Sustainable Drainage Assessment

Proposed Homes at Lordsgate Lane, Burscough

Client: GRC Developments

Contents

Document Revision History

Revision	Date	Author	Approved
0	10.11.20	KRS	DJR
A	29.6.21	KRS	DJR

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EXECUTIVE SUMMARY

This Sustainable Drainage Assessment demonstrates that the proposed development would be operated with minimal risk from flooding, would not increase flood risk elsewhere and is compliant with the requirements of the NPPF. The proposed development will considerably reduce the flood risk posed to the site and to off-site locations due to the adoption of a SuDS Strategy.

1.0 INTRODUCTION

1.1 Background

This Sustainable Drainage Assessment has been prepared to support a planning application for the proposed development on Lordsgate Lane, Burscough, L40 7UR

This Sustainable Drainage Assessment sets out an approach to achieve the required reduction using Sustainable Urban Drainage (SuDS) principles. It is recognised that developments that are designed without regards to the surface water runoff are likely to result in increased impact on existing off-site service provision and may leads to an increase in flood risk.

1.2 Purpose

This Sustainable Drainage Assessment complies with the principles of SuDS presented in the new Defra non-statutory technical standards for SuDS[1], and the National Planning Policy Framework (NPPF)[2]. A surface water drainage assessment is presented with reference to the hydrological and hydrogeological context of the development.

The report findings are based upon professional judgement and are summarised below with detailed recommendations provided at the end of the report. The report includes baseline data on: flood risk from the Environment Agency, rainfall data from the Flood Estimation Handbook (FEH) and hydrogeological information from the British Geological Survey (BGS). The assessment will summarise and refer to these datasets in the text.

1.3 What are SuDS?

A sustainable drainage system (SuDS) is designed to replicate, as closely as possible, the natural drainage from the site (before development) to ensure that the flood risk downstream of the Site does not increase as a result of the land being developed. SUDS can also significantly improve the quality of water leaving the site and can enhance the amenity and biodiversity that a site has to offer.

There are a range of SuDS options available to provide effective surface water management that intercept and store excess runoff. When considering these options, the destination of the runoff should be considered using the order of preference outlined the Building Regulations Part H document[3]:

- An adequate soakaway or some other adequate infiltration system.
- A watercourse.
- A sewer.

1.4 Site Description

The site is a car park to the Lordsgate Lane frontage and a disused parcel of land to the rear with a site area of 2,100m^2. The proposals are for the erection of 7 houses 7 (see Appendix 1). The existing and proposed impermeable areas are shown in Table 1. The proposed impermeable area is 1,036m^2.

[1] Department for Environment, Food and Rural Affairs (2015) Non-statutory technical standards for SUDS (March 2015).
[2] Ministry of Housing, Communities and Local Government (2019) National Planning Policy Framework.
[3] HM Government (2010) The building regulations 2010 Part H drainage and waste disposal (2015 edition).

Table 1 - Impermeable Areas (m^2)

Parameter	Pre-development	Post-development
Existing	235	--
Proposed Roof Area	--	360
Parking/drives	--	216
Highways	--	460
Total	**235**	**1,036**

Reference to the BGS online mapping (1:50,000 scale) indicates that superficial deposits underlaying the site consist of the Shirdley Hill Sand Formation. Superficial deposits formed up to 2 million years ago in the Quaternary Period. The bedrock deposits consist of the Helsby Sandstone Formation, sedimentary bedrock formed approximately 242 to 247 million years ago in the Triassic Period.

Site investigations recorded Made Ground at all borehole location which overlays the Shirdley Hill Sand Formation (see Appendix 2). Sand horizons were recorded to the west of the site at borehole locations RWS03 and RWS04 at depths of 1.00 to 2.00m Below Ground Level (mBGL). Groundwater levels were recorded to rise to 0.80m Below Ground Level (mBGL).

2.0 SURFACE WATER DRAINAGE

2.1 Surface Water Management Overview

It is recognised that consideration of flood issues should not be confined to the floodplain. The alteration of natural surface water flow patterns through developments can lead to problems elsewhere in the catchment, particularly flooding downstream. For example, replacing vegetated areas with roofs, roads and other paved areas can increase both the total and the peak flow of surface water runoff from the development site. Changes of land use on previously developed land can also have significant downstream impacts where the existing drainage system may not have sufficient capacity for the additional drainage.

A SuDS Strategy for the site proposals has been developed to manage and reduce the flood risk posed by the surface water runoff from the site. An assessment of the surface water runoff rates has been undertaken, in order to determine the surface water options and attenuation requirements for the site. The assessment considers the impact of the development compared to current conditions. Therefore, the surface water attenuation requirement for the developed site can be determined and reviewed against existing arrangements.

The requirement for managing surface water runoff from developments depends on the pre-developed nature of the site. If it is an undeveloped greenfield site, then the impact of the development will need to be mitigated so that the runoff from the site replicates the natural drainage characteristics of the pre-developed site. In the case of brownfield sites, drainage proposals will be measured against the existing performance of the site, although it is preferable for solutions to provide runoff characteristics that are similar to greenfield behaviour.

The surface water drainage arrangements for any development site should be such that the volumes and peak flow rates of surface water leaving a developed site are no greater than the rates prior to the proposed development unless specific off-site arrangements are made and result in the same net effect.

It should be acknowledged that the satisfactory collection, control and discharge of surface water runoff are now a principle planning and design consideration. This is reflected in recently implemented guidance as well as the new Defra non-statutory technical standards for SuDS.

2.2 Climate change

Projections of future climate change, in the UK, indicate more frequent, short-duration, high intensity rainfall and more frequent periods of long duration rainfall. Guidance included within the NPPF recommends that the effects of climate change are incorporated into a SuDS Strategy. Recommended precautionary sensitivity ranges for peak rainfall intensities and peak river flows are outlined in the associated Planning Practice Guidance to the NPPF[4].

Table 2 shows the anticipated changes in extreme rainfall intensity in small and urban catchments.

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

Table 2 - Peak Rainfall Intensity Allowance in Small and Urban Catchment (use 1961 to 1990 baseline)

Parameter	2010 to 2039	2040 to 2059	2060 to 2115
Upper end	+10%	+20%	+40%
Central	+5%	+10%	+20%

2.3 Opportunities for Discharge of Surface Water

There are three possible options to discharge the surface water runoff in accordance with requirement H3 of the Building Regulations, this hierarchy is also promoted within the NPPF. Rainwater shall discharge to one of the following, listed in order of priority:

- An adequate soakaway or some other adequate infiltration system; or, where that is not reasonably practicable.
- A watercourse; or where that is not reasonably practicable.
- A sewer.

It is necessary to identify the most appropriate method of controlling and discharging surface water. The design should seek to improve the local runoff profile by using systems that can either attenuate runoff and reduce peak flow rates or positively impact on the existing surface water runoff.

2.3.1 Soakaway/Infiltration System

In determining the future surface runoff from the site, the potential of using infiltration devices has been considered. Groundwater levels were recorded to rise to 0.80mBGL therefore, it will not be possible to discharge the surface water runoff from the site via infiltration devices such as soakaways.

2.3.2 Watercourse

The next option is discharge to a watercourse. There are no watercourses on, or within the vicinity of the site. Therefore, it will not be possible to discharge surface water runoff from the site into a watercourse.

2.3.3 Sewer

In the event that discharge of surface water via infiltration or discharge to a watercourse is deemed unsuitable, then discharge to the public sewers will be possible. All surface water runoff will be managed on site and then discharged to a public sewer. Discharge to the public sewer would be at 3.00 litres/second. A connection to the public sewer will be used at a location/s adjacent to the site. Therefore, it will be possible to discharge to the public sewer.

2.4 Surface Water Runoff Rates

An estimation of surface water runoff is required to permit effective site surface water management and prevent any increase in flood risk to off-site receptors. In accordance with The SuDS Manual, the Greenfield runoff from the site has been calculated using the IoH124 method. This is used as a reference representative of the Greenfield runoff generated within the site. Table 3 shows the QBAR (rural) for the proposed impermeable area is 0.26 litres/second (see Appendix 3).

The Wallingford Procedure has been used to calculate the pre- and post-development surface water runoff rates for a range of return periods, as shown in Table 4 (see Appendix 3).

Table 3 - IoH124 Method Runoff Rates

Return Period (years)	Litres/second
QBAR	0.26

Table 4 - Surface Water Runoff Rates

Return Period (years)	6 hour Storm Discharge Rates (l/s)	
	Pre-development	Post-development
1	2.50	5.10
30	5.40	11.00
100	6.90	14.30
100 +40%	9.66	20.02

2.5 SuDS and Water Quality

Current guidance promotes sustainable water management through the use of SuDS. SuDS measures should be used to control the surface water runoff from the proposed development site therefore, managing the flood risk to the site and surrounding areas from surface water runoff.

One of the aims of the NPPF is to provide not only flood risk mitigation but also to maximise additional gains such as improvements in runoff quality and provision of amenity and bio-diversity. Systems incorporating these features are often termed SuDS and it is the requirement of NPPF that these are considered as the primary means of collection, control and disposal for storm water as close to source as possible.

A hierarchy of techniques is identified[5]:

1. **Prevention** – the use of good site design and housekeeping measures on individual sites to prevent runoff and pollution (e.g. minimise areas of hardstanding).

2. **Source Control** – control of runoff at or very near its source (such as the use of rainwater harvesting, permeable paving, soakaways and/or green roofs).

3. **Site Control** – management of water from several sub-catchments (including routing water from roofs and car parks to one/several large soakaways for the whole site, swales and/or infiltration trenches).

4. **Regional Control** – management of runoff from several sites, typically in a detention pond, basins, tanks and/or wetland.

It is generally accepted that the implementation of SuDS as opposed to conventional drainage systems, provides several benefits by:

- reducing peak flows to watercourses or sewers and potentially reducing the risk of flooding downstream;

- reducing the volumes and frequency of water flowing directly to watercourses or sewers from developed sites;

[5] CIRIA (2004) Report C609, Sustainable Drainage Systems – Hydraulic, Structural and Water Quality advice.

- improving water quality over conventional surface water sewers by removing pollutants from diffuse pollutant sources;
- reducing potable water demand through rainwater harvesting;
- improving amenity through the provision of public open spaces and wildlife habitat; and
- replicating natural drainage patterns, including the recharge of groundwater so that base flows are maintained.

The most appropriate attenuation system will need to satisfy three main characteristics, firstly, provide the required volume of storage, secondly, minimise the loss of developable land and thirdly, where possible provide local amenity.

The application of The SuDS Manual requires that the runoff from sites is not only restricted to meet the Greenfield runoff characteristics but also that SuDS systems are utilised to improve the quality of the runoff prior to outfall to watercourses. The SuDS Manual and Environment Agency guidance applies a sustainability hierarchy to the various types of SuDS systems, this is summarised in Table 5.

Table 5 - Sustainability Hierarchy

Most Sustainable	SuDS Technique	Flood Reduction	Pollution Reduction	Landscape & Wildlife
	Living Roofs	✓	✓	✓
	Basins and Ponds - Constructed wetlands - Balancing ponds - Detention basins - Retention ponds	✓	✓	✓
	Filter Strips and Swales	✓	✓	✓
	Infiltration Devices - Soakaways	✓	✓	✓
	Permeable Surfaces and Filter Drains - Gravelled areas - Solid paving blocks - Permeable paving	✓	✓	
Least Sustainable	**Tanked Systems** - Over-sized pipes/tanks - Cellular storage	✓		

Systems at the top of the hierarchy provide a combination of attenuation, treatment and ecology and are deemed the most sustainable options. There are always specific scenarios where systems are more suitable than others and at this stage it is not possible to guide the development towards a particular strategy.

The usual approach is to consider the 'SuDS train' where each of the above options are considered in turn until a suitable solution is found. Thus, source control techniques such as soakaways, rainwater harvesting and/or infiltration trenches, if suitable on a site, are considered preferable to permeable conveyance and passive treatment systems such as tanks or ponds. The various options are considered in outline below.

2.6 Attenuation Storage Volumes

It is proposed that the impermeable area of 1,036m^2 including the highways will discharge to the public sewer. The principle applied in the design of storage is to limit the discharge rate of surface water runoff from the developed site for events of similar frequency of occurrence to the same peak rate of runoff as that which takes place from a site prior to the proposed development.

QBAR (rural) has been calculated to be 0.26 litres/second. A minimum discharge rate of 3.00 litres/second can be used when the greenfield runoff rate is less than 5.00 litres/second. Therefore, the surface water runoff from the site will be restricted to 3.00 litres/second.

Table 6 shows the volume of storage required for the proposed development estimated using the MicroDrainage Software for the 1 in 100 year event, with a 40% allowance for climate change (increase in peak rainfall) assuming the proposed impermeable areas with 3.00 litres/second used as the limiting discharge rate (see Appendix 5). An attenuation storage volume of 53.20m^3 is required. A conservative estimate of 100% runoff from impermeable areas has been used within the calculations.

Flooding will not occur on any part of the site during the 1 in 30 year event, no flooding will occur within any part of the buildings during the 1 in 100 year (+40%) event, all areas drained have been designed to accommodate the 1 in 100 year (+40%) event.

Table 6 - Attenuation Storage Volumes

Return Period (years)	Limiting Discharge Rate (l/s)	Impermeable Area (m^2)	Volume (m^3)
100 +40%	3.00	1,036	53.20

2.7 SuDS Strategy

The objective of this SuDS Strategy is to ensure that a sustainable drainage solution can be achieved which reduces the peak discharge rate to manage and reduce the flood risk posed by the surface water runoff from the site. The SuDS Strategy takes into account the following principles:

- No increase in the volume or runoff rate of surface water runoff from the site.
- No increase in flooding to people or property off-site as a result of the development.
- No surface water flooding of the site.
- The proposals take into account a 40% increase in rainfall intensity due to climate change during the next 100 years which is the lifetime of the development.

In line with adopting a 'management train' it is recommended that water is managed as close to source as possible. This will reduce the size and cost of infrastructure further downstream and also shares the maintenance burden more equitably. It is therefore recommended that the site provides its own attenuation. This will be in the form of:

- Underground cellular/oversized pipe storage with an outfall to the public sewer restricted to 3.00 litres/second.
- Paths around the buildings drain to grassed lawns.
- For larger events in other areas such as landscaped areas, provided that it will not cause damage or prevent access.

The proposed drainage layout is shown in Appendix 4. For all development, both the Building Regulations and NPPF promote a hierarchical approach to surface water management. This approach has been adopted within this SuDS Strategy however, surface water discharge via infiltration methods and to a watercourse will not be possible therefore, discharge of surface water will be to the public sewer at a restricted runoff rate of 3.00 litres/second with attenuation within cellular storage/oversized pipes.

The size of the attenuation storage has been calculated such that the proposed development has the capacity to accommodate the 1 in 100 year rainfall event including a 40% increase in rainfall intensity that is predicted to occur as a result of climate change.

A conservative estimate of 100% runoff from impermeable areas has been used within the calculations. Consequently, all areas drained have been designed to accommodate the 1 in 100 year (+40% climate change) storm event.

The paths around the buildings will be designed to drain to the grassed lawns. The remainder of the site that is not formally drained, i.e. landscaped areas, will be permeable (grass). The majority of rainwater falling on these areas will soak into the ground. Surface water runoff would be directed to the drainage system through drainage gullies located around the perimeter of the buildings and through contouring of the hardstanding areas.

These methods will reduce peak flows, the volume of runoff, and slow down flows and will provide a suitable SuDS solution for this site. The adoption of a SuDS Strategy for the site represents an enhancement from the current conditions as the current surface water runoff from the site is uncontrolled, untreated, unmanaged and unmitigated.

In adopting these principles, it has been demonstrated that a scheme can be developed that does not increase the risk of flooding to adjacent properties and development further downstream.

The greenfield 1 in 100 year 6 hour storm has a volume of 37.00m^3, the pre-development 1 in 100 year 6 hour storm has a volume of 53.50m^3, the post-development 1 in 100 year 6 hour storm has a volume of 110.00m^3. The surface water runoff has been constrained as much as reasonably practical to the greenfield runoff volume.

2.8 Designing for Local Drainage System Failure/Design Exceedance

When considering residual risk it is necessary to make predictions as to the impacts of a storm event that exceeds the design event, or the impact of a failure of the local drainage system. The SuDS Strategy applies a safe and sustainable approach to discharging rainfall runoff from the site and this reduces the risk of flooding however, it is not possible to completely remove the risk. This section is therefore associated with the way the residual risk is managed.

As part of the SuDS Strategy it must be demonstrated that the flooding of property would not occur in the event of local drainage system failure and/or design exceedance. It is not economically viable or sustainable to build a drainage system that can accommodate the most extreme events. Consequently, the capacity of the drainage system may be exceeded on rare occasions, with excess water flowing above ground[6].

The attenuation requirements have been designed to accommodate the 1 in 100 year storm event plus climate change (+40%). The design of the site layout provides an opportunity to manage this local drainage system failure/exceedance flow and ensure that indiscriminate flooding of property does not occur.

[6] CIRIA (2006) Designing for exceedance in urban drainage – good practice.

An exceedance or blockage event of the system would not affect the proposed buildings because the finished floor level will be raised above the external ground level, ensuring flooding of the buildings will not occur. The gardens and pathways of the properties will rise away from the highways and sewers so that any flows will not enter the property ensuring any exceedance flooding would not affect the buildings. Exceedance flows would be contained within the highways adjacent to the site and within the site and would flow to the lower ground levels where landscaped areas are located and manholes further downstream. It is not considered that there is an increased risk to the properties on the site or located adjacent to the site.

In particular, the landscaped areas will include preferential flow paths that convey water away from the proposed buildings as well as the existing buildings adjacent to the site. Surface water runoff would be directed to the drainage system through drainage gullies located around the perimeter of the buildings and through contouring of the hardstanding areas.

When considering the impacts of a storm event that exceeds the 1 in 100 year (+ 40%) event, there is safety factor for attenuation storage, even under the design event conditions. Consequently, if this event were to be exceeded there is additional capacity with the system in the manholes and pipes to accommodate this. If this freeboard was to be exceeded the consequences would be similar, if not less than for the local drainage system failure. Surface water runoff would be directed to the drainage system through drainage gullies located around the perimeter of the buildings and through contouring of the hardstanding areas. Drainage gullies will provide additional water storage and provide betterment. Consequently, the impact of an exceedance event is not considered to represent any significant flood hazard.

The above manages and mitigates the flood risk from surface water runoff to the proposed properties from surface water runoff generated by the site development and to offsite locations as well the risk from surface water runoff generated offsite.

3.0 Managing SuDS

3.1 Introduction

The SuDS have been designed for easy maintenance to comprise:

- Regular day to day care – litter collection, regular gardening to control vegetation growth and checking inlets where water enters the SuDS feature.

- Occasional tasks – checking the SuDS feature and removing any silt that builds up in the SuDS feature.

- Remedial Work – repairing damage where necessary.

The rate of build-up of silt and debris within a drainage system varies from site to site and is dependent upon individual site characteristics. Therefore, the frequency of actions below should be adopted as a minimum standard for a period of 24 months after development completion. This period will be sufficient to assess the system performance over 2 complete seasonal cycles after which the maintenance activity schedule may be reviewed accordingly.

3.2 Maintenance Responsibility

The underground drainage within the adoptable highway and downstream of the attenuation storage will be adopted by United Utilities. The remaining drainage will be maintained by a management company. The responsibility for the enacting of this SuDS Maintenance Plan is entrusted to the management company. The developer will provide this SuDS Maintenance Plan in addition to an Operation and Maintenance Manual for each management company.

The Operation and Maintenance Manual shall be passed on to subsequent future management companies covered by the document. This will include engineering drawings that detail the design and installation of the SuDS components so that persons undertaking any maintenance works will have a point of reference for the required specification of each of these.

Where applicable, the engineering drawings shall make reference to this SUDS Maintenance Plan. Following construction but prior to the completion of the apartment units, the responsibility for maintenance shall lie with the developer.

3.3 SuDS Scheme Checklist

The following lists the SuDS components and extra features which are found on site.

- Cellular/oversized pipe storage system will accept surface water runoff from access road and roof areas.

- Flows from site will be restricted using a flow control device which allows heavy rainfall to leave the site slowly and make its way through a piped network to the existing public sewers.

- Manholes, inspection chambers and rodding eyes are used on bends or where pipes come together. They allow access and cleaning to the system if necessary.

- Inlet structures such as rainwater down pipes and drainage channels. They should be free from obstruction at all times to allow free flow through the drainage network.

- Below ground drainage pipes convey water into and out of the attenuation system. They should be free from obstruction at all times to allow free flow.

3.4 Sustainable Drainage Maintenance Specification

General Requirements

Table 7 details the general requirements.

Table 7 - General Requirements

General Requirements	
Maintenance activities comprise • Regular maintenance • Occasional tasks • Remedial work	Frequency
Generally Litter Collect all litter or other debris and remove it from the site at each visit	Monthly

- Avoid use of weed-killers and pesticides to prevent chemical pollution.

- Avoid de-icing agents wherever possible.

- Protect all below ground drainage through careful selection and placement of hard and soft landscaping.

Cellular Storage/Oversized Pipes

Cellular storage systems and oversized pipes are designed to provide storage upstream of a flow control device. Table 8 provides details of the maintenance requirements.

Upon completion of the works the appointed maintenance contractor will carry out regular monthly inspections for the first 3 months and thereafter at 6 monthly intervals. The cellular storage SuDS system as specified allows almost the entire volume of the system to be inspected via CCTV. Flushing of the system can be achieved using a jetting system with a 150 bar pump pressure. The jet nozzle should be introduced to the system via the maintenance tunnel. The silt should be flushed to the inspect manhole and removed from there.

Table 8 - Cellular Storage/Oversized Pipes

Regular Maintenance	Frequency
• Inspect and identify any area that are not operating correctly. • Remove debris from the catchment surface (where it may cause risk to performance). • Remove sediment from inlet structures and inspection chambers. • Maintain vegetation to designed limits within the vicinity of the below ground tanked system to avoid damage to the system.	Monthly or as required
Remedial Work	**Frequency**
• Repair physical damage if necessary.	As required

Monitoring	Frequency
• Inspect inlets, outlets and vents to ensure that they are in good condition and operating as designed. • Survey inside of tanks for sediment build up and remove if necessary.	Annually Every 5 years or as required

Permeable Areas

Permeable areas will be porous to allow rain to percolate through the surface into underlying drainage layers. They must be protected from silt, sand, compost, mulch, etc. Table 9 provides details of the maintenance requirements.

Table 9 - Permeable Surfaces

Regular Maintenance	Frequency
Cleaning • Brush regularly and remove sweepings from all hard surfaces.	Monthly
Occasional Tasks	**Frequency**
• Permeable pavements. Brush and vacuum surfaces once a year to prevent silt blockages and enhance design life.	Annually
Remedial Work	**Frequency**

Inlet Structures and Inspection Chambers

Inlet structures such as rainwater downpipes, road gullies and channel drains. They should be free from obstruction at all times to allow free flow through the SuDS. Inspection chambers and rodding eyes are used on bends or where pipes come together. They allow access and cleaning to the system if necessary. Table 10 provides details of the maintenance requirements.

Table 10 - Inlet Structures and Inspection Chambers

Regular Maintenance	Frequency
Inlet Structures • Inspect rainwater downpipes, channel drains and road gullies, removing obstructions and silt, as necessary. Check there is no physical damage. • Strim vegetation 1m minimum surrounding structures and keep area free from silt and debris.	Monthly
Inspection Chambers and below ground control chambers • Remove cover and inspect, ensuring that the water is flowing freely and that the exit route for water is unobstructed. Removed debris and silt.	Annually
Occasional Maintenance	**Frequency**
• Check topsoil levels are 20mm above edges of chambers to avoid mower damage.	As required
Remedial Work	**Frequency**
• Repair physical damage if necessary.	As required

Below Ground Drainage Pipes

Below ground drainage pipes convey water to the SuDS system. They should be free from obstruction at all times to allow free flow. Table 11 provides details of the maintenance requirements.

Table 11 - Below Ground Drainage Pipes

Regular Maintenance	Frequency
• Inspect and identify any areas that are not operating correctly. If required, take remedial action. • Remove debris from the catchment surface (where it may cause risks to performance). • Remove sediment from pre-treatment inlet structures and inspection chambers. • Maintain vegetation to designed limits within vicinity of below ground drainage pipes and tanks to avoid damage to system.	Monthly for first 3 months then annually Monthly Annually or as required Annually or as required
Remedial Works	**Frequency**
• Repair physical damage if necessary.	As required
Monitoring	**Frequency**
• Inspect all inlets, outlets and vents to ensure that they are in good condition and operating as designed. • Survey inside of pipe runs for sediment build up and remove if necessary.	Annually Every 5 years or as required

3.5 Design Life

The design life of the development is likely to exceed the design life of each of the SuDS components listed above. During the routine inspections of any SuDS components it may become apparent that they have reached the end of their functional lifetime. In the interest of sustainability repairs should be the first choice solution where practicable. If this is not the case, then it will be necessary to undertake complete replacement of the component in question.

When undertaking maintenance, repairs or replacement, all engineering drawings used in the design, construction and installation of the SuDS components should be referred to for construction and specification details. This will help to ensure satisfactory performance of each of the SuDS components.

3.6 Spillage – Emergency Action

Most spillages on development are of compounds that do not pose a serious risk to the environment if they enter the drainage in a slow and controlled manner with time available for natural breakdown in a treatment system. Therefore, small spillages of oil, milk or other known organic substances should be removed where possible using soak mats as recommended by the Environment Agency, with residual spillage allowed to bioremediate in the drainage system.

In the event of a serious spillage, either by volume or of unknown or toxic compounds, then isolate the spillage with soil, turf or fabric and block outlet pipes from chamber(s) downstream of the spillage with a bung(s). (A bung for blocking pipes may be made by wrapping soil or turf in a plastic sheet or closely woven fabric.)

Contact the Environment Agency immediately. Tel: 03708 506 506.

4.0 SUMMARY AND CONCLUSIONS

4.1 Introduction

This report presents a Sustainable Drainage Assessment for the proposed development on Lordsgate Lane, Burscough, L40 7UR.

4.2 SuDS Strategy

The SuDS Strategy ensures that a sustainable drainage solution can be achieved which reduces the peak discharge rate to manage and reduce the flood risk posed by the surface water runoff from the site. The SuDS Strategy takes into account the following principles:

- No increase in the volume or runoff rate of surface water runoff from the site.
- No increase in flooding to people or property off-site as a result of the development.
- No surface water flooding of the site.
- The proposals take into account a 40% increase in rainfall intensity due to climate change during the next 100 years which is the lifetime of the development.

In line with adopting a 'management train' it is recommended that water is managed as close to source as possible. This will reduce the size and cost of infrastructure further downstream and also shares the maintenance burden more equitably. It is therefore recommended that the site provides its own attenuation. This will be in the form of:

- Underground cellular/oversized pipe storage with an outfall to the public sewers restricted to 3.00 litres/second.
- Paths around the buildings drain to grassed lawns.
- For larger events in other areas such as landscaped areas, provided that it will not cause damage or prevent access.

For all development, both the Building Regulations and NPPF promote a hierarchical approach to surface water management. This approach has been adopted within this SuDS Strategy however, surface water discharge via infiltration methods and to a watercourse will not be possible therefore, discharge of surface water will be to the public sewer at a restricted runoff rate of 3.00 litres/second with attenuation within cellular storage/oversized pipes.

The size of the attenuation storage has been calculated such that the proposed development has the capacity to accommodate the 1 in 100 year rainfall event including a 40% increase in rainfall intensity that is predicted to occur as a result of climate change.

A conservative estimate of 100% runoff from impermeable areas has been used within the calculations. Consequently, all areas drained have been designed to accommodate the 1 in 100 year (+40% climate change) storm event.

The paths around the buildings will be designed to drain to the grassed lawns. The remainder of the site that is not formally drained, i.e. landscaped areas, will be permeable (grass). The majority of rainwater falling on these areas will soak into the ground. Surface water runoff would be directed to the drainage system through drainage gullies located around the perimeter of the buildings and through contouring of the hardstanding areas.

These methods will reduce peak flows, the volume of runoff, and slow down flows and will provide a suitable SuDS solution for this site. The adoption of a SuDS Strategy for the site represents an enhancement from the current conditions as the current surface water runoff from the site is uncontrolled, untreated, unmanaged and unmitigated.

In adopting these principles, it has been demonstrated that a scheme can be developed that does not increase the risk of flooding to adjacent properties and development further downstream.

5.1 Conclusion

This Sustainable Drainage Assessment demonstrates that the proposed development would be operated with minimal risk from flooding, would not increase flood risk elsewhere and is compliant with the requirements of the NPPF. The proposed development will considerably reduce the flood risk posed to the site and to off-site locations due to the adoption of a SuDS Strategy.

APPENDIX 1 – Proposed Site Layouts

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Land North of the Bull & Dog Inn, Burscough, L40 0SA
PROPOSED SITE/ BLOCK PLAN
JAN 2018 AC Scale 1:500@A3
17-099 (OPL)410 Rev A

Randle White Limited
11 Bradshaw Lane
Grappenhall
Cheshire
WA4 2NJ
01925 601670
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APPENDIX 2 – Site Investigations

Exploratory Hole Key Sheet

Redstart

SAMPLES:

Undisturbed:

U	Driven tube sample
UT	Thin wall driven tube sample
TW	Pushed thin wall tube sample
P	Pushed piston sample
L	Liner sample (from windowless or similar sampler), full recovery unless otherwise stated
CBR	CBR mould sample
BLK	Block sample
CS	Core sample (from rotary core) taken for laboratory testing

Disturbed:

D	Small sample
B	Bulk sample
AMAL	Amalgamated sample

Environmental:

ES	Environmental soil sample
EW	Environmental water sample

Comments:

Sample reference numbers are assigned to every sample taken. A sample reference of 'NR' indicates that an attempt was made to take a tube sample; however, there was no recovery. Sample recovery is given as a percentage.

TESTS:

SPT S or SPT C — Standard Penetration Test, open shoe (S) or solid cone (C)

The Standard Penetration Test is defined in BS EN ISO 22476-3 (2005). The incremental blow counts are given in the Field Records column; each increment is 75mm unless stated otherwise and any penetration under self weight in mm (SW) is noted. Where the full 300mm test drive is achieved the total number of blows for the test drive is presented as N = ** in the Results column. Where the test drive blows reach 50 (either in total or for a single increment) the total blow count beyond the seating drive is given (without the N = prefix).

ICBR	In situ CBR
IV	In situ vane shear strength, peak (p) and remoulded (r), kPa
HV	Hand vane shear strength, peak (p) and remoulded (r), kPa
PP	Pocket penetrometer test, converted to shear strength, kPa
KFH, KRH, KPI	Variable head permeability tests (KFH = falling head test, KRH = rising head test, KPI = packer test), permeability value

Test results provided in Results column

DRILLING RECORDS:

The mechanical indices (TCR/SCR/RQD & If) are defined in BS 5930: 2015 and BS EN ISO 22575-1 (2006)

TCR	Total Core Recovery, %
SCR	Solid Core Recovery, %
RQD	Rock Quality Designation, %
If	Fracture spacing, mm. Minimum, typical and maximum spacings are presented.
NI	Non intact is used where the core is fragmented.
CRF	Core recovered (length in m) in the following run
AZCL	Assessed zone of core loss
NR	Not recovered

GROUNDWATER:

▽	Groundwater strike
▼	Groundwater level after standing period

INSTRUMENTATION:

Details of installations are given on the Record. Legend column shows installed instrument depths including slotted pipe section or tip depth, response zone filter material type and layers of backfill. The type of instrument installed is indicated by a code adjacent to the Legend column at the base of the instrument.

SP	Standpipe
SPIE	Standpipe piezometer
PPIE	Pneumatic piezometer
EPIE	Electronic piezometer
HPIE	Hydraulic piezometer
GMP	Gas monitoring standpipe
ICE	Biaxial inclinometer
ICM	Inclinometer tubing for use with probe
SLIP	Slip indicator
ESET	Electronic settlement cell/gauge
ETM	Magnetic extensometer settlement point
ETR	Rod extensometer

EXPLORATORY HOLE TYPE:

CP	Cable percussion
DP	Dynamic probe
DCP	Dynamic cone penetrometer
HA	Hand auger
IP	Inspection pit
OP	Observation pit/trench
PC	Pavement core
RC	Rotary core
RO	Rotary open hole
SH	Shaft
SNC	Sonic (resonance)
TP	Trial pit/trench
TRAV	Traverse
WLS	Windowless (dynamic) sample
WS	Window (dynamic) sample

AGS

Project: **Lordsgate Lane, Burscough**
Project No: **830**
Client: **GRC Developments Ltd**

Reference

KEY SHEET

Dynamic Sample Log

Redstart

Borehole formation details:

Type:	From:	To:	Start date:	End date:	Crew:	Plant:	Logger:	Logged:	Remarks:
WLS	0.00	5.45	16-09-20	16-09-20		Premier Compact 110	PS	16-09-20	

Location details:

mE: 343063.00
mN: 410503.00
mAOD: 35.30
Grid:
Method:

Backfill/ Instal'n	Water-strike	Legend	Level	Depth (thick-ness)	Stratum Description	Water	Casing	Depth	Type & No	Results
			35.28	0.02 (0.38)	ASPHALT. (MADE GROUND)					
			34.90	0.40	Grey sandy GRAVEL. Gravel of angular limestone with occasional concrete . (SUB-BASE)			0.30	ES	
					Firm orangish brown slightly fine sandy CLAY. Rare fine rounded gravel of quartzite. (SHIRDLEY HILL SAND FORMATION)	Dry	1.00	1.00 - 1.45	S	N=8 (1,1/1,2,2,3)
								1.50	B	
						Dry	1.00	2.00 - 2.45	S	N=17 (2,3/3,4,5,5)
				(5.05)		Dry	1.00	3.00 - 3.45	S	N=19 (3,3/5,4,5,5)
	SP					Dry	1.00	4.00 - 4.45	S	N=15 (3,3/3,4,4,4)
						Dry	1.00	5.00 - 5.45	S	N=14 (3,3/4,4,3,3)
			29.85	5.45	Dynamic sample ends at 5.45 m (Termination reason: Target depth)					

Groundwater entries:

Struck: Rose to: Casing: Sealed:

Diameter & casing:

From: to: Dia: Casing:

Depth related remarks:

From to: Remarks

Run details:

From: to: Duration: Recovery:

AGS

Notes: For explanation of symbols and abbreviations see Key Sheet. All depths and reduced levels are in meters.

Log issue: DRAFT
Scale: 1:50

Project: Lordsgate Lane, Burscough
Project No: 830
Client: GRC Developments Ltd

Exploratory position reference:

RWS01

Sheet 1 of 1

Dynamic Sample Log

Redstart

Borehole formation details:

Type:	From:	To:	Start date:	End date:	Crew:	Plant:	Logger:	Logged:	Remarks:
WLS	0.00	5.45	16-09-20	16-09-20		Premier Compact 110	PS	16-09-20	

Location details:

mE: 343051.00
mN: 410527.00
mAOD: 34.90
Grid:
Method:

Backfill/ Instal'n	Water-strike	Legend	Level	Depth (thickness)	Stratum Description	Water	Casing	Depth	Type & No	Results
			34.88	0.02	ASPHALT. (MADE GROUND)					
				(0.68)	Grey/red/black GRAVEL to BOULDERS of whole and broken brick with occasional angular concrete, sandstone and limestone (SUB-BASE)					
	▽		34.20	0.70	Firm orangish brown CLAY. Rare fine rounded gravel of quartzite. (SHIRDLEY HILL SAND FORMATION)					
						Dry	1.00	1.00 - 1.45	S	N=8 (1,1/1,2,2,3)
								1.30	ES	
								1.40	ES	
				(2.00)						
						Dry	1.00	2.00 - 2.45	S	N=16 (2,2/3,4,4,5)
			32.20	2.70	Firm orangish brown slightly fine sandy CLAY. Rare fine rounded gravel of quartzite. (SHIRDLEY HILL SAND FORMATION)					
						Dry	1.00	3.00 - 3.45	S	N=11 (1,2/2,3,3,3)
				(1.90)						
	SP					Dry	1.00	4.00 - 4.45	S	N=11 (2,2/2,3,3,3)
			30.30	4.60	Stiff orangish brown CLAY. Rare fine rounded gravel of quartzite. (SHIRDLEY HILL SAND FORMATION)					
				(0.85)		Dry	1.00	5.00 - 5.45	S	N=16 (2,3/4,4,4,4)
			29.45	5.45	Dynamic sample ends at 5.45 m (Termination reason: Target depth)					

Groundwater entries:

Struck:	Rose to:	Casing:	Sealed:

Diameter & casing:

From:	to:	Dia:	Casing:

Depth related remarks:

From	to:	Remarks

Run details:

From:	to:	Duration:	Recovery:

AGS

Notes: For explanation of symbols and abbreviations see Key Sheet. All depths and reduced levels are in meters.

Log issue: DRAFT
Scale: 1:50

Project: Lordsgate Lane, Burscough
Project No: 830
Client: GRC Developments Ltd

Exploratory position reference:
RWS02

Dynamic Sample Log

Redstart

Borehole formation details:

Type:	From:	To:	Start date:	End date:	Crew:	Plant:	Logger:	Logged:	Remarks:
WLS	0.00	5.45	16-09-20	16-09-20		Premier Compact 110	PS	16-09-20	

Location details:

mE: 343017.00
mN: 410512.00
mAOD: 35.80
Grid:
Method:

Water-strike	Level	Depth (thickness)	Stratum Description
		(1.00)	Dark brown/black slightly gravelly slightly sandy CLAY. Gravel of angular brick fragments and ash/clinker with rare coal. Rare cobbles of whole brick. Occasional roots . (MADE GROUND)
	34.80	1.00 (0.80)	Medium dense orangish brown slightly silty fine to medium SAND. (SHIRDLEY HILL SAND FORMATION)
	34.00	1.80 (0.70)	Soft bluish grey becoming orangish brown with depth, slightly fine sandy CLAY. (SHIRDLEY HILL SAND FORMATION)
	33.30	2.50 (0.50)	Soft orangish brown fine sandy CLAY. (SHIRDLEY HILL SAND FORMATION)
	32.80	3.00 (0.50)	Medium dense orangish brown slightly gravelly slightly silty fine to coarse SAND. (SHIRDLEY HILL SAND FORMATION)
	32.30	3.50	Soft orangish brown fine sandy CLAY. (SHIRDLEY HILL SAND FORMATION)
	32.25	3.55	Dense orangish brown slightly gravelly slightly silty fine to coarse SAND. (SHIRDLEY HILL SAND FORMATION)
	32.00	3.80	Dense orangish brown silty SAND AND GRAVEL. (SHIRDLEY HILL SAND FORMATION)
SP	31.80	4.00 (0.80)	Dense orangish brown slightly gravelly slightly silty fine to coarse SAND. (SHIRDLEY HILL SAND FORMATION)
	31.00	4.80	Soft orangish brown fine sandy CLAY. (SHIRDLEY HILL SAND FORMATION)
	30.95	4.85 (0.60)	Stiff orangish brown gravelly slightly silty fine to coarse SAND. (SHIRDLEY HILL SAND FORMATION)
	30.35	5.45	Dynamic sample ends at 5.45 m (Termination reason: Target depth)

Samples & In Situ Testing

Water	Casing	Depth	Type & No	Results
Dry	1.00	1.00 - 1.45	S	N=11 (3,3/3,2,3,3)
Dry	1.00	2.00 - 2.45	S	N=5 (0,0/0,1,2,2)
Dry	1.00	3.00 - 3.45	S	N=16 (2,2/3,4,4,5)
Dry	1.00	4.00 - 4.45	S	N=33 (5,5/6,9,8,10)
Dry	1.00	5.00 - 5.45	S	N=23 (4,4/5,6,6,6)

Groundwater entries: Struck: Rose to: Casing: Sealed:

Diameter & casing: From: to: Dia: Casing:

Depth related remarks: From to: Remarks

Run details: From: to: Duration: Recovery:

AGS Notes: For explanation of symbols and abbreviations see Key Sheet. All depths and reduced levels are in meters.

Log issue: DRAFT
Scale: 1:50

Project: Lordsgate Lane, Burscough
Project No: 830
Client: GRC Developments Ltd

Exploratory position reference:
RWS03

Dynamic Sample Log

Redstart

Borehole formation details:

Type:	From:	To:	Start date:	End date:	Crew:	Plant:	Logger:	Logged:	Remarks:
WLS	0.00	4.95	16-09-20	16-09-20		Premier Compact 110	PS	16-09-20	

Location details:

mE: 342988.00
mN: 410501.00
mAOD: 35.50
Grid:
Method:

Backfill/ Instal'n	Water-strike	Legend	Level	Depth (thickness)	Stratum Description	Water	Casing	Depth	Type & No	Results
			35.30	0.20	Brownish grey slightly sandy slightly gravelly CLAY. Gravel of angular brick, ceramic and concrete fragments. Occasional roots and rare coal. (MADE GROUND)			0.20	ES	
				(0.60)	Firm brown/grey slightly sandy CLAY. Occasional roots and rare fine gravel of coal.			0.40	ES	
			34.70	0.80	(MADE GROUND)					
					Soft to firm orangish brown mottled bluish grey slightly sandy CLAY. Rare fine rounded gravel of quartzite. (SHIRDLEY HILL SAND FORMATION)	Dry	1.00	1.00 - 1.45	S	N=7 (1,1/1,2,2,2)
				(1.20)				1.50	B	
			33.50	2.00	Medium dense orangish brown gravelly slightly silty fine to medium SAND. (SHIRDLEY HILL SAND FORMATION)	Dry	1.00	2.00 - 2.45	S	N=8 (1,1/1,2,3,2)
						Dry	1.00	3.00 - 3.45	S	N=15 (3,3/4,4,4,3)
				(2.95)						
	SP				*4.00 m: becoming dense*	Dry	1.00	4.00 - 4.45	S	N=35 (5,6/8,8,9,10)
						Dry	1.00	4.50 - 4.95	S	N=45 (6,7/8,12,12,13)
			30.55	4.95	Dynamic sample ends at 4.95 m (Termination reason: Wet sands preventing further drilling)					

Groundwater entries:
Struck: Rose to: Casing: Sealed:

Diameter & casing:
From: to: Dia: Casing:

Depth related remarks:
From to: Remarks

Run details:
From: to: Duration: Recovery:

AGS Notes: For explanation of symbols and abbreviations see Key Sheet. All depths and reduced levels are in meters.

Log issue: DRAFT
Scale: 1:50

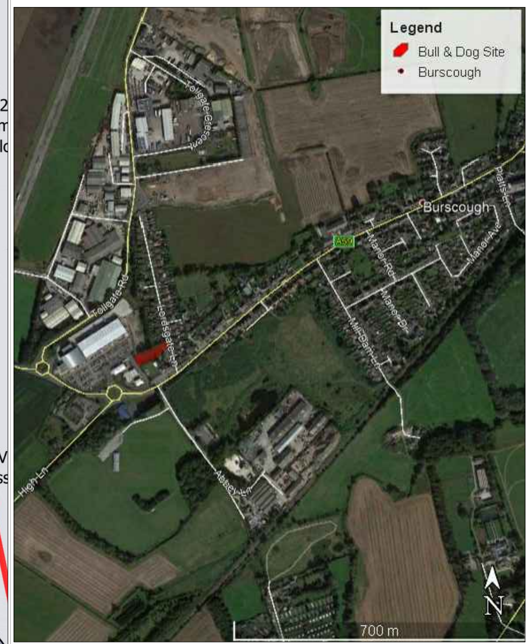
Project: Lordsgate Lane, Burscough
Project No: 830
Client: GRC Developments Ltd

Exploratory position reference:
RWS04
Sheet 1 of 1

LEGEND

Investigation Location

NOTES



Taken from Google Earth

Rev:	Description:	Date:
01	First Issue	06/10/2020

Redstart

Redstart Northwest Limited
Unit 6, Oak Green Business Park, Earl Road,
Cheadle Hulme, Cheshire, SK8 6QL
T: 0161 260 1333
www.redstartnw.com

Site:
Land to the Rear of The Bull and Dog Inn
Liverpool Road South
Bursough, Ormskirk
L40 7SS

Client: GRC Developments Ltd

Title: Investigation Location Plan

Scale: 1:250 @ A3 | Drawn By: DN

Project No: 590.00 | Dwg No: 590.00.ILP01

APPENDIX 3 – Surface Water Runoff Calculations

Hydrological Data:-

FSR Hydrology:-

Location = BURSCOUGH
M5-60 (mm) = 19.2
Soil runoff = 0.30
WRAP = 2
Hydrological area = 10

Grid reference = SD4310
r = 0.36
SAAR (mm/yr) = 925
Area = England & Wales
Hydrological zone = 8

Soil classification for WRAP type 2

i) Very permeable soils with shallow ground water;

ii) Permeable soils over rock or fragipan, commonly on slopes in western Britain associated with smaller areas of less permeable wet soils; (fragipan - a natural subsurface horizon having a higher bulk density than the solum above. Seemingly cemented when dry but showing moderate to weak brittleness when moist. The layer is low in organic matter, mottled and slowly or very slowly permeable to water. It is found in profiles of either cultivated or virgin soils but not in calcareous material).

iii) Moderately permeable soils, some with slowly permeable subsoils.

Design data:-

Area = 0.001036 Km^2 - 0.104 Ha - 1036 m^2

Calculation method:-

Runoff is calculated from:-

$$Q_{BAR(rural)} = 0.00108\ AREA^{0.89}\ .\ SAAR^{1.17}\ .\ SOIL^{2.17}$$

where

AREA = Site area in Km^2
SAAR = Standard Average Annual Rainfall (mm/yr)
SOIL = Soil value derived from Winter Rainfall Acceptance Potential
$Q_{BAR(rural)}$ = Runoff (cumecs)

$Q_{BAR(rural)}$ is then multiplied by a growth factor - GC(T) - for different storm return periods derived from EA publication W5-074/A.

Calculated data:-

For areas less than 50Ha, a modified calculation which multiplies the 50Ha runoff value by the ratio of the site area to 50Ha is used
Reducing factor used for these calculations is 0.002

Mean Annual Peak Flow $Q_{BAR(rural)}$ = 0.26 l/s

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Montgomery
Powys, SY15 6PZ
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Job No.	
Sheet no.	2
Date	05/10/20

Project Lordgate Lane

Title IoH 124 Runoff Calculations

By	Checked	Reviewed

Values for $Q_{BAR(rural)}$

Ret. per.	m³/hr	l/s	l/s/ha	Ret. per.	m³/hr	l/s	l/s/ha
1yr	0.800	0.222	2.146	100yr+20%	2.373	0.659	6.363
2yr	0.876	0.243	2.348	100yr+30%	2.571	0.714	6.893
5yr	1.140	0.317	3.055	100yr+40%	2.769	0.769	7.424
10yr	1.300	0.361	3.485	200yr	2.260	0.628	6.060
30yr	1.582	0.439	4.242	200yr + 30%	2.938	0.816	7.878
50yr	1.742	0.484	4.671	500yr	2.571	0.714	6.893
100yr	1.978	0.549	5.303	1000yr	2.863	0.795	7.676

Growth factors -

1yr	2yr	5yr	10yr	30yr	50yr	100yr	200yr	500yr	1000yr
0.85	0.93	1.21	1.38	1.68	1.85	2.10	2.40	2.73	3.04

The above is based on the Institute of Hydrology Report 124
to which you are referred for further details (see Sect 7).
Note that the 200 and above year growth curves were taken from W5-074.

Data:-

Hydrology (FSR):-

Location	= BURSCOUGH	WRAP	= 2
Long reference	= 343410	Grid reference	= SD4310
M5-60 (mm)	= 19.2	SAAR (mm/yr)	= 925
r	= 0.36	Soil	=0.30
Hyd. area	= 10	Hyd. zone	= 8
Hydrograph	= Summer	Area	= England & Wales

Site values used in design:-

Total site area	= 0.2100 ha	Climate change factor	= 40%
Pre-dev area drained	= 0.0235 ha	Post-dev area drained	= 0.1036 ha
Imperm runoff factor	= 100%	Perm runoff factor	= 20%

Pre-development

Area to soakaways	= 0.0000 ha	Area to other SUDS	= 0.0000 ha
Perv. area to SUDS	= 0.0000 ha	Pre-dev flow to drain	= 0.00 l/s

Post-development

Area to soakaways	= 0.0000 ha	Area to other SUDS	= 0.0000 ha
Perv. area to SUDS	= 0.0000 ha	Post-dev flow to drain	= 0.00 l/s

Calculations:-

Revised Post-dev Imperm. area = 0.104 ha
Equiv. Post-dev Imperm. area = 0.104 ha
Equiv. Post-dev Perm. area = 0.021 ha
Total Pre-dev equiv. area ha = 0.061 ha
Total Post-dev equiv. area ha = 0.125 ha
100 yr 6 hour mean intensity = 10.48mm/hr

Results:-

Pre-dev peakflow runoff (l/s) (m^3/s)

R.P.	15	30	60	120	240	360	480	600	Max	CCF	Final	R.P.
1	19.2	12.9	8.1	5.2	3.2	2.5	2.0	1.7	19.2	N/A	19.2	1
30	46.5	30.8	19.6	12.1	7.3	5.4	4.3	3.6	46.5	N/A	46.5	30
100	60.2	40.3	25.7	15.8	9.5	6.9	5.6	4.7	60.2	N/A	60.2	100

Post-dev peakflow runoff (l/s)

R.P.	15	30	60	120	240	360	480	600	Max	CCF	Final	R.P.
1	39.4	26.6	16.7	10.6	6.7	5.1	4.1	3.5	39.4	40	55.2	1
30	95.6	63.3	40.2	24.8	14.9	11.0	8.9	7.5	95.6	40	133.8	30
100	123.7	82.7	52.8	32.6	19.4	14.3	11.4	9.6	123.7	40	173.1	100

100 year 6 hour (x Climate Change Factor) storm gives:-

Pre-dev runoff volume m^3 = 38.2m^3
Post-dev rainfall volume = 110.0m^3
Post-dev volume m^3 (excess above SUDS) = 110.0m^3
100 yr 6 hour mean intensity = 10.48mm/hr
Pre-dev volume to drain at 0 l/s = 0.0 m^3
Post-dev volume to drain at 0 l/s = 0.0 m^3
Post-dev storage volume = 110.0m^3
Post-dev 5mm imperm volume = 5.2 m^3
Post-dev 5mm perm volume = 5.3 m^3

$Q_{BAR(rural)}$ = 0.530 l/s or 2.525 l/s/ha or 0.001 cumecs - from IoH 124.

The rainfall rates are calculated using the location specific values above in accordance with the Wallingford procedure.

MasterDrain HY 11.0	**KRS Environmental Limited.** www.krsenvironmental.com	3 Princes Square, Princes Street, Montgomery Powys, SY15 6PZ Tel: 01686 668957 Mob: 07857 264 376 email: keelan@krsenvironmental.com	Job No.		
			Sheet no. 2		
			Date 03/11/20		
	Project **Lordsgate Lane**		By	Checked	Reviewed
	Title **Surface Water Runoff Calcs**				

Data summary.

Use the data below for the SUR1 form

Site areas:-

Total site area = 0.2100 ha ;2100.0 m² [3A]
Pre-development impermeable area = 0.0235 ha [3B]
Pre-development permeable area = 0.1865 ha
Post-development impermeable area = 0.1036 ha [3C]
Post-development permeable area = 0.1064 ha

Peak runoff:-

Pre-development 1 year storm (15min) = 19.2 l/s [6A]
Pre-development 100 year storm (15min) = 60.2 l/s [6C]
Post-development 1 year storm (15min) = 39.4 l/s [6B]
Post-development 100 year storm (15min)= 123.67 l/s [6D]

Greenfield runoff:-

$Q_{BAR(rural)}$ = 0.530 l/s or 2.525 l/s/ha or 0.001 cumecs - from IoH 124.

Climate change factor:-

CCF = 40%

Volumes:-

Pre-development 100 yr/6hr storm [12A]= 53.5m³
Post-development 100 yr/6hr storm (add. volume with no SUDS) [12B]= 110.0m³
Post-development 100 yr/6hr storm (add. volume with SUDS) = 110.0m³
Post-development add. predicted volume (No SUDS) [12C] = 56.4m³

You may also require

Data relating to the infiltration test calculations (if applicable)
Evidence to show runoff reduction (if applicable)
Information on calculation methods (if applicable see next sheet)

Note

Numbers in square brackets relate to the
Nov. 2010 v1.1 / issued 11/02/10 copy of SUR1

Definitions and methods

Hydrology

The hydrological constants are derived from the Wallingford maps. They are used to calculate location specific rainfall figures.

Site values and factors

Areas of the site should be entered in hectares (10000 m²). If the Pre-development site is a green field, this box is blank.
Climate Change Factor is initially set at 20% - this may be changed as required.
Greenfield runoff is calculated using the method described in IoH 124.
Runoff factors

The impermeable runoff factor is initially set at 98%
The permeable runoff factor is initially set at 20%

Note: the CCF and the runoff factors may be changed by the user to suit the development
The areas draining to soakaways and other SUDS are entered in the appropriate box (in hectares)

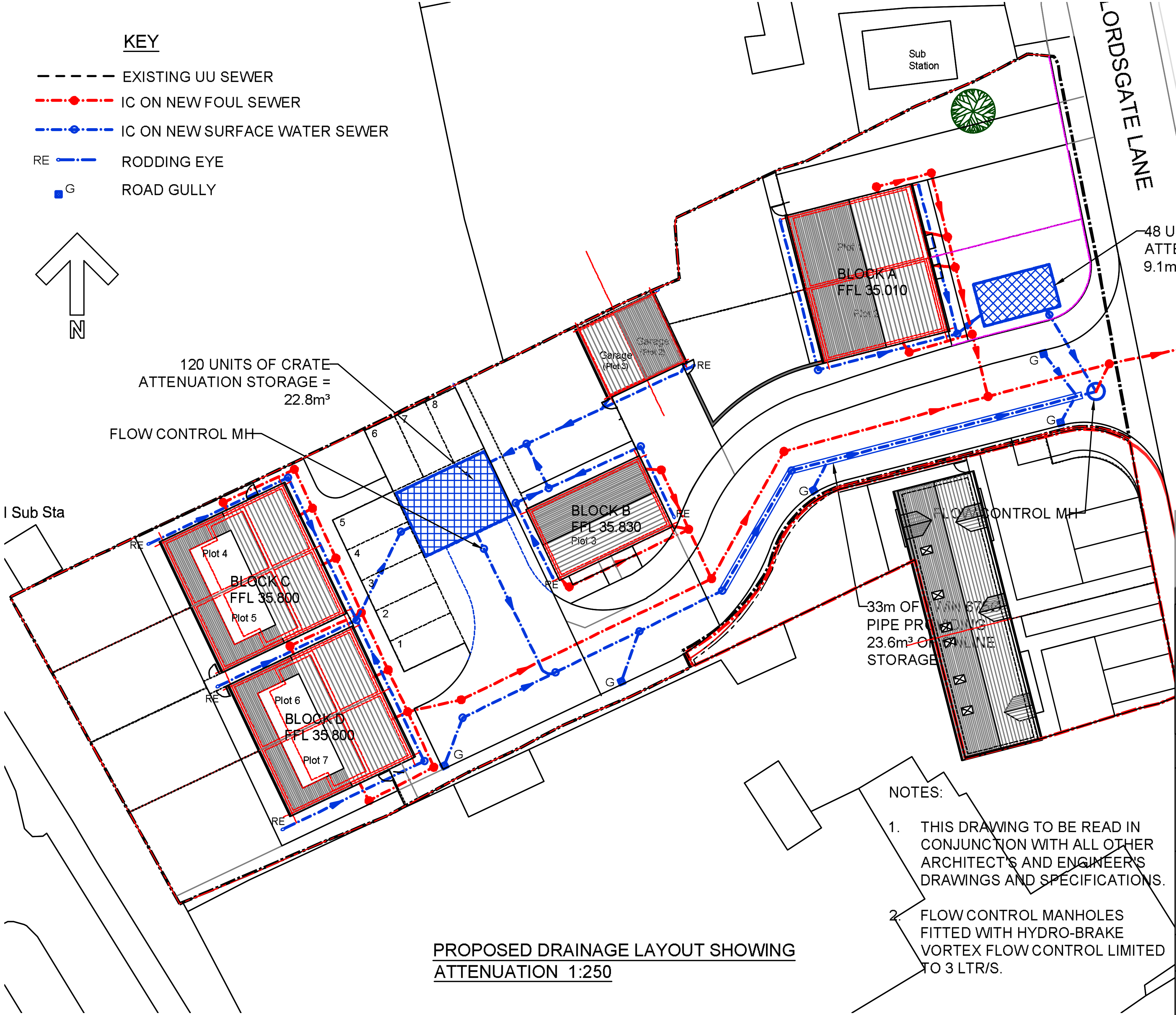
Calculations

The post-development area is reduced by subtracting the areas that drain to soakaways or other SUDS, to give a revised figure.
All areas are then multiplied by the appropriate runoff factor to give an equivalent area with 100% runoff.
These are then summated.
This gives a total pre-development equivalent area, and a similar figure for the post-development area.
The 'Post-dev volume to drain (no SUDS)' gives the total runoff to drain if no SUDS were used.

Results

The pre- and post-development areas are subjected to 1,30 and 100 year return period storms with a duration of 15 to 600 minutes.
The Revised Post-dev Imperm. area is the area (in ha) that is not going to SUDS x impervious runoff factor.
The runoff rates are calculated for the chosen hydrograph (Summer or Winter) as l/s. Figures in red indicate m^3/s
The peak value is measured, multiplied by the CCF and the total maximum rate is shown.
The pre- and post-development volumes for a 100 year / 6 hour storm are calculated from the area under the hydrograph curve.
Post-dev volume (i.e. excess above SUDS) is that volume produced by the drained area that does not go to SUDS.
Qbar(rural) is calculated in accordance with the procedure laid down in IoH 124

APPENDIX 4 – Proposed Drainage Layout



PROPOSED DRAINAGE LAYOUT SHOWING ATTENUATION 1:250

NOTES:

1. THIS DRAWING TO BE READ IN CONJUNCTION WITH ALL OTHER ARCHITECT'S AND ENGINEER'S DRAWINGS AND SPECIFICATIONS.
2. FLOW CONTROL MANHOLES FITTED WITH HYDRO-BRAKE VORTEX FLOW CONTROL LIMITED TO 3 LTR/S.

Rev:	Description:	Date:	By:	Chkd:
A	STORAGE VOLUMES ADJUSTED	30.06.21	TDA	DR

INTERIM CONSULTANCY SOLUTIONS
Church House
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Status: PLANNING

Project: NEW HOUSES AT LORDSGATE LANE BURSCOUGH L40 05A

Drg Title: PROPOSED DRAINAGE PLAN

Scale:	Size:	First Issue:	Drawn:	Checked:
1:250	A3	Oct 2020	AP	DR

Drg No: 682/STRL 100

Rev: A

APPENDIX 5 – Cellular Storage Volume Calculations

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

Half Drain Time : 157 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	34.052	0.552	0.0	3.0	3.0	31.5	O K
30 min Summer	34.215	0.715	0.0	3.0	3.0	40.8	O K
60 min Summer	34.352	0.852	0.0	3.0	3.0	48.6	O K
120 min Summer	34.426	0.926	0.0	3.0	3.0	52.8	O K
180 min Summer	34.422	0.922	0.0	3.0	3.0	52.6	O K
240 min Summer	34.403	0.903	0.0	3.0	3.0	51.5	O K
360 min Summer	34.357	0.857	0.0	3.0	3.0	48.8	O K
480 min Summer	34.309	0.809	0.0	3.0	3.0	46.1	O K
600 min Summer	34.262	0.762	0.0	3.0	3.0	43.4	O K
720 min Summer	34.214	0.714	0.0	3.0	3.0	40.7	O K
960 min Summer	34.107	0.607	0.0	3.0	3.0	34.6	O K
1440 min Summer	33.912	0.412	0.0	3.0	3.0	23.5	O K
2160 min Summer	33.738	0.238	0.0	3.0	3.0	13.6	O K
2880 min Summer	33.652	0.152	0.0	2.8	2.8	8.7	O K
4320 min Summer	33.594	0.094	0.0	2.3	2.3	5.4	O K
5760 min Summer	33.575	0.075	0.0	1.8	1.8	4.3	O K
7200 min Summer	33.565	0.065	0.0	1.5	1.5	3.7	O K
8640 min Summer	33.559	0.059	0.0	1.3	1.3	3.4	O K
10080 min Summer	33.555	0.055	0.0	1.2	1.2	3.1	O K
15 min Winter	34.052	0.552	0.0	3.0	3.0	31.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	129.530	0.0	33.6	18
30 min Summer	86.161	0.0	44.7	33
60 min Summer	54.663	0.0	56.8	62
120 min Summer	33.500	0.0	69.6	120
180 min Summer	24.804	0.0	77.4	156
240 min Summer	19.910	0.0	82.8	188
360 min Summer	14.554	0.0	90.8	254
480 min Summer	11.651	0.0	96.9	324
600 min Summer	9.797	0.0	101.8	392
720 min Summer	8.499	0.0	106.0	462
960 min Summer	6.786	0.0	112.9	598
1440 min Summer	4.933	0.0	123.1	834
2160 min Summer	3.579	0.0	134.0	1168
2880 min Summer	2.847	0.0	142.1	1500
4320 min Summer	2.059	0.0	154.1	2204
5760 min Summer	1.634	0.0	163.1	2936
7200 min Summer	1.365	0.0	170.3	3672
8640 min Summer	1.178	0.0	176.4	4368
10080 min Summer	1.040	0.0	181.7	5112
15 min Winter	129.530	0.0	33.6	18

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

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	34.216	0.716	0.0	3.0	3.0	40.8	O K
60 min Winter	34.354	0.854	0.0	3.0	3.0	48.7	O K
120 min Winter	34.433	0.933	0.0	3.0	3.0	53.2	O K
180 min Winter	34.428	0.928	0.0	3.0	3.0	52.9	O K
240 min Winter	34.400	0.900	0.0	3.0	3.0	51.3	O K
360 min Winter	34.336	0.836	0.0	3.0	3.0	47.7	O K
480 min Winter	34.265	0.765	0.0	3.0	3.0	43.6	O K
600 min Winter	34.189	0.689	0.0	3.0	3.0	39.3	O K
720 min Winter	34.099	0.599	0.0	3.0	3.0	34.2	O K
960 min Winter	33.934	0.434	0.0	3.0	3.0	24.7	O K
1440 min Winter	33.726	0.226	0.0	3.0	3.0	12.9	O K
2160 min Winter	33.607	0.107	0.0	2.5	2.5	6.1	O K
2880 min Winter	33.584	0.084	0.0	2.1	2.1	4.8	O K
4320 min Winter	33.564	0.064	0.0	1.5	1.5	3.6	O K
5760 min Winter	33.555	0.055	0.0	1.2	1.2	3.1	O K
7200 min Winter	33.549	0.049	0.0	1.0	1.0	2.8	O K
8640 min Winter	33.545	0.045	0.0	0.9	0.9	2.6	O K
10080 min Winter	33.542	0.042	0.0	0.8	0.8	2.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	86.161	0.0	44.7	32
60 min Winter	54.663	0.0	56.8	60
120 min Winter	33.500	0.0	69.6	116
180 min Winter	24.804	0.0	77.4	170
240 min Winter	19.910	0.0	82.8	192
360 min Winter	14.554	0.0	90.8	270
480 min Winter	11.651	0.0	96.9	348
600 min Winter	9.797	0.0	101.8	424
720 min Winter	8.499	0.0	106.0	494
960 min Winter	6.786	0.0	112.9	610
1440 min Winter	4.933	0.0	123.1	826
2160 min Winter	3.579	0.0	134.0	1128
2880 min Winter	2.847	0.0	142.1	1472
4320 min Winter	2.059	0.0	154.1	2188
5760 min Winter	1.634	0.0	163.1	2936
7200 min Winter	1.365	0.0	170.3	3656
8640 min Winter	1.178	0.0	176.4	4296
10080 min Winter	1.040	0.0	181.7	5112

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	1.000
Region	England and Wales	Cv (Winter)	1.000
M5-60 (mm)	19.300	Shortest Storm (mins)	15
Ratio R	0.372	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.104

Time From:	**(mins) To:**	**Area (ha)**
0	4	0.104

Model Details

Storage is Online Cover Level (m) 35.000

Cellular Storage Structure

Invert Level (m) 33.500 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	60.0	60.0	1.010	0.0	92.0
1.000	60.0	92.0			

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0082-3000-1000-3000
Design Head (m)	1.000
Design Flow (l/s)	3.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	82
Invert Level (m)	33.500
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	**Head (m)**	**Flow (l/s)**
Design Point (Calculated)	1.000	3.0
Flush-Flo™	0.297	3.0
Kick-Flo®	0.623	2.4
Mean Flow over Head Range	-	2.6

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	3.3	3.000	5.0	7.000	7.4
0.200	2.9	1.400	3.5	3.500	5.4	7.500	7.7
0.300	3.0	1.600	3.7	4.000	5.7	8.000	7.9
0.400	2.9	1.800	3.9	4.500	6.0	8.500	8.2
0.500	2.8	2.000	4.1	5.000	6.3	9.000	8.4
0.600	2.5	2.200	4.3	5.500	6.6	9.500	8.6
0.800	2.7	2.400	4.5	6.000	6.9		
1.000	3.0	2.600	4.7	6.500	7.2		