

BONHAMS, FLANSHAM, FELPHAM,
WEST SUSSEX PO22 8NP

Proposed Residential Development

Flood Risk Assessment

Prepared on behalf of

Pallant Homes Ltd

2017/D1298/FRA1.3

November 2017

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Bonhams, Flansham, Felpham, West Sussex PO22 8NP
2017/D1298/FRA1.3
November 2017

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Borhamts, Haslemere, Felpham, West Sussex PO22 8NP
2017/01298/FRA1.3
November 2017

1 INTRODUCTION

1.1 Background

- 1.1.1 RGP Design Ltd (RGP) is instructed by Pallant Homes Ltd. to prepare a Site-Specific Flood Risk Assessment (FRA) to support a planning application for a residential development at Bonhams, Flansham, Felpham, West Sussex PO22 8NP
- 1.1.2 This FRA has been undertaken in accordance with Planning Practice Guidance: Flood Risk and Coastal Change (FRCC) and National Planning Policy Framework Section 10.
- 1.1.3 The proposed development will involve the construction of 23 residential units, whilst allowing for the retention of both Bonhams and Flints – two properties which currently exist on the site.
- 1.1.4 In preparing this report, RGP has made reference to the following documents and information:
- Environment Agency Flood Maps for Planning
 - Long Term Flood Risk Assessment Surface Water Flood Risk Maps
 - Long Term Flood Risk Assessment Reservoir Flood Risk Maps
 - Local Authorities Strategic Flood Risk Assessment
 - West Sussex County Council Drainage Records
 - Topographical Survey
 - LiDAR data
 - British Geological Survey & Report

1.1.5 This FRA has been prepared to assess if the proposed development is suitable for the site and confirms if mitigation is required to ensure that flood risk is not increased and that the proposed development remains safe during its design life.

1.1.6 This report has been prepared for the benefit of the named Client only.

1.2 Site Location and Description

1.2.1 The site is located on the Southern side of Hoe Lane, Flansham. The site is currently accessible via Hoe Lane off the A259. The A259 runs both East and Westbound to the Southern boundary of the site.

1.2.2 The site is located approximately 2.41km inland and lies approximately 4km from Bognor Regis, 13km from Chichester, 21km from Worthing, 39km from Portsmouth and 43km from Brighton.

1.2.3 The site lies at approximately 3.12m AOD to 2.01m AOD and falls from South to North.

1.2.4 There are no main rivers recognised within the vicinity of the site, however there is an existing watercourse which runs from West to East at the Northern boundary of the site. WSCC also confirm that the site once had historic ditches running around most of its boundaries, as well as an historic watercourse running North to South across the site.

1.2.5 The site is currently occupied by two main existing structures; Bonhams and Flints. In addition to this, there are six outbuildings as well as two sheds of varying construction types. All existing structures, except for one shed, are located along the Western boundary of the site.

1.2.6 The overall site area is 1.97Ha as shown on drawing **SK200**.

1.2.7 The existing impermeable area is 1587m² (0.15Ha) as also shown on drawing **SK200**.

1.3 Ground Conditions

- 1.3.1 An intrusive geotechnical study has **not** been undertaken for the site, meaning precise infiltration testing results are not available. Furthermore, as a direct result it has not been possible to ascertain or determine the level of Groundwater, as Groundwater monitoring has not been conducted.
- 1.3.2 An historical borehole exists to the North East of the site (SU90SE27) as confirmed by BGS (**Appendix C**), with a recorded depth of 6.2m. At the time of the survey (October 1981), topsoil was recorded as being 400mm deep, with 'Brick earth' consisting of clay, silty, brown mottled grey-brown soil (2.40m thick), 'Raised Beach Deposits' consisting of silt, very sandy, chalky with chalk pebbles soil (1.9m thick) and 'Upper Chalk' (soft, weather at top) soil (1.50m thick) also contributing towards the overall recorded geological composition of the site.
- 1.3.3 With reference to the borehole mentioned in **1.3.2**, where the surface level was recorded as being 3.70m AOD, water was experienced during excavation works 800mm below the surface (2.90m AOD).
- 1.3.4 Information available from the BGS provides an indication as to the bedrock geology associated with the site. It is believed that the soil consists of Lewes Nodular Chalk Formation, Seaford Chalk Formation, Newhaven Chalk Formation and Culver Chalk Forma. This, to a certain extent, is supported by the information available from the historical boring conducted in site, as mentioned in 1.3.2.
- 1.3.5 Superficial deposits are reported by the BGS as being River Terrace Deposits (undifferentiated) – Sand, Silt, and Clay.
- 1.3.6 The site is not located in a groundwater source protection zone and is outside of any groundwater vulnerability zones.

1.4 Existing Drainage

- 1.4.1 The existing drainage systems have been identified by reviewing the topographic survey along with statutory records obtained from the local Water Authority, Southern Water.

1.4.2 Surface Water

- (i) The public sewer records (**Appendix B**) show there are no public or private Surface Water sewers within the vicinity of the site. It is believed that the site currently drains to the existing watercourse(s) located along the Southern and Northern edge of carriageway in Hoe Lane via an Outfall, at the Northern extent of the site.
- (ii) The run-off from the site is naturally drained partially by infiltration but mostly by overland flow to the existing watercourse beyond the northern boundary.
- (iii) Greenfield runoff rate (Qbar) has been calculated to be 7.1l/s (Q1=6.1l/s, Q30=16.2l/s and Q100 = 22.8l/s).
- (iv) The Greenfield run-off volume is calculated to be 463.552m³ (Based on FEH, SPR of 37.00%).

1.4.3 Foul Water

- (i) The public sewer records (**Appendix B**) show there is an existing Foul Water Pumped Rising Main crossing the centre of the site, running from the West to the East.
- (ii) Although not included in the public sewer records, it has been confirmed that the Pumped Rising Main material is Ductile Iron, and is 600mm dia. in size.
- (iii) Upon exiting the site via the Eastern boundary, the Pumped Rising Main then diverts in a North-Easterly direction.
- (iv) The existing buildings on site are understood to connect to the existing public foul water sewer which runs from East to West along the centre of Hoe Lane. The size and depth of the sewer is not recorded in the public sewer records.

1.4.4 Highway Drainage

- (i) Hoe Lane is drained by traditional road gullies, the outfall of which falls 'over the edge' into the existing watercourse(s).

- (ii) The A259 is also drained by traditional road gullies which discharge into an existing swale/pond system which was recently installed with the new relief road. It is understood that this has been designed to account for a 100 year return.

2 PROBABILITY

2.1 Sources of Information

2.1.1 The NPPF requires that all sources of flooding are considered being Tidal, Fluvial, Pluvial, Groundwater, Sewers and Man-made reservoirs/canals.

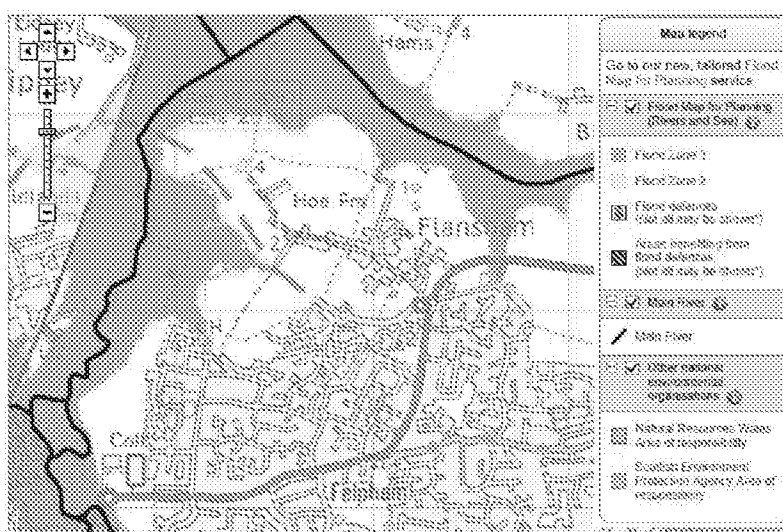
2.1.2 The likelihood of the site flooding has been established by reviewing the following information:

2.1.3

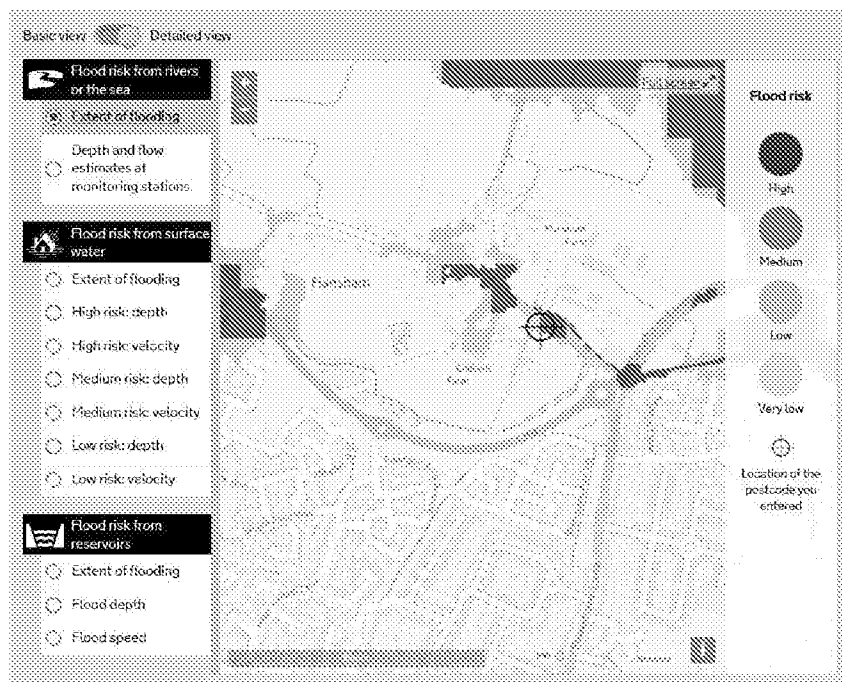
- Environment Agency Flood Maps for Planning
- Long Term Flood Risk Assessment Surface Water Flood Risk Maps
- Long Term Flood Risk Assessment Reservoir Flood Risk Maps
- Local Authorities Strategic Flood Risk Assessment
- Consultation with Local Authority/Lead Local Flood Authority
- Topographic Survey
- LiDAR Data

2.2 Flood Maps and Modelling

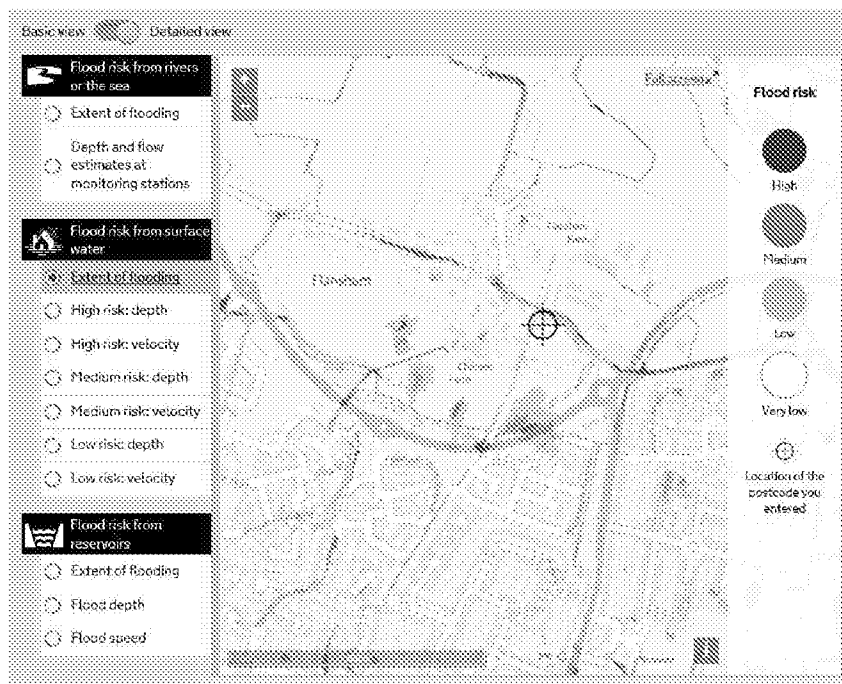
2.2.1 The Environment Agency's on-line Flood Maps for Planning (rivers and sea) show that the site is in Zone 1 (lowest risk of flooding). This is also confirmed by information and mapping obtained from West Sussex County Council. The Northern boundary of the site is highlighted as being an area which may be susceptible to low risk of flooding from rivers and sea, owing to the existence of the watercourse which runs along this boundary edge.



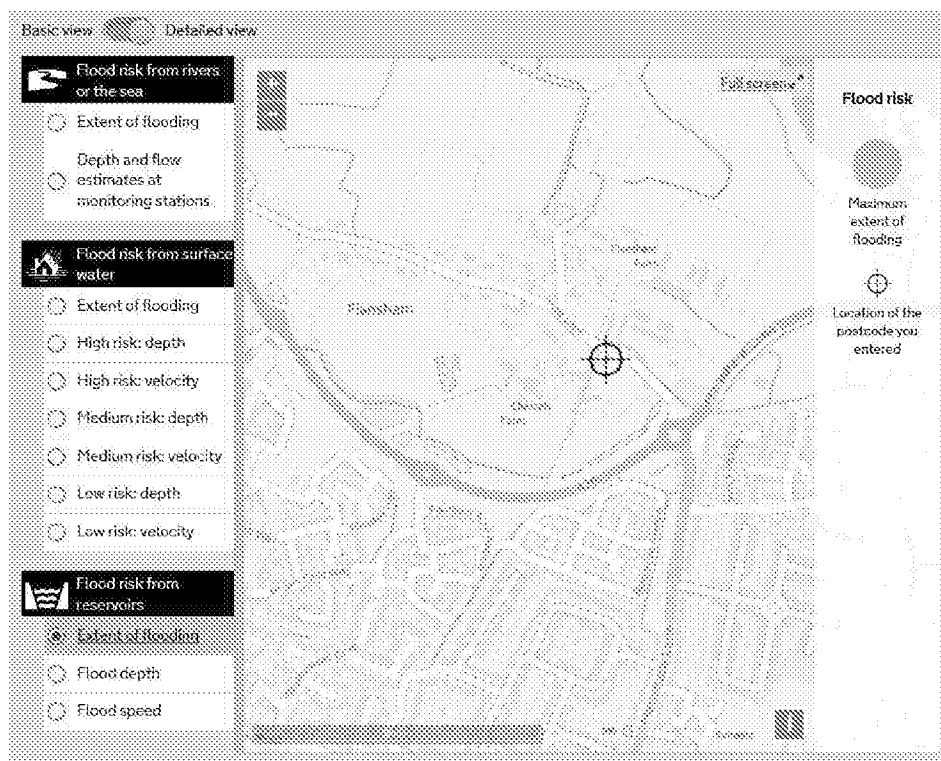
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2.2.2 The Long-Term Flood Risk Map for Surface Water show that the site is at low risk of surface water flooding. An area at the Southern extent of the site appears to be the area of the site most susceptible to this type of flooding, should such an event occur.



- 2.2.3 The Flood Maps for Reservoirs (gov.uk) show that the site is not at risk from this source.



- 2.2.4 WSCC have confirmed that ESI Groundwater Mapping shows that the north-east section of the site is at moderate to low risk of ground water flooding.

- 2.2.5 The south-east section of the site is at high risk of Groundwater flooding.

- 2.2.6 Overall, the site has a low susceptibility rating for Groundwater flooding.

2.3 Strategic Flood Risk Assessment

- 2.3.1 The site falls within the boundaries of West Sussex County Council (WSCC).

- 2.3.2 West Sussex County Council has published a Local Flood Risk Assessment, covering 2013-2018 which has been approved by the Environment Agency. This document does not specifically reference the site. Flood mapping and information obtained from West Sussex County Council is consistent with other flood maps reviewed and detailed within this report.

2.4 Historic Flooding

- 2.4.1 As confirmed by WSCC (**Appendix F**), an event of historical flooding was recorded within close vicinity of the site. The area adjacent to the site, including Hoe Lane and the A259 has flooded in the past, prior to the completion of the relief road, which has seen improved drainage and flood risk management systems installed as part of the overall design.
- 2.4.2 WSCC has confirmed that they are not aware of any historical flooding within the confines of the site.
- 2.4.3 Furthermore, WSCC has specified that they are not aware of any existing flood alleviation and defences in the area surrounding the site, nor are there any proposed in the near future.
- 2.4.4 The new relief road has been designed for 100 year return period plus climate change to mitigate against potential flood risk.

2.5 Summary of Flood Risk

- 2.5.1 WSCC's Flood Risk Management Team has provided a letter response confirming no recorded events have affected the site. WSCC has also confirmed the site is 'Flood Zone 1'.

Source of Flooding	Level of Risk
Rivers and Watercourses	Low
The Sea	Very low
Surface water	Low
Groundwater	Low
Sewers	Very low
Artificial Sources	None

3 PROPOSED DEVELOPMENT

3.1 Description of Development

- 3.1.1 The development comprises the construction of 23 dwellings with access roads, hardstanding and landscaping in addition to the retention of the two main structures currently occupying the site; Bonhams and Flints.
- 3.1.2 The type of development falls within the More Vulnerable classification (Flood Risk and Coastal Change Table 2) and is compatible with Flood Zones 1 and 2 (Flood Risk and Coastal Change Table 3).

Flood Zones	Flood Risk Vulnerability Classification				
	Essential infrastructure	Highly vulnerable	More vulnerable	Less vulnerable	Water compatible
Zone 1	✓	✓	✓	✓	✓
Zone 2	✓	Exception Test required	✓	✓	✓
Zone 3a †	Exception Test required †	x	Exception Test required	✓	✓
Zone 3b *	Exception Test required *	x	x	x	✓ x

- 3.1.3 The proposed development encompasses the entire site and has an impermeable area of approximately 5091m², compared to 1587m² in its current use. This is demonstrated as per drawing **SK200**.
- 3.1.4 The proposed site layout is shown on drawing **17-01_003_D (Appendix A)** prepared by MH Architects.

4 PROPOSED DRAINAGE STRATEGY

4.1 Surface Water

- 4.1.1 The SUDS manual and Building Regulations set out a hierarchy of drainage methods to ensure that developments maximise the use of sustainable drainage techniques. The Hierarchy favours infiltration methods of disposal over other methods such as watercourse and sewers.

SUDS Technique	Suitable	Comments
Living Roof	Possibly	
Basins and Ponds - Constructed Wetlands - Balancing Ponds - Detention Basins - Retention Ponds	Yes Yes Yes Yes	Constraints on site limits the use of these techniques
Filter strips and swales	Yes	
Infiltration Devices - Soakaways - Infiltration trenches and basins	No No	Precise infiltration potential of underlying soil unknown, although indications suggest infiltration would not be feasible
Permeable surfaces and filter drains - Gravelled areas - Solid paving blocks Porous paviers	Yes Yes Yes	
Tanked systems Oversized pipes Cellular tanks	Yes Yes	

- 4.1.2 As a result of the proposed development, the impermeable area(s) on the site will increase by 3504m² (from 1587m² to 5091m²), leading to a potential increase of surface water run-off. This will, however, be mitigated against through the utilisation of SuDS techniques as detailed above, as well as in the drainage strategy outlined as per drawing **SK300**.
- 4.1.3 As discussed in section 1.3, the soil underlying the site is expected to have low infiltration potential; therefore, the surface water drainage strategy should use alternative methods for disposal of surface water run-off, giving consideration to the existing overland flow routes available.

4.1.4 The proposed surface water drainage system should comprise flow restriction and surface water storage to ensure that the rate of run-off leaving the site is no more than the existing situation. The following flow rates should be applied to the design:

- **Q-Bar Rural** = **7.1l/s**
- **Q-Bar Urban** = **7.1l/s**
- **1 year return period** = **6.1l/s**
- **30 year return period** = **16.2l/s**
- **100 year return period** = **22.8l/s**

4.1.5 Surface water run-off will be discharged to the existing watercourse at a restricted rate with storage provided in the sub-base of the tanked porous paving. Roof water can be discharged into the sub-base layer(s) of the porous paving where possible. A new Surface Water outfall is proposed at the North of the site, discharging into the existing watercourse on the North boundary, subject to land drainage consent. It is proposed that the flow control device restricts the discharge to a minimum of 7.1l/s (Q-Bar).

4.1.6 The strategy above will ensure that there is no increase in the rate of run-off leaving the site, therefore no increase in the risk of flooding from this source.

4.1.7 The drainage strategy is shown on drawing **SK300**.

4.2 Treatment

4.2.1 The use of porous paving will ensure that the run-off from the road receives a level of treatment that meets the requirement of the SUDS Manual due to naturally occurring microbes digesting Hydrocarbons entering the system and the filtration effects of the aggregates and geotextiles.

4.2.2 Impermeable hard stand areas will be drained by trapped road gullies and/or channel with a sump providing a basic level of treatment by collecting silts and oil pollutants. Catchpits will also be provided to collect silts and oil pollutants.

4.2.3 The CIRIA SUDS Manual C753 outlines three categories of pollution hazard identification for the various types of land use as follows:

- (i) Total Suspended Solids (TSS).
- (ii) Metals (M).
- (iii) Hydrocarbons (H).

4.2.4 In accordance with C753 table 26.2 the proposed land uses at the site are categorised as follows:

- (i) Residential Roofs - very low/TSS-0.2/M-0.2/H-0.05.
- (ii) For other impermeable surfaces - low/TSS-0.5/M-0.4/H-0.4.

4.2.5 In accordance with C753 table 26.3 to establish whether a proposed surface water management technique can provide sufficient treatment for runoff, the values are compared. If the treatment score for each pollutant category is higher than the pollution score then the chosen technique is sufficient. If a single technique is not judged to provide enough treatment then other techniques can be added to the system.

4.2.6 The treatment afforded by the proposed outline surface water management strategy has been assessed based on the following components:

- (i) Permeable pavement – TSS-0.7/M-0.6/H-0.7

4.2.7 In conclusion, the proposed porous pavement can be considered to provide sufficient treatment.

4.3 Foul Water Drainage

4.3.1 The site General Arrangement has been designed to cater for the arterial sewer protection strips.

4.3.2 It is proposed to connect the proposed development to the existing public foul water sewer located in the centre of Hoe Lane, subject to confirmation of its levels.

4.3.3 Based on the residual design guidance provided in Sewers for Adoption, the proposed foul flow will be in the region of 1.06l/s or 4,000 l/day.

4.4 Climate Change

- 4.4.1 NPPF sets out percentage increases to be applied to the peak rainfall intensity values used in the design of a surface water drainage system to allow for the effects of climate change.
- 4.4.2 In accordance with NPPF 'climate change allowances' update 12th April 2016, an increase of 20% should be applied for this development and a review should be undertaken to determine the impact of an increase of 40%. This has been applied to relevant calculations.
- 4.4.3 The available flood maps and the SFRA suggest that the effects of climate change will not affect the flood zone in which the site lies.

5 RESIDUAL RISK AND MITIGATION

5.1 Residual Risk

- 5.1.1 As discussed in Section 2, the site is low risk of flooding from all sources therefore there is no residual risk of flooding.

5.2 Mitigation

- 5.2.1 As discussed in Section 2 the site is at low risk of flooding from all sources therefore no mitigation is proposed.

6 SEQUENTIAL AND EXCEPTION TESTS

6.1 Sequential Test

- 6.1.1 The site is in Flood Zone 1 and is at the lowest risk of flooding. In view of this, the application of the sequential test is not required.

6.2 Exception Test

- 6.2.1 Table 3 within Paragraph 067 of Flood Risk and Coastal Change confirms that developments classified as "More Vulnerable" are suitable for Zones 1 & 2. The proposed development is in Zone 1 and therefore an exception test is not required.

7 FLOOD RISK MANAGEMENT

7.1 Safe Access and Egress

- 7.1.1 The proposed development falls entirely within Flood Zone 1 and is expected to remain in that zone throughout its design life.
- 7.1.2 The site is confirmed as being at low risk of surface water flooding and, in view of such, the risk of access and egress being affected by flooding is low.

7.2 Flood Warning

- 7.2.1 The site is at low risk of flooding therefore there is no requirement for a Flood Plan or warning system to be implemented.

7.3 Maintenance

- 7.3.1 Maintenance plays an important part in the long-term performance of a surface water drainage system and will be required to ensure that it remains fully operational.
- 7.3.2 The traditional parts (inspection chambers, pipes, gullies etc.) of the proposed surface water drainage system will need a minimal amount of maintenance similar to other traditional systems.
- 7.3.3 The site will rely on the existing watercourse network to convey surface water run-off. The riparian owner of a watercourse is responsible for its maintenance. This is likely to include ensuring all branches of the watercourse are free flowing and de-silted at periodic intervals. Failure to do so could result in an increased risk of flooding upstream and/or downstream of the site.
- 7.3.4 It is recommended that the applicant prepares a simple maintenance strategy by monitoring the existing watercourses for the duration of the construction works to ensure the works and plant operations do not damage or silt up any of the watercourses. Any signs of damage or silting up should be rectified immediately and measures implemented to ensure that the problem is not repeated. All watercourse within the site shall be repaired and cleaned on completion of the works.

- 7.3.5 It is likely that this information will be required in order to obtain the Land Drainage Consent approval.
- 7.3.6 The SUDS devices will require slightly more maintenance focusing on reducing the amount of silt that is allowed to enter the system. Upstream catchpits and gully sumps will need to be regularly emptied of silt.
- 7.3.7 It is important to ensure that the porous paved areas are properly maintained in accordance with the manufacturers recommendations which may include:
- Periodic surface sweeping to reduce silt and debris accumulation.
 - Periodic silt removal from porous paved construction.
 - Redressing the joints on the block paved surface as required.
- 7.3.8 It is recommended that a simple maintenance strategy is prepared by monitoring the proposed drainage system over a specific duration to establish the rate at which silt builds up, which can then inform a programme of regular works.
- 7.3.9 It is anticipated that a management company will be responsible for the ongoing maintenance of the proposed surface water drainage system on the site.

8 OFFSITE IMPACTS

- 8.1.1 The proposed development will not have an impact on flooding issues off-site.
- 8.1.2 There will be no increase in the rate of run-off leaving the site and no significant impact to the existing water courses.
- 8.1.3 There will be no adverse impact on overland flood flow routes because the proposals will follow the existing general topography (falls from south to north).
- 8.1.4 The effects of climate change should be considered in the design of the proposed surface water drainage system, to ensure there is no off-site impact.

9 SUMMARY

- 9.1.1 This site-specific flood risk assessment is based on Flood Maps, the Local Authority's Strategic Flood Risk Assessment, Topographical Survey data, LiDAR and Public Sewer Records.
- 9.1.2 The site is currently occupied by two main existing structures; Bonhams and Flints, along with six additional outbuildings and two sheds. Apart from one shed, all structures are located along the Western boundary of the site.
- 9.1.3 The site is approximately 1.97Ha in size and lies at approximately 3.12m to 2.01m AOD, sloping from South to North.
- 9.1.4 The existing impermeable area is 0.16ha and will increase to 0.51Ha because of the development.
- 9.1.5 The site lies within Flood Zone 1 and it is expected to remain in that zone for the duration of the development's life expectancy.
- 9.1.6 The run-off from the site is naturally drained, partially by infiltration, but mostly by overland flow to the existing watercourse along the northern boundary.
- 9.1.7 The wastewater from the proposed development will require a new connection to the public foul sewer located to the North of the site, in Hoe Lane.
- 9.1.8 The proposed drainage system will be designed to accommodate a 1 in 100 year critical design storm and cater for the effects of climate change by including a 20% increase in peak rainfall intensity. The impact of a 40% increase will be assessed.
- 9.1.9 There will be an increase in the rate of run-off generated by the site which will be dealt with using SUDS techniques within the boundary of the site ensuring that there is no impact offsite.
- 9.1.10 Following completion of the development the flood risk both on and off the site will remain unchanged
- 9.1.11 Application of the Sequential Test and Exception Test is not required.

- 9.1.12 A maintenance regime should be established to ensure the long-term effectiveness of the surface water drainage system.
- 9.1.13 In conclusion, from a flood risk point of view the proposed development is suitable.

Plans and Drawings

SK100	Site Location Plan
SK101	LiDAR Contours
SK102	LiDAR Banding
SK200	Impermeable Area Comparison
SK300	Drainage Strategy



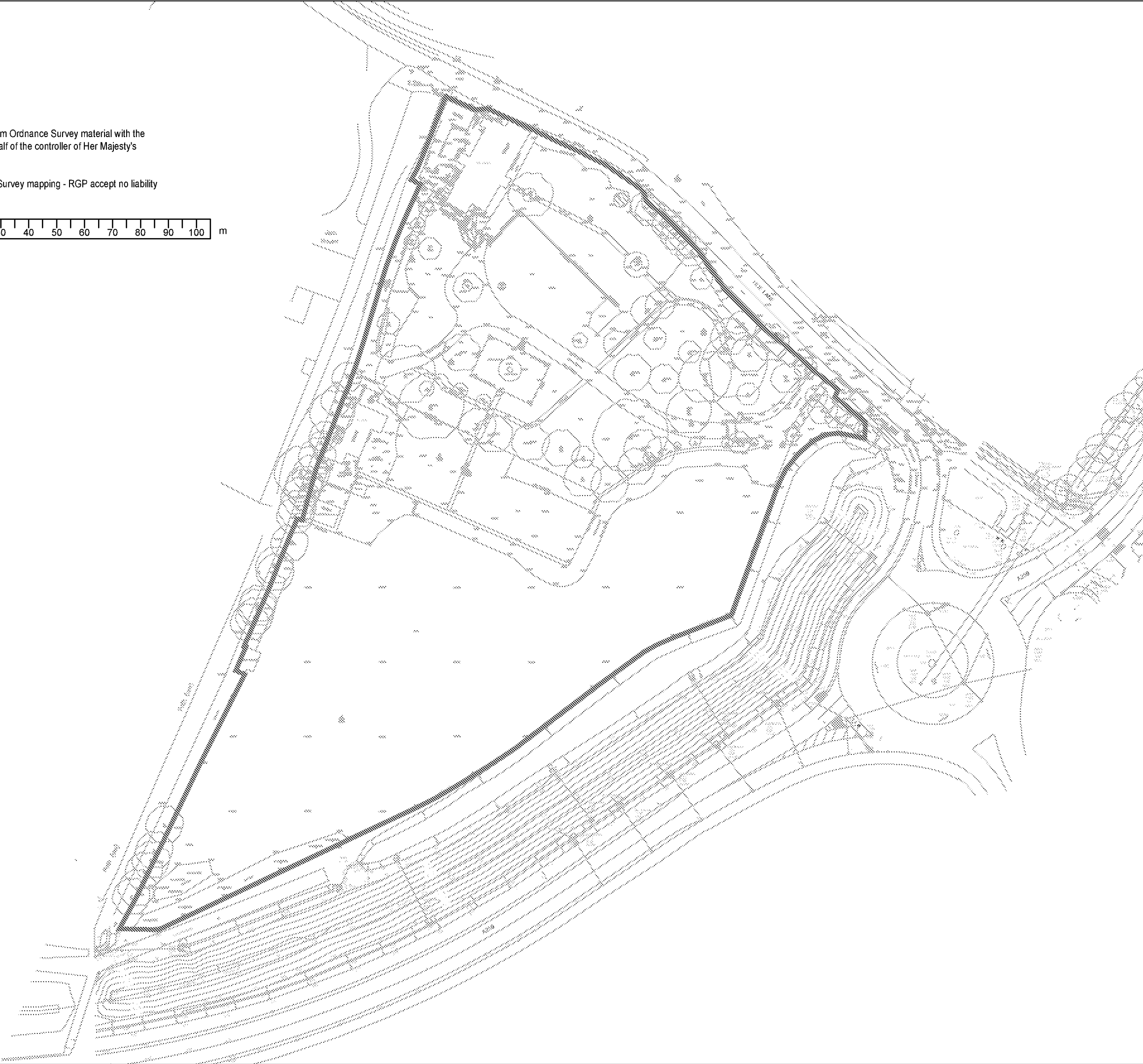
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NOTES

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4. Any information given regarding existing underground services is given in good faith after consultation with the relevant authority, however accuracy is not certain.

-KEY-

 Site Boundary - 1.97ha

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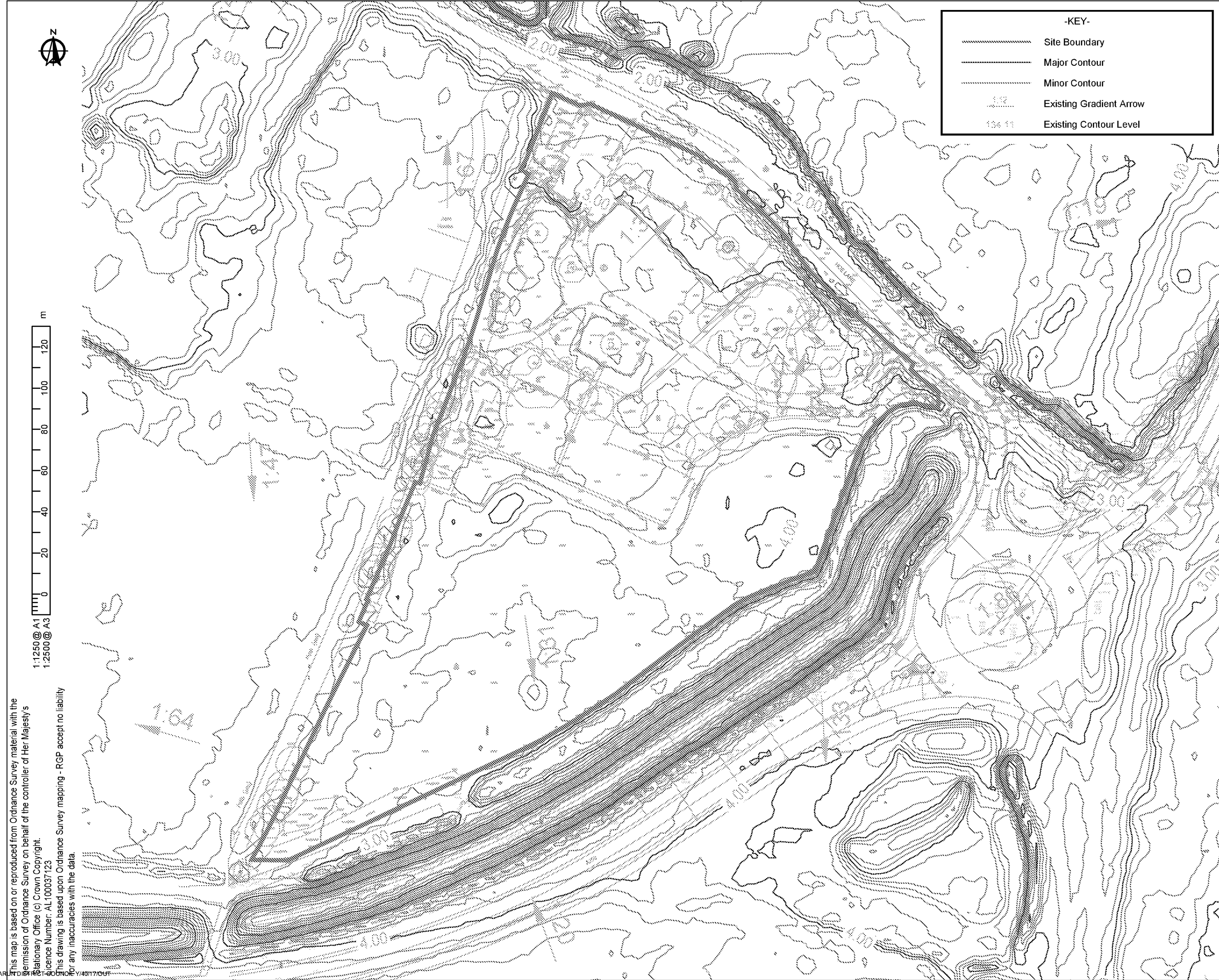
Project

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Drawing Title

Site Location Plan

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-KEY-	
	Site Boundary
	Major Contour
	Minor Contour
	Existing Gradient Arrow
	Existing Contour Level

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Client Pallant Homes Limited			
Project Bonhams, Flansham, Felpham, West Sussex PO22 8NP			
Drawing Title LIDAR Contours			
Scale	1:1250	Drawn By SPB	Checked By MJA
Date	May 2017	Approved By MJA	Rev. -



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- |
|------------------|---------------------------------|-----------|

Figure 1 is a line graph showing the variation of the ratio of the maximum value of the normalized velocity profile to the maximum value of the normalized velocity profile at the inlet ($V_{max}/V_{max,inlet}$) versus the normalized axial distance (z/L). The x-axis ranges from 0 to 120, and the y-axis ranges from 0 to 1.25. Three curves are plotted for different values of the parameter A : $A=1$ (solid line), $A=43$ (dashed line), and $A=43$ (dotted line). All curves start at (0, 1.0) and decrease as z/L increases. The curve for $A=1$ decreases most rapidly, reaching approximately 0.6 at $z/L=120$. The curves for $A=43$ (dashed and dotted) are nearly identical and decrease more slowly, reaching approximately 0.8 at $z/L=120$.

Pre Development Impermeable Area = 1587m²



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This drawing is based upon Ordnance Survey mapping - RGP accept no liability for any inaccuracies with the data.

Post Development Impermeable Area = 5091m²



-KEY-

Site Boundary

Existing Impermeable Area (1587sqm)

Proposed Impermeable Area (5091sqm)

Proposed Porous Paving Area (2962sqm)



NOTES

A3

- 1. This drawing is to be read in conjunction with all other RGP drawings, and with all relevant Architect's and Engineer's drawings and specification. Any discrepancies found are to be reported immediately to the Engineer
- 2. RGP accepts no responsibility for inaccuracies in data provided by third parties such as topographic surveys or Ordnance Survey mapping.
- 3. Do not scale, work to figured dimensions only. All dimensions are in millimeters unless noted otherwise and all levels are in metres from the topographic survey datum.
- 4. Any information given regarding existing underground services is given in good faith after consultation with the relevant authority, however accuracy is not certain.

B	23/11/2017	Revised Architects Layout	SPB
A	05/06/2017	Revised Architects Layout	SPB
-	15/05/2017	Original Issue	SPB
Rev	Date	Amendments	Drawn

Transport Planning and Infrastructure Design Consultants

Metro House, Northgate, Chichester, West Sussex, PO19 1BE

Tel: 01243 210418 Fax: 01483 861682 www.rgp.co.uk

Client

Pallant Homes Limited

Project	Bonhams, Flansham, Felpham, West Sussex PO22 8NP		
Drawing Title	Impermeable Areas Comparison		
Scale	1:1250	Drawn By SPB	Checked By MJA
Date	November 2017	Approved By MJA	Rev. B
		Drawing No. 2017_D1298_SK200	



Overland Flow Appraisal
Scale: 1:2000

Existing Foul Water Drains
to be Retained

Existing Watercourse(s)

Flow Control
manhole restricting
flow to 7.1/s

Proposed Surface Water outfall to
watercourse, subject to LAND
DRAINAGE CONSENT
IL 1.20 TBC at Detailed Design
Stage

Existing Culvert
IL 0.860

Existing Culvert
IL 0.970

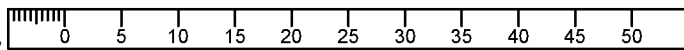
4.30m Public Sewer
Protected Strip
(SFA6)

Existing West Sussex County Council
Highway Drain SuDS Pond and
Swale Features

PUBLIC SEWERS OVERLAID TO OS
MAP FROM SOUTHERN WATER
RECORDS.

EXACT LOCATIONS OF APPARATUS
MAY VARY ON SITE & SHALL BE
VERIFIED PRIOR TO FINALISING
DRAINAGE STRATEGY.

1:500 @ A1
1:1000 @ A3



-LEGEND-	
	Site Boundary (19519sqm / 1.97ha)
	Existing Watercourse
	Existing Culvert
	Existing 8m Buffer Zone
	Existing 6000 Foul Water Rising Main
	Existing Foul Water Drain/Sewer
	Proposed Foul Water Drain
	Proposed Foul Water Manhole
	Proposed Storm Water Drain
	Proposed Storm Water Manhole
	Existing Road Gully
	Existing Highway Drainage
	Porous Paving TANKED (3538sqm)
	Proposed finished floor level subject to detailed design

NOTES

A3

1. This drawing is to be read in conjunction with all other RGP drawings, and with all relevant Architect's and Engineer's drawings and specification. Any discrepancies found are to be reported immediately to the Engineer.
2. RGP accepts no responsibility for inaccuracies in data provided by third parties such as topographic surveys or Ordnance Survey mapping.
3. Do not scale, work to figured dimensions only. All dimensions are in millimeters unless noted otherwise and all levels are in metres from the topographic survey datum.
4. Any information given regarding existing underground services is given in good faith after consultation with the relevant authority, however accuracy is not certain.

B	22/11/2017	Revised Architects Layout	SPB
A	05/06/2017	Revised Architects Layout	SPB
-	17/05/2017	Original Issue	SPB
Rev	Date	Amendments	Drawn

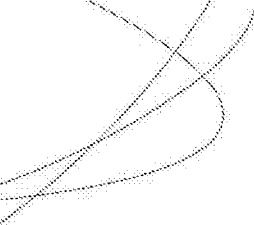

Transport Planning and Infrastructure Design Consultants
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Tel: 01243 210418 Fax: 01483 861682 www.rgp.co.uk
Client

Pallant Homes Limited

Project
Bonhams, Flansham,
Felpham, West Sussex PO22 8NP

Drawing Title
Proposed Drainage Strategy

Scale	1:1000	Drawn By	SPB	Checked By	MJA	Approved By	MJA
Date	November 2017	Drawing No.	2017_D1298_SK300	Rev.	B		



Appendices

Appendix A Architects Layout GA



Land at Bonhams
Hoe Lane
Flansham, Felpham
Pallant Homes

Project & Drawing title

Proposed Site plan

Drawn	Date	Checked	Date	Scale at A3	
CJP	May 17	HJG	May 17	1:1250	
Job N°	17-071	Drawing N°	003	Rev.	D
Status	PLANNING APPLICATION				

Ground Floor | Bicentennial Building
Southern Gate | Chichester
West Sussex | PO19 8EZ

T: 01243 774748
E: admin@mharchitects.co.uk
www.mharchitects.co.uk

Limited Company
Registered in England No 09999999

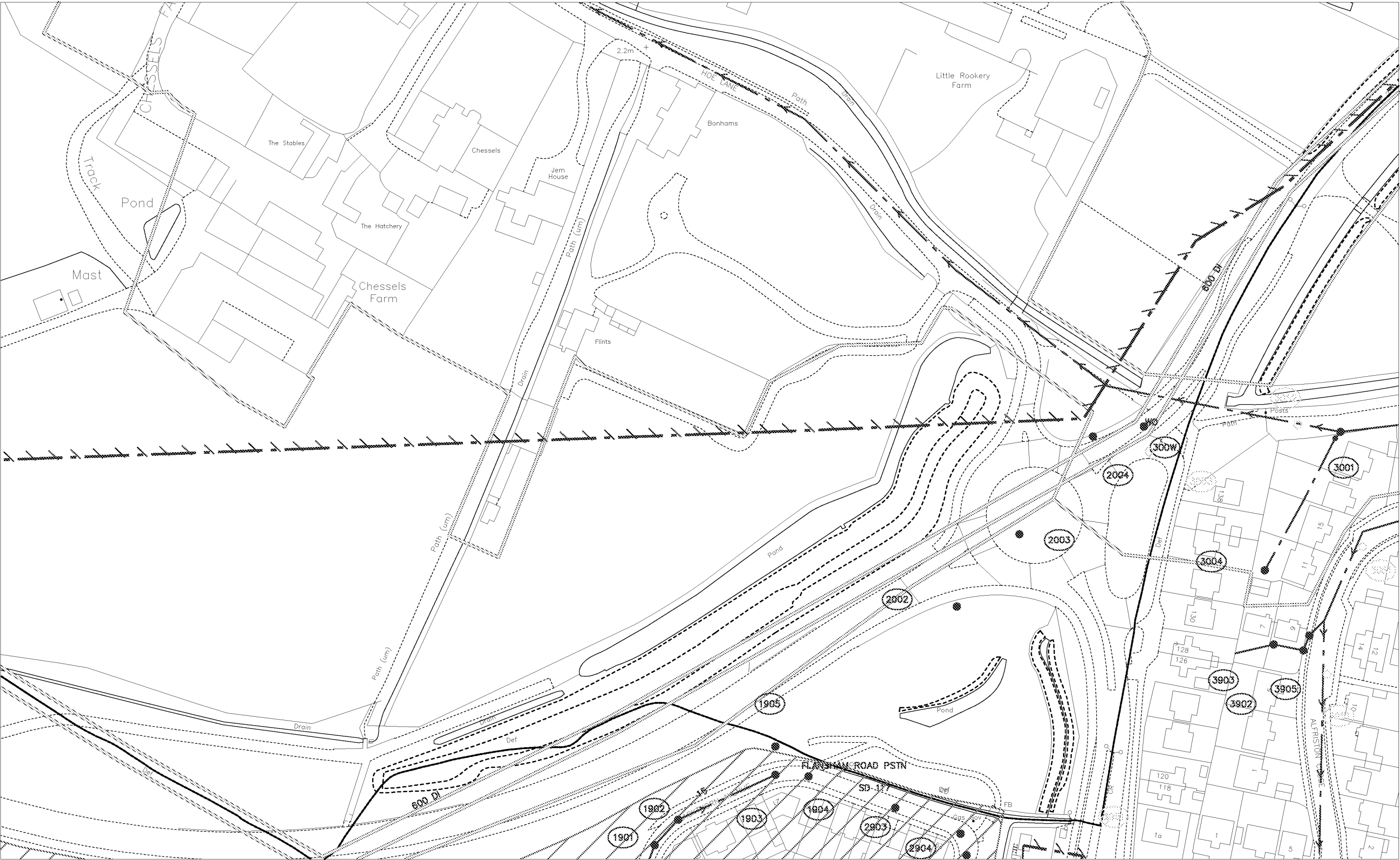
pallant
HOMES

mh
ARCHITECTS

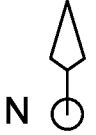
Appendix B Public Sewer Map

SEWER RECORDS PAGE 1 OF 2

101212



100924

496391	O.S. REF. SU9601SW		Drawn by: yadavs	The positions of pipes shown on this plan are believed to be correct, but Southern Water Services Ltd accept no responsibility in the event of inaccuracy. The actual positions should be determined on site. WARNING: BAC pipes are constructed of Bonded Asbestos Cement WARNING: Unknown (UNK) materials may include Bonded Asbestos Cement	 N 
	Title: 240409_Bonhams, Hoe Lane, Felp		Scale: 1:1250		
			Date: 06/04/2017		

496391

SEWER RECORDS PAGE 2 OF 2

Node	Cover	Invert	Size	Material	Shape
1101X	2.11	-0.42	525	BAC	RECT
1901X	4.801	1.577	150	VC	CIRC
1902X	4.751	1.494	150	VC	CIRC
1903X	4.437	1.172	225	VC	CIRC
1904X	4.338	1.948	150	VC	CIRC
1905X	4.35	1.082	225	VC	CIRC
2001X	2.06	0.035	525	BAC	RECT
2002X	3.69	0.625	225	VC	CIRC
2003X	3.65	0.325	225	VC	CIRC
2004X	3.2	0.057	225	VC	CIRC
2101X	2.17	-0.38	525	BAC	RECT
2903X	4.214	2.138	150	VC	CIRC
2904X	4.402	2.3	150	VC	CIRC
2905X	4.477	2.346	150	VC	CIRC
2951X	3	1.38	150	VC	CIRC
3001X	3.19		525	BAC	RECT
3002X	3.6	1.34	150	CI	CIRC
3003X	3.45	1.6	150	CI	CIRC
3004X	3.64		150	VC	RECT
3051X	3.54	1.88	150	VC	CIRC
3052X	1.88	0.8	150	VC	CIRC
3053X	2.55	1	150	VC	CIRC
3902X	3.8	1.7	150	VC	CIRC
3903X	3.74	1.87	150	VC	CIRC
3904X	3.72	2.01	150	VC	CIRC
3905X	3.76	1.5	150	VC	CIRC
3951X	3.7	2.08	300	VC	CIRC

ARUN DISTRICT COUNCIL Y/40/17/OUT

Appendix C Historical Borehole Records

SU 96 SE 27

9638 0133

Flansham

Block H

Surface level +3.7 m
 Water struck at -0.8 m
 October 1981

Waste 4.7 m
 Bedrock 1.5 m+

LOG

Geological classification

Lithology

Thickness Depth
 m m

Brickearth

Soil

0.4 0.4

Clay, silty, brown and mottled grey-brown

2.4 2.8

Raised Beach Deposits
 (younger)

Silt, very sandy, chalky, with chalk pebbles

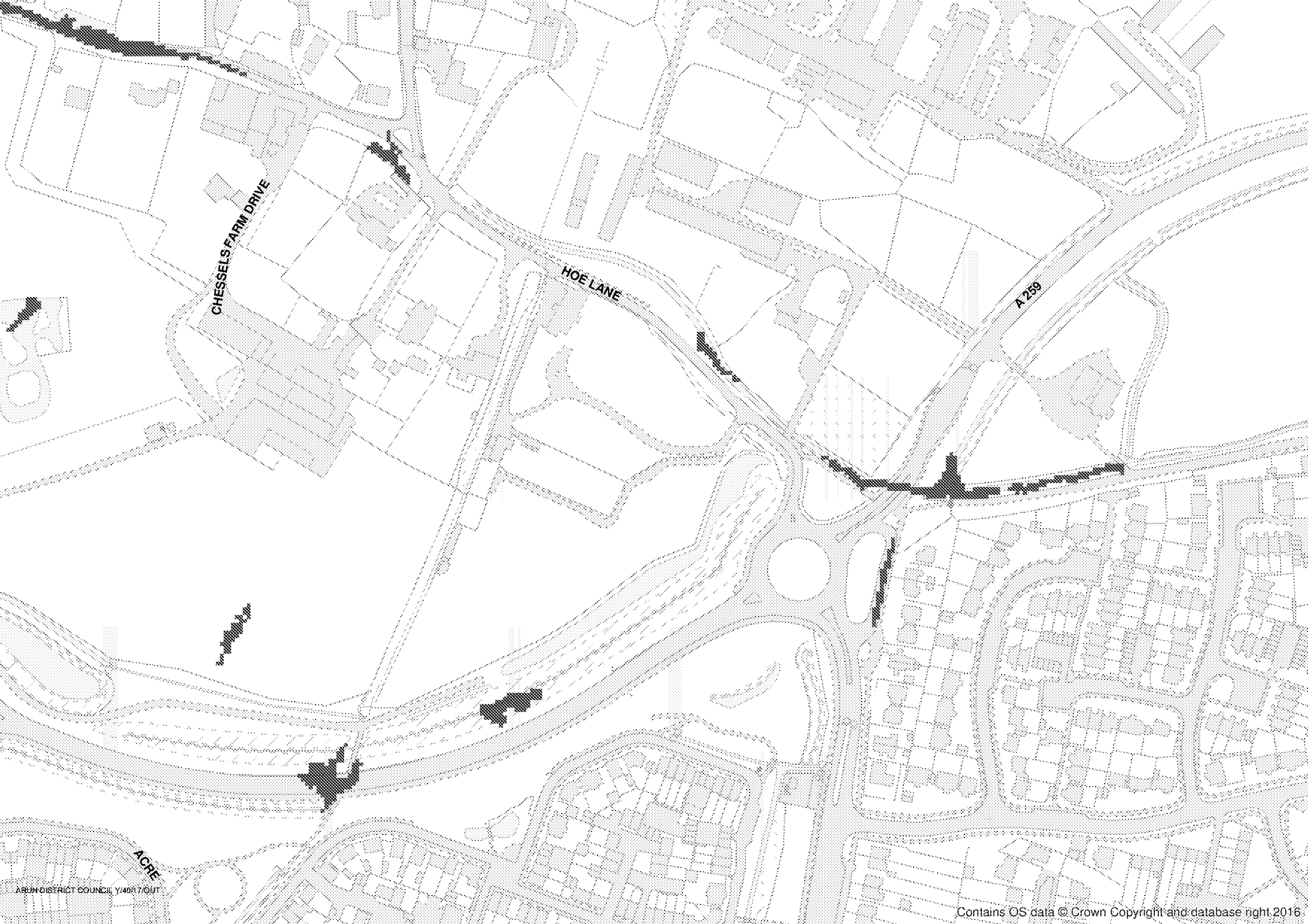
1.9 4.7

Upper Chalk

Chalk, soft, weathered at top

1.5+ 6.2

Appendix D WSCC Flood Risk Mapping & WSCC Highways

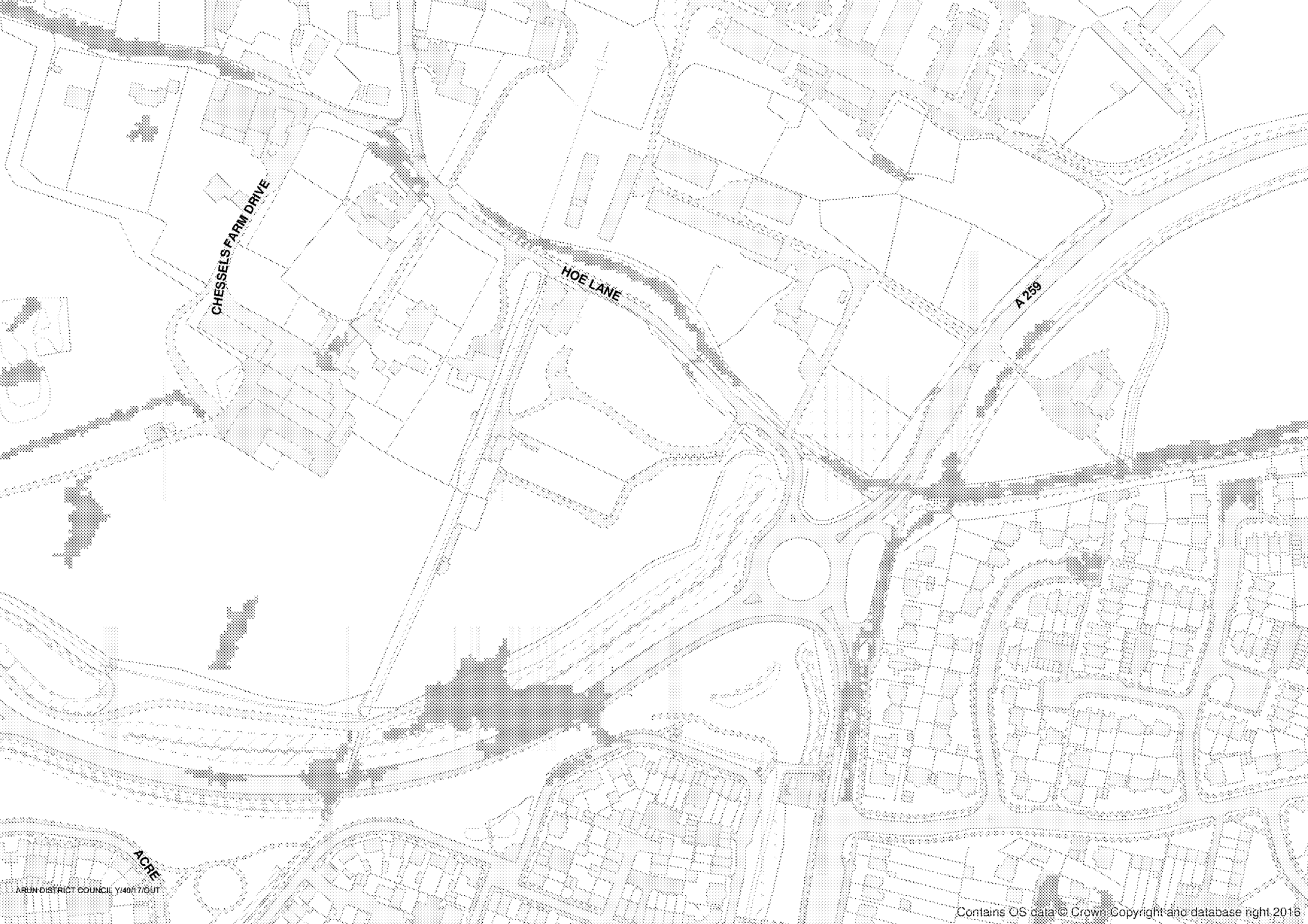


CHESELS FARM DRIVE

HOE LANE

A259

ACRE



CHESSELS FARM DRIVE

HOE LANE

A 259

ACRE

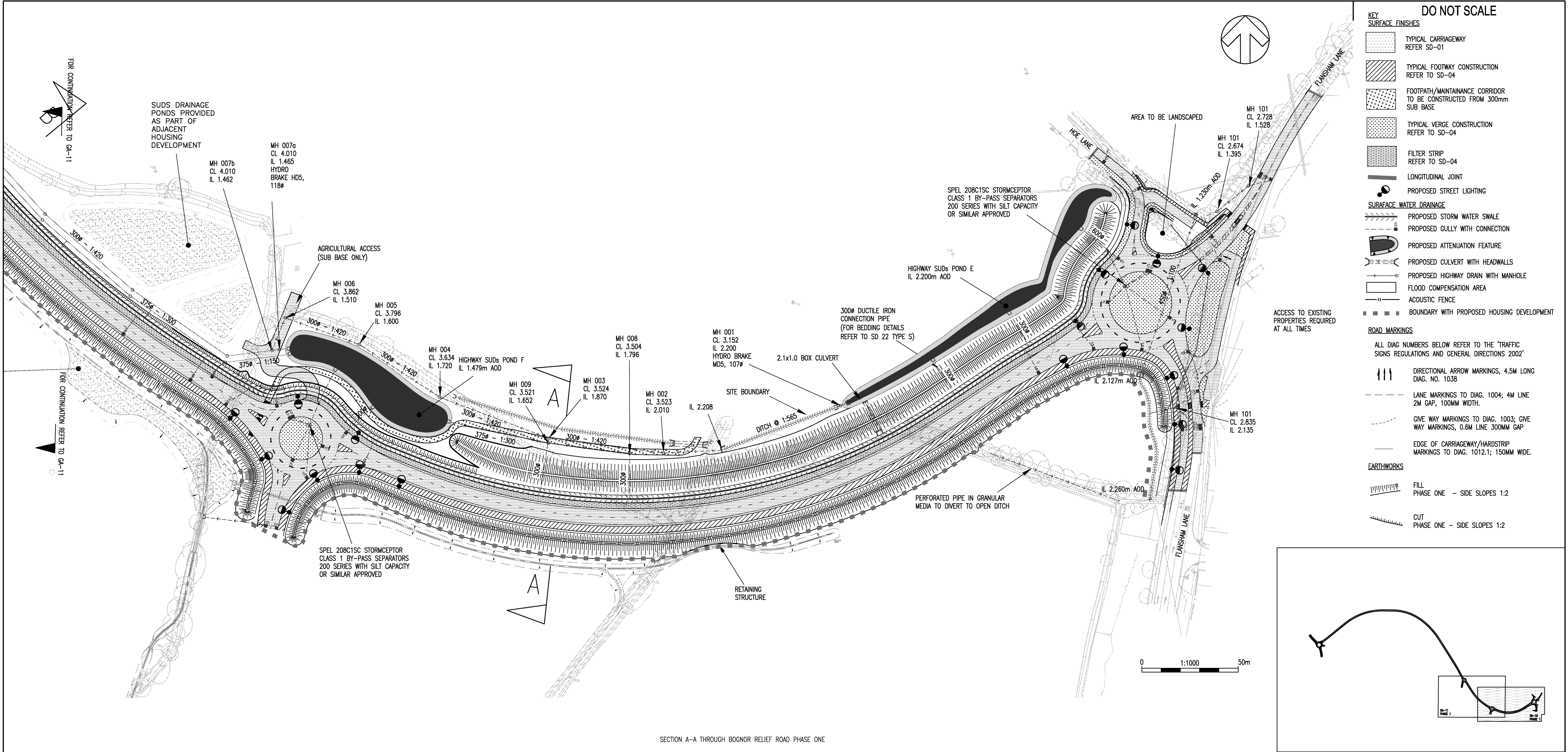


CHESELS FARM DRIVE

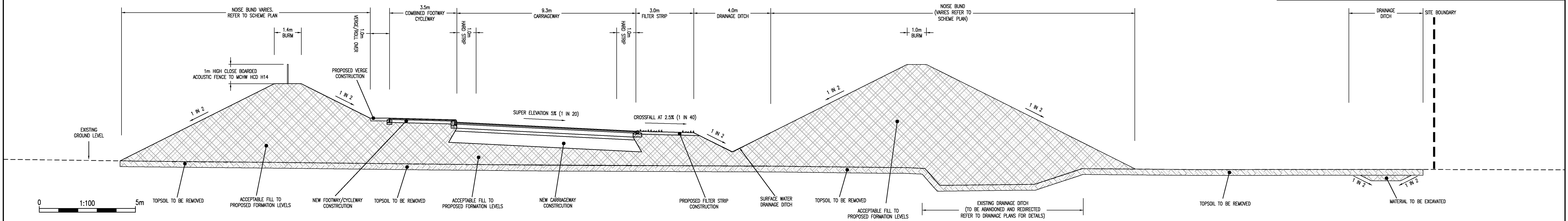
HOE LANE

A 259

ACRE



SECTION A-A THROUGH BOGNOR RELIEF ROAD PHASE ONE



NOTES:-

1. FOR BEDDING DETAILS OF PIPES UNDER THE HIGHWAY, REFER TO SD-22 TYPE 2. ALL OTHER PIPES TO HAVE BEDDING TYPE 'S' SURROUND.
2. PRIOR TO INFILLING OF DITCHES OR ABANDONMENT OF ANY EXISTING DRAINAGE COURSES THE CONTRACTOR SHALL PUT IN PLACE MEASURES TO MAINTAIN OR DIVERT EXISTING DRAINAGE ROUTES PENDING COMPLETION OF PROPOSED DRAINAGE SYSTEMS

REV	DATE	BY	DESCRIPTION	CHK	APP
C	17/12/07	GOB	DRAINAGE DETAILS ADDED	JWD	SJ
B	05/11/07	JH	STREET LIGHTING COLUMNS REMOVED	SJ	SJ
A	30/10/07	JWD	INITIAL ISSUE	SJ	SJ
DRAWING STATUS:					
FOR TECHNICAL APPROVAL					



Keble House, Southernhay Gardens, Southernhay East, Exeter, EX1 1NT
Tel: +44 (0)1392 267500 Fax: +44 (0)1392 267599
<http://www.wspgroup.com>

CLIENT:	BARRATT HOMES	PROJECT:	BOGNOR NORTHERN RELIEF ROAD	SCALE @ A1:	AS SHOWN	CHECKED:	SJ	APPROVED:	SJ
ARCHITECT:	SIMON COOPER DESIGN	CAD FILE:	11030854-GA-10	DESIGN-DRAWN:	GOB	DATE:	OCTOBER 2007	REV:	C
TITLE:		GENERAL ARRANGEMENT SURFACE FINISHES & DRAINAGE CONSTRUCTION PHASE 1 (SHEET 1 OF 2)		PROJECT No:	11030854	DRAWING No:	30854/GA/10	© WSP Group plc	

Appendix E Microdrainage/Run-off Calculations

RGP Design Limited		Page 1
Metro House Northgate Chichester PO19 1BE		
Date 09/05/2017 16:55 File	Designed by sburnett Checked by	
XP Solutions Source Control 2016.1		

ICP SUDS Mean Annual Flood

Input

Return Period (years)	100	Soil	0.400
Area (ha)	1.970	Urban	0.000
SAAR (mm)	739	Region Number	Region 7

Results l/s

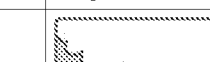
QBAR Rural	7.1
QBAR Urban	7.1
Q100 years	22.8
Q1 year	6.1
Q30 years	16.2
Q100 years	22.8

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RGP Design Limited		Page 1																										
Metro House Northgate Chichester PO19 1BE																												
Date 09/05/2017 16:58	Designed by sburnett																											
File	Checked by																											
XP Solutions		Source Control 2016.1																										
<u>Greenfield Runoff Volume</u> FSR Data <table> <tr> <td>Return Period (years)</td> <td>100</td> </tr> <tr> <td>Storm Duration (mins)</td> <td>360</td> </tr> <tr> <td>Region</td> <td>England and Wales</td> </tr> <tr> <td>M5-60 (mm)</td> <td>19.000</td> </tr> <tr> <td>Ratio R</td> <td>0.350</td> </tr> <tr> <td>Areal Reduction Factor</td> <td>1.00</td> </tr> <tr> <td>Area (ha)</td> <td>1.970</td> </tr> <tr> <td>SAAR (mm)</td> <td>740</td> </tr> <tr> <td>CWI</td> <td>110.161</td> </tr> <tr> <td>Urban</td> <td>0.000</td> </tr> <tr> <td>SPR</td> <td>37.000</td> </tr> </table> Results <table> <tr> <td>Percentage Runoff (%)</td> <td>37.33</td> </tr> <tr> <td>Greenfield Runoff Volume (m³)</td> <td>463.552</td> </tr> </table>			Return Period (years)	100	Storm Duration (mins)	360	Region	England and Wales	M5-60 (mm)	19.000	Ratio R	0.350	Areal Reduction Factor	1.00	Area (ha)	1.970	SAAR (mm)	740	CWI	110.161	Urban	0.000	SPR	37.000	Percentage Runoff (%)	37.33	Greenfield Runoff Volume (m³)	463.552
Return Period (years)	100																											
Storm Duration (mins)	360																											
Region	England and Wales																											
M5-60 (mm)	19.000																											
Ratio R	0.350																											
Areal Reduction Factor	1.00																											
Area (ha)	1.970																											
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CWI	110.161																											
Urban	0.000																											
SPR	37.000																											
Percentage Runoff (%)	37.33																											
Greenfield Runoff Volume (m³)	463.552																											
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RGP Design Limited							Page 1
Metro House Northgate Chichester PO19 1BE			D1298 Bonhams, Flansham, Felpham, West Sussex PO22 8NP				
Date 22/11/2017			Designed by SPB				
File Porous Paving Rev B.srcx			Checked by MJA				
XP Solutions			Source Control 2016.1				
<u>Summary of Results for 100 year Return Period (+40%)</u> Half Drain Time : 193 minutes.							
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	2.956	0.106	0.0	9.2	9.2	93.9	O K
30 min Summer	2.995	0.145	0.0	9.3	9.3	129.1	O K
60 min Summer	3.031	0.181	0.0	9.4	9.4	161.2	Flood Risk
120 min Summer	3.055	0.205	0.0	9.5	9.5	181.9	Flood Risk
180 min Summer	3.056	0.206	0.0	9.5	9.5	183.4	Flood Risk
240 min Summer	3.051	0.201	0.0	9.5	9.5	179.0	Flood Risk
360 min Summer	3.041	0.191	0.0	9.5	9.5	169.6	Flood Risk
480 min Summer	3.031	0.181	0.0	9.4	9.4	161.0	Flood Risk
600 min Summer	3.021	0.171	0.0	9.4	9.4	152.0	Flood Risk
720 min Summer	3.011	0.161	0.0	9.4	9.4	143.0	Flood Risk
960 min Summer	2.991	0.141	0.0	9.3	9.3	125.0	O K
1440 min Summer	2.953	0.103	0.0	9.2	9.2	91.5	O K
2160 min Summer	2.907	0.057	0.0	9.1	9.1	50.8	O K
2880 min Summer	2.876	0.026	0.0	9.0	9.0	22.8	O K
4320 min Summer	2.850	0.000	0.0	8.8	8.8	0.0	O K
5760 min Summer	2.850	0.000	0.0	7.0	7.0	0.0	O K
7200 min Summer	2.850	0.000	0.0	5.8	5.8	0.0	O K
8640 min Summer	2.850	0.000	0.0	5.0	5.0	0.0	O K
10080 min Summer	2.850	0.000	0.0	4.4	4.4	0.0	O K
15 min Winter	2.972	0.122	0.0	9.3	9.3	108.2	O K
Storm Event			Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
15 min Summer			124.633	0.0	103.3	25	
30 min Summer			83.789	0.0	144.5	38	
60 min Summer			53.779	0.0	190.1	66	
120 min Summer			33.337	0.0	238.4	122	
180 min Summer			24.832	0.0	267.8	170	
240 min Summer			20.006	0.0	289.0	200	
360 min Summer			14.706	0.0	319.0	264	
480 min Summer			11.818	0.0	342.5	332	
600 min Summer			9.966	0.0	361.6	400	
720 min Summer			8.665	0.0	376.9	468	
960 min Summer			6.943	0.0	403.1	602	
1440 min Summer			5.071	0.0	440.6	860	
2160 min Summer			3.696	0.0	479.3	1216	
2880 min Summer			2.949	0.0	507.3	1560	
4320 min Summer			2.142	0.0	547.2	0	
5760 min Summer			1.705	0.0	574.3	0	
7200 min Summer			1.427	0.0	594.4	0	
8640 min Summer			1.235	0.0	610.8	0	
10080 min Summer			1.093	0.0	624.2	0	
15 min Winter			124.633	0.0	117.8	25	
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RGP Design Limited							Page 2		
Metro House Northgate Chichester PO19 1BE			D1298 Bonhams, Flansham, Felpham, West Sussex PO22 8NP						
Date 22/11/2017			Designed by SPB						
File Porous Paving Rev B.srcx			Checked by MJA						
XP Solutions			Source Control 2016.1						
<u>Summary of Results for 100 year Return Period (+40%)</u>									
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status		
30 min Winter	3.017	0.167	0.0	9.4	9.4	148.3	Flood Risk		
60 min Winter	3.058	0.208	0.0	9.5	9.5	185.1	Flood Risk		
120 min Winter	3.089	0.239	0.0	9.6	9.6	212.3	Flood Risk		
180 min Winter	3.095	0.245	0.0	9.6	9.6	217.4	Flood Risk		
240 min Winter	3.090	0.240	0.0	9.6	9.6	212.9	Flood Risk		
360 min Winter	3.075	0.225	0.0	9.5	9.5	199.9	Flood Risk		
480 min Winter	3.061	0.211	0.0	9.5	9.5	187.2	Flood Risk		
600 min Winter	3.045	0.195	0.0	9.5	9.5	173.4	Flood Risk		
720 min Winter	3.029	0.179	0.0	9.4	9.4	159.2	Flood Risk		
960 min Winter	2.997	0.147	0.0	9.3	9.3	131.0	O K		
1440 min Winter	2.940	0.090	0.0	9.2	9.2	80.0	O K		
2160 min Winter	2.876	0.026	0.0	9.0	9.0	23.3	O K		
2880 min Winter	2.850	0.000	0.0	8.8	8.8	0.0	O K		
4320 min Winter	2.850	0.000	0.0	6.3	6.3	0.0	O K		
5760 min Winter	2.850	0.000	0.0	5.0	5.0	0.0	O K		
7200 min Winter	2.850	0.000	0.0	4.2	4.2	0.0	O K		
8640 min Winter	2.850	0.000	0.0	3.6	3.6	0.0	O K		
10080 min Winter	2.850	0.000	0.0	3.2	3.2	0.0	O K		
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)					
30 min Winter	83.789	0.0	163.8	38					
60 min Winter	53.779	0.0	214.0	66					
120 min Winter	33.337	0.0	269.5	122					
180 min Winter	24.832	0.0	302.2	176					
240 min Winter	20.006	0.0	325.2	228					
360 min Winter	14.706	0.0	359.7	284					
480 min Winter	11.818	0.0	386.5	360					
600 min Winter	9.966	0.0	406.8	436					
720 min Winter	8.665	0.0	425.4	510					
960 min Winter	6.943	0.0	453.6	650					
1440 min Winter	5.071	0.0	496.3	912					
2160 min Winter	3.696	0.0	540.3	1240					
2880 min Winter	2.949	0.0	572.7	0					
4320 min Winter	2.142	0.0	617.9	0					
5760 min Winter	1.705	0.0	649.6	0					
7200 min Winter	1.427	0.0	673.3	0					
8640 min Winter	1.235	0.0	692.9	0					
10080 min Winter	1.093	0.0	709.1	0					
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RGP Design Limited		Page 3
Metro House	D1298	
Northgate	Bonhams, Flansham,	
Chichester PO19 1BE	Felpham, West Sussex PO22 8NP	
Date 22/11/2017	Designed by SPB	
File Porous Paving Rev B.srcx	Checked by MJA	
XP Solutions	Source Control 2016.1	

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.000	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.509

Time (mins)	Area	Time (mins)	Area	Time (mins)	Area
From: To: (ha)		From: To: (ha)		From: To: (ha)	
0 4 0.170		4 8 0.170		8 12 0.169	

RGP Design Limited		Page 4
Metro House Northgate Chichester PO19 1BE	D1298 Bonhams, Flansham, Felpham, West Sussex PO22 8NP	
Date 22/11/2017	Designed by SPB	
File Porous Paving Rev B.srcx	Checked by MJA	
XP Solutions		Source Control 2016.1

Model Details

Storage is Online Cover Level (m) 3.300

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	10.0
Membrane Percolation (mm/hr)	1000	Length (m)	296.2
Max Percolation (l/s)	822.8	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	2.850	Membrane Depth (m)	0

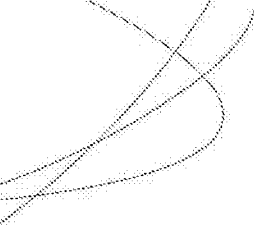
Hydro-Brake Optimum® Outflow Control

Unit Reference	MD-SHE-0124-7100-1000-7100
Design Head (m)	1.000
Design Flow (l/s)	7.1
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	124
Invert Level (m)	1.200
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	7.1
Flush-Flo™	0.299	7.1
Kick-Flo®	0.657	5.8
Mean Flow over Head Range	-	6.1

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake Optimum® as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.5	1.200	7.7	3.000	11.9	7.000	17.8
0.200	6.9	1.400	8.3	3.500	12.8	7.500	18.4
0.300	7.1	1.600	8.8	4.000	13.7	8.000	19.0
0.400	7.0	1.800	9.4	4.500	14.4	8.500	19.6
0.500	6.8	2.000	9.8	5.000	15.2	9.000	20.1
0.600	6.4	2.200	10.3	5.500	15.9	9.500	20.7
0.800	6.4	2.400	10.7	6.000	16.6		
1.000	7.1	2.600	11.1	6.500	17.2		



Appendix F WSCC Correspondence

From: Kevin Macknay [REDACTED]
Sent: Friday, March 31, 2017 4:50:23 PM
To: Mark Akmenkalns
Cc: Thomas Callaway; Paul Cann
Subject: RE: D1298 - Bonhams Felpham, West Sussex, PO22 8NP - FRA Enquiry

Mark,

Re. your recent enquiry:

Flood Zones

- **Please confirm the Flood Zones for this area.**
The site is within Flood Zone 1.
- **Please confirm surface water, reservoir flooding, sewer flooding. Please provide plans and depth data from your GIS UFMSW for 30yr, 100yr & 1000yr as applicable (OS Datum).**
See attached plans showing flood outlines for 30yr, 100yr & 1000yr events.
- **Please confirm mapping and records for any surface water assets owned or maintained.**
We do not have details of the new drainage layout recently constructed. You may be able to obtain this information from Andrew Howick.
- **Please confirm if there are any future drainage improvements proposed for this area.**
We are not aware of any currently planned.
- **Please confirm details of existing or planned flood alleviation and defences in this area.**
We are not aware of any current flood defences within the area.
- **Please confirm if you are aware of any historic flooding within the confines of the site.**
We are not aware of any historic flooding within the confines of the site. However, we are aware that the area has flooded
- **Please confirm if you are aware of any historic flooding in close vicinity and/or on the public highway.**
Yes, we are aware that the area adjacent to the site, including Hoe Lane and the A259 (old layout) has flooded in the past.

Groundwater

- **Please confirm details of any groundwater flooding issues in the area, including flood levels, flood extents and any available anecdotal information.**
ESI Groundwater mapping shows that the NE section of the site is at moderate to low risk of ground water flooding.
The SE section of the site is at high risk of ground water flooding.
The whole site has a low susceptibility rating for ground water flooding.

Assets

- **Please confirm mapping and records for any surface water assets owned or maintained.**
We do not have details of the new drainage layout recently constructed. You may be able to obtain this information from Andrew Howick.
- **Please confirm if there are any historic culverted watercourses within or in close vicinity to the site. Please provide map records where available.**
The site once had historic ditches running around most of its boundaries. It may also of had an historic watercourse running north / south across the site.

- **Please can you provide any map records denoting the highway drainage network. Is this a piped system or soakaways?**

We do not have details of the new drainage layout recently constructed. You may be able to obtain this information from Andrew Howick.

Policy/Future

- **Please confirm the most recent Strategic Flood Risk Assessment (SFRA).**

WSSC Strategic Flood Risk Assessment – January 2010

<https://www.westsussex.gov.uk/about-the-council/strategies-plans-and-policies/environment-planning-and-waste-plans-and-policies/minerals-and-waste-policy/new-minerals-local-plan/mineral-site-selection/>

WS Local Flood Risk Management Study – May 2014

<https://www.westsussex.gov.uk/fire-emergencies-and-crime/dealing-with-extreme-weather/dealing-with-flooding/flood-risk-management/local-flood-risk-management-strategy/>

- **Please confirm if there are any future drainage improvements proposed for this area.**
We are not aware of any currently planned.
- **Please confirm if any drainage studies and/or SWMP have/are being assess for this area.**
The EA are currently working on a catchment study for the Aldingbounre rife. However, we do not have a date for the publication of this study.

Kevin Macknay

Flood Risk Management – Team Leader

Economy, Infrastructure and Environment

Highways and Transport

West Sussex County Council

