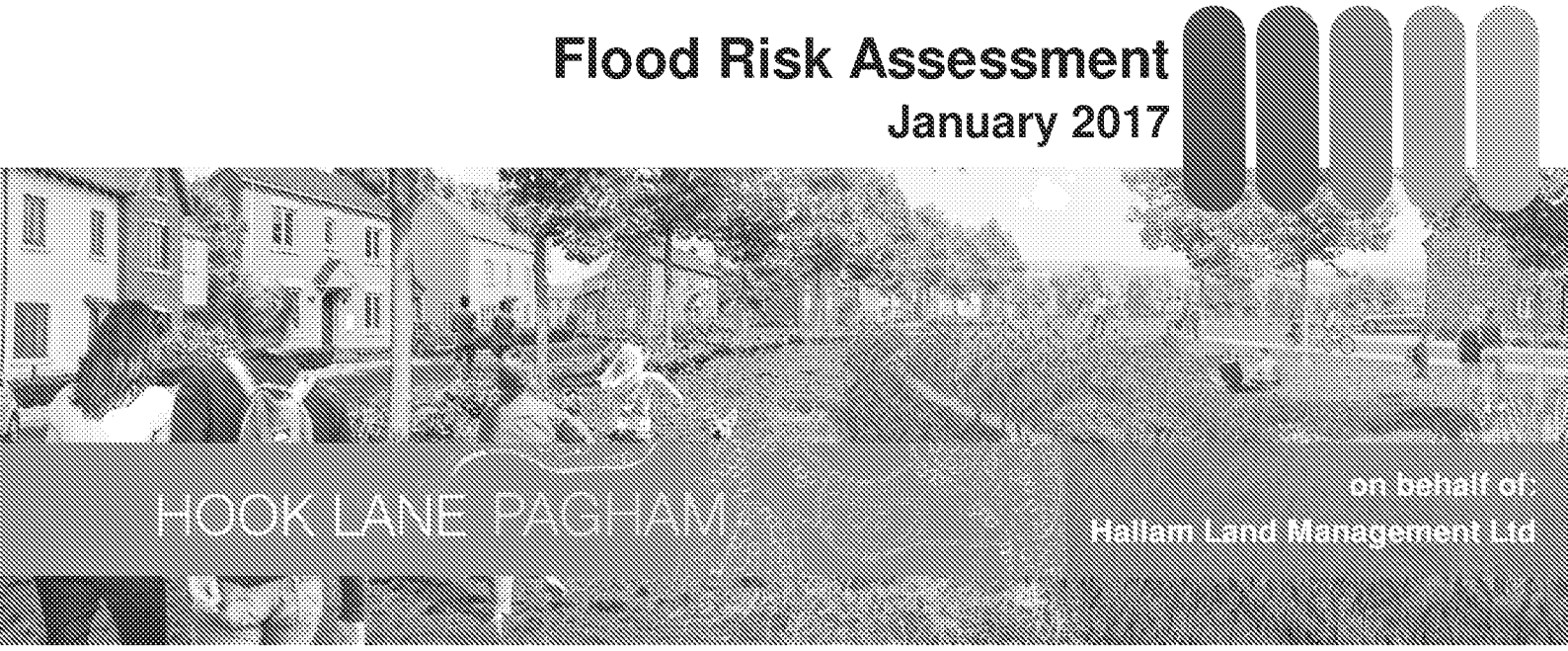
Flood Risk Assessment

January 2017



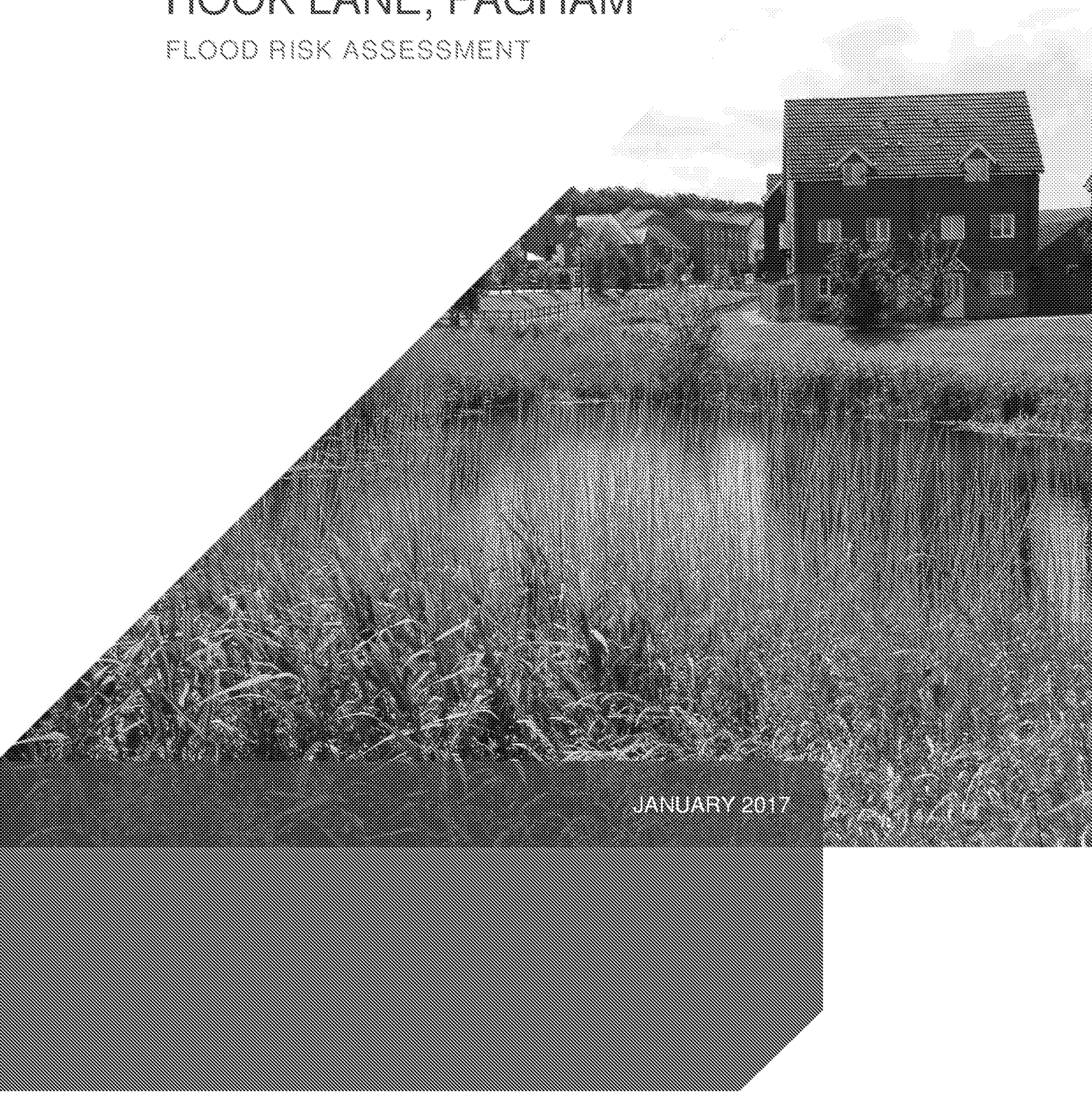
HOOK LANE PAGHAM

on behalf of:
Hallam Land Management Ltd

ARUN DISTRICT COUNCIL P/6/17/OUT

HOOK LANE, PAGHAM

FLOOD RISK ASSESSMENT



JANUARY 2017

WSP | PARSONS BRINCKERHOFF

ARUN DISTRICT COUNCIL P/6/17/OUT

HOOK LANE, PAGHAM

FLOOD RISK ASSESSMENT

Hallam Land Management Ltd

Project no: 70014147
Date: January 2017

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[redacted]

ARUN DISTRICT COUNCIL P/6/17/OUT

QUALITY MANAGEMENT

ISSUE/REVISION	FIRST ISSUE	REVISION 1	REVISION 2	REVISION 3	REVISION 4
Remarks	Draft for Comment	Revised with additional policy information	Final Issue	Revision based upon public consultation comments	Updated for new master-plan
Date	January 2016	October 2016	November 2016	December 2016	January 2017
Prepared by	Chris Brammeier	Chris Brammeier	Chris Brammeier	Phoebe Secker	Chris Brammeier
Signature					
Checked by	Dean Ward	Alison Caldwell	Alison Caldwell	Dean Ward	Dean Ward
Signature					
Authorised by	Chris Slater	Scott Mills	Dean Ward	Chris Slater	Chris Slater
Signature					
Project number	70014147	70014147	70014147	70014147	70014147
Report number	FRA01	FRA01	FRA01	FRA01	FRA01
File reference	4147 FRA Rv0	4147 FRA01 Rv1	4147 FRA01 Rv2	4147 FRA01 Rv3b	4147 FRA01 Rv4

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ARUN DISTRICT COUNCIL P/6/17/OUT

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ARUN DISTRICT COUNCIL P/6/17/OUT

1 EXECUTIVE SUMMARY

1.1.1 This Flood Risk Assessment has been undertaken to accompany the outline planning application for the proposed residential development at Hook Lane, Pagham

1.1.2 This report has been prepared by WSP UK Limited on behalf of Hallam Land Management Ltd in accordance with the guidelines set out in the National Planning Policy Framework (NPPF) published March 2012.

Table 1-1 Executive Summary

ITEM	RESPONSE
Site Location	The site is located between Pagham Road to the west, Hook Lane to the south and east and Sefter Lane to the north of the site in the Hook Lane area of Pagham. **NGR: 489600, 99200**
Proposed Development	The construction of up to 300 new homes, a care home of up to 80 beds, a 2 form entry primary school, the formation of new means of access onto Hook Lane and Pagham Road, new pedestrian and cycle links, the laying out of open space, new strategic landscaping, habitat creation, drainage features and associated ground works and infrastructure.
Environment Agency Flood Zone	The site lies wholly within Flood Zone 1; being land assessed as having less than a 1 in 1,000 year annual exceedance probability (0.1% AEP) of river or sea flooding and thus, the most appropriate location for development when appraised against the DCLG National Planning Practice Guidance 2014.
Flood Risk Vulnerability Classification	More Vulnerable
Fluvial Flood Risk	Low risk of fluvial flooding
Tidal Flood Risk	Low risk of tidal flooding
Surface Water Flood Risk	Low risk of surface water flooding
Groundwater Flood Risk	Low risk of groundwater flooding
Artificial Flood Risk	Low risk of flooding from artificial sources
Sequential and Exception Test	In accordance with current National, Local and Environment Agency guidance, the site lies in Flood Zone 1, being the preferred location for development and as such the sequential and exception test are not required and considered passed.
Storm Drainage	A Sustainable Drainage Scheme (SuDS) is proposed to deal with surface water run-off from the proposed development site in line with current best practice recommendations. Through utilisation of a number of above ground, naturally landscaped features such as attenuation basins, it will be possible to reduce run-off to a rate below the current baseline during extreme storms.
Foul Drainage	Foul drainage will discharge to the existing Southern Water network in the vicinity of the site. Southern Water has proposed a connection point but has stated there is insufficient capacity within the current network. Southern Water has provided an indication of required reinforcement work which will be required to provide capacity for foul flows.

2 INTRODUCTION

2.1 BACKGROUND

2.1.1 WSP | Parsons Brinkerhoff has been appointed by Hallam Land Management Ltd to prepare a Flood Risk Assessment (FRA) in accordance with the National Planning Policy Framework (NPPF) for a proposed development at Hook Lane, Pagham (Post Code: PO21 3PB), which is to have a residential end use.

2.1.2 The objective of the study is to demonstrate that the site can be developed safely, without exposing the development to an unacceptable degree of flood risk or increasing the flood risk to third parties. The objectives are to:

- Confirm the sources of flooding which may affect the site;
- Provide an appraisal of the availability and adequacy of existing information;
- Provide a drainage strategy for the proposed development; and
- Undertake an appraisal of the flood risk posed to the site and potential impact of the development on flood risk elsewhere.

2.2 LIMITATIONS

2.2.1 WSP | Parsons Brinkerhoff has prepared this report in accordance with the instructions of their client, Hallam Land Management Ltd, for their sole and specific use. Any persons who use any information contained herein do so at their own risk. © WSP UK Ltd 2016.

2.2.2 The conclusions and recommendations contained herein are limited by the availability of background information and the planned use for the site

2.2.3 Third party information has been used in the preparation of this report, which WSP UK Ltd, by necessity assumes is correct at the time of writing. Whilst all reasonable checks have been made on data sources and the accuracy of the data, WSP UK Ltd accepts no liability for same.

2.3 SITE LOCATION

2.3.1 The site is located in the Hook Lane area of Pagham. The site is bounded by Hook Lane to the west and south along with existing residential development. Sefter Road forms the northern boundary, beyond which are agricultural fields. Pagham Road forms the western boundary beyond which is Pagham Rife.

2.3.2 The site is currently used for agriculture with tree lines and hedgerows marking the site boundaries. The site is currently allocated as part of the Pagham North site within the Local Plan.

2.3.3 The site location plan is shown in Figure 2-1 below.

Figure 2-1 Site Location



2.4 DEVELOPMENT PROPOSALS

2.4.1 The construction of up to 300 new homes, a care home of up to 80 beds, a 2 form entry primary school, the formation of new means of access onto Hook Lane and Pagham Road, new pedestrian and cycle links, the laying out of open space, new strategic landscaping, habitat creation, drainage features and associated ground works and infrastructure.

2.4.2 The site masterplan is contained in **Appendix A**; the development proposals are planned over a gross area of circa 17.5ha.

2.5 TOPOGRAPHY

2.5.1 A detailed topographical survey was undertaken by Interlock Surveys in September 2015. This identified shallow gradients falling generally in a westerly direction towards Pagham Road. The site falls from a high point of approximately 6.68mAOD along the eastern boundary adjacent to Hook lane to a low point of approximately 4.2m in the north-west of the site, adjacent to the site boundary.

2.5.2 The full topographical survey is contained in **Appendix A**.

2.6 INFORMATION REVIEWED

2.6.1 The appraisal process consisted of a desk study, data research, site visit and consultation with regulatory bodies and third parties.

2.6.2 The following information has been used in the preparation of this report:

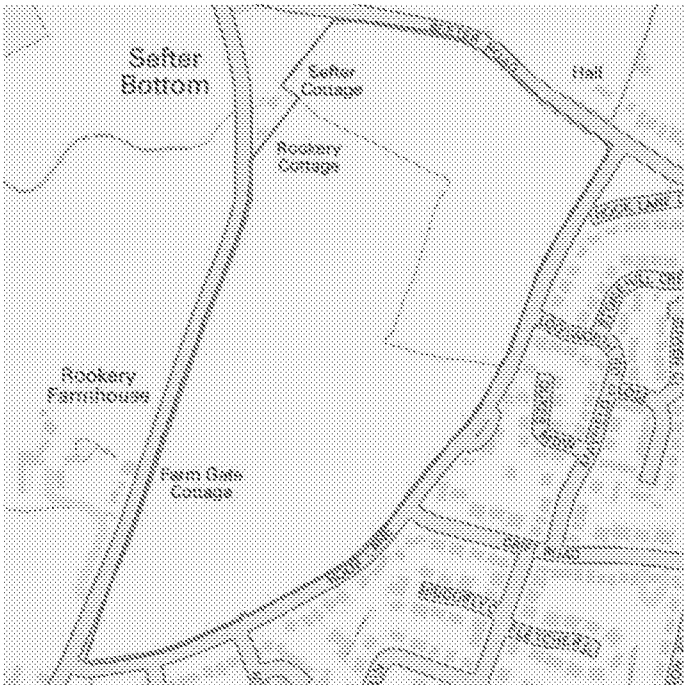
- Environment Agency Flood Mapping

- BGS Published Data
- Local Planning Policy
- National Planning Policy (NPPF, PPG)
- Good Practice Guidance (CIRIA 609, CIRIA 753)
- Site Masterplanning Information
- Topographic survey in **Appendix A**
- General correspondence in **Appendix C**
- Southern Water sewer records **Appendix D**

2.7 GEOLOGY

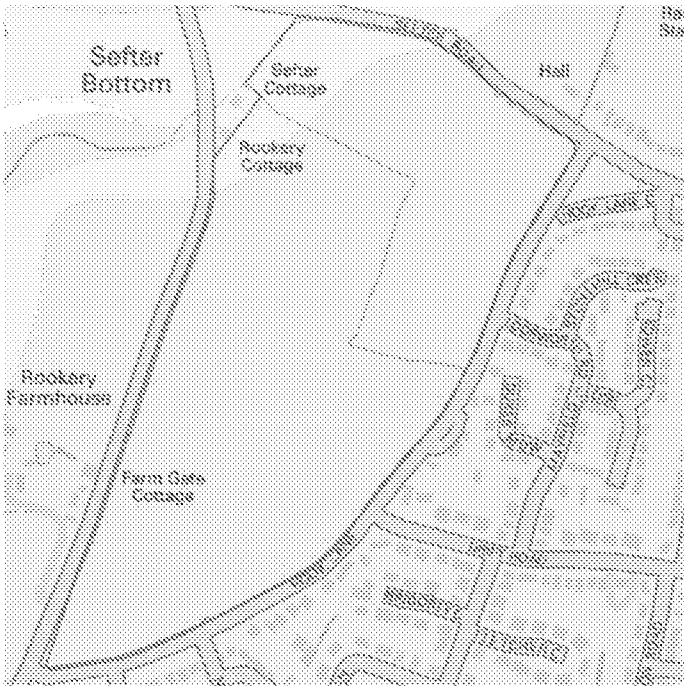
2.7.1 Reference to the BGS published mapping identifies the site to be underlain by bedrock of London Clay. Superficial deposits of predominantly River Terrace Deposits with a small amount of Raised Beach Deposits in the far northern corner are also identified. An extract of the BGS maps shown in Figure 2-2 and Figure 2-3 below.

Figure 2-2 BGS Bedrock Geology Map Extract[1]



[1] Contains British Geological Survey materials ©NERC [2013]

Figure 2-3 BGS Superficial Geology Map Extract[2]



River Terrace Deposits (Undifferentiated – Sand, Silt and Clay)

Raised Beach Deposits – Sand and Gravel

2.7.2 There is a single borehole registered to the north-west of the site boundary; no other boreholes are located close to the site. The following general ground profile is recorded:

Table 2-1 BGS Borehole Summary

DESCRIPTION	APPROXIMATE DEPTH (m BGL.)
Drift Deposits	Up to 5.5m
London Clay	5.5-53.3m
Reading Beds	53.3-85m
Upper Chalk	85m+

2.7.3 According to the Source Protection Zone map provided by the Environment Agency, the site does not lie within any Source Protection Zone.

2.7.4 The online Environment Agency Groundwater map (Superficial Deposits Designation) indicates the site is underlain by a secondary aquifer. This aquifer has been characterised as a 'Secondary A' aquifer. That is permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers.'

2.7.5 The online Environment Agency Groundwater map (Bedrock Designation) indicates that the site comprises stratum that is considered 'Unproductive Strata'. That is, impermeable layers incapable of supporting water supplies.

2.7.6 Site investigations completed by WSP | Parsons Brinckerhoff indicates the site geology consists of River Terrace Deposits, supporting the information provided by the BGS superficial geology map.

[2] Contains British Geological Survey materials ©NERC [2013]

2.7.7 Testing to BRE Digest 365 was conducted on site. Testing indicated that the underlying geology was relatively impermeable. The Soakaway Report produced by WSP | Parsons Brinckerhoff is included in **Appendix E.** The calculated infiltration rates are summarised below in Table 2-2.

Table 2-2 Calculated Infiltration Rates

EXPLORATORY LOCATION	STRATUM DESCRIPTION	TOTAL TEST TIME (M)	TOTAL FALL IN WATER LEVEL (M)	INFILTRATION RATE (M/S)
SA01C	Stiff grey brown slightly sandy CLAY	240	0.12	N/A
SA02B	Stiff light brown CLAY	180	0.05	N/A
SA03	Firm orange brown mottle grey brown CLAY	210	0.00	N/A
SA04	Stiff to firm orange brown slightly sandy CLAY	180	0.05	N/A
SA05	Firm orange brown CLAY	180	0.00	N/A
SA06C	Stiff orange brown CLAY	240	0.02	N/A

2.7.13 Quoting the Soakaway Report: *"Infiltration rates could not be calculated in accordance with BRE guidance for any of the test locations due to slow drainage rates and the absence of 75% effective depth soakage within the timeframe of the tests."* As such, it is unfeasible to drain the site via infiltration.

3 ASSESSMENT OF FLOOD RISK

3.1 NATIONAL PLANNING POLICY FRAMEWORK

3.1.1 The National Planning Policy Framework (NPPF) was published in March 2012 (replacing the previous guidance on flood risk – PPS25) and sets out the Government's national policies for flood risk management in a land use planning context within England.

3.1.2 Paragraph 100 of the NPPF states that local planning authorities should *'Inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk, but where development is necessary, making it safe without increasing flood risk elsewhere'.*

3.2 PLANNING PRACTICE GUIDANCE

3.2.1 The Planning Practice Guidance (PPG) expands and details the Government's national policies for flood risk management in a land use planning context within England.

3.2.2 The guidance states that local planning authorities should *'apply a sequential approach to the site selection so that development is, as far as reasonably possible, located where the risk of flooding (from all sources) is lowest, taking account of climate change and the vulnerability of future site uses to flood risk'.*

3.2.3 Allocation and planning of development must therefore be considered against a risk based search sequence as provided by the guidance. With regards to fluvial and tidal flooding, the guidance categorises the risk in four principal levels as shown in Table 3-1 below.

Table 3-1 Flood Zones (PPG Table 1)

FLOOD ZONE	PROBABILITY	DEFINITION
Flood Zone 1	Low <0.1% AEP	Land having a less than 1 in 1,000 annual probability of river or sea flooding. (Shown without colour (clear) on the Flood Map for Planning – all land outside Zones 2 and 3).
Flood Zone 2	Medium 0.1% - 1.0% AEP	Land having between a 1 in 100 and 1 in 1,000 annual probability of river flooding; or Land having between a 1 in 200 and 1 in 1,000 annual probability of sea flooding. (Land shown in light blue on the Flood Map for Planning).
Flood Zone 3a	High >1.0% AEP	Land having a 1 in 100 or greater annual probability of river flooding; or Land having a 1 in 200 or greater annual probability of sea flooding. (Land shown in dark blue on the Flood Map for Planning).
Flood Zone 3b	Functional Floodplain >5% AEP	This zone comprises land where water has to flow or be stored in times of flood. Local planning authorities should identify in their Strategic Flood Risk Assessments areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency. (Land that is also within the dark blue on the Flood Map for Planning – as not separately distinguished from Zone 3a).

3.2.4 Table 2 of the PPG gives the flood risk vulnerability classification of the development proposals as *'More Vulnerable'*. Therefore according to Table 3 of the PPG Flood Risk Guidance, the proposals are appropriate for development within Flood Zone 1.

3.3 STRATEGIC FLOOD RISK ASSESSMENT

3.3.1 Arun District Council published a joint Level 1 and Level 2 Strategic Flood Risk Assessment (SFRA) in August 2016 to replace the Level 1 and Level 2 SFRA originally published in February 2008. This document will be used in decision making and to inform decisions on the location of future development and the preparation of sustainable policies for the long-term management of flood risk.

3.3.2 The site is directly referenced in the SFRA as Pagham North 2a. Table 12-1 of the SFRA is included in **Appendix A** and states the majority of the site, 75%-100%, lies within Flood Zone 1 and 0%-25% lies within Flood Zone 2. Table 12-1 of the SFRA also states the site lies outside the Environment Agency's Historic Flood Map.

3.3.3 Pagham Harbour defences have been evaluated to determine the Standard of Protection provided to coastal flooding. The seaward defence provides protection from a flood event of an annual probability 1 in 200 however it was considered that the open beach may act to alter this defence standard. As such, the defences in Pagham Harbour provide a lower standard of protection with the raised wall defence also providing a standard of protection of 1 in 80.

3.3.4 The current preferred Shoreline Management Plan is to 'hold the line' where funds are available to maintain the current Standard of Protection. Without this approach it has been estimated that the first properties to be affected by coastal flooding would be in approximately 20 years' time.

DETAILED SITE SUMMARY

3.3.5 Further analysis of flood risk to the site is provided in the Level 2 Detailed Site Summary Tables in Appendix J of the SFRA. Relevant parts of the SFRA site specific assessment are quoted below.

"The site is entirely located within Flood Zone 1, the lowest flood risk zone for flooding from the Rivers and Sea. It is clear that the mixture of defences located along the Pagham Rife and the western section of Pagham village are influential at protecting the land adjacent to the western parcel of the site. However, in the absence of such defences, it is predicted that flooding will not affect the site area during the undefended Flood Zone 2 and 3a events. Therefore, Flood Zones are considered to represent the actual flood risk at the site."

"Groundwater flooding may be more likely, with the available datasets showing that the site is located within a 1km grid square where more than 75% of the 1km^2 area may be susceptible to groundwater flooding."

3.3.6 With regards to flood history, the Detailed Site Summary states

"There are no recorded flood incidents within this site, although incidences of flooding have been reported beyond the site boundary. Water sits on site adjacent to Elizabeth Close. Flooding of properties/highways in Elizabeth Close, Lincoln Avenue, Sefter Road, Hook Lane, Pagham Road"

3.3.7 It was determined by the SFRA that at the 100 year horizon, due to climate change, 1% of the site would be impacted by Flood Zone 3a which was modelled as a 45% increase in flood risk over the current flood extents. The area at risk of flooding due to climate change is shown in **Appendix A** and is outside of the proposed residential development area.

3.3.8 To ensure the proposed development remains safe and at a low risk of flooding from this source, it is proposed to keep this area clear of development, utilising it solely for SuDS and Open space.

3.4 STRATEGIC SURFACE WATER MANAGEMENT STUDY

3.4.1 In July 2016, Arun District Council published a Stage 1 Strategic Surface Water Management Study (SSWMS). This document was produced to develop an understanding of the current surface water catchments, identifying the required storage volumes at six strategic development site locations to mitigate surface water flood risk and outline options for surface water management schemes which may provide the necessary storage.

3.4.2 This document directly refers to the site as Pagham North and summarises the findings of a review of existing GIS and modelling data, published literature, consultations with Arun district Council and the Environment Agency, as well as a visit to the site and surrounding catchments.

3.4.3 In terms of historic flooding the document states *"Very few records of historic flooding have been found for the Pagham North strategic site. The extent of the major flood in June 2012 is one of them."* It was established that flooding had occurred at Sefter Cottage, Pagham Road after which alleviation works were carried out to mitigate the risks.

3.4.4 Further flood concerns also include surface water flooding on the northern side of Sefter Road due to a lack of maintenance by the landowner as well as regular highway flooding taking place. Drainage repairs have been carried out in Hook Lane to mitigate flood risk to property and highway which were caused by a number of issues including; highway drainage, land drainage and lack of maintenance of culverts and ditches by the landowner.

3.4.5 Further locations that are at risk to flooding include Hook Lane Close and Elizabeth Close from surface water flooding from water which is known to lie on the fields near Elizabeth Avenue. Exact causes of flooding at either location are unknown yet it is considered to be a combination of highway drainage issues, poor land drainage, lack of maintenance, blocked ditches and culvert issues.

3.4.6 The SSWMS makes a number of recommendations as to make best use of currently available drainage options to enhance future land drainage including an anti-tank ditch (culvert) that currently runs along the northern side of the site which could be utilised as part of future developments to convey flows off-site.

3.4.7 The Pagham North site was considered to be adequate to develop across the whole of the previously designated area with none of the land needed to be taken for additional flood storage.

3.5 BEACHY HEAD TO SELSEY BILL SHORELINE MANAGEMENT PLAN

3.5.1 The coastline is also covered by the Beachy Head to Selsey Bill Shoreline Management Plan, (2006) (SMP2), in which the following defence policy has been identified

"The recommended long-term plan for Felpham to Aldwick (including Felpham and Bognor Regis) is to continue to protect assets within the area through defending the present position; villages along the frontage act as a service centre for the sub region, providing a range of facilities and infrastructure that support surrounding communities. The frontage itself is an important tourist resort, offering a range of amenities for recreation, whilst the surrounding area is environmentally important, both geologically and biologically. The long term policy is considered sustainable in socio-economic, environmental and also technical terms, since the most number of assets will be protected, without detrimental loss of the beach."

3.5.2 This is summarised as 'Hold the Line' and is the recommended policy for each of the three epochs covered by the SMP: 2005-2025, 2025-2055 and 2055-2105. This policy includes continued management of the defences in the short-term, with works to maintain the standard of defence in the future. This offers reassurance that the defences will be maintained over the lifetime of the development, and that flood risk will be managed adequately.

3.6 LOCAL PLAN

3.6.1 Arun District Council published the Local Plan Publication Version in October 2014 and submitted to the Planning Inspectorate in January 2015. The plan outlines development policies up to 2031. Relevant policies from the Local Plan are included below. Where relevant, information on how the proposed development complies with the policies is also provided.

"Policy ECC SP1 – Adapting to climate change

- *The Council will support development which is located and appropriately designed to adapt to impacts arising from climate change such as the increased probability of tidal and fluvial flooding; water stress; health impacts as a result of extreme temperatures and a decline in the quality of habitats and richness of biodiversity.*
- *In order to achieve this, development must be designed to take account of the following issues:*
  - *Location (in relation to flood risk and vulnerability to coastal erosion);*
  - *Water efficiency;*
  - *Shade, cooling, ventilation, solar gain;*
  - *Connectivity to the green infrastructure network;*
  - *Layout and massing;*
  - *Resilience of buildings and building materials to extreme weather events; and*
  - *Capacity of drainage systems and incorporation of Sustainable urban Drainage Systems (SuDS)"*

3.6.2 The site is located within Flood Zone 1 and is therefore the best place to locate development. The SuDS features incorporated within the site have been sized appropriately to attenuate the critical 1 in 100 year + climate change event.

"Policy W DM2 – Flood risk

- *All development proposals must take account of relevant Surface Water Management Plans, Catchment Flood Management Plans and related Flood Defence Plans and strategies such as the Lower Tidal River Arun Strategy. The council may require financial contributions from development on sites where measures to address flood risk or to improve the environmental quality of watercourses have been identified by these Plans and Strategies."*

3.6.3 Information provided by the Strategic Flood Risk Assessment, Strategic Surface Water Management Strategy and Shoreline Management Plan are provided above in Sections 3.3, 3.4 and 3.5 respectively.

"*Policy W DM3 – Sustainable Urban Drainage Systems*

- *To increase the levels of water capture and storage and improve water quality, all development must identify opportunities to incorporate a range of Sustainable Urban Drainage Systems (SUDS), appropriate to the size of development, at an early stage of the design process.*
- *Proposals for both major and minor development proposals must incorporate SuDS within the private areas of the development in order to provide source control features to the overall SUDS design. These features include:*
  - *Green roofs*
  - *Permeable driveways and parking*

- *Soakaways*
- *Water harvesting and storage features including water butts.*

- *Proposals for major development must also integrate SUDS within public open spaces and roads, in liaison with West Sussex County Council, (the SUDS Approval Body) or its agent. SUDS must therefore be integrated into the overall design of a development and must:*
  - *Contribute positively to the appearance of the area*
  - *Effectively manage water (including its quality)*
  - *Accommodate and enhance biodiversity by making connections to existing Green Infrastructure assets and*
  - *Provide amenity for local residents (ensuring a safe environment) and*
  - *Retain existing open drainage ditches in their current form.*
- *In order to ensure that SUDS discharge water from the development at the same or lesser rate, as prior to construction, developers must:*
  - *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 and the SUDS manual produced by CIRIA.*
  - *Undertake up to six months groundwater monitoring within the winter period.*
  - *Undertake winter percolation testing in accordance with BRE365.*
  - *The proposed drainage system must be designed to ensure that there is no flooding on a 1 in 30 year storm event.*
  - *The design must also take account of the 1 in 100 year storm event plus 30% allowance for climate change, on stored volumes, to ensure that there is no flooding of properties or the public highway or inundation of the foul sewerage system. Any excess flows must be contained within the site boundary, and within designated storage areas.*
  - *Flow routes through the development must be demonstrated as a first stage in the design process, demonstrating how water will travel at or near the surface for three types of flow:*
    - ***Low flow routes**: Once surface water run-off has been collected, cleaned and controlled in source control features it will either be stored where it fell as rain in permeable pavement, or flow onward to local storage structures. The day-to-day flows from these features should travel in low flow channels through the development in a controlled way contributing to landscape quality.*
    - ***Overflows**: In the event of local blockages or surcharge a simple overflow arrangement should allow water to bypass the obstruction and return to the management train sequence until conditions return to normal.*
    - ***Exceedance routes**: When SUDS are overwhelmed by exceptional rainfall then exceedance routes protect people and property by providing unobstructed overland flow routes from the development and should be considered for all drainage schemes. The SUDS design must demonstrate that flow routes have been considered at each design stage to take into account the effect of proposed development on the natural flow pattern for the site. Exceedance routes should also be protected from future changes in land use."*

3.6.4 The proposed drainage strategy provides a disbursed system of above ground storage of surface water runoff providing both water quantity and water quality benefits along with wider bio-diversity benefits. Further information on the proposed drainage strategy is provided below in Section 5.

3.7 SEQUENTIAL AND EXCEPTION TESTS

SEQUENTIAL TEST

3.7.1 The PPG and NPPF Guidance states that Local Planning Authorities should complete a risk based "Sequential Test" when developing Local Plans, to ascertain areas most suitable, from a flood risk perspective, for future development.

3.7.2 The essence of the "Sequential Test" is to "steer new developments to areas with the lowest probability of flooding" (Paragraph 101 of the NPPF guidance)

3.7.3 In accordance with Table 2 of the PPG, the development is considered *"More Vulnerable"* which is defined as follows:

"More Vulnerable

- *Hospitals*
- *Residential institutions such as residential care homes, children's homes, social services homes, prisons and hostels.*
- *Buildings used for dwelling houses, student halls of residence, drinking establishments, nightclubs and hotels.*
- *Non–residential uses for health services, nurseries and educational establishments.*
- *Landfill* and sites used for waste management facilities for hazardous waste.*
- *Sites used for holiday or short-let caravans and camping, subject to a specific warning and evacuation plan."*

EXCEPTION TEST

3.7.4 The Sequential Test should be employed on all sites to direct development to locations having the lowest probability of flooding. Whereas, the Exception Test is to be used on selected sites where it is shown necessary, through the Sequential Test, to apply development of a given Flood Risk Vulnerability in a Flood Zone that is ordinarily reserved for a less vulnerable use.

3.7.5 Table 3 of the PPG identifies four circumstances where the combination of a given Vulnerability of Use and Flood Zone justify the application of the Exception Test. Table 3 is reprinted below:

Table 3-2 Flood Risk Vulnerability and Flood Zone Compatibility (PPG Table 3)

Flood risk vulnerability classification (see table 2)		Essential infrastructure	Water compatible	Highly vulnerable	More vulnerable	Less vulnerable
Flood Zone (see table 1)	Zone 1	✓	✓	✓	✓	✓
	Zone 2	✓	✓	Exception Test required	✓	✓
	Zone 3a	Exception Test required	✓	×	Exception Test required	✓
	Zone 3b functional floodplain	Exception Test required	✓	×	×	×

✓ Development is appropriate × Development should not be permitted

3.7.6 If identified above, any development required to complete the Exception Test must demonstrate compliance with the following requirements:

- It must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by a Strategic Flood Risk Assessment where one has been prepared; and
- A site-specific flood risk assessment must demonstrate that the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall

3.7.7 The site lies wholly within Flood Zone 1, being the area of lowest possible flood risk and therefore the most appropriate location for development. As such, the Sequential and Exception tests are not required and considered passed.

3.8 SOURCES OF FLOOD RISK

HISTORIC FLOODING

3.8.1 Historic flooding is shown in the SFRA's Appendix H included below in **Appendix A**. There are a number of historic flood events that have occurred in the immediate vicinity of the site:

- Two to the south of the site are classified as failure however the exact details are unknown.
- To the north-west of the site, there is a historic flood event recorded as a result of surface water while to the north-east of the site there are two flood events recorded as a result of surface water and sewer flooding.
- A number of unknown flood events have also been recorded to the west of the site.

3.8.2 The Detailed Site Summary within Appendix J of the SFRA states

"There are no recorded flood incidents within this site, although incidences of flooding have been reported beyond the site boundary. Water sits on site adjacent to Elizabeth Close. Flooding of properties/highways in Elizabeth Close, Lincoln Avenue, Sefter Road, Hook Lane, Pagham Road"

3.8.3 In addition, anecdotal evidence obtained from public consultation has also suggested flooding to Hook Lane.

3.8.4 The Environment Agency has been contacted for any information with regards to flood events in the vicinity of the site. The Environment Agency stated that due to the location of the site in Flood Zone 1, they have limited information with regards to flooding.

3.8.5 Arun District Council in their role as Local Planning Authority was contacted for any information regarding flooding in the vicinity of the site. The LPA provided details, included in **Appendix C**, regarding flooding at Sefter Cottage, to the immediate west of the site during the flood event during June 2012. West Sussex County Council in its role as LLFA produced a Section 19 Flood Incident report for the flood event which affected most of the County.

3.8.6 Heavy rain fell between the 10th and 12th June causing significant surface water flooding. Rainfall was highly localised with areas measuring between 58mm at Shoreham and 171mm recorded at Sefter Farm, adjacent to the site. The return period for the Bognor Regis area was estimated at approx. 1 in 212 years.

FLUVIAL FLOODING

3.8.7 The SFRA mentions the watercourse Pagham Rife that is in close proximity to the west of the site without discussing flood impact zones. It does however mention the flood defences present towards Pagham Harbour with it stating:

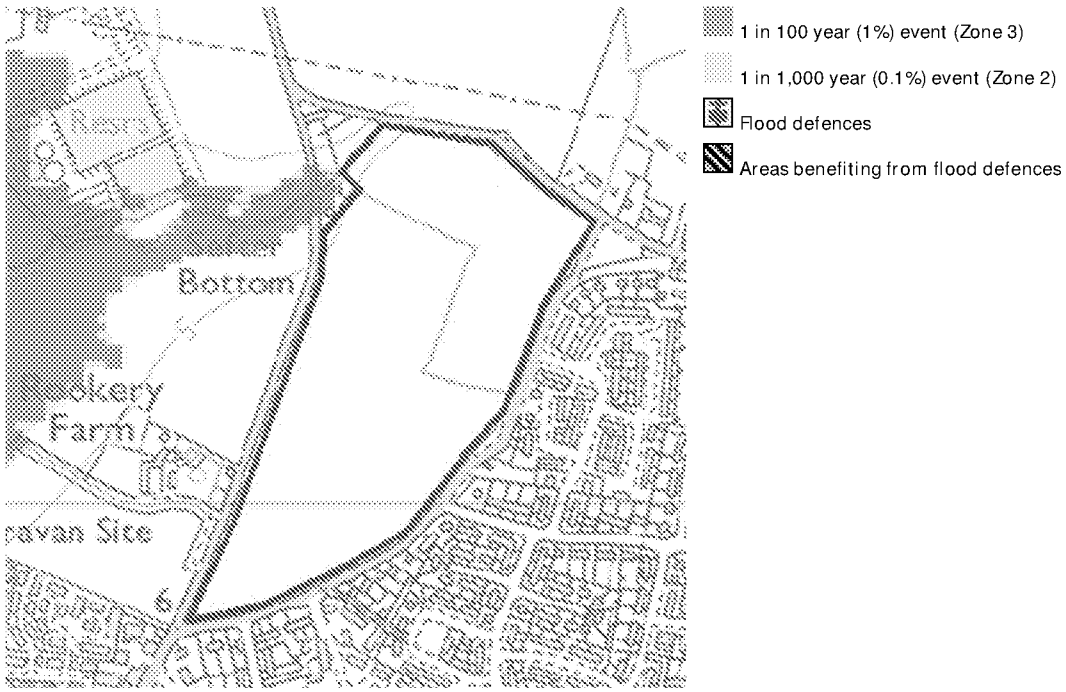
"This has been established to be the only Rife that lies within the Arun District boundary, with the others located within Chichester District Council's boundary. There are several defences in place along the western part of Pagham village. These defences are a mixture of embankment and raised walls, with shingle beaches bordering the coastal stretch of Pagham Harbour.

The condition grade for the embankment defence along Church Lane is rated as 'Good'. The condition grade recorded for the raised walls and shingles beaches is 'Fair', although given the Inner Harbour Bunds have only been recently completed it is expected the condition grade may be lower (better condition) than reported in the current available dataset."

3.8.8 Fluvial flood zones were produced as part of the SFRA and included in **Appendix A**. The map shows the site to be located within Flood Zone 1 with regards to fluvial flooding.

3.8.9 The Environment Agency's Flood Map for Planning shows flood zones from both fluvial and tidal flood sources as per the risk extents set out in Table 3-1; the Flood Map for Planning is reprinted below as Figure 3-1. The mapping shows the site lies wholly within Flood Zone 1 outside of both the 1 in 1,000 year fluvial and tidal flood extents of the nearby Pagham Rife and Harbour. This has also been confirmed by the Environment Agency; correspondence has been included in **Appendix C**.

Figure 3-1 Environment Agency Flood Map for Planning



ON-SITE DRAINAGE DITCH

3.8.10 As can be seen above in Figure 3-1, there is an ordinary watercourse which crosses the site in east-west direction, discharging into the Pagham Rife near Sefter Bottom. Further photographs of the ditch other drainage infrastructure is shown below in Figure 001 in Section 4.

3.8.11 Ground topography was assessed using the Environment Agency's LiDAR data, available online. From this, a catchment watershed to the north of Sefter Road was calculated with the catchment estimated to be approx. 67ha.

3.8.12 From studying the ditch network in the vicinity of the site, the catchment is believed to drain south towards Sefter Road then eastwards around the playground adjacent to Hook Lane Close. From there, it is believed surface water drains southwards in a highway ditch adjacent to Hook Lane and then westwards along the on-site drainage ditch.

3.8.13 The drainage ditch which cross the site is shown below in Figure 3-2 and is well incised. Topographical survey of the site has concluded the ditch is approximately 1.0m to 2.0m deep with side slopes of between 1 in 1 and 1 in 2.

3.8.14 At the western end of the ditch, flow is controlled by a 450mm diameter culvert; this culvert is estimated to have a maximum capacity of 164l/s and is shown in Figure 3-3.

Figure 3-2 On-Site Drainage Ditch



Figure 3-3 450mm Dia. Culvert



3.8.15 The discharge rate from the site is discussed later in the report in Section 5, alongside the drainage strategy. However, the greenfield runoff rate was assessed using the IoH124 methodology.

3.8.16 The site is approximately 17.5ha and the calculated greenfield runoff rate during the 1 in 100 year event is 11.24l/s/ha which equates to approximately 197l/s runoff from the site. Post development, surface water runoff will be attenuated in a number of attenuation basins and collectively discharged at the greenfield QBar runoff rate, approximately18.5l/s.

3.8.17 Alongside the above, a sequential based approach has been employed in masterplan development, locating areas of residential development away from areas most at risk of flooding. The masterplan also proposes to widen the on-site drainage ditch and provide a blue-green corridor providing some additional flood risk protection along with bio-diversity and ecological benefits.

3.8.18 As such, fluvial flood risk does not pose a risk to the proposed development and alongside this the proposed development provides some flood risk protection measures to downstream properties in reduced runoff rates.

TIDAL FLOODING

3.8.19 The risk of tidal flooding is shown alongside fluvial flood risk on the Flood Map for Planning, shown above in Figure 3-1. The risk of tidal flooding was also assessed as part of the 2016 SFRA.

3.8.20 As discussed previously, the site is located within Flood Zone 1 and is therefore deemed to have less than a 0.1% annual probability of tidal flooding as per the definitions in Table 3-1.

3.8.21 It should be noted that all Flood Zone maps, both those produced by the SFRA and those shown on the Flood Map for Planning are produced without the influence of any flood defences. As noted in the Shoreline Management Plan (Section 3.5), the policy for the coastal defences is 'hold the line.' As such the actual extents of the flooding with the defences in place may be lower.

3.8.22 A sequential based approach has been employed in masterplan development, locating areas of residential development away from areas most at risk of flooding. As such, tidal flooding is not considered a significant risk to the built development at this location and the overall flood risk is classified as low.

GROUNDWATER FLOODING

3.8.23 The risk of groundwater flooding was assessed within the SFRA. Appendix F, of the SFRA, shows the site to be at medium to high risk of groundwater flooding. BGS records indicate the site is underlain by London Clay with the nearest chalk outcrop located approximately two miles to the north of the site. It should be noted that the advice given with the map is that *"this data should only be used in combination with other information, for example with local data or historic data. It should not be used as sole evidence for any specific flood risk management, land use planning or other decisions at any scale."*

3.8.24 Online maps provided by the Environment Agency show that there are no Source Protect Zones in the immediate vicinity (1.5km radius) of the site. Infiltration from the proposed basins, albeit negligible will not pose a pollution risk to groundwater.

3.8.25 During public consultation, residents raised concerns with the proposed development due to shallow groundwater. Groundwater levels have been monitored on site over the course of a year with further analysis provided in report *70014147-R02 – Land at Pagham Groundwater Monitoring Report* prepared by WSP | Parsons Brinckerhoff. This report is summarised here.

3.8.26 Groundwater levels were monitored on site by eight groundwater monitoring wells installed across the site in November 2015 and a number of visits were undertaken between January and June 2016 to record groundwater levels within the wells. Further to this, dedicated level loggers were installed in two boreholes to obtain detailed groundwater elevation data between monitoring visits.

3.8.27 The results indicate the presence of a shallow sub-artesian groundwater body beneath the site with depths of groundwater typically recorded at depths of less than 1.0m below ground level.

3.8.28 Given the results of the monitoring, the risk of flooding from groundwater is initially considered medium. However, in order to ensure surface water runoff is adequately managed, minor earthworks will be required to provide surface water flow paths and as a result, the proposed development areas will be raised above the current ground levels. These surface water flow routes will also direct any groundwater flooding away from the proposed properties towards the attenuation basins.

3.8.29 The monitoring showed groundwater levels are typically responsive to rainfall events. An increase in impermeable area will decrease the responsiveness of the groundwater thereby reducing groundwater flood risk.

3.8.30 The drainage system has also been designed to utilise shallow drainage features, located above the level of any groundwater. Any deeper drainage features such as basins will require lining to prevent groundwater ingress and ensuring the attenuation features remain functional when required.

3.8.31 Given the mitigation measures to be employed on site, the risk of groundwater flooding to the proposed built development is considered low.

SURFACE WATER FLOODING

3.8.32 The site is undeveloped however; the Environment Agency's Risk of Flooding from Surface Water mapping identifies a number of areas that are at high risk of surface water flooding. The flood mapping is reprinted as Figure 3-2 below.

3.8.33 The mapping shows that there is a low to medium risk of surface water flooding from the ditches on site. There is a high risk area in the south-east of the site, adjacent to Pagham Road, corresponding to a low area on the topographical survey.

3.8.34 The production of this mapping has been undertaken at a national scale to provide the first publically available generation of surface water flood risk mapping. The two previous generations were primarily developed for regulator use as the approach and risk was refined. For example the first did not include any allowance for sewers, whilst the second incorporated a national loss coefficient.

3.8.35 Although this generation incorporates local estimates of the sewer infiltration loss along with various other refinements in runoff estimation, generally at an LLFA level, it does not allow for local improvements to the underlying DTM. This means that local features are represented as obtained from the LiDAR without any consideration to drainage features such as culverts which typically provide the associated surface water drainage.

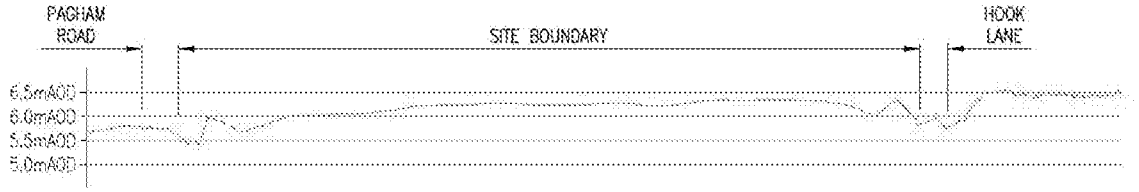
3.8.36 As a result, this leads to the localised ponding in the south-west corner of the site as can be observed in Figure 3-2. However, as shown later in this report, during a site visit a gully grate was discovered in this location, likely to allow surface water runoff to drain beneath Pagham Road.

Figure 3-4 Environment Agency Risk of Flooding from Surface Water map



3.8.37 Through public consultations, local residents and the Parish Council have raised concerns regarding surface water flooding in the vicinity of the site. Anecdotal evidence provided by residents on Hook Lane suggests highway flooding occurs on a semi-regular basis.

Figure 3-5 Cross Section through site



3.8.38 Figure 3-5 shows a cross section through the site, near to where the flooding is observed in Hook Lane. As can be seen in the cross section, the site is quite flat however there is a gentle fall to the west. As such, surface water runoff will drain westwards and hence the proposed development will not exacerbate flooding in Hook Lane.

3.8.39 Minor earthworks will also be required to provide gradients to ensure surface water drains in the correct direction, towards the proposed attenuation features. Once implemented, this ground raising will provide some flood risk reduction in ensuring surface water runoff from the proposed development is not directed into Hook Lane.

3.8.40 Within the development, a sequential based approach has been employed, locating areas of development outside of areas most at risk of surface water flooding.

3.8.41 Given that the highest risk areas are in the low points of the site where SuDS drainage is to situated, the sequential approach to masterplan development and the minor earthworks required to ensure catchments fall towards the basins, the risk of flooding from surface water sources will be low.

DEVELOPMENT EXCEEDANCE FLOWS

3.8.42 Careful regard has to be made in respect of potential exceedance flows, being events that are more extreme than current design criteria. Various national guidance has been published on the matter of exceedance flows and measures that should be incorporated into a development to ensure the safety of occupiers and those using the infrastructure.

3.8.43 Published guidance, in the form of Sewers for Adoption (7th Edition) and the Environment Agency document "Improving the Flood Performance of New Buildings: Flood Resilient Construction," states the design of developments should implement infrastructure routes that will safely convey flood waters resulting from sewer flooding or overland flows away from buildings and along defined corridors.

3.8.44 The principal aim is to direct exceedance flows away from properties and along defined corridors. At a local level, this may mean water being conveyed along a length of highway, as long as the predicted flow depths and velocities are acceptable. More strategically, the implementation of conveyance corridors are important in avoiding deep and high velocity flows that present a high risk.

3.8.45 Careful and considered design in other areas can also reduce the risk. For example the strategic SuDS system being promoted for the site, provides a layered and disbursed system of treatment across the site, thereby avoiding a traditional and more risky design that might, for example, have all storm water being collected in a strategic spine sewer that conveys flows to a large basin at the bottom of the catchment. This latter system concentrates peak discharges into a single corridor, that if blocked can have unacceptable consequences.

3.8.46 Clearly, whilst many of the measures for dealing with exceedance flows must be dealt with at detailed design stage, the strategic layout for the site provides the framework of a network that can effectively deal with any future exceedance problems.

3.8.47 Drawing 4147-D-02 in **Appendix A** shows the principal exceedance strategy.

3.8.48 The detailed design stage should comply with national standards for protection against exceedance flows. Given the baseline site characteristics and further mitigation measures to be implemented, the risk of flooding from exceedance flows is considered low.

FLOODING FROM OTHER SOURCES

RESERVOIRS

3.8.49 There are no reservoirs in the local area that would have an impact on the flood risk to the site. Therefore, the flood risk associated with reservoirs to the site is considered to be Low.

CANALS

3.8.50 There are no canals in the local area. Therefore, canal flooding is not considered a risk to this site.

SEWERS

3.8.51 Sewer flooding occurs as a result of a number of influencing factors. It's most likely to occur during storms, when large volumes of rainwater enter the sewers, however, it can also occur when pipes become blocked or damaged.

3.8.52 Existing sewerage systems are present on land surrounding the site, by way of existing private, highway and adopted public sewers serving built development. There are public sewer systems in the existing residential development to the north and east of the.

3.8.53 Should sewer flooding occur, the proposed exceedance flow routes will direct any flooding towards the attenuation basins. As such, the risk associated with sewer flooding is considered to be low.

4 EXISTING DRAINAGE

4.1 SURFACE WATER

4.1.1 Southern Water sewer record plans can be seen in **Appendix D**. These show public surface water gravity sewers located to the west, south and east of the site, collecting run-off from the existing residential areas. No surface water sewers are located within the site boundary.

4.1.2 To the east of the site, the surface water sewers drain in an easterly direction towards a drain located to the rear of properties in Mayfield Close. This drain appears to flow in southerly direction however its ultimate outfall is unknown. Surface water sewers to the south-east of the site also appear to discharge into this drain.

4.1.3 A surface water sewer to the south-west of the site in Pagham Road runs in a northerly direction and discharges into a ditch to the west of the site, adjacent to Rookery Farm.

4.1.4 Within and adjacent to the site, there are a number of highway drains and ordinary watercourses. The locations of these are shown below on Figure 001.

4.1.5 To the north of the site, land drainage ditches convey surface water runoff southwards towards Sefter Road. Alongside Sefter Road there is a highway ditch with headwalls at each end. It is assumed that the eastern end of this highway ditch enters a culvert and is connected with a small section of ditch to the east of the playground adjacent to Hook Lane Close.

4.1.6 From there, this ditch is culverted and connects into the highway drain running north to south adjacent to Hook Lane. It is then assumed this ditch discharges into the drainage ditch located on site.

4.1.7 The drainage ditch located within the site boundary flows in a westerly direction. The ditch begins at a headwall adjacent to Hook Lane which was submerged during the site visit undertaken. At the western boundary of the site, this ditch enters a 450mm diameter culvert and emerges on the far side of Pagham Road out of a 450mm culvert.

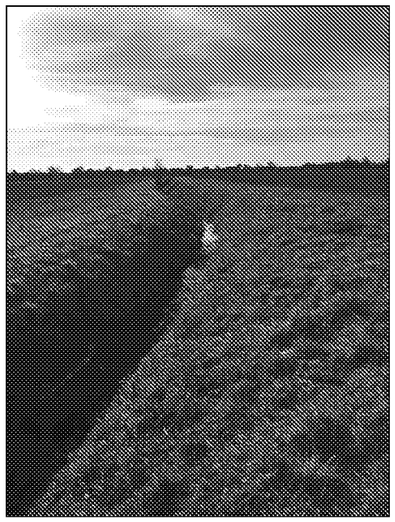
EXISTING DRAINAGE REGIME AND PHOTOGRAPHS

N.T.S.

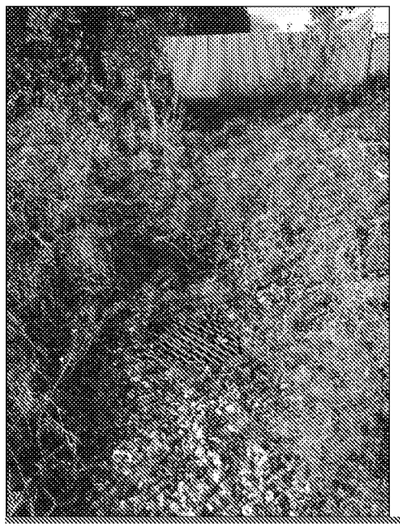
FIGURE 001



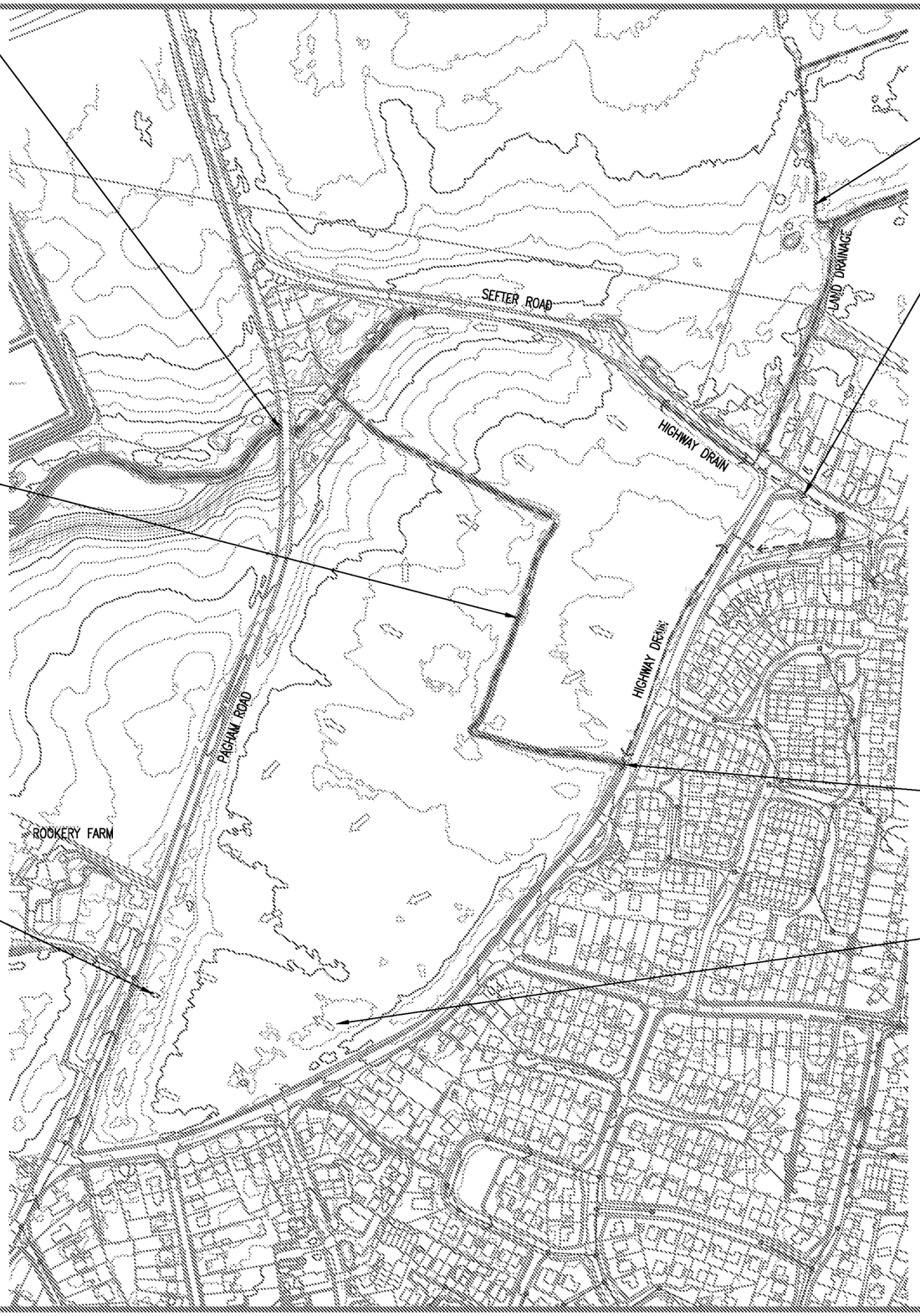
DRAINAGE DITCH IS CULVERTED BENEATH PAGHAM ROAD. THE CULVERT IS APPROX. 450mm IN DIAMETER AND IS ESTIMATED TO HAVE A MAX CAPACITY OF 164l/s



THE DRAINAGE DITCH WHICH RUNS EAST TO WEST ACROSS THE SITE IS APPROX 1.0–2.0m DEEP WITH SLOPES OF BETWEEEN 1 IN 1 AND 1 IN 2



INLET MANHOLE LOCATED ADJACENT TO PAGHAM ROAD. MANHOLE IS BELIEVED TO CONNECT BENEATH PAGHAM ROAD TO DRAIN RUNNING WESTERLY ALONGSIDE ROOKERY FARM



LAND DRAINAGE IS SHOWN FROM THE CATCHMENT TO THE NORTH OF THE SITE. THIS DRAINAGE IS ASSUMED TO CONNECT BENEATH SEFTER ROAD, AROUND THE PLAYGROUND ADJACENT TO HOOK LANE CLOSE AND INTO THE ON-SITE DRAINAGE DITCH



HEADWALL AND DITCH ENTERING SITE. HEADWALL WAS SUBMERGED DURING SITE VISIT THEREFORE THIS INLET DIAMETER IS UNKNOWN

CONTOURS ARE SHOWN AT 1.0m MAJOR INTERVALS (DARK) AND 0.25m MINOR INTERVALS (LIGHT). ARROWS SHOW THE DIRECTION OF EXISTING SURFACE WATER FLOW.
FLOW PATTERNS INDICATED SURFACE WATER FROM THE SOUTHERN HALF OF THE SITE WILL CONGREGATE AT THE LOW POINT WHERE AN INLET GULLY IS LOCATED, SHOWN IN THE PHOTOGRAPH OPPOSITE

PROJECT: HOOK LANE, PAGHAM

PROJECT No: 70014147

CLIENT: HALLAM LAND MANAGEMENT

ARUN DISTRICT COUNCIL CLIENT

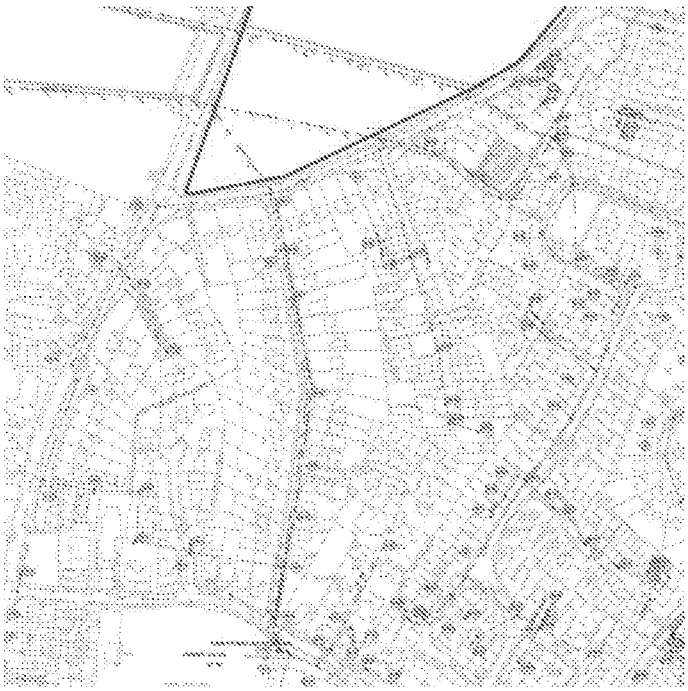
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APPROVED: DW
REVISION: A
DATE: December 2016

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4.2 FOUL WATER

4.2.1 Southern water records indicated an extensive foul water network serving the residential development to the south and east of the site. The Southern Water asset records are included in **Appendix D**. An extract showing the foul network arrangement in the southern part of the site is included in Figure 4-1 below.

Figure 4-1 Southern Water Network Plan



4.2.2 Due to the flat topography of the site, there are two foul water pumping stations located to the south of the site in Nyetimber Crescent and Nyetimber Lane. Rising mains from these two pumping stations cross the site near the southern boundary. A third overflow rising main crosses the site in a westerly direction slightly to the north of the other rising mains; this discharges into a ditch to the west of the site. No other foul sewers are located within the site boundary.

4.2.3 The locations of these rising mains are shown on the drainage strategy drawing 4147-D-002. Basin C has been sized to avoid the rising mains. Further consultation will be required with Southern Water to determine the required easements.

5 DRAINAGE STRATEGY

5.1 SURFACE WATER

5.1.1 The site topographic survey was used to assess where water flows across the existing site. This indicates where water will naturally collect and gives a good indication of where SuDS features such as basins should be positioned. This shows that all surface water on-site flows generally towards the western side of the site.

5.1.2 Current guidance requires that all new developments implement means of storm water attenuation and control referred to as Sustainable Drainage systems (SuDS) in order to maintain flow rates and volumes discharged to the identified receptor post development.

5.1.3 Coupled with this, ***Policy W DM3 – Sustainable Urban Drainage Systems*** from the Local Plan states:

- *Proposals for both major and minor development proposals must incorporate SuDS within the private areas of the development in order to provide source control features to the overall SUDS design*

5.1.4 In addition to the water control benefits, SuDS features also provide water quality, landscape, ecology and biodiversity benefits. National guidance in the form of CIRIA 609 outlines that by implementing SUDS, storm water from the site can be polished to an improved standard thus ensuring the development proposals have no adverse effects on the wider hydrology and ecology.

DISCHARGE LOCATION

5.1.5 In order to determine the most appropriate receptor for storm water discharges from the proposed development, the new PPG guidance provides the following order of priority, supported by the Environment Agency and Local Authority:

"Generally, the aim should be to discharge surface run off as high up the following hierarchy of drainage options as reasonably practicable:

- *into the ground (infiltration);*
- *to a surface water body;*
- *to a surface water sewer, highway drain, or another drainage system;*
- *to a combined sewer."*

5.1.6 As part of the site investigation, infiltration testing to BRE Digest 365 was conducted; infiltration rates are provided in Table 2-2 and **Appendix E**. The testing confirmed that infiltration is unfeasible as a means of draining the site.

5.1.7 Following the search sequence in order of priority, the next most appropriate receptor for storm water discharges is a watercourse or suitable water body subject to appropriate attenuation measures to ensure peak discharges are not increased.

5.1.8 Running through the northern part of the site is a land drainage ditch which crosses the site in a westerly direction before discharging into Pagham Rife. As part of the proposals for the site, this ditch is to be naturalised into a sinuous green corridor and watercourse. This represents a suitable receptor for post development run-off once attenuated to below the baseline greenfield rates.

5.1.9 In accordance with the above search sequence, it is proposed to discharge surface water flows to the existing naturalised watercourse on site.

DISCHARGE RATE

5.1.10 National policy dictates that new developments control the peak discharge of storm water from a site to the baseline, undeveloped site conditions. Over very large development areas, the baseline rate of run-off is normally estimated using the FEH methodologies. However, Paragraph 3.1.2 of the Flood Estimation Handbook (FEH) guidance states:

"The frequency estimation procedures can be used on any catchment, gauged or ungauged, that drains an area of at least 0.5km^2. The flood estimation procedure can be applied on smaller catchments only where the catchment is gauged and offers simple flood peak or flood event data"

5.1.11 On undeveloped and ungauged catchments of less than 0.5km in area, the accepted methodology is to complete baseline site discharge assessments using the nationally accepted IoH124 methodology for small rural catchments in a manner set out by the Environment Agency document SC030219 Rainfall Runoff Management for Developments and CIRIA C697.

5.1.12 This methodology requires that, for catchments of less than 50ha, the IoH assessment is completed for a 50ha area with the results linearly interpolated to determine the flow rate value based on the ratio of the development to 50ha.

5.1.13 The overall application boundary is below the 50ha threshold, thus the IoH124 methodology is therefore the most appropriate for appraising the baseline run-off from the development.

5.1.14 The baseline IoH run-off rates are shown on Table 5-1 below.

Table 5-1 IoH124 Assessment

EVENT	IOH124 (50HA)	IOH124 SCALED TO 1HA
1 in 1 Year (l/s)	149.70	2.99
QBar (l/s)	176.10	3.52
1 in 100 Year (l/s)	561.80	11.24

5.1.15 As the site is currently undeveloped, the proposals will result in an increase in impermeable area, which will increase the overall rate of water discharging from the site if left un-attenuated.

5.1.16 The strategy drawing 4147-D-002 in **Appendix A** indicates the site catchments based on the site topography as confirmed in Table 5-2 below.

5.1.17 In order to mitigate for the increased volume of run-off associated with built development, peak flows in the 1 in 100 year event must be attenuated to the mean annual flow (QBar).

Table 5-2 Existing Site Run-off Assessment

CATCHMENT	CATCHMENT DEVELOPMENT AREA (HA)	IMPERMEABLE AREA (HA)	1 IN 1 YEAR EVENT (L/S)	QBAR (L/S)	1 IN 100 YEAR EVENT (L/S)
1	2.70	1.62	8.07	9.51	30.34
2	2.69	1.61	8.04	9.47	30.22
3	4.51	2.71	13.48	15.88	50.67
Total	**9.90**	**5.94**	**29.60**	**34.87**	**111.23**

5.1.18 Assessments have thereafter been completed to determine the characteristics of the SuDS features required. The Micro Drainage Source Control module has been utilised to provide routing calculations for the 1 in 100 year flood event to identify the size and nature of storage required, ensuring the peak outflows are in line with those identified in Table 5-2 above.

5.1.19 Calculations demonstrate that attenuation storage extending to 3078m^3 will be required to attenuate storm water discharges from the site during the critical 1 in 100 year storm event to the above baseline rates based on the current site proposals.

5.1.20 A summary of the nature of SuDS proposed is contained in Table 5-3 below whilst the drainage strategy is shown on 4147-D-002 in **Appendix A** and Micro Drainage summary calculations are contained in **Appendix B**.

Table 5-3 Site Attenuation Requirements

CATCHMENT	CONTRIBUTING AREA (HA)	QBAR DISCHARGE RATE (L/S)	STORAGE AREA REQUIREMENT (M^2)	STORAGE VOLUME (M^3)
1	1.62	5.7	2316	857
2	1.61	5.7	1557	831
	2.71	9.5	4137	1390
Total	**5.94**	**18.5**	**8010**	**3078**

5.1.21 In accordance with legislative requirements, the detention proposals have also been assessed for the potential effects of climate change. The 1 in 100 year (1% AEP) return events have been modelled for 40% climate change (including peak rainfall intensity). Calculations for the climate change scenarios are also contained in the **Appendix B**.

5.1.22 Climate change assessments show each attenuation feature to perform adequately by retaining the additional flows within the system without overflow or unacceptable consequences.

5.1.23 The drainage system will be designed in accordance with Sewers for Adoption (7th Edition) such that the proposed network will not surcharge during the critical 1 in 2 year event and will not flood during the 1 in 30 year event. For the 1 in 100 year return period, the sewer network will be designed so that surface flooding will be contained and conveyed within the highway boundary and directed to the attenuation basin.

5.1.24 The 1 in 30 year criterion meets the requirements of BS EN 752 and is also in accordance with Sewers for Adoption 7th Edition. However, the design of the system exceeds the requirements of these documents by accommodating the volumes and flow rates generated by the 1 in 100 year event.

5.1.25 The drainage strategy is based upon the site masterplanning details at the time of production. Changes to the site development profile, impermeable areas across the site or other such aspects of the scheme will result in the need to revise the calculations.

DEVELOPMENT CREEP

5.1.26 Over the lifetime of a development, it is possible that the overall impermeable area within the site could increase by as much as 10% through the house buyers undertaking activities such as property extensions and introducing paved gardens.

5.1.27 Table 5-4 below shows how this increase in impermeable area relates to the three primary catchments within the site.

Table 5-4 Development Creep Assesament

CATCHMENT	CONTRIBUTING AREA [HA]	+10% [HA]	TOTAL IMPERMEABLE AREA [HA]
A	1.62	0.161	1.782
B	1.61	0.162	1.771
C	2.71	0.271	2.981
Total	**5.94**	**0.594**	**6.534**

5.1.28 Micro Drainage calculations contained in **Appendix B** confirm that the proposed SuDS system has sufficient capacity to accommodate a 10% increase in impermeable area during the 1 in 100 year +40% event without overflow.

5.1.29 In addition to this, during the detailed design phase, the positive impacts of the potential source control measures (permeable paving et al.,) should be further considered.

5.1.30 Without the benefit of a detailed plot level masterplan, it is not possible to appraise the function of the individual source control systems down to plot level. Source control measures should be further considered during detailed design and implemented as far as reasonably practicable in accordance with ***Policy W DM3*** of the Local Plan.

5.1.31 As such, the impacts of development creep on the proposed SuDS system are not considered to pose a significant risk to the site.

RESIDUAL RISK

5.1.32 Management of extreme event flood risk can be achieved through ensuring the finished floor levels of the proposed buildings are set above adjacent roads and open spaces in areas where designated overland flood routes are identified.

5.1.33 Safe access and egress will be available to and from the site for events in excess of the 1 in 100 year plus climate change (+40%) rainfall event via all proposed site entrances.

5.1.34 The above strategy shows that the proposed development can be undertaken in a sustainable manner without increasing the flood risk either at the site or to any third party land in line with NPPF requirements.

5.2 FOUL WATER

5.2.1 The site lies within the catchment of Pagham Wastewater Treatment Works which lies circa 1.1km west of the site. Asset locations maps and the existing drainage network are discussed above in Section 4.

5.2.2 The proposed pumped and gravity drainage network across the site will be designed to current Sewers for Adoption 7th Edition Standards. A sewer capacity check was submitted to Southern Water to assess the capacity of both the treatment works and the sewer network and determine an appropriate connection point.

5.2.3 No concerns have been raised by southern water as to the ability of the Pagham Sewage Treatment Works to accommodate the proposed development coupled with this a point of connection has been provided on the existing network in Drift Road. However, due to insufficient capacity to accommodate the increased flow from the proposed development enhancements to the downstream system are required.

5.2.4 Reinforcement works consisting of a 150m length of 150mm diameter sewer is required, running parallel to existing sewers to provide additional capacity. Further information is available in Southern Water's response, included in **Appendix C**.

5.2.5 Southern Water are however unable to reserve capacity at the treatment works. As the site lies close to the Lidsey Treatment Works, Southern Water has confirmed there is available capacity at this treatment works. It is possible to redirect flows to this location if the need arises.

5.3 ADOPTION AND MAINTENANCE

5.3.1 The proposed on-site surface water and foul drainage sewerage networks will be designed in accordance with Sewers for Adoption 7th Edition and will be offered for adopted by Southern Water.

5.3.2 With regards to SuDS, in view of the recent central government decision not to create SABS, some uncertainty remains regarding by whom and how these features will be adopted and maintained.

5.3.3 Correspondence with Arun District Council indicates they are unlikely to adopt any SuDS features. Also, Southern Water has stated they will not adopt any SuDS devices. This correspondence is included in **Appendix C**.

5.3.4 As an alternative, it is becoming increasingly common for SuDS features to be operated and maintained by a third party private maintenance company. Should this be necessary, a third party management company would be established to maintain the features in perpetuity. An adoption agreement between the developer and Maintenance Company would be based upon the CIRIA ICoP MA2 SuDS Maintenance Framework Agreement.

6 CONCLUSIONS

6.1.1 The risk of flooding to and from the proposed development has been assessed in accordance with the NPPF March 2012.

6.1.2 This assessment demonstrates that the site lies within Flood Zone 1 and is an appropriate location for the proposed residential land use. This is in accordance with the vulnerability classifications of the NPPF and is supported by the Local Planning Authority and the Environment Agency.

6.1.3 Management of extreme event flood risk can be achieved through ensuring the finished floor levels of the proposed buildings are set above adjacent roads and open space levels in areas where designated overland flood routes are identified.

6.1.4 In addition to NPPF, the proposed drainage strategy complies in drainage terms with local policy and site specific requirements.

6.1.5 The proposed drainage strategy aims to mimic the existing drainage regime of the site. Discharge from the site will provide betterment by maintaining existing discharge rates while allowing for a climate change increase in rainfall of up to 40%.

6.1.6 Safe access and egress will be available to and from the site for events up to and including the 1 in 100 year plus climate change (40%) rainfall events.

6.1.7 This report demonstrates that the proposed development can be undertaken in a sustainable manner without increasing the flood risk either at the site or to any third party land in line with NPPF requirements.

Appendix A

DRAWINGS

NORTH

Application Boundary (17.5ha)

Housing - up to 7.2ha
216 Residential Dwellings at an Average of 30 Dwellings Per Hectare (dph).

Primary School or Housing - 2.4ha
Land safeguarded for the provision of a Two Form Entry Primary School to include access, car parking and external play space - should this area not be required the development is to comprise up to 72 Residential Dwellings at an Average of 30dph.

Proposed D1 Use - 0.4ha
Potential for a Children's Day Nursery and / or Health Centre as required - should this area not be required the development is to comprise up to 12 Residential Dwellings at an Average of 30dph.

Care Home or Specialist Housing for the Elderley - 0.55ha

Vehicular Access

Primary Vehicular Route
Masterplan Option 1& 2.

Potential Vehicular Access
This is not required if the Two Form Entry Primary School is to be constructed.

Pedestrian Access
Proposed footpath connections onto Hook Lane

Potential Pedestrian Access
Potential footpath / Cycle link onto Sefter Road

Potential Vehicular Route
This is not required if the Two Form Entry Primary School is to be constructed.

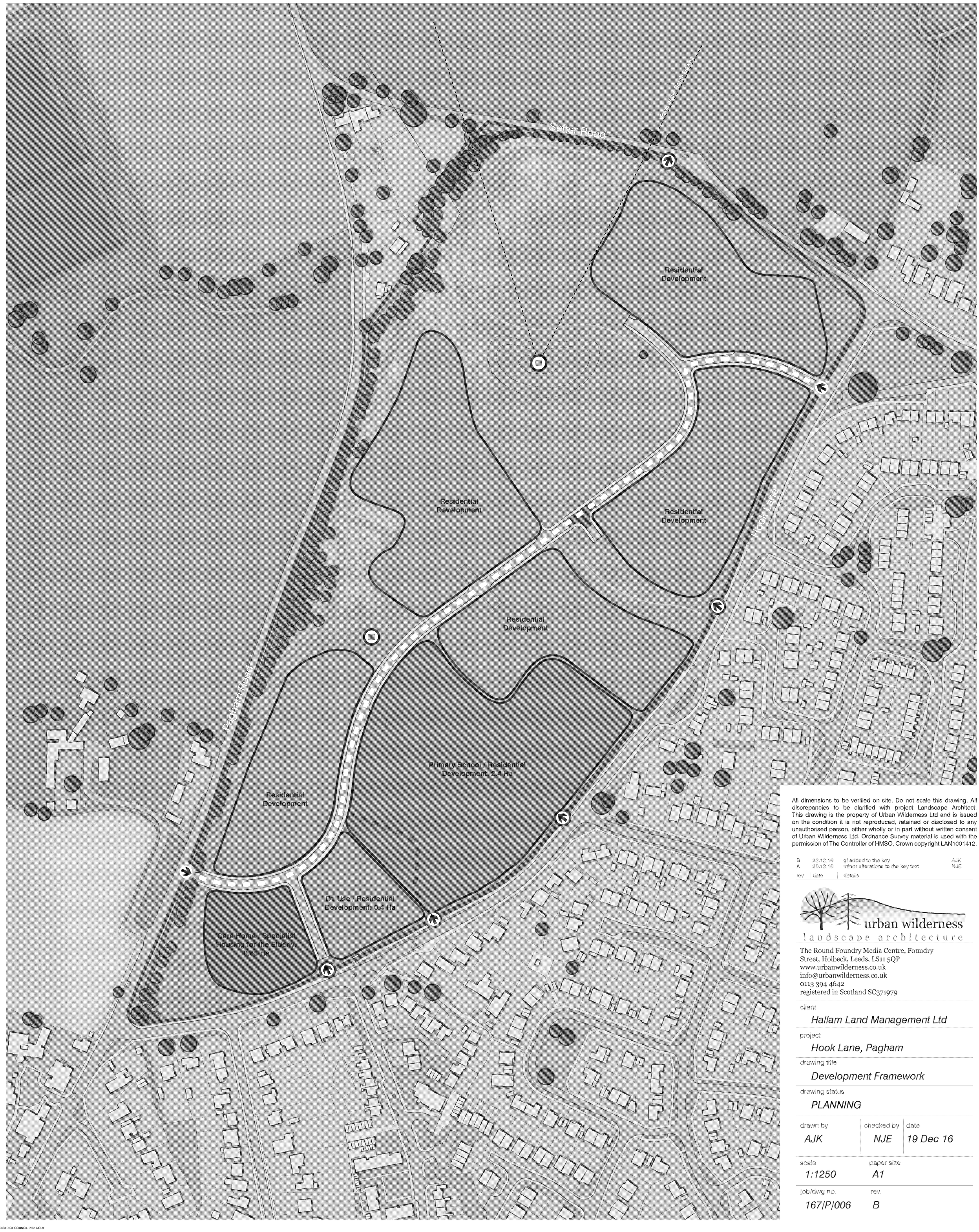
Areas of Interest
Viewing Mound - provides views towards the South Downs

Areas of Interest
Formal Equipped Children's Play Space

Green Infrastructure - 6.95ha
Framework of structural planting, open spaces (both hard and soft) and habitats - includes road infrastructure with single frontage development (excluding Semi-Private Drives)

Waterways & Ponds
Sustainable Drainage Systems Planted for Amenity Benefit

All areas shown on this development framework are approximate



All dimensions to be verified on site. Do not scale this drawing. All discrepancies to be clarified with project Landscape Architect. This drawing is the property of Urban Wilderness Ltd and is issued on the condition it is not reproduced, retained or disclosed to any unauthorised person, either wholly or in part without written consent of Urban Wilderness Ltd. Ordnance Survey material is used with the permission of The Controller of HMSO, Crown copyright LAN1001412.

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B	22.12.16	gi added to the key	AJK
A	20.12.16	minor alterations to the key text	NJE

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Hook Lane, Pagham

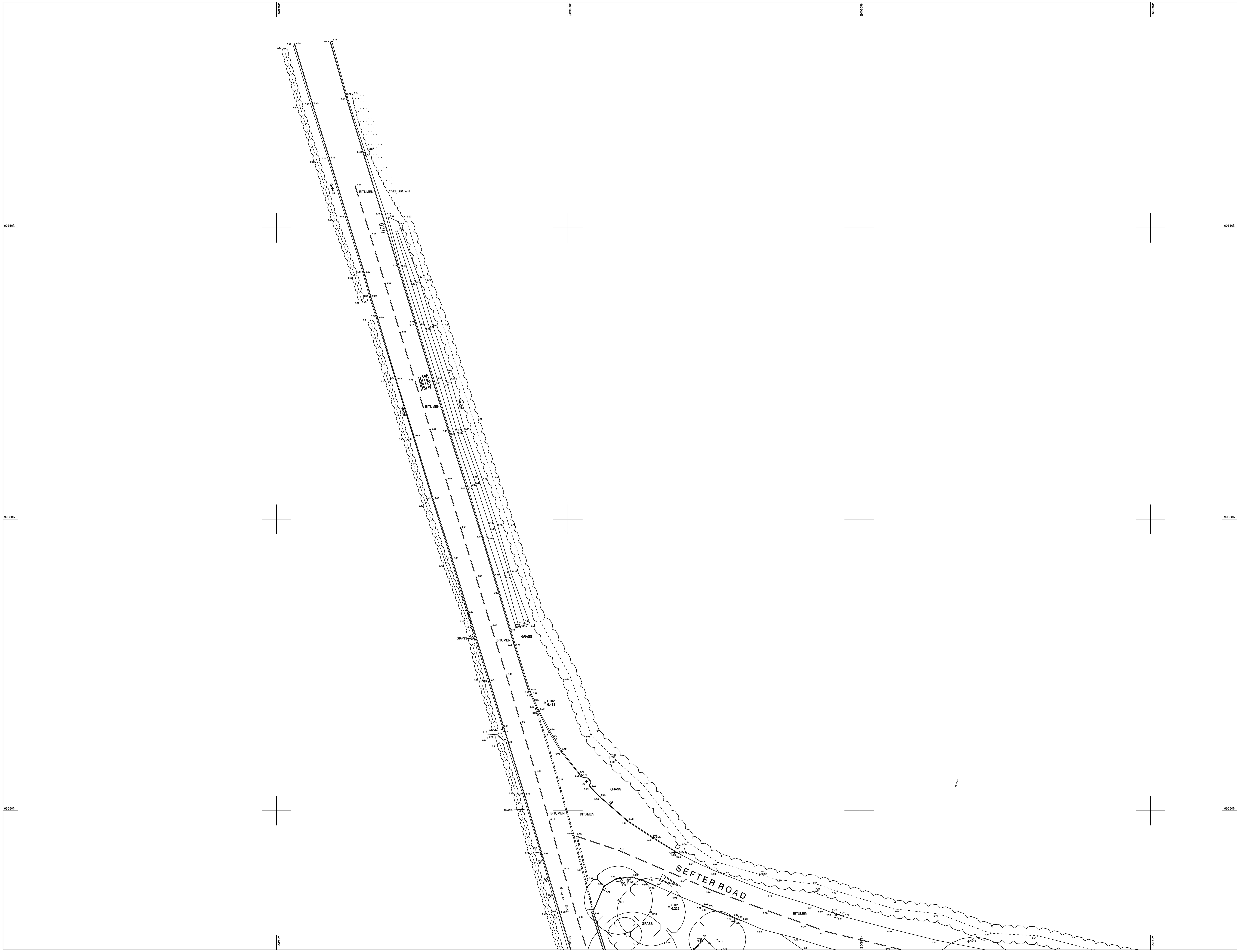
drawing title
Development Framework

drawing status
PLANNING

drawn by	checked by	date
AJK	NJE	19 Dec 16

scale	paper size
1:1250	A1

job/dwg no.	rev.
167/P/006	B



Symbol & Abbreviation Key.

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Notes.

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TOPOGRAPHICAL SURVEY

LAND AT PAGHAM, PAGHAM ROAD
PAGHAM
WEST SUSSEX
PO21 3PD

Dwg No. **150595 3D** Sheet **1 of 14**

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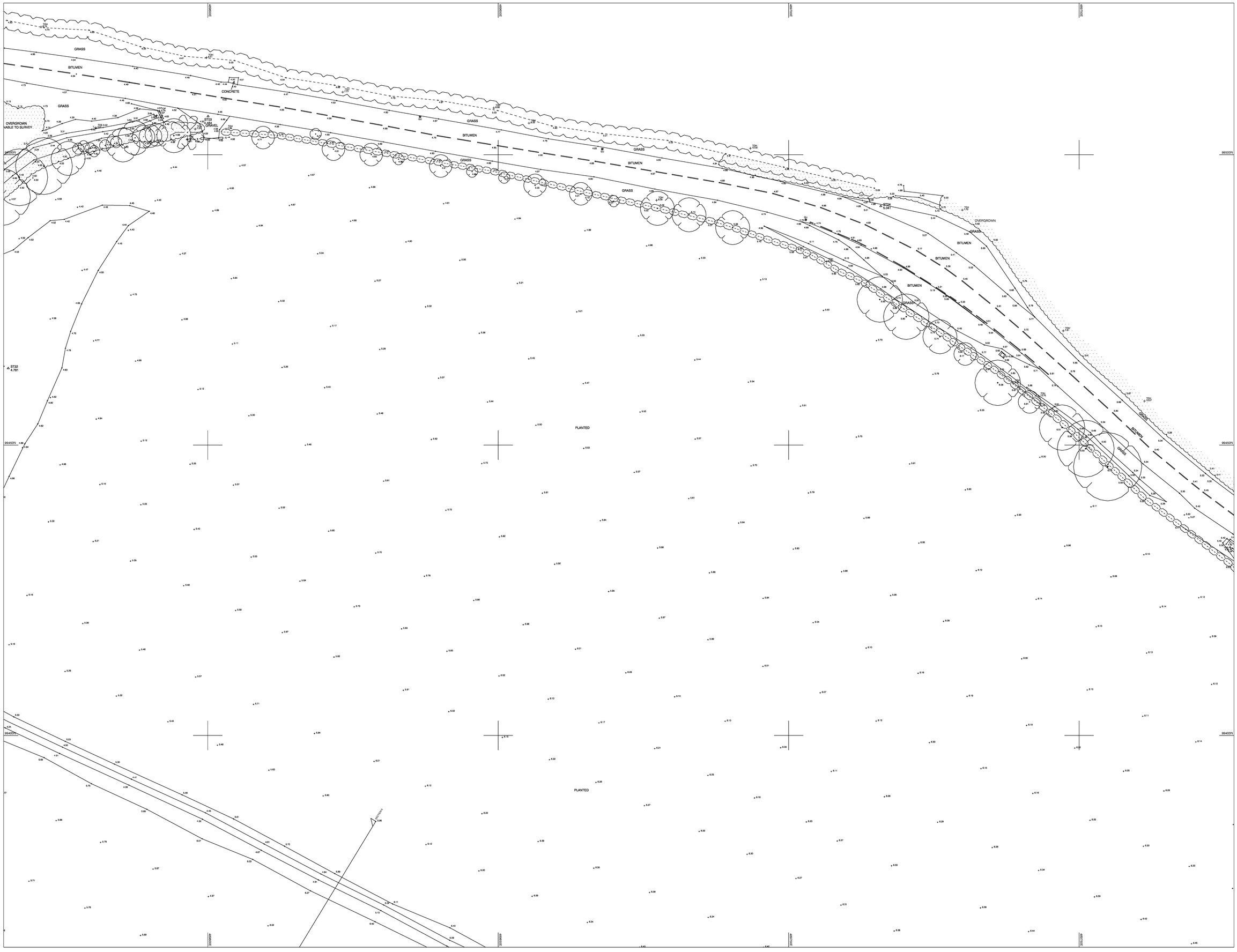
TOPOGRAPHICAL SURVEY

LAND AT PAGHAM, PAGHAM ROAD
PAGHAM
WEST SUSSEX
PO21 3PD

Dwg No. **150595 3D** Sheet **2 of 14**

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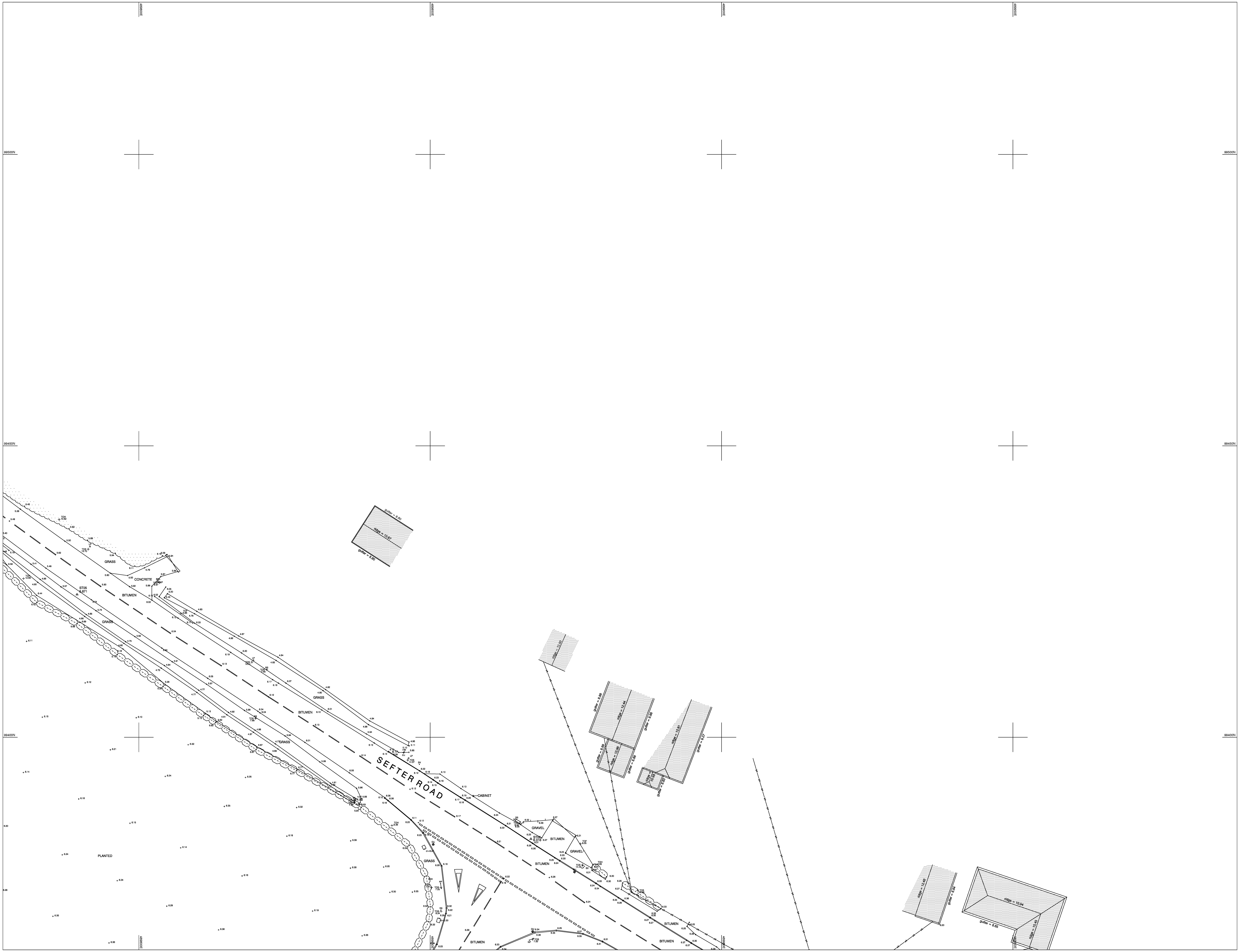
TOPOGRAPHICAL SURVEY

LAND AT PAGHAM, PAGHAM ROAD
PAGHAM
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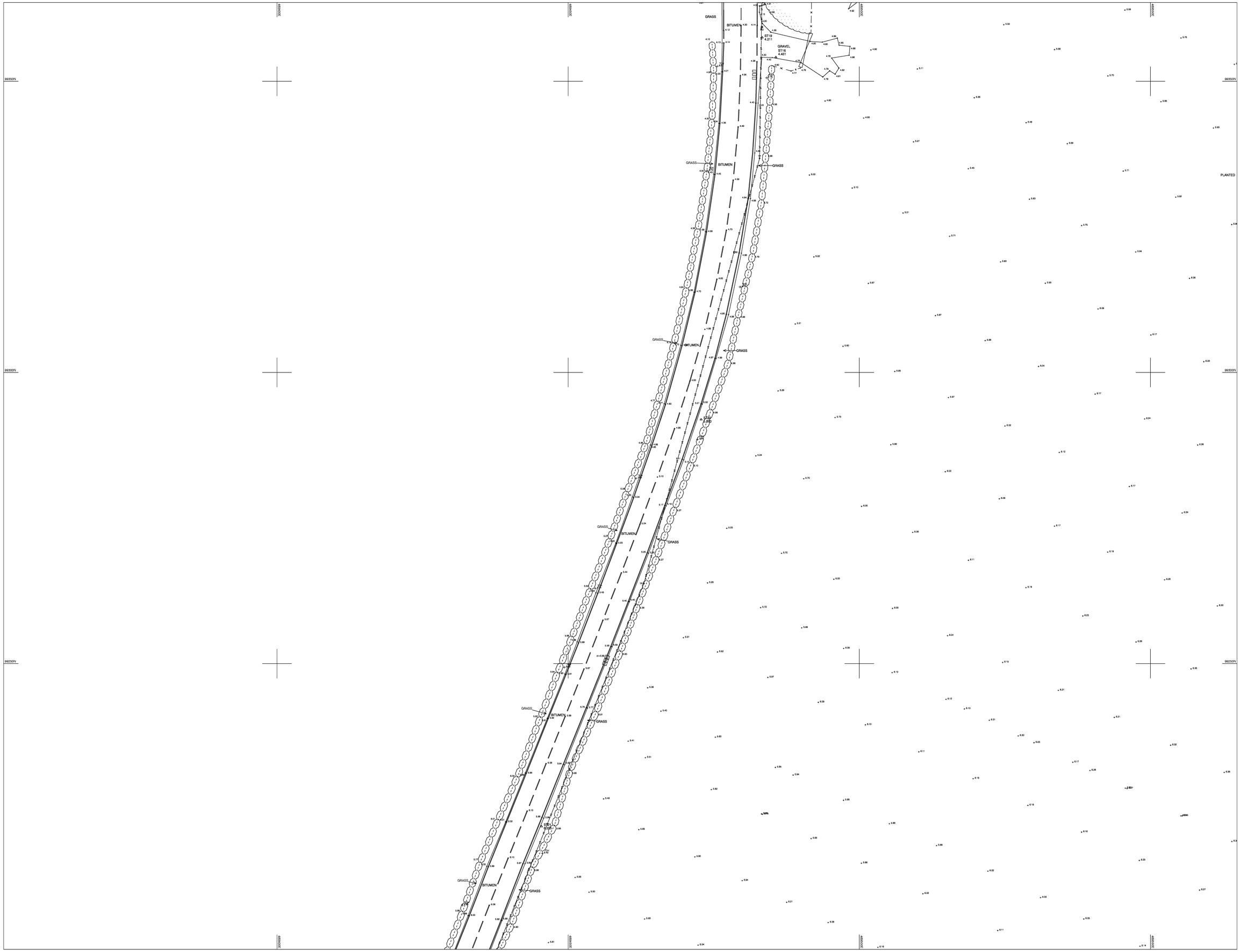
TOPOGRAPHICAL SURVEY

LAND AT PAGHAM, PAGHAM ROAD
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Dwg No. **150595 3D** Sheet **4 of 14**

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Dwg No. **150595 3D** Sheet **5 of 14**

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USE OF DIGITAL DATA SUBJECT TO TERMS AND CONDITIONS

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Client.

WSP ENVIRONMENT & ENERGY
ONE QUEENS DRIVE
BIRMINGHAM
B5 4PJ

Title.

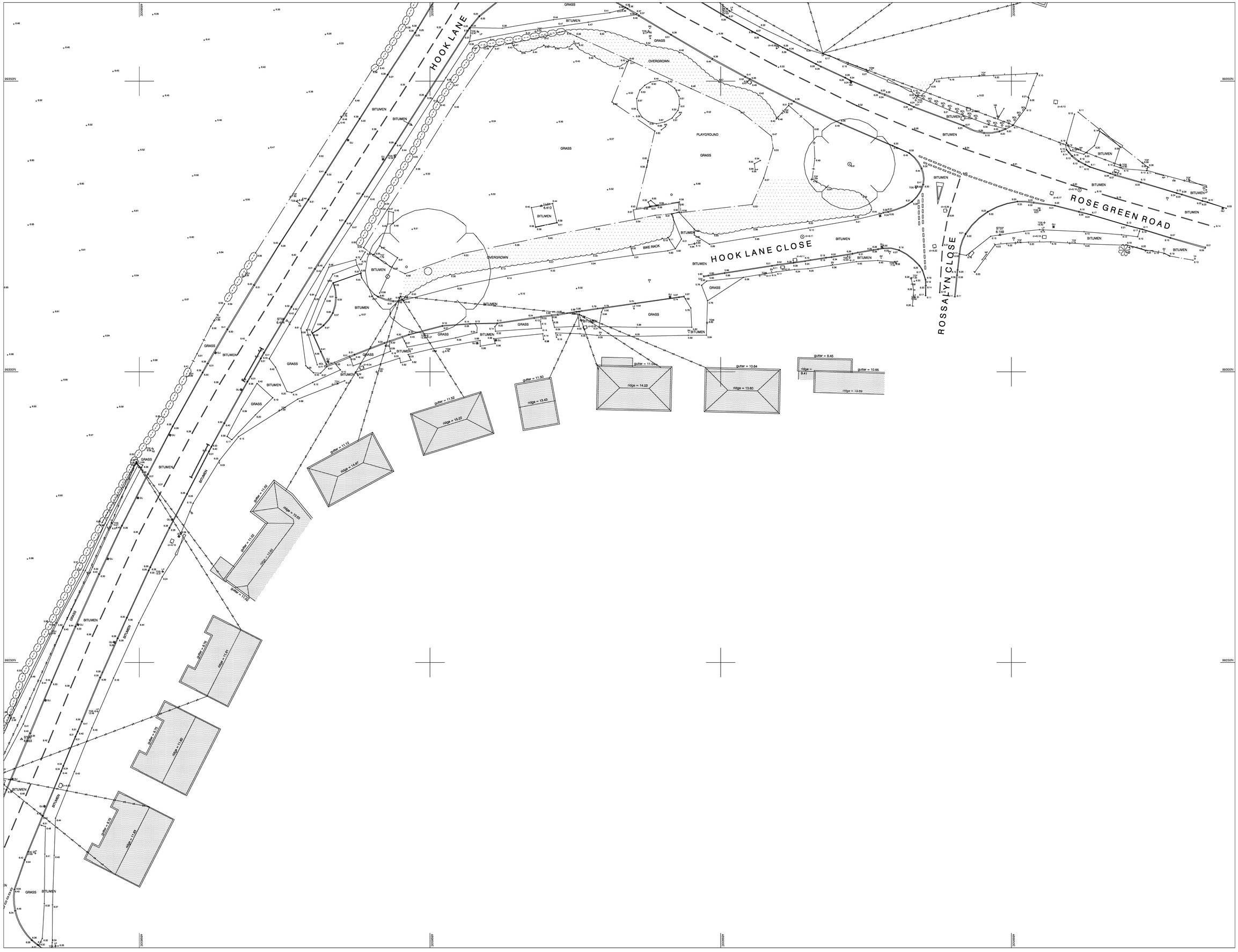
TOPOGRAPHICAL SURVEY

LAND AT PAGHAM, PAGHAM ROAD
PAGHAM
WEST SUSSEX
PO21 3PD

Dwg No. **150595 3D** Sheet **1 of 14**

Scale 1:200 A0 Sheet Rev. -

www.ordnancesurvey.co.uk/oswebsite/docs/licences/os-opendata-licence.pdf



Symbol & Abbreviation Key.

- BARBED WIRE FENCE
- POST & RAIL FENCE
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- KERB
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- BUILDING
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- SURVEY STATION
- ORDNANCE SURVEY BENCH MARK

A/C	AIR CONDITIONING UNIT	KO	KERB OFFLET
AV	AIR VALVE	LC	LIGHTING COLUMN
BOL	BOLLARD	LP	LAMP POST
BH	BOREHOLE	NP	NAME PLATE
BL	BED LEVEL	NB	NOTICE BOARD
BM	BENCH MARK	PR	PIPE RISER
BT	BRITISH TELECOM	RP	RODDING POINT
CTV	CABLE TV	RS	ROAD SIGN
CL	COVER LEVEL	SP	SIGN POST
CR	CABLE RISER	SV	STOP VALVE
DP	DOWN PIPE	TL	TRAFFIC LIGHT
ER	EARTH ROD	TP	TELEGRAPH POLE
EP	ELECTRICITY POLE	TOF	TOP OF FENCE
EM	ELECTRICITY MARKER	TOH	TOP OF HEDGE
FB	FUSE BOX	TOR	TOP OF RAILINGS
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FP	FENCE POST	TOW	TOP OF WALL
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GM	GAS MARKER	VP	VENT PIPE
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INDICATIVE ONLY

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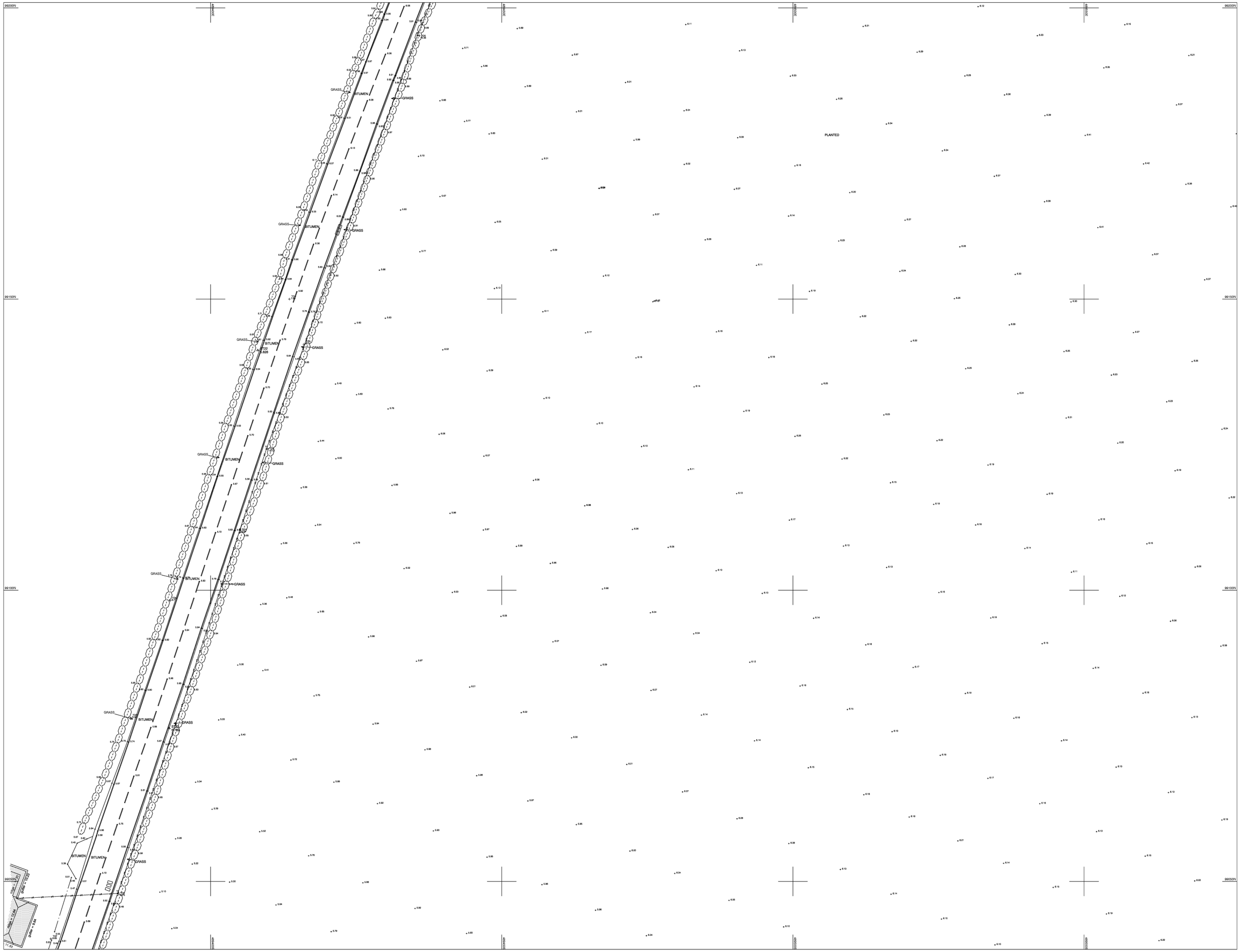
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TOPOGRAPHICAL SURVEY

LAND AT PAGHAM, PAGHAM ROAD
PAGHAM
WEST SUSSEX
PO21 3PD

Dwg No. **150595 3D** Sheet **7 of 14**

Scale 1:200 A0 Sheet Rev. -



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TOPOGRAPHICAL SURVEY

LAND AT PAGHAM, PAGHAM ROAD
PAGHAM
WEST SUSSEX
PO21 3PD

Dwg No. **150595 3D** Sheet **8 of 14**

Scale 1:200 A0 Sheet Rev. -

DRAWING/SPEC CODE: HLS 13.07

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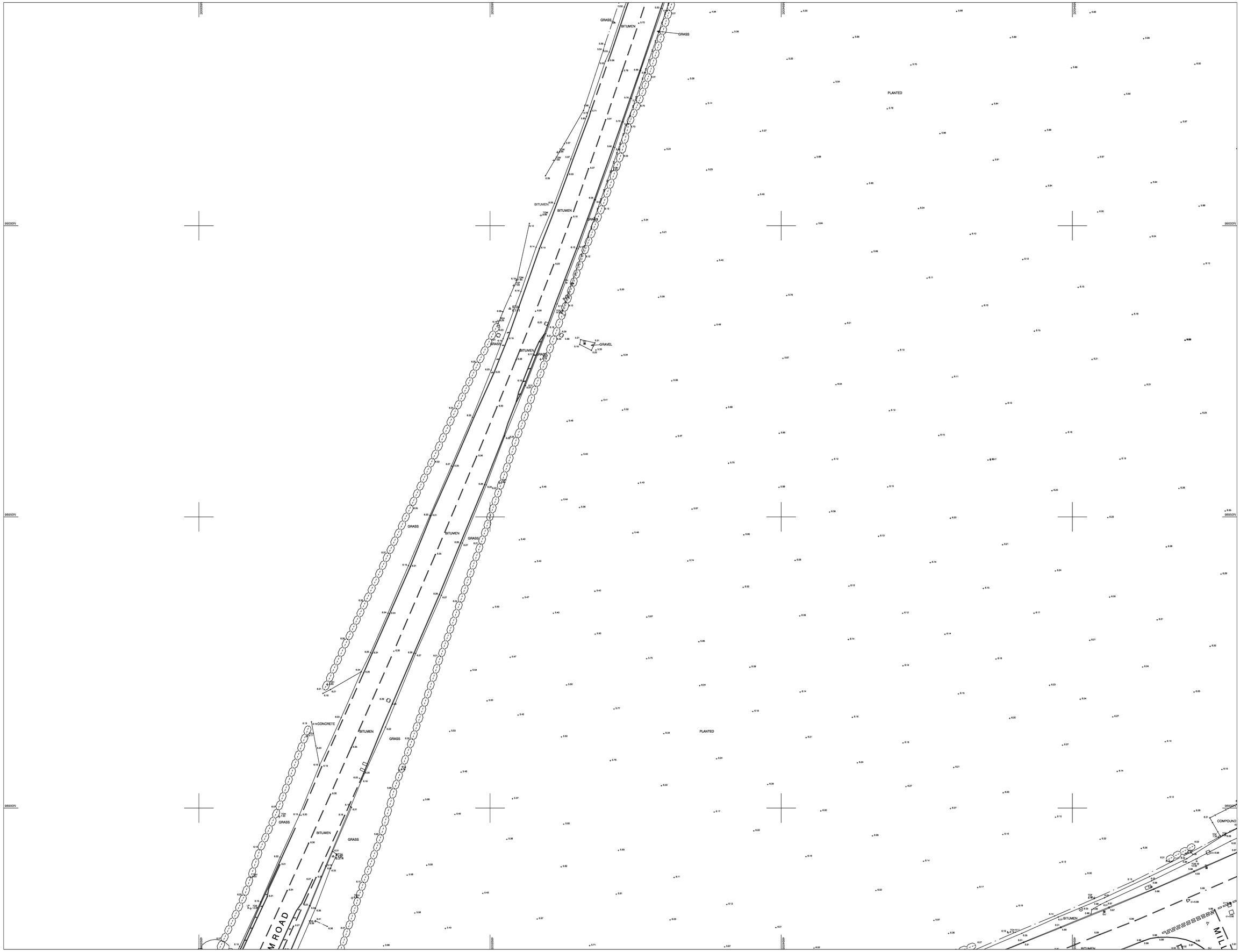
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TOPOGRAPHICAL SURVEY

LAND AT PAGHAM, PAGHAM ROAD
PAGHAM
WEST SUSSEX
PO21 3PD

Dwg No. **150595 3D** Sheet **9 of 14**

Scale 1:200 A0 Sheet Rev. -



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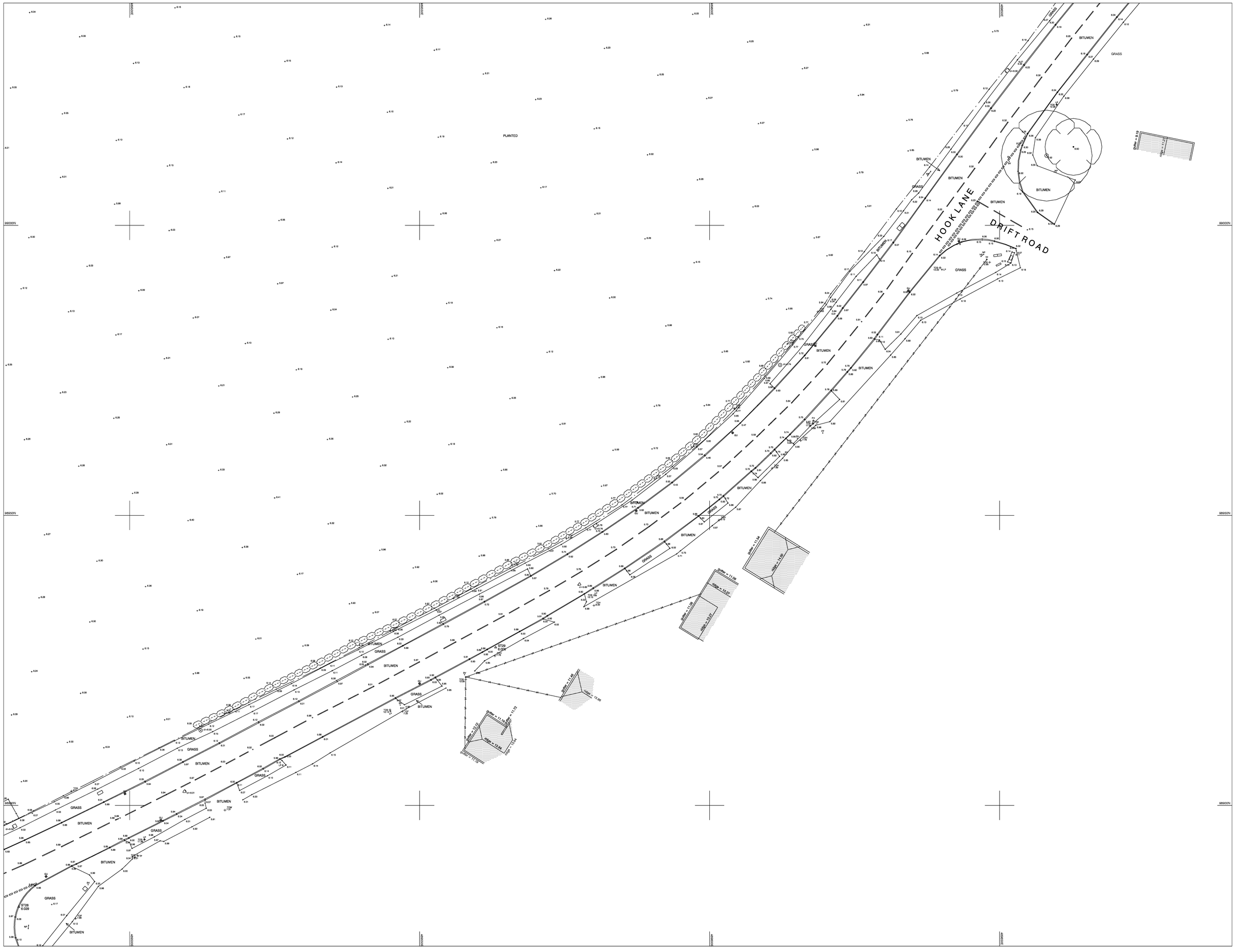
TOPOGRAPHICAL SURVEY

LAND AT PAGHAM, PAGHAM ROAD
PAGHAM
WEST SUSSEX
PO21 3PD

Dwg No. **150595 3D** Sheet **10 of 14**

Scale 1:200 A0 Sheet Rev. -

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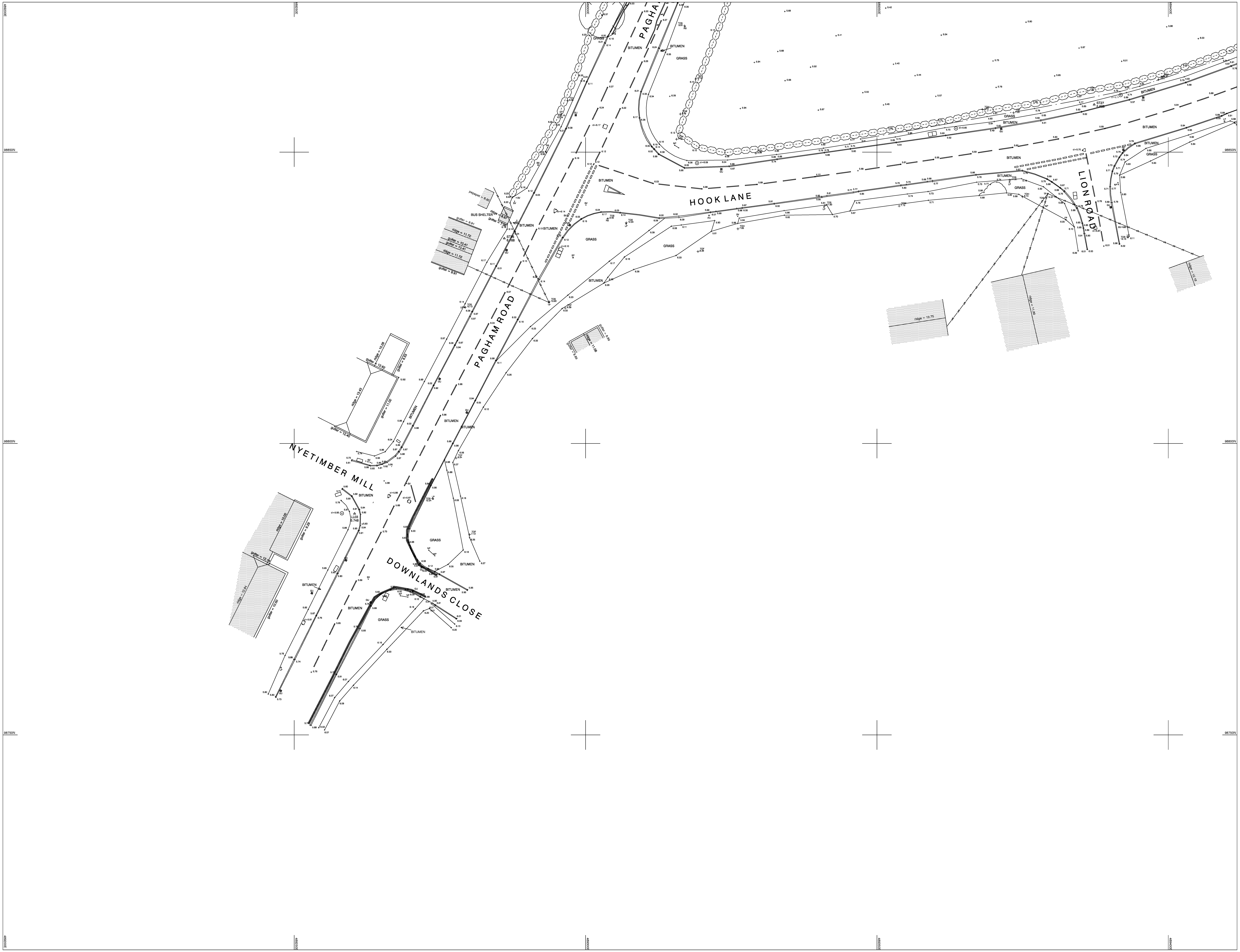
TOPOGRAPHICAL SURVEY

LAND AT PAGHAM, PAGHAM ROAD
PAGHAM
WEST SUSSEX
PO21 3PD

Dwg No. **150595 3D** Sheet **11 of 14**

Scale 1:200 A0 Sheet Rev. -

ARUN DISTRICT COUNCIL 21/01/16



Symbol & Abbreviation Key.

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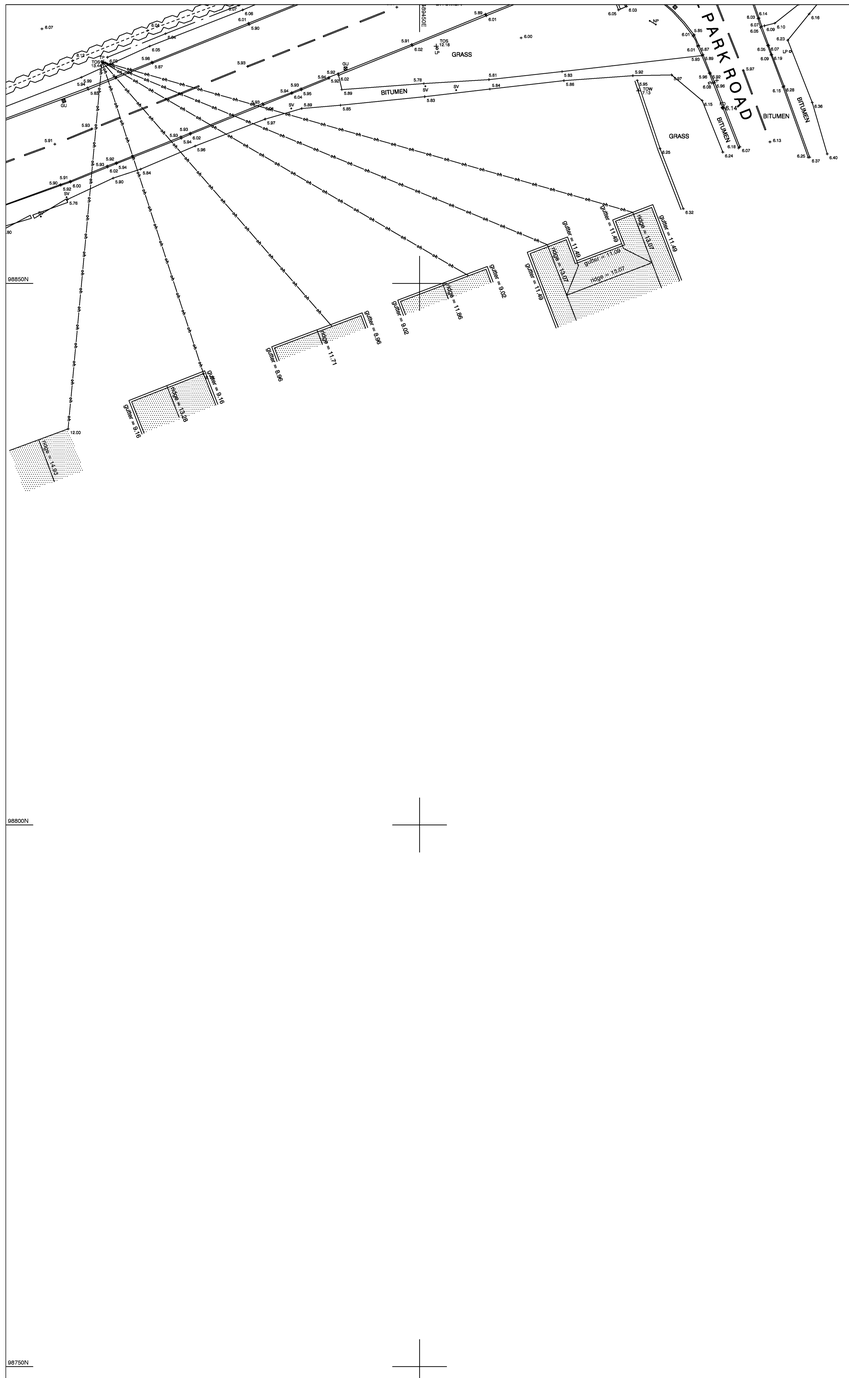
TOPOGRAPHICAL SURVEY

LAND AT PAGHAM, PAGHAM ROAD
PAGHAM
WEST SUSSEX
PO21 3PD

Dwg No. **150595 3D** Sheet **12 of 14**

Scale 1:200 A0 Sheet Rev. -

ARUN DISTRICT COUNCIL P/6/17/OUT



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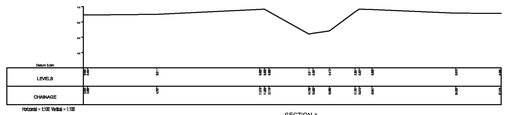
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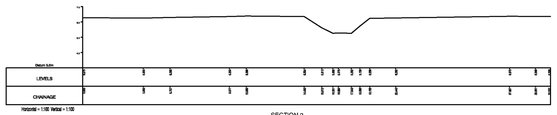
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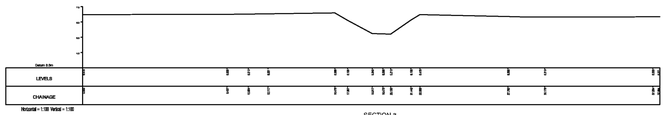
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SECTION 1



SECTION 2



SECTION 3

Cross Section 1

Chainage	Level	Easting	Northing	Note
0.000	8.719	486777.000	99117.000	Start
0.765	8.531	486778.063	99117.430	Ground level
1.768	8.301	486779.664	99118.142	Ground level
10.414	8.317	486788.310	99121.570	Ground level
11.853	8.800	486789.853	99121.854	Top of bank
12.114	8.869	486790.764	99122.870	Ground level
13.000	8.747	486791.650	99123.000	Bottom of bank
13.068	5.367	486793.729	99123.017	Bed level
18.086	5.113	486779.217	99128.240	Bottom of bank
18.213	5.207	486779.344	99128.240	Top of bank
18.613	8.807	486779.814	99128.240	Top of bank
18.849	8.808	486779.250	99129.170	Ground level
19.000	8.805	486779.400	99129.240	Ground level
27.278	8.345	486786.400	99129.600	End

Cross Section 2

Chainage	Level	Easting	Northing	Note
0.000	8.219	486852.163	99128.110	Start
0.000	8.219	486852.163	99128.110	Ground level
5.707	8.393	486878.672	99160.030	Ground level
9.317	8.202	486897.000	99188.640	Ground level
10.060	8.099	486901.870	99191.640	Ground level
13.000	8.047	486921.000	99197.000	Ground level
13.813	5.813	486930.883	99177.430	Ground level
16.261	5.292	486934.160	99179.046	Bottom of bank
16.387	5.297	486934.160	99179.046	Bed level
17.642	5.392	486953.812	99174.179	Bottom of bank
18.090	5.730	486954.850	99174.670	Ground level
19.000	8.047	486961.000	99175.000	Ground level
29.199	8.392	486935.863	99178.670	Ground level
27.887	8.370	486936.790	99183.670	Ground level
30.000	8.368	486938.000	99188.000	Ground level
30.307	8.358	486938.870	99188.080	End

Cross Section 3

Chainage	Level	Easting	Northing	Note
0.000	8.219	486852.163	99128.110	Start
5.707	8.393	486878.672	99160.030	Ground level
9.317	8.202	486897.000	99188.640	Ground level
10.060	8.099	486901.870	99191.640	Ground level
13.000	8.047	486921.000	99197.000	Ground level
13.813	5.813	486930.883	99177.430	Ground level
16.261	5.292	486934.160	99179.046	Bottom of bank
16.387	5.297	486934.160	99179.046	Bed level
17.642	5.392	486953.812	99174.179	Bottom of bank
18.090	5.730	486954.850	99174.670	Ground level
19.000	8.047	486961.000	99175.000	Ground level
29.199	8.392	486935.863	99178.670	Ground level
27.887	8.370	486936.790	99183.670	Ground level
30.000	8.368	486938.000	99188.000	Ground level
30.307	8.358	486938.870	99188.080	End

Cross Section 4

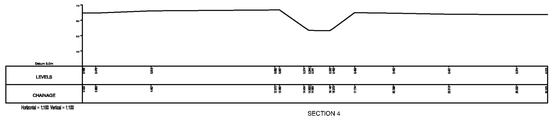
Chainage	Level	Easting	Northing	Note
0.000	8.197	486935.870	99203.240	Start
6.167	8.343	486941.670	99209.240	Ground level
10.801	8.517	486955.890	99231.670	Ground level
13.000	8.588	486967.000	99248.000	Ground level
16.178	8.388	486971.160	99253.170	Top of bank
17.267	8.165	486971.980	99252.240	Ground level
17.413	5.313	486973.170	99252.240	Bottom of bank
18.814	5.210	486974.170	99251.740	Bed level
20.190	5.316	486974.850	99251.240	Bottom of bank
21.416	8.178	486975.850	99251.240	Ground level
22.000	8.178	486976.000	99251.240	Ground level
27.178	8.219	486980.170	99251.170	Top of bank
30.178	8.219	486984.170	99218.780	Ground level
37.234	8.222	486986.870	99218.610	Ground level
37.864	8.202	486987.350	99218.670	End

Cross Section 5

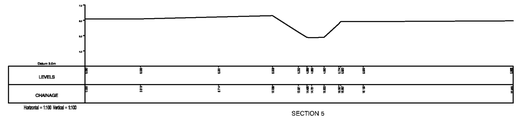
Chainage	Level	Easting	Northing	Note
0.000	8.198	486877.000	99208.670	Start
1.467	8.218	486878.460	99207.240	Ground level
4.167	8.818	486878.000	99207.240	Ground level
12.570	8.887	486883.890	99204.370	Ground level
13.000	8.888	486884.000	99204.000	Ground level
13.833	5.571	486885.670	99203.190	Ground level
14.800	5.341	486885.880	99203.240	Bottom of bank
14.913	5.337	486885.880	99203.240	Bed level
16.148	5.207	486886.860	99202.740	Bottom of bank
16.670	5.185	486887.060	99202.610	Ground level
17.774	8.189	486888.200	99202.030	Top of bank
20.298	8.182	486890.850	99200.610	Ground level
25.000	8.171	486894.000	99200.240	Ground level
28.213	8.214	486897.810	99201.290	Ground level
30.213	8.272	486898.990	99200.410	End

Cross Section 6

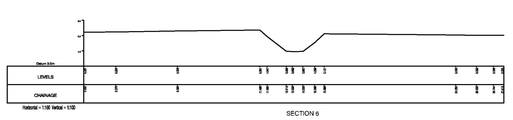
Chainage	Level	Easting	Northing	Note
0.000	8.091	486911.000	99199.240	Start
0.000	8.091	486911.000	99199.240	Ground level
6.009	8.308	486916.760	99197.170	Ground level
11.068	8.381	486918.140	99198.100	Top of bank
11.883	8.017	486918.750	99198.790	Ground level
12.218	5.886	486919.160	99199.790	Bottom of bank
12.318	5.881	486919.160	99199.790	Bed level
13.858	5.861	486920.140	99119.890	Bottom of bank
15.088	5.936	486920.950	99117.240	Ground level
16.000	8.017	486921.000	99117.240	Ground level
23.090	8.043	486926.180	99118.810	Ground level
25.800	8.072	486928.890	99119.890	Ground level
27.000	8.078	486930.000	99119.000	Ground level
27.418	8.078	486930.880	99197.170	End



SECTION 4



SECTION 5



SECTION 6

Symbol & Abbreviation Key.

BARBED WIRE FENCE
POST & RAIL FENCE
CLOSE BOARD FENCE
RAILINGS
CHAIN LINK FENCE
OTHER FENCE
KERB
DROPPED KERB
GULLY CHANNEL
TOP / BOTTOM OF BANK
FOLIAGE
DITCH
VERGE
OVERHEAD CABLES
GATE
HEDGE
TREE - BROAD LEAVED
TREE - CONIFEROUS
BUSH
BUILDING
BOREHOLE
SURVEY STATION
ORDNANCE SURVEY BENCH MARK

A/C	AIR CONDITIONING UNIT	KO	KERB OFFLET
AV	AIR VALVE	LC	LIGHTING COLUMN
BOL	BOLLARD	LP	LAMP POST
BH	BOREHOLE	NP	NAME PLATE
BL	BED LEVEL	NB	NOTICE BOARD
BM	BENCH MARK	PR	PIPE RISER
BT	BRITISH TELECOM	RP	RODDING POINT
CTV	CABLE TV	RS	ROAD SIGN
CL	COVER LEVEL	SP	SIGN POST
CR	CABLE RISER	SV	STOP VALVE
DP	DOWN PIPE	TL	TRAFFIC LIGHT
ER	EARTH ROD	TP	TELEGRAPH POLE
EP	ELECTRICITY POLE	TOF	TOP OF FENCE
EM	ELECTRICITY MARKER	TOH	TOP OF HEDGE
FB	FUSE BOX	TOR	TOP OF RAILINGS
FH	FIRE HYDRANT	TOS	SERVICE LEVEL
FP	FENCE POST	TOW	TOP OF WALL
FL	FLOOR LEVEL	UTL	UNABLE TO LIFT
GV	GAS VALVE	VM	VALVE MARKER
GM	GAS MARKER	VP	VENT PIPE
GU	GULLY	WL	WATER LEVEL
HM	HYDRANT MARKER	WM	WATER MARKER
IL	INVERT LEVEL	WO	WASH OUT

General.

This survey has been prepared with a scaling accuracy for a plot at a scale of 1:200.

All tree heights and spreads are approximate. We have tried to identify tree types, however if tree species are critical specialist advice should be gained.

Drainage pipe sizes have been measured from the surface. Chamber access has not been gained for safety reasons, therefore sizes should be regarded as approximate.

Some detail may have been omitted due to parked vehicles.

Notes.

Coordinates related to OS National Grid from ST03 by GPS (No scale factor added).
Levels related to GPS.

INDICATIVE ONLY

Rev	Details of Revision	Drawn	Date

Surveyed	Drawn	Date	Checked	Date	Approved	Date
GD	SE	18/09/15	GM	28/09/15	GM	28/09/15

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BIRMINGHAM
B5 4PJ

Title.

SECTIONS

LAND AT PAGHAM, PAGHAM ROAD
PAGHAM
WEST SUSSEX
PO21 3PD

Dwg No. **150595 3D** Sheet **14 of 14**

Scale 1:200 A1 Sheet Rev. -

Figure 12-1: Sites screened as part of the Level 1 SFRA

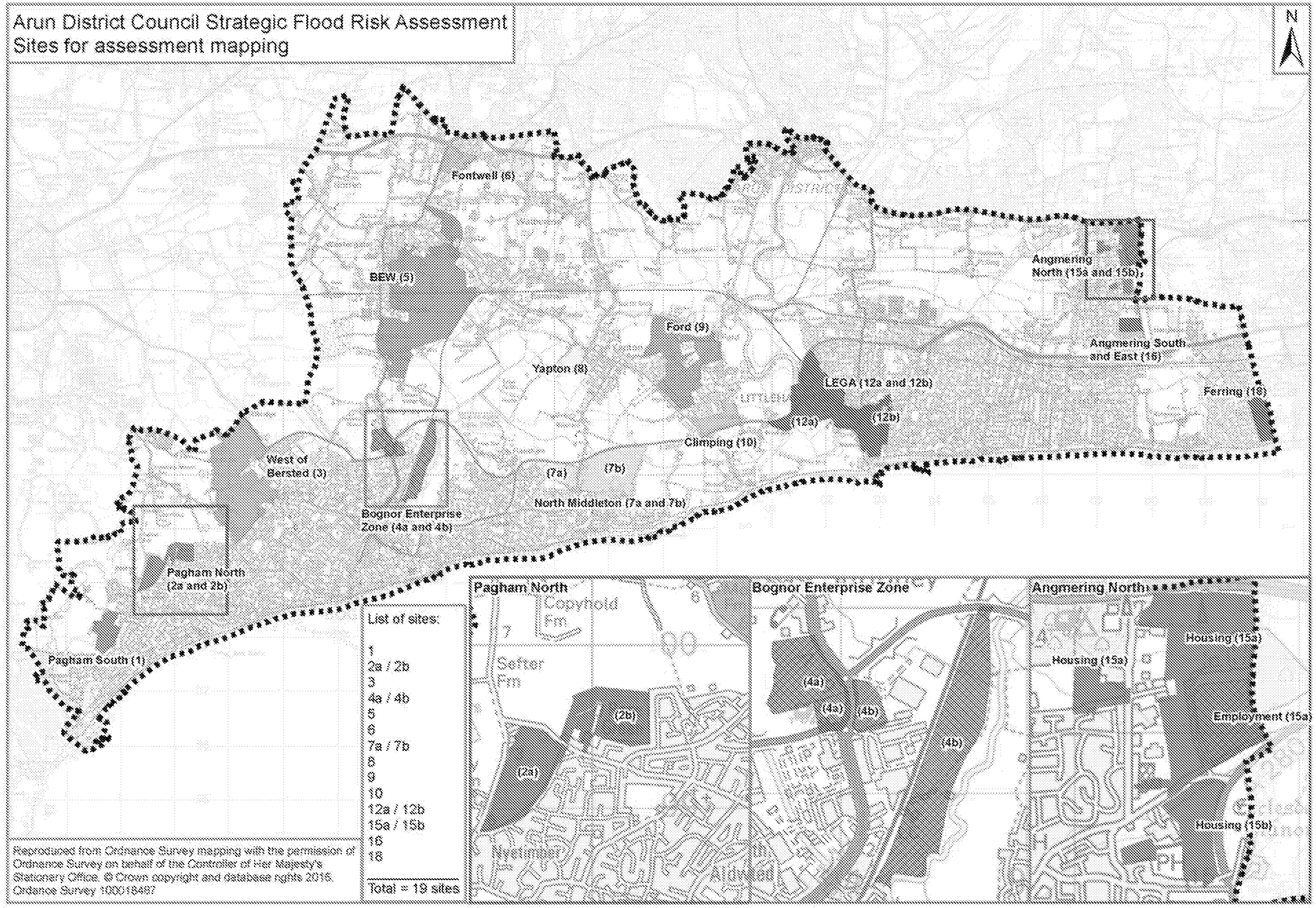


Table 12-1: Site summary assessment – flood risk and spatial datasets

Site no.	Site area (ha)	Proportion of site within Flood Zone 3b	Proportion of site within Flood Zone 3a	Proportion of site within Flood Zone 2	Proportion of site within Flood Zone 1	Proportion of site within EA Historic Flood Map	Proportion of site within uFMfSW 30 year extent	Proportion of site within uFMfSW 100 year extent	Proportion of site within uFMfSW 1000 year extent	Proportion of site within uFMfSW extent	Intersected by Risk of Flooding from Reservoirs Extent (Yes/No)	Highest ASTRIP class in site	Watercourse present within or adjacent to the site boundary? (Main River / Ordinary Watercourse / Both / No)	Site located within Flood Alert Area or Flood Warning Area (FAA / FWA / Both / No)
1	24.5	0%	0% > 25%	0% > 25%	75% > 100%	0%	0% > 25%	0% > 25%	0% > 25%	75% > 100%	0%	>=75%	Both	Both
2a	17.0	0%	0%	0% > 25%	75% > 100%	0%	0% > 25%	0% > 25%	0% > 25%	75% > 100%	0%	>=75%	Ordinary Watercourse	No
2b	15.3	0%	0%	0%	100%	0%	0% > 25%	0% > 25%	0% > 25%	75% > 100%	0%	>=75%	Ordinary Watercourse	No
3	1.6	0%	0%	0%	100%	0%	0% > 25%	0% > 25%	0% > 25%	75% > 100%	0%	>=75%	Ordinary Watercourse	Both
4a	14.9	0% > 25%	0% > 25%	0% > 25%	75% > 100%	0%	0% > 25%	0% > 25%	0% > 25%	75% > 100%	0%	>= 25% <50%	Both	Both
4b	33.0	0% > 25%	75% > 100%	0% > 25%	0% > 25%	0%	0% > 25%	0% > 25%	0% > 25%	75% > 100%	0%	>= 25% <50%	Both	Both
5	2.8	0% > 25%	0% > 25%	0% > 25%	75% > 100%	0% > 25%	0% > 25%	0% > 25%	0% > 25%	75% > 100%	0%	>=75%	Both	Both
6	18.1	0%	0%	0%	100%	0%	0% > 25%	0% > 25%	0% > 25%	75% > 100%	0%	>=75%	No	No
7a	10.3	0%	0%	0%	100%	0%	0% > 25%	0% > 25%	0% > 25%	75% > 100%	0%	>=75%	Ordinary Watercourse	No
7b	85.5	0% > 25%	0% > 25%	0% > 25%	50% > 75%	0%	0% > 25%	0% > 25%	0% > 25%	75% > 100%	0%	>=75%	Ordinary Watercourse	Both
8	21.2	0% > 25%	0% > 25%	0% > 25%	75% > 100%	0%	0% > 25%	0% > 25%	0% > 25%	75% > 100%	0%	>= 50% <75%	Both	No
9	1.2	0%	0%	0%	100%	0%	0% > 25%	0% > 25%	0% > 25%	75% > 100%	0%	>=75%	Ordinary Watercourse	No
10	26.4	0%	0%	0% > 25%	75% > 100%	0%	0%	0% > 25%	0% > 25%	75% > 100%	0%	>=75%	No	FAA
12a	46.3	0% > 25%	50% > 75%	0% > 25%	0% > 25%	0% > 25%	0% > 25%	0% > 25%	0% > 25%	75% > 100%	0%	>=75%	Both	Both
12b	98.7	0% > 25%	50% > 75%	0% > 25%	25% > 50%	0% > 25%	0% > 25%	0% > 25%	0% > 25%	75% > 100%	0%	>=75%	Both	Both
15a	36.4	0%	0%	0%	100%	0%	0% > 25%	0% > 25%	0% > 25%	75% > 100%	0%	>= 50% <75%	Both	FAA
15b	9.0	0% > 25%	0% > 25%	0% > 25%	75% > 100%	0%	0% > 25%	0% > 25%	0% > 25%	75% > 100%	0%	>= 25% <50%	Both	FAA
16	9.4	0%	0%	0%	100%	0%	0% > 25%	0% > 25%	0% > 25%	75% > 100%	0%	>= 25% <50%	Ordinary Watercourse	No
18	27.9	0% > 25%	0% > 25%	0% > 25%	75% > 100%	0%	0% > 25%	0% > 25%	0% > 25%	75% > 100%	0%	>= 50% <75%	No	No

Table 12-2: Site summary assessment – change in area of site intersected by Flood Zone 3a at 2031, 2061 and 2111 epochs (Higher Central flow allowance +15%, +30% and +45%, respectively)

Site no.	Site area (ha)	Proportion of site in Flood Zone 3a (including Flood Zone 3b) - River and Sea			
		Present day	2031 (+15%)	2061 (+30%)	2111 (+45%)
1	24.5	0%	0%	3%	18%
2a	17.0	0%	0%	0%	1%
2b	15.3	0%	0%	0%	0%
3	1.6	0%	0%	0%	0%
4a	14.9	17%	17%	51%	96%
4b	33.0	81%	82%	84%	97%
5	2.8	10%	10%	10%	10%
6	18.1	0%	0%	0%	0%
7a	10.3	0%	0%	0%	11%
7b	85.5	23%	27%	47%	71%
8	21.2	2%	2%	2%	2%
9	1.2	0%	0%	0%	0%
10	26.4	0%	0%	0%	0%
12a	46.3	81%	82%	83%	89%
12b	98.7	64%	67%	74%	81%
15a	36.4	0%	0%	0%	0%
15b	9.0	7%	7%	7%	7%
16	9.4	0%	0%	0%	0%
18	27.9	11%	11%	11%	11%

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N

Selsey Bottom

Selsey College

Bognor Regis Campus

Rose Green

Aldwick

Nyetimber

Mill Farm (Park Home Estate)

Notes

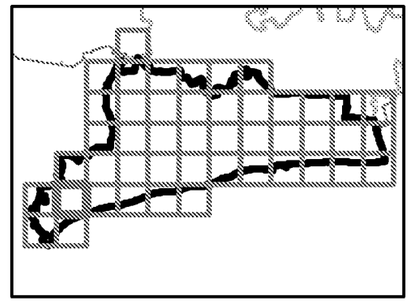
Zone 1: Comprised of land having a less than 1 in 1,000 annual probability of river or sea flooding in any year.

Zone 2: Comprised of land having between a 1 in 100 and 1 in 1,000 annual probability of river flooding or 1 in 200 and 1 in 1,000 annual probability of sea flooding in any year.

Zone 3a: This zone comprises land assessed as having a greater than 1in 100 annual probability of river flooding or a greater than 1 in 200 annual probability of flooding from sea in any year.

Zone 3b: This zone comprises land where water has to flow or be stored in times of flood (the functional floodplain). The SFRA identified this Flood Zone as land which would flood with an annual probability of 1 in 20 years, where detailed modelling exists. In the absence of detailed hydraulic model information, a precautionary approach has been adopted with the assumption that the extent of Flood Zone 3b would be equal to Flood Zone 3a. If development is shown to be in Flood Zone 3a, further work should be undertaken as part of a detailed site specific

Key Plan



Legend

- Arun District SFRA boundary
- Flood Zone 3b
- Flood Zone 3a
- Flood Zone 2

0 0.125 0.25 0.5 km

REF	Date	Comments
A	June 2016	-
B		
C		

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LEVEL 1 SFRA: APPENDIX C FLOOD ZONES

Sheet No: 4 of 44 Index Number: ADC_04

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ARUN DISTRICT COUNCIL P/6/17/OUT



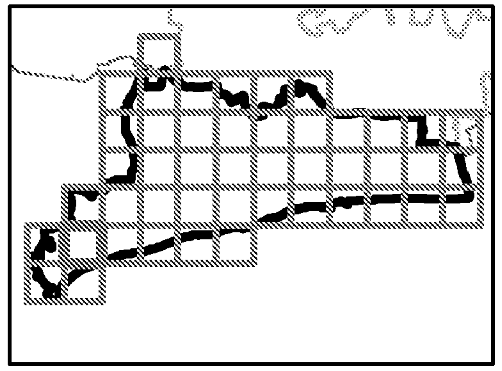
Notes

Hydraulic modelling has been undertaken as part of this SFRA to provide updated climate change flood mapping in the Arun District for Flood Zone 3a. This modelling followed the latest guidance for climate change in FRAs/SFRAs released by the Environment Agency in February 2016 (and updated in April 2016). Climate change for fluvial events has been based on the Higher Central estimates for the years 2031, 2061 and 2111. Present day flood risk information is available for comparison. Arun District is within the South East River Basin District and therefore allowance are:

- 2031 = +15% flows
- 2061 = +30% flows
- 2111 = +45% flows

For tidal/coastal models, undefended case still water level and defended case still water level with wave overtopping simulations have been completed to inform future flood risk within the Arun District. Again, climate change allowance predictions are for the years 2031, 2061 and 2111, with present day outputs for comparison.

Key Plan



Legend

- Arun District SFRA boundary
- Present Flood Zone 3a
- Future Flood Zone 3a (2031)
- Future Flood Zone 3a (2061)
- Future Flood Zone 3a (2111)

0 0.125 0.25 0.5 km

REF	Date	Comments
A	August 2016	
B		
C		

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LEVEL 1 SFRA: APPENDIX D
CLIMATE CHANGE MAPPING

Sheet No: 4 of 46 Index Number: ADC_04

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N

Sefter Bottom

Rose Green

Nyetimber

Arnwick

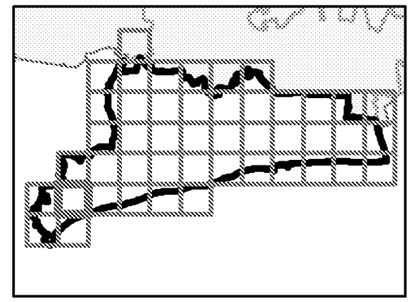
Notes

The updated Flood Map for Surface Water (uFMfSW) shows the flooding that takes place from the 'surface runoff' generated by rainwater (including snow and other precipitation) which:
(a) is on the surface of the ground (whether or not it is moving), and
(b) has not yet entered a watercourse, drainage system or public sewer.

The uFMfSW will pick out natural drainage channels, rivers, low areas in the floodplain and flow paths between buildings but it will only indicate flooding caused by local rainfall.

Note: The uFMfSW shows predictions of flooded areas but does not show whether individual properties will be affected by surface water flooding or have been affected in the past. The uFMfSW should not be used to predict if individual properties will flood.

Key Plan



Legend

- Arun District SFRA boundary
- uFMfSW 30-year extent
- uFMfSW 100-year extent
- uFMfSW 1,000-year extent

0 0.125 0.25 0.5 km

REF	Date	Comments
A	June 2014	-
B		
C		

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LEVEL 1 SFRA: APPENDIX E SURFACE WATER FLOOD RISK

Sheet No: 4 of 48 Index Number: ADC_04

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JBA

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N

Rose Green

Aldwick

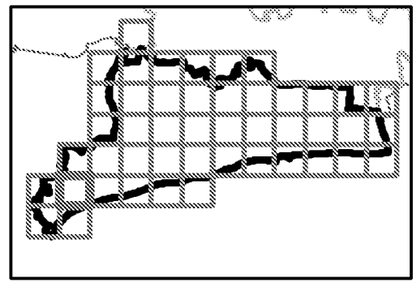
Notes

The Areas Susceptible to Groundwater Flooding (ASIGWF) is a strategic scale map showing groundwater flood areas on a 1km square grid. The data was produced to annotate indicative Flood Risk Areas for Preliminary Flood Risk Assessment (PFRA) studies and allow the Lead Local Flood Authorities (LLFAs) to determine whether there may be a risk of flooding from groundwater.

This data shows the proportion of each 1km grid square where geological and hydrogeological condition show that groundwater might emerge. It does not show the likelihood of groundwater flooding occurring. It does not take account of the chance of flooding from groundwater rebound. This dataset covers a large area of land, and only isolated locations within the overall susceptible area are actually likely to suffer the consequences of groundwater flooding.

The ASIGWF data should be used only in combination with other information, for example local data or historic data. It should not be used as sole evidence for any specific flood risk management, land use planning or other decisions at any scale. However, the data can help to identify areas for assessment at a local scale where finer resolution datasets exist.

Key Plan



Legend

- Arun District SFRA boundary
- < 25%
- >= 25% <50%
- >= 50% <75%
- >= 75%

0 0.125 0.25 0.5 km

REF	Date	Comments
A	June 2016	-
B		
C		

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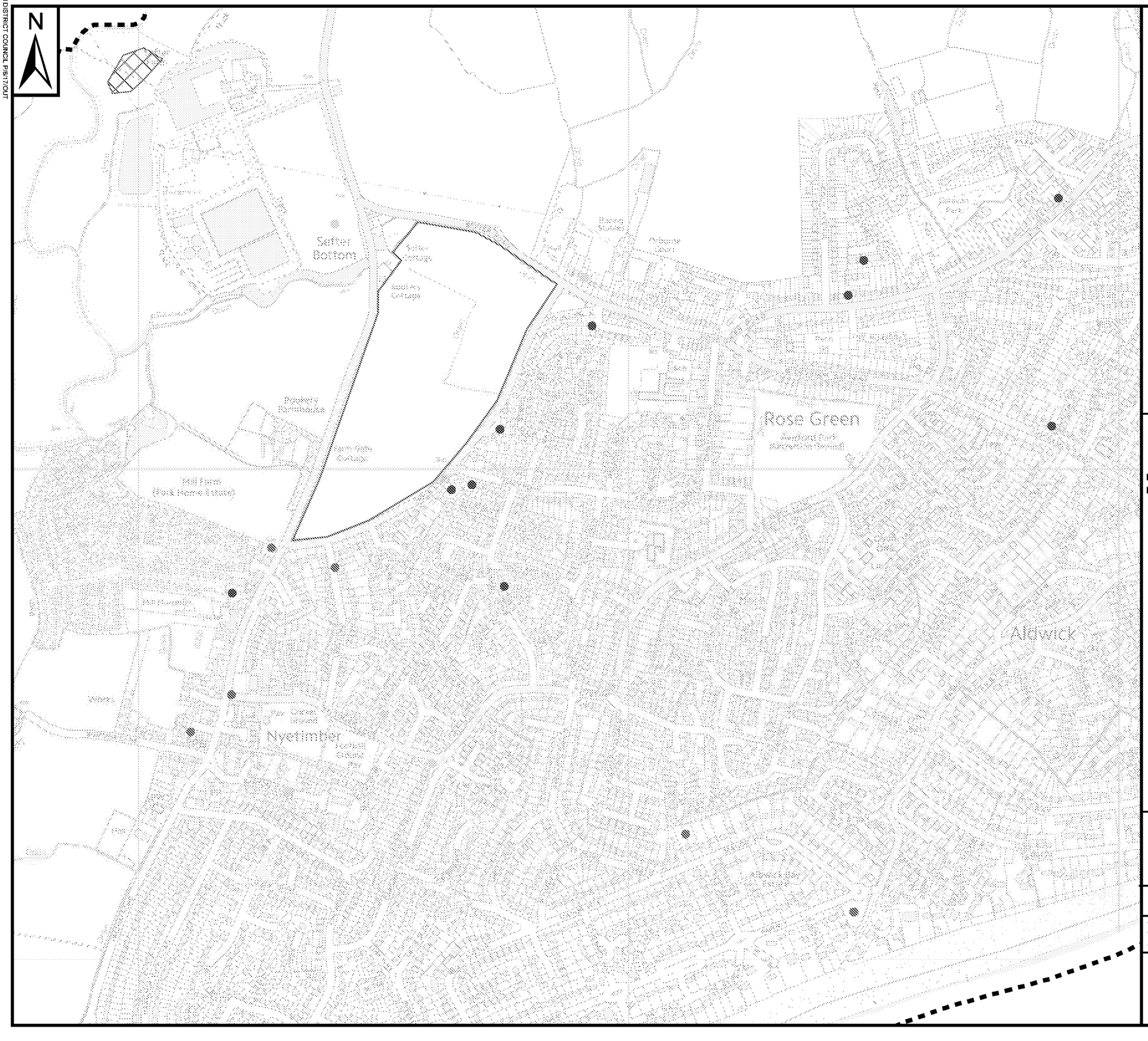
LEVEL 1 SFRA: APPENDIX F
AREAS SUSCEPTIBLE TO GROUNDWATER

Sheet No: 4 of 46 Index Number: ADC_04

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ARUN DISTRICT COUNCIL P/6/17/OUT



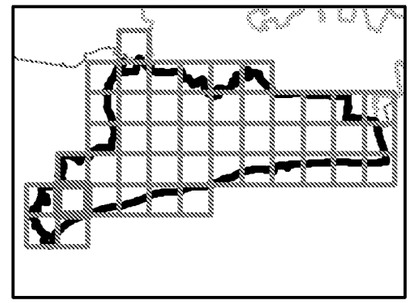
Notes

The Historic Flooding Map shows the recorded incidents and flood outlines provided by Arun District Council, West Sussex County Council, Southern Water and Environment Agency. Historical flood extent was obtained from the Environment Agency.

Flooding incidents provided have been categorised based upon the details provided in the records. Unknown flood points could not be determined from the information provided, and therefore could be from a number of sources.

Please note that not all historical records may be shown on this map, and that it is therefore advised you contact Arun District Council for updated information post 2015.

Key Plan



Legend

- Arun District SFRA boundary
- Historic flood outline

Source of flooding

- Fluvial
- Coastal
- Tidal
- Surface Water
- Failure
- Unknown

0 0.125 0.25 0.5 km

REF	Date	Comments
A	June 2018	-
B		
C		

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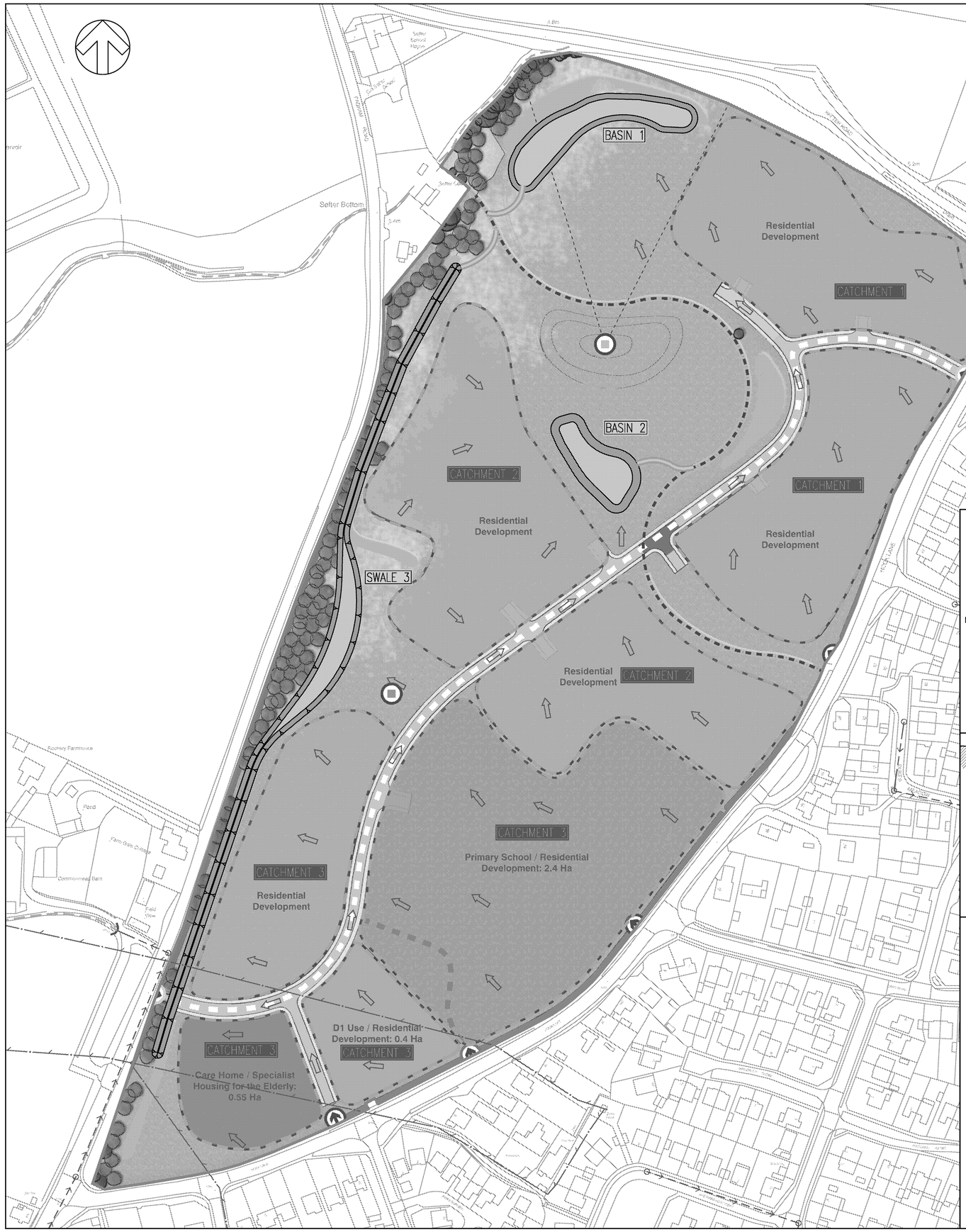
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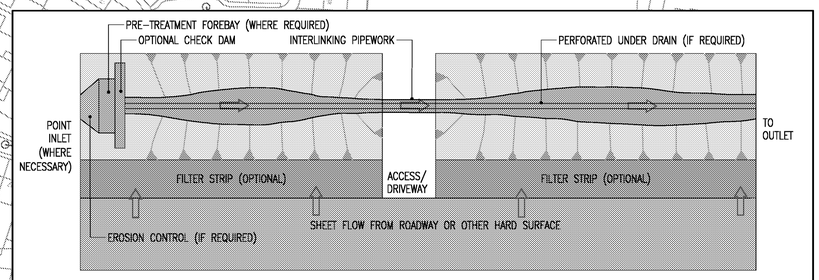
LEVEL 1 SFRA: APPENDIX H HISTORIC FLOODING RECORDS

Sheet No: 4 of 46 Index Number: ADC_04

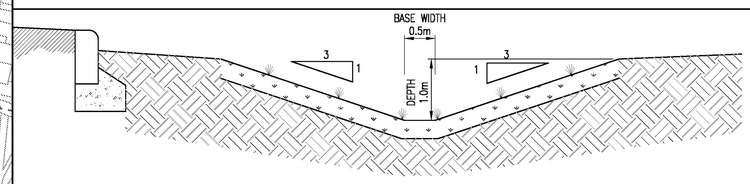
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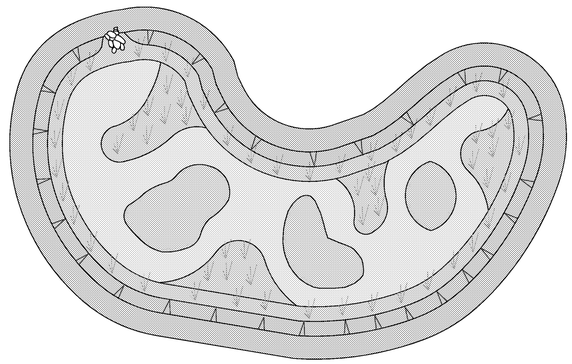




INDICATIVE ROADSIDE SWALE PLAN VIEW



SWALE C
INDICATIVE PROFILE AND DIMENSIONS
1:50



ILLUSTRATIVE BASIN LAYOUT – N.T.S.

DO NOT SCALE

NOTES

1. ALL LEVELS ARE IN METRES ABOVE ORDNANCE DATUM
2. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE STATED
3. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT SCHEME DRAWINGS AND SPECIFICATIONS
4. THIS DRAWING IS NOT BE REPRODUCED IN ANY PART OR FORM WITHOUT CONSENT OF WSP UK LTD. ALL COPYRIGHT RESERVED.
5. REPRODUCED FROM THE ORDNANCE SURVEY MAP WITH PERMISSION OF THE CONTROLLER OF HER MAJESTY'S STATIONARY OFFICE. LICENCE NO. 100048755. CROWN COPYRIGHT RESERVED
6. ILLUSTRATIVE DRAINAGE STRATEGY BASED ON:
   - 6.1. TOPOGRAPHICAL SURVEY PRODUCED BY INTERLOCK SURVEYS DATED 18TH SEPTEMBER 2015
   - 6.2. MASTERPLAN 167-P-006-RevB PRODUCED BY URBAN WILDERNESS DATED 19TH DECEMBER 2016
7. ALL STORAGE HYDRAULIC MODELLING CONDUCED USING WINDES SIMULATION SOFTWARE. STORAGE VOLUMES ARE APPROXIMATE AND WILL BE SUBJECT TO REFINEMENT FOLLOWING DETAILED ANALYSIS OF THE DEVELOPMENT DRAINAGE NETWORK.

KEY

- SITE RED LINE BOUNDARY
- PROPOSED ATTENUATION BASIN
- PROPOSED SURFACE WATER CONNECTION SWALE
- CATCHMENT BOUNDARY
- EXISTING WATERCOURSE
- PROPOSED WATERCOURSE
- EXISTING SURFACE WATER SEWERS
- EXISTING FOUL RISING MAINS

DRAINAGE CATCHMENT DETAILS

CATCHMENT	CONTRIBUTING AREA [ha]	PROPOSED DISCHARGE RATE (1 in 100 Yr Event) [l/s]	STORAGE VOLUME [m³]	STORAGE AREA [m²]
1	1.62	5.7	857	2316
2	1.61	5.7	831	1557
3	2.71	9.5	1390	4137
TOTAL	5.94	20.9	3078	8010

REV	DATE	BY	DESCRIPTION	CHK	APP.
E	06/01/17	CSB	UPDATED RED LINE BOUNDARY ALONG SEFTER ROAD	DW	CS
D	04/01/17	CSB	BASINS UPDATED FOR LATEST MASTERPLAN	DW	CS
C	05/10/16	CSB	BASINS UPDATED TO AVOID RISING MAIN	AC	CS
B	25/01/16	CSB	ADDED INDICATIVE SWALE PROFILE AND BASIN LAYOUT	DW	DW
A	15/12/15	CSB	FIRST ISSUE	DW	DW

DRAWING STATUS: FOR INFORMATION ONLY

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CLIENT: HALLAM LAND MANAGEMENT

ARCHITECT: URBAN WILDERNESS

PROJECT: HOOK LANE, PAGHAM

TITLE: ILLUSTRATIVE SURFACE WATER DRAINAGE STRATEGY

SCALE @ A1:	CHECKED:	APPROVED:
1 : 1250 m	DW	DW
CAD FILE: 4147-D-02	DESIGN-DRAWN: CSB	DATE: November 2015
PROJECT No: 70014147	DRAWING No: 4147-D-02	REV: E

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\\SER01HER1UK\PROJECTS\70014147 – ROSE GREEN, PAGHAM\E MODELS AND DRAWINGS\DEVELOPMENT\AUTOCAD\D DRAINAGE\4147-D-02.DWG 06/01/2017 14:45:52 Brammeier, Chris

Appendix B

CALCULATIONS

IH 124 Mean Annual Flood

Input

Return Period (years)	100	Soil	0.400
Area (ha)	50.000	Urban	0.000
SAAR (mm)	721	Region Number	Region 7

Results	**l/s**
QBAR Rural	176.1
QBAR Urban	176.1
Q100 years	561.8
Q1 year	149.7
Q2 years	155.1
Q5 years	225.4
Q10 years	285.3
Q20 years	352.8
Q25 years	378.3
Q30 years	399.1
Q50 years	461.4
Q100 years	561.8
Q200 years	660.4
Q250 years	692.1
Q1000 years	908.7

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	3.971	0.171	5.5	266.3	O K
30 min Summer	4.026	0.226	5.5	356.5	O K
60 min Summer	4.082	0.282	5.5	453.3	O K
120 min Summer	4.138	0.338	5.5	552.8	O K
180 min Summer	4.168	0.368	5.5	608.2	O K
240 min Summer	4.188	0.388	5.5	643.7	O K
360 min Summer	4.212	0.412	5.5	688.9	O K
480 min Summer	4.226	0.426	5.5	716.6	O K
600 min Summer	4.235	0.435	5.5	733.5	O K
720 min Summer	4.240	0.440	5.5	743.4	O K
960 min Summer	4.244	0.444	5.5	749.8	O K
1440 min Summer	4.240	0.440	5.5	742.4	O K
2160 min Summer	4.229	0.429	5.5	721.2	O K
2880 min Summer	4.214	0.414	5.5	693.7	O K
4320 min Summer	4.180	0.380	5.5	629.4	O K
5760 min Summer	4.141	0.341	5.5	557.9	O K
7200 min Summer	4.104	0.304	5.5	492.8	O K
8640 min Summer	4.072	0.272	5.5	435.5	O K
10080 min Summer	4.042	0.242	5.5	384.4	O K
15 min Winter	3.991	0.191	5.5	298.7	O K
30 min Winter	4.051	0.251	5.5	400.0	O K
60 min Winter	4.114	0.314	5.5	509.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	89.024	0.0	223.6	23
30 min Summer	59.849	0.0	304.3	37
60 min Summer	38.413	0.0	437.8	66
120 min Summer	23.812	0.0	543.5	126
180 min Summer	17.737	0.0	605.7	186
240 min Summer	14.290	0.0	648.2	246
360 min Summer	10.505	0.0	708.3	364
480 min Summer	8.441	0.0	750.2	484
600 min Summer	7.118	0.0	779.4	602
720 min Summer	6.190	0.0	798.5	722
960 min Summer	4.959	0.0	810.0	960
1440 min Summer	3.622	0.0	770.2	1202
2160 min Summer	2.640	0.0	1126.7	1580
2880 min Summer	2.107	0.0	1192.9	1992
4320 min Summer	1.530	0.0	1274.7	2812
5760 min Summer	1.218	0.0	1410.2	3584
7200 min Summer	1.019	0.0	1474.1	4328
8640 min Summer	0.882	0.0	1527.4	5104
10080 min Summer	0.781	0.0	1568.8	5848
15 min Winter	89.024	0.0	252.4	22
30 min Winter	59.849	0.0	339.9	37
60 min Winter	38.413	0.0	491.2	66

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
120 min Winter	4.176	0.376	5.5	621.9	O K
180 min Winter	4.210	0.410	5.5	684.9	O K
240 min Winter	4.231	0.431	5.5	725.1	O K
360 min Winter	4.258	0.458	5.5	777.0	O K
480 min Winter	4.275	0.475	5.5	809.9	O K
600 min Winter	4.286	0.486	5.5	830.9	O K
720 min Winter	4.292	0.492	5.5	844.3	O K
960 min Winter	4.299	0.499	5.5	856.5	O K
1440 min Winter	4.295	0.495	5.5	848.9	O K
2160 min Winter	4.279	0.479	5.5	817.6	O K
2880 min Winter	4.259	0.459	5.5	779.2	O K
4320 min Winter	4.211	0.411	5.5	687.5	O K
5760 min Winter	4.153	0.353	5.5	580.8	O K
7200 min Winter	4.096	0.296	5.5	478.7	O K
8640 min Winter	4.046	0.246	5.5	392.0	O K
10080 min Winter	4.004	0.204	5.5	319.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
120 min Winter	23.812	0.0	607.6	124
180 min Winter	17.737	0.0	675.1	182
240 min Winter	14.290	0.0	720.5	242
360 min Winter	10.505	0.0	781.8	358
480 min Winter	8.441	0.0	819.7	474
600 min Winter	7.118	0.0	839.6	590
720 min Winter	6.190	0.0	844.3	704
960 min Winter	4.959	0.0	828.5	926
1440 min Winter	3.622	0.0	789.5	1346
2160 min Winter	2.640	0.0	1260.1	1672
2880 min Winter	2.107	0.0	1331.9	2136
4320 min Winter	1.530	0.0	1402.3	3068
5760 min Winter	1.218	0.0	1580.0	3920
7200 min Winter	1.019	0.0	1652.2	4680
8640 min Winter	0.882	0.0	1712.8	5360
10080 min Winter	0.781	0.0	1760.9	6048

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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 %	+0

Time Area Diagram

Total Area (ha) 1.620

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.820	4	8	0.800

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Model Details

Storage is Online Cover Level (m) 4.600

Tank or Pond Structure

Invert Level (m) 3.800

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	1472.0	0.800	2316.0

Hydro-Brake Optimum® Outflow Control

Unit Reference	MD-SHE-0117-5700-0500-5700
Design Head (m)	0.500
Design Flow (l/s)	5.7
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Diameter (mm)	117
Invert Level (m)	3.800
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.500	5.5
Flush-Flo™	0.185	5.5
Kick-Flo®	0.376	4.8
Mean Flow over Head Range	-	4.5

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	4.1	1.200	8.2	3.000	12.7	7.000	19.1
0.200	5.5	1.400	8.8	3.500	13.7	7.500	19.8
0.300	5.3	1.600	9.4	4.000	14.6	8.000	20.4
0.400	4.9	1.800	10.0	4.500	15.4	8.500	21.0
0.500	5.5	2.000	10.5	5.000	16.2	9.000	21.7
0.600	5.9	2.200	10.9	5.500	16.9	9.500	22.3
0.800	6.8	2.400	11.4	6.000	17.7		
1.000	7.5	2.600	11.9	6.500	18.4		

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	5.288	0.288	5.7	264.0	O K
30 min Summer	5.376	0.376	5.7	353.2	O K
60 min Summer	5.466	0.466	5.7	448.6	O K
120 min Summer	5.553	0.553	5.7	545.9	O K
180 min Summer	5.599	0.599	5.7	599.6	O K
240 min Summer	5.628	0.628	5.7	633.2	O K
360 min Summer	5.662	0.662	5.7	674.8	O K
480 min Summer	5.682	0.682	5.7	699.4	O K
600 min Summer	5.694	0.694	5.7	713.4	O K
720 min Summer	5.700	0.700	5.7	720.7	O K
960 min Summer	5.701	0.701	5.7	722.4	O K
1440 min Summer	5.688	0.688	5.7	706.0	O K
2160 min Summer	5.662	0.662	5.7	674.6	O K
2880 min Summer	5.633	0.633	5.7	640.1	O K
4320 min Summer	5.567	0.567	5.7	562.9	O K
5760 min Summer	5.500	0.500	5.7	486.7	O K
7200 min Summer	5.438	0.438	5.7	419.2	O K
8640 min Summer	5.382	0.382	5.7	359.8	O K
10080 min Summer	5.333	0.333	5.7	308.6	O K
15 min Winter	5.320	0.320	5.7	296.1	O K
30 min Winter	5.417	0.417	5.7	396.5	O K
60 min Winter	5.516	0.516	5.7	504.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	89.024	0.0	248.7	23
30 min Summer	59.849	0.0	333.8	37
60 min Summer	38.413	0.0	453.0	66
120 min Summer	23.812	0.0	561.4	126
180 min Summer	17.737	0.0	626.1	186
240 min Summer	14.290	0.0	671.0	246
360 min Summer	10.505	0.0	735.6	364
480 min Summer	8.441	0.0	782.0	484
600 min Summer	7.118	0.0	815.0	602
720 min Summer	6.190	0.0	836.3	722
960 min Summer	4.959	0.0	842.1	960
1440 min Summer	3.622	0.0	801.6	1216
2160 min Summer	2.640	0.0	1137.7	1600
2880 min Summer	2.107	0.0	1208.3	1996
4320 min Summer	1.530	0.0	1307.5	2812
5760 min Summer	1.218	0.0	1408.1	3576
7200 min Summer	1.019	0.0	1472.7	4328
8640 min Summer	0.882	0.0	1528.1	5096
10080 min Summer	0.781	0.0	1574.3	5752
15 min Winter	89.024	0.0	278.9	22
30 min Winter	59.849	0.0	371.7	37
60 min Winter	38.413	0.0	507.5	66

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
120 min Winter	5.612	0.612	5.7	615.1	O K
180 min Winter	5.663	0.663	5.7	676.1	O K
240 min Winter	5.695	0.695	5.7	714.6	O K
360 min Winter	5.734	0.734	5.7	763.5	O K
480 min Winter	5.758	0.758	5.7	793.6	O K
600 min Winter	5.773	0.773	5.7	812.1	O K
720 min Winter	5.781	0.781	5.7	823.1	O K
960 min Winter	5.787	0.787	5.7	830.3	O K
1440 min Winter	5.776	0.776	5.7	815.8	O K
2160 min Winter	5.742	0.742	5.7	773.4	O K
2880 min Winter	5.705	0.705	5.7	727.3	O K
4320 min Winter	5.619	0.619	5.7	622.6	O K
5760 min Winter	5.512	0.512	5.7	499.6	O K
7200 min Winter	5.415	0.415	5.7	394.6	O K
8640 min Winter	5.332	0.332	5.7	307.4	O K
10080 min Winter	5.262	0.262	5.7	237.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
120 min Winter	23.812	0.0	627.7	124
180 min Winter	17.737	0.0	698.7	184
240 min Winter	14.290	0.0	747.3	242
360 min Winter	10.505	0.0	813.9	358
480 min Winter	8.441	0.0	854.0	474
600 min Winter	7.118	0.0	868.9	590
720 min Winter	6.190	0.0	864.7	704
960 min Winter	4.959	0.0	847.4	928
1440 min Winter	3.622	0.0	811.0	1354
2160 min Winter	2.640	0.0	1273.3	1688
2880 min Winter	2.107	0.0	1351.1	2160
4320 min Winter	1.530	0.0	1449.3	3072
5760 min Winter	1.218	0.0	1577.3	3864
7200 min Winter	1.019	0.0	1650.0	4608
8640 min Winter	0.882	0.0	1712.4	5280
10080 min Winter	0.781	0.0	1765.0	5952

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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 %	+0

Time Area Diagram

Total Area (ha) 1.610

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.805	4	8	0.805

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Model Details

Storage is Online Cover Level (m) 6.200

Tank or Pond Structure

Invert Level (m) 5.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	840.5	1.200	1556.5

Hydro-Brake Optimum® Outflow Control

Unit Reference	MD-SHE-0113-5700-0900-5700
Design Head (m)	0.900
Design Flow (l/s)	5.7
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Diameter (mm)	113
Invert Level (m)	5.000
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.900	5.7
Flush-Flo™	0.266	5.7
Kick-Flo®	0.590	4.7
Mean Flow over Head Range	-	4.9

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	4.0	1.200	6.5	3.000	10.0	7.000	14.9
0.200	5.6	1.400	7.0	3.500	10.7	7.500	15.4
0.300	5.6	1.600	7.4	4.000	11.4	8.000	15.9
0.400	5.5	1.800	7.8	4.500	12.1	8.500	16.4
0.500	5.3	2.000	8.2	5.000	12.7	9.000	16.8
0.600	4.7	2.200	8.6	5.500	13.3	9.500	17.3
0.800	5.4	2.400	9.0	6.000	13.9		
1.000	6.0	2.600	9.3	6.500	14.4		

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	4.199	0.299	9.4	444.4	O K
30 min Summer	4.276	0.376	9.4	594.8	O K
60 min Summer	4.350	0.450	9.4	755.6	O K
120 min Summer	4.420	0.520	9.4	920.0	O K
180 min Summer	4.455	0.555	9.4	1009.4	O K
240 min Summer	4.476	0.576	9.4	1064.7	O K
360 min Summer	4.502	0.602	9.4	1132.9	O K
480 min Summer	4.516	0.616	9.4	1172.7	O K
600 min Summer	4.524	0.624	9.4	1195.0	O K
720 min Summer	4.528	0.628	9.4	1206.0	O K
960 min Summer	4.528	0.628	9.4	1206.2	O K
1440 min Summer	4.519	0.619	9.4	1180.1	O K
2160 min Summer	4.500	0.600	9.4	1129.5	O K
2880 min Summer	4.480	0.580	9.4	1073.6	O K
4320 min Summer	4.435	0.535	9.4	957.4	O K
5760 min Summer	4.383	0.483	9.4	832.5	O K
7200 min Summer	4.333	0.433	9.4	716.3	O K
8640 min Summer	4.286	0.386	9.4	615.1	O K
10080 min Summer	4.242	0.342	9.4	526.1	O K
15 min Winter	4.228	0.328	9.4	498.5	O K
30 min Winter	4.310	0.410	9.4	667.6	O K
60 min Winter	4.391	0.491	9.4	849.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	89.024	0.0	417.6	23
30 min Summer	59.849	0.0	560.2	37
60 min Summer	38.413	0.0	762.0	68
120 min Summer	23.812	0.0	944.1	126
180 min Summer	17.737	0.0	1052.8	186
240 min Summer	14.290	0.0	1128.4	246
360 min Summer	10.505	0.0	1237.3	364
480 min Summer	8.441	0.0	1315.7	484
600 min Summer	7.118	0.0	1372.5	602
720 min Summer	6.190	0.0	1410.9	722
960 min Summer	4.959	0.0	1432.0	958
1440 min Summer	3.622	0.0	1367.9	1184
2160 min Summer	2.640	0.0	1915.1	1560
2880 min Summer	2.107	0.0	2033.8	1968
4320 min Summer	1.530	0.0	2197.0	2812
5760 min Summer	1.218	0.0	2370.1	3584
7200 min Summer	1.019	0.0	2479.0	4328
8640 min Summer	0.882	0.0	2572.2	5096
10080 min Summer	0.781	0.0	2649.8	5752
15 min Winter	89.024	0.0	468.3	22
30 min Winter	59.849	0.0	623.2	37
60 min Winter	38.413	0.0	853.6	66

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
120 min Winter	4.465	0.565	9.4	1035.1	O K
180 min Winter	4.503	0.603	9.4	1137.0	O K
240 min Winter	4.526	0.626	9.4	1201.1	O K
360 min Winter	4.555	0.655	9.4	1282.2	O K
480 min Winter	4.572	0.672	9.4	1331.8	O K
600 min Winter	4.582	0.682	9.4	1361.9	O K
720 min Winter	4.588	0.688	9.4	1379.4	O K
960 min Winter	4.591	0.691	9.4	1390.4	O K
1440 min Winter	4.582	0.682	9.4	1361.8	O K
2160 min Winter	4.559	0.659	9.4	1293.6	O K
2880 min Winter	4.532	0.632	9.4	1216.1	O K
4320 min Winter	4.469	0.569	9.4	1046.1	O K
5760 min Winter	4.395	0.495	9.4	860.4	O K
7200 min Winter	4.315	0.415	9.4	676.8	O K
8640 min Winter	4.241	0.341	9.4	525.3	O K
10080 min Winter	4.175	0.275	9.4	401.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
120 min Winter	23.812	0.0	1055.6	124
180 min Winter	17.737	0.0	1175.3	182
240 min Winter	14.290	0.0	1257.2	242
360 min Winter	10.505	0.0	1370.4	358
480 min Winter	8.441	0.0	1441.9	474
600 min Winter	7.118	0.0	1476.2	588
720 min Winter	6.190	0.0	1476.2	702
960 min Winter	4.959	0.0	1449.9	926
1440 min Winter	3.622	0.0	1394.8	1342
2160 min Winter	2.640	0.0	2143.5	1668
2880 min Winter	2.107	0.0	2274.7	2136
4320 min Winter	1.530	0.0	2439.0	3032
5760 min Winter	1.218	0.0	2654.9	3920
7200 min Winter	1.019	0.0	2777.3	4616
8640 min Winter	0.882	0.0	2882.3	5352
10080 min Winter	0.781	0.0	2970.8	5952

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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 %	+0

Time Area Diagram

Total Area (ha) 2.710

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	1.355	4	8	1.355

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Model Details

Storage is Online Cover Level (m) 4.900

Tank or Pond Structure

Invert Level (m) 3.900

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	1151.6	1.000	4136.7

Hydro-Brake Optimum® Outflow Control

Unit Reference	MD-SHE-0146-9500-0700-9500
Design Head (m)	0.700
Design Flow (l/s)	9.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Diameter (mm)	146
Invert Level (m)	3.900
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.700	9.4
Flush-Flo™	0.241	9.4
Kick-Flo®	0.510	8.2
Mean Flow over Head Range	-	7.9

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	5.3	1.200	12.2	3.000	18.8	7.000	28.3
0.200	9.4	1.400	13.1	3.500	20.3	7.500	29.2
0.300	9.4	1.600	14.0	4.000	21.6	8.000	30.1
0.400	9.1	1.800	14.8	4.500	22.9	8.500	31.1
0.500	8.3	2.000	15.5	5.000	24.1	9.000	32.0
0.600	8.8	2.200	16.2	5.500	25.2	9.500	32.9
0.800	10.1	2.400	16.9	6.000	26.3		
1.000	11.2	2.600	17.6	6.500	27.3		

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Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	4.057	0.257	5.5	410.9	O K
30 min Summer	4.137	0.337	5.5	551.5	O K
60 min Summer	4.220	0.420	5.5	704.2	O K
120 min Summer	4.301	0.501	5.5	862.0	Flood Risk
180 min Summer	4.346	0.546	5.7	951.0	Flood Risk
240 min Summer	4.374	0.574	5.8	1008.9	Flood Risk
360 min Summer	4.411	0.611	6.0	1086.0	Flood Risk
480 min Summer	4.435	0.635	6.1	1136.8	Flood Risk
600 min Summer	4.451	0.651	6.2	1171.3	Flood Risk
720 min Summer	4.462	0.662	6.2	1195.0	Flood Risk
960 min Summer	4.475	0.675	6.3	1221.5	Flood Risk
1440 min Summer	4.477	0.677	6.3	1227.4	Flood Risk
2160 min Summer	4.468	0.668	6.2	1206.5	Flood Risk
2880 min Summer	4.455	0.655	6.2	1178.0	Flood Risk
4320 min Summer	4.424	0.624	6.1	1112.1	Flood Risk
5760 min Summer	4.391	0.591	5.9	1043.6	Flood Risk
7200 min Summer	4.359	0.559	5.8	977.3	Flood Risk
8640 min Summer	4.328	0.528	5.6	915.5	Flood Risk
10080 min Summer	4.299	0.499	5.5	857.1	O K
15 min Winter	4.086	0.286	5.5	460.8	O K
30 min Winter	4.174	0.374	5.5	618.7	O K
60 min Winter	4.265	0.465	5.5	789.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	124.633	0.0	347.6	26
30 min Summer	83.789	0.0	437.7	40
60 min Summer	53.779	0.0	671.6	68
120 min Summer	33.337	0.0	812.5	128
180 min Summer	24.832	0.0	875.4	188
240 min Summer	20.006	0.0	896.9	246
360 min Summer	14.706	0.0	898.9	366
480 min Summer	11.818	0.0	898.4	484
600 min Summer	9.966	0.0	898.0	604
720 min Summer	8.665	0.0	897.6	724
960 min Summer	6.943	0.0	897.2	962
1440 min Summer	5.071	0.0	892.8	1402
2160 min Summer	3.696	0.0	1694.2	1732
2880 min Summer	2.949	0.0	1714.9	2108
4320 min Summer	2.142	0.0	1586.8	2940
5760 min Summer	1.705	0.0	2172.4	3752
7200 min Summer	1.427	0.0	2269.9	4608
8640 min Summer	1.235	0.0	2352.2	5440
10080 min Summer	1.093	0.0	2418.6	6248
15 min Winter	124.633	0.0	384.8	26
30 min Winter	83.789	0.0	452.0	40
60 min Winter	53.779	0.0	745.9	68

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Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
120 min Winter	4.354	0.554	5.7	967.7	Flood Risk
180 min Winter	4.403	0.603	6.0	1068.8	Flood Risk
240 min Winter	4.435	0.635	6.1	1135.1	Flood Risk
360 min Winter	4.476	0.676	6.3	1224.4	Flood Risk
480 min Winter	4.503	0.703	6.4	1284.4	Flood Risk
600 min Winter	4.522	0.722	6.5	1326.3	Flood Risk
720 min Winter	4.536	0.736	6.5	1356.1	Flood Risk
960 min Winter	4.552	0.752	6.6	1392.7	Flood Risk
1440 min Winter	4.561	0.761	6.6	1414.0	Flood Risk
2160 min Winter	4.549	0.749	6.6	1386.5	Flood Risk
2880 min Winter	4.533	0.733	6.5	1350.2	Flood Risk
4320 min Winter	4.493	0.693	6.4	1260.3	Flood Risk
5760 min Winter	4.447	0.647	6.2	1160.8	Flood Risk
7200 min Winter	4.400	0.600	5.9	1062.6	Flood Risk
8640 min Winter	4.355	0.555	5.7	970.4	Flood Risk
10080 min Winter	4.312	0.512	5.5	883.4	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
120 min Winter	33.337	0.0	880.0	126
180 min Winter	24.832	0.0	909.5	184
240 min Winter	20.006	0.0	913.3	242
360 min Winter	14.706	0.0	919.4	360
480 min Winter	11.818	0.0	925.8	476
600 min Winter	9.966	0.0	932.2	594
720 min Winter	8.665	0.0	939.1	708
960 min Winter	6.943	0.0	948.8	938
1440 min Winter	5.071	0.0	943.3	1384
2160 min Winter	3.696	0.0	1824.1	1984
2880 min Winter	2.949	0.0	1784.0	2248
4320 min Winter	2.142	0.0	1684.2	3160
5760 min Winter	1.705	0.0	2432.8	4088
7200 min Winter	1.427	0.0	2541.4	4968
8640 min Winter	1.235	0.0	2631.2	5800
10080 min Winter	1.093	0.0	2698.4	6664

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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) 1.782

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.820	4	8	0.800	8	12	0.162

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Model Details

Storage is Online Cover Level (m) 4.600

Tank or Pond Structure

Invert Level (m) 3.800

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	1472.0	0.800	2316.0

Hydro-Brake Optimum® Outflow Control

Unit Reference	MD-SHE-0117-5700-0500-5700
Design Head (m)	0.500
Design Flow (l/s)	5.7
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Diameter (mm)	117
Invert Level (m)	3.800
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.500	5.5
Flush-Flo™	0.185	5.5
Kick-Flo®	0.376	4.8
Mean Flow over Head Range	-	4.5

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	4.1	1.200	8.2	3.000	12.7	7.000	19.1
0.200	5.5	1.400	8.8	3.500	13.7	7.500	19.8
0.300	5.3	1.600	9.4	4.000	14.6	8.000	20.4
0.400	4.9	1.800	10.0	4.500	15.4	8.500	21.0
0.500	5.5	2.000	10.5	5.000	16.2	9.000	21.7
0.600	5.9	2.200	10.9	5.500	16.9	9.500	22.3
0.800	6.8	2.400	11.4	6.000	17.7		
1.000	7.5	2.600	11.9	6.500	18.4		

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Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	5.428	0.428	5.7	407.8	O K
30 min Summer	5.554	0.554	5.7	547.3	O K
60 min Summer	5.681	0.681	5.7	698.1	O K
120 min Summer	5.805	0.805	5.7	853.3	O K
180 min Summer	5.871	0.871	5.7	940.3	O K
240 min Summer	5.912	0.912	5.7	996.5	Flood Risk
360 min Summer	5.966	0.966	5.9	1070.5	Flood Risk
480 min Summer	6.000	1.000	6.0	1118.5	Flood Risk
600 min Summer	6.022	1.022	6.0	1150.6	Flood Risk
720 min Summer	6.037	1.037	6.1	1172.0	Flood Risk
960 min Summer	6.053	1.053	6.1	1194.4	Flood Risk
1440 min Summer	6.052	1.052	6.1	1193.2	Flood Risk
2160 min Summer	6.029	1.029	6.0	1160.8	Flood Risk
2880 min Summer	6.004	1.004	6.0	1124.5	Flood Risk
4320 min Summer	5.952	0.952	5.8	1051.7	Flood Risk
5760 min Summer	5.901	0.901	5.7	981.2	Flood Risk
7200 min Summer	5.851	0.851	5.7	914.2	O K
8640 min Summer	5.803	0.803	5.7	851.3	O K
10080 min Summer	5.756	0.756	5.7	791.0	O K
15 min Winter	5.474	0.474	5.7	457.4	O K
30 min Winter	5.611	0.611	5.7	614.2	O K
60 min Winter	5.750	0.750	5.7	783.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	124.633	0.0	379.6	25
30 min Summer	83.789	0.0	464.5	40
60 min Summer	53.779	0.0	694.3	68
120 min Summer	33.337	0.0	843.4	128
180 min Summer	24.832	0.0	899.6	188
240 min Summer	20.006	0.0	903.9	246
360 min Summer	14.706	0.0	900.7	366
480 min Summer	11.818	0.0	898.6	486
600 min Summer	9.966	0.0	897.8	604
720 min Summer	8.665	0.0	897.7	724
960 min Summer	6.943	0.0	900.9	962
1440 min Summer	5.071	0.0	904.1	1430
2160 min Summer	3.696	0.0	1726.2	1756
2880 min Summer	2.949	0.0	1744.6	2136
4320 min Summer	2.142	0.0	1611.0	2944
5760 min Summer	1.705	0.0	2168.5	3800
7200 min Summer	1.427	0.0	2268.0	4616
8640 min Summer	1.235	0.0	2353.7	5448
10080 min Summer	1.093	0.0	2426.9	6256
15 min Winter	124.633	0.0	418.9	25
30 min Winter	83.789	0.0	459.1	40
60 min Winter	53.779	0.0	772.6	68

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Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
120 min Winter	5.885	0.885	5.7	958.9	O K
180 min Winter	5.957	0.957	5.8	1058.1	Flood Risk
240 min Winter	6.003	1.003	6.0	1122.9	Flood Risk
360 min Winter	6.063	1.063	6.1	1209.6	Flood Risk
480 min Winter	6.102	1.102	6.2	1267.2	Flood Risk
600 min Winter	6.129	1.129	6.3	1307.0	Flood Risk
720 min Winter	6.147	1.147	6.3	1334.9	Flood Risk
960 min Winter	6.169	1.169	6.4	1368.0	Flood Risk
1440 min Winter	6.179	1.179	6.4	1383.1	Flood Risk
2160 min Winter	6.155	1.155	6.4	1347.7	Flood Risk
2880 min Winter	6.125	1.125	6.3	1301.6	Flood Risk
4320 min Winter	6.059	1.059	6.1	1203.1	Flood Risk
5760 min Winter	5.987	0.987	5.9	1100.1	Flood Risk
7200 min Winter	5.914	0.914	5.7	999.4	Flood Risk
8640 min Winter	5.844	0.844	5.7	904.4	O K
10080 min Winter	5.774	0.774	5.7	813.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
120 min Winter	33.337	0.0	903.4	126
180 min Winter	24.832	0.0	910.4	184
240 min Winter	20.006	0.0	910.5	244
360 min Winter	14.706	0.0	913.4	360
480 min Winter	11.818	0.0	918.8	478
600 min Winter	9.966	0.0	926.4	594
720 min Winter	8.665	0.0	936.1	710
960 min Winter	6.943	0.0	948.0	938
1440 min Winter	5.071	0.0	948.4	1386
2160 min Winter	3.696	0.0	1839.7	1996
2880 min Winter	2.949	0.0	1796.8	2252
4320 min Winter	2.142	0.0	1700.2	3196
5760 min Winter	1.705	0.0	2428.6	4096
7200 min Winter	1.427	0.0	2539.7	4976
8640 min Winter	1.235	0.0	2634.7	5880
10080 min Winter	1.093	0.0	2713.6	6752

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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) 1.771

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.805	4	8	0.805	8	12	0.161

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Model Details

Storage is Online Cover Level (m) 6.200

Tank or Pond Structure

Invert Level (m) 5.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	840.5	1.200	1556.5

Hydro-Brake Optimum® Outflow Control

Unit Reference	MD-SHE-0113-5700-0900-5700
Design Head (m)	0.900
Design Flow (l/s)	5.7
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Diameter (mm)	113
Invert Level (m)	5.000
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.900	5.7
Flush-Flo™	0.266	5.7
Kick-Flo®	0.590	4.7
Mean Flow over Head Range	-	4.9

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	4.0	1.200	6.5	3.000	10.0	7.000	14.9
0.200	5.6	1.400	7.0	3.500	10.7	7.500	15.4
0.300	5.6	1.600	7.4	4.000	11.4	8.000	15.9
0.400	5.5	1.800	7.8	4.500	12.1	8.500	16.4
0.500	5.3	2.000	8.2	5.000	12.7	9.000	16.8
0.600	4.7	2.200	8.6	5.500	13.3	9.500	17.3
0.800	5.4	2.400	9.0	6.000	13.9		
1.000	6.0	2.600	9.3	6.500	14.4		

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Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	4.319	0.419	9.4	686.5	O K
30 min Summer	4.420	0.520	9.4	921.5	O K
60 min Summer	4.517	0.617	9.4	1174.6	O K
120 min Summer	4.606	0.706	9.5	1435.1	Flood Risk
180 min Summer	4.652	0.752	9.8	1580.9	Flood Risk
240 min Summer	4.681	0.781	9.9	1675.1	Flood Risk
360 min Summer	4.718	0.818	10.2	1798.7	Flood Risk
480 min Summer	4.740	0.840	10.3	1878.8	Flood Risk
600 min Summer	4.755	0.855	10.4	1931.9	Flood Risk
720 min Summer	4.765	0.865	10.4	1967.2	Flood Risk
960 min Summer	4.775	0.875	10.5	2003.4	Flood Risk
1440 min Summer	4.774	0.874	10.5	1998.4	Flood Risk
2160 min Summer	4.759	0.859	10.4	1944.0	Flood Risk
2880 min Summer	4.741	0.841	10.3	1882.3	Flood Risk
4320 min Summer	4.706	0.806	10.1	1757.8	Flood Risk
5760 min Summer	4.669	0.769	9.9	1636.8	Flood Risk
7200 min Summer	4.634	0.734	9.7	1521.4	Flood Risk
8640 min Summer	4.599	0.699	9.4	1413.7	O K
10080 min Summer	4.565	0.665	9.4	1311.9	O K
15 min Winter	4.357	0.457	9.4	770.1	O K
30 min Winter	4.464	0.564	9.4	1033.6	O K
60 min Winter	4.567	0.667	9.4	1318.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	124.633	0.0	636.4	26
30 min Summer	83.789	0.0	771.5	40
60 min Summer	53.779	0.0	1167.9	68
120 min Summer	33.337	0.0	1421.7	128
180 min Summer	24.832	0.0	1530.7	188
240 min Summer	20.006	0.0	1549.8	246
360 min Summer	14.706	0.0	1550.3	366
480 min Summer	11.818	0.0	1551.6	484
600 min Summer	9.966	0.0	1553.7	604
720 min Summer	8.665	0.0	1556.3	724
960 min Summer	6.943	0.0	1564.7	962
1440 min Summer	5.071	0.0	1560.9	1402
2160 min Summer	3.696	0.0	2913.2	1736
2880 min Summer	2.949	0.0	2985.0	2112
4320 min Summer	2.142	0.0	2771.7	2940
5760 min Summer	1.705	0.0	3650.4	3752
7200 min Summer	1.427	0.0	3817.9	4608
8640 min Summer	1.235	0.0	3962.3	5376
10080 min Summer	1.093	0.0	4085.7	6248
15 min Winter	124.633	0.0	701.2	26
30 min Winter	83.789	0.0	764.8	40
60 min Winter	53.779	0.0	1300.4	68

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Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
120 min Winter	4.662	0.762	9.8	1612.9	Flood Risk
180 min Winter	4.712	0.812	10.1	1779.6	Flood Risk
240 min Winter	4.743	0.843	10.3	1888.1	Flood Risk
360 min Winter	4.783	0.883	10.5	2033.3	Flood Risk
480 min Winter	4.809	0.909	10.7	2129.7	Flood Risk
600 min Winter	4.826	0.926	10.8	2196.0	Flood Risk
720 min Winter	4.838	0.938	10.8	2242.4	Flood Risk
960 min Winter	4.852	0.952	10.9	2297.0	Flood Risk
1440 min Winter	4.858	0.958	11.0	2320.3	Flood Risk
2160 min Winter	4.842	0.942	10.9	2257.5	Flood Risk
2880 min Winter	4.822	0.922	10.8	2179.7	Flood Risk
4320 min Winter	4.777	0.877	10.5	2009.4	Flood Risk
5760 min Winter	4.727	0.827	10.2	1831.8	Flood Risk
7200 min Winter	4.676	0.776	9.9	1658.8	Flood Risk
8640 min Winter	4.626	0.726	9.6	1496.7	Flood Risk
10080 min Winter	4.576	0.676	9.4	1343.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
120 min Winter	33.337	0.0	1537.1	126
180 min Winter	24.832	0.0	1563.4	184
240 min Winter	20.006	0.0	1568.3	242
360 min Winter	14.706	0.0	1579.7	360
480 min Winter	11.818	0.0	1592.8	476
600 min Winter	9.966	0.0	1608.1	594
720 min Winter	8.665	0.0	1622.5	708
960 min Winter	6.943	0.0	1636.0	938
1440 min Winter	5.071	0.0	1627.6	1384
2160 min Winter	3.696	0.0	3145.3	1992
2880 min Winter	2.949	0.0	3079.0	2252
4320 min Winter	2.142	0.0	2923.6	3164
5760 min Winter	1.705	0.0	4088.2	4088
7200 min Winter	1.427	0.0	4275.5	4968
8640 min Winter	1.235	0.0	4435.9	5800
10080 min Winter	1.093	0.0	4570.1	6664

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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) 2.981

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	1.355	4	8	1.355	8	12	0.271

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Model Details

Storage is Online Cover Level (m) 4.900

Tank or Pond Structure

Invert Level (m) 3.900

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	1151.6	1.000	4136.7

Hydro-Brake Optimum® Outflow Control

Unit Reference	MD-SHE-0146-9500-0700-9500
Design Head (m)	0.700
Design Flow (l/s)	9.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Diameter (mm)	146
Invert Level (m)	3.900
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.700	9.4
Flush-Flo™	0.241	9.4
Kick-Flo®	0.510	8.2
Mean Flow over Head Range	-	7.9

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	5.3	1.200	12.2	3.000	18.8	7.000	28.3
0.200	9.4	1.400	13.1	3.500	20.3	7.500	29.2
0.300	9.4	1.600	14.0	4.000	21.6	8.000	30.1
0.400	9.1	1.800	14.8	4.500	22.9	8.500	31.1
0.500	8.3	2.000	15.5	5.000	24.1	9.000	32.0
0.600	8.8	2.200	16.2	5.500	25.2	9.500	32.9
0.800	10.1	2.400	16.9	6.000	26.3		
1.000	11.2	2.600	17.6	6.500	27.3		

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Appendix C

CORRESPONDENCE

Brammeier, Chris

From: Nicola Spencer <Nicola.Spencer@arun.gov.uk>
Sent: 04 September 2015 12:51
To: Brammeier, Chris
Subject: FW: Land at Pagham, Bognor Regis - Flood risk consultation
Attachments: SefterRdDrainage.pdf; Drainage - Supplementary Guidance Notes.pdf

Categories: Rose Green - Pagham

Dear Mr Brammeier

Thank you for your email. Please see the response below from the Council's engineers department.

Yours sincerely

Nicola Spencer

Nicola Spencer | Technical Support Manager, Planning Department, Arun District Council | Location: First Floor, Arun Civic Centre, Maltravers Road, Littlehampton, BN17 5LF
Internal: 37446 | External: +44 (0) 1903 737500 ext 37446 | E-mail: nicola.spencer@arun.gov.uk
Visit Arun's web site at www.arun.gov.uk Save the environment - think before you print.

From: Thomas Callaway
Sent: 04 September 2015 10:32
To: Nicola Spencer
Subject: RE: Land at Pagham, Bognor Regis - Flood risk consultation

Please forward on the following comments:

1. We have a record of Safter Cottage flooding during the June 2012 flooding event, and additionally it would be prudent to check the SFRA from 2008 (http://www.arun.gov.uk/planning-policy-flood-risk) and the report on flooding in June 2012 (http://www2.westsussex.gov.uk/osd/flood/final_report.pdf).
2. The EA surface water flood maps suggest that surface water may pond for the 1 in 30 year event opposite Farm Gate Cottage, and a land drain has been installed in this location. Other areas close to the boundaries and ditches show up for the 1 in 100 and 1 in 1000 year events.
3. Groundwater monitoring will be required over the winter period across the site before drainage can be approved and development can commence. The levels encountered will determine whether soakaways can be utilised.
4. Any discharge of surface water to a watercourse should have passed through some form of source control, especially if the runoff is from roads and parking areas. Runoff should also be restricted to greenfield runoff rate, but discharge to a watercourse should only be investigated if soakaways are found not to be suitable.
5. The surface water drainage system should prioritise infiltration, and winter groundwater monitoring and percolation testing is necessary to inform the design. Restricted discharge to a watercourse may be investigated if this is not suitable. The system should store the 1 in 100 year storm event plus 30% without causing flooding.
6. The LPA is unlikely to adopt SuDS features.

Please find further guidance and an extract of our mapped land drainage records attached.

In addition to this, it should be noted that all ditches, land drains and watercourses require a three metre easement for access and maintenance. A SuDS maintenance manual should also be provided following SuDS Manual guidance, and it would be best to incorporate ditch maintenance within this document also.

Regards

Tom Callaway

Thomas Callaway | Drainage & Coastal Engineer, Engineering Services, Arun District Council | Location: Second Floor, Arun Civic Centre, Maltravers Road, Littlehampton, BN17 5LF
Internal: 37616 | External: +44 (0) 1903 737616 | Fax: +44 (0) 1903 716019 | E-mail: Thomas.Callaway@arun.gov.uk
Arun is Working in Partnership with Chichester District Council
Visit our web site at www.arun.gov.uk and www.chichester.gov.uk
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From: Brammeier, Chris [mailto:Chris.Brammeier@wspgroup.com]
Sent: 24 August 2015 11:51
To: Planning
Cc: Ward, Dean
Subject: Land at Pagham, Bognor Regis - Flood risk consultation

Dear Sir / Madam

We are investigating if there are any flood risk issues at a site in Pagham, with approximate NGR 489600, 099220. Please find attached a plan indicating the location of the site for clarity.

In your role as Local Planning Authority I would be very grateful for your attention to the questions below, and in addition would welcome comments on any additional issues or concerns you may have involving this site.

- Any known historical flooding at the site. Any known information on the mechanism of flooding (including any studies undertaken) for the area would also be appreciated;
- Any issues related to surface water flooding (including past flooding linked to drainage systems) within the area? We have also contacted the LLFA and EA for their records;
- Any information in your possession on groundwater (e.g. groundwater level) and the potential for groundwater flooding within the area, if the site is located within a source protection zone and whether infiltration would be an appropriate means of disposing of surface water. SuDS.
- Any water quality issues/requirements for the tributary on site or downstream that we need to take into account?
- Any surface water or SuDS design criteria that we need to take into consideration
- In light of the non-implementation of Schedule 3 of the Flood and Water Management Act, will SuDS be eligible for adoption by the LPA or will maintenance of such devices need to be sought elsewhere i.e. by a third party management and maintenance company?

We would appreciate an early response, therefore if you require any further information regarding the site to assist with our queries, please do not hesitate to contact me on 01992 526026 or chris.brammeier@wspgroup.com.

Many Thanks,
Chris

Advanced Notice of Annual Leave: 10th – 26th October

WSP | PARSONS BRINCKERHOFF
Christopher Brammeier
Graduate Engineer

Unit 9, The Chase, John Tate Road,
Foxholes Business Park, Hertford SG13 7NN
Tel: +44(0) 1992 526026

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****

Brammeier, Chris

From: SSD Enquiries <SSDEnquiries@environment-agency.gov.uk>
Sent: 20 October 2015 16:44
To: Brammeier, Chris
Subject: FW: 151020 4 SSD/7262 Land at Pagham, Bognor Regis - Flood risk consultation
Attachments: SK-001A.PDF

Categories: Rose Green - Pagham

Dear Chris

Please accept our apologies for the delay in updating you with the available data for the specified site.

We can advise you that the majority of the site is outside the flood zone and is not covered by detailed modeling. The area nearby is covered by national generalized modeling which is only suitable for Flood Zone extent visualization not levels or depths data. IMPORTANT JFLOW data is not fit for Flood Risk Assessments.

We will put your request on hold unless you contact us again.

We are committed to providing a professional customer service. Please help us understand more about what is important to you by completing our two minute survey

Kind regards

Customers & Engagement Team
Solent and South Downs
External: 01903 703831
Internal: 723 3831
email: ssdenquiries@environment-agency.gov.uk

www.gov.uk/floodsdestroy

DO YOU KNOW WHAT TO DO? FLOODS DESTROY

From: SSD Enquiries
Sent: 04 September 2015 15:24
To: 'chris.brammeier@wspgroup.com'
Subject: 150904 SSD/7262 Land at Pagham, Bognor Regis - Flood risk consultation

Dear Chris

Thank you for your enquiry. Please accept our apologies for the delay in providing you with an update. We are waiting for clarification regarding the availability of the data and will contact you again in due course to advise the relevant charges.

In the meantime we have marked your enquiry below with guidance where you are able to freely access some of the information.

For your information the ngr provided is incorrect.

If you have further queries please do not hesitate to contact this office.

Kind regards
Cherry

From: Brammeier, Chris [mailto:Chris.Brammeier@wspgroup.com]
Sent: 24 August 2015 11:46
To: Planning Liaison, South Downs
Cc: Ward, Dean
Subject: Land at Pagham, Bognor Regis - Flood risk consultation

Dear Sir / Madam

We are investigating if there are any flood risk issues at a site in Pagham, with approximate NGR 489600, 099220. Please find attached a plan indicating the location of the site for clarity.

We would like to request the information below and in addition would welcome comments on any additional issues or concerns you may have involving this site.

- A Product 4 request centred on the site The site is in flood zone one, therefore limited data will be available
- Any records of flooding for the site or local area We will check however it is unlikely we have any records
- Confirmation on current flood zone classification. http://maps.environment-agency.gov.uk/wiyby/wiybyController?ep=maptopics&lang=_e
- Any known historical flooding at the site? Any known information on the mechanism of flooding for the area would also be appreciated (including corresponding return periods for flood events and studies undertaken). Limited information will be available

ARUN DISTRICT COUNCIL P/6/17/OUT

- Details of any flood alleviation schemes in the area and estimated standard of protection. http://maps.environment-agency.gov.uk/wiyby/wiybyController?x=357683&y=355134&scale=1&layerGroups=default&ep=map&textonly=off&lang=_e&topic=fcrmschemes
- Any information in your possession on groundwater (e.g. groundwater levels) and the potential for groundwater flooding within the area, if the site is located within a source protection zone and weather infiltration would be an appropriate means of disposing of surface water. https://www.gov.uk/government/statistics/sussex-groundwater-situation; http://maps.environment-agency.gov.uk/wiyby/wiybyController?ep=maptopics&lang=_e ;

- Any issues related to surface water flooding in the area (including past flooding linked to drainage systems) within the area? We have also contacted the LLFA for information. Contact the Local Council
- Any water quality issues/requirements for discharging surface water off-site that we need to take into account we would suggest you visit the following link for further information on Water Quality http://environment.data.gov.uk/catchment-planning/OperationalCatchment/chichester-chalk
- Details of any EA apparatus within the site boundary. We are not aware of any apparatus in the vicinity however we have groundwater monitoring sites to the North West of the site boundary
- Any site specific surface water plans Contact the Local Council
- Confirmation on the latest SFRA for the area or any proposed SFRA soon due for publication. Contact the Local Council
- Any surface water or SuDS design criteria that we need to take into consideration https://www.gov.uk/government/publications/pre-planning-application-enquiry-form-preliminary-opinion
- In light of the non-implementation of Schedule 3 of the Flood and Water Management Act, will SuDS be eligible for adoption by the Environment Agency or will maintenance of such devices need to be sought elsewhere i.e. by a third party management and maintenance company? We would suggest you submit a pre planning application via https://www.gov.uk/government/publications/pre-planning-application-enquiry-form-preliminary-opinion

We would appreciate an early response, therefore if you require any further information regarding the site to assist with our queries, please do not hesitate to contact me on 01992 526026 or chris.brammeier@wspgroup.com.

Many Thanks,
Chris

Advanced Notice of Annual Leave: 10th – 26th October

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Brammeier, Chris

From: Developer Services <Developer.Services@southernwater.co.uk>
Sent: 24 August 2015 12:27
To: Brammeier, Chris
Subject: RE: Land at Pagham, Bognor Regis - Flood risk consultation

Categories: Rose Green - Pagham

Dear Mr Brammeier,

Thank you for your email below.

In response to your queries, please see below.

1. Unfortunately, we do not hold any flood risk data for this area. You may be able to obtain further information from the Environmental Agency.
2. All surface water sewers should be designed in accordance with Sewers for Adoption and should make sure that no groundwater or land drainage is communicated with the public system.
3. Southern water will not adopt a SUDS system.

Yours sincerely,

Developer Services
Southern Water
[redacted]

From: Brammeier, Chris [redacted]
Sent: 24 August 2015 11:45
To: Developer Services
Subject: Land at Pagham, Bognor Regis - Flood risk consultation

Dear Sir / Madam

We are investigating if there are any flood risk issues at a site in Pagham, with approximate NGR 489600, 099220. Please find attached a plan indicating the location of the site for clarity.

In your role as Sewage Undertaker I would be very grateful for your attention to the questions below, and in addition would welcome comments on any additional issues or concerns you may have involving this site.

1. • Are you aware of any flooding incidents from surface water or foul water sewers that may have affected the above site in the past?
2. • Any surface water or SuDS design criteria that we need to take into consideration
3. • In light of the non-implementation of Schedule 3 of the Flood and Water Management Act, will SuDS be eligible for adoption by the Southern Water or will maintenance of such devices need to be sought elsewhere i.e. by a third party management and maintenance company?

We would appreciate an early response, therefore if you require any further information regarding the site to assist with our queries, please do not hesitate to contact me on 01992 526026 or chris.brammeier@wspgroup.com.

Many Thanks,
Chris

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Christopher Brammeier
Graduate Engineer

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Southern Water

17 FEB 2016

WSP Parsons Brinckerhoff
One Queens Drive
Birmingham
B5 4PJ

Developer Services
Southern Water
Sparrowgrove House
Sparrowgrove
Otterbourne
Hampshire
SO21 2SW

Tel: **0330 303 0119**
Email: ***developerservices@southernwater.co.uk***

Your Ref:

Our Ref:
CC-SUSS-00242

Date:
16th Feburary 2015

F.A.O: Mr Brammeier,

Site: Rose Green, Hook Lane, Pagham. PO21 3PD.

Dear Sir,

I am now in receipt of the results of the capacity check you requested for the above development site.

FOUL WATER

Please find enclosed the report which details the extent of works required in order for your proposed development site to be accommodated within the local sewerage infrastructure. It should be noted that the report is only a hydraulic solution to provide capacity for the proposed development site. There are other options available to you/ your client in discharging your proposed flows from the site such as making a connection application/requisition to a sewer at a point where capacity is currently available. Section 98 of the Water Industry Act 1991 provides a legal mechanism through which the appropriate infrastructure can be requested (by the developer) and provided to drain a specific location.

As you are aware the owner or occupier of the premises or private sewer or drain must give the sewerage undertaker notice of the proposed works. Upon receipt of the notice the undertaker may, within 21 days, refuse to allow him to make the connection if it considers that the mode of construction or the condition of the connecting sewer or drain either does not satisfy the standards reasonably required by the undertaker, or is such that the making of the communication would be prejudicial to its sewerage system.

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The right of refusal is limited to these criteria alone and the undertaker cannot refuse to allow the connection on the grounds that the sewerage system is inadequate to take the extra liquid that the connection will discharge into it. This is a matter that should be dealt with at the planning stage.

Yours faithfully,

[redacted]

Thomas Clark
Developer Services
Please note:

The information provided above does not grant approval for any designs/drawings submitted for the capacity analysis. The results quoted above are only valid for 12 months from the date of issue of this letter.

Southern Water

INFRASTRUCTURE ASSESSMENT FOR

FOUL DRAINAGE AT

ROSE GREEN
HOOK LANE
PAGHAM
PO21 3PD

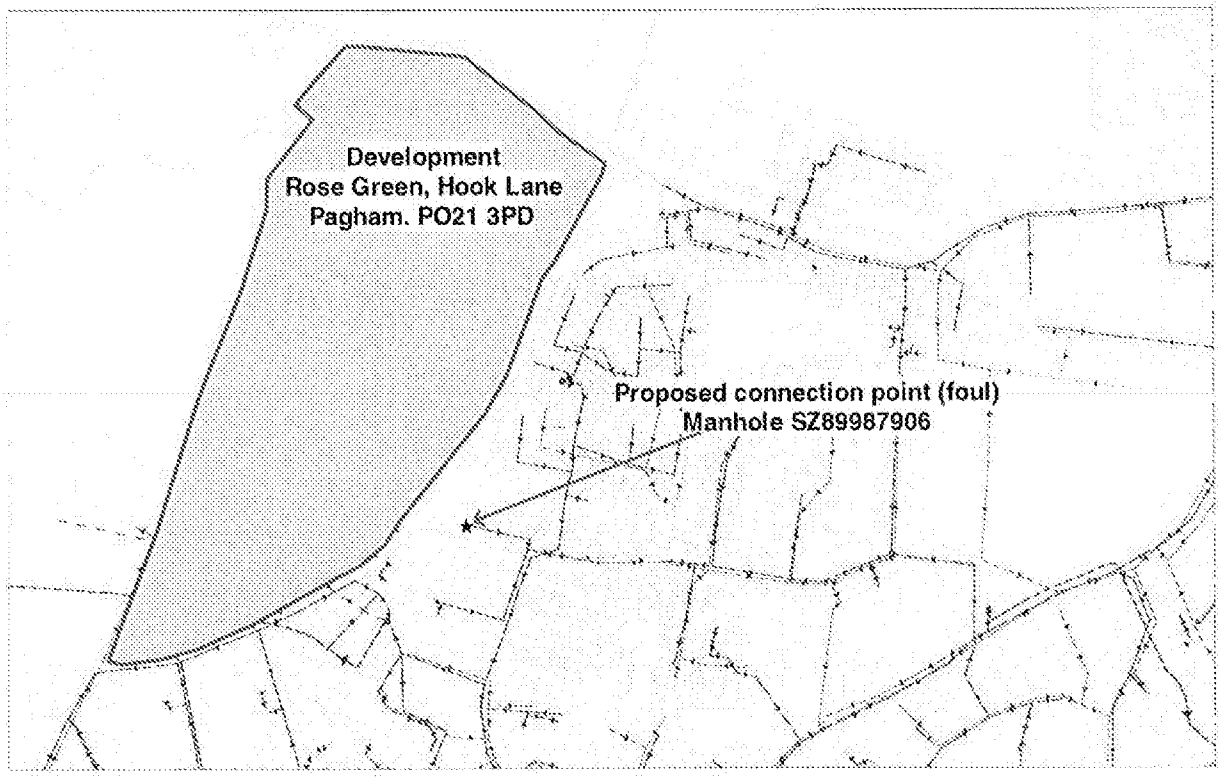
16 February 2016

REQUESTED:
WSP PARSONS BRINCKERHOFF

I. Development Details:

The proposal is to discharge foul flow from the development to the local foul sewerage systems at manhole reference SZ89987906 which is located on Drift Road.

Figure 1 - Proposed Development



II. Results and Conclusions:

Foul Water:

There is currently insufficient capacity within the local foul sewerage network to accommodate the additional flow at the proposed manhole SZ89987906. The additional flows significantly increase downstream surcharge and increase flooding so enhancements to the downstream system are required and detailed in Figure 2 and table 1.

7906 IL -A 4.53 -X 4.51
-B 4.54

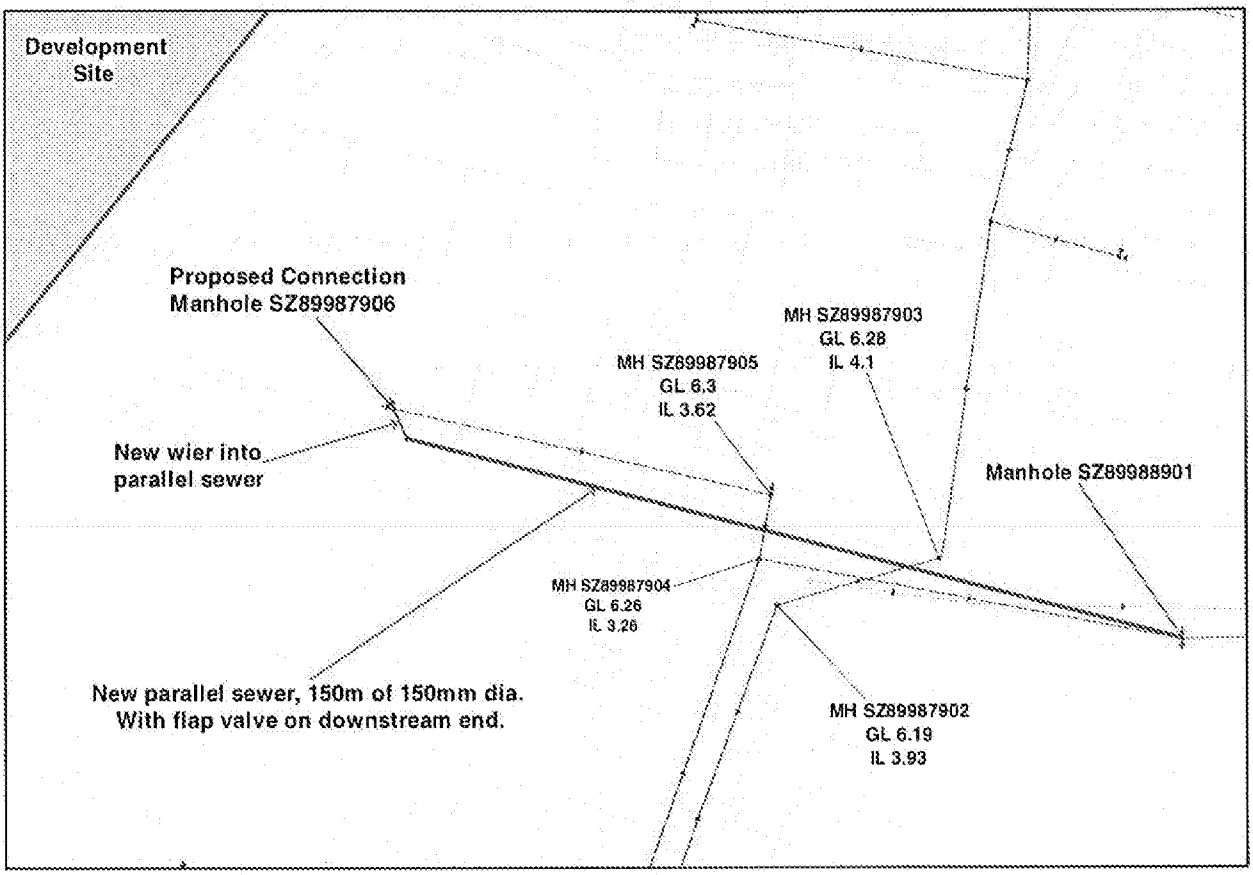


Figure 2- Proposed Improvements

Table 1 - Proposed Improvements Schedule

U/S Manhole	D/S Manhole	Sewer Diameter (mm)		Avg. Depth (m)	Length (m)
		Existing	Proposed		
SZ89987906*	SZ89988901**	-	150	~2.2	150

*Wier from SZ89987906 into the head of the proposed sewer. **Flap valve at base of the proposed sewer

The nearest point of the network where capacity is currently available for the foul water flow is at West Park Bognor Regis WPS, located approximately 2.5 km east of the proposed development site.

Section 98 of the Water Industry Act 1991 provides a legal mechanism through which the appropriate infrastructure can be requested (by the developer) and provided to drain a specific location.

Surface Water:

There is currently adequate capacity within the local surface water sewerage network to accommodate development surface water flows at the proposed manhole SU44158053. The proposed development does not significantly increase local flow to the proposed connection manhole, thus significant additional surcharge or flooding to the existing system is not predicted to occur. Therefore no remedial work is required to accommodate the proposed development.

Before any connections are made, an application form needs to be completed and approved by Southern Water Services.

Please note: - The information provided above does not grant approval for any designs /drawings submitted for the capacity analysis. The results are an indicative hydraulic assessment and should not be used as a basis for design. The results quoted above are only valid for 12 months from the date of issue of this letter.

PUBLIC SEWER RECORD

ARUN DISTRICT COUNCIL P/8/17/OUT

SOUTHERN WATER



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.

Based upon Ordnance Survey Digital Data with the permission of the controller of H.M.S.O. Crown Copyright Reserved Licence No. WU 298530

O.S. REF: SZ8998NE

Scale: 1:1250

Sewer Plot

WARNING: BAC pipes are constructed of Bonded Asbestos Cement

WARNING: Unknown (UNK) materials may include Bonded Asbestos Cement

N

Printed By: sierrob

Date: 18-1-2016

Southern Water MapGuide Browser

Requested By:
Sewer Record Extract

Southern Water

Appendix D

SOUTHERN WATER RECORDS

Southern Water

ATKINS CHECKED

JO

Your Ref 403SO/NVS

Our Ref 201500

Date 02 September 2015

Contact searches@southernwater.co.uk
Fax 01634 844514
DX:400450 Chatham 5

Atkins
The Hub, 500
Park Avenue
Aztec West
Almondsbury
Bristol
Attention: Sarah Generalski-Sparling

Dear Sirs

Provision of Sewer Main Record Extracts – VAT Receipt

Land between Pagham Road, Sefter Road, Hook Lane, Pagham, West Sussex PO21 3PD

Further to your recent enquiry regarding the provision of Southern Water apparatus record extracts for the above location.

Please be aware that there are areas within our region in which there are neither sewers nor water mains. Similarly, whilst the enclosed extract may indicate the approximate location of our apparatus in the area of interest, it should not be relied upon as showing that further infrastructure does not exist and may subsequently be found following site investigation. Therefore actual positions of the disclosed (and any undisclosed) infrastructure should be determined on site, because Southern Water does not accept any responsibility for inaccuracy or omission regarding the enclosed plan and accordingly it should not be considered to be a definitive document.

I confirm payment of the appropriate fee in the sum of £49.92

The breakdown of costs is as follows: -

- Provision of record extracts £41.60
- VAT @ 20.0% £8.32

VAT Registration Number 813 0378 56

Should you require any additional information regarding this matter please contact this office at the address given at the foot of this letter.

Yours faithfully

Land Search Department

Letter B

ARUN DISTRICT COUNCIL PLANNING Southern Water Services Ltd Registered Office: Southern House Yeoman Road Worthing BN13 3NX Registered in England No. 2366670

ARUN DISTRICT COUNCIL P/6/17/OUT

100031



98093

488574

490711

Node	Cover	Invert	Size	Material	Shape	
0001X	5.75		UNK	UNK	CIRC	
0051X	6.01	4.28	225	CP	CIRC	
0052X	5.74		UNK	UNK	CIRC	
0053X	5.96	4.38	225	CP	CIRC	
0101X	5.94		150	VC	CIRC	*
0101X	5.42	4.68	150	BAC	CIRC	*
0101X	5.59	0.42	300	SI	CIRC	*
0102X			150	VC	CIRC	*
0102X	5.24	4.36	150	BAC	CIRC	*
0103X	5.94	4.28	225	VC	CIRC	
0151X		5.07	150	VC	CIRC	*
0151X	5.92	4.62	225	CP	CIRC	*
0152X	5.95	4.83	225	CP	CIRC	*
0152X	6.03	4.8	150	CP	CIRC	*
0201X	6.18	3.39	150	CI	CIRC	*
0201X	5.77	5.11	150	BAC	CIRC	*
0201X	5.23	2.86	150	SI	CIRC	*
0202X	6.42	5.24	150	BAC	CIRC	*
0202X	5.35	2.13	150	SI	CIRC	*
0203X	6.035	3.383	150	VC	CIRC	*
0203X	5.34	0.24	300	SI	CIRC	*
0204X			UNK	UNK	CIRC	*
0204X	5.82	0.15	300	SI	CIRC	*
0205X	5.81		300	SI	CIRC	
0206X	5.32	1.59	150	SI	CIRC	
0207X	5.46	2.07	150	SI	CIRC	
020DX			150	VC	CIRC	
0251X	6.2	3.9	375	CP	CIRC	*
0251X	5.32	3.92	300	CP	CIRC	*
0252X	5.33	3.89	300	CP	CIRC	
0301X	5.73	4.05	150	BAC	CIRC	*
0301X	6.07	3.76	150	VC	CIRC	*
0301X	5.4	3.26	150	SI	CIRC	*
0302X	6.259	4.837	150	VC	CIRC	*
0302X	5.1	4.49	150	BAC	CIRC	*
0303X	6.3	4.68	150	VC	CIRC	
0304X	6.271	4.295	150	VC	CIRC	
0305X	6.382	4.055	150	VC	CIRC	
0306X	6.255	3.962	150	VC	CIRC	
0307X	6.1	3.822	150	VC	CIRC	
0308X			UNK	UNK	CIRC	
030DX			UNK	UNK	CIRC	
0351X	5.38	4.1	300	CP	CIRC	*
0351X	6.16	4.07	300	CP	CIRC	*
0352X	6.3	4.98	225	VC	CIRC	
0353X	6.271	4.302	600	GRC	CIRC	
0354X	6.382	4.232	600	GRC	CIRC	
0355X	6.298	4.212	600	GRC	CIRC	
0356X	6.15	4.12	600	GRC	CIRC	
0357X	6.187	4.728	225	VC	CIRC	
0358X	6.18	4.07	300	CP	CIRC	
0401X	5.35		150	BAC	CIRC	*
0401X	5.4	4.35	150	SI	CIRC	*
0402X	5.71	4.31	150	VC	CIRC	
0403X	5.77	4.62	150	PF	CIRC	
0404X	5.67	4.31	150	PF	CIRC	
0451X	5.19	4.12	375	CP	CIRC	
0452X	5.41	4.07	375	CP	CIRC	
0453X	5.67	4.45	225	CP	CIRC	
0454X	5.75	4.1	225	CP	CIRC	
045DX			375	CP	CIRC	
0501X	6.01	4.49	150	VC	CIRC	
0502X	5.97	4.21	150	VC	CIRC	
0503X	5.71	3.88	150	SI	CIRC	
0504X	5.62	3.71	150	SI	CIRC	
0505X	5.39	3.78	150	SI	CIRC	
0551X	5.99	4.9	225	CP	CIRC	
0552X	5.75	4.71	225	CP	CIRC	
0553X	5.51	4.61	225	CP	CIRC	
0554X	5.41	4.16	375	CP	CIRC	
0601X	5.93	3.33	150	SI	CIRC	
0701X	5.56	2.9	175	SI	CIRC	
0702X	5.61	3.17	150	VC	CIRC	
0703X	5.54	3.52	150	VC	CIRC	
0704X	5.52	3.65	150	VC	CIRC	
0705X	5.6	3.77	150	VC	CIRC	
0706X	5.62	3.26	150	VC	CIRC	
0751X	5.6	3.58	375	CP	CIRC	
0752X	5.66	3.65	300	CP	CIRC	
0753X	5.71	3.79	300	CP	CIRC	
0754X	5.79	3.57	300	CP	CIRC	
075IX		4.07	375	CP	CIRC	
0801X	6.04	4.29	150	VC	CIRC	
0901X	5.81	2.27	225	SI	CIRC	
0902X	5.81	2.13	225	SI	CIRC	
0951X	5.81	3.96	375	CP	CIRC	
0952X	5.82	3.87	375	CP	CIRC	
0953X	5.71	3.8	375	CP	CIRC	
0954X	5.89	3.8	375	CP	CIRC	
0955X	5.86	3.77	375	CP	CIRC	
1001X	5.87		UNK	UNK	CIRC	
1002X	5.84	2.08	200	CI	CIRC	
1051X	5.85		UNK	UNK	CIRC	
1052X	5.83	4.77	225	CP	CIRC	
1101X	6.06	4.83	150	VC	CIRC	*
1101X	5.94	2.42	200	CI	CIRC	*
1101X	5.92	2.93	150	SI	CIRC	*
1102X	6.09	4.62	150	VC	CIRC	*
1102X	5.84	2.54	150	CI	CIRC	*
1102X			100	PF	CIRC	*
1103X			100	PF	CIRC	
1104X		2.42	UNK	UNK	CIRC	*
1104X			100	PF	CIRC	*
1104X	6.24	4.05	150	VC	CIRC	*
1105X	6.08	4.41	150	VC	CIRC	
1106X			100	VC	CIRC	
110DX			200	CI	CIRC	*
110DX			100	PF	CIRC	*
111DX			UNK	UNK	CIRC	*
111DX			150	SI	CIRC	*
112DX			100	VC	CIRC	
1151X	5.97	4.35	300	CP	CIRC	*
1151X	5.87	5.03	150	VC	CIRC	*
1152X	6.05	5.32	150	CP	CIRC	
1153X	5.97	4.8	225	CP	CIRC	
1201X		4.4	225	VC	CIRC	*
1201X	6.12	2.78	200	CI	CIRC	*
1201X	5.41	2.25	150	VC	CIRC	*
1202X	6.15	2.92	200	CI	CIRC	*
1202X	5.78	2.48	225	SI	CIRC	*
1203X			100	VC	CIRC	
120DX			100	VC	CIRC	
121DX			200	CI	CIRC	
1251X	6.15	4.53	225	CP	CIRC	*
1251X	6.2	3.71	375	CP	CIRC	*
1251X		3.69	300	CP	CIRC	*
1252X	6.19	5.62	100	VC	CIRC	*
1252X	5.34	4.74	150	CP	CIRC	*
1253X	6.07	5.15	150	CP	CIRC	*
1253X		3.49	300	CP	CIRC	*
1254X	6.09	5.28	100	VC	CIRC	
1301X	6.711	5.508	150	VC	CIRC	*
1301X	5.47	3.51	150	BAC	CIRC	*
1301X	5.71	3.42	150	VC	CIRC	*
1302X	5.51	3.24	150	SI	CIRC	*
1302X	5.45	3.33	150	BAC	CIRC	*
1302X	6.717	5.191	150	VC	CIRC	*
1303X	5.91	5.12	150	BAC	CIRC	*
1303X	5.11	3.16	150	SI	CIRC	*
1304X	6.23	5.46	150	BAC	CIRC	*
1304X	5.58	3.02	150	SI	CIRC	*
1305X			100	PF	CIRC	*
1305X	5.47	2.81	150	SI	CIRC	*
1306X	5.48	2.73	150	VC	CIRC	
1307X	5.46	2.63	150	VC	CIRC	
1308X	5.47	2.46	150	VC	CIRC	
1309X			UNK	VC	CIRC	
130DX			UNK	VC	CIRC	
1310X			UNK	VC	CIRC	
131DX			150	BAC	CIRC	
132DX			100	PF	CIRC	
1351X	5.56	3.88	225	CP	CIRC	
1352X	5.13	4.2	150	CP	CIRC	
1353X	5.22	4.38	150	VC	CIRC	
1354X	5.4	4.9	150	CP	CIRC	
1355X	5.43	4.78	150	CP	CIRC	
1356X	5.42	4.62	150	CP	CIRC	
1357X	5.49	4.15	150	CP	CIRC	
1358X	5.42	4.27	150	CP	CIRC	
1359X	5.39	4.39	150	CP	CIRC	
1360X	5.47	4.53	150	CP	CIRC	
1361X	5.49	4.6	150	CP	CIRC	
1401X	5.68	3.99	150	BAC	CIRC	*
1401X	5.94	4.78	150	VC	CIRC	*
1402X	5.68	3.7	150	BAC	CIRC	*
1402X	5.69	4.45	150	VC	CIRC	*
1403X	5.78	4.02	150	VC	CIRC	*
1403X	5.79	4.44	150	BAC	CIRC	*
1404X	5.67	3.68	150	BAC	CIRC	*
1404X	5.66	3.86	150	VC	CIRC	*
1405X		3.64	150	BAC	CIRC	*
1405X	5.97	3.6	150	VC	CIRC	*
1406X	5.41	3.95	150	BAC	CIRC	
1407X	5.64	3.75	150	BAC	CIRC	
1409X			UNK	UNK	CIRC	
140DX			150	BAC	CIRC	
141DX			UNK	UNK	CIRC	
1451X	5.91	4.71	225	CP	CIRC	
1452X	5.96	4.85	225	CP	CIRC	
1453X	5.82	3.96	375	CP	CIRC	
1454X	5.97	4.21	225	CP	CIRC	
1501X	5.21	4.25	150	BAC	CIRC	*
1501X	5.74	2.73	150	SI	CIRC	*
1502X	6.09	5.02	150	VC	CIRC	*
1502X		4.45	150	BAC	CIRC	*
1503X	5.16	4.22	150	BAC	CIRC	
1504X			UNK	VC	CIRC	
1505X			UNK	VC	CIRC	
1507X			UNK	UNK	CIRC	

Node	Cover	Invert	Size	Material	Shape	
1508X			UNK	UNK	CIRC	
1551X	5.72	4.03	300	CP	CIRC	*
1551X	5.15	4.41	300	CP	CIRC	*
1552X	5.83	4.3	225	CP	CIRC	*
1552X	5.39	4.61	150	CP	CIRC	*
1553X	6.07	5.01	225	CP	CIRC	
1601X	5.55	2.41	225	SI	CIRC	
1602X	6	2.18	225	SI	CIRC	
1603X	5.42	2.68	150	SI	CIRC	
1604X	5.8	3.93	150	VC	CIRC	
1651X	5.62	4.15	300	CP	CIRC	*
1651X	5.5	4.69	225	CP	CIRC	*
1652X	5.4	4.29	225	VC	CIRC	
1653X	6.05	4.46	225	CP	CIRC	
1654X	5.78	4.66	225	CP	CIRC	
1655X	5.44	4.4	225	VC	CIRC	
1656X	5.66	4.48	225	VC	CIRC	
1701X	5.86	1.93	225	SI	CIRC	
1702X	5.9	2.12	150	SI	CIRC	
1703X	5.47	3.88	150	SI	CIRC	
1705X			100	VC	CIRC	
1706X			100	VC	CIRC	
1707X			100	VC	CIRC	
1751X	5.96	4.77	225	CP	CIRC	
1801X	5.57	2.38	175	SI	CIRC	
1851X	5.45	4.57	225	CP	CIRC	
1852X	5.72	3.34	375	CP	CIRC	
1853X	5.72	4.33	375	CP	CIRC	
1854X	5.55	4.18	375	CP	CIRC	
1901X	5.71	1.42	225	SI	CIRC	
1902X			UNK	UNK	CIRC	
1903X			UNK	UNK	CIRC	
190DX			UNK	UNK	CIRC	
193DX			225	SI	CIRC	
1951X	5.64	4.02	225	CP	CIRC	
1952X	5.7		225	VC	CIRC	*
1952Y	5.7		225	VC	CIRC	*
1953X	5.72	3.78	375	CP	CIRC	
2051X	5.93		450	CP	CIRC	
2101X	5.94	4.72	150	VC	CIRC	
2102X			150	UNK	CIRC	
2151X	5.87	4.93	150	CP	CIRC	*
2151X	5.95	3.27	450	CP	CIRC	*
2151Y	5.95		300	CP	CIRC	*
2152X		4.6	225	CP	CIRC	*
2152X	5.79	3.47	450	CP	CIRC	*
2153X	5.87	4.09	300	CP	CIRC	
2154X	5.95	4.25	225	CP	CIRC	
2155X	5.9	4.26	150	VC	CIRC	
2201X	5.82	3.16	150	SI	CIRC	*
2201X	6.34	3.05	200	CI	CIRC	*
2201X	6.23	5.21	150	VC	CIRC	*
2202X	6.64	3.83	150	VC	CIRC	*
2202X	6.35	5.07	150	VC	CIRC	*
2202X	5.8	2.84	150	SI	CIRC	*
2203X	6.25	4.49	150	VC	CIRC	*
2203X	6.22	4.87	150	VC	CIRC	*
2204X	6.11	4.73	150	BAC	CIRC	
2206X	6.08	5.29	150	VC	CIRC	
2207X	6.24	4.83	150	BAC	CIRC	
2251X	6.35		450	CP	CIRC	*
2251X	6.21	5.01	150	VC	CIRC	*
2252X	6.22	4.92	150	CP	CIRC	
2253X	6.21	3.84	375	CP	CIRC	*
2253X	6.17	5.27	150	CP	CIRC	*
2254X	6.07	4.95	150	CP	CIRC	
2255X	6.02	4.77	225	CP	CIRC	
2301X	5.57	3.21	150	BAC	CIRC	*
2301X	6.22	3.36	200	CI	CIRC	*
2301X	5.27	3.34	150	SI	CIRC	*
2302X		2.92	150	BAC	CIRC	*
2302X	5.24	3.52	150	VC	CIRC	*
2303X	5.53	3.65	150	VC	CIRC	
2351X	5.28	3.81	225	CP	CIRC	
2352X	5.28	3.6	225	CP	CIRC	
2353X	5.52	3.45	300	CP	CIRC	
2401X	5.83	4.16	150	VC	CIRC	
2402X	5.96	4.53	150	VC	CIRC	
2403X	5.94	4.86	150	VC	CIRC	
2404X			100	VC	CIRC	
2405X			100	VC	CIRC	
240DX			UNK	UNK	CIRC	
2451X	5.85	4.35	150	VC	CIRC	
2452X	5.95	4.71	150	VC	CIRC	
2453X	5.91	4.96	150	VC	CIRC	
2501X	6.17	3.33	150	BAC	CIRC	*
2501X	5.42	3.49	150	SI	CIRC	*
2502X	5.42	3.29	150	SI	CIRC	
2503X	5.49	3.58	150	SI	CIRC	
2504X	5.7	2.84	150	SI	CIRC	
2505X	5.69	3.79	150	SI	CIRC	
2506X			UNK	UNK	CIRC	
2507X			UNK	UNK	CIRC	
251DX			150	SI	CIRC	
252DX			UNK	UNK	CIRC	
2551X	5.39	4.3	375	CP	CIRC	*
2551X	5.47	3.68	375	CP	CIRC	*
2552X	5.45	3.76	375	CP	CIRC	
2553X	5.43	3.85	375	CP	CIRC	
2554X	5.5	3.99	225	CP	CIRC	
2555X	5.71	3.87	375	CP	CIRC	
2601X	6.33	3.6	150	BAC	CIRC	
2602X	6.31	3.47	150	BAC	CIRC	
2603X	5.96	3.8	150	BAC	CIRC	
2651X	5.82	4.2	225	CP	CIRC	
2652X	5.97	4.35	225	CP	CIRC	
2653X	6.21	4.63	225	CP	CIRC	
2654X	6.19	4.64	225	CP	CIRC	
2655X	6.01	4.75	225	CP	CIRC	
2701X			150	SI	CIRC	*
2701X	6.06	4.52	150	BAC	CIRC	*
2702X	6.23	4.99	150	VC	CIRC	*
2702X	5.77	1.76	225	SI	CIRC	*
2703X	5.84	4.42	150	BAC	CIRC	*
2703X	5.5	1.55	225	SI	CIRC	*
2704X	5.67		150	SI	CIRC	*
2704X	5.63	4.81	150	BAC	CIRC	*
2751X	5.97	4.79	225	CP	CIRC	*
2751X	5.6	4.37	225	CP	CIRC	*
2752X	5.86	4.44	300	CP	CIRC	*
2752X	5.72	4.21	225	CP	CIRC	*
2753X	5.43	3.91	300	CP	CIRC	*
2753X	6.19	5.31	150	CP	CIRC	*
2754X	5.6	3.94	225	CP	CIRC	
2755X	5.65	4.23	225	CP	CIRC	
2756X	5.82	4.38	225	CP	CIRC	
2801X	6.1	4.19	150	BAC	CIRC	*
2801X	5.62	1.34	225	SI	CIRC	*
2802X	5.42	0.69	225	SI	CIRC	
2803X	5.28	0.47	300	SI	CIRC	
2804X	5.63	1.83	175	SI	CIRC	
2805X	5.47	0.87	225	SI	CIRC	
2851X	5.36	3.2	375	CP	CIRC	
2852X	5.51	4.58	600	CP	CIRC	
2853X	5.63	4.45	600	CP	CIRC	
2901X	5.73	1.09	225	SI	CIRC	
2902Y	5.95	0.14	300	SI	CIRC	
292PX	5.95		UNK	UNK	CIRC	
2951X	5.69		150	VC	CIRC	
2952X	5.8	3.09	600	CP	CIRC	
3003X	5.92	3.77	150	VC	CIRC	
3101X	5.95	3.74	150	SI	CIRC	*
3101X	6.52	5.03	150	BAC	CIRC	*
3102X	6.26	4.3	150	BAC	CIRC	
3103X	6.27	3.65	150	BAC	CIRC	
3151X	5.9	3.89	450	CP	CIRC	
3152X	6.05	4.41	225	CP	CIRC	
3153X	6.11	4.52	225	CP	CIRC	
3154X	5.93	4.85	150	CP	CIRC	
3201X	6.06	4.21	150	BAC	CIRC	*
3201X	5.96	4.23	175	VC	CIRC	*
3201X	5.81	3.41	150	SI	CIRC	*
3202X	5.59	4.07	150	BAC	CIRC	*
3202X	5.87	4.55	225	VC	CIRC	*
3203X	6.54	4.09	150	BAC	CIRC	
3204X	6.63	4.05	150	BAC	CIRC	
3205X	6.54	3.83	150	BAC	CIRC	
3206X	6.85	4.14	150	BAC	CIRC	
3207X			UNK	UNK	CIRC	
3251X	6.46	4.38	300	CP	CIRC	
3252X	6.23	4.9	150	CP	CIRC	
3253X	6.41	4.63	150	CP	CIRC	
3254X	6.47	5.1	150	CP	CIRC	
325IX		4.04	450	CP	CIRC	
3301X	5.33	3.79	150	VC	CIRC	*
3301X	5.19	2.6	150	BAC	CIRC	*
3301X	6.12	3.64	200	CI	CIRC	*
3301Y	6.12		200	VC	CIRC	*
3302X	5.54	2.42	150	BAC	CIRC	*
3302X	5.13	4.04	150	VC	CIRC	*
3303X	6.43	2.37	150	BAC	CIRC	
3351X	6.16	3.99	375	CP	CIRC	*
3351X	5.18	4.14	150	VC	CIRC	*
335IX	4.39		450	CP	CIRC	
3401X	5.59	4.24	150	VC	CIRC	*
3401X	6.48	2.33	150	BAC	CIRC	*
3402X	5.68	4.71	150	VC	CIRC	
3451X	5.73	2.49	1050	CP	CIRC	
3452X	5.7	3.22	300	CP	CIRC	
3453X	5.72	2.46	1050	CP	CIRC	
3454X	5.63	3.57	375	CP	CIRC	
3455X	5.46	4.13	225	CP	CIRC	
3456X	5.47	2.98	600	CP	CIRC	
3457X	5.02	2.52	1050	CP	CIRC	
345IX		3.07	600	CP	CIRC	
3501X	6.22	2.87	150	BAC	CIRC	*
3501X			150	SI	CIRC	*
3502X	5.41	2.61	225	SI	CIRC	*
3502X	5.7	2.67	150	BAC	CIRC	*

Node	Cover	Invert	Size	Material	Shape	
3503X	6.29	3.15	150	BAC	CIRC	
3504X	6.28	4.57	150	VC	CIRC	
3551X	5.61	2.54	1050	CP	CIRC	*
3551X	5.61	4.22	450	CP	CIRC	*
3552X	5.56	4.31	375	CP	CIRC	*
3552X	5.39	2.56	1050	CP	CIRC	*
3553X	5.38	2.57	1050	CP	CIRC	
3554X	5.46	3.31	375	CP	CIRC	
3601X	5.88	2.25	225	SI	CIRC	
3651X	5.93	2.61	1050	CP	CIRC	
3652X	5.84	2.61	1050	CP	CIRC	
3653X	6	3.04	375	CP	CIRC	
3701X	6.59	5.5	150	VC	CIRC	*
3701X	6.01	2.03	225	SI	CIRC	*
3751X	6.15	2.63	1050	CP	CIRC	*
3751X	6.54	4.96	150	CP	CIRC	*
3801X	6.07	1.76	225	SI	CIRC	*
3801X	5.67	3.77	150	BAC	CIRC	*
3802X	5.79		150	SI	CIRC	
3803X			225	SI	CIRC	
380DX			150	BAC	CIRC	
381DX			100	PF	CIRC	
3851X	5.89	3.69	300	CP	CIRC	*
3851X	6.17	4.15	450	CP	CIRC	*
3852X	5.62	3.76	300	CP	CIRC	
3853X	5.75	3.71	300	CP	CIRC	
3854X	5.7	3.92	225	CP	CIRC	
3855X	5.58	4.03	225	CP	CIRC	
3901X	5.5	0.9	225	SI	CIRC	
3902X	5.66	0.71	225	SI	CIRC	
3951X	5.44	4.35	225	CP	CIRC	*
3951X	6.25	4.04	525	CP	CIRC	*
3952X	6.17	3.97	525	CP	CIRC	*
3952X	5.62	2.96	750	CP	CIRC	*
4101X	5.85	4.18	225	VC	CIRC	*
4101X	6.13	4.29	175	CI	CIRC	*
4101X	5.58	4.18	150	SI	CIRC	*
4102X	6.02	3.37	225	BAC	CIRC	*
4102X	5.66	4.43	150	VC	CIRC	*
4103X	6.16	3.85	225	BAC	CIRC	
4104X	5.93	4.3	225	BAC	CIRC	
4105X	6.24	4.52	150	BAC	CIRC	
4106X	6.12	4.63	150	PF	CIRC	
4107X	6.32	4.77	150	PF	CIRC	
4108X		4.94	150	VC	CIRC	
4109X	6.3	5.14	150	PF	CIRC	
4110X		5.25	150	PF	CIRC	
4111X	6.23	5.04	150	PF	CIRC	
4112X	6.6	5.36	150	PF	CIRC	
4113X	6.31	5.26	150	PF	CIRC	
4114X	6.44	5.42	150	VC	CIRC	
4151X	6.27	4.01	300	CP	CIRC	
4152X	6.38	4.46	150	CP	CIRC	
4153X	6.44	4.86	150	CP	CIRC	
4154X	6.25	3.94	375	CP	CIRC	
4155X	6	3.92	375	CP	CIRC	
4156X	6.15	4.7	150	CP	CIRC	
4157X	6.19	4.83	150	CP	CIRC	
4158X	6.28	4.86	150	VC	CIRC	
4159X	6.3	5.18	150	VC	CIRC	
4160X	6.54	5.15	150	CP	CIRC	
4161X		5.27	150	VC	CIRC	
4162X		5.47	150	VC	CIRC	
4163X	6.41	5.57	150	VC	CIRC	
4201X	6.53	4.87	150	BAC	CIRC	*
4201X	6.328	4.988	150	VC	CIRC	*
4202X	6.41	4.65	150	BAC	CIRC	
4203X	6.27	4.46	150	BAC	CIRC	
4204Y	6.44		UNK	UNK	CIRC	*
4204X	6.44	4.37	150	BAC	CIRC	*
4205X	6.55	5.49	150	VC	CIRC	
4206X			UNK	UNK	CIRC	
4207X			UNK	UNK	CIRC	
4208X			UNK	UNK	CIRC	
4251X	6.54	3.93	450	CP	CIRC	*
4251X	6.302	5.092	600	CO	CIRC	*
4252X	6.59	5.51	225	CP	CIRC	
4253X	6.48	5.26	300	CP	CIRC	
4254X	6.63	5.2	300	CP	CIRC	
4255X	6.21	5.39	300	CP	CIRC	
4256X	6.54	3.81	450	CP	CIRC	
4301Y	6.48	4.85	150	VC	CIRC	*
4301X	6.94	5.05	150	BAC	CIRC	*
4302X	6.75	5.13	150	BAC	CIRC	*
4302X	6.18		150	VC	CIRC	*
4303X	6.095	4.575	150	VC	CIRC	*
4303X	6.74	4.95	150	BAC	CIRC	*
4304X	6.215	4.415	150	VC	CIRC	*
4304X	6.6	5.41	150	BAC	CIRC	*
4305X	6.82	5.4	150	BAC	CIRC	*
4305X	6.13		150	VC	CIRC	*
4306X			100	VC	CIRC	
4351X	6.51		300	CP	CIRC	
4352X	6.68	4.32	1050	CP	CIRC	*
4352X			300	CP	CIRC	*
4353X	6.24		375	CP	CIRC	*
4353X	6.86	4.4	450	CP	CIRC	*
4354X	6.105	4.819	225	CO	CIRC	*
4354X	6.68	5.77	225	CP	CIRC	*
4401X	5.75	3.89	150	BAC	CIRC	
4402X	6.37	3.01	150	BAC	CIRC	
4403X	5.83	4.95	150	VC	CIRC	
4404X	5.66	3.7	150	VC	CIRC	
4405X	6.74	2.72	150	BAC	CIRC	
4406X	6.69	1.96	150	BAC	CIRC	
4407X			100	VC	CIRC	
440DX			100	VC	CIRC	
4451X	5.7	4.1	450	CP	CIRC	*
4451X	5.35	4.25	225	CP	CIRC	*
4452X	5.13	2.9	750	CP	CIRC	
4453X	5.17		1050	CP	CIRC	
4501X	5.53	3.3	150	SI	CIRC	*
4501X	6.32	5.05	150	BAC	CIRC	*
4502X			OTHER	BRC	CIRC	*
4502X	6.31	5.26	150	BAC	CIRC	*
4503X			UNK	PF	CIRC	
450DX			150	BAC	CIRC	
4551X	5.48	3.46	225	CP	CIRC	
4552X	5.51	3.31	600	CP	CIRC	
4553X	5.51	3.21	600	CP	CIRC	
4554X	5.4	3.2	600	CP	CIRC	
4601X	5.64	2.47	225	SI	CIRC	*
4601X	6.34	4.7	150	BAC	CIRC	*
4602X	6.43	4.85	150	BAC	CIRC	*
4602X	5.84	2.69	150	SI	CIRC	*
4603X	5.71	2.86	150	SI	CIRC	
4604X			UNK	UNK	CIRC	
4605X			UNK	UNK	CIRC	
4606X			UNK	UNK	UNK	
4651X	6.01	3.33	375	CP	CIRC	
4652X	5.99	3.39	375	CP	CIRC	
4653X	5.82	3.61	375	CP	CIRC	
4654X	5.84	3.66	375	CP	CIRC	
4655X	5.86	3.57	375	CP	CIRC	
4656X	5.73	3.69	150	VC	CIRC	
4657X	5.6	3.68	150	VC	CIRC	
4701X	6.21	2.25	225	SI	CIRC	*
4701X	6.53	4.27	150	BAC	CIRC	*
4702X			100	PF	CIRC	
4751X	6.18	3.89	375	CP	CIRC	
4801X	5.94	3.92	150	BAC	CIRC	*
4801X	6.01	1.67	225	SI	CIRC	*
4802X	5.89	3.39	150	BAC	CIRC	*
4802X	5.71	1.44	225	SI	CIRC	*
4803X			UNK	UNK	CIRC	
4804X			OTHER	BRC	CIRC	
4806X			100	VC	CIRC	
4808X			100	VC	CIRC	
4809X			100	VC	CIRC	
4810X			100	VC	CIRC	
4851X	6.02	2.7	1050	CP	CIRC	
4852X	5.79	2.71	1050	CP	CIRC	
4853X	5.97	3.51	225	CP	CIRC	
4855X	5.49	4.54	150	VC	CIRC	
4856X	5.61	3.79	600	CP	CIRC	
4901X	5.48	1.19	225	SI	CIRC	
4902X	5.25	1.22	225	SI	CIRC	
4903X			225	SI	CIRC	
4951X	5.41	2.71	1050	CP	CIRC	
4952X	5.12	2.73	900	CP	CIRC	
4953X	5.5	3.89	300	CP	CIRC	
4954X	5.37	3.86	OTHER	BRE	RECT	
495DX			900	CP	CIRC	
5001X	5.3		225	CI	CIRC	
5002X	5.4	1.7	225	CI	CIRC	
5003X	5.55	1.78	225	CI	CIRC	
5004X	5.39	1.74	225	CI	CIRC	
5007X	5.79	4.81	150	VC	CIRC	
5051X	5.43		150	VC	CIRC	
5052X	5.37	4.05	OTHER	BRE	RECT	
5053X	5.85	4.85	150	VC	CIRC	
5054X	5.3		900	CP	CIRC	
5055X	5.37	4.62	150	VC	CIRC	
5056X	5.7	4.08	600	CP	CIRC	
5101X	5.03	3.21	150	CI	CIRC	*
5101X	5.55	1.99	225	CI	CIRC	*
5101X	6.49	4.47	150	BAC	CIRC	*
5102X	5.76	3.72	225	VC	CIRC	*
5102X	5.29	3.33	150	PF	CIRC	*
5102X	6.13	4.3	225	BAC	CIRC	*
5103X	5.95	3.86	225	VC	CIRC	*
5103X	6.03	4.7	150	BAC	CIRC	*
5104X	5.97	5.02	150	PF	CIRC	
5105X	6.02	5.51	150	BAC	CIRC	
5106X	6.03	5.21	150	BAC	CIRC	
5151X	5.38	1.97	OTHER	CP	CIRC	*
5151X	5.61	2.87	900	CP	CIRC	*
5151X	6.19	3.7	OTHER	CP	CIRC	*
5152X	5.64	4.71	225	CP	CIRC	*

LEGEND - SEWERS

LINE STYLES / COLOURS
- Brown: Foul; Foul Syphon Sewer; Foul Vacuum Main; Foul Rising Main
- Red: Combined; Combined Syphon Sewer; Combined Rising Main; Lateral Drain
- Orange: Building Over Agreement Area
- Dark Blue: Treated Effluent
- Purple: Sludge; Sewer Catchment; Section 104 Area
- Light Blue: Surface Water; Surface Water Rising Main
- Yellow: Private
- Green: Access Shaft; Decommissioned

MATERIALS
- AK Alkathene
- BAC Bonded Asbestos Cement
- BRC Brick (Common)
- BRE Brick (Engineering)
- CC Concrete Box Culvert
- CI Cast Iron
- CO Concrete (In-Situ)
- CP Concrete (Pre-Cast)
- CSB Concrete Segments (bolted)
- CSU Concrete Segments (unbolted)
- DI Ductile Iron
- GRC Glass Reinforced Concrete
- GRP Glass Reinforced Plastic
- MAC Masonry in regular Courses
- MAR Masonry in random Courses
- PE Polyethylene
- PF Pitch Fibre
- PP Polypropylene
- PVC Polyvinyl Chloride
- RPM Reinforced Plastic Matrix
- SI Spun Iron
- ST Steel
- VC Vitrified Clay
- XXX Other
- ZZZ Unknown

Manhole (SW); Manhole (F&C); Lamp hole (SW); Lamp hole (F&C); Pumping Station (SW); Pumping Station (F&C); Side entry manhole (SW); Side entry manhole (F&C); Blind shaft (SW); Blind shaft (F&C); Ejector station (SW); Ejector station (F&C); Watertight door (SW); Watertight door (F&C); Flushing ch. No-e (SW); Flushing ch. No-e (F&C); Flushing ch. No-e (SW); Flushing ch. No-e (F&C); Dementation Chamber

Washout (SW); Washout (F&C); Rodding Eye (SW); Rodding Eye (F&C); Gauging point (SW); Gauging point (F&C); Intercept chamber (SW); Intercept chamber (F&C); Storm Tank (SW); Storm Tank (F&C); Vortex chamber (SW); Vortex chamber (F&C); Label ellipse; Dummy/S24 manhole; Outfall; Penstock chamber; Dambroards; Storm Overflow; Backdrop manhole

Other (s); Other; Change in sewer (s); Change in sewer; Reflux valve; Flap valve; Cascade; Anode; Valve; Closed Valve; Air Valve; Hatch box (SW); Hatch box (F&C); Direction arrow; Emptying valve; Catchpit; Soakaway; Inlet; Balancing Pond

Wastewater treatment works; Marine treatment works; Outfall headworks; Vent; Vent column; Tidal storage tank; Blank end; Head of Public Sewer; Micro Pumping Station

SHAPES (S)
- A Arched
- B Barrel
- C Circular
- E Egg
- H Horseshoe
- R Rectangular
- S Square
- T Trapezoidal
- U U-Shape
- X Other

NODE REFERENCING SYSTEM
- 1st digit: hundred metre easting identifier
- 2nd digit: hundred metre northing identifier
- 3rd digit: sewer type identifier; 0-4 = Foul/Combined; 5-9 = Surface Water
- 4th digit: next sequential node

WARNING: BAC pipes are constructed of Bonded Asbestos Cement

WARNING: Unknown (UNK) materials may include Bonded Asbestos Cement

O.S. Ref.	SZ8999NE	Drawn by:	kumaria
Scale:	1:2500	Date:	01/09/2015

Title: 201500_ Land between Pagham Ro

N

Southern Water

The information contained on this plan is provided as a guide to the approximate position of existing public sewers. The accuracy thereof cannot be guaranteed.

THIS INFORMATION MUST BE TREATED WITH CAUTION AND THE ACTUAL POSITION OF THE PUBLIC SEWERS MUST BE ESTABLISHED ON SITE, IN ALL CASES.

Southern Water must be informed before lifting manhole covers or excavating trial holes.

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SEWER RECORDS

Appendix E

SOAKAWAY REPORT

Our Ref: 70014147-L01

3 December 2015

Ruth McKeown
Hallam Land Management: South East Region
108 New Bond Street
London
W1S 1EF

WSP UK Limited
One Queens Drive
Birmingham
B5 4PJ

[redacted]

www.wspgroup.com
www.pbworld.com

Dear Ruth,

Subject: Land at Pagham – Soakaway Infiltration Testing Report

INTRODUCTION

Hallam Land Management (HLM) commissioned WSP | Parsons Brinkerhoff (WSP) to undertake preliminary soakaway infiltration testing at the Land at Pagham development site in accordance with our proposal reference 70014147-P03.

A Site Location Plan is included as **Figure 1** and a Site Boundary Plan as **Figure 2**, both within **Annex A**.

The limitations to the nature of our assessment are provided within the Notes on Limitations section at the end of this report.

BACKGROUND AND OBJECTIVES

The exact layout and final design have not yet been confirmed; however the current development plan is for circa 350 residential homes to be constructed across the site.

The soakaway infiltration testing is required to support the design of Sustainable Urban Drainage Systems (SUDs) and to refine the development masterplan.

SITE LAYOUT AND SETTING

The site is situated approximately 4.5km west of the centre of Bognor Regis and is bounded by Pagham Road in the west, Hook Lane in the south and east, and Sefter Road in the north. The development area is roughly rectangular in shape, approximately 345m wide at its widest point and 740m long. The site is bisected by a 500m long drain running at an east-west orientation across the site.

Published geological mapping indicates that the site is underlain by superficial deposits comprising River Terrace Deposits across the majority of the site, with Raised Beach Deposits along the northwest boundary. The underlying solid geology is shown to be London Clay Formation.

The River Terrace Deposits and Raised Beach Deposits are classified by the Environment Agency as Secondary A aquifers and the London Clay Formation as Unproductive Strata. No groundwater abstractions are present within a 1km radius of the site.

SITE WORKS METHODOLOGY

TRIAL PIT EXCAVATION

Site works were undertaken between 12 and 13 November 2015.

ARUN DISTRICT COUNCIL P/6/17/OUT

A buried services scan was undertaken by Midland Survey Limited at each test location and a total of 11 trial pits were excavated across the site to a maximum depth of 2.4m below ground level (bgl) using a tracked 8 tonne excavator. Groundwater was encountered in five trial pits (SA01A, SA01B, SA02A, SA06A and SA06B) at depths of between 1.2 and 2.2m bgl. Soakaway tests were undertaken in six trial pits; SA01C, SA02B, SAO3, SA04, SA05 and SA06C.

The soakaway locations are presented on **Figure 3** and associated exploratory hole logs are presented in **Annex B**.

SOAKAWAY TESTING

The soakaway infiltration tests were undertaken in general accordance with BRE 365 'Soakaway Design' (2007). Each soakaway pit was filled to an appropriate depth with water from a mobile bowser supplied by Tardis Environmental. The falling water level was then monitored at regular intervals to record the rate of infiltration.

The guidance suggests undertaking three tests per soakaway pit and that each soakaway test should be monitored until at least 75% effective depth has drained. Due to slow infiltration rates across the site, it was not possible to allow the recommended number of tests to be undertaken.

The tests were carried out within the River Terrace Deposits and due to the relatively stable excavation walls, a gravel fill was not required for temporary support during completion of the tests.

Upon completion of the soakaway infiltration tests, each trial pit was emptied of water, and advanced by approximately 0.5m to confirm the underlying geology prior to backfilling. Nominal compaction of the arisings was undertaken using the excavator.

GROUND CONDITIONS ENCOUNTERED

The ground conditions encountered were generally as anticipated from published geological mapping.

The geological profile encountered comprised the following general stratigraphy:

- **Topsoil** – encountered within all trial pits, ranging in thickness from 0.3 to 0.4m and comprising dark brown slightly sandy slightly gravelly clay;
- **River Terrace Deposits** – encountered in all trial pits to a maximum depth of between 1.2 and 2.4m bgl comprising light orange brown, occasionally mottled grey brown, clay locally with sandy and/or gravelly lenses. This was underlain by orange brown slightly clayey gravelly sand encountered at depths between 1.2 and 2.2m bgl.

Groundwater was encountered in locations SA01A, SA01B, SA02, SA06A and SA06B between depths of 1.2 bgl and 2.2m bgl at the interface between the overlying clay strata and the gravelly sand band within the River Terrace Deposits.

Representative soil samples of the clay and sand strata were obtained from the trial pits for geotechnical laboratory analysis for soil classification. The results of the Particle Size Distribution (PSD) analysis indicate that the samples of River Terrace Deposits obtained from SA01C, SA04 and SA06C contain between 30% and 93% of 'fine material' (silt and clay). PSD analysis on a sample obtained at 2.2m bgl in SA01A indicated a 96% granular (sand, gravel and cobbles) composition.

SOAKAWAY INFILTRATION RESULTS AND DISCUSSION

The results of the soakaway infiltration tests are summarised in **Table 1**, with soakaway testing data provided within **Annex C**.

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Table 1: Summary of Soil Infiltration Test Results

EXPLORATORY LOCATION	STRATUM DESCRIPTION	TOTAL TEST TIME (MINUTES)	TOTAL FALL IN WATER LEVEL (M)
SA01C	Stiff grey brown slightly sandy CLAY.	240	0.12
SA02B	Stiff light brown CLAY.	180	0.05
SA03	Firm orange brown mottled grey brown CLAY.	210	0.00
SA04	Stiff to firm orange brown slightly sandy CLAY.	180	0.05
SA05	Firm orange brown CLAY.	180	0.00
SA06C	Stiff orange brown CLAY.	240	0.02

Infiltration rates could not be calculated in accordance with BRE guidance for any of the test locations due to slow drainage rates and the absence of 75% effective depth soakage within the timeframe of the tests.

SUMMARY AND CONCLUSIONS

Although not completed in strict accordance with BRE 365 due to the slow drainage rates recorded, the soakaway tests undertaken provide a preliminary understanding of the infiltration capacity of the River Terrace Deposits beneath the site.

BRE 365 states that it should take 24 hours for a soakaway to discharge from full to half-full in readiness for subsequent storm in-flow. Based on the soakaway test results, this may not be achievable.

The River Terrace Deposits are not considered suitable to support soakaway drainage, but is likely to be suitable for construction of flood attenuation ponds or surface water storage ponds given the low infiltration capacity recorded.

Should soakaway drainage be considered further for the proposed development, it is recommended that testing is undertaken over a 24 hour period to confirm specific conditions in the proposed location(s) of the soakaway drainage features. In addition, the thickness and variability of the River Terrace Deposits will require consideration during the design stage, particularly given the variability of the cohesive and granular strata along with the relatively shallow groundwater beneath parts of the site.

CLOSING

We trust the above meets with your requirements. Should you have any comments or queries please do not hesitate to contact the undersigned.

Yours sincerely,

Vicky Kennaugh
Environmental Consultant
vicky.kennaugh@wspgroup.com

John Davies
Regional Director
john.davies@wspgroup.com

Encl. *Annex A – Figures*
Annex B – Exploratory Hole Logs
Annex C – Soakaway Results
Notes on Limitations

ARUN DISTRICT COUNCIL P/6/17/OUT

Annex A – Figures



File: Created using iGIS, WSP's Online Mapping System Drawn By: UKVXK003 Date Modified: 18/11/2015 13:55

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TITLE: Land at Pagham

FIGURE No: Figure 2



Drawn By: UKYXK003 Date Modified: 13/11/2015 12:53

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TITLE: Land at Pagham

FIGURE No: Figure 3

Annex B – Exploratory Hole Logs

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TRIAL PIT LOG

Project	Job No
Land at Pagham	70014147

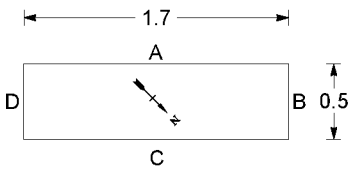


Depth	Type	PID (ppmV)	HSV (kN/m2)	P.Pen (kN/m2)	Water	Elev. (mAOD)	Depth (Thickness)	STRATA Description	Legend	Geology	Install / Backfill
							(0.20)	Firm brown slightly sandy CLAY with abundant fine root material. (TOPSOIL)		TS	
						5.65	0.20				
							(1.40)	Stiff greyish brown slightly sandy CLAY. (RIVER TERRACE DEPOSITS)		RT	
						4.25	1.60				
							(0.20)	Soft light brown sandy gravelly CLAY with occasional flint cobbles. Gravel is fine to coarse, subangular to subrounded flint. (RIVER TERRACE DEPOSITS)		RT	
						4.05	1.80				
							(0.40)	Light yellowish brown slightly clayey gravelly SAND. (RIVER TERRACE DEPOSITS)		RT	
2.20	B				1	3.65	2.20	Exploratory hole completed at 2.2m bgl.		END	

General Remarks
Groundwater encountered at 2.2m bgl rising to 2.0m bgl in one hour.
No visual or olfactory evidence of contamination.

Shoring/Support: None
Stability: Collapse of gravelly sand strata.

Notes: All dimensions in metres. Logs should be read in accordance with the provided Key. Descriptions are based on visual and manual identification.



Length	Logged By	Client	Sheet
1.70m	VK	Hallam Land Management	1 of 1

Width	Ground Level (m AOD)	Co-Ordinates (NGR)	Date	Trial Hole No.
0.50m	5.850	E 489727 N 99459	12-11-15	SA01A

Orientation	Method/Plant Used	Contractor	Scale
45 degrees from north	8 Tonne Excavator	Bastable Plant Hire	1:20.0

08 WSP TP LOG LS 1 PHOTO 70014147 - LAND AT PAGHAM.GPJ WSPETEMPLATE1.03.GDT 3/12/15

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TRIAL PIT LOG

Project	Job No
Land at Pagham	70014147

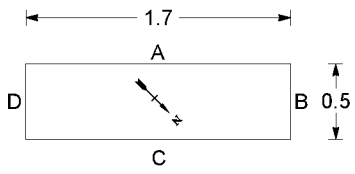


Depth	Type	PID (ppmV)	HSV (kN/m2)	P.Pen (kN/m2)	Water	Elev. (mAOD)	Depth (Thick-ness)	STRATA Description	Legend	Geology	Install / Backfill
							(0.20)	Firm brown slightly sandy CLAY with abundant fine root material. (TOPSOIL)		TS	
						5.65	0.20				
							(1.40)	Stiff greyish brown slightly sandy CLAY. (RIVER TERRACE DEPOSITS)		RT	
						4.25	1.60				
					1		(0.20)	Soft light brown sandy gravelly CLAY with occasional flint cobbles. Gravel is fine to coarse, subangular to subrounded flint. (RIVER TERRACE DEPOSITS)		RT	
						4.05	1.80	Exploratory hole completed at 1.8m bgl.		END	

General Remarks
Exploratory hole located approximately 5.0m to the east of SA01A.
Groundwater encountered at 1.8m bgl rising to 1.7m bgl in 30 minutes.
No visual or olfactory evidence of contamination.

Shoring/Support: None
Stability: Stable

Notes: All dimensions in metres. Logs should be read in accordance with the provided Key. Descriptions are based on visual and manual identification.



Length: 1.70m	Logged By: VK	Client: Hallam Land Management	Sheet: 1 of 1
Width: 0.50m	Ground Level (m AOD): 5.850	Co-Ordinates (NGR): E 489727 N 99459	Date: 12-11-15
Orientation: 45 degrees from north	Method/Plant Used: 8 Tonne Excavator	Contractor: Bastable Plant Hire	Scale: 1:20.0

Trial Hole No.

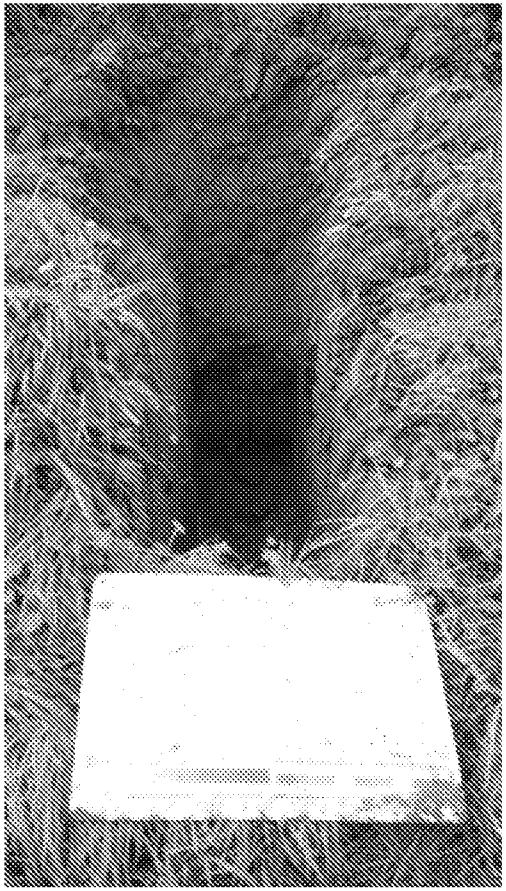
SA01B

08 WSP TP LOG LS 1 PHOTO 70014147 - LAND AT PAGHAM.GPJ WSPETEMPLATE1.03.GDT 3/12/15

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TRIAL PIT LOG

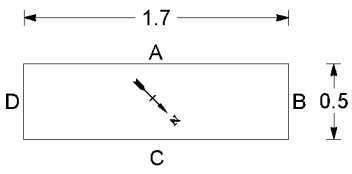
Project	Job No
Land at Pagham	70014147



Depth	Type	PID (ppmV)	HSV (kN/m2)	P.Pen (kN/m2)	Water	Elev. (mAOD)	Depth (Thickness)	STRATA Description	Legend	Geology	Install / Backfill
							(0.20)	Firm brown slightly sandy CLAY with abundant fine root material. (TOPSOIL)		TS	
						5.65	0.20				
								Stiff greyish brown slightly sandy CLAY. (RIVER TERRACE DEPOSITS)			
								0.60 m bgl Becoming orangeish brown.			
							(1.40)			RT	
1.50	B					4.25	1.60				
							(0.20)	Soft light brown sandy gravelly CLAY with occasional flint cobbles. Gravel is fine to coarse, subangular to subrounded flint. (RIVER TERRACE DEPOSITS)		RT	
						4.05	1.80				
								Exploratory hole completed at 1.8m bgl.		END	

General Remarks
Exploratory hole used as a soakway between 1.7m bgl and 0.7m bgl.
Exploratory hole located approximately 5.0m to the west of SA01A.
No groundwater encountered.
No visual or olfactory evidence of contamination.
Shoring/Support: None
Stability: Stable

Notes: All dimensions in metres. Logs should be read in accordance with the provided Key. Descriptions are based on visual and manual identification.



Length	Logged By	Client	Sheet
1.70m	VK	Hallam Land Management	1 of 1

Width	Ground Level (m AOD)	Co-Ordinates (NGR)	Date	Trial Hole No.
0.50m	5.850	E 489727 N 99459	12-11-15	SA01C

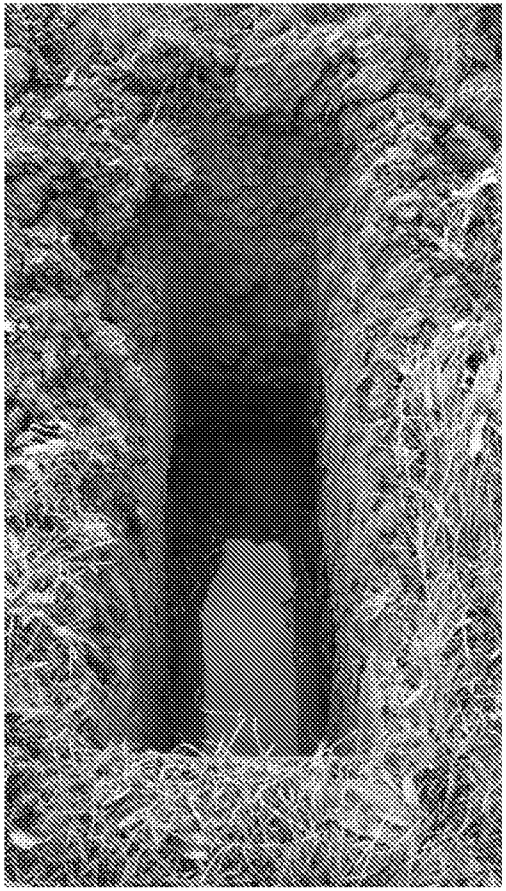
Orientation	Method/Plant Used	Contractor	Scale
45 degrees from north	8 Tonne Excavator	Bastable Plant Hire	1:20.0

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TRIAL PIT LOG

Project	Job No
Land at Pagham	70014147



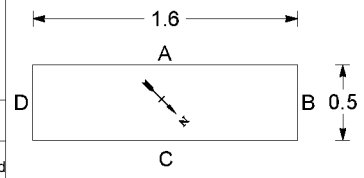
Depth	Type	PID (ppmV)	HSV (kN/m2)	P.Pen (kN/m2)	Water	Elev. (mAOD)	Depth (Thick-ness)	STRATA Description	Legend	Geology	Install / Backfill
							(0.30)	Firm brown slightly sandy CLAY with abundant fine root material. (TOPSOIL)		TS	
						4.48	0.30				
							(0.90)	Stiff orangeish brown CLAY. (RIVER TERRACE DEPOSITS)		RT	
						3.58	1.20				
					1		(0.40)	Orangeish brown slightly clayey gravelly SAND. Gravel is fine to coarse, subangular to subrounded flint. (RIVER TERRACE DEPOSITS)		RT	
1.60	B					3.18	1.60				
								Exploratory hole completed at 1.6m bgl.		END	

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General Remarks
Groundwater encountered at 1.5m bgl.
No visual or olfactory evidence of contamination.

Shoring/Support: None
Stability: Stable

Notes: All dimensions in metres. Logs should be read in accordance with the provided Key. Descriptions are based on visual and manual identification.



Length	Logged By	Client	Sheet
1.60m	VK	Hallam Land Management	1 of 1

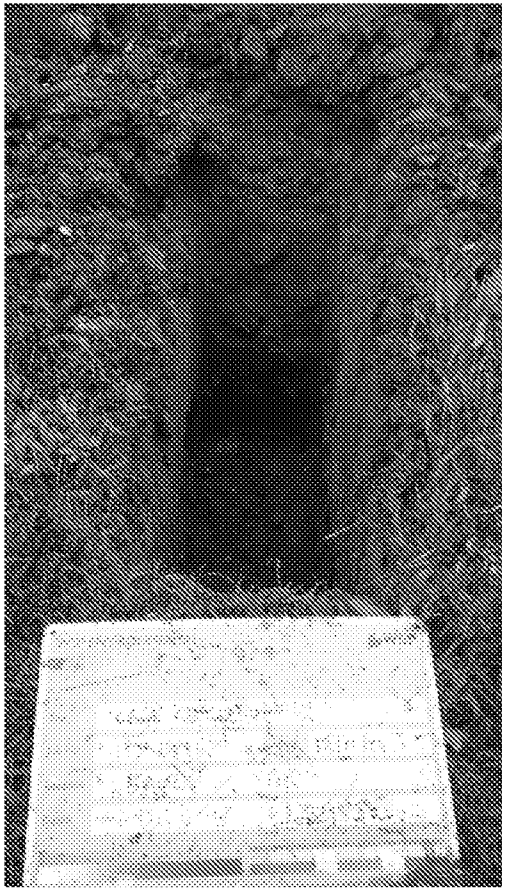
Width	Ground Level (m AOD)	Co-Ordinates (NGR)	Date	Trial Hole No.
0.50m	4.778	E 489497 N 99363	12-11-15	SA02A

Orientation	Method/Plant Used	Contractor	Scale
45 degrees from north	8 Tonne Excavator	Bastable Plant Hire	1:20.0

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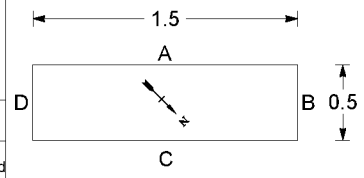
Project	Job No
Land at Pagham	70014147



Depth	Type	PID (ppmV)	HSV (kN/m2)	P.Pen (kN/m2)	Water	Elev. (mAOD)	Depth (Thickness)	STRATA Description	Legend	Geology	Install / Backfill
							(0.30)	Firm brown slightly sandy CLAY with abundant fine root material. (TOPSOIL)		TS	
						4.48	0.30				
							(1.40)	Stiff orangeish brown CLAY. (RIVER TERRACE DEPOSITS)		RT	
1.40	B					3.08	1.70				
								Exploratory hole completed at 1.7m bgl.		END	

General Remarks
Exploratory hole used as a soakway between 1.4m bgl and 0.4m bgl.
Exploratory hole located approximately 5.0m to the south of SA02A.
No groundwater encountered.
No visual or olfactory evidence of contamination.
Shoring/Support: None
Stability: Stable

Notes: All dimensions in metres. Logs should be read in accordance with the provided Key. Descriptions are based on visual and manual identification.



Length	Logged By	Client	Sheet
1.50m	VK	Hallam Land Management	1 of 1

Width	Ground Level (m AOD)	Co-Ordinates (NGR)	Date	Trial Hole No.
0.50m	4.778	E 489497 N 99363	12-11-15	SA02B

Orientation	Method/Plant Used	Contractor	Scale
45 degrees from north	8 Tonne Excavator	Bastable Plant Hire	1:20.0

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Project	Job No
Land at Pagham	70014147

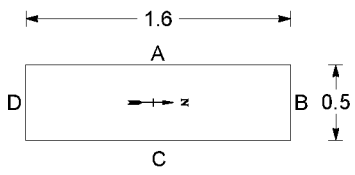


Depth	Type	PID (ppmV)	HSV (kN/m2)	P.Pen (kN/m2)	Water	Elev. (mAOD)	Depth (Thickness)	STRATA Description	Legend	Geology	Install / Backfill
							(0.40)	Firm brown slightly sandy CLAY with rare gravel and abundant fine root material. Gravel is fine to medium, subrounded to rounded flint. (TOPSOIL)		TS	
						6.29	0.40				
							(1.60)	Firm orangeish brown mottled greyish brown CLAY. (RIVER TERRACE DEPOSITS)		RT	
1.70	B										
						4.69	2.00				
							(0.40)	Firm orangeish brown sandy CLAY. (RIVER TERRACE DEPOSITS)		RT	
						4.29	2.40				
								Exploratory hole completed at 2.4m bgl.		END	

General Remarks
Exploratory hole used as a soakway between 1.7m bgl and 0.7m bgl.
No groundwater encountered.
No visual or olfactory evidence of contamination.

Shoring/Support: None
Stability: Stable

Notes: All dimensions in metres. Logs should be read in accordance with the provided Key. Descriptions are based on visual and manual identification.



Length	Logged By	Client	Sheet
1.60m	VK	Hallam Land Management	1 of 1

Width	Ground Level (m AOD)	Co-Ordinates (NGR)	Date	Trial Hole No.
0.50m	6.693	E 489782 N 99264	13-11-15	SA03

Orientation	Method/Plant Used	Contractor	Scale
90 degrees from north	8 Tonne Excavator	Bastable Plant Hire	1:20.0

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Project	Job No
Land at Pagham	70014147

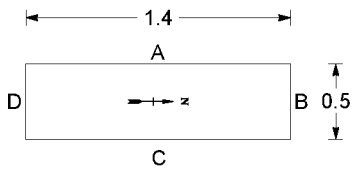


Depth	Type	PID (ppmV)	HSV (kN/m2)	P.Pen (kN/m2)	Water	Elev. (mAOD)	Depth (Thick-ness)	STRATA Description	Legend	Geology	Install / Backfill
						6.39	(0.20) 0.20	Firm brown slightly sandy CLAY with abundant fine root material. (TOPSOIL)		TS	
						6.09	(0.30) 0.50	Stiff brown slightly sandy CLAY. (RIVER TERRACE DEPOSITS)		RT	
						5.49	(0.60) 1.10	Stiff pale orangeish brown slightly sandy CLAY. (RIVER TERRACE DEPOSITS) 0.60 m bgl Tree root in southwestern corner of pit.		RT	
1.40	B					4.59	(0.90) 2.00	Firm pale brown mottled orangeish brown slightly sandy CLAY. (RIVER TERRACE DEPOSITS)		RT	
						4.39	(0.20) 2.20	Firm light grey mottled orangeish brown silty slightly sandy CLAY. (RIVER TERRACE DEPOSITS)		RT	
								Exploratory hole completed at 2.2m bgl.		END	

General Remarks
Exploratory hole used as a soakway between 1.5m bgl and 0.5m bgl.
No groundwater encountered.
No visual or olfactory evidence of contamination.

Shoring/Support: None
Stability: Stable

Notes: All dimensions in metres. Logs should be read in accordance with the provided Key. Descriptions are based on visual and manual identification.



Length	Logged By	Client	Sheet
1.40m	VK	Hallam Land Management	1 of 1

Width	Ground Level (m AOD)	Co-Ordinates (NGR)	Date	Trial Hole No.
0.50m	6.586	E 489729 N 99145	13-11-15	SA04

Orientation	Method/Plant Used	Contractor	Scale
90 degrees from north	8 Tonne Excavator	Bastable Plant Hire	1:20.0

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Project	Job No
Land at Pagham	70014147

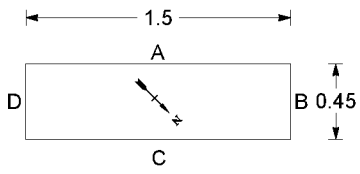


Depth	Type	PID (ppmV)	HSV (kN/m2)	P.Pen (kN/m2)	Water	Elev. (mAOD)	Depth (Thickness)	STRATA Description	Legend	Geology	Install / Backfill
							(0.30)	Firm brown slightly sandy CLAY with rare gravel and abundant fine root material. Gravel is fine to medium, subangular to subrounded flint. (TOPSOIL)		TS	
						5.65	0.30				
							(1.20)	Firm orangeish brown CLAY. (RIVER TERRACE DEPOSITS)		RT	
1.20	B					4.45	1.50				
								Exploratory hole completed at 1.5m bgl.		END	

General Remarks
Exploratory hole used as a soakway between 1.2m bgl and 0.4m bgl.
No groundwater encountered.
No visual or olfactory evidence of contamination.

Shoring/Support: None
Stability: Stable

Notes: All dimensions in metres. Logs should be read in accordance with the provided Key. Descriptions are based on visual and manual identification.



Length: 1.50m	Logged By: VK	Client: Hallam Land Management	Sheet: 1 of 1
Width: 0.45m	Ground Level (m AOD): 5.945	Co-Ordinates (NGR): E 489460 N 99027	Date: 12-11-15
Orientation: 45 degrees from north	Method/Plant Used: 8 Tonne Excavator	Contractor: Bastable Plant Hire	Scale: 1:20.0

Trial Hole No.

SA05

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TRIAL PIT LOG

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Project	Job No
Land at Pagham	70014147

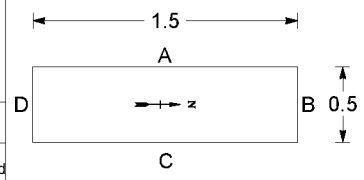


Depth	Type	PID (ppmV)	HSV (kN/m2)	P.Pen (kN/m2)	Water	Elev. (mAOD)	Depth (Thick-ness)	STRATA Description	Legend	Geology	Install / Backfill
							(0.40)	Firm brown slightly sandy slightly gravelly CLAY with abundant fine root material. Gravel is fine to medium, subangular to subrounded flint with rare brick fragments. (TOPSOIL)		TS	
						5.29	0.40				
							(1.00)	Stiff orangeish brown CLAY. (RIVER TERRACE DEPOSITS)		RT	
					1			0.90 m bgl becomming slightly gravelly. Gravel is fine to coarse, subangular to subrounded flint.			
						4.29	1.40				
1.50	B						(0.30)	Light orangeish brown slightly clayey gravelly SAND. Gravel is fine to coarse, subangular to rounded flint. (RIVER TERRACE DEPOSITS)		RT	
						3.99	1.70				
								Exploratory hole completed at 1.7m bgl.		END	

General Remarks
Groundwater encountered at 1.4m bgl.
No visual or olfactory evidence of contamination.

Shoring/Support: None
Stability: Stable

Notes: All dimensions in metres. Logs should be read in accordance with the provided Key. Descriptions are based on visual and manual identification.



Length	Logged By	Client	Sheet
1.50m	VK	Hallam Land Management	1 of 1

Width	Ground Level (m AOD)	Co-Ordinates (NGR)	Date	Trial Hole No.
0.50m	5.685	E 489338 N 98858	13-11-15	SA06A

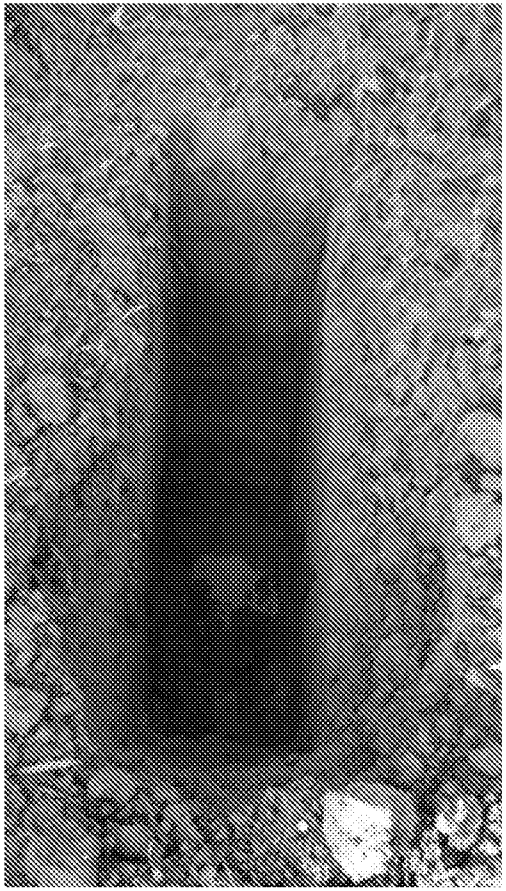
Orientation	Method/Plant Used	Contractor	Scale
90 degrees from north	8 Tonne Excavator	Bastable Plant Hire	1:20.0

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Project	Job No
Land at Pagham	70014147

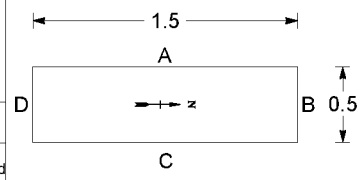


Depth	Type	PID (ppmV)	HSV (kN/m2)	P.Pen (kN/m2)	Water	Elev. (mAOD)	Depth (Thick-ness)	STRATA Description	Legend	Geology	Install / Backfill
							(0.40)	Firm brown slightly sandy slightly gravelly CLAY with abundant fine root material. Gravel is fine to medium, subangular to subrounded flint. (TOPSOIL)		TS	
						5.29	0.40				
							(0.80)	Stiff orangeish brown CLAY. (RIVER TERRACE DEPOSITS)		RT	
					1	4.49	1.20				
						4.39	1.30	Light orangeish brown slightly clayey gravelly SAND. Gravel is fine to coarse, subangular to rounded flint. (RIVER TERRACE DEPOSITS)		RT	
								Exploratory hole completed at 1.3m bgl.		END	

General Remarks
Exploratory hole located approximately 3.0m to the east of SA06A.
Groundwater encountered at 1.2m bgl.
No visual or olfactory evidence of contamination.

Shoring/Support: None
Stability: Stable

Notes: All dimensions in metres. Logs should be read in accordance with the provided Key. Descriptions are based on visual and manual identification.



Length	Logged By	Client	Sheet
1.50m	VK	Hallam Land Management	1 of 1

Width	Ground Level (m AOD)	Co-Ordinates (NGR)	Date	Trial Hole No.
0.50m	5.685	E 489338 N 98858	13-11-15	SA06B

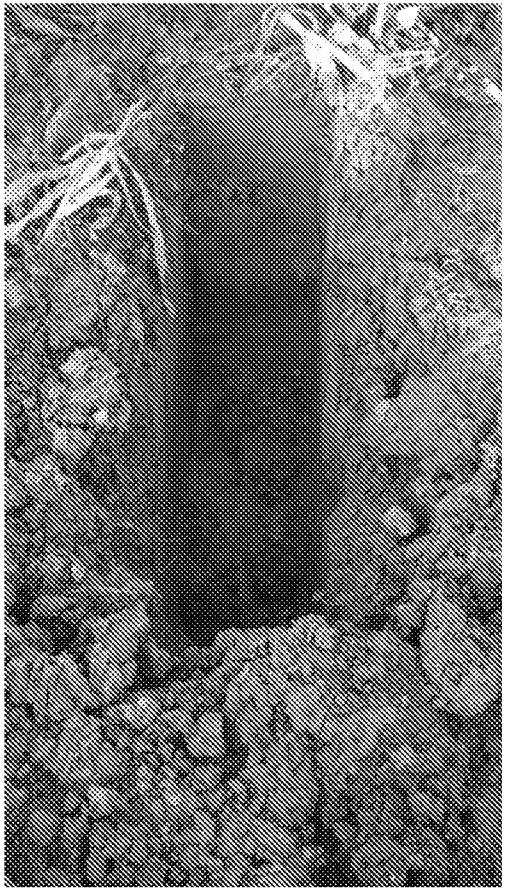
Orientation	Method/Plant Used	Contractor	Scale
90 degrees from north	8 Tonne Excavator	Bastable Plant Hire	1:20.0

08 WSP TP LOG LS 1 PHOTO 70014147 - LAND AT PAGHAM.GPJ WSPETEMPLATE1.03.GDT 3/12/15

WSP | Parsons Brinckerhoff
One Queens Drive, Birmingham
B5 4PJ

TRIAL PIT LOG

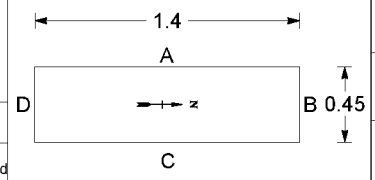
Project	Job No
Land at Pagham	70014147



Depth	Type	PID (ppmV)	HSV (kN/m2)	P.Pen (kN/m2)	Water	Elev. (mAOD)	Depth (Thick-ness)	STRATA Description	Legend	Geology	Install / Backfill
							(0.40)	Firm brown slightly sandy slightly gravelly CLAY with abundant fine root material. Gravel is fine to medium, subangular to subrounded flint. (TOPSOIL)		TS	
						5.29	0.40				
0.80	B						(0.80)	Stiff orangeish brown CLAY. (RIVER TERRACE DEPOSITS)		RT	
						4.49	1.20				
								Exploratory hole completed at 1.2m bgl.		END	

General Remarks
Exploratory hole used as a soakway between 1.0m bgl and 0.5m bgl.
Exploratory hole located approximately 6.0m to the east of SA06A.
No groundwater encountered.
No visual or olfactory evidence of contamination.
Shoring/Support: None
Stability: Stable

Notes: All dimensions in metres. Logs should be read in accordance with the provided Key. Descriptions are based on visual and manual identification.



Length	Logged By	Client	Sheet
1.40m	VK	Hallam Land Management	1 of 1

Width	Ground Level (m AOD)	Co-Ordinates (NGR)	Date	Trial Hole No.
0.45m	5.685	E 489338 N 98858	13-11-15	SA06C

Orientation	Method/Plant Used	Contractor	Scale
90 degrees from north	8 Tonne Excavator	Bastable Plant Hire	1:20.0

08 WSP TP LOG LS 1 PHOTO 70014147 - LAND AT PAGHAM.GPJ WSPETEMPLATE1.03.GDT 3/12/15

Annex C – Soakaway Results

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TRIAL PIT SOAKAGE TEST

Project: Land at Pagham
Code: 70014147
Client: Hallam Land Management

TEST DATA

Pit reference	SA01C
Test reference	1.0
Test date	12/11/2015
Test start time	10:52:00
Pit depth (m)	1.7
Pit width (m)	0.5
Pit length (m)	1.7
Depth to standing water (m)	0.7

Test 1

Time (min)	Depth (m)
0.0	0.70
0.5	0.70
1.0	0.70
2.0	0.70
3.0	0.70
4.0	0.70
5.0	0.70
10.0	0.70
15.0	0.70
30.0	0.70
60.0	0.76
120.0	0.80
150.0	0.80
180.0	0.81
210.0	0.82
240.0	0.82

Subsequent tests not undertaken.

Method of calculation: Test did not complete - no soil infiltration rate calculated.

Pit gravel filled? No

Max. depth (m) 1.70

Effective depth (m) 0.70
Effective drop (m) 1.00
75% effective full depth (m) 0.95
50% effective full depth (m) 1.20
25% effective full depth (m) 1.45
t75 (min)
t50 (min)
t25 (min)

Trial Pit Log

Depth (m bgl)	Geological description
0.0-0.2	Firm brown slightly sandy CLAY with abundant fine root material. (TOPSOIL)
0.2-1.6	Stiff greyish brown slightly sandy CLAY.
1.6-1.8	Soft light brown sandy gravelly CLAY with occasional flint cobbles. Gravel is fine to coarse, subangular to subrounded flint.

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TRIAL PIT SOAKAGE TEST

Project: Land at Pagham
Code: 70014147
Client: Hallam Land Management

TEST DATA

Pit reference	SA02B
Test reference	1.0
Test date	12/11/2015
Test start time	12:15:00
Pit depth (m)	1.4
Pit width (m)	0.6
Pit length (m)	1.6
Depth to standing water (m)	0.4

Test 1

Time (min)	Depth (m)
0.0	0.40
0.5	0.40
1.0	0.40
2.0	0.40
3.0	0.40
4.0	0.40
5.0	0.40
10.0	0.40
15.0	0.40
30.0	0.42
60.0	0.43
120.0	0.43
150.0	0.44
180.0	0.45

Subsequent tests not undertaken.

Method of calculation: Test did not complete - no soil infiltration rate calculated.

Pit gravel filled? No

Max. depth (m) 1.40

Effective depth (m) 0.40
Effective drop (m) 1.00
75% effective full depth (m) 0.65
50% effective full depth (m) 0.90
25% effective full depth (m) 1.15
t75 (min)
t50 (min)
t25 (min)

Trial Pit Log

Depth (m bgl)	Geological description
0.0-0.3	Firm brown slightly sandy CLAY with abundant fine root material. (TOPSOIL)
0.3-1.7	Stiff light brown CLAY.

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TRIAL PIT SOAKAGE TEST

Project: Land at Pagham
Code: 70014147
Client: Hallam Land Management

TEST DATA

Pit reference	SA03
Test reference	1.0
Test date	13/11/2015
Test start time	11:57:00
Pit depth (m)	1.6
Pit width (m)	0.50
Pit length (m)	1.7
Depth to standing water (m)	0.7

Test 1

Time (min)	Depth (m)
0.0	0.70
0.5	0.70
1.0	0.70
2.0	0.70
3.0	0.70
4.0	0.70
5.0	0.70
10.0	0.70
15.0	0.70
30.0	0.70
60.0	0.70
120.0	0.70
150.0	0.70
180.0	0.70

Subsequent tests not undertaken.

Method of calculation: Test did not complete - no soil infiltration rate calculated.

Pit gravel filled? No

Max. depth (m) 1.60

Effective depth (m) 0.70
Effective drop (m) 0.90
75% effective full depth (m) 0.93
50% effective full depth (m) 1.15
25% effective full depth (m) 1.38
t75 (min)
t50 (min)
t25 (min)

Trial Pit Log

Depth (m bgl)	Geological description
0.0-0.4	Firm brown slightly sandy CLAY with rare gravel and abundant fine root material. Gravel is fine to medium, subrounded to rounded flint. (TOPSOIL)
0.4-2.0	Firm orangeish brown mottled greyish brown CLAY.
2.0-2.4	Firm orangeish brown sandy CLAY.

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TRIAL PIT SOAKAGE TEST

Project: Land at Pagham
Code: 70014147
Client: Hallam Land Management

TEST DATA

Pit reference	SA04
Test reference	1.0
Test date	13/11/2015
Test start time	11:09:00
Pit depth (m)	1.5
Pit width (m)	0.50
Pit length (m)	1.4
Depth to standing water (m)	0.5

Test 1

Time (min)	Depth (m)
0.0	0.50
0.5	0.50
1.0	0.50
2.0	0.50
3.0	0.50
4.0	0.50
5.0	0.50
10.0	0.50
15.0	0.50
30.0	0.50
60.0	0.53
120.0	0.55
150.0	0.55
180.0	0.55
210.0	0.55

Subsequent tests not undertaken.

Method of calculation: Test did not complete - no soil infiltration rate calculated.

Pit gravel filled? No

Max. depth (m) 1.50

Effective depth (m) 0.50
Effective drop (m) 1.00
75% effective full depth (m) 0.75
50% effective full depth (m) 1.00
25% effective full depth (m) 1.25
t75 (min)
t50 (min)
t25 (min)

Trial Pit Log

Depth (m bgl)	Geological description
0.0-0.2	Firm brown slightly sandy CLAY with abundant fine root material. (TOPSOIL)
0.2-0.5	Stiff brown slightly sandy CLAY.
0.5-1.1	Stiff pale orangeish brown slightly sandy CLAY.
1.1-2.0	Firm pale brown mottled orangeish brown slightly sandy CLAY.
2.0-2.2	Firm light grey mottled orangeish brown silty slightly sandy CLAY.

TRIAL PIT SOAKAGE TEST

Project: Land at Pagham
Code: 70014147
Client: Hallam Land Management

TEST DATA

Pit reference	SA05
Test reference	1.0
Test date	12/11/2015
Test start time	13:05:00
Pit depth (m)	1.2
Pit width (m)	0.45
Pit length (m)	1.5
Depth to standing water (m)	0.4

Test 1

Time (min)	Depth (m)
0.0	0.40
0.5	0.40
1.0	0.40
2.0	0.40
3.0	0.40
4.0	0.40
5.0	0.40
10.0	0.40
15.0	0.40
30.0	0.40
60.0	0.40
120.0	0.40
150.0	0.40
180.0	0.40

Subsequent tests not undertaken.

Method of calculation: Test did not complete - no soil infiltration rate calculated.

Pit gravel filled? No

Max. depth (m) 1.20

Effective depth (m) 0.40
Effective drop (m) 0.80
75% effective full depth (m) 0.60
50% effective full depth (m) 0.80
25% effective full depth (m) 1.00
t75 (min)
t50 (min)
t25 (min)

Trial Pit Log

Depth (m bgl)	Geological description
0.0-0.3	Firm brown slightly sandy CLAY with rare gravel and abundant fine root material. Gravel is fine to medium, subangular to subrounded flint. (TOPSOIL)
0.3-1.5	Firm orangeish brown CLAY.

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TRIAL PIT SOAKAGE TEST

Project: Land at Pagham
Code: 70014147
Client: Hallam Land Management

TEST DATA

Pit reference	SA06C
Test reference	1.0
Test date	13/11/2015
Test start time	10:31:00
Pit depth (m)	1.0
Pit width (m)	0.45
Pit length (m)	1.4
Depth to standing water (m)	0.5

Test 1

Time (min)	Depth (m)
0.0	0.50
0.5	0.50
1.0	0.50
2.0	0.50
3.0	0.50
4.0	0.50
5.0	0.50
10.0	0.50
15.0	0.50
30.0	0.50
60.0	0.50
120.0	0.50
150.0	0.51
180.0	0.51
240.0	0.52

Subsequent tests not undertaken.

Method of calculation: Test did not complete - no soil infiltration rate calculated.

Pit gravel filled? No

Max. depth (m) 1.00

Effective depth (m) 0.50
Effective drop (m) 0.50
75% effective full depth (m) 0.63
50% effective full depth (m) 0.75
25% effective full depth (m) 0.88
t75 (min)
t50 (min)
t25 (min)

Trial Pit Log

Depth (m bgl)	Geological description
0.0-0.4	Firm brown slightly sandy slightly gravelly CLAY with abundant fine root material. Gravel is fine to medium, subangular to subrounded flint with rare brick fragments. (TOPSOIL)
0.4-1.2	Stiff orangeish brown CLAY.

Notes on Limitations

ARUN DISTRICT COUNCIL P/6/17/OUT

LIMITATIONS FOR WSP LAND RESTORATION AND GROUND ENGINEERING DIVISION

General

WSP Environmental Limited has prepared this report solely for the use of the Client and those parties with whom a warranty agreement has been executed, or with whom an assignment has been agreed and outlined in the body of the report. Unless explicitly agreed otherwise, in writing, this report has been prepared under WSP UK Limited standard Terms and Conditions as included within our proposal to the Client.

Project specific appointment documents may be agreed on a project by project basis, at our discretion. A charge may be levied for both the time to review and finalise appointments documents and also for associated changes to the appointment terms. WSP Environmental Limited reserve the right to amend the fee should any changes to the appointment terms create an increase risk to WSP

The report needs to be considered in the light of the WSP proposal and associated limitations of scope. The report needs to be read in full and isolated sections cannot be used without full reference to other elements of the report.

Phase 1 Geo Environmental and Preliminary Risk Assessments

The works undertaken to prepare this report comprised a study of available and easily documented information from a variety of sources (including the Client), together with (where appropriate) a brief walk over inspection of the Site and correspondence with relevant authorities and other interested parties. Due to the short timescales associated with these projects responses may not have been received from all parties. WSP Environmental Limited cannot be held responsible for any disclosures that are provided post production of our report and will not automatically update our report.

The opinions given in this report have been dictated by the finite data on which they are based and are relevant only for the purpose for which the report was commissioned. The information reviewed should not be considered exhaustive and has been accepted in good faith as providing true and representative data pertaining to site conditions. Should additional information become available which may affect the opinions expressed in this report, WSP Environmental Limited reserves the right to review such information and, if warranted, to modify the opinions accordingly.

It should be noted that any risks identified in this report are perceived risks based on the information reviewed. Actual risks can only be assessed following intrusive investigations of the Site.

WSP does not warrant work / data undertaken / provided by others.

This section covers reports with the following titles or combination of titles: phase 1; Desk top study; geo environmental assessment; development appraisal; preliminary environmental risk assessment; constraints report; due diligence report; geotechnical development review; environmental statement; environmental chapter; geotechnical development risk register or baseline environmental assessment.

Intrusive Investigation Reports

The investigation has been undertaken to provide information concerning the type and degree of contamination present at the Site in order to allow a generic risk assessment to be undertaken or the soil properties to allow for geotechnical development constraints to be identified.

The objectives of the investigation are limited to establishing the risks associated with potential contamination sources with the potential to cause harm to human health, building materials, the environment (including adjacent land), or controlled waters. For Geotechnical investigations the purpose is to broadly identify the development constraints associated with the physical property of the soils underlying the site.

The amount of exploratory work, soil property and chemical testing undertaken has necessarily been restricted by various factors which may include accessibility, the presence of services; existing buildings; current site usage or short timescales. The exploratory holes completed assess only a small percentage of the area in relation to the overall size of the Site, and as such can only provide a general indication of conditions. The number of sampling points and the methods of sampling and testing do not preclude the possible existence of localised "hotspots" of contamination where concentrations may be significantly higher than those actually encountered or ground conditions that vary from those identified. In addition, there may be exceptional ground conditions elsewhere on the site which have not been disclosed by this investigation and which have therefore not been taken into account in this report. For example these include spatial variations in soil properties; the varying thickness and physical nature of the strata identified and changes in groundwater levels or flow rates.

The inspection; testing and monitoring records relate specifically to the investigation points and the timeframe that the works were undertaken. They will also be limited by the techniques employed. WSP Environmental Limited have interpreted between these points based upon assumptions to develop our interpretation and conclusions. The assumption made in forming our conclusions is that the ground and groundwater conditions (both chemically and physically) are the same as have been encountered during the works undertaken at the specific points of investigation.

On 1st April 2010, BS EN 1997-1:2004 (Eurocode 7: Geotechnical Design – Part 1) became the mandatory baseline standard for geotechnical ground investigations.

In terms of geotechnical design for foundations, slopes, retaining walls and earthworks, EC7 sets guidance on design procedures including specific guidance on the numbers and spacings of boreholes for geotechnical design, there are limits to methods of ground investigation and the quality of data obtained and there are also prescriptive methods of assessing soil strengths and methods of design. Unless otherwise explicitly stated, the work has not been undertaken in accordance with EC7. A standard geotechnical interpretative report will not meet the requirements of the Geotechnical Design Report (GDR) under Eurocode 7. The GDR can only be prepared following confirmation of all structural loads and serviceability requirements. The report is likely to represent a Ground Investigation Report (GIR) under the Eurocode 7 guidance.

During any build programme WSP Environmental Limited should be consulted if alternative ground conditions are encountered. It assumes during any site works that the contractor will use their best endeavours to manage and control groundwater and other unforeseen ground conditions. WSP Environmental Limited will not be liable for actions taken prior to consultation.

The scope of the investigation was selected on the basis of the specific development and land use scenario proposed by the Client and may be inappropriate to another form of development or scheme. If the development layout was not known at the time of the investigation the report findings may need revisiting once the development layout is confirmed.

The risk assessment and opinions provided are based on currently available guidance relating to acceptable contamination concentrations; no liability can be accepted for the retrospective effects of any future changes or amendments to these values. Specific assumptions associated with the WSP Environmental Limited risk assessment process have been outlined within the body or associated appendix of the report.

Additional investigations may be required in order to satisfy relevant planning conditions or to resolve any engineering and environmental issues.

If costs have been included in relation to additional site works, and / or site remediation works these must be considered as indicative only and must, be confirmed by a qualified quantity surveyor.

The following report titles (or combination) may cover this category of work: geo environmental site investigation; geotechnical assessment; GIR (Ground Investigation reports); preliminary environmental and geotechnical risk assessment; geotechnical risk register.

Detailed Quantitative Risk Assessments and Remedial Strategy Reports

These reports build upon previous report versions and associated notes. The scope of the investigation; further testing and monitoring and associated risk assessments were selected on the basis of the specific development and land use scenario proposed by the Client and may not be appropriate to another form of development or scheme layout. The risk assessment and opinions provided are based on currently available approaches in the generation of Site Specific Assessment Criteria relating to contamination concentrations and are not considered to represent a risk in a specific land use scenario to a specific receptor. No liability can be accepted for the retrospective effects of any future changes or amendments to these values, associated models or associated guidance.

The outputs of the Detailed Quantitative Risk Assessments are based upon WSP Environmental Limited manipulation of standard risk assessment models. These are our interpretation of the risk assessment criteria. Prior to adoption they will need discussing and agreeing with the Regulatory Authorities prior to adoption on site. The regulatory discussion and engagement process may result in an alternative interpretation being determined and agreed. The process and timescales associated with the Regulatory Authority engagement are not within the control of WSP. All costs and programmes presented as a result of this process should be validated by a quantity surveyor and should be presumed to be indicative.

Geotechnical Design Report (GDR)

The GDR can only be prepared following confirmation of all structural loads and serviceability requirements. All the relevant information needs to be provided to allow for a GDR to be produced.

Monitoring (including Remediation Monitoring reports)

These reports are factual in nature and comprise monitoring, normally groundwater and ground gas and data provided by contractors as part of an earthworks or remedial works.

The data is presented and will be compared with assessment criteria.

Asbestos in soils

Unless explicitly included for in our proposal, our investigation does not include for a formal asbestos assessment. The inspection for asbestos, either as asbestos containing materials (ACMs) lying on the surface or as ACMs and/or as loose asbestos fibres within made ground / stockpiles are excluded.. Our report will include for the factual reporting of any soil screens that are collected. These results should be treated cautiously and should not be relied upon to provide detailed and representative information on the delineation, type and extent of bulk ACMs and/or trace loose asbestos fibres within the soil matrix at the site.

Where we indicate in our proposal that we will consider asbestos we will undertake screening of representative soil samples for the presences / absence of loose asbestos fibres. If these are found a further and more detailed specific investigation into asbestos in soils, where asbestos quantification testing will be undertaken. These investigations are associated with more rigorous monitoring of asbestos and health and safety provisions.

Appendix F

SUDS DESIGN STATEMENT

GENERAL PRINCIPLES AND CONSIDERATIONS

The purpose of the proposed drainage strategy is to ensure that the proposed scheme does not exacerbate any existing flood risks upstream or downstream of the site, in accordance with the principles set out within the NPPF.

Sustainable Drainage Systems (SuDS) will be implemented throughout this development scheme. The conceptual SuDS strategy for the proposed development has been devised using the principles outlined within the current published guidance in the form of the NPPF, PPG and CIRIA amongst others.

The impact of climate change is a key factor when determining a drainage strategy. The NPPF and PPG guidance advocate a "development lifespan" approach for dealing with climate change allowances. The PPG specifies a minimum design life for residential development of 100 years.

The Environment Agency published updated allowances for climate change[3] in February 2016. The updated allowances are based on a regional approach to peak river flow and sea level allowances along with updated allowances for peak rainfall intensity. Relevant parts of Tables 1 and 2 are included below.

SOUTH-EAST RIVER BASIN DISTRICT	TOTAL POTENTIAL CHANGE ANTICIPATED FOR '2020s' (2015 TO 2039)	TOTAL POTENTIAL CHANGE ANTICIPATED FOR '2050s' (2040 TO 2069)	TOTAL POTENTIAL CHANGE ANTICIPATED FOR '2080s' (2070 TO 2115)
Upper End	25%	50%	105%
Higher Central	15%	30%	45%
Central	10%	20%	35%

APPLIES ACROSS ALL OF ENGLAND	TOTAL POTENTIAL CHANGE ANTICIPATED FOR '2020s' (2015 TO 2039)	TOTAL POTENTIAL CHANGE ANTICIPATED FOR '2050s' (2040 TO 2069)	TOTAL POTENTIAL CHANGE ANTICIPATED FOR '2080s' (2070 TO 2115)
Upper end	10%	20%	40%
Central	5%	10%	20%

In light of the above guidance requirements, an increase of 40% in peak rainfall intensity has been used as the allowance for climate change within the proposed drainage design to determine the performance of the drainage system.

It is intended that all of the proposed SuDS and drainage exceedance devices located within the communal and open space areas will be offered for adoption to the LLFA or LPA. The proposed maintenance regimes for the devices should be in accordance with CIRIA C753 "The SuDS Manual" and other best practice guidelines. Should the LLFA or LPA not be willing to adopt certain aspects of the system, it is the intention that a third party management company be established to maintain the features in perpetuity. An adoption agreement between the developer and Maintenance Company will be based upon the CIRIA ICoP MA2 SuDS Maintenance Framework Agreement.

[3] https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances

It is the intention across the site to mimic the existing drainage regime as close as possible and therefore prevent flood risk from being exacerbated on or off site.

The proposed drainage system will comprise of a traditional drainage network that will be supplemented, where appropriate, with various SuDS devices to provide source control, water quality treatment and biodiversity enhancement. The pipe drainage network will be designed to the current edition of Sewers for Adoption and offered to the incumbent operator for adoption under Section 104 of the Water Industry Act.

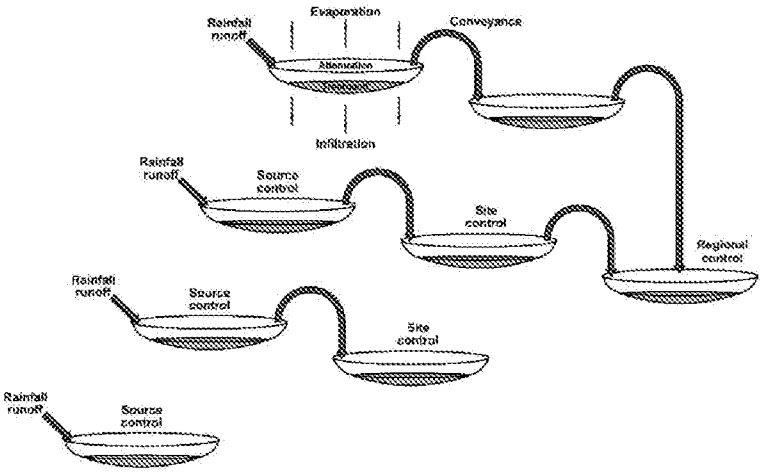
Due to the level of detail within the scheme layout at this stage, it is not possible to determine the final quantum and arrangement of the SuDS features within the site however, the intention of this report is to provide a commitment to the implementation of SuDS and a toolkit of options for future developers.

THE SUDS MANAGEMENT TRAIN

In order to mimic natural catchment processes as closely as possible, a SuDS Management Train is proposed and uses drainage techniques to incrementally reduce pollution, flow rates and volumes.

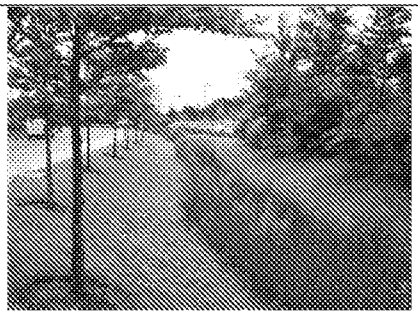
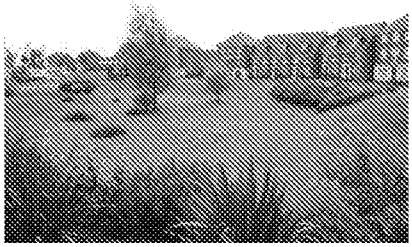
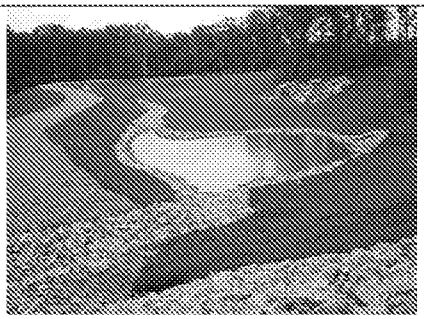
CIRIA C697 States:

"The management train is summarised in Figure 1.5. Wherever possible, storm water should be managed in small, cost-effective landscape features located within small sub-catchments rather than being conveyed to and managed in large systems at the bottom of drainage areas (end of pipe solutions). The techniques that are higher in the hierarchy are preferred to those further down so that prevention and control of water at source should always be considered before site or regional controls. However, where upstream control opportunities are restricted, a number of lower hierarchy options should be used in series. Water should be conveyed elsewhere only if it cannot be dealt with on site."

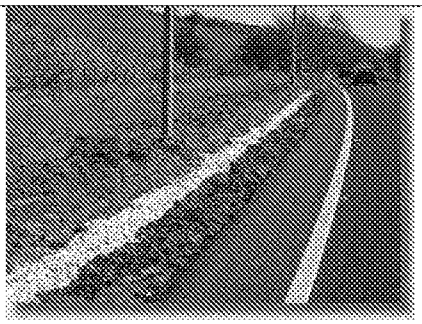
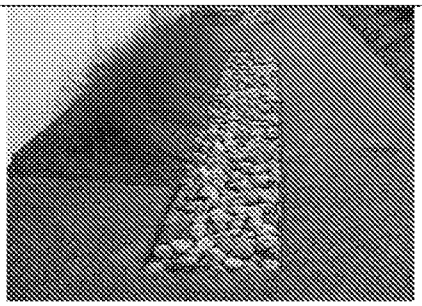
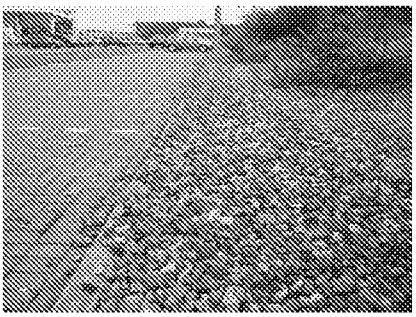
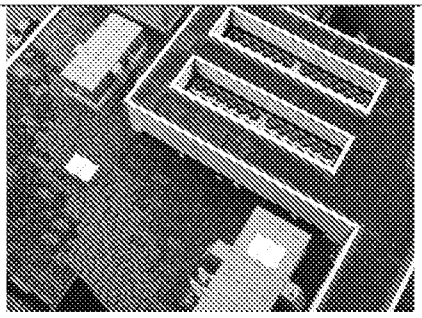


A hierarchy has been considered in applying the use of SuDS into the Proposed Development to help provide; prevention in terms of pollution, source control and site controls.

Whilst further details of the concept strategy are contained within **Chapter 5** of the FRA and **Appendices A and B**, the table below identifies a range of SuDS measures and their appropriateness within the site.

FEATURE	DESCRIPTION	EXAMPLE	APPROPRIATE
Filter Strips	These are wide, gently sloping areas of grass or other dense vegetation that treat runoff from adjacent impermeable areas.		✘ A lack of suitable infiltration rates recorded on site limits the use of infiltration based SuDS devices such as filter strips. As such, their use has not been considered.
Swales	Swales are broad, shallow channels covered by grass or other suitable vegetation. They are designed to convey and/or store runoff, and can infiltrate the water into the ground (if ground conditions allow).		✓ A large swale has been considered, collecting and attenuating all runoff from development south of the on-site drain. Further consideration will be given to roadside swales during the detailed design.
Infiltration Basins	Infiltration basins are depressions in the surface that are designed to store runoff and infiltrate the water to the ground. They may also be landscaped to provide aesthetic and amenity value.		✘ A lack of suitable infiltration rates recorded on site limits the use of infiltration based SuDS devices such as infiltration basins. As such, their use has not been considered.
Wet Ponds	Wet ponds are basins that have a permanent pool of water for water quality treatment. They provide temporary storage for additional storm runoff above the permanent water level. Wet ponds may provide amenity and wildlife benefits.		✓ It is expected wet ponds will be included below the invert level of the attenuation basins. The exact shape and size will be developed during the later design stage.
Extended Detention Basins	Extended detention basins are normally dry, though they may have small permanent pools at the inlet and outlet. They are designed to detain a certain volume of runoff as well as providing water quality treatment.		✓ Three basins are included in the proposed surface water strategy to attenuate runoff.

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Constructed Wetlands	Constructed wetlands are ponds with shallow areas and wetland vegetation to improve pollutant removal and enhance wildlife habitat.		✘ Constructed wetlands may be considered during the later stages of design as opposed to wet ponds.
Filter Drains	Filter drains are trenches that are filled with permeable material. Surface water from the edge of paved areas flows into the trenches, is filtered and conveyed to other parts of the site. A slotted or perforated pipe may be built into the base of the trench to collect and convey the water.		✘ Filter drains may be considered during the later stages of design subject to space and level constraints
Infiltration Devices	Infiltration devices temporarily store runoff from a development and allow it to percolate into the ground.		✘ A lack of suitable infiltration rates recorded on site limits the use of infiltration based SuDS devices. As such, their use has not been considered.
Pervious Surfaces	Pervious surfaces allow rainwater to infiltrate through the surface into an underlying storage layer, where water is stored before infiltration to the ground, reuse, or release to surface water.		✘ Pervious pavements may be included in the proposed strategy however due to poor infiltration rates any pervious surfaces may require some form of underdrain. It is expected the quantum and nature of any pervious surfaces will be detailed during the later stages of design.
Green Roofs	Green roofs are systems which cover a building's roof with vegetation. They are laid over a drainage layer, with other layers providing protection, waterproofing and insulation.		✘ Due to the residential use of the development, green roofs have not been included in the design.

WATER QUALITY

Impermeable surfaces collect pollutants from a wide variety of sources including cleaning activities, wear from car tyres, vehicle oil and exhaust leaks and general atmospheric deposition (source: CIRIA C609). The implementation of SuDS in development drainage provides a significant benefit in removal of pollutant from development run-off.

In most cases, contaminants become attached to sediment particles either before entering the water body or upon entry. CIRIA 609 reports that up to 90% of certain contaminants, usually trace elements, are transported in this way leaving a dissolved concentration of circa 10%.

Many SuDS systems rely on the infiltration of water through the ground layer into permeable sub soils or through sedimentation in low flow storage basins.

This settling and filtering of contaminated run off through a fine grained matrix separates the suspended contaminated sediment from the body of water subsequently causing the water to leave the SuDS device in a more polished form than how it entered; porous paving is a prime example of this.

Furthermore, by implementation of SuDS features it is possible to optimize overall pollutant removal as water will undergo this process of filtering before being discharged to an appropriate receptor. The overall percentage of removal can be calculated individually for each differing SuDS technique, this is shown by the formula below:

Overall pollutant removal = (TPLxC1) + (RPLxC2) + (RPLxC3) +.....for each other control in series

Where: ***TPL – Total Pollutant Load***
RPL – Remaining Pollutant Load (after previous treatment(s))
C(x) – Suds Control removal efficiency

At present, the site and surrounding area does not benefit from any additional measures of storm water treatment.

Due to the need to provide wider sustainability benefits and view the development at a strategic level, SuDS will be implemented to passively treat run off from the development so as to have a positive impact on the surrounding natural environment.

As the site is not presently served by any means of storm water treatment mechanisms, by providing the afore SuDS within the proposed development it will be possible to maintain present water quality in the area and thus the development can be seen to be having no significant environmental impact in relation to water.

HEALTH AND SAFETY

The proposed layout of the SuDS features will be designed in accordance with the best practice SuDS guidance documents and national standards, supplemented, where appropriate, with local LLFA / LPA guidance and the requirements of the water company and maintenance company to ensure the features are effective not only in terms of their hydraulic design but also from a safety perspective during construction, operation and maintenance.

Outline health and safety risk assessments should be completed for the individual drainage features proposed as part of the final site design, setting out the risks and incorporating proposals for how these are to be managed.