

Flood Risk Assessment
& Drainage Statement

**Land off Scratchface Lane
Bedhampton
Havant**



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**On behalf of
Crayfern Homes Ltd**

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Flood Risk Assessment & Drainage Statement

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1 INTRODUCTION

- 1.1 Stuart Michael Associates Limited, Consulting Engineers has prepared this Flood Risk Assessment and Drainage Statement, hereafter referred to as the 'Report', on the instructions of Crayfern Homes Ltd.
- 1.2 The Report supports a proposal for residential development on land off Scratchface Lane, Bedhampton, Havant, hereafter referred to as the 'Site'.
- 1.3 The purposes of the Report are as follows:
- (i) To confirm that the proposed development will not be subject to unacceptable flood risk or to show that flood risk can be managed in an acceptable manner,
 - (ii) To demonstrate that the proposed development will not increase risk of flooding elsewhere,
 - (iii) To confirm that satisfactory strategies for disposal of wastewater and surface water runoff from the proposed development are achievable.
- 1.4 The Report presents an independent assessment of flood risk in accordance with the document 'Planning Policy Statement 25: Development and Flood Risk' (PPS25), as required by the Environment Agency.
- 1.5 PPS25 provides guidance on how flood risk should be considered during the planning and development process. The requirement to protect both new and established development from increased risk of flooding forms an essential part of the guidance. Moreover, implementation of sustainable drainage systems for new development is encouraged.
- 1.6 Havant Borough Council (HBC) is the local planning authority controlling flood risk and water environment issues through policies and guidance presented in the Partnership for Urban South Hampshire (PUSH) Strategic Flood Risk Assessment (SFRA) Final Report (December 2007).
- 1.7 The Report confirms that the proposed development will satisfy the relevant planning policies of HBC and will meet the Environment Agency's long-term sustainability objectives.

2 THE SITE

Location

- 2.1 The Site is located south of Scratchface Lane in Bedhampton. The Site is bordered to the west by the A3 (M); residential development borders the east and south of the Site; Littlepark Wood is located to the north. A plan showing the location of the Site is presented as **Figure 1**.
- 2.2 The Ordnance Survey national grid reference for the approximate centre of the Site is 469515E, 106720N (SU695067). The Site, which is undeveloped and part used as a paddock, comprises an area of approximately 3.6 hectares.

Topography

- 2.3 Topographical survey information indicates that land north of Brookside Road Stream slopes southwards towards the stream. Levels at the highest north west corner of the slope are approximately 30.5 m AOD. Top of bank levels at the stream are in the order of 23.0 m AOD.
- 2.4 Land in the northern 80 m of the Site falls from the western boundary where levels approximate to 31.0 m to the eastern boundary, to a noticeable depression on the eastern boundary, at a level of approximately 28.5 m AOD.
- 2.5 Land in the southern part of the Site slopes from the southern end where levels are approximately 40 m AOD to the Brookside Road Stream at a level of approximately 23 m AOD.
- 2.6 A copy of the topographical survey is presented as **Figure 2**.

Geology and Hydrogeology

- 2.7 The British Geological Survey mapping (Sheet 316 – Fareham) indicates that the predominant geology in the vicinity of the Site is London Clay overlaying Chalk.
- 2.8 Soils Limited has undertaken an intrusive ground investigations, which indicate that generally the Site is underlain by Clay to depths up to 20 m, although Chalk was encountered in Borehole 1 in the south of the Site. Water seepage was observed at a depth of 19.5 m in Borehole 1.
- 2.9 A layer of Sand to a depth of 8.6 m was encountered between Clay strata in Borehole 3. No groundwater was encountered in the Sand layer. Water seepage was observed in the underlying Clay at a depth of 12.7 m.
- 2.10 A copy of the ground investigation report is included within **Appendix A**.
- 2.11 Mapping on the Environment Agency's website indicates that the southern part of the Site is located within Groundwater Protection Zone 1. The northern part of the Site is not located within a Groundwater Protection Zone.

Drains and Sewers

- 2.12 Sewer records obtained from Southern Water indicate that there are public foul sewers in Brooklands Road to the east of the Site, and Portsdown Hill Road to the south of the Site. A copy of the sewer records is included within **Appendix B**.
- 2.13 Sewer records supplied with Southern Water's Level 2 Capacity Assessment (**Appendix E**) indicate a 375 mm diameter public foul sewer located in Scratchface Lane to the north of the Site.
- 2.14 Sewer records also indicate the presence of public surface water sewers in Brooklands Road and Hillmead gardens to the east of the Site.

Watercourses

- 2.15 The Site is bisected by Brookside Road Stream orientated in a west / east direction. This watercourse, which is designated main river by the Environment Agency, enters a triple pipe culvert at the boundary of 34 Brooklands Road. The culvert discharges downstream in the ditch adjoining Brookside Road, approximately 0.5 km to the southeast of the Site.
- 2.16 A drainage ditch is located adjoining the northern boundary of the Site, to the south of Scratchface Lane. For the purpose of the Report, this watercourse is hereafter referred to as 'Scratchface Lane Ditch'.
- 2.17 Drainage ditches adjoining the western boundary are located at the bottom of the embankment to the A3 (M). The ditches are believed to convey runoff from an area of the A3 (M) to Brookside Road Stream. A length of the drainage ditch in the northern part of the Site conveys flows in a northerly direction and is believed to be the commencement of Scratchface Lane Ditch.
- 2.18 A plan showing the ditches and watercourses in the vicinity of the Site is presented as **Figure 3**.

Existing Drainage

- 2.19 A 150 mm diameter pipe connects to the outlet headwall of the ditch adjoining the northern boundary of the Site. The pipe appears to originate from within the northern part of the Site and may be an existing land drain, installed in an attempt to alleviate ponding that occurs due to runoff collecting in the depression that exists in the north west corner of the Site.

3 POTENTIAL SOURCES OF FLOODING

Coastal and Fluvial Flooding

- 3.1 Flood Zones shown on the Environment Agency's Flood Map are the main constraints used to inform local planning authorities when to consult the Agency on flood risk in development control decisions. The Environment Agency advises that Flood Zones should only be used for planning consultation purposes.
- 3.2 Flood Zones are a product of the Environment Agency's flood mapping programme and provide the main constraint map underpinning the Environment Agency's Standing Advice on Development and Flood Risk.
- 3.3 Table D.1 of PPS25 presents descriptions of Flood Zones, which show the probability of flooding without the presence of defences and significant man made structures such as bridges, culverts, and rail and motorway embankments. They show areas that may be at risk from flooding and where further investigation in the form of a Flood Risk Assessment should be used to ascertain the probable risk of flooding on Site.
- 3.4 Annex B of PPS25 sets out precautionary sensitivity ranges for peak rainfall and contingency allowances for net sea level rise. It states that:

"In making an assessment of the impacts of climate change on flooding from the land, rivers and sea as part of a flood risk assessment, the sensitivity ranges in Table B.2 may provide an appropriate precautionary response to the uncertainty about climate change impacts on rainfall intensities, river flow, wave height and wind speed".

Table B.2 of PPS25 indicates that for the period up to the year 2115, peak rainfall intensities could increase up to 30% and peak river flows might increase by 20%.

- 3.5 Flood Zones are based on annual probabilities of flooding. For example, a flood event with 1% chance of happening each year is equivalent to an event having a 1 in 100 year return period or 1% probability of occurrence. However, it is important to recognise that a 1% flood has a 26% probability of being equalled or exceeded at least once in 30 years (the duration of a typical mortgage) and a 49% probability of being equalled or exceeded at least once in 70 years (a typical human lifetime).
- 3.6 The Environment Agency advises that Flood Zones are to be used as a planning consultation tool and not to make an absolute judgement of flood risk. Flood Zones represent a consistent national data set as a planning constraint map. However, where detailed information exists, either from historic flooding, or from modelling taking into account flood defences, that information should also be used to inform planning responses.

3.7 Areas at risk from flooding are shown on the Flood Map, maintained by the Environment Agency on their web-site and are defined as follows:

- *Floodplain is the area that would naturally be affected by flooding if a river rises above its banks, or high tides and stormy seas cause flooding in coastal areas.*
- *There are two different kinds of area shown on the Flood Map. They can be described as follows:-*

Dark blue shows the area that could be affected by flooding, either from rivers or the sea, if there were no flood defences. This area could be flooded:

- o *from the sea by a flood that has a 0.5% (1 in 200) or greater chance of happening each year*
- o *or, from a river by a flood that has a 1% (1 in 100) or greater chance of happening each year.*

Light blue shows the additional extent of an extreme flood from rivers or the sea. These outlying areas are likely to be affected by a major flood, with up to a 0.1% (1 in 1000) chance of occurring each year.

- *These two colours show the extent of the natural floodplain if there were no flood defences or certain other manmade structures and channel improvements.*

3.8 Flood Zones are indicative and there may be additional areas at high risk from flooding that are not shown, such as floodplains associated with minor watercourses and areas subject to localised flooding. Therefore, the Environment Agency advises that the Flood Map should not be used as the sole basis for deciding the full extent of floodplains.

3.9 The Flood Map indicates that the Site is not located within Flood Zones 2 and 3. A plan showing the Flood Zones within the wider area of the Site is presented as **Figure 4**.

Coastal Flooding

3.10 The Site is not located within an area shown to be at risk from coastal flooding.

Fluvial Flooding

3.11 Brookside Road Stream bisects the Site. This watercourse is designated main river by the Environment Agency and a 9 m buffer zone will be required.

- 3.12 The source of the Brookside Road Stream is in the valley to the north east of the Site. The watercourse conveys flows to the east crossing under the A3 (M), where the main river designation starts. A plan indicating the possible upstream catchment to Brookside Road Stream is presented as **Figure 5**.

Historical Flooding

- 3.13 There are a number of reported and anecdotal flooding concerns in the vicinity of the Site. These problems are summarised below.

Flooding from Foul Water Sewers

- 3.14 Southern Water has identified multiple recurring flooding incidents from the public foul sewers located in the general vicinity of the Site. The majority of reported incidents have occurred along Brooklands Road, especially at numbers 31 and numbers 2 to 8, and along Maylands Road. The problems may be attributable to irregular changes in pipe diameters within the network causing constrictions.

Flooding from Watercourses

Brookside Road Stream

- 3.15 The original pipe culvert to Brookside Road Stream under Brooklands Road was designed to also accommodate flows from the adjoining development. The size of the culvert proved inadequate and resulted in flooding to properties along Brooklands Road and Brookside Road. The pipe culvert was later triplicated along part of its length in an attempt to alleviate the flooding.
- 3.16 Comments from Havant Borough Council's (HBC) Special Projects Engineer presented at the Development Consultation Forum (21 January 2010) indicate instances of overland flow caused by obstruction of the inlet grille at Brooklands Road.

Scratchface Lane Ditch

- 3.17 HBC's Special Projects Engineer has commented that the grille to the ditch adjoining the northern boundary of the Site is prone to blocking which causes overland flow down Scratchface Lane. There is also reportedly an unresolved issue with the riparian landowner relating to maintenance of the grille.

A3 (M) Toe Drains / Ditches

- 3.18 Inspection of the ditches indicates piped connections, probably conveying outflows from the A3 (M) drainage system. However, the ditches themselves exhibit little evidence of use and it is suspected that drainage from the A3 (M) probably connects directly to the Brookside Road Stream culvert.

Groundwater Flooding

- 3.19 There is no evidence of groundwater affecting the Site. The Site is underlain by a layer of London Clay and the ground investigation undertaken by Soils Limited encountered groundwater seepage at depths exceeding 12 m. Therefore, the risk of groundwater flooding affecting the Site is considered low.
- 3.20 Infiltration testing on the Site has confirmed that underlying Clay exhibits very low permeability. Site investigation has confirmed that a layer of Sand underlies the Clay in the location of an area of standing water in the northeast corner of the Site. Groundwater was not discovered in the Sand layer. The area of standing water on the Site is considered the result of runoff collecting in the localised depression and unable to dissipate.

Overland Flood Flow

- 3.21 Ordnance Survey mapping indicates that land in the general locality of the Site falls steeply to the east. The embankment to the A3 (M) along the western boundary of the Site forms a barrier to surface water from the east. Runoff is intercepted by ditches at the toe of the embankment and conveyed to Brookside Road Stream.

Climate Change Uncertainty

- 3.22 PPS25 advises in Annex B how to understand and interpret climate change. The Government established the UK Climate Impacts Programme (UKCIP), which identifies scenarios for climate change.
- 3.23 Table B.2 of PPS25 indicates that for the period up to 2115, peak rainfall intensities could increase up to 30%.

4 DEVELOPMENT PROPOSALS

- 4.1 The original proposals comprised construction of 92 dwellings together with car parking facilities, access roads and landscaping. A scheme layout is presented as **Figure 6**.
- 4.2 Vehicle access to the development will be from Brooklands Road. Pedestrian / cycle access will be from Brooklands Road to the east and Scratchface Lane to the north, and Portsdown Hill Road to the south.
- 4.3 The planning and detailed design of the development proposals will incorporate the advice, recommendations and requirements contained in this Report.

5 PROPOSED SURFACE WATER DRAINAGE

Sustainable Drainage Systems

- 5.1 Any development presents an opportunity to incorporate sustainable surface water drainage systems, which might include infiltration techniques or attenuation of flows to protect receiving sewers or watercourses. The choice of methods is dependent upon ground conditions and availability of suitable areas within the particular scheme layout.
- 5.2 The development proposals will incorporate sustainable drainage solutions to dispose of surface water runoff. The guidance given in the CIRIA report C697 'The SUDS Manual' will be followed during the design of the proposed sustainable drainage solution. Runoff will be managed both at source and across the Site as a whole.
- 5.3 The Interim Code of Practice for Sustainable Drainage Systems (ICP SUDS) sets out the recommended procedure for rainfall runoff management for developments. ICP SUDS states that for a range of annual flow rate probabilities up to and including the 1% annual probability (the 1 in 100 year event), the developed rate of runoff into a watercourse should be no greater than the undeveloped rate of runoff for the same event.
- 5.4 The limiting discharge for the 1-year, 30-year and 100-year return period storms should be constrained to the mean annual peak runoff for the greenfield site, (referred to as QBAR in the Institute of Hydrology Report 124: Flood Estimation for Small Catchments [1994]).
- 5.5 Soils Limited has undertaken ground investigations to confirm the permeability of the underlying strata. The investigations conclude that the Site is underlain by London Clay to depths exceeding 15 m. The formation exhibits very poor soakage characteristics.
- 5.6 Given the impermeable nature of the strata underlying the Site, the potential for infiltration of surface water is negligible. Therefore, the use of infiltration devices for the disposal of surface water has been discounted.
- 5.7 Therefore, the "surface water management train" will be designed to attenuate runoff with controlled discharges and implementation of sustainable drainage systems (SUDS) will minimise the risk of increasing downstream flood risk that might otherwise have resulted from the proposed development.
- 5.8 The array of SUDS implemented on the proposed development will maintain a restricted discharge to Brookside Road Stream and Scratchface Lane Ditch. A plan indicating the surface water drainage strategy is presented as **Figure 7**.
- 5.9 The surface water runoff storage / attenuation facilities will be designed to accommodate surface water runoff from the proposed development for all rainfall events up to and including the 1 in 100 year occurrence, including a 30% increase to allow for the possible effects of climate change.

Greenfield Discharge

Flow

5.10 Runoff from the Site in the undeveloped state discharges greenfield runoff to Brookside Road Stream and Scratchface Lane ditch. For the purpose of establishing the surface water drainage strategy, the areas of the Site to the north and south of Brookside Road Stream have been considered separately. Therefore, three outfalls from the Site are considered in the strategy:

- Outfall A, northern catchment to Scratchface Lane Ditch.
- Outfall B, northern catchment to Brookside Road Stream.
- Outfall C, southern catchment to Brookside Road Stream.

5.11 The EA/DEFRA Technical Report W5-074/a/TR/1 Revision C, 'Preliminary rainfall runoff management for developments (HR Wallingford)', recommends that for developments of less than 200 hectares, the Institute of Hydrology Report 124 'Flood Estimation for small catchments' (IOH124) should be used to determine peak greenfield runoff rates. Where developments are less than 50ha, the peak greenfield discharge rate is linearly interpolated from the ratio of the development size to 50ha. The IOH124 report was used to calculate the existing natural runoff from the undeveloped site for the 1-year, 30-year and 100-year event. These flow rates are provided within the following table. **Appendix C** and **Table 1** refers.

$$QBAR_{\text{rural}} = 0.00108 \text{AREA}^{0.89} \text{SAAR}^{1.17} \text{SOIL}^{2.17}$$

$$QBAR_{\text{rural}} = 177.2 \text{ l/s (50 ha)}$$

Return Period (years)	Existing Greenfield Runoff Rate to Outfall A (l/s)	Existing Greenfield Runoff Rate to Outfall B (l/s)	Existing Greenfield Runoff Rate to Outfall C (l/s)
1	1.9	5.3	3.3
QBAR (2.33)	2.2	6.2	3.8
30	5.0	14.1	8.7
100	7.0	19.8	12.2

Table 1: Existing Greenfield Runoff Rates

Volumes

- 5.12 The greenfield runoff volumes for the x-year return period 6-hour (360min) event storms are calculated using the guidance presented in Chapter 4 of CIRIA C697: The SUDS Manual, as follows:

$$\text{Runoff Volume} = \text{Percentage Runoff} \times \text{Area} \times \text{Rainfall Depth}$$

- 5.13 Rainfall profiles for the 1-year, 30-year and 100-year 6-hour (360min) storms were generated using the FSR Rainfall Model within the Micro Drainage WinDes software. **Appendix C** and **Table 2** refer.

Return Period (1:x-years)	Rainfall Depth (mm)	Existing Greenfield Runoff Volume (m ³)		
		Outfall A	Outfall B	Outfall C
1	19.7	45	128	79
30	44.3	106	298	184
100	57.7	145	409	253

Table 2: Existing Greenfield Runoff Volumes

Storage

Attenuation Storage Volumes

- 5.14 Generally, unrestricted runoff from developments through traditional pipe networks will discharge into receiving watercourses at orders of magnitude greater than runoff from undeveloped greenfield sites. The elevated runoff causes 'flash flows' in the receiving watercourse which may cause scour and erosion, affecting the morphology and ecology of the watercourse. Attenuation storage is provided to control runoff from the Site to minimise those problems.
- 5.15 Using the 'Quick Storage Estimate' module within the WinDes design suite, the storage volumes required to attenuate flows to QBAR for the 1-year, 30-year, 100-year and 100-year climate change storms for the developed site are presented in **Table 3**.

Return Period (years)	Storage Volume Outfall A (m ³) Impermeable Area = 0.065 ha	Storage Volume Outfall B (m ³) Impermeable Area = 1.00 ha	Storage Volume Outfall C (m ³) Impermeable Area = 0.36 ha
1	1.8 – 4.3	87 - 154	23 - 44
30	8.8 - 15	282 - 424	84 - 128
100	13 - 22	400 - 575	121 - 177
100 (+30%)	19 - 31	565 - 804	172 - 248

Table 3: Attenuation Storage Volumes (WinDes Quick Storage Estimate)

Surface Water Management Train

- 5.16 To reduce the impact of the development on the natural hydrology of the catchment, the proposed development will be designed with sustainable drainage solutions that mimic, as closely as possible, the existing natural flow regime of the greenfield site.
- 5.17 In accordance with CIRIA Report C697: The SUDS Manual, a “SUDS Management Train” process will be undertaken to assure that the proposed drainage strategy mimics the natural catchment of the Site as closely as possible.
- 5.18 Source control techniques will be incorporated into the drainage strategy to ensure that stormwater runoff is managed as close to source as possible.
- 5.19 All surface water drainage systems have been designed in accordance with CIRIA 697 and are capable of accommodating all runoff from all rainfall events up to and including the 1 in 100 year plus 30% climate change occurrence. A copy of all relevant Micro-Drainage computations is presented as **Appendix D**.

Site Control (Porous Car-Parks/Pervious surfaces)

- 5.20 Porous car parks with pervious surfaces are structures that allow rainwater to infiltrate through the surface layer and into the underlying sub-structure where water will be temporarily stored before being discharged into the drainage network at controlled rates. As runoff percolates through the sub-layers, pollutants and contaminants are filtered out by the surfacing layer and biological process in the sub-base.

5.21 CIRIA C697 promotes the use of these structures and lists amongst their advantages:

- Effective in removing urban runoff pollutants
- Significant reductions in volumes and rates of surface water runoff
- Suitable for installation within high density developments
- Low maintenance

5.22 Furthermore, CIRIA C697 advises that these structures enable high levels of pollutant removal of suspended solids, nutrients and heavy metals.

5.23 All parking areas within the proposed development will, where practical, be constructed using pervious surfaces. These structures which be designed with sufficient capacity to accommodate all runoff generated by the 100-year plus climate change rainfall event. Furthermore, runoff from the roofs of the properties surrounding these areas could drain into the porous car park construction, attenuating flows from the proposed development even further.

Site Control (Geocellular Storage)

5.24 Geocellular units are modular plastic systems with a high void ratio (typically, above 0.95) that can be used to create a below-ground storage structure.

5.25 CIRIA C697 promotes the use of these structures and list amongst their advantages:

- Modular and flexible
- High void ratio, providing high storage volume capacity
- Can be installed beneath private roads and parking areas
- Can be installed beneath public open spaces, e.g. amenity space

5.26 Geocellular storage devices can be located under private parking areas, utilizing their high storage volume capacity to provide additional volume for flow attenuation.

5.27 Geocellular / modular systems have no water quality treatment potential and are therefore not proposed to accept runoff directly from any vehicular hardstanding areas or road. These devices will only accept clean runoff from roof areas and treated outflows from the permeable pavements.

Site Control (Detention Basin)

5.28 Detention basins are vegetated depressions designed to store runoff and release it gradually to the local sewer or watercourse at a controlled rate. The design of the detention basin should incorporate sediment traps prior to runoff entering the basin.

- 5.29 The detention basins will be located within an areas of open space maintained by Havant Borough Council.
- 5.30 The basin will be designed to attenuate the 1 in 100 year + 30% climate change event, whilst restricting the runoff to the undeveloped Greenfield runoff rate (QBAR).
- 5.31 The Source Control module of the Micro Drainage software has been used for preliminary computations. A copy of all relevant Micro-Drainage computations is presented as **Appendix D**.

6 PROPOSED WASTEWATER DRAINAGE

- 6.1 Southern Water has undertaken a level 2 design capacity assessment for the proposed development. The level 2 capacity check identified a preferred solution for servicing the proposed development with a connection to the nearest point of sufficient capacity to cope with increased flows. Southern Water has confirmed that this process took into consideration concerns over existing flooding issues. A copy of Southern Water's report is presented as **Appendix E**.
- 6.2 Southern Water has identified that there is sufficient capacity in foul sewer in Scratchface Lane to serve the proposed development. This avoids a connection to the sewer in Brooklands Road, which has capacity problems and is known to cause flooding to properties in Brooklands Road and Maylands Road.
- 6.3 In order to achieve a connection to the sewer identified in Southern Water's report, it will be necessary to incorporate an adoptable pumping station into the design of the proposed wastewater system. The wastewater drainage strategy is presented as **Figure 7**.
- 6.4 A foul sewer will be required to connect the southern part of the proposed development to the northern part. This will require a pipe to be installed under Brookside Road stream which will require written consent from the Environment Agency under S109 of the Water Resources Act 1991.

7 FLOOD RISK ASSESSMENT

- 7.1 This section of the Report presents the potential effects of the sources of flooding identified within Section 4.

Fluvial Flood Risk (Flood Zones)

- 7.2 The Flood Map indicates that the Site is not located within Flood Zones 2 or 3. Therefore, the risk of flooding from fluvial sources is low.

Watercourses

Brookside Road Stream

- 7.3 There is no evidence of flooding of the designated main river within the Site boundary. The local planning authority has advised that the downstream culvert has been a cause of flooding to properties in Brooklands Road and Brookside Road. Improvements have been made to the culvert in attempts to alleviate the flooding.
- 7.4 The Environment Agency (EA) has confirmed that it has carried out improvements to the inlet structure and grille at Brooklands Road, and that there have been no reported incidents of flooding due to blockage of the grille since the improvements. The grille is routinely maintained and the EA's only reported concern is with the current access arrangement through the rear garden of 34 Brooklands Road. The EA has acknowledged that development proposals will improve access to the grille.
- 7.5 Flows to Brookside Road Stream from the proposed development will be restricted to the undeveloped greenfield runoff rates. Therefore, flows to the receiving watercourse are not expected to rise as a result of the proposed development.

Scratchface Lane Ditch

- 7.6 There is no known evidence of flooding to the Site as a result of flows exceeding the capacity of the channel. Anecdotal concerns of flooding relate to blockage of the inlet grille at Scratchface Lane.
- 7.7 Site inspection of the grille indicates that the design appears adequate and that the grille was noted clear of obstruction. Grilles are inherently prone to blocking and require regular maintenance. Investigations into ownership of the adjoining ditch and inlet structure should be undertaken and if ownership cannot be determined Future maintenance should be considered.
- 7.8 Flows to Scratchface Lane Ditch from the proposed development will be restricted to the undeveloped greenfield runoff. Therefore, flows to the receiving watercourse would not rise as a result of the development.

- 7.9 Development proposals should allow for a minimum 5 m buffer zone from the top of bank.

A3 (M) Toe Drains / Ditches

- 7.10 There is no known evidence of flooding to the Site from these ditches. The ditches appearance indicates that they convey low volumes of runoff at moderate gradients to Brookside Road Stream. Therefore, the risk of flooding from these ditches is considered low.

- 7.11 The development will not be making drainage connections to the highway ditches and flows within them are not expected to increase as a result of proposals.

- 7.12 Development proposals should allow for a minimum 5 m buffer zone from the top of bank.

Safe Access

- 7.13 The proposed access roads and pedestrian accesses are located within areas at low risk from flooding and therefore, safe access to the development will not be restricted.

Floodplain Storage

- 7.14 The Site is not located within Flood Zones 2 or 3. Therefore, floodplain storage will not be affected.

Flood Flows

- 7.15 The Site is not located within the Flood Zones 2 or 3. Therefore, flood flows will not be affected.

Overland Flows

- 7.16 The embankment to the A3 (M) forms a significant barrier to potential overland flows from higher lying ground to the west of the Site. The risk of flooding from overland flows entering the Site is considered low.

- 7.17 Floor levels will be elevated by at least 150 mm to comply with Building Regulations. This will provide a degree of confidence against minor overland flooding.

River Morphology

- 7.18 A 9 m buffer zone is required to the designated main river Brookside Road Stream. Development within the buffer zone will require consent from the Environment Agency.

- 7.19 Development proposals indicate a highway crossing of the main river. Consent will have to be obtained for this crossing. The Environment Agency would require clear span bridge crossing, designed with a minimum afflux of 50 mm in a 100 year flood event (including an allowance for climate change), and with a minimum freeboard of 600 mm above the 1 in 100 year flood event (including an allowance for climate change).
- 7.20 Written consent would have to be obtained from the Environment Agency under Section 109 of the Water Resources Act 1991 for this structure and for any works in, under, over, or within, 8 m of the top of the bank of Brookside Road Stream.
- 7.21 Any discharges to the Brookside Road Stream would be attenuated and thus flows are unlikely to cause increased scour which could affect the river morphology.

Groundwater

- 7.22 The Site is underlain by London Clay and the ground investigation revealed only minor ground water seepage at depths exceeding 12 m. The proposed development is therefore considered unlikely to be at risk from groundwater flooding.
- 7.23 There is a small area of standing water in the north east corner of the Site. The Development Consultation Forum (January 2010) reported this as groundwater. Evidence from the ground investigation and topographical survey suggests that the assumption at the forum was incorrect. This feature would appear more likely attributable to runoff collecting in a man-made / natural depression. Development proposals will fill the depression and post development runoff will be collected in the new drainage system.

Sewers

- 7.24 Potential blockages within the proposed wastewater and surface water drainage system within the Site presents low risks of flooding.
- 7.25 Southern Water has undertaken a study to identify a solution to accommodate wastewater discharges from the proposed development. Their solution identifies a connection point with sufficient capacity in Scratchface Lane which will not exacerbate existing flooding problems in Brooklands Road and Maylands Road.

Surface Water Runoff

- 7.26 The proposed development will increase the impermeable areas. Therefore, there will be a corresponding increase in the amount of runoff from those surfaces.

- 7.27 Surface water runoff will be drained to storage facilities within the proposed development. The storage facilities will be designed to accommodate runoff from the 1 in 100-year rainfall event, including 30% increase to allow for the possible effects of climate change. Discharges to the local watercourse will be restricted to the undeveloped greenfield runoff. Therefore, the risk of flooding attributable to the proposed development is considered low.

8 SUMMARY & CONCLUSIONS

- 8.1 This Report presents an assessment of flood risk in accordance with the guidelines set out in 'Planning Policy Statement 25: Development and Flood Risk' (PPS25). The Report demonstrates that the proposed development will be subject to minimal risk of flooding only and that the proposals will not create an unacceptable flood risk elsewhere. Moreover, sustainable methods of surface water disposal and satisfactory wastewater drainage are confirmed.
- 8.2 The Report confirms that the Site is suitable for residential development and complies with the relevant policies of the Environment Agency and Havant Borough Council.

Flood Risk

- 8.3 The Site is located within an area at low risk of fluvial flooding, as indicated by Flood Zone 1 on the Flood Map.
- 8.4 The proposed development would not affect fluvial flood flows or floodplain storage. Consent will have to be obtained from the Environment Agency for any works within 9 m of Brookside Road Stream. 5 m buffer zones should also be provided to all minor watercourses and ditches adjoining the Site boundaries.
- 8.5 All anecdotal concerns of historical flooding in the vicinity of the Site, raised at the Development Consultation Forum, have been addressed.
- 8.6 Southern Water has provided a solution to accommodate wastewater discharges from the proposed development that will not exacerbate flooding problems in the foul water sewer in Brooklands Road and Maylands Road.

Safe Access

- 8.7 The proposed access road and pedestrian accesses are located within areas at low flood risk. Therefore, access to the development will not be restricted.

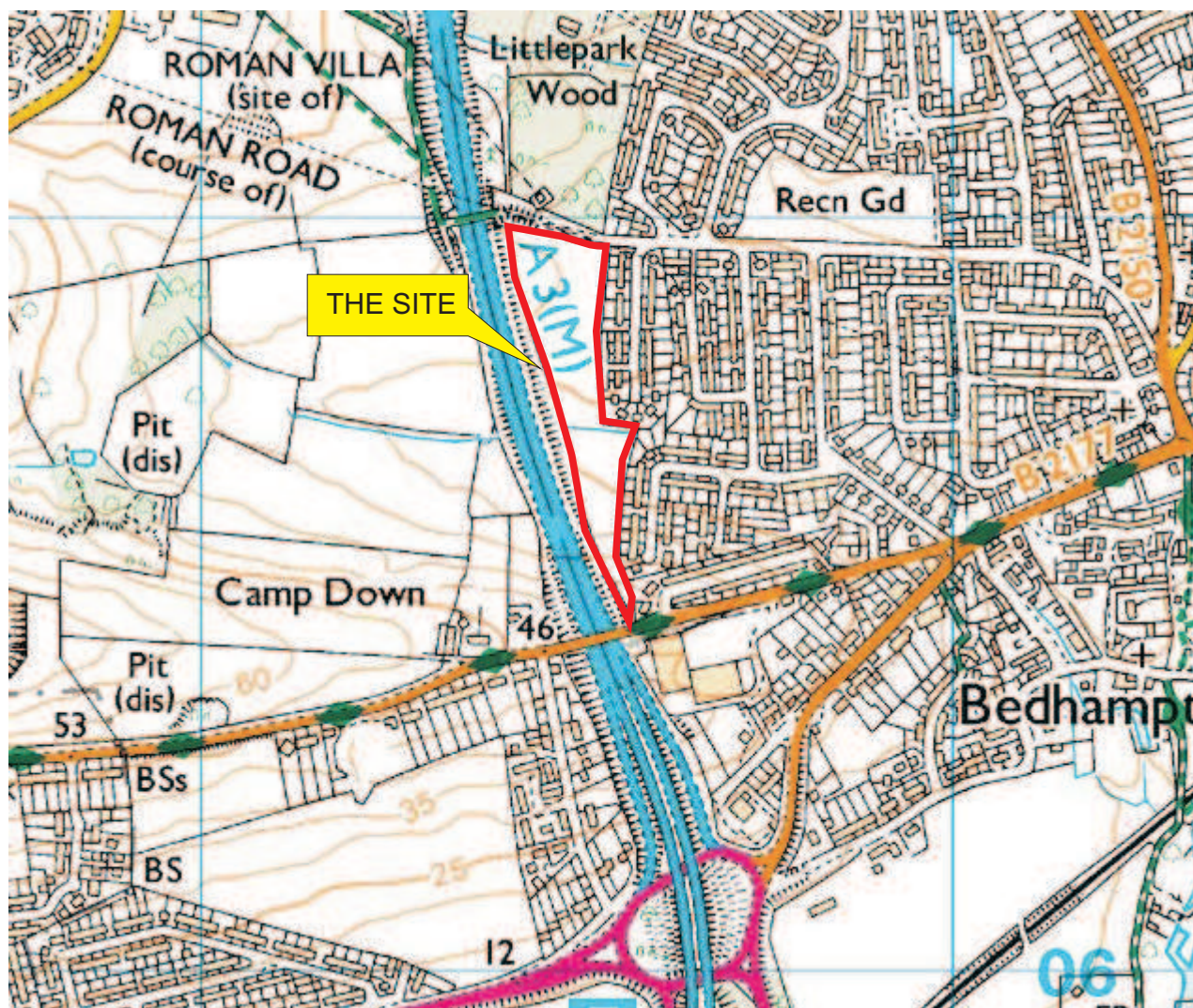
Disposal of Surface Water Runoff

- 8.8 The storage facilities will be designed to accommodate runoff from the roofs and paved areas resulting from the 1 in 100 year rainfall event and the potential 30% increase in rainfall as described in Table B.2 of PPS25.
- 8.9 Runoff from the proposed development will be restricted to the undeveloped greenfield rate (QBAR), and flows into the receiving watercourse are not expected to rise as a result of the development.

Wastewater

- 8.10 Disposal of wastewater from the proposed development will comprise an adoptable pumping station which will pump discharge to the existing public sewerage system located within Scratchface Lane.

Figure 1
Site Location Plan
(Ordnance Survey)



— *Approx. Site Boundary*



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ASSOCIATES**

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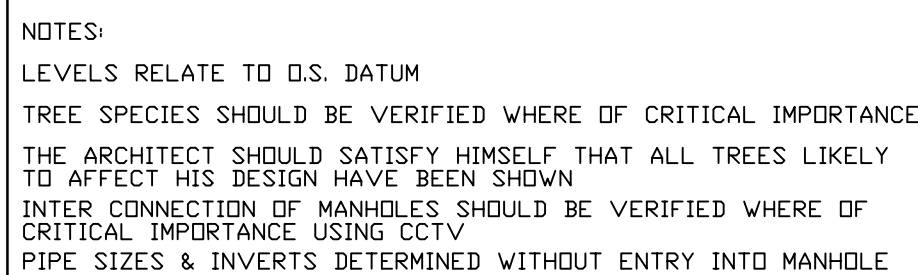
**Scratchface Lane,
Havant**

SITE LOCATION PLAN

Figure 1

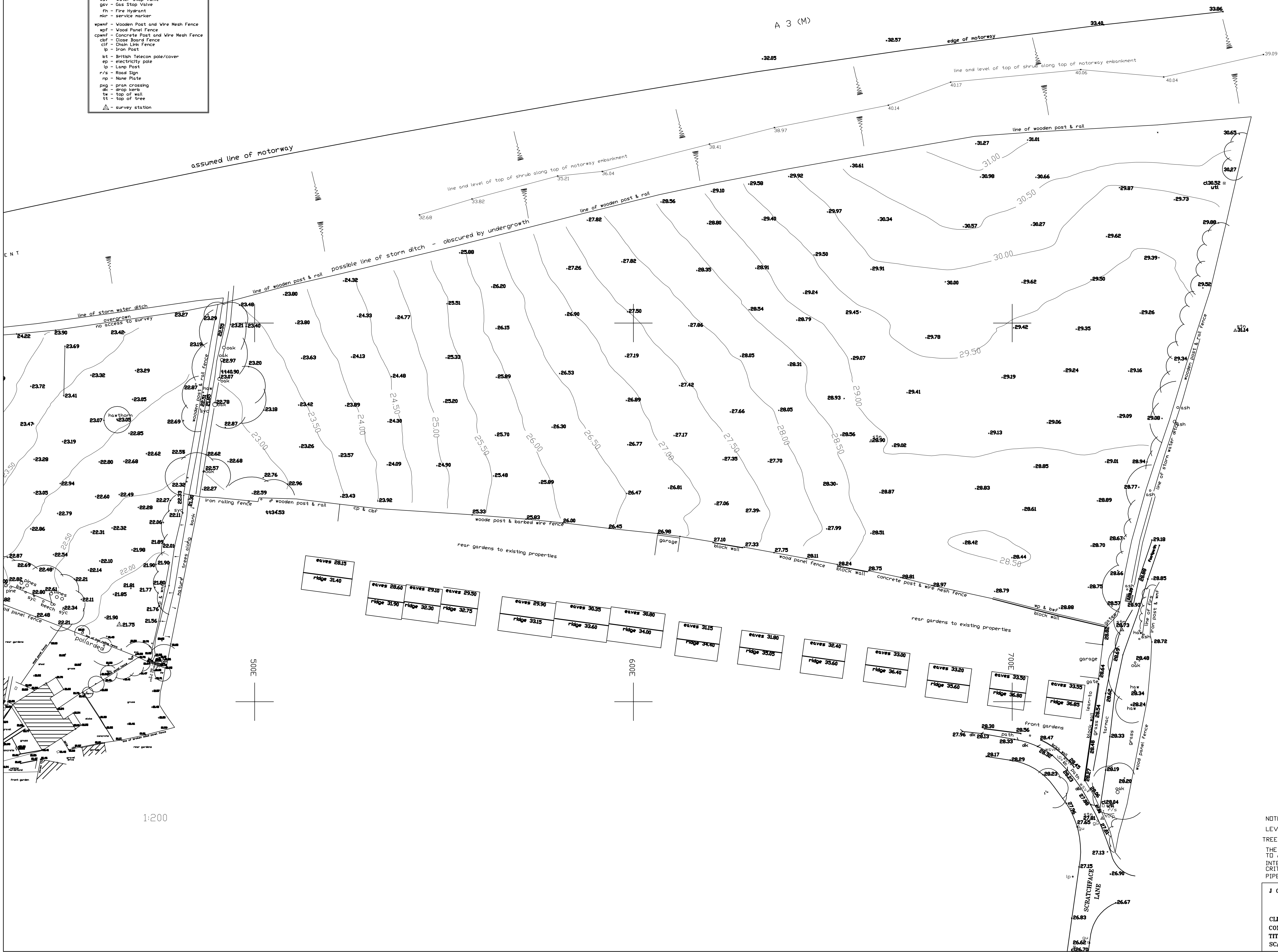
Figure 2

Topographical Survey
Site Engineering & Land Surveys Ltd



J C RADFORD	SITE ENGINEERING & LAND SURVEYS LTD 3-5 REDHILL BASSETT SOUTHAMPTON TEL (023) 8079 0217 MOBILE 07836 380795
CLIENT:	CRAYFERN HOMES
CONTRACT:	LAND OFF BROOKLANDS ROAD, BEDHAMPTON
TITLE:	EXISTING SURVEY
SCALE: 1:500	SURVEYED: JCR DRAWN: JCR DATE: FEB 00

- Key to terms used on survey:
- wsv - Water Stop Valve
 - gsv - Gas Stop Valve
 - fh - Fire Hydrant
 - slm - service marker
 - wpnf - Wooden Post and Wire Mesh Fence
 - wpf - Wood Panel Fence
 - cpwef - Concrete Post and Wire Mesh Fence
 - cbf - Close Board Fence
 - clf - Chain Link Fence
 - p - Iron Post
 - bt - British Telecom pole/cable
 - ep - electricity pole
 - lp - Lamp Post
 - r/s - Road Sign
 - no - None Plate
 - pac - pram crossing
 - dk - drop kerb
 - tw - top of wall
 - tt - top of tree
 - △ - survey station

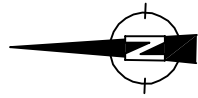


NOTES:
LEVELS RELATE TO D.S. DATUM
TREE SPECIES SHOULD BE VERIFIED WHERE OF CRITICAL IMPORTANCE
THE ARCHITECT SHOULD SATISFY HIMSELF THAT ALL TREES LIKELY TO AFFECT HIS DESIGN HAVE BEEN SHOWN
INTER CONNECTION OF MANHOLES SHOULD BE VERIFIED WHERE OF CRITICAL IMPORTANCE USING CCTV
PIPE SIZES & INVERTS DETERMINED WITHOUT ENTRY INTO MANHOLE

J C RADFORD SITE ENGINEERING & LAND SURVEYS LTD
3-5 REDHILL BASSETT SOUTHAMPTON
TEL (023) 8079 0217 MOBILE 07836 380795

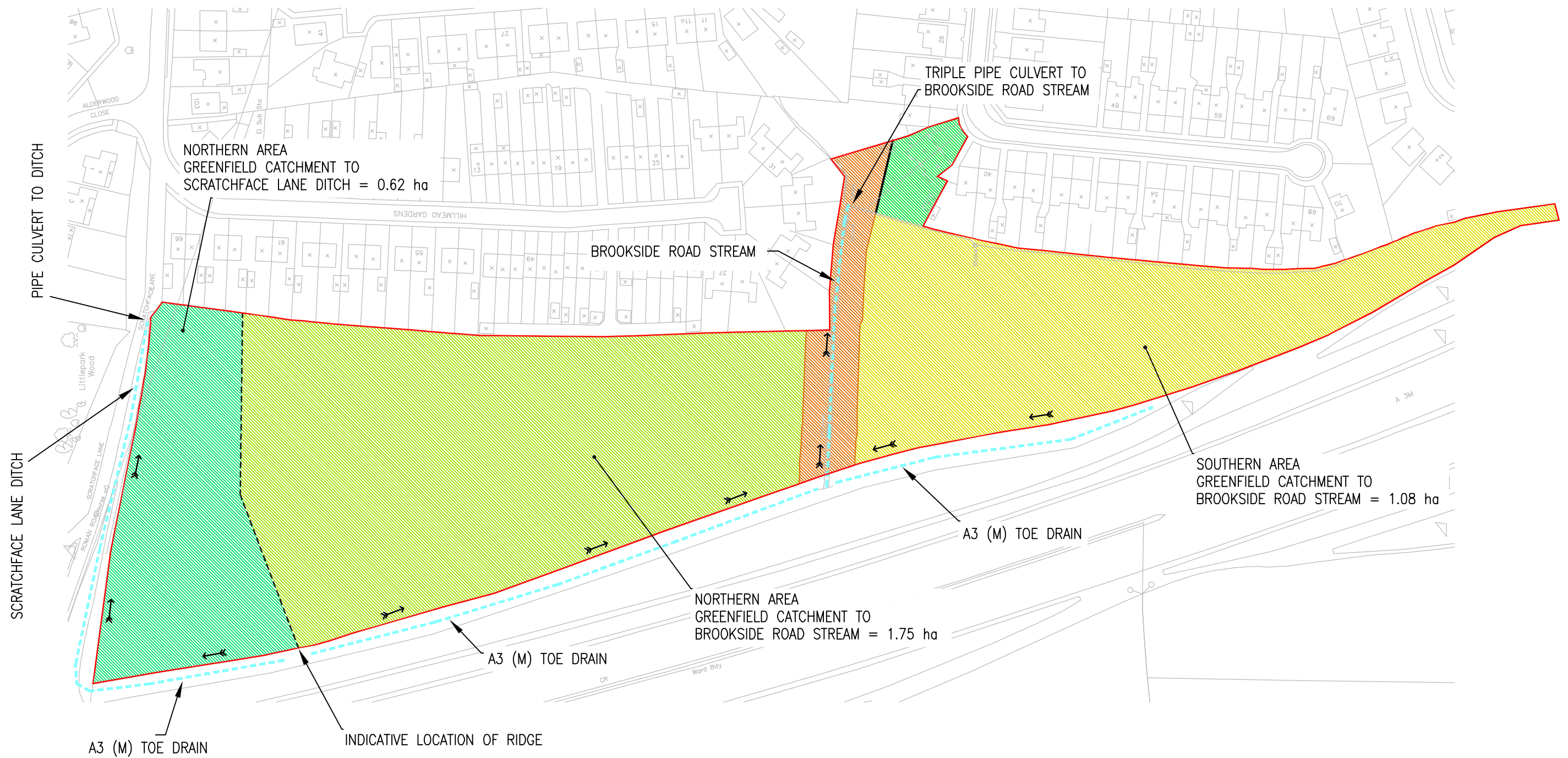
CLIENT: CRAYFERN HOMES
CONTRACT: LAND OFF SCRATCHFACE LANE, BEDHAMPTON
TITLE: EXISTING SURVEY
SCALE: 1:500 SURVEYED: JCR DRAWN: JCR DATE: SEPT 02

Figure 3
Site Ditches and Watercourses
Drawing Number 3356.401



NOTES:

1. DO NOT SCALE.
2. REPRODUCED FROM ORDNANCE SURVEY MAPPING WITH PERMISSION OF THE CONTROLLER OF THE HMSO UNDER LICENCE AL 545015 © CROWN COPYRIGHT.



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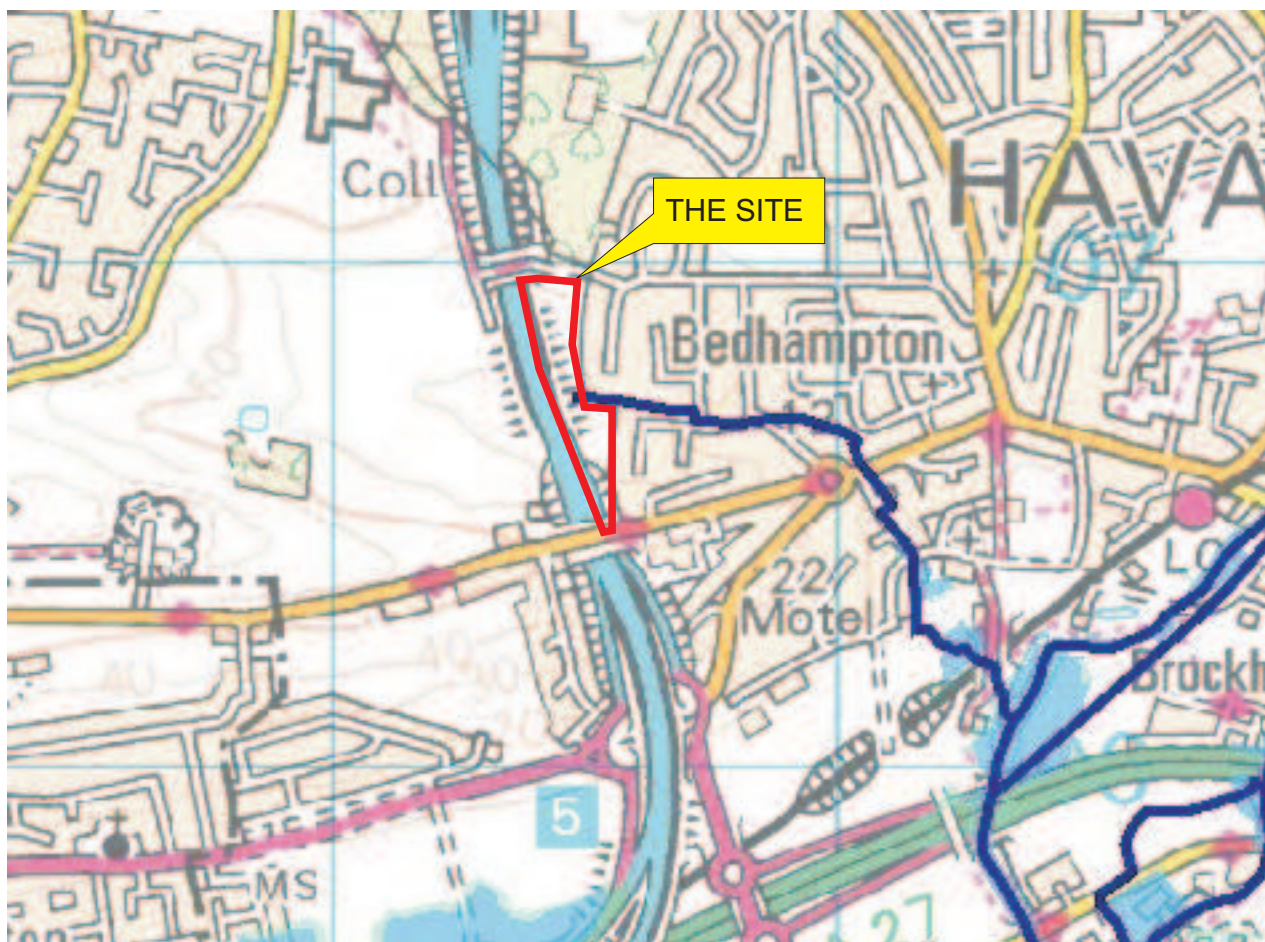
JOB TITLE

SCRATCHFACE LANE, HAVANT

DRAWING TITLE

BROOKSIDE ROAD STREAM
EXISTING DITCHES AND WATERCOURSES

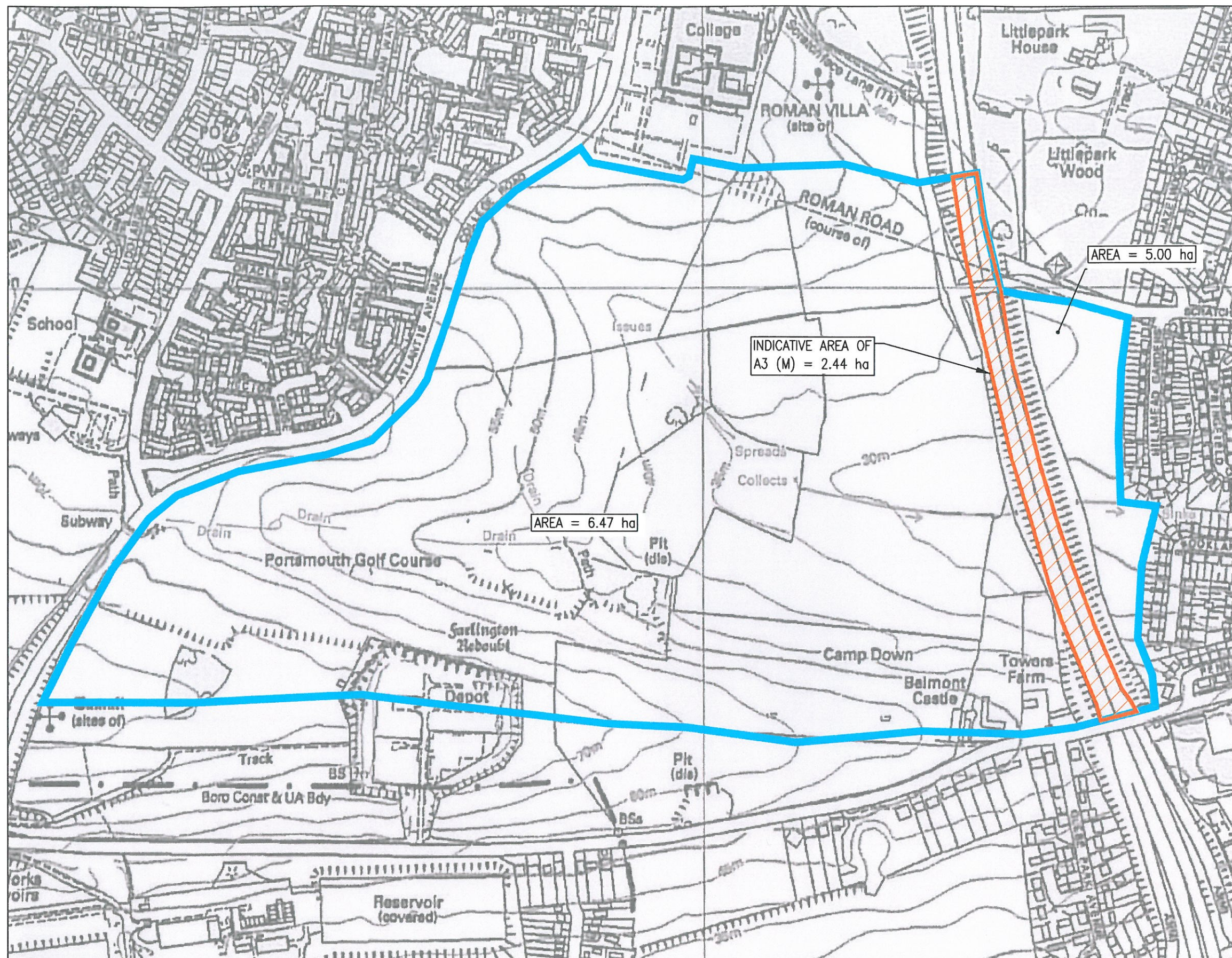
Rev	Description		Drn	Chk	Date
REVISIONS					
Preliminary		Approval		Tender	
			Const.		
DRAWING STATUS					
DATE		DRAWN		CHECKED	ISSUE CHECKBOX
FEB 2010		SH		JM	
DRAWING No.		REV	SCALE		
3356.401			1:1500		@ A3
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KEY

- Flood Zone 3
- Flood Zone 2
- Main River

Figure 5
Brookside Stream Catchment
Drawing Number 3356.402



NOTES:

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JOB TITLE

SCRATCHFACE LANE, HAVANT

DRAWING TITLE

BROOKSIDE ROAD STREAM
INDICATIVE UPSTREAM CATCHMENT

Rev	Description	Drn	Chk	Date
REVISIONS				
Preliminary	Approval	Tender	Const.	
DRAWING STATUS				
DATE	DRAWN	CHECKED	ISSUE CHECKBOX	
FEB 2010	SH	JM		
DRAWING No.	REV	SCALE		
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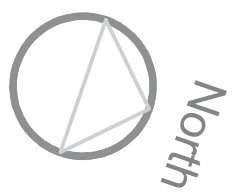


Key

House/Flat Symbol		Schedule	
Open Market		4 x 1 Bed Flat	(51 sq m GIA)
		5 x 2 Bed Flat	(66 sq m GIA)
		15 x 2 Bed	(69.2 sq m GIA)
		23 x 3 Bed	(80-94.4 sq m GIA)
		9 x 4 Bed	(116 sq m GIA)
		Sub Total: 56 Units	
Affordable		11 x 2 Bed	(67 sq m GIA)
		21 x 3 Bed	(82-94.4 sq m GIA)
		4 x 3 Bed	(108 sq m GIA)
		Sub Total: 36 Units	
		Total: 92 Units	



Scale



Preliminary

CLIENT:
Crayfern Homes

PROJECT:
Land off Scratchface Lane,
Bedhampton

DRAWING:
Proposed Site Layout Plan
(LPA Feedback Included).

SCALE: 1:750 @ A1 DWG NO: 9982/SK 14

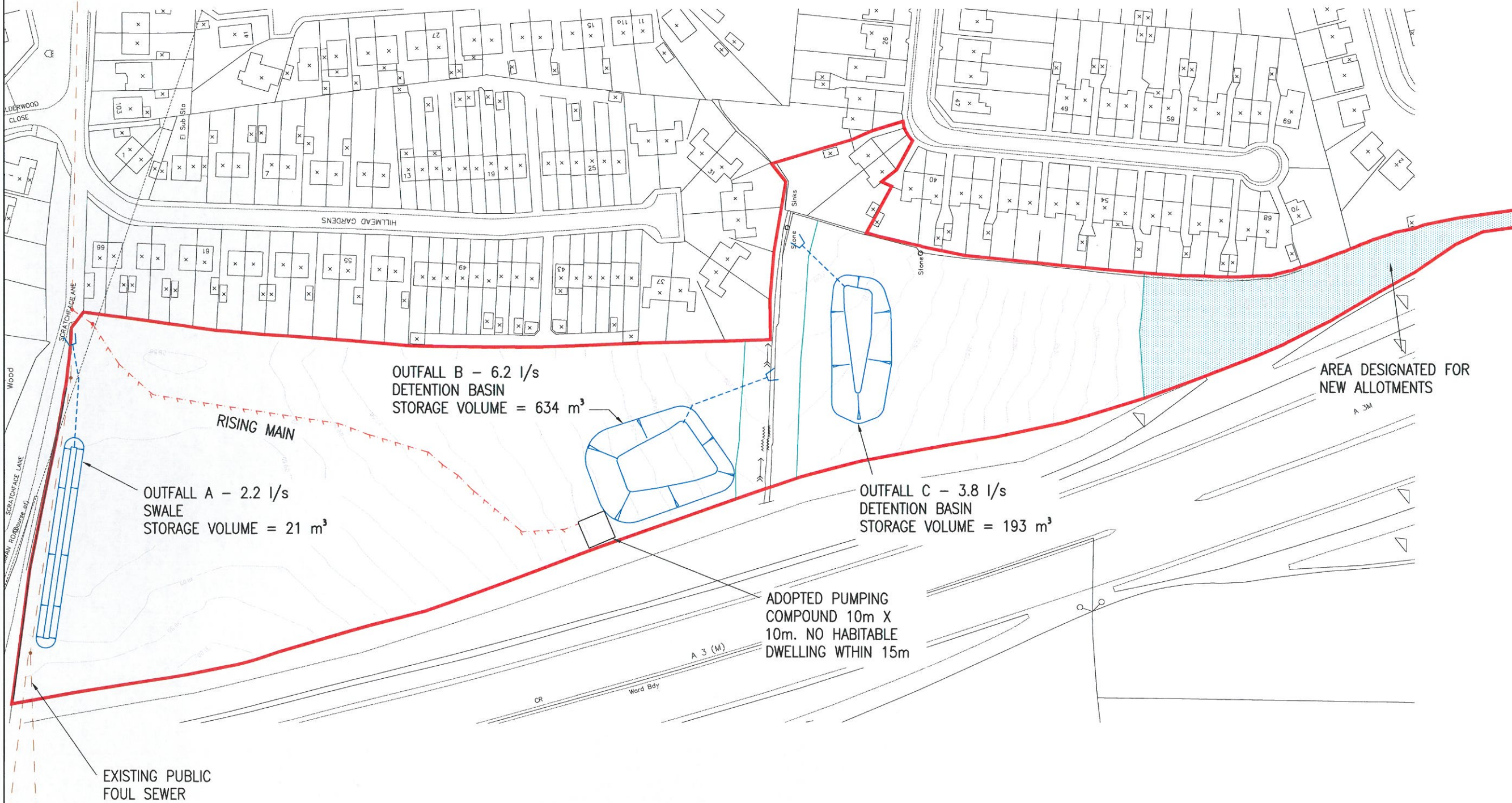
DATE: July 10 REV: #



Grosvenor Court, Winchester Road, Ampfield, Winchester, Hants, SO51 9BD
Tel: 01794 368 616 Fax: 01794 368 637
Ancient House, Cornmarket, Winchester, Dorset, BH21 1JL
Tel: 01202 840405 Fax: 01202 840406
The High House, 37 Oxford Street, Newbury, Berkshire, RG14 1JG
Tel: 01635 40184 Fax: 01635 41459

Figure 7

Drainage Strategies Plan
Drawing Number 3356.403



- | Rev | Description | Dwn | Chk | D |
|-----------------------|-------------|-------------------------|-----|---|
| REVISIONS | | | | |
| Preliminary Issue | | Submitted for S104 | | |
| Planning Issue | | Issued for Tender | | |
| Submitted for S38 | | Issued for Construction | | |
| Submitted for S278 | | As Built | | |
| DRAWING STATUS | | | | |

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DRAINAGE STRATEGY

DATE	FEB 2010	DRAWN	SH	CHECKED	JM	ISSUE CHECKED BY	
DRAWING NO.	3356.403	REV		SCALE	1:750		© A1

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Via Email only: David@crayfernhomes.co.uk

31st March 2010

Our Ref.: J11642

Dear David,

RE: Soakaway Testing and Boreholes – Land off Scratchface Lane, Bedhampton

We are writing with regard to the recent boreholes and soakaway tests undertaken at the above named site.

Site works were undertaken on the 15 - 17th March 2010 and comprised:

- The excavation of 6 trial holes using a JCB backhoe excavator to a maximum depth of 3.30m bgl with infiltration testing being carried out within each;
- The drilling of 3 shell and auger boreholes to a maximum depth of 20.00m bgl with groundwater monitoring wells installed to the base of each.

The location of the trial holes were determined by Stuart Michael Associates Ltd prior to attendance on site by Soils Limited.

The final location of the trial holes can be seen in Figure 1.

The trial holes showed highly variable geology across the site, with the southernmost trial holes (BH1 and TP7) showing chalk from surface (minor superficial deposits were noted). The remaining trial holes (BH2 – BH3 and TP1 – TP6) showed slightly gravelly clays and silty red laminated clays.

Full and complete logs, detailing ground conditions and testing results are given with Appendix A.

Infiltration tests were undertaken within TP1 – TP6 following the principles of BRE365. BRE 365 states that for an accurate infiltration rate to be obtained a soakage pit needs to be filled three times in quick succession. Each test can only be ended once 75% of the water present has drained away. Infiltration tests were not repeated three times due to time and water supply restrictions.

The results of the infiltration test can be seen in the table overleaf.

Summary of Calculated Infiltration Rates.		
Soakaway Test Location	Soakaway Base Level (m)	Soakage Rate (m/sec)
TP1	3.10	No Infiltration
TP2	3.00	No Infiltration
TP3	3.30	No Infiltration
TP4	2.70	No Infiltration
TP5	3.00	No Infiltration
TP6	3.00	No Infiltration
TP7	2.10	1.79×10^{-4}
		9.79×10^{-5}

The values indicated in bold should be used as the infiltration rate at each location.

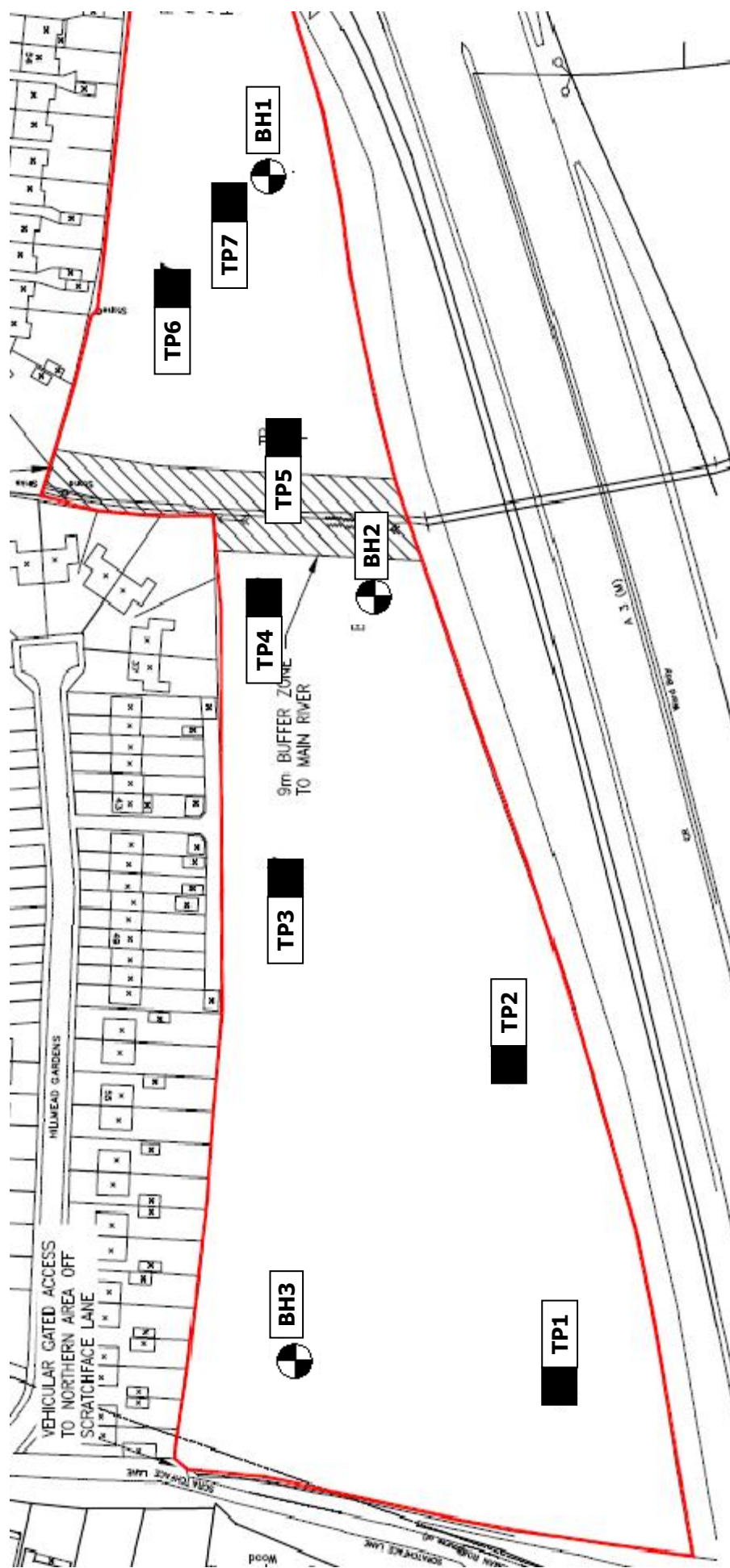
If you have any queries regarding the information enclosed then please do not hesitate to contact the undersigned.

Yours sincerely



Rob Ainsworth
Geo-Environmental Engineer
For and on behalf of Soils Limited

Enc: Figure 1: Trial Hole Location Plan
Appendix A: Trial Hole Logs



Project: Land off Scratchface Lane, Bedhampton

Client: Crayfern Homes

Date: March 2010

Title: Approximate Trial Hole Location Plan

Ref: J11642

soils
L I M I T E D
*Geotechnical & Environmental
Consultants*

Appendix A Trial Hole Logs



Trial Pit: TP 1

Site: Scratchface Lane, Behampton	Start Date: 15/03/2010	Ground Level: -
Client: Crayfern Homes	End Date: 15/03/2010	Easting: -
Project No: 11642	Logged By: RA	Northing: -
Site National Grid Reference:	Excavation Method:	
Site Level (mOD): 0.000	Plant:	
	Shoring/Support: None	
	Trial Pit Length: -	Trial Pit Width: -

Samples & Tests				Strata Details			
Depth	Type	Result	Hand Pen.	Elev.	Legend	DepthThick	Description
0.50 -	D					0.30	TOPSOIL Turf underlain by brown slightly gravelly clayey sand
						0.50	Orange brown soft silty slightly gravelly CLAY (weathered)
1.00 -	D		125.0			0.80	Orange brown and grey mottled very slightly silty CLAY
2.20 -	D					1.30	
						2.10	Pale grey stiff to very stiff CLAY with fine band of well rounded pebbles at top fraction
2.80 -	D					2.50	Orange brown fine silty SAND
			300.0			0.60	
						3.10	End of Trial Pit at 3.10 m

General Notes:

- All linear dimensions are in metres unless otherwise stated
- All relative density/shear strength descriptions are based only on field observations and available in-situ test data.
- Trial pit logged from the ground surface below 1.2 m depth.

Groundwater Observations: Standing at 1.9m after 1 hour	Stability: Stable	General Remarks: Roots observed to 1.9m
--	----------------------	--



Trial Pit: TP 2

Site: Scratchface Lane, Behampton	Start Date: 15/03/2010	Ground Level: -
Client: Crayfern Homes	End Date: 15/03/2010	Easting: -
Project No: 11642	Logged By: RA	Northing: -
Site National Grid Reference:	Excavation Method:	
Site Level (mOD): 0.000	Plant:	
	Shoring/Support: None	
	Trial Pit Length: -	Trial Pit Width: -

Samples & Tests				Strata Details			
Depth	Type	Result	Hand Pen.	Elev.	Legend	DepthThick	Description
0.50 -	D					0.20	TOPSOIL Dark brown very slightly gravelly clayey sand
						0.40	
1.00 -	D		300.0			0.60	Orange brown slightly silty gravelly CLAY. Gravel is sub-angular to sub-rounded fine to coarse chalk fragments
							Pale grey slightly orange mottled stiff CLAY
						2.10	
						2.70	
						0.30	CLAYSTONE / Iron stone band
						3.00	End of Trial Pit at 3.00 m

General Notes:

1. All linear dimensions are in metres unless otherwise stated
2. All relative density/shear strength descriptions are based only on field observations and available in-situ test data.
3. Trial pit logged from the ground surface below 1.2 m depth.

Groundwater Observations: Slight water seepage at 2.2m, 2.7, and standing at 2.95m after 1Hour	Stability: Stable	General Remarks: No roots observed
---	----------------------	---------------------------------------



Trial Pit: TP 3

Site: Scratchface Lane, Behampton	Start Date: 15/03/2010	Ground Level: -
Client: Crayfern Homes	End Date: 15/03/2010	Easting: -
Project No: 11642	Logged By: RA	Northing: -
Site National Grid Reference:	Excavation Method:	
Site Level (mOD): 0.000	Plant:	
	Shoring/Support: None	
	Trial Pit Length: -	Trial Pit Width: -

Samples & Tests				Strata Details			
Depth	Type	Result	Hand Pen.	Elev.	Legend	Depth	Description
0.50 -	D					0.20	TOPSOIL Dark brown very slightly gravelly clayey sand
1.00 -	D					0.60	Orange brown silty gravelly CLAY . Gravel is sub-angular to sub-rounded fine to coarse chalk fragments
			125.0			0.80	Pale grey and orange mottled slightly sandy silty CLAY
2.20 -	D		300.0			1.30	
						2.10	Pale grey and occasional orange mottled becoming grey brown blocky CLAY
						1.20	
						3.30	End of Trial Pit at 3.30 m

General Notes:

- All linear dimensions are in metres unless otherwise stated
- All relative density/shear strength descriptions are based only on field observations and available in-situ test data.
- Trial pit logged from the ground surface below 1.2 m depth.

Groundwater Observations: Seepage at 2.0m	Stability: Stable	General Remarks: No roots observed
--	----------------------	---------------------------------------



Trial Pit: TP 4

Site: Scratchface Lane, Behampton	Start Date: 15/03/2010	Ground Level: -
Client: Crayferm Homes	End Date: 15/03/2010	Easting: -
Project No: 11642	Logged By: RA	Northing: -
Site National Grid Reference:	Excavation Method:	
Site Level (mOD): 0.000	Plant:	
	Shoring/Support: None	
	Trial Pit Length: -	Trial Pit Width: -

Samples & Tests				Strata Details			
Depth	Type	Result	Hand Pen.	Elev.	Legend	DepthThick	Description
0.50 -	D					0.20	TOPSOIL Dark brown very slightly gravelly clayey sand
						1.10	Orange brown and grey mottled very slightly silty CLAY
2.00 -	D					1.30	Orange brown slightly sandy gravelly CLAY. Gravel is sub-angular to sub-rounded fine to coarse flint
						2.10	Red and grey laminated firm to stiff CLAY with partings of fine sand
						2.70	End of Trial Pit at 2.70 m

General Notes:

1. All linear dimensions are in metres unless otherwise stated
2. All relative density/shear strength descriptions are based only on field observations and available in-situ test data.
3. Trial pit logged from the ground surface below 1.2 m depth.

Groundwater Observations: Dry	Stability: Stable	General Remarks: Roots observed to 2.6m
----------------------------------	----------------------	--



Trial Pit: TP 5

Site: Scratchface Lane, Behampton	Start Date: 15/03/2010	Ground Level: -
Client: Crayfern Homes	End Date: 15/03/2010	Easting: -
Project No: 11642	Logged By: RA	Northing: -
Site National Grid Reference:	Excavation Method:	
Site Level (mOD): 0.000	Plant:	
	Shoring/Support: None	
	Trial Pit Length: -	Trial Pit Width: -

Samples & Tests				Strata Details			
Depth	Type	Result	Hand Pen.	Elev.	Legend	DepthThick	Description
0.50 -	D					0.20	TOPSOIL Dark brown very slightly gravelly clayey sand
1.00 -	D					0.70	Brown slightly sandy slightly gravelly silty CLAY. Gravel is sub-angular fine to medium flint and chalk with occasional rootlets
1.80 -	D		500.0			0.80	Orange brown sandy gravelly CLAY. Gravel is sub-angular to sub-rounded fine to coarse flint and chalk with rootlets
						1.70	Grey, pale grey brown and orange brown mottled red brown silty CLAY with occasional claystone and carbonised roots
						1.30	
						3.00	End of Trial Pit at 3.00 m

General Notes:

1. All linear dimensions are in metres unless otherwise stated
2. All relative density/shear strength descriptions are based only on field observations and available in-situ test data.
3. Trial pit logged from the ground surface below 1.2 m depth.

Groundwater Observations: Dry	Stability: Stable	General Remarks: Roots observed to 1.7m
----------------------------------	----------------------	--



Trial Pit: TP 6

Site: Scratchface Lane, Behampton	Start Date: 15/03/2010	Ground Level: -
Client: Crayfern Homes	End Date: 15/03/2010	Easting: -
Project No: 11642	Logged By: RA	Northing: -
Site National Grid Reference:	Excavation Method:	
Site Level (mOD): 0.000	Plant:	
	Shoring/Support: None	
	Trial Pit Length: -	Trial Pit Width: -

Samples & Tests				Strata Details			
Depth	Type	Result	Hand Pen.	Elev.	Legend	DepthThick	Description
0.40 -	D					0.20	TOPSOIL Dark brown very slightly gravelly, clayey sand
0.80 -	D		150.0			0.30	
						0.50	Brown slightly sandy slightly gravel silty CLAY. Gravel sub-angular fine to medium flint and chalk
						0.70	
						1.20	Orange brown sandy gravelly CLAY. Gravel is sub-angular to sub-rounded fine to coarse flint and chalk
1.80 -	D		300.0			1.80	Grey pale grey brown and orange brown mottled red brown silty CLAY with occasional claystone and rare decayed rootlets
						3.00	End of Trial Pit at 3.00 m

General Notes:

- All linear dimensions are in metres unless otherwise stated
- All relative density/shear strength descriptions are based only on field observations and available in-situ test data.
- Trial pit logged from the ground surface below 1.2 m depth.

Groundwater Observations: Seepage at 3.0m	Stability: Stable	General Remarks: Roots observed to 1.2m
--	----------------------	--



Trial Pit: TP 7

Site: Scratchface Lane, Behampton	Start Date: 15/03/2010	Ground Level: -
Client: Crayferm Homes	End Date: 15/03/2010	Easting: -
Project No: 11642	Logged By: RA	Northing: -
Site National Grid Reference:	Excavation Method:	
Site Level (mOD): 0.000	Plant:	
	Shoring/Support: None	
	Trial Pit Length: -	Trial Pit Width: -

Samples & Tests				Strata Details			
Depth	Type	Result	Hand Pen.	Elev.	Legend	DepthThick	Description
0.40 -	D					0.20	TOPSOIL Dark brown very slightly gravelly clayey sand
0.70 -	D					0.30	
						0.50	Brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to medium flint and chalk with rootlets
1.20 -	D					0.50	
						1.00	Weathered CHALK pale yellow brown to off white fine to medium chalk gravel in a comminated chalk matrix (Dm)
						1.10	Off white to white structureless CHALK recovered as sub-angular fine to medium weak chalk fragments and comminated chalk matrix (Dm)
						2.10	End of Trial Pit at 2.10 m

General Notes:

- All linear dimensions are in metres unless otherwise stated
- All relative density/shear strength descriptions are based only on field observations and available in-situ test data.
- Trial pit logged from the ground surface below 1.2 m depth.

Groundwater Observations: Dry	Stability: Stable	General Remarks: No roots observed
----------------------------------	----------------------	---------------------------------------

Soils Limited
Newton House
Cross Road
Tadworth
Surrey KT20 5SR
Tel: 01737 814221
Fax: 01737 812557



Record of Borehole BH 1

Sheet 1 of 2

Start Date: 15/03/2010
End Date: 15/03/2010
Logged By: RA

Ground Level: -
Easting: -
Northing: -

Site: Scratchface Lane, Behampton
Client: Crayfern Homes
Project No: 11642

Boring Method: CP
Weather:
Driller:

Samples, In-situ Tests & Installations						Strata	
Depth	Type	Result	S/Pipe	Elev	Legend	Depth/(Thk)	Description
0.40-0.60	B					0.10 0.10	TOPSOIL Turf underlain with dark brown clay
0.80-1.00	B					1.50	brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to medium flint and chalk
1.20-1.65	U						
1.65	D					1.60	
2.10	D	S N=35 (6,8,9,10,8,8)					Recovered as off white structureless CHALK with flint nodules. Chalk fragments medium density chalk fragment and comminuted chalk matrix (Dm)
3.00-3.40	U						
3.40	D						
4.00	D	S N=34 (10,10,10,8,8,8)					
5.00	U						
5.30	D						
5.50-5.70	B						
6.50	D	S N=18 (9,15,13,1,2,2)					
7.50	D						
8.00-8.25	U						
8.15	D						
9.00	D						
9.50	D	S N=43 (4,5,7,7,11,18)					
10.50	D					18.40	

Continued next sheet

Daily Progress					Water Strikes							Chiselling			Hole Diameter		Casing Diameter	
Date	Time	Hole	Depth	Water Depth	Strike Depth	Casing Depth	Date	Time	Post Depth	Elapsed Minutes	Depth Sealed	Start Depth	End Depth	Hours	Depth	Diam. (mm)	Depth	Diam. (mm)
																	12.40	150

General Remarks:
Water seep at 19.5m

Soils Limited
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Cross Road
Tadworth
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Tel: 01737 814221
Fax: 01737 812557



Record of Borehole BH 1

Sheet 2 of 2

Start Date: 15/03/2010
End Date: 15/03/2010
Logged By: RA

Ground Level: -
Easting: -
Northing: -

Site: Scratchface Lane, Behampton
Client: Crayfern Homes
Project No: 11642

Boring Method: CP
Weather:
Driller:

Samples, In-situ Tests & Installations						Strata	
Depth	Type	Result	S/Pipe	Elev	Legend	Depth/(Thk)	Description
11.00	D	S 48/145mm - Abandoned					Recovered as off white structureless CHALK with flint nodules. Chalk fragments medium density chalk fragment and comminated chalk matrix (Dm)
12.00	D						
12.50	D	S 265mm (15,10,16,13,11,10)					
13.50	D						
14.00	D	S 50/280mm (10,9,8,9,13,20)					
14.50-15.00	D						
15.50	D	S 52/105mm (18,7,27,25)					
16.50	D						
17.50	D						
18.50	D						
19.50	D						
						20.00	End of Borehole at 20.00 m

Daily Progress					Water Strikes					Chiselling				Hole Diameter		Casing Diameter	
Date	Time	Hole Depth	Water Depth	Strike Depth	Casing Depth	Date	Time	Post Depth	Elapsed Minutes	Depth Sealed	Start Depth	End Depth	Hours	Depth	Diam. (mm)	Depth	Diam. (mm)
																12.40	150

General Remarks:
Water seep at 19.5m

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Record of Borehole BH 2

Sheet 1 of 2

Start Date: 15/03/2010
End Date: 15/03/2010
Logged By: RA

Ground Level: -
Easting: -
Northing: -

Site: Scratchface Lane, Behampton
Client: Crayferm Homes
Project No: 11642

Boring Method: CP
Weather:
Driller:

Samples, In-situ Tests & Installations						Strata	
Depth	Type	Result	S/Pipe	Elev	Legend	Depth/(Thk)	Description
0.30-0.40	D					0.50	TOPSOIL Turf underlain with clay
0.80	D					0.50	Firm orange brown mottled silty CLAY
1.25-2.60	D					0.95	
1.60	D					1.45	Firm orange brown and grey mottled silty CLAY
2.00	D					1.05	
2.50	D	S N=16 (3,3,3,3,5,5)				2.50	Firm to stiff orange brown and grey silty CLAY with flint
3.50	D						
4.00-4.45	U					3.00	
4.45	D						
5.00	D						
5.50	D	S N=15 (1,3,3,3,4,5)				5.50	Firm to stiff red grey laminated silty CLAY with occasional parting of fine sand
6.50	D						
7.00-7.45	B						
7.50-7.90	U						
7.90	D						
8.50	D					6.00	
9.00	D	S N=40 (4,4,6,7,9,18)					
10.00	D						
10.50-10.95	U						

Continued next sheet

Daily Progress					Water Strikes							Chiselling			Hole Diameter		Casing Diameter	
Date	Time	Hole	Depth	Water Depth	Strike Depth	Casing Depth	Date	Time	Post Depth	Elapsed Minutes	Depth Sealed	Start Depth	End Depth	Hours	Depth	Diam. (mm)	Depth	Diam. (mm)

General Remarks:

Soils Limited
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Cross Road
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Record of Borehole BH 2

Sheet 2 of 2

Start Date: 15/03/2010
End Date: 15/03/2010
Logged By: RA

Ground Level: -
Easting: -
Northing: -

Site: Scratchface Lane, Behampton
Client: Crayfern Homes
Project No: 11642

Boring Method: CP
Weather:
Driller:

Samples, In-situ Tests & Installations						Strata	
Depth	Type	Result	S/Pipe	Elev	Legend	Depth/(Thk)	Description
11.50	D					11.50	Firm to stiff red grey laminated silty CLAY with occasional parting of fine sand
12.00	D	S N=45 (5,7,7,10,12,16)					Stiff grey orange brown sandy CLAY
13.00	D						
13.50-13.85	U					4.00	
13.85	D						
14.50	D						
15.00	D	Ø50/275mm (5,9,12,12,16,10)					
15.80	D					15.50	Stiff red grey silty CLAY
16.00	D						
16.50-16.95	U						
16.95	D						
17.50	D						
18.00	D					5.00	
18.95	D						
19.50	D						
20.50	D					20.50	End of Borehole at 20.50 m

Daily Progress					Water Strikes							Chiselling			Hole Diameter		Casing Diameter	
Date	Time	Hole	Depth	Water Depth	Strike Depth	Casing Depth	Date	Time	Post Depth	Elapsed Minutes	Depth Sealed	Start Depth	End Depth	Hours	Depth	Diam. (mm)	Depth	Diam. (mm)

General Remarks:

Soils Limited
Newton House
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Tadworth
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Record of Borehole BH 3

Sheet 1 of 2

Start Date: 15/03/2010
End Date: 15/03/2010
Logged By: RA

Ground Level: -
Easting: -
Northing: -

Site: Scratchface Lane, Behampton
Client: Crayfern Homes
Project No: 11642

Boring Method: CP
Weather:
Driller:

Samples, In-situ Tests & Installations					Strata	
Depth	Type	Result	S/Pipe	Elev	Legend	Description
0.40-0.60	B					TOPSOIL Turf underlain with dark brown clay
						Orange brown grey silty CLAY with occasional gravel
1.00	D					Orange SAND
1.20-1.60	U					
1.60	D					
2.00	D					Dense orange brown SAND
2.50	D	S N=21 (3,4,4,4,6,7)				
3.40-3.70	B					
4.00	D	S N=46 (4,6,7,14,13,12)				
5.50	D	S N=45 (6,7,9,10,13,13)				
6.00-6.40	B					
7.00	D	S N=35 (6,6,6,7,7,15)				
7.60	D					Dense grey brown SAND
8.00-8.45	D					
8.50-8.90	B					Soft to firm grey sandy CLAY
8.90-9.10	U					Firm to stiff grey silty CLAY with occasional shell fragments
9.50	D					
10.00	D	S N=29 (3,4,5,6,8,10)				Stiff grey silty CLAY

Continued next sheet

Daily Progress					Water Strikes							Chiselling			Hole Diameter		Casing Diameter	
Date	Time	Hole	Depth	Water Depth	Strike Depth	Casing Depth	Date	Time	Post Depth	Elapsed Minutes	Depth Sealed	Start Depth	End Depth	Hours	Depth	Diam. (mm)	Depth	Diam. (mm)
																	12.50	150

General Remarks:

Water seeping in at 12.7m

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Record of Borehole BH 3

Sheet 2 of 2

Start Date: 15/03/2010
End Date: 15/03/2010
Logged By: RA

Ground Level: -
Easting: -
Northing: -

Site: Scratchface Lane, Behampton
Client: Crayfern Homes
Project No: 11642

Boring Method: CP
Weather:
Driller:

Samples, In-situ Tests & Installations

Strata

Depth	Type	Result	S/Pipe	Elev	Legend	Depth/(Thk)	Description
11.00	D						Stiff grey silty CLAY
11.50-11.95	U						
11.95	D						
12.50	D					5.00	
13.00	D	S N=34 (3,4,6,7,9,12)					
14.00	D						
14.50-15.00	B					15.00	End of Borehole at 15.00 m

Daily Progress					Water Strikes					Chiselling				Hole Diameter		Casing Diameter	
Date	Time	Hole Depth	Water Depth	Strike Depth	Casing Depth	Date	Time	Post Depth	Elapsed Minutes	Depth Sealed	Start Depth	End Depth	Hours	Depth	Diam. (mm)	Depth	Diam. (mm)
																12.50	150

General Remarks:

Water seeping in at 12.7m

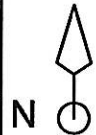
SEWER RECORDS PAGE 1 OF 2

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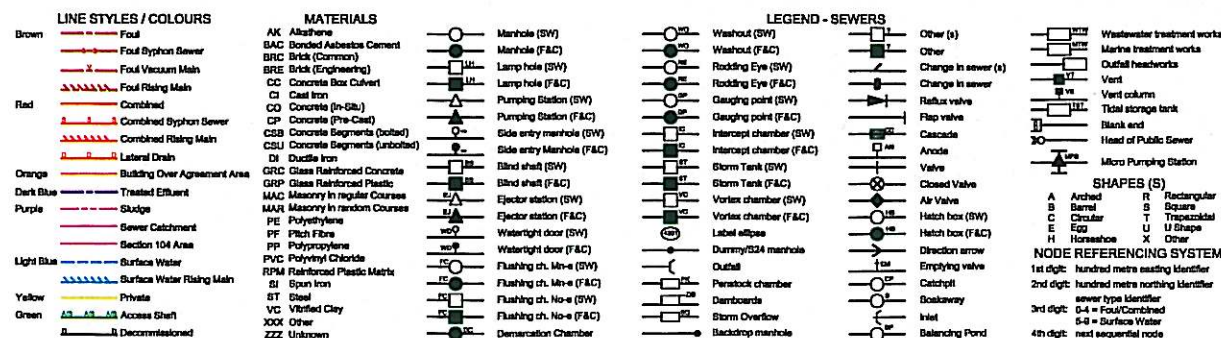
469123

O.S. REF. SU6906NE	Drawn by: Rahmans	The positions of pipes shown on this plan are believed to be correct, but Southern Water Services Ltd accept no responsibility in the event of inaccuracy. The actual positions should be determined on site. WARNING: BAC pipes are constructed of Bonded Asbestos Cement WARNING: Unknown (UNK) materials may include Bonded Asbestos Cement	 N	
	Scale: 1:2500			
Title: Brookland Road	Date: 07/01/2010	Based upon Ordnance Survey Digital Data with the permission of the controller of H.M.S.O. Crown Copyright Reserved Licence No. WU 298530.		

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SEWER RECORDS PAGE 2 OF 2

Node	Cover	Invert	Size	Material	Shape	Node	Cover	Invert	Size	Material	Shape	Node	Cover	Invert	Size	Material	Shape	Node	Cover	Invert	Size	Material	Shape
0350X	13.4	12.79	150	VC	CIRC	7650X	19.67	17.69	825	CP	CIRC												
0401X	14.37	12.91	175	VC	CIRC	7651X	18.46	15.4	825	CP	CIRC												
0501X	11.81	8.5	225	VC	CIRC	7701X	21.14	19.24	225	VC	CIRC												
0502X	14.04	11.65	225	VC	CIRC	7702X	20.24	18.21	225	VC	CIRC												
0503X	12	8.77	225	VC	CIRC	7750X	21.03	19.76	225	CP	CIRC												
0505X	10.13	8.05	225	VC	CIRC	7751X	20.6	19.19	225	CP	CIRC												
0505Y	10.13	8.29	175	CI	CIRC	7801X	23.03	21.23	225	VC	CIRC												
0506X	10.08	7.92	225	VC	CIRC	7902X	27.19	25.64	225	VC	CIRC												
0507X			UNK	UNK	CIRC	7903X	25.48	23	375	CP	CIRC												
0550X	14.11	11.68	225	CP	CIRC	7950X	25.17	23.48	300	CP	CIRC												
0551X	11.85	10.2	225	CP	CIRC	8401X	22.57	21.26	175	VC	CIRC												
0552X	12.32	10.17	900	CP	CIRC	8451X	22.42	21.66	225	CP	CIRC												
0560X	11.98	11.14	225	CP	CIRC	8452X	21.17	20.52	150	VC	CIRC												
0561X	12.09	10.58	225	CP	CIRC	8453X	21.69	20.83	225	CP	CIRC												
0601X	12.17	10.46	225	VC	CIRC	8501X	21.5	19.18	175	VC	CIRC												
0603X	12.74	11.07	225	VC	CIRC	8502X	19.73	18.11	175	VC	CIRC												
0701X	15.79	13.93	225	VC	CIRC	8503X	24.24	22.01	150	VC	CIRC												
0750X	15.65	13.75	300	CP	CIRC	8550X	24.25	22.42	225	VC	CIRC												
0751X	17.23	15.68	225	CP	CIRC	8551X	21.92	21.26	225	VC	CIRC												
0851X	18.88	16.99	225	CP	CIRC	8552X	20.82	19.06	225	VC	CIRC												
0902X	18.93	16.54	150	VC	CIRC	8601X	17.06	15.51	200	VC	CIRC												
0904X	19.17	16.33	375	CP	CIRC	8602X	16.47	15.41	225	VC	CIRC												
3401X	49.02	46.99	225	VC	CIRC	8650X	16.44	14.39	825	CP	CIRC												
3402X	49.19	47.18	225	VC	CIRC	8701X	16.78	15.11	225	VC	CIRC												
3403X	48.71	46.48	225	VC	CIRC	8750X	17.1	15.69	225	VC	CIRC												
4401X	46.45	44.8	225	VC	CIRC	8751X	18.38	17.07	225	VC	CIRC												
4401Y	46.45	44.86	150	VC	CIRC	8752X	18.82	17.49	225	VC	CIRC												
4401Y	48.03	45.39	225	VC	CIRC	8801X	22.75	21.23	150	VC	CIRC												
441	45.51	44.45	225	PVC	CIRC	8802X	20.07	18.41	200	VC	CIRC												
540...	40.04	37.79	175	VC	CIRC	8803X			UNK	UNK	CIRC												
5402X	40.4	39.37	175	VC	CIRC	880DX			UNK	UNK	CIRC												
5501X	32.21	30.97	150	VC	CIRC	881DX			UNK	UNK	CIRC												
5650X	25.64	24.08	150	VC	CIRC	882DX			150	VC	CIRC												
5750X	22.89		225	VC	CIRC	8850X	21.93	20.54	150	VC	CIRC												
5751X	22.23		225	VC	CIRC	8950X	23.45	20.93	300	CP	CIRC												
5850X	27.21		225	VC	CIRC	9402X	19.66	18.62	175	VC	CIRC												
5851X	24.48		225	VC	CIRC	9450X	19.78	18.91	225	CP	CIRC												
6401X	34.86	33.16	175	VC	CIRC	9451X	19.25	18.54	150	VC	CIRC												
6450X	30.84	29.34	225	VC	CIRC	9452X	17.84	17.11	225	VC	CIRC												
6501X	34.26	32.79	150	VC	CIRC	9501X	15.76	13.89	175	VC	CIRC												
6502X	28.61	26.58	150	VC	CIRC	9502X	16.41	14.85	150	PF	CIRC												
6550X	37.11	35.74	225	VC	CIRC	9550X	17.62	15.81	225	VC	CIRC												
6551X	34.33	33.15	225	VC	CIRC	9551X	14.18	11.02	900	CP	CIRC												
6601X	23.55	21.66	225	VC	CIRC	9552X	14.06	13.05	225	VC	CIRC												
6602X	22.25	19.84	225	VC	CIRC	9553X	14.38	12.65	225	VC	CIRC												
6603X	20.19	18.48	225	VC	CIRC	9601X	16.5	15.06	225	VC	CIRC												
6604X	25.95	24.04	225	VC	CIRC	9652X			UNK	UNK	CIRC												
6605X	21.72	19.98	150	VC	CIRC	9701X	16.03	14.41	225	VC	CIRC												
6651X	20.4	18.24	750	CP	CIRC	9702X	16.28	14.68	225	VC	CIRC												
6653X	23.33	21.89	150	VC	CIRC	9750X	16.3	14.25	225	VC	CIRC												
665DX			750	CP	CIRC	9751X	17.67	15.97	225	VC	CIRC												
6701X	21.43	20.45	150	VC	CIRC	9850X	19.19	17.95	225	VC	CIRC												
6702X			150	VC	CIRC	9901X	19.45	17.36	375	CP	CIRC												
6751X	21.57	20.11	225	VC	CIRC	9902X	19.49	16.86	375	CP	CIRC												
6752X	22.06	20.58	225	VC	CIRC	9903X	19.86	18.58	150	VC	CIRC												
6850X	24.83	23.8	225	VC	CIRC	9950X	19.33	17.4	300	CP	CIRC												
6950X	26.73		300	CP	CIRC																		
7501X	27.88	26.42	150	VC	CIRC																		
7502X	26.36	24.87	150	VC	CIRC																		
7503X	26	23.25	175	VC	CIRC																		
7504X	26.73	25.17	225	VC	CIRC																		
7505X	26.37	25.17	225	VC	CIRC																		
7552X	25.87	24.04	225	VC	CIRC																		
7601X	18.53	17.08	175	VC	CIRC																		
7602X	19.26	17.24	225	VC	CIRC																		



Drawn by: Rahmans

Title: Brookland Road

Date: 07/01/2010



GREENFIELD RUNOFF CALCULATION SHEET

Project:

Land at Scratchface Lane, Bedhampton

Outfall A - Northern Catchment to Stractchface Lane Ditch



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Designed By	Date	Checked By	Date	Project No.	Sheet No.	Rev
SH	23.02.10	SH	23.02.10	3356	1 of 9	-

Generated Rainfall (FSR Method)

Global Variables

Region	7
--------	---

M5-60	19.1
-------	------

Ratio r	0.35
---------	------

Rainfall Intensities

1-year

Peak Intensity (mm/hr)	9.37
------------------------	------

Average Intensity (mm/hr)	3.71
---------------------------	------

30-year

Peak Intensity (mm/hr)	20.60
------------------------	-------

Average Intensity (mm/hr)	8.14
---------------------------	------

100-year

Peak Intensity (mm/hr)	26.69
------------------------	-------

Average Intensity (mm/hr)	10.55
---------------------------	-------

100-year (+30% Climate Change)

Peak Intensity (mm/hr)	34.70
------------------------	-------

Average Intensity (mm/hr)	13.72
---------------------------	-------

Output

GREENFIELD RUNOFF CALCULATION SHEET

Project:

Land at Scratchface Lane, Bedhampton

Outfall A - Northern Catchment to Stractchface Lane Ditch



Designed By	Date	Checked By	Date	Project No.	Sheet No.	Rev
SH	23.02.10	SH	23.02.10	3356	2 of 9	-

Estimation of peak greenfield runoff rates

Greenfield runoff rates are calculated to determine the level of acceptable rate of discharge from the site to a receiving watercourse. The Environment Agency normally requires that, for a range of annual flow rate probabilities up to and including the 1% annual probability (1 in 100-year event), the developed rate of runoff into a watercourse should be no greater than the undeveloped rate of runoff for the same event.

The calculation of peak rates of runoff is related to catchment size. Table 4.2 CIRIA C697: The SUDS Manual, summarises the techniques to be used. For developments less than 50 hectares the Institute of Hydrology Report 124 (IOH124) Flood Estimation for Small Catchments (1994) is to be used to determine peak greenfield runoff rates.

Global Variables

AREA _{SITE} (Ha)	0.620	AREA _{IOH} (Ha)	50.000	SAAR (mm)	725	SOIL	0.4
---------------------------	-------	--------------------------	--------	-----------	-----	------	-----

Mean annual flood estimation, QBAR_{rural}

$$QBAR_{rural} = 0.00108 (AREA)^{0.89} (SAAR)^{1.17} (SOIL)^{2.17}$$

$$QBAR_{rural} = 0.1772 \text{ m}^3/\text{s}$$

Peak flood estimation, Q_x(yrs)

Hydrometric Region	Growth Factors								
	1	2	5	10	25	30	50	100	500
7	0.850	0.880	1.280	1.620	2.140	2.266	2.620	3.190	4.490
Q _x (m ³ /s)	0.0019	0.0019	0.0028	0.0036	0.0047	0.0050	0.0058	0.0070	0.0099
Q _x (l/s)	1.9	1.9	2.8	3.6	4.7	5.0	5.8	7.0	9.9

Allowable greenfield discharge rates, Q_x-year

Q _{1-year}	=	1.9	l/s
Q _{30-year}	=	5.0	l/s
Q _{100-year}	=	7.0	l/s

Minimum limits of discharge

A practicable minimum limit on the discharge rate from a flow attenuation device is often a compromise between attenuating flows to a satisfactory low rate whilst keeping the risk of blockages to an acceptable limit. ICP-SUDS suggests that:

- the minimum flow rate from an attenuation facility should be 5 l/s using an appropriate vortex flow control device.
- the minimum size of pipe discharging from a flow attenuation device should be a DN150 laid no flatter than 1 in 150.

Output

GREENFIELD RUNOFF CALCULATION SHEET

Project:

Land at Scratchface Lane, Bedhampton

Outfall A - Northern Catchment to Sratctchface Lane Ditch



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Designed By	Date	Checked By	Date	Project No.	Sheet No.	Rev
SH	23.02.10	SH	23.02.10	3356	3 of 9	-

Estimation of peak greenfield runoff volumes

Greenfield runoff volumes are calculated to determine the maximum volume that should ideally be discharged from the development site. ICP-SUDS states in para 6.2.8 (p.48):

"Volumes of runoff should also be reduced where possible. This can be achieved in two ways. Ideally, there should be minimal discharge to receiving watercourses for rainfall depths up to 5mm. Alternatively, the difference in volume pre- and post-development for the 100-year six-hour event (the additional runoff generated) should be disposed of by infiltration, or if this is not feasible due to ground conditions, discharged from the site at flow rates below 2 l/s/ha."

Global Variables

AREA	0.620	SPR (%)	37.000	CWI	108.226
------	-------	---------	--------	-----	---------

Runoff Volume, Vol_x

$$\text{Runoff Volume (Vol}_x\text{)} = \text{Percentage Runoff (PR}_{\text{rural}}\text{)} \times \text{Catchment Area (A)} \times \text{Rainfall Depth (P)}$$

$$\text{Percentage Runoff (PR}_{\text{rural}}\text{)} = \text{SPR} \times \text{DPR}_{\text{CWI}} \times \text{DPR}_{\text{RAIN}}$$

$$\text{DPR}_{\text{CWI}} = 0.25 (\text{CWI} - 125)$$

$$\text{DPR}_{\text{RAIN}} (\text{for } P > 40\text{mm}) = 0.45 (P - 40)^{0.7} \quad \left(\text{DPR}_{\text{RAIN}} = 0 \text{ for } P < 40\text{mm} \right)$$

Return Period (1:x-yrs)	Percentage Runoff (%)				Area (m ²)	p** (mm)	Volume (m ³)
	SPR	DPR _{CWI}	DPR _{RAIN}	PR _{rural}			
1	37.000	-4.194	0.000	32.807	6200	22.26	45.3
30	37.000	-4.194	2.106	34.912	6200	48.84	105.7
100	37.000	-4.194	4.150	36.956	6200	63.30	145.0
100 (+30%)	37.000	-4.194	6.298	39.105	6200	82.29	199.5

** Based on 360min (6-hr) Winter Profile Storm for volume calculations as recommended in ICP-SUDS

Where compliance to the 100-year volumetric criterion is not provided, the limiting discharge for the 30-year and 100-year return period storms will be constrained to the mean annual peak runoff for the greenfield site. Referred to as QBAR in the Institute of Hydrology Report No.124 - Flood Estimation for Small Catchments.

Therefore, the allowable greenfield discharge rate (Q_{BAR}) for the 30-year and 100-year return period storms would then be,

Q _{BAR}	=	2.2 l/s
------------------	---	---------

Output

GREENFIELD RUNOFF CALCULATION SHEET

Project:

Land at Scratchface Lane, Bedhampton

Outfall B - Northern Catchment to Brookside Road Stream



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Designed By	Date	Checked By	Date	Project No.	Sheet No.	Rev
SH	23.02.10	SH	23.02.10	3356	4 of 9	-

Generated Rainfall (FSR Method)

Global Variables

Region	7
M5-60	19.1
Ratio r	0.35

Rainfall Intensities

1-year

Peak Intensity (mm/hr)	9.37	Average Intensity (mm/hr)	3.71
------------------------	------	---------------------------	------

30-year

Peak Intensity (mm/hr)	20.60	Average Intensity (mm/hr)	8.14
------------------------	-------	---------------------------	------

100-year

Peak Intensity (mm/hr)	26.69	Average Intensity (mm/hr)	10.55
------------------------	-------	---------------------------	-------

100-year (+30% Climate Change)

Peak Intensity (mm/hr)	34.70	Average Intensity (mm/hr)	13.72
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Output

GREENFIELD RUNOFF CALCULATION SHEET

Project:

Land at Scratchface Lane, Bedhampton

Outfall B - Northern Catchment to Brookside Road Stream



STUART MICHAEL ASSOCIATES
CONSULTING ENGINEERS

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Designed By	Date	Checked By	Date	Project No.	Sheet No.	Rev
SH	23.02.10	SH	23.02.10	3356	5 of 9	-

Estimation of peak greenfield runoff rates

Greenfield runoff rates are calculated to determine the level of acceptable rate of discharge from the site to a receiving watercourse. The Environment Agency normally requires that, for a range of annual flow rate probabilities up to and including the 1% annual probability (1 in 100-year event), the developed rate of runoff into a watercourse should be no greater than the undeveloped rate of runoff for the same event.

The calculation of peak rates of runoff is related to catchment size. Table 4.2 CIRIA C697: The SUDS Manual, summarises the techniques to be used. For developments less than 50 hectares the Institute of Hydrology Report 124 (IOH124) Flood Estimation for Small Catchments (1994) is to be used to determine peak greenfield runoff rates.

Global Variables

AREA _{SITE} (Ha)	1.750	AREA _{IOH} (Ha)	50.000	SAAR (mm)	725	SOIL	0.4
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Mean annual flood estimation, QBAR_{rural}

$$QBAR_{rural} = 0.00108 (AREA)^{0.89} (SAAR)^{1.17} (SOIL)^{2.17}$$

$$QBAR_{rural} = 0.1772 \text{ m}^3/\text{s}$$

Peak flood estimation, Q_x(yrs)

Hydrometric Region	Growth Factors								
	1	2	5	10	25	30	50	100	500
7	0.850	0.880	1.280	1.620	2.140	2.266	2.620	3.190	4.490
Q _x (m ³ /s)	0.0053	0.0055	0.0079	0.0100	0.0133	0.0141	0.0163	0.0198	0.0279
Q _x (l/s)	5.3	5.5	7.9	10.0	13.3	14.1	16.3	19.8	27.9

Allowable greenfield discharge rates, Q_{x-year}

Q _{1-year}	=	5.3	l/s
Q _{30-year}	=	14.1	l/s
Q _{100-year}	=	19.8	l/s

Minimum limits of discharge

A practicable minimum limit on the discharge rate from a flow attenuation device is often a compromise between attenuating flows to a satisfactory low rate whilst keeping the risk of blockages to an acceptable limit. ICP-SUDS suggests that:

- the minimum flow rate from an attenuation facility should be 5 l/s using an appropriate vortex flow control device.
- the minimum size of pipe discharging from a flow attenuation device should be a DN150 laid no flatter than 1 in 150.

Output

GREENFIELD RUNOFF CALCULATION SHEET

Project:

Land at Scratchface Lane, Bedhampton

Outfall B - Northern Catchment to Brookside Road Stream



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SH	23.02.10	SH	23.02.10	3356	6 of 9	-

Estimation of peak greenfield runoff volumes

Greenfield runoff volumes are calculated to determine the maximum volume that should ideally be discharged from the development site. ICP-SUDS states in para 6.2.8 (p.48):

"Volumes of runoff should also be reduced where possible. This can be achieved in two ways. Ideally, there should be minimal discharge to receiving watercourses for rainfall depths up to 5mm. Alternatively, the difference in volume pre- and post-development for the 100-year six-hour event (the additional runoff generated) should be disposed of by infiltration, or if this is not feasible due to ground conditions, discharged from the site at flow rates below 2 l/s/ha."

Global Variables

AREA	1.750	SPR (%)	37.000	CWI	108.226
------	-------	---------	--------	-----	---------

Runoff Volume, Vol_x

$$\text{Runoff Volume (Vol}_x\text{)} = \text{Percentage Runoff (PR}_{\text{rural}}\text{)} \times \text{Catchment Area (A)} \times \text{Rainfall Depth (P)}$$

$$\text{Percentage Runoff (PR}_{\text{rural}}\text{)} = \text{SPR} \times \text{DPR}_{\text{CWI}} \times \text{DPR}_{\text{RAIN}}$$

$$\text{DPR}_{\text{CWI}} = 0.25 (\text{CWI} - 125)$$

$$\text{DPR}_{\text{RAIN}} (\text{for } P > 40\text{mm}) = 0.45 (P - 40)^{0.7} \quad \left(\text{DPR}_{\text{RAIN}} = 0 \text{ for } P < 40\text{mm} \right)$$

Return Period (1:x-yrs)	Percentage Runoff (%)				Area (m ²)	p** (mm)	Volume (m ³)
	SPR	DPR _{CWI}	DPR _{RAIN}	PR _{rural}			
1	37.000	-4.194	0.000	32.807	17500	22.26	127.8
30	37.000	-4.194	2.106	34.912	17500	48.84	298.4
100	37.000	-4.194	4.150	36.956	17500	63.30	409.4
100 (+30%)	37.000	-4.194	6.298	39.105	17500	82.29	563.1

** Based on 360min (6-hr) Winter Profile Storm for volume calculations as recommended in ICP-SUDS

Where compliance to the 100-year volumetric criterion is not provided, the limiting discharge for the 30-year and 100-year return period storms will be constrained to the mean annual peak runoff for the greenfield site. Referred to as QBAR in the Institute of Hydrology Report No.124 - Flood Estimation for Small Catchments.

Therefore, the allowable greenfield discharge rate (Q_{BAR}) for the 30-year and 100-year return period storms would then be,

Q _{BAR}	=	6.2 l/s
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Output

GREENFIELD RUNOFF CALCULATION SHEET

Project:

Land at Scratchface Lane, Bedhampton

Outfall C - Southern Catchment to Brookside Road Stream



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Designed By	Date	Checked By	Date	Project No.	Sheet No.	Rev
SH	23.02.10	SH	23.02.10	3356	7 of 9	-

Generated Rainfall (FSR Method)

Global Variables

Region	7
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M5-60	19.1
-------	------

Ratio r	0.35
---------	------

Rainfall Intensities

1-year

Peak Intensity (mm/hr)	9.37
------------------------	------

Average Intensity (mm/hr)	3.71
---------------------------	------

30-year

Peak Intensity (mm/hr)	20.60
------------------------	-------

Average Intensity (mm/hr)	8.14
---------------------------	------

100-year

Peak Intensity (mm/hr)	26.69
------------------------	-------

Average Intensity (mm/hr)	10.55
---------------------------	-------

100-year (+30% Climate Change)

Peak Intensity (mm/hr)	34.70
------------------------	-------

Average Intensity (mm/hr)	13.72
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Output

GREENFIELD RUNOFF CALCULATION SHEET

Project:

Land at Scratchface Lane, Bedhampton

Outfall C - Southern Catchment to Brookside Road Stream



Designed By	Date	Checked By	Date	Project No.	Sheet No.	Rev
SH	23.02.10	SH	23.02.10	3356	8 of 9	-

Estimation of peak greenfield runoff rates

Greenfield runoff rates are calculated to determine the level of acceptable rate of discharge from the site to a receiving watercourse. The Environment Agency normally requires that, for a range of annual flow rate probabilities up to and including the 1% annual probability (1 in 100-year event), the developed rate of runoff into a watercourse should be no greater than the undeveloped rate of runoff for the same event.

The calculation of peak rates of runoff is related to catchment size. Table 4.2 CIRIA C697: The SUDS Manual, summarises the techniques to be used. For developments less than 50 hectares the Institute of Hydrology Report 124 (IOH124) Flood Estimation for Small Catchments (1994) is to be used to determine peak greenfield runoff rates.

Global Variables

AREA _{SITE} (Ha)	1.080	AREA _{IOH} (Ha)	50.000	SAAR (mm)	725	SOIL	0.4
---------------------------	-------	--------------------------	--------	-----------	-----	------	-----

Mean annual flood estimation, QBAR_{rural}

$$QBAR_{rural} = 0.00108 (AREA)^{0.89} (SAAR)^{1.17} (SOIL)^{2.17}$$

$$QBAR_{rural} = 0.1772 \text{ m}^3/\text{s}$$

Peak flood estimation, Q_x(yrs)

Hydrometric Region	Growth Factors								
	1	2	5	10	25	30	50	100	500
7	0.850	0.880	1.280	1.620	2.140	2.266	2.620	3.190	4.490
Q _x (m ³ /s)	0.0033	0.0034	0.0049	0.0062	0.0082	0.0087	0.0100	0.0122	0.0172
Q _x (l/s)	3.3	3.4	4.9	6.2	8.2	8.7	10.0	12.2	17.2

Allowable greenfield discharge rates, Q_x-year

Q _{1-year}	=	3.3	l/s
Q _{30-year}	=	8.7	l/s
Q _{100-year}	=	12.2	l/s

Minimum limits of discharge

A practicable minimum limit on the discharge rate from a flow attenuation device is often a compromise between attenuating flows to a satisfactory low rate whilst keeping the risk of blockages to an acceptable limit. ICP-SUDS suggests that:

- the minimum flow rate from an attenuation facility should be 5 l/s using an appropriate vortex flow control device.
- the minimum size of pipe discharging from a flow attenuation device should be a DN150 laid no flatter than 1 in 150.

Output

GREENFIELD RUNOFF CALCULATION SHEET

Project:

Land at Scratchface Lane, Bedhampton

Outfall C - Southern Catchment to Brookside Road Stream



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Designed By	Date	Checked By	Date	Project No.	Sheet No.	Rev
SH	23.02.10	SH	23.02.10	3356	9 of 9	-

Estimation of peak greenfield runoff volumes

Greenfield runoff volumes are calculated to determine the maximum volume that should ideally be discharged from the development site. ICP-SUDS states in para 6.2.8 (p.48):

"Volumes of runoff should also be reduced where possible. This can be achieved in two ways. Ideally, there should be minimal discharge to receiving watercourses for rainfall depths up to 5mm. Alternatively, the difference in volume pre- and post-development for the 100-year six-hour event (the additional runoff generated) should be disposed of by infiltration, or if this is not feasible due to ground conditions, discharged from the site at flow rates below 2 l/s/ha."

Global Variables

AREA	1.080	SPR (%)	37.000	CWI	108.226
------	-------	---------	--------	-----	---------

Runoff Volume, Vol_x

$$\text{Runoff Volume (Vol}_x\text{)} = \text{Percentage Runoff (PR}_{\text{rural}}\text{)} \times \text{Catchment Area (A)} \times \text{Rainfall Depth (P)}$$

$$\text{Percentage Runoff (PR}_{\text{rural}}\text{)} = \text{SPR} \times \text{DPR}_{\text{CWI}} \times \text{DPR}_{\text{RAIN}}$$

$$\text{DPR}_{\text{CWI}} = 0.25 (\text{CWI} - 125)$$

$$\text{DPR}_{\text{RAIN}} (\text{for } P > 40\text{mm}) = 0.45 (P - 40)^{0.7} \quad \left(\text{DPR}_{\text{RAIN}} = 0 \text{ for } P < 40\text{mm} \right)$$

Return Period (1:X-yrs)	Percentage Runoff (%)				Area (m ²)	p** (mm)	Volume (m ³)
	SPR	DPR _{CWI}	DPR _{RAIN}	PR _{rural}			
1	37.000	-4.194	0.000	32.807	10800	22.26	78.9
30	37.000	-4.194	2.106	34.912	10800	48.84	184.2
100	37.000	-4.194	4.150	36.956	10800	63.30	252.6
100 (+30%)	37.000	-4.194	6.298	39.105	10800	82.29	347.5

** Based on 360min (6-hr) Winter Profile Storm for volume calculations as recommended in ICP-SUDS

Where compliance to the 100-year volumetric criterion is not provided, the limiting discharge for the 30-year and 100-year return period storms will be constrained to the mean annual peak runoff for the greenfield site. Referred to as QBAR in the Institute of Hydrology Report No.124 - Flood Estimation for Small Catchments.

Therefore, the allowable greenfield discharge rate (Q_{BAR}) for the 30-year and 100-year return period storms would then be,

Q _{BAR}	=	3.8 l/s
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Output

Stuart Michael Associates Limited		Page 1
Coombe House Coombe Square Thatcham RG19 4JF	Scratchface Lane Outfall A Swale	
Date 14 April 2010 11:10 File swale.src	Designed By sjh Checked By	
Micro Drainage	Source Control W.11.4 net	

Summary of Results for 100 year Return Period (+30%)

Half Drain Time : 89 minutes

Storm Duration (mins)	Maximum Control (l/s)	Maximum Filtration (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Maximum Volume (m³)	Status
15 Summer	2.0	0.0	2.0	28.7608	0.3607	12.5	0 K
30 Summer	2.1	0.0	2.1	28.7988	0.3987	15.8	0 K
60 Summer	2.2	0.0	2.2	28.8208	0.4207	17.9	0 K
120 Summer	2.2	0.0	2.2	28.8228	0.4227	18.1	0 K
180 Summer	2.1	0.0	2.1	28.8168	0.4167	17.5	0 K
240 Summer	2.1	0.0	2.1	28.8082	0.4082	16.7	0 K
360 Summer	2.1	0.0	2.1	28.7903	0.3902	15.0	0 K
480 Summer	2.0	0.0	2.0	28.7713	0.3712	13.4	0 K
600 Summer	2.0	0.0	2.0	28.7523	0.3522	11.8	0 K
720 Summer	1.9	0.0	1.9	28.7323	0.3322	10.4	0 K
960 Summer	1.9	0.0	1.9	28.6923	0.2922	7.7	0 K
1440 Summer	1.9	0.0	1.9	28.6083	0.2082	3.6	0 K
2160 Summer	1.8	0.0	1.8	28.4983	0.0983	0.7	0 K
2880 Summer	1.5	0.0	1.5	28.4788	0.0788	0.4	0 K
4320 Summer	1.1	0.0	1.1	28.4573	0.0572	0.2	0 K
5760 Summer	0.9	0.0	0.9	28.4458	0.0458	0.1	0 K
7200 Summer	0.7	0.0	0.7	28.4383	0.0383	0.1	0 K
8640 Summer	0.6	0.0	0.6	28.4333	0.0333	0.1	0 K
10080 Summer	0.5	0.0	0.5	28.4293	0.0292	0.1	0 K
15 Winter	2.1	0.0	2.1	28.7813	0.3812	14.2	0 K
30 Winter	2.2	0.0	2.2	28.8228	0.4227	18.2	0 K
60 Winter	2.2	0.0	2.2	28.8493	0.4492	20.9	0 K
120 Winter	2.2	0.0	2.2	28.8523	0.4522	21.3	0 K
180 Winter	2.2	0.0	2.2	28.8442	0.4442	20.4	0 K
240 Winter	2.2	0.0	2.2	28.8322	0.4322	19.2	0 K
360 Winter	2.1	0.0	2.1	28.8063	0.4062	16.5	0 K
480 Winter	2.1	0.0	2.1	28.7788	0.3787	14.0	0 K
600 Winter	2.0	0.0	2.0	28.7498	0.3497	11.7	0 K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
15 Summer	117.74	18
30 Summer	79.14	32
60 Summer	50.76	60
120 Summer	31.43	94
180 Summer	23.38	128
240 Summer	18.82	162
360 Summer	13.84	230
480 Summer	11.12	298
600 Summer	9.38	364
720 Summer	8.15	428
960 Summer	6.53	556
1440 Summer	4.77	792
2160 Summer	3.47	1100
2880 Summer	2.77	1468
4320 Summer	2.01	2164
5760 Summer	1.60	2864
7200 Summer	1.34	3544
8640 Summer	1.16	4288
10080 Summer	1.03	5088
15 Winter	117.74	17
30 Winter	79.14	31
60 Winter	50.76	60
120 Winter	31.43	100
180 Winter	23.38	138
240 Winter	18.82	176
360 Winter	13.84	250
480 Winter	11.12	320
600 Winter	9.38	388

Summary of Results for 100 year Return Period (+30%)

Storm Duration (mins)	Maximum Control (l/s)	Maximum Filtration (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Maximum Volume (m³)	Status
720 Winter	1.9	0.0	1.9	28.7203	0.3202	9.5	0 K
960 Winter	1.9	0.0	1.9	28.6538	0.2537	5.6	0 K
1440 Winter	1.8	0.0	1.8	28.4973	0.0973	0.7	0 K
2160 Winter	1.3	0.0	1.3	28.4713	0.0713	0.4	0 K
2880 Winter	1.1	0.0	1.1	28.4568	0.0567	0.2	0 K
4320 Winter	0.8	0.0	0.8	28.4413	0.0412	0.1	0 K
5760 Winter	0.6	0.0	0.6	28.4333	0.0332	0.1	0 K
7200 Winter	0.5	0.0	0.5	28.4278	0.0277	0.1	0 K
8640 Winter	0.5	0.0	0.5	28.4243	0.0242	0.0	0 K
10080 Winter	0.4	0.0	0.4	28.4213	0.0212	0.0	0 K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
720 Winter	8.15	456
960 Winter	6.53	578
1440 Winter	4.77	736
2160 Winter	3.47	1100
2880 Winter	2.77	1468
4320 Winter	2.01	2140
5760 Winter	1.60	2856
7200 Winter	1.34	3568
8640 Winter	1.16	4376
10080 Winter	1.03	5048

Rainfall Details

Region	ENG+WAL	Cv (Summer)	0.750	Summer Storms	Yes
Return Period (years)	100	Cv (Winter)	0.840	Winter Storms	Yes
M5-60 (mm)	19.300	Shortest Storm (mins)	15	Climate Change %	+30
Ratio-R	0.350	Longest Storm (mins)	10080		

Time / Area Diagram

Total Area (ha) = 0.065

Time	(mins)	Area
from:	to:	(ha)
	0	4
		0.065

Swale Details

Infil Coef - Base (m/hr)	0.000000	Length (m)	65.0
Infil Coef - Sides (m/hr)	0.000000	Side Slope (1:x)	4.0
Safety Factor	2.0	Invert Level (m)	28.400
Porosity	1.00	Cover Level (m)	29.000
Base Width (m)	2.0	Slope (1:x)	65.0

Hydro-Brake Outflow Control

Design Head (m)	0.450	Hydro-Brake Type	MD5	Invert Level (m)	28.400
Design Flow (l/s)	2.2	Diameter (mm)	74		

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.10	1.9	0.60	2.6	1.60	4.2	2.60	5.4	5.00	7.4	7.50	9.1
0.20	1.7	0.80	3.0	1.80	4.5	3.00	5.8	5.50	7.8	8.00	9.4
0.30	1.8	1.00	3.3	2.00	4.7	3.50	6.2	6.00	8.1	8.50	9.7
0.40	2.1	1.20	3.6	2.20	4.9	4.00	6.7	6.50	8.5	9.00	10.0
0.50	2.4	1.40	3.9	2.40	5.2	4.50	7.1	7.00	8.8	9.50	10.3

Summary of Results for 100 year Return Period (+30%)

Storm Duration (mins)	Maximum Control (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Maximum Volume (m³)	Status
15 Summer	4.4	4.4	22.6638	0.3637	217.5	0 K
30 Summer	4.7	4.7	22.7707	0.4707	290.3	0 K
60 Summer	5.0	5.0	22.8773	0.5772	367.4	0 K
120 Summer	5.4	5.4	22.9768	0.6768	443.3	0 K
180 Summer	5.6	5.6	23.0268	0.7268	482.9	0 K
240 Summer	5.7	5.7	23.0558	0.7558	506.0	0 K
360 Summer	5.8	5.8	23.0888	0.7888	533.0	0 K
480 Summer	5.9	5.9	23.1043	0.8043	545.9	0 K
600 Summer	5.9	5.9	23.1098	0.8098	550.5	0 K
720 Summer	5.9	5.9	23.1093	0.8093	550.3	0 K
960 Summer	5.9	5.9	23.1058	0.8058	547.1	0 K
1440 Summer	5.8	5.8	23.0903	0.7903	534.4	0 K
2160 Summer	5.7	5.7	23.0583	0.7583	508.2	0 K
2880 Summer	5.6	5.6	23.0233	0.7233	479.8	0 K
4320 Summer	5.3	5.3	22.9538	0.6538	425.3	0 K
5760 Summer	5.1	5.1	22.8888	0.5888	376.0	0 K
7200 Summer	4.9	4.9	22.8293	0.5292	332.1	0 K
8640 Summer	4.7	4.7	22.7742	0.4742	292.9	0 K
10080 Summer	4.5	4.5	22.7227	0.4227	257.3	0 K
15 Winter	4.5	4.5	22.7033	0.4032	243.8	0 K
30 Winter	4.8	4.8	22.8203	0.5202	325.7	0 K
60 Winter	5.3	5.3	22.9373	0.6373	412.5	0 K
120 Winter	5.7	5.7	23.0473	0.7473	499.1	0 K
180 Winter	5.9	5.9	23.1028	0.8028	544.8	0 K
240 Winter	6.0	6.0	23.1353	0.8353	572.0	0 K
360 Winter	6.1	6.1	23.1743	0.8743	605.3	0 K
480 Winter	6.2	6.2	23.1948	0.8948	623.0	0 K
600 Winter	6.2	6.2	23.2043	0.9043	631.5	0 K
720 Winter	6.2	6.2	23.2078	0.9078	634.2	0 K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
15 Summer	117.74	19
30 Summer	79.14	34
60 Summer	50.76	64
120 Summer	31.43	122
180 Summer	23.38	182
240 Summer	18.82	242
360 Summer	13.84	362
480 Summer	11.12	480
600 Summer	9.38	600
720 Summer	8.15	684
960 Summer	6.53	790
1440 Summer	4.77	1040
2160 Summer	3.47	1452
2880 Summer	2.77	1872
4320 Summer	2.01	2680
5760 Summer	1.60	3464
7200 Summer	1.34	4256
8640 Summer	1.16	5016
10080 Summer	1.03	5752
15 Winter	117.74	19
30 Winter	79.14	33
60 Winter	50.76	62
120 Winter	31.43	122
180 Winter	23.38	180
240 Winter	18.82	238
360 Winter	13.84	354
480 Winter	11.12	468
600 Winter	9.38	578
720 Winter	8.15	688

Summary of Results for 100 year Return Period (+30%)

Storm Duration (mins)	Maximum Control (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Maximum Volume (m³)	Status
960 Winter	6.2	6.2	23.2023	0.9023	629.4	0 K
1440 Winter	6.2	6.2	23.1818	0.8818	611.7	0 K
2160 Winter	6.0	6.0	23.1388	0.8388	575.1	0 K
2880 Winter	5.8	5.8	23.0893	0.7893	533.7	0 K
4320 Winter	5.5	5.5	22.9898	0.6898	453.4	0 K
5760 Winter	5.1	5.1	22.8968	0.5968	381.9	0 K
7200 Winter	4.8	4.8	22.8107	0.5107	318.8	0 K
8640 Winter	4.6	4.6	22.7302	0.4302	262.3	0 K
10080 Winter	4.4	4.4	22.6517	0.3517	209.5	0 K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
960 Winter	6.53	894
1440 Winter	4.77	1110
2160 Winter	3.47	1576
2880 Winter	2.77	2020
4320 Winter	2.01	2896
5760 Winter	1.60	3744
7200 Winter	1.34	4536
8640 Winter	1.16	5280
10080 Winter	1.03	6048

Stuart Michael Associates Limited		Page 7
Coombe House Coombe Square Thatcham RG19 4JF	Scratchface Lane Outfall B Pond / Basin	
Date 14 April 2010 11:23 File pond1.SRC	Designed By sjh Checked By	
Micro Drainage	Source Control W.11.4 net	

Rainfall Details

Region	ENG+WAL	Cv (Summer)	0.750	Summer Storms	Yes
Return Period (years)	100	Cv (Winter)	0.840	Winter Storms	Yes
M5-60 (mm)	19.300	Shortest Storm (mins)	15	Climate Change %	+30
Ratio-R	0.350	Longest Storm (mins)	10080		

Time / Area Diagram

Total Area (ha) = 1.000

Time	(mins)	Area
from:	to:	(ha)
0	4	1.000

Tank/Pond Details

Invert Level (m) 22.300 Ground Level (m) 23.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.00	536.0	0.50	712.7	1.00	914.5	1.50	1141.5	2.00	1393.6	2.50	1670.9
0.10	569.3	0.60	751.1	1.10	957.9	1.60	1189.9	2.10	1447.1		
0.20	603.7	0.70	790.4	1.20	1002.3	1.70	1239.3	2.20	1501.5		
0.30	639.0	0.80	830.8	1.30	1047.7	1.80	1289.8	2.30	1557.0		
0.40	675.4	0.90	872.2	1.40	1094.1	1.90	1341.2	2.40	1613.4		

Hydro-Brake Outflow Control

Design Head (m) 0.910 Hydro-Brake Type MD5 Invert Level (m) 22.300
Design Flow (l/s) 6.2 Diameter (mm) 104

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.10	3.1	0.60	5.1	1.60	8.3	2.60	10.6	5.00	14.7	7.50	18.0
0.20	4.4	0.80	5.9	1.80	8.8	3.00	11.4	5.50	15.4	8.00	18.6
0.30	4.4	1.00	6.6	2.00	9.3	3.50	12.3	6.00	16.1	8.50	19.1
0.40	4.5	1.20	7.2	2.20	9.7	4.00	13.1	6.50	16.7	9.00	19.7
0.50	4.8	1.40	7.8	2.40	10.2	4.50	13.9	7.00	17.4	9.50	20.2

Summary of Results for 100 year Return Period (+30%)

Storm Duration (mins)	Maximum Control (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Maximum Volume (m³)	Status
15 Summer	3.1	3.1	21.5738	0.2737	77.2	0 K
30 Summer	3.2	3.2	21.6518	0.3517	102.5	0 K
60 Summer	3.3	3.3	21.7263	0.4262	128.2	0 K
120 Summer	3.5	3.5	21.7902	0.4902	151.5	0 K
180 Summer	3.6	3.6	21.8168	0.5167	161.5	0 K
240 Summer	3.6	3.6	21.8278	0.5277	165.6	0 K
360 Summer	3.6	3.6	21.8323	0.5322	167.5	0 K
480 Summer	3.6	3.6	21.8313	0.5312	167.0	0 K
600 Summer	3.6	3.6	21.8278	0.5277	165.6	0 K
720 Summer	3.6	3.6	21.8223	0.5222	163.6	0 K
960 Summer	3.6	3.6	21.8092	0.5092	158.7	0 K
1440 Summer	3.5	3.5	21.7787	0.4787	147.2	0 K
2160 Summer	3.3	3.3	21.7307	0.4307	129.9	0 K
2880 Summer	3.2	3.2	21.6847	0.3847	113.7	0 K
4320 Summer	3.1	3.1	21.5997	0.2997	85.5	0 K
5760 Summer	3.1	3.1	21.5278	0.2277	63.0	0 K
7200 Summer	3.0	3.0	21.4813	0.1812	49.1	0 K
8640 Summer	2.8	2.8	21.4493	0.1493	39.9	0 K
10080 Summer	2.6	2.6	21.4248	0.1248	33.0	0 K
15 Winter	3.1	3.1	21.6033	0.3032	86.7	0 K
30 Winter	3.2	3.2	21.6893	0.3892	115.3	0 K
60 Winter	3.5	3.5	21.7712	0.4712	144.5	0 K
120 Winter	3.7	3.7	21.8423	0.5422	171.3	0 K
180 Winter	3.8	3.8	21.8733	0.5733	183.4	0 K
240 Winter	3.8	3.8	21.8873	0.5873	189.0	0 K
360 Winter	3.8	3.8	21.8973	0.5973	192.9	0 K
480 Winter	3.8	3.8	21.8943	0.5943	191.8	0 K
600 Winter	3.8	3.8	21.8888	0.5888	189.4	0 K
720 Winter	3.8	3.8	21.8823	0.5823	186.9	0 K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
15 Summer	117.74	19
30 Summer	79.14	33
60 Summer	50.76	62
120 Summer	31.43	122
180 Summer	23.38	182
240 Summer	18.82	240
360 Summer	13.84	338
480 Summer	11.12	394
600 Summer	9.38	458
720 Summer	8.15	520
960 Summer	6.53	656
1440 Summer	4.77	936
2160 Summer	3.47	1340
2880 Summer	2.77	1732
4320 Summer	2.01	2504
5760 Summer	1.60	3176
7200 Summer	1.34	3888
8640 Summer	1.16	4576
10080 Summer	1.03	5248
15 Winter	117.74	18
30 Winter	79.14	33
60 Winter	50.76	62
120 Winter	31.43	120
180 Winter	23.38	178
240 Winter	18.82	234
360 Winter	13.84	344
480 Winter	11.12	446
600 Winter	9.38	480
720 Winter	8.15	556

Summary of Results for 100 year Return Period (+30%)

Storm Duration (mins)	Maximum Control (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Maximum Volume (m³)	Status
960 Winter	3.7	3.7	21.8643	0.5643	179.9	0 K
1440 Winter	3.6	3.6	21.8208	0.5207	162.9	0 K
2160 Winter	3.4	3.4	21.7507	0.4507	137.0	0 K
2880 Winter	3.2	3.2	21.6827	0.3827	113.0	0 K
4320 Winter	3.1	3.1	21.5553	0.2552	71.4	0 K
5760 Winter	2.9	2.9	21.4738	0.1737	46.9	0 K
7200 Winter	2.6	2.6	21.4258	0.1258	33.3	0 K
8640 Winter	2.4	2.4	21.3983	0.0983	25.7	0 K
10080 Winter	2.1	2.1	21.3873	0.0873	22.7	0 K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
960 Winter	6.53	712
1440 Winter	4.77	1010
2160 Winter	3.47	1448
2880 Winter	2.77	1848
4320 Winter	2.01	2592
5760 Winter	1.60	3232
7200 Winter	1.34	3896
8640 Winter	1.16	4496
10080 Winter	1.03	5240

Rainfall Details

Region	ENG+WAL	Cv (Summer)	0.750	Summer Storms	Yes
Return Period (years)	100	Cv (Winter)	0.840	Winter Storms	Yes
M5-60 (mm)	19.300	Shortest Storm (mins)	15	Climate Change %	+30
Ratio-R	0.350	Longest Storm (mins)	10080		

Time / Area Diagram

Total Area (ha) = 0.360

Time	(mins)	Area
from:	to:	(ha)
	0	4 0.360

Tank/Pond Details

Invert Level (m)		21.300	Ground Level (m)		22.200						
Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.00	250.0	0.50	374.7	1.00	524.5	1.50	699.4	2.00	899.5	2.50	1124.7
0.10	272.9	0.60	402.6	1.10	557.4	1.60	737.4	2.10	942.5		
0.20	296.9	0.70	431.6	1.20	591.4	1.70	776.4	2.20	986.5		
0.30	321.8	0.80	461.5	1.30	626.4	1.80	816.4	2.30	1031.6		
0.40	347.7	0.90	492.5	1.40	662.4	1.90	857.4	2.40	1077.6		

Hydro-Brake Outflow Control

Design Head (m)		0.600	Hydro-Brake Type		MD5	Invert Level (m)		21.300			
Design Flow (l/s)		3.8	Diameter (mm)		91						
Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.10	2.5	0.60	3.9	1.60	6.3	2.60	8.0	5.00	11.1	7.50	13.6
0.20	3.1	0.80	4.4	1.80	6.7	3.00	8.6	5.50	11.6	8.00	14.0
0.30	3.1	1.00	5.0	2.00	7.0	3.50	9.3	6.00	12.2	8.50	14.5
0.40	3.3	1.20	5.4	2.20	7.4	4.00	9.9	6.50	12.6	9.00	14.9
0.50	3.5	1.40	5.9	2.40	7.7	4.50	10.5	7.00	13.1	9.50	15.3

Appendix E

Level 2 Design Capacity Assessment Report
Southern Water

Mr. Simon Hudson
Stuart Michael Associates Ltd
Coombe House
Coombe Square
Thatcham
Berkshire
RG19 4JF



Atkins Limited
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winchester.enquiries@atkinsglobal.com
www.atkinsglobal.com

10/03/2010

Our Ref: SWS-HANTS-CC-000417

RE: Level 2 foul capacity check application.

Site: Scratchface Lane, Bedhampton, Havant, PO99 3NN.

Dear Mr. Hudson,

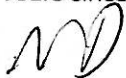
We have completed the capacity check for the above development site and the results are as follows:-

Foul capacity check:

There is currently adequate capacity in the local foul sewerage network to accommodate a foul flow of 4.4 l/s at manhole reference 4901 without any improvement works. Please note that no surface water flows (existing or proposed) can be accommodated within the system.

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

Yours sincerely



Network Development

Please note: -

The information provided 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.



STUDY INTO THE OPTIONS FOR
SURFACE WATER DRAINAGE PROVISION AT
SCRATCHFACE LANE
BEDHAMPTON
HAVANT
PO99 3NN

11 March 2010

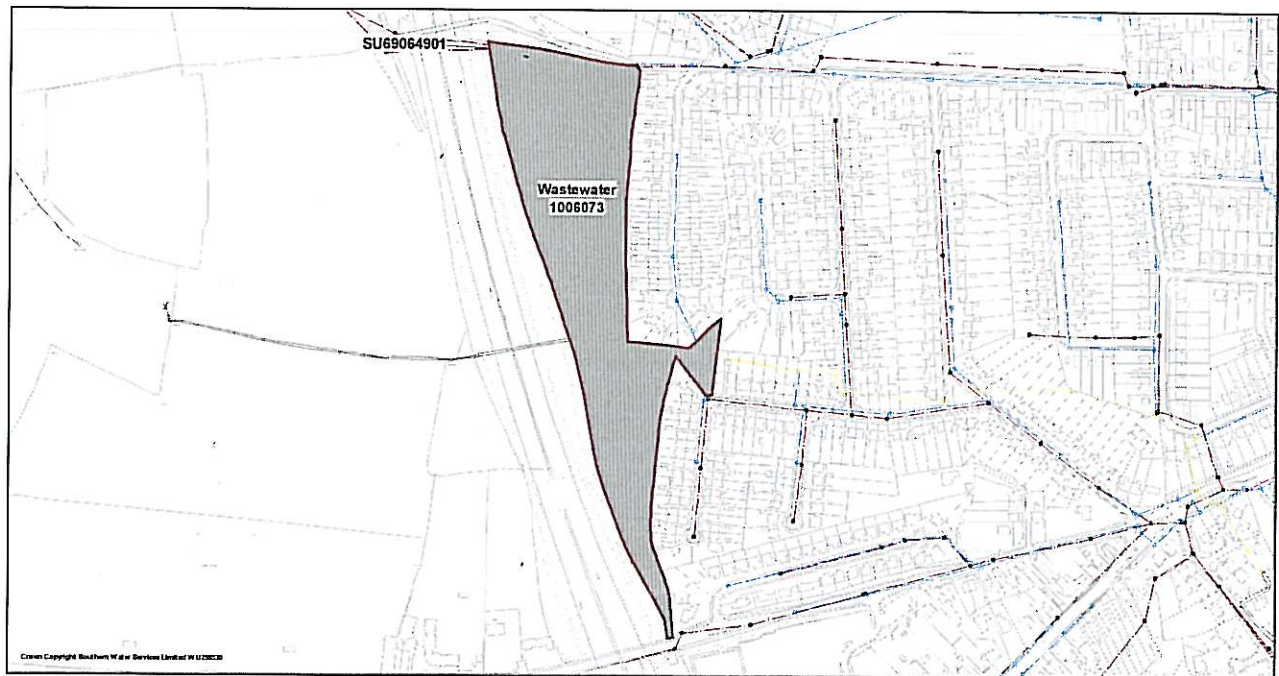
REQUESTED:
STUART MICHAEL ASSOCIATES

Study into the Options for foul Water Drainage Provision at Scrtchface Lane, Budds Farm

Development Details

The proposal is to discharge 4.4 l/s of foul flow to the public foul sewerage system. The connection point is at manhole references SU69064901 which is located in Scratchface Lane.

Figure 1 - Proposed Development



Results & Conclusion

We have completed the foul water capacity check for the above development site and the results are as follows:

Foul Water:

Hydraulic analysis of existing foul system indicates that there is currently adequate capacity in the local foul sewerage system to accommodate the proposed development's flow of 4.4 l/s of at manhole reference SU69064901.

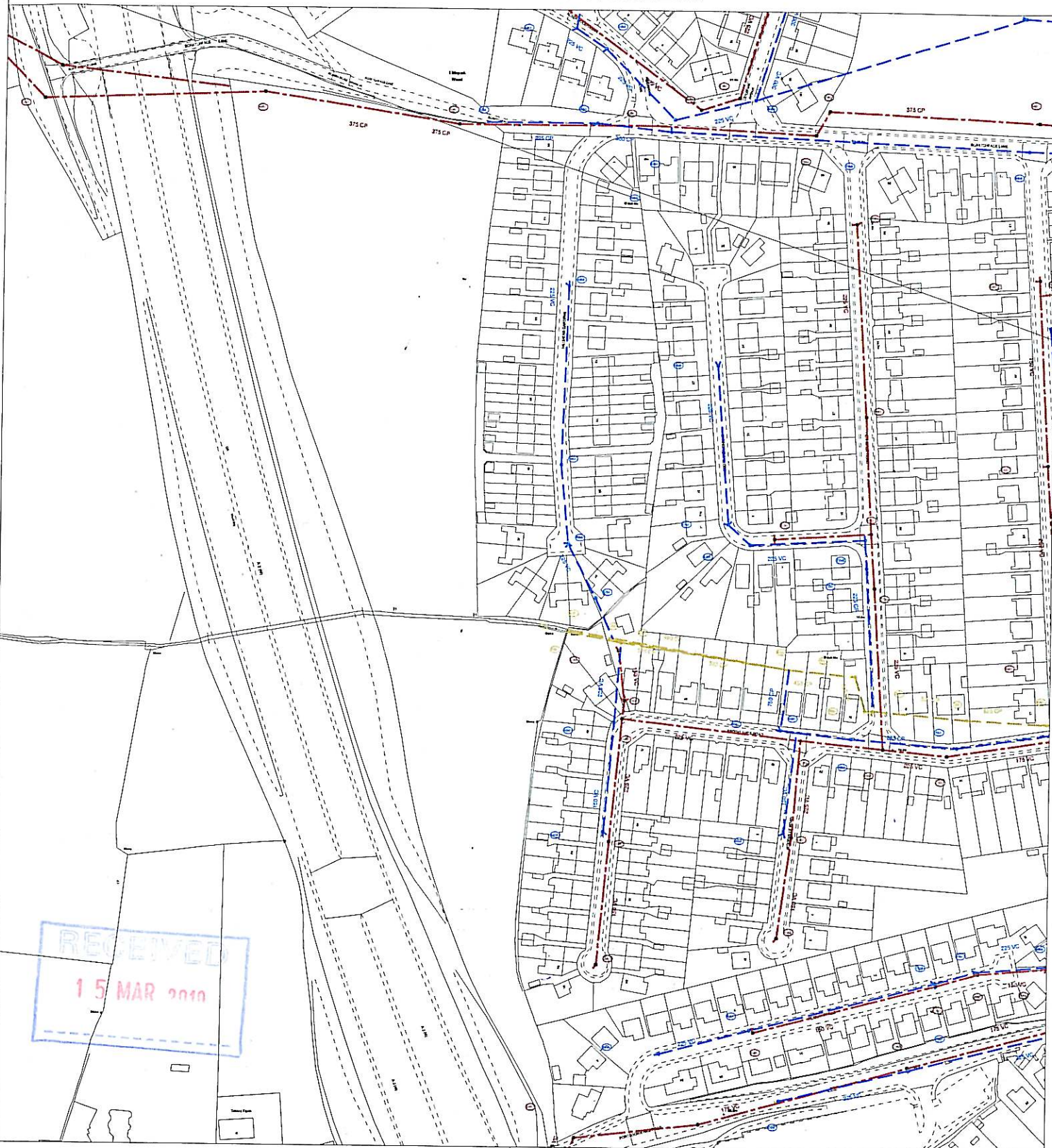
The assessment indicates that the substantial improvements will be necessary if the development is connected to manhole SU69066702.

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 quoted above are only valid for 12 months from the date of issue of this letter.

PUBLIC SEWER RECORD

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.

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O.S. REF: SU6906NE

Scale: 1:2500

Sewer Plot

WARNING: BAC pipes are constructed of Bonded Asbestos Cement

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

Southern Water

Printed By: Vishranthi

Date: 24-2-2010

Southern Water MapGuide Browser

Requested By:

