

TECHNICAL NOTE

Date:	10/07/2020	Ref:	402.06594.00008 - TN01 v01
Subject:	Middleton Development – Discharge of Surface Water Drainage Conditions Prepared for: Frontier Estates Ltd		

1. INTRODUCTION

This Technical Note summarises the surface water drainage strategy that has been developed and agreed for the proposed residential development by Frontier Estates Ltd at Yapton Poultry Farm, Middleton-on-Sea, PO26 6DY (Planning M/45/16/PL), in order to discharge planning conditions 11, 13 and 14 of the Planning Consent granted on 07/02/2017.

An email from Arun District Council dated 02/06/2020 provided comments from the Arun Drainage Engineer on the Drainage Strategy relating to the discharge of conditions 11, 13 and 14 relating to surface water drainage.

"The level of detail supplied is currently insufficient to enable the discharge of conditions 11, 13 or 14.

Firstly, we need to be sure that shallow infiltration is not possible, as part of an overall scheme. Please provide a plan showing all the groundwater monitoring point locations and the monitoring results for all, not just WS02. Achieving 1m freeboard between the base of structures and the peak recorded groundwater level is not a requirement in this particular area, so long as the base is above the peak recorded level. This information will dictate as to whether shallow winter infiltration testing will be required.

Regarding the ditches on the southern boundary, it is very likely that these will need improvements and I suggest a meeting takes place on site to look at these. Land Drainage Consent will be required for any alterations to them, including culverting and any discharge structures. This will all need to be fully detailed on the drawings.

Once we have agreed the scheme principles, fully detailed plans will be required to include pipe/structure, cover levels/invert levels/base levels/diameters/gradients, etc, along with fully detailed construction drawings for all drainage elements. Please note that open suds features should be employed where possible. The current arrangement of crates is currently not desirable, since they have been arranged in manner as to use almost every piece of available space outside the root protection zones (zones will need to be confirmed), rather than achieve a more practical layout whereby membranes can be wrapped around the crates in a more suitable manner i.e. reduce the number of corners. Please note that our tree officer will need to be involved in discussions in this respect due to protect the trees and the crates. Permeable paving will need to be employed wherever possible.

The maintenance manual can be commented upon, once the fundamentals have been agreed.

The applicant should also provide topographical evidence to show that no overland/exceedance run off flows from the field to the north will have any detrimental effect on the development/suds."

2. RESPONSE AND APPROACH

In response to these comments SLR Consulting has proposed a two stage approach to resolve the outstanding matters as detailed in Table 1 below:

Table 1

Item	Arun DC requirement	Purpose	Action
Stage 1: Agreeing the Principles of the Scheme			
i. Shallow Infiltration	Provide plan showing all points	Show all points and all data	This Technical Note Section 2.1
	Reaffirm in a technical note the findings from the winter groundwater testing	Re-state the current facts from the winter monitoring	This Technical Note Section 2.1
	Confirm whether the base of the proposed crate structures is above the peak recorded water level.	Will confirm the need for shallow winter infiltration testing	This Technical Note Section 2.1
ii. Overland Flowpath	Provide topographical evidence that no overland/flow path exists from the field to the north	To ensure that there is no detrimental effect to the development	Plan drawing and section in this Technical Note Section 2.2
iii. Southern Ditches	Site visit/meeting (planned for 26/06/2020)	To agree nature and extent of proposals.	SLR attended site with Paul Cann (Arun DC). Summary of agreed comments provided in this Technical Note Section 2.3 and Appendix 02 .
Stage 2: Providing the Details			
v. Southern Ditches	Land Drainage Consent process	Commence Land Drainage Consent for maintenance / discharge structure. Confirm need for new culvert beneath the access.	Detailed drawings (plan and detail drawings) prepared for the outfall consent to commence shortly.
vi. Further details	Full drainage details to be provided.	Drainage design and attenuation storage crate layout justified in Section 4.2 below.	Further detailed drawings shown in Appendix 04 .
vii. Maintenance Manual	Further maintenance and operation details to be provided.	Maintenance and operation details provided for the detailed plans.	Updated and expanded Maintenance Plan shown in Appendix 05 .

This Technical Note responds to each of the issues and describes how the proposed development has mitigated the risk of surface water flooding at the site.

3. STAGE 1: AGREEING THE PRINCIPLES OF THE SCHEME

3.1 Shallow Infiltration

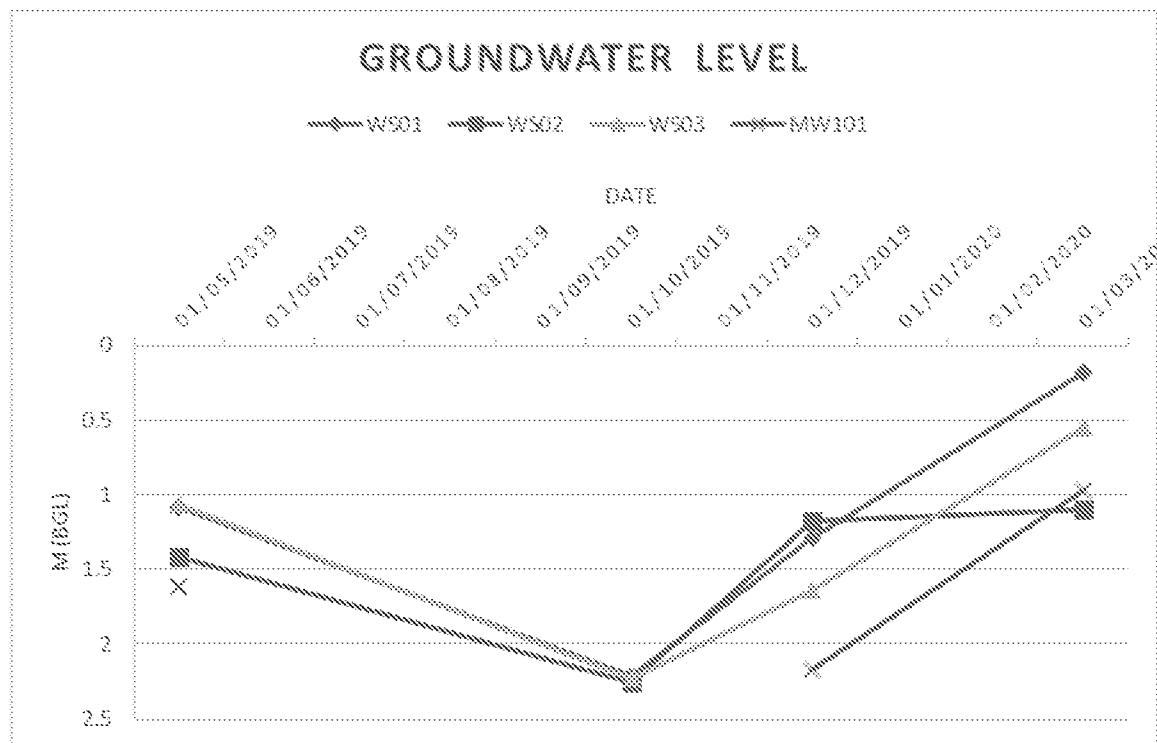
As stated in the surface water drainage strategy (SLR March 2020) the superficial geology is designated as a Secondary A aquifer, *'permeable layers capable of supporting water supplies as a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers'*.

Accordingly, ground water monitoring was carried out on 7th May 2019, 24th October 2019, 13th December 2019 and 20th March 2020 in three window sampler boreholes in the locations shown on the Site Plan in **Appendix 01**. Results from the manual monitoring is shown in Table 2 and Figure 1.

Table 2
Manual Groundwater Monitoring

Borehole	Depth to Groundwater (m) below ground level			
	07/05/2019	24/10/2019	13/12/2019	20/03/2020
WS01	1.080	2.212	1.290	0.185
WS02	1.418	2.254	1.173	1.095
WS03	1.065	2.229	1.640	0.551
MW101	1.615	-	2.172	0.973

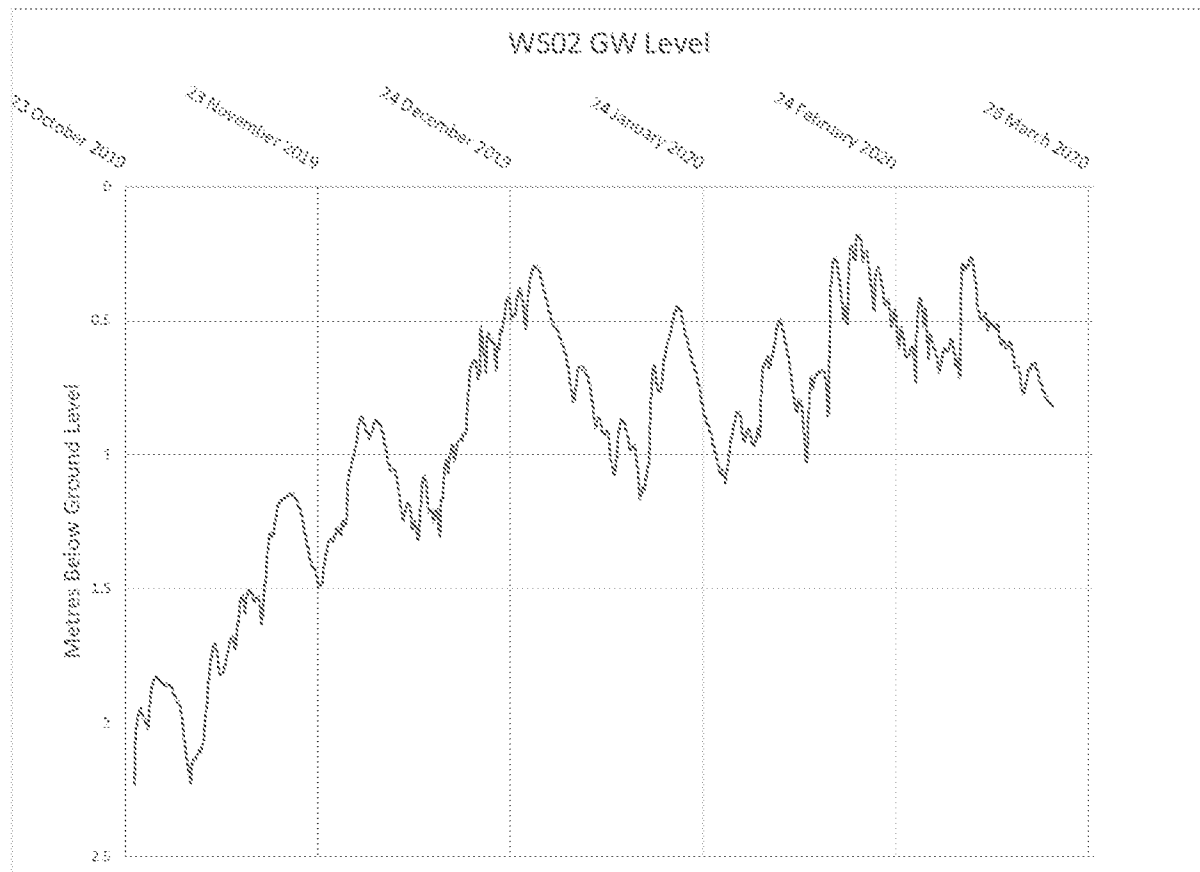
Figure 1
Groundwater Level at all Boreholes



The results from the manual dip monitoring over the winter period show that the peak water level was 0.18m below ground level at WS01.

Continuous monitoring was also completed throughout the winter of 2019/2020 to determine the peak ground water level at the site. Unfortunately, when the monitoring was installed two of the wells had been vandalised at WS01, and at WS03 which was at the most appropriate location closest to the predicted proposed attenuation storage. The logger was placed in the safer more remote location at WS02. The results from the data logger are summarised below and show that the peak water level over the winter period was 0.18m below the existing ground level at WS02.

Figure 2
 Data logger data at borehole WS02



In summary, the extensive winter groundwater monitoring has shown that the peak groundwater level in the area of the proposed attenuation storage will be just 0.18m bgl.

Whilst the data logger and the manual dip data correlate well, the final manual reading for WS02 shows a discrepancy. However, the underlying trends are clear that the groundwater level in both the north and the south of the site can be just 200mm below ground level during the early parts of the year.

The SuDS Manual recommends that *'there should be a minimum depth of 1m of unsaturated aquifer material between the base of any infiltration system and the maximum likely groundwater level (taking account of any shifts in groundwater level resulting from extended periods of wet weather)'*. As the peak groundwater level was recorded as 0.18m bgl and in order to protect the Lewes Nodular Chalk formation from pollution it is proposed that infiltration to the ground is discounted.

Where possible it is proposed that the base of the proposed 330mm deep crate structures is above the peak recorded water level, but in order to ensure floatation of the crates does not occur they should be anchored down.

3.2 Overland Flowpath

There is evidence of a ponded area in an adjacent field 75-100 metres to the north of the site. Figure 1 shows a ponded area during a site visit on 23/02/2020. This is considered to be the ponded area referred to by Arun DC.

Figure 3
 Ponded area near Yapton Road



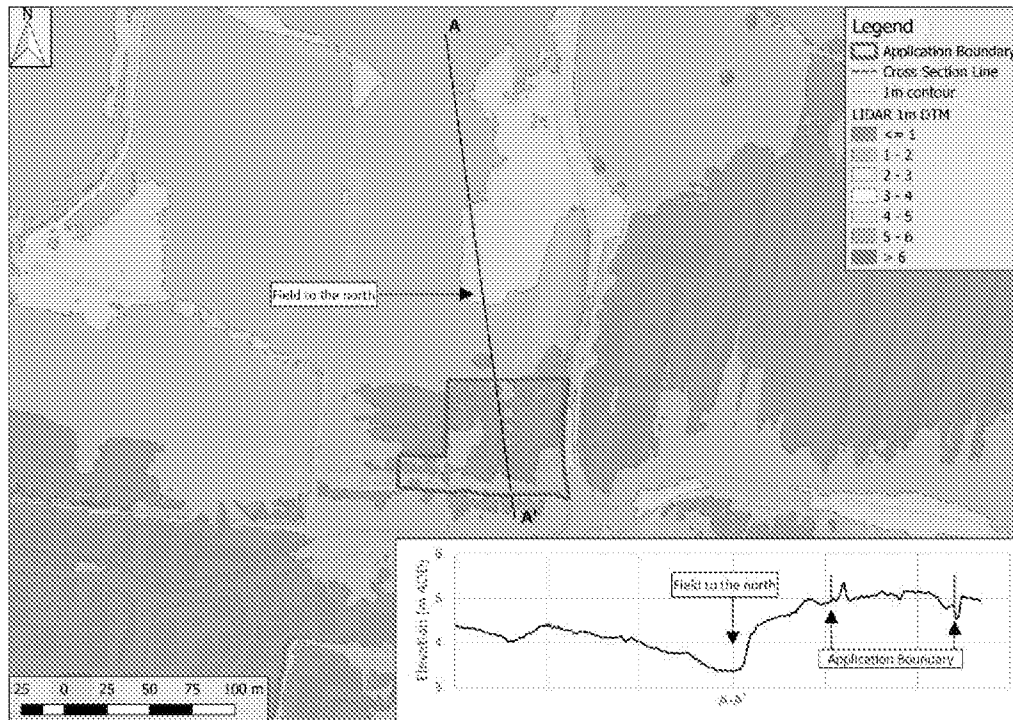
The 1m digital terrain model (LIDAR) has been used to investigate any potential pathways between the field and the proposed development.

Two principal pathways have been investigated; firstly, a direct flow route to the site, and secondly a route to Yapton Road to the south east of the site near the roundabout. A plan and long section for each route has been produced.

Route 1 Direct

Ground elevations generally decrease northwards towards the Ryebank Rife, which is located approximately 800m north of the site. As shown in Figure 4, the proposed development is located at a higher elevation (approximately 5m AOD) compared to the field located to the north of the development (approximately 3.4m AOD). Ground elevations immediately north of the field are also situated at a lower elevation than the proposed development, with the highest point situated at approximately 4.4m AOD. Therefore, any surface water ponding in the field will preferentially escape northwards away from the site and back towards the Ryebank Rife.

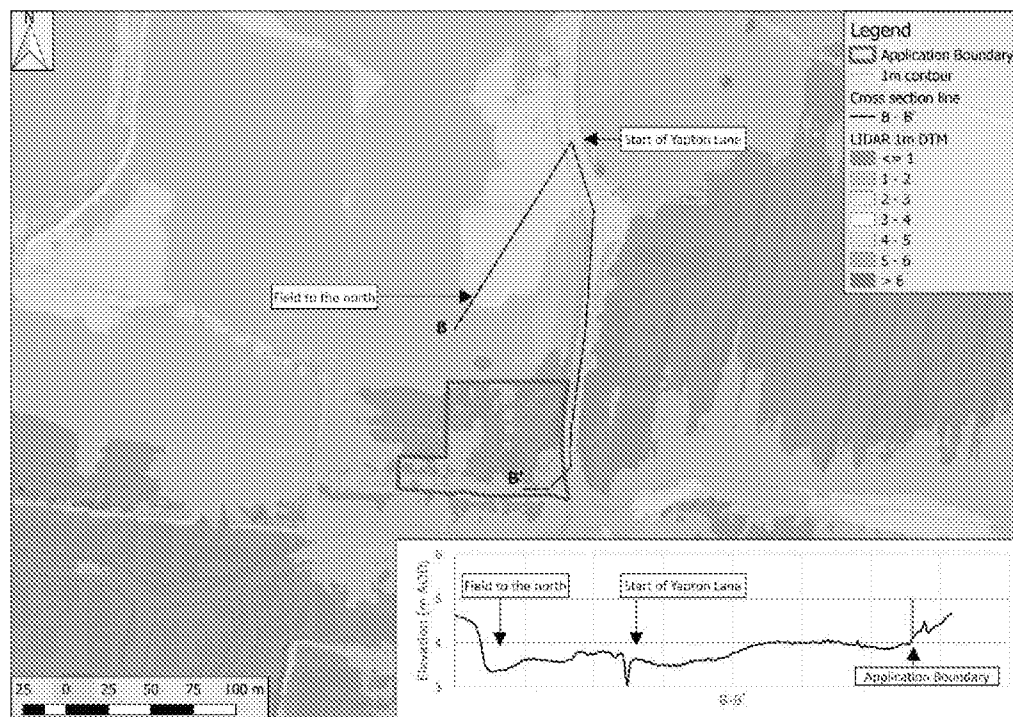
Figure 4
 Route 1 Plan and Section AA'



Route 2 Vapton Road

From the long section in Figure 5 it can be seen that the elevation profile increases from the field to the road, and then along the road to the site. However, there is a small area of low topography noted in the very south east corner of the site, as referenced in the Flood Risk Assessment.

Figure 5
 Route 2 Plan and Section BB'



Based on the line of section drawn, for the surface water to spill onto Yapton Lane, the surface water would need to rise from approximately 3.4m AOD at the base of the field to 3.8m AOD (400mm) nearer the roadside. However, with generally lower levels to the north it is considered that flow will preferentially head north to the Ryebank Rife rather than pass uphill to the site.

Summary

From the above analysis of the two most likely flow routes it is considered that no surface water runoff from a pond in the field will impact the proposed development.

3.3 Southern Ditches

A site visit/meeting was held on 26/06/2020 between Paul Cann (Arun DC) and Andrew Dannatt (SLR Consulting). Whilst the meeting discussed all the outstanding issues raised by Arun DC, the following scope of work was discussed and agreed to improve and make good the north and south ditches that run either side of the public footpath that runs along the southern site boundary.

A marked-up site plan showing the areas described during the discussions is attached at **Appendix 02**:

South side of footpath:

- i. Desilting/clearing the ditches to the headwall
- ii. Jetting of the culverts
- iii. Remove existing minor tree from the bed of the ditch
- iv. CCTV check survey to determine if tree has damaged the culvert

North side of footpath:

- i. Desilting/clearing the ditches to the headwall
- ii. Replacement culvert same diameter (225mm), twin wall poly or concrete
- iii. Pipe bed/surround of concrete or slab over for the access
- iv. Headwalls to be WSCC/Arun DC spec or brick/bagwork
- v. Outfall can be precast, must not encroach into stream, invert just higher than bed. No need for erosion control

4 STAGE 2: PROVIDING THE DETAILS

4.1 Southern Ditches

A Land Drainage Consent application is being prepared for submission to request consent for discharging the surface water outflow from the development to the surface water ditch on the southern boundary in accordance with the approved surface water drainage strategy and the SuDS Manual hierarchy.

In addition, the existing culvert beneath the access track is to be extended from 6 metres to 11 metres in order to be sufficient for safe vehicular movements in relation to the development site.

The proposed access layout is shown in **Appendix 03** with the drainage plan and details shown in **Appendix 04**.

4.2 Further Details

The strategy for the drainage design has been provided in the surface water drainage strategy document which was developed into the plans and details shown in **Appendix 04**.

In order to provide a sustainable gravity drainage system, ground levels have been raised from the existing. In particular, this is to ensure there is a minimum depth of cover to the crates of 500mm to comply with the manufacturers recommendations and to avoid floatation.

By raising the ground in the area of the crates the health of the trees will need to be protected. Accordingly, a crate layout has been refined to allow for more straightforward construction and maintenance.

The discharge control will be by a hydrobrake as stated in the Surface water drainage strategy document, at 56mm diameter. However, a hydrobrake of this diameter may be at risk of blockage. The minimum recommended hydrobrake size is 75mm, but a larger diameter will increase the discharge rate marginally. However, if the greater rate is acceptable to Arun DC then the advantage of a greater discharge rate will be that the crate volume can be reduced, thereby improving the likelihood of retaining the health of the trees.

The discharge to the southern ditch will be by an outfall structure as recommended by the Arun DC Officer and this is detailed in **Appendix 04** and will be submitted as part of the Land Drainage Consent application shortly.

4.3 Maintenance Manual

The Maintenance Manual introduced in the surface water management strategy document has been enhanced and expanded with the SuDS maintenance and management tasks that should be completed with the various SuDS components that have been detailed for the site.

A comprehensive Maintenance Plan is attached at **Appendix 05**.

APPENDIX 01 – SITE INVESTIGATION PLAN

06594.00008.019.003.0a_EXP_HOLE_LOC_PLAN.dwg



NOTES

1. DRAWING IS BASED ON EDMUND WILIAMS SITE LOCATION/EXISTING DRAWING, DATED FEB 2019.

LEGEND

	SITE BOUNDARY
	DENSE VEGETATION
	HISTORIC MONITORING WELL IDENTIFIED DURING WALKOVER
	SOUTHERN WATER MANHOLE, REF:3701
	SMALL STOCKPILES CONTAINING: SOIL, TIMBER, DEMOLITION MATERIAL, TYRES, CEMENT SHEETING (POSSIBLY CONTAINING ASBESTOS)
	BOREHOLE LOCATION
	TRIAL PIT LOCATION

FRONTIER

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**YAPTON ROAD POULTRY FARM
MIDDLETON-ON-SEA**

LAND QUALITY RISK ASSESSMENT

EXPLORATORY HOLE LOCATION PLAN

DWG No. 3

Scale
1:10,000 @ A3

Date
MAY 2019

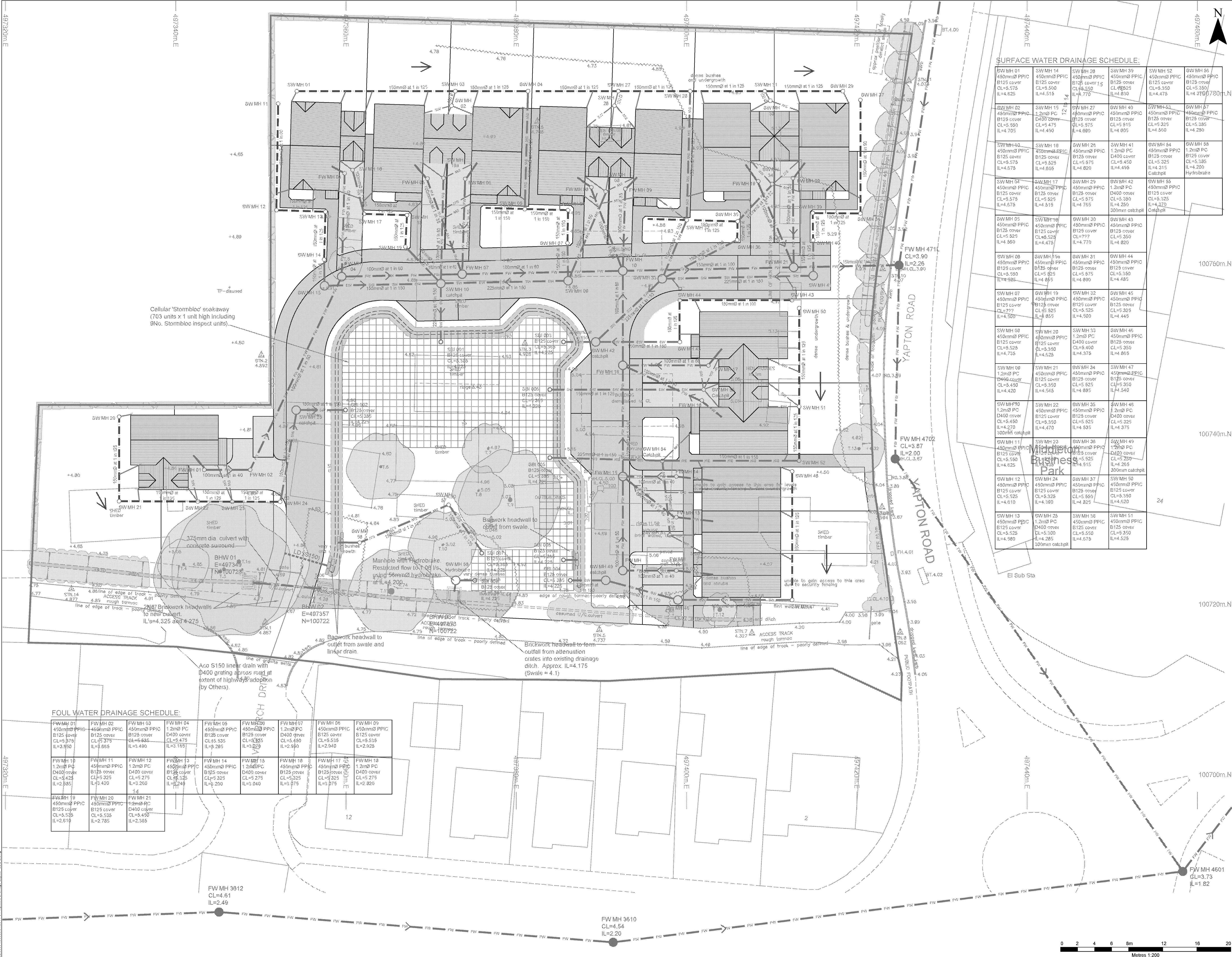
APPENDIX 02 – SITE DISCUSSIONS



Site:	YAPTON POULTRY FARM	
Project:	MIDDLETON RESIDENTIAL	
Date:	01/07/2020	
Drawing:	SITE VISIT DISCUSSION APPENDIX 02	01

APPENDIX 03 – SITE ACCESS LAYOUT

APPENDIX 04 – DEVELOPMENT PLANS AND DETAIL SHEETS



SURFACE WATER DRAINAGE SCHEDULE							
SW MH 01 450mmØ PPIC B125 cover CL=5.575 IL=4.625	SW MH 14 450mmØ PPIC B125 cover CL=5.560 IL=4.515	SW MH 28 450mmØ PPIC B125 cover CL=5.550 IL=4.770	SW MH 39 450mmØ PPIC B125 cover CL=5.515 IL=4.850	SW MH 52 450mmØ PPIC B125 cover CL=5.475 IL=4.475	SW MH 56 450mmØ PPIC B125 cover CL=5.350 IL=4.370	SW MH 57 450mmØ PPIC B125 cover CL=5.385 IL=4.280	SW MH 58 450mmØ PPIC B125 cover CL=5.385 IL=4.280
SW MH 02 450mmØ PPIC B125 cover CL=5.580 IL=4.705	SW MH 15 450mmØ PPIC B125 cover CL=5.475 IL=4.490	SW MH 27 450mmØ PPIC B125 cover CL=5.575 IL=4.680	SW MH 40 450mmØ PPIC B125 cover CL=5.515 IL=4.805	SW MH 53 450mmØ PPIC B125 cover CL=5.515 IL=4.550	SW MH 54 450mmØ PPIC B125 cover CL=5.325 IL=4.315	SW MH 55 450mmØ PPIC B125 cover CL=5.350 IL=4.290	SW MH 58 450mmØ PPIC B125 cover CL=5.385 IL=4.280
SW MH 03 450mmØ PPIC B125 cover CL=5.575 IL=4.675	SW MH 16 450mmØ PPIC B125 cover CL=5.525 IL=4.815	SW MH 29 450mmØ PPIC B125 cover CL=5.575 IL=4.820	SW MH 41 450mmØ PPIC B125 cover CL=5.450 IL=4.455	SW MH 54 450mmØ PPIC B125 cover CL=5.325 IL=4.315	SW MH 55 450mmØ PPIC B125 cover CL=5.325 IL=4.320	SW MH 56 450mmØ PPIC B125 cover CL=5.350 IL=4.270	SW MH 58 450mmØ PPIC B125 cover CL=5.385 IL=4.280
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FOUL WATER DRAINAGE SCHEDULE:

FW MH 01 450mmØ PPIC B125 cover CL=5.375 IL=3.950	FW MH 02 450mmØ PPIC B125 cover CL=5.375 IL=3.865	FW MH 03 450mmØ PPIC B125 cover CL=5.475 IL=3.489	FW MH 04 450mmØ PPIC B125 cover CL=5.475 IL=3.185	FW MH 05 450mmØ PPIC B125 cover CL=5.535 IL=2.295	FW MH 06 450mmØ PPIC B125 cover CL=5.450 IL=2.960	FW MH 07 450mmØ PPIC B125 cover CL=5.535 IL=2.940	FW MH 08 450mmØ PPIC B125 cover CL=5.535 IL=2.925	FW MH 09 450mmØ PPIC B125 cover CL=5.535 IL=2.925
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- NOTES
- Do not scale this drawing. If in doubt ask.
 - This drawing to be read in conjunction with all relevant Specialists and Engineers drawings and specifications.
 - Topographical survey information taken from 'Offington Land Surveyors Ltd' survey ref: 13950815 dated August 2015 supplied to SLR by Client.
 - Location of existing services currently unknown. Any services location and type to be confirmed prior to construction works.
 - Full Building Regulation approval should be obtained prior to the commencement of works on site, and any works carried out prior to this are undertaken at the Client's/ Contractor's own risk.
 - The works are to be carried out to the approval and satisfaction of the Building Control Officer, to accepted good building practice and with full compliance and in accordance with all relevant British Standards and Codes of practice.
 - Method statement must be agreed before work is carried out.
 - Engineered granular fill material in accordance with Specification for Highway Works. Class 6F1, 6F2 or 6N granular material in accordance with Table 6/1 Grading requirements to Table 6/4, and compaction to conform to Table 6/4.
 - Concrete grades are to be in accordance with BS8500-1: 2002 and BS8500-2: 2002 placed, compacted and protected in accordance with the National Standard Concrete Specification.
 - All drainage to be kitemark certified and installed in accordance with the latest edition of 'Sewers for Adoption'.
 - The Contractor is to remain responsible for the temporary stability of the surrounding ground throughout the construction.

LEGEND	
	Planning Boundary
	Foul Water Drainage
	Filter Drain
	Surface Water Drainage
	Cellular 'Stormbloc' Soakaway
	Exceedance Flow Route Above Design Flood Event

P0

DH

SDE

JUL 20

PLANNING ISSUE

Revision

By

Chkd By

Date

Comments

FRONTIER

SLR

global environmental solutions

TREEMOOD HOUSE

ROBINSON LANE

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Site

LAND WEST OF YAPTON ROAD

MIDDLETON-ON-SEA, BOGNOR REGIS

Project

SURFACE WATER DRAINAGE STRATEGY

Drawing Title

PROPOSED DRAINAGE LAYOUT

Scale

1:200 @ A1

Date

JULY 2020

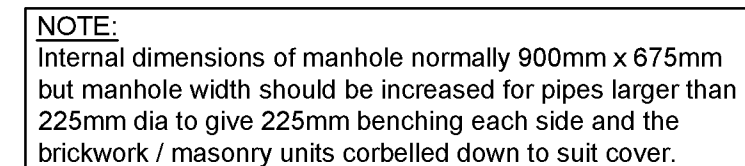
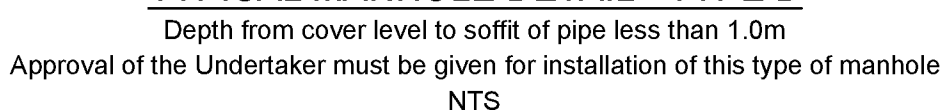
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Revision

P0

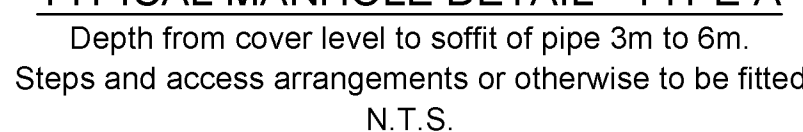
PLANNING



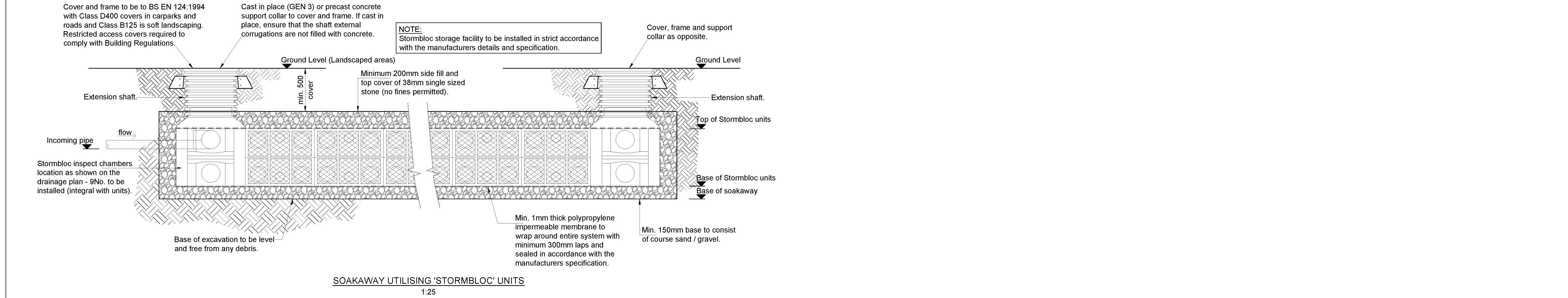
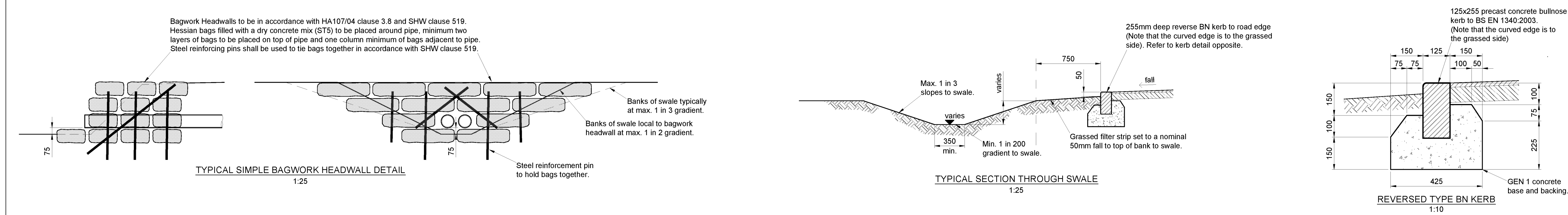
NOTE:
Type 'B' not to be used under carriageways and parking areas on clay sites indicated on sections. It is to be substituted by DOT Type 2.



Nominal Diameter of Sewer (mm)	L(mm)
150 to 600	600
675 to 750	1000
over 750	1250

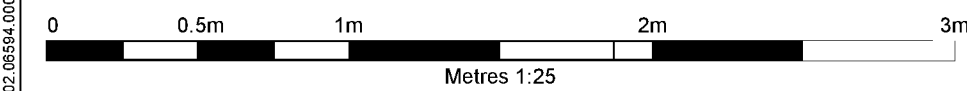


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|---|----|--|-----------------------|----------------|
| P0 | DH | SDE | JUL 20 | PLANNING ISSUE |
| Revision | By | Chk'd By | Date | Comments |
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|  | | <p>TREENWOOD HOUSE
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 F: 01225 309640</p> | | |
| global environmental solutions | | www.silconconsulting.co.uk | | |
| Site
LAND WEST OF YAPTON ROAD
MIDDLELETON-ON-SEA, BOGNOR REGIS | | | | |
| Project
SURFACE WATER DRAINAGE STRATEGY | | | | |
| Drawing Title:
<h2 style="text-align: center;">DRAINAGE DETAILS</h2> <h3 style="text-align: center;">SHEET 1 OF 2</h3> | | | | |
| Scale
1:25 @ A1 | | | Date
JULY 2020 | |
| Drawing Number
<h2 style="text-align: center;">402.06594.00008.07.002</h2> | | | Revision
P0 | |
| PLANNING | | | | |



- NOTES
1. Do not scale this drawing. If in doubt ask.
 2. This drawing to be read in conjunction with all relevant Specialists and Engineers drawings and specifications.
 3. Full Building Regulation approval should be obtained prior to the commencement of works on site, and any works carried out prior to this are undertaken at the Client's/ Contractor's own risk.
 4. The works are to be carried out to the approval and satisfaction of the Building Control Officer, to accepted good building practice and with full compliance and in accordance with all relevant British Standards and Codes of practice.
 5. All drainage to be kitemark certified and installed in accordance with the latest edition of 'Sewers for Adoption'.

402.06594.00008.07.Drainage_Details_MASTER_2020XX.dwg



APPENDIX 05 – MAINTENANCE PLAN

1.0 Introduction

1.1 Planning Condition

SLR Consulting Limited has been appointed by Frontier Limited ("the Applicant") to provide technical information on the future maintenance of surface water drainage associated with a residential development at Yapton Poultry Farm in Middleton-on-Sea, West Sussex, PO26 6DY ("the Site").

This report has been prepared in response to a condition to a planning application (Planning M/45/16/PL), in order to discharge planning conditions 11, 13 and 14 of the Planning Consent granted on 07/02/2017 to Arun District Council (ADC), which is the Local Planning Authority (LPA) and West Sussex County Council (WSCC) the Lead Local Flood Authority (LLFA) in this area.

1.2 Objective

Technical information provided in this report on behalf of the Applicant seeks to demonstrate that a robust and sustainable drainage strategy and maintenance plan has been prepared for the approved surface water drainage scheme for the Site, and that the requirements of Planning Condition 11, 13 and 14, pursuant to planning permission (Planning M/45/16/PL), have been satisfied.

1.3 Key Principles

The surface water drainage strategy for the development seeks to provide a sustainable and integrated surface water management scheme for the whole Site and aims to ensure no increase in downstream flood risk by managing discharges from the development to the local water environment in a controlled manner.

To comply with current guidance and best practice, the quantum and quality of surface water runoff discharged off-site from any proposed development at this Site will need to be controlled using Sustainable Drainage Systems (SuDS).

Further detailed requirements as specified in WSCC's SuDS Design Guidance have been specified for the disposal of surface water runoff, via a range of methods to attenuation storage providing a controlled discharge from the Site.

Details of the approved surface water drainage layout, and drainage details, have been presented in **Appendix 04** for clarity and completeness.

Typical examples of the surface water drainage and SuDS features integrated within the development have been set out below:

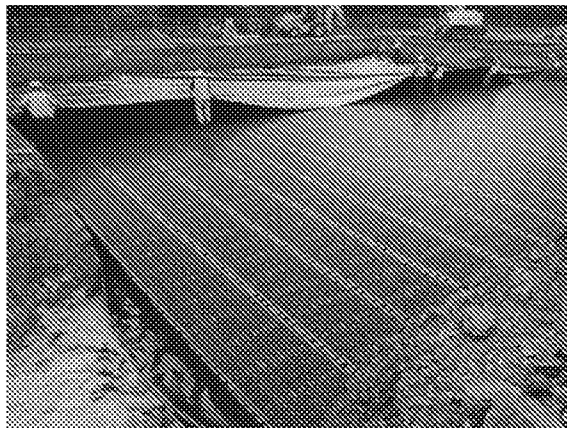


**Stone-Filled Filter Trench / French Drain (Cut-Off
 Drain integrated into landscape to intercept
 overland runoff)**

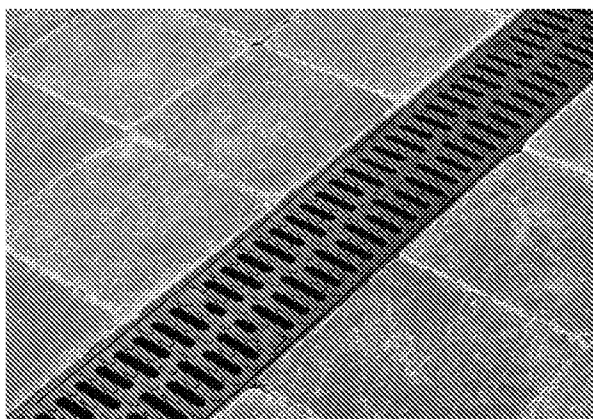


Road Gully

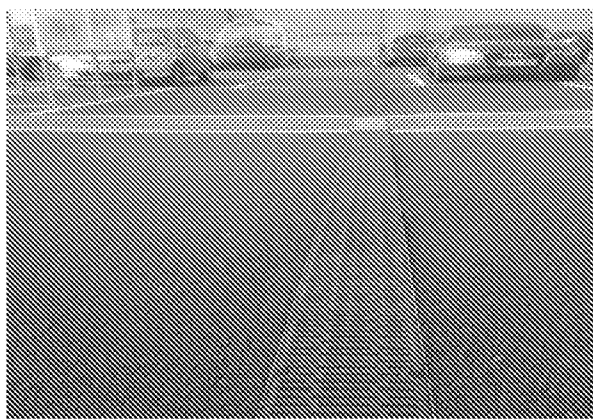
**Stone-Filled Filter Drain / Linear Soakaway
 integrated into hard landscape to intercept
 overland runoff**



**Geo-Cellular Storage Crates (Lined and under-
 drained on impermeable soils)**



Linear Drainage Channel *Aco) Medium Duty



Linear Drainage Channel *Aco) Heavy Duty

1.4 Best Practice

Current best practice guidance document; The SuDS Manual (CIRIA Report C753)¹, promotes sustainable water management through the use of SuDS. There are four main categories of SuDS which are referred to as the 'four pillars of SuDS' as shown in Figure 1-1.

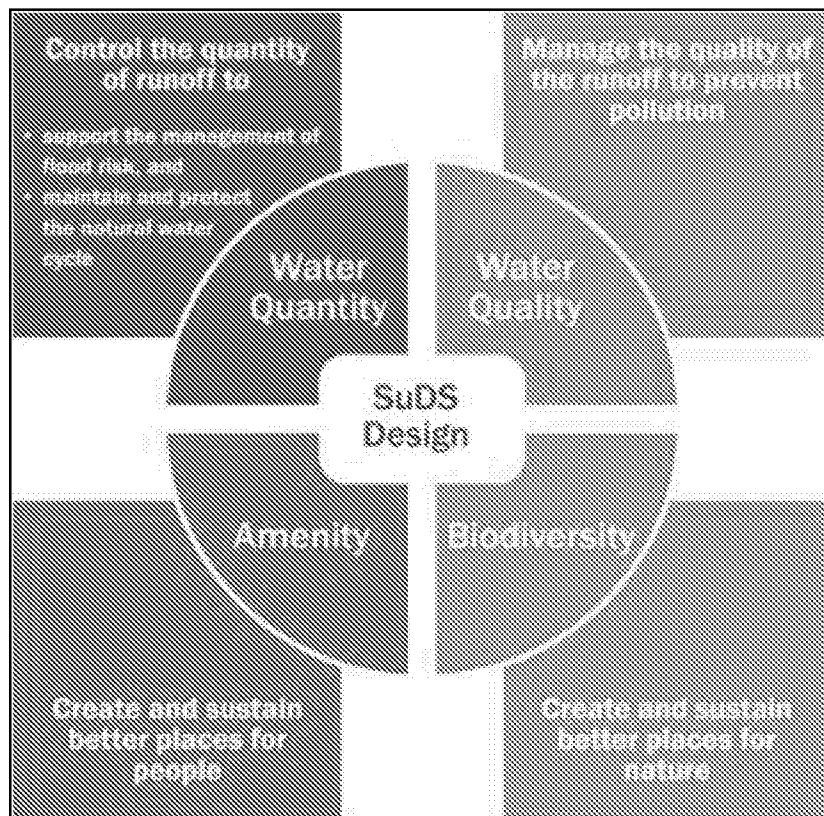
The SuDS Manual identifies a hierarchy of SuDS for managing runoff, which is commonly referred to as a 'management train':

- **Prevention** – the use of good site design and housekeeping measures on individual sites to prevent runoff and pollution (e.g. minimise areas of hard standing).
- **Source Control** – control of runoff at or very near its source (such as the use of rainwater harvesting).

1 ... CIRIA (2015). Report C753, The SuDS Manual

- ❖ **Site Control** – management of water from several sub-catchments (including routing water from roofs and car parks to one/several large soakaways for the whole site).
- ❖ **Regional Control** – management of runoff from several sites, typically in a retention pond or wetland.

Figure 1-1
 Four Pillars of SuDS (after CRIA Report C753)



It is generally accepted that the implementation of SuDS as opposed to conventional drainage systems, provides several benefits by:

- ❖ reducing peak flows to watercourses or sewers and potentially reducing the risk of flooding downstream;
- ❖ reducing the volumes and frequency of water flowing directly to watercourses or sewers from developed sites;
- ❖ improving water quality over conventional surface water sewers by removing pollutants from diffuse pollutant sources;
- ❖ reducing potable water demand through rainwater harvesting;
- ❖ improving amenity through the provision of public open spaces and wildlife habitat; and
- ❖ replicating natural drainage patterns, including the recharge of groundwater so that base flows are maintained.

2.0 Maintenance Plan

2.1 SuDS Maintenance Responsibilities

Client directly employed maintenance teams will manage and maintain the long-term integrity and function of the proposed surface water drainage SuDS facilities that will fall under private ownership.

2.2 Maintenance Access

The proposed development layout (for layout refer to **Appendix 04**) provides adequate maintenance access to all surface water drainage and SuDS features.

Gullies and linear drains are all located within the footprint of the on-site road network and parking bays. Maintenance access to these features will be readily available from the road network and parking bays for maintenance vehicles and maintenance operatives.

Maintenance access to the attenuation crate storage and swales will be readily available from the road network with parking bays for maintenance vehicles and maintenance operatives.

Filter drains will be located within private ownership with minimal maintenance required.

2.3 Maintenance Schedules

The following sub-sections provide recommended maintenance schedules and management plans for the various components of the sustainable surface water drainage system.

The anticipated lifetime of the SuDS facilities, their frequency of replacement, and methods for their replacement are largely dictated by the choice of installation, manufacturer, and the quality of the workmanship during construction. Where necessary, these maintenance and management schedules will be refined by the Applicant once the site is operational to suit the specific site conditions.

2.3.1 Swales and Headwalls

The anticipated maintenance and management plan for the swales and headwalls across the Site associated with the surface water drainage system is outlined in Table 2-1.

Table 2-1
 Typical Swale and Headwall Maintenance Plan

Maintenance Schedule	Required Action	Minimum Frequency
Regular Maintenance	Remove litter and debris	Monthly, or when required.
	Cut grass – to retain grass height within specified design range	Monthly, or when required.
	Manage other vegetation and remove nuisance plants	Monthly (during growing season), or when required.
Occasional Maintenance	Re-seed areas of poor vegetation growth, alter plant types to better suit conditions, if required	As required, or if bare soil is exposed over 10% or more of the swale treatment area.

Maintenance Schedule	Required Action	Minimum Frequency
Remedial Actions	Repair erosion or other damage by re-turfing or reseeded	As required.
	Re-level uneven surfaces and reinstate design levels	As required.
	Scarify and spike topsoil layer to improve infiltration performance, break up silt deposits and prevent compaction of the soil surface	As required.
	Remove build-up of sediment on upstream gravel trench, flow spreader or at top of filter strip	As required.
	Remove build-up of oils or petrol residues using safe standard practices.	As required.
Monitoring	Initial inspection.	Monthly for three months after installation.
	Inspect to ensure no excessive silt or debris enters the outfall drainage ditch downstream of the Site discharge, or carry out remedial action	Monthly.
	Inspect inlets, orifice plate outlets and overflows for blockages, and clear if required	Monthly.
	Inspect vegetation coverage and / or weed growth. If required, take remedial action.	Three-monthly. 48 hours after significant storms in the first 6 months.
	Inspect swales and ponds for silt accumulation, record areas where water is ponding for greater than 48 hours	Monthly, or when required.
	Inspect vegetation coverage	Monthly for 6 months, quarterly for 2 years, then half yearly.
	Inspect inlets and facility surface for silt accumulation, establish appropriate silt removal frequencies	Half yearly.
	Monitor inspection chambers.	Annually.
Replacement	With periodic rehabilitation of the SuDS features, the swales and headwalls are not expected to require full replacement more than once over the anticipated lifetime of the development.	➤ 25 years

2.3.2 Piped Systems (including Gullies and Linear Drainage Channels)

The anticipated maintenance and management plan for the traditional pipework, associated inspection chambers / catch pits, gullies and linear drainage channels across the Site associated with the surface water drainage system is outlined in Table 2-2.

Table 2-2
 Typical Piped Systems Maintenance Plan

Maintenance Schedule	Required Action	Minimum Frequency
Regular Maintenance	Ensuring drainage intakes are clear of debris / silt.	Monthly (or as required).
Occasional Maintenance	Clear gully pots using silt 'grabber' or suction (silt vac) unit.	Annually.
	Jet clean sewer lines, gully tails and linear drainage channels to remove grease, grit, sediment and other debris to ensure conveyance capacity is not compromised.	Every 5 years.
Intermittent Maintenance	CCTV survey of sewer lines to identify any defects/signs of performance degradation such as: ➤ Cracked/deteriorating pipes; ➤ Leaking joints/seals at manholes; ➤ High water lines showing regular high stage in pipes (sign of lack of capacity or downstream constraint); and ➤ Suspected infiltration or exfiltration.	Every 10 years.
Remedial Actions	Repair defects using suitable methods. Effective temporary repairs may be sufficient in short term until scheduled / capital improvements can be made.	As required.
Monitoring	Record areas of surface ponding / intake bypassing / surcharging (photos, inundated areas, depths) during extreme storm events and investigate the reasoning for this post-storm.	As required.
Replacement	With careful monitoring and timely maintenance and remedial actions, pipework is not expected to require full replacement over the anticipated lifetime of the development.	➤ 40 years
	With careful monitoring and timely maintenance and remedial actions, gullies and linear channel drains are not expected to require full replacement more than once over the anticipated lifetime of the development.	➤ 25 years

2.3.3 Filter Drains and Cut-off Drains

The anticipated maintenance and management plan for filter drains and cut-off drains across the Site associated with the surface water drainage system is outlined in Table 3-3.

Table 2-3
 Typical Filter Drain / Cut-Off Drain Maintenance Plan

Maintenance Schedule	Required Action	Minimum Frequency
Regular Inspections	Inspect inlets and outlets 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 as required.
	Inspect inlet and facility surface for silt accumulation, establish appropriate silt removal frequencies.	Annually.
Regular Maintenance	Remove litter (including leaf litter) and debris from trench surface, and access chambers.	Monthly, or as required.
	Manage other vegetation and remove nuisance plants.	Monthly at start, then as required.
	Remove sediment from access chambers and catch pits.	Every 2 years, or as required.
Remedial Actions	Re-level uneven surfaces and reinstate design levels.	As required.
	Remove build-up of sediment on trench surface.	As required.
	Remove and dispose of oils or petrol residues using safe standard practices.	As required.
	Remove or control tree roots where they are encroaching the sides of the trench	As required.
Replacement	With timely maintenance and remedial actions, trenches are not expected to require full replacement more than once over the anticipated lifetime of the development.	➤ 25 years

2.3.4 Geo-Cellular Crates

The proposed drainage scheme will utilise geo-cellular crates as a mechanism for treatment and attenuation of surface water runoff.

The anticipated maintenance and management for geo-cellular crates associated with the surface water drainage system is outlined in Table 3-4.

Table 2-4
 Typical Geo-Cellular Crates Maintenance Requirements

Maintenance Schedule	Required Action	Minimum Frequency
Regular Inspections	Inspect inlets and overflow pipework and identify any areas that are not operating correctly.	Monthly for 3 months, then annually.
	Inspect inlets and overflow pipework for silt accumulation and establish appropriate silt removal frequencies.	Six monthly.
	Remove sediment from pre-treatment devices.	Annually, or 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.
Remedial Actions	Remove or control tree roots where they are encroaching the sides of the crates, using recommended methods (e.g. NJUG, 2007 or BS 3998:2010).	As required.