Part of the STRI Group

epg

The Environmental Protection Group Ltd



Drainage Strategy for the Proposed Pitch & Car Park

Openshaw

Blakedown Sport & Play

EPG-9705-DS-01
21.03.22
Rev 1.0

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Project No: EPG 9705 Prepared by: John Roberts Date: 21.03.22

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Contents

1 Summary 2
2 Drainage Proposals 3
2.1 Design Parameters 3
2.2 Calculation Inputs 3
3 Proposed Design & Calculations 4
4 Maintenance 5
5 Appendix A: 7
Proposed Drainage layout & Details 7
6 Appendix B: 9
BGS Borehole 9
7 Appendix C: 11
Proposed Microdrainage Calculations 11

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1 SUMMARY

The following proposal outlines the storm water management system proposed for an Artificial Turf Pitch (ATP) and a car park at Openshaw Academy, Manchester.

The development is accessed from Whitworth Street to the north of the development. The proposed pitch shall be of permeable construction and be laid flat. The car park shall fall from east to west with temporary coach parking to the northern section.

The runoff from the pitch will percolate through the porous surfacing courses into a porous sub-base (30% void material). The pitch will be flow controlled and shall discharge to the car park attenuation tank. The car park drainage outfall will be restricted to less than 5 l/s during the proposed 1in100+40% climate change event.

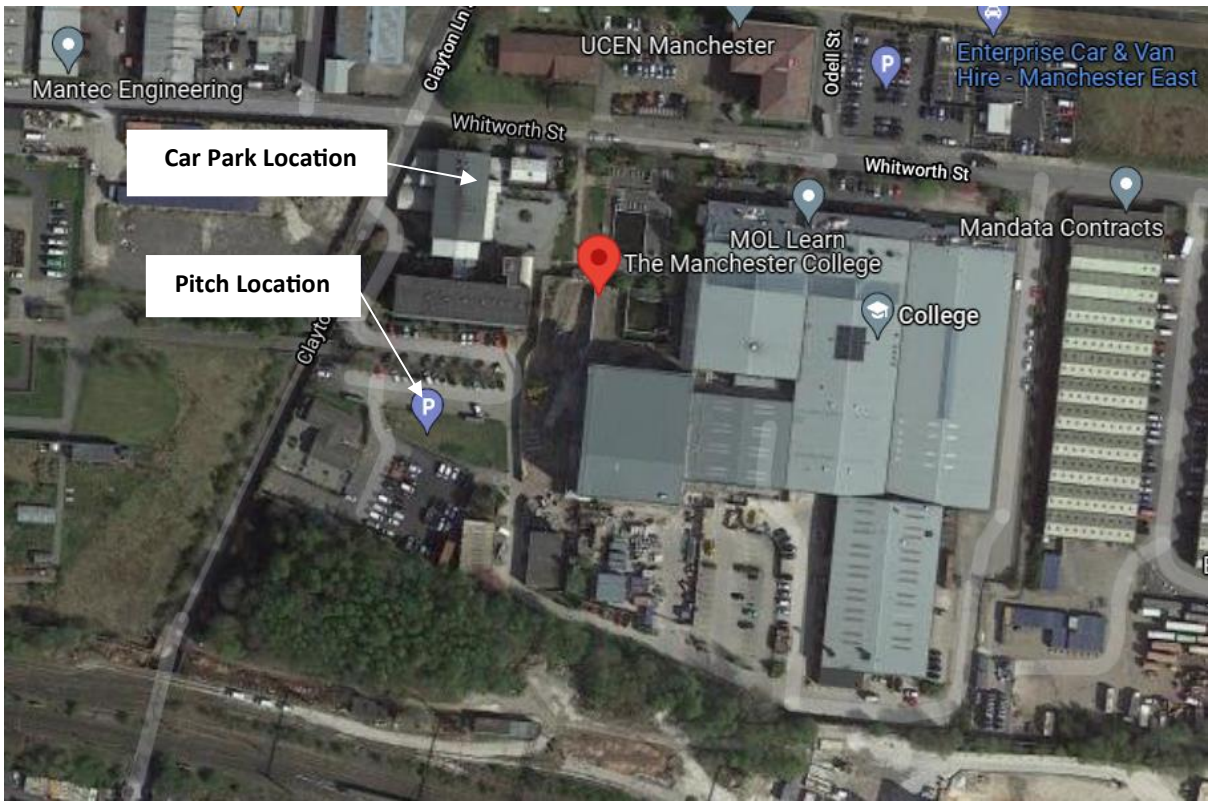


Fig 1. Proposed location plan

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2 DRAINAGE PROPOSALS

2.1 Design Parameters

EPG has reviewed the information provided and considered an approach based on previous experience of similar sites and current SuDS guidance provided in:

- National Planning Policy Framework (NPPF 25)
- Local/Regional Sustainable drainage plans/requirements
- CIRIA report C753 (2016); The SUDS manual
- CIRIA report C680 (2008); Structural design of modular geocellular drainage tanks
- CIRIA Report C724 (2013) Creating water sensitive places-scoping the potential for water sensitive urban design in the UK
- BS-ISO 24536:2019 – Guidelines for stormwater management in urban areas.

The NPPF requires that surface water arising from a developed site should as far as practicable be managed in a sustainable manner to mimic the surface water flows arising from the site prior to re-development. Opportunities to reduce the surface water run-off and the associated flood risk should be identified and climate change should be taken into account. Building Regulations (Part H), NPPF and Environment Agency advice notes require the consideration of sustainable drainage techniques based on a hierarchical approach to the management of surface water, with the emphasis on the use of Source Control techniques and a treatment train as the preferred option.

2.2 Calculation Inputs

Cv:	0.750 (summer) & 0.840 (winter)
M5-60:	18.000
Ratio, R:	0.360
Storm Durations:	15 mins to 10080 mins
Catchment Area Pitch & Car Park:	1 ha
Infiltration:	0 m/s
Design Flow Rate:	5 l/s
Design Storm:	1in100 year
Climate Change:	40%

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3 PROPOSED DESIGN & CALCULATIONS

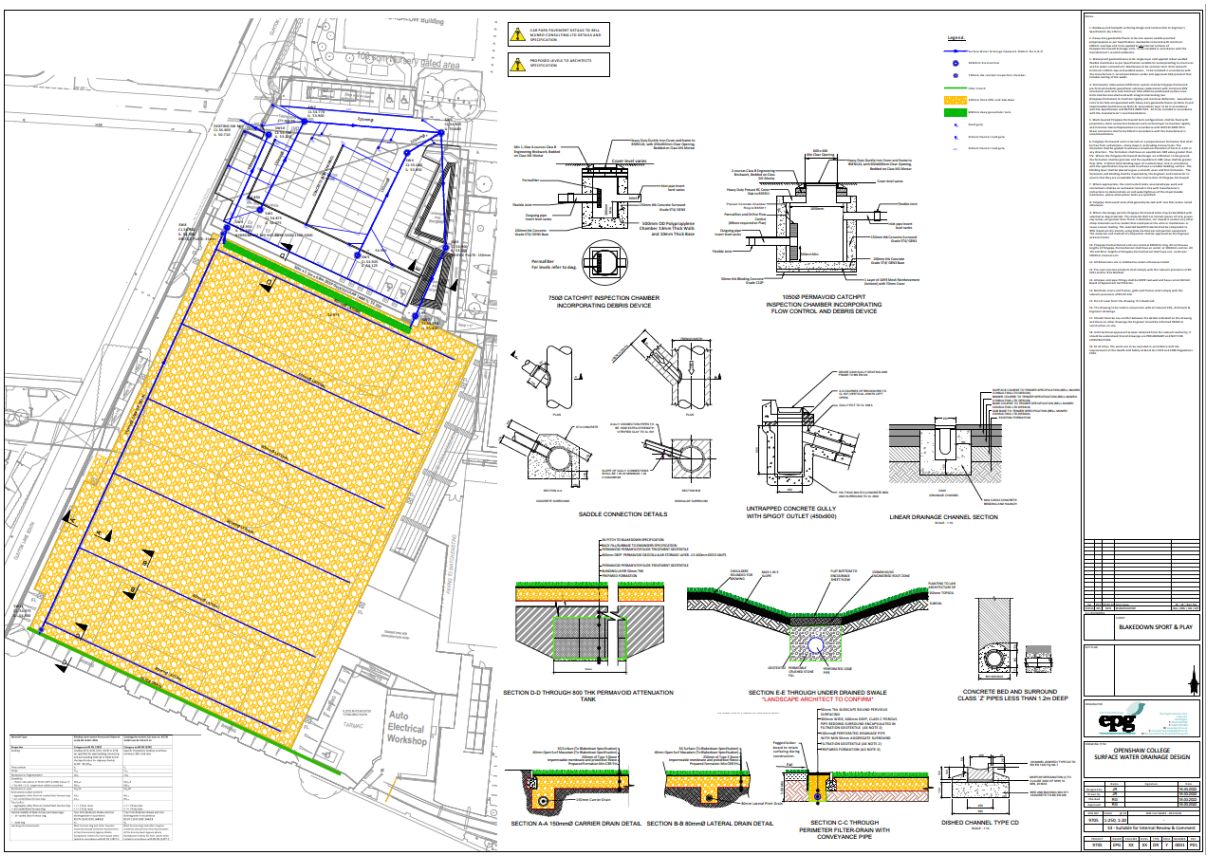


Fig 2. Snapshot of the proposed design

The proposed SuDS system is designed to restricted to 5 /ls during the 100-year storm event plus an additional 40% for climate change below ground. The proposed drainage layout and details can be found in Appendix A. Runoff from the pitch shall enter into the permeable stone sub-base for attenuation. The car park is drained by traditional gullies and channels with attenuation provided within the swales and a geocellular tank located below the pitch sub-base. The pitch and pond drainage systems combine with a restricted discharge of 5 l/s. The site outfalls to the culvert in Clayton Lane South.

Infiltration has been discounted by Bell Munro Consulting Ltd at tender stage due to the poor ground conditions and the raised nature of the development compared to the surrounding topography. A borehole scan from BGS in Appendix B shows the underlying Clay.

Microdrainage design software has been used to determine the storage volume required and the results can be found in Appendix C.

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4 MAINTENANCE

We would recommend that Pre-handover inspections are undertaken.

Sports Pitch:

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Remove litter and debris	Once a year, after autumn leaf fall, or reduced frequency as required, based on site-specific observations of clogging or manufacturer's recommendations
Occasional maintenance	Occasional sand re-dressing	As required and to manufacturers guidelines
	Removal of weeds or management using glyphospate applied directly into the weeds by an applicator rather than spraying	As required – once per year on less frequently used pavements
Remedial Actions	Initial inspection	Monthly for three months after installation
Monitoring	Inspect for evidence of poor operation and/or weed growth – if required, take remedial action	Three-monthly, 48 h after large storms in first six months
	Monitor inspection chambers	Annually

Pipework, catchpits and gullies:

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Inspect and identify any pipework that is not operating/flowing correctly. If required, take remedial action	Monthly for 3 months, then annually
	Remove debris and silt from sump chambers	Annually, or as required
Remedial actions	Clear blockages by jetting and line the pipework internally where required	As required
Monitoring	CCTV Drainage Survey	Every 5 years or as required

Geocelullar Tanks:

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial action	Monthly for 3 months, then annually
	Remove debris from the catchment surface (where it may cause risks to performance)	Monthly
	Where rainfall infiltrates into the tank from above, check surface of filter for blockage by sediment, algae or other matter; remove and replace surface infiltration medium as necessary.	Annually
	Remove sediment from pre-treatment components, as Catchpits and gullies above	As necessary – indicated by system inspections or immediately following significant spill
Remedial actions	Repair/rehabilitate inlet, outlet and vent	As required
Monitoring	Inspect/check all inlets, outlets to ensure that they are in good condition and operating as designed	Annually
	Survey inside of tank for sediment build-up and remove if necessary	Every 5 years or as required

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Accidental Spillages

Any accidental spillages will be of a domestic nature. And should be dealt with quickly and appropriately.

As soon as a spillage is identified, the outlet inlets should be covered to prevent pollution entering the system

- Washdown and dilute affected area.
- Empty inspection chamber of all pollution that has entered.

Management

It is understood that Openshaw College will undertake the maintenance and management duties for the pitch. The management team must be aware that the sub-base below the surfacing layer is necessary to manage the drainage of the pitch. They should inform any contractor working on any future repairs of the presence and requirement of the sub-base drainage system.

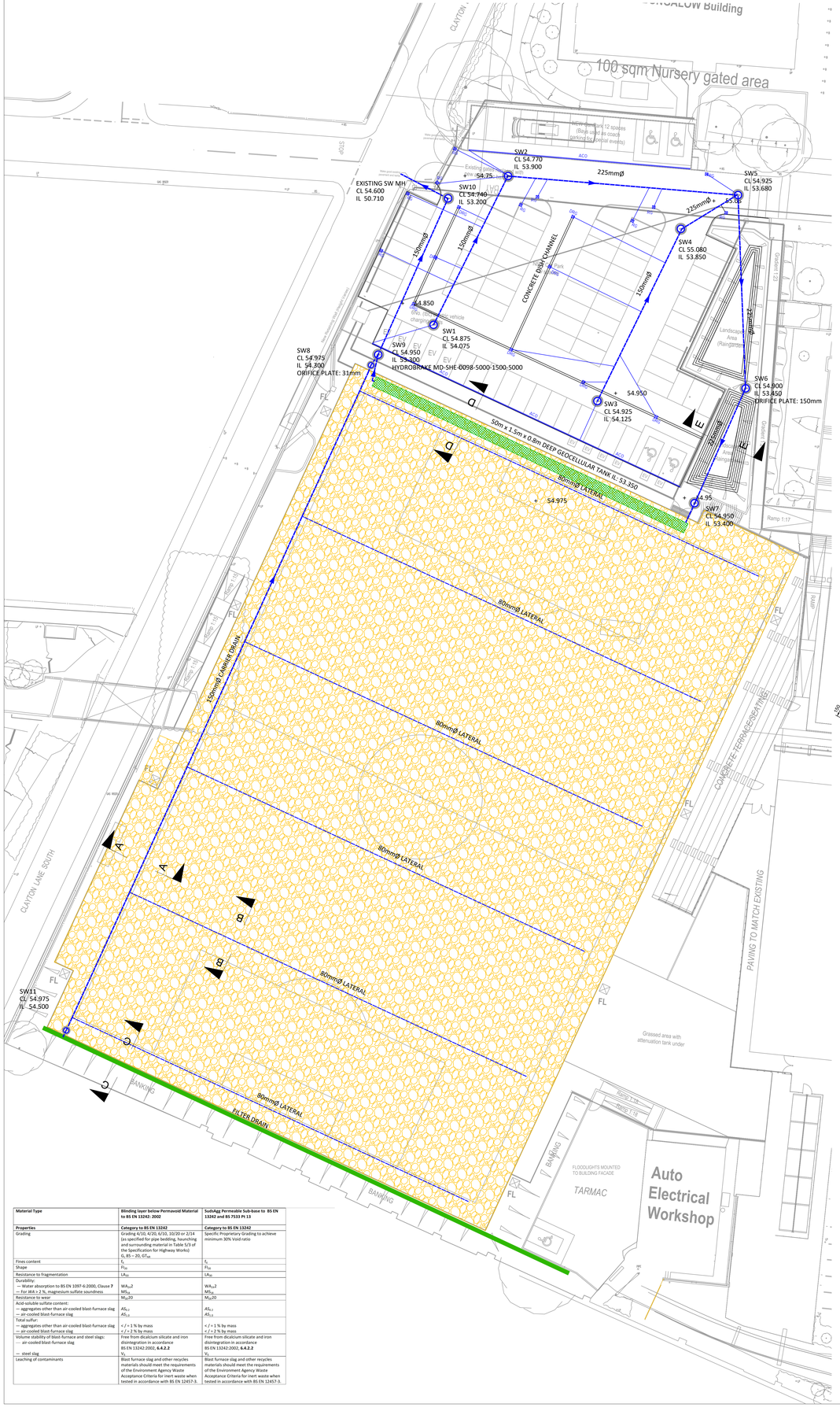
Openshaw College should keep records of all inspections and maintenance.

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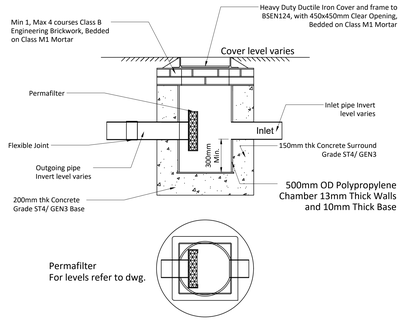
5 APPENDIX A:

Proposed Drainage layout & Details

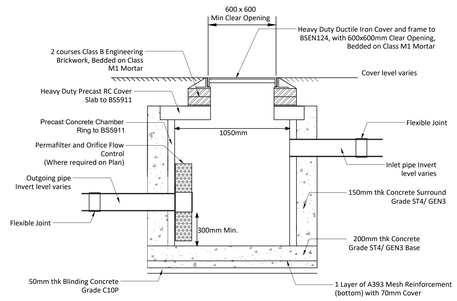
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Material Type	Blinding layer below Permavoid Material to BS EN 13242: 2002	SudsAgg Permeable Sub-base to BS EN 13242 and BS 7533 Pt 13
Properties	**Category to BS EN 13242**	**Category to BS EN 13242**
Grading	Grading 6/10, 6/20, 6/10, 10/20 or 2/14 (as specified for pipe bedding, haunching and surrounding material in Table 5/3 of the Specification for Highway Works) $G_C 85 - 20; GF_{80}$	Specific Proprietary Grading to achieve minimum 30% Void ratio
Fines content	f_c	f_c
Shape	FI_{20}	FI_{20}
Resistance to fragmentation	LA_{50}	LA_{50}
Durability: — Water absorption to BS EN 1097-6:2000, Clause 7 — For WA > 2 %, magnesium sulfate soundness	$WA_{24}2$ MS_{18}	$WA_{24}2$ MS_{18}
Resistance to wear	$M_{DE}20$	$M_{DE}20$
Acid-soluble sulfate content: — aggregates other than air-cooled blast-furnace slag — air-cooled blast-furnace slag	$AS_{0.2}$ $AS_{1.0}$	$AS_{0.2}$ $AS_{1.0}$
Total sulfur: — aggregates other than air-cooled blast-furnace slag — air-cooled blast-furnace slag	< / = 1 % by mass < / = 2 % by mass	< / = 1 % by mass < / = 2 % by mass
Volume stability of blast-furnace and steel slags: — air-cooled blast-furnace slag — steel slag	Free from dicalcium silicate and iron disintegration in accordance BS EN 13242:2002, **6.4.2.2** $V_{0.5}$	Free from dicalcium silicate and iron disintegration in accordance BS EN 13242:2002, **6.4.2.2** $V_{0.5}$
Leaching of contaminants	Blast furnace slag and other recycles materials should meet the requirements of the Environment Agency Waste Acceptance Criteria for inert waste when tested in accordance with BS EN 12457-3.	Blast furnace slag and other recycles materials should meet the requirements of the Environment Agency Waste Acceptance Criteria for inert waste when tested in accordance with BS EN 12457-3.



750Ø CATCHPIT INSPECTION CHAMBER INCORPORATING DEBRIS DEVICE



1050Ø PERMAVOID CATCHPIT INSPECTION CHAMBER INCORPORATING FLOW CONTROL AND DEBRIS DEVICE

Legend.

- Surface Water Drainage Pipework 150mm dia U.N.O
- 1050mm dia manhole
- 750mm dia catchpit inspection chamber
- Filter trench
- 250mm thick 30% void Sub-Base
- 800mm deep geocellular tank
- Road gully
- Dished channel road gully
- Dished channel road gully

Notes.

1. Roadway and footpath surfacing design and construction to Engineer's Specification (by others).

2. Heavy duty geotextile fleece to be non-woven needle-punched polypropylene as per Specification. Geotextile to be laid with minimum 300mm overlaps and to be applied to all external surfaces of Polypipe-Permavoid drainage units. To be installed in accordance with the manufacturer's recommendations.

3. Waterproof geomembrane to be single layer cold applied robust welded flexible membrane as per Specification suitable for waterproofing to structures and for water containment. Membrane to be nominal 1mm thick laid with minimum 120mm laps and welded seams. To be installed in accordance with the manufacturer's recommendations under and approved CQA protocol that includes testing of the welds.

4. Stormwater attenuation/infiltration system shall be Polypipe Permavoid pre-formed modular geocellular sub-base replacement with minimum 95% volumetric void ratio and minimum 52% effective perforated surface area. Units shall be manufactured with integral interlocking ties (Polypipe-Permaties) to maintain rigidity and minimise deflection. Geocellular units to be fully encapsulated with Heavy duty geotextile fleece (as Note 2) and impermeable membrane (as Note 3). Geocellular layer to be in accordance with the Specification and BS7533:2009 Pt13. All to be installed in accordance with the manufacturer's recommendations.

5. Multi-layered Polypipe-Permavoid tank configurations shall be fixed with proprietary shear connectors between each vertical layer to maintain rigidity and minimise lateral displacement in accordance with BS7533:2009 Pt13. Shear connectors shall to be fitted in accordance with the manufacturer's recommendations.

6. Polypipe Permavoid units to be laid on a prepared even formation that shall be free from undulations, sharp steps or protruding stones/rocks. The formation shall be graded to achieve a maximum deviation of 5mm in 3.0m in any direction. The formation shall have an equilibrium CBR value greater than 5%. Where the Polypipe-Permavoid discharges via infiltration to the ground the formation shall be granular and the equilibrium CBR value shall be greater than 10%. A 50mm thick blinding layer of crushed clean rock in accordance with the specification may be used to achieve a suitable bedding surface. The blinding layer shall be placed to give a smooth, even and firm formation. The formation and blinding shall be inspected by the Engineer and Contractor to ensure that they are acceptable for the construction of Polypipe-Permavoid.

7. Where appropriate, the constructed tanks, associated pipe work and connections shall be air and water tested in line with manufacturer's instructions to demonstrate air and watertightness of the impermeable membrane, where attenuation tanks are specified.

8. Polypipe-Permavoid units shall generally be laid with zero falls unless noted otherwise.

9. Where the design permits Polypipe-Permavoid tanks may be backfilled with selected as-dug materials. This material shall not contain pieces of rock, gravel, clay lumps, etc greater than 75mm in diameter, nor should it contain any other sharp materials such as metals that could pierce the units or membranes or cause uneven loading. The selected backfill material shall be compacted to 90% maximum dry density using plate mechanical compaction equipment. The materials and method of compaction shall be approved by the Engineer and Contractor.

10. Polypipe-Permachannel units are nominal 1000mm long. All continuous lengths of Polypipe-Permachannel shall have an outlet at 1000mm centres. All 'Hit and Miss' lengths of Polypipe-Permachannel shall have one outlet per 1000mm channel unit.

11. All dimensions are in millimetres unless otherwise stated.

12. Pre-cast concrete products shall comply with the relevant provisions of BS 5911 and be 'Kite Marked'.

13. All pipes and pipe fittings shall be HDPE twinwall and have current British Board of Agreement Certification.

14. Manhole covers and frames, grids and frames shall comply with the relevant provisions of BS EN 124.

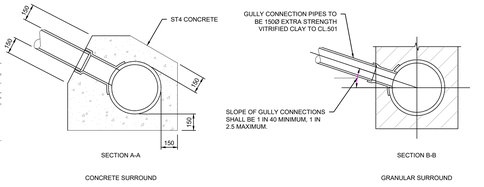
15. Do not scale from this drawing. If in doubt ask.

16. This drawing to be read in conjunction with all relevant EPG, Architects & Engineers drawings.

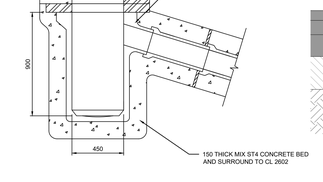
17. Should there be any conflict between the details indicated on this drawing and those on other drawings the Engineer should be informed PRIOR to construction on site.

18. Until technical approval has been obtained from the relevant Authority, It should be understood that all drawings are PRELIMINARY and NOT FOR CONSTRUCTION.

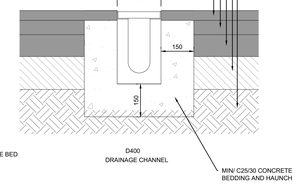
19. At all times the works are to be executed in accordance with the requirements of the Health And Safety at Work Act 1974 and CDM Regulations 2015.



SADDLE CONNECTION DETAILS

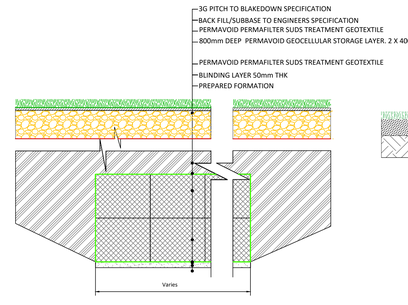


UNTRAPPED CONCRETE GULLY WITH SPIGOT OUTLET (450x900)

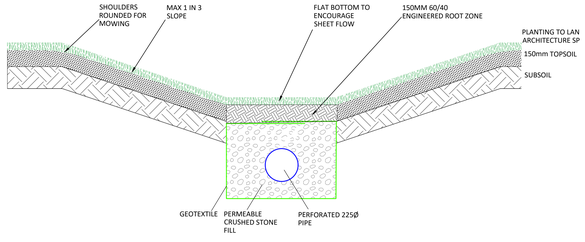


LINEAR DRAINAGE CHANNEL SECTION

SCALE - 1:10

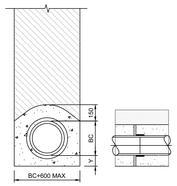


SECTION D-D THROUGH 800 THK PERMAVOID ATTENUATION TANK

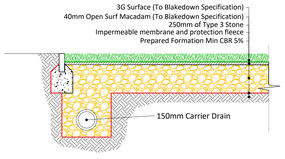


SECTION E-E THROUGH UNDER DRAINED SWALE

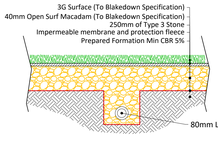
LANDSCAPE ARCHITECT TO CONFIRM



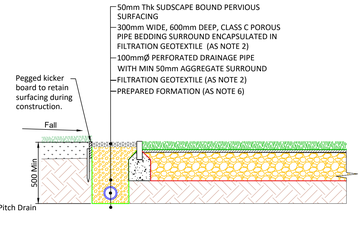
CONCRETE BED AND SURROUND CLASS `Z' PIPES LESS THAN 1.2m DEEP



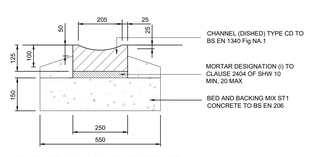
SECTION A-A 150mmØ CARRIER DRAIN DETAIL



SECTION B-B 80mmØ LATERAL DRAIN DETAIL



SECTION C-C THROUGH PERIMETER FILTER-DRAIN WITH CONVEYANCE PIPE



DISHED CHANNEL TYPE CD

SCALE - 1:10

S3	P01	18.03.22	First issue			JR	JR | RG | RG
STATUS	REV	DATE	REVISION HISTORY			DSG | DRW | CHK | APP	

ALL REVISIONS

CLIENT

BLAKEDOWN SPORT & PLAY

KEY PLAN

ORIGINATOR

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DRAWING TITLE

OPENSHAW COLLEGE
SURFACE WATER DRAINAGE DESIGN

	Name	Signature	Date
Designed by	JR		18.03.2022
Drawn by	JR		18.03.2022
Checked	RG		18.03.2022
Approved	RG		18.03.2022

EPG REF	SCALE	@ A0	BIM FILE NAME - REVISION
9705	1:250, 1:20		-
	S3 - Suitable for Internal Review & Comment		

PROJECT	ISSUER	VOLUME	LEVEL	TYPE	ROLE	NUMBER	REV
9705	EPG	XX	XX	DR	Y	0001	P01

6 APPENDIX B:

BGS Borehole

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SJ89NE 8718 9736 524

SIRATA SURVEYS LTD.,
Telephone: 0606 834637 Fax: 0606 836657

Borehole Number : 3
Sheet 1 of 1.

Job Number : 6555/3 Location : Manchester Alluminium Plant
Client : Manchester City Council

Dia. & Drilling Methods
150mm Diameter
light cable percussion

Description of Strata	Red. Level	Legend	Thick -ness	Depth m	Sample Depths	Sample Types	N Value	Cu	#	Water Level	Piezo -meter	Daily Prog.
MADE GROUND (200mm concrete over very loose black wet ashes cinder gravel and brick pieces)			(1.90)	0.00	1.00 1.00 - 1.45	D 1 S 1	N 4					
MADE GROUND (firm to stiff brown orange black silty sandy clay with grey fissures, patches of black ash, pockets of sand and silt, and occasional coal inclusions, brick pieces and root penetration)			(0.70)	1.90	2.00 - 2.45	U 1						
Very stiff brown silty sandy CLAY with grey fissures, gravel and coal inclusions pockets of sand and silt. Band of silt at 6.90m to 6.95m				2.60	2.60	D 2		92	0			
					3.00 - 3.45	U 2						
					3.60	D 3		307	0			
					4.00 - 4.45	U 3						
					4.60	D 4		205	0			
					5.00 - 5.45	U 4						
			(6.30)		5.60	D 5		166	0			
					6.50 - 6.95	U 5						
					7.10	D 6		177	0			
					8.30 - 8.75	U 6						
Medium dense very clayey slightly gravelly fine grained SAND. A band of Firm brown sandy silty Clay at 9.30 to 9.55m			(1.20)	8.90	8.90 9.10 9.10 - 9.55	D 7 D 8 U 7		211	0			
					9.70 - 10.15	S 2	N 17	85	0			
Borehole Completed				10.10								22/7

General Remarks :
No water encountered during drilling.

Dates : 22 JUL 92
Driller : DH
Engineer:

Coordinates :

7 APPENDIX C:

Proposed Microdrainage Calculations

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Cascade Summary of Results for Car Park Swale 1.SRCX

Upstream Structures	Outflow To	Overflow To
(None)	Car Park Swale 2.SRCX	(None)

Half Drain Time : 9 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	54.485	0.685	0.0	36.7	36.7	25.6	O K
30 min Summer	54.751	0.951	0.0	44.0	44.0	26.8	FLOOD
60 min Summer	54.752	0.952	0.0	44.0	44.0	27.2	FLOOD
120 min Summer	54.750	0.950	0.0	43.9	43.9	25.7	FLOOD
180 min Summer	54.136	0.336	0.0	24.0	24.0	24.7	O K
240 min Summer	54.088	0.288	0.0	21.7	21.7	21.2	O K
360 min Summer	54.033	0.233	0.0	18.7	18.7	16.2	O K
480 min Summer	54.003	0.203	0.0	16.3	16.3	13.6	O K
600 min Summer	53.984	0.184	0.0	14.1	14.1	12.1	O K
720 min Summer	53.970	0.170	0.0	12.5	12.5	11.0	O K
960 min Summer	53.949	0.149	0.0	10.2	10.2	9.5	O K
1440 min Summer	53.925	0.125	0.0	7.7	7.7	7.7	O K
2160 min Summer	53.902	0.102	0.0	5.6	5.6	6.1	O K
2880 min Summer	53.888	0.088	0.0	4.5	4.5	5.2	O K
4320 min Summer	53.876	0.076	0.0	3.3	3.3	4.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	118.613	0.0	44.5	20
30 min Summer	79.413	1.2	59.5	27
60 min Summer	50.812	1.6	76.2	42
120 min Summer	31.468	0.2	94.4	72
180 min Summer	23.466	0.0	105.6	108
240 min Summer	18.940	0.0	113.6	138
360 min Summer	13.882	0.0	124.9	196
480 min Summer	11.143	0.0	133.7	256
600 min Summer	9.389	0.0	140.8	316
720 min Summer	8.158	0.0	146.8	376
960 min Summer	6.531	0.0	156.7	496
1440 min Summer	4.764	0.0	171.5	736
2160 min Summer	3.468	0.0	187.3	1104
2880 min Summer	2.766	0.0	199.1	1464
4320 min Summer	2.007	0.0	216.7	2160

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Cascade Summary of Results for Car Park Swale 1.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
5760 min Summer	53.869	0.069	0.0	2.6	2.6	4.0	O K
7200 min Summer	53.862	0.062	0.0	2.2	2.2	3.6	O K
8640 min Summer	53.857	0.057	0.0	1.9	1.9	3.3	O K
10080 min Summer	53.854	0.054	0.0	1.7	1.7	3.0	O K
15 min Winter	54.751	0.951	0.0	44.0	44.0	26.7	FLOOD
30 min Winter	54.754	0.954	0.0	44.0	44.0	29.3	FLOOD
60 min Winter	54.752	0.952	0.0	44.0	44.0	27.7	FLOOD
120 min Winter	54.416	0.616	0.0	34.5	34.5	25.6	O K
180 min Winter	54.098	0.298	0.0	22.2	22.2	22.2	O K
240 min Winter	54.050	0.250	0.0	19.7	19.7	17.7	O K
360 min Winter	53.998	0.198	0.0	15.7	15.7	13.2	O K
480 min Winter	53.972	0.172	0.0	12.8	12.8	11.2	O K
600 min Winter	53.955	0.155	0.0	10.9	10.9	9.9	O K
720 min Winter	53.943	0.143	0.0	9.5	9.5	9.0	O K
960 min Winter	53.925	0.125	0.0	7.7	7.7	7.7	O K
1440 min Winter	53.901	0.101	0.0	5.6	5.6	6.1	O K
2160 min Winter	53.884	0.084	0.0	4.1	4.1	4.9	O K
2880 min Winter	53.876	0.076	0.0	3.3	3.3	4.4	O K
4320 min Winter	53.865	0.065	0.0	2.4	2.4	3.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
5760 min Summer	1.596	0.0	229.8	2928
7200 min Summer	1.336	0.0	240.4	3672
8640 min Summer	1.154	0.0	249.3	4392
10080 min Summer	1.020	0.0	257.0	5008
15 min Winter	118.613	1.1	49.8	19
30 min Winter	79.413	3.7	66.7	28
60 min Winter	50.812	2.1	85.3	42
120 min Winter	31.468	0.0	105.7	74
180 min Winter	23.466	0.0	118.2	110
240 min Winter	18.940	0.0	127.2	140
360 min Winter	13.882	0.0	139.9	198
480 min Winter	11.143	0.0	149.7	256
600 min Winter	9.389	0.0	157.7	316
720 min Winter	8.158	0.0	164.4	376
960 min Winter	6.531	0.0	175.5	496
1440 min Winter	4.764	0.0	192.1	738
2160 min Winter	3.468	0.0	209.7	1092
2880 min Winter	2.766	0.0	223.0	1444
4320 min Winter	2.007	0.0	242.7	2172

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Cascade Summary of Results for Car Park Swale 1.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
5760 min Winter	53.857	0.057	0.0	1.9	1.9	3.3	O K
7200 min Winter	53.852	0.052	0.0	1.6	1.6	3.0	O K
8640 min Winter	53.849	0.049	0.0	1.4	1.4	2.7	O K
10080 min Winter	53.846	0.046	0.0	1.2	1.2	2.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
5760 min Winter	1.596	0.0	257.4	2864
7200 min Winter	1.336	0.0	269.3	3656
8640 min Winter	1.154	0.0	279.2	4336
10080 min Winter	1.020	0.0	287.8	5032

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Cascade Rainfall Details for Car Park Swale 1.SRCX

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.000	Shortest Storm (mins)	15
Ratio R	0.360	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.200

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.060	4	8	0.060	8	12	0.060	12	16	0.020

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Cascade Model Details for Car Park Swale 1.SRCX

Storage is Online Cover Level (m) 54.750

Complex Structure

Tank or Pond

Invert Level (m) 53.800

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	53.5	0.700	0.0	1.400	0.0	2.100	0.0
0.100	66.7	0.800	0.0	1.500	0.0	2.200	0.0
0.200	81.4	0.900	0.0	1.600	0.0	2.300	0.0
0.300	97.5	1.000	0.0	1.700	0.0	2.400	0.0
0.400	0.0	1.100	0.0	1.800	0.0	2.500	0.0
0.500	0.0	1.200	0.0	1.900	0.0		
0.600	0.0	1.300	0.0	2.000	0.0		

Orifice Outflow Control

Diameter (m) 0.150 Discharge Coefficient 0.600 Invert Level (m) 53.800

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Cascade Summary of Results for Car Park Swale 2.SRCX

Upstream Structures	Outflow To	Overflow To
Car Park Swale 1.SRCX Proposed 3G Pitch.SRCX	(None)	(None)

Half Drain Time : 156 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	53.758	0.458	0.0	4.9	4.9	32.7	O K
30 min Summer	53.956	0.656	0.0	4.9	4.9	46.7	O K
60 min Summer	54.112	0.812	0.0	4.9	4.9	61.5	O K
120 min Summer	54.319	1.019	0.0	4.9	4.9	73.8	O K
180 min Summer	54.370	1.070	0.0	4.9	4.9	77.1	O K
240 min Summer	54.369	1.069	0.0	4.9	4.9	77.1	O K
360 min Summer	54.328	1.028	0.0	4.9	4.9	74.4	O K
480 min Summer	54.278	0.978	0.0	4.9	4.9	71.3	O K
600 min Summer	54.218	0.918	0.0	4.9	4.9	68.0	O K
720 min Summer	54.142	0.842	0.0	4.9	4.9	63.9	O K
960 min Summer	54.063	0.763	0.0	4.9	4.9	56.2	O K
1440 min Summer	53.901	0.601	0.0	4.9	4.9	42.8	O K
2160 min Summer	53.700	0.400	0.0	4.9	4.9	28.5	O K
2880 min Summer	53.580	0.280	0.0	4.7	4.7	20.0	O K
4320 min Summer	53.466	0.166	0.0	4.2	4.2	11.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	118.613	0.0	138.3	51
30 min Summer	79.413	0.0	157.1	63
60 min Summer	50.812	0.0	276.5	86
120 min Summer	31.468	0.0	302.7	136
180 min Summer	23.466	0.0	318.4	188
240 min Summer	18.940	0.0	329.4	236
360 min Summer	13.882	0.0	344.3	300
480 min Summer	11.143	0.0	355.4	368
600 min Summer	9.389	0.0	364.0	438
720 min Summer	8.158	0.0	371.0	500
960 min Summer	6.531	0.0	381.6	626
1440 min Summer	4.764	0.0	395.2	874
2160 min Summer	3.468	0.0	635.5	1220
2880 min Summer	2.766	0.0	645.1	1564
4320 min Summer	2.007	0.0	651.0	2256

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Cascade Summary of Results for Car Park Swale 2.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
5760 min Summer	53.421	0.121	0.0	3.8	3.8	8.6	O K
7200 min Summer	53.407	0.107	0.0	3.4	3.4	7.6	O K
8640 min Summer	53.397	0.097	0.0	3.1	3.1	6.9	O K
10080 min Summer	53.391	0.091	0.0	2.9	2.9	6.5	O K
15 min Winter	53.830	0.530	0.0	4.9	4.9	37.8	O K
30 min Winter	54.040	0.740	0.0	4.9	4.9	53.8	O K
60 min Winter	54.265	0.965	0.0	4.9	4.9	70.6	O K
120 min Winter	54.464	1.164	0.0	4.9	4.9	84.1	O K
180 min Winter	54.523	1.223	0.0	4.9	4.9	88.5	O K
240 min Winter	54.536	1.236	0.0	4.9	4.9	89.0	O K
360 min Winter	54.482	1.182	0.0	4.9	4.9	85.5	O K
480 min Winter	54.432	1.132	0.0	4.9	4.9	81.6	O K
600 min Winter	54.371	1.071	0.0	4.9	4.9	77.2	O K
720 min Winter	54.297	0.997	0.0	4.9	4.9	72.4	O K
960 min Winter	54.100	0.800	0.0	4.9	4.9	60.1	O K
1440 min Winter	53.847	0.547	0.0	4.9	4.9	39.0	O K
2160 min Winter	53.596	0.296	0.0	4.8	4.8	21.1	O K
2880 min Winter	53.486	0.186	0.0	4.4	4.4	13.3	O K
4320 min Winter	53.415	0.115	0.0	3.6	3.6	8.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
5760 min Summer	1.596	0.0	1071.4	2944
7200 min Summer	1.336	0.0	1066.0	3680
8640 min Summer	1.154	0.0	1051.1	4416
10080 min Summer	1.020	0.0	1028.9	5144
15 min Winter	118.613	0.0	145.0	52
30 min Winter	79.413	0.0	165.9	65
60 min Winter	50.812	0.0	289.9	90
120 min Winter	31.468	0.0	319.0	136
180 min Winter	23.466	0.0	336.5	188
240 min Winter	18.940	0.0	348.7	240
360 min Winter	13.882	0.0	365.2	314
480 min Winter	11.143	0.0	377.5	386
600 min Winter	9.389	0.0	387.0	464
720 min Winter	8.158	0.0	394.7	544
960 min Winter	6.531	0.0	406.4	686
1440 min Winter	4.764	0.0	421.4	924
2160 min Winter	3.468	0.0	671.5	1256
2880 min Winter	2.766	0.0	681.7	1584
4320 min Winter	2.007	0.0	686.8	2256

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Cascade Summary of Results for Car Park Swale 2.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
5760 min Winter	53.399	0.099	0.0	3.2	3.2	7.0	O K
7200 min Winter	53.390	0.090	0.0	2.9	2.9	6.4	O K
8640 min Winter	53.384	0.084	0.0	2.6	2.6	6.0	O K
10080 min Winter	53.379	0.079	0.0	2.5	2.5	5.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
5760 min Winter	1.596	0.0	1129.4	2952
7200 min Winter	1.336	0.0	1128.9	3768
8640 min Winter	1.154	0.0	1118.2	4512
10080 min Winter	1.020	0.0	1098.1	5248

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Cascade Rainfall Details for Car Park Swale 2.SRCX

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.000	Shortest Storm (mins)	15
Ratio R	0.360	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.000

Time (mins) From:	To:	Area (ha)
0	4	0.000

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Cascade Model Details for Car Park Swale 2.SRCX

Storage is Online Cover Level (m) 54.750

Complex Structure

Cellular Storage

Invert Level (m) 53.300 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	75.0	75.0	0.900	0.0	157.4
0.800	75.0	157.4			

Tank or Pond

Invert Level (m) 54.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	23.7	0.700	0.0	1.400	0.0	2.100	0.0
0.100	40.7	0.800	0.0	1.500	0.0	2.200	0.0
0.200	50.3	0.900	0.0	1.600	0.0	2.300	0.0
0.300	60.6	1.000	0.0	1.700	0.0	2.400	0.0
0.400	71.6	1.100	0.0	1.800	0.0	2.500	0.0
0.500	83.4	1.200	0.0	1.900	0.0		
0.600	0.0	1.300	0.0	2.000	0.0		

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0098-5000-1500-5000
Design Head (m)	1.500
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	98
Invert Level (m)	53.300
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

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Hydro-Brake® Optimum Outflow Control

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.500	5.0	Kick-Flo®	0.878	3.9
Flush-Flo™	0.431	4.9	Mean Flow over Head Range	-	4.3

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.2	1.200	4.5	3.000	6.9	7.000	10.3
0.200	4.4	1.400	4.8	3.500	7.4	7.500	10.7
0.300	4.8	1.600	5.1	4.000	7.9	8.000	11.0
0.400	4.9	1.800	5.4	4.500	8.4	8.500	11.3
0.500	4.9	2.000	5.7	5.000	8.8	9.000	11.6
0.600	4.8	2.200	6.0	5.500	9.2	9.500	11.9
0.800	4.3	2.400	6.2	6.000	9.6		
1.000	4.1	2.600	6.5	6.500	10.0		

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Cascade Summary of Results for Proposed 3G Pitch.SRCX

Upstream Structures	Outflow To	Overflow To
(None)	Car Park Swale 2.SRCX	(None)

Half Drain Time : 4106 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	54.652	0.077	0.0	1.2	1.2	175.9	O K
30 min Summer	54.678	0.103	0.0	1.2	1.2	235.2	O K
60 min Summer	54.706	0.131	0.0	1.3	1.3	299.7	O K
120 min Summer	54.736	0.161	0.0	1.3	1.3	368.2	O K
180 min Summer	54.754	0.179	0.0	1.3	1.3	408.6	O K
240 min Summer	54.766	0.191	0.0	1.3	1.3	436.4	O K
360 min Summer	54.782	0.207	0.0	1.4	1.4	472.8	O K
480 min Summer	54.794	0.219	0.0	1.4	1.4	499.1	O K
600 min Summer	54.802	0.227	0.0	1.4	1.4	518.6	O K
720 min Summer	54.809	0.234	0.0	1.4	1.4	533.7	O K
960 min Summer	54.819	0.244	0.0	1.4	1.4	555.3	O K
1440 min Summer	54.829	0.254	0.0	1.4	1.4	578.4	O K
2160 min Summer	54.833	0.258	0.0	1.4	1.4	587.8	O K
2880 min Summer	54.830	0.255	0.0	1.4	1.4	581.8	O K
4320 min Summer	54.819	0.244	0.0	1.4	1.4	556.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	118.613	0.0	97.3	31
30 min Summer	79.413	0.0	101.0	46
60 min Summer	50.812	0.0	203.7	76
120 min Summer	31.468	0.0	211.8	134
180 min Summer	23.466	0.0	216.4	194
240 min Summer	18.940	0.0	219.4	254
360 min Summer	13.882	0.0	223.1	374
480 min Summer	11.143	0.0	225.4	492
600 min Summer	9.389	0.0	227.0	612
720 min Summer	8.158	0.0	227.9	730
960 min Summer	6.531	0.0	228.7	970
1440 min Summer	4.764	0.0	227.6	1446
2160 min Summer	3.468	0.0	451.9	2164
2880 min Summer	2.766	0.0	449.7	2880
4320 min Summer	2.007	0.0	438.1	3592

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Cascade Summary of Results for Proposed 3G Pitch.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
5760 min Summer	54.808	0.233	0.0	1.4	1.4	530.8	O K
7200 min Summer	54.799	0.224	0.0	1.4	1.4	510.0	O K
8640 min Summer	54.790	0.215	0.0	1.4	1.4	491.1	O K
10080 min Summer	54.783	0.208	0.0	1.4	1.4	473.5	O K
15 min Winter	54.662	0.087	0.0	1.2	1.2	197.3	O K
30 min Winter	54.691	0.116	0.0	1.2	1.2	263.8	O K
60 min Winter	54.722	0.147	0.0	1.3	1.3	336.3	O K
120 min Winter	54.756	0.181	0.0	1.3	1.3	413.6	O K
180 min Winter	54.776	0.201	0.0	1.4	1.4	459.4	O K
240 min Winter	54.790	0.215	0.0	1.4	1.4	491.1	O K
360 min Winter	54.809	0.234	0.0	1.4	1.4	532.9	O K
480 min Winter	54.822	0.247	0.0	1.4	1.4	563.4	O K
600 min Winter	54.832	0.257	0.0	1.4	1.4	586.3	O K
720 min Winter	54.840	0.265	0.0	1.5	1.5	604.3	O K
960 min Winter	54.852	0.277	0.0	1.5	1.5	630.6	O K
1440 min Winter	54.865	0.290	0.0	1.5	1.5	660.8	O K
2160 min Winter	54.872	0.297	0.0	1.5	1.5	678.1	O K
2880 min Winter	54.873	0.298	0.0	1.5	1.5	678.8	O K
4320 min Winter	54.863	0.288	0.0	1.5	1.5	657.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
5760 min Summer	1.596	0.0	844.9	4328
7200 min Summer	1.336	0.0	829.1	5120
8640 min Summer	1.154	0.0	805.4	5960
10080 min Summer	1.020	0.0	775.5	6760
15 min Winter	118.613	0.0	98.7	31
30 min Winter	79.413	0.0	102.8	45
60 min Winter	50.812	0.0	208.1	74
120 min Winter	31.468	0.0	216.9	132
180 min Winter	23.466	0.0	221.9	192
240 min Winter	18.940	0.0	225.1	250
360 min Winter	13.882	0.0	229.0	368
480 min Winter	11.143	0.0	231.5	484
600 min Winter	9.389	0.0	233.1	602
720 min Winter	8.158	0.0	234.1	720
960 min Winter	6.531	0.0	234.8	954
1440 min Winter	4.764	0.0	233.3	1420
2160 min Winter	3.468	0.0	465.6	2104
2880 min Winter	2.766	0.0	462.5	2776
4320 min Winter	2.007	0.0	448.1	4032

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Cascade Summary of Results for Proposed 3G Pitch.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
5760 min Winter	54.850	0.275	0.0	1.5	1.5	627.1	O K
7200 min Winter	54.837	0.262	0.0	1.4	1.4	598.1	O K
8640 min Winter	54.825	0.250	0.0	1.4	1.4	570.4	O K
10080 min Winter	54.814	0.239	0.0	1.4	1.4	545.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
5760 min Winter	1.596	0.0	875.5	4568
7200 min Winter	1.336	0.0	863.2	5480
8640 min Winter	1.154	0.0	842.7	6408
10080 min Winter	1.020	0.0	814.0	7360

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Cascade Rainfall Details for Proposed 3G Pitch.SRCX

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.000	Shortest Storm (mins)	15
Ratio R	0.360	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.800

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.200	4	8	0.200	8	12	0.200	12	16	0.200

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Cascade Model Details for Proposed 3G Pitch.SRCX

Storage is Online Cover Level (m) 54.975

Complex Structure

Infiltration Blanket

Infiltration Coefficient Base (m/hr) 0.00000 Diameter/Width (m) 100.0
Safety Factor 2.0 Length (m) 76.0
Porosity 0.30 Cap Volume Depth (m) 0.300
Invert Level (m) 54.575

Orifice Outflow Control

Diameter (m) 0.031 Discharge Coefficient 0.600 Invert Level (m) 54.300

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