FERNBROOK
CONSULTING ENGINEERS

Sustainable Drainage Strategy

2 Silverdale Street, Haverigg

January 2021
Prepared for

Mr T. Jones

Project Number:21000
Doc Number: 21000-FCE-XX-XX-RP-C-0001

Rev	Issue Purpose	Author	Checked	Approved	Date
P01.1	Issued for comment	DR	CR	-	20.01.21
P01	Issued for planning	DR	CR	DR	21.01.21

Prepared by:
Fernbrook Consulting Engineers
Unit 302, 40 Bowling Green Lane
London
EC1R 0NE

E: info@fernbrook.co
W: fernbrook.co

Contents

1. **INTRODUCTION** 2
2. **SUSTAINABLE DRAINAGE STRATEGY** 3
3. **CONCLUSIONS** 7

Tables

Table 1.1 Site Characteristics 2
Table 2.1 Greenfield runoff estimates 3
Table 2.2 Drainage Hierarchy 3
Table 2.3 SuDS Management Train 4
Table 2.4 Attenuation Storage 5
Table 2.5 Simple Index Method 5
Table 2.6 SuDS Management Plan 6

Figures

Figure 1.1 Site Location Plan
Figure 1.2 Proposed Development Plan
Figure 2.1 United Utilities Sewer Records

Appendices

Appendix A – Proposed Development Plan
Appendix B – Drainage Calculations & Drawings
Appendix C – Northumbrian Water Records
Appendix D – SuDS Management Plan

1. Introduction

Background

1.1 Fernbrook Consulting Engineers has been appointed by Mr T. Jones to design a surface water and foul drainage strategy for the proposed residential development located at Silverdale Street, Haverigg.

1.2 This report has been prepared with specific reference to the Cumbria County Council Development Design Guide (Appendix 6 and 7), the National Planning Policy Framework (NPPF) and the Planning Practice Guidance (PPG). This report also takes into consideration the Non-statutory technical standards for sustainable drainage systems and CIRIA C753 The SuDS Manual.

1.3 This report should be read in conjunction with the Flood Risk Assessment by Ambiental Environmental Assessment, report ref. 5927 (dated 06.01.2021).

Site Location

1.4 The site is a plot of undeveloped land in the village of Haverigg, on the south west coast of Cumbria. Refer to **Table 1.1** below for Site characteristics and **Figure 1.1** for a Site Location Plan.

Table 1.1 Site Characteristics

Site Address	2 Silverdale Street, Haverigg, LA18 4EU	
Grid reference	316005mE, 478655mN (SD16005 78655)	
Site Area (ha)	0.027	
General Topography	Generally flat, falling west towards road.	
Existing Use	Undeveloped land	
Boundaries	North	Residential
	East	Greenfield land
	South	Old Road
	West	Silverdale Street
Access	Silverdale Street	

Figure 1.1 Site Location Plan

Development Proposals

1.5 The proposed development will provide 2no. residential dwellings with access from Silverdale Street. An extract of the proposed development plan is shown in **Figure 1.2** below. The full development plan and topographical survey is included in **Appendix A**.

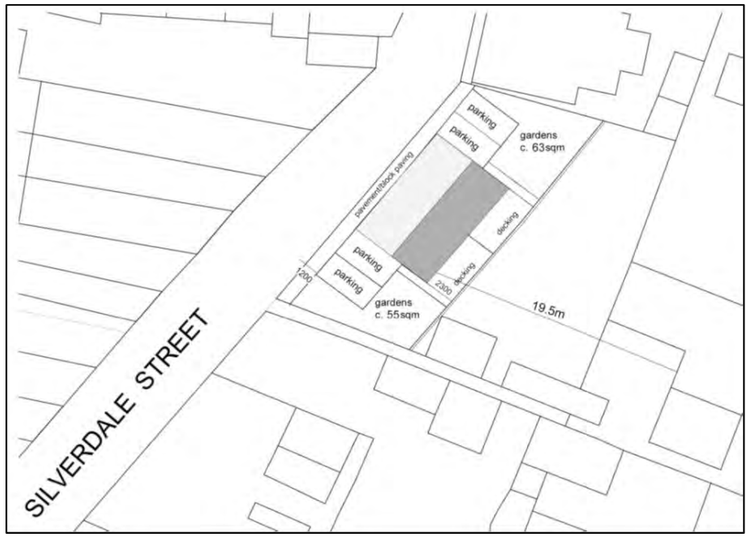


Figure 1.2 Proposed Development Plan

2. SUSTAINABLE DRAINAGE STRATEGY

Climate change allowances

2.1 The NPPF requires that to allow for predicted impacts of climate change on surface water runoff, the following increases to rainfall intensity should be allowed for:

- 2015 to 2039: +5% (10% Upper end);
- 2040 to 2069: +10% (20% Upper end); and
- 2070 to 2115: +20% (40% Upper end).

2.2 Therefore, under the NPPF an allowance of 40% for the effects of climate change will achieve the policy requirements for the proposed residential development.

Pre-development surface water run-off conditions

2.3 The site is currently comprised of unmade ground (grass and gravel), with no formal drainage arrangement. Therefore, runoff from the site is assumed to infiltrate into the ground.

2.4 In order to assess the current discharge from the Site, the Greenfield runoff rates have been estimated to predict the current surface water discharge rate from the site, refer to **Table 2.1** below and calculations in **Appendix B**.

Rainfall event	Runoff rate (l/s/ha)
Qbar	7.49
Q1	6.52
Q30	12.74
Q100	15.58

Table 2.1 Greenfield runoff estimates

Surface Water Drainage Design Philosophy

2.5 In accordance with the principles of sustainable drainage systems, surface water run off not collected for use should be discharged in the following hierarchy: To ground (infiltration techniques); To a surface water body; To a surface water sewer; To the combined sewer. Refer to **Table 2.2** below for an assessment of the drainage hierarchy.

Disposal method	Feasible	Comment
1st) To ground via infiltration	✖	Based on In-situ infiltration testing an infiltration rate of 2.4 x 10-6 m /s was calculated, therefore the underlying geology is not considered suitable for infiltration.
2nd) Watercourse	✖	Haverigg Pool is approximately 80m east of the site at the closest point.
3rd) Surface Water sewer	✖	No surface water sewers in close vicinity to the site.
4th) Combined Water sewer	✓	United Utilities sewer in Silverdale Street.

Table 2.2 Drainage Hierarchy

2.6 Based on the drainage hierarchy assessment, the proposed drainage strategy will seek to dispose surface water to the Combined sewer in Silverdale Street. Refer to **Figure 2.1** for an extract of the United Utilities sewer records. The full record plan is included in **Appendix C**.

Figure 2.1 United Utilities Sewer Records

Proposed Sustainable Drainage Systems (SuDS)

2.7 The constraints and opportunities for the use of SuDS techniques within the site are assessed in **Table 2.3** below. The assessment follows the management train approach outlined in CIRIA C753 'The SuDS Manual'.

SuDS Component	Feasible	Comment
Permeable Surfacing	✓	Parking areas could be paved with permeable surfacing.
Ponds / Basins	✖	In order to facilitate practicable maintenance and maximise attenuation benefits 1:3 side-slope basins tend to require a significant land requirement best located in public areas.
Attenuation Tank	✓	Should attenuation be required this could be achieved by use of oversized sewers or geo-cellular storage attenuation below the surface.

Table 2.3 SuDS Management Train

2.8 After consideration of the CIRIA C753 approach, the most viable SuDS options for this site is tanked permeable paving (Type C) to provide inception storage and water quality benefits.

Storage Requirements

2.9 The proposed drainage will be designed to ensure that there is no flooding up to the 1 in 30 year rainfall event.

2.10 The proposed development will increase impermeable areas on site to 0.019ha. Based on the runoff generated from the post-development impermeable areas, an attenuation volume of 4.8m^3 will be required to restrict surface water to 2.4 l/s for all events up to the 1 in 100 year + 40% climate change rainfall event.

2.11 Although it is best practice to restrict runoff to Qbar greenfield runoff rates, it would be unfeasible to restrict flows to 0.14 l/s (7.49 l/s/ha), without risking blockages.

2.12 MicroDrainage software was used to calculate the required storage volumes, refer to **Table 2.4** below for a summary of results and **Appendix B** for full calculations.

Impermeable Area (ha)	Attenuation Volume (m^3)	Max Discharge rate (l/s)		
		1 yr	30 yr	100yr+CC
0.019	4.8	1.0	1.7	2.4

Table 2.4 Attenuation Storage

2.13 Refer to **drawing No. 21000-FCE-XX-XX-DR-C-0500** in the **Appendix B** for the Proposed Drainage Strategy illustrating how the site could be drained, based on discharging to the combined sewer in Silverdale Street.

Urbanisation

2.14 A 10% increase in roof areas has been allowed for in the calculations to allow for urban creep.

Water Quality Management

2.15 The recommended stage of treatment in terms of water quality would be provided through the provision of permeable surfacing to ensure sediment is trapped prior to discharge to the public sewer.

2.16 The risk to surface water quality has been assessed using the Simple Index Method, refer to **Table 2.5** for details.

Pollution Hazard	Total suspended solids	Metals	Hydrocarbons
Low - Residential parking	0.5	0.4	0.4
Indicative SuDS mitigation indices for discharges to surface water			
Permeable surfacing	0.7	0.6	0.7
Check	***+0.2***	***+0.2***	***+0.3***

Table 2.5 Simple Index Method

2.17 Based on the simple index method assessment, the permeable surfacing will provide the required level of surface water treatment to runoff entering the public sewer.

Foul Drainage Strategy

2.18 The proposed drainage strategy will seek to discharge foul flows from the 2no. residential dwellings to the combined sewer in Silverdale Street. The peak flow is estimated at 0.09 l/s. It has been assumed that there is capacity within the public sewer network to accept foul flows from the site.

Management & Maintenance

2.19 The maintenance of all SuDS components will be in accord with the best practices and the CIRIA C753 The SuDS Manual. The recommended Operation and Maintenance requirements for the proposed permeable paving and potential attenuation tank are outlined in **Table 2.6** below. Refer to **Appendix D** for a recommended SuDS Management Plan.

Maintenance Task	Description	Frequency
Regular Maintenance		
Litter management	Pick up all litter in landscape areas and remove from site	Monthly
Tree / Grass maintenance	Mow all grass verges, paths and amenity at 35-50mm with 75mm max. Leaving grass in situ.	As required or monthly
Inlets and outlets	Inspect monthly, remove silt from slab aprons and debris. Strim 1m round for access	Monthly
Hard surfaces	Sweep all paving regularly.	As required
Occasional tasks		
Inspection and control chambers	Annual inspection, remove silt and check free flow	Annually
Remedial work		
Repairs	Inspect drainage system regularly to check for damage or failure. Undertake remedial work as required.	As required

Table 2.6 SuDS Management Plan

2.20 The proposed combined sewer connection may be offered for adoption. Residents will be responsible for maintaining private SuDS including the permeable paving.

3. Conclusions

3.1 Fernbrook Consulting Engineers has been appointed by Mr T. Jones to design a surface water and foul drainage strategy for the proposed residential development located at Silverdale Street, Haverigg.

3.2 The site is a 0.027 ha plot of undeveloped land in the village of Haverigg, Cumbria. The proposed development will provide 2no. residential dwellings with access from Silverdale Street.

3.3 The proposed drainage strategy will seek to convey surface water runoff to the United Utilities combined sewer in Silverdale Street, at the restricted rate of 2.4 l/s. A total of storage volume of 2.4m³ will be provided through tanked permeable paving to accommodate all rainfalls events up to the 1 in 100 year event with 40% climate change scenario.

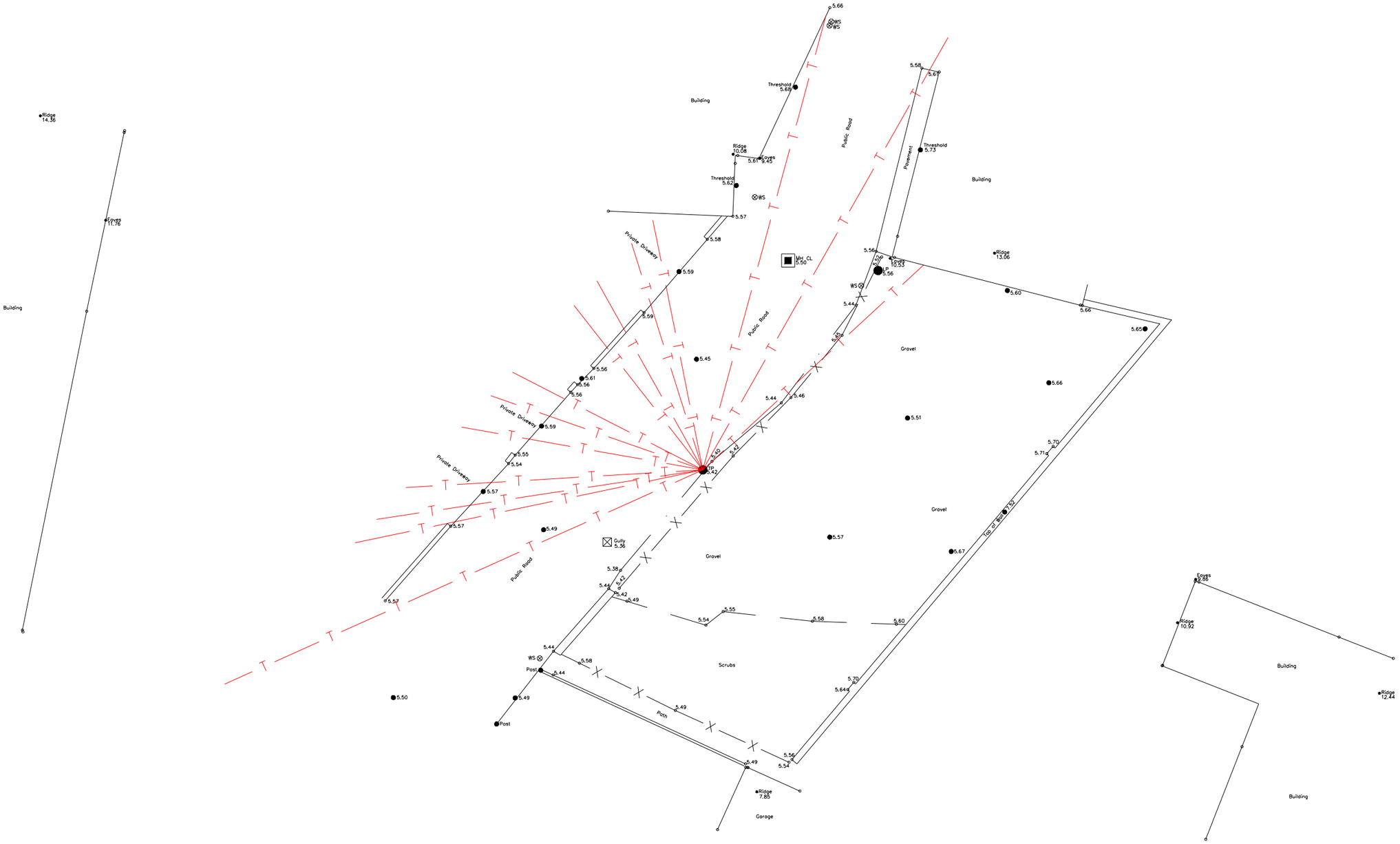
3.4 The peak foul flow from 2no units is estimated at 0.09 l/s. The strategy will seek to convey foul flows to the United Utilities combined sewer in Silverdale Street.

3.5 In conclusion, this report demonstrates that the proposals are consistent with the aims of the NPPF and its Planning Practice Guidance. Surface water runoff can be adequately managed without increasing the risk of flooding on site or elsewhere.

FERNBROOK

APPENDIX A – PROPOSED DEVELOPMENT PLAN & TOPOGRAPHICAL SURVEY

Vacant Land Silverdale St Haverigg	Drawing Number 2020 601
	Scale: 1250 REV. 1
	red line boundary



Revision Notes:

Survey Note:

Survey on planar grid, referenced to OSGB36 at the following point:
315989.66mE
478649.78mN

Survey Key:

Wall		Cover	
Kerb		Man Hole	
Fence		Fire Hydrant	
Vegetation Line	WS	Water Supply	
Tree	LP	Lamp Post	
Bush	EP	Electricity Pole	
Gate	TP	Telegraph Pole	
Drop Kerb		Anchor Point	
O/H Telecomms		Bench Mark	
O/H Power		Bore Hole	
	AV	Air Valve	
	FP	Fire Point	
	SV	Stop Valve	
	CATV	Cable TV	
	TBGH	Top of Bottom Gate Hanging	

SPATIAL DATA LIMITED
Chartered Land Surveyors
3 Boundary Bank, Kendal, Cumbria, LA9 5RR
Telephone:+44(0)1539 734400
E-mail: info@SpatialDataLtd.com
URL: www.SpatialDataLtd.com

Client: Craig and Meyer

Project: Silverdale Road, Haverigg

Site Survey: October 2020

Scale: 1:100 @ A1

Crew: HT,SM,EH Chk: NR Ref: LEE

0 2 4 6 8 10

Scale Bar - metres

FERNBROOK

APPENDIX B – DRAINAGE CALCULATIONS & DRAWINGS

Cromford Mills, Mill Lane
Cromford
Matlock
Derbyshire DE4 3RQ
T: +44 1773 829 988
info.derbyshire@idom.com
idom.com

SWIFT REMEDIAL LTD
102 Brackley Road,
Towcester,
Northants,
NN12 6DJ

Mr Tim Jones
Director

23 September 2020

Subject: Silverdale Street, Haverigg – Soakage Testing
Our ref: L-22185-2.4.2-20-617-DCE

Dear Tim,

Further to the soakage testing carried out at the above site, we are pleased to provide this letter report which includes a brief account of the ground conditions encountered along with an assessment of soakage potential of the near surface soils at the site.

Intrusive Investigation

IDOM Merebrook Ltd (IDOM) were commissioned by Swift Remedial Ltd to carry out soakage tests in order to inform the drainage strategy for the site. IDOM attended site on 15 September 2020 to undertake the following exploratory hole:

- One trial pit (STP1) excavated by hand to a depth of 1.7 metres below ground level (m bgl).

A soakage test was carried out in the trial pit over a period of twenty-one hours, with the sides and bases squared off prior to filling with water.

The trial pit location is shown on the attached plan (Drawing No. SK-22185-304-001), whilst a trial pit log and soakage test results are also attached to this letter.

Ground Conditions

Ground conditions at the site were found to comprise a limited thickness of made ground (0.38 m thick), described as dark brown clayey sand, including brick and concrete fragments. The made ground was underlain by natural soils consisting of light brown and light grey, mottled yellow fine sand. These soils represent superficial deposits of Alluvium or possibly Storm Beach Deposits.

The sidewalls of the trial pit were observed to be stable.

Groundwater was not encountered in STP1.

Soakage Test

A single soakage test was undertaken in trial pit STP1. The soakage test was performed as far as possible in accordance with BRE document 365. The accompanying data sheet shows that the water level fell by 1,200 mm over a period of twenty-one hours.

The BRE methodology for calculation of soil infiltration rate requires measurement of the volume out flowing from between 75 % and 25 % of the effective depth of the trial pit (height of water in the pit), i.e. three-quarters of the water should soak away. If, due to low levels of infiltration the water level does not fall from between 75 % to 25 % of the total water height, it may be possible to extrapolate from a curve derived from the plots of actual depth to water against time elapsed. The test performed in STP1 achieved 25 % effective depth and an infiltration rate of 2.4×10^{-6} m /s was calculated.

Based on this test result, the soils at the site, although granular in nature, may be considered as marginal in terms of soakage potential, however, in view of the relatively small size of the proposed development, a combination of measures to facilitate effective drainage of surface water could be employed, including permeable paving, decking, attenuation pond and buried attenuation (storage crates).

We trust the above information is helpful, however, if you have any questions, please do not hesitate to contact the undersigned.

Yours sincerely,

[redacted]

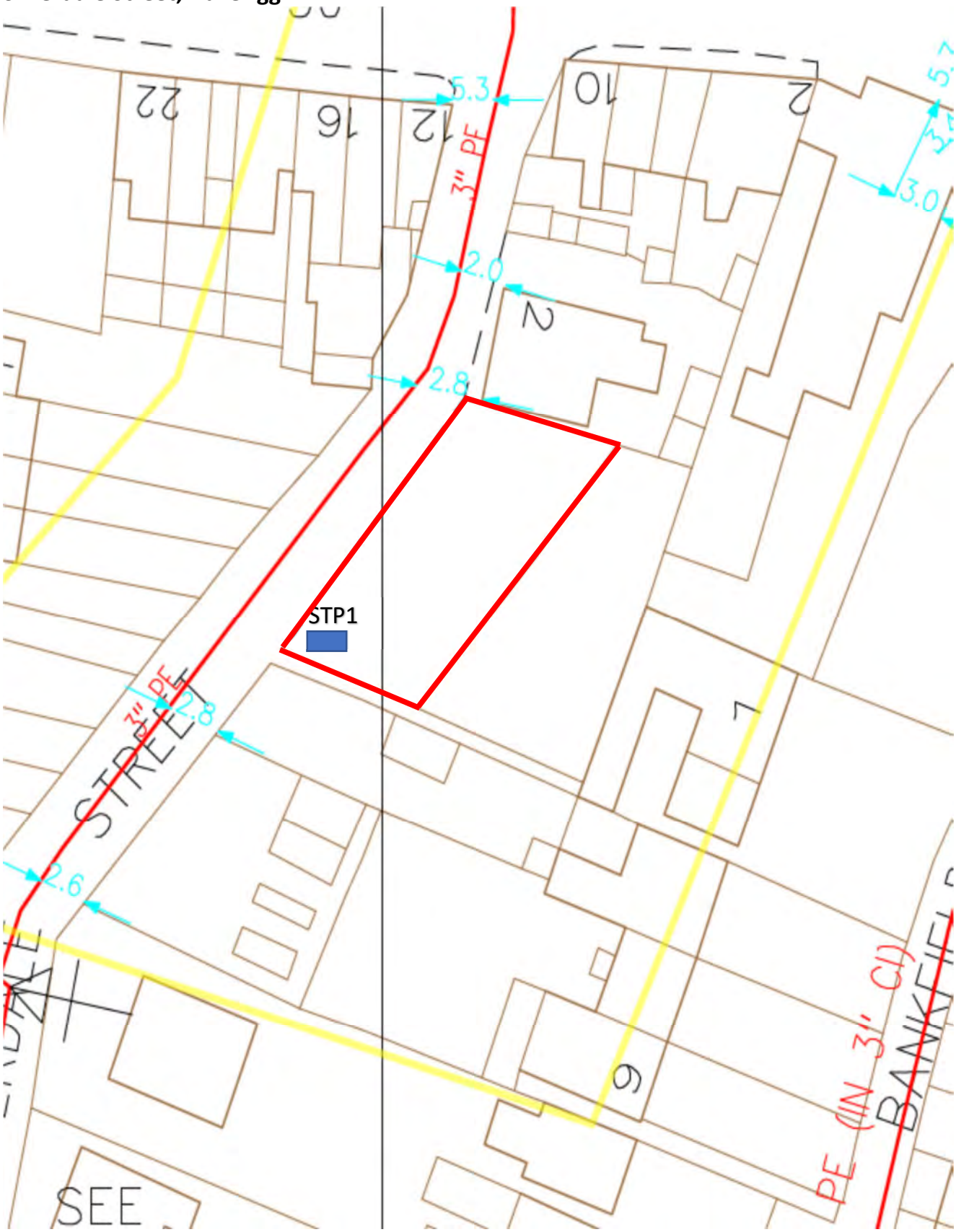
Darren Ettritch

For IDOM Merebrook Ltd

Cc File

Enc Drawing SK-22185-304-001
STP1 Log
Soakage Test Results Sheet

Silverdale Street, Haverigg



IDOM Soakage Test Pit

Site Boundary

TRIAL PIT LOG

TrialPit No: STP1

Sheet 1 of 1

Project Name:	Silverdale Street	Project No.: 22185	Co-ords: - Level:
Date: 15/09/2020			
Location:	Haverigg	Dimensions (m): 1.10 x 0.45 Depth 1.70	Scale: 1:25
Equipment:	Hand dug.		Logged: DCE Checked: DCE

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
							Dark brown clayey sand. Occasional brick and concrete fragments and many roots. MADE GROUND.
				0.38			Light brown fine SAND.
				0.70			Light grey fine SAND. Occasional yellow mottling.
				1.70			End of Pit at 1.700m

1
2
3
4
5

D = small disturbed sample (tub)
J = organic sample (amber glass jar)
V = volatile sample (amber glass vial)
B = bulk bag sample
HSV = hand shear vane (kPa)
PP = pocket penetrometer (kg.cm2)
PID = photoionisation detector (ppm)

Stability

Sidewalls of the pit were stable.

Remarks

Coordinates and levels, where indicated, must not be used for design purposes. The user is responsible for verifying all site and setting out dimensions.

Groundwater was not encountered.

DETERMINATION OF SOIL INFILTRATION RATE IN ACCORDANCE WITH BRE DIGEST 365

GENERAL INFORMATION

Site Name:	***Silverdale Street, Haverigg***			**Job No:**	***22185***
Engineer:	***D.Ettritch***	**Date:**	***15/09/2020***	**Weather:**	***Dry, sunny, warm***

TEST PIT DETAILS

Trial Pit Number:	***STP1***		**Test** ***1*** **of** ***1***				
Length (m):	***1.1***	**Width (m):**	***0.45***		**Depth (m):**	***1.7***	
Depth to Groundwater (m):	***n/a***						
Time Filling Commenced:	***11:02***		**Time Filling Completed:**			***11:03***	
Depth to Water at Start of Test:		***0.17***					
Effective Depths:		**75%:**	***0.55***	**50%:**	***0.94***	**25%:**	***1.32***

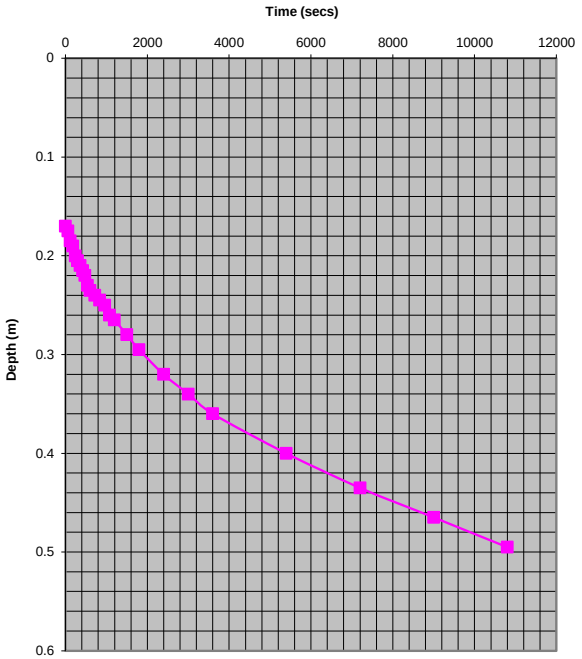
NOTE: Soakage to at least 25% effective depth is required in order to calculate infiltration rate. If infiltration rates are slow extrapolation maybe required to determine time at which 25% effective depth would be achieved.

TEST PIT RESULTS

TEST DATA

Time	t (mins)	t (secs)	Depth to Water (m)
11:03	0	0	0.170
	1	60	0.175
	2	120	0.185
	3	180	0.190
	4	240	0.200
	5	300	0.205
	6	360	0.210
	7	420	0.215
	8	480	0.220
	9	540	0.230
	10	600	0.235
	12	720	0.240
	14	840	0.245
	16	960	0.250
	18	1080	0.260
	20	1200	0.265
	25	1500	0.280
	30	1800	0.295
	40	2400	0.320
	50	3000	0.340
	60	3600	0.360
	90	5400	0.400
	120	7200	0.435
	150	9000	0.465
	180	10800	0.495
	240	14400	0.555
	300	18000	0.595
	360	21600	0.635
	420	25200	0.695
	1260	75600	1.370

STP1



t at 75% Effective Depth: ***13900*** secs
t at 25% Effective Depth: ***68400*** secs

Infiltration Rate f = Vp75-25 / ap50 x tp75-25

Vp75-25: ***0.38*** m3
ap50: ***2.8665*** m2
tp75-25 ***54500*** secs

f = *2.42E-06* m/s

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Dominic Ramdeen
Site name:	Silverdale Street
Site location:	Haverigg, LA18 4EU

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013) , the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Site Details

Latitude:	54.19677° N
Longitude:	3.28895° W
Reference:	57431907
Date:	Jan 20 2021 11:27

Runoff estimation approach

IH124

Site characteristics

Total site area (ha): 1

Methodology

Q_{BAR} estimation method:	Calculate from SPR and SAAR
SPR estimation method:	Calculate from SOIL type

Soil characteristics

	Default	Edited
SOIL type:	4	4
HOST class:	N/A	N/A
SPR/SPRHOST:	0.47	0.47

Hydrological characteristics

	Default	Edited
SAAR (mm):	1019	1019
Hydrological region:	10	10
Growth curve factor 1 year:	0.87	0.87
Growth curve factor 30 years:	1.7	1.7
Growth curve factor 100 years:	2.08	2.08
Growth curve factor 200 years:	2.37	2.37

Notes

(1) Is Q_{BAR} < 2.0 l/s/ha?

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

(3) Is SPR/SPRHOST ≤ 0.3?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

Greenfield runoff rates

	Default	Edited
Q_{BAR} (l/s):	7.49	7.49
1 in 1 year (l/s):	6.52	6.52
1 in 30 years (l/s):	12.74	12.74
1 in 100 year (l/s):	15.58	15.58
1 in 200 years (l/s):	17.75	17.75

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	2	PIMP (%)	100
M5-60 (mm)	17.700	Add Flow / Climate Change (%)	0
Ratio R	0.283	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.020	4-8	0.001

Total Area Contributing (ha) = 0.021

Total Pipe Volume (m³) = 0.509

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	6.013	0.050	120.3	0.010	4.00	0.0	0.600	o	150	Pipe/Conduit	
1.001	12.099	0.400	30.2	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
2.000	5.973	0.050	119.5	0.011	4.00	0.0	0.600	o	150	Pipe/Conduit	
2.001	1.246	0.400	3.1	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	4.11	4.950	0.010	0.0	0.0	0.0	0.92	16.2	1.4
1.001	50.00	4.22	4.900	0.010	0.0	0.0	0.0	1.84	32.5	1.4
2.000	50.00	4.11	4.950	0.011	0.0	0.0	0.0	0.92	16.2	1.5
2.001	50.00	4.11	4.900	0.011	0.0	0.0	0.0	5.75	101.7	1.5

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.002	3.497	0.050	69.9	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.002	50.00	4.27	4.500	0.021	0.0	0.0	0.0	1.20	21.3	2.8

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.002		5.500	4.450	4.450	1200	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Offline Controls	0	Number of Time/Area Diagrams	0
Number of Online Controls	2	Number of Storage Structures	2	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	2	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	17.700	Storm Duration (mins)	30
Ratio R	0.283		

Online Controls for Storm

Orifice Manhole: 2, DS/PN: 1.001, Volume (m³): 0.8

Diameter (m) 0.035 Discharge Coefficient 0.600 Invert Level (m) 4.900

Orifice Manhole: 4, DS/PN: 2.001, Volume (m³): 0.8

Diameter (m) 0.035 Discharge Coefficient 0.600 Invert Level (m) 4.900

Storage Structures for Storm

Porous Car Park Manhole: 2, DS/PN: 1.001

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	4.8
Membrane Percolation (mm/hr)	1000	Length (m)	4.8
Max Percolation (l/s)	6.4	Slope (1:X)	200.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	4.900	Membrane Depth (mm)	130

Porous Car Park Manhole: 4, DS/PN: 2.001

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	4.8
Membrane Percolation (mm/hr)	1000	Length (m)	4.8
Max Percolation (l/s)	6.4	Slope (1:X)	200.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	4.900	Membrane Depth (mm)	130

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Offline Controls	0	Number of Time/Area Diagrams	0
Number of Online Controls	2	Number of Storage Structures	2	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm)	17.700	Cv (Summer)	0.750
Region	England and Wales	Ratio R	0.283	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	30.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
1.000	1	15 Winter	1	+0%	100/30 Winter				4.980	-0.120
1.001	2	30 Winter	1	+0%	100/15 Summer				4.951	-0.099
2.000	3	15 Summer	1	+0%	100/15 Winter				4.981	-0.119
2.001	4	30 Winter	1	+0%	100/15 Summer				4.955	-0.095
1.002	3	30 Winter	1	+0%					4.526	-0.124

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	0.000	0.09		1.2	OK	
1.001	2	0.000	0.02		0.5	OK	
2.000	3	0.000	0.10		1.3	OK	
2.001	4	0.000	0.01		0.5	OK	
1.002	3	0.000	0.07		1.0	OK	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Offline Controls	0	Number of Time/Area Diagrams	0
Number of Online Controls	2	Number of Storage Structures	2	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm)	17.700	Cv (Summer)	0.750
Region	England and Wales	Ratio R	0.283	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	30.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
1.000	1	30 Winter	30	+0%	100/30 Winter				5.019	-0.081
1.001	2	30 Winter	30	+0%	100/15 Summer				5.017	-0.033
2.000	3	30 Winter	30	+0%	100/15 Winter				5.030	-0.070
2.001	4	30 Winter	30	+0%	100/15 Summer				5.028	-0.022
1.002	3	30 Winter	30	+0%					4.534	-0.116

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	0.000	0.16		2.1	OK	
1.001	2	0.000	0.03		0.8	OK	
2.000	3	0.000	0.17		2.3	OK	
2.001	4	0.000	0.02		0.9	OK	
1.002	3	0.000	0.12		1.7	OK	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Offline Controls	0	Number of Time/Area Diagrams	0
Number of Online Controls	2	Number of Storage Structures	2	Number of Real Time Controls	0

Synthetic Rainfall Details

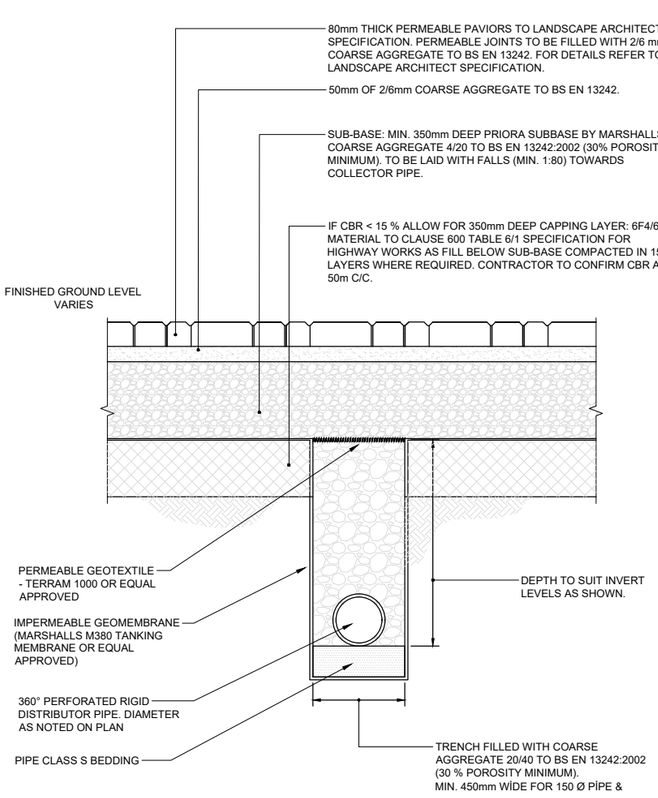
Rainfall Model	FSR	M5-60 (mm)	17.700	Cv (Summer)	0.750
Region	England and Wales	Ratio R	0.283	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	30.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

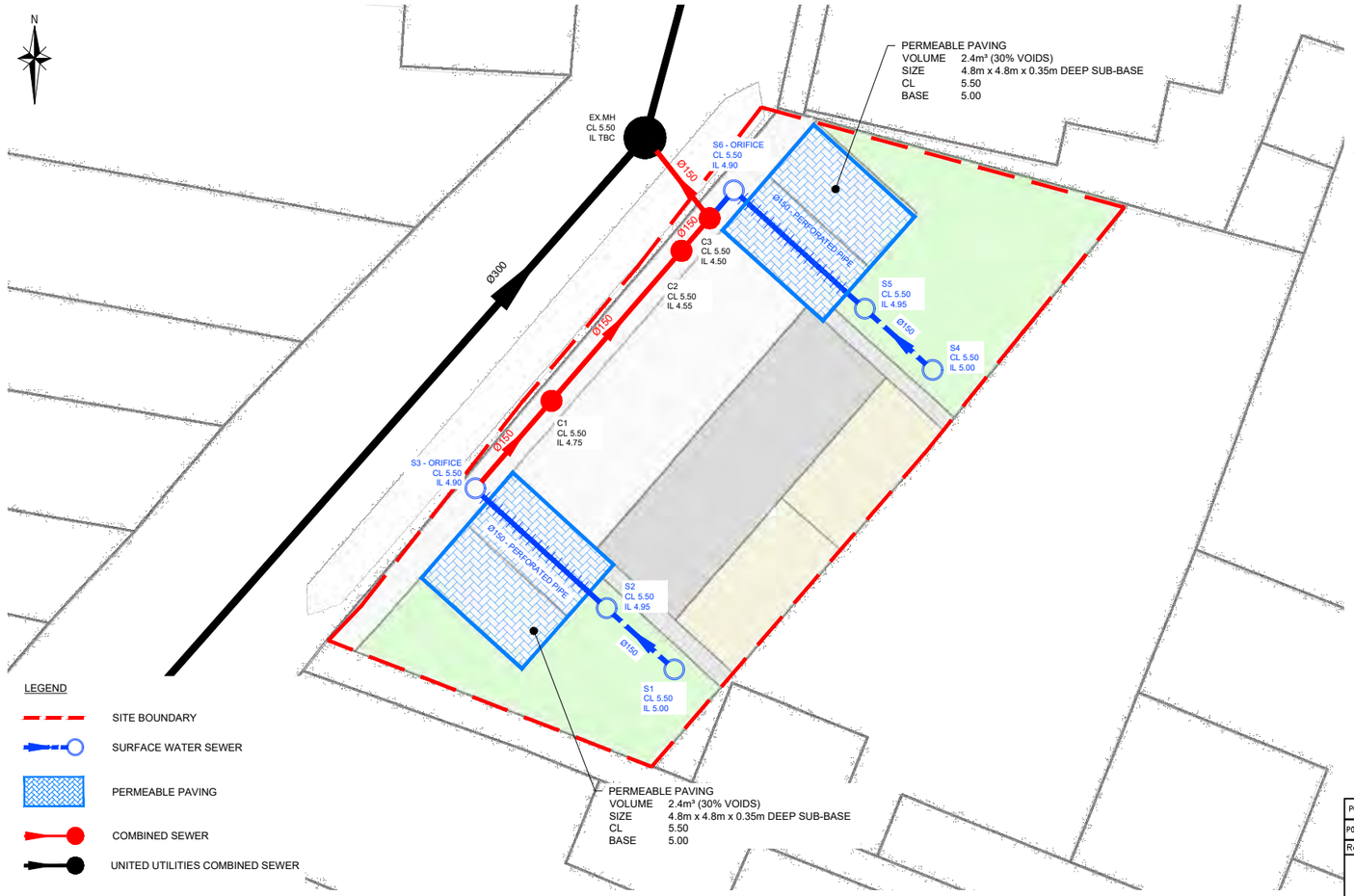
PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
1.000	1	60 Winter	100	+40%	100/30 Winter				5.130	0.030
1.001	2	60 Winter	100	+40%	100/15 Summer				5.127	0.077
2.000	3	60 Winter	100	+40%	100/15 Winter				5.156	0.056
2.001	4	60 Winter	100	+40%	100/15 Summer				5.153	0.103
1.002	3	60 Winter	100	+40%					4.542	-0.108

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	0.000	0.19		2.6	SURCHARGED	
1.001	2	0.000	0.04		1.2	SURCHARGED	
2.000	3	0.000	0.21		2.8	SURCHARGED	
2.001	4	0.000	0.03		1.2	SURCHARGED	
1.002	3	0.000	0.17		2.4	OK	



TYPICAL PERMEABLE PAVING DETAIL

(NOT TO SCALE)



NOTES

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE RELEVANT SPECIFICATION AND ALL OTHER RELATED DRAWINGS ISSUED BY THE ENGINEER.
2. DO NOT SCALE FROM THIS DRAWING. WORK FROM FIGURED DIMENSIONS ONLY. TO CHECK THAT THIS DRAWING HAS BEEN PRINTED TO THE INTENDED SCALE THIS BAR SHOULD BE 50mm LONG @ A1 OR 25mm LONG @ A3.
3. ALL DIMENSIONS SHOWN ON THIS DRAWING ARE IN METRES, UNLESS OTHERWISE STATED.
4. ALL DIMENSIONS, LEVELS AND SURVEY GRID CO-ORDINATES ARE TO BE CHECKED ON SITE AND THE ENGINEER NOTIFIED IMMEDIATELY OF ANY DISCREPANCIES PRIOR TO THE COMMENCEMENT OF THE WORKS.
5. NO DEVIATION FROM THE DETAILS SHOWN ON THIS DRAWING IS PERMITTED WITHOUT PRIOR PERMISSION FROM THE ENGINEER.
6. THIS DRAWING HAS BEEN BASED ON "RED LINE BOUNDARY", DRAWING No. 2020-601 REV 1.
7. THIS DRAWING HAS BEEN BASED ON "SITE SURVEY" BY SPATIAL DATA LIMITED, DATED OCTOBER 2020.
8. PRIVATE FOUL AND SURFACE WATER FLOW CONTROL MANHOLES TO BE FITTED WITH NON-RETURN VALVES TO PROTECT FROM PUBLIC SEWER SURCHARGE.
9. EXISTING DRAINAGE AND UTILITIES TO BE CONFIRMED IN-SITU BY THE CONTRACTOR, PRIOR TO STARTING WORKS.

CDM NOTES

THE ATTENTION OF THE CLIENT, PRINCIPAL DESIGNER, PRINCIPAL CONTRACTOR, DESIGNERS AND CONTRACTORS IS DRAWN TO THE FOLLOWING POTENTIAL RISKS IN CONJUNCTION WITH THE PROPOSED ON-SITE AND OFF-SITE WORKS AS DESIGNED FOR THIS PROJECT:

1. WORKS IN THE VICINITY OF LIVE SERVICES INCLUDING GAS, ELECTRICITY AND BT WILL BE NECESSARY AND THE ADVICE OF ALL STATUTORY SERVICE COMPANIES MUST BE SOUGHT BEFORE ANY WORKS COMMENCE.
2. WORKS WITHIN AND ABUTTING THE EXISTING HIGHWAY WILL ENTAIL TRAFFIC HAZARDS AND ALL APPROPRIATE SAFETY MEASURES INCLUDING BARRIERS, SIGNS AND LIGHTING MUST BE UNDERTAKEN TO THE APPROVAL OF THE LOCAL AUTHORITY, THE HIGHWAY AUTHORITY AND THE POLICE DEPARTMENT.
3. HAZARDOUS MATERIALS INCLUDING CEMENT AND BITUMINOUS MATERIALS ARE SPECIFIED AND THE MANUFACTURERS ADVICE ON SAFE HANDLING PROCEDURES MUST BE OBTAINED AND MADE CLEAR TO ALL OPERATIVES.
4. THE CONTRACTOR WILL BE RESPONSIBLE FOR LOCATING ALL EXISTING SERVICES WITHIN THE VICINITY OF THE WORKS HAND DUG AND ENSURE THESE ARE PROTECTED THROUGHOUT THE DURATION OF THE WORKS. ALL UTILITY PLANT SHOULD BE CLEARLY MARKED ON THE GROUND PRIOR TO COMMENCEMENT OF THE WORKS.
5. THE CONTRACTOR MUST ENSURE ALL WORKING AREAS ARE FULLY SECURE.

PLANNING ISSUE

FOR INFORMATION ONLY

Rev	Description	Drn	Chk	App	Date
P01	ISSUED FOR INFORMATION	DR	CR	DR	21.01.21
P01.1	DRAFT ISSUE	DR	CR	-	20.01.21

FERNBROOK
231 Shoreditch High Street
London
E1 6PJ
info@fernbrook.co

Client: MR T. JONES

Project Title: 2 SILVERDALE STREET, HAVERIGG

Drawing Title: INDICATIVE SURFACE WATER & FOUL DRAINAGE STRATEGY

A1 Scale	Date	Designed by
1:100	JAN 21	DR
Drawn by	Checked by	Approved by
DR	CR	DR

Drawing Number: 21000-FCE-XX-XX-DR-C-0500 Rev P01

FERNBROOK

APPENDIX C – UNITED UTILITIES SEWER RECORDS

United Utilities Maps for Safe Dig

Date :	09/09/2020 15:18:30
Centre X :	316008
Centre Y :	478659
Scale :	1250
UserName:	RMAPEH

Extract from maps of United Utilities' Underground Assets

The position of the underground apparatus shown on this plan is approximate only and is given in accordance with the best information currently available. The actual positions may be different from those shown on the plan and private service pipes may be shown by a blue broken line. United Utilities Water will not accept liability for any damage caused by the actual position being different from those shown.

United Utilities
Water for the North West

FERNBROOK

APPENDIX D – SUDS MANAGEMENT PLAN

SuDS MANAGEMENT PLAN

This long-term Management Plan of the Sustainable Drainage System (SuDS) should be implemented at **2 Silverdale Street, Haverigg, LA18 4EU** to ensure that the drainage network functions as designed. This plan is intended to cover all on-site drainage structures. The Site Management Team should oversee and implement the SuDS Management Plan and designate a qualified person who will be responsible for the proper operation and maintenance of the foul and stormwater structures.

Stormwater Runoff Quality

The stormwater management system protects and enhances the stormwater runoff water quality through the removal of sediment and pollutants, catchpit manholes and silt trapped gullies will reduce the amount of pollutants entering the system. Preventive maintenance of the system will include a comprehensive source reduction program of regular sweeping and litter removal, prohibitions on the use of pesticides, and maintenance of bin areas.

Drainage System

Maintenance and cleaning of surface water drainage and SuDS components will assure adequate performance. This maintenance program is outlined below;

Maintenance Program

The Site Management Team will conduct the operation and maintenance plan set forth in this document. The Site Management will ensure that inspections and record keeping are timely and accurate. Inspection & Maintenance Log Forms (attached) should include the date and physical conditions of the structures, depth of sediment in structures, evidence of overtopping or debris blockage and maintenance required of each structure. Records of maintenance will be kept on file at the property and copies of Inspection & Maintenance Log sheets indicating all work and inspections will be available to the Council upon request.

Concurrent with inspection and cleaning, all litter shall be picked up and removed from the parking areas, swales, and soft landscaping.

Regular maintenance should include;

- Inspect permeable paving and outlets - remove any debris every 6 months or as determined to be reasonable based on experience with the installed systems to ensure that the drainage is are working in their intended fashion and that they are free of debris; quarterly, inspect gully sumps and bottom of drain manholes; if depth of sediment in sumps exceeds 50% capacity, sediment must be removed. Excessive sediment shall be removed and properly disposed by a licensed drainage cleaning company.
- Inspection of external areas for spillage and scattered litter must be performed on a regular basis to prevent the spread of pollutants into the stormwater management system.

Winter Maintenance Program

Ensure that drainage structures are not blocked by ice, snow, debris or rubbish during winter months.

Fertiliser Use

Only slow-release organic low-phosphorous fertilisers will be used in any landscaped areas in order to limit the amount of nutrients that could enter the stormwater system.

Drainage Operation and Maintenance Log

Site Maintenance Supervisor:_____ Date:_____

☐ Routine ☐ Response to rainfall event __ in ☐ Other:_____

BMP	Frequency	Date Performed	Comments
Channel Drains and Inspection Chamber	Monthly Inspections		
	Maintenance Quarterly and as necessary		
Pavement Areas (parking, driveways, service areas)	Monthly Sweeping		
	Rubbish & Litter Removal as Necessary		
Landscaped & Vegetated Areas	Maintenance as necessary		