City of Greater Geelong, Statutory Planning - Date Received 20/08/2026

ALE CIVIL & STRUCTURAL ENGINEERS PTY LTD
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PROJECT:
PROPOSED RESIDENCE
360C AUTUMN STREET
HERNE HILL

CLIENT:
J3DESIGN ARCHITECTS

DATE:
AUG 2026

DESIGNED BY:
[redacted]
BEng(CIVIL), ,MIEAust, [redacted]

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ALE-2011	A		AA	AA	08/26	COVER SHEET
JOB NO.	REV NO.	DESCRIPTION	DESIGNED BY	CHECKED BY	DATE	SHEET NO

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SCOPE OF WORK

Provide design and documentation for the following:

- *LAYOUT AND DETAILS*
- *CONNECTIONS*
- *STORMEATER*

Calculation Method

- *Manual calculation*
- *Microsoft Excel spreadsheet*

Design Criteria Based on Information Provided by Client

- *Refer computation sheet*

References

- *A.S.3500 SAA STORMWATER Code*
-

Conclusion

- *Refer computation sheets and drawings for member layout and sizes*

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STORMWATER DETENTION V5.06

Laov Pty Ltd

Location: **Geelong, VIC**
Site: **305m² with tc = 25 and tcs = 10 mins.**
PSD: **ARI of 5 years, Above ground PSD = 1.28L/s**
Storage: **ARI of 10 years, Above ground volume = 1.16m³**

Design Criteria

Location =	Geelong, VIC	
Method =	A	(A)RI 2001,A(E)P 2019
PSD average recurrance interval (ARI) =	5	years
Storage average recurrance interval (ARI) =	10	years
PSD annual exceedance probabiliy (APE) =	20	%
Storage annual exceedance probabiliy (APE) =	10	%
Storage method =	A	(A)bove,(P)ipe,(U)nderground,(C)ustom
Permissible site discharge (Qu=Custom) =	1.281	L/s

Site Geometry

Site area (As) =	305	m² =	0.0305 Ha
Pre-development coefficient (Cp) =	0.35		
Post development coefficient (Cw) =	0.45		
Total catchment (tc) =	25	minutes	
Upstream catchment to site (tcs) =	10	minutes	

Coefficient Calculations

Pre-development

Zone	Area (m²)	C	Area * C
Concrete	200	0.90	180
Roof	300	0.90	270
Gravel	200	0.30	60
Garden	500	0.17	85
Total	1200 m²		595

Error - Total <> Site area

Cp = ΣArea*C/Total = 0.496

Post development

Zone	Area (m²)	C	Area * C
Concrete	35	0.90	32
Roof	80	0.90	72
Gravel	0	0.30	0
Garden	190	0.17	32
Total	305 m²		136

Cw = ΣArea*C/Total = 0.445

Permissible Site Discharge (PSD) (ARI of 5 years)

PSD Intensity (I) =	38.5	mm/hr	For catchment tc = 25 mins.
Pre-development (Qp = Cp*I*As/0.36) =	1.14	L/s	
Peak post development (Qa = 2*Cw*I*As/0.36) =	2.90	L/s	=(0.075 x I) Eq. 2.24
Storage method =	A	(A)bove,(P)ipe,(U)nderground,(C)ustom	
Permissible site discharge (Qu = PSD) =	1.281	L/s	

Above ground - Eq 3.8

$0 = PSD^2 - 2*Qa/tc*(0.667*tc*Qp/Qa + 0.75*tc+0.25*tcs)*PSD + 2*Qa*Qp$

Taking x as = PSD and solving

a = 1.0 b = -6.5 c = 6.6

PSD = $-b \pm \sqrt{(b^2-4ac)}/(2a)$

PSD = 1.281 L/s

Below ground pipe - Eq 3.3

$Qp = PSD*[1.6*tcs/\{tc*(1-2*PSD/(3*Qa))\}-0.6*tcs^{2.67}/\{tc*(1-2*PSDp/(3*Qa))\}^{2.67}]$

= 1.14

PSD = 1.425 L/s

Below ground rectangular tank - Eq 3.4

t =tcs/(tc*(1-2*PSD/(3*Qa))) = 0.595

$Qp = PSD*[0.005-0.455*t+5.228*t^2-1.045*t^3-7.199*t^4+4.519*t^5]$

= 1.14

PSD = 1.428 L/s

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Design Storage Capacity (ARI of 10 years)

Above ground (Vs) = [0.5*Qa*td-[(0.875*PSD*td)(1-0.917*PSD/Qa)+(0.427*td*PSD²/Qa)]]*60/10³ m³ Eq 4.23
Below ground pipe (Vs) = [(0.5*Qa-0.637*PSD+0.089*PSD²/Qa)*td]*60/10³ m³ Eq 4.8
Below ground rect. tank (Vs) = [(0.5*Qa-0.572*PSD+0.048*PSD²/Qa)*td]*60/10³ m³ Eq 4.13

td (mins)	I (mm/hr)	Qa (L/s)	Above Vs (m³)	Pipe Vs (m³)	B/G Vs (m³)
5	97.7	7.4	0.79	0.84	0.86
9	76.3	5.8	1.01	1.08	1.12
11	69.4	5.2	1.07	1.15	1.20
13	64.0	4.8	1.11	1.20	1.26
15	59.5	4.5	1.13	1.24	1.30
17	55.7	4.2	1.15	1.26	1.33
19	52.5	4.0	1.15	1.27	1.35
21	49.7	3.7	1.15	1.28	1.36
23	47.2	3.6	1.15	1.27	1.37
25	45.0	3.4	1.14	1.26	1.36

Table 1 - Storage as function of time for ARI of 10 years

Type	td (mins)	I (mm/hr)	Qa (L/s)	Vs (m³)
Above	19.9	51.2	3.9	**1.16**
Pipe	21.2	49.4	3.7	**1.28**
B/ground	23.2	47.0	3.5	**1.37**

Table 2 - Storage requirements for ARI of 10 years

Frequency of operation of Above Ground storage

Qop2 = 0.75 Cl 2.4.5.1
Qp2 =Qop2*Qp1 (where Qp1=PSD) = 0.96 L/s at which time above ground storage occurs
I = 360*Qp2/(2*Cw*As*10³) = 12.7 mm/h Eq 4.24

Period of Storage

Time to Fill:

Above ground (tf) = td*(1-0.92*PSD/Qa) Eq 4.27
Below ground pipe (tf) = td*(1-2*PSD/(3*Qa)) Eq 3.2
Below ground rect. tank (tf) = td*(1-2*PSD/(3*Qa)) Eq 3.2

Time to empty:

Above ground (te) = (Vs+0.33*PSD²*td/Qa*60/10³)*(1.14/PSD)*(10³/60) Eq 4.28
Below ground pipe (te) = 1.464/PSD*(Vs+0.333*PSD²*td/Qa*60/10³)*(10³/60) Eq 4.32
Below ground rect. tank (te) = 2.653/PSD*(Vs+0.333*PSD²*td/Qa*60/10³)*(10³/60) Eq 4.36

Storage period (Ps = tf + te) Eq 4.26

Type	td (mins)	Qa (L/s)	Vs (L/s)	tf (mins)	te (mins)	Ps (mins)
Above	19.9	3.9	1.2	13.8	19.6	33.4
Pipe	21.2	3.7	1.3	15.8	25.8	41.6
B/ground	23.2	3.5	1.4	17.0	50.6	67.5

Table 3 - Period of Storage requirements for ARI of 10 years

Orifice

Permissible site discharge (Qu=PSD) = 1.28 L/s (Above ground storage)
Orifice coefficient (CD) = 0.61 For sharp circular orifice
Gravitational acceration (g) = 9.81 m/s²
Maximum storage depth above orifice (H) = 1000 mm
Orifice flow (Q) = CD*Ao*√(2*g*H)

Therefore:
Orifice area (Ao) = 474 mm²
Orifice diameter (D = √(4*Ao/π)) = 24.6 mm

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