



Consulting Civil Engineers

Surface Water Drainage Scheme Report

Forge Cottage, Church Road, Yapton, BN18 0ER

For

Donald Macdonald

Rev – **P3**

Reference **C1508**

Date **18th January 2021**

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1 Introduction

- 1.1 CGS Civils Ltd have been appointed by Donald Madonald to undertake a Surface Water Drainage Scheme Report for a proposed development at Forge Cottage, Church Road, Yapton, BN18 0ER.
- 1.2 Arun District Council planning ref. no. Y/120/20/PL, proposed 2 storey side extension with a single storey rear extension, new terrace area and replacement car port with associated external works. The existing site consists of a single dwelling with associated access and parking.
- 1.3 The design should follow the hierarchy of preference for different types of surface water drainage disposal systems as set out in Approved Document H of the Building Regulations, the recommendations of the SUDS Manual produced by CIRIA. Winter groundwater monitoring to establish highest annual ground water levels and Percolation testing to BRE 365, or similar approved, will be required to support the design of any Infiltration drainage.

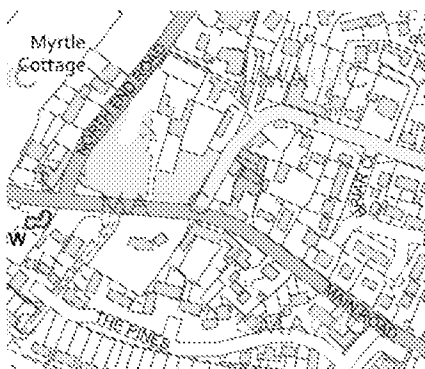


Fig 1. Site Location

2 Site Geology

2.1 British Geological Survey information

- 2.1.1 The British Geological Survey confirms the bedrock geology to be made up Lewes Nodular Chalk Formation, Seaford Chalk Formation, Newhaven Chalk Formation, Culver Chalk Formation and Portsdown Chalk Formation.
- 2.1.2 Borehole logs close to the site confirm the ground to be made up of clay and chalk.

Fig 2. British Geological Survey

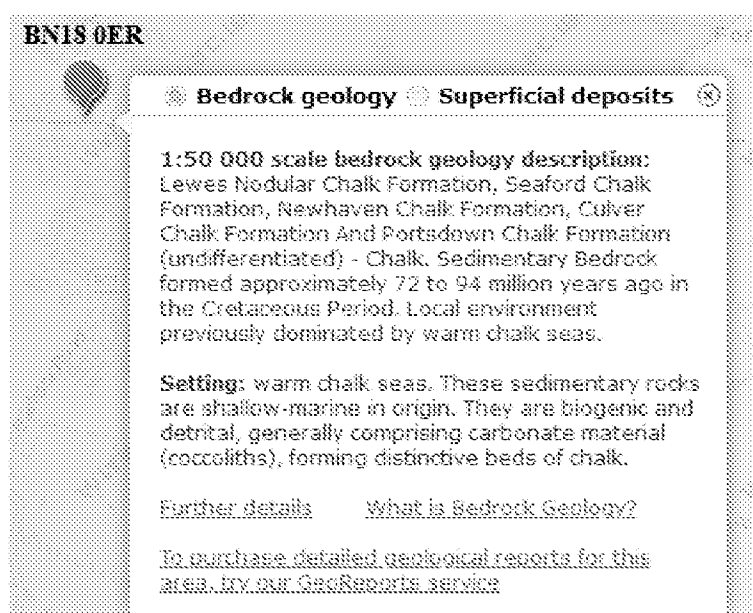
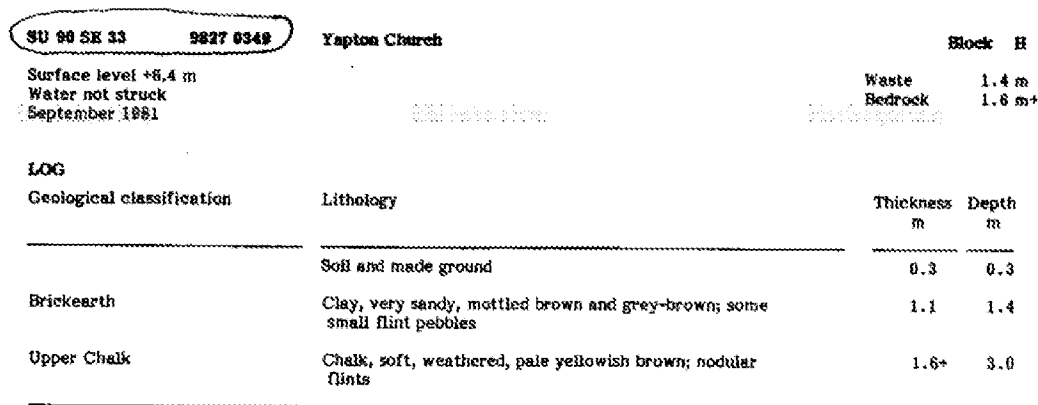


Fig 3. Borehole Scan



2.2 Geological Assessment

- 2.2.1 A soakage test to BRE 365 was carried out on 1st January 2021 which confirmed that the geology on site consisted of sand and clay which is usual for the local area.
- 2.2.2 Alongside the soakage test, a borehole was dug to 1.5m deep and no groundwater was noted over the course of 7 days. The site itself is elevated approximately 1.3m above the adjacent property to the south and therefore groundwater is anticipated to have no affect on the design.

2.3 Hydrogeology Setting

- 2.3.1 The Environment Agency (EA) mapping service, as provided by Magic Map, indicates the aquifer designation for the bedrock and superficial drift geology and the groundwater vulnerability in the area. The mapping, as included in Appendix E, provides the following information for the site:
- 2.3.2 The site will not pose a risk to the groundwater on site as there will be no discharge of any hazardous materials to ground.

Geology Map	Site Description
Aquifer Designation (Bedrock)	Principal
Aquifer Designation (Superficial Drift)	Secondary A
Groundwater Vulnerability	Medium
Groundwater Source Protection Zone	N/A

3 Existing Drainage

- 3.1.1 The existing ground floor extension is planned to be demolished, which currently drains directly to ground for both the existing car port and the ground floor extension with the exception of the Sun Room which drains to the existing soakaway. The new two storey extension and replacement car port requires a drainage solution.

4 Proposed Drainage Strategy

4.1 SuDS Hierarchy

- 4.1.1 All options for the destination of run-off generate 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.

Discharge Destination	
Discharge to Ground	Both roof and hard paved will discharge to ground via infiltration
Discharge to Watercourse	N/A
Discharge to Surface Water Sewer	N/A
Discharge to Other Sewer	N/A

- 4.1.2 Different SuDS Features have been assessed to determine if they are viable to use on site and can be seen in the following table:

SuDS Feature	Beneficial to Environment	Improves Water quality	on Suitable for low permeable soils ($<10^{-6}$)	Ground Water recharge	Suitable for small sites	Site specific restrictions	Appropriate for site
Wetlands	Y	Y	Y	N	N	Site Constraints	No
Pond	Y	Y	Y	N	N	Site Constraints	No
Detention Basin	Y	Y	Y	N	N	Site Constraints	No
Infiltration Basin	Y	Y	N	Y	N	Site Constraints	No
Soakaway	N	Y	N	Y	Y	None	Yes
Attenuation Tank	N	N	Y	N	Y	None	Yes
Swale	Y	Y	Y	Y	N	Site Constraints	No
Filter Strip	Y	Y	Y	Y	N	Site Constraints	No
Rainwater Harvesting	N	Y	Y	Y	Y	Site Constraints	No
Permeable Paving	N	Y	Y	Y	Y	None	Yes
Green Roof	Y	Y	Y	N	Y	Site Constraints	No
Rain garden	Y	Y	Y	N	N	Site Constraints	No

4.2 Surface Water Drainage

- 4.2.1 Based on the investigations that were carried out and favourable soakage rates, it is proposed that the site will discharge to ground via infiltration. All roof areas will be discharged to ground via a geocellular soakaway which has been designed based on the recorded infiltration rate of $5.8 \times 10^{-5} \text{m/s}$ which was the worst-case scenario infiltration rate. All hard paved areas are proposed to discharge to ground via infiltration using porous car park construction.
- 4.2.2 All infiltration features have been designed to cater for the 1 in 100 year storm + 40%.
- 4.2.3 Hydraulic calculations have been carried out which can be found at Appendix C.

4.3 Water Quality

- 4.3.1 A key requirement of any SuDS system is that it protects the receiving water body from the risk of pollution.
- 4.3.2 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.
- 4.3.3 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
- 4.3.4 The EA website indicates that the site does not lie within a Source Protection Zone.
- 4.3.5 The recommended approaches for water quality risk management are given in the SuDS Manual Table 26.1.

Fig 5. 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	

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

4.3.7 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
- Low traffic roads

4.3.8 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 $\geq$ pollution hazard index

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

Fig 6. 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

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

Table 1: 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	Ground Water	Very Low	0.2	0.2	0.05
Individual driveways, residential car parks and low traffic roads	Ground water	Low	0.5	0.4	0.4

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

Figure 7 Indicative SuDS Mitigation Indices for discharges to ground waters.

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

Characteristics of the material overlying the proposed infiltration surface, through which the runoff percolates	TSS	Metals	Hydrocarbons
A layer of dense vegetation underlain by a soil with good containment attenuation potential of at least 300mm in depth	0.6	0.5	0.6
A soil with good contaminant attenuation potential of at least 300mm in depth	0.4	0.3	0.3
Infiltration trench (where a suitable depth of filtration material is included that provides treatment, i.e., graded gravel with sufficient smaller particles but not single size coarse aggregate such as 20mm gravel) underlain by a soil with good contaminant attenuation potential of at least 300mm in depth.	0.4	0.4	0.4
Constructed permeable pavement (where a suitable filtration layer is included that provides treatment, and including a geotextile at the base separating the foundation from the subgrade) underlain by a soil with good contaminant attenuation potential of at least 300mm in depth	0.7	0.6	0.7
Bioretention underlain by a soil with good contaminant attenuation potential of at least 300mm in depth	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 2: SuDS mitigation index

Runoff Source	Destination of Runoff	Mitigation Index Source	Type of SuDS Component	Total Suspended Solids (TSS)	Metals	Hydrocarbons
Individual driveways, residential car parks and low traffic roads	Ground water	Table 26.4 (for ground waters) Table 26.3 (for surface waters)	Permeable Pavement	0.7	0.6	0.7

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

4.4 Construction Phase Drainage

- 4.4.1 It is an offence to cause or knowingly permit the entry of any polluting, poisonous or noxious material in the water environment. If the pollution is serious enough to lower the ecological status of the water body as set out in terms by the Water Framework Directive (2000/60/EC) then prosecution may occur.
- 4.4.2 Remediation of any damage caused will not require the polluter to be prosecuted first. If the water pollution is serious enough to be classed as environmental damage, the damage will require to be remediated such that the area is returned to the condition it would have been in if the damage had not occurred.
- 4.4.3 If any pollution has not been reported or the polluter has not taken actions to prevent any further damage; they would then be causing an offence. Third parties (e.g., Private water supply users, landowners, recreation users and the public) who may be affected by possible damage may also report the risk of any environmental damage to the enforcing authority.
- 4.4.4 The principles of SuDS (Sustainable Drainage Systems) shall be applied to all components of design and construction regarding surface water management. Any design or site works that may impact on the site drainage or the water quality shall:
- Soakaway where soils allow
 - Consider and manage erosion
 - Remove pollutants in surface water
 - Retain any silts on site and prevent silts from discharging to watercourses or drains
 - Keep runoff rates at existing greenfield runoff
 - Prevent accidental spillages reaching watercourse
- 4.4.5 As infiltration on site is viable, the temporary drainage for the development will be in the form of land drains which will discharge into the ground.
- 4.4.6 Pollution will be controlled via the use of catchpit manholes and geotextiles.
- 4.4.7 Any potential hazardous substances will be within a controlled compound with a separate drainage system that will contain a penstock valve / containment kit in the event of a spillage.

5 Maintenance

5.1 Introduction

- 5.1.1 During construction, the Contractor will be responsible for maintaining the drainage and SuDS (Sustainable Drainage Systems). Upon handover, the occupant/owner will take on the responsibility of these duties as laid out in this report.
- 5.1.2 The maintenance schedule for the proposed development will be split down into two separate categories; SuDS features and regular private drainage.

5.2 SuDS at Forge Cottage, Yapton

- 5.2.1 As listed above, in section 5.1.2, the SuDS features used on site will be a geocellular soakaway and porous paving.
- 5.2.2 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

5.3 SuDS Drainage Maintenance Specification

5.3.1 Soakaway

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

Table 5.3.1 Operation and maintenance requirements for attenuation storage tanks		
Maintenance Schedule	Required Action	Typical Frequency
Regular Maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial action	Monthly for 3 months, then annually
	Remove debris from the catchment surface (where it may cause risks to performance)	Monthly
	For systems where 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 pre-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

5.3.2 Permeable Paving

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

Table 21.4 Operation and maintenance requirements for permeable		
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

5.4 General Drainage Maintenance Specification

5.4.1 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

5.4.2 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

6 Summary and Conclusions

- 6.1.1 CGS Civils has been instructed by Donald Madonald to produce a Surface Water Drainage Scheme statement under National Planning Policy Framework (NPPF) to support the Planning Application for the proposed extension.
- 6.1.2 The Surface Water will discharge to ground via infiltration at a recorded infiltration rate of **5.8x10⁻⁵m/s**. All infiltration devices have been designed to cater for the 1 in 100-year storm +40%.
- 6.1.3 This report confirms that the proposed Surface Water Drainage Drainage measures ensure that suitable means of can be achieved for the proposed development.

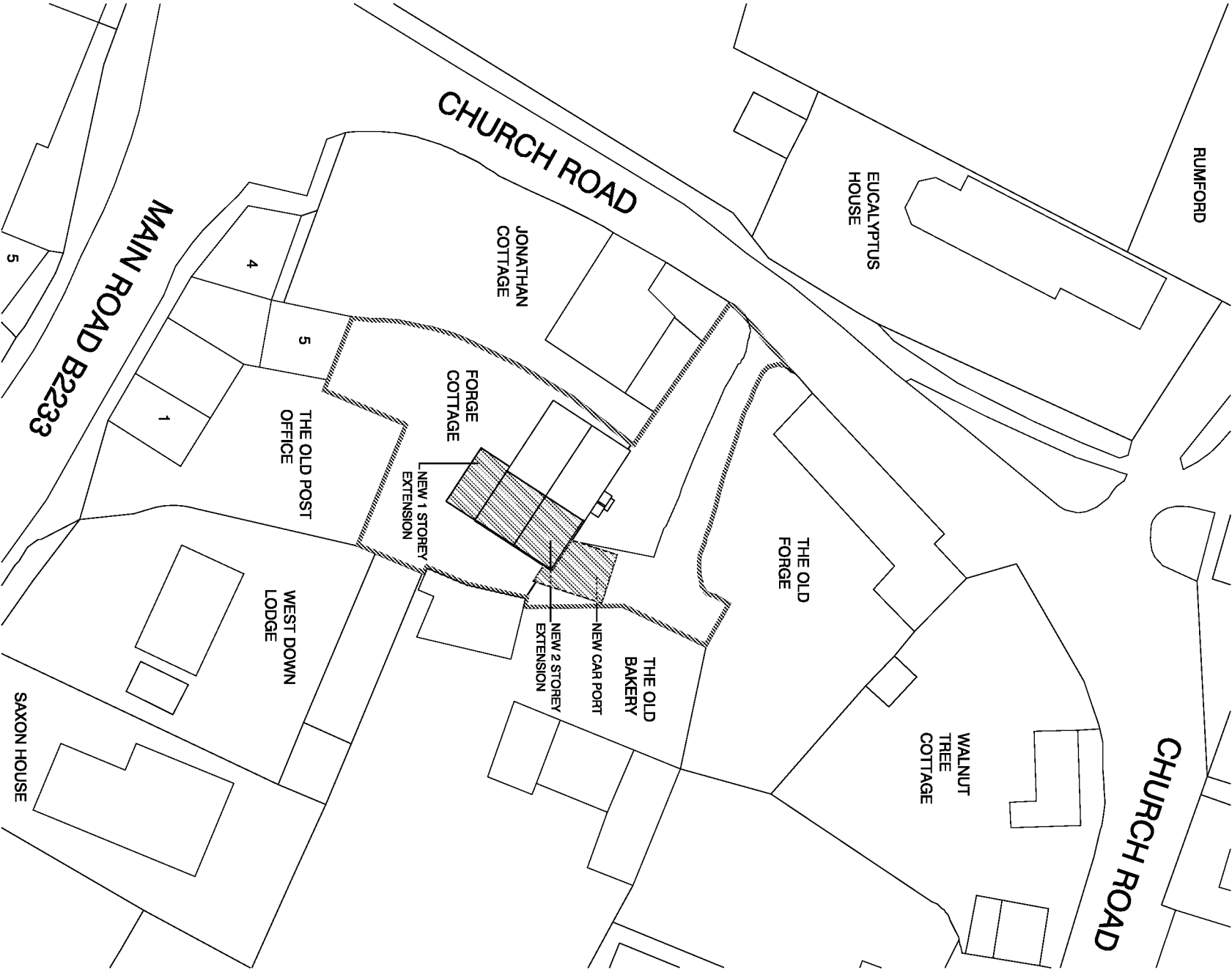
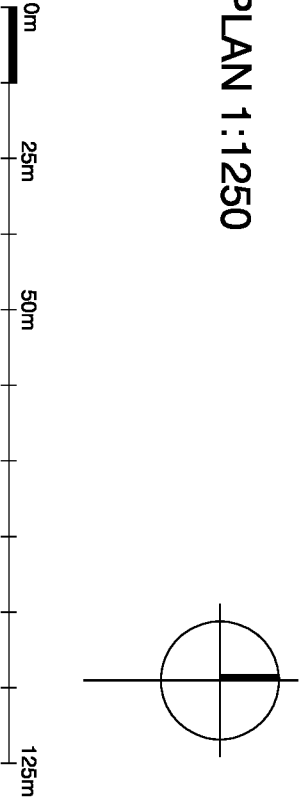
7 Appendices

7.1 Appendix A – Site Plan

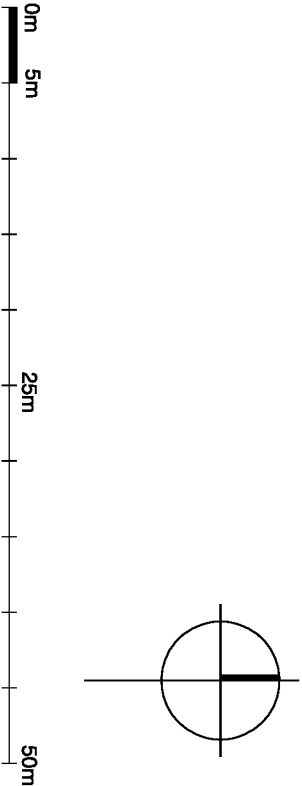


OS map Extracted from Blackwell Business Services/(www.blackwellmapping.co.uk) / CROWN COPYRIGHT 2016

LOCATION PLAN 1:1250



BLOCK PLAN 1:500



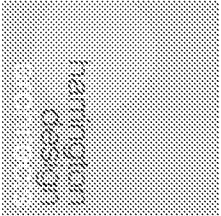
NOTES:

Dimensions to be checked on site before commencing work. Any discrepancies shall be reported to the architect immediately.
Do not scale from these drawings except for planning purposes. Use figured dimensions only.
Where applicable this drawing is to be read in conjunction with other consultants' drawings.

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A	12.05.17	CAR PORT AMENDED
Rev	Date	Amendment

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For
MR & MRS MACDONALD

Project
**EXTENSION TO FORGE COTTAGE
CHURCH ROAD
YAPTON**

Title
BLOCK & LOCATION PLAN

Date	Drawn	Scale	Checked
MAR 17	SR	1:500 & 1:1250 @A3	MAW
Job Number	Prefix	Drawing Number	Revision
17004	P	100	A

7.2 Appendix B – Drainage Layout

7.3 **Appendix C – Surface Water Calculations**

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	2	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	England and Wales	Connection Type	Level Soffits
M5-60 (mm)	20.000	Minimum Backdrop Height (m)	0.600
Ratio-R	0.400	Preferred Cover Depth (m)	1.200
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	5.00	Enforce best practice design rules	✓

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Node Type	Manhole Type	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
RE1		5.00	6.860	Manhole	Adoptable	100	245.302	119.447	0.350
S1	0.003	5.00	6.780	Manhole	Adoptable	450	245.302	106.641	0.578
S2	0.002		6.780	Manhole	Adoptable	450	238.045	106.641	0.644
PP1	0.002		6.860	Manhole	Adoptable	100	241.552	121.023	0.359
PP		5.00	6.860	Manhole	Adoptable	100	244.413	121.023	0.330

Links (Input)

Name	US Node	DS Node	Length (m)	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)
1.000	RE1	S1	12.806	6.510	6.202	0.308	41.6	100
1.001	S1	S2	7.257	6.202	6.136	0.066	110.0	100
2.000	PP	PP1	2.861	6.530	6.501	0.029	100.0	100

Simulation Settings

Rainfall Methodology	FSR	Analysis Speed	Normal
FSR Region	England and Wales	Skip Steady State	x
M5-60 (mm)	20.000	Drain Down Time (mins)	240
Ratio-R	0.400	Additional Storage (m³/ha)	20.0
Summer CV	0.750	Check Discharge Rate(s)	x
Winter CV	0.840	Check Discharge Volume	x

Storm Durations

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

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

Node S2 Soakaway Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	5.880	Depth (m)	0.400
Side Inf Coefficient (m/hr)	0.20880	Time to half empty (mins)	273	Inf Depth (m)	
Safety Factor	2.0	Pit Width (m)	2.000	Number Required	1
Porosity	0.95	Pit Length (m)	2.000		

Node PP1 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	6.501	Slope (1:X)	1000.0
Side Inf Coefficient (m/hr)	0.20880	Time to half empty (mins)	224	Depth (m)	0.250
Safety Factor	2.0	Width (m)	5.000	Inf Depth (m)	
Porosity	0.30	Length (m)	4.600		

Results for 30 year Critical Storm Duration. Lowest mass balance: 99.32%

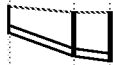
Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	RE1	1	6.510	0.000	0.0	0.0000	0.0000	OK
15 minute winter	S1	11	6.231	0.029	1.0	0.0076	0.0000	OK
120 minute winter	S2	116	6.205	0.069	0.5	1.2485	0.0000	OK
480 minute winter	PP1	304	6.570	0.069	0.1	0.4663	0.0000	OK
480 minute winter	PP	304	6.570	0.040	0.0	0.0003	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
15 minute summer	RE1	1.000	S1	0.0	0.000	0.000	0.0116
15 minute winter	S1	1.001	S2	1.0	0.541	0.173	0.0134
120 minute winter	S2	Infiltration		0.1			
480 minute winter	PP1	Infiltration		0.0			
480 minute winter	PP	2.000	PP1	0.0	-0.011	-0.002	0.0124

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 99.32%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
180 minute winter	RE1	176	6.627	0.117	0.2	0.0009	0.0000	FLOOD RISK
180 minute winter	S1	176	6.627	0.425	0.4	0.1118	0.0000	FLOOD RISK
180 minute winter	S2	176	6.627	0.491	0.7	1.6305	0.0000	OK
180 minute winter	PP1	168	6.630	0.129	0.3	0.8918	0.0000	OK
180 minute winter	PP	168	6.630	0.100	0.0	0.0008	0.0000	FLOOD RISK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
180 minute winter	RE1	1.000	S1	-0.2	-0.037	-0.019	0.1002
180 minute winter	S1	1.001	S2	0.4	0.411	0.070	0.0568
180 minute winter	S2	Infiltration		0.1			
180 minute winter	PP1	Infiltration		0.1			
180 minute winter	PP	2.000	PP1	0.0	-0.015	0.006	0.0224

Node Name	RE1	S1	S2
A4 drawing Hor Scale 1500 Ver Scale 100 Datum (m) 1.000			
Link Name	1.000	1.0	
Section Type	100m	100	
Slope (1:X)	41.6	110	
Cover Level (m)	6.860	6.780	6.780
Invert Level (m)	6.510	6.202	6.202
Length (m)	12.80	7.2	

Node Name	PPP1
A4 drawing Hor Scale 1500 Ver Scale 100 Datum (m) 1.000	
Link Name	2
Section Type	1
Slope (1:X)	1
Cover Level (m)	6.888
Invert Level (m)	6.501
Length (m)	2

7.4 **Appendix D – Percolation Test Results and Groundwater monitoring**

PERCOLATION TEST PROCEDURE

This Percolation Test follows the procedures laid out by the BRE Digest 365

Step 1 -Dig a trial hole.

On the 22nd and 24th Dec. the percolation trial hole was dug with dimensions of 1.0 m (length) x 0.3 m (width) and 0.9 m (depth) post clean and trim.

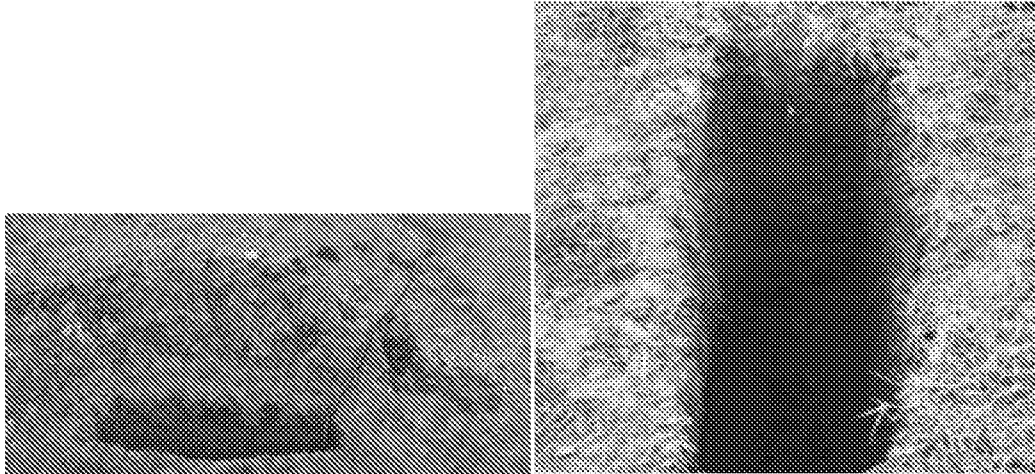


Figure 1: Site photographs

Ground water monitoring was conducted during the period from 24th Dec. 2020 until 3rd Jan 2021 observed at the base of an adjacent borehole at 1.5m deep which was performed daily; no ground water was observed.

During the dig for the percolation trial hole, the soil topography indicated that 0.36 m was loamy topsoil then sand/clay for the remaining depths.

Step 2 - Fill the hole with water

1. Fill trial hole with water – this needs to be done rapidly to mimic a real storm event.
2. Record the time taken for the water level to fall within the trial hole from 75% to 25% full.

where: -

$H_{25\%} * 0.9 \text{ m} = 0.23 \text{ m}$ height from trial pit base

$H_{75\%} * 0.9 \text{ m} = 0.68 \text{ m}$ height from trial pit base

Test 1

Testing commenced @ 08:30 on 1st Jan. 2021

t =1359 secs

Test 2

Testing commenced @ 08:55 on 1st Jan. 2021

t= 1407 secs

Test 3

t = 1589

Testing commenced @ 09.25 on 1st Jan. 2021

PERCOLATION TEST RESULTS

Applicant name: Donald Macdonald

Site address: Forge Cottage, Church Road, Yapton, Arundel, BN18 0ER

Planning application number: Y/34/17/HH

STAGE 1 – Measure the time for the water to soakaway between H_{75%} and H_{25%}

Test pit #1	Test Procedure	Test 1 (Secs)	Test 2 (Secs)	Test 3 (Secs)
Test pit #1	Time taken in seconds for the water level to drop from H _{75%} to H _{25%}	1359	1407	1589
Borehole #1	Ground water monitoring	No ground water observed		

STAGE 2 - Calculation of Soil Infiltration Rate

where:-

V_p = Volume of hole between H_{75%} and H_{25%}
l = Length of hole
w = Width of hole
H = Height from trial pit base, please note 75%, 50% & 25% of height respectively
as50 = Internal surface area of hole up to 50% of the height, H_{50%} including base area
t = Time for the water to soakaway between H_{75%} and H_{25%}
f = Soil infiltration rate

Soil infiltration rate

$$f = \frac{V_p}{as50 \times t}$$

so:-

$$V_p = l \times w \times (H_{75\%} - H_{25\%})$$

$$= 1.0 \times 0.3 \times (0.675 - 0.225) \\ = \underline{0.135 \text{ m}^3}$$

$$as50 = [(l \times H_{50\%} \times 2) + (w \times H_{50\%} \times 2) + (l \times w)]$$

$$= [(1 \times 0.45 \times 2) + (0.3 \times 0.45 \times 2) + (1 \times 0.3)] \\ = \underline{1.47 \text{ m}^2}$$

Results

f	Test 1	Test 2	Test 3
	6.8 x10 ⁵ m/s	6.5 x10 ⁵ m/s	5.8 x10 ⁵ m/s

7.5 **Appendix E – Magic Map from Environment Agency**



Legend

Aquifer Designation Map (Bedrock)
(England)

- Principal
- Secondary A
- Secondary B
- Secondary (undifferentiated)
- Unproductive

Projection = OSGB36
xmin = 482200
ymin = 90400
xmax = 509200
ymax = 118400



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Legend

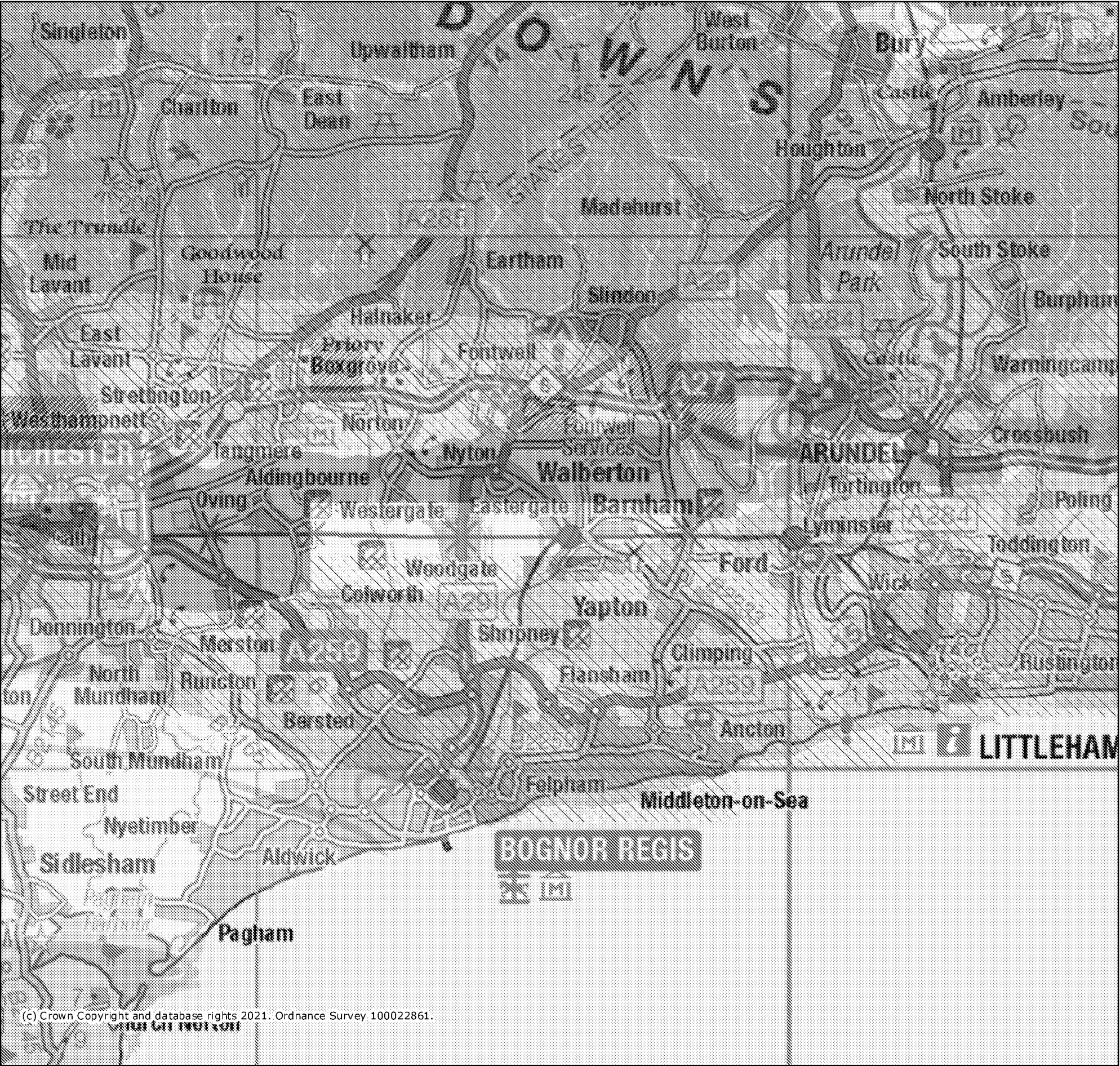
Aquifer Designation Map (Superficial Drift) (England)

- Principal
- Secondary A
- Secondary B
- Secondary (undifferentiated)
- Unknown (lakes+landslip)
- Unproductive

Projection = OSGB36
xmin = 482200
ymin = 90400
xmax = 509200
ymax = 118400



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Legend

Groundwater Vulnerability Map (England)

- Local Information
- Soluble Rock Risk
- High
- Medium - High
- Medium
- Medium - Low
- Low
- Unproductive

Projection = OSGB36
xmin = 482200
ymin = 90400
xmax = 509200
ymax = 118400



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