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Stormwater Management Report

244 MT MORTON RD, BELGRAVE



Belgrave Heights Performing Arts & Senior Learning Centre

ref: 20799

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PREPARED BY MILLAR MERRIGAN ON BEHALF OF:

Belgrave Heights Christian School

FORMAL LAND DESCRIPTION:

Lot 244 on PC374040N

PROPOSAL:

Belgrave Heights Performing Arts & Senior Learning Centre

RESPONSIBLE AUTHORITY:

Yarra Ranges Council

DOCUMENT STATUS:

Version: Date	Description	Prepared by	Checked by
No 1: September 2022	Stormwater Management Report	Laurence Gae Posadas	Pauline Tait

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1 BACKGROUND & CONTEXT

Millar Merrigan has been engaged by Belgrave Heights Christian School to prepare a Stormwater Management Report for 244 Mt Morton Rd, Belgrave. The purpose of this report is to address the Belgrave Heights Performing Arts & Senior Learning Centre's application to manage stormwater runoff generated by the developed site.

The intent of this report is to demonstrate correlation with Environmentally Sustainable Design (ESD) and Water Sensitive Urban Design (WSUD) principles and guidelines, as adopted by the drainage authority and Council. The constraints of the specific site have been evaluated in determining practical outcomes.

This report assesses the following.

- How major and minor stormwater events are managed.
- How Best Practice Environmental Management Guidelines (BPEMG) for water quality are to be addressed.
- Stormwater re-use potential.

Accompanying this report is hydrological and hydraulic modelling outputs as follows:

- OSD4W for calculating detention volume(s)
- Melbourne Water STORM Rating Report for calculating WSUD results.

We note that Council requests minimum WSUD treatment on development sites and allows offset contributions payable to Melbourne Water in lieu of treatment to supplement any shortfall.

Detailed analysis has been undertaken for this site to evaluate the best alternatives and combination of measure for this specific site.

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2 PROPOSED STRATEGY

2.1 MAJOR AND MINOR STORMWATER NETWORK

The subject site is located within local catchment jurisdiction of Yarra Ranges Council, an extract of the Legal Point of Discharge is shown below in figure 1.

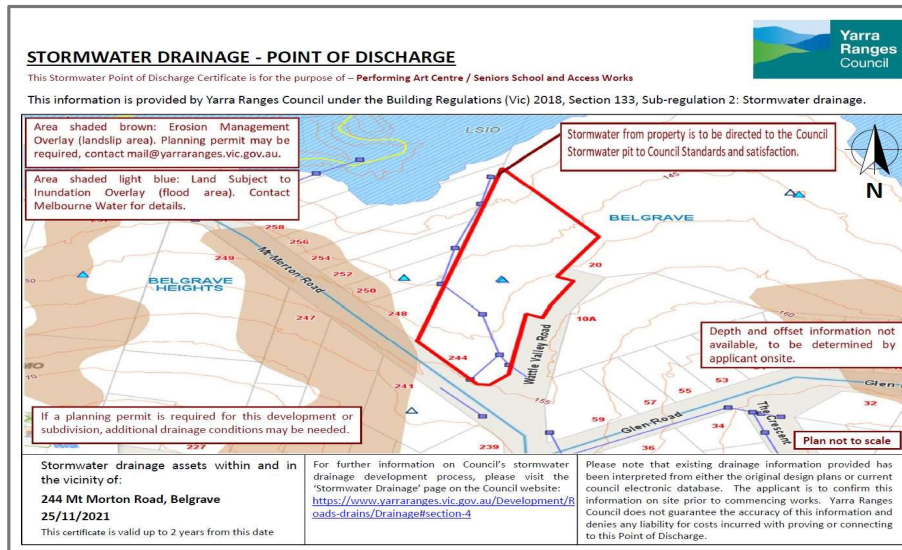


Figure 1 Legal Point of Discharge (Extract)

The Legal Point of Discharge (LPOD) is indicated to direct drainage to the existing swale situated within the easement in the north-west of 244 Mt Morton Rd, Belgrave. As there is an existing council drain through this section of the site to the west and north of the proposed building consideration in the detailed design of any surcharge from this piped drain. This could be along the proposed driveway or further west within the landscape area.

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2.2 STORMWATER TREATMENT (QUALITY)

The aim of stormwater treatment is to protect surrounding waterways by meeting Best Practice Environmental Management Guideline (BPEMG) objectives on site where practicable.

The ideal theoretical outcome of treatments is to achieve 100% BPEMG, which targets the removal of 80% total suspended solids, 45% total phosphorus, 45% total nitrogen and 70% gross pollutants.

While every effort is made to achieve the ideal, for practical applications this may be varied depending on factors such as the catchment priority as advised by Council and the ability to make treatment options fit the scope.

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TREATMENT PROPOSAL

For this site, it is proposed to implement the following combination of treatment solutions.

Rainwater Tanks

The purpose of the rainwater tank is to capture and use rainwater that falls on the roof and potentially direct it to internal uses that could be toilet, laundry, or irrigation. This reduces stormwater runoff volumes and pollutants reaching downstream waterways. All developments can utilise rainwater tanks but developments with large roof areas see the greatest benefits.

Permeable Pavement Systems

Permeable pavements work by allowing stormwater runoff on driveways to pass through the pavement and go into the soil. This reduces overland flow and filters water as it passes through the soils.

TREATMENT OUTCOMES

Based on the above treatments used on the site we have calculated a score of 80% using the STORM rating report. We believe that what we have proposed will be sufficient to satisfy council, due to the specific site constraints. To meet BPEMG, offset levies will be paid to Melbourne Water based on their drainage scheme provisions to satisfy the complete 100% Best Practice.

2.3 STORMWATER DETENTION

We note that the site is low in the catchment and would not usually require stormwater detention. In this instance we have covered for both options in this report. The aim of stormwater detention is to temporarily capture rainwater and slowly release/direct the water towards the legal point of discharge, thereby avoiding overloading the downstream external drainage pipes. There are two types of detention systems that can be used on this site: above ground detention using tanks, and underground detention using tanks, pits and/or pipes. However, Yarra Ranges Council have recently changed their guidelines and will only accept above ground detention if Statement of Compliance for land subdivision is not being sorted prior to building dwellings, otherwise all detention will need to be designed underground.

Based on the Yarra Ranges Council Engineering Guidelines, by using the Rational Method and OSD4W this site will need to detain approximately 106.48m³. The following approximation for stormwater detention split is proposed.

- 42.75 m³ detention in an above ground tank.
- 63.73 m³ detention in underground tank.
 - 6m of 600mm dia. pipe.

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This is not necessarily what will be denoted on the final detailed drainage design but gives a good guide to what could be expected, should detention be included.

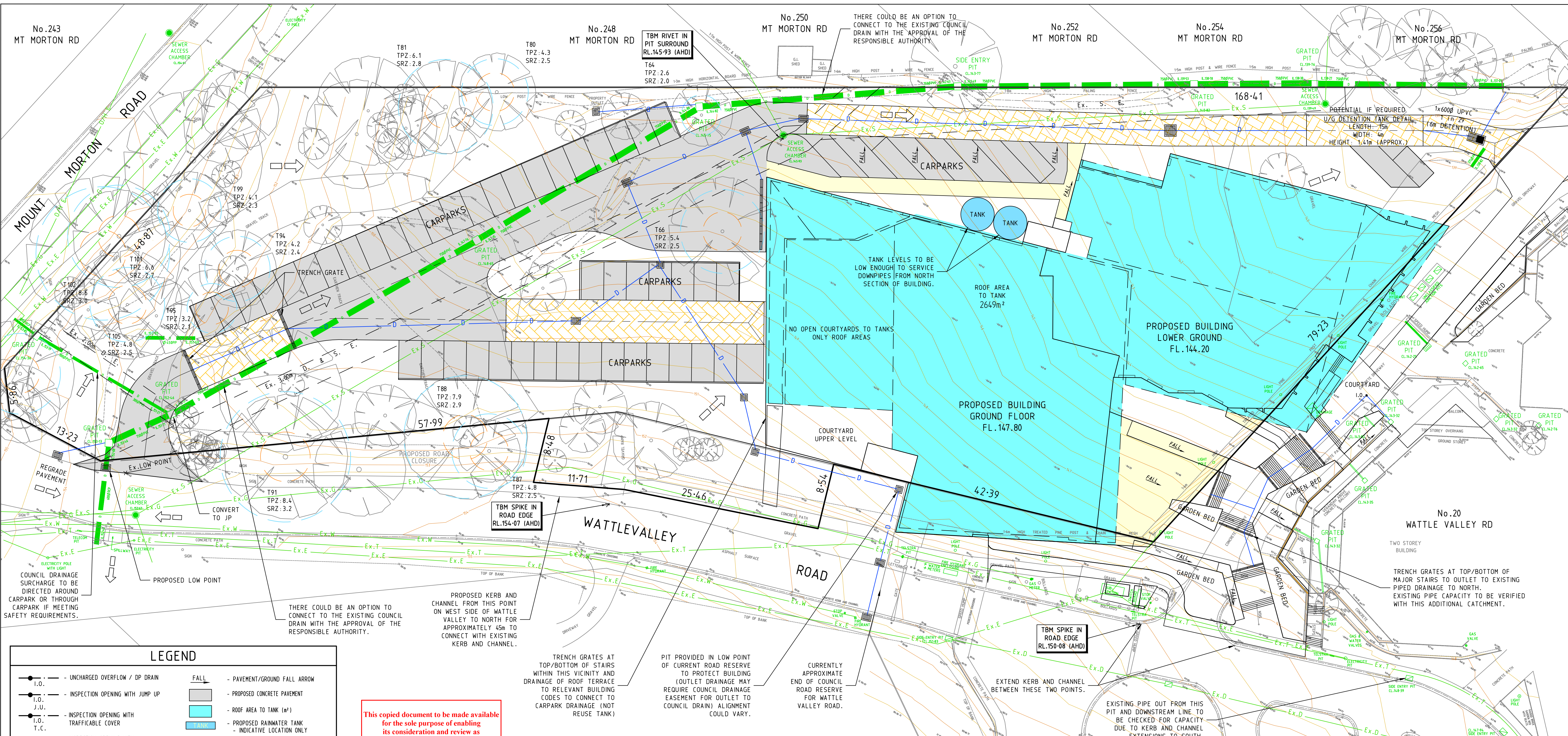
3 CONCLUSION

The following considerations and measures are recommended to be adopted for the basis of the detailed engineering design for submission to and approval by Council.

- The site lies within local jurisdiction of Yarra Ranges Council and the major drainage authority is Melbourne Water which provides water quality offset levies.
- Internal drainage will be via traditional below ground pipes discharging to a swale situated in the north-west corner and rear of the site, alternatively several connections to the existing council drain throughout the site could be an alternative should detention not be required.
- Overland flow paths for the development will be directed to lot 244's rear side and adjacent lots.
- To be included in the drainage design is rainwater tank/s for re-use:
 - Total site volume of 80,000 litres.
 - A minimum roof area of 2649 m² to be connected to the tank/s.
 - The reuse tank/s overflows could be dropped down to a pit connecting to an underground detention tank for further treatment.
 - Re-use tank must be connected to the toilets.
- Stormwater Quality offset contribution to be paid to Melbourne Water to satisfy 100% best practice.
- Total site volume of 106.48m³ of detention storage could be included (if required) in the drainage design.
- From previous experience Yarra Ranges Council insist on part of the driveway being treated and hence permeable paving has been proposed to reduce the overall impervious area across the site.
- This drainage design is indicative and may vary depending on various aspects including but not limited to, variations to the layout.

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DRAINAGE PIPE ALIGNMENTS MAY VARY DEPENDING ON IF DETENTION IS REQUIRED.

CAUTION
IT IS ESSENTIAL THE LOCATION OF GAS PIPES ARE PROVEN BY CAREFUL HAND EXCAVATION BEFORE THE USE OF MACHINERY. REFER TO GAS AUTHORITY DBYD RESPONSE FOR SPECIFIC REQUIREMENTS.

CAUTION
OVERHEAD HIGH VOLTAGE ELECTRICAL CABLES. ALL WORK IN THE VICINITY OF EXISTING ELECTRICAL ASSETS MUST BE IN ACCORDANCE WITH WORKSAFES "NO GO ZONE" REQUIREMENTS.

CAUTION
UNDERGROUND HIGH VOLTAGE ELECTRICAL CABLES. ALL WORK IN THE VICINITY OF EXISTING ELECTRICAL ASSETS MUST BE IN ACCORDANCE WITH WORKSAFES "NO GO ZONE" REQUIREMENTS.



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Drafted	LGP AUG 2022
Checked	
Authorised	
Approved by Council	

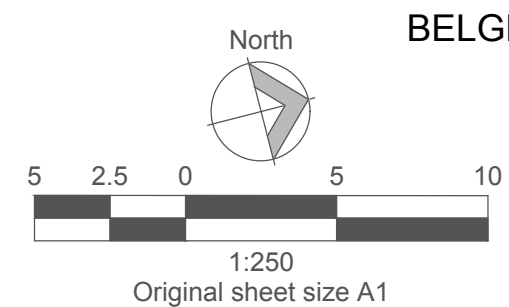
SUBJECT TO APPROVAL

No.	Revision Description	Design	Authorised	Date

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PSD, On-Site Storage, and Orifice Diameter Calculator

Project Name/Address	Belgrave Heights Performing Arts & Senior Learning Centre - 20 Wattle Rd, Belgrave
MM Reference	20799
Authority Reference	Yarra Ranges Council
Designer	Laurence Gae Posadas
Checker	

TABLE 1. Existing Site Conditions

Description	Symbol	Value	Unit	Notes/References
Total Site Area	A _T	8316	m ²	From survey/supplied data
Area of Building	A _{BC}	0	m ²	From survey/supplied data
Area of Driveway and Paths	A _{DP}	0	m ²	From survey/supplied data
Area of Carpark	A _C	0	m ²	From survey/supplied data
Total Impervious Area	A _{IM}	0	m ²	Sum of Roof, Garage, Driveway, Paths, and Carport
Remaining Pervious Area	A _{PE}	8316	m ²	A _T - A _{IM} (lawns, garden beds, etc.)
Weighted Coefficient of Runoff (Existing)	C_{WEX}	0.30	-	MUST consider YRC permissible coefficient
Weighted Coefficient of Runoff (Allowable)	C_{WAL}	0.30	-	Lower of C _{WEX} and 0.51

TABLE 2. Permissible Site Discharge (1 in 5 year ARI) Existing Conditions

Description	Symbol	Value	Unit	Notes/References
Weighted Coefficient of Runoff	C _{WEX}	0.30	-	Taken from TABLE 1
Effective Site Area	A _E	0.249	ha	A _T x C _{wex}
Time of Concentration	T _C	12	min	Assumption
5 year rainfall intensity	I ₅	57.9	mm/hr	Based on Tc above and location
1 in 5 year ARI Runoff	Q₅	40.12	l/s	Where Q ₅ =(A _E x I ₅)/360 x 1000

TABLE 3. Permissible Site Discharge (1 in 100 year ARI) Existing Conditions

Description	Symbol	Value	Unit	Notes/References
Weighted Coefficient of Runoff	C _{WEX}	0.30	-	Taken from TABLE 1
Effective Site Area	A _E	0.249	ha	Taken from TABLE 2
Time of Concentration	T _C	12	min	Assumption
100 year rainfall intensity	I ₁₀₀	118.5	mm/hr	Based on Tc above and location
1 in 100 year ARI Runoff	Q₁₀₀	82.12	l/s	Where Q ₅ =(A _E x I ₅)/360 x 1000

TABLE 4. Proposed Site Conditions

Description	Symbol	Value	Unit	Notes/References
Area of Building	A _B	2635	m ²	From Design plans data
Area Uncontrolled (Concrete)	A _{UC}	146	m ²	From Design plans data (Uncontrolled)
Area of Driveway and Paths (Concrete)	A _{DP}	1810	m ²	From Design plans data
Area of Driveway and Paths (Permeable Paving) C=0.70	A _{PP}	620	m ²	From Design plans data
Area Uncontrolled Pervious	A _{UP}	81	m ²	From Design plans data
Impervious Area (Controlled)	A _{IM}	4445	m ²	
Permeable Paving Area (Controlled)	A _{PP}	620	m ²	
Remaining Pervious Area	A _{PE}	3024	m ²	A _T - A _{IM} (lawns, garden beds, etc.)
Area Uncontrolled Total	A _U	227		
Weighted Coefficient of Runoff (Controlled)	C_{WC}	0.66	-	MUST consider YRC permissible coefficient
Weighted Coefficient of Runoff (Uncontrolled)	C_{WUC}	0.69	-	(A _{UC} x0.9+A _{UP} x0.3)/(A _{UC} +A _{UP})

TABLE 5. Permissible Site Discharge (1 in 5 year ARI) Uncontrolled Flow

Description	Symbol	Value	Unit	Notes/References
Weighted Coefficient of Runoff	C _{WUC}	0.69	-	Taken from TABLE 4
Effective Site Area	A _E	0.016	ha	A _U x C _{wuc}
Time of Concentration	T _C	6	min	Assumption Council
5 year rainfall intensity	I ₅	78.4	mm/hr	Based on Tc above and location
1 in 5 year ARI Runoff	Q₅	3.39	l/s	Where Q ₅ =(A _E x I ₅)/360 x 1000

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PSD, On-Site Storage, and Orifice Diameter Calculator

TABLE 6. Permissible Site Discharge (1 in 100 year ARI) Uncontrolled Flow

Description	Symbol	Value	Unit	Notes/References
Weighted Coefficient of Runoff	C_{WUC}	0.69	-	Taken from TABLE 4
Effective Site Area	A_E	0.016	ha	AuxCwuc
Time of Concentration	T_C	6	min	Assumption by council
100 year rainfall intensity	I_{100}	164.4	mm/hr	Based on Tc above and location
1 in 100 year ARI Runoff	Q_{100}	7.11	l/s	Where $Q_{100}=(A_E \times I_s)/360 \times 1000$

TABLE 7. Permissible Site Discharge remainder

Description	Symbol	Value	Unit	Notes/References
Q5 Remainder	Q_{5R}	36.73	l/s	Q_5 Site PSD - Q_5 Uncontrolled PSD
Q100 Remainder	Q_{100R}	75.01	l/s	Q_{100} Site PSD - Q_{100} Uncontrolled PSD

For Below ground Storage use OSD4

Variables to use	Symbol	Value	Unit	Notes/References
Existing Conditions (Areas)	A_{ex}	8316	m^2	$A_{IM} \times 0.9$ and $A_{PE} \times 0.3$ Per Table 1
Proposed Site (Areas)	A_{prop}	8089	m^2	$A_B + A_{DP} \times 0.9$ and $A_{PE} \times 0.3$ and $A_{PP} \times 0.7$ Per Table 4
Uncontrolled Area	A_{unct}	227	m^2	A_U Per Table 4 x C_{WUC} CoR Refer Table 4
Time of Concentration	T_C	10.00	min	Supplied value by Council
Time to site outlet	T_{so}	5.00	min	Supplied value by Council
Zone ARI Flow		100Year		Monbulk
Zone ARI Store		100Year		Monbulk
Storage Type		PIPE		Storage type value
PSD used Predeveloped Q_{100}	Q_{100}	75.01	l/s	Refer Table 7

OSD4 results Storage required	S_{T-O}	106.48	m^3	Refer attached OSD4 Calculations
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For Above ground Tank Storage

Variables to use Tank	Symbol	Value	Unit	Notes/References
Area of Building roof area to tank	A_r	2649	m^2	From Design plan data
The Q_5 allowable from tank	Q_{5A}	11.70	l/s	Where $Q_{5A}=(A_r/A_T) \times Q_5$ (Refer Table 7)

For Above Ground Storage Tank use OSD4

Variables to use	Symbol	Value	Unit	Notes/References
Time of Concentration	T_C	10.00	min	Supplied value by Council
Time to site outlet	T_{so}	5.00	min	Supplied value by Council
Zone ARI Flow		5Year		Monbulk
Zone ARI Store		5Year		Monbulk
Storage Type		TANK		Storage type value
PSD used Q_5	Q_{5A}	11.70	l/s	
OSD4 results Storage required Tank	S_T	42.75	m^3	Plus $80m^3$ SRR Reuse

For Above Ground Storage Tank Orifice Design

Variables to use	Symbol	Value	Unit	Notes/References
Q_{5a}	Q_{5A}	11.70	l/s	As above
Coefficient of discharge	C_d	0.60		For Circular Orifices
Head (Driving Head) Assume Tank Height = 3.2m	H	0.30	m	Measured from centre of orifice to Top Water Level
Gravity	g	9.81	m/s^2	Gravity constant
Orifice Area	A	0.0080385	m^2	Orifice area = $(Q_{5A}/1000)/((C_d \times \sqrt{2 \times g \times H}))$
Orifice Diameter Calculated	D_C	101.2	mm	Diameter of Orifice = $\sqrt{4 \times A / \pi}$
Orifice Diameter Adopted	D_A	100.0	mm	DN100 PVC DWV

OSD4 results Storage required Overall in Underground Detention	S_{T-U}	63.73	m^3	Volume balance $S_{T-O} - S_T$
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PSD, On-Site Storage, and Orifice Diameter Calculator

TABLE 8. Pipe Storage

D/S Pit	U/S Pit	Pipe Length	No. of	Pipe Dia.	% Full	Pipe Capacity (m ³)
1	2	6	1	600	100	1.70
Total Pipe Storage (m ³)						1.70

TABLE 9. Pit Storage

Pit Number	Area (m ²)	Controlling Level (RL)	Pit Base RL	Depth of Water	Pit Capacity
1	0.81	139.45	138.12	1.33	1.08
2	60.00	139.45	138.35	1.10	66.00
Total Pit Storage (m ³)					67.08
Overall Storage Volume (m ³)					68.77
Required Storage Volume from OSD4 (m ³)					63.73

TABLE 10. Orifice Pit Calculations

Description	Symbol	Value	Unit	Notes/References
Peak Permissible Discharge	Q _{PEAK}	36.73	l/s	Taken from TABLE 7 (Q ₅)
Coefficient of Discharge for Orifice	C _O	0.6	-	Standard value
Design Pit Head	H	1.27	m	Adjust this value to determine orifice diameter
Area of Orifice	A _O	0.012	m ²	Step Calculation
Orifice Diameter Calculated	D _C	125.0	mm	Diameter of Orifice=√(4xA/pi)
Orifice Diameter Adopted	D _A	125.0	mm	DN125 PVC DWV

TABLE 11. Orifice Pit Weir overflow Calculations

Description	Symbol	Value	Unit	Notes/References
Peak Permissible Discharge	Q _{PEAK}	82.12	l/s	Taken from TABLE 3 (Q ₁₀₀)
Pit Weir Length	P _L	0.9	m	Standard value
Flow Height Over Weir	P _h	0.2	m	Adjust this value to determine orifice diameter
Coefficient of discharge	C _d	0.620		Fixed standard for flow over a weir
Gravity	g	9.810		Gravity constant
Formulae Q overflow	Q _{check}	147	l/s	Q _{check} =2/3C _d Lx((2g) ^{1/2} (h) ^{2/3})*1000

TABLE 12. 100Y Pipe Capacity Calculations - Outflow Pipe from OP to Swale

Description	Symbol	Value	Unit	Notes/References
Peak Permissible Discharge	Q _{PEAK}	82.12	l/s	Taken from TABLE 3 (Q ₁₀₀)
Pipe Size	P _s	225	mm	Standard value
Pipe Grade	P _g	12	m/m	Pipe grade 1 in
Manning's Coefficient	n	0.009		Coefficient of roughness
Velocity	v	4.71	m/s	Velocity
Formulae Q overflow	Q _{check}	187.23	l/s	Q _{check} =2/3C _d Lx((2g) ^{1/2} (h) ^{2/3})*1000

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1. CLIENT DETAILS

Name : Yarra Ranges Council
Address line 1 :
Address line 2 :
Address line 3 :

2. JOB NAME AND REFERENCE

Job Reference : OSD4W-20799
Job Name : Belgrave Heights Performing Arts and Senior Learning Centre
Job Detail 1 : 20 Wattle Rd, Belgrave
Job Detail 2 :
Job Detail 3 :

3. AREAS (sq.m.) & RUN-OFF COEFFICIENTS

Total Site area : 8316

4. EXISTING SITE DETAILS

Aes1 : 0 Ces1 : 0.90
Aes2 : 8316 Ces2 : 0.30
Aes3 : 0 Ces3 : 0.15
Aes4 : 0 Ces4 : 0.12
Weighted C - site Cew : 0.30

5. PROPOSED SITE DETAILS

Aps1 : 4445 Cps1 : 0.90
Aps2 : 3024 Cps2 : 0.30
Aps3 : 620 Cps3 : 0.70
Aps4 : 227 Cps4 : 0.69 <-- Total uncontrolled portion(s) - weighted
Weighted C - site Cpw : 0.66
Uncontrolled portion(s) UPfrac : 0.06 <-- Weighted uncontrolled fraction of total site

6. CATCHMENT TIMES (minutes)

Time of concentration : 10.00
Travel time from discharge point
to catchment outlet : 5.00

7. OSD DESIGN

Flow Control Device : Orifice
Storage type : Pipe
Rainfall zone : MONBULK
ARI for OUTFLOW (years) : 100
ARI for STORAGE (years) : 100
Qptot (L/s) : 80.76 <-- Existing site discharge
Qu (L/s) : 5.04 <-- Exist. discharge from uncontrolled portion
Qp (L/s) : 75.72 <-- Exist. discharge from controlled portion(s)
Calculated PSD (L/s) : 92.58
Nominated PSD (L/s) : 75.01
Adopted PSD (L/s) : 75.01

8. STORAGE DETAILS

Volume (cub.m.) : 106.48
Time to fill storage (mins) : 24.0
Time to empty storage (mins) : 40.4
Critical storm duration (mins) : 31.9

9. STORM DURATIONS & RAINFALL INTENSITIES

PSD Duration : 10.0 min. Intensity : 116.5 mm/hr
MAX. STORAGE Duration : 31.9 min. Intensity : 66.1 mm/hr

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*** The runoff from portion(s) of the site will not be controlled by the OSD system.
*** OSD4W has calculated a reduced PSD and an increased storage volume to ensure that the
*** timewise discharge rates from the site satisfy the Swinburne Methodology criteria.

=====

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1. CLIENT DETAILS

Name : Yarra Ranges Council
Address line 1 :
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2. JOB NAME AND REFERENCE

Job Reference : OSD4W-20799
Job Name : Belgrave Heights Performing Arts and Senior Learning Centre
Job Detail 1 : 20 Wattle Rd, Belgrave
Job Detail 2 :
Job Detail 3 :

3. AREAS (sq.m.) & RUN-OFF COEFFICIENTS

Total Site area : 2649

4. EXISTING SITE DETAILS

Aes1 : 2649 Ces1 : 0.90
Aes2 : 0 Ces2 : 0.30
Aes3 : 0 Ces3 : 0.15
Aes4 : 0 Ces4 : 0.12
Weighted C - site Cew : 0.90

5. PROPOSED SITE DETAILS

Aps1 : 2649 Cps1 : 0.90
Aps2 : 0 Cps2 : 0.30
Aps3 : 0 Cps3 : 0.15
Aps4 : 0 Cps4 : 0.12
Weighted C - site Cpw : 0.90
Uncontrolled portion(s) UPfrac : 0.00

6. CATCHMENT TIMES (minutes)

Time of concentration : 10.00
Travel time from discharge point
to catchment outlet : 5.00

7. OSD DESIGN

Flow Control Device : Orifice
Storage type : Tank
Rainfall zone : MONBULK
ARI for OUTFLOW (years) : 5
ARI for STORAGE (years) : 5
Qptot (L/s) : 47.31
Qu (L/s) : 0.00
Qp (L/s) : 0.00
Calculated PSD (L/s) : 48.63
Nominated PSD (L/s) : 11.70
Adopted PSD (L/s) : 11.70

8. STORAGE DETAILS

Volume (cub.m.) : 42.75
Time to fill storage (mins) : 51.7
Time to empty storage (mins) : 181.7
Critical storm duration (mins) : 66.9

9. STORM DURATIONS & RAINFALL INTENSITIES

PSD Duration : 10.0 min. Intensity : 71.4 mm/hr
MAX. STORAGE Duration : 66.9 min. Intensity : 25.9 mm/hr

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STORM Rating Report

TransactionID: 1452612
Municipality: YARRA RANGES
Rainfall Station: YARRA RANGES
Address: Belgrave Heights Performing Arts and Senior Learning Centre
20 Wattle Rd
Belgrave Heights
VIC 3160
Assessor: Laurence Gae Posadas
Development Type: Industrial
Allotment Site (m2): 8,316.00
STORM Rating %: 80

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Description	Impervious Area (m2)	Treatment Type	Treatment Area/Volume (m2 or L)	Occupants / Number Of Bedrooms	Treatment %	Tank Water Supply Reliability (%)
Building Roof Area	2,649.00	Rainwater Tank	80,000.00	100	139.60	87.60
Driveway, Carpark, Paths	1,810.00	None	0.00	0	0.00	0.00
Ground Floor Entry	146.00	None	0.00	0	0.00	0.00

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