Proposed Residential Development, Land off Herschel Grange, Warfield, Bracknell

Flood Risk & Drainage Assessment

A108468

May 2019

Prepared on behalf of

Hodson Developments

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1.0 Introduction

1.1 Purpose of this Report

WYG Engineering Ltd has been commissioned by Hodson Developments to undertake a Flood Risk and Drainage Assessment (FRDA) with regards to a proposed development on land off Herschel Grange in Warfield, Bracknell.

This report has been produced in support of the revised full planning application for the proposed development as detailed in Section 1.2 below.

This report has been revised to address the comments made to the previous planning application (ref 1800650/FUL) by Bracknell Forest as Lead Local Flood Authority a copy of which is included within Appendix I.

In addition, a revised drainage strategy has been agreed with Thames Water and this is discussed in Section 4 below.

1.2 Proposed Development

A full planning application is being submitted for approval of the proposed development of 33 No dwellings and associated landscaping and infrastructure.

The proposed site layout is contained within Appendix A.

1.3 Requirement for a Flood Risk Assessment

The application site is located entirely in Flood Zone 1 (i.e. land assessed of having a lower than 1 in 1000 year annual probability of river or sea flooding (<0.1% Annual Exceedance Probability (AEP)) in any one year). However, as the site area is greater than 1 ha, then according with the National Planning Policy Framework (NPPF) and the Planning Practice Guidance (PPG) (Flood Risk and Coastal Change), a Flood Risk Assessment is required to support the planning application.

1.4 Scope of the Flood Risk Assessment

This FRDA will be undertaken in accordance with Environment Agency (EA) Guidance for Flood Risk Assessments in Flood Zone 1 https://www.gov.uk/guidance/flood-risk-assessment-in-flood-zone-1-and-critical-drainage-areas

In line with the PPG (Flood Risk and Coastal Change), the FRDA will take into consideration other sources of potential flood risk including sewers, overland flow routes, groundwater flooding and reservoir flooding.

The FRDA will also establish a management regime for surface water runoff from the site such that the flood risk to adjacent areas is not exacerbated and improved where possible. If not properly managed, surface water runoff from the site could potentially lead to increases in the flood risk to other areas of the development itself. Given that the planning application seeks full planning permission, a detailed surface water drainage strategy will be presented to demonstrate that the site can be adequately drained, and that flood risk elsewhere will not increase as a result of the development.

1.5 Foul Drainage Assessment

The Foul Drainage Assessment will review the existing foul water drainage systems adjacent to the development site and identify the increased peak flows from the proposed development to the existing discharge points as a result of the proposed development.

1.6 Limitations of this Report

This report has been prepared by WYG Engineering Ltd on behalf of Hodson Developments in connection with the scope of the report as described in Section 1.4 above and takes into account the particular instructions and requirements as set out in our fee proposal and the acceptance. It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

WYG Engineering Ltd accepts no duty of responsibility to any party other than Hodson Developments and disclaims all liability of any nature whatsoever to any such party in respect of this report.

2.0 Site Description

2.1 Existing Site

The site covers an area of approximately 1.25 ha and is located to off Herschel Grange in Warfield, Bracknell. The nearest postcode is RG42 6AT and the site's grid reference is SU87814 71318.

The application site is currently greenfield being used for grazing of horses. It is bounded by an existing equestrian centre to the north, by a static caravan park to the west, by residential development to the south and south east and open fields to the east.

The site location and boundary are shown below in Figures 1 and 2 respectively.

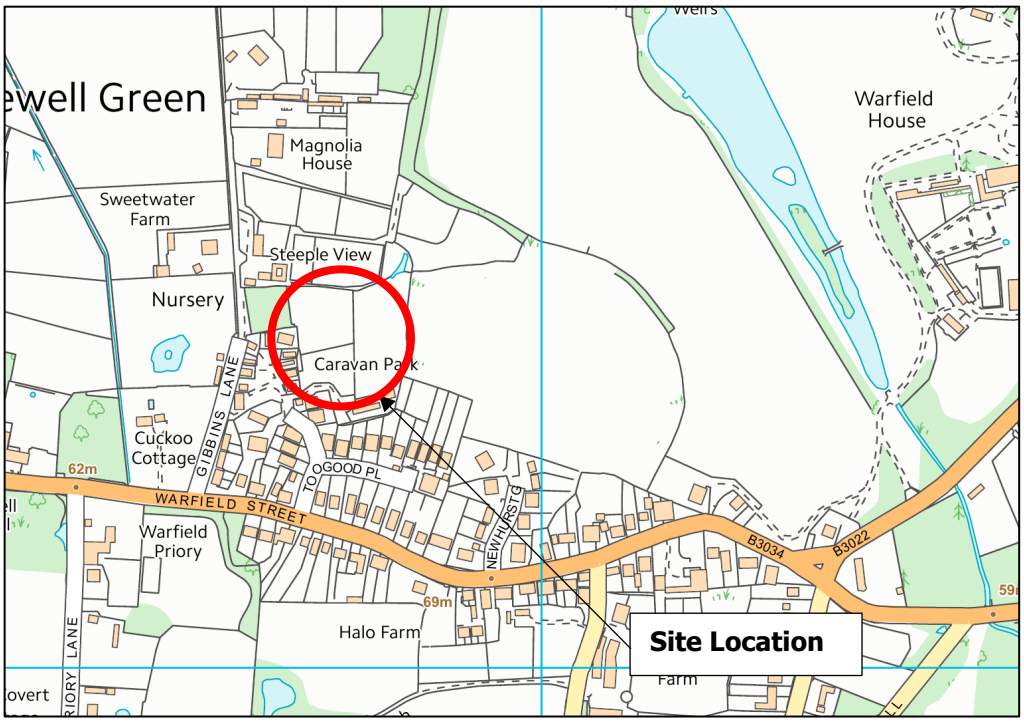


Figure 1 – Site Location Plan

A review of a topographic survey indicates that the site falls from south to north. The highest level is 65.52m AOD at a point near the south eastern corner of the site, and the lowest level is 62.82m AOD at a point in the north western corner of the site.

Appendix B includes a copy of the topographical survey.

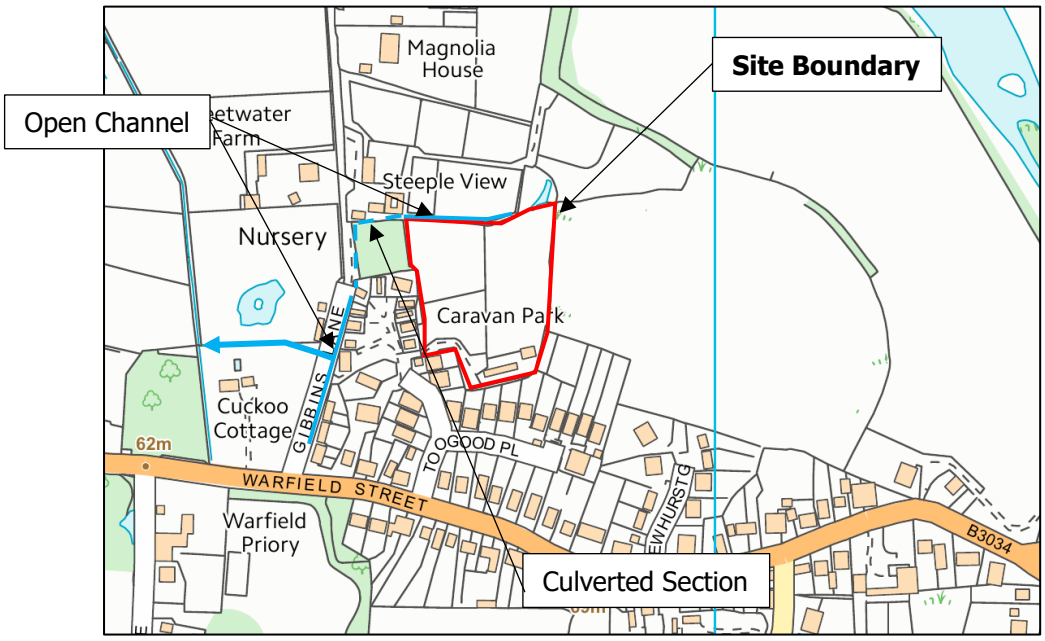


Figure 2 – Site Boundary & Watercourse Plan

2.2 Existing Drainage

2.2.1 Main Rivers

The nearest main river (as listed in the EA Flood Map for Planning) is Bull Brook 400m to the north east of the site.

2.2.2 Ordinary and Manmade Watercourses

There is a drainage ditch flowing alongside the northern boundary of the site. It was identified during a site visit that the watercourse flows west parallel to the northern boundary of the site towards Gibbins Lane. The watercourse is understood to be culverted before reaching Gibbins Lane, and then understood to flow in a piped system alongside the eastern side of Gibbins Lane where becomes an open channel again. Further investigations are required to confirm the route of the culverted section.

The section of open channel drains south along the eastern side of Gibbins Lane where at it natural low point it is culverted by a 300mm diameter pipe and drains west under Gibbins Lane into the adjacent property.

Figure 2 above includes an indication of the route of the watercourse.

2.2.3 Sewers

Thames Water

Sewer records obtained from Thames Water indicate that there are the following sewers adjacent to the site:

- 150mm foul sewer in Toogood Place/Herschel Grange;
- Approximately 140m to the east of the site there is a 225/300mm surface water sewer flowing north through Newhurst Gardens and the adjacent fields; and
- 150mm foul water sewer flowing parallel to the surface water sewer indicated above.

Appendix C includes the Thames Water sewer records.

3.0 Flood Risk

3.1 Fluvial Flood Risk

Fluvial flood risk is the risk arising from rivers and watercourses.

A floodplain is the area that would naturally be affected by flooding it a river rises above its banks. In England, floodplains are divided into flood zones (FZs) for planning purposes. These areas show the extent of the natural floodplain area at risk of inundation if there were no flood defences or certain other manmade structures and channel improvements. They are divided as follows:

1. Flood Zone 3 shows the land having a 1 in 100 of greater annual probability of river flooding.
2. Flood Zone 2 shows the additional extent of an extreme flood from rivers. It is land having between a 1 in 100 and 1 in 1000 annual probability of river flooding.
3. Flood Zone 1 is the area of land where flooding from rivers is very unlikely.

The EA Flood Map for Planning indicates that the site is located within Flood Zone 1 and therefore at very low risk from fluvial flooding.

3.2 Surface Water and Overland Flows

Surface water flooding occurs where high rainfall events exceed the drainage capacity in an area (i.e. sewer system and/or watercourse), leading to flooding.

Although the National Updated Flood Map for Surface Water shows errors in this location, it indicates that the site is at very low risk of flooding from surface water and overland flows. The extract of the plan has not been included due to the errors in the image.

3.2.1 Bracknell Forest PFRA

The Bracknell Forest PFRA dated 2011 includes a high level plan showing the areas at risk of flooding from surface water within the council boundaries. The plan does not show the site as being at risk of flooding from the 1 in 30 year nor 1 in 200 year return period storm events.

The PFRA indicates that surface water flooding has been recorded in a number of occasions within the district, although the locations of the flooding are not stated.

A consultation to Bracknell Forest Council as LLFA was issued as part of the previous planning application to confirm if there are any records of flooding near the site, however no formal response was received.

However, as part of the previous planning application process, the LLFA did provide a series of comments and these are discussed within Sections 4 and 5. A copy of the previous LLFA comments are contained within Appendix I.

3.3 Groundwater Flooding

The Bracknell Forest SFRA indicates that there are very few records of flooding within the council boundaries. The LFRMS indicates that the site is not within an area of high susceptibility to groundwater flooding. Therefore, it is considered that the site is at very low risk of flooding from groundwater.

3.4 Reservoir Flooding

Although the probability of a catastrophic dam failure is considered to be extremely low, the consequence of such an event would be severe. A review of the EA online 'Risk of Flooding from Reservoirs' map indicates that the site is not at risk of flooding from a reservoir failure.

3.5 Sewer Flooding

There are no sewers within the site and therefore it is considered that the risk of flooding from sewers is low.

3.6 Summary of Flood Risk

Based on the above it can be considered that the site is at very low risk of flooding from rivers, surface water, overland flooding, groundwater, sewers and reservoir failure.

It will also be essential to ensure that any proposed flood mitigation measures do not increase the risk of flooding downstream of the development and this matter is also discussed in more detail within Section 4.

4.0 Development Proposal

4.1 Proposed Development

It is proposed to develop 33 new dwellings and associated landscaping and infrastructure.

A copy of the indicative plan is included within this report as Appendix A.

4.2 Sequential and Exception Tests

One of the aims of the NPPF is to steer development away from zones of high flood risk towards Flood Zone 1. In accordance with Table 2 of the PPG (Flood Risk and Coastal Change), the proposed development is classified as 'More Vulnerable'. Therefore, in accordance with Table 3 of the PPG (Flood Risk & Coastal Change), as the site is located in Flood Zone 1, the proposed development is acceptable and the Sequential and Exception Tests are not required.

4.3 Local Planning Policies

4.3.1 Bracknell Forest Borough Council Core Strategy 2008

The council's core strategy dated 2008 does not contain any specific policies related to flood risk and drainage, although paragraph 128 indicates that SuDS should be used to manage surface water runoff.

4.3.2 Bracknell Forest Local Flood Risk Management Strategy (LFRMS)

A review was undertaken of the Bracknell Forest BC LFRMS dated 2016. This document provides a background to flood risk within the council boundaries and it sets out regional strategies to manage flood risk. Out of the objectives that were set, one seeks to ensure that flood risk issues are considered in planning decisions and that sustainable drainage systems are incorporated into new development.

4.4 Development and Flood Risk

4.4.1 Flood Risk to the Development

As stated in Section 3.6, the site is at very low risk of flooding from rivers, surface water, sewers, groundwater, and reservoir failure.

Additionally, in accordance with the requirements of the PPG and the NPPF, it is essential and required that the development of the site does not increase the risk of flooding off site.

4.4.2 Flood Risk Arising from the Development

The DEFRA Non-Statutory Technical Standards for Sustainable Drainage requires that the rate of surface water runoff from greenfield sites must not exceed the runoff rate from pre developed greenfield site. Therefore, on site attenuation will be provided within the application site to make sure that the proposed surface water drainage system does not exacerbate flood risk outside of the extent of the proposed development for all storm events up to and including the 1 in 100 plus 40% allowance for climate change storm event

4.5 Assessment of Pre and Post Development Areas and Rates

4.5.1 Existing and Proposed Development Areas

The site consists of an area of approximately 1.25 hectares and is classed as greenfield as it consists of greenfield land. Approximate pre and post development areas based on the site plan included as Appendix A are shown in Table 1 below.

Table 1 – Pre and Post Development Areas for the Application Site

Status	Permeable Area (ha)	Impermeable Area (ha)
Pre-Development	1.25	0.0
Post Development	0.62	0.63

The design of the drainage system is required to consider climate change. Guidance issued by the Environment Agency (February 2016) provides rainfall intensity allowances to be considered in an FRA (Table 2). Assuming that the development lifetime will extend to 2118, the applicable 'central' allowance is 20% and the upper end 40%.

4.5.2 Existing and Proposed Discharge Rates

The site currently generates runoff at greenfield runoff rates. Table 2 below shows the greenfield runoff rates generated by the 1.25 ha site and the proposed pre – development runoff discharge rates. The greenfield rates have been obtained using the FEH Method.

Table 2 – Greenfield and Proposed Discharge Rates (l/s)

Status	Qbar (l/s/ha)	1 in 1 year	1 in 30 year	1 in 100 year	1 in 100 year + 40% CC
Pre-Development	7.07	6.01	16.26	22.55	N/A
Post-Development	-	4.7	4.7	4.7	4.7

Based on a Q_{bar} discharge rate of 5.65 l/s/ha and an impermeable area of 0.63ha the allowable discharge rate will equate to 3.56 l/s. However, surface water flows will have to be pumped to the nearest surface water sewer and limiting discharge rates to 3.56 l/s would not comply with Thames Water adoption requirements. Therefore, it is proposed to restrict the discharge rates to 4.7 l/s. This has been agreed with Thames Water, who accept a slightly higher discharge rate in order to retain the operational benefits of the minimum size adoptable rising main.

A copy of the UK SuDS greenfield rates is included as Appendix E.

4.6 Proposed Surface Water Mitigations

4.6.1 Surface Water Runoff Mitigation

In order to ensure that surface water runoff from the site does not cause an increase in flood risk, the management of runoff has been considered via a sequential approach, in line with Building Regulations. The following options for the disposal of surface water runoff where considered, in order of preference:

i) A soakaway or some other infiltration system;

ii) A watercourse or tidal outfall;

iii) A sewer

4.6.1.1 Discharge to Soakaways

An in – situ ground investigation has been undertaken to confirm the feasibility of infiltration within the site. The investigation found that the site is underlain by clays with a very low infiltration rate. Therefore, infiltration has been discounted as a discharge mechanism.

Appendix D includes the ground investigation report.

4.6.1.2 Discharge to a Watercourse

There is a watercourse alongside the northern boundary of the site. Given that infiltration has been proved as being unfeasible, the hierarchy indicates that a discharge to the watercourse is the next option to be investigated.

The existing watercourse is believed to become culverted within the north western part of the site. However, intrusive investigations and clearance works were undertaken to locate the outfall pipe where the existing ditch becomes piped through the adjacent land. However,

despite clearing a large amount of debris and digging for the outlet pipe, none could be located and it appears that the assumed piped section of ditch may not in fact be piped and the surface water may just slowly infiltrate into the previous filled material.

The only way to fully investigate this issue would be to undertake excavations within the adjacent land owners land and at present they are not willing to give permission to allow these works to be undertaken.

Based on the above, it is not possible due to legal issues and access to confirm that the existing watercourse (ditch) will be able to provide a suitable outfall.

4.6.1.3 Discharge to a Sewer

The adjacent land owner is also not willing to allow any flows from the site to be piped through their land or discharge into their riparian owned watercourse located along the eastern side of Gibbins lane.

An alternative would be to requisition a surface water sewer, but as the adjacent land owner would not be willing to allow the final discharge into their watercourse, the only alternative outfall would be to a suitable Thames Water surface water sewer. Whilst it is acknowledged that pumping surface water is the least desirable solution and least sustainable, it is the only option to drain this site. This proposal has been agreed with Thames Water.

In their response to the pre-development enquiry, Thames Water have not stated any restrictions on the length of time or volume of surface water to be pumped into their sewer system.

4.6.2 Proposed Surface Water Drainage Strategy

As the application seeks full permission, a detailed drainage scheme has been developed to demonstrate that the site can be drained effectively.

As indicated above, it is proposed to discharge surface water runoff to the nearest public surface water sewer in the junction between Warfield Road and Newhurst Gardens. A surface water pumping station will be required as the existing levels indicate that a gravity connection would not be feasible. In order to comply with Thames Water adoption requirements, surface water will be pumped at a rate of 4.7 l/s to meet the minimum diameter and velocity requirements.

It is proposed to provide permeable pavements within the private drives of the proposed houses to provide an element of treatment to runoff before it is discharged to the watercourse.

The required attenuation storage volume will be provided by a combination of the permeable pavements, underground attenuation and oversized pipes.

The Arboricultural Survey identified a number of trees within the area of the proposed attenuation tank and pumping station. None of these are Category A trees and therefore they can be removed, with new trees being planted in alternative locations within the site.

Appendix F includes the proposed surface water drainage plan.

4.6.3 Assessment of Post-Development Surface Water Attenuation Volume

Table 3 below includes an initial estimate of the required attenuation volume to be provided to make sure that there is no flooding within the site during any rainfall event up to and including the 1 in 100 year plus 40% climate change return period event. Due to the sloping nature of the site, it would not be practical and possible to retain exceedance flows between the 1 in 30 year and 1 in 100 year plus climate change events within external areas.

The main surface water attenuation is to be provided by means of an underground concrete storage tank located within the proposed open space are to the south west of the application site. In addition, an element of additional attenuation will be provided by means of over-sized pipework.

Table 3 – Post Development Indicative Attenuation Requirements

Impermeable Area inc. 10% urban creep (ha)	Discharge Rate (l/s)	1 in 100 year + 40% CC Volume (m^3)
0.70	4.7	370

A copy of the supporting Micro Drainage calculations is provided as Appendix G.

4.7 Overland Flow Routes & Finished Floor Levels

In setting the final external levels for the development it is important to ensure that if flows in exceedance of the 1 in 100 years plus 40% allowance for climate change storm event occur, or a failure of the site surface water drainage system occurs, that suitable overland flood routes are provided to ensure no localised flooding of the building occurs.

It is not proposed to modify external levels and therefore exceedance flows that exceed the 1 in 100 year plus 40% climate change event will follow the existing ground contours and drain towards the northern watercourse and away from the development.

Additionally, it is proposed to raise Finished Floor Levels (FFLs) 150mm above the ground level in order to provide mitigation in the event that a failure of the drainage system or an event that exceeds the capacity of the system occur.

4.8 Future Maintenance

It is anticipated that the maintenance of the drainage system will be undertaken by a management company. This is further discussed in Section 5 below.

4.9 Residual Risk

If the above mitigation measures are provided as part of the development, it is considered that the primary residual failure would be as a result of some type of failure of the site drainage system during the life of the development. Regular, ongoing maintenance will therefore be required to ensure that the capacity of the system is maintained as it has been designed.

In addition, as discussed above there remains a residual risk of a storm event that exceeds the capacity of the drainage system, as events beyond the 1 in 100 year plus 40% allowance for climate change storm event will not be catered for explicitly.

5.0 Sustainable Drainage Systems

5.1 Review of SuDS Options

In order to comply with the national guidelines and policies set by the Environment Agency and the Non-Statutory Technical Standards for Sustainable Drainage, the design of the surface water drainage system should seek to maximise the use of SuDS techniques.

This section reviews the suitability of the different SuDS elements available for the application site.

As stated previously, where it is possible and viable[1], it is proposed to incorporate a fully compliant SuDS drainage system to deal with the discharge of surface water from the proposed development.

5.2 The SuDS Management Train

The overarching principles of a SuDS system are to minimise the impacts arising from the development on the quantity and quality of the development surface water run-off, whilst at the same time replicating the natural drainage from the site before development.

SuDS key objectives are to minimise the impacts from the development on the quantity and quality of run-off and to maximise amenity and biodiversity opportunities. The accepted SuDS management train consists of three elements:

Source Control

- Water butts, green roofs, filter drains, pervious surfaces, swales.

Site Control

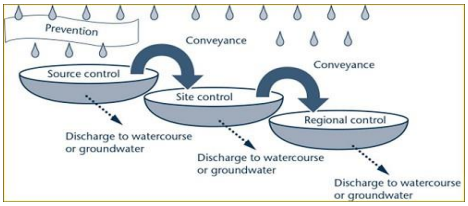
- Swales, ponds, wetlands, infiltration devices

Regional Control

- Basins, ponds and wetlands
- Reservoirs

[1] Reasonable and "what is reasonably practical" is as set out within paragraphs 082,083,084 and 085 of the PPG (Flood Risk & Coastal Change) and compliance with the Technical Standards (i.e. DEFRA Non Statutory Technical Standards for Sustainable Drainage) will be regarded as not practical, if the cost of compliance exceeds the cost of compliance with Building Regulations (unless compliance is necessary where there is a risk of flooding requiring the development to be safe and to avoid flood risk elsewhere).

The following is an illustration of these principles and how they may be applied to a development via a SuDS Management Train.



Various methods are currently available for source, site and regional control. A review has been undertaken of how best the various systems and sub techniques could be incorporated into the proposed surface water management design and these are set out below in Table 4.

Table 4 – Review of SuDS Elements for the Application Site

Type of SuDS		Description	Applicability to the Site
Source Control	Water butts	Small storage tanks on each individual housing plot	This is appropriate for this site.
	Rainwater harvesting	Recycling of water from roofs and impermeable areas.	This may be appropriate for this site.
	Green roofs	Vegetated roofs that reduce runoff and remove pollutants	This is not appropriate for the site.
	Pervious surfaces	Surfaces that allow surface water inflow into underlying surfaces	This is appropriate for the site.
Site & Regional Control	Filter drains	Linear drains or trenches filled with granular material that allow infiltration to the surrounding ground	This is not appropriate for the site.
	Swales	Vegetated channels to convey store and treat runoff.	This may be appropriate for the site
	Basins ponds	Shallow areas of open space that temporarily hold water and collect silt.	This is likely to be appropriate for the site.
	Infiltration basin	Shallow depression that stores runoff before it infiltrates into the subsoil	This is not appropriate for the site.
	Infiltration devices	Generally granular trenches or soakaways that store water and allow infiltration to the surrounding ground	This is not appropriate for the site.

5.3 Proposed Surface Water Drainage Principles

Within this application site a variety of SuDS techniques can be utilised provided that they comply with the DEFRA Non Statutory Technical Standards for Sustainable Drainage Systems. As explained above, the strategy will be based on providing a permeable pavements throughout the site and improvements to the watercourse network. The following section sets out in more detail the most appropriate SuDS elements for the development:

- Water Butts & Rainwater Harvesting

The use of water butts and rainwater recycling in individual dwellings could also be promoted in order to reduce runoff and to minimise water consumption.

- Permeable Pavements

Permeable paving is a type of paving designed to allow runoff to seep into its internal structure and this can provide an element of water attenuation. In this case, due to the presence of clays within the underlying strata the permeable paving will discharge surface water into the underlying basal stone layer and then into an on-site sewer system. By adopting this design this will provide an element of water quality improvement in respect to the run off from the key parking areas.

- Detention Basin

Detention basins are dry depressions that attenuate storm water run-off by providing temporary storage and controlled release of detained runoff. They are normally vegetated depressions (i.e. grass) that remain mainly dry, except during and immediately after storm events.

A review was undertaken of utilising an open detention basin and swales to provide an alternative means of draining the development, however, this required that several units would need to be lost within the north eastern corner and that the flows would still require to be pumped. In addition, the detention basin would not be considered as Public Open Space (POS) by Bracknell Forest Council. The provision of the required POS would require the loss of additional units within the site. Based on this loss of development it was identified that the scheme would not be commercially viable and therefore it is not considered practical to provide open detention basins within the site.

The PPG (Flood Risk and Coastal Change) sets out what is "*reasonably practical*" within paragraphs 082, 083, 084 and 085. These indicate that compliance with the Technical Standards (i.e. DEFRA Non Statutory Technical Standards for Sustainable Drainage) will be regarded as not practical, if the cost of compliance exceeds the cost of compliance with Building Regulations (unless compliance is necessary where there is a risk of flooding requiring the development to be safe and to avoid flood risk elsewhere

5.4 Water Quality

The SuDS design should seek to provide an appropriate management train of SuDS components to effectively mitigate the pollution risks associated with the site users.

Within this development, the key driver in respect of pollutant risk to the receiving ground water is pollution from parked vehicles within the site. According to Table 26.2 of The SUDs Manual[2], a train formed by one or two components will provide the required treatment to runoff from parking areas, then there should be no reduction in the overall water quality within the existing environment.

Oils, silts and other pollutants associated with vehicles are caused by leakages; and therefore in small residential developments such as the proposed these are generated in significant quantities when vehicles are parked. Reviewing the SuDS options, according to Table 26.3 of The SuDS Manual, the required level of treatment by driveways and parking areas can be provided by permeable pavements.

Runoff from the proposed access road will not contain significant levels of pollutants. The proposed network does provide an element of treatment as road gullies incorporate silt traps; with any silt that is not retained in gullies will also be partially retained within the catchpit manhole upstream of the main storage tank upstream of the pumping station.

Any vehicles using the main access road will be transitional and moving not be parked for any length of time and as such will not generate much pollution which could drain into the drainage system.

Although possible options have been stated above, alternative SuDS options may also be considered during the detailed design stage to achieve the same water quality objective.

[2] The SuDS Manual CIRIA C753

5.5 Future SuDS Maintenance Responsibilities

If Bracknell Forest Council or Thames Water do not adopt any site wide SuDS, maintenance of the drainage system will be the responsibility of individual homeowners or a management company if appointed. Where a site wide management company is appointed this will be funded by the residents or site owners and the requirement to fund the management company shall be written into the deeds of each property.

A summary of the general maintenance requirements for the proposed SuDS elements is shown in Table 5 below.

Table 5 –SuDS Maintenance Tasks and Frequency Required

SuDS Element	Maintenance Task	Recommended Frequency
Permeable Pavements	– Brushing and vacuuming – Weed removal – Rehabilitation of surface and upper substructure – Remediation of depressions and cracked blocks – Remediation of landscaping.	– Every 12 months – Every 12 months – As required – As required – As required

6.0 Foul Drainage Assessment

6.1 Existing Foul Drainage

The nearest public foul sewer is a 150mm diameter pipe in Herschel Grange.

6.2 Proposed Foul Drainage Strategy

It is proposed to discharge foul water from the proposed development site to the existing foul sewer in Herschel Grange.

A review of the existing levels has concluded that a gravity connection to the existing sewer is not viable and therefore a foul pumping station and a rising main discharging to the existing Thames Water MH No 7104 at the junction of Hershel Grange and Toogood Place will be required.

A copy of the preliminary foul drainage layout is included within Appendix F.

The estimated peak foul flow from the proposed 33 dwellings will be 1.52 l/s. A pre – development enquiry was submitted to Thames Water in order to confirm if the additional flows can be accepted by the network. In their response, TW indicated there is sufficient capacity in the existing sewer network to accommodate the foul flows generated by the proposed development.

Appendix H includes the responses from TW.

7.0 Conclusions and Recommendations

Based on the findings of this report the following conclusions have been made:

1. According to the EA Flood Map for Planning, the site is located in Flood Zone 1.
2. The site is greenfield and covers an area of 1.25ha.
3. It is proposed to develop up to 33 dwellings within the site.
4. The site is at very low risk of flooding from rivers, surface water, groundwater, sewers and reservoir failure.
5. The proposed development is classed as 'More Vulnerable' according to Table 2 of the Planning Practice Guidance (Flood Risk and Coastal Change).
6. It is not required to pass the Sequential or Exception Tests as the site is in FZ 1 in accordance with Table 3 of the PPG (Flood Risk and Coastal Change).
7. The land falls towards the west.
8. The nearest main river is Bull Brook 400m to the east of the site.
9. The greenfield runoff Qbar rate is 4.5 l/s per hectare.
10. In situ testing has confirmed that infiltration is not feasible at this location due to the presence of clays.
11. It is proposed to discharge surface water runoff to nearest Thames Water surface water sewer in Warfield Road. A rising main will be required as a gravity connection is not feasible. Discharge rates from the proposed development site will be limited to 4.7 l/s, the lowest adoptable pumping rate.
12. It should be noted that it is not possible due to legal issues with the adjacent landowner and establishing the route and condition of the adjacent piped watercourse downstream of the site, to discharge into the existing watercourse which runs along the northern boundary.
13. Attenuation storage for all rainfall events up to and including the 1 in 100 year return period event plus 40% climate change allowance is to be provided by a permeable pavements, oversized pipes and underground attenuation.
14. The main surface water attenuation is to be provided by means of an underground concrete storage tank located within the proposed open space are to the south west of the application site. In addition, an element of additional attenuation will be provided by means of oversized pipework.

15. Foul flows from the proposed development site will be pumped to the existing TW foul sewer manhole reference MH 7104 in Herschel Grange.

Based on the above conclusions, the following recommendations are made:

1. That the FFLs shall be set a minimum of 150mm above the external ground levels.
2. The final site layout and drainage design shall seek to maximise the use of SuDS techniques as outlined within this assessment.
3. Foul drainage shall be discharged to the existing TW foul sewer manhole reference MH 7104 in Herschel Grange via a new rising main laid within the application site.
4. Surface water shall be discharged to the nearest Thames Water surface water sewer in Warfield Road. A rising main will be required as a gravity connection is not feasible. Discharge rates from the proposed development site will be limited to 4.7 l/s, this being the lowest adoptable pumping rate acceptable to Thames Water.
5. On completion, a regular inspection & maintenance regime is to be provided in relation to the proposed non adopted SUDS elements. Where a site wide management company is appointed, this will be funded by the residents or site owners and the requirement to fund the management company shall be written into the deeds of each property.
6. Technical Approval will be required from Thames Water in relation to the Section 104 adoption of the Foul & Surface Water drainage design.

Appendix A - Proposed Site Layout

HERSCHEL GRANGE

TOOGOOD PLACE

KEY

- PROPOSED TREES
- EXISTING TREES TO BE RETAINED
- TREES TO BE REMOVED
- PROPOSED INDICATIVE PLANTING
- EXISTING PLANTING
- SITE BOUNDARY
- EXISTING HOUSE TO BE DEMOLISHED

NORTH

0 1 2 3 4 5 m 10 15 20

Scale 1:250

Rev.	Date	Detail

Status: PLANNING ISSUE

ASCOT DESIGN
Timeless architecture

Ascot Design Ltd, Berkshire House 39-51 High Street, Ascot, Berkshire, SL5 7HY
Tel: 01344 299330 Fax: 01344 299331 Email: info@ascotdesign .com
www.ascotdesign.com

Client: HODSON DEVELOPMENTS

Project Title: HERSCHEL GRANGE, WARFIELD, BRACKNELL

DRAWING Title: PROPOSED SITE PLAN

Scale.	Date	Drawn
1:250 @ A1	JUN 18	SF

DRAWING No. 17 - J2176 - 04

Rev.

Appendix B - Topographic Survey

D&H Surveys

The Manor Stables, Great Somerford, Chippenham
Wiltshire, SN15 5EH.
Email: admin@dhsurveys.co.uk
Website: www.dhsurveys.co.uk
Tel (01249) 720545
Fax (01249) 721124

Topographic Surveys
Elevation Surveys
Floor Plan Surveys
Volumetric Surveys
As Built Drainage Surveys
Site Setting Out
Co-ordination Of Site Layouts
Rectified Photo Elevations
C.A.D Plotting Bureau

Project Name:
Herschel Grange
Warfield

Drawing Title:
Topographic Survey

Client:
Hodson Developments

Agent:

Date:	Scale:
November 2017	1:250@A0

Drawn	Surveyor	Dwg No	Revision
KJH	G.M	SU-01	REV C

Site Datum	OSBM Reference
OSGM-02	
Grid Orientation	**Sheet ID**
OS Grid	Hodson Developments-Warfield

Disclaimer
D & H Surveys will Guarantee that this Survey Data is Correct to the Indicated Scale only.

Appendix C - Thames Water Sewer Records

Asset location search

Thames Water Property Searches

WYG Engineering Ltd
Arndale Court
Otley Road
LEEDS
LS6 2UJ

Search address supplied	Herschel Grange 4 Herschel Grange Warfield Bracknell RG42 6AT
Your reference	A108468
Our reference	ALS/ALS Standard/2018_3781184
Search date	24 April 2018

Keeping you up-to-date

Knowledge of features below the surface is essential in every development. The benefits of this not only include ensuring due diligence and avoiding risk, but also being able to ascertain the feasibility for any commercial or residential project.

An asset location search provides information on the location of known Thames Water clean and/or wastewater assets, including details of pipe sizes, direction of flow and depth. Please note that information on cover and invert levels will only be provided where the data is available.

Thames Water Utilities Ltd
Property Searches, PO Box 3189, Slough SL1 4WW
DX 151280 Slough 13

searches@thameswater.co.uk
www.thameswater-propertysearches.co.uk

0845 070 9148

Asset location search

Thames Water Property Searches

Search address supplied: Herschel Grange, 4, Herschel Grange, Warfield, Bracknell, RG42 6AT

Dear Sir / Madam

An Asset Location Search is recommended when undertaking a site development. It is essential to obtain information on the size and location of clean water and sewerage assets to safeguard against expensive damage and allow cost-effective service design.

The following records were searched in compiling this report: - the map of public sewers & the map of waterworks. Thames Water Utilities Ltd (TWUL) holds all of these.

This searchprovides maps showing the position, size of Thames Water assets close to the proposed development and also manhole cover and invert levels, where available.

Please note that none of the charges made for this report relate to the provision of Ordnance Survey mapping information. The replies contained in this letter are given following inspection of the public service records available to this company. No responsibility can be accepted for any error or omission in the replies.

You should be aware that the information contained on these plans is current only on the day that the plans are issued. The plans should only be used for the duration of the work that is being carried out at the present time. Under no circumstances should this data be copied or transmitted to parties other than those for whom the current work is being carried out.

Thames Water do update these service plans on a regular basis and failure to observe the above conditions could lead to damage arising to new or diverted services at a later date.

Contact Us

If you have any further queries regarding this enquiry please feel free to contact a member of the team on 0845 070 9148, or use the address below:

Thames Water Utilities Ltd
Property Searches
PO Box 3189
Slough
SL1 4WW

Email: searches@thameswater.co.uk
Web: www.thameswater-propertysearches.co.uk

Waste Water Services

Please provide a copy extract from the public sewer map.

Enclosed is a map showing the approximate lines of our sewers. Our plans do not show sewer connections from individual properties or any sewers not owned by Thames Water unless specifically annotated otherwise. Records such as "private" pipework are in some cases available from the Building Control Department of the relevant Local Authority.

Where the Local Authority does not hold such plans it might be advisable to consult the property deeds for the site or contact neighbouring landowners.

This report relates only to sewerage apparatus of Thames Water Utilities Ltd, it does not disclose details of cables and or communications equipment that may be running through or around such apparatus.

The sewer level information contained in this response represents all of the level data available in our existing records. Should you require any further Information, please refer to the relevant section within the 'Further Contacts' page found later in this document.

For your guidance:

- The Company is not generally responsible for rivers, watercourses, ponds, culverts or highway drains. If any of these are shown on the copy extract they are shown for information only.
- Any private sewers or lateral drains which are indicated on the extract of the public sewer map as being subject to an agreement under Section 104 of the Water Industry Act 1991 are not an ‘as constructed’ record. It is recommended these details be checked with the developer.

Clean Water Services

Please provide a copy extract from the public water main map.

With regard to the fresh water supply, this site falls within the boundary of another water company. For more information, please redirect your enquiry to the following address:

South East Water Ltd
3 Church Road
Haywards Heath

Asset location search

Thames Water Property Searches

West Sussex
RH16 3NY

Tel: 0333 000 0059

For your guidance:

- Assets other than vested water mains may be shown on the plan, for information only.
- If an extract of the public water main record is enclosed, this will show known public water mains in the vicinity of the property. It should be possible to estimate the likely length and route of any private water supply pipe connecting the property to the public water network.

Payment for this Search

A charge will be added to your suppliers account.

Further contacts:

Waste Water queries

Should you require verification of the invert levels of public sewers, by site measurement, you will need to approach the relevant Thames Water Area Network Office for permission to lift the appropriate covers. This permission will usually involve you completing a TWOSA form. For further information please contact our Customer Centre on Tel: 0845 920 0800. Alternatively, a survey can be arranged, for a fee, through our Customer Centre on the above number.

If you have any questions regarding sewer connections, budget estimates, diversions, building over issues or any other questions regarding operational issues please direct them to our service desk. Which can be contacted by writing to:

Developer Services (Waste Water)
Thames Water
Clearwater Court
Vastern Road
Reading
RG1 8DB

Tel: 0800 009 3921
Email: developer.services@thameswater.co.uk

Clean Water queries

Should you require any advice concerning clean water operational issues or clean water connections, please contact:

Developer Services (Clean Water)
Thames Water
Clearwater Court
Vastern Road
Reading
RG1 8DB

Tel: 0800 009 3921
Email: developer.services@thameswater.co.uk

Asset Location Search Sewer Map - ALS/ALS Standard/2018_3781184

The width of the displayed area is 500 m and the centre of the map is located at OS coordinates 487849,171237

The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.

NB. Levels quoted in metres Ordnance Newlyn Datum. The value -9999.00 indicates that no survey information is available

Manhole Reference	Manhole Cover Level	Manhole Invert Level
9001	68.35	66.78
9004	68.7	67.52
9005	68.7	67.5
9006	68.65	67.19
9002	68.68	67.28
9101	68.02	66.6
9102	67.52	66.02
9003	68.42	66.79
011A	n/a	n/a
0102	67.88	65.99
0001	67.78	66.48
0002	68.28	67.02
011B	n/a	n/a
0101	66.75	64.85
8104	65.57	64.03
8103	66.22	64.44
8102	66.44	64.56
8105	66.97	64.95
9201	66.95	65.09
9202	66.97	64.68
9204	66.34	64.11
9203	66.31	63.96
0302	64.66	62.81
0301	64.68	62.76
0404	62.86	60.97
0402	62.91	60.91
8101	66.87	65.32
7102	66.07	64.05
7106	65.47	62.95
7105	65.68	63.15
7101	64.43	61.85
6101	62.23	60.38
621B	n/a	n/a
621A	n/a	n/a
611A	n/a	n/a
721G	n/a	n/a
721H	n/a	n/a
721K	n/a	n/a
721J	n/a	n/a
721B	n/a	n/a
721A	n/a	n/a
721C	n/a	n/a
721D	n/a	n/a
721E	n/a	n/a
721F	n/a	n/a
721I	n/a	n/a
7104	65.15	63.66
7103	65.47	63.86

ALS Sewer Map Key

Public Sewer Types (Operated & Maintained by Thames Water)

Foul: A sewer designed to convey waste water from domestic and industrial sources to a treatment works.

Surface Water: A sewer designed to convey surface water (e.g. rain water from roofs, yards and car parks) to rivers or watercourses.

Combined: A sewer designed to convey both waste water and surface water from domestic and industrial sources to a treatment works.

Trunk Surface Water

Trunk Foul

Storm Relief

Trunk Combined

Vent Pipe

Bio-solids (Sludge)

Proposed Thames Surface Water Sewer

Proposed Thames Water Foul Sewer

Gallery

Foul Rising Main

Surface Water Rising Main

Combined Rising Main

Sludge Rising Main

Proposed Thames Water Rising Main

Vacuum

Sewer Fittings

A feature in a sewer that does not affect the flow in the pipe. Example: a vent is a fitting as the function of a vent is to release excess gas.

Air Valve

Dam Chase

Fitting

Meter

Vent Column

Operational Controls

A feature in a sewer that changes or diverts the flow in the sewer. Example: A hydrobrake limits the flow passing downstream.

Control Valve

Drop Pipe

Ancillary

Weir

End Items

End symbols appear at the start or end of a sewer pipe. Examples: an Undefined End at the start of a sewer indicates that Thames Water has no knowledge of the position of the sewer upstream of that symbol, Outfall on a surface water sewer indicates that the pipe discharges into a stream or river.

Outfall

Undefined End

Inlet

Other Symbols

Symbols used on maps which do not fall under other general categories

Public/Private Pumping Station

Change of characteristic indicator (C.O.C.I.)

Invert Level

Summit

Areas

Lines denoting areas of underground surveys, etc.

Agreement

Operational Site

Chamber

Tunnel

Conduit Bridge

Other Sewer Types (Not Operated or Maintained by Thames Water)

Foul Sewer

Surface Water Sewer

Combined Sewer

Gulley

Culverted Watercourse

Proposed

Abandoned Sewer

Notes:

1) All levels associated with the plans are to Ordnance Datum Newlyn.
2) All measurements on the plans are metric.
3) Arrows (on gravity fed sewers) or flecks (on rising mains) indicate direction of flow.
4) Most private pipes are not shown on our plans, as in the past, this information has not been recorded.
5) 'na' or '0' on a manhole level indicates that data is unavailable.
6) The text appearing alongside a sewer line indicates the internal diameter of the pipe in milimetres. Text next to a manhole indicates the manhole reference number and should not be taken as a measurement. If you are unsure about any text or symbology present on the plan, please contact a member of Property Insight on 0845 070 9148.

Terms and Conditions

All sales are made in accordance with Thames Water Utilities Limited (TWUL) standard terms and conditions unless previously agreed in writing.

1. All goods remain in the property of Thames Water Utilities Ltd until full payment is received.
2. Provision of service will be in accordance with all legal requirements and published TWUL policies.
3. All invoices are strictly due for payment 14 days from due date of the invoice. Any other terms must be accepted/agreed in writing prior to provision of goods or service, or will be held to be invalid.
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5. In case of dispute TWUL`s terms and conditions shall apply.
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7. Interest will be charged in line with current Court Interest Charges, if legal action is taken.
8. A charge may be made at the discretion of the company for increased administration costs.

A copy of Thames Water's standard terms and conditions are available from the Commercial Billing Team (cashoperations@thameswater.co.uk).

We publish several Codes of Practice including a guaranteed standards scheme. You can obtain copies of these leaflets by calling us on 0800 316 9800

If you are unhappy with our service you can speak to your original goods or customer service provider. If you are not satisfied with the response, your complaint will be reviewed by the Customer Services Director. You can write to her at: Thames Water Utilities Ltd. PO Box 492, Swindon, SN38 8TU.

If the Goods or Services covered by this invoice falls under the regulation of the 1991 Water Industry Act, and you remain dissatisfied you can refer your complaint to Consumer Council for Water on 0121 345 1000 or write to them at Consumer Council for Water, 1st Floor, Victoria Square House, Victoria Square, Birmingham, B2 4AJ.

Ways to pay your bill

Credit Card	**BACS Payment**	**Telephone Banking**	**Cheque**
Call **0845 070 9148** quoting your invoice number starting CBA or ADS / OSS	Account number **90478703** Sort code **60-00-01** A remittance advice must be sent to: **Thames Water Utilities Ltd., PO Box 3189, Slough SL1 4WW.** or email **ps.billing@thameswater.co.uk**	By calling your bank and quoting: Account number **90478703** Sort code **60-00-01** and your invoice number	Made payable to '**Thames Water Utilities Ltd**' Write your Thames Water account number on the back. Send to: **Thames Water Utilities Ltd., PO Box 3189, Slough SL1 4WW** or by DX to **151280 Slough 13**

Thames Water Utilities Ltd Registered in England & Wales No. 2366661 Registered Office Clearwater Court, Vastern Rd, Reading, Berks, RG1 8DB.

Search Code

IMPORTANT CONSUMER PROTECTION INFORMATION

This search has been produced by Thames Water Property Searches, Clearwater Court, Vastern Road, Reading RG1 8DB, which is registered with the Property Codes Compliance Board (PCCB) as a subscriber to the Search Code. The PCCB independently monitors how registered search firms maintain compliance with the Code.

The Search Code:

- provides protection for homebuyers, sellers, estate agents, conveyancers and mortgage lenders who rely on the information included in property search reports undertaken by subscribers on residential and commercial property within the United Kingdom
- sets out minimum standards which firms compiling and selling search reports have to meet
- promotes the best practise and quality standards within the industry for the benefit of consumers and property professionals
- enables consumers and property professionals to have confidence in firms which subscribe to the code, their products and services.

By giving you this information, the search firm is confirming that they keep to the principles of the Code. This provides important protection for you.

The Code's core principles

Firms which subscribe to the Search Code will:

- display the Search Code logo prominently on their search reports
- act with integrity and carry out work with due skill, care and diligence
- at all times maintain adequate and appropriate insurance to protect consumers
- conduct business in an honest, fair and professional manner
- handle complaints speedily and fairly
- ensure that products and services comply with industry registration rules and standards and relevant laws
- monitor their compliance with the Code

Complaints

If you have a query or complaint about your search, you should raise it directly with the search firm, and if appropriate ask for any complaint to be considered under their formal internal complaints procedure. If you remain dissatisfied with the firm's final response, after your complaint has been formally considered, or if the firm has exceeded the response timescales, you may refer your complaint for consideration under The Property Ombudsman scheme (TPOs). The Ombudsman can award compensation of up to £5,000 to you if he finds that you have suffered actual loss as a result of your search provider failing to keep to the Code.

Please note that all queries or complaints regarding your search should be directed to your search provider in the first instance, not to TPOs or to the PCCB.

TPOs Contact Details

The Property Ombudsman scheme
Milford House
43-55 Milford Street
Salisbury
Wiltshire SP1 2BP
Tel: 01722 333306
Fax: 01722 332296
Email: admin@tpos.co.uk

You can get more information about the PCCB from www.propertycodes.org.uk

PLEASE ASK YOUR SEARCH PROVIDER IF YOU WOULD LIKE A COPY OF THE SEARCH CODE

Appendix D - Ground Investigation Report

Herschel Grange
Warfield
Bracknell
Berkshire

In Situ Infiltration Testing Report

Report Beneficiary:
Hodson Developments
Office 9
55 Park Lane
London
W1K 1NA

Document Control			
Report Ref	**Date**	**Notes**	
R18-12995	5th June 2018	Final for issue	
Report Section		**Prepared By**	**Approved By**
In Situ Infiltration Testing		Lucy Griffiths BSc FGS	Rebecca Webb BSc FGS

Head Office
Unit 3
The Old Grain Store
Ditchling Common Business Park
Ditchling
West Sussex
BN6 8SG

Northern Office
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Dunham House
85-89 Cross Street
Sale
Cheshire
M33 7HH

Tel: 01273 483119
www.ashdownsi.co.uk

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TABLE OF CONTENTS

FIGURES AND APPENDICES

1. INTRODUCTION

It is understood that a surface water management strategy is to be implemented for a proposed new development at Herschel Grange, Warfield, Bracknell, Berkshire.

Ashdown Site Investigation Limited was requested to provide an estimate for carrying out in situ infiltration testing at the site by Mr T Hodson of Hodson Developments, Office 9, 55 Park Lane, London W1K 1NA. The scope of the works allowed for and the terms and conditions under which the works were to be undertaken were set out within the offer letter Q18-7263/rev1, dated 15th May 2018. The instruction to proceed was received from the client, Hodson Developments via purchase order number 0001/H178, dated 16th May 2018.

The objectives of the works were to:

a) Investigate the shallow ground and groundwater conditions at exploratory hole locations across the site; and
b) Undertake soakage testing and provide calculated soil infiltration rates to assist others in undertaking design of infiltration systems.

2. GROUND INVESTIGATION

The site works comprised the excavation of a series of dynamic sampler boreholes to depths of either 2m, 3m or 5m below ground level. The fieldwork was carried out on 24th May 2018. In situ soakage testing was carried out within the 2m or 3m deep boreholes. The exploratory hole locations are shown on Figure 1.

Groundwater monitoring standpipes together with dataloggers were installed within the 5m deep boreholes (WS02, WS04 and WS06) to record groundwater levels over a four week period. The results of the groundwater monitoring will be provided under separate cover.

Descriptions of the strata encountered and comments on groundwater conditions are shown in the exploratory hole records that are appended to this report. Notes to assist interpretation of the records are also appended.

3. GROUND CONDITIONS

3.1 Stratigraphy

3.1.1 Surface Covering

Each borehole was excavated through a surface cover of topsoil some 50mm to 200mm in thickness.

3.1.2 Made Ground/Reworked Ground

Underlying the surfacing, made ground/reworked soils, comprising gravelly sandy clay was generally encountered to depths of between 0.40m and 0.50m below ground level. The gravel fraction contained variable quantities of brick, flint and charcoal-like material.

Within borehole WS01 made ground comprising sandy gravel of flint and brick was recorded. Due to limited recovery of samples at this location, particularly below 1.00m, the depth of the made ground has been assumed to be at some 1.0m but may be shallower or deeper. Clay soils were noted on the sampler tube below 1.0m depth.

No made ground or reworked soils were recorded in boreholes WS04 or WS06.

3.1.3 London Clay Formation

Beneath the surfacing and made ground/reworked soils, where encountered, clay soils, interbedded with sandy clays and clayey sands were recorded to underlie the site. These soils persisted to the full depth of the investigation at 5.00m below existing ground level.

It is noted that whilst the published geological map indicates that the London Clay Formation soils are present beneath the site, superficial River Terrace Deposits are shown in the vicinity of the site. The coarser grained soils may be representative of either the upper part of the London Clay Formation or the River Terrace Deposits, however for the purposes of this report the soils encountered have been denoted as being the London Clay Formation.

3.2 Stability

Instability was recorded locally within the coarser grained deposits.

3.3 Groundwater Conditions

Where encountered during the intrusive works, groundwater was generally recorded to lie between depths of 1.90m and 4.80m below ground level on completion of the boreholes.

4. STORMWATER INFILTRATION SYSTEMS

In situ infiltration testing[1] was undertaken in each of the boreholes. From the test results, calculations were made to estimate the infiltration rate that could be expected for soakaways constructed to discharge into the underlying soils within the test zone.

The infiltration rates derived from the tests are summarised in the following table.

Table 1. Calculated Infiltration Rates

Exploratory Hole	Test Response Zone Depth (m)		Stratum	Infiltration Rate (f) (m/sec)	Driving Head of Water (m)
	Top	Bottom			
WS01	1.00	2.00	Likely clay of the London Clay Formation however no recovery of samples.	Negligible - No fall in the water level in 101 minutes.	
WS03	1.00	3.00	London Clay Formation (clay)	Negligible – the water fell only 30mm in 171 minutes	
WS05	1.00	3.00	London Clay Formation (sandy clay and clayey sand)	8.7×10^{-7}	1.50
WS07	1.00	3.00	London Clay Formation (sandy clay and clayey sand)	3.7×10^{-7}	1.75
WS08	1.00	2.00	London Clay Formation (sandy clay and clayey sand)	4.7×10^{-6}	1.00
WS09	1.00	3.00	London Clay Formation (sandy clay and clayey sand)	8.8×10^{-7}	1.50

The value 'f' is equivalent to the soil infiltration coefficient 'q' quoted in the Construction Industry Research and Information Association (CIRIA) Report 156.

The results from the infiltration tests indicate that the London Clay Formation deposits possess negligible to poor infiltration characteristics. The results from the infiltration tests should be provided to engineers responsible for the design of the drainage system.

To minimise the risk of subsidence, point discharging infiltration systems (conventional ring or trench soakaways) should be constructed a minimum of 5.0m away from proposed or existing buildings.

Whilst groundwater monitoring is currently underway, the Local Authority or other regulators may still require monitoring of groundwater levels during the worst annual case (wetter periods) to have been undertaken prior to designing the infiltration systems.

In the event that discharge to ground via infiltration systems is proposed, it is recommended that designers of the system provide for the prevention of pollution of groundwater. In this regard attention is drawn to guidance provided within BRE 365 and by the Environment Agency which requires a contamination risk assessment to be carried out in order to assess the potential risk to groundwater.

Appropriate consideration should be given to whether there is a need for inclusion of interceptors and oil separators. The Local Authority and/or relevant water company should be consulted in

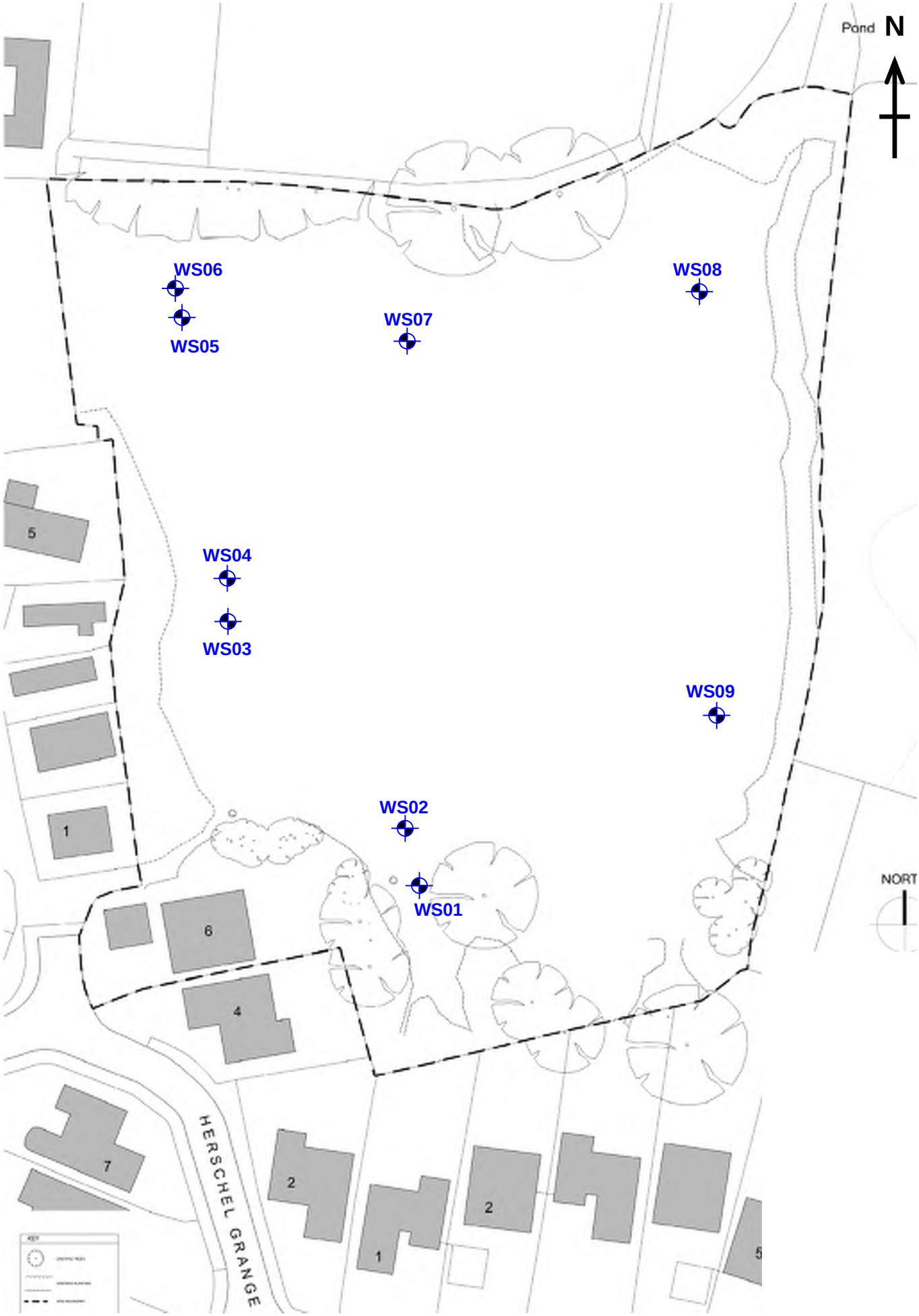
[1] Conducted in accordance with The Soakaway Design Guide, published by Kent County Council, July 2000.

relation to consent for discharge of water from rooftops, areas of hardstanding and roadways to drains.

Ashdown Site Investigation Ltd.
June 2018

FIGURES AND APPENDICES

Figure 1 Site Plan
Exploratory Hole Notes
Exploratory Hole Records
Summary of Borehole Falling Head Soakage Test Results



ASHDOWN SITE INVESTIGATION LIMITED	Site: Herschel Grange, Warfield, Bracknell, Berkshire	Site Plan. Not To Scale	Figure 1 R18-12995

NOTES FOR THE INTERPRETATION OF EXPLORATORY HOLE RECORDS

1 Symbols and abbreviations

Samples

U 'Undisturbed' Sample: - also known as 'U100' or 'U4' - 100mm diameter by 450mm long. The number of blows to drive in the sampling tube is shown after the test index letter in the SPT column.
Uo Sample not obtained.
U* Full penetration of sample not obtained.
Pi Piston Sample: 'Undisturbed' sample 100mm diameter by 600mm long.
D Disturbed Sample.
R Root Sample.
B Bulk Disturbed Sample.
W Water Sample.
J Jar Sample (sample taken in amber glass jar fitted with gas tight lid)
T Tub Sample
Vi Vial Sample

In situ Testing

S Standard penetration test (SPT): In the borehole record the depth of the test is that at the start of the normal 450mm penetration. The number of blows per 75mm penetration is recorded, with the initial 150mm for seating blows being recorded followed by the blows recorded for the remaining 300mm of the test. The total blows to achieve the standard penetration of 300mm, discounting the seating blows, is noted as the N value on the log. Where the full penetration of the test cannot be achieved (a refusal) the number of blows achieved and the penetration achieved will be reported.

C Standard Penetration Test (SPT) conducted usually in coarse grained soils or weak rocks using the same procedure as for the SPT but with a 50mm diameter, 60º apex solid cone fitted in place of the sampler. Variations in test results are indicated by the same symbols as for the SPT (above).

V Shear Vane Test: Undrained shear strength (cohesion) (kN/m^2) shown within the Vane/Pen Test and N Value column.

H Hand penetrometer Test: Undrained shear strength (cohesion) (kN/m^2) shown within the Vane/Pen Test and N Value column.

P Perth Penetrometer Test: See "In Situ Testing Notes" for full description. Number of blows for 300mm penetration shown under Vane/Pen Test and N Value column. In sand the number of blows is approximately equivalent to the SPT "N" value.

Excavation Method

CP Cable Percussion Borehole
WLS Dynamic Sampler Borehole using windowless sampler tubes
WS Dynamic Sampler Borehole using window sampler tubes
TP Trial Pit excavated using mechanic excavator
HDP Trial Pit excavated using hand tools

2 Soil Description

Description and classification of soils has been carried out using as a general basis the British Standard Geotechnical investigation and testing – Identification and classification of soil, Part 1 Identification and description (BS EN ISO 14688-1:2002+A1:2013) and Part 2 Principles of classification (BS EN 14688-2:2004+A1:2013) as well as the BS5930:2015 code of Practice for Ground Investigations.

Fine Grained Soils

The consistency of fine grained soils given in the report is based on visual inspection of the samples and the strength is based on results of in situ and/or laboratory undrained shear strength tests when carried out.

The consistency is determined on the following basis:

Consistency	**Manual Test**
Very Soft	Soil exudes between fingers when squeezed in hand
Soft	Soils can be moulded by light finger pressure
Firm	Cannot be moulded by finger but rolled to 3mm threads without breaking/crumbling
Stiff	Crumbles/breaks when rolled to 3mm thick threads but can be moulded into a lump again
Very Stiff	Cannot be moulded and crumbles under pressure, can be indented by thumbnail

The terms used for the designation of the undrained shear strength are as follows:

Undrained Shear Strength	
Extremely to Very Low	<20 kPa
Low	20-40 kPa
Medium	40-75 kPa
High	75-150 kPa
Very High	150-300 kPa
Extremely high	300-600 kPa

Note: The undrained shear strength of the soils is measured either by laboratory testing or in the field using hand shear vane.

It is recognised that any coarse grained soil that has in excess of approximately 35% fine grained soil (clay and silt) can often be expected to behave as a fine grained soil despite the dominance of coarse grained material within the soil mass. To reflect this, it is the soil type that dominates the behaviour of the soil mass that appears on the exploratory hole records.

Coarse Grained Soils

The relative densities of coarse grained soils (sand and gravel) given in the report are based on field estimations and the results of the Standard Penetration Test (SPT) and equivalent correlation from other testing. The classification in terms of "N" Values is as follows:

SPT 'N' Value	**Relative Density**
0-4	Very Loose
4-10	Loose
10-30	Medium Dense
30-50	Dense
Greater than 50	Very Dense

3 Rock Description

Description and classification of rocks has been carried out using as a general basis the British Standard Geotechnical investigation and testing – Identification and classification of rock, Part 1 Identification and classification (BS EN ISO 14689-1:2003) as well as the BS5930:2015 code of Practice for Ground Investigations.

The description of rock mass includes the type of rock, structure, discontinuities and weathering.

The unconfined compressive strength of rock material is determined on the following basis:

Term	**Field Identification**	**Unconfined Compressive Strength (MPa)**
Extremely Weak	Indented by thumbnail	Less than 1
Very Weak	Crumbles under firm blows with point of geological hammer, peeled by pocket knife	1 to 5
Weak	Peeled by pocket knife with difficulty, shallow indentations made by firm blow with geological hammer	5 to 25
Medium Strong	Cannot be peeled or scraped with knife, can be fractured with single firm blow of geological hammer	25 to 50
Strong	Requires more than one blow of geological hammer to fracture	50 to 100
Very Strong	Requires may blows of geological hammer to fracture it	100 to 250
Extremely Strong	Can only be chipped with geological hammer	Greater and 250

The terms describing discontinuity and bedding spacing are as follows:

Bedding Thickness	
Very Thick	>2000mm
Thick	2000-600mm
Medium	600-200mm
Thin	200-60mm
Very Thin	60-20mm
Thickly Laminated	20-6mm
Thinly Laminated	<6mm

Discontinuity Spacing	
Very Wide	>2000mm
Wide	2000-600mm
Medium	600-200mm
Close	200-60mm
Very Close	60-20mm
Extremely Close	<20mm

Chalk

Chalk description is based on BS EN ISO 14688, BS EN ISO 14689 and BS5930. The classification of chalk generally follows the guidance offered by the Construction Industry Research and Information Association (CIRIA) C574, 'Engineering in Chalk'. This is based on assessment of chalk density, discontinuity and aperture spacing, and the proportion of intact chalk to silt of chalk. See additional chalk classification notes.

ASHDOWN SITE INVESTIGATION LIMITED
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Site Name: Herschel Grange, Warfield, Bracknell, Berkshire

Job Number: R18-12995

Start Date: 24/05/2018

End Date: 24/05/2018

Borehole Number: **WS01**

Standpipe	Samples and In Situ Testing: Sample/ Test Type	Depth From (m)	Depth To (m)	Test Result	Legend	Depth	Stratum Description
						0.00	Topsoil.
						0.10	MADE GROUND. Grey brown sandy angular to subangular fine to coarse gravel of brick and flint.
							Depth of stratum boundary assumed.
						1.00	Brown clay (no recovery of sample as obstruction in tube, however brown clay noted on sampler).
						2.00	End of borehole at 2.00m

Remarks

Groundwater: Borehole dry on completion.

Stability: Borehole cased to 1.00m depth.

Notes: n/a

Excavation Method: WLS

Borehole Diameter: Various

Made By: MR

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Site Name: Herschel Grange, Warfield, Bracknell, Berkshire

Job Number: R18-12995

Start Date: 24/05/2018

End Date: 24/05/2018

Borehole Number: **WS02**

Standpipe	Samples and In Situ Testing: Sample/ Test Type	Depth From (m)	Depth To (m)	Test Result	Legend	Depth	Stratum Description
						0.00	Topsoil.
	D	0.30				0.20	MADE GROUND: Dark brown gravelly sandy clay. Gravel is angular to subangular fine to medium brick and flint.
	D	0.80				0.50	Orange brown mottled grey silty sandy CLAY with rare sand horizons. (London Clay Formation)
	D	1.50					becoming dark grey mottled orange below 1.50m depth.
	D	2.50					with crystals of selenite below 3.00m depth.
	D	3.50					
	D	4.50					
						5.00	End of borehole at 5.00m

Remarks

Groundwater: Standing water at 4.80m depth on completion of borehole.

Stability: Borehole stable on completion.

Notes: Standpipe installed to 5.00m depth; 5.00m to 1.00m slotted pipe with gravel surround; 1.00m to ground level plain pipe with bentonite seal; completed with end cap and security cover concreted flush with ground surface.

Excavation Method: WLS

Borehole Diameter: Various

Made By: RJ

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Tel: 01273 483119

Site Name: Herschel Grange, Warfield, Bracknell, Berkshire

Job Number: R18-12995

Start Date: 24/05/2018

End Date: 24/05/2018

Borehole Number: **WS03**

Standpipe	Samples and In Situ Testing: Sample/ Test Type	Depth From (m)	Depth To (m)	Test Result	Legend	Depth	Stratum Description
						0.00	Topsoil
	D	0.20				0.10	MADE GROUND: Grey brown slightly gravelly sandy clay. Gravel of angular to subrounded fine to coarse brick, flint and charcoal-like material. Sand is fine to coarse.
						0.40	Grey and orange brown mottled CLAY. (London Clay Formation)
	D	0.80					with rare gravel of flint in the upper 1.00m depth.
							becoming orange brown mottled grey below 1.20m depth.
	D	1.50					
	D	2.50					
						3.00	End of borehole at 3.00m

Remarks

Groundwater: Borehole dry on completion.

Stability: Borehole stable on completion.

Notes: n/a

Excavation Method: WLS

Borehole Diameter: Various

Made By: MR

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Web: www.ashdownsi.co.uk
Tel: 01273 483119

Site Name: Herschel Grange, Warfield, Bracknell, Berkshire

Job Number: R18-12995

Start Date: 24/05/2018

End Date: 24/05/2018

Borehole Number: **WS04**

Standpipe	Samples and In Situ Testing: Sample/ Test Type	Depth From (m)	Depth To (m)	Test Result	Legend	Depth	Stratum Description
						0.00	Topsoil.
						0.20	Orange brown and grey mottled CLAY with occasional horizons of fine to coarse SAND. (London Clay Formation)
	D	0.50					
	D	1.30					becoming very sandy between 1.20m and 1.40m depth.
	D	1.80					becoming dark grey and occasionally orange mottled below 1.60m depth.
	D	2.50					
	D	3.50				3.00	Orange brown very clayey fine to medium SAND. (London Clay Formation)
	D	4.50				4.00	Dark grey CLAY. (London Clay Formation)
						5.00	End of borehole at 5.00m

Remarks

Groundwater: Standing water at 2.90m depth on completion of borehole.

Stability: Borehole collapsed to 3.40m depth on completion.

Notes: Standpipe installed to 3.30m depth; 3.30m to 1.30m slotted pipe with gravel surround; 1.30m to ground level plain pipe with bentonite seal; completed with end cap and security cover concreted flush with ground surface.

Excavation Method: WLS

Borehole Diameter: Various

Made By: RJ

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Site Name: Herschel Grange, Warfield, Bracknell, Berkshire

Job Number: R18-12995

Start Date: 24/05/2018

End Date: 24/05/2018

Borehole Number: **WS05**

Standpipe	Samples and In Situ Testing: Sample/ Test Type	Depth From (m)	Depth To (m)	Test Result	Legend	Depth	Stratum Description
						0.00	Topsoil.
	D	0.30				0.05	MADE GROUND:/ Reworked: Grey brown gravelly sandy clay with rootlets. Gravel of subangular to subrounded fine to coarse flint. Sand is fine to coarse.
						0.40	Grey and orange brown mottled slightly sandy silty CLAY. Sand is fine to coarse. (London Clay Formation)
	D	0.80					
	D	1.50				1.70	Orange brown and grey mottled very clayey fine to medium SAND. (London Clay Formation) becoming grey clay between 1.90m and 2.00m depth.
	D	2.50				2.30	Dark grey mottled orange CLAY. (London Clay Formation)
						3.00	End of borehole at 3.00m

Remarks

Groundwater: Borehole dry on completion.

Stability: Borehole stable on completion.

Notes: n/a

Excavation Method: WLS

Borehole Diameter: Various

Made By: MR

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Site Name: Herschel Grange, Warfield, Bracknell, Berkshire

Job Number: R18-12995

Start Date: 24/05/2018

End Date: 24/05/2018

Borehole Number: **WS06**

Standpipe	Sample/ Test Type	Depth From (m)	Depth To (m)	Test Result	Legend	Depth	Stratum Description
						0.00	Topsoil.
						0.10	Orange brown mottled grey slightly sandy CLAY. Sand is fine to medium. (London Clay Formation)
	D	0.50					
	D	1.20					
	D	1.50					becoming sandy with occasional angular to subrounded fine to coarse gravel of flint between 1.40m and 1.70m depth.
	D	2.30					becoming dark brown and occasionally mottled orange brown below 2.00m depth.
						3.00	Orange brown very clayey fine to medium SAND. (London Clay Formation)
	D	3.50					
	D	4.50					
						5.00	End of borehole at 5.00m

Remarks

Groundwater: Standing water at 2.50m depth following installation of standpipe.

Stability: Borehole collapsed to 3.40m depth on completion.

Notes: Standpipe installed to 3.40m depth; 3.40m to 1.00m slotted pipe with gravel surround; 1.00m to ground level plain pipe with bentonite seal; completed with end cap and security cover concreted flush with ground surface.

Excavation Method: WLS

Borehole Diameter: Various

Made By: RJ

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Site Name: Herschel Grange, Warfield, Bracknell, Berkshire

Job Number: R18-12995

Start Date: 24/05/2018

End Date: 24/05/2018

Borehole Number: **WS07**

Standpipe	Samples and In Situ Testing: Sample/ Test Type	Depth From (m)	Depth To (m)	Test Result	Legend	Depth	Stratum Description
						0.00	Topsoil.
	D	0.30				0.10	MADE GROUND grey brown slightly gravelly sandy clay. Gravel of angular to rounded fine to coarse flint, brick and charcoal-like material. Sand is fine to coarse.
	D	0.80				0.45	Grey mottled orange CLAY with rare gravel of flint. (London Clay Formation) becoming sandy below 1.30m depth.
	D	1.50				1.80	Orange brown mottled grey very clayey fine to medium SAND with rare gravel of flint. (London Clay Formation)
						2.30	Brown mottled grey and orange brown CLAY. (London Clay Formation)
						3.00	End of borehole at 3.00m

Remarks

Groundwater: Borehole dry on completion.

Stability: Borehole stable on completion.

Notes: n/a

Excavation Method: WLS

Borehole Diameter: Various

Made By: MR

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Site Name: Herschel Grange, Warfield, Bracknell, Berkshire

Job Number: R18-12995

Start Date: 24/05/2018

End Date: 24/05/2018

Borehole Number: **WS08**

Standpipe	Samples and In Situ Testing: Sample/ Test Type	Depth From (m)	Depth To (m)	Test Result	Legend	Depth	Stratum Description
						0.00	Topsoil.
						0.10	MADE GROUND: Grey brown slightly gravelly sandy CLAY with rootlets. Gravel of angular to rounded fine to coarse brick and flint. Sand is fine to coarse.
	D	0.30				0.40	Orange and grey mottled slightly gravelly slightly sandy CLAY. Gravel is angular to subrounded fine to medium flint. Sand is fine to coarse. (London Clay Formation)
	D	0.80					
	D	1.20					becoming gravelly below 1.00m depth.
						1.50	Orange gravelly clayey fine to coarse SAND. Gravel is angular to rounded fine to coarse flint. (London Clay Formation)
	D	1.80				2.00	End of borehole at 2.00m

Remarks

Groundwater: Standing water at 1.90m depth on completion of borehole.

Stability: Borehole stable on completion.

Notes: No further progress below 2.00m depth - too hard/ dense.

Excavation Method: WLS

Borehole Diameter: Various

Made By: MR

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Site Name: Herschel Grange, Warfield, Bracknell, Berkshire

Job Number: R18-12995

Start Date: 24/05/2018

End Date: 24/05/2018

Borehole Number: **WS09**

Standpipe	Samples and In Situ Testing: Sample/ Test Type	Depth From (m)	Depth To (m)	Test Result	Legend	Depth	Stratum Description
						0.00	Topsoil.
						0.15	MADE GROUND/Reworked grey brown slightly gravelly very sandy clay with rootlets. Gravel of angular to subrounded fine to medium flint. Sand is fine to coarse.
	D	0.30				0.45	Grey mottled orange brown slightly gravelly CLAY. Gravel of subangular to subrounded fine to medium flint. Sand is fine to coarse. (London Clay Formation)
	D	0.80					
	D	1.20				1.00	Orange and grey mottled slightly gravelly sandy CLAY. Gravel is subangular to subrounded fine to medium flint. Sand is fine to coarse. (London Clay Formation)
							becoming very sandy with depth.
	D	1.90				1.80	Orange gravelly clayey fine to coarse SAND. Gravel is angular to subrounded fine to coarse flint. (London Clay Formation)
						2.20	Orange brown mottled grey CLAY. (London Clay Formation)
	D	2.50					
						3.00	End of borehole at 3.00m

Remarks

Groundwater: Borehole dry on completion.

Stability: Borehole unstable in coarse grained soils.

Notes: n/a

Excavation Method: WLS

Borehole Diameter: Various

Made By: MR

ASHDOWN SITE INVESTIGATION LIMITED

Site: Herschel Grange, Warfield, Bracknell, Berkshire	Report No.: R18-12995 Sheet No.: 1 of 2

SUMMARY OF BOREHOLE FALLING HEAD SOAKAGE TEST RESULTS

WS01	
Time (mins)	Depth to water (m bgl)
0	0.00
1	0.00
4	0.00
36	0.00
59	0.00
101	0.00
Borehole Depth (m bgl)	2.00
Casing Depth (m bgl)	1.00
Borehole Diameter (mm)	79.00
Casing Diameter (mm)	105.00

WS03	
Time (mins)	Depth to water (m bgl)
0	0.00
1	0.00
3	0.00
7	0.01
28	0.02
71	0.03
123	0.03
171	0.03
Borehole Depth (m bgl)	3.00
Casing Depth (m bgl)	1.00
Borehole Diameter (mm)	79.00
Casing Diameter (mm)	105.00

WS05	
Time (mins)	Depth to water (m bgl)
0	0.00
1	0.01
2	0.04
3	0.10
5	0.15
6	0.17
11	0.25
17	0.32
34	0.43
102	0.62
131	0.66
Borehole Depth (m bgl)	3.00
Casing Depth (m bgl)	1.00
Borehole Diameter (mm)	79.00
Casing Diameter (mm)	105.00

Notes: bgl – below ground level.

ASHDOWN SITE INVESTIGATION LIMITED

Site: Herschel Grange, Warfield, Bracknell, Berkshire	Report No.: R18-12995 Sheet No.: 2 of 2

SUMMARY OF BOREHOLE FALLING HEAD SOAKAGE TEST RESULTS

WS07	
Time (mins)	Depth to water (m bgl)
0	0.00
1	0.02
2	0.03
4	0.04
7	0.05
16	0.07
43	0.12
97	0.17
146	0.24
193	0.28
Borehole Depth (m bgl)	3.00
Casing Depth (m bgl)	1.00
Borehole Diameter (mm)	79.00
Casing Diameter (mm)	105.00

WS08	
Time (mins)	Depth to water (m bgl)
0	0.00
0.5	0.02
1	0.05
3	0.10
5	0.14
14	0.24
54	0.54
114	0.73
154	0.77
Borehole Depth (m bgl)	2.00
Casing Depth (m bgl)	1.00
Borehole Diameter (mm)	79.00
Casing Diameter (mm)	105.00

WS09	
Time (mins)	Depth to water (m bgl)
0	0.00
0.5	0.10
1	0.15
2	0.23
3	0.28
4	0.31
10	0.41
25	0.50
90	0.62
130	0.65
Borehole Depth (m bgl)	3.00
Casing Depth (m bgl)	1.00
Borehole Diameter (mm)	79.00
Casing Diameter (mm)	105.00

Notes: bgl – below ground level.

Appendix E - Greenfield Runoff Rate Calculation

HR Wallingford
Working with water

Greenfield runoff estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Francisco Aguilar
Site name:	Herschel Grange
Site location:	

This is an estimation of the greenfield runoff rate limits that are needed to meet normal best practice criteria in line with Environment Agency guidance "Preliminary rainfall runoff management for developments", W5-074/A/TR1/1 rev. E (2012) and the SuDS Manual, C753 (Ciria, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Site coordinates

Latitude:	51.43448° N
Longitude:	0.73801° W

Reference:	6379015
Date:	2018-06-14T14:41:39

Methodology	IH124

Site characteristics

Total site area (ha)	1.0

Methodology

Qbar estimation method	Calculate from SPR and SAAR
SPR estimation method	Calculate from SOIL type

	Default	Edited
SOIL type	4	4
HOST class	---	---
SPR/SPRHOST	0.47	0.47

Hydrological characteristics

	Default	Edited
SAAR (mm)	664	664
Hydrological region	6	6
Growth curve factor: 1 year	0.85	0.85
Growth curve factor: 30 year	2.3	2.3
Growth curve factor: 100 year	3.19	3.19

Notes:

(1) Is Q_{BAR} < 2.0 l/s/ha?

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consents are usually set at 5.0l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set in which case blockage work must be addressed by using appropriate drainage elements

(3) Is SPR/SPRHOST ≤ 0.3?

Greenfield runoff rates

	Default	Edited
Qbar (l/s)	4.54	4.54
1 in 1 year (l/s)	3.86	3.86
1 in 30 years (l/s)	10.44	10.44
1 in 100 years (l/s)	14.48	14.48

Appendix F - Proposed Surface & Foul Water **Drainage**

DO NOT SCALE: CONTRACTOR TO CHECK ALL DIMENSIONS AND REPORT ANY OMISSIONS OR ERRORS

NOTES

1. DIMENSIONS IN METRES UNLESS STATED OTHERWISE.
2. INDICATIVE IMPERMEABLE AREAS BASED ON A 60% RATE OF THE TOTAL SITE AREA. FIGURES INCLUDE A 10% ALLOWANCE FOR URBAN CREEP.
3. PROPOSED SITE LAYOUT PROVIDED BY ASCOT DESIGN THE 21 MAY 2019.

THIS DRAWING IS FOR PLANNING PURPOSES ONLY AND SUBJECT TO FURTHER DETAILED DESIGN AND CONFIRMATION OF FINAL SITE LEVELS AND FINISHED FLOOR LEVELS

FINAL DRAINAGE LAYOUT SUBJECT TO S104 TECHNICAL APPROVAL

KEY

- PROPOSED SW DRAINAGE
- PROPOSED PERMEABLE PAVEMENT
- PP PERMEABLE PAVEMENT REFERENCE IN MICRODRAINAGE MODEL
- PROPOSED SURFACE WATER RISING MAIN
- PROPOSED FOUL WATER RISING MAIN

FOR INFORMATION ONLY

P3	REVISED TO SUIT BRACKNELL COUNCIL REQUIREMENTS	FA	TB	TB	22.05.19
P2	REVISED DRAINAGE SYSTEM	JU	FA	TB	20.12.18
REV	DESCRIPTION	BY	CHK	APP	DATE

ARNDALE COURT
HEADINGLEY
LEEDS
LS6 2UJ

TEL: +44 (0)113 278 7111
FAX: +44 (0)113 278 3487
e-mail: leeds@wyg.com

Project:
HERSCHEL GRANGE, WARFIELD

Drawing Title:
PROPOSED SURFACE WATER DRAINAGE

Scale @ A1	Drawn	Date	Checked	Date	Approved	Date
AS SHOWN	FA	JUNE 18	FR	JUNE 18	TB	JUNE 18

Project No.	Office	Type	Drawing No.	Revision
A108468	21	C	D100	P3

0 2 4 6 8 10m
SCALE 1:200

0 5 10 15 20 25m
SCALE 1:500

DO NOT SCALE: CONTRACTOR TO CHECK ALL DIMENSIONS AND REPORT ANY OMISSIONS OR ERRORS

NOTES

1. DIMENSIONS IN METRES UNLESS STATED OTHERWISE
2. ALL LEVELS IN METRES ABOVE ORDNANCE DATUM
3. PIPE DIAMETERS IN MILLIMETRES
4. ALL LEVELS TO BE CONFIRMED DURING DETAILED DESIGN
5. LAYOUT PROVIDED BY ASCOT DESIGN

THIS DRAWING IS FOR PLANNING PURPOSES ONLY AND SUBJECT TO FURTHER DETAILED DESIGN AND CONFIRMATION OF FINAL SITE LEVELS AND FINISHED FLOOR LEVELS

FINAL DRAINAGE LAYOUT SUBJECT TO S104 TECHNICAL APPROVAL

KEY

- EXISTING WATERCOURSE
- EXISTING CULVERTED WATERCOURSE
- PROPOSED FOUL WATER DRAINAGE
- PROPOSED FOUL WATER RISING MAIN

FW07
CL 64.75
IL 63.50

FW08
CL 64.70
IL 63.60

FW06
CL 64.50
IL 63.15

FW05
CL 64.05
IL 62.70

FW12
CL 63.74
IL 62.39

FW04
CL 65.05
IL 63.95

FW13
CL 64.05
IL 62.56

FW04
CL 63.57
IL 62.22

FW04
CL 65.50
IL 64.40

FW14
CL 65.90
IL 64.60

FW03
CL 64.95
IL 63.85 (100ø)
IL 63.14 (150ø)

FW10
CL 65.30
IL 64.20

FW01
CL 64.70
IL 63.35

FW02
CL 64.80
IL 63.70 (100ø)
IL 63.10 (150ø)

FW09
CL 65.90
IL 64.80

MH7104
CL 65.15
IL 63.66

FOUL AND SURFACE WATER PUMPING STATION

PLAY AREA

bcp

below ground attenuation tank

screen planting

3.5m access road

4.8m wide road (shared surface)

5.5m wide road

footpath

grass verge

new footpath

Steeple View

Pond

The Hermitage Caravan Park

Cuckoo Cottage

GIBBINS LANE

HERSCHEL GRANGE

HOLLYGOOD PLACE

WARFIELD STREET

Carrick

Ashleigh

Woodleigh

Anvil Cott

Horseshoe House

Connantre

Lamorna

Brendon

Owls Wood

The Hollies

Forsythia

Rosemary

Greenock

Warfield Priory

SCALE 1:200

SCALE 1:500

FOR INFORMATION ONLY

REV	DESCRIPTION	BY	CHK	APP	DATE

ARNDALE COURT
HEADINGLEY
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FAX: +44 (0)113 278 3487
e-mail: leeds@wyg.com

Project:
HERSCHEL GRANGE, WARFIELD

Drawing Title:
PROPOSED FOUL WATER DRAINAGE

Scale @ A1	Drawn	Date	Checked	Date	Approved	Date
AS SHOWN	OC	JUNE 18	FA	JUNE 18	TB	JUNE 18

Project No.	Office	Type	Drawing No.	Revision
A108468	21	C	D101	P2

Appendix G - Supporting Micro Drainage Calculations

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	30	PIMP (%)	100
M5-60 (mm)	19.800	Add Flow / Climate Change (%)	0
Ratio R	0.400	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.502	4-8	0.198

Total Area Contributing (ha) = 0.700

Total Pipe Volume (m³) = 56.646

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
3.000	o	300	01	63.750	62.200	1.250	Open Manhole	1500
3.001	o	300	02	63.850	62.135	1.415	Open Manhole	1200
4.000	o	225	10	65.900	64.475	1.200	Open Manhole	1200
4.001	o	225	15	65.500	64.075	1.200	Open Manhole	1200
4.002	o	225	16	65.275	63.775	1.275	Open Manhole	1200
4.003	o	300	17	65.050	63.550	1.200	Open Manhole	1200
5.000	o	225	19	64.720	63.189	1.306	Open Manhole	1200
4.004	o	300	18	64.700	63.200	1.200	Open Manhole	1200
4.005	o	300	20	64.740	63.152	1.288	Open Manhole	1200
4.006	o	300	21	64.500	63.000	1.200	Open Manhole	1200
4.007	o	300	22	64.250	62.750	1.200	Open Manhole	1200
3.002	o	750	03	64.000	62.050	1.200	Open Manhole	1800
3.003	o	750	04	63.950	62.003	1.197	Open Manhole	1800
3.004	o	750	05	63.920	61.977	1.193	Open Manhole	1800
3.005	o	750	06	63.890	61.966	1.174	Open Manhole	1800
6.000	o	225	11	64.020	62.595	1.200	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
3.000	15.067	231.1	02	63.850	62.135	1.415	Open Manhole	1200
3.001	17.002	452.0	03	64.000	62.097	1.603	Open Manhole	1800
4.000	14.045	35.1	15	65.500	64.075	1.200	Open Manhole	1200
4.001	15.881	52.9	16	65.275	63.775	1.275	Open Manhole	1200
4.002	14.178	63.0	17	65.050	63.550	1.275	Open Manhole	1200
4.003	14.610	146.1	18	64.700	63.450	0.950	Open Manhole	1200
5.000	7.445	200.0	18	64.700	63.152	1.323	Open Manhole	1200
4.004	14.435	300.0	20	64.740	63.152	1.288	Open Manhole	1200
4.005	23.821	156.7	21	64.500	63.000	1.200	Open Manhole	1200
4.006	13.808	55.2	22	64.250	62.750	1.200	Open Manhole	1200
4.007	4.014	81.0	03	64.000	62.700	1.000	Open Manhole	1800
3.002	20.093	426.5	04	63.950	62.003	1.197	Open Manhole	1800
3.003	12.934	500.0	05	63.920	61.977	1.193	Open Manhole	1800
3.004	5.403	500.0	06	63.890	61.966	1.174	Open Manhole	1800
3.005	22.775	491.3	07	63.900	61.920	1.230	Open Manhole	2300
6.000	14.468	120.6	12	63.900	62.475	1.200	Open Manhole	1200

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
6.001	o	225	12	63.900	62.475	1.200	Open Manhole	1200
6.002	o	225	13	63.800	62.375	1.200	Open Manhole	1200
3.006	o	750	07	63.900	61.920	1.230	Open Manhole	2300
7.000	o	225	10	65.900	64.475	1.200	Open Manhole	1800
7.001	o	225	09	65.200	63.775	1.200	Open Manhole	1800
3.007	o	750	08	65.125	61.884	2.491	Open Manhole	2300
3.008	o	225	TANK	65.100	61.025	3.850	Open Manhole	1800

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
6.001	11.096	111.0	13	63.800	62.375	1.200	Open Manhole	1200
6.002	6.924	46.2	07	63.900	62.225	1.450	Open Manhole	2300
3.006	18.542	520.0	08	65.125	61.884	2.491	Open Manhole	2300
7.000	21.276	30.4	09	65.200	63.775	1.200	Open Manhole	1800
7.001	6.884	22.9	08	65.125	63.475	1.425	Open Manhole	2300
3.007	21.123	102.1	TANK	65.100	61.677	2.673	Open Manhole	1800
3.008	9.029	500.0		65.400	61.007	4.168	Open Manhole	0

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
3.000	-	-	100	0.030	0.030	0.030
3.001	-	-	100	0.000	0.000	0.000
4.000	-	-	100	0.000	0.000	0.000
4.001	-	-	100	0.000	0.000	0.000
4.002	-	-	100	0.000	0.000	0.000
4.003	-	-	100	0.000	0.000	0.000
5.000	-	-	100	0.000	0.000	0.000
4.004	-	-	100	0.000	0.000	0.000
4.005	-	-	100	0.000	0.000	0.000
4.006	-	-	100	0.050	0.050	0.050
4.007	-	-	100	0.030	0.030	0.030
3.002	-	-	100	0.110	0.110	0.110
3.003	-	-	100	0.040	0.040	0.040
3.004	-	-	100	0.050	0.050	0.050
3.005	-	-	100	0.050	0.050	0.050
6.000	-	-	100	0.030	0.030	0.030
6.001	-	-	100	0.000	0.000	0.000
6.002	-	-	100	0.090	0.090	0.090
3.006	-	-	100	0.060	0.060	0.060
7.000	-	-	100	0.090	0.090	0.090
7.001	-	-	100	0.020	0.020	0.020
3.007	-	-	100	0.050	0.050	0.050
3.008	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.700	0.700	0.700

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
3.008		65.400	61.007	0.000	0	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Storage Structures	16
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.800	Storm Duration (mins)	30
Ratio R	0.400		

Online Controls for Storm

Hydro-Brake® Optimum Manhole: TANK, DS/PN: 3.008, Volume (m³): 18.8

Unit Reference	MD-SHE-0083-4700-2675-4700
Design Head (m)	2.675
Design Flow (l/s)	4.7
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	83
Invert Level (m)	61.025
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.675	4.7
Flush-Flo™	0.363	3.2
Kick-Flo®	0.740	2.6
Mean Flow over Head Range	-	3.5

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.4	1.200	3.2	3.000	5.0	7.000	7.4
0.200	3.0	1.400	3.5	3.500	5.3	7.500	7.6
0.300	3.2	1.600	3.7	4.000	5.7	8.000	7.9
0.400	3.2	1.800	3.9	4.500	6.0	8.500	8.1
0.500	3.2	2.000	4.1	5.000	6.3	9.000	8.3
0.600	3.0	2.200	4.3	5.500	6.6	9.500	8.5
0.800	2.7	2.400	4.5	6.000	6.9		
1.000	3.0	2.600	4.6	6.500	7.1		

Storage Structures for Storm

Porous Car Park Manhole: 01, DS/PN: 3.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	15.0
Membrane Percolation (mm/hr)	1000	Length (m)	20.0
Max Percolation (l/s)	83.3	Slope (1:X)	1000.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	63.100	Membrane Depth (mm)	0

Porous Car Park Manhole: 10, DS/PN: 4.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	7.0
Membrane Percolation (mm/hr)	1000	Length (m)	10.0
Max Percolation (l/s)	19.4	Slope (1:X)	1000.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	65.195	Membrane Depth (mm)	0

Porous Car Park Manhole: 15, DS/PN: 4.001

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	6.0
Membrane Percolation (mm/hr)	1000	Length (m)	10.0
Max Percolation (l/s)	16.7	Slope (1:X)	1000.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	64.795	Membrane Depth (mm)	0

Porous Car Park Manhole: 16, DS/PN: 4.002

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	8.7
Membrane Percolation (mm/hr)	1000	Length (m)	10.0
Max Percolation (l/s)	24.2	Slope (1:X)	1000.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	64.570	Membrane Depth (mm)	0

Porous Car Park Manhole: 19, DS/PN: 5.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	14.0
Membrane Percolation (mm/hr)	1000	Length (m)	13.7
Max Percolation (l/s)	53.3	Slope (1:X)	1000.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	64.015	Membrane Depth (mm)	0

Porous Car Park Manhole: 20, DS/PN: 4.005

Infiltration Coefficient Base (m/hr)	0.00000	Max Percolation (l/s)	23.6
Membrane Percolation (mm/hr)	1000	Safety Factor	2.0

Porous Car Park Manhole: 20, DS/PN: 4.005

Porosity	0.30	Slope (1:X)	1000.0
Invert Level (m)	64.035	Depression Storage (mm)	5
Width (m)	10.0	Evaporation (mm/day)	3
Length (m)	8.5	Membrane Depth (mm)	0

Porous Car Park Manhole: 21, DS/PN: 4.006

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	8.8
Membrane Percolation (mm/hr)	1000	Length (m)	10.0
Max Percolation (l/s)	24.4	Slope (1:X)	1000.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	63.795	Membrane Depth (mm)	0

Porous Car Park Manhole: 22, DS/PN: 4.007

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	9.2
Membrane Percolation (mm/hr)	1000	Length (m)	10.0
Max Percolation (l/s)	25.6	Slope (1:X)	1000.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	63.545	Membrane Depth (mm)	0

Porous Car Park Manhole: 04, DS/PN: 3.003

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	7.7
Membrane Percolation (mm/hr)	1000	Length (m)	10.0
Max Percolation (l/s)	21.4	Slope (1:X)	1000.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	63.300	Membrane Depth (mm)	0

Porous Car Park Manhole: 05, DS/PN: 3.004

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	5.8
Membrane Percolation (mm/hr)	1000	Length (m)	4.0
Max Percolation (l/s)	6.4	Slope (1:X)	1000.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	63.300	Membrane Depth (mm)	0

Porous Car Park Manhole: 06, DS/PN: 3.005

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	9.0
Membrane Percolation (mm/hr)	1000	Length (m)	6.0
Max Percolation (l/s)	15.0	Slope (1:X)	1000.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	63.185	Membrane Depth (mm)	0

Porous Car Park Manhole: 11, DS/PN: 6.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	8.0
Membrane Percolation (mm/hr)	1000	Length (m)	6.5
Max Percolation (l/s)	14.4	Slope (1:X)	1000.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	63.315	Membrane Depth (mm)	0

Porous Car Park Manhole: 12, DS/PN: 6.001

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	4.0
Membrane Percolation (mm/hr)	1000	Length (m)	9.0
Max Percolation (l/s)	10.0	Slope (1:X)	1000.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	63.195	Membrane Depth (mm)	0

Porous Car Park Manhole: 10, DS/PN: 7.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	5.0
Membrane Percolation (mm/hr)	1000	Length (m)	10.0
Max Percolation (l/s)	13.9	Slope (1:X)	1000.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	65.300	Membrane Depth (mm)	0

Porous Car Park Manhole: 09, DS/PN: 7.001

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	10.0
Membrane Percolation (mm/hr)	1000	Length (m)	11.0
Max Percolation (l/s)	30.6	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	64.600	Membrane Depth (mm)	0

Cellular Storage Manhole: TANK, DS/PN: 3.008

Invert Level (m)	61.025	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.95
Infiltration Coefficient Side (m/hr)	0.00000		

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	110.0	0.0	3.010	0.0	0.0
3.000	110.0	0.0			

2 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	16
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH	Data Type	Point
FEH Rainfall Version	2013	Cv (Summer)	0.750
Site Location	GB 487808 171274	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	2, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
3.000	01	15 Winter	2	+0%	30/120 Winter				62.252
3.001	02	15 Winter	2	+0%	30/120 Summer				62.221
4.000	10	60 Winter	2	+0%					64.475
4.001	15	60 Winter	2	+0%					64.075
4.002	16	60 Winter	2	+0%					63.775
4.003	17	60 Winter	2	+0%					63.550
5.000	19	60 Winter	2	+0%	100/120 Winter				63.189
4.004	18	60 Winter	2	+0%	100/240 Winter				63.152
4.005	20	60 Winter	2	+0%	100/120 Winter				63.152
4.006	21	15 Winter	2	+0%	100/120 Summer				63.045
4.007	22	15 Winter	2	+0%	100/60 Summer				62.835
3.002	03	15 Winter	2	+0%	100/30 Winter				62.213
3.003	04	15 Winter	2	+0%	30/240 Winter				62.194
3.004	05	15 Winter	2	+0%	30/240 Winter				62.174
3.005	06	15 Winter	2	+0%	30/240 Winter				62.168
6.000	11	15 Winter	2	+0%	100/15 Summer				62.646
6.001	12	15 Winter	2	+0%	30/240 Winter				62.526
6.002	13	15 Winter	2	+0%	30/120 Winter				62.461
3.006	07	15 Winter	2	+0%	30/240 Winter				62.139

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2 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
3.000	01	-0.248	0.000	0.05		3.0	OK	
3.001	02	-0.214	0.000	0.07		2.8	OK	
4.000	10	-0.225	0.000	0.00		0.0	OK	
4.001	15	-0.225	0.000	0.00		0.0	OK	
4.002	16	-0.225	0.000	0.00		0.0	OK	
4.003	17	-0.300	0.000	0.00		0.0	OK	
5.000	19	-0.225	0.000	0.00		0.0	OK	
4.004	18	-0.348	0.000	0.00		0.0	OK	
4.005	20	-0.300	0.000	0.00		0.0	OK	
4.006	21	-0.255	0.000	0.05		6.7	OK	
4.007	22	-0.215	0.000	0.17		10.7	OK	
3.002	03	-0.587	0.000	0.06		23.3	OK	
3.003	04	-0.559	0.000	0.10		27.2	OK	
3.004	05	-0.553	0.000	0.09		32.7	OK	
3.005	06	-0.548	0.000	0.10		38.2	OK	
6.000	11	-0.174	0.000	0.11		4.7	OK	
6.001	12	-0.174	0.000	0.11		4.7	OK	
6.002	13	-0.139	0.000	0.31		16.8	OK	
3.006	07	-0.531	0.000	0.19		59.1	OK	

2 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
7.000	10	15 Winter	2	+0%					64.536
7.001	09	15 Winter	2	+0%					63.847
3.007	08	15 Winter	2	+0%	30/240 Winter				62.049
3.008	TANK	360 Winter	2	+0%	2/15 Summer				62.047

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
7.000	10	-0.164	0.000	0.16		14.2	OK	
7.001	09	-0.153	0.000	0.22		16.8	OK	
3.007	08	-0.585	0.000	0.11		77.7	OK	
3.008	TANK	0.797	0.000	0.20		3.2	SURCHARGED	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	16
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH	Data Type	Point
FEH Rainfall Version	2013	Cv (Summer)	0.750
Site Location	GB 487808 171274	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	2, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
3.000	01	360 Winter	30	+0%	30/120 Winter				62.798
3.001	02	360 Winter	30	+0%	30/120 Summer				62.797
4.000	10	60 Winter	30	+0%					64.475
4.001	15	60 Winter	30	+0%					64.075
4.002	16	60 Winter	30	+0%					63.775
4.003	17	60 Winter	30	+0%					63.550
5.000	19	60 Winter	30	+0%	100/120 Winter				63.189
4.004	18	60 Winter	30	+0%	100/240 Winter				63.152
4.005	20	60 Winter	30	+0%	100/120 Winter				63.152
4.006	21	15 Winter	30	+0%	100/120 Summer				63.080
4.007	22	15 Summer	30	+0%	100/60 Summer				62.906
3.002	03	360 Winter	30	+0%	100/30 Winter				62.797
3.003	04	360 Winter	30	+0%	30/240 Winter				62.795
3.004	05	360 Winter	30	+0%	30/240 Winter				62.795
3.005	06	360 Winter	30	+0%	30/240 Winter				62.795
6.000	11	360 Winter	30	+0%	100/15 Summer				62.796
6.001	12	360 Winter	30	+0%	30/240 Winter				62.796
6.002	13	360 Winter	30	+0%	30/120 Winter				62.796
3.006	07	360 Winter	30	+0%	30/240 Winter				62.795

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30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
3.000	01	0.298	0.000	0.03		1.6	SURCHARGED	
3.001	02	0.362	0.000	0.04		1.6	SURCHARGED	
4.000	10	-0.225	0.000	0.00		0.0	OK	
4.001	15	-0.225	0.000	0.00		0.0	OK	
4.002	16	-0.225	0.000	0.00		0.0	OK	
4.003	17	-0.300	0.000	0.00		0.0	OK	
5.000	19	-0.225	0.000	0.00		0.0	OK	
4.004	18	-0.348	0.000	0.00		0.0	OK	
4.005	20	-0.300	0.000	0.00		0.0	OK	
4.006	21	-0.220	0.000	0.16		20.1	OK	
4.007	22	-0.144	0.000	0.53		32.3	OK	
3.002	03	-0.003	0.000	0.03		11.5	OK	
3.003	04	0.042	0.000	0.05		13.2	SURCHARGED	
3.004	05	0.068	0.000	0.05		15.5	SURCHARGED	
3.005	06	0.079	0.000	0.05		18.0	SURCHARGED	
6.000	11	-0.024	0.000	0.04		1.6	OK	
6.001	12	0.096	0.000	0.04		1.6	SURCHARGED	
6.002	13	0.196	0.000	0.12		6.4	SURCHARGED	
3.006	07	0.125	0.000	0.09		26.8	SURCHARGED	

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30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
7.000	10	15 Winter	30	+0%					64.573
7.001	09	15 Winter	30	+0%					63.894
3.007	08	360 Winter	30	+0%	30/240 Winter				62.794
3.008	TANK	360 Winter	30	+0%	2/15 Summer				62.794

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
7.000	10	-0.127	0.000	0.39		33.7	OK	
7.001	09	-0.106	0.000	0.54		41.4	OK	
3.007	08	0.160	0.000	0.05		33.9	SURCHARGED	
3.008	TANK	1.544	0.000	0.24		3.9	SURCHARGED	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	16
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH	Data Type	Point
FEH Rainfall Version	2013	Cv (Summer)	0.750
Site Location	GB 487808 171274	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	2, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
3.000	01	480 Winter	100	+40%	30/120 Winter				63.732
3.001	02	480 Winter	100	+40%	30/120 Summer				63.733
4.000	10	60 Winter	100	+40%					64.475
4.001	15	60 Winter	100	+40%					64.075
4.002	16	60 Winter	100	+40%					63.775
4.003	17	480 Winter	100	+40%					63.732
5.000	19	480 Winter	100	+40%	100/120 Winter				63.732
4.004	18	480 Winter	100	+40%	100/240 Winter				63.732
4.005	20	480 Winter	100	+40%	100/120 Winter				63.732
4.006	21	480 Winter	100	+40%	100/120 Summer				63.732
4.007	22	480 Winter	100	+40%	100/60 Summer				63.732
3.002	03	480 Winter	100	+40%	100/30 Winter				63.733
3.003	04	480 Winter	100	+40%	30/240 Winter				63.733
3.004	05	480 Winter	100	+40%	30/240 Winter				63.732
3.005	06	480 Winter	100	+40%	30/240 Winter				63.733
6.000	11	480 Winter	100	+40%	100/15 Summer				63.733
6.001	12	480 Winter	100	+40%	30/240 Winter				63.733
6.002	13	480 Winter	100	+40%	30/120 Winter				63.733
3.006	07	480 Winter	100	+40%	30/240 Winter				63.732

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100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
3.000	01	1.232	0.000	0.04		2.2	FLOOD RISK	
3.001	02	1.298	0.000	0.06		2.2	FLOOD RISK	
4.000	10	-0.225	0.000	0.00		0.0	OK	
4.001	15	-0.225	0.000	0.00		0.0	OK	
4.002	16	-0.225	0.000	0.00		0.0	OK	
4.003	17	-0.118	0.000	0.00		0.1	OK	
5.000	19	0.318	0.000	0.00		0.0	SURCHARGED	
4.004	18	0.232	0.000	0.00		0.2	SURCHARGED	
4.005	20	0.280	0.000	0.00		0.2	SURCHARGED	
4.006	21	0.432	0.000	0.03		3.7	SURCHARGED	
4.007	22	0.682	0.000	0.10		6.0	SURCHARGED	
3.002	03	0.933	0.000	0.04		16.4	FLOOD RISK	
3.003	04	0.980	0.000	0.07		19.4	FLOOD RISK	
3.004	05	1.005	0.000	0.07		23.0	FLOOD RISK	
3.005	06	1.017	0.000	0.07		26.6	FLOOD RISK	
6.000	11	0.913	0.000	0.05		2.2	FLOOD RISK	
6.001	12	1.033	0.000	0.05		2.3	FLOOD RISK	
6.002	13	1.133	0.000	0.16		8.9	FLOOD RISK	
3.006	07	1.062	0.000	0.12		37.1	FLOOD RISK	

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100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
7.000	10	15 Winter	100	+40%					64.616
7.001	09	15 Winter	100	+40%					63.954
3.007	08	480 Winter	100	+40%	30/240 Winter				63.731
3.008	TANK	480 Winter	100	+40%	2/15 Summer				63.731

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
7.000	10	-0.084	0.000	0.70		60.6	OK	
7.001	09	-0.046	0.000	0.96		74.3	OK	
3.007	08	1.097	0.000	0.06		45.4	SURCHARGED	
3.008	TANK	2.481	0.000	0.29		4.7	SURCHARGED	

Appendix H - Thames Water Pre Development Enquiry

francisco.aguilar

From: DEVELOPER.SERVICES@THAMESWATER.CO.U <DEVELOPER.SERVICES@THAMESWATER.CO.UK>
Sent: 21 December 2018 07:51
To: francisco.aguilar
Subject: RE: RE: DS6047474 - Herschel Grange, Warfield - FAO Lance Cooper

21/12/18

Dear Francisco

Your proposed discharge rate of 4.7 ls/sec would be acceptable to Thames Water.

Regards

Lance Cooper

Original Text

From: "francisco.aguilar" <francisco.aguilar@wyg.com>
To: DEVELOPER.SERVICES@THAMESWATER.CO.U <DEVELOPER.SERVICES@THAMESWATER.CO.UK>
CC:
Sent: 18.12.18 15:58:42
Subject: RE: DS6047474 - Herschel Grange, Warfield - FAO Lance Cooper

Dear Lance,

Further to our previous email, the greenfield rate on this site is quite low and would be 2.8 l/s. This would not be compliant with an adoptable pumping station and therefore could you please confirm whether a discharge rate of 4.7 l/s (minimum adoptable rate) would be acceptable?

Thank you for your help

Regards

Francisco Aguilar
Flood Risk & Drainage Engineer

WYG
Arndale Court, Headingley, Leeds, West Yorkshire, LS6 2UJ
Tel: +44 113 219 2284

www.wyg.com

From: DEVELOPER.SERVICES@THAMESWATER.CO.U <DEVELOPER.SERVICES@THAMESWATER.CO.UK>
Sent: 16 November 2018 09:36
To: francisco.aguilar <francisco.aguilar@wyg.com>
Subject: RE: DS6047474 - Herschel Grange, Warfield - FAO Lance Cooper

16/11/18

Dear Francisco

I refer to your query attached.

Subject to you providing documented proof that surface water cannot be dealt with by any other means, a connection to the public surface water sewer, at a greenfield equivalent rate, would be acceptable.

Regards

Lance Cooper (Developer Services)

Original Text

From: "francisco.aguilar" <francisco.aguilar@wyg.com>
To: 'DEVELOPER.SERVICES@THAMESWATER.CO. <DEVELOPER.SERVICES@THAMESWATER.CO.UK>
CC: tom.beavis <tom.beavis@wyg.com>
Sent: 14.11.18 09:00:43
Subject: DS6047474 - Herschel Grange, Warfield - FAO Lance Cooper

Dear Lance,

Thank you for your letter last week. At this moment, only phase 1 of the development is being put forward so hydraulic modelling to be undertaken by Thames Water is not yet required, and I would think that the developer will request this once planning permission is granted.

In the meantime, we would like to consult with yourselves the possibility of discharging surface water to the existing sewer at the junction of Warfield Road and Newhurst Gardens as shown in the attached plan. Discharge rates are proposed to be limited to greenfield runoff rates. We previously thought that there is a suitable watercourse alongside the northern boundary of the site, however further investigations have shown that there is no inlet pipe from the open channel into the section of watercourse we thought was culverted. This is our preferred option given that the discharge into the watercourse and infiltration have proven to be unfeasible.

I look forward to receiving your comments.

Thank you for your help,

Regards

Francisco Aguilar
Flood Risk & Drainage Engineer

For more information about WYG Engineering, please have a look at our brochure

WYG
Arndale Court, Headingley, Leeds, West Yorkshire, LS6 2UJ
Tel: +44 113 219 2284

www.wyg.com

Please note that our UK offices will be closed on 24th December and will not reopen until the new year (2nd January / 3rd January in Scotland). We wish you seasons greetings and all the best for 2019.

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Francisco Aguilar
WYG
Arndale Court
Otley Road
Leeds
LS6 2UJ

Wastewater pre-planning

Our ref DS6047474

12 June 2018

Pre-planning enquiry: Capacity concerns

Dear Mr Aguilar

Thank you for providing information on your development at Herschel Grange, Warfield comprising 125 new dwellings in three phases: phase 1 – 35 units: phase 2 – 25 units and phase 3 65 units.

We've assessed your **foul water** proposals and concluded that our sewerage network will have enough capacity for you to connect the first two phases, but unfortunately we're unable to meet the needs of your **full** development at this time.

In considering your **surface water** needs, we support the use of sustainable drainage on development sites. You'll need to show the local authority and/or lead local flood authority how you've taken into account the surface water hierarchy that we've included.

In order to ensure we make the appropriate upgrades – or 'off-site reinforcement' – to serve the remainder of your development, we'll need to carry out modelling work, design a solution and build the necessary improvements. This work is done at our cost.

Once we've begun modelling, we may need to contact you to discuss changing the connection point for capacity reasons. Please note that we'll pay the cost of covering any extra distance if the connection needs to be made at a point further away than the nearest practicable point of at least the same diameter.

What do you need to tell us before we start modelling?

We're responsible for funding any modelling and reinforcement work. We need, though, to spend our customers' money wisely, so we'll only carry out modelling once we're confident that your development will proceed.

In order to have this confidence, we'll need to know that you **own the land and have either outline or full planning permission**. Please email this information to us as soon as you have it.

If you'd like us to start modelling work ahead of this point, we can do this if you agree to underwrite the cost of modelling and design. That means we'll fund the work – but you agree to pay the cost if you don't achieve first occupancy within five years.

If the modelling shows we need to carry out reinforcement work, then before we start construction we'll need you to supply us with notification that you've confirmed your 'nominated competent person' (NCP) submission to the Health and Safety Executive.

How long could modelling and reinforcement take?

Typical timescales for a development of your size are

Modelling: 8 months
Design: 6 months
Construction: 6 months
Total: 20 months

If the time you're likely to take from planning and construction through to first occupancy is longer than this, we'll be able to carry out the necessary upgrades in time for your development. If it's shorter, please contact me on the number below to discuss the timing of our activities.

What do I need to do next?

If we haven't heard from you by the end of July, we'll contact you so you can confirm whether you can provide the confidence we need. If so, we'll be able to start modelling if you still need it – but we won't do so until you've confirmed that you need it.

Please note that you must keep us informed of any changes to your design – for example, an increase in the number or density of homes. Such changes could mean there is no longer sufficient supply capacity.

Yours sincerely

Lance Cooper

Thames Water

Tel 02035779224

Appendix H - Bracknell LLFA Response to Planning Application Ref 18/00650/FUL

This application is for the construction of 33 residential dwellings adjacent to the mobile home site at the north end of Herschel Grange. As the application is a full application insufficient detail has been provided to determine if the drainage aspects of the proposals are acceptable.

Following earlier comments from the LLFA querying the location and suitability of the watercourse the Applicant has changed the drainage design to include a surface water pumping station discharging to a surface water sewer some distance away. There is no clear reason for this approach other than the statement that they were 'unable to locate the head wall of the ditch'. Thames Water's acceptance of the flows to the surface water sewer is conditional on it being demonstrated that there is no alternative means of draining the site, without further evidence of the extent of investigation into the ditch line such as trial pits, clearance works and dye testing the LLFA will not support the proposal to pump surface water. Our reasons are set out below:

Pumping surface water is an unsustainable operation due to the volumes it is required to deal with during 1 in 100-year events.

It is unclear whether Thames have agreed to receive all the restricted runoff from the development up to the 1 in 100-year storm as opposed to the restricted runoff rates up to the 1 in 30 year event.

The Applicant is proposing to discharge at a rate which is approximately double the existing QBar rate, therefore the Applicant has not demonstrated that the impact of the increased volume of runoff from the site has been mitigated.

The LLFA believe this represents a significant change in natural drainage catchment as the existing site would drain in a westerly direction away from the proposed discharge point.

Notwithstanding the concerns above the proposed SUDS scheme does not provide any treatment to the runoff from the road network. The Thames Water sewer that the development is proposing to utilise discharges directly into the River Cut and as such it is imperative that treatment to the roads is provided.

The provision of a detention basin/pond within the site would not only provide a treatment stage but would also provide interception, and may provide an area for flow to be diverted in the event of a pump failure, should this remain the preferred approach. It is of note that the FRA has not assessed the risk of failure of the pumping station.

The drainage design must be run for the FEH Rainfall events and should include a 10% increase in impermeable area for urban creep. The calculations have only been tested for 30% climate change not 40%.

Levels and references between the drawings and calculations must be shown: for instance Porous Paving area 17 we believe relates to Porous Car Park Manhole 2 would appear to be over 1m deep in construction which is excessive, and likely to impact on the foundation design of the properties abutting the tanks. This may also cause issues with foul sewer connections and utilities crossings. The membrane depth has been set at zero which means no loss of storage has been accounted for in the construction layer. We believe the current design over estimates the amount of permeable paving that could be delivered by the scheme when services, falls and recommended construction depths are considered.

We draw the Planning Officer and Tree Officers' attention to the conflict between the proposed drainage strategy and the Tree Retention plan Merewood Drawing dated June 2018 (unreferenced).

Recommendation: Further Information Required.