

SUDS Design



**STINGRAY ENVIRONMENTAL
ENGINEERING**
Protect Our Water

Reference Number: SEE-S343

Register Reference: SD21B/0589

Site: Tig Mhuire, Old Bridge Road, Templeogue, D16,
D16W6F4, X312821, Y228559

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February 2022

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Introduction

This design report is based on the findings of a soil infiltration test as per BRE Digest 365, carried out by David Ryan on the 12th of November 2021.

As required by South Dublin County Council, this report provides recommendations for the SUDS design in line with the requirements of *BRE365*.

1. Site Specific Information

Information supplied by client /architect.

- ✚ Total Impermeable Area Feeding SuDS:
 - 300 msg (proposed roof area dwelling and gym)
- ✚ Inlet drain: DN150 UPVC Wavin

Rainfall information

- ✚ Site Location: Tig Mhuire, Old Bridge Road, Templeogue, D16, D16W6F4, X312821, Y228559
- ✚ Return period: 100 years
- ✚ Storm Duration: 4h
- ✚ Rainfall Depth (incl. 20% Climate Change):0.08316m



Fig 1. Site Location D16W6F4

2. Infiltration Test BRE Digest 365

- Dimensions of the infiltration test pit A: L 1200mm x W 800mm x D 1100mm
- Effective Depth adopted: ED 400mm

Cillron Limited Newtownmoyagh, KILCOCK, Co. FDBare. www.cercofilters.ie Tel: 047 6636757		BRE Digest 365 Test			
		Revision	1.00		
Section: Tigallure, Old Bridge Road, Templeogue		Job No:	101	Page:	08/1
		Prepared By:	DR	Date:	12/11/2021

ALTERNATIVE SOAKAWAY SIZES			
width of trench (mm):	trench soakaways		
	450	600	900
required trench length (m):	22.72	18.51	13.48
	ring soakaways		
diameter of ring (mm):	1500	2100	2400
	required pit diameter (m):	2.18	2.18

* Based on effective depth and number of pits as in Soakaway Data table

SUMMARY OF CALCULATIONS	
critical design rainfall duration T_{crit}	= 360 min
required storage volume V_{req}	= 10.56 m ³
proposed storage volume V_{prop}	= 10.64 m ³
utilization factor	= 0.99 OK
required time to discharge 50% T_{50}	= 6.08 hours
utilization factor	= 0.29 OK

GENERAL DATA	
site location:	Ireland
soakaway type:	infiltrated pit or trench
impermeable area drained to soakaway A (m ²)	= 800
60 min rainfall depth of 5 year return period R (mm)	= 16
M5-60 to M5-24 rainfall ratio Y	= 0.28
allowance for climate change:	20%

SOAKAWAY DATA	
soakaway width W (m)	= 3.68
soakaway length L (m)	= 4.00
total depth from ground level D_g (m)	= 1.10
depth to drain invert level D_d (m)	= 0.80
soakaway effective depth D_{eff} (m)	= 0.80
free volume in brick aggregate (%)	= 95

SOIL INFILTRATION DATA	
allowance for infiltration through soakaway base:	50%
available on-site infiltration test results:	<input checked="" type="checkbox"/> yes <input type="checkbox"/> no
use soakage trial pit table below	
internal surface area of trial pit A_{trial} (m ²)	= 1.76
storage volume between 75-25% V_p (m ³)	= 0.19
time for water to fall from 75-25% t_p (min)	= 110.00
soil infiltration rate T (m/s)	= 1.55E-05

SOAKAGE TRIAL PIT DATA	
soakage trial pit width W_t (m)	= 0.80
soakage trial pit length L_t (m)	= 1.20
total depth from ground level D_{gt} (m)	= 1.10
depth to pipe invert level D_{dt} (m)	= 0.70
soakage trial pit effective depth $D_{eff,t}$ (m)	= 0.40
free volume in brick aggregate (%)	= 90

NOTE: faces of excavation assumed to be vertical

REQUIRED STORAGE CAPACITY PER RAINFALL DURATION											
rainfall duration (min)	rainfall factor Z1	M5-D rainfall (mm)	M5-D			ignore		ignore		outflow from soakaway (m ³)	required storage (m ³)
			Z2	rainfalls (mm)	inflow (m ³)	Z2	rainfalls (mm)	inflow (m ³)	Z2		
5	0.33	5.21	1.44	9.02	2.71					0.06	2.64
10	0.48	7.57	1.47	13.31	3.99					0.13	3.86
15	0.58	9.14	1.48	16.24	4.87					0.19	4.53
30	0.76	11.96	1.49	21.41	6.42					0.39	6.04
60	1.00	15.70	1.49	28.00	8.42					0.77	7.65
120	1.27	19.86	1.47	35.15	10.55					1.55	9.00
240	1.63	25.53	1.46	44.67	13.40					3.09	10.31
360	1.86	29.30	1.45	50.67	15.20					4.64	10.68
600	2.22	34.79	1.43	59.66	17.90					7.74	10.16
1440	3.05	47.85	1.38	79.36	23.81					18.57	5.24

* Z2 is a growth factor from 10 rainfalls

SOAKAGE TRIAL PIT INFILTRATION TEST RESULTS																					
water level measurement N ^o		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
		time (min)	0	90	180																
Soakage Trial 1	depth to water (m)	= 0.70	0.80	0.80																	
	time (min)	= 0	90	180																	
Soakage Trial 2	depth to water (m)	= 0.70	0.80	0.80																	
	time (min)	= 0	180	210																	
Soakage Trial 3	depth to water (m)	= 0.70	0.80	0.80																	
	time (min)	= 0	180	210																	

Spreadsheet provided at: www.FourGreenSystems.co.uk calculations are based on BRE Digest 365

Fig 2. BRE 365 by David Ryan 12-11-2021.

3. Sustainable Drainage System SuDS Design

Due to the relatively large, proposed catchment area (300msq), restricted space on site, proximity of the river and moderate infiltration rates ($f=1.65 \text{ E-05}$), the traditional soakaway system would not be suitable for stormwater disposal on proposed site. Accordingly, the developer shall instead implement an alternative approved Sustainable drainage system (SuDS) as per requirements of the GSDSDS (Greater Dublin Strategic Drainage study) Regional Drainage Policies Volume 2 New Development, August 2005.

The proposed storm water system will drain to the ground via 1No. separate Cultec stormwater management system (underground attenuation system) designed for 100years + 20% increase for climate change.

For details, please refer to Appendix A and B (Drawings 645-C01, 645-C02)

For full design details refer to section below:

a). Infiltration rates calculated as per BRE 365

$f=0.0000165\text{m/sec}$



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b). Cultec Stormwater Management System (underground attenuation system)

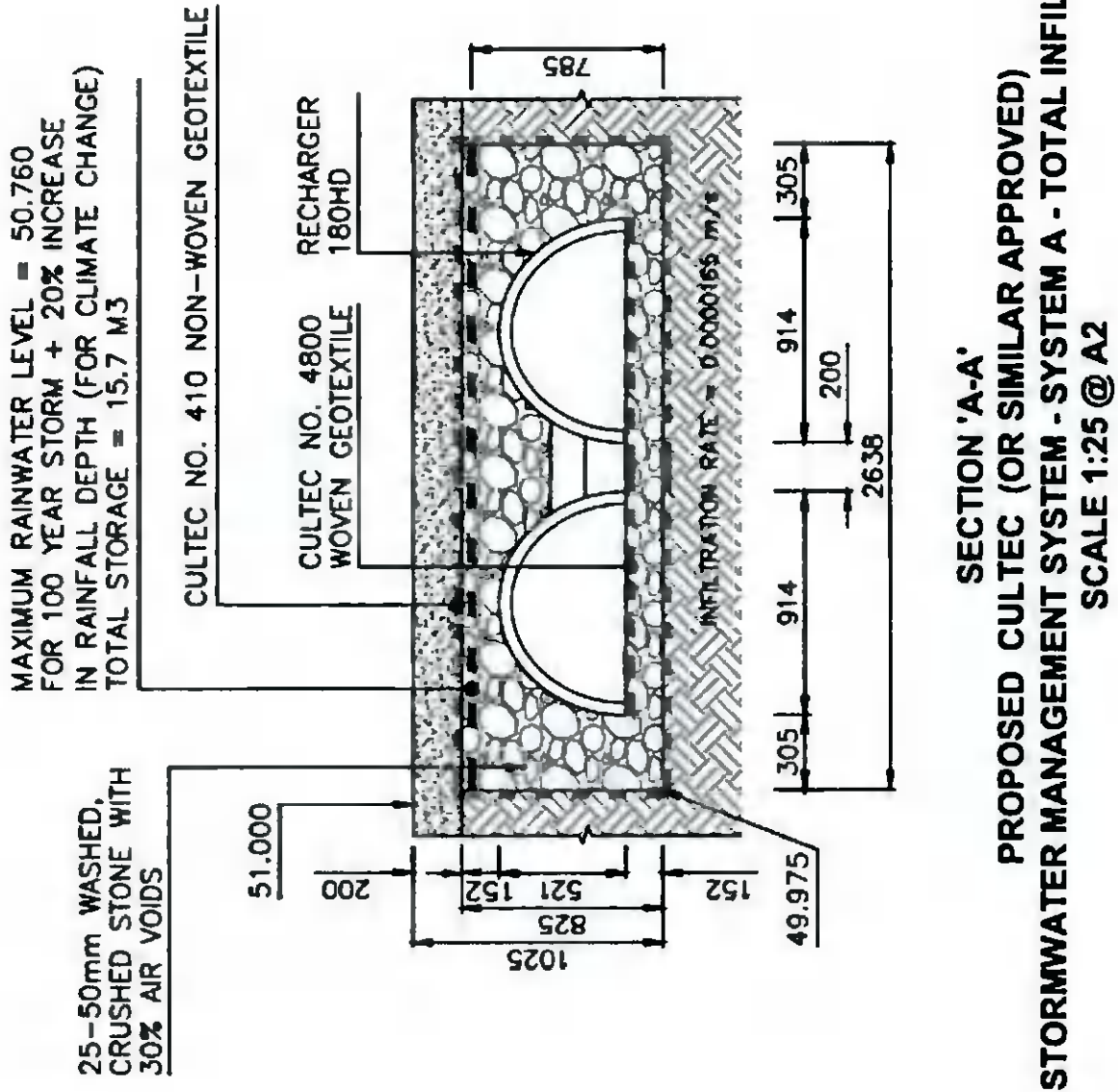


Fig 3. Cultec Storm attenuation system Cross Section.

HYDRAULIC CALCULATIONS FOR PROPOSED CULTEC (OR SIMILAR APPROVED) STORM WATER MANAGEMENT SYSTEM A WITH TOTAL INFILTRATION

Infiltration value: 0.0000165 m / sec = 0.0594 m / h

n - porosity of fill material (voids volume/total volume): 0.60
 q - infiltration coefficient: 0.0594000 m / h
 A_D - area to be drained: 300.0 m²
 R - Run-off Co-efficient: 0.90
 A_b - base area of infiltration system: 31.7 m²
 R - drainage ratio = A_D/A_b 8.52

$$H_{max} = (D \times (R \times I - q))/n$$

D - storm duration	Rainfall (100 year storm + 20% increase in rainfall depth for climate change) Return Period Rainfall Depths for sliding Durations Irish Grid: Easting: 312 821, Northing: 228 559	i - rainfall intensity	H _{max} - maximum depth of water in storm water management system
[h]	[m]	[m/h]	[m]
0.0833	0.02172	0.2606	0.300
0.1667	0.03024	0.1814	0.413
0.2500	0.03552	0.1421	0.479
0.5000	0.04404	0.0881	0.576
1.0000	0.05436	0.0544	0.673
2.0000	0.06720	0.0336	0.756
3.0000	0.07608	0.0254	0.783
4.0000	0.08316	0.0208	0.785
6.0000	0.09408	0.0157	0.742
9.0000	0.10656	0.0118	0.622
12.0000	0.11640	0.0097	0.464
18.0000	0.13176	0.0073	0.088
24.0000	0.14388	0.0060	0.334
48.0000	0.16080	0.0034	2.469
72.0000	0.17496	0.0024	4.644
96.0000	0.18744	0.0020	6.843
144.0000	0.20904	0.0015	11.289
192.0000	0.22776	0.0012	15.775
240.0000	0.24468	0.0010	20.287
288.0000	0.26028	0.0009	24.817
384.0000	0.28860	0.0008	33.919
480.0000	0.31428	0.0007	43.059
600.0000	0.34368	0.0006	54.521

From table above, H_{max} is: 0.785 m

Max. water depth = 785 mm is less than proposed minimum 825 mm deep Cultec stormwater management system. For details please refer to drawing 645-C02 Section 'A-A'

Fig 4. Design Calculations

c). Surface Water Network Design

Rainfall intensity roof = 75 mm/hr
 Rainfall intensity paved = 50 mm/hr
 Storm Return Period = 5 years
 Self cleansing Velocity = 0.8-3 m/s
 Roof Vol. run-off coefficient = 1.0
 Paved Vol. run-off coefficient = 1.0
 Pipe Roughness K_s = 0.6 mm

Pipe No.	Impermeable Area (A_p)		Gradient	Diameter	Actual Rate of Flow	Accumulative Rate of Flow	Discharge Velocity	Capacity Full bore flow	Full Bore Velocity	Proportional flow	Discharge Velocity	Proportional Depth
	Roof (A_{p1})	Paved (A_{p2})										
P	m^2	m^2	1 in	mm	l/s	l/s	m/s	l/s	m/s	OK?	OK?	OK?
S1-S2	90.0		25	150	1.9	1.9	1.08	35.68	2.02	OK	OK	OK
S2-S3	174.0		25	150	3.6	3.6	1.31	35.68	2.02	OK	OK	OK
S3-CULTEC	300.0		120	225	6.3	6.3	0.83	47.32	1.19	OK	OK	OK
S4-S5	126.0		30	150	2.6	2.6	1.12	32.55	1.84	OK	OK	OK

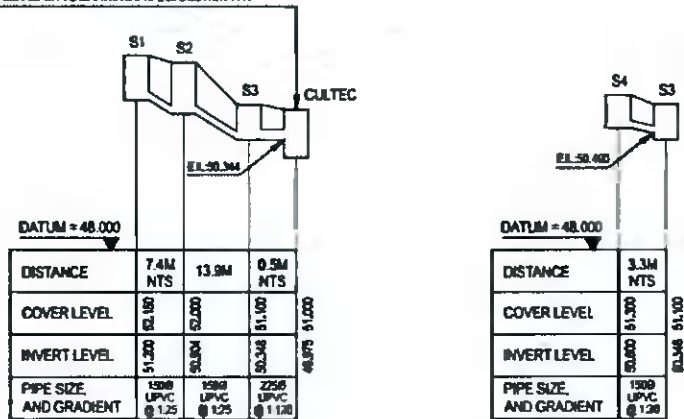
Fig 5. Surface Water Network Design-Calculations

S1	52.150		51.200							0.950
S2	52.000	50.904	50.904		7.4	25			150	1.096
S3	51.100	50.348	50.348		13.9	25			150	0.752
CULTEC	51.000	50.344	49.975		0.5	120			225	1.025

S4	51.300		50.600							0.700
S3	51.100	50.490	50.348		3.3	30			150	0.752

Fig 6. Surface Water Network Design-Levels

PROPOSED CULTEC (OR SIMILAR APPROVED) STORM WATER MANAGEMENT SYSTEM WITH TOTAL INFILTRATION SYSTEM DESIGNED FOR 100 YEAR STORM + 30% INCREASE IN RAINFALL DEPTH (FOR CLIMATE CHANGE). TOTAL STORAGE = 15.7 m³. COLLECTION AREA = 300.0 m². INFILTRATION RATE = 0.000185 mm. FOR DETAILS PLEASE REFER TO DRAWING BAS-C02 SECTION 7-A-K



**LONGITUDINAL SECTION
S1 TO CULTEC
SCALE: HORIZONTAL 1:1000
/ VERTICAL 1:100 @ A2**

**LONGITUDINAL SECTION
S4 TO S3
SCALE: HORIZONTAL 1:1000
/ VERTICAL 1:100 @ A2**

Fig 7. Surface Water Network Design-Level

4. **SuDS System Location**

The location and configuration of the underground storm attenuation system will depend on the topography, the presence of underground services, planning conditions, and on or other factors, whether existing, planned, or anticipated. The separation distances tabulated below are provided as a guide. Separation distances should be such that any excavation work required for the stormwater disposal system does not undermine adjacent features, such as buildings, roads, or walls.

Features	Required	Proposed Storm Management system
Sewage system	10m	14m Cultec to FPS
Building/Structure	5m	5m Cultec to dwelling
Road Boundary	5m	25m Cultec to road boundary
Site Boundary	3m	3m Cultec to site boundary
Watercourse	10m	7.9m Cultec to river Dodder*

Fig 8. Separation distances. * Due to a site space restrictions, minimum recommended separation distance for standard soakaway cannot be met. The advanced Cultec Storm Water Management SuDS system has been proposed as more advanced alternative. Collected storm water will be polished and discharged into ground with no direct connection to waterbody, thus protecting receiving waters to the best available standard.



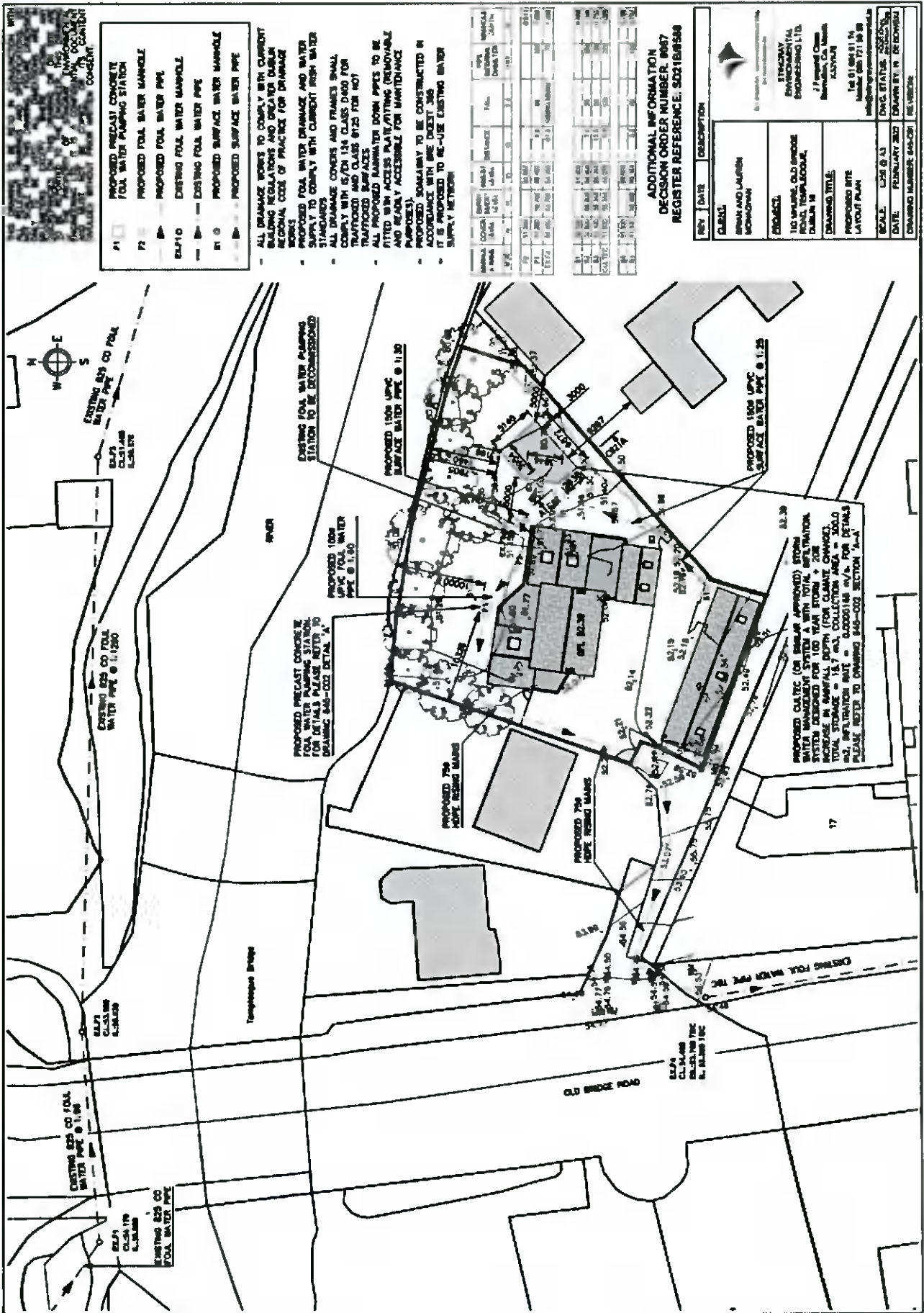


Fig 9. Proposed Drainage Layout

5. Recommendation

- ✚ It is the responsibility of the Project Supervisor (i.e., Engineer, Architect, or other competent person) to ensure that the stormwater management system is located and installed in accordance with planning conditions, SuDS and BRE 365 requirements.
- ✚ All elements of the attenuation system should be effectively maintained by qualified service technicians/engineers.

6. Important note

- ✚ The percentage run-off is taken as 100% from the drained area. No reduction is made to the design run-off volume discharged to the Cultec for losses due to surface wetting or the filling of puddles during the storm.
- ✚ No allowance is made for the time taken for run-off to discharge to the Cultech system. The required storage volume is calculated based on instantaneous discharge to the storm attenuation system.
- ✚ The outflow from the Cultec system is underestimated. Higher infiltration rates occur at the greater depths of storage in practice, than are adopted in design, and because the outflow is calculated of the rainfall duration rather than of run off duration. The latter maybe considerably longer depending on the size and length of drains.
- ✚ This report is only valid on the time of site inspection. The author cannot be responsible for any changes that could occur as result of construction, remediation, adjustment works completed afterwards.

7. Summary

- ✚ The effective storage of Cultec storm attenuation system filled with granular material (30% void) is 15.7m³.
- ✚ Storm attenuation system with minimum dimensions as per Drw.645-C01 & 645-C02 to be constructed. The sizing of the storm attenuation system can be further reduced if rainwater collection system or additional sustainable drainage systems will be installed.

Signed: *Waldemar Debowski* Date: 7 February 2022

Qualifications: B.Eng. P.Grad.Dips. FETAC Cert MIEI MIAH