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Stormwater Management Plan

Kennett River Tourism Infrastructure Improvements Project

Reference No. 30043113E
Prepared for Colac Otway Shire
03 March 2022

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Important Notice

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1 Introduction

SMEC has been engaged by Colac Otway Shire (COS) to complete the Kennett River Tourism Infrastructure Improvements Project. As part of this project, SMEC has developed a Stormwater Management Plan (SWMP) to set the drainage and water quality treatment strategy for the developments. This document has been created to demonstrate the stormwater management design intent and allow for authority review of the information provided, enabling the detailed design process to proceed.

1.1 Kennett River Tourism Infrastructure Site Description

The project comprises carpark, pedestrian and road improvements to both the local road networks and the Great Ocean Road along with a new public toilet building and associated wastewater treatment plant for this seaside hamlet. Figure 1-1 shows the Kennett River development plan.

1.2 Stormwater Management Plan Objectives

All development has the potential to adversely affect downstream environments through the effects of stormwater runoff. Increased impervious areas resulting in increased volumetric and peak flows have been extensively researched and linked to downstream environmental degradation. Contaminants contained in the runoff have also been linked with adverse changes to both water quality and stream ecology. The contribution of increased runoff would also be linked to downstream flooding and capacity constraints.

To overcome the affects hydrological and water quality mitigation measures were investigated.

1.2.1 General Considerations

The Victorian State Planning Policy Framework includes provisions incorporating the provisions for stormwater management in its integrated water management clauses. The Colac Otway Shire, as part of its planning requirements, incorporates BPEM water quality targets, setting out objectives for stormwater runoff.

1.2.2 Water Quality Requirements

Current water quality guidelines require developers to ensure water quality for the site meets best practice load-based reduction targets when compared with the unmitigated developed scenario. As listed by the Victorian EPA Best Practice Environmental Management (BPEM) Guidelines (1999) the development must meet:

- 80% Total Suspended Solids (TSS) reduction
- 45% Total Nitrogen reduction
- 45% Total Phosphorus reduction
- 70% Gross Pollutant capture

These water quality requirements are to be met in water quality treatment recommendations as part of this development.

1.2.3 Flood Storage Requirements

The development is to be designed to ensure that flows do not increase above the pre-development levels. Generally, this would be applied to the 1 % Annual Exceedance Probability (AEP) storm only and checked at each of the site discharge points. Attenuation would be applied at a basin and reductions in flow peak would be determined at the outlet of the basin. The size and/or requirement of any on-site detention will be explored within this report.

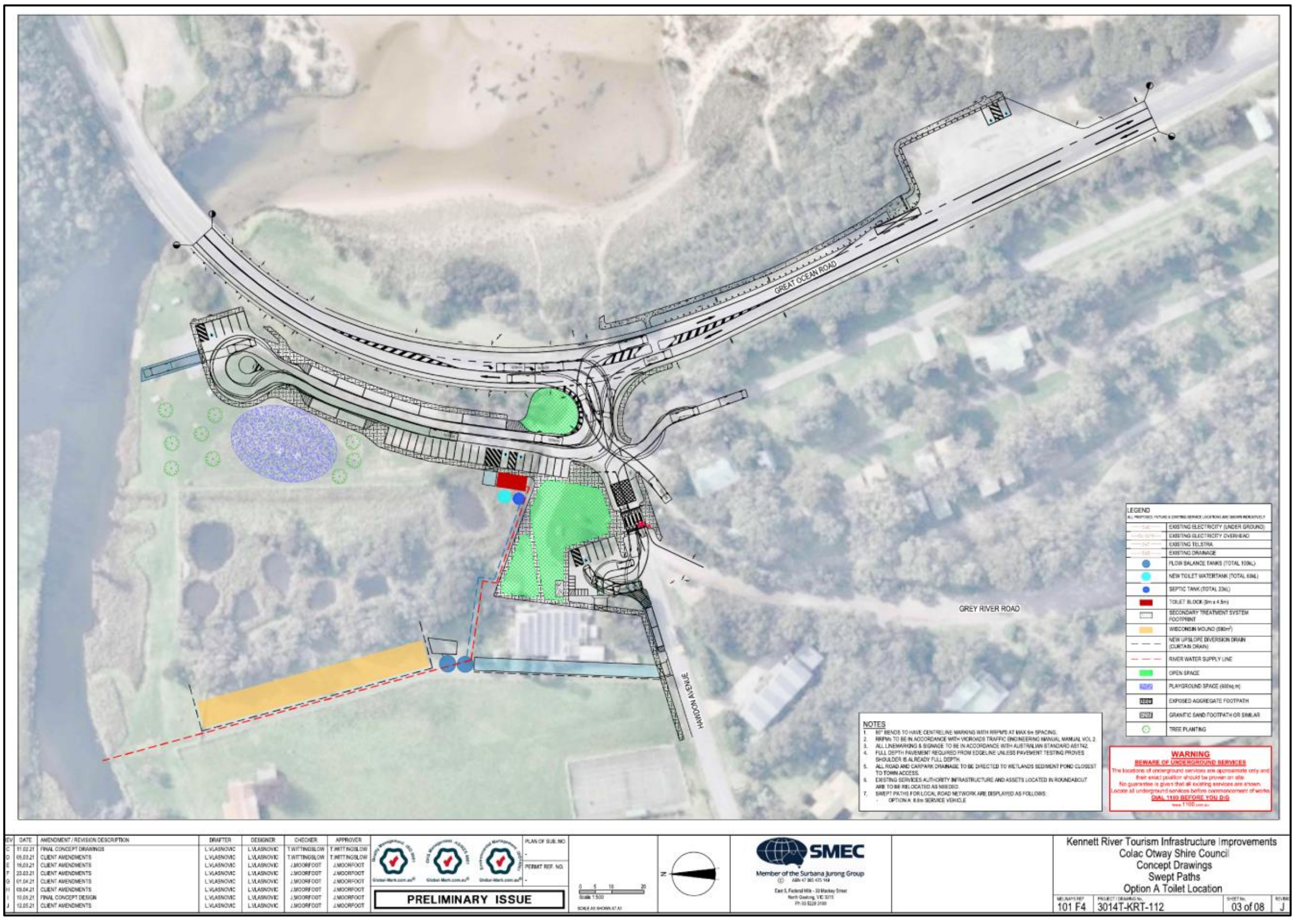


Figure 1-1 Kennett River Development Plan

2 Background Information

The following summarises key background information used as input for the development of the SWMP.

2.1 Topography

A survey of the site was completed in 2021 by SMEC and this was used, together with 1m LiDAR to define the internal and external catchments (Figure 2-1).

2.2 Existing Drainage Network

As shown in Figure 2-2, there are a few pits and pipes in the area that connects the existing roads and external catchment (south of the roundabout) to the Retarding Basin (RB) and wetlands just north of the roundabout.

There is also a culvert east of the sediment pond which convey the RB's overflow to the east of the Great Ocean Road.

2.3 Planning and Heritage Matters

A review of VicPlan identified a Heritage Overlay (HO312) and (HO209) for the Great Ocean Road, Land Subject to Inundation Overlay (LSIO) and Erosion Management Overlay (EMO01). Planning overlay, planning zones and Aboriginal Cultural Heritage Sensitivity Area for the site area are shown in Appendix A.

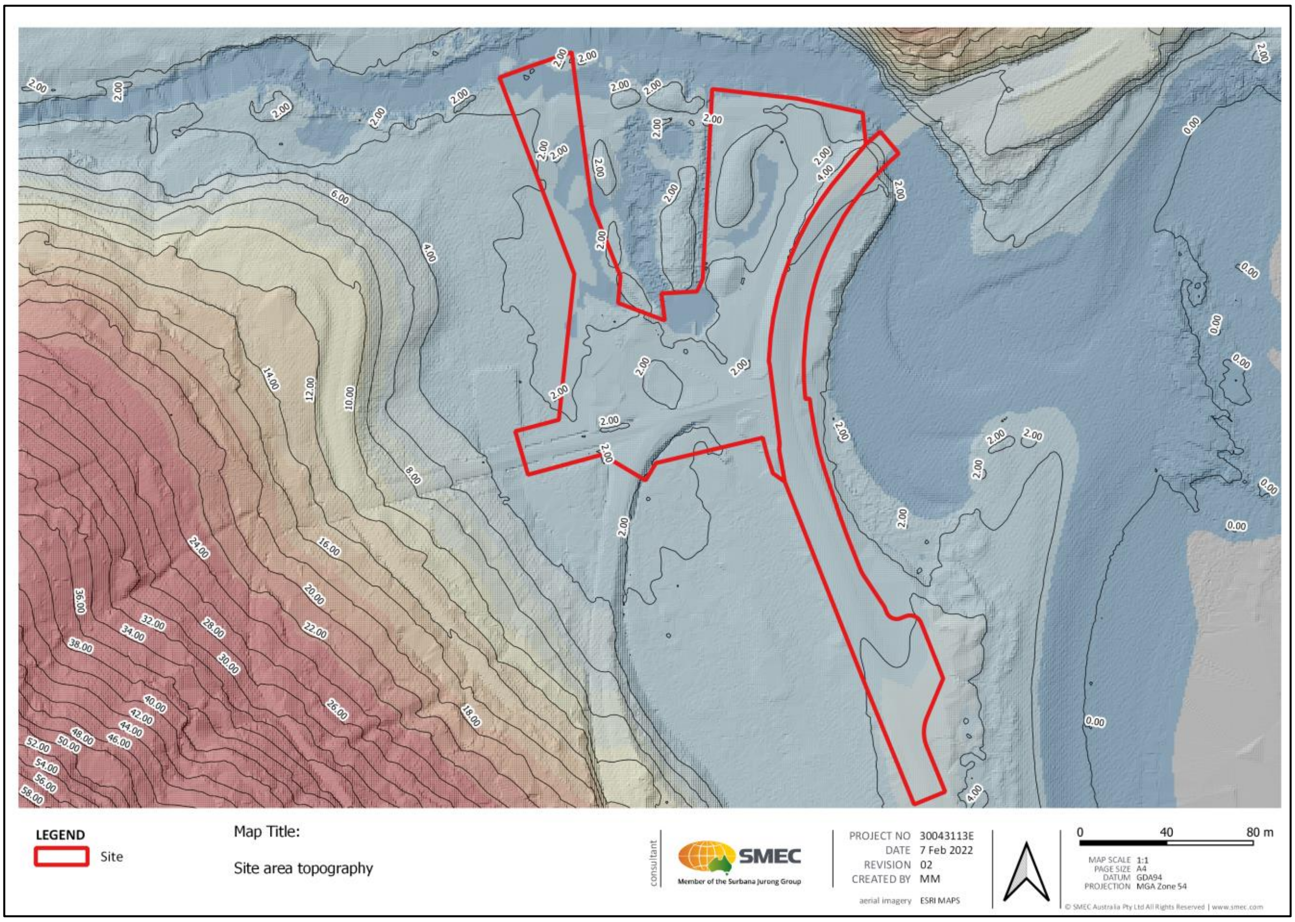


Figure 2-1 Site Topography

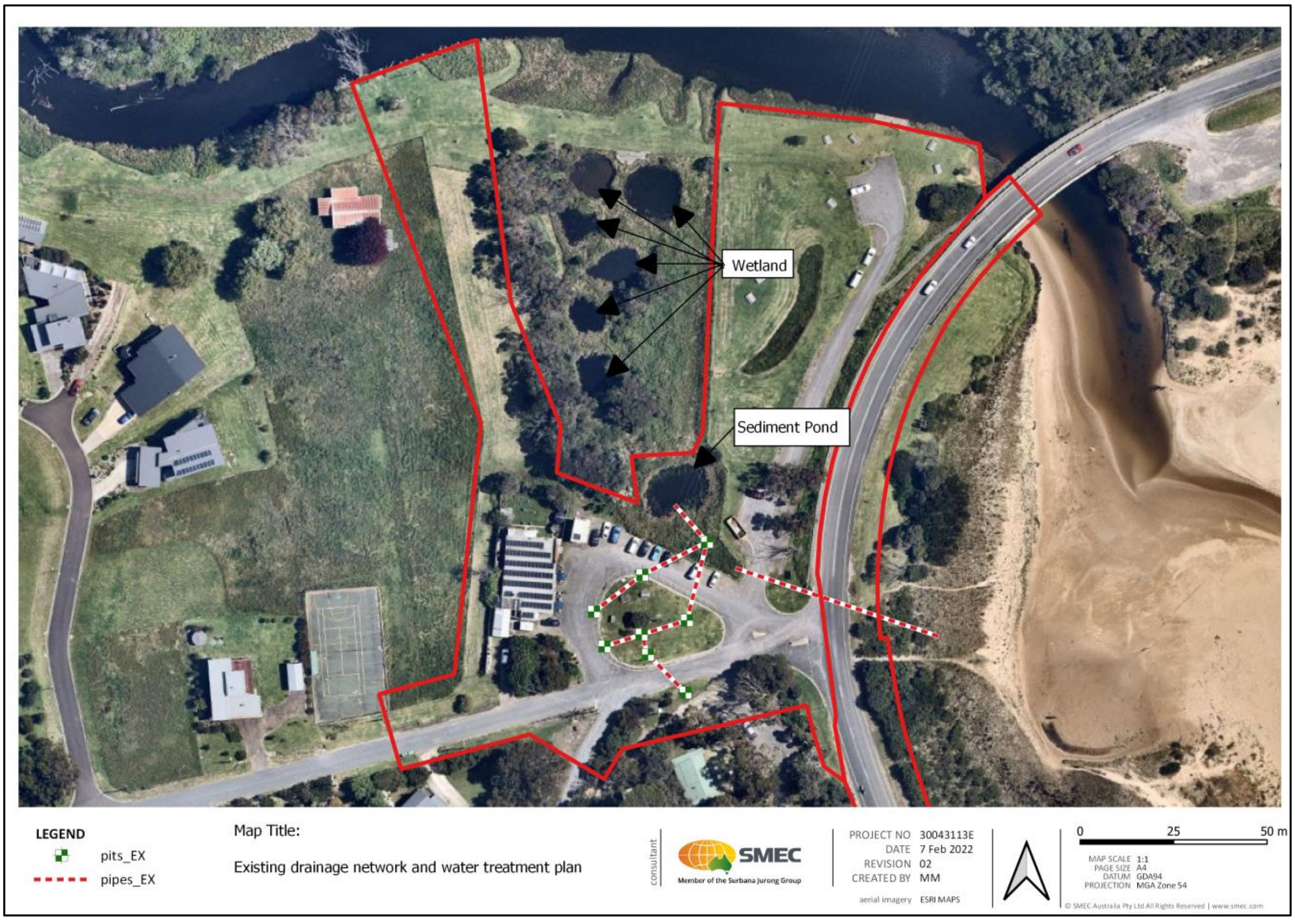


Figure 2-2 Existing Pits and Pipes network and water treatment plant including sediment pond and wetland

3 Stormwater Quantity

The following sections present the stormwater flow assessments and proposed drainage infrastructure required to meet COS drainage standards. Typically, an assessment of pre and post-development flows is completed to identify whether stormwater detention is required to mitigate the impacts of increases to stormwater flows on downstream drainage systems.

The Stormwater Management Plan considers the flows from the study site in addition to external catchments. Catchments and flow paths have been defined in Figure 3-1. SMEC has completed a desktop review of the catchment boundaries and considers these to be reasonable supported by the available LiDAR and Survey. The management of the contributing external and internal flows in the developed conditions are further discussed in detail below.

3.1 External Catchment

The external catchment divided into three sub-catchments (Figure 3-2). The sub-catchments are draining to the North directly into the Kennett River via the existing drainage network, to the East directly into the ocean via a culvert under the Great Ocean Road, and to the North-East into the RB system through the existing drainage network under the roundabout located at the study site area. Out of three external sub-catchments, only outflow for the latter sub-catchment (2.23ha) is considered for SWSM assessments as contributing external subcatchment to RBs. Table 3-1 presents hydrological characteristics and max peak flood for 1%AEP event (using rational method) at this external subcatchment

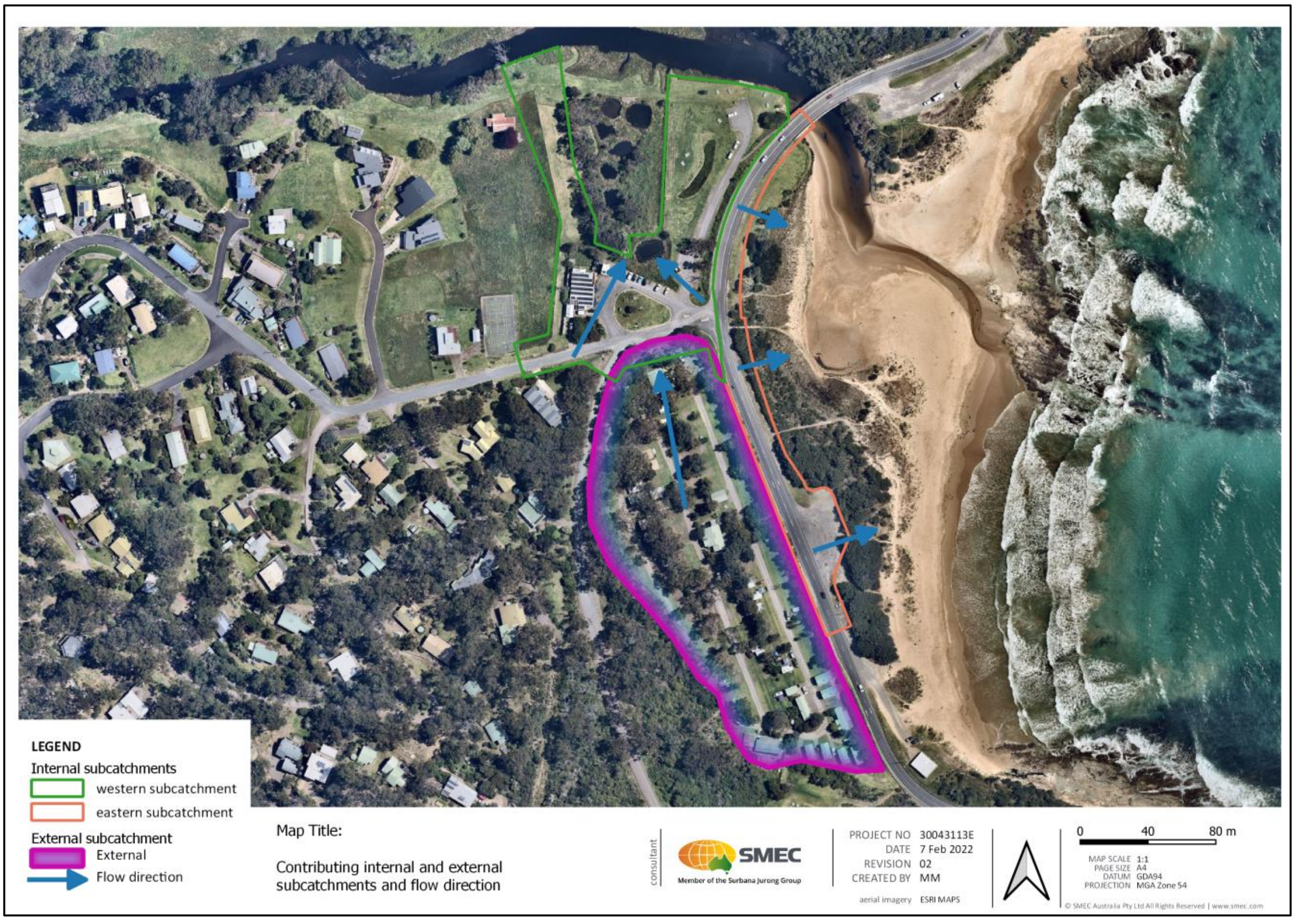


Figure 3-1 Contributing internal and external sub-catchments and flow direction

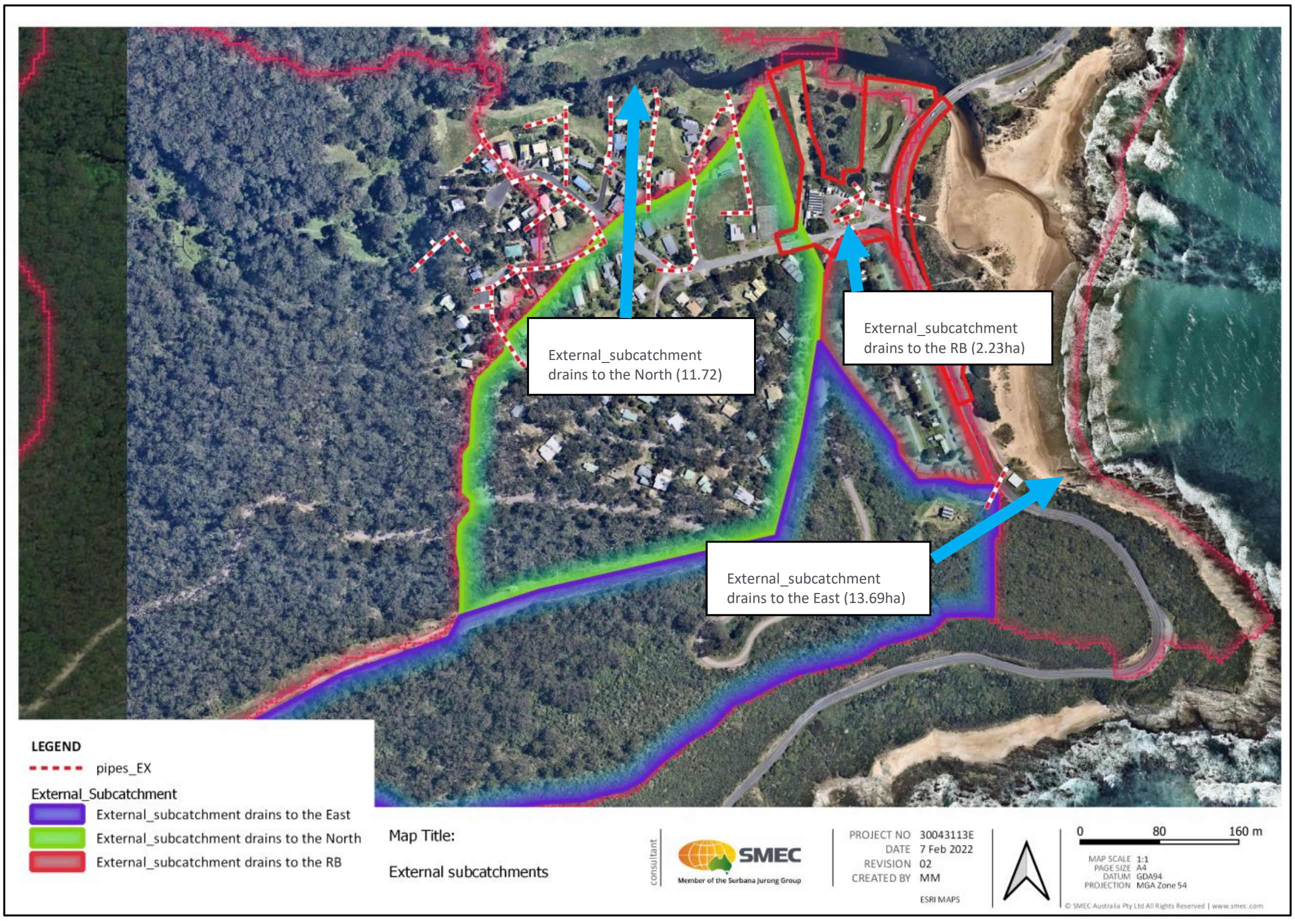


Figure 3-2 External subcatchments

Table 3-1 The contributing external subcatchment Peak Flow for 1%AEP event

CATCHMENT	AREA (HA)	IMPERVIOUS FRACTION (%)	10% AEP (L/S)	1% AEP (L/S)
External subcatchment	2.23	30	120	240

3.2 Internal Catchment

The internal subcatchments for the study area include the west subcatchment (1.52ha) and the east subcatchment (0.61ha). The west subcatchment consist of roads, parking area, roofs and green area draining to the Kennett River through the existing pits and pipes connected to the RB; where the east subcatchment including road and green area drains directly to the ocean via the Great Ocean Road without any treatment.

For western subcatchment, green space areas for existing and design were 1.16ha and 0.87ha respectively, where for eastern subcatchment they were estimated 0.28ha and 0.20ha accordingly.

The internal subcatchments for the existing and design conditions are shown in Figure 3-3 and Figure 3-4 respectively.

A Rational Method calculation was undertaken to estimate the 1% AEP and 10% AEP peak flows for the west and east subcatchments excluding open/green space (Table 3-2).

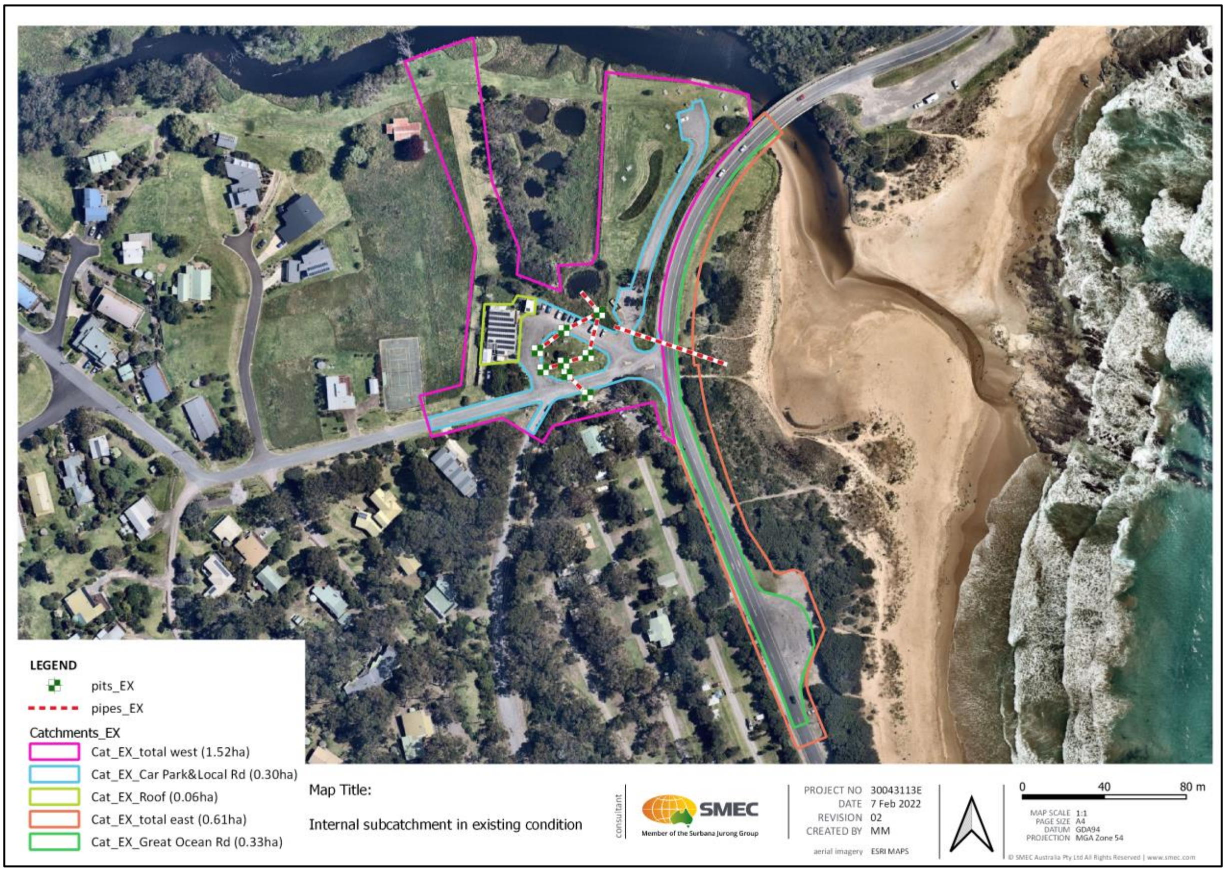


Figure 3-3 Internal subcatchment in existing condition

Figure 3-4 Internal subcatchment in design condition

Table 3-2 Peak flows for internal catchment (west & east subcatchments)

CATCHMENT		AREA (HA)	10% AEP (L/S)	1% AEP (L/S)
West subcatchment (Roads, Parking area and Roof)	Existing	0.36	50	90
	Design	0.45	80	140
East subcatchment (Great Ocean Rd)	Existing	0.33	50	90
	Design	0.41	70	130

3.2.1 Western internal subcatchment

There is a set of existing retarding/sedimentation basin and a wetland including six water bodies for the stormwater quantity and quality purposes (Figure 2-2). This water treatment plant (WTP) is supposed to capture overland flows from the western internal subcatchment and external subcatchment through the existing drainage network and discharge to Kennett River to the north.

The proposed development will increase the imperviousness of the area; therefore, an assessment was undertaken to investigate whether the existing WTP is able to cope with the increased flow.

Figure 3-5 and Table 3-3 present the component schematic and specification of all water bodies in this area.

Existing survey data was considered for extracting the volume between Normal Water Level (NWL) and Top Water Level (TWL) of WTP to be 200m^3. Meanwhile, the combined calculations of rational and Boyds methods (Figure 3-6) showed that the total required volume of contributing developed internal subcatchments and existing external sub-catchment to delineate 1%AEP (from 140l/s in developed conditions to 90l/s in existing conditions) were 14m^3. Therefore, no augmentation of WTP volume is required under the proposed development.

3.2.2 Eastern internal subcatchment

An existing table drain on the east side of the Great Ocean Rd captures overland flow discharging to the ocean. Considering a marginal increase in peak flows (from 90l/s in existing to 130l/s in design), an infiltration swale would be a proper option for both delineation and water quality purposes. More details of the swale will be elaborated in Section 4.

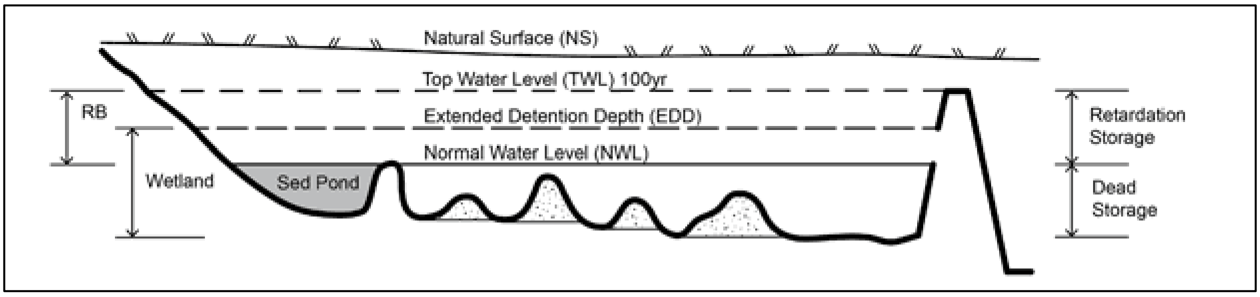


Figure 3-5Schematic of Water treatment plant components

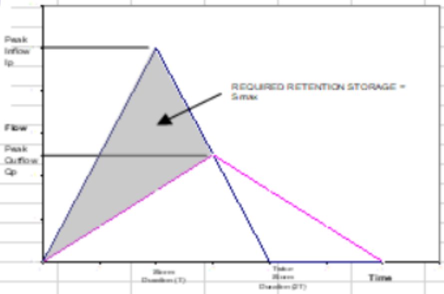
Table 3-3 Existing water treatment plant specifications

RB COMPONENT	WATER LEVEL	RL (M AHD)	AREA (M^2)	VOLUME BETWEEN NWL & TED (M^3)
Sediment pond	NWL	0.45	53	108
	TWL	1.5	120	
Part1	NWL	0.4	19	13
	TWL	0.8	38	
Part2	NWL	0.4	20	13
	TWL	0.8	35	
Part3	NWL	0.4	24	16
	TWL	0.8	44	
Part4	NWL	0.4	23	15
	TWL	0.8	40	
Part5	NWL	0.4	25	15
	TWL	0.8	40	
Part6	NWL	0.4	30	20
	TWL	0.8	53	

BOYDS FORMULA

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

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)



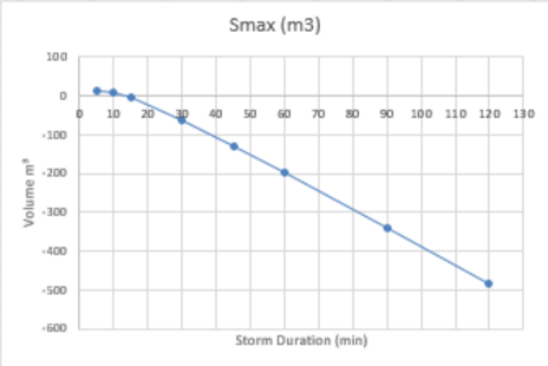
To be input by user (green)
Calculated by spreadsheet (blue)

Catchment Area (A) =	0.45	ha
Runoff Coefficient (100 Year) =	0.85	
100 Year Effective Catchment Area = ∑CA =	0.38	ha
Restricted outflow requirement =	0.09	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)	100 Year ntensity (mm/hr)	I_p (m^3/s)	Q_p (m^3/s)	V_1 (m^3)	S_{max} (m^3)
5	129	0.14	0.09	41	14
10	98.6	0.10	0.09	63	9
15	79.8	0.08	0.09	76	-5
30	52	0.06	0.09	99	-63
45	39.7	0.04	0.09	114	-129
60	32.9	0.03	0.09	126	-198
90	25.4	0.03	0.09	146	-340
120	21.4	0.02	0.09	164	-484



Volume needed= 14

Figure 3-6Boyd methodology details and outcomes

4 Stormwater Quality

The water quality assessments were completed to ensure water quality for the site meets best practice load-based reduction requirements. The water quality works must coincide with proposed development to ensure runoff does not directly discharge into existing drainage system to the detriment of downstream water quality.

4.1 MUSIC Modelling

MUSIC modelling is an industry standard approach to determine water quality treatment and sequencing. A model was created with updated assumptions for modelling of the specific site, adopted from City of Greater Geelong Design Notes. This included using 6min rainfall data, taken from the Geelong North rainfall station with the mean annual rainfall more than 500mm. Soil Storage Capacity and Field Capacity were set to 30mm and 20mm respectively in accordance with Geelong water quality standards.

It is worth noting that the water treatment plant node applied in current MUSIC model consists of a retarding/sedimentation basin, six small wetlands and an outlet pond.

4.2 MUSIC Model Setup

To ensure that the development meets the BPEM requirements of Clause 56-7.04, a MUSIC modelling (v6) was applied. MUSIC model is an industry standard model to determine water quality treatment. Guidance for model inputs was sourced from the City of Greater Geelong Design Notes.

In order to reach BPEM Guidelines the model was set up with the following notes/assumptions:

- The proposed project layout provided by SMEC urban team;
- Using Geelong guidelines including soil losses field capacity;
- An assumption of 350mm EDD;
- Geelong North rainfall station
- Catchments are in alignment with existing hydrological models provided by Cardno; and

Table 4-1 presents impervious fractions applied in MUSIC model across the project area.

Table 4-1 MUSIC input for internal subcatchment

CATCHMENT			AREA (HA)	IMPERVIOUS FRACTION (%)
Western subcatchment	Roads & Parking area	Existing	0.30	60
		Design	0.35	85
	Roofs	Existing	0.06	85
		Design	0.10	85
	Green area	Existing	1.16	5
		Design	1.07	5
Eastern subcatchment	Great Ocean Rd	Existing	0.33	60

CATCHMENT			AREA (HA)	IMPERVIOUS FRACTION (%)
		Design	0.41	85
	Green area	Existing	0.28	5
		Design	0.20	5

4.3 Western internal subcatchment

As shown in Figure 4-1, the existing WTP were considered identical in both existing and development conditions to test whether the existing plants are capable of coping with future developments .

Control of sediment from a developed area is an important consideration for both the hydraulic function of drainage and water quality assets. Build-up of sediment can lead to the failure of pipe networks (through blockage) and biological systems (through blockage and bypass). It is recommended that all local pipe network outlets where possible end in a sediment pond before discharge to the waterway or wetland.

If the sediment pond outlet flow is influenced by the water level in the wetland macrophyte zone, a single "wetland" node should be used to represent the system in MUSIC without a "sedimentation basin" node. The sediment pond should be represented by input parameters of the Inlet Pond Volume of the wetland node.

Sediment ponds were modelled as 'Inlet Ponds' when in the same drainage reserve as the wetland nodes as per MUSIC guidelines. Inlet ponds can reduce the sediment load into the wetlands themselves, hence increasing life expectancy. Sedimentation basins were sized using the Fair and Geyer equations, with the results summarised at Figure 4-3.

Biological treatment of stormwater reduces the loads of nutrients entering receiving waters, an important aspect of best practice guidelines. The general philosophy is to construct wetlands in preference to other water quality measures due to their robustness in long term survival, reduced maintenance, and ability to store greater amounts of water above the Normal Water Level (NWL) in a retarding basin situation. Wetland surface area dictates the potential effectiveness of these treatments, with plant selection and density being limited by available treatment area. Wetlands are designed to service the three-month flow or equivalent from the site. A schematic of a typical wetland as well as wetland parameters used in the modelling are shown in Figure 4-2 and Figure 4-3.

Based on the data presented above, the MUSIC modelling indicates that the existing sediment pond and wetland, without any changes, still will meet the BPEM requirements by treating stormwater runoff from the increased impervious area caused by the new roads, car park area and roofs as shown in Figure 4-4.

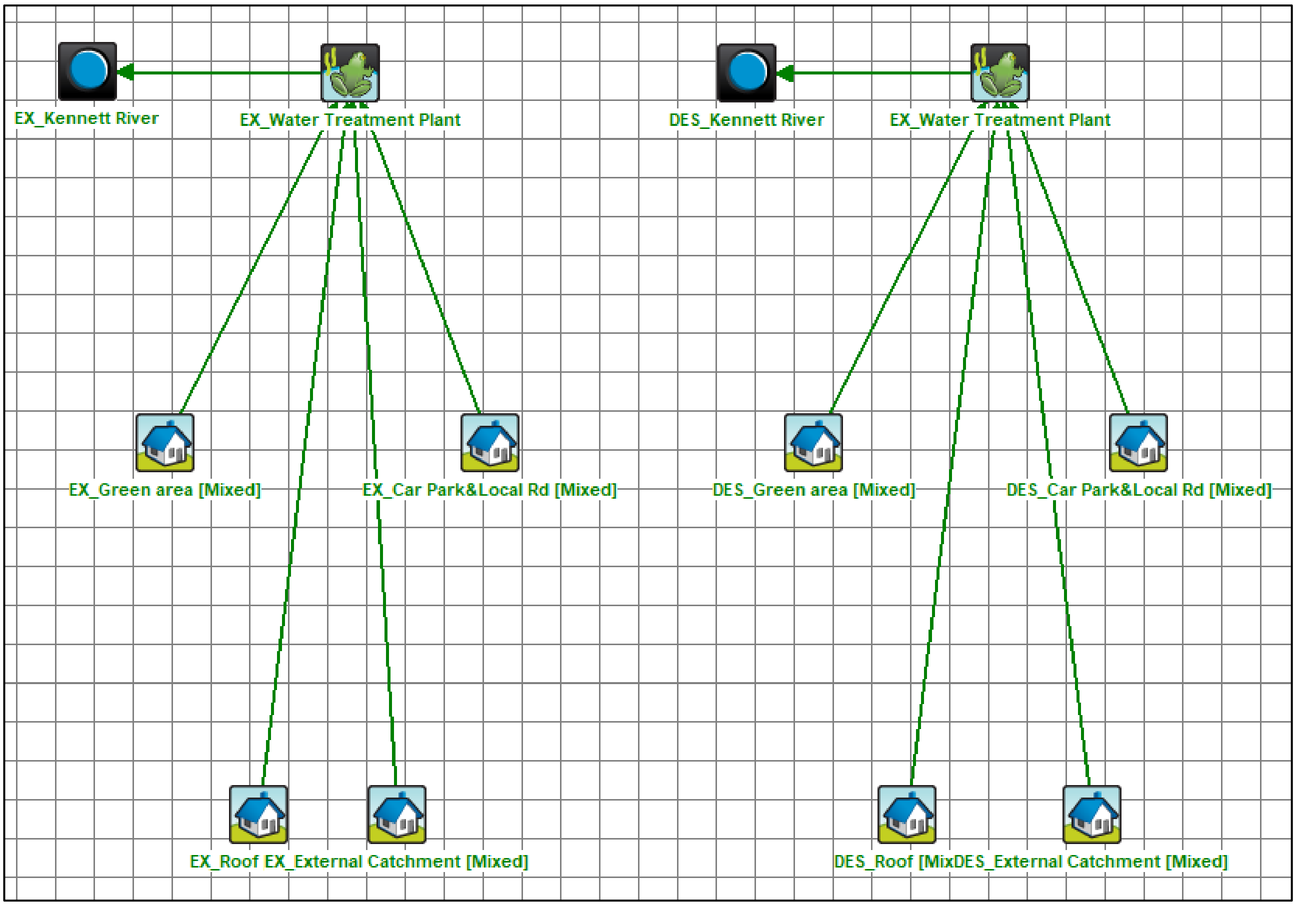


Figure 4-1 MUSIC model layout for the western subcatchment (Ex_Water Treatment Plant includes sediment pond and wetland)

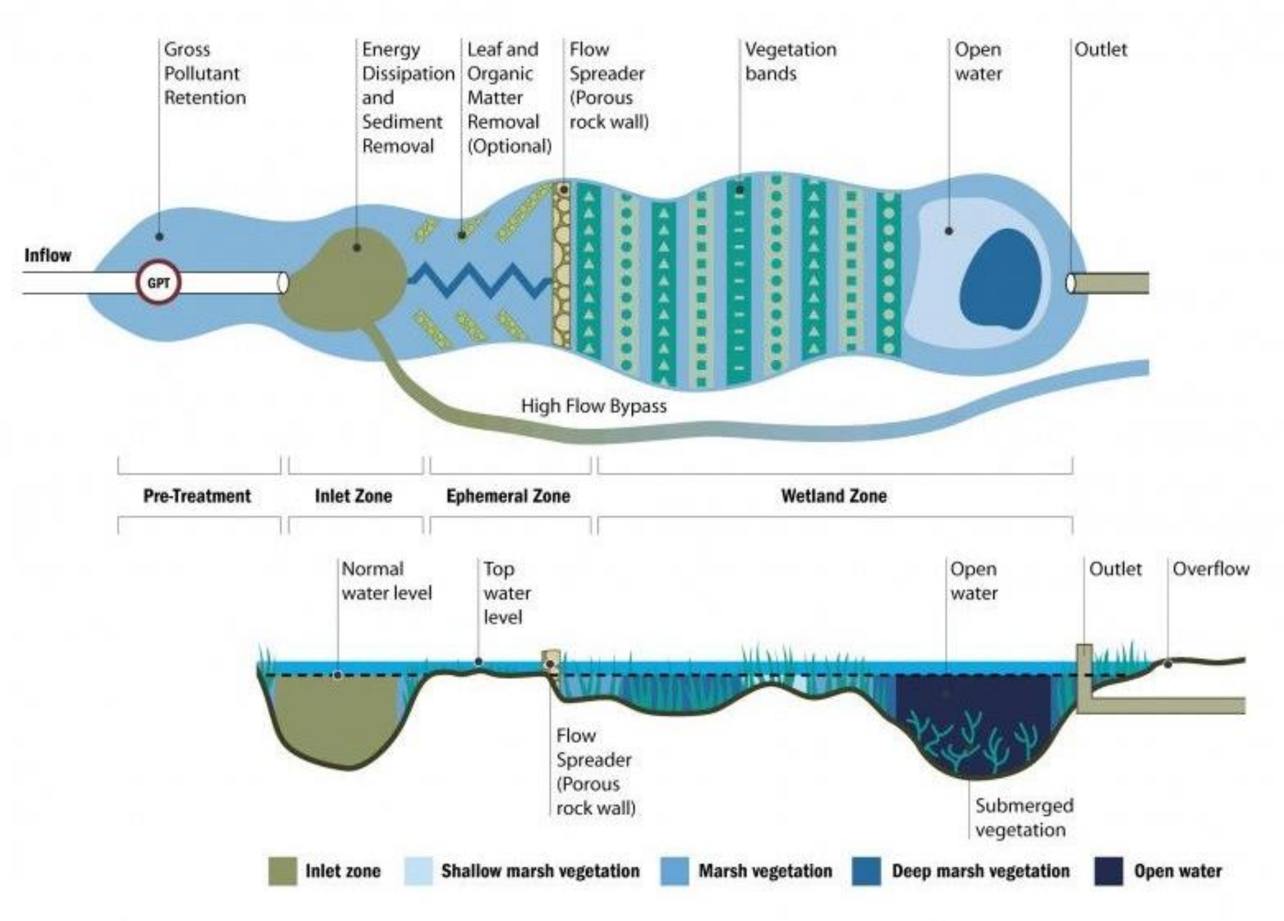


Figure 4-2 Schematic representation of a typical wetland (adopted from www.urbangreenbluegrids.com)

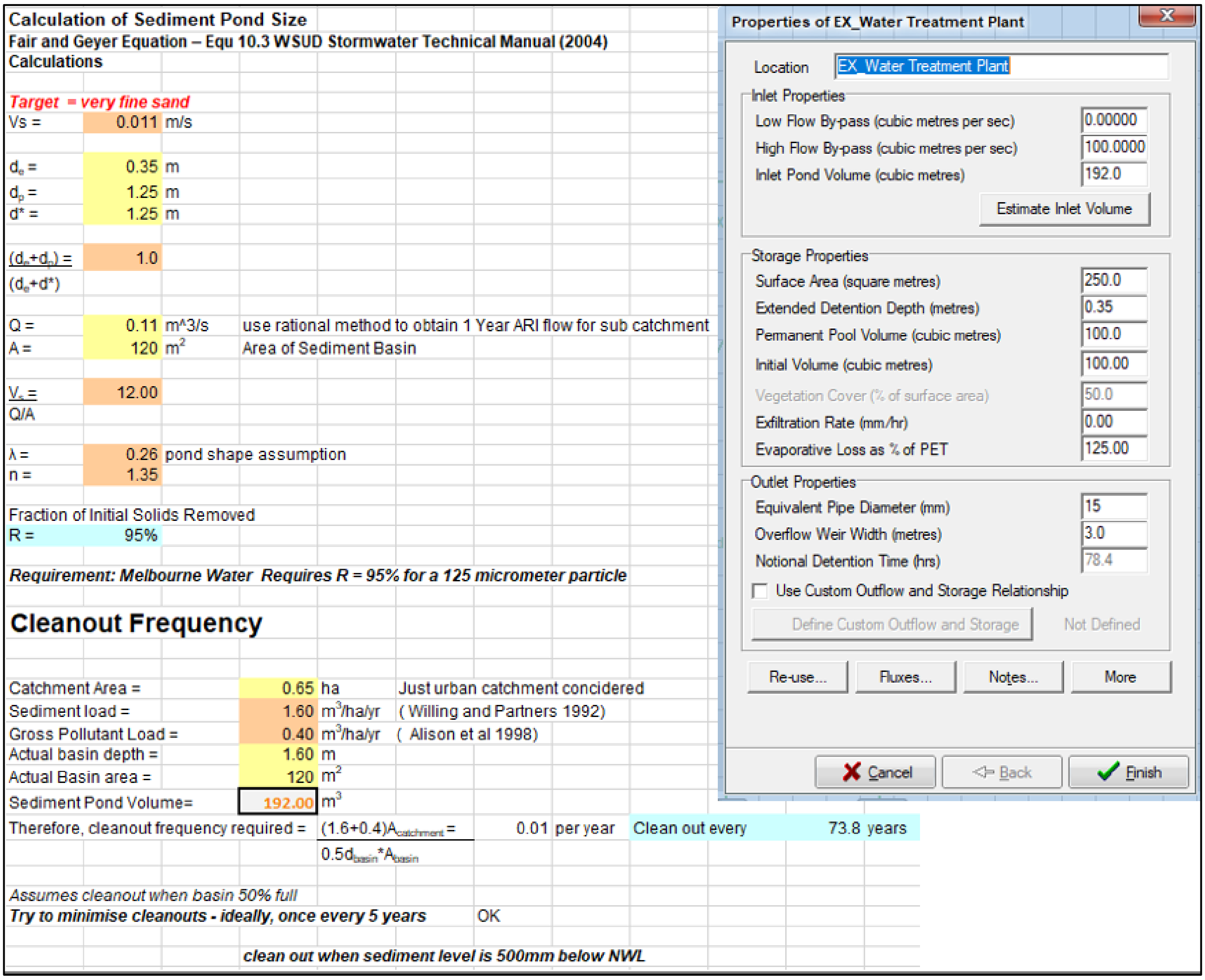
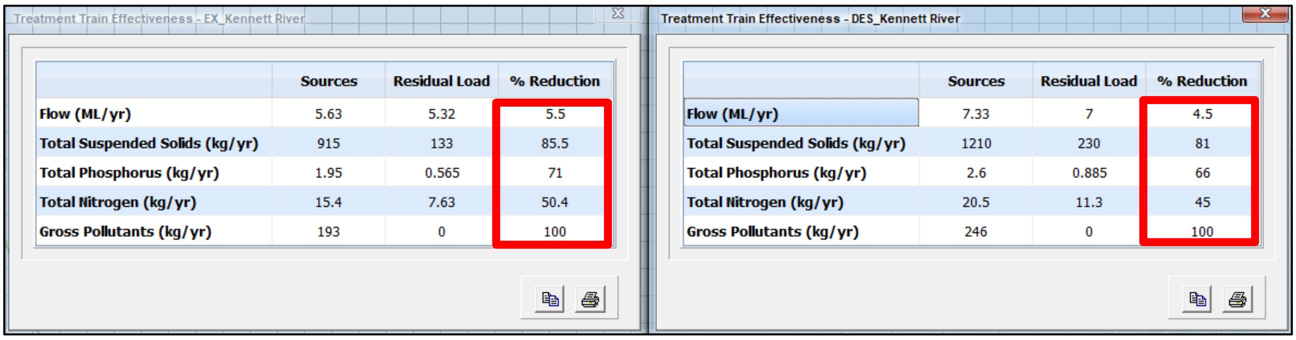


Figure 4-3 Existing WTP (Sediment Pond (Inlet Pond) and wetland) Specifications



Treatment Train Effectiveness - EX_Kennett River

	Sources	Residual Load	% Reduction
Flow (ML/yr)	5.63	5.32	5.5
Total Suspended Solids (kg/yr)	915	133	85.5
Total Phosphorus (kg/yr)	1.95	0.565	71
Total Nitrogen (kg/yr)	15.4	7.63	50.4
Gross Pollutants (kg/yr)	193	0	100

Treatment Train Effectiveness - DES_Kennett River

	Sources	Residual Load	% Reduction
Flow (ML/yr)	7.33	7	4.5
Total Suspended Solids (kg/yr)	1210	230	81
Total Phosphorus (kg/yr)	2.6	0.885	66
Total Nitrogen (kg/yr)	20.5	11.3	45
Gross Pollutants (kg/yr)	246	0	100

Figure 4-4 MUSIC model results - Treatment Efficiencies for the western subcatchment. Left panel: the existing conditions, Right panel: development condition

4.4 Eastern internal subcatchment

The development includes a 150-meter infiltration swale on the east side of the Great Ocean Rd (Figure 4-7). Figure 4-5 shows the Eastern subcatchment MUSIC model layout.

The infiltration swale is suggested to treat overland flows from the Great Ocean Rd. The infiltration solution had minimal excavation depth and assumes sandy soil. Conceptual diagram of swale and details of the infiltration swale are shown in Figure 4-6 and Figure 4-7. The road network is able to function as part of the stormwater system; under circumstances where traffic safety is not compromised elements of both minor and major storm conveyance can be accommodated in road design, and as such there is potential to reduce piped drainage. The swales provide infiltration and stormwater conveyance and can be incorporated into major road cross sections. This is an alternative to conventional nature strips and/or centre median strips allowing an overland flow path for major flows. It would require a consideration of standard boulevard widths to cater for flow conveyance alongside road formation width.

Based on the data presented above, the MUSIC modelling indicates that the swale treating stormwater runoff from the Great Ocean Rd will meet best practice guidelines for pollutant removal as shown in Figure 4-8.

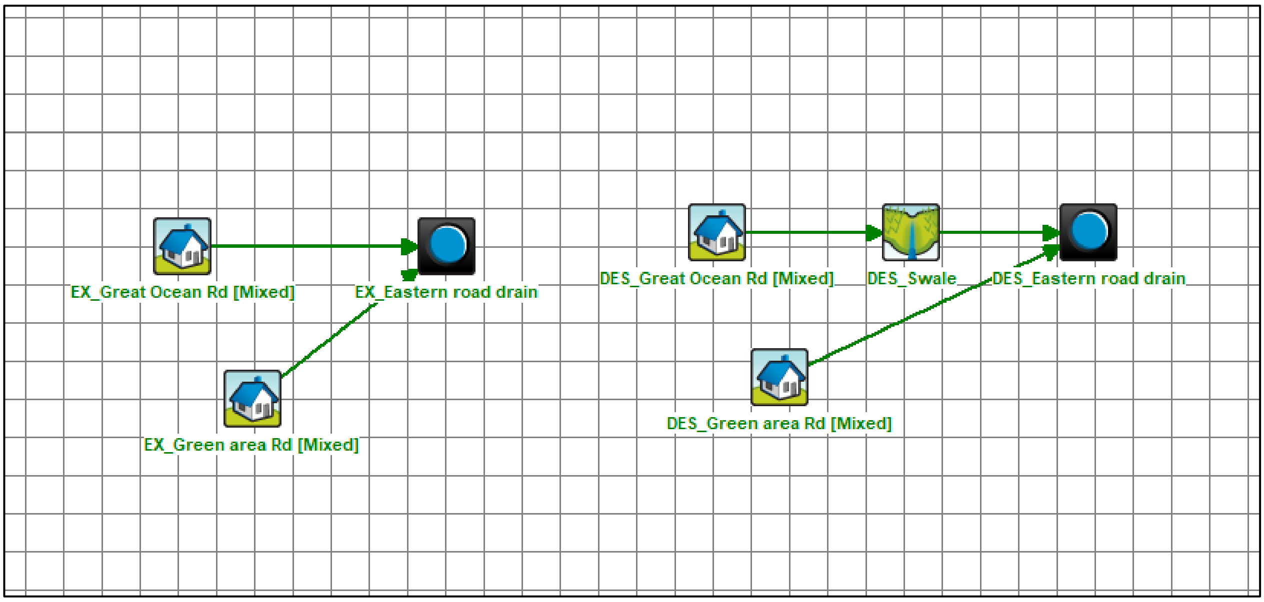


Figure 4-5 Eastern subcatchment MUSIC model layout

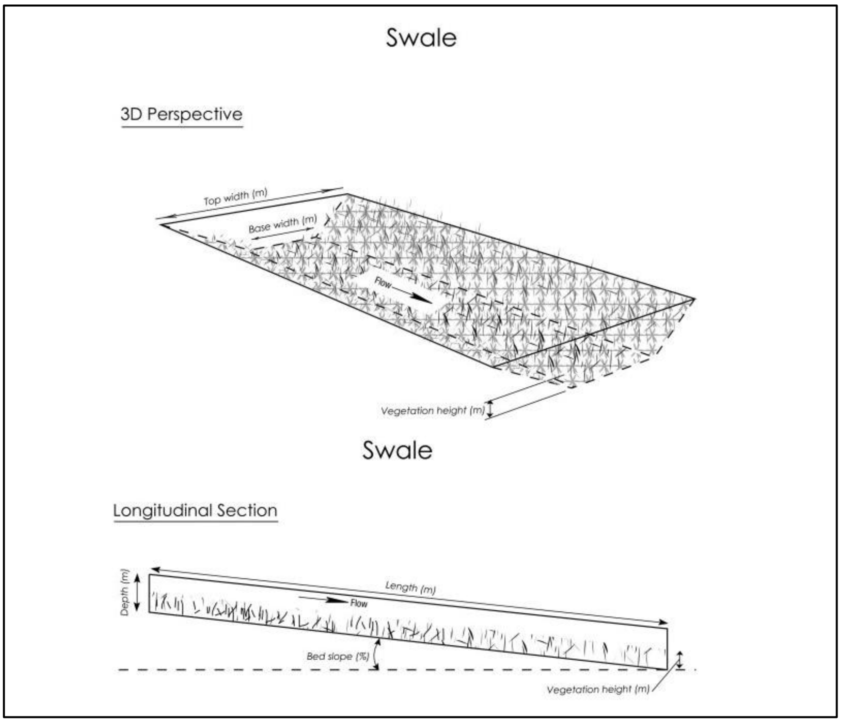


Figure 4-6 Conceptual diagram of swale properties

Figure 4-7 Proposed swale location and specification

Treatment Train Effectiveness - DES_Eastern road drain

	Sources	Residual Load	% Reduction
Flow (ML/yr)	1.65	0.697	57.8
Total Suspended Solids (kg/yr)	301	28.1	90.7
Total Phosphorus (kg/yr)	0.629	0.125	80.2
Total Nitrogen (kg/yr)	4.57	1.5	67.2
Gross Pollutants (kg/yr)	62.5	0.59	99.1

Figure 4-8 MUSIC model results - Treatment Efficiencies for the eastern subcatchment

5 Conclusion

This Stormwater Management Plan for Kennett River considered the existing drainage and catchment features, redevelopment intent, and all the site opportunities and constraints. A review of the site was completed and detailed the proposed drainage strategy for the site ensuring requirements are met.

Key conclusions and recommendations of the SWMP are as follows:

- A drainage strategy was developed to convey 10%AEP flows in a piped drainage system and provision is to be made for overland flows for the 1%AEP event.
- The existing water treatment plant can cope with the increased peak flow due to redevelopment.
- The existing water treatment plant can meet the BPEM guidelines (water quality) without any need of changes in the Design condition.
- It is proposed to include an infiltration swale in the east side of the great Ocean Rd to provide treatment of stormwater runoff. This alone will meet BPEM guidelines.
- The infiltration swale will work most effectively if the soils have a high permeability, such as the native dune sands. A geotechnical investigation should be completed to confirm this assessment.

6 References

Australian Rainfall and Runoff (ARR) (2019): A Guide to Flood Estimation, Commonwealth of Australia.

City of Greater Geelong (2012). DESIGN NOTES, No 3. August 2012

EPA (2021) Urban Stormwater Management Guidance – Publication 1739.1

Melbourne Water (2017). Retarding Basin Design and Assessment Guideline. September 2017.

Melbourne Water (2017). Wetland Design Manual. July 2017.

Melbourne Water (2018). MUSIC Guidelines - Input parameters and modelling approaches for MUSIC users in Melbourne Water's service area. March 2018.

Melbourne Water (2019). Constructed Waterway Design Manual. December 2019.

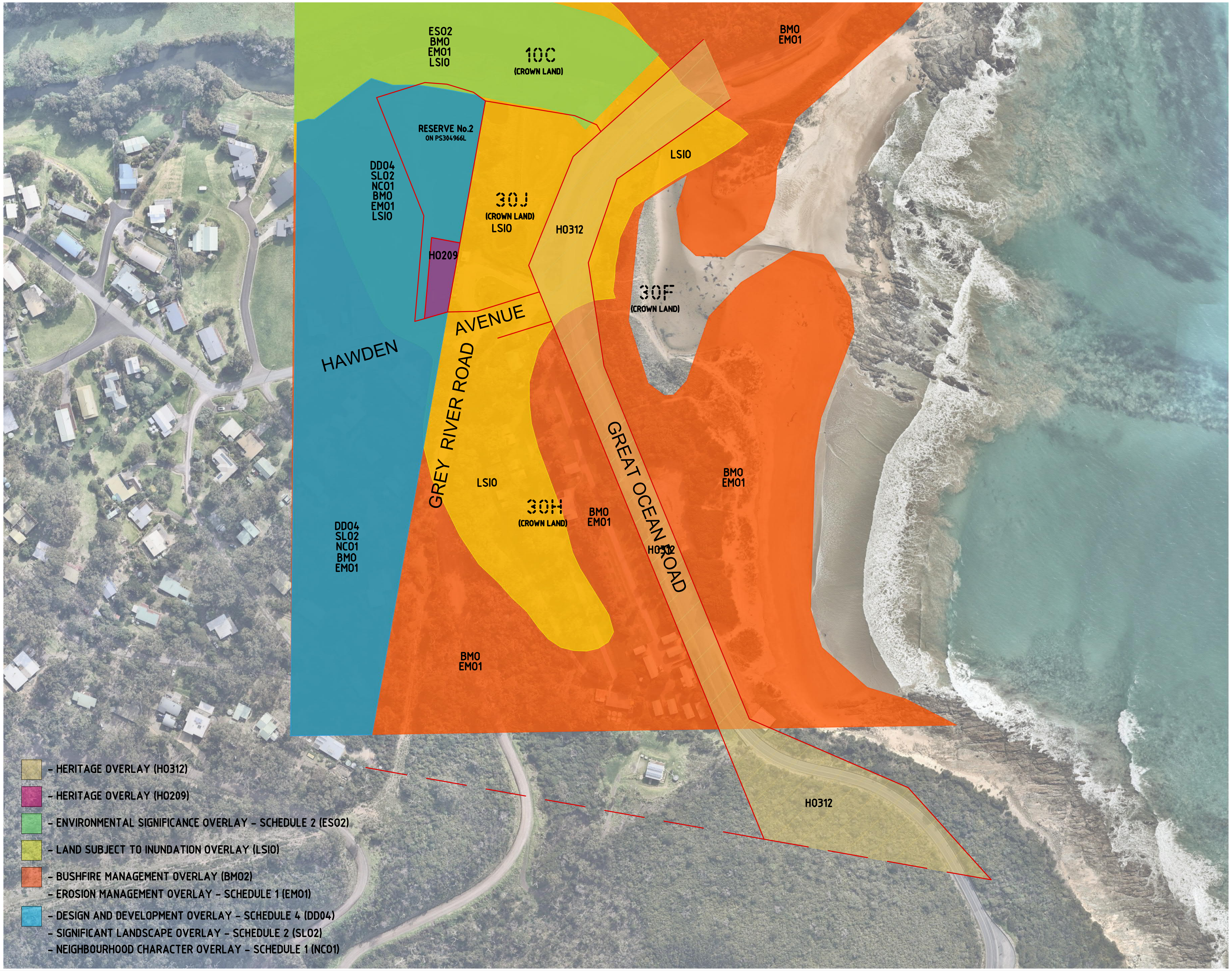
Appendix A

PLANNING OVERLAY

PLAN OF SURVEY:

APOLLO BAY HARBOUR

MGA2020
ZONE 54



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www.swansonsurveying.com.au

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SHEET 2 OF 4

SCALE 1:2500 @ A3

25 0 25 50 75 100
LENGTHS ARE IN METRES

CLIENT: COLAC OTWAY SHIRE COUNCIL
DATE OF SURVEY: 24/08/2020
SURVEYOR: MP
DRAFTED: NC

HEIGHT DATUM: -
CO-ORDINATE DATUM: MGA2020
CONTOUR INTERVAL: -
QA: LVK

NOTATIONS

This plan has been prepared for design and planning purposes.
It should not be used for any other purpose.

All dimensions are in metres

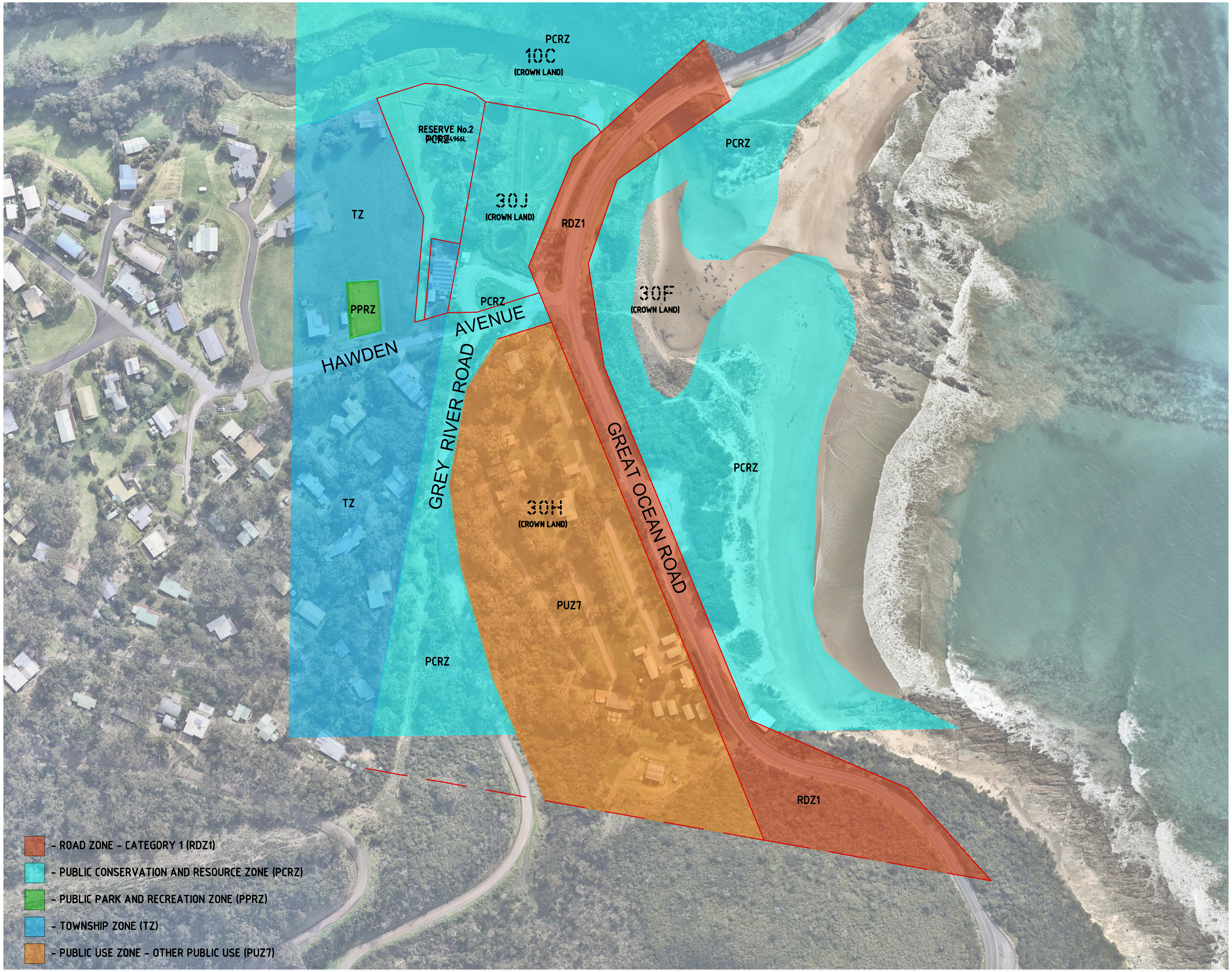
PLANNING ZONES

PLAN OF SURVEY:

APOLLO BAY HARBOUR

MGA2020

ZONE 54



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SHEET 3 OF 4

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ABORIGINAL CULTURAL HERITAGE SENSITIVITY AREA

MGA2020
ZONE 54

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local people
global experience

SMEC is recognised for providing technical excellence and consultancy expertise in urban, infrastructure and management advisory. From concept to completion, our core service offering covers the life-cycle of a project and maximises value to our clients and communities. We align global expertise with local knowledge and state-of-the-art processes and systems to deliver innovative solutions to a range of industry sectors.

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