GEO-ENVIRONMENTAL CONSULTING ENGINEERS

bEk Enviro Ltd
Suite One | No 3 Mitton Road Business Park
Mitton Road | Whalley | Lancashire | BB7 9YE

Our Ref: BEK/20804/210114-2-B

14 January 2021

FAO Mr and Mrs Bamford
Paddock Gate,
14 Wiswell Lane,
Whalley,
BB7 9

Detailed Drainage Design Statement – Land at Paddock Gate, Wiswell, Lancashire

BEK Enviro (BEK) has been instructed by Mr and Mrs Bamford to provide a Drainage Design for the proposed residential development of a single property, on land associated with the existing property named 'Paddock Gate' off Wiswell Lane, Wiswell, in Lancashire.

Hierarchy of Surface Water Disposal

In accordance with the NPPF and the Non-Statutory Technical Standards for SUDS: Practice Guidance the discharge of surface water shall comply with the drainage hierarchy detailed within the National Planning Policy Framework, Planning Practice Guidance and within Building Regulations Part H and specifies the following methods in order of preference:

- Infiltration via soakaway or other suitable infiltration device
- Discharge to watercourse
- Discharge to public sewer

Infiltration

The soilscapes viewer map indicates that the site is situated on slowly permeable seasonally wet clayey and loamy soils. These types of soils would generally be unsuitable for the dissipation of surface water via infiltration.

In addition, a single infiltration test was undertaken at the site in December 2020 to BRE 365 standards. The results of the infiltration testing indicates that infiltration is not viable at the site and as such should be discounted. A copy of the infiltration testing is included within Annex B of this report.

Due to the clayey soils beneath the site, the use of soakaways is considered to be unviable.

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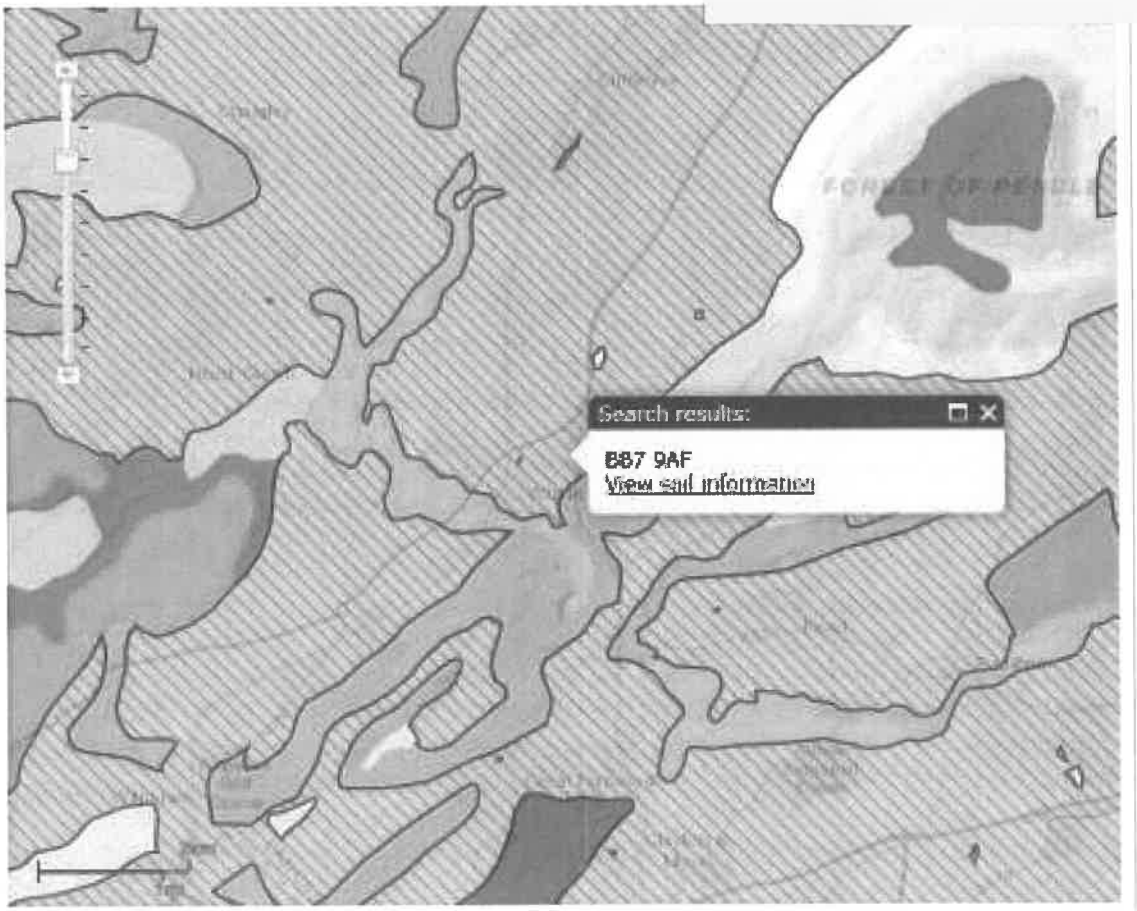


Figure 1: Soilscapes Viewer Map

Key

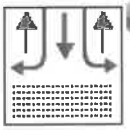
Soilscape 17:
Slowly permeable seasonally wet acid loamy and clayey soils

Texture:
Loamy and clayey

Coverage:
England: 7% Wales: 15.1%
England & Wales: 8.2%

Selected area:
NaNkm^2

Drainage:
Impeded drainage



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Discharge to Watercourse

The nearest watercourse to the development site is an unnamed watercourse located along the west boundary of the site.

Due to the proximity of the watercourse and the incompatibility of the underlying soil to dispose via soakaways, a connection to watercourse is considered the most suitable method of surface water disposal.

Existing Greenfield Runoff Rates

Utilising the ICP SUDS Method greenfield runoff rates for the 1 in 1 year, 1 in 30 year, 1 in 100 year return periods and Qbar have been calculated based on 0.154Ha and a summary of the results is tabulated below:

Greenfield Runoff Rates

Return Period	Peak Flow Rate (l/s)
Qbar	1.31
1 in 1 year	1.14
1 in 30 year	2.23
1 in 100 year	2.73

Allowable Discharge Rates

So not to increase surface water runoff volumes from the application site, flows have been restricted to no more than Qbar **1.3l/s** during all events up to and including the 100 year + 40% climate change event.

Proposed Drainage Strategy

Following development, the impermeable area of the undeveloped area will increase from $0m^2$ to approximately $330m^2$.

It is noted that the existing access road has not been included within the drainage strategy, as this is considered to be currently positively drained.

Within the proposed drainage strategy flows from the roof areas and driveway will be collected via rainwater down pipes and a gully, before being discharged into the unnamed watercourse located at the west of the site.

Flows will be restricted by means of a vortex flow control to no more than 1.3l/s during the 100 year + 40% climate change event. Flows in excess of 1.3l/s will be stored within a geo cellular tank located within the proposed driveway area.

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Geo-cellular Tank Details

- *CL = 65.570 tbc*
- *IL = 64.490*
- *Area = 20m²*
- *Depth of crate = 0.500m*
- *Cover = 0.580m*
- *Specifications to be provided by chosen manufacture*

Vortex Flow Control

- *Design depth = 1.107m*
- *Flow rate = 1.30l/s*
- *Specifications to be provided by chosen manufacture*

Proposed Discharge Rates

Return Period	Peak Flow Rate (l/s)
1 in 1 year	1.0
1 in 30 year	1.1
1 in 100 year + 40% Climate Change	1.3

Exceedance Routes

The proposed surface water drainage network has sufficient capacity to retain flows below ground level during all return periods up to the 100 year + 40% event with no surface flooding.

Maintenance and Management

Following development, the drainage network serving the site will remain private, upon request from the LPA the developer is to provide evidence of the funding mechanism for the management and maintenance of the drainage system.

General operational maintenance requirements table from CIRIA is provided below, which describes periodic maintenance and frequency for permeable paving and attenuation tanks.

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TABLE 21.3 Operation and maintenance requirements for attenuation storage tanks		
Maintenance schedule	**Required action**	**Typical frequency**
Regular maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial action	Monthly for 3 months, then annually
	Remove debris from the catchment surface (where it may cause risks to performance)	Monthly
	For systems where runoff infiltrates into the tank from above, check surface of filter for blockage by sediment, algae or other matter, remove and replace surface infiltration medium as necessary	Annually
	Remove sediment from pre-treatment structures and/or external forebays	Annually, or as required
Remedial actions	Repair/rehabilitate 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
	Survey inside of tank for sediment build-up and remove if necessary	Every 5 years or as required

I trust the above is satisfactory. Should you require anything further please do not hesitate to contact the undersigned.

Yours sincerely

D Emmott

DAVID EMMOTT
BSc (Hons) MSc MIEnvSci

Annex A – Greenfield Runoff Rates
Annex B – Infiltration Testing Results
Annex C – Proposed Drainage Layout
Annex D – Typical Drainage Details
Annex E – SW Modelled Calculation Report

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ANNEX A

Greenfield Runoff Rates

HR Wallingford
Working with water

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	christian vose
Site name:	Paddock Gate
Site location:	Wiswell

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:	53.82703° N
Longitude:	2.40103° W
Reference:	2055578111
Date:	Jan 07 2021 12:30

Runoff estimation approach

IH124

Site characteristics

Total site area (ha): 0.154

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):	1139	1139
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):	1.31	1.31
1 in 1 year (l/s):	1.14	1.14
1 in 30 years (l/s):	2.23	2.23
1 in 100 year (l/s):	2.73	2.73
1 in 200 years (l/s):	3.11	3.11

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ANNEX B

Infiltration Testing Results

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bEk Enviro Ltd
Suite One | No 3 Mitton Road Business Park
Mitton Road | Whalley | Lancashire | BB7 9YE

Our Ref: BEK/20804/201216-1-B

16 December 2020

FAO Mr & Mrs Bamford
Paddock Gate,
14 Wiswell Lane,
Whalley,
BB7 9

Dear Mr & Mrs Bamford,

Land at Paddock Gate, 14 Wiswell Lane, Whalley - BRE 365 Surface Water Infiltration Test

BEK Enviro (BEK) has been commissioned by Mr & Mrs Bamford to determine soil infiltration rates at the above site using the BRE 365 methodology (2016) to assess the viability of disposal of surface water from the site via infiltration.

Infiltration testing was undertaken in accordance with the requirements set out in BRE 365 (2016). A single test pit was excavated at the site with one test undertaken within the pit in December 2020 during dry conditions. The test location is presented on BEK Drawing No 20804-1, a copy of which is presented in Annex B.

In accordance with BRE 365 'the trial pit should be 0.3 to 1 m wide and 1 to 3 m long. It should have vertical sides trimmed square and, if necessary for stability, should be filled with granular material. Fill the pit and allow it to drain three times to near empty; each time record the water level and time filling. Calculate the soil infiltration rate from the time taken for the water level to fall from 75% to 25% effective storage depth in the pit, using the lowest *f* value of the three test results for design.'

The trial pit was excavated using a Kubota KX015-4 excavator to a maximum depth of 1.10 m with the sides trimmed square. Water was discharged into pit using a water supply and hosepipe.

The test pit dimensions are as follows:

Test Pit No.	Length (m)	Width (m)	Depth (m)	Area (m^3)
SA1	1.70	0.90	1.10	1.68

Table 1: *Test Pit Dimensions*

A single infiltration test was undertaken at the site. The location of the trial pit is included within Annex B of this report.

The ground conditions at the site comprised of brown silty clay. Water was discharged into the pit and the time taken for the water to infiltration into the soil was recorded as shown within the table below:

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Infiltration Test Results

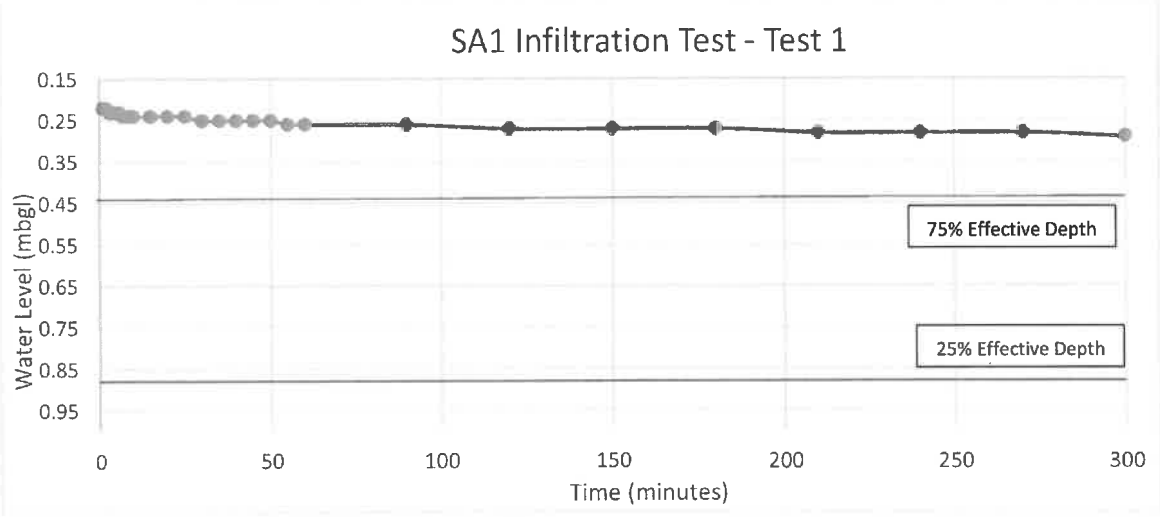
Infiltration Test 1

Depth to water at start of test: 0.22 m

A summary of the percolation test is shown within the table below:

Time (minutes)	Depth to Water (cm)	Notes
0	0.22	Start of Test
5	0.23	
10	0.24	
15	0.24	
30	0.25	
60	0.26	
90	0.27	
120	0.27	
150	0.27	
180	0.28	
210	0.28	
240	0.28	
270	0.29	
300	0.29	End of test

Table 2: *SA1 Infiltration Test*



Conclusion

It can be seen from the above table that the water did not reach 75% effective depth after 6 hours of the test. Furthermore, 3 tests are required to be undertaken with the slowest infiltration rate used for design purposes therefore the test is considered to have failed.

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Mitton Road | Whalley | Lancashire | BB7 9YE

I trust the above is satisfactory. Should you require anything further please do not hesitate to contact the undersigned.

Yours sincerely

DAVID EMMOTT
BSc (Hons) MSc MIEnvSci

GEO-ENVIRONMENTAL CONSULTING ENGINEERS

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ANNEX A

BRE 365 Infiltration Test Results

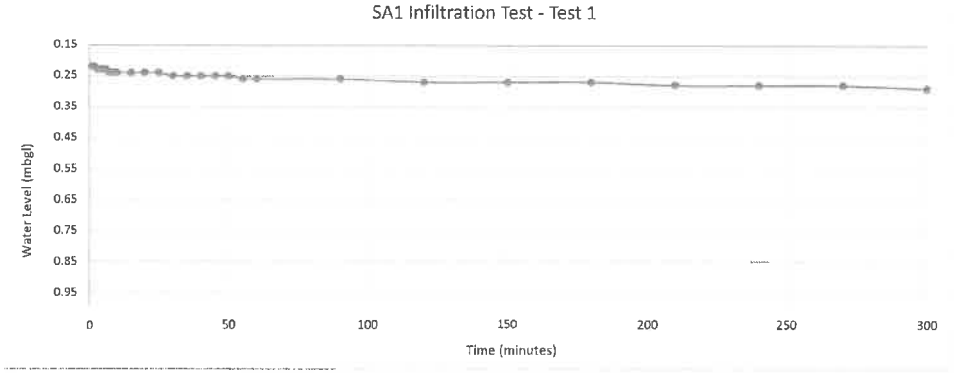
Paddock Gate, Wiswell Lane, Whalley - SA1 - Test 1

Date: Dec-20
Weather: Dry

Time (minutes)	Depth (mbgl)
0	0.22
1	0.22
2	0.23
3	0.23
4	0.23
5	0.23
6	0.24
7	0.24
8	0.24
9	0.24
10	0.24
15	0.24
20	0.24
25	0.25
30	0.25
35	0.25
40	0.25
45	0.25
50	0.26
55	0.26
60	0.26
90	0.27
120	0.27
150	0.27
180	0.28
210	0.28
240	0.28
270	0.29
300	0.29

	Length (m)	Width (m)	Depth (m)	Area (m^2)
Pit Dimensions:	1.70	0.90	1.10	1.68

Start water level (mbgl) =	0.22
Total Depth of test =	0.88
50% effective depth =	0.44
75% Effective Depth (mbgl) =	0.44
25% Effective Depth (mbgl) =	0.88



Soil Infiltration Rate (f) = $\frac{V_{p75-25}}{a_{p50} \times t_{p75-25}}$

Soil Infiltration Rate (f) = $\frac{V_{p75-25}}{a_{p50} \times t_{p75-25}}$

V_{p75-25} = effective storage volume of water in the trial pit between 75% and 25% effective depth
= 0.67 m^3

a_{p50} = internal surface area of the trial pit up to 50% effective depth and including base area
= 3.818 m^2

t_{p75-25} = time for water to fall from 75% to 25% effective depth
= - mins
= #VALUE! seconds

Soil Infiltration Rate (f) = **#VALUE!**
= #VALUE! m/s
= #VALUE! m/hour

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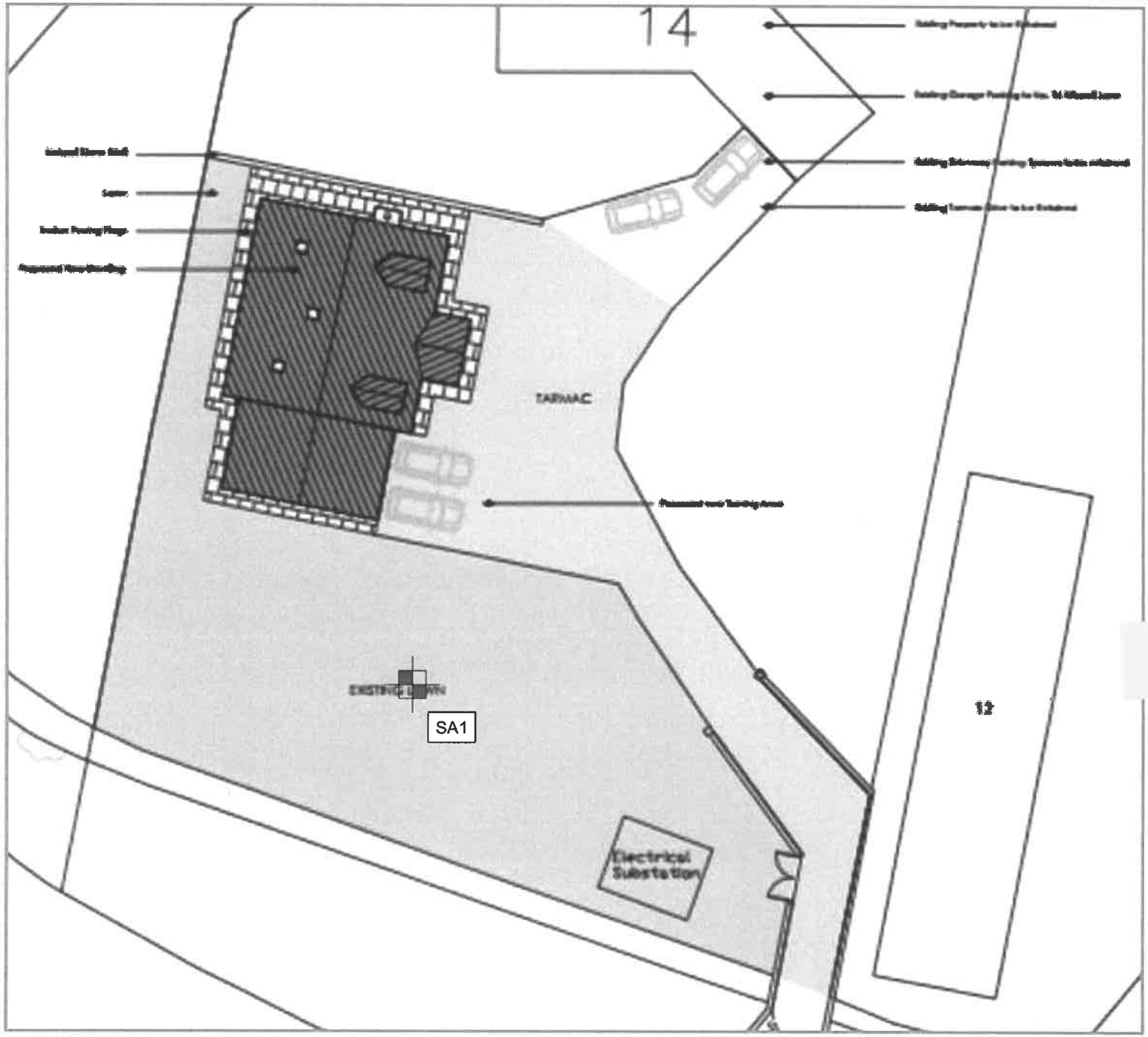
ANNEX B

Infiltration Test Location Plan



LEGEND

APPROX. SURFACE WATER INFILTRATION TEST LOCATION

REV	DESCRIPTION	DATE	BY

Suite One, No 3 Mitton Road Business Park, Mitton Road, Whalley, Lancashire BB7 0YE

MR & MRS BAMFORD

JOB TITLE.

PADDOCK GATE. 14 WISWELL LANE, WHALLEY

DRAWING TITLE.

INFILTRATION TEST LOCATION PLAN

SCALE @ A3.	DRAWN BY.	APPROVED BY.	DATE.
NTS	D.F.	M.B.	15/12/20

DRAWING No.	REV.
20804-1	-

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bEk Enviro Ltd
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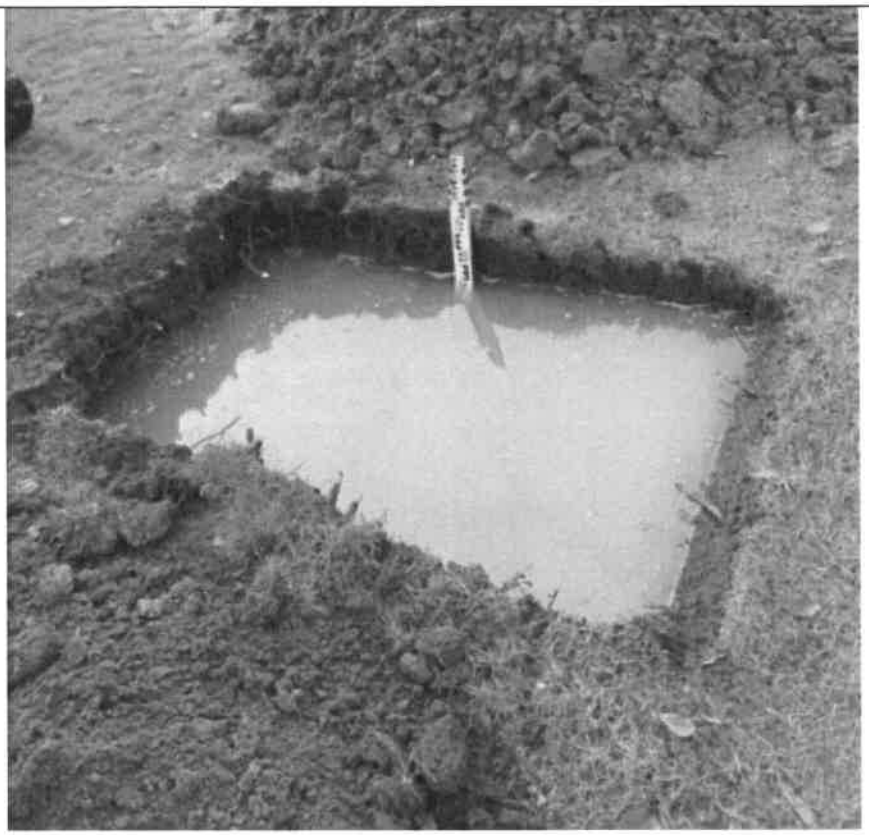
ANNEX C
Photographs

SA1 Surface Water Infiltration Test

Photograph 1

SA1 Surface Water Infiltration Test

Photograph 2



SA1 Surface Water Infiltration Test

Photograph 3

SA1 Surface Water Infiltration Test

Photograph 4

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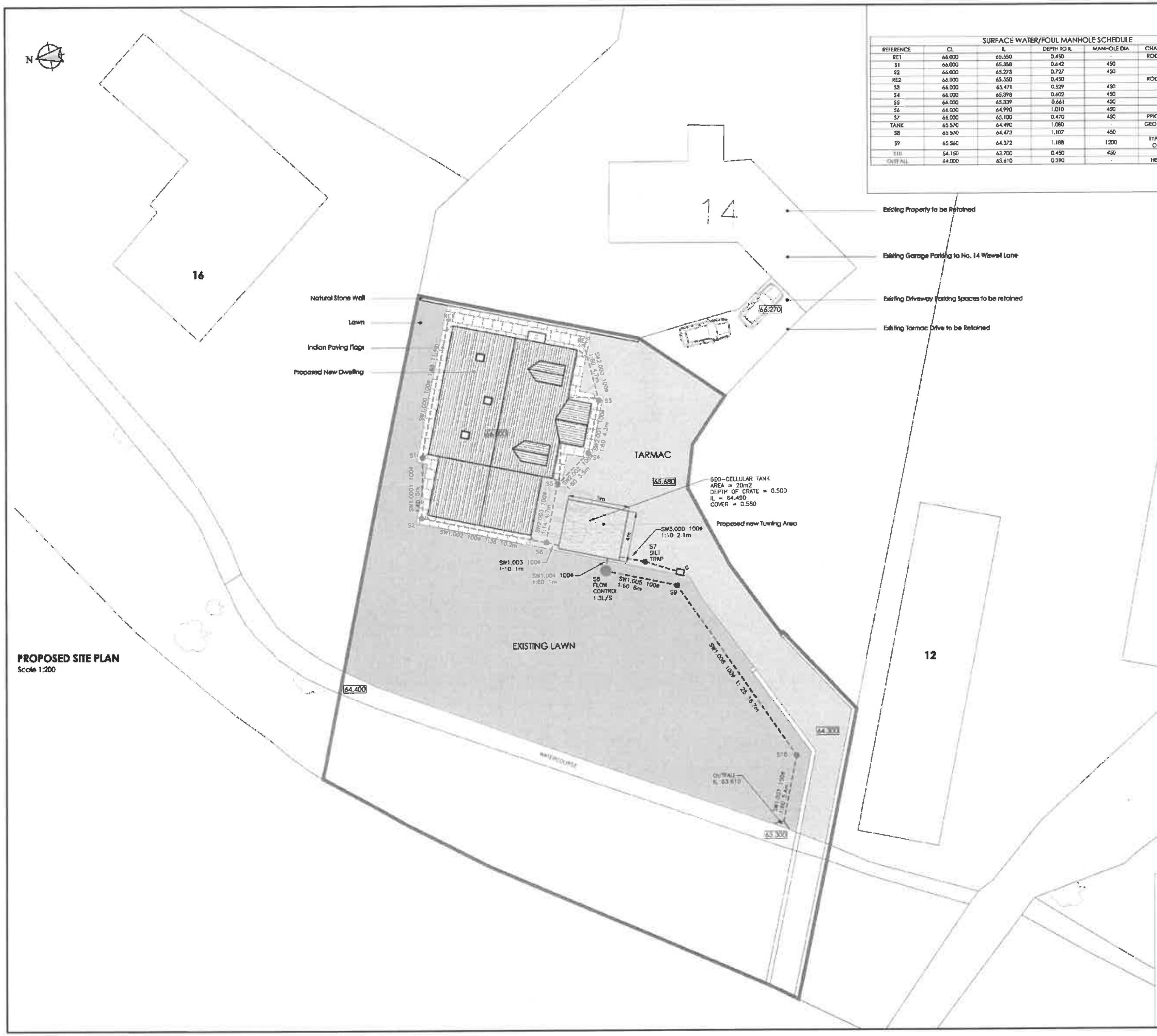
ANNEX C

Proposed Drainage Layout



SURFACE WATER/FOUL MANHOLE SCHEDULE

REFERENCE	CL	IL	DEPTH TO IL	MANHOLE DIA	CHAMBER TYPE	COVER TYPE
RE1	66.000	65.550	0.450	-	RODDING EYE	A15
S1	66.000	65.358	0.642	450	PPIC	A15
S2	66.000	65.273	0.727	450	PPIC	A15
RE2	66.000	65.550	0.450	-	RODDING EYE	A15
S3	66.000	65.471	0.529	450	PPIC	A15
S4	66.000	65.398	0.602	450	PPIC	A15
S5	66.000	65.339	0.661	450	PPIC	B125
S6	66.000	64.990	1.010	450	PPIC	B125
S7	66.000	65.100	0.470	450	PPIC SILT TRAP	B125
TANK	65.570	64.490	1.080	-	GEO-CELL TANK	B125
S8	65.570	64.473	1.107	450	PPIC	A15
S9	65.560	64.372	1.188	1200	TYPE B FLOW CONTROL	A15
[illegible]	54.150	63.700	0.450	450	PPIC	A15
OUTFALL	64.000	63.610	0.390	-	HEADWALL	

PROPOSED SITE PLAN
Scale 1:200

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5. NO DIMENSIONS TO BE SCALED FROM THIS DRAWING.
6. THE LOCATION AND LEVELS OF EXISTING DRAINAGE PIPES AND CULVERTS MUST BE CHECKED ON-SITE PRIOR TO CONSTRUCTION.
7. PROPOSED FINISHED LEVELS HAVE ONLY BEEN ASSUMED AND SHOULD BE FINALISED BY A CIVIL ENGINEER.
8. POSITION OF RAINWATER DOWN PIPES TO BE CONFIRMED BY THE ARCHITECT.

KEY

- 70.150 — PROPOSED LEVELS
- SW 1.000 — SURFACE WATER DRAIN
- S1 — SURFACE WATER MANHOLE
- G — SURFACE WATER GULLY
- ATTENUATION TANK

SURFACE WATER ATTENUATION

GEO-CELLULAR ATTENUATION TANK
AREA = 20m2
DEPTH OF CRATE = 0.500
IL = 64.490
COVER = 0.580

FLOW CONTROL DETAILS

HYDROBRAKE OR SIMILAR
CHAMBER 1200Ø
DESIGN DEPTH = 1.107m
FLOW = 1.3L/S
CHAMBER DETAILS TO BE SPECIFIED BY MANUFACTURE

PROPOSED DISCHARGE RATES

1 IN 1 YEAR = 1.0L/S
1 IN 30 YEAR = 1.1L/S
1 IN 100 YEAR + 40% CC = 1.3L/S

REVISION	COMMENT	DATE	BY

BEK ENVIRONMENTAL CONSULTING

BEK ENVIRONMENTAL CONSULTING ENGINEERS LTD
Suite 1, No 3 Milton Road Business Park, Milton Road, Whalley, Clitheroe BB7 9RX
TEL: 01254 377622

CLIENT: MR & MRS BAMFORD
DATE: 12/01/2021
STATUS:
PROJECT: PADDOCK GATE WISWELL LANCASHIRE
DRAWN BY: CV
SCALE: 1:100
DRAWING TITLE: PROPOSED SURFACE WATER LAYOUT & MANHOLE SCHEDULE
SIZE: A0
DRAWING REFERENCE: 2021-001-01
REVISION:

GEO-ENVIRONMENTAL CONSULTING ENGINEERS

bEk Enviro Ltd
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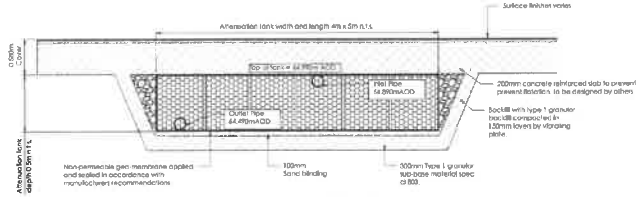
Mitton Road | Whalley | Lancashire | BB7 9YE

ANNEX D

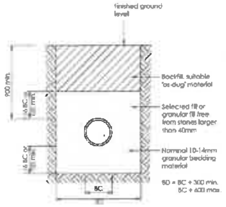
Typical Drainage Details



Indicative Section Through Attenuation Tank with Slab
Not to Scale

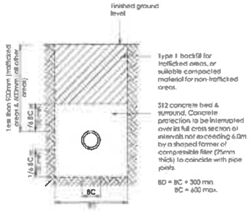
Installation Method

- Specialist supplier to prepare and submit appropriate layouts, schedules and details to enable fully compliant installation of geo-cellular units
- Excavate
- Install sub-base
- Install impermeable geomembrane (in accordance with manufacturers recommendations)
- Install crate units + connections (in accordance with manufacturers recommendations)
- Install inspection chambers as required
- Install crate and plates
- Cover sides & top with geotextile membrane (note, care taken not to rip, tear or puncture membrane
- Seal membrane
- Lateral backfilling
- Cover & backfill



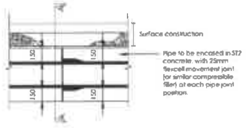
Typical Trench Detail
Scale 1:10

NOTE: to be used where cover depth
- >0.6m fields & gardens
- >0.9m lightly trafficked areas e.g. light roads & drives

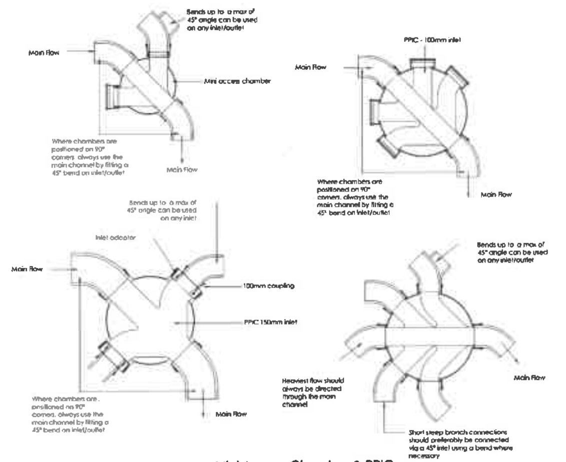


Shallow Trench Detail
Scale 1:10

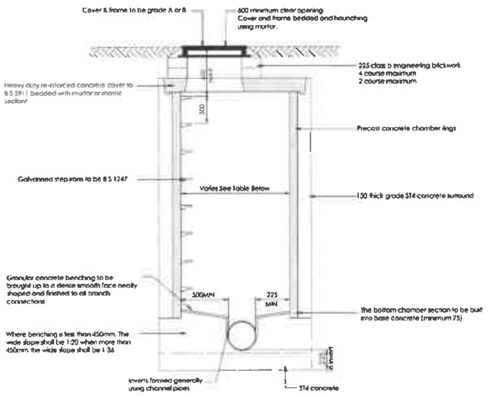
NOTE: To be used where cover depth
- <0.6m fields & gardens
- <0.9m lightly trafficked areas e.g. light roads & drives

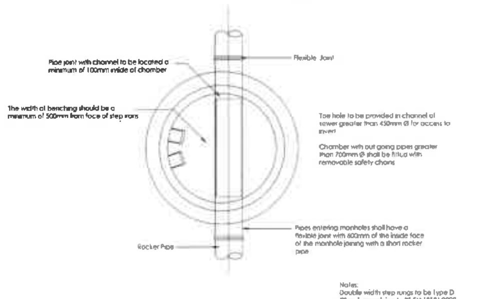


Joints for Concrete Encased Pipes
Scale 1:10

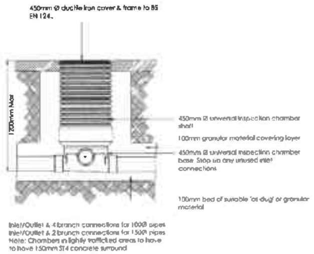


Mini Access Chamber & PPIC Installation Details
Scale 1:10

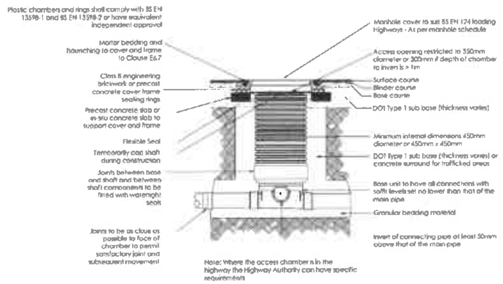




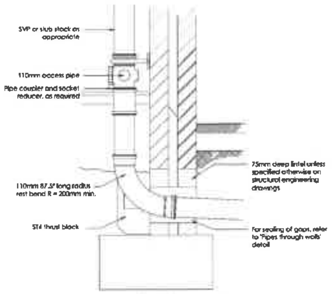
Typical Manhole Detail - Type B
Scale 1:20
(1.35m - 3m Deep with Step Irons)



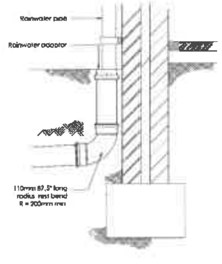
Typical Polypropylene Inspection Chamber
Max. 1.2m Deep
Scale 1:20
(for use in soft areas, driveways and parking bays only)



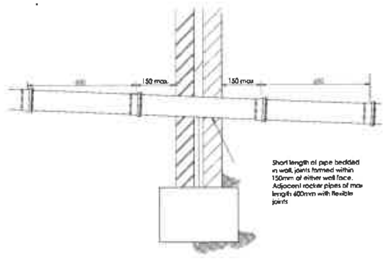
Typical Inspection Chamber
Max. 3m Deep Non Entry
Scale 1:20



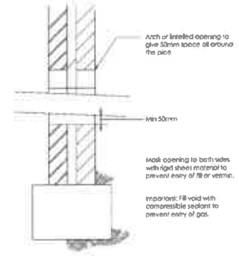
Internal SVP/Stub Stack Connection Through External Wall to Drain
Scale 1:10



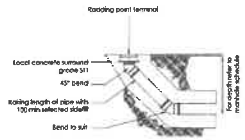
External RWP to Drain
Scale 1:10



Pipes Through Walls (a)
Scale 1:10



Pipes Through Walls (b)
Scale 1:10



Rodding Eye
Scale 1:20

GENERAL NOTES:

3. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS & ENGINEERS DRAWINGS & SPECIFICATIONS
4. ALL DIMENSIONS ARE SHOWN IN MILLIMETRES UNLESS OTHERWISE STATED
5. NO DIMENSIONS TO BE SCALED FROM THIS DRAWING
6. THE LOCATION AND LEVELS OF EXISTING DRAINAGE PIPES AND CULVERTS MUST BE CHECKED ON-SITE PRIOR TO CONSTRUCTION.

Extract from Table A2 WIS 4-08-02

Processed granular bedding & sidefill materials for flexible pipes

Pipe nominal bore (mm) (see note D)	Nominal Maximum particle size (mm)	Materials specified in British Standards (see note A)
100	10	10mm nominal single size
Over 100 to 150	15	10 or 14mm nominal single size or 14mm to 5mm graded
Over 150 to 300	20	10-14mm or 20mm nominal single size or 14-5mm graded or 20-5mm graded
Over 300 to 500	20	14 or 20mm nominal single size or 14-5mm graded or 20-5mm graded
Over 500	40	14 or 20mm or 40mm nominal single size or 14-5mm graded or 20-5mm graded or 40-5mm graded

Notes:
- A. Processed granular materials to include aggregates and air cooled blast furnace slag to BS EN 12620:220 + A1:2008 and lightweight aggregates to BS EN 13101:2002.
- B. -
- C. For the purpose of this table, PE pipe of 630mm OD can be regarded as having nominal bores of over 550mm, irrespective of wall thickness.
- D. Nominal bore is used in preference to DN because of the different nominal size classifications for flexible pipes

Minimum Recommended Trench Widths for Structured Wall Pipes in Poor Ground Conditions.

Native soil modulus between 3 & 4 MPA
Typical soil Classifications: Very loose gravel, loose sand, medium dense clayey silty sand, firm clay

Nominal pipe diameter (mm)	150	225	300	375	450	525	600	750	900
Minimum trench width (mm)*	450	525	600	750	900	1050	1200	1500	1800

* A vertical trench face has been assumed to allow a modulus of 7MPA to be achieved for the pipe bedding and sidefill material

Other assumed values:
Depth of cover = 6m (max)
Traffic loading = main road
Pipe stiffness = SN8

Note: Where the native soil modulus is below 3MPA or the depth of cover exceeds 6m guidance should be sought from the pipe manufacturer regarding structural design and installation details.

SURFACE WATER ATTENUATION

GEO-CELLULAR ATTENUATION TANK
AREA = 20m2
DEPTH OF CRATE = 0.500
IL = 64.490
COVER = 0.580

FLOW CONTROL DETAILS

HYDROBRAKE OR SIMILAR
[illegible]
DESIGN DEPTH = 1.107m
FLOW = 1.3L/S
CHAMBER DETAILS TO BE SPECIFIED BY MANUFACTURE

PROPOSED DISCHARGE RATES

1 IN 1 YEAR = 1.0L/S
1 IN 30 YEAR = 1.1L/S
1 IN 100 YEAR + 40% CC = 1.3L/S

REVISION	COMMENT	DATE	BY

BEK ENVIRONMENTAL CONSULTING ENGINEERS LTD	CLIENT: MR & MRS BAMFORD	DATE: 12/01/2021
Suite 1, No 3 Milton Road Business Park, Milton Road, Whalley, Clitheroe BB7 9RX		STATUS:
TEL: 01254 377822	PROJECT: PADDOCK GATE WISWELL LANCASHIRE	DRAWN BY: CV
		SCALE: AS SHOWN
	DRAWING TITLE: TYPICAL DRAINAGE DETAILS	SIZE: A0
	DRAWING REFERENCE: 2021-001-02	REVISION:

GEO-ENVIRONMENTAL CONSULTING ENGINEERS

bEk Enviro Ltd
Suite One | No 3 Mitton Road Business Park
Mitton Road | Whalley | Lancashire | BB7 9YE

ANNEX E

SW Modelled Output

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	1	Maximum Rainfall (mm/hr)	150.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	England and Wales	Connection Type	Level Soffits
M5-60 (mm)	20.000	Minimum Backdrop Height (m)	0.200
Ratio-R	0.300	Preferred Cover Depth (m)	0.350
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	4.00	Enforce best practice design rules	✓

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	11.400	59.4	100	Circular	66.000	65.550	0.350	66.000	65.358	0.542
1.001	5.000	58.8	100	Circular	66.000	65.358	0.542	66.000	65.273	0.627
1.002	10.200	36.0	100	Circular	66.000	65.273	0.627	66.000	64.990	0.910
2.000	4.700	59.5	100	Circular	66.000	65.550	0.350	66.000	65.471	0.429
2.001	4.300	58.9	100	Circular	66.000	65.471	0.429	66.000	65.398	0.502
2.002	3.500	59.3	100	Circular	66.000	65.398	0.502	66.000	65.339	0.561
2.003	4.700	13.5	100	Circular	66.000	65.339	0.561	66.000	64.990	0.910
1.003	1.000	10.0	100	Circular	66.000	64.990	0.910	65.570	64.890	0.580
3.000	2.100	10.0	100	Circular	65.570	65.100	0.370	65.570	64.890	0.580
1.004	1.000	58.8	100	Circular	65.570	64.490	0.980	65.580	64.473	1.007
1.005	6.000	59.4	100	Circular	65.580	64.473	1.007	65.560	64.372	1.088
1.006	16.100	24.0	100	Circular	65.560	64.372	1.088	64.150	63.700	0.350
1.007	5.400	60.0	100	Circular	64.150	63.700	0.350	64.000	63.610	0.290

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	RE1	150	Manhole	Adoptable	S1	450	Manhole	Adoptable
1.001	S1	450	Manhole	Adoptable	S2	450	Manhole	Adoptable
1.002	S2	450	Manhole	Adoptable	S6	450	Manhole	Adoptable
2.000	RE2	150	Manhole	Adoptable	S3	450	Manhole	Adoptable
2.001	S3	450	Manhole	Adoptable	S4	450	Manhole	Adoptable
2.002	S4	450	Manhole	Adoptable	S5	450	Manhole	Adoptable
2.003	S5	450	Manhole	Adoptable	S6	450	Manhole	Adoptable
1.003	S6	450	Manhole	Adoptable	TANK	450	Manhole	Adoptable
3.000	S7	450	Manhole	Adoptable	TANK	450	Manhole	Adoptable
1.004	TANK	450	Manhole	Adoptable	S8	1200	Manhole	Adoptable
1.005	S8	1200	Manhole	Adoptable	S9	450	Manhole	Adoptable
1.006	S9	450	Manhole	Adoptable	S10	450	Manhole	Adoptable
1.007	S10	450	Manhole	Adoptable	OUT	1	Manhole	Adoptable

Manhole Schedule

Node	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
RE1	66.000	0.450	150				
				0	1.000	65.550	100
S1	66.000	0.642	450	1	1.000	65.358	100
				0	1.001	65.358	100

Manhole Schedule

Node	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
S2	66.000	0.727	450	1	1.001	65.273	100
				0	1.002	65.273	100
RE2	66.000	0.450	150	0	2.000	65.550	100
S3	66.000	0.529	450	1	2.000	65.471	100
				0	2.001	65.471	100
S4	66.000	0.602	450	1	2.001	65.398	100
				0	2.002	65.398	100
S5	66.000	0.661	450	1	2.002	65.339	100
				0	2.003	65.339	100
S6	66.000	1.010	450	1	2.003	64.990	100
				2	1.002	64.990	100
				0	1.003	64.990	100
S7	65.570	0.470	450	0	3.000	65.100	100
TANK	65.570	1.080	450	1	3.000	64.890	100
				2	1.003	64.890	100
				0	1.004	64.490	100
S8	65.580	1.107	1200	1	1.004	64.473	100
				0	1.005	64.473	100
S9	65.560	1.188	450	1	1.005	64.372	100
				0	1.006	64.372	100
S10	64.150	0.450	450	1	1.006	63.700	100
				0	1.007	63.700	100
OUT	64.000	0.390	1	1	1.007	63.610	100

Simulation Settings

Rainfall Methodology	FSR	Analysis Speed	Normal
FSR Region	England and Wales	Skip Steady State	x
M5-60 (mm)	20.000	Drain Down Time (mins)	240
Ratio-R	0.300	Additional Storage (m³/ha)	20.0
Summer CV	0.750	Check Discharge Rate(s)	x
Winter CV	0.840	Check Discharge Volume	x

Storm Durations

15	60	180	360	600	960	2160	4320	7200	10080
30	120	240	480	720	1440	2880	5760	8640	

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
1	0	0	0
30	0	0	0
100	40	0	0

Node S8 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	64.473	Product Number	CTL-SHE-0052-1300-1107-1300
Design Depth (m)	1.107	Min Outlet Diameter (m)	0.075
Design Flow (l/s)	1.3	Min Node Diameter (mm)	1200

Node TANK Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	64.490
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	176

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	20.0	0.0	0.500	20.0	0.0	0.501	0.0	0.0

Results for 1 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	RE1	10	65.565	0.015	0.4	0.0023	0.0000	OK
15 minute winter	S1	10	65.380	0.022	0.8	0.0055	0.0000	OK
15 minute winter	S2	10	65.297	0.024	1.3	0.0064	0.0000	OK
15 minute winter	RE2	10	65.565	0.015	0.4	0.0023	0.0000	OK
15 minute summer	S3	10	65.488	0.017	0.5	0.0034	0.0000	OK
15 minute winter	S4	11	65.416	0.018	0.5	0.0028	0.0000	OK
15 minute winter	S5	10	65.355	0.016	0.9	0.0039	0.0000	OK
15 minute winter	S6	10	65.020	0.030	2.6	0.0071	0.0000	OK
15 minute winter	S7	10	65.121	0.021	1.6	0.0141	0.0000	OK
60 minute winter	TANK	44	64.575	0.085	2.4	1.6313	0.0000	OK
60 minute winter	S8	44	64.575	0.102	1.2	0.1150	0.0000	SURCHARGED
60 minute winter	S9	44	64.391	0.019	1.0	0.0030	0.0000	OK
60 minute winter	S10	44	63.725	0.025	1.0	0.0039	0.0000	OK
60 minute winter	OUT	44	63.634	0.024	1.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	RE1	1.000	S1	0.4	0.398	0.050	0.0114	
15 minute winter	S1	1.001	S2	0.8	0.582	0.099	0.0067	
15 minute winter	S2	1.002	S6	1.3	0.744	0.125	0.0174	
15 minute winter	RE2	2.000	S3	0.4	0.477	0.051	0.0039	
15 minute summer	S3	2.001	S4	0.5	0.547	0.062	0.0039	
15 minute winter	S4	2.002	S5	0.5	0.579	0.061	0.0029	
15 minute winter	S5	2.003	S6	0.9	0.641	0.052	0.0064	
15 minute winter	S6	1.003	TANK	2.6	1.489	0.134	0.0017	
15 minute winter	S7	3.000	TANK	1.6	1.407	0.083	0.0024	
60 minute winter	TANK	1.004	S8	1.2	0.369	0.149	0.0075	
60 minute winter	S8	Hydro-Brake®	S9	1.0				
60 minute winter	S9	1.006	S10	1.0	0.771	0.078	0.0204	
60 minute winter	S10	1.007	OUT	1.0	0.663	0.124	0.0079	3.4

Results for 30 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	RE1	10	65.574	0.024	1.0	0.0036	0.0000	OK
15 minute winter	S1	10	65.394	0.036	2.0	0.0091	0.0000	OK
15 minute winter	S2	10	65.312	0.039	3.3	0.0106	0.0000	OK
15 minute summer	RE2	10	65.575	0.025	1.0	0.0037	0.0000	OK
15 minute winter	S3	10	65.500	0.029	1.3	0.0057	0.0000	OK
15 minute winter	S4	10	65.427	0.029	1.3	0.0047	0.0000	OK
15 minute winter	S5	10	65.364	0.025	2.3	0.0063	0.0000	OK
15 minute winter	S6	10	65.046	0.056	6.9	0.0133	0.0000	OK
15 minute summer	S7	10	65.135	0.035	4.0	0.0236	0.0000	OK
60 minute winter	TANK	50	64.768	0.278	5.7	5.3294	0.0000	SURCHARGED
60 minute winter	S8	50	64.767	0.294	1.3	0.3329	0.0000	SURCHARGED
120 minute summer	S9	116	64.392	0.020	1.1	0.0032	0.0000	OK
30 minute summer	S10	34	63.726	0.026	1.1	0.0042	0.0000	OK
30 minute summer	OUT	34	63.635	0.025	1.1	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	RE1	1.000	S1	1.0	0.506	0.127	0.0227	
15 minute winter	S1	1.001	S2	2.0	0.741	0.252	0.0135	
15 minute winter	S2	1.002	S6	3.3	0.893	0.325	0.0376	
15 minute summer	RE2	2.000	S3	1.0	0.596	0.127	0.0079	
15 minute winter	S3	2.001	S4	1.3	0.688	0.164	0.0081	
15 minute winter	S4	2.002	S5	1.3	0.752	0.164	0.0060	
15 minute winter	S5	2.003	S6	2.3	0.771	0.137	0.0142	
15 minute winter	S6	1.003	TANK	6.8	1.812	0.355	0.0038	
15 minute summer	S7	3.000	TANK	4.0	1.768	0.207	0.0048	
60 minute winter	TANK	1.004	S8	1.3	0.449	0.169	0.0078	
60 minute winter	S8	Hydro-Brake®	S9	1.1				
120 minute summer	S9	1.006	S10	1.1	0.793	0.087	0.0220	
30 minute summer	S10	1.007	OUT	1.1	0.683	0.138	0.0085	5.8

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	RE1	10	65.583	0.033	1.8	0.0049	0.0000	OK
120 minute winter	S1	102	65.502	0.144	1.2	0.0365	0.0000	SURCHARGED
120 minute winter	S2	102	65.502	0.229	2.0	0.0616	0.0000	SURCHARGED
15 minute winter	RE2	10	65.584	0.034	1.8	0.0051	0.0000	OK
15 minute summer	S3	10	65.512	0.041	2.4	0.0080	0.0000	OK
120 minute winter	S4	102	65.502	0.104	0.8	0.0165	0.0000	SURCHARGED
120 minute winter	S5	102	65.502	0.163	1.4	0.0407	0.0000	SURCHARGED
120 minute winter	S6	102	65.502	0.512	4.2	0.1218	0.0000	SURCHARGED
120 minute winter	S7	102	65.501	0.401	2.5	0.2690	0.0000	FLOOD RISK
120 minute winter	TANK	102	65.501	1.011	6.7	9.6703	0.0000	FLOOD RISK
120 minute winter	S8	102	65.500	1.027	3.8	1.1616	0.0000	FLOOD RISK
120 minute winter	S9	102	64.394	0.022	1.3	0.0034	0.0000	OK
120 minute winter	S10	102	63.728	0.028	1.3	0.0045	0.0000	OK
120 minute winter	OUT	102	63.637	0.027	1.3	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	RE1	1.000	S1	1.8	0.579	0.229	0.0356	
120 minute winter	S1	1.001	S2	1.2	0.648	0.152	0.0391	
120 minute winter	S2	1.002	S6	2.0	0.861	0.198	0.0798	
15 minute winter	RE2	2.000	S3	1.8	0.677	0.229	0.0125	
15 minute summer	S3	2.001	S4	2.4	0.796	0.304	0.0130	
120 minute winter	S4	2.002	S5	0.8	0.659	0.102	0.0274	
120 minute winter	S5	2.003	S6	1.4	0.774	0.084	0.0368	
120 minute winter	S6	1.003	TANK	4.2	1.650	0.220	0.0078	
120 minute winter	S7	3.000	TANK	2.5	1.577	0.130	0.0164	
120 minute winter	TANK	1.004	S8	3.8	0.492	0.487	0.0078	
120 minute winter	S8	Hydro-Brake®	S9	1.3				
120 minute winter	S9	1.006	S10	1.3	0.827	0.101	0.0246	
120 minute winter	S10	1.007	OUT	1.3	0.712	0.161	0.0096	19.4