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OUTLINE PLANNING PERMISSION REF. 19/00616/OUT

CONDITION 11 REPORT

SURFACE WATER DRAINAGE SCHEME

PREPARED FOR:

CALA HOMES

JOB NO: P18-654

DATE: 7th September 2021

DOCUMENT HISTORY

Issue No.	Description	Date
1	Issued to discharge planning condition.	07.05.21
2	Appendix G added to report.	07.09.21

CONTENTS

APPENDICES

1. INTRODUCTION

1.1 This report has been prepared by Simpson | TWS on behalf of CALA Homes (Chiltern) Ltd to accompany an application for the discharge of Condition 11 of the outline planning application Ref. 19/00616/OUT for the proposed development comprising the erection of up to 28 dwellings and associated access at land off Fewcott Road, Fritwell. This report provides technical detail relating to the Surface Water Management Strategy for the residential development.

1.2 *Condition 11* of the Outline Planning Consent requires the following information to be provided in relation to the surface water drainage strategy:

> **Condition 11** – As part of any reserved matters for layout and prior to the development commencing detailed designs of the proposed surface water drainage scheme including details of implementation, maintenance and management shall be submitted to and approved in writing by the local planning authority. Those details shall include:
>
> **a.** Information about the design storm period and intensity, critical storm duration (1 in 30 & 1 in 100 (+40% allowance for climate change), discharge rates and volumes (both pre and post development), temporary storage facilities, means of access for maintenance, the methods employed to delay and control surface water discharged from the site, and the measures taken to prevent flooding and pollution of the receiving groundwater and/or surface waters;
> **b.** Any works required off-site to ensure adequate discharge of surface water without causing flooding or pollution (which should include refurbishment of existing culverts and headwalls or removal of unused culverts where relevant);
> **c.** Flood water exceedance routes, both on and off site;
> **d.** A timetable for implementation;
> **e.** Site investigation and test results to confirm infiltrations rates; and
> **f.** A management and maintenance plan, in perpetuity, for the lifetime of the development which shall include the arrangements for adoption by an appropriate public body or statutory undertaker, management and maintenance by a Residents' Management Company or any other arrangements to secure the operation of the surface water drainage scheme throughout its lifetime.
>
> No building hereby permitted shall be occupied until the sustainable drainage scheme for this site has been completed in accordance with the approved details. The sustainable drainage scheme shall be managed and maintained thereafter in accordance with the agreed management and maintenance plan.

2. SURFACE WATER MANAGEMENT & DRAINAGE STRATEGY

Surface Water Disposal

2.1 The NPPF Planning Practice Guidance advises that Sustainable Drainage Systems (SUDS) should be used to control surface water runoff close to where it falls as well as to mimic natural drainage as closely as possible with surface runoff discharged as high up the following hierarchy of drainage options as reasonably practicable.

- into the ground (infiltration);
- to a surface water body;
- to a surface water sewer, highway drain, or another drainage system;
- to a combined sewer.

2.2 The methods of disposal are summarised in *Table 1* below with an assessment of each method's suitability also provided.

Table 1: Surface Water Runoff Destination Assessment

Surface Water Runoff Destination	Assessment
Into the ground (infiltration)	Infiltration drainage techniques are deemed to be inappropriate following a ground investigation report carried out for the site by *The Brownfield Consultancy Ref, BC195L.003/JT* which identified shallow groundwater levels across the north of the site. A minimum clearance of 1m is required between the base of any soakaway and the top of the water table, which is not achievable across the entirety of the site. While groundwater was not encountered in the southernmost pits, the test pit excavations were terminated at the underlying bedrock encountered between 1.0 to 1.4mbgl, which was impenetrable. As such, it is deemed appropriate to assume infiltration would not be suitable. The ground investigation report & exploratory hole location plan and logs are included in *Appendix A* to illustrate where the tests were carried out as well as the underlying ground conditions encountered throughout the site for confirmation.
To a surface water body	An existing ditch runs adjacent the south-eastern boundary of the site, which discharges to a watercourse located south of the site. The drainage ditch and watercourse would be a feasible destination for the disposal of surface water runoff as this would be the natural destination for overland flows from the site resulting from extreme rainfall events in the existing situation.
To a surface water sewer, highway drain, or another drainage system	It has been established that it would be appropriate to discharge surface water runoff to the existing drainage ditch adjacent to the south-eastern boundary of the site. Therefore, it is not necessary to consider the discharge of surface water runoff to a surface water sewer or other drainage system in accordance with the hierarchical approach for surface water disposal.
To a combined sewer	It has been established that it would be appropriate to discharge surface water runoff to the existing drainage ditch adjacent to the south-eastern boundary of the site. Therefore, it is not necessary to consider the discharge of surface water runoff to a combined sewer in accordance with the hierarchical approach for disposal of surface water.

2.3 Based on the assessment in *Table 1*, it is considered appropriate to discharge surface water runoff from the development to the existing ditch adjacent to the south-eastern boundary of the site.

<u>Runoff Management</u>

2.4 Surface water runoff is to be managed in accordance with the suggested procedures set out in the March 2015 DEFRA Report "Sustainable Drainage Systems: Non-statutory technical standards for sustainable drainage systems."

2.5 The site is considered to be greenfield in nature. For developments on greenfield sites Policy S2 of the DEFRA report advises that the peak runoff rate from the development to any highway drain, sewer or surface water body for the 1 in 1 year rainfall event and the 1 in 100 year rainfall event should never exceed the peak greenfield runoff rate for the same event. Policy S4 of the DEFRA report advises that where reasonably practicable, for greenfield development, the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100 year, 6 hour rainfall event should never exceed the greenfield runoff volume for the same event.

2.6 Greenfield runoff rates and volumes have been estimated using the ICP SuDS method of calculation, using the Source Control Facility in the MicroDrainage Software Package. The design results are included in *Appendix B* and are based on the site's area of 1.57 hectares. The calculated rates & volumes for a variety of storm events up to the 1 in 100 year return period are summarised in *Table 2* below:

Table 2: Greenfield Runoff Rates & Volumes

Return Period	**Greenfield**	
	Peak Runoff Rate (l/s)	**6 hr Runoff Volume (m^3)**
QBAR	6.9	N/A
1 year	5.8	142.2
30 year	15.6	328.0
100 year	21.9	445.3

2.7 On this basis, it is proposed to limit flows from the development to match greenfield runoff rates and volumes. The minimum orifice diameter of a flow control device will be limited to 100mm to enable to surface water network to be suitable for adoption.

<u>Sustainable Drainage Systems (SUDS)</u>

2.8 Within the drainage strategy it is necessary to consider the use of SUDS, which encompass a wide range of drainage techniques intended to minimise the rate of discharge, volume and environmental impact of runoff and include; soakaways / infiltration systems; infiltration trenches and filter drains; permeable paving; swales and basins; ponds and wetlands. *Table 3* provides an assessment of each method's suitability.

Table 3: SUDS Assessment

System	Assessment
Green Roofs	The development comprises residential properties with pitched roof profiles, which are appropriate to the site and its context. Therefore, the use of green roofs is not considered suitable for the management of surface water runoff.
Rainwater Harvesting/ Attenuation tanks	Rainwater harvesting is unlikely to contribute to a reduction in surface water runoff volumes as the development use would have limited requirement for recycled rainwater. Therefore, rainwater harvesting has not been considered as part of the surface water drainage strategy for the development. An offline attenuation tank is proposed on the north-west part of the site, which will provide storage for excess flows up to and including the 100-year storm event with a further 40% allowance for future climate change.
Soakaway / Infiltration Systems / Infiltration Trenches	Infiltration drainage techniques are deemed to be inappropriate following a ground investigation report carried out for the site by *The Brownfield Consultancy Ref. BC195L.003/JT* which identified shallow groundwater levels across the north of the site. A minimum clearance of 1m is required between the base of any soakaway and the top of the water table, which is not achievable across the entirety of the site. While groundwater was not encountered in the southernmost pits, the test pit excavations were terminated at the underlying bedrock encountered between 1-1,4mbgl, which was impenetrable. As such, it is deemed appropriate to assume infiltration would not be suitable.
Filter drains & filter trenches / Permeable Pavements.	Driveways and parking bays would be suitable for permeable paving to be used to intercept and treat precipitation. Permeable paving could then be discharged to the surface water network via a perforated collector drain.
Swales, basins, ponds, wetlands.	A 32m swale is proposed along the site's south-eastern boundary. This would be the sites natural low point and the swale could be used to aid in providing treatment for runoff generated from the development's access roads and roof water, and provide attenuation for excess flows during extreme storm events whilst limiting the rates of discharge to greenfield runoff rates prior to discharging to the watercourse.

2.9 Based on the assessment in *Table 4*, a surface water drainage layout has been prepared for the site and is shown on the Preliminary Drainage Strategy Layout included in *Appendix C*. Surface water runoff from the dwellings, including roof runoff, will be drained via permeable paved driveways, and then discharged to the surface water network via perforated collector drains. The roads will be drained via series of trapped gullies. Surface water flows from the development will then be discharged into the 32m long swale at the south-eastern boundary of the site for treatment, conveyance & attenuation prior to discharge to existing drainage ditch adjacent the site boundary via flow control chamber, in order to match greenfield runoff rates. An offline Geocellular storage tank will be provided, designed to store and attenuate flows associated with storm events up to a 100-year return period with a further 40% allowance for future climate change.

2.10 The proposed drainage network would drain an impermeable area of 0.62 hectares, split into two main catchments as shown on the Impermeable Areas Layout included in *Appendix G*.

Hydraulic Analysis

2.11 The Source Control facility in the MicroDrainage software Package by Innovyze has been used to design the surface water management scheme based on a drained impermeable area of 0.62 hectares with design results included in *Appendix D* for a variety of storm events up to and including the 1 in 100 year storm return period with an additional allowance of 40% for climate change. The design results confirm that the surface water drainage network would store and attenuate surface water flows for all analysed storm events with no surface water flooding identified.

2.12 *Table 4* below compares the maximum rate of discharge analysed for each storm event to the peak greenfield rates determined in *Table 2*.

Table 4: Greenfield Runoff Rates & Volumes

Return Period	Greenfield		Post Development	
	Peak Runoff Rate (l/s)	6 hr Runoff Volume (m³)	Peak Runoff Rate (l/s)	6 hr Runoff Volume (m³)
QBAR	6.9	N/A	N/A	N/A
1 year	6.8	142.2	5.7	108.7
30 year	15.6	328.0	7.0	240.0
100 year	21.9	445.3	7.5	311.5
100 year + 40%	N/A	N/A	8.2	451.3

2.13 The above table confirms that the surface water drainage scheme would comply with Policy S2 of the DEFRA Report as the peak runoff rates from the development to the existing drainage ditches for the 1 in 1 year rainfall events and the 1 in 100 year rainfall events would not exceed the peak greenfield runoff rates for the same events and therefore offering an improvement in comparison to the site`s existing drainage characteristics.

2.14 *Table 4* also demonstrates that the surface water drainage scheme would comply with Policy S4 of the DEFRA Report as the runoff volumes from the development in the 1 in 100 year, 6 hour rainfall events do not exceed the greenfield runoff volumes for the same events.

Exceedance

2.15 In the event that the capacity of the surface water drainage network was exceeded, site levels would allow surface water to be channelled to the existing drainage ditch adjacent to the south-eastern boundary of the site, where flows would drain away from the development and any neighbouring properties. Further to this, the finished floor levels of all dwellings are raised above surrounding levels, including the highway, so there would be no risk of buildings being affected by such overland flows.

2.16 Exceedance routes from Fewcott road would be directed towards the ditch which starts at the north boundary of the development. They would then be channelled in an easterly direction to the north-east corner of the site, where the ditch changes direction and runs to the south. In the case of off-site flooding relating to the Hodgson Close development along the western boundary of the site, topographical information suggests exceedance routes would follow Hodgson Close with levels falling in a southerly direction, and channel surface water away from the proposed development. A copy of the Surface Water Exceedance Flow Plan is included in *Appendix E.*

Water Quality

2.17 CIRIA report C753 "The SUDS Manual" sets out requirements for delivering appropriate levels of treatment to surface water runoff using SUDS. *Table 5* below identifies that the proposed SUDS components would have a total pollution mitigation index equal to or exceeding the recommended pollution hazard index thus confirming the SUDS components would provide suitable treatment to surface water runoff.

Table 5: Water Quality Assessment

Use	Pollution Hazard Index			SUDS Components	Mitigation Index		
	TSS	**Metals**	**TPH**		**TSS**	**Metals**	**TPH**
Residential Roof	0.2	0.2	0.05	Swale	0.5	0.6	0.6
				Permeable Paving	0.7	0.6	0.7
Road Network, Parking Bays & Driveways	0.5	0.4	0.4	Permeable Paving	0.7	0.6	0.7
				Swale	0.5	0.6	0.6

2.18 All parking areas and driveways across the development will be constructed in permeable concrete block paving. In addition to the attenuation of flows, permeable paving will help to protect the quality of water discharged from the site by providing up to two levels of treatment. The first level of treatment would be provided by the permeable block paved surface, while a filter zone of sub-base located beneath the bedding layer would provide the second level of treatment.

2.19 Where practicable, roof water will also be discharged into the filter zone of sub-base beneath the bedding layer of the permeable paving in driveways and parking areas to provide a level of treatment to the runoff. Other areas will be discharged into a swale where runoff will receive treatment in the form of settlement.

2.20 The development's road network will be discharged into the swale to provide treatment in the form of settlement.

Management & Maintenance

2.21 It is recommended that the surface water drainage system is implemented, managed, and maintained in accordance with the SUDS Implementation, Management and Maintenance Plan included in *Appendix F.* The Contractor's Construction Health and Safety Plan shall incorporate the measures proposed in the plan. The plan shall also be incorporated into the site's Operation and Maintenance Manual.

3. CONCLUSIONS

3.1 It is considered that the following requirements of Condition 11 of the Outline planning application Ref. 19/00616/OUT have been satisfied by this report as follows:

a. *Information about the design storm period and intensity, critical storm duration (1 in 30 & 1 in 100 (+40% allowance for climate change), discharge rates and volumes (both pre and post development), temporary storage facilities, means of access for maintenance, the methods employed to delay and control surface water discharged from the site, and the measures taken to prevent flooding and pollution of the receiving groundwater and/or surface waters;*

Section 2.6 of this report provides details on the greenfield runoff rates & volumes, and sections 2.11, 2.12 & 2.13 demonstrates that the post development peak runoff rates & volumes for the 1, 30 & 100 year storm return periods will be lower than the respective greenfield runoff rates for the same storm events.

Section 2.19 of this report, alongside *Appendix F*, details information on maintenance of the proposed drainage network. Sections 2.2-2.13 of this report detail the methods employed to delay and control surface water discharged from the proposed development. Section 2.14 as well as *Appendix E* detail the measures taken to prevent flooding and demonstrate the exceedance flow routes on and off site. Finally, Sections 2.15-2.18 elaborate how surface water runoff will be treated prior to discharge to the existing ditch.

This report demonstrates that a robust surface water drainage strategy has been developed taking account of critical storm durations, climate change and surface water management.

b. *Any works required off-site to ensure adequate discharge of surface water without causing flooding or pollution (which should include refurbishment of existing culverts and headwalls or removal of unused culverts where relevant);*

A copy of the Drainage Strategy Layout included in *Appendix C* demonstrates all the proposed works on and off-site to ensure adequate discharge of surface water. There is no requirement to refurbish/ remove any existing culverts or headwalls to facilitate the proposed drainage strategy.

Therefore, this report demonstrates that the surface water drainage strategy will ensure no increase in the level of flood risk on or off site, while ensuring the water quality requirements have not been compromised.

c. *Flood water exceedance routes, both on and off site;*

Section 2.14 of this report details the exceedance plan for the site. A copy of the Exceedance Flow Plan is included in *Appendix E*. This demonstrated that there will not be any flooding of properties on or off the site as a result of the proposed development and associated surface water drainage strategy.

d. *A timetable for implementation;*

A copy of the Drainage Implementation, Management & Maintenance Plan is included in Appendix F, which sets out measures to be implemented during construction of the surface water drainage system for the scheme to ensure the site and areas downstream are protected from runoff during construction of the development. The appended document will ensure the safe implementation of the drainage strategy to minimise the impact of development at this site.

e. *Site investigation and test results to confirm infiltration rates; and*

A copy of the ground investigation report and soakage test results carried out by The Brownfield Consultancy Ref. BC195L.003/JT is included in *Appendix A*. Together with the statement provided within the Surface Water Runoff Destination Assessment in Table 1, the report confirms that infiltration will not be a viable option to dispose of surface water from the development.

f. *A management and maintenance plan, in perpetuity, for the lifetime of the development which shall include the arrangements for adoption by an appropriate public body or statutory undertaker, management and maintenance by a Residents' Management Company or any other arrangements to secure the operation of the surface water drainage scheme throughout its lifetime.*

A copy of the Drainage Implementation, Management & Maintenance Plan is included in Appendix F, which provides details of the plan proposed for maintenance and management of the drainage scheme associated with the proposed development. On this basis, it is considered that the requirements of this conditions have been satisfied.

APPENDIX A:

GROUND INVESTIGATION REPORT

The Brownfield Consultancy
Woodstock
Memorial Road
Fenny Compton.
CV47 2XU

Your Ref:

Our Ref: BC195 L.003 / JT

CALA Homes (Chiltern) Limited
Riverside House
Holtspur Lane
Wooburn Green
Buckinghamshire
HP10 0TJ

21st April 2020

For the attention of James Forbes

Dear James

FEWCOTT ROAD, FRITWELL. OX27 7QA
Results of Soakaway Testing

The Brownfield Consultancy was commissioned by CALA Chiltern to undertake trial pit soakaway testing in accordance with BRE 365 at the above site. The fieldwork was undertaken on 25th and 26th March 2020.

The site comprises of a square plot of paddock land on the south eastern outskirts of Fritwell, Oxfordshire. Access is off Fewcott Road. It is proposed to apply for planning permission for the construction of 32No. two storey houses with associated access roads, driveways and gardens. The site slopes gently from south to north. This report is subject to limitations which are presented in Appendix D.

A previous ground investigation was undertaken in November 2015 by The Brownfield Consultancy and reported in *'Fewcott Road, Fritwell – Report on Ground Conditions'* dated 29th December 2015. A second report entitled *'Desk Top Study and Contaminated Land Assessment'* was undertaken dated 8th April 2016.

1. FIELDWORK

Soakaway tests were undertaken within five trial pits denoted SA1, SA2, SA3, SA4 and SA6 as denoted on the exploratory hole location plan in Appendix A. The pits were excavated by a backhoe excavator, their dimensions carefully measured and then flooded using a mobile water bowser. The time for the water to drain was then measured.

2. GROUND CONDITIONS

The ground conditions encountered during the investigation were consistent with the published geological map and the findings of the previous investigations. A veneer of Topsoil or Made Ground overlies the Great Oolite Group described by the British Geological Survey as :-

'A variety of mudstone-dominated and ooidal, bioclastic and fine-grained limestone formations'.

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A summary of the strata encountered during the investigation is described in the following sections but for full details of the strata encountered, samples taken, results of any in-situ testing and any other relevant information, reference should be made to the exploratory hole logs presented in Appendix B.

Topsoil

Topsoil was encountered in SA1, SA3, SA4 and SA6 to depths varying between 0.30-0.45m bgl. Materials comprised dark brown clay with varying quantities of sand and gravel. Gravel comprised brown limestone.

Made Ground

Made Ground was encountered in SA2 and SA4 to depths of 0.30-0.40m. Materials were similar to the Tospoil with the inclusion of tile, red brick and string.

Great Oolite Group

The Great Oolite Group was encountered in all trial pit locations and comprised of brown gravel and cobbles of ooidal limestone in a clay matrix with varying quantities of sand. Occasionally, thin units of sandy gravelly clay were encountered. 'Bedrock' was encountered in SA3 at 1.40m and SA4 at 1.00m bgl where no further penetration was possible with the backhoe excavator.

Groundwater

Groundwater was encountered in trial pits SA1, SA2 and SA5. All three pits were located at the lowest level of the site (north). In SA1 soils were recorded as 'damp' from 1.40m to the base of the pit. Prior to the test, groundwater was recorded at 1.50m bgl. In SA2, soils were recorded as damp from 0.40-1.50m and a water seepage was recorded at 1.20m. Prior to flooding the pit, groundwater was recorded at 1.28m bgl. In SA5 a slow ingress of groundwater was encountered at 0.90m and the pit was abandoned and backfilled.

3. SOAKAWAY DRAINAGE

In accordance with the digest, three repeat tests were successfully undertaken in SA1, SA3 and SA4. A single successful test was undertaken in SA6. The test in trial pit SA2, which contained 22cm of groundwater at the start of the test, was not successful.

The following soil infiltration rates were obtained:

SA1 2.6×10^{-5}m/s, 4.6×10^{-5}m/s, 3.1×10^{-5}m/s

SA3 3.4×10^{-5}m/s, 1.5×10^{-5}m/s, 1.6×10^{-4}m/s

SA4 1.6×10^{-5}m/s, 1.2×10^{-5}m/s, 1.5×10^{-5}m/s

SA6 1.0×10^{-5}m/s

In accordance with BRE 365, it is recommended that the lowest infiltration rate of the three tests is taken as the design figure for each location. The full results of soakaway testing are presented in Appendix C.

Groundwater was encountered in SA1, SA2 and SA5 in the north of the site. A 'freeboard' of 1m is often required i.e. at least 1 metre clearance between the base of any soakaway and the top of the water table. Clearly this is not achievable in the north of the site. If soakaways are the only viable

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means of disposing of surface water at the site, then a number of boreholes will need to be installed across the site followed by the implementation of a groundwater level monitoring programme, to account for seasonal variations and extreme rainfall events.

We trust the above is satisfactory for your purposes. Should you have any queries please do not hesitate to contact me.

Yours sincerely

Jim Twaddle **CGeol**
Director

Appendix A	*Exploratory Hole Location Plan*
Appendix B	*Exploratory Hole Logs*
Appendix C	*Soakaway Test Calculations*
Appendix D	*Limitations*

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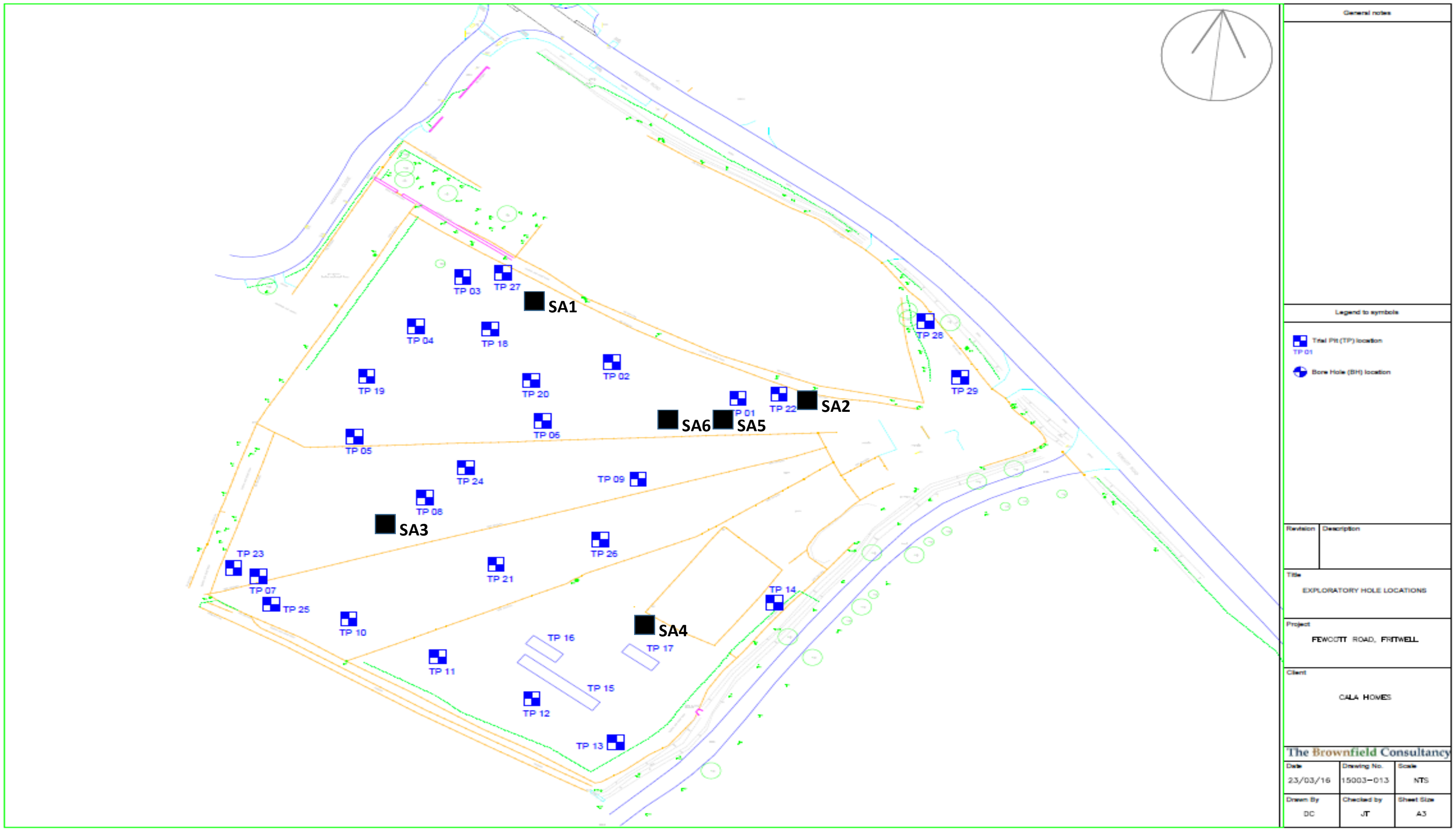
APPENDIX A

Exploratory Hole Location Plan

FRITWELL SOAKAWAY TESTS

Exploratory Hole Location Plan



APPENDIX B

Exploratory Hole Logs

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Fenny Compton, CV47 2YF
Phone: 07852881086

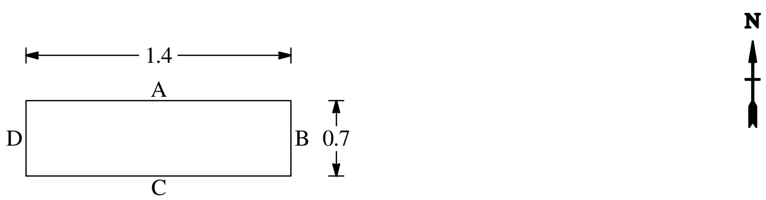
TRIAL PIT LOG

The Brownfield Consultancy

Project				TRIAL PIT No
Fewcott Road, Fritwell				SA1
Job No: BC195	Date: 25-03-20	Ground Level (m)	Co-Ordinates ()	
Contractor: BROWNFIELD CONSULTANCY				Sheet: 1 of 1

Depth	No	DESCRIPTION (STRATA)	Depth	No	Remarks/Tests (SAMPLES & TESTS)
0.00-0.40		Grass over dark brown slightly sandy gravelly CLAY. Gravel is subangular and subrounded fine to coarse buff brown limestone. (TOPSOIL)			
0.40-1.00		Buff brown sandy clayey locally very clayey GRAVEL of subangular and subrounded fine to coarse limestone with a low cobble content. Cobbles are limestone. (OOLITE)			
1.00-1.40		Buff brown slightly sandy slightly clayey GRAVEL of subangular and subrounded fine to coarse limestone with a low cobble content. Cobbles are limestone. (OOLITE)			
1.40-1.55		Damp buff brown sandy very clayey GRAVEL of subangular and subrounded fine to coarse limestone. (OOLITE)			
1.55		Trial pit terminated. Water level at 1.50m at the start of the soakaway test.			

Shoring/Support:
Stability: Sides stable.



GENERAL REMARKS

Soakaway test undertaken. Backfilled with arisings.

All dimensions in metres Scale 1:18.75	Client: CALA CHILTERN	Method/Plant Used: 5t excavator	Logged By: JT

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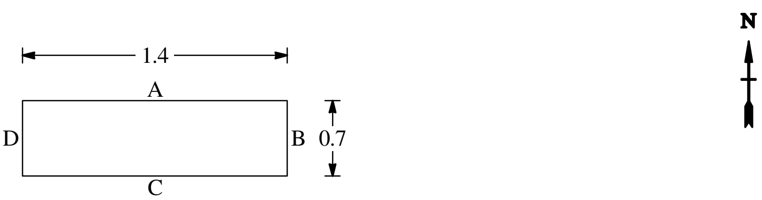
TRIAL PIT LOG

The Brownfield Consultancy

Project				TRIAL PIT No
Fewcott Road, Fritwell				SA2
Job No: BC195	Date: 25-03-20	Ground Level (m)	Co-Ordinates ()	
Contractor: BROWNFIELD CONSULTANCY				Sheet: 1 of 1

STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.40		Grass over dark brown slightly sandy gravelly CLAY. Gravel is subangular and subrounded fine to medium buff brown limestone, tile and red brick. (MADE GROUND)			
0.40-1.50		Damp buff brown slightly sandy clayey GRAVEL of subangular and subrounded fine to coarse limestone with a low cobble content. Cobbles are limestone. (OOLITE) 1.20 Seepage.			
1.50		Trial pit terminated. Water level at 1.28m bgl at the start of the soakaway test.			

Shoring/Support:
Stability: Sides stable.



GENERAL REMARKS

Soakaway test undertaken.
Backfilled with arisings.

All dimensions in metres Scale 1:18.75	Client: CALA CHILTERN	Method/ Plant Used: 5t excavator	Logged By: JT

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TRIAL PIT LOG

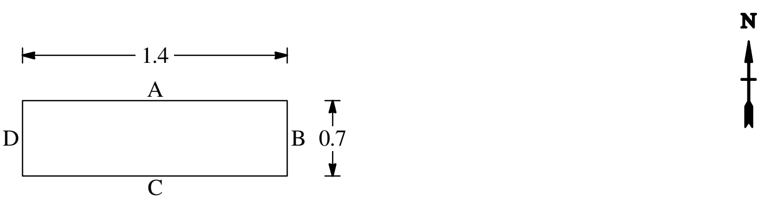
The Brownfield Consultancy

Project				TRIAL PIT No
Fewcott Road, Fritwell				**SA3**
Job No: BC195	Date: 25-03-20	Ground Level (m)	Co-Ordinates ()	
Contractor: BROWNFIELD CONSULTANCY				Sheet: 1 of 1

STRATA / SAMPLES & TESTS

Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.40		Grass over dark brown slightly sandy gravelly CLAY. Gravel is subangular and subrounded fine to coarse buff brown limestone. (TOPSOIL)			
0.40-1.20		Buff brown sandy clayey GRAVEL of subangular and subrounded fine to coarse limestone with a low cobble content. Cobbles are limestone. (OOLITE)			
1.20-1.40		Buff brown SAND & GRAVEL. Gravel is subangular and subrounded fine to coarse limestone. (OOLITE)			
1.40		No further progress. Unable to penetrate bedrock. Groundwater not encountered.			

Shoring/Support:
Stability: Sides stable.



GENERAL REMARKS

Soakaway test undertaken. Backfilled with arisings.

All dimensions in metres Scale 1:18.75	Client: CALA CHILTERN	Method/Plant Used: 5t excavator	Logged By: JT

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Fenny Compton, CV47 2YF
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TRIAL PIT LOG

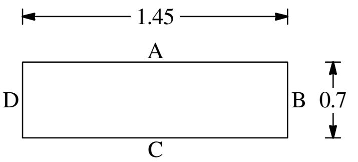
The Brownfield Consultancy

Project				TRIAL PIT No
Fewcott Road, Fritwell				SA4
Job No: BC195	Date: 25-03-20	Ground Level (m)	Co-Ordinates ()	
Contractor: BROWNFIELD CONSULTANCY				Sheet: 1 of 1

STRATA / SAMPLES & TESTS

Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.45		Grass over dark brown slightly sandy gravelly CLAY. Gravel is subangular and subrounded fine to coarse buff brown limestone. (TOPSOIL)			
0.45-0.80		Buff brown sandy clayey locally very clayey GRAVEL of subangular and subrounded fine to coarse limestone with a low cobble content. Cobbles are limestone. (OOLITE)			
0.80-0.90		Firm brown sandy very gravelly CLAY. Gravel is subangular and subrounded fine to coarse limestone. (OOLITE)			
0.90-1.00		Buff brown slightly sandy slightly clayey GRAVEL of subangular and subrounded fine to coarse limestone with a high cobble content. Cobbles are limestone. (OOLITE)			
1.00		No further progress. Unable to penetrate bedrock. Groundwater not encountered.			

Shoring/Support:
Stability: Sides stable.



N

GENERAL REMARKS

Soakaway test undertaken. Backfilled with arisings.

All dimensions in metres Scale 1:18.75	Client: CALA CHILTERN	Method/Plant Used: 5t excavator	Logged By: JT

Brownfield Consultancy
The Cottage, Mill Lane
Fenny Compton, CV47 2YF
Phone: 07852881086

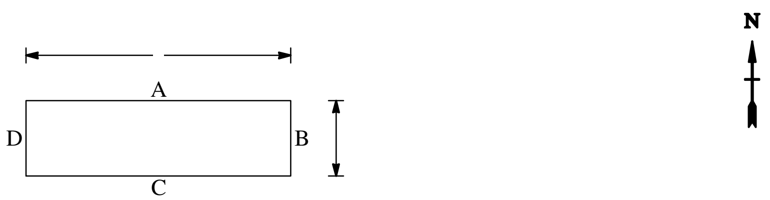
TRIAL PIT LOG

The Brownfield Consultancy

Project				TRIAL PIT No
Fewcott Road, Fritwell				**SA5**
Job No: BC195	Date: 25-03-20	Ground Level (m)	Co-Ordinates ()	
Contractor: BROWNFIELD CONSULTANCY				Sheet: 1 of 1

STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.30		Grass over dark brown slightly sandy gravelly CLAY. Gravel is subangular and subrounded fine to medium buff brown limestone, tile and pieces of orange string. (MADE GROUND)			
0.30-0.45		Firm brown sandy very gravelly CLAY. Gravel is angular to subrounded fine to coarse limestone. (OOLITE)			
0.45-0.90		Buff brown sandy clayey locally very clayey GRAVEL of subangular and subrounded fine to coarse limestone with a low cobble content. Cobbles are limestone. (OOLITE)			
0.90		Trial pit terminated. Slow ingress of groundwater at 0.90m.			

Shoring/Support:
Stability: Sides stable.



GENERAL REMARKS

Backfilled with arisings.

All dimensions in metres Scale 1:18.75	Client: CALA CHILTERN	Method/ Plant Used: 5t excavator	Logged By: JT

Brownfield Consultancy
The Cottage, Mill Lane
Fenny Compton, CV47 2YF
Phone: 07852881086

TRIAL PIT LOG

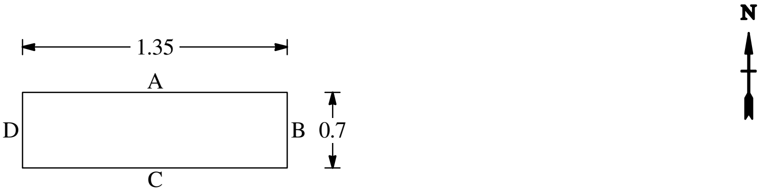
The Brownfield Consultancy

Project				TRIAL PIT No
Fewcott Road, Fritwell				SA6
Job No: BC195	Date: 25-03-20	Ground Level (m)	Co-Ordinates ()	
Contractor: BROWNFIELD CONSULTANCY				Sheet: 1 of 1

STRATA / SAMPLES & TESTS

Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.30		Grass over dark brown slightly sandy gravelly CLAY. Gravel is subangular and subrounded fine to coarse buff brown limestone. (TOPSOIL)			
0.30-0.40		Firm brown sandy very gravelly CLAY. Gravel is angular to subrounded fine to coarse limestone. (OOLITE)			
0.40-0.90		Buff brown sandy clayey locally very clayey GRAVEL of subangular and subrounded fine to coarse limestone with a low cobble content. Cobbles are limestone. (OOLITE)			
0.90		Trial pit terminated.			

Shoring/Support:
Stability: Sides stable.



GENERAL REMARKS

Soakaway test undertaken. Backfilled with arisings.

All dimensions in metres Scale 1:18.75	Client: CALA CHILTERN	Method/Plant Used: 5t excavator	Logged By: JT

APPENDIX C

Soakaway Calculation Sheets

The Brownfield Consultancy

SOIL INFILTRATION TEST

Woodstock
Memorial Road
Fenny Compton
CV47 2XU
Tel: 07852881086

Project:
Fewcott Road, Fritwell

Project No:
BC195

Test Location: SA1   Test No: 1   Date: 25.3.20

Water level during test

Time mins	Depth m bgl
0	0.740
22	1.270
36	1.330
55	1.360
65	1.380

Trial pit dimensions

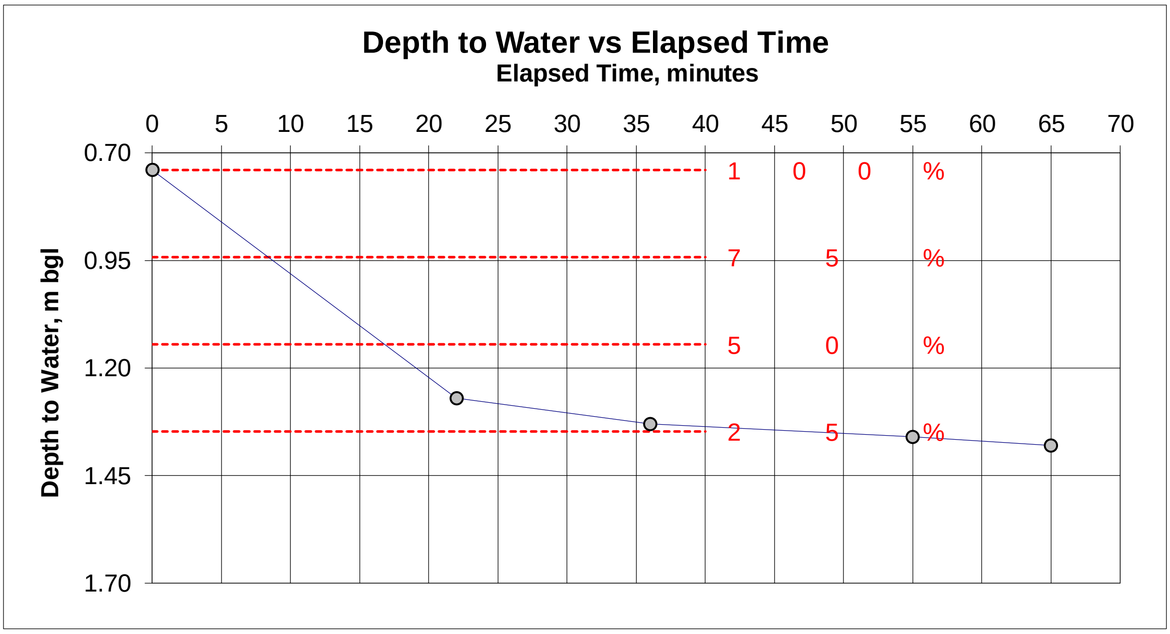
depth (m)	1.55
length (m)	1.40
width (m)	0.70

$$f = \frac{V_p}{\alpha_p \times t_p}$$

f = soil infiltration rate
Vp = volume of water from 75% to 25% effective depth
αp = Internal surface area at 50% effective depth
tp = time for the water level to fall from 75% to 25% effective depth

time at 75% effective depth (mins)	8
time at 25% effective depth (mins) (from graph)	50

Calculated Soil Infiltration Rate = 4.6E-05 m/sec



The Brownfield Consultancy

Woodstock
Memorial Road
Fenny Compton
CV47 2XU
Tel: 07852881086

SOIL INFILTRATION TEST

Project:
Fewcott Road, Fritwell

Project No:
BC195

Test Location: SA1 | Test No: 2 | Date: 25.3.20

Water level during test

Time mins	Depth m bgl
0	0.700
15	1.150
37	1.290
87	1.350
99	1.350

Trial pit dimensions

depth (m)	1.55
length (m)	1.40
width (m)	0.70

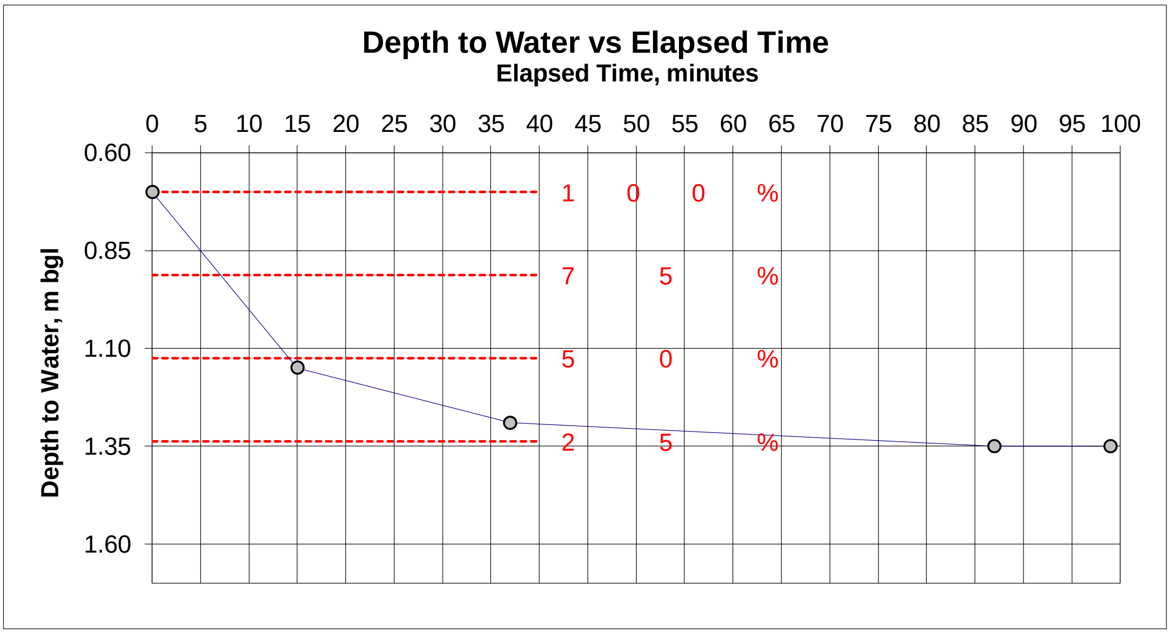
$$f = \frac{V_p}{\alpha_p \times t_p}$$

f = soil infiltration rate
Vp = volume of water from 75% to 25% effective depth
αp = Internal surface area at 50% effective depth
tp = time for the water level to fall from 75% to 25% effective depth

time at 75% effective depth (mins)	7
time at 25% effective depth (mins)	80

(from graph)

Calculated Soil Infiltration Rate = 2.6E-05 m/sec



The Brownfield Consultancy	**SOIL INFILTRATION TEST**
Woodstock **Memorial Road** **Fenny Compton** **CV47 2XU** **Tel: 07852881086**	**Project:** Fewcott Road, Fritwell **Project No:** BC195

Test Location: SA1 | Test No: 3 | Date: 25.3.20

Water level during test

Time mins	Depth m bgl
0	0.700
37	1.290
62	1.330
77	1.350
87	1.360

Trial pit dimensions

depth (m)	1.55
length (m)	1.40
width (m)	0.70

$$f = \frac{V_p}{\alpha_p \times t_p}$$

f = soil infiltration rate

Vp = volume of water from 75% to 25% effective depth

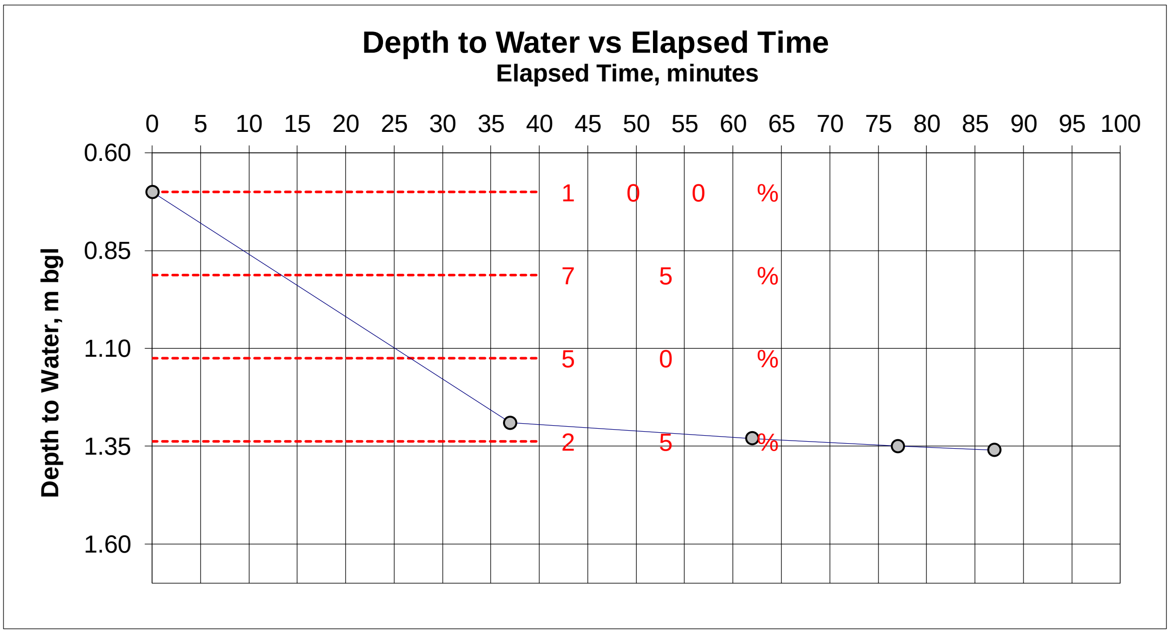
αp = Internal surface area at 50% effective depth

tp = time for the water level to fall from 75% to 25% effective depth

time at 75% effective depth (mins)	13
time at 25% effective depth (mins)	75

(from graph)

Calculated Soil Infiltration Rate = 3.1E-05 m/sec



The Brownfield Consultancy

SOIL INFILTRATION TEST

Woodstock
Memorial Road
Fenny Compton
CV47 2XU
Tel: 07852881086

Project:
Fewcott Road, Fritwell

Project No:
BC195

Test Location: SA2 Test No: 1 Date: 25.3.20

Water level during test

Time mins	Depth m bgl
0	0.660
15	0.670
38	0.690
72	0.720
194	0.720
228	0.720

Trial pit dimensions

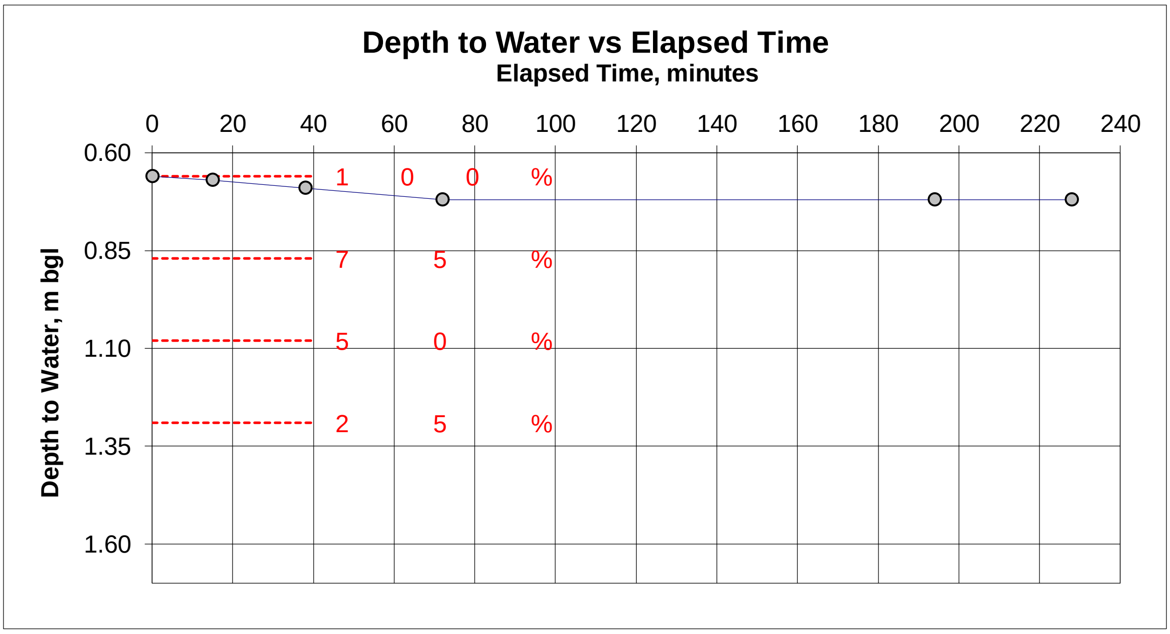
depth (m)	1.50
length (m)	1.40
width (m)	0.70

$$f = \frac{V_p}{\alpha_p \times t_p}$$

f = soil infiltration rate
Vp = volume of water from 75% to 25% effective depth
αp = Internal surface area at 50% effective depth
tp = time for the water level to fall from 75% to 25% effective depth

time at 75% effective depth (mins)
time at 25% effective depth (mins)
(from graph)

Calculated Soil Infiltration Rate = - m/sec



The Brownfield Consultancy	SOIL INFILTRATION TEST
Woodstock **Memorial Road** **Fenny Compton** **CV47 2XU** **Tel: 07852881086**	**Project:** Fewcott Road, Fritwell **Project No:** BC195

Test Location: SA3 Test No: 1 Date: 25.3.20

Water level during test

Time mins	Depth m bgl
0	0.700
6	0.790
20	0.900
42	1.050
72	1.200
99	1.300
107	1.330

Trial pit dimensions

depth (m)	1.40
length (m)	1.40
width (m)	0.70

$$f = \frac{V_p}{\alpha_p \times t_p}$$

f = soil infiltration rate

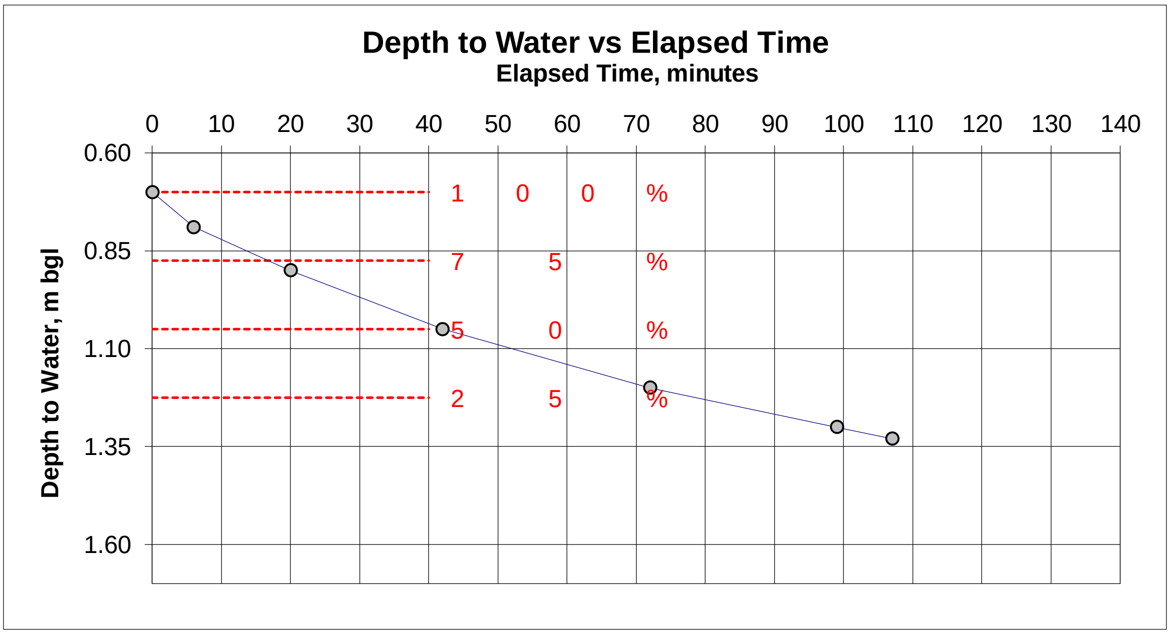
Vp = volume of water from 75% to 25% effective depth

αp = Internal surface area at 50% effective depth

tp = time for the water level to fall from 75% to 25% effective depth

time at 75% effective depth (mins)	18
time at 25% effective depth (mins)	80
(from graph)	

Calculated Soil Infiltration Rate = 3.4E-05 m/sec



The Brownfield Consultancy	**SOIL INFILTRATION TEST**
Woodstock **Memorial Road** **Fenny Compton** **CV47 2XU** **Tel: 07852881086**	**Project:** Fewcott Road, Fritwell **Project No:** BC195

Test Location: SA3 Test No: 2 Date: 25.3.20

Water level during test

Time mins	Depth m bgl
0	0.450
10	0.530
25	0.700
40	0.780
70	0.900
82	0.930
135	1.100
159	1.150
176	1.180

Trial pit dimensions

depth (m)	1.40
length (m)	1.40
width (m)	0.70

$$f = \frac{V_p}{\alpha_p \times t_p}$$

f = soil infiltration rate

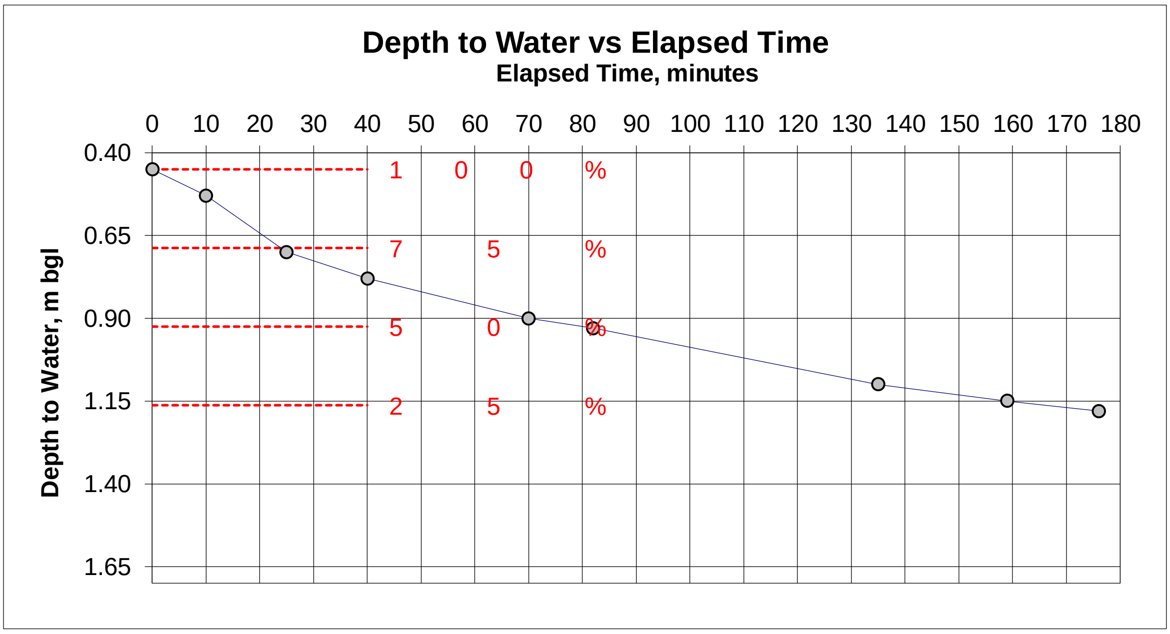
Vp = volume of water from 75% to 25% effective depth

αp = Internal surface area at 50% effective depth

tp = time for the water level to fall from 75% to 25% effective depth

time at 75% effective depth (mins)	25
time at 25% effective depth (mins) (from graph)	160

Calculated Soil Infiltration Rate = 1.5E-05 m/sec



The Brownfield Consultancy
Woodstock
Memorial Road
Fenny Compton
CV47 2XU
Tel: 07852881086

SOIL INFILTRATION TEST

Project: Fewcott Road, Fritwell

Project No: BC195

Test Location: SA3 Test No: 3 Date: 26.3.20

Water level during test

Time mins	Depth m bgl
0	0.550
7	0.700
22	1.150
37	1.400

Trial pit dimensions

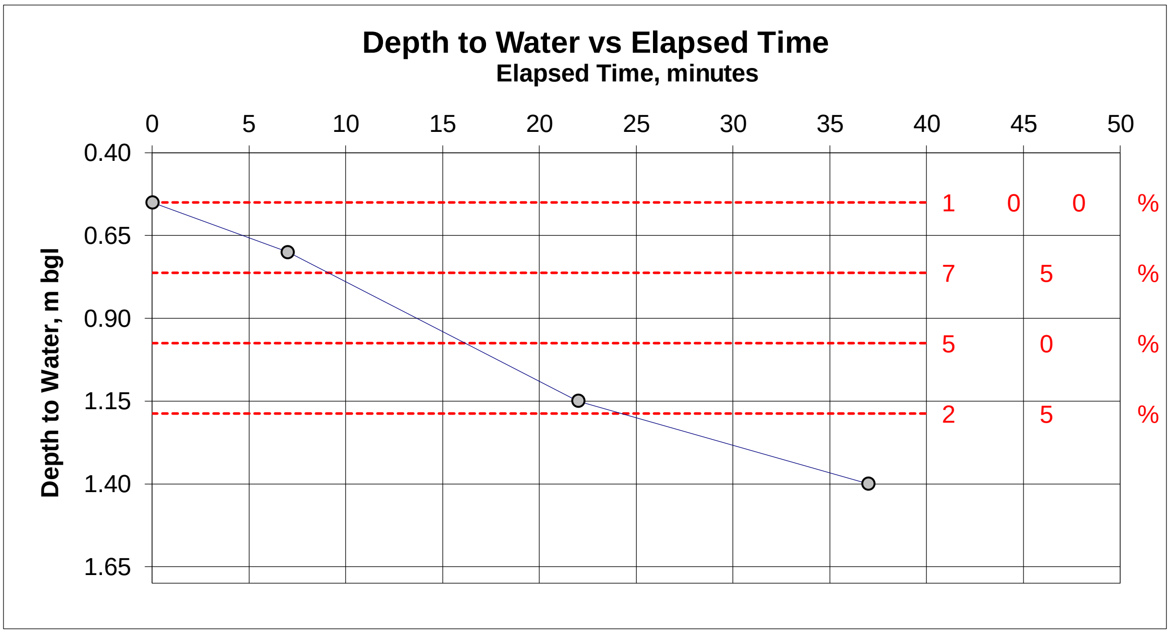
depth (m)	1.40
length (m)	1.40
width (m)	0.70

$$f = \frac{V_p}{\alpha_p \times t_p}$$

f = soil infiltration rate
Vp = volume of water from 75% to 25% effective depth
αp = Internal surface area at 50% effective depth
tp = time for the water level to fall from 75% to 25% effective depth

time at 75% effective depth (mins)	8
time at 25% effective depth (mins)	24
(from graph)	

Calculated Soil Infiltration Rate = 1.6E-04 m/sec



The Brownfield Consultancy	**SOIL INFILTRATION TEST**
Woodstock **Memorial Road** **Fenny Compton** **CV47 2XU** **Tel: 07852881086**	**Project:** Fewcott Road, Fritwell **Project No:** BC195

Test Location: SA4 | Test No: 1 | Date: 25.3.20

Water level during test

Time mins	Depth m bgl
0	0.300
4	0.350
12	0.400
36	0.530
49	0.590
63	0.640
82	0.700
121	0.800
145	0.850
158	0.880

Trial pit dimensions

depth (m)	1.00
length (m)	1.45
width (m)	0.70

$$f = \frac{V_p}{\alpha_p \times t_p}$$

f = soil infiltration rate

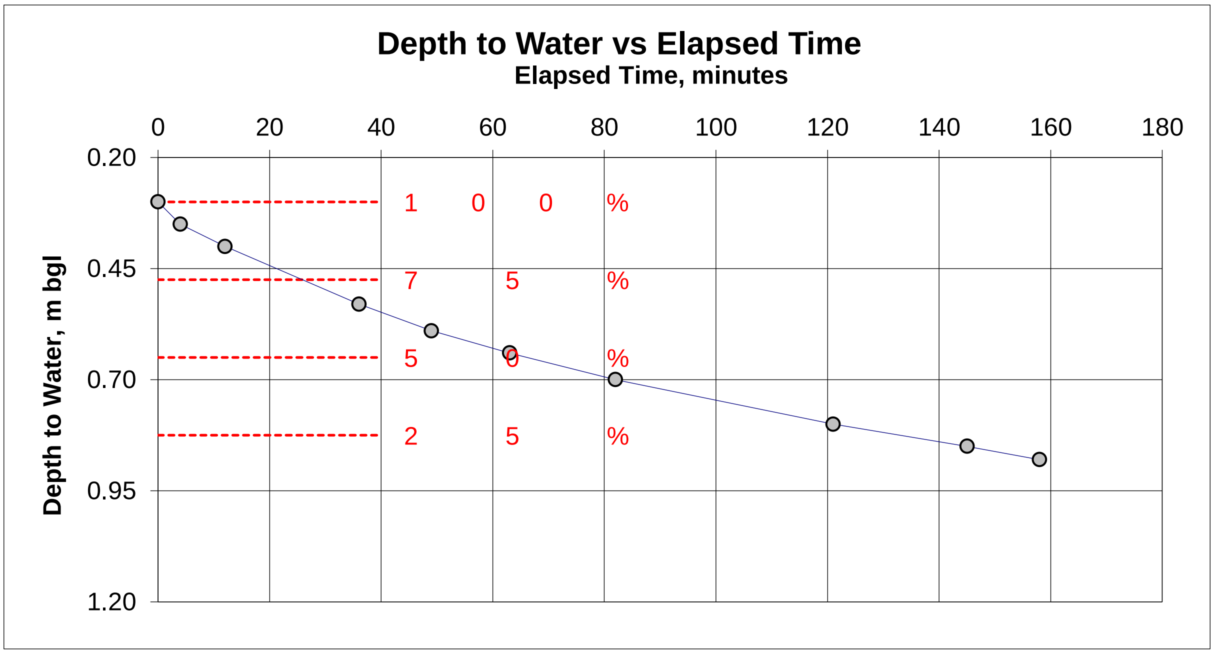
Vp = volume of water from 75% to 25% effective depth

αp = Internal surface area at 50% effective depth

tp = time for the water level to fall from 75% to 25% effective depth

time at 75% effective depth (mins)	25
time at 25% effective depth (mins)	144
(from graph)	

Calculated Soil Infiltration Rate = 1.6E-05 m/sec



The Brownfield Consultancy
Woodstock
Memorial Road
Fenny Compton
CV47 2XU
Tel: 07852881086

SOIL INFILTRATION TEST

Project:
Fewcott Road, Fritwell

Project No:
BC195

Test Location: SA4 | Test No: 2 | Date: 25.3.20

Water level during test

Time mins	Depth m bgl
0	0.400
20	0.500
34	0.530
62	0.610
84	0.670
119	0.730
157	0.790
178	0.830
204	0.880

Trial pit dimensions

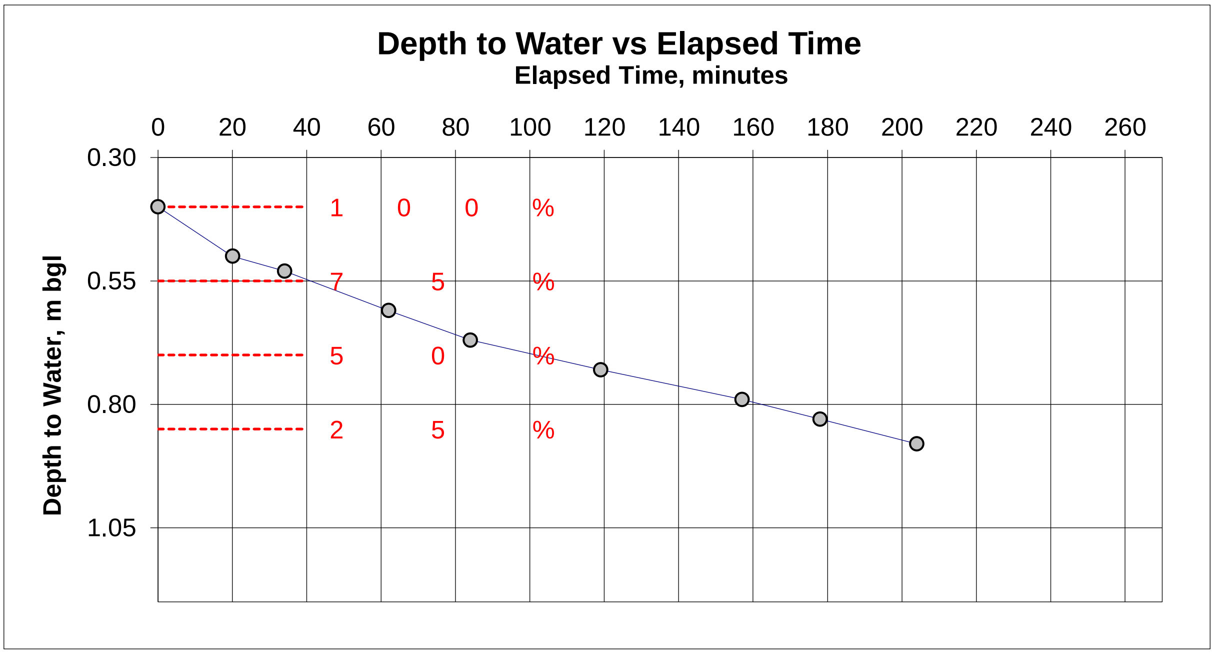
depth (m)	1.00
length (m)	1.45
width (m)	0.70

$$f = \frac{V_p}{\alpha_p \times t_p}$$

f = soil infiltration rate
Vp = volume of water from 75% to 25% effective depth
αp = Internal surface area at 50% effective depth
tp = time for the water level to fall from 75% to 25% effective depth

time at 75% effective depth (mins)	40
time at 25% effective depth (mins) (from graph)	185

Calculated Soil Infiltration Rate = 1.2E-05 m/sec



The Brownfield Consultancy	SOIL INFILTRATION TEST
Woodstock **Memorial Road** **Fenny Compton** **CV47 2XU** **Tel: 07852881086**	**Project:** Fewcott Road, Fritwell **Project No:** BC195

Test Location: SA4 Test No: 3 Date: 26.3.20

Water level during test

Time mins	Depth m bgl
0	0.500
37	0.630
58	0.700
92	0.790
155	0.900

Trial pit dimensions

depth (m)	1.00
length (m)	1.45
width (m)	0.70

$$f = \frac{V_p}{\alpha_p \times t_p}$$

f = soil infiltration rate

Vp = volume of water from 75% to 25% effective depth

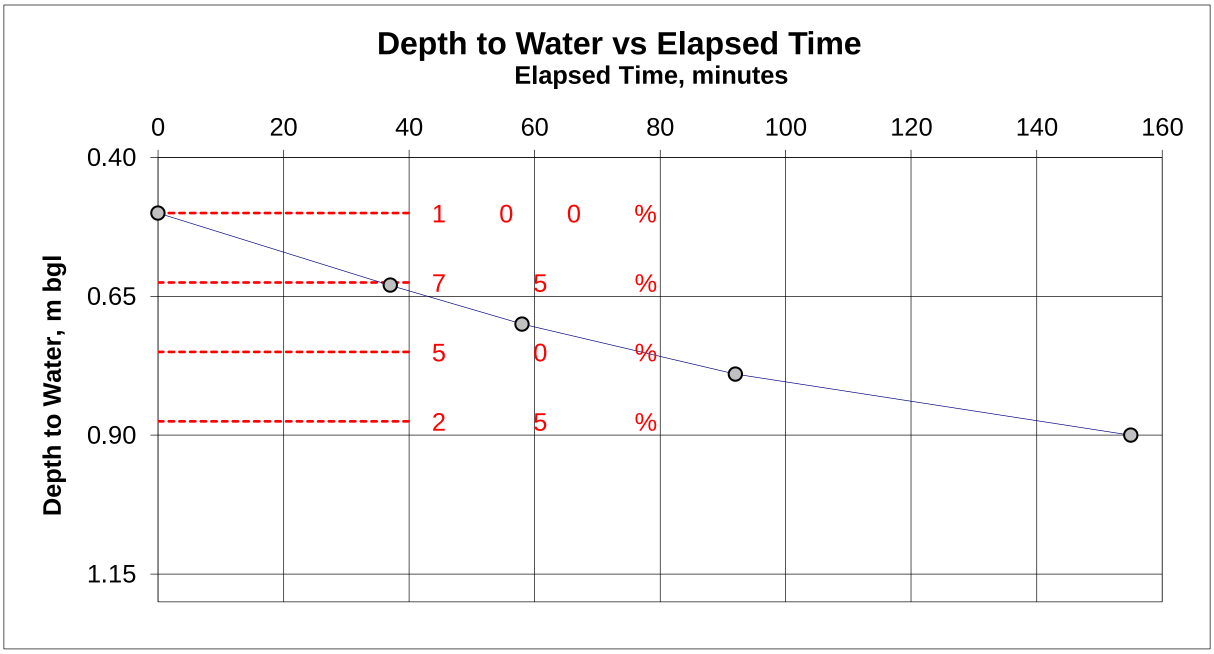
αp = Internal surface area at 50% effective depth

tp = time for the water level to fall from 75% to 25% effective depth

time at 75% effective depth (mins)	38
time at 25% effective depth (mins)	150

(from graph)

Calculated Soil Infiltration Rate = 1.5E-05 m/sec



The Brownfield Consultancy

Woodstock
Memorial Road
Fenny Compton
CV47 2XU
Tel: 07852881086

SOIL INFILTRATION TEST

Project:
Fewcott Road, Fritwell

Project No:
BC195

Test Location: SA6 | Test No: 1 | Date: 26.3.20

Water level during test

Time mins	Depth m bgl
0	0.290
6	0.350
31	0.450
53	0.500
65	0.530
108	0.600
123	0.630
140	0.660
171	0.710
189	0.740
203	0.770

Trial pit dimensions

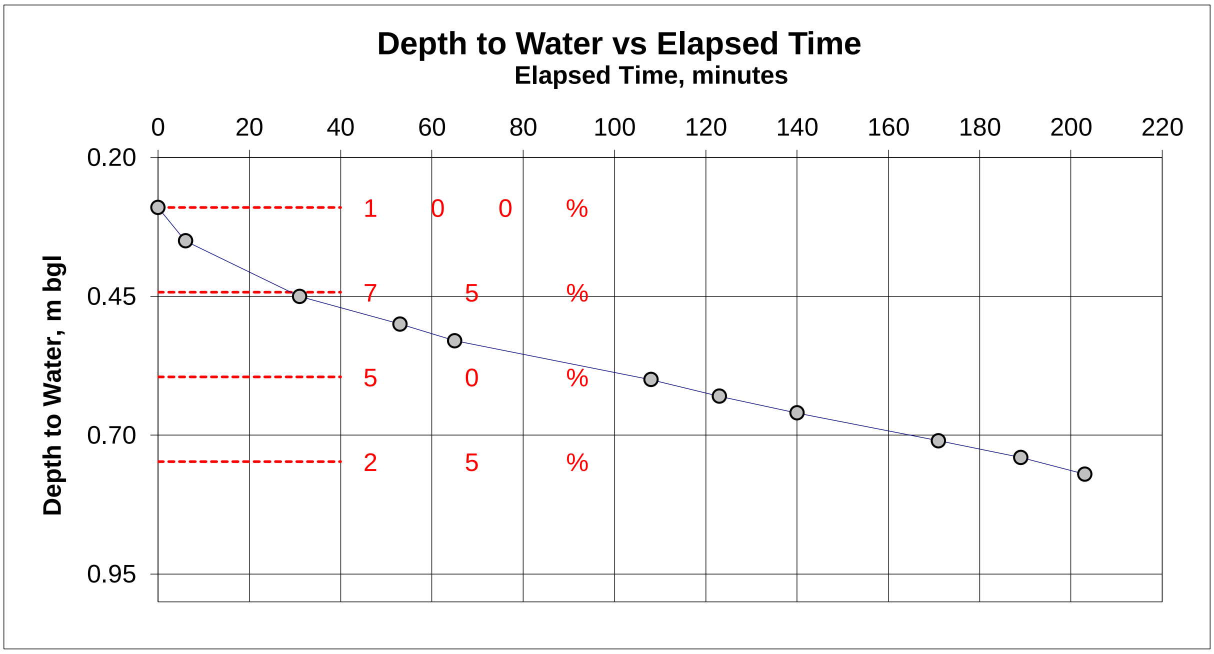
depth (m)	0.90
length (m)	1.35
width (m)	0.70

$$f = \frac{V_p}{\alpha_p \times t_p}$$

f = soil infiltration rate
Vp = volume of water from 75% to 25% effective depth
αp = Internal surface area at 50% effective depth
tp = time for the water level to fall from 75% to 25% effective depth

time at 75% effective depth (mins)	32
time at 25% effective depth (mins)	200
(from graph)	

Calculated Soil Infiltration Rate = 1.0E-05 m/sec



APPENDIX D

Limitations

NOTES ON LIMITATIONS

This report has been prepared by the Brownfield Consultancy with all reasonable skill, care and diligence. This report is confidential and has been prepared solely for the benefit of the client as stated at the front of the report in relation to a specific development or scheme; and those parties with whom a warranty agreement has been executed, or with whom an assignment has been agreed. Should any third party wish to use or rely upon the contents of the report, written approval must be sought from The Brownfield Consultancy; a charge may be levied against such approval. We accept no responsibility or liability for the consequences of this document being used for any purpose or project other than for which it was commissioned, and: this document to any third party with whom an agreement has not been executed.

Any comments given are based on the understanding that the proposed development will be as detailed. The Brownfield Consultancy warrants the accuracy of this report up to and including the published date. Additional information, improved practice or changes in legislation may necessitate this report having to be reviewed in whole or in part after that date.

This report is only valid when used it its entirety. Any information or advice included in the report should not be relied upon until considered in the context of the whole report. Whilst this report and the opinion made herein are correct to the best of our belief we cannot guarantee the accuracy or completeness of any information provided by third parties.

The opinions and recommendations expressed in this report are based on statute, guidance, and appropriate practice current at the date of its preparation. The Brownfield Consultancy does not accept any liability whatsoever for the consequences of any future legislative changes or the release of subsequent guidance documentation, etc. Such changes may render some of the opinions and advice in this report inappropriate or incorrect and we will be pleased to advise if any report requires revision due to changing circumstances. Following delivery of a report we have no obligation to advise the Client or any other party of such changes or their repercussions.

Phase 1 Reports

The work undertaken to provide the basis of a Phase I report comprised a study of available documented information from a variety of sources, together with (where appropriate) a brief walk over inspection of the site. The opinions given in this report have been dictated by the finite data on which they are based and are relevant only to the purpose for which the report was commissioned. The information reviewed should not be considered exhaustive and has been accepted in good faith as providing true and representative data pertaining to site conditions. It should be noted that any risks identified in this report are perceived risks based on the information reviewed; actual risks can only be assessed following a physical investigation of the site.

Historical maps and aerial photographs provide a “snap shot” in time about conditions or activities at the site and cannot be relied upon as indicators of any events or activities that may have taken place at other times.

Phase II Intrusive Investigations

The investigation of the site has been carried out to provide sufficient information concerning the type and degree of contamination, and ground and groundwater conditions to allow a reasonable risk assessment to be made. The conclusions and recommendations made in this site appraisal report and the opinions expressed are based on the information reviewed and/or the ground conditions encountered in exploratory holes and the results of any field or laboratory testing undertaken. There may be ground conditions at the site that have not been disclosed by the information reviewed or by the investigative work undertaken. Such undisclosed conditions cannot be taken into account in any analysis and reporting.

Some of the conclusions in this site appraisal report may be based on third party data. No guarantee can be given for the accuracy or completeness of any of the third party data used.

The evaluation and conclusions do not preclude the existence of contamination, which could not reasonably have been revealed by the current work. Given the discrete nature of sampling, no investigation technique is capable of identifying all conditions present in all areas. The number of sampling points and the methods of sampling and testing do not preclude the existence of localised “hotspots” of contamination where concentrations may be significantly higher than those actually encountered. Hence this report should be used for information purposes only and should not be construed as a comprehensive characterisation of all site conditions.

It should be noted that groundwater levels, groundwater chemistry, surface water levels, surface water chemistry, soil gas concentrations and soil gas flow rates can vary due to seasonal, climatic, tidal and man-made effects.

The interpretation carried out in this report is based on scientific and engineering appraisal carried out by suitably experienced and qualified technical consultants based on the scope of our engagement. We have not taken into account the perceptions of, for example, banks, insurers, other funders, lay people, etc., unless the report has been prepared specifically for that purpose. Advice from other specialists may be required such as the legal, planning and architecture professions, whether specifically recommended in our report or not.

The objectives of the investigation have been linked to establishing the risks associated with potential human targets, building materials, the environment (including adjacent land), and to surface and ground water. The amount of exploratory work and chemical testing undertaken has necessarily been restricted by the short timescale available, and the locations of exploratory holes have been restricted to areas unoccupied by the building(s) on the site and by buried services.

Registered Office:-

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Woodstock
Memorial Road
Fenny Compton
CV47 2XU

Company No: 8143932

Jim.twaddle@brownfieldconsultancy.co.uk

Tel: 07852 881086

APPENDIX B:

GREENFIELD RUNOFF RATES & VOLUMES CALCULATIONS

ICP SUDS Mean Annual Flood

Input

Return Period (years)	100	SAAR (mm)	698	Urban	0.000
Area (ha)	1.570	Soil	0.450	Region Number	Region 6

Results	**l/s**
QBAR Rural	6.9
QBAR Urban	6.9
Q100 years	21.9
Q1 year	5.8
Q30 years	15.6
Q100 years	21.9

Greenfield Runoff Volume

FSR Data

Return Period (years)	1
Storm Duration (mins)	360
Region	England and Wales
M5-60 (mm)	20.000
Ratio R	0.410
Areal Reduction Factor	1.00
Area (ha)	1.570
SAAR (mm)	698
CWI	104.640
Urban	0.000
SPR	47.000

Results

Percentage Runoff (%)	41.91
Greenfield Runoff Volume (m^3)	142.182

Greenfield Runoff Volume

FSR Data

Return Period (years)	30
Storm Duration (mins)	360
Region	England and Wales
M5-60 (mm)	20.000
Ratio R	0.410
Areal Reduction Factor	1.00
Area (ha)	1.570
SAAR (mm)	698
CWI	104.640
Urban	0.000
SPR	47.000

Results

Percentage Runoff (%)	43.79
Greenfield Runoff Volume (m³)	328.024

Greenfield Runoff Volume

FSR Data

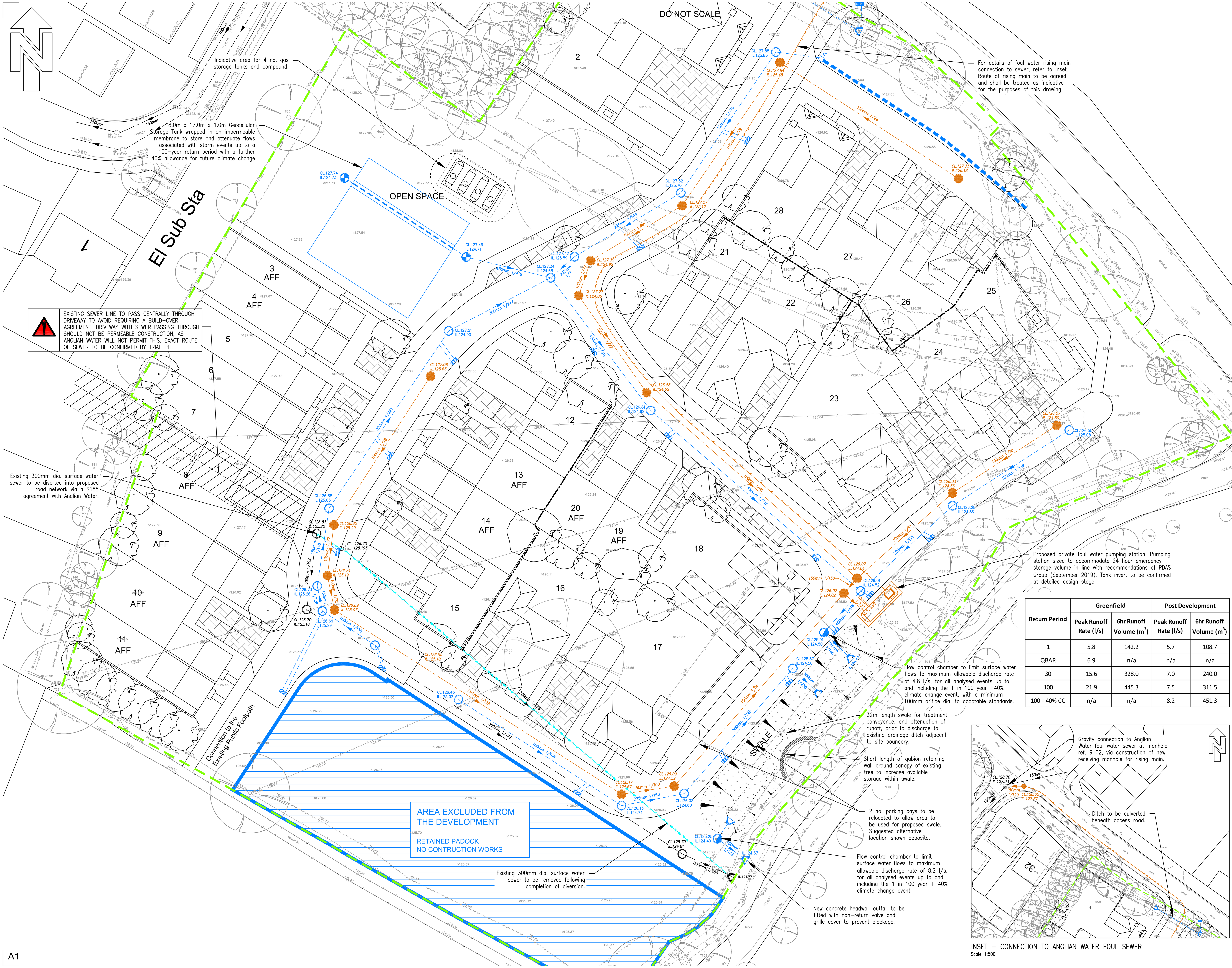
Return Period (years)	100
Storm Duration (mins)	360
Region	England and Wales
M5-60 (mm)	20.000
Ratio R	0.410
Areal Reduction Factor	1.00
Area (ha)	1.570
SAAR (mm)	698
CWI	104.640
Urban	0.000
SPR	47.000

Results

Percentage Runoff (%)	45.81
Greenfield Runoff Volume (m^3)	445.268

APPENDIX C:

DRAINAGE STRATEGY LAYOUT



Return Period	Greenfield Peak Runoff Rate (l/s)	Greenfield 6hr Runoff Volume (m^3)	Post Development Peak Runoff Rate (l/s)	Post Development 6hr Runoff Volume (m^3)
1	5.8	142.2	5.7	108.7
QBAR	6.9	n/a	n/a	n/a
30	15.6	328.0	7.0	240.0
100	21.9	445.3	7.5	311.5
100 + 40% CC	n/a	n/a	8.2	451.3

MK	REVISION	BY	DATE
P4	PLOT TYPES AND ROAD LAYOUTS UPDATED. DRAINAGE LAYOUT UPDATED TO SUIT.	JJH	22.01.21
P3	COVER LEVELS UPDATED FOR RAISED SITE.	GPH	09.11.20
P2	UPDATED FOR LATEST SITE PLAN LAYOUT.	GPH	07.10.20
P1	ISSUED FOR INFORMATION.	GPH	27.07.20

DRAWING STATUS
PRELIMINARY

DRAWING TITLE
PRELIMINARY DRAINAGE STRATEGY

PROJECT
LAND AT FEWCOTT ROAD FRITWELL

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Drawn	Ch'kd	Scales	Date
BCT	GPH	1:250 @ A1	JULY 2020

Purpose of Issue
INFORMATION

Project Number	Drawing Number	Revision
P18-654	SK01	P4

APPENDIX D:

MICRODRAINAGE SOURCE CONTROL CALCULATIONS

Cascade Summary of Results for P18-654 Open Space Storage - 1yr.srcx

Upstream Structures	Outflow To	Overflow To
(None)	P18-654 Outfall Storage - 1yr.srcx	(None)

Half Drain Time : 68 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	124.787	0.287	0.0	4.8	4.8	24.3	O K
30 min Summer	124.803	0.303	0.0	4.8	4.8	29.5	O K
60 min Summer	124.811	0.311	0.0	4.8	4.8	32.2	O K
120 min Summer	124.810	0.310	0.0	4.8	4.8	31.7	O K
180 min Summer	124.806	0.306	0.0	4.8	4.8	30.5	O K
240 min Summer	124.801	0.301	0.0	4.8	4.8	29.0	O K
360 min Summer	124.790	0.290	0.0	4.8	4.8	25.3	O K
480 min Summer	124.778	0.278	0.0	4.7	4.7	21.5	O K
600 min Summer	124.767	0.267	0.0	4.7	4.7	18.0	O K
720 min Summer	124.757	0.257	0.0	4.7	4.7	14.8	O K
960 min Summer	124.740	0.240	0.0	4.7	4.7	9.6	O K
1440 min Summer	124.720	0.220	0.0	4.6	4.6	3.3	O K
2160 min Summer	124.620	0.120	0.0	3.9	3.9	0.8	O K
2880 min Summer	124.596	0.096	0.0	3.2	3.2	0.5	O K
4320 min Summer	124.576	0.076	0.0	2.4	2.4	0.3	O K
5760 min Summer	124.566	0.066	0.0	1.9	1.9	0.2	O K
7200 min Summer	124.560	0.060	0.0	1.6	1.6	0.2	O K
8640 min Summer	124.555	0.055	0.0	1.4	1.4	0.2	O K
10080 min Summer	124.552	0.052	0.0	1.3	1.3	0.1	O K
15 min Winter	124.797	0.297	0.0	4.8	4.8	27.8	O K
30 min Winter	124.817	0.317	0.0	4.8	4.8	34.1	O K
60 min Winter	124.829	0.329	0.0	4.8	4.8	38.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	31.246	0.0	29.4	20
30 min Summer	20.306	0.0	38.2	34
60 min Summer	12.800	0.0	48.1	60
120 min Summer	7.903	0.0	59.4	92
180 min Summer	5.931	0.0	66.9	126
240 min Summer	4.833	0.0	72.6	160
360 min Summer	3.601	0.0	81.2	228
480 min Summer	2.913	0.0	87.6	294
600 min Summer	2.471	0.0	92.9	356
720 min Summer	2.161	0.0	97.4	418
960 min Summer	1.748	0.0	105.1	534
1440 min Summer	1.296	0.0	116.9	754
2160 min Summer	0.962	0.0	130.2	1096
2880 min Summer	0.779	0.0	140.4	1468
4320 min Summer	0.577	0.0	156.1	2184
5760 min Summer	0.467	0.0	168.4	2880
7200 min Summer	0.396	0.0	178.7	3544
8640 min Summer	0.347	0.0	187.6	4272
10080 min Summer	0.310	0.0	195.4	5128
15 min Winter	31.246	0.0	32.9	21
30 min Winter	20.306	0.0	42.7	34
60 min Winter	12.800	0.0	53.9	60

Cascade Summary of Results for P18-654 Open Space Storage - 1yr.srcx

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control Σ (l/s)	Max Outflow (l/s)	Max Volume (m³)	Status
120 min Winter	124.827	0.327	0.0	4.8	4.8	37.4	O K
180 min Winter	124.821	0.321	0.0	4.8	4.8	35.3	O K
240 min Winter	124.812	0.312	0.0	4.8	4.8	32.7	O K
360 min Winter	124.794	0.294	0.0	4.8	4.8	26.7	O K
480 min Winter	124.775	0.275	0.0	4.7	4.7	20.7	O K
600 min Winter	124.758	0.258	0.0	4.7	4.7	15.3	O K
720 min Winter	124.744	0.244	0.0	4.7	4.7	10.7	O K
960 min Winter	124.723	0.223	0.0	4.6	4.6	4.0	O K
1440 min Winter	124.617	0.117	0.0	3.8	3.8	0.8	O K
2160 min Winter	124.587	0.087	0.0	2.9	2.9	0.4	O K
2880 min Winter	124.575	0.075	0.0	2.3	2.3	0.3	O K
4320 min Winter	124.562	0.062	0.0	1.7	1.7	0.2	O K
5760 min Winter	124.554	0.054	0.0	1.4	1.4	0.2	O K
7200 min Winter	124.550	0.050	0.0	1.2	1.2	0.1	O K
8640 min Winter	124.546	0.046	0.0	1.0	1.0	0.1	O K
10080 min Winter	124.543	0.043	0.0	0.9	0.9	0.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
120 min Winter	7.903	0.0	66.5	98
180 min Winter	5.931	0.0	74.9	138
240 min Winter	4.833	0.0	81.4	174
360 min Winter	3.601	0.0	90.9	246
480 min Winter	2.913	0.0	98.1	314
600 min Winter	2.471	0.0	104.0	376
720 min Winter	2.161	0.0	109.1	436
960 min Winter	1.748	0.0	117.7	534
1440 min Winter	1.296	0.0	130.9	730
2160 min Winter	0.962	0.0	145.8	1084
2880 min Winter	0.779	0.0	157.3	1432
4320 min Winter	0.577	0.0	174.9	2156
5760 min Winter	0.467	0.0	188.6	2968
7200 min Winter	0.396	0.0	200.1	3664
8640 min Winter	0.347	0.0	210.1	4280
10080 min Winter	0.310	0.0	218.9	5064

Cascade Rainfall Details for P18-654 Open Space Storage - 1yr.srcx

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	1	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.410	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Time Area Diagram

Total Area (ha) 0.501

Time (mins) From:	**To:**	**Area (ha)**	**Time (mins) From:**	**To:**	**Area (ha)**
0	4	0.193	4	8	0.308

Cascade Model Details for P18-654 Open Space Storage - 1yr.srcx

Storage is Online Cover Level (m) 125.760

Complex Structure

Pipe

Diameter (m) 0.450 Slope (1:X) 416.000 Length (m) 87.000 Invert Level (m) 124.500

Cellular Storage

Invert Level (m) 124.720 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)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	288.0	288.0	1.000	288.0	356.0	1.001	0.0	356.0

Filter Drain

Infiltration Coefficient Base (m/hr)	0.00000	Pipe Diameter (m)	0.450
Infiltration Coefficient Side (m/hr)	0.00000	Pipe Depth above Invert (m)	0.000
Safety Factor	2.0	Slope (1:X)	0.0
Porosity	0.30	Cap Volume Depth (m)	1.000
Invert Level (m)	124.720	Cap Infiltration Depth (m)	0.000
Trench Width (m)	1.0	Number of Pipes	1
Trench Length (m)	18.0		

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0100-4800-1220-4800
Design Head (m)	1.220
Design Flow (l/s)	4.8
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	100
Invert Level (m)	124.500
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.220	4.8	Kick-Flo®	0.757	3.8
Flush-Flo™	0.362	4.8	Mean Flow over Head Range	-	4.2

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)	Depth (m)	Flow (l/s)
0.100	3.3	0.600	4.5	1.600	5.4	2.600	6.8	5.000	9.3
0.200	4.5	0.800	3.9	1.800	5.8	3.000	7.3	5.500	9.7
0.300	4.8	1.000	4.4	2.000	6.0	3.500	7.9	6.000	10.1
0.400	4.8	1.200	4.8	2.200	6.3	4.000	8.4	6.500	10.5
0.500	4.7	1.400	5.1	2.400	6.6	4.500	8.8	7.000	10.9

Hydro-Brake® Optimum Outflow Control

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
7.500	11.3	8.000	11.6	8.500	12.0	9.000	12.3	9.500	12.6

Cascade Summary of Results for P18-654 Open Space Storage - 30yr.srcx

Upstream Structures	Outflow To	Overflow To
(None)	P18-654 Outfall Storage - 30yr.srcx	(None)

Half Drain Time : 219 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	124.917	0.417	0.0	4.8	4.8	66.4	O K
30 min Summer	124.972	0.472	0.0	4.8	4.8	83.8	O K
60 min Summer	125.019	0.519	0.0	4.8	4.8	98.2	O K
120 min Summer	125.044	0.544	0.0	4.8	4.8	105.8	O K
180 min Summer	125.040	0.540	0.0	4.8	4.8	104.4	O K
240 min Summer	125.027	0.527	0.0	4.8	4.8	100.7	O K
360 min Summer	125.006	0.506	0.0	4.8	4.8	94.3	O K
480 min Summer	124.989	0.489	0.0	4.8	4.8	88.9	O K
600 min Summer	124.972	0.472	0.0	4.8	4.8	83.6	O K
720 min Summer	124.955	0.455	0.0	4.8	4.8	78.4	O K
960 min Summer	124.923	0.423	0.0	4.8	4.8	68.3	O K
1440 min Summer	124.866	0.366	0.0	4.8	4.8	50.1	O K
2160 min Summer	124.800	0.300	0.0	4.8	4.8	28.6	O K
2880 min Summer	124.755	0.255	0.0	4.7	4.7	14.3	O K
4320 min Summer	124.685	0.185	0.0	4.5	4.5	2.2	O K
5760 min Summer	124.610	0.110	0.0	3.6	3.6	0.7	O K
7200 min Summer	124.592	0.092	0.0	3.0	3.0	0.5	O K
8640 min Summer	124.582	0.082	0.0	2.6	2.6	0.4	O K
10080 min Summer	124.575	0.075	0.0	2.3	2.3	0.3	O K
15 min Winter	124.944	0.444	0.0	4.8	4.8	75.0	O K
30 min Winter	125.009	0.509	0.0	4.8	4.8	95.2	O K
60 min Winter	125.067	0.567	0.0	4.8	4.8	112.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	76.671	0.0	72.0	22
30 min Summer	49.712	0.0	93.4	36
60 min Summer	30.811	0.0	115.8	66
120 min Summer	18.537	0.0	139.3	122
180 min Summer	13.628	0.0	153.6	180
240 min Summer	10.910	0.0	164.0	208
360 min Summer	7.952	0.0	179.3	268
480 min Summer	6.352	0.0	190.9	334
600 min Summer	5.333	0.0	200.4	402
720 min Summer	4.621	0.0	208.4	470
960 min Summer	3.685	0.0	221.5	604
1440 min Summer	2.675	0.0	241.2	858
2160 min Summer	1.940	0.0	262.4	1216
2880 min Summer	1.543	0.0	278.3	1560
4320 min Summer	1.117	0.0	302.2	2208
5760 min Summer	0.887	0.0	320.1	2864
7200 min Summer	0.742	0.0	334.7	3664
8640 min Summer	0.641	0.0	347.0	4312
10080 min Summer	0.567	0.0	357.7	4992
15 min Winter	76.671	0.0	80.7	22
30 min Winter	49.712	0.0	104.6	36
60 min Winter	30.811	0.0	129.7	64

Cascade Summary of Results for P18-654 Open Space Storage - 30yr.srcx

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control Σ (l/s)	Max Outflow (l/s)	Max Volume (m³)	Status
120 min Winter	125.105	0.605	0.0	4.8	4.8	123.7	O K
180 min Winter	125.108	0.608	0.0	4.8	4.8	124.4	O K
240 min Winter	125.096	0.596	0.0	4.8	4.8	121.0	O K
360 min Winter	125.064	0.564	0.0	4.8	4.8	111.5	O K
480 min Winter	125.038	0.538	0.0	4.8	4.8	103.8	O K
600 min Winter	125.012	0.512	0.0	4.8	4.8	95.9	O K
720 min Winter	124.985	0.485	0.0	4.8	4.8	87.9	O K
960 min Winter	124.935	0.435	0.0	4.8	4.8	72.2	O K
1440 min Winter	124.849	0.349	0.0	4.8	4.8	44.5	O K
2160 min Winter	124.758	0.258	0.0	4.7	4.7	15.2	O K
2880 min Winter	124.690	0.190	0.0	4.5	4.5	2.3	O K
4320 min Winter	124.600	0.100	0.0	3.3	3.3	0.5	O K
5760 min Winter	124.582	0.082	0.0	2.6	2.6	0.4	O K
7200 min Winter	124.572	0.072	0.0	2.2	2.2	0.3	O K
8640 min Winter	124.566	0.066	0.0	1.9	1.9	0.2	O K
10080 min Winter	124.561	0.061	0.0	1.7	1.7	0.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
120 min Winter	18.537	0.0	156.0	122
180 min Winter	13.628	0.0	172.1	178
240 min Winter	10.910	0.0	183.6	232
360 min Winter	7.952	0.0	200.8	290
480 min Winter	6.352	0.0	213.9	364
600 min Winter	5.333	0.0	224.4	440
720 min Winter	4.621	0.0	233.4	512
960 min Winter	3.685	0.0	248.1	654
1440 min Winter	2.675	0.0	270.2	912
2160 min Winter	1.940	0.0	293.8	1240
2880 min Winter	1.543	0.0	311.7	1500
4320 min Winter	1.117	0.0	338.4	2156
5760 min Winter	0.887	0.0	358.5	2928
7200 min Winter	0.742	0.0	374.9	3544
8640 min Winter	0.641	0.0	388.6	4384
10080 min Winter	0.567	0.0	400.6	5032

Cascade Rainfall Details for P18-654 Open Space Storage - 30yr.srcx

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.410	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Time Area Diagram

Total Area (ha) 0.501

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.193	4	8	0.308

Cascade Model Details for P18-654 Open Space Storage - 30yr.srcx

Storage is Online Cover Level (m) 125.760

Complex Structure

Pipe

Diameter (m) 0.450 Slope (1:X) 416.000 Length (m) 87.000 Invert Level (m) 124.500

Cellular Storage

Invert Level (m) 124.720 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)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	288.0	288.0	1.000	288.0	356.0	1.001	0.0	356.0

Filter Drain

Infiltration Coefficient Base (m/hr)	0.00000	Pipe Diameter (m)	0.450
Infiltration Coefficient Side (m/hr)	0.00000	Pipe Depth above Invert (m)	0.000
Safety Factor	2.0	Slope (1:X)	0.0
Porosity	0.30	Cap Volume Depth (m)	1.000
Invert Level (m)	124.720	Cap Infiltration Depth (m)	0.000
Trench Width (m)	1.0	Number of Pipes	1
Trench Length (m)	18.0		

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0100-4800-1220-4800
Design Head (m)	1.220
Design Flow (l/s)	4.8
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	100
Invert Level (m)	124.500
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.220	4.8	Kick-Flo®	0.757	3.8
Flush-Flo™	0.362	4.8	Mean Flow over Head Range	-	4.2

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)	Depth (m)	Flow (l/s)
0.100	3.3	0.600	4.5	1.600	5.4	2.600	6.8	5.000	9.3
0.200	4.5	0.800	3.9	1.800	5.8	3.000	7.3	5.500	9.7
0.300	4.8	1.000	4.4	2.000	6.0	3.500	7.9	6.000	10.1
0.400	4.8	1.200	4.8	2.200	6.3	4.000	8.4	6.500	10.5
0.500	4.7	1.400	5.1	2.400	6.6	4.500	8.8	7.000	10.9

Hydro-Brake® Optimum Outflow Control

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
7.500	11.3	8.000	11.6	8.500	12.0	9.000	12.3	9.500	12.6

Cascade Summary of Results for P18-654 Open Space Storage - 100yr.srcx

Upstream Structures	Outflow To	Overflow To
(None)	P18-654 Outfall Storage - 100yr.srcx	(None)

Half Drain Time : 323 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	124.985	0.485	0.0	4.8	4.8	87.7	O K
30 min Summer	125.067	0.567	0.0	4.8	4.8	112.6	O K
60 min Summer	125.144	0.644	0.0	4.8	4.8	134.7	O K
120 min Summer	125.199	0.699	0.0	4.8	4.8	150.1	O K
180 min Summer	125.208	0.708	0.0	4.8	4.8	152.8	O K
240 min Summer	125.199	0.699	0.0	4.8	4.8	150.1	O K
360 min Summer	125.163	0.663	0.0	4.8	4.8	140.2	O K
480 min Summer	125.137	0.637	0.0	4.8	4.8	132.6	O K
600 min Summer	125.114	0.614	0.0	4.8	4.8	126.1	O K
720 min Summer	125.093	0.593	0.0	4.8	4.8	120.0	O K
960 min Summer	125.053	0.553	0.0	4.8	4.8	108.4	O K
1440 min Summer	124.981	0.481	0.0	4.8	4.8	86.7	O K
2160 min Summer	124.893	0.393	0.0	4.8	4.8	58.7	O K
2880 min Summer	124.826	0.326	0.0	4.8	4.8	37.2	O K
4320 min Summer	124.745	0.245	0.0	4.7	4.7	11.0	O K
5760 min Summer	124.681	0.181	0.0	4.4	4.4	2.1	O K
7200 min Summer	124.614	0.114	0.0	3.7	3.7	0.7	O K
8640 min Summer	124.598	0.098	0.0	3.2	3.2	0.5	O K
10080 min Summer	124.587	0.087	0.0	2.9	2.9	0.4	O K
15 min Winter	125.022	0.522	0.0	4.8	4.8	99.0	O K
30 min Winter	125.119	0.619	0.0	4.8	4.8	127.5	O K
60 min Winter	125.211	0.711	0.0	4.8	4.8	153.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	99.536	0.0	93.5	22
30 min Summer	65.075	0.0	122.3	37
60 min Summer	40.510	0.0	152.2	66
120 min Summer	24.362	0.0	183.1	124
180 min Summer	17.855	0.0	201.3	184
240 min Summer	14.239	0.0	214.0	242
360 min Summer	10.317	0.0	232.6	310
480 min Summer	8.210	0.0	246.8	368
600 min Summer	6.871	0.0	258.2	430
720 min Summer	5.939	0.0	267.8	496
960 min Summer	4.714	0.0	283.4	630
1440 min Summer	3.400	0.0	306.6	894
2160 min Summer	2.448	0.0	331.1	1272
2880 min Summer	1.937	0.0	349.4	1620
4320 min Summer	1.391	0.0	376.4	2292
5760 min Summer	1.099	0.0	396.4	2936
7200 min Summer	0.915	0.0	412.5	3592
8640 min Summer	0.787	0.0	425.9	4352
10080 min Summer	0.693	0.0	437.5	4984
15 min Winter	99.536	0.0	104.7	22
30 min Winter	65.075	0.0	136.9	36
60 min Winter	40.510	0.0	170.5	66

Cascade Summary of Results for P18-654 Open Space Storage - 100yr.srcx

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control Σ (l/s)	Max Outflow (l/s)	Max Volume (m³)	Status
120 min Winter	125.283	0.783	0.0	4.8	4.8	173.8	O K
180 min Winter	125.304	0.804	0.0	4.8	4.8	179.5	O K
240 min Winter	125.302	0.802	0.0	4.8	4.8	179.1	O K
360 min Winter	125.274	0.774	0.0	4.8	4.8	171.3	O K
480 min Winter	125.232	0.732	0.0	4.8	4.8	159.4	O K
600 min Winter	125.197	0.697	0.0	4.8	4.8	149.5	O K
720 min Winter	125.164	0.664	0.0	4.8	4.8	140.5	O K
960 min Winter	125.102	0.602	0.0	4.8	4.8	122.6	O K
1440 min Winter	124.989	0.489	0.0	4.8	4.8	88.9	O K
2160 min Winter	124.858	0.358	0.0	4.8	4.8	47.5	O K
2880 min Winter	124.770	0.270	0.0	4.7	4.7	19.1	O K
4320 min Winter	124.634	0.134	0.0	4.1	4.1	1.0	O K
5760 min Winter	124.598	0.098	0.0	3.3	3.3	0.5	O K
7200 min Winter	124.584	0.084	0.0	2.7	2.7	0.4	O K
8640 min Winter	124.575	0.075	0.0	2.3	2.3	0.3	O K
10080 min Winter	124.569	0.069	0.0	2.1	2.1	0.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
120 min Winter	24.362	0.0	205.0	122
180 min Winter	17.855	0.0	225.4	180
240 min Winter	14.239	0.0	239.7	238
360 min Winter	10.317	0.0	260.5	348
480 min Winter	8.210	0.0	276.4	446
600 min Winter	6.871	0.0	289.2	472
720 min Winter	5.939	0.0	299.9	544
960 min Winter	4.714	0.0	317.4	688
1440 min Winter	3.400	0.0	343.4	966
2160 min Winter	2.448	0.0	370.9	1340
2880 min Winter	1.937	0.0	391.3	1648
4320 min Winter	1.391	0.0	421.5	2204
5760 min Winter	1.099	0.0	444.0	2912
7200 min Winter	0.915	0.0	461.9	3544
8640 min Winter	0.787	0.0	477.0	4408
10080 min Winter	0.693	0.0	490.0	5056

Cascade Rainfall Details for P18-654 Open Space Storage - 100yr.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)	20.000	Shortest Storm (mins)	15
Ratio R	0.410	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Time Area Diagram

Total Area (ha) 0.501

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	4	0.193	4	8	0.308

Cascade Model Details for P18-654 Open Space Storage - 100yr.srcx

Storage is Online Cover Level (m) 125.760

Complex Structure

Pipe

Diameter (m) 0.450 Slope (1:X) 416.000 Length (m) 87.000 Invert Level (m) 124.500

Filter Drain

Infiltration Coefficient Base (m/hr)	0.00000	Pipe Diameter (m)	0.450
Infiltration Coefficient Side (m/hr)	0.00000	Pipe Depth above Invert (m)	0.000
Safety Factor	2.0	Slope (1:X)	0.0
Porosity	0.30	Cap Volume Depth (m)	1.000
Invert Level (m)	124.720	Cap Infiltration Depth (m)	0.000
Trench Width (m)	1.0	Number of Pipes	1
Trench Length (m)	18.0		

Cellular Storage

Invert Level (m)	124.720	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)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	288.0	288.0	1.000	288.0	356.0	1.001	0.0	356.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0100-4800-1220-4800
Design Head (m)	1.220
Design Flow (l/s)	4.8
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	100
Invert Level (m)	124.500
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.220	4.8	Kick-Flo®	0.757	3.8
Flush-Flo™	0.362	4.8	Mean Flow over Head Range	-	4.2

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)	Depth (m)	Flow (l/s)
0.100	3.3	0.600	4.5	1.600	5.4	2.600	6.8	5.000	9.3
0.200	4.5	0.800	3.9	1.800	5.8	3.000	7.3	5.500	9.7
0.300	4.8	1.000	4.4	2.000	6.0	3.500	7.9	6.000	10.1
0.400	4.8	1.200	4.8	2.200	6.3	4.000	8.4	6.500	10.5
0.500	4.7	1.400	5.1	2.400	6.6	4.500	8.8	7.000	10.9

Hydro-Brake® Optimum Outflow Control

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
7.500	11.3	8.000	11.6	8.500	12.0	9.000	12.3	9.500	12.6

Cascade Summary of Results for P18-654 Open Space Storage - 100yr + 40%cc.srcx

Upstream Structures	Outflow To	Overflow To
(None)	P18-654 Outfall Storage - 100yr + 40%cc.srcx	(None)

Half Drain Time : 529 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	125.129	0.629	0.0	4.8	4.8	130.5	O K
30 min Summer	125.266	0.766	0.0	4.8	4.8	169.0	O K
60 min Summer	125.395	0.895	0.0	4.8	4.8	205.0	O K
120 min Summer	125.499	0.999	0.0	4.8	4.8	234.2	Flood Risk
180 min Summer	125.537	1.037	0.0	4.8	4.8	244.7	Flood Risk
240 min Summer	125.546	1.046	0.0	4.8	4.8	247.3	Flood Risk
360 min Summer	125.531	1.031	0.0	4.8	4.8	243.1	Flood Risk
480 min Summer	125.499	0.999	0.0	4.8	4.8	234.2	Flood Risk
600 min Summer	125.470	0.970	0.0	4.8	4.8	226.0	Flood Risk
720 min Summer	125.445	0.945	0.0	4.8	4.8	219.0	O K
960 min Summer	125.401	0.901	0.0	4.8	4.8	206.8	O K
1440 min Summer	125.321	0.821	0.0	4.8	4.8	184.2	O K
2160 min Summer	125.189	0.689	0.0	4.8	4.8	147.4	O K
2880 min Summer	125.074	0.574	0.0	4.8	4.8	114.5	O K
4320 min Summer	124.910	0.410	0.0	4.8	4.8	64.2	O K
5760 min Summer	124.809	0.309	0.0	4.8	4.8	31.5	O K
7200 min Summer	124.749	0.249	0.0	4.7	4.7	12.3	O K
8640 min Summer	124.720	0.220	0.0	4.6	4.6	3.3	O K
10080 min Summer	124.637	0.137	0.0	4.1	4.1	1.1	O K
15 min Winter	125.188	0.688	0.0	4.8	4.8	147.0	O K
30 min Winter	125.343	0.843	0.0	4.8	4.8	190.6	O K
60 min Winter	125.491	0.991	0.0	4.8	4.8	231.9	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	139.350	0.0	136.4	22
30 min Summer	91.106	0.0	178.3	37
60 min Summer	56.713	0.0	222.0	66
120 min Summer	34.106	0.0	267.1	126
180 min Summer	24.997	0.0	293.6	184
240 min Summer	19.934	0.0	312.2	244
360 min Summer	14.444	0.0	339.3	362
480 min Summer	11.493	0.0	360.0	456
600 min Summer	9.620	0.0	376.6	510
720 min Summer	8.314	0.0	390.6	574
960 min Summer	6.600	0.0	413.4	700
1440 min Summer	4.760	0.0	447.2	980
2160 min Summer	3.427	0.0	483.0	1368
2880 min Summer	2.712	0.0	509.7	1736
4320 min Summer	1.948	0.0	549.0	2464
5760 min Summer	1.538	0.0	578.2	3112
7200 min Summer	1.281	0.0	601.6	3752
8640 min Summer	1.102	0.0	621.3	4408
10080 min Summer	0.970	0.0	638.2	5136
15 min Winter	139.350	0.0	152.8	22
30 min Winter	91.106	0.0	199.7	37
60 min Winter	56.713	0.0	248.7	66

Cascade Summary of Results for P18-654 Open Space Storage - 100yr + 40%cc.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
120 min Winter	125.615	1.115	0.0	4.8	4.8	266.7	Flood Risk
180 min Winter	125.665	1.165	0.0	4.8	4.8	280.6	Flood Risk
240 min Winter	125.683	1.183	0.0	4.8	4.8	285.6	Flood Risk
360 min Winter	125.680	1.180	0.0	4.8	4.8	285.0	Flood Risk
480 min Winter	125.656	1.156	0.0	4.8	4.8	278.1	Flood Risk
600 min Winter	125.620	1.120	0.0	4.8	4.8	268.0	Flood Risk
720 min Winter	125.582	1.082	0.0	4.8	4.8	257.4	Flood Risk
960 min Winter	125.526	1.026	0.0	4.8	4.8	241.7	Flood Risk
1440 min Winter	125.414	0.914	0.0	4.8	4.8	210.4	O K
2160 min Winter	125.224	0.724	0.0	4.8	4.8	157.2	O K
2880 min Winter	125.043	0.543	0.0	4.8	4.8	105.4	O K
4320 min Winter	124.824	0.324	0.0	4.8	4.8	36.3	O K
5760 min Winter	124.723	0.223	0.0	4.6	4.6	4.1	O K
7200 min Winter	124.621	0.121	0.0	4.0	4.0	0.8	O K
8640 min Winter	124.603	0.103	0.0	3.4	3.4	0.6	O K
10080 min Winter	124.591	0.091	0.0	3.0	3.0	0.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
120 min Winter	34.106	0.0	299.1	124
180 min Winter	24.997	0.0	328.8	182
240 min Winter	19.934	0.0	349.6	238
360 min Winter	14.444	0.0	380.0	352
480 min Winter	11.493	0.0	403.2	462
600 min Winter	9.620	0.0	421.8	564
720 min Winter	8.314	0.0	437.5	604
960 min Winter	6.600	0.0	463.0	744
1440 min Winter	4.760	0.0	500.9	1056
2160 min Winter	3.427	0.0	541.0	1496
2880 min Winter	2.712	0.0	570.8	1852
4320 min Winter	1.948	0.0	614.9	2512
5760 min Winter	1.538	0.0	647.6	3000
7200 min Winter	1.281	0.0	673.8	3560
8640 min Winter	1.102	0.0	695.8	4264
10080 min Winter	0.970	0.0	714.8	5088

Cascade Rainfall Details for P18-654 Open Space Storage - 100yr + 40%cc.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)	20.000	Shortest Storm (mins)	15
Ratio R	0.410	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.522

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.183	4	8	0.339

Cascade Model Details for P18-654 Open Space Storage - 100yr + 40%cc.srcx

Storage is Online Cover Level (m) 125.760

Complex Structure

Pipe

Diameter (m) 0.450 Slope (1:X) 416.000 Length (m) 87.000 Invert Level (m) 124.500

Cellular Storage

Invert Level (m) 124.720 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)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	288.0	288.0	1.000	288.0	356.0	1.001	0.0	356.0

Filter Drain

Infiltration Coefficient Base (m/hr)	0.00000	Pipe Diameter (m)	0.450
Infiltration Coefficient Side (m/hr)	0.00000	Pipe Depth above Invert (m)	0.000
Safety Factor	2.0	Slope (1:X)	0.0
Porosity	0.30	Cap Volume Depth (m)	1.000
Invert Level (m)	124.720	Cap Infiltration Depth (m)	0.000
Trench Width (m)	1.0	Number of Pipes	1
Trench Length (m)	18.0		

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0100-4800-1220-4800
Design Head (m)	1.220
Design Flow (l/s)	4.8
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	100
Invert Level (m)	124.500
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.220	4.8	Kick-Flo®	0.757	3.8
Flush-Flo™	0.362	4.8	Mean Flow over Head Range	-	4.2

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)	Depth (m)	Flow (l/s)
0.100	3.3	0.600	4.5	1.600	5.4	2.600	6.8	5.000	9.3
0.200	4.5	0.800	3.9	1.800	5.8	3.000	7.3	5.500	9.7
0.300	4.8	1.000	4.4	2.000	6.0	3.500	7.9	6.000	10.1
0.400	4.8	1.200	4.8	2.200	6.3	4.000	8.4	6.500	10.5
0.500	4.7	1.400	5.1	2.400	6.6	4.500	8.8	7.000	10.9

Hydro-Brake® Optimum Outflow Control

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
7.500	11.3	8.000	11.6	8.500	12.0	9.000	12.3	9.500	12.6

Cascade Summary of Results for P18-654 Outfall Storage - 1yr.srcx

Upstream Structures	Outflow To	Overflow To
P18-654 Open Space Storage - 1yr.srcx	(None)	(None)

Half Drain Time : 22 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	124.543	0.133	0.0	4.9	4.9	7.2	O K
30 min Summer	124.574	0.164	0.0	5.0	5.0	9.3	O K
60 min Summer	124.599	0.189	0.0	5.3	5.3	11.2	O K
120 min Summer	124.611	0.201	0.0	5.5	5.5	12.2	Flood Risk
180 min Summer	124.612	0.202	0.0	5.5	5.5	12.3	Flood Risk
240 min Summer	124.612	0.202	0.0	5.5	5.5	12.3	Flood Risk
360 min Summer	124.610	0.200	0.0	5.5	5.5	12.1	Flood Risk
480 min Summer	124.607	0.197	0.0	5.4	5.4	11.9	Flood Risk
600 min Summer	124.603	0.193	0.0	5.4	5.4	11.6	Flood Risk
720 min Summer	124.599	0.189	0.0	5.3	5.3	11.3	O K
960 min Summer	124.591	0.181	0.0	5.2	5.2	10.6	O K
1440 min Summer	124.568	0.158	0.0	4.9	4.9	8.9	O K
2160 min Summer	124.515	0.105	0.0	4.6	4.6	5.4	O K
2880 min Summer	124.496	0.086	0.0	3.8	3.8	4.3	O K
4320 min Summer	124.477	0.067	0.0	2.8	2.8	3.3	O K
5760 min Summer	124.467	0.057	0.0	2.3	2.3	2.7	O K
7200 min Summer	124.461	0.051	0.0	1.9	1.9	2.4	O K
8640 min Summer	124.456	0.046	0.0	1.7	1.7	2.2	O K
10080 min Summer	124.453	0.043	0.0	1.5	1.5	2.0	O K
15 min Winter	124.553	0.143	0.0	4.9	4.9	7.8	O K
30 min Winter	124.583	0.173	0.0	5.1	5.1	10.0	O K
60 min Winter	124.610	0.200	0.0	5.5	5.5	12.1	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	31.246	0.0	35.1	23
30 min Summer	20.306	0.0	45.6	37
60 min Summer	12.800	0.0	57.5	64
120 min Summer	7.903	0.0	71.0	102
180 min Summer	5.931	0.0	79.9	134
240 min Summer	4.833	0.0	86.8	168
360 min Summer	3.601	0.0	97.0	238
480 min Summer	2.913	0.0	104.7	306
600 min Summer	2.471	0.0	111.0	374
720 min Summer	2.161	0.0	116.5	442
960 min Summer	1.748	0.0	125.6	576
1440 min Summer	1.296	0.0	139.8	806
2160 min Summer	0.962	0.0	155.6	1108
2880 min Summer	0.779	0.0	167.9	1472
4320 min Summer	0.577	0.0	186.7	2200
5760 min Summer	0.467	0.0	201.3	2888
7200 min Summer	0.396	0.0	213.6	3672
8640 min Summer	0.347	0.0	224.2	4400
10080 min Summer	0.310	0.0	233.7	5136
15 min Winter	31.246	0.0	39.3	23
30 min Winter	20.306	0.0	51.1	36
60 min Winter	12.800	0.0	64.4	62

Cascade Summary of Results for P18-654 Outfall Storage - 1yr.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
120 min Winter	124.624	0.214	0.0	5.6	5.6	13.3	Flood Risk
180 min Winter	124.626	0.216	0.0	5.7	5.7	13.5	Flood Risk
240 min Winter	124.625	0.215	0.0	5.7	5.7	13.4	Flood Risk
360 min Winter	124.621	0.211	0.0	5.6	5.6	13.0	Flood Risk
480 min Winter	124.614	0.204	0.0	5.5	5.5	12.5	Flood Risk
600 min Winter	124.608	0.198	0.0	5.5	5.5	12.0	Flood Risk
720 min Winter	124.601	0.191	0.0	5.4	5.4	11.4	Flood Risk
960 min Winter	124.586	0.176	0.0	5.2	5.2	10.2	O K
1440 min Winter	124.514	0.104	0.0	4.5	4.5	5.4	O K
2160 min Winter	124.488	0.078	0.0	3.4	3.4	3.8	O K
2880 min Winter	124.476	0.066	0.0	2.8	2.8	3.2	O K
4320 min Winter	124.463	0.053	0.0	2.0	2.0	2.5	O K
5760 min Winter	124.455	0.045	0.0	1.6	1.6	2.1	O K
7200 min Winter	124.450	0.040	0.0	1.4	1.4	1.9	O K
8640 min Winter	124.447	0.037	0.0	1.2	1.2	1.7	O K
10080 min Winter	124.444	0.034	0.0	1.1	1.1	1.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
120 min Winter	7.903	0.0	79.5	102
180 min Winter	5.931	0.0	89.5	138
240 min Winter	4.833	0.0	97.2	176
360 min Winter	3.601	0.0	108.7	252
480 min Winter	2.913	0.0	117.3	324
600 min Winter	2.471	0.0	124.3	396
720 min Winter	2.161	0.0	130.4	464
960 min Winter	1.748	0.0	140.7	590
1440 min Winter	1.296	0.0	156.5	754
2160 min Winter	0.962	0.0	174.3	1108
2880 min Winter	0.779	0.0	188.0	1468
4320 min Winter	0.577	0.0	209.1	2204
5760 min Winter	0.467	0.0	225.5	2904
7200 min Winter	0.396	0.0	239.3	3680
8640 min Winter	0.347	0.0	251.1	4312
10080 min Winter	0.310	0.0	261.7	5088

Cascade Rainfall Details for P18-654 Outfall Storage - 1yr.srcx

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	1	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.410	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Time Area Diagram

Total Area (ha) 0.098

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	4	0.042	4	8	0.056

Cascade Model Details for P18-654 Outfall Storage - 1yr.srcx

Storage is Online Cover Level (m) 124.900

Complex Structure

Tank or Pond

Invert Level (m) 124.410

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	44.1	0.490	133.6

Pipe

Diameter (m) 0.300 Slope (1:X) 243.000 Length (m) 24.325 Invert Level (m) 124.500

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SCU-0106-8200-0500-8200
Design Head (m)	0.500
Design Flow (l/s)	8.2
Flush-Flo™	Calculated
Objective	Linear discharge profile
Application	Surface
Sump Available	Yes
Diameter (mm)	106
Invert Level (m)	124.400
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.500	8.2	Kick-Flo®	0.158	4.8
Flush-Flo™	0.134	4.9	Mean Flow over Head Range	-	5.4

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)	Depth (m)	Flow (l/s)
0.100	4.0	0.800	10.2	2.000	15.8	4.000	22.0	7.000	28.9
0.200	5.4	1.000	11.4	2.200	16.5	4.500	23.3	7.500	29.9
0.300	6.5	1.200	12.4	2.400	17.2	5.000	24.5	8.000	30.9
0.400	7.4	1.400	13.3	2.600	17.9	5.500	25.6	8.500	31.9
0.500	8.2	1.600	14.2	3.000	19.2	6.000	26.8	9.000	32.8
0.600	8.9	1.800	15.0	3.500	20.7	6.500	27.9	9.500	33.7

Cascade Summary of Results for P18-654 Outfall Storage - 30yr.srcx

Upstream Structures	Outflow To	Overflow To
P18-654 Open Space Storage - 30yr.srcx	(None)	(None)

Half Drain Time : 35 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	124.642	0.232	0.0	5.8	5.8	14.8	Flood Risk
30 min Summer	124.683	0.273	0.0	6.3	6.3	18.6	Flood Risk
60 min Summer	124.714	0.304	0.0	6.6	6.6	21.6	Flood Risk
120 min Summer	124.730	0.320	0.0	6.8	6.8	23.4	Flood Risk
180 min Summer	124.735	0.325	0.0	6.8	6.8	23.8	Flood Risk
240 min Summer	124.733	0.323	0.0	6.8	6.8	23.6	Flood Risk
360 min Summer	124.722	0.312	0.0	6.7	6.7	22.5	Flood Risk
480 min Summer	124.713	0.303	0.0	6.6	6.6	21.5	Flood Risk
600 min Summer	124.704	0.294	0.0	6.5	6.5	20.7	Flood Risk
720 min Summer	124.697	0.287	0.0	6.4	6.4	19.9	Flood Risk
960 min Summer	124.684	0.274	0.0	6.3	6.3	18.7	Flood Risk
1440 min Summer	124.662	0.252	0.0	6.1	6.1	16.7	Flood Risk
2160 min Summer	124.638	0.228	0.0	5.8	5.8	14.5	Flood Risk
2880 min Summer	124.617	0.207	0.0	5.6	5.6	12.7	Flood Risk
4320 min Summer	124.568	0.158	0.0	4.9	4.9	8.9	O K
5760 min Summer	124.510	0.100	0.0	4.3	4.3	5.1	O K
7200 min Summer	124.493	0.083	0.0	3.6	3.6	4.1	O K
8640 min Summer	124.483	0.073	0.0	3.1	3.1	3.6	O K
10080 min Summer	124.476	0.066	0.0	2.8	2.8	3.2	O K
15 min Winter	124.659	0.249	0.0	6.0	6.0	16.4	Flood Risk
30 min Winter	124.702	0.292	0.0	6.5	6.5	20.5	Flood Risk
60 min Winter	124.735	0.325	0.0	6.8	6.8	23.8	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	76.671	0.0	86.1	22
30 min Summer	49.712	0.0	111.6	35
60 min Summer	30.811	0.0	138.4	62
120 min Summer	18.537	0.0	166.5	94
180 min Summer	13.628	0.0	183.7	126
240 min Summer	10.910	0.0	196.0	160
360 min Summer	7.952	0.0	214.3	230
480 min Summer	6.352	0.0	228.3	298
600 min Summer	5.333	0.0	239.6	364
720 min Summer	4.621	0.0	249.1	430
960 min Summer	3.685	0.0	264.8	560
1440 min Summer	2.675	0.0	288.4	812
2160 min Summer	1.940	0.0	313.7	1192
2880 min Summer	1.543	0.0	332.7	1564
4320 min Summer	1.117	0.0	361.2	2268
5760 min Summer	0.887	0.0	382.7	2936
7200 min Summer	0.742	0.0	400.2	3648
8640 min Summer	0.641	0.0	414.9	4328
10080 min Summer	0.567	0.0	427.7	5112
15 min Winter	76.671	0.0	96.4	21
30 min Winter	49.712	0.0	125.0	35
60 min Winter	30.811	0.0	155.0	60

Cascade Summary of Results for P18-654 Outfall Storage - 30yr.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
120 min Winter	124.751	0.341	0.0	6.9	6.9	25.6	Flood Risk
180 min Winter	124.754	0.344	0.0	7.0	7.0	25.9	Flood Risk
240 min Winter	124.751	0.341	0.0	6.9	6.9	25.5	Flood Risk
360 min Winter	124.737	0.327	0.0	6.8	6.8	24.1	Flood Risk
480 min Winter	124.723	0.313	0.0	6.7	6.7	22.6	Flood Risk
600 min Winter	124.711	0.301	0.0	6.6	6.6	21.4	Flood Risk
720 min Winter	124.701	0.291	0.0	6.5	6.5	20.3	Flood Risk
960 min Winter	124.683	0.273	0.0	6.3	6.3	18.6	Flood Risk
1440 min Winter	124.655	0.245	0.0	6.0	6.0	16.0	Flood Risk
2160 min Winter	124.623	0.213	0.0	5.6	5.6	13.2	Flood Risk
2880 min Winter	124.585	0.175	0.0	5.2	5.2	10.2	O K
4320 min Winter	124.500	0.090	0.0	3.9	3.9	4.5	O K
5760 min Winter	124.483	0.073	0.0	3.1	3.1	3.6	O K
7200 min Winter	124.473	0.063	0.0	2.6	2.6	3.1	O K
8640 min Winter	124.467	0.057	0.0	2.3	2.3	2.7	O K
10080 min Winter	124.462	0.052	0.0	2.0	2.0	2.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
120 min Winter	18.537	0.0	186.5	96
180 min Winter	13.628	0.0	205.7	134
240 min Winter	10.910	0.0	219.5	172
360 min Winter	7.952	0.0	240.0	244
480 min Winter	6.352	0.0	255.7	314
600 min Winter	5.333	0.0	268.3	384
720 min Winter	4.621	0.0	279.0	450
960 min Winter	3.685	0.0	296.6	582
1440 min Winter	2.675	0.0	323.0	850
2160 min Winter	1.940	0.0	351.3	1236
2880 min Winter	1.543	0.0	372.6	1580
4320 min Winter	1.117	0.0	404.6	2204
5760 min Winter	0.887	0.0	428.7	2864
7200 min Winter	0.742	0.0	448.2	3672
8640 min Winter	0.641	0.0	464.7	4360
10080 min Winter	0.567	0.0	479.0	5016

Cascade Rainfall Details for P18-654 Outfall Storage - 30yr.srcx

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.410	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Time Area Diagram

Total Area (ha) 0.098

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.042	4	8	0.056

Cascade Model Details for P18-654 Outfall Storage - 30yr.srcx

Storage is Online Cover Level (m) 124.900

Complex Structure

Tank or Pond

Invert Level (m) 124.410

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	44.1	0.490	133.6

Pipe

Diameter (m) 0.300 Slope (1:X) 243.000 Length (m) 24.325 Invert Level (m) 124.500

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SCU-0106-8200-0500-8200
Design Head (m)	0.500
Design Flow (l/s)	8.2
Flush-Flo™	Calculated
Objective	Linear discharge profile
Application	Surface
Sump Available	Yes
Diameter (mm)	106
Invert Level (m)	124.400
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.500	8.2	Kick-Flo®	0.158	4.8
Flush-Flo™	0.134	4.9	Mean Flow over Head Range	-	5.4

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)	Depth (m)	Flow (l/s)
0.100	4.0	0.800	10.2	2.000	15.8	4.000	22.0	7.000	28.9
0.200	5.4	1.000	11.4	2.200	16.5	4.500	23.3	7.500	29.9
0.300	6.5	1.200	12.4	2.400	17.2	5.000	24.5	8.000	30.9
0.400	7.4	1.400	13.3	2.600	17.9	5.500	25.6	8.500	31.9
0.500	8.2	1.600	14.2	3.000	19.2	6.000	26.8	9.000	32.8
0.600	8.9	1.800	15.0	3.500	20.7	6.500	27.9	9.500	33.7

Cascade Summary of Results for P18-654 Outfall Storage - 100yr.srcx

Upstream Structures	Outflow To	Overflow To
P18-654 Open Space Storage - 100yr.srcx	(None)	(None)

Half Drain Time : 41 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	124.684	0.274	0.0	6.3	6.3	18.7	Flood Risk
30 min Summer	124.732	0.322	0.0	6.8	6.8	23.6	Flood Risk
60 min Summer	124.766	0.356	0.0	7.1	7.1	27.3	Flood Risk
120 min Summer	124.785	0.375	0.0	7.3	7.3	29.3	Flood Risk
180 min Summer	124.789	0.379	0.0	7.3	7.3	29.9	Flood Risk
240 min Summer	124.788	0.378	0.0	7.3	7.3	29.8	Flood Risk
360 min Summer	124.777	0.367	0.0	7.2	7.2	28.5	Flood Risk
480 min Summer	124.764	0.354	0.0	7.1	7.1	27.0	Flood Risk
600 min Summer	124.752	0.342	0.0	7.0	7.0	25.7	Flood Risk
720 min Summer	124.742	0.332	0.0	6.9	6.9	24.6	Flood Risk
960 min Summer	124.725	0.315	0.0	6.7	6.7	22.8	Flood Risk
1440 min Summer	124.699	0.289	0.0	6.4	6.4	20.1	Flood Risk
2160 min Summer	124.670	0.260	0.0	6.2	6.2	17.4	Flood Risk
2880 min Summer	124.649	0.239	0.0	5.9	5.9	15.4	Flood Risk
4320 min Summer	124.615	0.205	0.0	5.5	5.5	12.5	Flood Risk
5760 min Summer	124.570	0.160	0.0	5.0	5.0	9.1	O K
7200 min Summer	124.513	0.103	0.0	4.5	4.5	5.3	O K
8640 min Summer	124.498	0.088	0.0	3.9	3.9	4.4	O K
10080 min Summer	124.488	0.078	0.0	3.4	3.4	3.8	O K
15 min Winter	124.704	0.294	0.0	6.5	6.5	20.7	Flood Risk
30 min Winter	124.755	0.345	0.0	7.0	7.0	26.1	Flood Risk
60 min Winter	124.791	0.381	0.0	7.3	7.3	30.1	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	99.536	0.0	111.8	21
30 min Summer	65.075	0.0	146.2	35
60 min Summer	40.510	0.0	182.0	60
120 min Summer	24.362	0.0	218.9	92
180 min Summer	17.855	0.0	240.6	126
240 min Summer	14.239	0.0	255.9	160
360 min Summer	10.317	0.0	278.1	228
480 min Summer	8.210	0.0	295.0	296
600 min Summer	6.871	0.0	308.7	362
720 min Summer	5.939	0.0	320.1	426
960 min Summer	4.714	0.0	338.8	556
1440 min Summer	3.400	0.0	366.5	808
2160 min Summer	2.448	0.0	395.9	1188
2880 min Summer	1.937	0.0	417.7	1560
4320 min Summer	1.391	0.0	450.0	2296
5760 min Summer	1.099	0.0	473.9	3000
7200 min Summer	0.915	0.0	493.1	3664
8640 min Summer	0.787	0.0	509.2	4392
10080 min Summer	0.693	0.0	523.1	5040
15 min Winter	99.536	0.0	125.2	21
30 min Winter	65.075	0.0	163.7	34
60 min Winter	40.510	0.0	203.8	60

Cascade Summary of Results for P18-654 Outfall Storage - 100yr.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
120 min Winter	124.808	0.398	0.0	7.5	7.5	32.1	Flood Risk
180 min Winter	124.809	0.399	0.0	7.5	7.5	32.2	Flood Risk
240 min Winter	124.805	0.395	0.0	7.4	7.4	31.7	Flood Risk
360 min Winter	124.790	0.380	0.0	7.3	7.3	30.0	Flood Risk
480 min Winter	124.773	0.363	0.0	7.2	7.2	28.0	Flood Risk
600 min Winter	124.757	0.347	0.0	7.0	7.0	26.2	Flood Risk
720 min Winter	124.744	0.334	0.0	6.9	6.9	24.8	Flood Risk
960 min Winter	124.722	0.312	0.0	6.7	6.7	22.5	Flood Risk
1440 min Winter	124.690	0.280	0.0	6.4	6.4	19.2	Flood Risk
2160 min Winter	124.656	0.246	0.0	6.0	6.0	16.1	Flood Risk
2880 min Winter	124.630	0.220	0.0	5.7	5.7	13.8	Flood Risk
4320 min Winter	124.527	0.117	0.0	4.9	4.9	6.2	O K
5760 min Winter	124.499	0.089	0.0	3.9	3.9	4.5	O K
7200 min Winter	124.485	0.075	0.0	3.2	3.2	3.7	O K
8640 min Winter	124.476	0.066	0.0	2.8	2.8	3.2	O K
10080 min Winter	124.470	0.060	0.0	2.5	2.5	2.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
120 min Winter	24.362	0.0	245.1	94
180 min Winter	17.855	0.0	269.5	132
240 min Winter	14.239	0.0	286.6	168
360 min Winter	10.317	0.0	311.5	240
480 min Winter	8.210	0.0	330.4	310
600 min Winter	6.871	0.0	345.7	378
720 min Winter	5.939	0.0	358.5	444
960 min Winter	4.714	0.0	379.5	576
1440 min Winter	3.400	0.0	410.5	836
2160 min Winter	2.448	0.0	443.4	1228
2880 min Winter	1.937	0.0	467.9	1616
4320 min Winter	1.391	0.0	504.0	2248
5760 min Winter	1.099	0.0	530.8	2928
7200 min Winter	0.915	0.0	552.3	3640
8640 min Winter	0.787	0.0	570.3	4344
10080 min Winter	0.693	0.0	585.8	5120

Cascade Rainfall Details for P18-654 Outfall Storage - 100yr.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)	20.000	Shortest Storm (mins)	15
Ratio R	0.410	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Time Area Diagram

Total Area (ha) 0.098

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	4	0.042	4	8	0.056

Cascade Model Details for P18-654 Outfall Storage - 100yr.srcx

Storage is Online Cover Level (m) 124.900

Complex Structure

Tank or Pond

Invert Level (m) 124.410

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	44.1	0.490	133.6

Pipe

Diameter (m) 0.300 Slope (1:X) 243.000 Length (m) 24.325 Invert Level (m) 124.500

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SCU-0106-8200-0500-8200
Design Head (m)	0.500
Design Flow (l/s)	8.2
Flush-Flo™	Calculated
Objective	Linear discharge profile
Application	Surface
Sump Available	Yes
Diameter (mm)	106
Invert Level (m)	124.400
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.500	8.2	Kick-Flo®	0.158	4.8
Flush-Flo™	0.134	4.9	Mean Flow over Head Range	-	5.4

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)	Depth (m)	Flow (l/s)
0.100	4.0	0.800	10.2	2.000	15.8	4.000	22.0	7.000	28.9
0.200	5.4	1.000	11.4	2.200	16.5	4.500	23.3	7.500	29.9
0.300	6.5	1.200	12.4	2.400	17.2	5.000	24.5	8.000	30.9
0.400	7.4	1.400	13.3	2.600	17.9	5.500	25.6	8.500	31.9
0.500	8.2	1.600	14.2	3.000	19.2	6.000	26.8	9.000	32.8
0.600	8.9	1.800	15.0	3.500	20.7	6.500	27.9	9.500	33.7

Cascade Summary of Results for P18-654 Outfall Storage - 100yr + 40%cc.srcx

Upstream Structures	Outflow To	Overflow To
P18-654 Open Space Storage - 100yr + 40%cc.srcx	(None)	(None)

Half Drain Time : 52 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	124.743	0.333	0.0	6.9	6.9	25.4	Flood Risk
30 min Summer	124.798	0.388	0.0	7.4	7.4	31.8	Flood Risk
60 min Summer	124.839	0.429	0.0	7.7	7.7	36.8	Flood Risk
120 min Summer	124.861	0.451	0.0	7.9	7.9	39.6	Flood Risk
180 min Summer	124.867	0.457	0.0	7.9	7.9	40.3	Flood Risk
240 min Summer	124.865	0.455	0.0	7.9	7.9	40.1	Flood Risk
360 min Summer	124.853	0.443	0.0	7.8	7.8	38.6	Flood Risk
480 min Summer	124.838	0.428	0.0	7.7	7.7	36.7	Flood Risk
600 min Summer	124.821	0.411	0.0	7.6	7.6	34.6	Flood Risk
720 min Summer	124.806	0.396	0.0	7.4	7.4	32.7	Flood Risk
960 min Summer	124.784	0.374	0.0	7.2	7.2	30.1	Flood Risk
1440 min Summer	124.753	0.343	0.0	7.0	7.0	26.6	Flood Risk
2160 min Summer	124.721	0.311	0.0	6.7	6.7	23.0	Flood Risk
2880 min Summer	124.697	0.287	0.0	6.4	6.4	20.5	Flood Risk
4320 min Summer	124.663	0.253	0.0	6.1	6.1	17.2	Flood Risk
5760 min Summer	124.638	0.228	0.0	5.8	5.8	14.8	Flood Risk
7200 min Summer	124.617	0.207	0.0	5.6	5.6	13.0	Flood Risk
8640 min Summer	124.595	0.185	0.0	5.3	5.3	11.1	O K
10080 min Summer	124.529	0.119	0.0	4.9	4.9	6.4	O K
15 min Winter	124.768	0.358	0.0	7.1	7.1	28.2	Flood Risk
30 min Winter	124.828	0.418	0.0	7.6	7.6	35.4	Flood Risk
60 min Winter	124.875	0.465	0.0	8.0	8.0	41.4	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	139.350	0.0	162.0	21
30 min Summer	91.106	0.0	211.8	34
60 min Summer	56.713	0.0	263.7	62
120 min Summer	34.106	0.0	317.2	94
180 min Summer	24.997	0.0	348.7	128
240 min Summer	19.934	0.0	370.8	162
360 min Summer	14.444	0.0	403.0	230
480 min Summer	11.493	0.0	427.5	294
600 min Summer	9.620	0.0	447.3	358
720 min Summer	8.314	0.0	463.9	420
960 min Summer	6.600	0.0	491.0	540
1440 min Summer	4.760	0.0	531.2	794
2160 min Summer	3.427	0.0	573.7	1168
2880 min Summer	2.712	0.0	605.3	1532
4320 min Summer	1.948	0.0	652.1	2292
5760 min Summer	1.538	0.0	686.8	3008
7200 min Summer	1.281	0.0	714.6	3752
8640 min Summer	1.102	0.0	737.9	4472
10080 min Summer	0.970	0.0	758.0	5144
15 min Winter	139.350	0.0	181.4	21
30 min Winter	91.106	0.0	237.2	34
60 min Winter	56.713	0.0	295.3	62

Cascade Summary of Results for P18-654 Outfall Storage - 100yr + 40%cc.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
120 min Winter	124.896	0.486	0.0	8.2	8.2	44.2	Flood Risk
180 min Winter	124.899	0.489	0.0	8.2	8.2	44.6	Flood Risk
240 min Winter	124.893	0.483	0.0	8.1	8.1	43.8	Flood Risk
360 min Winter	124.873	0.463	0.0	8.0	8.0	41.1	Flood Risk
480 min Winter	124.850	0.440	0.0	7.8	7.8	38.2	Flood Risk
600 min Winter	124.827	0.417	0.0	7.6	7.6	35.3	Flood Risk
720 min Winter	124.805	0.395	0.0	7.4	7.4	32.7	Flood Risk
960 min Winter	124.771	0.361	0.0	7.1	7.1	28.6	Flood Risk
1440 min Winter	124.736	0.326	0.0	6.8	6.8	24.7	Flood Risk
2160 min Winter	124.700	0.290	0.0	6.5	6.5	20.9	Flood Risk
2880 min Winter	124.675	0.265	0.0	6.2	6.2	18.3	Flood Risk
4320 min Winter	124.639	0.229	0.0	5.8	5.8	14.9	Flood Risk
5760 min Winter	124.607	0.197	0.0	5.4	5.4	12.1	Flood Risk
7200 min Winter	124.519	0.109	0.0	4.7	4.7	5.7	O K
8640 min Winter	124.502	0.092	0.0	4.0	4.0	4.7	O K
10080 min Winter	124.491	0.081	0.0	3.6	3.6	4.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
120 min Winter	34.106	0.0	355.2	102
180 min Winter	24.997	0.0	390.5	140
240 min Winter	19.934	0.0	415.3	178
360 min Winter	14.444	0.0	451.3	250
480 min Winter	11.493	0.0	478.8	320
600 min Winter	9.620	0.0	501.0	386
720 min Winter	8.314	0.0	519.6	448
960 min Winter	6.600	0.0	549.9	552
1440 min Winter	4.760	0.0	594.9	796
2160 min Winter	3.427	0.0	642.6	1176
2880 min Winter	2.712	0.0	678.0	1560
4320 min Winter	1.948	0.0	730.3	2340
5760 min Winter	1.538	0.0	769.2	3080
7200 min Winter	1.281	0.0	800.3	3672
8640 min Winter	1.102	0.0	826.4	4392
10080 min Winter	0.970	0.0	848.9	5040

Cascade Rainfall Details for P18-654 Outfall Storage - 100yr + 40%cc.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)	20.000	Shortest Storm (mins)	15
Ratio R	0.410	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.098

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.042	4	8	0.056

Cascade Model Details for P18-654 Outfall Storage - 100yr + 40%cc.srcx

Storage is Online Cover Level (m) 124.900

Complex Structure

Tank or Pond

Invert Level (m) 124.410

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	44.1	0.490	133.6

Pipe

Diameter (m) 0.300 Slope (1:X) 243.000 Length (m) 39.266 Invert Level (m) 124.470

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SCU-0106-8200-0500-8200
Design Head (m)	0.500
Design Flow (l/s)	8.2
Flush-Flo™	Calculated
Objective	Linear discharge profile
Application	Surface
Sump Available	Yes
Diameter (mm)	106
Invert Level (m)	124.400
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

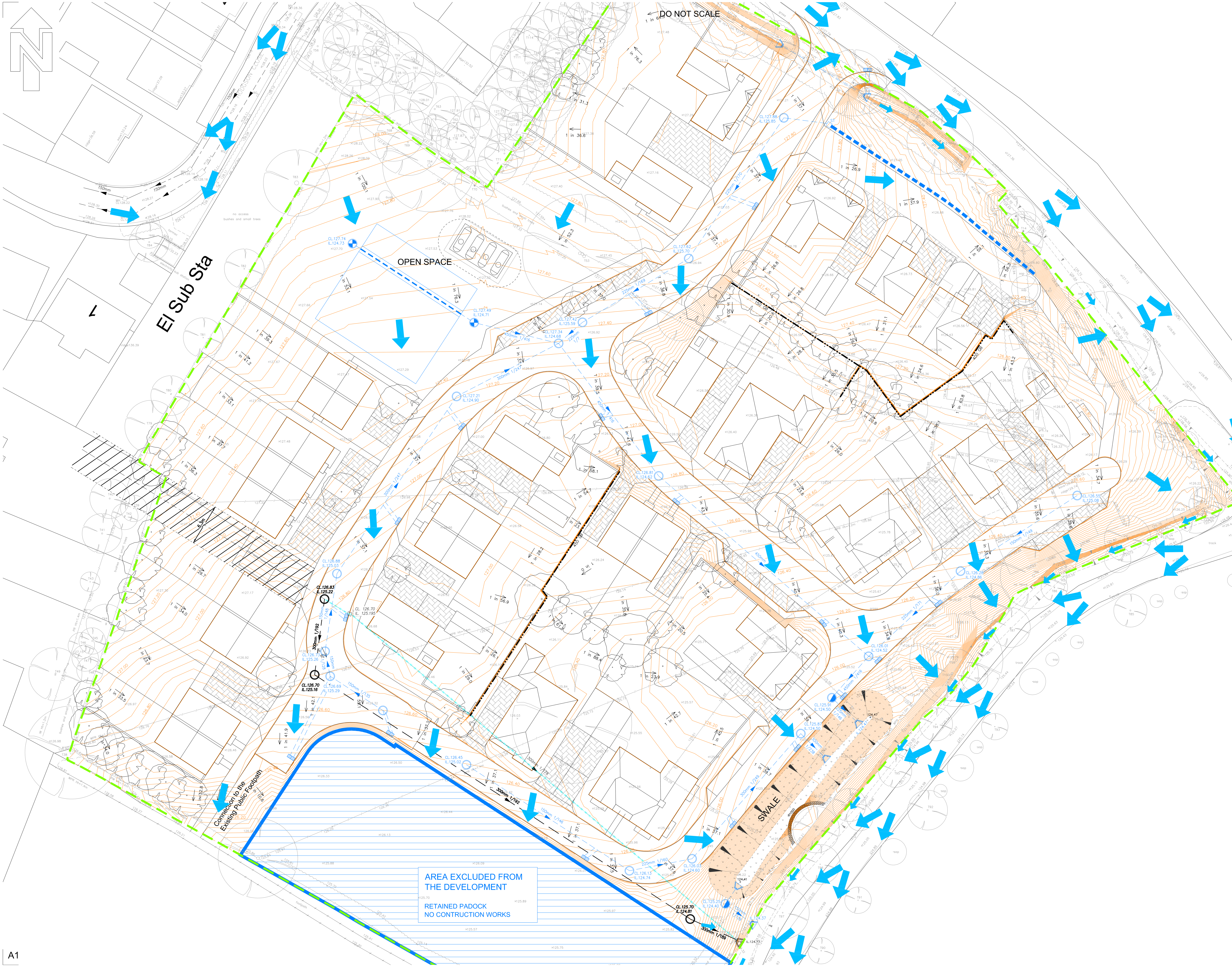
Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.500	8.2	Kick-Flo®	0.158	4.8
Flush-Flo™	0.134	4.9	Mean Flow over Head Range	-	5.4

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)	Depth (m)	Flow (l/s)
0.100	4.0	0.800	10.2	2.000	15.8	4.000	22.0	7.000	28.9
0.200	5.4	1.000	11.4	2.200	16.5	4.500	23.3	7.500	29.9
0.300	6.5	1.200	12.4	2.400	17.2	5.000	24.5	8.000	30.9
0.400	7.4	1.400	13.3	2.600	17.9	5.500	25.6	8.500	31.9
0.500	8.2	1.600	14.2	3.000	19.2	6.000	26.8	9.000	32.8
0.600	8.9	1.800	15.0	3.500	20.7	6.500	27.9	9.500	33.7

APPENDIX E:

SURFACE WATER EXCEEDANCE FLOW PLAN



A1

LEGEND

- Surface water drain
- Surface water filter drain
- Surface water catchpit manhole
- Surface water flow control chamber
- Surface water manhole
- Concrete headwall
- Exceedance flow route
- Existing surface water sewer
- Section of existing surface water sewer to be diverted
- Surface water sewer diversion route
- Existing foul water sewer
- Denotes extent of permeable block paved driveway
- Proposed contours at 50mm intervals
- Proposed gradient
- Site Boundary.

P1	ISSUED TO ACCOMPANY APPLICATION TO DISCHARGE CONDITION 11.	MM	07.05.21
MK	REVISION	BY	DATE

DRAWING STATUS

PRELIMINARY

DRAWING TITLE

EXCEEDANCE FLOW ROUTES PLAN

PROJECT

LAND AT FEWCOTT ROAD FRITWELL

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Drawn	Ch'kd	Scales	Date
MM	GPH	1:250 @ A1	MAY 2021

Purpose of Issue: INFORMATION

Project Number	Drawing Number	Revision
P18-654	SK05	P1

APPENDIX F:

DRAINAGE IMPLEMENTATION MANAGEMENT & MAINTENANCE PLAN

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DRAINAGE IMPLEMENTATION, MANAGEMENT & MAINTENACE PLAN

LAND AT FEWCOTT ROAD

FRITWELL

BICESTER

PREPARED FOR:

CALA HOMES

JOB NO: P18-654

DATE: 7th May 2021

DOCUMENT HISTORY

Issue No.	Description	Date
1	Issued to discharge planning condition.	07.05.21

CONTENTS

APPENDICES

1. INTRODUCTION

1.1 This report has been prepared by Simpson TWS on behalf of CALA Homes (Chiltern) Ltd. to accompany an application for the discharge of Condition 11 of the outline planning application *Ref. 19/00616/OUT* for the proposed development at Land at Fewcott Road, Fritwell. This report provides details of the implementation, management and maintenance requirements of the proposed drainage scheme.

1.2 *Part '**f.**' of Condition 11* of the Outline Planning Consent requires the following information to be provided in relation to the operation and maintenance requirements for the drainage proposals for the development:

> **Condition 11** – As part of any reserved matters for layout and prior to the development commencing detailed designs of the proposed surface water drainage scheme including details of implementation, maintenance and management shall be submitted to and approved in writing by the local planning authority. Those details shall include:
>
> **a.** Information about the design storm period and intensity, critical storm duration (1 in 30 & 1 in 100 (+40% allowance for climate change), discharge rates and volumes (both pre and post development), temporary storage facilities, means of access for maintenance, the methods employed to delay and control surface water discharged from the site, and the measures taken to prevent flooding and pollution of the receiving groundwater and/or surface waters;
> **b.** Any works required off-site to ensure adequate discharge of surface water without causing flooding or pollution (which should include refurbishment of existing culverts and headwalls or removal of unused culverts where relevant);
> **c.** Flood water exceedance routes, both on and off site;
> **d.** A timetable for implementation;
> **e.** Site investigation and test results to confirm infiltrations rates; and
> **f.** A management and maintenance plan, in perpetuity, for the lifetime of the development which shall include the arrangements for adoption by an appropriate public body or statutory undertaker, management and maintenance by a Residents' Management Company or any other arrangements to secure the operation of the surface water drainage scheme throughout its lifetime.
>
> No building hereby permitted shall be occupied until the sustainable drainage scheme for this site has been completed in accordance with the approved details. The sustainable drainage scheme shall be managed and maintained thereafter in accordance with the agreed management and maintenance plan.

1.3 On occupation of the development, this maintenance and management plan should be incorporated into the development's "Operation and Maintenance Manual" with the as-built drainage system operated and maintained in accordance with the requirements set out in the following section of this report to prevent a reduction in the performance of the drainage system over the lifetime of the development.

1.4 The maintenance contractor tasked with carrying out any maintenance works should provide a risk assessment and method statement that adopts best practice health and safety policies for maintenance personnel throughout the duration of any maintenance works. Measures may include:

- Ensure the use of safe systems of work and procedures are followed.
- Certificated operatives only to be used for all confined space entry.
- Ensure appropriate PPE is worn at all times including the use of safety goggles, ear defenders and other relevant equipment when using high pressure jetting.
- Do not work in weather conditions where flooding or surging is likely.
- Erect barriers where appropriate and provide adequate lighting.
- No operations to be carried out by operatives working alone.
- Time maintenance to not conflict with other on-site activities.
- Method statement to be prepared and approved prior to entry into confined space.

2. SITE DETAILS

2.1 The development is proposed at land off Fewcott Road, Fritwell as shown on *Figure 1* below. The site is centred on grid reference SP 52957 29070 and the nearby postcode is OX27 7QP.

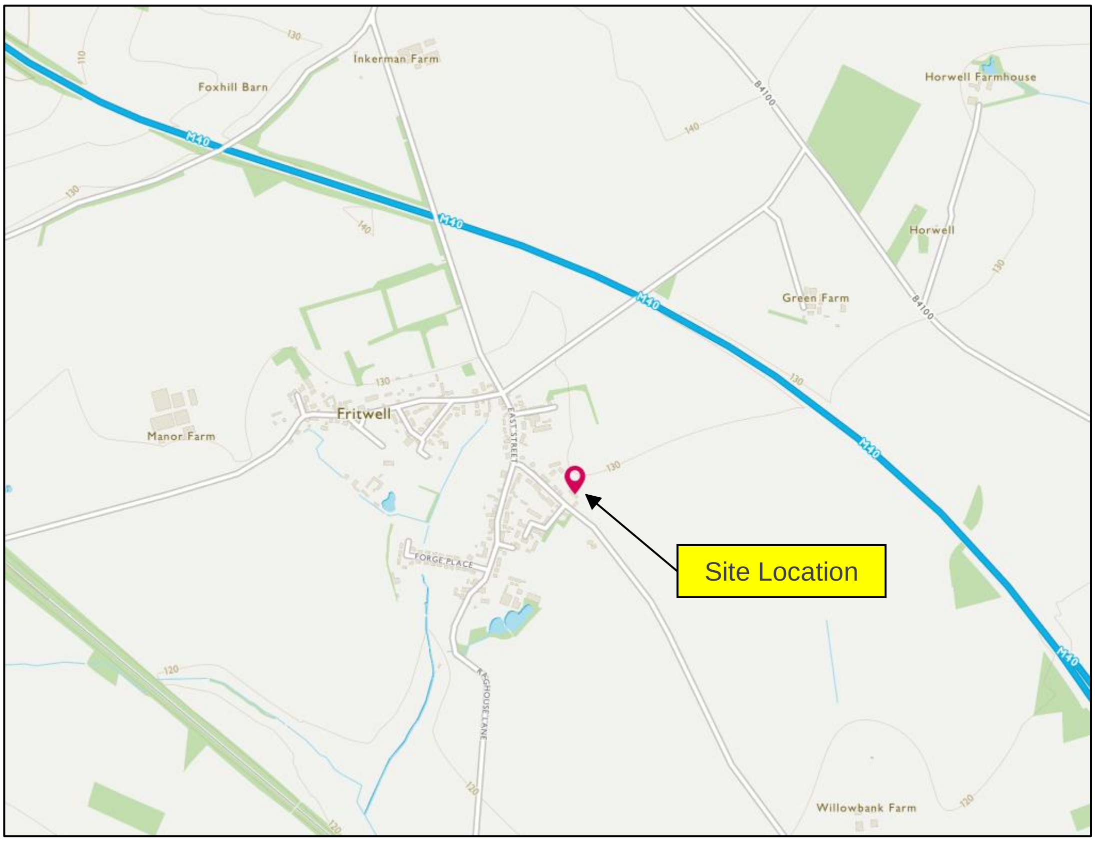

Figure 1: Site Location

2.2 The site is approximately 1.57ha in area and currently comprises of agricultural land.

3. DRAINAGE IMPLEMENTATION PLAN

3.1 This SUDS Implementation Plan sets out measures to be implemented during construction of the surface water drainage system for the scheme to ensure the site and areas downstream are protected from runoff during construction of the development. It is recommended that the plan is incorporated into the Contractors Construction Health and Safety Plan with the development carried out in accordance with the measures proposed.

3.2 During construction, it is normal practice for a drainage system to be installed at an early stage in the programme. However, it is not always possible to ensure that new impermeable areas created as part of the development are immediately connected to the new drainage system.

3.3 To ensure areas downstream of the development are protected during construction of the development it is recommended that the following management measures are implemented during construction:

- Protective coverings would be used to help prevent runoff stripping material stockpiles.

- Plant and wheel washing would take place in a designated location. The area would be tanked and not allowed to discharge into the drainage system or infiltrate into the ground. Effluent should be treated as contaminated waste and disposed off site by a licensed waste management operator.

- Surfaces used as access roads and storage areas during construction should be swept regularly to prevent accumulation of dust and mud.

- Should groundwater be encountered in excavations such water should not be discharged to the drainage system until the amount of suspended solids has been reduced though the controlled use of skips or tanks, which will act as stilling basins

- To prevent contamination associated with the use of oils and hydrocarbons during construction, the Contractor would ensure that the following precautionary measures are employed during construction:

  - Regular maintenance of machinery and plant.
  - Use of drip trays.
  - Regular checking of machinery and plant for oil leaks.
  - Use of correct storage facilities.
  - Regular checks for signs of wear and tear on tanks.
  - Specific procedures are followed when refuelling.
  - Use of a designated area for refuelling.
  - Emergency spill kit to be located near refuelling area.
  - Regular emptying of bunds.
  - Tanks should be located in secure areas to stop vandalism.

3.4 The above measures would help to ensure that untreated construction runoff would not be discharged to the surface water drainage system.

3.5 The use of porous surfacing will require changes to conventional construction practices and procedures used for traditional car parking and other paved areas, which during the initial stages of the development are often used as access roads and storage areas. Together with runoff from the construction site, which can be heavily laden with silt, such activities are likely to block the porous surfacing system, therefore, the following measures would be implemented to address the issue.

- Installation of the porous surfacing would be carried out at the end of the development programme, when most construction activities are complete, thus minimising the risk of clogging.

- Should it be necessary to construct areas of porous surfacing at an early stage in the construction programme, an impermeable layer of Dense Bitumen Macadam (DBM) would be laid beneath the surfacing materials to act as a temporary road surface. When most construction activities are complete, holes would be punched through the impermeable layer with final surfacing laid.

3.6 During construction, all components of the drainage system should be constructed in accordance with relevant drawings, specifications and manufacturer's guidelines. Further to this Building Control should visit site on a regular basis to inspect completed works and ensure that the drainage system is installed correctly.

3.7 Upon completion, all underground pipework would be jet cleaned and CCTV surveyed, areas of porous surfacing would be swept and cleaned and silt / debris present in filter drains would be removed. The Contractor would be responsible for rectifying any significant defects identified at this stage and for a period of approximately 12 months thereafter. At the end of this period a further inspection will be carried out by the Contract Administrator and on completion of any outstanding remedial works, the drainage system would be handed over.

4. DRAINAGE MANAGEMENT & MAINTENANCE PLAN

4.1 This Drainage Management and Maintenance Plan provides details of the plan proposed for maintenance and management of the drainage scheme associated with the proposed development.

4.2 On occupation of the development, it is recommended that each element of the as-built drainage system is maintained in accordance with the regime set out in the tables below.

Table 1: Below Ground Drainage System - Operation and Maintenance Requirements

Maintenance schedule	Required action	Frequency
Regular maintenance	Remove all litter and debris from external hard landscaped areas and adjacent landscaping, which may pose a risk to the performance of the system.	Monthly.
	Remove build-up of sediment / silt in catch-pits and dispose of oils / petrol residues using safe standard practices.	As required.
	Stabilise and mow adjacent landscaped areas and remove weeds.	
Remedial actions	Repair or rehabilitate inlet and outlets to ensure they are in good condition and operating as designed.	
	Remediate any landscaping, which has raised to within 50mm of the level of adjacent hard landscaping.	
Monitoring	Check of all inlets / outlets for blockages or evidence of physical damage with any necessary remedial action or clearance carried out if required.	On a monthly basis for the first 3 months of operation, thereafter every 6 months & following severe rainfall events.
	Inspect all surfaces for ponding, or silt accumulation. Record areas where water is ponding for more than 48 hours and carry out any remedial work deemed necessary.	After severe storms.

Table 2: Porous Surfacing - Operation and Maintenance Requirements

Maintenance schedule	**Required action**	**Frequency**
Regular maintenance	Remove all litter and debris from drained surfaces areas and adjacent hard / soft landscaping, which may pose a risk to the performance of the system.	Monthly.
	Sweep permeable paved areas. If necessary use jet wash or suction sweeper. Any jointing aggregate lost from the joints must be replaced as necessary with 2/6.3mm single sized aggregate, brushed into joints.	Three times a year at end of winter, mid-summer, after autumn leaf fall, or as required based on site-specific observations of clogging.
	Stabilise and mow adjacent landscaped areas and remove weeds.	As required.
Remedial actions	Remediate any landscaping, which has raised to within 50mm of the level of adjacent hard landscaping.	
	Carry out remedial work to any depressions, rutting and cracked or broken paving blocks within the permeable paved areas that are considered detrimental to the structural performance or a hazard to users.	
	Carry out repair / rehabilitation works to inlets, outlets, overflows and vents.	
Monitoring	Inspect silt accumulation rates within the permeable paved areas and establish appropriate brushing frequencies.	Annually.
	Check of all inlets, outlets, overflows and vents for blockages or evidence of physical damage with any necessary remedial action or clearance carried out if required.	On a monthly basis for the first 3 months of operation, thereafter every 6 months & following severe rainfall events.
	Inspect and identify any areas that are not operating correctly	On a monthly basis for the first 3 months of operation, thereafter every 6 months & following severe rainfall events.

Table 3: Swale - Operation and Maintenance Requirements

Maintenance schedule	Required action	Frequency
Regular maintenance	Litter and debris removal.	Monthly or as required.
	Grass cutting – to retain grass height within specified design range.	Monthly during growing season or as required.
	Manage other vegetation and remove nuisance plants.	Monthly at start, then as required.
Occasional Maintenance	Check for poor vegetation growth due to lack of sunlight or dropping of leaf litter, and cut back adjacent vegetation where possible.	Annually.
	Re-seed areas of poor vegetation growth. Alter plant types to better suit conditions, if required.	Annually, or if bare soil is exposed over 10 % or more of the swale treatment area.
Remedial actions	Repair erosion or other damage by re-turfing or reseeding.	As required.
	Re-level uneven surfaces and reinstate design levels.	
	Scarify and spike topsoil layer to improve infiltration performance, break up silt deposits and prevent compaction of the soil surface.	
	Remove build up of sediment on upstream gravel trench, flow spreader or at top of filter strip.	
	Remove and dispose of oils or petrol residues using safe standard practices.	
Monitoring	Inspect inlets, outlets and overflows for blockages, and clear if required.	Monthly.
	Inspect infiltration surfaces for ponding, compaction, silt accumulation. Record areas where water is ponding for > 48 hours.	Monthly, or when required.
	Inspect inlets and facility surface for silt accumulation. Establish appropriate silt removal frequencies.	Half yearly.

Table 4: Geocellular Storage Tanks - Operation and Maintenance Requirements

Maintenance schedule	Required action	Frequency
Regular maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial action.	Monthly for first 3 months of operation, then every 6 months.
	Debris removal from catchment surface (where may cause risks to performance).	Monthly.
	Where rainfall infiltrates into blocks from above, check surface of filter for blockage by silt, algae or other matter. Remove and replace surface infiltration medium as necessary.	Monthly / after severe storms.
	Remove sediment from pre-treatment structures.	Annually, or as required.
Remedial actions	Repair/rehabilitation of inlets, outlet, overflows and vents.	As required.
Monitoring	Inspect/check all inlets, outlets, vents and overflows to ensure that they are in good condition and operating as designed.	Annually and after large storms.

Table 5: Flow Control Chambers - Operation and Maintenance Requirements

Maintenance schedule	Required action	Frequency
Regular maintenance	Cleaning off the flow control device of any debris/ sediment.	As required
Remedial Actions	Flow control device repairs.	As required
	Repair of erosion damage, or damage to chamber.	
Monitoring	Inspection of the chamber for debris and sediment build up.	Monthly for first 3 months, thereafter, every 6 months and following severe storm events.

APPENDIX A
PERMEABLE PAVING OPERATION & MAINTENANCE MANUAL

MARSHALLS LANDSCAPE PRODUCTS

TECHNICAL ADVISORY SERVICES DEPARTMENT

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www.marshalls.co.uk

GUIDELINES FOR THE MAINTENANCE OF MARSHALLS PRIORA CONCRETE BLOCK PAVING

These notes are intended for general guidance and are not intended to be exhaustive.

Marshalls manufacture a range of paving materials in clay, concrete and natural stone which provide a durable, hardwearing surface. All surfacing materials may, during service, experience some degree of surface staining and therefore require regular maintenance and good cleaning practice to maintain the overall appearance of the paving.

MAINTENANCE

To ensure the performance of the Priora permeable paving, Marshalls recommend that there is a maintenance regime undertaken.

The maintenance of the pavement is to ensure the infiltration of the paving is not compromised. The following guidelines are offered as an initial regime, but maybe either increased or decreased depending on paving's local environment and any external contributing factors.

- A visual inspection of the paving should be carried out on a regular basis, ensuring that the joints are kept fully filled. This will confirm the effectiveness of the agitation maintenance due to variations between sites and allow any refinement of the regular agitation activity if necessary.

- The paving should be agitated (e.g. brushed, vacuumed, etc.) at least twice a year. This is to ensure no vegetation of any sort is allowed to grow and develop in the joints. Ideally, this activity should be carried out in the spring and autumn seasons.

- The paving should be inspected after any heavy precipitation to ensure no displacement of any organic matter onto the surface of the pavement.

- For winter maintenance, the controlled use of de-icing products may be used without causing significant detrimental effects towards the permeable pavements performance. When used carefully, the use of these chlorides will not result in an increase in the chloride levels in the local ground.

- Where non-infiltration systems have been employed, the inspection of the outfalls should be undertaken initially on a twice-yearly basis.

- Weed growth – when sedimentation occurs in areas of permeable paving then there is the potential for weed growth, this will typically occur where there are overhanging trees or soft landscaping slopes down on to the paving or in areas which do not receive over run from vehicles particularly frequently.

- Weeds can be removed from the surface through the application of weed killers containing Glyphosate. Glyphosate based weed killers are the most common for general-purpose use, they are most effective on grasses and perennial weeds with non-woody stems. Weeds should be sprayed when they are actively growing so that the Glyphosate will go down to the root and kill the weed completely. Glyphosate will be neutralized upon contact with the ground, which makes it safe to plant in the area soon after treatment. It is available ready mixed or as a concentrate. With the ready mix you will paying a lot for the water that it is diluted with, but if you only have a small plot or if you don't have a safe chemical storage cupboard, then ready mix is the best option.

- Glyphosate based weed killers include: ***Roundup, Tumbleweed*** **and** ***B&Q complete*****.**

Depending on the amount of usage and the environment the permeable pavement has received and been exposed to, the laying course material may require either cleaning after a 25 to 30 year period. This would be evident if the infiltration rate of the paving became prolonged, allowing ponding to develop. Should this occur, the uplifting and cleaning (or replacing) of the laying course maybe considered. The laying course material, jointing and Priora blocks may be reused, minimising costs.

Marshalls would advise during the design stage of the project, consideration should be given to the placement and location of underground utilities. This is intended to minimise the need to carry out any excavation work within the main permeable pavement construction

Should a situation arise where access is required, Marshalls would suggest the following approach to the works.

- The initial trench width for excavating should be related to the depth of the sub-base material. For example, consideration to the width of the utility should be considered, plus a degree of working space. The utility undertaker will decide this. In addition to this figure, Marshalls would advise the overall width is determined by the depth of the open graded material plus 20%.

- When removing the first block, a suitable location, such as at the perimeter of the installation or where a unit exists with a larger joint width surrounding it should be considered. Next, as much jointing material should be cleared as possible to reduce the integrity being offered by this material.

- Once a block has become suitably loosened, a block lifter should used to remove it. Due to the interlock offered by the spacer nib profile, it may be necessary to have the block being lifted held in a lifted position, whilst a second person taps the adjacent blocks with a suitable lump hammer or rubber mallet. This may be repeated for the first few units during removal.

- Once the desired area of paving has been removed and carefully staked for reuse, a suitable surfacing material (e.g. membrane, wooden boards, etc.) should be placed on the surrounding paving for the laying course and sub-base materials to be separately stock-piled.

- Once completion of the utility work, the pavement should be reconstructed in accordance with the Marshalls Installation Guide.

- If the pavement construction contains any water-proof membranes or geotextiles, these should be sliced, folded back and weighed down during the opening of the pavement.

- Upon reinstatement, these should be folded back into their original position and be overlaid with a new corresponding material (overlap dimension to be determined between the utility contractor and the membrane/geotextile manufacturer; consideration to bonding/welding the reinstated material should be given depending on site conditions) which has been cut to an appropriate size, before continuing with the next layer of construction.

APPENDIX B
GEOCELLULAR STORAGE TANK OPERATION & MAINTENANCE MANUAL

GEOLIGHT maintenance

Once received stormwater reaches the storage reservoir through one or more distribution pipes laid out on the side faces of the Geolight blocks.

These distribution pipes are covered in a trench filled with draining material requiring little compaction, like washed rolled pebbles, free from fines, and 15/25 grading.

A 10 mm mesh geogrid or GEOtextile, laid between the distribution pipe and Geolight, prevents the horizontal Geolight blocks being clogged by the draining materials.

The permeability of the supply and distribution pipe located on the periphery of the reservoir is designed to prevent any clogging of the system upstream of the stormwater drain.
This sizing is checked for each supply. It is obtained thanks to design programmes by SDS limited following testing of a size 1 reservoir in which all hydraulic configurations were studied.

These tests also made it possible to check the very good vertical and horizontal permeabilities of Geolight blocks and this general layout is usually accepted.

The choice of one of these layouts or a combination of them is according to:
- the place reserved for the reservoir
- available slopes
- hydraulic parameters (discharge)
- position of stormwater input and output systems.

The ends of feeder drains (distribution pipes) are connected to inspection chambers(manholes), acting as settling tanks and making inspection and maintenance of the whole distribution pipe possible. *The silts and sediments contained within the surface water network will remain within the distribution pipe which can be accessed for ongoing maintenance in line with the contract requirements. This means that this sediment cannot enter the crate structure of the attenuation tanks which will not require any maintenance.*

For small discharges, stormwater does not penetrate Geolight blocks, but circulates either in an appropriate bypass, or in the distribution pipe drain. This is for draining the first water which will be handled downstream if required.

When the reservoir is drained, water is drained through a distribution pipe possibly the same as the one located at the input which operates in the opposite direction. Drainage discharge is controlled by the downstream system piping.

A ventilation system consisting of a drainage geocomposite is fresh air vented in the inspection pits. It is laid out in the upper part of the distribution pipes and the general space occupied by the reservoir.

We generally recommend that the stormwater tank inspection chambers are checked periodically in conjunction with general maintenance of the underground pipe network.

APPENDIX C
FLOW CONTROL CHAMBER OPERATION & MAINTENANCE MANUAL

HYDRO-BRAKE® FLOW CONTROL

MAINTENANCE AND SAFETY DATA SHEET

MAINTENANCE

Normally, little maintenance is required as there are no moving parts within the Hydro-Brake® Flow Control. Experience has shown that if blockages occur they do so at the intake, and the cause on such occasions has been due to a lack of attention to engineering detail such as approach velocities being too low, inadequate benching, or the use of units below the minimum recommended size. Hydro-Brake® Flow Controls are fitted with a pivoting by-pass door, which allows the manhole chamber to be drained down should blockages occur. The smaller type conical units, below the minimum recommended size, are also supplied with roding facilities or vortex suppressor pipes as standard.

Following installation of the Hydro-Brake® Flow Control it is vitally important that any extraneous material i.e. Building materials are removed from the unit and the chamber. After the system is made live, and assuming that the chamber design is satisfactory, it is recommended that each unit be inspected monthly for three months and thereafter at six monthly intervals with hose down if required. If problems are experienced please do not hesitate to contact the company so that an investigation may be made.

Hydro-Brake® Flow Controls are typically manufactured from grade 304 Stainless Steel which has an estimated life span in excess of the design life of drainage systems.

COSHH

Hydro-Brake® Flow Controls are manufactured from Stainless Steel, which is not regarded as hazardous to health and exhibits no chemical hazard when used under normal circumstances for the stated applications.

MANUAL HANDLING

The handling of Hydro-Brake® Flow Controls should be in accordance with current legislation and regulations:

- The Health and Safety at Work Act 1972.
- The Management of Health and Safety at Work Regulations 1992.
- The Manual Handling Operations Regulations 1992.

All published and printed by the Health and Safety Executive.

APPENDIX G:

IMPERMEABLE AREAS LAYOUT

LEGEND

Denotes extents of impermeable area drained and limited to 4.8l/s. Total area = 0.522ha

Denotes extents of impermeable area drained and limited to 8.4l/s. Total area = 0.098ha

Total cumulative area = 0.62ha

MK	REVISION	BY	DATE

DRAWING STATUS

PLANNING

DRAWING TITLE

IMPERMEABLE AREAS LAYOUT

PROJECT

LAND AT FEWCOTT ROAD FRITWELL

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Drawn	Ch'kd	Scales	Date
MM	AR	1:250 @ A1	SEPT'21

Purpose of Issue: INFORMATION

Project Number	Drawing Number	Revision
P18-654	SK07	-