based on 3 calibration events.
Kc (Routing Coefficient)	0.77	0.62	Scaled from the Post Office Creek RORB model developed by WMS with a K_c/d_{av} ratio of 1.275.
M (Non-Linearity exponent)	0.8	0.8	Unchanged from default. Also consistent with Kyneton Flood Study completed in 2019 (North Central CMA, 2019).
Average Stream Length (d_{av})	0.61	0.49	Based on delineated catchments.
Reach Type	Natural Unlined	Natural Unlined except for developed flow paths along roads which were excavated but unlined.	

3.2 EXISTING SCENARIO

The existing site RORB model, shown in Figure 3-1 represents existing conditions (pre-development). The sub-areas have been schematised to align with the proposed development layout to expediate the update of the model to developed conditions. The majority of the site under existing conditions consists of vegetated grassland. There are three main contributing overland flow paths within the site which discharge into Post Office Creek.

The 1% AEP peak flows are shown in Figure 3-1 and flows for all the modelled durations 10 minutes to 6 hours are summarised in Table 3-2 (peaks are in bold text). The Flood behaviour of the site under existing conditions for the peak 1% AEP event are outlined below:

- A peak flow of 1.11 m^3/s with a 1.5 hour critical duration outlets from the eastern tributary under Pipers Creek Road through three box culverts (3 m width x 2 m height) into Post Office Creek.
- A small central tributary, which outlets at sub-catchment 21b into Post Office Creek produces an overland flow path with a peak flow of 0.49m^3/s for the 1 hour critical duration.
- The western main tributary (25m) with the largest area of 26.31 hectares outlets downstream of the central and eastern tributaries into Post Office Creek. A peak flow of 1.69 m^3/s with a 6 hour critical duration is produced. It is noted that sub-catchment 25m is out of the 1% AEP flood extent.
- The combination of the three tributaries with a total catchment area of 45.49 hectares produces a combined peak flow into Post Office Creek of 3.09 m^3/s in the 1.5 hour critical 1% AEP storm.

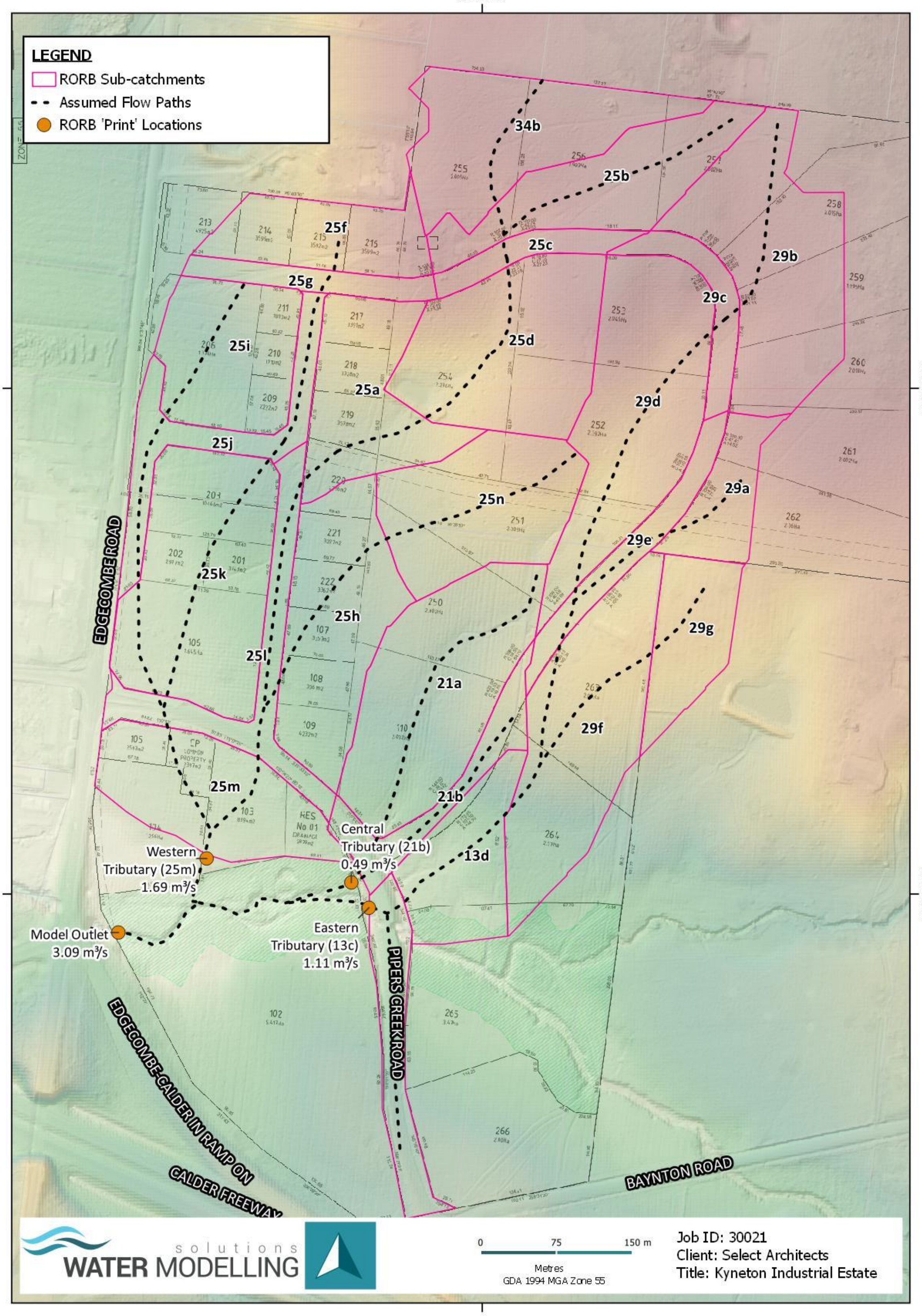

Figure 3-1 Existing Site RORB Model Setup with 1% AEP Peak Flows

Table 3-2 1% AEP Site Flows under Existing Conditions

Duration	Peak Flow (m^3/s)			
	Western Tributary (25m)	Eastern Tributary (13c)	Central Tributary (21b)	Site Outlet
10 min	0.22	0.45	0.35	0.28
15 min	0.68	0.44	0.34	0.76
20 min	0.91	0.59	0.39	1.16
25 min	0.95	0.69	0.42	1.48
30 min	1.11	0.75	0.43	1.76
45 min	1.50	0.93	0.46	2.35
1 hour	1.80	1.03	**0.49**	2.74
1.5 hour	1.94	**1.11**	0.45	**3.09**
2 hour	1.90	1.05	0.43	3.08
3 hour	1.85	1.03	0.40	3.03
4.5 hour	1.52	0.87	0.32	2.53
6 hour	**1.69**	0.98	0.36	2.83

3.3 DEVELOPED SCENARIO

Conditions for the developed scenario were based on the initial layout lot plan of the estate. Sub-catchments were delineated accordingly to differentiate between the main proposed uses including commercial, rural residential, petrol station and local roads. Sub-catchment areas remained unchanged however routing was changed based on the assumption that flows would be routed down roadside drainage where applicable. The updated sub-catchment configuration, when compared to the existing scenario is summarised in Table 3-3 and shown in Figure 3-2.

Fraction impervious was increased based on the changed land uses, other RORB parameters can be found in Table 3-1.

Table 3-3 RORB Updated Sub-Catchment Areas

Existing Scenario	Area (ha)	Developed Scenario	Area (ha)
Eastern Tributary (13c)	15.19	Eastern Tributary (13c) - Rural Residential	7.47
Central Tributary (21b)	3.99	Central Tributary (21b) - Rural Residential	11.71
Western Tributary (25m)	26.31	Western Tributary - Commercial Zone	24.17
-	-	Petrol Station (25m)	2.14
Total	**45.49**	**Total**	**45.49**

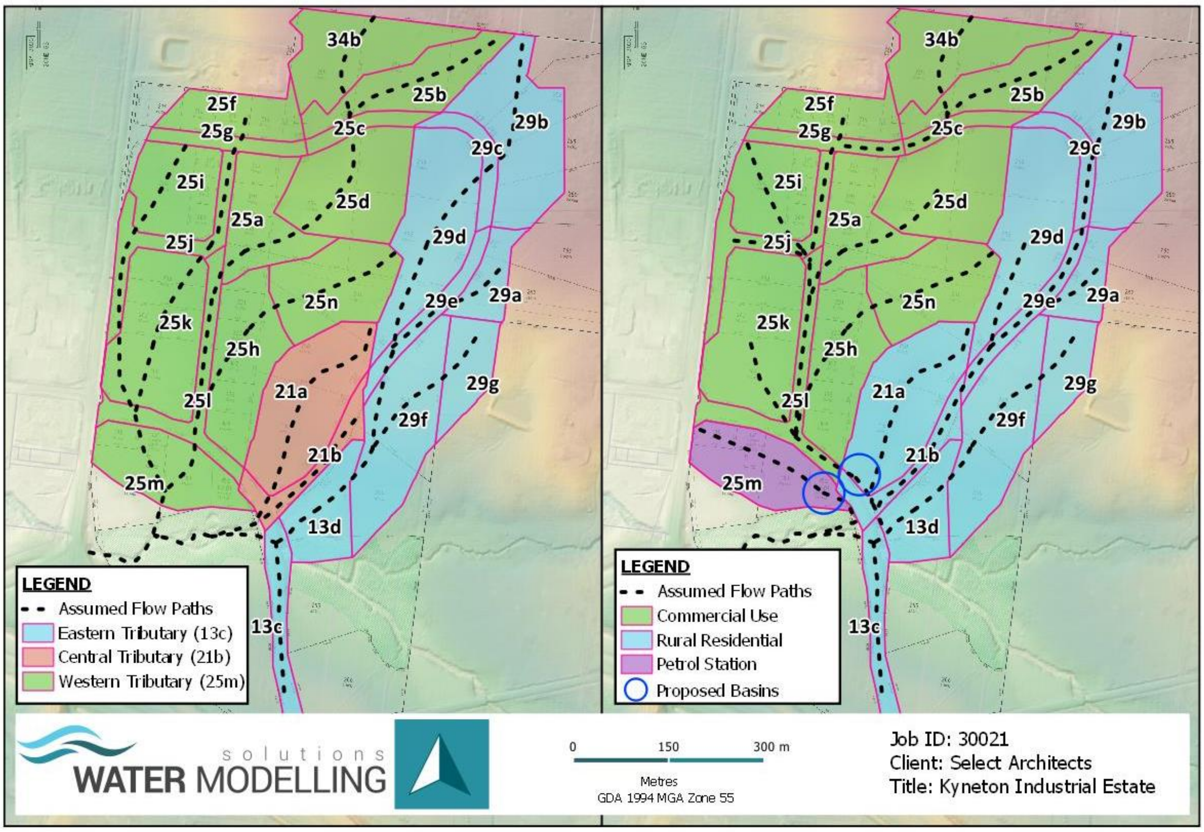

Figure 3-2 Site RORB Existing and Developed RORB Tributaries

The total flow at the outlet for the unmitigated developed scenario increased by 30% from 3.09 m^3/s to 4.02 m^3/s when compared to the existing scenario. Flood behaviour for the site under the unmitigated developed scenario, as shown in Figure 3-3 are the following:

- The predominately rural residential eastern tributary (13c) has a slight increase in fraction impervious but a decreased area due to sub-catchment rerouting. The tributary, which outlets into Post Office Creek produces a peak flow of 0.86 m^3/s for the 45 min critical duration 1% AEP event.
- The central tributary (21b) which has a slight increase in fraction impervious and a large increase in area which produces a peak flow of 1.11 m^3/s for the 1.5 hours critical duration 1% AEP event.
- The large western tributary which is predominately proposed commercial use produces a peak flow of 3.66 m^3/s for the 1 hour critical duration 1% AEP event.
- The combination of the three tributaries with a total catchment area of 45.49 hectares produces a combined peak flow into Post Office Creek of 4.02 m^3/s in the 1 hour critical duration 1% AEP event.

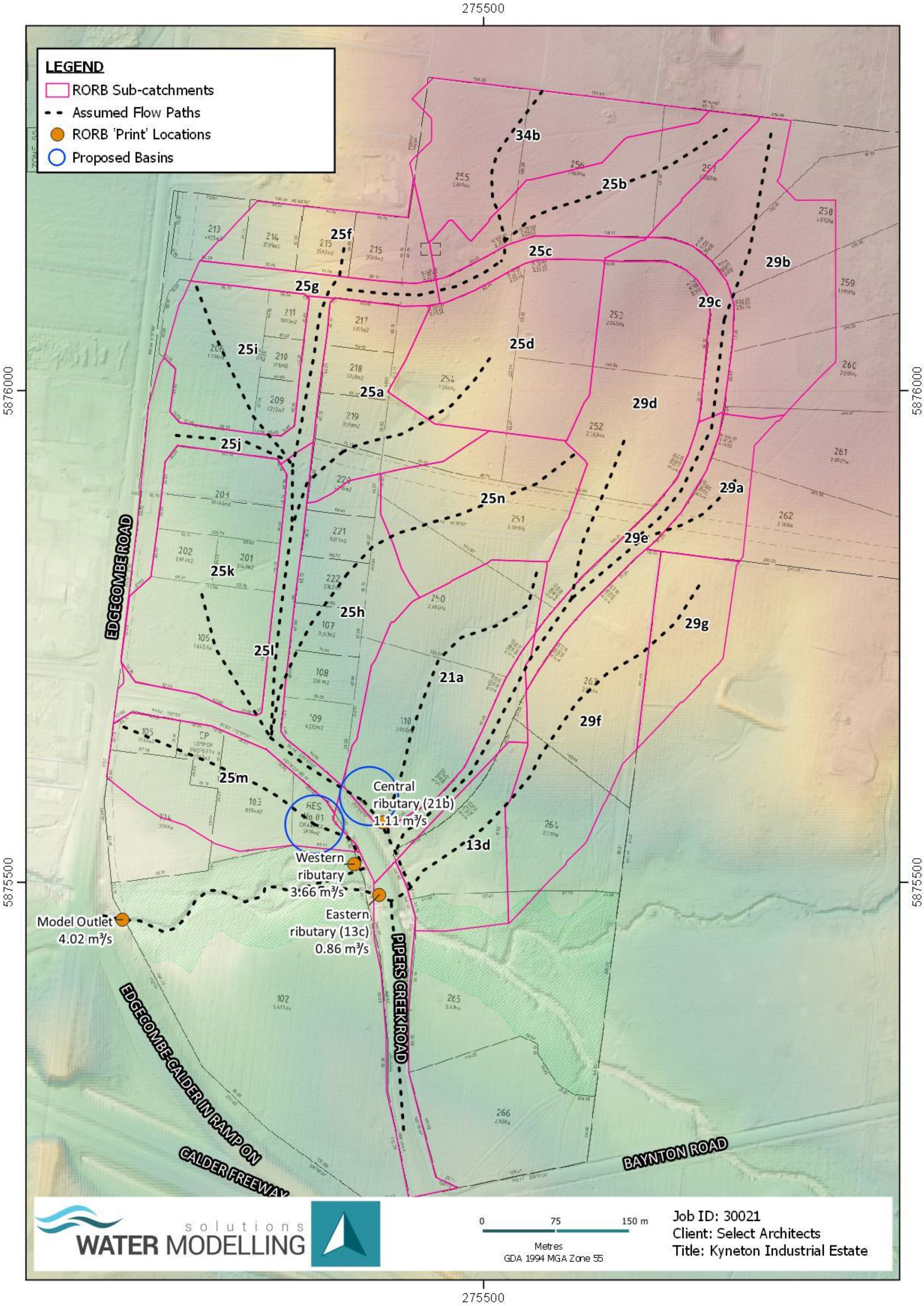

Figure 3-3 Developed Site RORB Model Setup with Peak Flows (Unmitigated)

3.4 MITIGATED SCENARIO

Under the developed mitigated scenario, two detention basins 'West Minor' and 'East Major' (location shown Figure 3-4) are proposed to retain the 1% AEP peak flows. Due to sub-catchment rerouting in the developed scenario, peak flows from the mitigated tributaries could not be compared like for like with existing peak flows. Like for like peak flows were however compared at the site outlet as shown in Table 3-4.

It is proposed that the west minor basin will drain the commercial lots to the south of Pipers Creek Road which includes a proposed service station and retail development. Finished surface levels across the lots would be design to ensure they can drain under gravity into the west minor basin. The basin outlet would direct flow into Post Office Creek via the roadside drainage adjacent to Pipers Creek Road.

The east major basin would drain the remainder of the commercial lots. Flow would be received via subsurface drainage in minor events and via roadside drainage in major events. The basin outlet would direct flow into Post Office Creek, under the proposed road immediately to the south and then via the roadside drainage adjacent to Pipers Creek Road.

Both basins would be co-located with stormwater treatment devices which are described further below.

Basin parameters and the required storage capacities summarised in Table 3-5 and the storage relationships are for the 'East Major' and 'West Minor' and summarised in Table 3-6 and Table 3-7.

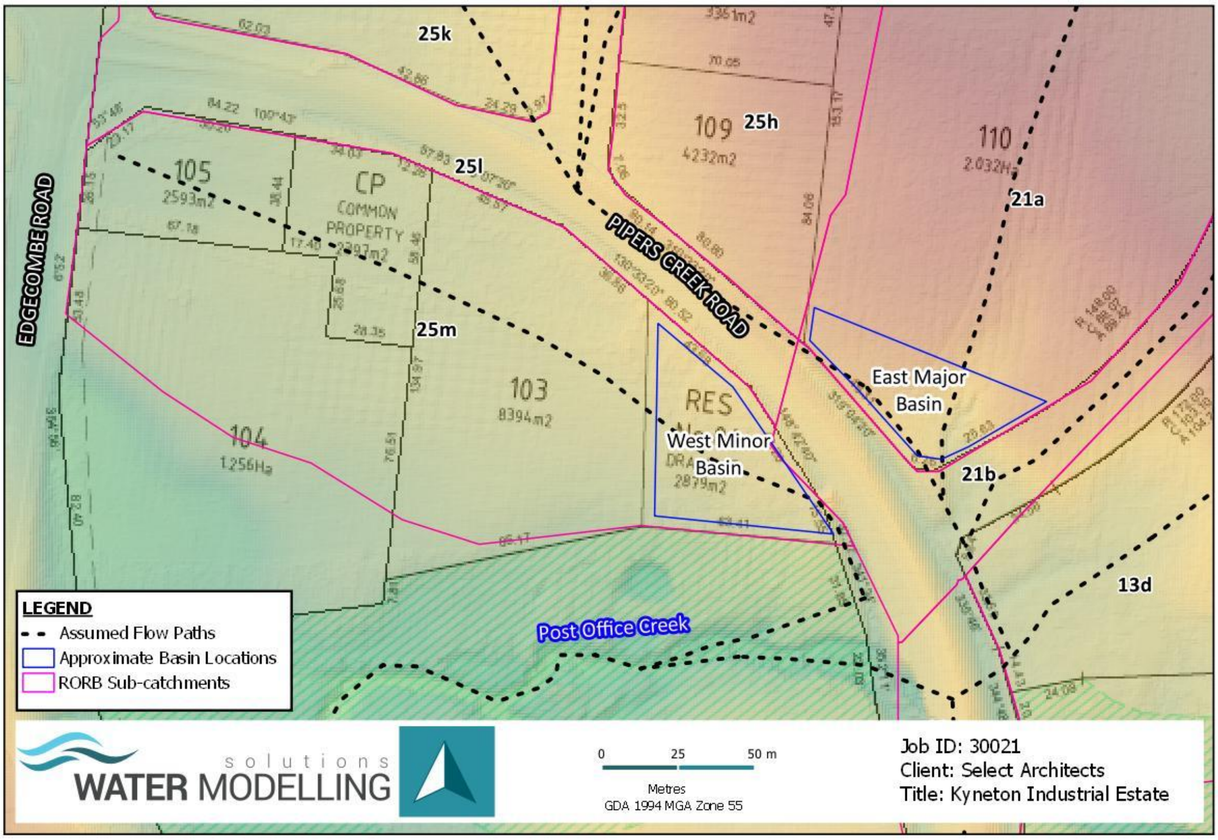

Figure 3-4 Detention Basin Locations

The following runoff behaviour was observed under developed mitigated conditions:

- A combined 1% AEP peak flow at the model outlet of 2.97 m^3/s for the 1 hour critical duration event, which is less than the peak flow of 3.09 m^3/s under existing conditions.
- The critical duration has slightly decreased from the 1.5 hour to the 1 hour storm.

- Both basins have been designed to not spill in the 1% AEP event across all storm durations. The spillway level is set at just above the peak 1% AEP storage level.

Table 3-4 1% AEP Results Comparison at Outlet

Duration	1% AEP Peak Flows at Site Outlet (m³/s)		
	Existing	Developed Unmitigated	Developed Mitigated
10 min	0.28	1.30	1.22
15 min	0.76	2.10	1.80
20 min	1.16	2.71	2.11
25 min	1.48	3.13	2.34
30 min	1.76	3.50	2.50
45 min	2.35	3.90	2.81
1 hour	2.74	**4.02**	**2.97**
1.5 hour	**3.09**	3.94	2.97
2 hour	3.08	3.77	2.90
3 hour	3.03	3.56	2.90
4.5 hour	2.53	3.21	2.55
6 hour	2.83	3.34	2.74

Table 3-5 Detention Basin Parameters

Parameter	East Major Basin	West Minor Basin
Base Elevation (mAHD)	508.3 mAHD	507.6 mAHD
Maximum Detention Depth (m)	1.65 m	1.15 m
Maximum Storage Capacity (m^3)	3,500 m^3	430 m^3
1% AEP Peak Storage (m^3)	2,700 m^3	344 m^3
Spillway Length (m)	5 m	5 m
Spillway Elevation (m)	1.35 mAHD	0.85 mAHD
Outlet Pipe Configuration	3 x 375 mm RCP	1 x 300 mm RCP
1% AEP Flood Depth (m)	1.34 m	0.84 m
Basin Inflow (m^3/s)	2.21 m^3/s	0.73 m^3/s
Basin Outflow (m^3/s)	0.99 m^3/s	0.16 m^3/s

Table 3-6 East Major Basin Storage Relationship

Depth (m)	Stage (mAHD)	Flood Storage(m^3)
0.00	508.3	0
0.35	508.7	566
0.70	509.0	1223
1.00	509.3	1857
1.35	509.7	2700
1.65	510.0	3500

Table 3-7 West Minor Basin Storage Relationship

Depth (m)	Stage (mAHD)	Flood Storage(m^3)
0.00	507.6	0
0.21	507.8	63
0.43	508.0	140
0.64	508.2	233
0.85	508.5	344
1.15	508.6	431

The following key points regarding the detention basins are also provided:

- Two LPOD (Legal Points of Discharge) are proposed, and to be located on either side of Pipers Creek Road. The Major basin would drain to the south through culverts under the new roadway and then into Post Office Creek. The Minor basin would drain immediately to the south into Post Office Creek downstream of Pipers Creek Road.
- The detention basins have been designed to focus on runoff from the commercial lots of the subdivision. The majority of the large residential lots do not drain into the detention basins. Given the large lot sizes proposed and small proportion of surface area that would become impervious under developed conditions (5% or less) detention is not required. The results show that the combined peak flow from the development under developed mitigated is less than under existing (pre-developed) conditions.

4 WATER QUALITY

4.1 BACKGROUND AND OBJECTIVES

SPEL Total Stormwater has been commissioned by Water Modelling Solutions to prepare a Conceptual Stormwater Management Plan (CSMP) for the proposed precinct development located at 106 Edgecombe Road Kyneton VIC. The full stormwater treatment plan prepared by SPEL is provided in Appendix B. The section below summaries their plan.

Both Macedon Ranges Shire and the Infrastructure Design Manual specify the treatment of stormwater so that annual pollutant loads achieve targets set out in the Best Practice Environmental Management Guidelines (BPEMG). These are:

- 80% reduction in Total Suspended Solids (TSS) from typical urban loads;
- 45% reduction in Total Nitrogen (TN) from typical urban loads;
- 45% reduction in Total Phosphorus (TP) from typical urban loads; and
- 70% reduction in Gross Pollutants (GP) from typical urban loads.

4.2 TREATMENT CONCEPT AND MODELLING RESULTS

Based on the site characteristics and the range of available Stormwater Quality Improvement Devices (SQIDs), an overall concept has been developed that would satisfy the requirements of downstream environmental protection. Figure 4-1 shows a schematic representation of the proposed treatment train elements.

A single Puraceptor would be located on-site at the proposed service station (Lot 104) and would be an asset of the service station.

A Stormceptor and SPEL Hydrosystem device would be co-located at each of the proposed detention basins. These devices would become Council assets along with the two detention basins. Information regarding maintenance scheduling and costing is provided in the SPEL report in Appendix B.

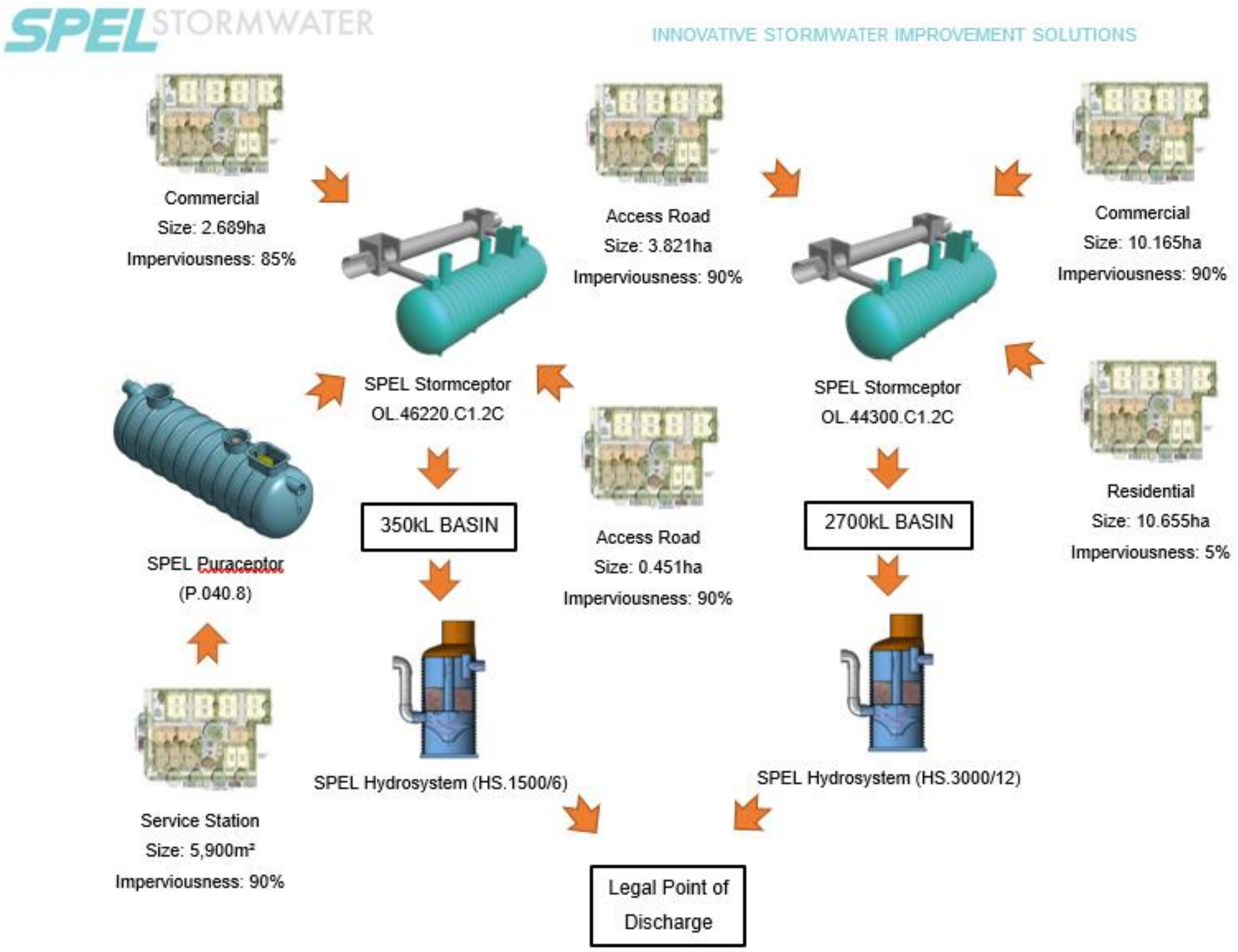

Figure 4-1 Treatment Train Schematic

The stormwater quality modelling was undertaken using the MUSIC version 6.2 software. Results of the MUSIC modelling for the treatment train effectiveness are summarised in Table 4-1. The results indicate the 80%, 45%, 45% and 70% reduction target for TSS, TP, TN and gross pollutants respectively are achieved as set our in the Infrastructure Design Manual. A screen capture of the MUSIC modelling results is included as Figure 4-2.

Table 4-1 Treatment Train Effectiveness

Pollutant	Inflows (kg/yr)	Outflows (kg/yr)	Reduction Achieved (%)	Reduction Target (%)
Flow (ML/yr)	148	147	0.5	0
Total Suspended Solids	26,300	2,060	92.2	80
Total Phosphorus	55.9	15.5	72.4	45
Total Nitrogen	411	212	48.6	45
Gross Pollutants	4850	0	100	70

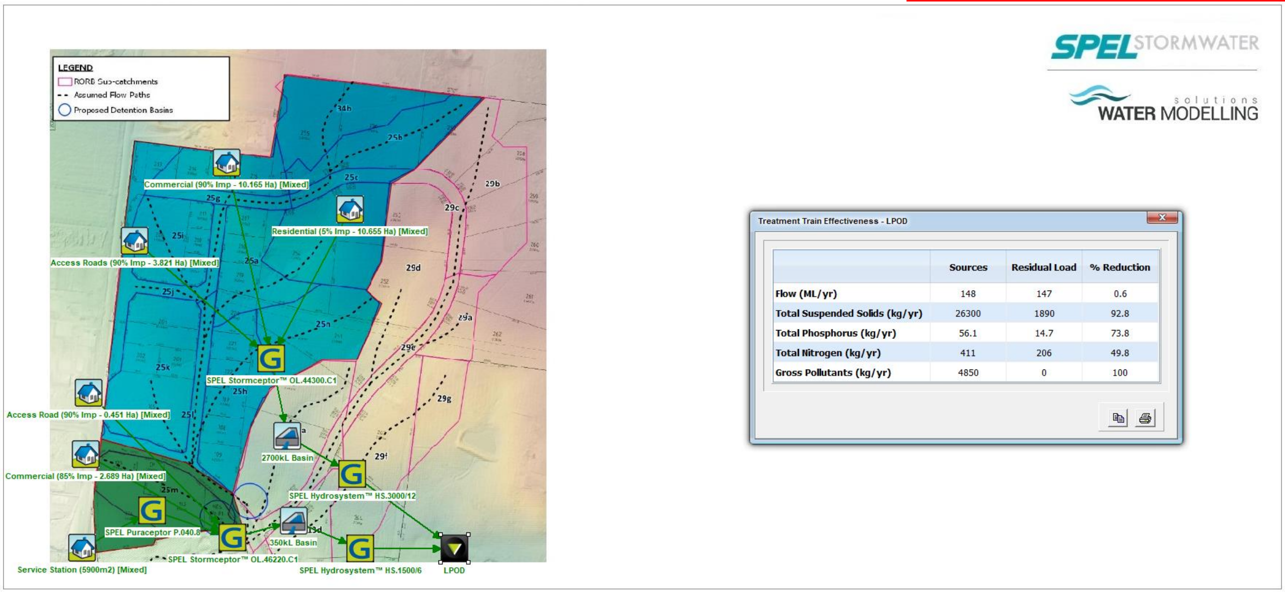

Figure 4-2 Treatment Train Effectiveness & Layout

Based on the water quality assessment using the MUSIC software, it was determined that the pollutant reduction targets will be achieved by adopting the Stormwater Quality Improvement Devices (SQIDs) specified in Table 4-2**.** The recommended SQIDs are designed to treat stormwater at the downstream end of the drainage network and treat runoff prior to discharging into Post Office Creek. Two legal points of discharge are proposed, on either side of Pipers Creek Road and associated with the two detention basins.

Table 4-2 Recommended Stormwater Quality Improvement Devices

Stormwater Quality Improvement Device	Quantity
SPEL Stormceptor OL.4130.C1.2C	4
SPEL Puraceptor P.040.8 (Service Station Asset)	1
SPEL Hydrosystem (SHS.1000)	1

5 CONCLUSION

The following summaries the key outcomes of the stormwater management plan and which address the applicable requirements set out in Council's RFI (Requests for Information:

- Two detention basins have been proposed which are designed to retard flows from the commercial portions of the subdivision. These areas will drain runoff into the basins under gravity.
- The proposed detention basins have been sized to retard flows up to and including the 1% AEP storm event ensuring combined peak flows are less than under existing conditions.
- Both detention basins and corresponding outlets have been positioned outside of the 1% AEP flood extent from Post Office Creek and are not subject to backwater effects. Two legal points of discharge are proposed on either side of Pipers Creek Road.
- The proposed water treatment solution ensures that the 70%, 80%, 45% and 45% reduction targets for Gross Pollutants (GP), Total Suspended Solids (TSS), Total Phosphorus (TP) and Total Nitrogen (TN) respectively will be achieved.

APPENDIX A

DEVELOPMENT LAND USE PLAN

LANDUSE MASTERPLAN

Advertised 18/05/2020

LOT DEVELOPMENT SUMMARY

STAGE No.	TYPE	LOT NUMBER
STAGE 1	RESIDENTIAL	110
STAGE 1A	COMMERCIAL	106,107,108,109
STAGE 1B	COMMERCIAL	103,104,105, CP, RES No.01
STAGE 2	COMMERCIAL	201,202,203,209,219,220,221,222
STAGE 2	RESIDENTIAL	265,266
STAGE 3	COMMERCIAL	206,210,211,213,214,215,216,217,218
STAGE 3	RESIDENTIAL	250,251,263,264
STAGE 4	RESIDENTIAL	252,253,254,255,256,257,258,259,260,261,262

LEGEND

- 40m x 40m BUILDING ENVELOPE, MIN. 20m SETBACK FROM ROADS, MIN. 10m SETBACK FROM BOUNDARIES MIN. 40m SETBACK BETWEEN DWELLINGS
- NEW PLANTING
- EXISTING TREE
- SCREEN PLANTING ZONE
- RIPARIAN ZONE - CHMP - NORTH CENTRAL CATCHMENT MANAGEMENT AUTHORITY
- EXISTING BOUNDARIES
- POWERLINE EASEMENT

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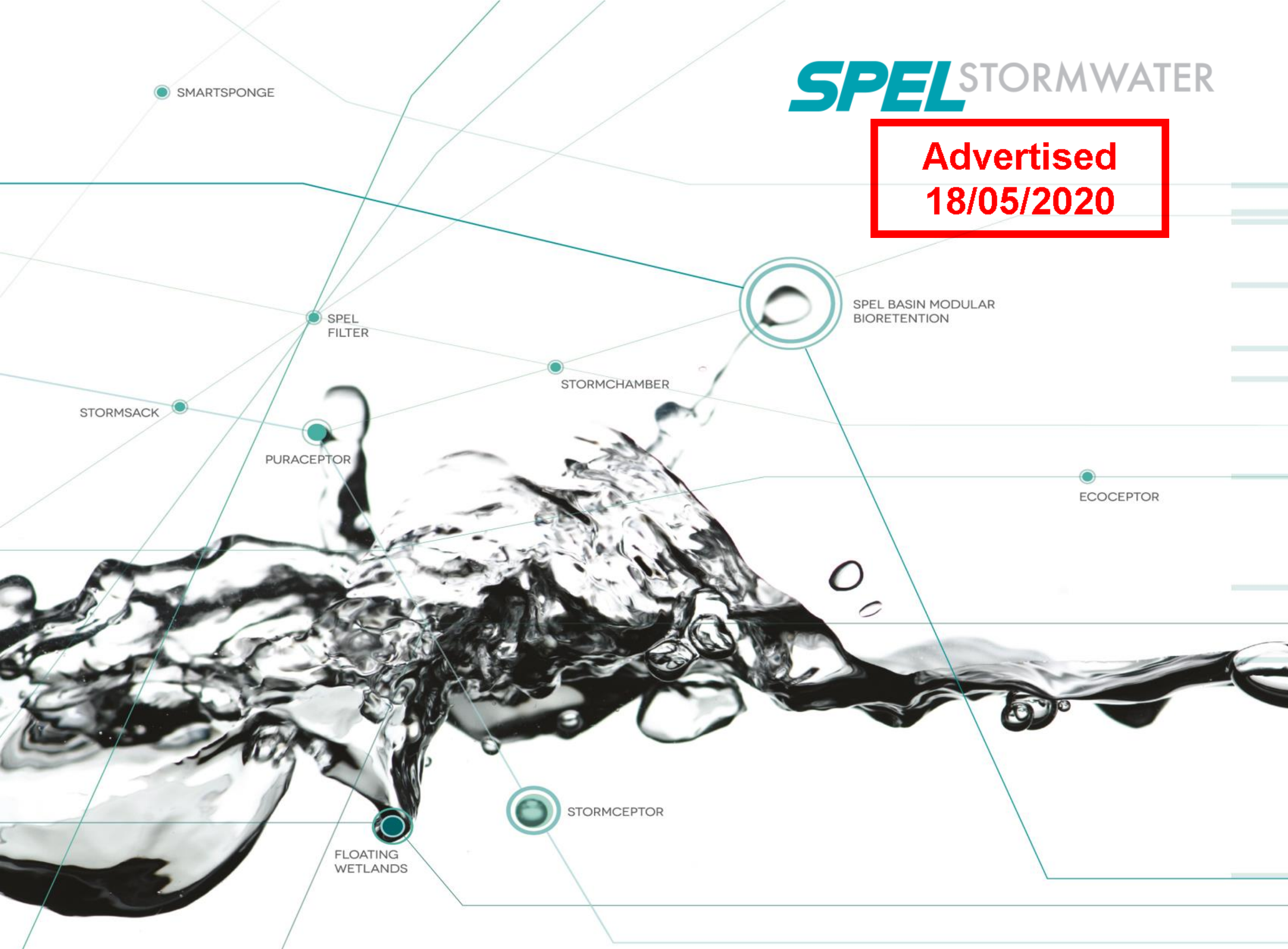
APPENDIX B

SPEL STORMWATER TREATMENT PLAN

SPEL STORMWATER



Stormwater Management Plan for 106 Edgecombe Road Kyneton VIC

Date: April 24, 2020

Client: Water Modelling Solutions

Issue: R2

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Table of Contents

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Signed:	
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1	SUBMISSION	24 April 2020	[signature]
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Advertised 18/05/2020

Confidentiality

Section 1

Advertised 18/05/2020

1 Confidentiality

1.1 Conferee

This entire document has been presented to Water Modelling Solutions as **commercial-in-confidence** on the basis that it should not be disclosed in any part or whole to any third party without written consent from SPEL Total Stormwater.
This document contains:

- **Intellectual Property** – Material and design that are commercially sensitive intellectual property
- **Pricing Schedule** - Information from SPEL Total Stormwater and details about commercially sensitive pricing

1.2 Request for Information

Please direct all enquiries regarding this submission to:

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Advertised
18/05/2020

Executive Summary

Section 2

Advertised 18/05/2020

2 Executive Summary

SPEL Total Stormwater has been commissioned by Water Modelling Solutions to prepare a Conceptual Stormwater Management Plan (CSMP) for the proposed precinct development located at 106 Edgecombe Road Kyneton VIC.

The stormwater quality modelling was undertaken using the MUSIC version 6.2 software. The modelling results (see **Table 2.1**) indicate the 70%, 80%, 45% and 45% reduction targets for Gross Pollutants (GP), Total Suspended Solids (TSS), Total Phosphorus (TP) and Total Nitrogen (TN) respectively can be achieved.

Table 2.1: Treatment Train Effectiveness

Pollutant	Inflows (kg/yr)	Outflows (kg/yr)	Reduction Achieved (%)	Reduction Target (%)
Flow (ML/yr)	148	147	**0**.6	0
Total Suspended Solids	26300	1890	**9**2.8	80
Total Phosphorus	56.1	14.7	**7**3.8	45
Total Nitrogen	411	206	**4**9.8	45
Gross Pollutants	4850	0	**100**	70

Stormwater management for the site is achieved using the following devices:

- One (1) x SPEL Stormceptor OL.44300.C1.2C
- One (1) x SPEL Stormceptor OL.46220.C1.2C
- One (1) x SPEL Puraceptor P.040.8
- One (1) x SPEL Hydrosystem (HS.1500/6)
- One (1) x SPEL Hydrosystem (HS.3000/12)
- One (1) x 350kL Basin
- One (1) x 2700kL Basin

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Overview

Section 3

Advertised 18/05/2020

3 Overview

3.1 Company Background

SPEL Total Stormwater is a market leader in the environmental compliance sector since 1991. During that time, we have established many satisfied customers who return to SPEL Total Stormwater when they require new and more advanced technological solutions and services. SPEL Total Stormwater devotes a great deal of time, effort and financial investment to maintain our position as a market leader in a rapidly developing field. We employ the latest industry knowledge and advancements, providing our customers with the most progressive stormwater improvement technology.

SPEL Total Stormwater develops long term partnerships with our clients and providing on-going technical support which include a comprehensive scheduled service and maintenance program. We take pride in delivering quality workmanship and customer satisfaction that has created a market reputation, taking SPEL Total Stormwater to where it is today. In order maintain this vision and standard, we are heavily committed to Australian manufacturing and site water quality testing programs to control and maintain consistent quality.

SPEL Total Stormwater is committed to the health and safety of its people and protecting the environment in which they work. We understand the challenges associated with a project of this nature and the physical environment involved. Our safety, environmental and quality standards apply to all our people, products and services, providing certainty that the client’s safety, environmental and quality requirements are adhered to.

3.2 Introduction

This report has been prepared by SPEL Total Stormwater to accompany and be considered part of a Development Application (DA) for a proposed precinct development located at 106 Edgecombe Road Kyneton VIC. The site is located within the catchment of the Macedon Ranges Shire Council.

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3.3 Site Locality

The subject site is bounded by Edgecombe Road to the west. Situated in Macedon Ranges Shire Council the site has a total area of 28.371ha (see **Figure 3.1**).

Figure 3.1 Site Location

Advertised
18/05/2020

3.4 Site Layout

Advertised
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The proposed development is presented on **Figure 3.2**.

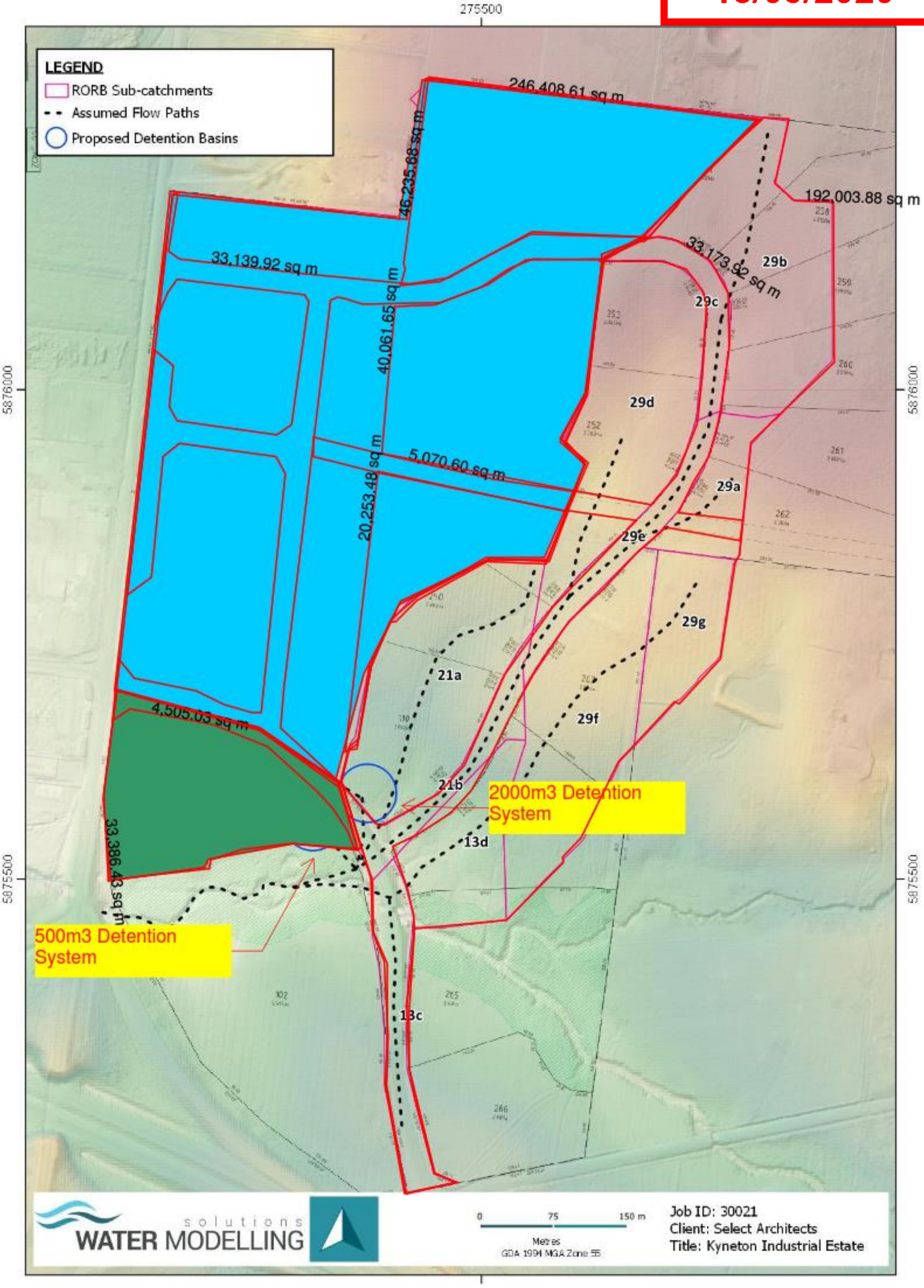

Figure 3.2 Proposed Site Layout

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Quality Management – Operational Controls

Section 4

4 Quality Management – Operational Controls

4.1 Water Quality Objectives

Melbourne Water (2016) requires treatment of stormwater so that annual pollutant loads achieve targets set out in the Best Practice Environmental Management Guidelines (BPEMG). These are:

- 80% reduction in Total Suspended Solids (TSS) from typical urban loads;
- 45% reduction in Total Nitrogen (TN) from typical urban loads;
- 45% reduction in Total Phosphorus (TP) from typical urban loads; and
- 70% reduction in Gross Pollutants (GP) from typical urban loads.

4.2 Treatment Train

Based on the site characteristics and the range of available Stormwater Quality Improvement Devices (SQIDs), this study has developed an overall concept that will satisfy the requirements of downstream environmental protection. **Figure 4.1** shows a schematic representation of the proposed treatment train elements.

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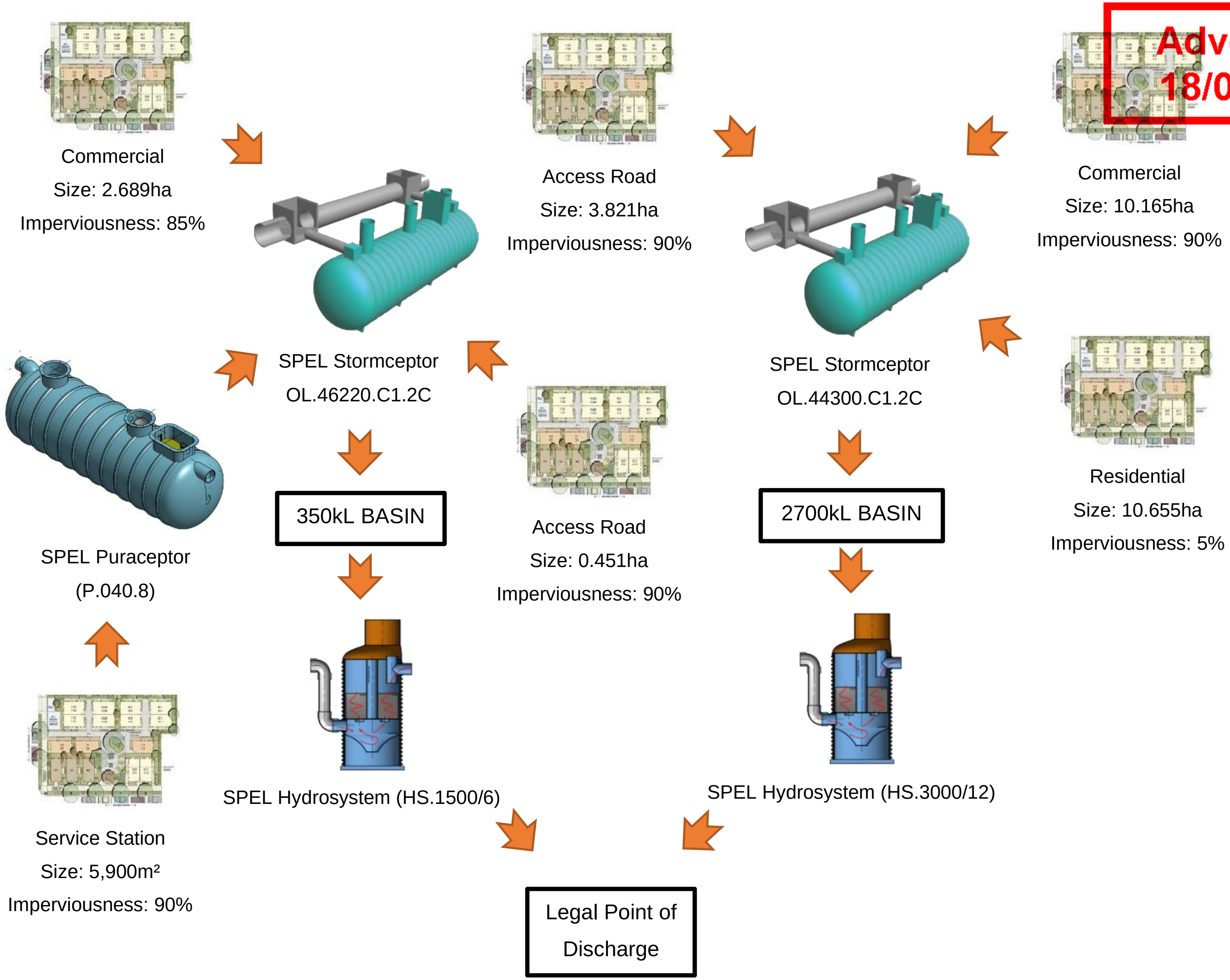

Figure 4.1 Treatment Train Schematic

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4.2.1 SPEL Puraceptor Class 1

The SPEL Puraceptor Class 1™ is an integrated oil-spill capture and light liquid treatment separator that provides an environmentally sustainable and certified solution for the treatment and capture of hydrocarbons in surface water runoff from high risk sites such as service station forecourts for stormwater discharge. The Class 1™ treatment system surpasses the traditional sewer system for water quality and hydrocarbons capture with the independently tested and proven design complying with the stormwater discharge quality requirements of;

- Department of Environment Climate Change Water of NSW (DECCW) for stormwater quality;
- OEH NSW stipulates that hydrocarbons are to be of `no visible trace` complying with ANZECC 2000 Guidelines;
- Department of Environment and Resource Management (DERM) Queensland;
- Environmental Protection Agency (EPA) of South Australia, Northern Territory, Tasmania & Victoria;
- Australian and New Zealand Environment Conservation Council;
- Guidelines for recreational water quality and aesthetics (Chapter 5) “Surface films, Oil and petrochemicals should not be noticeable as a visible film on the water nor should they be detectable by odour;
- Australian Airport (Federal) Environmental Protection Act; and
- Department of Water, Western Australia.

4.2.1.1 Generational Information for Class 1 Puraceptor

Class 1™ was introduced by the UK Environment Agency (UKEA), with guidelines tailored specifically for the treatment and capture of hydrocarbons from service station forecourts. Class 1™ stipulates a discharge water quality of less than 5ppm from a tested inflow concentration of 5,000ppm (hydrocarbon content). The UKEA has adopted the European Standard BS EN 858.1 - Separator systems for light liquids (oil/petrol/diesel), (know henceforth as ‘The Standard’) for the: design; use; selection; installation; operation; and maintenance of prefabricated separators. Separators have to satisfy essential mandate requirements by ‘The Standard’, including independent testing in accordance with Clause 8.3, in order to be certified as a Class 1™ separator.

SPEL Class 1™ separators have been independently lab tested (tier one) by HR Wallingford Research Laboratory UK and the University of South Australia (UniSA) Hydraulics Research Centre to ‘The Standard’ with a discharge water quality of : `no visible trace` and less than 5ppm from an inflow concentration of 5,000ppm under test flow conditions.

4.2.1.2 SPEL Class 1 Tank Structure-Certification:

SPEL Class 1™ units are glass reinforced plastic vessels made by the technical advanced chop hoop filament winding process (patented) producing circumferential and longitudinal strength complying with BS 4994 - FRP Vessel and Tanks in Reinforced Plastics[3] and AS 2634 - FRP Chemical Plant Equipment[4] to ensure the construction meets the necessary strength, stability and serviceability requirements. The tank is designed to accept ground conditions with low stiffness down to 4.8Mpa, water tables are set to ground level as standard with a minimum depth of cover, based on a standard soil density.

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4.2.1.3 Components and Hydraulics of Class 1 Puraceptor

The Class 1™ SPEL Puraceptor is gravity-driven, passive, full retention flow process that treats all flows through two chambers. Low velocity laminar flow provides quiescent conditions in the separator enabling the light liquid content of the oil water mixture to separate and rise to the surface due to the difference in density of the oil and water. Contaminated water cannot flow directly across the surface before effective separation has taken place. Treatment process involves the `cleaner` water passing from the primary chamber by underflow into the secondary chamber and finally through a coalescing filter mounted in the secondary chamber to `collect` smaller droplets of hydrocarbons and encourage larger droplets to form enabling better removal by gravity to the collecting area in the sealed secondary chamber.

The Puraceptor is sized to treat and capture all flows with a hydraulic fall across the system of 1%. There is no bypass facility, meaning all pollutants are captured and retained between maintenance cycles. See **4.3** below for Class 1™ SPEL Puraceptor schematic.

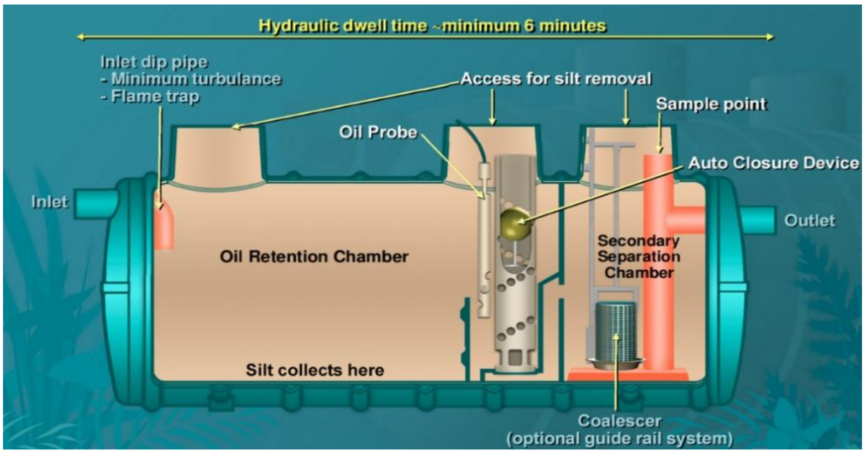

Figure 4.3: SPEL Puraceptor Class 1™ Schematic

Coalescing filter:

The coalescer is a high- reticulated and high-contact surface filter with a minimum life span of eight years. It is mounted into the secondary chamber, encouraging a coalescing process for emulsified oil droplets. Incorporating the coalescer into the second chamber prevents blockages in the event of major spills, large amounts of accumulated hydrocarbon and heavy silt content contained in surface runoff.

Fire Trap:

SPEL Class 1™ tanks are designed with an immersed inlet dip pipe to extinguish flames and prevent inflammable vapours from passing through to the drainage system. The dipped inlet pipe design also facilitates in the prevention of Mosquito breeding.

Oil Alert Probe:

The Puraceptor Class 1™ is fitted with an SPEL oil alert probe (Model: OILSET 1000)[5] in the primary chamber for oil spill detection and maintenance monitoring which includes an alarm panel for remote mounting (see **4.4** below). The alarm is triggered when hydrocarbon build-up accumulates to 10% of the primary chamber`s volume.

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18/05/2020

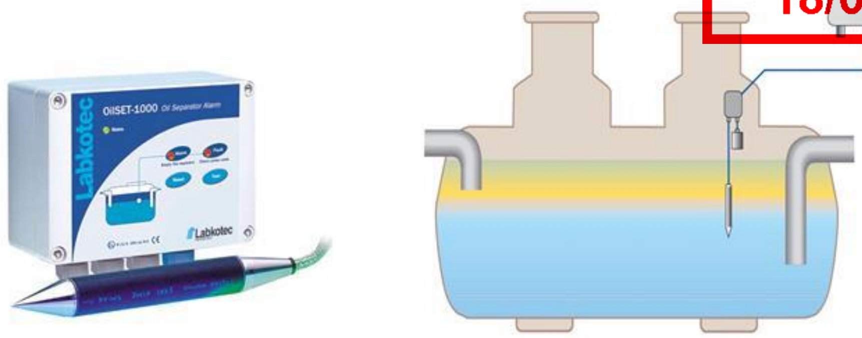

Figure 4.4: Oil Alert Probe and its Location in the Puraceptor

No Scouring: Suitable for Flood & Tidal Conditions:

The horizontal configuration, internally sealed treatment chambers and its coalescing function ensures no risk of scouring including when the separator is submerged in flood or tidal events.

Auto Closure Device (ACD):

The Automatic Closure Device (ACD) is found in the first chamber of a Puraceptor. The ACD is triggered when the maximum storage capacity of light liquid is attained which prevents further discharge (see **4.5** below). The ACD ensures that in the event of a major spillage, pollutants do not pass into the drainage system and is to be used in conjunction with an oil alert prob.

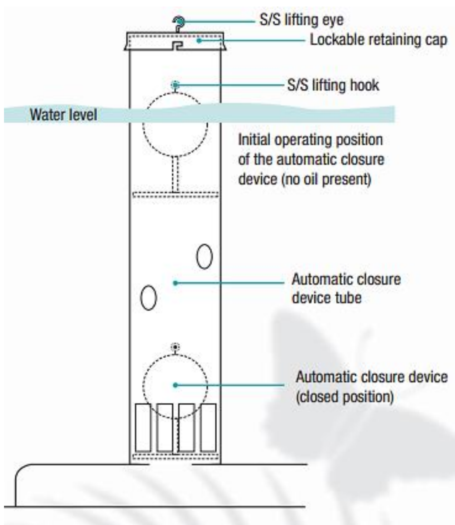

Figure 4.5: Automatic Closure Device with the SPEL Puraceptor

Operation and Maintenance

To ensure effluent water quality is maintained according to 'The Standard' and other local regulatory bodies, regular maintenance must be continually performed. Maintenance is performed, at a minimum of, every six months or if the probe alarm is activated, by eduction method (suction). Continual monitoring of the unit, via visual inspection, must be conducted every 3 – 4 months ensuring effectiveness.

Hydrocarbon and Sediment Removal:

Retained oil from both chambers of the SPEL Puraceptor followed by silt deposited on the base of the vessel is vaccumed out, leaving sufficient water to ensure the ACD remains floating. The cylindrical shape ensures sediment collects at the base of the chamber allowing for easier maintenance. Floatables, such as Gross pollutants and litter, are removed by the same process described above.

Coalescer Unit (Including Foam Insert):

During maintenance schedules the coalescer unit is removed using the lifting handle and/or chain and retained in an area so pollutants do not escape. Once the foam insert has been removed from the coalescer unit backwash/rinse thoroughly, under normal water pressure, ensuring dirty water runs into the first chamber of the SPEL Puraceptor. Reassemble the coalescer unit and lower, using the handle and/or chain, along the guide rails back into position.

SPEL Automatic Alarm/Monitoring System:

The SPEL automatic alarm/monitoring system probe should be lifted out of the probe protection tube, wiped clean and re-inserted. Once the probe has been cleaned the system should be reset according to the Oil Alert Technical Settings and Operation & Maintenance Manual.

Operation & Maintenance Manual:

The Class 1 SPEL Puraceptor Operation and Maintenance manual will be kept on the premises at all times, with a ledger recording all maintenance and inspection activities. This will provide a useful and efficient record for Council Inspection officers to facilitate random verification.

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4.2.2 SPEL Stormceptor

The SPEL Stormceptor Class 1 is an integrated oil-spill capture and light liquid treatment separator that provides an environmentally sustainable and certified solution for the treatment and capture of hydrocarbons in surface water runoff from high risk sites such as retail fuel forecourts for stormwater discharge (see **Appendix 1**). The Stormceptor treatment system surpasses the traditional sewer system for water quality and hydrocarbons capture with the independently tested and proven design complying with the stormwater discharge quality requirements of;

- Department of Environment Climate Change Water of NSW (DECCW) for stormwater quality;
- OEH NSW stipulates that hydrocarbons are to be of `no visible trace` complying with ANZECC 2000 Guidelines;
- Department of Environment and Resource Management (DERM) Queensland;
- Environmental Protection Agency (EPA) of South Australia, Northern Territory, Tasmania & Victoria
- Australian and New Zealand Environment Conservation Council;
- Guidelines for recreational water quality and aesthetics (Chapter 5) "Surface films, Oil and petrochemicals should not be noticeable as a visible film on the water nor should they be detectable by odour";
- Australian Airport (Federal) Environmental Protection Act;
- Department of Water, Western Australia

Current guidelines stipulate that hydrocarbon content in stormwater or any receiving waters is to be of "no visible trace or sheen of oil or grease on released waters". Environmental Authorities worldwide regard a minimum of 10 ppm as being the benchmark for no visible trace or sheen. The treatment efficiency in SPEL Stormceptor Class 1 is:

- >99.9% hydrocarbons reduction
- >97% sediment reduction. Median particle size distribution 70µm
- >30% Phosphorus reduction

4.2.2.1 General Information for Class 1 Stormceptor

Class 1 was introduced by the UK Environment Agency (UKEA), with guidelines tailored specifically for the treatment and capture of hydrocarbons from service station forecourts. Class 1 stipulates a discharge water quality of less than 5ppm from a tested inflow concentration of 5,000ppm (hydrocarbons content). The UKEA has adopted the European Standard BS EN 858.1 Separator systems for light liquids (oil/petrol/diesel). (known hence in this document as The Standard) for the design, use, selection, installation, operation and maintenance of prefabricated separators. Separators have to satisfy essential requirements mandated by the Standard`s clauses including independent testing to the test methodology of Clause 8.3., in order to be certified as a Class 1 separator.

SPEL Class 1 separators have been independently tested by HR Wallingford Research Laboratory UK and the University of South Australia Hydraulics Research Centre to The Standard with a discharge water quality of : `no visible trace` and less than 5ppm from an inflow concentration of 5,000ppm under test flow conditions. Relevant certificates and the Standard are in **Appendix 2**.

Australian Compliance

The Standard and Class 1 system exceeds all Australian regulatory requirements pertaining to hydrocarbons with the exception of South Australia, who have themselves recently adopted the Class 1 Standard and treatment system for forecourt hydrocarbons management.

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Treatment and Capture Efficacy

Hydrocarbons separation dynamics act no differently anywhere in the world. The density of oils and fuel is lighter than water and will always rise, however the Class 1 system requires an efficacy in the quality of separation that depends upon the right conditions in which to achieve no visible trace in the water column. This includes suitable retention time (as specified by BS EN 858 & Stokes law), low velocity water flow, and enhanced by a coalescing filter action.

Proven Record in Australia

Class 1 is not solely a design theory but has indeed a proven record in the UK, one of the world`s most industrialized and urban environments, and for the past 21 years in Australia. **Table 4.3** lists the SPEL Stormceptor application in Australian projects. The comprehensive list is in **Appendix 3**.

Table 4.3 List of Similar Stormceptor Installation in Australia

Council	Project	Model Number	APPLICATION
Newcastle	Sandvik Heatherbrae NSW	S.300/80.C1.2C.A.450.RCP	5 Off Line Stormceptors treating industrial site. Treatment train includes a swale
Camden	M2 Milk Smeaton Grange NSW	OL.300.080.30.C1.2C.SP	Off Line Stormceptor for TSS reduction prior to bioretention
Federal Aviation	18 Canberra Ave ACT	S.200/70.C1.2C.A.225	2 Stormceptors for stormwater treatment of airport carparks
Geraldton Council	ARG – Narngulu WA	S.100/25.C1.2C.A.225	
Geraldton Council	ARG – Narngulu WA	S.100/25.C1.3C.PS.SP	
Adelaide City Council	BP – Reynella SA	S.200/40.C1.2C.A.300	Large service station carpark treatment before stormfilters
AKS Industries	BP Dandenong VIC	S.300/220.C1.2C.A.375	Large service station carpark treatment before stormfilters
Canberra	ECLIPSE APPARTMENTS ACT	S.300/160.C1.2C.A.450	Offline Stormceptor as part of treatment train for apartment development
Canberra	ULLADULLA HIGH SCHOOL NSW	S.900/406060	Stormceptor for school grounds run off
Lake Macquarie City Council	CALTEX SWANSEA NSW	S.300/100.C1.2C.A.300	Large service station carpark treatment before stormfilters
Geelong City Council	MACKILLOP ST DENTAL SURGERY	S.100/25.C1.2C.A.150	TSS removal prior to stormfilters
SIMS METAL	ST MARYS NSW	S.400/600.C1.2C.G.525	Industrial site runoff
City of Unley	CENTENNIAL PARK SA	S.300/130.C1.2C.A.300	
Tasmania	Netco TAS	S.100/15.C1.2C.A.100	
City of Greater Geelong	Eastern Park – VIC	S.300/160.C1.2C.A.450	Pre-treatment prior to a Constructed Wetland
Federal Aviation	QANTAS JET BASE – SYDNEY	S.300/220.C1.2C.A.300	Stormceptors for stormwater treatment of airport carparks
Federal Aviation	QANTAS JET BASE – SYDNEY	S.300/100.C1.2C.A.300	Stormceptors for stormwater treatment of airport carparks
Belconnen Community Council	BELCONNEN ACT	S.200/40.C1.2C.A.300	
Knox City Council	BATTERHAM PARK VIC	S.300/80.T.C1.3C.PS.SP	TSS removal prior to wetland for urban subdivision
Maroondah City Council	MAROONDAH HWY UNITS VIC	S.300/130.C1.2C.A.300	Treatment of carparks and grounds in conjunction with swale
Whyalla City Council	Quest Apartments Whyalla – SA	S.100/15.C1.2C.A.100	Treatment of carparks and grounds in conjunction with swale
Port Hedland Council	PORT HEDLAND REFUELING FACILITY	S.400/1100.C1.2C.A.375	
Brisbane City Council	TJH – BRISBANE AIRPORT LINK – QLD	S.400/850/20.C1.3C.SP.C.600	8 Stormceptors to compress the size of bioretention basins and provide hydrocarbon treatment from road

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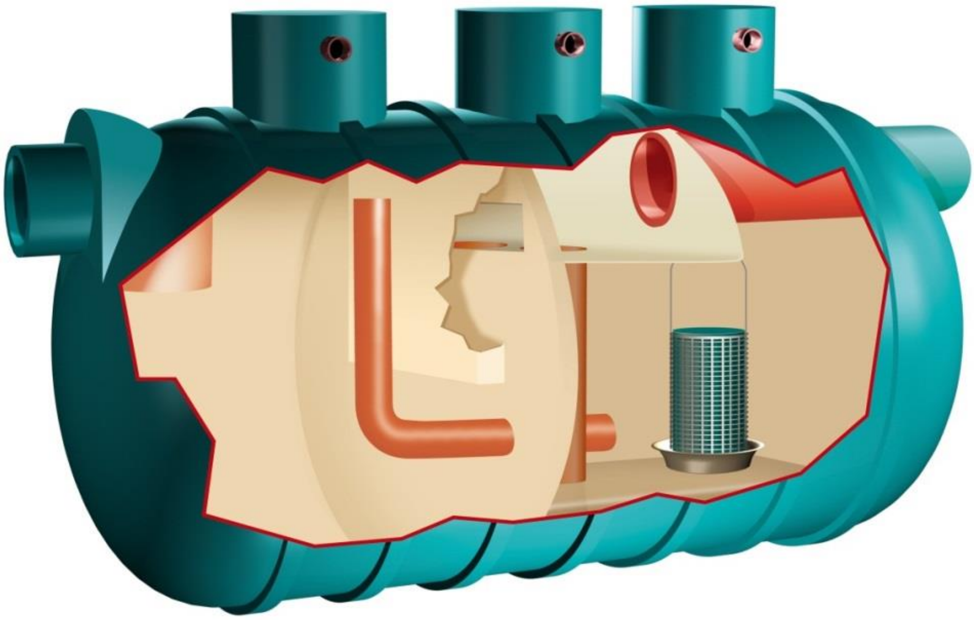

Figure 4.2: The schematic of SPEL Stormceptor Class 1™

Independent Standard and Validation

The Standard and the independent validation that applies to the SPEL Class 1™ separators provides the council and the authority the appropriate latitude to assess the product and the catchment design unencumbered by commercial partiality. Please refer to the test data in **Appendix 4**.

Current Guidelines and Practices Pollute the Environment

Existing ` traditional` guidelines are, and have proved to be, totally unsatisfactory in protecting the environment from hydrocarbon pollution, both for egress to receiving waters and soil absorption. Sewer systems cannot receive stormwater meaning there is a significant portion of the forecourt catchment that egresses to stormwater or to soil (on sites where there is no stormwater). The majority of service stations within the council`s and the territories precinct are marked by these defects and consequently are non-compliant.

4.2.2.2 Components and Hydraulics of Class 1 Stormceptor

The Stormceptor Class 1 is a gravity-type, passive, full retention flow process that treats all flows through two chambers. Low velocity laminar flow provides quiescent conditions in the separator enabling the light liquid content of the water to separate and rise to the surface due to the difference in density of the oil and water. Contaminated water cannot flow directly across the surface before effective separation has taken place. Treatment process involves the `cleaner` water passing from the primary chamber by underflow into the secondary chamber and finally through a coalescing filter mounted in the secondary chamber to `collect` smaller droplets of hydrocarbons and encourage larger droplets to form enabling better removal by gravity to the collecting area in the sealed secondary chamber.

The SPEL Stormceptor Class 1 is sized to treat and capture all flows. There is no bypass facility, meaning all pollutants are captured and retained between maintenance cycles.

Coalescing filter

The coalescer is a high- reticulated and high-contact surface filter with a minimum life span of eight years. It is mounted into the secondary chamber, providing a coalescing process for the separation of smaller oil droplets. Incorporated in the secondary chamber prevents the coalescer from being blocked in the event of major spillages and large amounts of accumulated hydrocarbon or heavy silt content in the surface water. It can be simply lifted out for cleaning during routine maintenance.

Fire Trap

SPEL Stormceptor Class 1 tanks contain an immersed inlet dip pipe to extinguish flames and prevent inflammable vapours from passing through to the drainage system. It is also prevents mosquito breeding.

No Scouring: Suitable for Flood & Tidal Conditions

The horizontal configuration, internally sealed treatment chambers and its coalescing function ensures no risk of scouring including when the separator is submerged in flood or tidal events.

4.2.2.3 Performance Analysis

SPEL Class 1™ devices have undergone rigorous and comprehensive testing for total suspended solids, total phosphorus and hydrocarbons. The reduction values listed within are from flow tests conducted by the University of South Australia (UniSA) Hydraulics Research Laboratory.

Total Petroleum Hydrocarbons (TPH)

Tests were performed at the UniSA Hydraulics Research facility and at HR Wallingford UK with the device in flow mode, with the following results. Test methodology was done to European Standard BS EN 85.1 Section 8.3. **Table 4.4** shows that discharge water quality reduction remains constant at <0.1ppm of TPH translating to `no visible trace` from a constant inflow concentration of 5,000ppm

Table 4.4 Reduction of Total Petroleum Hydrocarbons

Hydrocarbon Fraction	EQL*	Inflow Concentration (Total 5699.0)	Outlet Samples TPH Fraction Concentrations					Calculated Mean Concentration
			1	2	3	4	5	
C6-C9	0.02	0.15	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
C10-C14	0.04	125.43	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
C15-C28	0.10	5570.62	<0.1	0.162	<0.1	<0.1	<0.1	< 0.032
C29-C36	0.1	3.42	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
* Sensitivity: Estimated Quantitation Limit Results expressed in mg/l								

Results show `no detection` of hydrocarbons of all carbon fractions with the exception of Sample 2 C15-C28 with 1 sample showing` Inflow concentration of >5,000ppm.

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Caution: Claims made of 98% Hydrocarbon Reduction

Data expressed by competitors in terms of percentages are erroneous. Claims expressed in percentage form are unreliable and misleading. A 98% reduction of TPH off catchments with vehicular activity would result in discharge loads ranging from 20ppm to 100ppm. This exceeds the concentration of TPH `visibility` which is approximately 10ppm rendering such devices as non-compliant.

Total Suspended Solids: Particle Size Distribution (PSD)

In depth investigation of particle size capture performance was developed for the first time at the UNISA hydraulic research facilities for assessment for typical stormwater TSS characteristics. The make-up of particulate size was weighted fine fraction <125um which makes up 90% of the load reflecting MUSIC load characteristics. The test was conducted at the UNISA research facility with the device in flow mode. This is stressed as the most accurate method in determining reduction as opposed to accumulative loads analysis.

In summary the reduction of Total Suspended Solids and the relevant particle size distribution (PSD) is as follow:

- >97% >75um (Refer Annexure for validation)
- >55% <75um. (Refer Annexure for validation)

TSS UNISA Test Methodology

The sediment added to the inlet of the SPEL Stormceptor Class 1™ consisted of 10 kg of dry material. Half of this material (by weight) was a sand material sourced from a brick sand quarrying operation in Noarlunga, SA which was pre-sieved to remove particles finer than 600 µm. The second half (by weight) was a commercially sourced silica product (Unimin Silica 60G). The particle size distribution (PSD) of the sediment produced was determined to 75 µm by sieving in accordance with AS 1289.3.6.1 – 2009 prior to adding the material to the concentrated pollutant mixture. The PSD of material less than 75 µm was determined using laser diffraction.

At the completion of the test the suspended solids retained by Chamber 1 and Chamber 2 of the SPEL unit were collected. The collected sediment was harvested by draining all water from the tank at the completion of the test through a geofabric filter to manually collect retained sediment. Retained sediment was then dried in the oven at 105°C and sieved to 75 µm in accordance with AS 1289.3.6.1 – 2009. The sediment fraction which was not collected was assumed to pass through the tank in normal running conditions.

Although the loss of retained sediment during the retained sediment collection method is considered possible, it was considered appropriate because this method represents a conservative approach to determining the total mass of retained sediment as losses are considered to pass through the SPEL Stormceptor Class 1™. Furthermore, as sediment that is lost through the cloth filter is most likely to be in the smaller particle size range, this added a further degree of conservatism as it leads to an under-estimation of the amount of retained low diameter particles.

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TSS Results

Overall, 10 kg of sediment was added to the SPEL Class 1™ unit, and 8.486 kg of sediment was retained. Analysis of the PSD of sediment indicated that the retained sediment was predominantly larger particle sizes. The SPEL Stormceptor Class 1™ removed more than 95% of sediment larger than 75 µm, and more than half the particles less than 75 µm. These results are based on repeated tests of approximately 100 to 200 g of retained material, and for this reason the retained percentages are approximate – the percentage reduction for particles greater than 125 µm, for example, was consistently greater than 95%, with minor fluctuations between 95 and 100%. These results are illustrated in **figure 4.3**.

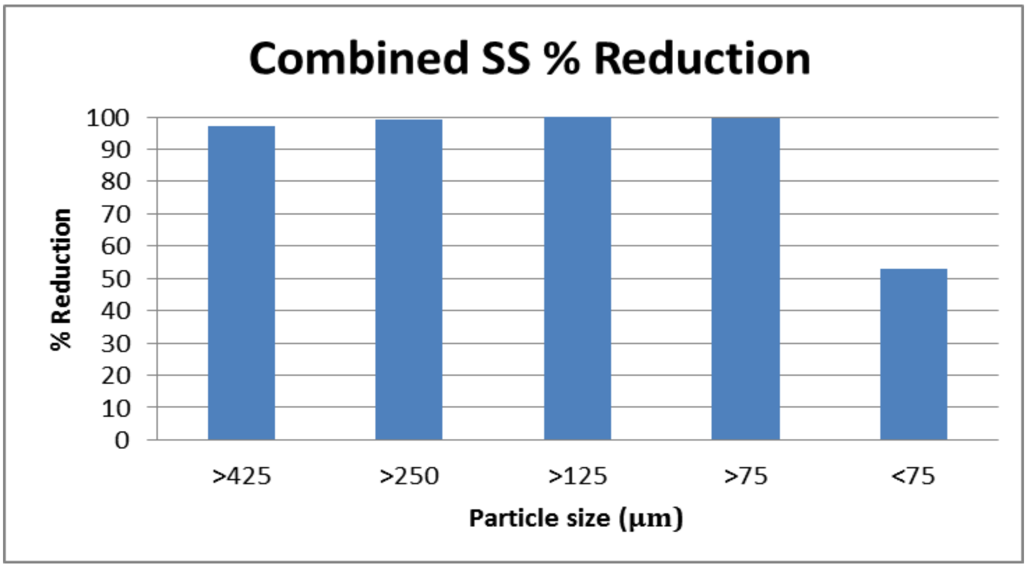

Figure 4.3: Percentage of Sediment Retained by the SPEL Stormceptor Based on Particle Size

The PSD of sediment which was placed into the pollutant mixture and that which was retained within the SPEL unit (retained) is shown in **Figure 4.4**. The data was determined by laser diffraction. **Figure 4.5** compares the inlet PSD of sediment used in this test with the assumed PSD of sediment in the MUSIC model. The comparison indicates that there was generally a broader PSD Distribution than that assumed by the MUSIC software.

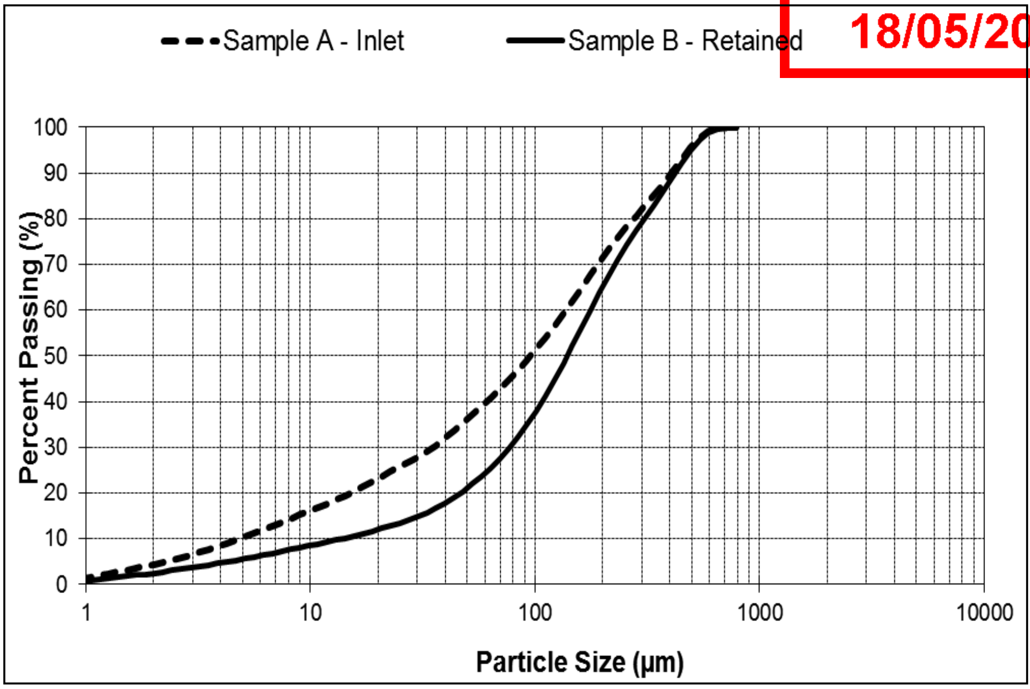

Figure 4.4: PSD of sediment at the inlet and retained by the SPEL Stormceptor (by laser diffraction)

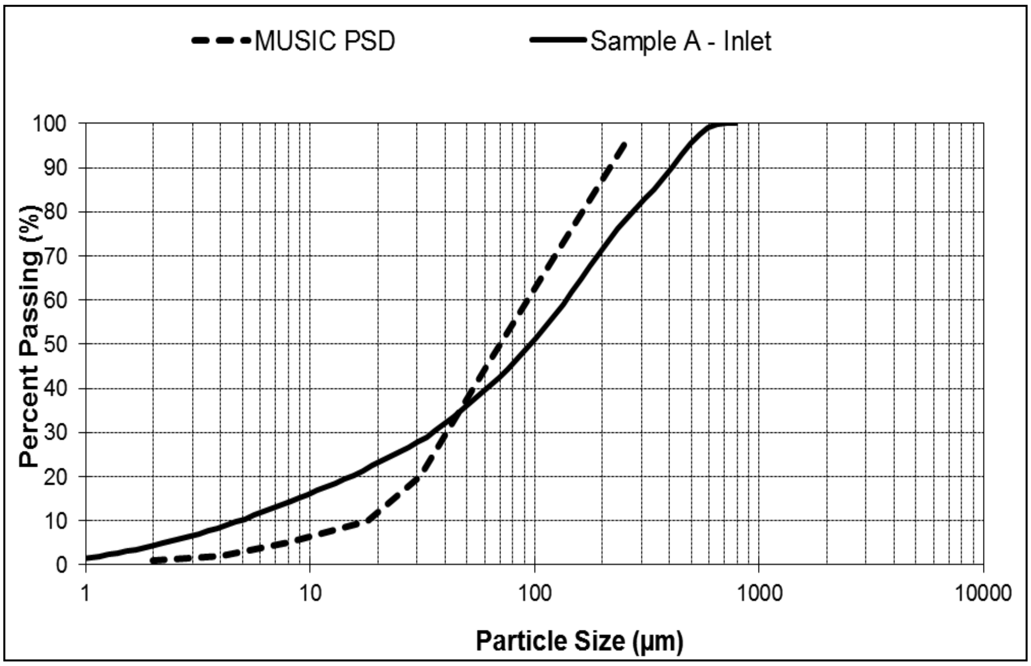

Figure 4.5: PSD of sediment at the inlet of the SPEL Stormceptor compared to that assumed in the MUSIC model (by laser diffraction)

TSS Summary of Findings

The results indicate that there is a consistent reduction in the sediment concentrations. Sieve testing of sediment at the inlet and retained by the SPEL Stormceptor Class 1™ indicated that most particles retained were in the larger particle size range. Removal of sediment was determined based on particle size as follows:

- For particles greater than 425 µm, over 96% of particles were retained
- For particles between 425 µm and 250 µm, over 98% of particles were retained
- For particles between 250 µm and 125 µm, over 99% of particles were retained
- For particles between 125 µm and 75 µm, over 99% of particles were retained
- For particles less than 75 µm, over 52% of particles were retained

Total Phosphorus

Tests were performed in flow mode at the UNISA Research facility and in-situ capture tests of units treating a commercial/mixed subdivision with removal particulate-bound.

Reduction of Total Phosphorus (TP)

In the meantime eight site tests were performed in western Sydney. Five tests were dismissed due to vagaries; either whilst sampling was being conducted or catchment activities that distorted the inflow concentration levels. The catchment is a mixed commercial/industrial subdivision with a typical suburban streetscape. The TSS inflow concentration is >500mg/l (upper Fletcher et al (2004)) .This is due to the catchment being flat with a gradient of <0.5% and the presence of gravel streets, excavated allotments and some construction activity within the catchment at the time of testing period. The data reveals a consistent reduction of >95% of TSS.

Site tests of cadmium, chromium, lead, aluminium and zinc (particulate) show removal rates >90 %. The comprehensive validation report is available in **Appendix 4**.

Gross Pollutants

SPEL Class 1™ retains 100% of gross pollutants >5mm size in treatable flow conditions.

4.2.2.4 Tank Structure-Certification & Maintenance for Class 1 Stormceptor

SPEL Stormceptor Class 1 units are glass reinforced plastic vessels made by the technical advanced chop hoop filament winding process (patented) producing circumferential and longitudinal strength complying with BS4994 FRP Pressure Vessel code and AS 2634FRP Chemical Equipment to ensure the construction meets the necessary strength and stability requirements. The tank is designed to accept ground conditions with low stiffness down to 4.8Mpa, water tables are set to ground level as standard with a minimum depth of cover, based on a standard soil density.

Maintenance Operation

Maintenance is performed at a minimum of every six months or if the probe alarm is activated, by eduction method (suction).

Coalescing Filter Media

The coalescer is a high- reticulated and high-contact surface filter with a minimum life span of eight years. It is mounted into the secondary chamber, providing a coalescing process for the separation of smaller oil droplets. Incorporated in the secondary chamber prevents the coalescer from being blocked by large amounts of heavy sediment that are separated in the primary chamber. It can be simply lifted out for cleaning during routine maintenance.

Sediment:

Sediment is removed by a vacuum loading truck from the base of the primary chamber. The cylindrical shape ensures sediment collects at the base of the chamber. Floatables: Gross pollutants and litter are removed by the same process described above.

Operation & Maintenance Manual:

The Maintenance Programme will be kept on the premises at all times, with a ledger recording all maintenance and inspection activities. This will provide a useful and efficient record for Council Inspection officers to facilitate random verification.

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4.2.3 SPEL Hydrosystem – General Information

The SPEL Hydrosystem is a tertiary stromwater treatment filtration device targeting known pollutants of concern including Total Suspended Solids (TSS); Nutrients (TP & TN); Gross Pollutants; as well as Heavy Metals (i.e. Cu, Zn, Pb). This specialist stormwater filtration system is installed within conventional concrete manholes, polyethylene and fibreglass shafts. The pre-fabricated and pre-assembled SPEL Hydrosystem is quickly and safely installed using onsite diggers (see Figure 4.3 below). This system is designed for an array of applications with treatment flow rates ranging from 2.5l/s up to 144l/s. The Hydrosystem is designed in an off-line configuration and operates at full treatment flow with a hydraulic fall of 250mm across the system.

Figure 4.3: SPEL Hydrosystem (SHS.1000) installation using onsite digger

4.2.3.1 International Validation and Testing

SPEL Hydrosystem have been lab and field tested by several Universities and Institutes across Germany. The German Institute for Structural Engineering (DIBt) granted a general technical approval (Z-84.2-4)1 passing all test conditions under heavy trafficable conditions. Field test data has been obtained across Germany including Bremer Straße in Hamburg-Harburg2 reinforcing the above approval.

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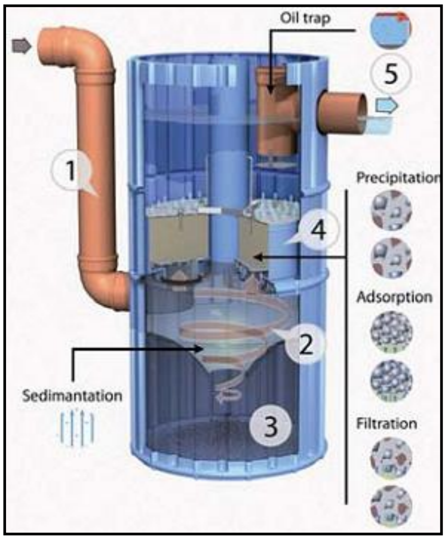
Function Principles:

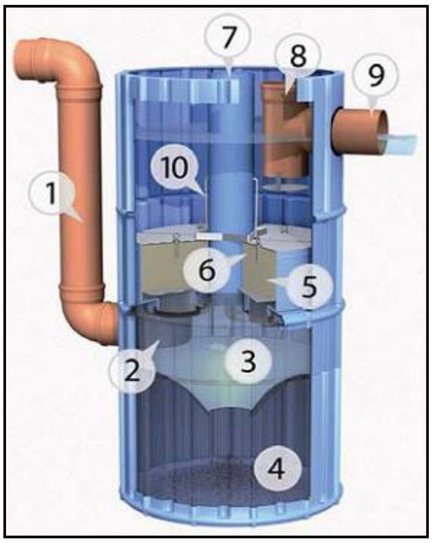
1. The rainwater from the connected area is fed into the basal section of the filter housing. The angled inlet generates a radial flow pattern.
2. The hydrodynamic separator converts turbulent waters into a radial laminar flow pattern, generating particle sedimentation, particularly of the sand fraction.
3. This takes place over an inlet to the lower section of the filter shaft. The sediment is retained in a silt trap chamber below the separator. The silt trap needs to be emptied out at intervals.
4. In the central section of the filter housing is the actual filter,
5. Filter Element: Metal. The filter element filters out the fine materials in an up-flow process and dissolved materials are precipitated and adsorbed. The filter can be backwashed. When exhausted the filter is easily exchanged.
6. The filter element is easily pulled up via shaft openings.
7. Above the filter element is the clean water. It passes via a blockade of light substances and then flows over the outlet into a soak away.



Schematic of SPEL Hydrosystem Process

Product Components:

1. Rainwater Inlet (DN 200).
2. Angled Inlet.
3. Separator Chamber.
4. Silt Trap.
5. Filter Elements (4 No.).
6. Removal Device for Filter Element.
7. Overflow.
8. Blockade of light substances and suction pipe
9. Outlet to storage or to waste.
10. Locking buoyancy control system



Schematic of SPEL Hydrosystem Components

4.3 Maintenance Procedure

The SPEL treatment train specified above is an engineered stormwater treatment solution for the reduction in TSS, nutrients, gross pollutants and hydrocarbons. The Stormwater Quality Improvement Devises (SQIDs) identified in the stormwater treatment solution will required on-going maintenance for a prescribed period as specified by their respective council/authority. A draft of the proposed treatment train maintenance contract can be seen in Appendix 2.

Quality Analysis - MUSIC

Section 5

5 Quality Analysis – MUSIC

Water quality modelling has been undertaken of the post-development (mitigated) scenario using the Model for Urban Stormwater Improvement Conceptualisation (MUSIC) software to demonstrate the load based reduction targets are achieved. A stormwater treatment train has been developed and modelled to determine the effectiveness of the proposed system in achieving the relevant water quality objectives.

5.1 Rainfall and Evapotranspiration Parameters

Table 5.1 summarized the meteorological and rainfall-runoff data used in the MUSIC model.

Table 5.1 Meteorological and Rainfall Runoff Data

Parameter	Value
Rainfall station	086085 – Narre
Time step	6 minute
Modelling period	January 1984 – December 1993
Mean annual rainfall (mm)	932 mm
Evapotranspiration	985 mm

5.2 Catchment Parameters

Based on the proposed land uses within the development, the subject site has been modelled as an urban source node. The rainfall-runoff parameters and pollutant generation parameters are based on parameters recommended by Melbourne Water (2016) (**Tables 5.2** and **5.3**).

Table 5.2 Rainfall Runoff Parameters

Parameter	All Nodes
Rainfall threshold (mm)	1.0
Soil storage capacity (mm)	120
Initial storage (% capacity)	25
Field capacity (mm)	80
Infiltration capacity coefficient a	200
Infiltration capacity exponent b	1
Initial depth (mm)	10
Daily recharge rate (%)	25
Daily base flow rate (%)	5
Daily deep seepage rate (%)	0

Table 5.3: Pollutant Export Parameters for Urban Sites

Catchment ID		Total Suspended Solids [log (mm/L)]		Total Phosphorous [log (mm/L)]		Total Nitrogen [log (mm/L)]	
		Mean	Std. Deviation	Mean	Std. Deviation	Mean	Std. Deviation
Landscape	Storm Flow Concentration	2.2	0.32	-0.45	0.25	0.42	0.19
	Base Flow Concentration	1.1	0.17	-0.82	0.19	0.32	0.12
Hardstand	Storm Flow Concentration	2.2	0.32	-0.45	0.25	0.42	0.19
	Base Flow Concentration	1.1	0.17	-0.82	0.19	0.32	0.12
Roof	Storm Flow Concentration	2.2	0.32	-0.45	0.25	0.42	0.19
	Base Flow Concentration	1.1	0.17	-0.82	0.19	0.32	0.12

5.3 Treatment Node Parameters

The following sections describe the modelling parameters applied to MUSIC for each of the treatment nodes included as part of the water quality assessment.

Advertised 18/05/2020

5.3.1 SPEL Stormceptor Parameters

A generic treatment node in MUSIC has been used to simulate the treatment efficiency of the Stormceptor based on third party field testing results. The SPEL Stormceptor treatment node parameters are summarised in **Table 5.4**.

Table 5.4 SPEL Stormceptor Treatment Node Parameters

Parameters		Value
Are the proposed pollutant reduction efficiencies independently verified using a method suited to local conditions?		Y
Does the data provided include performance results under dry weather flows (to account for potential pollutant leeching?)		Y
It the assumed high-glow bypass rate consistent with manufacturer specifications?		Y
High Flow Bypass (m^3/s)		0.3 & 0.22
Low Flow Bypass (m^3/s)		0.000
Total Suspended Solids	Input (mg/L)	1000
	Output (mg/L)	170
Total Nitrogen	Input (mg/L)	100
	Output (mg/L)	77
Total Phosphorus	Input (mg/L)	100
	Output (mg/L)	89
Gross Pollutants	Input (mg/L)	15.0
	Output (mg/L)	0.0

5.3.2 SPEL Puraceptor Parameters

SPEL engages ongoing site tests for water quality of the Stormceptor devices continually across a wide spectrum of catchments on Australia`s east coast. The SPEL Puraceptor parameters utilised within MUSIC are summarised in **Table 5.6**:

Table 5.6 SPEL Ecoceptor Treatment Node Parameters

Catchment ID	SPEL Puraceptor
Are the proposed pollutant reduction efficiencies independently verified using a method suited to local conditions?	Yes
Does the data provided include performance results under dry weather flows (to account for potential pollutant leeching?)	Yes
It the assumed high-glow bypass rate consistent with manufacturer specifications?	Yes
High Flow by-pass (m^3/s)	0.04
Low Flow	0.000
TSS Input (mg/L) Output (mg/L)	1000 170
TN Input (mg/L) Output (mg/L)	50 38.5
TP Input (mg/L) Output (mg/L)	5 4.45
Gross Pollutants Input (mg/L) Output (mg/L)	15 0

5.3.3 SPEL Hydrosystem Parameters

A generic node has been utilized in MUSIC, for the purpose of simulating treatment efficacy of SPEL Hydrosystem and the transform function in the node has been modified based on SPEL Total Stormwater's 2nd and 3rd Party field testing product data. These test results and papers are available upon request from SPEL Total Stormwater. The SPEL Hydrosystem parameters utilised within MUSIC are summarised in **Table 5.5**.

Table 5.5: SPEL Hydrosystem Parameters

Catchment ID	SPEL Hydrosystem
Are the proposed pollutant reduction efficiencies independently verified using a method suited to local conditions?	Y
Does the data provided include performance results under dry weather flows (to account for potential pollutant leeching?)	Y
It the assumed high-glow bypass rate consistent with manufacturer specifications?	Y
High Flow by-pass (m^3/s) (for each separate system)	0.024 & 0.048
Low Flow	0.000
TSS Input (mg/L) Output (mg/L)	1000 150
TN Input (mg/L) Output (mg/L)	100 57
TP Input (mg/L) Output (mg/L)	100 34
Gross Pollutants Input (mg/L) Output (mg/L)	15 0

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18/05/2020

5.4 MUSIC Results

Results of the MUSIC modelling for the treatment train effectiveness are summarised in **Table 5.6**. The results indicate the 80%, 45%, 45% and 70% reduction target for TSS, TP, TN and gross pollutants respectively are achieved. A screen capture of the MUSIC modelling results is included as **Figure 5.2**.

Table 7.6: Treatment Train Effectiveness

Pollutant	Inflows (kg/yr)	Outflows (kg/yr)	Reduction Achieved (%)	Reduction Target (%)
Flow (ML/yr)	148	147	**0**.6	0
Total Suspended Solids	26300	1890	**9**2.8	80
Total Phosphorus	56.1	14.7	**7**3.8	45
Total Nitrogen	411	206	**4**9.8	45
Gross Pollutants	4850	0	**100**	70

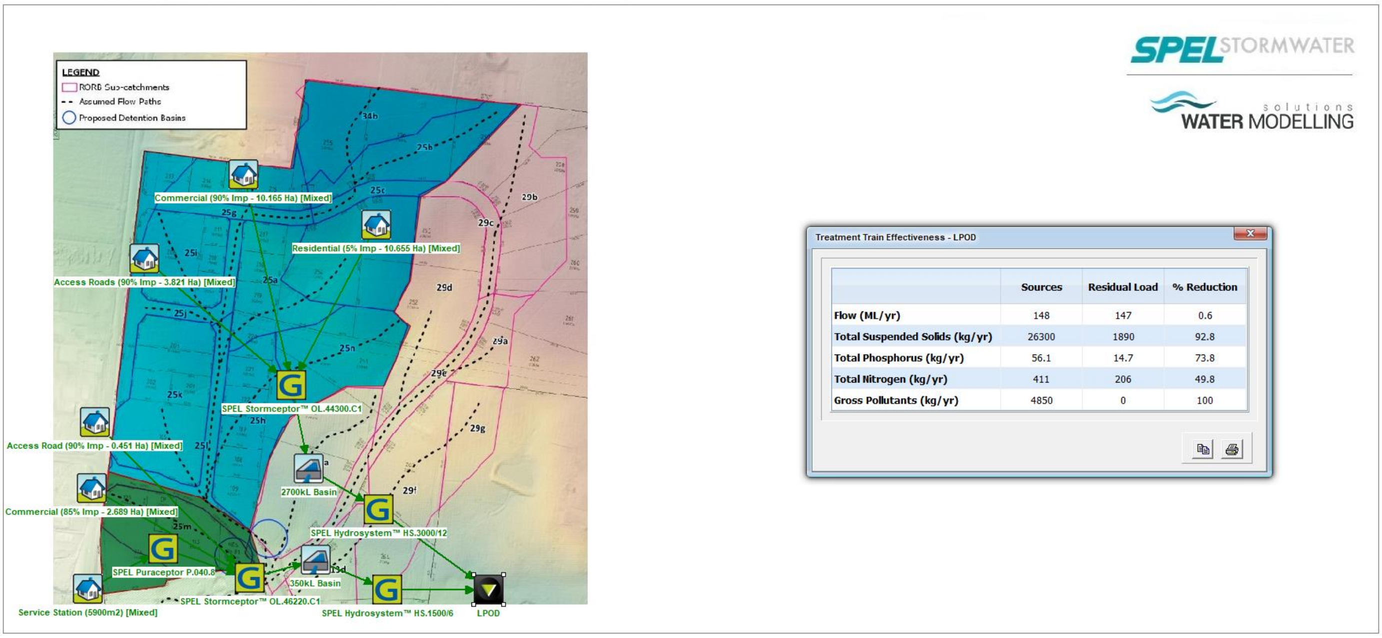

Figure 5.2: Treatment Train Effectiveness & Layout

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18/05/2020

Summary and Recommendation

Section 6

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18/05/2020

6 Summary and Recommendation

Based on the water quality assessment using the MUSIC software, it is found that the pollutant reduction targets can be achieved by adopting the SQIDs specified in **Table 6.1**.

Table 6.1: Recommended Stormwater Quality Improvement Devices

Stormwater Quality Improvement Device	Quantity
SPEL Stormceptor OL.4130.C1.2C	4
SPEL Puraceptor P.040.8	1
SPEL Hydrosystem (SHS.1000)	1

The recommended SQIDs are designed to capture stormwater at the downstream end of the drainage network and treat the runoff prior to discharging into the local waterway. The pollutant reduction targets achieved (as modelled in MUSIC) are summarised in **Table 6.2**.

Table 6.2: MUSIC modelling results

Pollutant	Inflows (kg/yr)	Outflows (kg/yr)	Reduction Achieved (%)	Reduction Target (%)
Flow (ML/yr)	148	147	**0**.6	0
Total Suspended Solids	26300	1890	**9**2.8	80
Total Phosphorus	56.1	14.7	**7**3.8	45
Total Nitrogen	411	206	**4**9.8	45
Gross Pollutants	4850	0	**100**	70

References

Section 7

7 References

Melbourne Water (2016). *MUSIC Guidelines – Input Parameters and modelling approaches for MUSIC users in Melbourne Water's service area 2016*

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18/05/2020

List of Appendices

Appendix 1 – SPEL SQID Product Guides

Appendix 2 – Draft Treatment Train Maintenance Contract

Appendix 1 – SPEL SQID Product Guides

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18/05/2020

Appendix 2 – Draft Treatment Train Maintenance Contract

SPEL STORMWATER

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18/05/2020

EDGECOMBE ROAD KYNETON VIC

20-0272

10 YEAR MAINTENANCE CONTRACT

SPEL STORMWATER QUALITY TREATMENT DEVICE MAINTENANCE AGREEMENT

FOR

20-0272 106 EDGECOMBE ROAD KYNETON VIC

This Equipment Maintenance Agreement (the "Maintenance Agreement") is made and effective __/ __/ ____

BETWEEN: SPEL Total Stormwater (the "Service Provider"), of
191 Station Street, Corio VIC 3214 (ABN:32 379 724 600) hereafter known as SPEL

AND: _________________________ (the "Client") of
____

SUMMARY

This 10 year maintenance contract covers the monitoring and servicing of the SPEL Stormceptor, SPEL Puraceptor and SPEL Hydrosystem at 106 EDGECOMBE ROAD KYNETON VIC

Where the Client has requested the provision of maintenance and the Service Provider is willing to provide such services as per the terms of this agreement both parties agree to:

1. WARRANTY

SPEL operational warranty on the Stormceptor, Puraceptor and Hydrosystem is in place for as long as there is an active maintenance regime with SPEL on the specified units.

- Excludes construction silt loads
- Excludes unusual/accidental silt loads
- SPEL maintains the site

Goods sold shall only have the benefit of a manufacturer's warranty if the purchaser has complied with the manufacturer's instructions in relation to installation, maintenance and operation of the said goods.

2. MAINTENANCE CALLS

Service Provider agrees to provide maintenance service including up to three [3] maintenance calls annually and interim calls as required at the installation address specified above on the equipment listed. All charges specified are those currently in effect and are subject to change only at the time of subsequent annual renewal. The new charges shall become effective upon the date specified in the renewal invoice. Client calls hereunder are restricted to the normal working hours of the Service Provider.

All service commenced outside of Service Provider's normal working hours will be charged at published rates for service time and expense only.

3. SERVICES

The following services are included:

Maintenance Summary

The SPEL Stormceptor, SPEL Puraceptor and Hydrosystem treatment train system will be inspected in accordance with the Maintenance Manual

Stormceptor

- Visual inspection of the Stormceptor conditions every four (4) months
- Includes inspection of the containment chamber and coalescer chamber & unit.
- If there is an oil/fuel build up (approx. 50mm) or after a spill, it will need to be vacuumed out. Costing to be confirmed at time of activity and will be additional cost to the standard contract value outlined below.

Puraceptor

- Visual inspection of the Puraceptor is governed by the Oil Alert Probe. Usually on a four (4) month interval.
- Includes inspection of the containment chamber, coalescer chamber & unit, auto closure device (ACD), and the alarm monitoring system
- If there is an oil/fuel build up (approx. 50mm) or after a spill, it will need to be vacuumed out. Costing to be confirmed at time of activity and will be additional cost to the standard contract value outlined below.

Hydrosystem

- The SPEL Hydrosystem system will be inspected annually.
- The SPEL Hydrosystem change out maintenance process comprises the removal and replacement of each SPEL Hydrosystem cartridge and the cleaning of the silt out of the vault or manhole with a vacuum truck. In the event these works are required, Client will be notified accordingly.

The SPEL personnel that enter the tank [if necessary] will be trained in confined space entry

Life Cycle Cost (LCC) – The maintenance requirements for the SPEL Stormceptor, SPEL Puraceptor and and SPEL Hydrosystem is very site specific and actually relates to the sediment load and sediment characteristics.

Maintenance Triggers

The basic activities included in the maintenance contract are as follows:

- Visual inspection of the vault and filter conditions annually
- If there is a silt build up, it will need to be vacuumed out an additional cost. Costing to be confirmed at time of activity and will be additional cost to the standard contract value outlined below.
- TSS accumulation in the filters is what dictates the life cycle of individual filter.

Optimum performance of the equipment covered by this Agreement can be expected only if supplies provided by, or meeting the specifications of Service Provider are used. Service Provider shall have full and free access to the equipment to provide service thereon. If persons other than Service Provider's representatives perform maintenance or repairs, and as a result further work is required by Service Provider to restore the equipment to operating condition, such repairs will be billed at Service Provider's published time and material rates then in effect.

4. ANNUAL RATE FOR SERVICES

ACTIVITY	FREQUENCY [subject to site characteristics]	COST BREAK-DOWN [subject to CPI index]
2 SPEL Stormceptor, 1 SPEL Puraceptor and 18 cartridges Hydrosystem - Visual inspection of the Stormceptors, vault and filter conditions – SPEL technician onsite. Empty the Stormceptors.	Every four months	$4,125.00 per annum
SPEL Hydrosystem replacement – allowance for 1 time replacement of Hydrosystem cartridges throughout the 10 year period. All old cartridges removed, disposed and replaced. Vault to be cleaned out via vacuum truck prior to installation of new replacements.	Based on the past experience we estimate the life of the SPEL Hydrosystem to be between 5 – 7 years, subject to silt condition on the site. SPEL System Silt Removal is dictated by silt condition on site	1 x Labour, travel expenses 6 x SPEL 1500 Hydrosystem Cartridges Replacement 12 x SPEL 3000 Hydrosystem Cartridges Replacement Total once in 10 years = $59,100.00
Vacuum out the hydrosystem, Puraceptor, and Stormceptor, removal and disposal of pollutants	When necessary, based on inspection	This is an additional cost to the regular maintenance contract and has not been included in the annual rate indicated below. Costing to be confirmed at time of activity based on extent of pollutants removed and disposed.
SUMMARY		
SPEL will inspect onsite 3 times per annum - $4,125.00 per annum **Replace the 18 Hydrosystem cartridges in accordance with above in 10 years, turnkey operation $59,100.00 spread over 10 years.** **Total value Per Annum $10,160.00 + GST**		

The annual rate for maintenance of SPEL Stormceptor, SPEL Puraceptor, & SPEL Hydrosystem for a 10 year term is $10,160.00 + GST and shall be paid in advance as at the renewal date each year. The annual rate shall be indexed by CPI at each annual renewal date. Any payment not made by the 30th day of the month shall be considered overdue and in addition to Service Provider's other remedies, Service Provider may levy a late payment charge equal to 4% per month on any overdue amount.

5. PAYMENTS

For service as specified above on the equipment listed, the undersigned Client agrees to pay in advance the total annual charge specified below to Service Provider, in accordance with the terms specified on the face of the invoice. There shall be added to the charges provided for in this Agreement amounts equal to any taxes, however designated, levied or based on such charges or on this Agreement, or on the services rendered or parts supplied pursuant hereto, including GST.

6. BINDING AGREEMENT

The undersigned Client represents that he is the owner of the equipment, or that they have the owner's authority to enter into this agreement.
This Agreement is subject to acceptance by Service Provider. It takes effect on the date written above and continues in effect for one year and will remain in force thereafter, with automatic annual renewal at the indexed rates, until cancelled in writing by either party or at the end of a ten year period – whichever is earlier.

IN WITNESS WHEREOF, the parties hereto have executed this contract as of the day and year first above written.

Client Signature

____
Authorized Signature
Name:

Date:

Billing Entity:

ABN:

Contact:

Phone:

SPEL Total Stormwater
191 Station Street, Corio VIC 3214

____
Authorized Signature
Name:

Date: