



SURFACE/STORMWATER MANAGEMENT STRATEGY

89 Ross Watt Road, Gisborne

Permit 1 Area

ID_Land

June 2024

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Author/s	Alex Sims Jonathon McLean

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1 Introduction

Alluvium Consulting Australia Pty Ltd (Alluvium) has been engaged by ID_Land to prepare a Surface/Storm Water Management Strategy (SWMS), in support of its Permit 1 area application for the land parcel at 89 Ross Watt Road, Gisborne.

The purpose of this SWMS is to propose management strategies for:

- Stormwater quantity
- Stormwater quality
- Existing and constructed waterways

Through meeting these objectives, this SWMS acts as a critical component of the development servicing strategy and ensures stormwater is managed in accordance with Melbourne Water's and Council's requirements. The strategy will directly inform the local drainage design for the site and will include appropriate mitigation measures to protect the local environment values.

Alluvium has previously prepared a Stormwater Management Strategy (SWMS – Jan 2024) for the overall 89 Ross Watt Road site as part of the VCAT process. The purpose of Alluvium's June 2024 document (this report) is to provide a standalone SWMS for the Permit 1 area only, which does not include any sections pertaining to the future Permit 2 application area. The content within the Permit 1 SWMS (June 2024) is consistent with the January 2024 strategy. There has been no change to the catchment analysis, modelling or strategic approach and outcomes.

2 Site Overview

The 89 Ross Watt Road site covers an area of approximately 88 ha, of which about 67ha is developable land. The site is generally bound by Jacksons Creek to the west and south, Ross Watt Road to the north and Swinburne Avenue to the east (refer to Figure 1).

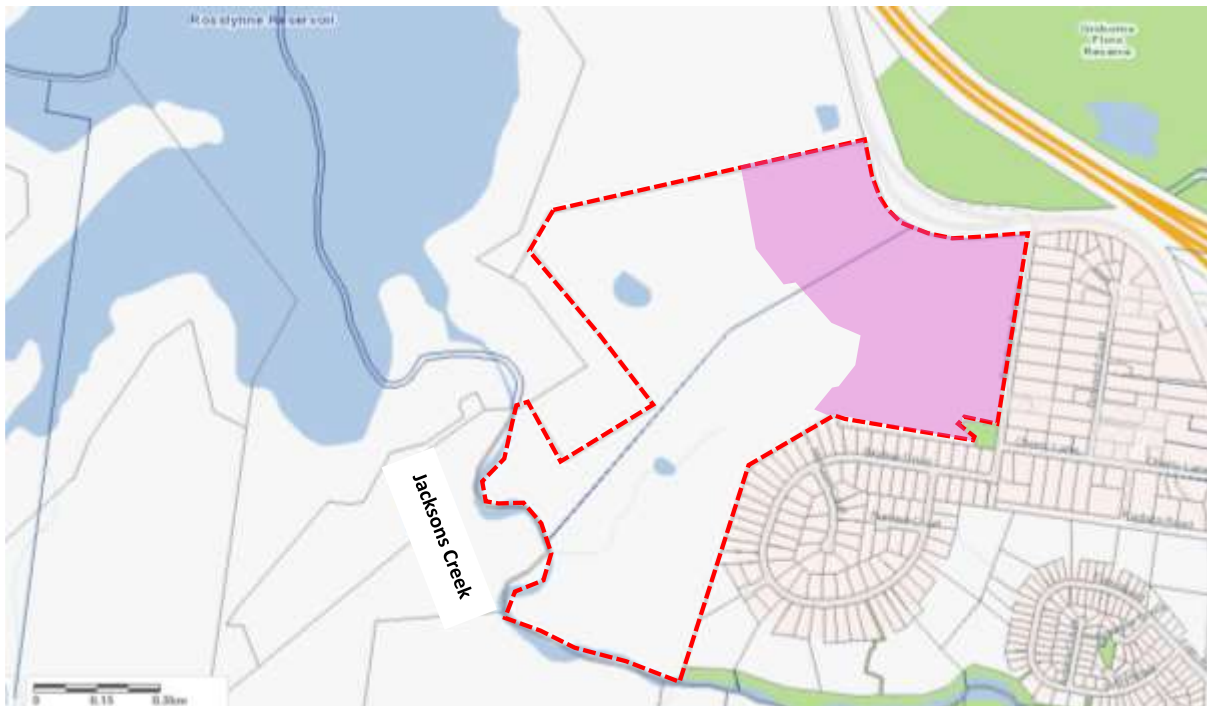


Figure 1. Site location (overall 89 Ross Watt Rd landholding shown as red dash line; Permit 1 area (subject site) shown as pink shade)

The subject site is within the Jacksons Creek catchment. Rosslynne Reservoir is located to the north of the proposed site, however all of the proposed development naturally drains to the south and enters Jacksons Creek downstream of the reservoir. The topography of the subject site varies with grades on the plateau typically ranging from 0.5 to 2%, whilst the grades on the escarpment to Jacksons Creek are extremely steep.

Jacksons Creek is located immediately to the south of the subject site and is one of the more significant waterways within the metropolitan Melbourne system. The Healthy Waterways Strategy (2018) provides a framework for addressing community expectations and the responsibilities for waterway management. For each of the five major catchments within the Port Phillip and Westernport region (Werribee, Maribyrnong, Yarra, Dandenong and Westernport), the Strategy outlines catchment-specific visions, goals, long-term targets (10 to 50 years) for key values and waterway conditions, and short-term performance objectives (10-years). Effort and investment at catchment and sub-catchment scale are prioritised and aligned to ensure they contribute to broader, regional goals and outcomes. The 89 Ross Watt Road site is located within the Maribyrnong catchment.

The subject site is not located within a Precinct Structure Plan area. Apart from a very small area in the north west corner of the site, the proposed development is not located in a Melbourne Water Development Services Scheme (DSS). The small area that is within the New Gisborne DSS does not have any proposed scheme infrastructure to service the development of this land. Under existing conditions runoff from this small catchment does not actually outfall to the Racecourse Marshlands Reserve (ie the Gisborne Conservation Area) as the flow path is contained by Ross Watt Road and as a result all flows continue to outfall in a south-easterly direction.

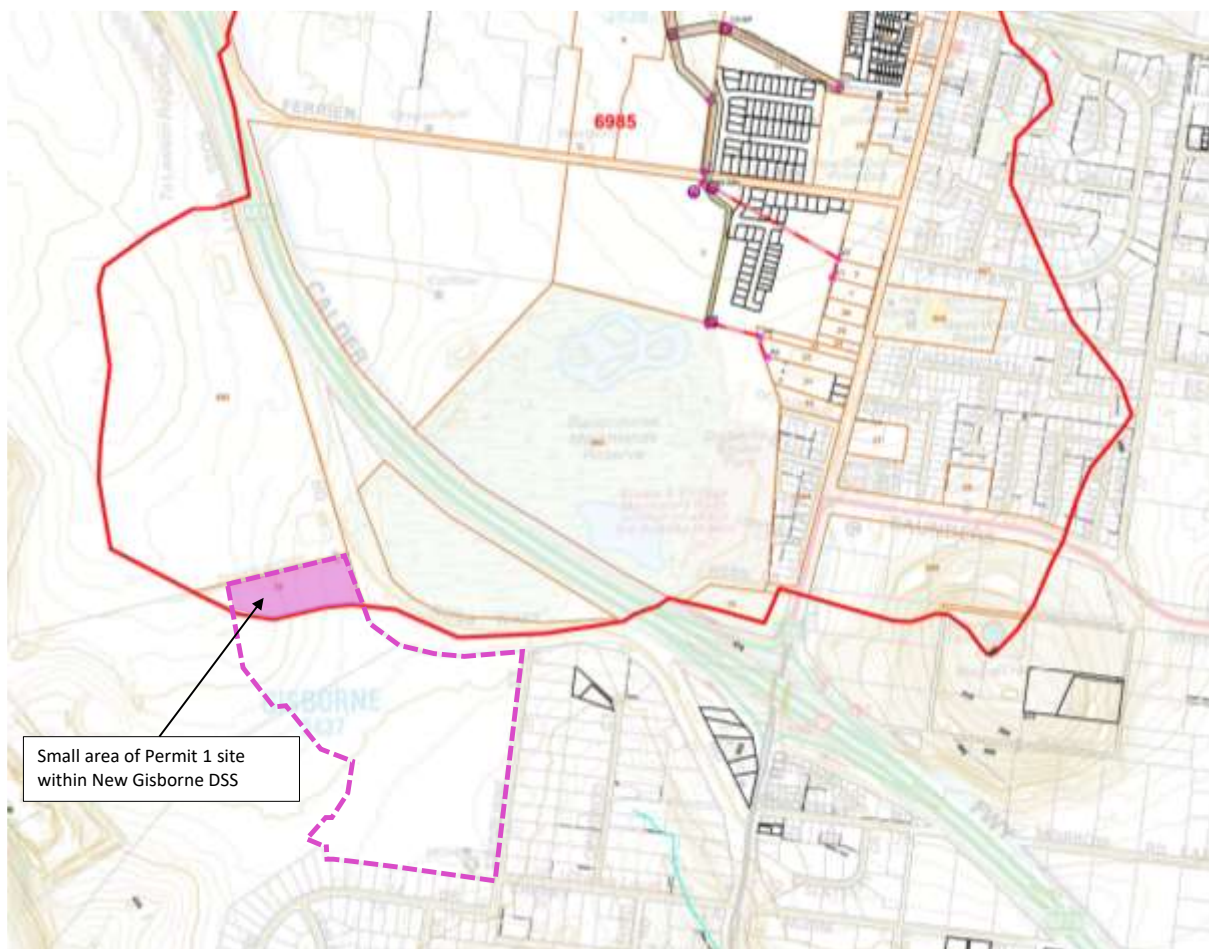


Figure 2 New Gisborne DSS (Permit 1 area (subject site) shown by pink dash line)

3 Existing Conditions: Tributaries and Geomorphology

3.1 Waterway/tributary assessment

A detailed field assessment of the existing drainage lines in the study areas was undertaken by a geomorphologist (Alex Sims) and an urban drainage engineer (Jonathon McLean) from Alluvium. The field assessments included a walkover survey of all the drainage lines that discharge to Jackson Creek and drainage pathways to existing road infrastructure. A range of indicators in the field were assessed, including the relationship between the floodplains and drainage lines; the channel planform, gradient and any areas of active or incipient erosion or sedimentation. The field assessment focussed on the physical geomorphic features and processes sensitive to, or likely to be affected by, future altered hydrology.

The field observations were synthesised and combined with the literature review outputs to provide an assessment of the condition and trajectory of waterways and drainage lines within the proposed development sites. Summary results of the baseline geomorphic assessment are provided below.

One of the main subjects of the geomorphology assessment was the 350 metre long tributary waterway, located at the southern margin of the overall 89 Ross Watt Road landholding. This reach is a small drainage line that flows across the steep escarpment edge and into Jacksons Creek (Figure 3). However this tributary is located outside of the Permit 1 application area, therefore the findings of the field assessment associated with the tributary is not included within this SWMS report. The two sites (sites A and B in Figure 3) of interest with respect to the Permit 1 application area are located along an unnamed waterway to the east of the proposed development. The unnamed waterway is expected to receive stormwater generated by the proposed development and sites A and B are expected to receive additional stormwater from the surrounding urban area.

The geomorphic processes at sites A and B were assessed using two methods:

- A desktop assessment that used high-resolution aerial imagery, geological and soil mapping and the proposed development layout
- A site assessment that included GPS photos, field notes and the use of a small UAV (drone).

The desktop and field assessments were used to understand the existing condition of the waterways, geomorphic processes operating in the waterways, and the likely response of the waterways to increased flows from stormwater following further development of the catchment.



Figure 3. Permit 1 assessment at sites A and B – which were assessed for their suitability to accommodate additional flows

3.2 Site A

Site A is located on a small waterway (ie Honeysuckle Creek) to the east of the proposed development, at the Cherry Lane culvert. Flows discharge from a buried pipe and into the unnamed waterway. The waterway at site A is narrow and well-vegetated. The bed is comprised of sediment ranging in size from silt to gravel. Deposition within the bed of this waterway, which already receives stormwater from the urban catchment, suggests that stream power is relatively low. The likelihood of bed incision due to a relatively small increase in stormwater delivery from the proposed development is low.

3.3 Site B

Site B is at the base of the exposed section of Honeysuckle Creek, where flow is directed into a sealed pipe at the culvert beneath Frith Road. This section of the waterway is covered in dense vegetation and basalt boulders can be seen on some sections of the channel bed. This section of waterway is unlikely to be impacted by the increased delivery of stormwater from the proposed development.

3.4 Recommendations and findings

The change from an agricultural to urban/recreation land use in and adjacent to the study waterway will remove the main pressures driving erosion of the channel bed and banks: stock.



Figure 4. Melbourne Water mapped waterways

From a channel stability perspective, additional stormwater delivery to either site A (the head of a small waterway) or Site B (the small culvert at the downstream end of that waterway) will have little to no impact on those waterways. Dense vegetation and large basalt boulders prevents any small increase in total flow energy from eroding the channel bed or banks.

4 Existing conditions: Hydrology

4.1 Major Catchments

There are two main catchments associated with the 89 Ross Watt Road site, an eastern catchment and a western catchment (see Figure 33). The Permit Area 1 boundary is located entirely within the “East Catchment”.

East Catchment

- Total catchment area is 33.4ha
- Outlet/discharge point is at the corner of Swinburne Ave/Cherry Lane
- A small area to the north of the 89 Ross Watt Road site is shown as part of Melbourne Water’s New Gisborne DSS. However, there is no infrastructure within the scheme to drain future development from this area. Under existing conditions runoff from this area naturally drains outside the subject site temporarily before flowing back into the subject site further to the east (refer to section 4.2).
- Outfall pipe required to be constructed along Cherry Lane
- Will need to retard back to equivalent pre-development peak flow rate for flows up to the 1% AEP event
- The Planning Scheme shows localised areas along Jacksons Creek (near Station Street) that is impacted by a Land Subject to Inundation Overlays (LSIO) (refer to Figure 6). Based on this overlay the criteria for the developed flows outfalling into Jacksons creek should be to control peak flow rates back to the equivalent pre-developed peak flow rates for rainfall events up to the 1% AEP.
- Stormwater quality to meet Best Practice pollutant removal targets at the outlet

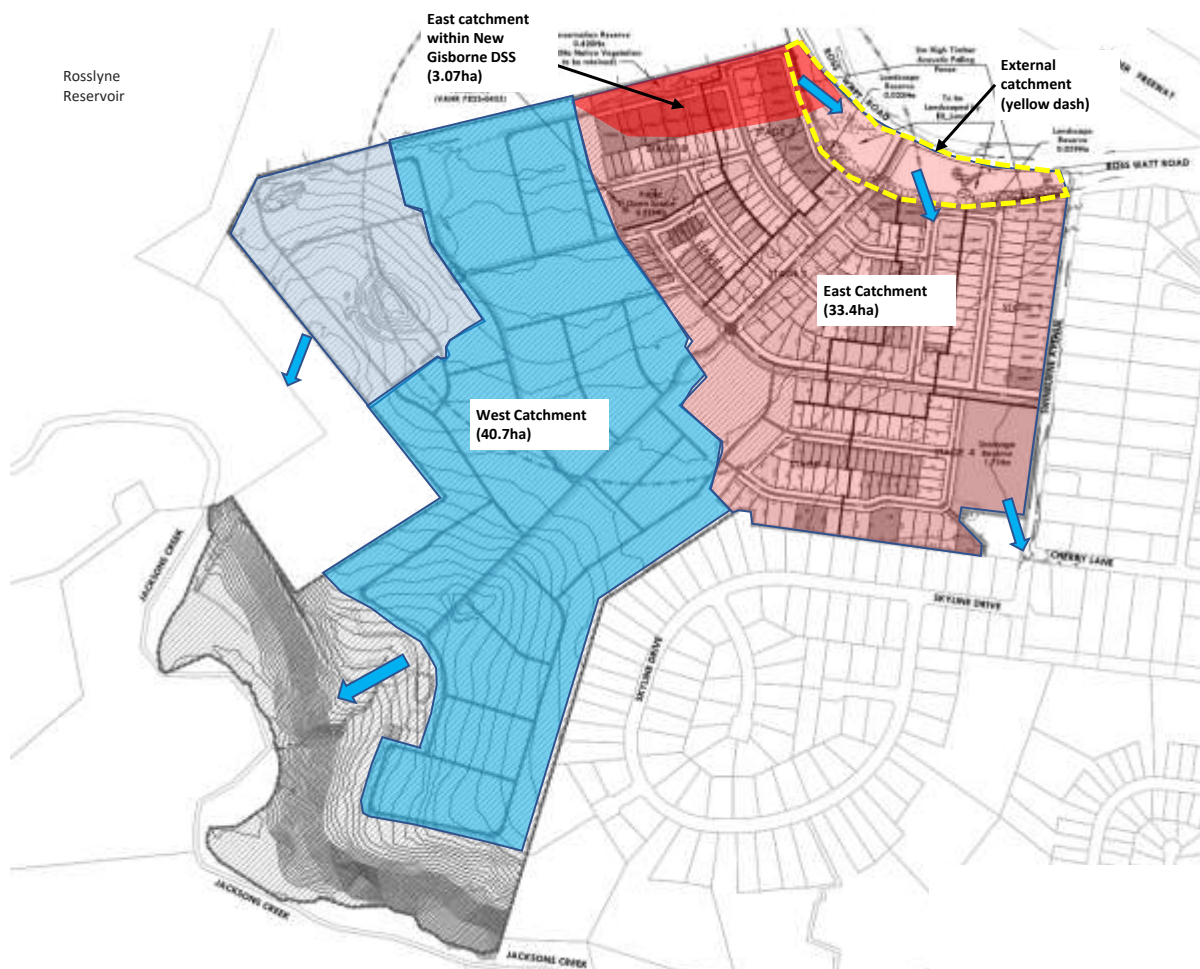


Figure 5 – Major catchment plan – Permit Area 1 (east catchment) & Future Permit Application area (west catchment)

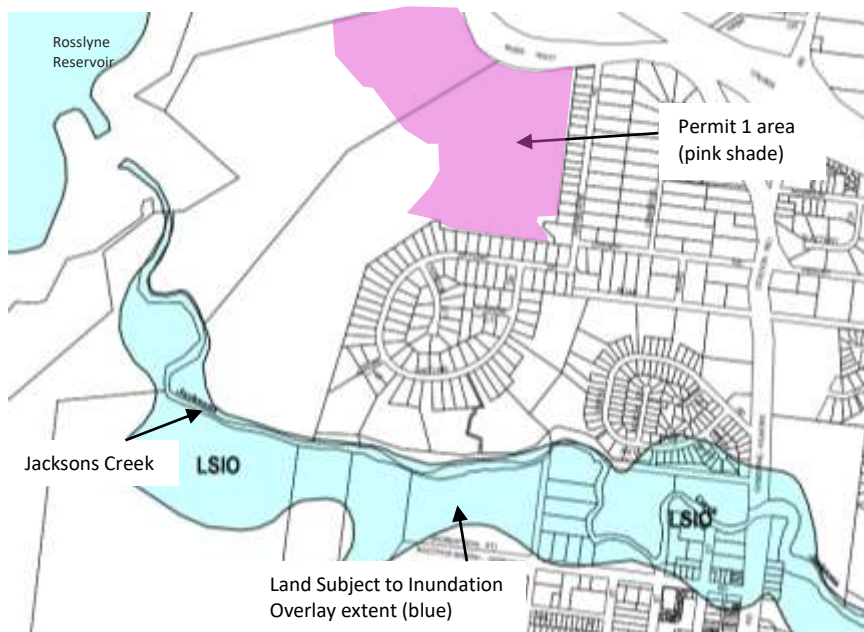


Figure 6 Land Subject to Inundation (LSIO) extent

4.2 Eastern flows near Gisborne Nature Conservation Reserve

The northern catchment area of the subject site within the New Gisborne DSS flows in an easterly direction towards Ross Watt Road. Based on levels from the site survey there is a small depression that runs between the subject site and an unnamed access track for Ross Watt Road, and another more formal swale running in-between Ross Watt Road and the unnamed track (see Figure 7 and Figure 8). Together these depressions/swales convey flows parallel to Ross Watt Road and are discharged back within the subject site. As such, all flows within the subject site remain south of Ross Watt Road and do not enter Gisborne Nature Conservation Reserve (located north of Ross Watt Road).

Development within the subject site will result in flows being conveyed within the road reserves and contained within the subject site. As such no flows will enter the Gisborne Nature Conservation Reserve and there will be no change to the hydrological regime (ie quantity or quality) within the conservation reserve as a result of the development of the 89 Ross Watt Road site.



Figure 7 Depression parallel to Ross Watt Road (looking south)

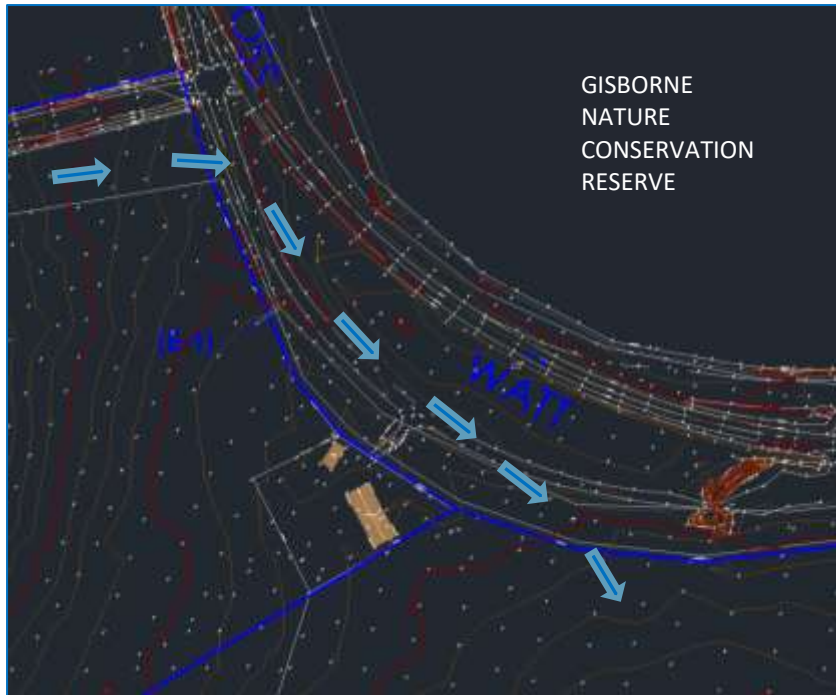


Figure 8 Field survey showing small depression parallel to Ross Watt Road

4.3 Rosslynne Reservoir

Rosslynne Reservoir is a key distribution storage facility for surrounding townships. Southern Rural Water, as the water storage manager, has an obligation to protect Melbourne's water supply from a range of potential contaminants. This includes ensuring that urban development does not lead to a decline in water quality and contamination of the Reservoir through stormwater run-off. The protection of the Reservoir is essential to the health of all communities that rely on the Reservoir for drinking water.

The Permit 1 application area is located within the eastern catchment of the 89 Ross Watt Road site, which naturally falls in the opposite direction to the Rosslynne Reservoir. Therefore there is no potential risks to water quality within Rosslynne Reservoir posed by urban development within the Permit 1 area.

Protection to Rosslynne Reservoir will need to be considered when development occurs within the western catchment (which will be subject to a future permit application).

4.4 Sub catchment delineation

Catchment delineation was conducted based on available survey data and the proposed road network for Permit Area 1 using the proposed subdivision layout plan (BPD Ref: 7213_UD_SLP04_V22). Under existing conditions flow paths are determined by the existing topography of the subject site. When the area is developed, flow paths will be influenced by the road network (see Figure 9).



Figure 9 Sub-catchment area plan

There are two major catchment types considered in this report; these are referred to as the “External Catchment” and the “Internal Catchment.” For the purposes of this report, the term “external catchment” refers to any land outside the Permit Area 1 boundary. The updated sub-areas relevant to the Permit 1 Application Area are detailed in Table 1. The total catchment area contributing to the “Eastern Catchment” is 33.4ha.

Table 1 Descriptions of “Eastern Catchment” sub-catchments for Permit 1 Application Area Only

Sub-catchment Label	Area (ha)	Type	Comment
G	5.28	Internal	Catchment G outfalls through catchment M
G1	1.11	External	Catchment G outfalls through catchment G
H	3.21	Internal	Catchment H outfalls through catchment I
H1	0.92	External	Catchment H1 outfalls through catchment H
I	2.36	Internal	Catchment I outfalls through catchment M
I1	0.10	External	Catchment I1 outfalls through catchment I
J	8.86	Internal	Catchment J outfalls through catchment G
J1	0.31	External	Catchment J1 outfalls through catchment J
K	3.41	Internal	Catchment K outfalls through catchment I
K1	0.09	External	Catchment K1 outfalls through catchment K
L	3.85	Internal	Catchment L outfalls through catchment M
M	1.69	Internal	Catchment M outfalls into Swinburne Ave/Cherry Lane
EX1	2.27	External	External catchment EX1 outfalls through catchment J

4.5 Existing stormwater quantity

The hydrological conditions of the subject were established using the RORB software package and rational method. These tools were used to estimate the peak design flows from the subject area under existing (i.e. pre-development) conditions discharging into Jacksons Creek and Swinburne Ave/Cherry Lane.

The following design rainfall parameters were adopted for the subject site based upon the Bureau of Meteorology's (BOM) "Intensity Frequency Duration (IFD) Tool – AR&R 2019) (refer to Figure 10).

Requested coordinate Latitude: -37.8312 Longitude: 144.5785
Nearest grid cell Latitude: 37.8375 (S) Longitude: 144.5875 (E)

IFD Design Rainfall Depth (mm)

Issued: 25 March 2022

Rainfall depth in millimetres for Durations, Exceedance per Year (EY), and Annual Exceedance Probabilities (AEP).

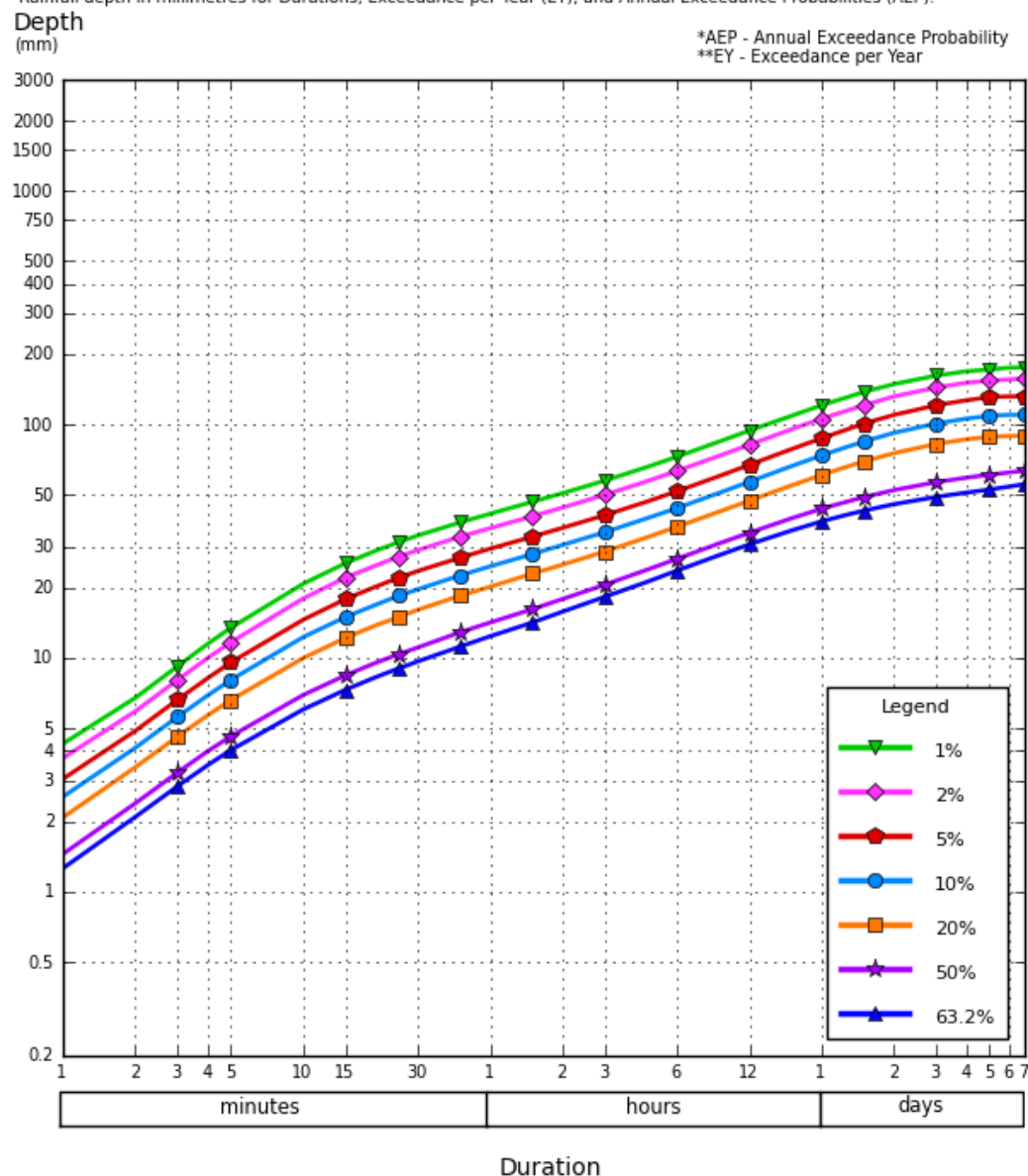


Figure 10 Design rainfall intensities for subject site

Existing Peak flowrates

Under existing conditions, the subject site largely consists of a greenfield used for agricultural purposes with a few residential buildings and a farm dam. As such a fraction of impervious of 0.1 was assumed. Critical flowrates for existing and developed conditions were established using the RORB software package. In accordance with best practice modelling procedures, at least 4 subareas exist upstream from the point of interest. The hydrologic modelling considered a range of design storms, from 10 minutes duration through to 72 hours, for a range of temporal patterns, in order to determine the critical duration event with respect to storage (i.e. the 60th percentile peak flow for a given duration).

The RORB model parameters were “derived” using Melbourne Water’s regional equation for the Yarra and Maribyrnong catchments. Table 2 summarises the RORB input variables for the East catchment (33.4 hectares).

Table 2 RORB Pre-developed input variables

RORB input variable (Pre-developed)	East catchment	Method of derivation
m	0.8	Standard value
kc	0.65	Adopted based on Melbourne Water standard equation for Yarra and Maribyrnong catchments
IL	27	Sourced from ARR datahub
CL	3.1	Sourced from ARR datahub

The table below summarises the flowrates under pre-developed conditions.

Table 3 RORB Pre-developed flowrates

Location	20% AEP flowrate - m³/s (Crit. duration)	1% AEP flowrate - m³/s (Crit. duration)
East Catchment main outfall	0.55 (9 hr)	2.03 (1.5 hr)

5 Stormwater Management Objectives

While traditionally stormwater management strategies are typically concerned with meeting 1% AEP flood management and stormwater quality objectives, the unique landscape associated with the Jacksons Creek catchment also requires some additional considerations.

The table below summarises the parameters and stormwater management for the subject site.

Table 4 Objectives

Key issue	Objective	Commentary
Tributary/waterway stability	Ensure the tributary has the stability and resilience to receive runoff from the urbanised catchment	Informed by previous Alluvium's geomorphic field investigations for the site.
Protection of Rosslynne Reservoir	Ensure no runoff from urban development flows into Rosslynne Reservoir	All developed flows from the Permit 1 area naturally flow away from the Rosslynne Reservoir 89. As a result there are no risks to the Reservoir associated with urban development of the Permit 1 area.
Stormwater quality	Best practice environmental management targets (BPEM) in terms of percentage reduction TSS: 80%, TP: 45%, TN: 45%	
Stormwater quantity	Developed flows to be controlled back pre-developed conditions for events up to the 1% AEP. Minor drainage system of 20% AEP for residential Major drainage system to safely convey flows through developed areas.	LSIO requirement to provide retardation to control peak flow events (eg 1% AEP) back to predevelopment peak flow rates prior to entering Jacksons Creek. Local requirement to provide retardation to control peak flow events (eg 1% AEP) back to predevelopment peak flow rates prior at the Cherry Lane outfall.

6 Stormwater Quantity – Proposed Strategy

The proposed internal drainage system should be designed and constructed in accordance with the minor / major drainage system philosophy. For drainage assets within a catchment area of 60 hectares, Council design standards are expected to apply. For drainage assets greater than 60 hectares, Melbourne Water design standards are expected to apply. The sub-catchments and the location of flows at key points of interest are shown in Figure 14.

6.1 Minor Drainage

The minor drainage system would consist essentially of an underground piped network and should be designed to accommodate a 20% annual exceedance probability (AEP) rainfall event. The calculations adopted a 20% AEP runoff coefficient of 0.57 for residential areas, based on a combined fraction impervious for the site of 0.60. Table 5 summarises the minor drainage flows for the subject site, derived using the rational method.

Table 5 Minor drainage for subject site (Permit 1 area)

Location	Contributing catchment	Area (ha)	tc (min)	I (20% AEP-mm/h)	Minor flows (20% AEP) (m ³ /s)	Indicative pipe size (mm)
9	G,G1	6.39	11.30	62.93	0.64	675
10	H,H1	4.13	8.50	71.35	0.47	525
11	K1,0.5K	1.80	6.50	77.0	0.21	375
12	K1,K, J,J1, EX1	14.94	11.80	61.90	1.47	825
13	L	3.85	8.50	71.35	0.43	450
14	EX1	2.27	10.00	65.60	0.24	375
15	K1,K,J,J1,EX1,G, G1	21.33	12.20	60.98	2.06	900
16	H1,H,I,I1	6.59	9.00	69.40	0.72	675
17	G1,G, H,H1, I,I1, J,J1, K,K1 L, I,I1, EX1,M	33.46	14.98	55.33	2.93	1050

Based on the catchment areas, the entire pipe networks within the subject site is expected to become the responsibility of Council.

Stormwater quantity criteria:

- ✓ Convey minor flows (20% AEP) through residential catchments in a piped network
 - ✓ Maximum pipe size of 1050 mm
 - ✓ All pipes are Council assets

6.2 Major Drainage

The major drainage system will convey the 1% AEP flows through the study area. This consists of the road reserves throughout the development. Generally, the flows required to be conveyed in road reserves will be the gap flow, 1% AEP flow minus the pipe flow (ie 20% AEP) which will be contained within the minor piped drainage system. The calculations adopted a 1% AEP runoff coefficient of 0.70 for residential areas, based on a fraction impervious of 0.60. Table 6 summarises the major drainage flows for the subject site, derived using the rational method.

Table 6 Major drainage flowrates for subject site (Permit 1 area)

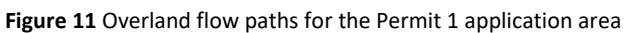
Location	Contributing catchment	Area (ha)	tc (min)	I	Major flows	Gap Flow
9	G,G1	6.52	12.6	117.60	1.46	0.82
10	H,H1	4.13	10.30	126.70	1.02	0.55
11	K1,0.5K	1.80	8.00	142.50	0.50	0.29
12	K,K1, J,J1, EX1	14.94	13.10	115.50	3.36	1.89
13	L	3.85	9.00	135.00	1.01	0.58
14	EX1	2.27	10.00	128.00	0.56	0.33
15	K1,K,J,J1,EX1,G, G1	21.33	13.60	113.50	4.71	2.65
16	H,H1,I,I1	6.59	11.00	123.90	1.59	0.87

Based on the road width and slope, and the maximum allowable nature strip cross-fall of 1 in 15, the capacity that can be contained within the main road reserves is shown in Table 7. This capacity has been determined using HEC-RAS based on the DELWP 2019 document “Guidelines for Development in Flood Affected Areas” and Council’s requirement that 1% AEP design flows must be contained within the road reserve and must not enter any part of private allotments.

Table 7 Road reserve flow capacities

Road width	Slope	Road capacity (m ³ /s)
16 m	2.5 %	2.6
16 m	1.0 %	2.5
16 m	0.5 %	2.3
20 m	0.5 %	2.8
20 m	1.5 %	3.1
24 m	1.0 %	3.1

Based on the above information all overland flows can be safely contained within the proposed road reserves. Figure 11 shows the overland flow paths through the subject site.



- ✓ Convey internal major flows through road reserves and pipe system
 - Maximum gap flow = $2.67 \text{ m}^3/\text{s}^*$

*Flow location 8 in drainage reserve, as such not subject to overland road capacity requirements

6.3 Retardation and Outfall overview

The eastern catchment (which includes the Permit 1 area) naturally outfalls to Swinburne Avenue and Cherry Lane. The existing outfall is a swale/table drain along Cherry Lane where it discharges to the open channel known as Honeysuckle Creek (refer to Figure 12). The southern portion of the Swinburne Avenue/Cherry Lane intersection is raised, which results in overland flows in large events (eg. 1% AEP) flowing east along the Cherry Lane road reserve.

The proposed development will need to provide retardation to attenuate post development peak flow rates to the equivalent pre-development peak flow rate for events up to the 1% AEP. The retardation storage will be integrated with the wetland asset (East WLRB) within the proposed drainage reserve (1.70ha) in the south east corner of the site (refer to Figure 13).

The invert level of the subdivisional drainage system and the outlet from the wetland/retarding basin will be significantly lower than existing table drain depth in Swinburne Avenue/Cheery Lane. As a result an underground drainage outfall will need to be constructed along Cherry Lane from the proposed drainage reserve to the outlet at Honeysuckle Creek. The upstream portion of the pipe will control flows up to the 1% AEP before progressively surcharging along Cherry Lane to revert to a 20% AEP capacity pipe (refer to Figure 12).

The minor flows within the east catchment will be conveyed by the pipe network to outfall into the sediment basin associated with the East WLRB.

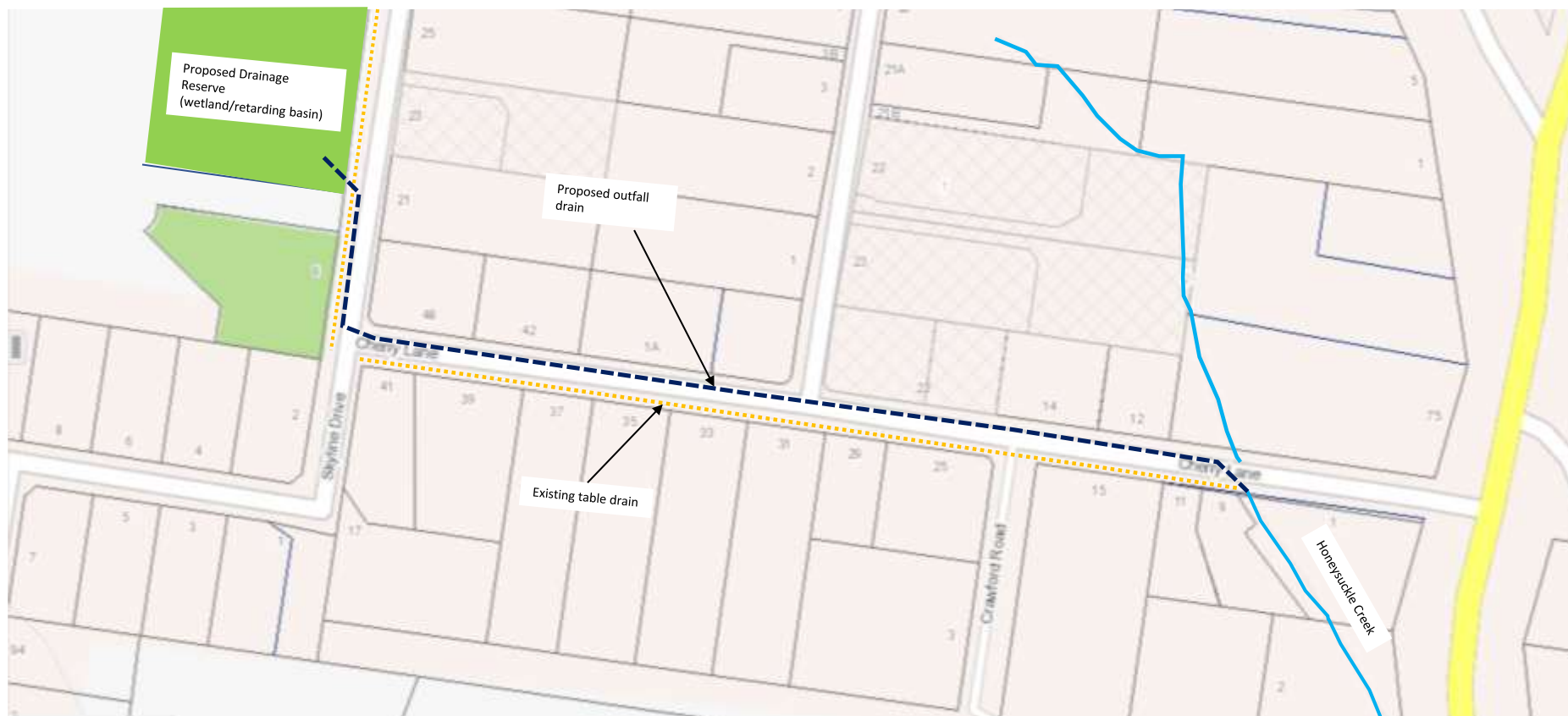


Figure 12 Outfall arrangements along Swinburne Avenue / Cherry Lane

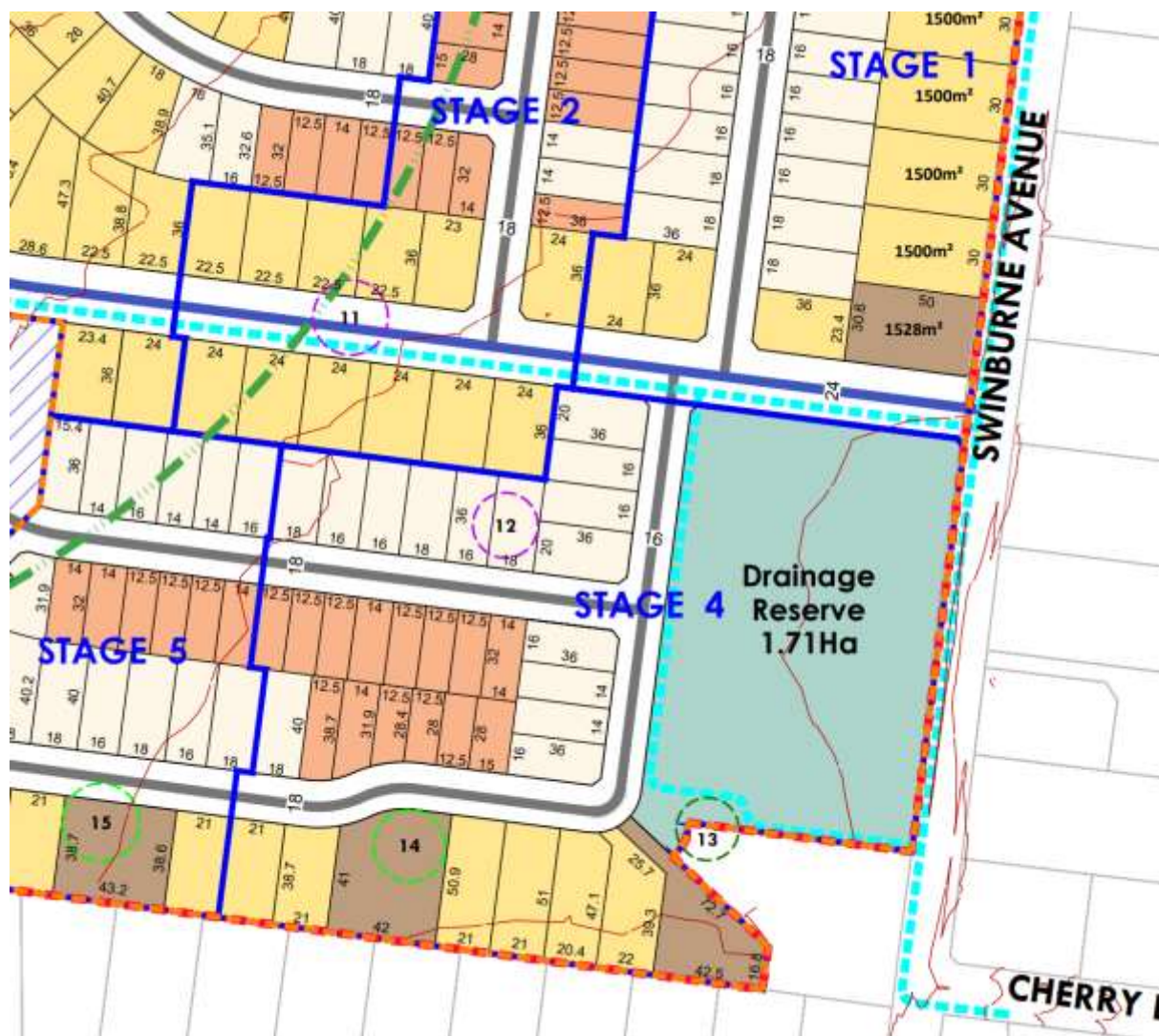


Figure 13 Location of proposed drainage reserve to control stormwater runoff (quality and retardation) from the Permit 1 area and the east catchment

6.4 Retarding basin sizing

For the post development scenario of the Permit 1 area, detention storage is required to attenuate flows back to the peak flow rates identified in Section 4. Specifically, this requires peak flowrates in developed conditions to be attenuated back to the following pre-developed 1% AEP flowrates:

- East Catchment: 2.03 m³/s

Flows from the Eastern catchment will be discharged into an underground pipe along Cherry Lane, sized to convey the 1% AEP flowrates from the subject site.

Hydrologic Modelling

The RORB software package was used to produce a hydrological model and determine the retardation storage requirements for the site under developed conditions. Table 9 summarises the RORB input variables used for the developed conditions.

Table 8 Developed RORB inputs variables

RORB input variable (Developed)	East Catchment	Method of derivation
m	0.8	Standard value
kc	0.65	Adopted based on Melbourne Water standard equation for Yarra and Maribynong catchments
IL	15.1	Taken as 60% of ARR datahub value (minus medium pre-burst value)
CL	3.1	Sourced from ARR datahub

The RORB hydrological model was iteratively run to determine the minimum storage size for the RBWL while still meeting the 1% AEP flowrate requirements. The hydrologic modelling considered a range of design storms, from 10 minutes duration through to 72 hours, for an ensemble of temporal patterns, in order to determine the critical duration event with respect to storage (i.e. the 60th percentile peak flow for a given duration). A summary of the detention modelling results for the 1% AEP event is provided below:

Table 9 Summary retarding basin sizing

East Catchment	
Critical storm duration (hr)	2
1% AEP design flows with attenuation (m ³ /s)	1.81
1% AEP existing flow (m ³ /s)	2.03
Peak storage (m ³)	7,820
Outlet pipe diameter (mm)	1 x 1350

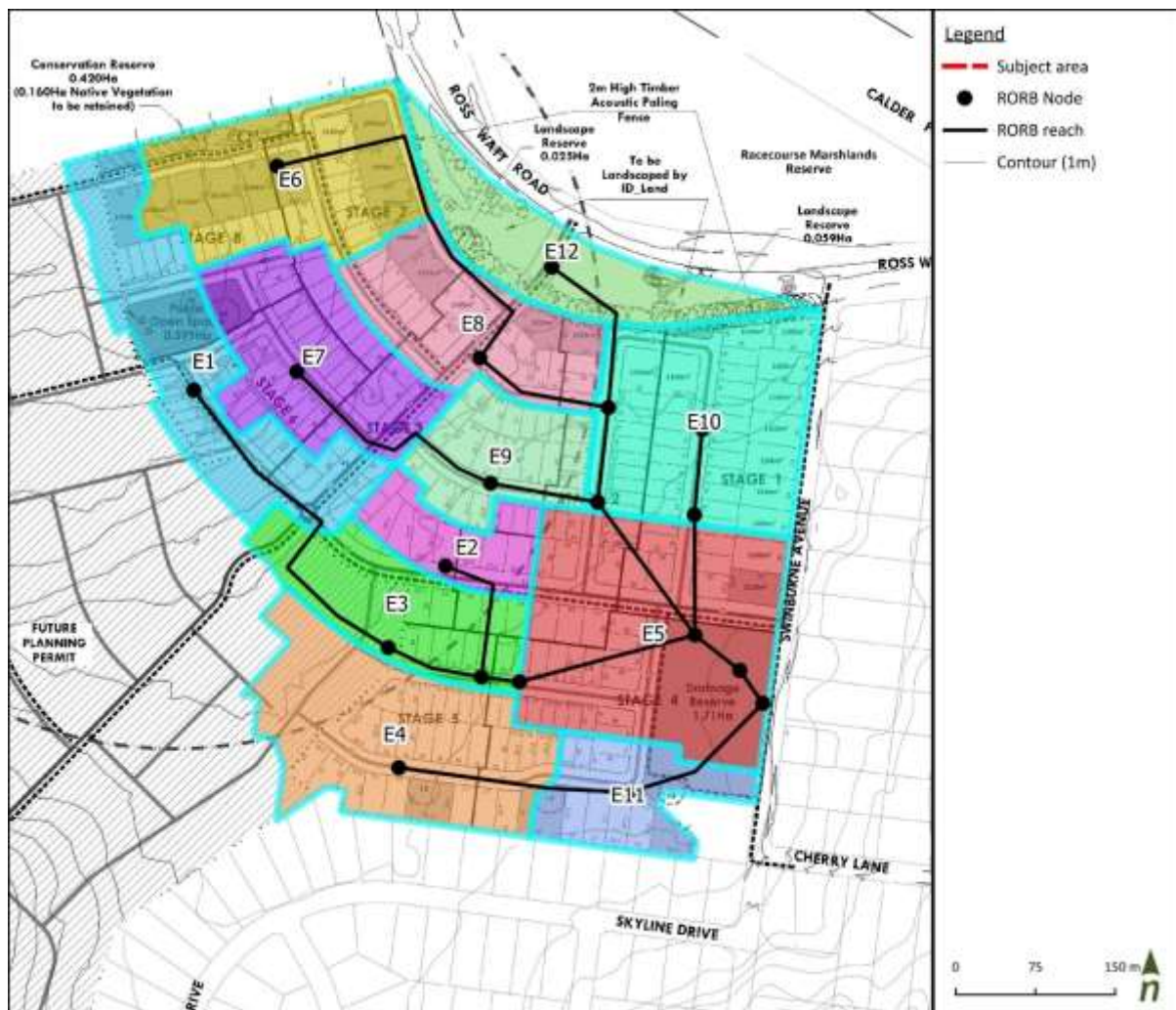


Figure 14 RORB East catchment plan (ie Permit 1 area)

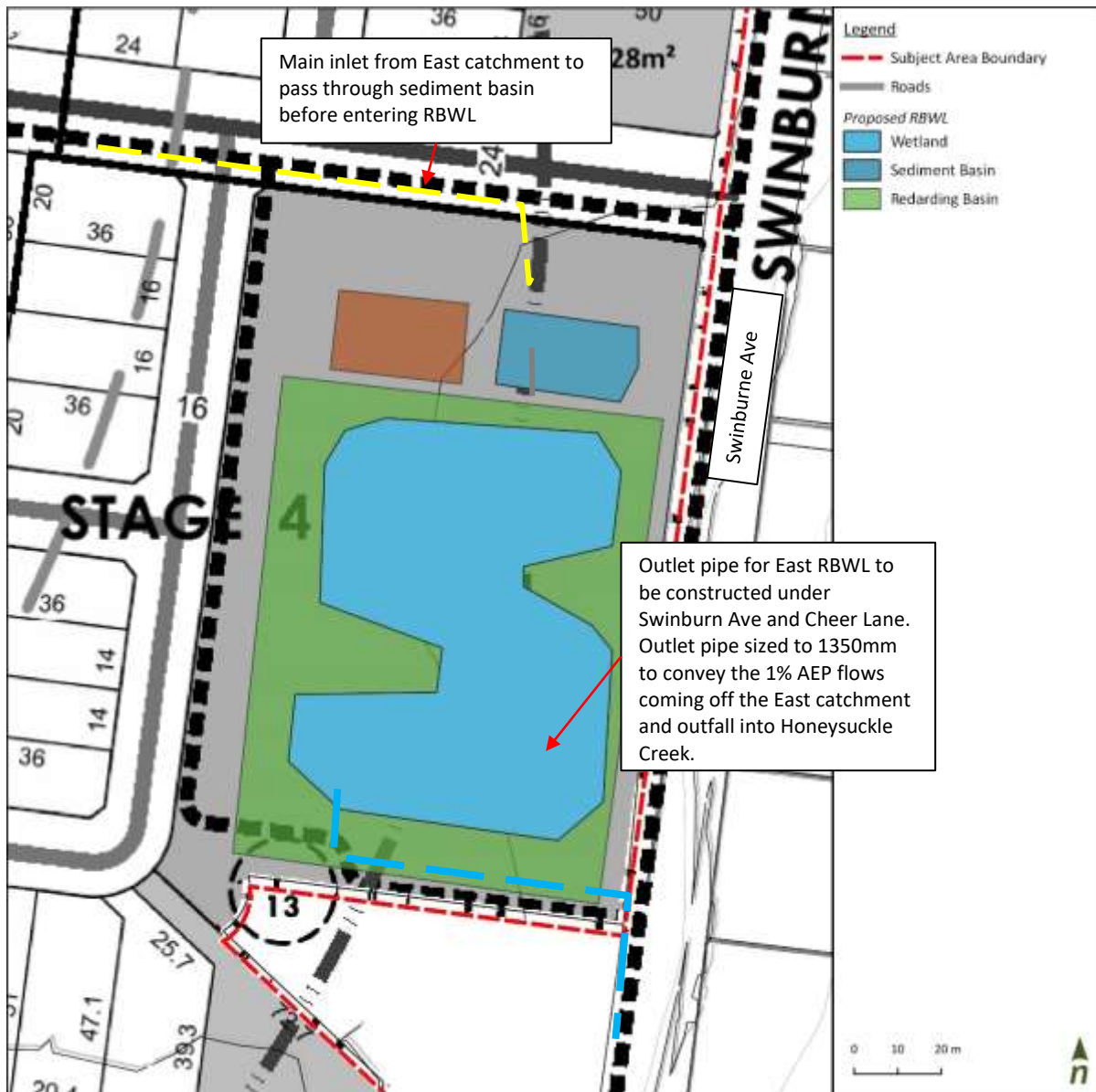


Figure 15 East RBWL proposed asset plan

7 Rosslynne Reservoir Protection

As outlined in Section 4.3, the Permit 1 application area is located within the eastern catchment of the 89 Ross Watt Road site, which naturally falls in the opposite direction to the Rosslynne Reservoir. Therefore there is no potential risks to water quality within Rosslynne Reservoir posed by urban development within the Permit 1 area.

Protection to Rosslynne Reservoir will need to be considered when development occurs within the western catchment (which will be subject to a future permit application).

8 Stormwater Quality

Alluvium understands that a key principle for the development of the site is that all stormwater is to be treated to best practice (ie Best Practice Environmental Management Guidelines (BPEM)) before being discharged off-site and into a waterway. The following BPEM targets have been adopted:

- 70% removal of the total Gross Pollutant load
- 80% removal of total Suspended Solids (TSS)
- 45% removal of total Nitrogen (TN)
- 45% removal of total Phosphorus (TP)

The catchments and stormwater treatment train have been modelled via MUSIC using parameters defined in Table 14. The analysis has been based on the latest Melbourne Water MUSIC modelling guidelines. This includes:

- The ten year rainfall template for the Kooweerup station between the years 1971 – 1980
- Soil store parameters with a soil store capacity of 120mm and a field capacity of 50mm.
- Fraction impervious value of 0.60 for residential area

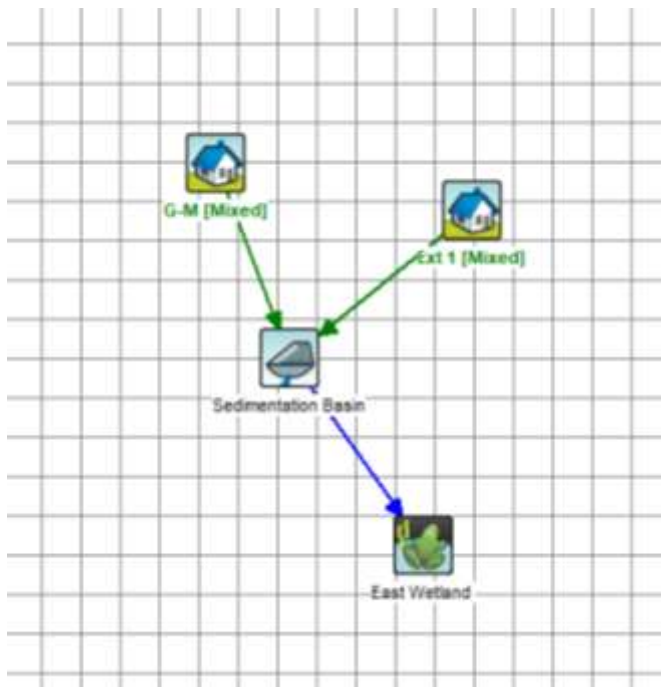


Figure 16. MUSIC model for the east catchment (ie Permit 1 area)

The configuration of the treatment train is provided in Table 10. It consists of a sediment basin and wetland. Wetland performance is given in Table 11, demonstrating the design meets the BPEM pollutant reduction targets.

Table 10. Treatment asset parameters

Description	<i>East Catchment</i>	
	<i>Sediment Basin</i>	<i>Wetland</i>
NWL area, m ²	700	5800
Average depth, m	1.0	0.40
Extended detention, m	0.35	0.35
Residence time, h		72

Table 11. Overall treatment performance of the system

Parameter	East Catchment
Total Suspended Solids (TSS) removed	83.3%
Total Phosphorus (TP) removed	70.1%
Total Nitrogen (TN) removed	45.0%

The sediment pond has been sized in accordance with Melbourne Waters sediment pond design guidelines using the Fair and Geyer equation, design calculations are provided in Table 12.

Table 12. Sediment basin design parameters and checks (east catchment)

	Parameter	Proposed design
Conditions	Contributing Catchment (ha)	33.4
	Area of Basin (m ²)	700
Capture Efficiency	Settling Velocity of Target Sediment (mm/s) [Particle size 125 µm]	11
	Hydraulic Efficiency (λ)	0.19
	Permanent Pool Depth, dp (m)	1.5 (empty); 0.5 (full)
	Extended detention depth, de	0.35
	Number of CTSR's, n	1.23
	Depth below permanent pool that is sufficient to retain sediment, d* (m)	0.5
	Design Discharge (m ³ /s) [4EY]	0.58
	Capture Efficiency	95.2%
	Check (>95%)	OK
Sediment Storage	Sediment Loading rate, Lo (m ³ /ha/yr)	2.0
	Desired clean-out frequency, Fr	5
	Storage volume required, St	322
	Available sediment storage volume	360
	Check (Available storage > required storage)	OK
Sediment dewatering	Depth for dewatering area (m)	0.5
	Area required for dewatering (m ²)	644

The location of the proposed wetland within the drainage reserve is shown in Figure 17.

[illegible]

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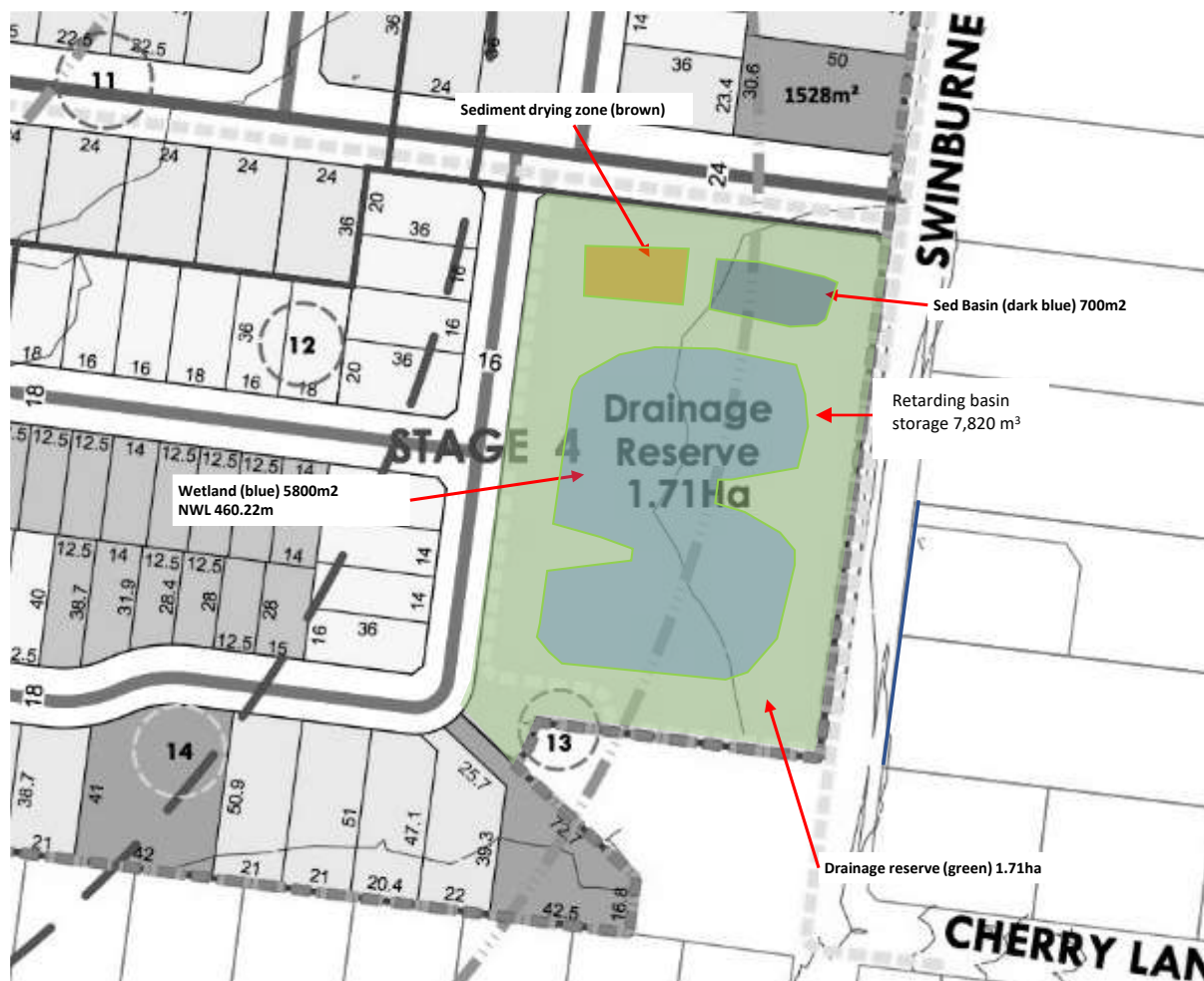


Figure 18. Proposed east wetland layout

9 Timing of Stormwater Assets

The Permit 1 development area has one catchment outfalls, which is located in the south-east corner of the site. All of the underground drainage from the Permit 1 area outfalls to this location which includes an ultimate stormwater quality treatment train consisting of a sediment basin and a wetland.

From a timing perspective it is proposed to deliver the key stormwater assets in a phase approach as outlined below:

- Phase 1:
 - Temporary sediment basin and retardation storage to be constructed with the first stage in the east catchment (which will provide treatment and storage for approx 200 lots)
 - Provide the temporary sediment basin and retardation within the envelope of the ultimate drainage reserve. This will include a proposed temporary outfall pipe to convey flows to the table drain in Cheery Lane (the pipe will daylight about 50 metres downstream of the intersection).

- Phase 2:
 - East Catchment:
 - The ultimate wetland and retarding basin to be designed and tendered before the title of the 200th lot in the east catchment. This will also include the ultimate outfall pipe works along Cherry Lane.
 - Construction of the ultimate wetland, retarding basin and outfall pipe to be completed before title of 300th lot in the east catchment. This timing would align with the Cherry Lane upgrade.

10 Integrated Water Management Plan

An Integrated Water Management (IWM) Plan will be prepared for the site post permit. The IWM assessment will consider the opportunities to incorporate rainwater tanks, passive irrigation, water efficiency and stormwater harvesting in addition to the sediment basins and wetlands already identified in Section 8 of this report. Given the catchment scale, the evaluation and feasibility of these opportunities will be discussed with Council during the process.

11 Conclusion

This Storm Water Management Strategy (SWMS) report has proposed a management strategy for stormwater quantity and quality for the 89 Ross Watt Road development site. A hydrological assessment has been conducted for the site and stormwater infrastructure and assets have been preliminarily designed to meet stormwater quantity and quality objectives. Through meeting these objectives, this SWMS acts as a critical component of the development servicing strategy and ensures stormwater is managed in accordance with Melbourne Water's and Council's requirements.

A sodic soils and geomorphology assessment has been undertaken which identified that the development site is susceptible to dispersion but are amenable to improvement and stabilisation. As a result a sodic/dispersive soils management plan has been prepared which provides the required recommendations and actions.

APPENDIX A
PERMIT 1 LAYOUT

