cgs civils

Consulting Civil Engineers

SuDS and Drainage Report

Land east of Commonmead Barn, Pagham Road, Pagham, West Sussex PO21 3PY

Rev: **P4**

Ref: **C3552**

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[redacted]

1 Introduction

1.1.1 CGS Civils Ltd has been appointed to undertake a drainage strategy report for a proposed development at Land east of Commonmead Barn in Pagham, West Sussex.

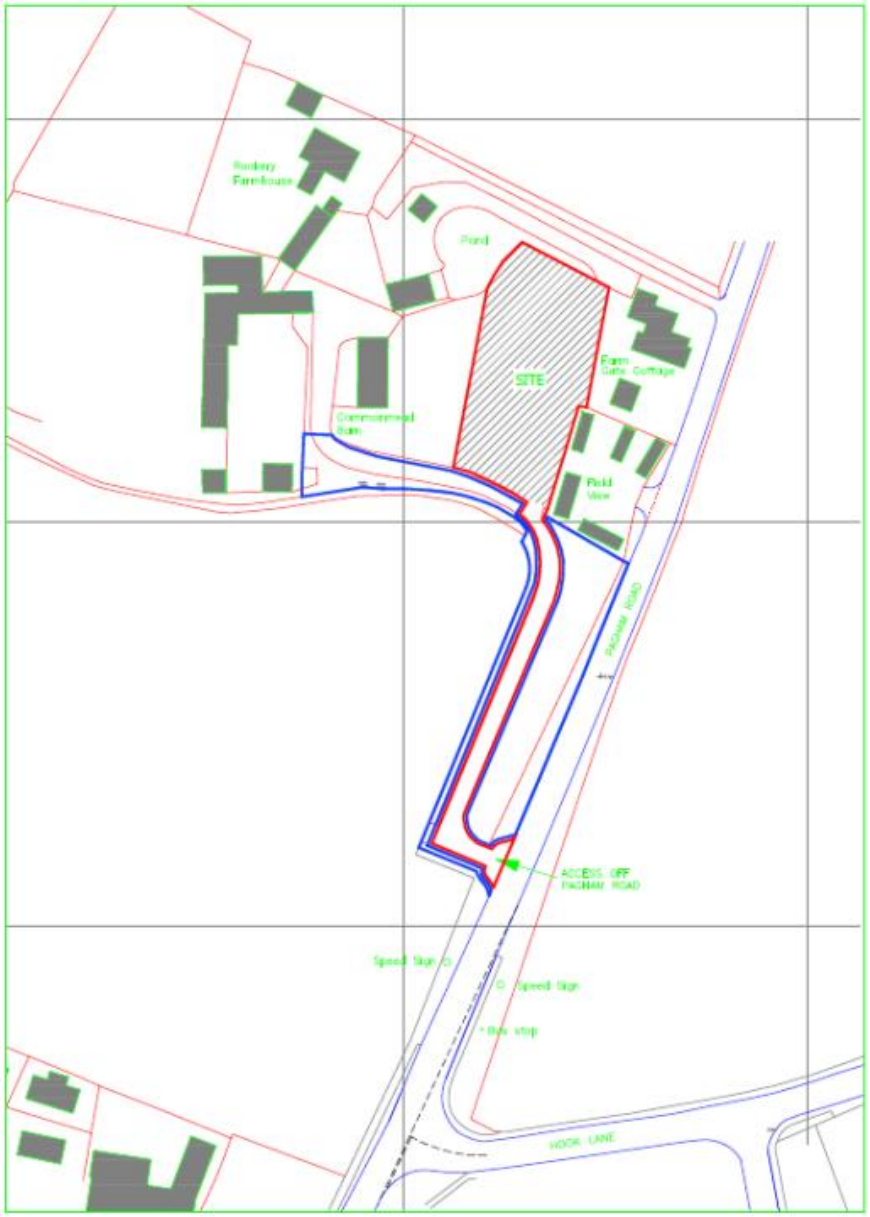
1.1.2 The proposed development will consist of the construction of 2 No. detached dwellings and associated parking. The proposed development is located as OS Grid Reference SZ 89332 99033 and has the post code PO21 3PY.

1.1.3 This report has been prepared in accordance with current National SuDS standards and all recommended guidance.

1.1.4 The purpose of this drainage strategy is to demonstrate how the development area can be satisfactorily drained without increasing flood risk onsite and elsewhere. In addition, the following report is intended to supply the relevant data:

- The results of an assessment into the potential for disposing of surface water by means of Sustainable Drainage System (SuDS).
- Details of a management and maintenance plan for the drainage scheme
- The appropriate design standard for the surface water drainage scheme must be the 1 in 100-year return period with a 45% allowance for climate change with an additional 10% urban creep.

Fig 1. Site Location



[redacted]

2 Executive Summary:

2.1.1 The proposed scheme consists of the construction of 2 No. detached dwellings and associated parking.

2.1.2 The underlying geology is noted to be comprised of Clay, silt and sand with groundwater being recorded at 1.02mbgl. Onsite infiltration testing recorded a fair rate of 5.04×10^{-6}m/s, however, it was deemed that infiltration is not viable due to high groundwater and site conditions observed.

2.1.3 The Surface Water will discharge to the existing culverted watercourse that runs across the site at a rate of 1.0l/s. Surface water runoff from the roof areas will be discharged at a restricted rate of 0.5l/s per plot. The network will utilise the tanked sub-base of permeable paving and a geocellular attenuation tank in order to cater or the 1 in 100-year +45% storm +10% urban creep.

2.1.4 The Foul water will be treated on site via a new package treatment plant prior to discharge to the existing culverted watercourse.

3 Site Geology

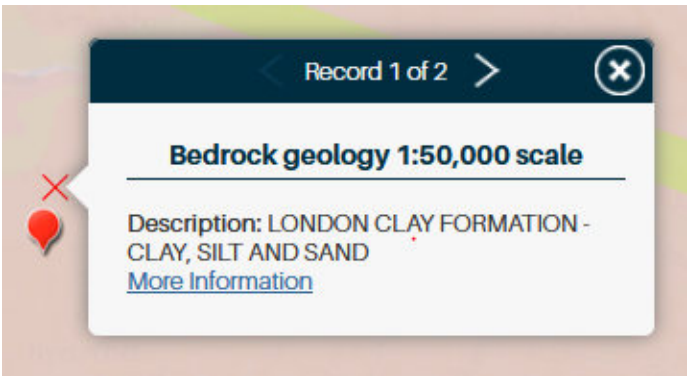
3.1 British Geological Survey information

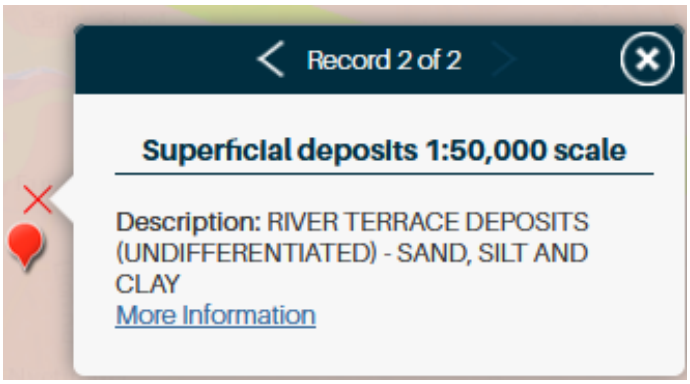
3.1.1 The British Geological Survey confirms the bedrock geology to be made up London Clay Formation. The BGS website confirms the superficial deposits on site to be made up of River Terrace Deposits. Both formations are comprised of Sand, Silt and Clay.

3.1.2 The British Geological survey also holds records of historical boreholes near the site which give some insight into the ground geology.

- Borehole SZ89NE4 (Located approx. 500m North of the site) – Gravel, Clay and Sand.

Fig 2. British Geological Survey





3.2 Geological Assessment

3.2.1 An infiltration test to BRE365 was conducted on site on the 25th and 27th June 2024, which recorded a worst-case infiltration rate of 5.04×10^{-6}m/s. This is deemed to be a fair rate and confirms that infiltration is viable on site. During the testing, the ground was noted to be thick clay, photographs can be found in **Fig 3.** A copy of the soakaway tests results can be found in **Appendix E.**

3.2.2 Ground water monitoring was carried out on site over the 2024/2025 winter period, with the monitoring commencing at the start of October and finishing at the end of March. The highest recorded groundwater level was recorded at 1.02mbgl which rules out the use of conventional soakaways due to the requirement of a 1m easement between the base of the soakaway and highest recorded groundwater level as set out by Arun DC. The groundwater monitoring results can be found in **Appendix E.**

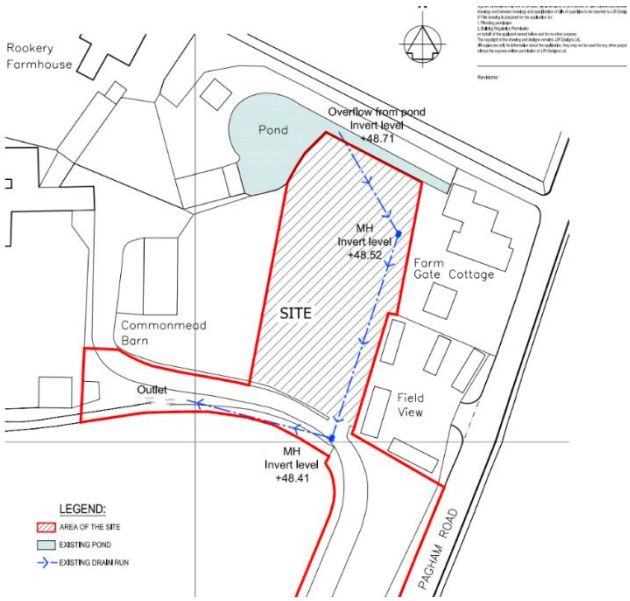
Fig 3. Soakaway test photographs

4 Existing Drainage

4.1.1 The site is currently an undeveloped space with no private drainage. It is noted that there is an existing 300mm culverted watercourse that runs across the site prior to discharging into a larger watercourse on the adjacent site of the site access to the south.

4.1.2 The existing culvert has a 3m easement which has been adhered to; the proposed dwellings are located outside the 3m easement in addition to the majority of drainage features.

Fig 4. Route and depth of existing culvert



5 Proposed Drainage Strategy

5.1 SuDS Hierarchy

5.1.1 All options for the destination of run-off generated on site have been assessed in line with the SuDS hierarchy as set out in Building Regulations Part H document and DEFRA's Draft National Standards for SuDS.

Table 1. SuDS Discharge Hierarchy

Discharge Destination	
Rainwater Harvesting	Yes – rainwater harvesting has been included within the scheme.
Discharge to Ground (infiltration)	On-site infiltration test resulted in a viable infiltration rate, however, due to high groundwater the use of conventional soakaways is ruled out. Infiltration can still be achieved within permeable paving and bio-retention planters which are proposed on site.
Discharge to Watercourse	Surface water runoff from the roof areas are to be discharged into the existing culverted watercourse at a restricted rate of 0.5 l/s per plot or 1.0l/s for the entire site.
Discharge to Surface Water Sewer	N/A due to above
Discharge to Other Sewer	N/A due to above

5.2 Proposed Hydraulic Calculation Specifications:

Table 2. SuDS Calculation Settings.

Hydraulic Calculations Settings – Bio-Retention unit:	
Rainfall Methodology	**FEH-22**
Volumetric Run-off Coefficient Cv	**1**
CV Winter and Summer	**1**
Additional Storage (m^3 / ha)	**0.0**
Maximum Rainfall (mm/hr)	**75**
Flow Control 1	**0.825m Head @ 0.5 l/s discharge**
Flow Control 2	**0.825m Head @ 0.5l/s discharge**
Attenuation tank	Base Coefficient (m/hr): **0.00000**
	Side Coefficient (m/hr): **0.00000**
	Factor of Safety: **2**
	Porosity: **30%**
	Time to Half Empty (mins): **176 + 280**
Permeable Paving	Base Coefficient (m/hr): **0.00000**
	Side Coefficient (m/hr): **0.00000**
	Factor of Safety: **2**
	Porosity: **30%**
	Time to Half Empty (mins): **424**

[redacted]

5.3 Surface Water Drainage

5.3.1 Although onsite testing by others indicated a favourable infiltration rate, conventional soakaways are not feasible due to the recorded groundwater level. Surface water was also observed during the site walkover confirming that infiltration drainage would not be suitable for storm water disposal. The highest groundwater level of 1.02mbgl means that the required 1m distance between the soakaway base and groundwater level, as specified in the latest National Standards for SuDS, cannot be maintained.

5.3.2 The surface water runoff is to be captured and discharged into an existing culverted watercourse which runs across the site from north to south. The runoff from roof and hard paved areas are to be captured into a positive drainage network prior to discharging into the culvert at a restricted rate o 0.5 l/s per plot or 1.0l/s for the entire site. The hard paved areas are to be utilised as a storage feature by wrapping the sub-base in an impermeable geomembrane which will allow it to act as a blanket attenuation tank. The network will also utilise geocellular attenuation tanks as additional storage in order to cater for the 1 in 100-year +45% storm + 10% urban creep.

5.3.3 Each plot will have a rainwater harvesting tank installed which will allow the reuse of rainwater within the gardens and external areas of each property. The plots will also be fitted with bio-retention planters where possible to provide interception, water quality and bio-diversity benefits.

5.3.4 A few parking spaces are to be constructed from a 'no-dig' surface that will be utilised to protect the root protection areas that are present. This 'no-dig' surface will be permeable to allow runoff to freely drain to ground via infiltration which will mimic the existing site whilst also providing betterment through the engineered construction and storage beneath the surface course.

5.3.5 The existing culvert is a 300mm pipe which discharges to the south into an existing watercourse which then flows to the west. The existing culvert and watercourse are within the client's ownership. In order to obtain the necessary permissions for the discharge, an Ordinary Watercourse Consent application is to be undertaken with West Sussex County Council.

Fig 5. Existing manhole/Culvert and existing watercourse.

5.3.6 Greenfield Runoff and Hydraulic calculations have been carried out which can be found at Appendix C. It should be noted that a 10% urban creep has been applied to the roof areas only. This has been included within the hydraulic calculations as additional area which is highlighted within the impermeable areas plan in **Appendix B.**

5.3.7 Due to the chambers that will be present within the tanked access road, the total storage volume will be reduced by 0.3m³. This has been reflected within the calculations in Appendix C by reducing the storage area of the sub-base.

Table 3. Greenfield Runoff Calculations

Greenfield Runoff Calculations			
Storm period	**Greenfield runoff rate (l/s)**	**Proposed Discharge Rate (l/s)**	**Difference (l/s)**
Q_{BAR}	0.1	1	+ 0.9
2	0.1	1	+ 0.9
10	0.19	1	+ 0.81
30	0.26	1	+ 0.74
100	0.37	1	+ 0.63

5.4 Water Quality

5.4.1 A key requirement of any SuDS system is that it protects the receiving water body from the risk of pollution.

5.4.2 Frequent and short duration rainfall events are those that are most loaded with potential contaminants (silts, fines, heavy metals, and various organic and inorganic contaminants) Therefore the first 5-10mm of rainfall should be adequately treated with SuDS.

5.4.3 The new SuDS Manual (Ciria C753, November 2015) introduces slightly different approach compared to the previous version for the water quality management of surface water. The Manual describes risks posed by the surface water runoff to the receiving environment as a function of:

- The pollution hazard at a particular site (i.e., the pollution source)
- The effectiveness of SuDS treatment components in reducing levels of pollutants to environmentally acceptable levels
- The sensitivity of the receiving environment

5.4.4 The recommended approaches for water quality risk management are given in the SuDS Manual Table 26.1.

Table 26.1 from SuDS manual. Approaches to Water Quality Risk Management

Table 26.1 Approaches to Water Quality Risk Management			
Design method	**Hazard Characterisation**	**Risk Reduction**	
		For Surface Water	**For Groundwater**
Simple Index Approach	Simple pollution hazard indices based on land use (Table 26.2)	Simple SuDS hazard mitigation indices (Table 26.3)	Simple SuDS hazard mitigation indices (Table 26.4)
Risk Screening	Factors characterising traffic density and extent of infiltration likely to occur (Table 26.5)	N/A	Factors characterising unsaturated soil depth and type, and predominant flow type through the soils (Table 26.5)
Detailed Risk Assessment	Site specific information used to define likely pollutants and their significance	More detailed, component specific performance information used to demonstrate that the proposed SuDS components reduce the hazard to acceptable levels	
Process-based treatment modelling	Time series rainfall used with generic pollution characteristics to determine statistical distributions of likely concentrations and loadings in the runoff	Models that represent the treatment processes in the proposed SuDS components give estimates of reductions in even mean discharge concentrations and total annual load reductions delivered by the system	

5.4.5 As per Table 26.1 Simple Index approach will be used as a design method for this site.

5.4.6 Table 26.2 will provide hazard classification of different land uses. The land uses for the surface water drainage for this site are.

- Residential Roofs
- Individual Property driveways and residential car parks

5.4.7 To deliver adequate treatment, the selected SuDS components should have a total pollution mitigation index for each contaminant type that equals or exceeds the pollution hazard index for each contaminant type. Therefore, the following must be achieved for the surface running off the site.

Total SuDS mitigation index >=pollution hazard index

5.4.8 Pollution Hazard Indices are given for different land uses in Table 26.2 of the SuDS manual;

Table 26.2 from SuDS manual. Pollution Hazard Indices for Different Land Use Classifications

Table 26.2 Pollution hazard indices for different land use classifications				
Land Use	**Pollution Hazard Level**	**Total Suspended solids (TSS)**	**Metals**	**Hydro-Carbons**
Residential roofs	Very Low	0.2	0.2	0.05
Other roofs (Typically commercial/industrial roofs)	Low	0.3	0.2 (up to 0.8 where there is potential for metals to leach from the roof)	0.05
Individual property driveways, residential car parks, low traffic roads (e.g., cul-de-sacs, homezones and general access roads) and non-residential car parking with infrequent change (e.g., schools, offices) i.e., < 300 traffic movements/day	Low	0.5	0.4	0.4
Commercial yard and delivery areas, non-residential car parking with frequent change (e.g., hospitals, retail), all roads except low traffic roads and trunk roads/motorways	Medium	0.7	0.6	0.7
Sites with heavy pollution (e.g., haulage yards, lorry parks, highly frequented lorry approaches to industrial estates, waste sites), sites where chemicals and fuels (other than domestic fuel oil) are to be delivered, handled, stored, used or manufactured; industrial sites; trunk roads and motorways	High	0.8	0.8	0.9

5.4.9 From Table 26.2 the following information is tabulated in Table 1

Table 3: **Pollution hazard index and destination of runoff for the proposed site**

Table 3: Pollution Hazard Index and Destination of runoff for the proposed Site					
Land Use	**Destination of Runoff**	**Pollution Hazard Level**	**Total Suspended Solids**	**Metals**	**Hydrocarbons**
Residential Roof	Surface Water	Very Low	0.2	0.2	0.05
Individual driveways, residential car parks and low traffic roads	Surface water	Low	0.5	0.4	0.4

5.4.10 The SuDS mitigation index will be obtained from Table 26.4 (for groundwater) of the SuDS manual.

[redacted]

Table 26.4 from SuDS manual. Indicative SuDS Mitigation Indices for discharges to ground waters.

5.4.11 SuDS mitigation index are tabulated in Table 5 as followed.

Table 26.5 Indicative SuDS mitigation indices for discharges to surface waters			
	Mitigation Indices		
Type of SuDS Components	**TSS**	**Metals**	**Hydrocarbons**
Filter Strip	0.4	0.4	0.5
Filter Drain	0.4	0.4	0.4
Swale	0.5	0.6	0.6
Bioretention System	0.8	0.8	0.8
Permeable Pavement	0.7	0.6	0.7
Detention Basin	0.5	0.5	0.6
Pond	0.7	0.7	0.5
Wetland	0.8	0.8	0.8
Proprietary treatment systems	These must demonstrate that they can address each of the contaminant types to acceptable levels for inflow concentrations relevant to the contributing drainage area		

Table 4: SuDS mitigation index

Table 4 Mitigation Indices						
Runoff Source	**Destination of Runoff**	**Mitigation Index Source**	**Type of SuDS Component**	**Total Suspended Solids (TSS)**	**Metals**	**Hydrocarbons**
Residential Roof	Surface Water	Table 26.5	Bioretention system	0.8	0.8	0.8
Individual driveways, residential car parks and low traffic roads	Surface water	Table 26.5	Permeable paving	0.7	0.6	0.7

5.4.12 The above analysis demonstrates that the SuDS devices within the design will mitigate any pollution present within the surface water system.

5.5 Foul water drainage

5.5.1 The foul water will be treated on site via a new package treatment plant; all treated effluent runoff will be discharged into the existing watercourse.

5.5.2 The proposed foul water discharge does not require Environment Agency approval as it adheres to the general binding rules for small discharge to surface water. This is because the proposed discharge:

- Is less than 5m³ a day
- Utilises a sufficient treatment system
- Is not causing pollution
- Is not within 500 meters of a protected site
- Is not within 50m of any other exempt discharge

[redacted]

6 Summary and Conclusions

6.1.1 CGS Civils has been instructed to produce a Drainage statement under National Planning Policy Framework (NPPF) to support the Planning Application for the construction of 2 No. dwellings.

6.1.2 The Surface Water will discharge to the existing culverted watercourse that runs across the site at a rate of 1.0l/s. Surface water runoff from the roof areas will be discharged at a restricted rate of 0.5l/s per plot. The network will utilise the tanked sub-base of permeable paving and a geocellular attenuation tank in order to cater or the 1 in 100-year +45% storm +10% urban creep.

6.1.3 The Foul water will be treated on site via a new package treatment plant prior to discharge to the existing culverted watercourse.

6.1.4 The report has demonstrated that the proposed drainage measures ensure that suitable means of surface and foul water drainage can be achieved for the proposed development.

6.1.5 A maintenance schedule has been written up for the drainage network including the SuDS features and can be found within **Appendix F.**

[redacted]

7 Appendices

7.1 Appendix A – Site Plan

JJR DESIGNS Limited

Figured dimensions only are to be used. All dimensions to be checked on site. Differences between drawings and between drawings and specification or bills of quantities to be reported to JJR Designs Ltd
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Revisions:

1:200

4m 0 4m 8m

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Client:
MR H. PHILLIPS

Project:
LAND EAST OF COMMONMEAD BARN
PAGHAM ROAD PO21 3PY

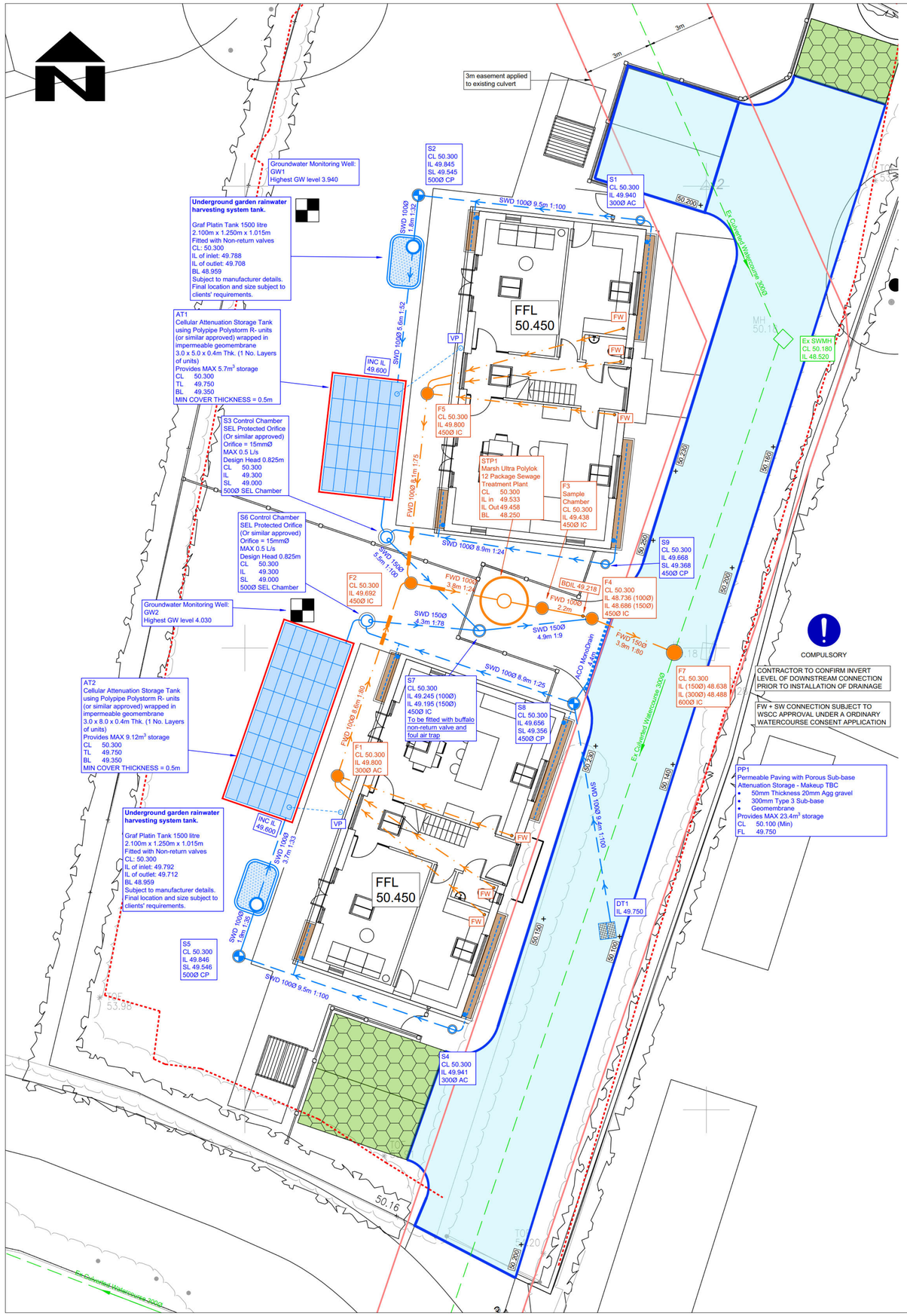
Drawing Title:
PROPOSED SITE PLAN

Issue status:

Outline proposals ☐	Production Information ☐	Scheme design ☐
Tender drawing ☐	Detail design ☐	Contract drawing ☐

Scale:	Drawn:	Checked:	Date:
1:200 @A3			20.08.2025
Job No: 1683		Drawing No: PL 103	Revision:

7.2 Appendix B – Drainage Layout



EXISTING FEATURES

- Ex SWD — Existing Culverted Watercourse
- Culvert 3m Easement

PROPOSED FEATURES

- FWD — Foul Drainage
- SWD — Surface Water Drainage
- Pipe crossing (thickening denotes pipe above)
- CD — Channel drain
- Rainwater pipe
- Storm water access chamber (300Ø)
- Storm water inspection chamber (450Ø)
- Storm water catchpit chamber (450Ø)
- Extent of tanked permeable paving with attenuated sub-base
- DT — Permavoid diffuser units
- 'NO DIG' Construction
- Storm water orifice flow control chamber (500Ø)
- Foul water access chamber (300Ø)
- Foul water inspection chamber (450/600Ø)
- FW — Soil stack (type TBC by architect/m&e engineer)
- 00.000 — Finished floor level
- 100Ø 4.5m 1:100 Z BED — Pipe info - diameter, length, gradient, bedding type

ABBREVIATIONS

MH	- MANHOLE
IC	- INSPECTION CHAMBER
AC	- ACCESS CHAMBER
CP	- CATCHPIT
BC	- BRAKE CHAMBER
RE	- RODDING EYE
IL	- INVERT LEVEL
SL	- SUMP LEVEL
RA	- RESTRICTED ACCESS COVER
CL	- COVER LEVEL
TL	- TOP OF CELLULAR SA
BL	- BASE OF CELLULAR SA
FL	- FORMATION LEVEL

- Root Protection Area
- Groundwater monitoring well location
- 18.250 — Existing surface level
- Bioretention Planter
- BDIL 49.218 — Backdrops

STANDARD DRAINAGE NOTES

1. DO NOT SCALE FROM THIS DRAWING, REFER TO FIGURED DIMENSIONS ONLY. THE CONTRACTOR SHOULD CHECK ALL DIMENSIONS ON SITE.
2. ALL DIMENSIONS IN MILLIMETRES AND ALL LEVELS ARE IN METERS UNLESS NOTED OTHERWISE.
3. THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT ARCHITECT AND ENGINEERING DETAILS, DRAWINGS AND SPECIFICATIONS.
4. ANY DISCREPANCIES SHOULD BE REPORTED TO THE ARCHITECT AND/OR ENGINEER IMMEDIATELY, SO THAT CLARIFICATION CAN BE SOUGHT PRIOR TO THE COMMENCEMENT OF WORK.
5. BEFORE COMMENCING CONSTRUCTION THE CONTRACTOR MUST CHECK THE INVERT LEVELS OF EXISTING SEWERS TO WHICH CONNECTIONS ARE MADE. IN ADDITION THE CONTRACTOR MUST LOCATE AND DETERMINE INVERT LEVELS OF THE EXISTING SPURS TO WHICH CONNECTIONS ARE PROPOSED. ANY DISCREPANCIES ARE TO BE NOTIFIED TO THE ENGINEER IMMEDIATELY, PRIOR TO CONSTRUCTION.
6. ALL DRAINAGE WORKS SHOULD COMMENCE AT THE PROPOSED DOWNSTREAM CONNECTION POINT, THE WORKS CONTINUING UPSTREAM FOLLOWING CONFIRMATION OF THE TIE-IN INVERT LEVELS TO THE ENGINEER. CONNECTIONS TO MANHOLES OR LARGER SIZED PIPES ETC. SHOULD BE SOFFIT TO SOFFIT UNLESS OTHERWISE INSTRUCTED BY THE ENGINEER, IF THIS IS NOT POSSIBLE INFORM THE ENGINEER IMMEDIATELY.
7. COVER LEVELS SHOWN ARE APPROXIMATE. COVERS AND FRAMES SHALL BE SET TO FINISHED GROUND LEVELS AND FALLS.
8. ALL UN-REFERENCED PIPES ARE TO BE 100mm DIA
9. ALL PIPES TO BE ADOPTED, OR CONNECTING TO ADOPTED SEWERS, TO BE VITRIFIED CLAY TO BS EN 295 AND BS65 (SWS ONLY), OR CONCRETE PIPES TO BE EN 1916 AND BS5911:PART 1.
10. ROAD GULLY OUTLET PIPES ARE TO BE 150mm DIA. WITH CONCRETE SURROUND AND FLEXIBLE JOINTS. ALL GULLIES SHALL BE FITTED WITH GRADE D400 GRATINGS AND FRAMES TO BS EN124, UNLESS OTHERWISE STATED.
11. ALL ADOPTABLE SEWERS SHALL BE CONSTRUCTED TO THE STANDARDS AND SPECIFICATION LAID DOWN DOWN IN 'SEWERS FOR ADOPTION' 6th EDITION, WITH A VIEW TO ADOPTION UPON COMPLETION OF WORKS.
12. ALL PRIVATE DRAINAGE TO BE IN ACCORDANCE WITH THE BUILDING REGULATIONS APPROVED DOCUMENT PART-H, AND TO THE SATISFACTION OF THE BUILDING CONTROL INSPECTOR.
13. THE CONTRACTOR IS TO KEEP A RECORD OF ANY VARIATIONS MADE ON SITE, INCLUDING THE RELOCATION OF SEWERS OR DRAINS, SO THAT AN AS CONSTRUCTED DRAWING CAN BE PREPARED UPON COMPLETION OF THE PROJECT.
14. STUB CONNECTIONS TO ADOPTABLE MANHOLES SHALL BE MADE FROM VITRIFIED CLAY AND CONSIST OF TWO ROCKER PIPES LAID AT THE SAME GRADIENT AS THE UP OR DOWNSTREAM PIPE.
15. IF ANY SUB SOIL DRAINAGE SYSTEMS ARE UNCOVERED DURING THE WORKS CONTACT THE ENGINEER FOR INSTRUCTIONS. SUB SOIL DRAINS ARE TO BE DIVERTED AROUND NEW WORKS AND CONNECTED INTO THE SURFACE WATER.
16. NO PRIVATE AREAS ARE TO DRAIN ONTO ADOPTABLE AREAS AND VICE VERSA.
17. ALL EXISTING MANHOLE COVER'S, GULLIES, ETC, ARE TO BE RAISED/LOWERED TO SUIT NEW LEVELS.
18. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO CONFIRM THE LOCATION AND DEPTH OF ALL EXISTING SERVICES AND UTILITIES THAT MAY BE PRESENT
19. UPON COMPLETION BUT PRIOR TO HANDOVER, CONTRACTOR TO CARRY OUT FULL CCTV SURVEY OF DRAINAGE SYSTEM WHICH IS TO BE REVIEWED BY ENGINEER TO ENSURE SATISFACTORY INSTALLATION
20. PROPRIETARY PRODUCTS TO BE INSTALLED IN FULL ACCORDANCE WITH MANUFACTURER'S GUIDANCE.
21. MANHOLE AND CHAMBER COVER GRADES:
    - 'A15' IN ALL LANDSCAPED AREAS AND ON FOOTPATHS
    - 'B125' IN ALL DRIVEWAYS
    - 'C250' IN PRIVATE PARKING AREAS
    - 'D400' IN CARRIAGEWAY/ACCESS ROAD

Prefixed to drawing numbers shall signify the following:-

PL = PLANNING	Shall not be used for contract or construction purposes
P = PRELIMINARY	Shall not be used for contract or construction purposes
T = TENDER	Shall not be used for construction purposes
C = CONSTRUCTION	These are the only drawings that shall be used for construction purposes
R = RECORD	Record of actual completed work

REV	DATE	DESCRIPTION	BY	CHK	APP
4	04.03.26	REVISED TO REMOVE INFILTRATION AND REDUCE DISCHARGE RATE CHANGES	LH	CS	CS
P3	03.12.25	REVISED TO INCLUDE RWHT	LH	CS	CS
P2	07.10.25	REVISED TO SUIT PAVING AS STORAGE	LH	CS	CS
P1	10.09.25	REVISED TO NEW SITEPLAN	LH	CS	CS
P-	15.05.25	PRELIMINARY ISSUE	LH	CS	CS

DESIGN SUBJECT TO THE APPROVAL OF:
PLANNING AUTHORITY
BUILDING CONTROL

DESIGN SUBJECT TO THE CONFIRMATION OF:
EXTERNAL LEVELS DESIGN
ORDINARY WATERCOURSE APPROVAL

Site Specific Notes

1. The proposed scheme consists of the construction of 2 No. dwelling with associated parking and access.
2. The British Geological survey website confirms the geology on site to be made up of London Clay formation and River terrace deposits, which are comprised of Sand, Silt and Clay.
3. An infiltration test to BRE365 was undertaken on site by UNDA which recorded a worst case infiltration rate of $5.04x10^{-6}$m/s which is deemed a fair rate; however, groundwater was recorded at a depth of 1.02mbgl which rules out the use of conventional soakaways due to Arun DC policies restricting the use of soakaways if there is groundwater within 1m of the base of the soakaway.
4. It is therefore proposed that all surface water runoff is discharged into the existing culverted watercourse which runs across the site at a restricted rate of 1.0l/s. The surface water networks will make use of geocellular attenuation tanks in order to cater for the 1 in 100-year +45% storm + 10% urban creep.
5. It is proposed that the access road and parking areas are to be constructed from a tanked permeable surface which will act as blanket attenuation. Diffuer units are to be fitted to allow runoff to discharge into the remainder of the surface water network.
6. All storage volumes and flow controls are designed to the critical 1 in 100 year storm event plus an allowance of 45% for the predicted effects of climate change + 10% Urban creep.
7. The foul water is to be treated via a new package treatment plant and all treated effluent runoff is to discharge into the culverted watercourse.

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Consulting Civil Engineers

CLIENT: HOWARD PHILLIPS

ARCHITECT: JJR DESIGNS LTD

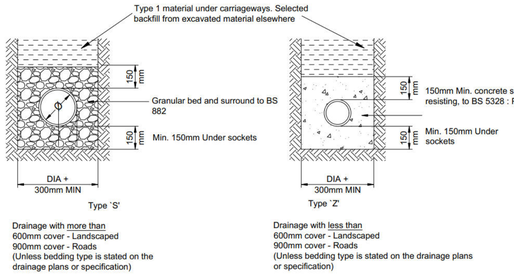
JOB TITLE: LAND EAST OF COMMONMEAD BARN PAGHAM

DRAWING TITLE: DRAINAGE LAYOUT

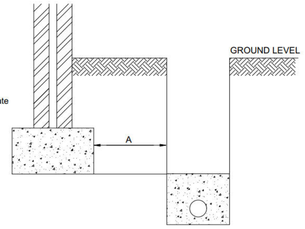
DRAWN	ENGINEER	CHECKED	APPROVED
LH	C SLADE	CS	CS

DATE	SCALE @ A1
MAY 2025	1:100

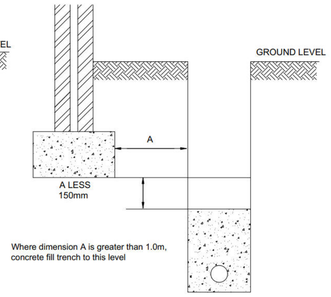
JOB No.	STATUS	DRAWING No.	REV.
C3552	P	101	4



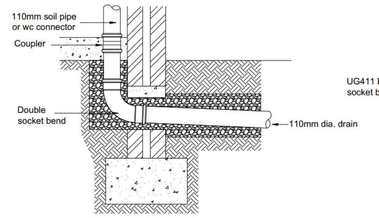
Pipe bedding details in private Areas



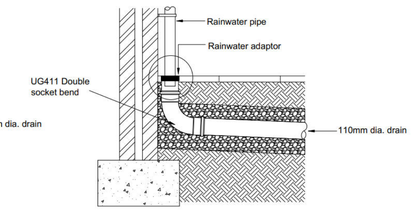
Pipes near buildings



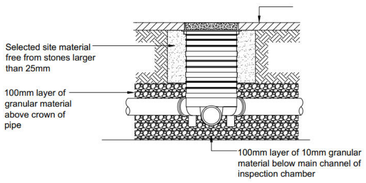
Pipes near buildings



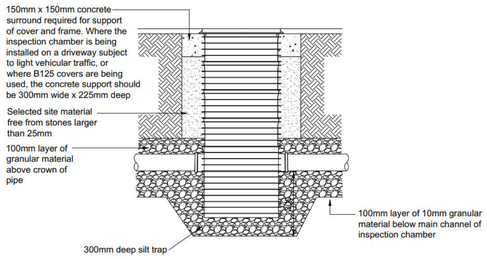
Soil pipe / wc connection



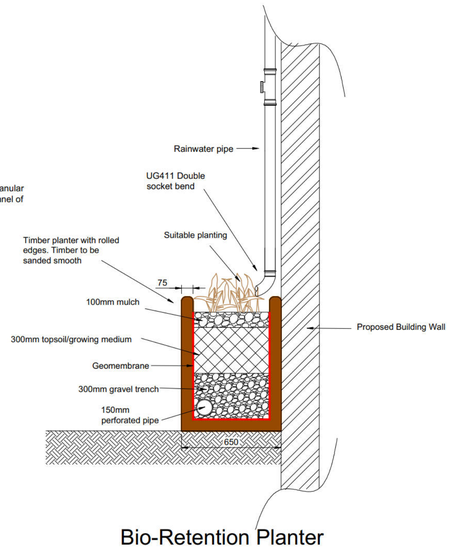
Rainwater pipe connection



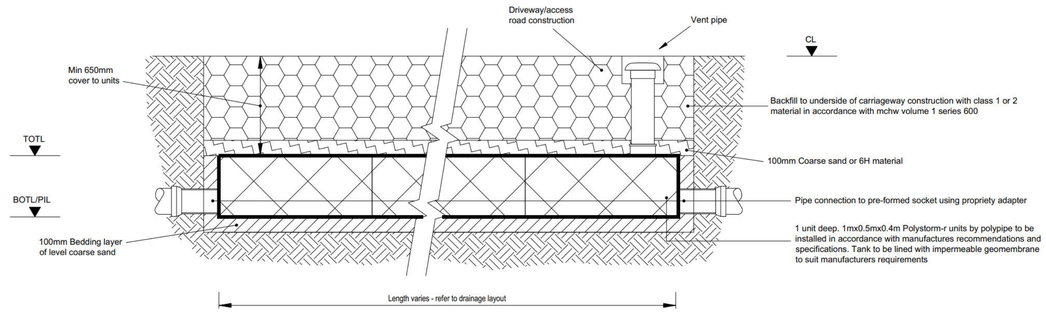
300mmØ SHALLOW INSPECTION CHAMBER DETAIL



460mmØ POLYPIPE BASIC SILT TRAP DETAIL



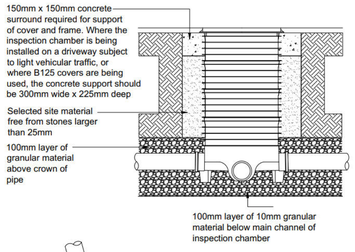
Bio-Retention Planter

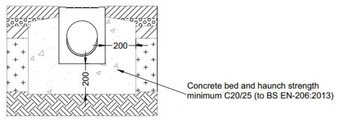


Attenuation tank using polystorm-r geomodular units trafficked areas

0.4m thick

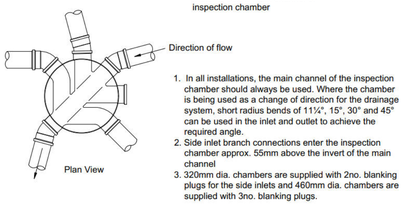
All storage tank drainage works shall be carried out in accordance with the specifications, method statements and recommendations of Polypipe



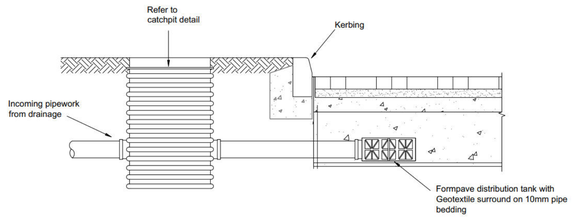


Aco Monodrain Construction Detail in Block Paving

(To be read in conjunction with Aco installation specification)

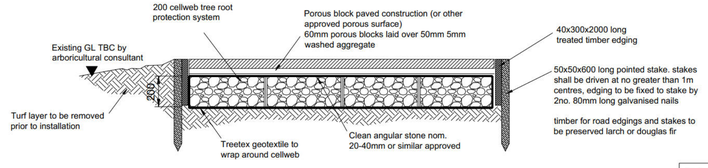


460mmØ INSPECTION CHAMBER DETAIL



Formpave Diffuser tank construction

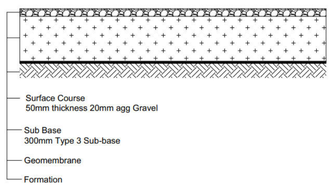
Single Unit: 0.354x0.708x0.150m DP



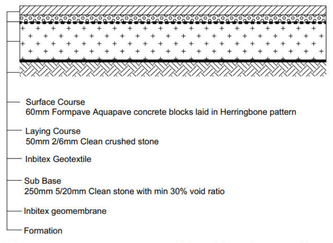
Typical 'no dig' access road construction

subject to detailed design by geosynthetics ltd

to be installed in accordance with geosynthetic ltds sinstallation guide and specification

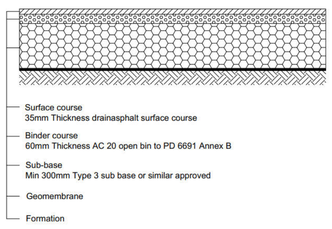


Infiltrating Gravel Car Parking area construction



Formpave permeable block paving private driveway construction

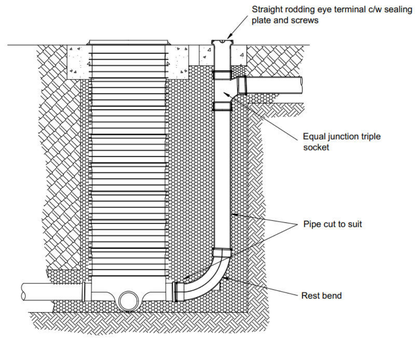
To be read in accordance with Formpave details and specification



Permeable asphalt construction

To be read in accordance with Aggregate Industries details and specification

PERMEABLE PAVED CONSTRUCTION
TBC BY CLIENT
1:20



Backdrop connection to PPIC with vertical rodding point

Prefixed to drawing numbers shall signify the following:-

PL = PLANNING	Shall not be used for contract or construction purposes
P = PRELIMINARY	Shall not be used for contract or construction purposes
T = TENDER	Shall not be used for construction purposes
C = CONSTRUCTION	These are the only drawings that shall be used for construction purposes
R = RECORD	Record of actual completed work

REV	DATE	DESCRIPTION	BY	CHK	APP
p1	04.03.26	REVISED TO SUIT DRAINAGE LAYOUT	LH	CS	CS
P-	15.05.25	PRELIMINARY ISSUE	LH	CS	CS

cgs civils
Consulting Civil Engineers

CLIENT: HOWARD PHILLIPS

ARCHITECT: JJR DESIGNS LTD

JOB TITLE: LAND EAST OF COMMONMEAD BARN PAGHAM

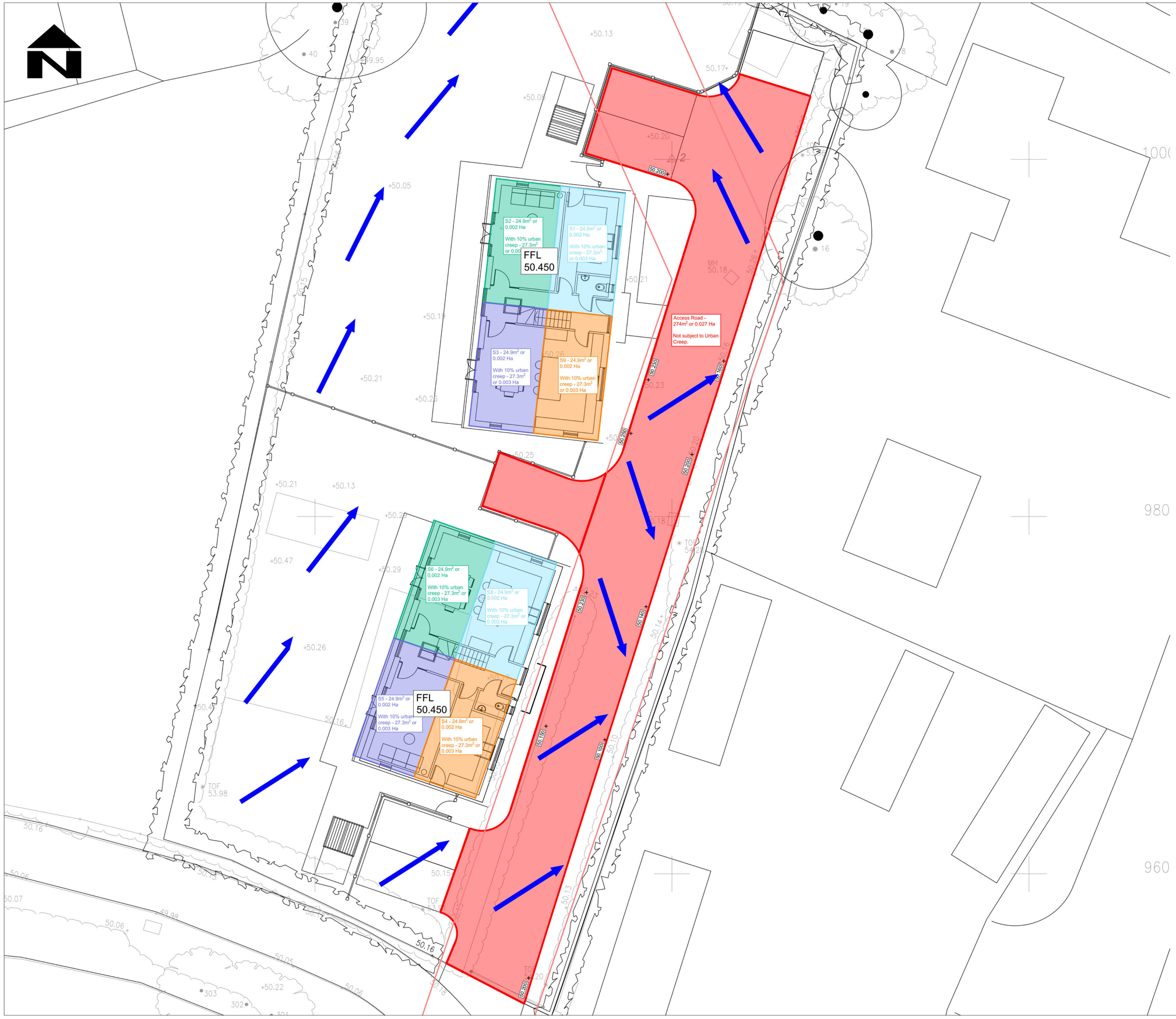
DRAWING TITLE: CONSTRUCTION DETAILS

DRAWN	ENGINEER	CHECKED	APPROVED
LH	C SLADE	CS	CS

DATE	SCALE @ A1
MAY 2025	1:20

JOB No.	STATUS	DRAWING No.	REV.
C3552	P	301	P1

FOR PLANNING ONLY



FOR PLANNING ONLY

Prefixed to drawing numbers shall signify the following:-

PL = PLANNING	**Shall not be used for contract or construction purposes**
P = PRELIMINARY	**Shall not be used for contract or construction purposes**
T = TENDER	**Shall not be used for construction purposes**
C = CONSTRUCTION	These are the only drawings that shall be used for construction purposes
R = RECORD	Record of actual completed work

REV	DATE	DESCRIPTION	BY	CHK	APP
P2	04.03.26	REVISED TO SUIT DRAINAGE LAYOUT	LH	CS	CS
P1	10.09.25	REVISED TO SUIT NEW SITEPLAN	LH	CS	CS
P-	15.05.25	PRELIMINARY ISSUE	LH	CS	CS

cgs civils
Consulting Civil Engineers

CLIENT
HOWARD PHILLIPS

ARCHITECT
JJR DESIGNS LTD

JOB TITLE
LAND EAST OF COMMONMEAD BARN
PAGHAM

DRAWING TITLE
IMPERMEABLE AREAS
& OVERLAND FLOW ROUTE PLAN

DRAWN	ENGINEER	CHECKED	APPROVED
LH	C SLADE	CS	CS

DATE	SCALE @ A1
MAY 2025	1:100

JOB No.	STATUS	DRAWING No.	REV.
C3552	P	401	P2

7.3 Appendix C – Surface Water Calculations

Design Settings

Rainfall Methodology	FEH-22	Minimum Velocity (m/s)	1.00
Return Period (years)	2	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	0.200
CV	1.000	Preferred Cover Depth (m)	0.350
Time of Entry (mins)	2.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	✓
Maximum Rainfall (mm/hr)	75.0		

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)	Invert Level (m)
S3	0.009	2.00	50.300	500	986.208	984.874	1.000	49.300
S9	0.003	2.00	50.300	450	995.621	983.628	0.632	49.668
S7			50.300	450	990.163	980.746	1.105	49.195
S6	0.009	2.00	50.300	500	985.291	981.182	1.000	49.300
S8	0.003	2.00	50.300	450	993.829	977.741	0.644	49.656
OUTFALL	0.000		50.300	450	995.043	981.273	1.154	49.146
DT1	0.027	2.00	50.100	100	995.495	968.089	0.350	49.750

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	S3	S7	5.717	0.600	49.300	49.195	0.105	54.4	150	2.18	57.0
1.001	S9	S3	9.495	0.600	49.668	49.350	0.318	29.9	100	2.11	57.0
2.003	S6	S7	4.891	0.600	49.300	49.195	0.105	46.6	150	2.38	57.0
3.000	S8	S6	9.205	0.600	49.656	49.350	0.306	30.1	100	2.33	57.0
1.003	S7	OUTFALL	4.908	0.600	49.195	49.146	0.049	100.2	150	2.46	57.0
3.001	DT1	S8	9.795	0.600	49.750	49.656	0.094	104.2	100	2.22	57.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	1.366	24.1	2.5	0.850	0.955	0.012	0.0	33	0.884
1.001	1.417	11.1	0.6	0.532	0.850	0.003	0.0	16	0.755
2.003	1.478	26.1	8.0	0.850	0.955	0.039	0.0	57	1.304
3.000	1.412	11.1	6.2	0.544	0.850	0.030	0.0	54	1.451
1.003	1.004	17.7	10.5	0.955	1.004	0.051	0.0	83	1.044
3.001	0.753	5.9	5.6	0.250	0.544	0.027	0.0	77	0.855

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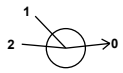
Pipeline Schedule

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	5.717	54.4	150	Circular	50.300	49.300	0.850	50.300	49.195	0.955
1.001	9.495	29.9	100	Circular	50.300	49.668	0.532	50.300	49.350	0.850
2.003	4.891	46.6	150	Circular	50.300	49.300	0.850	50.300	49.195	0.955
3.000	9.205	30.1	100	Circular	50.300	49.656	0.544	50.300	49.350	0.850
1.003	4.908	100.2	150	Circular	50.300	49.195	0.955	50.300	49.146	1.004
3.001	9.795	104.2	100	Circular	50.100	49.750	0.250	50.300	49.656	0.544

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	S3	500	Manhole	Adoptable	S7	450	Manhole	Adoptable
1.001	S9	450	Manhole	Adoptable	S3	500	Manhole	Adoptable
2.003	S6	500	Manhole	Adoptable	S7	450	Manhole	Adoptable
3.000	S8	450	Manhole	Adoptable	S6	500	Manhole	Adoptable
1.003	S7	450	Manhole	Adoptable	OUTFALL	450	Manhole	Adoptable
3.001	DT1	100	Manhole	Adoptable	S8	450	Manhole	Adoptable

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections		Link	IL (m)	Dia (mm)
S3	986.208	984.874	50.300	1.000	500		1	1.001	49.350	100
							0	1.000	49.300	150
S9	995.621	983.628	50.300	0.632	450		0	1.001	49.668	100
S7	990.163	980.746	50.300	1.105	450		1	1.000	49.195	150
							2	2.003	49.195	150
							0	1.003	49.195	150
S6	985.291	981.182	50.300	1.000	500		1	3.000	49.350	100
							0	2.003	49.300	150
S8	993.829	977.741	50.300	0.644	450		1	3.001	49.656	100
							0	3.000	49.656	100
OUTFALL	995.043	981.273	50.300	1.154	450		1	1.003	49.146	150

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Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
DT1	995.495	968.089	50.100	0.350	100	0			
						0	3.001	49.750	100

Simulation Settings

Rainfall Methodology	FEH-22	Analysis Speed	Normal	Starting Level (m)	
Rainfall Events	Singular	Skip Steady State	x	Check Discharge Rate(s)	x
Summer CV	1.000	Drain Down Time (mins)	1440	Check Discharge Volume	x
Winter CV	1.000	Additional Storage (m³/ha)	0.0		

Storm Durations

15	30	60	120	180	240	360	480	600	720	960	1440

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	0	0	0
10	0	0	0
30	45	0	0
100	45	0	0

Node S3 Online Orifice Control

Flap Valve	x	Design Depth (m)	0.825	Discharge Coefficient	0.650
Replaces Downstream Link	x	Design Flow (l/s)	0.5		
Invert Level (m)	49.300	Diameter (m)	0.015		

Node S6 Online Orifice Control

Flap Valve	x	Design Depth (m)	0.825	Discharge Coefficient	0.650
Replaces Downstream Link	x	Design Flow (l/s)	0.5		
Invert Level (m)	49.300	Diameter (m)	0.015		

Node DT1 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	49.750	Slope (1:X)	153.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	424	Depth (m)	0.300
Safety Factor	2.0	Width (m)	26.000	Inf Depth (m)	
Porosity	0.30	Length (m)	10.000		

Node S3 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	49.350
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	15.0	15.0	0.400	15.0	20.5	0.401	0.0	20.5

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Node S6 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	49.350
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	280

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	24.0	24.0	0.400	24.0	30.9	0.401	0.0	30.9

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Results for 2 year Critical Storm Duration. Lowest mass balance: 99.09%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
120 minute winter	S3	92	49.436	0.136	0.8	1.2585	0.0000	OK
15 minute summer	S9	9	49.686	0.018	0.8	0.0029	0.0000	OK
240 minute winter	S7	184	49.212	0.017	0.5	0.0027	0.0000	OK
360 minute winter	S6	296	49.620	0.320	1.2	6.2277	0.0000	SURCHARGED
15 minute summer	S8	10	49.690	0.034	2.8	0.0055	0.0000	OK
15 minute summer	OUTFALL	1	49.890	0.744	0.3	0.0000	0.0000	OK
30 minute summer	DT1	19	49.797	0.047	5.5	1.3000	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)
120 minute winter	S3	1.000	S7	0.2	0.246	0.008	0.0044	
15 minute summer	S9	1.001	S3	0.8	0.763	0.072	0.0214	
240 minute winter	S7	1.003	OUTFALL	0.5	0.423	0.026	0.0053	11.9
360 minute winter	S6	2.003	S7	0.3	0.396	0.011	0.0041	
15 minute summer	S8	3.000	S6	2.8	1.120	0.252	0.0418	
30 minute summer	DT1	3.001	S8	2.4	0.815	0.400	0.0288	

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Results for 10 year Critical Storm Duration. Lowest mass balance: 99.58%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
120 minute winter	S3	112	49.530	0.230	1.3	2.6119	0.0000	SURCHARGED
15 minute summer	S9	9	49.693	0.025	1.5	0.0040	0.0000	OK
120 minute winter	S7	114	49.214	0.019	0.6	0.0031	0.0000	OK
240 minute winter	S6	228	49.803	0.503	2.5	9.2415	0.0000	SURCHARGED
240 minute winter	S8	228	49.804	0.148	1.9	0.0235	0.0000	SURCHARGED
15 minute summer	OUTFALL	1	49.890	0.744	0.4	0.0000	0.0000	OK
30 minute summer	DT1	20	49.816	0.066	10.6	2.5932	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)
120 minute winter	S3	1.000	S7	0.2	0.265	0.010	0.0053	
15 minute summer	S9	1.001	S3	1.5	0.703	0.135	0.0399	
120 minute winter	S7	1.003	OUTFALL	0.6	0.457	0.033	0.0064	16.3
240 minute winter	S6	2.003	S7	0.4	0.417	0.014	0.0049	
240 minute winter	S8	3.000	S6	1.9	0.598	0.175	0.0720	
30 minute summer	DT1	3.001	S8	4.2	0.938	0.705	0.0439	

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Results for 30 year +45% CC Critical Storm Duration. Lowest mass balance: 99.89%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
180 minute summer	S3	148	49.717	0.417	2.8	5.3162	0.0000	SURCHARGED
180 minute summer	S9	148	49.717	0.049	0.7	0.0078	0.0000	OK
240 minute winter	S7	228	49.216	0.021	0.7	0.0034	0.0000	OK
240 minute winter	S6	236	49.953	0.653	4.2	9.2707	0.0000	SURCHARGED
240 minute winter	S8	236	49.953	0.297	3.3	0.0472	0.0000	SURCHARGED
15 minute summer	OUTFALL	1	49.890	0.744	0.6	0.0000	0.0000	OK
240 minute winter	DT1	236	49.953	0.203	4.3	13.2694	0.0000	FLOOD RISK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
180 minute summer	S3	1.000	S7	0.3	0.302	0.013	0.0063	
180 minute summer	S9	1.001	S3	0.7	0.437	0.062	0.0552	
240 minute winter	S7	1.003	OUTFALL	0.7	0.485	0.041	0.0074	35.9
240 minute winter	S6	2.003	S7	0.4	0.449	0.016	0.0056	
240 minute winter	S8	3.000	S6	3.1	0.720	0.282	0.0720	
240 minute winter	DT1	3.001	S8	2.9	0.809	0.495	0.0766	

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Results for 100 year +45% CC Critical Storm Duration. Lowest mass balance: 99.81%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
240 minute summer	S3	168	50.171	0.871	2.7	5.8850	0.0000	FLOOD RISK
240 minute summer	S9	168	50.171	0.503	0.7	0.0800	0.0000	FLOOD RISK
240 minute summer	S7	172	49.219	0.024	0.9	0.0038	0.0000	OK
360 minute winter	S6	352	50.042	0.742	3.1	9.2883	0.0000	FLOOD RISK
360 minute winter	S8	352	50.042	0.386	2.5	0.0614	0.0000	FLOOD RISK
15 minute summer	OUTFALL	1	49.890	0.744	0.6	0.0000	0.0000	OK
360 minute winter	DT1	352	50.043	0.293	3.8	20.2455	0.0000	FLOOD RISK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
240 minute summer	S3	1.000	S7	0.5	0.361	0.020	0.0076	
240 minute summer	S9	1.001	S3	0.7	0.437	0.063	0.0743	
240 minute summer	S7	1.003	OUTFALL	0.9	0.514	0.050	0.0085	43.3
360 minute winter	S6	2.003	S7	0.4	0.456	0.017	0.0062	
360 minute winter	S8	3.000	S6	2.3	0.699	0.210	0.0720	
360 minute winter	DT1	3.001	S8	2.2	0.745	0.365	0.0766	

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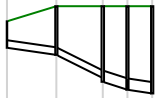
Node Name		DT1	S8	S6	S7	OUTFALL
A4 drawing Hor Scale 1500 Ver Scale 100 Datum (m) 44.000						
Link Name		3.00	3.00	2.(	1.(	
Section Type		100r	100r	15	15	
Slope (1:X)		104.	30.1	46	10	
Cover Level (m)		50.100	50.300	50.300	50.300	50.300
Invert Level (m)		49.750 49.656	49.656 49.350	49.305 49.300	49.146 49.195	
Length (m)		9.79	9.20	4.8	4.9	

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Node Name	S9	S3	S7
A4 drawing Hor Scale 1500 Ver Scale 100 Datum (m) 44.000			
Link Name	1.00	1.0	
Section Type	100r	15	
Slope (1:X)	29.9	54	
Cover Level (m)	50.300	50.300	50.300
Invert Level (m)	49.668 49.350	49.306 49.300	
Length (m)	9.49	5.7	

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Greenfield runoff rate estimation tool

hr wallingford www.uksuds.com | Greenfield runoff rate estimation tool (https://www.uksuds.com/)

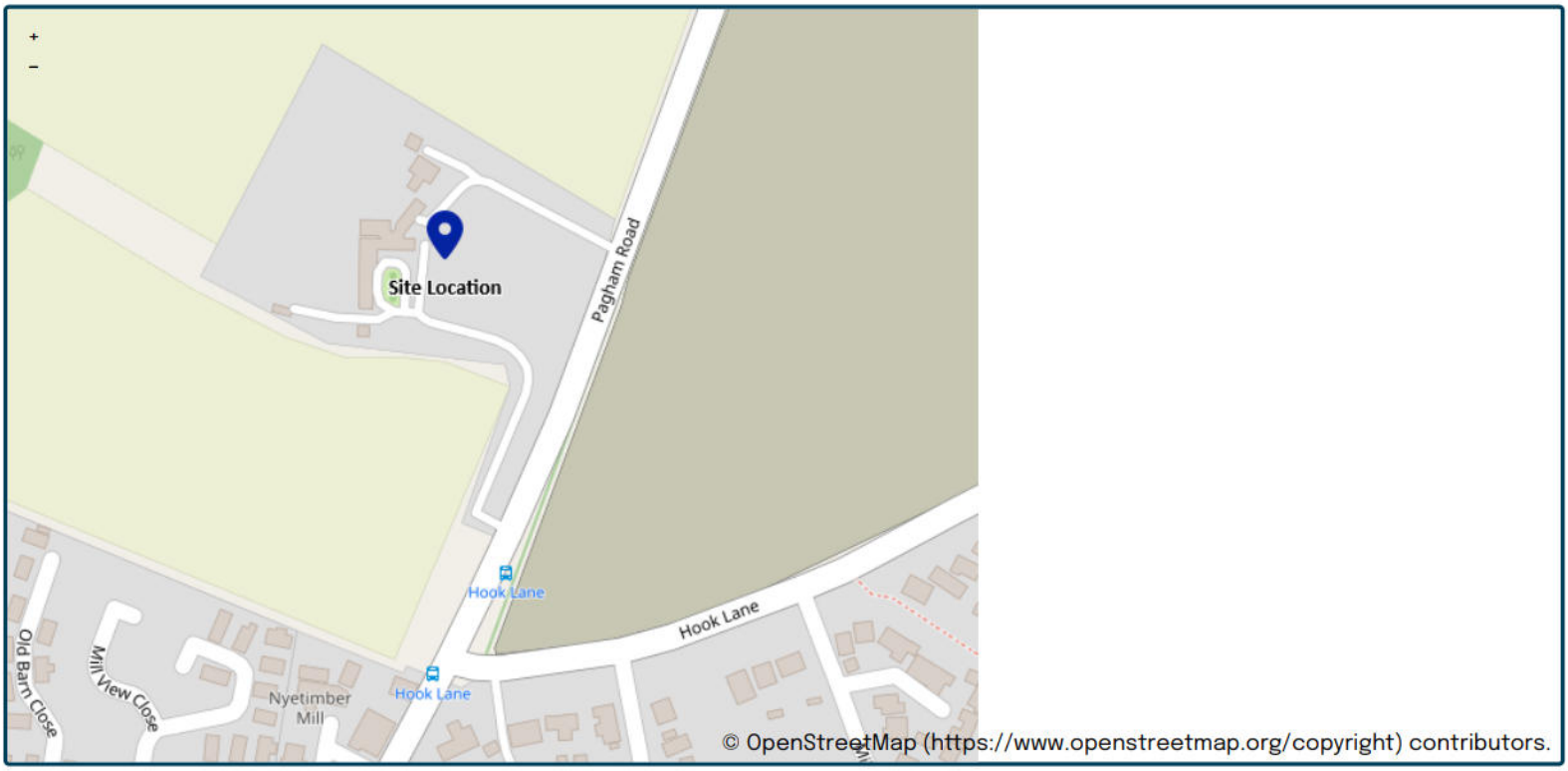
This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013), the SuDS Manual C753 (CIRIA, 2015) and the non-statutory standards for SuDS (Defra, 2015).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

Project details

Date	06/05/2025
Calculated by	LH
Reference	C3552
Model version	2.0.0

Location

Site name	Land east of commonmead Barn
Site location	Pagham



Site easting	489293
Site northing	99035

Site details

Total site area (ha)	0.04 ha

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Greenfield runoff

Method

Method	IH124

IH124

	My value		Map value
SAAR (mm)	700	mm	700
How should SPR be derived?	WRAP soil type		
WRAP soil type	3		3
SPR	0.37		
QBar (IH124) (l/s)	0.11	l/s	

Growth curve factors

	My value	Map value
Hydrological region	7	7
1 year growth factor	0.85	
2 year growth factor	0.88	
10 year growth factor	1.62	
30 year growth factor	2.3	
100 year growth factor	3.19	
200 year growth factor	3.74	

Results

Method	IH124	
Flow rate 1 year (l/s)	0.098	l/s
Flow rate 2 year (l/s)	0.1	l/s
Flow rate 10 years (l/s)	0.19	l/s
Flow rate 30 years (l/s)	0.26	l/s
Flow rate 100 years (l/s)	0.37	l/s
Flow rate 200 years (l/s)	0.43	l/s

Disclaimer

This report was produced using the Greenfield runoff rate estimation tool (2.0.0) developed by HR Wallingford and available at uksuds.com (https://www.uksuds.com/). The use of this tool is subject to the UK SuDS terms and conditions and licence agreement, which can both be found at uksuds.com/terms-conditions (https://www.uksuds.com/terms-conditions). The outputs from this tool have been used to estimate Greenfield runoff rates. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, Centre for Ecology and Hydrology, Wallingford Hydrosolutions or any other organisation for the use of these data in the design or operational characteristics of any drainage scheme.

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MORE INFO

7.4 Appendix D – Borehole Logs

British Geological Survey
BGS ID: 456072 : BGS Reference: SZ89NE4
British National Grid (27700) : 489470,99520

SZ 89 NE 14

332/19

PAGHAM.

SZ 8947 9962 73 NE

Seftr School

From samples communicated by Duke & Ockenden, who sunk the well.

W.S.Sx.I. p. 72.

332/19. Pagham, Seftr School. See W.S. Sx.I. p.72. We should be glad of any details, ? deepening of shaft.

From Duke & Ockenden 23/7/41 - No water, hole abandoned.

		Thickness (Feet)	Depth
Drift 18 ft.	Loamy gravel	8	8
	Shrave	10	18
London Clay 157 ft.	Hard blue clay, more or less sandy	6	24
	Buff and brown sand	8	32
	Buff sand	14	46
	Blue clay and shells	11	57
	Brownish and blue clay	11	68
	Blue clay, not sandy	23	91
	Blue clay, more sandy	9	100
	Blue clay, with pyrites and fragments of large oyster	9	109
	Blue and brownish clay	34	143
	Blue and brownish clay, more sandy	13	156
	Blue and brownish clay, still more sandy	11	167
	Black sandy loam	5	172
	Brown sandy loam	3	175 53
Reading Beds 104 ft.	Mottled red and brown clay and sand	7	182 -48 35 -83
	Grey loam	7	189
	Blackish loam	3	192
	Mottled clays	87	279
Upper Chalk	Chalk and flints (no water)	188	467

Shaft

Unable to locate [illegible]

This school is near Pagham village, well south the lady [illegible] the house adjoining [illegible] the well has been filled in. Now on [illegible]

Heavy charges of explosives were exploded in the well, to increase the yield of water, but without result, and the well has been abandoned.

Sited on 6" Sussex 73 NE/W OD 5 ft. Still in use Visited P. Buchan 19.2.41. Chalk -261

Information from F.W. Ockenden records, at Barnington, May 1941: 6/1890 School Committee. Depth 467 ft. RCH

977 / 16 / 261

Contact BGS: ngdc@bgs.ac.uk

British Geological Survey
BGS ID: 456072 : BGS Reference: SZ89NE4
British National Grid (27700) : 489470,99520

SZ89/2

332/19

PAGHAM.

73 NE

Seftr School

From samples communicated by Duke & Ockenden, who sunk the well.

W.S.Sx. I, p. 72.

332/19. Pagham, Seftr School. See W.S. Sx.I. p.72. We should be glad of any details, ? deepening of shaft.

From Duke & Ockenden 23/9/01

- No water hole abandoned.

		Thickness (Feet)	Depth
Drift 18 ft.	Loamy gravel	8	8
	Shrave	10	18
	Hard blue clay, more or less sandy	6	24
	Buff and brown sand	8	32
	Buff sand	14	46
	Blue clay and shells	11	57
	Brownish and blue clay	11	68
	Blue clay, not sandy	23	91
	Blue clay, more soapy	9	100
London Clay 157 ft.	Blue clay, with pyrites and fragments of large oyster	9	109
	Blue and brownish clay	34	143
	Blue and brownish clay, more sandy	13	156
	Blue and brownish clay, still more sandy	11	167
	Black sandy loam	5	172
	Brown sandy loam	3	175
Reading Beds 104 ft.	Mottled red and brown clay and sand	7	182
	Grey loam	7	189
	Blackish loam	3	192
	Mottled clays	87	279
Upper Chalk	Chalk and flints (no water)	188	467

Unable to locate shaft. This school is now Pagham Village Hall and the lady living in the house adjoining says the well has been filled in now on mains water.

Visited LMB 22-10-57

Heavy charges of dynamite were exploded in this well, to increase the yield of water, but without result, and the well has been abandoned.

Sited on 6" Sussex 73 NE/W OD IF. Still in use Visited P. Buchan 19.2.41. Chalk

Information from F.W. Ockenden records, at Basingstoke, May 1941: 6/1890 School Committee. Depth 467 ft.

Contact BGS: ngdc@bgs.ac.uk

British Geological Survey
BGS ID: 456072 : BGS Reference: SZ89NE4
British National Grid (27700) : 489470,99520

332/19 The Village Hall, Pagham (formerly Sefter School). (Filled in)

W.S.Sx. I, p. 72. Surface +18. Shaft. Ck -261. Shots fired. Yield small.
Dando, June 1890.

SZ89/2

Drift	Loamy gravel	8	8
18	Shrave	10	18
	Hard blue clay, more or less sandy	6	24
	Buff and brown sand ...	8	32
	Buff sand	14	46
	Blue clay and shells ...	11	57
	Brownish and blue clay ...	11	68
	Blue clay, not sandy ...	23	91
LC	Blue clay, more soapy ...	9	100
157	Blue clay, with pyrites and fragments of large oyster	9	109
	Blue and brownish clay ...	34	143
	Blue and brownish clay, more sandy	13	156
	Blue and brownish clay, still more sandy	11	167
	Black sandy loam ...	5	172
	Brown sandy loam ...	3	175
	Mottled red and brown clay and sand	7	182
RB	Grey loam	7	189
104	Blackish loam ...	3	192
	Mottled clays ...	87	279
UCk	Chalk and flints (no water)	188	467
188			

SZ 8947 9952.

Contact BGS: ngdc@bgs.ac.uk

7.5 Appendix E – Groundwater monitoring and infiltration test results

Groundwater Monitoring

Hole ID	Instrument ID	Instrument Type	Recorded Base of Instrument (mBGL)	Reading			
				Date	Water Level (mBGL)	Water level (mOD)	Ground Level m(OD)
GW1	1	SP	2m	03.10.24	1.940	3.11	5.05
				09.10.24	1.92	3.13	5.05
				17.10.24	1.895	3.155	5.05
				25.10.24	1.885	3.17	5.05
				08.11.24	1.800	3.25	5.05
				22.11.24	1.770	3.28	5.05
				13.12.24	1.735	3.32	5.05
				27.12.24	1.420	3.63	5.05
				03.01.25	1.200	3.85	5.05
				17.01.25	1.720	3.33	5.05
				31.01.25	1.480	3.57	5.05
				06.02.25	1.400	3.65	5.05
				22.02.25	1.330	3.72	5.05
				26.02.25	1.110	3.94	5.05
				02.03.25	1.290	3.76	5.05
				10.03.25	1.44	3.61	5.05
				18.03.25	1.520	3.53	5.05
				28.03.25	1.470	3.58	5.05
GW2	2	SP	2m	03.10.24	1.905	3.145	5.05
				09.10.24	1.89	3.16	5.05
				17.10.24	1.855	3.195	5.05
				25.10.24	1.825	3.23	5.05
				08.11.24	1.715	3.34	5.05
				22.11.24	1.660	3.39	5.05
				13.12.24	1.630	3.42	5.05
				27.12.24	1.380	3.67	5.05
				03.01.25	1.075	3.98	5.05
				17.01.25	1.520	3.53	5.05
				31.01.25	1.440	3.61	5.05
				06.02.25	1.250	3.80	5.05
				22.02.25	1.250	3.80	5.05
				26.02.25	1.020	4.03	5.05
				02.03.25	1.220	3.83	5.05
				10.03.25	1.40	3.65	5.05
				18.03.25	1.400	3.65	5.05
				28.03.25	1.470	3.58	5.05

The soil infiltration rate (f) is calculated by dividing the volume of water lost between 75% and 25% of the initial test depth by the sum of the average surface area of the sides of the trial pit in contact with the water during the test monitoring period (time taken for the water level to fall between 75% and 25% of the initial test depth), and its base area. This figure is then divided by the test duration to give the soil infiltration rate in metres per second. Each pit should be filled and allowed to drain three times to near empty on the same or consecutive days.

Trail Pit 1							
V(p75-25)		Length	Width	Total Depth	75% depth	25% depth	50%depth
length*width*(75%depth-25%depth)		0.3	1	0.4	0.3	0.1	0.2
0.06							
a(p50)							
(length*(50% total depth)*2)+(width*(50% total depth)*2)+(area base)							
0.82							
t(p75-25)							
Cycle 1 =	61						
Cycle 2 =	161						
Cycle 3 =	242						
f=V(p75-25)/(ap50*tp75-25)							
1.9992E-05	Test 1	m/s					
7.57461E-06	Test 2	m/s					
5.03931E-06	Test 3	m/s					

The soil infiltration rate (f) is calculated by dividing the volume of water lost between 75% and 25% of the initial test depth by the sum of the average surface area of the sides of the trial pit in contact with the water during the test monitoring period (time taken for the water level to fall between 75% and 25% of the initial test depth), and its base area. This figure is then divided by the test duration to give the soil infiltration rate in metres per second. Each pit should be filled and allowed to drain three times to near empty on the same or consecutive days.

Trail Pit 2							
V(p75-25)		Length	Width	Total Depth	75% depth	25% depth	50%depth
length*width*(75%depth-25%depth)		0.3	1	0.6	0.45	0.15	0.3
0.09							
a(p50)							
(length*(50% total depth)*2)+(width*(50% total depth)*2)+(area base)							
1.08							
t(p75-25)							
Cycle 1 =	128						
Cycle 2 =	252						
Cycle 3 =	200						
f=V(p75-25)/(ap50*tp75-25)							
1.08507E-05	Test 1	m/s					
5.51146E-06	Test 2	m/s					
6.94444E-06	Test 3	m/s					

7.6 Appendix F – Maintenance Schedule

Consulting Civil Engineers

SuDS Maintenance Schedule

Land East of Commonmead Barn, Pagham

Rev – **2**

Reference **C3552**

Date **4th March 2026**

Revision	Date of Issue	Comments	Prepared By	Checked By
P1	01/12/2025	Initial Issue	LH	CS
2	04/03/2026	Revised to include attenuation tanks	LH	CS

[redacted]

1 Maintenance

1.1 Introduction

1.1.1 During construction, the Contractor will be responsible for maintaining the drainage and SuDS (Sustainable Drainage Systems). Upon handover, the occupiers will take on the responsibility of these duties as laid out in this report.

1.1.2 The maintenance schedule for the proposed development will be split down into two separate categories; SuDS features and regular private drainage.

1.2 SuDS at Land East of Commonmead Barn, Pagham

1.2.1 As listed above, in section 5.1.2, the SuDS features used on site will be **Permeable Paving, Rainwater Harvesting and Bio-retention planters**

1.2.2 The SuDS features have been designed for easy maintenance and comprise:

- Regular Day-to-Day care – litter collection, regular gardening to control vegetation growth and checking inlets where water enters the SuDS features
- Occasional tasks – checking the SuDS features and removing any silt that builds up in the SuDS feature
- Remedial work – repairing damage where necessary
-

1.3 SuDS Drainage Maintenance Specification

1.3.1 Rainwater Harvesting Tank

In order to maintain the functioning of the rainwater harvesting tanks, the following maintenance requirements should be adhered to:

Operation and maintenance requirements for rainwater harvesting tanks		
Maintenance Schedule	**Required Action**	**Typical Frequency**
Regular Maintenance	Ensure that all inlets and outlets are clear of debris and blockage	Weekly
	Remove debris inlets and outlets	Weekly
	Inspect first flush diverter to ensure it is working correctly and not clogged	Weekly – Clean if necessary
	Clean Filter screens	Monthly – Replace if damaged
	Inspect the tank for sediment build-up and any signs of algae	Monthly
	Inspect roof and gutters and clear of all debris	Every 3 months
	Inspect pump for any signs of wear or damage and test to ensure it is functioning correctly	Every 3 months
	Check bottom of the tank for sediment build-up and clear if necessary	Every 6 months
	Ensure all downpipes are clear and functioning correctly and clear if necessary	Every 6 months
	Test water	Every 6 months
	Thorough tank cleaning – drain tank, scrub interior and rinse	Annually or as required
	Service the pump and filtration system and replace any worn parts	Annually
	Inspect overflow to ensure it is working correctly and clear any obstructions	Annually
Monitoring	Monitor Water levels	Annually
	Inspect for pests e.g mosquitoes and take measures to prevent	As required

[redacted]

1.3.2 Permeable Paving

In order to maintain the functioning of the permeable paving, the following maintenance requirements should be adhered to:

Table 21.3 Operation and maintenance requirements for permeable paving

Maintenance Schedule	Required Action	Typical Frequency
Regular Maintenance	Brushing and vacuuming (standard cosmetic sweep over whole surface)	Once a year, after autumn leaf fall, or reduced frequency as required, based on site-specific observations of clogging or manufacturer's recommendations – pay particular attention to areas where water runs onto pervious surface from adjacent impermeable areas as this area is most likely to collect the most sediment
Occasional maintenance	Stabilise and mow contributing and adjacent areas	As required
	Removal of weeds or management using glyphosate applied directly into the weeds by an applicator rather than spraying	As required – once per year on less frequently used pavements
Remedial Actions	Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50mm of level of the paving	As required
	Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users, and replace lost jointing material	As required
	Rehabilitation of surface and upper substructure by remedial sweeping	Every 10 to 15 years or as required (if infiltration performance is reduced due to significant clogging)
Monitoring	Initial inspection	Monthly for three months after installation
	Inspect for evidence of poor operation and/or weed growth – if required take remedial action	Three-monthly, 48h after large storms in first six months
	Inspect silt accumulation rate and establish appropriate brushing frequencies	Annually
	Monitor inspection chambers	Annually

[redacted]

1.3.3 Bio retention systems

In order to maintain the functioning of the bio retention systems, the following maintenance requirements should be adhered to:

Table 18.3 Operation and maintenance requirements for bio retention systems

Maintenance Schedule	Required Action	Typical Frequency
Regular Inspections	Inspection infiltration surfaces for silting and ponding, record de-watering time of the facility and assess standing water levels in underdrain (if appropriate) to determine if maintenance is necessary	Quarterly
	Check operation of underdrains by inspection of flows after rain	Annually
	Assess plants for disease infection, poor growth, invasive species etc and replace as necessary	Quarterly
	Inspect inlets and outlets for blockages	Quarterly
Regular maintenance	Remove litter and surface debris and weeds	Quarterly (or more frequently for tidiness or aesthetic reasons)
	Replace any plants, to maintain planting density	As required
	Remove sediment, litter and debris build-up from around inlets or from forebays	Quarterly to biannually
Occasional maintenance	Infill any holes or scour in the filter medium, improve erosion protection if required	As required
	Repair minor accumulations of silt by raking away surface mulch, scarifying surface of medium and replacing mulch	As required
Remedial actions	Remove and replace filter medium and vegetation above	As required but likely to be > 20 years

[redacted]

1.3.4 Attenuation Tank

In order to maintain the functioning of the attenuation tank, the following maintenance requirements should be adhered to:

Operation and maintenance requirements for attenuation 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 rainfall infiltrates into the tank from above, check surface of filter for blockage by sediment, algae, or other matter; remove and replace surface infiltration medium as necessary.	Annually
	Remove sediment from per-treatment structures and/or internal 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

1.4 General Drainage Maintenance Specification

1.4.1 Inlet Structures and Inspection Chambers

- Inlet structures such as rainwater downpipes, road gullies and channel drains should be free from obstruction at all times to all free flow through the SuDS
- Inspection Chambers and Rodding Eyes are used on bends or where pipes come together. They allow access and cleaning to the system if necessary.

Inlet Structures and Inspection Chambers	
Regular Maintenance	**Frequency**
Inlet Structures **Inspect rainwater downpipes, channel drains and road gullies, removing obstructions and silt as necessary. Check that there is no physical damage.** **Strim vegetation 1m min surround to structures and keep area free from silt and debris**	Monthly
Inspections Chambers and below ground control chambers. **Remove cover and inspect, ensuring that the water is flowing freely and that the exit route for water is unobstructed. Remove debris and silt.** **Undertake inspection after leaf fall in Autumn**	Annually
Occasional Maintenance **Check topsoil levels are 20mm above edges of chambers to avoid mower damage.**	As necessary
Remedial Work **Repair physical damage if necessary**	As required

[redacted]

1.4.2 Below ground drainage pipes

- Below ground drainage pipes convey water to the SuDS system. They should always be free from obstruction to allow free flow.

Below Ground Drainage Pipes	
Regular Maintenance	**Frequency**
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
Remove sediment from pre-treatment inlet structures and inspection chambers.	Annually or as required
Maintain vegetation to designed limits within the vicinity of below ground drainage pipes and tanks.	Monthly or as required
Remedial Work	
Repair physical damage if necessary	As required
Monitoring	
Inspect all inlets, outlets and vents to ensure that they are in good conditions and operating as designed.	Annually
Survey inside of pipe runs for sediment build up and remove if necessary.	Every 5 years or as required

[redacted]

7.7 Appendix G – ADC Checklist

[redacted]

Full SuDS Design Checklist

This checklist has been created to assist designers, by clearly defining our expectations and requirements for surface water drainage designs that are submitted to support planning applications. It is recommended that applicants and their designers take time, at the outset of the planning process, to familiarise themselves with the checklist and our guidance.

The checklist, critical items and guidance have been designed to align with the National Standards for SuDS and The SuDS Manual, offering clarity where there are deviations between them.

Surface water drainage must be adequately considered when formulating the layout of a site, therefore it is expected that sufficient surface water drainage information is submitted with all planning applications. Surface water drainage information may be requested for smaller proposals where drainage is expected to affect determination – for example, within the Lidsey Wastewater Treatment Catchment area.

The items listed in the checklist cover our expectations for a fully detailed surface water drainage design. The final details of a design may be agreed via planning condition, or prior to determination of a full, or reserved matters planning application.

Critical items are highlighted in **bold**. A failure to address these will result in an **objection** to any application to discharge a surface water drainage design condition and will likely result in an objection on a full or reserved matters planning application.

Applicants who submit all the information requested by the checklist, as early as possible in the planning process, benefit from quicker review times and less delays caused by requests for further information. The omission of information may lead to objection to, or refusal of planning applications or applications to discharge conditions.

Applicants for major development sites must be aware that West Sussex County Council [WSCC] acting as Lead Local Flood Authority [LLFA] are a statutory consultee for flood risk and surface water drainage design. It is important to consult WSCC guidance in addition to ours, and this checklist.

A major planning application is defined as:

- The creation of 10 or more residential units,
- Residential development of on a site of 0.5 hectares or more (where the number of residential units is not yet known i.e. for outline applications),
- Non-Residential development or change of use on a site of at least 1 hectare,
- Creation or change of use of 1000 square metres or more of gross floor space (not including housing).

Applicants have the option to apply for confidential pre-application advice relating to their surface water drainage design from either Arun District Council or WSCC. Bespoke advice is not offered outside of a fee-paying application.

ADC pre-application advice: https://www.arun.gov.uk/pre-application-advice
WSCC pre-application advice: https://www.westsussex.gov.uk/roads-and-travel/information-for-developers/flood-risk-management-pre-application-advice/

Fully Detailed Surface Water Drainage Design Checklist

Site name/address:	Land east of Commonmead Barn
Application description:	
Any relevant planning application references:	

Policy and Guidance Information

Arun District Council Local Plan – Section 18, Water Adopted Local Plan.pdf (arun.gov.uk)

National planning Policy Framework - National Planning Policy Framework (publishing.service.gov.uk)

Arun District Council Surface Water Drainage Guidance - https://www.arun.gov.uk/surfacewater

Land Drainage Consent – https://www.westsussex.gov.uk/fire-emergencies-and-crime/dealing-with-extreme-weather/flooding/flood-risk-management/ordinary-watercourse-land-drainage-consent/

Arun District Council Land Drainage Byelaws - https://www.arun.gov.uk/byelaws/

Arun District Council surface water pre-commencement conditions - https://www.arun.gov.uk/planning-pre-commencement-conditions

The National Standards for SuDS - https://www.gov.uk/government/publications/national-standards-for-sustainable-drainage-systems/national-standards-for-sustainable-drainage-systems-suds

The SuDs Manual [C753] by CIRIA

Ground Investigation Results

☒ **Adequate winter groundwater monitoring data must be supplied to support all surface water drainage designs[i]. – C3552 GWM**
☒ Plan showing location of monitoring points provided[ii]. – Within drainage layout
☒ Depths of holes detailed[iii]. **C3552 GWM**
☒ Dates of observations and depth to groundwater recorded. **C3552 GWM**
☒ Evidence of the strata within borehole or monitoring pits provided.
☒ Plan showing the peak groundwater levels at each monitoring point in mAOD (preferred).
☒ Peak groundwater levels recorded in metres below ground level and mAOD (preferred).

☒ **Adequate winter infiltration testing is supplied to justify the proposed discharge method and design infiltration rates. C3552 GWM**
☒ **Infiltration testing is completed strictly in accordance with BRE DG 365, CIRIA R156 or a similar approved method. C3552 Drainage Report**
☐ Plan showing location of trial pits provided.
☐ Pit dimensions provided.
☐ Depths of testing provided[iv].
☒ Dates, times and readings of each test recorded.
☒ Calculations for the infiltration rate for each test provided.
☒ Incomplete testing results are not extrapolated to obtain design values for infiltration rates.

☐ Evidence of the strata within trial pits provided.
☐ Test locations, and depths correspond with the expected location and depths of proposed infiltration features.
☐ Depths of testing provided in m below ground level and mAOD (optional).

☐ Specialist advice is submitted to support designs where infiltration is proposed where there may be, - Non Applicable

- **risk of dissolution,**
- **risk of slope instability,**
- **infiltrating features closer than 5m to buildings or highways,**
- **contamination,**
- **made ground at the infiltration depth[v],**
- **ground raising proposed,**
- **deep bore soakaways proposed[vi].**

Surface Water Drainage Statement

☒ A statement which explains compliance or departures from the National Standards for SuDS is submitted. Where a standard is not applicable to this stage of the planning process that is clarified.

1. Runoff destination

Existing Site

☒ The condition, performance (including capacity where appropriate) and ownership of any existing site surface water drainage infrastructure must be accurately reported.

☐ It is clear what the natural drainage characteristics of the site and hydraulically linked areas are[vii].
☒ Natural flow paths are identified on a plan (where applicable).
☒ Existing site drainage features are investigated – condition, performance, and ownership[viii].
☐ Environmentally sensitive receiving water bodies are identified – for example groundwater source protection zones.
☒ Existing and future flood risk from any source is detailed[ix].

Proposed Design

☒ The proposed discharge methods must accord with the SuDS hierarchy as given below (in priority order). C3552 Drainage Report

1. Rainwater reuse
2. Infiltration into the ground
3. Hybrid infiltration and restricted discharge to an appropriate water body[x] or surface water sewer is proposed
4. Restricted discharge to a water body
5. Restricted discharge to a surface water sewer or another piped surface water drainage system
6. Restricted discharge to a public combined sewer[xi]

☒ Adequate evidence is supplied to justify the proposed discharge method[xii].
☒ No connection of surface water to the public foul sewer is proposed[xiii].
☒ It is demonstrated that the drainage proposals will integrate with and not compromise the function of the natural and existing drainage systems on the site.
☒ The design is gravity based with no use of pumps[xiv].

☒ **1m unsaturated ground is provided between peak groundwater levels and the base of any infiltration feature. – Groundwater recorded at 1.02mbgl, infiltration not suitable.**
☒ **If surface water must be discharged to a sewer network, then hydraulic capacity checks are provided. – Surface water discharging to watercourse network via 300mm culvert.**

☒ Details of any offsite works, plus any associated permissions or legal agreements from asset or landowners are identified, and evidence of consents provided. – N/A
☒ Where phased construction is proposed, the phases correspond to natural catchments and can function independently from subsequent stages. – N/A
☒ Where there is existing drainage infrastructure on the site it is clearly explained or illustrated what is being retained, upgraded, or removed. – Existing culvert retained. Easement from culvert provided
☒ Relevant restrictions relating to discharging to an environmentally sensitive receiving water body – for example a groundwater source protection zone - are investigated, reported and adhered to. – N/A
☒ Adequate freeboard is provided between the top water level of any open storage features and the top of the bank. – N/A
☒ Self-cleansing velocities are achieved where pipes are proposed.

Preferred
☒ Ground raising is avoided where possible.
☐ Any previous relevant correspondence or pre-application advice from the Local Planning Authority [LPA] or the Lead Local Flood Authority [LLFA] regarding the surface water drainage design is included with the submission.

2. Interception drainage

☒ **An interception assessment is submitted to demonstrate that the first 5mm of rainfall for the majority of rainfall events does not result in runoff from the site[xv].**

☒ **Where infiltration is not viable due to high groundwater levels or other ground conditions[xvi], interception drainage is demonstrated prior to the scale and layout of the development being approved.**

3. Extreme rainfall and flooding

☒ **The proposed discharge rate is explained and justified for attenuation designs.**
☒ **Proposed discharge rates do not increase flood risk on site or elsewhere.**
☒ **Proposed discharge volumes do not increase flood risk on site or elsewhere.**
☒ **There is no unacceptable flooding of the system.**
☒ Previously developed sites aspire to achieve greenfield runoff rates and volumes, where infiltration is not viable. If the proposed run off rate is higher than the greenfield run off rate, then an acceptable justification is provided, and the rate has been agreed with any relevant bodies. – N/A
☒ **Any relaxation factors applied to discharge rates for previously developed sites[xvii] are agreed prior to the scale and layout of the development being approved.**

☒ Statement confirming the proposed design criteria including fixed design calculation inputs for the SuDS system. Examples include:

- Climate change allowances,
- Urban creep allowance,
- CV values,
- Rainfall data,

- MADD factor or additional storage[xviii].

☒ **It is shown how a surface water drainage design will not conflict with additional areas of flood storage or compensation from any source.** – N/A
☒ **Surface water flow entering the site from elsewhere is conveyed safely around or through the site without compromising the SuDS system.**
☐ Where runoff from elsewhere is drained together with the site runoff, the contributing catchment is modelled as part of the drainage system. – N/A
☒ If the surface water drainage is designed to flood in the 1% Annual Exceedance Probability [AEP] + Climate Change Allowance [CCA] event, then the flood volume is contained safely on site without flooding any part of a building or utility plant susceptible to water or affecting safe access or egress.

4. Water quality

☒ **Water quality and treatment is adequately assessed – with an assessment appropriate for the scale and proposed use of the site.**
☒ **The assessment considers all sub-catchments of the site as appropriate.**
☒ **Source, site and regional water quality control measures are provided where possible. Source control measures are prioritised.**

5. Amenity

☒ **Multifunctional benefits are provided.**
☒ **Water depths in open features do not exceed 2m in the most extreme events.** – N/A
☒ **Open features for conveyance and storage are prioritised.**
☐ The health and safety, and amenity implications are assessed where water depths in open features exceed 1.5m. – N/A

6. Biodiversity

☒ **Biodiversity benefits are provided by the drainage system (assessed by others).**
☒ **The surface water drainage design positively contributes towards the biodiversity net gain requirements where applicable.**

7. Construction, operation, maintenance, decommissioning and structural integrity

☒ **Adoption standards are referred to and adhered to where applicable.** – N/A
☒ **There should be no conflict between surface water drainage infrastructure and existing or proposed trees or planting.** – N/A
☒ **There are no clashes with other infrastructure.** – N/A
☒ Where orifice sizes of less than 50mm diameter are proposed these are to be robustly protected (by design) from risk of blockage. – Changed to Vortex flow control units
☐ A construction method statement for the SuDS system, appropriate to the scale of the development, is submitted. – N/A at this stage
☒ Where there is a risk that the base of an attenuation feature may penetrate peak groundwater levels, additional mitigation measures to prevent groundwater ingress are incorporated into the design and construction method statement. – N/A
☐ Phased developments must not increase flood risk during the construction period. This can be demonstrated with a phased management plan. – N/A
☒ SuDS Maintenance is not inhibited by the scale or layout of the development. (See maintenance checklist for further detail).

☒ A maintenance plan for the SuDS system, appropriate to the scale of the development, is submitted. [Please refer to our SuDS Maintenance Checklist where this is stipulated by condition.]
☒ Biodiversity and ecological enhancements do not impede the functionality, maintenance or capacity of the drainage system.
☐ Any potential health and safety issues relating to SuDS implementation and management have been considered and managed.

Surface Water Drainage Calculations/Modelling

General
☒ FEH22 point descriptors for the site are submitted confidentially[xix].
☒ The most recently applicable, or previously agreed FEH rainfall data is used.
☒ CV values for all events must be set to 1 for impervious surfaces. This includes summer, winter, design, and simulation events.
☒ The correct climate change allowances, appropriate for the full lifetime of the development, have been applied to all calculations.
☒ A 10% allowance for urban creep is applied to all residential roof areas.
☒ 50% Annual Exceedance Probability [AEP] + Climate Change Allowance [CCA] (1 in 2 year) event calculations provided.
☒ 3.33% AEP + CCA (1 in 30 year) event calculations provided showing that the full surface water volume is contained within the designed system without flooding.
☒ 1% AEP + CCA (1 in 100 year) event calculations provided showing that the full surface water volume is contained safely on site, without flooding any part of a building or utility plant susceptible to water or affecting safe access or egress.

Infiltration
☒ Half drain times do not exceed 24 hours for the critical 3.33% AEP + CCA event.
☒ The most precautionary design infiltration rate is used[xx].
☒ Design infiltration rates are applied to the sides of soakaways only. – N/A
☒ Design infiltration rates are applied to the base of permeable paving, infiltration blankets or basins only.
☒ Where the design infiltration rate is applied to the base an appropriate factor of safety is applied.
☒ 10% AEP + CCA (1 in 10 year) event calculations provided showing that the incoming pipe (invert level) to any infiltration feature is above this level.

Attenuation and Restricted Discharge
☒ The contributing area for the greenfield run off rates must be equal to the contributing area for the proposed SuDS design for the 3.33% AEP and the 1% AEP events. Pervious surface areas must be considered where applicable[xxi].
☒ Discharge rates are restricted to QBAR or 3 l/s/ha, depending on whichever is greater, for all storms up to the 1% AEP + CCA event.
☒ A surcharged outfall to a watercourse, sewer or tidal waterbody has been modelled[xxii].
☐ Where there is a risk that the base of an attenuation feature may penetrate peak groundwater levels the effects of buoyancy have been considered in the design. – N/A

Drainage Plans and Specifications

Plans are provided showing:
☒ A contributing area plan is provided showing all positively drained areas including open surface water storage plan areas[xxiii].
☒ The proposed design within the proposed site layout.

☒ Existing and proposed site sections and levels.
☒ Long and cross sections for the proposed drainage system including final finished floor levels.
☒ Exceedance flow management routes.
☒ Details of connections to watercourses and sewers.
☐ Where phased construction is proposed, each phase is shown on a plan. – N/A
☐ Maintenance access and any arisings storage and disposal arrangements. – N/A

Essential
☒ Plan areas, depths, gradients and levels of drainage infrastructure must accurately correspond with the supporting calculations.
☒ Appropriate easements and permissions relating to watercourses[xxiv], infiltrating structures[xxv], other services and third-party land[xxvi] must be evidenced and shown on all plans where applicable. – OWC will be applied for at conditional stage.
☐ Maintenance easements are shown from the top of the bank from all open SuDS features on all plans. – N/A
☒ Existing and proposed trees and their mature root protection zones are shown on any drainage layout.
☐ Different drainage catchments are demarcated[xxvii].

These plans must be of sufficient detail that a reviewer can be confident that the design can be constructed without flood risk being increased on site or elsewhere.

Specifications are required for all materials used in the design. We suggest that this is best achieved and illustrated with site specific construction detail drawings. The combination of construction details, with plans and sections, ensure that the proposed standard of construction will facilitate adoption and maintenance by an appropriate body and have structural integrity.

The following checklist is designed to demonstrate the level of detail required:

Detail
☒ All infiltration or attenuation features (including permeable paving) are clearly labelled with their dimensions, invert/base levels and cover levels.
☒ It can be clearly determined what a **pipe's diameter**, pipe materials, **gradients**, **flow directions** and invert levels are from the plans.
☒ It can be clearly determined what an inspection chamber or manhole's **cover level**, **invert level**, cover loading grade and sump depth (where applicable) are from the plans.
☒ Control structures are labelled with **discharge rates**, **hydraulic head, invert and cover levels** and a suggested flow control device model number (where applicable).
☐ Operational characteristics of any other mechanical features are detailed.
☒ Measures to protect drainage from tree root damage are clearly shown on any drainage layout.
☐ Any areas of necessary ground raising are clearly justified and demarcated on a plan, with depths and levels.
☒ If the 1% AEP + CCA event floods, then the extent and depth of the flooding is shown on a site plan. This plan includes proposed external ground levels and finished floor levels of buildings.
☐ Potential flow routes off site are shown. The plan also includes proposed external ground levels, finished floor levels of buildings and designed slopes on all impermeable surfaces such as highways or car parks.
☒ Cross sections and long sections of all open features are provided.
☒ Construction detail drawings are site specific.
☒ Construction detail drawings are provided for all components including but not limited to:

- ☒ Infiltration structures

- ☐ Attenuation structures
- ☒ Manholes/inspection chambers
- ☒ Catchpits/silt traps
- ☒ Flow control devices
- ☒ Permeable paving
- ☐ Headwalls
- ☐ Channel drains
- ☐ Gullies
- ☒ Pipe bed and surround
- ☒ Pipe to pipe connections
- ☐ Filter strips or drains
- ☐ Swales
- ☐ Bio-retention systems
- ☐ Ponds and wetlands
- ☐ Tree pits and measures to protect drainage from root incursion
- ☐ Water treatment features
- ☐ Green roofs
- ☐ Measures to protect drainage from tree roots.
- ☐ Water butts or alternative methods of water reuse – also to be shown on plans.

The following items are requested to aid assessment or confidence in construction:

☐ Where features have a non-uniform plan area, a plan showing the coordinates of the perimeter is provided.
☐ All drainage infrastructure is labelled to correspond with the supporting calculations.

Other
☐ Open feature planting specification is provided (to be assessed by others).

This checklist is designed to aid an applicant with their submission. The list is not exhaustive, and our engineers may request additional information to enable them to review a proposal to their satisfaction.

The checklist may also request information that an applicant does not feel is relevant to their submission. In this case the applicant can provide an explanation as to why they have omitted certain information in their drainage statement. However, the appraising engineer reserves the right to request this information if they believe it is necessary for their review.

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[i] See Arun District Council guidance note regarding groundwater monitoring requirements at www.arun.gov.uk/surfacewater
[ii] The monitoring locations must correspond with the location and depth of proposed infiltration features.
[iii] Groundwater monitoring holes must be deep enough to allow for 1m of unsaturated ground between the peak groundwater level and the base of any potential or proposed infiltration feature.
[iv] Testing depths and must account for groundwater levels and 1m of unsaturated ground between the base of the test pit and the peak groundwater level.
[v] Infiltration into made ground should be generally avoided.
[vi] Deep bore soakaways are strongly resisted and any planning application that suggests the use of them without formal acceptance from the Environment Agency will be objected to. Designers are referred to 1.18 of the NSfS.
[vii] It is suggested that this is achieved with reference to the ground investigations and a topographical plan. Where there is more than one catchment these should be clearly identified.
[viii] Confirmation, plans and surveys of any existing drainage infrastructure on the site.

[ix] Flood maps (fluvial, tidal, pluvial, groundwater, sewer, and reservoir) are supplied (or Flood Risk Assessment referred to). Full details of any known flooding on the site is referred to.
[x] A water body may be defined as a river, watercourse, ditch, culverted watercourse, reservoir, wetland or the sea.
[xi] A combined sewer must be designed and intended to receive both foul and surface water runoff. The classification of a public combined sewer is defined by the public sewer records. Evidence of sewer capacity or any evidence of existing surface water connections have no bearing on it's formal classification.
[xii] Evidence includes ground investigations, locations, mapping, network types, flow direction, ownership/responsibility, depth, capacity, condition and cost. Higher priority destinations must be used to the maximum extent practicable.
[xiii] Engineers will object to any proposed connection of surface water to the foul sewer under all circumstances.
[xiv] All surface water drainage designs must drain via gravity to corresponding points of discharge where possible. The use of pumps for surface water drainage will only be agreed to in exceptional circumstances.
[xv] See Arun District Council guidance note regarding interception drainage at www.arun.gov.uk/surfacewater.
[xvi] 'Other ground conditions' refers to the conditions that may need specialist geotechnical advice in the ground investigations section of the checklist. It does not refer to when infiltration cannot provide a total solution due to design infiltration rates that are slower than 1 $x10^{-6}$m/s.
[xvii] See Arun District Council guidance note regarding surface water drainage of previously developed sites at www.arun.gov.uk/surfacewater.
[xviii] Must be set to zero unless it can be demonstrated where this additional storage is being provided.
[xix] Please submit FEH22 point data files, in accordance with clause 5.1.7 of the FEH Web Service terms of use (https://fehweb.ceh.ac.uk/Home/Terms). These must be submitted directly to land.drainage@arun.gov.uk rather than to the planning portal (via the planning officer), this is to ensure that the data remains confidential in accordance with those terms.
[xx] Designs must be based upon the slowest infiltration rate evidenced closest to a proposed infiltration feature. Average design rates will not be accepted.
[xxi] See Arun District Council guidance note regarding contributing areas at www.arun.gov.uk /surfacewater.
[xxii] The surcharge level should be based on the worst-case available modelling or known topographic constraints – for example the top of a watercourse bank, maximum predicted tidal levels or the cover level of the receiving sewer or drain.
[xxiii] Contributing areas are shown in m^2 on the plan(s). The plans include pervious contributing areas where these discharge to the SuDS system for extreme events.
[xxiv] 3m from the top of the bank of all ordinary watercourses, and from the edge of all culverted watercourses. 8m from the top of the bank of all main rivers - unless an alternative easement has been stipulated by the Environment Agency.
[xxv] 5m from all buildings and highways, unless an alternative easement is recommended by a geotechnical specialist. (Aside from permeable paving that does not take any extra impermeable catchment such as a roof).
[xxvi] As stipulated by the utility owner or landowner.
[xxvii] Demarcated impermeable areas correspond with the distribution of those areas in the supporting calculations.

7.8 Appendix H – Previous Application Comments and Responses

1. Runoff destination - Discharge to culverted watercourse proposed. No infiltration included. 3m easement is shown on plans – runoff destination is in accordance with NSfS

1.1. The groundwater monitoring shows winter groundwater levels within 1 metre of the base of the proposed infiltration features. The report notes piped outlets to the onsite culverted watercourse but none are shown on the drainage layout.

1.2. The 3m easement for the culverted watercourse should be shown on the plans and may conflict with the proposed building location.

1.3. The runoff destination is not currently in accordance with the requirements of the NSfS.

2. Interception drainage – Interception still provided by means of bioretention planets and permeable paving, in addition to rainwater harvesting all of which is in line with NSfS and Arun DC policy.

2.1. Interception drainage is currently provided by bio retention installations and permeable paving, however, once the design is altered to remove infiltration within 1 metre of groundwater, measures to include interception drainage will need to be added.

2.2. Please note, consideration of interception drainage is critical to the conceptual design of the site in determining the scale and layout of the development.

2.3. Where infiltration is not viable, there is a risk that interception drainage for the impermeable areas drained to the permeable paving may only be delivered by evapotranspiration. Additional interception features may need to be included within the proposed layout.

2.4. Inception drainage (once infiltration is removed) is not currently in accordance with the requirements of the NSfS.

3. Extreme rainfall and flooding – We've removed infiltration from all features as required and also reduced the discharge rate from 1.0 l/s to 0.5 l/s per plot. This is a slow as can be practically achieved whilst ensuring self-cleansing velocity within the network. NSfS dictates that discharge rate should be restricted to greenfield runoff or 3l/s/ha whichever is greater. Unfortunately, in this case, both are unachievable with greenfield runoff having a QBAR of 0.1l/s and the 3l/s/ha results in a discharge of 0.4l/s for the site. A drained areas plan has been supplied within Appendix B.

3.1. The risk to the development from external sources in the present day is low or very low. The site is partly within a future year flood zone for rivers and seas. The future year flood level at the site is not known and should be presented within the FRA. Due to the position on the edge of the extreme future year flood zone, the risk of internal flooding to the dwellings will be low. We therefore do not object to the development on flood risk grounds.

3.2. The drainage layout and calculations are currently based upon an infiltration solution, which is not acceptable due to high groundwater. The report notes connection to the exiting culverted ordinary watercourse at a peak rate of 2l/s. This peak outflow rate is arbitrary and not restricted to greenfield runoff rates in accordance with the National SuDS Standards. Design flow restriction should be based upon greenfield runoff equivalent for the drained area and if necessary a relaxation applied where constraints preclude meeting the GFR rate. Modern flow controls can achieve rates much lower than 1l/s with adequate blockage mitigation incorporated.

3.3. A drained areas plan should be provided. It is noted that the urban creep allowance is incorporated into the model simulations.

3.4. The infrastructure within the permeable paving storage may reduce the available capacity and any significant chambers and any utilities margin should be removed from the plan area / volume calculation.

4. Water quality – Remains the same as before – still within report and relevant

4.1. The mitigation provided by the bioretention installations and permeable paving (including when lined) is sufficient to mitigate the risk of pollution from the development.

4.2. Please note we will need to re-assess if the design changes.

5. Amenity – This is what bioretention planters do. I've highlighted this within a sentence within the report

5.1 No mitigation or specific design is proposed for amenity/multifunctionality and no assessment is provided on the amenity aspect for the sustainable drainage system.

5.2 Whilst the opportunities on a site such as this may be limited, there should be consideration of this aspect of sustainable drainage design and incorporation where feasible.

5.3 If there is no feasible opportunity, a departure from the NSfS should be requested.

6. Biodiversity – As above.

6.1 No mitigation or specific design is proposed for biodiversity and no assessment is provided on the biodiversity aspect for the sustainable drainage design.

6.2 Whilst the opportunities on a site like this may be limited, there should be consideration of this aspect of sustainable drainage design and incorporation where feasible.

6.3 If there is no feasible opportunity, a departure from the NSfS should be requested.

6.4 Water quality mitigation is not currently in accordance with the requirements of the NSfS (Standard 6).

7. Construction, operation, maintenance, decommissioning and structural integrity – Included within the appendices of the report.

7.1 An outline Management and Maintenance Plan should be provided within the planning application. This will need to incorporate information on ownership and management responsibilities for shared infrastructure.

7.2 The development proposal is not currently in accordance with the requirements of the NSfS (Standard 7).

[redacted]