Of beauty rich and rare.

Level 1a, 10-14 Paterson Street
Launceston TAS 7250
P. 6388 9200

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Our Ref: 210073

18th February 2022

Paul Godier
Northern Midlands Council
PO Box 156
Longford TAS 7301

ATT: PLANNING DEPARTMENT

Dear Paul

RESPONSE TO RFI PLN21-0301, 17 CHURCH STREET, CAMPBELL TOWN

Rare Innovation have been engaged by M|Arkitecture to provide civil and structural engineering services for the development at the above address. Please refer this letter and its attachments addressing the request for information.

Attached to this letter are the following documents

A. Concept stormwater plan
B. Upper Catchment (Catchment 1) stormwater infiltration calculations
C. Lower Catchment (Catchment 2) stormwater infiltration and detention calculations
D. Concept Site Levels

Planning Permit PLN-21-0138 states the stormwater disposal requirements as per the below.

2.2 Stormwater absorption drain – Lot 1
The owner of Lot 1 must enter in to, and comply with, all conditions of an agreement under Part 5 of the Land Use Planning and Approvals Act 1993 to provide for the following:

a. A stormwater absorption drain must be constructed prior to any building works on Lot 1.
b. The absorption drain must be designed by a certified hydraulic engineer to cater for all hardstand areas that cannot be drained to Church Street.
c. Plans and calculations from a certified hydraulic engineer must be submitted to the General Manager for assessment.
d. Construction of the drain must not commence until the plans are approved.
e. The drain shall be sized taking into account the saturated permeability of the soil.
f. The drain shall be sized with sufficient storage capacity to dispose of the full range of 5% AEP storms, with an additional safety factor volume 50% above the calculated need. Absorption drain calculations shall be undertaken in accordance with the procedures detailed in Water Sensitive Urban Design – Engineering Procedures for Stormwater Management in Tasmania (Derwent Estuary Program, 2012).
g. The drain shall be located to command the stormwater discharge from all areas of the site.
h. The drain shall be installed along the contour at a minimum of 6.0 metres clear of boundaries down slope of any structures.
i. The installation shall be located to ensure there is no concentrated discharge from any structures.
j. A system operation / maintenance manual is to be provided and approved by the Engineering Services Manager.
k. The system shall be marked on an "As Constructed" plan to Council requirements with the

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plan provided to Council.

l. *The system is to be installed prior to site occupancy, operated and maintained by the owner in conformity with the manufacturer or design engineer's instruction manual and any additional conditions as required by Council. Any nuisance / concentrated discharge from the facility shall be rectified by the owner to Council's requirements and at the owner's expense within 14 days' notice of the nuisance.*

Stormwater Disposal – Planning Permit Compliance

a. A stormwater absorption drain is part of this development and will be in place prior to the construction of the impervious areas.
b. The design will be certified by a company director.
c. Sketch plans and detailed calculations are attached. Detailed plans will be submitted as part of the Building Approval documents
d. The construction of the drain will not commence until the plans are approved.
e. The drain has taken into account the saturation permeability of the soil. This is certified by Geoton, report GL21409Ab.
f. The drainage design has in fact got a factor of safety of 50% of the 5% AEP storm for the absorption bed that can overflow to the street. The drainage design has a factor of safety 50% on absorption storage for the bed that can not flow over the street.
g. All the stormwater will be captured by the system.
h. The drainage is not possible to be located 6m from the boundary. As such a tech dry retaining wall and onsite detention pond has need installed to ensure no flow will cross the property boundary.
i. No concentrated discharge from any structure will be achieved.
j. A manual can be provided
k. The plumber will submit "As Constructed" plans
l. The property owner will operate, maintain and repair the system.

Stormwater Disposal Design

In response to your request for further information this letter has been prepared to verify the site stormwater can be disposed of either through infiltration into the soil within the boundary lines or through disposal to the street.

The site is split into two catchments, the upper catchment that includes the buildings and the upper carpark, and the lower catchment that includes the driveways and lower carparks.

Catchment 1

The upper catchment will utilise high level stormwater pipes to ensure the roof drainage falls to the upper infiltration bed.

Site Area = 1434 m2

Impervious Area = 1200 m2

Catchment Infiltration Bed Area = 75 m2

Infiltration Rate = 2.60 L/s

5% AEP Storage required = 9.65 m3

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5% AEP Storage with 50% FoS = 14.48 m3

Infiltration Bed Storage provided = 15 m3

An overland flow path is provided from the infiltration bed to the street swale drain. This will ensure any flows greater than 5% AEP will not flow on to a neighbouring property.

Catchment 2

The lower catchment falls to vee drains that protect the property boundary. These all fall to the low point on the site. This pit then feeds into a secondary infiltration bed. The lower catchment is designed for the 1% AEP storm so that this site is not allowing stormwater to overflow onto neighbouring properties.

Site Area = 1869 m2

Impervious Area = 1869 m2

Catchment Infiltration Bed Area = 60.5 m2

Infiltration Rate = 2.10 L/s

1% AEP Storage required = 37.34 m3

1% AEP Storage with 50% FoS = 56.01 m3

Infiltration Bed Storage provided = 12.1 m3

Above Ground Pond storage provided = 45.4 m3

Total storage provided = 57.5 m3

The infiltration bed is protected from flooding by a flow rate restricting orifice that ensures the flow rate from the above ground pond is restricted to less than the infiltration rate of the ground. The required orifice size is 39mm diameter.

Stormwater Summary

The upper catchment is designed to infiltrate the 5% AEP storm with the 1% AEP storm overflowing to the street.

The lower catchment is designed to detain and infiltrate the 1% AEP storm so that there is not concentration of stormwater crossing into neighbouring boundaries.

The only condition of the planning permit that can not be achieved is point h. above. This has been mitigated by the design of a Tech Dry blockwork wall that will provide a bund against the property boundaries and any nuisance flows.

The use of stormwater tanks for water reuse can be added to this concept without any complications.

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Site Fill

The site required filling to address two issues.

Issue one is the stormwater disposal discussed above and issue two is to maintain safe driveways for access and a mostly level building.

Refer attachments D and E.

Should you have any further queries please do not hesitate to contact us.

Yours faithfully,

Matthew Peart
Senior Structural Engineer // Buildings Division Manager
B.E.Hons // M.E.M // MIEAust

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CONCEPT STORMWATER CATCHMENT PLAN.

210073 - Attachment A.

STORMWATER CATCHMENT 1

STORMWATER CATCHMENT 2.

STORMWATER DETENTION / INFILTRATION BED 1.

INFILTRATION RATE = 2.3L/s

STORAGE AREA = 11.2m³

RAIN HEAD & OVER FLOW.

STORMWATER AT HIGH LEVEL.

STORMWATER AT HIGH LEVEL.

DETENTION POND STORAGE = 91m³

FLOW RESTRICTING ORIFICE Ø39mm FLOW = 2.1L/s

STORMWATER DETENTION BASIN / INFILTRATION BED 2.

INFILTRATION RATE = 2.1L/s

CONCEPT SITE LEVELS

210073 - Attachment D.

FFL = 216.15

OVERLAND FLOW LINE

1:200.

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Appendix A - Stormwater Infiltration and Detention Calculations - Catchment 1

NOTE: Revised cells highlighted

Site Area	1434	m^2
Predevelopment Impervious Site Area	0	m^2
Postdevelopment Impervious Site Area	1200	m^2

Permissible Site Discharge Conditions

Rational Method

Q	L/s	Peak Flow
C		Rational Method Runoff Coefficient
I	mm/hr	Average Rainfall Invensity
A	m2	Catchment Area
F	1/3600	Conversion Factor

Q =F.C.I.A

Site Location Storm Rainfall

Time Interval		Rain Fall Intensity 20 Year 5%	Rain Fall Intensity 100 Year 1%
Minutes	Hours	mm/hr	mm/hr
5		82	111
10		62.6	87.8
20		43.8	61.4
30		34.4	47.4
60	1	22	29.2
120	2	14	17.9
180	3	10.7	13.6
360	6	6.96	8.83
720	12	4.55	5.9
1440	24	2.92	3.89
2880	48	1.79	2.41
4320	72	1.3	1.74

$^{10}I_1$ 10%, 1Hr 19.1 mm/hr

C_{10} $=0.9 \times f + C^1_{10} \times (1 - f)$ C^1_{10} $=0.1 + 0.0133 \times (^{10}I_1 - 25)$

C_{10} Lookup Table

f	25	30	35	40	45	50	55	60	65	70
0	0.1	0.1665	0.233	0.2995	0.366	0.4325	0.499	0.5655	0.632	0.6985
0.05	0.14	0.203175	0.26635	0.329525	0.3927	0.455875	0.51905	0.582225	0.6454	0.708575
0.1	0.18	0.23985	0.2997	0.35955	0.4194	0.47925	0.5391	0.59895	0.6588	0.71865
0.15	0.22	0.276525	0.33305	0.389575	0.4461	0.502625	0.55915	0.615675	0.6722	0.728725
0.2	0.26	0.3132	0.3664	0.4196	0.4728	0.526	0.5792	0.6324	0.6856	0.7388
0.25	0.3	0.349875	0.39975	0.449625	0.4995	0.549375	0.59925	0.649125	0.699	0.748875
0.3	0.34	0.38655	0.4331	0.47965	0.5262	0.57275	0.6193	0.66585	0.7124	0.75895
0.35	0.38	0.423225	0.46645	0.509675	0.5529	0.596125	0.63935	0.682575	0.7258	0.769025
0.4	0.42	0.4599	0.4998	0.5397	0.5796	0.6195	0.6594	0.6993	0.7392	0.7791
0.45	0.46	0.496575	0.53315	0.569725	0.6063	0.642875	0.67945	0.716025	0.7526	0.789175
0.5	0.5	0.53325	0.5665	0.59975	0.633	0.66625	0.6995	0.73275	0.766	0.79925
0.55	0.54	0.569925	0.59985	0.629775	0.6597	0.689625	0.71955	0.749475	0.7794	0.809325
0.6	0.58	0.6066	0.6332	0.6598	0.6864	0.713	0.7396	0.7662	0.7928	0.8194
0.65	0.62	0.643275	0.66655	0.689825	0.7131	0.736375	0.75965	0.782925	0.8062	0.829475
0.7	0.66	0.67995	0.6999	0.71985	0.7398	0.75975	0.7797	0.79965	0.8196	0.83955
0.75	0.7	0.716625	0.73325	0.749875	0.7665	0.783125	0.79975	0.816375	0.833	0.849625
0.8	0.74	0.7533	0.7666	0.7799	0.7932	0.8065	0.8198	0.8331	0.8464	0.8597
0.85	0.78	0.789975	0.79995	0.809925	0.8199	0.829875	0.83985	0.849825	0.8598	0.869775
0.9	0.82	0.82665	0.8333	0.83995	0.8466	0.85325	0.8599	0.86655	0.8732	0.87985
0.95	0.86	0.863325	0.86665	0.869975	0.8733	0.876625	0.87995	0.883275	0.8866	0.889925
1	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9

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Percentage Impervious		
f	0.84	
$^{10}I_1$	25	mm/hr
C10	0.74	

ARI	% AEP		Freq.Factor	C_x
1	0.632	63.2	0.8	0.592
2	0.393	39.3	0.85	0.629
5	0.181	18.1	0.95	0.703
10	0.095	9.5	1	0.74
20	0.049	4.9	1.05	0.777
50	0.02	2	1.15	0.851
100	0.01	1	1.2	0.888

Site Infiltration Conditions

Permeability	p	3	m/day
		0.000035	m/s
Infiltration Area	A	75	m^2
Infiltration Flow	Q	0.00260	m^3/s
		2.60	L/s

Catchment Discharge (Q, L/s)

	Q=	C.I.A/3600		
	C_{20}	0.777		Figure 1.13 from AR&R Book 8, 2001
	I	82	mm/hr	From Bureau of Meteorology
	A	1434	m^2	
	Q_{10}	25.38	L/s	
∴		Catchment Discharge =	**25.4**	L/s

Catchment Discharge (Q, L/s)

	Q=	C.I.A/3600		
	C_{100}	0.888		Figure 1.13 from AR&R Book 8, 2001
	I	111	mm/hr	From Bureau of Meteorology
	A	1434	m^2	
	Q_{100}	39.26	L/s	
∴		Catchment Discharge =	**39.3**	L/s

Design Flow

Design Storm for Detention		1:20 ARI or 5% AEP	
Design Flow	Q	**25.4**	L/s

Runoff Coefficient for Developed Site

C_{20}	0.777
C_{100}	0.888

Time Interval		Rain Fall Intensity		Permissible Discharge		Site Volume		Required Storage	
		20 Year	100 Year	20 Year	100 Year	20 Year	100 Year	20 Year	100 Year
Minutes	Hours	mm/hr	mm/hr	m^3	m^3	m^3	m^3	m^3	m^3
5		82	111	0.78	0.78	7.61	11.78	6.83	11.00
6		62.6	87.8	0.94	0.94	6.98	11.18	6.04	10.24
10		43.8	61.4	1.56	1.56	8.13	13.03	6.57	11.47
20		34.4	47.4	3.13	3.13	12.78	20.12	9.65	16.99
30		22	29.2	4.69	4.69	12.26	18.59	7.57	13.90
60	1	14	17.9	9.38	9.38	15.60	22.79	6.22	13.42
120	2	10.7	13.6	18.75	18.75	23.84	34.64	5.09	15.89
180	3	6.96	8.83	28.13	28.13	23.26	33.73	-4.86	5.61
360	6	4.55	5.9	56.25	56.25	30.42	45.08	-25.83	-11.17
720	12	2.92	3.89	112.50	112.50	39.04	59.44	-73.46	-53.06
1440	24	1.79	2.41	225.00	225.00	47.87	73.65	-177.13	-151.35
2880	48	1.3	1.74	450.00	450.00	69.53	106.35	-380.47	-343.65
4320	72	0	0	675.00	675.00	0.00	0.00	-675.00	-675.00
								Max. Volumes	
							m^3	**9.65**	**16.99**
							+ 50% FoS	**14.48**	**25.49**

Where

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Permissible Discharge	$Q_{dis} = T \times Q_{inf}$ T = Time in seconds Q_{inf} = Infiltration flow in m/s
Site Volume	$V_{site} = ((C \times I \times A)/3600) \times T$ C = Run off coefficient I = rainfall intensity A = site area T = Time in seconds
Required Storage	$V_{store} = Q_{dis} - V_{site}$

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Gravel Depth	D	0.8	m
Gravel Porosity	p	0.25	
Bed Storage Available	V	15	m^3

For storm events greater than the 5% AEP the stormwater will overflow to the street.

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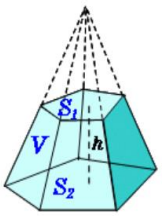

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Appendix B - Stormwater Infiltration and Detention Calculations - Catchment 2

NOTE: Revised cells highlighted

Site Area	1869	m^2
Predevelopment Impervious Site Area	0	m^2
Postdevelopment Impervious Site Area	1869	m^2

Permissible Site Discharge Conditions

Rational Method

Q	L/s	Peak Flow
C		Rational Method Runoff Coefficient
I	mm/hr	Average Rainfall Invensity
A	m2	Catchment Area
F	1/3600	Conversion Factor

Q =F.C.I.A

Site Location Storm Rainfall

Time Interval		Rain Fall Intensity	
		20 Year	100 Year
		5%	1%
Minutes	Hours	mm/hr	mm/hr
5		82	111
10		62.6	87.8
20		43.8	61.4
30		34.4	47.4
60	1	22	29.2
120	2	14	17.9
180	3	10.7	13.6
360	6	6.96	8.83
720	12	4.55	5.9
1440	24	2.92	3.89
2880	48	1.79	2.41
4320	72	1.3	1.74

$^{10}I_1$ 10%, 1Hr 19.1 mm/hr

C_{10} $=0.9 \times f + C^1_{10} \times (1 - f)$ C^1_{10} $=0.1 + 0.0133 \times (^{10}I_1 - 25)$

C_{10} Lookup Table

f	25	30	35	40	45	50	55	60	65	70
0	0.1	0.1665	0.233	0.2995	0.366	0.4325	0.499	0.5655	0.632	0.6985
0.05	0.14	0.203175	0.26635	0.329525	0.3927	0.455875	0.51905	0.582225	0.6454	0.708575
0.1	0.18	0.23985	0.2997	0.35955	0.4194	0.47925	0.5391	0.59895	0.6588	0.71865
0.15	0.22	0.276525	0.33305	0.389575	0.4461	0.502625	0.55915	0.615675	0.6722	0.728725
0.2	0.26	0.3132	0.3664	0.4196	0.4728	0.526	0.5792	0.6324	0.6856	0.7388
0.25	0.3	0.349875	0.39975	0.449625	0.4995	0.549375	0.59925	0.649125	0.699	0.748875
0.3	0.34	0.38655	0.4331	0.47965	0.5262	0.57275	0.6193	0.66585	0.7124	0.75895
0.35	0.38	0.423225	0.46645	0.509675	0.5529	0.596125	0.63935	0.682575	0.7258	0.769025
0.4	0.42	0.4599	0.4998	0.5397	0.5796	0.6195	0.6594	0.6993	0.7392	0.7791
0.45	0.46	0.496575	0.53315	0.569725	0.6063	0.642875	0.67945	0.716025	0.7526	0.789175
0.5	0.5	0.53325	0.5665	0.59975	0.633	0.66625	0.6995	0.73275	0.766	0.79925
0.55	0.54	0.569925	0.59985	0.629775	0.6597	0.689625	0.71955	0.749475	0.7794	0.809325
0.6	0.58	0.6066	0.6332	0.6598	0.6864	0.713	0.7396	0.7662	0.7928	0.8194
0.65	0.62	0.643275	0.66655	0.689825	0.7131	0.736375	0.75965	0.782925	0.8062	0.829475
0.7	0.66	0.67995	0.6999	0.71985	0.7398	0.75975	0.7797	0.79965	0.8196	0.83955
0.75	0.7	0.716625	0.73325	0.749875	0.7665	0.783125	0.79975	0.816375	0.833	0.849625
0.8	0.74	0.7533	0.7666	0.7799	0.7932	0.8065	0.8198	0.8331	0.8464	0.8597
0.85	0.78	0.789975	0.79995	0.809925	0.8199	0.829875	0.83985	0.849825	0.8598	0.869775
0.9	0.82	0.82665	0.8333	0.83995	0.8466	0.85325	0.8599	0.86655	0.8732	0.87985
0.95	0.86	0.863325	0.86665	0.869975	0.8733	0.876625	0.87995	0.883275	0.8866	0.889925
1	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9

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Percentage Impervious		
f	1.00	
$^{10}I_1$	25	mm/hr
C10	0.86	

ARI		% AEP	Freq.Factor	C_x
1	0.632	63.2	0.8	0.688
2	0.393	39.3	0.85	0.731
5	0.181	18.1	0.95	0.817
10	0.095	9.5	1	0.86
20	0.049	4.9	1.05	0.903
50	0.02	2	1.15	0.989
100	0.01	1	1.2	1.032

Site Infiltration Conditions

Permeability	p	3	m/day
		0.000035	m/s
Infiltration Area	A	60.5	m^2
Infiltration Flow	Q	0.00210	m^3/s
		2.10	L/s

Catchment Discharge (Q, L/s)

Q=	C.I.A/3600			
C_{20}	0.903			Figure 1.13 from AR&R Book 8, 2001
I	82	mm/hr		From Bureau of Meteorology
A	1869	m^2		
Q_{10}	38.44	L/s		
∴	Catchment Discharge =		**38.4**	L/s

Catchment Discharge (Q, L/s)

Q=	C.I.A/3600			
C_{100}	1.032			Figure 1.13 from AR&R Book 8, 2001
I	111	mm/hr		From Bureau of Meteorology
A	1869	m^2		
Q_{100}	59.47	L/s		
∴	Catchment Discharge =		**59.5**	L/s

Design Flow

Design Storm for Detention		1:100 ARI or 1% AEP	
Design Flow	Q	**59.5**	L/s

Runoff Coefficient for Developed Site

C_{20}	0.903
C_{100}	1.032

Time Interval		Rain Fall Intensity		Permissible Discharge		Site Volume		Required Storage	
		20 Year	100 Year	20 Year	100 Year	20 Year	100 Year	20 Year	100 Year
Minutes	Hours	mm/hr	mm/hr	m^3	m^3	m^3	m^3	m^3	m^3
5		82	111	0.63	0.63	11.53	17.84	10.90	17.21
6		62.6	87.8	0.76	0.76	10.57	16.93	9.81	16.18
10		43.8	61.4	1.26	1.26	12.32	19.74	11.06	18.48
20		34.4	47.4	2.52	2.52	19.35	30.48	16.83	27.95
30		22	29.2	3.78	3.78	18.56	28.16	14.78	24.38
60	1	14	17.9	7.56	7.56	23.63	34.53	16.07	26.96
120	2	10.7	13.6	15.13	15.13	36.12	52.46	20.99	37.34
180	3	6.96	8.83	22.69	22.69	35.24	51.09	12.55	28.41
360	6	4.55	5.9	45.38	45.38	46.07	68.28	0.70	22.90
720	12	2.92	3.89	90.75	90.75	59.14	90.04	-31.61	-0.71
1440	24	1.79	2.41	181.50	181.50	72.50	111.56	-109.00	-69.94
2880	48	1.3	1.74	363.00	363.00	105.31	161.09	-257.69	-201.91
4320	72	0	0	544.50	544.50	0.00	0.00	-544.50	-544.50
								Max. Volumes	
							m^3	**20.99**	**37.34**
							+ 50% FoS	**31.49**	**56.01**

Where

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Permissible Discharge	$Q_{dis} = T \times Q_{inf}$ T = Time in seconds Q_{inf} = Infiltration flow in m/s
Site Volume	$V_{site} = ((C \times I \times A)/3600) \times T$ C = Run off coefficient I = rainfall intensity A = site area T = Time in seconds
Required Storage	$V_{store} = Q_{dis} - V_{site}$

Gravel Depth	D	0.8	m
Gravel Porosity	p	0.25	
Bed Storage Available	V	12.1	m^3

As an overland flow path can not be provided the design will allow for the 100 year stormevent to be detained and infriltated into the ground.

Discharge Bed has a storage capacity of 12.10 m^3

Additional required storage is 25.24 m^3

Additional storage to be achieved through a detention basin in the lower carpark with a flow restricting orifice

Discharge Orifice Size

Permissible Discharge Flow Rates = Soil Infiltration Rate

Q_{100} 2.10 L/s 0.002 m^3/s

Depth of storage for 100 year rainfall event

h= 0.45 m (depth of ponded water + depth to centre of the orifice)

Flow through an orifice

Q= k.A.V

k= Shape factor 0.62

A= Area of the orifice

V= Flow velocity

Velocity

V= $\sqrt{}2.g.h$

g= gravity (9.81m/s^2)

h= pressure head

∴ V= 3.0 m/s

Required area of the orifice for 100 year rainfall event discharge

A= Q/(k.V)

∴ A= 0.0011

1140 mm^2

Diametre of the orifice

A= $\pi D^2/4$

D= $\sqrt{}(4.A/\pi)$

∴ D= 39 mm

Detention Storage Calculation

Considering pond from pit to bottom of the kerb as a Frustum

Area 1

Pit Dimensions

a = 0.45 m

b = 0.45 m

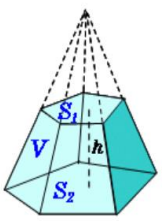
Area S1 = 0.2025 m^2

Pond Area

Area S2 = 140 m^2

Depth of Pond

h = 0.07 m



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Volume of Pond

V1 = 3.395629 m^3

Considering the pond area above the kerb as a prism

Area 2

Pond Area =	140	m^2
Pond Depth =	0.3	m
Pond Volume =	42	m^3

Total Above Ground Storage

V = 45.40 m3